NBS MONOGRAPH 145
Part I

U.S. DEPARTMENT OF COMMERCE / National Bureau of Standards

Tables of Spectral-Line Intensities

Arranged by Elements

W. F. Meggers prepares to measure one of the spectrograms on which these tables of spectral-line intensities are based.

Tables of Spectral-Line Intensities
Part I - Arranged by Elements

Second Edition

William F. Meggers, Charles H. Corliss and
Bourdon F. Scribner

Institute for Basic Standards
National Bureau of Standards
Washington, D.C. 20234

The intensity, character, wavelength, spectrum, and energy levels of 39 000 lines between 2000 Å and 9000 Å observed in copper arcs containing 0.1 atomic percent of each of 70 elements.

(Supersedes NBS Monograph 32, Parts I and II and its Supplement)

U.S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS, Richard W. Roberts, *Director*

Issued May 1975

Library of Congress Cataloging in Publication Data

Meggers, William Frederick, 1888-1966.
Tables of spectral-lines intensities.

(National Bureau of Standards Monograph 145)
"The intensity, character, wavelength, spectrum, and energy levels of 39,000 lines between 2000 Å and 9000 Å observed in copper arcs containing 0.1 atomic percent of each of 70 elements."

"Supersedes NBS Monograph 32, Parts I and II, and its Supplement."
CONTENTS: Pt. 1. Arranged by elements.—Pt. 2. Arranged by wavelengths.
Supt. of Docs. No.: C13.44:145.
1. Spectrum analysis—Tables, etc. I. Corliss, Charles H., joint author. Tables of spectral-line intensities. II. Title. III. Series: United States. National Bureau of Standards. Monograph 145.
QC100.U556 No. 145 [QC453] 389'.08s [535'.84] 74-16256

National Bureau of Standards Monograph 145

Nat. Bur. Stand. (U.S.), Monogr. 145, 403 pages (May 1975)
CODEN: NBSMA6

U.S. GOVERNMENT PRINTING OFFICE
WASHINGTON: 1975

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402
(Order by SD Catalog No. C13.44:145/I). Price $8.55 (Part I); $6.80 (Part II)
Stock Number 0303–01337 (Part I); 0303–01338 (Part II)

Preface

A second edition of the NBS Tables of Spectral-Line Intensities (Part I, Arranged by Elements and Part II, Arranged by Wavelengths) has been prepared. New classifications have been provided for 8500 previously unclassified lines, improved wavelengths are given for about 9000 lines and some revision of the intensity scale has been made. (Supersedes NBS Monograph 32, Parts I and II and its Supplement.)

Key words: Classification of spectral lines; intensities of spectral lines; spectral-line intensities; tables of spectral-line intensities; wavelengths of spectral lines.

This new edition of the NBS Tables of Spectral-Line Intensities incorporates three improvements on the original edition of 1961. In the original edition only about 25 000 of the 39 000 lines in the tables had been classified. In the ensuing thirteen years, about 8500 more lines (chiefly rare-earths) have been classified and the new classifications are here incorporated.

Furthermore in the course of spectroscopic research during that period, many spectra have been remeasured. About 9000 improved wavelength values have been adopted here. Many of the new values are accurate to somewhat better than two decimal places but in most cases there remains some uncertainty in the third place. We have therefore printed only two decimal places in this edition.

The third improvement to be found in this edition is in the intensity scale. Three changes have been made. The calibration of the region below 2450 Å, which was published by Corliss [1967], has been incorporated in the new edition. Secondly, a slight error in the original reduction of the intensity data from the overlapping regions of the plates has been corrected. In the original reduction the duplicate observations in the overlapping regions were simply averaged. This was a theoretically correct procedure since the observations had already been normalized to the intensity scale of the copper matrix. However, it was observed that this normalization did not produce identical scales on each plate. A more practical procedure would have been to have adjusted each plate to a common scale determined by the mean intensity level of all the plates. This was pointed out by J. L. Tech [1971] who has now applied this correction to all of the complex spectra in the tables. The elements with less than 100 lines (simple spectra) remain uncorrected for this relatively minor error because there are not enough lines in the overlapping regions to determine correction factors.

Finally, the whole scale of relative intensity numbers has been multiplied by ten to eliminate numbers less than unity. The intensity numbers now range from 1 to 90 000.

For the convenience of the user, the tables are presented in two separate parts, in the same way as the original edition. Part I is arranged by element in alphabetic order of chemical name. In Part II all observed lines are consolidated in a single table arranged in order of increasing wavelength and in a supplementary table of selected strong lines.

The values of ionization potentials for many of the elements are taken from the compilations of C. E. Moore but those for the lanthanides, actinides and Hf are taken from the compilation of W. C. Martin, Lucy Hagan, Joseph Reader and Jack Sugar (J. Phys. Chem. Ref. Data, Vol. **3**, No. 3, 1974). The values of atomic weights are taken from the 1969 Report of the International Commission on Atomic Weights.

References

Corliss, C. H. (1967), Revision of the NBS Tables of Spectral-Line Intensities below 2450 Å. NBS Monograph 32 Supplement.

Tech, J. L. (1971), A High-Dispersion Spectral Analysis of the Ba II Star HD 204075 (ζ Capricorni). NBS Monograph 119.

Charles H. Corliss

Washington, D.C., April 25, 1974

Contents

List of Tables

*Melting and boiling points are quoted from American Institute of Physics Handbook, 3rd ed., New York, 1969.

Tables of Spectral-Line Intensities—Part I Arranged by Elements

The relative intensities, or radiant powers, of 39 000 spectral lines with wavelengths between 2000 and 9000 Ångstroms have been determined on a uniform energy scale for seventy chemical elements. This was done by mixing 0.1 atomic percent of each element in powdered copper, pressing the powder-mixture to form solid electrodes which were burned in a 10 ampere, 220 volt direct-current arc, and photographing the spectra with a stigmatic concave grating while a step sector was rotating in front of the slit. The sectored spectrograms facilitated the estimation of intensities of all element lines relative to copper lines which were then calibrated on an energy scale provided by standardized lamps, and all estimated line intensities were finally adjusted to fit this calibration. Comparisons with other intensity measurements in individual spectra indicate that the National Bureau of Standards spectral-line intensities may have average errors of 20 percent, but first of all they provide uniform quantitative values for the seventy chemical elements commonly determined by spectrochemists. These data are presented by element in part I, and all 39 000 observed lines are given in order of wavelength in part II.

Key words: Classification of spectral lines; intensities of spectral lines; spectral-line intensities; tables of spectral-line intensities; wavelengths of spectral lines.

1. Introduction

Spectrochemistry was born a century ago when Kirchhoff and Bunsen [1][1] definitely demonstrated that chemical elements were uniquely identified by spectral radiations, or lines as seen in a spectroscope provided with a slit. This led immediately to the identification of many chemical elements in the sun and to the discovery of several new elements, but no quantitative chemical analyses were made until much later.

In 1874, Lockyer [2] stated that "while the qualitative spectrum analysis depends upon the *positions* of the lines, the quantitative analysis depends not upon their position but upon their *length*, *brightness*, *thickness*, and *number* as compared with the number visible in the spectrum of a pure vapor". Thus, position (or wavelength) and brightness (or intensity) are recognized as being the two most important properties of spectral lines; wavelengths identify chemical elements and intensities indicate the concentrations of identified elements in mixtures or chemical compounds.

During the past century there has been spectacular improvement in the accuracy of spectral wavelength determinations; the early ones were limited to 3 or 4 figures, the later use of diffraction gratings and wavelength standards permitted the specification of 5 or 6 figures. Since 1900 the application of interferometers and better gratings has refined many wavelengths to 7 figures, and recently some 8-figure values of wavelength standards have been provided. Unfortunately during this past century very little progress has been made in assigning uniform quantitative intensity values to spectral radiations. The great bulk of spectral observations have been made photographically because photographic emulsions provide detailed, permanent records of spectra not only in the visible but also in the invisible ultraviolet and infrared regions. But even if the light source is reproducible and standardized it is not easy to evaluate the spectral efficiencies of spectrographs and photographic emulsions so the usual procedure has been to make subjective visual estimates of relative intensities of spectral lines on an arbitrary scale based on the relative blackness and/or width of spectral-line images appearing on a developed photographic plate. Consequently, in thousands of individual papers and in numerous comprehensive compilations of spectral data we find only qualitative data on intensities which may have some meaning for adjacent lines in a given spectrum but none at all when comparing widely spaced lines, or lines of different spectra of the same element or of different chemical elements.

In the beginning, most intensity data were reported on an arbitrary scale of 10 steps, weak lines being assigned an intensity of 1, and the strongest line intensity 10. Even as late as 1945 extensive new spectral tables prepared by Gatterer and Junkes [3] displayed estimated intensities on this limited 1 to 10 scale. Since 1910 some spectroscopists have arbitrarily expanded this arbitrarily compressed

[1] Figures in brackets indicate the literature references on page xiv.

scale. For example, in the very extensive spectral tables published by Exner and Haschek [4] the estimated intensities range from 1 to 1000. In wavelength tables compiled by Twyman and Smith [5] the maximum intensity is 20, in the compilation of Kayser and Ritschl [6] estimated intensities rise to 4000, and in the well-known M.I.T. Wavelength Tables [7] they soar to 9000. The most recent compilation of Tables of Spectrum Lines by Zaĭdel, Prokof'ev, and Raiskiĭ [8] quotes data from the M.I.T. Tables and more modern sources but adds nothing new on spectral line intensities.

In or about the year 1925, microdensitometers were developed for the purpose of quantitative measurement of relative intensities among related lines in multiplets to test the sum rules derived from the quantum theory of spectral structure, but no general applications were made. Since then thousands of spectrochemists have applied microdensitometers to quantitative chemical analyses by calibrating intensity ratios of analysis- and internal-standard lines but such measurements have contributed nothing to the basic data on spectral line intensities. Likewise, with few exceptions, the modern substitution of electronic photodetectors for photographic emulsions has added nothing to our knowledge of true line intensities over long ranges of different spectra of many chemical elements.

How may one hope to obtain, with a reasonable amount of labor, quantitative intensity data on the same scale for thousands of spectral lines representing practically all of the metallic elements? A hint was given in 1874 by Lockyer [2] who observed that "the lines of any constituent of a mechanical mixture disappeared from the spectrum as its percentage was reduced." Acting on this suggestion, Hartley [9], in 1884, began to study the spark spectra of metals in solutions with concentrations of 1 percent, 0.1 percent, 0.01 percent, and 0.001 percent, and proposed a method of quantitative spectrochemical analysis based on the lines that could be detected at each dilution. Similar studies were later made by Pollok and Leonard [10], by de Gramont [11], and by Löwe [12], all showing that with progressive dilution of an element its spectral lines weakened and vanished until only the most sensitive line remained to reveal its presence. In all these works the principle of quantitative spectrochemistry appeared to rest on the *number of lines* detectable rather than on their individual *intensities*. Casual observation must have shown lines of equal strength in spectra of solutions differing 1000 fold in concentration but no one mentioned it. It is difficult to understand why these early studies of residual spectra in quantitively prepared mixtures or solutions did not suggest a method for obtaining physical intensities, but it is a fact that before our work had begun no one had attempted to express spectral line intensities as directly proportional to the number of radiating atoms or concentration of the element. The present monograph reports such an attempt [13].

Our method of deriving line intensities from arc spectra of elements diluted in copper was recently adopted by Allen [14, 15] to obtain oscillator strengths of some radiations from 3200 to 5400 Å representing nine elements.

At various times since 1932 we have photographed the arc spectra of 70 chemical elements diluted in silver or in copper, and determined the line intensities of the diluted elements relative to selected lines of the matrix. An energy calibration of the latter finally led to physical intensities of 39,000 spectral lines representing 70 elements, all on the same energy scale. These experiments and results are based on the following propositions, regarded as fundamental for the quantitative description of residual spectra of diluted elements excited in ordinary d—c arcs.

1. *The limiting detectability of any line is defined as the atomic concentration that ensures positive detection of the line.* This limit is determined mainly by unavoidable background on a fully exposed spectrogram. The spectrum of an arc burning in air consists of discrete lines due to atoms, and of more or less extensive band systems from transient compounds (usually monoxides), all superposed on a continuous background arising from thermal radiation of incandescent oxides, from transitions in the continuum, and possibly from scattered light. This background sets a limit to the exposure for faint lines that may be given by any actual spectrograph. If this were not true, the exposure could be increased indefinitely to compensate for unlimited reduction in concentration, and detectability would always be infinite. Faint lines are not recorded by underexposure, and they cannot be recognized on a very dense background produced by overexposure. In order to guarantee positive recognition and unambiguous chemical identification a spectral line should be sufficiently well defined to permit accurate wavelength measurement. Experience shows that the minimum photographic density that meets this requirement is of the order of 0.05 above that of the background.

2. *The limiting detectability of any element in an arc depends on the matrix in which the element finds itself.* There is no doubt that in the conventional arc relative volatilities of the chemical elements as well as relative ionization potentials affect the relative strengths of their mixed spectra. In general, the elements with high-vapor pressure and/or low-ionization potential will be favored in spectral excitation, but elements with either high or low volatility may be underestimated if not uniformly present during the exposure, and easily ionized elements may appear less sensitive because of more complete ionization. In this connection it must be noted that large differences in apparent detectability are possible if concentrations are expressed in relative weights instead of numbers of atoms. Thus,

0.01 atomic percent of boron in uranium is equal to < 0.0005 weight percent since the uranium atom is 22 times heavier than the boron atom.

3. *The primary substance (matrix) has no important effect on the relative intensities of lines due to a secondary substance.* It is conceded that the relative intensities of analogous spectra of different elements, and of successive spectra of the same element, may vary with the composition of the samples and/or with the type, or portion, of light source from which radiation is taken, but there is no evidence that the relative intensities of lines in any particular spectrum of a given element are thereby greatly changed. It may be expected, therefore, that the relative intensities of lines observed in one metal arc will remain valid in any other metal arc, provided the arcs are at approximately the same temperature. The absolute intensities and the relative strengths of successive spectra may be altered by excitation conditions. For example, silicon may be more sensitive in carbon than in calcium, and it is well known that when easily ionized alkalies are present in sufficient quantity to influence discharge conditions they reduce the intensity of other spectra, especially those characteristic of ionized atoms.

4. *The order of lines arranged according to decreasing detectability in progressive dilution is the same as the order of decreasing intensity in the spectrum of the pure element.* In other words, emission line intensities in residual arc spectra (barring self-absorption) are proportional to the number of radiating atoms; and relative intensities may therefore be derived from concentrations at which different lines show the same intensity or limiting detectability.

Arc spectra usually exhibit a variety of lines, sharp or narrow ones, diffuse or wide ones (including band heads), strong ones accompanied by photographic spreading of developed images, others wide on account of hyperfine structure, and some partially reversed. All of these types, except the last, appear in residual arc spectra at low concentrations, and it may be questioned if it is possible to place them on a uniform intensity scale. It may be assumed that if total blackening integrated over the width of the line when recorded at a moderate level of density be considered in estimating relative intensities these will be on a uniform scale within the limits of precision in making such estimates on lines of different types.

5. *The order of spectral lines arranged according to decreasing intensity is the same when the intensities are decreased by rotating stepped sectors as when the intensity reduction is produced by successive dilution of the element in a matrix.* This was recognized by Löwe [12] who published an atlas of spark spectra of 44 elements diluted from 1 percent to 0.001 percent and later obtained practically the same results by observing spectra with stepped exposure times [16]. In our experiments the labor of preparing samples of 70 elements in four or more dilutions was greatly reduced by adopting only one dilution (0.1 atomic percent) and then producing further reductions of spectral-line intensities by means of rotating step sectors.

6. *Limiting detectability (as defined in 1.) may be adopted as a physical scale of intensities.* Such intensities may be fixed as follows: In a fully exposed spectrogram of copper containing 0.1 atomic percent of another element any faint but unmistakable line at a given wavelength is assigned unit intensity. Any similar line appearing with unit intensity in a spectrogram when the energy, or concentration, is reduced to $\frac{1}{5}$ is said to be 5 times as strong. Thus, all lines can be assigned relative intensities proportional to their limiting detectabilities by determining either the energy reduction or the concentration reduction at which the stronger lines finally show unit intensity. The atomic percent concentration at which any line will show unit intensity then results from dividing 0.1 by its required energy or concentration reduction. For example, a line of intensity 10 should show plainly at 0.01 atomic percent, while one of intensity 1000 should be easily seen at 0.0001 atomic percent (one in a million). Assuming the ratio concentration/intensity to be constant, the maximum intensity at 100 percent is easily obtained. Thus, a line of intensity 1000 at 0.1 atomic percent will have an intensity value of $1000 \times 100/0.1 = 1{,}000{,}000$ at 100 percent. This indicates a much larger range of spectral intensities than mentioned heretofore, but it is not unrealistic.

2. Experiments

Whereas all earlier experiments on residual spectra of diluted elements involved spark excitation of solutions or fused salts, we decided to employ d–c arc excitation for the following reasons. It has been shown [17] that the first ionization potentials of some seventy metallic elements range from 4 to 11 V and the strongest spectral lines of most of these elements have wavelengths between 2000 and 9000 Å, which is the spectral region covered by the present investigations. Furthermore, it is known [18] that the second ionization potential of these elements ranges from 10 to 75 V and that the strongest lines of singly ionized atoms generally have shorter wavelengths than those of neutral atoms, nearly half of them being shorter than 2000 Å so that they can be detected only in vacuum spectrographs.

Because low-voltage arcs have less ionizing action than high-voltage sparks more atoms will remain in the neutral state and, in general, therefore, arc spectra will exhibit stronger lines and higher sensitivity than spark spectra.

The use of arc spectra in these experiments threatened to introduce errors on account of self-absorption of radiated energy in the arc aura or envelope which consists largely of unexcited neutral vapor atoms. In all spectra of arcs between metal electrodes this is the cause of conspicuous self-reversal of all lines involving the atom's ground state. However, this is a function of vapor density surrounding the arc and if this is reduced to 0.001, self-reversal is usually negligible (see fig. 2). This is our reason for making these experiments with individual elements diluted in copper in the ratio 1 to 1000. When ground-state lines of extraordinary intensity were suspected of some self-absorption, intensity ratios were checked or corrected by examining our earlier spectrograms made with this element diluted to 0.0002 atomic percent in silver.

2.1. Dilution in Silver

Our preliminary experiments, begun in 1932, can be described briefly as follows: solutions of known strength of the elements under investigation were prepared and proper amounts added to pure silver oxide, which was then reduced to metal by heating to make samples containing 8 definite atomic ratios extending from 0.05 to 0.0002 atomic percent of the element added to silver, with a factor of about 2 between 7 successive dilutions. In order to save time and labor, each series of silver samples incorporated 3 to 6 chemical elements, in addition to zinc which supplied internal standards. These samples were burned on pure copper electrodes of a 220 volt d–c arc with 10 amperes. An image of the arc was projected onto the slit of a stigmatic concave grating spectrograph by means of a fused-quartz lens. Each series of excited samples was exposed on successive segments of the slit, and was photographed in four spectral regions ranging from 2000 to 9000 Å (see fig. 1). A comparator was employed to measure wavelengths (relative to silver and copper lines) for the identification of the added elements, and relative intensities of all lines belonging to residual spectra of diluted substances were estimated and related to concentration. These results were not satisfactory for the following reasons: The use of silver as a matrix and of copper for arc electrodes precluded the possibility of getting any data for these two elements or for any lines masked by silver and copper lines. Also the inclusion of 3 or more elements in each series of samples resulted in the blending of many lines, especially in complex spectra, so that it was not possible to assign proper intensities in these cases. Furthermore, the method of sample preparation and observing appeared to be unsuited to very volatile elements, or compounds, because no residual spectra could be recorded for them even at concentrations of 0.1 atomic percent.

2.2. Dilution in Copper

In 1941 these preliminary experiments were abandoned in favor of a modified procedure which led to satisfactory results. The chief changes in procedure came with the availability and use of pure metal powders, and a hydraulic press to form solid electrodes of mixed powders. Instead of reducing spectral line intensities to the limit of detectability by successive dilutions of the element in different samples only one dilution (0.1 atomic percent) was prepared and line intensities were reduced by observing through rotating step sectors. The successful procedure may be outlined as follows: An element under investigation was mixed with pure copper powder in the atomic ratio of 1 to 1000. These mixtures were pressed into solid electrodes, and burned in a 220-V, 10-A d–c arc which was imaged entirely on the collimator of a stigmatic grating spectrograph by a lens at the slit. A rotating step sector in front of the slit reduced the spectral intensities to one-fifth in each of four steps (see fig. 2). Spectral intensities of the element added to copper were estimated relative to those of selected copper lines, and this was done separately for each of 70 elements throughout the range of spectrum from 2000 to 9000 Å. The true intensities of the selected copper lines above 3300 Å that served as internal standards were then measured, by photographic photometry, relative to the known energy distribution in the spectrum of an incandescent tungsten-strip filament at a certain

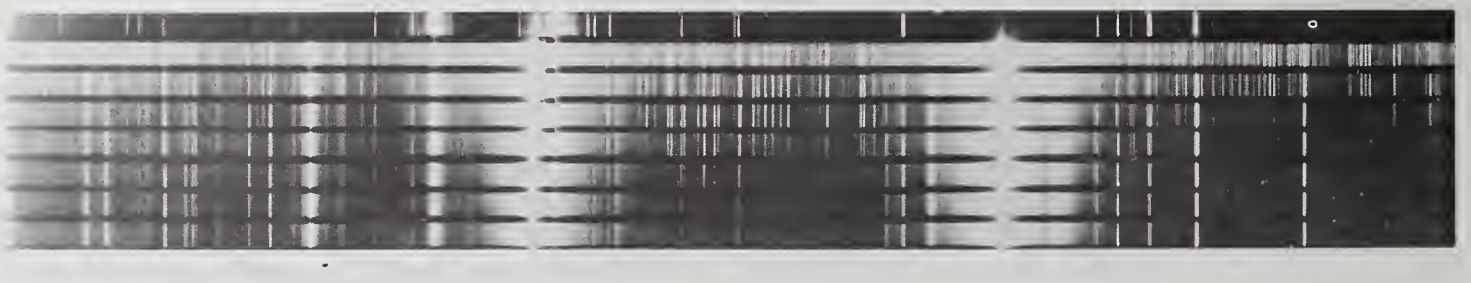

FIGURE 1. *Arc spectra of elements (V, Nb, Ta) diluted progressively in silver, and burned on copper electrodes.*
Spectral range 3880 to 4320 Å.

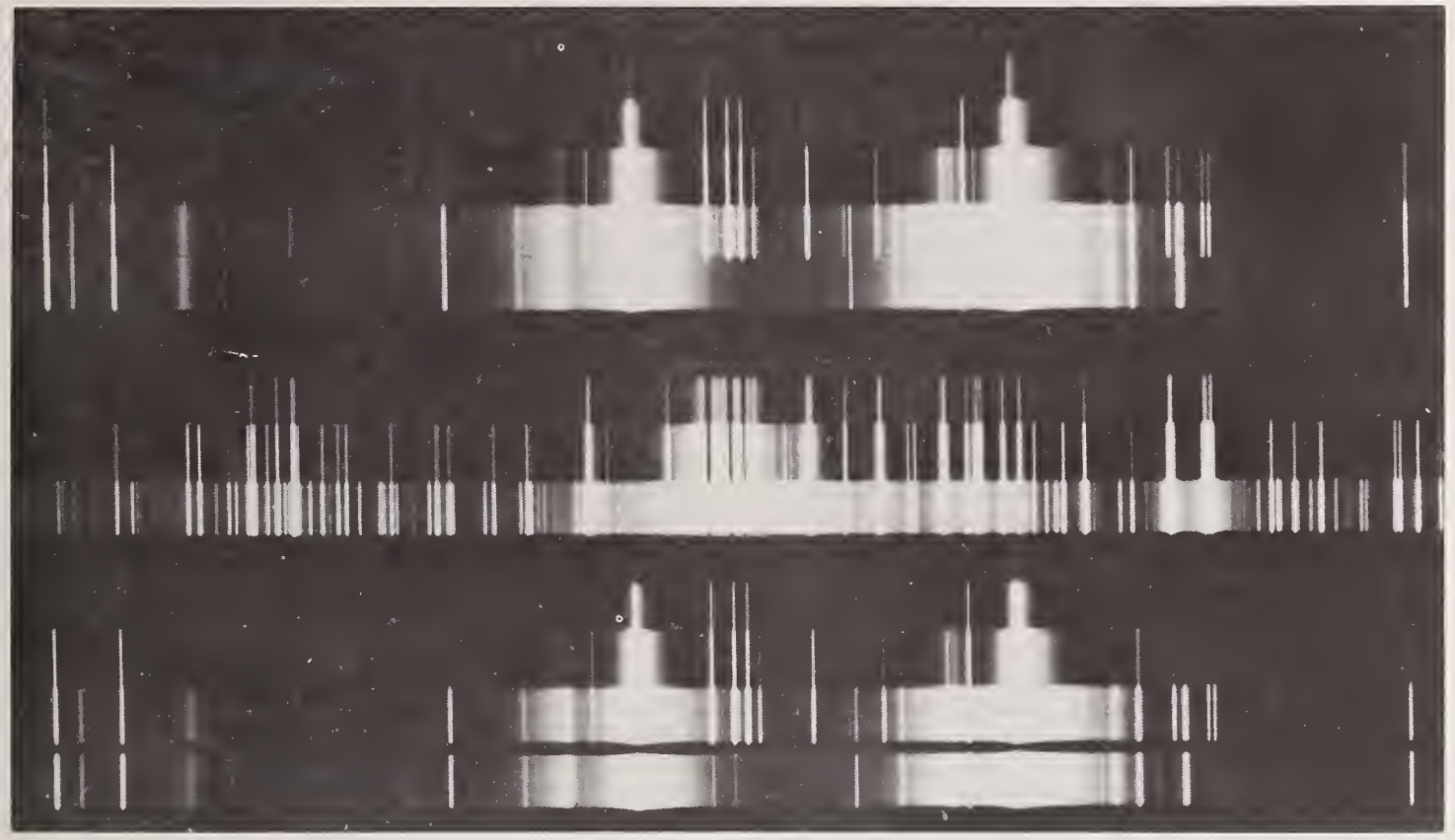

FIGURE 2. *Arc spectra of pure manganese (center), and of copper containing 0.1 percent Mn (above and below), all through a rotating step sector.*
Spectral range 3960 to 4105 Å.

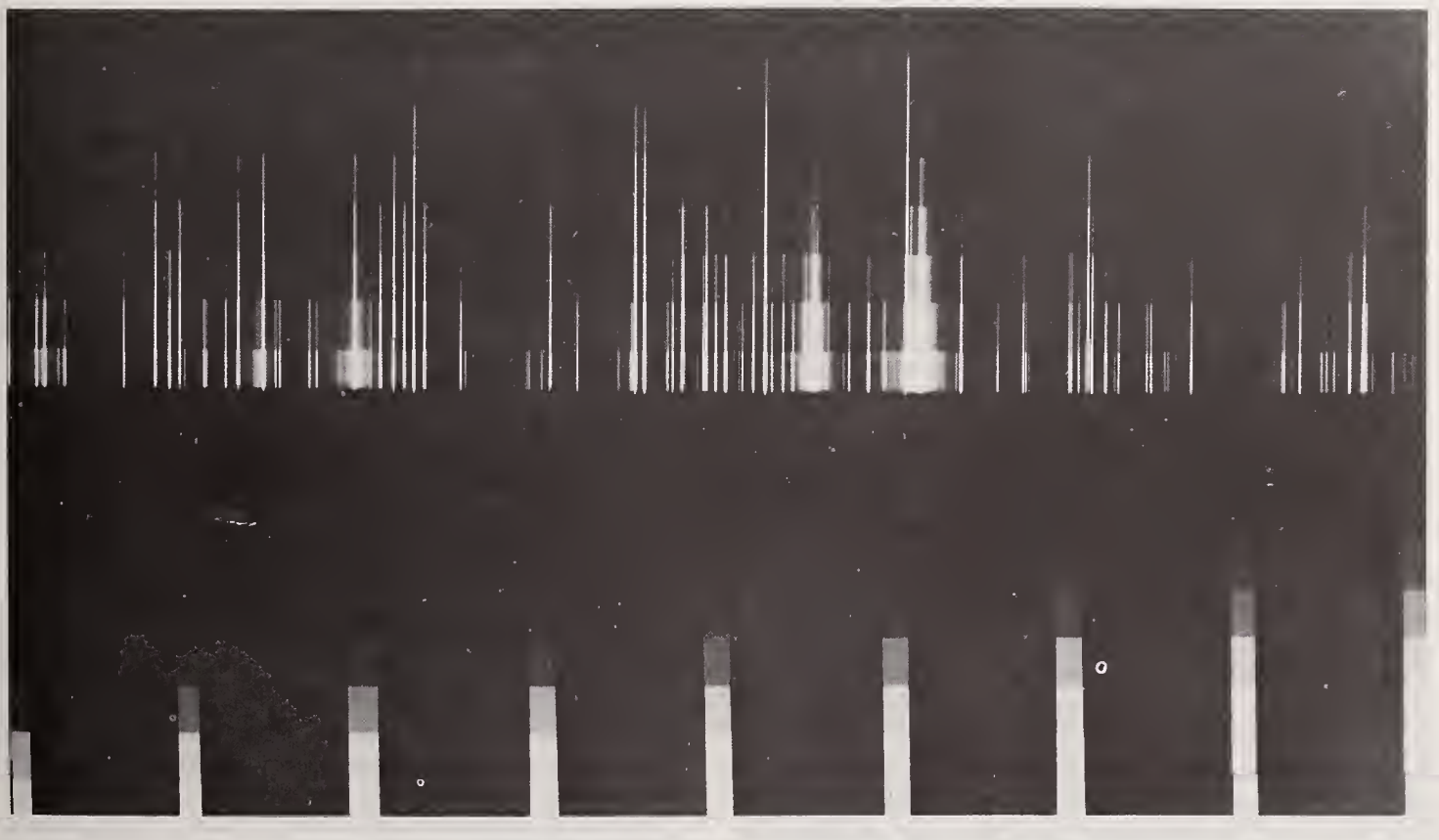

FIGURE 3. *Energy calibration of copper lines.*
Above, arc spectrum of copper through rotating step sector. Spectral range 3400 to 3850 Å. Below, standard-lamp spectrum at 50 Å intervals through same step sector.

temperature (see fig. 3). Between 2000 and 3300 Å a calibrated hydrogen lamp was used to determine the relative intensities of copper lines. Finally the apparent intensities of 39 000 spectral lines of 70 elements, relative to copper, were adjusted to fit the copper calibrations. These experiments thus provide empirically determined lists of the principal lines of all elements actually detectable under average conditions in arc spectra when their concentrations are 0.1 atomic percent, and the individual lines bear intensity numbers approximately proportional to their detectability or their relative energy. That these intensity numbers really represent physical intensities was proved by comparing them with earlier, accurately measured relative intensities of lines in multiplets and with published relative *f*-values or oscillator strengths of lines in different multiplets extending over a wide range of spectrum.

In order to provide intensity data for spectral lines that are partially or wholly obscured by copper lines a sectored spectrogram of the pure element excited with self-electrodes, or of a metallic compound or salt excited in a carbon arc, was photographed on every plate so that any lines blended with copper could be interpolated with proper estimates of their relative intensities. Comparison of relative intensities in copper and in carbon matrices also supplied new information on successive spectra, I and II, especially of rare-earth spectra. Similar data for copper itself were obtained by using pressed electrodes of pure silver powder to which 0.1 atomic percent of copper was added, plus the same quantities of gold and zinc to serve as internal standards.

Further details of experimental materials, apparatus, and procedure are given in the following paragraphs.

2.3. Arc Electrodes

For this investigation materials of high purity were acquired, preferably in the form of metal powders, although some elements, not available in pure powdered metal form, were obtained as oxides. In every case the proper amount was added to powdered copper to produce a mixture in which there was one atom of the added element to each 1000 atoms of copper. These mixtures were homogenized by mechanical shaking and then compressed into solid cylindrical pellets in an hydraulic press at 5000 psi. The pellets were ¼ in in diameter, ¼ in in length, and weighed about 1.5 g. Two of a kind were mounted in massive water-cooled clamps in an arc stand and a direct current of 10 A passed between them from a 220-V line with ballast resistance. A 3-mm gap was maintained between the electrodes during the exposures which varied in duration from 1 s to 5 min depending on spectrographic efficiency and sensitivity of photographic plates in different spectral regions.

The arc was imaged on the collimator of a concave grating spectrograph by means of a quartz lens immediately in front of the slit to obtain uniform illumination along its length and collect light from all parts of the arc. Rotating step sectors were operated immediately in front of the collecting lens, one with 5 to 1 ratio was used for all line-intensity spectrograms, but a 2 to 1 step was used for the energy calibration of copper lines.

2.4. Spectrograph

The dispersing apparatus was a 6-in grating with 15 000 lines per inch, and 22 ft radius of curvature in a Wadsworth-type mounting to give stigmatic images on photographic plates. All observations were made in the first-order spectrum in which the reciprocal dispersion was 5A/mm, and the practical resolving power about 50,000 with a slit width of 30 μ.

2.5. Photographic Plates

In order to determine, relative to copper, the intensities of all lines of 70 chemical elements diluted 1000 fold it was necessary to make many hundreds of spectrograms, and to employ 4 varieties of photographic plates to cover the wavelength range 2000 to 9000 Å. The spectral range 2000 to 3000 Å was recorded on Eastman[2] 103–0 Ultraviolet Sensitive plates, 2600 to 4900 Å on Eastman 33 plates, 4600 to 6900 Å on Eastman II–F plates, and 6600 to 9000 Å on Eastman I–N plates. Each plate was developed for 4 min in a rocking tray containing D–19 developer at 70 °F.

The exposure times in each spectral range were chosen by trial to obtain a suitable continuous background in the first step of the rotating step sector. Because of variations in spectral sensitivity of photographic materials and in spectrographic efficiency two exposures of the contaminated-copper arcs were usually made on each plate, with exposure durations in the ratio 2 to 1, and the sectored comparison spectrum of the contaminant was placed between them. Measurements were usually confined to the exposures which showed the optimum background in the first step of the rotating sector.

2.6. Energy Calibration of Copper Lines

In order to determine the factors necessary to convert the estimates of apparent intensities of the lines of 70 elements relative to copper into true relative intensities, it was necessary to determine the true relative intensities of selected reference lines in the spectrum of copper. The energy calibration of copper lines was performed as follows:

[2] Certain commercial products and instruments are identified in this paper in order to specify adequately the experimental procedure. In no case does such identification imply recommendation or endorsement by the National Bureau of Standards, nor does it imply that the products or equipment identified are necessarily the best available for the purpose.

A G.E. tungsten ribbon filament lamp (type F339–85, 30 A, 6V) equipped with a fused quartz window served as the reference standard of spectral energy distribution in the wavelength range 3300 to 9000 Å. The brightness temperature of the filament at 6500 Å was measured at two values of filament current by Henry Shenker in the National Bureau of Standards Pyrometry Laboratory. The true temperature T of the filament was determined from the brightness temperature by means of the following equation obtained from Wien's law

$$\frac{1}{T}=\frac{1}{T_B}+\frac{\lambda}{C_2}\ln A$$

where $C_2=1.438$ cm-deg and A is the product of the emissivity of tungsten (0.427) and the transmittance of the quartz window (0.916) at 6500 Å.

TABLE 1. *Temperature of tungsten lamp*

Current	Brightness temperature	True temperature
A	*K*	*K*
38.00	2492	2787
40.00	2567	2881

The energy distribution from blackbodies operated at these temperatures was taken from tables prepared by Stair and Smith [19] in the 2300 to 3500 Å range, by Skogland [20] in the 3200 to 7600 Å range and by Lowan and Blanch [21] in the 7200 to 10 000 Å range. The data from these tables were adjusted to a common basis and multiplied by the emissivity of tungsten and the transmittance of fused quartz at intervals increasing from 50 Å in the ultraviolet to 200 Å in the infrared. The emissivity of tungsten was taken from a weighted mean curve of published values to which reference is made by Stair and Smith [19]. The transmittance of fused quartz was calculated from data on its index of refraction published by Sosman [22]. The final product, representing the relative energy distribution of the radiation emerging from the quartz window of the lamp, was plotted on a convenient scale to permit interpolation to any wavelength in the range 2300 to 10 000 Å.

Spectrograms of the pure copper arc and of the tungsten lamp were made under conditions identical with those described above except that for these a 2 to 1 step sector with 8 steps was used for closer calibration (fig. 3). Microphotometer measurements of transmittance were made in each step of the standard-lamp spectrum at intervals of 50 Å and a family of calibration curves of transmittance versus log exposure (hereafter referred to as log J) was drawn up for each plate. The exposure of the standard-lamp J_s was read from the calibration curve for each wavelength at a transmittance of 40 percent (where the curve is linear) and then divided by the calculated intensity I_S at that wavelength. I_s is the calculated intensity emitted by the standard-lamp. A standardization curve of log J_s/I_s versus λ was plotted for each plate. Calibration curves of transmittance versus log J were then drawn from measurements on each of the selected copper lines and the log exposure (log J_{Cu}) of each copper line at a transmittance of 40 percent was read from each curve. Log J_s/I_s was then subtracted from the average of numerous values of log J_{Cu} to give log I_{Cu} which is the log of the true relative intensity of the copper line. The values of log I_{Cu} from plates in adjacent wavelength regions were adjusted to a common basis by means of lines common to both plates. The plot of log J_s/I_s versus λ is the relative response function of the plate-spectrograph combination and as such was itself useful in the infrared where the copper spectrum lacks lines suitable for use as an intensity reference.

From 2 to 24 determinations were made on each of 202 lines of Cu I between 2800 and 8100 Å with an average of about 9 determinations per line. The values of I_{Cu} obtained by this procedure below 3300 Å were systematically low because of the rapid decline in intensity from the standard lamp in the direction of short wavelengths. The intensity from the lamp at 5500 Å is about 40 times the intensity at 3300 Å and about 300 times the intensity at 2800 Å. This fact introduces possible errors from scattered light of the intense visible radiation which tends to raise J_s and consequently depress I_{Cu}.

The spectrum of copper is composed of sharp lines and diffuse lines. Since the microphotometer measurements were made at the peaks of the lines rather than integrated over their widths, the measured intensities of the two groups of lines are on different relative scales, the scale of the diffuse lines being smaller than that of the sharp lines. The reference lines selected for calibration of the estimates of apparent intensity are all sharp lines.

The random error of the photometric procedure, including microphotometer error and irregularities of response of the "*N*" plates was determined from 92 measurements of apparent relative intensities in spectra of the standard lamp on two plates. The standard deviation of individual measurements from the mean was found to be about 1.5 percent. It is probable, therefore, that the uncertainties in these intensity measurements of the copper lines lie entirely in the systematic errors discussed above and in the random fluctuations of the arc under study.

Since the ribbon filament lamp was too faint in the region from 2000 to 3300 Å to serve as a standard, recourse was taken to a Hanovia hydrogen arc lamp. Output from this lamp was compared by R. Stair in the Radiometry Section of the Bureau with a standard tungsten-in-quartz lamp and a

standard mercury arc in the region from 2500 to 3800 Å; this provided an independent overlapping calibration which carried us down to 2500 Å.

The intensity numbers below 2500 Å become less accurate as the short wavelength limit is approached. Lacking any reliable energy calibration for shorter waves, the intensity estimates from 2500 to 2000 Å were necessarily adjusted by judicious extrapolation, guided by the declining densities of background in the spectrograms, caused by the increasing absorption in the apparatus and in the air at shorter wavelengths.

3. Results

Because these relative intensities of 39,000 lines of 70 elements are based on empirical detectability they will be generally applicable to spectrochemical analysis provided that proper corrections are made on account of different excitation in different matrices. Chemical elements differ in volatility, electron emission, spectral excitation, and spectral background, and consequently their spectral detectability in different mixtures or matrices depends on certain controlling factors. One of the important factors is the atomic ionization potential which ranges from 3.9 V for Cs to 11.3 V for C, and for the investigated 70 elements has an average value of 7.3 V. By mixing these 70 elements with copper, which has an ionization potential of 7.7 V, we obtained excitation conditions very near the average for all. To convert our intensity numbers from copper to any other matrix would require the empirical determination of the proper conversion factor for each element.

It should be pointed out that sensitivity of detection in spectrochemical analysis is commonly given in percent by weight. In order to find the weight percent from the atomic percent given in the tables the following simple relation applies,

$$C_w = \frac{C_a A_x}{A_{Cu}}$$

where C_w is the concentration in percent by weight, C_a is the atomic percent (0.1 in this case), A_{Cu} is the atomic weight of copper, and A_x is the atomic weight of the element X.

Although our original intention was to determine the relative strengths of many spectral lines from different chemical elements for purposes of quantitative spectrochemical analysis we believe that the results may also interest theoretical spectroscopists and astrophysicists. For instance, if our intensity numbers, based on concentration detectability and relative energy calibration, actually express relative energies then all may be converted to oscillator strengths, or to relative gf-values, or even to absolute f-values, if the proper conversion factors can be found.

Because of the low concentration of each element in the copper arc from which the spectra were observed, the lines were extraordinarily free from self absorption. This fact suggests that these emission intensities could be converted into relative gf-values, provided that a valid excitation temperature can be assigned to the copper arc.

The temperature of the copper arc can be determined by comparing the observed relative intensities of the lines of an element with the relative gf-values of those lines [23], provided that the arc can be shown to be in local thermodynamic equilibrium for the energy states under consideration. A preliminary investigation of this sort has been carried out by using relative gf-values determined by R. B. King and his coworkers for Ti I [24], Ti II [25], V I [26], Cr I [27], Fe I [28], [29] and Ni I [30] in the region above 3000 Å. Figure 4 is a typical example of the correlation of intensities and gf-values indicating the temperature of the copper arc. The comparison shows that our copper arc is sufficiently in equilibrium to yield a temperature which may be useful in calculating approximate gf-values of some utility from our intensity numbers. A preliminary value of 5000 K ± 300 K has been obtained as the average temperature of the 10 A, 220 V, copper arc.

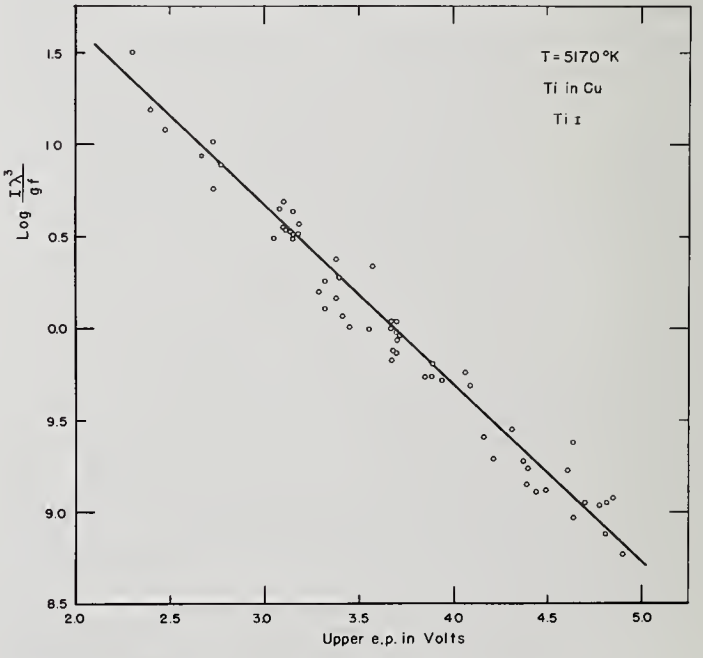

FIGURE 4. *Plot of log intensity* λ^3 *over* gf *versus upper excitation potential of* Ti I *lines.*
The temperature of the arc is derived from the slope of the line which best fits the points.

Because our intensity data represent single (some times two) personal subjective estimates of photographic densities in sectored spectrograms there is no possibility of deriving statistically any probable errors or standard deviations for individual values. However, an estimate of the accuracy or reliability of our data may be obtained by comparing them with quantitative results published by other investigators. For example, figure 4 shows the ratios of our intensities to the relative f-values (or intensities) reported by King and King [24] who measured the total absorptions of Ti I lines in furnace absorption spectra; they stated [28] that "The average deviations of the individual intensity measures from the mean values vary from 4 to 15 percent for different lines" measured between 4 and 16 times on different plates. Each little circle plotted in figure 4 represents a Ti I multiplet of 1 to 12 lines. The average of 59 deviations from the mean of all is 25 percent.

A second indication of the reliability of our intensities is obtained by comparing our values with the relative intensities of lines in multiplets of five elements (Cr, Fe, Mn, Ti, V) measured with photographic densitometry by Frerichs [31] to test the sum rules. Such a comparison in 21 different multiplets indicates deviations ranging from 5 to 22 percent, with an overall average of 14 percent.

A third estimate of the errors in our data results from their comparison with photoelectric intensity measurements in the iron arc by Crosswhite [32], who claims an accuracy of the order of 1 percent. The average difference between intensities of 330 iron lines (3175 to 5658 Å) common to these two sets of observations is ± 27 percent, but some of this difference may be due to temperature if this is not the same in both arcs.

Other comparisons could be made but the above three are different and typical; they suggest that the average error of our spectral-line intensities within a spectrum of each element is probably between 15 and 25 percent. The uniformity of the intensity scale between the spectra of the various elements is more difficult to assess. Considerable care was taken to obtain spectrograms under comparable conditions for all of the elements; however, differences in volatilities of the elements or their oxides, and differences in ease of excitation may possibly result in shifts of intensity scales between elements. An inspection of the intensities of the strongest lines of the elements indicates that the values are generally in the same order as sensitivity of detection of the elements where these are known. Although no high precision was expected in our mass-production of intensities it is emphasized that reasonably uniform, quantitative values are now available for 39 000 lines emitted by 70 chemical elements.

The tables of spectral-line intensities resulting from this investigation are presented in two parts. In part I the data are arranged by element in alphabetical order of chemical name. The heading of each table by element states the atomic symbol, atomic number, atomic weight, ratio of atomic weight to that of copper, the electron configuration and term symbol of the normal state of each spectrum and the corresponding ionization potential expressed in cm^{-1}. Following the heading is a selected list of references. Under *Wavelengths* are listed all of the sources from which the wavelengths used in the table were compiled. Under *Classification* or *Spectrum Assignments* are listed the sources from which the assignment of spectrum and energy levels were obtained. A few spectra showed bands of metallic oxides. References to data about these bands are given under *Molecular Spectra.*

Following the references there is abstracted from the main table a list of the strong lines arranged in order of decreasing intensity. These lists of the strong lines generally contain 2 percent or more of the lines in the main table.

Electron configurations and spectral term designations of quantum numbers are of unusual interest in the production of the strongest spectral lines, or *raies ultimes.* According to well-known rules governing the relative intensities of lines in multiplets, the strongest line arises from transitions between levels having the largest J and L values when $\Delta J = \Delta L = 1$. A rule relating to *raies ultimes* was expressed [33] a quarter of a century ago as follows: "A *raie ultime* in any spectrum originates with a simple interchange of a single electron between s and p states, usually preferring configurations in which only one electron occurs in such states." The above simple rules for the strongest lines appear to be valid for all spectra.

Then comes the main table, listing in order of wavelength, for every line of an element which appears on our plates, the intensity, character, wavelength, spectrum, and energy levels. The calibrated intensity numbers in the first column represent the relative radiant power emitted by our arc at each wavelength. Lines which differ in profile from a normal sharp symmetrical shape are described in the second column, with the notation suggested in the Transactions of the Joint Commission for Spectroscopy [34] as follows:

b – band head,
c – complex,
d – unresolved double line,
h – hazy,
l – shaded longward,
s – shaded shortward,
w – wide.

The wavelengths in column 3 are taken from the places noted in the list of references and are given

to the nearest 0.01 Å. They are all normal air wavelengths, even those below 2000 Å. Column 4 gives the spectrum, I, II, or III (respectively from neutral, singly ionized and doubly ionized atoms) in which the line occurs or the molecule from which a band head originates and column 5 the numerical values, rounded off to the nearest wavenumber, of the levels between which the transition occurs. These data are taken from the *Classification* reference.

The wavelength of a doubly classified line appears before the first pair of energy levels and the second pair follows immediately. In these tables all energy levels are given in vacuum wavenumber units, cm^{-1}, for which the name kayser (K) has been proposed [35]. For all spectral lines explained as transitions between energy levels this serves as a mutual check since the wavelengths in normal air, when converted to vacuum wavenumbers by a conversion table [36], will coincide within one unit with the difference between the two energy levels. Furthermore these numbers serve as an index to the term designation in "Atomic Energy Levels" [37] where electron configurations, quantum numbers, and magnetic splitting factors are given.

A comparison of the excitation energies of any two classified lines may be made by directly comparing their energy levels in cm^{-1}. This direct and simple procedure avoids the labor of converting all energy levels from cm^{-1} to electron volts by means of the relation one $eV = 8065\ cm^{-1}$.

In part II the intensity data are arranged in two tables in order of increasing wavelengths. In table 1 the strong lines of each element which were abstracted from the main tables in part I are here arranged in order of wavelength. Following this is table 2 in which the individual main tables of part I have been consolidated into a single table arranged by wavelength. This table contains about 39 000 lines of 70 elements. The intensities in the table are on a scale of relative radiant power and the scale is the same from element to element. Following the intensity numbers are given the wavelength, the element symbol, and the spectrum. The intensity of a double line appears before the first wavelength and the second wavelength follows immediately.

This investigation has extended over a period of 28 years, and represents a very considerable amount of intermittent labor contributed mainly by a relatively small number of individuals. The program was initiated by Meggers and Scribner; the latter prepared diluted-element mixtures, electrodes and spectrograms, while the former identified wavelengths, supplied many line classifications, and estimated relative intensities of some fifty thousand lines. In the production of the mixtures and the copper electrodes and spectrograms valuable assistance was given by Harriet E. Brown. Corliss contributed the copper calibration, the conversion of apparent intensities to relative radiant powers, and prepared the final tables. Mrs. Ruth Peterson carefully prepared and checked all the data on IBM cards so that it could be printed automatically. Valuable advice and assistance on the IBM machine operations was given by William Bozman. To all our able and reliable assistants the authors extend their sincere appreciation and thanks for cheerful and conscientious cooperation.

4. References

[1] G. Kirchhoff and R. Bunsen, Chemische Analyse durch Spectralbeobachtungen, Ann. d. Phys. **186**, 161–189 (1860).

[2] J. N. Lockyer, Researches in spectrum-analysis in connection with the spectrum of the Sun, Phil. Trans. **164**, 479–494 (1874).

[3] A. Gatterer and J. Junkes, Spektren der Seltenen Erden, 347 pp, Vatican City (1945).

[4] F. Exner and E. Haschek, Die Spektren der Elemente bei normalem Druck, 3 volumes, Franz Deuticke, Leipzig and Vienna (1911).

[5] F. Twyman and D. M. Smith, Wavelength tables for spectrum analysis, 2d ed. 180 pp, Adam Hilger, Ltd., London (1931).

[6] H. Kayser and R. Ritschl, Tabelle der Hauptlinien der Linienspektren aller Elemente, 2d ed. 269 pp, Julius Springer, Berlin (1939).

[7] G. R. Harrison, Massachusetts Institute of Technology Wavelength Tables, 429 pp (John Wiley & Sons, Inc., New York, N.Y., 1939).

[8] A. N. Zaidel, V. K. Prokof'ev and S. M. Raiskii, Tables of Spectrum Lines, 550 pp, Veb Verlag Technik, Berlin (1955).

[9] W. N. Hartley, Researches in Spectrum Photography in Relation to new methods of Quantitative Chemical Analysis, Phil. Trans. **175**, 49, 325 (1884).

[10] J. Pollok and A. H. Leonard, On the quantitative spectra of chemical elements, Proc. Roy. Soc. Dublin (2) **11**, 217, 229, 257, 270, 331 (1908).

[11] A. de Gramont, Sur les indications quantitatives qui peuvent être fournies par les spectres de dissociation. Compt. rend. **147**, 307 (1908).

[12] F. Löwe, Atlas der letzten Linien der wichtigsten Elemente, 44 pp., T. Steinkopff, Dresden and Leipzig (1928).

[13] W. F. Meggers, C. H. Corliss, and B. F. Scribner, Intensities of 30,000 spectral lines, Science **121**, 624 (1955).

[14] C. W. Allen and A. S. Asaad, Oscillator strengths from arc spectra of diluted copper alloys, Monthly Notices, Roy. Astron. Soc. **117**, 36–49 (1957).

[15] C. W. Allen, Absolute oscillator strength measurements in Mg, Ca and other atoms, Monthly Notices, Roy. Astron. Soc. **117**, 622–628 (1957).

[16] F. Löwe, Atlas der Analysenlinien der wichtigsten Elemente, 40 pp., T. Steinkopff, Dresden and Leipzig (1936).

[17] W. F. Meggers, The physical basis of spectrochemical analysis, J. Opt. Soc. Am. **31**, 39–46 (1941).
[18] W. F. Meggers, The strongest lines of singly ionized atoms, J. Opt. Soc. Am. **31**, 605–611 (1941).
[19] R. Stair and W. O. Smith, A tungsten-in-quartz lamp and its applications in photoelectric radiometry, J. Research NBS **30**, 449–459 (1943).
[20] J. F. Skogland, Tables of spectral energy distribution and luminosity for use in computing light transmissions and relative brightnesses from spectrophotometric data, NBS Misc. Publ. 86, p. 23 (1929).
[21] A. N. Lowan and G. Blanch, Tables of Planck's radiation and photon functions, J. Opt. Soc. Am. **30**, 70–81 (1940).
[22] R. B. Sosman, Properties of Silica (Chemical Catalog Co., New York, N.Y., 1927).
[23] H. Hemmendinger, Electrode concentrations and total intensity of spectral lines, J. Opt. Soc. Am. **31**, 150–156 (1941).
[24] R. B. King and A. S. King, Relative *f*-values for lines of Fe I and Ti I, Astrophys. J. **87**, 24–39 (1938).
[25] R. B. King, Relative *f*-values for lines of Ti II, Astrophys. J. **94**, 27–29 (1941).
[26] R. B. King, Relative *f*-values for lines of V I, Astrophys. J. **105**, 376–389 (1947).
[27] A. J. Hill and R. B. King, Relative *f*-values for lines of Cr I, J. Opt. Soc. Am. **41**, 315–321 (1951).
[28] R. B. King and A. S. King, Relative *f*-values for lines of Fe I, Astrophys. J. **82**, 377–395 (1935).
[29] W. W. Carter, Measurement of *f*-values in the iron spectrum, Phys. Rev. **76**, 962–966 (1949).
[30] R. B. King, Relative *gf*-values of Ni I, Astrophys. J. **108**, 87–91 (1948).
[31] R. Frerichs, Intensitätsmessungen an Multipletts, Ann. d. Physik **386**, 807–845 (1926).
[32] H. M. Crosswhite, Photoelectric intensity measurements in the iron arc, Spectrochimica Acta **4**, 122–151 (1950).
[33] W. F. Meggers and B. F. Scribner, Second spectrum of hafnium (Hf II), J. Research NBS **13**, 657 (1934).
[34] Transactions of the joint commission for spectroscopy, J. Opt. Soc. Am. **43**, 410–430 (1953).
[35] W. F. Meggers, Modern Interferometers, review, J. Opt. Soc. Am. **41**, 1064 (1951).
[36] C. D. Coleman, W. R. Bozman and W. F. Meggers, Table of wavenumbers, NBS Mono. 3, 2 volumes (U.S. Government Printing Office, Washington, D.C., 1960).
[37] C. E. Moore, Atomic energy levels, NBS Circ. 467, Vol. **1** (1949), Vol. **2** (1952), Vol. **3** (1958).

WASHINGTON, D.C., January 1, 1961.

559-795 O - 75 - 2 (Pt.1)

Tables of Spectral-Line Intensities—Part I

Arranged by Elements

Aluminum

Al, $Z=13$, $M=26.9815$, Ratio $\frac{\text{Al}}{\text{Cu}}=0.4246$

Al I Normal state of valence electrons $3s^2 3p\ ^2P^\circ_{1/2}=0$. I.P. $=48279$ cm^{-1}.
Al II Normal state of valence electrons $3s^2\ ^1S_0=0$. I.P. $=151860$ cm^{-1}.

References

Wavelengths:
K. B. S. Eriksson and H. B. S. Isberg, Arkiv for Fysik **23**, 527 (1962).

Classification:
Al I, F. Paschen, Ann. Physik **12**, 516 (1932).

Aluminum—all observed lines

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
500 d	2269.10	I	112 – 44169	40	2575.40	I	112 – 38929
	2269.22	I	112 – 44166	150	2652.48	I	0 – 37689
460	2367.05	I	0 – 42234	200	2660.39	I	112 – 37689
850	2373.12	I	112 – 42238	3200	3082.15	I	0 – 32435
170	2373.35	I	112 – 42234	6500 d	3092.71	I	112 – 32437
					3092.84	I	112 – 32435
40	2378.40	I	112 – 42144	4500	3944.01	I	0 – 25348
240	2567.98	I	0 – 38929				
480	2575.10	I	112 – 38934	9000	3961.52	I	112 – 25348

Antimony

Sb, $Z=51$, $M=121.7$, Ratio $\frac{\text{Sb}}{\text{Cu}}=1.916$

Sb I Normal state of valence electrons $5s^2 5p^3\ {}^4S^\circ_{1\,1/2}=0$. I.P. = 69700 cm^{-1}.
Sb II Normal state of valence electrons $5s^2 5p^2\ {}^3P_0=0$. I.P. = 133328 cm^{-1}.

References

Wavelengths and classification:
Sb I, W. F. Meggers and C. J. Humphreys, J. Research NBS **28**, 463 (1942) RP 1464.

Antimony—all observed lines

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
3000	2029.49	I	16396 – 65653	18	2474.57	I	18464 – 58863
5000	2039.77	I	9854 – 58863	180	2478.32	I	16396 – 56733
13000	2049.57	I	8512 – 57287	35	2480.44	I	16396 – 56699
42000	2068.33	I	0 – 48332				
5000	2098.41	I	8512 – 56152	30	2510.54	I	8512 – 48332
				3200	2528.52	I	9854 – 49391
1000	2118.48	I	18464 – 65653	12	2554.64	I	18464 – 57597
1900	2127.39	I	0 – 46991	80	2574.06	I	16396 – 55233
3200	2139.69	I	8512 – 55233	6000	2598.05	I	8512 – 46991
1600	2141.83	I			2598.09	I	9854 – 48332
3200	2144.86	I	8512 – 55121				
				340	2612.31	I	18464 – 56733
8500	2175.81	I	0 – 45945	320	2652.60	I	18464 – 56152
1500	2179.19	I	9854 – 55728	380	2670.64	I	8512 – 45945
400	2201.32	I	16396 – 61809	140	2682.76	I	18464 – 55728
1000	2208.45	I	9854 – 55121				
650	2220.73	I	8512 – 53528	50	2692.25	I	16396 – 53528
				170	2718.90	I	18464 – 55233
320	2224.93	I	8512 – 53443	50	2727.23	I	18464 – 55121
550	2262.51	I	16396 – 60581	900	2769.95	I	9854 – 45945
120	2288.98	I	9854 – 53528	70	2851.11	I	18464 – 53528
380	2293.44	I	9854 – 53443				
200	2306.46	I	16396 – 59738	1400	2877.92	I	8512 – 43249
				500	3029.83	I	16396 – 49391
2200	2311.47	I	0 – 43249	1000	3232.52	I	18464 – 49391
50	2360.50	I	16396 – 58747	850	3267.51	I	16396 – 46991
100	2373.67	I	18464 – 60581	100	3383.15	I	16396 – 45945
80	2383.64	I	18464 – 60404				
60	2422.13	I	18464 – 59738	100	3637.83	I	18464 – 45945
				50	3722.79	I	16396 – 43249
80	2426.35	I	16396 – 57597	40	4033.55	I	18464 – 43249
190	2445.51	I	8512 – 49391				

Arsenic

As, $Z = 33$, $M = 74.9216$, Ratio $\frac{\text{As}}{\text{Cu}} = 1.179$

As I Normal state of valence electrons $4s^2 4p^3\ {}^4S^\circ_{1\,1/2} = 0$. I.P. = 79165 cm^{-1}.
As II Normal state of valence electrons $4s^2 4p^2\ {}^3P_0 = 0$. I.P. = 163000 cm^{-1}.

References

Wavelengths and Classification:
As I, W. F. Meggers, A. G. Shenstone, and C. E. Moore, J. Research NBS **45**, 346 (1950) RP 2144.

Arsenic—all observed lines

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
55000	1936.96	I	0 – 51610	400	2370.77	I	18648 – 60815
65000	1971.97	I	0 – 50694	400	2381.18	I	10915 – 52898
36000	1989.70	I	10592 – 60835				
11000	1990.48	I	10592 – 60815	110	2437.23	I	10592 – 51610
5000	1994.78	I	18186 – 68301	360	2456.53	I	10915 – 51610
				440	2492.91	I	10592 – 50694
44000	2003.34	I	10915 – 60815	440	2745.00	I	18186 – 54605
5500	2009.19	I	18648 – 68403	1400	2780.22	I	18648 – 54605
4200	2013.32	I	18648 – 68301				
480	2165.52	I	18648 – 64812	900	2860.44	I	18186 – 53136
2600	2288.12	I	10915 – 54605	200	2898.71	I	18648 – 53136
				30	2990.99	I	18186 – 51610
160	2344.03	I	18186 – 60835	80	3032.85	I	18648 – 51610
2600	2349.84	I	10592 – 53136	40	3119.60	I	18648 – 50694
500	2369.67	I	18648 – 60835				

Barium

Ba, $Z = 56$, $M = 137.3$, Ratio $\frac{\text{Ba}}{\text{Cu}} = 2.161$

Ba I Normal state of valence electrons $5p^6 6s^2\ {}^1S_0 = 0$. I.P. $= 42035\ \text{cm}^{-1}$.
Ba II Normal state of valence electrons $5p^6 6s\ {}^2S_{1/2} = 0$. I.P. $= 80687\ \text{cm}^{-1}$.

References

Wavelengths:

G. R. Harrison, Massachusetts Institute of Technology Wavelength Tables (John Wiley & Sons, New York, 1939).

F. Sullivan and K. Burns, Sci. Studies St. Bonaventure Coll. **9**, 7 (1941).

H. N. Russell and C. E. Moore, J. Research NBS **55**, 299 (1955) RP 2633.

Classification:

Ba I, H. N. Russell and C. E. Moore, J. Research NBS **55**, 299 (1955) RP 2633.

Ba II, A. Fowler, Report on Series in Line Spectra (Fleetway Press, London, 1922).

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
1400		2304.24	II	4874 – 48259
2000		2335.27	II	5675 – 48484
190		2347.58	II	5675 – 48259
60		2528.51	II	20262 – 59799
100		2634.78	II	21952 – 59895
30		2702.63	I	0 – 36990
18		2771.36	II	21952 – 58025
180		3071.58	I	0 – 32547
500		3501.11	I	0 – 28554
70		3889.33	I	0 – 25704
1400	l	3891.78	II	20262 – 45949
30		3892.66	I	11395 – 37077
100		3909.91	I	9034 – 34603
140		3935.72	I	9216 – 34617
35		3937.87	I	9216 – 34603
180		3993.40	I	9597 – 34631
30		3995.66	I	9597 – 34617
1500	h	4130.66	II	21952 – 46155
60		4132.43	I	0 – 24192
200		4166.00	II	21952 – 45949
200		4283.10	I	11395 – 34736
70	h	4350.33	I	12637 – 35617
100		4402.54	I	12637 – 35344
150		4431.89	I	12266 – 34823
30		4488.97	I	13515 – 35785
35	h	4493.64	I	13515 – 35762
130		4505.92	I	12637 – 34823
50	h	4523.24	I	13515 – 35617
130		4524.93	II	20262 – 42355
65000		4554.03	II	0 – 21952
80		4573.85	I	12637 – 34494
140		4579.64	I	13515 – 35344
40		4599.75	I	12637 – 34371
20		4619.98	I	12266 – 33905
30		4673.62	I	9597 – 30987
130		4691.62	I	13515 – 34823
30		4700.43	I	12637 – 33905
80		4726.45	I	11395 – 32547
400		4899.97	II	21952 – 42355
18		4902.90	I	13515 – 33905
20000		4934.09	II	0 – 20262
30		4947.33	I	18060 – 38267
20		5054.98	I	18060 – 37837
60	h	5159.92	I	18060 – 37435
20	h	5267.03	I	18060 – 37041
220	hl	5424.55	I	12266 – 30696
14	h	5473.69	I	
320	hl	5519.05	I	12637 – 30751
6500		5535.48	I	0 – 18060
20		5680.18	I	9216 – 26816
500	hl	5777.62	I	13515 – 30818
90	l	5800.23	I	13515 – 30751
70		5805.68	I	9597 – 26816
300		5826.28	I	11395 – 28554
2800		5853.68	II	4874 – 21952
50		5907.64	I	9034 – 25957
500		5971.70	I	9216 – 25957
500		5997.09	I	9034 – 25704
500		6019.47	I	9034 – 25642
1100		6063.12	I	9216 – 25704
1700		6110.78	I	9597 – 25957
20000		6141.72	II	5675 – 21952
500		6341.68	I	9216 – 24980
360		6450.85	I	9034 – 24532
600		6482.91	I	11395 – 26816
12000		6496.90	II	4874 – 20262
1600		6498.76	I	9597 – 24980
700		6527.31	I	9216 – 24532
650		6595.32	I	9034 – 24192
320		6675.27	I	9216 – 24192
320		6693.84	I	9597 – 24532
16	h	6771.85	I	23074 – 37837
60		6865.69	I	11395 – 25957
12	h	6867.85	I	22947 – 37504
1400		7059.94	I	9597 – 23757
190		7120.33	I	9034 – 23074
6		7153.58	I	23757 – 37732
60		7195.24	I	12266 – 26160
20		7228.84	I	22065 – 35894
950		7280.30	I	9216 – 22947
110		7392.41	I	12637 – 26160
20		7417.53	I	9597 – 23074
30	hl	7459.78	I	22947 – 36349
170		7488.08	I	9597 – 22947
20		7610.48	I	23062 – 36200
10	hl	7636.90	I	23074 – 36165
40	hl	7642.91	I	23757 – 36837
500		7672.09	I	9034 – 22065
300		7780.48	I	9216 – 22065
8	h	7839.57	I	24980 – 37732
170		7905.75	I	13515 – 26160
80		7911.34	I	0 – 12637
60	h	8210.24	I	18060 – 30237
400	h	8559.95	I	11395 – 23074
30		8860.98	I	12637 – 23919
35		8914.99	I	12266 – 23480

Beryllium

$$\text{Be}, Z = 4, M = 9.01218, \text{Ratio } \frac{\text{Be}}{\text{Cu}} = 0.1418$$

Be I Normal state of valence electrons $2s^2\ {}^1S_0 = 0$. I.P. = 75192 cm^{-1}.
Be II Normal state of valence electrons $2s\ {}^2S_{1/2} = 0$. I.P. = 146882 cm^{-1}.

References

Wavelengths and Classification:
Be I, L. Johansson, Arkiv for Fysik **23,** 119 (1962).
Be II, F. Paschen and P. G. Kruger, Ann. Physik **8,** 1005 (1931).

Molecular Spectra:
BeO, A. Lagerqvist and R. Westoo, Arkiv Mat. Astron. Fysik **32A,** No. 10 (1945).

Beryllium—all observed lines

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
1100 h	2174.99	I	21979 – 67942	4800	3130.42	II	0 – 31935
	2175.10	I	21981 – 67942	3200	3131.07	II	0 – 31929
9500	2348.61	I	0 – 42565	600	3321.01	I	21978 – 52081
700	2494.54	I	21978 – 62054		3321.08	I	21979 – 52081
	2494.58	I	21979 – 62054	1000	3321.34	I	21981 – 52081
1000	2494.73	I	21981 – 62054				
1400 c	2650.45	I	21979 – 59697	120	4572.66	I	42565 – 64428
	2650.55	I	21978 – 59695	70 bl	4708.60	Be O	
	2650.61	I	21979 – 59695	40 h	8254.10	I	42565 – 54677
	2650.62	I	21981 – 59697				
	2650.69	I	21979 – 59694				
	2650.76	I	21981 – 59695				

Bismuth

$$\text{Bi}, Z = 83, M = 208.9806, \text{Ratio } \frac{\text{Bi}}{\text{Cu}} = 3.289$$

Bi I Normal state of valence electrons $6s^2 6p^3\ {}^4S^\circ_{1\,1/2} = 0$. I.P. = 58790 cm^{-1}.
Bi II Normal state of valence electrons $6s^2 6p^2\ {}^3P_0 = 0$. I.P. = 134600 cm^{-1}.

References

Wavelengths:
G. R. Harrison, Massachusetts Institute of Technology Wavelength Tables (John Wiley & Sons, New York, 1939), above 2000 Å.
G. R. Toshniwal, Phil. Mag. **4**, 774 (1927), below 2000 Å.

Classification:
Bi I, S. Mrozowski, Phys. Rev. **62**, 526 (1942).

Bismuth—all observed lines

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
48000	1953.89	I	0 – 51158	4000	2897.98	I	11418 – 45915
9000	1959.48	I	0 – 51019	3200	2938.30	I	15437 – 49461
10000	2021.21	I	0 – 49461	2800	2989.03	I	11418 – 44865
44000	2061.70	I	0 – 48489				
4600	2110.26	I	0 – 47371	700	2993.34	I	11418 – 44817
				2400	3024.64	I	15437 – 48489
2500	2133.63	I	11418 – 58272	60	3034.87	I	
360	2228.25	I	0 – 44865	36000 c	3067.72	I	0 – 32588
1700	2230.61	I	0 – 44817	140	3076.66	I	11418 – 43912
340	2276.58	I	0 – 43912				
190	2400.88	I	15437 – 57075	550 c	3397.21	I	15437 – 44865
				500 c	3510.85	I	15437 – 43912
25	2515.69	I	11418 – 51158	380 c	3596.11	I	21660 – 49461
70	2524.49	I	11418 – 51019	140	4121.53	I	21660 – 45915
700	2627.91	I	11418 – 49461	140	4121.86	I	
280 c	2696.76	I	11418 – 48489				
140 d	2730.50	I	21660 – 58272	600 c	4722.19	I	11418 – 32588
					4722.55	I	
360	2780.52	I	11418 – 47371		4722.83	I	
140 c	2809.62	I	15437 – 51019	10 c	5552.35	I	

Boron

$$\text{B},\ Z = 5,\ M = 10.81,\ \text{Ratio}\ \frac{\text{B}}{\text{Cu}} = 0.1701$$

B I Normal state of valence electrons $2s^2 2p\ ^2P^\circ_{1/2} = 0$. I.P. $= 66928\ \text{cm}^{-1}$.
B II Normal state of valence electrons $2s^2\ ^1S_0 = 0$. I.P. $= 202895\ \text{cm}^{-1}$.

References

Wavelengths:
G. R. Harrison, Massachusetts Institute of Technology Wavelength Tables (John Wiley & Sons, New York, 1939).

Classification:
B I, H. E. Clearman, J. Opt. Soc. Am. **42**, 373 (1952).

Boron—all observed lines

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
4200	2088.93	I	0 – 47857	2400	2496.78	I	0 – 40040
6500	2089.59	I	16 – 47857	4800	2497.73	I	16 – 40040

Cadmium

$$\text{Cd},\ Z = 48,\ M = 112.40,\ \text{Ratio}\ \frac{\text{Cd}}{\text{Cu}} = 1.769$$

Cd I Normal state of valence electrons $4d^{10}\,5s^2\,{}^1S_0 = 0$. I.P. = 72539 cm^{-1}.
Cd II Normal state of valence electrons $4d^{10}\,5s\ {}^2S_{1/2} = 0$. I.P. = 136375 cm^{-1}.

References

Wavelengths:
G. R. Harrison, Massachusetts Institute of Technology, Wavelength Tables (John Wiley & Sons, New York, 1939).

Classification:
Cd I, A. Fowler, Report on Series in Line Spectra (Fleetway Press, London, 1922).
Cd II, A. G. Shenstone and J. T. Pittenger, J. Opt. Soc. Am. **39**, 219 (1949).

Cadmium—all observed lines

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
19000		2144.38	II	0 – 46619	50		3133.17	I	30656 – 62563
9000		2265.02	II	0 – 44136	320		3261.06	I	0 – 30656
150		2267.47	I	30656 – 74745	800		3403.65	I	30114 – 59486
15000		2288.02	I	0 – 43692					
400		2306.61	I	30656 – 73996	2500		3466.20	I	30656 – 59498
					800		3467.66	I	30656 – 59486
190		2312.84	II	46619 – 89844	3600		3610.51	I	31827 – 59516
300	h	2329.28	I	31827 – 74745	700		3612.88	I	31827 – 59498
50		2572.93	II	44136 – 82991	70		3614.45	I	31827 – 59486
50	h	2836.91	I	30114 – 65354					
80	h	2880.77	I	30656 – 65359	800		4678.16	I	30114 – 51484
					1400		4799.92	I	30656 – 51484
20		2881.23	I	30656 – 65354	2800		5085.82	I	31827 – 51484
160	h	2980.63	I	31827 – 65367	260	h	6438.47	I	43692 – 59220

Calcium

Ca, $Z = 20$, $M = 40.08$, Ratio $\frac{Ca}{Cu} = 0.6307$

Ca I Normal state of valence electrons $4s^2\ {}^1S_0 = 0$. I.P. = 49305 cm^{-1}.
Ca II Normal state of valence electrons $4s\ {}^2S_{1/2} = 0$. I.P. = 95752 cm^{-1}.

References

Wavelengths and Classification:

Ca I, G. Risberg, Arkiv for Fysik **37**, 231 (1967).

Ca II, B. Edlen and P. Risberg, Arkiv for Fysik **10**, 553 (1956).

Calcium—all observed lines

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
70		2398.56	I	0 – 41679	60	h	5041.62	I	21850 – 41679
30		2721.64	I	0 – 36732	100	h	5188.85	I	23652 – 42919
35		2994.96	I	15158 – 48538	110		5261.71	I	20335 – 39335
20		2997.31	I	15210 – 48564	130		5262.24	I	20335 – 39333
20		2999.64	I	15210 – 48538	110		5264.24	I	20349 – 39340
					280		5265.56	I	20349 – 39335
20		3000.86	I	15210 – 48524					
70		3006.86	I	15316 – 48564	480		5270.27	I	20371 – 39340
30		3009.20	I	15316 – 48538	160		5349.47	I	21850 – 40538
200		3158.87	II	25192 – 56839	25	h	5512.98	I	23652 – 41786
500		3179.33	II	25414 – 56858	120		5581.97	I	20349 – 38259
					700		5588.76	I	20371 – 38259
90		3181.28	II	25414 – 56839					
50		3624.11	I	15158 – 42743	100		5590.12	I	20335 – 38219
100		3630.75	I	15210 – 42745	360		5594.47	I	20349 – 38219
100		3644.41	I	15316 – 42747	240		5598.49	I	20335 – 38192
120		3706.03	II	25192 – 52167	120		5601.28	I	20371 – 38219
					120		5602.85	I	20349 – 38192
150		3736.90	II	25414 – 52167					
42000		3933.66	II	0 – 25414	220		5857.45	I	23652 – 40720
12		3948.90	I	15158 – 40474	340		6102.72	I	15158 – 31540
35		3957.05	I	15210 – 40474	950		6122.22	I	15210 – 31540
22000		3968.47	II	0 – 25192	30		6161.29	I	20349 – 36575
					1400		6162.17	I	15316 – 31540
140		3973.71	I	15316 – 40474					
11000		4226.73	I	0 – 23652	30	h	6163.76	I	20335 – 36555
240		4283.01	I	15210 – 38552	60	h	6166.44	I	20335 – 36548
220		4289.36	I	15158 – 38465	70		6169.05	I	20349 – 36555
200		4298.99	I	15210 – 38465	140	h	6169.56	I	20371 – 36575
					700		6439.07	I	20371 – 35897
1100		4302.53	I	15316 – 38552					
260		4307.74	I	15210 – 38418	180		6449.81	I	20335 – 35835
400		4318.65	I	15316 – 38465	35		6455.60	I	20349 – 35835
300		4425.44	I	15158 – 37748	700		6462.57	I	20349 – 35819
650		4434.96	I	15210 – 37752	80		6471.66	I	20371 – 35819
					320		6493.78	I	20335 – 35730
180		4435.69	I	15210 – 37748					
1400		4454.78	I	15316 – 37757	80		6499.65	I	20349 – 35730
180		4455.89	I	15316 – 37752	20		6572.78	I	0 – 15210
10		4456.61	I	15316 – 37748	40	h	6717.68	I	21850 – 36732
16	h	4526.94	I	21850 – 43933	190		7148.15	I	21850 – 35835
					90		7202.19	I	21850 – 35730
25		4578.55	I	20335 – 42170	60	h	7326.15	I	23652 – 37298
50		4581.40	I	20349 – 42171	120		8498.02	II	13650 – 25414
80		4585.86	I	20371 – 42171	1000		8542.09	II	13711 – 25414
50	h	4878.13	I	21850 – 42344	550		8662.14	II	13650 – 25192

Carbon

$$C, Z = 6, M = 12.011, \text{Ratio } \frac{C}{Cu} = 0.1890$$

C I Normal state of valence electrons $2s^2 2p^2\ ^3P_0 = 0$. I.P. $= 90820\ cm^{-1}$.
C II Normal state of valence electrons $2s^2 2p\ ^2P^\circ_{1/2} = 0$. I.P. $= 196659\ cm^{-1}$.

References

Wavelength:
L. Johansson, Arkiv for Fysik **31**, 201 (1966).

Classification:
C I, A. Fowler and E. H. Selwyn, Proc. Roy. Soc. (London) [A] **118**, 34 (1928).

Observed line of carbon

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
100	2478.56	I	21648 – 61982

Cerium

$$\text{Ce, } Z = 58,\ M = 140.12,\ \text{Ratio } \frac{\text{Ce}}{\text{Cu}} = 2.205$$

Ce I Normal state of valence electrons $4f5d6s^2\ {}^1G^\circ_4 = 0$. I.P. = 44100 cm^{-1}.
Ce II Normal state of valence electrons $4f5d^2\ {}^4H^\circ_{3\,1/2} = 0$. I.P. = 87500 cm^{-1}.

References

Wavelengths:
W. C. Martin and C. H. Corliss, unpublished material (1969).

Classification:
Ce I, W. C. Martin, unpublished material (1969).
Ce II, C. H. Corliss, J. Res. Nat. Bur. Stand. (U.S.), **77A**, (Phys. and Chem.), No. 4, 419–546 (July–Aug. 1973).

Molecular Spectra:
CeO, W. W. Watson, Phys. Rev. **53**, 639 (1938).

Strong lines of cerium

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
3500	4186.60	II	6968 – 30847	1100	4248.68	II	5514 – 29044
3100	3952.54	II	2642 – 27935	1100	4572.28	II	5514 – 27379
2800	3999.24	II	2382 – 27380	1000	3577.45	II	3794 – 31738
2700	3942.75	II	6913 – 32269	1000	3709.29	II	4204 – 31156
2700	4012.39	II	4523 – 29439	1000	3709.93	II	988 – 27935
2700	4133.80	II	6968 – 31152	1000	3808.11	II	2382 – 28634
2500	3801.52	II	7234 – 33531	1000	3889.98	II	5456 – 31156
2400	4460.21	II	3854 – 26268	990	3201.71	II	6913 – 38138
2100	4040.76	II	3594 – 28335	990	3272.25	II	5651 – 36202
2100	4562.36	II	3854 – 25766	980	3912.44	II	2382 – 27935
2000	3942.15	II	0 – 25360	980	3956.28	II	4911 – 30180
2000	4137.65	II	4166 – 28327	980	4123.87	II	6913 – 31156
2000	4289.94	II	2642 – 25945	980	4127.37	II	5514 – 29735
1800	3655.85	II	2563 – 29909	980	4149.94	II	5819 – 29909
1800	4073.48	II	3854 – 28396	980	4239.92	II	3854 – 27433
1700	4391.66	II	2596 – 25360	980	4337.77	II	2635 – 25682
1700	4628.16	II	4166 – 25766	980	4418.78	II	6968 – 29592
1500	3882.45	II	2596 – 28345	910	3993.82	II	7341 – 32373
1500	4075.71	II	5651 – 30180	910	4003.77	II	7523 – 32492
1500	4075.85	II	4911 – 29439	910	4014.90	II	4266 – 29167
1500	4222.60	II	988 – 24663	910	4042.58	II	3996 – 28725
1500	4296.67	II	4166 – 27433	910	4083.23	II	5651 – 30135
1400	3716.37	II	0 – 26900	910	4202.94	II	3594 – 27380
1400	4151.97	II	5514 – 29592	910	4364.66	II	3996 – 26900
1400	4471.24	II	5617 – 27976	910	4382.17	II	5514 – 28327
1300	4165.61	II	7341 – 31340	880	3221.17	II	4523 – 35559
1200	3560.80	II	5456 – 33531	880	3660.64	II	988 – 28298
1200	3854.18	II	1874 – 27812	880	3667.98	II	2880 – 30135
1200	3854.31	II	1874 – 27811	860	3786.63	II	1410 – 27811
1100	3838.54	II	2642 – 28686	860	3848.59	II	4204 – 30180
1100	3878.36	II	1410 – 27187	860	3853.15	II	0 – 25945
1100	4071.81	II	2635 – 27187				

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
85	2461.48	II	
130	2462.97	II	9779 – 50368
55	2464.36	II	
45	2473.39	II	7011 – 47430
45	2486.37	II	7259 – 47466
55	2498.98	II	
85	2513.30	II	7713 – 47489
110	2518.51	II	
45	2519.02	II	988 – 40674
85	2543.09	II	9778 – 49089
200	2548.68	II	11341 – 50564
28	2551.77	II	11387 – 50564
35	2562.42	II	9316 – 48330
55	2569.17	II	12260 – 51171
35	2569.88	II	
70	2573.14	II	9779 – 48630
28	2592.34	II	2635 – 41198
70	2609.50	II	8278 – 46588
28	2609.90	II	12260 – 50564
70	2613.90	II	9779 – 48025
85	2635.15	II	7011 – 44949
35	2647.11	II	9723 – 47489
28	2648.30	II	11340 – 49089
35	2649.33	II	9725 – 47459
340	2651.01	II	9779 – 47489
35	2656.84	II	10703 – 48330
75	2666.50	II	3594 – 41085
50	2673.07	II	1410 – 38810
60	2682.73	II	3594 – 40858
30	2687.99	II	10274 – 47466
30	2691.69	II	11949 – 49089
60	2695.96	II	4911 – 41992
120	2696.07	II	1874 – 38954
120	2706.88	II	4266 – 41198
35	2708.13	II	5119 – 42034
35	2709.41	II	5676 – 42573
75	2715.17	II	2581 – 39400
35	2715.24	II	
35	2717.28	II	11760 – 48550
35	2719.98	II	5819 – 42573
120	2723.38	II	11949 – 48657
35	2724.95	II	2635 – 39322
30	2729.16	II	5943 – 42573
10	2730.70	II	10820 – 47430
15	2730.80	II	5965 – 42573
30	2732.04	II	4266 – 40858
50	2732.17	II	13028 – 49618
60	2732.83	II	7062 – 43643
35	2736.33	II	5924 – 42459
110	2741.96	II	
75	2745.72	II	11742 – 48151
100	2750.89	II	5651 – 41992
35	2756.80	II	7818 – 44081
150	2761.42	II	0 – 36202
85	2762.22	II	8403 – 44595
35	2762.90	II	6390 – 42573
35	2767.01	II	2141 – 38270
50	2780.01	II	2581 – 38542
35	2781.89	II	988 – 36924
35	2781.99	II	6638 – 42573
120	2784.27	II	8176 – 44081
100	2785.35	II	12260 – 48151
100	2790.53	II	7818 – 43643
140	2791.42	II	9316 – 45130
45	2803.04	II	5924 – 41589
35	2810.18	II	2563 – 38138
30	2811.87	II	2581 – 38134
85	2814.81	II	4323 – 39839
60	2814.96	II	7059 – 42573
60	2817.50	II	5716 – 41198
270	2830.90	II	7259 – 42573
100	2833.31	II	
45	2835.60	II	5943 – 41198
17	2837.89	II	6521 – 41748
12	2837.99	II	0 – 35226
35	2839.36	II	2596 – 37804
22	2841.72	II	8281 – 43461
30	2842.52	II	2635 – 37804
22	2842.83	II	
35	2845.45	II	11455 – 46588
45	2849.03	II	3363 – 38453
85	2854.67	II	1874 – 36894
85	2854.88	II	2635 – 37652
45	2855.32	II	16159 – 51171
45	2855.45	II	2642 – 37652
45	2855.72	II	2581 – 37588
75	2858.01	II	16192 – 51171
35	2859.52	II	9634 – 44595
22	2861.35	II	988 – 35926
45	2861.62	II	2596 – 37531
50	2862.79	II	0 – 34921
35	2866.81	II	4523 – 39395
45	2871.08	II	988 – 35808
25	2871.63	II	0 – 34813
250	2874.14	II	
75	2880.64	II	5969 – 40674
35	2881.13	II	7294 – 41992
75	2882.61	II	6518 – 41198
50	2885.29	II	6550 – 41198
45	2888.70	II	14481 – 49089
35	2890.17	II	9491 – 44081
17	2892.03	II	6518 – 41085
17	2892.15	II	4266 – 38833
50	2894.09	II	4266 – 38810
60	2894.22	II	2382 – 36924
85	2896.73	II	2382 – 36894
110	2908.42	II	4460 – 38833
30	2912.91	II	10275 – 44595
30	2915.56	II	3363 – 37652
45	2916.68	II	4266 – 38542
100	2918.67	II	2642 – 36894
25	2918.78	II	4202 – 38453
35	2922.37	II	16159 – 50368
25	2922.58	II	4323 – 38529
75	2925.19	II	16192 – 50368
30	2929.11	II	4323 – 38453
25	2934.35	II	4460 – 38529
35	2939.54	II	9634 – 43643
45 h	2940.79	II	3594 – 37588
60	2944.35	II	10642 – 44595
50	2950.30	II	3704 – 37589
45	2955.60	II	7259 – 41083
120	2955.94	II	2382 – 36202
30	2956.71	II	0 – 33812
50	2959.11	II	13675 – 47459
110	2964.80	II	5676 – 39395
85	2965.27	II	5119 – 38833
45	2970.32	II	3996 – 37652
100	2972.58	II	4911 – 38542
50	2974.48	II	5283 – 38893

559-795 O - 75 - 3 (Pt. 1)

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
50	2974.61	II	4845 – 38453	60	3091.29	II	2581 – 34921
400	2976.91	II	4266 – 37849	45	3095.59	II	5675 – 37971
150	2977.46	II	5819 – 39395	170	3096.50	II	4911 – 37196
120	2980.41	II	14482 – 48025	60	3096.88	II	1874 – 34155
85	2981.91	II	4323 – 37849	35	3097.08	II	2642 – 34921
50	2984.56	II	2642 – 36138	45	3102.56	II	3704 – 35926
60	2985.82	II	4323 – 37804	370	3103.38	II	3594 – 35808
35	2985.91	II	3363 – 36844	85	3104.01	II	3996 – 36202
25	2986.67	II	1874 – 35346	200	3107.47	II	6638 – 38810
250	2990.87	II	2382 – 35808	100	3108.96	II	8928 – 41083
35	2991.72	II	15134 – 48550	320	3110.28	II	3996 – 36138
25	2991.90	II	4202 – 37616	300	3111.17	II	2635 – 34768
110	2994.42	II	4266 – 37652	45	3114.05	II	1874 – 33977
320	2995.64	II	5437 – 38810	45	3123.57	II	4511 – 36517
50	2998.77	II	4511 – 37849	220	3127.53	II	3594 – 35559
22	2999.43	II	3594 – 36924	200	3130.33	II	4266 – 36202
22	2999.48	II	4323 – 37652	240	3130.87	II	0 – 31931
75	3000.07	II	2880 – 36202	140	3132.59	II	2382 – 34295
160	3002.14	II	3594 – 36894	160	3133.33	II	5943 – 37849
190	3002.75	II	4511 – 37804	160	3136.72	II	4266 – 36138
120	3003.56	II	2642 – 35926	100	3137.60	II	3363 – 35226
85	3008.13	II	6638 – 39872	45	3138.30	II	3704 – 35559
400	3008.79	II	2581 – 35808	100	3142.31	II	988 – 32802
50	3011.88	II	4460 – 37652	200	3144.60	II	2635 – 34426
370	3017.20	II	5676 – 38810	290	3145.28	II	2642 – 34426
75	3020.88	II	5716 – 38810	45	3146.23	II	5119 – 36894
50	3021.04	II	5437 – 38529	290	3146.41	II	2382 – 34155
30	3022.79	II	16545 – 49617	100	3148.46	II	3594 – 35346
25	3023.43	II	4523 – 37588	65	3148.65	II	7059 – 38810
35	3023.49	II	8928 – 41992	45	3149.43	II	4460 – 36202
35	3024.57	II	10115 – 43168	75	3151.13	II	5119 – 36844
35	3026.62	II	4202 – 37232	130	3154.51	II	2642 – 34333
25	3027.63	II	4323 – 37342	160	3155.69	II	4523 – 36202
60	3028.96	II	6390 – 39395	160	3155.79	II	1874 – 33553
170	3030.31	II	5819 – 38810	290	3164.15	II	2382 – 33977
35	3032.73	II	2382 – 35346	140	3166.24	II	2581 – 34155
75	3033.12	II	4845 – 37804	100	3166.61	II	2596 – 34166
210	3037.73	II	4323 – 37232	45	3167.23	II	9634 – 41198
45	3039.51	II	5651 – 38542	45	3167.32	II	3996 – 35559
45	3044.40	II	5011 – 37849	290	3169.18	II	5651 – 37196
60	3046.71	II	5716 – 38529	290	3171.61	II	2635 – 34155
35	3050.59	II	4845 – 37616	45	3172.30	II	2642 – 34155
200	3051.98	II	4323 – 37079	130	3176.80	II	8403 – 39872
350	3055.24	II	4511 – 37232	45	3177.14	II	4460 – 35926
320	3056.78	II	2642 – 35346	45	3178.75	II	3363 – 34813
45	3058.55	II	5119 – 37804	45	3180.82	II	2382 – 33812
25	3059.74	II	4523 – 37196	480	3183.52	II	4523 – 35926
680	3063.01	II	7234 – 39872	75	3184.21	II	2581 – 33977
60	3068.68	II	4266 – 36844	240	3186.13	II	5819 – 37196
85	3069.64	II	4511 – 37079	180	3188.79	II	3996 – 35346
75	3071.11	II	1874 – 34426	100	3189.64	II	2635 – 33977
85	3071.62	II	2382 – 34929	200	3190.34	II	2642 – 33977
50	3072.39	II	2382 – 34921	45	3193.33	II	9779 – 41085
100	3072.89	II	5119 – 37652	710	3194.83	II	4911 – 36202
45	3076.25	II	4845 – 37342	45	3195.94	II	2596 – 33876
60	3077.33	II	5651 – 38138	200	3199.28	II	5676 – 36924
50	3077.64	II	5651 – 38134	45 d	3200.52	II	4323 – 35559
100	3079.64	II	5676 – 38138	990	3201.71	II	6913 – 38138
85	3079.91	II	1874 – 34333	100	3205.96	II	7012 – 38195
75	3080.64	II	15593 – 48045	100	3210.95	II	6518 – 37652
100	3082.30	II	3704 – 36138	200	3218.38	II	3363 – 34426
320	3083.67	II	6390 – 38810	710	3218.94	II	6913 – 37971
250	3084.44	II	5437 – 37849	100	3220.87	II	6550 – 37589
200	3090.37	II	7523 – 39872	880	3221.17	II	4523 – 35559
75	3090.52	II	2581 – 34929	45	3222.41	II	4202 – 35226

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
45	3223.37	II	7818 – 38833
330	3225.67	II	8403 – 39395
710	3227.11	II	2596 – 33574
100	3229.12	II	4266 – 35226
240	3229.36	II	2596 – 33553
45	3230.08	II	988 – 31938
480	3231.24	II	3996 – 34934
140	3233.44	II	2635 – 33553
710	3234.16	II	2642 – 33553
330	3234.89	II	7234 – 38138
45	3235.01	II	4323 – 35226
75	3235.67	II	4911 – 35808
390	3236.74	II	4460 – 35346
390	3243.37	II	4523 – 35346
100	3245.17	II	4460 – 35266
200	3246.67	II	3363 – 34155
100	3249.19	II	2642 – 33410
45	3249.43	II	4460 – 35226
140	3252.48	II	7234 – 37971
140	3254.01	II	3704 – 34426
100	3258.87	II	7294 – 37971
200	3260.98	II	8176 – 38833
140	3263.45	II	8176 – 38810
200	3263.88	II	3704 – 34333
45	3265.42	II	7523 – 38138
100	3271.15	II	3594 – 34155
100	3271.55	II	6638 – 37196
16	3271.96	II	7062 – 37616
27	3272.06	II	2596 – 33149
990	3272.25	II	5651 – 36202
330	3274.86	II	5676 – 36202
140	3276.25	II	2635 – 33149
140	3279.01	II	5437 – 35926
200	3279.84	II	2382 – 32863
75	3280.49	II	4460 – 34934
45	3281.10	II	7062 – 37531
100	3283.35	II	7523 – 37971
65	3283.68	II	2635 – 33080
45	3284.22	II	5119 – 35559
330	3285.22	II	3996 – 34426
100	3286.03	II	4511 – 34934
100	3290.33	II	3594 – 33977
45	3290.58	II	4845 – 35226
45	3293.59	II	4460 – 34813
240	3295.28	II	3996 – 34333
140	3296.18	II	7259 – 37588
200	3296.88	II	6521 – 36844
100	3299.99	II	6550 – 36844
220	3300.15	II	5819 – 36112
240	3304.84	II	5676 – 35926
140	3306.63	II	5969 – 36202
140	3307.23	II	2635 – 32863
55	3307.99	II	2642 – 32863
150	3308.02	II	2581 – 32802
45	3308.08	II	988 – 31208
100	3309.27	II	5716 – 35926
140	3311.50	II	3363 – 33553
200	3312.22	II	8897 – 39079
65	3313.30	II	5965 – 36138
100	3314.03	II	0 – 30166
240	3314.72	II	3996 – 34155
200	3317.80	II	5676 – 35808
75	3318.96	II	5437 – 35559
55	3318.98	II	2596 – 32717
45	3320.42	II	3704 – 33812
45	3325.06	II	3594 – 33660
180	3325.34	II	8131 – 38195
45	3327.66	II	2596 – 32638
65	3327.91	II	5676 – 35716
140	3329.01	II	4737 – 34768
75	3330.49	II	7062 – 37079
45	3331.23	II	4323 – 34333
100	3333.04	II	0 – 29994
100	3333.66	II	5819 – 35808
200	3334.46	II	10058 – 40040
100	3339.51	II	2382 – 32318
75 h	3340.89	II	5011 – 34934
240	3341.87	II	4511 – 34426
330	3343.86	II	5819 – 35716
440	3344.76	II	4266 – 34155
100	3346.52	II	4460 – 34333
100	3349.96	II	5716 – 35559
45	3349.98	II	7746 – 37589
100	3352.28	II	4511 – 34333
100	3352.94	II	3594 – 33410
65	3352.99	II	5119 – 34934
75	3353.33	II	6390 – 36202
200	3355.02	II	1410 – 31208
180	3356.41	II	3363 – 33149
240	3357.22	II	4266 – 34044
200	3360.54	II	11310 – 41059
180	3361.77	II	3794 – 33531
100	3364.35	II	988 – 30703
240	3366.55	II	4460 – 34155
55	3368.70	II	2642 – 32318
45	3368.80	II	13785 – 43461
200	3371.18	II	4511 – 34166
200	3373.46	II	2563 – 32198
200	3373.73	II	4523 – 34155
75	3375.78	II	8928 – 38542
480	3377.13	II	4911 – 34514
140	3379.17	II	4460 – 34044
100	3381.49	II	6638 – 36202
200	3383.68	II	4266 – 33811
75	3387.78	II	5716 – 35226
100	3390.52	II	3594 – 33080
100	3393.92	II	4204 – 33660
65	3394.14	II	4523 – 33977
40	3396.72	II	3746 – 33177
45	3400.25	II	7523 – 36924
75	3403.60	II	4202 – 33574
40	3404.13	II	2563 – 31931
200	3404.91	II	1874 – 31235
240	3405.98	II	4460 – 33812
45	3407.25	II	
90	3416.57	II	5965 – 35226
140	3416.86	II	988 – 30246
290	3417.45	II	5676 – 34929
75	3417.90	II	8403 – 37652
100	3418.93	II	12751 – 41992
140	3420.18	II	4323 – 33553
45	3422.49	II	8928 – 38138
45	3422.53	II	2642 – 31851
600	3422.71	II	3594 – 32802
110	3423.85	II	9634 – 38833
75	3425.35	II	2382 – 31568
65	3425.95	II	7713 – 36894
390	3426.21	II	988 – 30166
75	3426.59	II	2563 – 31738
130	3430.32	II	7059 – 36202

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
65	3431.50	II	4911 – 34044	45	3520.98	II	5651 – 34044
180	3433.09	II	10275 – 39395	330	3521.88	II	4911 – 33297
35	3435.20	I		90	3524.07	II	5965 – 34333
27	3435.21	II	8702 – 37804	210	3526.68	II	8170 – 36517
22	3435.25	II	5819 – 34921	120	3527.85	II	0 – 28338
45	3437.81	II		65	3528.05	II	5819 – 34155
35	3437.82	I	0 – 29079	45	3528.64	II	12751 – 41083
140	3439.84	II	4511 – 33574	45	3529.04	II	5716 – 34044
290	3441.21	II	2880 – 31931	160	3530.02	II	2382 – 30703
140	3442.39	II	4511 – 33553	90	3530.95	II	4737 – 33050
65	3442.96	II	5119 – 34155	65	3531.59	II	4737 – 33045
90	3446.73	II	2563 – 31568	27	3531.62	1	2378 – 30686
75	3451.57	II	5965 – 34929	90	3532.61	II	7259 – 35559
45	3454.80	I		90	3532.88	II	0 – 28298
45	3456.67	II	988 – 29909	600	3534.05	II	4204 – 32492
100	3456.77	II	6638 – 35559	150	3534.44	II	7523 – 35808
75	3459.84	II	9634 – 38529	90	3535.57	II	2880 – 31156
45	3460.17	II	2140 – 31033	110	3536.70	II	10275 – 38542
100	3461.35	II	4266 – 33149	65	3537.15	II	6550 – 34813
45	3461.79	II	7259 – 36138	110	3537.43	II	5716 – 33977
100	3463.22	II	7059 – 35926	35	3538.76	II	9723 – 37974
100	3463.76	II	5651 – 34514	27	3538.81	II	6518 – 34768
100	3464.16	II	2880 – 31738	770	3539.08	II	2581 – 30829
75	3464.21	II	5119 – 33977	45	3541.66	II	3704 – 31931
45	3467.78	II	1874 – 30703	90	3543.29	II	9634 – 37849
100	3468.11	II	4323 – 33149	45	3543.52	II	5943 – 34155
55	3468.89	II	988 – 29807	210	3545.60	II	2880 – 31076
22	3469.00	II	9634 – 38453	45	3545.75	II	9778 – 37973
45	3470.40	II	988 – 29794	65	3545.79	II	2635 – 30829
75	3474.22	II	3363 – 32139	55	3545.91	II	7523 – 35716
100	3475.67	II	1874 – 30637	290	3546.19	II	1874 – 30065
480	3476.84	II	10642 – 39395	150	3547.01	II	4323 – 32508
35	3477.39	II	4911 – 33660	65	3548.83	II	9634 – 37804
45	3477.45	II	7059 – 35808	90	3551.43	II	2596 – 30745
100	3479.60	II	0 – 28731	110	3551.66	II	3704 – 31851
65	3480.28	II	0 – 28725	22	3551.77	II	4266 – 32413
35	3480.34	II	1410 – 30135	55	3552.07	II	3594 – 31738
45	3480.38	II	3594 – 32318	240	3552.73	II	2563 – 30703
75	3480.98	II	12366 – 41085	110	3554.64	II	9492 – 37616
75	3481.16	II	5437 – 34155	420	3555.00	II	2581 – 30703
140	3482.14	II	3704 – 32413	65	3556.90	II	12751 – 40858
240	3482.35	II	4845 – 33553	40	3558.71	II	5716 – 33808
55	3484.70	II	4460 – 33149	1200	3560.80	II	5456 – 33531
75	3484.74	II	2880 – 31568	45	3561.54	II	4166 – 32235
710	3485.05	II	0 – 28686	90	3562.10	II	4204 – 32269
180	3488.55	II	7059 – 35716	110	3563.82	II	4266 – 32318
140	3490.13	II	5651 – 34295	120	3568.13	II	9634 – 37652
90	3493.11	II	4460 – 33080	90	3569.32	II	5651 – 33660
100	3493.73	II	3704 – 32318	45	3570.98	II	2581 – 30577
75	3495.01	II	3594 – 32198	120	3572.43	II	5676 – 33660
100	3495.94	II	4266 – 32863	90	3573.71	II	3594 – 31568
75	3496.33	II	2642 – 31235	45	3575.30	II	8176 – 36138
55	3500.68	II	10275 – 38833	210	3576.23	II	1410 – 29365
160	3501.46	II	1874 – 30425	1000	3577.45	II	3794 – 31738
45	3506.25	II	2563 – 31076	90	3580.57	II	1874 – 29794
210	3507.94	II	1410 – 29909	90	3583.66	II	9634 – 37531
90	3508.47	II	2581 – 31076	110	3584.34	II	4911 – 32802
65	3508.71	II	12366 – 40858	90	3586.77	II	4266 – 32139
55	3510.69	II	5819 – 34295	45	3587.22	II	5943 – 33812
45	3513.79	II	988 – 29439	160	3587.64	II	5943 – 33808
65	3513.85	II	11388 – 39839	35	3587.69	II	9723 – 37589
600	3517.38	II	7294 – 35716	90	3588.13	II	7059 – 34921
55	3518.37	II	10115 – 38529	160	3588.43	II	5437 – 33297
150	3519.08	II	2635 – 31043	55	3588.49	II	10114 – 37973
210	3520.52	II	1410 – 29807	330	3590.60	II	5969 – 33812

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
22	3594.58	II	6521 – 34333
22	3594.62	II	0 – 27812
22	3594.64	II	10641 – 38452
110	3596.11	II	8403 – 36202
45	3596.73	II	4523 – 32318
150	3598.20	II	2382 – 30166
90	3599.97	II	4737 – 32508
160	3600.58	II	6390 – 34155
65	3603.36	II	5119 – 32863
150	3604.20	II	988 – 28725
390	3607.63	II	5437 – 33149
550	3609.69	II	7234 – 34929
120	3610.91	II	7341 – 35027
45	3611.31	II	2382 – 30065
75	3611.34	II	2563 – 30246
16	3611.64	II	7878 – 35559
27	3611.73	II	3363 – 31043
90	3612.34	II	4523 – 32198
420	3613.70	II	4266 – 31931
55	3615.64	II	2141 – 29790
120	3616.20	II	5651 – 33297
160	3618.58	II	5011 – 32638
65	3619.95	II	2563 – 30180
45	3621.15	II	5437 – 33045
440	3622.15	II	6913 – 34513
65	3622.41	II	3363 – 30962
380	3623.74	II	5964 – 33552
440	3623.84	II	6390 – 33977
130	3624.15	II	2581 – 30166
90	3628.25	II	2581 – 30135
45	3628.61	I	2208 – 29759
55	3630.42	II	10115 – 37652
200	3631.19	II	3704 – 31235
150	3632.11	II	2642 – 30166
45	3633.40	II	0 – 27515
90	3637.75	II	3594 – 31076
130	3638.28	II	5819 – 33297
45	3640.69	II	6518 – 33977
55	3642.83	II	4323 – 31766
45	3644.30	II	5716 – 33149
130	3645.23	II	5437 – 32863
130	3645.45	II	2642 – 30065
150	3646.65	II	4523 – 31938
350	3646.97	II	2382 – 29794
260	3647.75	II	7523 – 34929
260	3647.95	II	8403 – 35808
45	3649.73	II	4460 – 31851
90	3650.12	II	2596 – 29984
180	3650.88	II	8176 – 35559
130	3652.11	II	3995 – 31369
65	3652.26	II	11949 – 39322
420	3653.11	II	2880 – 30246
660	3653.67	II	3794 – 31156
310	3654.97	II	2642 – 29994
1800	3655.85	II	2563 – 29909
45	3658.26	II	2581 – 29909
440	3659.23	II	1410 – 28731
350	3659.97	II	1410 – 28725
180	3660.16	II	10275 – 37588
880	3660.64	II	988 – 28298
130	3661.73	II	4266 – 31568
100	3662.99	II	4266 – 31559
90	3663.70	II	4911 – 32198
55	3664.73	II	5437 – 32717
75	3665.05	II	3854 – 31131
45	3666.01	I	0 – 27269
45	3666.04	I	0 – 27269
90	3667.28	II	5819 – 33080
880	3667.98	II	2880 – 30135
150	3668.72	II	0 – 27250
90	3670.52	II	7059 – 34295
130	3671.94	II	2581 – 29807
220	3672.18	I	
350	3672.79	II	7294 – 34514
180	3673.64	II	2581 – 29794
45	3674.06	II	9634 – 36844
45	3674.14	II	10925 – 38134
90	3676.16	II	2596 – 29790
90	3679.16	II	2635 – 29807
220	3679.42	II	8176 – 35346
180	3680.08	II	2642 – 29807
45	3680.85	II	2635 – 29794
180	3681.38	II	8403 – 35559
180	3682.08	II	5651 – 32802
45	3686.04	I	2208 – 29330
180	3687.80	II	3594 – 30703
65	3688.66	II	5943 – 33045
45	3689.16	II	4460 – 31559
100	3693.42	II	10275 – 37342
50	3693.71	II	8281 – 35346
300	3694.91	II	2382 – 29439
75	3695.96	II	10925 – 37974
60	3696.12	II	3996 – 31043
120	3697.66	II	7259 – 34295
60	3698.13	II	4202 – 31235
110	3698.36	II	6521 – 33553
140	3698.66	II	2880 – 29909
150	3699.92	II	4911 – 31931
120	3702.79	II	3704 – 30703
220	3704.98	II	5819 – 32802
110	3706.94	II	4202 – 31171
85	3707.39	II	4166 – 31131
1000	3709.29	II	4204 – 31156
1000	3709.93	II	988 – 27935
50	3713.99	II	988 – 27905
110	3714.77	II	8804 – 35716
35	3715.14	II	4460 – 31369
120	3715.47	II	6390 – 33297
1400	3716.37	II	0 – 26900
110	3716.93	II	7259 – 34155
75	3717.48	II	6518 – 33410
420	3718.19	II	1410 – 28298
420	3718.38	II	4204 – 31090
210	3719.80	II	2563 – 29439
60	3722.10	II	5514 – 32373
150	3722.29	II	2581 – 29439
110	3722.76	II	2596 – 29450
45	3723.66	II	4323 – 31171
150	3724.64	II	5011 – 31851
420	3725.68	II	5969 – 32802
170	3726.96	II	988 – 27812
490	3728.02	II	5676 – 32492
110	3728.18	II	2635 – 29450
800	3728.42	II	5456 – 32269
50	3729.00	II	4266 – 31076
75	3729.92	II	3363 – 30166
140	3730.33	II	11742 – 38542
17	3731.19	I	3312 – 30105
20	3731.25	I	1279 – 28072
110	3731.88	II	8928 – 35716

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
100	3732.46	II	2382 – 29167
30	3732.56	I	3976 – 30759
30	3732.58	II	2581 – 29365
150	3733.52	II	4266 – 31043
110	3737.52	II	4460 – 31208
160	3737.74	II	6913 – 33660
75	3740.13	II	10115 – 36844
75	3741.01	II	2642 – 29365
75	3741.73	II	7259 – 33977
22	3742.21	I	228 – 26943
15	3742.25	I	0 – 26714
50	3743.97	I	0 – 26702
50	3744.05	II	5437 – 32139
60	3746.26	II	2595 – 29281
170	3746.38	II	4523 – 31208
320	3748.06	II	5819 – 32492
170	3750.08	II	6638 – 33297
150	3751.00	II	3594 – 30246
250	3751.45	II	10275 – 36924
35	3751.76	II	2635 – 29281
140	3752.34	II	5676 – 32318
75	3753.77	II	12763 – 39395
200	3755.43	II	3363 – 29984
170	3755.72	II	5617 – 32235
160	3757.22	II	7818 – 34426
160	3757.86	II	2563 – 29167
50	3760.40	II	2581 – 29167
75	3760.69	II	4460 – 31043
300	3762.98	II	7341 – 33908
85	3763.61	II	4266 – 30829
680	3764.12	II	2880 – 29439
200	3765.04	II	4523 – 31076
85	3765.89	II	5651 – 32198
160	3766.51	II	3704 – 30246
50	3768.00	II	4511 – 31043
300	3768.76	II	8403 – 34929
100	3769.04	II	1410 – 27935
160	3769.94	II	8403 – 34921
210	3770.76	II	7062 – 33574
300	3771.60	II	4323 – 30829
60	3772.65	II	5819 – 32318
85	3773.20	II	6550 – 33045
75	3773.44	II	5437 – 31931
75	3776.15	II	15517 – 41992
250	3776.61	II	3594 – 30065
140	3777.66	II	1874 – 28338
45	3779.61	II	4511 – 30962
25	3781.10	II	5119 – 31559
620	3781.62	II	4266 – 30703
440	3782.52	II	3996 – 30425
100	3783.03	II	7234 – 33660
200	3783.58	II	5716 – 32139
860	3786.63	II	1410 – 27812
35	3787.46	II	11742 – 38138
100	3787.57	II	2635 – 29029
120	3787.91	II	988 – 27380
45	3788.20	II	4845 – 31235
520	3788.75	II	3794 – 30180
25	3790.34	II	5943 – 32318
12	3790.83	II	
50	3790.88	II	7202 – 33574
85	3791.68	II	7294 – 33660
300	3792.32	II	3704 – 30065
50	3793.42	II	7522 – 33876
75	3793.51	II	5965 – 32318
25	3793.83	I	0 – 26351
18	3793.85	II	7059 – 33410
100	3794.68	II	6518 – 32863
170	3795.25	II	3794 – 30135
50	3796.67	II	7713 – 34044
75	3799.04	II	3594 – 29909
35	3799.09	I	1279 – 27594
2500	3801.52	II	7234 – 33531
800	3803.09	II	2880 – 29167
15	3803.83	I	228 – 26510
35	3803.84	II	12260 – 38542
50	3804.16	II	5651 – 31931
120	3807.69	II	5676 – 31931
1000	3808.11	II	2382 – 28634
490	3809.21	II	4911 – 31156
75	3809.50	II	4460 – 30703
35	3810.10	II	3746 – 29984
100	3810.90	II	5965 – 32198
60	3811.60	II	11743 – 37971
250	3812.20	II	4737 – 30962
35	3814.94	II	3704 – 29909
85	3815.01	II	2140 – 28345
490	3815.85	II	6518 – 32717
50	3816.31	II	5943 – 32139
470	3817.46	II	4845 – 31033
100	3818.69	II	4523 – 30703
300	3819.02	II	4460 – 30637
170	3821.26	II	2563 – 28725
190	3821.69	II	4266 – 30425
150	3823.70	II	8281 – 34426
470	3823.90	II	2581 – 28725
100	3827.22	II	5437 – 31559
120	3827.37	II	14963 – 41083
160	3829.69	II	1410 – 27515
170	3830.02	II	6390 – 32492
470	3830.55	II	7713 – 33812
490	3831.08	II	3854 – 29949
110	3832.22	II	5651 – 31738
100	3832.74	II	2642 – 28725
490	3834.55	II	2563 – 28634
85	3834.78	II	3996 – 30065
50	3835.75	II	7234 – 33297
50	3835.89	II	7746 – 33808
270	3836.10	II	1874 – 27935
110	3837.20	II	2581 – 28634
1100	3838.54	II	2642 – 28686
120	3839.49	II	7259 – 33297
120	3841.71	II	10115 – 36138
50	3842.04	II	7059 – 33080
200	3843.76	II	7523 – 33531
60	3845.28	II	3996 – 29994
100	3845.48	II	10115 – 36112
220	3846.52	II	8176 – 34166
250	3848.10	II	4266 – 30246
860	3848.59	II	4204 – 30180
35	3849.48	II	3703 – 29673
75	3849.56	II	1410 – 27380
50	3849.66	II	10925 – 36894
120	3850.10	II	5965 – 31931
100	3852.10	II	2382 – 28335
860	3853.15	II	0 – 25945
1200	3854.18	II	1874 – 27812
1200	3854.31	II	1874 – 27811
620	3855.29	II	4204 – 30135
390	3857.02	II	5819 – 31738

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
170	3857.23	II	3363 – 29281	130	3909.75	II	4166 – 29736
370	3857.64	II	2382 – 28298	130	3909.93	II	7234 – 32802
75	3857.81	II	4511 – 30425	140	3910.70	II	9634 – 35198
50	3857.93	II	3996 – 29909	140	3911.30	II	6638 – 32198
200	3862.46	II	5676 – 31559	230	3912.19	II	4511 – 30065
85	3865.40	I		980	3912.44	II	2382 – 27935
160	3866.81	II	988 – 26841	110	3913.99	II	4523 – 30065
200	3868.13	II	3594 – 29439	100	3914.95	II	3746 – 29281
60	3868.47	II	5119 – 30962	390	3915.52	II	5676 – 31208
100	3868.51	II	5716 – 31559	390	3916.14	II	4266 – 29794
60	3869.56	II	9723 – 35559	140	3916.90	II	2382 – 27905
160	3870.87	II	5514 – 31340	70	3917.25	II	3508 – 29029
35	3871.80	II	7259 – 33079	230	3917.64	II	5119 – 30637
60	3873.04	I	1279 – 27091	770	3918.28	II	5617 – 31131
60	3873.25	II	10115 – 35926	480	3919.81	II	5651 – 31156
270	3874.68	II	8176 – 33977	590	3921.73	II	5716 – 31208
140	3875.01	II	3996 – 29794	560	3923.11	II	4511 – 29994
140	3875.06	II	4266 – 30065	450	3924.64	II	4511 – 29984
170	3876.13	II	4911 – 30703	70	3924.80	II	4323 – 29794
620	3876.97	II	4460 – 30246	35	3927.00	II	7259 – 32717
1100	3878.36	II	1410 – 27187	110	3927.39	II	2880 – 28335
120	3879.06	II	15517 – 41289	70	3927.57	II	11742 – 37196
60	3879.31	II	5437 – 31208	150	3928.32	II	4460 – 29909
60	3879.60	II	12366 – 38134	70	3929.96	II	5651 – 31090
60	3880.40	II	14276 – 40040	110	3930.81	II	7059 – 32492
170	3881.87	II	2581 – 28335	770	3931.09	II	1410 – 26841
1500	3882.45	II	2596 – 28345	310	3931.37	II	2382 – 27812
60	3883.54	II	4323 – 30065	230	3931.83	II	5943 – 31369
75	3883.58	II	2596 – 28338	150	3932.15	II	5651 – 31076
100	3884.21	II	12457 – 38195	310	3933.73	II	5676 – 31090
100	3886.50	II	4523 – 30246	70	3934.07	I	228 – 25640
100	3888.36	II	14963 – 40674	35	3934.75	II	4266 – 29673
120	3888.39	II	5119 – 30829	50	3935.93	II	5676 – 31076
120	3889.00	II	4460 – 30166	55	3937.15	II	12260 – 37652
75	3889.30	II	3746 – 29450	50	3937.63	II	5819 – 31208
75	3889.48	II	2635 – 28338	50	3937.81	II	2563 – 27950
1000	3889.98	II	5456 – 31156	560	3938.09	II	4523 – 29909
210	3890.75	II	2140 – 27835	55	3939.52	II	8532 – 33908
210	3890.98	II	2642 – 28335	55	3939.66	II	1874 – 27250
50	3891.77	II	4737 – 30425	770	3940.34	II	2563 – 27935
170	3893.23	II	5283 – 30962	100	3940.64	II	3996 – 29365
75	3893.85	II	7878 – 33553	310	3940.97	II	3363 – 28731
75	3894.30	II	4323 – 29994	2000	3942.15	II	0 – 25360
620	3895.11	II	3363 – 29029	2700	3942.75	II	6913 – 32269
590	3896.80	II	4511 – 30166	150	3943.14	II	2581 – 27935
50	3897.43	II	10275 – 35926	55	3943.50	II	8804 – 34155
490	3898.27	II	3794 – 29439	770	3943.89	II	6390 – 31738
270	3898.94	II	1874 – 27515	70	3944.84	II	10115 – 35457
50	3899.39	II	5514 – 31152	85	3944.92	II	2563 – 27905
75	3900.20	II	8176 – 33808	110	3946.68	II	7818 – 33149
120	3901.30	II	5943 – 31568	310	3947.97	II	3363 – 28686
60	3901.68	II	9723 – 35346	180	3949.39	II	1874 – 27187
200	3903.34	II	4523 – 30135	35	3949.78	II	5924 – 31234
85	3903.93	II	12366 – 37974	65	3949.82	I	4455 – 29766
250	3904.34	II	4460 – 30065	180	3950.42	II	5119 – 30425
50	3904.58	II	7259 – 32863	70	3950.80	II	7746 – 33050
200	3906.92	II	4202 – 29790	110	3951.62	II	7746 – 33045
770	3907.29	II	8928 – 34514	100	3952.11	II	4511 – 29807
150	3907.45	II	4166 – 29750	3100	3952.54	II	2642 – 27935
100	3908.09	II	4845 – 30425	340	3953.66	II	3996 – 29281
560	3908.41	II	6913 – 32492	150	3953.95	II	4523 – 29807
390	3908.54	II	3704 – 29281	310	3955.36	II	7341 – 32616
110	3908.77	II	7062 – 32638	150	3955.92	II	4523 – 29794
35	3909.05	II	8403 – 33977	230	3956.06	II	5819 – 31090
270	3909.31	II	3594 – 29167	980	3956.28	II	4911 – 30180

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
17	3956.74	I	1663 – 26929
28	3956.78	I	1279 – 26545
140	3956.90	II	5437 – 30703
35	3957.15	II	2642 – 27905
35	3957.20	I	228 – 25492
150	3957.97	II	7234 – 32492
230	3958.27	II	5819 – 31076
230	3958.87	II	7062 – 32314
180	3959.62	II	4202 – 29450
150	3959.80	II	4737 – 29984
100	3960.38	II	5965 – 31208
770	3960.91	II	2596 – 27835
150	3962.09	II	7818 – 33050
100	3963.37	II	4911 – 30135
150	3964.18	II	12751 – 37970
390	3964.50	II	2596 – 27812
770	3967.05	II	2635 – 27835
150	3967.18	II	5437 – 30637
110	3967.53	II	9723 – 34921
150	3970.04	II	11742 – 36924
55	3970.42	II	9634 – 34813
170	3970.64	II	2635 – 27812
450	3971.68	II	3996 – 29167
110	3971.88	II	2642 – 27812
270	3972.07	II	6390 – 31559
70	3973.03	II	4511 – 29673
85	3974.00	I	1388 – 26545
70	3974.19	II	5011 – 30166
270	3975.07	II	7713 – 32863
70	3976.78	II	7059 – 32198
35	3977.53	II	8774 – 33908
150	3977.77	II	5943 – 31076
770	3978.65	II	4323 – 29450
560	3980.88	II	5716 – 30829
40	3981.90	II	5969 – 31076
110	3982.16	I	2208 – 27313
560	3982.89	II	6638 – 31738
310	3983.29	II	4166 – 29263
770	3984.68	II	7713 – 32802
55	3986.40	II	5965 – 31043
370	3989.44	II	7259 – 32318
35	3989.76	II	4737 – 29795
180	3990.11	II	2880 – 27935
70	3990.69	II	5651 – 30703
22	3991.22	II	13785 – 38833
55	3991.33	II	5119 – 30166
70	3992.13	II	7818 – 32860
700	3992.39	II	3594 – 28635
370	3992.91	II	5924 – 30962
910	3993.82	II	7341 – 32373
110	3994.57	II	5676 – 30703
35	3995.42	II	3704 – 28725
14	3996.36	II	
70	3996.49	II	4266 – 29281
50	3997.48	II	6550 – 31559
140	3997.72	II	8804 – 33812
2800	3999.24	II	2382 – 27380
17	4000.68	II	9779 – 34768
17	4000.80	II	5437 – 30425
110	4001.06	II	5716 – 30703
230	4001.56	II	5011 – 29994
140	4001.73	II	3704 – 28686
180	4002.81	II	7294 – 32269
110	4002.97	II	3363 – 28338
110	4003.17	II	5011 – 29984
910	4003.77	II	7523 – 32492
55	4004.08	II	1873 – 26841
100	4004.58	II	7234 – 32198
370	4005.64	II	988 – 25945
70	4007.45	II	5119 – 30065
210	4007.59	II	4845 – 29790
40	4008.66	II	7259 – 32198
55	4009.06	II	7202 – 32139
140	4010.14	II	6638 – 31568
100	4011.56	II	5716 – 30637
2700	4012.39	II	4523 – 29439
910	4014.90	II	4266 – 29167
250	4015.88	II	8403 – 33297
140	4017.60	II	5819 – 30703
200	4019.04	II	8176 – 33050
140	4019.90	II	8176 – 33045
240	4022.27	II	9054 – 33908
35	4023.37	II	6521 – 31369
140	4024.35	II	4523 – 29365
840	4024.49	II	3794 – 28634
240	4025.15	II	3508 – 28345
70	4027.05	II	6913 – 31738
170	4027.69	II	5924 – 30745
840	4028.41	II	2563 – 27380
55	4030.16	II	10115 – 34921
250	4030.34	II	2382 – 27187
840	4031.34	II	2581 – 27380
55	4037.39	II	8774 – 33536
340	4037.67	II	5943 – 30703
170	4038.25	II	10870 – 35626
85	4039.89	II	8789 – 33536
2100	4040.76	II	3594 – 28335
110	4041.27	II	5965 – 30703
55	4042.14	II	8928 – 33660
910	4042.58	II	3996 – 28725
230	4045.21	II	6521 – 31235
85	4045.32	II	10314 – 35027
620	4046.34	II	4460 – 29167
130	4047.28	II	5283 – 29984
110	4049.03	II	3996 – 28686
85	4050.81	II	7059 – 31738
210	4051.43	II	5119 – 29794
210	4051.99	II	5965 – 30637
700	4053.51	II	0 – 24663
450	4054.99	II	2596 – 27250
85	4055.16	II	6518 – 31171
110	4055.84	I	1279 – 25928
85	4056.90	II	8403 – 33045
85	4058.24	II	3704 – 28338
50	4058.78	II	3704 – 28335
110	4060.47	II	6550 – 31171
50	4060.71	I	0 – 24619
28	4061.80	I	4199 – 28812
280	4062.22	II	11016 – 35626
230	4062.94	II	2581 – 27187
110	4063.92	II	3746 – 28345
85	4064.91	II	3704 – 28298
85	4065.16	II	7259 – 31851
85	4066.50	II	12260 – 36844
55	4066.91	I	3976 – 28557
280	4067.28	II	8532 – 33111
85	4068.44	II	7278 – 31851
420	4068.84	II	5676 – 30246
55	4070.09	II	20881 – 45443
70	4070.84	II	12366 – 36924

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
85	4071.08	II	5437 – 29994
1100	4071.81	II	2635 – 27187
270	4072.92	II	2642 – 27187
1800	4073.48	II	3854 – 28396
210	4073.74	II	8449 – 32989
28	4074.65	II	1410 – 25945
1500	4075.71	II	5651 – 30180
1500	4075.85	II	4911 – 29439
210	4076.24	II	6518 – 31043
420	4077.47	II	2382 – 26900
530	4078.32	II	7722 – 32235
270	4078.52	II	7455 – 31967
85	4079.02	II	7059 – 31568
140	4079.67	II	7234 – 31738
270	4080.44	II	2880 – 27380
670	4081.22	II	3854 – 28350
910	4083.23	II	5651 – 30135
110	4083.48	II	9054 – 33536
110	4083.64	II	16192 – 40673
450	4085.23	II	5437 – 29909
85	4086.42	II	4266 – 28731
250	4087.36	II	4266 – 28725
70	4087.57	II	8532 – 32989
40	4088.58	II	6638 – 31090
230	4088.85	II	5716 – 30166
70	4089.74	II	7294 – 31738
70	4089.86	II	6518 – 30962
130	4090.47	II	6521 – 30962
130	4090.95	II	6638 – 31076
50	4092.09	II	4204 – 28634
100	4092.72	II	5819 – 30246
50	4093.29	I	2208 – 26632
150	4093.96	II	4266 – 28686
35	4098.14	I	4417 – 28812
85	4098.98	II	5676 – 30065
40	4099.75	II	8695 – 33080
450	4101.77	II	6968 – 31340
70	4102.36	II	8928 – 33297
50	4104.43	II	5437 – 29794
250	4105.00	II	8532 – 32885
70	4106.13	II	5819 – 30166
70	4106.85	II	8702 – 33045
55	4106.92	II	3996 – 28338
510	4107.42	II	3996 – 28335
50	4107.80	II	8774 – 33111
25	4108.26	II	7234 – 31568
40	4109.56	II	3508 – 27835
200	4110.38	II	8789 – 33111
70	4110.84	II	2581 – 26900
250	4111.39	II	5819 – 30135
35	4111.93	II	6390 – 30703
100	4113.73	II	3996 – 28298
50	4114.15	II	7259 – 31559
420	4115.37	II	7455 – 31747
250	4117.01	II	11015 – 35298
200	4117.29	II	5965 – 30246
200	4117.59	II	10642 – 34921
770	4118.14	II	5617 – 29893
250	4119.02	II	4460 – 28731
310	4119.79	II	8774 – 33040
310	4119.88	II	2635 – 26900
450	4120.83	II	2581 – 26841
510	4123.24	II	5819 – 30065
510	4123.49	II	7722 – 31967
980	4123.87	II	6913 – 31156
510	4124.79	II	5514 – 29751
50	4125.78	II	3704 – 27935
55	4126.66	II	4460 – 28686
980	4127.37	II	5514 – 29735
250	4127.74	II	4511 – 28731
200	4128.07	II	3594 – 27812
180	4128.36	II	7523 – 31738
85	4129.18	II	5969 – 30180
530	4130.71	II	4523 – 28725
480	4131.10	II	2642 – 26841
28	4131.86	II	6550 – 30745
100	4132.31	II	5716 – 29909
55	4132.64	II	6638 – 30829
2700	4133.80	II	6968 – 31152
270	4135.44	II	4511 – 28686
55	4135.89	II	10642 – 34813
55	4136.77	II	5283 – 29450
85	4136.90	II	5969 – 30135
270	4137.47	II	5119 – 29281
2000	4137.65	II	4166 – 28327
270	4138.10	II	7454 – 31613
210	4138.35	II	10870 – 35027
55	4139.43	II	3363 – 27515
55	4140.75	II	4202 – 28345
770	4142.40	II	5617 – 29751
150	4142.83	II	5676 – 29807
390	4144.49	II	3854 – 27976
670	4145.00	II	5617 – 29735
480	4146.23	II	4523 – 28634
85	4148.16	II	5965 – 30065
280	4148.90	II	8789 – 32885
420	4149.79	II	5716 – 29807
980	4149.94	II	5819 – 29909
420	4150.91	II	8531 – 32616
1400	4151.97	II	5514 – 29592
55	4152.93	II	13515 – 37588
230	4153.13	II	1874 – 25945
50	4153.93	II	3746 – 27812
85	4155.28	II	
180	4155.53	II	9054 – 33111
450	4159.03	II	8281 – 32318
70	4160.11	II	4266 – 28296
70	4160.18	II	7059 – 31090
110	4161.18	II	7722 – 31747
150	4162.63	II	7059 – 31076
310	4163.52	II	11016 – 35027
1300	4165.61	II	7341 – 31340
55	4166.20	II	10925 – 34921
150	4166.65	II	4737 – 28731
620	4166.88	II	10869 – 34861
250	4167.80	II	9054 – 33040
320	4169.77	II	5819 – 29795
320	4169.88	II	4323 – 28298
55	4171.39	II	5943 – 29909
110	4172.16	II	2880 – 26841
110	4174.48	II	4737 – 28686
70	4175.24	II	5965 – 29909
130	4176.08	II	3996 – 27935
340	4176.70	II	9054 – 32989
70	4179.29	II	3594 – 27515
340	4181.08	II	5119 – 29029
340	4185.33	II	3363 – 27250
3500	4186.60	II	6968 – 30847
530	4187.32	II	4460 – 28335
50	4189.18	II	5943 – 29807

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
55	4189.64	II	7294 – 31156
170	4190.63	II	7234 – 31090
55	4191.03	II	20783 – 44637
560	4193.09	II	7234 – 31075
370	4193.28	II	8532 – 32373
370	4193.87	II	4460 – 28298
180	4194.91	II	9054 – 32885
70	4195.82	II	4511 – 28338
630	4196.34	II	3363 – 27187
140	4197.51	II	3996 – 27812
180	4197.67	II	3996 – 27811
280	4198.00	II	4911 – 28725
180	4198.43	II	4523 – 28335
280	4198.67	II	7341 – 31152
840	4198.72	II	4166 – 27976
240	4201.24	II	7294 – 31090
100	4201.32	II	8403 – 32198
910	4202.94	II	3594 – 27380
55	4203.51	II	0 – 23783
70	4204.74	II	6390 – 30166
55	4205.16	II	9779 – 33553
35	4205.79	II	7059 – 30829
35	4205.89	II	10275 – 34044
270	4209.41	II	5514 – 29263
70	4210.00	II	5283 – 29029
100	4213.04	II	5437 – 29167
370	4214.04	II	4911 – 28634
310	4217.59	II	8532 – 32235
55	4221.17	II	7062 – 30745
1500	4222.60	II	988 – 24663
110	4223.88	II	4266 – 27935
40	4224.56	II	9198 – 32863
100	4227.42	II	5716 – 29365
770	4227.75	II	5617 – 29263
85	4228.30	II	7059 – 30703
85 h	4230.13	II	4202 – 27835
390	4231.74	II	10035 – 33659
100	4232.06	II	7722 – 31345
140	4232.56	II	5819 – 29439
85	4233.20	II	6550 – 30166
240	4234.21	II	4202 – 27812
85	4234.73	II	6638 – 30246
200	4236.02	II	4737 – 28338
85	4236.36	II	8774 – 32373
980	4239.92	II	3854 – 27433
85	4242.01	II	7523 – 31090
390	4242.72	II	2382 – 25945
85	4243.74	II	13785 – 37342
310	4245.89	II	5819 – 29365
310	4245.98	II	4266 – 27812
85	4246.40	II	7203 – 30745
390	4246.72	II	2141 – 25682
70	4247.46	II	3363 – 26900
70	4248.10	II	10275 – 33808
1100	4248.68	II	5514 – 29044
35	4250.66	II	3996 – 27515
55	4251.60	II	8804 – 32318
55	4251.86	II	4323 – 27835
390	4253.37	II	3746 – 27250
70	4254.74	II	6638 – 30135
620	4255.79	II	5676 – 29167
170	4256.16	II	4323 – 27812
110	4257.12	II	3704 – 27187
130	4259.75	II	7234 – 30703
110	4261.17	II	8774 – 32235
200	4263.43	II	8403 – 31851
70	4263.95	II	8789 – 32235
170	4264.37	II	7259 – 30703
100	4267.23	II	4523 – 27950
55	4268.30	II	5943 – 29365
140	4269.25	II	7818 – 31235
620	4270.19	II	4523 – 27935
390	4270.72	II	7722 – 31131
130	4273.44	II	8804 – 32198
70	4275.46	II	8176 – 31559
140	4275.57	II	4523 – 27905
40	4278.25	II	10799 – 34166
200	4278.86	II	2581 – 25945
140	4280.14	II	5924 – 29281
110	4281.00	II	4460 – 27812
85	4281.16	II	4460 – 27811
280	4285.37	II	7341 – 30670
200	4288.66	II	2635 – 25945
200	4289.44	II	3594 – 26900
2000	4289.94	II	2642 – 25945
110	4292.58	II	6518 – 29807
110	4292.76	II	4523 – 27812
70	4294.75	II	8281 – 31559
200	4296.07	II	8928 – 32198
40	4296.37	II	6521 – 29790
1500	4296.67	II	4166 – 27433
420	4296.78	II	6913 – 30180
70	4299.09	II	3996 – 27250
590	4299.36	II	1410 – 24663
770	4300.33	II	3594 – 26841
40	4300.86	II	6550 – 29795
85	4302.65	II	10642 – 33876
110	4304.28	II	9634 – 32860
150	4304.72	II	5943 – 29167
420	4305.14	II	6913 – 30135
770	4306.72	II	4166 – 27379
110	4309.58	II	5969 – 29167
390	4309.74	II	3704 – 26900
150	4310.70	II	3996 – 27187
110	4311.59	II	7059 – 30246
35	4313.10	II	5119 – 28298
55	4314.93	II	6638 – 29807
100	4315.41	II	7259 – 30425
140	4317.33	II	8403 – 31559
55	4317.99	II	6521 – 29673
560	4320.72	II	3704 – 26841
70	4324.60	I	0 – 23117
150	4324.79	II	7713 – 30829
70	4326.82	II	5924 – 29029
310	4330.45	II	2596 – 25682
150	4331.75	II	9723 – 32802
310	4332.71	II	5651 – 28725
70	4334.87	II	8278 – 31340
55	4335.49	II	8176 – 31235
240	4336.23	II	5676 – 28731
150	4336.28	II	4460 – 27515
980	4337.77	II	2635 – 25682
340	4339.31	II	10870 – 33908
70	4340.56	II	8176 – 31208
55	4342.14	II	4911 – 27935
70	4342.48	II	10275 – 33297
55	4343.56	I	228 – 23244
70	4345.85	II	9634 – 32638
150	4345.96	II	4511 – 27515
70	4346.43	II	8170 – 31171

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
28	4347.60	II	8176 – 31171	85	4439.24	II	11016 – 33536
40	4347.70	II	4911 – 27905	130	4440.88	II	6518 – 29029
700	4349.79	II	4266 – 27250	150	4443.75	II	5437 – 27935
560	4352.71	II	4845 – 27812	480	4444.39	II	7455 – 29949
170	4353.37	II	12751 – 35716	450	4444.70	II	8532 – 31024
35	4356.75	II	7234 – 30180	55	4446.15	II	10925 – 33410
55	4357.91	II	9198 – 32139	28	4447.67	I	0 – 22477
100	4359.07	II	8804 – 31738	770	4449.34	II	4911 – 27380
100	4360.18	II	6521 – 29450	100	4449.64	II	8170 – 30637
28	4360.41	II	7818 – 30745	620	4450.73	II	5514 – 27976
40	4360.44	II	8281 – 31208	55	4452.55	II	15517 – 37970
35	4361.36	II	7062 – 29984	55	4453.16	II	4737 – 27187
130	4361.66	II	4266 – 27187	85	4454.99	II	4460 – 26900
35	4363.39	II	5819 – 28731	85	4455.66	II	2382 – 24819
22	4363.47	II	10642 – 33553	40	4457.78	II	8403 – 30829
910	4364.66	II	3996 – 26900	2400	4460.21	II	3854 – 26268
100	4367.00	II	11016 – 33908	450	4461.14	II	7341 – 29751
70	4367.56	II	8281 – 31171	420	4463.41	II	7722 – 30120
85	4368.23	II	7294 – 30180	55	4464.17	II	7341 – 29735
70	4369.24	II	7012 – 29893	140	4464.69	II	8278 – 30670
100	4372.40	II	4323 – 27187	40	4465.44	II	7062 – 29450
50	4373.24	II	5437 – 28298	280	4467.54	II	4523 – 26900
350	4373.82	II	4523 – 27380	1400	4471.24	II	5617 – 27976
50	4375.17	II	7059 – 29909	450	4472.72	II	3594 – 25945
530	4375.92	II	3996 – 26841	40	4474.69	II	8789 – 31131
110	4380.06	II	5011 – 27835	700	4479.36	II	4523 – 26841
110	4381.78	II	5819 – 28634	700	4483.90	II	6968 – 29263
910	4382.17	II	5514 – 28327	170	4484.82	II	9054 – 31345
70	4386.35	II	7202 – 29994	85	4485.52	II	7878 – 30166
170	4386.70	II	4460 – 27250	840	4486.91	II	2382 – 24663
700	4386.84	II	1874 – 24663	40	4488.81	II	8804 – 31076
310	4388.01	II	6968 – 29751	40	4492.95	II	7341 – 29592
170	4390.28	II	11742 – 34514	140	4494.22	II	6390 – 28634
1700	4391.66	II	2596 – 25360	130	4495.39	II	5011 – 27250
150	4393.19	II	5969 – 28725	140	4496.23	II	8403 – 30637
85	4394.78	II	7059 – 29807	250	4497.85	II	7722 – 29949
70	4396.58	II	7012 – 29751	85	4500.34	II	9723 – 31938
200	4398.79	II	4460 – 27187	25	4501.10	I	0 – 22210
510	4399.20	II	2635 – 25360	100	4506.41	I	0 – 22184
70	4400.54	II	2642 – 25360	70	4508.08	II	5011 – 27187
70	4400.87	II	5119 – 27835	35	4509.12	II	7092 – 29263
55	4403.30	II	11341 – 34044	28	4509.17	II	10869 – 33040
70	4405.47	II	5119 – 27812	22	4509.25	II	7722 – 29892
170	4407.28	II	5651 – 28335	55	4510.17	II	7818 – 29984
65	4408.85	II	7234 – 29909	50	4510.92	II	8928 – 31090
35	4408.90	II	10314 – 32989	85	4511.64	II	9779 – 31938
350	4410.64	II	10870 – 33536	110	4515.86	II	8532 – 30670
350	4410.76	II	7455 – 30120	35	4518.02	I	0 – 22127
130	4412.02	II	5676 – 28335	100	4519.59	II	10870 – 32989
110	4413.19	II	987 – 23640	40	4521.96	I	3100 – 25208
70	4413.80	II	7259 – 29909	22	4522.08	II	7059 – 29167
310	4416.90	II	4266 – 26900	770	4523.08	II	4166 – 26268
980	4418.78	II	6968 – 29592	840	4527.35	II	2581 – 24663
70	4419.30	II	5676 – 28298	840	4528.47	II	6968 – 29044
50	4423.44	I	0 – 22600	40	4531.28	I	1663 – 23725
200	4423.68	II	8532 – 31131	50	4531.33	I	228 – 22291
310	4427.07	II	3363 – 25945	40	4532.01	I	1663 – 23722
480	4427.92	II	4323 – 26900	110	4532.49	II	13659 – 35716
310	4428.44	II	4266 – 26841	28	4534.22	II	7746 – 29795
650	4429.27	II	8774 – 31345	85	4536.89	II	12260 – 34295
70	4430.00	II	16268 – 38835	70	4537.88	II	7878 – 29909
55	4432.72	II	11742 – 34295	110	4539.07	II	11016 – 33040
70	4432.92	II	5283 – 27835	840	4539.75	II	2642 – 24663
50	4433.73	II	7259 – 29807	210	4544.96	II	3363 – 25360
110	4437.61	II	6638 – 29167	35	4545.87	II	5943 – 27935

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
40		4546.06	I	228 – 22219
55		4548.89	I	3100 – 25077
70		4549.64	II	11016 – 32989
70		4550.30	II	9054 – 31024
250		4551.30	II	5969 – 27935
22		4552.06	I	228 – 22190
22		4553.06	I	1663 – 23620
28		4554.56	II	3996 – 25945
70		4555.43	II	20783 – 42729
25		4556.22	II	16192 – 38134
70		4558.60	II	4911 – 26841
650		4560.28	II	7341 – 29263
310		4560.96	II	5514 – 27433
2100		4562.36	II	3854 – 25766
28		4563.38	II	6390 – 28298
55		4565.23	I	228 – 22127
420		4565.84	II	8774 – 30670
40		4569.66	II	10924 – 32802
1100		4572.28	II	5514 – 27379
85		4572.79	II	11949 – 33812
55		4576.48	II	9723 – 31568
70		4578.78	II	13027 – 34861
85		4579.28	II	20881 – 42712
35		4581.10	I	3312 – 25134
420		4582.50	II	5617 – 27433
22		4583.09	I	0 – 21813
130		4591.12	II	8928 – 30703
840		4593.93	II	5617 – 27379
55		4597.17	II	10869 – 32616
22		4599.02	II	5969 – 27706
35		4601.37	II	10646 – 32373
22		4604.21	II	8281 – 29994
35		4605.48	II	9317 – 31024
420		4606.40	II	7341 – 29044
70		4608.49	I	2378 – 24071
55		4608.75	II	11387 – 33079
55		4610.46	I	0 – 21683
85		4611.56	II	12366 – 34044
70		4613.02	II	7059 – 28731
70		4615.18	I	0 – 21661
420		4624.90	II	9054 – 30670
1700		4628.16	II	4166 – 25766
40		4630.79	I	1663 – 23251
170		4632.32	I	0 – 21581
35		4633.60	II	7059 – 28634
40	h	4636.74	II	5819 – 27380
70		4640.86	I	3312 – 24853
70		4641.06	I	2437 – 23978
85		4643.17	I	
70		4644.20	II	8281 – 29807
40		4647.28	II	2641 – 24153
40		4647.38	II	5676 – 27187
70		4649.88	I	0 – 21499
110		4650.51	I	228 – 21725
130		4654.29	II	4202 – 25682
55		4659.40	II	3363 – 24819
35		4659.94	II	7713 – 29167
40		4663.24	II	12097 – 33535
35		4665.28	II	9779 – 31208
35		4666.71	II	4523 – 25945
110		4669.50	II	11454 – 32864
85		4670.74	II	5437 – 26841
50		4670.89	I	3312 – 24715
22		4670.91	I	
85		4674.49	I	1663 – 23049
150		4680.13	II	8532 – 29893
28		4680.99	II	11016 – 32373
270		4684.61	II	7294 – 28634
55		4685.23	II	7012 – 28350
65		4686.77	II	8804 – 30134
80		4688.89	I	1279 – 22600
18		4689.50	II	8928 – 30246
22		4690.17	II	7012 – 28327
28		4690.50	II	8278 – 29592
45		4690.71	I	4417 – 25730
45		4692.06	II	5943 – 27250
65		4694.88	II	6518 – 27812
65		4696.50	I	1663 – 22949
65		4701.45	II	9779 – 31043
65		4702.01	II	6550 – 27812
45		4707.00	I	4199 – 25438
55		4707.24	I	0 – 21237
45		4707.94	II	7092 – 28327
22		4710.00	II	3593 – 24819
200		4714.00	II	8928 – 30135
100		4714.81	II	8532 – 29735
90		4717.88	II	5651 – 26841
35		4722.30	II	4511 – 25682
35		4723.31	II	5676 – 26841
16		4724.31	I	0 – 21161
40		4724.83	I	0 – 21158
110		4725.09	II	4202 – 25360
16		4727.56	I	228 – 21375
80		4730.13	II	7202 – 28338
100		4733.52	II	10115 – 31235
35		4733.96	I	1663 – 22781
40		4734.69	I	1388 – 22503
22		4735.35	II	7523 – 28634
310		4737.28	II	8789 – 29893
40		4739.12	II	7202 – 28298
100		4739.53	II	10058 – 31152
45		4741.64	II	8281 – 29365
45		4744.80	I	7780 – 28850
45		4744.94	II	3593 – 24663
160		4747.17	II	2581 – 23640
16		4749.50	II	12763 – 33812
22		4750.83	I	2208 – 23251
22		4751.53	II	10035 – 31075
28		4752.24	II	12260 – 33297
22		4752.58	I	3100 – 24135
55		4755.54	II	5819 – 26841
110		4757.84	II	7713 – 28725
16		4759.92	II	8804 – 29807
65		4763.90	II	8278 – 29263
22		4764.72	I	2208 – 23190
100		4768.77	II	7012 – 27976
230		4773.94	II	7455 – 28396
22		4775.08	I	1388 – 22325
16		4775.10	I	3312 – 24248
28		4780.23	II	11949 – 32863
40		4783.94	II	12763 – 33660
28		4784.78	I	4199 – 25093
28		4784.78	I	8904 – 29798
35		4786.57	I	1663 – 22549
45		4787.14	II	7092 – 27975
55		4788.43	I	3976 – 24853
35		4789.69	II	5969 – 26841
45		4793.12	II	11340 – 32198
65		4800.90	II	7293 – 28117
45		4805.93	I	1388 – 22190

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
28		4807.66	I	228 – 21023
28		4807.66	I	6475 – 27269
35		4808.50	I	4417 – 25208
45		4820.03	I	2208 – 22949
28		4820.61	I	1388 – 22127
110		4822.55	I	0 – 20730
40		4834.05	I	2369 – 23049
45		4835.63	II	7722 – 28396
65		4836.71	I	1279 – 21948
28		4837.48	I	3312 – 23978
45		4843.06	I	2208 – 22851
28		4844.29	II	6550 – 27187
90		4845.53	I	0 – 20631
55		4846.59	II	7722 – 28350
140		4847.77	I	4762 – 25384
55		4849.91	I	0 – 20613
20		4850.20	II	11325 – 31937
45		4852.62	I	6234 – 26836
45		4852.62	I	3100 – 23701
40		4853.59	I	3312 – 23909
40		4858.72	II	9317 – 29893
65		4859.50	I	2208 – 22781
28		4861.74	I	228 – 20791
22		4863.13	I	
65		4863.25	I	1663 – 22219
35		4868.65	I	1279 – 21813
65		4874.00	II	8928 – 29439
35		4874.35	I	0 – 20509
28		4881.54	I	228 – 20708
180		4882.46	II	12326 – 32802
20		4886.18	I	9379 – 29839
45		4889.59	I	1279 – 21725
28		4891.88	I	3976 – 24412
22		4892.85	I	228 – 20661
90		4893.95	II	10704 – 31131
35		4897.09	I	5315 – 25730
35		4898.20	I	3312 – 23722
80		4899.90	I	
28		4901.67	I	228 – 20624
28	d	4904.89	I	1279 – 21661
20		4908.14	I	4766 – 25134
45		4914.94	II	7092 – 27433
55		4915.32	I	0 – 20338
55		4915.32	I	7890 – 28229
45		4915.66	I	6238 – 26576
28		4919.88	I	0 – 20320
45		4920.80	I	4762 – 25078
22		4921.92	I	4746 – 25058
45		4924.25	I	1279 – 21581
22		4924.90	I	6238 – 26538
22		4928.09	II	7092 – 27379
13		4930.54	I	0 – 20276
16		4930.70	I	2437 – 22713
55		4939.12	I	1279 – 21520
28		4939.65	I	
19		4940.39	I	4455 – 24691
110		4943.44	I	9726 – 29949
28		4943.83	II	7713 – 27935
95		4944.61	II	8131 – 28350
19		4948.68	I	3100 – 23301
11		4948.72	I	4417 – 24619
35		4949.53	II	15517 – 35716
9		4951.90	I	2378 – 22567
11		4951.94	I	5802 – 25990
19		4954.02	I	2369 – 22549
19		4955.96	I	3976 – 24148
28		4960.85	II	13659 – 33811
19		4961.50	II	5617 – 25766
19		4965.16	I	
28		4966.37	I	7780 – 27910
28		4968.40	II	8176 – 28297
28		4970.66	I	2208 – 22321
130		4971.50	II	14404 – 34513
28		4971.92	I	4746 – 24853
45		4972.23	I	11517 – 31623
28		4974.09	I	2378 – 22477
45		4977.20	II	7294 – 27380
35		4984.42	II	8281 – 28338
15		4984.57	II	7878 – 27935
45		4986.37	II	8278 – 28327
45		4986.44	I	6238 – 26287
65		4987.54	I	3196 – 23240
35		4988.69	I	2437 – 22477
55		4991.00	II	11310 – 31340
45		4992.39	I	4173 – 24198
130		4994.63	I	7780 – 27796
45		4998.13	I	2208 – 22210
45		5002.78	II	8702 – 28686
23		5004.81	I	4160 – 24135
23		5006.42	I	6663 – 26632
23		5006.42	I	4746 – 24715
210		5009.10	I	3196 – 23154
100		5011.77	II	8449 – 28396
35		5012.52	I	5315 – 25260
35		5013.74	I	
23		5013.78	I	3312 – 23251
19		5014.29	I	8603 – 28540
19		5014.29	I	5409 – 25346
19		5016.48	I	7890 – 27819
19		5016.48	I	3312 – 23240
23		5016.55	I	0 – 19928
65		5021.44	I	3976 – 23885
120		5022.87	II	8424 – 28327
23	h	5025.15	I	4766 – 24660
19		5027.34	II	11455 – 31340
65		5028.33	I	1279 – 21161
23	h	5030.64	I	3210 – 23083
35		5031.77	I	4173 – 24041
35		5031.99	II	11341 – 31208
23		5033.81	I	
19		5033.85	I	8603 – 28463
45	h	5036.64	I	1388 – 21237
120		5037.78	II	8131 – 27976
23		5039.73	I	1663 – 21499
35		5039.80	II	13027 – 32864
23		5039.94	I	
120		5040.85	I	3764 – 23596
35		5042.08	I	3312 – 23139
15		5042.24	I	5519 – 25346
23		5043.20	I	9379 – 29202
180		5044.02	II	9772 – 29592
65		5048.83	I	2369 – 22170
35		5050.98	I	4455 – 24248
23		5053.26	I	2378 – 22162
35		5053.54	I	3100 – 22882
55		5054.18	I	1279 – 21059
35		5055.79	I	3976 – 23749
45		5063.96	I	5802 – 25543
95		5065.93	I	6809 – 26543
35		5067.16	II	12762 – 32492

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
14		5071.50	I	
23		5071.55	I	1663 – 21375
120		5071.78	I	7780 – 27491
75		5074.72	I	4160 – 23860
240		5075.35	II	8278 – 27976
65		5076.48	II	11458 – 31152
75		5077.85	II	11388 – 31076
470		5079.68	II	11166 – 30847
65		5080.47	I	1663 – 21340
23		5083.55	I	4746 – 24412
23		5084.17	I	4762 – 24426
19		5084.46	I	7174 – 26836
35		5089.62	I	6856 – 26498
35		5090.88	II	13659 – 33296
45		5091.73	I	1388 – 21023
45		5091.73	I	6663 – 26297
35		5093.37	I	3764 – 23391
23	h	5097.26	I	3100 – 22713
23		5099.38	I	1663 – 21267
45		5111.61	I	4762 – 24320
130		5112.70	I	4455 – 24009
95		5115.24	I	4746 – 24290
95		5115.24	I	7169 – 26713
65		5115.65	I	5802 – 25344
160		5117.17	II	11310 – 30847
19		5117.95	II	10058 – 29592
45		5118.88	I	3210 – 22740
23		5119.46	I	7174 – 26702
23		5119.46	I	6856 – 26384
23		5119.51	I	5904 – 25431
65		5120.78	I	4199 – 23722
45		5121.36	I	9206 – 28726
65		5122.39	I	2208 – 21725
28		5122.68	I	
65		5125.01	I	4455 – 23962
7		5127.93	I	8055 – 27551
15		5128.02	I	7348 – 26843
170		5129.57	I	
55		5134.45	I	9379 – 28850
35	d	5135.32	I	4417 – 23885
45		5137.12	I	8235 – 27696
23		5137.78	I	5802 – 25260
23		5138.00	I	0 – 19457
19		5139.77	I	1279 – 20730
45		5140.50	I	2437 – 21885
110		5147.57	II	10314 – 29735
65		5149.66	I	1663 – 21076
100		5149.99	I	
65		5150.39	I	2208 – 21619
28		5153.91	I	6337 – 25734
35		5153.99	I	4199 – 23596
19		5154.39	II	6550 – 25945
280		5159.69	I	5315 – 24691
280		5159.69	I	2437 – 21813
280		5159.69	I	7169 – 26545
280		5161.48	I	7780 – 27149
55		5163.27	II	11341 – 30703
75		5164.38	I	8235 – 27593
19		5169.23	I	4173 – 23513
35		5169.72	I	228 – 19566
190		5174.55	I	
19		5177.73	I	3210 – 22518
28		5178.68	I	4417 – 23722
75		5180.88	I	0 – 19296
23		5181.75	I	3210 – 22503
45		5181.93	I	2369 – 21661
35		5183.20	I	2437 – 21725
35		5183.20	I	5572 – 24859
370		5187.46	II	9772 – 29044
19		5188.53	II	
75		5188.66	I	
35		5189.26	I	9379 – 28644
210		5191.66	II	7012 – 26268
65		5191.71	I	5802 – 25058
19		5194.76	I	0 – 19244
35		5200.11	I	3100 – 22325
40		5200.40	I	2437 – 21661
13		5200.46	I	7890 – 27114
55		5201.36	I	0 – 19220
45		5202.46	I	8055 – 27271
45		5202.58	I	4746 – 23962
55		5203.27	I	2369 – 21582
55		5204.27	I	4417 – 23627
35		5204.72	I	3976 – 23184
35		5205.13	I	3312 – 22518
35		5205.51	II	10058 – 29263
35		5208.70	I	8400 – 27594
28		5208.91	I	4199 – 23391
28		5210.34	II	7713 – 26900
35		5211.04	I	4762 – 23947
190		5211.92	I	6809 – 25990
35		5216.38	I	6475 – 25640
45		5221.90	I	2437 – 21582
45		5222.94	I	3976 – 23117
260		5223.46	I	4762 – 23901
19		5226.24	I	4766 – 23895
19		5226.38	II	7713 – 26841
180		5229.75	I	2208 – 21324
45		5230.16	I	3210 – 22325
55		5230.84	I	5315 – 24427
140		5232.92	II	10646 – 29751
19		5233.77	I	228 – 19330
55		5234.02	II	8278 – 27379
23		5235.77	II	11949 – 31043
45		5237.07	II	10646 – 29735
13		5238.47	I	3100 – 22184
40		5238.50	I	1663 – 20747
19		5238.90	I	2437 – 21520
17		5239.83	II	9317 – 28396
19		5240.12	I	4173 – 23251
65		5243.07	I	4173 – 23240
95		5244.50	I	2437 – 21499
19		5245.28	I	1279 – 20338
260		5245.92	I	4762 – 23819
19		5249.16	I	1663 – 20708
35		5249.61	I	3312 – 22355
35		5251.06	I	7933 – 26972
55		5251.99	I	11850 – 30885
19		5252.02	I	5006 – 24041
75		5252.67	II	9317 – 28350
19		5253.41	I	2369 – 21399
55		5254.82	I	5802 – 24826
28		5255.98	I	9333 – 28353
28		5258.40	II	5651 – 24663
28		5259.92	I	2369 – 21375
85		5261.70	I	3210 – 22210
85		5264.18	I	4199 – 23190
130		5265.71	II	10058 – 29044
35		5269.51	I	2369 – 21340
15		5269.54	I	5006 – 23978

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
35	5271.04	I	4173 – 23139
35	5271.81	I	3100 – 22063
45	5271.86	I	4746 – 23709
35	5271.92	I	8587 – 27551
340	5274.23	II	8424 – 27379
35	5275.79	II	10314 – 29263
28	5276.24	I	8603 – 27551
17	5277.52	I	0 – 18943
15	5278.43	I	10673 – 29613
17	5281.35	I	228 – 19158
35	5286.81	I	4173 – 23083
45	5290.92	I	1279 – 20174
17	5291.29	I	3100 – 21993
17	5291.29	I	7696 – 26589
17	5292.45	I	4160 – 23049
65	5294.05	I	4199 – 23083
17	5294.95	I	4746 – 23627
130	5296.56	I	3976 – 22851
35	5298.26	I	2369 – 21237
17	5299.16	I	5409 – 24274
15	5302.11	I	5802 – 24658
15	5303.08	I	
23	5303.32	I	2208 – 21059
11	5303.33	I	1663 – 20513
23	5308.30	I	9135 – 27968
23	5308.30	I	8101 – 26934
65	5308.53	I	5315 – 24148
13	5309.89	I	8055 – 26883
13	5309.89	I	5904 – 24731
35	5313.93	I	7174 – 25987
35	5314.38	I	7890 – 26702
23	5314.84	I	4160 – 22970
23	5315.05	I	6234 – 25044
19	5317.59	I	2437 – 21237
35	5323.28	I	7933 – 26713
130	5328.08	I	3976 – 22739
35	5329.56	I	7780 – 26538
190	5330.54	II	7012 – 25766
28	5332.34	I	1663 – 20411
17	5334.02	I	8101 – 26843
17	5334.71	I	7696 – 26436
75	5335.76	I	3210 – 21946
65	5336.22	I	4455 – 23190
17	5337.79	I	
15	5340.66	I	5006 – 23725
7	5340.77	I	6238 – 24957
17	5345.12	I	7841 – 26545
23	5346.55	I	7933 – 26632
23	5346.55	I	2208 – 20907
35	5347.84	II	5969 – 24663
15	5349.27	I	3196 – 21885
35	5350.53	I	7169 – 25854
23	5350.65	I	
14	5350.72	I	8587 – 27271
19	5351.37	I	3312 – 21993
13	5352.22	I	5519 – 24198
23	5352.28	I	11030 – 29708
450	5353.53	II	7092 – 25766
55	5355.18	I	8603 – 27271
23	5355.59	I	3210 – 21877
15	5355.96	I	4417 – 23083
45	5357.20	I	0 – 18661
45	5357.20	I	4455 – 23117
19	5359.26	I	2369 – 21023
23	5359.50	II	14387 – 33040
28	5359.97	I	4199 – 22851
6	5362.64	I	5572 – 24214
9	5362.73	I	1388 – 20030
75	5363.33	I	5519 – 24159
75	5363.33	I	7467 – 26107
15 d	5366.92	I	4455 – 23083
23	5367.54	I	6809 – 25434
15	5368.05	I	4746 – 23370
23	5369.07	I	2378 – 20998
15	5369.17	I	0 – 18619
23	5370.31	I	5519 – 24135
19	5371.56	I	0 – 18611
23	5378.32	II	14276 – 32864
28	5379.92	I	3976 – 22558
11	5380.11	I	4199 – 22781
35	5382.58	I	3312 – 21885
15	5384.12	I	4173 – 22741
75	5386.32	I	2437 – 20998
55	5386.78	II	9779 – 28338
19	5391.82	I	5904 – 24445
23	5391.88	I	4199 – 22740
300	5393.40	II	8897 – 27433
55	5394.87	I	9462 – 27993
35	5395.24	I	228 – 18758
28	5395.70	I	4020 – 22549
150	5397.64	I	2208 – 20730
15	5397.99	I	7467 – 25987
23	5399.06	I	5210 – 23727
14	5399.56	I	7348 – 25863
23	5399.60	I	3210 – 21725
28	5401.21	I	3710 – 22219
28	5401.21	I	6856 – 25365
15	5402.56	I	5519 – 24024
35	5404.36	I	7169 – 25668
15	5406.65	II	13256 – 31747
19	5407.67	I	3196 – 21683
15	5408.36	I	6475 – 24960
280	5409.23	II	8897 – 27379
15	5411.54	I	6238 – 24712
19	5411.76	I	3210 – 21683
28	5414.11	I	4417 – 22882
15	5417.83	II	8928 – 27380
35	5418.70	I	1663 – 20112
110	5420.38	I	4746 – 23190
11	5421.29	I	6856 – 25297
7	5421.38	I	12297 – 30738
6	5422.16	I	6621 – 25059
6	5422.23	I	4746 – 23184
11	5422.26	I	5572 – 24009
23	5423.43	I	4417 – 22851
15	5426.37	I	228 – 18652
15	5426.60	I	3196 – 21619
23	5427.26	I	3764 – 22184
13	5428.26	I	9379 – 27796
11	5429.42	I	2378 – 20791
8	5429.52	I	
35	5430.25	I	6856 – 25266
19	5430.53	I	5210 – 23620
28	5431.41	I	5572 – 23978
23	5433.34	I	3100 – 21499
6	5436.04	I	5904 – 24294
9	5436.11	I	5572 – 23962
28	5437.86	I	6234 – 24619
19	5438.44	I	228 – 18611
23	5445.43	I	228 – 18587

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
23	5446.18	I	3100 – 21456
28	5446.45	I	7890 – 26245
140	5449.24	I	5802 – 24148
23	5450.03	I	4160 – 22503
35	5451.74	I	5572 – 23909
35	5453.96	I	4173 – 22503
45	5456.39	I	1388 – 19711
35	5457.20	I	4199 – 22518
15	5457.86	I	4160 – 22477
28	5458.83	I	0 – 18313
55	5459.20	II	13028 – 31340
45	5460.06	I	3210 – 21520
9	5460.09	I	2437 – 20747
55	5464.21	II	11455 – 29751
95	5465.34	I	2369 – 20661
140	5468.37	II	11310 – 29592
140	5472.29	II	10058 – 28327
28	5472.87	I	7174 – 25441
28	5473.39	I	7841 – 26107
28	5473.53	I	1279 – 19544
15	5477.41	I	6621 – 24873
28	5478.62	I	1388 – 19636
19	5481.15	I	5572 – 23811
55	5481.97	I	6856 – 25093
11	5483.39	I	5637 – 23869
17	5483.50	I	5904 – 24135
28	5491.15	I	5519 – 23725
45	5498.16	I	3764 – 21946
9	5506.10	I	4199 – 22355
13	5506.46	I	5572 – 23727
28	5510.68	I	4020 – 22162
260	5512.08	II	8131 – 26268
13 h	5513.12	II	11458 – 29592
19	5514.21	I	6234 – 24364
28	5516.08	II	13028 – 31152
19	5517.39	I	8587 – 26707
9	5517.84	I	6234 – 24352
55	5518.47	II	9317 – 27433
35	5522.46	I	4455 – 22558
13	5526.08	I	5210 – 23301
35	5526.85	II	4201 – 22290
23	5527.18	I	3976 – 22063
95	5535.23	I	3100 – 21161
35	5537.54	I	3100 – 21153
28	5540.54	I	8307 – 26351
15	5542.71	I	5637 – 23673
13	5542.87	I	8509 – 26545
19	5544.62	I	4160 – 22190
19	5546.51	I	5572 – 23596
13 h	5547.50	I	6303 – 24325
65	5548.80	I	1279 – 19296
35	5550.04	II	10314 – 28327
19	5550.66	I	4173 – 22184
13	5551.41	I	0 – 18008
9	5552.27	I	0 – 18005
110	5556.25	I	4746 – 22739
55	5556.95	II	14625 – 32616
13	5558.65	I	4199 – 22184
55	5559.20	I	4455 – 22438
6	5560.01	I	8991 – 26972
7	5560.10	I	9333 – 27313
15 h	5561.45	II	11760 – 29735
6	5562.13	I	2437 – 20411
7	5562.20	I	1663 – 19636
45	5563.02	I	7715 – 25686
35	5564.24	I	5315 – 23282
170	5564.97	I	3196 – 21161
28	5565.28	I	5006 – 22970
130	5565.97	I	3764 – 21725
19	5566.48	I	9830 – 27790
45	5567.82	I	8587 – 26543
13 h	5569.29	I	3210 – 21161
19	5572.19	I	1388 – 19330
6	5575.00	I	10879 – 28812
7	5575.11	I	8055 – 25987
19	5577.28	I	6234 – 24159
35	5578.28	I	8088 – 26010
28	5578.90	I	3764 – 21683
19	5582.69	I	4417 – 22325
45	5582.73	I	1388 – 19296
15	5584.61	I	3976 – 21877
19	5584.66	I	2437 – 20338
7	5586.62	I	6836 – 24731
11	5586.74	I	
13	5588.10	I	4173 – 22063
28	5588.33	I	3210 – 21100
9	5589.24	I	6663 – 24549
9	5590.10	I	7890 – 25774
13	5590.53	I	2437 – 20320
15	5593.68	I	6663 – 24535
13	5593.75	I	5519 – 23391
65	5594.96	I	5315 – 23184
100	5595.88	I	4455 – 22321
35	5597.96	I	5572 – 23430
23	5598.86	I	1388 – 19244
240	5601.28	I	6809 – 24657
19	5606.42	I	5409 – 23240
19	5606.53	I	1388 – 19220
11	5609.45	I	2378 – 20200
75	5610.24	II	8449 – 26268
45	5610.93	I	3764 – 21581
35	5613.69	II	11455 – 29263
75	5614.72	I	2369 – 20174
17	5615.98	I	3196 – 20998
9	5616.53	I	7467 – 25266
17	5620.38	I	3210 – 20998
9	5622.68	I	8270 – 26050
13	5623.00	II	4511 – 22290
11	5623.74	I	228 – 18005
11	5625.25	I	4746 – 22518
11	5628.21	I	6856 – 24619
28	5632.49	I	6663 – 24412
17	5633.04	I	4199 – 21946
28	5633.10	I	3312 – 21059
11	5634.44	I	1663 – 19406
7	5634.52	I	6621 – 24364
45	5637.35	II	11310 – 29044
35	5638.20	I	0 – 17731
11	5638.42	I	5409 – 23139
11	5638.63	I	0 – 17729
19	5640.10	I	4160 – 21885
11	5640.79	I	5210 – 22933
35	5646.58	I	4020 – 21725
45	5650.59	I	4746 – 22438
11	5652.98	I	
190	5655.14	I	4199 – 21877
11	5656.18	I	8055 – 25730
11	5659.79	I	1279 – 18943
11	5663.20	I	4160 – 21813
13	5663.46	I	2378 – 20030

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
55	5663.98	I	5802 – 23452
19	5664.69	I	7696 – 25344
9	5665.41	I	4417 – 22063
95	5668.92	II	8131 – 25766
240	5669.96	I	3210 – 20842
11	5671.42	I	6663 – 24290
35	5671.89	I	1388 – 19014
23	5675.12	I	0 – 17615
55	5676.87	I	7933 – 25544
11	5677.22	I	4746 – 22355
120	5677.75	I	4455 – 22063
11	5679.03	II	13527 – 31131
17	5680.26	II	2382 – 19982
11	5682.76	I	1279 – 18871
13	5683.11	II	15235 – 32826
28	5683.76	II	11455 – 29044
45	5685.84	II	15281 – 32864
11	5687.82	I	6234 – 23811
23	5688.49	I	4746 – 22321
11	5691.47	II	5010 – 22576
23	5692.12	I	5409 – 22972
120	5692.94	I	3764 – 21324
23	5695.66	I	4160 – 21712
75	5695.84	II	13117 – 30669
300	5696.99	I	5315 – 22864
370	5699.23	I	6809 – 24350
55	5702.39	I	3100 – 20631
35	5703.22	II	10820 – 28349
17	5709.06	I	5572 – 23083
9	5710.04	I	6856 – 24364
45	5711.43	II	11760 – 29263
17	5712.29	I	4160 – 21661
35 h	5715.25	II	12457 – 29949
35	5716.46	I	6836 – 24325
11	5718.36	I	1388 – 18871
11	5718.58	II	15134 – 32616
240	5719.03	I	5802 – 23282
9	5719.54	I	1279 – 18758
35	5721.96	I	2208 – 19680
95	5725.83	I	4417 – 21877
17	5726.13	I	4160 – 21619
19	5727.25	II	17571 – 35026
9	5729.34	I	5210 – 22660
7	5729.42	I	8509 – 25958
17	5733.94	I	3196 – 20631
19	5735.69	I	5519 – 22949
95	5743.53	I	2437 – 19843
19	5744.68	I	8587 – 25990
11	5746.46	I	3764 – 21161
9	5748.26	I	7174 – 24565
17	5748.94	I	3764 – 21153
11	5752.50	I	8055 – 25434
35	5758.11	I	7696 – 25058
35	5758.29	I	7174 – 24535
9	5760.59	I	4020 – 21375
11	5763.00	II	28096 – 45443
23	5764.77	I	2369 – 19711
23	5765.33	I	1279 – 18619
75	5768.90	II	10646 – 27976
23	5769.93	I	4173 – 21499
35	5770.40	I	5519 – 22844
13	5771.98	II	10058 – 27379
35	5772.22	I	3312 – 20631
45	5772.88	I	1388 – 18706
140	5773.12	I	4746 – 22063
23	5773.59	I	0 – 17315
19	5774.99	I	3100 – 20411
13	5775.80	II	15576 – 32885
35	5782.42	I	8055 – 25344
13	5782.78	I	3210 – 20498
13	5783.99	II	11760 – 29044
45	5784.86	I	6663 – 23944
11	5786.87	I	7169 – 24445
13	5787.20	I	7933 – 25208
120	5788.15	I	8587 – 25859
11	5791.34	I	5097 – 22360
17	5791.66	I	5519 – 22781
9	5794.79	I	3710 – 20962
35	5796.09	I	7467 – 24715
19	5799.79	II	3703 – 20940
95	5804.43	I	2437 – 19661
55	5810.73	I	8055 – 25260
11	5811.84	I	7348 – 24549
120	5812.92	I	4455 – 21654
11	5815.47	I	3974 – 21165
28	5817.78	II	8176 – 25360
45	5820.37	I	6337 – 23513
55	5822.98	I	5572 – 22740
11	5823.46	II	15822 – 32989
13	5829.96	I	4020 – 21168
19	5830.13	I	0 – 17147
19	5831.38	I	7933 – 25077
95	5831.91	I	3196 – 20338
19	5834.24	I	3210 – 20346
95	5835.84	I	7696 – 24826
75	5838.15	I	3976 – 21100
35	5839.36	I	0 – 17120
11	5843.10	I	3210 – 20320
35	5843.73	I	4160 – 21267
6	5845.96	I	
14	5846.08	I	7174 – 24274
35	5848.32	I	7467 – 24561
11	5848.84	II	14252 – 31345
28	5851.02	I	1279 – 18365
23	5851.10	I	8991 – 26077
35	5853.06	I	5210 – 22291
23	5853.34	I	3196 – 20276
35	5853.67	I	2378 – 19457
45	5857.11	I	4199 – 21267
23	5858.14	I	3210 – 20276
19 h	5858.56	II	10314 – 27379
45	5859.37	I	5802 – 22864
95	5862.49	I	4173 – 21226
11	5870.85	I	6856 – 23885
75	5871.59	I	2208 – 19235
13	5873.90	I	2437 – 19457
11	5878.03	I	3312 – 20320
11	5878.14	II	14739 – 31747
23	5878.90	I	5315 – 22321
13	5879.03	II	15859 – 32864
19	5888.52	I	9830 – 26808
13	5892.47	I	3764 – 20730
35	5893.19	I	6663 – 23627
11	5897.75	I	5409 – 22360
13	5898.08	II	7713 – 24663
11	5899.71	I	7467 – 24412
11	5900.68	I	0 – 16942
23	5901.29	I	5904 – 22844
13	5901.39	I	8603 – 25544
23	5905.99	I	2369 – 19296

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
11	5907.49	I	8270 – 25193	35	6035.49	II	13028 – 29592
55	5909.86	I	4160 – 21076	110	6043.39	II	9726 – 26268
55	5910.12	I	1279 – 18194	28	6045.42	I	7348 – 23885
45	5912.92	I	4746 – 21654	55	6047.40	I	3312 – 19843
11	5914.82	I	3210 – 20112	19	6051.80	II	1873 – 18393
45	5920.42	I	4173 – 21059	23	6057.50	I	1388 – 17892
23	5924.04	I	2369 – 19244	35	6058.00	I	2369 – 18871
19	5924.90	II	10641 – 27515	23	6066.75	I	1663 – 18141
55	5926.31	I	0 – 16869	9	6068.64	I	6809 – 23282
85	5928.35	I	2208 – 19072	19	6069.46	I	12960 – 29432
19	5929.50	I	4199 – 21059	35	6069.48	I	7696 – 24167
28	5929.82	I	4455 – 21314	35	6072.00	I	3196 – 19661
23	5932.16	I	3210 – 20063	35	6076.61	I	7696 – 24148
17	5933.58	II	2634 – 19483	17	6077.16	I	3210 – 19661
55	5934.32	I	8587 – 25434	17	6080.37	I	12114 – 28555
40	5934.45	I	7715 – 24561	17	6081.28	I	228 – 16668
95	5937.72	I	3976 – 20812	19	6088.86	I	
19	5938.44	I	4746 – 21581	19	6088.96	I	11810 – 28229
230	5940.86	I	3764 – 20591	35	6093.19	I	6475 – 22882
28	5941.54	II	8927 – 25753	45	6098.34	II	14276 – 30670
28	5942.67	I	228 – 17051	11	6099.80	I	2369 – 18758
28	5944.86	I	6475 – 23292	28	6108.74	II	13527 – 29893
23	5947.64	I	4417 – 21226	9	6111.82	I	5637 – 21994
23	5950.61	I	3312 – 20112	7	6111.92	I	8055 – 24412
11	5951.21	I	4199 – 20998	15	6118.56	I	7174 – 23513
9	5956.68	I	9462 – 26245	17	6118.90	I	5315 – 21654
14	5956.84	I	8991 – 25774	9	6119.81	I	1663 – 17998
35	5959.69	II	13118 – 29893	45	6123.67	I	7841 – 24167
9	5960.70	II	14252 – 31024	9	6124.25	I	7890 – 24214
13	5960.87	I	8055 – 24826	9	6130.15	I	13124 – 29432
11	5963.33	I	1663 – 18427	19	6132.00	II	14827 – 31130
8	5964.62	I	5409 – 22170	19	6132.18	I	
8	5964.64	I		11	6135.45	I	7715 – 24009
28	5966.18	I	5802 – 22558	7	6135.55	I	13939 – 30233
45	5966.33	I	5904 – 22660	9	6137.23	I	15131 – 31421
28	5972.09	I	15333 – 32073	23	6139.03	I	
11	5972.79	I	5210 – 21948	15	6142.92	I	4455 – 20730
75	5975.87	II	10704 – 27433	35	6143.36	II	13676 – 29949
35	5975.98	I	1279 – 18008	23	6146.43	I	6475 – 22740
19	5979.37	I	1279 – 17998	19	6147.84	I	5802 – 22063
11	5981.20	I	13572 – 30286	9	6149.56	I	4766 – 21023
45	5989.38	I	3100 – 19791	23	6151.72	I	4160 – 20411
45	5992.67	I	4417 – 21100	19	6159.82	I	7715 – 23944
35	5995.26	II	10704 – 27379	19	6162.14	I	2437 – 18661
35	5995.45	II	13218 – 29893	19	6165.45	I	12707 – 28922
19	5997.03	II	16192 – 32862	7	6172.84	I	14310 – 30505
11	6000.18	I	1663 – 18324	7	6172.86	I	13902 – 30098
55	6001.90	I	8603 – 25260	19	6175.28	I	12366 – 28555
4	6003.62	I		35	6186.17	I	8400 – 24561
7	6003.68	I	11061 – 27713	9	6186.93	I	11850 – 28008
55	6005.86	I	2369 – 19014	15	6187.97	I	228 – 16384
15	6006.20	I	228 – 16873	15	6195.23	I	3210 – 19347
55	6006.82	I	4199 – 20842	19	6195.53	I	4455 – 20591
19	6007.37	I	7169 – 23811	19	6198.05	I	13605 – 29734
75	6013.42	I	2437 – 19062	35	6208.98	I	9333 – 25434
23	6016.59	I	1279 – 17895	9	6209.56	I	3196 – 19296
4	6018.78	I	1388 – 17998	9	6211.05	I	4746 – 20842
6	6018.82	I		3	6212.29	I	8055 – 24148
9	6020.60	I	4160 – 20765	7	6212.49	I	
110	6024.20	I	3196 – 19791	11	6216.82	I	
15	6027.16	I	4160 – 20747	9	6223.25	I	1279 – 17343
11	6031.26	I	5006 – 21582	9	6228.23	I	0 – 16051
23	6033.58	II	17475 – 34044	35	6228.94	I	
35	6034.20	II	11760 – 28327	19	6229.13	I	
23	6034.41	I	5097 – 21664	23	6232.45	II	9726 – 25766

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
28	6237.45	I	3764 – 19791
13	6238.71	I	3210 – 19235
11	6241.87	I	0 – 16016
3	6241.95	I	4766 – 20782
13	6242.91	I	
15	6253.65	I	2208 – 18194
9	6256.36	I	12960 – 28940
13	6257.99	I	13124 – 29099
15	6264.27	I	13605 – 29564
9	6270.28	I	7348 – 23292
45	6272.05	II	12457 – 28396
15	6276.47	I	2437 – 18365
7	6286.39	I	7467 – 23370
7	6286.43	I	14609 – 30511
35	6295.58	I	0 – 15879
28	6299.51	II	15282 – 31152
23	6300.21	I	1279 – 17147
13	6306.64	I	3210 – 19062
35	6310.01	I	0 – 15843
5	6317.95	I	15396 – 31219
4	6317.99	I	6303 – 22127
8	6331.97	I	228 – 16017
9	6335.36	I	3764 – 19544
15	6335.40	I	
11	6337.21	I	1663 – 17438
13	6340.70	I	8400 – 24167
35	6343.95	II	2634 – 18393
6	6353.48	I	6475 – 22210
6	6360.22	I	
35	6371.11	II	12705 – 28396
6	6372.99	I	2208 – 17895
4	6386.10	I	12467 – 28122
5	6386.26	I	5572 – 21226
28	6386.84	I	12114 – 27766
7	6390.32	I	4199 – 19843
23	6393.02	II	11742 – 27379
11	6395.16	I	
7	6396.22	I	2369 – 17998
4	6396.27	I	14027 – 29657
6	6399.90	I	13124 – 28744
3	6399.94	I	6856 – 22477
11	6425.29	II	17976 – 33535
35	6430.07	I	
19	6434.39	I	228 – 15766
23	6436.40	I	3764 – 19296
8	6439.97	I	2369 – 17892
19	6446.12	I	14027 – 29536
6	6451.99	I	
35	6458.03	I	1388 – 16869
8	6461.88	I	3764 – 19235
19	6466.88	II	14276 – 29735
28	6467.39	I	2437 – 17895
6	6468.97	II	7746 – 23200
35	6473.72	I	
17	6490.97	I	6663 – 22064
6	6494.94	I	7348 – 22740
11	6503.27	II	17000 – 32372
4	6503.98	I	3976 – 19347
4	6504.12	I	4173 – 19544
11	6507.16	II	14387 – 29751
7	6509.01	I	228 – 15587
23	6513.59	II	14387 – 29735
19	6517.31	I	3210 – 18550
6	6519.12	I	13605 – 28940
6	6530.68	I	3764 – 19072
6	6534.51	I	3312 – 18611
7	6537.49	II	15859 – 31152
19	6551.70	I	3976 – 19235
45	6555.65	I	6475 – 21725
6	6560.79	I	3312 – 18550
7	6563.46	I	
7	6565.67	I	8400 – 23627
9	6573.60	I	6475 – 21683
5	6577.45	I	1388 – 16588
23	6579.10	I	
7	6599.63	I	4199 – 19347
7	6605.35	I	2208 – 17343
15	6606.35	I	2378 – 17511
15	6606.86	II	13218 – 28350
22	6612.06	I	
10	6623.00	I	3100 – 18194
30	6628.93	I	2208 – 17289
13	6650.89	I	15491 – 30523
4	6651.43	I	5315 – 20346
3	6651.51	I	1663 – 16693
22	6652.72	II	12326 – 27353
10	6661.41	I	7348 – 22355
13	6665.59	I	3196 – 18194
10	6675.54	II	12457 – 27433
7	6679.80	I	3976 – 18942
7	6679.88	I	4020 – 18987
15	6686.60	I	12960 – 27912
26	6700.66	I	12960 – 27880
35	6704.27	I	2208 – 17120
13	6704.52	II	19950 – 34861
10	6706.04	II	14827 – 29735
3	6710.09	I	3100 – 17998
7	6713.47	I	4455 – 19347
9	6720.28	II	14387 – 29263
3	6726.54	I	7696 – 22558
15	6728.71	I	2208 – 17066
15	6729.57	I	3764 – 18619
4	6733.21	II	15822 – 30669
15	6744.70	II	13527 – 28350
10	6746.90	I	13939 – 28757
4	6749.38	I	9996 – 24808
7	6749.49	I	3196 – 18008
4	6755.08	II	13527 – 28327
6	6764.45	I	7348 – 22127
6	6767.68	I	1279 – 16051
4	6770.15	I	8603 – 23370
30	6774.28	II	13218 – 27975
35	6775.59	I	12114 – 26868
10	6778.28	I	0 – 14748
9	6780.21	II	
9	6780.71	I	4199 – 18943
6	6793.84	I	13194 – 27910
5	6801.72	I	4173 – 18871
5	6803.28	I	2208 – 16903
18	6807.81	I	3210 – 17895
10	6808.82	I	2437 – 17120
6 h	6811.62	I	7841 – 22518
9	6815.29	I	11061 – 25730
15	6818.23	I	1388 – 16051
7	6826.44	I	4417 – 19062
7	6829.38	II	4844 – 19483
10	6829.73	II	14626 – 29263
6	6834.24	II	12751 – 27379
2	6839.92	I	6621 – 21237
3	6839.97	I	10318 – 24934

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
4	6844.26	I	4455 – 19062
4	6844.48	II	16545 – 31151
7	6846.78	II	15134 – 29735
13	6847.25	I	1279 – 15879
9	6853.59	I	8603 – 23190
12	6856.55	I	8603 – 23184
3	6885.49	I	4173 – 18692
2	6885.71	I	1279 – 15798
10	6893.66	I	12366 – 26868
7	6894.56	I	2369 – 16869
10	6898.45	II	18393 – 32885
9	6899.06	I	2208 – 16699
6	6904.58	I	7841 – 22321
4	6909.35	I	7715 – 22184
9	6919.27	II	13527 – 27976
30	6924.81	I	6663 – 21100
10	6939.45	I	228 – 14635
2	6970.40	I	7841 – 22184
2	6970.53	I	3710 – 18052
19	6973.50	II	18704 – 33040
10	6983.82	II	13118 – 27433
30	6986.02	I	228 – 14539
9	6999.89	I	1663 – 15945
9	6999.93	I	1279 – 15561
6	7013.35	I	6475 – 20730
6	7014.81	I	5315 – 19567
7	7017.24	I	3974 – 18221
4	7018.72	I	4417 – 18661
4	7018.79	I	17147 – 31391
6	7031.00	I	
6	7031.05	I	
6	7049.61	I	7696 – 21877
6	7049.73	I	4020 – 18201
12	7054.51	I	12366 – 26538
11	7058.68	II	2382 – 16545
11	7060.00	I	14743 – 28904
35	7061.75	II	15594 – 29751
11	7064.49	I	8587 – 22739
35	7086.35	II	17232 – 31340
11	7105.04	II	4322 – 18393
7	7113.17	I	9830 – 23885
11	7115.08	II	14276 – 28327
7	7120.86	II	5942 – 19982
6	7123.44	I	6475 – 20509
10	7124.73	I	4020 – 18052
7	7132.07	II	5964 – 19982
7	7136.08	I	8055 – 22064
16	7141.42	I	3976 – 17975
7	7141.68	I	1279 – 15277
19	7150.23	II	15282 – 29263
10	7151.67	I	2369 – 16347
16	7155.25	I	14531 – 28503
16	7156.99	II	4511 – 18479
7	7175.00	II	4459 – 18393
7	7177.44	I	6663 – 20591
7	7182.30	I	5315 – 19235
6	7186.20	II	18704 – 32616
16	7189.40	II	13527 – 27433
10	7191.72	I	2437 – 16338
11	7201.56	II	4511 – 18393
16	7201.89	I	0 – 13881
10	7203.55	I	5802 – 19680
12	7210.67	I	3210 – 17075
6	7213.92	I	2208 – 16066
19	7217.36	I	1388 – 15240
16	7235.71	II	
22	7238.36	II	12457 – 26268
12	7241.73	I	7715 – 21520
25	7252.75	I	
12	7262.64	I	5802 – 19567
11 h	7277.90	I	2208 – 15945
6	7279.94	I	3976 – 17708
11	7296.17	I	2378 – 16080
19	7301.42	II	14404 – 28096
19	7313.45	II	15594 – 29263
25	7329.91	I	13214 – 26853
16	7334.68	II	19481 – 33111
12	7343.44	I	2437 – 16051
6	7345.62	I	4160 – 17770
6 h	7361.89	I	3764 – 17343
6	7362.40	I	2437 – 16016
4	7363.09	I	1663 – 15240
2	7363.19	I	12720 – 26297
6	7372.54	I	
6	7383.74	I	9830 – 23370
9	7390.46	II	0 – 13527
6	7393.40	I	4762 – 18284
25	7397.77	I	0 – 13513
11	7401.27	I	2437 – 15945
12	7417.94	II	2382 – 15859
6	7421.00	I	3196 – 16668
11	7424.70	CeO	
12	7433.08	I	4199 – 17649
11	7438.56	I	4455 – 17895
6	7440.49	I	2208 – 15644
12	7444.44	I	2369 – 15798
6 h	7458.42	II	15859 – 29263
9	7462.32	I	2369 – 15766
10	7472.41	I	14743 – 28122
6	7478.71	I	3976 – 17343
16	7486.57	II	20554 – 33908
9	7500.70	I	2437 – 15766
6	7508.13	I	8904 – 22219
9 h	7509.49	I	7348 – 20661
11	7527.46	I	11796 – 25077
11	7527.68	I	
10	7533.73	I	5802 – 19072
4	7539.52	I	1279 – 14539
4	7539.58	I	5572 – 18831
10	7551.25	I	4199 – 17438
12	7562.44	I	
10	7562.86	I	2369 – 15587
10 h	7563.60	I	7841 – 21059
9	7586.01	I	5409 – 18587
10	7603.10	I	4746 – 17895
25	7616.11	II	12365 – 25492
7	7632.55	I	8055 – 21153
12	7646.08	I	4455 – 17530
10	7647.88	I	6856 – 19928
7 h	7663.39	II	15282 – 28327
7	7670.76	II	
7	7678.13	I	9830 – 22851
12	7682.47	I	3210 – 16223
25	7689.17	II	12751 – 25753
9	7702.84	I	5315 – 18294
6	7717.68	II	1873 – 14827
6 h	7724.61	II	14963 – 27905
10	7732.33	I	3764 – 16693
5	7741.43	II	19950 – 32864
4	7743.77	I	9830 – 22740

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
4	7746.65	II	3363 – 16268
16	7748.35	I	4746 – 17649
4	7752.86	II	2634 – 15529
5	7762.95	I	4173 – 17051
6	7769.75	I	4199 – 17066
5	7785.10	II	7713 – 20554
10	7797.70	I	3196 – 16017
4	7806.80	I	3210 – 16016
7	7812.70	I	5802 – 18598
9	7835.88	I	6809 – 19567
4	7838.38	II	19481 – 32235
12	7842.59	I	1388 – 14136
22	7844.94	II	14963 – 27706
16	7850.02	II	5969 – 18704
16	7851.18	II	15594 – 28327
22	7857.54	II	7259 – 19982
12	7864.49	I	5315 – 18027
10	7866.04	I	1388 – 14098
2	7874.13	I	10673 – 23370
2	7874.22	I	7715 – 20411
16	7898.96	II	7293 – 19950
11	7913.52	I	6663 – 19296
10	7927.30	CeO	
10	7927.72	I	4455 – I7066
10	7934.50	II	15517 – 28117
5	7953.61	I	7841 – 20411
9	7972.11	I	2208 – 14748
7	7972.34	II	988 – 13527
9	8002.56	I	
9	8002.70	I	7348 – 19840
30	8025.56	II	0 – 12457
5	8030.69	II	3704 – 16152
5	8031.45	I	4455 – 16903
6	8040.02	I	32I0 – 15644
5 h	8066.91	I	53I5 – 17708
16	8070.71	I	4199 – 16586
5	8079.37	I	4746 – 17120
10	8094.43	I	3210 – 15561
16	8120.36	I	2437 – 14748
6	8171.39	I	1279 – 13513
5	8175.59	II	3594 – 15822
5	8199.29	I	6234 – 18427
9	8220.70	I	3210 – 15371
7	8223.61	I	4746 – 16903
7	8224.29	II	3704 – 15859
6	8239.48	I	6809 – 18942
10	8241.55	II	988 – 13118
7	8245.20	I	1388 – 13513
5	8246.82	I	11061 – 23184
6	8250.64	II	1410 – 13527
12	8261.09	I	2437 – 14539
2	8300.59	I	3196 – 15240
2	8300.73	I	5572 – 176I5
9	8310.23	I	3210 – 15240
7	8312.34	I	4173 – 16200
5 h	8327.67	II	2382 – 14387
6	8355.15	II	18704 – 30669
9	8396.39	I	5802 – 17708
6 d	8405.25	II	2382 – 14276
16	8418.23	II	6517 – 18393
11	8495.82	I	2369 – 14136
6 h	8511.36	I	
9 h	8523.34	I	2369 – 14098
12	8539.08	II	1410 – 13118
9 h	8564.58	I	2208 – 13881
7 h	8567.48	I	3976 – 15644
10	8612.64	I	3764 – 15371
10 h	8647.66	I	4455 – 16016
11 h	8702.38	II	3794 – 15282
7	8716.66	II	988 – 12457
25	8772.14	II	2880 – 14276
9	8782.17	I	5315 – 16699
12	8810.84	I	2437 – 13784
30	8891.20	II	1874 – 13118

Cesium

Cs, $Z = 55$, $M = 132.9055$, Ratio $\frac{\text{Cs}}{\text{Cu}} = 2.091$

Cs I Normal state of valence electrons $5p^6 6s\ ^2S_{1/2} = 0$. I.P. = 31407 cm^{-1}.
Cs II Normal state of valence electrons $5p^6\ ^1S_0 = 0$. I.P. = 186600 cm^{-1}.

References

Wavelengths and Classification:
H. Kleiman, J. Opt. Soc. Am. **52**, 441 (1962).

Cesium—all observed lines

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
400	4555.31	I	0 – 21946	200 hs	6723.29	I	11178 – 26048
200	4593.20	I	0 – 21765	200 hs	6973.30	I	11732 – 26069
30 hs	5664.02	I	11178 – 28829	35	6983.49	I	11732 – 26048
25 hs	5845.14	I	11732 – 28836	40	7608.90	I	11178 – 24317
80 hs	6010.49	I	11178 – 27811	60 hl	8015.72	I	14499 – 26971
14 h	6034.09	I	11732 – 28300	80 hl	8079.03	I	14597 – 26971
120 hs	6213.10	I	11732 – 27823	15000	8521.24	I	0 – 11732
8	6217.60	I	11732 – 27811	550	8761.42	I	11178 – 22589
25 h	6354.55	I	11178 – 26911	8000	8943.59	I	0 – 11178
30 h	6586.51	I	11732 – 26911				

Chromium

$$\text{Cr},\ Z = 24,\ M = 51.996,\ \text{Ratio}\ \frac{\text{Cr}}{\text{Cu}} = 0.8182$$

Cr I Normal state of valence electrons $3d^5 4s\ {}^7S_3 = 0$. I.P. = 54570 cm^{-1}.
Cr II Normal state of valence electrons $3d^5\ {}^6S_{2\,1/2} = 0$. I.P. = 133060 cm^{-1}.

References

Wavelengths:
G. R. Harrison, Massachusetts Institute of Technology Wavelength Tables (John Wiley & Sons, New York, 1939).
Supplemented by lines from Kiess (below).

Classification:
Cr I, C. C. Kiess, J. Research NBS **51**, 247 (1953) RP 2457.
Cr II, C. C. Kiess, J. Research NBS **47**, 385 (1951) RP 2266.

Strong lines of chromium

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
20000	4254.35	I	0 – 23499	2300	4351.77	I	8308 – 31280
19000	2055.52	II	0 – 48632	2100	2986.47	I	8308 – 41782
19000	3578.69	I	0 – 27935	1900	3919.16	I	8308 – 33816
17000	3593.49	I	0 – 27820	1900	3963.69	I	20520 – 45741
16000	4274.80	I	0 – 23386	1900	4344.51	I	8095 – 31106
14000	2061.49	II	0 – 48491	1800	2677.16	II	12304 – 49646
13000	3605.33	I	0 – 27729			II	12497 – 49838
11000	5208.44	I	7593 – 26788	1700	2843.25	II	12304 – 47465
10000	4289.72	I	0 – 23305	1600	3969.75	I	20524 – 45707
8900	2065.42	II	0 – 48399	1600	3976.66	I	20524 – 45663
8400	5206.04	I	7593 – 26796	1600	4646.17	I	8308 – 29825
5300	5204.52	I	7593 – 26802	1500	2986.00	I	8095 – 41575
2800	3017.57	I	8095 – 41225	1400	3014.92	I	7927 – 41086
2800	3021.56	I	8308 – 41393	1400	5409.79	I	8308 – 26787
2500	2835.63	II	12497 – 47752	1200	2849.84	II	12148 – 47228

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
19000		2055.52	II	0 – 48632
14000		2061.49	II	0 – 48491
8900		2065.42	II	0 – 48399
80	h	2364.71	I	0 – 42275
130		2383.33	I	8308 – 50253
140		2408.62	I	8308 – 49812
170		2496.31	I	7927 – 47975
110		2502.53	1	8095 – 48043
190		2504.31	I	8095 – 48014
50		2508.11	1	7927 – 47786
60		2508.98	I	7927 – 47772
40		2513.62	I	8095 – 47866
110		2516.92	1	8095 – 47814
80		2518.71	I	8095 – 47786
390		2519.52	I	8308 – 47986
190		2527.12	1	8308 – 47866
40		2530.45	I	8308 – 47814
70		2534.34	II	12497 – 51943
50		2545.64	1	7751 – 47022
160		2549.54	I	7811 – 47022
40		2553.06	I	7811 – 46968
80		2557.15	I	7927 – 47022
130		2560.69	I	7927 – 46968
150		2571.74	I	8095 – 46968
100		2577.65	1	8095 – 46878
50		2588.20	I	8095 – 46720
380		2591.85	1	8308 – 46878
35		2603.57	1	8308 – 46705
35		2622.86	I	8308 – 46422
22		2625.32	I	8095 – 46174
18		2626.60	I	8308 – 46368
18		2629.82	I	8095 – 46109
35		2642.12	I	24200 – 62037
250		2653.59	II	12033 – 49706
250		2658.59	II	11962 – 49565
70		2661.73	II	12148 – 49706
320		2663.42	II	12304 – 49838
70		2663.68	II	11962 – 49493
440		2666.02	II	12148 – 49646
280		2668.71	II	12033 – 49493
350		2671.81	II	12148 – 49565
280		2672.83	II	12304 – 49706
1800		2677.16	II	12304 – 49646
			II	12497 – 49838
35		2678.16	I	7927 – 45255
320		2678.79	II	12033 – 49352
18		2680.34	II	40415 – 77714
230		2687.09	II	12148 – 49352
60		2688.04	I	8095 – 45286
55		2688.29	II	30157 – 67344
26		2690.26	1	8095 – 45255
280		2691.04	II	12497 – 49646
35		2693.52	II	30219 – 67334
35		2697.91	II	30299 – 67354
			II	39825 – 76879
180		2698.41	II	12304 – 49352
180		2698.69	II	11962 – 49006
18		2700.60	I	8095 – 45113
110		2701.99	1	8308 – 45306
18		2702.53	I	24200 – 61191
70		2703.48	I	8308 – 45286
		2703.55	II	30392 – 67369
35		2703.86	II	12033 – 49006
18		2705.43	I	24056 – 61008
60		2708.79	II	33521 – 70427
35		2709.31	II	33418 – 70317
140		2712.31	II	12148 – 49006
45		2716.18	I	8308 – 45113
55		2717.51	II	31083 – 67871
45		2718.43	II	31532 – 68306
170		2722.75	II	12033 – 48750
18		2724.04	II	31169 – 67868
420	h	2726.51	I	7593 – 44259
45		2727.26	II	31219 – 67876
280	h	2731.91	I	7593 – 44187
170	h	2736.47	I	7593 – 44126
70		2739.38	I	23934 – 60428
70		2740.10	II	12148 – 48632
95		2741.07	I	24056 – 60528
95		2742.03	II	12033 – 48491
95		2742.17	I	24200 – 60657
250		2743.64	II	11962 – 48399
35		2746.21	II	29952 – 66355
			II	38315 – 74718
110	h	2748.29	I	7751 – 44126
330		2748.98	II	12033 – 48399
390		2750.73	II	12148 – 48491
45		2751.60	I	7927 – 44259
280		2751.87	II	12304 – 48632
110	h	2752.88	I	7811 – 44126
35		2754.28	II	31083 – 67380
22		2754.90	I	24834 – 61123
22		2755.27	I	
22		2756.75	I	24897 – 61161
150		2757.10	I	7927 – 44187
350		2757.72	II	12148 – 48399
60		2758.98	II	38270 – 74505
80		2759.39	II	31219 – 67449
45		2759.73	II	31169 – 67394
90	h	2761.76	I	7927 – 44126
750		2762.59	II	12304 – 48491
22		2763.06	I	27817 – 63998
80	h	2764.35	1	8095 – 44259
750		2766.54	II	12497 – 48632
22		2767.54	I	25038 – 61161
250	h	2769.92	I	8095 – 44187
18		2771.45	I	23934 – 60005
45		2778.06	II	39825 – 75810
22		2779.14	1	25106 – 61078
80		2780.30	II	33521 – 69478
			II	38363 – 74319
610		2780.70	I	8308 – 44259
70		2785.70	II	33619 – 69506
35		2787.63	II	30865 – 66727
35		2787.84	I	
90		2792.16	II	33694 – 69498
55		2798.67	II	
70		2800.77	II	33694 – 69388
80		2812.01	II	33619 – 69171
			II	38563 – 74114
60		2818.36	II	33521 – 68993
45		2822.01	II	33418 – 68844
180		2822.37	II	30392 – 65813
22		2826.75	I	27817 – 63183
180		2830.47	II	30299 – 65618
70		2834.26	II	34631 – 69903
2500		2835.63	II	12497 – 47752
45		2836.48	II	35608 – 70852
55		2838.79	II	38270 – 73486
110		2840.02	II	30219 – 65420

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
1700		2843.25	II	12304 – 47465
22		2846.02	I	27704 – 62830
45		2849.29	I	27817 – 62903
			II	30299 – 65384
1200		2849.84	II	12148 – 47228
120		2851.36	II	30157 – 65218
55		2853.22	II	30219 – 65257
			II	42898 – 77935
55		2855.07	II	32855 – 67871
			II	35569 – 70585
880		2855.68	II	12033 – 47041
90		2856.77	II	19631 – 54626
70		2857.40	II	19798 – 54785
610		2858.91	II	12497 – 47465
440		2860.93	II	11962 – 46906
790		2862.57	II	12304 – 47228
750		2865.11	II	12148 – 47041
55		2865.33	II	19528 – 54418
610		2866.74	II	12033 – 46906
90		2867.10	II	19631 – 54500
480		2867.65	II	11962 – 46824
210		2870.44	II	19798 – 54626
110		2871.63	I	8095 – 42908
160		2873.48	II	12033 – 46824
90		2873.82	II	19631 – 54418
320		2875.99	II	20024 – 54785
230		2876.24	II	12148 – 46906
180		2877.98	II	12304 – 47041
70		2878.45	II	12497 – 47228
120		2879.27	I	7927 – 42648
95		2880.87	II	19798 – 54500
30		2881.14	I	24056 – 58754
170		2887.00	I	7811 – 42439
55		2888.74	II	36273 – 70880
700		2889.29	I	
55		2889.82	II	32854 – 67449
55		2891.42	I	24200 – 58775
370		2893.25	I	8095 – 42648
190		2894.17	I	7751 – 42293
55		2896.46	II	32854 – 67369
			II	40228 – 74743
210		2896.75	I	7927 – 42439
55	d	2897.67	II	35608 – 70108
		2897.73	II	32845 – 67344
90		2898.54	II	31219 – 65710
80		2899.21	I	7811 – 42293
55		2899.48	II	32855 – 67334
26		2903.97	II	31118 – 65543
55		2904.68	I	24940 – 59358
180		2905.49	I	7811 – 42218
260		2909.05	I	7927 – 42293
260		2910.90	I	8095 – 42439
250		2911.14	I	8308 – 42648
45		2911.68	II	35569 – 69903
60		2913.73	I	25177 – 59488
22		2915.23	II	35611 – 69903
22		2915.46	II	39825 – 74114
90		2921.24	II	40202 – 74424
60		2921.82	II	31169 – 65384
60		2927.08	II	38563 – 72717
80		2928.15	II	30308 – 64449
95		2928.30	II	31118 – 65257
			II	38509 – 72649
26		2929.44	II	36273 – 70399
35		2930.85	II	29952 – 64063
26		2932.70	II	31169 – 65257
55		2933.97	II	31083 – 65157
90		2935.14	II	30865 – 64924
45		2940.22	II	42987 – 76988
60		2946.84	II	34813 – 68738
55		2953.36	II	29952 – 63802
45		2953.71	II	34631 – 68477
55		2961.73	II	30308 – 64062
			II	33694 – 67449
45		2966.05	II	31219 – 64924
480		2967.64	I	8095 – 41782
480		2971.11	I	7927 – 41575
210		2971.91	II	30392 – 64031
480		2975.48	I	7811 – 41409
30		2976.72	II	30865 – 64449
190		2979.74	II	30299 – 63849
350		2980.79	I	7751 – 41289
110		2985.32	II	30219 – 63707
480		2985.85	I	7927 – 41409
1500		2986.00	I	8095 – 41575
2100		2986.47	I	8308 – 41782
660		2988.65	I	7593 – 41043
160		2989.19	II	30157 – 63601
480		2991.89	I	7811 – 41225
230		2994.07	I	7593 – 40983
300		2995.10	I	7593 – 40971
700		2996.58	I	7927 – 41289
210		2998.79	I	7593 – 40930
1100		3000.89	I	8095 – 41409
750		3005.06	I	8308 – 41575
140		3013.03	I	7751 – 40930
710		3013.71	I	7811 – 40983
710		3014.76	I	7811 – 40971
1400		3014.92	I	7927 – 41086
710		3015.19	I	7751 – 40906
2800		3017.57	I	8095 – 41225
430		3018.50	I	7811 – 40930
240		3018.82	I	7927 – 41043
430		3020.67	I	7811 – 40906
2800		3021.56	I	8308 – 41393
1100		3024.35	I	7927 – 40983
85		3026.65	II	35708 – 68738
170		3029.16	I	7927 – 40930
710		3030.24	I	8095 – 41086
140		3031.35	I	7927 – 40906
28		3032.93	II	21823 – 54785
390		3034.19	I	8095 – 41043
550		3037.04	I	8308 – 41225
80		3039.78	I	24200 – 57088
550		3040.85	I	8095 – 40971
		3040.91	II	34631 – 67506
55		3041.74	II	35611 – 68477
110		3050.14	II	34813 – 67589
710		3053.88	I	8308 – 41043
24		3059.52	II	21825 – 54500
85		3065.07	I	24940 – 57557
28		3067.16	II	21824 – 54418
85		3073.68	I	25177 – 57702
55		3077.83	I	25106 – 57587
28		3095.86	I	21841 – 54133
28		3109.34	I	24834 – 56986
28		3110.86	I	24897 – 57033
240		3118.65	II	19528 – 51584
45		3119.25	I	25038 – 57088
40		3119.71	I	24940 – 56986

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
430	3120.37	II	19631 – 51670
28	3122.60	II	33694 – 65710
470	3124.94	II	19798 – 51789
	3125.02	II	34659 – 66650
120	3128.70	II	19631 – 51584
590	3132.06	II	20024 – 51943
140	3136.68	II	19798 – 51670
140	3147.23	II	20024 – 51789
		II	33619 – 65384
85	3148.44	I	23934 – 55686
100	3155.15	I	24056 – 55741
100	3163.76	I	24200 – 55799
240	3180.70	II	20513 – 51943
30	3181.43	II	20520 – 51943
65 h	3188.01	I	24092 – 55451
220	3197.08	II	20520 – 51789
24	3198.11	I	24092 – 55353
30	3208.59	II	20513 – 51670
170	3209.18	II	20518 – 51670
140	3217.40	II	20513 – 51584
30	3229.20	I	27817 – 58775
28	3234.06	II	34631 – 65543
65	3237.73	I	23934 – 54811
120	3245.54	I	23934 – 54736
130	3251.84	I	24056 – 54799
130	3257.82	I	24200 – 54887
95	3259.98	I	24200 – 54866
30	3295.43	II	33694 – 64031
24	3307.02	II	33619 – 63849
55	3324.06	II	19631 – 49706
		II	38509 – 68583
28	3326.59	I	24940 – 54993
30	3328.35	II	19528 – 49565
30	3329.05	I	25177 – 55207
95	3336.33	II	19528 – 49493
130	3339.80	II	19631 – 49565
110	3342.59	II	19798 – 49706
30	3343.34	I	24897 – 54799
95	3346.02	I	24200 – 54078
95	3346.74	I	24056 – 53927
95	3347.84	II	19631 – 49493
65	3349.07	I	24282 – 54133
55	3349.32	I	25038 – 54887
30	3351.60	I	25038 – 54866
55	3351.97	I	0 – 29825
55 h	3353.03	I	31055 – 60871
	3353.13	II	20024 – 49838
170	3358.50	II	19798 – 49565
160	3360.30	II	25034 – 54785
65	3361.77	II	25047 – 54785
55	3362.21	I	20519 – 50253
430	3368.05	II	20024 – 49706
30	3376.40	I	31048 – 60657
55	3378.34	II	25034 – 54626
30	3379.17	I	20517 – 50102
30	3379.37	II	25043 – 54626
95	3379.83	II	25047 – 54626
140	3382.68	II	19798 – 49352
95	3391.43	II	19528 – 49006
55	3392.99	II	25036 – 54500
70	3393.84	II	25043 – 54500
55	3394.30	II	25047 – 54500
30	3402.40	II	25036 – 54418
170	3403.32	II	19631 – 49006
		II	25043 – 54418
360	3408.76	II	20024 – 49352
210	3421.21	II	19528 – 48750
270	3422.74	II	19798 – 49006
140	3433.31	II	19631 – 48750
270	3433.60	I	20519 – 49635
55	3434.11	I	20524 – 49635
160	3436.19	I	20524 – 49618
70	3441.12	I	20521 – 49573
140	3441.44	I	20524 – 49573
30	3443.79	I	23934 – 52963
170	3445.62	I	20524 – 49538
30	3447.02	I	20517 – 49520
170	3447.43	I	20521 – 49520
70	3447.76	I	20524 – 49520
190	3453.33	I	20517 – 49467
40	3453.74	I	20521 – 49467
130	3455.60	I	20524 – 49454
100	3460.43	I	24282 – 53172
65	3465.25	I	20521 – 49371
40	3467.02	I	24282 – 53117
70	3467.72	I	24056 – 52885
45	3469.59	I	24304 – 53117
16	3472.76	I	21841 – 50628
24	3472.91	I	23934 – 52720
40	3473.61	I	21848 – 50628
70	3481.30	I	21841 – 50557
55	3481.54	I	24200 – 52915
55	3494.97	I	24056 – 52660
40	3495.38	II	19798 – 48399
80	3510.54	I	24200 – 52678
40	3511.84	II	20024 – 48491
120	3550.64	I	25771 – 53927
80	3558.52	I	25206 – 53299
130	3566.16	I	25360 – 53394
130	3573.64	I	21848 – 49823
80	3574.04	I	21840 – 49812
330 h	3574.80	I	21857 – 49823
	3574.94	I	21848 – 49812
19000	3578.69	I	0 – 27935
160 h	3584.33	I	25771 – 53663
130	3585.30	II	21823 – 49706
17000	3593.49	I	0 – 27820
350	3601.67	I	21841 – 49598
40	3602.57	I	21848 – 49598
85	3603.74	I	21848 – 49589
	3603.78	II	21824 – 49565
13000	3605.33	I	0 – 27729
40	3608.40	I	31049 – 58754
40	3609.48	I	20521 – 48218
40	3610.05	I	20517 – 48210
70	3612.61	I	31055 – 58728
85	3615.64	I	0 – 27650
130	3632.84	I	20524 – 48043
350	3636.59	I	20524 – 48014
630	3639.80	I	20519 – 47986
85	3640.39	I	20523 – 47986
70	3641.47	I	20521 – 47975
220	3641.83	I	20524 – 47975
45	3646.16	I	20524 – 47942
85	3648.53	I	20517 – 47918
220	3649.00	I	20521 – 47918
170	3653.91	I	20517 – 47877
220	3656.26	I	20524 – 47866
45	3662.84	I	20521 – 47814
130	3663.21	I	20524 – 47814

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
45	3665.98	I	20524 – 47794
95	3666.64	I	20521 – 47786
55	3668.03	I	20517 – 47772
65	3676.32	I	24092 – 51287
40	3677.68	II	21823 – 49006
55	3677.89	II	21824 – 49006
40	3679.82	I	20521 – 47689
19	3681.69	I	24092 – 51247
120	3685.55	I	20519 – 47645
130	3686.80	I	20524 – 47640
130	3687.25	I	20517 – 47629
75	3687.54	I	20521 – 47631
19	3688.46	I	20517 – 47621
75	3712.95	II	21824 – 48750
40	3716.53	I	31393 – 58292
130	3730.81	I	0 – 26796
150	3732.03	I	0 – 26787
95	3742.97	I	20519 – 47229
480	3743.58	I	20524 – 47229
570	3743.88	I	20519 – 47222
85	3744.49	I	20524 – 47222
55	3748.61	I	20521 – 47190
340	3749.00	I	20524 – 47190
50	3757.17	I	20517 – 47126
230	3757.66	I	20521 – 47126
60	3758.04	I	20524 – 47126
24	3767.43	I	20519 – 47055
260	3768.24	I	20517 – 47047
95	3768.73	I	20521 – 47047
95	3788.86	I	24277 – 50663
95	3790.45	I	24286 – 50661
130	3791.38	I	24286 – 50655
130	3792.14	I	24300 – 50663
120	3793.29	I	24300 – 50655
130	3793.88	I	24304 – 50655
85	3794.61	I	24282 – 50628
140	3797.13	I	24300 – 50628
200	3797.72	I	24304 – 50628
530	3804.80	I	24282 – 50558
110	3806.83	I	27817 – 54078
110	3807.93	I	24304 – 50557
180	3815.43	I	21841 – 48042
70	3818.48	I	20524 – 46705
180	3819.56	I	21841 – 48014
70	3823.52	I	7751 – 33897
130	3826.42	I	21848 – 47975
130	3830.03	I	27825 – 53927
380	3841.28	I	21841 – 47866
190	3848.98	I	21841 – 47814
140	3849.36	I	24282 – 50253
290	3850.04	I	21848 – 47814
140	3852.22	I	7811 – 33762
190	3854.22	I	21848 – 47786
110	3855.29	I	21857 – 47788
140	3855.57	I	24282 – 50211
260	3857.63	I	21857 – 47772
70	3874.53	I	24300 – 50102
		I	27825 – 53628
660	3883.29	I	31352 – 57097
50	3883.66	I	24277 – 50019
		I	31355 – 57097
570	3885.22	I	7811 – 33542
380	3886.79	I	8095 – 33816
60	3891.93	I	23934 – 49621
260	3894.04	I	7751 – 33424
40	3897.65	I	
35	3902.11	I	
360	3902.92	I	7927 – 33542
60	3903.16	I	7811 – 33425
960	3908.76	I	8095 – 33672
120 hd	3911.82	I	27729 – 53284
	3912.00	I	27820 – 53375
120	3915.84	I	24282 – 49812
190	3916.24	I	7811 – 33338
35	3917.60	I	23163 – 48682
1900	3919.16	I	8308 – 33816
600	3921.02	I	7927 – 33424
30	3926.65	I	36578 – 62038
600	3928.64	I	8095 – 33542
410	3941.49	I	8308 – 33672
30	3951.10	I	24286 – 49589
40	3952.40	I	24304 – 49598
35	3953.16	I	24300 – 49589
1900	3963.69	I	20520 – 45741
120	3969.06	I	20519 – 45707
1600	3969.75	I	20524 – 45707
85	3971.26	I	21848 – 47022
1600	3976.66	I	20524 – 45663
85	3978.68	I	21841 – 46968
40	3979.80	I	21848 – 46968
85	3981.23	I	21857 – 46968
960	3983.91	I	20521 – 45615
190	3984.34	I	20524 – 45615
160	3989.99	I	31393 – 56449
960	3991.12	I	20517 – 45566
160	3991.67	I	20521 – 45566
190	3992.84	I	21841 – 46878
40	3993.97	I	21848 – 46878
160	4001.44	I	31378 – 56362
120	4012.47	II	45670 – 70585
30	4014.67	I	31378 – 56280
85	4022.26	I	31355 – 56210
70	4025.01	I	20521 – 45359
120	4026.17	I	20524 – 45354
85	4027.10	I	20524 – 45349
85	4030.68	I	31352 – 56155
190	4039.10	I	31048 – 55799
160	4048.78	I	31049 – 55741
120	4058.77	I	31055 – 55686
40	4065.72	I	20524 – 45113
		I	33113 – 57702
85	4066.94	I	21841 – 46422
		I	25039 – 49621
35	4074.86	I	35934 – 60468
40	4076.06	I	33060 – 57587
40	4077.09	I	21848 – 46368
40	4077.68	I	33040 – 57557
40	4104.87	I	20521 – 44875
		I	23934 – 48288
40	4109.58	I	21848 – 46174
40	4120.61	I	21848 – 46109
40	4121.82	I	24056 – 48310
35	4122.16	I	21857 – 46109
40	4123.39	I	24200 – 48446
140	4126.52	I	20519 – 44746
35	4127.30	I	33113 – 57335
40	4127.64	I	21857 – 46077
40	4131.36	I	31009 – 55207
30	4152.78	I	31028 – 55102
120	4153.82	I	20524 – 44591

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
85	4161.42	I	35934 – 59957
140	4163.62	I	20524 – 44534
70	4165.52	I	35884 – 59884
40	4169.84	I	33113 – 57088
35	4170.20	I	33060 – 57033
40	4172.77	I	37234 – 61192
170	4174.80	I	
30	4175.94	I	24286 – 48226
170	4179.26	I	25106 – 49028
35	4184.90	I	24897 – 48786
30	4186.36	I	31049 – 54929
35	4190.13	I	23163 – 47022
85	4191.27	I	20521 – 44373
35	4192.10	I	32097 – 55945
85	4193.66	I	31048 – 54887
70	4194.95	I	31055 – 54887
40	4197.23	I	31048 – 54866
85	4198.52	I	31055 – 54866
60	4203.59	I	20517 – 44300
40	4204.47	I	32097 – 55875
35	4208.36	I	31055 – 54811
110	4209.37	I	31049 – 54799
40	4209.76	I	25038 – 48786
40	4211.35	I	24304 – 48043
40	4216.36	I	24304 – 48014
85	4217.63	I	24282 – 47986
40	4221.57	I	24834 – 48515
		I	31055 – 54737
40	4222.73	I	24300 – 47975
40	4238.96	I	24282 – 47866
60	4240.70	I	24056 – 47630
		I	24940 – 48515
20000	4254.35	I	0 – 23499
70	4255.50	I	24200 – 47693
60	4261.35	I	23499 – 46959
110	4263.14	I	31048 – 54498
30	4271.06	I	25038 – 48445
40	4272.91	I	23386 – 46783
16000	4274.80	I	0 – 23386
85	4280.40	I	31049 – 54405
10000	4289.72	I	0 – 23305
40	4291.96	I	27597 – 50890
85	4295.76	I	21841 – 45113
70	4297.74	I	31055 – 54317
35	4300.51	I	27704 – 50950
50	4301.18	I	27817 – 51060
30	4305.45	I	23305 – 46525
35	4319.64	I	23305 – 46449
60	4325.08	I	23934 – 47048
780	4337.57	I	7811 – 30859
1100	4339.45	I	7927 – 30965
380	4339.72	I	7751 – 30787
60	4340.13	I	21841 – 44875
1900	4344.51	I	8095 – 31106
70	4346.83	I	24056 – 47055
380	4351.05	I	7811 – 30787
2300	4351.77	I	8308 – 31280
570	4359.63	I	7927 – 30859
70	4363.13	I	23934 – 46847
530	4371.28	I	8095 – 30965
		I	35884 – 58755
70	4373.25	I	7927 – 30787
110	4374.16	I	24200 – 47055
70	4375.33	I	24056 – 46905
50	4381.11	I	21848 – 44667
530	4384.98	I	8308 – 31106
60	4387.50	I	24092 – 46878
		I	24200 – 46986
70	4391.75	I	8095 – 30859
60	4403.50	I	32097 – 54800
24	4410.30	I	24300 – 46968
60	4411.09	I	24304 – 46968
35	4412.25	I	8308 – 30965
50	4413.87	I	28637 – 51287
60	4424.28	I	24282 – 46878
24	4428.50	I	24304 – 46878
50	4430.49	I	24282 – 46847
		I	28682 – 51247
50	4432.18	I	23163 – 45719
110	4458.54	I	24282 – 46705
		I	28637 – 51060
30	4459.74	I	24304 – 46720
30	4465.36	I	24300 – 46688
30	4482.88	I	27176 – 49477
40	4488.05	I	24092 – 46368
50	4489.47	I	28682 – 50950
60	4492.31	I	27223 – 49477
660	4496.86	I	7593 – 29825
50	4498.73	I	23512 – 45734
70	4500.30	I	24834 – 47048
50	4501.11	I	23512 – 45722
		I	28679 – 50890
22	4501.79	I	23512 – 45719
24	4506.85	I	33763 – 55945
95	4511.90	I	24897 – 47055
12	4514.37	I	33763 – 55908
35	4514.53	I	23499 – 45643
24	4521.14	I	33763 – 55875
24	4526.11	I	24897 – 46986
380	4526.47	I	20519 – 42606
70 d	4527.34	I	20524 – 42606
	4527.47	I	24092 – 46174
24	4529.85	I	20519 – 42589
380	4530.74	I	20524 – 42589
50	4535.15	I	20521 – 42565
240	4535.72	I	20524 – 42565
40	4539.79	I	20517 – 42539
240	4540.50	I	20521 – 42539
240	4540.72	I	25038 – 47055
35	4541.07	I	20524 – 42539
19	4541.51	I	24834 – 46847
24	4542.62	I	24897 – 46905
140	4544.62	I	20517 – 42515
		I	24300 – 46298
24	4545.34	I	20521 – 42515
600	4545.96	I	7593 – 29585
50	4556.17	I	25106 – 47048
22	4558.66	II	32854 – 54785
19	4564.17	I	38538 – 60441
120	4565.51	I	7927 – 29825
95	4569.64	I	25177 – 47055
120	4571.68	I	20519 – 42387
22	4575.12	I	27176 – 49027
360	4580.06	I	7593 – 29421
24	4586.14	I	25106 – 46905
360	4591.39	I	7811 – 29585
70	4595.59	I	33763 – 55517
50	4600.10	I	20519 – 42252
480	4600.75	I	8095 – 29825
50	4601.02	I	20524 – 42252

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
240		4613.37	I	7751 – 29421
600		4616.14	I	7927 – 29585
70		4619.55	I	24092 – 45734
85		4621.96	I	20524 – 42154
			I	31048 – 52678
70		4622.49	I	28637 – 50264
24		4622.76	I	24092 – 45719
550		4626.19	I	7811 – 29421
24		4632.18	I	28682 – 50264
40		4637.18	I	20521 – 42080
50		4637.77	I	20524 – 42080
50	d	4639.52	I	25089 – 46637
		4639.70	I	28637 – 50184
1600		4646.17	I	8308 – 29825
24		4646.81	I	25011 – 46525
24		4648.13	I	20517 – 42026
24		4648.87	I	20521 – 42026
			I	28679 – 50184
35		4649.46	I	20524 – 42026
			I	28682 – 50184
570		4651.28	I	7927 – 29421
840		4652.16	I	8095 – 29585
35		4654.74	I	24971 – 46449
19		4656.19	I	24897 – 46368
40		4663.33	I	25011 – 46449
70		4663.83	I	25089 – 46525
95		4664.80	I	25206 – 46637
35		4665.90	I	28679 – 50105
22		4666.22	I	23934 – 45358
70		4666.51	I	25360 – 46783
50		4669.34	I	25549 – 46959
40		4680.54	I	25089 – 46449
19		4680.87	I	24940 – 46298
70		4689.37	I	25206 – 46525
60		4693.95	I	24056 – 45354
24		4695.15	I	24056 – 45349
			I	35808 – 57101
60		4697.06	I	21841 – 43125
240	d	4698.46	I	25360 – 46637
		4698.62	I	21848 – 43125
35		4700.61	I	21857 – 43125
190		4708.04	I	25549 – 46783
240		4718.43	I	25772 – 46959
50		4723.10	I	24834 – 46000
50		4724.42	I	24897 – 46058
50		4727.15	I	24200 – 45349
24		4729.72	I	
120		4730.71	I	24834 – 45966
140		4737.35	I	24897 – 46000
19		4745.31	I	21841 – 42908
70		4752.08	I	33763 – 54800
340		4756.11	I	25038 – 46058
50		4764.29	I	28637 – 49621
22		4766.63	I	28679 – 49653
30		4767.86	I	28682 – 49650
190		4789.32	I	20519 – 41393
95		4792.51	I	25106 – 45966
120		4801.03	I	25177 – 46000
110		4829.38	I	20524 – 41225
14		4836.86	I	25038 – 45707
17		4861.20	I	20521 – 41086
70		4861.84	I	20524 – 41086
140		4870.80	I	24834 – 45358
35		4885.78	I	20521 – 40983
19		4885.96	I	24897 – 45358
130		4887.01	I	24897 – 45354
19		4888.53	I	20521 – 40971
35		4903.24	I	20517 – 40906
260		4922.27	I	25038 – 45349
110		4936.33	I	25106 – 45358
70		4942.50	I	7593 – 27820
110		4954.81	I	25177 – 45354
35		4964.93	I	7593 – 27729
60		5013.32	I	21841 – 41782
17		5051.90	I	7593 – 27382
17		5065.91	I	21841 – 41575
40		5067.71	I	21848 – 41575
40		5072.92	I	7593 – 27300
30		5110.75	I	21848 – 41409
17		5113.13	I	21857 – 41409
17		5123.46	I	8308 – 27820
50		5139.65	I	27597 – 47048
14		5144.67	I	21857 – 41289
70		5166.23	I	27704 – 47055
35		5177.43	I	27650 – 46959
70		5184.59	I	27500 – 46783
70		5192.00	I	27382 – 46637
12		5193.49	I	27597 – 46847
85		5196.44	I	21848 – 41086
35		5200.19	I	27300 – 46525
5300		5204.52	I	7593 – 26802
8400		5206.04	I	7593 – 26796
11000		5208.44	I	7593 – 26788
19		5214.13	I	27176 – 46349
30		5221.75	I	27223 – 46368
85		5224.94	I	27825 – 46959
12		5226.89	I	21857 – 40983
19		5238.97	I	21848 – 40930
30		5243.40	I	27382 – 46449
290		5247.56	I	7751 – 26802
60		5254.92	I	27500 – 46525
60		5255.13	I	27935 – 46959
19		5261.75	I	29825 – 48824
530		5264.15	I	7811 – 26802
30		5265.16	I	27650 – 46637
180		5265.72	I	7811 – 26796
35		5272.01	I	27820 – 46783
30		5273.44	I	27825 – 46783
95	h	5275.17	I	23305 – 42256
			I	27223 – 46174
35	h	5275.69	I	23305 – 42255
70	h	5276.03	I	23305 – 42253
19		5280.29	I	27176 – 46109
10		5287.19	I	27729 – 46637
340		5296.69	I	7927 – 26802
70	h	5297.36	I	23386 – 42258
660		5298.27	I	7927 – 26796
85		5300.75	I	7927 – 26788
17		5304.21	I	27935 – 46783
24		5312.88	I	27820 – 46637
24		5318.78	I	27729 – 46525
340	h	5328.34	I	23499 – 42261
70	h	5329.17	I	23499 – 42258
17	h	5329.72	I	23499 – 42256
14		5340.44	I	27729 – 46449
10		5344.76	I	27820 – 46525
780		5345.81	I	8095 – 26796
380		5348.32	I	8095 – 26787
30		5386.98	I	27176 – 45734
22		5387.57	I	27163 – 45719

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
10		5390.39	I	27176 – 45722
40		5400.61	I	27223 – 45734
22		5405.00	I	27223 – 45719
1400		5409.79	I	8308 – 26787
12		5442.41	I	27597 – 45966
19		5463.97	I	27704 – 46000
19		5480.50	I	27817 – 46058
24		5628.64	I	27597 – 45358
7		5642.36	I	31106 – 48824
12	h	5649.37	I	30965 – 48661
24		5664.04	I	27704 – 45354
7	h	5681.20	I	
7	h	5682.48	I	30965 – 48559
24		5694.73	I	31106 – 48661
40		5698.33	I	31280 – 48824
24		5702.31	I	27817 – 45349
12		5712.64	I	36578 – 54078
24		5712.78	I	24282 – 41782
7		5719.82	I	24304 – 41782
7		5746.43	I	28679 – 46077
			I	31048 – 48445
7		5753.69	I	36552 – 53927
12	h	5781.20	I	24282 – 41575
			I	26796 – 44089
6	h	5781.81	I	23934 – 41225
			I	26802 – 44093
24	h	5783.11	I	28679 – 45966
			I	26802 – 44089
30	h	5783.93	I	26796 – 44081
24	h	5785.00	I	26787 – 44069
19	h	5785.82	I	26802 – 44081
60	h	5787.99	I	26796 – 44069
180	h	5791.00	I	26787 – 44051
35		6330.10	I	7593 – 23386
22		6362.87	I	7593 – 23305
19		6661.08	I	33816 – 48824
11		6669.26	I	33672 – 48661
5	h	6881.62	I	27729 – 42256
10	h	6882.38	I	27729 – 42255
21	h	6883.03	I	27729 – 42253
27	h	6924.13	I	27820 – 42258
17	h	6925.20	I	27820 – 42256
30	h	6978.48	I	27935 – 42261
11	h	6979.82	I	27935 – 42258
7		7185.52	I	31393 – 45306
6	h	7236.20	I	41393 – 55209
85		7355.90	I	23305 – 36896
130		7400.21	I	23386 – 36896
150		7462.31	I	23499 – 36896
11	h	7942.04	I	35398 – 47986
5	h	8163.18	I	35398 – 47645
9		8348.28	I	21841 – 33816
6		8450.26	I	21841 – 33672
3		8455.24	I	21848 – 33672
6		8548.86	I	21848 – 33542
40		8947.15	I	25039 – 36212
19		8976.83	I	24898 – 36034

Cobalt

$$\text{Co}, Z=27, M=58.9332, \text{Ratio}\quad \frac{\text{Co}}{\text{Cu}}=0.9274$$

Co I Normal state of valence electrons $3d^7 4s^2\ {}^4F_{4\,1/2}=0$. I.P. $=63430\ \text{cm}^{-1}$.
Co II Normal state of valence electrons $3d^8\ {}^3F_4=0$. I.P. $=137572\ \text{cm}^{-1}$.

References

Wavelengths:

G. R. Harrison, Massachusetts Institute of Technology Wavelength Tables (John Wiley & Sons, New York, 1939).

Supplemented by references for Co I and Co II (below).

Classification:

Co I, H. N. Russell, R. B. King, and C. E. Moore, Phys. Rev. **58**, 407 (1940).

Co II, J. H. Findlay, Phys. Rev. **36**, 5 (1930); N. E. Hager, Jr., unpublished material (1951). R. Velasco and J. Adames, Publ. del Inst. de Optica de Madrid No. **26** (1966).

Strong lines of cobalt

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
21000	3453.50	I	3483 – 32431	5300	2407.25	I	0 – 41529
11000	3405.12	I	3483 – 32842	5300	2411.62	I	816 – 42269
9600	3502.28	I	3483 – 32028	5100	3462.80	I	5076 – 33946
8800	3443.64	I	4143 – 33173	5100	3465.80	I	0 – 28845
8800	3569.38	I	7442 – 35451	4800	2414.46	I	1407 – 42811
8000	3474.02	I	0 – 28777	4800	2415.30	I	1809 – 43200
		I	4690 – 33467	4800	3489.40	I	7442 – 36092
7900	3894.08	I	8461 – 34134	4800	3512.64	I	4690 – 33151
7300	3529.81	I	4143 – 32465	4800	3518.35	I	8461 – 36875
7000	3506.32	I	4143 – 32654	4500	3409.18	I	4143 – 33467
6900	3845.47	I	7442 – 33440	4500	3433.04	I	5076 – 34196
6700	3412.34	I	4143 – 33440	4400	4121.32	I	7442 – 31700
6700	3587.19	I	8461 – 36330	4300	2521.36	I	0 – 39649
6400	3526.85	I	0 – 28346	4100	2286.16	II	3350 – 47078
6000	3995.31	I	7442 – 32465	4100	2424.93	I	0 – 41226
5500	3873.12	I	3483 – 29295	4100	3449.17	I	4690 – 33674

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
1100		2174.60	I	0 – 45971
720		2245.13	II	4029 – 48556
290		2268.17	I	4143 – 48217
260		2274.49	I	0 – 43952
810		2276.53	I	
240		2283.52	II	4029 – 47807
260		2284.85	I	816 – 44568
4100		2286.16	II	3350 – 47078
720		2287.81	I	4143 – 47839
240		2291.46	I	4690 – 48317
290		2292.00	II	17772 – 61388
260		2293.39	II	4561 – 48151
260		2295.23	I	0 – 43555
220		2296.05	I	5076 – 48616
450		2296.71	I	4690 – 48217
190		2303.97	I	3483 – 46873
290		2304.18	I	816 – 44202
360		2305.18	I	816 – 44183
2900		2307.86	II	4029 – 47346
2600		2309.02	I	0 – 43295
1800		2311.60	II	4561 – 47807
1800		2314.05	II	4950 – 48151
1400		2314.98	II	5204 – 48388
430		2316.16	I	1407 – 44568
530		2316.86	I	1407 – 44556
2400		2323.14	I	816 – 43848
810		2324.32	II	4029 – 47039
570		2325.55	I	1407 – 44394
770		2326.14	II	4561 – 47537
770		2326.48	II	3350 – 46321
140		2329.10	II	18338 – 61260
530		2330.35	II	4950 – 47848
1400		2335.99	I	1407 – 44202
670		2337.94	II	
1600		2338.67	I	1809 – 44556
480		2339.05	I	816 – 43555
620		2344.26	II	5204 – 47848
620		2346.16	I	816 – 43426
910		2347.39	II	4950 – 47537
190		2350.28	I	4690 – 47225
140		2351.39	I	1407 – 43922
1600		2352.85	I	3483 – 45971
2000		2353.42	I	816 – 43295
			II	4561 – 47039
620		2355.48	I	1407 – 43848
530		2358.18	I	1809 – 44202
95		2361.53	II	5204 – 47537
1900		2363.79	II	4029 – 46321
960		2365.07	I	0 – 42269
360		2369.68	I	4143 – 46330
240		2370.51	I	816 – 42988
170	h	2371.44	I	17234 – 59389
340		2371.86	I	1407 – 43555
95		2372.83	I	1407 – 43538
140		2373.38	I	
170		2375.18	II	4950 – 47039
220		2377.22	I	5076 – 47129
2000		2378.62	II	3350 – 45379
1400		2380.48	I	816 – 42811
170		2381.75	II	
1800		2383.46	II	4029 – 45972
1400		2384.86	I	0 – 41918
1000		2386.36	II	4561 – 46453
140		2387.46	I	4690 – 46563
3300		2388.92	II	3350 – 45198
670		2389.54	II	4950 – 46786
170		2391.37	I	
240		2392.60	II	22009 – 63792
240		2393.90	II	4561 – 46321
120	h	2397.03	I	
620		2397.39	II	9813 – 51512
60		2400.84	I	4690 – 46330
1100	d	2402.06	I	816 – 42434
		2402.17	I	1809 – 43426
410		2404.17	II	5204 – 46786
120		2406.27	I	4143 – 45688
5300		2407.25	I	0 – 41529
260		2407.67	II	10708 – 52230
310		2408.75	II	4950 – 46453
240		2410.51	I	14036 – 55509
5300		2411.62	I	816 – 42269
1600		2412.76	I	1809 – 43243
95		2413.19	I	5076 – 46502
95		2413.58	I	14399 – 55819
480		2414.06	II	4561 – 45972
4800		2414.46	I	1407 – 42811
4800		2415.30	I	1809 – 43200
140		2416.90	II	11322 – 52684
140		2417.05	I	
1000		2417.65	II	4029 – 45379
670		2419.12	I	
120		2420.73	II	
190		2422.56	I	13796 – 55061
120		2423.62	II	5204 – 46453
4100		2424.93	I	0 – 41226
60		2425.59	I	4690 – 45905
140		2427.00	I	
120		2428.29	II	4029 – 45198
410		2428.60	I	
120		2429.23	I	816 – 41969
3300		2432.21	I	816 – 41918
770		2435.09	I	
720		2435.83	I	0 – 41041
2900		2436.66	I	1407 – 42434
70		2436.98	II	4950 – 45972
2400		2439.05	I	1809 – 42797
530		2441.05	I	17234 – 58187
60		2449.16	II	4561 – 45379
95		2450.00	II	10708 – 51512
240		2456.24	I	3483 – 44183
29		2460.21	I	15184 – 55819
480		2460.81	I	1809 – 42434
60		2462.12	I	13796 – 54399
85		2463.78	I	1407 – 41983
85		2464.20	II	9813 – 50382
50		2464.62	I	1407 – 41969
290		2467.69	I	1407 – 41918
480		2470.28	I	3483 – 43952
120		2473.90	I	816 – 41226
480		2476.64	I	3483 – 43848
430		2483.61	I	4143 – 44394
29		2485.36	II	9813 – 50036
95		2486.44	II	10708 – 50914
70		2493.93	I	8461 – 48546
120		2494.73	I	3483 – 43555
380		2495.55	I	4143 – 44202
380		2496.71	I	4143 – 44183
2200		2511.02	I	3483 – 43295
29	h	2500.50	I	
29		2502.28	I	7442 – 47394

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
570	2504.52	I	3483 – 43399
570	2506.46	II	9813 – 49698
360	2506.88	I	4690 – 44568
290	2507.68	I	4690 – 44556
29	2512.40	II	24075 – 63865
95	2512.90	I	7442 – 47225
120	2513.12	I	4143 – 43922
860	2517.87	I	4690 – 44394
290	2519.82	II	10708 – 50382
4300	2521.36	I	0 – 39649
290	2524.96	II	11322 – 50914
1100	2528.62	II	9813 – 49348
2900	2528.97	I	816 – 40346
720	2530.13	I	4690 – 44202
860	2532.18	I	5076 – 44556
60	2535.36	I	7442 – 46873
2900	2535.96	I	1407 – 40828
860	2536.49	I	4143 – 43555
150	2541.94	II	10708 – 50036
1700	2544.25	I	1809 – 41102
190	2544.86	I	4143 – 43426
23	2546.74	II	24412 – 63665
340	2548.34	I	7442 – 46672
230	2549.30	I	1407 – 40622
230	2553.00	I	4690 – 43848
310	2553.37	I	4143 – 43295
310	2555.07	I	5076 – 44202
190	2556.76	I	4143 – 43243
230	2559.41	II	11322 – 50382
960	2562.15	I	1809 – 40828
310	2564.04	II	10708 – 49698
1100	2567.35	I	1407 – 40346
95	2572.24	I	4690 – 43555
65	2573.40	I	4690 – 43538
75	2573.54	I	4143 – 42988
960	2574.35	I	816 – 39649
35	2574.86	II	13405 – 52230
35	2575.73	I	1809 – 40622
770	2580.33	II	9813 – 48556
120	2580.84	I	4690 – 43426
310	2582.24	II	11322 – 50036
120	2585.34	I	8461 – 47129
310	2587.22	II	10708 – 49348
150	2590.59	I	7442 – 46032
120	2591.69	I	4690 – 43264
75	2594.16	I	1809 – 40346
55	2600.98	I	3483 – 41918
95	2606.12	I	5076 – 43436
40	2610.76	I	4143 – 42434
95	2613.49	II	13261 – 51512
75	2614.13	I	1407 – 39649
150	2614.36	II	17772 – 56011
120	2616.26	I	8461 – 46672
75	2617.86	I	5076 – 43264
95	2622.06	I	4143 – 42269
95	2622.43	I	4690 – 42811
270	2627.64	I	3483 – 41529
130	2632.24	II	18032 – 56011
55	2644.78	I	8461 – 46260
310	2646.42	I	4143 – 41918
770	2648.64	I	3483 – 41226
75	2649.94	I	8461 – 46186
95	2650.27	I	5076 – 42797
150	2663.53	II	9813 – 47346
120	2675.98	I	5076 – 42434
120	2679.76	I	8461 – 45767
170	2685.34	I	4690 – 41918
55	2694.68	II	10708 – 47807
190	2695.85	I	4143 – 41226
55	2705.85	I	13796 – 50742
190	2715.99	I	16468 – 53276
130	2731.12	I	16471 – 53075
65	2740.46	I	7442 – 43922
190	2745.10	I	16778 – 53196
95	2761.37	I	4143 – 40346
190	2764.19	I	3483 – 39649
130	2766.22	I	17234 – 53374
130	2778.82	I	15184 – 51160
40	2796.23	I	5076 – 40828
55	2797.08	I	8461 – 44202
95	2803.77	I	4690 – 40346
150	2815.56	I	4143 – 39649
23	2820.01	I	8461 – 43911
75	2837.15	I	16778 – 52014
55	2850.04	I	8461 – 43538
75	2862.61	I	1407 – 36330
27	2872.50	I	8461 – 43264
190	2886.44	I	816 – 35451
55	2899.82	I	16471 – 50945
27	2903.20	I	16468 – 50903
95	2927.67	I	16778 – 50925
30	2928.81	I	0 – 34134
95	2929.51	I	16468 – 50593
27	2957.68	I	16778 – 50579
690	2987.16	I	0 – 33467
690	2989.59	I	0 – 33440
30	2995.15	I	17234 – 50611
120	3000.55	I	816 – 34134
330	3013.60	I	0 – 33173
690	3017.55	I	816 – 33946
120	3026.37	I	15184 – 48217
55	3034.43	I	1407 – 34352
210	3042.48	I	816 – 33674
3100	3044.00	I	0 – 32842
420	3048.89	I	1407 – 34196
120	3060.05	I	15774 – 48444
1700	3061.82	I	816 – 33467
50	3062.20	I	816 – 33463
65	3064.37	I	816 – 33440
920	3072.34	I	1407 – 33946
540	3082.62	I	0 – 32431
670	3086.78	I	1809 – 34196
270	3089.60	I	816 – 33173
220	3098.20	I	1407 – 33674
270	3121.42	I	0 – 32028
95	3121.57	I	816 – 32842
350	3137.33	I	1809 – 33674
270	3139.94	I	816 – 32654
410	3147.06	I	1407 – 33173
95	3152.71	I	16196 – 47905
410 d	3154.68	I	16471 – 48160
	3154.79	I	15184 – 46873
350	3158.78	I	816 – 32465
130	3177.27	I	
130	3188.37	I	15774 – 47129
95	3219.15	I	816 – 31871
130	3232.87	I	16471 – 47394
220	3243.84	I	15184 – 46003
260	3247.18	I	15184 – 45971
380	3254.21	I	15184 – 45905

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
260	3260.82	I	16471 – 47129
130	3271.78	I	15774 – 46330
510	3283.46	I	16778 – 47225
80	3287.19	I	15774 – 46186
130	3307.15	I	15774 – 46003
190	3314.08	I	14036 – 44202
240	3319.48	I	23612 – 53728
240	3322.20	I	16471 – 46563
190	3325.24	I	16196 – 46260
350	3326.99	I	23612 – 53660
700	3334.14	I	3483 – 33467
190	3339.78	I	23856 – 53789
160	3342.73	I	16778 – 46685
190	3346.94	I	23856 – 53725
110	3348.11	I	16471 – 46330
610	3354.38	I	4143 – 33946
110	3361.56	I	24628 – 54367
110	3362.80	I	24628 – 54356
570	3367.11	I	3483 – 33173
110	3370.33	I	4690 – 34352
110	3373.23	I	18390 – 48026
960	3385.22	I	4143 – 33674
1100	3388.17	I	4690 – 34196
2200	3395.38	I	4690 – 34134
11000	3405.12	I	3483 – 32842
4500	3409.18	I	4143 – 33467
6700	3412.34	I	4143 – 33440
2200	3412.63	I	0 – 29295
510	3414.74	I	5076 – 34352
2700	3417.16	I	4690 – 33946
220	3424.51	I	16778 – 45971
80	3428.23	I	24628 – 53789
2500	3431.58	I	816 – 29949
4500	3433.04	I	5076 – 34196
80	3438.91	I	26450 – 55521
1600	3442.93	I	1407 – 30444
8800	3443.64	I	4143 – 33173
110	3446.09	I	25938 – 54948
4100	3449.17	I	4690 – 33674
2100	3449.44	I	3483 – 32465
21000	3453.50	I	3483 – 32431
1000	3455.23	I	1809 – 30743
110	3456.93	I	816 – 29735
300	3461.18	I	25569 – 54452
5100	3462.80	I	5076 – 33946
5100	3465.80	I	0 – 28845
95	3471.38	I	25569 – 54367
8000	3474.02	I	0 – 28777
		I	4690 – 33467
65	3478.56	I	18390 – 47129
1900	3483.41	I	4143 – 32842
380	3485.37	I	25139 – 53822
4800	3489.40	I	7442 – 36092
95	3490.74	I	4143 – 32782
480	3491.32	I	1809 – 30444
2400	3495.69	I	5076 – 33674
480	3496.68	I	4143 – 32733
9600	3502.28	I	3483 – 32028
570	3502.62	I	1407 – 29949
7000	3506.32	I	4143 – 32654
2900	3509.84	I	4690 – 33173
1400	3510.43	I	816 – 29295
4800	3512.64	I	4690 – 33151
3800	3513.48	I	816 – 29270
4800	3518.35	I	8461 – 36875
1300	3520.08	I	816 – 29216
2700	3521.57	I	3483 – 31871
3800	3523.43	I	5076 – 33449
6400	3526.85	I	0 – 28346
2700	3529.03	I	1407 – 29735
7300	3529.81	I	4143 – 32465
1900	3533.36	I	1809 – 30103
270	3543.26	I	15184 – 43399
95	3548.44	I	13796 – 41969
540	3550.60	I	1407 – 29563
95	3552.99	I	15774 – 43911
95	3558.78	I	4690 – 32782
1100	3560.89	I	5076 – 33151
880	3564.95	I	4690 – 32733
8800	3569.38	I	7442 – 35451
1600	3574.96	I	4690 – 32654
2500	3575.36	I	816 – 28777
50	3578.08	I	18390 – 46330
50 d	3578.90	I	14036 – 41970
	3579.03	I	14036 – 41969
1000	3585.16	I	4143 – 32028
6700	3587.19	I	8461 – 36330
1900	3594.87	I	1407 – 29216
1600	3602.08	I	1809 – 29563
940	3605.36	I	4143 – 31871
210	3611.70	I	18775 – 46455
75	3615.39	I	15774 – 43426
45	3620.43	I	18390 – 46003
40	3624.33	I	14399 – 41983
75	3624.96	I	5076 – 32654
1000	3627.81	I	4143 – 31700
150	3631.39	I	816 – 28346
130	3632.84	I	23184 – 50703
150	3634.71	I	23208 – 50712
75	3636.72	I	15774 – 43264
210	3639.44	I	15774 – 43243
130	3641.79	I	16471 – 43922
150	3643.18	I	16471 – 43911
110	3647.66	I	1809 – 29216
190	3649.35	I	23184 – 50579
680	3652.54	I	1407 – 28777
65	3654.45	I	15774 – 43130
55	3656.97	I	4690 – 32028
280	3662.16	I	18390 – 45688
260	3676.55	I	23184 – 50376
380	3683.05	I	16778 – 43922
75	3684.48	I	16778 – 43911
65	3690.72	I	16468 – 43555
230	3693.11	I	16778 – 43848
230	3693.48	I	16471 – 43538
280	3702.24	I	23208 – 50211
680	3704.06	I	8461 – 35451
55	3707.47	I	16471 – 43436
230	3708.82	I	16471 – 43426
45	3712.18	I	16468 – 43399
23	3726.66	I	13796 – 40622
280	3730.48	I	15184 – 41983
380	3732.40	I	15184 – 41969
190	3733.49	I	16778 – 43555
95	3734.14	I	16471 – 43243
150	3735.93	I	16778 – 43538
1100	3745.50	I	7442 – 34134
110	3749.94	I	16471 – 43130
45	3751.63	I	16778 – 43426
40	3754.35	I	20501 – 47129

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
110		3755.45	I	16778 – 43399
26		3760.39	I	14036 – 40622
55		3774.60	I	16778 – 43264
35		3777.54	I	16778 – 43243
70		3808.11	I	3483 – 29735
70		3814.46	I	15774 – 41983
140		3816.33	I	15774 – 41970
120		3816.47	I	15774 – 41969
60		3841.46	I	7442 – 33467
1400		3842.05	I	7442 – 33463
6900		3845.47	I	7442 – 33440
650		3861.16	I	8461 – 34352
5500		3873.12	I	3483 – 29295
2800		3873.96	I	4143 – 29949
280		3876.84	I	3483 – 29270
790		3881.87	I	4690 – 30444
120		3884.62	I	8461 – 34196
60		3885.29	I	7442 – 33173
28		3892.12	I	20501 – 46186
28	h	3893.07	I	18775 – 44455
7900		3894.08	I	8461 – 34134
550		3894.98	I	5076 – 30743
28		3898.49	I	15184 – 40828
28	h	3904.05	I	28845 – 54452
140		3906.29	I	4143 – 29735
160		3909.93	I	0 – 25569
140		3917.11	I	18390 – 43911
80		3922.75	I	8461 – 33946
30		3925.16	I	21216 – 46685
28	h	3929.25	I	28346 – 53789
30		3933.91	I	4690 – 30103
1500		3935.97	I	7442 – 32842
160		3940.89	I	5076 – 30444
250		3941.73	I	3483 – 28845
210		3945.33	I	7442 – 32782
45		3952.33	I	3483 – 28777
370		3952.92	I	7442 – 32733
210		3957.94	I	4690 – 29949
45		3961.00	I	21216 – 46455
100		3969.12	I	20501 – 45688
80		3972.53	I	28346 – 53512
90		3973.15	I	15184 – 40346
90		3974.73	I	4143 – 29295
28		3977.18	I	18775 – 43911
140		3978.66	I	4143 – 29270
120		3979.52	I	816 – 25938
45		3987.12	I	4143 – 29216
70		3990.30	I	15774 – 40828
70		3991.54	I	29270 – 54316
70		3991.69	I	4690 – 29735
45		3994.54	I	5076 – 30103
6000		3995.31	I	7442 – 32465
970		3997.91	I	8461 – 33467
70		4013.94	I	16196 – 41102
23		4019.30	I	4690 – 29563
350		4020.90	I	3483 – 28346
23		4023.40	I	15774 – 40622
70		4027.04	I	1407 – 26232
90	h	4035.55	I	28845 – 53618
370		4045.39	I	8461 – 33173
60		4052.92	I	28845 – 53512
28		4057.20	I	1809 – 26450
80		4058.19	I	4143 – 28777
80		4058.60	I	16196 – 40828
350		4066.37	I	7442 – 32028
140		4068.54	I	15774 – 40346
280		4086.31	I	15184 – 39649
830		4092.39	I	7442 – 31871
30		4104.75	I	18775 – 43130
550		4110.54	I	8461 – 32782
2800		4118.77	I	8461 – 32733
4400		4121.32	I	7442 – 31700
28		4158.42	I	23184 – 47225
45	h	4162.17	I	28845 – 52864
28		4187.25	I	16471 – 40346
90		4190.71	I	0 – 23856
23		4234.00	I	0 – 23612
60		4252.31	I	816 – 24326
23		4285.79	I	1407 – 24733
23		4331.24	I	27497 – 50579
45		4339.62	I	20501 – 43538
23		4371.13	I	16778 – 39649
23	h	4373.63	I	28346 – 51204
18		4391.57	I	24326 – 47091
23		4417.40	I	24733 – 47365
18		4421.34	I	23612 – 46223
16		4431.62	I	23208 – 45767
18		4445.72	I	25041 – 47528
60		4466.89	I	24326 – 46707
90		4469.56	I	23856 – 46223
35		4471.55	I	24733 – 47091
21		4478.32	I	25041 – 47365
18		4483.93	I	25233 – 47528
16		4494.76	I	28471 – 50712
35		4517.11	I	25233 – 47365
690		4530.96	I	23612 – 45676
70		4533.99	I	25041 – 47091
60		4543.81	I	21920 – 43922
90		4549.66	I	24733 – 46707
140		4565.59	I	24326 – 46223
16	h	4570.02	I	29295 – 51170
16		4580.14	I	7442 – 29270
190		4581.60	I	23856 – 45676
35	h	4594.63	I	29295 – 51053
35	h	4596.90	I	29295 – 51042
14		4623.04	I	25740 – 47365
18	h	4625.78	I	29949 – 51561
120		4629.38	I	24628 – 46223
85		4663.41	I	25269 – 46707
50		4682.38	I	25740 – 47091
45		4693.21	I	26063 – 47365
11		4698.38	I	26250 – 47528
9		4727.94	I	3483 – 24628
7		4734.83	I	26250 – 47365
50		4749.68	I	24628 – 45676
9		4754.36	I	26063 – 47091
11		4768.08	I	25740 – 46707
35		4771.11	I	25269 – 46223
35		4776.32	I	26598 – 47528
50		4780.01	I	26450 – 47365
110		4792.86	I	26232 – 47091
75		4813.48	I	25938 – 46707
100		4840.27	I	25569 – 46223
11		4843.46	I	26450 – 47091
150		4867.88	I	25139 – 45676
14		4882.72	I	26232 – 46707
10		4899.52	I	16471 – 36875
10		5108.89	I	31700 – 51268
17		5122.77	I	29563 – 49078
14		5125.69	I	31700 – 51204

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
17		5126.20	I	29216 – 48719
17		5133.45	I	31700 – 51174
35		5146.74	I	28777 – 48202
17		5154.05	I	31871 – 51268
17		5156.34	I	32733 – 52121
21		5176.08	I	16778 – 36092
50		5212.71	I	28346 – 47524
50		5230.22	I	14036 – 33151
45		5235.21	I	17234 – 36330
50		5247.93	I	14399 – 33449
10		5250.00	I	33674 – 52717
9		5254.65	I	32028 – 51053
17		5257.62	I	32028 – 51042
9		5265.82	I	29216 – 48202
26		5266.30	I	29735 – 48719
45		5266.49	I	16468 – 35451
26		5268.52	I	30103 – 49078
17	h	5276.19	I	33173 – 52121
45	h	5280.65	I	29270 – 48202
9		5283.49	I	33173 – 52095
7		5287.57	I	29295 – 48202
8		5287.81	I	32654 – 51561
26		5301.06	I	13796 – 32654
4		5310.20	I	33946 – 52772
17	h	5312.66	I	33946 – 52764
10		5316.78	I	32465 – 51268
3		5321.72	I	33674 – 52460
15	h	5325.28	I	32431 – 51204
5		5325.95	I	33946 – 52717
21		5331.47	I	14399 – 33151
8		5332.67	I	28777 – 47524
8		5333.65	I	32431 – 51174
8		5334.84	I	32431 – 51170
12	h	5341.33	I	33440 – 52156
50		5342.71	I	32431 – 51143
26		5343.39	I	32465 – 51174
7		5347.49	I	33467 – 52162
7		5349.09	I	33467 – 52156
50		5352.05	I	28845 – 47524
26		5353.48	I	33440 – 52114
14		5359.18	I	33467 – 52121
21	h	5362.77	I	34134 – 52775
35		5369.58	I	14036 – 32654
6		5381.10	I	15774 – 34352
9	h	5381.75	I	34196 – 52772
14	h	5407.51	I	33674 – 52162
7	h	5436.99	I	33173 – 51561
21	h	5444.57	I	32842 – 51204
7		5452.30	I	30743 – 49078
17	h	5454.56	I	32842 – 51170
7		5469.30	I	15184 – 33463
9		5470.46	I	30444 – 48719
9		5477.08	I	29949 – 48202
45		5483.34	I	13796 – 32028
9		5483.96	I	29295 – 47524
8	h	5489.65	I	32842 – 51053
4		5495.67	I	27497 – 45688
12		5523.29	I	18775 – 36875
7	h	5524.98	I	33173 – 51268
17		5530.77	I	13796 – 31871
3		5558.82	I	28471 – 46455
15		5590.73	I	16471 – 34352
6	h	5636.12	I	33463 – 51201
17		5647.22	I	18390 – 36092
3		5659.11	I	16468 – 34134
4		5830.08	I	28777 – 45925
12		5890.48	I	16468 – 33440
12		5915.54	I	17234 – 34134
6		5935.39	I	15184 – 32028
5		5946.49	I	29563 – 46375
7	h	5984.08	I	14036 – 30743
17		5991.88	I	16778 – 33463
9		6000.67	I	29216 – 45877
6	h	6006.36	I	35451 – 52095
6	h	6007.67	I	36330 – 52971
6	h	6049.10	I	36330 – 52857
17		6082.44	I	28346 – 44782
7		6086.65	I	27497 – 43922
12		6093.13	I	14036 – 30444
9		6116.98	I	14399 – 30743
9		6122.65	I	28777 – 45106
12		6189.00	I	13796 – 29949
7		6230.97	I	14399 – 30444
9		6249.51	I	16468 – 32465
6	h	6257.58	I	29949 – 45925
5		6273.03	I	32782 – 48719
17		6282.63	I	14036 – 29949
6		6320.41	I	35451 – 51268
6	h	6347.83	I	35451 – 51200
5		6395.20	I	30743 – 46375
9		6417.82	I	18775 – 34352
5		6429.91	I	17234 – 32782
45		6450.24	I	13796 – 29295
21		6455.00	I	29295 – 44782
8	h	6477.88	I	30444 – 45877
6	h	6490.34	I	16468 – 31871
3		6551.44	I	15184 – 30444
15		6563.42	I	16468 – 31700
7		6595.90	I	29949 – 45106
15		6632.44	I	18390 – 33463
3		6678.81	I	15774 – 30743
11		6771.06	I	15184 – 29949
14		6814.94	I	15774 – 30444
14		6872.40	I	16196 – 30743
3		6937.81	I	21920 – 36330
11		7016.61	I	16196 – 30444
4		7027.81	I	31700 – 45925
21		7052.89	I	15774 – 29949
5		7054.04	I	21920 – 36092
45		7084.99	I	15184 – 29295
4		7113.56	I	31871 – 45925
3		7134.32	I	32733 – 46746
4		7154.71	I	16471 – 30444
4		7159.18	I	32782 – 46746
2		7193.60	I	32028 – 45925
3		7285.28	I	23153 – 36875
3		7354.59	I	15184 – 28777
5		7388.70	I	21920 – 35451
8		7417.38	I	16471 – 29949
5		7457.36	I	31700 – 45106
2		7533.48	I	32654 – 45925
4		7553.99	I	31871 – 45106
1		7564.96	I	39649 – 52864
2		7586.72	I	23153 – 36330
2	h	7590.57	I	16778 – 29949
3	h	7606.30	I	32782 – 45925
3	h	7610.24	I	21216 – 34352
8		7712.68	I	20501 – 33463
2		7734.23	I	33449 – 46375
2		7743.27	I	31871 – 44782

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
5	7838.17	I	32028 – 44782	9		8093.96	I	32431 – 44782
2	7840.05	I	33173 – 45925					
2	7855.85	I	33151 – 45877	2		8116.41	I	32465 – 44782
1	7869.90	I	33173 – 45877	1		8152.11	I	32842 – 45106
1	7871.39	I	33674 – 46375	4		8193.03	I	33674 – 45877
				3		8208.66	I	34196 – 46375
7	7908.71	I	32465 – 45106	9		8372.84	I	32842 – 44782
3	7926.55	I	34134 – 46746					
9	7987.38	I	16778 – 29295	3		8378.39	I	33173 – 45106
13	8007.27	I	33440 – 45925	2	h	8574.57	I	21780 – 33440
3	8022.13	I	33463 – 45925	4		8575.35	I	22475 – 34134
				1		8586.74	I	33463 – 45106
3	8029.26	I	32654 – 45106	3		8589.73	I	33467 – 45106
5	8043.33	I	33946 – 46375					
6	8056.06	I	33467 – 45877	2		8661.09	I	21920 – 33463
1	8066.49	I	34352 – 46746	3		8819.15	I	41529 – 52864

Copper

$$\text{Cu},\ Z = 29,\ M = 63.546,\ \text{Ratio}\ \frac{\text{Cu}}{\text{Cu}} = 1.0000$$

Cu I Normal state of valence electrons $3d^{10}4s\ ^2S_{1/2} = 0$. I.P. = 62317 cm^{-1}.
Cu II Normal state of valence electrons $3d^{10}\ ^1S_0 = 0$. I.P. = 163666 cm^{-1}.

References

Wavelengths and Classification:
Cu I, A. G. Shenstone, Phil. Trans. Roy. Soc. (London) [A] **241**, 297 (1948).
Cu II, A. G. Shenstone, Phil. Trans. Roy. Soc. (London) [A] **235**, 195 (1936).

Copper—all observed lines

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
5500		1999.69	II	21929 – 71920
2400		2024.34	I	0 – 49383
1600		2035.84	II	23998 – 73102
2200		2037.12	II	22847 – 71920
3800		2043.79	II	21929 – 70842
650		2112.09	II	26265 – 73596
2000		2135.98	II	21929 – 68731
700		2138.53	I	11203 – 57949
1400		2165.09	I	0 – 46173
1800		2178.94	I	0 – 45879
1200		2181.72	I	0 – 45821
360		2192.26	II	22847 – 68448
1700	d	2199.58	I	11203 – 56651
		2199.75	I	13245 – 58691
550		2214.58	I	11203 – 56344
460		2225.70	I	0 – 44916
950		2227.78	I	13245 – 58119
1200		2230.08	I	11203 – 56030
400		2247.00	II	21929 – 66419
280		2293.84	I	11203 – 54784
50		2369.89	II	26265 – 68448
70		2441.64	I	0 – 40944
360		2492.15	I	0 – 40114
400		2618.37	I	11203 – 49383
50		2700.96	II	73353 – 110366
80		2766.37	I	13245 – 49383
500		2824.37	I	11203 – 46598
50		2882.93	I	11203 – 45879
240		2961.16	I	11203 – 44963
40		2997.36	I	13245 – 46598
70		3010.84	I	11203 – 44406
60		3036.10	I	13245 – 46173
40		3063.41	I	13245 – 45879
25		3093.99	I	11203 – 43514
80		3194.10	I	13245 – 44544
25		3208.23	I	13245 – 44406
50000		3247.54	I	0 – 30784
25000		3273.96	I	0 – 30535
40		3279.82	I	13245 – 43726
80		3307.95	I	40909 – 71131
70		3337.84	I	11203 – 41153
35		3599.13	I	43514 – 71291
35		3602.03	I	43514 – 71268
20	h	4022.63	I	30535 – 55388
40		4275.11	I	39019 – 62403
20		4530.78	I	30784 – 52849
80		4651.12	I	40909 – 62403
400		5105.54	I	11203 – 30784
200		5153.24	I	30535 – 49935
240		5218.20	I	30784 – 49942
40		5220.07	I	30784 – 49935
40	h	5292.52	I	43514 – 62403
100		5700.24	I	13245 – 30784
400		5782.13	I	13245 – 30535
200		7933.13	I	30535 – 43137
400		8092.63	I	30784 – 43137

Dysprosium

Dy, $Z = 66$, $M = 162.5$, Ratio $\frac{\text{Dy}}{\text{Cu}} = 2.557$

Dy I Normal state of valence electrons $4f^{10}6s^2\ {}^5I_8 = 0$. I.P. = 47810 cm^{-1}
Dy II Normal state of valence electrons $4f^{10}6s\ {}^6I_{81/2} = 0$. I.P. = 94100 cm^{-1}.

References

Wavelengths:
J. G. Conway and E. F. Worden, Univ. Cal. Rad. Lab., UCRL–19944 (1970).

Spectrum Assignments:
A. S. King, Astrophys. J. **72**, 221 (1930).
A. S. King and C. E. Moore, Astrophys. J. **98**, 33 (1943).
A. S. King, unpublished material (1956).
J. G. Conway and E. F. Worden, Univ. Cal. Rad. Lab., UCRL–19944 (1970).

Classification:
J. G. Conway and E. F. Worden, J. Opt. Soc. Am. **61**, 704 (1971).
J. F. Wyart, Thesis, Univ. Paris-Sud, Orsay (1973).

Molecular Spectra:
DyO, A. Gatterer, J. Junkes and E. W. Salpeter, Molecular Spectra of Metallic Oxides (Specola Vaticana, Vatican, 1957).

Strong lines of dysprosium

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
22000	3531.70	II	0 – 28306	4400	3523.98	II	4341 – 32709
16000	4211.72	I	0 – 23736	4400	3534.96	II	828 – 29109
14000	3968.39	II	0 – 25192	4400	3538.52	II	0 – 28252
12000	4045.97	I	0 – 24708	4400	3550.22	II	4755 – 32914
12000	4186.82	I	0 – 23877	4400	3576.24	II	4755 – 32709
11000	3645.40	II	828 – 28252	4400	4218.09	I	4134 – 27834
10000	3944.68	II	0 – 25343	4400	4221.11	I	4134 – 27817
8000	4000.45	II	828 – 25818	4000	3630.24	II	4341 – 31879
7400	4077.96	II	828 – 25343	3900	4103.30	II	828 – 25192
7000	3872.11	II	0 – 25818	3800	3393.57	II	828 – 30287
6800	4194.84	I	0 – 23832	3800	3445.57	II	0 – 29014
5800	3898.53	II	4755 – 30399	3700	4215.16	I	0 – 23717
5700	4167.97	I	0 – 23985	3300	3585.06	II	0 – 27885
5500	3536.02	II	4341 – 32613	3300	3786.18	II	828 – 27232
5300	3385.02	II	828 – 30361	2700	3454.32	II	828 – 29769
5300	3407.80	II	0 – 29336	2700	3978.57	II	7463 – 32591
4700	3694.81	II	828 – 27885	2700	4225.16	I	7050 – 30711
4700	3757.37	II	828 – 27435	2500	4073.12	II	4341 – 28885
4400	3460.97	II	0 – 28885	2300	3836.50	II	4341 – 30399
4400	3494.49	II	828 – 29436				

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
260	2356.91	II	
65	2381.95		
130	2387.36	II	
150	2392.15		
180	2402.29	II	
240	2410.01	II	
150	2422.75	II	
260	2439.84	II	
90	2455.15	II	828 – 41546
110	2459.99	II	
90	2471.40	II	
110	2480.93	II	
170	2490.61	II	
90	2510.31	II	
170	2513.55	II	
170	2517.61	II	0 – 39708
130	2543.81	II	
90	2545.12	II	4763 – 44043
150	2552.29	II	
180	2557.94	II	828 – 39910
90	2560.21	II	
90	2566.25	II	
220	2585.30	I	
90	2591.56	II	
75	2592.54	II	
130	2600.16	II	12336 – 50783
130	2600.76	II	
75	2608.69	II	
370	2623.69	I	0 – 38102
440	2634.80	II	0 – 37942
110	2642.15	I	0 – 37836
110	2645.35	II	
110	2667.94	I	0 – 37471
55	2676.84	II	
50	2677.34	II	12336 – 49675
85	2689.31	II	13610 – 50783
85	2692.83	II	10594 – 47718
55	2709.01	II	0 – 36902
55	2727.17	II	11394 – 48052
85	2729.50	II	
55	2735.79	I	
40	2739.30	II	12336 – 48831
85	2740.70	II	
220	2755.75	II	
55	2757.08	II	10594 – 46853
70	2766.50	II	13408 – 49544
70	2772.42	II	0 – 36058
110	2772.61	II	828 – 36884
40	2779.58	II	17036 – 53002
55	2791.44	II	11394 – 47208
120	2800.33	II	12336 – 48035
110	2800.53	II	11394 – 47091
110	2801.41	II	12336 – 48022
85	2810.85	II	0 – 35565
50	2811.09	II	14895 – 50457
85	2811.42	II	828 – 36387
55	2815.22	II	
300	2816.39	II	0 – 35495
140	2825.42	II	4763 – 40146
55	2828.37	II	828 – 36173
50 d	2835.12	II	12336 – 47597
	2835.29	II	
55	2837.00	II	
55	2837.61	II	828 – 36058
55	2842.04	II	828 – 36003
70	2848.93	I	
85	2856.42	II	
17	2857.01	II	15530 – 50521
40	2857.11	II	
50	2859.72	II	
55	2860.17	II	4341 – 39293
70	2860.67	II	
140	2862.70	I	0 – 34921
85	2866.26	II	13610 – 48489
70	2867.62	II	11394 – 46256
28	2869.82	II	
95	2876.39	II	12336 – 47091
190	2877.88	II	828 – 35565
85	2878.70	II	
85	2881.06	II	15822 – 50521
110	2884.28	II	4755 – 39416
70	2884.81	II	
120	2885.53	I	4134 – 38779
70	2890.44	II	15822 – 50408
120	2890.74	II	
70	2891.02	II	
120	2900.82	II	4341 – 38804
110	2904.62	II	4341 – 38758
190	2906.39	II	0 – 34396
70	2909.37	II	
35	2909.69	II	12336 – 46694
35	2909.88	II	
35	2913.74	II	13408 – 47718
390	2913.95	II	0 – 34307
70	2918.65	II	
70	2927.06	II	12336 – 46490
70	2931.00	II	13610 – 47718
110	2934.31	II	
250	2934.52	II	14421 – 48489
110	2941.05	II	15822 – 49813
140	2944.56	II	10594 – 44545
85	2946.31	II	828 – 34759
95	2946.77	II	4341 – 38266
150	2947.06	II	11394 – 45317
150	2947.21	II	12336 – 46256
250	2948.31	II	10594 – 44501
170	2950.33	II	12336 – 46220
110	2952.12	II	828 – 34692
55	2953.03	II	7463 – 41317
140	2953.70	II	
85	2957.75	II	13408 – 47208
85	2962.36	II	13610 – 47357
220	2964.60	I	0 – 33721
55	2964.74	II	
40	2975.55	II	13610 – 47208
85	2975.85	II	14895 – 48489
110	2977.42	II	0 – 33576
50	2979.65	II	19451 – 53002
110	2985.97	II	10594 – 44074
35	2987.88	II	15530 – 48988
50	2988.71	II	16601 – 50051
70	2989.77	II	12336 – 45773
85	2991.36	II	16260 – 49680
70	2991.61	II	11394 – 44812
55	2992.41	II	12674 – 46082
50	2995.43	II	4755 – 38130
85	3002.38	II	10594 – 43891
110	3003.76	II	828 – 34110
55	3008.81	II	16875 – 50101
140	3015.07	II	14895 – 48052

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
220	3015.68	II	11394 – 44545
180	3016.95	II	
170	3025.59	II	4341 – 37382
390	3026.16	II	0 – 33035
85	3027.56	II	12336 – 45356
210	3029.81	II	
110	3030.40	II	828 – 33817
85	3031.15	II	17036 – 50017
	3031.19	II	16875 – 49856
95	3033.19	II	15530 – 48489
120	3036.70	II	
610	3038.28	II	12336 – 45240
50	3042.09	II	
280	3043.13	II	17606 – 50457
170	3043.43	II	13408 – 46256
70	3044.54	II	20166 – 53002
55	3046.38	II	
210	3047.56	II	12336 – 45139
150	3049.12	II	12336 – 45123
180	3051.45	II	4755 – 37517
180	3052.32	II	20985 – 53738
95	3056.96	II	14895 – 47597
85	3059.47	II	14347 – 47023
110	3060.02	II	14421 – 47091
280	3060.64	II	
120	3061.36	II	9432 – 42087
85	3061.49	II	11394 – 44049
110	3062.18	II	15822 – 48469
390	3062.62	II	12674 – 45317
220	3066.99	II	14347 – 46943
85	3070.46	II	
330	3071.91	II	4341 – 36884
280	3073.54	II	
55	3075.18	II	
110	3076.89	II	828 – 33319
140	3078.33	II	12336 – 44812
220	3078.68	II	10594 – 43066
150	3079.33	II	12674 – 45139
95	3080.92	II	12674 – 45123
140	3082.51	II	4755 – 37187
85	3084.68	II	10594 – 43002
120	3093.10	II	4755 – 37076
95	3093.82	II	14895 – 47208
120	3095.74	II	13408 – 45701
280	3101.93	II	16260 – 48489
220	3103.24	II	4755 – 36970
190	3103.83	II	12336 – 44545
180	3104.99	II	14895 – 47091
410	3109.76	II	10594 – 42741
85	3110.75	II	12674 – 44812
50	3117.50	II	15530 – 47597
190	3120.18	II	9432 – 41472
170	3126.20	II	12674 – 44653
330	3128.41	II	10594 – 42550
830	3135.38	II	10594 – 42478
360	3140.64	II	13408 – 45240
500	3141.14	II	0 – 31826
140	3142.30	II	14347 – 46161
95	3143.18	II	18978 – 50783
220	3143.83	II	14895 – 46694
140	3145.22	II	828 – 32613
250	3146.16	II	15822 – 47597
120	3147.53	II	16260 – 48022
120	3151.89	II	4341 – 36058
100	3152.22	II	
120	3152.37	II	12336 – 44049
100	3153.31	II	
1200	3156.52	II	11394 – 43066
65	3157.55	II	14421 – 46082
120	3160.50	II	4755 – 36387
110	3161.03	II	
670	3162.83	II	11394 – 43002
100 d	3164.04	II	
	3164.13	II	
120	3167.40	II	
80 h	3167.76	II	18121 – 49680
80	3168.15	II	12336 – 43891
100	3168.95	I	0 – 31547
1000	3169.99	II	0 – 31536
180	3170.75	II	13610 – 45139
80	3170.97	II	4755 – 36282
65	3171.47	II	13610 – 45132
130	3174.88	II	11394 – 42883
400	3177.89	II	16260 – 47718
220	3178.37	II	828 – 32281
80	3181.94	II	4755 – 36173
65	3183.19	II	
80 d	3184.19	II	
200	3184.79	II	828 – 32218
330	3186.38	II	12674 – 44049
240	3187.68	II	14895 – 46256
65	3188.66	II	14421 – 45773
65	3192.97	II	17036 – 48346
330	3193.30	II	0 – 31306
130	3205.46	II	14895 – 46082
240	3206.40	II	16881 – 48059
80	3206.64	II	16875 – 48052
220	3207.12	II	14895 – 46066
290	3208.85	II	4341 – 35495
130	3212.04	II	14421 – 45545
80	3212.44	II	
80	3212.68	II	15530 – 46647
190	3214.63	II	
470	3215.19	II	13408 – 44501
830	3216.63	II	16881 – 47960
80	3217.38	II	
160	3220.46	II	13610 – 44653
240	3221.49	II	17036 – 48069
170	3221.64	II	7463 – 38495
290	3223.28	II	12674 – 43689
240	3225.08	II	828 – 31826
330	3225.95	II	10594 – 41583
80	3226.07	II	18549 – 49537
140	3226.38	II	17036 – 48022
170	3228.97	II	16015 – 46976
170	3229.36	II	15822 – 46779
110	3229.94	II	4755 – 35707
140	3232.64	II	4341 – 35266
490	3235.89	II	0 – 30894
290	3236.69	II	828 – 31715
140	3240.86	II	20793 – 51640
100 h	3243.72	II	14421 – 45241
	3243.78	II	
490	3245.12	II	14895 – 45701
200	3248.36	II	14347 – 45123
90	3250.99	II	7463 – 38214
1200	3251.27	II	10953 – 41702
170	3251.90	II	11394 – 42137
200	3252.19	II	17606 – 48346
80	3253.91	II	18121 – 48844

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
80	3254.48	II	14421 – 45139
290	3256.26	II	14421 – 45123
80	3257.37	II	15530 – 46220
170	3260.02	II	13408 – 44074
140	3260.70	II	9432 – 40091
140	3261.21	II	20985 – 51640
170	3266.00	II	19492 – 50101
	3266.02	II	4755 – 35365
200	3266.21	II	
240	3269.11	II	0 – 30580
80	3272.09	II	15530 – 46082
200	3272.73	II	12336 – 42883
120	3275.93	II	10594 – 41111
100	3279.45	II	18978 – 49462
160	3279.70	II	16875 – 47357
890	3280.09	II	828 – 31306
80	3281.65	II	13610 – 44074
490	3282.77	II	
100	3282.89	II	4755 – 35207
80	3284.36	II	13610 – 44049
90	3286.57	II	4341 – 34759
200	3287.94	II	12336 – 42741
130	3288.62	II	0 – 30399
100	3291.12	II	
200	3293.88	II	17007 – 47357
200	3296.30	II	12674 – 43002
130	3297.60	II	20467 – 50783
80	3300.92	II	19251 – 49537
200	3305.40	II	14895 – 45139
200	3305.51	II	15530 – 45773
240	3306.19	II	17596 – 47833
440	3308.79	II	12336 – 42550
1100	3308.88	II	10594 – 40807
100	3310.97	II	
510	3312.72	II	4341 – 34519
120	3313.31	II	19956 – 50129
780	3316.32	II	828 – 30973
240	3317.12	II	7485 – 37623
100	3318.13	II	4755 – 34884
1000	3319.88	II	0 – 30112
270	3326.19	II	4341 – 34396
90 d	3326.42	II	20467 – 50521
	3326.52	II	
130	3327.08	II	
80	3327.30	II	16601 – 46647
90	3328.80	II	7485 – 37517
100	3331.27	II	10594 – 40604
130	3334.14	II	9432 – 39416
65	3334.45	II	19251 – 49233
190	3339.51	II	4755 – 34691
780	3341.00	II	10594 – 40516
130	3341.44	II	828 – 30747
270	3341.88	II	4341 – 34255
200	3347.83	II	10594 – 40455
270	3352.69	II	16875 – 46694
510	3353.58	II	828 – 30638
120	3355.06	II	18549 – 48346
190	3356.21	II	I5530 – 45317
130	3358.30	II	4755 – 34524
190	3358.60	II	0 – 29765
240	3359.46	II	14895 – 44653
90	3360.65	II	
130	3365.81	II	14347 – 44049
510	3368.11	II	0 – 29681
160	3370.85	II	13408 – 43066
160	3371.69	II	14895 – 44545
160	3371.81	II	9432 – 39081
130	3372.78	II	17007 – 46647
90	3374.29	II	14421 – 44049
180	3375.74	II	12674 – 42289
90	3376.00	II	7463 – 37076
180	3376.37	II	4341 – 33950
130	3376.62	II	14895 – 44501
160	3377.10	II	7463 – 37066
90	3378.21	II	15530 – 45123
180	3378.42	II	7485 – 37076
100	3378.88	II	10953 – 40541
90	3381.54	II	10594 – 40158
100 h	3384.09	II	14126 – 43668
5300	3385.02	II	828 – 30361
210	3386.57	II	18549 – 48069
610	3388.85	II	4755 – 34256
100	3389.44	II	15822 – 45317
140 d	3391.16	II	
210	3391.96	II	18549 – 48022
90	3393.36	II	4755 – 34216
3800	3393.57	II	828 – 30287
140	3393.98	II	13610 – 43066
1300	3396.16	II	0 – 29436
90	3398.32	II	
90	3399.36	II	12674 – 42083
110	3402.01	I	9990 – 39376
140	3403.24	II	
110	3403.43	II	18678 – 48052
210	3404.99	II	9870 – 39231
270	3405.65	II	4755 – 34110
110 h	3406.76	II	16875 – 46220
	3406.82	II	
380	3407.16	II	7463 – 36805
5300	3407.80	II	0 – 29336
420	3408.14	II	13408 – 42741
100	3409.46	II	
140	3410.71	II	10953 – 40264
110	3411.22	II	
110	3411.52	II	9870 – 39175
1300	3413.78	II	828 – 30112
530	3414.82	II	4341 – 33616
120	3415.71	II	14421 – 43689
270	3417.13	II	10953 – 40209
270	3418.10	II	12336 – 41583
780	3419.63	II	7485 – 36719
90	3420.79	I	4134 – 33358
160	3421.31	II	17036 – 46256
130	3422.60	II	11394 – 40604
270	3422.86	II	16875 – 46082
110	3423.23	II	9432 – 38635
90 h	3423.82	II	
	3423.91	II	
530	3425.06	II	4341 – 33529
90	3425.40	II	
110 h	3428.99	II	17007 – 46161
420	3429.44	II	9870 – 39021
270	3431.79	II	13610 – 42741
220	3432.58	II	4341 – 33465
130	3432.86	II	11394 – 40516
1900	3434.37	II	0 – 29109
90	3435.26	II	9870 – 38972
130	3435.60	II	
130	3436.09	II	19251 – 48346
90	3436.92	II	17606 – 46694

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
330		3438.94	II	13408 – 42478
130		3439.33	II	
90		3440.45	II	18978 – 48035
560		3440.93	II	I6881 – 45934
1300		3441.45	II	828 – 29877
55		3442.50	II	18678 – 47718
55		3442.55	II	
90		3443.48	II	20985 – 50017
130		3444.25	II	9432 – 38457
3800		3445.57	II	0 – 29014
830		3446.99	II	7463 – 36466
170		3447.26	II	14421 – 43422
170		3447.73	II	14895 – 43891
440		3449.89	II	4341 – 33319
110		3450.22	II	
2700		3454.32	II	828 – 29769
440		3454.51	II	13610 – 42550
1300		3456.56	II	4755 – 33677
110		3458:98	II	7485 – 36387
220		3460.40	II	9432 – 38322
110		3460.66	II	9870 – 38758
4400		3460.97	II	0 – 28885
90		3461.31	II	20793 – 49675
190		3463.34	II	7485 – 36350
200		3463.87	II	4755 – 33616
90		3467.86	II	
720		3468.43	II	9432 – 38255
90		3468.78	II	
130		3470.19	II	22908 – 51716
560		3471.14	II	7463 – 36264
560	d	3471.53	II	7485 – 36282
		3471.60	II	7463 – 36260
380		3473.70	II	7485 – 36264
220		3474.27	II	12336 – 41111
1300		3477.07	II	4755 – 33507
90		3477.93	II	20793 – 49537
90		3478.48	II	11801 – 40541
90		3480.42	II	9432 – 38156
220		3480.81	II	
110		3482.10	II	7463 – 36173
220		3484.68	II	7485 – 36173
190		3485.92	II	13610 – 42289
130		3487.20	II	15979 – 44647
170		3487.57	II	17036 – 45701
		3487.60	II	20166 – 48831
110		3488.99	II	10953 – 39607
130		3490.65	II	16601 – 45241
220		3494.13	II	22172 – 50783
4400		3494.49	II	828 – 29436
560		3496.34	II	7463 – 36057
90		3497.13	II	9870 – 38457
400		3497.81	II	14421 – 43002
830		3498.71	II	4341 – 32914
220		3498.93	II	7485 – 36057
140	d	3499.86	II	14347 – 42911
		3499.96	II	4755 – 33319
400		3501.50	II	4755 – 33306
220		3501.86	II	
220		3502.14	II	10953 – 39499
270		3503.17	II	7463 – 36001
830		3504.53	II	9432 – 37958
830		3505.45	II	7485 – 36003
270		3505.84	II	
1300		3506.81	II	828 – 29336
290		3511.68	II	21134 – 49603
290		3512.56	II	1442I – 42883
290		3512.70	II	17606 – 46066
560		3517.26	II	10953 – 39377
110		3519.76	II	
190		3521.16	II	
90		3522.28	II	10953 – 39336
290		3522.86	II	7463 – 35841
4400		3523.98	II	4341 – 32709
170		3524.63	II	9432 – 37795
90		3524.93	II	15530 – 43891
270		3525.74	II	10953 – 39308
130		3526.64	II	10953 – 39301
190		3526.90	II	11801 – 40146
55		3528.90	II	12674 – 41004
200		3529.03	II	0 – 28328
22000		3531.70	II	0 – 28306
140		3534.45	II	16260 – 44545
4400		3534.96	II	828 – 29109
5500		3536.02	II	4341 – 32613
290		3536.58	II	12336 – 40604
290		3537.66	II	9870 – 38130
4400		3538.52	II	0 – 28252
400		3539.37	II	4755 – 33001
110		3539.64	II	7485 – 35728
160		3540.69	II	11801 – 40036
1700		3542.33	II	7463 – 35685
90		3542.86	II	19183 – 47401
400		3544.20	II	9870 – 38078
400		3544.35	II	9432 – 37637
1400		3546.83	II	828 – 29014
110		3547.58	II	10953 – 39134
90		3547.91	II	17596 – 45773
330		3548.19	II	13408 – 41583
140		3548.72	II	14895 – 43066
130		3549.25	II	12674 – 40841
4400		3550.22	II	4755 – 32914
190		3551.15	II	
2200		3551.62	II	4755 – 32903
90		3553.2I	II	16601 – 44737
130		3555.97	II	18978 – 47091
110		3557.62	II	18678 – 46779
440	h	3558.23	II	9432 – 37527
440		3559.30	II	9870 – 37958
290		3560.14	II	7485 – 35565
2200		3563.15	II	828 – 28885
560		3563.69	II	
220		3564.24	II	
90		3565.69	II	11801 – 39838
200		3569.66	II	0 – 28005
100		3571.44	I	4134 – 32126
90		3571.67	II	11801 – 39791
780		3573.83	II	13610 – 41583
1400		3574.15	II	7463 – 35434
110		3576.00	II	828 – 28784
4400		3576.24	II	4755 – 32709
90		3576.58	II	20517 – 48469
1700		3576.87	II	7485 – 35434
830		3577.98	II	4341 – 32281
160		3579.11	II	9432 – 37363
90		3579.44	II	22854 – 50783
440		3580.04	II	9870 – 37795
190		3582.02	II	19492 – 47401
400		3584.42	II	11801 – 39691
3300		3585.06	II	0 – 27885
1400		3585.78	II	7485 – 35365

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
560	3586.11	II	4341 – 32218
360	3590.07	II	14895 – 42741
290	3590.66	II	12674 – 40516
1100	3591.41	II	
560	3591.81	II	10594 – 38427
560	3592.11	II	7463 – 35294
100	3593.16	II	4755 – 32578
220	3594.56	I	7565 – 35377
1800	3595.04	II	10594 – 38402
160	3595.28	II	11801 – 39607
400	3596.06	II	9870 – 37671
100	3596.48	II	9432 – 37229
220	3597.28	I	12892 – 40683
110	3597.94	II	14126 – 41912
110	3598.26	II	7485 – 35268
110	3599.04	II	16875 – 44653
100	3599.56	II	22083 – 49856
180	3600.25	II	9432 – 37199
560	3600.38	II	9870 – 37637
360	3602.82	II	11801 – 39549
140	3603.16	II	7485 – 35230
90	3604.34	I	
1800	3606.12	II	7485 – 35207
100	3606.38	II	17596 – 45317
130	3606.90	II	21272 – 48988
110	3609.25	II	11801 – 39499
110	3611.23	I	7565 – 35249
290	3612.78	II	
220	3613.08	II	16875 – 44545
290	3614.07	II	14421 – 42083
100	3614.70	II	9870 – 37527
100	3614.95	II	14895 – 42550
130	3616.08	II	9870 – 37517
110	3616.37	II	9432 – 37076
130	3617.20	II	4341 – 31978
110	3617.63	II	9432 – 37066
100	3617.78	II	17606 – 45240
290	3618.10	II	16260 – 43891
440	3618.51	II	828 – 28456
160	3619.45	II	14126 – 41747
200	3619.98	II	17036 – 44653
560	3620.16	II	11801 – 39416
100	3620.58	II	7463 – 35075
470	3624.27	II	14895 – 42478
1100	3629.42	II	11394 – 38939
4000	3630.24	II	4341 – 31879
220	3630.48	II	7463 – 35000
110	3630.60	II	
440	3632.78	II	12674 – 40194
220	3633.02	II	18549 – 46066
110	3633.76	II	9870 – 37382
90	3634.18	II	17036 – 44545
110	3634.32	II	11801 – 39308
400	3635.27	II	11801 – 39301
180	3636.25	II	9870 – 37363
360	3637.28	II	4341 – 31826
220	3639.90	II	
1100	3640.25	II	4755 – 32218
90	3640.83	II	26279 – 53738
400	3643.92	II	0 – 27435
11000	3645.40	II	828 – 28252
360	3645.86	II	7463 – 34884
180	3646.61	II	11801 – 39215
160	3646.89	I	4134 – 31547
180	3648.46	II	7463 – 34864
1000	3648.78	II	13408 – 40807
110	3654.18	II	9870 – 37229
130	3654.88	II	15530 – 42883
110	3655.62	I	8519 – 35866
160	3661.78	II	10953 – 38255
700	3664.62	II	11801 – 39081
190	3665.23	II	16881 – 44156
400	3666.84	I	7565 – 34829
150	3668.90	II	7463 – 34712
150	3671.69	II	7463 – 34691
990	3672.30	II	10594 – 37817
420	3672.70	II	
400	3673.14	II	0 – 27216
1400	3674.08	II	0 – 27209
230	3674.45	I	4134 – 31341
120	3676.02	II	9870 – 37066
2200	3676.59	II	828 – 28019
640	3678.51	I	7565 – 34742
820	3684.85	I	
1300	3685.78	I	7565 – 34689
120	3688.36	II	18978 – 46082
160	3693.87	I	11673 – 38737
140	3694.42	II	7463 – 34524
4700	3694.81	II	828 – 27885
140	3696.95	II	24967 – 52008
370	3697.31	II	7485 – 34524
990	3698.21	II	11394 – 38427
230	3700.58	II	
540	3701.63	II	11394 – 38402
330	3707.40	II	4341 – 31306
440	3707.57	II	828 – 27792
440	3708.22	II	4755 – 31715
120	3708.36	II	
420	3710.07	II	4755 – 31701
120	3710.74	II	10953 – 37895
330	3711.66	II	9870 – 36805
160	3713.84	II	9432 – 36350
110	3715.31	II	9432 – 36340
95	3715.57	II	13610 – 40516
160	3716.94	II	16016 – 42911
95	3717.28	I	
80	3718.14	II	
1600	3724.45	II	4341 – 31183
95	3725.94	I	9990 – 36822
300	3728.00	I	9990 – 36807
120	3730.67	I	
930	3739.34	I	12892 – 39627
110	3739.86	II	7485 – 34216
1200	3747.82	II	828 – 27502
130	3750.32	II	14347 – 41004
160	3751.80	II	7463 – 34110
1400	3753.51	II	0 – 26634
1400	3753.75	II	4341 – 30973
95	3754.81	II	9432 – 36057
1200	3757.05	I	7565 – 34174
4700	3757.37	II	828 – 27435
95	3758.99	II	9870 – 36466
640	3767.63	I	8519 – 35053
330	3771.11	I	13495 – 40005
95	3771.35	I	12007 – 38515
160	3772.64	I	9990 – 36490
640	3773.05	I	9990 – 36487
230	3773.30	II	14347 – 40841
70	3773.77	I	
370	3774.71	I	8519 – 35003

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
95	3776.92	II	9870 – 36340
220	3777.43	I	14367 – 40833
95	3779.03	II	11801 – 38255
150	3779.23	II	13338 – 39791
95	3780.31	I	12007 – 38452
95	3780.94	I	12655 – 39096
420	3781.47	I	12007 – 38444
190	3782.87	II	4755 – 31183
150	3783.60	II	11394 – 37817
150	3783.94	I	10088 – 36508
330	3785.41	II	9432 – 35841
3300	3786.18	II	828 – 27232
120	3786.83	I	13495 – 39895
130	3787.26	II	13338 – 39735
1600	3788.44	II	828 – 27216
700	3791.87	II	828 – 27193
120	3801.93	II	17596 – 43891
510	3804.14	II	0 – 26279
120	3804.35	I	12007 – 38285
580	3806.27	II	12674 – 38939
110	3807.90	II	9432 – 35685
280	3809.02	II	10953 – 37199
210	3809.82	I	7565 – 33806
180	3809.97	II	4341 – 30580
470	3812.27	I	8519 – 34742
160	3813.10	II	4755 – 30973
470	3813.67	II	7463 – 33677
230	3816.21	I	13495 – 39692
1400	3816.76	II	7485 – 33677
190	3817.53	I	7565 – 33753
120	3818.75	II	13338 – 39517
120	3819.44	I	
95	3821.47	I	8519 – 34679
110	3821.88	I	8519 – 34676
280	3822.58	II	7463 – 33616
95	3824.02	I	12892 – 39035
700	3825.68	II	7485 – 33616
190	3829.78	I	
95	3831.08	II	14421 – 40516
210	3831.64	II	12336 – 38427
150	3832.88	II	10953 – 37036
2300	3836.50	II	4341 – 30399
160	3838.66	II	7463 – 33507
370	3840.89	I	14367 – 40396
1400	3841.31	II	828 – 26853
330	3842.00	II	4341 – 30361
330	3844.36	I	10088 – 36093
420	3846.34	II	4755 – 30747
420	3847.02	I	7565 – 33552
330	3849.39	II	9870 – 35841
1200	3853.03	II	4341 – 30287
420	3858.40	I	7565 – 33475
210	3865.48	II	9432 – 35294
370	3866.58	II	7463 – 33319
95	3867.85	II	14347 – 40194
560	3868.45	II	7463 – 33306
1600	3868.81	I	7565 – 33406
300	3869.42	II	9432 – 35268
820	3869.86	II	0 – 25833
210	3871.63	II	7485 – 33306
7000	3872.11	II	0 – 25818
1200	3873.99	II	828 – 26634
80	3875.18	II	10953 – 36751
470	3879.11	II	4341 – 30112
300	3881.99	II	12674 – 38427
110	3887.54	I	
190	3888.43	II	15979 – 41689
190	3889.01	II	
280	3891.86	II	16601 – 42289
280	3892.90	I	7565 – 33246
80	3894.53	I	12007 – 37676
160	3895.37	II	14126 – 39791
5800	3898.53	II	4755 – 30399
270	3899.17	I	
100	3901.38	I	13495 – 39120
85	3903.33	I	8519 – 34131
160	3904.21	II	4755 – 30361
110	3905.60	II	14347 – 39944
110	3905.94	I	14153 – 39748
120	3912.54	I	12892 – 38444
85	3912.86	II	14347 – 39896
140	3913.62	I	7565 – 33110
160	3913.97	II	12336 – 37878
540	3914.87	II	4341 – 29877
540	3915.59	II	4755 – 30287
540 d	3917.29	I	7565 – 33086
	3917.38	I	12007 – 37527
110	3918.55	II	10953 – 36466
140	3919.12	I	15862 – 41371
320	3923.38	II	12336 – 37817
110	3924.47	II	15530 – 41004
420	3927.86	I	11673 – 37125
140	3929.33	II	17036 – 42478
540	3930.14	I	12892 – 38329
190	3931.28	II	7485 – 32914
2100	3931.52	II	4341 – 29769
110	3932.08	II	4341 – 29765
320	3932.22	II	9870 – 35294
370	3933.00	II	7485 – 32903
320	3934.21	II	
160	3936.05	II	11801 – 37199
85	3936.30	II	9870 – 35268
420	3936.70	I	9990 – 35385
140	3937.16	I	8519 – 33911
270	3938.04	II	10953 – 36340
210	3938.20	I	11673 – 37058
540	3942.53	II	4755 – 30112
10000	3944.68	II	0 – 25343
420	3946.93	II	13610 – 38939
540	3950.39	II	10953 – 36260
85	3953.19	I	12007 – 37295
420	3954.55	II	9432 – 34712
85	3956.32	I	14620 – 25268
800	3957.79	II	9432 – 34691
85	3959.38	II	17007 – 42256
370	3962.59	I	9990 – 35219
110	3963.16	I	14153 – 39378
85	3963.81	II	13338 – 38559
110	3966.36	I	12007 – 37212
320	3967.51	I	7565 – 32763
14000	3968.39	II	0 – 25192
160	3971.21	I	12298 – 37472
85	3972.41	I	
160	3973.88	I	7565 – 32722
2700	3978.57	II	7463 – 32591
270	3979.47	II	4755 – 29877
110	3981.37	I	7565 – 32675
1400	3981.92	II	7485 – 32591
1600	3983.65	II	4341 – 29436
800	3984.21	II	9432 – 34524

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
85	3984.69	II	14I26 – 39215
85	3987.07	II	15530 – 40604
60	3988.88	I	9990 – 35053
60	3988.93	I	
75	3990.34	II	16418 – 41472
540	3991.32	II	10953 – 36001
170	3993.57	I	8519 – 33552
85	3994.53	I	4134 – 29161
85	3995.99	I	
1600	3996.69	II	4755 – 29769
110	3998.06	II	828 – 25833
8000	4000.45	II	828 – 25818
420	4005.84	I	8519 – 33475
320	4006.07	I	8519 – 33474
100	4007.76	II	828 – 25772
120	4010.07	II	19571 – 44501
540	4011.29	II	7463 – 32386
540	4013.82	I	0 – 24906
540	4014.70	II	7485 – 32386
210	4015.17	II	11801 – 36699
160	4020.87	II	
370	4023.71	I	7565 – 3241I
250	4024.43	II	9870 – 34712
250	4024.90	I	9990 – 34829
420	4027.78	II	9870 – 34691
520 d	4028.32	II	20884 – 45701
	4028.41	I	7565 – 32382
85	4031.08	I	12007 – 36807
520	4032.47	II	13610 – 38402
160	4032.84	I	13495 – 38285
420	4033.65	II	9432 – 34216
420	4036.32	II	4341 – 29109
250	4038.51	II	7463 – 32218
190	4038.83	I	10088 – 34841
320	4041.98	II	7485 – 32218
12000	4045.97	I	0 – 24708
85	4047.73	I	9990 – 34689
85	4048.38	II	
250	4048.93	I	8519 – 33210
140	4049.36	I	4134 – 28822
1600	4050.56	II	4755 – 29436
250	4053.83	I	4134 – 28795
520	4055.14	II	9870 – 34524
120	4057.44	II	23707 – 48346
85	4060.57	II	13338 – 37958
100	4072.61	II	17036 – 41583
2500	4073.12	II	4341 – 28885
120	4073.98	II	11801 – 36340
7400	4077.96	II	828 – 25343
75	4079.26	I	
85	4083.10	I	10088 – 34573
190	4085.13	I	7050 – 31522
370	4085.34	I	7565 – 32036
190	4087.20	II	11801 – 36260
85	4087.38	I	10088 – 34547
85	4089.50	I	11673 – 36119
190	4091.52	II	10953 – 35387
120	4091.76	II	14126 – 38559
85	4093.64	I	8519 – 32940
390	4096.10	I	12892 – 37299
100	4096.62	I	12655 – 37058
100	4099.88	I	4134 – 28518
75	4101.93	II	15822 – 40194
3900	4103.30	II	828 – 25192
860	4103.87	I	7050 – 31410
200	4105.04	II	4755 – 29109
75	4106.38	II	9870 – 34216
I500	4111.34	II	0 – 24316
120	4II3.05	I	10925 – 35231
200	4II9.31	II	9432 – 33701
490	4124.63	II	7463 – 31701
150	4126.08	I	12892 – 37I21
390	4128.24	II	7485 – 31701
350	4129.12	I	10925 – 35136
990	4129.42	II	434I – 28550
350	4130.35	I	0 – 24204
120	4131.02	II	I1801 – 36001
75	4132.83	II	13338 – 37527
170	4133.35	II	12336 – 36522
390	4133.85	I	9990 – 34174
250	4134.15	I	10925 – 35107
100	4134.71	I	7050 – 31229
150	4138.54	I	8519 – 32675
120	4139.56	I	7050 – 31200
470	4141.50	II	828 – 24967
1200	4143.10	II	4755 – 28885
990	4146.06	I	9211 – 33324
75	4147.97	I	
150 h	4152.48	II	9432 – 33507
100	4153.12	I	
75	4154.24	I	
120	4159.31	I	8519 – 32554
75	4160.25	I	
75	4162.25	I	
5700	4167.97	I	4134 – 28119
75	4169.25	II	828 – 24806
75	4170.56	I	
370	4171.93	I	
	4172.00	I	
140 d	4176.60	I	
	4176.78	I	
50	4181.27	I	8519 – 32428
250	4183.60	I	7050 – 30946
930	4183.72	I	4134 – 28029
12000	4186.82	I	0 – 23877
320	4190.94	I	7050 – 30904
2200	4191.64	I	4134 – 27984
6800	4194.84	I	0 – 23832
320	4195.19	II	9870 – 33701
800	4198.02	I	9211 – 33025
680	4201.30	I	10925 – 34720
680	4202.24	I	7050 – 30840
230	4205.06	I	
370	4206.54	II	0 – 23765
140	4207.70	I	9211 – 32970
440	4211.24	I	4134 – 27873
16000	4211.72	I	0 – 23736
1800	4213.18	I	7050 – 30778
85	4214.41	I	7565 – 31287
3700	4215.16	I	4134 – 27851
4400	4218.09	I	4134 – 27834
4400	4221.11	I	4134 – 27817
75	4222.05	II	4341 – 28019
540	4222.21	I	9211 – 32889
75	4224.67	I	
2700	4225.16	I	7050 – 30711
680	4232.02	I	9211 – 32834
75	4234.83	I	16288 – 39895
680	4239.85	I	9211 – 32790
75	4243.44	I	7565 – 31124

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
440		4245.91	I	10925 – 34470
140		4247.34	II	12674 – 36212
75		4248.45	II	14347 – 37878
440		4256.33	II	828 – 24316
85		4258.15	I	7050 – 30528
75		4267.87	I	
75		4268.26	I	4134 – 27556
250		4276.69	I	7050 – 30426
85		4279.73	I	
120		4291.95	I	4134 – 27427
370	d	4294.93	II	
		4295.04	I	
75		4298.91	I	9990 – 33246
75		4302.71	II	4755 – 27990
1000		4308.63	II	0 – 23202
60		4313.93	I	7565 – 30739
75		4322.53	II	13338 – 36466
140		4325.11	II	13408 – 36522
320		4325.86	I	
100		4326.38	I	15567 – 38674
120		4328.90	II	4341 – 27435
160		4339.65	II	4755 – 27792
60	d	4346.37	II	20793 – 43794
160		4347.71	I	13495 – 36490
200		4358.44	II	828 – 23765
60		4361.34	II	14895 – 37817
100		4364.20	II	19571 – 42478
160		4366.72	I	7565 – 30459
320		4374.24	II	0 – 22854
320		4374.76	II	4341 – 27193
120		4375.31	II	17606 – 40455
60		4384.30	II	7485 – 30287
75		4389.77	I	
140		4394.98	II	828 – 23575
540		4409.38	II	0 – 22672
60		4426.87	I	
60		4430.99	II	18549 – 41111
150		4444.58	I	12892 – 35385
740		4449.70	II	0 – 22467
110		4455.60	II	4755 – 27193
250		4468.14	II	828 – 23202
60		4484.36	I	10088 – 32382
60		4503.23	II	7485 – 29685
60		4516.95	I	11673 – 33806
60		4518.51	II	22031 – 44156
100	d	4527.58	I	19557 – 41638
		4527.76	II	828 – 22908
100		4541.66	II	19571 – 41583
60		4555.22	I	7565 – 29512
140		4565.09	I	0 – 21899
60		4567.04	I	13495 – 35385
60		4573.85	II	20884 – 42741
420		4577.78	I	0 – 21838
75		4587.91	II	14421 – 36212
2100		4589.36	I	0 – 21783
60		4591.78	II	20517 – 42289
990		4612.26	I	0 – 21675
50		4613.83	I	17514 – 39182
50		4614.82	I	17513 – 39176
60		4617.26	II	4755 – 26407
140		4620.03	II	828 – 22467
50		4662.72	I	18462 – 39903
110		4664.66	II	4341 – 25772
85		4673.60	II	17036 – 38427
50		4682.03	II	19251 – 40604
50		4689.75	II	14895 – 36212
95		4698.68	II	16601 – 37878
85		4721.22	I	
70		4727.13	II	24786 – 45934
170		4731.84	II	4341 – 25468
40		4745.73	II	7485 – 28550
60		4754.99	II	19492 – 40516
50		4760.04	II	4341 – 25343
60		4771.94	I	17613 – 38563
50		4774.80	I	
120	h	4775.79	I	15972 – 36905
75		4786.92	II	0 – 20884
95		4791.29	I	4134 – 24999
29		4800.64	I	15567 – 36392
50		4807.94	I	7565 – 28358
40		4810.28	I	17514 – 38297
50		4812.80	I	8519 – 29291
75		4819.04	I	15972 – 36717
85		4824.96	I	18462 – 39182
75		4828.88	I	
50		4829.68	II	20884 – 41583
70		4832.38	I	17514 – 38202
35		4833.75	II	15530 – 36212
75		4841.75	I	18472 – 39120
40		4856.24	II	19571 – 40158
40		4868.05	II	20467 – 41004
40		4875.93	I	
85		4880.16	I	0 – 20485
40		4884.55	I	
95		4888.08	I	8519 – 28971
40		4889.33	II	
75		4890.10	II	828 – 21272
50		4893.68	I	16288 – 36717
24		4899.24	I	
55		4916.41	I	18021 – 38356
50		4922.22	II	
65		4923.16	II	828 – 21134
480		4957.34	II	0 – 20166
24		4959.59	I	19240 – 39398
28		4973.57	I	18462 – 38563
40		4985.52	I	12502 – 32554
50		5003.87	I	17727 – 37706
55		5004.28	II	7485 – 27462
24		5010.60	I	19797 – 39750
24		5017.98	II	20884 – 40807
70		5022.12	I	4134 – 24040
30		5024.03	I	
24		5024.54	I	7565 – 27462
40		5027.87	I	18472 – 38356
50		5033.00	I	17687 – 37551
160		5042.63	I	7565 – 27390
24		5047.25	I	8519 – 28326
50	h	5050.21	I	7050 – 26846
16		5053.19	I	
30		5053.35	I	0 – 19783
24		5055.46	I	19797 – 39573
95		5070.68	I	9990 – 29706
120		5077.67	I	0 – 19688
80		5090.38	II	828 – 20467
80		5110.32	I	19557 – 39120
130	h	5120.04	I	17513 – 37039
30		5135.02	I	8519 – 27987
190		5139.60	II	0 – 19451
40		5161.03	II	24786 – 44156
40		5164.12	II	23707 – 43066

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
50		5165.34	I	18339 – 37694
110		5169.69	II	828 – 20166
20		5172.90	II	
80		5185.30	I	12007 – 31287
40		5188.45	II	18549 – 37817
290		5192.86	II	0 – 19251
95		5197.66	II	4341 – 23575
15		5205.66	I	20193 – 39398
15		5205.73	I	
50		5246.94	II	
16		5248.14	II	
16		5258.37	II	19927 – 38939
70		5259.88	I	19240 – 38247
130		5260.56	I	
55	bl	5263.3	Dy O	
65		5267.11	I	9990 – 28971
50		5272.25	II	4341 – 23303
50		5275.29	II	19451 – 38402
50		5279.70	II	19492 – 38427
55		5282.07	I	8519 – 27445
28		5284.99	II	17606 – 36522
40		5297.82	II	
160		5301.58	I	0 – 18857
40		5309.02	II	19571 – 38402
50		5324.69	I	7050 – 25825
24		5337.43	II	14845 – 33576
65		5340.30	I	
30		5352.11	I	7565 – 26244
30		5368.20	II	828 – 19451
16		5369.24	II	14845 – 33465
20		5385.63	II	7485 – 26047
85		5389.58	II	0 – 18549
40		5395.57	I	0 – 18528
20	h	5398.26	Dy O	
24		5399.93	II	4341 – 22854
50		5404.19	I	4134 – 22633
80		5419.13	I	20884 – 39332
16		5420.77	I	9990 – 28433
70		5423.32	I	0 – 18433
30		5424.27	I	17514 – 35945
40		5426.70	II	20517 – 38939
30		5443.34	II	19451 – 37817
95		5451.11	I	0 – 18339
30		5455.47	II	19492 – 37817
24		5469.10	II	16117 – 34396
16		5471.91	II	17788 – 36058
28		5496.83	I	18903 – 37090
24		5502.79	I	9990 – 28158
28		5506.52	I	
24		5515.41	II	4341 – 22467
30		5528.01	I	12655 – 30739
13		5542.20	I	20209 – 38247
65		5547.27	I	0 – 18021
16		5562.48	I	
40	d	5600.65	II	828 – 18678
24		5605.53	I	12007 – 29841
30		5613.23	I	20209 – 38019
20		5627.49	I	4134 – 21899
100		5639.50	I	0 – 17727
16		5641.50	II	828 – 18549
55	h	5645.99	I	17514 – 35221
80		5652.01	I	0 – 17687
11		5666.43	I	20193 – 37836
14		5671.25	I	19240 – 36868
14		5677.68	I	17613 – 35221
24		5685.58	I	7050 – 24634
28	h	5693.67	Dy O	
24	h	5694.10	Dy O	
28	cw	5694.54	Dy O	
28		5698.72	II	20884 – 38427
24		5702.91	I	7565 – 25095
11		5705.95	Dy O	
70	h	5718.46	I	18462 – 35945
28	h	5725.84	Dy O	
55	h	5728.64	Dy O	
24	h	5738.73	Dy O	
50		5740.20	I	22487 – 39903
55		5745.53	I	9990 – 27390
24		5750.48	I	
24		5758.79	I	8519 – 25879
80	h	5832.01	Dy O	
55	h	5833.85	Dy O	
40	h	5834.86	Dy O	
28	h	5844.41	Dy O	
24		5845.65	Dy O	
40	h	5848.05	Dy O	
40		5855.56	Dy O	
55	h	5868.11	II	0 – 17036
40		5915.16	II	
20		5924.56	II	14952 – 31826
70		5945.80	I	12892 – 29706
50	l	5964.46	I	9990 – 26752
120		5974.49	I	0 – 16733
24		5984.86	I	19240 – 35945
10		5985.99	I	9211 – 25912
140		5988.56	I	0 – 16693
14		6000.84	I	20209 – 36868
14		6003.26	I	11673 – 28326
24	h	6005.75	Dy O	
24	h	6006.54	Dy O	
24	h	6006.97	Dy O	
30		6008.94	I	7050 – 23687
65		6010.82	I	4134 – 20766
24		6017.26	I	9211 – 25825
24		6030.98	I	8519 – 25095
24	bl	6042.49	Dy O	
24		6058.18	I	7050 – 23552
30		6085.06	I	7050 – 23479
140		6088.26	I	4134 – 20554
24		6127.15	I	12655 – 28971
24		6133.64	I	10088 – 26387
24		6158.28	I	7565 – 23799
100		6168.43	I	4134 – 20341
20		6196.23	II	15691 – 31826
270		6259.09	I	0 – 15972
30		6260.36	I	13495 – 29465
14		6343.32	I	22487 – 38247
40		6386.80	I	7565 – 23218
24		6396.60	II	
50		6421.92	I	0 – 15567
13	h	6436.55	I	22487 – 38019
8		6460.83	I	7050 – 22524
10		6468.58	II	33677 – 49132
11		6474.91	I	23736 – 39176
20		6483.59	II	16117 – 31536
28		6486.59	I	15567 – 30979
8		6548.26	II	14845 – 30112
20		6558.02	I	7050 – 22294
160		6579.37	I	0 – 15194
14		6594.14	II	14952 – 30112

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
6	h	6611.73	II	17589 – 32709
7		6639.21	I	16717 – 31775
15		6643.37	I	4134 – 19182
7		6654.23	II	17589 – 32613
22		6658.36	I	19907 – 34922
29		6661.64	I	15972 – 30979
75		6667.86	I	15567 – 30560
9		6670.16	I	20789 – 35777
10		6700.64	II	14845 – 29765
7	h	6713.05	I	15567 – 30459
6	h	6724.70	I	20554 – 35421
6	h	6736.07	I	12007 – 26848
7	h	6743.68	I	
29		6747.93	I	16693 – 31509
7	h	6750.21	I	10088 – 24899
10		6757.62	I	20341 – 35135
45		6765.89	I	16733 – 31509
6		6787.37	I	16693 – 31423
7		6790.30	I	4134 – 18857
8		6794.23	I	13952 – 28666
8	h	6803.20		
8		6805.54	I	16733 – 31423
9		6807.31	II	
12		6818.20	I	13495 – 28158
9		6827.07	I	23479 – 38123
4		6828.35	II	18866 – 33507
180		6835.42	I	0 – 14625
4	h	6843.75	I	25912 – 40520
7		6845.76	I	20817 – 35421
4	h	6851.99	I	23479 – 38070
80		6852.96	I	15972 – 30560
22		6856.46	I	20341 – 34922
4	h	6886.40	I	23552 – 38070
22		6888.83	I	8519 – 23031
4		6894.51	I	23479 – 37980
4		6895.51	I	12892 – 27390
15		6897.97	II	17788 – 32281
65		6899.32	II	14845 – 29336
22		6906.53	II	18234 – 32709
7		6912.20	II	16117 – 30580
7	h	6925.49	I	23687 – 38123
15		6929.55	I	4134 – 18561
7		6932.45	II	15691 – 30112
4		6939.65	I	23687 – 38093
6		6942.11	I	13495 – 27896
4	h	6945.26	I	4134 – 18528
29		6950.28	II	14952 – 29336
11		6951.42	I	22487 – 36868
6		6952.93	II	18234 – 32613
4		6957.63	I	
40		6958.08	I	0 – 14367
6		6970.43	I	12007 – 26349
13	h	6982.44	I	20817 – 35135
13		6991.30	I	4134 – 18433
45		6998.10	I	16693 – 30979
3	h	7014.64	II	21806 – 36058
20		7017.42	I	16733 – 30979
3	h	7036.37	I	12298 – 26506
7		7037.53	I	4134 – 18339
35		7055.95	II	14845 – 29014
9	h	7062.30	I	20766 – 34922
24		7075.14	II	
3	h	7100.54	II	21627 – 35707
5		7101.66	II	15691 – 29769
17		7109.26	II	14952 – 29014
11		7120.81	II	14845 – 28885
9		7121.23	I	4134 – 18172
3		7141.52	II	18219 – 32218
5		7149.30	II	18234 – 32218
6	h	7156.48	I	23736 – 37706
13		7175.11	II	14952 – 28885
3	h	7198.65	I	4134 – 18021
3	h	7206.77	I	12007 – 25879
11		7213.27	I	12892 – 26752
3		7222.52	I	17687 – 31529
3		7222.90	I	7050 – 20891
17	h	7230.04	I	16733 – 30560
4	h	7234.68	II	20700 – 34519
13		7250.01	I	9990 – 23780
7		7261.74	I	7050 – 20817
8		7273.57	II	15691 – 29436
3		7279.90	I	12655 – 26387
9		7288.24	II	17589 – 31306
3	h	7300.28	I	12655 – 26349
2	h	7314.71	II	35565 – 49233
17		7345.13	II	0 – 13610
3		7349.64	II	
3	h	7354.39	II	828 – 14421
5		7361.58	II	21627 – 35207
11		7370.23	II	16117 – 29681
20		7376.04	I	4134 – 17687
9		7381.57	I	9990 – 23534
9	h	7403.10	I	7050 – 20554
3		7404.02	I	10088 – 23591
11		7407.59	I	0 – 13495
24		7412.37	I	18021 – 31509
55		7426.86	II	14845 – 28306
5	h	7428.54	I	22487 – 35945
9		7451.11	II	15691 – 29109
20		7457.05	II	14845 – 28252
3	h	7459.99	I	18021 – 31423
7		7483.03	I	22061 – 35421
3		7509.60	I	9211 – 22524
17		7516.61	II	14952 – 28252
7	h	7533.16	I	23736 – 37007
55		7543.73	I	17727 – 30979
17	h	7553.00	I	21899 – 35135
5	h	7557.85	I	9990 – 23218
27		7559.78	I	7565 – 20789
40		7562.96	II	16117 – 29336
20	h	7577.46	II	15691 – 28885
3		7587.76	I	22045 – 35221
27	h	7591.30	I	18339 – 31509
5	h	7594.86	I	24906 – 38070
4		7609.17	I	24931 – 38070
13	h	7611.55	I	22286 – 35421
5	h	7616.21	I	22294 – 35421
11	h	7617.70	I	24999 – 38123
5	h	7635.32	I	20817 – 33911
5	h	7639.30	I	23877 – 36964
35	h	7641.09	I	21838 – 34922
17		7645.86	I	18433 – 31509
13		7646.64	I	22061 – 35135
4		7648.11	II	18234 – 31306
9		7661.48	I	7565 – 20614
80		7662.36	I	17513 – 30560
11		7666.78	II	14845 – 27885
9	h	7676.69	I	21899 – 34922
3		7693.86	I	
5		7696.54	I	14970 – 27959

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
6		7711.91	II	18219 – 31183
35		7715.33	I	18021 – 30979
5	h	7721.01	II	27209 – 40158
45		7729.76	II	14952 – 27885
5	h	7739.38	II	21338 – 34255
4		7750.15	I	10925 – 23824
20		7751.62	II	16117 – 29014
5		7757.32	I	9211 – 22099
4		7760.08	I	23877 – 36760
4		7780.89	I	22286 – 35135
8		7790.02	I	17727 – 30560
35		7812.06	I	18711 – 31509
4		7814.60	I	15194 – 27987
7		7832.77	I	7050 – 19813
7	h	7835.52	II	20748 – 33507
8		7864.31	II	21806 – 34519
8		7864.96	I	18711 – 31423
27		7909.38	I	18339 – 30979
5		7934.98	I	4134 – 16733
3		7962.77	I	8519 – 21074
11		7968.63	I	18433 – 30979
9		7973.13	I	18021 – 30560
12		7982.85	II	17589 – 30112
4		8004.47	II	23976 – 36466
8		8008.70	II	14952 – 27435
9	h	8025.31	I	4134 – 16591
6	h	8027.22	I	24708 – 37163
6		8040.09	I	14625 – 27059
4		8047.28	I	12007 – 24430
4		8050.85	I	14367 – 26785
8		8116.90	II	18866 – 31183
3		8140.72	II	14952 – 27232
4		8144.30	II	
13		8147.29	I	8519 – 20789
4	h	8169.06	II	21338 – 33576
27		8198.77	II	15691 – 27885
100		8201.57	II	16117 – 28306
3		8208.34	II	18219 – 30399
8	h	8217.04	II	20748 – 32914
11		8218.62	II	18234 – 30399
6		8233.56	II	18219 – 30361
4		8243.91	II	18234 – 30361
20		8265.53	I	8519 – 20614
4		8323.85	I	27190 – 39201
35		8326.10	I	0 – 12007
5		8388.53	I	11673 – 23591
35		8392.01	II	20700 – 32613
12		8405.85	II	18219 – 30112
20		8416.64	II	18234 – 30112
24		8438.58	II	17589 – 29436
9		8444.46	II	21076 – 32914
5		8472.58	II	23495 – 35294
4		8480.66	II	14845 – 26634
5		8490.15	I	12655 – 24430
9		8510.79	II	17589 – 29336
4		8517.68	II	21177 – 32914
7		8525.73	II	21177 – 32903
4	h	8528.32	II	21806 – 33529
8		8548.93	II	21813 – 33507
9		8557.79	II	14952 – 26634
7		8567.97	I	24999 – 36667
8		8575.58	II	18219 – 29877
11		8630.12	I	12007 – 23591
9		8635.78	II	21338 – 32914
27		8655.94	II	18219 – 29769
17		8657.68	II	17788 – 29336
7	h	8667.37	II	18234 – 29769
7		8672.62	I	12007 – 23534
17		8678.49	II	17589 – 29109
5		8685.26	I	7050 – 18561
11		8696.83	II	18866 – 30361
11	h	8715.95	II	20748 – 32218
20		8750.40	II	17589 – 29014
12		8780.83	I	
45		8791.39	II	21338 – 32709
7		8832.81	II	24685 – 36003
13		8833.08	II	23976 – 35294
24		8850.37	II	17589 – 28885
45		8905.75	II	17788 – 29014

Erbium

$$\text{Er}, Z = 68, M = 167.2, \text{Ratio } \frac{\text{Er}}{\text{Cu}} = 2.632$$

Er I Normal state of valence electrons $4f^{12}6s^2\ {}^3H_6 = 0$. I.P. = 49210 cm^{-1}.
Er II Normal state of valence electrons $4f^{12}6s\ {}^4H_{6\,1/2} = 0$. I.P. = 96200 cm^{-1}.
Er III Normal state of valence electrons $4f^{12}\ {}^3H_6 = 0$. I.P. = 183400 cm^{-1}.

References

Wavelengths:
Below 2670 Å;
A. Gatterer and J. Junkes, Spektren der Seltenen Erden, (Specola Vaticana, 1945).
From 2670 to 6900 Å;
L. C. Marquet, Thesis, Univ. of Calif. at Berkeley (1963).
Above 6900 Å;
Th. A. M. van Kleef, unpublished (1973).

Spectrum assignments were made primarily from our plates and supplemented from S. Held, Report IA–813, Israel A.E.C. (1966).

Classification:

Er I, L. C. Marquet and S. P. Davis, unpublished (1967).
N. Spector, J. Opt. Soc. Am. **56**, 341 (1966); **57**, 308 (1967).
Er I and II, L. C. Marquet, Thesis, Univ. of Calif. (Berkeley, 1963).
K. L. Vander Sluis, unpublished (1969).
Th. A. M. van Kleef, unpublished (1973).
Er III, N. Spector, J. Opt. Soc. Am. **63**, 358 (1973).

Strong lines of erbium

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
14000	4007.96	I	0 – 24943	3000	4020.51	I	6958 – 31824
11000	3906.31	II	0 – 25592	2700	3264.78	II	0 – 30621
7900	3692.65	II	440 – 27514	2700	3973.04	I	0 – 25162
7700	3372.71	II	0 – 29641	2300	3230.58	II	440 – 31386
7500	3862.85	I	0 – 25880	2300	3312.42	II	440 – 30621
6900	4151.11	I	0 – 24083	2300	3392.00	II	0 – 29472
6700	3499.10	II	440 – 29011	2100	3938.63	II	0 – 25382
5200	3896.23	II	440 – 26099	1800	3786.84	II	0 – 26400
4200	3892.68	I	0 – 25682	1700	3385.08	II	440 – 29973
3600	3830.48	II	0 – 26099	1600	3638.68	I	
3500	4087.63	I	0 – 24457	1600	3810.33	I	0 – 26237
3200	3937.01	I	0 – 25392	1500	2910.36	II	6824 – 41174
3200	3944.42	I	5035 – 30380	1500	2964.52	II	6824 – 40547
3200	3973.58	I	0 – 25159	1500	3558.02	I	7696 – 35794
3100	3616.56	II	0 – 27643	1500	3880.61	II	5132 – 30894

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
80	2341.82	II	
110	2358.51	II	0 – 42387
80	2377.83	II	
80	2383.28	II	440 – 42387
100	2386.58	II	
120	2387.17	II	
110	2396.38	III	19316 – 61032
90	2397.30	II	6824 – 48525
40	2400.30	II	
35	2404.41	II	
40	2410.53	II	
70	2420.28	II	
60	2425.23	II	
90	2427.28	II	
40	2439.45	II	
140	2446.39	II	0 – 40864
40	2458.03	II	
40	2459.75	II	6824 – 47466
40	2460.71	II	
60	2464.63	III	20470 – 61032
35	2467.26	II	
20	2477.59	II	6824 – 47174
40	2478.32	II	6824 – 47162
35	2485.17	II	6824 – 47050
40	2487.47	II	
60	2491.56	II	
40	2492.27	II	5403 – 45515
60	2493.27	II	
90	2499.67	I	
80	2503.48	II	6824 – 46757
60	2507.64	II	
50	2513.94	II	
26	2520.95	II	
50	2534.99	II	6824 – 46260
100	2537.02	II	
60	2544.90	II	6824 – 46106
110	2547.28	II	
40	2564.78	II	
50	2579.59	II	
90	2581.56	II	
290	2586.73	II	
110	2587.04	II	0 – 38642
35	2587.34	II	
35	2591.91	II	
130	2592.57	II	
120	2595.03	II	
80	2602.66	I	
80	2604.86	I	
30	2606.69	II	11309 – 49660
60	2612.37	II	13338 – 51606
50	2614.54	II	13338 – 51574
60	2616.87	II	440 – 38642
80	2621.72	II	
140	2624.18	II	6824 – 44920
40	2627.77	II	
35	2637.78	III	17647 – 55547
40	2647.14	II	13338 – 51103
35	2651.35	II	
70	2653.73	II	13338 – 51010
40	2654.11	II	
70	2655.25	II	
70	2656.10	II	
60	2657.00	II	
80	2665.04	II	
90	2666.30	II	5132 – 42626
490	2670.26	II	6824 – 44263
330	2672.25	II	6824 – 44235
100	2675.35	II	11309 – 48676
40	2688.40	II	13060 – 50246
40	2689.93	II	
60	2698.39	III	
26	2700.67	II	5132 – 42149
60	2701.69	II	
60	2711.53	II	
100	2712.12	II	5403 – 42264
60	2713.25	II	
30	2716.60	II	10667 – 47466
60	2720.74	II	
60	2721.59	II	13719 – 50451
180	2726.22	II	440 – 37110
120	2730.10	II	12388 – 49005
80	2731.56	II	440 – 37038
270	2739.31	II	6824 – 43319
310	2750.19	II	13027 – 49378
60	2750.92	II	
230	2755.01	II	
610	2755.63	II	5403 – 41682
110	2765.61	II	0 – 36148
120	2766.38	II	12388 – 48525
510	2770.02	II	10667 – 46757
90	2774.62	II	13060 – 49091
230	2778.97	II	12815 – 48788
60	2779.61	II	14280 – 50246
100	2781.19	II	13060 – 49005
60	2781.54	II	13719 – 49660
40	2782.00	II	5132 – 41067
150	2784.95	II	5132 – 41029
120	2786.11	II	440 – 36322
60	2787.40	II	11309 – 47174
180	2787.71	II	12815 – 48676
30	2788.33	II	11309 – 47162
50	2788.47	II	
60	2792.52	III	20226 – 56025
50	2793.84	II	
80	2799.54	II	
35	2799.72	II	440 – 36148
230	2802.53	II	0 – 35672
100	2802.87	II	13338 – 49005
80	2803.54	II	13719 – 49378
310	2804.35	II	13027 – 48676
150	2806.75	II	0 – 35618
100	2818.86	II	13060 – 48525
26	2819.34	II	440 – 35899
40	2819.81	II	12388 – 47840
410	2820.19	II	11309 – 46757
40	2820.46	II	440 – 35885
50	2824.32	II	
50	2824.90	II	
30	2825.66	II	14280 – 49660
60	2829.38	II	
80	2830.42	II	5403 – 40723
40	2831.21	II	
270 d	2833.91	II	0 – 35277
60	2837.11	II	7150 – 42386
390	2838.71	II	13572 – 48788
100	2840.63	II	
50	2841.89	II	440 – 35618
120	2845.86	II	
60	2846.26	II	13027 – 48151
40	2847.02	II	

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
80	2848.06	II	16473 – 51574
270	2848.37	II	14280 – 49378
50	2848.92	II	13060 – 48151
150	2850.65	II	13719 – 48788
250	2855.41	II	
120	2858.56	II	0 – 34972
310	2859.84	II	13719 – 48676
40	2860.26	II	11309 – 46260
40	2862.60	II	
30	2866.35	II	
30	2869.19	II	5132 – 39975
30	2870.52	II	
90	2871.68	II	13338 – 48151
60	2872.83	II	
150	2873.80	II	13060 – 47847
110	2874.78	II	440 – 35215
80	2877.26	II	
50	2878.54	II	
60	2878.90	II	14280 – 49005
30	2879.22	II	
30	2882.60	II	7195 – 41876
80	2886.11	II	
100	2887.09	II	16948 – 51574
100	2888.16	II	
50	2893.49	II	17842 – 52392
150	2893.90	II	0 – 34545
50	2895.92	II	5133 – 39654
60	2896.57	II	15732 – 50246
310	2896.96	II	13338 – 47847
390	2897.52	II	13338 – 47840
80	2903.44	II	13719 – 48151
1000	2904.47	II	6824 – 41244
120	2906.50	II	14280 – 48676
100	2908.53	II	
210	2909.58	II	12815 – 47174
1500	2910.36	II	6824 – 41174
70	2911.07	II	0 – 34342
30	2912.30	II	
40	2912.82	II	5403 – 39724
100	2914.66	I	
270	2915.62	II	10667 – 44955
40	2918.83	II	
100	2919.28	II	14280 – 48525
80	2920.24	II	440 – 34674
80	2923.30	II	
60	2927.36	II	
150	2927.71	II	13027 – 47174
160	2928.28	II	14649 – 48788
110	2928.45	II	
350	2929.27	II	13338 – 47466
100	2929.73	II	440 – 34563
120	2930.64	II	
80	2931.55	II	13060 – 47162
60	2931.66	II	12815 – 46915
35	2932.36	II	
30	2932.60	II	16948 – 51037
80	2934.51	II	13719 – 47786
60	2934.64	II	
50	2939.32	II	7195 – 41206
60	2939.47	II	5403 – 39413
120	2941.17	II	13060 – 47050
90	2941.71	II	
140	2942.21	II	
100	2944.07	II	440 – 34397
270	2945.28	II	12815 – 46757
40	2946.43	II	18463 – 52392
230	2946.62	II	15732 – 49660
150	2948.80	II	
30	2949.26	II	
80	2950.07	II	13027 – 46915
90	2951.26	II	5403 – 39277
60	2955.37	II	
50	2955.60	II	
60	2956.45	II	16643 – 50457
80	2956.95	II	16643 – 50451
90	2958.89	II	
60	2960.12	II	
120 h	2962.49	II	
150	2963.70	II	
80	2963.90	II	13027 – 46757
60	2964.25	II	
1500	2964.52	II	6824 – 40547
60	2964.83	II	12388 – 46106
60	2965.21	II	5133 – 38847
80	2965.87	II	13719 – 47426
60	2966.17	II	
80	2967.94	II	
60	2968.47	II	
410	2968.76	II	0 – 33674
150	2970.06	II	0 – 33660
60	2970.96	II	5404 – 39053
50	2971.26	II	11309 – 44955
80 d	2971.63	II	
	2971.73	II	
150	2972.27	II	
150	2973.74	II	5403 – 39021
210	2974.47	II	0 – 33610
230	2975.68	II	10667 – 44263
40	2979.95	II	440 – 33988
110	2983.06	II	12388 – 45900
140	2983.22	II	11309 – 44820
270	2983.80	II	
130	2985.52	I	0 – 33485
40	2987.31	II	
30	2988.20	II	
140	2989.31	II	13719 – 47162
80	2989.56	II	
30	2994.09	II	19606 – 52996
110	2994.47	I	
40	2995.47	II	
90	2996.37	II	440 – 33804
80	2997.87	II	
70	2998.06	II	5133 – 38478
1200	3002.41	II	6824 – 40121
310	3002.65	II	
90	3003.83	II	440 – 33722
60	3005.05	II	
150	3008.19	II	13027 – 46260
40	3009.44	II	440 – 33660
50	3009.70	II	
80	3010.31	II	440 – 33650
90	3011.16	II	13060 – 46260
230	3012.47	II	5132 – 38318
60	3013.84	II	12587 – 45758
30	3013.96	II	6824 – 39994
30	3014.62	II	
230	3016.84	II	14649 – 47786
120	3017.74	II	6824 – 39952
100	3019.76	II	0 – 33106
50	3020.33	II	

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
60	3022.73	II	17378 – 50451
290	3025.95	II	13719 – 46757
270	3028.27	II	0 – 33012
370	3031.31	II	6824 – 39804
310	3036.22	II	11309 – 44235
70	3048.39	II	
50	3049.21	II	19606 – 52392
90	3049.30	II	
70	3050.00	II	14649 – 47426
70	3050.85	II	13338 – 46106
70	3053.78	II	17378 – 50115
210	3054.42	II	
50	3061.29	II	12815 – 45471
140	3061.68	II	10667 – 43319
60	3064.83	II	0 – 32619
70	3064.97	II	
230	3066.22	II	5133 – 37737
120	3069.22	II	440 – 33012
450	3070.74	II	10667 – 43223
560	3072.53	II	
610	3073.34	II	0 – 32528
70	3078.25	II	16529 – 49005
210	3078.87	II	12815 – 45285
70	3081.38	II	13027 – 45471
720	3082.08	II	
610	3084.02	II	0 – 32416
60	3087.12	II	
70	3087.80	II	7150 – 39526
70	3088.76	II	
150	3093.14	II	10667 – 42987
120	3095.84	II	
370	3099.19	II	13027 – 45285
70	3099.60	II	
150	3102.69	II	13338 – 45559
70	3104.46	II	
230	3106.78	II	440 – 32619
150	3110.88	II	
310 d	3113.43	II	
	3113.54	II	14649 – 46757
80	3115.09	II	7149 – 39242
130	3115.53	II	440 – 32528
150	3116.95	II	0 – 32074
150	3118.83	II	15732 – 47786
80	3119.05	II	
150	3121.94	II	0 – 32023
770	3122.72	II	5133 – 37147
80	3123.09	II	11309 – 43319
150	3125.18	II	
150	3125.65	II	
60	3127.38	II	5133 – 37099
80	3131.07	II	
130	3132.03	II	0 – 31919
290	3132.52	II	11309 – 43223
470	3132.77	II	
80	3135.62	II	16643 – 48525
130	3137.85	II	13060 – 44920
160	3138.50	II	16935 – 48788
410	3141.10	II	440 – 32267
	3141.15	II	14280 – 46106
70	3141.81	II	
80	3142.80	II	
80	3143.63	II	0 – 31801
250	3144.33	II	
160	3144.51	II	13027 – 44820
130	3150.55	II	5133 – 36864
140	3152.37	II	
410	3154.29	II	15732 – 47426
190	3160.35	II	440 – 32074
60	3161.36	II	
60	3164.52	II	
190	3167.10	II	13719 – 45285
80	3171.52	II	
80	3172.62	II	5133 – 36643
160	3175.52	II	0 – 31482
80	3179.61	II	15732 – 47174
160	3181.61	II	5404 – 36825
160	3181.74	II	12815 – 44235
870	3181.92	II	11042 – 42461
410	3183.42	II	440 – 31844
250	3185.25	II	0 – 31386
160	3187.79	II	440 – 31801
120	3192.64	II	
310	3200.58	II	13027 – 44263
120	3203.45	II	13027 – 44235
80	3203.95	II	13060 – 44263
230	3205.15	II	14280 – 45471
80	3208.05	II	12815 – 43977
270	3214.44	II	13719 – 44820
870	3220.73	II	
610	3223.31	II	5133 – 36148
210	3227.16	II	12600 – 43578
80	3229.93	II	5403 – 36355
2300	3230.58	II	440 – 31386
250	3232.03	II	12388 – 43319
330	3237.98	II	5133 – 36007
140	3240.48	II	
180	3243.25	II	
90	3243.47	II	14649 – 45471
330	3249.34	II	5133 – 35899
90	3256.35	II	
90	3258.48	II	
560	3259.05	II	
	3259.11	II	14280 – 44955
180	3262.80	II	14280 – 44920
2700	3264.78	II	0 – 30621
90	3266.66	II	5404 – 36007
430	3267.10	II	12388 – 42987
	3267.18	II	12815 – 43413
330	3269.41	II	13060 – 43638
90	3273.32	II	7195 – 37737
90	3277.70	II	0 – 30500
250	3278.22	II	5404 – 35899
720	3279.33	II	5133 – 35618
720	3280.22	II	440 – 30917
180	3286.18	II	7195 – 37617
470	3286.77	II	5404 – 35820
140	3287.99	II	
90	3291.27	II	10893 – 41268
90	3301.93	II	10893 – 41170
330 d	3303.88	II	13060 – 43319
	3303.95	II	13719 – 43977
90	3304.07	II	
370	3305.56	II	7195 – 37439
80	3307.46	II	11042 – 41268
2300	3312.42	II	440 – 30621
90	3313.49	II	14649 – 44820
180	3313.66	II	5133 – 35302
180	3314.43	II	13060 – 43223
80	3314.94	II	0 – 30158
560	3316.39	II	

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
I50	3317.47	II	
80	3318.23	II	11042 – 41170
90	3318.77	II	0 – 30123
770	3323.19	II	5133 – 35215
290	3329.66	II	
770	3332.70	II	7149 – 37146
80	3336.74	II	7150 – 37110
370	3337.25	II	5403 – 35359
290	3337.79	II	7195 – 37146
250	3340.03	II	5133 – 35064
90	3340.48	II	12600 – 42527
90	3341.60	II	
290	3341.84	II	7195 – 37110
150	3343.68	II	
90	3344.37	II	0 – 29892
1300	3346.04	II	440 – 30318
150	3346.35	II	
120	3347.64	II	11042 – 40905
160	3347.73	II	7195 – 37057
180	3348.14	II	0 – 29859
60	3348.76	II	10893 – 40747
470	3350.06	II	13572 – 43413
350	3350.26	II	5133 – 34972
180	3351.32	II	
90	3356.21	II	
180	3358.15	II	5133 – 34902
150	3361.01	II	13558 – 43302
90	3361.67	II	15732 – 45471
1400	3364.08	II	440 – 30158
190	3366.69	I	7696 – 37391
1400 d	3368.02	II	440 – 30123
	3368.13	I	7696 – 37378
450	3370.55	II	5404 – 35063
7700	3372.71	II	0 – 29641
970	3374.17	II	0 – 29628
90	3376.10	II	7150 – 36761
80	3376.99	II	13558 – 43161
70	3379.01	II	14649 – 44235
130	3381.08	II	440 – 30008
290	3381.32	II	7195 – 36761
230	3382.06	I	7176 – 36735
1700	3385.08	II	440 – 29973
150	3389.59	II	7150 – 36643
450	3389.74	II	0 – 29492
2300	3392.00	II	0 – 29472
90	3394.09	II	10667 – 40121
90	3394.39	II	440 – 29892
190	3394.86	II	7195 – 36643
350	3396.07	II	
290	3396.84	II	5133 – 34563
190	3398.27	II	440 – 29859
90	3401.20	II	11043 – 40436
390	3401.83	II	
70	3406.95	II	440 – 29784
180	3408.69	II	14649 – 43977
150	3409.87	I	9350 – 38668
180	3417.28	II	10893 – 40148
350	3417.63	II	
190	3420.18	II	10893 – 40123
190	3422.90	I	9350 – 38556
270	3425.08	II	440 – 29628
490	3428.39	II	7195 – 36355
190	3429.88	II	11042 – 40189
140	3431.06	I	9350 – 38487
270	3433.13	II	0 – 29120
140	3434.63	II	10893 – 40000
100	3437.63	II	11042 – 40124
160	3438.31	II	
80	3438.47	II	
770	3441.13	II	440 – 29492
390	3442.68	I	7696 – 36735
100	3443.75	II	12587 – 41617
270	3446.87	I	10557 – 39561
100	3447.52	II	7150 – 36148
160	3448.06	II	5404 – 34397
160	3453.66	I	7176 – 36123
180	3461.39	II	17378 – 46260
250	3462.57	I	11557 – 40429
270	3464.53	II	5133 – 33988
490	3469.51	I	7696 – 36511
270	3469.72	II	11309 – 40121
970	3471.71	II	
100	3477.93	II	
610	3479.41	II	7195 – 35927
290	3480.44	II	11042 – 39766
100	3484.55	II	7195 – 35885
190	3485.16	II	11309 – 39994
970	3485.85	II	440 – 29120
350	3486.82	II	5403 – 34074
270	3489.35	I	8620 – 37271
140	3492.50	II	7195 – 35820
350	3496.86	II	5133 – 33722
6700	3499.10	II	440 – 29011
610	3502.78	I	7176 – 35717
270	3505.07	II	7150 – 35672
290	3505.68	I	9655 – 38172
390	3508.38	II	11309 – 39804
110	3508.81	I	10557 – 39049
80	3508.93	I	7176 – 35667
490	3514.89	II	
390	3518.18	II	10667 – 39082
210	3522.52	I	7176 – 35557
610	3524.91	II	0 – 28361
270	3526.81	I	11401 – 39747
100	3531.27		
210	3539.47	II	15732 – 43977
410	3539.59	I	11887 – 40131
250	3543.02	II	13027 – 41244
270	3545.86	I	7176 – 35370
270	3547.50	I	11557 – 39738
310	3548.26	II	5132 – 33307
210	3549.55	I	7195 – 35359
820	3549.84	II	5404 – 33566
140	3551.79	II	13027 – 41174
310	3553.20	II	5404 – 33539
210	3554.30	II	7150 – 35277
100	3556.08	I	15185 – 43298
160	3556.39	I	10557 – 38668
100	3556.84	II	7195 – 35302
210	3557.07	I	11401 – 39506
1500	3558.02	I	7696 – 35794
510	3558.71	I	8620 – 36712
1000	3559.90	II	0 – 28082
210	3563.54	I	0 – 28053
310	3565.17	I	9350 – 37391
210	3569.27	I	7176 – 35185
210	3569.93	I	11557 – 39561
160	3570.56	I	10557 – 38556
920	3570.75	II	5132 – 33130
140	3573.86	II	5133 – 33106

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
310	3578.24	I	11799 – 39738	35	3710.79	II	5133 – 32073
190	3579.44	I	10557 – 38487	100	3711.82	II	13060 – 39994
1000	3580.52	II	440 – 28361	520	3712.39	II	6824 – 33753
370	3586.60	I	8620 – 36494	120	3715.97	I	6958 – 33861
210	3587.79	II		100	3717.25	II	14280 – 41174
210	3588.32	I	7696 – 35557	320	3719.35	I	7176 – 34055
610	3590.76	I	8620 – 36461	100	3721.46	II	5404 – 32267
410	3595.84	I	11557 – 39360	65	3723.64	II	12600 – 39447
610	3599.50	II	11309 – 39082	170	3724.36	II	10894 – 37737
1000	3599.83	II	10667 – 38438	90	3724.49	II	
210	3604.71	II	12388 – 40121	230	3724.91	II	7150 – 33988
510	3604.90	II	12815 – 40547	1300	3729.52	II	0 – 26805
160	3605.69	I	6958 – 34684	450	3731.26	II	7195 – 33988
210	3607.20	I	15083 – 42797	55 d	3731.79	II	
410	3607.42	I	9350 – 37062	45	3732.22	I	9350 – 36136
3100	3616.56	II	0 – 27643	190	3734.45	II	5132 – 31902
510	3617.85	II	12815 – 40447	270	3734.58	II	0 – 26769
510	3618.92	II	5404 – 33028	65	3735.71	I	7696 – 34458
100	3625.28	II	17378 – 44955	540	3738.16	II	13060 – 39804
720	3628.04	I	5035 – 32590	180	3740.29	II	13719 – 40447
310	3629.37	I	11887 – 39432	340	3741.10	II	6824 – 33547
210	3630.06	II	19375 – 46915	900	3742.64	II	5133 – 31844
140	3630.30	II		200	3744.99	II	12388 – 39082
140	3631.78	I		140	3745.11	II	11043 – 37737
220	3632.09	II	7150 – 34674	55	3745.71	II	12587 – 39277
100	3632.78	II	13027 – 40547	900	3747.43	I	7176 – 33853
270	3633.26	I	8620 – 36136	55	3749.02	I	9655 – 36321
1000	3633.54	II	0 – 27514	190	3750.54	II	13338 – 39994
5I0	3634.67	I		35	3751.97	II	13188 – 39833
210	3636.41	I	11557 – 39049	540	3756.05	I	7696 – 34313
270	3637.16	II	5133 – 32619	35	3756.40	II	13338 – 39952
1600	3638.68	I		230	3761.99	I	7176 – 33750
270	3641.27	II	13719 – 41174	230	3766.16	II	10894 – 37439
65	3641.92	II		65	3767.73	II	
900	3645.94	II	13027 – 40447	160	3768.79	II	7195 – 33722
65	3646.78	II	7150 – 34563	270	3771.10	II	7150 – 33660
520	3650.41	II	5404 – 32790	110	3772.47	II	7150 – 33650
360	3652.58	II	5132 – 32502	90	3774.84	I	9350 – 35833
500	3652.87	II	7195 – 34563	110	3775.31	I	9655 – 36136
35	3656.38	II	5404 – 32745	230	3775.66	II	16935 – 43413
140	3659.58	I	7696 – 35014	160	3777.62	II	7195 – 33660
110	3660.78	II	19606 – 46915	110	3778.32	II	12388 – 38847
110	3662.04	II	16935 – 44235	140	3778.67	I	7696 – 34153
180	3662.86	I	7696 – 34990	410	3781.01	II	11043 – 37483
360	3664.45	I	7176 – 34458	65	3783.87	II	17842 – 44263
470	3669.02	II	7150 – 34397	1800	3786.84	II	0 – 26400
80	3675.18	II	7195 – 34397	65	3787.38	II	11043 – 37439
190	3676.51	II	7150 – 34342	560	3787.86	II	17842 – 44234
190	3678.95	I	8620 – 35794	110	3791.16	I	8620 – 34990
65	3680.10	II	13558 – 40723	90	3791.54	I	9350 – 35717
500	3682.70	II	7195 – 34342	560	3791.83	II	440 – 26805
320	3684.01	I	7176 – 34313	500	3792.79	I	7696 – 34055
380	3684.28	II	5133 – 32267	560	3797.06	II	440 – 26769
160	3689.12	II	5404 – 32503	80	3798.21	I	6958 – 33279
7900	3692.65	II	440 – 27514	180	3798.63	I	5035 – 31353
450	3696.25	II	7150 – 34196	65	3803.73	I	9350 – 35632
160	3696.92	II	16935 – 43977	45	3806.05	II	14280 – 40547
100	3697.27	I		80	3807.07	II	13I88 – 39447
380	3697.68	I	7696 – 34733	1600	3810.33	I	0 – 26237
540	3700.72	II	440 – 27454	80	3817.75	II	5403 – 31589
190	3701.57	II	7195 – 34203	90	3818.71	II	5132 – 31312
35	3702.51	II	7195 – 34196	65	3827.31	I	5035 – 31155
100	3705.77	I	7176 – 34153	3600	3830.48	II	0 – 26099
160	3706.52	I	9350 – 36321	110	3832.31	II	5404 – 31490
520	3707.64	II	14280 – 41244	80	3832.53	I	15083 – 41168

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
80	3835.65	II	12587 – 38651
200	3837.64	II	12388 – 38438
110	3838.50	I	9350 – 35394
90	3839.26	II	16948 – 42987
40	3842.93	I	
80	3848.31	II	5404 – 31382
90	3849.29	II	0 – 25971
540	3849.91	I	8620 – 34587
320	3851.60	II	7150 – 33106
680	3855.90	I	5035 – 30962
540	3858.39	II	7195 – 33106
7500	3862.85	I	0 – 25880
250	3864.80	II	10894 – 36761
50	3868.23	II	10893 – 36738
50	3871.75	I	11557 – 37378
150	3874.83	I	5035 – 30835
100	3875.72		
1500	3880.61	II	5132 – 30894
1200	3882.89	II	7150 – 32896
100	3884.12	I	13097 – 38836
50	3885.38	II	12587 – 38318
150	3887.15	II	11043 – 36761
250	3888.08	II	
150	3889.79	II	7195 – 32896
400	3890.61	II	11042 – 36738
4200	3892.68	I	0 – 25682
160	3895.80	II	7150 – 32811
5200	3896.23	II	440 – 26099
250	3899.03	I	9350 – 34990
810	3902.76	II	7195 – 32811
50	3903.84	II	17378 – 42987
250	3903.98	I	5035 – 30642
250	3904.56	II	7150 – 32753
1200	3905.40	I	0 – 25598
11000	3906.31	II	0 – 25592
100	3908.44	II	13188 – 38766
110	3910.50	I	5035 – 30600
110	3911.54	II	7195 – 32753
50	3911.91	II	440 – 25996
140	3912.42	II	11309 – 36861
50	3915.69	II	
85	3916.00	I	10751 – 36280
280	3918.05	I	12377 – 37893
210	3918.35	II	5404 – 30917
280	3921.88	II	5403 – 30894
810	3932.25	II	7195 – 32619
3200	3937.01	I	0 – 25392
2100	3938.63	II	0 – 25382
85	3938.92	II	17842 – 43223
50	3939.36	II	13060 – 38438
150	3942.58	I	15083 – 40440
150	3943.18	II	7150 – 32503
3200	3944.42	I	5035 – 30380
550	3948.06	I	8620 – 33942
110	3950.98	I	13097 – 38400
250	3951.48	I	13097 – 38397
320	3956.42	I	0 – 25268
50	3959.90	II	12388 – 37634
160	3961.21	I	9350 – 34587
110	3963.36	II	6824 – 32048
85	3964.51	I	5035 – 30252
280	3966.35	I	10751 – 35955
160	3969.44	II	5132 – 30317
2700	3973.04	I	0 – 25162
3200	3973.58	I	0 – 25159
1400	3974.72	II	440 – 25592
280	3976.73	I	10750 – 35890
810	3977.02	I	5035 – 30172
50	3979.13	II	12587 – 37711
160	3980.14	II	7150 – 32267
160	3980.60	I	12377 – 37492
1100	3982.33	I	6958 – 32062
110	3983.14	II	12600 – 37698
280	3987.53	I	13097 – 38168
810	3987.66	I	5035 – 30105
230	3991.15	I	15083 – 40131
50	3994.85	II	5132 – 30157
60	3995.26	II	13558 – 38580
60	3999.07	I	8620 – 33619
100	3999.16	II	5132 – 30130
230	4004.05	I	6958 – 31926
14000	4007.96	I	0 – 24943
230	4008.18	II	440 – 25382
280	4009.16	II	0 – 24936
150	4009.78	I	9655 – 34587
1100	4012.58	I	6958 – 31873
50	4012.98	II	
350	4015.57	II	5132 – 30028
110	4016.36	I	13097 – 37989
3000	4020.51	I	6958 – 31824
450	4021.55	I	5035 – 29894
110	4022.01	II	18463 – 43319
190	4036.11	I	5035 – 29804
180	4037.69	I	5035 – 29794
75	4039.64	I	12377 – 37125
230	4043.01	II	5403 – 30130
1000	4046.96	I	10751 – 35454
280	4048.34	II	7150 – 31844
200	4049.49	II	0 – 24687
940	4055.47	II	5132 – 29783
550	4059.51	I	10751 – 35378
690	4059.78	II	5404 – 30029
140	4072.38	I	
140	4074.00	II	12587 – 37126
420	4077.88	I	5035 – 29551
550	4081.24	II	440 – 24936
140	4083.05	I	6958 – 31443
3500	4087.63	I	0 – 24457
75	4091.78	I	10557 – 34990
210	4092.90	I	5035 – 29460
140	4094.64	II	0 – 24415
1100	4098.10	I	6958 – 31353
350	4100.56	II	5404 – 29784
60	4103.98	II	5133 – 29492
60	4106.58	II	12587 – 36932
130	4109.33	I	6958 – 31286
140	4112.62	II	16935 – 41244
320	4116.36	I	9655 – 33942
320	4118.55	I	10750 – 35024
140	4123.08	II	
140	4124.76	I	5035 – 29272
600	4131.50	I	6958 – 31155
550	4142.91	II	5132 – 29263
6900	4151.11	I	0 – 24083
60	4160.31	I	10557 – 34587
190	4164.83	I	6958 – 30962
130	4171.54	I	10750 – 34716
140	4172.22	I	5035 – 28996
140	4185.48	I	0 – 23885
280	4189.98	II	5403 – 29263

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
1000	4190.70	I	0 – 23855
140	4194.72	I	13097 – 36930
60	4197.43	I	11401 – 35218
130	4205.32	I	13097 – 36870
1400	4218.43	I	
200	4220.99	I	6958 – 30642
60	4223.49	I	
60	4223.73	II	
320	4230.20	II	
60	4232.46	I	
140	4234.78	II	5404 – 29011
75	4235.18	I	5035 – 28640
60	4237.03	I	11799 – 35394
200	4251.94	II	16935 – 40447
60	4263.72	I	0 – 23447
60	4264.87	I	12377 – 35818
60	4269.95	I	11887 – 35300
140	4276.48	II	12815 – 36192
690	4286.56	I	5035 – 28357
60	4288.51	I	0 – 23311
320	4298.91	I	
60	4301.26	I	12377 – 35620
320	4301.60	II	0 – 23241
140	4303.81	II	5132 – 28361
60	4306.36	I	11799 – 35014
110	4319.94	II	13719 – 36861
130	4328.81	I	10750 – 33845
50	4330.27	II	10667 – 33753
110	4331.36	I	0 – 23080
60	4335.03	I	10557 – 33619
50	4339.00	II	14280 – 37321
140	4340.92	I	11557 – 34587
190	4348.34	I	5035 – 28026
50	4351.63	I	7176 – 30149
110	4369.39	II	10667 – 33547
60	4378.35	II	7195 – 30029
60	4380.65	I	5035 – 27856
160	4382.17	I	7176 – 29989
300	4384.70	II	440 – 23240
300	4386.40	I	7176 – 29967
60	4388.38	II	18463 – 41244
75	4397.42	I	10751 – 33485
100	4403.17	II	17842 – 40547
810	4409.34	I	0 – 22672
75	4413.74	I	8620 – 31270
60	4414.35	I	12377 – 35024
180	4418.70	I	7176 – 29801
570	4419.61	II	13572 – 36192
110	4422.51	II	17842 – 40447
320	4424.57	I	5035 – 27629
370	4426.77	I	0 – 22583
50	4432.23	I	6958 – 29514
110	4437.66	I	10750 – 33279
50	4448.62	II	13719 – 36192
100	4459.24	II	440 – 22859
100	4473.50	II	
85	4484.48	I	7696 – 29989
30	4488.90	I	7696 – 29967
50	4489.05	I	
130	4496.39	I	7696 – 29930
200	4500.75	II	14649 – 36861
45	4503.27	II	
35	4512.21	I	
35	4518.66	I	0 – 22124
75	4519.44	II	
130	4522.74	I	7696 – 29801
35	4526.92	II	18463 – 40547
35	4531.08	I	7696 – 29760
35	4551.99	I	7176 – 29138
75	4552.14	II	17842 – 39804
50	4555.70	I	10750 – 32695
160	4563.26	II	11309 – 33217
35	4563.93	I	
50	4566.38	II	5403 – 27296
35	4569.29	I	16464 – 38344
75	4592.92	I	
45	4596.74	I	7696 – 29445
75	4598.12	I	7176 – 28918
60	4602.07	I	17073 – 38797
1000	4606.61	I	0 – 21702
75	4611.25	II	
30	4624.78	II	
160	4630.88	II	15732 – 37321
110	4640.60	II	14649 – 36192
35	4656.69	II	17378 – 38847
110	4665.44	II	
30	4667.59	II	
45	4671.59	I	
310	4673.16	I	0 – 21392
570	4675.62	II	10667 – 32048
150	4679.06	II	12388 – 33753
35	4688.64	II	
75	4697.17	II	
35	4702.18	II	
30	4708.71	I	
35	4718.69	I	17157 – 38343
230	4722.69	I	0 – 21168
85	4724.54	II	
150	4729.05	I	8620 – 29760
85	4731.59	II	15732 – 36861
40	4736.96	II	16529 – 37634
60	4745.27	I	6958 – 28026
130	4751.52	II	
170	4759.65	II	0 – 21004
60	4762.64	II	16643 – 37634
95	4795.48	II	
190	4820.35	II	11309 – 32048
30	4828.67	I	
21	4829.52	I	7696 – 28397
85	4831.15	II	13060 – 33753
21	4834.74	II	16643 – 37321
60	4842.03	I	5035 – 25682
85	4848.83	I	9350 – 29967
30	4851.64	II	17063 – 37669
40	4853.12	II	
30	4854.41	II	
140	4857.44	I	8620 – 29201
50	4858.47	II	19375 – 39952
35	4861.60	II	440 – 21004
150	4872.09	II	13027 – 33547
30	4872.48	II	0 – 20517
30	4878.33	II	7150 – 27643
26	4879.89	II	13060 – 33547
30	4886.29	II	5132 – 25592
27	4888.84	I	7176 – 27625
27	4896.95	II	13338 – 33753
80	4898.15	I	15083 – 35493
210	4900.08	II	12815 – 33217
55	4903.64	II	19606 – 39994
27	4904.43	II	18463 – 38847

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
27	4917.08	I	19326 – 39658
27	4925.06	I	
45	4925.43	II	
18	4927.00	II	17378 – 37669
22	4927.33	II	23973 – 44263
70	4928.88	I	7176 – 27459
210	4934.11	II	23973 – 44235
130	4944.36	I	8620 – 28839
180	4951.74	II	13027 – 33217
45	4953.60	II	
27	4954.68	II	
35	4966.62	II	19992 – 40121
60	4966.97	I	5035 – 25163
55	4969.88	I	
130	4976.42	I	
35	4990.31	I	15185 – 35218
45	4992.36	II	
90	5000.38	II	0 – 19992
250	5007.25	I	5035 – 25000
90	5008.96	II	
45	5024.28	II	
140	5028.33	I	7696 – 27578
120	5028.91	II	440 – 20319
35	5029.77	II	
200	5035.94	I	9350 – 29201
210	5042.05	II	13719 – 33547
130	5043.86	I	15846 – 35667
130	5044.89	I	7176 – 26993
35	5045.98	II	
55	5052.66	I	15846 – 35632
70	5070.32	II	
130	5077.59	II	
70	5080.52	I	5035 – 24712
60	5119.64	II	
120	5124.56	I	0 – 19508
130	5127.41	II	13719 – 33217
120	5131.53	I	7696 – 27178
130	5133.83	II	14280 – 33753
60	5143.58	II	
35	5144.09	II	
55	5163.80	II	
170	5164.77	II	
130	5172.78	I	0 – 19326
27	5179.49	II	26805 – 46106
160	5188.90	II	14280 – 33547
150	5206.52	I	0 – 19201
60	5212.91	II	
30	5215.13	II	
30	5218.26	II	
45	5229.34	II	21004 – 40121
140	5255.93	II	13027 – 32048
22	5256.47	II	17842 – 36861
27	5257.02	II	
35	5264.77	II	
80	5272.91	I	
55	5277.71	I	9655 – 28598
27	5279.34	II	14280 – 33217
45	5302.30	II	19992 – 38847
55	5333.06	I	16472 – 35218
27	5333.33	II	
27	5334.23	II	
22	5343.94	II	
30	5344.50	II	
90	5348.06	I	9350 – 28043
45	5350.47	I	7176 – 25861
35	5368.85	I	19723 – 38344
35	5395.87	II	20319 – 38847
60	5414.63	II	0 – 18463
18	5422.81	II	
18 h	5451.30	I	
35	5454.27	II	13719 – 32048
180	5456.62	I	9655 – 27977
35	5462.43	II	21819 – 40121
90	5468.32	I	10557 – 28839
18	5477.47	II	
80	5485.97	II	
27	5497.44	II	
27	5516.02	I	11557 – 29681
80	5593.46	I	11887 – 29760
45 d	5601.14	I	10557 – 28406
	5601.32	I	9350 – 27198
45 h	5609.94	I	28053 – 45874
60	5611.82	I	7176 – 24991
70	5622.01	I	7696 – 25479
80	5626.53	II	14280 – 32048
30	5636.20	I	11401 – 29138
90	5640.36	I	9655 – 27380
22	5641.42	I	19362 – 37083
22 h	5658.63	II	
70	5664.95	I	8620 – 26268
45	5665.44	II	
55	5675.48	I	5035 – 22649
14	5695.53	II	11042 – 28595
27	5710.87	II	
55	5717.48	I	10557 – 28043
70	5719.55	I	8620 – 26099
55	5726.97	I	0 – 17456
22	5733.43	II	
22	5736.56	I	17297 – 34724
22	5736.94	I	
100	5739.19	I	10557 – 27977
35	5740.61	I	5035 – 22450
60	5748.65	I	6958 – 24348
55	5752.53	I	10751 – 28130
70	5757.63	II	
290	5762.80	I	0 – 17347
70	5769.92	I	5035 – 22361
45	5782.82	I	6958 – 24246
70	5784.66	I	11557 – 28839
22	5791.15	II	21819 – 39082
70	5800.79	I	5035 – 22269
22	5806.10	I	15083 – 32301
13	5814.23	I	
13	5814.34	I	17796 – 34990
430	5826.79	I	0 – 17157
11	5833.88	II	
45	5835.84	I	
14	5839.95	I	11799 – 28918
18	5841.16	I	11401 – 28516
100	5850.07	I	5035 – 22124
120	5855.31	I	0 – 17073
12	5860.69	II	
14	5871.63	I	10751 – 27777
140	5872.35	I	7696 – 24721
18	5873.53	I	10557 – 27578
120	5881.14	I	8620 – 25619
27	5886.30	II	
27	5902.08	II	440 – 17378
55	5906.06	I	6958 – 23885
45	5909.24	I	9350 – 26268

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
I8		5916.46	I	6958 – 23856
35		5933.50	I	11557 – 28406
14		5937.16	II	
22		5946.37	I	11887 – 28699
55		5968.68	I	9350 – 26099
27		5975.49	I	11557 – 28288
35		6006.79	II	0 – 16643
14	h	6007.90	I	10557 – 27198
22		6008.75	II	
55		6014.83	I	10557 – 27178
35		6015.74	II	21819 – 38438
70		6022.56	I	8620 – 25220
22		6032.12	II	23973 – 40547
22		6045.63	II	
22		6048.14	II	0 – 16529
45		6054.85	I	9350 – 25861
70		6061.25	I	
60		6076.45	II	
14		6105.18	II	17378 – 33753
35		6116.01	I	11401 – 27747
35		6125.32	I	0 – 16321
12		6149.32	II	
30		6170.06	II	440 – 16643
27		6183.21	II	17378 – 33547
360		6221.02	I	0 – 16070
35		6230.90	I	11887 – 27932
55		6262.56	I	9655 – 25619
45		6267.93	I	
60		6268.87	I	11799 – 27747
35		6274.94	I	7696 – 23628
30		6286.86	I	11557 – 27459
18		6288.59	I	16321 – 32218
45		6299.42	I	9350 – 25220
130		6308.77	I	0 – 15846
55		6326.13	I	7176 – 22979
22		6347.16	II	
11		6351.56	II	
45		6388.19	I	16070 – 31719
14		6398.13	I	16321 – 31946
11		6413.59	I	
9		6423.05	I	9655 – 25220
9		6423.17	I	9655 – 25220
22		6432.53	I	10557 – 26099
16		6441.32	II	16552 – 32073
7		6451.56	I	16070 – 31565
7		6454.02	II	
14		6481.74	I	23447 – 38870
27		6485.87	I	
55		6492.35	I	16321 – 31719
12		6520.52	I	21551 – 36883
22		6541.57	I	7696 – 22979
11		6556.33	II	16552 – 31801
18		6557.82	I	16321 – 31565
60		6583.48	I	0 – 15185
16		6593.51	I	
70		6601.11	I	17073 – 32218
12		6616.74	II	23973 – 39082
14		6637.65	I	10557 – 25619
6		6648.97	I	23885 – 38921
4		6649.06	I	16070 – 31105
11		6663.52	I	10751 – 25754
13		6687.14	I	17073 – 32023
7		6690.02	II	20728 – 35671
7		6701.75	I	17029 – 31946
11		6721.00	I	22269 – 37144
27		6721.91	I	17073 – 31946
13		6722.76	I	17347 – 32218
70		6759.87	I	17157 – 31946
12		6761.68	II	
22		6762.92	I	23885 – 38667
11		6764.55	I	17073 – 31852
11		6766.62	I	22124 – 36898
9		6768.42	II	18889 – 33659
18		6768.94	II	
27		6773.37	I	22124 – 36883
16		6776.14	II	
14		6780.03	I	22269 – 37014
18		6780.76	I	6958 – 21702
8		6787.92	I	22269 – 36997
35		6790.92	I	17157 – 31878
14		6796.96	II	6824 – 21533
18		6803.85	II	
22		6825.44	I	24246 – 38893
22		6825.98	I	17073 – 31719
12		6835.90	I	24246 – 38870
70		6848.10	I	17347 – 31946
9		6857.24	I	11557 – 26136
55		6865.13	I	17157 – 31719
11		6873.09	I	
18		6873.66	I	24348 – 38893
16		6874.77	I	11557 – 26099
27		6879.98	I	17347 – 31878
11		6884.09	I	22361 – 36883
7		6892.39	I	17347 – 31852
14		6897.48	II	19903 – 34397
9		6908.23	I	11799 – 26271
12		6925.93	I	6958 – 21392
6		6926.25	I	22450 – 36883
18		6938.36	I	17157 – 31565
6		6944.94	II	18617 – 33012
18		6951.88	I	11887 – 26268
9		6973.01	I	11799 – 26136
7		6989.30	I	11557 – 25861
22		7001.40	I	9350 – 23628
12		7058.55	I	10557 – 24721
12	h	7065.04	I	17796 – 31946
11		7070.99	II	21533 – 35671
18		7101.27	I	11401 – 25479
8		7109.67	I	11799 – 25861
11		7155.40	II	
5		7161.91	I	6958 – 20917
14	h	7197.00	I	
7	h	7264.82	II	
7	h	7283.95	I	
14		7329.73	II	18889 – 32528
18		7355.37	I	11887 – 25479
11		7356.34	I	11401 – 24991
18		7428.67	I	25463 – 38921
55		7459.55	I	18816 – 32218
9		7460.42	I	19125 – 32525
120		7469.51	I	18335 – 31719
22		7532.34	I	25598 – 38870
6	h	7539.18	I	23885 – 37144
27		7556.26	I	18335 – 31565
6	h	7574.21	I	
5	h	7590.51	I	19047 – 32218
11		7597.33	I	23855 – 37014
6		7607.23	I	23855 – 36997
11		7613.52	I	29550 – 42681
6		7623.48	I	23883 – 36997

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
16	h	7645.67	I	24068 – 37144
8		7650.63	I	
22		7654.45	II	0 – 13060
12	h	7658.05	I	
22		7659.25	I	23831 – 36883
4		7665.64	I	
35		7680.01	I	19201 – 32218
9		7722.14	I	27822 – 40769
8		7726.19	II	16552 – 29492
11	h	7747.44	I	26017 – 38921
22		7754.63	I	19326 – 32218
4		7762.16	I	23831 – 36710
9		7796.69	I	19201 – 32023
35		7797.47	I	19125 – 31946
9		7838.80	I	19125 – 31878
11		7844.00	I	19201 – 31946
16		7847.55	I	7176 – 19915
5		7875.36	I	26198 – 38893
5		7879.36	I	16464 – 29152
18		7899.55	I	19563 – 32218
8		7913.08	I	26237 – 38870
35		7921.85	I	19326 – 31946
30		7937.84	I	19125 – 31719
8		7952.93	I	
12		7964.51	I	19326 – 31878
8		7979.03	II	
8		7980.87	I	
5		8023.03	I	19563 – 32023
12		8035.91	I	19125 – 31565
12		8181.85	I	7696 – 19915
35		8312.82	I	7696 – 19723
18		8328.57	II	18617 – 30621
5		8367.58	II	440 – 12388
55		8409.90	I	0 – 11887
11		8466.18	II	16552 – 28361
35		8472.42	I	0 – 11799
14		8517.71	II	
18		8521.37	II	18889 – 30621
22		8768.64	I	0 – 11401
11	h	8776.63	II	18617 – 30008
9		8866.84	II	18617 – 29892

Europium

$$\text{Eu}, Z = 63, M = 151.96, \text{Ratio } \frac{\text{Eu}}{\text{Cu}} = 2.391$$

Eu I Normal state of valence electrons $4f^7 6s^2\ {}^8S^\circ_{3\,1/2} = 0$. I.P. = 45700 cm^{-1}.
Eu II Normal state of valence electrons $4f^7 6s\ {}^9S^\circ_4 = 0$. I.P. = 90660 cm^{-1}.

References

Wavelengths:
A. S. King, Astrophys. J. **89**, 377 (1939).

Classification:
Eu I, H. N. Russell and A. S. King, Astrophys. J. **90**, 155 (1939).
Eu II, H. N. Russell, W. Albertson, and D. N. Davis, Phys. Rev. **60**, 641 (1941).

Strong lines of europium

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
60000 cw	4205.05	II	0 – 23774	6400	3688.42	II	0 – 27104
39000 cw	3819.67	II	0 – 26173	4200	2727.78	II	0 – 36649
33000 cw	4129.70	II	0 – 24208	3400	2813.94	II	0 – 35527
32000 cw	3930.48	II	1669 – 27104	3200	2906.68	II	0 – 34394
30000 cw	3971.96	II	1669 – 26838	3000	4522.57	II	1669 – 23774
28000 cw	3907.10	II	1669 – 27256	2000	2820.78	II	0 – 35441
20000 cw	3724.94	II	0 – 26839	1900	2802.84	II	1669 – 37337
14000 cw	4435.56	II	1669 – 24208	1400	6645.11	II	11128 – 26173
11000	4594.03	I	0 – 21761	1000	2638.77	II	1669 – 39554
9800	4627.22	I	0 – 21605				
8300	4661.88	I	0 – 21445	1000	3212.81	I	0 – 31116

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
21	2499.39	II	1669 – 41667
26	2554.78	II	16861 – 55991
26	2559.18	II	17004 – 56067
160	2564.17	II	17004 – 55991
110	2568.17	II	17141 – 56067
26	2574.76	II	17141 – 55968
230	2577.14	II	16861 – 55652
26	2581.86	II	17248 – 55968
26	2604.61	I	
30	2635.50	II	0 – 37932
1000	2638.77	II	1669 – 39554
380	2641.27	II	0 – 37849
40	2653.61	II	
640	2668.34	II	1669 – 39135
110	2673.42	II	
250	2678.29	II	1669 – 38996
250	2685.66	II	0 – 37224
550	2692.03	II	1669 – 38805
700	2701.14	II	0 – 37011
800	2701.90	II	0 – 37000
240	2705.28	II	0 – 36954
180	2709.99	I	0 – 36890
700	2716.98	II	1669 – 38464
70	2723.96	I	0 – 36700
4200	2727.78	II	0 – 36649
190	2729.33	II	0 – 36628
380	2729.44	II	1669 – 38296
50	2731.37	I	0 – 36601
40	2732.61	I	0 – 36584
80	2735.25	I	0 – 36549
160	2740.62	II	1669 – 38146
70	2743.28	I	0 – 36442
120	2744.26	II	0 – 36429
40	2745.61	I	0 – 36411
70	2747.29	II	1669 – 38058
80	2747.83	I	0 – 36381
90	2752.17	II	1669 – 37994
480	2781.89	II	1669 – 37606
1900	2802.84	II	1669 – 37337
220	2811.75	II	1669 – 37224
30	2813.08	II	
3400	2813.94	II	0 – 35527
550	2816.18	II	1669 – 37168
2000	2820.78	II	0 – 35441
400 cw	2828.72	II	1669 – 37011
120	2829.30	II	1669 – 37003
140	2833.26	II	1669 – 36954
80	2843.96	II	1669 – 36821
60	2852.05	II	
260	2859.67	II	1669 – 36628
280	2862.57	II	0 – 34923
25	2864.42	II	11128 – 46029
60	2876.06	II	1669 – 36429
100	2878.87	I	0 – 34726
80	2887.85	II	0 – 34618
200	2892.54	I	0 – 34562
140	2893.03	I	0 – 34556
360	2893.83	I	
		II	0 – 34546
3200	2906.68	II	0 – 34394
160	2908.99	I	0 – 34366
30	2917.44	II	1669 – 35936
850	2925.04	II	1669 – 35847
60	2947.29	II	0 – 33920
200 cw	2952.68	II	1669 – 35527
30	2958.91	I	0 – 33786
35	2959.47	II	0 – 33780
260	2960.21	II	1669 – 35441
300	2991.33	II	0 – 33420
35	2995.22	II	1669 – 35046
40	3006.26	II	1669 – 34923
35	3022.15	I	
30	3040.77	II	1669 – 34546
320 cw	3054.94	II	1669 – 34394
120	3058.98	I	0 – 32681
35	3069.11	II	24208 – 56781
35	3076.07	II	
220	3077.36	II	0 – 32486
35	3089.35	II	
120	3097.45	II	1669 – 33944
320	3106.18	I	0 – 32185
950	3111.43	I	0 – 32130
120	3130.73	II	
40	3132.16	I	
45	3149.88	II	
85	3173.61	II	0 – 31501
40	3185.54	I	0 – 31383
420	3210.57	I	0 – 31138
1000	3212.81	I	0 – 31116
420	3213.75	I	0 – 31107
45	3235.13	I	0 – 30902
95	3241.40	I	0 – 30842
45	3246.03	I	0 – 30798
45	3247.32	II	
100	3247.55	I	0 – 30784
100	3266.39	II	23774 – 54380
150	3272.77	II	23774 – 54321
210	3277.78	II	23774 – 54274
150	3301.95	II	24208 – 54484
45	3304.50	II	
140	3308.02	II	24208 – 54429
140	3313.33	II	24208 – 54380
65	3319.89	II	24208 – 54321
95	3321.86	II	11128 – 41223
85	3322.26	I	0 – 30091
950	3334.33	I	0 – 29982
45	3338.75	II	26838 – 56781
110	3350.40	I	0 – 29839
40	3351.56	II	
40	3354.38	II	
45	3367.64	II	10082 – 39768
140	3369.06	II	10643 – 40317
65	3380.25	II	24208 – 53783
75	3390.78	II	
190	3391.99	II	10082 – 39554
280	3396.58	II	26838 – 56271
45	3419.84	II	
65	3423.09	II	
150	3425.02	II	11128 – 40317
45	3426.44	II	9923 – 39099
45	3435.05	II	
65	3435.20	II	
40	3435.72	II	
45	3440.82	II	27256 – 56311
150	3441.00	II	10082 – 39135
45	3445.18	II	10082 – 39099
85	3457.05	I	0 – 28918
45	3457.56	II	10082 – 38996
130	3461.38	II	9923 – 38805
85	3467.88	I	0 – 28828

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
75	3477.07	I	
75 h	3505.30	II	1669 – 30189
470 cw	3521.09	II	26173 – 54565
75	3531.15	II	26173 – 54484
45	3532.23	II	27256 – 55559
65	3538.08	II	26173 – 54429
150	3542.15	II	9923 – 38146
85	3543.85	II	
45	3549.71	II	
180	3552.52	II	10643 – 38784
75	3589.27	I	0 – 27853
45	3591.31	II	
150	3603.20	II	10313 – 38058
75	3611.57	II	10313 – 37994
45	3616.15	II	26838 – 54484
95	3622.54	II	11128 – 38725
95	3632.18	II	10082 – 37606
45	3673.19	II	27104 – 54321
45	3674.63	II	10643 – 37849
45	3678.26	II	27256 – 54435
6400	3688.42	II	0 – 27104
60	3710.87	II	10643 – 37584
95	3713.45	II	10082 – 37003
95	3714.90	II	10313 – 37224
35	3716.94	II	
35	3717.69	II	
40	3719.16	I	14564 – 41444
20000 cw	3724.94	II	0 – 26839
45	3729.68	II	
45	3729.74	II	11128 – 37932
21	3732.20	I	14068 – 40854
45	3738.08	II	
350	3741.31	II	11128 – 37849
100	3743.56	II	9923 – 36628
260	3761.12	II	10643 – 37224
95	3765.93	II	10082 – 36628
40	3774.10	I	16612 – 43101
60	3781.40	II	
40	3788.76	II	27104 – 53490
45	3791.50	II	10643 – 37011
130	3799.01	II	10313 – 36628
70	3801.36		
95	3807.54	II	
120	3811.33	I	14068 – 40298
120	3815.50	II	
39000 cw	3819.67	II	0 – 26173
120	3826.68	II	26838 – 52963
140	3844.23	II	10643 – 36649
190	3865.57	I	15582 – 41444
45	3872.72	I	15582 – 41396
70	3877.27	II	
150	3884.75	I	14564 – 40298
23	3896.78	I	
23	3900.18	I	
70	3900.51	I	13222 – 38852
28000 cw	3907.10	II	1669 – 27256
45	3915.24	II	
45	3916.00	I	
230	3917.29	I	13049 – 38569
23	3917.70	II	9923 – 35441
40	3918.52	I	13779 – 39291
100	3919.09	II	
40	3928.87	II	10082 – 35527
32000 cw	3930.48	II	1669 – 27104
55	3941.56	II	
30 h	3942.21	II	10082 – 35441
60	3942.94	II	
120	3943.08	II	23774 – 49128
30	3944.59	II	
30	3945.67	II	
30	3949.13	II	
60	3949.60	I	13049 – 38361
45	3950.76	II	
55	3951.33	II	
60	3955.75	I	15582 – 40854
40	3957.92	II	
30	3963.61	I	15952 – 41175
120	3964.90	II	10313 – 35527
150	3966.59	II	
45	3967.18	I	14068 – 39268
30000 cw	3971.96	II	1669 – 26838
60	3978.42	I	13457 – 38586
30	3979.63	II	
55 h	3986.60	I	13457 – 38534
40	3988.24	II	
30	3993.93	II	
55	3995.98	II	
60	4003.71	II	
180	4011.69	II	24208 – 49128
150	4017.58	II	10643 – 35527
120	4039.19	I	
45 h	4078.24	I	13779 – 38292
120	4085.38	II	9923 – 34394
75	4096.80	II	10643 – 35046
60	4106.88	I	12924 – 37266
90 h	4112.04	II	10082 – 34394
45	4119.30	II	
75	4127.28	I	16080 – 40302
33000 cw	4129.70	II	0 – 24208
30	4136.59	II	
40	4137.07	I	16080 – 40245
30	4141.02	II	
60	4141.72	II	
30	4151.52	II	10313 – 34394
45	4151.64	II	
30	4157.72	I	13049 – 37094
110	4172.80	II	
30	4175.16	II	
110	4182.22	I	13222 – 37126
40	4195.36	II	
40	4196.18	II	
60000 cw	4205.05	II	0 – 23774
45	4221.08	II	
40	4223.88	II	
90 h	4227.40	II	
75	4229.33	II	
75	4232.45	II	
90	4237.51	II	
45	4238.69	II	
45	4244.74	I	13049 – 36601
45	4247.06	II	
45	4253.80	II	
30	4270.24	II	
150	4298.73	I	13779 – 37035
90	4329.36	I	13457 – 36549
75	4329.97	I	13779 – 36867
60	4330.61	II	
40	4331.18	I	12924 – 36006
90	4337.68	I	13457 – 36504
240	4355.09	II	26173 – 49128

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
27		4361.57	II	
55		4369.47	II	
45	h	4372.20	II	
75		4383.17	II	26838 – 49647
90		4387.88	I	13222 – 36006
21	h	4405.27	II	16861 – 39554
55		4407.07	II	
18		4419.66	II	
120		4434.81	II	27104 – 49647
14000	cw	4435.56	II	1669 – 24208
75	h	4464.97	II	27256 – 49647
24		4485.15	II	26838 – 49128
3000		4522.57	II	1669 – 23774
45	h	4535.59	I	15952 – 37994
11000		4594.03	I	0 – 21761
21		4602.63	I	16080 – 37800
9800		4627.22	I	0 – 21605
8300		4661.88	I	0 – 21445
30		4713.59	I	15680 – 36890
27		4740.50	I	13457 – 34546
45		4792.59	I	13457 – 34317
40	h	4829.30	I	15680 – 36381
60		4830.33	I	17341 – 38037
40	h	4840.47	I	17341 – 37994
60	h	4849.64	I	15952 – 36567
110		4867.62	I	13779 – 34317
40	h	4884.05	I	16080 – 36549
90		4894.68	I	16080 – 36504
60		4900.86	I	14068 – 34467
150		4907.18	I	14068 – 34440
180		4911.40	I	14068 – 34423
55		4953.52	I	15891 – 36073
55		4960.21	I	15891 – 36045
55		4962.55	I	15952 – 36098
45		4975.76	I	17945 – 38037
180		5013.17	I	14564 – 34506
170		5022.91	I	14564 – 34467
110		5029.54	I	14564 – 34440
90		5033.55	I	15952 – 35813
75		5067.95	I	13222 – 32948
75	h	5092.69	I	16612 – 36242
90	h	5096.44	I	19447 – 39063
170		5114.37	I	13049 – 32596
90		5124.77	I	15891 – 35398
170		5129.10	I	13457 – 32948
90		5130.08	I	15891 – 35378
210		5133.52	I	12924 – 32398
270		5160.07	I	13222 – 32596
210		5166.70	I	13049 – 32398
60		5193.74	I	17341 – 36589
200		5199.85	I	17341 – 36567
110		5200.96	I	15952 – 35174
120		5206.44	I	16612 – 35813
750		5215.10	I	13779 – 32948
300		5223.49	I	13457 – 32596
120		5239.24	I	13049 – 32130
200		5266.40	I	13779 – 32762
390		5271.96	I	15582 – 34545
110		5272.48	I	13457 – 32418
150		5282.82	I	15582 – 34506
55		5287.25	I	13222 – 32130
60		5289.25	I	17707 – 36608
120		5291.26	I	19273 – 38167
60		5293.68	I	15582 – 34467
120		5294.64	I	17707 – 36589
90		5303.85	I	16612 – 35461
30	h	5350.41	I	17945 – 36630
75	h	5351.69	I	15421 – 34102
40		5352.84	I	17945 – 36622
90		5355.10	I	16612 – 35280
540		5357.61	I	13457 – 32117
60		5360.83	I	15138 – 33786
120		5361.61	I	16080 – 34726
110		5376.94	I	16612 – 35205
120		5392.94	I	15249 – 33786
450		5402.77	I	13222 – 31726
45		5405.33	I	16612 – 35107
45		5411.86	I	17341 – 35813
55		5421.07	I	16612 – 35053
90		5426.94	I	15680 – 34102
40		5443.56	I	15421 – 33786
380		5451.51	I	13779 – 32117
260		5452.94	I	13049 – 31383
40		5457.62	I	19273 – 37591
90		5472.32	I	13457 – 31726
120		5488.65	I	12924 – 31138
45		5495.20	I	12924 – 31116
15		5500.83	I	15952 – 34126
120		5510.52	I	14068 – 32210
30		5526.63	I	13049 – 31138
30		5533.25	I	13049 – 31116
30		5542.54	I	17341 – 35378
200		5547.44	I	12924 – 30945
150		5570.33	I	13779 – 31726
200		5577.14	I	13457 – 31383
75		5579.63	I	14564 – 32481
120		5580.03	I	13222 – 31138
90		5586.24	I	13049 – 30945
75		5586.83	I	13222 – 31116
18		5592.25	I	12924 – 30801
18		5599.80	I	13049 – 30902
18		5605.86	I	17341 – 35174
40		5618.81	I	13222 – 31014
60		5622.44	I	14068 – 31849
75		5632.54	I	13049 – 30798
210		5645.80	I	0 – 17707
15		5651.11	I	17707 – 35398
60		5673.85	I	13222 – 30842
27		5681.10	I	13222 – 30819
27		5684.24	I	19447 – 37035
60		5730.87	I	13457 – 30902
60		5739.00	I	19447 – 36867
330		5765.20	I	0 – 17341
180		5783.69	I	14564 – 31849
15		5792.72	I	19631 – 36890
60		5800.27	I	13779 – 31014
170		5818.74	II	9923 – 27104
600	cw	5830.98	I	13779 – 30924
27		5845.77	I	19447 – 36549
27		5860.97	I	19447 – 36504
15		5864.77	I	19364 – 36411
90		5872.98	II	10082 – 27104
15		5895.31	I	19544 – 36502
27		5902.97	I	19764 – 36700
12		5909.94	I	15680 – 32596
75		5915.74	I	15582 – 32481
12		5925.30	I	19712 – 36584
27		5926.52	I	16080 – 32948
45		5942.72	I	19462 – 36285
27		5953.49	I	19794 – 36586

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
27	5953.84	II	10313 – 27104
30	5954.28	I	19794 – 36584
90	5963.76	I	15421 – 32185
330	5966.07	II	10082 – 26838
480 cw	5967.10	I	13457 – 30211
15 h	5968.43	I	19631 – 36381
30	5971.69	I	19544 – 36285
170	5972.75	I	15680 – 32418
15	5980.47	I	19364 – 36081
27	5983.14	I	15421 – 32130
27	5983.78	I	19364 – 36072
240	5992.83	I	16080 – 32762
60	6004.36	I	15138 – 31788
15 h	6005.61	I	15680 – 32327
60 h	6012.20	I	15582 – 32210
110	6012.56	I	15249 – 31876
60	6015.58	I	19462 – 36081
420	6018.15	I	0 – 16612
60	6023.15	I	15138 – 31736
170	6029.00	I	15421 – 32003
60	6044.66	I	15249 – 31788
420	6049.51	II	10313 – 26838
140	6057.36	I	15680 – 32185
90	6075.58	I	15421 – 31876
30	6077.38	I	15680 – 32130
240	6083.84	I	13779 – 30211
240	6099.35	I	13222 – 29613
60	6108.15	I	19364 – 35732
120	6118.78	I	16080 – 32418
60	6124.67	I	15680 – 32003
330	6173.05	II	10643 – 26838
110	6178.76	I	19273 – 35453
260 cw	6188.13	I	13457 – 29613
140	6195.07	I	13049 – 29186
15 h	6207.60	I	16080 – 32185
15	6230.51	I	15680 – 31726
90 h	6233.73	I	16080 – 32117
55	6250.47	I	12924 – 28918
240	6262.25	I	13222 – 29186
55	6266.95	I	0 – 15952
15 h	6285.95	I	12924 – 28828
60	6291.34	I	0 – 15891
170	6299.77	I	13049 – 28918
230	6303.41	II	10313 – 26173
24 h	6313.78	I	13779 – 29613
15	6318.58	I	19631 – 35453
75	6335.82	I	13049 – 28828
120 cw	6350.04	I	12924 – 28667
60	6355.89	I	13457 – 29186
60	6369.25	I	13222 – 28918
55	6382.73	I	15138 – 30801
75	6383.86	I	15138 – 30798
120 cw	6400.93	I	13049 – 28667
40	6406.11	I	13222 – 28828
180	6410.04	I	12924 – 28520
140	6411.32	I	15249 – 30842
55	6428.29	I	15249 – 30801
830	6437.64	II	10643 – 26173
18	6439.93	I	15421 – 30945
120	6457.96	I	15421 – 30902
12	6470.70	I	14068 – 29518
18	6483.02	I	15421 – 30842
45	6501.55	I	15421 – 30798
60	6519.59	I	15680 – 31014
15	6522.72	I	15891 – 31217
8 h	6549.12	I	15952 – 31217
75	6567.87	I	15680 – 30902
45	6593.79	I	15680 – 30842
18 h	6603.55	I	15680 – 30819
1400	6645.11	II	11128 – 26173
26	6685.21	I	14564 – 29518
95	6693.96	I	16080 – 31014
7 h	6701.06	I	19447 – 34366
12 h	6710.45	I	21761 – 36659
30	6744.88	I	16080 – 30902
30 h	6782.54	I	16080 – 30819
14 h	6787.48	I	15891 – 30619
140	6802.72	I	14068 – 28764
35	6816.06	I	15952 – 30619
11 h	6834.30	I	21445 – 36073
17	6840.93	I	21605 – 36219
17 h	6844.83	I	16612 – 31217
14 h	6847.04	I	21445 – 36045
360	6864.54	I	0 – 14564
21	6898.21	I	21605 – 36098
60 h	6903.67	I	21761 – 36242
14 h	6910.17	I	21605 – 36073
30 h	6914.82	I	21761 – 36219
120	7040.20	I	14564 – 28764
12	7074.54	I	16080 – 30211
330	7077.10	II	10082 – 24208
100	7106.48	I	0 – 14068
6	7164.66	I	21445 – 35398
30	7175.55	I	15680 – 29613
570	7194.81	II	10313 – 24208
570	7217.55	II	9923 – 23774
11 h	7224.68	I	21445 – 35282
15	7258.72	I	21605 – 35378
30	7262.77	I	15421 – 29186
11 h	7281.53	I	21445 – 35174
6 h	7297.56	I	21761 – 35461
540	7301.17	II	10082 – 23774
11	7310.46	I	21605 – 35280
12	7313.63	I	15249 – 28918
55 cw	7336.18	I	15891 – 29518
4	7346.25	I	21445 – 35053
4	7356.65	I	21445 – 35034
11	7362.25	I	15249 – 28828
55 cw	7369.60	I	15952 – 29518
720	7370.22	II	10643 – 24208
4	7387.36	I	16080 – 29613
12	7389.16	I	15138 – 28667
11 h	7404.41	I	21605 – 35107
300	7426.57	II	10313 – 23774
21 h	7436.59	I	21761 – 35205
8	7470.53	I	15138 – 28520
5 h	7491.00	I	21761 – 35107
50 cw	7528.70	I	17341 – 30619
5 h	7533.02	I	15249 – 28520
6	7547.32	I	15421 – 28667
160	7583.91	I	15582 – 28764
60 cw	7742.57	I	17707 – 30619
70	7746.19	I	16612 – 29518
8 h	7803.32	I	15952 – 28764
8	7818.21	I	19631 – 32418
35	7887.99	I	17945 – 30619
7	8015.47	I	19712 – 32185
24 cw	8209.80	I	17341 – 29518
15 cw	8226.81	I	16612 – 28764
6 h	8464.71	I	17707 – 29518

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
21 cw	8642.67	I	19447 – 31014				
7	8727.77	I	19447 – 30902				
6	8782.46	I	19631 – 31014				
12 cw	8790.88	I	19447 – 30819				
18	8870.30	I	19631 – 30902				

Gadolinium

$$\text{Gd}, Z = 64, M = 157.2, \text{Ratio}\frac{\text{Gd}}{\text{Cu}} = 2.475$$

Gd I Normal state of valence electrons $4f^7 5d 6s^2\ {}^9\text{D}^\circ_2 = 0$. I.P. $= 49500\ \text{cm}^{-1}$.
Gd II Normal state of valence electrons $4f^7 5d 6s\ {}^{10}\text{D}^\circ_{21/2} = 0$. I.P. $= 97500\ \text{cm}^{-1}$.

References

Wavelengths:
A. S. King, Astrophys. J. **97**, 323 (1943).

Classification:
Gd I and Gd II, H. N. Russell, J. Opt. Soc. Am. **40**, 550 (1950).
J. Blaise, J. Chevillard, J. Verges and J. F. Wyart Spectrochimica Acta **26B**, 1(1971).

Molecular Spectra:
GdO, A. Gatterer, J. Junkes and E. W. Salpeter, Molecular Spectra of Metallic Oxides (Specola Vaticana, 1957).

Strong lines of gadolinium

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
8700	3768.39	II	633 – 27162	2900	3783.05	I	999 – 27425
6900	3422.47	II	1935 – 31146	2800	4078.70	I	533 – 25044
6100	3646.19	II	1935 – 29353	2700	3439.99	II	1935 – 30997
5400	3350.47	II	1159 – 30997	2700	3463.98	II	3444 – 32304
5400	3362.23	II	633 – 30367	2700	3664.60	II	7992 – 35272
5400	3584.96	II	1159 – 29045	2700	3712.70	II	3082 – 30009
5100	3796.37	II	262 – 26595	2600	4053.64	I	999 – 25661
5100	3850.97	II	0 – 25960	2600	4058.22	I	215 – 24850
4800	4225.85	I	1719 – 25376	2600	4098.61	II	6605 – 30997
4500	3743.47	II	1159 – 27865	2600 d	4325.57	II	11067 – 34179
4300	3358.62	II	262 – 30027		4325.69	I	533 – 23644
4300	3545.80	II	1159 – 29353	2400	4175.54	I	1719 – 25661
4300	3852.45	II	262 – 26212	2400	4184.25	II	3972 – 27865
3900	3549.36	II	1935 – 30101	2200	3481.28	II	4841 – 33558
3900	3654.62	II	633 – 27988	2200	3916.51	II	4841 – 30367
3700	3813.97	II	0 – 26212	2200	4049.86	II	7992 – 32677
3500	3100.50	II	1935 – 34179	2200	4130.37	II	5897 – 30101
3300	3850.69	II	633 – 26595	2200	4190.78	I	999 – 24854
3100	3656.15	II	1159 – 28502	2200	4346.46	I	999 – 24000
3100	3687.74	II	2857 – 29966				

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
100	2468.22	II	8551 – 49054	70	3003.58	II	3427 – 36711
55	2471.58	II	8885 – 49332	100	3005.09	II	3444 – 36711
35	2485.67	II	9329 – 49547	70	3009.37	II	3427 – 36647
70	2487.46	II	9143 – 49332	35	3009.65	II	4841 – 38058
110	2488.72	II	8885 – 49054	2100	3010.13	II	0 – 33212
55	2493.29	II	9452 – 49547	80	3010.90	II	3444 – 36647
35	2496.35	II	9452 – 49498	130	3012.19	II	4841 – 38030
45	2499.04	II	9329 – 49332	40	3022.10	II	10292 – 43372
28	2543.68	II	3444 – 42745	1900	3027.60	II	1159 – 34179
28	2586.13	II	3972 – 42628	120	3028.98	II	4841 – 37846
28	2661.50	II	11492 – 49054	45	3030.65	II	10292 – 43279
70	2720.50	II		2100	3032.84	II	633 – 33596
430	2750.22	II	3427 – 39777	1600	3034.05	II	262 – 33212
460	2764.08	II	2857 – 39025	60	3040.34	II	4852 – 37734
40	2768.51	II	3427 – 39537	130	3043.01	I	999 – 33852
320	2769.81	II	3444 – 39537	160	3046.48	I	533 – 33348
230	2770.17	II	3082 – 39170	280	3053.57	II	3972 – 36711
21	2770.98	II	2856 – 38934	100	3059.92	I	215 – 32886
45	2778.76	I	215 – 36192	1000	3068.64	II	633 – 33212
45	2779.14	II	2857 – 38828	70	3069.42	I	215 – 32785
440	2781.40	II	3082 – 39025	560	3072.56	II	10092 – 42628
70	2787.68	I	533 – 36395	640	3076.92	II	0 – 32491
390	2791.96	II	3444 – 39251	150	3077.08	II	3972 – 36461
100	2794.66	II	2857 – 38629	2100	3081.99	II	1159 – 33596
930	2796.93	II	3427 – 39170	95	3083.35	II	262 – 32685
60	2808.38	II	3427 – 39025	140	3084.01	II	9943 – 42359
750	2809.72	II	3444 – 39025	70	3085.06	II	9092 – 41497
160	2810.93	II	3972 – 39537	95	3087.05	I	0 – 32384
45	2814.01	II	7992 – 43518	280	3089.95	II	10392 – 42745
300	2833.75	II	3972 – 39251	140	3092.06	II	10633 – 42965
35	2836.69	II	9943 – 45185	460	3098.64	II	0 – 32263
70	2837.00	II	3082 – 38320	190	3098.90	II	0 – 32260
560	2840.23	II	3972 – 39170	3500	3100.50	II	1935 – 34179
140	2841.33	II	3444 – 38629	120	3101.18	II	10392 – 42628
40	2853.91	II		230	3101.91	II	262 – 32491
60	2856.52	II	4027 – 39025	580	3102.55	II	8551 – 40773
19	2859.78	II	4213 – 39170	130	3108.36	II	10803 – 42965
120	2862.48	II	4852 – 39777	170	3111.19	I	1719 – 33852
60	2865.06	II	3427 – 38320	160	3113.17	II	10633 – 42745
40	2866.33	II	10292 – 45170	120	3118.60	II	10908 – 42965
40	2871.75	II	4213 – 39025	120	3119.01	I	533 – 32585
460	2881.33	II	4841 – 39537	510	3119.94	II	262 – 32304
40	2882.13	II	4484 – 39170	100	3120.18	II	8885 – 40925
130	2885.60	II	7992 – 42636	60	3123.69	II	8884 – 40888
35	2907.44	II	9092 – 43476	370	3123.99	II	262 – 32263
170	2910.53	II	3972 – 38320	120	3124.25	II	262 – 32260
60	2913.08	II	4852 – 39170	95	3127.25	I	999 – 32967
45	2918.52	II	9943 – 44197	130	3128.56	II	9143 – 41097
95	2923.32	II	5340 – 39537	95	3129.96	II	9452 – 41392
35	2924.25	II	9092 – 43279	130	3130.81	II	9329 – 41260
35	2928.34	II	2857 – 36996	100	3133.09	II	0 – 31908
35	2947.80	II	3082 – 36996	460	3133.85	II	8885 – 40785
70	2948.01	II	5340 – 39251	210	3135.03	II	262 – 32150
35	2952.43	I	1719 – 35579	190	3136.93	I	0 – 31869
35	2955.60	II	9092 – 42916	190	3137.30	I	0 – 31865
70	2960.93	II	3082 – 36845	120	3138.71	I	533 – 32384
130	2963.60	II	9092 – 42825	95	3142.90	II	9452 – 41260
80	2965.43	II	4841 – 38553	230	3143.13	II	4841 – 36647
29	2972.74	II	3082 – 36711	930	3145.00	II	1159 – 32946
560	2980.15	II	633 – 34179	370	3145.52	II	9143 – 40925
35	2983.74	II	7992 – 41497	230	3146.88	II	9329 – 41097
40	2991.52	II	3427 – 36845	980	3156.53	II	633 – 32304
95	2993.04	II	3444 – 36845	200	3158.63	I	215 – 31865
1200	2999.04	II	262 – 33596	140	3160.69	II	633 – 32263
370	3002.86	II	7992 – 41284	980	3161.37	II	1935 – 33558

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
80	3167.20	I	999 – 32564
80	3169.47	II	11084 – 42626
90	3171.09	II	1159 – 32685
220	3190.28	I	533 – 31869
90	3193.17	II	5340 – 36647
220	3199.30	I	1719 – 32967
160	3199.58	I	533 – 31778
110	3203.41	I	999 – 32207
70	3206.47	II	18369 – 49547
50	3215.26	I	999 – 32092
690	3223.74	II	1935 – 32946
	3223.78	I	1719 – 32730
110	3225.46	II	9092 – 40086
160	3226.32	II	8551 – 39537
220	3232.78	I	533 – 31457
90	3238.62	II	10392 – 41260
100	3250.19	II	10633 – 41392
110	3259.25	II	10803 – 41476
540	3266.73	I	533 – 31136
250	3267.64	I	215 – 30809
140	3268.34	II	262 – 30850
110	3274.18	II	10392 – 40925
110	3279.53	II	10908 – 41392
100	3281.61	II	10633 – 41097
250	3282.25	I	999 – 31457
	3282.30	II	10803 – 41260
430	3291.48	I	1719 – 32092
370	3292.21	II	8885 – 39251
430	3294.08	I	533 – 30882
330	3313.73	II	3427 – 33596
200	3315.59	II	3444 – 33596
90	3316.56	II	9943 – 40086
190	3320.44	II	9143 – 39251
130	3329.34	II	9143 – 39170
430	3330.34	II	7992 – 38010
1400	3331.38	II	0 – 30009
830	3332.13	II	8551 – 38553
90	3334.06	II	9092 – 39077
1100	3336.18	II	0 – 29966
90	3336.98	II	8551 – 38510
590	3345.98	II	0 – 29878
200	3350.10	II	9329 – 39170
5400	3350.47	II	1159 – 30997
220	3357.61	I	533 – 30308
270	3358.43	II	3444 – 33212
4300	3358.62	II	262 – 30027
780	3360.71	II	262 – 30009
5400	3362.23	II	633 – 30367
270	3364.24	II	0 – 29716
200	3365.59	II	262 – 29966
150	3367.66	II	10092 – 39777
150	3369.62	II	8885 – 38553
100	3373.84	I	0 – 29631
220	3374.69	II	3972 – 33596
220	3379.76	II	10392 – 39971
100	3380.01	II	7992 – 37569
220	3380.52	II	9452 – 39025
90	3390.88	II	9452 – 38934
1100	3392.53	II	633 – 30101
150	3393.63	II	10633 – 40092
540	3395.12	II	10092 – 39537
220 d	3397.22	I	1719 – 31147
	3397.32	I	0 – 29426
200	3399.41	II	3082 – 32491
540	3399.99	II	2857 – 32260
110	3401.07	II	633 – 30027
540	3402.07	II	10392 – 39777
110	3403.08	II	9452 – 38828
90	3405.04	II	10803 – 40162
200	3406.92	I	533 – 29877
1100 d	3407.56	II	10633 – 39971
	3407.61	II	4841 – 34179
250	3409.30	II	3427 – 32750
220	3411.02	I	999 – 30308
110	3412.02	II	9329 – 38629
220	3413.27	II	10803 – 40092
1400	3416.95	II	3427 – 32685
130	3417.33	II	10908 – 40162
1400	3418.73	II	0 – 29242
6900	3422.47	II	1935 – 31146
390	3422.75	II	1159 – 30367
1100	3423.90	I	999 – 30197
	3423.92	II	0 – 29198
830	3424.59	II	2857 – 32049
390	3425.93	II	3082 – 32263
100	3426.34	II	9143 – 38320
220	3428.47	II	10092 – 39251
110	3430.24	II	10633 – 39777
150	3430.98	II	9092 – 38230
690	3432.99	II	2857 – 31977
1700	3439.21	II	3082 – 32150
830	3439.78	II	3427 – 32491
2700	3439.99	II	1935 – 30997
110	3441.79	II	3444 – 32491
390	3449.62	II	262 – 29242
1400	3450.38	II	3972 – 32946
1100	3451.23	II	3082 – 32049
540	3454.14	II	1159 – 30101
880	3454.90	II	262 – 29198
200	3455.27	I	1719 – 30652
200	3457.05	II	9092 – 38010
220	3461.95	II	3427 – 32304
220	3463.00	II	1159 – 30027
2700	3463.98	II	3444 – 32304
100	3466.50	II	5340 – 34179
330	3466.95	II	3427 – 32263
1700	3467.27	II	3427 – 32260
150	3468.08	II	3082 – 31908
1700	3468.99	II	3444 – 32263
80	3469.31	II	3444 – 32260
1400	3473.22	II	262 – 29045
150	3476.31	II	10292 – 39050
2200	3481.28	II	4841 – 33558
1700	3481.80	II	3972 – 32685
490	3482.60	II	3444 – 32150
220	3486.20	I	533 – 29209
110	3491.74	II	11084 – 39715
980	3491.95	II	0 – 28629
1700	3494.40	II	633 – 29242
90	3497.09	I	533 – 29120
100 h	3501.58	II	9092 – 37643
80	3503.21	II	10633 – 39170
1400	3505.51	II	3972 – 32491
780	3512.22	II	3444 – 31908
1100	3512.50	II	10092 – 38553
830	3513.65	I	999 – 29451
90	3516.78	II	11670 – 40097
100	3517.89	II	10092 – 38510
90	3522.45	II	2857 – 31238
980	3524.20	II	262 – 28629

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
110		3525.15	I	999 – 29359
430		3528.54	II	3972 – 32304
100		3534.24	II	9944 – 38230
150		3537.15	II	10292 – 38556
540		3542.77	II	5340 – 33558
4300		3545.80	II	1159 – 29353
3900		3549.36	II	1935 – 30101
90		3553.72	II	10803 – 38934
1400		3557.05	II	4841 – 32946
540		3558.19	II	8551 – 36647
430		3558.47	II	4852 – 32946
200		3564.05	II	4213 – 32263
90		3564.64	II	11670 – 39715
110	d	3567.12	II	10803 – 38828
110		3567.65	II	4027 – 32049
100		3569.57	II	4484 – 32491
90		3570.41	II	12309 – 40309
690		3571.93	II	0 – 27988
330		3574.74	II	10092 – 38058
100		3576.77	II	4027 – 31977
390		3578.36	II	4213 – 32150
100		3579.55	II	10392 – 38320
150		3580.62	II	10908 – 38828
980		3581.91	II	8551 – 36461
100		3583.65	I	215 – 28112
5400		3584.96	II	1159 – 29045
90		3586.58	II	11670 – 39544
150		3587.19	II	633 – 28502
80		3588.21	I	0 – 27861
540		3590.47	II	4841 – 32685
90		3591.44	II	4213 – 32049
130		3591.91	II	4852 – 32685
1100		3592.71	II	8885 – 36711
200		3593.44	II	4484 – 32304
110		3596.84	I	999 – 28793
540		3600.96	II	8885 – 36647
100		3602.00	II	10092 – 37846
1100		3604.87	I	1719 – 29451
270		3605.26	II	9092 – 36821
250		3605.66	II	262 – 27988
130		3607.12	II	12309 – 40024
830		3608.75	II	9143 – 36845
830		3610.76	II	10633 – 38320
220		3610.91	II	9092 – 36778
80		3612.88	II	
540		3613.39	II	9329 – 36996
270	d	3614.21	II	5897 – 33558
		3614.42	I	0 – 27660
430		3617.16	II	10392 – 38030
390		3620.46	II	7992 – 35605
190		3622.81	II	11084 – 38679
270		3624.89	II	10292 – 37872
170		3625.26	II	8885 – 36461
170	d	3626.32	II	9143 – 36711
		3626.41	II	11670 – 39237
250		3629.51	II	9452 – 36996
90		3630.25	II	10292 – 37831
130		3630.88	II	11344 – 38877
330		3634.76	II	9143 – 36647
220		3639.05	II	12072 – 39544
250		3640.18	II	4841 – 32304
330		3641.39	II	10392 – 37846
870		3645.62	II	3427 – 30850
6100		3646.19	II	1935 – 29353
100		3648.48	I	1719 – 29120
310		3649.44	II	9452 – 36845
450		3650.95	II	9329 – 36711
160		3651.19	II	11670 – 39050
620		3652.54	II	7992 – 35362
3900		3654.62	II	633 – 27988
3100		3656.15	II	1159 – 28502
210		3658.19	I	533 – 27861
100		3661.66	II	11084 – 38386
1400		3662.26	II	0 – 27298
2700		3664.60	II	7992 – 35272
80		3668.32	II	11670 – 38922
2000		3671.20	II	633 – 27865
1000		3674.05	I	215 – 27425
350		3679.21	I	533 – 27705
2000		3684.13	I	0 – 27136
720		3686.33	II	7992 – 35111
3100		3687.74	II	2857 – 29966
210		3694.03	II	3082 – 30144
130		3696.76	II	11344 – 38386
100		3696.93	I	0 – 27042
2000		3697.73	II	262 – 27298
1300		3699.73	II	2857 – 29878
40		3703.51	II	13031 – 40024
60		3709.13	II	6605 – 33558
2700		3712.70	II	3082 – 30009
2000		3713.57	I	215 – 27136
40		3715.23	II	11084 – 37993
100		3715.92	I	215 – 27119
1400		3716.36	II	262 – 27162
2000		3717.48	I	533 – 27425
1800	d	3719.45	II	9944 – 36822
		3719.53	II	3972 – 30850
250		3722.07	II	13926 – 40785
60		3723.69	II	13926 – 40773
430		3725.47	II	9944 – 36778
90		3726.57	I	215 – 27042
1500		3730.84	II	3082 – 29878
270		3732.32	I	1719 – 28504
230		3732.45	II	633 – 27418
230		3732.67	I	533 – 27316
510		3733.08	II	9944 – 36724
100		3736.44	I	1719 – 28475
490		3739.76	I	999 – 27731
330		3740.02	II	9092 – 35823
90		3741.91	II	11670 – 38386
4500		3743.47	II	1159 – 27865
40		3744.14	II	3444 – 30145
620		3744.83	I	1719 – 28415
40		3746.44	II	13031 – 39715
120		3748.88	II	11343 – 38010
100		3751.10	I	215 – 26866
80		3755.24	II	9944 – 36566
80		3755.56	II	10092 – 36711
230		3757.74	II	12318 – 38922
1000		3757.94	I	533 – 27136
1400		3758.31	II	3427 – 30027
820		3759.00	II	0 – 26595
100		3759.98	I	0 – 26588
100		3760.47	I	7562 – 34147
620		3760.71	II	3444 – 30027
290		3760.92	II	3427 – 30009
870		3762.20	I	999 – 27572
150		3763.00	II	1935 – 28502
210		3763.33	II	3444 – 30009
370		3764.20	II	11084 – 37643

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
160	3764.60	II	10092 – 36647
870	3767.04	II	3427 – 29966
8700	3768.39	II	633 – 27162
620	3769.45	II	3444 – 29966
1400	3770.69	II	9092 – 35605
250	3771.26	I	533 – 27042
210	3773.45	I	7654 – 34147
160	3774.30	II	11343 – 37830
210	3776.83	I	7235 – 33705
100	3779.83	II	9092 – 35541
1000	3782.34	II	10292 – 36723
2900	3783.05	I	999 – 27425
60	3783.73	II	13515 – 39936
170	3787.15	I	0 – 26397
1100	3787.56	II	3972 – 30367
200	3790.63	I	215 – 26588
770	3791.17	II	10092 – 36461
80	3791.72	II	4484 – 30850
490	3792.39	II	12318 – 38679
80	3795.25	II	2857 – 29198
160	3795.75	I	999 – 27337
120	3795.93	II	13030 – 39367
5100	3796.37	II	262 – 26595
160	3798.39	II	10392 – 36711
720	3801.29	II	11343 – 37642
150	3802.85	II	3427 – 29715
210	3804.39	I	7427 – 33705
210	3805.09	II	10292 – 36565
560	3805.52	II	9092 – 35362
150	3807.65	II	10392 – 36647
40	3810.25	II	12318 – 38555
3700	3813.97	II	0 – 26212
430	3814.74	II	13030 – 39237
770	3816.64	II	262 – 26455
430	3818.75	II	11343 – 37522
60	3821.51	II	3082 – 29242
120	3822.17	II	4841 – 30997
120	3824.15	I	7562 – 33705
350	3826.05	II	3972 – 30101
230	3827.33	II	13515 – 39635
230	3829.46	II	10292 – 36398
180	3830.98	II	13515 – 39610
370	3831.80	II	262 – 26352
210	3832.97	I	533 – 26615
330	3834.99	II	12318 – 38386
970	3836.91	II	3972 – 30027
40	3838.90	I	999 – 27041
1000	3839.64	II	3972 – 30009
120	3840.26	I	215 – 26248
1200	3842.20	II	9092 – 35111
1400	3843.28	I	1719 – 27731
80	3843.80	II	4841 – 30850
1400	3844.58	II	1159 – 27162
120	3845.47	II	4852 – 30850
150	3846.49	I	6976 – 32967
3300	3850.69	II	633 – 26595
5100	3850.97	II	0 – 25960
4300	3852.45	II	262 – 26212
140	3854.18	II	4027 – 29966
470	3855.56	II	1935 – 27865
140	3858.45	I	6976 – 32886
160	3861.14	II	13030 – 38922
250	3863.05	II	9943 – 35822
130	3864.79	I	999 – 26866
1600	3866.99	I	1719 – 27572
140	3867.26	II	4027 – 29878
140	3871.54	II	633 – 26455
140	3872.62	II	3427 – 29242
250	3873.57	I	6976 – 32785
160	3874.46	I	533 – 26336
220	3875.46	II	4213 – 30009
110	3881.84	II	3444 – 29198
65	3884.66	II	11084 – 36819
75	3887.16	II	633 – 26352
75	3887.73	I	533 – 26248
150	3888.93	I	10947 – 36653
85	3890.42	I	7234 – 32931
55	3890.85	II	11084 – 36778
45	3892.72	I	7103 – 32785
1500	3894.70	II	0 – 25669
170	3895.23	II	4213 – 29878
450	3895.79	II	9943 – 35605
65	3897.32	I	7235 – 32886
750	3902.40	II	3427 – 29045
300	3902.71	I	999 – 26615
240	3904.29	I	215 – 25821
450	3905.65	I	1719 – 27316
65	3907.12	I	6976 – 32563
45	3909.25	I	6976 – 32549
65	3909.94	I	532 – 26100
45	3911.62	I	7426 – 32984
75	3912.75	I	7235 – 32785
65	3913.78	II	4484 – 30027
2200	3916.51	II	4841 – 30367
120	3918.06	II	9092 – 34608
120	3918.24	II	4852 – 30367
450	3923.25	II	4484 – 29966
110	3926.68	I	7427 – 32886
120	3932.98	II	9943 – 35362
1200	3934.79	I	533 – 25940
	3934.82	II	262 – 25669
220	3935.38	I	0 – 25403
75	3938.11	II	12318 – 37703
110	3938.97	II	11343 – 36723
450	3941.80	I	1719 – 27081
590	3942.63	I	215 – 25572
270	3943.24	I	0 – 25353
220	3943.62	I	7235 – 32585
1400	3945.54	I	999 – 26337
		I	0 – 25338
55	3949.25	II	11084 – 36398
300	3952.00	II	1159 – 26455
590	3953.37	I	533 – 25821
1200	3957.67	II	4841 – 30101
110	3958.68	I	0 – 25254
750	3959.44	II	4852 – 30101
	3959.52	II	5897 – 31146
180	3960.11	I	6976 – 32221
55	3962.10	II	4483 – 29715
220	3963.66	II	11343 – 36565
75	3965.04	I	7235 – 32448
590	3966.28	I	1719 – 26925
590	3968.26	II	1159 – 26352
750	3969.00	I	215 – 25403
270	3969.29	II	4841 – 30027
65	3970.18	I	6976 – 32157
140	3971.06	II	4852 – 30027
450	3971.75	II	4027 – 29198
85	3972.17	II	9943 – 35111
390	3972.71	I	0 – 25165

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
590	3973.98	II	4852 – 30009
300	3974.81	I	1719 – 26870
120	3975.11	II	11669 – 36819
750	3979.33	I	215 – 25338
150	3983.01	II	5897 – 30997
450	3987.21	II	3972 – 29045
470	3987.84	I	0 – 25069
95	3989.25	II	11084 – 36144
320	3992.69	I	533 – 25572
220	3993.21	II	633 – 25669
650	3994.16	II	4213 – 29242
700	3996.32	II	9092 – 34108
320	3997.76	II	8551 – 33558
65	4000.18	I	6786 – 31778
470	4001.26	II	4213 – 29198
65	4001.96	II	
65	4003.85	II	11492 – 36461
260	4004.94	II	11669 – 36631
110	4006.96	I	215 – 25165
320	4008.33	I	999 – 25940
300	4008.91	II	9092 – 34029
110	4009.22	II	12071 – 37007
150	4013.43	I	7427 – 32336
300	4013.80	II	11084 – 35991
85	4013.95	II	3082 – 27989
150	4015.22	I	7235 – 32133
200	4015.58	I	1719 – 26615
300	4017.25	I	7562 – 32448
430	4017.71	I	6976 – 31859
300	4019.73	I	533 – 25403
300	4022.33	II	11084 – 35938
1100	4023.14	I	1719 – 26568
810	4023.35	I	533 – 25381
220	4027.61	I	999 – 25821
1100	4028.15	I	6976 – 31795
860	4030.88	I	6976 – 31778
700	4033.49	I	7235 – 32020
340	4035.40	I	215 – 24989
260	4036.84	I	7235 – 32000
1400	4037.33	II	5340 – 30101
700	4037.90	II	4484 – 29242
110	4039.49	II	12309 – 37058
170	4039.67	II	12071 – 36819
65	4042.76	II	11669 – 36398
410	4043.71	I	7427 – 32150
45	4044.02	I	533 – 25254
1600	4045.01	I	0 – 24715
130	4045.15	II	4484 – 29198
270	4046.84	II	11669 – 36373
270	4047.09	I	7654 – 32356
160	4047.81	II	12309 – 37007
110	4048.60	II	9092 – 33785
270	4049.20	I	7562 – 32252
1300	4049.43	II	5340 – 30027
2200	4049.86	II	7992 – 32677
270	4050.37	I	7654 – 32336
810	4053.29	II	9943 – 34608
2600	4053.64	I	999 – 25661
810	4054.72	I	0 – 24656
2600	4058.22	I	215 – 24850
110	4059.37	II	13926 – 38553
650	4059.88	I	7235 – 31859
270	4061.30	II	12071 – 36687
650	4062.59	II	10292 – 34900
1900	4063.39	II	7992 – 32595
540	4063.59	II	4027 – 28629
260	4066.04	I	7562 – 32150
520	4068.35	I	7427 – 32000
260	4068.74	I	7562 – 32133
750	4070.29	II	4484 – 29045
	4070.39	II	3427 – 27988
650	4073.20	II	3444 – 27988
300	4073.76	II	6605 – 31146
1300	4078.44	II	4841 – 29353
2800	4078.70	I	533 – 25044
190	4080.53	I	215 – 24715
520	4083.70	I	6976 – 31457
65	4084.68	II	11669 – 36144
1500	4085.56	II	5897 – 30367
260	4087.69	II	11084 – 35541
650	4090.41	I	215 – 24656
45	4091.75	I	7427 – 31859
1100	4092.71	I	1719 – 26146
260	4093.72	I	7427 – 31848
260	4094.48	II	4213 – 28629
2600	4098.61	II	6605 – 30997
520	4098.90	II	4852 – 29242
650	4100.26	I	999 – 25381
95	4104.99	I	7103 – 31457
75	4108.40	II	12662 – 36996
45	4110.43	II	11669 – 35991
150	4110.60	II	11084 – 35404
390	4111.44	II	10292 – 34607
130	4111.74	II	12318 – 36631
65	4112.94	I	7562 – 31869
45	4113.77	II	12071 – 36373
75	4115.38	II	12704 – 36996
65	4119.21	I	11296 – 35566
65	4119.38	II	11669 – 35938
55	4125.78	I	8499 – 32730
45	4127.72	II	12776 – 36996
2200	4130.37	II	5897 – 30101
270	4131.48	II	11343 – 35541
1100	4132.28	II	4852 – 29045
750	4134.16	I	533 – 24715
410	4137.10	II	9943 – 34108
45	4138.03	I	6976 – 31136
120	4140.45	II	4484 – 28629
45	4141.02	II	12704 – 36845
45	4144.25	I	7426 – 31549
280	4148.86	I	1719 – 25815
55	4149.48	I	7235 – 31328
45	4150.61	II	9943 – 34029
40	4151.63	II	12318 – 36398
110	4153.51	II	12776 – 36845
190	4154.86	II	8885 – 32946
190	4157.78	I	999 – 25044
40	4158.48	I	7562 – 31602
540	4162.73	II	3972 – 27988
280	4163.09	II	5340 – 29353
280	4167.16	II	3427 – 27418
	4167.27	I	999 – 24989
130	4170.11	II	3444 – 27418
120	4171.71	I	11830 – 35795
120	4173.56	II	12892 – 36845
2400	4175.54	I	1719 – 25661
95	4182.77	I	7235 – 31136
2400	4184.25	II	3972 – 27865
85	4188.10	II	3427 – 27298
45	4188.82	I	12520 – 36386

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
65		4190.20	I	6976 – 30834
2200		4190.78	I	999 – 24854
750		4191.07	II	3444 – 27298
750		4191.63	I	999 – 24850
75		4193.15	II	9943 – 33785
110		4197.07	II	12892 – 36711
450		4197.68	II	10292 – 34108
85		4202.52	II	13030 – 36819
590		4204.86	II	4213 – 27988
55		4208.08	I	6550 – 30308
1300		4212.00	II	3427 – 27162
970		4215.02	II	3444 – 27162
650		4217.20	II	5340 – 29045
45		4223.02	II	12318 – 35991
65		4224.27	I	7480 – 31147
320		4225.03	I	1719 – 25381
160		4225.15	II	4841 – 28502
4800		4225.85	I	1719 – 25376
220		4227.14	II	4852 – 28502
220		4229.80	II	13076 – 36711
75		4232.47	II	12318 – 35938
65		4232.93	I	13506 – 37123
55		4235.07	II	8885 – 32491
85		4235.88	II	13030 – 36631
650		4238.78	II	9092 – 32677
95		4241.28	II	13076 – 36647
180		4243.84	II	11343 – 34900
150		4245.34	I	7103 – 30652
200		4246.57	II	9143 – 32685
65		4250.28	I	6786 – 30308
1700		4251.73	II	3082 – 26595
860		4253.37	II	4484 – 27988
650		4253.61	II	9092 – 32595
810		4260.12	I	533 – 24000
1600		4262.09	I	6786 – 30242
			II	5897 – 29353
650		4266.60	I	999 – 24430
470		4267.00	I	215 – 23644
160		4268.73	II	8885 – 32304
55		4270.28	I	6786 – 30197
55	h	4273.29	I	7234 – 30629
300		4274.17	I	0 – 23390
55	h	4278.22	II	13030 – 36398
910		4280.49	II	2857 – 26212
45		4282.79	II	13030 – 36373
430		4285.82	I	6550 – 29877
300		4286.12	I	1719 – 25044
55		4289.88	II	13515 – 36819
540		4296.08	II	4027 – 27298
140		4296.30	II	13378 – 36647
220		4297.17	II	11343 – 34608
45		4298.43	II	13800 – 37058
430		4299.29	I	6378 – 29631
130		4304.90	II	12318 – 35541
1100		4306.34	I	0 – 23215
30		4307.87	II	13800 – 37007
260		4309.29	I	7947 – 31147
85		4310.98	II	3972 – 27162
1800		4313.84	I	215 – 23390
520		4314.40	I	7480 – 30652
520		4316.05	II	5340 – 28502
65		4316.27	II	9328 – 32490
370		4320.52	I	7103 – 30242
750		4321.11	II	4852 – 27988
		4321.20	I	1719 – 24854
130		4322.20	II	3082 – 26212
130		4324.06	II	9143 – 32263
2600	d	4325.57	II	11067 – 34179
		4325.69	I	533 – 23644
45		4326.32	II	17817 – 40925
1900		4327.12	I	0 – 23104
			II	2857 – 25960
120		4328.94	I	7103 – 30197
370		4329.58	I	6786 – 29877
340		4330.61	II	4213 – 27298
240		4331.38	I	6550 – 29631
75		4333.24	I	13506 – 36576
40		4335.29	II	17725 – 40785
40	d	4336.63	I	14669 – 37722
		4336.78	I	15121 – 38173
140		4337.51	I	6378 – 29426
			II	17725 – 40773
40		4340.60	I	17600 – 40632
450		4341.28	II	3427 – 26455
910		4342.18	II	4841 – 27865
1000		4344.30	II	4852 – 27865
2200		4346.46	I	999 – 24000
910		4346.62	I	215 – 23215
220		4347.31	II	10600 – 33596
75		4353.79	I	14253 – 37215
30		4354.06	II	13030 – 35991
55		4359.15	II	4484 – 27418
30		4359.64	II	9329 – 32260
160		4360.92	II	3427 – 26352
160		4369.15	I	12057 – 34938
300		4369.77	II	3082 – 25960
190		4370.18	I	6550 – 29426
970		4373.83	I	533 – 23390
85		4376.07	I	6786 – 29631
190		4378.56	I	7562 – 30395
140		4380.64	II	9329 – 32150
95		4382.06	II	4484 – 27298
140		4383.12	II	9452 – 32260
45		4386.20	I	15121 – 37913
30		4387.17	I	14253 – 37041
180		4387.67	II	3427 – 26212
180		4389.88	I	7103 – 29877
180		4390.00	I	11685 – 34458
150		4390.95	II	3444 – 26212
65		4391.44	II	9143 – 31908
280		4392.06	I	7480 – 30242
27		4394.72	II	6605 – 29353
180		4397.51	II	9943 – 32677
30		4400.18	II	9329 – 32049
85		4400.76	I	7480 – 30197
1400		4401.86	I	1719 – 24430
520		4403.14	I	7947 – 30652
260		4406.67	II	11492 – 34179
260		4408.25	II	4484 – 27162
220		4409.25	I	8498 – 31172
520		4411.16	I	533 – 23196
27		4413.44	I	6976 – 29628
860		4414.16	I	8498 – 31147
700		4414.73	I	999 – 23644
340		4419.03	II	3972 – 26595
140		4421.24	II	10600 – 33212
1400		4422.41	I	215 – 22821
45		4424.10	II	9452 – 32049
120		4425.01	I	12345 – 34938
55		4426.15	II	3082 – 25669

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
45		4427.61	II	9329 – 31908
1100		4430.63	I	0 – 22564
85		4431.76	I	7947 – 30505
45		4433.64	II	10633 – 33182
240	d	4436.10	I	1719 – 24254
		4436.22	II	13926 – 36461
160		4438.27	II	5340 – 27865
30		4444.98	I	13506 – 35997
75		4446.49	II	3972 – 26455
27		4449.02	I	14777 – 37248
27		4449.41	I	14777 – 37246
40		4452.73	I	12487 – 34938
40		4453.93	II	8551 – 30997
22	d	4458.32	I	15852 – 38276
		4458.41	I	15121 – 37544
30		4461.36	I	7427 – 29835
110		4462.83	I	12057 – 34458
55		4463.25	II	10092 – 32491
300		4464.74	I	12520 – 34911
300		4466.55	II	4213 – 26595
		4466.60	I	6976 – 29359
520		4467.08	I	
75		4467.23	II	10803 – 33182
110		4471.29	II	10392 – 32750
65		4473.28	I	215 – 22564
700		4474.13	I	
860		4476.12	I	0 – 22335
220		4478.80	II	4841 – 27162
280		4481.06	II	4852 – 27162
220		4483.33	II	8551 – 30850
220		4484.70	I	12520 – 34811
27		4485.48	I	533 – 22821
65		4486.35	II	18641 – 40925
280		4486.90	I	1719 – 24000
65	h	4488.40	II	10908 – 33182
500		4497.13	I	999 – 23229
220		4497.32	I	
170		4498.28	II	3444 – 25669
27		4503.79	I	999 – 23196
430		4506.21	I	533 – 22718
140		4506.33	II	4027 – 26212
55		4506.93	II	3427 – 25609
55		4509.08	II	10092 – 32263
140		4514.50	II	11067 – 33212
85		4516.98	I	14253 – 36384
1100		4519.66	I	215 – 22335
65		4520.07	II	10633 – 32750
55		4521.30	II	4484 – 26595
75		4521.94	II	18677 – 40785
300		4522.82	II	11492 – 33596
150		4524.12	I	13506 – 35603
95		4536.97	I	12520 – 34555
910		4537.81	I	533 – 22564
220		4540.02	II	18753 – 40773
300		4542.03	I	215 – 22226
65		4544.23	I	7427 – 29426
240		4548.00	I	10947 – 32928
65		4550.95	II	5897 – 27865
45		4554.99	II	10803 – 32750
120		4558.08	II	4027 – 25960
27		4559.62	I	14253 – 36179
45	d	4561.08	I	16775 – 38693
27		4564.59	I	10884 – 32785
30	h	4570.98	II	10392 – 32263
85		4572.20	I	6976 – 28842
130		4573.81	I	0 – 21858
260		4575.91	I	7947 – 29795
280		4579.59	I	12346 – 34175
85		4581.09	II	5340 – 27162
410		4581.29	I	999 – 22821
95		4582.38	II	10092 – 31908
130		4582.53	II	8551 – 30367
410		4583.07	I	7480 – 29294
85		4584.26	I	7947 – 29754
160		4586.99	I	12057 – 33851
220		4596.98	II	4213 – 25960
320		4597.91	II	4852 – 26595
410		4598.90	I	7103 – 28842
340		4601.05	II	4484 – 26212
240		4602.93	I	999 – 22718
55	h	4606.06	I	15720 – 37425
30		4608.03	II	19402 – 41097
27		4608.58	I	533 – 22226
55	h	4611.04	I	15720 – 37401
520		4614.50	I	6786 – 28451
85	bl	4615.6	GdO	
65		4619.14	I	10222 – 31865
140		4624.42	I	6550 – 28169
430		4636.64	I	6550 – 28112
110		4639.00	II	8551 – 30101
170		4640.04	I	11685 – 33231
170		4646.00	I	11830 – 33348
170		4647.64	I	1719 – 23229
170	d	4648.59	I	12345 – 33851
		4648.70	I	10360 – 31865
430		4653.54	I	6378 – 27861
85		4654.99	II	8551 – 30027
45		4664.27	II	17817 – 39251
55		4666.45	II	11067 – 32491
140	h	4670.87	I	
55		4678.25	I	16534 – 37904
170		4679.18	I	12487 – 33852
260		4680.04	I	7480 – 28842
65		4683.07	I	7103 – 28451
430		4683.33	I	7947 – 29294
65	h	4686.41	I	17016 – 38348
140		4688.12	I	533 – 21858
85		4691.16	I	6550 – 27861
700		4694.33	I	8498 – 29795
170		4695.49	I	12057 – 33348
430		4697.42	I	6378 – 27660
170		4703.13	I	8498 – 29754
200		4709.78	I	999 – 22226
55		4711.98	II	8885 – 30101
30		4712.80	II	20047 – 41260
110		4721.46	I	12057 – 33231
150		4728.47	II	8885 – 30027
85		4728.64	I	533 – 21675
220		4732.60	II	8885 – 30009
45		4734.43	II	5340 – 26455
260		4735.75	I	6550 – 27660
65		4738.11	I	11685 – 32785
410		4743.65	I	6786 – 27861
110		4745.82	I	7103 – 28169
30	h	4749.15	I	16758 – 37809
30	d	4755.35	II	19750 – 40773
		4755.50	II	20369 – 41391
45		4758.26	I	533 – 21543
320		4758.70	I	7103 – 28112
110		4760.74	I	1719 – 22718

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
130		4763.82	I	10884 – 31869
470		4767.24	I	7480 – 28451
65	d	4780.99	I	11297 – 32207
		4781.13	I	12057 – 32966
180		4781.92	I	999 – 21905
40	d	4783.47	I	11685 – 32585
		4783.56	I	11830 – 32730
300		4784.62	I	7947 – 28842
110		4786.75	I	12345 – 33231
45		4786.91	II	9143 – 30027
45		4791.15	II	9143 – 30009
140		4801.05	II	9143 – 29966
30		4802.58	II	4852 – 25669
40		4803.54	II	11492 – 32304
27		4805.82	II	8551 – 29353
220		4807.45	I	8498 – 29294
45	h	4808.01	I	13926 – 34719
55		4816.83	I	11830 – 32585
320		4821.69	I	1719 – 22452
45		4829.94	I	11685 – 32384
85		4834.23	II	9328 – 30009
130		4835.26	I	999 – 21675
110		4848.10	I	12345 – 32966
45		4856.17	I	11685 – 32273
65		4856.72	I	16758 – 37343
75		4859.22	I	10884 – 31457
75		4861.78	I	11297 – 31859
110		4862.59	I	10576 – 31136
170		4865.02	II	9329 – 29878
85		4870.04	I	12057 – 32585
120		4871.50	I	10360 – 30882
30		4873.34	II	9452 – 29966
85		4881.08	I	11297 – 31778
65		4881.36	I	12487 – 32967
27		4881.92	II	18151 – 38629
85		4883.19	I	10222 – 30695
27		4889.19	I	11685 – 32133
65	bl	4892.1	GdO	
85		4894.30	II	9452 – 29878
75		4910.12	I	6976 – 27337
30		4915.83	I	7235 – 27572
45		4916.60	I	10222 – 30556
65		4923.58	II	17725 – 38030
85		4929.84	I	15758 – 36037
65		4930.69	I	15519 – 35794
280		4934.12	I	11830 – 32092
85		4936.01	I	15833 – 36087
85		4936.33	I	10884 – 31136
220		4938.61	I	12487 – 32730
45		4948.56	I	15989 – 36191
65		4950.11	I	10360 – 30556
30		4951.58	I	11830 – 32020
110		4952.47	I	1719 – 21905
65		4953.15	I	11685 – 31869
40		4956.80	I	15173 – 35342
65		4957.29	I	15833 – 36000
130		4958.79	I	11297 – 31457
			II	8885 – 29045
40		4961.47	I	12057 – 32206
27		4965.05	II	19402 – 39537
22		4968.58	II	17725 – 37846
95		4969.16	I	10576 – 30695
55		4972.61	I	6976 – 27081
19		4985.30	II	10091 – 30144
55		4998.37	II	18319 – 38320
75		4999.07	I	10884 – 30882
65		5010.82	II	8551 – 28502
55		5011.74	I	11830 – 31778
750		5015.04	I	8498 – 28433
30		5019.36	II	10092 – 30009
27		5020.37	I	7562 – 27476
			II	9329 – 29242
55		5023.13	II	9143 – 29045
65		5031.29	II	13076 – 32946
40		5031.56	II	9329 – 29198
75		5039.09	I	11297 – 31136
19		5048.78	II	19223 – 39024
65		5050.88	II	12892 – 32685
27		5061.06	II	10391 – 30144
27		5062.86	II	9452 – 29198
30		5067.06	II	20047 – 39777
45		5070.19	I	
45		5071.02	II	12776 – 32491
30		5072.99	I	16534 – 36241
55		5073.74	I	16296 – 36000
55		5082.80	I	16534 – 36203
95		5092.25	II	13926 – 33558
65		5096.06	II	8885 – 28502
130		5098.38	II	13076 – 32685
55		5100.94	II	12892 – 32491
910		5103.45	I	7947 – 27536
180		5108.91	II	13378 – 32946
30		5123.68	II	10633 – 30144
120		5125.56	II	11492 – 30997
65		5130.28	II	12776 – 32263
65		5135.59	I	17015 – 36482
75		5136.04	I	7103 – 26568
85		5140.84	II	12704 – 32150
75		5141.50	I	7480 – 26925
75		5142.68	I	7427 – 26866
15		5149.38	II	13076 – 32491
30		5149.84	II	12892 – 32304
860		5155.84	I	7480 – 26870
55		5156.76	II	12662 – 32049
75		5158.48	I	7235 – 26615
45		5160.90	II	12892 – 32263
75		5163.70	I	6976 – 26337
55		5164.54	II	11492 – 30850
45		5171.69	I	0 – 19331
190		5176.28	II	8551 – 27865
40		5178.10	II	13378 – 32685
45		5178.84	II	19947 – 39251
40		5179.92	II	11067 – 30367
45		5186.92	II	12704 – 31977
55		5187.24	II	12776 – 32049
55		5187.88	I	6550 – 25821
55		5191.08	II	12892 – 32150
410		5197.77	I	7103 – 26337
45		5199.21	II	13076 – 32304
27		5200.55	II	19947 – 39170
55		5210.49	II	13076 – 32263
85		5217.48	I	999 – 20160
280		5219.40	I	6786 – 25940
75		5220.30	II	10092 – 29242
130		5233.93	I	7235 – 26336
22		5244.38	I	17318 – 36381
65		5246.87	I	7562 – 26616
320		5251.18	I	8498 – 27536
120		5252.14	II	11067 – 30101
			I	6786 – 25821

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
85		5254.75	I	6378 – 25403
140		5255.80	I	6550 – 25572
22		5260.81	I	15833 – 34836
30		5263.81	I	533 – 19525
22		5268.01	I	7947 – 26925
65		5268.78	I	533 – 19507
22		5271.79	I	6976 – 25940
30		5272.37	I	15989 – 34951
55		5272.91	I	6378 – 25338
55		5282.48	I	10576 – 29502
280		5283.08	I	7947 – 26870
30		5298.58	I	10222 – 29090
280		5301.67	I	7480 – 26337
220		5302.76	I	6550 – 25403
55		5306.70	I	6976 – 25815
280		5307.30	I	7103 – 25940
45		5311.84	I	16758 – 35579
22	h	5315.79	II	19223 – 38029
30		5316.80	II	19750 – 38553
45		5321.25	I	6550 – 25338
130		5321.50	I	6378 – 25165
280		5321.78	I	6786 – 25572
30		5322.37	I	10222 – 29006
45		5322.69	I	10576 – 29359
110		5327.32	I	10360 – 29126
65		5328.30	I	10222 – 28985
45		5331.92	I	10222 – 28971
170		5333.30	I	10884 – 29628
55		5337.53	I	10360 – 29090
30		5341.17	I	7103 – 25821
30		5341.81	I	1719 – 20434
300		5343.00	I	11297 – 30007
85		5345.13	I	6550 – 25254
75		5345.68	I	999 – 19701
200		5348.67	I	6378 – 25069
300		5350.38	I	12487 – 31172
240		5353.26	I	11830 – 30505
45		5357.79	II	9329 – 27988
45		5359.18	I	16296 – 34951
55		5361.66	I	10360 – 29006
95		5365.38	I	10576 – 29209
30		5367.70	I	10360 – 28985
30		5368.79	I	7947 – 26568
30		5369.61	I	10884 – 29502
95		5369.92	I	6786 – 25403
150		5370.63	I	10222 – 28837
		5370.74	I	6550 – 25165
40		5372.22	II	11492 – 30101
45		5384.15	I	10884 – 29451
45		5385.39	I	17015 – 35579
85		5389.50	I	10576 – 29126
27		5411.20	I	10884 – 29359
22		5412.64	II	10091 – 28561
85		5413.20	I	7103 – 25572
45		5413.39	I	6786 – 25254
85		5415.69	I	7480 – 25940
27		5419.88	II	10600 – 29045
45		5421.19	I	1719 – 20160
45		5436.30	I	7947 – 26337
27		5441.58	I	8499 – 26870
22		5447.74	II	10091 – 28442
65		5453.46	I	11297 – 29628
30		5455.31	I	10884 – 29209
45		5469.72	I	7103 – 25381
			II	8885 – 27162
22		5475.72	I	6786 – 25044
22		5480.23	I	10884 – 29126
22		5482.01	I	10884 – 29120
22		5493.42	I	7947 – 26146
27		5498.75	I	7480 – 25661
40		5499.97	I	11830 – 30007
40		5500.43	II	11067 – 29242
27	h	5505.11	I	16824 – 34984
22		5515.61	I	16920 – 35046
27		5521.75	I	6550 – 24656
19		5524.60	II	19750 – 37846
22		5533.37	I	6976 – 25044
27		5538.32	II	10391 – 28442
27		5539.81	II	
22		5545.01	II	10600 – 28629
27	d	5548.20	I	12487 – 30505
19		5550.21	I	6976 – 24989
22		5559.73	I	1719 – 19701
30		5560.69	II	11067 – 29045
27		5572.53	I	7103 – 25044
40		5576.13	I	6786 – 24715
55		5583.68	II	8551 – 26455
13		5586.16	II	10092 – 27988
22		5586.32	I	7480 – 25376
55	d	5591.85	I	14669 – 32548
40		5594.13	I	14036 – 31907
19		5597.21	II	11492 – 29353
22		5614.45	I	1719 – 19525
27		5616.21	II	8551 – 26352
190		5617.91	I	0 – 17795
17		5621.43	II	18677 – 36461
65		5629.55	I	215 – 17974
110		5632.25	I	0 – 17750
30		5633.49	I	7103 – 24850
260		5643.24	I	215 – 17931
27		5644.84	II	8885 – 26595
13	h	5653.33	I	7654 – 25338
40	bl	5664.42	GdO	
30		5677.45	I	14298 – 31907
55	bl	5680.89	GdO	
40		5683.33	I	
27		5684.11	GdO	
22		5686.66	I	215 – 17795
40		5692.13	I	7480 – 25044
390		5696.22	I	533 – 18084
95		5701.35	I	215 – 17750
65		5709.42	I	999 – 18509
40		5710.32	I	14669 – 32176
22		5721.99	II	13378 – 30850
45		5724.75	I	11830 – 29294
120		5733.86	II	11067 – 28502
45		5735.98	I	7947 – 25376
45		5744.66	I	215 – 17618
85		5746.36	I	533 – 17931
40		5749.41	II	10600 – 27988
40		5751.88	I	0 – 17381
85	d	5754.17	I	7480 – 24854
22		5771.20	GdO	
17		5774.56	II	9143 – 26455
75		5776.02	I	12487 – 29795
240		5791.38	I	533 – 17795
65	h	5796.80	I	15720 – 32966
55		5802.92	I	0 – 17227
27		5807.05	II	12662 – 29878
55	hs	5807.72	I	6786 – 24000

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
55	h	5809.22	I	15852 – 33061
55		5815.85	II	12776 – 29966
65	hs	5819.51	GdO	
45		5820.99	II	12704 – 29878
45	h	5823.97	I	215 – 17381
55		5840.47	II	12892 – 30009
22		5845.71	II	12776 – 29878
220		5851.63	I	999 – 18084
55		5855.24	II	12892 – 29966
280		5856.22	I	999 – 18070
45		5856.96	II	9143 – 26212
55		5860.73	II	8551 – 25609
65		5877.26	II	11492 – 28502
55		5886.46	I	15173 – 32157
45		5897.62	II	13076 – 30027
55		5904.07	II	13076 – 30009
110		5904.56	I	999 – 17931
170		5911.45	II	
65		5913.55	II	18366 – 35272
55		5916.77	I	7103 – 24000
85		5930.29	I	6786 – 23644
85		5936.84	I	6550 – 23390
65		5937.71	I	6378 – 23215
55	h	5940.95	GdO	
55	h	5942.78	GdO	
55		5951.60	II	11067 – 27865
55		5956.48	II	8885 – 25669
85		5977.25	I	6378 – 23104
110	h	5988.02	I	15852 – 32548
85		5999.08	I	6550 – 23215
65		6000.96	GdO	
75	h	6001.87	GdO	
55		6004.57	II	13378 – 30027
55		6008.71	I	15519 – 32157
55		6021.13	I	6786 – 23390
55		6080.65	II	13926 – 30367
430		6114.07	I	1719 – 18070
55		6180.42	II	13926 – 30101
110	bl	6182.68	GdO	
110	bl	6200.86	GdO	
110	bl	6211.71	GdO	
110	bl	6220.93	GdO	
55	bl	6231.62	GdO	
75	bl	6241.66	GdO	
55	b	6252.12	GdO	
55	bl	6262.64	GdO	
45	b	6273.00	GdO	
85		6289.73	II	17910 – 33804
30		6292.87	I	999 – 16886
75		6305.15	II	10600 – 26455
30		6309.11	II	16061 – 31907
27		6317.19	I	999 – 16825
40		6331.35	I	18014 – 33804
17		6333.75	I	6550 – 22335
17		6336.34	I	6786 – 22564
27		6346.65	II	10600 – 26352
27	h	6351.72	I	17795 – 33535
17		6363.23	I	16196 – 31907
40		6380.95	II	13378 – 29045
17		6382.19	II	21157 – 36821
22		6408.55	I	1719 – 17319
22		6422.42	II	21157 – 36723
17		6424.52	I	7654 – 23215
19	h	6470.29	I	18084 – 33535
15		6480.11	II	13926 – 29353
40	h	6538.15	I	16886 – 32176
22		6549.25	I	17931 – 33195
55		6564.78	I	17319 – 32548
10		6568.00	II	17725 – 32946
10		6573.80	I	17750 – 32958
30		6591.60	I	1719 – 16886
15		6593.42	I	17795 – 32958
10		6610.04	II	13378 – 28502
9		6628.43	I	16825 – 31907
50		6634.36	II	10600 – 25669
35		6640.08	I	1719 – 16775
10		6642.76	I	12487 – 27536
30		6643.98	I	18014 – 33061
10		6646.85	I	11297 – 26337
10		6653.55	I	18509 – 33535
10		6679.56	II	20574 – 35541
35		6681.23	II	11492 – 26455
10		6692.86	I	10884 – 25821
6		6694.92	II	21005 – 35938
9		6702.12	II	18641 – 33558
10		6704.18	II	13076 – 27988
14		6718.14	II	18677 – 33558
17		6727.83	II	11492 – 26352
85		6730.73	I	999 – 15852
50		6752.67	II	18753 – 33558
14		6753.91	II	20098 – 34900
9		6772.03	I	25676 – 40439
14		6783.39	I	11830 – 26568
26		6786.33	II	19376 – 34108
10		6787.18	I	10947 – 25676
12		6814.56	I	7235 – 21905
26		6816.49	I	999 – 15665
17		6820.90	I	17906 – 32563
100		6828.25	I	533 – 15174
35		6846.60	II	11067 – 25669
9		6849.89	I	20160 – 34755
30		6857.13	II	17725 – 32304
15		6864.25	I	19479 – 34044
21		6887.63	II	20093 – 34607
14		6900.73	II	17817 – 32304
100		6916.57	I	215 – 14669
21		6920.62	II	17817 – 32263
15		6924.99	II	10091 – 24528
21		6926.49	I	10222 – 24656
17		6945.98	II	17870 – 32263
15		6957.74	II	9328 – 23697
15		6959.24	II	18319 – 32685
14		6964.33	I	10360 – 24715
15		6971.66	II	18151 – 32491
12		6976.35	II	9142 – 23473
10		6978.27	II	20574 – 34900
26	h	6980.86	I	20434 – 34755
8	h	6983.53	I	11830 – 26146
50		6985.89	II	18366 – 32677
10		6988.75	II	18641 – 32946
75		6991.92	I	0 – 14298
21		6993.18	I	10360 – 24656
60		6996.76	II	18389 – 32677
17		7000.75	II	17870 – 32150
45		7006.16	II	18677 – 32946
10		7016.60	I	7427 – 21675
7		7017.73	II	9451 – 23697
21		7037.26	II	18389 – 32595
7		7045.02	II	22533 – 36723
14		7051.00	II	17972 – 32150

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
7		7052.79	I	999 – 15174
13		7054.62	II	18319 – 32491
10		7058.02	II	18096 – 32260
10		7068.09	II	9328 – 23472
7		7069.93	II	8884 – 23025
18		7071.00	I	10576 – 24715
18		7073.63	I	1719 – 15852
5		7084.18	I	17795 – 31907
			II	18151 – 32263
7		7085.52	II	18151 – 32260
5		7093.90	I	18084 – 32176
14		7098.11	I	11297 – 25381
14		7098.73	I	215 – 14298
6		7099.44	I	12487 – 26568
7		7100.71	I	10576 – 24656
4		7101.73	II	17972 – 32049
10	h	7116.77	II	18001 – 32049
21		7118.86	II	18641 – 32685
35		7122.57	I	0 – 14036
8		7133.16	II	20093 – 34108
13		7135.73	II	20098 – 34108
6	h	7141.17	II	18151 – 32150
6		7146.13	II	17988 – 31977
18		7147.31	II	18690 – 32677
6		7150.77	I	7562 – 21543
13		7158.28	I	10884 – 24850
6		7164.30	II	21157 – 35111
170		7168.37	I	1719 – 15665
21		7172.26	II	13926 – 27865
4		7173.40	II	17972 – 31908
28		7189.57	II	18690 – 32595
6		7191.49	II	23970 – 37871
13		7197.08	II	18369 – 32260
6	h	7198.63	I	7562 – 21450
13		7201.41	II	9142 – 23025
10		7228.02	I	10884 – 24715
25		7233.45	I	215 – 14036
6		7242.24	II	9451 – 23255
14		7252.70	II	13378 – 27162
28		7262.66	I	533 – 14298
14		7291.35	I	215 – 13926
4		7301.22	II	20093 – 33785
21		7313.28	I	999 – 14669
18		7324.89	II	8884 – 22533
8		7327.07	I	20160 – 33804
14		7373.81	I	11297 – 24854
14		7376.41	I	11297 – 24850
13		7377.27	II	23270 – 36821
6		7377.77	I	11830 – 25381
13		7380.28	I	11830 – 25376
8		7385.97	II	18955 – 32491
13		7394.90	II	13076 – 26595
13		7430.19	I	1719 – 15174
4		7432.57	II	21157 – 34607
5		7434.46	I	17362 – 30809
35		7441.85	I	0 – 13434
40		7464.36	I	533 – 13926
6		7489.44	II	9328 – 22677
6		7505.35	II	12892 – 26212
55		7562.97	I	215 – 13434
10		7563.19	II	19376 – 32595
6		7566.10	I	11830 – 25044
10		7588.20	I	12487 – 25661
10		7611.78	I	11297 – 24430
21		7621.96	I	10884 – 24000
21		7650.32	I	10576 – 23644
25		7672.56	I	10360 – 23390
10		7676.06	I	11830 – 24854
7		7677.16	I	19525 – 32548
7	h	7683.36	I	19165 – 32176
13		7694.45	I	10222 – 23215
4		7717.66	I	7480 – 20434
80		7733.50	I	999 – 13926
6		7738.09	II	9142 – 22062
3	h	7748.37	II	19402 – 32304
35		7749.30	I	533 – 13434
10		7755.97	I	12487 – 25376
10		7766.48	II	21157 – 34029
7	h	7787.22	II	22062 – 34900
8		7834.46	I	10884 – 23644
7		7838.84	II	23970 – 36723
11	h	7844.87	I	10360 – 23104
10		7845.80	I	19165 – 31907
35		7846.35	II	22531 – 35272
35		7856.93	I	6976 – 19701
5		7867.73	I	17600 – 30307
14		7869.72	I	11297 – 24000
4		7884.39	I	7480 – 20160
4	h	7908.06	II	17725 – 30367
6		7910.08	I	10576 – 23215
25		7930.25	II	8551 – 21157
6	h	7963.25	II	19750 – 32304
4		7966.66	I	6976 – 19525
6		7978.15	I	6976 – 19507
6		7993.82	I	10884 – 23390
6		8006.26	I	7947 – 20434
6		8010.53	II	8884 – 21364
6		8019.82	I	7235 – 19701
4		8037.40	I	19718 – 32157
6		8048.08	I	7103 – 19525
13		8077.59	I	7103 – 19480
3		8089.96	II	19947 – 32304
4	h	8144.00	I	16228 – 28504
18		8146.15	I	7235 – 19507
4	h	8185.90	I	7947 – 20160
5		8209.07	I	19978 – 32157
11		8218.08	I	7235 – 19400
10		8275.42	I	7427 – 19507
5	h	8315.02	II	8551 – 20574
7		8316.38	II	20574 – 32595
10		8349.73	I	7427 – 19400
4		8374.76	I	10884 – 22821
4		8377.79	I	11297 – 23229
11		8398.30	I	7427 – 19331
7		8442.58	II	23270 – 35111
10		8445.47	I	7562 – 19400
13	h	8527.88	I	7562 – 19285
5		8559.11	I	10884 – 22564
6		8561.72	I	7653 – 19331
4	h	8579.77	II	25167 – 36819
4		8615.97	II	25404 – 37007
6	h	8659.66	I	17906 – 29451
8	h	8661.48	II	8551 – 20093
21		8668.63	I	6976 – 18509
5		8674.86	I	11297 – 22821
6		8752.77	I	11297 – 22718
11		8770.36	I	11830 – 23229
13		8784.85	I	6550 – 17931
10		8795.76	I	11830 – 23196
21	h	8832.06	II	

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
14 h	8849.14	I	6786 – 18084				
18 h	8867.31	I	7235 – 18509				

Gallium .

$$\text{Ga}, Z = 31, M = 69.72, \text{Ratio}\,\frac{\text{Ga}}{\text{Cu}} = 1.0972$$

Ga I Normal state of valence electrons $4s^2 4p\ ^2P^\circ_{1/2} = 0$. I.P. = 48388 cm^{-1}.
Ga II Normal state of valence electrons $4s^2\ ^1S_0 = 0$. I.P. = 165458 cm^{-1}.

References

Wavelengths:
G. R. Harrison, Massachusetts Institute of Technology Wavelength Tables (John Wiley & Sons, New York, 1939).

Classification:
Ga I, W. F. Meggers and R. J. Murphy, J. Research NBS **48**, 334 (1952) RP 2320.

Gallium—all observed lines

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
35	2294.20	I	0 – 43574	340	2659.87	I	0 – 37585
70	2338.28	I	826 – 43578	800	2719.65	I	826 – 37585
40	2371.32	I	0 – 42158				
110	2418.70	I	826 – 42158	5000	2874.24	I	0 – 34782
750	2450.07	I	0 – 40803	9500	2943.64	I	826 – 34787
1300 h	2500.17	I	826 – 40811	1500	2944.18	I	826 – 34782
120	2500.70	I	826 – 40803	10000	4032.98	I	0 – 24788
25	2624.82	I	826 – 38913	20000	4172.06	I	826 – 24788

559-795 O - 75 - 9 (Pt. 1)

Germanium

$$\text{Ge}, Z = 32, M = 72.6, \text{Ratio}\frac{\text{Ge}}{\text{Cu}} = 1.142$$

Ge I Normal state of valence electrons $4s^2 4p^2\ {}^3P_0 = 0$. I.P. = 63715 cm^{-1}.
Ge II Normal state of valence electrons $4s^2 4p\ {}^2P^\circ_{1/2} = 0$. I.P. = 128521 cm^{-1}.

References

Wavelengths and Classification:
K. L. Andrew and K. W. Meissner, J. Opt. Soc. Am. **49,** 146 (1959).

Germanium—all observed lines

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
30000	1954.47	I	557 – 51705	900	2497.96	I	0 – 40020
20000	1961.36	I	7125 – 58093	700	2533.23	I	557 – 40020
32000	1970.23	I	1410 – 52148	25	2556.30	I	16367 – 55474
14000	1987.62	I	1410 – 51705	280	2589.19	I	1410 – 40020
42000	1998.24	I	1410 – 51437	5000	2592.54	I	557 – 39118
17000	2019.07	I	557 – 50069	60	2644.19	I	16367 – 54175
24000	2041.71	I	0 – 48962	12000	2651.18	I	1410 – 39118
16000	2043.77	I	1410 – 50323	5500	2651.58	I	0 – 37702
4200	2054.46	I	1410 – 50069	5000	2691.34	I	557 – 37702
2200	2057.24	I	7125 – 55718	8500	2709.63	I	557 – 37452
7500	2065.21	I	557 – 48962	400	2740.43	I	16367 – 52847
26000	2068.66	I	557 – 48882	6500	2754.59	I	1410 – 37702
4200	2086.02	I	557 – 48180	70	2793.94	I	16367 – 52148
20000	2094.26	I	1410 – 49144	80	2829.01	I	16367 – 51705
2400	2105.82	I	1410 – 48882	7500	3039.06	I	7125 – 40020
950	2124.74	I	7125 – 54175	600	3067.01	I	16367 – 48962
3400	2198.71	I	7125 – 52592	200	3124.82	I	7125 – 39118
180	2256.00	I	7125 – 51437	1100	3269.49	I	7125 – 37702
180	2314.20	I	7125 – 50323	700	4226.57	I	16367 – 40020
240	2327.92	I	7125 – 50069	60	4685.84	I	16367 – 37702
200	2379.14	I	7125 – 49144	6	8789.87	I	37702 – 49076
1300	2417.37	I	7125 – 48480				

Gold

$$\text{Au}, Z = 79, M = 196.9665, \text{Ratio}\,\frac{\text{Au}}{\text{Cu}} = 3.100$$

Au I Normal state of valence electrons $5d^{10}6s\,^2S_{1/2} = 0$. I.P. = 74410 cm^{-1}.
Au II Normal state of valence electrons $5d^{10}\,^1S_0 = 0$. I.P. = 165000 cm^{-1}.

References

Wavelengths:
G. R. Harrison, Massachusetts Institute of Technology Wavelength Tables (John Wiley & Sons, New York, 1939).

Classification:
Au I and Au II, J. R. Platt and R. A. Sawyer, Phys. Rev. **60**, 866 (1941).

Gold—all observed lines

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
11000	2012.00	I	9161 – 58845	320	3029.20	I	9161 – 42164
2600	2021.38	I	9161 – 58616	1600	3122.78	I	9161 – 41174
180	2352.65	I	9161 – 51654	40	3897.89	I	42164 – 67812
120	2387.75	I	9161 – 51029	40	4040.94	I	21435 – 46174
2600	2427.95	I	0 – 41174	70	4065.08	I	37359 – 61952
16	2544.19	I	21435 – 60729	20	4315.09	I	45537 – 68705
30	2590.04	I	21435 – 60033	12	4437.27	I	46174 – 68705
260	2641.49	I	9161 – 47007	25	4488.25	I	45537 – 67812
3400	2675.95	I	0 – 37359	90	4607.34	I	47007 – 68705
30	2688.71	I	21435 – 58616	50	4792.60	I	41174 – 62034
80	2700.89	I	9161 – 46174	25	5837.40	I	37359 – 54485
1100	2748.26	I	9161 – 45537	60	6278.18	I	21435 – 37359
16	2883.45	I	21435 – 56106	60	7510.75	I	41174 – 54485
16	2932.19						

Hafnium

$$\text{Hf},\ Z = 72,\ M = 178.5,\ \text{Ratio}\ \frac{\text{Hf}}{\text{Cu}} = 2.809$$

Hf I Normal state of valence electrons $5d^26s^2\ {}^3F_2 = 0$. I.P. = 53600 cm^{-1}.
Hf II Normal state of valence electrons $5d6s^2\ {}^2D_{1\ 1/2} = 0$. I.P. = 120000 cm^{-1}.

References

Wavelengths:
G. R. Harrison, Massachusetts Institute of Technology Wavelength Tables (John Wiley & Sons, New York, 1939).
C. H. Corliss and W. F. Meggers, J. Research NBS **61**, 269 (1958) RP 2904.

Classification:
Hf I, W. F. Meggers, unpublished material (1966).
Hf II, W. F. Meggers and B. F. Scribner, J. Research NBS **13**, 625 (1934) RP 732.

Molecular Spectra:
HfO, W. F. Meggers, unpublished material (1958).

Strong lines of hafnium

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
8500	2028.18	II	13486 – 62775	1200	2820.22	II	3051 – 38499
6200	2012.78	II	3051 – 52717	1200	2904.41	I	4568 – 38988
2300	3399.80	II	0 – 29405	1200	2950.68	I	2357 – 36237
2200	3682.24	I	0 – 27150	1200	3020.53	I	2357 – 35454
2100	2866.37	I	0 – 34877	1200	3505.23	II	8362 – 36882
2100	3072.88	I	0 – 32533	1100	2638.71	II	0 – 37886
2000	2916.48	I	4568 – 38845	1100	2641.41	II	8362 – 46209
2000	2940.77	I	0 – 33995	1100	2954.20	I	4568 – 38408
1800	2898.26	I	2357 – 36850	1100	2980.81	I	0 – 33538
1400	2964.88	I	2357 – 36075	1100	3012.90	II	0 – 33181
1400	3777.64	I	0 – 26464	1100	3016.94	II	0 – 33136
1400	3785.46	I	4568 – 30977	1100	3057.02	I	4568 – 37270
1300	3561.66	II	0 – 28069	1100	3569.04	II	6344 – 34355
1300	3820.73	I	4568 – 30733	1100	4174.34	I	2357 – 26306
1200	2096.18	II	15084 – 62775	1000	3717.80	I	2357 – 29247

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
6200	2012.78	II	3051 – 52717	200	2537.33	II	3645 – 43044
8500	2028.18	II	13486 – 62775	110	2548.20	II	13486 – 52717
1200	2096.18	II	15084 – 62775	320	2551.40	II	17389 – 56572
540	2210.82	II	36883 – 82101	27	2551.85	II	12921 – 52097
320	2254.01	II	3645 – 47996	60	2559.02	I	2357 – 41422
160	2255.15	II	3645 – 47973	130	2559.19	II	12071 – 51134
250	2266.83	II	4905 – 49006	250	2563.61	II	4905 – 43901
620	2277.16	II	0 – 43901	55	2570.71	II	15084 – 53973
230	2321.14	II	4905 – 47973	890	2571.67	II	3645 – 42518
580	2322.47	II	0 – 43044	320	2573.90	II	12071 – 50910
300	2323.25	II	3645 – 46675	60	2574.89	I	5638 – 44463
120	2324.50	II	12071 – 55077	320	2576.82	II	8362 – 47158
300	2324.89	II	4905 – 47904	300	2578.14	II	4905 – 43681
200	2332.97	II	3645 – 46495	320	2582.54	II	3051 – 41761
200	2337.33	II	0 – 42771	130	2591.33	II	0 – 38579
230	2343.32	II	6344 – 49006	30	2594.12	I	4568 – 43105
320	2347.44	II	6344 – 48931	55	2599.22	II	15084 – 53546
540	2351.22	II	0 – 42518	55	2602.67	I	2357 – 40768
110	2353.02	I	0 – 42485	27	2602.87	I	0 – 38408
90	2365.98	II	4905 – 47158	390	2606.37	II	3051 – 41407
250	2380.30	II	3645 – 45643	450	2607.03	II	6344 – 44691
100	2381.00	II	14360 – 56346	55	2607.24	II	14360 – 52703
170	2393.18	II	12921 – 54693	120	2608.45	I	0 – 38325
450	2393.36	II	4905 – 46675	35	2609.96	I	4568 – 42871
670	2393.83	II	0 – 41761	22	2612.59	I	5522 – 43786
130	2400.78	II	3051 – 44691	230	2613.60	II	17389 – 55639
70	2404.56	II	13486 – 55060	70	2614.29	II	15254 – 53494
540	2405.42	II	6344 – 47904	90	2616.61	I	5639 – 43845
130	2406.44	II	11952 – 53494	450	2622.74	II	3645 – 41761
370	2410.14	II	8362 – 49841	35	2623.32	I	8984 – 47092
90	2413.33	II	12071 – 53494	70	2626.95	II	6344 – 44400
55	2415.96	II	11952 – 53331	27	2635.57	I	6573 – 44504
320	2417.69	II	3051 – 44400	60	2635.79	II	17711 – 55639
120	2425.98	II	13486 – 54693	160	2637.00	I	2357 – 40267
45	2428.75	I	2357 – 43518	1100	2638.71	II	0 – 37886
120	2428.99	II	12071 – 53227	1100	2641.41	II	8362 – 46209
130	2433.57	II	17369 – 58448	70	2642.08	I	2357 – 40194
45	2434.74	II	17389 – 58448	160	2642.75	I	4568 – 42396
35	2444.99	I	4568 – 45455	670	2647.29	II	8362 – 46125
390	2447.25	II	3051 – 43901	45	2649.15	II	14360 – 52097
140	2449.44	II	6344 – 47158	100	2651.16	II	17369 – 55077
35	2452.30	II	11952 – 52717	30	2652.86	II	41407 – 79090
110	2453.34	II	17369 – 58117	60	2657.50	II	15084 – 52703
450	2460.49	II	3051 – 43681	160	2657.84	II	4905 – 42518
70	2463.97	II	12921 – 53494	210	2661.88	II	6344 – 43901
430	2464.19	II	8362 – 48931	90	2665.97	II	12921 – 50420
90	2465.06	II	15084 – 55639	90	2668.28	I	5639 – 43105
35	2465.67	I	4568 – 45112	80	2669.00	II	3051 – 40507
140	2467.97	II	0 – 40507	45	2671.25	II	13486 – 50910
210	2469.18	II	13486 – 53973	22	2676.63	II	17711 – 55060
100	2473.92	II	12921 – 53331	18	2677.58	II	6344 – 43681
55	2481.44	II	17830 – 58117	18	2678.43	II	17369 – 54693
55	2482.65	I	0 – 40267	35	2682.19	I	6573 – 43845
55	2487.16	I	0 – 40194	290	2683.35	II	15084 – 52340
290	2496.99	II	3645 – 43681	55	2685.22	II	17830 – 55060
70	2500.74	II	15084 – 55060	18	2686.36	I	6572 – 43786
70	2502.66	I	2357 – 42302	18	2688.35	I	8984 – 46170
580	2512.69	II	4905 – 44691	70	2696.18	I	2357 – 39435
580	2513.03	II	6344 – 46125	60	2699.63	I	
130	2515.48	II	13486 – 53227	670	2705.61	I	0 – 36949
890	2516.88	II	3051 – 42771	110	2706.73	II	13486 – 50420
70	2517.86	I	0 – 39704	70	2711.83	I	8984 – 45848
70	2521.49	II	17830 – 57478	45	2711.99	II	17830 – 54693
340	2531.19	II	4905 – 44400	22	2712.14	II	12071 – 48931
80	2532.97	II	3051 – 42518	210	2712.42	II	4905 – 41761

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
140	2713.84	I	2357 – 39194
60	2718.51	II	14360 – 51134
250	2718.59	I	0 – 36773
80	2726.70	I	5639 – 42302
70	2729.10	I	2357 – 38988
90	2730.71	I	0 – 36610
120	2730.85	I	4568 – 41175
35	2732.68	II	17389 – 53973
70	2737.83	I	5522 – 42036
710	2738.76	II	4905 – 41407
200	2743.64	I	5639 – 42076
35	2746.62	I	5639 – 42036
360	2751.81	II	8362 – 44691
60	2756.91	II	17711 – 53973
30	2758.31	I	10533 – 46776
90	2758.78	I	0 – 36237
450	2761.63	I	4568 – 40768
60	2762.69	I	5639 – 41825
160	2766.96	I	5639 – 41769
55	2770.46	II	12921 – 49006
45	2772.32	II	14360 – 50420
170	2773.02	I	2357 – 38408
980	2773.36	II	6344 – 42391
180	2774.02	II	8362 – 44400
55	2775.27	II	11952 – 47973
390	2779.37	I	2357 – 38325
70	2783.69	I	6572 – 42485
45	2786.30	II	15254 – 51134
100	2789.50	II	17389 – 53227
140	2789.73	II	17711 – 53546
	2789.80	II	12071 – 47904
230	2808.00	II	4905 – 40507
27	2812.32	I	10509 – 46056
230	2813.86	II	3051 – 38579
170	2814.48	II	13486 – 49006
90	2814.76	II	17711 – 53227
45	2815.82	I	6573 – 42076
45	2816.07	II	17830 – 53330
230	2817.68	I	8984 – 44464
140	2818.94	I	6572 – 42036
200	2819.74	I	0 – 35454
1200	2820.22	II	3051 – 38499
55	2820.42	II	13486 – 48931
490	2822.68	II	6344 – 41761
80	2829.32	II	17369 – 52703
180	2833.28	I	0 – 35284
110	2834.13	I	8984 – 44258
70	2841.49	I	5522 – 40704
410	2845.83	I	5639 – 40768
270	2849.21	II	12071 – 47158
70	2850.15	II	12921 – 47996
270	2850.96	I	5639 – 40704
180	2851.21	II	6344 – 41407
55	2857.65	II	12921 – 47904
55	2860.31	II	17389 – 52340
180	2860.56	I	0 – 34948
760	2861.01	II	0 – 34942
760	2861.70	II	3645 – 38579
2100	2866.37	I	0 – 34877
55	2867.70	I	8984 – 43845
130	2869.82	II	3051 – 37886
27	2873.65	I	10532 – 45321
150	2876.33	II	15084 – 49841
45	2877.16	I	10509 – 45255
55	2879.11	II	11952 – 46675
55	2885.47	II	14360 – 49006
210	2887.14	I	4568 – 39194
100	2887.54	I	6572 – 41194
800	2889.62	I	0 – 34596
60	2892.56	I	
18	2894.84	I	8984 – 43518
1800	2898.26	I	2357 – 36850
130	2898.71	II	13486 – 47973
1200	2904.41	I	4568 – 38988
890	2904.75	I	2357 – 36773
140	2909.91	II	0 – 34355
2000	2916.48	I	4568 – 38845
30	2917.49	II	17830 – 52097
580	2918.58	I	2357 – 36610
320	2919.59	II	3645 – 37886
180	2924.62	I	5522 – 39704
60	2929.01	I	6572 – 40704
490	2929.63	II	0 – 34124
450	2929.90	I	8984 – 43105
710	2937.80	II	8362 – 42391
2000	2940.77	I	0 – 33995
160	2944.71	I	0 – 33949
55	2947.13	II	15084 – 49006
1200	2950.68	I	2357 – 36237
27	2951.90	I	10509 – 44375
1100	2954.20	I	4568 – 38408
540	2958.02	I	5639 – 39435
60	2960.82	II	17369 – 51134
120	2961.80	II	12921 – 46675
1400	2964.88	I	2357 – 36075
620	2966.93	I	6572 – 40267
140	2967.23	II	11952 – 45643
710	2968.81	II	4905 – 38579
110	2973.37	I	6572 – 40194
890	2975.88	II	4905 – 38499
70	2977.60	II	12921 – 46495
150	2979.28	I	5639 – 39194
1100	2980.81	I	0 – 33538
210	2982.72	I	10533 – 44049
55	2984.05	I	8984 – 42485
170	3000.10	II	3051 – 36373
800	3005.56	I	10533 – 43795
80	3011.24	II	17711 – 50910
1100	3012.90	II	0 – 33181
540	3016.78	I	0 – 33138
1100	3016.94	II	0 – 33136
27	3017.37	I	6572 – 39704
980	3018.31	I	0 – 33122
1200	3020.53	I	2357 – 35454
80	3024.60	I	8984 – 42036
80	3024.76	II	17369 – 50420
140	3025.29	II	8362 – 41407
410	3031.16	II	4905 – 37886
110	3046.08	II	15084 – 47904
80	3049.29	I	8984 – 41769
710	3050.76	I	5639 – 38408
80	3054.52	II	3645 – 36373
45	3055.44	II	15254 – 47973
1100	3057.02	I	4568 – 37270
130	3063.78	I	5522 – 38152
130	3064.68	II	12071 – 44691
850	3067.41	I	2357 – 34948
90	3069.18	I	10532 – 43105
2100	3072.88	I	0 – 32533
170	3074.10	I	2357 – 34877

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
250	3074.79	I	5639 – 38152
27	3075.30	I	10509 – 43016
150	3080.66	II	17389 – 49841
430	3080.84	I	2357 – 34806
90	3092.24	II	12071 – 44400
200	3096.76	I	4568 – 36850
340	3101.40	II	6344 – 38579
710	3109.12	II	6344 – 38499
130	3110.87	II	14360 – 46495
70	3116.95	II	15084 – 47158
130	3119.98	I	4568 – 36610
45	3126.29	II	4905 – 36883
90	3128.76	I	0 – 31952
70	3129.58	I	0 – 31944
710	3131.81	I	10533 – 42454
45	3133.50	II	41761 – 73665
850	3134.72	II	3051 – 34942
130	3137.51	I	10533 – 42396
170	3139.65	II	6344 – 38186
120	3140.76	II	12071 – 43901
220	3145.32	II	0 – 31784
220	3148.41	I	6572 – 38325
120	3151.63	I	8984 – 40704
35	3152.96	I	14092 – 45799
450	3156.63	I	4568 – 36237
270	3159.82	I	2357 – 33995
710	3162.61	II	12071 – 43681
45	3163.39	I	10509 – 42112
90	3165.73	I	6573 – 38152
450	3168.39	I	10509 – 42062
890	3172.94	I	4568 – 36075
450	3176.86	II	4905 – 36373
45	3178.43	I	14542 – 45995
35	3179.61	I	
220	3181.01	I	5522 – 36949
120	3181.15	I	4568 – 35994
130	3189.62	I	0 – 31342
360	3193.53	II	3051 – 34355
670	3194.19	II	3645 – 34942
60	3195.61	II	14360 – 45643
200	3196.93	I	
130	3199.99	II	15254 – 46495
45	3203.67	II	13486 – 44691
310	3206.11	I	2357 – 33538
180	3210.98	I	5639 – 36773
90	3213.72	I	14542 – 45649
180	3217.30	II	3051 – 34124
180	3220.61	II	15084 – 46125
130	3230.06	I	
130	3239.44	I	
130	3243.35	I	16767 – 47590
360	3247.66	I	2357 – 33139
220	3249.53	I	2357 – 33121
890	3253.70	II	3051 – 33776
70	3254.86	I	14741 – 45455
270	3255.28	II	3645 – 34355
45	3261.90	I	14435 – 45083
120	3262.47	I	10533 – 41175
90	3265.29	I	15673 – 46290
70	3267.01	I	
70	3267.18	I	5639 – 36237
180	3273.66	II	6344 – 36883
270	3279.98	II	3645 – 34124
45	3283.38	II	12071 – 42518
160	3291.05	I	6572 – 36949
210	3306.12	I	4568 – 34806
120	3309.19	I	8984 – 39194
340	3310.27	I	6573 – 36773
45	3310.86	II	13486 – 43681
670	3312.86	I	2357 – 32533
70	3316.19	I	17901 – 48048
180	3317.99	II	3051 – 33181
45	3323.36	II	23146 – 53227
130	3328.21	II	4905 – 34942
45	3331.89	I	10509 – 40514
890	3332.73	I	0 – 29997
370	3352.06	II	8362 – 38186
90	3356.09	II	17369 – 47158
130	3356.78	I	15673 – 45455
70	3358.30	II	17389 – 47158
230	3358.91	I	14741 – 44504
180	3360.06	I	0 – 29753
140	3366.68	I	14092 – 43786
35	3372.21	I	5639 – 35284
180	3378.93	I	2357 – 31943
140	3384.14	II	14360 – 43901
230	3384.70	II	3645 – 33181
170	3386.21	I	16767 – 46290
800	3389.83	II	3645 – 33136
230	3392.81	I	15673 – 45139
230	3394.59	II	4905 – 34355
140	3394.98	II	17711 – 47158
230	3397.26	I	4568 – 33995
230	3397.60	I	8984 – 38408
2300	3399.80	II	0 – 29405
170	3400.21	I	0 – 29402
180	3402.51	I	4568 – 33949
90	3407.14	I	8984 – 38325
140	3407.76	II	12071 – 41407
230	3410.17	II	15084 – 44400
60	3412.34	I	14542 – 43838
90	3413.74	II	13486 – 42771
230	3417.34	I	2357 – 31611
410	3419.18	I	5639 – 34877
45	3421.42	II	4905 – 34124
140	3427.44	I	8984 – 38152
200	3428.37	II	0 – 29160
250	3438.24	II	18898 – 47973
140	3438.43	I	5522 – 34596
100	3441.84	I	14741 – 43786
45	3448.29	I	
100	3452.31	I	5639 – 34596
140	3462.64	II	4905 – 33776
140	3467.60	I	15673 – 44504
710	3472.40	I	0 – 28790
200	3478.99	II	17389 – 46125
480	3479.28	II	3051 – 31784
45	3487.57	II	17830 – 46495
250	3495.75	II	6344 – 34942
80	3495.93	II	15084 – 43681
250	3497.16	I	
980	3497.49	I	0 – 28584
100	3498.98	I	4568 – 33139
1200	3505.23	II	8362 – 36882
150	3513.28	I	10532 – 38988
130	3518.75	II	14360 – 42771
55	3521.56	I	17901 – 46290
980	3523.02	I	2357 – 30733
100	3530.87	I	19293 – 47606
100	3531.23	I	5639 – 33949

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
980	3535.54	II	4905 – 33181
760	3536.62	I	0 – 28267
180	3548.81	I	18011 – 46181
540	3552.70	II	3645 – 31784
150	3554.00	I	14542 – 42671
1300	3561.66	II	0 – 28069
150	3564.31	I	0 – 28048
270	3567.36	I	6572 – 34596
1100	3569.04	II	6344 – 34355
150	3579.90	I	14435 – 42361
110	3583.28	I	5639 – 33538
210	3597.42	II	15254 – 43044
	3597.51	I	8984 – 36773
540	3599.87	I	16767 – 44537
110	3615.04	1	0 – 27654
800	3616.89	I	2357 – 29997
110	3617.68	1	14542 – 42176
90	3620.04	I	5522 – 33138
110	3624.00	II	12921 – 40507
320	3630.87	II	28105 – 55639
100	3635.43	I	5639 – 33138
55	3637.59	I	5639 – 33122
800	3644.36	II	6344 – 33776
320	3649.10	1	2357 – 29753
90	3650.53	I	19293 – 46678
200	3651.84	I	4568 – 31943
140	3661.05	II	15084 – 42391
80	3664.60	I	14018 – 41298
220	3665.35	II	11952 – 39226
100	3668.21	I	8984 – 36237
200	3672.27	I	
480	3675.74	I	15673 – 42871
2200	3682.24	1	0 – 27150
280	3696.51	1	2357 – 29402
100	3698.40	II	17369 – 44400
240	3699.72	II	13486 – 40507
340	3701.15	II	17389 – 44400
100	3704.92	1	18381 – 45365
120	3705.40	II	17711 – 44691
1000	3717.80	I	2357 – 29247
650	3719.28	II	4905 – 31784
140	3726.19	1	10509 – 37336
160	3729.10	I	20960 – 47769
460	3733.79	I	4568 – 31342
160	3737.88	II	18898 – 45643
120	3739.04	I	10533 – 37270
60	3743.99	I	18381 – 45083
100	3744.98	II	23146 – 49841
400	3746.80	I	14741 – 41422
80	3747.49	II	15084 – 41761
140	3753.22	I	17901 – 44537
60	3762.51	II	31878 – 58448
100	3765.05	I	18225 – 44778
100	3765.56	I	6572 – 33122
170	3766.92	II	20135 – 46675
200	3768.25	I	10509 – 37039
60	3771.36	II	12070 – 38579
60	3773.12	I	14018 – 40514
1400	3777.64	I	0 – 26464
35	3782.43	I	5522 – 31952
70	3782.78	II	12070 – 38499
1400	3785.46	I	4568 – 30977
35	3787.37	1	18381 – 44778
650	3793.37	II	3051 – 29405
100	3798.66	I	10532 – 36850
850 d	3800.38	I	0 – 26306
	3800.45	I	5639 – 31944
70	3804.53	I	
140	3806.07	II	21638 – 47904
320	3811.78	1	2357 – 28584
100	3817.20	II	17711 – 43901
100	3819.38	I	14092 – 40267
1300	3820.73	I	4568 – 30733
140	3829.67	I	16767 – 42871
280	3830.02	I	14092 – 40194
800	3849.18	I	5639 – 31611
140	3849.52	II	17711 – 43681
600	3858.31	I	2357 – 28267
230	3860.91	I	8984 – 34877
80	3867.34	II	17830 – 43681
200	3872.55	II	12071 – 37886
160	3877.10	II	23146 – 48931
380	3880.82	II	3645 – 29405
200	3882.52	I	15673 – 41422
150	3883.77	II	13486 – 39226
200	3889.23	I	10532 – 36237
200	3889.33	I	5639 – 31342
70	3892.47	I	19791 – 45475
620	3899.94	I	0 – 25634
35	3900.65	II	30942 – 56572
45	3906.89	I	14542 – 40130
80	3909.18	I	19791 – 45365
80	3917.45	II	21638 – 47158
620	3918.09	II	3645 – 29160
200	3923.90	II	12921 – 38399
120	3926.42	I	10533 – 35994
150	3927.57	I	14741 – 40194
110	3929.54	II	28105 – 53546
320	3931.38	1	4568 – 29997
120	3935.65	II	17369 – 42771
120	3939.04	I	6572 – 31952
80	3950.80	I	24085 – 49389
410	3951.83	1	2357 – 27654
80	3964.95	II	17830 – 43044
160	3968.01	I	0 – 25194
150 bI	3970.05	Hf O	
200	3973.48	1	2356 – 27516
80	3979.40	II	28105 – 53227
180	4032.27	I	2357 – 27150
90	4044.39	I	16163 – 40882
100	4047.96	II	30942 – 55639
70	4049.45	II	17830 – 42518
70	4049.74	I	
230	4062.84	I	10509 – 35115
140	4066.21	I	14542 – 39128
180	4083.35	I	10509 – 34992
35	4087.96	I	16163 – 40619
540	4093.16	II	3645 – 28069
110	4104.23	I	5639 – 29997
140	4106.58	I	10532 – 34877
110	4113.53	II	12071 – 36373
35	4115.90	I	18381 – 42671
110	4118.60	I	10532 – 34806
70	4118.91	I	14018 – 38289
150	4127.80	II	14360 – 38579
140	4145.76	I	5639 – 29753
80	4158.88	II	17369 – 41407
150	4162.36	II	17389 – 41407
110	4162.69	I	4568 – 28584
1100	4174.34	I	2357 – 26306

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
80		4187.66	II	18898 – 42771
120		4190.95	I	14435 – 38289
160		4206.58	II	20135 – 43901
190		4209.70	I	14542 – 38289
170		4228.08	I	0 – 23645
170		4232.44	II	18898 – 42518
80		4245.16	I	8984 – 32533
40		4245.84	II	20135 – 43681
120	bl	4252.08	Hf O	
170		4260.98	I	10533 – 33994
200		4263.39	I	0 – 23449
170		4272.85	II	13486 – 36883
320		4294.79	I	2357 – 25634
80		4296.41	I	5522 – 28790
120		4318.14	I	5639 – 28790
80		4320.67	II	17369 – 40507
160		4330.27	I	4568 – 27654
40		4334.64	II	23146 – 46209
180		4336.66	II	21638 – 44691
35	h	4349.74	I	24785 – 47769
150		4350.51	II	23146 – 46125
40	h	4351.15	I	
80		4352.57	I	8984 – 31952
70		4353.34	I	16163 – 39128
250		4356.33	I	4568 – 27516
55		4356.99	I	5639 – 28584
70		4365.37	I	14435 – 37336
110		4367.90	II	13486 – 36373
180		4370.97	II	12071 – 34942
55	b	4408.81	Hf O	
120		4417.35	II	15254 – 37886
160		4417.91	I	5639 – 28267
35		4418.25	I	8984 – 31611
35		4422.23	I	10532 – 33139
200		4438.04	I	5522 – 28048
55	h	4443.07	I	18381 – 40882
55		4453.00	I	0 – 22451
140		4457.34	I	2357 – 24785
140		4461.18	I	5639 – 28048
45		4466.40	II	20135 – 42518
55		4486.13	II	12071 – 34355
55		4499.65	I	6572 – 28790
45		4518.29	I	16163 – 38289
140		4540.93	I	5639 – 27654
80		4544.02	I	10532 – 32533
250		4565.94	I	5639 – 27534
23		4573.79	II	17369 – 39226
45	h	4597.90	I	23644 – 45387
500	d	4598.80	I	0 – 21739
		4598.92	I	4568 – 26306
23		4605.77	II	12071 – 33776
90		4608.09	I	6573 – 28267
230		4620.86	I	4568 – 26203
70		4622.70	II	20135 – 41761
45	h	4630.61	I	19293 – 40882
210		4655.19	I	6572 – 28048
80		4664.12	II	12921 – 34355
26		4669.24	I	10532 – 31943
120		4699.01	I	18011 – 39286
40		4699.72	II	20135 – 41407
45	h	4708.84	I	22901 – 44132
45	h	4719.10	II	11952 – 33136
45	h	4731.37	II	17369 – 38499
40		4738.58	I	14018 – 35115
40		4757.58	I	8984 – 29997
90		4766.51	I	14018 – 34992
80		4773.72	I	5522 – 26464
26		4774.89	I	22901 – 43838
160		4782.74	I	18225 – 39128
40		4790.72	II	17711 – 38578
310		4800.50	I	5638 – 26464
35		4817.21	II	21638 – 42391
65		4818.87	I	18381 – 39128
40		4834.19	I	14435 – 35115
80		4837.23	I	5639 – 26306
21		4850.61	I	10509 – 31119
40		4858.41	I	6572 – 27150
130		4859.24	I	14542 – 35115
80		4863.27	I	14435 – 34992
21		4872.94	I	20960 – 41476
80		4877.58	I	19293 – 39789
22		4915.26	I	19791 – 40130
25		4934.45	II	12921 – 33181
55		4948.94	I	10533 – 30733
25		4962.37	I	18143 – 38289
120		4975.25	I	2357 – 22450
15		4999.68	II	14360 – 34355
95		5018.20	I	20960 – 40882
15		5021.75	I	18381 – 38289
55		5040.82	II	11952 – 31784
95		5047.45	I	8984 – 28790
55	b	5074.74	Hf O	
30		5079.65	II	18898 – 38579
55	b	5093.88	Hf O	
15		5112.13	I	5639 – 25194
19		5128.53	II	17389 – 36883
30		5157.96	I	22901 – 42283
55		5167.42	I	24785 – 44132
75		5170.18	I	19791 – 39128
230		5181.86	I	0 – 19293
30		5186.84	I	22901 – 42176
30		5187.75	II	15084 – 34355
110		5243.99	I	8984 – 28048
55		5247.10	II	28105 – 47158
25		5260.44	II	17369 – 36373
30		5264.95	II	18898 – 37886
55		5275.04	I	16163 – 35115
22		5286.09	I	23449 – 42361
120		5294.87	I	4568 – 23449
45		5298.06	II	15254 – 34124
30		5307.82	I	23449 – 42283
45		5309.68	I	16163 – 34992
55		5311.60	II	14360 – 33181
12		5324.26	II	14360 – 33136
9		5346.30	II	28458 – 47158
110		5354.73	I	25462 – 44132
110		5373.86	I	2357 – 20960
40		5389.34	I	8984 – 27534
19		5391.36	II	17830 – 36373
19		5404.47	I	19791 – 38289
28		5424.02	I	22451 – 40882
12		5435.78	I	21738 – 40130
40		5438.74	I	0 – 18381
14		5444.07	II	20135 – 38499
75		5452.92	I	4568 – 22901
30		5463.38	II	13486 – 31784
15		5497.30	I	29753 – 47938
15		5510.12	I	0 – 18143
15		5510.45	I	18381 – 36524
19		5524.35	II	15084 – 33181

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
45		5538.02	I	21739 – 39791
28		5538.26	I	10533 – 28584
230		5550.60	I	0 – 18011
230		5552.12	I	5639 – 23645
55		5575.86	I	26203 – 44132
14		5600.77	I	23449 – 41298
95		5613.27	I	5639 – 23449
25		5614.01	I	21739 – 39546
8		5628.27	I	23449 – 41211
19		5650.83	I	10509 – 28201
40	bl	5698.03	Hf O	
25		5713.28	I	24785 – 42283
160		5719.18	I	8984 – 26464
25	bl	5720.16	Hf O	
12		5748.72	I	24785 – 42176
14		5767.18	II	12071 – 29405
12		5809.50	II	11952 – 29160
19		5817.47	I	14435 – 31620
25		5842.23	II	17830 – 34942
25		5845.87	I	14018 – 31119
19		5847.77	I	22451 – 39546
22		5883.66	I	23645 – 40636
15		5926.47	I	23645 – 40514
60		5933.69	I	18143 – 34992
75		5974.28	I	18381 – 35115
25		5974.72	I	19791 – 36524
60		5978.66	I	18270 – 34992
25		5992.96	I	23448 – 40130
45	c	6016.79	I	27516 – 44132
28	b	6021.12	Hf O	
25	b	6043.19	Hf O	
25		6054.17	I	14542 – 31055
95		6098.67	I	4568 – 20960
95		6185.13	I	0 – 16163
55		6210.70	I	24785 – 40882
28		6216.82	I	26203 – 42283
45		6238.58	I	2357 – 18381
60		6248.95	II	12071 – 28069
22	h	6299.54	I	26306 – 42176
25	h	6311.85	I	22451 – 38289
19		6318.33	I	19293 – 35115
30		6338.10	I	10532 – 26306
19	h	6380.19	I	15673 – 31342
60		6386.23	I	2357 – 18011
19	h	6409.52	I	21739 – 37336
15	h	6556.50	I	25634 – 40882
28		6587.23	I	16766 – 31943
45		6644.60	II	14360 – 29405
19		6647.06	II	23146 – 38186
11		6659.40	I	14741 – 29753
30		6713.48	I	16163 – 31055
6		6716.00	I	22451 – 37336
17		6754.61	II	14360 – 29160
11		6769.95	I	27516 – 42283
85		6789.27	I	4568 – 19293
160		6818.94	I	8984 – 23645
15		6826.56	I	23645 – 38289
13		6850.07	I	25194 – 39789
35		6858.70	I	16766 – 31342
45		6911.40	I	8984 – 23449
10		6926.19	I	14092 – 28526
19		6979.59	I	15673 – 29997
21		6980.91	II	15084 – 29405
7		7019.25	I	29247 – 43489
7		7030.33	II	20135 – 34355
7		7035.13	I	16767 – 30977
11		7061.90	I	25634 – 39791
15		7062.87	I	25634 – 39789
160		7063.83	I	5639 – 19791
11	h	7094.40	I	25194 – 39286
15		7100.54	I	15673 – 29753
55		7119.52	I	17901 – 31943
570		7131.81	I	0 – 14018
650		7237.10	I	4568 – 18381
410		7240.87	I	2357 – 16163
6		7262.62	I	14435 – 28201
75		7320.05	I	4568 – 18225
16		7321.76	I	5639 – 19293
6		7356.10	I	23449 – 37039
6		7365.28	I	15673 – 29247
20		7390.70	I	14741 – 28267
6		7423.69	I	8984 – 22450
25		7437.56	I	14092 – 27534
13		7463.86	I	23645 – 37039
7		7484.56	I	22880 – 36237
15		7556.37	I	16766 – 29997
75		7562.93	I	6572 – 19791
15		7564.22	I	34806 – 48022
11		7576.95	I	18381 – 31576
11		7592.96	I	23253 – 36419
13		7608.59	I	31943 – 45083
360		7624.40	I	10533 – 23645
20		7645.64	I	17901 – 30977
110		7740.17	I	10532 – 23449
8		7743.57	I	15673 – 28584
5		7757.89	II	18898 – 31784
40		7790.90	I	17901 – 30733
7		7796.81	I	23253 – 36075
35		7814.55	I	14741 – 27534
310		7845.35	I	5639 – 18381
7		7846.56	I	23253 – 35994
130		7920.71	I	5522 – 18143
29		7938.06	I	15673 – 28267
250		7994.73	I	5639 – 18143
7		8010.58	I	16766 – 29247
25		8056.52	I	14741 – 27150
25		8080.32	I	5639 – 18011
16		8173.89	I	20908 – 33139
130		8204.58	I	2357 – 14542
7		8248.81	I	36237 – 48357
55		8276.95	I	2357 – 14435
13		8305.91	II	17369 – 29405
25		8344.25	I	15673 – 27654
5		8380.06	I	28584 – 40514
5		8382.98	I	22880 – 34806
35		8460.01	I	16767 – 28584
150		8546.48	I	6572 – 18270
160		8640.06	I	6572 – 18143
40		8711.24	I	15673 – 27150
65		9004.73	I	14092 – 25194

Holmium

$$\text{Ho, } Z = 67, \; M = 164.9303, \; \text{Ratio } \frac{\text{Ho}}{\text{Cu}} = 2.595$$

Ho I Normal state of valence electrons $4f^{11}6s^2\ {}^4I^\circ_{71/2} = 0$. I.P. = 48540 cm^{-1}.
Ho II Normal state of valence electrons $4f^{11}\,6s\ {}^5I^\circ_8 = 0$. I.P. = 95200 cm^{-1}.

References

Wavelengths:
Below 7000 Å;
A. Gatterer and J. Junkes, Spektren der Seltenen Erden (Specola Vaticana, Vatican, 1945).
About 50 wavelengths were measured on our plates, including all lines above 7000 Å.

Classification:
Ho I, J. Blaise, P. Camus, G. Guelachvili, J. Verges, and J. F. Wyart, C. R. Acad. Sc. Paris, Ser. B.275,81 (1972); 274,1302 (1972).
Ho II, J. Sugar, J. Opt. Soc. Am. **58**, 1519 (1968).

Spectrum Assignments:
From 3837 Å to 4661 Å: A. S. King, Astrophys. J. **72**, 221 (1930).
The rest of the assignments are from our plates.

Molecular Spectra:
HoO, A. Gatterer, Ricerche Spettroscop. **1**, 139 (1942).

Strong lines of holmium

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
16000	c	3456.00	II		2900		4108.62	I	
13000	c	3891.02	II	637 – 26331	2700	c	3861.68	II	
8900	c	3796.75	II	0 – 26331	2700		4040.81	I	0 – 24740
8900	c	3810.73	II	0 – 26234					
8900		4103.84	I	0 – 24361	2500	c	3494.76	II	
					2500		4173.23	I	
8100	c	3398.98	II	0 – 29412	2000	c	3425.34	II	
8100		4053.93	I	0 – 24660	2000	c	3428.13	II	
8100		4163.03	I		2000		4227.04	I	
6300		3484.84	II						
5400		3416.46	II	637 – 29899	1800	c	3854.07	II	
					1700		4065.09	II	
5400	c	3474.26	II	637 – 29412	1600		3461.97	II	
5400	c	4045.44	II	0 – 24712	1600		3546.05	II	
4300		4127.16	I		1600	c	3662.29	I	
4100	c	3515.59	II						
3200		3453.14	II		1500		4120.20	I	
					1500		4136.22	I	
3200	cw	3748.17	II		1400	c	3414.90	II	0 – 29275
3000	c	3888.96	II		1400		3667.97	I	

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
170		2502.91	II	
80		2508.53	II	
110		2513.55	II	
95		2518.73	II	
170		2533.80	I	
130		2536.86	II	
80		2556.84	I	0 – 39098
80		2567.73	II	
80		2586.52	I	
60		2591.05	II	
95		2592.99	I	
190		2605.86	II	
110		2610.51	II	
95		2613.99	II	
60		2625.20	II	
80		2640.09	I	0 – 37865
80		2640.30	II	
60		2649.68	II	
80		2666.24	II	
70		2689.03	II	
45		2704.18	II	
45		2709.30	II	
210		2713.65	II	
45	c	2721.77	II	
45		2728.32	II	
230		2733.95	II	
45		2738.79	I	
270		2750.35	II	
45		2757.77	II	
110	c	2759.35	II	
110		2766.85	II	
270		2769.89	II	
70		2772.60	II	
110		2772.83	II	
70		2773.84	II	
140		2777.10	II	
55		2778.87	II	
55		2787.20	II	
55		2791.08	II	
55		2793.90	II	
140		2794.41	II	
100		2799.99	II	
100		2806.72	II	
70		2807.31	II	
80		2809.09	II	
160	c	2809.99	II	
220		2811.36	II	
180		2812.00	II	
80		2814.44	II	
190		2814.74	II	
70		2814.91	II	
45		2819.68	II	
90		2819.80	II	
80		2823.36	II	
70		2823.73	II	
300		2824.20	II	
140		2826.64	II	
55		2830.92	II	
270	c	2831.69	II	
55		2833.79	II	
210		2834.99	II	
110		2835.85	II	
55		2836.70	II	
70		2843.39	II	
110		2844.18	II	
100		2844.68	II	
270		2849.10	II	
45		2852.89	II	
40		2860.87	II	
100		2861.23	II	
250		2861.49	II	
150		2862.72	II	
90		2866.79	II	
210		2871.99	II	
90		2872.44	II	
70		2873.88	II	
230		2874.06	II	
160		2874.43	II	
360		2880.26	II	
460		2880.98	II	
55		2882.04	II	
35		2883.47	II	
80		2884.64	II	
70		2891.29	II	
340		2894.99	II	
160		2895.62	II	
170		2900.84	II	
55		2902.19	II	
570	c	2909.41	II	
55		2910.40	II	
70		2914.09	II	
45		2915.12	II	
170		2915.82	II	
300		2919.62	II	
55		2921.85	II	
70		2922.60	II	
110		2925.35	II	
160		2926.09	II	
90		2926.99	II	
300	c	2928.30	II	
55		2936.24	II	
90		2940.99	I	
220		2942.05	II	
55		2942.59	II	
300		2944.49	II	
35		2945.04	II	
55		2945.83	II	
70		2952.36	II	
55		2952.73	II	
250	c	2953.11	II	
70		2954.28	II	
70	c	2954.94	II	
35		2955.27	II	
70		2957.41	II	
70	c	2964.40	II	
55		2972.43	II	
390		2973.00	II	
55		2975.24	II	
410	c	2979.63	II	
55		2980.64	II	
180		2981.46	II	
80		2984.07	II	
140		2985.48	II	
410		2987.64	II	
250		2990.27	II	
90	c	2992.71	II	
110		2995.86	II	
90		2998.29	II	
70		3000.69	II	
45		3005.29	II	

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
45		3007.08	II	
320	c	3008.10	II	
160		3009.48	II	
55		3012.07	II	
220		3014.60	II	
110		3016.21	II	
45		3017.73	II	
70		3018.16	II	
160		3023.14	II	
130	c	3024.38	II	
70	c	3026.13	II	
110		3028.18	II	
130		3033.44	II	
170		3035.65	II	
270		3038.69	II	
90		3044.40	II	
70		3046.44	II	
480	c	3049.38	II	
160		3050.73	II	
410	c	3054.00	II	
130	c	3054.87	II	
500	c	3057.45	II	
70		3060.24	II	
110	c	3062.53	II	
80		3063.14	II	
180		3064.19	II	
230		3074.30	II	
100		3075.53	II	
80	c	3078.41	II	
500	c	3082.34	II	
910		3084.36	II	
430	c	3086.54	II	
180		3102.69	II	
150		3105.18	II	
200		3108.31	II	
150		3108.65	II	
200	c	3109.91	II	
65		3111.85	II	
65		3114.36	II	
760		3118.50	II	
65		3129.21	II	
70		3130.77	II	
300	c	3130.99	II	
200	c	3134.39	II	
300	c	3144.36	II	
70		3146.13	II	
150	c	3148.85	II	
120		3149.94	II	
65	c	3153.04	II	
130		3153.82	I	
200		3156.18	II	
270		3156.97	II	
120		3157.35	I	
120		3158.40	II	
200	c	3159.67	II	
65		3160.47	II	
65		3164.06	II	
120		3165.69	II	
580	c	3166.62	II	
160		3167.89	II	
390	dl	3171.72	II	
80		3172.37	II	
810		3173.78	II	
390		3174.84	II	
270	c	3176.97	II	
810	c	3181.50	II	
390		3183.84	II	
270	cw	3184.48	II	
200		3186.37	I	
140		3187.39	II	
160		3191.02	II	
70		3195.09	II	
140	c	3196.07	II	
65		3196.52	II	
390	c	3197.83	II	
110		3201.00	I	
390		3201.76	II	
160		3204.28	II	
100		3206.17	I	
200		3206.86	II	
270	c	3210.41	II	
120		3211.85	II	
80		3213.28	II	
140		3215.36	II	
200	c	3221.42	II	
80		3224.27	II	
65		3230.04	II	
80	c	3231.67	II	
320		3233.34	II	
80		3233.87	II	
200		3236.90	II	
200		3237.40	II	
65		3240.42	II	
80		3243.00	II	
80		3247.22	II	
80		3256.28	II	
200	c	3257.45	II	
120	c	3258.45	II	
80		3262.20	II	
70		3263.66	II	
80		3266.34	II	
90		3267.36	II	
80		3277.16	II	
390	c	3278.15	II	
270		3279.25	II	
120		3281.18	II	
980	c	3281.97	II	
140		3283.08	II	
390		3288.46	II	
270	c	3290.96	II	
120	c	3297.06	II	
90		3298.12	II	
130		3301.34	I	
200	c	3305.16	II	
130		3312.39	II	
140		3315.66	II	
200		3319.87	II	
230		3320.25	II	
80		3321.11	II	
110		3323.74	II	
120	c	3329.02	II	
200		3331.93	II	
160		3333.16	II	
630	c	3337.23	II	
390	c	3338.86	II	
160		3340.44	II	
80		3342.70	II	
980	c	3343.58	II	0 – 29899
200		3344.47	II	
65		3344.79	II	

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
110		3348.61	II	
360		3350.49	II	
320		3352.10	II	
320	cw	3353.55	II	
320		3354.58	II	
80		3356.98	II	
320		3357.91	II	
140		3360.87	II	
120		3363.41	II	
320		3364.27	II	
80	c	3368.36	II	
100		3369.89	II	
290		3370.87	II	
100		3372.43	II	
230		3374.16	II	
70		3374.36	II	
80		3380.49	II	
80		3386.41	I	
160	c	3389.56	II	
290	c	3390.75	II	
160	c	3392.05	II	
80		3392.47	II	
320	c	3394.60	II	
110		3397.33	II	
8100	c	3398.98	II	0 – 29412
110		3400.60	II	
200		3401.59	II	
130		3402.18	II	
120		3406.27	II	
200		3408.21	II	
200	c	3409.06	II	
810	c	3410.26	II	
390	c	3410.65	II	
290		3411.55	II	
150		3412.87	II	
200	c	3414.25	II	
1400	c	3414.90	II	0 – 29275
5400		3416.46	II	637 – 29899
80	c	3418.19	II	
120		3418.47	I	8378 – 37623
1200		3421.63	II	
290		3424.11	I	8427 – 37623
2000	c	3425.34	II	
230		3426.76	II	
2000	c	3428.13	II	
630	c	3429.18	II	
320	c	3432.10	II	
140		3434.76	II	
140		3435.61	II	
160		3436.31	II	
290		3437.04	I	
130	c	3437.91	II	
65	c	3438.35	II	
160		3445.66	II	
130	c	3449.01	II	
390		3449.35	I	
140		3451.23	I	
3200		3453.14	II	
110	c	3453.85	II	
810	c	3455.70	II	
16000	c	3456.00	II	
140		3461.36	II	
1600		3461.97	II	
360	c	3467.07	II	
80		3468.13	I	
140		3469.40	II	
130	c	3470.76	II	
230	c	3472.31	II	
810	c	3473.91	II	
5400	c	3474.26	II	637 – 29412
200		3477.75	II	
200	c	3478.06	II	
80		3483.89	II	
6300		3484.84	II	
200	c	3485.87	II	
160	c	3486.34	II	
490		3489.58	II	
290	c	3490.95	II	637 – 29275
65		3492.11	I	
580	c	3493.09	II	
80		3493.60	I	
2500	c	3494.76	II	
80		3497.65	II	
810	c	3498.88	II	
70		3505.43	II	
410	c	3506.95	II	
130		3507.99	I	
320		3509.37	II	
810		3510.73	I	9147 – 37623
160		3511.76	II	
4100	c	3515.59	II	
410	c	3519.94	II	
220	c	3520.16	II	
150		3532.76	I	
220		3538.89	II	
130	c	3539.35	II	
630		3540.76	II	
200		3541.41	I	
1600		3546.05	II	
160		3548.53	II	
80	c	3550.60	II	
1100	c	3556.78	II	
80	c	3558.15	II	
70		3559.03	II	
410		3560.15	II	
160	c	3563.45	II	
110		3567.32	II	
160		3568.79		
290		3570.44	I	
410	c	3573.24	II	
35		3574.20	II	
630	c	3574.80	II	
810		3579.12	I	
410		3580.75	II	
410		3581.83	II	
80	c	3582.80	II	
250	cw	3589.77	I	
150		3591.23	II	
630	c	3592.23	II	
170	c	3593.07	II	
1100	cw	3598.77	II	
340		3599.48	I	
540	c	3600.95	II	
130	c	3602.65	II	
130		3605.77	I	
340		3613.31	II	
110	c	3616.93	II	
70		3618.08	II	
410		3618.43	I	
200		3619.41	II	

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
200		3623.59	I	
170	c	3625.46	II	
430	c	3626.69	II	
490		3627.25	II	
200		3630.91	I	
430	c	3631.76	II	
110		3632.95	II	
130	c	3634.67	II	
80	c	3635.35	II	
430	c	3638.30	II	
130	c	3640.17	II	
220		3641.25	I	
80	c	3642.36	II	
90	c	3649.60	II	
220		3654.45	II	
200	c	3658.48	I	
1600	c	3662.29	I	
430		3662.99	I	
720		3666.65	I	
130		3667.05	II	
1400		3667.97	I	
320		3669.05	II	
450		3669.52	I	
90		3670.28	II	
70		3672.69	I	
140	c	3674.36	II	
450	c	3674.77	II	
180	cw	3677.64	II	
220		3678.59	II	
720		3679.19	I	
670		3679.70	I	
160	c	3680.00	II	
720		3682.65	I	
430		3685.16	II	
140	c	3686.65	II	
580		3690.65	I	
230	c	3691.32	II	
340		3691.95	I	
130		3694.66	I	
110		3695.69	I	
410		3700.04	I	
130		3701.27	I	
130		3701.78	II	
490	c	3702.35	II	
80		3704.54	II	
100		3706.90	II	
250		3709.27	II	
320		3709.76	I	
160	c	3710.74	II	
160		3711.31	II	
430		3712.88	I	
270		3718.62	I	
450		3720.72	I	
180	c	3721.32	II	
160	c	3721.80	II	
270		3724.45	I	
70		3725.05	I	
180	c	3725.98	II	
1100		3731.40	I	
360		3732.09	I	
220		3732.59	I	
180		3734.99	I	
810		3736.35	I	
180		3737.65	II	
200		3742.40	I	
3200	cw	3748.17	II	
110	c	3748.78	II	
90		3750.19	II	
100	c	3752.07	II	
130	c	3753.01	II	
320	c	3753.73	II	
160		3754.45	I	
270	c	3757.26	II	
90		3760.48	I	
340		3769.09	I	
250		3772.40	I	
110		3773.83	I	
220		3774.58	I	
180		3774.90	I	
130		3775.37	I	
250		3776.15	I	
130	hc	3778.00	I	
290		3780.37	II	
110	c	3780.99	II	
110		3782.65	II	
180		3785.23	II	
320		3788.08	II	
110		3788.44	II	
270		3791.00	II	
220		3791.55	I	
110		3791.97	II	
290		3792.95	I	
180		3794.69	I	
8900	c	3796.75	II	0 – 26331
200		3797.26	I	
220		3798.25	II	
290	c	3801.28	II	
250		3804.15	I	
110		3807.90	I	
130		3809.49	II	
110	c	3809.93	II	
8900	c	3810.73	II	0 – 26234
490		3811.86	I	
900	c	3813.25	II	
180		3818.69	II	
300		3821.73	II	
220		3825.64	I	
390		3829.27	I	
320	cw	3831.9	II	
410	c	3835.35	II	
1300	cw	3837.51	II	
220		3838.36	II	
410	c	3842.05	II	
1100		3843.86	II	
490	c	3846.73	II	
300		3849.88	I	
230	h	3851.54	II	
320		3852.40	II	
1800	c	3854.07	II	
390	cw	3856.94	II	
720		3857.72	II	
250		3859.34	I	
2700	c	3861.68	II	
540		3862.62	I	
110		3864.91	II	
360		3872.05	II	
320	c	3874.09	II	
630		3874.68	II	
250		3879.59	II	
540		3881.61	II	

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
3000	c	3888.96	II	
490		3890.42	I	
13000	c	3891.02	II	637 – 26331
290	c	3893.08	II	
100		3893.52	II	
540		3896.76	II	
270	c	3897.27	II	
130		3899.64	II	
130		3900.79	I	
290		3902.23	II	
320		3904.44	I	
1300	cw	3905.68	II	637 – 26234
100		3909.56	I	
120		3910.30	I	
320		3911.80	I	
110		3912.44	II	
320		3919.45	I	
100	c	3923.28	II	
100		3924.55	II	
100		3925.64	II	
130	ch	3929.93	II	
320	c	3936.44	II	
220		3938.85	I	
320	cw	3940.53	II	
180		3942.54	I	
100		3949.00	I	
220		3950.56	I	
90		3951.14	I	
90	c	3955.05	II	
580		3955.73	I	
120		3957.39	I	
230	c	3959.51	II	
490		3959.68	I	
120		3963.29	II	
120		3967.33	I	
100		3972.64	II	
90		3973.83	II	
110		3974.55	I	
220		3975.88	I	
390	c	3976.93	I	
170		3976.97	II	
130		3982.04	II	
220	cw	3985.71	II	
160		3992.72	I	
220		3993.73	II	
80		3997.18	II	
130		3998.29	I	
380		3999.58	I	
80	c	4001.32	II	
160	cw	4002.59	II	
220		4003.39	I	
110		4013.50	I	
320		4014.20	II	
160	c	4018.09	II	
160	c	4022.76	II	
160	c	4023.94	II	
110		4025.39	I	
320		4027.21	I	
270		4028.86	I	
180	c	4031.80	I	
220		4037.62	I	
220	c	4038.87	II	
2700		4040.81	I	0 – 24740
5400	c	4045.44	II	0 – 24712
220	c	4047.52	I	
8100		4053.93	I	0 – 24660
540		4054.48	II	
270		4057.55	I	
220		4060.31	I	
1700		4065.09	II	
170		4067.57	I	8427 – 33005
720		4068.05	I	
270		4071.83	I	
270		4073.13	I	
290		4073.51	I	
120	c	4080.23	II	
230		4083.67	I	
140		4085.09	I	
170		4087.35	I	
200		4087.59	I	
140		4091.64	I	
120		4094.78	I	
230		4100.22	I	
90		4101.09	I	
8900		4103.84	I	0 – 24361
120		4105.04	I	
270		4106.50	I	
100		4107.36	I	
2900		4108.62	I	
300		4112.00	I	
100		4112.72	I	
270		4116.73	I	
90		4118.94	I	
1500		4120.20	I	
1300		4125.65	I	
4300		4127.16	I	
300		4134.54	I	
90		4135.08	I	
1500		4136.22	I	
130		4139.34	I	
230		4142.19	I	
290		4148.97	I	
980	cw	4152.61	II	637 – 24712
8100		4163.03	I	
160		4172.23	I	
2500		4173.23	I	
540		4194.35	I	
100		4198.08	I	
130		4203.21	I	
65		4203.39	II	
100		4211.30	II	
90		4219.10	I	
290		4222.29	I	
290		4223.47	I	
2000		4227.04	I	
390		4229.52	II	
130	h	4231.24	I	
290		4243.78	I	
90		4245.40	II	
1300	cw	4254.43	I	
130	c	4258.61	II	
490		4264.05	I	0 – 23445
300		4266.04	I	
100		4273.63	II	
80		4284.58	II	
90		4290.18	II	
90	c	4298.47	II	
90		4299.15	I	
90		4301.09	II	
200		4311.04	I	

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
90		4315.03	II	
250		4330.64	II	
80	c	4332.55	II	
300		4337.13	II	
100	cw	4346.84	II	
1300		4350.73	I	
290		4356.73	II	
140		4363.93	II	
70		4371.43	II	
70		4373.33	I	
80		4376.58	II	
170		4379.14	II	
90		4379.83	II	
180	c	4384.83	II	
70	c	4388.69	II	
70	h	4394.98	I	
150		4400.55	II	
120		4401.24	II	
180		4403.27	I	
200		4420.56	II	
55		4426.20	II	
80		4429.81	II	
70		4434.96	I	15081 – 37623
130		4444.63	I	15130 – 37623
70		4445.07	II	
80		4447.23	II	
65		4463.40	II	
70		4467.28	I	
70		4470.23	I	
100		4473.59	II	
300		4477.64	II	
120		4484.57	II	
140		4510.82	I	
90		4512.55	II	
100	c	4526.14	II	
170		4530.08	II	
170	c	4531.28	I	
130	c	4531.65	II	
170		4534.58	I	
65		4543.80	I	
90		4548.94	II	
45		4558.11	II	
200		4562.52	I	8427 – 30338
65	c	4567.82	II	
55		4572.42	II	
90	c	4578.07	I	
70		4589.70	II	
90	c	4608.00	I	
45		4608.67	II	
120	cw	4609.32	II	
		4609.52	II	
130		4613.37	I	8378 – 30048
45		4613.99	II	
100		4618.84	I	
100	c	4628.22	I	
290		4629.10	II	
55	h	4632.84	I	
45	c	4638.19	II	
		4638.29	II	
70		4647.75	II	
200	c	4649.77	II	
45		4651.39	II	
35		4652.71	II	
130	c	4661.33	II	
140	c	4674.62	II	
55		4683.08	I	
55		4685.83	II	
45		4688.19	II	
70		4701.17	II	
80		4701.69	II	
130		4709.84	II	
65		4711.39	I	
130	c	4717.52	I	9147 – 30338
35	c	4728.72	II	
35		4738.00	II	
290		4742.04	II	
35	c	4749.09	II	
35		4751.40	I	
100	c	4757.01	I	
35		4762.39	II	
35		4763.57	II	
55		4777.48	II	
30		4779.42	I	
70	c	4781.19	I	
65		4782.92	I	9147 – 30048
55	c	4786.29	I	16735 – 37623
35		4791.48	II	
35		4795.92	II	
45	h	4798.87	I	
27		4812.92	II	
55		4832.31	II	
30		4833.32	I	
30		4855.54	II	
45		4860.39	I	
27	c	4889.67	II	
30		4892.35	I	18737 – 39171
35		4896.44	II	
55		4906.99	II	
45		4922.73	I	
55	c	4934.89	I	
290		4939.01	I	0 – 20241
27	c	4946.80	I	
45		4948.18	II	
65	c	4959.42	II	
35		4961.03	II	
55	cw	4966.73	II	
250	c	4967.21	II	
220		4979.97	I	0 – 20074
35	c	4988.96	I	8378 – 28417
90		4995.05	I	
35	c	5012.42	I	
55		5013.28	II	
65		5026.53	I	
30		5028.17	I	
55		5032.95	II	
65	c	5037.60	I	
130		5042.37	I	
35		5044.73	I	8427 – 28244
30		5051.44	II	
30		5054.92	II	
35	c	5060.75	I	
65		5074.34	I	
80		5093.07	I	
140		5127.81	I	
55		5129.27	II	
130		5142.59	II	
110		5143.22	II	
160		5149.59	II	
90	c	5167.88	I	
130	c	5182.11	I	8378 – 27670

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
55		5187.85	I	9147 – 28417
90		5190.11	II	
18		5195.23	I	
45		5221.54	I	
35	c	5244.47	I	
65		5251.82	I	
55		5275.48	I	
90		5301.25	I	0 – 18858
35		5319.24	I	
35		5319.65	I	
80		5330.11	I	0 – 18756
90		5359.99	I	0 – 18651
55		5381.40	I	
30		5384.56	I	
30		5384.97	I	
18	h	5393.85	I	
70		5403.17	I	
100		5407.08	I	
14		5413.62	II	
16		5434.39	II	
18		5435.87	I	8378 – 26770
30		5445.39	I	
18		5449.8	II	
30	h	5451.90	I	0 – 18337
14		5454.0	II	
30	c	5498.57	I	
30		5504.51	I	
27		5515.56	II	
18		5516.45	II	
30		5534.33	I	
27		5553.14	I	
35	c	5560.94	I	
35	b	5563.6	Ho O	
70		5566.52	I	21378 – 39338
18		5573.96	II	
35	bl	5584.7	Ho O	
55	b	5591.1	Ho O	
55	bl	5592.3	Ho O	
30	b	5607.1	Ho O	
27		5613.64	I	
45	b	5626.4	Ho O	
65		5627.60	I	8378 – 26143
30		5628.24	II	
55		5640.62	I	22024 – 39747
70	bs	5655.9	Ho O	
65	b	5658.9	Ho O	
140		5659.58	I	
70	c	5671.84		
65		5674.70	I	
140	c	5691.47	I	
70	bs	5696.3	Ho O	
140	c	5696.57	I	
27		5734.02	I	
45		5736.4	Ho O	
55		5739.24	I	
22		5749.58	I	
30		5766.64		
27	b	5803.8	Ho O	
45	b	5819.2	Ho O	
27	h	5821.90	I	
22		5839.47	I	
45	b	5849.4	Ho O	
140	c	5860.28	I	0 – 17059
27	h	5864.42	I	
45		5870.85	I	9741 – 26770
27	b	5879.6	Ho O	
70	c	5882.99	I	
35	c	5892.56	I	
22		5904.29	I	
70		5921.76	I	0 – 16882
30	c	5933.71	I	
70	cw	5948.03	I	
45		5955.98	I	
70		5972.76	I	
90		5973.52	I	0 – 16735
22		5981.43	I	11530 – 28244
230	c	5982.90	I	0 – 16709
55		6002.04	I	
27		6005.33	I	
35		6021.43	I	
16		6038.97	I	11689 – 28244
27		6050.71	I	
45		6060.31	I	
120		6081.79	I	0 – 16438
70	cw	6133.60	I	
35		6156.38	I	
27		6156.58	I	
55		6191.68	I	
70		6208.65	I	
18		6234.17	I	
45	c	6255.75	I	11689 – 27670
70	c	6305.36	I	0 – 15855
22		6306.68	I	22392 – 38244
30		6321.94		
30	c	6354.35	I	
30	c	6372.59	I	
14	h	6373.86	I	
22	h	6413.41	I	15855 – 31443
27	c	6471.77	I	
13		6479.17	I	
11		6515.30	I	
11	h	6538.99	I	
70		6550.97	I	15855 – 31115
15		6560.08	I	11530 – 26770
35	d	6600.58	I	
260		6604.94	I	0 – 15136
55		6607.47	I	0 – 15130
13		6628.35	I	
120		6628.99	I	0 – 15081
15		6632.24	I	
9	h	6652.98	I	
15		6662.52	I	16438 – 31443
19	c	6680.46	I	
24	c	6681.62	I	
15	h	6682.02		
55	cw	6694.32	I	16882 – 31816
15	cw	6722.34	I	
40		6745.05	I	5419 – 20241
13		6766.74	I	
28	c	6774.68	I	17059 – 31816
55	c	6785.43	I	16709 – 31443
13		6793.7	I	
13	cw	6811.04	I	16438 – 31115
15	cw	6820.38	I	
24		6821.64	I	5419 – 20074
17	c	6825.72	I	
8	h	6826.62		
8	h	6852.97		
17	cw	6865.85	I	16882 – 31443
9		6883.36	I	

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
13		6888.50	I	
15	c	6892.96	I	
17		6897.95	I	11530 – 26023
15	h	6903.80	I	21682 – 36163
15	cw	6913.47	I	
9		6916.70	I	11689 – 26143
40	cw	6939.49	I	16709 – 31115
45	cw	6950.39	I	
13	hl	6955.3	I	
19		6976.7	II	
10		6985.11		
9		6994.38		
14	h	7000.71		
10		7079.07		
12		7098.58		
9		7242.08	I	12339 – 26143
9		7250.60	I	12339 – 26127
14		7308.55		
25		7341.43		
18		7389.40		
5	h	7496.20	I	5419 – 18756
10	h	7510.74	I	
140		7555.09	I	
18		7589.20	I	8378 – 21552
25		7591.87	I	
9	h	7593.64	I	
7	h	7594.35	I	
12		7602.31	II	
16		7605.35	I	
12		7617.05	I	8427 – 21552
14		7627.98	I	8378 – 21485
40	c	7628.42	I	
9	c	7641.14	I	
4		7648.16	I	
14	c	7653.80	I	
12	c	7667.30	I	
20		7690.43	I	8378 – 21378
50	c	7693.15	I	
40	cw	7715.06	I	
16		7719.05	I	8427 – 21378
16	h	7738.98	I	
8	c	7752.01	I	
60	cw	7815.48	I	18651 – 31443
40	cw	7823.63	I	
8	h	7879.22	I	
60		7894.64	I	
10	h	8464.66	I	9741 – 21552
10	h	8482.67	I	
50		8512.94	I	9741 – 21485
20		8545.61	II	
18		8601.84	II	
40		8670.19	I	0 – 11530
8	h	8697.32		
16	h	8805.48	II	
20	c	8834.49	I	5419 – 16735
90		8915.98	II	

Indium

$$\text{In, } Z = 49,\ M = 114.82,\ \text{Ratio } \frac{\text{In}}{\text{Cu}} = 1.807$$

In I Normal state of valence electrons $5s^2 5p\ ^2P^\circ_{1/2} = 0$. I.P. = 46670 cm^{-1}.
In II Normal state of valence electrons $5s^2\ ^1S_0 = 0$. I.P. = 152195 cm^{-1}.

References

Wavelengths and Classification:
In I, F. Paschen, Ann. der Physik **32**, 148 (1938).
In II, F. Paschen and J. S. Campbell, Ann. der Physik **31**, 29 (1938).

Indium—all observed lines

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
180	2306.06	II	0 – 43349	180 c	2836.92	I	2213 – 37452
40	2389.54	I	0 – 41836	30 c	2858.14	I	0 – 34978
60	2460.08	I	0 – 40637	1100	2932.63	I	2213 – 36302
30 h	2468.02	I	2213 – 42718	20 c	2957.01	I	2213 – 36020
100	2521.37	I	2213 – 41862	8000	3039.36	I	0 – 32892
1100	2560.15	I	0 – 39048	13000	3256.09	I	2213 – 32916
200	2601.76	I	2213 – 40637	3000	3258.56	I	2213 – 32892
1600	2710.26	I	2213 – 39098	17000	4101.76	I	0 – 24373
300	2713.94	I	2213 – 39048	18000	4511.31	I	2213 – 24373
700	2753.88	I	0 – 36302	8 h	6847.44	I	24373 – 38972
40	2775.37	I	0 – 36020	4 h	6900.13	I	24373 – 38861

Iridium

$$\text{Ir, } Z = 77.\ M = 192.2,\ \text{Ratio } \frac{\text{Ir}}{\text{Cu}} = 3.025$$

Ir I Normal state of valence electrons $5d^7 6s^2\ {}^4F_{4\,1/2} = 0$. I.P. = 73000 cm^{-1}.
Ir II Normal state of valence electrons $5d^7 6s\ {}^5F_5 = 0$.

References

Wavelengths:
G. R. Harrison, Massachusetts Institute of Technology Wavelength Tables (John Wiley & Sons, New York, 1939).

Classification:
Ir I, W. Albertson, Phys. Rev. **54,** 183 (1938); T. A. M. van Kleef, Physica **23,** 843 (1957).
Ir II, T. A. M. van Kleef, unpublished material (1969).

Strong lines of iridium

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
17000	2088.82	I	0 – 47858	4500	2175.24	I	0 – 45957
15000	2033.57	I	0 – 49159	4400	2924.79	I	0 – 34180
14000	2092.63	I	2835 – 50606				
9900	2010.65	I	0 – 49719	4100	2502.98	I	0 – 39940
8700	2022.35	I	2835 – 52266	3800	2849.72	I	0 – 35081
				3700	2083.22	I	5785 – 53772
7900	2158.05	I	2835 – 49159	3700	2148.22	I	7107 – 53642
7900	2543.97	I	2835 – 42132	3500	2152.68	II	4788 – 51227
6200	2052.22	I	6324 – 55036				
5800	2169.42	II		3500	2372.77	I	0 – 42132
5100	3220.78	I	2835 – 33874	3500	2639.71	I	0 – 37872
				3400	3133.32	I	6324 – 38230
5000	2060.64	I	7107 – 55619	3300	2475.12	I	0 – 40390
4500	2126.81	II	0 – 47004	3200	3513.64	I	0 – 28452
4500	2127.94	I	0 – 46979				

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
9900	2010.65	I	0 – 49719
8700	2022.35	I	2835 – 52266
15000	2033.57	I	0 – 49159
6200	2052.22	I	6324 – 55036
5000	2060.64	I	7107 – 55619
3700	2083.22	I	5785 – 53772
3100	2085.74	I	7107 – 55036
17000	2088.82	I	0 – 47858
14000	2092.63	I	2835 – 50606
2700	2112.68	I	6324 – 53642
1800	2119.54	I	0 – 47165
2000	2125.44	I	7107 – 54141
4500	2126.81	II	0 – 47004
2000	2127.52	I	2835 – 49824
4500	2127.94	I	0 – 46979
3700	2148.22	I	7107 – 53642
2500	2150.54	I	4079 – 50564
3500	2152.68	II	4788 – 51227
2900	2155.81	I	0 – 46372
7900	2158.05	I	2835 – 49159
2100	2162.88	I	0 – 46220
5800	2169.42	II	
4500	2175.24	I	0 – 45957
2700	2178.17	I	0 – 45896
1600	2187.43	II	
1100	2190.38	II	
740	2191.64	I	2835 – 48449
910	2208.09	II	
1300	2220.37	I	2835 – 47858
790	2221.07	II	8187 – 53196
2500	2242.68	II	0 – 44576
620	2245.76	II	11719 – 56234
2100	2253.38	I	7107 – 51471
	2253.49	I	4079 – 48441
2100	2255.10	I	2835 – 47165
1400	2255.81	I	5785 – 50101
350	2258.51	I	9878 – 54141
1400	2258.86	I	6324 – 50580
830	2264.61	I	2835 – 46979
1100	2266.33	I	6324 – 50434
1000	2268.90	I	10579 – 54639
660	2280.00	I	6324 – 50170
950	2281.02	II	
660	2281.91	I	9878 – 53687
330	2284.60	I	13940 – 57698
330	2295.08	I	5785 – 49342
790	2298.05	I	11831 – 55333
	2298.16	I	6324 – 49824
460	2299.53	I	7107 – 50580
910	2300.50	I	6324 – 49779
2700	2304.22	I	2835 – 46220
410	2305.47	I	5785 – 49146
210	2307.27	I	7107 – 50434
910	2308.93	I	6324 – 49621
460	2315.38	I	0 – 43176
410	2321.45	I	7107 – 50170
410	2321.58	I	2835 – 45896
210	2327.98	I	12218 – 55161
540	2333.30	I	5785 – 48629
740	2333.84	I	6324 – 49159
580	2334.50	I	6324 – 49146
1600	2343.18	I	5785 – 48449
740	2343.61	I	5785 – 48441
100	2352.62	I	12218 – 54711
580	2355.00	I	9878 – 52327
230	2357.53	II	
410	2358.16	I	4079 – 46472
500	2360.73	I	9878 – 52224
2500	2363.04	I	6324 – 48629
370	2368.04	II	4788 – 47004
3500	2372.77	I	0 – 42132
290	2375.09	II	
250	2377.28	I	7107 – 49159
250	2377.98	I	7107 – 49146
500	2379.38	I	4079 – 46094
540	2381.62	I	6324 – 48299
210	2383.17	I	13088 – 55036
85	2383.79	I	9878 – 51815
120	2386.58	II	
1300	2386.89	I	6324 – 48207
2500	2390.62	I	2835 – 44652
2700	2391.18	I	2835 – 44643
85	2401.77	I	13088 – 54711
230	2407.59	I	7107 – 48629
290	2409.37	I	4079 – 45571
290	2410.17	I	13088 – 54566
290	2410.73	I	12218 – 53687
540	2413.31	I	4079 – 45503
370	2415.86	I	5785 – 47165
620	2418.11	I	7107 – 48449
120	2424.32	I	10579 – 51815
120	2424.66	I	9878 – 51108
210	2424.89	I	5785 – 47011
370	2424.99	I	6324 – 47549
290	2425.66	I	6324 – 47537
170	2426.53	II	
50	2426.78	I	5785 – 46979
540	2427.61	I	4079 – 45259
540	2431.24	I	0 – 41119
1300	2431.94	I	4079 – 45186
170	2432.36	I	7107 – 48207
100	2432.58	I	13940 – 55036
270	2435.14	I	13088 – 54141
85	2436.42	I	13088 – 54119
250	2445.34	I	6324 – 47206
40	2447.49	I	17779 – 58625
250	2447.76	I	6324 – 47165
190	2448.23	I	5785 – 46618
40	2449.02	I	12952 – 53772
910	2452.81	I	2835 – 43592
85	2454.12	I	12952 – 53687
1300	2455.61	I	0 – 40711
230	2455.87	I	4079 – 44785
210	2457.03	I	5785 – 46472
210	2457.23	I	13088 – 53772
85	2462.36	I	13088 – 53687
85	2463.03	I	12218 – 52807
85	2464.90	I	11831 – 52388
120	2465.09	I	13088 – 53642
870	2467.30	I	4079 – 44597
3300	2475.12	I	0 – 40390
210	2478.11	I	2835 – 43176
40	2479.16	I	13940 – 54264
2100	2481.18	I	0 – 40291
100	2485.38	I	9878 – 50101
40	2486.37	I	18547 – 58754
40	2486.75	I	13940 – 54141
40	2489.20	I	16103 – 56265
620	2493.08	I	7107 – 47206
210	2496.27	I	6324 – 46372

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
85		2500.27	I	11831 – 51815
250		2502.63	I	9878 – 49824
4100		2502.98	I	0 – 39940
170		2504.37	I	17779 – 57697
120		2505.74	I	6324 – 46220
85		2506.60	I	12506 – 52388
120		2507.63	I	10579 – 50445
85		2508.35	I	12952 – 52807
170		2509.71	I	12218 – 52052
170		2511.94	I	12506 – 52304
170		2512.58	II	4788 – 44575
210		2513.71	I	6324 – 46094
120		2515.36	I	9878 – 49621
40		2524.88	II	
170		2525.05	I	10579 – 50170
40		2526.77	I	19061 – 58625
50		2532.20	I	18547 – 58027
120		2532.52	I	5785 – 45259
990		2533.13	I	9878 – 49342
1100		2534.46	I	2835 – 42279
580		2537.22	I	5785 – 45186
170		2537.68	I	16103 – 55497
40		2538.88	I	12952 – 52327
40		2540.40	I	12952 – 52304
100		2541.48	I	11831 – 51166
580		2542.02	I	5785 – 45112
40		2542.80	II	
7900		2543.97	I	2835 – 42132
150		2545.54	I	12952 – 52224
790		2546.03	I	7107 – 46372
120		2547.20	I	6324 – 45571
120		2547.69	I	13088 – 52327
210		2551.40	I	12952 – 52134
190		2554.40	I	13088 – 52224
210		2555.35	I	4079 – 43202
170		2555.88	I	7107 – 46220
150		2563.28	I	5785 – 44785
910		2564.18	I	7107 – 46094
210		2569.88	I	12952 – 51852
100		2570.62	I	12218 – 51108
70		2572.07	I	10579 – 49446
70		2572.37	I	12952 – 51815
230		2572.70	I	5785 – 44643
740		2577.26	I	7107 – 45896
100		2578.71	I	16565 – 55333
70		2578.91	I	13088 – 51852
35		2579.49	II	17478 – 56234
35		2583.18	I	18547 – 57248
740		2592.06	I	0 – 38568
740		2599.04	I	7107 – 45571
150		2602.04	I	16565 – 54985
190		2604.55	I	13088 – 51471
190		2607.52	I	13088 – 51427
700		2608.25	I	6324 – 44652
1800		2611.30	I	2835 – 41119
70		2612.04	I	6324 – 44597
210		2614.98	I	0 – 38230
70	d	2615.88	I	16103 – 54320
		2616.00	I	12952 – 51166
330		2617.78	I	4079 – 42268
210		2619.88	I	0 – 38158
70		2623.64	II	
250		2625.32	I	7107 – 45186
40		2625.67	I	16565 – 54639
100		2626.76	I	12506 – 50564
50		2628.20	I	16103 – 54141
40		2629.41	I	13088 – 51108
700		2634.17	I	12218 – 50170
170		2635.27	I	4079 – 42014
35		2638.97	I	12218 – 50101
250		2639.42	I	2835 – 40711
3500		2639.71	I	0 – 37872
50		2640.38	I	10579 – 48441
210		2644.19	I	5785 – 43592
170		2653.76	I	9878 – 47549
70		2653.95	I	16103 – 53772
100		2656.81	I	10579 – 48207
35		2657.71	I	11831 – 49446
1800		2661.98	I	2835 – 40390
350		2662.63	I	7107 – 44652
80		2663.31	I	7107 – 44643
2700		2664.79	I	0 – 37515
140		2668.99	I	2835 – 40291
55		2669.46	I	16103 – 53553
520		2669.91	I	4079 – 41522
520		2671.84	I	5785 – 43201
330		2673.61	I	5785 – 43176
120		2676.83	I	13088 – 50434
95		2679.06	I	11831 – 49146
55		2681.10	I	5785 – 43072
27		2682.46	I	6324 – 43592
110		2684.04	I	10579 – 47825
55		2691.06	I	12952 – 50101
270		2692.34	I	4079 – 41210
27		2692.88	I	12218 – 49342
27		2693.49	I	17779 – 54895
3000		2694.23	I	2835 – 39940
110		2704.03	I	2835 – 39806
40		2704.93	I	10579 – 47537
27		2706.88	I	17779 – 54711
160		2712.74	I	6324 – 43176
70		2720.45	I	6324 – 43072
35		2723.76	I	16103 – 52807
40		2729.56	I	10579 – 47204
55		2730.71	I	11831 – 48441
70		2732.67	I	12218 – 48802
35		2739.32	I	13940 – 50434
35		2740.00	I	7107 – 43592
35		2740.18	I	5785 – 42268
140		2744.00	I	10579 – 47011
27		2747.51	I	19593 – 55979
27		2749.32	I	17779 – 54141
80		2758.23	I	5785 – 42029
70		2759.32	I	12218 – 48449
55		2759.91	I	12218 – 48441
27		2767.65	I	16103 – 52224
80		2771.61	I	7107 – 43176
330		2772.46	I	13088 – 49146
27		2774.58	I	16103 – 52134
250		2775.55	I	9878 – 45896
80	d	2777.43	I	11831 – 47825
		2777.53	I	17779 – 53772
520		2781.29	I	6324 – 42268
330		2785.22	I	10579 – 46472
80		2796.46	I	16103 – 51852
540		2797.35	I	5785 – 41522
1600		2797.70	I	2835 – 38568
380		2798.18	I	4079 – 39806
40		2799.74	I	16681 – 52388
410		2800.82	I	9878 – 45571

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
40		2812.80	I	13088 – 48629
680		2823.18	I	0 – 35411
1200		2824.45	I	2835 – 38230
70		2830.17	I	2835 – 38158
55		2830.51	I	12218 – 47538
40		2831.36	I	9878 – 45186
110		2833.24	II	11719 – 47004
110		2835.66	I	12952 – 48206
820		2836.40	I	4079 – 39324
160		2837.33	I	9878 – 45112
1100		2839.16	I	13088 – 48299
		2839.24	I	4079 – 39289
820		2840.22	I	6324 – 41522
160		2842.28	I	7107 – 42279
3800		2849.72	I	0 – 35081
40	d	2855.82	I	18547 – 53553
		2855.93	I	16103 – 51108
40		2860.66	I	12218 – 47165
110		2863.84	I	9878 – 44786
55		2866.69	I	12952 – 47825
35		2867.63	I	16565 – 51427
80		2869.70	I	10579 – 45415
380		2875.60	I	9878 – 44643
380		2875.98	I	12218 – 46979
270		2877.68	I	5785 – 40525
140		2879.41	I	9878 – 44597
55		2881.16	I	12506 – 47204
820		2882.64	I	2835 – 37515
650		2897.15	I	5785 – 40291
80		2899.63	I	16103 – 50580
35		2900.39	I	19593 – 54061
260		2901.95	I	13088 – 47538
260		2904.80	I	7107 – 41522
40		2905.64	I	4079 – 38485
200		2907.24	I	6324 – 40711
70		2909.56	I	13940 – 48299
440		2916.36	I	4079 – 38358
230		2918.57	I	12218 – 46472
4400		2924.79	I	0 – 34180
80		2930.63	I	12506 – 46618
1200		2934.64	I	6324 – 40390
880		2936.68	I	4079 – 38121
250		2938.47	I	5785 – 39806
190		2939.27	I	7107 – 41119
140		2940.54	I	16103 – 50101
40		2941.08	I	10579 – 44570
2700		2943.15	I	6324 – 40291
230		2946.97	I	13088 – 47011
200		2949.76	I	13088 – 46979
1200		2951.22	I	0 – 33874
150		2962.99	I	11831 – 45571
50		2965.20	I	9878 – 43592
35		2968.49	I	12218 – 45896
27		2974.10	I	4079 – 37693
200		2974.95	I	16565 – 50170
440		2980.65	I	5785 – 39324
150		2985.80	I	6324 – 39806
190		2990.62	I	11831 – 45259
300		2996.08	I	4079 – 37446
70		2997.19	I	11831 – 45186
180		2997.41	I	12218 – 45571
220		3002.25	I	9878 – 43176
600		3003.63	I	7107 – 40390
80		3005.21	I	13940 – 47206
40		3009.90	I	16565 – 49779
160		3011.69	I	9878 – 43072
120		3016.43	I	12952 – 46094
270		3017.31	I	13088 – 46221
140		3019.23	I	26307 – 59419
80		3020.01	I	26307 – 59410
80		3022.41	I	26307 – 59384
110		3025.82	I	13940 – 46979
380		3029.36	I	6324 – 39324
70		3032.41	I	12218 – 45186
40		3033.62	I	11831 – 44786
95		3037.75	I	12506 – 45415
330		3039.26	I	12218 – 45112
55		3040.47	I	18547 – 51427
35		3042.65	II	11719 – 44576
300		3047.16	I	13088 – 45896
300		3049.44	I	5785 – 38568
40		3052.16	I	19061 – 51815
80		3053.60	I	11831 – 44570
300		3057.28	I	7107 – 39806
70		3061.41	I	17779 – 50434
40		3064.51	I	10579 – 43201
1600		3068.89	I	2835 – 35411
190		3069.09	I	5785 – 38358
190		3069.71	I	12218 – 44785
170		3076.69	I	10579 – 43072
320		3083.22	I	12218 – 44643
240		3086.44	I	9878 – 42268
390		3088.04	I	5785 – 38158
70		3094.01	I	4079 – 36390
510		3100.29	I	2835 – 35081
510		3100.45	I	6324 – 38568
60		3114.05	I	16103 – 48206
90		3114.55	I	13088 – 45186
340		3120.76	I	6324 – 38358
200		3121.78	I	13088 – 45112
90		3122.38	I	13940 – 45957
70		3128.39	I	13940 – 45896
70		3133.09	I	5785 – 37693
3400		3133.32	I	6324 – 38230
70		3140.41	I	12952 – 44786
70		3145.07	I	28452 – 60239
190		3150.61	I	5785 – 37515
70		3154.55	I	12952 – 44643
190		3154.74	I	10579 – 42268
190		3159.15	I	12952 – 44597
140		3168.18	I	13088 – 44643
490		3168.88	I	6324 – 37872
370		3177.58	I	7107 – 38568
170		3180.35	I	16103 – 47538
370		3198.92	I	7107 – 38358
610		3212.12	I	7107 – 38230
70		3213.55	I	19061 – 50170
70		3218.46	I	16103 – 47165
370		3219.51	I	7107 – 38158
5100		3220.78	I	2835 – 33874
100		3221.28	I	28452 – 59487
300		3229.28	I	12218 – 43176
100		3230.76	I	10579 – 41522
60		3232.00	I	28452 – 59384
470		3241.52	I	4079 – 34920
80		3254.40	I	19061 – 49779
200		3262.01	I	9878 – 40525
390		3266.44	I	5785 – 36390
160		3277.28	I	13088 – 43592
60		3287.06	I	9878 – 40291

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
100	3287.59	I	7107 – 37515
160	3310.52	I	11831 – 42029
80	3312.13	I	11831 – 42014
200	3322.60	I	13088 – 43176
80	3322.87	I	19060 – 49147
130	3334.16	I	13088 – 43072
60	3338.37	I	10579 – 40525
560	3368.48	I	2835 – 32513
60	3419.42	I	13940 – 43176
660	3437.02	I	6324 – 35411
100	3437.50	I	16103 – 45186
410	3448.97	I	4079 – 33065
80	3476.46	I	6324 – 35081
60	3477.77	I	10579 – 39325
80	3484.48	I	9878 – 38568
3200	3513.64	I	0 – 28452
220	3515.95	I	7107 – 35540
410	3522.03	I	4079 – 32464
160	3557.17	I	16681 – 44785
320	3558.99	I	5785 – 33874
60	3568.00	I	12506 – 40525
1200	3573.72	I	7107 – 35081
320	3594.39	I	7107 – 34920
220	3609.77	I	2835 – 30530
190	3617.21	I	9878 – 37515
80	3625.71	I	12952 – 40525
160	3626.29	I	9878 – 37446
660	3628.67	I	6324 – 33874
220	3636.20	I	11831 – 39324
300	3661.71	I	13088 – 40390
300	3664.62	I	5785 – 33065
320	3674.98	I	13088 – 40291
200	3687.08	I	10579 – 37693
80	3698.10	I	19060 – 46094
140	3725.38	I	19060 – 45896
200	3731.36	II	
130	3738.53	I	6324 – 33065
530	3747.20	I	5785 – 32464
40	3750.40	I	32831 – 59487
40	3753.32	I	16565 – 43201
65	3768.68	I	11831 – 38358
50	3770.73	I	9878 – 36390
120	3793.79	I	13940 – 40291
35	3794.06	I	12218 – 38568
3100	3800.12	I	0 – 26308
230	3817.24	I	6324 – 32513
170	3865.64	I	11831 – 37693
480	3902.51	I	2835 – 28452
95	3902.66	I	12952 – 38568
480	3915.38	I	9878 – 35411
400	3934.84	I	7107 – 32513
120	3946.27	I	16681 – 42014
65	3951.95	I	12218 – 37515
30	3952.62	I	17779 – 43072
30	3962.78	I	12218 – 37446
35	3966.09	I	12952 – 38158
590	3976.31	I	13088 – 38230
460	3992.12	I	9878 – 34920
180	4020.03	I	26307 – 51176
350	4033.76	I	13088 – 37872
130	4040.08	I	5785 – 30530
370	4069.92	I	12952 – 37515
150	4070.68	I	11831 – 36390
100	4092.61	I	13088 – 37515
140	4115.78	I	13940 – 38230
23	4127.92	I	13940 – 38158
27	4155.70	I	28452 – 52509
15	4166.04	I	9878 – 33874
90	4172.56	I	16565 – 40525
35	4182.47	I	32513 – 56416
15 h	4183.21	I	38230 – 62128
18	4185.66	I	12506 – 36390
23	4197.54	I	11831 – 35648
27	4217.76	I	16103 – 39806
13	4220.80	I	26365 – 50050
75	4259.11	I	2835 – 26308
27	4265.30	I	12952 – 36390
260	4268.10	I	7107 – 30530
23	4286.62	I	12218 – 35540
75	4301.60	I	16565 – 39806
55	4310.59	I	12218 – 35411
220	4311.50	I	9878 – 33065
18	4351.30	I	18547 – 41522
18	4352.56	I	19061 – 42029
18	4392.59	I	16565 – 39325
160	4399.47	I	16565 – 39289
65	4403.78	I	12218 – 34920
110	4426.27	I	9878 – 32464
15	4450.18	I	16103 – 38568
55	4478.48	I	13088 – 35411
16	4495.35	I	33065 – 55304
11 h	4496.03	I	34180 – 56416
55	4545.68	I	13088 – 35081
30	4548.48	I	30530 – 52509
13	4550.78	I	12952 – 34920
35	4568.09	I	10579 – 32464
18	4570.02	I	23310 – 45186
18	4604.48	I	35081 – 56793
75	4616.39	I	12218 – 33874
26	4656.18	I	13940 – 35411
17 h	4668.99	I	16103 – 37515
21	4708.88	I	19060 – 40291
50	4728.86	I	13940 – 35081
21	4731.86	I	16565 – 37693
26	4756.46	I	33874 – 54893
13	4757.96	I	16681 – 37693
65	4778.16	I	12952 – 33874
30	4795.67	I	12218 – 33065
10	4807.14	I	19593 – 40390
21	4809.47	I	13088 – 33874
10	4840.77	I	9878 – 30530
17	4845.38	I	11831 – 32464
50	4938.09	I	12218 – 32464
26	4970.48	I	12952 – 33065
25	4999.74	I	32513 – 52509
25	5002.74	I	6324 – 26308
17	5009.17	I	12506 – 32464
30	5014.98	I	13940 – 33874
17	5046.06	I	35081 – 54893
30	5123.66	I	12952 – 32464
20	5177.95	I	16103 – 35411
22	5238.92	I	16565 – 35648
12	5340.74	I	23310 – 42029
35	5364.32	I	19593 – 38230
75	5449.50	I	32831 – 51176
30	5454.50	I	34180 – 52509
7	5469.40	I	19593 – 37872
10	5620.04	I	37515 – 55304
45	5625.55	I	16103 – 33874
10	5828.55	I	38230 – 55382

Iridium—all observed lines—Continued

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
10	5882.30	I	34180 – 51176	7	6334.44	I	16681 – 32464
7	5887.36	I	23310 – 40291	5	6624.73	I	40291 – 55382
35	5894.06	I	16103 – 33065	10	6686.08	I	39940 – 54893
7	6026.10	I	13940 – 30530				
12	6067.83	I	39940 – 56416	5	6830.01	I	37872 – 52509
				5	6929.88	I	16103 – 30530
20	6110.67	I	16103 – 32464	4	7183.71	I	18547 – 32464
12	6288.28	I	16565 – 32464	6	7834.32	I	42132 – 54893

Iron

$$\text{Fe}, Z=26, M=55.85, \text{Ratio}\ \frac{\text{Fe}}{\text{Cu}}=0.879$$

Fe I Normal state of valence electrons $3d^6 4s^2\ {}^5D_4 = 0$. I.P. $= 63700\ \text{cm}^{-1}$.
Fe II Normal state of valence electrons $3d^6 4s\ {}^6D_{4\,1/2} = 0$. I.P. $= 130524\ \text{cm}^{-1}$.

References

Wavelengths:
G. R. Harrison, Massachusetts Institute of Technology Wavelength Tables (John Wiley & Sons, New York, 1939).

Classification:
Fe I, H. N. Russell, C. E. Moore, and D. W. Weeks, Trans. Am. Phil. Soc. **34**, 111 (1944).
Fe II, J. C. Dobbie, Ann. Solar Phys. Observatory, Cambridge, England, **5**, 1 (1938).

Strong lines of iron

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
7000	3734.87	I	6928 – 33695	2800	2522.85	I	0 – 39626
6000	3581.20	I	6928 – 34844	2800	3020.64	I	0 – 33096
6000	3719.94	I	0 – 26875	2600	2488.15	I	416 – 40594
5000	3820.43	I	6928 – 33096	2600	2719.02	I	0 – 36767
4200	3859.91	I	0 – 25900	2400	3745.56	I	704 – 27395
4000	3440.61	I	0 – 29056	2000	2599.40	II	0 – 38459
4000	3570.10	I	7377 – 35379	2000	3608.86	I	8155 – 35856
4000	3749.49	I	7377 – 34040	2000	3618.77	I	7986 – 35612
3600	2166.77	I	0 – 46137	2000	3631.46	I	7728 – 35257
3400	3737.13	I	416 – 27167	1800	2489.75	I	978 – 41131
3200	3825.88	I	7377 – 33507	1800	2490.64	I	704 – 40842
3000	2084.12	I	0 – 47967	1800	3886.28	I	416 – 26140
3000	3758.24	I	7728 – 34329	1700	2966.90	I	0 – 33695
3000	4045.82	I	11976 – 36686	1700	3763.79	I	7986 – 34547
2800	2483.27	I	0 – 40257	1700	4383.55	I	11976 – 34782

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
3000	2084.12	I	0 – 47967
3600	2166.77	I	0 – 46137
1500	2178.09	I	416 – 46314
630	2191.84	I	704 – 46314
600	2196.04	I	888 – 46410
220	2297.79	I	416 – 43923
260	2332.80	II	385 – 43239
140	2338.00	II	863 – 43621
360	2343.49	II	0 – 42658
120	2348.10	II	1873 – 44447
120	2348.30	II	668 – 43239
110	2359.10	II	863 – 43239
110	2360.00	II	1873 – 44233
90	2360.29	II	2430 – 44785
200	2364.83	II	385 – 42658
100	2368.60	II	2838 – 45044
260	2373.73	II	0 – 42115
70	2375.19	II	3118 – 45207
150	2379.28	II	2430 – 44447
150	2380.76	II	668 – 42658
1300	2382.04	II	0 – 41968
80	2383.24	II	2838 – 44785
60	2384.39	II	3118 – 45044
320	2388.63	II	385 – 42237
1100	2395.62	II	385 – 42115
360	2399.24	II	668 – 42335
70	2404.43	II	863 – 42440
1000	2404.88	II	668 – 42237
300	2406.66	II	863 – 42401
300	2410.52	II	863 – 42335
220	2411.07	II	977 – 42440
220	2413.31	II	977 – 42401
50	2424.14	II	22637 – 63876
35	2430.07	II	22810 – 63949
80	2439.74	I	19390 – 60366
60	2440.11	I	19788 – 60758
110	2442.57	I	19621 – 60549
50	2443.87	I	6928 – 47835
40	2444.51	II	20831 – 61726
30	2445.56	II	21812 – 62690
70	2447.71	I	0 – 40842
60	2453.47	I	7377 – 48123
180	2457.60	I	6928 – 47606
70	2458.78	II	25805 – 66464
110	2462.18	I	416 – 41018
700	2462.64	I	0 – 40594
35	2463.73	I	7728 – 48305
140	2465.15	I	7377 – 47930
35	2467.73	I	7728 – 48239
140	2468.88	I	6928 – 47420
140	2472.34	I	6928 – 47363
900	2472.88	I	704 – 41131
	2472.91	I	416 – 40842
220	2474.81	I	7728 – 48123
70	2479.48	I	7986 – 48305
1000	2479.78	I	704 – 41018
2800	2483.27	I	0 – 40257
900	2484.19	I	888 – 41131
90	2486.37	I	0 – 40207
70	2486.69	I	7728 – 47930
90	2487.06	I	8155 – 48351
35	2487.37	I	704 – 40895
2600	2488.15	I	416 – 40594
1800	2489.75	I	978 – 41131
1800	2490.64	I	704 – 40842
1400	2491.16	I	888 – 41018
180	2493.18	II	21430 – 61528
	2493.26	II	21252 – 61347
140	2496.53	I	7377 – 47420
100	2498.89	I	416 – 40422
		II	21582 – 61587
900	2501.13	I	0 – 39970
35	2501.70	I	6928 – 46889
100	2507.90	I	7728 – 47590
900	2510.83	I	416 – 40231
70	2511.76	II	21712 – 61513
70	2512.36	I	416 – 40207
90	2517.66	I	7986 – 47693
700	2518.10	I	704 – 40405
60	2519.63	I	8155 – 47831
2800	2522.85	I	0 – 39626
140	2523.66	I	
500	2524.29	I	888 – 40491
60	2525.02	I	
70	2525.39	II	21252 – 60838
50	2526.30	II	20831 – 60402
1400	2527.43	I	416 – 39970
500	2529.13	I	704 – 40231
60	2529.55	II	22637 – 62158
160	2529.83	I	888 – 40405
70	2530.69	I	704 – 40207
70	2533.63	II	21430 – 60888
60	2533.80	I	
60	2534.42	II	21712 – 61157
700	2535.60	I	978 – 40405
120	2536.82	II	21582 – 60990
120	2537.17		
70	2538.81	II	21430 – 60807
70	2539.00	II	21252 – 60625
800	2540.98	I	888 – 40231
160	2542.10	I	21039 – 60365
35	2543.38	II	21582 – 60888
160	2543.92	I	20875 – 60172
70	2544.71	I	20641 – 59927
800	2545.98	I	704 – 39970
650	2549.61	I	416 – 39626
25	2550.02	II	26353 – 65556
60	2551.09	I	
200	2562.53	II	7955 – 46967
130	2563.47	II	8392 – 47390
60	2566.91	II	8680 – 47626
60	2570.52	II	
40	2574.37	II	20831 – 59663
60	2575.74	I	
100	2576.69	I	6928 – 45726
90	2577.92	II	8847 – 47626
50	2582.30	I	
90	2582.58	II	8680 – 47390
260	2584.54	I	6928 – 45608
650	2585.88	II	0 – 38660
90	2588.00	I	
90	2591.54	II	8392 – 46967
30	2592.78	II	32875 – 71432
90	2593.73	II	8847 – 47390
650	2598.37	II	385 – 38859
2000	2599.40	II	0 – 38459
300	2599.57	I	7377 – 45833
80	2605.65	I	6928 – 45295
160	2606.82	I	7377 – 45726
650	2607.09	II	668 – 39013

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
800	2611.87	II	385 – 38660
320	2613.82	II	863 – 39109
320	2617.62	II	668 – 38859
120	2618.02	I	7728 – 45914
90	2620.41	II	863 – 39013
170	2621.67	II	977 – 39109
150	2623.53	I	7728 – 45833
440	2625.67	II	385 – 38459
320	2628.29	II	977 – 39013
40	2629.59	I	978 – 38996
550	2631.05	II	863 – 38859
550	2631.32	II	668 – 38660
80	2632.24	I	7986 – 45965
160	2635.81	I	7986 – 45914
60	2641.65	I	7377 – 45221
120	2644.00	I	8155 – 45965
30	2647.56	I	416 – 38175
40	2656.15	I	19390 – 57028
30	2662.06	I	7728 – 45282
70	2664.66	II	27315 – 64832
50	2666.64	II	27620 – 65110
100	2666.82	I	6928 – 44415
180	2679.06	I	6928 – 44244
120	2689.21	I	7377 – 44551
80	2699.11	I	7377 – 44415
40	2703.99	II	27315 – 64286
60	2706.02	I	19390 – 56334
180	2706.58	I	7728 – 44664
70	2708.57	I	20641 – 57550
20	2710.55	I	12969 – 49851
80	2711.65	I	7377 – 44244
I90	2714.41	II	7955 – 44785
100	2718.44	I	7986 – 44761
2600	2719.02	I	0 – 36767
1200	2720.90	I	416 – 37158
700	2723.58	I	704 – 37410
80	2724.96	I	7728 – 44415
80	2726.05	I	8155 – 44827
I80	2727.54	II	8392 – 45044
60	2728.02	I	7377 – 44023
50	2728.82	I	19788 – 56423
90	2730.74	II	8680 – 45290
700	2733.58	I	6928 – 43500
30	2734.00	I	7986 – 44551
30	2734.27	I	I7550 – 54112
280	2735.48	I	7377 – 43923
I00	2736.97	II	8680 – 45207
700	2737.3I	I	888 – 37410
750	2739.55	II	7955 – 44447
80	2742.26	I	7728 – 44184
550	2742.4I	I	704 – 37I58
280	2743.20	II	8847 – 45290
50	2743.56	I	7728 – 44I66
300	2744.07	I	978 – 37410
60	2744.53	I	7986 – 4441I
420	2746.48	II	8680 – 45080
380	2746.98	I	6928 – 4332I
		II	8392 – 44785
I20	2749.I8	II	8680 – 45044
600	2749.32	II	8392 – 44754
700	2750.I4	I	4I6 – 36767
30	2750.88	I	I7550 – 53892
80	2753.29	II	26353 – 62662
40	2753.69	I	8I55 – 44459
40	2754.04	I	7986 – 44285
750	2755.74	II	7955 – 44233
240	2756.26	I	416 – 36686
	2756.33	I	888 – 37158
80	2757.32	I	8155 – 44411
20	2759.82	I	8155 – 44378
150	2761.78	I	7986 – 44184
	2761.81	II	8847 – 45044
160	2762.03	I	7728 – 43923
50	2763.11	I	7986 – 44166
20	2764.33	I	17727 – 53892
20	2766.91	I	8155 – 44285
180	2767.50	II	26170 – 62293
	2767.52	I	7377 – 43500
180	2772.08	I	6928 – 42992
30	2773.24	I	
30	2774.73	I	8155 – 44184
150	2778.22	I	6928 – 42912
30	2778.84	I	
35	278I.84	I	7986 – 43923
700	2788.10	I	6928 – 42784
20	2789.80	I	21716 – 57550
25	2791.79	I	19621 – 55430
20	2795.01	I	0 – 35768
80	2797.78	I	7377 – 43109
150	2804.52	I	7377 – 43023
160	2806.98	I	7377 – 42992
420	2813.29	I	7377 – 42912
20	2817.51	I	7728 – 43210
500	2823.28	I	7728 – 43138
150	2825.56	I	7728 – 43109
30	2825.69	I	0 – 35379
25	2828.81	I	7986 – 43326
320	2832.44	I	7728 – 43023
25	2835.46	I	0 – 35257
100	2838.I2	I	7986 – 43210
25	2840.42	I	416 – 35612
90	2843.63	I	7377 – 42533
260	2843.98	I	7986 – 43138
70	2845.60	I	7728 – 42860
16	2848.72	I	7986 – 43079
380	2851.80	I	8155 – 432I0
50	2863.44	I	11976 – 46889
40	2863.86	I	704 – 356I2
25	2866.63	I	7986 – 42860
80	2869.3I	I	416 – 35257
50	2872.34	I	7728 – 42533
I00	2874.17	I	0 – 34782
25	2875.30	I	11976 – 46745
50	2877.30	I	I1976 – 46721
10	2887.8I	I	217I6 – 56334
80	2894.50	I	18378 – 529I6
40	2895.04	I	12561 – 47093
40	2899.42	I	18378 – 52858
20	290I.92	I	19350 – 53800
25	2907.52	I	21999 – 56383
200	29I2.16	I	0 – 34329
80	2918.03	I	26106 – 60366
50	2920.69	I	12969 – 47197
80	2923.29	I	26351 – 60549
50	2923.85	I	21716 – 55907
60	2926.59	II	7955 – 42115
200	2929.01	I	416 – 34547
800	2936.90	I	0 – 34040
I30	2941.34	I	704 – 34692
35	2944.40	II	13673 – 47626

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
800	2947.88	I	416 – 34329
35	2948.43	I	21999 – 55906
600	2953.94	I	704 – 34547
320	2957.36	I	888 – 34692
80	2959.99	I	21716 – 55490
180	2965.26	I	978 – 34692
1700	2966.90	I	0 – 33695
40	2969.36	I	888 – 34556
80	2969.48	I	6928 – 40594
340	2970.10	I	888 – 34547
600	2973.13	I	704 – 34329
1200	2973.24	I	416 – 34040
10	2976.13	I	18378 – 51969
10	2980.54	I	22249 – 55791
280	2981.45	I	416 – 33947
12	2981.85	I	17550 – 51077
1400	2983.57	I	0 – 33507
120	2984.78	I	6928 – 40422
	2984.83	II	13474 – 46967
12	2986.46	I	888 – 34363
120	2987.29	I	7377 – 40842
50	2990.39	I	21999 – 55430
1200	2994.43	I	416 – 33802
10	2996.39	I	19552 – 52916
360	2999.51	I	6928 – 40257
50	3000.45	I	11976 – 45295
1100	3000.95	I	704 – 34017
100	3003.03	I	7728 – 41018
35	3007.14	I	11976 – 45221
100	3007.28	I	704 – 33947
900	3008.14	I	888 – 34122
280	3009.57	I	7377 – 40594
50	3011.48	I	22249 – 55446
80	3016.18	I	7986 – 41131
200	3017.63	I	888 – 34017
180	3018.98	I	7728 – 40842
600	3020.49	I	704 – 33802
2800	3020.64	I	0 – 33096
1600	3021.07	I	416 – 33507
260	3024.03	I	888 – 33947
180	3025.64	I	19390 – 52431
380	3025.84	I	978 – 34017
180	3026.46	I	7986 – 41018
190	3030.15	I	19621 – 52613
190	3031.22	I	19788 – 52769
190	3031.64	I	8155 – 41131
950	3037.39	I	888 – 33802
170	3040.43	I	7377 – 40257
70	3041.64	I	12561 – 45428
120	3041.74	I	7728 – 40594
60	3042.02	I	8155 – 41018
190	3042.66	I	7986 – 40842
1300	3047.60	I	704 – 33507
60	3055.26	I	12561 – 45282
650	3057.45	I	6928 – 39626
1000	3059.09	I	416 – 33096
400	3067.24	I	7377 – 39970
340	3075.72	I	7728 – 40231
240	3083.74	I	7986 – 40405
200	3091.58	I	8155 – 40491
550 d	3099.90	I	8155 – 40405
	3099.97	I	7377 – 39626
260	3100.30	I	7986 – 40231
260	3100.67	I	7728 – 39970
60	3116.63	I	8155 – 40231
110	3125.65	I	7986 – 39970
70	3175.45	I	19351 – 50833
140	3180.23	I	19757 – 51192
60	3184.90	I	416 – 31805
70	3191.66	I	0 – 31323
70	3192.80	I	20020 – 51331
110	3193.23	I	0 – 31307
240	3196.93	I	19562 – 50833
140	3199.52	I	19562 – 50808
150	3200.48	I	19913 – 51149
110	3205.40	I	20020 – 51208
70	3210.83	I	19913 – 51048
150	3211.99	I	19351 – 50475
300	3214.04	I	19757 – 50862
60	3214.40	I	704 – 31805
70	3215.94	I	19913 – 50999
50	3217.38	I	19351 – 50423
120	3219.58	I	19757 – 50808
70	3219.81	I	19562 – 50611
340	3222.07	I	19351 – 50378
500	3225.79	I	19351 – 50342
190	3227.75	II	13474 – 44447
	3227.80	I	19562 – 50534
70	3230.97	I	19757 – 50699
70	3233.97	I	19562 – 50475
300	3239.44	I	19562 – 50423
220	3244.19	I	19562 – 50378
130	3265.62	I	17550 – 48163
150	3271.00	I	17727 – 48290
280	3286.76	I	17550 – 47967
280	3305.97	I	17727 – 47967
280	3306.35	I	17927 – 48163
60	3355.23	I	26627 – 56423
80	3369.55	I	21999 – 51668
120	3370.79	I	21716 – 51374
80	3383.98	I	17550 – 47093
70	3392.31	I	17727 – 47197
150	3392.66	I	17550 – 47017
220	3399.34	I	17727 – 47136
150	3404.36	I	17727 – 47093
300	3407.46	I	17550 – 46889
230	3413.14	I	17727 – 47017
150	3417.84	I	17927 – 47177
150	3418.51	I	17927 – 47172
80	3422.66	I	17927 – 47136
160	3424.29	I	17550 – 46745
70	3426.39	I	17550 – 46727
70	3426.64	I	17727 – 46902
320	3427.12	I	17550 – 46721
80	3428.20	I	17727 – 46889
4000	3440.61	I	0 – 29056
800	3440.99	I	416 – 29469
400	3443.88	I	704 – 29733
160	3445.15	I	17727 – 46745
50	3447.28	I	17727 – 46727
80	3450.33	I	17927 – 46902
80	3451.92	I	17927 – 46889
80	3452.28	I	7728 – 36686
600	3465.86	I	888 – 29733
800	3475.45	I	704 – 29469
320	3476.70	I	978 – 29733
60	3485.34	I	17727 – 46410
800	3490.58	I	416 – 29056
60	3495.29	I	20641 – 49243
80	3497.11	I	17550 – 46137

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
240	3497.84	I	888 – 29469	750	3727.62	1	7728 – 34547
60	3506.50	I	18378 – 46889	120	3732.40	1	17727 – 44512
400	3513.82	I	6928 – 35379	700	3733.32	I	888 – 27666
360	3521.26	I	7377 – 35768	7000	3734.87	I	6928 – 33695
180	3526.04	I	704 – 29056	3400	3737.13	I	416 – 27167
130	3526.17	I	7728 – 36079	70	3738.31	I	26351 – 53094
80	3533.20	I	23245 – 51540	600	3743.36	I	7986 – 34692
200	3536.56	I	23193 – 51461	2400	3745.56	I	704 – 27395
240	3541.09	I	22997 – 51229	600	3745.90	I	978 – 27666
220	3542.08	I	23111 – 51335	1400	3748.26	I	888 – 27560
60	3553.74	I	28820 – 56951	4000	3749.49	I	7377 – 34040
280	3554.93	I	22846 – 50968	70	3753.61	I	17550 – 44184
650	3558.52	I	7986 – 36079	3000	3758.24	1	7728 – 34329
1600	3565.38	1	7728 – 35768	60	3760.05	I	19390 – 45978
4000	3570.10	I	7377 – 35379	16	3760.53	I	17927 – 44512
6000	3581.20	1	6928 – 34844	1700	3763.79	1	7986 – 34547
130	3584.66	I	21716 – 49604	140	3765.54	I	26106 – 52655
360	3585.32	I	7728 – 35612	1200	3767.19	I	8155 – 34692
300	3585.71	1	7377 – 35257	10	3774.83	1	17927 – 44411
130	3586.11	I	26106 – 53983	10	3776.46	I	17550 – 44023
400	3586.99	I	7986 – 35856	30	3785.95	I	19621 – 46027
70	3589.11	I	6928 – 34782	30	3786.68	I	8155 – 34556
80	3594.64	1	22997 – 50808	460	3787.88	I	8155 – 34547
160	3603.21	I	21716 – 49461	60	3790.10	I	7986 – 34363
240	3605.46	I	21999 – 49727	30	3794.34	I	19788 – 46136
320	3606.68	1	21716 – 49434	650	3795.00	1	7986 – 34329
2000	3608.86	I	8155 – 35856	60	3797.52	I	26106 – 52431
200	3610.16	I	22650 – 50342	320	3798.51	I	7377 – 33695
130	3617.79	I	24336 – 51969	480	3799.55	I	7728 – 34040
2000	3618.77	I	7986 – 35612	120	3805.34	1	26628 – 52899
240	3621.46	I	21999 – 49604	60	3806.70	1	26351 – 52613
160	3622.00	I	22249 – 49851	30	3807.54	I	17927 – 44184
80	3623.19	1	19390 – 46982	320	3812.96	1	7728 – 33947
50	3625.15	I	22846 – 50423	1600	3815.84	I	11976 – 38175
2000	3631.46	I	7728 – 35257	5000	3820.43	I	6928 – 33096
80	3632.04	I	24772 – 52297	70	3821.18	I	26351 – 52514
130	3638.30	I	22249 – 49727	800	3824.44	1	0 – 26140
220	3640.39	I	21999 – 49461	3200	3825.88	1	7377 – 33507
60	3645.82	I	25091 – 52512	1300	3827.82	I	12561 – 38678
1600	3647.84	I	7377 – 34782	30	3833.31	I	20641 – 46721
160	3649.51	I	21716 – 49109	1300	3834.22	1	7728 – 33802
300	3651.47	I	22249 – 49628	35	3839.26	1	24575 – 50614
80	3659.52	I	19788 – 47107	800	3840.44	I	7986 – 34017
160	3669.52	1	21999 – 49243	800	3841.05	I	12969 – 38996
200	3677.63	I	22249 – 49433	60	3843.26	I	24575 – 50587
650	3679.92	I	0 – 27167	60	3846.80	I	26225 – 52213
160	3682.21	I	28605 – 55754	500	3849.97	I	8155 – 34122
110	3683.06	1	416 – 27560	70	3850.82	I	7986 – 33947
110	3684.11	I	21999 – 49135	20	3852.58	I	17550 – 43500
130	3686.00	I	23711 – 50833	850	3856.37	1	416 – 26340
800	3687.46	I	6928 – 34040	60	3859.22	I	19390 – 45295
130	3689.46	I	23711 – 50808	4200	3859.91	I	0 – 25900
240	3694.01	I	24507 – 51570	340	3865.53	I	8155 – 34017
80	3695.05	I	20875 – 47930	20	3867.22	I	24336 – 50187
300	3701.09	I	24181 – 51192	340	3872.50	I	7986 – 33802
80	3704.46	I	21716 – 48703	35	3873.76	I	19621 – 45428
800	3705.57	I	416 – 27395	500	3878.02	I	7728 – 33507
280 d	3707.82	I	704 – 27666	850	3878.58	I	704 – 26479
	3707.92	I	17550 – 44512	25	3885.51	1	19552 – 45282
850	3709.25	I	7377 – 34329	1800	3886.28	I	416 – 26140
60	3716.45	I	23711 – 50611	350	3887.05	1	7377 – 33096
6000	3719.94	I	0 – 26875	350	3888.52	1	12969 – 38678
800	3722.56	I	704 – 27560	35	3893.39	1	23784 – 49461
80	3724.38	I	18378 – 45221	350	3895.66	1	888 – 26550
30	3726.92	I	24507 – 51331	35	3897.90	I	21716 – 47363

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
35	3898.01	I	8155 – 33802
550	3899.71	I	704 – 26340
550	3902.95	I	12561 – 38175
18	3903.90	I	24119 – 49727
140	3906.48	I	888 – 26479
20	3916.73	I	26106 – 51630
40	3917.18	I	7986 – 33507
30	3918.65	I	24339 – 49851
360	3920.26	I	978 – 26479
550	3922.91	I	416 – 25900
700	3927.92	I	888 – 26340
750	3930.30	I	704 – 26140
20	3935.82	I	22838 – 48239
16	3940.88	I	7728 – 33096
14	3942.44	I	22947 – 48305
35	3948.78	I	26351 – 51668
35	3949.96	I	17550 – 42860
30	3951.17	I	26406 – 51708
20	3952.61	I	21716 – 47008
35	3956.46	I	26106 – 51374
70	3956.68	I	21716 – 46982
40	3966.07	I	12969 – 38175
30	3966.63	I	25900 – 51103
30	3967.42	I	26628 – 51826
550	3969.26	I	11976 – 37163
25	3971.33	I	21716 – 46889
60	3977.74	I	17727 – 42860
20	3981.77	I	21999 – 47107
40	3983.96	I	21999 – 47093
80	3997.40	I	21999 – 47008
30	3998.06	I	21716 – 46721
400	4005.25	I	12561 – 37521
35	4009.72	I	17927 – 42860
40	4014.53	I	28820 – 53722
40	4021.87	I	22249 – 47107
3000	4045.82	I	11976 – 36686
30	4062.44	I	22947 – 47556
1200	4063.60	I	12561 – 37163
1000	4071.74	I	12969 – 37521
40	4107.49	I	22838 – 47177
30	4109.81	I	22947 – 47272
80	4118.55	I	28820 – 53094
20	4127.61	I	23052 – 47272
320	4132.06	I	12969 – 37163
40	4134.68	I	22838 – 47017
80	4143.42	I	24575 – 48703
400	4143.87	I	12561 – 36686
20	4147.67	I	11976 – 36079
40	4154.50	I	22838 – 46902
40	4156.80	I	22838 – 46889
35	4175.64	I	22947 – 46889
80	4181.76	I	22838 – 46745
30	4184.90	I	22838 – 46727
130	4187.04	I	19757 – 43634
130	4187.80	I	19562 – 43435
80	4191.44	I	19913 – 43764
110	4198.31	I	19351 – 43163
130	4199.10	I	24575 – 48383
340	4202.03	I	11976 – 35768
14	4203.99	I	22947 – 46727
40	4210.35	I	20020 – 43764
16	4216.19	I	0 – 23711
70	4219.36	I	28820 – 52514
40	4222.22	I	19757 – 43435
130	4227.43	I	26875 – 50523
110	4233.61	I	20020 – 43634
170	4235.94	I	19562 – 43163
30	4238.82	I	27395 – 50980
30	4247.43	I	27167 – 50704
120	4250.13	I	19913 – 43435
240	4250.79	I	12561 – 36079
360	4260.48	I	19351 – 42816
120	4271.16	I	19757 – 43163
1000	4271.76	I	11976 – 35379
80	4282.41	I	17550 – 40895
140	4294.13	I	11976 – 35257
120	4299.24	I	19562 – 42816
1000	4307.91	I	12561 – 35768
60	4315.09	I	17727 – 40895
950	4325.76	I	12969 – 36079
40	4337.05	I	12561 – 35612
40	4352.74	I	17927 – 40895
14	4369.77	I	24575 – 47453
60	4375.93	I	0 – 22846
1700	4383.55	I	11976 – 34782
850	4404.75	I	12561 – 35257
480	4415.12	I	12969 – 35612
60	4427.31	I	416 – 22997
50	4442.34	I	17727 – 40231
20	4443.20	I	23052 – 45552
50	4447.72	I	17927 – 40405
50	4459.12	I	17550 – 39970
30	4461.65	I	704 – 23111
60	4466.55	I	22838 – 45221
60	4476.02	I	22947 – 45282
30 d	4482.17	I	888 – 23193
	4482.26	I	17927 – 40231
60	4494.57	I	17727 – 39970
100	4528.62	I	17550 – 39626
20	4531.15	I	11976 – 34040
25	4602.94	I	11976 – 33695
16	4736.78	I	25900 – 47006
20	4859.75	I	23193 – 43764
60	4871.32	I	23111 – 43634
35	4872.15	I	23245 – 43764
12	4878.22	I	23270 – 43764
35	4890.77	I	23193 – 43634
80	4891.50	I	22997 – 43435
10	4903.32	I	23245 – 43634
50	4919.00	I	23111 – 43435
120	4920.50	I	22846 – 43163
40	4957.31	I	22997 – 43163
130	4957.61	I	22650 – 42816
12	5001.87	I	31307 – 51294
10	5005.72	I	31323 – 51294
25	5006.13	I	22846 – 42816
12	5012.07	I	6928 – 26875
10	5041.76	I	11976 – 31805
20	5049.82	I	18378 – 38175
10	5051.64	I	7377 – 27167
10	5068.79	I	23711 – 43435
8	5083.34	I	7728 – 27395
10	5098.71	I	17550 – 37158
20	5110.41	I	0 – 19562
25	5133.68	I	33695 – 53169
25	5139.26	I	24181 – 43634
35	5139.48	I	23711 – 43163
130	5167.49	I	11976 – 31323
60	5171.60	I	11976 – 31307
40	5191.47	I	24507 – 43764

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
60		5192.36	I	24181 – 43435
30		5194.95	I	12561 – 31805
25		5202.34	I	17550 – 36767
25		5216.28	I	12969 – 32134
30		5226.88	I	24507 – 43634
120		5227.19	I	12561 – 31686
110		5232.94	I	23711 – 42816
50		5266.58	I	24181 – 43163
220		5269.54	I	6928 – 25900
80		5270.36	I	12969 – 31937
20		5281.80	I	24507 – 43435
40		5283.63	I	26140 – 45061
25		5302.31	I	26479 – 45334
70		5324.18	I	25900 – 44677
180		5328.05	I	7377 – 26140
25		5328.53	I	12561 – 31323
14		5339.94	I	26340 – 45061
18		5341.03	I	12969 – 31686
12		5364.88	I	35856 – 54491
14	h	5367.46	I	35612 – 54237
20		5369.96	I	35257 – 53874
120		5371.49	I	7728 – 26340
30		5383.37	I	34782 – 53353
20		5393.18	I	26140 – 44677
70		5397.13	I	7377 – 25900
35	h	5404.15	I	35768 – 54267
70		5405.78	I	7986 – 26479
18		5410.91	I	36079 – 54555
30	h	5415.21	I	35379 – 53841
35	h	5424.08	I	34844 – 53275
80		5429.70	I	7728 – 26140
50		5434.53	I	8155 – 26550
10	h	5445.04	I	35379 – 53739
60		5446.92	I	7986 – 26340
40		5455.61	I	8155 – 26479
I6		5497.52	I	8155 – 26340
10		5501.47	I	7728 – 25900
20		5506.78	I	7986 – 26I40
20		5569.62	I	27560 – 45509
30		5572.85	I	27395 – 45334
7		5576.11	I	27666 – 45595
40		5586.76	I	27I67 – 45061
8		5602.96	I	27666 – 45509
50		5615.65	I	26875 – 44677
10		5624.55	I	27560 – 45334
12		5658.83	I	27395 – 4506I
7		5763.01	I	33947 – 51294
8		6024.06	I	36686 – 53282
12		6065.49	I	21039 – 37521
30		6136.62	I	19788 – 36079
20		6137.70	I	20875 – 37163
20		6191.56	I	19621 – 35768
20		6230.73	I	20641 – 36686
7		6246.34	I	29056 – 45061
12		6252.56	I	19390 – 35379
5		6265.14	I	17550 – 33507
6		6301.52	I	29469 – 45334
5		6318.02	I	19788 – 35612
10		6393.60	I	19621 – 35257
16		6400.02	I	29056 – 44677
10		6411.66	I	29469 – 45061
8		6421.36	I	18378 – 33947
10		6430.85	I	17550 – 33096
30		6494.98	I	19390 – 34782
6		6546.24	I	22249 – 37521
9		6592.92	I	21999 – 37163
18		6677.99	I	21716 – 36686
4		6945.21	I	19552 – 33947
3		6978.86	I	20038 – 34363
6		7130.94	I	34017 – 48037
8		7164.47	I	33802 – 47756
20		7187.34	I	33096 – 47006
12		7207.41	I	33507 – 47378
6		7389.42	I	34692 – 48221
7		7411.18	I	34547 – 48037
14		7445.78	I	34329 – 47756
18		7495.09	I	34040 – 47378
30		7511.04	I	33695 – 47006
5		7531.17	I	35257 – 48532
3		7568.92	I	34547 – 47756
4		7583.80	I	24339 – 37521
10		7586.04	I	34782 – 47961
3		7620.54	I	38175 – 51294
2		7661.22	I	34329 – 47378
6		7664.30	I	24119 – 37163
10		7748.28	I	23784 – 36686
10		7780.59	I	36079 – 48928
14		7832.22	I	35768 – 48532
14		7937.17	I	34782 – 47378
14		7945.88	I	35379 – 47961
14		7998.97	I	35257 – 47756
3		8028.34	I	36079 – 48532
12		8046.07	I	35612 – 48037
10		8085.20	I	35856 – 48221
3		8198.95	I	35768 – 47961
30		8220.41	I	34844 – 47006
3		8232.35	I	35612 – 47756
40		8327.06	I	17727 – 29733
9		8331.94	I	35379 – 47378
4		8339.43	I	35768 – 47756
35		8387.78	I	17550 – 29469
12		8468.41	I	17927 – 29733
9		8514.08	I	17727 – 29469
3		8515.11	I	24339 – 36079
6		861I.81	I	22947 – 34556
35		8661.91	I	17927 – 29469
9		8674.75	I	22838 – 34363
70		8688.63	I	17550 – 29056
8		8757.19	I	22947 – 34363
8		8764.00	I	37521 – 48928
6		8793.38	I	37163 – 48532
40		8824.23	I	17727 – 29056
10		8866.96	I	36686 – 47961
25		8999.56	I	22838 – 33947

559-795 O - 75 - 10 (Pt. 1)

Lanthanum

$$\text{La, } Z = 57,\ M = 138.905,\ \text{Ratio } \frac{\text{La}}{\text{Cu}} = 2.186$$

La I Normal state of valence electrons $5d6s^2\ ^2D_{1\,1/2} = 0$. I.P. = 44981 cm^{-1}.
La II Normal state of valence electrons $5d^2\ ^3F_2 = 0$. I.P. = 89200 cm^{-1}.
La III Normal state of valence electrons $5d^2D_{1\,1/2} = 0$. I.P. = 154675 cm^{-1}.

References

Wavelengths:
A. Gatterer and J. Junkes, Spektren der Seltenen Erden (Specola Vaticana, Vatican, 1945), below 7550 Å.
G. R. Harrison, Massachusetts Institute of Technology Wavelength Tables (John Wiley & Sons, New York, 1939), above 7550 Å.

Classification:
La I, La II and La III, H. N. Russell and W. F. Meggers, J. Research NBS **9**, 625 (1932) RP 497.
La I, A. Giachetti and M. Wilson, J. Opt. Soc. Am. **58**, 740A (1968).

Molecular Spectra:
LaO, W. F. Meggers and J. A. Wheeler, J. Research NBS **6**, 239 (1931) RP 273.

Strong lines of lanthanum

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
9000	3949.10	II	3250 – 28565	2200	3929.22	II	1394 – 26838
5500	4086.72	II	0 – 24463	2000	4429.90	II	1895 – 24463
4600	4333.74	II	1394 – 24463				
4400	3988.52	II	3250 – 28315	1700	3886.37	II	2592 – 28315
4400	4123.23	II	2592 – 26838	1600	3849.02	II	0 – 25973
				1600	4238.38	II	3250 – 26838
3900	3794.78	II	1971 – 28315	1500	3337.49	II	3250 – 33204
3700	3790.83	II	1016 – 27388	1500	3380.91	II	2592 – 32161
3600	3995.75	II	1394 – 26414				
3400	3871.64	II	1016 – 26838	1500	4196.55	II	2592 – 26414
3000	4042.91	II	7473 – 32201	1300	3916.05	II	1895 – 27424
				1100	2297.78	III	1603 – 45111
2800	4031.69	II	2592 – 27388	1100	3921.54	II	1895 – 27388
2800	4077.35	II	1895 – 26414	1100	4151.97	II	1895 – 25973
2400	3759.08	II	1971 – 28565				

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
240	2187.87	II	0 – 45692
770	2256.76	II	1394 – 45692
1100	2297.78	III	1603 – 45111
90	2317.82	II	18895 – 62026
200	2319.44	II	2592 – 45692
75	2328.75	II	16599 – 59528
1000	2379.38	III	0 – 42015
20	2438.01	II	18895 – 59900
65	2471.90	II	5250 – 45692
35	2472.44	II	17826 – 58259
35	2479.85	II	19215 – 59528
65	2487.59	II	17212 – 57400
45	2533.14	II	6227 – 45692
45	2560.37	II	19215 – 58259
18	2580.82	II	15699 – 54435
22	2582.56	II	14148 – 52858
35	2596.09	II	16599 – 55107
400	2610.34	II	7395 – 45692
55	2672.91	II	18580 – 55982
60	2695.47	II	19750 – 56838
55	2725.58	I	1053 – 37732
55	2791.51	II	22106 – 57919
55	2798.56	II	22537 – 58259
420	2808.39	II	10095 – 45692
11	2838.45	II	19215 – 54435
16	2840.51	II	29498 – 64693
45	2855.90	II	24523 – 59528
26	2862.98	II	20403 – 55321
90	2880.65	II	20403 – 55107
130	2885.14	II	21332 – 55982
160	2893.07	II	22283 – 56838
110	2950.50	II	28526 – 62408
180	3104.59	II	0 – 32201
60	3108.46	II	0 – 32161
130	3142.76	II	1394 – 33204
150	3171.68	III	13591 – 45110
75	3193.02	II	1895 – 33204
35	3215.81	I	1053 – 32141
510	3245.13	II	1394 – 32201
260	3249.35	II	1394 – 32161
550	3265.67	II	2592 – 33204
800	3303.11	II	1895 – 32161
1500	3337.49	II	3250 – 33204
95	3342.23	I	1053 – 30965
870	3344.56	II	1895 – 31786
200	3376.33	II	2592 – 32201
1500	3380.91	II	2592 – 32161
130	3452.18	II	1394 – 30353
180	3453.17	II	3250 – 32201
65	3461.18	I	1053 – 29937
75	3510.00	II	1016 – 29498
75	3512.93	II	1895 – 30353
45	3514.07	I	1053 – 29502
75	3517.14	III	13591 – 42015
45	3550.82	II	0 – 28155
65	3557.26	II	1394 – 29498
200	3574.43	I	0 – 27969
65	3601.06	II	2592 – 30353
50	3610.25	II	
75	3612.34	II	24463 – 52138
75	3613.08	I	0 – 27669
320	3628.83	II	1016 – 28565
35	3636.67	I	1053 – 28543
120	3637.15	II	5718 – 33204
170 d	3641.53	I	1053 – 28506
	3641.66	II	27388 – 54840
1000	3645.42	II	0 – 27424
90	3649.53	I	0 – 27393
390	3650.18	II	0 – 27388
170	3662.08	II	1016 – 28315
17	3672.02	I	0 – 27225
35	3701.81	II	28315 – 55321
120	3704.54	I	1053 – 28040
320	3705.82	II	6227 – 33204
550	3713.54	II	1394 – 28315
140	3714.87	II	5250 – 32161
270	3715.53	II	2592 – 29498
90	3725.05	II	0 – 26838
35	3735.85	II	1394 – 28155
2400	3759.08	II	1971 – 28565
75	3773.12	II	26838 – 53333
120	3780.67	II	5718 – 32161
65	3784.81	II	0 – 26414
3700	3790.83	II	1016 – 27388
3900	3794.78	II	1971 – 28315
65	3808.79	II	3250 – 29498
190	3835.08	II	5718 – 31786
600	3840.72	II	1394 – 27424
120	3846.00	II	1394 – 27388
1600	3849.02	II	0 – 25973
130	3854.91	II	6227 – 32161
80	3864.49	II	28565 – 54435
3400	3871.64	II	1016 – 26838
1700	3886.37	II	2592 – 28315
50	3898.60	I	0 – 25643
35	3902.58	I	0 – 25617
40	3910.81	II	2592 – 28155
1300	3916.05	II	1895 – 27424
1100	3921.54	II	1895 – 27388
160	3927.56	I	0 – 25454
2200	3929.22	II	1394 – 26838
180	3936.22	II	1016 – 26414
9000	3949.10	II	3250 – 28565
40	3953.68	I	1053 – 26339
4400	3988.52	II	3250 – 28315
3600	3995.75	II	1394 – 26414
180	4015.39	I	1053 – 25950
90	4023.59	II	14376 – 39222
250	4025.88	II	2592 – 27424
2800	4031.69	II	2592 – 27388
40	4036.59	II	7395 – 32161
140	4037.21	I	0 – 24763
3000	4042.91	II	7473 – 32201
320	4050.08	II	15774 – 40458
220	4060.33	I	4122 – 28743
160	4064.79	I	3495 – 28089
60	4065.58	I	1053 – 25643
850	4067.39	II	1394 – 25973
110	4076.71	II	0 – 24523
2800	4077.35	II	1895 – 26414
120	4079.18	I	0 – 24508
5500	4086.72	II	0 – 24463
180	4089.61	I	3010 – 27455
280	4099.54	II	14148 – 38534
110	4104.87	I	2668 – 27023
50	4109.80	I	1053 – 25378
50	4117.68	I	
4400	4123.23	II	2592 – 26838
110	4137.04	I	1053 – 25218
550	4141.74	II	3250 – 27388

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
1100		4151.97	II	1895 – 25973
220		4152.78	II	14148 – 38221
40		4157.52	I	0 – 24046
100		4160.26	I	1053 – 25083
50		4172.32	I	3495 – 27455
70		4177.48	I	1053 – 24984
280		4187.32	1	0 – 23875
280		4192.36	II	14375 – 38221
1500		4196.55	II	2592 – 26414
240		4204.04	II	5718 – 29498
300		4217.56	II	15699 – 39403
200		4230.95	II	15774 – 39403
1600		4238.38	II	3250 – 26838
140		4249.99	II	15699 – 39222
50		4262.34	I	1053 – 24508
320		4263.59	II	15774 – 39222
480		4269.50	II	14375 – 37791
240		4275.64	II	2592 – 25973
300		4280.27	I	1053 – 24410
600		4286.97	II	15699 – 39019
600		4296.05	II	6227 – 29498
120		4300.44	II	0 – 23247
50		4315.90	II	3250 – 26414
440		4322.51	II	1394 – 24523
4600		4333.74	II	1394 – 24463
20		4334.96	II	14148 – 37210
40		4340.73	1	8446 – 31477
550		4354.40	II	7395 – 30353
60		4354.80	1	9184 – 32141
110		4364.67	II	5250 – 28155
110	bl	4371.97	La O	
110	bl	4375.84	La O	
110		4378.10	II	14375 – 37210
60	bl	4379.72	La O	
280		4383.44	II	14148 – 36955
100		4385.20	II	14375 – 37173
60		4389.87	I	9719 – 32493
50		4402.65	I	9044 – 31752
50		4411.21	II	28565 – 51229
220	bl	4418.24	La O	
80		4419.16	II	16599 – 39222
160	bl	4423.17	La O	
160		4423.90	I	9920 – 32518
260		4427.55	II	14375 – 36955
100	bl	4428.10	La O	
2000		4429.90	II	1895 – 24463
160	bl	4432.98	La O	
50		4435.85	II	0 – 22537
100	bl	4438.01	La O	
50	bl	4443.00	La O	
100		4452.15	I	
100		4455.80	II	5718 – 28155
40		4468.97	I	3010 – 25380
40		4486.06	I	7490 – 29776
40		4493.11	I	1053 – 23303
40		4494.71	I	2668 – 24910
90		4500.22	I	7680 – 29895
850		4522.37	II	10095 – 32201
170		4525.31	II	15699 – 37791
420		4526.12	II	6227 – 28315
30		4541.79	1	7490 – 29502
80		4549.50	1	3010 – 24984
400		4558.46	II	2592 – 24523
110		4559.29	II	6227 – 28155
160		4567.91	1	3495 – 25380
200		4570.02	I	4122 – 25997
400		4574.88	II	1394 – 23247
200		4580.06	II	5718 – 27546
35		4602.05	I	8052 – 29776
160		4605.78	II	5718 – 27424
410		4613.39	II	5718 – 27388
23		4615.07	I	7231 – 28893
410		4619.88	II	14148 – 35788
40		4636.43	II	18895 – 40458
110		4645.28	II	1016 – 22537
45		4646.34	I	9961 – 31477
70		4647.51	II	15699 – 37210
80		4648.65	I	2668 – 24174
35		4650.33	I	3010 – 24508
45		4652.08	I	3495 – 24984
540		4655.50	II	15699 – 37173
35		4660.70	I	8052 – 29502
360		4662.51	II	0 – 21442
230		4663.76	II	15774 – 37210
200		4668.91	II	14375 – 35788
160		4671.83	II	15774 – 37173
90		4691.18	II	1394 – 22705
230		4692.50	II	14148 – 35453
90		4699.63	II	3250 – 24523
35		4700.26	I	13260 – 34530
35		4702.64	I	4122 – 25380
140		4703.28	II	15699 – 36955
35		4708.19	I	9184 – 30417
70		4712.93	II	3250 – 24463
170		4716.44	II	6227 – 27424
35		4717.59	II	16599 – 37791
140		4719.94	II	15774 – 36955
35		4724.43	II	6227 – 27388
230		4728.42	II	1394 – 22537
500		4740.28	II	1016 – 22106
390		4743.09	II	14375 – 35453
320		4748.73	II	7473 – 28526
45		4750.41	I	9920 – 30965
160		4766.89	I	0 – 20972
35		4770.43	I	7012 – 27969
28		4796.69	II	7473 – 28315
28		4800.00	I	9961 – 30788
23		4800.25	I	7680 – 28506
160		4804.04	II	1895 – 22705
160		4809.01	II	1895 – 22684
28	h	4817.17	I	9184 – 29937
200		4824.06	II	5250 – 25973
23		4826.88	II	1394 – 22106
70		4839.52	I	7012 – 27669
45		4840.01	II	2592 – 23247
45		4850.58	II	6227 – 26838
70		4850.82	I	1053 – 21663
23		4854.95	I	9184 – 29776
320		4860.91	II	1971 – 22537
35		4870.56	I	8446 – 28972
65		4878.86	1	8052 – 28543
26		4887.61	I	8052 – 28506
850		4899.92	II	0 – 20403
65		4901.87	1	1053 – 21448
26		4905.13	I	7012 – 27393
1000		4920.98	II	1016 – 21332
1000		4921.79	II	1971 – 22283
140		4934.83	II	10095 – 30353
26		4935.62	II	5718 – 25973
26		4945.85	I	7012 – 27225

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
110		4946.47	II	1895 – 22106
370		4949.77	I	0 – 20197
65		4952.07	II	19215 – 39403
340		4970.39	II	2592 – 22705
35		4977.95	I	0 – 20083
370		4986.83	II	1394 – 21442
140		4991.28	II	7395 – 27424
65		4993.88	I	0 – 20019
35		4996.82	II	19215 – 39222
720		4999.47	II	3250 – 23247
50		5001.79	I	8052 – 28040
35		5002.13	II	18236 – 38221
35	h	5019.51	I	
140		5046.88	I	3495 – 23303
26		5048.04	II	19215 – 39019
210		5050.57	I	3010 – 22804
170		5056.46	I	2668 – 22439
45		5062.92	II	6227 – 25973
45		5067.90	I	3495 – 23221
24		5078.92	I	15197 – 34881
35		5079.38	I	
35	h	5080.21	II	15774 – 35453
24		5103.13	I	15197 – 34787
200		5106.23	I	2668 – 22247
470		5114.56	II	1895 – 21442
45		5120.88	I	8446 – 27969
470		5122.99	II	2592 – 22106
21		5135.44	I	15197 – 34664
24		5139.16	I	16099 – 35552
450		5145.42	I	3010 – 22439
180		5156.74	II	1016 – 20403
180		5157.43	II	17826 – 37210
290		5158.69	I	0 – 19379
120		5163.62	II	1971 – 21332
80		5167.79	I	4122 – 23467
26		5172.91	II	18895 – 38221
80		5173.84	II	32201 – 51524
580		5177.31	I	3495 – 22804
24		5179.12	I	8446 – 27749
850		5183.42	II	3250 – 22537
90		5183.92	I	1053 – 20338
260		5188.22	II	19750 – 39019
170		5204.15	II	18580 – 37791
720		5211.86	I	4122 – 23303
35		5226.21	II	17826 – 36955
520		5234.27	I	4122 – 23221
35		5239.55	I	8052 – 27133
26		5240.83	I	15197 – 34272
340		5253.46	I	1053 – 20083
35		5257.85	I	16538 – 35552
110		5259.39	II	1394 – 20403
370		5271.19	I	1053 – 20019
50		5276.42	I	8446 – 27393
26		5279.13	II	18236 – 37173
140		5290.84	II	0 – 18895
370		5301.98	II	3250 – 22106
140		5302.62	II	16599 – 35453
180		5303.55	II	2592 – 21442
45		5304.02	I	7490 – 26339
24		5307.53	I	15197 – 34033
16		5320.16	I	3495 – 22286
35		5323.57	I	8446 – 27225
110		5340.67	II	18236 – 36955
110		5357.86	I	7680 – 26339
21		5365.89	I	7012 – 25643
130		5377.09	II	18580 – 37173
21		5380.01	I	9961 – 28543
140		5380.99	II	7395 – 25973
80		5381.92	II	17212 – 35788
21	bl	5405.66	La O	
24	bl	5407.69	La O	
26		5415.68	I	7490 – 25950
40		5429.86	I	7231 – 25643
21		5437.54	I	7231 – 25617
500		5455.15	I	1053 – 19379
35		5458.69	II	18895 – 37210
45		5464.38	II	6227 – 24523
13		5466.92	I	8052 – 26339
40		5475.17	I	
26		5480.73	II	17212 – 35453
65		5482.27	II	0 – 18236
26		5491.07	I	7012 – 25218
40		5493.45	II	1016 – 19215
470		5501.34	I	0 – 18172
26		5502.25	I	9920 – 28089
18		5502.67	I	3495 – 21663
90		5503.81	I	4122 – 22286
50		5506.00	I	0 – 18157
40		5515.28	I	7490 – 25617
65		5517.34	I	9920 – 28040
18		5529.87	I	9961 – 28040
13		5532.06	I	7012 – 25083
90		5535.67	II	10095 – 28155
65		5541.26	I	9184 – 27225
24		5544.91	I	9719 – 27749
50		5565.44	I	7680 – 25643
40		5565.72	I	3010 – 20972
24		5566.94	II	19215 – 37173
80		5568.46	I	3495 – 21448
16		5570.38	I	0 – 17947
80		5588.34	I	3495 – 21384
80	bl	5600.02	La O	
110	bl	5602.50	La O	
35	bl	5626.03	La O	
45	bl	5628.60	La O	
160		5631.22	I	3010 – 20763
65		5632.03	I	7012 – 24763
40		5639.31	I	7490 – 25218
240		5648.25	I	9920 – 27620
35	b	5654.82	La O	
			I	7231 – 24910
16		5656.54	I	9719 – 27393
130		5657.72	I	2668 – 20338
50		5671.55	II	17826 – 35453
90		5696.19	I	1053 – 18604
13		5699.39	I	4122 – 21663
45		5703.33	II	5718 – 23247
10		5710.85	I	9719 – 27225
65		5712.40	II	1394 – 18895
40		5714.02	I	7012 – 24508
13		5714.55	I	9961 – 27455
45		5720.02	I	3495 – 20972
26		5727.29	II	5250 – 22705
40		5734.95	I	9961 – 27393
180		5740.66	I	2668 – 20083
18		5742.94	I	7231 – 24639
160		5744.41	I	7680 – 25083
160		5761.84	I	2668 – 20019
160		5769.07	II	10095 – 27424
370		5769.34	I	3010 – 20338

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
80		5769.99	I	8052 – 25378
320		5789.24	I	3495 – 20763
450		5791.34	I	4122 – 21384
220		5797.58	II	1971 – 19215
160		5805.78	II	1016 – 18236
10		5808.06	I	9920 – 27132
50		5808.32	II	0 – 17212
140		5821.99	I	9961 – 27132
50		5823.83	I	8052 – 25218
24		5827.56	I	9184 – 26339
80		5829.72	I	7490 – 24639
16		5839.79	I	1053 – 18172
24		5845.03	I	1053 – 18157
65		5848.38	I	13260 – 30354
13		5848.95	II	21442 – 38534
35	h	5852.27	I	7680 – 24763
80		5855.58	I	3010 – 20083
80		5863.71	II	7473 – 24523
16	bl	5866.42	La O	
16	bl	5869.50	La O	
16		5869.95	I	8052 – 25083
21		5874.00	II	6227 – 23247
45		5874.73	I	7490 – 24508
21		5877.63	I	3010 – 20019
16		5877.99	I	8446 – 25454
65		5880.64	II	1895 – 18895
16	bh	5893.57	La O	
65		5894.85	I	7680 – 24639
16	bh	5896.67	La O	
10		5900.75	I	7231 – 24174
16		5901.96	II	22283 – 39222
16		5904.30	I	8052 – 24984
45		5917.63	I	1053 – 17947
16	bh	5920.84	La O	
16	bh	5923.97	La O	
16		5927.71	II	22537 – 39403
21		5928.49	I	7012 – 23875
320		5930.62	I	1053 – 17910
		5930.68	I	0 – 16857
65		5935.24	I	3495 – 20338
50		5936.22	II	1394 – 18236
13		5940.83	I	7680 – 24508
18	h	5948.30	II	20403 – 37210
26		5960.59	I	8446 – 25218
16		5962.60	I	9184 – 25950
16		5965.30	I	
13		5971.09	II	10095 – 26838
45		5973.53	II	22283 – 39019
18	h	5975.75	I	7680 – 24410
26		5982.35	I	2668 – 19379
16		5992.36	I	7490 – 24174
65		6007.36	I	4122 – 20763
16		6017.16	I	13260 – 29875
50		6038.59	I	7490 – 24046
13		6041.55	I	14804 – 31352
13		6067.14	II	6227 – 22705
45		6068.68	I	7231 – 23705
13		6072.05	I	8446 – 24910
16	h	6084.89	I	16857 – 33287
40		6100.38	II	5718 – 22106
16		6107.27	I	3010 – 19379
80		6108.48	I	7680 – 24046
45		6111.72	I	8052 – 24410
80		6126.09	II	10095 – 26414
26		6127.05	I	8446 – 24763
80		6129.56	II	6227 – 22537
50		6134.39	I	7231 – 23528
24	h	6142.98	I	
13		6145.30	I	15020 – 31288
18		6146.53	II	1971 – 18236
80		6165.70	I	7490 – 23705
35		6172.73	II	1016 – 17212
26		6188.09	II	23247 – 39403
16		6203.51	II	22106 – 38221
13		6218.20	I	9920 – 25997
35		6233.51	I	7490 – 23528
35	h	6234.86	I	9184 – 25218
18	h	6236.17	I	
13	h	6236.74	I	7231 – 23261
18	h	6238.59	I	7680 – 23705
720		6249.93	I	4122 – 20117
260	d	6262.30	II	3250 – 19215
90		6266.02	I	9920 – 25875
13		6273.76	II	24523 – 40458
18		6287.74	I	9184 – 25083
16		6288.56	I	9719 – 25617
65		6293.57	I	3495 – 19379
180		6296.09	II	10095 – 25973
21		6305.46	II	1971 – 17826
16		6310.14	I	17910 – 33753
35		6310.92	II	21332 – 37173
16		6318.26	I	8052 – 23875
160		6320.39	II	1394 – 17212
110		6325.91	I	1053 – 16857
35		6358.13	II	5718 – 21442
35		6360.22	I	9044 – 24763
170		6390.48	II	2592 – 18236
450		6394.23	I	3495 – 19129
50		6399.05	II	21332 – 36955
210		6410.99	I	3010 – 18604
35		6446.61	II	22283 – 37791
21		6448.11	I	2668 – 18172
13		6450.34	I	9719 – 25218
90	c	6454.52	I	2668 – 18157
250		6455.99	I	1053 – 16538
13	h	6468.44	I	9184 – 24639
24	h	6485.55	I	8052 – 23467
40		6498.19	II	20403 – 35788
10		6506.23	I	14096 – 29461
21	h	6520.74	I	
110		6526.99	II	1895 – 17212
10	h	6529.73	II	7395 – 22705
130		6543.16	I	2668 – 17947
26		6565.44	I	1053 – 16280
8		6570.96	II	6227 – 21442
140		6578.51	I	0 – 15197
10		6582.19	I	16099 – 31288
45		6593.46	I	3010 – 18172
35		6600.17	I	3010 – 18157
45		6608.26	I	9961 – 25090
50		6616.59	I	3495 – 18604
10		6631.21	I	
10		6636.53	II	7473 – 22537
26		6642.79	II	20403 – 35453
35		6644.41	I	1053 – 16099
18		6645.16	I	16243 – 31288
70		6650.81	I	0 – 15032
80		6661.40	I	4122 – 19129
35	c	6671.40	II	3250 – 18236
40		6692.87	I	3010 – 17947

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
8		6699.25	I	
9		6699.85	I	
180		6709.50	I	3010 – 17910
19		6714.09	II	22283 – 37173
7		6718.68	II	24523 – 39403
7		6732.78	II	22106 – 36955
35		6748.13	I	8446 – 23261
60		6753.04	I	0 – 14804
120		6774.26	II	1016 – 15774
7		6796.73	I	0 – 14709
29	h	6808.86	II	1016 – 15699
14		6813.66	II	22537 – 37210
45		6823.78	I	7012 – 21663
35		6834.05	II	1971 – 16599
23		6837.90	II	2592 – 17212
8	h	6859.03	II	3250 – 17826
21		6917.24	I	3495 – 17947
12		6918.30	I	1053 – 15504
70		6925.24	I	7012 – 21448
45		6935.01	I	3495 – 17910
8	h	6952.51	II	1394 – 15774
21	h	6954.52	II	0 – 14375
35		6958.10	II	10095 – 24463
10		6976.86	I	
13	b	6996.89	La O	
13	b	7011.22	La O	
75		7023.67	I	8052 – 22286
26		7032.05	I	9044 – 23261
26	b	7040.84	La O	
110		7045.96	I	2668 – 16857
13	b	7054.80	La O	
160		7066.23	II	0 – 14148
65		7068.37	I	1053 – 15197
21	bl	7070.79	La O	
13		7076.38	I	9961 – 24088
21	bl	7085.40	La O	
26	bl	7101.02	La O	
10	h	7116.8	II	7395 – 21442
19	bl	7131.58	La O	
10		7149.77	I	7680 – 21663
40	h	7158.08	I	1053 – 15020
50		7161.25	I	7012 – 20972
10		7162.60	La O	
21		7219.91	I	3010 – 16857
10	b	7257.16	La O	
26		7270.09	I	7012 – 20763
10		7270.30	I	1053 – 14804
110	cw	7282.34	II	1971 – 15699
10		7320.91	I	1053 – 14709
110	cw	7334.18	I	0 – 13631
65		7345.34	I	8052 – 21663
50	bl	7379.71	La O	
85	bl	7380.08	La O	
35		7382.73	I	9719 – 23261
110	bl	7403.52	La O	
210	bl	7403.75	La O	
50	b	7411.34	La O	
65	bl	7434.28	La O	
110	bl	7434.36	La O	
30	b	7442.92	La O	
50	h	7463.08	I	8052 – 21448
50	bl	7465.25	La O	
95	bl	7465.48	La O	
75	cw	7483.50	II	1016 – 14375
40	bl	7496.50	La O	
95	bl	7496.78	La O	
50		7498.83	I	8052 – 21384
30	b	7506.79	La O	
19	bl	7528.21	La O	
50	bl	7528.39	La O	
30		7533.59	I	3010 – 16280
85		7539.23	I	0 – 13260
35	bl	7560.09	La O	
35	bl	7592.26	La O	
19	h	7612.94	II	1016 – 14148
19	b	7624.99	La O	
21		7664.34	I	3495 – 16538
15	h	7841.80	I	3495 – 16243
21	b	7876.87	La O	
75	bl	7877.22	La O	
75	bl	7910.19	La O	
150	bl	7910.54	La O	
50	b	7944.61	La O	
110	bl	7944.95	La O	
40		7964.83	I	2668 – 15220
35	b	7979.34	La O	
75	bl	7979.70	La O	
35	h	8001.89	I	3010 – 15504
21	b	8014.43	La O	
65	bl	8014.79	La O	
30	b	8019.48	La O	
35	hc	8051.39	I	4122 – 16538
75		8086.05	I	2668 – 15031
15	b	8122.20	La O	
15	b	8159.02	La O	
7	h	8203.38	I	3010 – 15197
50		8247.44	I	4122 – 16243
13	h	8316.04	I	3010 – 15031
85		8324.69	I	3495 – 15504
95		8346.53	I	4122 – 16099
8	h	8379.80	I	19129 – 31060
8	b	8453.55	La O	
8	h	8467.62	I	20117 – 31924
26		8476.48	I	3010 – 14804
13	h	8507.37	I	8446 – 20197
13	h	8513.57	I	9920 – 21663
8	h	8514.65	II	7473 – 19215
17	b	8526.59	La O	
17	c	8543.46	I	9961 – 21663
65		8545.44	I	3010 – 14709
15	b	8563.54	La O	
9	h	8590.94	I	8446 – 20083
9	b	8600.81	La O	
7	h	8624.22	I	7012 – 18604
15		8638.47	I	8446 – 20019
19	hw	8672.11	I	9920 – 21448
40		8674.43	I	3495 – 15020
13	h	8720.41	I	9920 – 21384
35		8748.38	I	2668 – 14096
19		8818.93	I	13747 – 25083
35		8825.82	I	8052 – 19379
21		8839.63	I	3495 – 14804

Lead

Pb, $Z = 82$, $M = 207.2$, Ratio $\frac{\text{Pb}}{\text{Cu}} = 3.261$

Pb I Normal state of valence electrons $6s^2 6p^2\ {}^3P_0 = 0$. I.P. = 59820 cm^{-1}.
Pb II Normal state of valence electrons $6s^2 6p\ {}^2P^\circ_{1/2} = 0$. I.P. = 121243 cm^{-1}.

References

Wavelengths:
G. R. Harrison, Massachusetts Institute of Technology Wavelength Tables (John Wiley & Sons, New York, 1939).
W. F. Meggers, unpublished material (1955).

Classification:
Pb I, D. R. Wood and K. L. Andrew, J. Opt. Soc. Am. **58**, 818 (1968).
Pb II, L. T. Earls and R. A. Sawyer, Phys. Rev. **47**, 115 (1935).

Lead—all observed lines

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
6000	2022.02	I	0 – 49440	3000	2663.16	I	10650 – 48189
7000	2053.27	I	0 – 48687	10000	2801.99	I	10650 – 46329
5500	2169.99	I	0 – 46069	4100	2823.20	I	10650 – 46061
1400	2203.53	II	14081 – 59448	9500	2833.06	I	0 – 35287
200	2246.88	I	7819 – 52312	2800	2873.32	I	10650 – 45443
70	2332.44	I	10650 – 53511	30	3220.57	I	21458 – 52500
35	2388.80	I	10650 – 52500	1100	3572.74	I	21458 – 49440
1700	2393.79	I	10650 – 52412	5500	3639.58	I	7819 – 35287
30	2399.60	I	10650 – 52312	340	3671.51	I	21458 – 48687
600	2401.95	I	7819 – 49440	14000	3683.48	I	7819 – 34960
130	2411.73	I	10650 – 52102	2800	3739.95	I	21458 – 48189
20 h	2428.63	I	21458 – 62621	400	4019.64	I	21458 – 46329
380	2443.84	I	7819 – 48726	34000	4057.83	I	10650 – 35287
700	2446.19	I	7819 – 48687	550	4062.14	I	21458 – 46069
1300	2476.38	I	7819 – 48189	130	4168.03	I	21458 – 45443
1100	2577.27	I	10650 – 49440				
500	2613.65	I	7819 – 46069	90	5005.44	I	29467 – 49440
7000	2614.18	I	7819 – 46061	35	5201.47	I	29467 – 48687
240	2628.28	I	10650 – 48687	8 hl	6001.93	I	35287 – 51944
16	2657.09	I	7819 – 45443	140	7229.00	I	21458 – 35287

Lithium

$$\text{Li}, Z = 3, M = 6.94, \text{Ratio } \frac{\text{Li}}{\text{Cu}} = 0.1092$$

Li I Normal state of valence electrons $1s^2 2s\ ^2S_{1/2} = 0$. I.P. = 43487 cm^{-1}.
Li II Normal state of valence electrons $1s^2\ ^1S_0 = 0$. I.P. = 610079 cm^{-1}.

References

Wavelengths and Classification:
Li I, I. Johansson, Ark. for Fysik **15**, 169 (1958).

Lithium—all observed lines

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
50	2741.18	I	0 – 36470	3200	6103.62	I	14904 – 31283
170	3232.63	I	0 – 30925	36000	6707.84	I	0 – 14904
130 hl	4602.86	I	14904 – 36623	480	8126.34	I	14904 – 27206
80 h	4971.70	I	14904 – 35012				

Lutetium

$$\text{Lu}, Z = 71, M = 174.97, \text{ Ratio } \frac{\text{Lu}}{\text{Cu}} = 2.753$$

Lu I Normal state of valence electrons $5d6s^2\ {}^2D_{1\,1/2} = 0$. I.P. = 43762 cm^{-1}.
Lu II Normal state of valence electrons $6s^2\ {}^1S_0 = 0$. I.P. = 112000 cm^{-1}.
Lu III Normal state of valence electrons $6s\ {}^2S_1 = 0$. I.P. = 169049 cm^{-1}.

References

Wavelengths, Spectrum Assignments and Molecular Spectra (LuO):
W. F. Meggers and B. F. Scribner, J. Research NBS **19,** 31 (1937) RP 1008.

Classification:
Lu I, P. F. A. Klinkenberg, Physica **21,** 53 (1954).
Lu II, L. F. H. Bovey and R. W. B. Pearse, Atomic Energy Research Establishment C/R 1976 (Harwell, 1956).
Lu III, W. F. Meggers and B. F. Scribner, J. Research NBS **5,** 73 (1930) RP 187.
A. Steudel, Zeits. Physik **152,** 599 (1958).

Strong lines of lutetium

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
18000		2615.42	II	0 – 38223	4800	3567.84	I	0 – 28020
9000		2911.39	II	14199 – 48537	4500	2900.30	II	12435 – 46904
8300	c	3507.39	II	0 – 28503				
7600		3281.74	I	1994 – 32457	4200	2701.71	II	14199 – 51202
7600		3359.56	I	1994 – 31751	4200	2963.32	II	11796 – 45532
					4100	3397.07	II	11796 – 41225
7500		3077.60	II	12435 – 44919	3800	3278.97	I	0 – 30489
6300		2894.84	II	14199 – 48733	3600	2754.17	II	12435 – 48733
6200		3312.11	I	0 – 30184				
6200		3376.50	I	0 – 29608	3300	4518.57	I	0 – 22125
5100	h	3081.47	I	1994 – 34436	3100	4124.73	I	7476 – 31714
					3000	2847.51	II	11796 – 46904
4800		3254.31	II	14199 – 44919	3000	3020.54	II	12435 – 45532
4800		3472.48	II	12435 – 41225	3000	3118.43	I	
4800		3554.43	II	17332 – 45458				

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
1700	h	2195.54	II	0 – 45532
580		2236.17	III	0 – 44705
95		2276.94	II	27264 – 71169
190		2297.41	II	28503 – 72017
1300		2392.19	II	17332 – 59122
120		2399.14	II	32453 – 74122
80		2419.21	II	38223 – 79547
55		2430.26	II	32453 – 73588
130		2459.64	II	12435 – 53079
80		2469.27	II	28503 – 68989
21	h	2481.72	II	32453 – 72736
370		2536.95	II	11796 – 51202
40		2546.87	II	32453 – 71705
20		2549.44	I	0 – 39212
20		2549.72	I	4136 – 43344
35		2561.80	II	12435 – 51458
930		2571.23	II	14199 – 53079
1700		2578.79	II	12435 – 51202
80	h	2582.13	II	32453 – 71169
570	c	2603.33	III	0 – 38400
1800		2613.40	II	11796 – 50049
18000		2615.42	II	0 – 38223
1800		2619.26	II	11796 – 49963
90		2657.05		
2700		2657.80	II	12435 – 50049
90	h	2677.25	I	7476 – 44816
570	h	2685.08	I	4136 – 41368
90	h	2685.54	I	1993 – 39220
4200		2701.71	II	14199 – 51202
90	h	2715.91	I	
180	d	2719.09	I	4136 – 40901
480	h	2728.95	I	0 – 36633
75	c	2738.17	II	27264 – 63774
3600		2754.17	II	12435 – 48733
750	h	2765.74	I	4136 – 40282
390		2772.58	III	8648 – 44705
2700		2796.63	II	17332 – 53079
35		2821.23	III	
270	c	2834.35	II	28503 – 63774
330	h	2845.13	I	1994 – 37131
3000		2847.51	II	11796 – 46904
570	h	2885.14	I	
6300		2894.84	II	14199 – 48733
4500		2900.30	II	12435 – 46904
300		2903.05	I	0 – 34436
9000		2911.39	II	14199 – 48537
270	h	2949.73	I	7476 – 41368
1200		2951.69	II	17332 – 51202
60		2955.78	II	
4200		2963.32	II	11796 – 45532
2400		2969.82	II	11796 – 45458
1800		2989.27	I	0 – 33443
3000		3020.54	II	12435 – 45532
120		3027.29	II	12435 – 45458
2100		3056.72	II	14199 – 46904
140		3057.90	III	5708 – 38400
7500		3077.60	II	12435 – 44919
390		3080.11	I	0 – 32457
5100	h	3081.47	I	1994 – 34436
3000		3118.43	I	
2400		3171.36	I	0 – 31523
100		3183.73	II	17332 – 48733
260		3191.80	II	32453 – 63774
1400		3198.12	II	14199 – 45458
4800		3254.31	II	14199 – 44919
3800		3278.97	I	0 – 30489
7600		3281.74	I	1994 – 32457
6200		3312.11	I	0 – 30184
7600		3359.56	I	1994 – 31751
6200		3376.50	I	0 – 29608
950		3385.50	I	1994 – 31523
160	h	3391.55	I	
1400		3396.82	I	
4100		3397.07	II	11796 – 41225
4800		3472.48	II	12435 – 41225
8300	c	3507.39	II	0 – 28503
1600		3508.42	I	1994 – 30489
4800		3554.43	II	17332 – 45458
4800		3567.84	I	0 – 28020
340		3596.34	I	7476 – 35275
800		3623.99	II	17332 – 44919
680		3636.25	I	0 – 27493
2600		3647.77	I	4136 – 31542
60		3684.32	I	
60		3710.95	I	
110		3756.70	I	4136 – 30748
110		3756.79	I	4136 – 30747
30	h	3786.18	I	
150		3800.67	I	
75	h	3829.07	I	
2700		3841.18	I	1994 – 28020
75		3843.61	I	
95		3853.29	I	
40		3874.61	I	4136 – 29938
530		3876.65	II	12435 – 38223
29		3911.77	I	
50		3918.86	I	
35	h	3926.62	I	
480		3968.46	I	0 – 25192
50		3991.38	I	
670		4054.45	I	4136 – 28793
75	bl	4096.13	LuO	
35	h	4107.44	I	
95	h	4112.67	I	0 – 24308
310		4122.49	I	
3100		4124.73	I	7476 – 31714
150	c	4131.79	I	
460		4154.08	I	7476 – 31542
24		4158.98	I	
1600		4184.25	II	17332 – 41225
150		4277.50	I	
250		4281.03	I	
330	d	4295.97	I	7476 – 30748
		4296.09	I	7476 – 30747
150		4309.57	I	1994 – 25192
75		4332.72	I	
29		4341.98	II	36098 – 59122
65	h	4420.96	I	21462 – 44076
190	c	4430.48	I	
35		4438.79	I	
190		4450.81	I	7476 – 29938
50	h	4471.55	I	
60	h	4498.85	I	0 – 22222
3300		4518.57	I	0 – 22125
24	b	4560.95	LuO	
24	b	4575.31	LuO	
85	c	4605.39	I	18851 – 40559
95	h	4645.47	I	
100	h	4648.21	I	
95	h	4648.85	I	

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
65	b	4654.03	LuO	
1000		4658.02	I	0 – 21462
85	h	4659.03	I	
630	bl	4661.75	LuO	
310	bl	4672.31	LuO	
420	bl	4684.16	LuO	
270	bl	4695.46	LuO	
190	bl	4708.00	LuO	
30		4716.70	I	0 – 21195
65	b	4720.86	LuO	
65	h	4726.20	I	
100	bl	4735.00	LuO	
75	bl	4749.11	LuO	
40	bl	4764.22	LuO	
150		4785.42	II	17332 – 38223
85		4815.05	I	0 – 20762
50	c	4839.62	II	11796 – 32453
18		4865.36	II	38575 – 59122
460		4904.88	I	4136 – 24518
180		4942.34	I	1994 – 22222
800		4994.13	II	12435 – 32453
800		5001.14	I	4136 – 24126
55	h	5057.60	I	17427 – 37194
140		5134.05	I	17427 – 36900
2700		5135.09	I	1994 – 21462
130	bl	5170.11	LuO	
170		5196.61	I	18505 – 37743
90		5206.47	I	1994 – 21195
40		5304.40	I	20433 – 39279
80		5349.12	I	18505 – 37194
500		5402.57	I	0 – 18505
140	c	5421.90	I	1994 – 20433
100		5437.88	I	
35		5453.57	I	4136 – 22468
2100		5476.69	II	14199 – 32453
9		5664.89	II	30889 – 48537
14		5713.49	II	29407 – 46904
550		5736.55	I	0 – 17427
55		5775.40	I	20433 – 37743
80		5800.59	I	
40	h	5860.79	I	22222 – 39279
9		5866.30	I	7476 – 24518
690	cw	5983.9	II	11796 – 28503
140		5997.13	I	22609 – 39279
1400		6004.52	I	7476 – 24125
35	h	6041.66	I	21195 – 37743
440		6055.03	I	1994 – 18505
11		6140.71	I	21462 – 37743
150		6159.94	II	32504 – 48733
160		6199.66	II	29407 – 45532
2100		6221.87	II	12435 – 28503
35		6228.14	II	29407 – 45458
80		6235.36	II	32504 – 48537
160		6242.34	II	30889 – 46904
16	h	6248.80	I	21195 – 37194
70	h	6345.35	I	23524 – 39279
18	h	6354.85	I	21462 – 37194
9		6365.79	I	21195 – 36900
16		6366.00	I	
22		6441.14	I	22222 – 37743
11		6444.89	II	29407 – 44919
1100		6463.12	II	11796 – 27264
29		6477.67	I	1994 – 17427
55	c	6523.18	I	
35	cw	6611.28	II	17332 – 32453
		6611.58	II	
		6611.80	II	
		6611.95	II	
		6612.04	II	
11		6619.15	II	36098 – 51202
23	c	6677.14	I	22222 – 37194
9	h	6735.76	I	20433 – 35275
30	c	6793.77	I	4136 – 18851
11		6826.59	II	36557 – 51202
45		6917.31	I	
8		6943.96	II	35652 – 50049
23		7031.24	I	23524 – 37743
14	c	7096.34	I	25192 – 39279
45		7125.84	II	30889 – 44919
9		7142.79	I	
7		7143.10	I	
8		7165.94	II	36098 – 50049
14	ch	7237.98	I	21462 – 35275
5		7409.70	II	36557 – 50049
11	c	7441.52	I	24308 – 37743
8		7456.96	II	36557 – 49963
7	ch	7640.08	I	24109 – 37194
7	cw	7758.30	I	24308 – 37194
7	h	7815.9	I	24109 – 36900
9	c	8178.16	I	
17		8382.08	I	7476 – 19403
35		8459.19	II	29407 – 41225
10	d	8478.50	I	
29	c	8508.08	I	23524 – 35275
35	c	8610.98	I	22222 – 33832

Magnesium

$$\text{Mg},\ Z = 12,\ M = 24.305,\ \text{Ratio}\ \frac{\text{Mg}}{\text{Cu}} = 0.3825$$

Mg I Normal state of valence electrons $2p^6 3s^2\ {}^1S_0 = 0$. I.P. = 61671 cm^{-1}.
Mg II Normal state of valence electrons $2p^6 3s\ {}^2S_{1/2} = 0$. I.P. = 121268 cm^{-1}.

References

Wavelengths:
G. R. Harrison, Massachusetts Institute of Technology Wavelength Tables (John Wiley & Sons, New York, 1939).

Classification:
Mg I, F. Paschen, Sitzber. Preuss. Akad. Wiss., Physik. math. Kl. **32**, 709 (1931).
Mg II, A. Fowler, Report on Series in Line Spectra, p. 118 (Fleetway Press, London, 1922).

Magnesium—all observed lines

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
380	2776.69	I	21870 – 57874	20 h	2942.11	I	21911 – 55892
320	2778.29	I	21850 – 57833	140 hl	3096.90	I	21911 – 54192
900	2779.83	I	21911 – 57874	60	3332.15	I	21870 – 51872
		I	21870 – 57833	90	3336.68	I	21911 – 51872
320	2781.42	I	21870 – 57813	1400	3829.35	I	21850 – 47957
360	2782.97	I	21911 – 57833	3000	3832.31	I	21870 – 47957
130	2790.79	II	35669 – 71491	5000	3838.26	I	21911 – 47957
10000	2795.53	II	0 – 35761	70	4703.02	I	35051 – 56308
160	2798.06	II	35761 – 71490	750	5167.34	I	21850 – 41197
6000	2802.70	II	0 – 35669	2200	5172.70	I	21870 – 41197
60000	2852.13	I	0 – 35051	4000	5183.62	I	21911 – 41197
16	2928.75	II	35669 – 69805	60 h	5528.46	I	35051 – 53135
30	2936.54	II	35761 – 69805	140	8806.79	I	35051 – 46403

Manganese

$$\text{Mn}, Z = 25, M = 54.9380, \text{ Ratio } \frac{\text{Mn}}{\text{Cu}} = 0.865$$

Mn I Normal state of valence electrons $3d^5 4s^2\ {}^6S_{2\,1/2} = 0$. I.P. = 59970 cm^{-1}.
Mn II Normal state of valence electrons $3d^5 4s\ {}^7S_3 = 0$. I.P. = 126145 cm^{-1}.

References

Wavelengths:
G. R. Harrison, Massachusetts Institute of Technology Wavelength Tables (John Wiley & Sons, New York, 1939).

Classification:
Mn I, M. A. Catalan, W. F. Meggers, and O. Garcia-Riquelme, J. Res. Nat. Bur. Stand. (U.S.), **68A** (Phys. and Chem.), No. 1, 9–59 (Jan.–Feb. 1964).
Mn II, L. Iglesias and R. Velasco, Publ. Inst. de Optica de Madrid, No. **23** (1964).

Strong lines of manganese

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
27000	4030.76	I	0 – 24802	3700	2801.06	I	0 – 35690
19000	4033.07	I	0 – 24788	3200	3806.72	I	17052 – 43314
18000	2003.85	I	0 – 49888	2200	3569.49	I	18705 – 46713
14000	1998.86	I	0 – 50013				
12000	2576.10	II	0 – 38807	2100	3823.51	I	17282 – 43429
				1900	2949.20	II	9473 – 43370
11000	4034.49	I	0 – 24779	1900	4055.54	I	17282 – 41933
9700	1995.41	I	0 – 50099	1700	2109.58	I	0 – 47388
6200	2593.73	II	0 – 38543	1500	2092.16	I	0 – 47782
6200	2794.82	I	0 – 35770				
5600	4041.36	I	17052 – 41790	1500	2939.30	II	9473 – 43485
				1500	4018.10	I	17052 – 41933
5100	2798.27	I	0 – 35726	1500	4035.73	I	17282 – 42054
4300	2605.69	II	0 – 38366	1400	3577.88	I	17052 – 44994

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
9700	1995.41	I	0 – 50099
14000	1998.86	I	0 – 50013
18000	2003.85	I	0 – 49888
1500	2092.16	I	0 – 47782
1700	2109.58	I	0 – 47388
290	2208.81	I	0 – 45259
540	2213.85	I	0 – 45156
770	2221.84	I	0 – 44994
75	2533.06	I	25266 – 64732
50	2543.45	II	27589 – 66894
75	2556.57	II	27583 – 66686
95	2558.59	II	27571 – 66643
150	2563.65	II	27547 – 66542
580	2572.76	I	18532 – 57389
480	2575.51	I	18402 – 57218
12000	2576.10	II	0 – 38807
550	2584.31	I	18705 – 57389
45	2589.71	II	32788 – 71390
250	2592.94	I	18532 – 57086
6200	2593.73	II	0 – 38543
250	2595.76	I	18705 – 57218
95	2598.90	II	29951 – 68417
		II	32857 – 71323
40	2602.14	I	
45	2603.72	II	29889 – 68284
4300	2605.69	II	0 – 38366
190	2610.20	II	27547 – 65847
140	2622.90	I	25281 – 63395
150	2624.04	I	25266 – 63363
40	2624.80	II	27571 – 65658
200	2625.58	II	27583 – 65658
95	2626.64	I	18402 – 56462
30	2630.26	I	25281 – 63289
60	2630.57	I	25285 – 63289
190	2632.35	II	27588 – 65566
130	2638.17	II	27589 – 65483
80	2639.84	II	32788 – 70657
27	2650.99	II	32788 – 70497
60	2655.91	II	32857 – 70497
45	2667.00	I	18705 – 56190
110	2672.59	II	29889 – 67295
55	2673.37	II	32836 – 70231
55	2674.43	II	33147 – 70527
30	2676.33	I	23549 – 60903
45	2680.34	II	33248 – 70546
40	2681.72	I	
45	2683.02	I	
23	2683.75	I	
55	2684.55	II	33278 – 70518
55	2685.94	II	30523 – 67744
110	2688.25	II	52383 – 89572
85	2692.66	I	25266 – 62393
27	2693.19	II	29889 – 67009
55	2695.36	II	29919 – 67009
27	2698.97	II	29889 – 66929
85	2701.00	II	29889 – 66901
160	2701.70	II	27547 – 64550
130	2705.74	II	27571 – 64519
80	2707.53	II	27571 – 64494
110	2708.45	II	27583 – 64494
45	2709.96	II	27583 – 64473
80	2710.33	II	27588 – 64473
110	2711.58	II	27588 – 64456
55	2728.61	II	41182 – 77820
30	2738.86	I	30354 – 66855
45 h	2760.93	I	17052 – 53261
30	2771.44	I	17052 – 53124
30 h	2776.23	I	17282 – 53291
30	2780.00	I	23297 – 59257
55	2789.20	I	17282 – 53124
60	2790.36	I	17282 – 53109
60	2791.08	I	17052 – 52870
6200	2794.82	I	0 – 35770
5100	2798.27	I	0 – 35726
220	2799.84	I	17052 – 52758
3700	2801.06	I	0 – 35690
70	2804.10	I	17452 – 53103
60	2806.14	I	25266 – 60891
55	2808.02	I	17282 – 52884
110	2809.11	I	17282 – 52870
60	2812.84	I	17568 – 53109
70	2813.47	I	17568 – 53101
60	2815.02	II	35004 – 70518
85	2817.97	I	17282 – 52758
40	2818.77	I	17637 – 53103
55	2821.45	I	17452 – 52884
55	2822.55	I	17452 – 52870
80	2830.79	I	17568 – 52884
27	2836.31	I	17637 – 52884
60	2870.08	II	44315 – 79147
80	2879.49	II	33147 – 67866
40	2882.90	I	17452 – 52129
70	2886.68	II	33278 – 67910
160	2889.58	II	33248 – 67846
55	2892.39	II	33248 – 67812
80	2900.16	II	36274 – 70745
40	2907.22	I	25266 – 59653
140 h	2914.60	I	18402 – 52702
190 h	2925.57	I	18532 – 52703
27	2928.68	I	25281 – 59416
1100	2933.06	II	9473 – 43557
27	2934.02	I	25288 – 59361
1500	2939.30	II	9473 – 43485
250 h	2940.39	I	18705 – 52705
	2940.48	I	18705 – 52703
60	2941.04	I	25266 – 59257
1900	2949.20	II	9473 – 43370
40	3007.66	I	25281 – 58520
40	3011.16	I	25286 – 58486
40	3011.38	I	25288 – 58486
40	3014.67	I	25266 – 58427
60	3016.45	I	25286 – 58427
70	3022.75	I	25266 – 58339
55	3031.06	II	34762 – 67744
95	3040.60	I	25281 – 58160
27	3042.73	I	25281 – 58137
85	3043.36	I	25288 – 58137
330	3044.57	I	17052 – 49888
120	3045.59	I	25286 – 58110
200	3047.04	I	25266 – 58075
40	3048.86	I	25286 – 58075
250	3054.36	I	17282 – 50012
140	3062.12	I	17452 – 50099
170	3066.02	I	17282 – 49888
170	3070.27	I	17452 – 50012
160	3073.13	I	17569 – 50099
90	3079.63	I	17637 – 50099
50	3081.33	I	17569 – 50012
23	3082.05	I	17452 – 49888
40	3097.06	I	27248 – 59527

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
40		3110.68	I	27201 – 59339
60	h	3148.18	I	18403 – 50158
90	h	3161.04	I	18532 – 50158
140	h	3178.50	I	18705 – 50158
220		3212.88	I	17052 – 48168
65		3216.95	I	0 – 31076
1000		3228.09	I	17052 – 48021
300		3230.72	I	17282 – 48226
850		3236.78	I	17282 – 48168
330		3243.78	I	17452 – 48271
650		3248.52	I	17452 – 48226
100		3251.14	I	17569 – 48318
310		3252.95	I	17569 – 48301
65		3254.04	I	17052 – 47774
310		3256.14	I	17569 – 48271
220		3258.41	I	17637 – 48318
180		3260.23	I	17637 – 48301
180		3264.71	I	17282 – 47904
65		3296.88	I	17452 – 47774
65		3298.22	I	27201 – 57512
65		3320.69	I	17282 – 47388
70		3330.67	I	17452 – 47467
720		3441.99	II	14326 – 43370
360		3460.33	II	14594 – 43485
360	h	3474.04	II	14594 – 43370
		3474.13	II	14781 – 43557
290		3482.91	II	14781 – 43485
180		3488.68	II	14901 – 43557
140		3495.84	II	14960 – 43557
50		3496.81	II	14781 – 43370
100		3497.54	II	14901 – 43485
360		3531.85	I	18402 – 46708
		3532.00	I	18402 – 46707
1100		3532.12	I	18402 – 46706
1300		3547.80	I	18532 – 46710
1100		3548.03	I	18532 – 46708
390		3548.20	I	18532 – 46707
2200		3569.49	I	18705 – 46713
720		3569.80	I	18705 – 46710
		3570.04	I	18705 – 46708
1400		3577.88	I	17052 – 44994
720		3586.54	I	17282 – 45156
290		3595.12	I	17452 – 45259
420		3607.54	I	17282 – 44994
420		3608.49	I	17452 – 45156
360		3610.30	I	17569 – 45259
290		3619.28	I	17637 – 45259
220		3623.79	I	17569 – 45156
140		3629.74	I	17452 – 44994
100		3660.40	I	37420 – 64732
70		3670.52	I	17052 – 44289
70		3676.96	I	37631 – 64820
50		3682.09	I	37737 – 64888
280		3693.67	I	34139 – 61205
180		3696.57	I	23297 – 50341
70		3701.73	I	17282 – 44289
210		3706.08	I	34251 – 61226
130		3718.93	I	34344 – 61226
55		3728.89	I	23549 – 50359
130		3731.93	I	41404 – 68192
260		3790.22	I	17052 – 43429
55		3799.26	I	17282 – 43596
110		3800.55	I	31001 – 57306
55		3801.91	I	25266 – 51561
3200		3806.72	I	17052 – 43314
700		3809.59	I	17282 – 43524
55		3810.69	I	25281 – 51516
90		3816.75	I	17452 – 43644
2100		3823.51	I	17282 – 43429
390		3823.89	I	17452 – 43596
200		3829.68	I	17568 – 43673
480		3833.86	I	17568 – 43644
1300		3834.36	I	17452 – 43524
350		3839.78	I	17637 – 43673
670		3841.08	I	17568 – 43596
350		3843.98	I	17637 – 43644
65		3918.32	I	34139 – 59653
120		3926.47	I	31001 – 56462
65		3952.84	I	33825 – 59117
55		3975.89	I	34845 – 59990
65		3977.08	I	34463 – 59600
130		3982.58	I	25281 – 50383
150		3985.24	I	25288 – 50373
190		3986.83	I	25266 – 50341
150		3987.10	I	25286 – 50359
1500		4018.10	I	17052 – 41933
150		4026.44	I	25266 – 50095
27000		4030.76	I	0 – 24802
19000		4033.07	I	0 – 24788
11000		4034.49	I	0 – 24779
1500		4035.73	I	17282 – 42054
55		4038.73	I	30354 – 55108
5600		4041.36	I	17052 – 41790
210	d	4045.13	I	34939 – 59653
		4045.21	I	34139 – 58853
1100		4048.76	I	17452 – 42144
80		4049.00	I	35041 – 59732
55		4051.73	I	
65		4052.47	I	35115 – 59784
150		4055.21	I	35165 – 59818
1900		4055.54	I	17282 – 41933
210		4057.95	I	24779 – 49415
1100		4058.93	I	17569 – 42199
150		4059.39	I	24788 – 49415
730		4061.74	I	24802 – 49415
730		4063.53	I	17452 – 42054
80		4065.08	I	34251 – 58843
80		4068.00	I	17569 – 42144
290		4070.28	I	17637 – 42199
730		4079.24	I	17282 – 41790
730		4079.42	I	17637 – 42144
1100		4082.94	I	17569 – 42054
1100		4083.63	I	17452 – 41933
65		4089.94	I	34423 – 58867
55		4105.36	I	34939 – 59290
200		4110.90	I	34939 – 59257
150		4131.12	I	34139 – 58339
120		4135.04	I	34251 – 58427
80		4141.06	I	34344 – 58486
55		4147.53	I	27202 – 51306
80		4148.80	I	34423 – 58520
150		4176.60	I	34139 – 58075
120		4189.99	I	34251 – 58110
65		4201.76	I	34344 – 58136
65		4211.75	I	34423 – 58160
370		4235.14	I	23549 – 47155
510		4235.29	I	23297 – 46901
190		4239.72	I	23720 – 47299
290		4257.66	I	23819 – 47299
290		4265.92	I	23720 – 47155

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
270	4281.10	I	23549 – 46901
65	4284.08	I	23819 – 47155
65	4312.55	I	23720 – 46901
45	4374.95	I	27248 – 50099
45	4381.70	I	38670 – 61485
55	4411.88	I	38009 – 60668
350	4414.88	I	23297 – 45941
55	4419.78	I	38120 – 60739
210	4436.35	I	23549 – 46084
800	4451.59	I	23297 – 45754
160	4453.00	I	23720 – 46170
130	4455.01	I	24779 – 47220
160	4455.32	I	24779 – 47218
110	4455.82	I	24779 – 47216
55	4457.04	I	24788 – 47218
210	4457.55	I	24788 – 47216
270	4458.26	I	24788 – 47212
55	4460.38	I	24802 – 47216
150	4461.08	I	24802 – 47212
510	4462.02	I	24802 – 47207
290	4464.68	I	23549 – 45941
200	4470.14	I	23720 – 46084
130	4472.79	I	23819 – 46170
40	4479.40	I	41230 – 63548
170	4490.08	I	23819 – 46084
240	4498.90	I	23720 – 45941
240	4502.22	I	23549 – 45754
80	4605.36	I	38120 – 59828
80	4626.54	I	38009 – 59617
35	4671.69	I	23297 – 44696
50	4701.16	I	23549 – 44815
160	4709.72	I	23297 – 44524
180	4727.48	I	23549 – 44696
130	4739.11	I	23720 – 44815
1000	4754.04	I	18403 – 39431
180	4761.53	I	23819 – 44815
750	4762.38	I	23297 – 44289
300	4765.86	I	23720 – 44696
500	4766.43	I	23549 – 44524
940	4783.42	I	18532 – 39431
1000	4823.52	I	18705 – 39431
25	4844.32	I	31001 – 51638
35	4965.88	I	23297 – 43429
19	5004.91	I	23549 – 43524
30	5074.79	I	27202 – 46901
60	5117.94	I	25281 – 44815
50	5150.89	I	25288 – 44696
50	5196.59	I	25286 – 44524
85	5255.32	I	25266 – 44289
160	5341.06	I	17052 – 35770
19	5349.88	I	43314 – 62001
95	5377.63	I	31001 – 49591
95	5394.67	I	0 – 18532
50	5399.49	I	31076 – 49591
95	5407.42	I	17282 – 35770
35	5413.69	I	31125 – 49591
85	5420.36	I	17282 – 35726
35	5432.55	I	0 – 18402
12	5457.47	I	17452 – 35770
60	5470.64	I	17452 – 35726
40	5481.40	I	17452 – 35690
30	5505.87	I	17568 – 35726
50	5516.77	I	17568 – 35690
40	5537.76	I	17637 – 35690
21	5551.98	I	44289 – 62295
8	5567.76	I	44523 – 62479
7	5573.01	I	35165 – 53103
8	5573.68	I	35165 – 53101
7	5738.29	I	34139 – 51561
7	5780.19	I	34251 – 51546
7	5816.84	I	34344 – 51531
140	6013.50	I	24779 – 41404
200	6016.64	I	24788 – 41404
290	6021.80	I	24802 – 41404
7	6384.67	I	30426 – 46084
17	6440.97	I	30420 – 45941
24	6491.71	I	30354 – 45754
14 h	6942.52	I	41789 – 56190
12	6989.96	I	42054 – 56356
14	7069.84	I	37420 – 51561
12	7184.25	I	37631 – 51546
10	7247.82	I	37737 – 51531
24 h	7283.82	I	35690 – 49415
35 h	7302.89	I	35726 – 49415
50	7326.51	I	35770 – 49415
12	7680.20	I	44289 – 57306
10	7712.42	I	44524 – 57486
10 h	7764.72	I	43314 – 56190
10 h	8670.92	I	35690 – 47220
12 h	8672.06	I	35690 – 47218
10 h	8673.97	I	35690 – 47216
12 h	8701.05	I	35726 – 47216
17 h	8703.76	I	35726 – 47212
30 h	8740.93	I	35770 – 47207

559-795 O - 75 - 11 (Pt. 1)

Mercury

$$\text{Hg},\ Z = 80,\ M = 200.6,\ \text{Ratio}\ \frac{\text{Hg}}{\text{Cu}} = 3.157$$

Hg I Normal state of valence electrons $5d^{10}6s^2\ {}^1S_0 = 0$. I.P. = 84184 cm^{-1}.
Hg II Normal state of valence electrons $5d^{10}6s\ {}^2S_{1/2} = 0$. I.P. = 151280 cm^{-1}.

References

Wavelengths:
G. R. Harrison, Massachusetts Institute of Technology Wavelength Tables (John Wiley & Sons, New York, 1939).

Classification:
Hg I, K. Burns, K. B. Adams, and J. Longwell, J. Opt. Soc. Am. **40**, 339 (1950).

Mercury—all observed lines

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
15000	2536.52	I	0 – 39412	300	3654.83	I	44043 – 71396
60	2752.78	I	37645 – 73961	80	3662.88	I	44043 – 71336
100	2893.60	I	39412 – 73961	240	3663.28	I	44043 – 71333
1200	2967.28	I	37645 – 71336	1800	4046.56	I	37645 – 62350
200	3021.50	I	44043 – 77129	120	4077.81	I	39412 – 63928
400	3125.66	I	39412 – 71396	4000	4358.35	I	39412 – 62350
320	3131.55	I	39412 – 71336	3200	5460.74	I	44043 – 62350
320	3131.83	I	39412 – 71333	240 hs	5769.59	I	54069 – 71396
60	3341.48	I	44043 – 73961	280 h	5790.65	I	54069 – 71333
2800	3650.15	I	44043 – 71431				

Molybdenum

$$\text{Mo},\ Z = 42,\ M = 95.9,\ \text{Ratio}\ \frac{\text{Mo}}{\text{Cu}} = 1.510$$

Mo I Normal state of valence electrons $4d^5 5s\ {}^7S_3 = 0$. I.P. = 57260 cm^{-1}.
Mo II Normal state of valence electrons $4d^5\ {}^6S_{2\,1/2} = 0$. I.P. = 130300 cm^{-1}.

References

Wavelengths:
G. R. Harrison, Massachusetts Institute of Technology Wavelength Tables (John Wiley & Sons, New York, 1939).
Supplemented by Kiess, cited below.

Classification:
Mo I, C. C. Kiess, unpublished material (1966).
Mo II, C. C. Kiess, J. Research NBS **60**, 375 (1958). RP 2856.

Strong lines of molybdenum

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
40000	2020.30	II	0 – 49481	2500	5570.45	I	10768 – 28715
29000	3798.25	I	0 – 26321	2400	2089.52	II	15199 – 63041
29000	3864.11	I	0 – 25872	2300	4069.88	I	16784 – 41348
21000	2038.44	II	0 – 49041	2200	2092.50	II	15331 – 63105
19000	2015.11	II	0 – 49609	1900	3384.62	I	11859 – 41396
19000	3902.96	I	0 – 25614	1900	4381.64	I	16784 – 39600
17000	2045.98	II	0 – 48861	1700	2775.40	II	13461 – 49481
14000	3132.59	I	0 – 31913	1700	2816.15	II	13461 – 48960
8700	3170.35	I	0 – 31533	1700	2848.23	II	12900 – 47999
7800	5506.49	I	10768 – 28924	1700	2871.51	II	12417 – 47232
7600	3193.97	I	0 – 31300	1700	3833.75	I	12346 – 38423
6000	3158.16	I	0 – 31655	1600	3358.12	I	11454 – 41224
5200	5533.05	I	10768 – 28837	1500	2104.29	II	15447 – 62954
4800	2081.68	II	0 – 48022	1500	4232.59	I	16748 – 40367
4000	2093.11	II	15447 – 63207	1400	2108.02	II	23248 – 70670
3200	3447.12	I	12346 – 41348	1400	3112.12	I	0 – 32123
3000	3208.83	I	0 – 31155	1400	3581.89	I	16785 – 44695
2900	4143.55	I		1400	3624.46	I	16748 – 44330
2700	2100.84	II	15428 – 63012	1400	3694.94	I	16641 – 43698
2500	4188.32	I		1400	4062.08	I	16785 – 41396
2500	4411.57	I	16784 – 39445	1400	4288.64	I	11859 – 35169
	4411.70	I	16785 – 39445				

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
19000		2015.11	II	0 – 49609
40000		2020.30	II	0 – 49481
21000		2038.44	II	0 – 49041
17000		2045.98	II	0 – 48861
4800		2081.68	II	0 – 48022
2400		2089.52	II	15199 – 63041
2200		2092.50	II	15331 – 63105
4000		2093.11	II	15447 – 63207
2700		2100.84	II	15428 – 63012
1500		2104.29	II	15447 – 62954
1400		2108.02	II	23248 – 70670
400		2269.69	II	15447 – 59492
160		2304.25	II	27627 – 71011
160		2306.97	II	15427 – 58761
130		2325.94	I	12346 – 55328
240		2330.46	I	
110		2332.12	II	15330 – 58197
190		2340.47	I	
190		2341.59	II	15199 – 57892
80		2352.61	I	12346 – 54839
80		2355.22	I	11143 – 53589
80		2355.42	II	15699 – 58141
70		2364.37	I	11454 – 53736
50		2366.09	II	15890 – 58141
140		2372.27	I	11454 – 53595
100		2380.41	I	11859 – 53855
150		2383.52	I	11859 – 53800
110		2389.20	II	23853 – 65695
140		2403.61	II	23833 – 65425
80		2404.66	II	24509 – 66082
140		2405.86	I	
40		2408.39	I	12346 – 53855
40		2412.84	II	22444 – 63877
120		2413.01	II	15890 – 57320
70		2415.33	I	12346 – 53736
80		2417.96	II	16796 – 58141
65		2419.01	II	23934 – 65261
80		2420.18	II	24138 – 65444
70		2424.00	II	23833 – 65075
65		2430.43	I	12346 – 53479
65		2435.96	II	22864 – 63904
65		2440.28	II	17174 – 58141
40		2461.81	II	24836 – 65444
50		2466.68	II	22864 – 63392
50		2466.97	II	16796 – 57320
50		2468.78	II	23833 – 64326
30		2470.04	II	23853 – 64326
150	h	2471.97	I	10768 – 51210
70		2477.57	II	26041 – 66391
70	h	2481.81	I	10768 – 51049
65		2482.57	II	23934 – 64203
40		2484.75	II	23934 – 64168
40	h	2485.31	I	
24		2496.24	II	22444 – 62492
85		2498.28	II	15691 – 55706
40		2500.44	II	22444 – 62425
65		2502.84	II	12900 – 52843
50	h	2508.67	I	
50		2509.56	I	12346 – 52182
50		2511.80	II	12417 – 52217
30		2513.33	I	
65		2515.08	II	22980 – 62728
24		2515.66	I	12346 – 52085
50	h	2517.46	I	11454 – 51165
24		2517.83	I	
95	h	2524.81	I	11454 – 51049
70		2527.14	II	24836 – 64395
50		2530.34	II	24659 – 64168
70		2532.31	II	22864 – 62342
70		2536.85	I	12346 – 51753
440		2538.46	II	13461 – 52843
50		2539.44	II	24509 – 63877
110	h	2540.45	I	11859 – 51210
330		2542.67	II	12900 – 52217
65		2543.35	I	11859 – 51165
40		2543.61	II	22444 – 61746
330		2548.22	I	10768 – 49999
110	h	2550.85	I	11859 – 51049
65		2555.42	II	23833 – 62954
40		2556.75	II	23853 – 62954
80		2558.88	II	24836 – 63904
		2558.94	I	11858 – 50926
65		2562.08	II	27725 – 66744
85		2564.34	II	25342 – 64326
40		2566.26	II	12417 – 51373
250		2567.05	I	10768 – 49712
20		2571.45	II	26406 – 65282
320		2572.34	I	12346 – 51210
50		2574.42	II	12900 – 51732
40		2575.77	I	11858 – 50670
40		2576.56	II	24138 – 62937
40		2578.36	II	26488 – 65261
95		2578.77	I	11858 – 50625
250		2582.16	I	10768 – 49484
30		2585.95	II	23833 – 62492
65		2588.78	II	23934 – 62551
40		2591.77	II	23853 – 62425
70		2591.98	I	11143 – 49712
250		2593.70	II	12034 – 50577
100		2595.40	I	10966 – 49484
40		2596.77	I	21343 – 59841
30		2597.22	I	10768 – 49259
40		2597.38	II	23853 – 62342
50		2599.64	I	12346 – 50802
80		2601.69	I	
250		2602.80	II	11783 – 50192
28		2603.32	I	10768 – 49169
40		2605.08	II	26739 – 65115
40		2605.93	II	17344 – 55706
250		2607.37	I	11143 – 49484
30		2608.86	I	20930 – 59250
190		2611.20	I	20951 – 59236
290		2613.08	I	11454 – 49712
130		2615.39	I	10966 – 49190
400		2616.78	I	11143 – 49346
70		2619.34	II	11783 – 49949
140		2621.07	I	11859 – 49999
320		2627.55	I	11143 – 49190
160		2628.74	I	11454 – 49484
80		2628.97	I	11143 – 49169
440		2629.85	I	11454 – 49468
65		2631.50	I	10966 – 48956
70		2635.57	I	11859 – 49790
330		2636.67	II	12034 – 49949
250		2638.30	I	11454 – 49346
720		2638.76	II	12417 – 50302
30		2639.49	I	
30		2639.68	I	
80		2640.28	I	
410		2640.99	I	11859 – 49712

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
40	2643.81	I	11143 – 48956
600	2644.35	II	12900 – 50706
30	2645.79	I	
370	2646.49	II	12417 – 50192
30	2647.25	I	10768 – 48532
30	2649.25	I	11454 – 49190
640	2649.46	I	11859 – 49591
40	2650.68	I	11454 – 49169
480	2653.35	II	12900 – 50577
560 h	2655.03	I	12346 – 49999
40	2655.93	I	10768 – 48409
40	2656.49	I	11143 – 48775
290	2658.11	I	11859 – 49468
640	2660.58	II	12034 – 49609
110	2665.10	I	11859 – 49370
50	2666.75	I	11859 – 49346
65	2670.32	I	10768 – 48206
55	2671.83	II	15427 – 52843
720	2672.84	II	12900 – 50302
250	2673.27	II	15447 – 52843
20	2673.84	I	
30	2678.67	I	11454 – 48775
1000	2679.85	I	12346 – 49651
95	2681.36	II	23833 – 61116
30	2682.62	I	11143 – 48409
640	2683.23	II	11783 – 49041
880	2684.14	II	13461 – 50706
560	2687.99	II	12417 – 49609
50	2688.64	I	21343 – 58526
30	2692.61	II	27725 – 64852
28	2693.04	I	12346 – 49468
20	2693.53	I	
55	2695.22	II	23833 – 60925
65	2696.07	I	10768 – 47848
30	2696.83	II	33601 – 70671
85	2697.81	I	10966 – 48022
55	2699.41	II	22444 – 59478
65	2700.21	I	12346 – 49370
140	2701.03	I	11858 – 48870
480	2701.42	II	12034 – 49041
30	2701.87	II	26041 – 63041
30	2704.93	II	33045 – 70004
50	2705.24	I	11454 – 48409
95	2706.12	I	11143 – 48085
50	2709.25	I	
40	2710.19	II	15330 – 52217
65	2710.74	I	11143 – 48022
30	2711.49	II	23833 – 60702
50	2712.35	II	33146 – 70004
190	2713.51	II	13461 – 50302
50	2715.17	I	10768 – 47588
80	2717.16	I	
290	2717.35	II	15428 – 52217
80	2720.17	I	11454 – 48206
110	2724.41	I	16784 – 53479
180	2725.15	I	11143 – 47827
50	2725.95	I	11859 – 48532
28	2726.65	I	21154 – 57818
85	2726.97	II	26069 – 62728
16	2728.34	I	
85	2728.70	I	11143 – 47779
55	2729.13	I	11454 – 48085
140	2729.68	II	12417 – 49041
80	2730.20	II	26488 – 63105
330	2732.88	II	12900 – 49481
250	2733.39	I	11454 – 48028
28	2735.65	I	16784 – 53327
24	2735.88	I	11858 – 48399
28	2736.42	I	18356 – 54889
160	2736.96	II	15691 – 52217
80 h	2737.88	II	35406 – 71920
50	2738.60	II	27627 – 64130
40	2741.32	II	26739 – 63207
55	2741.62	II	24509 – 60973
240	2743.07	I	11143 – 47588
95	2743.71	I	10966 – 47402
80	2745.09	I	10768 – 47186
40	2745.38	I	16784 – 53198
290	2746.30	II	15330 – 51732
55	2748.49	I	11454 – 47827
320	2751.47	I	11859 – 48192
30	2754.29	I	10768 – 47064
30	2755.37	I	10966 – 47248
110	2756.07	II	
65 d	2758.63	II	11783 – 48022
28	2759.58	I	11859 – 48085
20	2760.53	II	26739 – 62954
190	2761.53	I	12346 – 48547
65	2762.70	I	12346 – 48532
65	2763.03	I	11143 – 47324
220	2763.62	II	15199 – 51373
40	2763.93	I	11859 – 48028
110	2766.26	I	11143 – 47282
40	2766.72	I	11454 – 47588
30	2767.22	I	10768 – 46895
40	2768.09	I	
240	2769.76	II	27114 – 63207
28	2771.36	I	10966 – 47039
160	2773.78	II	15691 – 51732
190	2774.39	II	15699 – 51732
1700	2775.40	II	13461 – 49481
130	2777.74	I	11858 – 47848
65	2777.86	II	12034 – 48022
70	2779.48	I	11143 – 47110
880	2780.04	II	12900 – 48861
400	2784.99	II	16947 – 52843
30	2786.11	I	
180	2787.83	I	12346 – 48206
70	2788.94	I	12346 – 48192
24	2790.01	I	16748 – 52579
95	2790.31	I	11454 – 47282
	2790.41	II	23853 – 59680
40	2791.54	II	30019 – 65831
80	2792.96	I	11454 – 47248
30	2796.78	I	24096 – 59841
240 d	2797.93	I	11454 – 47184
	2798.01	I	11859 – 47588
220	2801.47	I	10768 – 46453
	2801.55	I	
30	2807.36	I	11454 – 47064
400	2807.76	II	12417 – 48022
70	2808.37	I	11454 – 47052
30	2809.96	I	11143 – 46720
24	2810.43	I	18229 – 53800
30	2811.50	I	
28	2812.58	II	23934 – 59478
24	2814.67	II	28877 – 64395
30	2815.54	I	18229 – 53736
70	2815.91	I	11454 – 46956
1700	2816.15	II	13461 – 48960

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
220		2817.44	II	15890 – 51373
		2817.50	I	23516 – 58999
40		2818.30	I	11454 – 46926
50		2822.03	II	11783 – 47208
30		2822.43	I	11454 – 46874
24		2822.86	I	18229 – 53644
50		2825.67	I	18356 – 53736
240		2826.54	I	24823 – 60191
50		2826.75	I	18229 – 53595
80		2827.74	II	27627 – 62980
40		2828.79	I	24096 – 59437
40		2829.79	I	11858 – 47186
70		2829.94	I	11858 – 47184
40		2831.44	II	33601 – 68909
30		2832.07	II	24836 – 60135
80		2834.39	II	16947 – 52217
80		2835.33	II	15447 – 50706
20		2835.91	I	11858 – 47110
10		2836.03	I	16641 – 51891
40	h	2837.32	I	
50		2837.90	I	21154 – 56381
55		2839.58	I	11858 – 47064
160		2842.15	II	12034 – 47208
65		2842.37	I	
24		2843.73	II	33895 – 69050
220		2844.39	I	24466 – 59612
1700		2848.23	II	12900 – 47999
160		2849.38	I	
65	d	2850.79	I	11859 – 46926
		2850.90	I	10768 – 45835
30		2851.18	I	12346 – 47409
370		2853.23	II	27114 – 62152
40		2853.58	I	16641 – 51675
40	d	2854.87	I	24823 – 59841
50		2856.00	II	27724 – 62728
50		2859.57	I	20948 – 55908
30		2862.84	I	
24		2863.20	II	24138 – 59053
370		2863.81	II	26739 – 61648
160		2864.31	I	24096 – 58998
140		2864.66	I	11859 – 46756
40		2865.62	II	15691 – 50577
220		2866.69	II	17344 – 52217
40		2868.11	II	26069 – 60924
40		2868.32	II	26604 – 61457
70		2869.56	I	12346 – 47184
28		2870.18	I	12346 – 47177
28		2870.90	I	21154 – 55976
1700		2871.51	II	12417 – 47232
28		2871.89	I	
85		2872.88	II	27628 – 62425
40		2873.64	I	24823 – 59612
50		2876.54	I	21154 – 55908
40		2878.38	I	11858 – 46590
220		2879.05	II	30391 – 65115
40		2882.54	I	20158 – 54839
65		2885.74	I	25549 – 60192
85		2886.61	I	21343 – 55976
28		2887.62	I	10768 – 45389
65		2888.15	II	33146 – 67760
40		2889.84	I	11858 – 46453
1300		2890.99	II	12034 – 46614
95		2891.28	II	16796 – 51373
190		2892.81	II	17174 – 51732
65		2893.23	I	25639 – 60192
950		2894.45	II	13461 – 47999
28		2896.44	I	12346 – 46861
28		2896.97	I	
140		2897.63	II	15691 – 50192
80		2898.65	I	20350 – 54839
70		2900.80	II	29034 – 63498
290		2903.07	II	26488 – 60924
160		2905.27	I	12346 – 46756
65		2906.06	I	20130 – 54531
80		2907.12	II	17344 – 51732
28		2907.78	I	11454 – 45835
24		2908.16	I	21154 – 55530
600		2909.12	II	11783 – 46148
1100		2911.92	II	12900 – 47232
70		2913.52	I	10768 – 45081
55		2913.81	II	28989 – 63298
50		2915.26	I	25549 – 59841
55		2915.38	I	20281 – 54572
50		2916.10	I	11143 – 45425
120		2918.83	II	15699 – 49949
24		2919.20	I	11143 – 45389
55		2919.38	I	12346 – 46590
1300		2923.39	II	12417 – 46614
140		2924.32	II	26041 – 60227
65		2927.54	II	30019 – 64168
50		2930.06	II	28883 – 63002
1100		2930.50	II	12034 – 46148
55		2930.77	II	30019 – 64130
50		2931.08	I	12346 – 46453
800		2934.30	II	11783 – 45853
65		2934.84	I	25549 – 59612
65		2935.20	II	15890 – 49949
80		2936.50	I	21343 – 55387
120		2937.66	I	
40		2938.30	II	28989 – 63012
95		2940.10	II	27114 – 61116
50		2940.98	I	20350 – 54343
110		2941.22	II	30213 – 64203
55		2942.85	I	11454 – 45425
140		2944.21	I	0 – 33955
150		2944.82	II	35099 – 69047
80		2945.43	I	20948 – 54889
140		2945.66	I	11143 – 45080
		2945.95	II	30391 – 64326
190		2946.01	I	11454 – 45389
140		2946.42	I	
140		2946.69	II	30213 – 64140
95		2947.28	II	29034 – 62954
50		2953.56	I	16784 – 50631
95		2955.84	II	26406 – 60227
240		2956.06	II	12034 – 45853
70		2956.90	II	35099 – 68909
85	h	2957.75	I	
80		2959.48	I	20158 – 53938
80		2959.80	I	11859 – 45635
95		2960.24	II	13461 – 47232
140		2962.89	I	
250		2963.79	II	12417 – 46148
50		2964.96	II	28877 – 62595
210		2965.27	II	12900 – 46614
70		2971.91	II	26041 – 59680
250		2972.61	II	16947 – 50577
80		2972.96	I	11454 – 45081
80		2975.40	II	29699 – 63298
50		2977.27	I	20158 – 53736

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
180		2978.28	I	11859 – 45425
120		2981.52	I	11858 – 45389
50		2983.04	I	19970 – 53483
65		2983.81	I	20350 – 53855
50		2985.16	I	12346 – 45836
50		2985.84	I	25517 – 58999
110		2987.92	I	20130 – 53588
80		2988.23	I	20281 – 53736
160		2988.68	I	20350 – 53800
190		2989.80	I	20158 – 53595
95		2992.84	II	17174 – 50577
50		2993.52	II	16796 – 50192
50		3000.23	I	20158 – 53479
190		3002.21	I	0 – 33299
40		3004.46	II	26406 – 59680
50		3010.26	I	12346 – 45556
130		3013.39	I	18229 – 51405
140	h	3013.76	I	
80		3016.78	I	21154 – 54292
250		3025.00	I	18356 – 51405
95		3027.77	II	17174 – 50192
50		3035.33	I	18229 – 51165
100		3036.31	I	18480 – 51405
50		3039.82	I	25639 – 58526
300		3041.70	I	16784 – 49650
150		3046.80	I	16784 – 49596
210		3047.31	I	16785 – 49591
210		3055.32	I	16748 – 49468
100		3060.78	II	16947 – 49609
160		3061.59	I	16693 – 49346
800		3064.28	I	16784 – 49408
250		3065.04	II	38054 – 70670
100		3068.00	I	16785 – 49370
250		3070.90	I	16748 – 49302
85		3071.44	I	16641 – 49190
800		3074.37	I	16784 – 49302
85		3077.66	II	35406 – 67889
150		3079.88	I	23515 – 55975
210		3080.41	I	16693 – 49147
40		3081.16	I	18480 – 50926
800		3085.62	I	16748 – 49147
270		3087.62	II	27114 – 59492
100		3089.12	I	16784 – 49147
100		3089.71	I	16641 – 48997
190		3092.07	II	15691 – 48022
560		3094.66	I	16693 – 48997
110		3099.93	I	16748 – 48999
110		3100.88	I	23668 – 55908
560		3101.34	I	16641 – 48876
55		3106.34	I	16693 – 48876
1400		3112.12	I	0 – 32123
55		3117.54	I	24823 – 56891
290		3122.00	II	26740 – 58761
14000		3132.59	I	0 – 31913
40		3135.60	I	
55		3135.89	I	24096 – 55976
95		3136.46	I	16748 – 48622
50		3136.75	I	23516 – 55387
110		3138.72	II	26041 – 57892
55		3144.34	I	
220		3147.35	I	16784 – 48547
220		3152.82	II	26488 – 58197
55		3155.64	II	29022 – 60702
55		3156.51	I	11858 – 43530
6000		3158.16	I	0 – 31655
95		3163.90	I	16641 – 48238
120		3164.53	I	11454 – 43046
8700		3170.35	I	0 – 31533
55		3171.38	I	
95		3172.03	II	17344 – 48860
40		3172.37	I	16693 – 48206
160		3172.74	II	15699 – 47208
95		3177.90	I	16748 – 48206
95		3179.77	I	
370		3183.03	I	16785 – 48192
120		3184.57	I	16693 – 48085
370		3185.10	I	11858 – 43246
180		3185.71	I	16641 – 48022
120	d	3187.59	II	23853 – 55216
		3187.68	I	18229 – 49591
65		3188.09	I	23668 – 55026
65		3188.40	I	23534 – 54889
95		3191.52	I	21343 – 52667
95		3192.80	I	21154 – 52465
7600		3193.97	I	0 – 31300
65		3194.87	I	24096 – 55387
290		3195.96	I	16748 – 48028
120		3198.85	I	12346 – 43598
65		3200.21	I	18229 – 49468
65		3200.89	I	18480 – 49712
40		3201.50	II	16796 – 48022
330		3205.22	I	10966 – 42156
120		3205.54	I	11858 – 43046
880		3205.88	I	12346 – 43530
3000		3208.83	I	0 – 31155
240		3210.97	I	16693 – 47827
120		3212.59	I	
65		3213.32	I	11858 – 42970
120		3214.44	I	16748 – 47848
560		3215.07	I	11143 – 42237
65		3220.86	I	10768 – 41807
350		3221.74	I	18229 – 49259
65		3223.49	I	11143 – 42156
880		3228.22	I	11454 – 42422
600		3229.79	I	12346 – 43299
1100		3233.14	I	16784 – 47705
190		3235.38	I	12346 – 43246
950		3237.08	I	20281 – 51165
110		3237.98	I	16784 – 47659
190		3240.49	I	12346 – 43197
65		3240.71	II	17174 – 48022
50		3244.47	I	18356 – 49169
65		3245.92	I	27727 – 58526
65		3249.92	I	16641 – 47402
950		3256.21	I	11454 – 42156
110		3259.16	I	24466 – 55140
65		3260.48	I	16748 – 47409
300		3262.63	I	16641 – 47282
110		3263.83	I	10768 – 41398
480		3264.40	I	16785 – 47409
130		3265.14	I	
800		3270.90	I	11859 – 42422
65		3279.44	I	16692 – 47177
240		3285.02	I	10966 – 41398
320		3285.36	I	16748 – 47177
65		3287.38	I	16641 – 47052
1100		3289.02	I	11454 – 41850
190		3289.84	I	16784 – 47172
950		3290.82	I	11858 – 42237
190		3292.31	II	25342 – 55706

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
130	3294.85	I	11143 – 41484
100	3296.40	I	11858 – 42186
100	3303.34	I	16693 – 46956
180	3304.22	I	11143 – 41398
320	3305.56	I	10768 – 41012
130	3305.90	I	21619 – 51859
320	3307.12	I	11859 – 42088
160	3310.77	I	10768 – 40964
95	3312.33	I	16693 – 46874
100	3313.62	II	28884 – 59053
130	3319.59	I	16693 – 46808
130	3319.79	I	16641 – 46755
190	3320.90	II	25112 – 55216
640	3323.95	I	12346 – 42422
360	3325.67	I	10768 – 40829
360	3327.30	I	10966 – 41012
65	3329.04	I	11454 – 41485
65	3331.40	I	16748 – 46756
130	3336.51	I	18229 – 48192
240	3340.17	I	10768 – 40698
95	3343.72	I	
1300	3344.75	I	11143 – 41032
95	3346.40	II	25342 – 55216
320	3347.02	I	11143 – 41012
65	3349.19	I	18356 – 48206
130	3350.30	I	12346 – 42186
130	3354.99	I	10768 – 40566
1600	3358.12	I	11454 – 41224
250	3361.37	I	12346 – 42088
130	3362.37	I	10966 – 40698
950	3363.78	I	10768 – 40488
65	3369.25	I	18356 – 48028
65	3375.22	I	18229 – 47848
65	3375.65	I	21619 – 51234
130	3378.20	I	11143 – 40736
130	3378.46	I	25549 – 55140
950	3379.97	I	11454 – 41032
65	3382.29	I	11454 – 41012
320	3382.48	I	11143 – 40699
1900	3384.62	I	11859 – 41396
65	3385.88	I	26636 – 56162
95	3387.75	I	11454 – 40964
160	3389.80	I	18356 – 47848
95	3392.17	I	21154 – 50625
160	3393.65	I	21343 – 50802
130	3395.36	II	36289 – 65732
160	3397.69	I	11143 – 40566
130	3402.81	I	27766 – 57144
65	3403.35	I	11454 – 40829
640	3404.34	I	11859 – 41224
65	3405.20	I	18229 – 47588
1300	3405.94	I	
240	3418.52	I	11454 – 40698
50	3418.96	I	20350 – 49591
250	3420.04	I	18356 – 47588
190	3421.25	I	10768 – 39989
250	3422.31	I	20158 – 49370
190	3424.60	I	10768 – 39960
95	3424.76	I	16748 – 45939
95	3425.19	I	20281 – 49468
130	3425.48	I	16784 – 45969
130	3426.00	I	18229 – 47409
160	3426.79	I	11859 – 41032
80	3427.90	I	27727 – 56891
95	3432.87	I	16748 – 45870
95	3434.04	I	11454 – 40566
380	3434.79	I	11859 – 40964
320	3435.45	I	25639 – 54739
640	3437.22	I	16785 – 45870
250	3438.87	I	10966 – 40037
250	3441.44	I	12346 – 41396
65	3442.66	I	20130 – 49169
250	3443.26	I	11454 – 40488
95	3445.04	I	20350 – 49370
190	3445.26	I	16693 – 45710
130	3446.08	II	23833 – 52843
3200	3447.12	I	12346 – 41348
640	3449.07	I	11859 – 40844
95	3449.85	I	20281 – 49259
300	3451.75	I	
250	3452.60	I	18229 – 47184
100	3454.22	I	16693 – 45635
190	3456.15	I	18356 – 47282
950	3456.39	I	0 – 28924
65	3458.15	I	20281 – 49190
160	3459.92	I	11143 – 40037
130	3460.23	I	18356 – 47248
640	3460.78	I	16748 – 45635
320	3466.83	I	0 – 28836
65	3466.97	I	18229 – 47064
250	3467.85	I	18356 – 47184
320	3469.22	I	16641 – 45458
65	3469.63	I	24823 – 53637
190	3470.92	I	18480 – 47282
65	3473.22	I	16641 – 45425
190	3475.03	I	18480 – 47248
180	3479.43	I	16693 – 45425
100	3480.09	I	18229 – 46956
100	3481.79	I	20158 – 48870
190	3482.40	I	11859 – 40566
95	3483.67	I	18229 – 46926
190	3483.84	I	18356 – 47052
240	3485.93	I	11143 – 39821
130 d	3491.77	I	18480 – 47110
	3491.87	I	11858 – 40488
130	3493.34	I	12346 – 40964
800	3504.41	I	18229 – 46756
240	3505.32	I	20350 – 48870
560	3508.12	I	12346 – 40844
100	3510.78	I	28241 – 56717
100	3513.70	I	18356 – 46808
130	3517.56	I	25517 – 53938
130	3518.22	I	18480 – 46895
480	3521.41	I	20158 – 48547
65	3522.37	I	11859 – 40241
100	3524.23	I	11454 – 39821
190	3524.65	I	25821 – 54184
240	3524.98	I	18229 – 46590
640	3537.28	I	21619 – 49880
320	3542.17	I	18229 – 46452
95	3554.20	I	20281 – 48409
65	3555.43	I	20281 – 48399
520	3558.10	I	18356 – 46453
400	3563.14	I	11859 – 39916
65	3563.76	I	19970 – 48022
300	3566.05	I	20158 – 48192
240	3570.65	I	25639 – 53637
320	3573.88	I	18480 – 46452
110	3580.54	I	28241 – 56162
1400	3581.89	I	16785 – 44695

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
65		3586.86	I	25456 – 53327
100		3588.95	I	20350 – 48206
200		3590.74	I	20350 – 48192
65		3592.02	I	16693 – 44525
100		3595.55	I	20281 – 48085
65		3595.71	I	20608 – 48411
210		3598.88	I	25549 – 53327
95		3600.28	I	16693 – 44461
270		3602.94	I	20281 – 48028
65		3604.07	I	25997 – 53736
210		3608.37	I	11454 – 39160
140		3612.00	I	20350 – 48028
100		3612.45	I	20948 – 48622
140		3613.37	I	11454 – 39122
100		3613.64	I	21154 – 48819
65		3615.15	I	26639 – 54292
65		3615.74	I	20130 – 47779
70		3616.84	I	18229 – 45870
200		3623.23	I	
1400		3624.46	I	16748 – 44330
330		3626.18	I	12346 – 39916
65		3628.35	I	20158 – 47711
100		3628.66	I	16641 – 44192
24		3629.31	I	25639 – 53184
28		3635.14	II	25342 – 52843
1000		3635.43	I	16693 – 44192
65		3637.52	I	11143 – 38626
160		3638.20	I	18356 – 45835
140		3640.62	I	20951 – 48411
95		3640.99	I	20130 – 47588
70		3642.20	I	20951 – 48399
70		3648.61	I	16641 – 44041
140		3651.35	I	11143 – 38522
400		3657.35	I	16641 – 43975
70		3660.92	I	26336 – 53644
180		3661.78	I	11858 – 39160
140		3662.99	I	25906 – 53198
140		3663.30	I	20948 – 48238
80		3664.30	I	16693 – 43975
540		3664.81	I	18356 – 45635
290		3666.72	I	16748 – 44012
110		3666.94	I	11858 – 39122
65		3668.00	I	20951 – 48206
70		3668.49	I	20158 – 47409
220		3669.34	I	21154 – 48399
35		3670.42	I	20350 – 47588
590		3672.82	I	26636 – 53855
90		3675.36	I	25997 – 53198
23		3675.98	I	18229 – 45425
90		3676.24	I	20130 – 47324
90		3677.70	I	
1300		3680.60	I	16784 – 43946
		3680.68	I	16785 – 43946
90	d	3681.55	I	20930 – 48085
		3681.72	I	20158 – 47311
45		3684.22	II	36741 – 63877
		3684.33	I	20951 – 48085
35		3686.11	I	20281 – 47402
65		3688.31	II	25112 – 52217
70		3688.97	I	25906 – 53006
240		3690.59	I	20951 – 48039
23		3692.08	I	18480 – 45556
180		3692.64	II	24659 – 51732
160		3693.38	I	11454 – 38522
1400		3694.94	I	16641 – 43698
90		3696.04	I	29982 – 57030
55		3698.53	I	20281 – 47311
70		3700.01	I	20158 – 47177
220		3702.03	I	16693 – 43698
180		3702.55	I	20281 – 47282
55		3705.41	I	20130 – 47110
80		3707.17	I	20281 – 47248
80		3708.56	I	23668 – 50625
55		3710.14	I	18480 – 45425
27		3711.51	I	10966 – 37902
80		3712.95	I	19970 – 46895
80		3713.47	I	20130 – 47052
70		3714.55	I	21619 – 48532
220		3715.65	I	16693 – 43598
140		3716.07	I	
80		3716.87	I	20281 – 47177
55		3718.48	I	26759 – 53644
120		3719.55	I	
		3719.74	I	20951 – 47827
70		3720.25	I	25707 – 52579
70		3723.51	I	20930 – 47779
35		3723.81	I	21343 – 48189
180		3725.56	I	20350 – 47184
140		3726.22	I	20281 – 47110
		3726.32	I	20951 – 47779
500		3727.69	I	
160		3728.30	I	23668 – 50482
150		3728.50	I	
27		3730.56	I	20158 – 46956
330	d	3732.71	I	
		3732.80	I	16748 – 43530
120		3733.03	I	21619 – 48399
80		3733.40	I	21343 – 48121
80		3734.37	I	20281 – 47052
80		3735.62	I	25906 – 52667
90		3735.91	I	20350 – 47110
27		3736.17	I	20281 – 47039
180		3737.91	I	16784 – 43530
27		3740.76	I	18356 – 45081
240		3742.28	I	20350 – 47064
55		3743.81	I	20158 – 46861
27		3744.10	I	20350 – 47052
80		3744.37	II	
27		3744.94	I	
90		3745.48	I	18229 – 44921
110		3747.19	I	
150		3748.49	I	26636 – 53306
130		3751.20	I	20158 – 46808
140		3755.10	I	25821 – 52444
30		3755.54	I	21619 – 48238
30		3755.84	I	23516 – 50134
180		3758.52	I	20158 – 46756
30		3759.60	I	26636 – 53227
90		3760.88	I	25997 – 52579
90		3761.76	I	20350 – 46926
55		3762.09	I	21619 – 48192
150		3763.35	I	11859 – 38423
55		3764.44	I	21154 – 47711
90		3765.22	I	16748 – 43299
55		3765.74	I	
30		3767.73	I	21343 – 47877
65		3768.62	I	20281 – 46808
65		3768.74	I	27766 – 54292
65		3770.00	I	27774 – 54292
360		3770.45	I	16784 – 43299
		3770.52	I	11454 – 37968

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
180	3771.95	I	16693 – 43197
150	3772.82	I	16748 – 43246
30	3775.65	I	19970 – 46448
30	3776.10	I	25707 – 52182
30	3776.55	I	20930 – 47402
65	3777.72	I	28241 – 54704
55	3777.96	I	20948 – 47409
220	3779.77	I	16748 – 43197
360	3781.59	I	11143 – 37579
65	3782.19	I	20158 – 46590
55	3783.53	I	
90	3785.03	I	16785 – 43197
55	3785.51	I	26336 – 52747
90	3788.26	I	26189 – 52579
110	3793.62	I	16693 – 43046
90	3794.43	I	23516 – 49864
55	3796.04	I	24466 – 50802
250	3797.30	I	10966 – 37293
29000	3798.25	I	0 – 26321
290	3801.84	I	20158 – 46453
110	3804.52	I	16693 – 42970
110	3805.93	I	25821 – 52088
	3805.99	I	23534 – 49801
65	3807.65	I	21154 – 47409
110	3811.39	I	21619 – 47848
110	3812.47	I	16748 – 42970
75	3818.66	I	20930 – 47110
140	3819.87	I	20281 – 46452
190	3822.98	I	11143 – 37293
75	3825.32	I	23516 – 49651
520	3826.70	I	11454 – 37579
95	3827.16	I	23668 – 49790
940	3828.87	I	11859 – 37968
75	3830.82	I	25795 – 51891
35	3831.07	I	27384 – 53479
35	3831.76	I	16693 – 42783
150	3832.11	I	25997 – 52085
1700	3833.75	I	12346 – 38423
40	3834.97	I	25517 – 51585
75	3835.31	I	21343 – 47409
65	3843.90	I	20948 – 46956
120	3845.95	I	16748 – 42742
380	3847.25	I	11143 – 37128
190	3848.30	I	24823 – 50802
75	3851.99	I	25906 – 51859
29000	3864.11	I	0 – 25872
35	3866.69	I	25821 – 51675
580	3869.08	I	11454 – 37293
580	3886.82	I	11859 – 37579
75	3888.18	I	20158 – 45870
75	3888.88	I	21154 – 46861
35	3890.71	I	26189 – 51884
35	3893.32	I	20158 – 45836
35	3896.38	I	20281 – 45938
35	3896.85	I	21154 – 46808
380	3901.77	I	12346 – 37968
19000	3902.96	I	0 – 25614
75	3906.92	I	
	3906.98	I	25997 – 51585
140	3908.25	I	20130 – 45710
75	3909.55	I	
75	3911.09	I	16784 – 42345
35	3911.94	I	26336 – 51891
75	3913.36	I	26636 – 52182
110	3915.44	I	22876 – 48409
75	3916.92	I	22876 – 48399
150	3917.54	I	20350 – 45870
75	3917.78	I	20930 – 46448
75	3922.32	I	19970 – 45458
120	3923.75	I	23668 – 49147
65	3928.79	I	21619 – 47064
30	3931.40	I	20281 – 45710
35	3935.02	I	23516 – 48922
65	3941.48	II	25342 – 50706
230	3943.04	I	20281 – 45635
35	3943.51	I	20951 – 46302
75	3945.25	I	16748 – 42088
35	3947.17	I	20130 – 45458
75	3950.99	I	16784 – 42088
120	3953.93	I	20350 – 45635
65	3955.49	I	30113 – 55387
35	3958.60	I	24096 – 49351
30	3963.53	I	26636 – 51859
30	3963.99	I	26639 – 51859
35	3965.76	I	16641 – 41850
75	3968.75	I	21619 – 46808
150	3973.77	I	29982 – 55140
120	3973.93	I	16693 – 41850
65	3975.96	I	20281 – 45425
65	3977.90	I	
35	3979.22	I	27342 – 52465
75	3980.20	I	26759 – 51876
75	3982.05	I	23516 – 48622
35	3982.60	I	16748 – 41850
140	3986.20	I	25517 – 50596
35	3991.39	I	25549 – 50596
35	3991.85	I	20930 – 45974
35	3993.93	I	23516 – 48547
35	3998.29	I	22244 – 47248
65	4000.39	I	20948 – 45938
120	4000.50	I	26415 – 51405
75	4006.05	I	26321 – 51276
30	4008.05	I	24466 – 49408
120	4009.37	I	24466 – 49400
65	4011.97	I	25872 – 50791
40	4017.38	I	24466 – 49351
130	4021.02	I	29842 – 54704
170	4024.09	I	16641 – 41484
65	4028.65	I	21154 – 45969
40	4032.50	I	16693 – 41484
40	4033.63	I	21154 – 45938
40	4037.30	I	20948 – 45710
85	4037.78	I	20951 – 45710
130	4038.08	I	16641 – 41398
30	4041.12	I	27727 – 52465
130	4042.87	I	25549 – 50277
30	4050.09	I	20951 – 45635
270	4056.01	I	16748 – 41396
75	4056.32	I	26759 – 51405
40	4057.58	I	25639 – 50277
190	4059.61	I	21343 – 45969
1400	4062.08	I	16785 – 41396
85	4066.37	I	24823 – 49408
2300	4069.88	I	16784 – 41348
190	4075.25	I	16693 – 41224
50	4075.54	I	
190	4076.19	I	24096 – 48622
1300	4081.44	I	20930 – 45425
940	4084.38	I	16748 – 41224

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
150		4086.02	I	20948 – 45415
180		4096.81	I	21154 – 45556
50		4098.18	I	20130 – 44525
150		4098.74	I	16641 – 41032
250		4102.15	I	16641 – 41012
150		4105.08	I	24466 – 48819
50		4105.53	I	21619 – 45969
730		4107.47	I	16693 – 41032
85		4114.93	I	
95		4118.96	I	16693 – 40964
630		4120.10	I	
140		4123.65	I	20281 – 44525
140		4124.54	I	24823 – 49062
50		4126.53	I	
150		4128.28	I	16748 – 40964
75		4128.83	I	21343 – 45556
180		4131.92	I	25456 – 49651
75		4132.23	I	18229 – 42422
40		4135.38	I	
2900		4143.55	I	
230		4148.94	I	16748 – 40844
75		4151.88	I	25517 – 49596
250		4155.28	I	16785 – 40844
180		4155.58	I	16641 – 40698
40		4156.79	I	22876 – 46926
200		4157.40	I	25549 – 49596
180		4162.68	I	25549 – 49565
40		4164.08	I	18229 – 42237
40		4166.28	I	24823 – 48819
85		4169.82	I	23516 – 47492
85		4171.07	I	
150		4177.26	I	22876 – 46808
200		4178.27	I	25639 – 49565
85		4181.05	I	20130 – 44041
40		4184.39	I	25517 – 49408
480		4185.82	I	25517 – 49400
50		4186.28	I	18356 – 42237
2500		4188.32	I	
95		4190.00	I	25549 – 49408
250		4194.56	I	25517 – 49351
50		4200.57	I	18356 – 42156
50		4201.32	I	16693 – 40488
95		4205.81	I	25639 – 49408
50		4211.02	I	16748 – 40488
40		4219.40	I	18480 – 42173
35		4222.41	I	18480 – 42156
1500		4232.59	I	16748 – 40367
40		4233.49	I	24096 – 47711
35		4235.03	I	21154 – 44760
85		4237.16	I	20930 – 44525
95	d	4239.07	I	16784 – 40367
		4239.19	I	16785 – 40367
140		4240.08	I	18229 – 41807
140		4240.28	I	24823 – 48400
190		4240.83	I	20951 – 44525
35		4242.80	I	24096 – 47659
190		4246.02	I	25517 – 49062
170		4251.87	I	28241 – 51753
140		4254.96	I	26639 – 50134
95		4260.36	I	26336 – 49801
40		4260.66	I	25906 – 49370
30		4261.44	I	27342 – 50802
95		4266.18	I	20608 – 44041
75		4268.08	I	25639 – 49062
270		4269.28	I	21343 – 44760
30		4272.06	I	26189 – 49591
130		4273.07	I	16641 – 40037
890		4276.91	I	16693 – 40068
1200		4277.24	I	12346 – 35719
40		4281.83	I	16641 – 39989
85	h	4284.60	I	
120		4287.08	I	16641 – 39960
1400		4288.64	I	11859 – 35169
140		4289.42	I	21154 – 44461
40	h	4290.18	I	25517 – 48819
40		4291.20	I	26415 – 49712
680		4292.13	I	11143 – 34435
890		4293.21	I	11454 – 34740
360		4293.88	I	10966 – 34248
40		4296.16	I	25549 – 48819
30		4296.62	I	16693 – 39960
30		4298.90	I	18229 – 41484
30		4301.26	I	
40		4304.92	I	16693 – 39916
85		4310.39	I	24466 – 47659
40		4312.80	I	16641 – 39821
40		4312.97	I	20350 – 43530
170		4317.93	I	
75		4321.97	I	16785 – 39916
840		4326.14	I	16641 – 39750
250		4326.74	I	11143 – 34248
30		4329.63	I	20951 – 44041
40		4332.51	I	27727 – 50802
120		4334.81	I	26284 – 49346
40		4338.71	I	18356 – 41398
40		4339.82	I	27767 – 50802
85		4340.75	I	26759 – 49790
130		4341.42	I	20948 – 43975
30		4344.66	I	26336 – 49346
230		4350.34	I	11454 – 34435
30		4351.55	I	
75		4353.31	I	20281 – 43246
40		4357.34	I	24466 – 47409
30		4359.62	I	26415 – 49346
40		4362.02	I	18480 – 41398
40		4362.71	I	11858 – 34774
85		4364.47	I	26284 – 49190
75		4366.54	I	20350 – 43246
230		4369.04	I	11859 – 34740
35		4373.32	I	24096 – 46956
40		4374.89	I	25549 – 48400
75		4375.01	I	27774 – 50625
150		4380.29	I	12346 – 35169
35		4380.59	I	16641 – 39463
1900		4381.64	I	16784 – 39600
75		4382.41	I	20158 – 42970
26		4385.89	I	11454 – 34248
75		4391.54	I	24096 – 46861
75		4392.12	I	25639 – 48400
50		4394.32	I	27384 – 50134
50		4394.47	I	20948 – 43697
140		4396.66	I	16784 – 39522
150		4397.29	I	18229 – 40964
35		4402.49	I	27774 – 50482
75		4402.90	I	24466 – 47172
30		4404.55	I	16748 – 39445
35		4406.87	I	29982 – 52667
35		4409.44	I	25517 – 48189
75		4409.95	I	24823 – 47493
2500		4411.57	I	16784 – 39445
		4411.70	I	16785 – 39445

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
110	4412.77	I	18356 – 41012
35	4422.06	I	18356 – 40964
210	4423.62	I	18229 – 40829
170	4426.67	I	20158 – 42742
990	4434.95	I	16748 – 39290
110	4436.89	I	18480 – 41012
65	4438.96	I	27342 – 49864
200	4442.20	I	16784 – 39290
110	4443.07	I	11454 – 33955
85	4446.43	I	29982 – 52465
21	4447.23	I	27384 – 49864
340	4449.74	I	16693 – 39160
30	4452.56	I	23516 – 45969
21	4455.30	I	27363 – 49801
480	4457.36	I	16693 – 39122
30	4458.65	I	23516 – 45938
65	4460.62	I	16748 – 39160
65	4464.77	I	20350 – 42742
190	4468.28	I	16748 – 39122
50	4471.66	I	21619 – 43975
50	4472.04	I	28241 – 50596
130	4473.18	I	18480 – 40829
630	4474.56	I	16641 – 38983
	4474.65	I	18356 – 40698
95	4475.62	I	18229 – 40566
150	4484.97	I	16693 – 38983
85	4487.05	I	22244 – 44525
30	4489.00	I	23668 – 45938
65	4490.19	I	20158 – 42422
230	4491.28	I	18229 – 40488
30	4491.66	I	33904 – 56162
50	4499.44	I	18480 – 40698
50	4501.29	I	18356 – 40566
120	4504.90	I	25997 – 48189
50	4506.67	I	26636 – 48819
140	4512.15	I	11143 – 33299
85	4515.18	I	20281 – 42422
230	4517.13	I	18356 – 40488
50	4517.41	I	10768 – 32899
21	4518.44	I	20158 – 42282
50	4522.19	I	20130 – 42237
230	4524.34	I	11859 – 33955
85	4526.37	I	18480 – 40566
30 h	4528.62	I	27093 – 49169
120	4529.40	I	20350 – 42422
40	4535.38	I	20130 – 42173
400	4536.80	I	28241 – 50277
40	4541.56	I	
50	4553.32	I	21343 – 43299
26	4553.80	I	25456 – 47409
110	4558.11	I	10966 – 32899
26	4558.74	I	20158 – 42088
85	4560.13	I	23534 – 45458
85	4567.68	I	20350 – 42237
21	4569.02	I	23668 – 45548
50	4570.13	I	20281 – 42156
40	4574.48	I	25639 – 47493
	4574.61	I	21343 – 43197
210	4576.50	I	11454 – 33299
26	4577.78	I	18229 – 40068
26	4582.35	I	31510 – 53327
26	4582.50	I	21154 – 42970
26	4586.06	I	25906 – 47705
26	4586.57	I	22244 – 44041
21	4586.79	I	
26 h	4590.38	I	
40	4592.21	I	26639 – 48409
170	4595.16	I	11143 – 32899
30	4597.88	I	30113 – 51856
26	4598.25	I	27867 – 49608
50	4599.16	I	20350 – 42088
30	4608.71	I	20158 – 41850
360	4609.88	I	18229 – 39916
50	4611.15	I	18356 – 40037
30	4616.62	I	25517 – 47172
30	4617.95	I	22876 – 44525
100	4621.38	I	18356 – 39989
30	4623.46	I	25549 – 47172
30	4624.24	I	29171 – 50790
460	4626.47	I	12346 – 33955
100	4627.48	I	18356 – 39960
50	4630.02	I	18229 – 39821
45	4633.10	I	28274 – 49852
30	4642.70	I	25639 – 47172
75	4647.81	I	18480 – 39989
30	4649.12	I	25906 – 47409
65	4651.05	I	29781 – 51276
75	4661.93	I	11454 – 32899
220	4662.76	I	11859 – 33299
130	4671.90	I	21343 – 42742
30	4683.83	I	25517 – 46861
30	4685.81	I	27727 – 49062
26	4686.10	I	28274 – 49608
130	4688.22	I	28241 – 49565
40	4690.86	I	25549 – 46861
40	4693.93	I	
30	4696.51	I	20951 – 42237
50	4700.49	I	28837 – 50105
75	4706.06	I	23516 – 44760
640	4707.26	I	20158 – 41396
150	4708.22	I	18229 – 39463
30	4714.51	I	20951 – 42156
220	4717.92	I	20158 – 41348
40	4718.88	I	28667 – 49852
26	4723.06	I	32688 – 53855
20	4725.34	I	27766 – 48922
100	4729.14	I	20948 – 42088
700	4731.44	I	21154 – 42283
100	4750.39	I	20350 – 41396
45	4758.50	I	29781 – 50790
770	4760.19	I	21343 – 42345
75	4764.42	I	18480 – 39463
75	4773.44	I	20281 – 41224
40	4774.22	I	21343 – 42283
65	4775.66	I	21154 – 42088
150	4776.34	I	18229 – 39160
50	4782.94	I	20130 – 41032
		I	20948 – 41850
90	4785.12	I	18229 – 39122
40	4786.46	I	10768 – 31655
20	4788.18	I	18480 – 39358
65	4792.74	I	20948 – 41807
65	4793.41	I	20951 – 41807
20	4793.82	I	27384 – 48238
100	4796.52	I	21343 – 42186
18	4804.91	I	20158 – 40964
30	4805.58	I	18356 – 39160
30	4808.09	I	23668 – 44461
90	4811.06	I	30496 – 51276

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
18	4814.47	I	10768 – 31533
26	4817.70	I	20281 – 41032
410	4819.25	I	21343 – 42088
18	4822.42	I	20281 – 41012
26	4828.47	I	
410	4830.51	I	21154 – 41850
40	4832.92	I	20158 – 40844
26	4833.96	I	20350 – 41032
15	4838.11	I	24096 – 44760
18	4839.59	I	
20	4845.17	I	27766 – 48399
45	4858.22	I	28241 – 48819
26	4860.05	I	
360	4868.00	I	20948 – 41484
50	4869.20	I	10768 – 31300
23	4878.37	I	20350 – 40844
26	4886.47	I	23516 – 43975
20	4889.22	I	20951 – 41398
20	4897.26	I	25456 – 45870
65	4903.81	I	10768 – 31155
26	4907.43	I	31485 – 51856
20	4909.19	I	24096 – 44461
23	4924.78	I	30502 – 50802
40	4926.19	I	24466 – 44760
40	4926.43	I	18229 – 38522
80	4933.10	I	12346 – 32612
80	4941.66	I	25906 – 46136
110	4950.62	I	18229 – 38423
150	4957.54	I	18356 – 38522
26	4964.19	I	25997 – 46136
40	4964.41	I	20350 – 40488
23	4973.36	I	20930 – 41032
210	4979.12	I	10768 – 30847
26	4985.56	I	21343 – 41395
23	4995.32	I	23516 – 43530
110	4999.91	I	24466 – 44461
20	5010.81	I	26639 – 46590
180	5014.60	I	24823 – 44760
26	5016.78	I	27384 – 47311
20	5019.85	I	25795 – 45710
80	5029.00	I	24096 – 43975
65	5030.78	I	25997 – 45870
23	5038.91	I	25795 – 45635
26	5046.52	I	21154 – 40964
100	5047.71	I	20930 – 40736
50	5055.00	I	12346 – 32123
35	5058.07	I	27727 – 47492
200	5059.88	I	20157 – 39916
35	5062.52	I	20951 – 40699
29	5064.64	I	18229 – 37968
35	5079.87	I	26189 – 45870
100	5080.02	I	20281 – 39960
35	5081.26	I	11859 – 31533
40	5090.97	I	25997 – 45635
35	5091.34	I	20930 – 40566
35	5092.16	I	
40	5095.89	I	20948 – 40566
100	5096.65	I	20951 – 40566
130	5097.52	I	18356 – 37968
35	5098.03	I	20350 – 39960
130	5109.71	I	20350 – 39916
80	5114.97	I	18356 – 37902
35	5116.97	I	20951 – 40488
29	5123.83	I	27415 – 46926
150	5145.38	I	20608 – 40037
110	5147.39	I	18480 – 37902
80	5163.19	I	31913 – 51276
100	5167.76	I	21619 – 40964
160 d	5171.08	I	25614 – 44947
	5171.25	I	20130 – 39463
230 h	5172.94	I	25614 – 44941
160 h	5174.18	I	25614 – 44936
40	5191.44	I	31533 – 50790
110	5200.17	I	21619 – 40844
50	5200.74	I	18356 – 37579
26	5210.44	I	12346 – 31533
50	5211.86	I	20281 – 39463
80	5219.40	I	22244 – 41398
65	5231.06	I	27342 – 46453
26	5232.36	I	20930 – 40037
100	5234.26	I	18480 – 37579
460 h	5238.20	I	25872 – 44957
230 h	5240.88	I	25872 – 44947
110 h	5242.81	I	25872 – 44941
100	5245.51	I	20930 – 39989
150	5259.04	I	20951 – 39961
16	5260.17	I	30847 – 49852
65	5261.14	I	20158 – 39160
20	5268.95	I	
35	5271.80	I	20158 – 39122
35	5276.28	I	21619 – 40566
65	5279.65	I	16784 – 35719
210	5280.86	I	22876 – 41807
20	5283.84	I	26636 – 45556
55	5292.08	I	16828 – 35719
35	5293.46	I	18480 – 37366
55	5295.47	I	20281 – 39160
16	5302.35	I	25906 – 44760
20	5306.26	I	20281 – 39122
55	5313.89	I	18480 – 37293
35	5315.04	I	20350 – 39160
20	5319.89	I	31485 – 50277
20	5324.47	I	26639 – 45415
35	5327.06	I	23516 – 42283
16	5334.79	I	23668 – 42408
16	5337.20	I	24466 – 43197
16	5349.79	I	27766 – 46453
20	5352.35	I	27774 – 46453
80	5354.88	I	23516 – 42186
35	5355.51	I	32123 – 50790
65	5356.48	I	32612 – 51276
560 hl	5360.56	I	26321 – 44970
110 hl	5364.28	I	26321 – 44957
35 hl	5367.11	I	26321 – 44947
35	5372.40	I	22876 – 41484
26	5388.69	I	31300 – 49852
65	5394.52	I	20930 – 39463
35	5397.38	I	22876 – 41398
50	5400.47	I	20951 – 39463
35	5405.79	I	27342 – 45836
35	5406.39	I	22244 – 40736
16	5414.67	I	
40	5417.38	I	22244 – 40699
23	5426.89	I	16748 – 35169
11	5427.55	I	23668 – 42088
16	5431.02	I	20951 – 39359
55	5435.68	I	20130 – 38522
65	5437.75	I	16785 – 35169
15	5439.71	I	34912 – 53291
40	5450.51	I	21619 – 39961

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
15		5453.03	I	23516 – 41850
35		5456.46	I	22244 – 40566
26		5460.53	I	31300 – 49608
23		5465.57	I	21154 – 39445
13		5473.37	I	20157 – 38423
35		5475.90	I	
13		5488.67	I	27342 – 45556
35		5490.28	I	20951 – 39160
20		5492.17	I	21619 – 39821
26	h	5493.80	I	31655 – 49852
13	h	5496.94	I	24096 – 42283
26		5498.49	I	23668 – 41850
50		5501.54	I	20350 – 38522
23		5501.87	I	20951 – 39122
26	h	5503.54	I	
7800		5506.49	I	10768 – 28924
11		5511.49	I	23668 – 41807
23		5520.04	I	31485 – 49596
26		5520.64	I	27727 – 45836
13		5521.17	I	25906 – 44012
40		5526.52	I	24096 – 42186
40		5526.97	I	22876 – 40964
5200		5533.05	I	10768 – 28837
40		5539.41	I	16692 – 34740
13		5541.65	I	25906 – 43946
50		5543.12	I	20948 – 38983
40		5544.49	I	27384 – 45415
10		5552.19	I	21154 – 39160
55		5556.28	I	16748 – 34740
26		5556.72	I	24096 – 42088
11		5562.49	I	
20		5564.05	I	21154 – 39121
40		5568.62	I	22876 – 40829
26		5569.48	I	23534 – 41484
2500		5570.45	I	10768 – 28715
35		5575.19	I	19970 – 37902
20		5591.58	I	24466 – 42345
10		5596.32	I	23534 – 41398
8		5598.47	I	34810 – 52667
15		5601.05	I	33904 – 51753
40		5602.76	I	25456 – 43299
23		5608.62	I	26636 – 44461
23		5609.23	I	26189 – 44012
100		5610.93	I	24466 – 42283
23		5613.07	I	20158 – 37968
20		5618.45	I	16641 – 34435
10		5618.77	I	22244 – 40037
23		5619.38	I	27766 – 45556
330		5632.47	I	10966 – 28715
50		5634.86	I	16693 – 34435
230		5650.13	I	11143 – 28837
11		5651.87	I	30160 – 47848
11		5664.34	I	29842 – 47492
		5664.38	I	27766 – 45415
13		5667.30	I	27774 – 45415
10		5672.07	I	35042 – 52667
23		5673.63	I	20281 – 37902
55		5674.47	I	20350 – 37968
40		5677.89	I	16641 – 34248
35		5682.89	I	20930 – 38522
10		5687.64	I	22244 – 39821
460		5689.14	I	11143 – 28715
10		5694.39	I	23668 – 41224
13		5696.03	I	30160 – 47711
11		5698.27	I	29642 – 47186
23		5699.28	I	21619 – 39160
11		5702.11	I	25997 – 43530
80		5705.72	I	24823 – 42345
23		5711.80	I	21619 – 39122
210		5722.74	I	11454 – 28924
11		5723.11	I	29642 – 47110
23		5728.77	I	25795 – 43246
26	d	5729.45	I	20130 – 37579
		5729.59	I	
15		5729.87	I	23516 – 40964
16		5734.06	I	12346 – 29781
11		5739.66	I	27342 – 44760
15		5741.71	I	31510 – 48922
16		5747.67	I	25906 – 43299
620		5751.40	I	11454 – 28837
10		5769.75	I	23517 – 40844
10		5771.05	I	19970 – 37293
23		5774.55	I	11858 – 29171
10		5778.19	I	25997 – 43299
40		5779.36	I	20281 – 37579
10		5780.11	I	23668 – 40964
23	h	5783.33	I	25456 – 42742
10		5785.69	I	
520		5791.85	I	11454 – 28715
23	h	5795.77	I	34740 – 51990
26		5800.46	I	20130 – 37366
35		5802.67	I	20350 – 37579
8		5803.98	I	25821 – 43046
10		5806.19	I	22244 – 39463
16		5806.69	I	26759 – 43975
10		5808.23	I	11454 – 28667
8		5809.03	I	34435 – 51644
10		5813.86	I	39521 – 56717
16		5815.52	I	
10		5815.74	I	29982 – 47172
10		5820.69	I	23668 – 40844
23		5825.20	I	20130 – 37293
23		5835.59	I	11143 – 28274
20		5839.99	I	27342 – 44461
20	h	5848.86	I	28715 – 45806
55	h	5849.73	I	28715 – 45805
50	h	5851.52	I	28715 – 45800
520		5858.27	I	11859 – 28924
20		5861.38	I	26189 – 43246
13		5868.76	I	25707 – 42742
50		5869.33	I	27727 – 44760
26		5876.59	I	20281 – 37293
10		5881.53	I	20130 – 37128
10		5882.72	I	27766 – 44760
820		5888.33	I	11859 – 28837
11	h	5891.56	I	28837 – 45806
23		5892.29	I	25456 – 42422
50	h	5893.38	I	28837 – 45800
20		5898.78	I	
		5898.82	I	27093 – 44041
40		5901.47	I	18229 – 35169
8		5912.12	I	26336 – 43246
10	h	5923.79	I	28924 – 45800
40	h	5926.36	I	28924 – 45793
160	h	5928.88	I	28924 – 45786
16		5937.91	I	25906 – 42742
10		5965.57	I	35719 – 52478
8		5968.48	I	27774 – 44525
15		5974.26	I	27727 – 44461
16		5982.93	I	26336 – 43046

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
40		5988.17	I	27767 – 44461
16		5989.47	I	33904 – 50596
10		5990.01	I	
10		5991.35	I	27774 – 44461
35		6025.49	I	27384 – 43976
16		6027.27	I	22876 – 39463
1300		6030.66	I	12346 – 28924
20		6047.83	I	25707 – 42237
20		6054.81	I	18229 – 34740
20		6079.58	I	23516 – 39960
10		6081.27	I	25906 – 42345
40		6101.87	I	18356 – 34740
10		6130.63	I	
10		6197.66	I	32688 – 48819
20		6217.89	I	18356 – 34435
10		6264.27	I	33904 – 49864
16		6265.88	I	18480 – 34435
15		6290.74	I	18356 – 34248
13		6301.75	I	24096 – 39961
11		6323.54	I	30160 – 45969
40		6357.22	I	18229 – 33955
16		6389.11	I	26636 – 42283
11		6391.12	I	
35		6401.07	I	
26		6409.11	I	18356 – 33955
10		6412.39	I	
100		6424.37	I	20158 – 35719
20		6446.34	I	25456 – 40964
20		6471.20	I	23534 – 38983
20		6473.99	I	25906 – 41348
10		6493.13	I	30160 – 45556
23		6519.84	I	30502 – 45836
7		6590.90	I	26639 – 41807
15	h	6611.20	I	25707 – 40829
230		6619.13	I	10768 – 25872
10		6624.57	I	26759 – 41850
5		6637.16	I	26336 – 41398
50		6650.38	I	25456 – 40488
13		6659.68	I	20158 – 35169
4	h	6678.89	I	25872 – 40840
5		6687.87	I	26450 – 41398
18		6690.47	I	18356 – 33299
4		6691.08	I	27342 – 42283
9		6728.04	I	25707 – 40566
110		6733.98	I	10768 – 25614
21		6746.08	I	18480 – 33299
50		6746.27	I	20350 – 35169
35		6753.97	I	27384 – 42186
13		6763.50	I	25707 – 40488
4		6764.92	I	29982 – 44760
8		6787.98	I	26284 – 41012
8		6788.94	I	26759 – 41484
10	h	6799.88	I	
10		6802.62	I	26336 – 41032
10		6812.03	I	26336 – 41012
13		6825.63	I	30113 – 44760
18	d	6828.87	I	26759 – 41398
		6829.05	I	26189 – 40829
40		6838.88	I	27727 – 42345
16		6848.92	I	26415 – 41012
21		6886.28	I	27766 – 42283
16		6892.36	I	25456 – 39960
10		6898.01	I	31300 – 45793
10		6898.98	I	25997 – 40488
13		6908.20	I	11143 – 25614
35		6914.01	I	20281 – 34740
9		6931.40	I	20350 – 34774
13		6934.10	I	11454 – 25872
5		6946.75	I	27093 – 41484
10		6947.39	I	20350 – 34740
8		6953.78	I	26189 – 40566
10		6960.64	I	26336 – 40698
8		6961.48	I	25707 – 40068
16		6978.71	I	26639 – 40964
8		6980.37	I	27766 – 42088
7		6984.67	I	27774 – 42087
26		6988.94	I	20130 – 34435
9		6991.69	I	26189 – 40488
12		6999.13	I	26415 – 40699
8		6999.88	I	25707 – 39989
16		7001.60	I	19970 – 34248
9		7016.44	I	26450 – 40698
7		7018.43	I	
7		7025.32	I	26336 – 40566
22		7037.98	I	26639 – 40844
9	h	7045.29	I	26639 – 40829
22		7060.21	I	11454 – 25614
13		7063.34	I	20281 – 34435
13		7081.22	I	20130 – 34248
9		7102.65	I	27774 – 41850
110		7109.87	I	25614 – 39675
8		7122.65	I	27363 – 41398
27		7134.08	I	11858 – 25872
8		7240.46	I	26759 – 40566
150		7242.50	I	25872 – 39675
40		7245.85	I	20158 – 33955
22		7267.62	I	11858 – 25614
7		7281.53	I	25906 – 39635
17		7300.19	I	
8		7322.25	I	26336 – 39989
8		7322.79	I	
8		7333.71	I	26189 – 39821
13		7348.49	I	20350 – 33955
5		7360.38	I	25707 – 39290
13		7361.65	I	27384 – 40964
10	h	7364.41	I	
8		7365.25	I	
40		7391.36	I	12346 – 25872
10		7434.10	I	25997 – 39445
13		7447.34	I	31533 – 44957
13	h	7452.85	I	25707 – 39122
7		7475.43	I	27363 – 40736
140		7485.74	I	26320 – 39675
5		7501.62	I	25795 – 39122
13		7504.47	I	26639 – 39960
7		7571.53	I	27363 – 40566
11		7572.64	I	26759 – 39960
7		7579.58	I	27774 – 40964
7		7591.66	I	20130 – 33299
11	h	7595.16	I	25997 – 39160
11		7601.84	I	27415 – 40566
7		7649.52	I	27774 – 40844
5		7653.26	I	26759 – 39821
17	h	7656.76	I	31913 – 44970
13		7679.49	I	20281 – 33299
9		7709.54	I	25456 – 38423
27		7720.77	I	20350 – 33299
9		7723.63	I	27093 – 40037
9		7732.49	I	19970 – 32899
4		7752.34	I	27093 – 39989

Molybdenum — all observed lines — Continued

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
17	7829.65	I	20130 – 32899	4	8058.22	I	45786 – 58193
15	7854.45	I	27093 – 39821				
8	7887.74	I	27363 – 40037	5	8104.67	I	39521 – 51856
5	7917.62	I	27363 – 39989	9	8153.45	I	25707 – 37968
11	7923.15	I	20281 – 32899	4 h	8192.60	I	23516 – 35719
				22 h	8245.06	I	28715 – 40840
9	7968.85	I	27415 – 39960	40 h	8328.44	I	28836 – 40840
4	7984.35	I	26639 – 39160	9	8351.15	I	25997 – 37968
15	7986.60	I	25906 – 38423	45 h	8389.32	I	28924 – 40840
7	8027.32	I	20158 – 32612	45 h	8483.39	I	25795 – 37579

Neodymium

$$\text{Nd},\ Z = 60,\ M = 144.2,\ \text{Ratio}\ \frac{\text{Nd}}{\text{Cu}} = 2.270$$

Nd I Normal state of valence electrons $4f^4 6s^2\ {}^5I_4 = 0$. I.P. = 44270 cm^{-1}.
Nd II Normal state of valence electrons $4f^4 6s\ {}^6I_{3\,1/2} = 0$. I.P. = 86500 cm^{-1}.

References

Wavelengths:
Below 5000 Å:
A. S. King, Astrophys. J. **78,** 9 (1933).
Supplemented by A. Gatterer and J. Junkes, Spektren der Seltenen Erden (Specola Vaticana, Vatican, 1945).
F. Exner and E. Haschek, Spektren der Elemente bei Normalen Druck (Franz Deuticke, Leipzig and Vienna, 1911).
From 5000 to 6900 Å:
A. Gatterer and J. Junkes, Spektren der Seltenen Erden (Specola Vaticana, Vatican, 1945).
Supplemented by C. C. Kiess, Sci. Papers BS **18,** 201 (1922).
Above 6900 Å:
J. F. Wyart, Thesis, Univ. Paris (Orsay) (1968).
C. C. Kiess, Sci. Papers BS **18,** 201 (1922).
Supplemented by G. R. Harrison, Massachusetts Institute of Technology Wavelength Tables (John Wiley & Sons, New York, 1939).
W. Albertson, G. R. Harrison, and J. R. McNally, Phys. Rev. **61,** 167 (1942).

Classification:
Nd I, F. W. Paul, Phys. Rev. **49,** 156 (1936) (Spectrum assignment only).
P. F. A. Klinkenberg, Thesis, Univ. of Amsterdam (1955).
Nd I and Nd II, A. S. King, Astrophys. J. **78,** 9 (1933) (Spectrum assignment only).
J. F. Wyart, Thesis, Univ. Paris (Orsay) (1968).
R. Hoekstra, Thesis, Univ. Amsterdam (1969).
Nd II, W. E. Albertson, G. R. Harrison, and J. R. McNally, Phys. Rev. **61,** 167 (1942).
J. Blaise, J. Chevillard, J. Verges and J.–F. Wyart, Spectrochimica Acta **25B,** 333 (1970).

Strong lines of neodymium

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
5400		4303.58	II	0 – 23230	1700		3905.89	II	1650 – 27245
4700		4061.09	II	3802 – 28419	1500		3848.52	II	3066 – 29043
3700	d	3863.33	II	0 – 25877	1400		3775.50	II	5985 – 32464
		3863.40	II	0 – 25876	1400		3963.12	II	3802 – 29027
3700		4012.25	II	5086 – 30002					
					1400		3990.10	II	3802 – 28857
3000		4040.80	II	1470 – 26211	1400		4109.08	II	513 – 24843
3000		4156.08	II	1470 – 25524	1400		4451.57	II	3067 – 25524
2500		3805.36	II	2585 – 28856	1300		3889.93	II	2585 – 28285
2500		4109.46	II	2585 – 26913	1300		3890.58	II	5085 – 30781
2400		3784.25	II	3066 – 29484					
					1300		3890.94	II	513 – 26206
2400	d	3851.66	II	2585 – 28540	1300		3901.84	II	5085 – 30707
		3851.74	II	1470 – 27425	1300		4232.38	II	513 – 24134
2400		4177.32	II	513 – 24445	1200		3685.80	II	9228 – 36352
2000		3900.21	II	3801 – 29434	1200		3803.47	II	1650 – 27934
2000		3911.16	II	3801 – 29362					
					1200		3826.42	II	513 – 26640
2000		3941.51	II	513 – 25877	1200		3880.78	II	513 – 26274
2000		3951.16	II	1470 – 26772	1200		4023.00	II	1650 – 26500
2000		4247.38	II	0 – 23537	1200		4031.82	II	5985 – 30781
1700		3838.98	II	0 – 26041					
1700	d	3848.24	II	1470 – 27449					
		3848.31	II	2585 – 28563					

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
75	2702.46		
75	2704.54		
75	2764.98	I	
60	2785.79	I	
50	2863.95		
50	2921.26		
55	2962.88	II	
65	2963.58	II	
80	2993.20	II	11939 – 45338
40	2994.73		
95	3007.97	II	10091 – 43326
95	3014.19	II	1650 – 34817
95	3018.35	II	10091 – 43212
80	3026.47	II	12306 – 45338
50	3038.98	II	
50	3043.29		
50	3051.11	II	
80	3052.15	II	
140	3056.71	II	
130	3069.73	II	
65 d	3071.43	II	
	3071.50	II	
160	3075.38	II	3801 – 36308
95	3079.38	II	13337 – 45802
95	3080.94	II	
95	3092.73		
240	3092.92	II	1470 – 33792
140	3098.48	II	3066 – 35331
55	3099.52	II	0 – 32253
130	3105.43	II	12013 – 44205
95	3106.18	II	14835 – 47020
65	3108.01	II	11939 – 44104
260	3115.18	II	12013 – 44104
190	3116.15	II	11273 – 43354
50	3119.75	II	11310 – 43354
160	3123.06	II	
190	3124.58	II	
290	3133.60	II	11273 – 43176
220	3134.90	II	15130 – 47020
100	3137.24	II	11310 – 43176
170	3141.46	II	
170	3142.44	II	
100	3144.55	II	
100	3144.82	II	11273 – 43062
100	3148.51	II	11310 – 43062
100	3149.29	II	
100	3149.51	II	11273 – 43014
100	3162.62	II	513 – 32123
100	3175.99	II	11273 – 42750
50	3181.54	II	11273 – 42695
50	3188.73	II	
50	3200.62	II	13804 – 45039
150	3203.47	II	2585 – 33792
85	3211.00	II	
100	3217.12	II	
50	3222.62	I	
50	3228.04	II	
60	3234.62		
40	3237.91	II	
100	3254.08	II	1470 – 32191
50	3256.91	II	1470 – 32165
220	3259.24	II	513 – 31186
100	3260.66	II	0 – 30659
220	3265.12	II	
50	3265.38	II	513 – 31128
170	3267.25	II	3801 – 34399
100	3273.18	II	1650 – 32192
320	3275.22	II	5085 – 35609
50	3281.49	II	12861 – 43326
50	3282.78	II	0 – 30453
290	3285.10	II	0 – 30431
100	3286.62	II	2585 – 33003
50	3289.52		
100	3290.65	II	513 – 30893
70	3293.84	II	12861 – 43212
70	3294.68	II	1650 – 31993
70	3298.61		
300	3300.16	II	0 – 30293
140	3300.91	II	3801 – 34087
70	3304.66	II	
85	3305.33		
100	3310.38	II	3801 – 34001
140	3310.91	II	1650 – 31844
200	3312.75	II	0 – 30177
100	3313.16	II	2585 – 32759
100	3316.02	II	1470 – 31618
200	3325.90	II	513 – 30571
70 h	3326.26		
50	3327.69		
410	3328.28	II	0 – 30037
250	3331.57	II	3801 – 33809
290	3334.48	II	1470 – 31451
290	3339.07	II	513 – 30453
85	3345.71	II	513 – 30393
85	3347.56	II	1650 – 31513
100	3347.89		
170	3348.17	II	2585 – 32444
320	3353.59	II	5085 – 34895
85	3354.60	II	1650 – 31451
200	3355.93	II	2585 – 32374
85	3356.55		
170	3359.76	II	5085 – 34840
270	3364.96	II	1470 – 31179
85	3375.23	II	15420 – 45039
70	3386.29	II	13804 – 43326
100	3386.52	II	1470 – 30990
100	3388.03	II	9228 – 38736
70	3389.33		
70	3392.31	II	5085 – 34555
290	3393.63	II	3801 – 33260
150	3410.25	II	2585 – 31900
70	3412.39	II	4512 – 33809
50	3415.55	II	1650 – 30919
190	3425.22	II	3066 – 32253
170	3428.93	II	1650 – 30805
100	3432.99	II	5985 – 35106
50	3435.43	II	1470 – 30570
100	3443.32	II	5085 – 34119
50	3454.38	II	4512 – 33452
50	3461.83	II	3066 – 31944
120	3468.42	II	513 – 29336
120	3470.86	II	1650 – 30453
150	3481.44	II	
120 h	3484.88	I	
120	3510.70	II	12306 – 40783
120	3522.05	II	3067 – 31451
200	3527.53	II	0 – 28340
85 h	3531.71	II	
170	3533.59	II	3801 – 32093
190	3541.60	II	2585 – 30813

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
290	3543.35	II	0 – 28213
70	3553.99	II	5085 – 33215
200	3555.77	II	2585 – 30700
410	3560.75	II	3801 – 31878
70	3561.61	II	513 – 28582
340	3568.87	II	5085 – 33097
70	3576.16	II	1470 – 29425
190	3582.63		
100	3582.88		
85	3586.82	II	1650 – 29521
470	3587.51	II	1470 – 29336
120	3588.23	II	3066 – 30927
85	3592.09	II	13337 – 41168
300	3592.59	II	513 – 28340
120	3595.41	II	0 – 27805
120	3595.91	II	15130 – 42931
340	3598.02	II	513 – 28298
70	3600.12		
300	3600.91	II	2585 – 30348
70	3606.30		
120	3607.72		
320	3609.79	II	0 – 27694
85	3612.75	II	12013 – 39685
370	3615.82	II	1650 – 29298
300	3618.96	II	3066 – 30691
190	3624.65	II	4512 – 32093
120	3626.18	II	7524 – 35094
120	3627.41	II	3801 – 31362
85	3629.59	II	16395 – 43938
170	3629.94	II	5985 – 33526
300	3631.02	II	13819 – 41352
70	3633.47		
340	3634.30	II	
170	3634.87	II	3066 – 30570
70	3635.11		
240	3637.00	II	15518 – 43005
240	3637.23	II	12199 – 39685
190	3637.79	II	
70	3638.70		
240	3640.24	II	11273 – 38736
190	3641.50	II	13804 – 41257
70	3642.46	II	17356 – 44803
190	3643.63	II	
70	3645.63	II	8716 – 36138
240	3645.78	II	513 – 27934
120	3647.93		
340	3648.20	II	12199 – 39602
240	3649.46		
240	3650.42	II	1650 – 29036
50	3650.69		
190	3651.59	II	13479 – 40857
120	3652.45	II	11273 – 38644
410	3653.15	II	10667 – 38033
240	3654.16		
120	3655.03	II	3801 – 31153
120	3659.94	II	1470 – 28785
120	3660.97		
470	3662.26	II	15518 – 42816
85	3663.03	II	513 – 27805
540	3665.18	II	1650 – 28926
150	3668.79		
190	3669.45		
85	3669.75		
150	3670.92	II	0 – 27233
120	3671.66	II	2585 – 29813
540	3672.36	II	10667 – 37890
580	3673.54	II	10091 – 37305
100	3674.65		
85	3677.60		
240	3678.18	II	0 – 27179
100	3678.88	II	16325 – 43499
85	3684.29		
1200	3685.80	II	9228 – 36352
120	3686.07	II	11310 – 38431
440	3687.30	II	1470 – 28582
410	3689.69	II	3066 – 30161
300	3694.81	II	
120	3697.17	II	12861 – 39901
410	3697.56	II	13819 – 40857
100	3701.75		
240	3702.84		
120	3703.88		
240	3704.95	II	16192 – 43176
200	3712.81		
470	3713.70	II	5985 – 32905
370	3714.20	II	14835 – 41751
640 d	3714.73	II	
	3714.81	II	513 – 27425
250	3715.04	II	13337 – 40247
200	3715.39	II	0 – 26907
470	3715.68	II	3801 – 30707
85	3716.58	II	3801 – 30700
410	3718.54	II	1470 – 28354
85	3719.21		
140	3720.54	I	6764 – 33634
410	3721.35	II	10667 – 37531
220	3722.42	II	15348 – 42205
780	3723.50	II	2585 – 29434
410	3724.87	II	513 – 27352
250	3726.90	II	11310 – 38134
710	3728.13	II	1470 – 28285
470	3730.58	II	3066 – 29864
170	3731.22	II	0 – 26793
85	3731.63	II	12013 – 38803
100	3732.02	II	11273 – 38060
270	3732.78	II	15130 – 41912
1000 d	3735.54	II	4512 – 31274
	3735.60	II	
440	3737.10	II	2585 – 29336
1000	3738.06	II	4512 – 31256
270	3741.42	II	513 – 27233
120	3742.59	II	11273 – 37985
140	3744.24	II	1470 – 28170
150	3749.10	II	3801 – 30467
200	3749.85	II	1470 – 28129
320	3750.31	II	13479 – 40136
100	3750.74	II	2585 – 29239
120	3752.29	I	
580	3752.49	II	4512 – 31153
370	3752.67	II	0 – 26640
250	3754.83	II	11310 – 37935
370	3755.60	II	1470 – 28089
100	3756.83	II	513 – 27124
510	3757.82	II	3801 – 30405
930	3758.95	II	
300	3759.79	II	5085 – 31675
140	3761.58	II	12306 – 38883
85	3762.09	II	4512 – 31085
930	3763.47	II	1650 – 28213
120	3765.34	II	16395 – 42945

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
120		3765.92	II	3801 – 30348
300		3766.59	II	12199 – 38741
100		3768.71	II	11310 – 37836
510		3769.65	II	1650 – 28170
140		3772.40	II	513 – 27014
140		3772.93	II	12306 – 38803
190		3773.18	II	14673 – 41168
100		3774.93	II	4512 – 30995
1400		3775.50	II	5985 – 32464
250		3776.34	II	12013 – 38486
140		3777.00	II	11273 – 37741
710		3779.47	II	1470 – 27921
580		3780.40	II	3802 – 30247
510		3781.32	II	5985 – 32424
300		3783.78	II	16395 – 42816
2400		3784.25	II	3066 – 29484
270		3784.73	II	13819 – 40234
190		3784.85	II	513 – 26926
150		3785.11	II	5985 – 32397
120		3785.40	II	13247 – 39657
120		3788.97		
340		3791.50	II	3066 – 29434
150		3792.81	II	3066 – 29425
340		3795.45	II	1650 – 27990
120		3796.49	II	14835 – 41168
170		3799.24	II	2585 – 28899
240		3799.55	II	1470 – 27781
370		3801.12	II	4512 – 30813
200		3801.38	II	1470 – 27769
340		3802.30	II	0 – 26292
1200		3803.47	II	1650 – 27934
200		3804.10	II	513 – 26793
2500		3805.36	II	2585 – 28856
340		3805.55	II	3066 – 29336
470		3807.23	II	513 – 26772
140		3808.25	II	1470 – 27721
540		3808.77	II	513 – 26761
440		3809.06	II	513 – 26759
580		3810.49	II	5985 – 32221
240		3811.06	II	3067 – 29298
270		3811.77	II	0 – 26227
200		3812.53	II	15130 – 41352
710		3814.73	II	0 – 26206
190		3817.38	II	513 – 26702
100		3818.84	II	10256 – 36434
240		3819.70	II	3066 – 29239
410		3822.47	II	3801 – 29955
85		3823.26	II	1650 – 27798
1200		3826.42	II	513 – 26640
240		3828.00	II	0 – 26115
540		3828.85	II	
440		3829.16	II	5985 – 32093
510		3830.47	II	16906 – 43005
100		3832.76	II	1470 – 27553
740		3836.54	II	4512 – 30570
340		3837.91	II	1470 – 27518
1700		3838.98	II	0 – 26041
340		3839.51	II	10667 – 36704
410	d	3841.82	II	3066 – 29088
		3841.88	II	14835 – 40857
100		3844.18		
100		3845.74	II	11310 – 37305
190		3846.71	II	1650 – 27638
100		3846.97	II	513 – 26500
1700	d	3848.24	II	1470 – 27449
		3848.31	II	2585 – 28563
1500		3848.52	II	3066 – 29043
470		3850.22	II	
2400	d	3851.66	II	2585 – 28540
		3851.74	II	1470 – 27425
340		3858.55	II	513 – 26422
120		3859.42	II	1650 – 27553
270		3860.94	II	4512 – 30405
300		3862.52	II	1470 – 27352
3700	d	3863.33	II	0 – 25877
		3863.40	II	0 – 25876
170		3865.98	II	3066 – 28926
240		3866.52	II	513 – 26369
220		3866.81	II	1650 – 27504
850		3869.07	II	1470 – 27309
240		3875.74	II	1650 – 27444
470		3875.87	II	3066 – 28860
1100		3878.58	II	1470 – 27245
1000		3879.55	II	2585 – 28354
780		3880.38	II	1470 – 27233
1200		3880.78	II	513 – 26274
200		3881.59		
100		3883.76		
100		3884.08	II	13804 – 39543
100		3884.74	II	
85	h	3886.09	II	11939 – 37664
540		3887.87	II	513 – 26227
370	h	3889.66	II	1650 – 27352
1300		3889.93	II	2585 – 28285
170		3890.22	II	4512 – 30210
1300		3890.58	II	5085 – 30781
1300		3890.94	II	513 – 26206
580		3891.51	II	5985 – 31675
470		3892.06	II	11748 – 37434
810		3894.63	II	513 – 26182
140		3895.37	II	11377 – 37041
85		3895.91		
270		3896.13	II	3066 – 28725
440		3897.63	II	1650 – 27299
2000		3900.21	II	3801 – 29434
1300		3901.84	II	5085 – 30707
140		3902.51	I	
120		3903.51	II	2585 – 28196
100		3905.56		
1700		3905.89	II	1650 – 27245
140		3906.09	II	1650 – 27244
100		3907.50		
200		3907.70	II	1650 – 27233
510		3907.84	II	4512 – 30094
2000		3911.16	II	3801 – 29362
850		3912.23	II	9228 – 34782
340		3913.69	II	1470 – 27014
440		3915.13	II	
610		3915.95	II	1650 – 27179
340		3917.65	II	12013 – 37531
85		3918.90	II	11939 – 37449
220		3919.92	II	5985 – 31489
1100		3920.96	II	3066 – 28563
140		3924.49	II	1650 – 27124
85		3924.98	I	0 – 25470
85		3925.63	II	13337 – 38803
70		3926.62	II	
510		3927.10	II	1470 – 26926
200		3929.26	II	4512 – 29955
150		3934.09	II	14835 – 40247

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
610	3934.82	II	2585 – 27992
410	3936.11	II	12087 – 37485
140	3937.00	I	
70	3937.57	II	0 – 25389
510	3938.86	II	13048 – 38429
140	3939.52	II	5985 – 31362
2000	3941.51	II	513 – 25877
85	3942.12	II	513 – 25873
150	3942.62	II	16395 – 41751
70	3946.81	II	11377 – 36707
100	3947.61	I	2366 – 27691
150	3948.32	II	5085 – 30405
70	3950.42		
2000	3951.16	II	1470 – 26772
810	3952.20	II	0 – 25295
320	3952.87	II	1470 – 26761
85	3953.40	II	3066 – 28354
320	3953.52	II	3801 – 29088
100	3954.41		
60	3955.09	II	1650 – 26926
120	3955.95	II	5985 – 31256
240	3957.45	II	13479 – 38741
590	3958.00	II	513 – 25772
510	3962.21	II	2585 – 27816
1400	3963.12	II	3802 – 29027
270	3963.90	II	5085 – 30306
120	3967.06	II	1470 – 26670
150	3967.75	II	2585 – 27781
170	3968.88	II	4512 – 29701
120	3969.67	II	2585 – 27769
1100	3973.30	II	5086 – 30247
740	3973.69	II	2585 – 27744
150	3975.20	II	10786 – 35935
120	3976.09	II	1650 – 26793
740	3976.85	II	0 – 25138
100	3977.29	II	513 – 25648
60	3977.99	II	13048 – 38179
70	3979.03		
740	3979.49	II	1650 – 26772
60	3980.98		
140	3981.24	II	1650 – 26761
320	3982.36	II	3067 – 28170
85	3983.41	II	3801 – 28899
70	3983.58	II	10786 – 35882
470	3986.25	II	11273 – 36352
60	3987.25	II	12232 – 37305
50	3987.81	II	4512 – 29581
70	3988.82	II	3066 – 28129
1400	3990.10	II	3802 – 28857
1000	3991.74	II	0 – 25045
85	3992.16	II	11310 – 36352
85	3992.28	II	12087 – 37128
170	3992.60	II	11377 – 36416
1100	3994.68	II	2585 – 27611
140	3995.26	II	3066 – 28089
70	3997.44	II	5085 – 30094
70	3997.78	II	13479 – 38486
170	3997.93	II	15130 – 40136
85	3998.16		
170	3998.69		
410	4000.50	II	1650 – 26640
540	4004.02	II	513 – 25481
100	4004.26		
410	4007.43	II	3801 – 28748
85	4008.75	II	12861 – 37799
100	4010.45	II	3801 – 28729
150	4011.09	II	3801 – 28725
3700	4012.25	II	5086 – 30002
540	4012.70	II	0 – 24913
140 h	4013.22	II	1470 – 26380
70	4015.56	II	13971 – 38867
370	4018.81	II	513 – 25389
120	4019.79	II	5085 – 29955
85	4020.05	II	10256 – 35124
1000	4020.87	II	2585 – 27449
1000	4021.34	II	2585 – 27446
1000	4021.78	II	1470 – 26328
1200	4023.00	II	1650 – 26500
340	4024.78	II	513 – 25352
410	4030.47	II	1470 – 26274
1200	4031.82	II	5985 – 30781
120	4033.50		
100	4033.90	II	11939 – 36722
70	4034.01	II	513 – 25295
270	4038.12	II	1470 – 26227
3000	4040.80	II	1470 – 26211
200	4041.06	II	3801 – 28540
85	4042.51	II	1650 – 26380
85	4043.05	II	10439 – 35165
410	4043.59	II	2585 – 27309
85	4044.35	II	1650 – 26369
410	4048.81	II	12013 – 36704
850	4051.15	II	3067 – 27744
85	4054.86	II	3066 – 27721
85	4056.83	II	13247 – 37890
850	4059.96	II	1650 – 26274
4700	4061.09	II	3802 – 28419
85	4067.73	II	1650 – 26227
1100	4069.28	II	513 – 25081
100	4071.46	II	13479 – 38033
140	4074.42	II	5085 – 29622
710	4075.12	II	1650 – 26182
470	4075.28	II	513 – 25045
240	4077.62	II	10091 – 34608
470	4080.23	II	513 – 25014
140	4082.55	II	13545 – 38033
240	4085.82	II	0 – 24468
70	4086.82	II	16395 – 40857
85	4088.56	II	3066 – 27518
70	4089.12	II	1470 – 25918
120	4089.68	II	
85	4091.00	II	13048 – 37485
140	4094.62	II	12306 – 36722
85	4095.43	II	13479 – 37890
270	4096.13	II	2585 – 26991
100	4096.71	II	1470 – 25873
220	4098.18	II	3801 – 28196
100	4098.91	II	11748 – 36138
190	4100.24	II	3067 – 27449
85	4101.45	II	
85	4102.53	II	13063 – 37431
150	4104.23	II	3066 – 27425
50	4104.54	II	
200	4106.59	II	4512 – 28857
120	4107.44	II	12013 – 36352
120	4107.96	II	15348 – 39685
1400	4109.08	II	513 – 24843
2500	4109.46	II	2585 – 26913
510	4110.48	II	0 – 24321
300 h	4113.83	II	1470 – 25772

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
70		4116.34	II	13550 – 37836
35		4116.77	II	513 – 24797
85		4120.66	II	5986 – 30247
85		4121.94	II	15348 – 39602
410		4123.88	II	3067 – 27309
50		4125.05	II	
85		4128.70	II	5487 – 29701
50		4129.87	II	17544 – 41751
50		4130.72	II	13247 – 37449
85		4132.56	II	3801 – 27993
470		4133.36	II	2585 – 26772
85		4134.72	II	3066 – 27245
510		4135.33	II	5085 – 29260
100		4136.76	II	3066 – 27233
170		4144.56	II	1650 – 25772
140		4146.13	II	13337 – 37449
170		4151.68	II	3066 – 27146
100		4153.73	II	14673 – 38741
3000		4156.08	II	1470 – 25524
510		4156.26	II	0 – 24053
70		4157.58	II	12306 – 36352
140		4159.57	II	19465 – 43499
340		4160.57	II	4512 – 28540
60		4164.41	II	11440 – 35446
60		4164.85	II	0 – 24003
150		4165.04	II	17349 – 41352
410		4168.00	II	11748 – 35734
70		4168.76	II	13550 – 37531
100		4170.46	II	
100		4170.76	II	5985 – 29955
100		4173.38	II	513 – 24468
60		4174.46	II	12087 – 36035
810		4175.61	II	5086 – 29027
2400		4177.32	II	513 – 24445
170	d	4178.44	II	16906 – 40832
		4178.53	II	3066 – 26991
200		4178.64	II	1470 – 25394
640		4179.59	II	1470 – 25389
85		4182.52	II	11377 – 35279
70		4183.13	I	5048 – 28947
250		4184.98	II	11939 – 35827
85		4185.77	II	18029 – 41912
140		4186.04	II	1470 – 25352
70		4187.11		
70		4188.26	II	2585 – 26455
35		4195.03	II	1650 – 25481
85		4198.17	II	14673 – 38486
120		4199.11	II	513 – 24321
70		4200.04	II	513 – 24315
70	h	4203.43	II	
120		4205.25	II	5487 – 29260
470		4205.60	II	5086 – 28857
470		4211.29	II	1650 – 25389
70		4212.75	II	1470 – 25200
85		4213.07	II	10786 – 34515
85		4213.22	II	12091 – 35819
100		4214.22	II	11377 – 35099
100		4214.60	II	1470 – 25190
120		4217.28	II	3067 – 26772
70		4218.55	II	11748 – 35446
70		4219.56	II	3066 – 26759
290		4220.25	II	2585 – 26274
170	h	4221.14	II	4512 – 28196
120		4223.21	II	3066 – 26738
140		4224.84	II	5085 – 28748
70		4226.99	II	14835 – 38486
440		4227.73	II	3802 – 27449
190		4228.03	II	1650 – 25295
190		4228.20	II	3802 – 27446
100		4229.50	II	0 – 23636
1300		4232.38	II	513 – 24134
100		4233.15	II	11273 – 34889
250		4234.19	II	1470 – 25081
290	h	4235.24	II	11310 – 34915
290		4239.84	II	11310 – 34889
140		4241.21	II	15348 – 38920
85		4244.56		
85		4244.96	II	1650 – 25200
120		4246.88	II	513 – 24053
2000		4247.38	II	0 – 23537
85		4248.15		
850		4252.44	II	
120	h	4252.88	II	
100		4253.87	II	10439 – 33940
290		4254.29		
70		4256.24	II	1650 – 25138
100		4256.47	I	0 – 23487
100		4256.82	II	1470 – 24955
170		4257.79	II	4512 – 27992
70		4259.62	II	2585 – 26055
410		4261.84	II	13247 – 36704
150		4262.24	II	5085 – 28540
150		4263.44	II	5985 – 29434
150	h	4263.91	II	2585 – 26031
		4264.00	II	14049 – 37495
340		4266.71	II	1650 – 25081
240		4270.56	II	0 – 23410
340		4272.79	II	0 – 23397
340		4275.09	II	13337 – 36722
140		4277.29	II	1470 – 24843
70		4280.17	II	12087 – 35444
470		4282.44	II	3801 – 27146
240		4282.57	II	513 – 23857
710		4284.52	II	5086 – 28419
120		4290.96	II	11310 – 34608
85	h	4294.19	II	7524 – 30805
70		4297.36	II	1650 – 24913
270		4297.80	II	3066 – 26328
85		4299.71	II	1470 – 24721
70		4301.22	I	2367 – 25609
5400		4303.58	II	0 – 23230
340		4304.45	II	13479 – 36704
70		4305.48	II	
120		4306.75	II	14049 – 37262
200		4307.78	II	3067 – 26274
100		4310.51	II	1650 – 24843
85		4311.25	I	2366 – 25555
85		4313.36	II	15309 – 38486
170		4314.38	II	13550 – 36722
470		4314.52	II	0 – 23171
1100		4325.76	II	3802 – 26913
510		4327.93	II	4512 – 27611
540		4338.70	II	5986 – 29027
140		4342.07	II	513 – 23537
70		4343.50	I	0 – 23016
85		4349.10	II	13048 – 36035
70		4350.21	II	
680		4351.29	II	1470 – 24445
150		4356.02	II	11939 – 34889
850		4358.17	II	2585 – 25524

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
85		4358.70	II	4512 – 27449
70		4359.25	II	4512 – 27446
70		4360.87	II	9198 – 32123
50	h	4361.40	II	15013 – 37935
120		4364.14	II	5085 – 27993
240		4366.38	II	2585 – 25481
340		4368.64	II	513 – 23397
60		4372.14	II	
60		4372.28	II	513 – 23378
60	h	4372.73	II	
470	d	4374.93	II	1470 – 24321
		4375.04	II	0 – 22851
50		4376.45	II	11939 – 34782
60		4377.40	II	7868 – 30707
120		4382.74	II	3067 – 25877
710		4385.66	II	1650 – 24445
250		4390.66	II	12013 – 34782
70		4391.10	II	2585 – 25352
40		4392.12	II	14387 – 37149
40		4394.18	II	
40		4395.50	II	5985 – 28729
40		4395.89	II	4437 – 27179
50		4398.03	II	5085 – 27816
40		4399.58		
540		4400.83	II	513 – 23230
120		4407.08	II	513 – 23197
510		4411.06	II	1470 – 24134
140		4412.27	II	513 – 23171
70		4414.44	II	513 – 23160
140		4416.89	II	4512 – 27146
50	d	4420.11	I	2366 – 24984
40		4420.52	II	2585 – 25200
35		4426.83	II	1470 – 24053
60		4432.30	II	5985 – 28540
85		4439.00	II	1470 – 23991
35		4444.29	II	3066 – 25561
60		4444.99	I	0 – 22491
580		4446.39	II	1650 – 24134
1400		4451.57	II	3067 – 25524
200		4451.99	II	0 – 22456
300		4456.40	II	5986 – 28419
170		4462.42	II	1650 – 24053
740		4462.99	II	4512 – 26913
100		4465.07	II	0 – 22390
120		4465.60	II	1470 – 23857
85		4467.85	II	12232 – 34608
140		4469.26	II	5985 – 28354
85		4470.97	II	5086 – 27446
85		4471.41	II	0 – 22358
40		4475.57	II	513 – 22851
30		4475.84	I	2367 – 24703
50		4477.46	II	3066 – 25394
140		4477.88	I	5048 – 27374
140		4480.97	I	1128 – 23438
70		4481.90	I	1128 – 23434
40		4485.95	II	3067 – 25352
85		4493.42	II	4512 – 26761
40		4497.27	II	3801 – 26031
40		4497.40	I	0 – 22228
85		4497.93	II	4512 – 26738
410		4501.82	II	1650 – 23857
200		4506.59	II	513 – 22697
170		4513.34	II	513 – 22663
250		4516.36	II	2585 – 24721
70		4522.84	II	5985 – 28089
40		4523.58	II	2585 – 24685
120		4527.25	I	
70		4529.94	I	3681 – 25750
340		4541.27	II	3067 – 25081
85		4542.06	I	0 – 22010
340		4542.61	II	5985 – 27993
40		4544.26	II	
35		4545.33	II	6931 – 28926
85		4548.24	I	3682 – 25662
40		4549.02	II	4512 – 26489
35		4554.97	II	3067 – 25014
50		4555.14	II	4512 – 26459
100		4556.14	II	513 – 22456
85		4556.74	II	1470 – 23410
170		4559.67	I	2367 – 24292
60		4560.42	I	1128 – 23049
60		4561.18	II	0 – 21918
70		4561.86	I	3681 – 25596
340		4563.22	II	1470 – 23378
85		4567.61	II	1650 – 23537
200		4578.89	II	2585 – 24418
200		4579.32	II	5985 – 27816
40		4584.04	II	1650 – 23458
100		4586.62	I	3681 – 25478
60		4586.96	I	
85		4594.45	II	1650 – 23410
200		4597.02	II	1650 – 23397
100		4603.82	I	5049 – 26764
40		4607.38	II	4512 – 26211
100		4609.87	I	1128 – 22815
35		4612.47	II	513 – 22188
300		4621.94	I	2367 – 23996
85		4624.21	I	2366 – 23985
85		4626.50	I	1128 – 22737
100		4627.98	I	2366 – 23968
60		4629.91	II	3801 – 25394
60		4631.29	I	5048 – 26634
50		4632.64	II	1650 – 23230
510		4634.24	I	0 – 21572
60		4637.20	I	0 – 21559
85		4638.72	II	3801 – 25353
85		4639.14	I	1128 – 22678
340		4641.10	I	5048 – 26589
250		4645.77	II	4512 – 26031
200		4646.40	I	3681 – 25197
300		4649.67	I	
60		4652.39	I	0 – 21488
200		4654.73	I	1128 – 22606
70	h	4664.45	II	
130		4670.56	II	513 – 21918
45		4671.10	I	1128 – 22530
24		4673.97	I	2367 – 23756
60		4675.52	I	3682 – 25064
170		4680.74	II	513 – 21871
310		4683.45	I	0 – 21346
110		4684.04	I	1128 – 22471
14		4688.55	I	6764 – 28086
110		4690.35	I	0 – 21314
190		4696.44	I	3682 – 24968
130		4703.57	II	3067 – 24321
470		4706.54	II	0 – 21241
140		4706.96	I	1128 – 22367
190		4709.71	II	1470 – 22697
190		4715.59	II	1650 – 22851
60		4717.08	II	1470 – 22663

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
240		4719.02	I	0 – 21184
190		4724.35	II	5985 – 27146
29		4726.55	I	2366 – 23517
140		4731.77	I	1128 – 22256
35		4734.90	I	1128 – 22241
19		4736.20	II	1470 – 22578
29		4749.03		
29		4749.56	II	4512 – 25561
70		4749.75	I	3682 – 24730
45		4755.85	I	3682 – 24703
24		4759.10	I	3682 – 24688
21		4760.45	I	1128 – 22129
45		4763.62	II	3067 – 24053
80		4763.87	II	1470 – 22456
70		4770.20	I	2366 – 23324
24		4771.73		
19		4772.26	I	1128 – 22076
40		4772.88	II	5085 – 26031
40		4777.72	II	3066 – 23991
14		4778.40	I	1128 – 22049
120		4779.46	I	2366 – 23283
70		4783.80	II	513 – 21411
40		4786.06	II	1470 – 22358
21		4787.40	I	1128 – 22010
170		4789.41	II	2585 – 23459
120		4797.15	II	4512 – 25352
60		4799.42	II	0 – 20830
40		4806.62	I	1128 – 21927
240		4811.34	II	513 – 21292
35		4817.17	II	5985 – 26738
24		4818.96	II	3801 – 24547
14		4819.64	II	1470 – 22212
140		4820.34	II	1650 – 22390
14		4824.18	II	4512 – 25235
350		4825.48	II	1470 – 22188
24	d	4827.57	I	
		4827.74	II	1650 – 22358
45		4828.58	II	3066 – 23771
130		4832.28	II	4512 – 25200
29		4835.66	I	2367 – 23040
70		4835.98	II	0 – 20673
60		4836.62	I	1128 – 21797
110		4849.06	II	3801 – 24418
80		4853.33	I	1128 – 21727
35		4855.31	I	1128 – 21718
280		4859.02	II	2585 – 23160
29		4859.58	I	2366 – 22938
24		4861.77	I	
45		4864.78	II	7868 – 28419
190		4866.74	I	0 – 20542
45		4867.84	II	1650 – 22188
45		4869.27	I	3682 – 24213
35		4871.44	I	8411 – 28933
35		4874.37	I	8800 – 29310
60	d	4875.73	I	2366 – 22870
		4875.84	II	5985 – 26489
24		4876.12	II	4512 – 25014
45		4879.79	I	3682 – 24168
29		4882.88	II	5985 – 26459
350		4883.81	I	5048 – 25518
45		4885.01	I	5048 – 25513
140		4889.10	II	1470 – 21918
220		4890.70	II	3801 – 24243
240		4891.07	I	3681 – 24121
45		4893.23	I	1128 – 21559
280		4896.93	I	1128 – 21543
120		4901.53	I	3681 – 24077
210		4901.84	I	2366 – 22761
110		4902.03	II	513 – 20907
29		4907.26	I	2367 – 22739
29		4907.78	I	2367 – 22737
60		4910.05	I	0 – 20361
190		4913.41	I	
170		4914.37	II	3067 – 23410
330		4920.68	II	513 – 20830
35		4921.14	I	3682 – 23996
35		4922.45	I	3681 – 23991
470		4924.53	I	0 – 20301
35		4930.72	II	6637 – 26913
35		4942.95	II	5986 – 26211
60		4943.90	II	1650 – 21871
260		4944.83	I	1128 – 21345
65		4947.02	II	4512 – 24721
35		4949.03	II	5085 – 25286
35		4950.29	I	3681 – 23876
27		4950.67	I	2366 – 22560
55		4952.46	I	1128 – 21314
290		4954.78	I	0 – 20177
55		4958.10	II	3067 – 23230
290		4959.13	II	513 – 20673
150		4961.39	II	5086 – 25235
80		4963.33	I	5048 – 25190
35		4969.75	I	2366 – 22482
35		4970.93	II	2585 – 22697
35		4972.82		
23		4973.40	I	
90		4975.50	I	5048 – 25141
27		4980.88	I	6764 – 26835
70		4981.28	II	5985 – 26055
35		4982.89	I	3681 – 23744
90		4987.17	II	5985 – 26031
23		4989.41	II	5487 – 25524
13		4989.51	II	1470 – 21506
250		4989.94	II	5085 – 25120
90		4998.55	II	3801 – 23802
70		5000.44	II	2585 – 22578
55		5011.67	II	7868 – 27816
65		5014.55	I	2366 – 22303
18		5015.40	II	5985 – 25918
18		5022.67	I	6764 – 26668
90		5027.15	I	5048 – 24935
65		5027.85	II	4438 – 24321
90		5029.45	I	1128 – 21005
150		5033.52	II	9166 – 29027
27		5039.92	I	3681 – 23517
55		5040.20	I	1128 – 20963
45		5051.06	I	3681 – 23474
90		5056.89	I	0 – 19770
27		5060.04	I	2366 – 22123
110		5063.73	II	7868 – 27611
35		5066.85	II	4512 – 24243
65		5071.87	I	1128 – 20839
35		5073.87	I	3682 – 23385
35		5074.52	I	0 – 19700
360		5076.59	II	5985 – 25678
70		5077.16	II	6637 – 26327
55		5079.09	I	2366 – 22049
30		5081.89		
150	h	5089.84	II	1650 – 21292
360		5092.80	II	3067 – 22697

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
65		5096.52	II	4438 – 24053
180		5102.39	II	5488 – 25081
70		5103.11	I	0 – 19590
150	d	5105.21	II	9166 – 28748
		5105.35	I	
360		5107.59	II	6637 – 26211
27		5114.53	I	
35		5119.61	II	5488 – 25014
35		5121.30	II	9042 – 28563
340		5123.79	II	3066 – 22578
680		5130.60	II	10517 – 30002
170		5132.33	II	4512 – 23991
23		5134.23		
45		5136.83	II	5085 – 24547
80		5143.33	II	1470 – 20907
45		5156.01	II	11392 – 30781
70		5161.71	II	5985 – 25353
170		5165.14	II	5488 – 24843
90		5167.92	II	4512 – 23857
23		5170.91	II	4437 – 23771
80		5176.79	II	9042 – 28354
18		5178.75	I	1128 – 20432
30		5179.78	II	5985 – 25286
130		5181.17	II	6932 – 26227
120		5182.60	II	6005 – 25295
18		5187.05	I	2366 – 21640
500		5191.45	II	1650 – 20907
630		5192.62	II	9166 – 28419
55		5195.60	I	2367 – 21608
55		5198.07	I	1128 – 20361
330		5200.12	II	4512 – 23737
65		5204.38	I	0 – 19209
310		5212.37	II	1650 – 20830
150		5213.23	I	2367 – 21543
90		5215.65	II	10194 – 29362
65		5221.57	II	3066 – 22212
130		5225.05	II	6005 – 25138
130		5228.43	II	3067 – 22188
450		5234.20	II	4438 – 23537
250		5239.79	II	
720		5249.59	II	7869 – 26913
200		5250.82	II	6005 – 25045
360		5255.51	II	1650 – 20673
23		5257.35		
35		5264.22	I	1128 – 20119
27	h	5265.74		
23	h	5266.64	I	6764 – 25746
120		5269.48	II	4437 – 23409
90		5269.78	II	
55		5270.09	I	8411 – 27381
55		5270.69	II	1650 – 20617
27		5272.00	II	7950 – 26912
590		5273.43	II	5488 – 24445
150		5276.88	II	6932 – 25877
55		5286.68	II	
35		5287.13	II	6005 – 24913
110		5291.67	I	6853 – 25746
680		5293.17	II	6637 – 25524
23		5298.88	I	1128 – 19994
27		5300.58	I	1128 – 19989
160		5302.28	II	11392 – 30247
27		5302.61	I	8475 – 27328
65		5303.21	II	3066 – 21918
110		5306.47	II	6932 – 25772
27		5308.28	I	8800 – 27633
27		5308.42	II	10195 – 29027
45		5310.01	II	9166 – 27993
220		5311.46	II	7950 – 26772
35		5314.55	II	7950 – 26761
55		5316.60	II	3066 – 21870
45		5319.11		
500		5319.82	II	4438 – 23230
27		5320.79	I	8800 – 27589
35		5324.59	I	
27		5329.11	II	10941 – 29701
18		5329.88	I	11887 – 30644
27		5332.43	I	9692 – 28440
27		5334.33	I	0 – 18741
90		5336.55	II	4438 – 23171
45		5338.01	II	26369 – 45097
16		5343.65	I	10898 – 29606
80		5345.71	II	9043 – 27744
23		5349.26	I	
35		5349.58	I	1128 – 19816
180		5356.98	II	10195 – 28857
45		5361.17	II	4512 – 23160
290		5361.47	II	5488 – 24134
35		5365.12	II	
14		5370.16	II	24134 – 42750
150		5371.94	II	11392 – 30002
35		5377.79	I	0 – 18589
23		5378.23	I	8411 – 27000
30		5383.85	II	9042 – 27611
110		5385.90	II	5985 – 24547
23		5388.23	II	10194 – 28748
18		5396.72	II	
23		5399.12	II	7525 – 26041
30		5400.20	I	513 – 19026
27		5402.90	I	
45		5406.17	II	10942 – 29434
18		5411.93	I	2367 – 20839
30		5414.80	II	6005 – 24468
18		5415.31	I	2366 – 20827
70		5416.38	II	6932 – 25389
18		5420.66	I	6764 – 25207
80		5421.56	II	3066 – 21506
18		5424.07	I	
18		5429.30	I	9692 – 28105
70		5430.79	II	9877 – 28285
160		5431.53	II	9043 – 27449
35		5432.36	II	9043 – 27446
35		5441.26	II	12334 – 30707
90		5442.27	II	5488 – 23857
27		5447.28	I	
35		5447.56	II	8420 – 26772
55		5449.21	II	10194 – 28541
110		5451.12	II	
70		5455.82	II	7950 – 26274
30		5456.56	II	12459 – 30781
18		5458.60		
35		5473.08	II	9043 – 27309
45		5474.73	II	7950 – 26211
27		5478.61	I	9814 – 28062
18		5483.12	II	7950 – 26182
45	h	5485.10	II	4437 – 22664
170		5485.70	II	10195 – 28419
23		5487.03	II	8420 – 26640
35		5492.30	I	
14		5493.34	I	11812 – 30011
65		5494.01	II	

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
18		5496.42	I	
13		5498.86	I	
35		5501.47	I	0 – 18172
18		5507.66	II	16700 – 34851
35		5508.40	II	6932 – 25081
18		5516.29	I	9692 – 27815
27	d	5520.60	II	24315 – 42424
13		5522.17	I	12065 – 30169
18		5523.82	I	1128 – 19226
45		5525.72	I	6764 – 24856
35		5528.33	II	6637 – 24721
18		5529.07	I	1128 – 19209
90		5533.82	I	2367 – 20432
55		5535.27	II	11373 – 29434
23		5537.77	II	1650 – 19703
27		5539.21	II	6005 – 24053
55		5543.24	I	8800 – 26835
45		5545.91	II	
55		5548.47	II	4438 – 22456
27		5548.68	II	10337 – 28354
27		5550.09	II	9908 – 27921
35		5557.62	II	
55		5561.17	I	0 – 17977
35		5569.96	II	10337 – 28285
27		5575.50	I	8402 – 26333
27		5576.70	I	3682 – 21608
27		5577.70	I	10898 – 28821
23		5578.66	II	4437 – 22358
30		5581.60	II	6932 – 24843
27		5587.61	I	13101 – 30993
18		5587.96	II	5487 – 23378
30		5588.91	II	9357 – 27245
18		5592.67	II	9357 – 27233
240		5594.43	II	9043 – 26913
18		5595.81	II	6931 – 24797
55		5601.43	I	
45		5601.92	I	9939 – 27785
35		5602.68	II	8796 – 26640
27		5603.65	II	3067 – 20907
35		5614.30	II	8420 – 26227
18		5615.35	I	14304 – 32107
35		5617.71	II	
27		5619.00	II	14301 – 32093
220		5620.54	I	0 – 17787
11		5623.62	I	11108 – 28885
35		5625.72	II	7525 – 25295
65		5635.76	I	
45		5639.54	I	9115 – 26842
18		5647.98	I	
35		5653.57	I	11887 – 29570
35		5659.78	II	12906 – 30570
18		5662.46	I	10784 – 28440
11		5665.26	I	11918 – 29564
70		5668.87	II	11392 – 29027
65		5669.77	I	3681 – 21314
140	d	5675.97	I	1128 – 18741
55		5676.33	I	
11		5681.16	I	8475 – 26072
220		5688.53	II	7950 – 25524
23		5689.51	I	11109 – 28680
11		5695.23	I	8475 – 26029
45		5698.93	II	12460 – 30002
30		5701.57	I	
130		5702.24	II	6005 – 23537
80		5706.21	II	7525 – 25045
160		5708.28	II	6932 – 24445
80		5718.12	II	11373 – 28857
30		5719.09	II	4437 – 21918
65		5726.83	II	8420 – 25877
100		5729.29	I	2366 – 19816
16		5731.05	I	
23		5734.55		
45		5739.96	II	10194 – 27611
70		5740.86	II	9358 – 26772
27		5741.28	II	12021 – 29434
45		5742.08	II	8796 – 26206
27		5742.76	II	13298 – 30707
30		5743.20	II	10337 – 27744
11		5744.14	II	6005 – 23410
45		5744.77	II	7950 – 25352
30		5748.15	II	6005 – 23397
27		5749.06	II	6931 – 24321
55		5749.19	I	8475 – 25864
27		5749.66	I	0 – 17387
27		5753.53	II	1650 – 19026
18		5760.00	II	11392 – 28748
30		5761.70	II	8420 – 25772
14		5762.08	I	11959 – 29309
11		5764.23	II	10942 – 28285
23		5767.33	I	2366 – 19700
35		5769.87	II	10887 – 28214
45		5770.50	II	8717 – 26041
45		5776.12	I	1128 – 18436
45		5784.96	I	2367 – 19648
45		5788.22	I	5048 – 22320
27		5795.17	II	10194 – 27445
45		5800.09	I	3681 – 20918
160		5804.02	II	6005 – 23230
45		5809.25	II	5487 – 22696
80		5811.57	II	6931 – 24134
45		5813.89	I	
16		5815.44	I	8402 – 25593
27		5820.37	I	1128 – 18304
14		5823.18	II	9042 – 26210
30		5823.35	II	11373 – 28541
14		5823.72	I	
14		5823.91	II	6005 – 23171
70		5825.87	II	8717 – 25877
30		5826.74	I	3682 – 20839
16		5830.72	I	8475 – 25621
80		5842.39	II	10337 – 27449
16		5843.23	II	10883 – 27992
30		5844.66	I	10160 – 27265
23		5845.95	I	11959 – 29061
16		5846.36	II	12334 – 29434
13		5847.59	I	10784 – 27881
30		5857.52	II	
55		5858.91	I	10898 – 27961
35		5865.06	II	11373 – 28419
35		5867.08	I	13953 – 30993
30		5868.90	I	15073 – 32107
27		5871.04	I	11486 – 28514
27		5877.83	II	9198 – 26206
27		5882.78	II	4512 – 21506
30		5883.29	I	10785 – 27777
23		5886.24	I	12902 – 29886
30		5887.91	I	0 – 16979
35		5891.53	II	8420 – 25389
18		5899.49	I	8800 – 25746
23		5900.43	II	7525 – 24468

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
27		5906.65	II	6932 – 23857
35		5909.87	II	9357 – 26274
9		5914.40	I	11918 – 28821
27		5921.22	I	
9		5922.79	I	11001 – 27880
27		5934.75	II	6005 – 22851
30		5943.22	II	
14		5949.64	I	9115 – 25918
27		5955.87	I	
14		5961.16	I	9115 – 25885
30		5989.34	II	6005 – 22697
30		5994.76	I	11109 – 27785
27		5996.47	I	9939 – 26611
45		6007.67	I	9692 – 26333
14		6009.30	II	3066 – 19703
9		6025.54	I	5048 – 21640
35		6031.27	II	10337 – 26913
27		6033.29	I	14304 – 30874
45		6034.24	II	12460 – 29027
55		6066.03	I	12902 – 29383
27		6071.70	I	10376 – 26842
30		6073.97	I	8475 – 24934
14		6101.75	I	11959 – 28344
14		6108.41	II	9674 – 26041
23	d	6133.47	II	14481 – 30781
		6133.58	II	14957 – 31256
27		6149.28	I	9814 – 26072
27		6155.06	I	11918 – 28160
14		6156.16	I	9115 – 25354
35		6157.83	II	4437 – 20672
23		6166.67	II	11709 – 27921
35		6170.49	II	9674 – 25877
45		6178.59	I	14304 – 30484
27		6183.91	II	9358 – 25524
18		6201.74	II	
13		6208.01	II	14301 – 30405
27		6208.24	I	10774 – 26878
9		6210.68	II	9198 – 25295
13		6216.69	I	9115 – 25196
45		6223.39	I	13101 – 29165
27		6226.50	I	8800 – 24856
23		6238.50	II	8420 – 24445
35		6244.08	I	11959 – 27970
13		6248.28	II	9877 – 25877
9		6250.43	II	9357 – 25352
23		6257.49	I	9815 – 25791
27		6258.73	II	10666 – 26640
18		6263.23	II	13298 – 29260
18		6269.42	I	9939 – 25885
13		6270.27	I	
23		6277.29	II	15749 – 31675
18		6282.00	I	11109 – 27023
27		6285.79	I	12056 – 27961
23		6292.84	II	1470 – 17356
23		6297.07	I	11959 – 27835
16		6298.42	II	7525 – 23397
18	h	6301.97	I	
11		6308.26	I	12065 – 27913
55		6310.49	I	10898 – 26740
18		6319.69	II	
11		6321.22	I	8402 – 24218
18		6330.17	II	14301 – 30094
27		6341.51	II	14481 – 30246
9		6355.95	I	12056 – 27785
18		6361.43	II	11709 – 27425
18		6362.09	II	8420 – 24134
18		6365.55	II	7525 – 23230
11		6375.97	I	13101 – 28781
23		6382.07	II	11580 – 27245
65		6385.20	II	9358 – 25014
18		6390.00	II	12276 – 27921
13		6403.20	I	10898 – 26510
18		6425.79	II	13298 – 28856
18		6428.65	II	1650 – 17201
6		6429.84	I	10785 – 26333
16		6432.65	I	10376 – 25918
9		6445.79	II	
14		6451.23	I	10898 – 26394
7		6454.80	I	13333 – 28821
13		6457.13	I	9939 – 25422
14		6463.58	I	9115 – 24582
11		6465.24	II	17001 – 32464
13		6480.21	II	14327 – 29754
5		6482.28	II	2585 – 18008
35		6485.69	I	9115 – 24529
16		6492.35	II	12887 – 28285
7		6495.59	II	10883 – 26274
16		6500.16	I	10774 – 26155
8		6504.46	II	9675 – 25045
16		6514.96	II	1470 – 16815
13		6519.86	II	15923 – 31256
7		6523.15	II	7525 – 22851
13		6539.94	II	6005 – 21292
14		6549.54	II	513 – 15777
14		6550.19	II	2585 – 17848
13		6553.07	II	6932 – 22188
13		6558.97	II	12276 – 27518
7		6568.47	II	17001 – 32221
13		6572.65	II	10666 – 25877
18	h	6580.94	II	11580 – 26772
18		6585.71	II	11580 – 26761
16		6588.03	II	14259 – 29434
11		6591.43	II	1650 – 16817
16		6601.76	I	10774 – 25918
18		6611.99	I	9814 – 24934
11		6615.88	I	10774 – 25885
16	c	6618.53	I	11918 – 27023
18		6619.35	I	8475 – 23578
45		6630.14	I	8475 – 23553
9		6636.15	II	16610 – 31675
18		6637.19	II	11709 – 26772
35		6637.96	II	
45		6650.57	II	15749 – 30781
30		6655.67	I	8475 – 23496
10		6669.65	II	8420 – 23410
10		6670.37	I	12056 – 27044
11		6678.52	II	12276 – 27245
19		6680.14	II	13597 – 28563
6		6698.65	II	13246 – 28170
10		6712.27	I	14687 – 29581
6		6714.15	II	15923 – 30813
19		6727.74	II	14624 – 29484
25		6737.79	II	12906 – 27744
40		6740.11	II	513 – 15345
25		6742.54	I	13333 – 28160
10		6763.01	I	9083 – 23866
9		6763.78	I	11959 – 26740
9		6764.61	II	14481 – 29260
30		6790.37	II	1470 – 16192
11		6801.34	I	10898 – 25596

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
16		6803.06	I	14687 – 29383
30		6804.00	II	11580 – 26274
13	h	6812.30	II	13246 – 27921
13		6816.02	II	6005 – 20673
9		6825.35	I	10774 – 25422
16		6842.66	II	
25		6846.72	II	11580 – 26182
11		6846.94	II	8796 – 23397
11		6852.23	I	9939 – 24529
10		6857.00	I	10774 – 25354
10		6873.05	II	14481 – 29027
14		6874.66	II	12906 – 27448
8		6876.00	II	10942 – 25481
10		6886.78	I	16092 – 30608
14		6896.65	I	12276 – 26772
13		6897.29	II	1650 – 16144
40		6900.43	II	0 – 14487
11		6901.42	II	16295 – 30781
10		6906.03	I	6764 – 21240
17		6923.86	I	0 – 14438
12		6926.87	II	
7		6932.16	I	8800 – 23221
9		6936.44	II	9908 – 24321
12		6938.67	II	10887 – 25295
17		6940.14	II	14957 – 29362
24		6941.39	II	12906 – 27308
5		6964.50	I	13672 – 28027
8		6964.71		
9		6982.65		
7	h	6985.25	I	0 – 14312
9	h	6995.19	I	3681 – 17973
17	h	7010.80	II	12887 – 27146
8		7018.85	II	8420 – 22663
17		7020.92	II	14301 – 28540
17		7024.58	II	2585 – 16817
10		7033.21		
35		7037.30	II	3801 – 18008
7		7052.14	II	9877 – 24053
7		7054.74	II	16610 – 30781
7		7061.47	II	10887 – 25044
40		7066.89	II	5085 – 19232
8		7082.93	II	2585 – 16700
12	h	7089.71	II	9357 – 23459
12	h	7092.09		
12	h	7092.74	II	9908 – 24003
12	h	7092.94		
17	h	7093.98	I	1128 – 15220
20	h	7095.42	I	11360 – 25450
29		7129.35	II	1470 – 15492
12	h	7142.04	II	12276 – 26274
10		7143.72		
8		7151.03	II	11373 – 25353
6		7153.09	I	10774 – 24751
6	h	7185.01		
10		7189.09	II	10337 – 24243
24		7189.42	II	2585 – 16490
20		7192.01	II	11580 – 25481
10		7199.00	II	0 – 13887
8	h	7227.01	I	14327 – 28160
15		7236.54	II	513 – 14328
7	h	7261.64	II	8420 – 22188
9		7285.29	II	9675 – 23397
9		7288.56	II	7525 – 21241
6		7291.38	II	13597 – 27308
7		7298.72	II	12334 – 26031
12		7316.81	II	3801 – 17465
7	h	7321.43	I	13726 – 27381
7		7323.12	II	2585 – 16237
6		7334.54	I	0 – 13630
6		7357.10	I	14438 – 28027
6		7374.04	II	14259 – 27816
7		7381.79	II	1470 – 15013
9		7401.31	I	6764 – 20271
10		7406.62	II	8420 – 21918
6		7411.20	II	1650 – 15139
10		7418.18	II	10942 – 24418
9		7427.41	II	12021 – 25481
9		7448.71	II	12906 – 26328
5		7481.28	II	1650 – 15013
12		7511.16	II	14301 – 27611
17		7513.73	II	7525 – 20830
7	h	7514.44	II	12906 – 26210
7		7516.02	II	10942 – 24243
9		7526.45	II	9877 – 23160
12		7528.99	II	15749 – 29027
10		7538.26	II	11580 – 24842
5		7540.97	II	9198 – 22455
7		7547.00	II	5985 – 19232
5		7577.54	II	1650 – 14843
7		7587.65	II	9675 – 22851
6		7590.75	II	3066 – 16237
6		7603.73	II	7525 – 20673
5		7605.92	II	14301 – 27445
5		7614.72	I	12611 – 25740
9		7639.79	II	5085 – 18171
8		7646.00	II	8796 – 21871
6		7663.52	II	11373 – 24418
12		7696.56	II	9198 – 22187
6		7718.20	II	4512 – 17465
4		7743.90	II	
4		7748.92	II	12334 – 25235
10		7750.95	II	3801 – 16700
6		7773.06	II	0 – 12861
7		7792.22	II	9358 – 22188
6		7796.40	II	10337 – 23160
8		7797.32	II	
5		7798.32	II	9877 – 22696
10		7808.47	II	5085 – 17888
7		7818.83	II	12334 – 25120
5		7825.20	II	10516 – 23292
12		7863.04	II	2585 – 15299
5	h	7872.03	I	11108 – 23808
7		7886.60	II	13597 – 26274
4	h	7896.50	II	12459 – 25120
9		7900.40	II	10883 – 23537
5	h	7906.03	I	15382 – 28027
12		7917.01	II	1470 – 14097
10		7925.03	II	8796 – 21411
5		7947.93	II	9877 – 22455
10		7949.68	II	10883 – 23459
5	h	7955.38	II	12276 – 24842
12		7958.95	I	8800 – 21361
12		7965.73	II	513 – 13063
15		7982.09	II	8717 – 21241
12		7982.68	II	3801 – 16325
12		8000.76	II	8796 – 21291
9		8007.70	I	10785 – 23269
4	h	8020.07		
8		8026.35		
10		8043.24	I	9692 – 22121

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
8		8051.33	II	1470 – 13887
5		8064.00	II	12021 – 24418
10		8099.17	I	11887 – 24231
10		8120.93	II	9877 – 22187
12		8122.07	II	2585 – 14894
12		8141.75	II	9908 – 22187
12		8143.27	II	10883 – 23160
7	h	8164.97	I	
8		8172.56	II	0 – 12232
9		8179.83	II	12021 – 24243
9		8182.41	II	10942 – 23159
4		8185.58	II	12334 – 24547
7	h	8205.38	II	10666 – 22850
10		8231.52	II	1470 – 13615
4		8248.76	II	6637 – 18757
5	h	8249.68	II	5487 – 17606
4	h	8262.80	II	12222 – 24321
7	h	8266.72	II	9198 – 21291
4		8272.79	II	12334 – 24418
4	h	8302.74	II	9877 – 21918
10		8307.72	II	8796 – 20830
6		8324.50	II	9908 – 21918
4		8332.01	II	15148 – 27146
12		8346.36	II	513 – 12491
4		8375.16	II	13298 – 25235
4		8375.33	II	4437 – 16374
4		8394.71	II	12334 – 24243
7		8400.85	II	11392 – 23292
5	h	8456.87	II	13298 – 25120
4		8530.53	II	513 – 12232
5		8582.03	II	13703 – 25352
5		8591.53	II	10942 – 22578
7		8594.87	II	9198 – 20830
8	c	8643.43	II	9675 – 21241
5		8667.07	II	10194 – 21729
5		8677.48		
6		8691.29	II	10887 – 22389
6		8695.07	II	13703 – 25200
6		8712.82	II	9198 – 20672
6		8715.03	I	8800 – 20271
17		8839.10	II	0 – 11310

Nickel

$$\text{Ni, } Z = 28, \; M = 58.7, \; \text{Ratio } \frac{\text{Ni}}{\text{Cu}} = 0.924$$

Ni I Normal state of valence electrons $3d^8 4s^2\ {}^3F_4 = 0$. I.P. $= 61579\ \text{cm}^{-1}$.
Ni II Normal state of valence electrons $3d^9\ {}^2D_{2\,1/2} = 0$. I.P. $= 146532\ \text{cm}^{-1}$.

References

Wavelengths:

G. R. Harrison, Massachusetts Institute of Technology Wavelength Tables (John Wiley & Sons, New York, 1939), below 6000 Å.

K. Burns and F. Sullivan, Sci. Studies St. Bonaventure Coll. **13**, 2 (1947), above 6000 Å.

Classification:

Ni I, H. N. Russell, Phys. Rev. **34**, 821 (1940).

Ni II, A. G. Shenstone, Phys. Rev. **30**, 255 (1927).

Strong lines of nickel

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
8200	3414.76	I	205 – 29481	3700	3012.00	I	3410 – 36601
8200	3524.54	I	205 – 28569	3500	3050.82	I	205 – 32973
6600	3515.05	I	880 – 29321	3300	3380.57	I	3410 – 32982
6600	3619.39	I	3410 – 31031	3300	3392.99	I	205 – 29669
5500	3492.96	I	880 – 29501	2900	3134.11	I	1713 – 33611
5000	3458.47	I	1713 – 30619	2900	3369.57	I	0 – 29669
5000	3461.65	I	205 – 29084	2600	2320.03	I	0 – 43090
5000	3566.37	I	3410 – 31442	2600	3101.55	I	880 – 33112
4800	3446.26	I	880 – 29888	2600	3433.56	I	205 – 29321
4000	3002.49	I	205 – 33501	2600	3510.34	I	1713 – 30192

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
1600	2289.98	I	0 – 43655	55	3195.57	I	2217 – 33501
630	2300.78	I	205 – 43655	150	3197.11	I	1713 – 32982
2000	2310.96	I	0 – 43259	55	3202.14	I	25754 – 56974
1700	2312.34	I	1332 – 44565	180	3214.06	I	25754 – 56858
1400	2313.66	I		180	3217.83	I	25754 – 56821
1400	2313.98	I	2217 – 45419	100	3221.27	I	30923 – 61958
430	2316.04	II	8394 – 51558	150	3221.65	I	0 – 31031
1400	2317.16	I	1332 – 44475	210	3225.02	I	3410 – 34409
2600	2320.03	I	0 – 43090	1100	3232.96	I	0 – 30923
1900	2321.38	I	2217 – 45281	290	3234.65	I	880 – 31786
240	2322.68	I		600	3243.06	I	205 – 31031
1400	2325.79	I	1332 – 44315	100	3248.46	I	205 – 30980
940	2329.96	I	2217 – 45122	120	3250.74	I	3410 – 34163
460	2337.49	I	0 – 42768	100	3271.12	I	880 – 31442
160	2337.82	I	1713 – 44475	120	3282.70	I	1332 – 31786
1200	2345.54	I	0 – 42621	660	3315.66	I	880 – 31031
190	2346.63	I	1332 – 43933	330	3320.26	I	1332 – 31442
400	2347.52	I	0 – 42585	310	3322.31	I	3410 – 33501
160	2360.63	I	2217 – 44565	330	3361.56	I	880 – 30619
200	2362.06	I	1332 – 43655	330	3365.77	I	3410 – 33112
240	2386.58	I	880 – 42768	330	3366.17	I	1332 – 31031
320	2394.52	II	13550 – 55300	65	3366.81	I	27261 – 56954
220	2416.14	II	14995 – 56371	65	3367.89	I	205 – 29888
240	2419.31	I	1332 – 42654	2900	3369.57	I	0 – 29669
85	2421.23	I	1332 – 42621	400	3371.99	I	1332 – 30980
70	2423.33	I	1332 – 42585	260	3374.22	I	205 – 29833
70	2423.66	I	2217 – 43464	130	3374.64	I	27261 – 56885
70	2424.03	I	1713 – 42954	3300	3380.57	I	3410 – 32982
100	2437.89	II	13550 – 54557	240	3380.85	I	2217 – 31786
85	2453.99	I	2217 – 42954	1300	3391.05	I	0 – 29481
160	2472.06	I	2217 – 42656	3300	3392.99	I	205 – 29669
85	2476.87	I	0 – 40361	130	3409.58	I	0 – 29321
45	2696.49	I	3410 – 40484	330	3413.48	I	1332 – 30619
150	2798.65	I	880 – 36601			I	28542 – 57829
250	2821.29	I	205 – 35639	330	3413.94	I	880 – 30163
50	2865.50	I	1713 – 36601	8200	3414.76	I	205 – 29481
60	2907.46	I	2217 – 36601	1600	3423.71	I	1713 – 30913
25	2914.01	I	1332 – 35639	2600	3433.56	I	205 – 29321
500	2943.91	I	205 – 34163	990	3437.28	I	0 – 29084
570	2981.65	I	880 – 34409	4800	3446.26	I	880 – 29888
250	2984.13	I	0 – 33501	1300	3452.89	I	880 – 29833
500	2992.60	I	205 – 33611	5000	3458.47	I	1713 – 30619
1000	2994.46	I	205 – 33590	5000	3461.65	I	205 – 29084
4000	3002.49	I	205 – 33501	200	3467.50	I	1332 – 30163
2200	3003.63	I	880 – 34163	240	3469.49	I	2217 – 31031
3700	3012.00	I	3410 – 36601	1600	3472.54	I	880 – 29669
350	3019.14	I	0 – 33112	550	3483.77	I	2217 – 30913
120	3031.87	I	0 – 32973	130	3485.89	I	1713 – 30392
1700	3037.94	I	205 – 33112	5500	3492.96	I	880 – 29501
150	3045.01	I	1332 – 34163	660	3500.85	I	1332 – 29888
3500	3050.82	I	205 – 32973	65	3502.60	I	0 – 28542
1500	3054.32	I	880 – 33611	55	3507.69	I	1332 – 29833
1900	3057.64	I	1713 – 34409	2600	3510.34	I	1713 – 30192
500	3064.62	I	880 – 33501	260	3513.93	I	1713 – 30163
420	3080.76	I	1713 – 34163	6600	3515.05	I	880 – 29321
260	3097.12	I	1332 – 33611	660	3519.77	I	2217 – 30619
210	3099.12	I	1332 – 33590	8200	3524.54	I	205 – 28569
2600	3101.55	I	880 – 33112	110	3527.98	I	1332 – 29669
1300	3101.88	I	3410 – 35639	330	3548.18	I	2217 – 30392
220	3105.47	I	2217 – 34409	55	3551.53	I	1332 – 29481
270	3114.12	I	880 – 32982	65	3561.75	I	0 – 28068
2900	3134.11	I	1713 – 33611	5000	3566.37	I	3410 – 31442
55	3145.72	I	1332 – 33112	990	3571.87	I	1332 – 29321
55	3181.74	I	15610 – 47030	130	3587.93	I	205 – 28068
100	3184.37	I	2217 – 33611	1300	3597.70	I	1713 – 29501

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
1300		3610.46	I	880 – 28569
530		3612.74	I	2217 – 29888
6600		3619.39	I	3410 – 31031
130		3624.73	I	0 – 27580
200		3664.10	I	2217 – 29501
130		3669.24	I	1332 – 28578
180		3670.43	I	1332 – 28569
260		3674.15	I	3410 – 30619
160		3688.42	I	2217 – 29321
80		3693.93	I	880 – 27944
120		3722.48	I	1713 – 28569
150		3736.81	I	3410 – 30163
60		3739.23	I	1332 – 28068
600		3775.57	I	3410 – 29888
700		3783.53	I	3410 – 29833
700		3807.14	I	3410 – 29669
110		3831.69	I	3410 – 29501
1200		3858.30	I	3410 – 29321
30		3889.67	I	1713 – 27415
35		3972.17	I	3410 – 28578
110		3973.56	I	3410 – 28569
110		4401.55	I	25754 – 48467
85		4459.04	I	26666 – 49086
18		4462.46	I	27944 – 50346
55		4470.48	I	27415 – 49778
35		4592.53	I	28578 – 50346
18		4600.37	I	29013 – 50745
65		4605.00	I	28068 – 49778
18		4606.23	I	29013 – 50717
75		4648.66	I	27580 – 49086
23		4686.22	I	29013 – 50346
110		4714.42	I	27261 – 48467
22		4715.78	I	28578 – 49778
30		4756.52	I	28068 – 49086
15		4763.95	I	29481 – 50466
45		4786.54	I	27580 – 48467
22		4807.00	I	29669 – 50466
22	h	4829.03	I	28569 – 49271
19		4831.18	I	29084 – 49778
45		4855.41	I	28569 – 49159
30		4866.27	I	28542 – 49086
17		4873.44	I	29833 – 50346
40		4904.41	I	28569 – 48953
22		4918.36	I	30980 – 51306
16		4935.83	I	31786 – 52040
45		4980.16	I	29084 – 49158
45		4984.13	I	30619 – 50678
16	h	5000.34	I	29321 – 49314
18		5012.46	I	29833 – 49778
50		5017.59	I	28542 – 48467
100		5035.37	I	29321 – 49175
16		5048.85	I	31031 – 50832
100		5080.52	I	29481 – 49158
65		5081.11	I	31031 – 50706
26	h	5084.08	I	29669 – 49333
18		5099.32	I	29481 – 49086
26	h	5099.95	I	29669 – 49271
21		5115.40	I	30923 – 50466
18	h	5129.38	I	29669 – 49159
23		5137.08	I	13521 – 32982
23	h	5142.77	I	29888 – 49328
40	h	5146.48	I	29888 – 49314
40	h	5155.76	I	31442 – 50832
16		5168.66	I	29833 – 49175
13		5176.56	I	31442 – 50754
8		5435.87	I	16017 – 34409
180		5476.91	I	14729 – 32982
6		5510.00	I	31031 – 49175
6		5578.73	I	13521 – 31442
9		5587.86	I	15610 – 33501
13		5592.28	I	15734 – 33611
9		5614.79	I	33501 – 51306
5	h	5625.33	I	32982 – 50754
4		5649.70	I	33611 – 51306
5		5664.02	I	36601 – 54251
12		5682.20	I	33112 – 50706
8		5695.00	I	32982 – 50537
23		5709.56	I	13521 – 31031
10		5711.90	I	15610 – 33112
10		5715.09	I	32973 – 50466
16		5754.68	I	15610 – 32982
8		5760.85	I	33112 – 50466
10		5857.76	I	33611 – 50678
10		5892.88	I	16017 – 32982
10		6108.12	I	13521 – 29888
10		6176.81	I	32973 – 49158
10		6191.18	I	13521 – 29669
13		6256.36	I	13521 – 29501
10		6314.66	I	15610 – 31442
16		6643.64	I	13521 – 28569
22		6767.77	I	14729 – 29501
9		6772.32	I	29501 – 44263
10		6914.56	I	15734 – 30192
5		7110.90	I	15610 – 29669
26		7122.20	I	28569 – 42606
6		7182.00	I	30192 – 44112
5		7197.02	I	15610 – 29501
5		7261.93	I	15734 – 29501
5		7291.45	I	15610 – 29321
4		7385.24	I	22102 – 35639
16		7393.60	I	29084 – 42606
16		7409.35	I	30619 – 44112
5		7414.51	I	16017 – 29501
23		7422.28	I	29321 – 42790
13		7522.76	I	29501 – 42790
9		7525.12	I	29321 – 42606
19		7555.60	I	31031 – 44263
8		7574.05	I	30913 – 44112
23		7617.00	I	29481 – 42606
9		7619.21	I	29669 – 42790
16		7714.32	I	15610 – 28569
5	h	7715.58	I	29833 – 42790
19		7727.61	I	29669 – 42606
19		7748.89	I	29888 – 42790
10		7788.94	I	15734 – 28569
13		7797.59	I	31442 – 44263
2		7917.44	I	30163 – 42790
2		8809.42	I	31442 – 42790
9		8862.55	I	32982 – 44263

Niobium

Nb, $Z=41$, $M=92.9064$, Ratio $\frac{\text{Nb}}{\text{Cu}}=1.462$

Nb I Normal state of valence electrons $4d^4 5s\ {}^6D_{1/2}=0$. I.P. $=55000$ cm^{-1}.
Nb II Normal state of valence electrons $4d^4\ {}^5D_0=0$. I.P. $=115000$ cm^{-1}.

References

Wavelengths:
G. R. Harrison, Massachusetts Institute of Technology Wavelength Tables (John Wiley & Sons, New York, 1939).
Supplemented by Humphreys' and Meggers' paper cited below.

Classification:
Nb I and Nb II, C. J. Humphreys and W. F. Meggers, J. Research NBS **34**, 477 (1945). RP1656.

Strong lines of niobium

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
16000 c	4058.94	I	1050 – 25680	2000	3535.30	I	0 – 28278
12000	4079.73	I	695 – 25200			I	695 – 28973
6700	4100.92	I	392 – 24770	1800	3094.18	II	4146 – 36455
5300	4123.81	I	154 – 24397	1700	2125.21	II	3030 – 50069
5000	3580.27	I	1050 – 28973	1700	3349.06	I	2154 – 32005
4400	4152.58	I	695 – 24770	1700	3358.42	I	2805 – 32573
4400	4163.66	I	154 – 24165	1700	3742.39	I	0 – 26713
4000	4164.66	I	392 – 24397	1700	3787.06	I	154 – 26552
3500	3791.21	I	1050 – 27420	1500	2131.18	II	2629 – 49537
3500	4168.13	I	0 – 23985	1500	3130.79	II	3542 – 35474
3300	2029.32	II		1500	3575.85	I	695 – 28653
3300	3713.01	I	1050 – 27975	1500	3697.85	I	392 – 27427
3000	2032.99	II	3542 – 52715	1300	3341.97	I	1143 – 31057
2700	3726.24	I	154 – 26983	1300	3343.71	I	1587 – 31485
2700	3739.80	I	695 – 27427	1300	3537.48	I	392 – 28653
2700	3798.12	I	392 – 26713	1300	3790.15	I	1050 – 27427
2700	3802.92	I	695 – 26983	1300	4195.66	I	8827 – 32654
2700	4139.71	I	1050 – 25200	1200	3163.40	II	3030 – 34632
2300	4137.10	I	0 – 24165	1200	4190.88	I	1050 – 24905
2000	2109.42	II	4146 – 51537	1200	4606.77	I	2805 – 24507

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
3300	2029.32	II	
3000	2032.99	II	3542 – 52715
2000	2109.42	II	4146 – 51537
1700	2125.21	II	3030 – 50069
1100	2126.54	II	3542 – 50552
1500	2131.18	II	2629 – 49537
370	2295.68	II	1225 – 44771
280	2302.08	II	801 – 44227
170	2376.40	II	801 – 42869
110	2387.09	II	10836 – 52715
140	2387.52	II	7901 – 49772
45	2388.27	II	7901 – 49759
160	2398.48	II	10247 – 51927
55	2405.34	II	10653 – 52215
55	2405.85	II	10836 – 52389
140	2412.46	II	8320 – 49759
160	2416.99	II	10919 – 52280
140	2418.69	II	10604 – 51936
75	2433.80	II	9510 – 50585
40	2435.95	II	9813 – 50852
35	2436.33	I	2154 – 43187
45	2437.42	II	7506 – 48520
40	2442.14	II	10247 – 51182
28	2442.68	II	16219 – 57145
65	2451.87	II	12263 – 53036
65	2453.95	II	13690 – 54429
55	2458.09	II	14791 – 55461
65	2462.89	I	2805 – 43396
35	2466.73	I	2805 – 43333
55	2469.08	I	2154 – 42643
110	2477.38	II	6192 – 46545
65	2478.29	II	10247 – 50585
65	2479.94	II	10186 – 50498
35	2483.88	II	10604 – 50852
28	2502.49	II	10604 – 50552
110	2504.65	I	2805 – 42719
110	2511.00	II	5562 – 45375
40	2520.51	I	
110	2521.40	II	9510 – 49158
28	2524.99	I	1143 – 40735
90	2525.81	II	10919 – 50498
55	2530.97	II	14626 – 54125
28	2531.25	II	14678 – 54173
90	2540.62	II	14661 – 54010
90	2541.42	II	1225 – 40561
390	2544.80	II	7261 – 46545
28	2548.63	II	13055 – 52280
110	2551.38	II	6192 – 45375
55	2555.63	II	9510 – 48627
130	2556.94	II	7261 – 46359
75	2558.94	I	1143 – 40210
130	2562.41	II	6192 – 45207
130	2565.41	I	1587 – 40555
70	2567.51	I	1143 – 40079
100	2569.03	I	9329 – 48242
28	2570.78	I	1587 – 40474
28	2571.05	I	1587 – 40470
110	2571.33	II	1225 – 40104
70	2572.10	I	1143 – 40010
45	2574.84	II	159 – 38984
55	2576.60	I	2154 – 40953
55	2578.20	I	1587 – 40362
200	2578.74	I	2154 – 40921
45	2580.28	II	9510 – 48253
60	2583.11	I	8827 – 47528
45	2583.22	I	2154 – 40854
390	2583.99	II	9813 – 48501
28	2589.27	I	
390	2590.94	II	10186 – 48771
270	2592.20	I	2805 – 41371
45	2594.34	II	801 – 39335
95	2594.74	II	7901 – 46429
55	2597.14	I	1587 – 40079
85	2601.29	II	10186 – 48617
40	2601.84	I	1587 – 40010
35	2602.01	I	
27	2603.31	I	2154 – 40555
35 h	2608.84	I	2154 – 40474
35	2608.96	II	9813 – 48130
85	2610.28	I	1587 – 39886
75	2612.38	I	2154 – 40422
13	2613.85	II	438 – 38685
130	2616.48	I	2154 – 40362
80	2620.45	II	7506 – 45656
13	2622.00	I	8827 – 46954
130	2623.51	I	1143 – 39248
130	2627.44	I	2805 – 40854
130	2628.49	I	1587 – 39620
95	2632.52	II	8320 – 46296
40	2634.71	I	1587 – 39530
35	2637.98	II	10604 – 48501
95	2640.92	I	2154 – 40009
27	2641.06	II	10919 – 48771
200	2642.24	II	9510 – 47345
320	2646.26	II	438 – 38216
330	2647.50	I	1143 – 38903
240	2649.52	I	2154 – 39886
85	2651.12	II	10919 – 48627
35	2652.94	I	8827 – 46510
95	2653.38	I	2805 – 40482
330	2654.45	I	1587 – 39248
40	2655.70	I	8827 – 46471
310	2656.08	II	159 – 37797
65	2656.98	I	9329 – 46954
160	2657.62	I	2805 – 40422
27	2658.88	II	8320 – 45919
27	2660.04	II	10919 – 48501
40	2661.86	I	2805 – 40362
27	2663.56	II	9813 – 47345
110	2665.25	II	10247 – 47756
110	2666.59	II	801 – 38291
40	2667.15	II	8320 – 45802
110	2667.30	II	0 – 37480
85	2667.76	II	10604 – 48078
130	2668.29	I	2154 – 39620
400	2671.93	II	801 – 38216
200	2673.57	II	15396 – 52788
200	2675.94	II	438 – 37797
27	2677.66	II	10919 – 48253
65	2678.66	II	159 – 37480
95	2679.01	I	1587 – 38903
45	2680.06	II	8320 – 45622
27	2682.13	I	2154 – 39427
65	2686.39	II	18508 – 55722
130	2687.15	I	2805 – 40009
160	2691.77	II	159 – 37298
95	2695.04	I	2154 – 39248
40	2696.05	I	2805 – 39886
1000	2697.06	II	1225 – 38291
320	2698.86	II	438 – 37480

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
40	2700.15	II	7901 – 44925
20	2700.56	II	3542 – 40561
320	2702.20	II	801 – 37797
150	2702.52	II	1225 – 38216
40 h	2704.26	II	13480 – 50447
95	2706.40	II	438 – 37377
35	2707.83	II	9510 – 46429
20	2714.20	I	2805 – 39638
27	2715.34	II	16219 – 53036
27	2715.50	I	2805 – 39620
27	2715.69	I	1143 – 37955
40	2715.88	II	13055 – 49864
65	2716.10	I	1587 – 38393
60	2716.31	II	159 – 36963
470	2716.62	II	1225 – 38024
35	2717.33	II	
27	2717.63	II	9510 – 46296
27	2720.02	I	5965 – 42719
27	2720.26	II	3030 – 39780
40	2721.63	II	0 – 36732
470	2721.98	II	801 – 37528
27	2722.31	I	1143 – 37865
35	2723.66	II	13055 – 49759
60	2723.98	I	2154 – 38854
55	2726.08	I	1143 – 37815
27	2727.43	II	13119 – 49772
35	2728.08	I	1587 – 38232
27	2729.83	I	2805 – 39427
55	2730.32	II	13119 – 49733
310	2733.26	II	801 – 37377
80	2733.46	II	159 – 36732
20	2734.35	II	7506 – 44067
110	2737.09	II	438 – 36963
85	2740.18	II	9813 – 46296
40	2741.15	I	8827 – 45297
27	2744.96	II	10653 – 47073
60	2745.30	II	4146 – 40561
65	2745.73	II	9510 – 45919
200	2746.91	I	1143 – 37537
200	2748.85	I	1587 – 37955
190	2753.01	I	
75	2753.14	II	15396 – 51707
27	2754.07	I	
65	2754.52	II	438 – 36732
95	2755.29	I	8827 – 45110
80	2755.64	I	1587 – 37865
60	2757.26	II	12263 – 48520
280	2758.61	I	2154 – 38393
27	2758.78	II	10836 – 47073
55	2761.00	I	
80	2763.38	I	2805 – 38982
55	2764.56	II	801 – 36963
65	2765.28	II	1225 – 37377
35	2765.93	II	7506 – 43649
17	2766.18	I	12102 – 48242
240	2768.13	II	438 – 36553
17	2769.57	II	10247 – 46343
65	2771.40	II	21073 – 57145
20	2771.65	II	13690 – 49759
310	2773.20	I	2805 – 38854
55	2779.36	I	1143 – 37112
65	2779.72	I	
270	2780.24	II	4146 – 40104
130	2782.36	I	9329 – 45259
27	2790.57	II	10604 – 46429
80	2791.74	II	9813 – 45622
110	2793.05	II	3542 – 39335
27	2795.14	II	13480 – 49246
20	2795.86	I	1587 – 37344
60 c	2797.69	II	11340 – 47073
45	2798.91	II	7901 – 43618
35	2799.36	I	2154 – 37866
40	2800.32	I	1587 – 37287
20	2802.07	I	2154 – 37832
60	2803.81	II	3030 – 38685
40	2808.05	I	1587 – 37188
27	2809.17	II	2629 – 38216
75	2810.81	II	8320 – 43887
40	2811.63	I	11525 – 47081
27	2816.68	II	13666 – 49158
55	2819.21	I	
40	2820.80	II	2357 – 37797
20	2821.92	I	2805 – 38232
75	2825.18	I	2154 – 37540
23	2825.86	II	10919 – 46296
65	2826.48	I	2154 – 37524
190	2827.08	II	159 – 35521
40	2829.75	II	1225 – 36553
95	2835.12	II	3030 – 38291
150	2836.24	I	
110	2840.94	I	2154 – 37344
250	2841.15	II	3030 – 38216
23	2842.02	I	5298 – 40474
280	2842.65	II	2629 – 37797
27	2843.64	II	10186 – 45342
27	2844.44	II	14626 – 49772
55	2845.80	II	9510 – 44639
160	2846.28	II	2357 – 37480
23	2847.24	II	14661 – 49772
65	2848.30	II	14661 – 49759
75	2849.56	II	438 – 35521
110	2851.45	I	10238 – 45297
85	2851.98	I	12102 – 47155
65	2854.17	I	2805 – 37832
45	2857.29	I	5965 – 40953
40	2859.04	II	10836 – 45802
95	2859.96	I	2805 – 37761
240	2861.09	II	2357 – 37298
100	2864.32	I	
100	2865.61	II	0 – 34886
40	2866.67	I	1143 – 36016
500	2868.52	II	2629 – 37480
95	2874.57	I	1143 – 35920
800	2875.39	II	3030 – 37797
270	2876.95	II	3542 – 38291
530	2877.03	II	2629 – 37377
65	2878.74	II	159 – 34886
45	2879.36	II	801 – 35521
45	2879.49	I	2805 – 37524
100	2880.72	II	10919 – 45622
570	2883.18	II	3542 – 38216
65	2884.97	I	12503 – 47155
23	2887.69	II	14626 – 49246
280	2888.83	II	2357 – 36963
35	2889.90	I	1587 – 36180
40	2894.42	II	10836 – 45375
470	2897.81	II	3030 – 37528
400	2899.24	II	3542 – 38024
95	2903.65	I	1587 – 36016
470	2908.24	II	2357 – 36732

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
80		2908.88	II	14791 – 49158
670		2910.59	II	3030 – 37377
470		2911.74	II	2629 – 36963
65		2917.05	II	10653 – 44925
1100		2927.81	II	4146 – 38291
110		2931.47	II	2629 – 36732
35	h	2932.66	II	10836 – 44925
27		2935.29	II	9510 – 43568
35		2937.33	II	10604 – 44639
95		2938.07	I	2154 – 36180
870		2941.54	II	3542 – 37528
110	h	2945.88	II	10836 – 44771
110		2946.12	II	3030 – 36963
110		2946.90	II	2629 – 36553
1100		2950.88	II	4146 – 38024
20		2954.02	II	14678 – 48520
40		2954.53	II	14791 – 48627
35		2955.45	I	10238 – 44063
40		2956.89	II	7901 – 41710
20		2959.97	I	2154 – 35928
40		2963.68	I	4998 – 38730
80		2965.48	I	4998 – 38710
35	d	2970.40	II	12263 – 45919
		2970.47	II	13690 – 47345
400		2972.57	II	11340 – 44971
320		2974.10	II	10919 – 44532
210		2977.68	II	10653 – 44227
60		2978.94	II	17292 – 50852
55		2979.88	II	21473 – 55021
95		2980.72	II	12263 – 45802
65		2981.64	I	2805 – 36334
200		2982.11	II	3030 – 36553
40		2983.14	I	1143 – 34655
55		2985.05	II	13055 – 46545
85		2987.29	I	5298 – 38763
65	d	2988.69	I	9439 – 42889
		2988.79	I	4998 – 38447
330		2990.26	II	11340 – 44771
80		2991.95	II	10653 – 44067
470		2994.73	II	4146 – 37528
27		3000.12	I	
65		3002.21	II	11340 – 44639
40		3005.14	I	1587 – 34854
65		3005.77	II	17292 – 50552
40		3010.38	II	15949 – 49158
40		3010.69	II	17292 – 50498
65		3020.67	I	5298 – 38393
65		3022.74	II	17425 – 50498
140		3024.74	II	10836 – 43887
350		3028.44	II	3542 – 36553
35		3029.74	II	12806 – 45802
300		3032.77	II	10604 – 43568
35		3039.41	II	2629 – 35521
65		3039.68	I	5965 – 38854
40		3039.82	II	11340 – 44227
100		3044.76	II	13666 – 46500
150		3048.10	I	5965 – 38763
110		3053.09	I	5965 – 38710
100		3055.52	II	16053 – 48771
75		3056.62	I	
35		3061.11	I	9329 – 41987
35		3061.24	I	5298 – 37955
75		3063.79	II	13666 – 46296
220		3064.53	II	10247 – 42869
75		3065.26	II	10836 – 43450
35		3066.10	II	13690 – 46296
110		3069.68	II	13055 – 45622
100		3070.90	II	14791 – 47345
35		3071.18	II	15949 – 48501
110		3071.56	II	11340 – 43887
40		3072.41	I	4998 – 37537
65		3072.51	II	13119 – 45656
100		3073.24	II	2357 – 34886
400		3076.87	II	3030 – 35521
110		3080.35	II	10836 – 43290
75		3087.86	II	12263 – 44639
1800		3094.18	II	4146 – 36455
65		3096.50	I	1587 – 33872
140		3099.19	II	2629 – 34886
150		3111.45	I	1587 – 33717
75		3116.36	I	10238 – 42317
65		3122.65	I	2154 – 34169
270		3127.53	II	17425 – 49390
35		3129.64	II	10653 – 42597
1500		3130.79	II	3542 – 35474
75		3133.08	I	8827 – 40735
75		3136.97	I	1143 – 33011
75		3140.50	II	12806 – 44639
390		3145.40	II	8320 – 40104
140		3151.87	I	2154 – 33872
65		3152.16	II	21073 – 52788
1200		3163.40	II	3030 – 34632
40		3172.51	I	1143 – 32654
75		3173.20	II	14791 – 46296
150		3175.78	II	10653 – 42133
		3175.86	II	7506 – 38984
390		3180.29	II	7901 – 39335
65		3181.40	II	7261 – 38685
75		3184.22	II	15949 – 47345
75		3186.54	I	4998 – 36371
200		3187.49	I	2805 – 34169
75		3189.28	II	17425 – 48771
300		3191.10	II	4146 – 35474
150		3191.43	II	17292 – 48617
1000		3194.98	II	2629 – 33919
65		3200.53	I	2154 – 33390
120		3203.35	II	17292 – 48501
300		3206.34	II	7506 – 38685
75		3210.29	I	9329 – 40470
390		3215.60	II	3542 – 34632
90		3217.29	I	5298 – 36371
65		3217.86	I	1587 – 32654
75		3223.32	II	8320 – 39335
800		3225.48	II	2357 – 33351
140		3229.56	II	7261 – 38216
400		3236.40	II	3030 – 33919
40		3246.78	I	1143 – 31934
200		3247.47	II	7901 – 38685
120		3248.94	II	6192 – 36963
160		3249.52	I	1143 – 31908
75		3251.62	I	2154 – 32899
320		3254.07	II	2629 – 33351
75		3260.14	I	1143 – 31808
230		3260.56	II	17470 – 48130
160		3263.37	II	21073 – 51707
160		3264.59	I	2805 – 33428
75		3267.05	I	8827 – 39427
120		3270.47	I	
100		3270.76	I	1143 – 31708
200		3272.07	I	1587 – 32140

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
75	3272.22	II	14791 – 45342
160	3277.67	I	1587 – 32088
200	3283.46	II	16053 – 46500
230	3285.66	I	1587 – 32013
200	3287.59	I	1143 – 31551
160	3287.92	I	5965 – 36371
85	3291.06	II	3542 – 33919
160	3292.02	II	15551 – 45919
85	3294.36	II	15949 – 46296
320	3296.01	I	2805 – 33136
160	3299.61	I	2154 – 32452
120	3304.83	I	13146 – 43396
120	3308.05	I	1587 – 31808
120	3310.47	I	2805 – 33004
85	3311.34	I	12982 – 43173
400	3312.60	I	2154 – 32333
200	3315.22	I	8827 – 38982
200	3318.98	I	1587 – 31708
120	3319.26	I	2805 – 32924
120	3319.58	II	7261 – 37377
40	3320.81	II	15551 – 45656
240	3326.62	I	9329 – 39381
170	3329.36	I	8827 – 38854
110	3332.16	I	2154 – 32156
130	3341.60	II	10186 – 40104
1300	3341.97	I	1143 – 31057
1300	3343.71	I	1587 – 31485
85	3343.96	II	8320 – 38216
130	3346.93	I	4998 – 34868
1700	3349.06	I	2154 – 32005
420	3349.52	I	11525 – 41371
40	3352.59	I	2154 – 31973
340	3354.74	I	2805 – 32605
130	3357.04	I	2154 – 31934
1700	3358.42	I	2805 – 32573
130	3365.58	II	8320 – 38024
340	3366.96	I	9329 – 39021
85	3367.38	I	8705 – 38393
130	3369.16	II	15949 – 45622
65	3369.83	I	9043 – 38710
170	3371.33	I	2154 – 31808
65	3372.09	I	2805 – 32452
65	3372.56	II	10919 – 40561
40	3374.25	II	7901 – 37528
350	3374.92	I	8827 – 38449
65	3376.34	I	12137 – 41746
85	3376.73	I	11248 – 40854
65	3380.05	I	2805 – 32382
270	3380.41	I	1143 – 30716
130	3380.86	I	5298 – 34868
	3380.93	II	16053 – 45622
85	3383.80	I	8411 – 37955
85	3384.66	I	12018 – 41555
170	3386.24	II	9813 – 39335
85	3387.75	I	5298 – 34808
85	3390.63	I	9498 – 38982
40	3391.33	I	12137 – 41615
350	3392.34	I	1587 – 31057
40	3394.98	II	12263 – 41710
170	3395.93	I	1587 – 31026
85	3398.25	I	
120	3399.40	I	2805 – 32214
85	3399.71	II	14661 – 44067
85	3403.02	I	
230	3405.41	I	9498 – 38854
130	3406.13	I	9043 – 38393
270	3408.38	I	2154 – 31485
230	3408.68	II	6192 – 35521
180	3409.19	II	5562 – 34886
75	3409.91	I	11044 – 40362
230	3412.94	II	7261 – 36553
90	3414.07	I	2805 – 32088
180	3415.97	I	9498 – 38763
90	3417.86	I	8705 – 37955
90	3420.63	II	7506 – 36732
180	3423.76	I	2805 – 32005
230	3425.42	II	10919 – 40104
130	3425.85	I	13012 – 42194
230	3426.57	II	10604 – 39780
230	3427.45	I	2805 – 31973
40	3428.79	I	10923 – 40079
130	3429.04	I	5965 – 35120
40	3432.42	I	8411 – 37537
180	3432.70	II	16219 – 45342
75	3433.09	I	9329 – 38449
90	3436.96	II	15551 – 44639
90	3439.92	II	7901 – 36963
180	3440.59	II	8320 – 37377
65	3442.65	I	8827 – 37866
35	3442.79	I	12102 – 41140
90	3445.68	I	12358 – 41371
90	3452.35	II	14661 – 43618
	3452.37	I	11525 – 40482
75	3456.54	I	9329 – 38251
90	3457.79	I	9043 – 37955
75	3458.95	I	5965 – 34868
90	3459.70	I	9498 – 38393
50	3462.65	I	2154 – 31026
170	3463.81	I	13012 – 41874
180	3465.86	I	1143 – 29987
90	3467.47	I	8705 – 37537
130	3469.44	I	9329 – 38144
100	3471.19	I	16919 – 45719
140	3473.02	I	13146 – 41931
50	3475.58	I	12982 – 41746
290	3478.69	I	5965 – 34704
	3478.78	II	10247 – 38984
200	3479.56	II	10604 – 39335
50	3481.05	I	4998 – 33717
100	3484.05	II	6192 – 34886
50	3485.93	I	13515 – 42194
75	3489.09	II	7901 – 36553
230	3491.03	I	1143 – 29779
50	3491.48	I	1143 – 29776
75	3496.03	I	12358 – 40953
200	3497.81	I	392 – 28973
500	3498.63	I	5298 – 33872
100	3503.20	I	9329 – 37866
50	3505.81	I	9439 – 37955
460	3507.96	I	154 – 28653
200	3510.26	II	16053 – 44532
85	3511.19	I	10238 – 38710
200	3515.42	II	10247 – 38685
50	3516.20	I	9329 – 37761
85	3516.86	I	9439 – 37865
200	3517.67	II	16219 – 44639
	3517.76	I	5298 – 33717
200	3520.06	I	1587 – 29987
85	3525.23	I	13012 – 41371
100	3533.66	I	154 – 28445

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
50	3534.12	I	5965 – 34253
2000	3535.30	I	0 – 28278
		I	695 – 28973
1300	3537.48	I	392 – 28653
100	3539.65	I	9043 – 37287
250	3540.96	II	8320 – 36553
100	3541.90	I	13146 – 41371
50	3542.56	I	2805 – 31026
90	3542.98	I	1143 – 29360
500	3544.02	I	0 – 28208
250	3544.65	I	5965 – 34169
100	3548.13	I	1587 – 29763
50	3549.26	I	13405 – 41572
300	3550.45	I	392 – 28549
250	3554.52	I	2154 – 30279
1000	3554.66	I	154 – 28278
50	3559.12	I	4998 – 33087
630	3563.50	I	154 – 28208
630	3563.62	I	392 – 28445
50	3568.51	II	7506 – 35521
100	3568.72	I	4998 – 33011
180	3569.47	I	2154 – 30162
50	3575.13	I	12018 – 39981
1500	3575.85	I	695 – 28653
200	3577.72	I	10238 – 38180
5000	3580.27	I	1050 – 28973
85	3582.36	I	5965 – 33872
500	3584.97	I	392 – 28278
750	3589.11	I	695 – 28549
500	3589.36	I	2805 – 30658
500	3593.97	I	392 – 28208
50	3597.26	I	12288 – 40079
50	3598.35	I	0 – 27783
150	3599.28	I	13146 – 40921
150	3599.63	I	1587 – 29360
500	3602.56	I	695 – 28445
50	3604.08	I	695 – 28434
150	3615.50	I	12358 – 40009
90	3617.71	I	17476 – 45110
50	3618.44	I	154 – 27783
90	3618.90	I	4998 – 32623
300	3619.51	II	7901 – 35521
50	3619.73	II	15949 – 43568
200	3621.03	I	2154 – 29763
140	3625.17	I	10238 – 37815
140	3625.71	I	12982 – 40555
150	3630.62	I	12102 – 39638
100	3633.00	I	12692 – 40210
90	3633.31	II	16053 – 43568
150	3633.71	I	154 – 27666
100	3634.44	I	8827 – 36334
100	3635.32	I	12503 – 40003
100	3636.96	I	12358 – 39846
100	3637.54	I	12137 – 39620
150	3637.83	I	
100	3638.79	I	2805 – 30279
200	3639.33	I	13012 – 40482
150	3640.64	I	154 – 27614
85	3643.34	I	12982 – 40422
85	3643.72	I	15282 – 42719
100	3644.94	I	9439 – 36867
50	3647.31	I	13012 – 40422
420	3649.85	I	392 – 27783
250	3650.81	I	1050 – 28434
400	3651.19	II	7506 – 34886
100	3655.98	I	154 – 27499
100	3657.11	I	13146 – 40482
200	3659.61	II	15551 – 42869
630	3660.37	I	2805 – 30117
55	3661.68	I	10238 – 37540
90	3662.05	I	1143 – 28442
900	3664.70	I	695 – 27975
55	3666.53	I	11248 – 38514
45	3667.00	I	12358 – 39620
55 d	3667.66	I	10923 – 38180
	3667.76	I	
130	3668.62	I	4998 – 32249
220	3669.01	I	5298 – 32546
100	3669.74	I	12288 – 39530
35	3671.37	I	12018 – 39248
55 hc	3672.44	I	392 – 27614
27	3673.23	I	13146 – 40362
270	3674.78	I	392 – 27597
27	3675.17	I	
90	3676.31	I	12692 – 39886
90	3677.08	I	11044 – 38232
110	3677.78	I	9329 – 36511
29	3678.72	I	15467 – 42643
85	3686.56	I	2154 – 29272
29	3687.44	I	12137 – 39248
120	3687.97	II	17425 – 44532
85	3688.18	II	10919 – 38024
120	3688.70	I	695 – 27797
85	3689.04	I	11044 – 38144
150	3693.37	I	4998 – 32066
150	3694.67	I	11525 – 38583
95	3695.90	II	14661 – 41710
130	3697.39	I	5965 – 33004
1500	3697.85	I	392 – 27427
95	3699.93	I	
130	3703.16	I	13012 – 40008
130	3703.91	I	13012 – 40003
140	3704.14	I	11525 – 38514
65	3707.80	I	1587 – 28549
190	3709.25	II	11340 – 38291
	3709.42	I	5298 – 32249
65	3710.45	I	10923 – 37866
330	3711.34	I	0 – 26937
50	3711.78	I	5965 – 32899
3300	3713.01	I	1050 – 27975
190	3713.82	I	695 – 27614
85	3716.21	I	695 – 27597
480	3716.99	I	11248 – 38144
	3717.06	II	13666 – 40561
140	3717.54	I	10923 – 37815
85	3720.46	II	13690 – 40561
65	3721.52	I	12982 – 39846
95	3722.32	I	13146 – 40003
95	3722.95	I	
65	3725.22	I	9498 – 36334
2700	3726.24	I	154 – 26983
140	3727.23	I	11044 – 37866
95	3732.03	I	11044 – 37832
65	3733.32	I	18332 – 45110
65	3733.62	I	1143 – 27919
270	3738.42	I	10238 – 36979
2700	3739.80	I	695 – 27427
670	3740.73	II	13055 – 39780
	3740.84	I	695 – 27420
270	3741.78	I	0 – 26718

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
1700	3742.39	I	0 – 26713
190	3744.00	I	10923 – 37625
140	3746.91	I	
170	3748.55	I	8827 – 35496
65	3750.63	I	1143 – 27797
250	3753.18	I	695 – 27332
40	3755.28	I	1587 – 28208
210	3755.77	I	11248 – 37866
140	3759.55	I	392 – 26983
40	3760.64	I	11248 – 37832
170	3761.13	I	11044 – 37625
40	3762.45	I	
530	3763.49	I	154 – 26718
150	3764.12	I	154 – 26713
350	3765.08	I	0 – 26552
250	3766.13	I	392 – 26937
170	3769.15	I	1143 – 27666
140	3769.98	I	12503 – 39021
75	3770.71	I	11248 – 37761
140	3770.87	I	
530	3771.85	I	392 – 26897
110	3773.15	I	11044 – 37540
65	3774.44	I	5965 – 32452
140	3775.45	I	11044 – 37524
40	3776.60	I	1143 – 27614
50	3777.28	I	2805 – 29272
60	3777.67	I	15282 – 41746
870	3781.01	I	392 – 26832
110	3781.38	II	13666 – 40104
140	3783.84	I	10923 – 37344
140	3786.22	I	2805 – 29209
1700	3787.06	I	154 – 26552
65	3787.48	I	2154 – 28549
65	3789.50	I	2154 – 28535
1300	3790.15	I	1050 – 27427
3500	3791.21	I	1050 – 27420
85	3794.47	I	12102 – 38449
140	3795.54	I	
110	3796.44	I	15282 – 41615
110	3796.59	I	1587 – 27919
110	3796.85	I	13515 – 39846
2700	3798.12	I	392 – 26713
170	3800.94	I	9329 – 35631
270	3801.30	I	11044 – 37344
2700	3802.92	I	695 – 26983
670	3803.88	I	1050 – 27332
530	3804.74	I	11248 – 37524
		II	17292 – 43568
170	3806.20	I	10923 – 37188
60	3806.63	I	14211 – 40474
670	3810.49	I	11525 – 37761
530	3811.03	I	154 – 26386
35	3813.47	I	
530	3815.51	I	695 – 26897
65	3816.34	I	1587 – 27783
210	3818.86	II	12806 – 38984
210	3819.15	I	4998 – 31175
35	3821.19	I	8705 – 34868
670	3824.88	I	695 – 26832
110	3827.01	I	13515 – 39638
35	3828.24	II	13666 – 39780
35	3830.00	I	8705 – 34808
170	3831.84	II	13690 – 39780
35	3833.26	I	12503 – 38583
350	3835.18	I	0 – 26067
250	3836.45	I	9439 – 35497
65	3837.08	I	14899 – 40953
170	3841.81	I	13405 – 39427
140	3842.71	I	9329 – 35345
35	3843.93	I	5965 – 31973
65	3844.08	I	11248 – 37254
210	3845.90	I	392 – 26386
110	3853.38	I	10923 – 36867
35	3854.70	I	11044 – 36979
65	3855.15	I	11044 – 36976
65	3855.45	I	0 – 25930
290	3858.95	I	154 – 26061
35	3860.86	I	12358 – 38251
140 d	3862.93	I	0 – 25880
	3863.05	II	12806 – 38685
350	3863.38	I	5298 – 31175
65	3865.02	II	13119 – 38984
	3865.04	I	13515 – 39381
270	3867.92	I	1050 – 26897
65	3871.19	I	9043 – 34868
35	3875.42	I	12018 – 37815
170	3875.76	I	1143 – 26937
140	3876.96	I	12358 – 38144
530	3877.56	I	1050 – 26832
870	3878.82	I	392 – 26166
	3878.97	I	1587 – 27360
65	3879.35	II	14791 – 40561
670	3883.14	I	695 – 26440
1100	3885.44	I	11525 – 37254
670	3885.68	I	11248 – 36976
210	3886.07	I	154 – 25880
40	3889.63	I	
29	3889.80	I	2154 – 27855
580	3891.30	I	695 – 26386
50	3893.73	I	392 – 26067
50	3894.03	I	11044 – 36717
40	3894.70	I	392 – 26061
170	3895.90	I	9439 – 35100
110	3898.28	II	13690 – 39335
110	3898.56	I	2154 – 27797
65	3899.25	I	15282 – 40921
120	3904.18	I	12018 – 37625
85	3906.91	I	8827 – 34416
40	3908.59	I	13405 – 38982
210	3908.97	I	1143 – 26718
65	3909.60	I	13012 – 38583
130	3913.01	I	11318 – 36867
670	3914.70	I	10923 – 36460
65	3919.00	I	9329 – 34838
65	3919.16	I	12358 – 37866
35	3919.72	II	13480 – 38984
530	3920.20	I	13012 – 38514
110	3922.35	I	12137 – 37625
65	3924.49	I	12358 – 37832
170	3925.00	I	695 – 26166
65	3926.61	I	2154 – 27614
130	3929.29	I	2154 – 27597
35	3931.46	I	9439 – 34868
35	3934.14	I	10923 – 36334
95	3934.41	I	1143 – 26552
85	3935.45	I	12137 – 37540
60	3936.45	I	1587 – 26983
670	3937.44	I	1050 – 26440
95	3937.96	I	12137 – 37524
170	3941.27	I	695 – 26061

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
520		3943.67	I	1587 – 26937
95		3947.53	I	12018 – 37344
65	d	3949.33	I	9439 – 34753
		3949.46	II	14791 – 40104
60		3949.94	I	1587 – 26897
65		3952.37	II	13690 – 38984
95		3953.08	I	11044 – 36334
110		3955.68	I	2154 – 27427
65		3959.36	I	12982 – 38232
35		3960.98	I	13012 – 38251
35		3964.66	I	9439 – 34655
250		3965.69	I	5965 – 31175
910	d	3966.09	I	12137 – 37344
		3966.25	I	2154 – 27360
65		3970.65	I	2154 – 27332
210		3971.85	I	12018 – 37188
		3971.93	I	2805 – 27975
170		3972.52	I	12358 – 37524
110		3973.62	I	16829 – 41987
130		3976.67	I	15282 – 40422
110		3977.94	I	13012 – 38144
110		3978.75	I	1587 – 26713
65		3979.37	I	12692 – 37815
40		3980.48	I	1050 – 26166
35		3982.06	I	13146 – 38251
29		3984.81	I	15467 – 40555
60		3985.18	I	11248 – 36334
110		3988.16	I	16829 – 41896
29		3990.67	I	12137 – 37188
110		3991.68	I	
29		3994.43	I	11248 – 36276
140		3999.18	I	13146 – 38144
40		4000.60	II	14791 – 39780
75		4001.13	I	12358 – 37344
29		4002.26	I	
40	d	4005.93	I	
140		4008.28	I	10238 – 35179
140		4009.71	I	12692 – 37625
65		4012.06	I	1143 – 26061
190		4013.27	I	16919 – 41829
29		4014.93	I	12288 – 37188
40		4016.08	I	
120		4017.56	I	12982 – 37866
29		4020.24	I	
29		4022.39	I	13012 – 37866
150		4023.14	I	12982 – 37832
65		4027.31	I	12288 – 37112
65		4027.98	I	13012 – 37832
29		4029.22	I	
40	h	4030.35	I	
1100		4032.52	I	2805 – 27597
29		4033.20	I	1143 – 25930
65		4035.10	I	13405 – 38180
65		4035.93	I	15439 – 40210
40	h	4038.18	I	
85		4039.10	I	11525 – 36276
250		4039.53	I	13012 – 37761
65	h	4040.47	I	2154 – 26897
85		4042.57	I	12137 – 36867
85		4043.16	I	15282 – 40009
160		4044.10	I	13146 – 37866
130		4044.71	I	13515 – 38232
170		4049.76	I	13146 – 37832
170		4051.52	I	9329 – 34004
35		4056.94	I	12982 – 37625
29		4057.27	I	15439 – 40079
16000	c	4058.94	I	1050 – 25680
210		4059.51	I	10126 – 34753
120		4060.31	I	2805 – 27427
350		4060.79	I	154 – 24773
40		4061.26	I	10238 – 34854
140		4061.54	I	2805 – 27420
85		4064.81	I	12692 – 37287
85		4066.12	I	11044 – 35631
170		4067.16	I	12137 – 36717
210		4068.26	I	10923 – 35496
29		4070.04	I	
140		4070.96	I	12982 – 37540
40		4072.07	II	13666 – 38216
85		4073.51	I	15439 – 39981
		4073.64	I	12982 – 37524
60		4076.09	I	2805 – 27332
75		4077.09	I	15461 – 39981
50		4078.35	I	392 – 24905
40		4078.60	I	13012 – 37524
12000		4079.73	I	695 – 25200
40		4083.78	I	1587 – 26067
85		4084.18	I	5298 – 29776
270		4084.86	I	1587 – 26061
85		4086.63	I	9439 – 33902
40		4087.05	I	13405 – 37865
140		4090.16	I	12018 – 36460
50		4095.56	I	13405 – 37815
40	h	4097.64	I	17476 – 41874
50		4098.22	I	13146 – 37540
170		4099.07	I	154 – 24543
440		4100.40	I	392 – 24773
6700		4100.92	I	392 – 24770
75		4106.18	I	9043 – 33390
35		4106.78	I	1587 – 25930
40		4109.88	I	5298 – 29623
140		4112.13	I	16829 – 41140
50		4113.35	I	12982 – 37287
170		4113.94	I	11044 – 35345
310		4116.90	I	0 – 24283
85		4119.28	II	21073 – 45342
120		4122.81	I	11248 – 35496
5300		4123.81	I	154 – 24397
75		4125.25	I	10923 – 35157
50		4125.58	I	2154 – 26386
50		4126.90	I	
85		4127.45	I	16919 – 41140
670		4129.43	I	695 – 24905
770		4129.93	I	
85		4131.53	I	12137 – 36334
170		4134.59	I	11318 – 35497
75		4135.42	I	12692 – 36867
2300		4137.10	I	0 – 24165
75		4137.59	I	12018 – 36180
50		4138.30	I	18036 – 42194
440		4139.44	I	392 – 24543
2700		4139.71	I	1050 – 25200
50		4142.24	I	11044 – 35179
350		4143.21	I	154 – 24283
50		4146.00	I	11044 – 35157
160		4147.19	I	11525 – 35631
85		4148.74	I	8827 – 32924
870		4150.12	I	
120		4152.04	I	695 – 24773
4400		4152.58	I	695 – 24770

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
35	4156.68	II	16053 – 40104
170	4158.01	I	12137 – 36180
50	4160.80	I	2805 – 26832
75	4161.25	I	13515 – 37540
50	4162.81	I	10238 – 34253
870	4163.47	I	2154 – 26166
4400	4163.66	I	154 – 24165
4000	4164.66	I	392 – 24397
85	4165.85	I	12018 – 36016
3500	4168.13	I	0 – 23985
170	4169.57	I	12358 – 36334
120	4173.95	I	18036 – 41987
85	4174.34	I	8705 – 32654
50	4177.44	I	10238 – 34169
85	4179.76	I	12358 – 36276
85	4181.34	I	11248 – 35157
310	4184.44	I	392 – 24283
75	4186.10	I	13405 – 37287
60	4189.99	I	18036 – 41896
85	4190.65	I	9043 – 32899
1200	4190.88	I	1050 – 24905
870	4192.07	I	695 – 24543
60	4193.83	I	8411 – 32249
870	4195.09	I	154 – 23985
1300	4195.66	I	8827 – 32654
50	4196.95	I	11525 – 35345
50	4197.61	I	16919 – 40735
310	4198.51	I	695 – 24507
75	4198.85	I	11044 – 34854
35	4200.99	I	5965 – 29763
350	4201.52	I	11044 – 34838
65	4203.41	I	13405 – 37188
65	4204.32	I	8827 – 32605
870	4205.31	I	392 – 24165
85	4206.13	I	12692 – 36460
150	4208.16	I	154 – 23911
85	4212.04	I	12982 – 36717
85	4212.53	I	10923 – 34655
85	4213.26	I	12288 – 36016
40	4213.46	I	16829 – 40555
350	4214.73	I	1050 – 24770
420	4217.94	I	695 – 24397
40	4222.68	I	9329 – 33004
75	4226.22	I	8411 – 32066
40	4227.51	I	9438 – 33087
420	4229.15	I	9498 – 33136
170	4229.83	I	2805 – 26440
130	4230.32	I	12288 – 35920
170	4231.95	I	392 – 24015
75	4237.81	I	11248 – 34838
85	4241.45	I	9329 – 32899
120	4242.63	I	18332 – 41896
130	4246.30	I	8705 – 32249
29	4248.66	I	154 – 23684
130	4249.46	I	0 – 23526
160	4252.97	I	9498 – 33004
140	4253.70	I	9043 – 32546
130	4254.69	I	8411 – 31908
250	4255.44	I	10923 – 34416
40	4255.94	I	
85	4258.91	I	9329 – 32802
85	4261.71	I	9043 – 32501
770	4262.05	I	1050 – 24507
420	4266.02	I	8705 – 32140
85	4268.67	I	154 – 23574
290	4270.69	I	9043 – 32452
35	4272.97	I	10923 – 34319
29	4273.36	I	12102 – 35496
75	4274.69	I	8827 – 32214
130	4277.50	I	154 – 23526
75	4279.50	I	8705 – 32066
40	4279.71	I	12137 – 35496
160	4280.60	I	5298 – 28653
75	4286.22	I	12692 – 36016
400	4286.99	I	695 – 24015
190	4289.44	I	5965 – 29272
140	4291.19	I	8411 – 31708
75	4292.04	I	392 – 23684
140	4292.48	I	9043 – 32333
110	4295.62	I	12358 – 35631
120	4296.16	I	
580	4299.60	I	5298 – 28549
580	4300.99	I	5965 – 29209
29	4303.88	I	8705 – 31934
75	4306.28	I	9439 – 32654
40	4308.12	I	9043 – 32249
75	4308.69	I	8705 – 31908
120	4309.56	I	12982 – 36180
390	4311.27	I	13146 – 36334
	4311.39	I	13146 – 36334
65	4311.70	I	1587 – 24773
120	4312.45	I	392 – 23574
40	4313.88	I	16829 – 40003
40	4316.48	I	12018 – 35179
40	4318.01	I	10238 – 33390
29	4323.47	I	9329 – 32452
350	4326.33	I	9498 – 32605
120	4327.38	I	8705 – 31808
95	4328.43	I	9043 – 32140
75	4329.73	I	154 – 23244
390	4331.37	I	4998 – 28079
29	4337.56	I	9498 – 32546
29	4338.70	I	12137 – 35179
140	4342.82	I	12137 – 35157
95	4345.32	I	0 – 23007
40	4346.12	I	8705 – 31708
40	4347.31	I	13515 – 36511
140	4348.65	I	695 – 23684
110	4349.03	I	12358 – 35345
40	4350.30	I	8827 – 31808
290	4351.57	I	8827 – 31801
60	4353.27	I	1050 – 24015
29	4354.19	I	11044 – 34004
29	4356.85	I	12982 – 35928
65	c 4359.85	I	9043 – 31973
35	4361.65	I	4998 – 27919
40	4367.97	II	13666 – 36553
210	4368.43	I	9329 – 32214
24	4369.62	I	695 – 23574
60	4370.36	I	2805 – 25680
40	4374.78	I	391 – 23244
29	4375.25	I	10238 – 33087
140	4377.96	I	12018 – 34854
65	4379.52	I	9329 – 32156
40	4381.13	I	13515 – 36334
24	4382.49	I	12288 – 35100
35	4382.84	I	1587 – 24397
65	4384.86	I	12358 – 35157
65	4387.74	I	4998 – 27783
130	4388.36	I	5298 – 28079

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
160	4392.69	I	9329 – 32088
65	4397.04	I	12102 – 34838
35	4400.35	I	16919 – 39638
60	4400.83	I	12137 – 34854
35	4402.05	I	
35	4406.55	I	5965 – 28653
330	4410.21	I	4998 – 27666
95	4411.52	I	10238 – 32899
24	4412.18	I	8827 – 31485
29	4414.88	I	9043 – 31688
24	4416.41	I	12018 – 34655
190	4419.44	I	5298 – 27919
60	4419.83	I	2154 – 24773
60	4420.45	I	2154 – 24770
95	4420.64	I	392 – 23007
29	4423.87	I	16829 – 39427
95	4426.68	I	5965 – 28549
95	4429.44	I	5965 – 28535
230 c	4437.22	I	
24	4437.90	I	17476 – 40003
19	4440.43	I	12982 – 35496
60	4441.81	I	9498 – 32005
60	4445.85	I	1050 – 23537
75	4446.17	I	13146 – 35631
290	4447.18	I	5965 – 28445
140	4456.80	I	1143 – 23574
140	4457.42	I	1587 – 24015
60	4458.12	I	13405 – 35829
50	4460.20	I	
85	4460.42	I	13515 – 35928
85	4464.15	I	2805 – 25200
24	4465.92	I	10238 – 32623
24	4466.42	I	1143 – 23526
50	4469.32	I	5298 – 27666
140	4469.71	I	12288 – 34655
140	4471.29	I	9329 – 31688
140	4472.53	I	2154 – 24507
29	4475.28	I	
29	4481.44	I	10238 – 32546
19	4492.96	II	21040 – 43290
50	4494.57	I	5965 – 28208
19	4497.25	I	8827 – 31057
75	4499.80	I	12102 – 34319
150	4503.04	I	5298 – 27499
24	4503.42	I	13146 – 35345
50	4508.41	I	12982 – 35157
75	4511.09	I	17476 – 39638
19	4512.13	I	9329 – 31485
530	4523.41	I	1143 – 23244
75	4524.12	I	1587 – 23684
24	4527.65	II	12806 – 34886
24	4529.42	I	11318 – 33390
40	4542.80	I	0 – 22007
480	4546.82	I	1587 – 23574
24	4547.85	I	9043 – 31026
85	4553.84	I	5965 – 27919
40	4556.84	I	4998 – 26937
19	4559.42	I	
370	4564.53	I	12102 – 34004
24	4570.95	I	12982 – 34854
720	4573.08	I	2154 – 24015
19	4574.33	I	11044 – 32899
75	4574.84	I	154 – 22007
40	4575.37	I	10238 – 32088
24	4579.45	II	13690 – 35521
480	4581.62	I	12503 – 34323
75	4582.29	I	5965 – 27783
24	4599.48	I	9439 – 31175
95	4600.21	I	12503 – 34235
19	4602.86	I	4998 – 26718
1200	4606.77	I	2805 – 24507
24	4608.58	I	13146 – 34838
19	4610.69	I	10923 – 32605
29	4612.12	I	11248 – 32924
170	4616.17	I	1587 – 23244
19	4627.48	I	
450	4630.11	I	11525 – 33116
65	4638.10	I	11248 – 32802
26	4643.31	I	2154 – 23684
65 c	4643.68	I	11044 – 32573
55	4646.95	I	18332 – 39846
450	4648.95	I	1143 – 22647
110	4649.27	I	
35	4658.18	I	5965 – 27427
450	4663.83	I	1587 – 23023
26	4665.33	I	12288 – 33717
340	4666.24	I	11248 – 32672
240	4667.22	I	2154 – 23574
35	4669.87	I	11044 – 32452
580	4672.09	I	2805 – 24203
35	4673.59	I	18036 – 39427
530	4675.37	I	2154 – 23537
110	4678.48	I	8411 – 29779
26	4682.66	I	16672 – 38021
320	4685.14	I	11044 – 32382
65	4694.51	I	16981 – 38277
65	4695.47	I	10923 – 32214
90	4697.47	I	8705 – 29987
130 c	4706.14	I	
260	4708.29	I	10923 – 32156
35	4713.05	I	8411 – 29623
150	4713.50	I	2805 – 24015
65	4715.83	I	16672 – 37871
65	4718.02	I	
55	4723.80	I	17937 – 39101
55	4727.33	I	11525 – 32672
65	4730.31	I	11248 – 32382
80	4733.48	I	392 – 21512
110 c	4733.89	I	9043 – 30162
55	4735.33	I	11044 – 32156
65	4736.49	I	17476 – 38583
65	4740.61	I	5298 – 26386
65	4743.84	I	8705 – 29779
80	4744.62	I	12358 – 33428
220 c	4749.70	I	11525 – 32573
65	4751.42	I	16981 – 38021
26	4755.32	I	13146 – 34169
65	4766.81	I	17304 – 38277
35	4771.85	I	9329 – 30279
80	4773.25	I	9043 – 29987
21	4777.62	I	12503 – 33428
26	4785.70	I	12982 – 33872
65	4789.96	II	19690 – 40561
26	4802.45	I	695 – 21512
40	4807.06	I	12102 – 32899
55	4809.37	I	12137 – 32924
80 c	4810.60	I	9498 – 30279
110	4816.38	I	11248 – 32005
55	4829.30	I	17937 – 38638
65	4833.37	I	154 – 20838

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
26		4837.62	I	18435 – 39101
26		4837.99	I	9498 – 30162
55		4842.15	I	12358 – 33004
55		4845.17	I	12503 – 33136
110	c	4848.37	I	9498 – 30117
80		4868.99	I	18876 – 39409
90		4890.75	I	11044 – 31485
55		4892.50	I	12018 – 32452
26		4895.58	I	5965 – 26386
65		4900.79	I	12102 – 32501
65		4904.53	I	0 – 20384
80		4910.95	I	13515 – 33872
50		4928.98	I	13146 – 33428
29		4941.52	I	12102 – 32333
29		4953.13	I	9439 – 29623
85	c	4965.37	I	10923 – 31057
130	c	4967.78	I	13012 – 33136
50		4971.93	I	0 – 20107
110		4973.14	I	12503 – 32605
50		4975.14	I	12358 – 32452
190		4988.97	I	695 – 20734
65		4994.30	I	
75		4997.88	I	12137 – 32140
85		5000.95	I	13146 – 33136
65		5002.25	I	12102 – 32088
40		5013.27	I	12982 – 32924
230		5017.75	I	392 – 20316
40		5019.51	I	12982 – 32899
150		5026.36	I	12018 – 31908
40		5030.13	I	13515 – 33390
210		5039.04	I	154 – 19994
40		5047.96	I	14899 – 34704
170		5058.01	I	0 – 19765
65		5059.35	I	12692 – 32452
130		5065.25	I	695 – 20432
40		5077.40	I	12018 – 31708
750		5078.96	I	1050 – 20734
40	c	5094.41	I	0 – 19624
420		5095.30	I	695 – 20316
170		5100.16	I	392 – 19994
170		5120.30	I	392 – 19917
85		5121.80	I	12982 – 32501
85		5127.66	I	10126 – 29623
40		5133.34	I	5298 – 24773
210		5134.75	I	154 – 19624
75		5140.58	I	12692 – 32140
75		5147.54	I	15282 – 34704
40		5150.64	I	11248 – 30658
75		5152.63	I	9043 – 28445
250		5160.33	I	392 – 19765
250		5164.38	I	2154 – 21512
230		5180.31	I	695 – 19994
110		5186.98	I	154 – 19428
190		5189.20	I	1050 – 20316
170		5193.08	I	1587 – 20838
150		5195.84	I	1143 – 20384
65		5203.22	I	8705 – 27919
35		5205.13	I	9329 – 28535
85	c	5219.10	I	9498 – 28653
65		5225.16	I	11525 – 30658
150		5232.81	I	9329 – 28434
85	c	5237.43	I	8411 – 27499
29		5240.39	I	8705 – 27783
150	d	5251.62	I	0 – 19037
		5251.81	I	392 – 19428
75		5253.03	I	11248 – 30279
85		5253.93	I	8827 – 27855
50		5269.92	I	8827 – 27797
270		5271.53	I	1143 – 20107
25		5272.48	I	8705 – 27666
130	c	5276.20	I	9498 – 28445
29	c	5279.43	I	9498 – 28434
50		5285.26	I	
35		5296.34	I	14211 – 33087
50		5315.55	I	5965 – 24773
17		5317.01	I	11044 – 29846
250		5318.60	I	1587 – 20384
50		5319.49	I	8705 – 27499
75		5334.87	I	9043 – 27783
25		5336.81	I	695 – 19428
50		5340.80	I	11044 – 29763
25		5343.58	I	
460		5344.17	I	2805 – 21512
340		5350.74	I	2154 – 20838
40		5353.28	I	20734 – 39409
25		5355.31	I	12358 – 31026
40		5355.70	I	11525 – 30191
29		5359.19	I	8705 – 27360
17		5362.01	I	392 – 19037
40		5375.27	I	11248 – 29846
40		5381.34	I	5965 – 24543
17		5388.30	I	9043 – 27597
21		5395.86	I	4998 – 23526
29		5396.33	I	8411 – 26937
29		5411.24	I	11044 – 29519
21		5416.30	I	11318 – 29776
65		5422.44	I	10923 – 29360
21		5431.26	I	1587 – 19994
110		5437.27	I	5298 – 23684
19		5448.31	I	10923 – 29272
19		5456.19	I	20316 – 38638
40		5458.04	I	9043 – 27360
19	h	5468.10	I	19994 – 38277
40		5481.00	I	18036 – 36276
13		5483.09	I	
19		5483.49	I	8705 – 26937
13		5491.06	I	20432 – 38638
17		5499.53	I	1587 – 19765
40		5504.58	I	2154 – 20316
17		5509.12	I	13405 – 31551
35	c	5512.82	I	
17		5517.39	I	
50		5523.57	I	9498 – 27597
25		5541.47	I	10238 – 28278
85		5551.35	I	4998 – 23007
29		5563.00	I	10238 – 28208
17	c	5571.44	I	18332 – 36276
35	c	5576.16	I	2805 – 20734
35		5578.29	I	12358 – 30279
50		5586.97	I	1143 – 19037
17	c	5590.95	I	
13		5594.89	I	17476 – 35345
17	c	5599.59	I	9043 – 26897
40		5603.52	I	1587 – 19428
13		5603.93	I	2154 – 19994
25		5628.26	I	2154 – 19917
65		5629.17	I	12358 – 30117
35	c	5635.42	I	
170		5642.11	I	5965 – 23684
35		5645.30	I	5298 – 23007

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
17	5654.14	I	10238 – 27919
130	5664.71	I	1143 – 18791
170	5665.63	I	13012 – 30658
17	5666.86	I	15282 – 32924
65 cw	5671.02	I	11345 – 28973
85	5671.91	I	12137 – 29763
25	5677.47	I	5965 – 23574
25	5693.09	I	5965 – 23526
35 d	5697.90	I	13629 – 31175
	5698.03	I	10238 – 27783
40	5706.16	I	15282 – 32802
85	5706.48	I	8411 – 25930
29	5709.33	I	13515 – 31026
17	5715.59	I	12288 – 29779
65	5716.35	I	12358 – 29846
25	5725.66	I	18036 – 35496
130	5729.19	I	1587 – 19037
21	5737.36	I	
13	5738.20	I	
85	5751.44	I	12137 – 29519
110	5760.34	I	8705 – 26061
65	5764.99	I	12018 – 29360
29	5771.08	I	15282 – 32605
50 c	5776.07	I	11345 – 28653
17	5780.34	I	12692 – 29987
85	5787.54	I	2154 – 19428
17	5789.79	I	13012 – 30279
50	5794.24	I	12018 – 29272
50	5804.03	I	8705 – 25930
29 h	5815.33	I	12018 – 29209
110	5819.43	I	13012 – 30191
35	5820.62	I	16829 – 34004
75	5834.90	I	13146 – 30279
25	5838.15	I	11318 – 28442
130 d	5838.64	I	9043 – 26166
50	5842.47	I	2805 – 19917
17	5846.09	I	11345 – 28445
65	5866.47	I	5965 – 23007
35	5874.70	I	9043 – 26061
17	5877.79	I	4998 – 22007
40	5893.44	I	14211 – 31175
190 cw	5900.62	I	9498 – 26440
40 c	5903.80	I	11345 – 28278
29	5927.41	I	15467 – 32333
40 c	5934.16	I	17476 – 34323
40	5957.70	I	12982 – 29763
150	5983.22	I	5298 – 22007
65	5986.08	I	13146 – 29846
85 cw	5997.93	I	9498 – 26166
50	6029.75	I	12692 – 29272
50	6031.84	I	15439 – 32013
50	6045.50	I	12982 – 29519
25	6048.72	I	17476 – 34004
29	6056.65	I	15467 – 31973
29	6107.71	I	15439 – 31808
40	6142.51	I	14899 – 31175
50	6148.13	I	13515 – 29776
50	6164.32	I	13405 – 29623
29	6213.06	I	15461 – 31551
75	6221.96	I	8705 – 24773
40 c	6251.76	I	18332 – 34323
21	6260.77	I	18036 – 34004
85 c	6430.46	I	5965 – 21512
50 c	6433.22	I	5298 – 20838
17	6497.84	I	4998 – 20384
65	6544.61	I	9498 – 24773
15	6574.73	I	8705 – 23911
19 cw	6591.00	I	
19	6606.16	I	
19	6607.28	I	13405 – 28535
35	6614.15	I	8411 – 23526
19	6626.98	I	5298 – 20384
210 cw	6660.84	I	9498 – 24507
150 cw	6677.33	I	9043 – 24015
65	6701.20	I	13515 – 28434
130 c	6723.62	I	8705 – 23574
75	6739.88	I	8411 – 23244
25	6795.31	I	
85	6828.11	I	9043 – 23684
25 c	6849.35	I	8411 – 23007
19	6870.92	I	
40	6876.36	I	8705 – 23244
25 c	6902.89	I	9043 – 23526
35	6908.07	I	9439 – 23911
40	6918.32	I	13405 – 27855
17	6946.07	I	13405 – 27797
17	6972.49	I	14211 – 28549
25	6986.09	I	14899 – 29209
85	6990.32	I	8705 – 23007
17 c	6996.11	I	13629 – 27919
21	7023.48	I	14211 – 28445
17	7038.04	I	12692 – 26897
190 c	7046.81	I	9498 – 23684
8	7066.41	I	12018 – 26166
8	7075.23	I	5298 – 19428
40 c	7098.94	I	12358 – 26440
17 cw	7102.01	I	9498 – 23574
19	7119.31	I	12018 – 26061
15	7122.95	I	
35	7126.17	I	12137 – 26166
17	7130.06	I	12692 – 26713
130	7159.43	I	9043 – 23007
17	7191.37	I	
19 c	7208.94	I	14211 – 28079
50	7252.35	I	10126 – 23911
15	7274.81	I	15467 – 29209
13	7317.03	I	24905 – 38568
17 c	7323.92	I	14899 – 28549
29 cw	7328.38	I	12288 – 25930
65 c	7353.16	I	8411 – 22007
190 cw	7372.50	I	11345 – 24905
13	7419.83	I	12692 – 26166
15	7436.02	I	
19	7478.20	I	12692 – 26061
65	7515.93	I	8705 – 22007
29 c	7519.77	I	13146 – 26440
170 c	7574.58	I	11345 – 24543
17 c	7583.21	I	12982 – 26166
13	7639.81	I	
13	7647.71	I	24770 – 37842
25	7703.33	I	25200 – 38178
75 c	7726.68	I	11345 – 24283
25	7757.31	I	25680 – 38568
6	7787.11	I	
13 cw	7873.41	I	14899 – 27597
35	7885.31	I	11525 – 24203
25	7938.89	I	11318 – 23911
8	7954.76	I	9439 – 22007
40	8135.20	I	11248 – 23537
13 cw	8240.00	I	8705 – 20838

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
29 cw	8320.93	I	9498 – 21512	17 c	8560.54	I	8705 – 20384
29	8346.08	I	11044 – 23023	17	8575.87	I	12358 – 24015
10	8350.04	I	8411 – 20384	21 c	8697.55	I	13012 – 24507
17	8439.77	I	12358 – 24203				
17 cw	8475.98	I	9043 – 20838	21	8740.96	I	12137 – 23574
				21	8767.97	I	8705 – 20107
25	8526.99	I	10923 – 22647	29 cw	8815.56	I	9498 – 20838
13 c	8547.25	I	8411 – 20107	35	8905.78	I	12018 – 23244

Osmium

$$\text{Os}, Z=76, M=190.2, \text{ Ratio } \frac{\text{Os}}{\text{Cu}}=2.993$$

Os I Normal state of valence electrons $5d^6 6s^2\ {}^5D_4=0$. I.P. $=69000\ \text{cm}^{-1}$.
Os II Normal state of valence electrons $5d^6 6s\ {}^6D_{4\frac{1}{2}}=0$.

References

Wavelengths:

G. R. Harrison, Massachusetts Institute of Technology Wavelength Tables (John Wiley & Sons, New York, 1939).

W. Albertson, unpublished material (1938).

Th. A. M. van Kleef, Proc. Koninkl. Ned. Akad. Wetenschap. B. **63**, 501–601 (1960).

Classification:

Os I, W. Albertson, Phys. Rev. **45**, 304 (1934).
G. G. Gluck, Y. Bordarier, J. Bauche, and Th. A. M. van Kleef, Physica **30**, 2068 (1964).

Os I and Os II, Th. A. M. van Kleef, Proc. Koninkl. Ned. Akad. Wetenschap. B. **63**, 501–601 (1960).

Strong lines of osmium

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
29000	2018.14	I	0 – 49534	7800	2067.21	II	3593 – 51952
29000	2020.26			7600	3301.56	I	0 – 30280
26000	2045.36	I	0 – 48875	7200	2076.95	I	0 – 48132
18000	2034.44	I	0 – 49138	7200	2078.09		
17000	2010.15	I	0 – 49731	6600	2119.79		
14000	2022.76	I	2740 – 52162	6000	2097.60	I	5144 – 52802
14000	2028.23	I	4159 – 53447	5300	2100.63	I	2740 – 50330
14000	2079.97	I	0 – 48062	5300	2137.11	I	4159 – 50937
13000	2003.73	I	4159 – 54050	5100	2838.63	I	5144 – 40362
13000	2061.69	I	2740 – 51229	4900	4260.85	I	0 – 23463
9600	2001.45	I	0 – 49947	4900	4420.47	I	0 – 22616
9600	2909.06	I	0 – 34365	4800	2117.96	I	0 – 47200
9000	2004.78			4500	2488.55	I	5144 – 45316
8600	2058.69	I	0 – 48559	4400	3018.04	I	0 – 33124
	2058.78	I	4159 – 52716	4200	2070.67	II	3929 – 52206
8600	3058.66	I	0 – 32685	3800	2637.13	I	0 – 37909
7800	2048.28	I	2740 – 51546	3700	3752.52	I	2740 – 29382
7800	2049.42	I	4159 – 52938				

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
9600	2001.45	I	0 – 49947
13000	2003.73	I	4159 – 54050
9000	2004.78		
17000	2010.15	I	0 – 49731
29000	2018.14	I	0 – 49534
29000	2020.26		
14000	2022.76	I	2740 – 52162
14000	2028.23	I	4159 – 53447
18000	2034.44	I	0 – 49138
26000	2045.36	I	0 – 48875
7800	2048.28	I	2740 – 51546
7800	2049.42	I	4159 – 52938
8600	2058.69	I	0 – 48559
	2058.78	I	4159 – 52716
13000	2061.69	I	2740 – 51229
7800	2067.21	II	3593 – 51952
4200	2070.67	II	3929 – 52206
7200	2076.95	I	0 – 48132
7200	2078.09		
14000	2079.97	I	0 – 48062
2900	2082.54	I	4159 – 52162
2900	2089.03	I	0 – 47854
2900	2089.21	I	2740 – 50589
6000	2097.60	I	5144 – 52802
5300	2100.63	I	2740 – 50330
2100	2117.66	I	2740 – 49947
4800	2117.96	I	0 – 47200
6600	2119.79		
1900	2123.84	I	4159 – 51229
5300	2137.11	I	4159 – 50937
2400	2149.97		
2600	2154.59	I	2740 – 49138
1300	2157.84	I	0 – 46328
1200	2158.53	I	2740 – 49054
2400	2161.00		
3100	2166.90	I	4159 – 50294
1100	2167.75	I	0 – 46117
2100	2171.65	I	2740 – 48773
960	2184.68	I	0 – 45759
840	2194.39	II	3593 – 49149
760	2202.49	I	0 – 45389
600	2227.98	I	0 – 44870
1100	2234.61	I	2740 – 47477
1300	2252.15	I	8743 – 53131
2000	2255.85	II	0 – 44315
1400	2264.60	I	4159 – 48303
360	2268.28	I	2740 – 46813
960	2270.17	I	2740 – 46776
1400	2282.26	II	0 – 43802
840	2283.67	I	4159 – 47935
570	2289.32	I	4159 – 47828
380	2297.31	I	0 – 43516
660	2308.31	I	5144 – 48452
190	2313.75	II	5592 – 48799
550	2320.18	I	
310	2323.98	I	
660	2324.24	I	0 – 43011
170	2325.51	I	5144 – 48132
330	2326.99	I	6093 – 49054
310	2334.56	I	2740 – 45562
720	2336.80	II	3593 – 46374
430	2338.63	I	0 – 42747
290	2340.69	I	5144 – 47854
430	2343.74	I	4159 – 46813
260	2345.75	I	4159 – 46776
430	2347.38	I	8743 – 51329
230	2350.23	II	5592 – 48128
60	2351.55	I	10166 – 52678
60	2351.72	I	11378 – 53887
360	2352.99	I	8743 – 51229
120	2355.28	II	3929 – 46374
240	2356.92	I	
240	2357.25	I	8743 – 51152
310	2362.41	I	0 – 42317
900	2362.77	I	0 – 42310
190	2363.33	I	8743 – 51043
500	2367.35	II	3929 – 46157
290	2369.24	I	8743 – 50937
500	2370.70	I	4159 – 46328
480	2371.18	I	8743 – 50903
85	2374.33	I	4159 – 46264
95	2374.51	I	11031 – 53131
95	2375.06	II	
2600	2377.03	I	5144 – 47200
260	2377.61	I	11378 – 53424
95	2378.14	I	5766 – 47802
95	2378.74	I	12774 – 54800
900	2379.39	I	5144 – 47158
180	2379.64	I	4159 – 46170
180	2379.84		
95	2380.82	I	2740 – 44730
180	2382.46	I	11378 – 53338
240	2384.62	I	2740 – 44663
1700	2387.29	I	0 – 41876
330	2394.29	I	11378 – 53131
290	2395.39	I	2740 – 44475
1100	2395.88	I	0 – 41726
220	2396.78	I	12774 – 54484
60	2397.61	I	11378 – 53073
110	2398.18	I	11031 – 52716
960	2401.13	I	8743 – 50377
260	2402.23	I	4159 – 45775
200	2403.54	I	10166 – 51759
330	2403.85	I	8743 – 50330
95	2405.08	II	
290	2405.45	I	11378 – 52938
200	2405.96	I	8743 – 50294
360	2408.67	I	11031 – 52535
240	2410.98	I	13020 – 54484
95	2411.90		
95	2414.10	I	8743 – 50154
290	2414.52	I	2740 – 44144
180	2415.32	I	14091 – 55481
530	2417.99	I	4159 – 45503
85	2418.35	I	11378 – 52716
530	2418.53	I	2740 – 44075
50	2419.63		
95	2420.02	II	13137 – 54445
50	2421.15	I	12774 – 54064
85	2421.86	I	14091 – 55369
85	2421.94		
200	2423.07	II	7892 – 49149
70	2424.02	II	13204 – 54445
50	2424.19	I	12774 – 54013
500	2424.56	I	0 – 41232
1400	2424.97	I	0 – 41225
60	2426.19	I	8743 – 49947
240	2426.81	I	11031 – 52224
70	2427.90	II	13204 – 54379
50	2429.67	I	10166 – 51311

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
380	2431.19	I	5144 – 46264
380	2431.61	I	11378 – 52491
140	2435.51	I	5766 – 46813
140	2435.65	I	13020 – 54064
30	2436.51	I	13020 – 54050
70	2437.73		
40	2440.68	I	11378 – 52338
85	2442.00	I	13365 – 54302
70	2445.88	I	12774 – 53647
360	2446.02	I	2740 – 43611
35	2449.88		
900	2450.74	I	8743 – 49534
70	2451.19	I	11378 – 52162
530	2451.73	I	2740 – 43516
60	2453.29	I	5766 – 46515
530	2453.90	I	8743 – 49483
110	2454.91	II	3593 – 44315
530	2456.46	I	2740 – 43437
70	2457.16	I	13365 – 54050
70	2458.76		
110	2459.84	I	5766 – 46407
1800	2461.42	I	5144 – 45759
110	2464.00		
180	2464.50	I	12774 – 53338
70	2465.16		
110	2468.09	I	10166 – 50671
110	2468.90	II	11460 – 51952
60	2470.82	I	16212 – 56673
290	2472.28	I	5766 – 46202
290	2474.78	I	8743 – 49138
110	2475.69	I	11378 – 51759
900	2476.84	I	0 – 40362
30	2480.71	I	11031 – 51329
180	2481.79	I	14852 – 55134
360	2482.43	I	2740 – 43011
35	2484.04	I	5144 – 45389
60	2485.32	I	15391 – 55615
530	2486.24	II	3593 – 43802
4500	2488.55	I	5144 – 45316
70	2489.04	I	10166 – 50330
290	2491.02	I	8743 – 48875
290	2491.69	I	11031 – 51152
360	2492.42	I	6093 – 46202
180	2493.62	I	15391 – 55481
60	2493.83	I	0 – 40087
70	2496.45		
60	2496.61	I	14852 – 54895
2600	2498.41	I	8743 – 48756
330	2499.92	I	14339 – 54328
95	2500.72		
95	2500.91	I	14091 – 54064
60	2501.84	I	14091 – 54050
330	2502.29	I	11378 – 51329
35	2503.16		
95	2503.67		
500	2504.39	I	2740 – 42658
260	2504.51	I	4159 – 44075
85	2506.38		
85	2506.66		
35	2507.18	II	3929 – 43802
170	2508.61	I	11378 – 51229
70	2509.71	II	17569 – 57403
170	2509.94	I	12774 – 52604
660	2512.87	I	8743 – 48526
2400	2513.25	I	5144 – 44921
660	2515.04	I	5144 – 44893
35	2517.61	I	13365 – 53073
500	2517.92	I	4159 – 43863
660	2518.44	I	5144 – 44839
200	2519.29	I	2740 – 42422
330	2519.79	I	
70	2524.79	I	4159 – 43755
170	2526.01	I	2740 – 42317
70	2526.83	I	12774 – 52338
130	2527.09	I	8743 – 48303
200	2532.44	I	14852 – 54328
120	2534.17	I	10166 – 49615
780	2538.00	II	0 – 39390
240	2538.10	I	12774 – 52162
130	2539.73	I	14091 – 53454
170	2540.14	I	4159 – 43516
180	2540.74	I	11031 – 50377
70	2541.65	I	14091 – 53424
1000	2542.51	I	8743 – 48062
130	2543.80	I	11031 – 50330
160	2546.17	I	11031 – 50294
140	2547.70	I	13365 – 52604
160	2548.10	I	14339 – 53572
30	2548.83	II	17569 – 56791
310	2554.46	I	2740 – 41876
160	2555.11	I	11378 – 50503
120	2555.27	I	11031 – 50154
160	2555.80	I	14339 – 53454
110	2556.08	I	8743 – 47854
95	2557.77	I	8743 – 47828
120	2558.09	I	15223 – 54302
50	2560.19	I	14848 – 53896
50	2560.47	I	14852 – 53896
160	2562.66	I	13365 – 52375
190	2563.16	II	13204 – 52206
120	2564.37	I	12774 – 51759
130	2565.17	I	10166 – 49138
60	2565.72	I	5766 – 44730
600	2566.49	I	11378 – 50330
290	2566.88	I	10166 – 49112
480	2568.83	I	11031 – 49947
75	2571.14	I	12774 – 51656
340	2571.78	I	8743 – 47615
75	2572.48		
75	2573.09	I	4159 – 43011
40	2573.48	I	14091 – 52938
27	2574.74	I	15223 – 54050
85	2578.16	I	11378 – 50154
150	2578.32	II	15606 – 54379
130	2580.03	II	13204 – 51952
360	2581.05	I	5144 – 43876
740	2581.96	I	5144 – 43863
110	2582.62	I	5766 – 44475
130	2586.08		
130	2587.49	I	13020 – 51656
40	2588.26	I	14091 – 52716
85	2588.44	I	15391 – 54013
85	2589.39	I	10166 – 48774
55	2589.51	I	14848 – 53454
1000	2590.76	I	4159 – 42747
200	2591.98	I	11378 – 49947
30	2593.90	I	16212 – 54753
150	2594.14	I	12774 – 51311
170	2596.00	II	24466 – 62974
27	2596.37	I	11031 – 49534

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
150	2596.69	I	4159 – 42658
150	2597.20	I	2740 – 41232
	2597.29	I	14848 – 53338
130	2597.58	I	0 – 38486
110	2599.13	I	14339 – 52802
150	2599.91	I	11031 – 49482
110	2600.45	I	12774 – 51218
65	2600.75	I	
95	2602.33	I	8743 – 47158
65	2603.22		
65	2603.80	I	13365 – 51759
190	2604.60	I	6093 – 44475
40	2604.96	I	14339 – 52716
210	2609.20	I	8743 – 47057
380	2609.56	I	5766 – 44075
400	2610.78	I	13365 – 51656
110	2611.33	I	14848 – 53131
470	2612.63	I	0 – 38264
1800	2613.06	I	5144 – 43402
55	2614.06	I	10166 – 48409
27	2614.50	I	11378 – 49615
65	2615.96	I	12774 – 50990
55	2617.18	I	13020 – 51218
55	2619.28		
800	2619.94	I	4159 – 42317
230	2620.62	I	2740 – 40888
530	2621.82	I	0 – 38130
65	2623.61	I	11378 – 49482
65	2624.57	I	16212 – 54302
380	2628.48	I	8743 – 46776
27	2631.22	II	24981 – 62974
110	2632.89	I	13020 – 50990
65	2634.29	I	14852 – 52802
65	2634.44	I	15391 – 53338
3800	2637.13	I	0 – 37909
65	2637.98	I	12774 – 50671
27	2639.98	I	14848 – 52716
65	2641.17	I	15223 – 53073
170	2641.60	I	11031 – 48875
85	2643.63	I	12774 – 50590
1900	2644.11	I	0 – 37809
340	2646.89	I	10166 – 47935
380	2647.73	I	2740 – 40498
380	2649.34	I	11378 – 49112
65	2650.68	I	15223 – 52938
150	2652.98	I	15391 – 53073
150	2653.78	I	5766 – 43437
65	2655.19	I	13020 – 50671
55	2655.78	I	14848 – 52491
490	2656.68	I	10166 – 47796
1900	2658.60	I	5144 – 42747
640	2659.83	I	8743 – 46328
95	2660.92	I	13020 – 50590
380	2661.18	I	4159 – 41726
40	2661.93	I	12774 – 50330
110	2662.55	I	15391 – 52938
110	2663.22	I	12774 – 50312
40	2664.29	II	25452 – 62974
120	2665.99		
120	2666.21	I	11031 – 48526
150	2669.53	I	10166 – 47615
580	2674.57	I	11378 – 48756
400	2674.88	I	10166 – 47540
55	2679.38	I	15391 – 52702
75	2679.74	I	13365 – 50671
110	2682.19	I	11031 – 48303
75	2684.36	I	16212 – 53454
	2684.41		
110	2688.08	I	14852 – 52043
110	2689.35	I	12774 – 49947
2100	2689.82	I	5144 – 42310
150	2692.70	I	14091 – 51218
140	2694.52	I	11031 – 48132
65	2694.75	I	12774 – 49873
40	2696.61	I	4159 – 41232
85	2697.24	I	18417 – 55481
510	2699.59	I	2740 – 39772
110	2700.75	I	8743 – 45759
75	2702.83	I	13020 – 50007
75	2704.45	I	13365 – 50330
580	2706.70	I	2740 – 39675
180	2707.42	I	11378 – 48302
110	2708.18		
190	2709.86	I	10166 – 47057
3000	2714.64	I	0 – 36826
580	2715.36	I	5766 – 42583
150	2715.64	I	14339 – 51152
65	2716.80	I	11031 – 47828
110	2718.71	I	15391 – 52162
110	2718.91	I	18417 – 55186
1300	2720.04	I	2740 – 39494
850	2721.86	I	4159 – 40888
65	2722.60		
150	2727.94	I	10166 – 46813
120	2728.27	I	2740 – 39383
580	2730.61	I	5144 – 41754
40	2731.36	II	15606 – 52206
580	2732.80	I	5144 – 41726
85	2736.39	I	5766 – 42300
55	2738.33	I	13365 – 49873
65	2738.46	I	15391 – 51897
170	2740.32	I	14848 – 51329
140	2740.61	I	18417 – 54895
130	2740.75	I	11378 – 47854
65	2741.38	I	11378 – 47845
40	2742.69	I	11378 – 47828
150	2747.91	I	14848 – 51229
130	2748.86	I	15391 – 51759
130	2749.18	I	12774 – 49138
85	2751.15	I	12774 – 49112
65	2753.72	I	14848 – 51152
110	2755.59	I	12774 – 49054
170	2757.81	I	13365 – 49615
140	2758.82	I	11378 – 47615
150	2761.08	I	6093 – 42300
690	2761.42	I	4159 – 40362
470	2763.27	I	8743 – 44921
150	2763.94	I	11031 – 47200
340	2765.04	I	15391 – 51546
65	2765.45	I	8743 – 44893
130	2767.12	I	11031 – 47158
160	2769.88	I	13020 – 49112
110	2770.10	I	14848 – 50937
960	2770.71	I	5144 – 41225
40	2771.04	I	19109 – 55186
120	2773.07	I	14852 – 50903
120	2774.02	I	14339 – 50377
110	2774.38	I	13020 – 49054
110	2774.90	I	11031 – 47057
300	2776.91	I	2740 – 38741

559-795 O - 75 - 14 (Pt. 1)

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
40	2778.57	I	21124 – 57103
740	2782.55	I	4159 – 40087
40	2783.88	II	7892 – 43802
40	2785.04		
640	2786.31	I	5144 – 41023
130	2786.80	I	2740 – 38614
65	2790.90	I	15223 – 51043
230	2793.99	I	11378 – 47158
230	2794.19	I	14852 – 50630
21	2796.11	I	13020 – 48774
530	2796.73	I	2740 – 38486
35	2799.53		
95	2801.93	I	11378 – 47057
320	2804.07	I	15391 – 51043
2800	2806.91	I	0 – 35616
40	2807.48	I	10166 – 45775
40	2807.80		
30	2808.24	I	15391 – 50990
470	2808.94	I	2740 – 38331
21	2811.56	I	
420	2813.84	I	14848 – 50377
740	2814.20	I	2740 – 38264
40	2814.84	I	4159 – 39675
40	2815.27	I	13365 – 48875
300	2815.78	I	2740 – 38244
40	2817.51	I	14848 – 50330
140	2820.18	I	15223 – 50671
95	2820.56	I	14091 – 49534
190	2821.25	I	11378 – 46813
130	2824.17	I	11378 – 46776
40	2824.67	I	14339 – 49731
21	2829.03	I	10166 – 45503
420	2829.27	I	4159 – 39494
21	2831.59	I	14848 – 50154
130	2832.24	I	11031 – 46328
230	2837.42	I	11031 – 46264
470	2838.17	I	4159 – 39383
5100	2838.63	I	5144 – 40362
110	2840.44	I	14339 – 49534
740	2841.60	I	2740 – 37922
2300	2844.40	I	5144 – 40291
85	2844.68	I	14339 – 49482
420	2846.39	I	5766 – 40888
150	2846.55	I	8743 – 43863
420	2848.25	I	14848 – 49947
95	2849.05	I	15223 – 50312
40	2849.30	I	10166 – 45252
1500	2850.76	I	2740 – 37809
130	2855.34	I	8743 – 43755
55	2857.54	I	18902 – 53887
110	2860.06	I	16212 – 51166
1500	2860.96	I	5144 – 40087
35	2863.37	II	11460 – 46374
40	2864.26	I	15391 – 50294
85	2865.68	I	11378 – 46264
40	2867.59		
40	2869.39	I	12774 – 47615
170	2872.40	I	0 – 34804
170	2873.42	I	11378 – 46170
95	2874.15	I	13020 – 47802
40	2874.59	I	16212 – 50990
360	2874.96	I	8743 – 43516
190	2877.35	I	11031 – 45775
300	2878.40	I	5766 – 40498
35	2879.39	II	11654 – 46374
30	2880.20	II	17242 – 51952
30	2883.94	I	14091 – 48756
85	2884.41	I	8743 – 43402
21	2886.06	I	19411 – 54050
40	2886.50	I	14848 – 49482
40	2890.85	I	4159 – 38741
55	2891.83	I	25013 – 59583
85	2892.35	I	10166 – 44730
95	2895.06	I	11031 – 45562
260	2896.06	I	13020 – 47540
65	2901.32	I	13020 – 47477
65	2903.07	I	18902 – 53338
130	2903.21	I	14091 – 48526
190	2905.73	I	6093 – 40498
110	2905.97	I	24223 – 58625
30	2908.03	I	16212 – 50590
9600	2909.06	I	0 – 34365
110	2909.67	I	11031 – 45389
35	2911.34	I	19109 – 53447
2100	2912.33	I	4159 – 38486
140	2913.84	I	10166 – 44475
75	2914.71	I	18417 – 52716
530	2917.26	I	8743 – 43011
130	2917.83	I	5144 – 39406
2100	2919.79	I	15223 – 49461
55	2921.07	I	15391 – 49615
35	2923.18		
110	2924.49	I	11378 – 45562
40	2925.28	I	13365 – 47540
300	2925.57	I	4159 – 38331
360	2929.51	I	0 – 34126
110	2930.19	I	18417 – 52535
120	2930.57	I	22616 – 56729
510	2931.28	I	4159 – 38264
40	2932.45	I	15391 – 49482
40	2933.98	I	18301 – 52375
260	2934.64	I	2740 – 36806
27	2936.81	I	14091 – 48132
130	2936.99	I	12774 – 46813
40	2938.38	I	19109 – 53131
110	2942.20	I	10166 – 44144
200	2942.85	I	4159 – 38130
1100 h	2948.23	I	5766 – 39675
1400	2949.53	I	2740 – 36634
210 d	2949.81	I	11031 – 44921
	2949.90	I	15223 – 49112
130	2952.34	I	11031 – 44893
85	2955.00	I	15223 – 49054
95	2957.08	I	18417 – 52224
55	2958.34	I	14339 – 48132
300	2961.01	I	4159 – 37922
530	2962.15	I	4159 – 37909
110	2962.33	I	15391 – 49138
450	2964.06	I	5766 – 39494
55	2964.62	I	15391 – 49112
35	2965.10		
30	2968.45	I	14848 – 48526
35	2970.69	I	15223 – 48875
740	2970.97	I	4159 – 37809
110	2972.25	I	25013 – 58648
130	2973.06	I	18417 – 52043
110	2975.34	I	14852 – 48452
450	2977.64	I	8743 – 42317
110	2978.21	I	8743 – 42310
95	2978.53	I	21303 – 54868

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
85	2979.43	I	12774 – 46328
75	2982.56		
510	2982.90	I	11378 – 44893
340	2983.49		
130	2985.61	I	15391 – 48875
65	2988.26	I	14848 – 48303
110	2989.13	I	19893 – 53338
150	2992.11	I	13365 – 46776
110	2993.57	I	12774 – 46170
260	2997.65	I	10166 – 43516
170	3003.48	I	11378 – 44663
95	3007.90	I	18902 – 52138
330	3013.07	I	2740 – 35920
120	3015.65	I	13365 – 46515
570	3017.25	I	8743 – 41876
4400	3018.04	I	0 – 33124
480	3019.38	I	5766 – 38876
95	3020.86		
1100	3030.70	I	5144 – 38130
120	3031.01	I	8743 – 41726
75	3031.30	I	14848 – 47828
95	3032.81	I	13365 – 46328
2900	3040.90	I	2740 – 35616
120	3042.74	II	11460 – 44315
210	3043.50	I	5766 – 38614
120	3043.64	I	10166 – 43011
55	3044.07	I	16212 – 49054
55	3044.41	I	13365 – 46202
150	3044.91	I	11031 – 43863
55	3045.32	I	23323 – 56151
95	3049.04	I	12774 – 45562
230	3049.46	I	6093 – 38876
210	3050.39	I	22616 – 55389
120	3051.17	I	5144 – 37909
95	3054.97	I	11031 – 43755
150	3055.21	I	14091 – 46813
8600	3058.66	I	0 – 32685
290	3060.30	I	4159 – 36826
570	3062.19	I	4159 – 36806
75	3066.12	I	15223 – 47828
210	3069.94	I	5766 – 38331
360	3074.08	I	6093 – 38614
290	3074.96	I	22616 – 55127
180	3077.06	I	8743 – 41232
290	3077.44	I	11031 – 43516
1100	3077.72	I	8743 – 41225
360	3078.11	I	5766 – 38244
230	3078.38	I	4159 – 36634
150	3083.74	I	22616 – 55034
55	3084.60	I	13365 – 45775
55	3086.27	I	15223 – 47615
230	3090.08	I	14848 – 47200
140	3090.30	I	2740 – 35090
120	3090.49	I	14852 – 47200
55	3091.25	I	17667 – 50007
270	3093.59	I	18902 – 51218
310	3101.53	I	13020 – 45253
95	3104.98	I	13365 – 45562
360	3105.99	I	4159 – 36346
55	3107.38	I	14091 – 46264
310	3108.98	I	5766 – 37922
620	3109.38	I	6093 – 38244
250	3111.09	I	10166 – 42300
120	3114.81	I	12774 – 44870
120	3116.48	I	14091 – 46170
95	3118.12	I	22616 – 54677
310	3118.33	I	11378 – 43437
120	3129.23	I	17667 – 49615
480	3131.12	I	14848 – 46776
95	3140.31	I	15223 – 47057
95	3152.07	I	11031 – 42747
250	3152.67	I	10166 – 41876
290	3153.61	I	12774 – 44475
3100	3156.25	I	5144 – 36818
250	3156.78	I	23463 – 55132
130	3157.24	I	23463 – 55127
120	3161.44	I	19049 – 50671
120	3161.73	I	8743 – 40362
85	3164.61	I	15223 – 46813
310	3166.51	I	23463 – 55034
120	3168.28	I	15223 – 46776
120	3173.20	I	13365 – 44870
180	3173.93	II	7892 – 39390
420	3178.06	I	4159 – 35616
110	3180.12	I	19893 – 51329
230	3181.88	I	14339 – 45758
170	3182.57	I	14091 – 45503
230	3185.33	I	2740 – 34126
310	3186.98	I	11378 – 42747
55	3187.34	I	13365 – 44730
310	3189.46	I	8742 – 40087
310	3194.23	I	14091 – 45389
190	3195.38	I	11031 – 42317
120	3195.97	I	11378 – 42658
150	3213.31	II	13204 – 44315
1900	3232.06	I	4159 – 35090
290	3238.63	I	5766 – 36634
190	3241.04	I	11031 – 41876
120	3248.00	I	13365 – 44144
190	3254.91	I	14848 – 45562
190	3256.92	I	11031 – 41726
190	3260.30	I	8743 – 39406
3100	3262.29	I	4159 – 34804
380	3262.75	I	8743 – 39383
3100	3267.94	I	0 – 30592
620	3269.21	I	5766 – 36346
190	3272.16	I	15223 – 45775
530	3275.20	I	5766 – 36290
330	3277.97	I	5766 – 36264
65	3280.92		
65	3286.67	I	13020 – 43437
190	3288.84	I	28372 – 58769
1200	3290.26	I	2740 – 33124
7600	3301.56	I	0 – 30280
250	3306.23	I	12774 – 43011
620	3310.91	I	11031 – 41225
120	3315.42	I	5766 – 35920
95	3315.69	I	13365 – 43516
95	3316.69	I	18417 – 48559
250	3324.33	I	13365 – 43437
310	3327.42	I	14848 – 44893
960	3336.15	I	4159 – 34126
110	3351.74	I	6093 – 35920
120	3353.91		
230	3357.97	I	14091 – 43863
250	3361.15	I	8743 – 38486
190	3364.12	I	2740 – 32457
120	3370.20	I	14091 – 43755
960	3370.59	I	5144 – 34804
160	3372.08	I	13365 – 43011

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
120	3378.68	I	19893 – 49482
310	3384.00	I	12774 – 42317
85	3384.60	I	14339 – 43876
190	3385.94	I	12774 – 42300
85	3386.14	I	14339 – 43863
620	3387.84	I	10166 – 39675
65	3394.59	I	19109 – 48559
95	3395.72	I	15223 – 44663
120	3401.17	I	23323 – 52716
620	3401.86	I	8743 – 38130
250	3402.51	I	0 – 29382
95	3406.28	I	24223 – 53572
95	3406.67	I	14091 – 43437
120	3408.76	I	10166 – 39494
120	3412.74	I	13365 – 42658
120	3421.69	I	10166 – 39383
65	3427.44	I	23323 – 52491
150	3427.67	I	8743 – 37909
65	3435.26	I	12774 – 41876
95	3439.49	I	8743 – 37809
250	3440.60	I	11031 – 40087
120	3444.46	I	14852 – 43876
160	3445.55	I	14848 – 43863
310	3449.20	I	11378 – 40362
65	3455.03	I	13365 – 42300
120	3458.38	I	14848 – 43755
120	3465.44	I	17667 – 46515
120	3478.53	I	17667 – 46407
120	3482.11	I	10166 – 38876
65	3482.23	I	11378 – 40087
65	3487.25	I	14848 – 43516
120	3487.46	I	19893 – 48559
120	3490.33		
95	3491.50	I	19893 – 48526
50	3495.62		
160	3498.54	I	10166 – 38741
250	3501.16	I	14848 – 43402
620	3504.66	I	4159 – 32685
440	3512.99	I	12774 – 41232
95	3513.86	I	16212 – 44663
65	3516.63	I	19049 – 47477
310	3518.72	I	25602 – 54013
120	3520.00	I	30591 – 58992
480	3523.64	I	0 – 28372
120	3526.04	I	11031 – 39383
1200	3528.60	I	0 – 28332
230	3530.06	I	10166 – 38486
230	3532.80	I	4159 – 32457
120	3533.41	I	15223 – 43516
65	3541.91	I	14091 – 42317
230	3542.71	I	14091 – 42310
95	3555.97	I	12774 – 40888
960	3559.79	I	8743 – 36826
1200	3560.86	I	8743 – 36818
120	3562.34	I	8743 – 36806
310	3569.78	I	11378 – 39383
120	3574.08	I	14339 – 42310
65	3586.51	I	18902 – 46776
120	3587.32	I	13020 – 40888
65	3592.32	I	23323 – 51152
620	3598.11	I	2740 – 30525
190	3601.83	I	10166 – 37922
95	3604.48	II	11654 – 39390
65	3609.15	I	18417 – 46117
250	3616.57	I	10166 – 37809
120	3619.43	I	15391 – 43011
65	3629.95	I	5144 – 32685
450	3640.33	I	14848 – 42310
50	3648.81	I	19760 – 47158
230	3654.49	I	15391 – 42747
330	3656.90	I	2740 – 30078
120	3666.31	I	18902 – 46170
480	3670.89	I	11031 – 38264
120	3675.45	I	15223 – 42422
85	3681.57	I	19109 – 46264
250	3689.06	I	11031 – 38130
35	3698.83	I	14848 – 41876
190	3703.25	I	17667 – 44663
120	3706.56	I	23323 – 50294
120	3709.14	I	11378 – 38331
85	3712.84	I	15391 – 42317
230	3713.73	I	15391 – 42310
85	3718.34	I	11378 – 38264
210	3719.52	I	14848 – 41726
230	3720.13	I	8743 – 35616
35	3721.96	I	24292 – 51152
60	3729.22	I	17667 – 44475
85	3730.73	I	14091 – 40888
180	3746.47	I	14339 – 41023
3700	3752.52	I	2740 – 29382
100	3757.12	I	12774 – 39383
130	3766.30	I	11378 – 37922
120	3768.14	I	11378 – 37909
120	3774.40	I	18902 – 45389
110	3774.62	I	15391 – 41876
120	3776.25	I	13020 – 39494
290	3776.99	I	10166 – 36634
2100	3782.20	I	4159 – 30592
85	3789.11	I	14848 – 41232
620	3790.14	I	14848 – 41225
180	3790.73	I	14852 – 41225
370	3793.91	I	18902 – 45252
40	3794.66	I	28332 – 54677
85	3795.67	I	24292 – 50630
85	3827.14	I	22616 – 48737
250	3836.06	I	8743 – 34804
150	3840.30	I	29099 – 55132
150	3841.29	I	25013 – 51039
80	3843.66	I	15223 – 41232
190	3849.94	I	12774 – 38741
230	3857.09	I	4159 – 30078
230	3865.47	I	25275 – 51138
730	3876.77	I	11031 – 36818
250	3881.86	I	10166 – 35920
40	3886.75	I	13020 – 38741
40	3895.18	I	15223 – 40888
140	3900.39	I	2740 – 28372
190	3901.71	I	8743 – 34365
35	3907.65	I	14091 – 39675
35	3911.81	I	12774 – 38331
35	3918.97	I	27954 – 53464
35	3922.03	I	12774 – 38264
35	3925.10	I	12774 – 38244
35	3926.77	I	18417 – 43876
45	3928.41	I	11378 – 36826
45	3928.54	I	5144 – 30592
100	3930.00	I	14852 – 40291
80	3931.52	I	11378 – 36806
250	3938.59	I	8743 – 34126
90	3939.57	I	13365 – 38741

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
100		3949.78	I	13020 – 38331
55		3952.77	I	14091 – 39383
45		3955.37	I	15223 – 40498
90		3960.51	I	24292 – 49534
200		3961.02	I	14848 – 40087
1000		3963.63	I	4159 – 29382
100		3964.96	I	2740 – 27954
150		3969.67	I	14852 – 40036
110	h	3975.44	I	12774 – 37922
730		3977.23	I	5144 – 30280
45		3979.36	I	30280 – 55403
100		3988.18	I	14339 – 39406
40		3988.62	I	19411 – 44475
40		3991.49	I	2740 – 27787
45		3994.93	I	21303 – 46328
40		3996.80	I	0 – 25013
55		3998.93	I	19893 – 44893
150		4003.48	I	15391 – 40362
100		4004.02	I	11378 – 36346
150		4005.16	I	18902 – 43863
65	h	4015.04	I	13365 – 38264
160		4018.26	I	13365 – 38244
55	h	4029.32	I	30592 – 55403
90		4032.92	I	23985 – 48773
100		4037.84	I	5766 – 30525
55		4038.64	I	19109 – 43863
280		4041.92	I	19411 – 44144
160		4048.05	I	15391 – 40087
55		4051.43	I	16212 – 40888
960		4066.69	I	22616 – 47199
250		4070.86	I	14848 – 39406
190		4071.56	I	14852 – 39406
230		4074.68	I	14848 – 39383
65		4088.44	I	15223 – 39675
490		4091.82	I	6093 – 30525
55		4098.10	I	14091 – 38486
120		4100.30	I	8743 – 33124
55		4103.62	I	27787 – 52149
1200		4112.02	I	5766 – 30078
180		4124.60	I	11378 – 35616
180		4128.96	I	4159 – 28372
2500		4135.78	I	4159 – 28332
150		4137.84	I	15223 – 39383
65		4158.78	I	14091 – 38130
65		4159.96	I	12774 – 36806
180		4172.57	I	10166 – 34126
1200		4173.23	I	5144 – 29099
620		4175.63	I	8743 – 32685
120		4184.13	I	18417 – 42310
320		4189.91	I	12774 – 36634
55		4195.14	I	14091 – 37922
180		4201.45	I	4159 – 27954
250		4202.06	I	14339 – 38130
1200		4211.86	I	23463 – 47199
120		4213.86	I	25013 – 48737
100		4215.16	I	14091 – 37809
55		4226.53	I	15223 – 38876
170		4233.46	I	13020 – 36634
4900		4260.85	I	0 – 23463
100		4264.75	I	13365 – 36806
120		4269.61	I	18902 – 42317
55		4277.15	I	19049 – 42422
100		4285.90	I	13020 – 36346
560		4293.95	I	14848 – 38130
65		4296.22	I	13365 – 36634
55		4308.88	I	19109 – 42310
560		4311.40	I	5144 – 28332
110		4326.25	I	15223 – 38331
340		4328.68	I	11031 – 34126
100		4338.75	I	15223 – 38264
100		4351.53	I	18902 – 41876
65	h	4354.46	I	10166 – 33124
45		4357.98	I	15391 – 38331
65		4358.14	I	30525 – 53464
210		4365.67	I	13020 – 35920
110		4370.66	I	15391 – 38264
45		4376.90	I	37809 – 60649
90		4391.08	I	19109 – 41876
520		4394.86	I	11378 – 34126
160		4397.26	I	14091 – 36826
55		4400.58	I	32685 – 55403
160		4402.74	I	28332 – 51039
55		4404.21	I	15223 – 37922
40		4411.13	I	16212 – 38876
4900		4420.47	I	0 – 22616
100		4432.41	I	13365 – 35920
290		4436.32	I	2740 – 25275
50		4437.09	I	15391 – 37922
100		4439.64	I	15391 – 37909
40		4445.69	I	14339 – 36826
230		4447.35	I	14339 – 36818
80	d	4459.53	I	15391 – 37809
35		4462.29	I	21034 – 43437
35		4465.94	I	38264 – 60649
90		4479.81	I	12774 – 35090
120		4484.76	I	10166 – 32457
40		4488.60	I	2740 – 25013
35		4518.89	I	19109 – 41232
35		4520.32	I	19109 – 41225
65		4524.87	I	11031 – 33124
65		4529.67	I	13020 – 35090
28		4537.62	I	16212 – 38244
65		4539.92	I	25594 – 47615
110		4548.66	I	14848 – 36826
540		4550.41	I	14848 – 36818
140		4551.30	I	14852 – 36818
35		4579.04	I	19893 – 41726
90		4595.04	I	29382 – 51138
90		4597.16	I	11378 – 33124
28		4605.04	I	16212 – 37922
170		4616.78	I	11031 – 32685
170		4631.83	I	15223 – 36806
35		4634.77	I	23323 – 44893
35		4641.83	I	8743 – 30280
140		4663.82	I	15391 – 36826
28		4682.31	I	12774 – 34126
65		4692.06	I	11378 – 32685
28		4732.80	I	15223 – 36346
22		4738.04	I	25070 – 46170
45		4738.35		
45		4743.89	I	17667 – 38741
28		4752.16	I	34365 – 55403
35		4763.10	I	38613 – 59602
670		4793.99	I	4159 – 25013
22		4813.80	I	14848 – 35616
22		4815.50	I	13365 – 34126
45		4815.96	I	30280 – 51039
22		4826.66	I	14091 – 34804
22		4843.87	I	8743 – 29382
110		4865.60	I	30592 – 51138

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
45	4899.22	I	28332 – 48737
65	4912.60	I	12774 – 33124
28	4935.81	I	17667 – 37922
28	4942.94	I	15391 – 35616
40	4979.32	I	16212 – 36290
55	5031.83	I	15223 – 35090
45	5039.12	I	18902 – 38741
35	5072.88	I	16212 – 35920
35	5074.77	I	15391 – 35090
35	5079.09	I	12774 – 32457
90	5103.50	I	8743 – 28332
55	5110.81	I	11031 – 30592
22	5122.23	I	14848 – 34365
22	5145.54	I	18902 – 38331
140	5149.74	I	15391 – 34804
28	5152.01	I	36818 – 56223
28	5168.98	I	38486 – 57827
40	5193.52	I	11031 – 30280
270	5202.63	I	10166 – 29382
35	5203.23	I	11378 – 30592
20	5250.46		
45	5255.82	I	19109 – 38130
55	5265.15	I	23323 – 42310
20	5283.89	I	19411 – 38331
20	5295.65	I	16212 – 35090
40	5298.78	I	28332 – 47199
13	5302.58	I	19411 – 38264
18	5336.23	I	15391 – 34126
11	5346.03	I	11378 – 30078
13	5352.25	I	17667 – 36346
110	5376.79	I	14091 – 32685
16	5403.43	I	36346 – 54847
13	5412.14	I	21033 – 39505
120	5416.34	I	30280 – 48737
45	5416.69	I	4159 – 22616
28	5417.51	I	32685 – 51138
16	5441.82	I	19893 – 38264
55	5443.31	I	14091 – 32457
22	5446.93	I	32685 – 51039
11	5447.76	I	11031 – 29382
20	5449.37	I	14339 – 32685
20	5453.40	I	23985 – 42317
22	5457.30	I	5144 – 23463
28	5470.00	I	14848 – 33124
13	5474.58	I	25602 – 43863
13	5475.13	I	21124 – 39383
9	5477.27	I	17667 – 35920
16	5481.85	I	19893 – 38130
22	5509.33	I	30592 – 48737
9	5516.01	I	28140 – 46263
270	5523.53	I	29099 – 47199
22	5546.82	I	34125 – 52149
9	5549.79	I	33124 – 51138
13	5552.88	I	11378 – 29382
11	5560.62	I	35616 – 53595
16	5580.66	I	33124 – 51039
80	5584.44	I	15223 – 33124
8	5600.50	I	36826 – 54677
35	5620.08	I	10166 – 27954
9	5637.41	I	15391 – 33124
22	5642.56	I	19109 – 36826
28	5645.25	I	19109 – 36818
7	5648.98	I	19109 – 36806
9	5660.21	I	26200 – 43863
7	5674.38	I	18301 – 35920
28	5680.88	I	34804 – 52402
11	5709.37	I	37909 – 55419
170	5721.93	I	5144 – 22616
8	5737.89	I	17667 – 35090
8	5739.72	I	25594 – 43011
22	5765.05	I	11031 – 28372
170	5780.82	I	15391 – 32685
40	5800.60	I	15223 – 32457
8	5842.49	I	22564 – 39675
110	5857.76	I	15391 – 32457
28	5860.64	I	13020 – 30078
11	5882.92	I	11378 – 28372
11	5903.98	I	19893 – 36826
11	5906.84	I	19893 – 36818
7	5908.95	I	30280 – 47199
7	5981.36	I	18902 – 35616
11	5983.22	I	25602 – 42310
65	5996.00	I	34365 – 51039
20	6015.79	I	21303 – 37922
7	6054.63	I	27351 – 43863
20	6144.53	I	8743 – 25013
11	6158.03	I	34804 – 51039
35	6227.70	I	32685 – 48737
7	6241.70	I	13365 – 29382
22	6269.41	I	43012 – 58957
11	6274.94	I	40291 – 56222
11	6286.83	I	18902 – 34804
9	6398.86	I	25602 – 41225
22	6403.15	I	33124 – 48737
9	6448.13	I	41225 – 56729
6	6520.85	I	21303 – 36634
7	6528.87	I	21034 – 36346
7	6533.14	I	15223 – 30525
11	6538.30	I	14091 – 29382
11	6576.83	I	15391 – 30592
8	6614.56	I	24292 – 39406
4	6615.43	I	40291 – 55403
7	6661.81	I	13365 – 28372
27	6729.56	I	15223 – 30078
18	6791.53	I	8743 – 23463
14	6806.61	I	15391 – 30078
5	6878.70	I	14848 – 29382
4	6901.58	I	25602 – 40087
11	6956.02	I	34365 – 48737
6	6984.95	I	16212 – 30525
15	7060.67	I	15223 – 29382
22	7145.54	I	15391 – 29382
10	7149.89	I	11031 – 25013
4	7184.10	I	38486 – 52402
10	7206.33	I	8743 – 22616
5	7209.96	I	16212 – 30078
9	7251.16	I	21303 – 35090
6	7253.49	I	18902 – 32685
6	7375.07	I	18902 – 32457
9	7407.95	I	23323 – 36818
26	7602.95	I	15223 – 28372
4	7701.46	I	15391 – 28372
7	7789.96	I	34365 – 47199
7	7852.17	I	15223 – 27954
6	7981.20	I	24292 – 36818
7	8041.29	I	11031 – 23463

Palladium

Pd, $Z=46$, $M=106.4$, Ratio $\frac{\text{Pd}}{\text{Cu}}=1.674$

Pd I Normal state of valence electrons $4d^{10}\,{}^1S_0=0$. I.P.$=67236$ cm^{-1}.
Pd II Normal state of valence electrons $4d^9\,{}^2D_{21/2}=0$. I.P.$=156700$ cm^{-1}.

References

Wavelengths:

G. R. Harrison, Massachusetts Institute of Technology Wavelength Tables (John Wiley & Sons, New York, 1939).

Classification:

Pd I, A. G. Shenstone, Phys. Rev. **36**, 669 (1930).
Pd II, A. G. Shenstone, Phys. Rev. **32**, 30 (1928).

Palladium—all observed lines

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
1100	2447.91	I	0 – 40839	2500	4212.95	I	11722 – 35451
1700	2476.42	I	0 – 40369	180	4473.59	I	11722 – 34069
50	2486.53	II	27094 – 67299	55 h	4788.18	I	34069 – 54948
130	2488.92	II	25081 – 65247	45 h	4817.51	I	34069 – 54821
60	2498.78	II	32278 – 72285	35	4875.43	I	34069 – 54574
1900	2763.09	I	0 – 36181	55	5110.81	I	35451 – 55012
24	2854.58	II	32278 – 67299	75	5117.02	I	38812 – 58349
520	2922.49	I	6564 – 40771	160	5163.84	I	35451 – 54811
650	3002.65	I	6564 – 39858	55	5234.86	I	35928 – 55025
45	3009.78	I	25101 – 58317	120	5295.63	I	35928 – 54806
1500	3027.91	I	7755 – 40771	18	5312.57	I	36181 – 54998
1100	3065.31	I	7755 – 40369	15	5345.10	I	39858 – 58562
2600	3114.04	I	7755 – 39858	35	5395.24	I	39858 – 58388
270	3142.81	I	25101 – 56911	55	5542.80	I	36976 – 55012
11000	3242.70	I	6564 – 37394	35	5547.02	I	36976 – 54998
2700	3251.64	I	10094 – 40839	27	5619.44	I	40771 – 58562
3500	3258.78	I	10094 – 40771	15	5642.69	I	40839 – 58556
460	3287.25	I	6564 – 36976	14	5655.42	I	40771 – 58448
3600	3302.13	I	10094 – 40369	75	5670.07	I	37394 – 55025
5000	3373.00	I	7755 – 37394	11	5690.14	I	40839 – 58408
24000	3404.58	I	6564 – 35928	55 h	5695.09	I	37394 – 54948
13000	3421.24	I	7755 – 36976	18	5736.61	I	37394 – 54821
5000	3433.45	I	11722 – 40839	23	6774.54	I	25101 – 39858
6400	3441.40	I	11722 – 40771	65	6784.52	I	34069 – 48804
7700	3460.77	I	6564 – 35451	4 h	6833.42	I	40369 – 54998
10000	3481.15	I	10094 – 38812	11	7016.44	I	38088 – 52336
2000	3489.77	I	11722 – 40369	13 h	7310.06	I	38812 – 52488
12000	3516.94	I	7755 – 36181	75	7368.12	I	35451 – 49020
12000	3553.08	I	11722 – 39858	27	7391.92	I	38812 – 52336
4500	3571.16	I	10094 – 38088	16	7486.90	I	35451 – 48804
20000	3609.55	I	7755 – 35451	120	7764.03	I	35928 – 48804
20000	3634.70	I	6564 – 34069	27	7786.67	I	36181 – 49020
5500	3690.34	I	11722 – 38812	45	7915.80	I	39858 – 52488
1400	3718.91	I	10094 – 36976	18	7961.08	I	28214 – 40771
1500	3799.19	I	7755 – 34069	55	8132.82	I	25101 – 37394
1500	3832.29	I	10094 – 36181	45	8300.83	I	36976 – 49020
2200	3894.20	I	11722 – 37394	9 h	8353.58	I	40369 – 52336
1500	3958.64	I	11722 – 36976	18 h	8532.74	I	40771 – 52488
290	4087.34	I	11722 – 36181	16 h	8599.10	I	37394 – 49020
90	4169.84	I	10094 – 34069	65	8761.35	I	37394 – 48804

Phosphorus

$$P, Z = 15, M = 30.9738, \text{Ratio } \frac{P}{Cu} = 0.487$$

P I Normal state of valence electrons $3s^2 3p^3\ {}^4S^\circ_{1\frac{1}{2}} = 0$. I.P. = 84580 cm^{-1}.
P II Normal state of valence electrons $3s^2 3p^2\ {}^3P_0 = 0$. I.P. = 159100 cm^{-1}.

References

Wavelengths:
G. R. Harrison, Massachusetts Institute of Technology Wavelength Tables (John Wiley & Sons, New York, 1939).

Classification:
P I, C. C. Kiess, J. Research NBS **8**, 393 (1932) RP 425.
P I and P II, W. C. Martin, J. Opt. Soc. Am. **49**, 1071 (1959).

Phosphorus—all observed lines

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
340	2135.47	I	11362 – 58174	220	2534.01	I	18722 – 58174
3400	2136.18	I	11376 – 58174	600	2535.65	I	18748 – 58174
2600	2149.14	I	11362 – 57877	380	2553.28	I	18722 – 57877
280	2152.94	I	18722 – 65157	150	2554.93	I	18748 – 57877
550	2154.08	I	18748 – 65157				

Platinum

$$\text{Pt}, Z = 78, M = 195.1, \text{ Ratio } \frac{\text{Pt}}{\text{Cu}} = 3.070$$

Pt I Normal state of valence electrons $5d^9 6s\ ^3D_3 = 0$. I.P. = 72300 cm^{-1}.
Pt II Normal state of valence electrons $5d^9\ ^2D_{2\ 1/2} = 0$. I.P. = 149700 cm^{-1}.

References

Wavelengths:
G. R. Harrison, Massachusetts Institute of Technology Wavelength Tables (John Wiley & Sons, New York, 1939).

Classification:
Pt I, A. C. Haussman, Astrophys. J. **66**, 333 (1927).
J. J. Livingood, Phys. Rev. **34**, 185 (1929).
Pt II, A. G. Shenstone, Phil. Trans. Roy. Soc. (London) [A]**237**, 453 (1938).

Strong lines of platinum

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
5500	2049.37	I	0 – 48779	1800	2733.96	I	776 – 37342
4400	2032.41	I		1800	2997.97	I	776 – 34122
3200	2030.63	I		1700	2929.79	I	0 – 34122
3200	3064.71	I	0 – 32620	1600	2705.89	I	824 – 37769
3000	2084.59	I	824 – 48779	1500	2067.50	I	0 – 48352
2800	2659.45	I	0 – 37591	1500	2174.67	I	
2000	2702.40	I	776 – 37769				
1900	2144.23	I	0 – 46622				
		II	4787 – 51408				

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
3200	2030.63	I	
4400	2032.41	I	
5500	2049.37	I	0 – 48779
1500	2067.50	I	0 – 48352
3000	2084.59	I	824 – 48779
1000	2103.33	I	824 – 48352
950	2128.61	I	776 – 47741
1900	2144.23	I	0 – 46622
		II	4787 – 51408
600	2165.17	I	0 – 46170
1500	2174.67	I	
400	2202.22	I	776 – 46170
320	2222.61	I	6568 – 51546
150	2249.30	I	0 – 44444
190	2268.84	I	
280	2274.38	I	776 – 44730
150	2289.27	I	776 – 44444
150	2292.40	I	824 – 44433
240	2308.04	I	6568 – 49881
90	2315.50	I	
220	2318.29	I	824 – 43946
100	2326.10	I	6568 – 49545
170	2340.18	I	6568 – 49286
280	2357.10	I	776 – 43188
180	2368.28	I	6568 – 48779
130	2383.64	I	10132 – 52072
40	2386.81	1	776 – 42660
120	2389.53	I	824 – 42660
35	2396.17	I	13496 – 55217
70	2401.87	1	10132 – 51752
200	2403.09	I	6140 – 47741
100	2418.06	I	13496 – 54839
80	2428.04	I	6568 – 47741
50	2428.20	I	10117 – 51287
25	2429.10	1	10132 – 51287
180	2436.69	I	776 – 41803
650	2440.06	I	0 – 40970
60	2450.97	1	0 – 40788
440	2467.44	I	0 – 40516
35	2471.01	I	13496 – 53953
1000	2487.17	I	0 – 40194
25	2488.74	II	
200	2490.12	1	824 – 40970
160	2495.82	I	6568 – 46623
240	2498.50	I	776 – 40788
50	2505.93	I	
120	2508.50	I	6568 – 46420
50	2514.07	I	10117 – 49881
60	2515.03	I	10132 – 49881
240	2515.58	I	776 – 40516
140	2524.30	I	6568 – 46170
40	2529.41	I	13496 – 53019
50	2536.49	1	10132 – 49545
160	2539.20	I	824 – 40194
18	2549.46	1	13496 – 52708
50	2552.25	I	10117 – 49286
50	2596.00	I	15502 – 54011
70	2603.14	I	10132 – 48536
50	2619.57	I	6568 – 44730
1100	2628.03	I	776 – 38816
130	2639.35	I	6568 – 44444
1000	2646.89	I	0 – 37769
500	2650.86	I	824 – 38536
20	2658.17	1	10132 – 47741
2800	2659.45	I	0 – 37591
40	2674.57	I	6568 – 43946
440	2677.15	I	0 – 37342
200	2698.43	I	6140 – 43188
2000	2702.40	I	776 – 37769
1600	2705.89	I	824 – 37769
60	2713.13	I	10117 – 46965
1300	2719.04	I	824 – 37591
130	2729.92	I	6568 – 43188
1800	2733.96	I	776 – 37342
70	2738.48	I	10117 – 46623
70	2747.61	I	13496 – 49881
80	2753.86	I	10132 – 46434
200	2754.92	I	10132 – 46420
30	2769.84	I	6568 – 42660
500	2771.67	I	776 – 36845
40	2773.24	I	13496 – 49545
20	2774.00	I	10132 – 46170
50	2793.27	I	13496 – 49286
16	2794.21	II	13311 – 49089
140	2803.24	1	6140 – 41803
10	2808.51	I	15502 – 51098
50	2818.25	I	824 – 36296
1400	2830.30	I	0 – 35322
70	2834.71	1	10132 – 45398
16	2853.11	I	13496 – 48536
25	2888.20	I	10117 – 44730
25	2893.22	I	15502 – 50055
600	2893.86	I	776 – 35322
300	2897.87	I	824 – 35322
60	2905.90	I	6568 – 40970
120	2912.26	I	10117 – 44444
120	2913.54	I	10132 – 44444
70	2919.34	1	13496 – 47741
30	2921.38	1	6568 – 40788
1700	2929.79	I	0 – 34122
30	2942.76	I	30157 – 64129
30	2944.75	I	6568 – 40516
25	2959.10	I	15502 – 49286
60	2960.75	I	
1800	2997.97	I	776 – 34122
220	3002.27	I	824 – 34122
30	3017.88	I	13496 – 46623
130	3036.45	I	13496 – 46420
800	3042.64	I	824 – 33681
3200	3064.71	1	0 – 32620
30	3071.94	1	10117 – 42660
130	3100.04	I	6568 – 38816
320	3139.39	I	776 – 32620
140	3156.56	I	10132 – 41803
120	3200.71	I	13496 – 44730
320	3204.04	1	6568 – 37769
30	3230.29	I	13496 – 44444
20	3233.42	I	15502 – 46420
20	3250.36	I	
40	3251.98	I	10132 – 40874
160	3255.92	I	6140 – 36845
25	3268.42	I	
25	3281.97	I	33681 – 64141
120	3290.22	I	10132 – 40516
500	3301.86	I	6568 – 36845
60	3315.05	I	0 – 30157
35	3323.80	I	10117 – 40194
340	3408.13	I	824 – 30157
35	3427.93	I	13496 – 42660
60	3483.43	I	10117 – 38816

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
160	3485.27	I	10132 – 38816
120	3628.11	I	6568 – 34122
70	3638.79	I	10117 – 37591
70	3643.17	I	18567 – 46007
50	3663.10	I	13496 – 40788
80	3671.99	I	10116 – 37342
80	3674.04	I	10132 – 37342
35	3699.91	I	13496 – 40516
18	3706.53	I	
20	3801.05		
80	3818.69	I	10117 – 36296
40	3900.73	I	34122 – 59751
110	3922.96	I	30157 – 55641
35	3948.40	I	13496 – 38816
100	3966.36	I	10117 – 35322
20	3996.57	I	15502 – 40516
110	4118.69	I	13496 – 37769
80	4164.56	I	10117 – 34122
40	4192.43	I	13496 – 37342
18	4327.06	I	33680 – 56784
18	4391.83	I	21967 – 44730
80	4442.55	I	10117 – 32620
14	4445.55	I	10132 – 32620
25	4498.76	I	30157 – 52379
12	4520.90	I	37769 – 59882
35	4552.42	I	33680 – 55641
12	4879.53	I	36296 – 56784
14	5044.04	I	15502 – 35322
30	5059.48	I	32620 – 52379
35	5227.66	I	13496 – 32620
40	5301.02	I	36782 – 55641
12	5368.99	I	15502 – 34122
12	5390.79	I	34122 – 52667
14	5475.77	I	34122 – 52379
14	5478.50	I	38536 – 56784
6	5763.57	I	35322 – 52667
20	5840.12	I	15502 – 32620
8	5844.84	I	38536 – 55641
6	6026.04	I	40194 – 56784
7	6318.37	I	36845 – 52667
8	6326.58	I	21967 – 37769
9	6523.45	I	37342 – 52667
10	6710.42	I	37769 – 52667
20	6760.02	I	37591 – 52379
60	6842.60	I	37769 – 52379
20	7113.73	I	18566 – 32620
10	8224.74	I	21967 – 34122

Potassium

$$K,\ Z=19,\ M=39.10,\ \text{Ratio}\ \frac{K}{Cu}=0.615$$

K I Normal state of valence electrons $3p^6 4s\ ^2S_{1/2}=0$. I.P.$=35010$ cm^{-1}.
K II Normal state of valence electrons $3p^6\ ^1S_0=0$. I.P.$=256637$ cm^{-1}.

References

Wavelengths and Classification:
P. Risberg, Ark. for Fysik **10**, 583 (1956).

Potassium—all observed lines

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
320		4044.14	I	0 – 24720	25	hl	6911.08	I	12985 – 27451
160		4047.21	I	0 – 24701	50	hl	6938.77	I	13043 – 27451
10	l	5782.38	I	12985 – 30274	18000		7664.90	I	0 – 13043
14	l	5801.75	I	13043 – 30274	9000		7698.96	I	0 – 12985

Praseodymium

Pr, $Z = 59$, $M = 140.9077$, Ratio $\frac{\text{Pr}}{\text{Cu}} = 2.217$

Pr I Normal state of valence electrons $4f^3 6s^2\ {}^4\text{I}^\circ_{4\frac{1}{2}} = 0$. I.P. $= 43730\ \text{cm}^{-1}$.
Pr II Normal state of valence electrons $4f^3 6s\ {}^5\text{I}^\circ_4 = 0$. I.P. $= 85100\ \text{cm}^{-1}$.

References

Wavelengths:
R. Zalubas, unpublished material (1973).

Classification:
Pr I and Pr II, (Spectrum assignment only)
A. S. King, Astrophys. J. **68**, 194 (1928).
R. Zalubas, unpublished material (1973).
Pr I and II, J. Blaise, J. Verges, J. F. Wyart, P. Camus, and R. Zalubas, unpublished material (1973).
Pr II, N. Rosen, G. R. Harrison, and J. R. McNally, Phys. Rev. **60**, 722 (1941).

Molecular Spectra:
PrO, W. W. Watson, Phys. Rev. **53**, 639 (1938).

Strong lines of praseodymium

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
5200		4179.38	II	1649 – 25569	1500		4305.76	II	442 – 23660
3800		4222.98	II	442 – 24115	1300	h	3816.02	II	
3800		4225.31	II	0 – 23660	1300	c	3918.85	II	2998 – 28509
3400		4062.83	II	3403 – 28010	1300	c	3989.69	II	442 – 25500
3100		3908.44	II	0 – 25578	1300		4044.82	II	0 – 24716
2900	c	4100.71	II	4437 – 28816	1300		4333.97	II	1649 – 24716
2700		4143.12	II	2998 – 27128	1200		3850.79	II	
2500		4189.48	II	2998 – 26861	1200		4368.33	II	0 – 22886
2500	c	4206.71	II	4437 – 28202	1200	c	4429.13	II	0 – 22571
2200		4054.86	II	1744 – 26398			4429.25	II	2998 – 25569
2200		4056.53	II	5079 – 29724	1100	c	3965.25	II	1649 – 26861
2100	c	3982.05	II	3403 – 28509	1100		4297.76	II	0 – 23261
1900		4008.70	II	5079 – 30018	1100		4351.84	II	1744 – 24716
1700	c	3877.18	II	442 – 26226	1100		4496.44	II	442 – 22675
1700	c	4118.45	II	442 – 24716	960		3830.72	II	
1700	c	4164.19	II	1649 – 25657	960		3852.80	II	
1700		4408.84	II	0 – 22675	960		3925.44	II	0 – 25468
1600	c	3964.81	II	442 – 25657	960		4033.84	II	2998 – 27782
1600		3994.79	II	442 – 25468	960		4241.02	II	4437 – 28010
1500	c	4141.21	II	4437 – 28578	960		4468.71	II	1744 – 24115

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
25		2558.58	II	
25		2578.27	I	
30		2579.31	I	
40	h	2598.04	II	
25		2608.92	II	
25		2615.75	II	
25		2648.48	II	
30		2654.75	II	
25		2666.70	II	
20		2672.52	II	
30		2685.19	II	
45		2685.70	II	
50		2698.92	II	
60		2700.38	II	
30		2702.25	II	
100	h	2707.37	II	
20		2714.16	II	
60		2720.17	II	
30		2721.90	II	
50		2726.50	II	
12		2731.78	II	
25		2733.12	II	
50		2734.30	II	
25		2737.90	II	
40		2742.12	II	
25		2744.66	II	
20		2746.28	II	
60		2760.35	II	
50		2769.60	II	
50	d	2775.94	II	
		2776.03	II	
40		2778.80	II	
50		2783.31	II	
30		2789.05	II	
35		2792.51	II	
50		2802.05	II	
20		2823.17	II	
20		2824.14	II	
20		2828.29	II	
20		2842.98	I	
20		2844.01	II	
20		2850.62	I	
25		2853.99	II	
30		2865.64	II	
50		2881.60	I	
30		2882.31	II	
30		2884.89	II	
30		2943.97	II	
30		2967.58	II	
30		2971.13	II	
40	d	2971.40	II	
		2971.46	II	
50		2984.98	II	
30		2986.18	II	
30		2990.22	II	
80		3013.46	II	
50		3029.27	II	
25		3032.71	II	
50		3045.16	II	
40		3046.79	II	
20		3049.17	I	
80		3053.25	II	
40		3062.06	II	
80		3063.68	II	
35		3068.66	I	
60		3069.23	II	
25		3074.58	I	
35		3078.95	II	
110		3082.11	II	
30		3084.90	II	
		3085.02	II	
50		3085.86	II	
35		3091.33	II	
50		3097.77	II	
80		3098.50	II	
40	d	3101.27	II	
20		3103.11	II	
40		3105.38	II	
40		3109.78	I	
40		3110.58	II	
100		3111.34	II	
30		3114.13	II	
30		3119.03	II	
140		3121.58	II	
40		3122.96	II	
85		3129.20	II	
25		3135.35	II	
40		3136.79	II	
50		3146.44	II	
60		3151.54	II	
60		3153.23	II	
50		3153.82	II	
85		3158.65	II	
140		3163.73	II	
75		3164.81	II	
270		3168.24	II	
25		3169.36	II	
21		3171.23	II	
160		3172.31	II	
85		3182.44	II	
110		3191.42	II	
65		3191.74	II	
200	d	3195.99	II	
		3196.09	II	
110		3199.04	II	
30		3204.81	II	
100		3207.89	II	
50		3213.58	II	
35		3214.42	II	
190		3219.48	II	
35		3230.23	II	
100		3234.27	II	
25		3235.43	II	
40		3238.86	II	
100		3245.48	II	
50		3276.66	II	
75		3295.52	II	
25		3296.38	II	
25		3303.18	II	
40		3314.38	II	
40		3324.56	II	
21		3341.47	II	
40		3350.27	II	
140		3355.67	II	
21		3359.26	II	
40	h	3363.24	II	
40	d	3370.25	II	
40		3372.50	II	
40		3376.65	II	
40		3379.76	II	

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
35		3383.36	I	
40		3383.73	II	
40		3388.02	II	
110		3394.62	II	
21		3403.56	II	
65		3415.69	II	
65		3418.41	II	
35		3419.23	II	
21		3421.11	II	
40		3427.55	II	
85		3430.27	II	
40		3430.50	II	
21		3431.62	II	
85	h	3433.50	II	
30		3434.77	II	
30		3442.76	II	
35	h	3447.84	I	
40		3448.19	II	
40		3449.80	II	
25		3451.48	II	
50		3455.97	II	
25		3460.58	II	
110		3465.74	II	
40		3466.73	II	
35		3467.03	II	
65		3473.84	II	
50		3487.56	II	
25		3491.49	I	
25		3491.94	II	
25		3494.26	II	
60		3499.06	II	
50		3499.53	II	
65		3503.06	II	
50		3504.27	II	
50		3508.20	II	
25		3537.31	II	
50	h	3539.92	II	
35		3542.38	II	
25		3548.05	II	
25		3549.53	II	
40		3551.33	I	
8		3551.41	I	0 – 28149
25		3551.98	II	
40		3555.24	II	
25		3557.70	II	
40		3562.24	II	
40		3562.56	II	
25		3568.67	II	
50		3569.56	II	
25		3570.56	I	
50		3574.96	II	
25		3575.51		
75	d	3577.47	II	
25	h	3579.05	II	
50	h	3579.96	I	
50	h	3582.25	II	
200		3584.21	II	
40	d	3587.93	II	
25		3588.64	II	
50		3589.49	II	
25	h	3593.00	II	
75		3596.18	II	
75		3600.74	II	
95		3605.05	II	
50		3605.96	II	
25	h	3607.81	II	
130		3611.94	II	
25		3612.71	II	
50		3615.16	II	
75		3616.66	II	
25		3618.08	II	
25		3619.15	II	
50		3621.07	II	
65	h	3622.32	II	
25	h	3622.64	II	
		3622.74	II	
170		3630.96	II	5855 – 33388
25		3634.47	II	
95		3635.28	II	
40		3637.64	II	
25		3638.58	II	
95		3641.62	II	
65		3643.32	II	
25		3644.55	II	
100		3645.55	II	5855 – 33278
250		3645.66	II	
250		3646.30	II	
100		3648.30	II	
65		3650.13	II	
50		3651.04	II	
35		3652.38	II	
50		3657.42	II	
50		3658.21	II	
75		3659.05	II	
40		3660.08	II	
150	c	3660.36	II	
100		3661.62	II	
40		3662.32	II	
40		3664.64	II	
25		3667.14	II	
95		3667.67	II	
370		3668.83	II	
40		3669.53	II	
40		3670.26	II	
40		3671.91	II	
50		3674.14	II	
21		3674.88	II	
50		3680.00	II	
50	h	3681.85	II	
25		3685.26	II	
250		3687.03	II	
150		3687.19	II	
100		3689.71	II	7228 – 34323
50		3691.47	II	
50		3693.36	II	
50		3693.48	II	
25		3696.65	II	
150		3698.06	II	
60		3699.53	II	
95		3701.81	II	
40		3704.33	II	
230		3706.75	II	
170	c	3711.10	II	442 – 27380
60		3712.33	II	
60		3713.27	II	
290		3714.05	II	
60		3715.62	II	
95		3716.28	II	
60		3717.83	II	
60		3718.03	II	

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
60		3719.42	II	
29		3720.28	II	
29		3722.06	II	
40		3723.57	II	
75		3725.01	II	
50		3726.29	II	
35		3729.11	II	
50		3729.40	II	
85	c	3730.55	II	
50		3731.49	II	
120	c	3733.03	II	
210	c	3734.41	II	
60		3735.28	II	
250		3735.76	II	
190		3736.49	II	
410		3739.18	II	5854 – 32590
150		3740.99	II	
120		3743.98	II	
35		3747.26	II	
40		3747.47	II	
29		3748.50	II	
60		3748.82	II	
75		3750.08	II	
75		3750.50	II	
190		3750.98	II	
50	c	3751.59	II	
60		3752.32	II	
60		3753.40	II	
50		3754.40	II	
85	c	3755.00	II	
50		3756.80	II	
140		3759.60	II	
120		3760.08	II	
680		3761.87	II	
35		3762.36	II	
29		3762.56	II	
60		3763.03	II	
29		3764.10	II	
230		3764.77	II	
29		3765.98	II	
60		3766.47	II	
230		3768.94	II	
95		3769.68	II	442 – 26962
60		3770.46	II	
170	c	3772.82	II	
170		3774.06	II	
75		3776.09	II	
60	c	3777.13	II	
140		3777.62	II	
60		3778.75	II	
85		3780.26	II	
170		3780.66	II	
29		3781.91	II	7888 – 34323
50		3782.35	II	
50	c	3783.31	II	
35		3783.84	II	
		3783.98	II	
150		3785.46	II	
40		3786.00	II	
150		3786.86	II	
24		3788.06	II	
40		3790.58	II	
210		3792.51	II	
50		3792.95	II	
60		3793.45	II	
190		3794.93	II	
50		3795.77		
40		3796.28	II	
680		3800.30	II	
95	c	3801.35	II	
29		3802.30	II	
290		3804.84	II	
60		3806.14	II	
140		3809.18	II	
60		3809.97	II	
390		3811.84	II	0 – 26226
40		3813.89	II	7228 – 33440
1300	h	3816.02	II	
120		3817.66	II	
95		3817.87	II	
680		3818.28	II	
40		3818.74	II	
120		3819.14	II	
310		3821.80	II	
60		3822.78	II	
150	c	3823.18	II	7832 – 33981
40		3823.59	II	0 – 26146
95		3824.08	II	7888 – 34031
95	c	3826.20	II	
120		3826.67	II	8198 – 34323
40		3828.33	II	
40		3828.74	II	
35	c	3829.32	II	
960		3830.72	II	
60		3831.80	II	
75		3832.97	II	441 – 26523
75		3833.54	II	
140		3834.93	II	
480		3840.99	II	
270		3842.34	II	
60		3843.35	II	
60		3843.78	II	
150	c	3844.54	II	
580		3846.59	II	
95		3846.94	II	
1200		3850.79	II	
720	c	3851.55	II	
35		3852.07	II	
960		3852.80	II	
95		3855.88	II	
95	c	3856.99	II	
		3857.13	II	
120		3858.25	II	
110		3859.14	II	
75		3861.30	II	8141 – 34031
75		3862.04	II	
75		3864.08	II	
480	c	3865.45	II	
210		3867.52	II	
65		3868.52	II	0 – 25842
75		3869.17	II	
95		3869.85	II	8198 – 34031
75		3870.41	II	
210		3870.72	II	
40		3872.69	II	0 – 25814
50		3873.01	II	
35		3873.36	II	
95		3874.45	II	
480		3876.19	II	
1700	c	3877.18	II	442 – 26226

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
95		3878.32	II	
270		3879.20	II	
680		3880.47	II	0 – 25763
75		3880.83	II	
85		3882.28	II	
40	h	3884.05	II	1649 – 27388
440	c	3885.19	II	1649 – 27380
35		3888.06	II	
50		3888.29	II	
440	c	3889.34	II	442 – 26146
24	h	3889.97	II	
120	c	3891.71	II	
50		3892.51	II	
29		3894.14	II	
29		3894.89	II	
50		3895.04	II	
40		3896.82	II	
65		3897.03	II	
190		3897.25	II	8379 – 34031
40		3897.71	II	
210		3898.84	II	
85	c	3899.54	II	1744 – 27380
250		3902.45	II	
65		3903.92	II	7832 – 33440
35		3904.85	II	8379 – 33981
65		3906.08	II	
29		3907.29	II	
770	c	3908.05	II	4437 – 30018
3100		3908.44	II	0 – 25578
110		3909.62	II	
40		3911.29	II	
35		3911.79	II	
40		3911.99	II	7832 – 33388
50		3912.25	II	8478 – 34031
65		3912.63	II	
630		3912.90	II	1649 – 27198
310		3913.55	II	0 – 25545
210		3914.76	II	
170		3915.46	II	
24		3916.78	II	
95		3917.24	II	
75	c	3917.96	II	
1300	c	3918.85	II	2998 – 28509
420		3919.63	II	
250		3920.53	II	0 – 25500
65		3922.23	II	
95		3923.55	II	
130		3924.15	II	8141 – 33617
50		3924.99	I	
960		3925.47	II	0 – 25468
480		3927.46	II	1744 – 27198
120		3927.71	II	
85		3928.69	II	
65		3928.92	II	7832 – 33278
370		3929.29	II	
85		3929.88	II	
35		3930.62	II	
29		3932.11	II	
130		3932.97	II	8198 – 33617
50		3934.27	II	
110	c	3935.17	II	
370		3935.82	II	442 – 25842
29		3936.68	II	
29		3937.02	II	
250		3938.30	II	
95	c	3940.16	II	442 – 25814
29		3941.45	II	
120		3942.27	II	
50		3942.88	II	
55	c	3943.40	II	
65		3943.75	II	
90		3944.13	II	
35		3944.61	II	
65		3944.90	II	
65		3945.41	I	1377 – 26715
110		3945.60	II	
180		3946.89	II	
730	c	3947.63	II	1649 – 26974
900	c	3949.43	II	1649 – 26962
45	c	3950.65	II	
65		3951.18	II	
35		3951.84	I	
65		3952.11	II	
45		3952.35	II	
900	c	3953.51	II	4437 – 29724
40		3954.99	II	
35		3955.24	II	
22		3955.42	II	
22		3956.34	I	
35		3956.55	II	
380		3956.75	II	
55		3957.68	II	
65		3958.22	II	
65		3958.49	II	
190		3959.44	I	
45		3959.75	II	8141 – 33388
90	c	3960.49	II	
55		3961.28	II	8379 – 33617
470		3962.45	II	1744 – 26974
160	c	3963.11	II	
45		3963.71	II	
560		3964.26	II	1744 – 26962
1600	c	3964.81	II	442 – 25657
1100	c	3965.25	II	1649 – 26861
45		3965.61	II	
560	c	3966.57	II	2998 – 28202
160		3967.15	II	
160		3968.14	II	
55		3970.07	II	
500		3971.16	II	3403 – 28578
320		3971.67	II	
620	c	3972.14	II	442 – 25610
55		3973.09	II	
55	c	3973.90	II	
90	c	3974.30	II	
320		3974.85	II	
55		3976.30	II	
80		3976.56	II	
100		3976.79	II	8477 – 33616
55		3977.43	II	
40	h	3977.73	I	
40		3979.68	II	
90		3980.21	II	
90		3980.84	II	
65	h	3981.16	II	
2100	c	3982.05	II	3403 – 28509
100	h	3982.45	II	441 – 25545
90	h	3983.59	II	
90		3984.24	II	
90	c	3985.64	II	

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
65		3986.17	II	8198 – 33278
120		3987.37	II	
90		3988.00	II	
1300	c	3989.68	II	442 – 25500
45		3991.22	II	
230		3991.91	II	
340		3992.16	II	
65	h	3992.90	II	
45	c	3993.16	II	2998 – 28034
90		3994.01	II	
1600		3994.79	II	442 – 25468
270		3995.83	II	
560	c	3997.04	II	2998 – 28010
230		3997.96	II	
320		3999.12	II	
620	c	4000.17	II	1649 – 26641
110		4000.45	II	
90	c	4000.89	II	
65		4001.43	II	
45		4003.73	II	
730		4004.70	II	1744 – 26707
150		4006.67	II	
65		4007.76	II	
1900		4008.69	II	5079 – 30018
90		4009.24	II	
65		4009.96	I	
620		4010.60	II	
90		4013.23	II	
110		4013.38	II	5108 – 30018
90		4014.32	II	
730		4015.39	II	1744 – 26641
28		4016.78	II	
620		4020.96	II	
90		4022.18	II	
470		4022.71	II	
110		4024.30	II	
65		4025.18	II	
360		4025.54	II	
230		4026.83	II	
230		4029.00	II	
360	c	4029.72	II	
65		4030.47	II	
150		4031.07	II	
730	c	4031.75	II	1649 – 26445
230		4032.47	II	5226 – 30018
150		4032.96	II	
960		4033.83	II	2998 – 27782
230		4034.33	II	1744 – 26524
65	c	4036.55	II	
65		4037.21	II	
230		4038.22	II	
730		4038.45	II	0 – 24755
55		4039.02	II	
470		4039.34	II	1649 – 26398
1300		4044.81	II	0 – 24716
230		4045.70	II	
230		4046.63	II	
340		4047.08	II	7888 – 32591
180		4048.13	II	
450		4051.13	II	
90		4052.57	II	
2200		4054.88	II	1744 – 26398
2200		4056.54	II	5079 – 29724
140		4058.20	II	
450		4058.80	II	3403 – 28034
110		4059.37	II	
110	h	4061.32	II	5108 – 29724
230		4062.22	II	
3400		4062.81	II	3403 – 28010
210		4068.80	II	
170		4070.24	II	
190		4072.50	II	7228 – 31776
90		4074.83	II	
55		4076.20	II	
500	c	4079.77	II	
500	c	4080.98	II	1649 – 26146
790		4081.85	II	
500		4083.34	II	1744 – 26226
100	c	4084.71	II	
100		4085.11	II	
55		4085.26	II	
55		4086.20	II	
65		4086.72	II	9212 – 33674
200	c	4087.21	II	
40		4088.88	II	
40		4089.08	II	
55		4089.46	II	
55		4089.88	II	
80		4090.72	II	
80	h	4092.61	II	
40		4092.84	II	
90	c	4094.96	II	1649 – 26062
80		4095.89	II	
80		4096.32	II	
560		4096.82	II	1744 – 26146
380		4098.40	II	8198 – 32591
55		4098.65	II	
160		4100.22	II	
2900	c	4100.72	II	4437 – 28816
35		4104.85	II	
110		4105.71	II	
28		4107.11	II	
35		4107.52	II	9336 – 33674
90		4107.70	II	
65		4108.33	II	
35		4109.09	II	
35		4109.37	II	
28	h	4110.11	II	
55		4110.46	II	
45		4110.91	II	1744 – 26062
150	c	4111.86	II	442 – 24755
28	h	4112.72	II	
270	c	4113.89	II	
55		4114.82	II	
45		4115.82	II	
1700	c	4118.46	II	442 – 24716
45		4119.33	II	
90		4119.85	II	
35	h	4120.11	I	
28		4120.92	II	
90		4124.03	II	
90		4124.32	II	
90		4125.03	II	
55	h	4126.14	II	
250		4129.15	II	8379 – 32591
340		4130.77	II	
170	c	4132.20	II	1649 – 25842
200		4133.61	II	
35		4137.15	II	
35		4138.20	II	

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
28	h	4140.28	II	
1500	c	4141.22	II	4437 – 28578
65		4141.95	II	
2700		4143.11	II	2998 – 27128
28		4144.21	II	
270	c	4146.50	II	
28		4147.12	II	
45		4147.51	II	
270		4148.44	II	1744 – 25842
40		4149.29	II	
80		4150.04	II	
40		4150.94	II	9532 – 33617
28		4151.74	II	
90		4154.01	II	
200		4156.50	II	9335 – 33387
35		4156.82	II	
55		4157.73	II	
40		4159.46	II	
28		4159.73	II	
45		4160.47	II	
1700	c	4164.16	II	1649 – 25657
270		4168.04	II	
230		4169.45	II	3403 – 27380
620		4171.82	II	2998 – 26962
730		4172.25	II	1649 – 25610
40		4173.72	II	
250		4175.32	II	7832 – 31776
250		4175.62	II	9336 – 33278
100		4176.32	II	
200		4178.63	II	
5200		4179.39	II	1649 – 25569
40		4180.38	II	
65		4180.65	II	1744 – 25657
40		4182.30	II	
40		4182.58	II	
55		4182.90	II	
110		4184.26	II	
40		4184.60	II	
140		4185.12	II	7888 – 31776
45		4185.88	II	
55		4186.38	II	
65		4187.76	II	
2500		4189.48	II	2998 – 26861
45		4190.59	II	10466 – 34323
560	c	4191.60	II	1649 – 25500
45	c	4192.47	II	
55		4194.57	II	
55	c	4195.49	II	
55		4195.96	II	
110		4196.76	II	
35		4197.13	II	
22		4197.22	II	
290		4201.17	II	
110	c	4201.55	II	
2500	c	4206.72	II	4437 – 28202
120		4207.79	II	
500		4208.32	II	1744 – 25500
320		4211.86	II	4437 – 28173
45		4213.28	II	
180		4213.56	II	
55		4214.00	II	1744 – 25468
120	hc	4216.12	II	
80		4217.19	II	
320		4217.81	II	
160		4219.61	II	
3800		4222.93	II	442 – 24115
90		4223.46	II	
3800		4225.35	II	0 – 23660
160	h	4225.59	II	
90	c	4228.52	II	
90	c	4229.10	II	
65		4229.80	II	
90		4230.60	II	
320		4233.11	II	
320	c	4236.15	II	1649 – 25249
140		4236.60	II	
65		4237.04	II	
65		4238.37	II	
270		4240.02	II	8198 – 31776
960		4241.01	II	4437 – 28010
170	c	4241.30	II	
340		4243.51	II	3403 – 26962
65		4245.46	II	
65		4246.16	II	
840	c	4247.63	II	442 – 23978
90		4249.08	II	0 – 23528
90		4249.48	II	2998 – 26524
190		4250.34	II	10802 – 34323
160	c	4251.45	II	10466 – 33981
65		4253.09	II	
500		4254.40	II	5079 – 28578
140	c	4261.78	II	3403 – 26861
190		4262.27	II	
90		4262.80	II	
90		4263.14	II	
270	c	4263.78	II	2998 – 26445
100		4267.74	II	
320		4269.09	II	
160		4271.77	II	
790	c	4272.27	II	2998 – 26398
90	c	4275.21	II	
90		4275.82	II	
120		4276.18	II	9212 – 32591
120		4278.05	II	
90		4279.00	II	
470	c	4280.07	II	
790	c	4282.42	II	4437 – 27782
45		4285.37	II	
45		4286.98	II	
45	c	4288.47	II	
80		4289.41	II	
120		4289.88	II	3403 – 26707
55		4290.40	II	
55		4290.99	II	8478 – 31776
80	h	4291.59	II	
110	c	4293.14	II	
140		4293.58	II	
160	c	4294.69	II	
90		4295.11	II	
1100		4297.76	II	0 – 23261
450	c	4298.98	II	
100	c	4302.15	II	3403 – 26641
290		4303.61	II	
1500		4305.76	II	442 – 23660
110		4306.04	II	
45		4307.63	II	10466 – 33674
100	c	4308.90	II	
80		4311.09	II	
45		4311.92	II	
80		4315.51	II	

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
80		4316.12	II	
45		4317.05	II	
90		4317.82	II	
110		4319.00	II	
55	h	4320.15	II	
210		4323.55	II	5079 – 28202
55		4328.21	II	
180		4328.40	II	
160		4328.98	II	5079 – 28173
270		4329.41	II	1744 – 24835
55		4330.42	II	442 – 23528
55		4331.28	II	
55		4333.13	II	
1300		4333.97	II	1649 – 24716
90		4334.63	II	442 – 23505
200		4335.74	II	
360		4338.70	II	3403 – 26445
65		4339.68	I	
80	d	4342.63	II	
		4342.82	II	
45		4343.88	II	
620	cw	4344.30	II	
45		4346.87	II	
470	c	4347.49	II	3403 – 26398
340		4350.40	II	
1100		4351.84	II	1744 – 24716
450		4354.91	II	
45		4355.18	II	5079 – 28034
45		4357.49	II	11089 – 34031
140		4359.09	II	
410	c	4359.79	II	5079 – 28010
45		4361.24	II	
45		4361.79	II	9671 – 32591
100		4362.99	II	
100		4363.24	II	
1200		4368.33	II	0 – 22886
90		4370.79	II	10802 – 33674
320		4371.62	II	
80		4373.81	II	
120		4374.41	II	
40		4379.34	II	
110		4380.30	II	
160		4382.39	II	
55	c	4382.77	II	
110	c	4384.09	II	
80		4384.85	II	
40	d	4385.30	II	
		4385.48	I	
45		4391.50	II	
180		4394.98	II	
180		4395.80	II	3403 – 26146
270		4396.08	II	
28		4396.86	II	
55		4398.27	II	
180		4399.32	II	
90		4400.02	II	
80		4400.25	II	
65		4403.29	II	
170		4403.60	II	5079 – 27782
100		4405.12	II	
430		4405.83	II	4437 – 27128
65		4406.68	II	
1700		4408.82	II	0 – 22675
80	h	4412.15	II	2998 – 25657
410		4413.77	II	1744 – 24394
80		4414.39	II	
160		4419.04	II	
190		4419.65	II	11055 – 33674
160	c	4421.22	II	2998 – 25610
22		4424.16	II	
160		4424.58	II	
1200	c	4429.13	II	0 – 22571
		4429.25	II	2998 – 25569
22		4431.86	II	
110		4432.28	II	
22		4434.91	II	
90		4438.15	II	
55	c	4444.03	II	
65		4445.85	II	
90		4446.99	II	
730		4449.83	II	1649 – 24115
80	c	4450.21	II	
140		4451.90	II	
65		4454.36	II	442 – 22886
140		4454.68	II	
90	h	4458.30	II	4437 – 26861
65	h	4461.29	II	
100		4465.97	II	
960		4468.66	II	1744 – 24115
22		4469.65	II	
55		4472.92	II	
55		4473.84	II	
140	c	4477.26	II	1649 – 23978
35		4483.48	II	
45		4485.54	II	
28		4487.79	II	442 – 22718
65		4488.19	II	
55	c	4492.42	II	3403 – 25657
35	d	4492.91	I	2847 – 25098
		4493.06	II	2998 – 25249
35		4493.70	II	
35		4494.18	II	
1100		4496.46	II	442 – 22675
40		4501.82	II	3403 – 25610
55	c	4504.61	II	
790		4510.15	II	3403 – 25569
22		4516.45	II	
200	c	4517.58	II	442 – 22571
55		4520.75	II	
55		4531.08	II	1649 – 23713
340	c	4534.15	II	5079 – 27128
340		4535.92	II	0 – 22040
55	h	4539.26	II	
65		4542.53	II	4437 – 26445
28		4543.94	II	
80		4548.52	II	
40		4549.82	II	
28		4550.08	II	0 – 21971
35		4550.83	II	1649 – 23617
65		4552.26	I	0 – 21961
200		4563.12	II	1744 – 23652
22	h	4568.55	II	5079 – 26962
65	h	4570.54	II	1744 – 23616
28		4571.61	II	
22		4572.13	I	1376 – 23242
65	h	4576.33	II	3403 – 25249
55	h	4578.17	II	2998 – 24835
22		4592.12	II	
28		4593.93	II	1744 – 23505
28		4595.88	II	5108 – 26860

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
65		4596.93	II	11927 – 33674
22		4598.95	I	
35		4600.38	II	
22		4603.81	II	
40	h	4606.45	II	4437 – 26140
140		4612.08	II	0 – 21676
22		4617.72	I	0 – 21650
22		4618.00	II	
35		4627.07	II	3893 – 25500
270	c	4628.74	II	442 – 22040
140		4632.28	I	4381 – 25963
140		4635.68	I	0 – 21566
200		4639.55	I	1376 – 22924
80		4640.21	I	1376 – 22921
110	c	4643.49	II	442 – 21971
140		4646.05	II	1744 – 23261
55		4647.00	I	0 – 21513
200	c	4651.50	II	1649 – 23141
28		4658.09	II	0 – 21462
35		4658.74	I	4381 – 25840
55	h	4660.91	I	
140		4664.65	II	3403 – 24835
270	c	4672.09	II	1744 – 23141
55		4678.20	II	4098 – 25468
40		4679.09	II	5079 – 26445
55	c	4684.92	II	442 – 21781
180		4687.80	I	
290		4695.77	I	
55		4707.55	II	1649 – 22886
140	cw	4708.07	II	442 – 21676
140		4709.52	I	4381 – 25609
90		4713.11	I	0 – 21212
90		4714.15	I	4381 – 25588
55		4728.64	II	1744 – 22886
180		4730.67	I	1377 – 22509
22		4733.74	I	4432 – 25551
45	c	4734.17	II	2998 – 24115
250		4736.69	I	0 – 21106
28		4741.48	I	
100		4744.16	I	0 – 21072
90		4744.91	II	1649 – 22718
150		4746.92	II	5079 – 26140
65	c	4756.03	II	442 – 21462
80	c	4757.91	II	1649 – 22660
100		4762.72	II	3403 – 24394
65	c	4765.24	II	2998 – 23978
20	c	4775.18	I	
28	c	4779.23	II	7660 – 28578
110		4783.35	II	2998 – 23898
16		4788.28	I	0 – 20878
13		4799.93	II	1744 – 22571
90		4801.13	II	3893 – 24716
28		4808.18	I	0 – 20792
45		4814.32	II	8958 – 29724
90		4822.98	II	1744 – 22472
35		4827.30	I	4432 – 25142
40	c	4832.07	II	442 – 21131
45	c	4837.03	II	1649 – 22317
40		4839.51	II	4098 – 24755
28		4840.74		
11		4845.96	I	
40	c	4848.53	II	442 – 21061
35		4853.67	I	4432 – 25029
22		4857.36	I	4432 – 25014
16		4858.57	II	
28		4859.00	II	3403 – 23978
55		4865.23	II	5108 – 25656
22		4869.34	I	
35		4876.26	II	5108 – 25610
90	c	4877.84	II	3403 – 23898
11	c	4879.11	II	5079 – 25569
28		4882.24	I	0 – 20476
13		4884.47	I	0 – 20467
28		4886.04	II	5108 – 25569
55		4890.26	II	6418 – 26861
45		4896.13	I	1377 – 21795
28		4901.48	II	7806 – 28202
110		4906.99	I	4381 – 24754
55		4912.62	II	7660 – 28010
140		4914.02	I	0 – 20344
22		4915.41	I	
200		4924.60	I	1376 – 21677
22		4925.32	I	
28		4925.66	II	4097 – 24393
28		4932.15	I	0 – 20269
140		4936.00	I	4381 – 24635
40		4938.89	I	
320		4939.74	I	2847 – 23085
160		4940.30	I	1377 – 21613
28		4943.73	II	3893 – 24115
380		4951.37	I	0 – 20190
28		4956.06	I	0 – 20171
80	c	4956.64	II	5079 – 25249
55		4960.25	I	0 – 20154
28		4967.87	I	
28		4970.93	I	
80		4974.92	I	1376 – 21471
110		4975.75	I	4381 – 24473
80		4976.39	I	0 – 20089
90		4989.29	II	1744 – 21781
90		5002.44	II	6414 – 26398
45		5004.59	II	7806 – 27782
28		5015.56	II	1744 – 21676
120		5018.59	I	0 – 19920
200		5019.76	I	2847 – 22762
200		5026.96	I	1377 – 21264
35		5031.97	II	
100		5033.38	I	0 – 19861
270		5034.41	II	8958 – 28816
65	c	5037.46	II	1649 – 21495
110		5043.83	I	0 – 19820
320		5045.52	I	4381 – 24195
160		5053.40	I	1376 – 21159
40		5063.40	I	1376 – 21120
28	c	5064.90	II	3403 – 23141
28	c	5070.02	II	1744 – 21462
45	c	5075.71	II	
180		5087.12	I	2847 – 22499
360		5110.38	II	4098 – 23660
560		5110.76	II	9255 – 28816
40		5117.29	I	
22	c	5118.03	II	4437 – 23970
410		5129.52	II	5226 – 24716
270		5133.44	I	0 – 19474
270		5135.14	II	7660 – 27128
100		5139.81	I	1377 – 20827
28		5147.48	I	1377 – 20798
28		5149.88	I	
100	c	5152.30	II	442 – 19845
80		5156.52	II	1744 – 21131

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
200	5161.74	II	3893 – 23261
28	5168.33	I	0 – 19343
620	5173.90	II	7806 – 27128
80	5175.27	II	1744 – 21061
45 c	5175.84	II	3403 – 22718
45	5177.36	I	2847 – 22156
45	5183.84	II	5108 – 24394
22	5188.22	II	7438 – 26707
200	5191.32	II	3403 – 22661
120	5194.43	I	1376 – 20622
150	5195.11	II	8958 – 28202
200	5195.31	II	6414 – 25657
80	5195.50	I	
360	5206.55	II	7660 – 26861
150	5207.90	II	6414 – 25610
45	5216.73	II	4098 – 23261
360	5219.05	II	6414 – 25569
560	5220.11	II	6418 – 25569
110	5227.97	I	0 – 19122
22 c	5230.21	I	
22 c	5242.71	II	3403 – 22472
20	5243.69	II	
22	5249.86	I	4432 – 23475
65 c	5251.71	II	5079 – 24115
680	5259.73	II	5108 – 24115
180	5263.88	II	3893 – 22886
16	5272.72	II	7438 – 26398
22 c	5277.39	II	
90	5285.65	II	3403 – 22317
45	5289.34	I	4866 – 23767
340 c	5292.02	II	5079 – 23970
340	5292.62	II	5226 – 24115
230	5298.09	II	5108 – 23978
22	5308.96	II	6418 – 25249
90	5311.11	II	8958 – 27782
65 cw	5312.37	II	5079 – 23898
28	5313.41	II	
16	5316.56	I	
90	5321.07	II	4098 – 22886
40	5321.81	II	7660 – 26445
430	5322.76	II	3893 – 22675
65	5331.48	II	5226 – 23978
16 cw	5341.55	I	
20	5342.58	II	
55	5343.89	II	7438 – 26146
200	5352.40	II	3893 – 22571
35	5358.99	I	4432 – 23087
18	5372.37	I	4866 – 23475
18	5374.24	I	
13	5377.45	II	
18	5381.26	II	4098 – 22675
18	5381.70	II	
28 c	5395.83	I	
13	5400.95	I	
28	5402.59	I	
18	5404.80	II	8465 – 26962
45 cwd	5410.54	II	
55	5411.54	II	4098 – 22571
80 cw	5413.22	II	442 – 18910
28	5422.36	I	
18	5427.24	I	8734 – 27154
18	5427.96	II	
28	5432.05	II	7438 – 25842
18	5432.58	II	
18	5432.90	I	
28 c	5437.36	I	
16 h	5445.41	I	
18	5457.06	I	
28	5460.26	I	0 – 18309
11	5469.71	I	
22	5469.93	I	8080 – 26357
35 c	5475.67	II	
40	5479.75	I	
16	5481.77	I	0 – 18237
16	5485.54	I	
16	5486.61	I	6313 – 24534
45 c	5487.58	I	
16	5488.94	I	7630 – 25844
16	5490.57	I	
28	5492.37	II	
16 c	5497.25	I	
16	5501.50	I	
40	5508.79	II	
65	5509.15	II	3893 – 22040
16 c	5511.63	II	1743 – 19882
55	5513.58	II	7446 – 25578
28	5515.12	II	8100 – 26226
13	5519.38	II	11611 – 29724
20 c	5520.31	II	
45 c	5522.79	II	1744 – 19845
28 c	5524.15	I	
28 c	5525.91	II	3403 – 21495
16 c	5527.93	I	
13	5530.21	I	
45	5531.16	I	
150	5535.17	II	7438 – 25500
28	5538.37	I	8734 – 26784
20	5538.78	II	
55	5545.01	II	7438 – 25467
20	5548.33	II	7744 – 25763
11	5553.42	II	9378 – 27380
22	5561.46	II	
45 c	5562.06	I	
13	5565.52	I	
13	5566.91	II	
45	5571.83	II	4098 – 22040
11	5574.61	II	8465 – 26398
11	5578.81	I	4866 – 22786
13	5582.35	II	8490 – 26398
11	5584.02	II	
22	5594.92	I	
22	5597.29	II	
13	5601.30	II	10730 – 28578
90	5605.65	II	7744 – 25578
13	5606.68	I	
28	5608.93	II	1744 – 19567
55	5610.22	II	9379 – 27198
11	5620.06	II	16243 – 34031
20	5620.26	I	
45 c	5621.89	II	3893 – 21676
110	5623.05	II	10730 – 28509
90	5624.45	II	12244 – 30018
11 h	5633.03	I	
22	5636.46	II	8490 – 26226
55 c	5638.79	II	5079 – 22809
16	5640.37	II	
16 cw	5643.16	I	
22	5645.41	II	
35	5654.23	II	8465 – 26146
55	5659.84	II	

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
35	h	5661.57	I	10720 – 28378
16		5662.19	II	8490 – 26146
65	c	5668.46	I	
45		5669.55	II	
35		5669.99	II	
16		5674.14	II	
16		5677.03	II	5108 – 22718
55		5681.89	II	9379 – 26974
13		5685.60	II	9379 – 26962
16		5686.52	I	
22	h	5687.17	II	4098 – 21676
65		5688.44	II	
22		5689.21	II	11005 – 28578
55	h	5690.97	II	
22		5695.90	II	9647 – 27198
22		5704.38	I	14262 – 31787
65		5707.61	I	
40		5711.63	II	11005 – 28509
22		5713.83	II	
16		5716.08	II	
45		5719.08	II	6418 – 23898
45	d	5719.63	II	8100 – 25578
		5719.80	II	
11		5728.38	I	
40		5731.88	II	
20		5747.13	II	
11		5747.74	I	8080 – 25473
11		5747.95	II	5079 – 22472
22		5753.02	II	8465 – 25842
90		5756.17	II	8100 – 25467
16		5759.40	II	
22		5760.20	I	
22		5769.16	II	9378 – 26707
16		5769.79	II	9647 – 26973
45		5773.16	II	7438 – 24755
11		5775.91	II	7447 – 24755
16		5777.29	II	10730 – 28034
90		5779.28	I	
65	c	5785.28	II	
65		5786.17	II	7438 – 24716
16	h	5788.29	II	
16		5788.92	II	7446 – 24716
16		5790.86	II	10117 – 27380
45		5791.36	II	9379 – 26641
22		5792.95	I	
40		5810.58	II	11611 – 28816
16		5813.55	II	11005 – 28202
160	d	5815.17	II	8465 – 25657
		5815.33	II	12827 – 30018
55		5818.57	II	9045 – 26226
40		5820.62	II	
16	h	5821.36	I	
55		5822.59	II	
90		5823.72	II	1744 – 18910
45		5830.94	II	8465 – 25610
40		5835.13	I	4866 – 21999
35	c	5844.65	II	5079 – 22184
40		5844.98	II	
65		5847.13	II	10030 – 27128
65	c	5850.64	II	3403 – 20491
45		5852.63	II	10117 – 27198
11	c	5854.44	I	
45		5856.07	II	
55		5856.90	II	
90		5859.68	II	11448 – 28509
80		5868.83	II	8465 – 25500
22		5873.83	II	9378 – 26398
35		5874.72	I	8080 – 25098
35		5878.10	I	9647 – 26654
35		5879.04	I	
80		5879.25	II	11005 – 28010
35	c	5884.72	I	5823 – 22811
55		5892.23	II	11611 – 28578
22		5894.22	II	
40		5903.11	II	
45		5904.45	II	10030 – 26962
40		5908.67	II	
11		5915.31	I	
11		5915.97	I	7630 – 24529
40		5920.76	I	9647 – 26532
40		5930.66	II	10117 – 26973
16		5936.33	II	
160		5939.90	II	10030 – 26861
65		5940.72	II	11749 – 28578
22		5941.65	I	
35		5947.16	II	10163 – 26973
22	c	5949.76	I	
55		5951.27	II	9647 – 26445
20		5951.76	II	8966 – 25763
90		5956.60	II	11794 – 28577
		5956.70	I	
13		5959.25	I	
20		5962.18	I	
28		5963.00	I	8733 – 25498
110		5967.82	II	9647 – 26398
13	c	5976.95	I	
13		5978.88	I	8734 – 25454
65		5981.19	II	11794 – 28509
40		5986.14	I	
45	c	5987.14	I	
		5987.29	II	10163 – 26860
13		5991.27	I	
13	c	5994.89	I	
11		5996.06	I	9684 – 26357
29		6002.44	II	8100 – 24755
90		6006.33	II	13374 – 30018
13		6008.54	I	8835 – 25474
55		6016.48	II	8100 – 24716
150		6017.80	II	8966 – 25578
28	c	6019.85	I	
150		6025.72	II	11611 – 28202
35		6042.87	II	10163 – 26707
55		6046.66	II	9045 – 25578
35		6049.26	I	7630 – 24156
28		6050.04	II	10117 – 26641
11		6050.88	I	8835 – 25357
140		6055.13	I	8080 – 24591
13		6067.27	II	10163 – 26641
13		6085.81	I	8250 – 24677
28		6086.16	II	10536 – 26962
65		6087.52	II	9045 – 25467
20		6090.38	II	10030 – 26445
28		6093.09	II	11794 – 28202
18		6096.28	I	
22		6106.72	II	9129 – 25500
18		6109.08	I	8733 – 25097
65		6114.38	II	13374 – 29724
22	c	6118.02	I	8250 – 24591
22	c	6122.15	I	
35		6141.51	II	9379 – 25657

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
65		6148.23	I	6714 – 22974
		6148.24	II	11749 – 28010
22		6157.82	II	10163 – 26398
13		6159.10	II	9379 – 25610
190		6161.18	II	8490 – 24716
18		6165.38	I	9646 – 25861
270		6165.94	II	7447 – 23660
55		6182.34	II	11611 – 27782
13		6187.96	I	9684 – 25840
35		6197.45	II	10730 – 26861
35		6200.81	II	11005 – 27128
13		6205.63	II	10117 – 26226
13		6210.59	I	6714 – 22811
22		6212.73	I	
18		6218.06	I	
20	h	6236.80	I	
20	h	6241.05	I	
45		6244.35	II	9647 – 25657
35		6255.10	II	10163 – 26146
40		6262.55	II	9647 – 25610
18		6264.54	II	12244 – 28202
22	c	6274.66	II	11447 – 27380
		6274.81	II	1743 – 17676
40		6278.68	II	9647 – 25569
110		6281.28	II	7744 – 23660
18	c	6289.02	I	
11	c	6298.01	I	
11		6302.05	I	
35		6302.35	II	10536 – 26398
16		6304.05	I	7630 – 23488
35		6305.23	II	11005 – 26861
11	h	6318.13	II	7438 – 23261
45	c	6322.36	I	
22	h	6343.88	I	
28		6347.11	II	12827 – 28578
18	c	6350.98	I	10669 – 26410
22	c	6357.20	I	8250 – 23976
55	c	6359.03	I	
11	h	6363.62	II	9045 – 24755
16		6377.61	I	10432 – 26107
16		6378.59	I	9684 – 25357
11		6389.57	I	10669 – 26315
18	c	6391.99	I	10720 – 26361
40		6393.18	I	
45		6397.96	II	8490 – 24115
10	h	6410.69	I	10720 – 26315
55		6411.23	I	
40		6413.68	II	9129 – 24716
10		6415.43	I	10669 – 26252
45		6429.63	II	13029 – 28578
45		6431.84	II	11419 – 26962
7	h	6442.78	II	11611 – 27128
9	h	6443.91	II	11448 – 26962
16	c	6453.44	I	8665 – 24156
9		6454.84	II	8490 – 23978
9		6456.18	I	9684 – 25169
9	h	6460.19	I	
18		6467.72	II	
9	h	6475.26	II	7447 – 22886
35	cw	6478.02	II	3403 – 18836
45		6486.55	I	
9	h	6486.97	II	5079 – 20491
40	h	6491.75	I	
9		6493.49	I	6604 – 21999
11		6494.89	I	8734 – 24126
22	c	6497.11	I	
18		6498.94	II	10117 – 25500
22		6500.72	I	9647 – 25026
9		6504.09	I	10411 – 25782
8		6517.14	I	8734 – 24073
16		6518.79	II	10163 – 25500
8		6534.52	I	
16		6540.47	I	6714 – 21999
7	h	6553.30	I	6714 – 21970
22		6564.62	II	7447 – 22675
45		6566.77	II	1743 – 16967
7		6571.03	I	
6		6578.00	I	10411 – 25609
6		6584.56	II	12827 – 28010
9	h	6593.74	II	8100 – 23261
11		6595.48	I	8734 – 23891
15		6609.86	I	9647 – 24772
55		6616.67	I	8734 – 23843
11		6618.34	II	11419 – 26524
7	h	6631.00	I	6893 – 21970
13	h	6632.06	I	
14		6647.12	I	
75		6656.83	II	14706 – 29724
55		6673.41	II	13029 – 28010
75		6673.78	II	11419 – 26398
5	h	6687.51	II	
4	h	6699.25	I	10411 – 25334
13		6736.79	I	11815 – 26654
35	c	6747.09	I	8250 – 23067
19	c	6749.19	I	9647 – 24459
7	c	6784.99	II	
55	cw	6798.60	I	8080 – 22785
11		6811.76	II	8465 – 23141
17	cw	6812.87	II	3403 – 18077
13		6814.04	II	10163 – 24835
9		6817.61	I	11746 – 26410
35	cw	6827.60	II	
19		6830.50	II	13374 – 28010
9		6844.39	I	11746 – 26353
9	h	6845.47	II	11794 – 26398
9		6846.59	II	7438 – 22040
17	c	6850.46	II	7447 – 22040
11		6852.77	I	
11	c	6870.44	I	
7		6884.66	I	
8		6892.71	I	
8	h	6970.38		
8	c	6980.12	I	
40		7021.51	II	11419 – 25657
10		7024.53	I	8835 – 23067
13		7042.40	I	9647 – 23843
8		7044.45	II	11418 – 25610
7		7051.07	I	0 – 14178
10		7079.99	I	6892 – 21013
11	c	7095.18	I	
20		7114.55	I	8734 – 22785
10	h	7116.90	I	11815 – 25862
11		7118.24	II	
7		7137.33	II	8465 – 22472
10	h	7159.88	I	4866 – 18829
7		7167.77	II	10030 – 23978
7	h	7189.95	I	
10	c	7208.85	II	10030 – 23898
24		7227.70	II	13029 – 26860
13		7231.53	I	

Praseodymium—all observed lines—Continued

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
7 c	7243.26	I	
7 c	7259.21	I	4432 – 18204
7 c	7287.61	I	
7 h	7289.19	I	10411 – 24126
7 cw	7324.42	I	8320 – 21970
7	7328.47	I	10432 – 24073
7	7344.86		
16	7407.56	II	14706 – 28202
20 c	7451.74	II	13029 – 26445
11 h	7495.59	I	4866 – 18204
6 h	7499.42	I	
14	7541.02	II	0 – 13257
6	7574.86	I	
20	7645.66	II	14706 – 27782
7	7704.98	II	11419 – 24394
16	7721.84	I	
6 h	7786.16	II	3403 – 16243
6 cw	7841.27	I	
14	7871.67	I	
6	7881.09	I	7630 – 20315
6 cw	7888.56	II	1743 – 14416
6	7915.19	II	10030 – 22661
6	8031.92	I	6893 – 19340
6	8055.43	I	6893 – 19304
14	8067.44	I	
10 cw	8122.78	II	
11	8141.10	I	
5	8181.34	II	13029 – 25249
5 c	8211.93	I	
6	8289.93	I	
6	8379.84	I	
6 h	8427.82	I	15470 – 27332
6 h	8605.27	II	10163 – 21781
10	8714.59	II	7438 – 18910

Rhenium

Re, $Z = 75$, $M = 186.2$, Ratio $\frac{\text{Re}}{\text{Cu}} = 2.930$

Re I Normal state of valence electrons $5d^5 6s^2\ {}^6S_{2\frac{1}{2}} = 0$. I.P. = 63530 cm^{-1}.
Re II Normal state of valence electrons $5d^5 6s\ {}^7S_3 = 0$. I.P. = 134000 cm^{-1}.

References

Wavelengths:
W. F. Meggers, J. Research NBS **49**, 187 (1952) RP 2355.

Classification:
Re I, P. F. A. Klinkenberg, W. F. Meggers, R. Velasco, and M. A. Catalán, J. Research NBS **59**, 319 (1957) RP 2804.
Re II, W. F. Meggers, M. A. Catalán, and M. Sales, J. Research NBS **61**, 441 (1958) RP 2914.

Strong lines of rhenium

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
55000	c	3460.46	I	0 – 28890	4000		3399.30	I	11754 – 41164
40000	c	3464.73	I	0 – 28854	4000		3725.76	I	23632 – 50464
27000		2049.08	I	0 – 48786	3700		2083.92	I	0 – 47971
25000		2003.53	I	0 – 49895	3700		2156.67	I	0 – 46353
16000		2017.87	I	0 – 49541	3600	c	4227.46	I	18950 – 42598
16000	c	3451.88	I	0 – 28962	3400		2139.04	II	
10000		2085.59	I	0 – 47932	3400		2176.21	I	0 – 45937
9800		2097.12	I	0 – 47669	2900		2287.51	I	0 – 43702
8000		3424.62	I	11754 – 40946	2900		2887.68	I	11754 – 46374
5500		2999.60	I	11754 – 45083	2700		2109.22	I	
5200	c	2275.25	II	0 – 43938	2700		2294.49	I	0 – 43569
4900		2167.94	I	0 – 46112	2600		4513.31	I	20448 – 42598
4700		2092.41	II		2500		2428.58	I	0 – 41164
4200		2074.70	I	0 – 48184	2200		2214.58	I	
4200	c	2214.26	II	0 – 45148	2200	cw	4889.14	I	0 – 20448

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
25000		2003.53	I	0 – 49895
16000		2017.87	I	0 – 49541
27000		2049.08	I	0 – 48786
4200		2074.70	I	0 – 48184
3700		2083.92	I	0 – 47971
10000		2085.59	I	0 – 47932
4700		2092.41	II	
9800		2097.12	I	0 – 47669
2700		2109.22	I	
3400		2139.04	II	
1600		2142.74	II	
		2142.97	I	0 – 46649
3700		2156.67	I	0 – 46353
4900		2167.94	I	0 – 46112
3400		2176.21	I	0 – 45937
4200	c	2214.26	II	0 – 45148
2200		2214.58	I	
1700		2226.42	I	0 – 44901
920		2235.44	I	0 – 44720
440		2255.73	I	11584 – 55902
860		2256.19	I	0 – 44309
2000		2264.39	I	0 – 44148
2100		2274.62	I	0 – 43950
5200	c	2275.25	II	0 – 43938
1600		2281.62	I	0 – 43815
2900		2287.51	I	0 – 43702
2700		2294.49	I	0 – 43569
390		2298.09	II	27628 – 71128
390		2299.77	I	11755 – 55224
610		2302.99	I	0 – 43408
680		2306.54	I	0 – 43342
230		2312.97	I	15058 – 58280
220		2313.34	I	
220		2319.19	I	16307 – 59412
370		2320.16	I	16307 – 59394
800		2322.49	I	0 – 43044
300		2328.66	I	11584 – 54514
270		2334.33	I	11584 – 54410
270		2335.73	I	11754 – 54554
220		2336.10	I	16619 – 59412
270		2337.95	I	11754 – 54514
860		2344.78	I	
140		2345.28	I	13826 – 56452
140		2347.06	I	11584 – 54177
230		2349.39	I	14621 – 57173
220	d	2350.46	I	
680		2352.07	I	11584 – 54087
210	d	2353.95	I	
		2354.08	I	11754 – 54221
250		2356.50	I	11754 – 54177
200		2365.32	I	
1200		2365.90	I	0 – 42254
570		2367.68	I	15058 – 57281
180		2368.53	II	14930 – 57139
520		2369.27	I	11755 – 53949
220		2370.76	II	14883 – 57050
210		2371.52	I	11584 – 53738
150		2373.48	II	14930 – 57050
320		2375.07	I	14217 – 56308
150		2375.82	I	11584 – 53662
100		2377.33	I	
75		2378.53	II	27746 – 69776
370		2379.77	I	
180		2380.22	I	16619 – 58619
75		2380.89	I	16307 – 58295
180		2381.14	I	11754 – 53738
180		2383.46	I	14217 – 56160
180		2386.90	II	20976 – 62859
85		2387.46	I	16307 – 58180
340		2388.57	I	
170		2389.11	I	0 – 41844
170		2390.43	I	
85		2391.28	I	11584 – 53390
230		2393.65	I	13826 – 55590
320		2394.37	I	11584 – 53336
320		2396.79	I	11584 – 53294
200		2397.31	I	15166 – 56866
75		2398.71	I	16619 – 58295
75		2398.89	I	
210	d	2400.72	I	15058 – 56699
		2400.89	I	
210		2401.68	I	11754 – 53379
150		2402.60	I	
75		2403.04	II	23341 – 64942
150		2404.34	I	
1500		2405.06	I	11754 – 53321
740		2405.60	I	0 – 41557
320		2406.70	I	
270		2410.37	I	11584 – 53059
120		2410.99	I	
180		2413.22	I	
120		2414.59	I	15770 – 57173
120		2416.30	I	
120		2416.44	I	11584 – 52954
120		2417.66	I	16307 – 57657
60		2418.20	II	25988 – 67328
170		2419.40	I	15770 – 57090
1200		2419.81	I	0 – 41313
170		2421.38	I	15166 – 56452
300		2421.73	I	14621 – 55901
300		2421.88	I	
60		2423.50	I	15058 – 56308
60		2423.84	II	
60		2425.38	I	
100		2426.64	I	16328 – 57524
2500		2428.58	I	0 – 41164
110		2429.65	I	16307 – 57453
490		2431.54	I	
420		2432.18	I	11754 – 52857
150		2432.70	I	15166 – 56260
170		2433.28	I	16307 – 57391
100		2433.61	I	
100		2436.05	I	16619 – 57657
180		2438.46	I	13826 – 54823
140		2439.06	I	11754 – 52741
75		2440.41	I	
75		2440.58	I	
340	c	2441.47	I	0 – 40946
230		2442.51	I	15770 – 56699
85		2444.09	I	
250		2444.94	I	11584 – 52472
610		2446.98	I	15058 – 55912
120		2448.20	I	
85		2449.03	II	18846 – 59666
85		2449.52	II	26237 – 67049
610		2449.71	I	0 – 40809
85		2450.89	I	11584 – 52373
85		2453.14	I	16619 – 57372
200		2455.83	II	14352 – 55059
60		2455.99	I	

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
85		2460.24	I	11584 – 52218
390		2461.20	I	11754 – 52373
800	c	2461.84	II	
85		2462.54	I	
110		2463.31	I	13826 – 54410
120		2465.13	I	16619 – 57173
200		2467.57	II	14930 – 55444
120		2467.85	II	26768 – 67276
150	c	2469.36	II	18846 – 59330
60	h	2470.05	I	
120		2470.61	II	20463 – 60927
75		2471.05	II	19140 – 59596
150		2473.72	II	
160		2474.73	I	15058 – 55454
160		2475.17	II	23894 – 64282
75		2476.28	I	11584 – 51955
75		2477.43	II	
200		2479.02	I	17331 – 57657
180		2480.82	I	14217 – 54514
1200		2483.92	I	11754 – 52001
390		2485.81	1	16307 – 56523
120		2486.78	I	11754 – 51955
60		2486.97	I	
980		2487.33	1	11755 – 51946
75		2490.16	II	30982 – 71128
200		2492.84	I	13826 – 53929
150		2495.26	I	11584 – 51648
370		2496.04	I	14217 – 54268
35		2496.70	I	17331 – 57372
200		2498.22	I	13826 – 53843
110		2498.86	I	11584 – 51590
75		2500.31	I	22160 – 62143
140		2500.57	I	23956 – 63935
370		2501.72	I	14217 – 54177
570		2502.35	II	20976 – 60927
230		2504.60	II	17224 – 57139
75		2505.43	I	
270		2505.94	I	11754 – 51648
150		2507.40	I	14217 – 54087
1800	c	2508.99	I	0 – 39845
75		2512.55	I	14621 – 54410
75	c	2514.51	I	
60		2515.47	I	
120		2516.12	I	11754 – 51486
50		2517.08	I	
570		2520.01	I	0 – 39670
540		2521.50	I	14621 – 54268
110		2525.55	I	
60		2526.81	I	13826 – 53390
140		2529.50	I	14217 – 53738
150		2533.31	I	13826 – 53288
150		2534.10	II	14352 – 53802
370		2534.80	I	11754 – 51193
110		2539.33	I	17331 – 56699
570		2540.51	I	11584 – 50934
110		2543.67	1	15166 – 54467
60		2543.84	I	13826 – 53125
110		2544.22	I	16619 – 55912
740	d	2544.74	I	11584 – 50869
		2544.88	I	
370		2545.48	I	11754 – 51028
110		2548.14	I	13826 – 53059
150		2548.88	I	14621 – 53842
60		2549.37	I	17238 – 56452
160		2550.09	II	20463 – 59666
300		2552.02	I	14217 – 53390
35		2552.73	I	14217 – 53379
150	c	2553.59	II	17224 – 56372
75		2554.18	I	
370		2554.63	II	20463 – 59596
60		2554.93	I	13826 – 52954
1000		2556.51	I	14217 – 53321
150		2558.06	I	17331 – 56411
250		2559.08	I	0 – 39065
75		2559.71	I	13826 – 52881
75		2559.88	I	15770 – 54823
150		2561.46	I	15058 – 54087
150		2563.01	I	
340		2564.19	I	11584 – 50571
75		2565.84	I	21775 – 60737
35		2566.57	I	
540		2568.64	II	14883 – 53802
150		2571.26	I	11584 – 50464
370		2571.81	II	14930 – 53802
150		2573.76	I	14217 – 53059
50		2574.21	I	16619 – 55454
75		2576.32	I	17331 – 56134
50		2578.12	I	
150		2579.01	I	15166 – 53929
100		2580.31	I	15770 – 54514
150		2581.44	I	11584 – 50311
110		2582.77	I	
75		2584.77	I	15166 – 53842
380		2586.79	I	11754 – 50401
65		2587.00	I	13826 – 52469
65		2591.13	I	17331 – 55912
180		2591.59	I	11584 – 50159
90	h	2592.84	I	11755 – 50311
160	c	2594.85	I	11584 – 50110
180		2595.23	I	0 – 38521
110		2596.40	1	
160		2596.78	1	15770 – 54268
110		2596.95	I	16327 – 54823
65		2597.96	I	
290		2599.86	I	13826 – 52278
65		2600.87	1	14621 – 53059
90		2601.87	I	16307 – 54730
55		2602.55	I	
90		2602.93	I	15770 – 54177
130		2603.46	1	
290		2603.89	I	
55		2607.32	1	
660		2608.50	II	14352 – 52677
610	d	2611.54	1	
		2611.60	I	11584 – 49863
110		2613.74	1	15770 – 54018
160		2614.56	1	14621 – 52857
55		2615.68	1	
160	c	2616.72	II	18846 – 57050
100		2617.11	I	
90		2617.44	I	16619 – 54813
170		2620.03	I	14217 – 52373
170		2620.34	1	21775 – 59927
200		2622.76	I	
90		2623.28	I	11754 – 49863
45		2625.04	I	11584 – 49667
55	c	2630.75	I	15058 – 53059
90		2631.57	I	11584 – 49573
45		2633.01	1	15770 – 53738
130		2633.61	I	15166 – 53125

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
310		2635.83	II	17224 – 55151
550		2636.64	I	0 – 37916
190		2637.01	II	19140 – 57050
90		2641.02	II	14824 – 52677
270		2642.75	I	11754 – 49583
160		2647.13	I	0 – 37766
65		2648.46	II	14930 – 52677
270		2649.05	I	14217 – 51955
45		2649.58	I	17238 – 54969
660		2651.90	I	0 – 37698
130		2652.91	I	15058 – 52741
400		2654.12	I	11584 – 49250
45		2655.18	I	13826 – 51477
45		2655.84	I	16307 – 53949
65		2659.02	I	14621 – 52218
65		2659.79	I	26349 – 63935
45		2660.54	I	
220		2663.63	I	11755 – 49286
65		2664.22	I	15770 – 53294
65		2664.81	I	16327 – 53842
65		2667.13	I	17331 – 54813
65		2670.24	I	11584 – 49023
110		2670.79	I	14217 – 51648
160		2671.84	I	11754 – 49171
75		2672.77	I	
940		2674.34	I	0 – 37381
160		2677.03	I	
130		2677.76	I	14621 – 51955
130		2679.10	I	15058 – 52373
160		2679.91	I	22160 – 59464
130		2683.56	I	22160 – 59412
65		2685.31	I	
220		2688.53	I	15770 – 52954
110	h	2690.25	I	16307 – 53467
45	h	2690.79	I	
75		2694.39	I	11754 – 48858
160		2695.56	I	15770 – 52857
90		2697.26	I	0 – 37064
45		2698.79	I	16619 – 53662
35		2699.58	I	11754 – 48786
75		2702.67	I	
130		2704.37	I	16327 – 53294
45		2706.06	I	15058 – 52001
35		2707.40	I	
45		2710.22	I	
65		2712.48	I	14621 – 51477
90		2713.02	I	16619 – 53467
65		2713.16	I	17331 – 54177
1300		2715.47	I	11754 – 48570
180		2715.77	I	14217 – 51028
65		2716.75	I	16327 – 53125
45		2719.54	I	16619 – 53379
180		2722.21	I	
190		2722.70	I	14217 – 50934
100		2723.84	I	15770 – 52472
110		2727.55	I	14217 – 50869
45		2728.63	I	13826 – 50464
65		2729.64	I	16327 – 52952
45		2730.83	I	14621 – 51230
200		2731.56	II	18846 – 55444
220		2732.21	I	15058 – 51648
610		2733.04	II	17224 – 53802
55		2734.31	I	14621 – 51183
90		2738.32	I	15770 – 52278
120		2739.94	I	
65		2741.97	I	22160 – 58619
65	d	2742.74	I	
		2742.86	I	15770 – 52218
90		2743.87	I	16307 – 52741
140		2747.44	I	11584 – 47971
75		2752.85	I	11584 – 47899
130		2753.05	I	14621 – 50934
110	h	2753.64	II	19140 – 55444
55		2755.21	I	13826 – 50110
55		2757.49	I	
220		2758.00	I	14621 – 50869
55		2758.71	I	16619 – 52857
110		2761.93	I	11584 – 47780
90		2763.30	I	11754 – 47932
210		2763.79	I	15058 – 51230
200		2766.39	I	27130 – 63268
310		2767.74	I	11584 – 47704
220		2768.85	I	11754 – 47860
220		2769.32	I	
350		2770.42	I	11584 – 47669
170		2773.11	I	17238 – 53288
75		2777.71	I	17331 – 53321
90		2778.09	I	
75		2778.50	I	14218 – 50197
180		2781.43	I	14217 – 50159
550		2783.57	I	11754 – 47669
160		2785.21	I	14217 – 50110
55		2786.14	I	21775 – 57657
120		2786.56	I	15058 – 50934
90	c	2789.27	I	13826 – 49667
140		2790.94	I	15770 – 51590
220		2791.29	I	16307 – 52122
45		2793.66	I	
100		2798.10	I	17331 – 53059
140	h	2800.75	I	
55	h	2802.25	I	
120		2803.28	II	13777 – 49439
100		2807.86	I	11754 – 47358
55		2812.07	I	17331 – 52881
75		2812.36	I	16328 – 51874
55		2813.11	I	14621 – 50159
170		2813.96	I	17331 – 52857
220		2814.68	I	11584 – 47102
170		2816.32	I	22160 – 57657
100		2816.96	I	14621 – 50110
75		2819.78	II	17224 – 52677
880		2819.95	I	11754 – 47206
110		2822.12	I	13826 – 49250
110		2824.25	I	21775 – 57173
100		2825.46	I	16619 – 52001
110		2827.52	I	14217 – 49573
55		2830.35	I	
310		2834.08	I	14621 – 49896
200		2837.55	I	22160 – 57391
200		2840.35	I	13826 – 49023
220		2843.00	I	15770 – 50934
100		2844.16	I	11584 – 46733
100		2846.97	I	
270		2850.98	I	11584 – 46649
90		2852.84	I	17331 – 52373
55		2860.07	I	14217 – 49171
55		2860.25	I	14621 – 49573
55		2864.56	I	27244 – 62143
240		2867.19	I	16619 – 51486
160		2871.82	I	14217 – 49028

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
55		2872.30	I	15058 – 49863
45		2872.67	I	15770 – 50571
200		2875.28	I	11584 – 46353
65		2879.27	I	16307 – 51028
200		2883.44	I	17331 – 52001
65		2884.04	I	23956 – 58619
110		2884.64	I	
65		2887.31	I	17331 – 51955
2900		2887.68	I	11754 – 46374
130	c	2888.06	II	14824 – 49439
90		2889.45	I	11754 – 46353
100		2891.48	I	16619 – 51193
180		2891.88	I	14217 – 48786
160		2892.63	I	19458 – 54018
110		2894.32	I	15770 – 50311
45		2895.65	I	15058 – 49583
490		2896.01	I	0 – 34520
35		2898.79	I	20482 – 54969
830	c	2902.48	I	18950 – 53392
210		2905.58	I	14621 – 49028
180		2906.02	I	14621 – 49023
100		2908.34	I	
550		2909.82	I	16307 – 50663
55		2910.08	I	11584 – 45937
65		2913.15	I	17331 – 51648
65	h	2916.73	II	25321 – 59596
65		2918.88	I	16619 – 50869
100		2919.41	I	16327 – 50571
160		2924.60	I	11754 – 45937
120		2925.20	I	26661 – 60837
65		2926.93	I	17331 – 51486
830	c	2927.42	I	11754 – 45904
180		2929.53	I	15770 – 49895
270		2930.61	I	15058 – 49171
65		2932.31	I	15770 – 49863
130		2936.50	I	16619 – 50663
45		2941.56	I	20482 – 54467
440		2943.14	I	14217 – 48184
65		2944.32	I	13826 – 47780
65		2946.57	I	20482 – 54410
120		2949.09	I	17331 – 51230
65		2949.88	I	16307 – 50197
130		2950.83	I	11584 – 45463
120		2954.34	I	13826 – 47665
130	h	2957.91	II	23341 – 57139
140		2961.74	I	14217 – 47971
270		2962.27	I	11584 – 45332
65		2962.87	I	22160 – 55901
720		2965.11	I	14217 – 47932
1500		2965.76	I	11754 – 45463
90		2967.25	I	16619 – 50311
180		2968.04	I	14217 – 47899
90		2968.98	II	
75		2975.02	I	17331 – 50934
120		2975.25	I	19458 – 53059
310		2976.29	I	0 – 33589
65		2977.30	I	16619 – 50197
210		2978.15	I	16327 – 49895
220		2980.82	I	11584 – 45122
65		2981.01	I	19758 – 53294
220		2982.19	I	
65		2984.75	I	19458 – 52952
220		2988.47	I	14217 – 47669
1800		2992.36	I	0 – 33409
65		2992.82	I	
170		2995.40	I	30560 – 63935
5500		2999.60	I	11754 – 45083
350		3001.14	I	14621 – 47932
220		3004.14	I	14621 – 47899
65		3004.34	I	13826 – 47102
200		3006.42	I	15770 – 49023
130		3011.92	I	11754 – 44946
190		3013.14	I	13826 – 47004
500		3016.02	I	11754 – 44901
300		3016.49	I	14217 – 47358
40		3016.97	I	11584 – 44720
120		3021.88	I	14621 – 47704
60		3022.99	I	17331 – 50401
380		3030.45	I	14217 – 47206
60		3031.27	I	23155 – 56134
60		3032.79	I	16619 – 49583
130		3034.55	I	20448 – 53392
60		3036.55	I	16327 – 49250
100		3037.96	I	13826 – 46733
130		3040.03	I	14217 – 47102
100		3041.00	I	15058 – 47932
60		3041.99	I	16307 – 49171
60		3042.29	I	
100		3044.08	I	15058 – 47899
240		3047.25	I	28030 – 60837
100		3053.63	I	21775 – 54514
130		3054.90	I	11584 – 44309
90		3057.66	I	16327 – 49023
200		3058.78	I	13826 – 46509
130		3060.32	I	16619 – 49286
100		3061.61	I	22160 – 54813
70		3064.60	I	17238 – 49860
1600		3067.40	I	0 – 32592
320		3069.94	I	11584 – 44148
260		3071.16	I	16619 – 49171
200		3072.96	I	17331 – 49863
90		3076.14	I	15166 – 47665
100		3078.86	I	11754 – 44225
550		3082.43	I	14217 – 46649
180		3084.21	I	15770 – 48184
90		3087.15	I	14621 – 47004
340		3088.76	I	11584 – 43950
110		3089.94	I	22160 – 54514
200		3093.64	I	13826 – 46141
200		3095.06	I	15058 – 47358
180		3095.79	I	14217 – 46509
100		3096.41	I	13826 – 46112
700		3100.67	I	16327 – 48569
140		3103.06	II	17224 – 49439
140		3103.26	II	
140		3104.65	I	15770 – 47971
700		3108.81	I	14217 – 46374
340		3110.86	I	14217 – 46353
140		3111.56	I	15770 – 47899
340	c	3118.19	I	11754 – 43815
340		3121.36	I	14621 – 46649
70		3123.16	I	15770 – 47780
70		3125.52	I	11584 – 43569
420		3128.94	I	16619 – 48569
260		3134.02	I	15770 – 47669
70		3139.79	I	17331 – 49171
70		3139.94	I	15166 – 47004
250		3141.38	I	11584 – 43408
140		3142.65	I	
70		3151.16	I	19458 – 51183

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
440	3151.64	I	14217 – 45937
330	3153.79	I	11754 – 43453
360 c	3158.31	I	11754 – 43408
220	3164.52	I	15058 – 46649
50	3167.16	I	16619 – 48184
700	3168.37	I	16307 – 47860
140	3173.09	I	13826 – 45332
220	3174.61	I	14621 – 46112
140	3174.78	I	27130 – 58619
440	3177.71	I	11584 – 43044
260	3178.61	I	15058 – 46509
70	3182.66	I	19458 – 50869
600	3182.87	I	18950 – 50359
1100	3184.76	I	18950 – 50341
1100	3185.57	I	18950 – 50333
120	3186.29	I	27244 – 58619
150	3190.17	I	16328 – 47665
260	3190.78	I	17238 – 48569
260	3192.36	I	14621 – 45937
140	3193.20	I	22160 – 53467
200	3194.50	I	15058 – 46353
220	3198.58	I	14621 – 45876
70	3199.49	I	14217 – 45463
150	3200.04	I	16619 – 47860
100	3200.72	I	15770 – 47004
1100 c	3204.25	I	16307 – 47507
70	3205.42	I	24724 – 55912
140	3211.75	I	14217 – 45343
120	3212.94	I	14217 – 45332
70	3213.49	I	
120	3214.11	I	26349 – 57453
150	3227.46	I	15166 – 46141
70	3228.73	I	15770 – 46733
380	3235.94	I	13826 – 44720
150	3237.51	I	15058 – 45937
80	3241.47	I	14621 – 45463
80	3248.55	I	16327 – 47102
150	3252.26	I	15770 – 46509
600	3258.85	I	16327 – 47004
600	3259.55	I	11584 – 42254
200	3261.56	I	15166 – 45817
120	3262.77	I	17331 – 47971
120	3266.85	I	17331 – 47932
150	3268.48	I	16619 – 47206
300	3268.89	I	15770 – 46353
160	3277.71	I	14621 – 45122
160	3285.64	I	17238 – 47665
80	3287.13	I	27244 – 57657
200	3294.83	I	15770 – 46112
280	3296.70	I	18950 – 49275
280	3296.99	I	16327 – 46649
80	3300.97	I	15058 – 45343
280	3301.60	I	14621 – 44901
240	3302.23	I	15058 – 45332
320	3303.21	II	14883 – 45148
280	3303.75	I	11584 – 41844
80	3307.01	I	27161 – 57391
80	3308.25	I	
80	3312.29	I	16327 – 46509
240	3313.95	I	15770 – 45937
160	3318.67	I	13826 – 43950
600	3322.48	I	11754 – 41844
70	3324.93	I	16307 – 46374
200	3331.52	I	14217 – 44225
160	3335.36	I	11584 – 41557
2000	3338.18	I	20448 – 50396
140	3339.68	I	17238 – 47173
1600	3342.24	I	20448 – 50359
810	3344.32	I	20448 – 50341
320	3346.20	I	13826 – 43702
130	3353.21	I	16327 – 46141
160	3355.29	I	22423 – 52218
240 d	3356.33	I	22160 – 51946
	3356.46	I	16327 – 46112
200	3358.02	I	17331 – 47102
160	3359.22	I	23632 – 53392
160	3361.14	I	13826 – 43569
200	3362.74	I	11584 – 41313
160 d	3365.73	I	23155 – 52857
	3365.84	I	21775 – 51477
240	3377.74	I	16307 – 45904
320	3379.06	II	14352 – 43938
320	3379.70	I	11584 – 41164
160	3384.45	I	27161 – 56699
200	3385.76	I	14621 – 44148
240	3389.43	I	17238 – 46733
200	3390.25	I	22160 – 51648
80	3394.12	I	21775 – 51230
80	3397.21	I	26349 – 55777
4000	3399.30	I	11754 – 41164
80	3401.17	I	
650	3404.72	I	11584 – 40946
650	3405.89	I	14217 – 43569
240	3408.67	I	14621 – 43950
320	3409.83	I	17331 – 46649
80	3413.74	I	16619 – 45904
320	3417.77	I	15058 – 44309
810	3419.41	I	14217 – 43453
160	3420.75	I	11584 – 40809
8000	3424.62	I	11754 – 40946
400	3426.19	I	17331 – 46509
300	3427.61	I	15058 – 44225
320	3437.71	I	14621 – 43702
80	3441.25	I	
60	3442.97	I	16307 – 45343
400	3449.37	I	15166 – 44148
16000 c	3451.88	I	0 – 28962
80	3453.28	I	15770 – 44720
240	3453.50	I	14621 – 43569
160	3458.88	I	17238 – 46141
55000 c	3460.46	I	0 – 28890
40000 c	3464.73	I	0 – 28854
400	3467.96	I	20448 – 49275
160	3472.72	I	14621 – 43409
240	3476.44	I	15058 – 43815
80	3477.14	I	27161 – 55912
400	3480.38	I	16619 – 45343
320	3480.85	I	14621 – 43342
240	3482.23	I	22160 – 50869
110	3490.86	I	17238 – 45876
80	3494.72	I	17331 – 45937
130 c	3495.90	I	
80	3502.73	I	20482 – 49023
560	3503.06	I	15770 – 44309
100 c	3512.28	I	16619 – 45083
320	3516.65	I	13826 – 42254
320	3517.33	I	14621 – 43044
80 c	3520.72	I	15058 – 43453
80	3524.54	I	
60	3529.21	I	16619 – 44946

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
120	3534.82	I	16619 – 44901
320	3537.46	I	11584 – 39845
160	3539.33	I	19458 – 47704
60	3539.94	I	22160 – 50401
240	3549.89	I	11754 – 39916
160	3551.29	I	22160 – 50311
160	3553.65	I	17331 – 45463
160	3558.94	I	11754 – 39845
80	3564.73	I	15770 – 43815
160	3568.23	I	24724 – 52741
240	3570.26	I	17331 – 45332
360	3579.12	I	15770 – 43702
810 c	3580.15	II	17224 – 45148
650	3580.97	I	16307 – 44225
810	3583.02	I	11754 – 39656
70	3590.88	I	22423 – 50263
80	3595.16	I	21775 – 49583
160	3596.39	I	11754 – 39552
80	3598.77	I	23155 – 50934
80	3604.39	I	22423 – 50159
160	3610.49	I	16307 – 43996
320	3617.08	I	15770 – 43409
80	3617.25	I	15770 – 43408
160	3621.46	I	16619 – 44225
160	3625.91	I	15770 – 43342
60	3629.20	I	19458 – 47004
140	3637.06	I	13826 – 41313
810	3637.84	I	11584 – 39065
35	3642.99	I	11754 – 39197
80	3651.66	I	16619 – 43996
440	3651.97	I	16327 – 43702
80	3653.62	I	23632 – 50994
60	3660.52	I	27244 – 54554
40	3662.13	I	27514 – 54813
120	3669.78	I	16327 – 43569
80	3670.36	I	23956 – 51193
320	3670.53	I	14217 – 41453
80	3672.41	I	14621 – 41844
60	3676.00	I	16619 – 43815
35	3680.21	I	24425 – 51590
35	3681.28	I	26132 – 53288
860 c	3689.50	I	14217 – 41313
1500 c	3691.48	I	16327 – 43409
100	3697.71	I	27141 – 54177
35	3700.37	I	
520	3703.24	I	13826 – 40822
70	3704.45	I	
60	3704.84	I	13826 – 40810
100	3705.02	I	13826 – 40809
240	3709.93	I	14217 – 41164
35	3715.02	I	17238 – 44148
360 c	3717.28	I	17331 – 44225
4000	3725.76	I	23632 – 50464
140	3731.87	I	16619 – 43408
140	3732.28	I	15058 – 41844
240 c	3735.01	I	11754 – 38521
810	3735.31	I	23632 – 50396
40	3736.84	I	24724 – 51477
910	3740.10	I	14217 – 40946
140	3740.41	I	23632 – 50359
130	3742.26	II	17224 – 43938
300 cw	3745.44	I	14621 – 41313
80	3755.62	I	17331 – 43950
140	3766.48	I	14621 – 41164
120	3768.26	I	
140	3777.66	I	17238 – 43702
700	3787.52	I	15058 – 41453
160	3796.59	I	11584 – 37916
160	3797.59	I	14621 – 40946
190	3807.74	I	15058 – 41313
120	3815.66	I	14621 – 40822
120	3836.30	I	14434 – 40494
240	3869.94	I	16307 – 42140
240	3875.26	I	11584 – 37381
240	3876.86	I	15770 – 41557
80	3887.49	I	27141 – 52857
80	3887.95	I	17331 – 43044
70	3889.96	I	22160 – 47860
80	3896.11	I	20482 – 46141
80	3900.91	I	14217 – 39845
40	3901.09	I	11754 – 37381
100	3908.21	I	27161 – 52741
130	3913.92	I	15770 – 41313
380 c	3917.27	I	16619 – 42140
60 c	3920.85	I	27244 – 52741
70 c	3927.59	I	14217 – 39670
550	3929.85	I	14217 – 39656
60	3931.20	I	21775 – 47206
140	3936.90	I	15770 – 41164
60	3941.54	I	19758 – 45122
110	3944.72	I	27514 – 52857
180	3945.91	I	14217 – 39552
70	3950.64	I	14621 – 39927
35	3954.43	I	22423 – 47704
280	3961.04	I	13826 – 39065
350 c	3962.48	I	16327 – 41557
60	3963.27	I	16619 – 41844
30	3964.81	I	23956 – 49171
70	3967.39	I	22160 – 47358
35	3975.65	I	16307 – 41453
35	3983.91	I	
40	3984.25	I	
35	3991.03	I	14621 – 39670
100	4004.93	I	19758 – 44720
60	4012.26	I	26661 – 51578
35	4018.40	I	27244 – 52122
140	4022.96	I	18950 – 43801
100	4023.31	I	14217 – 39065
60	4028.53	I	23155 – 47971
110 c	4029.63	I	13826 – 38635
220	4033.31	I	15058 – 39845
110	4037.49	I	15166 – 39927
200	4048.99	I	16307 – 40998
50	4061.86	I	15058 – 39670
240	4081.43	I	16327 – 40822
50	4083.36	I	16327 – 40810
50	4083.58	I	16327 – 40809
40	4089.92	I	14621 – 39065
140	4104.42	I	19458 – 43815
240 c	4110.89	I	17238 – 41557
50	4113.40	I	14217 – 38521
190	4121.64	I	20448 – 44703
50	4132.28	I	13826 – 38019
240 cw	4133.42	I	16307 – 40494
1800	4136.45	I	11754 – 35923
50	4137.60	I	21775 – 45937
700	4144.36	I	17331 – 41453
140	4149.96	I	13826 – 37916
70	4152.29	I	33589 – 57665
50	4152.63	I	15770 – 39845

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
90	4159.92	I	27161 – 51193
160	4170.40	I	27514 – 51486
220	4182.90	I	15770 – 39670
220	4183.06	I	14621 – 38521
90	4194.67	I	17331 – 41164
90	4204.52	I	22160 – 45937
70	4213.27	I	27141 – 50869
650	4221.08	I	11584 – 35268
35	4223.18	I	
3600 c	4227.46	I	18950 – 42598
35	4232.96	I	17695 – 41313
40	4236.24	I	16327 – 39927
30	4238.59	I	18950 – 42536
90	4241.16	I	17238 – 40810
150	4241.39	I	17238 – 40809
70	4246.82	I	34520 – 58061
40	4255.75	I	17331 – 40822
260 c	4257.60	I	14217 – 37698
120 c	4291.17	I	16619 – 39916
80	4291.65	I	14621 – 37916
30	4299.92	I	23956 – 47206
200	4304.40	I	16619 – 39845
30	4314.58	I	21775 – 44946
80	4318.58	I	27514 – 50663
40	4319.53	I	14621 – 37766
200	4332.25	I	14621 – 37698
40	4357.98	II	
380	4358.69	I	11584 – 34520
190	4367.58	I	16307 – 39197
140	4391.34	I	11754 – 34520
70 cw	4392.45	I	14621 – 37381
360 cw	4394.38	I	15770 – 38521
60	4396.80	I	16327 – 39065
80	4402.60	I	15058 – 37766
110 cw	4406.40	I	16307 – 38995
180	4415.82	I	15058 – 37698
60	4440.44	I	17331 – 39845
30 c	4453.92	I	35923 – 58369
30	4454.62	I	14621 – 37064
30	4463.53	I	35268 – 57665
30	4467.54	I	24724 – 47102
80	4467.92	I	16619 – 38995
150	4475.08	I	17331 – 39670
80	4477.99	I	17331 – 39656
120	4478.39	I	15058 – 37381
25	4496.43	I	19758 – 41991
120 c	4507.04	I	28854 – 51035
50	4508.01	I	28854 – 51031
2600	4513.31	I	20448 – 42598
260	4516.64	I	28854 – 50988
80	4519.76	I	28854 – 50973
500	4522.73	I	28890 – 50994
120	4523.88	I	28890 – 50988
80	4526.01	I	20448 – 42536
70	4528.97	I	28962 – 51035
120	4529.95	I	28962 – 51031
50	4530.89	I	22160 – 44225
40	4541.80	I	28962 – 50973
100	4545.17	I	15770 – 37766
50	4559.27	I	15770 – 37698
70	4559.68	I	13826 – 35751
50 c	4565.30	I	15166 – 37064
120	4580.68	I	11584 – 33409
25	4591.68	I	20482 – 42254
120	4605.73	I	14217 – 35923
25 cw	4614.66	I	17331 – 38995
100	4621.38	I	21775 – 43408
25 h	4625.96	I	15770 – 37381
80 c	4630.82	I	16327 – 37916
90	4652.33	I	14434 – 35923
40	4662.49	I	13826 – 35268
50	4682.32	I	19458 – 40809
25	4687.86	I	27244 – 48570
25 c	4694.99	I	15770 – 37064
40	4700.44	I	21775 – 43044
60	4705.04	I	22160 – 43408
25	4725.93	I	23155 – 44309
60	4727.60	I	16619 – 37766
60	4748.38	I	16327 – 37381
25	4749.03	I	14217 – 35268
40	4758.83	I	11584 – 32592
20	4763.67	I	17238 – 38225
190 c	4791.42	I	15058 – 35923
2200 cw	4889.14	I	0 – 20448
50	4915.02	I	12251 – 32592
220	4923.90	I	14217 – 34520
80	4946.72	I	15058 – 35268
50	4956.76	I	23632 – 43801
80	4985.98	I	17331 – 37381
40	5058.56	I	13826 – 33589
70	5096.50	I	16307 – 35923
20	5120.32	I	24425 – 43950
25	5161.65	I	17695 – 37064
40 c	5178.89	I	16619 – 35923
20	5181.74	I	22160 – 41453
35	5234.31	I	23155 – 42254
50	5248.86	I	21775 – 40822
1300	5270.95	I	23632 – 42598
1600 cw	5275.56	I	0 – 18950
100	5278.24	I	16327 – 35268
30	5305.56	I	
20	5317.28	I	26661 – 45463
35	5321.28	I	14621 – 33409
50	5327.46	I	13826 – 32592
20	5331.90	I	15770 – 34520
20	5332.76	I	
20	5333.85	I	27161 – 45904
35	5369.48	I	24425 – 43044
50 c	5369.80	I	13826 – 32444
100 c	5377.10	I	17331 – 35923
25	5431.90	I	39656 – 58061
14	5437.03	I	22423 – 40810
14	5447.92	I	15058 – 33409
25	5460.64	I	19458 – 37766
14 h	5520.05	I	28030 – 46141
25	5521.10	I	28542 – 46649
50 c	5532.68	I	21775 – 39845
50 c	5563.24	I	14621 – 32592
25	5573.47	I	17331 – 35268
25	5584.72	I	16619 – 34520
10 h	5607.21	I	27514 – 45343
12 h	5612.27	I	
100	5667.88	I	15770 – 33409
25	5711.43	I	22423 – 39927
18	5716.95	I	26661 – 44148
110 c	5752.93	I	11584 – 28962
110 cw	5776.83	I	11584 – 28890
18	5791.60	I	16327 – 33589
10 c	5815.92	I	17331 – 34520
550	5834.31	I	11754 – 28890

559-795 O - 75 - 16 (Pt. 1)

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
10		5919.86	I	24425 – 41313
60		5943.24	I	15770 – 32592
10		5950.21	I	28542 – 45343
18	h	5969.77	I	26661 – 43408
10		5989.99	I	23155 – 39845
18	h	5995.73	I	27141 – 43815
30		6114.22	I	17238 – 33589
35	c	6145.81	I	27141 – 43408
50		6146.82	I	16327 – 32592
18		6203.24	I	16327 – 32444
25		6217.97	I	17331 – 33409
30	cw	6229.42	I	28854 – 44903
35	cw	6243.24	I	28890 – 44903
35	d	6260.02	I	
		6260.24	I	
18	c	6271.37	I	28962 – 44903
18		6278.76	I	21775 – 37698
10		6286.41	I	27141 – 43044
10		6303.42	I	26132 – 41992
200		6307.70	I	28854 – 44703
200		6321.90	I	28890 – 44703
80	d	6350.75	I	28962 – 44703
16	h	6382.94	I	29800 – 45463
14		6411.47	I	26661 – 42254
50		6511.47	I	17238 – 32592
14		6515.25	I	30560 – 45904
12		6544.91	I	22423 – 37698
35	c	6577.11	I	28854 – 44054
40	cw	6592.52	I	28890 – 44054
100	cw	6605.19	I	13826 – 28962
30	c	6623.91	I	28962 – 44054
10	c	6637.25	I	19458 – 34520
27	cw	6652.39	I	13826 – 28854
15	h	6683.28	I	22423 – 37381
9	c	6711.30	I	17695 – 32592
30		6751.22	I	
5	c	6761.19	I	20482 – 35268
180	c	6813.41	I	14217 – 28890
260		6829.90	I	14217 – 28854
85		6971.53	I	14621 – 28962
35	cw	7006.63	I	14621 – 28890
65	cw	7024.15	I	14621 – 28854
65	cw	7246.67	I	15058 – 28854
13	cw	7292.72	I	28890 – 42598
40	cw	7578.73	I	15770 – 28962
13		7611.89	I	19458 – 32592
7	cw	7620.25	I	15770 – 28890
50	cw	7640.94	I	15770 – 28854
65	cw	7912.94	I	16327 – 28962
35	cw	7980.77	I	16327 – 28854
40		8417.13	I	11754 – 23632
29	cw	8527.73	I	17238 – 28962

Rhodium

Rh, $Z = 45$, $M = 102.9055$, Ratio $\frac{\text{Rh}}{\text{Cu}} = 1.619$

Rh I Normal state of valence electrons $4d^8 5s\ {}^4F_{4\frac{1}{2}} = 0$. I.P. = 60197 cm^{-1}.
Rh II Normal state of valence electrons $4d^8\ {}^3F_4 = 0$. I.P. = 145800 cm^{-1}.

References

Wavelengths:

G. R. Harrison, Massachusetts Institute of Technology Wavelength Tables (John Wiley & Sons, New York, 1939).

H. Kayser and R. Ritschl, Tabelle der Hauptlinien der Linienspektren aller Elemente (Julius Springer, Berlin, 1939).

Classification:

Rh I, J. P. Molnar and W. J. Hitchcock, J. Opt. Soc. Am. **30,** 523 (1940).

Rh II, F. J. Sancho, Anales Real. Soc. Esp. Fis. y Quim. **54A,** 41 (1958).

Strong lines of rhodium

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
9400	3692.36	I	0 – 27075	4900	3799.31	I	5691 – 32004
8800	3528.02	I	1530 – 29866	4700	3470.66	I	3473 – 32277
8200	3434.89	I	0 – 29105	4700	3474.78	I	3473 – 32243
8200	3657.99	I	1530 – 28860	4700	3583.10	I	1530 – 29431
7600	3700.91	I	1530 – 28543	4700	3596.19	I	2598 – 30397
5900	3462.04	I	2598 – 31474	4200	3323.09	I	1530 – 31614
5900	3502.52	I	0 – 28543	4200	4374.80	I	5691 – 28543
5900	3597.15	I	3310 – 31102	3800	3793.22	I	5691 – 32046
5900	3856.52	I	5691 – 31614	3800	3822.26	I	7791 – 33946
5600	3396.82	I	0 – 29431	3800	3958.86	I	7791 – 33044

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
150		2276.21	II	27439 – 71359
140		2288.57	I	2598 – 46280
110		2309.82	I	3473 – 46753
55		2318.36	I	5691 – 48811
95		2319.10	I	5691 – 48798
95		2321.73	I	1530 – 44588
350		2322.58	I	0 – 43042
140		2326.47	I	3310 – 46280
80		2328.64	I	7791 – 50721
190		2334.77	II	16885 – 59702
55		2345.41	I	
55		2352.47	I	0 – 42495
55		2359.18	I	1530 – 43905
300		2361.92	I	0 – 42325
110		2368.34	I	3473 – 45683
270		2382.89	I	0 – 41953
230		2383.40	I	0 – 41944
40		2384.65	I	7791 – 49713
270		2386.14	II	16885 – 58780
80		2407.88	I	1530 – 43048
27		2408.19	I	1530 – 43042
27		2410.25	I	3310 – 44787
80		2415.84	II	19793 – 61173
55		2418.64		
45		2419.75	I	3473 – 44787
45		2420.18	II	33845 – 75152
65		2420.98	II	20647 – 61940
75		2423.94		
65		2427.11	II	18540 – 59729
130		2427.68	I	2598 – 43777
230		2429.52	I	3473 – 44621
40		2431.85	II	21180 – 62288
40		2432.66	I	5658 – 46753
18		2437.08	I	7791 – 48811
110		2437.90	I	7791 – 48797
330		2440.34	I	1530 – 42495
50	h	2444.27	I	
65		2448.84	I	2598 – 43421
50		2449.04	I	5691 – 46511
75		2450.56	I	
30		2455.70	II	20647 – 61356
65		2458.90	II	19792 – 60448
90		2461.04	II	18540 – 59161
30		2463.61	I	
75		2470.39	I	3310 – 43777
90		2471.47	I	2598 – 43048
30		2472.51	I	
130		2473.09	I	1530 – 41953
15		2475.64	II	31730 – 72112
15		2477.54	II	
25		2482.04	I	
50		2483.33	I	3473 – 43729
150		2487.47	I	
100		2490.77	II	16885 – 57021
30		2492.30	I	3310 – 43421
75	h	2494.51		
15		2499.02	I	
40		2500.58		
130		2502.46	I	3473 – 43421
15		2503.84	II	20647 – 60573
300		2504.29	II	
40		2505.10	II	19792 – 59699
150		2505.67	I	2598 – 42495
350		2509.70	I	2598 – 42431
50		2510.66	II	18540 – 58358
300		2511.03	II	34726 – 74538
75		2513.36	II	36366 – 76141
200		2515.75	I	3310 – 43048
130		2520.53	II	16885 – 56547
13		2525.99	I	9221 – 48798
13		2531.74	I	5691 – 45178
50		2532.66		
13		2533.59		
50		2534.07		
110		2536.71		
110		2537.04	II	
30		2539.72		
40		2544.22		
350		2545.70	I	
13		2548.60		
550		2555.36	I	3310 – 42431
25		2558.62	I	
50		2565.79	I	5658 – 44621
45		2566.04	I	3473 – 42431
25		2566.92	II	38688 – 77633
50		2567.28		
25		2574.66		
25		2575.75	I	14788 – 53600
13		2576.23		
40		2587.29	II	27439 – 66078
30		2598.07		
30		2603.32	II	32605 – 71006
75		2606.44	II	
75		2613.60		
150		2622.58	I	5658 – 43777
230		2625.88	I	5658 – 43729
100		2630.42	I	2598 – 40603
40		2634.99	I	
30		2638.74	II	34243 – 72128
75		2643.00	I	
110		2647.28	I	5658 – 43421
400		2652.66	I	2598 – 40285
30		2659.01	I	1530 – 39127
30		2671.06	I	3473 – 40900
65		2676.11	I	5691 – 43048
25		2680.28	I	
100		2680.63	I	3310 – 40603
30		2681.78	I	14788 – 52065
30	h	2686.50		
30	h	2686.91		
50		2694.31	I	3473 – 40577
400		2703.73	I	3310 – 40285
40		2705.63	II	25377 – 62326
40		2707.23	I	2598 – 39525
75		2714.41	I	7791 – 44620
100		2715.31	II	25377 – 62194
75		2717.51	I	0 – 36787
180		2718.54	I	5658 – 42431
65		2720.14	I	
30		2720.52	I	13975 – 50721
160		2728.94	I	2598 – 39231
40		2736.76	I	2598 – 39127
75		2741.75	I	9221 – 45683
50		2767.73	I	2598 – 38718
100		2771.51	I	2598 – 38669
50		2778.06	I	7791 – 43777
75		2779.54	I	10313 – 46280
130		2783.03	I	3310 – 39231
25		2791.16	I	3310 – 39127
75		2796.63	I	11006 – 46753

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
150		2826.43	I	10313 – 45683
180		2826.68	I	9221 – 44588
30		2827.31	I	3310 – 38669
75		2834.12	I	11006 – 46280
45		2835.44	I	1530 – 36787
75		2836.69	I	5658 – 40900
50		2856.16	I	3473 – 38474
50	d	2860.68	I	5658 – 40605
		2860.76	I	5658 – 40603
280		2862.94	I	5658 – 40577
65		2864.40	I	3310 – 38211
50		2871.35	I	
30		2873.62	I	
110		2878.66	I	3310 – 38038
75		2880.76	I	3310 – 38013
140		2882.37	I	9221 – 43905
75		2885.97	I	7791 – 42431
75		2889.11	I	1530 – 36133
75		2889.84	I	5691 – 40285
65		2899.96	I	10313 – 44787
25		2904.81	I	14382 – 48798
160		2907.21	I	2598 – 36985
65		2910.17	II	25377 – 59729
75		2912.62	I	5658 – 39981
90		2915.42	I	5691 – 39981
30		2923.10	I	9221 – 43421
180		2924.02	I	2598 – 36787
130		2929.11	I	5658 – 39788
130		2931.94	I	5691 – 39788
30		2955.41	I	9221 – 43048
230		2968.66	I	3310 – 36985
25		2974.03	I	11006 – 44621
160		2977.68	I	5658 – 39231
450		2986.20	I	3310 – 36787
90		2986.99	I	5658 – 39127
50		2987.45	I	10313 – 43777
110		3004.46	I	9221 – 42495
50		3019.54	I	10313 – 43421
130		3023.91	I	5658 – 38718
50		3028.43	I	5658 – 38669
30		3045.77	I	3310 – 36133
30		3046.76	I	7791 – 40603
25		3057.89	I	16119 – 48811
65		3067.30	I	12723 – 45316
180		3083.96	I	1530 – 33946
29		3087.42	I	5658 – 38038
70		3114.91	I	3310 – 35404
140		3121.76	I	3310 – 35334
240		3123.70	I	0 – 32004
35		3130.79	I	3473 – 35404
95		3137.71	I	3473 – 35334
45		3151.36	I	14788 – 46511
45		3152.60	I	5658 – 37369
130		3155.78	I	9221 – 40900
70		3179.73	I	7791 – 39231
80		3185.59	I	9221 – 40603
140		3189.05	I	2598 – 33946
470		3191.19	I	5658 – 36985
190		3197.13	I	2598 – 33867
70		3214.32	I	0 – 31102
80		3237.66	I	7791 – 38669
520		3263.14	I	3310 – 33946
520		3271.61	I	3310 – 33867
2300		3280.55	I	1530 – 32004
110		3281.70	I	11968 – 42431
2300		3283.57	I	2598 – 33044
280		3289.14	I	3473 – 33867
45		3289.64	I	14788 – 45178
210		3294.28	I	12723 – 43070
45		3296.72	I	12723 – 43048
260		3300.46	I	10313 – 40603
4200		3323.09	I	1530 – 31614
60		3331.09	I	5658 – 35670
45		3331.24	I	9221 – 39231
330		3338.54	I	1530 – 31474
70		3342.90	I	9221 – 39127
80		3344.20	I	11006 – 40900
60		3359.90	I	13975 – 43729
280		3360.80	I	5658 – 35404
60		3362.18	I	3310 – 33044
420		3368.38	I	2598 – 32277
45		3369.68	I	10313 – 39981
1100		3372.25	I	2598 – 32243
110		3377.14	I	12723 – 42325
80		3377.71	I	11006 – 40603
110		3385.78	I	13521 – 43048
5600		3396.82	I	0 – 29431
820		3399.70	I	2598 – 32004
160		3406.55	I	14382 – 43729
820		3412.27	I	16018 – 45316
60		3420.16	I	12723 – 41953
330		3421.22	I	12723 – 41944
120	d	3424.38	I	7791 – 36985
8200		3434.89	I	0 – 29105
1400		3440.53	I	16121 – 45178
35		3442.63	I	14382 – 43421
120		3447.74	I	7791 – 36787
60		3448.58	I	14788 – 43777
120		3450.29	I	13521 – 42495
60		3451.15	I	3310 – 32277
400		3455.22	I	3310 – 32243
60		3455.42	I	11968 – 40900
180		3457.07	I	10313 – 39231
220		3457.93	I	13521 – 42431
5900		3462.04	I	2598 – 31474
180		3469.62	I	10313 – 39127
4700		3470.66	I	3473 – 32277
120		3472.25	I	9221 – 38013
4700		3474.78	I	3473 – 32243
2100		3478.91	I	3310 – 32046
95		3484.04	I	3310 – 32004
80		3491.07	I	11968 – 40605
110		3494.44	I	11968 – 40577
1200		3498.73	I	3473 – 32046
5900		3502.52	I	0 – 28543
60		3505.41	I	11006 – 39525
2800		3507.32	I	2598 – 31102
60		3511.78	I	16121 – 44588
60		3513.10	I	13975 – 42431
60		3519.54	I	10313 – 38718
8800		3528.02	I	1530 – 29866
880	d	3538.14	I	5691 – 33946
		3538.26	I	14788 – 43042
280		3541.91	I	11006 – 39231
1200		3543.95	I	5658 – 33867
1800		3549.54	I	3310 – 31474
240		3564.13	I	14382 – 42431
1200		3570.18	I	3473 – 31474
4700		3583.10	I	1530 – 29431
120		3583.53	I	10313 – 38211

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
4700	3596.19	I	2598 – 30397	50	3935.84	I	11968 – 37369
5900	3597.15	I	3310 – 31102	590	3942.72	I	10313 – 35670
310	3605.86	I	10313 – 38038	95	3958.24	I	13975 – 39231
3100	3612.47	I	3473 – 31147	3800	3958.86	I	7791 – 33044
240	3614.78	I	16121 – 43777	45	3964.54	II	35787 – 61003
200	3620.46	I	7791 – 35404	380	3975.31	I	13521 – 38669
1800	3626.59	I	9221 – 36787	240	3984.40	I	10313 – 35404
95	3627.80	I	11968 – 39525	240	3995.61	I	10313 – 35334
310	3639.51	I	11006 – 38474	380	3996.15	I	11968 – 36985
350	3654.87	I	5691 – 33044	120	4023.14	I	14382 – 39231
8200	3657.99	I	1530 – 28860	60	4048.41	I	13975 – 38669
280	3661.86	I	16121 – 43421	23	4049.04	I	13521 – 38211
1300	3666.22	I	2598 – 29866	40	4053.44	I	11006 – 35670
180	3666.91	I	11968 – 39231	23	4056.34	I	9221 – 33867
140	3674.76	I	11006 – 38211	70	4077.57	I	13521 – 38038
560	3681.04	I	11968 – 39127	560	4082.78	I	7791 – 32277
1900	3690.70	I	3310 – 30397	19	4084.28	I	2598 – 27075
9400	3692.36	I	0 – 27075	45	4087.79	I	16121 – 40577
60	3694.95	I	13521 – 40577	60	4088.50	I	7791 – 32243
940	3695.52	I	16018 – 43070	140	4097.52	I	11006 – 35404
280	3698.26	I	11006 – 38038	45	4107.49	I	14788 – 39127
380	3698.60	I	16018 – 43048	70	4116.33	I	14382 – 38669
7600	3700.91	I	1530 – 28543	120	4119.68	I	16018 – 40285
940	3713.02	I	3473 – 30397	1100	4121.68	I	7791 – 32046
60	3713.43	I	16121 – 43042	1500	4128.87	I	7791 – 32004
45	3714.83	I	9221 – 36133	2100	4135.27	I	5691 – 29866
16	3724.94	I	11968 – 38807	240	4154.37	I	12723 – 36787
650	3735.28	I	13521 – 40285	330	4196.50	I	9221 – 33044
420	3737.27	I	11968 – 38718	70	4206.62	I	3310 – 27075
420	3744.17	I	11968 – 38669	3300	4211.14	I	5691 – 29431
1200	3748.22	I	10313 – 36985	29	4230.20	I	10313 – 33946
240	3754.12	I	13975 – 40605	40	4244.44	I	10313 – 33867
380	3754.27	I	13975 – 40603	60	4273.43	I	13975 – 37369
490	3755.58	I	5658 – 32277	60	4278.60	I	11968 – 35334
1000	3760.40	I	5658 – 32243	820	4288.71	I	7791 – 31102
2300	3765.08	I	5691 – 32243	70	4296.77	I	13521 – 36787
490	3769.97	I	14382 – 40900	23	4342.44	I	9221 – 32243
70	3775.72	I	16018 – 42495	45	4373.04	I	11006 – 33867
380	3778.13	I	13521 – 39981	4200	4374.80	I	5691 – 28543
1000	3788.47	I	5658 – 32046	95	4379.92	I	9221 – 32046
1300	3792.18	I	11006 – 37369	23	4433.32	I	16119 – 38669
3800	3793.22	I	5691 – 32046	35	4492.47	I	9221 – 31474
4900	3799.31	I	5691 – 32004	29	4503.78	I	14788 – 36985
760	3805.92	I	13521 – 39788	23	4528.72	I	7791 – 29866
1300	3806.76	I	2598 – 28860	16	4544.27	I	14788 – 36787
45	3809.50	I	11968 – 38211	35	4548.73	I	11968 – 33946
95	3812.45	I	14382 – 40605	40	4551.64	I	10313 – 32277
470	3815.01	I	16121 – 42325	19	4560.89	I	16119 – 38038
760	3816.47	I	14382 – 40577	16	4565.19	I	11968 – 33867
1300	3818.19	I	9221 – 35404	130	4569.00	I	9221 – 31102
3800	3822.26	I	7791 – 33946	14	4571.31	I	
2300	3828.48	I	9221 – 35334	29	4608.12	I	13975 – 35670
2000	3833.89	I	7791 – 33867	14	4619.91	I	
45	3834.75	I	11968 – 38038	23	4643.18	I	16944 – 38474
5900	3856.52	I	5691 – 31614	150	4675.03	I	5691 – 27075
490	3870.01	I	16121 – 41953	19	4721.00	I	9221 – 30397
70	3872.39	I	5658 – 31474	70	4745.11	I	7791 – 28860
380	3877.34	I	5691 – 31474	12	4755.58	I	14382 – 35404
70	3888.34	I	13521 – 39231	23	4810.49	I	27075 – 47857
29	3904.22	I	13521 – 39127	21	4842.43	I	9221 – 29866
23	3912.83	I	3310 – 28860	45	4843.99	I	27075 – 47714
120	3913.51	I	1530 – 27075	60	4851.63	I	
240	3922.19	I	5658 – 31147	60	4963.71	I	11006 – 31147
2000	3934.23	I	5691 – 31102	60	4977.75	I	10313 – 30397
45	3934.98	I	14382 – 39788	40	4979.18	I	11968 – 32046

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
14		5085.52	I	
70		5090.63	I	9221 – 28860
23		5120.69	I	13521 – 33044
19		5130.76	I	14382 – 33867
60		5155.54	I	11006 – 30397
14		5157.09	I	28543 – 47928
40		5158.69	I	28860 – 48239
60		5175.97	I	28543 – 47857
12		5177.27	I	32046 – 51356
35		5184.19	I	7791 – 27075
95		5193.14	I	28543 – 47793
16		5206.95	I	
16		5211.52	I	31102 – 50285
19		5212.73	I	11968 – 31147
16		5214.79	I	28543 – 47714
19		5222.66	I	32277 – 51419
19		5230.62	I	32243 – 51356
45		5237.16	I	31102 – 50191
9		5237.80	I	
14		5269.27	I	28860 – 47832
11	h	5280.12	I	31474 – 50408
14		5292.14	I	12723 – 31614
14		5314.79	I	31474 – 50285
40	h	5329.74	I	29105 – 47862
14	h	5331.08	I	29105 – 47857
9		5349.31	I	29105 – 47794
130		5354.40	I	31614 – 50285
23		5356.47	I	31614 – 50278
45		5379.10	I	31614 – 50199
95		5390.44	I	10313 – 28860
23	h	5404.73	I	29431 – 47928
60	h	5424.07	I	29431 – 47862
19		5424.72	I	11968 – 30397
19	h	5425.45	I	29431 – 47857
12		5439.58	I	12723 – 31102
12	h	5441.36	I	29866 – 48239
9	h	5444.32	I	29431 – 47794
35	h	5445.23	I	
23	h	5468.11	I	29431 – 47714
35	h	5470.85	I	32004 – 50278
12		5476.12	I	14788 – 33044
12		5481.42	I	32046 – 50285
16		5484.23	I	32004 – 50233
9		5504.65	I	32046 – 50208
29		5535.04	I	29866 – 47928
21	l	5544.58	I	29866 – 47897
160		5599.42	I	9221 – 27075
7		5607.71	I	16119 – 33946
16		5608.35	I	16121 – 33946
5		5632.77	I	16119 – 33867
9		5659.62	I	14382 – 32046
40		5686.38	I	13521 – 31102
9	h	5702.47	I	33946 – 51478
6		5727.30	I	14788 – 32243
29		5792.66	I	14788 – 32046
9		5795.79	I	25820 – 43070
9		5803.34	I	25820 – 43047
40		5806.91	I	14788 – 32004
6		5821.84	I	13975 – 31147
35		5831.58	I	12723 – 29866
7		5907.31	I	I6121 – 33044
9		5918.54	I	11968 – 28860
7		5941.46	I	31102 – 47928
130		5983.60	I	12723 – 29431
9		5991.19	I	14788 – 31474
35		6102.72	I	12723 – 29105
6		6116.15	I	13521 – 29866
8		6128.06	I	14788 – 31102
8		6186.89	I	16119 – 32277
14		6199.99	I	16119 – 32243
16		6253.72	I	16018 – 32004
5		6276.66	I	16119 – 32046
8		6277.46	I	16121 – 32046
6		6293.38	I	16119 – 32004
29		6319.53	I	12723 – 28543
12		6414.72	I	28860 – 44445
16		6510.41	I	16119 – 31474
19		6519.70	I	16944 – 32277
9		6627.80	I	16018 – 31102
19		6630.16	I	14788 – 29866
40		6752.35	I	27075 – 41881
9		6796.65	I	35334 – 50043
13		6827.33	I	14788 – 29431
11		6857.68	I	29866 – 44445
20		6879.94	I	16944 – 31474
65		6965.67	I	12723 – 27075
8		6972.91	I	31474 – 45812
16		6979.15	I	31147 – 45471
16		7001.58	I	16119 – 30397
11		7038.76	I	16944 – 31147
18		7101.64	I	30397 – 44475
15		7104.45	I	14788 – 28860
6		7142.55	I	31474 – 45471
9		7219.06	I	16018 – 29866
18		7268.18	I	14788 – 28543
35		7270.82	I	28543 – 42293
12		7271.94	I	16119 – 29866
5		7273.03	I	16121 – 29866
9		7375.57	I	13521 – 27075
5	h	7386.64	I	32277 – 45812
9		7430.80	I	16944 – 30397
18	h	7442.39	I	28860 – 42293
7		7446.77	I	32046 – 45471
12		7475.74	I	31102 – 44475
12		7495.24	I	28543 – 41881
8		7542.02	I	36787 – 50043
11		7557.67	I	32243 – 45471
8		7577.22	I	32277 – 45471
11		7690.05	I	31474 – 44475
18		7772.90	I	29431 – 42293
29		7791.61	I	31614 – 44445
55		7824.91	I	29105 – 41881
15		7830.05	I	
15		7846.50	I	16119 – 28860
21		8029.91	I	29431 – 41881
11	h	8036.09	I	32004 – 44445
29		8045.36	I	29866 – 42293
7		8063.50	I	32046 – 44445
15		8136.20	I	14788 – 27075
7	h	8193.67	I	32243 – 44445
5	h	8369.67	I	33867 – 45812
8		8425.59	I	33946 – 45812

Rubidium

Rb, $Z=37$, $M=85.467$, Ratio $\frac{\text{Rb}}{\text{Cu}}=1.345$

Rb I Normal state of valence electrons $4p^6 5s\ ^2S_{1/2}=0$. I.P.$=33691$ cm^{-1}.
Rb II Normal state of valence electrons $4p^6\ ^1S_0=0$. I.P.$=220105$ cm^{-1}.

References

Wavelengths:

G. R. Harrison, Massachusetts Institute of Technology Wavelength Tables (John Wiley & Sons, New York, 1939).

Classification:

Rb I, A. Fowler, Report on Series in Line Spectra (Fleetway Press, London, 1922).

Rubidium—all observed lines

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
320	4201.85	I	0 – 23793	50	7408.17	I	12817 – 26311
160	4215.56	I	0 – 23715	70	7618.93	I	12579 – 25701
12 h	5648.10	I	12579 – 30280	110 hl	7757.65	I	12817 – 25704
20 I	5724.45	I	12817 – 30282				
25	6206.31	I	12579 – 28687	20	7759.43	I	12817 – 25701
40 h	6298.33	I	12817 – 28689	30000	7800.23	I	0 – 12817
35 hl	7280.00	I	12579 – 26311	15000	7947.60	I	0 – 12579

Ruthenium

Ru, $Z = 44$, $M = 101.1$, Ratio $\frac{\text{Ru}}{\text{Cu}} = 1.590$

Ru I Normal state of valence electrons $4d^7 5s\ ^5F_5 = 0$. I.P. $= 59410\ \text{cm}^{-1}$.
Ru II Normal state of valence electrons $4d^7\ ^4F_{4\frac{1}{2}} = 0$. I.P. $= 135200\ \text{cm}^{-1}$.

References

Wavelengths:

G. R. Harrison, Massachusetts Institute of Technology Wavelength Tables (John Wiley & Sons, New York, 1939).

Supplemented by K. G. Kessler and W. F. Meggers, J. Research NBS **55**, 97 (1955) RP 2609.

Classification:

Ru I, K. G. Kessler, J. Res. Nat. Bur. Stand. (U.S.), **63A** (Phys. and Chem.), No. 3, 213–251 (Nov.–Dec. 1959).

Ru II, A. G. Shenstone and W. F. Meggers, J. Research NBS **61**, 373 (1959) RP 2908.

Strong lines of ruthenium

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
11000	3728.03	I	0 – 26816	5400	4554.51	I	6545 – 28495
8700	3726.93	I	1191 – 28015	4900	3428.31	I	0 – 29161
8300	3498.94	I	0 – 28572	3900	3786.06	I	2713 – 29119
7600	3798.90	I	1191 – 27507	3700	4297.71	I	8084 – 31346
7600	3799.35	I	0 – 26313	3500	3742.28	I	2713 – 29427
7600	4199.90	I	6545 – 30348	3300	3925.92	I	0 – 25465
7100	3730.43	I	2092 – 28891	3100	3417.35	I	2092 – 31346
6900	3593.02	I	2713 – 30537	3100	3634.93	I	2092 – 29595
6400	3436.74	I	1191 – 30280	2800	3745.59	I	12207 – 38898
6400	3589.22	I	3105 – 30959	2600	2083.77	I	1191 – 49165
6400	3596.18	I	2092 – 29891	2400	2076.43	I	0 – 48144
6200	3661.35	I	1191 – 28495	2400	2090.89	I	
6000	3790.51	I	2092 – 28466	2400	4372.21	I	7483 – 30348
6000	4080.60	I	6545 – 31044	2000	4144.16	I	8084 – 32208
5400	4212.06	I	6545 – 30280	1900	4112.74	I	8084 – 32392

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
2400	2076.43	I	0 – 48144
2600	2083.77	I	1191 – 49165
2400	2090.89	I	
690	2255.52	I	0 – 44322
290	2259.53	I	0 – 44243
780	2272.09	I	0 – 43999
240	2278.19	I	1191 – 45071
780	2279.57	I	
170	2285.38	I	0 – 43743
290	2302.54	I	1191 – 44608
480	2317.80	I	1191 – 44322
150	2322.01	I	1191 – 44243
120	2334.96	II	10151 – 52964
240	2340.69	I	2092 – 44801
190 h	2342.85	II	10151 – 52820
190	2349.34	I	1191 – 43743
310	2351.33	I	2092 – 44608
170	2357.91	II	9152 – 51549
140	2360.56	I	2092 – 44442
170	2370.17	I	2713 – 44891
240	2375.27	I	2713 – 44801
80	2375.63	II	11604 – 53685
160	2392.42	I	3105 – 44891
95	2396.71	II	9152 – 50863
780	2402.72	II	9152 – 50758
150	2407.92	II	11304 – 52820
55	2410.89	I	
55	2414.82	II	10151 – 51549
130	2420.82	I	
55	2422.92	I	
45	2429.60	I	8575 – 49722
65	2432.93	I	6545 – 47635
30	2447.45	I	9492 – 50339
30	2450.58	I	6545 – 47339
65	2454.92	I	8044 – 48766
180	2455.53	II	10151 – 50863
150	2456.44	II	10852 – 51549
370	2456.57	II	10151 – 50845
65 h	2458.62	I	7483 – 48144
55	2462.94	I	8575 – 49165
85	2464.70	I	8044 – 48604
30	2474.04	I	9620 – 50028
110	2475.41	I	7483 – 47868
100	2476.88	I	8044 – 48405
280	2478.93	II	10852 – 51179
28	2481.11	II	29019 – 69311
30	2489.91	I	6545 – 46695
18	2491.78	I	9184 – 49304
65	2493.69	II	26109 – 66199
85	2494.02	I	9058 – 49141
45	2494.48	II	11304 – 51380
85	2495.69	II	27545 – 67602
65	2496.56	I	7483 – 47526
140	2498.42	II	11304 – 51317
140	2498.57	II	10852 – 50863
85	2499.78	I	
30	2500.84	I	9073 – 49048
75	2501.48	I	9073 – 49037
55	2501.89	I	9184 – 49141
260	2507.01	II	11304 – 51179
130	2508.27	I	7483 – 47339
110	2509.07	I	9121 – 48964
30	2511.56	I	
110	2512.81	I	8084 – 47868
110	2513.32	II	11604 – 51380
65	2515.28	I	8044 – 47789
110	2517.32	II	11604 – 51317
55	2517.62	I	9058 – 48766
30	2519.95	I	
55	2521.61	I	9121 – 48766
28	2525.17	I	8575 – 48165
75	2526.83	I	7483 – 47047
55	2528.88	I	9073 – 48604
55	2530.64	I	8044 – 47547
45	2533.24	I	7483 – 46947
150	2535.59	II	26911 – 66338
45	2541.28	I	8771 – 48109
65	2543.25	II	25952 – 65260
280	2544.22	I	8575 – 47868
120	2546.67	I	8084 – 47339
280	2549.48	I	7483 – 46695
550	2549.58	I	6545 – 45756
23	2555.86	I	
30	2556.00	I	9492 – 48604
35	2556.31	I	9058 – 48165
45	2558.54	I	8084 – 47157
130	2560.26	I	8771 – 47818
120	2560.83	I	
110	2563.15	I	8044 – 47047
28	2564.58	I	9184 – 48165
55	2566.59	I	8575 – 47526
160	2568.77	I	7483 – 46401
28	2569.74	I	8044 – 46947
100	2570.97	I	
28	2572.28	I	8771 – 47635
55	2572.41	I	8084 – 46947
28 h	2575.24	I	6545 – 45365
100	2578.57	I	8575 – 47345
55	2578.95	I	8575 – 47339
45	2579.22	I	8044 – 46804
100	2579.53	I	8771 – 47526
90	2580.80	I	9073 – 47809
75	2581.14	I	9058 – 47789
65	2581.91	I	8084 – 46804
55	2583.04	I	8044 – 46746
75	2584.14	I	8575 – 47262
45	2585.74	I	8084 – 46746
100	2589.57	I	9184 – 47789
65	2590.97	I	7483 – 46067
170	2591.12	I	8575 – 47157
35	2591.64	I	8771 – 47345
120	2592.02	I	8771 – 47339
100	2593.70	I	12817 – 51360
110	2594.85	I	6545 – 45071
45	2597.33	I	9058 – 47547
85	2601.46	I	
75	2605.35	I	8575 – 46947
65	2605.86	I	9184 – 47547
370	2609.06	I	8084 – 46401
45	2609.48	I	10624 – 48934
85	2611.05	I	9058 – 47345
830	2612.07	I	7483 – 45756
90	2614.07	I	1191 – 39434
55	2614.59	I	2713 – 40949
100	2615.09	I	8575 – 46804
75	2617.79	I	9620 – 47809
90	2619.67	I	9184 – 47345
85	2620.61	I	8044 – 46191
28	2623.83	I	16191 – 54292
55	2627.65	I	7483 – 45529

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
220	2631.30	I	7483 – 45476
55	2631.57	I	9058 – 47047
45	2632.13	I	10624 – 48604
45	2632.50	I	8771 – 46746
28	2633.46	I	11447 – 49409
220	2635.86	I	9620 – 47547
170	2636.67	I	12207 – 50122
90	2638.51	I	9058 – 46947
75	2639.12	I	9620 – 47501
110	2640.33	I	9184 – 47047
460	2642.96	I	8575 – 46401
28	2646.02	I	10624 – 48405
110	2647.32	I	9184 – 46947
30	2648.45	I	8044 – 45790
28	2648.78	I	12207 – 49949
65	2649.51	I	9058 – 46789
110	2651.29	I	8084 – 45790
330	2651.84	I	6545 – 44243
28	2656.25	II	25952 – 63588
13	2656.56	I	
13	2656.69	I	8771 – 46401
45	2658.40	I	9184 – 46789
400	2659.62	I	7483 – 45071
23	2661.17	II	25952 – 63518
330	2661.61	II	9152 – 46711
200	2664.76	I	1191 – 38706
30	2667.40	II	26109 – 63588
35	2667.97	I	9058 – 46528
55	2673.48	I	9073 – 46466
45	2673.60	I	8084 – 45476
690	2678.76	II	9152 – 46471
220	2686.29	I	8575 – 45790
28	2687.50	II	26109 – 63308
30	2688.11	I	26118 – 63308
	2688.16	II	
18	2689.90	I	10624 – 47789
330	2692.06	II	10151 – 47285
35	2693.29	I	9073 – 46191
90	2699.88	I	8044 – 45071
110	2701.34	I	9184 – 46191
110	2702.83	I	8084 – 45071
35	2707.97	I	2092 – 39009
170	2709.20	I	8575 – 45476
200	2712.41	II	10852 – 47708
75	2713.19	I	9620 – 46466
45	2717.40	I	3105 – 39895
23	2718.83	I	
690	2719.52	I	7483 – 44243
90	2721.56	I	9058 – 45790
130	2722.65	I	9073 – 45790
75	2724.06	I	9492 – 46191
140	2725.47	II	11304 – 47984
55	2728.83	I	9121 – 45756
23	2729.46	I	8575 – 45202
55	2730.33	I	2092 – 38706
90	2730.93	I	9183 – 45790
45	2733.59	I	9620 – 46191
310	2734.35	II	10151 – 46711
1800	2735.72	I	0 – 36543
170	2739.22	I	8575 – 45071
75	2743.94	I	6545 – 42978
130	2744.45	I	8771 – 45197
35	2747.97	II	11604 – 47984
75	2752.45	II	10151 – 46471
75	2752.77	II	19379 – 55695
90	2753.44	I	
35	2762.31	I	8044 – 44235
260	2763.42	I	1191 – 37367
35	2765.44	II	20515 – 56665
90	2768.93	II	11604 – 47708
35	2774.48	I	
100	2778.38	II	11304 – 47285
55	2785.65	I	9184 – 45071
110	2787.83	II	10852 – 46711
35	2792.64	I	8044 – 43842
140	2802.81	I	8575 – 44243
35	2806.74	II	21646 – 57263
350	2810.03	I	2092 – 37668
1700	2810.55	I	1191 – 36760
55	2812.82	I	
75	2817.09	I	2713 – 38200
350	2818.36	I	0 – 35471
35	2818.95	I	8771 – 44235
110	2822.03	I	8084 – 43509
200	2827.87	I	1191 – 36543
400	2829.16	I	6545 – 41881
130	2834.00	I	2092 – 37367
35	2836.57	I	9058 – 44301
150	2840.54	I	6545 – 41739
35	2841.68	II	20515 – 55695
75	2843.17	I	9073 – 44235
35	2846.32	I	9121 – 44244
85	2848.58	I	3105 – 38200
640	2854.07	I	2092 – 37119
180	2860.02	I	2713 – 37668
420	2861.41	I	6545 – 41483
550	2866.64	I	2092 – 36965
85	2868.19	I	9121 – 43976
110	2868.31	I	
90	2871.64	I	
1800	2874.98	I	0 – 34773
220	2879.76	I	6545 – 41260
45	2881.28	I	3105 – 37802
55	2882.12	II	19379 – 54065
130	2883.60	I	2092 – 36760
65	2884.51	I	9184 – 43842
740	2886.54	I	2713 – 37347
75	2888.00	I	1191 – 35807
35	2891.65	I	15550 – 50122
180	2892.56	I	
75	2896.53	I	3105 – 37620
55	2898.54	I	8044 – 42534
110	2901.94	I	8084 – 42534
55	2902.10	I	10624 – 45071
18	2903.08	I	9073 – 43509
140	2905.65	I	2713 – 37119
65	2905.83	I	6545 – 40949
75	2906.32	I	7483 – 41881
370	2908.88	I	3105 – 37473
30	2909.22	I	8575 – 42939
35	2913.17	I	11786 – 46103
35	2914.30	I	11753 – 46056
1100	2916.26	I	1191 – 35471
28	2917.77	I	8084 – 42347
150	2919.61	I	3105 – 37347
28	2927.12	I	14700 – 48854
35	2927.54	II	20515 – 54663
35	2939.94	I	11786 – 45790
55	2940.36	I	7483 – 41483
75	2943.92	I	8575 – 42534

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
I80	2945.67	II	19379 – 53317
180	2946.99	I	8084 – 42007
370	2949.50	I	6545 – 40439
35	2952.50	I	3105 – 36965
150	2954.49	I	8043 – 41881
75	2958.00	I	8084 – 41881
28	2959.74	I	7483 – 41260
75	2961.69	I	11447 – 45202
18	2963.40	II	21246 – 54981
55	2963.72	I	6545 – 40277
550	2965.16	I	2092 – 35807
170	2965.55	II	20515 – 54225
55	2968.48	I	10624 – 44301
85	2968.95	I	8084 – 41756
35	2973.99	I	9492 – 43108
28	2974.34	I	10624 – 44235
140	2976.59	II	19379 – 52964
550	2976.92	I	1191 – 34773
45	2977.23	II	21646 – 55224
75	2979.72	I	15054 – 48604
		II	20515 – 54065
75	2979.96	II	21246 – 54794
55	2981.94	I	2713 – 36239
1400	2988.95	I	0 – 33447
35	2989.66	I	8044 – 41483
35	2991.62	II	21246 – 54663
110	2993.27	I	8084 – 41483
460	2994.96	I	2092 – 35471
55	2996.90	I	9058 – 42416
28	2997.43	I	10624 – 43976
90	2998.35	I	
55	3001.64	I	8575 – 41881
440	3006.59	I	2713 – 35964
35	3008.26	I	9184 – 42416
55	3008.80	I	9121 – 42347
55	3012.92	I	8575 – 41756
55	3013.36	I	8084 – 41260
330	3017.24	I	3105 – 36239
18	3019.37	I	8771 – 41881
310	3020.88	I	2713 – 35807
240	3033.45	I	7483 – 40439
65	3034.06	I	9058 – 42007
60	3035.47	I	9073 – 42007
60	3038.18	I	8044 – 40949
200	3040.31	I	1191 – 34072
220	3042.48	I	3105 – 35964
60	3042.83	I	10655 – 43510
110	3045.71	I	9184 – 42007
60	3048.50	I	7483 – 40277
110	3048.78	I	2092 – 34882
150	3054.94	I	8044 – 40768
390	3064.84	I	9121 – 41739
90	3068.26	I	
90	3073.34	I	11447 – 43976
90	3080.90	I	11786 – 44235
60	3086.07	I	11447 – 43842
170	3089.14	I	9121 – 41483
120	3089.80	I	8084 – 40439
60	3090.23	I	17097 – 49448
60	3091.87	I	2713 – 35047
330	3096.57	I	12207 – 44492
120	3097.60	I	10624 – 42897
830	3099.28	I	1191 – 33447
740	3100.84	I	1191 – 33431
90	3110.55	I	9121 – 41260
60	3124.17	I	2092 – 34091
I20	3125.96	I	2092 – 34072
90	3132.88	I	10624 – 42534
90	3136.56	I	8044 – 39917
90	3140.97	I	9121 – 40949
90	3144.26	I	14700 – 46495
60	3150.69	I	8044 – 39774
120	3153.82	I	8044 – 39742
60	3158.89	I	9121 – 40768
290	3159.92	I	2092 – 33729
200	3168.52	I	11447 – 42998
60	3177.05	II	19379 – 50845
180	3186.04	I	2713 – 34091
240	3188.34	I	2092 – 33447
240	3189.98	I	2092 – 33431
180	3196.59	I	3105 – 34380
60	3212.97	I	9121 – 40235
60	3216.52	I	2092 – 33172
180	3223.27	I	2713 – 33729
110	3226.37	I	3105 – 34091
100	3227.88	I	8771 – 39742
220	3228.53	I	8044 – 39009
220	3238.53	I	15054 – 45923
120	3241.24	I	9073 – 39917
120	3243.50	I	6545 – 37367
80	3254.54	I	2713 – 33431
60	3254.71	I	9058 – 39774
280	3260.35	I	1191 – 31853
120 d	3264.55	I	3105 – 33729
	3264.66	I	8084 – 38706
120	3266.44	I	10655 – 41260
200	3268.21	I	13646 – 44235
200	3273.08	I	8044 – 38587
200	3274.71	I	10655 – 41183
100	3277.57	I	14700 – 45202
490	3294.11	I	0 – 30348
60	3296.11	I	13646 – 43976
60	3297.96	I	9121 – 39434
370	3301.59	I	0 – 30280
220	3306.17	I	8771 – 39009
60	3315.05	I	8044 – 38200
290	3315.23	I	1191 – 31346
290	3316.39	I	10624 – 40768
60	3317.89	I	8575 – 38706
60	3318.82	I	14700 – 44823
	3318.91	I	9620 – 39742
100	3325.00	I	3105 – 33172
40	3332.05	I	31385 – 61388
120	3335.69	I	11786 – 41756
930	3339.55	I	8771 – 38706
240	3341.66	I	9121 – 39037
60	3344.53	I	0 – 29891
200	3361.15	I	17046 – 46789
60	3362.00	I	11447 – 41183
370	3368.45	I	2713 – 32392
100	3371.86	I	9058 – 38706
130	3374.65	I	8044 – 37668
120	3378.02	I	0 – 29595
100	3379.60	I	10655 – 40235
130	3380.18	I	8044 – 37620
130	3385.14	I	12207 – 41739
130	3388.71	I	11447 – 40949
100	3389.50	I	2713 – 32208
60	3391.89	I	14828 – 44301
370	3392.54	I	0 – 29468

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
310	3401.74	I	9620 – 39009	40	3638.02	I	15054 – 42534
310	3409.28	I	8044 – 37367	200	3640.64	I	12817 – 40277
190	3411.64	I	8044 – 37347	170	3646.11	I	12817 – 40235
3100	3417.35	I	2092 – 31346	290	3650.32	I	8084 – 35471
70	3420.08	I	11786 – 41017	60	3652.32	I	2713 – 30085
4900	3428.31	I	0 – 29161	310	3654.40	I	16240 – 43597
130	3428.63	I	1191 – 30348	50	3660.81	I	16240 – 43549
190	3429.54	I	10624 – 39774	6200	3661.35	I	1191 – 28495
490	3430.77	I	2713 – 31853	830	3663.37	I	7483 – 34773
100	3432.21	I	9073 – 38200	650	3669.49	I	12207 – 39451
310	3432.74	I	9121 – 38243	240	3678.32	I	2713 – 29892
190	3433.26	I	10624 – 39742	45	3685.95	I	13646 – 40768
160	3435.19	I	3105 – 32208	260	3696.59	I	10624 – 37668
6400	3436.74	I	1191 – 30280	110	3697.76	I	8771 – 35807
260	3438.37	I	8044 – 37119	130	3700.99	I	17097 – 44109
220	3440.20	I	7483 – 36543	27	3702.24	I	8044 – 35047
160	3448.95	I	11447 – 40433	110	3712.30	I	17046 – 43976
100	3452.90	I	2092 – 31044	55	3715.56	I	9058 – 35964
70	3456.62	I	15054 – 43976	110	3716.18	I	6545 – 33447
70	3463.14	I	2092 – 30959	410	3717.00	I	8575 – 35471
260	3473.75	I	10655 – 39434	260	3719.33	I	17097 – 43976
240	3481.30	I	8044 – 36760	170	3724.97	I	8044 – 34882
130	3483.16	I	1191 – 29892	55	3725.49	I	11753 – 38587
130	3483.29	I	1191 – 29891	550	3726.10	I	12207 – 39037
130	3494.25	I	9058 – 37668	8700	3726.93	I	1191 – 28015
130	3495.97	I	8771 – 37367	11000	3728.03	I	0 – 26816
8300	3498.94	I	0 – 28572	7100	3730.43	I	2092 – 28891
70	3502.42	I	8575 – 37119	85	3732.03	I	13646 – 40433
640	3514.49	I	2092 – 30537	85	3733.05	I	9184 – 35964
330	3519.64	I	1191 – 29595	280	3737.40	I	9058 – 35807
200	3528.68	I	2713 – 31044	55	3737.74	I	9492 – 36239
130	3531.39	I	9058 – 37367	45	3738.63	I	13699 – 40439
240	3532.81	I	14700 – 42998	110	3738.91	I	16240 – 42978
100	3535.37	I	1191 – 29468	410	3739.46	I	13699 – 40433
130	3535.83	I	9073 – 37347	3500	3742.28	I	2713 – 29427
390	3537.95	I	2092 – 30348	870	3742.78	I	15550 – 42261
790	3539.37	I	2713 – 30959	280	3744.22	I	8771 – 35471
200	3541.63	I	6545 – 34773	410	3744.40	I	16240 – 42939
130	3550.27	I	2092 – 30250	2800	3745.59	I	12207 – 38898
130	3553.85	I	11786 – 39917	760	3753.54	I	12817 – 39451
100	3556.63	I	11786 – 39895	310	3755.09	I	9184 – 35807
130	3564.56	I	9073 – 37119	870	3755.93	I	12817 – 39434
130	3567.16	I	13982 – 42007	1200	3759.84	I	7483 – 34072
690	3570.59	I	15550 – 43549	370	3760.03	I	3105 – 29694
200	3574.58	I	8575 – 36543	600	3761.51	I	13699 – 40277
70	3579.77	I	2092 – 30018	600	3767.35	I	13699 – 40235
390	3587.20	I	16240 – 44109	55	3773.17	I	10624 – 37119
6400	3589.22	I	3105 – 30959	1500	3777.59	I	3105 – 29570
6900	3593.02	I	2713 – 30537	150	3778.70	I	12817 – 39273
6400	3596.18	I	2092 – 29891	460	3781.18	I	20056 – 46495
1300	3599.76	I	8771 – 36543	600	3782.74	I	27289 – 53718
130	3605.64	I	9620 – 37347	3900	3786.06	I	2713 – 29119
100	3608.73	I	9058 – 36760	6000	3790.51	I	2092 – 28466
60	3616.95	I	9121 – 36760	240	3794.92	I	16191 – 42534
100	3619.20	I	12817 – 40439			I	9620 – 35964
60	3620.28	I	13646 – 41260	85	3795.18	I	10624 – 36965
60	3623.64	I	10655 – 38243	760	3798.05	I	3105 – 29427
350	3625.20	I	10624 – 38299	7600	3798.90	I	1191 – 27507
370	3626.74	I	17097 – 44662	7600	3799.35	I	0 – 26313
40	3627.29	I	13699 – 41260	310	3800.26	I	8575 – 34882
180	3631.71	I	6545 – 34072	85	3803.20	I	20242 – 46528
85	3633.92	I	17097 – 44608	310	3808.68	I	14700 – 40949
3100	3634.93	I	2092 – 29595	600	3812.72	I	12817 – 39037
120	3635.52	I	9620 – 37119	150	3814.86	I	15054 – 41260
210	3637.47	I	13699 – 41183	760	3817.27	I	15550 – 41739

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
760	3819.03	I	2713 – 28891	55	3993.53	I	9058 – 34091
55	3819.77	I	11447 – 37620	280	3995.98	I	9073 – 34091
650	3822.09	I	16191 – 42347	27	3996.51	I	9058 – 34072
550	3824.93	I	10624 – 36760	140	4005.64	I	8771 – 33729
130	3828.71	I	8771 – 34882	85	4006.60	I	9120 – 34073
760	3831.80	I	12207 – 38297	55	4007.54	I	14827 – 39774
220	3835.05	I	14700 – 40768	85	4008.27	I	13646 – 38587
310	3838.07	I	8044 – 34091	85	4013.50	I	7483 – 32392
930	3839.70	I	12207 – 38243	55	4021.00	I	15054 – 39917
150	3840.82	I	8044 – 34072	1500	4022.16	I	8575 – 33431
85	3843.16	I	3105 – 29119	600	4023.83	I	1191 – 26036
480	3846.68	I	9058 – 35047	85	4031.00	I	6545 – 31346
760	3850.43	I	7483 – 33447	150	4032.20	I	2713 – 27507
130	3852.14	I	17046 – 42998	40	4037.74	I	9620 – 34380
480	3856.46	I	2092 – 28015	310	4039.21	I	14700 – 39451
1300	3857.55	I	14700 – 40616	35	4040.48	I	22519 – 47262
220	3860.72	I	15054 – 40949	170	4045.76	I	17046 – 41756
650	3862.69	I	17097 – 42978	65	4049.41	I	15054 – 39742
130	3865.40	I	9184 – 35047	1400	4051.40	I	8771 – 33447
1300	3867.84	I	6545 – 32392	170	4052.20	I	9058 – 33729
260	3873.52	I	9073 – 34882	710	4054.05	I	8771 – 33431
35	3876.08	I	13982 – 39774	55	4062.85	I	20056 – 44662
100	3882.01	I	2713 – 28466	120	4062.99	I	13982 – 38587
130	3884.02	I	14700 – 40439	110	4064.10	I	9492 – 34091
100	3884.68	I	13699 – 39434	370	4064.46	I	8575 – 33172
100	3887.77	I	15054 – 40768	200	4067.61	I	16191 – 40768
150	3890.20	I	9184 – 34882	760	4068.37	I	14700 – 39273
65	3891.41	I	16191 – 41881	150	4071.40	I	13646 – 38200
650	3892.21	I	8044 – 33729	200	4073.00	I	9184 – 33729
35	3892.77	I	20242 – 45923	980	4076.73	I	9058 – 33580
35	3894.24	I	11447 – 37119	6000	4080.60	I	6545 – 31044
100	3897.24	I	9121 – 34773	75	4082.79	I	11753 – 36239
100	3898.36	I	8084 – 33729	310	4085.43	I	16713 – 41183
150	3901.24	I	1191 – 26816	110	4091.06	I	17046 – 41483
130	3908.76	I	14700 – 40277	110	4097.03	I	8771 – 33172
760	3909.08	I	13699 – 39273	930	4097.79	I	9184 – 33580
100	3912.11	I	9492 – 35047	75	4100.37	I	2092 – 26473
150	3914.85	I	8044 – 33580	350	4101.74	I	9058 – 33431
260	3920.92	I	8575 – 34072	75	4102.28	I	7483 – 31853
1500	3923.47	I	12817 – 38297	130	4107.84	I	14700 – 39037
65	3924.63	I	20056 – 45529	27	4109.65	I	9120 – 33447
3300	3925.92	I	0 – 25465	1900	4112.74	I	8084 – 32392
600	3931.76	I	9620 – 35047	160	4113.38	I	16713 – 41017
		I	12817 – 38243	35	4114.13	I	8044 – 32343
310	3933.55	I	2092 – 27507	65	4118.50	I	1191 – 25464
120	3937.90	I	8044 – 33431	160	4120.99	I	8084 – 32343
65	3941.65	I	8084 – 33447	160	4123.06	I	9184 – 33431
85	3942.06	I	3105 – 28466	65	4123.81	I	16191 – 40433
65	3944.19	I	8084 – 33431	120	4127.44	I	2092 – 26313
760	3945.57	I	16240 – 41578	120	4127.87	I	13982 – 38200
40	3946.31	I	11786 – 37119	100	4137.23	I	8044 – 32208
65	3949.42	I	11447 – 36760	2000	4144.16	I	8084 – 32208
120	3950.04	I	20056 – 45365	650	4145.74	I	9058 – 33172
460	3950.21	I	6545 – 31853	260	4146.77	I	9620 – 33729
150	3950.41	I	9073 – 34380	85	4148.38	I	9073 – 33172
65	3951.21	I	8771 – 34072	55	4150.30	I	9492 – 33580
310	3952.68	I	16191 – 41483	35	4159.17	I	16240 – 40277
40	3957.45	I	9620 – 34882	130	4161.66	I	13646 – 37668
460	3964.90	I	0 – 25214	110	4166.88	I	6545 – 30537
35	3969.79	I	10624 – 35807	870	4167.51	I	9184 – 33172
85	3974.50	I	8575 – 33729	110	4170.05	I	13646 – 37620
600	3978.44	I	8044 – 33172	55	4175.43	I	20056 – 43999
600	3979.42	I	1191 – 26313	110	4182.46	I	17046 – 40949
870	3984.86	I	8084 – 33172	65	4182.64	I	7483 – 31385
27	3987.80	I	16191 – 41260	35	4189.46	I	7483 – 31346

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
150	4196.87	I	13982 – 37802	100	4383.36	I	10624 – 33431
550	4197.58	I	8575 – 32392	870	4385.39	I	7483 – 30280
550	4198.88	I	8044 – 31853	1300	4385.65	I	9058 – 31853
7600	4199.90	I	6545 – 30348	100	4386.27	I	14827 – 37620
1500	4206.02	I	8084 – 31853	27	4388.99	I	22419 – 45197
190	4207.64	I	14828 – 38587	1700	4390.44	I	8575 – 31346
5400	4212.06	I	6545 – 30280	85	4391.03	I	7483 – 30250
760	4214.44	I	13646 – 37367	35	4394.96	I	15550 – 38297
930	4217.27	I	6545 – 30250	170	4397.80	I	9121 – 31853
370	4220.68	I	13982 – 37668	40	4399.59	I	9620 – 32343
110	4225.09	I	20242 – 43903	35	4404.82	I	17046 – 39742
75	4226.66	I	15054 – 38706	1600	4410.03	I	9184 – 31853
190	4229.31	I	13982 – 37620	65	4420.84	I	8771 – 31385
550	4230.31	I	8575 – 32208	160	4421.46	I	8575 – 31186
150	4232.32	I	8771 – 32392	40	4424.78	I	11786 – 34380
110	4236.67	I	14700 – 38297	330	4428.46	I	8771 – 31346
760	4241.05	I	8771 – 32343	460	4439.76	I	10655 – 33172
760	4243.06	I	7483 – 31044	85	4444.51	I	8044 – 30537
110	4244.83	I	9620 – 33172	440	4449.34	I	8575 – 31044
190	4246.33	I	14700 – 38243	1100	4460.04	I	8771 – 31186
370	4246.73	I	20056 – 43597	22	4467.26	I	20242 – 42621
40	4248.14	I	15054 – 38587	190	4473.93	I	6545 – 28891
310	4258.99	I	13646 – 37119	27	4479.41	I	13646 – 35964
75	4260.00	I	10624 – 34091	150	4480.45	I	15054 – 37367
35	4263.40	I	10624 – 34072	35	4482.03	I	11786 – 34091
75	4265.61	I	10655 – 34091	85	4488.39	I	8771 – 31044
35	4277.26	I	14827 – 38200	55	4490.24	I	8084 – 30348
40	4278.69	I	13982 – 37347	45	4491.68	I	13982 – 36239
45	4281.93	I	15550 – 38898	350	4498.14	I	9121 – 31346
75	4282.22	I	6545 – 29891	120	4510.10	I	8084 – 30250
760	4284.33	I	9058 – 32392	85	4511.20	I	13646 – 35807
190	4287.05	I	13646 – 36965	220	4516.89	I	11447 – 33580
220	4293.28	I	9058 – 32343	220	4517.82	I	9058 – 31186
260	4294.79	I	8575 – 31853	110	4520.95	I	9073 – 31186
550	4295.93	I	9121 – 32392	65	4530.85	I	15054 – 37119
						I	20934 – 42998
3700	4297.71	I	8084 – 31346				
930	4307.60	I	9183 – 32392	27	4543.69	I	9184 – 31186
40	4309.21	I	26036 – 49235	170	4547.33	I	7483 – 29468
110	4314.30	I	25214 – 48386	110	4547.85	I	13982 – 35964
75	4316.64	I	9184 – 32343	27	4549.43	I	8044 – 30018
370	4318.43	I	9058 – 32208	45	4549.96	I	23393 – 45365
550	4319.87	I	8044 – 31186	45	4552.11	I	8575 – 30537
40	4320.58	I	17097 – 40235	5400	4554.51	I	6545 – 28495
35	4321.30	I	9073 – 32208	110	4559.98	I	9121 – 31044
35	4322.96	I	25201 – 48327	22	4562.60	I	15054 – 36965
170	4325.05	I	13646 – 36760	40	4564.69	I	9058 – 30959
170	4326.82	I	10624 – 33729	65	4580.07	I	11753 – 33580
110	4327.43	I	8084 – 31186	1700	4584.44	I	8084 – 29891
100	4331.16	I	8771 – 31853	45	4587.10	I	11786 – 33580
40	4332.50	I	23453 – 46528	110	4591.10	I	9184 – 30959
75	4336.42	I	7483 – 30537	150	4592.52	I	10624 – 32392
170	4337.27	I	6545 – 29595	65	4596.71	I	23453 – 45202
35	4338.68	I	20934 – 43976	330	4599.08	I	10655 – 32392
45	4340.34	I	16240 – 39273	55	4601.76	I	11447 – 33172
40	4341.04	I	16713 – 39742	40	4605.66	I	15054 – 36760
550	4342.07	I	9184 – 32208	22	4612.32	I	8575 – 30250
110	4346.48	I	8044 – 31044	170	4635.69	I	9620 – 31186
350	4349.70	I	13982 – 36965	200	4645.09	I	20056 – 41578
710	4354.13	I	8084 – 31044	720	4647.61	I	8084 – 29595
140	4354.80	I	10624 – 33580	290	4654.32	I	9058 – 30537
870	4361.21	I	6545 – 29468	24	4669.14	I	14827 – 36239
35	4370.42	I	8084 – 30959	70	4669.98	I	7483 – 28891
65	4371.20	I	17046 – 39917	95	4674.65	I	11786 – 33172
2400	4372.21	I	7483 – 30348	290	4681.79	I	9184 – 30537
35	4381.27	I	16191 – 39009	190	4684.02	I	8084 – 29427

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
290	4690.11	I	8575 – 29891
1400	4709.48	I	9121 – 30348
30	4720.92	I	16191 – 37367
140	4731.33	I	9121 – 30250
120	4733.52	I	8771 – 29891
30	4738.40	I	
35	4743.02	I	22519 – 43597
70	4756.23	I	8575 – 29595
500	4757.84	I	7483 – 28495
21	4764.40	I	27507 – 48490
95	4769.30	I	6545 – 27507
21	4773.15	I	11447 – 32392
35	4774.00	I	20242 – 41183
50	4784.27	I	11447 – 32343
35	4794.38	I	8575 – 29427
35	4795.57	I	8044 – 28891
50	4798.44	I	9058 – 29892
60	4804.88	I	8084 – 28891
19	4806.19	I	
260	4815.52	I	11447 – 32208
19	4817.34	I	15054 – 35807
70	4833.00	I	
50	4839.01	I	26313 – 46972
19	4839.77	I	8771 – 29427
120	4844.56	I	9058 – 29694
24	4854.56	I	26313 – 46906
85	4861.87	I	10624 – 31186
550	4869.15	I	7483 – 28015
80	4895.32	I	8044 – 28466
160	4895.60	I	10624 – 31044
80	4899.25	I	11447 – 31853
470	4903.05	I	10655 – 31044
40	4905.02	I	8084 – 28466
120	4907.89	I	9058 – 29427
260	4921.07	I	8575 – 28891
180	4938.43	I	9184 – 29427
90	4955.26	I	26816 – 46991
45	4959.86	I	26816 – 46972
160	4968.90	I	8771 – 28891
35	4974.12	I	22162 – 42261
90	4976.20	I	26816 – 46906
160	4980.35	I	9620 – 29694
55	4983.45	I	9058 – 29119
55	4987.26	I	9073 – 29119
120	4992.74	I	7483 – 27507
160	5011.23	I	9620 – 29570
90	5014.95	I	9184 – 29119
90	5026.18	I	8575 – 28466
65	5028.16	I	10655 – 30537
35	5040.35	I	20934 – 40768
35	5040.74	I	9058 – 28891
65	5047.31	I	9620 – 29427
450	5057.33	I	6545 – 26313
21	5062.64	I	13982 – 33729
90	5072.97	I	9184 – 28891
120	5076.32	I	10655 – 30348
200	5093.83	I	9492 – 29119
80	5107.07	I	12817 – 32392
24	5123.73	I	11447 – 30959
55	5127.26	I	9620 – 29119
65	5133.89	I	13699 – 33172
530	5136.55	I	8044 – 27507
170	5142.76	I	8575 – 28015
250	5147.24	I	8084 – 27507
110	5151.07	I	9058 – 28466
55	5153.20	I	11786 – 31186
500	5155.14	I	9073 – 28466
55	5160.00	I	9121 – 28495
920	5171.03	I	7483 – 26816
180	5195.02	I	8771 – 28015
80	5199.87	I	29160 – 48386
45	5202.12	I	20056 – 39273
45	5213.43	I	28495 – 47671
65	5223.55	I	12207 – 31346
40	5242.38	I	10624 – 29694
55	5251.67	I	12817 – 31853
40	5257.07	I	30537 – 49554
40	5266.47	I	20934 – 39917
40	5266.83	I	20056 – 39037
40	5280.82	I	8575 – 27507
130	5284.08	I	6545 – 25465
40	5291.16	I	9121 – 28015
80	5304.86	I	9620 – 28466
260	5309.27	I	7483 – 26313
13	5315.33	I	20934 – 39742
40	5332.93	I	13646 – 32392
45 h	5334.70	I	
110	5335.93	I	8771 – 27507
130	5361.77	I	
65	5377.84	I	28495 – 47085
65	5385.88	I	13646 – 32208
110 h	5401.04	I	
40	5401.39	I	13699 – 32208
40	5418.86	I	9058 – 27507
55	5427.59	I	28572 – 46991
26 I	5439.21	I	
13	5452.71	I	28572 – 46906
80 h	5454.82	I	31186 – 49513
90	5456.13	I	9184 – 27507
13 h	5475.18	I	31346 – 49605
55	5479.40	I	31346 – 49591
26	5480.30	I	30280 – 48522
80	5484.32	I	8084 – 26313
18	5484.64	I	12817 – 31044
26	5496.69	I	20056 – 38243
13	5501.02	I	30348 – 48522
130	5510.71	I	12207 – 30348
20	5512.37	I	30250 – 48386
8	5517.86	I	15054 – 33172
12	5521.78	I	31186 – 49291
12	5530.99	I	20934 – 39009
24	5540.66	I	12207 – 30250
12	5556.52	I	8044 – 26036
90	5559.75	I	7483 – 25465
11	5569.03	I	8084 – 26036
21	5578.40	I	
21	5603.14	I	10624 – 28466
8	5603.55	I	
13	5606.73	I	29160 – 46991
11	5629.79	I	22519 – 40277
290	5636.24	I	8575 – 26313
11	5641.66	I	12817 – 30537
7	5649.56	I	9121 – 26816
7	5653.30	I	12207 – 29891
11	5665.20	I	13699 – 31346
16	5679.63	I	22293 – 39894
180	5699.05	I	8771 – 26313
13	5724.82	I	12817 – 30280
13	5725.73	I	8575 – 26036
16	5745.99	I	13646 – 31044

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
16	5747.47	I	21643 – 39037
11	5752.02	I	8084 – 25465
11	5756.83	I	11753 – 29119
11	5767.92	I	11786 – 29119
16	5804.39	I	23393 – 40616
65	5814.98	I	9121 – 26313
8	5828.06	I	15054 – 32208
16 h	5833.21	I	30348 – 47487
55	5919.34	I	8575 – 25465
80	5921.45	I	10624 – 27507
21	5926.87	I	16713 – 33580
26	5932.38	I	9184 – 26036
8	5936.65	I	30348 – 47188
8	5951.15	I	15054 – 31853
21 h	5973.38	I	30348 – 47085
8	5974.17	I	20934 – 37668
16	5988.67	I	8771 – 25465
35	5993.65	I	11786 – 28466
18	6116.77	I	9121 – 25465
26	6199.42	I	17046 – 33172
26	6225.20	I	11447 – 27507
9	6284.49	I	22293 – 38200
18	6295.22	I	23393 – 39273
13	6330.62	I	25465 – 41256
9	6336.12	I	22519 – 38297
9 h	6363.41	I	28466 – 44176
9	6376.45	I	12817 – 28495
16	6390.23	I	23393 – 39037
8	6417.57	I	34773 – 50351
26 h	6444.84	I	27507 – 43019
8	6496.44	I	27507 – 42895
11	6528.74	I	
4	6560.45	I	23005 – 38243
4	6593.74	I	17046 – 32208
9	6618.20	I	16240 – 31346
21	6663.14	I	28015 – 43019
55	6690.00	I	26313 – 41256
11	6707.52	I	23393 – 38297
15	6718.30	I	28015 – 42895
15	6730.45	I	16191 – 31044
7	6756.54	I	32392 – 47188
21	6766.95	I	29119 – 43892
30	6775.02	I	17097 – 31853
13	6787.23	I	15550 – 30280
8	6813.51	I	22293 – 36965
15	6823.88	I	29694 – 44344
21	6824.17	I	28466 – 43116
7	6831.52	I	25643 – 40277
26	6911.48	I	29427 – 43892
110	6923.23	I	26816 – 41256
26	6982.01	I	27507 – 41825
26	7027.98	I	28891 – 43116
9	7086.06	I	16240 – 30348
12	7087.35	I	12207 – 26313
4	7141.72	I	17046 – 31044
6	7219.26	I	25603 – 39451
35	7238.92	I	28015 – 41825
7	7266.96	I	
8	7323.56	I	16240 – 29891
16	7393.93	I	29595 – 43116
18	7468.91	I	30959 – 44344
12	7475.40	I	
26	7485.79	I	30537 – 43892
70	7499.75	I	28495 – 41825
7	7532.07	I	24927 – 38200
26	7559.61	I	29891 – 43116
5	7612.94	I	31044 – 44176
18	7621.50	I	31853 – 44970
18	7722.87	I	15550 – 28495
5	7729.91	I	30959 – 43892
22	7791.86	I	31346 – 44176
4	7797.89	I	
4	7806.82	I	37367 – 50173
3	7813.43	I	20934 – 33729
4	7829.81	I	30250 – 43019
5 h	7833.39	I	32208 – 44970
6 h	7841.90	I	36543 – 49291
30	7847.80	I	30280 – 43019
80	7881.19	I	28572 – 41256
16	7890.37	I	30348 – 43019
16	7924.43	I	30280 – 42896
5	7948.15	I	32392 – 44970
9	7967.81	I	30348 – 42895
9	8112.47	I	31853 – 44176
18	8264.96	I	29161 – 41256
11	8348.98	I	31044 – 43019
6	8352.94	I	32208 – 44176
4	8435.77	I	31044 – 42895
11	8473.64	I	33172 – 44970
11	8483.56	I	32392 – 44176
22	8710.84	I	30348 – 41825
14	8724.98	I	20934 – 32392
9	8777.36	I	33580 – 44970

559-795 O - 75 - 17 (Pt. 1)

Samarium

Sm, $Z=62$, $M=150.4$, Ratio $\frac{\text{Sm}}{\text{Cu}}=2.367$

Sm I Normal state of valence electrons $4f^6 6s^2\ {}^7F_0=0$. I.P. $=45400\ \text{cm}^{-1}$.
Sm II Normal state of valence electrons $4f^6 6s\ {}^8F_{1/2}=0$. I.P. $=89300\ \text{cm}^{-1}$.

References

Wavelengths:
A. Gatterer and J. Junkes, Spektren der Seltenen Erden (Specola Vaticana, Vatican, 1945), below 2900 Å.
A. S. King, Astrophys. J. **82**, 140 (1935), above 2900 Å.

Classification:
Sm I, W. Albertson, Phys. Rev. **47**, 370 (1935).
W. Albertson, Phys. Rev. **52**, 644 (1937).
Sm II, W. Albertson, Astrophys. J. **84**, 26 (1936).
Sm I and II, A. Carlier, Thesis, Univ. of Paris. (Orsay) (1967).
J. Blaise, C. Morillon, M. G. Schweighofer, and J. Verges, Spectrochimica Acta **24B**, 405 (1969).

Strong lines of samarium

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
4200	3568.27	II	3910 – 31926	1800	4434.32	II	3053 – 25598
4200	3592.60	II	3053 – 30880	1700	3306.39	II	3910 – 34145
3700	3885.29	II	3910 – 29641	1700	3604.28	II	3910 – 31646
3400	3609.49	II	2238 – 29935	1700	3621.23	II	838 – 28445
3400	3634.29	II	1489 – 28997	1600	3728.47	II	5318 – 32131
2900	3739.12	II	326 – 27063	1600	3735.98	II	2238 – 28997
	3739.20	II	4386 – 31122	1600	3793.97	II	838 – 27188
2900	4424.34	II	3910 – 26506	1600	3797.73	II	4386 – 30710
2700	3854.21	II	5317 – 31255	1600	3826.20	II	4386 – 30514
2500	3922.40	II	3053 – 28540	1600	3843.50	II	3499 – 29510
2200	3661.36	II	327 – 27631	1600	3896.98	II	327 – 25980
2200	3670.84	II	838 – 28073	1600	4296.74	I	4021 – 27288
2200	4280.79	II	3910 – 27263	1600	4390.86	II	1489 – 24257
2200	4467.34	II	5318 – 27696	1600	4433.88	II	3499 – 26046
2100	3731.26	II	838 – 27631	1500	3788.12	II	2003 – 28394
2100	4256.39	II	3053 – 26540	1500	3963.00	II	326 – 25552
1900	3760.69	II	1489 – 28072	1500	3971.40	II	3499 – 28672
1900	3928.28	II	1489 – 26938	1500	3990.00	II	0 – 25056
1900	4118.55	II	5318 – 29591		3990.02	I	3125 – 28181
1900	4318.94	II	2238 – 25385	1500	4420.53	II	2689 – 25304
1800	4329.02	II	1489 – 24583				

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
45		2610.07		
90		2640.27		
35		2649.17		
45		2657.68		
70		2662.42		
120		2675.15		
100		2688.60		
45		2690.90	II	4386 – 41537
130		2693.34		
45		2693.74		
60		2696.08		
85		2707.96		
50		2732.42		
35		2739.87		
29		2762.28		
35		2764.18		
85		2767.85	II	838 – 36956
60		2774.77		
85		2776.11		
85		2779.23	II	1518 – 37488
85		2786.64		
150		2789.38	II	2003 – 37842
130	h	2796.70		
85		2807.36		
150		2809.50		
120		2810.86	II	2003 – 37569
85		2817.20	II	2003 – 37488
29		2820.96	II	1518 – 36956
220		2830.94		
60		2840.30		
60		2847.49	II	10214 – 45322
60		2851.35		
120		2866.09	II	2688 – 37569
70		2868.40	II	2003 – 36855
70		2881.34		
85		2881.68		
60		2883.09		
45		2889.06		
60		2891.34		
85	d	2907.88		
		2907.99	II	10960 – 45337
130		2910.28	II	
85		2937.48	II	
70		2943.49	II	2003 – 35966
150		2953.19	II	
85		2962.74	II	
160		2969.02	II	
100		2983.43	II	
60		2991.57	II	
100		3021.01		
150		3034.84	II	5317 – 38258
100		3039.13	II	2688 – 35583
120		3046.93	II	
45		3050.80	II	
85		3065.78	II	327 – 32935
150		3067.54		
120		3071.29	II	
100		3086.45	II	
85		3096.68	II	1489 – 33773
120		3096.88	II	
100	h	3102.30	II	
250		3106.52	II	2238 – 34419
220		3110.20	II	1518 – 33661
60		3115.05	II	2238 – 34331
200		3117.72	II	
85		3134.18	II	
270		3136.30	II	1489 – 33364
150		3139.97	II	3052 – 34890
85		3143.30	II	3499 – 35303
150		3147.19	II	2689 – 34454
180		3152.10	II	3053 – 34768
410		3152.52	II	838 – 32549
85		3162.15	II	2238 – 33853
150		3162.30	II	838 – 32451
360		3169.88	II	2238 – 33776
85		3170.21	II	2238 – 33773
180		3178.12	II	1489 – 32945
720		3183.92	II	326 – 31725
85		3186.02	II	2688 – 34066
310		3187.01	II	1489 – 32858
430		3187.22	II	3053 – 34419
360		3187.79	II	2238 – 33599
85		3188.72	II	2689 – 34040
360		3193.01	II	0 – 31309
360		3196.18	II	3053 – 34331
150		3201.80	II	3499 – 34722
150		3204.90	II	2689 – 33882
360		3207.18	II	0 – 31171
180		3208.17	II	4386 – 35547
600		3211.73	II	2237 – 33364
150		3214.12	II	2003 – 33107
270		3215.26	II	3053 – 34145
530		3216.85	II	838 – 31916
600		3218.61	II	1489 – 32549
150		3219.43	II	0 – 31052
270		3226.84	II	3909 – 34890
180		3228.50	II	
270		3228.78	II	4386 – 35349
720		3230.56	II	1489 – 32435
360		3231.53	II	838 – 31775
150		3231.95	II	2003 – 32935
430		3233.68	II	2237 – 33153
720		3236.64	II	838 – 31725
150		3237.89	II	3499 – 34375
720		3239.66	II	3910 – 34768
530		3241.16	II	327 – 31171
180		3241.59	II	1518 – 32359
180		3242.04	II	3909 – 34745
150		3244.69	II	1489 – 32299
85		3245.80	I	1490 – 32290
240		3249.75	II	326 – 31089
720		3250.37	II	0 – 30757
360		3253.40	II	838 – 31566
270		3253.94	II	3053 – 33776
850		3254.38	II	327 – 31045
110		3255.63	II	2238 – 32945
85		3258.25	II	2003 – 32686
360		3262.28	II	2689 – 33333
430		3264.94	II	2238 – 32858
180		3270.49	II	3499 – 34066
180		3270.68	II	
430	d	3272.48	II	1518 – 32067
		3272.60	II	3909 – 34457
430		3272.81	II	3052 – 33599
85		3273.32	II	3499 – 34040
430		3273.48	II	0 – 30539
85		3275.87	II	1489 – 32007
430		3276.75	II	3910 – 34419
270		3280.84	II	838 – 31309
180		3285.66	II	1489 – 31916

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
430		3286.23	II	3910 – 34331
85		3286.54	II	2689 – 33107
720	d	3290.28	II	1518 – 31902
		3290.39	II	3499 – 33882
180		3290.65	II	2688 – 33069
240		3293.37	II	2003 – 32359
360		3295.44	II	4386 – 34722
430		3295.81	II	838 – 31171
720		3298.10	II	2237 – 32549
170		3300.98	II	1489 – 31775
340		3301.68	II	3910 – 34189
340		3304.52	II	0 – 30253
340		3305.18	II	2689 – 32935
1700		3306.39	II	3910 – 34145
170		3306.61	II	3052 – 33286
850		3307.02	II	5317 – 35547
340		3309.52	II	838 – 31045
850		3310.66	II	2238 – 32435
600		3312.42	II	1489 – 31670
410		3316.58	II	2237 – 32380
85		3319.56	II	838 – 30954
430		3320.16	II	1489 – 31600
110		3320.59	II	
1200		3321.18	II	3053 – 33154
340		3323.77	II	3499 – 33576
340		3325.26	II	2003 – 32067
170		3325.48	II	2237 – 32299
340		3327.88	II	3499 – 33539
85		3329.62	II	3910 – 33935
85		3332.70	II	2689 – 32686
170		3333.64	II	4386 – 34375
85		3335.03	II	326 – 30302
170		3336.12	II	2238 – 32204
850		3340.58	II	327 – 30253
85		3341.43	II	838 – 30757
240		3343.49	II	3909 – 33809
110		3343.64	II	2003 – 31902
240		3344.35	II	3053 – 32945
85		3346.35	II	5318 – 35192
85		3346.91	II	
170		3347.30	II	3910 – 33776
240		3348.68	II	3910 – 33763
220		3350.88	II	3499 – 33333
410	d	3354.18	II	3053 – 32858
		3354.30	II	2688 – 32492
170		3354.72	II	3052 – 32852
85		3361.43	II	2237 – 31978
85		3364.80	II	
1200		3365.86	II	838 – 30539
150		3367.27	II	3910 – 33599
340		3368.57	II	2238 – 31916
85		3369.04	II	838 – 30511
340		3369.46	II	2689 – 32359
170		3370.59	II	327 – 29986
340		3371.21	II	4386 – 34040
150		3376.48	II	3499 – 33107
70		3377.81	II	2003 – 31600
1200		3382.40	II	1489 – 31045
510		3384.66	II	3053 – 32589
150		3384.86		
60		3385.39	II	2238 – 31768
150		3387.66	II	838 – 30348
410		3389.32	II	4386 – 33882
150		3391.11	II	1489 – 30969
410		3396.19	II	3499 – 32935
150		3397.76	II	0 – 29422
150		3399.84	II	5317 – 34722
600		3402.46	II	3053 – 32435
210		3403.09	II	3909 – 33286
850		3408.68	II	2237 – 31566
85		3411.28	II	2003 – 31309
85		3413.90	II	2238 – 31522
270		3418.15	II	3052 – 32299
430		3418.51	II	3910 – 33154
170		3419.77	II	3052 – 32286
120		3424.78	II	4386 – 33576
170		3426.20	II	5317 – 34496
85		3427.97	II	1489 – 30652
95		3429.75	II	838 – 29986
170		3433.68	II	2237 – 31352
60		3435.27	II	5318 – 34419
150		3437.10	II	2689 – 31775
170		3438.06	II	3053 – 32131
240		3440.50	II	5318 – 34375
85		3444.62	II	1489 – 30511
70		3449.56	II	2689 – 31670
85		3452.78	II	3053 – 32007
170		3453.56	II	4386 – 33333
85		3454.97	II	3499 – 32435
170		3459.20	II	4386 – 33286
120		3459.42	II	3499 – 32397
240		3461.13	II	2237 – 31122
85		3462.69	II	5318 – 34189
120		3464.07	II	1489 – 30348
70		3464.43	II	1489 – 30346
170		3467.87	II	5318 – 34145
130		3473.96	II	3053 – 31830
130		3479.53	II	2238 – 30969
130		3480.26	II	
170		3480.56	II	5317 – 34040
170		3487.41	II	2003 – 30669
85		3492.62	II	1489 – 30113
170		3493.61	II	1489 – 30104
60		3495.92	II	2003 – 30599
220		3499.84	II	1518 – 30082
170		3500.54	II	4386 – 32945
120		3506.85	II	3499 – 32007
120		3507.09	II	
130		3509.10	II	
340		3511.23	II	838 – 29310
170	d	3512.93	II	5318 – 33776
		3513.06	II	
85		3516.30		
130		3523.12	II	
85		3525.51	II	2689 – 31045
310		3530.60	II	1489 – 29805
220		3532.57	II	3052 – 31352
270		3535.65	II	3499 – 31775
85		3536.77	II	
85		3542.46	II	3910 – 32131
120		3552.30	II	0 – 28143
240		3554.15	II	2689 – 30817
170		3556.74	II	2238 – 30346
170		3557.38	II	327 – 28429
510		3559.10	II	3909 – 31998
85		3560.27	II	2003 – 30082
170		3561.59	II	3052 – 31122
220		3566.84	II	2003 – 30031
4200		3568.27	II	3910 – 31926
270		3577.79	II	0 – 27942

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
85	3579.67		
390	3580.94	II	3052 – 30970
85	3582.67	II	1518 – 29422
310	3583.39	II	1489 – 29388
170	3584.26	II	838 – 28730
170	3585.83		
130	3587.46	II	2237 – 30104
85	3589.50	II	2688 – 30539
85	3591.74	II	838 – 28672
4200	3592.60	II	3053 – 30880
85	3593.73	II	4386 – 32204
340	3601.69	II	1489 – 29246
1700	3604.28	II	3910 – 31646
3400	3609.49	II	2238 – 29935
110	3612.43	II	11791 – 39465
170	3613.58	II	
130	3615.24	II	2003 – 29656
170	3620.10	II	327 – 27942
240	3620.58	II	3910 – 31522
1700	3621.23	II	838 – 28445
170	3622.50	II	327 – 27924
240	3623.32	II	838 – 28429
850	3627.01	II	2238 – 29801
170	3627.97	II	838 – 28394
170	3630.67	II	5317 – 32852
850	3631.13	II	3909 – 31441
3400	3634.29	II	1489 – 28997
240	3634.93	II	327 – 27830
120	3636.11	II	3052 – 30546
410	3638.77	II	
170	3642.76	II	4386 – 31830
360	3645.29	II	1489 – 28914
300	3645.39	II	2689 – 30113
170	3645.90	II	1518 – 28939
85	3647.29	II	
660	3649.53	II	3053 – 30446
340	3650.19	II	2003 – 29391
170	3651.00	II	4386 – 31768
130	3654.86	II	2238 – 29591
340	3656.22	II	2688 – 30031
170	3659.62	II	3499 – 30817
2200	3661.36	II	327 – 27631
170	3662.27	II	2689 – 29986
220	3662.69	II	1518 – 28812
170	3662.90	II	3053 – 30346
340	3667.93	II	2238 – 29494
340	3670.66	II	2003 – 29238
2200	3670.84	II	838 – 28073
170	3674.07	II	0 – 27210
340	3677.79	II	1489 – 28672
130	3680.98	I	3125 – 30284
270	3681.73	II	3499 – 30652
85	3687.10	II	
270	3688.42	II	838 – 27942
85	3690.08	I	2273 – 29365
85	3690.93	II	838 – 27924
270	3692.22	II	2238 – 29314
120	3692.76	II	2237 – 29310
1100	3693.99	II	0 – 27063
190	3694.30	II	3909 – 30970
290	3700.60	II	3499 – 30514
290	3700.92	II	3499 – 30511
110	3701.56	II	2238 – 29246
480	3706.75	II	3910 – 30880
480	3706.98	II	5317 – 32286
110	3707.17	II	2689 – 29656
480	3708.41	II	327 – 27285
930	3708.65	II	1489 – 28445
130	3709.52	II	
160	3710.87	II	1489 – 28429
480	3711.54	II	2003 – 28939
240	3712.11	II	2688 – 29619
350	3712.76	II	2003 – 28930
930	3718.88	II	3053 – 29935
130	3720.57	II	4386 – 31255
95	3721.03	I	1490 – 28356
930	3721.85	II	3052 – 29913
40	3724.02	II	2688 – 29533
420	3724.90	II	327 – 27165
19	3726.24	II	
190	3726.80	II	1489 – 28314
55	3727.38	II	2689 – 29510
1600	3728.47	II	5318 – 32131
95	3728.93	II	2003 – 28812
210	3729.75	II	4386 – 31189
55	3730.74	I	2273 – 29070
2100	3731.26	II	838 – 27631
1600	3735.98	II	2238 – 28997
800	3737.14	II	2238 – 28988
320	3737.48	II	3053 – 29801
190	3738.27	II	
2900	3739.12	II	326 – 27063
	3739.20	II	4386 – 31122
800	3741.29	II	1518 – 28239
1200	3743.87	II	2689 – 29391
930	3745.46	I	1490 – 28181
	3745.60	II	0 – 26690
480	3747.62	II	2238 – 28914
160 d	3748.52	I	293 – 26962
	3748.63	II	2003 – 28672
80	3750.66	II	12841 – 39495
160	3751.57	II	327 – 26974
21	3753.09	II	3909 – 30546
160	3754.86	II	1518 – 28143
800	3755.28	II	2689 – 29310
800	3756.41	I	812 – 27426
290	3756.53	II	2237 – 28850
		II	3499 – 30113
1200	3757.53	II	3499 – 30104
450	3758.45	II	0 – 26599
660	3758.97	II	4386 – 30981
350	3760.04	II	3053 – 29641
1900	3760.69	II	1489 – 28072
660	3762.59	II	2003 – 28573
1100	3764.37	II	2689 – 29246
130	3765.43	II	2688 – 29238
480	3767.36	II	3910 – 30446
480	3767.76	II	1489 – 28022
130	3770.73	II	5318 – 31830
80	3771.35	II	13777 – 40285
210	3772.64	II	3499 – 29998
370 d	3773.33	I	292 – 26786
	3773.42	II	1518 – 28012
290	3774.29	II	3499 – 29986
190	3774.68	II	0 – 26485
95	3777.08	II	
130	3777.84	II	
1100	3778.14	II	12045 – 38505
130	3779.56	II	5318 – 31768
660	3780.76	II	0 – 26442

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
420		3780.93	II	3053 – 29494
95		3782.42	II	4386 – 30817
45		3782.68	I	293 – 26721
95		3783.06	II	2003 – 28429
130		3783.36	II	1518 – 27942
190		3785.35	II	
320		3787.20	II	327 – 26724
1500		3788.12	II	2003 – 28394
270		3791.28	II	
270		3792.02	II	327 – 26690
1600		3793.97	II	838 – 27188
420		3797.28	II	838 – 27165
1600		3797.73	II	4386 – 30710
500		3799.54	II	1518 – 27830
270		3800.37	II	3499 – 29805
800		3800.89	II	2238 – 28540
160		3803.94	I	0 – 26281
320		3805.63	II	838 – 27108
27		3806.04	II	4386 – 30652
190		3806.47	I	4021 – 30284
130		3806.77	II	3053 – 29314
190		3807.92	II	0 – 26254
420		3808.46	II	2689 – 28939
320		3809.75	II	2689 – 28930
320		3809.88	II	838 – 27078
420		3810.43	II	2003 – 28239
500		3812.07	II	838 – 27063
480		3813.63	II	3909 – 30123
110		3813.83	I	4021 – 30234
420		3814.63	II	2238 – 28445
45		3818.36	I	1490 – 27671
930	d	3820.82		
530		3824.18	II	1489 – 27631
1600		3826.20	II	4386 – 30514
130		3826.56	II	4386 – 30511
240		3828.05	II	326 – 26442
530		3830.29	II	838 – 26938
1100		3831.50	II	3499 – 29591
110		3832.81	I	2273 – 28356
530		3833.83	II	2238 – 28314
560		3834.48	I	4021 – 30093
560		3834.60	II	3052 – 29123
370		3835.72	II	1489 – 27553
500		3838.94	II	2689 – 28730
400		3840.45	II	327 – 26358
80		3840.61	II	
270		3842.36	II	2238 – 28256
1600		3843.50	II	3499 – 29510
270		3843.77	II	2003 – 28012
110	h	3844.50	II	1489 – 27493
65		3846.28	I	812 – 26803
160		3846.76	I	293 – 26281
530		3847.51	II	2689 – 28672
640		3848.78	II	1489 – 27464
420		3851.88	II	2238 – 28192
530		3853.30	I	3125 – 29070
2700		3854.21	II	5317 – 31255
480		3854.56	I	1490 – 27426
800		3855.90	II	327 – 26254
480		3857.91	II	2238 – 28151
190		3858.52	I	1490 – 27399
400		3858.74	I	2273 – 28181
660		3862.05	II	838 – 26724
350		3862.23	II	2689 – 28573
190	h	3863.42	II	
150		3864.05	II	5317 – 31189
320		3865.24	II	327 – 26191
80		3865.69	II	3053 – 28914
800		3871.78	II	1489 – 27310
130		3873.22	II	3499 – 29310
190		3873.47	II	7524 – 33333
27		3874.39	II	
400		3875.19	II	3052 – 28850
560		3875.54	II	1489 – 27285
160		3877.20	II	2237 – 28022
240		3877.49	I	4021 – 29803
800		3880.77	II	838 – 26599
450		3881.38	II	2689 – 28445
450		3881.79	II	
320		3882.50	II	2237 – 27987
27		3883.80	II	2689 – 28429
3700		3885.29	II	3910 – 29641
240		3885.91	II	4386 – 30113
65		3887.11	II	4386 – 30104
660		3889.16	II	2689 – 28394
		3889.22	II	
610		3890.08	II	1489 – 27188
320		3891.21	II	1518 – 27210
400		3894.05	II	3053 – 28726
45		3895.09	II	
45		3895.42	II	5317 – 30981
1600		3896.98	II	327 – 25980
45		3897.26	II	5318 – 30969
270		3900.89	II	2003 – 27631
65		3902.32	II	1489 – 27108
1300		3903.42	II	2237 – 27849
60		3906.81	II	1489 – 27078
90		3909.95	I	3125 – 28694
90		3910.09	II	2689 – 28256
50		3910.92	II	5318 – 30880
120		3912.98	II	4386 – 29935
120		3913.37	II	
90		3913.62	II	7524 – 33069
60		3916.36	II	8679 – 34205
620		3917.44	II	838 – 26358
190		3918.62	II	1489 – 27001
50		3920.10	II	13604 – 39106
190		3922.05	II	2003 – 27493
2500		3922.40	II	3053 – 28540
90		3922.70	II	1489 – 26974
290		3925.22	I	812 – 26281
1900		3928.28	II	1489 – 26938
35		3931.16	II	3499 – 28930
90		3932.97	II	4386 – 29805
290		3933.58	II	4386 – 29801
50		3935.18	II	3910 – 29314
470		3935.76	II	2238 – 27638
290		3937.06	II	5317 – 30710
29		3938.43	II	2689 – 28073
50		3939.64	II	838 – 26214
1300		3941.87	II	0 – 25361
620		3943.24	II	838 – 26191
500		3946.51	II	1489 – 26821
290		3947.84	II	2689 – 28012
740		3948.11	II	838 – 26160
50		3949.85	I	2273 – 27583
470		3951.89	I	1489 – 26786
120		3954.20	II	1489 – 26772
29		3954.97		
50		3957.52	II	3052 – 28314

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
120	3958.72	II	2689 – 27942
370	3959.53	II	838 – 26086
190	3961.80	II	4386 – 29619
90	3962.13	I	1489 – 26721
90	3962.24	II	3499 – 28730
1500	3963.00	II	326 – 25552
620	3966.04	II	2003 – 27210
90	3966.34	II	4386 – 29591
470	3967.68	II	5318 – 30514
740	3970.53	II	0 – 25178
1500	3971.40	II	3499 – 28672
190	3974.45	II	
620	3974.66	I	2273 – 27426
160	3975.22	II	2238 – 27387
960	3976.27	II	838 – 25980
1000	3976.43	II	2689 – 27830
960	3979.20	II	4386 – 29510
50	3980.88	II	
740	3983.14	II	3053 – 28151
150	3986.00	II	1518 – 26599
29	3986.23	II	3909 – 28988
740	3986.68	II	1489 – 26566
150	3986.90	II	2003 – 27078
370	3987.43	II	2238 – 27310
1500	3990.00	II	0 – 25056
	3990.02	I	3125 – 28181
150	3991.02	I	4020 – 29069
740	3993.31	II	327 – 25361
90	3995.59	II	
190	3998.35	I	4020 – 29023
280	4003.46	II	2003 – 26974
90	4003.72	II	3052 – 28022
50	4004.26	II	1518 – 26485
190	4006.60	II	838 – 25790
90	4006.82	II	2238 – 27188
470	4007.48	II	3499 – 28445
150	4008.10	II	2689 – 27631
150	4008.33	II	3909 – 28850
90	4011.73	II	0 – 24920
60	4015.77	II	3499 – 28394
120	4019.84	II	2238 – 27108
280	4019.98	II	1489 – 26358
90	4022.73	II	327 – 25178
880	4023.23	II	327 – 25175
150	4032.98	II	326 – 25115
740	4035.11	II	2689 – 27464
180	4037.10	II	2238 – 27001
150	4038.10	II	3499 – 28256
590	4041.68	II	1518 – 26254
740	4042.72	II	327 – 25056
880	4042.90	II	838 – 25566
240	4044.11	II	2003 – 26723
560	4045.05	II	838 – 25553
440	4046.16	II	838 – 25546
740	4047.16	II	1489 – 26191
100	4047.35	II	2238 – 26938
210	4048.62	II	3499 – 28192
75	4049.58	II	2003 – 26690
590	4049.81	II	0 – 24686
440	4058.87	II	3910 – 28540
560	4063.54	II	327 – 24929
280	4064.32	II	1489 – 26086
1400	4064.58	II	2689 – 27285
	4064.58	II	2003 – 26599
810	4066.74	II	2238 – 26821
710	4068.33	II	3499 – 28073
810	4075.84	II	4386 – 28914
280	4076.65	II	838 – 25361
90	4076.86	II	327 – 24848
100	4079.83	I	2273 – 26777
240	4080.56	II	2689 – 27188
130	4081.97	II	1489 – 25980
410	4082.60	II	5318 – 29805
90	4083.24	II	5318 – 29801
280	4083.58	II	2003 – 26485
220	4084.40	II	2689 – 27165
45	4086.16	II	838 – 25304
29	4089.48	II	9406 – 33852
1000	4092.27	II	0 – 24430
50	4093.04	II	3499 – 27924
290	4094.05	II	2689 – 27108
120	4098.97	II	2689 – 27078
60	4099.96	I	3125 – 27509
240	4104.13	II	327 – 24686
90	4106.62	II	4386 – 28730
810	4107.28	II	838 – 25178
	4107.39	II	4386 – 28726
60	4107.80	II	838 – 25175
130	4108.32	II	3053 – 27387
410	4109.40	II	2238 – 26566
280	4110.19	II	5318 – 29641
410	4113.90	II	1489 – 25790
190	4116.46	II	2689 – 26974
1900	4118.55	II	5318 – 29591
150	4119.57	II	2238 – 26506
410	4121.36	II	3053 – 27310
120	4121.54	II	327 – 24583
280	4122.51	II	2003 – 26254
710	4123.96	II	3910 – 28151
60	4125.23	I	2273 – 26507
90	4125.85	II	
29	4128.12	II	838 – 25055
280	4129.23	II	2003 – 26214
100	4133.19	II	2003 – 26191
250	4135.14	II	5318 – 29494
45	4135.50	I	1490 – 25664
50	4138.97	II	4386 – 28540
75	4142.67	II	3499 – 27631
75	4145.24	I	4020 – 28137
160	4146.75	II	1489 – 25598
320	4147.71	II	327 – 24430
810	4149.83	II	838 – 24929
1200	4152.21	II	1489 – 25566
530	4153.33	II	5318 – 29388
560	4155.22	II	4386 – 28445
130	4156.25	II	3499 – 27553
100	4159.40	II	2689 – 26724
100	4159.51	II	1518 – 25553
160	4163.14	II	0 – 24013
100	4163.72	II	838 – 24848
45	4165.54	II	12987 – 36987
50	4166.34	II	
810	4169.48	II	2003 – 25980
410	4171.57	II	3499 – 27464
190	4174.43	II	3053 – 27001
440	4178.02	II	4386 – 28314
	4178.02	II	1489 – 25417
530	4181.10	II	2689 – 26599
210	4183.33	I	1490 – 25387
530	4183.76	II	327 – 24222

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
1000	4188.13	II	4386 – 28256
410	4191.93	II	2237 – 26086
160	4192.16	II	838 – 24686
45	4197.90	II	1489 – 25304
270	4199.45	II	4386 – 28192
26	4201.22	II	2689 – 26485
650	4202.92	II	3910 – 27696
1100	4203.05	II	3499 – 27285
50	4204.82	II	3053 – 26828
160	4205.78	I	4020 – 27790
660	4206.13	II	3053 – 26821
270	4206.62	II	4386 – 28151
660	4210.35	II	838 – 24583
100	4213.05	II	3910 – 27639
26	4213.94	II	
100	4218.63	I	4020 – 27718
50	4219.31	I	293 – 23986
180	4220.14	II	3499 – 27188
740	4220.66	II	4386 – 28072
150	4223.70	II	2689 – 26358
50	4224.23	II	3499 – 27165
1000	4225.33	II	1518 – 25178
	4225.33	II	0 – 23659
150	4226.18	I	812 – 24467
740	4229.70	II	327 – 23962
50	4230.73	I	0 – 23630
620	4234.57	II	3499 – 27108
1200	4236.74	II	5318 – 28914
500	4237.66	II	838 – 24430
45	4240.45	I	1490 – 25065
620	4244.70	II	2238 – 25790
120	4245.18	II	2003 – 25553
50	4247.39	II	1518 – 25056
210	4249.55	II	2689 – 26214
250	4251.78	II	3053 – 26566
60	4253.72	II	2688 – 26190
2100	4256.39	II	3053 – 26540
210	4258.58	II	3499 – 26974
50	4259.39	II	2689 – 26160
1300	4262.68	II	3053 – 26506
500	4265.08	II	1489 – 24930
120	4266.31	I	812 – 24245
35	4269.77	II	2003 – 25417
50	4270.73	II	1489 – 24898
150	4270.84	II	5318 – 28726
50	4271.86	I	2273 – 25676
50	4272.01	II	1518 – 24920
1200	4279.68	II	2238 – 25598
	4279.75	II	1489 – 24848
240	4279.94	II	2003 – 25361
90	4280.32	II	838 – 24194
2200	4280.79	II	3910 – 27263
190	4281.01	II	0 – 23352
710	4282.21	I	3125 – 26471
470	4282.83	I	2273 – 25616
240	4283.50	I	812 – 24151
35	4284.50	II	326 – 23659
50	4285.50	II	2238 – 25566
350	4286.64	II	3499 – 26821
35	4291.62	II	
350	4292.18	II	2689 – 25980
60	4295.74	II	3499 – 26772
1600	4296.74	I	4021 – 27288
90	4299.14	I	293 – 23547
90	4299.34	II	4386 – 27639
45	4301.28	I	4020 – 27263
320	4304.94	II	5318 – 28540
880	4309.01	II	1489 – 24690
240	4312.85	I	2273 – 25453
180	4313.73	II	2003 – 25178
	4313.73	II	838 – 24013
75 d	4315.35	II	4386 – 27552
	4315.38	II	4386 – 27553
1900	4318.94	II	2238 – 25385
470	4319.53	I	1490 – 24634
590	4323.28	II	838 – 23962
240	4324.46	I	2273 – 25391
45	4327.51	II	2689 – 25790
1800	4329.02	II	1489 – 24583
440	4330.02	I	293 – 23381
120	4331.45	I	1489 – 24570
1300	4334.15	II	2238 – 25304
880	4336.14	I	3125 – 26182
45	4336.74	II	2003 – 25055
90	4338.96	I	812 – 23852
35	4339.92	I	812 – 23847
35 h	4342.38	II	
560	4345.86	II	838 – 23842
90	4346.49	II	4386 – 27387
1100	4347.80	II	3053 – 26046
560	4350.46	II	3910 – 26889
24	4350.82	I	1490 – 24467
560	4352.10	II	3909 – 26880
24	4357.90	I	3125 – 26066
560	4360.72	II	2003 – 24929
220	4361.07	II	4386 – 27310
810	4362.04	II	3910 – 26828
440	4362.91	I	0 – 22914
220	4363.45	II	1518 – 24430
24	4364.05	II	8046 – 30954
45	4365.95	I	812 – 23710
500	4368.03	II	3053 – 25940
210	4369.92	II	2689 – 25566
45	4370.48	II	5318 – 28192
440	4373.46	II	3499 – 26358
320	4374.98	II	327 – 23177
880	4378.24	II	5318 – 28151
530	4380.42	I	1490 – 24312
290	4384.29	II	4386 – 27188
120	4386.22	I	2273 – 25065
21	4388.99	II	7524 – 30302
1600	4390.86	II	1489 – 24257
21	4392.60	II	7135 – 29894
210	4393.35	I	1490 – 24245
290	4397.34	I	812 – 23547
90	4399.88	II	4386 – 27108
410	4401.17	I	3125 – 25840
810 d	4403.06	II	1489 – 24194
	4403.13	I	2273 – 24978
410	4403.36	II	1518 – 24222
35	4405.67	II	3499 – 26191
60	4407.52	II	2003 – 24686
520	4409.33	II	2689 – 25361
290	4411.58	I	1490 – 24151
120	4411.83	II	2238 – 24898
380	4417.58	II	3910 – 26540
470	4419.33	I	293 – 22914
1500	4420.53	II	2689 – 25304
960	4421.14	II	3053 – 25665
75	4423.38	I	293 – 22893

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
2900		4424.34	II	3910 – 26506
35		4425.99	II	3499 – 26086
180		4427.58	II	2003 – 24583
75		4427.81	II	2238 – 24816
470		4429.66	I	812 – 23381
120		4433.08	I	293 – 22844
1600		4433.88	II	3499 – 26046
1800		4434.32	II	3053 – 25598
530		4441.81	I	1490 – 23997
440		4442.28	I	812 – 23317
100		4442.47	II	3909 – 26413
50		4443.27	I	2273 – 24773
710		4444.26	II	4386 – 26880
710		4445.15	I	3125 – 25616
35		4445.84	II	2688 – 25175
45		4446.96	II	3499 – 25980
1300		4452.73	II	2238 – 24690
250		4452.95	I	4021 – 26471
1200		4454.63	II	4386 – 26828
90		4456.11	II	4386 – 26821
1000		4458.52	II	838 – 23261
250		4459.29	I	812 – 23231
29		4463.90	I	2273 – 24669
2200		4467.34	II	5318 – 27696
90		4469.66	II	2688 – 25055
810		4470.89	I	2273 – 24634
470		4472.43	II	1489 – 23842
620		4473.02	II	2238 – 24588
75		4475.18	II	838 – 23177
50		4477.50	I	3125 – 25453
740		4478.66	II	5317 – 27639
120		4480.32	I	0 – 22314
29		4485.57	II	7135 – 29422
26		4490.02	I	3125 – 25391
24		4495.14	II	2689 – 24929
370		4499.11	I	1490 – 23710
370		4499.48	II	2003 – 24222
60		4501.38	II	2689 – 24898
240		4503.38	I	293 – 22492
180		4505.05	II	2003 – 24194
120		4511.33	I	4021 – 26182
560		4511.83	II	1489 – 23647
440		4515.09	II	1518 – 23659
29		4517.27	II	7524 – 29656
880		4519.63	II	4386 – 26506
60		4522.55	I	1490 – 23595
440		4523.04	II	327 – 22429
		4523.18	I	812 – 22914
650		4523.91	II	3499 – 25598
60		4527.42	I	812 – 22893
75		4532.44	I	1490 – 23547
290		4533.80	I	2273 – 24324
270		4536.51	II	838 – 22875
710		4537.95	II	3910 – 25940
150		4538.53	II	4386 – 26413
290		4540.19	II	2238 – 24257
380		4542.06	II	2003 – 24013
810		4543.95	II	2689 – 24690
100		4544.83	II	2689 – 24686
29		4545.81	II	5318 – 27310
45		4550.03	I	2273 – 24245
410		4552.66	II	2003 – 23962
270		4554.45	II	838 – 22789
90	d	4556.50	II	8046 – 29986
		4556.63	I	3125 – 25065
240		4560.43	II	327 – 22248
18		4561.19	II	3499 – 25417
60		4564.10	II	0 – 21904
470		4566.21	II	2689 – 24583
60		4566.77	I	1490 – 23381
35		4569.58	I	2273 – 24151
590		4577.69	II	2003 – 23842
45		4578.72	II	1518 – 23352
75		4579.09	II	1489 – 23321
290		4581.58	I	812 – 22632
440		4581.73	I	4021 – 25840
560		4584.83	II	3499 – 25304
45		4589.43	II	9406 – 31189
290		4591.82	II	1489 – 23261
380		4593.54	II	3053 – 24816
35		4594.59	II	11094 – 32852
560		4595.29	II	3910 – 25665
240		4596.74	I	292 – 22041
90		4598.35	II	2689 – 24430
60		4603.12	II	12044 – 33763
220		4604.18	II	327 – 22040
290		4606.51	II	0 – 21702
45		4606.88	II	4386 – 26086
75		4611.25	I	812 – 22492
75		4613.50	II	2689 – 24358
290		4615.44	II	4386 – 26046
470		4615.69	II	1518 – 23177
29		4616.49	II	0 – 21655
15		4620.25	II	
24		4624.97	II	10214 – 31830
29		4629.43	I	4021 – 25616
150		4630.21	II	838 – 22429
90		4636.26	II	5317 – 26880
880		4642.24	II	3053 – 24588
290		4645.40	I	293 – 21813
290		4646.68	II	2238 – 23753
90		4647.53	II	5318 – 26828
240		4648.16	II	0 – 21508
380		4649.49	I	812 – 22314
150		4655.13	II	3910 – 25385
290		4663.56	I	2273 – 23710
75		4665.13	II	3499 – 24929
740		4669.40	II	838 – 22248
620		4669.65	II	2238 – 23647
470	d	4670.75	I	1490 – 22894
		4670.83	I	1490 – 22893
1100		4674.60	II	1489 – 22875
680		4676.91	II	327 – 21702
210		4681.55	I	1490 – 22844
75		4682.69	II	3499 – 24848
370		4687.18	II	327 – 21655
370		4688.73	I	2273 – 23595
40		4689.57	II	2003 – 23321
130		4693.63	II	1489 – 22789
120		4699.34	II	2689 – 23962
530		4704.40	II	0 – 21251
60		4710.64	II	5318 – 26540
270		4713.06	II	4386 – 25598
75		4714.62	II	3053 – 24257
130		4715.26	II	838 – 22040
730		4716.10	I	3125 – 24324
270		4717.07	I	0 – 21194
210		4717.72	II	3499 – 24690
190		4718.33	II	5318 – 26506
29		4718.64	I	3125 – 24312

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
270	4719.84	II	327 – 21508
35	4720.12	II	4386 – 25566
29	4721.39	II	2003 – 23177
130	4726.02	II	2689 – 23842
770	4728.42	I	1490 – 22632
50	4741.72	II	3499 – 24583
470	4745.68	II	838 – 21904
150	4750.72	I	2273 – 23317
40	4755.37	II	2238 – 23261
730	4760.27	I	812 – 21813
110	4770.20	I	2273 – 23231
110	4774.15	II	1489 – 22429
190	4777.85	II	327 – 21251
70	4781.84	II	3910 – 24816
580	4783.10	I	293 – 21194
350	4785.86	I	812 – 21701
160	4789.96	I	3125 – 23997
230	4791.58	II	838 – 21702
15 h	4804.90	II	14084 – 34890
430	4815.81	II	1489 – 22248
85	4816.01	II	3499 – 24257
130	4829.57	II	3053 – 23753
40	4833.32	II	
75	4834.62	II	3910 – 24588
35	4836.67	II	838 – 21508
40	4837.65	II	10214 – 30880
970	4841.70	I	4021 – 24669
310	4844.21	II	2238 – 22875
140	4847.76	II	5318 – 25940
270	4848.32	I	2273 – 22893
120	4854.36	II	3053 – 23647
85	4859.55	II	2689 – 23261
75	4869.98	II	9407 – 29935
8	4873.20	II	11155 – 31669
210	4883.77	I	293 – 20763
730	4883.97	I	3125 – 23595
12	4891.94	II	10873 – 31309
75	4893.35	II	4386 – 24816
35	4894.30	II	2003 – 22429
40	4900.73	II	8046 – 28445
24	4901.90	II	9407 – 29801
170	4904.97	I	812 – 21194
630	4910.40	I	2273 – 22632
350	4913.25	II	5318 – 25665
14	4914.30	II	3499 – 23842
430	4918.99	I	1490 – 21813
75	4920.38	II	8679 – 28997
60	4923.83	II	4386 – 24690
110	4924.04	I	4021 – 24324
29	4929.56	II	5318 – 25598
45	4936.03	II	3499 – 23753
120	4938.10	II	2003 – 22248
95	4946.32	I	1490 – 21701
170	4948.63	II	4386 – 24588
120	4952.37	II	2689 – 22875
45	4953.03	II	1518 – 21702
29 d	4955.95	II	10873 – 31045
	4956.13	II	13604 – 33776
170	4961.94	II	3499 – 23647
45	4964.56	II	1518 – 21655
60	4972.16	II	7525 – 27631
35	4973.74	II	2689 – 22789
170	4975.98	I	0 – 20091
45	4981.73	II	5318 – 25385
29	4983.38	II	14084 – 34145
35	4989.44	II	2003 – 22040
70	4992.02	II	8046 – 28072
45	5001.22	II	1518 – 21508
45	5016.61	II	7135 – 27063
60	5023.50	II	2003 – 21904
140	5028.44	II	12045 – 31926
29	5031.18	II	12045 – 31916
400	5044.28	I	3125 – 22944
45	5049.51	I	293 – 20091
200	5052.76	II	11094 – 30880
65	5057.74	II	8679 – 28445
60	5059.85	I	15418 – 35176
70	5060.93	I	1490 – 21243
29	5064.24	II	2689 – 22429
22	5066.86	II	11791 – 31522
170	5069.46	II	10214 – 29935
540	5071.20	I	4020 – 23734
65	5076.69	I	13814 – 33507
60	5079.86	I	
29	5087.08	II	2003 – 21655
29	5087.65	II	11395 – 31045
60	5088.32	I	812 – 20459
22	5088.97	II	12790 – 32435
170	5100.22	II	12045 – 31646
	5100.39	I	13095 – 32696
260	5103.09	II	9407 – 28997
140	5104.48	II	8046 – 27631
140	5116.70	II	7525 – 27063
510	5117.16	I	2273 – 21809
350	5122.14	I	3125 – 22643
50	5124.86	II	9406 – 28913
35	5132.21	I	12445 – 31924
35	5135.86	I	11877 – 31342
60	5154.23	II	12045 – 31441
360	5155.03	II	8679 – 28072
60	5155.86	I	11044 – 30435
65	5157.07	II	10960 – 30346
	5157.23	I	293 – 19677
29	5162.86	II	8578 – 27942
22	5164.62	I	11877 – 31234
80	5166.06	II	11094 – 30446
50	5168.35	I	15418 – 34761
50	5169.57	II	
250	5172.74	I	2273 – 21600
470	5175.42	I	4020 – 23337
70 h	5178.01	II	7135 – 26442
45	5187.09	I	1490 – 20763
45	5194.73	I	13095 – 32340
250	5200.59	I	1490 – 20713
29	5201.45	I	12445 – 31665
60	5202.73	II	2689 – 21904
60	5209.92	I	13095 – 32284
60	5218.40	I	
29	5221.12	I	14591 – 33739
60 h	5228.80	II	8046 – 27165
45 h	5234.18	II	10214 – 29314
29 h	5237.58	I	12846 – 31934
260	5251.92	I	2273 – 21308
35	5252.77	II	8046 – 27078
22	5253.80	I	11406 – 30435
25	5265.67	I	0 – 18986
400	5271.40	I	812 – 19777
25	5272.82	II	7524 – 26484
250	5282.91	I	4020 – 22944
25 h	5289.94	I	

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
35	5294.65	I	13814 – 32696
35	5303.23	I	14056 – 32907
22	5309.50	I	13095 – 31924
35	5312.23	II	2689 – 21508
22	5313.76	I	
190	5320.60	I	2273 – 21063
18 h	5321.82	I	
22 hd	5324.99	I	
18	5332.09	I	12313 – 31062
110	5341.29	I	293 – 19010
29	5348.08	I	293 – 18986
45	5348.74	I	13458 – 32149
35	5349.14	I	812 – 19501
45	5350.62	I	3125 – 21809
35 h	5355.88	I	14202 – 32868
22	5364.39	II	10214 – 28850
140	5368.36	I	4021 – 22643
14	5369.18	II	
22	5370.06	I	
14 h	5378.09	I	
35	5387.97	I	13369 – 31923
22	5389.85	I	
22	5392.69	I	14920 – 33458
29	5394.48	II	9410 – 27942
95	5403.70	I	1490 – 19990
130	5405.23	I	293 – 18788
60	5411.39	I	3125 – 21600
35	5415.98	II	17005 – 35463
9	5419.07	I	4020 – 22468
45	5421.57	I	2273 – 20713
18	5425.63	I	
18	5433.55	I	13687 – 32086
18	5433.82	I	812 – 19210
29	5436.33	I	15418 – 33808
220	5453.00	I	3125 – 21459
18	5461.55	I	14563 – 32868
140	5466.72	I	1490 – 19777
25	5478.29	II	10181 – 28429
65	5485.42	I	0 – 18225
230	5493.72	I	812 – 19010
80	5498.21	I	293 – 18475
29	5511.09	I	4020 – 22160
80	5512.10	I	812 – 18949
230	5516.09	I	2273 – 20397
10	5525.61	I	14056 – 32149
29	5537.07	II	13466 – 31522
50	5548.95	I	292 – 18309
140	5550.40	I	1490 – 19501
14	5561.37	I	812 – 18788
45	5573.42	I	3125 – 21063
29	5574.89	I	293 – 18225
35	5588.20	I	2273 – 20163
50	5600.86	II	11791 – 29641
50	5621.79	I	293 – 18076
70	5626.01	I	0 – 17770
14	5637.30	II	8679 – 26413
85	5644.10	I	
22	5656.34	I	13095 – 30770
140	5659.86	I	812 – 18475
9	5661.54	II	
22	5663.91	I	14591 – 32242
29	5686.75	II	10960 – 28540
14	5686.98	I	4021 – 21600
9	5692.05	I	13095 – 30659
22	5696.24	II	7135 – 24685
120	5696.73	I	
85	5706.20	I	1490 – 19010
22	5706.75	I	292 – 17810
22	5709.73	I	13050 – 30559
35	5710.93	I	
14	5711.45	I	2273 – 19777
29	5717.92	I	12445 – 29929
14	5719.12	II	8679 – 26159
29	5720.19	I	293 – 17770
22	5721.38	I	13095 – 30569
12	5724.45	I	15617 – 33081
14	5729.30	I	11406 – 28855
10	5730.13	I	11406 – 28853
50	5732.95	I	4021 – 21459
22	5736.84	I	13050 – 30476
29	5738.01	II	14504 – 31926
22	5740.89	I	14154 – 31568
10	5741.19	I	812 – 18225
50	5743.35	II	14115 – 31522
9	5745.50	I	11044 – 28445
29	5748.09	I	13814 – 31207
22	5757.97	I	12445 – 29807
45	5759.52	II	12988 – 30346
29	5763.91	I	
70	5773.77	I	13815 – 31129
60	5778.33	I	
45	5779.24	I	1490 – 18788
45	5781.93	II	8046 – 25336
70 d	5786.98	II	13604 – 30880
	5787.15	I	11877 – 29152
14	5787.53	I	11877 – 29151
60	5788.38	I	3125 – 20397
60	5800.52	I	13095 – 30330
14	5801.24	I	13542 – 30775
9 h	5801.66	II	10960 – 28192
65	5802.84	I	2273 – 19501
14	5806.77	I	13095 – 30312
45	5814.89	I	11877 – 29069
12	5816.34	I	11044 – 28233
13	5818.32	I	13095 – 30278
18	5820.68	II	
29	5830.51	I	11877 – 29023
45	5831.02	II	12790 – 29935
22 h	5831.74	II	14504 – 31646
45	5836.37	II	8046 – 25175
22	5842.60	II	8679 – 25790
22	5843.76	I	14591 – 31699
22	5848.67	II	12842 – 29935
14	5860.27	II	7135 – 24194
35	5860.78	I	3125 – 20183
65	5867.79	I	3125 – 20163
45	5868.61	I	4021 – 21056
35	5871.06	I	3125 – 20153
50	5874.21	I	812 – 17831
9	5875.10	I	13542 – 30559
13	5875.92	I	1490 – 18503
13	5878.11	II	10181 – 27188
25	5891.41	I	12313 – 29282
22	5895.16	I	13458 – 30416
45	5897.39	II	12045 – 28997
50	5898.96	I	11044 – 27992
29	5902.60	I	2273 – 19210
29	5903.50	I	12445 – 29379
18	5906.05	I	1490 – 18417
22	5909.04	I	2273 – 19191

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
9		5910.83	I	12313 – 29226
29		5912.61	I	10801 – 27709
22		5913.56	I	14202 – 31108
14		5915.56	I	
14		5916.36	I	293 – 17190
22		5919.33	II	10960 – 27849
22		5921.01	I	12846 – 29731
22		5923.34	I	15082 – 31960
22		5924.66	I	13458 – 30332
25		5932.18	I	13095 – 29948
25		5932.90	II	12790 – 29641
35		5938.90	II	7525 – 24358
22		5942.33	I	15418 – 32242
25		5946.37	I	14202 – 31015
25	h	5955.82	II	11659 – 28445
25		5956.76	I	15082 – 31865
22		5957.52	II	9410 – 26191
25		5960.09	I	11044 – 27818
25		5963.22	II	12232 – 28997
65		5965.71	II	10180 – 26938
35	h	5968.82	II	11791 – 28540
13		5969.49	I	13687 – 30435
25		5979.38	I	1490 – 18210
35		5984.29	I	12445 – 29151
13	h	5993.85	II	10873 – 27552
25		5994.64	II	11395 – 28072
29		5995.09	I	2273 – 18949
22		6001.94	I	11877 – 28534
22		6004.18	I	812 – 17462
25		6011.22	II	11799 – 28429
12		6016.80	I	14591 – 31207
18		6017.39	II	10214 – 26828
25		6027.16	I	3125 – 19712
18		6033.23	II	9410 – 25980
29		6041.40	I	11877 – 28425
18		6042.84	I	14612 – 31156
50		6045.00	I	2273 – 18811
45		6045.39	I	10801 – 27338
9	h	6053.88	I	11406 – 27920
12		6067.78	II	11155 – 27631
50		6070.06	I	1490 – 17959
12	h	6075.72	I	11877 – 28331
45		6084.12	I	812 – 17244
12		6088.62	I	12445 – 28864
35	h	6091.40	I	11406 – 27818
14		6096.78	I	13458 – 29855
14	h	6099.90	I	293 – 16682
18		6101.96	I	14202 – 30586
22		6103.37	I	13095 – 29475
45		6110.66	II	11791 – 28151
12	h	6112.98	I	14856 – 31210
18		6114.58	II	8578 – 24928
22		6114.73	I	
18		6122.75	I	15418 – 31746
22		6123.60	II	10214 – 26540
14		6124.88	II	12988 – 29310
14		6126.33	I	14856 – 31175
12		6130.62	I	12445 – 28752
22		6135.85	I	11044 – 27338
18		6138.05	I	11877 – 28164
18		6139.33	I	13095 – 29379
22		6140.60	I	15418 – 31699
18		6143.09	I	
12		6143.59	I	13458 – 29731
29		6149.10	II	12988 – 29246
14		6156.90	II	11047 – 27284
14	h	6157.55	II	11395 – 27631
45	h	6159.56	I	2273 – 18503
22		6160.42	II	10960 – 27188
12		6164.51	II	7135 – 23352
18		6165.84	I	14202 – 30416
12	h	6168.33	II	12790 – 28997
18		6173.95	I	12313 – 28505
18		6174.45	I	4020 – 20211
18		6174.96	II	10873 – 27063
18		6179.41	I	14591 – 30770
22	h	6179.82	II	10181 – 26358
18		6181.05	II	13466 – 29641
29	h	6182.89	II	11094 – 27263
22		6188.00	II	9410 – 25566
29		6192.64	II	11798 – 27942
18		6194.39	I	3125 – 19265
10		6198.14	II	11155 – 27284
18		6201.13	I	11044 – 27166
25		6203.86	I	13814 – 29929
22		6206.87	I	14591 – 30698
10		6207.13	I	13542 – 29648
18		6217.17	I	13050 – 29130
10		6225.48		
18		6226.70	I	2273 – 18329
29		6237.66	II	12045 – 28072
18		6238.30	I	15082 – 31108
25	h	6244.21	II	8679 – 24690
45		6246.76	II	8579 – 24583
14		6248.11	I	11406 – 27406
45		6256.54	I	15955 – 31934
45		6256.66	II	9407 – 25385
100		6267.28	II	9410 – 25361
10		6279.49	II	10960 – 26880
25		6289.90	II	9410 – 25304
50		6291.82	II	11395 – 27285
14		6292.94	I	14202 – 30089
29		6294.68	II	10371 – 26253
22		6301.12	II	10181 – 26046
18		6302.40	II	12567 – 28429
29		6303.15	II	10960 – 26820
13		6305.19	II	10743 – 26599
35		6307.06	II	8579 – 24430
13		6315.78	II	14084 – 29913
25		6321.75	II	13777 – 29591
13		6322.51	I	13814 – 29627
18		6325.54	II	11659 – 27464
70		6327.47	II	10181 – 25980
13		6328.01	I	15524 – 31322
25		6340.10	I	13458 – 29226
22		6353.54	II	10518 – 26253
13		6355.35	I	14856 – 30586
29		6357.18	II	10873 – 26599
14		6367.41	I	1490 – 17190
22		6368.28	II	12842 – 28540
6		6371.01	I	4021 – 19712
5		6380.05	I	11044 – 26714
14	h	6386.77	I	14202 – 29856
29		6389.85	II	9410 – 25056
25		6390.81	II	8579 – 24222
9	h	6403.98	II	13777 – 29387
12	h	6406.24	II	10960 – 26566
29		6417.50	II	8679 – 24257
45		6426.64	II	14085 – 29641
22		6428.32	II	11047 – 26599

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
10		6428.94	I	15082 – 30633
22		6431.00	II	10960 – 26506
10		6431.96	II	11395 – 26938
10		6435.34	I	
7		6447.56	II	12566 – 28072
12		6452.08	I	14154 – 29648
14		6455.60	II	11799 – 27285
10		6456.25	II	10873 – 26357
10		6457.55	I	14856 – 30337
4		6459.36	I	15082 – 30560
18	h	6470.46	II	10214 – 25665
10		6471.59	I	14154 – 29602
45		6472.34	II	11094 – 26540
35		6484.52	II	10181 – 25598
29		6487.62	II	9407 – 24816
29		6490.82	II	12790 – 28192
35		6498.67	II	8579 – 23962
9		6502.00	II	12567 – 27942
13	h	6507.70		
29	hl	6509.44	I, SmO	293 – 15651
13	h	6526.64	II	10873 – 26190
18	h	6528.02	I	2273 – 17587
18	h	6529.70	I	13542 – 28853
18	h	6532.25	I	812 – 16116
		6533.96	I	812 – 16112
50		6542.76	II	9410 – 24689
18		6544.57	II	9410 – 24686
18	h	6549.77	II	8579 – 23842
13	h	6551.80	I	1490 – 16748
140		6569.31	II	12045 – 27263
35	h	6570.67	II	8046 – 23261
27		6574.38	II	11047 – 26253
40	h	6585.21	II	9407 – 24588
7	h	6587.54	I	
27		6588.91	I	3125 – 18298
110		6589.72	II	10214 – 25385
12		6591.50	II	
40		6601.83	II	12045 – 27188
95		6604.56	II	13777 – 28913
11		6617.61	II	10873 – 25980
6		6625.28	II	11791 – 26880
20	h	6628.88	II	8578 – 23659
14	h	6630.61	II	12232 – 27310
40	h	6632.28	II	13466 – 28540
12	h	6646.22	I	15617 – 30659
20	h	6649.02	II	11155 – 26190
20		6651.61	II	11791 – 26821
27		6656.19	II	9410 – 24430
17	h	6667.22	II	10181 – 25175
50		6671.51	I	4021 – 19006
70		6679.21	II	8679 – 23647
17	h	6681.53	II	11395 – 26358
17	h	6687.79	II	13777 – 28725
70		6693.55	II	13604 – 28540
11	h	6694.69	II	11047 – 25980
14		6703.61	I	17655 – 32568
20	h	6707.45	II	7525 – 22429
14		6712.62	II	12045 – 26938
40	d	6723.07	I	13050 – 27920
		6723.26	I	
27		6724.73	I	16859 – 31726
20		6725.88	I	0 – 14864
120	d	6731.84	II	9407 – 24257
70	d	6734.06	II	11094 – 25940
40	d	6734.81	II	12045 – 26889
55		6741.47	II	8046 – 22875
17	h	6754.68	II	11799 – 26599
		6754.85	I	16131 – 30931
17		6759.25	I	16131 – 30921
14		6766.52	II	11791 – 26566
20		6778.19	II	11791 – 26540
40	h	6778.61	II	10181 – 24929
14	h	6780.03	II	14193 – 28938
17	h	6781.17	II	8046 – 22789
20		6782.95	II	17391 – 32130
60		6790.00	II	7525 – 22248
14	h	6792.55	II	12567 – 27285
95		6794.20	II	11791 – 26506
20	h	6802.96	I	812 – 15507
		6803.1	I	
10		6807.50	I	14380 – 29066
20	h	6808.31	I	15507 – 30191
8		6813.48	II	10873 – 25546
14	h	6820.91	I	14380 – 29037
27		6829.86	II	10960 – 25598
17		6830.54	I	14916 – 29552
12	h	6837.20	I	13542 – 28164
17		6838.33	I	14856 – 29475
10	h	6839.64	II	15897 – 30514
20	h	6841.75	I	15579 – 30191
55		6844.71	II	10960 – 25566
27	d	6846.54	II	10214 – 24816
14		6848.16	II	
		6848.31	I	14154 – 28752
10	h	6853.54	I	16344 – 30931
14	h	6854.50	II	11395 – 25980
75		6856.03	II	8679 – 23261
10	h	6858.12	I	16345 – 30922
120		6860.93	I	293 – 14864
		6861.10	II	11094 – 25665
40		6862.82	II	7135 – 21702
8		6867.11	I	13814 – 28373
27	h	6872.43	II	13604 – 28151
10	h	6875.27	II	12567 – 27108
12	h	6877.10	II	10518 – 25055
14		6879.50	I	17194 – 31726
27	h	6885.16	II	12790 – 27310
17	h	6887.42	II	7524 – 22039
10		6900.28	II	10874 – 25361
10		6904.51	II	13777 – 28256
17		6906.22	I	17270 – 31746
14		6909.81	II	12842 – 27310
13	d	6918.78	I	13542 – 27992
		6919.03	I	18119 – 32568
16		6927.03	II	9410 – 23842
12		6929.60	II	11659 – 26086
16		6930.41	II	10960 – 25385
16		6941.56	II	10181 – 24583
12		6949.23	II	
30		6950.51	II	8046 – 22429
120		6955.29	II	10214 – 24588
9		6958.97	II	16615 – 30981
16		6968.65	II	9407 – 23753
13		6984.16	II	11047 – 25361
13		6988.36	I	16392 – 30698
13		6993.40	II	13777 – 28072
90		7020.44	II	9407 – 23647
13		7036.73	II	15897 – 30104
90		7039.22	II	8046 – 22248
90		7042.24	II	8679 – 22875

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
13		7049.15	II	10873 – 25055
90		7051.52	II	7525 – 21702
16		7054.97	II	11395 – 25566
19		7074.67	I	14365 – 28496
90		7082.37	II	7135 – 21251
40	d	7085.52	II	8679 – 22789
26		7088.30	I	812 – 14916
16		7091.16	I	4021 – 18119
30		7095.50	I	1490 – 15579
16		7096.33	I	293 – 14380
30		7104.54	I	2273 – 16345
19		7106.23	I	3125 – 17194
26		7115.96	I	15418 – 29467
23		7117.51	II	14193 – 28239
26	h	7119.81	II	12045 – 26086
12		7122.40	II	14115 – 28151
23	h	7125.11	II	12790 – 26821
13		7131.80	I	1490 – 15507
10		7136.01	I	15617 – 29627
12		7139.39	II	15243 – 29246
40	d	7143.98	II	8046 – 22040
85	d	7149.60	II	7525 – 21508
10		7172.67	I	2273 – 16211
10		7189.57	II	14667 – 28573
9		7210.95	I	13542 – 27406
23		7213.82	I	2273 – 16132
26	d	7218.09	II	10371 – 24221
13		7220.07	I	16345 – 30191
13		7237.02	II	12232 – 26046
60		7240.90	II	11791 – 25598
9		7257.11	II	12790 – 26566
9	d	7261.52	II	11798 – 25565
13		7279.25	I	3125 – 16859
26		7281.47	II	10960 – 24690
8		7282.21	I	17194 – 30922
19		7283.33	II	14667 – 28394
16		7288.92	II	12790 – 26506
13		7290.23	I	14591 – 28305
26	h	7300.72	II	15897 – 29591
13		7327.08	II	11659 – 25304
13		7332.65	I	4021 – 17655
8		7338.04	I	13542 – 27166
26		7347.30	I	18119 – 31726
26		7376.69	II	12045 – 25598
13		7393.98	II	12045 – 25565
30		7444.56	I	19138 – 32567
26		7445.41	I	18298 – 31725
26	d	7453.03	II	12567 – 25980
13		7470.76	I	13814 – 27196
26		7481.99	II	13466 – 26828
23	h	7502.39	II	8579 – 21904
10	h	7517.00	II	14193 – 27492
23	h	7541.42	II	12790 – 26046
9		7544.74	I	17504 – 30755
10		7546.57	I	15617 – 28864
12	h	7560.03	II	13604 – 26828
19		7562.94	II	10743 – 23962
23		7570.95	II	12842 – 26046
23		7572.29	II	15242 – 28445
19		7578.09	II	14504 – 27696
30		7585.85	II	14085 – 27263
23		7588.31	II	11047 – 24221
10		7598.01	I	18350 – 31508
23	d	7607.48	II	10518 – 23659
		7607.74	I	15567 – 28708
12		7613.94	II	11799 – 24929
10	h	7631.77	II	15897 – 28997
23		7637.94	II	10874 – 23962
45		7645.09	II	8579 – 21655
12		7645.82	I	13095 – 26171
19		7648.02	II	12232 – 25304
10		7655.78	II	12988 – 26046
19		7667.20	II	13466 – 26506
8		7672.49	II	11659 – 24689
10	h	7678.79	II	9410 – 22429
10	h	7695.78	I	20211 – 33202
23		7712.04	II	14667 – 27631
30		7728.56	II	13604 – 26540
30		7736.26	II	11659 – 24582
30		7749.30	II	13604 – 26506
23		7755.20	II	11799 – 24690
10		7794.50	I	16211 – 29037
10		7801.54	I	12445 – 25259
8	h	7812.75	II	14084 – 26880
16		7820.15	II	11799 – 24583
10		7831.40	II	14115 – 26880
40	w	7835.08	II	14504 – 27263
26		7837.27	II	12842 – 25598
10		7844.82	II	14085 – 26828
6		7859.53	I	19006 – 31726
19		7863.65	II	14115 – 26828
10	h	7880.01	II	11155 – 23842
16		7895.96	I	16891 – 29552
26		7914.96	II	11799 – 24430
90		7928.14	II	12988 – 25598
9		7931.92	I	17587 – 30191
19		7937.09	II	12790 – 25385
16		7948.12	II	12988 – 25566
19	w	8001.61	II	9410 – 21904
19	w	8014.92	II	13466 – 25940
23		8025.12	II	12232 – 24690
23	w	8026.32	II	14085 – 26540
16		8032.03	II	11395 – 23842
40		8048.70	II	14085 – 26506
16		8065.16	I	11406 – 23802
45		8068.46	II	14115 – 26506
9	w	8117.16	II	12988 – 25304
9		8125.12	II	10874 – 23177
26		8161.82	II	17391 – 29640
19	w	8195.50	II	13466 – 25665
6		8206.30	II	11659 – 23842
26	w	8218.76	II	11799 – 23962
9		8230.33	I	21055 – 33202
16		8240.98	II	13466 – 25598
19	w	8289.26	II	13604 – 25665
10		8300.88	II	11799 – 23842
40	w	8305.79	II	14504 – 26540
10		8315.45	I	12445 – 24467
19	w	8348.68	II	12842 – 24816
19		8383.71	I	11877 – 23802
19		8387.77	II	13466 – 25385
30	w	8432.64	II	14085 – 25940
19	w	8473.54	II	12790 – 24588
45	w	8485.99	II	13604 – 25385
30	w	8510.90	II	12842 – 24588
23		8543.22	II	12988 – 24690
23	w	8617.03	II	12045 – 23647
23	w	8632.82	II	14085 – 25665
12	w	8677.81	II	12232 – 23752
13		8706.32	II	14115 – 25598

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
45 w	8708.43	II	11395 – 22875	26	8859.76	II	10371 – 21655
30 w	8717.89	II	12790 – 24257	95	8913.66	II	12045 – 23261
30 w	8758.28	II	12232 – 23647				
16 w	8780.59	II	10518 – 21904				
23 w	8788.83	II	10874 – 22248				

Scandium

Sc, $Z=21$, $M=44.9559$, Ratio $\frac{Sc}{Cu}=0.707$

Sc I Normal state of valence electrons $3d4s^2\ ^2D_{1\ 1/2}=0$. I.P. $=52920$ cm^{-1}.
Sc II Normal state of valence electrons $3d4s\ ^3D_1=0$. I.P. $=103240$ cm^{-1}.
Sc III Normal state of valence electrons $3d\ ^2D_{1\ 1/2}=0$. I.P. $=199677$ cm^{-1}.

References

Wavelengths:

A. Gatterer and J. Junkes, Spektren der Seltenen Erden (Specola Vaticana, Vatican, 1945), below 7000 Å.
G. R. Harrison, Massachusetts Institute of Technology Wavelength Tables (John Wiley & Sons, New York, 1939), above 7000 Å.
The last five lines in the table are observed for the first time on our plates.

Classification:

Sc I and Sc II, H. N. Russell and W. F. Meggers, Sci. Papers NBS **22**, 329 (1927)

Molecular Spectra:

ScO, W. F. Meggers, and J. A. Wheeler, J. Research NBS **6**, 239 (1931) RP 273.

Strong lines of scandium

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
28000	3613.84	II	178 – 27841	9900	3576.35	II	68 – 28021
23000	3911.81	I	168 – 25725	7700	3580.94	II	0 – 27918
20000	3630.75	II	68 – 27602	6600	3372.15	II	178 – 29824
20000	3907.49	I	0 – 25585	6600	3558.55	II	68 – 28161
20000	4020.40	I	0 – 24866	6600	3645.31	II	178 – 27602
20000	4023.69	I	168 – 25014	6100	3567.70	II	0 – 28021
15000	4246.83	II	2541 – 26081	6100	4082.40	I	168 – 24657
13000	3572.53	II	178 – 28161	5500	3273.63	I	168 – 30707
13000	3642.79	II	0 – 27444	5500	3996.61	I	0 – 25014
9900	3353.73	II	2541 – 32350	5500	4054.55	I	0 – 24657

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
65		2429.16	I	
110		2438.62	I	
560		2545.22	II	68 – 39345
2900		2552.37	II	178 – 39345
560		2555.82	II	0 – 39114
2300		2560.25	II	68 – 39114
1100		2563.21	II	0 – 39002
40		2611.22	II	26081 – 64366
19		2684.23	II	39345 – 76588
120		2692.78	I	0 – 37126
60		2699.11	III	25537 – 62576
360		2706.77	I	0 – 36934
210		2707.95	I	168 – 37086
580		2711.35	I	168 – 37040
30		2819.54	II	27918 – 63374
35		2822.15	II	28021 – 63444
60		2826.68	II	28161 – 63528
340		2965.86	I	0 – 33707
1200		2974.01	I	0 – 33615
1400		2980.75	I	168 – 33707
340		2988.95	I	168 – 33615
2200		3015.36	I	0 – 33154
2700		3019.34	I	168 – 33279
360		3030.76	I	168 – 33154
30		3039.93	II	32350 – 65236
70		3045.72	II	27444 – 60267
85		3052.93	II	27602 – 60348
120	h	3056.31	I	
130		3065.11	II	27841 – 60457
45		3139.75	II	28161 – 60002
990		3251.32	II	68 – 30816
1500		3255.69	I	0 – 30707
4400		3269.91	I	0 – 30573
5500		3273.63	I	168 – 30707
110	d	3343.28	II	27841 – 57743
270		3352.05	II	0 – 29824
9900		3353.73	II	2541 – 32350
65	d	3357.30	II	
2000		3359.68	II	68 – 29824
1700		3361.27	II	0 – 29742
1700		3361.94	II	0 – 29736
4000		3368.95	II	68 – 29742
6600		3372.15	II	178 – 29824
90		3416.68	I	15757 – 45016
130		3418.51	I	15882 – 45126
65		3419.36	I	15673 – 44910
200		3429.21	I	15757 – 44910
200		3429.48	I	15673 – 44823
270		3431.36	I	15882 – 45016
530		3435.56	I	16027 – 45126
90		3439.41	I	15757 – 44823
65		3440.18	I	
65		3448.49	I	16027 – 45016
270		3457.45	I	16211 – 45126
180		3462.19	I	16141 – 45016
130	d	3469.65	I	16010 – 44823
110		3471.13	I	16022 – 44823
200		3498.91	I	16027 – 44599
2700		3535.73	II	2541 – 30816
6600		3558.55	II	68 – 28161
6100		3567.70	II	0 – 28021
13000		3572.53	II	178 – 28161
9900		3576.35	II	68 – 28021
7700		3580.94	II	0 – 27918
4000		3589.64	II	68 – 27918
4000		3590.48	II	178 – 28021
28000		3613.84	II	178 – 27841
110		3617.43	I	
20000		3630.75	II	68 – 27602
13000		3642.79	II	0 – 27444
6600		3645.31	II	178 – 27602
110		3646.90	I	
5300		3651.80	II	68 – 27444
110		3664.25	II	2541 – 29824
290		3666.54	II	178 – 27444
55		3675.26	II	2541 – 29742
40		3678.35	II	32350 – 59528
75	h	3717.10	I	
270		3833.07	II	0 – 26081
610		3843.03	II	68 – 26081
90		3894.97	I	
20000		3907.49	I	0 – 25585
23000		3911.81	I	168 – 25725
45		3923.51	II	2541 – 28021
4400		3933.38	I	168 – 25585
45		3952.27	I	16210 – 41505
45		3989.06	II	2541 – 27602
5500		3996.61	I	0 – 25014
530		4014.49	II	2541 – 27444
20000		4020.40	I	0 – 24866
20000		4023.69	I	168 – 25014
220		4030.67	I	16023 – 40826
140		4031.39	I	15757 – 40555
100		4034.23	I	16022 – 40803
220		4043.80	I	15882 – 40604
200		4046.48	I	16097 – 40803
2700		4047.79	I	168 – 24866
120		4049.95	I	16141 – 40826
5500		4054.55	I	0 – 24657
220		4056.59	I	16027 – 40671
160	h	4074.97	I	16022 – 40555
160		4078.57	I	16010 – 40521
6100		4082.40	I	168 – 24657
200		4086.67	I	16141 – 40604
400		4087.16	I	16211 – 40671
40	h	4093.13	I	16097 – 40521
65		4094.85	I	16141 – 40555
55	h	4098.35	I	16211 – 40604
65		4100.33	I	15042 – 39424
440	h	4133.00	I	15673 – 39861
530	h	4140.30	I	15757 – 39903
65	h	4147.40	I	15757 – 39861
720		4152.36	I	15882 – 39958
55	h	4154.72		
90	hd	4161.88	I	15882 – 39903
1100	h	4165.19	I	16027 – 40028
65	h	4171.56	I	15757 – 39722
45	h	4186.45	I	16022 – 39902
65	h	4187.62	I	15882 – 39755
75		4205.20	I	16027 – 39800
65		4212.34	I	16022 – 39755
45		4212.49	I	16023 – 39755
75	h	4216.10	I	16010 – 39722
110	h	4218.26	I	16022 – 39722
110	h	4219.73	I	16010 – 39701
40		4221.88	I	16022 – 39701
90	d	4225.59	I	16141 – 39800
180		4231.93	I	
200		4233.61	I	16141 – 39755
100		4237.82	I	

559-795 O - 75 - 18 (Pt. 1)

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
400		4238.05	I	16211 – 39800
90		4239.57	I	16141 – 39722
100		4246.12	I	16211 – 39755
15000		4246.83	II	2541 – 26081
55		4283.56		
290		4294.77	II	4883 – 28161
350		4305.71	II	4803 – 28021
4200		4314.09	II	4988 – 28161
3300		4320.74	II	4883 – 28021
2400		4325.01	II	4803 – 27918
28		4348.53	I	15882 – 38872
180		4354.61	II	4883 – 27841
110		4358.64	I	16023 – 38959
55		4359.08	I	18571 – 41505
28		4364.92	I	18571 – 41474
2000		4374.46	II	4988 – 27841
130		4384.81	II	4803 – 27602
45	h	4389.60	I	16097 – 38872
1100		4400.37	II	4883 – 27602
880		4415.56	II	4803 – 27444
28		4420.66	II	4988 – 27602
45		4431.36	II	4883 – 27444
65		4542.55	I	14926 – 36934
90		4544.68	I	15042 – 37040
120	h	4557.24	I	21400 – 43337
160	h	4573.99	I	21480 – 43337
65	h	4592.94	I	21400 – 43167
65	h	4598.45	I	21480 – 43221
55	h	4604.72	I	
45		4609.53	I	
45		4609.95	I	21480 – 43167
350		4670.40	II	10945 – 32350
40	h	4680.49	I	
50		4698.29	II	4803 – 26081
120		4706.97	I	18516 – 39755
120		4709.34	I	18571 – 39800
200		4728.77	I	11610 – 32752
490		4729.23	I	11558 – 32697
40	h	4732.30	I	16023 – 37148
590		4734.10	I	11520 – 32637
60		4735.08		
690		4737.65	I	11558 – 32659
790		4741.02	I	11610 – 32697
1200		4743.81	I	11677 – 32752
200		4753.16	I	0 – 21033
220		4779.35	I	168 – 21086
90		4791.50	I	168 – 21033
100		4827.28	I	17948 – 38658
100		4833.67	I	17919 – 38602
170		4839.44	I	18000 – 38658
40		4840.47	I	17948 – 38602
80		4847.68	I	17948 – 38571
80		4852.68	I	18000 – 38602
140	bld	4857.79	ScO	
		4858.09	ScO	
80		4906.67	I	16141 – 36516
90		4909.76	I	16211 – 36573
90		4922.84	I	16023 – 36330
90		4934.25	I	17919 – 38180
45		4935.74	I	16022 – 36277
70		4941.33	I	17948 – 38180
170		4954.06	I	18000 – 38180
120		4973.66	I	17025 – 37126
150		4980.37	I	I7013 – 37086
80		4983.45	I	I7025 – 37086
140		4991.92	I	17013 – 37040
80		5018.39	I	17013 – 36934
70		5020.14	I	
80		5021.51	I	17025 – 36934
530		5031.02	II	10945 – 30816
55		5032.74	I	
250		5064.32	I	11610 – 31351
80		5068.86	I	16023 – 35746
530		5070.23	I	11558 – 31275
250		5075.81	I	11520 – 31216
2100		5081.56	I	11677 – 31351
1200		5083.72	I	11610 – 31275
1100		5085.55	I	11558 – 31216
750		5086.95	I	11520 – 31173
390		5087.14	I	20237 – 39889
270		5089.89	I	20240 – 39881
45		5092.46	I	
390		5096.73	I	11558 – 31173
620		5099.23	I	11610 – 31216
370		5101.12	I	11677 – 31275
180		5109.06	I	17918 – 37486
150		5112.86	I	18000 – 37553
320		5116.69	I	17947 – 37486
70	b	5133.68	ScO	
45	b	5171.06	ScO	
390		5210.52	I	20237 – 39424
45		5211.28	I	20239 – 39423
280		5219.67	I	20240 – 39392
350		5239.82	II	11736 – 30816
280		5258.33	I	20237 – 39249
35		5284.97	I	20237 – 39153
210		5285.76	I	20240 – 39153
35		5301.94	I	0 – 18856
22		5318.35	II	10945 – 29742
70		5331.77	I	15673 – 34423
14		5334.23	II	12074 – 30816
95		5339.41	I	15757 – 34480
120		5341.05	I	15673 – 34390
95		5342.96	I	0 – 18711
350		5349.30	I	14926 – 33615
120		5349.71	I	168 – 18856
60		5350.30	I	15882 – 34567
210		5355.75	I	15757 – 34423
530		5356.10	I	15042 – 33707
14		5357.19	II	12154 – 30816
270		5375.35	I	15882 – 34480
370		5392.08	I	16027 – 34567
45		5416.12	I	16022 – 34480
45		5425.57	I	16141 – 34567
45		5429.41	I	16010 – 34423
35		5432.94	I	16022 – 34423
55		5433.23	I	16023 – 34423
45		5438.22	I	16097 – 34480
55		5439.03	I	16010 – 34390
55	h	5442.60	I	16022 – 34390
270		5446.20	I	16211 – 34567
18		5447.39	I	14926 – 33279
120		5451.34	I	16141 – 34480
30		5455.21	I	16097 – 34423
18		5465.20	I	18856 – 37148
55		5468.40	I	16141 – 34423
60		5472.19	I	16211 – 34480
I8		5474.64	I	
750		5481.99	I	15042 – 33279
530		5484.62	I	14926 – 33154

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
570		5514.22	I	14926 – 33056
16		5515.39	I	15673 – 33799
660		5520.50	I	15042 – 33151
45		5526.06	I	15673 – 33764
660		5526.82	II	14261 – 32350
55		5541.04	I	15757 – 33799
30		5546.40	I	15882 – 33906
18		5550.40	I	18504 – 36516
5		5552.25	II	11736 – 29742
35		5553.59	I	18571 – 36573
16		5561.10	I	18516 – 36493
70		5564.86	I	15882 – 33847
18		5571.24	I	18571 – 36516
14		5579.76	I	15882 – 33799
110		5591.33	I	16027 – 33906
35	h	5593.38	I	21086 – 38959
22		5604.19	I	21033 – 38872
22		5631.02	I	16010 – 33764
80		5640.98	II	12101 – 29824
45		5646.36	I	16141 – 33847
16		5647.60	I	16097 – 33799
55		5649.56	I	16211 – 33906
250		5657.88	II	12154 – 29824
60		5658.34	II	12074 – 29742
55		5667.16	II	12101 – 29742
70		5669.04	II	12101 – 29736
1500		5671.81	I	11677 – 29304
95		5684.20	II	12154 – 29742
1200		5686.84	I	11610 – 29190
1100		5700.21	I	11558 – 29096
190		5708.61	I	11677 – 29190
880		5711.75	I	11520 – 29023
230		5717.28	I	11610 – 29096
180		5724.08	I	11558 – 29023
55	bl	5736.85	Sc O	
55	bl	5764.45	Sc O	
95	bl	5772.74	Sc O	
55	bl	5775.32	Sc O	
70	bl	5809.84	Sc O	
70	bl	5811.60	Sc O	
95	bl	5847.73	Sc O	
70	bl	5849.07	Sc O	
70	b	5887.38	Sc O	
35	bl	5918.04	Sc O	
30		5919.11	I	18856 – 35746
60	bl	5928.10	Sc O	
35		5961.49	I	21086 – 37856
60	bl	5968.25	Sc O	
35		5969.19	I	21033 – 37781
90		5988.42	I	17013 – 33707
160	bl	6017.07	Sc O	
60		6026.18	I	17025 – 33615
620	bl	6036.17	Sc O	
490	bl	6064.31	Sc O	
440	bl	6072.65	Sc O	
620	bl	6079.30	Sc O	
320	bl	6101.87	Sc O	
370	bl	6109.93	Sc O	
370	bl	6115.97	Sc O	
180	b	6148.70	Sc O	
150	b	6153.93	Sc O	
150	b	6188.09	Sc O	
150	b	6192.90	Sc O	
620		6210.68	I	0 – 16097
90		6239.41	I	0 – 16023
320		6239.78	I	0 – 16022
120		6245.63	II	12154 – 28161
110		6249.96	I	18571 – 34567
250		6258.96	I	168 – 16141
60		6262.25	I	18516 – 34480
55		6276.31	I	168 – 16097
45		6279.76	II	12101 – 28021
18		6300.70	II	12154 – 28021
750		6305.67	I	168 – 16023
26		6309.90	II	12074 – 27918
16		6320.85	II	12101 – 27918
26		6344.83	I	0 – 15757
60		6378.82	I	0 – 15673
55	bl	6408.41	Sc O	
90		6413.35	I	168 – 15757
26	b	6437.08	Sc O	
55	bl	6446.24	Sc O	
26	b	6457.78	Sc O	
35	b	6485.40	Sc O	
26	b	6495.90	Sc O	
55	b	6525.62	Sc O	
22	b	6535.30	Sc O	
45	b	6557.84	Sc O	
35	b	6566.88	Sc O	
18	b	6575.85	Sc O	
60		6604.60	II	10945 – 26081
26	bl	6609.99	Sc O	
18	bl	6617.94	Sc O	
18	bl	6645.08	Sc O	
22	bl	6654.42	Sc O	
26	bl	6661.01	Sc O	
18	b	6700.48	Sc O	
18	b	6705.93	Sc O	
65		6737.87	I	
35		6739.40	I	
35		6817.08	I	
50		6819.52	I	21086 – 35746
29		6829.54	I	21033 – 35671
50		6835.03	I	
5	b	6963.12	Sc O	
5	bl	6990.68	Sc O	
5	bl	7025.72	Sc O	
8	b	7035.77	Sc O	
5	b	7072.37	Sc O	
5	b	7094.38	Sc O	
12	h	7138.14	I	24866 – 38872
14		7169.13	I	25014 – 38959
12		7257.57	I	31351 – 45126
8		7275.57	I	31275 – 45016
3	h	7300.62	I	31216 – 44910
12	h	7524.13	I	25585 – 38872
14	h	7553.96	I	25725 – 38959
15	h	7574.44	I	24657 – 37856
11		7617.45	I	24657 – 37781
14	h	7665.72	I	20237 – 33279
30		7697.73	I	25585 – 38572
18		7729.72	I	25725 – 38658
55	h	7741.17	I	20237 – 33151
5	h	7750.37	I	29023 – 41922
5		7752.72	I	29190 – 42085
6	h	7771.06	I	29096 – 41961
15		7785.17	I	25014 – 37856
8		7794.68	I	29190 – 42016
30		7800.44	I	20240 – 33056
11		7821.64	I	29304 – 42085

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
11	h	8196.98	I	25585 – 37781	15	h	8823.8	I	
15		8241.13	I	25725 – 37856	30	h	8834.35	I	25014 – 36330
19	h	8761.40	I	24866 – 36277					
11	h	8774.8							
15	h	8794.72	I	29304 – 40671					

Selenium

Se, $Z = 34$, $M = 78.9$, Ratio $\frac{\text{Se}}{\text{Cu}} = 1.243$

Se I Normal state of valence electrons $4s^2 4p^4\ {}^3P_2 = 0$. I.P. $= 78658$ cm^{-1}.
Se II Normal state of valence electrons $4s^2 4p^3\ {}^4S^\circ_{1\ 1/2} = 0$. I.P. $= 171000$ cm^{-1}.

References

Wavelengths and Classification:
Se I, J. E. Ruedy and R. C. Gibbs, Phys. Rev. **46**, 880 (1934).

Selenium—all observed lines

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
90000	1960.26	I	0 – 50997	50	8918.80	I	48182 – 59391
40000	2039.85	I	1989 – 50997				
11000	2062.79	I	2534 – 50997				
2000	2074.79	I	0 – 48182				

Silicon

Si, $Z=14$, $M=28.086$ Ratio $\frac{\text{Si}}{\text{Cu}}=0.442$

Si I Normal state of valence electrons $3s^2 3p^2\ {}^3P_0=0$. I.P. = 65747 cm^{-1}.
Si II Normal state of valence electrons $3s^2 3p\ {}^2P^\circ_{1/2}=0$. I.P. = 131838 cm^{-1}.

References

Wavelengths and Classification:
L. J. Radziemski, Jr. and K. L. Andrew, J. Opt. Soc. Am. **55**, 474 (1965).

Silicon—all observed lines

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
2200	2124.12	I	6299 – 53362	1200	2519.20	I	77 – 39760
300	2207.98	I	0 – 45276	2400	2524.11	I	77 – 39683
300	2210.89	I	77 – 45294				
480	2216.67	I	223 – 45322	2000	2528.51	I	223 – 39760
320	2435.15	I	6299 – 47352	240	2631.28	I	15394 – 53387
1700	2506.90	I	77 – 39955	2600	2881.58	I	6299 – 40992
1600	2514.32	I	0 – 39760	150	2987.65	I	6299 – 39760
3600	2516.11	I	223 – 39955	110	3905.52	I	15394 – 40992

Silver

Ag, $Z=47$, $M=107.868$, Ratio $\frac{\text{Ag}}{\text{Cu}}=1.697$

Ag I Normal state of valence electrons $4d^{10}5s\ ^2S_{1/2}=0$. I.P.= 61106 cm^{-1}.
Ag II Normal state of valence electrons $4d^{10}\ ^1S_0.=0$. I.P.=173300 cm^{-1}.

References

Wavelengths:
G. R. Harrison, Massachusetts Institute of Technology Wavelength Tables (John Wiley & Sons, New York, 1939).

Classification:
Ag I, A. G. Shenstone, Phys. Rev. **57**, 894 (1940).
Ag II, A. G. Shenstone, Phys. Rev. **31**, 317 (1928).

Silver—all observed lines

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
80	2331.37	II	40741 – 83621	50 hl	4476.08	I	29552 – 51887
150	2413.18	II	40741 – 82168	60 hl	4668.48	I	30473 – 51887
90	2437.79	II	39164 – 80172				
30	2447.93	II	46046 – 86884	1000	5209.07	I	29552 – 48744
60	2721.77	I	30242 – 66972	1000	5465.49	I	30473 – 48764
55000	3280.68	I	0 – 30473	100	5471.55	I	30473 – 48744
28000	3382.89	I	0 – 29552	320	7687.78	I	29552 – 42556
90 hs	4210.94	I	30473 – 54214	500	8273.52	I	30473 – 42556

Sodium

$$\text{Na, } Z = 11,\ M = 22.9898,\ \text{Ratio } \frac{\text{Na}}{\text{Cu}} = 0.3618$$

Na I Normal state of valence electrons $2p^6 3s\ ^2S_{1/2} = 0$. I.P. $= 41449\ \text{cm}^{-1}$.
Na II Normal state of valence electrons $2p^6\ ^1S_0 = 0$. I.P. $= 381528\ \text{cm}^{-1}$.

References

Wavelengths and Classification:
P. Risberg, Ark. for Fysik **10**, 583 (1956).

Sodium—all observed lines

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
300		3302.37	I	0 – 30273	20000		5889.95	I	0 – 16973
150		3302.98	I	0 – 30267	10000		5895.92	I	0 – 16956
10	l	5148.84	I	16956 – 36373	30	l	6154.23	I	16956 – 33201
20	l	5153.40	I	16973 – 36373	60	l	6160.75	I	16973 – 33201
70	l	5682.63	I	16956 – 34549	1100		8183.26	I	16956 – 29173
140	l	5688.20	I	16973 – 34549	2200		8194.82	I	16973 – 29173

Strontium

$$\text{Sr},\ Z = 38,\ M = 87.62,\ \text{Ratio}\ \frac{\text{Sr}}{\text{Cu}} = 1.379$$

Sr I Normal state of valence electrons $4p^6 5s^2\ {}^1S_0 = 0$. I.P. = 45932 cm^{-1}.
Sr II Normal state of valence electrons $4p^6 5s\ {}^2S_{1/2} = 0$. I.P. = 88964 cm^{-1}.

References

Wavelengths:
G. R. Harrison, Massachusetts Institute of Technology Wavelength Tables (John Wiley & Sons, New York, 1939).

Classification:
Sr I, F. J. Sullivan, Univ. of Pittsburgh Bull. **35**, 1 (1938).
Sr II, F. A. Saunders, E. G. Schneider and E. Buckingham, Proc. Nat. Acad. Sci. U.S. **20**, 291 (1934).

Strontium—all observed lines

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
1400		2152.84	II	14556 – 60992
1400		2165.96	II	14836 – 60992
16		2428.10	I	0 – 41172
12		2569.47	I	0 – 38907
20		2931.83	I	0 – 34098
30		3301.73	I	14318 – 44596
30		3329.99	I	14504 – 44526
40		3351.25	I	14899 – 44730
30		3366.33	I	14899 – 44596
650		3380.71	II	23715 – 53286
950		3464.46	II	24517 – 53373
120		3474.89	II	24517 – 53286
30	h	3940.80	I	14318 – 39686
60		3969.26	I	14504 – 39691
30		3970.04	I	14504 – 39686
130		4030.38	I	14899 – 39703
30		4032.38	I	14899 – 39691
46000		4077.71	II	0 – 24517
200		4161.80	II	23715 – 47737
32000		4215.52	II	0 – 23715
340		4305.45	II	24517 – 47737
35	h	4438.04	I	14899 – 37425
6500		4607.33	I	0 – 21698
320		4722.28	I	14504 – 35675
220		4741.92	I	14318 – 35400
140		4784.32	I	14504 – 35400
480		4811.88	I	14899 – 35675
360		4832.08	I	14504 – 35194
			I	14318 – 35007
50		4855.04	I	18159 – 38750
60		4868.70	I	18219 – 38752
300		4872.49	I	14504 – 35022
60		4876.06	I	14504 – 35007
200		4876.32	I	14899 – 35400
100		4891.98	I	18319 – 38755
800		4962.26	I	14899 – 35045
130		4967.94	I	14899 – 35022
80	h	5156.07	I	20150 – 39539
140		5222.20	I	18159 – 37302
200		5225.11	I	18159 – 37292
200		5229.27	I	18219 – 37336
280		5238.55	I	18219 – 37302
480		5256.90	I	18319 – 37336
35	h	5329.82	I	20150 – 38907
150		5450.84	I	18219 – 36560
700		5480.84	I	18319 – 36560
110		5486.12	I	18159 – 36382
350		5504.17	I	18219 – 36382
260		5521.83	I	18159 – 36264
200		5534.81	I	18319 – 36382
200		5540.05	I	18219 – 36264
25	h	5543.36	I	21698 – 39733
20	h	5970.10	I	21698 – 38444
25	h	6345.75	I	18219 – 33973
25	h	6363.94	I	18159 – 33868
35	h	6369.96	I	18159 – 33853
100		6380.75	I	18159 – 33827
90	h	6386.50	I	18319 – 33973
60	h	6388.24	I	18219 – 33868
900		6408.47	I	18319 – 33919
25		6446.68	I	18319 – 33827
25	h	6465.79	I	21698 – 37160
550		6504.00	I	18219 – 33590
100		6546.79	I	18319 – 33590
170		6550.26	I	21698 – 36961
300		6617.26	I	18159 – 33267
80		6643.54	I	18219 – 33267
180		6791.05	I	14318 – 29039
480		6878.38	I	14504 – 29039
120		6892.59	I	0 – 14503
550		7070.10	I	14899 – 29039
6		7153.09	I	21698 – 35675
25	h	7167.24	I	20150 – 34098
20		7232.27	I	20150 – 33973
250		7309.41	I	20150 – 33827
50		7621.50	I	20150 – 33267
40	h	7673.06	I	21698 – 34727

Tantalum

$$\text{Ta, } Z = 73, \; M = 180.948, \; \text{Ratio } \frac{\text{Ta}}{\text{Cu}} = 2.848$$

Ta I Normal state of valence electrons $5d^3 6s^2\ {}^4F_{1\,1/2} = 0$. 1.P. = 63600 cm^{-1}.
Ta II Normal state of valence electrons $5d^3 6s\ {}^5F_1 = 0$. I.P. = 130000 cm^{-1}.

References

Wavelengths:

G. R. Harrison, Massachusetts Institute of Technology Wavelength Tables (John Wiley & Sons, New York, 1939).

C. C. Kiess, unpublished material (1961).

Classification:

Ta I, P. F. A. Klinkenberg, G. J. van den Berg, and J. C. van den Bosch, Physica **16**, 861 (1950).
G. J. van den Berg, P. F. A. Klinkenberg, and J. C. van den Bosch, Physica **18**, 221 (1952).
C. C. Kiess and H. K. Kiess, unpublished material (1961).

Ta II, C. C. Kiess, J. Res. Nat. Bur. Stand. (U.S.), **66A** (Phys. and Chem.), No. 2, 111–161 (Mar.–Apr. 1962).

Strong lines of tantalum

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
2600	2653.27	I	2010 – 39688	1400	2239.48	II	2642 – 47281
2600	2714.67	I	0 – 36826	1400	2387.06	II	4416 – 46295
2400	2400.63	II	6187 – 47830				
2400	2647.47	I	0 – 37761	1400	2608.63	I	2010 – 40333
1900	2656.61	I	0 – 37630	1200	2182.71	II	1031 – 46831
				1200	2250.76	II	1031 – 45447
1900	2850.98	I	5621 – 40686	1200 d	2526.35	I	2010 – 41581
		II	14581 – 49647		2526.45	I	3964 – 43533
1800	3012.54	II	5331 – 38516				
1700	2933.55	I	0 – 34078	1200	2559.43	I	0 – 39060
1500	2146.87	II	1031 – 47596	1200	2635.58	II	1031 – 38962
				1200	2710.13	I	3964 – 40851
1500	2196.03	II	4416 – 49938	1200	2748.78	I	3964 – 40333
1500	2199.67	II	0 – 45447	1200	2940.22	I	0 – 34001
1500	2661.34	I	5621 – 43185				
1500	2685.17	II	4125 – 41355	1100	2193.88	II	6187 – 51754
1500	2850.49	I		1100	3311.16	I	5621 – 35813
				1100	2140.13	II	
1500	2963.32	I	2010 – 35746	1000	2698.30	I	2010 – 39060
1400 d	2210.03	II	0 – 45234	1000	2758.31	I	2010 – 38253
	2210.19	II	4416 – 49647				

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
1100		2140.13	II	
1500		2146.87	II	1031 – 47596
740		2150.62	II	1031 – 47515
600		2165.01	II	0 – 46175
740		2178.03	II	3180 – 49080
1200		2182.71	II	1031 – 46831
540		2193.20	II	2642 – 48223
1100		2193.88	II	6187 – 51754
1500		2196.03	II	4416 – 49938
1500		2199.67	II	0 – 45447
500		2207.14	II	
1400	d	2210.03	II	0 – 45234
		2210.19	II	4416 – 49647
420		2215.60	II	4416 – 49536
1400		2239.48	II	2642 – 47281
240		2248.48	II	9746 – 54207
480		2249.79	II	0 – 44435
1200		2250.76	II	1031 – 45447
260		2254.86	II	3180 – 47515
440		2255.77	II	12436 – 56753
360		2256.51	II	9746 – 54048
500		2258.71	II	0 – 44259
840		2261.42	II	0 – 44206
260		2261.62	II	1031 – 45234
990		2262.30	II	2642 – 46831
220		2269.56	II	12705 – 56753
740		2271.85	II	2642 – 46646
990		2272.59	II	3180 – 47169
200		2279.85	I	
320		2282.19	II	1031 – 44835
130		2285.02	II	5331 – 49080
790		2285.25	II	2642 – 46387
600		2286.59	II	9746 – 53466
240		2287.27	II	12436 – 56142
990		2289.16	II	3180 – 46851
180		2292.54	II	0 – 43606
160		2295.18		
160		2301.47	II	12705 – 56142
440		2302.24	II	5658 – 49080
440		2302.93	II	4416 – 47825
300		2303.49	II	1031 – 44430
100		2308.46	II	5658 – 48963
440		2312.60	II	1031 – 44259
420		2315.46	II	1031 – 44206
260		2319.16	II	12436 – 55543
100		2331.29	II	11767 – 54649
690		2331.98	II	
550		2332.19	II	4416 – 47281
110		2334.13	II	
180		2334.88	II	6831 – 49647
140		2335.75	II	12705 – 55505
300		2338.28	II	6988 – 49741
200		2340.94	II	6831 – 49536
200		2341.61	II	12436 – 55128
130		2343.64	II	
100		2346.42	II	
90		2351.99	II	
170		2353.86	II	5331 – 47801
120		2355.22	II	
170		2356.05	II	9690 – 52121
140		2356.90	II	4416 – 46831
250		2357.30	I	0 – 42408
170		2359.16	II	9746 – 52121
260		2361.09	I	2010 – 44350
160		2362.78	II	
130		2363.32	II	
600		2364.24	II	6187 – 48470
50		2367.24	II	4416 – 46646
150		2369.32	II	2642 – 44835
300		2370.76	II	5658 – 47825
320		2371.58	I	3964 – 46117
			II	0 – 42153
70		2372.80	II	6831 – 48963
100		2373.94	II	10713 – 52825
70		2375.91	I	
150		2378.31	II	1031 – 43065
440		2381.13	II	2642 – 44626
240		2381.52	II	0 – 41977
170		2383.72	II	5658 – 47596
240		2384.28	II	1031 – 42960
130		2385.73	I	0 – 41902
1400		2387.06	II	4416 – 46295
80		2388.37	II	5658 – 47515
160		2389.11	II	9690 – 51534
70		2396.30	I	5621 – 47340
110		2399.15	I	
50		2399.92	II	3180 – 44835
2400		2400.63	II	6187 – 47830
140		2402.13	II	2642 – 44259
100		2403.68	II	11875 – 53466
130		2406.55	I	2010 – 43551
40		2407.57	I	2010 – 43533
130		2408.26	II	5658 – 47169
40	d	2412.53	II	14581 – 56019
		2412.67	I	
120		2414.32	I	9253 – 50660
240		2415.21	II	6831 – 48223
320		2416.89	II	2642 – 44005
80		2417.33	II	0 – 41355
220		2417.86	II	
150		2418.77	II	
140		2421.03	I	3964 – 45256
150		2421.85	II	14581 – 55859
170		2423.48	II	3180 – 44430
130		2425.91	II	12436 – 53645
360		2427.64	I	0 – 41180
60		2428.00	II	5658 – 46831
360		2429.71	II	0 – 41145
170		2431.06	II	1031 – 42153
60		2431.66	I	11796 – 52907
480		2432.70	II	6187 – 47281
130		2433.59	II	3180 – 44259
130		2436.51	II	12436 – 53466
110		2437.07	I	
90		2437.67	I	0 – 41010
110		2438.64	II	6831 – 47825
200		2439.91	I	2010 – 42983
130		2442.39	I	5621 – 46552
100		2444.13	II	2642 – 43544
90		2444.67	II	
50		2445.53	II	
100		2447.17	I	
80		2449.44	II	6988 – 47801
80		2454.21	I	9705 – 50439
100		2454.48	I	3964 – 44693
50		2454.70	II	11767 – 52493
100		2458.68	I	
100		2460.55	I	9253 – 49882
80	d	2461.06	II	10713 – 51334
160		2463.82	II	12436 – 53011

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
80		2465.26	I	5621 – 46172
130		2466.99	II	1031 – 41555
130		2467.37	II	5658 – 46175
50		2468.41	II	15851 – 56351
380		2470.90	II	6187 – 46646
120		2471.38	I	
120		2472.13	I	3964 – 44403
150		2473.13	I	3964 – 44386
120		2473.31	II	4416 – 44835
600		2474.62	I	2010 – 42408
120		2475.33	I	9759 – 50146
200		2476.67	II	3180 – 43544
150		2478.22	I	0 – 40339
80		2479.58	II	2642 – 42960
120		2481.86	II	11875 – 52156
100		2482.10	I	
100		2482.58	II	
80		2483.46	II	
100		2484.04	II	
80		2484.72	II	0 – 40234
500		2484.95	I	0 – 40230
120		2486.70	I	3964 – 44166
600		2488.70	II	4416 – 44585
500		2490.46	I	
50		2496.24	I	6069 – 46117
70		2496.64	I	12865 – 52907
50		2497.77	II	0 – 40024
90		2498.33	II	4416 – 44430
140		2501.98	II	9690 – 49647
100		2503.01	II	
600		2504.45	I	3964 – 43881
100		2505.32	II	5331 – 45234
600		2507.45	I	2010 – 41879
100		2508.92	II	9690 – 49536
100		2510.71	II	15726 – 55544
50	d	2511.69	II	
240		2512.65	I	0 – 39787
100		2513.10	II	3180 – 42960
70		2513.88	II	11767 – 51534
100		2519.78	I	6049 – 45724
140		2526.02	II	5658 – 45234
1200	d	2526.35	I	2010 – 41581
		2526.45	I	3964 – 43533
50		2531.29	I	5621 – 45115
600		2532.12	II	2642 – 42123
120		2533.00	I	
70		2534.16	I	
50		2534.47	I	9705 – 49149
120		2534.97	I	5621 – 45058
160		2537.94	II	9690 – 49080
90	d	2542.23	I	10690 – 50014
		2542.35	II	11875 – 51197
50		2544.27	I	
		2544.37	II	12831 – 52121
240		2545.49	II	1031 – 40305
240		2546.80	I	0 – 39253
140		2549.38	I	3964 – 43177
460	d	2551.07	I	2010 – 41198
		2551.19	I	5621 – 44807
140		2551.73	II	5658 – 44835
70		2553.18	II	
460		2554.62	II	2642 – 41775
120		2554.91	II	4416 – 43544
240		2555.05	I	3964 – 43090
140		2556.51	II	5331 – 44435
180		2557.71	II	9690 – 48776
1200		2559.43	I	0 – 39060
180		2560.68	I	
460		2562.10	I	3964 – 42983
80		2563.33	I	2010 – 41010
140		2563.70	I	0 – 38994
120		2569.13	II	2642 – 41555
340		2571.51	II	5331 – 44206
430		2573.54	I	0 – 38845
390		2573.79	I	2010 – 40852
150		2574.38	I	9976 – 48809
150		2575.47	I	9253 – 48070
600		2577.37	II	11099 – 49887
340		2577.78	I	5621 – 44403
70		2578.24	II	12705 – 51480
100		2579.62	I	0 – 38754
210		2580.16	I	2010 – 40756
35		2581.60	II	9746 – 48470
340		2584.03	II	
140		2584.49	II	13475 – 52156
150		2584.69	I	9253 – 47931
100		2585.61	I	9705 – 48369
35		2588.88	II	6831 – 45447
75		2589.81	II	5658 – 44259
21		2590.20	II	13560 – 52156
70	d	2592.44	I	
		2592.53	II	13560 – 52121
430		2593.08	I	5621 – 44174
410		2593.66	II	4416 – 42960
310		2594.25	II	0 – 38535
560		2595.26	I	5621 – 44141
120		2595.59	II	0 – 38516
85		2596.12	I	0 – 38508
310	l	2596.45	II	2642 – 41145
60		2596.61	I	
100		2598.21	II	
45		2598.75	I	6049 – 44518
220		2600.14	I	0 – 38448
70		2600.73	II	6187 – 44626
140		2601.06	I	6049 – 44484
85		2602.38	I	6069 – 44484
600		2603.49	II	6187 – 44585
60		2603.82	I	9976 – 48369
60		2605.32	I	9253 – 47625
70		2606.43	II	15851 – 54206
120		2607.84	II	
50		2608.20	I	2010 – 40339
1400		2608.63	I	2010 – 40333
210		2609.00	I	6069 – 44386
35		2610.13	I	6049 – 44350
310	d	2611.34	I	3964 – 42247
		2611.46	I	6068 – 44350
110		2612.61	II	1031 – 39296
70		2615.25	I	9705 – 47931
340		2615.46	I	9705 – 47928
310		2615.66	I	2010 – 40230
50		2620.18	I	
170		2624.12	I	6049 – 44146
85		2625.46	I	6069 – 44146
45		2627.43	I	
70		2628.85	II	18494 – 56522
75		2630.53	II	6831 – 44835
100		2632.27	II	
85		2633.79	II	18494 – 56451
1200		2635.58	II	1031 – 38962

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
70		2635.93	I	2010 – 39936
50		2636.37	I	9705 – 47625
470		2636.67	I	3964 – 41879
860		2636.90	I	5621 – 43533
50		2637.93	II	0 – 37897
85		2638.67	II	5658 – 43544
50		2639.19	II	11767 – 49647
170		2643.89	I	6069 – 43880
120		2644.60	II	2642 – 40444
120		2645.10	II	6831 – 44626
510		2646.22	I	10690 – 48468
600		2646.37	I	2010 – 39787
150	d	2646.74	II	11875 – 49647
		2646.89	II	11767 – 49536
2400		2647.47	I	0 – 37761
50		2650.02	I	
70		2650.28	I	9253 – 46974
270		2651.22	II	4416 – 42123
45		2652.32	I	9705 – 47397
2600		2653.27	I	2010 – 39688
21		2654.01	I	
35		2655.68	I	
45		2656.08	I	
1900		2656.61	I	0 – 37630
70		2657.30	I	3964 – 41585
50		2658.14	II	
120		2658.86	II	6831 – 44430
85		2659.41	II	2642 – 40234
35		2659.66	I	
1500		2661.34	I	5621 – 43185
150		2661.89	I	5621 – 43177
130		2662.10	I	
26		2663.88	II	14628 – 52156
50		2664.24	II	17982 – 55505
220		2665.60	II	1031 – 38535
35		2665.94	I	
45		2667.00	II	1031 – 38516
50		2667.17	I	6069 – 43551
220		2668.07	I	5621 – 43090
600		2668.62	I	0 – 37461
150		2669.58	II	24870 – 62318
100		2671.63	I	10950 – 48369
100		2672.50	II	5658 – 43065
50		2674.18	II	15851 – 53235
35		2674.49	I	10690 – 48070
770		2675.90	II	4416 – 41775
50		2676.48	II	10713 – 48064
70		2678.80	II	18186 – 55505
270		2680.06	II	5658 – 42960
220		2680.66	II	4416 – 41709
26		2681.63	I	12865 – 50145
110		2681.87	I	
600		2684.28	I	2010 – 39253
1500		2685.17	II	4125 – 41355
35		2686.29	I	9759 – 46974
100		2689.24	II	6831 – 44005
35		2690.54	I	9253 – 46410
340		2691.31	I	0 – 37146
50		2691.80	II	4416 – 41555
260		2692.40	I	5621 – 42752
45		2692.83	II	3180 – 40305
95		2693.34	I	6049 – 43167
50		2693.50	I	5621 – 42737
470		2694.52	II	2642 – 39744
150		2694.76	I	6069 – 43167
45		2695.54	II	10713 – 47801
26		2695.71	II	9746 – 46831
240		2696.81	I	9253 – 46323
1000		2698.30	I	2010 – 39060
50		2700.70	I	12866 – 49882
120		2702.80	II	0 – 36988
85		2703.06	I	2010 – 38994
85		2704.31	I	
470		2706.69	I	10690 – 47625
30		2706.92	I	10690 – 47621
310		2709.27	II	9746 – 46646
1200		2710.13	I	3964 – 40851
26		2710.72	II	24226 – 61106
2600		2714.67	I	0 – 36826
240		2717.18	I	3964 – 40756
150		2718.38	I	6069 – 42845
470		2720.76	I	2010 – 38754
170		2721.83	I	6049 – 42779
110		2725.42	II	
26		2726.32	I	2010 – 38679
470		2727.44	II	5331 – 41984
410		2727.78	I	10690 – 47340
50		2730.73	II	28044 – 64653
85		2732.06	I	15391 – 51982
70		2732.92	I	0 – 36580
30		2733.34	II	18554 – 55128
100		2735.26	II	9746 – 46295
310		2736.25	II	
210		2739.26	II	5658 – 42153
30		2740.70	II	17168 – 53645
150		2741.17	I	9253 – 45724
26		2742.92	I	10950 – 47397
210		2743.59	I	2010 – 38448
510		2746.68	I	5621 – 42018
120		2746.83	II	15726 – 52121
85		2747.25	I	
30		2747.85	I	11244 – 47625
1200		2748.78	I	3964 – 40333
860		2749.83	I	9705 – 46061
70		2750.41	II	11875 – 48223
150		2752.30	I	10690 – 47013
410		2752.49	II	2642 – 38962
70	h	2757.26	II	12705 – 48963
1000		2758.31	I	2010 – 38253
70		2759.06	II	6831 – 43065
430		2761.68	II	1031 – 37231
60		2762.05	II	
110		2763.37	II	0 – 36177
50		2768.09	II	3180 – 39296
70		2771.83	II	
100		2774.88	I	15391 – 51418
130		2775.11	II	5331 – 41355
35		2775.35	II	18186 – 54207
770		2775.88	I	0 – 36014
26		2776.71	II	17231 – 53235
50		2778.82	II	13560 – 49536
100		2779.10	I	3964 – 39936
50		2779.70	I	9759 – 45724
100		2780.34	II	1031 – 36988
30		2780.89		
100		2781.37	I	9705 – 45648
26		2781.79	I	10950 – 46888
150		2784.97	II	5658 – 41555
60		2786.77	II	2642 – 38516
390		2787.69	I	9253 – 45115

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
130		2788.30	I	6049 – 41902
50		2789.15	II	17168 – 53011
50		2789.77	I	12235 – 48070
100		2790.71	I	3964 – 39787
140		2791.37	II	5331 – 41145
120		2791.67	I	6069 – 41879
50		2793.86	II	3180 – 38962
50		2795.20	II	12705 – 48470
680		2796.34	I	2010 – 37761
75		2796.56	I	9976 – 45724
680		2797.76	II	1031 – 36764
190		2798.40	I	3963 – 39688
50		2800.57	I	12235 – 47931
380		2802.07	I	3964 – 39641
50		2804.76	I	6049 – 41693
430		2806.30	I	6069 – 41693
510		2806.58	I	2010 – 37630
140		2810.92	I	12235 – 47800
70		2811.72	II	
100		2814.31	II	6187 – 41709
95		2814.80	I	6069 – 41585
95		2815.01	I	2010 – 37524
95		2815.12	I	6069 – 41581
260		2817.10	II	5658 – 41145
50		2817.50	I	10690 – 46172
45		2819.14	II	10713 – 46175
95		2819.37	I	3964 – 39422
50		2821.99	I	26363 – 61789
45		2824.81	I	12235 – 47625
70		2826.18	I	10950 – 46323
35		2826.42	I	10690 – 46061
95		2827.18	I	5621 – 40982
95	d	2827.48	II	14581 – 49938
		2827.60	II	3180 – 38535
150		2828.58	II	31267 – 66610
35		2829.79	II	4416 – 39744
70		2832.70	II	6831 – 42123
170		2833.64	I	9976 – 45256
70		2834.41	I	9976 – 45246
35		2836.62	I	0 – 35243
50		2837.94	I	10950 – 46177
85		2838.24	II	15851 – 51074
75		2840.39	II	
260		2842.82	I	11244 – 46410
70		2843.51	II	18186 – 53344
640		2844.25	I	6049 – 41198
290		2844.46	II	1031 – 36177
170		2844.76	I	
290	c	2845.35	I	5621 – 40756
35		2845.84	I	6069 – 41198
70		2846.75	I	13351 – 48468
150		2848.05	I	9705 – 44807
560		2848.52	I	3964 – 39060
100		2849.82	I	11244 – 46323
1500		2850.49	I	
1900		2850.98	I	5621 – 40686
			II	14581 – 49647
60		2852.36	II	18186 – 53235
70		2856.69	II	12601 – 47596
100		2857.28	II	9705 – 44693
220		2858.44	II	5331 – 40305
60		2860.88	II	6831 – 41775
50		2861.12	I	6069 – 41010
360		2861.98	I	9759 – 44689
150		2864.50	I	15114 – 50014
75		2865.32	II	17231 – 52121
70		2866.14	I	
100		2867.41	II	17982 – 52846
310		2868.65	I	3964 – 38813
470		2871.42	I	2010 – 36826
270		2873.36	I	0 – 34792
260		2873.56	I	3964 – 38754
210		2874.17	I	6069 – 40852
140		2876.11	I	9759 – 44518
85		2877.05	II	13475 – 48223
100		2877.69	II	9690 – 44430
70		2879.05	II	6831 – 41555
35		2879.52	I	13352 – 48070
120		2879.74	I	3964 – 38679
380		2880.02	I	5621 – 40333
35		2881.23	I	9705 – 44403
35		2882.33	II	9746 – 44430
85		2885.40	II	5658 – 40305
95		2889.38	I	17383 – 51982
75		2890.25	II	2642 – 37231
85		2891.04	I	13352 – 47931
770		2891.84	I	2010 – 36580
100		2894.15	I	9976 – 44518
140		2895.10	I	12866 – 47397
35		2896.41	I	
35		2898.42	I	15391 – 49882
260		2899.04	I	3964 – 38448
170		2900.36	I	9705 – 44174
60		2900.75	II	12705 – 47169
45		2901.05	I	9705 – 44166
560		2902.05	I	13352 – 47800
150		2904.07	I	10690 – 45115
170		2905.24	II	4125 – 38535
170		2908.91	I	10690 – 45058
35		2913.32	I	5621 – 39936
35		2913.45	II	6831 – 41145
210		2914.12	I	10950 – 45256
26		2914.94	I	10950 – 45246
170		2915.34	I	10950 – 45241
310		2915.49	I	3964 – 38253
35		2917.12	I	6069 – 40339
35		2917.56	II	13560 – 47825
95		2918.96	II	17231 – 51480
35		2922.11	II	15726 – 49938
70		2922.84	II	
410		2925.19	I	6069 – 40245
35		2925.66	I	9976 – 44146
100		2926.46	I	6069 – 40230
35		2930.99	I	12866 – 46974
310		2932.70	I	12235 – 46323
1700		2933.55	I	0 – 34078
70		2934.85	I	9705 – 43769
35		2938.00	II	18554 – 52580
35		2938.43	I	12866 – 46888
150		2939.28	I	11244 – 45256
470		2940.06	I	10690 – 44693
1200		2940.22	I	0 – 34001
150		2941.37	I	13352 – 47340
60		2941.50		
240		2942.14	I	3964 – 37943
35		2943.77	I	
35		2945.69	I	12235 – 46172
150		2946.91	I	9253 – 43177
35		2949.92	II	14581 – 48470
510		2951.92	I	2010 – 35877
			II	15726 – 49593

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
100		2952.99	II	9690 – 43544
340		2953.56	I	5621 – 39468
100	c	2955.32	II	
120	c	2956.84	II	15726 – 49536
170		2957.60	I	5621 – 39422
35		2957.88	II	9746 – 43544
35		2963.06	I	10950 – 44689
1500		2963.32	I	2010 – 35746
120		2963.91	I	9253 – 42983
770		2965.13	II	0 – 33715
770		2965.54	I	2010 – 35721
95		2965.92	II	0 – 33706
35		2968.28	II	11767 – 45447
340		2969.47	I	3964 – 37630
70		2969.90	I	13352 – 47013
430		2975.56	I	3964 – 37561
85		2976.10	I	9253 – 42845
85		2976.26	II	12705 – 46295
60		2976.76	I	
100		2978.18	II	18554 – 52121
170		2978.75	I	
60		2981.19	I	9705 – 43239
60		2984.36	I	9253 – 42752
120		2986.81	II	2642 – 36113
190		2988.58	I	10690 – 44141
60		2989.05	I	11243 – 44689
190		2989.50	I	6049 – 39490
100		2991.25	I	6069 – 39490
70		2999.37	II	14495 – 47825
50		3001.54	I	12866 – 46172
35		3002.98	II	13560 – 46851
70		3004.15	I	9705 – 42983
75		3004.92	II	9690 – 42960
40		3006.56	I	12865 – 46116
110		3010.84	II	5331 – 38535
180		3011.12	I	13352 – 46552
210		3011.88	I	5621 – 38813
1800		3012.54	II	5331 – 38516
70		3016.37	I	11244 – 44386
60		3019.67	I	11244 – 44350
90		3024.09	I	5621 – 38679
180		3025.16	I	9705 – 42752
290	d	3027.48	I	12235 – 45256
		3027.61	II	14495 – 47515
90		3028.78	I	9976 – 42983
110		3030.29	I	6069 – 39059
110		3037.50	II	6831 – 39744
40		3040.70	II	5658 – 38535
75		3040.98	I	
290		3042.06	II	4125 – 36988
110		3042.44	II	11767 – 44626
75		3043.92	I	10690 – 43533
110		3045.96	I	13352 – 46172
180		3048.86	I	2010 – 34800
530		3049.56	I	2010 – 34792
110		3050.10	I	6069 – 38845
75		3056.62	II	17231 – 49938
110		3057.22	II	14581 – 47281
140		3058.64	I	6069 – 38754
140		3060.29	I	3964 – 36631
180		3063.56	I	5621 – 38253
40		3063.88	I	
530		3069.24	I	12235 – 44807
60		3073.39	I	10950 – 43478
40		3076.38	I	6049 – 38546
360		3077.24	I	10690 – 43177
140		3078.23	I	6069 – 38546
110		3079.96	I	12235 – 44693
180		3081.85	I	6069 – 38508
170		3085.54	I	10690 – 43090
140		3087.53	I	6069 – 38448
60		3087.76	II	9746 – 42123
30		3092.06	I	9253 – 41585
180		3092.44	I	9253 – 41581
40		3092.99	I	5621 – 37943
150		3093.87	I	9705 – 42018
180		3095.39	I	13352 – 45648
75		3101.03	II	11767 – 44005
40		3101.72	I	15391 – 47621
560		3103.25	I	0 – 32215
40		3104.42	I	9975 – 42178
75		3107.21	I	9705 – 41879
40		3110.82	II	
100		3113.90	I	
75		3115.86	I	2010 – 34095
150		3117.44	I	2010 – 34078
75		3119.59	I	10690 – 42737
40		3120.92	I	10950 – 42983
380		3124.97	I	2010 – 34001
150		3127.76	II	9746 – 41709
60		3129.55	I	9253 – 41198
110		3129.95	I	5621 – 37561
380		3130.58	I	11244 – 43177
270		3132.64	I	3964 – 35877
40		3133.55	I	9976 – 41879
75		3133.89	II	5331 – 37231
180		3135.89	I	9705 – 41585
			II	12705 – 44585
60		3137.44	II	9690 – 41555
60		3142.96	II	9746 – 41555
75	c	3147.37	I	13352 – 45115
140		3148.04	I	9253 – 41010
40		3150.85	I	9253 – 40982
40		3155.25	II	6831 – 38516
40		3156.76	II	11875 – 43544
75		3157.96	II	5331 – 36988
40		3159.05	I	12235 – 43881
75		3162.72	I	9976 – 41585
140		3163.13	I	9976 – 41581
70		3163.82	I	9253 – 40852
75		3167.53	I	6068 – 37630
70		3168.18	II	15726 – 47281
320		3170.29	I	3963 – 35497
75		3172.87	I	11244 – 42752
270		3173.59	I	0 – 31501
200		3176.29	I	6049 – 37524
140		3178.16	I	5621 – 37077
		3178.27	I	6069 – 37524
600		3180.95	I	0 – 31428
110		3181.69	I	9759 – 41180
110		3182.57	I	6049 – 37461
240		3184.55	I	6069 – 37461
120		3191.16	I	10690 – 42018
75		3192.25	I	
200		3198.67	I	3964 – 35218
40		3201.98	I	9976 – 41198
75		3205.00		
150		3206.39	I	5621 – 36800
45		3207.85	I	11244 – 42408

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
200		3213.91	II	5658 – 36764
150		3216.93	I	6069 – 37146
75		3221.32	I	9976 – 41010
300		3223.83	I	5621 – 36631
180		3227.32	I	9253 – 40230
230		3229.24	I	
85		3229.88	II	14495 – 45447
120		3230.86	I	12235 – 43177
85		3234.69	I	17384 – 48290
40		3236.40	I	
70		3239.99	I	12235 – 43090
120		3240.94	II	5331 – 36177
200		3242.05	I	3964 – 34800
200		3242.83	I	3964 – 34792
40		3248.52	I	11244 – 42018
40		3250.36	I	6069 – 36826
70		3260.18	I	0 – 30665
210		3274.95	II	3180 – 33706
85		3275.68	II	5658 – 36177
70		3279.29	I	9759 – 40245
70		3280.87	I	9759 – 40230
30		3292.48	I	9976 – 40339
40		3293.93	I	
140		3295.33	I	11244 – 41581
120		3299.77	I	6049 – 36346
70		3304.38	I	9976 – 40230
75		3309.78	I	2010 – 32215
1100		3311.16	I	5621 – 35813
210		3317.93	I	3964 – 34095
70		3318.53	I	5621 – 35746
680		3318.84	I	2010 – 32132
330	d	3330.99	II	
		3331.02	I	12235 – 42247
85		3332.41	I	9253 – 39253
70		3337.80	I	2010 – 31961
85		3338.49	I	6069 – 36014
130		3339.91	II	6831 – 36764
30		3343.47	I	11792 – 41693
130	c	3349.21	II	14581 – 44430
90		3350.96	I	13352 – 43185
130		3351.51	I	9759 – 39588
230		3358.47	I	
170		3361.64	I	13352 – 43090
40		3362.53	I	9759 – 39490
45		3366.66	I	
110		3369.28	I	6049 – 35721
640		3371.54	I	3964 – 33615
130		3376.05	I	9976 – 39588
45		3376.49	II	
140		3379.52	II	4125 – 33706
360		3385.05	I	3964 – 33497
40		3387.46	I	11244 – 40756
40		3388.82	I	9253 – 38754
230		3398.33	I	2010 – 31428
170		3406.66	II	6831 – 36177
450		3406.94	I	0 – 29344
90		3412.89	I	9253 – 38546
140		3414.14	II	6831 – 36113
45		3417.03	II	0 – 29257
75		3419.74	I	3964 – 33198
140		3424.45	I	6049 – 35243
90		3426.73	I	6069 – 35243
180		3430.94	I	
75		3434.50	I	9705 – 38813
140		3436.00	I	11244 – 40339
45		3438.40		
90		3440.24	II	14495 – 43554
45		3445.10	I	9976 – 38994
70		3445.91	I	15391 – 44402
75	c	3446.91	II	12705 – 41709
90		3447.29	I	9253 – 38253
230		3463.77	I	0 – 28862
45		3472.52	I	17383 – 46172
45		3473.90	I	9976 – 38754
45		3477.22	I	15391 – 44141
100		3477.45	I	9759 – 38508
490		3480.52	I	6069 – 34792
45		3484.62	I	0 – 28689
75		3490.93	I	10950 – 39588
380		3497.85	I	2010 – 30591
75		3502.50	I	11244 – 39787
130		3502.87	I	10950 – 39490
240		3503.87	I	9976 – 38508
130		3504.98	I	3964 – 32487
75		3505.18	I	12235 – 40756
490		3511.04	I	5621 – 34095
200		3513.61	I	11792 – 40245
55		3527.06	I	11244 – 39588
75		3528.61	I	12866 – 41198
150		3531.58	I	9253 – 37561
40		3532.21	I	10950 – 39253
75		3536.30	I	9253 – 37524
55		3540.82	I	
100		3541.88	II	1031 – 29257
120		3549.05	I	3964 – 32132
55		3553.42	I	0 – 28134
55		3557.95	I	12235 – 40333
55		3564.79	I	10950 – 38994
180		3566.72	I	6049 – 34078
150		3571.85	I	10690 – 38679
150	c	3573.44	I	15114 – 43090
110		3584.21	I	9253 – 37146
85		3584.51	I	12866 – 40756
150		3586.29	I	5621 – 33497
150		3595.64	I	10950 – 38754
55		3602.48	I	11244 – 38994
750		3607.41	I	2010 – 29723
55		3625.23	I	5621 – 33198
980		3626.62	I	3964 – 31530
55		3633.75	I	
500		3642.06	I	5621 – 33070
40		3653.39	I	12866 – 40230
21		3653.83	I	15391 – 42752
40		3656.89	I	
60		3657.27	I	13352 – 40686
60		3657.49	I	2010 – 29344
85		3658.78	I	
65		3661.69	I	11244 – 38546
65		3662.34	II	9690 – 36988
35		3667.82	I	
65		3674.83	I	11244 – 38448
35		3675.12	I	11792 – 38994
40		3681.04	I	13352 – 40510
40		3681.24	I	
60		3683.06	I	
100		3686.18	I	9705 – 36826
100		3689.73	I	9705 – 36800
75		3693.05	I	12866 – 39936
60		3694.52	II	14495 – 41555
60		3695.38	I	11792 – 38845

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
21		3701.34	I	11244 – 38253
17		3710.79	I	
40		3723.07	I	2010 – 28862
130		3731.02	I	0 – 26795
140		3736.76	I	11792 – 38546
130		3746.36	I	
110		3754.52	I	3964 – 30591
75		3755.11	I	9253 – 35877
23		3757.75	I	9976 – 36580
45		3759.75	I	0 – 26590
23		3760.21	I	9759 – 36346
45		3762.11	I	10950 – 37524
40		3770.52	I	
45		3770.93	I	5621 – 32132
110		3777.10	I	9253 – 35721
19		3784.25	I	6069 – 32487
110		3792.02	I	0 – 26364
95		3823.60	I	6069 – 32215
40		3826.17	I	12866 – 38994
85		3826.85	I	2010 – 28134
95		3828.95	I	10690 – 36800
35		3830.00	II	5658 – 31760
210		3833.74	II	3180 – 29257
65		3836.60	I	3964 – 30021
85		3839.03	I	9705 – 35746
40		3844.04	I	
40		3846.64	I	9253 – 35243
100		3848.05	I	5621 – 31601
40		3849.42	I	
40		3859.80	I	9976 – 35877
100		3885.20	I	11792 – 37524
19		3893.03	I	12866 – 38546
19	bl	3896.43	Ta O	
35		3898.78	I	
65		3909.33	I	
40		3912.13	I	17224 – 42779
40		3912.44	I	21381 – 46933
210		3918.51	I	0 – 25513
40		3919.47	I	
55		3922.42	II	6831 – 32318
140		3922.78	I	6069 – 31554
140		3922.92	I	9759 – 35243
65		3930.94	I	6069 – 31501
40		3936.55	I	10950 – 36345
85		3937.84	I	12866 – 38253
19		3942.24	I	6069 – 31428
65		3952.16	I	15391 – 40686
40		3954.29	I	
65		3956.57	I	9976 – 35243
19		3956.82	I	
28		3959.73	I	
210		3970.10	I	0 – 25181
65		3979.28	I	10690 – 35813
19		3981.01	II	11875 – 36988
85		3981.95	I	15904 – 41010
19		3983.82	I	9705 – 34800
17		3984.98	I	9705 – 34792
85		3988.70	I	10950 – 36014
40		3990.40	I	24546 – 49599
210		3996.17	I	6049 – 31066
100		3999.28	I	6069 – 31066
65		4003.70	I	5621 – 30591
190		4006.84	I	2010 – 26960
35		4007.23	I	15904 – 40852
65		4012.11	I	19178 – 44095
65		4013.19	I	12235 – 37146
190		4026.94	I	6069 – 30895
140		4029.94	I	10690 – 35497
85		4033.07	I	11792 – 36580
19		4033.38	I	19178 – 43964
17		4033.63	I	2010 – 26795
65		4035.89	I	10950 – 35721
35		4039.63	I	9253 – 34001
120		4040.87	I	5621 – 30361
85		4041.06	I	0 – 24739
65		4058.46	I	11244 – 35876
410		4061.40	I	6049 – 30665
210		4064.63	I	6069 – 30665
100		4067.24	I	2010 – 26590
310		4067.91	I	2010 – 26586
40		4073.00	I	15391 – 39936
65		4079.19	I	17993 – 42501
19		4081.13	I	17383 – 41879
40		4085.80	I	17224 – 41693
40		4091.26	I	15904 – 40339
19	h	4095.55	II	11767 – 36177
40		4097.19	I	5621 – 30021
120		4105.02	I	2010 – 26364
19		4114.77	I	9705 – 34001
19		4118.07	I	
55		4123.17	I	15114 – 39360
85		4127.88	I	3964 – 28183
210		4129.38	I	13351 – 37561
230		4136.20	I	3964 – 28134
230		4147.89	I	5621 – 29723
75	h	4161.00	I	
210		4175.21	I	9253 – 33198
75		4176.90	II	14581 – 38516
		4176.99	I	12866 – 36800
100		4177.92	I	11792 – 35721
130		4181.15	I	9705 – 33615
85		4191.20	I	6049 – 29902
55		4193.10	I	10950 – 34792
300		4205.88	I	3964 – 27734
120		4206.40	I	17384 – 41151
95		4228.61	I	12235 – 35877
35		4232.94	I	
55		4235.94	II	24870 – 48470
28		4243.99	I	11244 – 34800
130		4245.35	I	11244 – 34792
130		4268.26	I	15391 – 38813
65		4271.51	I	10690 – 34095
95		4279.06	I	0 – 23363
65		4286.38	I	19178 – 42502
55		4294.36	I	13352 – 36631
160	c	4302.98	I	9253 – 32487
95		4314.52	I	2010 – 25181
65		4318.81	I	12866 – 36014
65		4322.68	I	17383 – 40510
85		4329.57	I	15904 – 38994
35		4336.20	I	23927 – 46982
85		4344.31	I	21153 – 44165
110		4355.14	I	22682 – 45637
45		4360.83	I	10690 – 33615
45		4364.84	I	
55		4369.35	I	12866 – 35746
28		4374.21	I	12866 – 35721
45		4375.14	I	15904 – 38754
28		4376.31	I	19657 – 42501
28		4377.98	I	24982 – 47817

559-795 O - 75 - 19 (Pt. 1)

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
100		4378.82	I	3964 – 26795
23		4381.88	I	21168 – 43982
150		4386.07	I	6069 – 28862
110		4398.45	I	2010 – 24739
180		4402.50	I	9253 – 31961
130		4415.74	I	6049 – 28689
45		4419.55	I	6069 – 28689
35		4424.96	I	20647 – 43239
65		4430.41	I	12235 – 34800
35		4431.09	I	5621 – 28183
40		4432.98	I	15391 – 37943
55		4441.03	I	9976 – 32487
75		4441.68	I	10690 – 33198
75		4450.72	I	13352 – 35813
19	h	4451.87	I	9759 – 32215
95		4459.76	I	19178 – 41595
95		4473.52	I	9253 – 31601
45		4480.93	I	25009 – 47319
40		4494.97	I	21855 – 44095
40		4496.50	I	2010 – 24243
360	c	4510.98	I	5621 – 27783
75		4511.50	I	5621 – 27781
55		4521.09	I	5621 – 27734
35		4521.71	I	21855 – 43964
65		4527.50	I	22380 – 44461
190		4530.85	I	6069 – 28134
28		4547.15	I	9976 – 31961
130		4551.95	I	3964 – 25926
45		4553.69	I	11244 – 33198
85		4556.35	I	11244 – 33185
45		4559.46	I	12866 – 34792
17		4561.48	I	2010 – 23927
170		4565.85	I	9705 – 31601
28		4566.86	I	25926 – 47817
45		4573.29	I	12235 – 34095
340		4574.31	I	0 – 21855
28		4580.69	I	9705 – 31530
19		4583.17	I	9253 – 31066
40		4601.42	I	15904 – 37630
45		4602.19	I	9705 – 31428
17	h	4604.28	I	22429 – 44141
35	h	4604.85	I	23927 – 45637
260		4619.51	I	9253 – 30895
30		4622.96	I	22761 – 44386
17		4624.84	I	21622 – 43239
45		4633.06	I	9976 – 31554
85		4661.12	I	13352 – 34800
130		4669.14	I	9253 – 30665
450		4681.88	I	2010 – 23363
45		4684.87	I	5621 – 26960
40		4685.27	I	9253 – 30591
19		4688.84	I	17224 – 38546
130		4691.90	I	9759 – 31066
85		4693.35	I	22682 – 43982
65		4701.32	I	10950 – 32215
65		4706.09	I	11244 – 32487
45		4722.88	I	0 – 21168
85		4730.12	I	12866 – 34001
27	h	4738.35	I	23363 – 44461
150		4740.16	I	9976 – 31066
40		4745.93	I	17383 – 38448
220		4756.51	I	3964 – 24982
45		4758.03	I	10950 – 31961
120		4768.98	I	12235 – 33198
85		4780.94	I	10690 – 31601
21		4786.64	I	9705 – 30591
220		4812.75	I	0 – 20772
85		4819.53	I	13352 – 34095
85		4825.43	I	11244 – 31961
55		4832.18	I	9976 – 30665
65		4846.45	I	25009 – 45637
30		4852.17	I	10950 – 31554
19		4871.70	I	6069 – 26590
13		4879.14	I	23913 – 44403
11		4881.94	I	10950 – 31428
75		4883.95	I	9253 – 29723
65		4904.59	I	15114 – 35497
40		4907.73	I	2010 – 22380
30		4914.96	I	0 – 20340
110		4920.11	I	12866 – 33185
100		4921.27	I	6049 – 26364
20		4923.47	I	5621 – 25926
25		4924.96	I	17224 – 37524
110		4926.00	I	6069 – 26364
150		4936.42	I	12235 – 32487
50		4937.63	I	17383 – 37630
18		4958.11	I	
25		4968.53	I	22380 – 42502
45		4969.73	I	10950 – 31066
18		4972.06	I	15391 – 35497
25		4976.20	I	9253 – 29344
75		5012.52	I	10950 – 30895
200		5037.37	I	13352 – 33198
90		5037.66	I	2010 – 21855
90		5043.32	I	11244 – 31066
18		5044.42	I	22428 – 42247
25	h	5058.70	I	17383 – 37146
100		5067.87	I	12235 – 31961
45		5076.37	I	17383 – 37077
30		5082.25	I	10690 – 30361
65		5087.37	I	11244 – 30895
90		5090.71	I	9705 – 29344
40		5095.27	I	12866 – 32487
25	c	5109.37	II	9690 – 29257
20		5109.77	I	5621 – 25186
110		5115.84	I	26575 – 46116
40		5117.25	I	27783 – 47319
45		5132.12	I	24981 – 44461
30		5136.47	I	6049 – 25513
100		5141.62	I	6069 – 25513
100		5143.69	I	9253 – 28689
75		5147.62	I	11244 – 30665
25		5148.78	I	17383 – 36800
25		5150.87	I	15391 – 34800
75		5153.42	I	3964 – 23363
330		5156.56	I	5621 – 25009
75		5161.81	I	9976 – 29344
65		5163.65	I	5621 – 24982
25		5166.79	I	12866 – 32215
20		5171.63	I	10690 – 30021
40	c	5180.98	I	21855 – 41151
20		5188.93	I	12866 – 32132
20	c	5193.99	I	17383 – 36631
20		5206.26	I	14875 – 34078
110		5212.74	I	0 – 19178
110	d	5218.45	I	2010 – 21168
		5218.66	I	9705 – 28862
40		5230.80	I	6069 – 25181
30		5235.39	I	12866 – 31961
30		5237.53	II	14628 – 33715

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
18		5244.78	I	9705 – 28767
30		5275.02	I	10950 – 29902
18		5279.82	I	17224 – 36159
18		5281.02	I	9759 – 28689
90		5295.01	I	9253 – 28134
40	c	5318.67	I	25186 – 43983
75		5328.38	I	2010 – 20772
30		5336.13	I	12866 – 31601
140		5341.05	I	3964 – 22682
25		5342.25	I	9976 – 28689
50		5349.09	I	6049 – 24739
50		5349.57	I	12866 – 31554
65		5354.68	I	6069 – 24739
15		5365.95	I	17383 – 36014
20		5373.01	I	
25	c	5388.51	I	28767 – 47319
90		5389.30	I	2010 – 20560
40		5395.99	I	9253 – 27781
25		5397.56	I	17224 – 35746
200		5402.51	I	0 – 18505
13		5403.54	I	15114 – 33615
45		5404.96	I	17224 – 35721
13		5405.80	I	17383 – 35877
30		5408.78	I	22428 – 40911
18		5410.55	I	9705 – 28183
25	c	5413.48	I	6049 – 24517
130		5419.19	I	6069 – 24517
23		5431.66	I	21381 – 39786
65		5435.27	I	10950 – 29344
25		5458.41	I	21153 – 39468
90		5461.29	I	5621 – 23927
13		5471.56	I	
30		5475.57	I	22428 – 40686
15		5481.16	I	23355 – 41595
20		5483.43	I	23363 – 41595
40		5490.11	I	
20		5494.78	I	6049 – 24243
50		5499.44	I	13352 – 31530
18		5500.68	I	6069 – 24243
20		5505.66	I	9976 – 28134
15	c	5516.27	I	
90		5518.91	I	17383 – 35498
9		5521.15	I	20647 – 38754
10		5523.98	I	26363 – 44461
13		5528.36	I	3964 – 22047
10	l	5545.20	I	12866 – 30895
20		5548.32	I	17224 – 35243
30		5584.02	I	27734 – 45637
15		5598.75	I	27781 – 45637
30		5599.52	I	27783 – 45637
9	c	5605.50	I	17383 – 35218
9	c	5617.71	I	23355 – 41151
40		5620.68	I	12235 – 30021
13		5628.20	I	26219 – 43982
20		5635.71	I	10950 – 28689
40		5640.18	I	12866 – 30591
150		5645.91	I	9253 – 26960
130		5664.90	I	2010 – 19658
30		5688.25	I	17224 – 34800
40		5699.24	I	9253 – 26795
15		5704.31	I	21153 – 38679
25		5706.28	I	24982 – 42502
30		5715.24	I	10690 – 28183
8		5716.53	I	12235 – 29723
23		5746.71	I	26586 – 43983
30		5755.81	I	23141 – 40510
15	h	5761.61	I	24243 – 41595
25		5766.56	I	9253 – 26590
30	c	5767.91	I	9253 – 26586
10		5771.93	I	25181 – 42502
130		5776.77	I	6049 – 23355
25		5780.02	I	20647 – 37943
90		5780.71	I	6069 – 23363
130		5811.10	I	3964 – 21168
25		5816.51	I	26795 – 43983
45	c	5843.94	I	9759 – 26866
13		5849.68	I	10690 – 27781
15		5866.61	I	21153 – 38194
240		5877.36	I	13352 – 30361
130		5882.30	I	23515 – 40510
90		5901.91	I	11244 – 28183
30		5916.51	I	11792 – 28689
90		5918.95	I	9976 – 26866
15		5925.90	I	28766 – 45636
15		5930.62	I	12866 – 29723
23		5931.05	I	24739 – 41595
20		5931.68	I	17224 – 34078
18		5935.54	I	23913 – 40756
130		5939.76	I	9759 – 26590
240		5944.02	I	9976 – 26795
25		5951.78	I	39253 – 56050
18		5960.13	I	23913 – 40686
190	c	5997.23	I	13352 – 30021
25	h	6009.89	I	24517 – 41151
25		6015.90	I	17383 – 34001
100		6020.72	I	9759 – 26364
250		6045.39	I	11244 – 27781
100		6047.25	I	12235 – 28767
25		6053.70	I	9705 – 26220
30		6090.82	I	25181 – 41595
18		6092.06	I	22842 – 39253
100		6101.58	I	22429 – 38813
25		6140.07	I	26220 – 42502
65		6144.56	I	10690 – 26960
30		6152.54	I	27734 – 43983
130		6154.50	I	9976 – 26220
40		6158.84	I	17383 – 33615
15		6170.46	I	27781 – 43983
15		6189.66	I	22842 – 38994
15		6193.11	I	21381 – 37523
25		6208.37	I	25478 – 41581
40		6249.79	I	12866 – 28862
150		6256.68	I	6069 – 22047
150		6268.70	I	12235 – 28183
50		6278.34	I	21153 – 37076
65		6281.33	I	10950 – 26866
15		6287.36	I	21622 – 37523
40		6287.91	I	12235 – 28134
40		6289.34	I	10690 – 26586
50		6309.06	I	23514 – 39360
150		6309.58	I	10950 – 26795
25	c	6312.22	I	24917 – 40755
75		6325.08	I	6049 – 21855
50		6332.91	I	6069 – 21855
65		6341.17	I	22428 – 38194
30		6346.02	I	9759 – 25513
75		6356.16	I	9253 – 24982
65		6360.84	I	11244 – 26960
40		6373.06	I	22761 – 38448
15		6379.07	I	26575 – 42247

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
90		6389.45	I	21153 – 36800
23	h	6392.21	I	10950 – 26590
65		6428.60	I	11244 – 26795
250		6430.79	I	12235 – 27781
13		6437.36	I	
40		6444.61	I	20646 – 36159
30		6445.87	I	23912 – 39422
200		6450.36	I	12235 – 27734
20		6455.83	I	9253 – 24739
30		6459.92	I	9705 – 25181
380		6485.37	I	13352 – 28767
18	h	6502.43	I	2010 – 17384
65		6505.52	I	20646 – 36013
100		6514.39	I	11244 – 26590
100		6516.10	I	11244 – 26586
25	h	6561.60	I	10690 – 25926
25	cw	6564.26	I	20646 – 35876
100		6574.84	I	9976 – 25181
10		6585.13	I	22761 – 37943
15	c	6587.16	I	21622 – 36799
110		6611.95	I	11244 – 26364
75		6621.30	I	6069 – 21168
15	cw	6662.24	I	21153 – 36159
100		6673.73	I	9759 – 24739
180		6675.53	I	11244 – 26220
30		6684.00	I	21622 – 36580
15		6693.61	I	23512 – 38447
15		6706.46	I	15114 – 30021
25		6709.39	I	23913 – 38813
10		6714.44	I	26022 – 40911
15	h	6723.61	I	22761 – 37630
75	c	6740.73	I	13352 – 28183
40		6754.91	I	26795 – 41595
13	c	6755.85	I	11792 – 26590
13		6770.37	I	23913 – 38679
75		6771.74	I	9976 – 24739
40	cw	6774.25	I	9759 – 24517
40	cw	6788.99	I	12235 – 26960
13	c	6790.06	I	24917 – 39641
13		6799.27	I	6069 – 20772
40	c	6810.46	I	23514 – 38194
160	c	6813.25	I	9253 – 23927
20		6819.36	I	21153 – 35813
18	c	6824.96	I	22428 – 37076
13		6832.00	I	21381 – 36013
15		6850.83	I	21153 – 35746
15		6865.13	I	10950 – 25513
210		6866.23	I	12235 – 26795
180		6875.27	I	9976 – 24517
40		6877.49	I	21622 – 36159
15		6896.77	I	10690 – 25186
40		6900.55	I	26022 – 40510
150		6902.10	I	9759 – 24243
140		6927.38	I	13352 – 27783
140		6928.54	I	13352 – 27781
8	h	6939.33	I	26575 – 40981
20	c	6946.87	I	21622 – 36013
65		6951.26	I	13352 – 27734
45		6953.88	I	17224 – 31601
180		6966.13	I	12235 – 26586
8		6969.49	I	21153 – 35497
8	c	6971.31	I	23912 – 38253
9		6971.53	I	21381 – 35721
23		6983.52	I	22761 – 37077
110	d	6995.22	I	10690 – 24982
		6995.49	I	6049 – 20340
20		7000.21	I	23912 – 38194
40		7005.07	I	6069 – 20340
75		7006.96	I	9976 – 24243
50		7025.03	I	10950 – 25181
13		7031.51	I	17383 – 31601
40		7039.07	I	22429 – 36631
15	h	7081.30	I	23512 – 37630
20		7085.40	I	9253 – 23363
23		7093.02	I	12866 – 26960
8		7108.05	I	22761 – 36826
15	c	7117.52	I	25376 – 39422
20		7121.27	I	22761 – 36800
40		7125.72	I	3963 – 17993
150		7148.63	I	12235 – 26220
110		7172.90	I	11244 – 25181
13	c	7174.91	I	
13		7191.35	I	24546 – 38447
8		7233.45	I	
30	h	7250.27	I	10950 – 24739
11	h	7264.82	I	24917 – 38679
6		7272.29	I	
30		7276.96	I	11244 – 24982
5		7277.54	I	22842 – 36580
9		7286.36	I	11792 – 25513
13	c	7296.32	I	
140		7301.74	I	12235 – 25926
20		7319.84	I	9705 – 23363
11	c	7322.72	I	15114 – 28767
13		7325.95	I	21153 – 34799
11	cw	7340.19	I	21622 – 35242
160		7346.41	I	6049 – 19658
140	c	7352.86	I	9759 – 23355
100		7356.96	I	6069 – 19658
90	cw	7369.09	I	10950 – 24517
160		7407.89	I	11244 – 24739
11	c	7435.19	I	26022 – 39468
23		7440.17	I	25376 – 38813
30		7467.75	I	9976 – 23363
23		7486.01	I	20646 – 34001
30		7520.56	I	10950 – 24243
6		7569.23	I	17383 – 30591
9		7590.22	I	22842 – 36013
6		7649.62	I	22428 – 35497
11	h	7722.02	I	12235 – 25181
11		7763.11	I	
9	c	7779.67	I	20646 – 33497
20	c	7842.76	I	12235 – 24982
100		7882.37	I	11244 – 23927
30		7950.19	I	13352 – 25926
5		7952.07	I	
6		7998.75	I	17224 – 29723
6		8022.09	I	21153 – 33615
75		8026.50	I	6049 – 18505
5		8029.04	I	11792 – 24243
15		8039.08	I	6069 – 18505
8		8053.93	I	10950 – 23363
15		8068.98	I	15391 – 27781
5		8100.11	I	9705 – 22047
13		8128.76	I	23514 – 35813
9		8158.54	I	24546 – 36799
5	c	8180.74	I	
13	c	8248.95	I	11244 – 23363
20	d	8264.85	I	9759 – 21855
75		8281.62	I	9976 – 22047

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
11	8389.06	I	21153 – 33070	11 h	8550.49	I	12235 – 23927
5	8415.73	I	9976 – 21855	15	8575.92	I	13352 – 25009
25 cw	8447.62	I	13352 – 25186	10 cw	8595.84	I	13352 – 24982

Tellurium

$$\text{Te},\ Z = 52,\ M = 127.6,\ \text{Ratio}\ \frac{\text{Te}}{\text{Cu}} = 2.008$$

Te I Normal state of valence electrons $5s^2 5p^4\ {}^3P_2 = 0$. I.P. = 72667 cm^{-1}.
Te II Normal state of valence electrons $5s^2 5p^3\ {}^4S^\circ_{1\,1/2} = 0$. I.P. = 150000 cm^{-1}.

References

Wavelengths:
J. F. Ward, unpublished material (1969).

Classification:
Te I, O. Bartelt, Z. Physik **88**, 522 (1934).

Tellurium—all observed lines

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
14000	1994.18	I	4751 – 54877	500	2259.02	I	0 – 44253
26000	2002.02	I	4751 – 54685	1200	2383.26	I	4706 – 46653
6500	2081.16	I	10559 – 58596	1500	2385.78	I	4751 – 46653
18000	2142.81	I	0 – 46653	120	2530.72	I	4751 – 44253
3200	2147.25	I	10559 – 57116	110	2677.13	I	
360	2159.85	I	10559 – 56845	100	3175.14	I	23199 – 54685

Terbium

Tb, $Z = 65$, $M = 158.9254$, Ratio $\frac{\text{Tb}}{\text{Cu}} = 2.501$

Tb I Normal state of valence electrons $4f^9 6s^2\ {}^6H^\circ_{7\frac{1}{2}} = 0$. I.P. = 47200 cm^{-1}.
Tb II Normal state of valence electrons $4f^9 6s\ {}^7H_8 = 0$. I.P. = 92900 cm^{-1}.

References

Wavelengths:
A. Gatterer and J. Junkes, Spektren der Seltenen Erden (Specola Vaticana, Vatican, 1945).
Supplemented by:
J. M. Eder, Sitzber, Akad. Wiss. Wien, Math. naturw. Kl. **131**, 199 (1922).
A. S. King, Astrophys. J. **72**, 221 (1930).
P. F. A. Klinkenberg and E. Meinders (see below).
About 70 lines above 7000 Å were measured on our plates.

Classification:
Tb I, P. F. A. Klinkenberg and E. Meinders, Physica **32**, 1113, 1617 (1966); **37**, 197 (1967); **38**, 253 (1968); **42**, 213 (1969); **50**, 625 (1970); **57**, 594 (1972).
Tb II, E. Meinders, Physica **42**, 427 (1969) and unpublished material (1969).

Spectrum Assignments:
From 3837 to 4677 Å the assignment of spectrum is from A. S. King, Astrophys. J. **72**, 221 (1930).
The rest of the assignments are from our plates.

Strong lines of terbium

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
5700		3509.17	II	0 – 28488	1600		3568.98	II	
4700		3702.86	II	1016 – 28014	1600		3600.44	II	
4200		3568.52	II	0 – 28014	1600		3901.33	I	462 – 26087
3800		3324.40	II		1500		3293.07	II	6372 – 36731
3800		3676.35	II	1016 – 28209	1500		3830.26	I	285 – 26386
3700		3848.73	II	0 – 25975	1300		3523.66	II	
3500	w	3874.17	II	0 – 25804	1300		4061.58	I	462 – 25076
3200		3561.74	II	3010 – 31078	1200		3219.98	II	
3000		4326.43	I	0 – 23107	1100		3218.93	II	
2400		3703.92	II		1100		3540.24	II	
2400		3899.20	II	3010 – 28649	1100		3579.20	II	
2300		3650.40	II		1100		3755.24	II	
2200	d	3976.84	II	0 – 25138	1100		4144.41	II	1016 – 25138
2200		4318.83	I	0 – 23147	1000		3285.04	II	
2100		3776.49	II		1000	d	3711.76	II	3542 – 30476
2100		4033.03	II	1016 – 25804	970		4002.59	II	5171 – 30148
2000		3658.88	II	1016 – 28339	870		3747.17	II	
1900		4005.47	II	1016 – 25975	870		3747.34	II	
1800		3981.87	II	3542 – 28649	870		4032.28	I	2310 – 27103
1700		3765.14	I	509 – 27061	870		4336.43	I	2771 – 25825
1700		4338.41	I	0 – 23043	870		4356.81	I	2771 – 25717

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
29	2577.73	II	
110	2584.61	II	
29	2590.31	II	
29	2591.42	II	
24	2592.64	II	
55	2597.71	II	
40	2602.93	II	
110	2608.57	II	
40	2616.90		
130	2628.69	II	0 – 38030
55	2655.96	II	
50	2661.40	II	
24	2661.64	II	
55	2667.64	II	
50	2668.86	II	
140	2669.29	II	
40	2674.13	II	
40	2674.69	II	
29	2678.15	II	
40	2683.97	II	
35	2687.82	II	0 – 37193
50	2691.90	II	
35	2693.05	II	
55	2693.41	II	
35	2695.46	II	
50	2696.83	II	
35	2701.52	II	
190	2704.07	II	
95	2706.28	II	
50	2713.22	II	
35	2720.89	II	
35	2724.29	II	
35	2726.49	II	
65 d	2730.21	II	
35	2733.90	II	
35	2735.45	II	
35	2735.99	II	
130	2736.24	II	
65	2742.26	II	
85	2743.50	II	
35	2757.41	II	
160	2759.47	II	
65	2760.96	II	
35	2766.57	II	
35	2767.02	II	
270	2769.53	II	
35	2782.35	II	
35	2783.00	II	
130	2784.49	II	
35	2785.50	II	
40	2796.95	II	
180	2800.51	II	
75	2800.63	II	
250	2802.75	II	
250	2809.30	II	1016 – 36601
180	2812.64	II	
40	2818.48	II	
40	2819.78	II	
85	2827.41	II	
75	2833.03	II	
85	2838.72	II	
40	2842.00	II	
75	2843.95	II	
75	2845.93	II	
55	2851.04	II	
190	2852.14	II	
75	2854.20	II	
75	2854.96	II	
75	2855.65	II	0 – 35007
110	2857.68	II	
95	2861.34	II	
40	2864.48	II	
50	2867.42	II	
50	2872.32	II	0 – 34804
40	2872.55	II	
75	2881.25	II	
95	2884.68	II	
75	2885.90	II	
230	2886.29	II	
75	2887.44	II	
50	2888.10	II	
40	2888.31	II	
40	2888.82	II	
75	2889.66	II	
40	2892.49	II	
160	2894.45	II	
55	2896.04	II	
320	2897.44	II	
160	2898.86	II	
110	2901.54	II	
65	2903.24	II	
40	2907.10	II	
110	2910.30	II	
75	2911.77	II	
40	2912.65	II	
40	2913.39	II	
160	2914.75	II	
160	2915.30	II	
190	2915.60	II	
120	2916.24	II	
120	2918.89	II	
65	2919.00	II	
120	2924.16	II	
120	2924.53	II	3010 – 37193
65	2925.94	II	
75	2931.41	II	
160	2932.89	II	
75	2933.79	II	
55	2934.80	II	1016 – 35080
55	2936.39	II	
150	2940.05	II	
85	2941.70	II	
85	2944.90	II	
95	2945.70	II	
75	2946.87	II	
55	2949.04	II	
55	2950.04	II	
250	2956.21	II	
40	2957.32		
40	2957.70	II	
65	2960.58	II	0 – 33767
55	2962.78	II	
95	2963.97	II	
85	2964.76	II	
55	2965.32	II	
170	2968.87	II	
40	2974.15	II	
170	2977.78	II	
40	2981.99	II	
110	2987.03	II	

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
110	2988.57	II	
40	2989.84	II	
85	2991.96	II	
50	2992.54	II	
130	2996.00	II	
110	2999.03	II	
75	3002.45	II	
85	3004.58	II	
130	3005.52	II	
55	3007.11	II	
170 -	3009.30	II	
55	3010.12	II	
230	3010.59	II	
65	3013.61	II	
230	3016.18	II	
130	3019.17	II	
170	3020.29	II	
55	3021.95	II	
110	3023.43	II	
75	3023.70	II	
170	3027.33	II	
50	3027.58	II	
85	3029.23	II	
230	3031.60	II	
85	3032.83	II	
75	3034.09	II	
85	3034.91	II	
50	3037.04	II	
85	3038.66	II	
50	3042.07	II	
50	3042.50	II	
40	3042.83	II	
95	3043.65	II	
230	3044.96	II	
50	3047.00	II	
50	3050.57	II	
190	3051.13	II	
95	3052.18	II	
130	3053.24	II	
460	3053.55	II	
50	3061.80	II	
130	3062.78	II	
230	3064.09	II	
50	3064.51	II	
50 h	3065.17	II	
110	3065.69	II	
75	3065.86	II	
230	3067.20	II	
270	3069.03	II	
460	3070.05	II	
270	3072.60	II	
55	3074.71	II	
95	3076.06	II	
670	3078.86	II	
65	3080.11	II	
95	3081.55	II	
65	3082.01	II	
480	3082.36	II	
75	3083.81	II	
65	3085.99	II	
120	3086.78	II	
65	3087.54	II	
250	3088.43	II	
50	3089.10	II	
480	3089.58	II	
95 d	3091.62	II	
95	3092.96	II	
65	3093.20	II	
95	3096.86	II	
50	3097.40	II	
230	3102.54	II	
480	3102.96	II	
95	3108.41	II	
65	3109.15	II	
65	3109.82	II	
65	3112.43	II	
50	3112.53	II	
75	3113.62	II	
50	3116.66	II	
75	3117.26	II	3010 – 35080
290	3117.89	II	
290	3119.62	II	
95	3121.43	II	
230	3121.94	II	
75	3122.83	II	
230	3123.05	II	
50	3124.02	II	
160	3124.54	II	
95	3126.16	II	
50	3128.88	II	
110	3131.35	II	
250	3134.26	II	
95	3135.35	II	
95	3137.22	II	
50	3138.63	II	
440	3139.64	II	
190	3140.06	II	1016 – 32853
85	3143.38	II	
230	3145.22	II	
150	3146.67	II	
310	3147.04	II	
310	3147.15	II	
65	3148.21	II	
310	3148.71	II	
65	3154.69	II	
65	3155.10	II	
120	3155.62	II	
50	3156.52	II	
50	3157.49	II	
75	3158.66	II	
95	3159.22	II	
95	3159.39	II	
130	3162.42	II	
290	3162.93	II	
95	3163.85	II	
75	3164.10	II	
95	3164.77	II	
190	3165.74	II	
380	3167.52	II	
140	3168.32	II	
50	3168.59	II	
230	3169.84	II	
95	3171.19	II	
190	3173.76	II	
380	3174.66	II	
75	3175.45	II	
50	3179.84	II	
380	3180.54	II	
50	3181.22	II	
95	3183.28	II	

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
95	3183.64	II	
140	3183.88	II	
95	3186.23	II	
480	3187.26	II	0 – 31365
290	3188.03	II	
95	3188.55	II	
50	3188.83	II	
95	3189.97	II	
50	3190.72	II	
65	3192.76	II	
50	3194.18	II	
190	3194.69	II	
380	3195.60	II	
50	3198.02	II	
480	3199.56	II	
150	3200.73	II	
95	3202.70	II	
65	3202.95	II	
75	3207.09	II	
130	3207.53	II	
95	3207.96	II	
65	3209.54	II	
50	3210.01	II	
150	3210.22	II	
95	3215.01	II	
1100	3218.93	II	
1200	3219.98	II	
95	3220.17	II	
50	3222.37	II	
95	3222.97	II	
50	3227.48	II	
150	3229.19	II	
250	3230.03	II	
250	3231.06	II	
95	3231.46	II	
85	3232.00	II	
50	3232.73	II	
95	3234.50	II	
110	3235.78	II	0 – 30895
95	3236.20	II	
210 d	3239.60	II	
250	3240.00	II	
190	3240.65	II	
75	3243.20	II	
50	3244.60	II	
95	3245.17	II	
50	3245.42	II	
50	3247.18	II	
65	3249.61	II	
50	3250.75	II	
50	3250.95	II	
150	3251.25	II	
480	3252.32	II	
65	3253.54	II	
65	3255.22	II	
95	3259.38	II	
190	3260.05	II	
50	3260.66	II	
95	3260.83	II	
190	3261.74	II	
95	3262.68	II	
250	3262.97	II	
50	3263.65	II	
230 d	3263.87	II	
50	3264.06	II	
230	3264.90	II	
75	3265.93	II	
400	3266.40	II	
190	3268.10	II	
150	3268.52	II	
75	3270.63	II	
150	3272.35	II	1016 – 31566
250	3274.14	II	
250	3274.33	II	
65	3275.66	II	
210	3277.32	II	
110	3277.73	II	
760	3280.31	II	0 – 30476
760	3281.40	II	
520	3283.10	II	
50	3283.81	II	
1000	3285.04	II	
150	3285.21	II	
50	3286.98	II	
310	3287.55	II	
310	3291.56	II	
1500	3293.07	II	6372 – 36731
110	3294.00	II	1016 – 31365
210	3295.33	II	
110	3298.20	II	
310	3298.66	II	
110	3304.10	II	
110	3304.26	II	
210	3304.95	II	
110	3305.37	II	
75	3306.41	II	
420 d	3307.44	II	
85	3307.80	II	
210	3308.51	II	
110	3309.17	II	
50	3310.10	II	
75	3310.37	II	
110	3310.80	II	
150	3312.53	II	
150	3312.78	II	
210	3314.38	II	
50	3314.70	II	
110	3315.07	II	
50	3317.58	II	
110	3319.16	I	0 – 30119
340 d	3321.15	II	
420	3322.28	II	
210	3323.38	II	
210	3323.89	II	
3800	3324.40	II	
150	3325.49	II	1016 – 31078
110	3327.11	II	
520	3329.08	II	
110	3333.21	II	
120	3333.93	II	
110	3334.25	II	
210	3334.48	II	
110	3335.42	II	
250	3336.70	II	
310	3338.03	II	
250	3339.00	II	
120	3339.61	II	
50	3342.98	II	
120	3343.77	II	
50	3343.93	II	

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
50		3346.32	II	
210		3347.27	II	
210		3348.07	II	
85		3348.23	II	
150		3348.54	II	
760		3349.42	II	
180		3351.44	II	
180		3352.89	II	
50		3356.18	II	
120		3357.37	II	
50		3358.46	II	
110		3359.86	II	
50		3360.05	II	
50		3360.29	II	
320		3362.25	II	
110		3364.24	II	
85		3364.36	II	
760		3364.93	II	
110		3365.27	II	
150		3367.18	II	
230	d	3370.61	II	
320		3371.50	II	
520		3372.36	II	
460	d	3372.72	II	
190		3374.41	II	
520		3375.03	II	
110		3376.36	II	
160		3376.66	II	
190		3377.66	II	
110		3378.40	II	
320		3378.73	II	
520		3378.86	II	
85		3379.15	II	
160		3380.60	II	
85		3380.89	II	
320		3382.80	II	
110	d	3386.49	II	
85		3388.37	II	
55		3388.63	II	
110		3390.02	II	
210		3390.60	II	
380		3391.28	II	
75		3391.72	II	
160		3392.01	II	
55		3393.01	II	
160		3393.49	II	1016 – 30476
110		3394.77	II	
160		3395.02	II	
55		3397.60	II	
270		3398.35	II	
85		3398.58	II	
320		3399.10	II	
85		3399.30	II	
110		3399.97	II	
270		3400.53	II	
210	d	3400.86	II	
420		3402.33	II	
55		3402.78	II	
55		3404.24	II	
160		3404.71	II	
190		3406.01	II	
40		3407.10	II	
85		3408.86	II	
160	d	3409.94	II	
210		3410.40	II	
210		3410.68	II	3542 – 32853
520		3413.76	II	
270		3416.24	II	
85		3417.72	II	
55		3417.91	II	
55		3418.86	II	
55		3418.95	II	
85		3419.54	II	
400	d	3420.34	II	
190		3422.44	II	
75		3423.05	II	
110		3423.96	II	
190	d	3424.35	II	
110		3424.66	II	
55		3425.92	II	
110	d	3428.16	II	
55		3428.71	II	
55		3429.09	II	
210		3430.61	II	
55		3431.86	II	
110		3432.35	II	
110		3432.90	II	
320		3433.26	II	
55		3434.54	II	
75		3434.92	II	
75		3435.53	II	
85		3436.97	II	
190		3438.57	II	
75		3439.05	II	
270		3439.72	II	
520		3440.37	II	
75		3441.68	II	
320		3444.58	II	
210		3446.40	II	
270		3449.46	II	
110		3450.30	II	
110		3452.37	II	
75		3453.46	II	
810		3454.06	II	
110		3455.35	II	
55		3455.99	II	
110		3456.55	II	
160	h	3457.03	II	
190		3458.71	II	
380		3460.38	II	
190		3461.00	II	
230	d	3462.97	II	
55		3464.63	II	
110		3465.98	II	
75		3466.92	II	
620		3468.03	II	
110		3469.70	II	
75		3469.85	II	
160		3470.36	II	
270		3471.73	II	
270		3472.37	II	
810	d	3472.79	II	1016 – 29803
210		3473.00	II	
55		3473.28	II	
75		3473.79	II	
55		3475.72	II	
110		3476.12	II	
110		3476.29	II	
55		3479.29	II	
380		3480.17	II	

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
85		3481.50	II	
75		3482.80	II	
230		3483.04	II	
230		3483.69	II	
110		3487.28	II	
85		3487.62	II	
290	d	3489.51	II	0 – 28649
110		3489.78	II	
75		3491.24	II	6372 – 35007
210	d	3492.00	II	
160		3492.56	II	
110		3492.99	II	
270		3494.21	II	
160		3494.92	I	285 – 28890
270		3495.36	II	
55		3496.20	II	
160		3499.33	I	
160		3500.28	II	0 – 28561
810		3500.84	II	3010 – 31566
95		3504.04	II	
140		3504.75	II	
110		3505.09	II	
270	d	3505.90	II	
75		3506.56	II	
570		3507.45	II	6372 – 34875
5700		3509.17	II	0 – 28488
380		3510.10	II	
95		3511.04	II	
160		3512.60	II	
320		3513.10	II	
290		3513.86	II	
290		3515.04	II	
110		3515.44	II	
210		3516.14	II	6372 – 34804
160		3516.63	I	462 – 28890
160		3518.97	I	509 – 28919
570		3519.76	II	
160		3520.79	II	
55		3522.92	II	
55		3523.20	II	
1300		3523.66	II	
380		3525.14	II	
440		3525.61	II	3010 – 31365
160		3525.79	II	
85		3526.73	II	
110		3529.76	II	
210		3531.70	II	
160		3532.70	II	
140		3533.86	II	
440		3536.32	II	
85		3536.62	I	1371 – 29638
230		3537.11	II	
110		3537.69		
570		3537.94	II	
140		3538.90		
140		3539.81		
1100		3540.24	II	
110		3541.75		
290		3543.23	II	
810		3543.89	II	0 – 28209
95		3544.36	II	
55		3545.40	II	
75		3546.05	II	
290		3546.52		
110		3548.82		
55		3549.21		
150		3549.36	II	
310	d	3551.03		
320		3551.96	II	
160		3555.29		
55		3556.05		
110		3556.25		
75		3558.09		
460	d	3558.77		
55		3559.14		
290		3559.39	I	285 – 28372
230		3559.76	II	
3200		3561.74	II	3010 – 31078
480		3562.90	II	
160		3565.34		
570		3565.74		
810		3567.35	II	3542 – 31566
4200		3568.52	II	0 – 28014
1600		3568.98	II	
320		3572.07	II	
160		3575.90	I	3174 – 31131
160		3576.64		
230		3576.83	I	2840 – 30789
230		3577.08		
110		3578.70		
1100		3579.20	II	
710		3585.03	II	3010 – 30895
570		3587.44	II	
110		3587.76	I	5484 – 33348
110		3589.53		
55		3591.39		
110		3591.66	II	
230	cw	3593.07	II	3542 – 31365
110		3593.75		
75		3594.65	I	285 – 28096
110		3594.98	II	
810		3596.38	II	
440		3598.06	II	
190		3600.04		
1600		3600.44	II	
110		3601.75	II	
320		3604.90	II	
290		3606.04	II	
290		3606.16	II	
55		3608.25	II	
320		3611.33	II	
270		3611.41	II	5171 – 32853
160		3613.06	II	
95		3613.36	II	
230		3613.68	II	6912 – 34577
320		3614.63	II	
320	d	3615.66	II	
320		3616.58	II	
380		3617.86	II	1016 – 28649
160		3618.18	II	
110		3618.90	II	
380		3619.73	II	5234 – 32853
130		3622.11	II	
290		3623.92	II	
110		3624.80	II	
810		3625.54	II	
570		3626.50	II	
160		3626.87	II	
290	d	3628.20	II	
380		3629.44	II	1016 – 28561

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
290	3630.28	II	
110	3631.46	II	
670	3633.29	II	5171 – 32687
190	3635.42	II	
670	3638.46	II	
160	3638.89	I	462 – 27935
290	3639.82	II	3010 – 30476
670	3641.66	II	5234 – 32687
290	3642.68	II	
75	3643.26	II	
75	3643.76	II	
95	3644.13	II	
230	3645.38	II	
110	3645.82	II	
95	3646.46	II	
440	3647.06	II	
570	3647.75	II	
95	3649.41	II	
2300	3650.40	II	
290	3650.93	II	
230	3651.86	II	
230	3652.26	II	
190	3652.97	II	
160	3653.87	II	
810	3654.88	II	3542 – 30895
240	3658.22	II	
2000	3658.88	II	1016 – 28339
120	3659.45	II	
100	3660.44	II	
200	3660.75	II	
450	3663.12	II	
90	3665.60	II	
40	3668.00	II	
80	3668.50	II	
260	3669.64	I	285 – 27528
100	3674.05	II	
220	3675.78	II	5171 – 32369
3800	3676.35	II	1016 – 28209
300	3677.89	II	
100	3678.78	II	
810	3682.26	II	
220	3684.81	II	
320	3688.15	II	
240	3689.12	II	
120	3689.72	II	
610	3691.15	II	
300	3692.95	II	
450	3693.58	I	462 – 27528
140	3694.75	II	
170	3696.30	II	
320	3696.85	II	
200	3699.33	II	
450	3700.12	I	509 – 27528
200	3701.15	I	462 – 27473
150	3701.33	I	285 – 27295
80	3701.50	II	
4700	3702.86	II	1016 – 28014
300	3703.12	I	
80	3703.50	II	
2400	3703.92	II	
240	3705.06	I	509 – 27492
280	3706.34	II	
100	3706.80	I	3819 – 30789
100	3708.42	I	462 – 27420
180	3708.76	II	
370	3709.30	II	
1000 d	3711.76	II	3542 – 30476
80	3714.37	II	
140	3716.08	II	
200	3716.43	II	
100	3717.47	II	
80	3717.90	I	509 – 27399
40	3718.24	II	
180	3718.44	II	
300	3719.45	II	
140	3723.04	II	5171 – 32023
45	3723.84	II	
140	3724.92	I	
85	3725.32	II	
75	3728.65		
130	3728.96		
650	3729.91	II	
85	3731.00	I	
150	3731.52	I	2419 – 29210
430	3732.39	II	
85	3732.65	I	6989 – 33772
130 d	3734.80		
	3735.04		
45	3738.45		
170	3740.32		
220	3741.24		
220	3741.58	II	
260	3741.89		
170 d	3742.43		
430	3743.09		
170	3743.64	I	
650	3745.04	I	1371 – 28065
75	3746.30	I	3719 – 30405
220	3746.54		
870	3747.17	II	
870	3747.34	II	
85	3748.80	II	
130	3749.70	I	2310 – 28971
75 d	3750.24	I	3174 – 29832
45	3751.35	I	6989 – 33638
45	3751.62		
85	3753.00	I	4695 – 31333
85	3753.52		
1100	3755.24	II	
45	3757.05	I	2310 – 28919
430	3757.44	II	3542 – 30148
430 d	3757.90	II	
650	3759.35	I	2840 – 29433
85	3760.02	I	1371 – 27959
120	3760.13	I	5484 – 32071
350	3761.14	I	2310 – 28890
65	3762.51	I	
65	3762.74		
85	3763.96	I	6351 – 32911
1700	3765.14	I	509 – 27061
200	3767.50	II	
85	3769.43	I	
45	3771.03		
160	3775.26	II	6372 – 32853
2100	3776.49	II	
120	3777.48		
330	3779.22		
65	3782.18		
55	3782.62	I	
600	3783.53	I	285 – 26708

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
55		3784.15	I	
120		3785.38		
410	d	3787.22	II	3010 – 29407
120		3787.60		
85		3787.71	I	
160		3789.00		
120		3789.68		
410		3789.92	I	
120		3791.05	I	2840 – 29210
390		3792.20	I	5353 – 31715
75		3793.25		
600		3793.55		
130		3796.25	I	3719 – 30054
75		3797.00	I	5829 – 32159
160		3798.59		
200		3798.95	II	
75	h	3801.36		
330		3801.80	II	
160		3802.17	II	
120		3804.42	I	509 – 26787
95		3806.26		
760	d	3806.85	II	3542 – 29803
40	d	3810.57		
240		3811.65	I	
240		3812.73		
240		3813.16		
150	d	3814.96		
120		3816.27		
240		3816.89		
150		3820.11	II	
75		3821.00	I	509 – 26673
120		3823.12	I	2840 – 28989
65		3824.14		
75	h	3826.74		
65		3828.74	1	2310 – 28421
1500		3830.26	I	285 – 26386
75		3832.63	1	2419 – 28503
540		3833.42	1	2840 – 28919
180		3834.02	I	509 – 26584
75		3837.18	I	
150		3837.83	1	285 – 26334
920	d	3842.50	II	
180		3842.98		
370	d	3845.61	II	6372 – 32369
180		3847.88	1	5425 – 31406
3700		3848.73	II	0 – 25975
45		3849.59	I	509 – 26479
110	w	3851.37		
260		3851.86	II	
75		3855.38	I	4646 – 30577
170		3855.58	II	
140		3868.90	II	
450	d	3869.75	II	
85		3873.00	I	285 – 26098
210		3873.78	II	
3500	w	3874.17	II	0 – 25804
240		3875.22	II	
65		3876.69	I	509 – 26297
130		3878.23	II	
95		3879.99	I	
95		3880.35	I	
95		3881.29	1	285 – 26043
260		3881.76	II	
330		3883.34	I	509 – 26253
200		3885.09	I	1371 – 27103
260		3886.82	II	
160	d	3887.64	II	1016 – 26731
160		3887.88	I	2840 – 28554
480		3888.22	I	
95		3889.84	II	
65		3890.95	I	
160		3893.38	II	
65		3893.69	I	6488 – 32163
160		3894.46	II	
490		3894.64	I	3719 – 29388
65		3895.08	I	4646 – 30313
65		3895.37	I	6351 – 32016
330		3895.99	I	2840 – 28500
330		3896.58	II	
45		3897.26	I	1371 – 27023
330		3897.89	I	509 – 26157
2400		3899.20	II	3010 – 28649
160		3899.57	II	
130		3900.74	I	2419 – 28048
1600		3901.33	I	462 – 26087
95		3901.68	II	
95	d	3902.00	II	
30		3903.08	I	3819 – 29433
75		3904.17	I	3719 – 29326
55		3906.54	II	
480		3908.06	I	462 – 26043
65		3908.68	I	285 – 25862
380		3909.14	I	285 – 25859
330		3909.55	I	5830 – 31401
95		3910.14	II	
160		3910.40	I	
160		3910.84	I	
110		3912.26		0 – 25553
75		3912.77	II	
280		3913.48	I	7060 – 32605
150		3914.63	I	2310 – 27848
650		3915.43	I	285 – 25818
65		3916.64	I	3719 – 29244
45		3916.94	I	5425 – 30948
75		3917.30	I	285 – 25806
95		3918.78	II	
75		3919.02	I	3174 – 28684
480		3919.52	II	6372 – 31879
150		3920.72	II	
300		3922.10	II	
480		3922.74	II	
150		3923.31	II	
65	d	3924.42	II	
110		3924.81	II	
760		3925.45	II	5171 – 30639
65		3929.75	I	
75		3929.89	I	285 – 25724
55		3930.76	II	
220		3932.35	I	3719 – 29142
130		3934.38	I	
650		3935.24	II	
65		3937.13	I	5829 – 31221
160		3937.61	I	2310 – 27699
65		3938.07	I	1371 – 26757
810	d	3939.52	II	0 – 25376
260		3941.21	II	
220		3942.21	II	
110		3942.93	I	2310 – 27664
95		3943.66	I	509 – 25860
160		3944.88	II	

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
650		3946.89	II	3010 – 28339
45		3947.25	I	7824 – 33151
260		3948.35	II	
65		3949.51	II	
210		3950.13	I	509 – 25818
210		3950.43	I	3819 – 29126
65		3951.87	I	
210		3954.05	I	
45		3955.65	I	
65		3956.18	II	
170		3957.35	I	462 – 25724
280		3957.97	II	
350	d	3958.36	II	
30	h	3960.12	II	
65		3960.29	I	509 – 25753
95		3960.69	I	
30		3962.61	I	
170		3965.10	I	4646 – 29859
170		3965.95	II	
95		3967.22	II	3010 – 28209
220		3967.65	I	5353 – 30550
55		3969.93	I	2310 – 27492
170	d	3970.19	II	
220		3971.77	I	3719 – 28890
170		3972.06	II	
170		3974.29	II	
170		3974.67	I	5425 – 30577
2200	d	3976.84	II	0 – 25138
260		3981.16	II	6912 – 32023
1800		3981.87	II	3542 – 28649
300		3983.85	II	
260		3984.05	II	
150		3984.84	II	
150		3985.12	II	
260		3986.35	II	
150		3987.66	I	1371 – 26441
75		3989.48	I	
55		3990.22	I	6352 – 31406
220		3990.63	I	5353 – 30405
75	d	3991.58	I	3174 – 28220
180	d	3993.54	I	
85		3995.12	I	1371 – 26394
75	d	3995.80	II	
150		3997.43	II	
150		3998.40	II	
110		3998.87	I	509 – 25509
65		3999.24	II	
350		3999.40	II	
150		4000.01	II	6372 – 31365
180		4001.26	I	2310 – 27295
350	d	4002.19	II	
970		4002.59	II	5171 – 30148
110		4003.78	II	
65		4003.91	II	
75		4004.52	II	
1900		4005.47	II	1016 – 25975
110		4005.97	II	
150		4009.18	I	2419 – 27355
150		4009.56	II	
300		4010.04	I	1371 – 26301
150		4010.85	I	285 – 25210
760		4012.75	II	5234 – 30148
150		4012.86	II	
330		4013.26	I	2310 – 27220
75		4017.85	II	
110		4018.45	I	6488 – 31366
370		4019.14	II	
540		4020.47	II	
220		4022.88	I	
180	d	4024.10	II	
370		4024.77	I	509 – 25349
170		4025.73	II	5234 – 30068
170	d	4028.31	II	
85		4028.59	I	
520		4031.66	II	
870		4032.28	I	2310 – 27103
140	d	4032.62	I	285 – 25076
		4032.70	I	3174 – 27964
2100		4033.03	II	1016 – 25804
350		4036.22	I	3719 – 28488
45		4036.46	II	
210		4038.86	I	1371 – 26123
30		4039.21	II	
150		4039.48	I	462 – 25210
150		4040.10	I	
130		4040.41	II	
65		4041.84	I	8097 – 32832
95		4042.34	II	
45		4043.67	II	
65		4045.35	I	2024 – 26737
150		4047.14	I	509 – 25211
65		4048.80	I	2840 – 27532
55		4049.87	II	
65		4051.49	II	
300		4051.86	II	
300		4052.87	II	3542 – 28209
150		4053.96	I	462 – 25122
430		4054.12	I	
410		4060.37	I	509 – 25131
220		4060.87	II	
1300		4061.58	I	462 – 25076
220		4063.89	II	
390		4066.22	II	
150		4070.10	I	2840 – 27402
110	d	4070.54	II	
55		4070.71	I	8097 – 32656
110		4071.21	I	509 – 25065
130	d	4072.69	I	2419 – 26966
110		4073.75	II	
75		4073.94	I	285 – 24824
130		4074.16	I	3819 – 28358
260		4075.22	I	
95		4078.47	II	
55	d	4078.79	I	3174 – 27684
390		4081.24	I	
27	h	4082.24	II	
130		4082.79	I	3819 – 28306
110		4083.21	I	285 – 24769
110		4084.27	I	2310 – 26787
110		4084.82	I	2840 – 27314
210		4086.60	I	
45		4087.70	II	
120		4089.34	I	2310 – 26757
55		4089.51	II	
65	d	4091.30	I	4018 – 28453
		4091.42	I	5425 – 29859
210		4092.19	I	7839 – 32270
130		4094.03	I	2840 – 27259
260		4094.37	II	
260		4094.49	I	285 – 24701

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
120		4095.91	I	4018 – 28426
95		4097.36	II	
110		4097.48	II	
55		4098.62	II	
45		4099.15		
75	d	4099.48	II	
130	d	4100.90	I	
130		4101.65	I	
85		4102.53	II	
75		4103.21	I	3705 – 28070
170		4103.36	I	2310 – 26673
85		4103.46	I	462 – 24824
260		4103.90	II	1016 – 25376
650		4105.37	I	285 – 24637
45		4106.35	I	3719 – 28065
55		4107.79	I	3819 – 28157
55		4110.09	I	7839 – 32163
55		4110.86	I	7839 – 32159
300		4112.50	I	509 – 24819
130		4112.88	I	462 – 24769
55	h	4114.13	II	
55	d	4115.36	II	
110		4117.23	I	1371 – 25652
55		4118.36	I	2310 – 26584
260		4119.92	I	509 – 24775
110		4120.51	II	
85		4121.03	I	3705 – 27964
110		4122.47	I	3819 – 28070
85		4126.71	I	6351 – 30577
140		4127.29	I	3719 – 27942
140		4130.14	I	285 – 24491
55		4131.11	I	
140		4131.45	I	
45		4132.23		
140		4132.48	I	509 – 24701
85		4132.83	I	5353 – 29543
55		4133.51	I	8646 – 32832
55	d	4134.32	I	3174 – 27355
130		4135.37	I	462 – 24637
40		4136.47	I	
40		4137.03		
55		4139.06	I	285 – 24438
140		4139.78	I	509 – 24658
140		4141.55	I	1371 – 25509
55		4142.43	I	3174 – 27308
55		4143.24	I	3719 – 27848
280		4143.51	I	509 – 24637
140		4143.63	I	2840 – 26966
1100		4144.41	II	1016 – 25138
110		4146.96	I	285 – 24392
45		4148.21	II	
110		4149.17	II	
55		4150.54		
55		4150.87	I	3174 – 27259
85		4152.24	I	2840 – 26916
85		4156.28	I	6351 – 30405
55		4158.28	II	
350		4158.53	I	285 – 24325
120	cw	4161.35	I	
55		4166.51		
240		4169.09	I	3719 – 27699
240		4169.32	I	1371 – 25349
120		4169.91	I	4695 – 28670
85		4170.48	I	
240		4171.05	I	2840 – 26808
150		4171.80	I	5425 – 29388
240		4172.60	I	6989 – 30948
240		4172.82	I	285 – 24243
260		4173.47	I	
65		4175.05	I	3719 – 27664
85		4175.85	I	
150	d	4178.98	II	
65		4179.79	II	
180		4180.40	I	
85		4181.33	II	
180		4184.29	I	3719 – 27611
65		4185.91	I	509 – 24392
240		4186.21	I	
300		4187.16	I	
180		4188.11	I	1371 – 25241
75		4188.51	II	
150		4191.08	I	509 – 24363
180		4191.59	I	3174 – 27025
55		4193.35	I	1371 – 25211
75		4194.01	I	6989 – 30826
390		4196.74	I	
85		4198.43	I	2419 – 26231
65		4198.98	I	3719 – 27528
65		4199.05	I	2310 – 26118
450		4201.00	II	
650		4203.74	I	2310 – 26091
600		4206.49	I	
65		4206.90	I	285 – 24049
120		4207.54	I	1371 – 25131
65		4208.65	I	2840 – 26594
55		4208.73	I	3719 – 27473
300	cw	4213.50	I	4695 – 28422
300		4214.42	II	3010 – 26731
480		4215.09	I	5425 – 29142
95	h	4216.67	I	
300		4217.56	I	
95		4218.84	I	2310 – 26006
260		4219.16	I	1371 – 25065
85		4220.10	II	
55		4221.37	I	2840 – 26522
95		4222.70	I	1371 – 25046
75		4223.32	II	
260		4224.28	I	285 – 23951
480	cw	4226.45	II	0 – 23653
85		4230.62	I	3819 – 27450
65		4231.35	I	462 – 24088
260		4231.89	I	462 – 24085
180		4232.19	II	
480		4232.82	I	5353 – 28972
65		4234.22	I	4695 – 28306
300		4235.35	I	285 – 23889
160		4239.28	I	509 – 24092
95		4239.91	I	509 – 24088
95		4242.56	II	
95		4245.14	I	2310 – 25860
130		4246.59	I	462 – 24003
65		4248.57	II	
55		4250.26	II	
130		4251.33	I	6351 – 29867
130		4251.72	II	
95		4252.70	I	6351 – 29859
65		4254.04	I	3719 – 27220
370		4255.24	I	509 – 24003
95		4256.10	I	2419 – 25908
480		4258.23	II	5171 – 28649

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
55		4261.84	I	2840 – 26297
260		4263.66	I	509 – 23957
65		4264.72	I	509 – 23951
75		4264.98	I	2840 – 26280
650		4266.34	I	
330		4269.69	I	2310 – 25724
95		4271.53	I	285 – 23689
95		4272.21	I	2840 – 26240
220		4275.21	I	
110	d	4276.75	II	3010 – 26385
95		4277.77	I	
760	cw	4278.52	II	
300		4285.13	II	
65		4285.75	II	
65		4286.13	II	
120		4286.91	II	
150		4287.11	I	
300		4289.70	I	
65	h	4293.13	I	6351 – 29638
65	h	4294.04	I	
150		4295.34	I	2310 – 25584
85		4296.30	I	7824 – 31093
370		4298.36	I	462 – 23720
300		4299.90	I	
65		4301.15	I	
240		4302.95	I	
120		4304.00	I	462 – 23689
65		4304.27	I	
240		4307.18	I	509 – 23720
150	d	4308.68	II	
450		4310.42	I	6674 – 29867
75		4310.96	II	
85		4311.29	I	
300		4311.56	I	462 – 23649
110		4312.08	II	
370		4313.25	I	
120	h	4313.41	I	
150		4315.73	I	
2200		4318.83	I	0 – 23147
150		4320.26	I	285 – 23425
55		4321.49	I	
600		4322.23	I	
170		4322.87	I	462 – 23588
85	d	4323.66	II	
120		4325.50	I	
600		4325.83	II	
85		4326.14	I	285 – 23394
3000		4326.43	I	0 – 23107
240		4328.90	I	
85		4330.31	I	5829 – 28916
600		4332.12	I	
55		4333.69	I	2840 – 25908
150		4334.65	I	5425 – 28488
870		4336.43	I	2771 – 25825
600		4337.64	I	
1700		4338.41	I	0 – 23043
150		4339.62	I	6351 – 29388
85		4339.87	I	
700		4340.62	I	
110		4341.00	I	
430	cw	4342.53	I	1371 – 24392
55	h	4343.85	I	2419 – 25433
45		4344.21	II	
55		4346.49	I	
110		4349.60	I	
55	h	4350.74	I	2840 – 25818
55		4351.60	II	
55		4351.72	II	
430	d	4353.20	II	3010 – 25975
280		4356.09	I	7839 – 30789
870		4356.81	I	2771 – 25717
45		4357.46	I	285 – 23228
280		4360.16	I	509 – 23438
55	w	4362.44	I	2310 – 25226
45		4366.00	II	
220		4367.30	II	6912 – 29803
220		4372.02	I	2771 – 25637
55		4374.43	I	3819 – 26673
55		4376.43	II	3542 – 26385
85		4381.29	I	285 – 23103
330		4382.45	I	4646 – 27458
45		4384.06	II	
130		4385.68	I	
130		4386.08	II	
300		4388.23	I	2771 – 25553
55	h	4389.81	I	
260		4390.91	I	509 – 23277
45		4392.96	I	8190 – 30948
55		4394.03	I	462 – 23213
45		4394.92	II	
180		4396.56	I	
45		4401.54	II	
75		4403.18	I	2310 – 25014
75		4405.40	II	
55		4406.76	I	
95	d	4409.52	II	
55		4411.14	I	
55		4411.93	I	4695 – 27355
55		4413.63	I	
200		4416.27	II	1016 – 23653
140		4420.19	I	
350		4423.10	I	2771 – 25373
45		4427.34	I	1371 – 23951
45	d	4430.13	II	
95		4430.66	I	
110		4432.72	I	6488 – 29041
95		4434.47	II	
75		4435.01	I	
75		4435.55	II	
240		4436.12	I	
95		4438.97	II	
110		4439.38	I	
45		4441.27	II	
75	h	4441.45	I	2840 – 25349
240		4448.04	I	
85		4451.63	I	
85	d	4452.82	I	
45	h	4459.38	II	
45		4461.27	I	
110		4467.69	I	
65		4469.12	I	
45		4471.72	II	
40		4485.68	I	
85		4488.16	I	
65		4491.01	I	
430		4493.07	I	
45		4499.47	I	
45	d	4509.04	II	
150	h	4511.52	I	
45		4512.96	II	

559-795 O - 75 - 20 (Pt. 1)

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
75		4514.31	II	
45		4519.72	II	
45		4525.01	II	
45		4529.76		
45	h	4531.83	II	
45		4534.13	I	8646 – 30695
45		4537.14	I	6488 – 28522
45		4537.23	I	3719 – 25753
110		4549.07	I	3819 – 25796
45		4549.72	II	
110		4550.45	I	
110		4556.46	I	
55		4562.24	II	
110		4563.69	II	
30		4564.85	II	
55		4573.19	II	
210		4578.69	II	3542 – 25376
65		4584.84	II	
65		4591.56	II	
45		4592.38	I	509 – 22279
45	h	4604.10	II	
30		4611.96	I	8190 – 29867
45	h	4615.92	II	
27		4617.49	I	2840 – 24491
30		4619.36	II	
75	d	4626.32	II	
95		4626.94	II	
65		4632.07	I	8277 – 29859
65	h	4636.59	I	8506 – 30068
30		4636.99	II	5171 – 26731
85		4641.00	II	
210		4641.98	II	
260	cw	4645.31	II	0 – 21521
80		4647.23	I	8190 – 29702
60		4658.38	I	8277 – 29737
20		4658.73		
80		4662.79	I	4646 – 26087
50	c	4665.45	I	4695 – 26123
40		4669.40	I	2310 – 23720
80		4676.90	I	
70	c	4681.87	I	8506 – 29859
50		4682.52	I	462 – 21812
25	c	4682.79	II	
80		4688.63	II	
80		4693.11	II	
30	h	4693.39	II	
200		4702.41	II	
110		4707.94	II	
40	w	4716.07	II	
40		4728.16	II	
60	cw	4734.20	I	2840 – 23957
80		4739.93	I	8646 – 29737
70		4747.80	I	8646 – 29702
410	cw	4752.53	II	0 – 21035
40		4758.44	II	
40		4760.19	II	
30		4762.37	II	1016 – 22008
25		4764.47	II	
35		4778.36	II	
35		4778.80	II	
180		4786.78	I	2840 – 23725
40	cw	4789.91	II	6372 – 27244
30		4801.87	II	
100		4813.77	I	
60		4837.59	II	
25		4840.39	I	
30	c	4842.69	II	
30		4844.89	II	
30		4854.81	I	9145 – 29737
20		4856.54	II	
30		4858.87	II	
80		4875.57	II	1016 – 21521
25		4876.12	II	
80		4881.15	II	
29		4894.33		
95		4915.90	I	
35		4924.09	I	
35		4926.83	I	4646 – 24938
50		4928.93	I	
65		4931.79	I	285 – 20556
19		4940.72	II	
19		4959.93	II	
19		4962.28	II	
29		4970.99	II	
29		4971.42	I	
29		4973.04	I	
29		4980.16	II	
29		4980.56	I	462 – 20534
85		4993.82	II	1016 – 21035
50		4995.84	II	
55		4997.95	I	2840 – 22843
19		5004.84	I	2419 – 22394
29		5006.10	II	
50		5022.16	I	6488 – 26394
29		5024.24	II	
29		5024.65	I	9145 – 29041
50		5033.12	I	
50	w	5042.06	II	
55		5054.30	I	
55		5065.79	I	6351 – 26086
110		5078.25	I	
24		5080.05	II	
24		5081.11	I	
19		5081.80	I	3819 – 23492
75		5089.12	II	
24		5089.66	I	
24		5101.09	I	
24		5108.56	I	
35		5118.39	I	3175 – 22707
24		5120.18	I	509 – 20035
19		5121.61	II	
50	w	5131.69	I	
50	w	5141.08	II	
50		5147.58	I	8190 – 27611
24		5164.27	I	9145 – 28503
29		5170.13	I	4695 – 24032
24		5170.61	I	8277 – 27611
50		5176.51	I	285 – 19598
50		5179.97	I	8277 – 27576
50		5184.59	I	8190 – 27473
85		5186.13	I	8646 – 27923
50		5188.48	I	8190 – 27458
50		5198.86	I	8190 – 27420
35	w	5202.77	I	8277 – 27492
40		5204.55	I	8190 – 27399
40		5207.97	I	8277 – 27473
19		5209.34	II	
40		5214.28	I	
40		5221.99	I	462 – 19606
120		5228.12	I	8277 – 27399

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
40		5235.11	I	509 – 19606
75		5248.71	I	285 – 19332
75	w	5262.11	II	3010 – 22008
13		5264.92		
19	w	5272.07	II	
24		5275.03	I	8506 – 27458
75		5281.05	I	8646 – 27576
13		5287.30	I	2310 – 21218
65		5304.72	I	8646 – 27492
29		5308.19	I	
29		5309.46	I	5829 – 24658
110		5319.23	I	285 – 19080
15		5322.11	II	
15		5323.92	I	9145 – 27923
15		5329.05	I	4695 – 23455
35		5331.04	I	8646 – 27399
11		5332.58	I	10456 – 29204
65	w	5337.90	I	
35	d	5338.59	I	
15		5346.04	I	462 – 19162
24		5347.83	II	1016 – 19710
160		5354.88	I	462 – 19131
10		5363.62	I	2840 – 21479
75		5369.72	I	462 – 19080
75		5375.98	I	285 – 18882
19	w	5377.88	II	
15		5397.90		
29	d	5402.06	II	5171 – 23678
15		5403.82	II	
29		5413.65	I	
29		5416.20	I	
50		5424.10	II	
19		5425.00	I	
29	c	5426.43	I	
13		5427.47	I	462 – 18882
13		5432.45	II	
13		5437.10	I	
13		5438.12	I	2840 – 21223
35		5443.38	I	
29		5457.00	I	1371 – 19691
55		5459.81	I	
19		5464.39	I	509 – 18805
29	w	5470.34	II	
11		5476.96	I	
24		5481.45	I	
11		5488.26	II	
11		5500.10	I	285 – 18461
55		5509.61	I	462 – 18607
50		5514.54	I	
65		5524.12	I	509 – 18607
24	c	5525.62	I	3719 – 21812
11		5536.26	II	
11		5556.30	II	
35		5565.93	I	1371 – 19332
11		5572.82	I	1371 – 19310
19		5586.96	I	
19		5589.56	I	
11		5591.62	II	
11		5621.55	II	
19		5636.56	I	
29	c	5638.80	I	
19	c	5645.75	I	
19		5671.84	I	510 – 18136
29	c	5685.74	II	
40	c	5686.48	I	8506 – 26087
17		5712.45	II	
85	c	5747.58	I	
9		5761.62	II	
24		5762.66	I	285 – 17634
24		5785.18	II	6372 – 23653
75		5795.64	I	
75		5803.13	II	11261 – 28488
65		5815.36	I	
29		5842.97	I	
65		5851.07	I	
65		5870.62	I	
35		5898.84	I	
24		5902.40	I	
35		5904.71	I	
15		5910.10	I	
65	c	5920.78	I	
15		5937.09	I	
50	c	5939.38	I	
35		5940.17	I	
24		5951.17	I	2840 – 19639
15		5951.78	I	
19		5961.00	II	
75		5967.34	II	11261 – 28014
15	c	5979.83	I	
11		6010.65	II	
15		6019.24	I	509 – 17118
29		6038.97	I	
29		6039.38	I	
15		6061.83	I	8277 – 24769
15		6077.84	II	12200 – 28649
15		6084.34	I	7839 – 24271
15		6093.99	II	
24		6104.29	II	
13		6106.03	I	5829 – 22202
13		6134.39	I	2310 – 18607
13		6137.00	II	
13	c	6156.29	I	3719 – 19958
11		6171.88	II	13605 – 29803
11		6193.64	I	6351 – 22493
11		6194.52	II	12200 – 28339
11	c	6195.14	I	10456 – 26594
10		6218.4	II	
13		6222.25	I	4695 – 20762
10		6225.95	II	
11	h	6272.36	I	3719 – 19658
24	c	6292.43	I	4646 – 20534
19		6303.78	II	
10		6317.82	I	462 – 16286
19		6321.59	II	12200 – 28014
19		6322.33	II	
35		6331.68	II	
24		6334.91	II	
10		6336.83	I	509 – 16286
11		6337.85	II	
9		6356.40	II	
9		6359.88	II	
17	c	6405.97	II	
13		6424.43	II	
10	c	6441.03	I	6351 – 21873
24		6446.87	II	
10	c	6461.74	II	
13		6470.86	II	
8	c	6501.33	I	6801 – 22178
9		6512.19	II	
35	cw	6518.68	I	

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
17		6527.63	II	
9		6562.50	II	
24	c	6574.04	II	
35		6581.82	I	
14		6593.66	I	3719 – 18882
30		6607.17	II	
16		6640.14	II	
8	c	6642.27	II	
18		6645.41	II	13605 – 28649
6		6665.94	I	2419 – 17417
90		6677.94	II	
8		6689.51	II	
18		6693.38	II	
40	cw	6702.61	I	8932 – 23847
20	c	6706.79	II	
12	c	6714.98	II	
7		6727.21	I	8097 – 22959
7	c	6734.86	II	
7		6754.29	I	
14		6755.01	II	
14		6769.81	II	
30		6785.12	II	13605 – 28339
13	c	6792.48	II	
130		6794.58	II	11261 – 25975
40		6874.18	II	11261 – 25804
55		6896.37	II	
45	h	6899.95	I	6488 – 20977
40		6901.98	I	4647 – 19131
13		6916.69	I	8190 – 22644
13	h	6923.09	II	
11		6989.60	II	
9		7005.99	II	
17		7082.85	II	
11		7089.22	II	
11		7112.69	I	
10		7187.48	I	
10	h	7195.89	II	
65		7204.28	I	
19	h	7234.98	I	1371 – 15189
40		7257.73	I	
17		7311.57	I	
45		7348.88	II	
10		7398.27	II	
15	h	7424.24	II	
10	h	7429.62	II	
9		7472.15	I	
22		7484.54	I	
9		7495.45	I	285 – 13622
45		7496.12	I	
17		7499.69	II	
27		7511.40	I	
9		7519.77	II	
6		7557.59	II	
27	h	7582.03	II	
27		7587.49	I	
45		7590.24	I	
65		7596.44	I	462 – 13622
17	h	7601.18	II	
17		7616.01	II	
22	h	7624.05	I	509 – 13622
30		7627.81	I	509 – 13616
9	h	7639.05	II	
8		7672.72	II	
8	h	7694.74	II	
22	h	7706.16	II	
22	h	7726.97	II	
30		7737.63	I	2419 – 15339
22		7793.20	I	
8		7807.33	II	
16		7832.91	II	
30		7855.79	II	
15		7864.99	I	
6	h	7885.70	I	
6		7913.11	I	3819 – 16453
27		7927.90	II	
13		7955.31	I	3719 – 16286
11		7998.03	I	2840 – 15339
17		8001.04	I	
13	h	8010.16	II	
30		8025.42	II	
6		8053.80	I	
19		8067.35	II	
30		8085.06	II	
27		8164.17	I	1371 – 13616
13		8171.70	I	3720 – 15954
65		8194.82	II	13605 – 25804
95		8212.57	I	
11		8214.33	I	
8		8259.08	I	
40		8450.06	II	
8	h	8465.80	II	
13		8502.70	I	4695 – 16453
30	h	8511.80	I	7060 – 18805
45		8583.45	II	
30		8603.40	I	
9		8678.25	I	3819 – 15339
65		8765.74	II	

Thallium

Tl, $Z = 81$, $M = 204.4$, Ratio $\frac{\text{Tl}}{\text{Cu}} = 3.216$

Tl I Normal state of valence electrons $6s^2\ 6p\ {}^2P^\circ_{1/2} = 0$. I.P. $= 49267\ \text{cm}^{-1}$.

Tl II Normal state of valence electrons $6s^2\ {}^1S_0 = 0$. I.P. $= 164765\ \text{cm}^{-1}$.

References

Wavelengths:

G. R. Harrison, Massachusetts Institute of Technology Wavelength Tables (John Wiley & Sons, New York, 1939).

A. Fowler, Report on Series in Line Spectra (Fleetway Press, London, 1922).

Classification:

Tl I, A. Fowler, Report on Series in Line Spectra (Fleetway Press, London, 1922).

Thallium—all observed lines

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
140		2315.98	I	0 – 43166	2800		2918.32	I	7793 – 42049
900	h	2379.69	I	0 – 42011	440		2921.52	I	7793 – 42011
700		2580.14	I	0 – 38746	1200		3229.75	I	7793 – 38746
60		2608.99	I	7793 – 46110	20000		3519.24	I	7793 – 36200
80		2665.57	I	7793 – 45296	5000		3529.43	I	7793 – 36118
420		2709.23	I	7793 – 44693	12000	cw	3775.72	I	0 – 26478
50	h	2710.67	I	7793 – 44673	18000		5350.46	I	7793 – 26478
4400	d	2767.87	I	0 – 36118	16	h	6549.77	I	26478 – 41741
280		2826.16	I	7793 – 43166	6	h	6713.69	I	26478 – 41368

Thorium

Th, $Z=90$, $M=232.0381$, Ratio $\frac{Th}{Cu}=3.651$

Th I Normal state of valence electrons $6d^27s^2\ ^3F_2=0$. I.P. $=49000\ cm^{-1}$.
Th II Normal state of valence electrons $6d^27s\ ^4F_{11/2}=0$. I.P. $=96000\ cm^{-1}$.

References

Wavelengths and Spectrum Assignments:
R. Zalubas, NBS Monograph **17** (1960) and unpublished material (1969).

Classification:
Th I, R. Zalubas, J. Opt. Soc. Am. **58,** 1195 (1968) and unpublished material (1969).
Th II, R. Zalubas and C. H. Corliss, J. Res. Nat. Bur. Stand. (U.S.), **78A** (Phys. and Chem.), No. 2, 163–246 (Mar.–Apr. 1974).
Th III, P. F. A. Klinkenberg, Physica **16,** 618 (1950);
U. Litzen, Phys. Scr. **10,** 103 (1974).

Strong lines of thorium

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
4200	4019.13	II	0 – 24874
1300	3392.04	II	1522 – 30994
1300	3469.92	II	4147 – 32957
1300	3741.18	II	1522 – 28244
1300	4381.86	II	6700 – 29515
1200	2837.30	II	6214 – 41448
1100	3180.20	II	1522 – 32957
1100	4116.71	II	6168 – 30453
1100	4391.11	II	4490 – 27257
980	3351.23	II	1522 – 31353
980	3402.70	II	6214 – 35594
980	3434.00	II	1860 – 30972
980	3609.44	II	4113 – 31811
910	3256.27	II	9238 – 39939
910	3262.67	II	6168 – 36809
910	3291.74	II	6214 – 36584
910	4069.20	II	6691 – 31259
840	3325.12	II	4147 – 34212
840	3839.74	II	6700 – 32736
840	4108.42	II	4490 – 28824
800	2832.31	II	4147 – 39443
770	3188.23	II	6213 – 37569
770	3435.98	II	0 – 29095
770	3721.82	II	1860 – 28721
700	3675.57	II	1522 – 28721
700	4085.04	II	10189 – 34662
700	4086.52	II	0 – 24464
700	4094.75	II	0 – 24415
700	4282.04	II	6168 – 29515
670	3078.83	II	4113 – 36584
670 d	3511.56	II	4490 – 32960
	3511.67	II	15305 – 43733
670	3539.59	II	0 – 28244
670 d	3617.02	II	15305 – 42944
	3617.12	II	10855 – 38494
650	3752.57	II	9238 – 35879
620	3287.79	II	1522 – 31929
620	3292.52	II	6700 – 37063
620	3334.60	II	6214 – 36194
620	3337.87	II	1860 – 31811
620	3358.60	II	1860 – 31626
620	4178.06	II	7332 – 31259
620	4208.89	II	6700 – 30453
590	3238.12	II	4113 – 34987
590	3719.44	I	0 – 26878
590	3803.08	I	0 – 26287
590	3929.67	II	0 – 25440
560	3221.29	II	10189 – 41223
560	3229.01	II	7332 – 38292
560	3659.51	II	13407 – 40725
550	2870.41	II	1860 – 36688
530	3439.71	II	10379 – 39443
530	3559.45	II	6244 – 34330
530	3575.32	II	6700 – 34662
530	3994.55	II	0 – 25027
520	2747.16	II	0 – 36390
510	3108.30	II	6700 – 38863
510	3119.53	II	4147 – 36194
510	3122.96	II	6168 – 38180
510	3321.45	II	4113 – 34212
510	3762.88	II	6168 – 32736
	3762.94	I	3688 – 30255
500	2565.59	II	1860 – 40826

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
110		2326.93	II	1860 – 44822
85		2354.03	II	9061 – 51529
85		2356.76	II	0 – 42418
40		2366.04	II	1522 – 43774
95		2366.99	II	9712 – 51947
40		2368.05	II	4490 – 46706
130		2373.84	II	0 – 42113
85		2375.08	II	4490 – 46582
190		2377.84	II	4113 – 46156
55		2384.36	II	12570 – 54497
55		2388.14	II	1522 – 43383
55		2393.11	II	4490 – 46264
90		2404.17	II	8379 – 49961
90		2404.50	II	4113 – 45689
45		2411.30	II	8378 – 49837
100		2413.41	II	1522 – 42944
45		2423.01	II	
90		2423.68	II	13250 – 54498
28		2431.15	II	4490 – 45611
55		2432.85	II	10855 – 51947
45		2437.54	II	14484 – 55496
35		2443.96	II	4490 – 45395
28		2444.47	II	1522 – 42418
28		2450.79	II	
90		2456.30	II	4490 – 45190
23		2456.87	II	8378 – 49068
28		2459.01	II	0 – 40655
90		2466.13	II	4113 – 44651
55		2468.15	II	4147 – 44651
45		2470.13	II	
35		2476.97	II	1860 – 42220
14		2485.06	II	9061 – 49289
70		2489.62	II	6214 – 46368
35		2494.62	II	
70		2495.35	II	4490 – 44553
20		2497.56	III	9953 – 49980
55		2498.40	II	4490 – 44504
55		2498.87	II	6700 – 46706
35		2502.88	II	
100		2504.28	II	8379 – 48299
40		2505.60	II	4490 – 44389
55		2507.92	II	0 – 39862
28		2509.96	II	9585 – 49415
28		2516.43	II	12220 – 51947
80		2520.66	II	4113 – 43773
14		2525.92	II	9712 – 49289
28	d	2526.22	II	6691 – 46264
		2526.34	II	7331 – 46903
45		2532.43	II	6214 – 45689
45		2535.87	II	7001 – 46424
35		2542.64	II	4490 – 43808
55		2545.34	II	6214 – 45489
35		2545.74	II	4113 – 43383
150		2547.90	II	4147 – 43383
35		2548.13	II	9585 – 48818
11		2549.98	II	6700 – 45904
14		2551.23	II	1522 – 40707
11		2554.65	II	1522 – 40655
20		2555.17	III	3188 – 42312
8		2560.93	II	14484 – 53520
80		2561.94	II	6168 – 45190
500		2565.59	II	1860 – 40826
270		2566.59	II	1522 – 40472
28		2567.94	II	
70		2574.48	II	4113 – 42944
11		2576.32	II	13468 – 52272
200		2576.69	II	4147 – 42944
100		2579.43	II	4490 – 43247
23		2580.35	II	10379 – 49121
55		2580.70	II	4490 – 43228
35		2583.45	II	13250 – 51947
14		2586.15	II	10189 – 48844
11		2587.24	II	6168 – 44808
230		2589.06	II	1860 – 40472
55		2595.03	II	8379 – 46903
230		2597.05	II	0 – 38494
230		2600.88	II	9238 – 47675
28		2607.48	II	1522 – 39862
23		2608.32	II	8379 – 46706
100		2609.85	II	4113 – 42418
23		2611.62	I	0 – 38279
230		2618.91	II	4147 – 42319
270		2623.45	II	4113 – 42220
270		2625.74	II	4147 – 42220
28		2626.40	II	7331 – 45395
55		2628.81	II	4490 – 42519
18		2630.02	II	9720 – 47731
45		2633.33	II	8460 – 46424
40		2639.51	II	1522 – 39397
14		2639.88	II	7829 – 45698
14		2640.27	II	13818 – 51681
14		2640.39	II	4490 – 42352
270		2641.49	II	0 – 37846
14		2642.60	II	
14		2643.28	II	7001 – 44822
45		2649.48	II	4490 – 42222
45		2649.87	II	10572 – 48299
170		2650.58	II	0 – 37716
150		2658.66	II	0 – 37602
35		2661.39	II	9585 – 47148
55		2662.35	II	8606 – 46156
40		2662.86	II	10189 – 47731
23		2664.06	II	8379 – 45904
18		2665.89	II	6244 – 43744
11		2667.55	II	7331 – 44808
18		2669.46	II	13818 – 51268
18		2671.48	II	8378 – 45800
18		2672.94	II	9202 – 46603
35		2675.68	II	9061 – 46424
18		2678.94	II	9585 – 46903
360		2684.29	II	1522 – 38765
130		2687.13	II	8018 – 45221
18		2688.34	II	4490 – 41677
23		2691.06	I	0 – 37149
45		2691.18	II	9238 – 46385
480		2692.42	II	0 – 37130
18		2693.96	II	6700 – 43809
18		2695.02	II	9061 – 46156
80		2695.21	II	8606 – 45698
110		2695.55	II	10379 – 47466
28		2695.82	II	8606 – 45689
40		2696.83	II	12220 – 49289
45		2697.55	II	1522 – 38582
70		2698.74	II	6244 – 43288
18		2700.60	II	9585 – 46603
28		2701.82	II	13469 – 50470
270		2703.96	II	1522 – 38494
170		2708.18	II	1522 – 38436
11		2710.48	II	9720 – 46603
35		2711.45	II	12488 – 49357

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
35	2714.62	II	
40	2715.09	II	15349 – 52170
90	2716.31	II	8018 – 44822
35	2719.46	II	8460 – 45221
55	2719.93	II	11116 – 47871
230	2721.69	II	6214 – 42944
170	2722.38	II	10189 – 46910
18	2723.32	II	17460 – 54169
70	2724.88	II	0 – 36688
40	2726.49	II	9238 – 45904
28	2727.24	II	9712 – 46368
45	2728.91	II	1860 – 38494
250	2729.33	II	9061 – 45689
100	2730.26	II	8606 – 45221
40	2731.58	II	
35	2731.92	II	4113 – 40706
250	2732.81	II	0 – 36582
11	2733.21	II	1860 – 38436
160	2734.40	II	4146 – 40706
28	2735.83	II	4113 – 40655
23	2736.44	II	9720 – 46253
70	2737.42	II	8379 – 44899
45	2738.32	II	4147 – 40655
23	2738.82	II	4490 – 40992
18	2740.47	II	14545 – 51024
180	2743.06	II	0 – 36445
520	2747.16	II	0 – 36390
18	2747.59	II	17460 – 53845
45	2747.85	II	7001 – 43383
40	2748.80	II	13468 – 49837
100	2749.53	II	4113 – 40472
18	2749.71	II	12488 – 48844
410	2752.17	II	1522 – 37846
18	2753.09	II	12219 – 48532
18	2755.96	II	16033 – 52307
18	2758.96	II	1521 – 37756
45	2759.41	II	15453 – 51681
130	2760.39	II	8606 – 44822
150	2763.61	II	6244 – 42418
100	2764.64	II	9061 – 45221
100	2765.12	II	4490 – 40644
270	2768.84	II	6214 – 42319
200	2770.82	II	1522 – 37602
200	2771.51	II	4113 – 40184
18	2772.01	II	10189 – 46253
18	2773.02	II	6700 – 42751
140 d	2773.95	II	13251 – 49289
	2774.07	II	4147 – 40184
45	2774.84	II	10189 – 46217
20	2775.05	III	6288 – 42313
70	2777.80	II	10379 – 46368
40	2778.02	II	1860 – 37846
70	2778.71	II	9712 – 45689
45	2780.70	II	13406 – 49357
18	2782.37	II	10673 – 46603
110	2783.05	II	4490 – 40412
70	2783.49	II	7828 – 43744
45	2784.06	II	10673 – 46581
70	2784.98	II	7332 – 43228
35	2785.61	II	9238 – 45126
18	2786.24	II	15145 – 51025
70	2786.91	II	13250 – 49121
100	2787.13	II	6244 – 42113
35	2787.67	II	14545 – 50407
35	2788.68	II	12472 – 48320
45	2790.42	II	12472 – 48299
70	2791.01	II	6700 – 42519
35	2791.43	II	10572 – 46385
90	2794.26	II	9712 – 45489
70	2797.02	II	1860 – 37602
70	2797.74	II	4490 – 40223
55	2798.27	II	8018 – 43744
28	2798.67	II	9585 – 45306
55	2799.11	II	4147 – 39862
70	2800.57	II	9202 – 44899
35	2803.38	II	9238 – 44898
55	2807.72	II	9202 – 44808
110	2807.83	II	9585 – 45190
180	2808.99	II	9061 – 44651
20	2812.42	II	10189 – 45735
70	2814.32	II	6700 – 42222
45	2814.58	II	15144 – 50663
45	2816.07	II	6700 – 42200
18	2817.14	II	11117 – 46603
100	2819.32	II	7829 – 43288
45	2820.34	II	6700 – 42147
40	2821.60	II	8379 – 43809
100	2822.02	II	8379 – 43804
35	2822.36	II	9401 – 44822
20	2822.56	II	12902 – 48320
20	2822.69	II	7001 – 42418
20	2823.55	II	9720 – 45126
170	2826.86	II	8018 – 43383
20	2827.76	II	14484 – 49837
45	2827.99	II	9202 – 44553
20	2829.93	II	11576 – 46903
70	2830.44	II	6168 – 41488
800	2832.31	II	4147 – 39443
55	2833.33	II	8460 – 43744
160	2834.48	II	8018 – 43288
130	2836.05	II	4147 – 39397
45	2836.44	II	6691 – 41936
1200	2837.30	II	6214 – 41448
80	2839.24	II	4490 – 39701
14	2839.34	II	6700 – 41909
70	2840.15	II	0 – 35199
90	2841.16	II	9202 – 44389
20	2841.81	II	9720 – 44899
320	2842.81	II	1522 – 36688
20	2843.30	II	6168 – 41328
20	2845.19	II	11116 – 46253
20	2845.84	II	16818 – 51947
90	2847.35	II	10379 – 45489
20	2848.01	II	17460 – 52562
270	2851.26	II	1522 – 36584
80	2851.44	II	1522 – 36582
23	2852.50	II	14790 – 49837
45	2854.13	II	13818 – 48844
23	2854.92	II	15453 – 50470
55	2855.90	II	11576 – 46582
55	2857.49	II	6691 – 41677
320 d	2861.33	II	9712 – 44651
	2861.42	II	10673 – 45611
55	2862.61	II	1522 – 36445
70	2864.66	II	17272 – 52170
35	2866.41	II	4490 – 39367
35	2866.65	II	14484 – 49357
35	2868.46	I	0 – 34852
45	2868.68	II	8379 – 43228
70	2869.92	II	10855 – 45689

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
550		2870.41	II	1860 – 36688
28		2870.82	II	10572 – 45395
70		2876.42	II	6168 – 40924
40		2879.20	II	1860 – 36582
23		2879.53	II	8379 – 43097
45		2881.14	II	6700 – 41399
45		2882.01	II	11576 – 46264
40		2882.51	II	8606 – 43288
23		2883.62	II	9720 – 44389
320		2884.29	II	4490 – 39151
360		2885.05	II	4113 – 38765
45		2886.24	II	6691 – 41328
45		2886.51	II	10855 – 45489
360		2887.82	II	4147 – 38765
160		2891.25	II	8379 – 42956
160	d	2891.73	II	9238 – 43809
		2891.82	II	9202 – 43772
40		2892.17	II	9238 – 43804
23		2894.50	II	10189 – 44727
130		2895.14	II	1860 – 36390
70		2897.07	II	15453 – 49961
35		2898.26	II	6213 – 40706
45		2899.37	II	13818 – 48299
250		2899.72	II	6168 – 40644
45		2903.17	II	4147 – 38582
23		2904.27	II	12902 – 47324
45		2905.93	II	6168 – 40570
28		2906.12	II	8018 – 42418
80		2908.36	II	4490 – 38864
23		2909.77	II	7332 – 41688
200		2910.60	II	4147 – 38494
90		2911.32	II	8606 – 42944
90		2912.01	II	0 – 34330
90	d	2912.66	II	4113 – 38436
		2912.76	II	9061 – 43383
40		2916.37	I	2558 – 36837
45		2917.03	II	10379 – 44651
160		2917.41	II	4490 – 38757
55		2917.79	II	13468 – 47731
45		2917.90	II	10189 – 44450
140		2919.84	II	4490 – 38729
45		2920.37	II	6691 – 40924
45		2920.93	II	10673 – 44899
23		2921.37	II	12485 – 46706
160		2921.53	II	9585 – 43803
		2921.62	II	13248 – 47466
70		2922.60	II	13468 – 47675
45		2922.80	II	12220 – 46424
23		2922.99	II	8018 – 42220
23		2924.10	II	13818 – 48006
250		2925.05	II	15349 – 49527
250		2928.25	II	8379 – 42519
40		2928.70	III	9953 – 44088
40		2929.30	II	14484 – 48612
45		2930.91	II	12472 – 46581
28		2932.64	II	9720 – 43809
55		2933.10	II	9720 – 43804
55		2934.14	II	1522 – 35594
130		2936.19	II	6168 – 40216
170		2936.47	II	9202 – 43246
70		2937.44	II	12902 – 46936
28		2938.10	II	9202 – 43228
100		2939.56	II	9238 – 43246
		2939.62	II	15349 – 49357
35		2940.59	II	7332 – 41328
35		2940.67	II	17272 – 51268
28		2941.34	II	10189 – 44177
23		2941.89	II	9401 – 43383
130		2942.63	II	8379 – 42352
340		2942.86	II	6214 – 40184
23		2944.95	II	14545 – 48492
28		2946.26	I	2869 – 36800
28		2946.61	II	16033 – 49960
150		2949.07	II	4490 – 38389
90		2949.93	II	9238 – 43127
80		2950.44	II	9061 – 42944
70		2951.20	II	6700 – 40575
45		2954.89	II	6691 – 40524
55		2955.04	II	10673 – 44504
55		2955.60	II	7001 – 40826
35		2955.85	II	8379 – 42200
170		2957.58	II	4490 – 38292
90		2957.92	II	12570 – 46368
70		2958.14	II	10855 – 44651
28		2959.88	II	14545 – 48320
28		2963.61	II	4113 – 37846
28		2963.88	II	11576 – 45306
28		2964.00	II	12488 – 46217
55		2964.11	II	6168 – 39895
110		2964.92	II	9238 – 42956
110		2965.50	II	6700 – 40412
270		2968.69	II	4490 – 38165
28		2969.38	II	6700 – 40367
45		2969.82	I	0 – 33662
110		2971.48	II	4113 – 37756
80		2972.22	II	1522 – 35157
110		2973.54	II	10189 – 43809
220		2974.01	II	4490 – 38105
110		2976.02	II	7332 – 40924
28		2976.65	II	12571 – 46156
28		2980.11	I	3688 – 37234
55		2980.33	II	9401 – 42944
160		2981.34	II	6168 – 39701
160		2981.49	II	8379 – 41909
28		2981.84	II	9720 – 43247
28		2982.00	II	6691 – 40216
28		2983.02	II	9238 – 42751
55		2983.57	II	8606 – 42113
140		2983.82	II	13407 – 46911
160		2985.24	II	4113 – 37602
80		2986.79	II	7001 – 40472
28		2987.67	I	3688 – 37149
360		2988.23	II	4490 – 37945
150		2991.06	II	4147 – 37570
90		2991.70	II	12488 – 45904
70		2993.63	II	10379 – 43774
160		2993.80	II	13468 – 46861
28		2995.27	II	9720 – 43097
110		2996.99	II	9061 – 42418
28		2997.20	I	
180		2999.09	II	11116 – 44450
28		2999.27	II	4490 – 37822
45		2999.80	II	14546 – 47871
70		3000.97	II	7331 – 40644
180		3001.26	II	8379 – 41688
220		3002.40	II	1860 – 35157
35		3006.00	II	6691 – 39949
110		3006.93	II	12488 – 45735
130		3007.62	II	6700 – 39939
110		3007.80	II	10572 – 43809

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
70		3007.95	II	9720 – 42956
70		3008.28	II	10572 – 43804
180		3008.50	II	6214 – 39443
70		3009.77	II	0 – 33216
55		3011.60	II	6700 – 39895
85		3012.71	II	6214 – 39397
70		3013.60	II	13250 – 46424
40		3014.93	II	9061 – 42220
85		3015.72	II	9202 – 42352
85		3017.13	II	10673 – 43808
110		3018.49	II	13249 – 46368
110		3019.42	II	8379 – 41488
40		3021.49	II	13468 – 46555
110		3022.09	II	7332 – 40412
40		3024.67	II	9061 – 42113
150		3026.57	II	9720 – 42751
130		3028.58	II	6691 – 39701
40		3030.49	I	4962 – 37950
40		3030.86	II	9238 – 42222
85	d	3031.20	I	3688 – 36669
		3031.29	II	11116 – 44096
40		3031.70	II	4490 – 37465
70		3031.96	II	13406 – 46378
370		3034.06	II	8379 – 41328
170		3035.11	II	10189 – 43127
40		3035.54	II	9585 – 42518
85		3038.60	II	6168 – 39069
70		3040.05	II	7332 – 40216
130		3043.06	II	6700 – 39552
130		3045.56	II	10189 – 43014
170		3046.95	II	13407 – 46217
420		3049.09	II	4490 – 37277
85		3049.64	II	15710 – 48492
40		3049.86	II	14546 – 47324
85		3050.98	II	10189 – 42956
85		3051.79	II	6700 – 39458
40		3057.64	II	6168 – 38864
28		3057.90	II	11117 – 43809
85		3058.43	II	14484 – 47171
180		3060.18	II	8379 – 41047
85		3060.44	I	0 – 32666
220		3061.70	II	6700 – 39352
220	d	3063.03	II	12488 – 45126
		3063.13	II	9585 – 42222
85		3065.93	II	9712 – 42319
40		3066.41	II	12220 – 44822
450		3067.73	II	13250 – 45838
220	d	3068.91	I	0 – 32575
		3068.98	II	4113 – 36688
40		3069.26	II	10673 – 43244
270		3070.82	II	10572 – 43127
370		3072.11	II	4147 – 36688
85		3072.82	II	13818 – 46352
28		3075.84	II	9720 – 42222
85		3077.34	II	9202 – 41688
70		3077.93	II	9720 – 42200
670		3078.83	II	4113 – 36584
50		3079.89	II	6691 – 39151
480		3080.22	II	10189 – 42645
50		3081.66	II	13249 – 45689
200		3081.98	II	4147 – 36584
140		3082.15	II	13469 – 45904
140		3082.99	II	12472 – 44899
140		3083.30	II	10673 – 43097
240		3088.47	II	7332 – 39701
130		3090.09	II	1860 – 34212
85		3093.05	II	1521 – 33843
50		3096.26	II	16033 – 48320
100		3096.43	II	9202 – 41488
140		3097.27	II	4113 – 36390
100	d	3099.74	II	12571 – 44822
		3099.86	II	9238 – 41488
200	d	3100.79	II	13249 – 45489
		3100.94	II	12488 – 44727
50		3101.69	II	11576 – 43808
200		3102.66	II	6168 – 38389
85	d	3104.97	I	0 – 32197
		3105.05	II	9202 – 41399
280		3105.75	II	9720 – 41909
50		3106.69	II	10572 – 42751
200		3107.03	II	6691 – 38867
510		3108.30	II	6700 – 38863
250		3110.02	II	6691 – 38836
50		3112.09	II	6168 – 38292
50		3114.07	II	9585 – 41688
50		3114.27	II	8605 – 40706
250		3116.30	II	12571 – 44650
100		3116.48	II	10673 – 42751
140		3117.68	II	6691 – 38758
100		3119.35	II	8605 – 40654
510		3119.53	II	4147 – 36194
50		3120.88	I	2558 – 34591
510		3122.96	II	6168 – 38180
370		3124.39	II	6168 – 38165
220		3125.21	II	8379 – 40367
480		3125.51	II	9238 – 41223
140		3125.74	II	1859 – 33843
85		3127.21	II	9720 – 41688
50		3129.97	II	10379 – 42318
150		3131.07	II	0 – 31929
85		3133.62	II	9585 – 41488
150		3134.42	II	14484 – 46379
100		3136.22	I	4962 – 36838
50		3136.83	I	0 – 31870
420		3139.31	II	9202 – 41047
100		3139.87	II	11117 – 42956
100		3140.27	I	2869 – 34704
210		3141.85	II	7332 – 39151
420		3142.84	II	9238 – 41047
50		3145.64	I	0 – 31781
310		3146.04	II	6168 – 37945
150		3150.46	II	14484 – 46217
100		3151.65	II	10189 – 41909
310		3154.30	II	1522 – 33216
310		3154.77	II	13406 – 45095
100		3155.83	II	9720 – 41399
100		3156.40	II	6168 – 37841
50		3158.62	II	10572 – 42222
50		3159.07	II	9061 – 40706
70		3161.69	II	6168 – 37788
110		3162.84	II	9720 – 41328
110		3164.48	II	6700 – 38292
55		3165.62	II	7001 – 38582
110		3165.82	II	8606 – 40184
140		3166.10	II	4490 – 36066
85		3167.56	II	15350 – 46911
110		3169.33	II	6213 – 37756
55		3170.43	II	7331 – 38864
55		3171.28	I	0 – 31524
40		3171.73	II	11725 – 43244

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
55		3173.43	I	2869 – 34372
110		3174.20	II	1859 – 33354
420		3175.73	II	6700 – 38180
55		3176.50	II	6244 – 37716
55		3177.20	II	6700 – 38165
85		3178.24	I	2869 – 34324
270		3179.05	II	4147 – 35594
1100		3180.20	II	1522 – 32957
110		3181.19	II	7331 – 38757
55		3181.67	I	4962 – 36383
85		3182.40	II	6691 – 38105
110		3182.64	II	9061 – 40472
55		3183.56	II	11117 – 42519
55		3183.79	II	13251 – 44651
310		3184.95	II	4490 – 35879
55		3187.00	II	9202 – 40570
55		3187.40	II	10855 – 42220
770		3188.23	II	6213 – 37569
270	d	3190.07	II	9585 – 40924
		3190.16	II	10572 – 41909
110		3191.09	II	1522 – 32850
85		3191.22	II	9720 – 41047
55		3192.59	I	4962 – 36275
55		3193.16	II	13818 – 45126
55		3195.69	I	0 – 31283
110		3198.23	II	13468 – 44727
110		3198.48	II	8606 – 39862
110		3198.69	II	6691 – 37945
85		3198.97	II	4490 – 35741
55		3203.23	II	10189 – 41398
40		3203.62	II	15349 – 46555
55		3203.88	II	12570 – 43773
55		3205.29	II	15236 – 46426
55		3206.93	II	8379 – 39552
55		3207.78	II	9202 – 40367
55		3208.03	II	12220 – 43383
170		3210.31	II	6700 – 37841
55		3211.20	I	2869 – 34001
170		3213.57	II	6168 – 37277
55		3214.08	I	2558 – 33662
55		3214.38	I	4962 – 36063
55		3215.78	II	6700 – 37788
170		3217.46	II	9401 – 40472
55		3217.73	II	10379 – 41448
170		3220.35	II	4113 – 35157
560		3221.29	II	10189 – 41223
280		3225.41	II	9711 – 40706
55		3225.66	II	17460 – 48453
55		3225.90	II	1860 – 32850
55		3226.12	II	8379 – 39367
55		3226.41	II	9585 – 40570
110		3227.77	II	0 – 30972
560		3229.01	II	7332 – 38292
110		3230.87	II	9712 – 40655
110		3232.12	I	2869 – 33800
40		3232.30	I	0 – 30929
55		3235.00	I	3688 – 34591
480		3235.84	II	6168 – 37063
590		3238.12	II	4113 – 34987
55		3238.93	I	2869 – 33735
100		3239.29	II	6700 – 37562
110		3240.48	II	6691 – 37542
55		3240.64	I	2869 – 33718
240		3241.11	II	7001 – 37846
110		3244.45	I	0 – 30813
280		3245.76	II	9061 – 39862
110		3247.59	II	9400 – 40184
110		3248.49	II	12472 – 43246
100		3249.86	I	0 – 30762
280		3251.92	I	3688 – 34430
140		3252.72	II	17272 – 48006
140		3254.81	II	7001 – 37716
140		3255.51	II	13469 – 44177
910		3256.27	II	9238 – 39939
180		3257.16	II	9585 – 40278
180		3257.37	I	2869 – 33560
110		3259.06	I	7280 – 37955
110		3259.62	II	11576 – 42246
110		3260.92	II	9238 – 39895
110		3261.54	II	10572 – 41223
910		3262.67	II	6168 – 36809
110		3263.03	II	9585 – 40223
110		3264.43	II	12472 – 43097
110		3265.58	II	7332 – 37945
180		3267.00	II	7001 – 37602
110		3269.47	II	6700 – 37277
110		3270.82	II	0 – 30565
110		3272.03	I	0 – 30553
310		3273.92	II	10189 – 40725
310		3275.07	II	13249 – 43774
310		3280.37	II	8018 – 38494
55		3282.98	II	15453 – 45904
130		3285.75	I	2869 – 33295
310		3286.58	II	8018 – 38436
620		3287.79	II	1522 – 31929
130		3290.13	II	15350 – 45735
910		3291.74	II	6214 – 36584
620		3292.52	II	6700 – 37063
130		3293.60	II	14546 – 44899
240		3293.95	II	9202 – 39552
130		3295.00	II	13469 – 43809
180		3295.32	II	6244 – 36582
130		3295.52	II	9061 – 39397
150		3296.61	II	12902 – 43228
130		3297.37	II	10673 – 40992
240		3297.83	II	9238 – 39552
55		3298.05	I	4962 – 35274
55		3300.62	II	1522 – 31811
240		3301.26	II	11725 – 42008
		3301.35	II	11117 – 41399
240		3301.65	I	4961 – 35240
130		3303.48	II	14546 – 44808
480		3304.24	I	0 – 30255
55		3305.30	I	3865 – 34111
130		3309.14	II	7332 – 37542
130		3309.36	I	0 – 30209
180		3310.25	II	6244 – 36445
55		3313.07	I	10527 – 40701
180		3313.65	I	4962 – 35131
240		3314.83	II	8606 – 38765
55		3317.75	II	13251 – 43383
55		3318.98	II	6691 – 36813
280		3320.30	II	6700 – 36809
510		3321.45	II	4113 – 34212
55		3322.09	I	2558 – 32651
390		3324.75	II	1860 – 31929
840		3325.12	II	4147 – 34212
100		3326.46	II	4490 – 34544
130		3327.19	I	3688 – 33734
55		3328.26	II	13251 – 43288

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
55		3329.73	I	7795 – 37819
250		3330.48	I	0 – 30017
100		3332.40	II	12220 – 42220
170		3333.13	I	2869 – 32863
620		3334.60	II	6214 – 36194
130		3335.06	II	8606 – 38582
620		3337.87	II	1860 – 31811
130		3338.40	II	7332 – 37277
55	bl	3341.31	ThO	
55		3343.26	II	15787 – 45689
130		3343.62	II	17272 – 47171
130		3344.87	II	8605 – 38493
100	bl	3345.89	ThO	
180		3346.55	II	9585 – 39458
310		3348.77	I	0 – 29853
130		3348.95	II	10855 – 40706
980		3351.23	II	1522 – 31353
130		3353.95	II	11117 – 40924
310		3354.18	II	10379 – 40184
200		3354.62	II	8379 – 38180
130		3355.27	II	10572 – 40367
100		3356.82	II	9585 – 39367
620		3358.60	II	1860 – 31626
130		3360.15	II	11576 – 41328
130		3360.37	II	10189 – 39939
310	d	3361.62	II	17727 – 47466
		3361.73	II	9720 – 39458
100		3362.18	II	12488 – 42222
130		3362.52	II	9712 – 39443
70		3362.67	II	4113 – 33843
130		3363.07	II	8379 – 38105
130		3363.68	II	13406 – 43127
250		3364.69	II	12488 – 42200
130		3365.34	I	2869 – 32575
250		3366.52	II	13249 – 42944
390		3367.82	II	4490 – 34175
250		3371.80	II	12571 – 42220
130		3373.49	I	2869 – 32504
250		3374.58	II	9238 – 38863
250		3374.98	I	4962 – 34583
70		3376.84	II	10673 – 40278
390		3378.58	II	8018 – 37608
130		3380.86	I	2869 – 32439
70		3381.34	II	15324 – 44890
55		3381.37	II	9585 – 39151
130		3383.15	II	16818 – 46368
310		3385.53	II	4490 – 34019
310		3386.50	II	9061 – 38582
110		3387.92	I	7795 – 37303
110		3388.58	II	9238 – 38740
130		3389.46	I	8111 – 37606
310		3389.64	II	1860 – 31353
110		3390.37	I	
1300		3392.04	II	1522 – 30994
70		3393.23	II	8379 – 37841
110		3394.14	II	11116 – 40570
130		3394.80	II	17722 – 47171
110		3395.37	II	7001 – 36445
130		3396.39	II	15787 – 45221
		3396.46	II	17272 – 46706
200		3396.73	I	3865 – 33297
220		3397.52	I	
250		3398.54	I	2869 – 32285
200		3401.65	II	7001 – 36390
200		3402.03	II	8460 – 37846
980		3402.70	II	6214 – 35594
200		3403.27	II	9061 – 38436
170		3404.65	II	10189 – 39552
200		3405.56	I	3688 – 33043
130		3406.24	II	6691 – 36041
70		3407.83	I	7795 – 37131
250	d	3408.64	II	10855 – 40184
		3408.75	I	2869 – 32197
200		3409.27	II	10572 – 39895
170		3411.78	II	7829 – 37130
250		3413.01	I	2869 – 32160
130		3414.50	II	9585 – 38864
70		3415.88	I	3688 – 32955
200		3418.78	II	19880 – 49121
200		3418.95	II	8606 – 37846
270		3419.17	II	13407 – 42645
390		3421.21	I	4962 – 34183
200		3422.66	I	
130		3423.13	II	12472 – 41677
270		3423.99	I	0 – 29197
130		3425.18	II	9202 – 38389
130		3425.94	II	9401 – 38582
200		3429.00	I	2558 – 31713
110		3429.39	II	9238 – 38389
130		3429.90	II	4490 – 33637
130		3431.81	II	20158 – 49289
980		3434.00	II	1860 – 30972
130		3434.76	I	10414 – 39520
770		3435.98	II	0 – 29095
270		3436.73	I	3865 – 32954
130		3437.02	II	8379 – 37465
340		3437.31	I	2869 – 31953
340		3438.95	II	13249 – 42319
70		3439.40	I	3688 – 32755
530		3439.71	II	10379 – 39443
130		3441.04	II	9712 – 38765
130		3441.36	II	6691 – 35741
110		3442.58	I	4962 – 34001
70		3443.11	II	9401 – 38436
70		3443.98	I	
200		3445.22	II	10379 – 39397
70		3445.39	II	12472 – 41488
200		3445.74	II	14791 – 43804
70		3449.29	II	23187 – 52170
170		3449.65	II	10572 – 39552
110		3450.95	II	13251 – 42220
130		3451.70	I	
270		3452.68	II	6244 – 35199
110		3453.51	I	15490 – 44438
100		3454.21	II	9238 – 38180
200		3461.02	I	0 – 28885
270		3461.22	I	4962 – 33845
340		3462.85	II	9712 – 38582
270		3463.72	II	13251 – 42113
70		3465.06	I	8244 – 37095
450		3465.76	II	6700 – 35546
130		3465.92	II	4113 – 32957
130		3466.54	I	4962 – 33801
140		3466.64	I	10414 – 39252
390		3468.22	II	6700 – 35525
170		3469.34	I	3688 – 32504
1300		3469.92	II	4147 – 32957
170		3471.22	I	3865 – 32666
70		3471.96	I	7280 – 36074
130		3473.03	II	9061 – 37846

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
100		3473.42	II	9712 – 38494
170		3476.54	II	6700 – 35456
70		3477.70	II	15349 – 44096
130		3478.13	II	9202 – 37945
130		3478.46	II	13407 – 42147
250		3479.17	II	6691 – 35426
70		3480.05	I	8111 – 36838
130		3482.55	II	9585 – 38292
130		3482.76	II	1860 – 30565
200		3485.21	II	8379 – 37063
390		3486.51	II	10189 – 38862
		3486.55	I	0 – 28673
70		3490.27	II	14484 – 43127
70		3490.45	II	15324 – 43966
70		3491.58	II	17272 – 45904
270		3493.52	II	7829 – 36445
130		3495.70	I	4962 – 33560
70		3496.81	I	0 – 28589
70		3497.01	II	10855 – 39443
70		3497.26	II	9202 – 37788
200		3498.01	II	1521 – 30101
130		3498.62	I	8244 – 36818
130		3498.96	I	7502 – 36074
		3498.99	II	9720 – 38292
200		3499.99	II	8018 – 36582
140		3501.46	II	10189 – 38740
70		3501.87	I	5563 – 34111
200		3502.78	II	9061 – 37602
140		3503.62	II	13818 – 42352
70		3503.79	I	7280 – 35813
140		3505.49	II	13818 – 42336
70		3506.85	II	15237 – 43744
70		3509.09	I	6362 – 34852
110		3511.16	I	3688 – 32160
670	d	3511.56	II	4490 – 32960
		3511.67	II	15305 – 43733
140		3512.74	II	9720 – 38180
200		3514.53	II	9401 – 37846
70		3514.96	II	9238 – 37680
140		3516.35	II	8379 – 36809
140		3516.82	II	8018 – 36445
140		3518.40	I	2869 – 31283
70		3518.90	II	7332 – 35741
70		3521.06	I	3688 – 32080
340		3521.91	II	10379 – 38765
70		3523.50	I	
70		3526.63	I	0 – 28348
140		3528.82	II	6691 – 35021
270		3528.95	II	10189 – 38518
110		3530.51	I	8111 – 36427
140		3531.45	I	4962 – 33271
140		3531.93	II	18118 – 46423
200		3537.16	II	9202 – 37465
340		3539.32	II	4490 – 32736
670		3539.59	II	0 – 28244
140		3541.62	II	8460 – 36688
70		3542.50	I	6362 – 34583
180		3544.02	I	8800 – 37009
70		3544.99	II	9401 – 37602
250	d	3545.18	II	13249 – 41448
		3545.28	II	1522 – 29720
70		3545.96	I	12848 – 41041
140		3547.34	I	3688 – 31870
170		3549.60	I	8111 – 36275
70		3550.29	II	12486 – 40644
140		3551.40	I	2869 – 31019
200		3553.11	II	12570 – 40706
70		3553.38	II	9712 – 37846
200	d	3555.01	I	2869 – 30991
		3555.10	II	9720 – 37841
70		3555.70	I	10414 – 38530
170		3557.46	II	6168 – 34270
530		3559.45	II	6244 – 34330
270		3559.94	II	12488 – 40570
70		3561.78	I	6362 – 34430
110		3563.38	I	11197 – 39252
70		3564.71	II	9711 – 37756
140		3565.40	II	9238 – 37277
70		3567.05	II	6700 – 34727
170		3567.26	I	0 – 28025
70		3567.70	II	12902 – 40924
70		3569.62	II	6168 – 34175
140		3569.82	I	3865 – 31870
110		3571.57	II	10189 – 38180
340		3572.39	II	8460 – 36445
200		3573.22	II	8606 – 36584
530		3575.32	II	6700 – 34662
200		3576.56	I	
340		3579.33	II	8460 – 36390
140		3580.23	II	12488 – 40412
200		3582.01	II	10855 – 38765
140	d	3583.04	II	16907 – 44808
		3583.10	I	4962 – 32863
110		3584.18	I	2869 – 30762
130		3585.05	II	16564 – 44450
270	d	3585.77	II	9585 – 37465
		3585.88	II	12488 – 40367
170		3588.22	II	9202 – 37063
		3588.30	II	1859 – 29720
110		3589.15	II	6700 – 34553
200		3589.36	II	6691 – 34544
170		3589.75	I	7502 – 35351
110		3591.06	II	8606 – 36445
140		3591.45	I	3688 – 31524
270		3592.78	I	8800 – 36626
		3592.83	II	9238 – 37063
140		3593.88	II	13406 – 41223
70		3595.33	II	12472 – 40278
70		3595.62	I	8244 – 36047
270		3598.12	I	0 – 27784
390		3601.03	II	17727 – 45489
340		3603.20	II	9720 – 37465
70		3603.36	II	12472 – 40216
70		3604.06	I	7502 – 35241
110		3604.68	I	3865 – 31599
70		3605.19	I	13175 – 40905
110		3605.65	II	10855 – 38582
170		3608.38	I	
200		3609.22	II	10673 – 38372
980		3609.44	II	4113 – 31811
240	d	3610.04	II	13407 – 41099
		3610.12	II	9585 – 37277
170		3610.40	II	7332 – 35021
200		3610.80	II	4113 – 31800
200		3612.43	I	0 – 27674
70		3612.87	I	0 – 27671
140		3613.78	II	4147 – 31811
140		3614.01	II	14484 – 42147
70		3614.21	I	
70		3614.35	I	10527 – 38186

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
480	3615.13	II	4147 – 31800
670 d	3617.02	II	15305 – 42944
	3617.12	II	10855 – 38494
110	3618.36	I	7502 – 35131
40	3619.71	II	10673 – 38292
200	3620.37	II	12571 – 40184
270	3621.12	II	10572 – 38180
140	3622.29	I	10783 – 38382
140	3622.34	I	5563 – 33162
110	3622.80	I	3688 – 31283
270	3624.90	II	6700 – 34279
390	3625.63	II	1522 – 29095
200	3625.90	I	7280 – 34851
110	3632.62	II	9061 – 36582
140	3632.83	I	11242 – 38761
240	3634.58	I	7795 – 35301
140	3635.24	II	15787 – 43288
200	3635.42	II	22028 – 49527
270	3635.94	I	
110	3637.56	II	6691 – 34175
55	3638.32	I	4962 – 32439
70	3638.64	I	8800 – 36275
340	3639.45	II	6168 – 33637
310	3642.25	I	0 – 27448
110	3643.51	I	6362 – 33801
70	3644.35	II	10673 – 38105
100	3647.30	II	12486 – 39895
	3647.37	II	14791 – 42200
150	3647.65	II	12488 – 39895
110	3648.17	II	0 – 27403
140	3648.42	II	1521 – 28923
310	3649.25	II	7332 – 34727
170	3649.74	I	5563 – 32955
170	3650.77	II	9061 – 36445
370	3652.17	II	10189 – 37562
140	3652.54	II	7829 – 35199
100	3656.20	II	9720 – 37063
420	3658.06	II	7001 – 34330
560	3659.51	II	13407 – 40725
55	3661.62	I	3687 – 30990
220	3663.20	I	2869 – 30160
340	3663.70	II	9401 – 36688
130	3666.98	I	8800 – 36063
140	3668.14	I	8244 – 35498
280	3669.97	I	8111 – 35351
	3670.06	II	4113 – 31353
100	3671.54	I	6362 – 33591
140	3673.28	II	10572 – 37787
200	3673.79	II	7332 – 34544
700	3675.57	II	1522 – 28721
200	3678.02	II	8018 – 35199
200	3678.04	II	9400 – 36581
280	3679.71	II	13407 – 40575
85	3681.88	II	11576 – 38729
240	3688.76	II	13468 – 40570
210	3690.49	II	9720 – 36809
180	3691.88	I	7795 – 34874
170	3692.57	I	3688 – 30762
280	3693.90	II	12488 – 39552
150	3695.97	II	11117 – 38165
70	3696.65	II	9401 – 36445
70	3697.03	II	6168 – 33209
180	3698.11	I	9805 – 36838
55	3698.26	II	
110	3700.77	II	15305 – 42319
40	3700.98	I	5563 – 32575
40	3702.86	II	19912 – 46911
85	3703.78	I	4962 – 31953
250 w	3703.91	II	10855 – 37846
	3703.99	II	10572 – 37562
	3704.08	II	9400 – 36390
85 d	3704.86	I	2869 – 29853
	3704.97	II	15237 – 42220
340	3706.77	I	8111 – 35081
40	3707.00	I	
40	3707.43	II	0 – 26965
35	3708.75	II	16818 – 43774
280	3711.30	II	6700 – 33637
85	3711.62	I	6362 – 33297
55	3712.53	II	17461 – 44389
40	3717.83	II	14102 – 40992
40	3718.17	II	9238 – 36125
590	3719.44	I	0 – 26878
450	3719.98	II	10189 – 37063
270	3720.31	II	9712 – 36584
770	3721.82	II	1860 – 28721
340	3722.12	II	4113 – 30972
50	3723.29	II	15350 – 42200
55	3723.66	II	4147 – 30994
85	3724.73	II	17460 – 44300
70	3725.39	I	
220	3726.72	II	4147 – 30972
110	3727.90	I	2869 – 29686
130	3730.37	I	6362 – 33162
170	3730.75	II	15350 – 42147
22	3731.30	I	
40	3731.42	II	15144 – 41936
50	3732.98	I	10527 – 37307
50	3733.67	I	8111 – 34887
100	3734.60	II	4490 – 31259
100	3737.51	I	3865 – 30614
170	3738.85	II	8460 – 35199
110	3740.85	II	11117 – 37841
1300	3741.18	II	1522 – 28244
150	3742.92	I	4962 – 31671
40	3743.51	II	10572 – 37277
55	3744.74	II	8460 – 35157
50	3745.66	I	14482 – 41172
340	3745.97	II	7332 – 34019
310	3747.54	II	9202 – 35879
40	3751.02	I	0 – 26652
	3751.12	I	11242 – 37893
650	3752.57	II	9238 – 35879
35	3753.24	I	7795 – 34431
55	3754.03	I	8244 – 34874
130	3754.59	II	0 – 26626
130	3755.21	I	11197 – 37819
50	3756.29	I	8111 – 34725
140	3757.69	I	10527 – 37131
130	3758.47	I	2558 – 29157
130	3759.26	I	8111 – 34704
50	3760.27	II	0 – 26586
70	3761.10	II	12488 – 39069
50	3761.47	I	9805 – 36383
510	3762.88	II	6168 – 32736
	3762.94	I	3688 – 30255
50	3763.32	II	16818 – 43383
110	3765.24	I	8800 – 35351
200	3767.90	II	9061 – 35594
180	3770.06	I	5563 – 32080

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
200		3771.37	I	0 – 26508
100		3772.24	II	7829 – 34330
170		3773.76	II	10572 – 37063
50		3774.20	II	19880 – 46368
70		3775.90	II	14349 – 40826
85		3776.27	I	8800 – 35274
25		3777.41	I	7502 – 33968
50		3780.97	I	2869 – 29310
25		3781.32	I	7280 – 33718
170		3783.01	II	13469 – 39895
140		3783.29	II	0 – 26425
340		3785.60	II	6168 – 32577
50		3785.91	II	17771 – 44177
70		3786.88	II	7332 – 33731
50		3788.36	II	4490 – 30880
310		3789.12	II	1860 – 28244
85	h	3790.36	I	
200		3790.79	I	7795 – 34167
70		3791.30	II	11576 – 37945
110		3792.37	I	10414 – 36775
100		3794.15	II	11117 – 37465
55		3794.70	I	13175 – 39520
85		3795.39	I	
55		3796.73	I	8800 – 35131
40		3797.45	II	15787 – 42113
55		3798.10	I	4962 – 31283
130		3801.44	I	7502 – 33801
28		3802.15	II	9585 – 35879
590		3803.08	I	0 – 26287
85		3803.98	I	8800 – 35081
110		3805.82	II	6691 – 32960
370		3807.88	II	9202 – 35456
55		3808.61	I	10527 – 36775
55		3809.83	II	14484 – 40725
100		3810.99	I	7502 – 33735
28		3812.40	I	15490 – 41713
340		3813.07	II	9238 – 35456
40		3815.03	II	10379 – 36584
110		3817.48	I	8244 – 34431
50		3818.68	I	4962 – 31141
170		3821.43	II	11117 – 37277
170		3822.15	II	9585 – 35741
85		3823.58	II	13251 – 39397
28		3826.37	I	10527 – 36654
110		3826.95	II	14349 – 40472
450		3828.38	I	0 – 26113
150		3829.42	II	17122 – 43228
55		3830.06	I	10414 – 36516
110		3830.77	I	0 – 26097
270		3831.74	II	14484 – 40575
50		3832.97	II	
70		3836.54	I	7502 – 33560
55		3836.58	I	4962 – 31019
250		3837.88	I	2869 – 28918
840		3839.74	II	6700 – 32736
85		3840.80	I	4962 – 30991
280		3841.96	II	9720 – 35741
85		3842.90	I	11197 – 37212
28		3846.25	II	22014 – 48006
85		3852.14	I	3688 – 29640
390		3854.51	II	10189 – 36125
140		3859.84	II	8379 – 34279
450		3863.40	II	6700 – 32577
340		3872.72	II	10379 – 36193
370		3873.82	I	2869 – 28676
250		3874.86	I	4962 – 30762
210		3875.37	I	10414 – 36211
28		3875.65	I	7502 – 33297
140		3879.64	I	7502 – 33271
55		3884.52	II	9720 – 35456
140		3884.82	II	19912 45646
55		3885.77	II	1522 – 27250
100		3886.92	I	2869 – 28589
100		3887.02	I	10414 – 36133
85		3891.05	II	11117 – 36809
28		3891.72	I	11197 – 36885
50		3892.31	II	6244 – 31929
55		3893.11	II	13407 – 39086
28		3893.42	II	12488 – 38165
340		3895.42	I	7795 – 33459
50		3898.44	I	2869 – 28513
35		3898.51	I	11242 – 36885
28		3900.13	II	12472 – 38105
55		3900.58	I	8800 – 34430
340		3900.88	II	7332 – 32960
55		3901.15	II	12220 – 37846
50		3902.17	I	
110		3903.10	I	7795 – 33409
140		3904.08	II	4113 – 29720
170		3905.19	II	13469 – 39069
50		3908.75	I	11242 – 36818
28		3909.14	I	12114 – 37688
85		3911.91	I	4962 – 30517
110		3912.28	II	10572 – 36125
100		3913.00	II	13818 – 39367
		3913.08	I	11601 – 37149
55		3913.82	II	1860 – 27403
50		3916.42	I	0 – 25526
140		3916.80	II	17722 43246
55		3917.27	I	10526 – 36047
85		3918.07	I	14482 – 39997
55		3918.50	II	
110		3919.02	I	3688 – 29197
55		3922.22	II	9238 – 34727
28		3923.80	I	2869 – 28347
140		3925.09	I	3688 – 29158
28		3926.71	II	12486 – 37945
110		3927.18	II	13407 – 38863
110		3927.42	II	14484 – 39939
590		3929.67	II	0 – 25440
55		3932.00	II	14791 – 40216
85		3932.23	II	9238 – 34662
200		3932.91	I	7795 – 33215
140	d	3935.48	I	
		3935.63	II	16818 – 42220
140		3937.04	II	10673 – 36066
110		3937.92	II	7828 – 33216
110	d	3938.61	I	8800 – 34183
		3938.78	II	6244 – 31626
110	h	3941.23	I	5563 – 30929
50		3942.07	I	7502 – 32862
70		3942.64	II	10189 – 35546
150		3943.39	II	9202 – 34553
85		3943.69	II	12472 – 37822
220		3945.51	II	10855 – 36193
85		3945.82	II	10189 – 35525
220		3946.14	II	13407 – 38741
110		3947.33	I	9805 – 35131
50		3948.03	I	0 – 25322
20		3948.13	I	8244 – 33565

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
200 h	3948.96	II	9238 – 34554
200	3950.39	I	0 – 25306
28	3951.11	II	12486 – 37788
220	3951.52	II	12488 – 37788
50	3952.76	I	3865 – 29157
110	3955.17	I	9805 – 35081
50	3955.89	I	2869 – 28141
390 d	3956.59	II	10189 – 35456
	3956.69	II	0 – 25267
55	3957.16	II	20989 – 46253
110	3959.30	I	5563 – 30813
70	3960.33	II	13251 – 38494
55	3962.42	I	3688 – 28918
50	3963.22	II	15350 – 40575
28	3963.47	II	10379 – 35602
50 d	3964.74	II	17121 – 42336
	3964.86	II	10379 – 35594
390	3967.39	I	4962 – 30160
70	3969.00	II	0 – 25188
200	3972.15	I	7795 – 32963
70	3972.64	I	8244 – 33409
150	3973.20	I	6362 – 31524
55	3974.22	II	14546 – 39701
210	3976.41	II	9585 – 34727
55	3979.04	II	15243 – 40367
150	3980.09	I	
55	3980.75	II	24381 – 49495
200	3981.10	II	13407 – 38518
55	3981.83	I	12848 – 37955
85	3987.22	I	7502 – 32575
200	3988.02	II	9202 – 34270
55	3988.60	II	1521 – 26586
70	3988.84	II	6691 – 31754
110	3990.49	I	3865 – 28918
110	3991.73	I	8800 – 33845
55	3992.28	II	9238 – 34279
530	3994.55	II	0 – 25027
250	3996.06	II	15350 – 40367
55	3997.47	II	11117 – 36125
150	3997.86	II	9720 – 34727
55	4000.28	I	10414 – 35405
110	4001.06	I	7795 – 32782
55	4001.73	II	4113 – 29095
110	4003.10	II	10572 – 35546
240	4003.31	II	9202 – 34175
55	4005.09	I	3688 – 28649
140	4005.53	II	15453 – 40411
100	4006.38	II	10572 – 35525
250	4007.02	II	11117 – 36066
220	4008.21	I	7795 – 32737
220	4009.06	I	11197 – 36134
28	4009.72	I	8111 – 33043
28	4009.82	I	13175 – 38107
55	4011.59	I	6362 – 31283
110	4011.74	I	4962 – 29881
280	4012.50	I	2869 – 27784
55	4014.51	II	1522 – 26425
55	4018.10	I	0 – 24880
4200	4019.13	II	0 – 24874
110	4019.77	ThO	
210	4022.07	I	8244 – 33099
	4022.09	II	4490 – 29345
210	4025.65	II	9720 – 34553
170	4026.14	II	
140	4027.01	I	3688 – 28513
250	4030.84	I	2869 – 27671
110	4032.46	II	
110	4032.60	I	8800 – 33591
140	4034.25	II	6214 – 30994
70	4034.92	II	4146 – 28923
250	4036.05	I	0 – 24770
240	4036.56	II	1860 – 26626
110	4039.86	I	14207 – 38953
240	4041.20	II	10855 – 35594
70	4043.13	II	1859 – 26586
110	4043.39	I	4962 – 29686
50	4045.63	II	6168 – 30880
55	4048.29	I	7502 – 32197
55	4048.43	I	12114 – 36808
85 d	4049.94	I	3688 – 28373
110	4050.89	I	
140	4053.53	I	7795 – 32458
140	4059.25	I	6362 – 30991
250	4063.41	I	11197 – 35800
55	4064.33	I	11197 – 35794
55	4065.69	II	9585 – 34175
55	4067.45	I	2869 – 27448
910	4069.20	II	6691 – 31259
55	4071.75	I	8244 – 32796
55	4075.50	I	2558 – 27088
55	4080.71	I	7795 – 32294
110	4081.37	I	8800 – 33295
110	4082.26	II	11576 – 36066
70	4083.47	I	1865 – 28348
700	4085.04	II	10189 – 34662
85	4085.43	I	8800 – 33271
700	4086.52	II	0 – 24464
50	4087.28	I	10414 – 34873
70	4088.73	I	6362 – 30813
55	4089.14	I	2869 – 27317
50	4091.35	II	9202 – 33637
85	4093.39	II	7332 – 31754
700	4094.75	II	0 – 24415
55	4097.32	I	6362 – 30761
110	4097.75	I	2869 – 27266
170	4098.93	II	8460 – 32850
150	4100.34	I	0 – 24381
140	4100.82	II	14484 – 38863
55	4102.62	I	7502 – 31870
140	4104.38	II	8379 – 32736
270	4105.34	II	7001 – 31353
70	4105.91	II	10675 – 35021
55	4107.37	II	11117 – 35456
55	4107.86	I	3688 – 28025
840	4108.42	II	4490 – 28824
55	4109.32	I	8111 – 32439
110 d	4110.51	II	12488 – 36809
	4110.64	II	6244 – 30565
85	4110.83	I	
240	4112.75	I	0 – 24308
280	4115.76	I	5563 – 29853
1100	4116.71	II	6168 – 30453
50	4118.49	I	13297 – 37571
55	4122.70	II	
110	4123.53	II	8606 – 32850
200	4127.41	I	
55	4130.33	I	15490 – 39694
110	4131.00	I	7795 – 31996
110	4131.42	II	8379 – 32577
340	4132.75	II	9711 – 33902

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
140	h	4133.46	ThO	
200		4134.06	I	0 – 24182
		4134.11	II	9202 – 33384
140	d	4136.29	I	11878 – 36047
		4136.39	II	13407 – 37575
70	h	4139.19	ThO	
220		4140.24	II	9238 – 33384
150		4141.63	II	17771 – 41909
170		4142.48	II	14484 – 38617
250		4142.70	II	0 – 24132
55		4145.84	I	14032 – 38146
220		4148.18	II	7829 – 31929
50		4148.72	I	7502 – 31599
450		4149.99	II	10572 – 34662
55	d	4152.20	I	
		4152.34	I	
110		4155.30		
70		4155.47		
130		4156.24	II	10673 – 34727
340		4156.51	II	9585 – 33637
28		4157.27	I	
28		4157.39	I	10414 – 34461
110		4158.54	I	9805 – 33845
85		4159.66	II	14484 – 38518
55	d	4161.59	II	13818 – 37841
		4161.74	I	7502 – 31524
55		4162.51	I	10414 – 34431
140		4162.68	II	14276 – 38292
170		4163.64	II	9720 – 33731
110		4164.25	II	9202 – 33209
55		4165.07	II	15350 – 39352
140		4165.77	I	7795 – 31794
55	h	4168.05	I	
170		4168.63	II	10572 – 34553
220		4170.47	II	9238 – 33209
		4170.53	I	4962 – 28933
55		4170.78	II	13818 – 37788
110		4171.34	II	
50	d	4176.33	II	14791 – 38729
		4176.48	I	15970 – 39907
620		4178.06	II	7332 – 31259
250		4179.71	II	1522 – 25440
150		4179.96	II	9720 – 33637
55		4180.88	I	
110		4182.16	II	14276 – 38180
55		4183.56	II	9061 – 32957
50		4184.71	II	14276 – 38165
50		4189.56	I	13297 – 37160
55		4191.83	II	11576 – 35426
28		4192.36	I	6362 – 30209
130		4193.02	I	8111 – 31953
50		4194.94	I	7795 – 31627
70		4195.56	II	18817 – 42645
85		4195.83	II	14546 – 38372
		4195.95	II	15243 – 39069
55		4199.02	II	13469 – 37277
170		4201.85	II	8018 – 31811
50		4206.66	II	17722 – 41488
620		4208.89	II	6700 – 30453
55		4210.76	I	7795 – 31537
130		4210.92	I	0 – 23741
55		4213.07	I	2558 – 26287
28		4214.54	II	17727 – 41447
28		4214.83	I	4962 – 28681
55		4217.22	II	6168 – 29874
55		4218.19	II	11726 – 35426
55		4218.54	II	10572 – 34270
55		4220.06	I	5563 – 29253
55		4224.24	II	1522 – 25188
55		4227.39	I	7280 – 30929
100		4229.45	II	12488 – 36125
85		4230.43	I	11242 – 34873
55		4233.29	II	15453 – 39069
85		4235.46	I	0 – 23604
50		4240.59	II	6213 – 29788
85		4243.93	II	9401 – 32957
28		4247.60	II	4490 – 28026
140		4248.00	II	9202 – 32736
55		4249.68	II	7829 – 31353
170		4250.34	II	
110		4253.54	I	13297 – 36801
70		4256.09	II	9720 – 33209
70		4256.25	I	7502 – 30991
100		4257.50	I	0 – 23481
110		4260.33	I	9805 – 33271
28		4262.61	I	16784 – 40237
55		4263.36	II	9401 – 32850
28		4269.94	I	8111 – 31524
55		4270.33	II	15453 – 38864
50		4271.10	II	1860 – 25267
55		4272.88	I	8800 – 32197
280		4273.36	II	8379 – 31773
110		4274.02	II	12488 – 35879
100		4276.81	II	8379 – 31754
55		4276.97	II	9202 – 32577
480		4277.31	II	0 – 23373
70		4278.32	I	14204 – 37571
28		4280.57	I	5563 – 28918
130		4281.07	II	1522 – 24874
110		4281.42	II	8460 – 31811
700		4282.04	II	6168 – 29515
110		4283.52	II	9238 – 32577
70		4284.98	II	16565 – 39895
50		4286.19	II	17722 – 41047
		4286.23	I	6362 – 29686
55		4288.05	II	14791 – 38105
28		4288.47	I	13848 – 37160
28		4288.67	I	7502 – 30813
55		4291.81	I	8244 – 31537
85		4295.04	II	17771 – 41047
55		4297.31	I	11197 – 34461
70		4298.83	II	12486 – 35741
85		4299.84	I	11197 – 34447
55		4306.37	II	19912 – 43127
100		4307.18	I	11197 – 34408
28		4308.12	I	11242 – 34447
200		4309.99	II	10189 – 33384
28		4311.58	I	11803 – 34990
28		4311.80	I	8244 – 31429
140		4312.99	I	2869 – 26049
55		4315.25	I	2869 – 26036
110	d	4318.29	II	9585 – 32736
		4318.42	I	
28		4319.10	II	15243 – 38389
140		4320.13	II	4490 – 27631
85		4320.59	II	12902 – 36041
40		4327.09	II	4490 – 27594
40		4327.23	II	4146 – 27249
55		4328.69	II	17272 – 40367
55		4329.49	II	14484 – 37575

559-795 O - 75 - 21 (Pt. 1)

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
28		4330.84	I	8111 – 31195
55		4331.92	II	14484 – 37562
28		4333.93	II	22028 – 45095
28		4335.31	II	12485 – 35545
170		4335.69	II	11117 – 34175
130		4337.28	I	0 – 23049
		4337.38	II	
50		4338.11	I	10414 – 33459
55	d	4340.90	I	8111 – 31141
		4341.03	II	23187 – 46216
85		4342.26	II	12571 – 35594
70		4342.44	I	8244 – 31266
100		4343.95	II	1860 – 24874
130		4344.33	II	0 – 23012
170		4344.62	ThO	
70		4346.43	I	7280 – 30281
25		4347.19	II	14791 – 37788
25		4347.24	II	14546 – 37542
55		4348.60	I	13848 – 36837
55		4349.07	I	4962 – 27949
140	h	4350.82	ThO	
85		4352.68	II	12488 – 35456
85		4353.40	II	10673 – 33637
55		4354.48	I	13175 – 36133
110		4355.32	II	8018 – 30972
55		4357.61	II	1522 – 24464
55		4358.32	I	10783 – 33721
85		4359.37	I	10527 – 33459
85		4361.31	II	15243 – 38165
85		4365.93	I	8244 – 31142
85		4369.32	II	8379 – 31259
85		4373.90	II	9720 – 32577
85		4374.12	I	0 – 22855
130		4374.78	II	4113 – 26965
55		4378.18	I	2869 – 25703
70		4381.40	II	4146 – 26963
1300		4381.86	II	6700 – 29515
28		4384.66	I	
1100		4391.11	II	4490 – 27257
55		4392.97	I	7795 – 30553
28		4393.76	I	7502 – 30255
85		4394.89	II	8606 – 31353
70		4396.48	II	9061 – 31800
85		4397.91	II	6700 – 29431
50		4399.09	II	20288 – 43014
55		4401.58	I	7795 – 30508
55		4402.93	I	2869 – 25575
85		4408.88	I	3688 – 26363
28		4410.49	II	17272 – 39939
85		4412.56	I	13175 – 35831
210		4412.74	II	6168 – 28824
55		4414.49	I	8244 – 30890
85		4416.24	II	10572 – 33209
28		4416.84	I	9805 – 32439
28		4418.66	II	16818 – 39443
50		4421.54	II	1522 – 24132
50		4422.05	I	10783 – 33391
55		4427.66	II	14484 – 37063
28		4432.25	I	6362 – 28918
250		4432.96	II	9202 – 31754
22		4436.05	II	10673 – 33209
28		4436.29	II	9238 – 31773
40		4436.55	II	14276 – 36809
140		4439.12	II	11117 – 33637
40		4440.57	II	0 – 22513
140		4440.87	II	8460 – 30972
50		4443.09	II	8378 – 30879
28		4445.03	I	10783 – 33274
28		4445.90	I	
110		4447.83	II	6244 – 28721
25		4452.56	I	2869 – 25322
25		4454.51	II	11576 – 34019
85		4458.00	I	3688 – 26113
85	d	4461.06	II	13469 – 35878
		4461.24	I	3688 – 26097
40		4461.53	I	8244 – 30651
40		4461.70	II	18816 – 41223
220		4465.34	II	8606 – 30994
55		4469.53	I	10414 – 32782
35		4472.28	II	13248 – 35602
40		4474.07	II	13249 – 35594
85		4480.82	II	4113 – 26425
40		4482.17	I	4962 – 27266
40		4485.80	II	10673 – 32960
25		4486.63	II	18817 – 41099
25		4486.90	I	2558 – 24839
110		4487.50	II	4147 – 26425
140		4488.68	II	4490 – 26762
40		4492.24	II	12472 – 34727
170		4493.33	I	0 – 22249
40		4496.32	II	19912 – 42146
24		4497.91	I	13848 – 36074
110		4498.95	I	5563 – 27784
70		4499.98	I	7795 – 30011
55		4505.22	I	8800 – 30991
24		4506.47	I	7502 – 29686
280		4510.53	II	10572 – 32736
40		4512.48	II	11576 – 33731
55		4513.68	I	9805 – 31953
40		4515.12	I	0 – 22142
40		4515.96	II	20990 – 43127
22		4517.04	II	16033 – 38165
22		4518.64	II	17771 – 39895
22		4519.26	I	3688 – 25809
22		4519.75	II	12902 – 35021
70	h	4521.20	I	2869 – 24981
		4521.24	II	
22		4522.78	II	24757 – 46861
40		4524.84	II	7001 – 29095
28		4525.09	II	11117 – 33209
20		4529.48	II	12472 – 34544
22		4530.32	I	11242 – 33309
70		4531.71	II	13818 – 35879
85		4532.26	II	12486 – 34544
170		4533.30	II	9720 – 31773
70		4534.12	II	10572 – 32621
40		4535.26	I	8244 – 30287
70		4537.07	II	15242 – 37277
55		4540.40	II	14791 – 36809
70		4544.51	II	4490 – 26489
35		4545.82	II	12220 – 34212
		4545.92	I	
22		4551.47	I	13848 – 35813
35		4552.15	I	8800 – 30762
70		4555.81	I	3865 – 25809
70		4561.35	I	7280 – 29197
90		4563.29	II	18817 – 40725
40		4563.66	I	8111 – 30017
21		4564.18	II	10673 – 32577
30		4566.65	II	7829 – 29720

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
21		4567.24	I	7795 – 29684
65		4570.97	I	11197 – 33068
26		4573.70	II	6168 – 28026
21		4575.25	II	1522 – 23373
21		4575.42	II	14276 – 36125
21		4581.23	II	16906 – 38728
40		4581.58	II	15243 – 37063
30		4584.37	II	12472 – 34279
30		4588.23	II	16033 – 37822
50		4588.43	I	10414 – 32202
40		4589.12	II	12486 – 34270
30		4589.67	II	12488 – 34270
50		4592.67	I	8244 – 30011
19		4593.64	I	13089 – 34852
75		4595.42	I	3688 – 25443
45		4602.88	II	7001 – 28721
26		4606.50	II	12472 – 34174
50		4609.37	II	12486 – 34174
65		4611.86	II	9202 – 30880
26		4612.54	II	9585 – 31259
65		4619.48	II	9238 – 30879
40		4619.56	II	14484 – 36125
30		4623.89	II	20288 – 41909
26		4624.14	II	11117 – 32736
26		4625.05	II	16565 – 38180
140		4631.76	II	10189 – 31773
45		4633.76	I	12114 – 33689
65		4639.70	II	12472 – 34019
65		4640.04	II	10379 – 31924
30		4641.24	I	11242 – 32782
140		4651.55	II	7332 – 28824
30		4651.99	II	1522 – 23012
23		4663.20	I	2869 – 24308
65		4666.00	II	6168 – 27594
50		4666.80	I	6362 – 27784
90		4668.17	I	7502 – 28918
50	h	4669.98	I	8244 – 29651
75		4673.66	I	2869 – 24260
65		4676.06	I	10414 – 31794
30		4680.64	II	6168 – 27527
15		4686.20	I	2869 – 24203
100		4689.17	II	6691 – 28011
15		4690.68	II	17837 – 39150
40		4691.05	II	19912 – 41223
15		4691.63	I	6362 – 27671
140		4694.09	II	0 – 21297
50	d	4694.92	II	4147 – 25440
		4695.04	I	3688 – 24981
50		4700.14	II	14276 – 35546
15		4702.31	II	9712 – 30972
50		4703.99	I	0 – 21253
130		4705.76	II	9711 – 30956
40		4706.25	II	7001 – 28244
15		4708.10	II	11726 – 32960
65		4712.39	II	9238 – 30453
		4712.48	I	9804 – 31019
26		4715.43	II	10572 – 31773
65		4718.62	II	19912 – 41099
40		4719.98	II	14276 – 35456
30		4722.09	I	7502 – 28673
90		4723.44	I	0 – 21165
120		4723.78	II	1522 – 22686
50		4724.77	II	9720 – 30880
30	d	4726.33	II	1860 – 23012
		4726.46	II	12486 – 33637
30		4729.13	I	7795 – 28935
45		4729.88	II	8379 – 29515
13		4732.67	II	22686 – 43809
190		4740.53	II	6168 – 27257
13		4741.31	I	6362 – 27448
26		4742.24	II	
		4742.26	II	10673 – 31754
45		4743.69	II	4113 – 25188
26		4749.20	I	7795 – 28846
21		4749.97	I	8111 – 29158
140		4752.41	II	6214 – 27250
45	h	4758.14	I	
65		4761.11	II	16565 – 37562
40		4764.34	II	17121 – 38105
13		4766.60	I	3865 – 24839
65		4774.25	II	6691 – 27631
26		4777.19	I	14204 – 35131
26		4778.29	I	0 – 20922
13		4779.59	II	
23		4782.76	II	6691 – 27594
15		4784.04	I	15619 – 36516
40		4789.39	I	3688 – 24562
13		4800.17	II	6700 – 27527
21		4803.48	II	19912 – 40725
12		4803.95	II	13469 – 34279
45		4808.13	I	4962 – 25754
26	d	4813.72	I	
		4813.89	I	7795 – 28563
45		4818.64	II	17771 – 38518
18		4820.88	II	12472 – 33209
12		4821.27	II	13818 – 34553
26		4822.86	I	4962 – 25690
23		4823.18	II	4147 – 24874
30		4823.60	I	6362 – 27088
40		4826.70	I	13088 – 33801
45		4831.12	I	3688 – 24381
13		4831.60	I	8244 – 28935
65		4832.80	II	0 – 20686
45		4840.47	II	1860 – 22513
50		4840.84	I	2869 – 23521
45		4844.16	II	11117 – 31754
18		4844.56	II	9238 – 29874
30		4848.36	I	3688 – 24308
40		4849.04	II	22028 – 42645
75		4850.44	II	4147 – 24758
15		4852.87	I	16218 – 36818
12		4858.10	II	18973 – 39552
40		4858.33	II	10379 – 30956
13		4861.22	I	8111 – 28676
280		4863.16	II	6213 – 26770
45		4865.48	I	7795 – 28342
12		4868.27	II	18817 – 39352
12		4868.88	I	11242 – 31775
40		4872.92	I	6362 – 26878
13		4874.36	I	8800 – 29310
50		4877.00	II	16565 – 37063
26		4878.73	I	2558 – 23049
45		4894.96	I	0 – 20424
30		4898.46	II	17771 – 38180
13		4898.80	II	17272 – 37680
26		4899.24	I	
18		4911.38	I	9805 – 30160
40		4912.53	II	4113 – 24464
15		4914.12	II	17122 – 37465
240		4919.82	II	6168 – 26489

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
26	4920.53	II	8605 – 28923
65	4921.61	II	9202 – 29515
18	4922.95	II	10572 – 30880
26	4924.42	II	4113 – 24415
18	4927.78	I	8244 – 28531
18	4929.98	II	14275 – 34553
18	4933.85	II	7332 – 27594
40	4936.77	I	8800 – 29050
40	4939.64	I	7795 – 28034
17	4943.06	I	2869 – 23094
17	4945.46	I	0 – 20215
17	4946.66	II	19248 – 39458
60	4947.56	II	10673 – 30879
50	4950.62	II	9238 – 29431
95	4954.56	II	11576 – 31754
	4954.66	II	14484 – 34661
19	4960.42	I	
	4960.49	II	9720 – 29874
24	4963.18	II	11117 – 31259
50	4964.12	II	10855 – 30994
24	4968.75	I	13848 – 33968
40	4970.03	II	8605 – 28720
35	4972.17	II	15350 – 35456
35	4973.38	II	15324 – 35426
35	4975.95	II	12486 – 32577
19	4976.59	II	12488 – 32577
19	4980.95	II	6691 – 26762
24	4985.37	I	3688 – 23741
110	4987.15	II	18817 – 38863
19	4989.31	I	7280 – 27317
24	4997.80	II	15453 – 35456
19	4999.94	II	14276 – 34270
50	5002.10	I	2869 – 22855
19	5008.19	II	17983 – 37945
50	5015.89	II	
260	5017.26	II	7332 – 27257
40	5019.32	II	14102 – 34019
17	5020.54	II	13818 – 33731
130	5028.61	II	10572 – 30453
17	5029.63	II	15145 – 35021
24	5039.23	I	2558 – 22397
40 h	5040.15	ThO	
24	5040.56	II	22685 – 42518
24	5040.68	I	3688 – 23521
50	5044.72	I	0 – 19817
	5044.75	I	7795 – 27612
19	5045.25	I	7502 – 27317
19	5047.05	I	4962 – 24770
24	5047.43	II	15787 – 35593
240	5049.80	II	6691 – 26489
24	5050.78	I	3688 – 23481
85	5055.34	II	1522 – 21297
70	5058.56	II	14790 – 34553
24	5059.86	I	7502 – 27260
40	5061.22	II	14791 – 34544
19	5064.60	I	4962 – 24701
24	5066.78	I	18011 – 37742
110	5067.97	I	7795 – 27522
24	5075.47	II	15324 – 35021
24	5090.75	II	8606 – 28244
21	5094.13	I	14207 – 33832
40	5095.07	I	18432 – 38053
50	5098.04	II	1521 – 21131
21	5100.62	I	4962 – 24562
24	5107.24	II	7829 – 27403
50	5110.86	II	16565 – 36125
30	5115.04	I	3865 – 23410
40	5131.07	II	15243 – 34727
24	5140.77	I	6362 – 25809
95	5143.27	II	1860 – 21297
24	5143.92	I	10414 – 29849
24	5145.04	II	7332 – 26762
120	5148.21	II	15243 – 34662
50	5151.61	I	3687 – 23093
24	5151.86	II	4113 – 23518
50	5154.24	I	7795 – 27191
85	5158.60	I	2869 – 22249
70	5160.72	I	7280 – 26652
24	5163.46	I	3688 – 23049
50	5164.98	I	14204 – 33560
24	5170.22	II	11117 – 30453
50	5176.96	I	11197 – 30508
35	5182.53	II	18816 – 38107
35	5183.99	II	12488 – 31773
14	5187.46	I	
21	5189.67	II	20288 – 39552
50	5190.87	II	4113 – 23373
40	5193.82	II	0 – 19248
50 h	5195.82	I	4962 – 24203
50	5198.80	I	10527 – 29756
95	5199.16	I	3865 – 23094
24	5205.78	II	15349 – 34553
60	5206.49	II	6213 – 25414
	5206.66	II	10673 – 29874
50	5211.23	I	3865 – 23049
24	5213.35	I	7795 – 26971
95	5216.59	II	1522 – 20686
50	5218.53	II	7332 – 26489
35	5219.11	I	8111 – 27266
110	5231.16	I	2558 – 21669
24	5232.04	II	
85	5233.22	II	9720 – 28824
40	5237.91	II	17722 – 36809
40	5240.20	II	6168 – 25246
95	5247.65	II	0 – 19051
19	5253.44	II	15145 – 34175
35	5258.36	I	3865 – 22878
12	5266.71	I	3688 – 22670
70	5277.50	II	10572 – 29515
12	5280.10	II	14276 – 33209
30	5297.75	I	8800 – 27671
35	5301.40	II	14102 – 32960
12	5303.05	II	12902 – 31754
12	5304.62	II	14791 – 33637
17	5305.58	II	9401 – 28244
30	5307.47	II	16564 – 35400
40	5310.26	II	1860 – 20686
35	5312.00	I	3688 – 22508
35	5312.53	I	5563 – 24381
60	5325.14	II	12486 – 31259
50	5326.98	I	8111 – 26878
24	5329.37	II	10673 – 29431
	5329.48	II	18816 – 37575
60	5343.58	I	3688 – 22397
30	5345.31	II	
14	5347.04	II	22028 – 40724
14	5351.13	I	15619 – 34301
40	5375.35	II	1522 – 20120
24	5375.77	II	15305 – 33902
12	5378.84	I	14482 – 33068

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
35	5382.92	II	4113 – 22686
12	5384.03	I	
35	5386.61	I	4962 – 23521
70	5390.46	II	6700 – 25246
50	5392.57	II	4147 – 22686
12	5394.76	I	3865 – 22397
24	5398.92	I	8800 – 27318
24	5407.65	I	11197 – 29684
21	5410.77	I	6362 – 24839
70	5415.46	II	14276 – 32736
24	5417.49	I	3688 – 22142
19	5421.84	II	7001 – 25440
21	5424.01	I	10414 – 28845
60	5425.68	II	9585 – 28011
12	5431.11	I	6362 – 24770
10	5433.70	II	11117 – 29515
12	5435.13	II	12486 – 30880
50	5435.89	II	12488 – 30879
24	5437.38	II	12570 – 30956
35	5443.11	II	4147 – 22513
40	5449.48	II	14276 – 32621
30	5452.22	I	9805 – 28141
24	5461.74	II	13469 – 31773
30	5462.61	II	14276 – 32577
19	5474.86	II	1860 – 20120
24	5484.14	II	11117 – 29346
24	5488.62	II	0 – 18214
7	5495.81	II	14546 – 32736
10	5496.14	I	5563 – 23753
30	5499.26	I	2558 – 20737
12	5501.94	II	6244 – 24415
19	5504.30	I	7280 – 25443
35	5509.99	I	9805 – 27949
12	5510.68	II	15243 – 33384
19	5514.87	I	7795 – 25923
19	5518.99	I	16347 – 34461
12	5521.75	I	19227 – 37332
24	5524.22	II	16565 – 34662
12	5524.58	I	13175 – 31271
12 h	5528.00	II	20081 – 38165
12	5537.13	II	9202 – 27257
50	5539.26	I	9805 – 27853
70	5539.91	II	9585 – 27631
19	5542.89	I	10527 – 28563
10	5546.12	I	
35	5548.18	I	6362 – 24381
24	5551.37	II	9585 – 27594
24	5557.04	I	8800 – 26790
12	5557.31	II	16564 – 34553
50	5558.34	I	8111 – 26097
7	5559.89	I	3688 – 21669
60	5564.20	II	12486 – 30453
35	5568.00	II	13818 – 31773
35	5571.19	I	11197 – 29142
17	5572.47	I	7502 – 25443
40	5573.36	I	8111 – 26049
24 d	5576.00	I	
	5576.20	I	10414 – 28342
35	5579.36	I	5563 – 23481
21	5583.76	II	9061 – 26965
60	5587.03	I	4962 – 22855
24	5587.73	II	20288 – 38179
24	5588.87	II	6244 – 24132
24	5593.61	II	7001 – 24874
24	5595.06	I	8244 – 26112
7	5601.60	I	0 – 17847
50	5604.51	II	0 – 17837
7	5605.30	I	
12	5610.24	I	7502 – 25322
19	5610.68	I	11601 – 29419
12	5612.07	I	10414 – 28228
35	5615.32	I	3865 – 21669
24	5615.73	II	17722 – 35525
7	5626.73	II	19912 – 37680
7	5630.30	I	19986 – 37742
70	5639.75	II	1522 – 19248
50	5645.89	II	11117 – 28824
12	5652.90	II	17771 – 35456
12	5654.02	II	6700 – 24381
12	5657.93	I	12848 – 30517
17	5665.18	I	8244 – 25890
30	5665.62	II	9711 – 27357
14	5674.99	I	11803 – 29419
7	5678.92	II	16033 – 33637
24	5700.45	II	9712 – 27250
95	5700.70	II	9720 – 27257
	5700.91	II	4146 – 21682
95	5707.10	II	6214 – 23731
19	5719.62	I	7502 – 24981
50	5720.18	I	3688 – 21165
30	5725.39	I	9805 – 27266
30	5732.98	II	17727 – 35165
7	5738.31	II	17121 – 34543
19	5741.17	II	7001 – 24415
24	5742.08	II	13468 – 30879
10	5745.68	II	20990 – 38389
10	5748.74	I	6362 – 23753
30	5749.38	II	1860 – 19248
10	5753.03	I	4962 – 22339
70	5760.55	I	0 – 17355
10	5763.53	I	2869 – 20215
10	5784.87	II	17272 – 34553
21	5796.42	II	11576 – 28824
35	5804.14	I	0 – 17224
17	5806.28	II	12570 – 29788
19	5815.42	II	1860 – 19051
10	5838.94	II	0 – 17122
7	5852.68	I	10414 – 27496
17	5859.67	II	13818 – 30879
17	5870.55	II	12486 – 29515
14	5885.70	I	9805 – 26790
8	5891.45	I	10527 – 27496
40	5914.39	II	9585 – 26489
17	5914.65	I	7280 – 24182
19	5925.87	II	10379 – 27250
17	5938.83	I	5563 – 22397
10	5944.65	I	10527 – 27344
30	5973.66	I	3688 – 20424
30	5975.07	I	6362 – 23094
85	5989.04	II	1522 – 18214
14	5991.00	I	6362 – 23049
24	5994.13	I	3865 – 20544
7	6001.21	I	8111 – 24770
21	6007.07	I	8800 – 25443
11	6010.16	I	2869 – 19503
30	6015.42	II	15305 – 31924
12	6019.00	II	15145 – 31754
17	6021.04	I	7795 – 24399
17	6037.70	I	3865 – 20424
24	6044.43	II	4147 – 20686

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
12		6066.50	II	26647 – 43127
30		6073.10	II	1522 – 17983
12		6085.26	II	6214 – 22642
30		6087.26	II	15350 – 31773
24		6099.08	II	10379 – 26770
11		6102.60	I	10414 – 26796
30		6104.57	I	15619 – 31996
40		6112.84	II	1860 – 18214
30		6120.56	II	14546 – 30880
14		6151.99	I	7502 – 23753
60		6169.82	I	4962 – 21165
50		6182.62	I	2869 – 19039
12		6184.79	I	13089 – 29253
19		6188.13	I	8244 – 24399
12		6191.91	I	6362 – 22508
24		6193.86	II	11117 – 27257
10		6198.22	I	3688 – 19817
12		6200.43	II	1860 – 17983
12		6203.49	I	4962 – 21077
19		6207.22	I	5563 – 21669
12		6224.53	I	2869 – 18930
12		6232.97	II	9401 – 25440
24	h	6234.86	I	6362 – 22396
12	h	6258.60	II	4147 – 20120
21		6261.06	II	4113 – 20081
21		6261.42	I	10414 – 26380
11		6266.17	II	8460 – 24415
50		6274.12	II	4147 – 20081
11		6277.23	II	6214 – 22140
30		6279.16	II	12902 – 28824
17		6285.28	II	11726 – 27631
11	h	6289.48	II	9711 – 25607
11		6301.42	I	
11	h	6304.24	II	8606 – 24464
7		6326.36	I	11242 – 27044
21		6327.28	I	11197 – 26997
35		6342.86	I	8800 – 24562
11	h	6348.56	II	22642 – 38389
7		6358.62	II	19880 – 35602
14		6369.14	I	17166 – 32862
40		6376.93	I	14204 – 29881
40	bl	6406.2	ThO	
19		6408.63	II	1522 – 17122
30		6411.90	I	7502 – 23094
24		6413.62	I	13297 – 28885
17		6416.10	II	9401 – 24982
14		6424.81	II	22014 – 37575
60		6457.28	I	7795 – 23277
50		6462.62	I	16554 – 32024
8		6471.20	II	12488 – 27937
14		6490.74	I	8800 – 24203
12		6503.51	II	11117 – 26489
7	h	6511.36	II	9061 – 24415
50	h	6531.34	I	6362 – 21669
6		6554.16	I	4962 – 20215
14		6560.06	II	14276 – 29515
10		6569.63	II	12570 – 27787
5		6572.88	II	15243 – 30453
19		6577.65	II	15349 – 30548
24		6583.91	I	2869 – 18054
24		6588.54	I	3865 – 19039
12		6591.48	I	0 – 15167
24		6593.94	I	5563 – 20724
24		6605.42	II	4113 – 19248
10		6617.05	II	12485 – 27594
24		6619.94	II	4147 – 19248
21		6644.66	II	9712 – 24758
8		6646.54	II	12486 – 27527
6		6648.50	II	11726 – 26762
4		6648.96	II	10379 – 25414
6	h	6658.68	I	11242 – 26256
30		6662.27	I	7502 – 22508
4		6678.71	I	7280 – 22249
8		6692.72	II	4113 – 19051
8		6704.05	II	11576 – 26489
8		6713.97	I	6362 – 21253
8		6719.20	I	10527 – 25405
16		6727.46	I	5563 – 20424
8		6733.75	I	14204 – 29051
6		6742.88	I	12848 – 27674
20		6756.45	I	2558 – 17355
6		6765.68	I	18614 – 33391
10		6770.10	II	8606 – 23373
8		6772.18	I	15493 – 30255
6		6778.31	I	3865 – 18614
7		6780.13	I	8244 – 22989
11		6780.42	I	8111 – 22855
6		6787.73	I	14204 – 28933
6		6788.84	I	11197 – 25923
6		6791.23	I	8800 – 23521
6		6804.73	II	12902 – 27594
8		6810.54	II	12571 – 27250
6		6812.76	II	10572 – 25246
8		6824.68	I	11242 – 25890
11		6829.04	I	7502 – 22142
14		6834.92	I	4962 – 19588
7		6854.11	I	13089 – 27674
6		6868.46	I	13297 – 27853
8		6874.75	I	2869 – 17411
20		6889.30	II	1521 – 16033
11	bl	6894.4	ThO	
15		6909.84	II	13468 – 27937
24		6911.23	I	0 – 14465
35		6943.61	I	9805 – 24203
6		6952.96	II	10379 – 24758
55		6989.66	I	7795 – 22098
24		6993.03	II	7001 – 21297
18		7000.81	I	9805 – 24085
10		7018.56	I	0 – 14244
5		7021.28	I	15970 – 30209
7		7036.28	I	11197 – 25405
30		7045.80	II	1522 – 15711
15		7053.61	II	1860 – 16033
6		7060.65	I	3688 – 17847
6		7064.45	I	14207 – 28358
6		7072.39	I	14207 – 28342
24		7075.33	II	11117 – 25246
30		7084.16	I	9805 – 23917
24		7089.33	II	0 – 14102
10		7100.51	II	8606 – 22686
11		7124.56	I	0 – 14032
4		7130.29	I	24032 – 38053
5		7131.35	I	
5		7140.45	II	13248 – 27249
5		7148.56	I	10414 – 24399
5		7150.28	I	3865 – 17847
10	hw	7154.95	I	7280 – 21253
15	hs	7155.5	ThO	
5		7156.94	I	4962 – 18930
8	hs	7158.56	ThO	

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
18	hs	7159.10	ThO	
5		7159.94	I	13297 – 27260
7	hs	7164.88	ThO	
30		7168.90	I	0 – 13945
7		7173.37	I	14204 – 28141
5		7176.72	II	10379 – 24309
40		7191.13	II	10855 – 24757
7		7200.04	I	7280 – 21165
5		7206.48	I	10527 – 24399
35		7208.00	I	8800 – 22670
11		7212.69	I	14482 – 28342
10		7217.76	II	1859 – 15710
11		7218.06	I	9805 – 23655
4		7219.16	I	4962 – 18810
5		7230.87	I	17501 – 31327
5		7244.69	I	7795 – 21594
7		7284.90	I	3688 – 17411
5	hs	7285.62	ThO	
7	hs	7287.05	ThO	
11	hs	7288.98	ThO	
11		7305.40	II	7001 – 20686
7		7324.81	I	14204 – 27853
7		7328.28	I	7280 – 20922
7		7335.57	I	
8		7341.15	I	10414 – 24032
5		7342.57	I	18011 – 31627
5		7346.34	II	10855 – 24463
6	h	7358.35	II	12902 – 26489
8		7376.88	I	14482 – 28034
7		7383.71	I	20868 – 34408
18		7385.50	I	3688 – 17224
3		7393.43	II	13249 – 26771
5		7402.25	I	10527 – 24032
21		7428.94	I	7280 – 20737
10		7430.26	I	6362 – 19817
4		7447.85	I	11242 – 24665
10		7481.35	I	8800 – 22163
7		7511.35	II	7001 – 20310
50		7525.51	II	9401 – 22686
4		7528.49	I	11601 – 24880
5		7536.41	I	12847 – 26113
7		7549.32	I	7280 – 20523
7		7566.53	II	17272 – 30484
18		7567.74	I	9805 – 23015
12		7585.69	I	16554 – 29733
12		7585.78	I	2558 – 15737
4		7598.20	I	11241 – 24399
7		7625.70	I	14482 – 27592
5		7627.18	I	4962 – 18069
4	h	7630.31	I	8800 – 21902
30		7647.38	I	9805 – 22878
7		7653.83	I	14204 – 27266
4		7658.32	I	8111 – 21165
7		7676.21	II	1522 – 14546
4		7678.12	I	7502 – 20523
21		7685.30	II	4113 – 17121
4		7693.80	I	17166 – 30160
8	h	7701.10	II	14275 – 27257
5		7709.59	II	16906 – 29873
4		7710.26	I	8111 – 21077
10		7731.72	II	9711 – 22642
4		7742.55	I	15619 – 28531
3		7743.93	II	
7		7782.32	I	
15		7787.79	II	8460 – 21297
15		7788.93	I	11197 – 24032
5		7798.36	I	5563 – 18383
21		7817.77	I	10414 – 23202
8		7834.45	II	12486 – 25246
3		7840.29	I	13297 – 26049
3		7840.44	I	19986 – 32737
5		7841.78	I	11242 – 23990
15		7847.54	I	8800 – 21540
4		7848.44	I	15490 – 28228
4		7849.62	II	14791 – 27527
12		7865.95	I	14482 – 27191
10	bl	7868.3	ThO	
6		7886.27	I	6362 – 19039
7		7897.9	ThO	
11		7900.31	I	15619 – 28273
11		7941.72	I	16347 – 28935
7	h	7972.60	I	4962 – 17501
24		7978.98	I	3688 – 16218
5		7981.21	II	8605 – 21131
4		7981.67	II	16906 – 29431
11		7987.97	I	13848 – 26363
11		8032.43	I	7502 – 19948
4		8054.52	II	12570 – 24982
11		8062.64	I	19227 – 31626
5		8075.65	I	11803 – 24182
5		8085.23	I	8800 – 21165
5		8093.63	I	3865 – 16218
7		8122.72	I	19986 – 32294
11		8138.47	I	5563 – 17847
5	h	8139.90	II	9401 – 21683
18		8143.14	I	8800 – 21077
5		8152.39	II	10379 – 22642
12		8159.74	I	6362 – 18614
10		8163.12	II	7001 – 19248
7		8166.44	II	1860 – 14102
7		8169.79	I	7280 – 19517
15		8186.92	I	8111 – 20322
12		8203.19	II	12571 – 24758
7		8217.22	II	13248 – 25414
5		8252.40	I	0 – 12114
4		8261.01	I	15490 – 27592
5		8263.93	I	9805 – 21902
18		8275.63	I	11197 – 23277
15		8320.86	I	7502 – 19517
30		8330.46	I	7502 – 19503
4		8358.73	I	11242 – 23202
4		8369.33	I	13945 – 25890
6		8387.09	II	4113 – 16033
18		8403.79	II	12485 – 24381
15		8416.74	I	0 – 11878
5		8418.00	I	12114 – 23990
12		8421.23	I	3865 – 15737
8		8445.50	I	8111 – 19948
21		8446.52	I	
5		8450.68	II	10855 – 22686
18		8478.35	I	5563 – 17355
5		8500.67	II	10379 – 22139
6	h	8516.55	I	19588 – 31326
4		8543.72	I	15490 – 27191
4		8544.59	I	29310 – 41010
4	h	8556.32	I	10414 – 22098
4		8568.20	II	18816 – 30484
11		8573.12	I	5563 – 17224
5	h	8587.63	II	20158 – 31800
12		8591.83	II	10379 – 22015

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
4	8639.44	I	10526 – 22098	15	8758.25	I	8800 – 20215
4	8645.31	I	13962 – 25526	8 h	8775.58	I	8111 – 19503
10	8665.49	I	7502 – 19039	8 h	8784.55	II	1522 – 12902
4	8668.12	I	12848 – 24381	8	8816.16	II	4113 – 15453
4	8686.07	II	6213 – 17722	6	8841.17	I	7502 – 18809
5	8709.23	I	3688 – 15167	18	8842.07	II	4147 – 15453
5	8719.62	II	15305 – 26771	15	8868.82	I	9804 – 21077
5	8721.65	II	15787 – 27249	15	8957.97	II	12571 – 23731
8	8732.43	I		40	8967.64	I	8800 – 19948
18	8748.04	I	7502 – 18930	15 bl	8971.96	ThO	
6	8749.17	I					

Thulium

Tm, $Z=69$, $M=168.9342$, Ratio $\frac{\text{Tm}}{\text{Cu}}=2.658$

Tm I Normal state of valence electrons $4f^{13}6s^2\ {}^2F^{\circ}_{31/2}=0$. I.P. $=49880\ \text{cm}^{-1}$.
Tm II Normal state of valence electrons $4f^{13}6s\ {}^3F^{\circ}_{4}=0$. I.P. $=97200\ \text{cm}^{-1}$.
Tm III Normal state of valence electrons $4f^{13}\ {}^2F^{\circ}_{31/2}=0$. I.P. $=191000\ \text{cm}^{-1}$.

References

Wavelengths and Spectrum Assignments:
W. F. Meggers and J. Sugar, unpublished material (1966).

Classification:
Tm I, J. Sugar, W. F. Meggers, and P. Camus, J. Res. Nat. Bur. Stand. (U.S.), **77A** (Phys. and Chem.), No. 1, 1–43 (Jan.–Feb. 1973).
Tm II, J. Sugar, private communication (1974).
Tm III, J. Sugar, J. Opt. Soc. Am. **69**, 454 (1970).

Strong lines of thulium

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
10000	4094.19	I	0 – 24418	4900	3453.66	II	237 – 29183
9500	4105.84	I	0 – 24349	4800	3700.26	II	237 – 27254
8900	3848.02	II	0 – 25980	4800	3761.91	II	0 – 26575
8800	4187.62	I	0 – 23873	4000	3362.61	II	237 – 29967
8500	3462.20	II	0 – 28875	3800	3701.36	II	0 – 27009
7700	3717.91	I	0 – 26889	3500	3916.48	I	8771 – 34297
7400	3131.26	II	0 – 31927	3000	4242.15	II	237 – 23803
7100	3795.75	II	237 – 26575	2700	4359.93	I	0 – 22930
6800	3883.13	I	0 – 25745	2400	3734.12	II	237 – 27009
6400	3425.08	II	237 – 29425	2300	3133.89	II	0 – 31900
6000	3761.33	II	0 – 26579	2300	3172.83	II	237 – 31745
6000	4203.73	I	0 – 23782	2300	3241.54	II	0 – 30841
5400	3887.35	I	0 – 25717	2300	3291.00	II	0 – 30377
5000	3744.06	I	0 – 26701	2100	3608.77	II	0 – 27702
4900	3441.50	II	237 – 29286	2000	3302.46	II	237 – 30509

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
360		2284.79	II	0 – 43754
120		2329.77	II	
230		2331.80	III	31037 – 73909
220		2338.36	III	25920 – 68672
70		2340.92	II	
310		2357.05	III	25302 – 67715
120		2361.23	III	33802 – 76140
120		2363.91	II	
		2363.97	III	31368 – 73657
45		2365.96	II	12457 – 54710
160		2367.11	II	
150		2383.68	II	236 – 42176
110		2388.95	II	0 – 41846
55		2408.23	II	0 – 41511
450		2409.02	II	
110		2412.44	II	12457 – 53896
65		2419.37	II	
30		2420.20	II	20619 – 61925
120		2421.65	II	12457 – 53738
23		2423.28	II	
450		2426.17	II	
55		2428.43	II	0 – 41166
30		2430.77	II	20619 – 61745
55		2434.75	II	
45		2436.19	II	
65		2437.67	II	0 – 41010
90		2440.70	II	0 – 40959
140		2445.47	II	12457 – 53336
35		2445.94	II	
65		2447.38	II	12457 – 53304
80		2451.20	II	
35		2454.91	II	237 – 40959
80		2458.58	II	
80		2464.95	II	12457 – 53013
18		2471.37	II	
80		2476.97	II	0 – 40359
770		2480.13	II	236 – 40545
150		2481.15	II	
130		2487.52	II	
150		2489.44	III	27557 – 67715
35		2490.93	II	17974 – 58107
250		2491.60	II	237 – 40359
90		2499.20	II	
100		2499.54	II	237 – 40232
55		2502.70	II	17974 – 57919
65		2504.71	III	27547 – 67460
27		2505.90	II	0 – 39894
27		2506.45	II	17974 – 57859
130		2507.15	II	12457 – 52331
1300		2509.08	II	0 – 39843
45		2511.84	II	20619 – 60418
90	d	2513.78	I	0 – 39768
		2513.87	II	17974 – 57741
23		2518.48	II	
100		2519.78	III	36466 – 76140
200		2520.87	II	237 – 39893
		2520.94	II	
250		2522.17	II	0 – 39636
180		2524.11	II	
130		2527.02	I	0 – 39560
110		2527.42	II	
35		2527.85	I	0 – 39547
18		2531.45	II	17974 – 57465
120		2542.66	II	237 – 39554
30		2544.03	II	19682 – 58978
30		2551.51	II	26256 – 65436
120		2552.46	III	22897 – 62063
360		2552.76	I	0 – 39161
540		2561.65	II	0 – 39025
150		2563.86	II	0 – 38991
65		2565.98	II	237 – 39197
35		2568.26	II	237 – 39162
35		2569.34	II	16567 – 55476
45		2574.52	III	34826 – 73657
35		2583.42	I	0 – 38696
430		2588.27	II	12457 – 51081
35		2594.98	II	19526 – 58051
170	h	2596.49	I	0 – 38502
110		2601.09	I	0 – 38433
220		2606.02	II	0 – 38361
810		2607.06	II	237 – 38583
60		2609.46	II	
80		2613.59	II	
40		2615.99	II	18291 – 56506
80		2616.32	II	19619 – 57829
40		2616.99	II	0 – 38200
40		2620.93	II	16567 – 54710
80		2622.21	II	237 – 38361
730		2624.33	II	0 – 38094
70		2629.78	II	
40		2632.23	II	
60		2637.23	II	19619 – 57526
70		2638.41	II	19682 – 57573
210		2640.76	II	237 – 38094
40		2642.83	II	
40		2643.50	II	12457 – 50274
130		2646.45	II	0 – 37775
70		2648.14	II	
160		2650.27	II	237 – 37958
35		2653.40	II	21021 – 58698
190		2658.48	II	237 – 37841
250		2660.09	II	0 – 37581
50		2664.45	II	25219 – 62739
140		2668.20	II	
40		2674.98	II	23024 – 60396
60		2677.12	II	20619 – 57961
50		2678.09	II	16567 – 53896
310		2679.57	II	12457 – 49765
95		2682.32	III	25302 – 62572
95		2684.07	II	236 – 37482
35	d	2686.20	II	
		2686.32	II	21021 – 58236
35		2689.99	II	17974 – 55138
35		2693.46	II	19526 – 56642
170		2697.50	II	
40	h	2698.21	III	30664 – 67715
40		2699.49	III	38055 – 75088
40		2699.80	III	0 – 37028
50		2700.18	II	19619 – 56642
40		2701.96	II	
80		2707.03	III	33802 – 70732
19		2708.18	II	237 – 37151
95		2709.74	III	33831 – 70724
110		2711.50	II	0 – 36869
40		2717.56	III	39934 – 76721
200		2719.47	III	25302 – 62063
540		2721.19	II	12457 – 49195
29		2721.90	II	
200		2727.56	III	25920 – 62572
150		2729.04	II	237 – 36869

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
35	2730.72	II	17974 – 54583
70	2731.38	III	34124 – 70724
50	2735.33	II	0 – 36548
95	2742.95	II	16567 – 53013
200	2744.08	II	20619 – 57050
110	2750.76	II	17974 – 54317
110	2753.18	II	237 – 36548
150	2756.69	II	8769 – 45034
90	2758.97	II	20619 – 56853
40	2759.55	II	19526 – 55753
70	2766.81	II	0 – 36132
50	2767.09	II	18291 – 54419
110	2771.04	II	8957 – 45034
90	2773.79	II	0 – 36041
70	2774.77	II	21022 – 57050
180	2774.97	II	18291 – 54317
50	2776.68	II	
120	2777.04	II	22052 – 58051
90	2777.50	II	8957 – 44950
50	2778.39	II	17974 – 53955
270	2779.55	II	0 – 35966
110	2780.87	II	19526 – 55476
350	2785.07	II	237 – 36132
95	2786.18	II	22355 – 58236
50	2787.96	II	
29	2791.43	II	
120	2791.61	II	
180	2792.16	II	237 – 36041
680	2794.60	II	0 – 35772
95 h	2796.09	II	0 – 35754
730	2797.27	II	12457 – 48195
60	2797.98	II	237 – 35966
95	2800.39	II	17974 – 53673
70	2803.10	II	18291 – 53955
40	2806.77	III	33236 – 68853
180	2807.98	II	17974 – 53576
170	2808.42	II	237 – 35834
95	2812.25	II	
40	2813.02	II	19619 – 55157
29	2813.82	II	23768 – 59297
140	2814.41	II	22052 – 57573
140	2814.50	II	17974 – 53494
29	2814.74	II	25696 – 61213
40	2816.55	II	23803 – 59297
90	2817.31	II	21021 – 56506
110	2818.14	II	22052 – 57526
250	2818.47	II	12457 – 47927
70	2819.08	II	19526 – 54988
24	2820.22	II	20619 – 56066
40	2823.54	II	
60	2824.76	II	8769 – 44160
95	2826.43	II	19619 – 54988
250	2827.02	II	17974 – 53336
80	2827.76	II	20619 – 55972
580	2827.92	II	12457 – 47808
50	2830.16	II	
200	2831.55	II	19682 – 54988
70	2833.81	II	
50	2836.16	II	
40	2838.63	II	22355 – 57573
160	2838.93	II	20619 – 55833
95	2839.10	II	
70	2839.85	II	18291 – 53494
120	2841.38	II	19526 – 54710
40	2842.42	II	22355 – 57526
29	2842.76	II	
310	2844.67	II	237 – 35380
60	2845.35	II	20619 – 55753
95	2848.86	II	19619 – 54710
29	2848.98	II	8957 – 44047
29	2852.59	II	18291 – 53336
29	2853.25	II	237 – 35274
90	2854.02	II	17974 – 53002
200	2854.17	I	0 – 35026
60	2854.89	II	23961 – 58978
200	2860.12	II	26188 – 61141
50	2860.36	II	21021 – 55972
70	2860.55	II	237 – 35185
200	2861.74	II	17974 – 52907
95	2863.35	II	0 – 34914
150	2863.75	II	
29	2864.75	I	15271 – 50167
160	2868.01	II	20619 – 55476
1600	2869.23	II	12457 – 47299
80	2873.00	II	8957 – 43754
40	2878.20	II	
60	2878.36	II	21021 – 55753
18	2883.04	II	
140	2886.45	II	237 – 34871
60 h	2887.95	II	18291 – 52907
95	2889.64	II	23904 – 58500
29	2889.93	II	25014 – 59607
35	2890.74	II	23768 – 58351
630	2890.94	II	0 – 34580
50	2893.62	II	20619 – 55167
170	2894.47	II	20619 – 55157
130	2903.08	II	
29	2904.10	II	26709 – 61133
95	2905.42	II	
70	2907.17	II	17974 – 52361
60	2908.69	II	19526 – 53896
29	2910.37	II	12457 – 46807
50	2911.87	II	23904 – 58236
130	2913.96	II	0 – 34308
170	2914.84	I	0 – 34297
130	2916.53	II	19619 – 53896
210	2918.27	II	
70	2920.98	II	21608 – 55833
60	2921.26	II	
70	2922.09	II	19526 – 53738
70	2922.84	II	23904 – 58107
270	2925.65	II	20465 – 54636
70	2925.92	II	236 – 34404
680	2926.74	II	0 – 34157
29	2927.31	II	22355 – 56506
50	2927.67	II	23904 – 58051
110	2928.22	II	26256 – 60396
29	2928.63	II	21021 – 55157
50	2930.56	II	31323 – 65436
40	2931.09	I	16456 – 50563
70	2932.58	II	23961 – 58051
80	2932.97	I	0 – 34085
29	2933.78	II	
40	2933.88	II	26188 – 60262
29	2935.49	II	19682 – 53738
630	2935.99	II	16567 – 50617
29	2936.59	II	22308 – 56352
70	2943.36	II	20619 – 54583
95	2946.83	II	23904 – 57829
140	2948.00	II	17974 – 51885

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
95		2948.15	II	25980 – 59889
35		2950.07	II	27254 – 61141
350		2951.26	II	
50		2951.80	II	23961 – 57829
50		2952.47	II	27254 – 61114
60		2953.58	II	26478 – 60325
50		2955.05	II	23768 – 57599
29		2957.04	II	
60		2957.54	II	22355 – 56157
29		2957.66	II	20619 – 54419
180		2959.64	II	19526 – 53304
50		2961.39	II	22308 – 56066
430		2965.86	II	16567 – 50274
120		2967.75	II	19619 – 53304
120		2969.50	II	0 – 33666
490		2973.22	I	0 – 33624
160		2973.38	II	19682 – 53304
110		2974.28	II	23961 – 57573
29		2974.60	II	28095 – 61703
150		2978.42	II	0 – 33565
35		2979.44	II	26709 – 60262
540		2981.48	II	12457 – 45987
70		2983.12	II	8957 – 42470
70		2985.08	II	
130		2985.37	II	19526 – 53013
350		2986.52	II	
630		2990.54	II	237 – 33666
35		2992.88	II	22355 – 55758
200		2993.26	II	0 – 33399
120		2993.90	II	0 – 33392
29		2994.33	II	25257 – 58644
130		2999.60	II	237 – 33565
35		3001.15	II	26578 – 59889
29		3004.16	II	20619 – 53896
60		3006.35	II	17974 – 51227
120		3008.91	II	16567 – 49792
29		3009.20	II	25015 – 58236
70		3013.59	II	
230		3013.71	II	19619 – 52791
430		3014.65	II	237 – 33399
1500		3015.30	II	237 – 33392
70	d	3016.09	II	23904 – 57050
		3016.18	II	28096 – 61241
35		3016.79	II	28974 – 62113
270		3017.09	II	19526 – 52661
70		3017.26	II	23024 – 56157
29		3018.26	II	25257 – 58379
95		3018.59	II	
60		3019.79	II	22052 – 55157
35		3022.07	II	28276 – 61356
330		3026.07	II	0 – 33036
55		3028.73	II	
75		3031.67	II	21608 – 54583
75		3034.08	II	23904 – 56853
85		3035.98	II	21608 – 54536
280		3042.35	II	237 – 33097
340	d	3046.76	II	22355 – 55167
		3046.87	I	0 – 32811
170		3048.81	II	18291 – 51081
320		3050.73	II	
75		3053.70	II	23768 – 56506
150		3054.04	II	12457 – 45191
340		3056.07	II	19619 – 52331
75		3058.35	II	
75		3058.98	II	23961 – 56642
75		3061.14	II	22052 – 54710
75		3062.05	II	19682 – 52331
75		3064.00	II	16567 – 49195
55		3068.11	II	22052 – 54636
580		3073.08	II	
150		3073.48	II	
75		3073.84	II	
360		3081.12	I	0 – 32446
150		3087.01	II	19619 – 52003
180		3093.11	II	19682 – 52003
120		3096.96	II	21608 – 53888
740		3098.60	II	236 – 32500
75		3099.60	II	23904 – 56157
55		3101.85	II	28096 – 60325
75		3102.87	II	8769 – 40988
55		3113.31	II	22308 – 54419
150		3122.53	I	8771 – 40787
40		3123.29	II	22308 – 54317
75		3124.90	II	21021 – 53013
75		3125.73	II	18291 – 50274
150		3126.01	II	21021 – 53002
7400		3131.26	II	0 – 31927
2300		3133.89	II	0 – 31900
150		3142.43	I	8771 – 40584
230		3144.90	II	
230		3146.16	II	8769 – 40545
75		3149.15	II	0 – 31745
75		3150.06	II	
1900		3151.04	II	0 – 31726
1500		3157.34	II	237 – 31900
75		3162.44	II	23024 – 54636
75		3164.87	II	8957 – 40545
190		3168.19	II	19526 – 51081
75		3168.82	II	30197 – 61745
450		3172.65	I	0 – 31510
2300		3172.83	II	237 – 31745
380		3173.58	II	18291 – 49792
130		3177.46	II	8770 – 40232
75		3178.20	II	17974 – 49429
150		3180.56	I	0 – 31432
150		3185.47	II	12457 – 43840
230		3195.33	II	8770 – 40056
130		3196.54	II	8957 – 40232
130		3199.99	II	16567 – 47808
320		3210.56	II	18291 – 49429
320		3210.82	II	0 – 31136
320		3212.01	II	8770 – 39894
130		3214.63	II	8957 – 40056
75		3216.11	II	23904 – 54988
75		3226.81	II	22355 – 53336
75		3228.90	II	22052 – 53013
230		3231.51	II	8957 – 39894
75		3233.74	I	0 – 30915
470		3235.44	II	237 – 31136
1200		3236.81	II	8957 – 39843
1600		3240.23	II	237 – 31090
2300		3241.54	II	0 – 30841
130		3245.86	II	237 – 31037
320		3246.96	I	8771 – 39560
420		3247.46	II	8770 – 39554
75		3249.83	II	26837 – 57599
75		3251.33	II	19526 – 50274
160		3251.63	II	8770 – 39514
1900		3258.05	II	0 – 30684
400		3261.65	II	20465 – 51116

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
320		3264.10	II	0 – 30627
1600		3266.64	II	237 – 30841
1200		3267.40	II	8957 – 39554
790		3268.99	II	
1100		3276.81	II	0 – 30509
1200		3283.40	II	237 – 30684
85		3284.68	II	22355 – 52791
1200		3285.61	II	8770 – 39197
2300		3291.00	II	0 – 30377
2000		3302.46	II	237 – 30509
210		3306.01	II	8957 – 39197
210		3306.91	II	8769 – 39000
210		3308.01	II	31135 – 61356
1200		3309.80	II	8957 – 39162
640		3310.59	II	0 – 30197
85		3316.17	II	19619 – 49765
400		3316.88	II	237 – 30377
210		3318.65	II	
160		3323.21	II	19682 – 49765
85		3327.58	II	8957 – 39000
85		3335.05	II	22355 – 52331
230		3349.99	I	13119 – 42961
230		3354.86	II	
4000		3362.61	II	237 – 29967
130		3368.33	II	24059 – 53738
130		3368.60	I	16957 – 46634
160		3369.64	II	19526 – 49195
490		3374.50	II	8957 – 38583
55		3380.04	II	22308 – 51885
170		3380.53	I	
420	d	3384.99	II	23803 – 53336
		3385.08	I	15270 – 44803
170		3393.19	I	13119 – 42581
1700		3397.50	II	0 – 29425
65		3397.87	I	13119 – 42541
170		3398.02	II	16567 – 45987
420		3399.95	II	8957 – 38361
850		3410.05	I	0 – 29317
55		3411.57	II	8957 – 38261
340		3412.59	I	15271 – 44565
340		3416.59	I	0 – 29260
170		3421.79	I	15587 – 44803
65		3424.50	I	18692 – 47885
6400		3425.08	II	237 – 29425
950		3425.63	II	0 – 29183
170		3428.61	II	21608 – 50766
340		3429.33	I	16456 – 45608
850		3429.96	II	8769 – 37916
420		3431.19	II	8957 – 38094
55		3434.90	II	23803 – 52907
190		3435.35	I	16456 – 45557
85		3437.63	II	16567 – 45648
140		3438.80	II	8769 – 37841
4900		3441.50	II	237 – 29286
170		3442.99	I	15270 – 44307
85		3444.16	I	
85		3446.55	I	17454 – 46461
170	d	3447.26	II	8957 – 37958
		3447.35	I	13119 – 42119
170		3449.76	II	23024 – 52003
85	h	3453.03	I	18693 – 47644
4900		3453.66	II	237 – 29183
55		3456.36	I	
140		3458.55	I	18853 – 47759
140		3461.16	II	8957 – 37841
8500		3462.20	II	0 – 28875
210		3467.51	I	15587 – 44418
340		3476.69	I	13119 – 41874
340		3480.98	I	15587 – 44307
340		3481.75	II	8769 – 37482
170		3487.08	II	19526 – 48195
420		3487.38	I	13119 – 41786
130		3489.52	I	19466 – 48115
55		3491.72	I	18853 – 47484
210		3492.58	II	8957 – 37581
85		3495.19	II	24059 – 52661
340		3499.95	I	
130		3503.36	I	
250		3513.02	II	22308 – 50766
85		3514.11	I	0 – 28449
85		3514.86	I	
250		3517.60	I	
140		3517.72	I	19466 – 47885
170		3522.43	II	8770 – 37151
85		3525.03	I	18853 – 47214
65		3525.28	I	
250		3534.85	II	19526 – 47808
1700		3535.52	II	0 – 28276
490		3536.21	II	16567 – 44838
850		3536.58	II	0 – 28268
420		3537.91	I	
55		3542.08	I	18990 – 47214
140		3548.48	II	21021 – 49195
85		3550.16	II	27598 – 55758
85		3550.83	II	25257 – 53411
85		3551.68	I	
210		3555.82	I	16456 – 44571
85		3556.57	I	16456 – 44565
85		3557.34	I	17454 – 45557
420		3557.79	II	8770 – 36869
340		3560.92	I	18693 – 46767
420		3563.88	I	0 – 28051
490		3565.91	II	19619 – 47654
1300		3566.47	II	237 – 28268
420		3567.36	I	0 – 28024
130		3569.80	I	13119 – 41124
280		3574.06	II	19682 – 47654
85		3575.29	I	13119 – 41081
85		3583.43	I	16957 – 44855
280		3586.07	I	16456 – 44334
130		3590.73	I	15587 – 43429
170		3598.62	I	15271 – 43051
85		3599.16	II	25014 – 52791
130		3607.35	II	22052 – 49765
2100		3608.77	II	0 – 27702
250		3609.53	II	18291 – 45987
65		3611.61	II	19619 – 47299
95		3612.39	II	17974 – 45648
85		3613.03	II	16567 – 44237
180		3619.97	II	34307 – 61924
30		3623.42	II	8957 – 36548
85		3624.20	I	15271 – 42855
380		3638.41	I	13119 – 40596
35		3639.89	II	237 – 27702
85		3642.94	I	15587 – 43030
950		3643.65	II	
180		3646.70	I	13119 – 40533
140		3647.22	II	22355 – 49765
240		3647.72	II	12457 – 39863
600		3653.61	II	8770 – 36132

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
85		3660.88	II	20619 – 47927
500		3665.81	II	8770 – 36041
1100		3668.09	II	0 – 27254
120		3673.14	II	17974 – 45191
410		3677.98	II	12457 – 39638
450	d	3678.85	II	8957 – 36132
		3678.95	II	21021 – 48195
140		3683.20	II	22052 – 49195
410		3694.74	II	237 – 27294
		3694.82	II	24059 – 51116
85		3697.57	II	
170		3699.87	II	12457 – 39477
4800		3700.26	II	237 – 27254
3800		3701.36	II	0 – 27009
330		3704.85	II	8769 – 35753
7700		3717.91	I	0 – 26889
70		3719.71	II	8957 – 35834
890		3725.06	II	0 – 26837
120		3730.81	II	8957 – 35753
2400		3734.12	II	237 – 27009
5000		3744.06	I	0 – 26701
1700		3751.81	I	0 – 26646
310		3756.86	II	8770 – 35380
6000		3761.33	II	0 – 26579
4800		3761.91	II	0 – 26575
70		3765.85	II	18291 – 44838
85		3781.15	I	0 – 26440
260		3783.55	II	8957 – 35380
50		3787.01	I	16456 – 42855
380		3795.16	II	237 – 26579
7100		3795.75	II	237 – 26575
770		3798.54	I	8771 – 35089
240		3798.75	II	8957 – 35274
70		3802.07	I	15587 – 41881
600		3807.72	I	8771 – 35026
380		3810.72	II	8769 – 35003
550		3817.39	II	0 – 26188
60		3821.62	I	17454 – 43614
290		3826.39	I	0 – 26127
1300		3838.20	II	8957 – 35003
290		3840.87	I	15271 – 41299
8900		3848.02	II	0 – 25980
70		3853.10	II	18291 – 44237
140		3857.84	II	8957 – 34871
6800		3883.13	I	0 – 25745
1800		3883.44	II	237 – 25980
5400		3887.35	I	0 – 25717
440		3890.53	II	0 – 25696
440		3896.62	I	0 – 25656
680		3900.79	II	8769 – 34398
3500		3916.48	I	8771 – 34297
120		3928.66	II	8957 – 34404
570		3929.58	II	8957 – 34398
1500		3949.27	I	8771 – 34085
55		3957.42	II	237 – 25498
1500		3958.10	II	0 – 25258
95		3976.68	I	16742 – 41881
440		3995.58	II	237 – 25258
1800		3996.52	II	0 – 25014
220		4024.23	I	16456 – 41299
80		4034.76	II	25014 – 49792
380		4044.47	I	8771 – 33489
80		4055.81	I	13119 – 37768
80		4090.29	II	8957 – 33399
80		4091.49	II	8957 – 33392
10000		4094.19	I	0 – 24418
9500		4105.84	I	0 – 24349
70		4107.93	I	16742 – 41078
120		4132.69	II	19526 – 43717
1100		4138.33	I	8771 – 32928
120		4149.14	I	
55		4150.10	I	17752 – 41841
120		4158.60	I	8771 – 32811
70		4159.54	II	19682 – 43717
70		4170.45	I	18990 – 42961
8800		4187.62	I	0 – 23873
520		4199.92	II	0 – 23803
6000		4203.73	I	0 – 23782
220		4206.00	II	0 – 23768
55		4212.79	II	8770 – 32500
380		4222.67	I	8771 – 32446
95		4236.94	II	24059 – 47654
3000		4242.15	II	237 – 23803
55		4246.39	II	8957 – 32500
70		4268.56	I	17343 – 40763
270		4271.71	I	8771 – 32174
150		4298.36	I	13119 – 36377
95		4318.40	I	17613 – 40763
70		4344.48	I	17752 – 40763
70		4346.48	I	15587 – 38588
55		4351.00	II	21022 – 43998
95		4351.18	II	8770 – 31745
2700		4359.93	I	0 – 22930
95		4363.66	II	16567 – 39477
55		4367.89	II	19682 – 42570
1400		4386.43	I	0 – 22791
200		4394.42	I	8771 – 31520
120		4395.96	I	15271 – 38012
140		4396.50	I	8771 – 31510
55		4399.72	I	18853 – 41576
55		4437.40	II	22308 – 44838
80		4442.74	I	16742 – 39244
50		4447.58	I	16742 – 39220
120		4454.03	I	16742 – 39187
80		4459.99	I	
50		4467.98	I	15270 – 37646
540		4481.26	II	0 – 22309
80		4489.70	II	8770 – 31037
150		4519.60	I	16742 – 38861
260		4522.57	II	
180		4529.38	II	237 – 22309
80		4532.15	I	15587 – 37646
110		4548.60	I	17343 – 39322
40		4556.68	II	26256 – 48195
40		4561.86	II	8770 – 30684
80		4564.68	I	17343 – 39244
40		4567.11	II	17974 – 39863
95		4596.63	I	17613 – 39362
270		4599.02	I	0 – 21738
35		4601.29	II	8957 – 30684
55		4603.43	II	
40		4604.85	I	17752 – 39462
50		4613.97	I	17752 – 39419
40		4614.47	II	22052 – 43717
300		4615.94	II	16567 – 38225
35		4619.06	II	22355 – 43998
40		4621.72	I	17613 – 39244
80		4626.33	II	21608 – 43217
95		4626.56	II	0 – 21608
40		4626.97	I	17613 – 39220

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
110		4634.26	II	18291 – 39863
40		4642.96	II	22308 – 43840
95		4643.12	I	8771 – 30302
35		4644.58	I	17752 – 39277
120		4655.09	I	17613 – 39089
35		4666.70	II	23768 – 45191
35		4671.99	II	26256 – 47654
35		4675.10	I	
80		4675.31	I	15270 – 36653
40		4677.86	II	237 – 21608
160		4681.92	I	8771 – 30124
70		4685.11	I	13119 – 34457
120		4691.11	I	8771 – 30082
110		4724.26	I	0 – 21161
680		4733.34	I	0 – 21121
35		4750.75	II	
70		4759.90	I	15270 – 36273
27		4789.92	II	28276 – 49147
27		4807.48	I	16456 – 37252
35		4808.68	I	15587 – 36377
35		4813.50	I	19748 – 40517
27		4826.99	II	28096 – 48807
27		4828.97	I	16456 – 37159
80		4831.20	II	23024 – 43717
35		4835.75	I	13119 – 33793
27	d	4851.76	I	19132 – 39737
		4851.90	II	27009 – 47614
19		4872.28	II	22052 – 42570
27		4879.19	I	18990 – 39479
27		4891.64	I	
24		4909.74	I	15271 – 35633
55		4923.83	I	18853 – 39157
140		4957.18	I	18990 – 39157
40		4970.87	II	19526 – 39638
27		4971.26	I	19548 – 39658
40		4975.12	II	23904 – 43998
50		4978.90	I	19548 – 39628
40		4980.68	II	23768 – 43840
55		4989.32	II	23961 – 43998
27		4993.79	II	19619 – 39638
19		4994.72	II	27598 – 47614
35		5001.02	I	22742 – 42733
27		5001.59	I	19753 – 39741
160		5009.77	II	19682 – 39638
35		5014.56	II	23904 – 43840
27		5017.87	II	28974 – 48898
160		5034.22	II	19619 – 39477
27	h	5041.00	II	28095 – 47927
22		5043.50	I	17454 – 37276
35		5045.41	I	19748 – 39563
27		5060.42	II	23961 – 43717
150		5060.90	I	0 – 19754
27		5062.25	I	0 – 19748
27		5065.88	I	19753 – 39488
80		5066.67	I	19748 – 39479
27		5072.42	I	19753 – 39462
27		5076.36	I	21799 – 41493
27		5077.18	I	19753 – 39444
35		5085.09	I	19753 – 39413
40		5107.53	I	19748 – 39322
95		5113.97	I	0 – 19549
50		5114.55	II	23024 – 42570
22		5120.67	I	19753 – 39277
22		5140.28	II	23768 – 43217
40		5149.40	II	23803 – 43217
19		5182.68	I	21799 – 41089
40		5185.25	I	8771 – 28051
14		5204.51	II	27598 – 46807
80		5213.38	I	16456 – 35633
22		5228.23	II	
14		5260.93	II	26188 – 45191
24		5267.34	II	25257 – 44237
40		5291.14	I	21799 – 40693
40		5294.32	I	24611 – 43494
35		5300.21	I	15587 – 34449
35		5302.69	I	8771 – 27624
55		5305.87	II	21022 – 39863
650		5307.12	I	0 – 18837
16		5322.99	II	35535 – 54317
35		5338.90	I	16957 – 35682
		5339.03	I	17454 – 36179
80		5346.49	II	19526 – 38225
27		5372.98	II	19619 – 38225
14		5391.96	II	25696 – 44237
27		5400.46	II	24059 – 42570
27		5402.23	I	
14		5405.98	II	
14		5461.95	II	34027 – 52331
14		5464.14	I	22559 – 40855
14		5465.54	II	0 – 18291
16		5500.30	II	
14		5526.82	II	34913 – 53002
24		5528.34	I	22419 – 40503
14		5539.03	II	26188 – 44237
27		5566.00	I	13119 – 31080
22		5581.37	I	20406 – 38318
14		5586.65	II	34766 – 52661
14		5589.94	II	
14		5606.64	I	20406 – 38237
270		5631.41	I	0 – 17753
40		5642.60	I	8771 – 26488
27		5645.40	I	22419 – 40128
70		5658.30	I	8771 – 26440
520		5675.84	I	0 – 17614
14		5683.59	I	16456 – 34046
40		5684.76	II	22052 – 39638
14		5696.42	II	
35		5709.97	II	22355 – 39863
22		5715.79	I	15271 – 32761
14		5733.81	II	33182 – 50617
11	d	5737.20	II	22052 – 39477
		5737.25	II	
14	h	5738.92	II	40959 – 58379
27		5758.02	I	15587 – 32950
55		5760.20	I	8771 – 26127
190		5764.29	I	0 – 17343
5		5778.82	II	30508 – 47808
19		5782.36	II	17624 – 34913
22		5784.46	II	
11		5799.97	II	34766 – 52003
14		5811.19	II	21022 – 38225
14	h	5816.46	I	16456 – 33644
35		5838.76	II	22355 – 39477
240		5895.63	I	0 – 16957
35		5899.47	I	8771 – 25717
24		5901.57	I	18693 – 35633
8		5912.58	I	25520 – 42429
11		5931.70	I	15587 – 32441
27		5935.90	I	15271 – 32112
140		5971.26	I	0 – 16742

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
27		5975.02	I	20406 – 37138
11		5984.87	I	
19		6025.44	I	17454 – 34046
11		6067.78	II	
16		6131.53	I	16456 – 32761
14		6175.29	I	13119 – 29308
14		6181.41	II	22052 – 38225
14		6299.46	II	22355 – 38225
27		6352.66	I	16742 – 32479
22		6401.44	I	16742 – 32359
8		6430.94	II	35535 – 51081
14		6440.54	I	16956 – 32479
200		6460.26	I	16742 – 32217
14		6490.70	I	16956 – 32359
14		6519.78	I	25656 – 40989
8		6575.54	I	
95		6604.96	I	17343 – 32479
8		6627.25	I	26126 – 41211
35		6657.72	I	17343 – 32359
11		6658.64	I	24348 – 39362
11		6692.93	I	19132 – 34069
30		6721.36	I	17343 – 32217
9		6726.34	I	26126 – 40989
9		6727.94	II	38717 – 53576
18		6739.22	I	
9	h	6767.48	I	26439 – 41211
9		6777.93	I	26439 – 41189
110		6779.77	I	17613 – 32359
14	h	6782.00	I	24348 – 39089
18		6788.52	I	17752 – 32479
13	h	6820.27	I	17454 – 32112
14		6826.95	I	24418 – 39061
14		6829.12	II	21133 – 35772
23		6831.09	I	26439 – 41074
120		6844.26	I	17752 – 32359
80		6845.76	I	17613 – 32217
18		6854.12	I	26488 – 41074
6		6898.56	I	
6		6915.86	I	27037 – 41493
10		6937.37	I	16957 – 31367
5		6949.54	I	
5	h	6976.69	II	30508 – 44838
5		7010.79	I	
6	h	7014.31	II	21713 – 35966
10		7017.90	I	26448 – 40693
6	h	7029.40	I	
12		7034.34	I	
10		7056.43	II	25696 – 39863
5		7060.97	I	8771 – 22930
6		7079.78	II	17624 – 31745
10		7106.14	I	18693 – 32761
5	h	7231.33	I	25717 – 39542
5		7233.74	II	24273 – 38093
4		7257.72	I	17613 – 31388
17		7272.62	I	17752 – 31499
8		7284.30	I	19132 – 32856
11	h	7286.16	I	15587 – 29308
14		7310.51	I	27314 – 40989
11		7336.63	II	34027 – 47654
14		7432.18	I	18990 – 32441
5		7434.51	II	21133 – 34580
5		7439.95	II	20228 – 33665
75		7481.08	I	18853 – 32217
75		7490.20	I	19132 – 32479
10	h	7507.28	I	25745 – 39061
14		7545.78	I	13119 – 26368
140		7558.33	I	18990 – 32217
17	h	7580.61	I	28024 – 41211
20	h	7593.74	I	28023 – 41189
17		7595.07	II	20228 – 33391
5		7629.85	I	19753 – 32856
5	h	7648.76	II	32917 – 45987
17		7655.00	I	30914 – 43974
4		7660.32	I	28340 – 41391
7	h	7666.24	I	26701 – 39741
8		7676.04	II	21133 – 34157
8	h	7701.46	I	25520 – 38502
80		7731.53	I	19548 – 32479
4	h	7778.27	I	26889 – 39741
12	h	7782.35	I	28143 – 40989
8	h	7785.51	I	26701 – 39542
		7785.90	I	21120 – 33961
17		7803.93	I	19548 – 32359
4		7829.22	I	26701 – 39470
40		7856.08	I	19753 – 32479
3		7861.67	I	26646 – 39362
5		7918.10	I	28448 – 41074
55		7927.51	I	19748 – 32359
110		7930.84	I	19753 – 32359
6		7971.56	I	28448 – 40989
11	h	7985.93	I	28555 – 41074
14	h	8014.77	I	26889 – 39362
95		8017.90	I	19748 – 32217
3	h	8021.33	I	19753 – 32217
14		8194.19	I	26889 – 39089
5		8294.52	I	19466 – 31519
7		8365.75	I	19548 – 31499
7		8460.79	II	33022 – 44838
27		8472.01	II	17624 – 29424
7	h	8546.07	II	20228 – 31926
11		8565.73	II	20228 – 31899

Tin

Sn, $Z = 50$, $M = 118.7$, Ratio $\frac{\text{Sn}}{\text{Cu}} = 1.868$

Sn I Normal state of valence electrons $5s^2 5p^2\ {}^3P_0 = 0$. I.P. = 59232 cm^{-1}.
Sn II Normal state of valence electrons $5s^2 5p\ {}^2P^o_{1/2} = 0$. I.P. = 118017 cm^{-1}.

References

Wavelengths and Classification:
Sn I, W. F. Meggers, J. Research NBS **24**, 153 (1940) RP 1275.

Tin—all observed lines

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
26000	1970.80	I	1692 – 52416	1100	2483.39	I	3428 – 43683
15000 h	1983.55	I	3428 – 53826	1100	2495.70	I	8613 – 48670
8000	2040.66	I	3428 – 52416	150	2523.92	I	8613 – 48222
4800	2073.08	I	0 – 48222	2400	2546.55	I	0 – 39257
5500	2091.58	I	1692 – 49487	1000	2571.58	I	8613 – 47488
1400 h	2096.39	I	8613 – 56299	550	2594.42	I	8613 – 47146
1500	2100.93	I	3428 – 51010	1400	2661.24	I	1692 – 39257
5500	2113.93	I	1692 – 48982	7000	2706.51	I	1692 – 38629
600	2148.73	I	1692 – 48216	110	2761.78	I	3428 – 39626
1400	2151.43	I	3428 – 49894	1000	2779.81	I	8613 – 44576
1600	2194.49	I	3428 – 48982	320	2785.03	I	8613 – 44509
2200	2199.34	I	1692 – 47146	120	2812.59	I	17163 – 52707
3200	2209.65	I	3428 – 48670	600	2813.58	I	8613 – 44145
300	2211.05	I	8613 – 53826	14000	2839.99	I	3428 – 38629
480	2231.72	I	3428 – 48222	1700	2850.62	I	8613 – 43683
4200	2246.05	I	0 – 44509	10000	2863.33	I	0 – 34914
190	2251.17	I	8613 – 53021	240 h	2913.54	I	17163 – 51475
480	2267.19	I	8613 – 52707	7000	3009.14	I	1692 – 34914
3200	2268.91	I	3428 – 47488	400	3032.80	I	17163 – 50126
650	2286.68	I	3428 – 47146	8500	3034.12	I	1692 – 34641
2200	2317.23	I	8613 – 51754	40	3141.84	I	17163 – 48982
1400	2334.80	I	1692 – 44509	5500	3175.05	I	3428 – 34914
5500	2354.84	I	1692 – 44145	5500	3262.34	I	8613 – 39257
60	2357.90	I	8613 – 51010	1100	3330.62	I	8613 – 38629
200	2380.72	I	1692 – 43683	400	3655.78	I	17163 – 44509
260	2408.15	I	8613 – 50126	2800	3801.02	I	8613 – 34914
3600	2421.70	I	8613 – 49894	400	4524.74	I	17163 – 39257
5500	2429.49	I	3428 – 44576	40	5631.71	I	17163 – 34914
35	2433.47	I	3428 – 44509	8 h	8552.60	I	34914 – 46603
50	2455.24	I	3428 – 44145				

559-795 O - 75 - 22 (Pt. 1)

Titanium

Ti, $Z = 22$, $M = 47.9$, Ratio $\frac{\text{Ti}}{\text{Cu}} = 0.754$

Ti I Normal state of valence electrons $3d^2 4s^2\ {}^3F_2 = 0$. I.P. = 55138 cm^{-1}.
Ti II Normal state of valence electrons $3d^2 4s\ {}^4F_{1\ 1/2} = 0$. I.P. = 109506 cm^{-1}.

References

Wavelengths:
G. R. Harrison, Massachusetts Institute of Technology Wavelength Tables (John Wiley & Sons, New York, 1939).

Supplemented by the following:
A. S. King, Astrophys. J. **39**, 139 (1914).
C. C. Kiess and W. F. Meggers, Sci. Papers BS **16**, 51 (1920).
H. Crew, Astrophys. J. **60**, 108 (1924).
A. S. King, Astrophys. J. **59**, 155 (1924).
W. F. Meggers and C. C. Kiess, J. Research NBS **9**, 309 (1932) RP 473.
H. W. Banks, W. R. Bozman, and C. M. Wilson, Georgetown Obs. Mono. No. **20** (1966).

Classification:
Ti I, H. N. Russell, Astrophys. J. **66**, 347 (1927).
W. F. Meggers and C. C. Kiess, J. Research NBS **9**, 309 (1932) RP 473.
Ti II, H. N. Russell, Astrophys. J. **66**, 283 (1927).

Molecular Spectra:
TiO, F. Lowater, Proc. Phys. Soc. (London) **41**, 557 (1929).

Strong lines of titanium

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
12000	3349.41	II	393 – 30241	5200	3236.57	II	225 – 31114
7800	3998.64	I	387 – 25388	5200	3752.86	I	387 – 27026
7200	3361.21	II	225 – 29968	5200	3958.21	I	387 – 25644
	3361.26	I	170 – 29912	4800	3635.46	I	0 – 27499
7200	3653.50	I	387 – 27750	4800	3981.76	I	0 – 25107
6600	3234.52	II	393 – 31301	4600	4991.07	I	6743 – 26773
6600	3642.68	I	170 – 27615	4500	3948.67	I	0 – 25318
6000	4305.92	I	6843 – 30060	4500	3956.34	I	170 – 25439
6000	4533.24	I	6843 – 28896	4300	3349.04	II	4898 – 34748
5800	4981.73	I	6843 – 26911	4300	3371.45	I	387 – 30039
5700	3341.88	I	0 – 29915	4100	3239.04	II	94 – 30959
		II	4629 – 34543	4100	3354.64	I	170 – 29971
5700	3372.80	II	94 – 29734	4100	4301.09	I	6743 – 29986
5700	3383.76	II	0 – 29544	4000	4999.51	I	6661 – 26657
5700	3989.76	I	170 – 25227	3800	3199.92	I	387 – 31629

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
140	2272.61	I	387 – 44376
180	2273.28	I	0 – 43976
130	2276.70	I	170 – 44079
190	2279.96	I	387 – 44233
150	2299.85	I	0 – 43468
140	2302.73	I	170 – 43583
190	2305.67	I	387 – 43745
65	2380.81	I	387 – 42377
35	2384.52	I	387 – 42311
55	2418.36	I	0 – 41337
75	2421.30	I	170 – 41458
95	2424.24	I	387 – 41624
40	2428.23	I	0 – 41170
35	2433.22	I	170 – 41255
19	2434.10	I	387 – 41458
35	2440.21	II	12629 – 53597
65	2440.98	I	387 – 41342
24	2450.44	II	12758 – 53555
24	2504.54	I	
75	2517.43	II	1087 – 40798
40	2519.04	I	0 – 39686
140	2520.54	I	0 – 39662
75	2524.64	II	984 – 40582
360	2525.60	II	1216 – 40798
29	2527.98	I	170 – 39716
210	2529.85	I	170 – 39686
190	2531.25	II	1087 – 40582
190	2534.62	II	984 – 40426
130	2535.87	II	908 – 40330
190	2541.92	I	387 – 39716
65	2555.99	II	4629 – 43741
110	2571.03	II	4898 – 43781
50	2572.65	II	
50	2580.82	I	
35	2590.26	I	170 – 38765
190	2593.64	I	0 – 38544
65	2596.58	I	170 – 38671
270	2599.92	I	0 – 38451
340	2605.15	I	170 – 38544
510	2611.28	I	387 – 38671
75	2611.48	I	170 – 38451
300	2619.94	I	387 – 38544
170	2631.54	I	170 – 38160
170	2632.42	I	0 – 37977
640	2641.10	I	0 – 37852
800	2644.26	I	170 – 37977
950	2646.64	I	387 – 38160
30	2649.30	I	
15	2654.93	I	0 – 37655
35	2657.19	I	0 – 37623
85	2661.97	I	0 – 37555
95	2669.60	I	170 – 37618
130	2679.93	I	387 – 37690
26	2684.80	I	
30	2685.14	I	387 – 37618
65	2688.82	I	
26	2716.25	II	8744 – 45549
85	2725.07	I	8492 – 45178
75	2727.42	I	8437 – 45091
21	2731.13	I	8602 – 45206
40	2731.58	I	8492 – 45091
170	2733.26	I	8602 – 45178
55	2735.29	I	8492 – 45041
40	2735.61	I	7255 – 43800
85	2739.81	I	8602 – 45091
250	2742.32	I	7255 – 43710
40	2749.06	I	8492 – 44858
65	2757.40	I	8602 – 44858
95	2758.08	I	12118 – 48365
15	2761.29	II	8710 – 44915
250	2802.50	I	7255 – 42928
55	2805.70	I	8602 – 44233
30	2806.50	II	9851 – 45473
40	2809.17	I	8492 – 44079
75	2810.30	II	29734 – 65307
30	2812.98	I	8437 – 43976
30	2817.40	I	8492 – 43976
65	2817.84	I	8602 – 44079
	2817.87	II	29968 – 65446
65	2828.07	I	6557 – 41907
	2828.15	II	30241 – 65589
130	2832.16	II	4629 – 39927
190	2841.94	II	4898 – 40075
110	2851.10	II	9851 – 44915
40	2853.93	II	4898 – 39927
95	2862.32	II	9976 – 44902
55	2868.74	II	4629 – 39477
180	2877.44	II	8998 – 43741
280	2884.11	II	9118 – 43781
65	2888.93	II	4629 – 39233
55	2891.07	II	4898 – 39477
55	2905.66	I	
30	2909.92	II	393 – 34749
450	2912.08	I	7255 – 41585
340	2928.34	I	12118 – 46258
15	2931.03		
180	2933.55	I	0 – 34079
26	2935.96		
150	2937.32	I	170 – 34205
1100	2942.00	I	0 – 33981
1300	2948.26	I	170 – 34079
30	2954.58		
1600	2956.13	I	387 – 34205
170	2956.80	I	170 – 33981
30	2958.77		
26	2959.71	I	8492 – 42270
35	2959.99	I	8602 – 42377
170	2965.71	I	8602 – 42311
190	2967.22	I	387 – 34079
26	2968.23	I	0 – 33680
75	2970.38	I	0 – 33656
30	2974.93	I	8602 – 42207
170	2983.31	I	170 – 33680
35	3000.87	I	387 – 33701
120	3017.19	II	12775 – 45909
140	3029.73	II	12677 – 45674
110	3046.68	II	9396 – 42209
130	3056.74	II	9364 – 42069
130	3057.40	II	0 – 32698
170	3058.09	II	9518 – 42209
85	3059.74	II	9396 – 42069
1300 d	3066.22	II	94 – 32698
	3066.35	II	0 – 32603
70	3071.24	II	9518 – 42069
600	3072.11	II	225 – 32767
1100	3072.97	II	0 – 32532
1600	3075.22	II	94 – 32603
2300	3078.64	II	225 – 32698
3600	3088.02	II	393 – 32767
180	3089.40	II	15266 – 47625

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
180	3097.19	II	9931 – 42209
180	3100.67	I	8602 – 40844
230	3103.80	II	15258 – 47467
230	3105.08	II	9873 – 42069
260	3106.23	II	10025 – 42209
70	3106.81	I	8492 – 40671
50	3110.67	II	9931 – 42069
50	3112.48	I	8437 – 40556
140	3117.67	II	9931 – 41997
720	3119.72	I	12118 – 44163
	3119.80	II	10025 – 42069
190	3123.07	I	7255 – 39266
240	3130.80	II	94 – 32026
140	3141.54	I	7255 – 39078
95	3141.67	I	17215 – 49036
220	3143.76	II	225 – 32026
240	3148.04	II	0 – 31757
240	3152.25	II	984 – 32698
240	3154.20	II	908 – 32603
240	3155.67	II	1087 – 32767
500	3161.20	II	908 – 32532
780	3161.77	II	984 – 32603
1000	3162.57	II	1087 – 32698
1600	3168.52	II	1216 – 32767
2400	3186.45	I	0 – 31374
1000	3190.87	II	8744 – 40075
3100	3191.99	I	170 – 31489
50	3197.52	II	225 – 31491
3800	3199.92	I	387 – 31629
780	3202.54	II	8710 – 39927
50	3203.44	II	0 – 31207
240	3203.83	I	170 – 31374
50	3204.87	I	8492 – 39686
110	3213.14	II	94 – 31207
260	3214.24	I	387 – 31489
190	3214.75	II	393 – 31491
1100	3217.06	II	225 – 31301
110	3217.94	I	15877 – 46944
260	3218.27	II	12677 – 43741
110	3219.21	I	15976 – 47030
110	3221.38	I	16106 – 47140
1300	3222.84	II	94 – 31114
220	3223.52	I	16268 – 47281
240	3224.24	II	12775 – 43781
140	3226.13	I	16459 – 47447
530	3228.60	II	8710 – 39675
780	3229.19	II	0 – 30959
530	3229.42	II	9118 – 40075
110	3231.32	II	1087 – 32026
240	3232.28	II	8998 – 39927
6600	3234.52	II	393 – 31301
220	3236.12	II	8710 – 39603
5200	3236.57	II	225 – 31114
4100	3239.04	II	94 – 30959
220	3239.66	II	8744 – 39603
2600	3241.99	II	0 – 30837
1200	3248.60	II	10025 – 40798
950	3251.91	II	94 – 30837
1200	3252.91	II	225 – 30959
1200	3254.25	II	393 – 31114
1200	3261.60	II	15258 – 45909
310	3271.65	II	10025 – 40582
310	3272.08	II	9873 – 40426
200	3278.29	II	9931 – 40426
260	3278.92	II	8744 – 39233
220	3282.33	II	9873 – 40330
530	3287.66	II	15266 – 45674
290	3292.08	I	7255 – 37623
170	3299.41	I	7255 – 37555
170	3306.88	I	17215 – 47447
220	3308.39	I	8437 – 38654
220	3308.81	II	1087 – 31301
260	3309.50	I	8492 – 38700
60	3309.73	I	17075 – 47281
110	3312.69	I	16961 – 47140
840	3314.42	I	8602 – 38765
	3314.52	I	8492 – 38654
290	3315.32	II	9873 – 40027
330	3318.02	II	984 – 31114
550	3321.70	II	9931 – 40027
2900	3322.94	II	1216 – 31301
380	3326.76	II	908 – 30959
2100	3329.46	II	1087 – 31114
550	3332.11	II	10025 – 40027
1800	3335.20	II	984 – 30959
1100	3340.34	II	908 – 30837
5700	3341.88	I	0 – 29915
		II	4629 – 34543
120	3342.15	I	0 – 29912
260	3343.77	II	1216 – 31114
330	3346.73	II	1087 – 30959
4300	3349.04	II	4898 – 34748
12000	3349.41	II	393 – 30241
120	3352.94	I	170 – 29986
4100	3354.64	I	170 – 29971
290	3358.28	I	0 – 29769
290	3360.99	I	170 – 29915
7200	3361.21	II	225 – 29968
	3361.26	I	170 – 29912
120	3361.84	I	170 – 29907
1100	3370.44	I	0 – 29661
4300	3371.45	I	387 – 30039
140	3372.21	II	4898 – 34543
5700	3372.80	II	94 – 29734
60	3374.35	II	9976 – 39603
2900 d	3377.48	I	387 – 29986
	3377.58	I	170 – 29769
290	3379.22	I	387 – 29971
1400	3380.28	II	393 – 29968
170	3382.31	I	8602 – 38160
5700	3383.76	II	0 – 29544
170	3385.66	I	387 – 29915
1400	3385.95	I	387 – 29912
1400	3387.84	II	225 – 29734
60	3388.76	II	9976 – 39477
140	3390.68	I	8492 – 37977
140	3392.71	I	12118 – 41585
1100	3394.58	II	94 – 29544
60	3398.63	I	8437 – 37852
60	3402.42	II	9851 – 39233
60	3407.20	II	393 – 29734
95	3409.81	II	225 – 29544
60	3439.30	I	11777 – 40844
890	3444.31	II	1216 – 30241
60	3452.47	II	16516 – 45473
180	3456.39	II	16625 – 45549
600	3461.50	II	1087 – 29968
95	3467.26	I	8492 – 37325
600	3477.18	II	984 – 29734
60	3478.92	I	8437 – 37173

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
240	3480.53	I	8602 – 37325
60	3485.69	I	8492 – 37173
60	3489.74	II	1087 – 29734
480	3491.05	II	908 – 29544
60	3495.75	I	8492 – 37091
95	3499.10	I	8602 – 37173
890	3504.89	II	15258 – 43781
120	3506.64	I	387 – 28896
600	3510.84	II	15266 – 43741
60	3520.25	II	16516 – 44915
310	3535.41	II	16625 – 44902
190	3547.03	I	12118 – 40303
120	3573.74	II	4629 – 32603
60	3574.24	I	18288 – 46258
60	3587.13	II	4898 – 32767
240	3596.05	II	4898 – 32698
190	3598.72	I	7255 – 35035
600	3610.16	I	7255 – 34947
190	3624.82	II	9851 – 37431
95	3635.20	I	387 – 27888
4800	3635.46	I	0 – 27499
120	3637.97	I	0 – 27480
190	3641.33	II	9976 – 37431
6600	3642.68	I	170 – 27615
180	3646.20	I	0 – 27418
7200	3653.50	I	387 – 27750
290	3654.59	I	0 – 27355
660	3658.10	I	170 – 27499
120	3659.76	II	12758 – 40075
380	3660.63	I	170 – 27480
190	3662.24	II	12629 – 39927
380	3668.97	I	170 – 27418
600	3671.67	I	387 – 27615
3100	3685.20	II	4898 – 32026
120	3685.96	I	11532 – 38654
95	3687.35	I	387 – 27499
600	3689.91	I	387 – 27480
140	3694.45	I	11640 – 38700
30	3698.18	I	18145 – 45178
60	3698.43	I	11640 – 38671
60	3700.08	I	
120	3702.29	I	8437 – 35439
190	3704.30	I	11777 – 38765
140	3706.23	II	12629 – 39603
50	3707.53	I	16268 – 43232
290	3709.96	I	8492 – 35439
30	3715.40	I	
450	3717.40	I	0 – 26893
140	3721.64	II	4629 – 31491
330	3722.57	I	170 – 27026
600	3724.57	I	12118 – 38960
380	3725.16	I	8602 – 35439
2900	3729.82	I	0 – 26803
50	3735.67	I	
60	3738.90	I	15157 – 41895
3300	3741.06	I	170 – 26893
330	3741.64	II	12758 – 39477
160	3748.10	I	15108 – 41781
5200	3752.86	I	387 – 27026
600	3753.64	I	170 – 26803
140	3757.69	II	12629 – 39233
3300	3759.30	II	4898 – 31491
2900	3761.32	II	4629 – 31207
50	3761.89	II	20892 – 47467
60	3766.45	I	8492 – 35035
600	3771.66	I	387 – 26893
30	3776.06	II	12758 – 39233
840	3786.04	I	7255 – 33661
120	3789.30	I	11777 – 38160
70	3795.90	I	11640 – 37977
60	3798.31	I	11532 – 37852
70	3818.22	I	18193 – 44376
60	3822.03	I	17075 – 43232
240	3828.19	I	17215 – 43330
95	3833.68	I	
95	3836.78	I	
60	3846.45	I	
130	3853.05	I	15877 – 41823
130	3853.73	I	15976 – 41917
170	3858.14	I	16106 – 42018
240	3866.44	I	16268 – 42124
170	3868.40	I	15976 – 41819
120	3873.21	I	16106 – 41917
260	3875.26	I	0 – 25798
		I	16106 – 41903
170	3882.15	I	16268 – 42019
170	3882.33	I	16268 – 42018
500	3882.89	I	16459 – 42206
60 h	3888.02	I	16106 – 41819
70	3889.95	I	0 – 25700
200 h	3895.25	I	16459 – 42124
85	3898.49	I	0 – 25644
530	3900.54	II	9118 – 34748
180	3900.96	I	170 – 25798
2600	3904.78	I	7255 – 32858
110 h	3911.19	I	16459 – 42019
500	3913.46	II	8998 – 34543
500	3914.34	I	387 – 25927
24	3914.74	I	0 – 25537
35	3919.82	I	12118 – 37623
290	3921.42	I	0 – 25494
1100	3924.53	I	170 – 25644
110	3926.32	I	20796 – 46258
890	3929.88	I	0 – 25439
35	3932.02	II	9118 – 34543
70	3934.24	I	387 – 25798
1100	3947.78	I	170 – 25494
4500	3948.67	I	0 – 25318
4500	3956.34	I	170 – 25439
5200	3958.21	I	387 – 25644
950	3962.85	I	0 – 25227
950	3964.27	I	170 – 25388
4800	3981.76	I	0 – 25107
570	3982.48	I	0 – 25103
60	3984.33	I	16961 – 42053
35	3985.25	I	
60	3985.59	I	
5700	3989.76	I	170 – 25227
35	3994.70	I	16875 – 41901
7800	3998.64	I	387 – 25388
70	3999.36	I	16961 – 41959
70	4002.49	I	17075 – 42053
70	4003.81	I	17215 – 42185
35	4005.97	I	16961 – 41917
70	4008.06	I	17075 – 42018
950	4008.93	I	170 – 25107
190	4009.66	I	170 – 25103
70	4012.39	II	4629 – 29544
180	4013.58	I	17215 – 42124
70	4015.38	I	16817 – 41714

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
35	4016.28	I	17215 – 42107
120 h	4017.77	I	16875 – 41757
140	4021.83	I	16961 – 41819
1200	4024.57	I	387 – 25227
40	4025.14	II	4898 – 29734
190 h	4026.54	I	17075 – 41903
40	4027.48	I	
40	4028.34	II	15258 – 40075
190 h	4030.51	I	17215 – 42019
40	4033.91	I	17424 – 42207
30	4034.91	I	17370 – 42146
110	4035.83	I	17540 – 42311
35 h	4040.32	I	17075 – 41819
290	4055.02	I	8437 – 33091
85	4057.62	I	18594 – 43232
85	4058.14	I	18695 – 43330
410	4060.26	I	8492 – 33114
200	4064.22	I	8492 – 33091
200	4065.10	I	8492 – 33085
840	4078.47	I	8602 – 33114
40	4079.72	I	17424 – 41929
290	4082.46	I	8602 – 33091
85	4099.17	I	17540 – 41929
220	4112.71	I	387 – 24695
85	4122.17	I	21470 – 45722
40	4123.31	I	22405 – 46650
85	4123.57	I	21588 – 45832
130	4127.54	I	21740 – 45960
40	4129.17	I	
40	4131.25	I	18525 – 42724
140	4137.29	I	18695 – 42859
85	4143.05	I	18594 – 42724
170	4150.96	I	17540 – 41624
85	4159.64	I	17424 – 41458
70	4163.65	II	20892 – 44902
35	4164.14	I	15108 – 39116
40	4166.32	I	15157 – 39152
85	4169.35	I	15220 – 39198
120	4171.03	I	17370 – 41337
40	4171.90	II	20952 – 44915
35	4183.30	I	18062 – 41959
360	4186.12	I	12118 – 36000
40	4188.69	I	18062 – 41929
70	4200.75	I	18145 – 41944
85	4203.46	I	18145 – 41929
35	4211.73	I	20063 – 43800
40	4224.79	I	22405 – 46068
40	4227.65	I	20063 – 43710
130	4237.89	I	20210 – 43800
85	4249.12	I	18525 – 42053
130	4256.04	I	18695 – 42185
70	4258.54	I	18483 – 41959
70	4261.60	I	18594 – 42053
330	4263.13	I	15220 – 38671
35	4265.71	I	15108 – 38544
40	4266.22	I	18525 – 41959
70	4270.14	I	18695 – 42107
85	4272.43	I	6661 – 30060
240	4274.58	I	6599 – 29986
		I	15157 – 38544
120	4276.43	I	13982 – 37359
120	4278.23	I	20796 – 44163
30	4278.81	I	18594 – 41959
110	4281.38	I	6557 – 29907
220	4282.71	I	15108 – 38451
160	4284.99	I	14028 – 37359
890	4286.01	I	6661 – 29986
840	4287.40	I	6743 – 30060
30	4288.16	I	6599 – 29912
		I	8492 – 31806
950	4289.07	I	6599 – 29907
120	4290.23	II	9396 – 32698
840	4290.94	I	6557 – 29855
120	4291.14	I	
140	4294.12	II	8744 – 32026
840	4295.76	I	6557 – 29829
2000	4298.66	I	6599 – 29855
200	4299.23	I	14106 – 37359
200	4299.64	I	6661 – 29912
200	4300.05	II	9518 – 32767
2900	4300.56	I	6661 – 29907
4100	4301.09	I	6743 – 29986
85	4301.93	II	9364 – 32603
6000	4305.92	I	6843 – 30060
180	4307.90	II	9396 – 32603
35	4308.50	I	8602 – 31806
40	4311.65	I	17370 – 40556
85	4312.87	II	9518 – 32698
85	4314.35	I	6743 – 29915
1200	4314.80	I	6743 – 29912
		I	6599 – 29769
360	4318.64	I	18193 – 41342
180	4321.66	I	18037 – 41170
190	4325.13	I	18141 – 41255
160	4326.36	I	6661 – 29769
30	4334.84	I	6599 – 29661
160	4337.92	II	8710 – 31756
24	4344.29	II	8744 – 31756
70	4346.11	I	18037 – 41040
35	4354.06	I	17424 – 40385
95	4360.49	I	17540 – 40467
24	4368.94	I	18288 – 41170
95	4369.68	I	20796 – 43674
60	4372.38	I	20063 – 42928
30	4388.08	I	18062 – 40844
170	4393.92	I	18288 – 41040
330	4395.04	II	8744 – 31491
60	4399.77	II	9976 – 32698
240	4404.28	I	18145 – 40844
60	4404.90	I	15157 – 37852
30	4405.68	I	8492 – 31184
60	4416.54	I	15108 – 37744
220	4417.28	I	15220 – 37852
60	4417.72	II	9396 – 32026
120	4421.76	I	18062 – 40671
120	4422.82	I	8602 – 31206
24	4424.39	I	18288 – 40883
30	4425.83	I	8602 – 31191
120	4426.06	I	15157 – 37744
890	4427.10	I	12118 – 34700
21	4430.02	I	19422 – 41988
85	4430.37	I	11640 – 34205
50	4431.28	I	17996 – 40556
30	4432.60	I	
24	4433.58	I	19323 – 41872
170	4434.00	I	11532 – 34079
		I	15108 – 37655
70	4436.59	I	15157 – 37690
30	4438.23	I	18145 – 40671
130	4440.35	I	15108 – 37623

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
50	4441.27	I	15108 – 37618
230	4443.80	II	8710 – 31207
24	4444.27	I	18062 – 40556
840	4449.15	I	15220 – 37690
30	4450.49	II	8744 – 31207
550	4450.90	I	15157 – 37618
840	4453.32	I	11532 – 33981
290	4453.71	I	15108 – 37555
950	4455.33	I	11640 – 34079
1100	4457.43	I	11777 – 34205
21	4462.09	I	0 – 22405
70	4463.38	I	15157 – 37555
95	4463.54	I	15220 – 37618
290	4465.81	I	14028 – 36415
240	4468.50	II	9118 – 31491
240	4471.24	I	13982 – 36341
95	4474.85	I	11640 – 33981
95	4479.70	I	13982 – 36298
50	4480.59	I	14028 – 36341
530	4481.26	I	14106 – 36415
95	4482.69	I	11777 – 34079
19	4488.32	II	25193 – 47467
260	4489.09	I	14028 – 36298
24	4492.55	I	16961 – 39214
40	4495.01	I	
240	4496.15	I	14106 – 36341
24	4497.73	I	17075 – 39302
200	4501.27	II	8998 – 31207
40	4503.78	I	17215 – 39413
21	4506.36	I	
50	4511.17	I	
780	4512.74	I	6743 – 28896
19	4515.62	I	17075 – 39214
1000	4518.03	I	6661 – 28788
95	4518.70	1	11532 – 33656
1000	4522.80	I	6599 – 28703
780	4527.31	I	6557 – 28639
6000	4533.24	1	6843 – 28896
240	4533.97	II	9976 – 32026
3600	4534.78	I	6743 – 28788
2400	4535.58	I	6661 – 28703
1200	4535.92	I	6599 – 28639
1200	4536.05	I	6557 – 28596
24	4537.23	I	
24	4539.10	I	
720	4544.69	I	6599 – 28596
950	4548.77	I	6661 – 28639
240	4549.63	II	12775 – 34748
950	4552.46	I	6743 – 28703
24	4555.08	I	19422 – 41369
720	4555.49	I	6843 – 28788
19	4557.86	I	19938 – 41872
19	4558.11	I	18912 – 40844
60	4559.92	I	11777 – 33701
50	4562.63	I	170 – 22081
35	4563.43	I	19574 – 41481
110	4563.77	II	9851 – 31756
35	4570.91	I	19323 – 41194
240	4571.98	II	12677 – 34543
19	4585.84		
24	4589.95	II	9976 – 31756
60	4599.23	I	
21	4609.37	I	
950	4617.27	I	14106 – 35758
24	4619.52	I	18826 – 40467
480	4623.09	I	14028 – 35653
190	4629.34	I	13982 – 35577
50 d	4634.87		
60	4637.88	I	18912 – 40467
240	4639.37	I	14028 – 35577
220	4639.67	I	14106 – 35653
190	4639.95	I	13982 – 35528
140	4645.19	I	13982 – 35503
120	4650.02	I	14028 – 35528
24	4656.04	I	14106 – 35577
720	4656.47	I	0 – 21470
840	4667.59	I	170 – 21588
70	4675.12	I	8602 – 29986
950	4681.92	I	387 – 21740
21	4686.92	I	17370 – 38700
24	4690.80	I	8602 – 29915
190	4691.34	I	8602 – 29912
40	4693.68	I	170 – 21470
24	4696.94	I	17370 – 38654
190	4698.76	I	8492 – 29769
120	4710.19	I	8437 – 29661
24	4715.30	I	387 – 21588
65	4722.62	I	8492 – 29661
65	4723.17	I	8602 – 29769
55	4731.17	I	17540 – 38671
45	4733.43	I	17424 – 38544
18	4734.68	I	18037 – 39152
22	4742.11	I	17370 – 38451
170	4742.79	I	18037 – 39116
22	4747.68	I	18141 – 39198
310	4758.12	I	18141 – 39152
310	4759.28	I	18193 – 39198
45	4766.33	I	18141 – 39116
28	4769.77	I	18193 – 39152
65	4778.26	I	18037 – 38960
45	4781.72	I	6843 – 27750
110	4792.49	I	18826 – 39686
45	4796.22	I	18818 – 39662
35	4797.98	I	18826 – 39662
110	4799.80	I	18288 – 39116
28	4805.10	II	16625 – 37431
110	4805.43	I	18912 – 39716
45	4808.53	I	24695 – 45485
22	4811.08	I	15220 – 36000
40	4812.25	I	18912 – 39686
200	4820.42	I	12118 – 32858
22	4825.46	I	18695 – 39413
40	4836.13	I	18288 – 38960
470	4840.87	I	7255 – 27907
65	4848.47	I	17540 – 38160
290	4856.01	I	18193 – 38780
35	4864.18	I	17424 – 37977
200	4868.26	I	18037 – 38573
250	4870.14	I	18141 – 38669
28	4880.91	I	17370 – 37852
45	4882.35	I	18193 – 38669
400	4885.08	I	15220 – 35685
380	4899.91	I	15157 – 35560
320	4913.62	I	15108 – 35454
55	4915.24	I	15220 – 35560
130	4919.87	I	17424 – 37744
180	4921.77	I	17540 – 37852
55	4925.41	I	15157 – 35454
30	4926.16	I	6599 – 26893
150	4928.34	I	17370 – 37655

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
30		4937.74	I	6557 – 26803
95		4938.29	I	20796 – 41040
30		4941.58	I	17424 – 37655
21		4948.19	I	17540 – 37744
21		4958.25	I	7255 – 27418
55		4964.75	I	15877 – 36014
21		4966.04	I	17424 – 37555
65		4968.58	I	15976 – 36096
75		4973.05	I	16106 – 36209
120		4975.35	I	20210 – 40303
65		4977.74	I	16268 – 36351
120		4978.20	I	15877 – 35959
5800		4981.73	I	6843 – 26911
150		4989.15	I	15976 – 36014
4600		4991.07	I	6743 – 26773
30		4995.08	I	18145 – 38160
140		4997.10	I	0 – 20006
4000		4999.51	I	6661 – 26657
230		5001.01	I	16106 – 36096
3600		5007.21	I	6599 – 26564
120		5009.65	I	170 – 20126
230		5013.30	I	16268 – 36209
3200	d	5014.19	I	0 – 19938
		5014.24	I	6557 – 26494
580		5016.17	I	6843 – 26773
840		5020.03	I	6743 – 26657
840		5022.87	I	6661 – 26564
580		5024.84	I	6599 – 26494
300		5025.58	I	16459 – 36351
1200		5035.91	I	11777 – 31629
840		5036.47	I	11640 – 31489
740		5038.40	I	11532 – 31374
1200		5039.95	I	170 – 20006
75		5040.62	I	6661 – 26494
85		5043.59	I	6743 – 26564
35		5044.27	I	17540 – 37359
55		5045.41	I	6843 – 26657
26		5048.21	I	17370 – 37173
110		5052.87	I	17540 – 37325
21		5054.08	I	21588 – 41369
110		5062.11	I	17424 – 37173
35		5064.07	I	21740 – 41481
1400		5064.66	I	387 – 20126
95		5065.99	I	11640 – 31374
35	h	5068.33	I	21470 – 41194
65		5069.35	I	17370 – 37091
130		5071.48	I	11777 – 31489
40		5085.34	I	11532 – 31191
130		5087.07	I	11532 – 31184
21		5103.15	I	
55		5109.44	I	11640 – 31206
190		5113.44	I	11640 – 31191
270		5120.42	I	20796 – 40320
30		5129.15	II	15258 – 34748
270		5145.47	I	11777 – 31206
230		5147.48	I	0 – 19422
210		5152.20	I	170 – 19574
21	bl	5166.86	Ti O	
1100		5173.75	I	0 – 19323
40		5186.34	I	17075 – 36351
85		5188.70	II	12758 – 32026
30		5189.58	I	18061 – 37325
1300		5192.98	I	170 – 19422
85	h	5194.04	I	16961 – 36209
65		5201.10	I	16875 – 36096
120		5206.08	I	20063 – 39266
75		5207.87	I	16817 – 36014
65		5208.42		
1400		5210.39	I	387 – 19574
65		5212.29	I	
150		5219.71	I	170 – 19323
95		5222.69	I	16817 – 35959
85		5223.64	I	16875 – 36014
250		5224.32	I	17215 – 36351
95		5224.56	I	16961 – 36096
190		5224.95	I	17075 – 36209
65		5226.56	II	12629 – 31756
120		5238.58	I	6843 – 25927
21		5246.15	I	20210 – 39266
55		5246.57	I	6743 – 25798
75		5247.31	I	16961 – 36014
21		5250.95	I	6661 – 25700
110		5252.11	I	387 – 19422
75		5255.83	I	17075 – 36096
55		5259.99	I	22081 – 41087
55		5263.50	I	17215 – 36209
150		5265.98	I	15220 – 34205
40		5282.39	I	8492 – 27418
140		5283.45	I	15157 – 34079
35		5284.39	I	8437 – 27355
26		5288.81		
65		5295.79	I	8602 – 27480
120		5297.26	I	15108 – 33981
65		5298.44	I	20210 – 39078
26		5336.81	II	12758 – 31491
17		5341.50	I	34947 – 53663
75		5351.08	I	22405 – 41087
26		5366.65	I	6599 – 25227
55		5369.64	I	
40		5389.18	I	6557 – 25107
55		5389.99	I	15108 – 33656
17		5396.60	I	170 – 18695
85		5397.09	I	15157 – 33680
35		5404.02	I	18826 – 37325
110		5409.61	I	15220 – 33701
40		5426.26	I	170 – 18594
75		5429.15	I	18912 – 37325
26		5436.73	I	7255 – 25644
17		5438.32	I	11532 – 29915
40		5446.64	I	18818 – 37173
11	bl	5448.34	Ti O	
30		5448.90	I	18826 – 37173
21		5449.16	I	11640 – 29986
35		5453.65	I	11640 – 29971
55		5460.51	I	387 – 18695
75		5471.21	I	11640 – 29912
35		5472.70	I	11640 – 29907
40	h	5473.55	I	18826 – 37091
85		5474.23	I	11777 – 30039
30		5474.46	I	18912 – 37173
120	h	5477.71	I	19574 – 37825
110		5481.43	I	19422 – 37660
75		5481.87	I	11532 – 29769
85	h	5488.20	I	19323 – 37539
150		5490.15	I	11777 – 29986
26		5490.84	I	387 – 18594
110		5503.90	I	20796 – 38960
40		5511.78	I	20063 – 38201
340		5512.53	I	11777 – 29912
270		5514.35	I	11532 – 29661

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
320		5514.54	I	11640 – 29769
26		5530.49		
110		5565.49	I	18037 – 36000
13		5579.16		
21	h	5582.98		
30	h	5585.68		
65	bl	5597.85	Ti O	
55	bl	5629.28	Ti O	
17		5635.84		
250		5644.14	I	18288 – 36000
75		5648.58	I	20126 – 37825
26	bl	5661.55	Ti O	
190		5662.16	I	18695 – 36351
75		5662.91	I	20006 – 37660
21		5673.42	I	25103 – 42724
130		5675.44	I	18594 – 36209
30	h	5679.94	I	19938 – 37539
95		5689.47	I	18525 – 36096
75		5702.68	I	18483 – 36014
35		5708.23	I	18695 – 36209
65		5711.88	I	18594 – 36096
40	h	5713.92	I	18463 – 35959
95		5715.13	I	18193 – 35685
55		5716.48	I	18525 – 36014
35		5720.48	I	18483 – 35959
85		5739.51	I	18141 – 35560
40		5740.02	I	18037 – 35454
19		5741.22	I	20210 – 37623
21		5752.84	I	18062 – 35439
19		5756.86	I	
40	h	5762.27	I	26494 – 43844
55	h	5766.35	I	26564 – 43902
75	h	5774.05	I	26657 – 43972
30		5780.78	I	18145 – 35439
75	h	5785.98	I	26773 – 44051
65	hl	5804.26	I	26911 – 44135
21	bl	5814.96	Ti O	
40		5823.71	I	18288 – 35454
21	h	5841.18		
21		5852.34		
400		5866.46	I	8602 – 25644
65		5880.31	I	8492 – 25494
21	h	5888.68		
230		5899.32	I	8492 – 25439
55		5903.33	I	8602 – 25537
120		5918.55	I	8602 – 25494
150		5922.12	I	8437 – 25318
75		5937.82	I	8602 – 25439
120		5941.76	I	8492 – 25318
300		5953.17	I	15220 – 32014
200		5965.84	I	15157 – 31914
270		5978.56	I	15108 – 31830
340		5999.04	I	17540 – 34205
65		5999.68	I	18037 – 34700
21		6012.73		
110		6064.63	I	8437 – 24921
120		6085.23	I	8492 – 24921
120		6091.17	I	18288 – 34700
40		6092.81	I	15220 – 31629
40	h	6098.67	I	24695 – 41087
35	h	6121.01	I	15157 – 31489
120		6126.22	I	8602 – 24921
19		6138.38	I	17370 – 33656
30		6146.22	I	15108 – 31374
21		6149.74	I	17424 – 33680
30	bl	6162.23	Ti O	
35		6186.15	I	17540 – 33701
95	h	6215.28	I	21740 – 37825
75	h	6220.49	I	21588 – 37660
65	h	6221.41	I	21470 – 37539
380		6258.10	I	11640 – 27615
380		6258.70	I	11777 – 27750
300		6261.10	I	11532 – 27499
65		6303.75	I	11640 – 27499
55		6312.24	I	11777 – 27615
26		6318.03	I	11532 – 27355
30		6336.10	I	11640 – 27418
35		6366.35	I	11777 – 27480
11		6419.10	I	17540 – 33114
17		6497.69	I	11640 – 27026
19		6508.14	I	11532 – 26893
55		6546.28	I	11532 – 26803
65		6554.23	I	11640 – 26893
11	h	6554.83		
75		6556.07	I	11777 – 27026
19	h	6565.62	I	
14	h	6575.18	I	20796 – 36000
35		6599.11	I	7255 – 22405
18	bl	6651.46	Ti O	
18	h	6666.55	I	11777 – 26773
22	h	6667.74		
9		6668.39		
18		6677.18	I	20063 – 35035
22	b	6691.21	Ti O	
26		6716.68	I	20063 – 34947
16	bl	6723.95	Ti O	
80		6743.12	I	7255 – 22081
22		6745.52	I	18037 – 32857
18		6844.64		
18		6860.39		
35		6861.47	I	18288 – 32858
9		6873.92	I	21588 – 36132
12		6913.19	I	21740 – 36201
14	h	6933.15	I	25107 – 39527
14	h	6943.70	I	25388 – 39786
23		6996.63	I	18826 – 33114
15		7004.66	I	18818 – 33091
14		7008.35	I	18826 – 33091
14		7010.94	I	18826 – 33085
14	h	7035.86	I	25318 – 39527
40		7038.80	I	18912 – 33114
14		7050.65	I	18912 – 33091
40	bl	7054.51	Ti O	
23		7069.11	I	25644 – 39786
23		7072.05		
45	bl	7087.89	Ti O	
30	b	7124.9	Ti O	
40	bl	7125.61	Ti O	
26		7138.91	I	11640 – 25644
26		7167.13		
23		7171.53		
55		7189.89	I	20796 – 34700
26	b	7203.64	Ti O	
260		7209.44	I	11777 – 25644
60		7216.20	I	11640 – 25494
130		7244.86	I	11640 – 25439
130		7251.72	I	11532 – 25318
19		7263.40		
19		7266.29	I	13982 – 27740
19	b	7269.05	Ti O	

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
15		7315.56	I	17540 – 31206
26		7318.39	I	18145 – 31806
120		7344.72	I	11777 – 25388
11		7352.16	I	20063 – 33661
90		7357.74	I	11640 – 25227
60		7364.11	I	11532 – 25107
26		7440.60	I	18193 – 31629
9		7474.94	I	14106 – 27480
26		7489.61	I	18141 – 31489
19		7496.12	I	18037 – 31374
12		7580.55	I	17996 – 31184
9	bl	7589.62	Ti O	
15		7614.50	I	18062 – 31191
23		7654.44	I	18145 – 31206
11	bl	7705.21	Ti O	
30		7949.17	I	12118 – 24695
26	h	7961.58	I	26657 – 39214
60		7978.88	I	15220 – 27750
9		7979.07	I	26773 – 39302
30		7996.53	I	26911 – 39413
7	h	8003.55		
55		8024.84	I	15157 – 27615
30		8068.24	I	15108 – 27499
8		8267.62		
14	h	8306.31	I	27750 – 39786
9	h	8307.41	I	6661 – 18695
9	h	8311.76	I	27499 – 39527
8	h	8312.85	I	27615 – 39641
12		8334.37	I	6599 – 18594
14		8353.15	I	6557 – 18525
75		8364.24	I	6743 – 18695
100		8377.85	I	6661 – 18594
100		8382.54	I	6599 – 18525
55		8382.82	I	6557 – 18483
75		8396.87	I	6557 – 18463
120		8412.36	I	6599 – 18483
19		8416.98	I	18037 – 29915
15		8424.41	I	16961 – 28829
170		8426.52	I	6661 – 18525
490		8434.94	I	6843 – 18695
240		8435.70	I	6743 – 18594
40		8438.93	I	18193 – 30039
40		8450.89	I	18141 – 29971
9	h	8457.10	I	14106 – 25927
19	h	8467.15	I	17075 – 28882
45		8468.50	I	15220 – 27026
15		8496.04	I	18145 – 29912
19	h	8518.05	I	17215 – 28952
40		8518.32	I	15157 – 26893
14		8539.38	I	18062 – 29769
40		8548.12	I	15108 – 26803
9		8569.77	I	17996 – 29661
9	h	8598.18	I	18288 – 29915
90		8675.39	I	8602 – 20126
45		8682.99	I	8492 – 20006
23		8692.33	I	8437 – 19938
19		8734.69	I	8492 – 19938
23		8766.64	I	8602 – 20006
15	h	8778.71	I	14106 – 25494

Tungsten

$$W,\ Z = 74,\ M = 183.8,\ \text{Ratio}\ \frac{W}{Cu} = 2.893$$

W I Normal state of valence electrons $5d^4 6s^2\ {}^5D_0 = 0$. I.P. = 64400 cm^{-1}.
W II Normal state of valence electrons $5d^4 6s\ {}^6D_{1/2} = 0$. I.P. = 143000 cm^{-1}.

References

Wavelengths:

G. R. Harrison, Massachusetts Institute of Technology Wavelength Tables (John Wiley & Sons, New York, 1939).

D. D. Laun and C. H. Corliss, J. Res. Nat. Bur. Stand. (U.S.), **72A** (Phys. and Chem.), No. 6, 609–755 (Nov.–Dec. 1968).

Classification:

W I, D. D. Laun and C. H. Corliss, J. Res. Nat. Bur. Stand. (U.S.), **72A** (Phys. and Chem.), No. 6, 609–755 (Nov.–Dec. 1968).

W II, D. D. Laun, J. Res. Nat. Bur. Stand. (U.S.), **68A** (Phys. and Chem.), No. 2, 207–252 (Mar.–Apr. 1964).

Strong lines of tungsten

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
15000	2029.98	II	6147 – 55393	2400	2098.60	II	1519 – 49154
13000	2008.07	II	4716 – 54499	2400	2121.59	II	3173 – 50292
9700	2079.11	II	6147 – 54229	2400	2944.40	I	2951 – 36904
8600	4008.75	I	2951 – 27890	2400	2946.99	I	2951 – 36874
7300	2026.08	II	4716 – 54057	2300	2065.57	II	4716 – 53114
6100	2094.75	II	1519 – 49242	2200	2075.59	II	8711 – 56875
5800	2001.71	II	3173 – 53114	2200	2089.14	II	4716 – 52567
5300	2049.63	II	1519 – 50292	2200	2100.67	II	0 – 47589
5100	2009.98	II	1518 – 51254	2200	4302.11	I	2951 – 26189
5000	4074.36	I	2951 – 27488	2100	2118.87	II	0 – 47180
4100	2010.23	II	3173 – 52902	2100	2681.42	I	2951 – 40234
4100	2014.23	II	3173 – 52803	2100	2718.91	I	2951 – 39720
4100	4294.61	I	2951 – 26230	1900	3617.52	I	2951 – 30587
3600	2088.19	II	3173 – 51045	1800	2435.96	I	4830 – 45869
3400	2071.21	II	3173 – 51438	1800	3867.99	I	2951 – 28797
2700	2035.03	II	7420 – 56544	1700	2090.48	I	0 – 47820
2700	2551.35	I	0 – 39183	1700 d	2405.58	I	1670 – 43228
2600	2724.35	I	2951 – 39646		2405.69	I	4830 – 46385

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
5800		2001.71	II	3173 – 53114
13000		2008.07	II	4716 – 54499
5100		2009.98	II	1518 – 51254
4100		2010.23	II	3173 – 52902
4100		2014.23	II	3173 – 52803
7300		2026.08	II	4716 – 54057
15000		2029.98	II	6147 – 55393
2700		2035.03	II	7420 – 56544
5300		2049.63	II	1519 – 50292
2300		2065.57	II	4716 – 53114
3400		2071.21	II	3173 – 51438
2200		2075.59	II	8711 – 56875
9700		2079.11	II	6147 – 54229
3600		2088.19	II	3173 – 51045
2200		2089.14	II	4716 – 52567
1700		2090.48	I	0 – 47820
6100		2094.75	II	1519 – 49242
2400		2098.60	II	1519 – 49154
2200		2100.67	II	0 – 47589
1500		2101.54	I	3326 – 50894
1500		2106.18	II	1519 – 48983
1300		2110.34	II	4716 – 52087
2100		2118.87	II	0 – 47180
2400		2121.59	II	3173 – 50292
850		2153.56	II	6147 – 52567
850		2157.80	II	4716 – 51045
1500		2166.32	II	4716 – 50863
480		2182.90	I	6219 – 52015
440		2194.52	II	0 – 45554
1300		2204.48	II	6147 – 51495
460		2248.75	II	0 – 44455
460		2249.80	I	1670 – 46105
180		2270.24	II	1519 – 45554
95		2271.37	I	3326 – 47338
510		2277.58	I	0 – 43893
160		2284.91	I	1670 – 45422
320		2285.17	I	6219 – 49966
530	d	2294.49	I	6219 – 49789
		2294.54	II	4716 – 48285
270		2298.33	I	4830 – 48326
240		2303.83	II	1519 – 44912
240		2306.59	I	2951 – 46292
340		2309.02	I	6219 – 49514
440		2313.17	I	0 – 43217
220		2314.17	I	6219 – 49418
190		2315.02	II	3173 – 46355
110		2318.96	I	15070 – 58179
460		2321.63	I	3326 – 46385
290		2326.09	II	6147 – 49125
390	d	2326.56	I	6219 – 49188
		2326.70	I	3326 – 46292
75		2328.31	II	1519 – 44455
180		2331.29	I	12162 – 55043
75		2331.91	I	15460 – 58330
75		2332.76	I	6219 – 49073
130		2333.77	II	1519 – 44355
210		2341.37	I	1670 – 44367
60		2343.12	I	17008 – 59673
75		2347.97	I	3326 – 45902
75		2349.26	II	20534 – 63088
		2349.33	I	13307 – 55859
120	d	2350.37	II	20456 – 62990
		2350.46	I	4830 – 47362
320		2354.61	I	6219 – 48676
60		2358.07	I	12162 – 54557
60		2358.81	II	3173 – 45554
580		2360.44	I	3326 – 45678
850		2363.07	I	1670 – 43975
60		2364.22	II	14968 – 57252
110		2365.45	I	0 – 42262
110		2365.85	I	17008 – 59264
110		2366.18	I	4830 – 47079
95		2366.96	I	9528 – 51763
150		2367.69	I	1670 – 43893
95		2370.89	I	2951 – 45117
35		2371.39	I	17107 – 59264
50		2374.13	I	6219 – 48326
510		2374.47	I	4830 – 46932
85		2374.76	I	3326 – 45422
95		2376.06	I	15070 – 57143
50		2376.57	I	17107 – 59172
50		2377.05	I	16431 – 58487
210		2382.99	I	6219 – 48171
670		2384.82	I	6219 – 48138
85		2386.16	I	17008 – 58904
240		2389.08	I	1670 – 43515
120		2390.37	II	7421 – 49242
120		2392.93	II	4716 – 46493
120		2395.48	I	9528 – 51260
730		2397.09	II	3173 – 44877
560		2397.73	I	3326 – 45019
560		2397.98	I	3326 – 45015
60		2399.04	I	17107 – 58778
30		2401.30	I	6219 – 47851
95		2402.45	I	13778 – 55389
75		2404.24	II	8711 – 50292
50		2405.26	I	13349 – 54912
1700	d	2405.58	I	1670 – 43228
		2405.69	I	4830 – 46385
95		2409.03	I	4830 – 46328
60		2410.62	I	6219 – 47689
75		2411.54	II	17437 – 58892
320		2414.04	I	3326 – 44737
610		2415.68	I	1670 – 43054
50		2416.24	I	6219 – 47593
50		2419.34	II	20040 – 61361
60		2420.20	I	13778 – 55084
50		2421.01	II	13412 – 54705
130		2422.29	I	3326 – 44596
40		2422.66	I	6219 – 47484
870		2424.21	I	4830 – 46068
190	d	2425.98	I	13349 – 54557
		2426.08	I	19535 – 60741
130		2427.28	I	15070 – 56256
190		2427.49	II	3173 – 44355
170		2429.39	II	26929 – 68079
170		2429.84	I	6219 – 47362
120		2430.44	I	14976 – 56109
580		2431.08	I	3326 – 44447
630		2433.98	I	4830 – 45902
60		2435.01	II	20534 – 61590
1800		2435.96	I	4830 – 45869
29		2436.26	I	2951 – 43985
250		2436.62	I	3326 – 44353
29		2437.95	I	9528 – 50534
60		2442.98	I	13348 – 54269
24		2443.33	I	19826 – 60741
95		2443.61	I	17008 – 57919
580		2444.06	I	1670 – 42573
160		2446.39	II	7421 – 48285

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
270		2448.39	I	12162 – 52993
270		2451.35	I	12162 – 52943
780		2451.48	II	1519 – 42298
870		2452.00	I	0 – 40771
430		2454.72	I	15070 – 55796
630		2454.98	I	4830 – 45551
780		2455.51	I	6219 – 46932
780		2456.53	I	3326 – 44020
1100		2459.30	I	3326 – 43975
270		2460.16	I	6219 – 46855
190		2461.57	I	12162 – 52774
480		2462.79	I	1670 – 42262
270		2464.30	I	3326 – 43893
95		2465.20	I	17008 – 57561
230		2466.52	II	1519 – 42049
1400		2466.85	I	3326 – 43851
75		2470.80	II	20781 – 61241
75		2471.21	I	17107 – 57561
480		2472.51	I	4830 – 45263
95	d	2473.70	I	14976 – 55389
		2473.82	I	0 – 40411
1200		2474.15	I	6219 – 46625
290		2477.80	II	6147 – 46493
870		2480.13	I	1670 – 41979
40		2480.66	I	2951 – 43251
390		2480.96	I	1670 – 41965
1500		2481.44	I	6219 – 46506
480	d	2482.10	I	2951 – 43228
		2482.21	I	12162 – 52436
29		2484.40	II	20040 – 60279
580		2484.74	I	12162 – 52395
130		2486.30	I	17107 – 57315
390		2487.50	I	4830 – 45019
270		2488.77	II	7420 – 47589
120		2488.93	I	6219 – 46385
390		2489.23	II	4716 – 44877
70		2489.72	I	3326 – 43479
75		2490.85	I	17008 – 57143
75		2492.93	II	14857 – 54959
70		2493.39	I	12162 – 52256
630		2495.26	I	1670 – 41734
230		2496.64	II	4716 – 44758
50		2496.97	I	17107 – 57143
95		2497.48	II	6147 – 46175
95		2499.43	I	13349 – 53346
140		2499.69	II	7420 – 47413
40		2500.11	II	18000 – 57986
160	d	2501.78	I	2951 – 42911
		2501.90	II	13412 – 53370
14		2503.04	I	15070 – 55009
40		2503.96	I	14976 – 54900
70		2504.53	I	9528 – 49444
680		2504.70	I	1670 – 41583
40		2505.37	I	3326 – 43228
95		2505.65	I	12162 – 52060
270		2506.02	I	3326 – 43217
24		2508.00	II	16553 – 56413
95		2508.44	I	12162 – 52015
190		2508.73	I	6219 – 46068
250		2510.17	I	15070 – 54896
75		2510.47	II	19071 – 58892
29		2512.94	I	17008 – 56790
140		2513.93	I	4830 – 44596
85		2516.55	I	17107 – 56832
60		2518.14	II	10593 – 50292
29		2518.50	I	12162 – 51856
95		2519.87	I	13307 – 52979
310		2520.46	I	15070 – 54733
60		2520.98	I	13348 – 53003
780		2521.32	I	2951 – 42601
270		2522.04	II	4716 – 44355
780		2523.41	I	4830 – 44447
60		2523.59	I	17701 – 57315
75		2524.81	I	13349 – 52943
140		2525.68	I	2951 – 42532
95		2526.42	I	6219 – 45790
430		2527.76	I	17008 – 56557
190		2529.72	I	17008 – 56527
24		2530.99	I	2951 – 42450
780		2533.64	I	1670 – 41127
29		2533.98	I	15460 – 54912
50		2534.68	I	15460 – 54900
50		2534.82	II	20781 – 60219
85		2535.11	I	1670 – 41104
70		2539.31	I	13434 – 52803
75		2541.70	I	6219 – 45551
120		2543.44	I	13348 – 52653
29		2544.17	I	14976 – 54269
580		2545.34	I	3326 – 42601
1200		2547.14	I	3326 – 42573
35		2548.15	I	6219 – 45452
35		2548.56	I	13777 – 53003
50		2549.09	II	3173 – 42390
40		2550.10	II	23235 – 62437
780		2550.38	I	1670 – 40868
140		2551.00	I	3326 – 42514
2700		2551.35	I	0 – 39183
29		2551.99	I	17107 – 56280
170		2553.17	I	4830 – 43985
450		2553.82	I	4830 – 43975
410		2554.86	II	0 – 39129
580		2555.09	II	3173 – 42298
		2555.21	I	3326 – 42450
40		2556.27	I	13777 – 52885
310		2556.75	I	1670 – 40771
75		2557.57	I	13349 – 52436
29		2558.48	I	19256 – 58330
290		2560.12	I	15070 – 54119
29		2560.76	I	23484 – 62524
85		2561.53	I	2951 – 41979
730		2561.97	I	4830 – 43851
230		2563.16	II	17437 – 56440
110		2563.91	II	11301 – 50292
150		2564.70	I	17008 – 55988
140		2567.51	I	3326 – 42262
130		2568.21	I	3326 – 42251
95		2568.56	I	2951 – 41872
75		2568.99	I	19648 – 58563
190		2569.25	I	12162 – 51072
		2569.30	II	15147 – 54057
160		2570.10	I	6219 – 45117
530		2571.44	II	3173 – 42049
170	d	2572.24	II	20534 – 59399
		2572.35	II	13412 – 52276
190		2573.53	I	13307 – 52153
75		2573.95	II	16553 – 55393
50		2575.47	I	19828 – 58644
140		2577.03	I	15070 – 53863
190		2579.26	II	23955 – 62714
190		2579.41	I	13307 – 52064
		2579.54	II	7420 – 46175

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
290		2580.34	I	2951 – 41694
870		2580.49	I	1670 – 40411
140		2581.06	I	12162 – 50894
40		2581.20	II	6147 – 44877
75		2583.22	I	13777 – 52477
390		2584.39	I	17008 – 55691
40		2585.24	I	23484 – 62154
110		2585.43	I	13349 – 52015
40		2586.35	I	3326 – 41979
50		2586.64	I	4830 – 43479
120		2586.94	I	12162 – 50806
95		2587.77	I	2951 – 41583
390		2589.17	II	6147 – 44758
170		2591.49	II	0 – 38576
70		2593.39	I	2951 – 41499
50		2596.35	I	19826 – 58330
70		2596.67	I	15460 – 53959
75		2597.73	I	17008 – 55492
70		2598.42	I	17701 – 56175
110		2598.74	II	8711 – 47180
75		2600.73	I	17107 – 55546
370		2601.96	I	4830 – 43251
75		2602.51	II	18000 – 56413
130		2602.80	I	3326 – 41734
75		2603.02	II	16553 – 54959
270		2603.54	I	4830 – 43228
150		2604.38	I	17107 – 55492
170		2605.51	I	3326 – 41694
680		2606.39	I	0 – 38356
75		2606.89	I	17107 – 55455
		2606.98	II	8833 – 47180
320		2607.38	I	1670 – 40011
370		2608.32	I	6219 – 44547
50		2610.74	I	9528 – 47819
180		2612.19	I	19648 – 57919
970		2613.08	I	3326 – 41583
480		2613.82	I	2951 – 41198
230		2615.12	I	6219 – 44447
70		2615.44	II	15147 – 53370
160		2618.81	I	3326 – 41499
210		2619.18	I	15070 – 53238
400		2620.25	I	2951 – 41104
400		2622.21	I	15070 – 53194
400		2625.22	I	4830 – 42911
80		2626.24	I	14976 – 53042
210		2628.26	I	1670 – 39707
160	d	2628.89	I	14976 – 53003
		2629.00	II	13412 – 51438
400		2632.48	I	12162 – 50137
400		2632.70	I	2951 – 40924
810		2633.13	I	1670 – 39637
290		2636.54	I	2951 – 40868
400	d	2638.62	I	19256 – 57143
		2638.75	I	15460 – 53346
160		2643.12	I	13778 – 51600
80		2644.60	I	6219 – 44020
210		2645.69	I	15070 – 52856
650		2646.18	I	3326 – 41104
400		2646.73	I	4830 – 42601
160		2647.09	I	6219 – 43985
75		2647.74	II	25209 – 62966
80		2649.98	I	17008 – 54733
160		2652.59	I	16431 – 54119
40		2653.42	II	16553 – 54229
80		2653.57	II	4716 – 42390
130		2654.66	I	15460 – 53118
80	d	2655.56	I	19826 – 57471
		2655.67	II	8711 – 46355
1600		2656.54	I	2951 – 40583
400		2657.38	I	4830 – 42450
400	d	2658.04	II	1519 – 39129
		2658.18	I	19535 – 57143
80		2660.53	I	19256 – 56832
80		2661.55	I	13349 – 50909
810		2662.84	I	3326 – 40868
80		2663.94	I	14976 – 52503
160		2664.32	I	6219 – 43741
		2664.34	II	17437 – 54959
260		2664.97	I	1670 – 39183
160		2665.78	I	6219 – 43721
75		2666.49	II	7421 – 44912
210		2669.30	I	13349 – 50800
40		2669.78	I	3326 – 40771
810		2671.47	I	4830 – 42251
80		2673.59	II	18000 – 55392
65		2674.69	I	22852 – 60229
40		2675.13	I	13349 – 50719
40		2675.40	I	15070 – 52436
130		2675.87	I	1670 – 39030
650		2677.28	I	3326 – 40666
160	d	2677.79	II	4716 – 42049
		2677.91	I	17701 – 55033
40		2678.53	I	19826 – 57149
400		2678.88	I	2951 – 40269
130		2680.05	I	17008 – 54310
2100		2681.42	I	2951 – 40234
290		2683.35	I	12162 – 49418
80		2687.37	I	18974 – 56175
210		2691.09	I	4830 – 41979
40		2692.16	I	18974 – 56108
650		2695.67	I	3326 – 40411
130		2697.51	I	2951 – 40011
210		2697.71	II	1519 – 38576
160		2698.84	I	4830 – 41872
650		2699.59	I	6219 – 43251
400		2700.01	I	12162 – 49188
40		2701.48	II	14857 – 51863
160		2702.11	II	13434 – 50431
210		2702.52	I	19535 – 56527
80		2706.02	I	3326 – 40269
400		2706.58	I	13349 – 50285
40		2707.03	I	23484 – 60414
65		2707.88	I	19256 – 56175
40		2708.19	I	16431 – 53346
400		2708.59	I	15070 – 51979
400	d	2708.80	I	1670 – 38576
		2708.93	I	4830 – 41734
80		2709.58	II	14968 – 51863
40		2710.78	II	16235 – 53114
400		2715.50	I	6219 – 43034
80		2716.32	II	14634 – 51438
80		2717.53	I	14976 – 51763
		2717.61	I	15070 – 51856
80		2718.04	II	16590 – 53370
2100		2718.91	I	2951 – 39720
320		2719.33	I	16431 – 53194
210		2719.86	I	2951 – 39707
160	d	2722.67	I	14976 – 51694
		2722.81	II	15147 – 51863

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
2600		2724.35	I	2951 – 39646
210		2724.62	I	6219 – 42911
400		2725.03	I	3326 – 40011
		2725.06	I	1670 – 38356
130		2727.95	I	6219 – 42866
80		2729.62	II	8833 – 45457
80		2733.18	I	9528 – 46105
40		2735.98	I	19256 – 55796
40		2738.00	I	16431 – 52943
75		2740.79	II	23804 – 60279
160		2743.43	I	13349 – 49789
80		2744.34	I	19828 – 56256
40		2746.21	I	15069 – 51473
80		2746.74	I	15460 – 51856
650		2748.84	I	4830 – 41198
160		2753.05	I	19535 – 55847
80		2754.92	I	13349 – 49637
40		2755.27	I	17107 – 53390
80		2755.94	I	4830 – 41104
40		2760.04	I	15070 – 51291
40	d	2760.74	II	19277 – 55488
		2760.84	I	13307 – 49517
80		2761.59	II	8711 – 44912
400		2762.34	I	0 – 36190
400		2764.27	II	0 – 36165
210		2768.98	I	1670 – 37774
400		2769.74	I	4830 – 40924
810		2770.88	I	2951 – 39030
210		2773.70	I	19648 – 55690
810		2774.00	I	4830 – 40868
810		2774.48	I	6219 – 42251
160		2776.50	II	14857 – 50863
40		2778.69	II	16590 – 52567
160		2779.73	I	16431 – 52395
80		2780.28	I	19535 – 55492
160		2783.13	I	19535 – 55455
40		2785.90	I	18974 – 54859
210		2787.98	I	3326 – 39183
130		2789.07	I	19648 – 55492
40		2789.68	I	4830 – 40666
340		2791.96	I	12162 – 47969
810		2792.70	I	2951 – 38748
80		2796.15	I	4830 – 40583
40		2797.20	I	13778 – 49517
80		2799.03	II	15147 – 50863
400		2799.93	I	3326 – 39030
160	d	2801.05	II	13434 – 49125
		2801.17	I	12162 – 47851
80		2802.96	I	13778 – 49444
80		2804.02	I	6219 – 41872
130		2804.24	I	16431 – 52081
80		2804.68	I	17701 – 53346
130		2805.63	I	18117 – 53749
130		2805.92	II	16235 – 51863
80		2807.72	I	19254 – 54859
65		2808.57	I	18280 – 53875
40		2812.25	II	13434 – 48983
40		2813.13	I	17701 – 53238
80		2815.42	I	19535 – 55043
810		2818.06	I	6219 – 41694
160		2822.57	II	13412 – 48831
130	d	2827.15	I	19648 – 55009
		2827.29	I	15069 – 50429
260		2829.82	I	13349 – 48676
40		2830.29	I	12162 – 47484
1600		2831.38	I	2951 – 38259
810		2833.63	I	6219 – 41499
210		2835.64	I	2951 – 38206
80		2836.25	I	19648 – 54896
110		2837.34	I	1670 – 36904
40		2837.77	I	18117 – 53345
40		2838.89	I	15070 – 50285
130		2839.34	I	9528 – 44737
400		2841.57	I	4830 – 40011
40		2842.57	I	16431 – 51600
80		2843.78	I	
160		2847.83	I	3326 – 38430
810		2848.02	I	2951 – 38053
160	d	2849.47	I	19828 – 54912
		2849.56	I	13307 – 48390
130		2850.81	I	15070 – 50138
40		2852.91	I	16431 – 51473
80		2853.50	I	15460 – 50495
40		2853.84	I	3326 – 38356
80		2855.35	I	13307 – 48319
650		2856.03	I	1670 – 36674
80		2857.14	I	14976 – 49966
160		2858.04	I	6219 – 41198
130		2863.01	I	1670 – 36588
130		2863.89	I	19826 – 54733
650		2866.06	I	3326 – 38206
40		2866.39	I	4830 – 39707
40		2870.91	I	13349 – 48171
130		2871.36	I	4830 – 39646
130		2875.21	I	12162 – 46932
230		2878.72	I	3326 – 38053
610		2879.11	I	2951 – 37674
610		2879.40	I	0 – 34719
40		2880.63	I	6219 – 40924
90		2884.18	I	19648 – 54310
90		2887.66	I	13349 – 47969
40		2893.12	I	17701 – 52256
40		2894.26	I	13778 – 48319
440		2896.01	I	1670 – 36190
1500		2896.44	I	2951 – 37466
50		2900.52	I	13778 – 48244
50		2901.79	I	17701 – 52153
50		2907.26	I	18117 – 52503
90	d	2908.27	I	16431 – 50806
		2908.40	I	18280 – 52653
90		2909.12	I	9528 – 43893
230		2910.48	I	3326 – 37674
270		2911.00	I	0 – 34342
90		2915.12	I	14976 – 49270
90		2915.59	I	17008 – 51296
50		2917.67	I	18974 – 53238
360		2918.25	I	6219 – 40476
50		2918.63	II	11301 – 45554
360		2923.10	I	4830 – 39030
230		2923.54	I	2951 – 37146
230		2925.13	I	15460 – 49637
90		2926.99	I	17701 – 51856
50		2927.93	I	18974 – 53118
90		2928.19	I	3326 – 37466
50		2928.66	I	13349 – 47484
80		2930.15	I	15070 – 49188
690		2935.00	I	1670 – 35732
50		2935.63	I	15460 – 49514
95		2936.01	I	6219 – 40269
50		2936.66	I	23046 – 57089

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
95		2937.14	I	19826 – 53863
140		2939.05	I	6219 – 40234
50		2941.25	I	13349 – 47338
2400		2944.40	I	2951 – 36904
2400		2946.99	I	2951 – 36874
480		2947.39	I	4830 – 38748
210		2952.29	II	14968 – 48831
95		2954.90	I	18974 – 52806
95		2960.15	I	13307 – 47079
440		2964.52	I	2951 – 36674
95		2966.58	I	17107 – 50806
50		2967.07	I	17107 – 50800
50		2967.55	I	15460 – 49148
80		2969.62	I	13778 – 47443
150		2971.68	I	1670 – 35311
150		2972.92	I	12162 – 45790
95		2976.80	I	13349 – 46932
480		2977.11	I	19648 – 53228
		2977.21	I	3326 – 36904
730	d	2979.71	I	19256 – 52806
		2979.86	I	3326 – 36874
150		2982.61	I	19256 – 52774
95		2984.14	I	6219 – 39720
150		2990.51	I	4830 – 38259
50		2990.71	I	6219 – 39646
400		2993.61	I	6219 – 39614
240		2995.26	I	4830 – 38206
190		2997.79	I	3326 – 36674
50		3000.24	I	19535 – 52856
80		3001.98	I	13778 – 47079
50		3002.83	I	19826 – 53118
190		3009.09	I	4830 – 38053
360		3013.79	I	4830 – 38001
520		3016.47	I	6219 – 39361
770		3017.44	I	2951 – 36082
110		3024.50	II	11301 – 44355
210		3024.93	I	1670 – 34719
310	d	3026.67	I	19826 – 52856
		3026.79	I	13778 – 46806
160		3033.56	I	12162 – 45117
160		3034.19	I	19826 – 52774
160		3039.31	I	
440	d	3041.73	I	15460 – 48326
		3041.86	I	3326 – 36190
270		3043.80	I	4830 – 37674
440		3046.44	I	1670 – 34486
110		3048.66	I	18280 – 51072
80		3049.00	I	28392 – 61180
810		3049.69	I	2951 – 35732
55		3054.01	I	9528 – 42262
110		3064.93	I	3326 – 35943
180		3073.28	I	6219 – 38748
110		3077.52	II	23955 – 56439
180	d	3084.83	I	17107 – 49514
		3084.91	I	3326 – 35732
95	c	3089.06	I	23484 – 55847
		3089.18	I	14976 – 47338
		3089.31	I	2951 – 35311
65		3090.58	I	19254 – 51600
370		3093.50	I	4830 – 37146
65		3105.88	I	19828 – 52015
240		3107.23	I	3326 – 35499
240		3108.02	I	2951 – 35117
65		3111.12	I	15460 – 47593
230		3117.57	I	13307 – 45374
260		3120.18	I	6219 – 38259
160		3133.88	I	13778 – 45678
130		3141.42	I	12162 – 43985
65		3149.85	II	13173 – 44912
65		3152.95	I	16431 – 48138
65		3155.09	I	18280 – 49966
95		3159.18	I	13778 – 45422
290		3163.42	I	15070 – 46672
130		3164.44	I	13349 – 44940
130		3165.38	I	18117 – 49700
65		3167.58	I	27849 – 59410
95		3170.21	I	2951 – 34486
320		3176.60	I	1670 – 33141
130		3179.06	I	17701 – 49148
65		3180.74	I	13307 – 44737
190		3181.82	I	16431 – 47851
130		3184.05	I	18117 – 49514
130		3184.42	I	3326 – 34719
65		3189.24	II	15147 – 46493
390		3191.57	I	0 – 31323
390		3198.84	I	4830 – 36082
520		3207.25	I	2951 – 34122
140		3208.28	I	3326 – 34486
1000		3215.56	I	6219 – 37309
140		3221.21	I	18117 – 49152
140		3221.91	I	3326 – 34354
190		3232.49	I	6219 – 37146
80		3232.65	I	15460 – 46385
140		3237.09	I	9528 – 40411
140		3242.03	I	21449 – 52285
140		3252.29	I	23047 – 53786
210		3254.36	I	15070 – 45789
140		3259.43	I	18117 – 48788
210		3259.66	I	4830 – 35499
210	d	3266.62	I	21453 – 52057
		3266.77	I	19535 – 50138
150		3281.94	I	20064 – 50525
150		3293.71	I	12162 – 42514
730		3300.82	I	4830 – 35117
440		3311.38	I	2951 – 33141
75		3316.09	I	1670 – 31818
75		3320.36	I	9528 – 39637
440		3326.20	I	6219 – 36275
440		3331.69	I	2951 – 32958
75		3345.09	I	29460 – 59346
75		3345.86	I	13349 – 43228
150		3354.45	I	4830 – 34633
75		3363.34	I	6219 – 35943
150		3371.04	I	4830 – 34486
80		3371.35	I	1670 – 31323
390		3373.75	I	3326 – 32958
80		3388.82	I	21449 – 50949
80		3391.09	I	15460 – 44940
80		3391.52	I	15070 – 44547
80		3398.09	I	19256 – 48676
80	h	3408.38	I	23047 – 52378
150		3412.96	I	4830 – 34122
150		3413.53	I	2951 – 32238
150		3422.42	I	24763 – 53974
150		3427.71	I	13349 – 42514
230		3429.59	I	19535 – 48685
240		3443.00	I	12162 – 41198
80		3448.83	I	15460 – 44447
80		3463.25	I	2951 – 31818
80		3468.40	I	13778 – 42601

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
80	3475.82	I	12162 – 40924
160	3477.94	I	26676 – 55420
80	3481.82	I	19256 – 47969
400	3495.24	I	19648 – 48251
160	3508.73	I	3326 – 31818
160	3510.02	I	2951 – 31433
80	3521.91	I	13349 – 41734
160	3526.85	I	13349 – 41694
160	3535.54	I	13307 – 41583
160	3537.45	I	15070 – 43331
650	3545.22	I	0 – 28199
80	3554.21	I	4830 – 32958
160	3568.04	I	15460 – 43479
240	3570.65	I	3326 – 31323
80	3572.48	II	10593 – 38576
160	3575.22	I	17008 – 44971
80	3575.97	I	13778 – 41734
80	3590.82	I	15070 – 42911
80	3592.42	II	11301 – 39129
240	3606.06	I	1670 – 29393
80	3607.06	I	19826 – 47541
80	3613.79	II	14634 – 42298
1900	3617.52	I	2951 – 30587
160	3622.34	I	19256 – 46855
130	3627.24	I	13307 – 40868
320	3631.94	I	1670 – 29196
240	3641.41	II	8711 – 36165
80	3646.52	II	14634 – 42049
80	3651.00	I	17008 – 44390
80	3657.59	II	8833 – 36165
95	3663.35	I	16431 – 43721
80	3667.71	I	18117 – 45374
80	3668.66	I	19256 – 46506
95	3674.58	I	19648 – 46855
160	3675.55	I	12162 – 39361
80	3679.60	I	15070 – 42239
650	3682.08	I	6219 – 33370
400	3683.30	I	18280 – 45422
	3683.39	I	15460 – 42601
160	3683.93	I	19535 – 46672
80	3684.65	I	19254 – 46385
570	3688.06	I	19648 – 46755
80	3699.41	I	19648 – 46672
80	3702.31	I	14976 – 41979
80	3703.38	I	29773 – 56768
810	3707.92	I	2951 – 29913
60	3714.23	I	17008 – 43924
60	3714.84	I	23982 – 50894
60	3715.03	I	20428 – 47338
60	3716.08	II	15147 – 42049
85	3717.08	I	17701 – 44596
100	3719.39	I	17107 – 43985
85	3722.24	I	19648 – 46506
85	3730.42	I	19826 – 46625
50	3736.22	II	18001 – 44758
30	3739.48	I	18280 – 45015
120	3741.71	I	14976 – 41694
75	3742.68	I	22477 – 49188
70	3749.66	I	22852 – 49514
35	3751.42	I	19254 – 45902
35	3757.08	I	6219 – 32828
510	3757.92	I	4830 – 31433
680	3760.13	I	3326 – 29913
26	3761.61	I	18974 – 45551
70	3764.31	I	19828 – 46385
70	3767.84	I	19256 – 45790
1000	3768.45	I	1670 – 28199
120	3769.21	I	14976 – 41499
120	3769.86	I	15460 – 41979
70	3772.42	I	20983 – 47484
340	3773.71	I	13778 – 40269
75	3778.55	I	19648 – 46106
75	3778.69	I	18280 – 44737
1000	3780.77	I	2951 – 29393
50	3783.73	I	19256 – 45678
35	3786.37	I	17008 – 43411
170	3792.76	I	13349 – 39707
85	3794.34	I	15070 – 41417
35	3796.28	I	19535 – 45869
70	3801.51	I	13349 – 39646
85	3801.91	I	19256 – 45551
26	3804.07	I	19826 – 46106
290	3809.22	I	2951 – 29196
190	3810.38	I	18117 – 44353
260	3810.79	I	13778 – 40011
35	3815.77	I	25983 – 52183
70	3816.39	I	19256 – 45452
1400	3817.48	I	2951 – 29139
35	3820.11	I	16431 – 42601
35	3824.15	I	18974 – 45117
95	3824.39	I	19648 – 45790
95	3826.19	I	15070 – 41198
110	3829.13	I	1670 – 27778
35	3834.04	I	19828 – 45902
1100	3835.06	I	3326 – 29393
290	3838.51	I	12162 – 38206
90	3842.31	I	6219 – 32238
730	3846.22	I	1670 – 27662
250	3847.49	I	0 – 25984
27	3851.57	II	13173 – 39129
150	3855.55	I	13778 – 39707
150	3859.30	I	18117 – 44020
75	3861.07	I	14976 – 40868
35	3861.24	I	12162 – 38053
180	3864.34	I	3326 – 29196
65	3866.06	I	13778 – 39637
1800	3867.99	I	2951 – 28797
250	3872.84	I	3326 – 29139
110	3874.41	I	19648 – 45452
75	3875.68	I	14976 – 40771
730	3881.41	I	4830 – 30587
35	3883.83	I	18280 – 44020
35	3890.75	I	18280 – 43975
110	3892.72	I	13349 – 39030
140 h	3897.91	I	29773 – 55420
35	3901.83	I	18974 – 44596
35	3903.98	I	29773 – 55381
75	3905.97	I	19828 – 45422
75	3918.59	I	12162 – 37674
35	3924.36	I	20428 – 45902
35	3924.69	I	18974 – 44447
35	3926.03	I	15460 – 40924
65	3930.24	I	19826 – 45263
80	3930.47	I	14976 – 40411
35	3930.96	I	18083 – 43515
150	3935.03	I	13778 – 39183
35	3936.22	I	18117 – 43515
120	3936.97	I	18974 – 44367
35	3937.61	I	19535 – 44924
35	3939.43	I	

559-795 O - 75 - 23 (Pt. 1)

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
120		3947.98	I	19648 – 44971
120		3952.52	I	14976 – 40269
120		3952.90	I	19256 – 44547
160		3953.15	I	19828 – 45117
200		3955.30	I	19648 – 44924
75		3958.87	I	13778 – 39030
80		3962.32	I	17008 – 42239
80		3964.99	I	6219 – 31433
160		3965.14	I	22477 – 47689
130		3968.59	I	19256 – 44447
80		3969.20	I	19828 – 45015
150	h	3970.80	I	28797 – 53974
80		3975.47	I	12162 – 37309
45		3975.90	I	17107 – 42251
130		3979.29	I	13307 – 38430
130		3980.64	I	19826 – 44940
35		3982.87	I	18117 – 43217
90		3982.97	I	19254 – 44353
250		3983.29	I	19826 – 44924
80		3991.23	I	21449 – 46497
75		3992.76	I	33291 – 58330
45		3993.91	I	23047 – 48078
45		3997.14	I	18974 – 43985
45		3998.16	I	21454 – 46458
75		3998.76	I	18974 – 43975
80	h	4000.70	I	28797 – 53786
80		4001.38	I	12162 – 37146
75		4005.40	I	1670 – 26630
8600		4008.75	I	2951 – 27890
45		4010.38	I	23047 – 47975
540		4015.22	I	19648 – 44547
170	h	4016.52	I	27488 – 52378
220		4019.23	I	3326 – 28199
130		4022.12	I	19535 – 44390
180		4028.79	I	9528 – 34342
45		4035.36	I	15460 – 40234
180		4036.86	I	19256 – 44020
140		4039.85	I	18974 – 43721
45		4040.59	I	19648 – 44390
45		4043.89	I	19254 – 43975
140	h	4044.28	I	26230 – 50949
910		4045.59	I	2951 – 27662
90		4046.70	I	13349 – 38053
45		4047.94	I	1670 – 26367
90		4053.93	I	14976 – 39637
45		4060.70	I	19828 – 44447
180		4064.79	I	19256 – 43851
150		4069.79	I	19826 – 44390
730		4069.95	I	4830 – 29393
340		4070.61	I	1670 – 26230
100		4071.93	I	15460 – 40011
80		4073.15	I	15070 – 39614
5000		4074.36	I	2951 – 27488
150		4082.96	I	19256 – 43741
130		4088.33	I	3326 – 27778
45		4088.77	I	19535 – 43985
100		4095.69	I	17008 – 41417
45		4097.66	I	18117 – 42514
35		4099.02	I	19535 – 43924
45		4101.84	I	
1000		4102.70	I	6219 – 30587
55		4108.53	I	18117 – 42450
150		4109.75	I	13349 – 37674
55		4110.57	I	18280 – 42601
100		4111.82	I	1670 – 25984
55		4115.58	I	15070 – 39361
150		4118.05	I	18974 – 43251
100		4118.19	I	13778 – 38053
100		4120.85	I	15460 – 39720
55		4122.01	I	18974 – 43228
55		4123.05	I	15460 – 39707
100		4125.16	I	16431 – 40666
150		4126.80	I	19254 – 43479
55		4132.20	I	19828 – 44020
100		4133.48	I	19535 – 43721
55		4136.35	I	18280 – 42450
540		4137.46	I	3326 – 27488
150		4138.02	I	13307 – 37466
90		4138.30	I	19828 – 43985
55		4139.32	I	16431 – 40583
110		4142.25	I	18117 – 42251
140		4145.16	I	13349 – 37466
110		4145.95	I	12162 – 36275
55		4149.44	I	19648 – 43741
160		4154.66	I	19389 – 43452
55		4160.03	I	20983 – 45015
45		4160.34	I	22477 – 46506
90		4168.65	I	18280 – 42262
160		4170.53	I	18280 – 42251
450		4171.17	I	4830 – 28797
55		4180.23	I	19826 – 43741
55		4183.66	I	18083 – 41979
90		4183.82	I	19826 – 43721
45		4186.00	I	17701 – 41583
45		4199.62	I	17107 – 40912
55		4200.02	I	16431 – 40234
90		4203.82	I	12162 – 35943
160		4204.40	I	19256 – 43034
220		4207.05	I	19648 – 43411
110		4215.38	I	19535 – 43251
55		4218.55	I	18280 – 41979
250		4219.37	I	6219 – 29913
110		4222.04	I	15070 – 38748
55		4224.76	I	23930 – 47593
45		4226.34	I	19256 – 42911
55		4226.92	I	18083 – 41734
55		4233.00	I	18117 – 41734
150		4234.34	I	19256 – 42866
290		4241.44	I	15460 – 39030
55		4243.63	I	18974 – 42532
540		4244.36	I	6219 – 29773
55		4249.45	I	13349 – 36874
55		4258.52	I	17107 – 40583
290		4259.35	I	21449 – 44920
55		4259.93	I	17008 – 40476
200		4260.29	I	18117 – 41583
200		4263.30	I	23047 – 46497
55		4266.54	I	23930 – 47362
1400		4269.38	I	2951 – 26367
110		4269.77	I	18280 – 41694
55		4273.69	I	22477 – 45869
220		4274.55	I	20064 – 43452
160		4275.49	I	18117 – 41499
160		4276.74	I	19535 – 42911
110		4282.34	I	19256 – 42601
45		4284.96	I	19535 – 42866
110		4286.01	I	13349 – 36674
110		4294.10	I	13307 – 36588
4100		4294.61	I	2951 – 26230
2200		4302.11	I	2951 – 26189

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
160	4306.87	I	24763 – 47975
110	4307.64	I	19826 – 43034
55	4316.80	I	23455 – 46613
55	4327.40	I	27849 – 50951
80	4330.66	I	19826 – 42911
80	4330.97	I	19828 – 42911
110	4332.13	I	14976 – 38053
45	4345.83	I	18974 – 41979
100	4347.00	I	19254 – 42251
45	4347.50	I	19256 – 42251
55	4348.11	I	20983 – 43975
150	4355.17	I	12162 – 35117
100	4361.81	I	6219 – 29139
150	4364.78	I	3326 – 26230
100 d	4365.95	I	28393 – 51291
	4366.07	I	18974 – 41872
150	4372.52	I	3326 – 26189
200	4378.48	I	4830 – 27662
180	4384.85	I	15460 – 38259
55	4389.84	I	19828 – 42601
80	4394.07	I	18117 – 40868
100	4403.95	I	17008 – 39709
200	4408.28	I	26676 – 49355
130	4412.19	I	3326 – 25984
45	4415.08	I	18280 – 40924
45	4418.44	I	20428 – 43054
90	4420.46	I	19256 – 41872
80	4423.77	I	22853 – 45452
45	4425.91	I	18280 – 40868
160	4436.90	I	20983 – 43515
45	4438.28	I	18974 – 41499
75	4441.81	I	17107 – 39614
90	4445.14	I	14976 – 37466
90	4449.00	I	12162 – 34633
45	4450.34	I	22477 – 44940
35	4455.46	I	19256 – 41694
35	4456.10	I	27849 – 50284
45	4458.09	I	13307 – 35732
35	4458.28	I	19828 – 42251
140	4460.49	I	13778 – 36190
75	4463.50	I	23930 – 46328
140	4466.34	I	13349 – 35732
140	4466.74	I	
45	4474.03	I	23982 – 46327
45	4481.27	I	23982 – 46291
640	4484.19	I	1670 – 23965
45	4489.01	I	29912 – 52183
45	4492.30	I	17107 – 39361
75	4493.96	I	19254 – 41499
80	4494.50	I	19256 – 41499
45	4495.29	I	15070 – 37309
30	4498.45	I	18974 – 41198
35	4504.13	I	24610 – 46806
160	4504.84	I	12162 – 34354
130	4512.88	I	18117 – 40269
120	4513.25	I	13349 – 35499
35	4519.15	I	23982 – 46104
35	4529.74	I	22477 – 44547
35	4530.45	I	12162 – 34229
65	4534.68	I	19826 – 41872
80	4535.03	I	19828 – 41872
65	4536.64	I	21856 – 43893
35	4542.87	I	15460 – 37466
150	4543.54	I	21449 – 43452
150	4546.47	I	18280 – 40269
150	4551.82	I	13349 – 35311
35	4556.83	I	23930 – 45869
35	4558.94	I	18083 – 40011
35	4559.10	I	14976 – 36904
75	4563.57	I	19828 – 41734
35	4565.30	I	14976 – 36874
140	4570.64	I	23047 – 44920
35	4578.32	I	29460 – 51296
35	4579.69	I	32828 – 54657
65	4586.83	I	9528 – 31323
170	4588.73	I	26189 – 47975
75	4592.39	I	19648 – 41417
55	4592.57	I	13349 – 35117
140	4599.94	I	24763 – 46497
30	4600.41	I	18280 – 40011
140	4609.89	I	15460 – 37146
160	4613.30	I	6219 – 27890
23	4614.83	I	19535 – 41198
30	4620.52	I	19535 – 41171
27	4623.64	I	16431 – 38053
60	4634.79	I	16431 – 38001
35	4641.76	I	4830 – 26367
100	4642.53	I	13778 – 35311
35	4643.12	I	20983 – 42514
35	4646.14	I	19254 – 40771
130	4657.42	I	27890 – 49355
640	4659.87	I	0 – 21454
25	4661.24	I	22477 – 43924
35	4661.98	I	15460 – 36904
40	4668.46	I	15460 – 36874
50	4676.62	I	19535 – 40912
60	4677.69	I	19826 – 41198
30	4679.04	I	18280 – 39646
640	4680.51	I	4830 – 26189
40	4683.54	I	19826 – 41171
100	4693.72	I	26676 – 47975
30	4698.62	I	19828 – 41104
50	4700.42	I	6219 – 27488
30	4702.47	I	18974 – 40234
20	4706.16	I	16431 – 37674
25	4710.32	I	27849 – 49073
25	4711.17	I	19256 – 40476
40	4712.49	I	14976 – 36190
25	4716.86	I	17008 – 38203
25	4718.62	I	23930 – 45117
25	4720.39	I	13307 – 34486
50	4725.12	I	19254 – 40411
80	4729.65	I	13349 – 34486
20	4745.59	I	18117 – 39183
30	4752.20	I	18974 – 40011
30	4752.58	I	13307 – 34342
20	4753.39	I	23982 – 45014
140	4757.54	I	2951 – 23965
25	4757.78	I	15070 – 36082
20	4758.20	I	23930 – 44940
18	4767.78	I	29460 – 50429
35	4773.89	I	13778 – 34719
16	4780.50	I	23455 – 44367
25	4787.92	I	13349 – 34229
20	4788.42	I	16431 – 37309
25	4797.55	I	19828 – 40666
80	4799.91	I	19648 – 40476
50	4807.38	I	12162 – 32958
20	4816.10	I	19254 – 40011
20	4816.84	I	28600 – 49355

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
25	4835.01	I	20428 – 41104	13	5368.68	I	28233 – 46855
790	4843.81	I	3326 – 23965	22	5374.14	I	20428 – 39030
40	4854.08	I	13349 – 33944	22	5388.00	I	19648 – 38203
25	4863.06	I	22477 – 43034	15	5397.95	I	19254 – 37774
25	4878.28	I	18083 – 38576	11	5419.39	I	22477 – 40924
380	4886.90	I	6219 – 26676	7	5422.88	I	22477 – 40912
16	4888.37	I	13778 – 34229	7	5423.93	I	19828 – 38259
16	4890.27	I	16431 – 36874	55	5435.03	I	1670 – 20064
16	4890.87	I	20428 – 40868	11	5435.59	I	17107 – 35499
30	4892.42	I	22477 – 42911	9	5440.05	I	19826 – 38203
30	4902.32	I	19254 – 39646	22	5456.58	I	23930 – 42251
16	4902.95	I	19256 – 39646	7	5457.92	I	29853 – 48170
25	4910.74	I	19256 – 39614	11	5475.11	I	28199 – 46458
30	4916.18	I	14976 – 35311	40	5477.78	I	9528 – 27778
40	4931.55	I	15460 – 35732	15	5486.01	I	31433 – 49656
35	4953.08	I	19828 – 40011	10	5487.77	I	4830 – 23047
40	4957.37	I	13778 – 33944	65	5492.31	I	29773 – 47975
15	4972.56	I	19256 – 39361	10	5496.23	I	22477 – 40666
55	4979.84	I	18280 – 38356	27	5500.49	I	19826 – 38001
220	4982.59	I	0 – 20064	27	5503.44	I	14976 – 33141
35	4983.53	I	19648 – 39709	10	5508.61	I	20428 – 38576
22	4984.70	I	18974 – 39030	220	5514.68	I	3326 – 21454
65	4986.92	I	15070 – 35117	9	5521.00	I	18083 – 36190
22	4989.08	I	23982 – 44021	15	5531.38	I	18117 – 36190
15	4994.08	I		15	5537.72	I	19256 – 37309
15	4995.29	I	22853 – 42866	9	5539.48	I	20983 – 39030
15	5002.79	I	20428 – 40411	13	5568.09	I	34228 – 52183
330	5006.15	I	6219 – 26189	7	5576.32	I	20428 – 38356
220	5015.30	I	4830 – 24763	13	5604.31	I	31818 – 49656
55	5040.36	I	13307 – 33141	9	5616.15	I	27213 – 45014
22	5052.23	I	20983 – 40771	9	5617.05	I	17701 – 35499
820	5053.28	I	1670 – 21454	5	5624.58	I	19535 – 37309
210	5054.60	I	1670 – 21449	9	5629.67	I	15070 – 32828
27	5055.52	I	22477 – 42251	11	5631.27	I	33370 – 51123
210	5069.12	I	3326 – 23047	27	5631.94	I	12162 – 29913
120	5071.74	I	29643 – 49354	5	5635.50	I	29853 – 47593
40	5110.36	I	15070 – 34633	8	5642.03	I	1670 – 19389
40	5124.23	I	14976 – 34486	4	5644.47	I	23982 – 41694
35	5130.11	I	23965 – 43452	65	5648.37	I	18974 – 36674
40	5138.40	I	28233 – 47689	8	5660.07	I	18280 – 35943
45	5145.77	I	20983 – 40411	35	5660.72	I	19648 – 37309
17	5153.56	I	22852 – 42251	8	5664.33	I	18083 – 35732
35	5183.97	I	18974 – 38259	8	5673.53	I	19254 – 36874
45	5192.71	I	14976 – 34229	27	5674.39	I	19256 – 36874
22	5195.63	I	25984 – 45225	7	5675.37	I	18117 – 35732
45	5203.25	I	19535 – 38748	13	5676.60	I	12162 – 29773
55	5204.52	I	20428 – 39637	15	5676.90	I	17701 – 35311
55	5206.18	I	19828 – 39030	15	5697.79	I	13778 – 31323
45	5212.81	I	28797 – 47975	7	5723.05	I	25984 – 43452
770	5224.66	I	4830 – 23965	55	5735.09	I	27488 – 44920
35	5233.52	I	19254 – 38356	5	5739.60	I	32238 – 49656
75	5242.98	I	16431 – 35499	7	5747.27	I	30683 – 48078
35	5254.54	I	15460 – 34486	13	5749.24	I	30587 – 47975
45	5255.40	I	22477 – 41499	5	5754.57	I	20983 – 38355
65	5259.34	I	27488 – 46497	11	5756.10	I	15460 – 32828
13	5263.22	I	23455 – 42449	7	5759.65	I	29139 – 46497
45	5275.53	I	19256 – 38206	13	5793.06	I	27662 – 44920
27	5318.86	I	27662 – 46458	13	5796.49	I	17107 – 34354
27	5337.35	I	26189 – 44920	4	5799.51	I	13349 – 30587
45	5348.93	I	26230 – 44920	45	5804.85	I	26230 – 43452
35	5350.43	I	29393 – 48078	13 d	5806.05	I	18280 – 35499
22	5351.89	I	27778 – 46458		5806.24	I	28233 – 45452
22	5354.45	I	9528 – 28199	7	5822.60	I	22477 – 39646
13	5355.25	I	19535 – 38203	13	5833.61	I	22477 – 39614
13	5357.09	I	15460 – 34122	13	5838.97	I	17107 – 34229

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
17	5845.27	I	29393 – 46497
28	5851.58	I	26367 – 43452
11	5856.61	I	20983 – 38053
22	5864.63	I	19828 – 36874
11	5874.22	I	19256 – 36275
9	5875.69	I	17107 – 34122
13	5880.21	I	34122 – 51123
13	5891.61	I	18974 – 35943
13	5901.20	I	23982 – 40923
40	5902.64	I	19254 – 36190
13	5928.58	I	22773 – 39636
55	5947.57	I	13778 – 30587
13	5953.96	I	20983 – 37774
13	5956.19	I	17701 – 34486
27	5960.83	I	27213 – 43985
55	5965.86	I	18974 – 35732
27	5972.51	I	3326 – 20064
20	5978.86	I	28199 – 44920
20	5983.82	I	28233 – 44940
13	6009.01	I	18083 – 34719
55	6012.78	I	19648 – 36275
40	6021.52	I	18117 – 34719
20	6028.32	I	29913 – 46497
20	6043.31	I	31433 – 47975
13	6049.92	I	18974 – 35499
13	6065.08	I	20983 – 37466
22	6081.44	I	18280 – 34719
13	6111.66	I	15460 – 31818
13	6115.52	I	14976 – 31323
22	6128.25	I	28233 – 44547
13	6143.94	I	22477 – 38748
20	6153.72	I	19254 – 35499
20	6154.87	I	17701 – 33944
20	6203.51	I	19828 – 35943
20	6254.28	I	33370 – 49355
27	6285.88	I	19828 – 35732
45	6292.02	I	13307 – 29196
20	6303.21	I	19256 – 35117
13	6386.47	I	23982 – 39636
35	6404.21	I	14976 – 30587
40	6445.12	I	18974 – 34486
11	6508.05	I	13778 – 29139
15	6532.39	I	20428 – 35732
13	6538.11	I	19826 – 35117
13	6563.20	I	19254 – 34486
20	6573.93	I	20983 – 36190
11	6607.13	I	17107 – 32238
11	6609.05	I	15460 – 30587
17	6611.62	I	32958 – 48078
11	6621.74	I	19535 – 34632
13	6678.42	I	18974 – 33944
15	6693.08	I	14976 – 29913
5	6746.56	I	23930 – 38748
5	6764.45	I	27670 – 42449
7	6805.31	I	19254 – 33944
9	6814.92	I	22477 – 37146
9	6820.27	I	19828 – 34486
8	6828.43	I	31818 – 46458
4	6853.74	I	19535 – 34122
4	6876.01	I	35117 – 49656
5	6908.29	I	13307 – 27778
9	6934.23	I	14976 – 29393
8	6964.12	I	13307 – 27662
13	6984.27	I	13349 – 27662
8	6993.27	I	19826 – 34122
4	6994.06	I	19828 – 34122
8	7017.88	I	28204 – 42449
3	7028.68	I	23982 – 38206
3	7098.22	I	44547 – 58631
4 h	7111.18	I	20428 – 34486
15	7140.52	I	13778 – 27778
9	7162.64	I	18280 – 32238
5 h	7191.33	I	31323 – 45225
5	7198.62	I	19254 – 33141
11	7200.16	I	13778 – 27662
5	7216.35	I	18974 – 32828
4	7226.06	I	19535 – 33370
8	7237.12	I	37309 – 51123
5	7274.47	I	38259 – 52002
10	7278.24	I	15460 – 29196
15	7285.81	I	19648 – 33370
15	7296.55	I	19256 – 32958
3	7298.25	I	27213 – 40911
7	7385.08	I	18280 – 31818
4	7451.39	I	24789 – 38206
3	7456.37	I	26861 – 40269
8	7483.35	I	20983 – 34342
7	7504.13	I	13307 – 26630
10	7509.00	I	19828 – 33141
3	7520.66	I	19535 – 32828
9	7537.45	I	18974 – 32238
9	7550.48	I	18083 – 31323
17	7569.92	I	18117 – 31323
5	7582.88	I	28233 – 41417
3	7612.18	I	23455 – 36588
17	7614.15	I	19828 – 32958
3	7631.29	I	27670 – 40770
3	7654.81	I	13307 – 26367
13	7688.97	I	19826 – 32828
4	7701.01	I	19256 – 32238
5	7761.16	I	13349 – 26230
3	7776.73	I	24610 – 37466
11	7784.15	I	18974 – 31818
7	7808.96	I	14976 – 27778
2	7823.82	I	29460 – 42239
4	7863.47	I	20428 – 33141
2	7867.04	I	16431 – 29139
4	7880.40	I	14976 – 27662
5	7886.48	I	13307 – 25984
9	7940.92	I	13778 – 26367
3	7957.06	I	19254 – 31818
22	8017.19	I	18117 – 30587
7	8054.89	I	13778 – 26189
22	8055.64	I	19828 – 32238
5	8060.38	I	18280 – 30683
13	8123.82	I	18280 – 30587
5	8143.19	I	23455 – 35731
3	8165.72	I	28233 – 40476
5	8210.22	I	19256 – 31433
4	8322.05	I	23930 – 35943
10	8338.08	I	19828 – 31818
4	8348.81	I	20983 – 32958
7	8358.72	I	23982 – 35943
3	8382.94	I	9528 – 21454
4	8402.60	I	19535 – 31433
4	8475.14	I	18117 – 29913
27	8585.11	I	22477 – 34122
10	8594.42	I	18280 – 29913
8	8613.27	I	19826 – 31433
3	8614.50	I	19828 – 31433
13	8865.53	I	18117 – 29393

Uranium

U, $Z = 92$, $M = 238.029$, Ratio $\frac{U}{Cu} = 3.746$

U I Normal state of valence electrons $5f^36d7s^2\ {}^5L_6^\circ = 0$. I.P. = 48800 cm^{-1}.
U II Normal state of valence electrons $5f^37s^2\ {}^4I^\circ_{4\ 1/2} = 0$. I.P. = 96000 cm^{-1}.

References

Wavelengths:
G. R. Harrison, Massachusetts Institute of Technology Wavelength Tables (John Wiley & Sons, New York, 1939).
C. C. Kiess, C. J. Humphreys, and D. D. Laun, unpublished material (1946).

Spectrum Assignments:
C. C. Kiess, C. J. Humphreys, and D. D. Laun, unpublished material (1946).

Classification:
U I, C. C. Kiess, C. J. Humphreys, and D. D. Laun, J. Research NBS **37**, 1 (1946) RP 1723.
U I and II, Z. Ben Osman, Thesis, Univ. of Paris (1966).
F. Guyon, Thesis, University of Paris-Sud, Orsay (1972).
D. W. Steinhaus, M. V. Phillips, J. B. Moody, L. J. Radziemski, K. J. Fisher, and D. R. Hahn, Los Alamos Report LA 4944 (1972).
U II, J. C. van den Bosch, Physica **15**, 503 (1949).
D. D. Laun, unpublished material (1969).

Strong lines of uranium

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
4900	3859.58	II	289 – 26191	1100	3701.52	II	5527 – 32535
3200	3584.88	I	0 – 27887	1000	3881.46	II	4585 – 30342
2800	3670.07	II	915 – 28154	1000	4042.76	I	620 – 25349
2400	3854.66	II	4663 – 30599	1000	4241.67	II	4585 – 28154
2300	3566.60	I	620 – 28650	970	2865.68	II	0 – 34886
2200	3890.36	II	289 – 25986	970	3111.62	II	1749 – 33877
2200	4090.14	II	1749 – 26191	960	3659.16	I	620 – 27941
2000	3831.46	II	4663 – 30756	950	3748.68	II	5716 – 32384
2000	3932.03	II	289 – 25714	920	2832.06	II	
1900	3782.84	II	289 – 26717	880	4062.55	II	0 – 24608
1900	3812.00	I	0 – 26226	880	4153.97	I	0 – 24067
1900	3865.92	II	2295 – 28154	870	2802.56	II	289 – 35960
1600	3489.37	I	0 – 28650	870	2821.12	II	
1600	3514.61	I	0 – 28444	840	3638.20	I	3801 – 31279
1600	4050.04	II	0 – 24684	830	2793.94	II	
1500	3871.04	I	0 – 25826	830	2943.90	II	
1400	4171.59	II	1749 – 25714	810	4116.10	II	0 – 24288
1300	2941.92	II	5527 – 39508	780	2906.80	II	
1200	2889.63	II	289 – 34886	780	2908.28	II	
1200	3550.82	II	0 – 28154	780	3507.34	I	0 – 28504
1200	3561.80	I	0 – 28067	750	3826.51	II	289 – 26415
1200	3839.62	I	3801 – 29838	730	3291.34	II	
1200	3943.82	I	0 – 25349	730	3390.39	I	620 – 30107
1200	3985.80	II	5260 – 30342	680	4341.69	II	289 – 23315
1100	3305.90	II	2294 – 32534				

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
I00		24I9.57	II	0 – 413I7
50		2423.70	II	
65		2427.45	II	
50		2432.4	II	
65		2448.93	II	
65		2450.44	II	
60		2454.37	II	
35		2455.68	II	
50		2468.26	II	
85		2470.64	II	
40		2477.18	II	
50		2484.01	II	
20		2490.93	II	
27		2498.83	II	5526 – 45533
I70		2500.86	II	
20		2503.9	II	
85		2514.77	II	4420 – 44174
85		2518.97	II	
40		2528.10	II	
50		2533.23	II	
50		2534.95	II	
85		2537.30	II	
150		2538.43	II	
40		2538.73	II	
40		2541.37	II	
35		2544.36	II	
85		2549.30	II	4420 – 43635
270		2556.19	II	0 – 39109
50		2559.49	II	
200		2562.94	II	
440		2565.41	II	0 – 38968
30		2567.11	II	
85		2567.96	II	
85		2568.87	II	
30		2568.98	II	5259 – 44174
340		2569.71	II	0 – 38903
150		2570.67	II	
130		2577.32	II	
85		2579.16	II	
85		2579.44	II	
85		2579.57	II	
40		2582.11	II	
40		2583.48	II	
130		2584.42	II	0 – 38681
85		2584.90	II	
85		2586.20	II	
100	d	2587.07	II	
50		2589.59	II	
340		2591.25	II	
130		2592.57	II	
150		2593.57	II	
240		2597.69	II	
120		2598.86	II	
190		2601.54	II	
27		2603.55	II	
85		2604.31	II	
130		2606.52	II	
130		2606.73	II	
130		2608.20	II	
65		2609.26	II	
85		2612.46	II	
150		2613.95	II	
50		2615.95	II	
100		2616.07	II	
65		2621.81	II	
85		2623.54	II	
130		2624.92	II	
I30		2625.26	II	
65		2625.86	II	
85		2628.50	II	
200		2628.93	II	
35		2629.15	II	
85		2631.26	II	
170		2632.66	II	
240		2632.98	II	
610		2635.53	II	
50		2636.25	II	
100		2637.70	II	
27		2638.6	II	
50		2639.01	II	
130		2639.84	II	
65		2639.89	II	
65		2641.55	II	5790 – 43635
100		2641.93	II	
24		2643.24	II	
24		2643.54	II	
130		2644.12	II	
40		2644.48	II	
470		2645.47	II	0 – 37789
35		2647.02	II	914 – 38681
24		2647.53	II	
65		2648.79	II	
250		2649.07	II	289 – 38027
200		2652.83	II	
100		2654.58	II	
65	d	2656.46	II	
24	d	2657.86	II	
24	d	2658.36	II	
65		2659.02	II	0 – 37596
85		2659.46	II	
130		2660.14	II	
65		2661.17	II	
170		2664.15	II	
100		2665.70	II	
100		2665.87	II	289 – 37789
130		2666.54	II	
50		2668.02	II	
340		2669.17	II	
130		2670.52	II	
50		2670.89	II	
100		2672.21	II	
50		2672.69	II	
24		2673.58	II	
130		2675.12	II	
130		2675.88	II	1749 – 39109
220		2676.41	II	6283 – 43635
35		2676.69	II	
24		2678.86	II	
35	d	2681.73	II	
470		2683.28	II	8276 – 45533
150		2684.04	II	
24		2684.29	II	
65		2685.61	II	
270		2685.98	II	1749 – 38968
24		2689.13	II	
130		2690.51	II	
320		2691.04	II	
100		2691.80	II	8394 – 45533
200		2692.36	II	
170		2693.77	II	

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
50		2694.22	II	
200		2695.49	II	
50		2695.91	II	
40		2696.30	II	
100		2697.40	II	
270		2698.06	II	
100		2698.45	II	
24		2699.37	II	
65		2700.96	II	
85		2701.55	II	
35		2704.80	II	
200	d	2705.19	II	
27		2705.77	II	
370		2706.95	II	
27		2708.50	II	
50	d	2709.03	II	
100		2709.51	II	4420 – 41317
65		2711.10	II	914 – 37789
65		2711.76	II	
130		2712.06	II	
65		2713.91	II	
100		2714.58	II	
100		2715.54	II	2295 – 39109
85		2716.39	II	
50		2717.56	II	
130		2719.33	II	
200		2723.03	II	
35		2725.07	II	
100		2725.52	II	
130		2725.94	II	2294 – 38968
100		2727.34	II	
120		2728.55	II	
120		2728.7	II	
50		2729.26	II	
170		2730.31	II	
100		2731.27	II	
50	d	2732.95	II	
50		2733.77	II	
370		2733.97	II	
120		2734.96	II	
85		2735.58	II	
85	d	2737.07	II	
100		2738.13	II	
50		2738.41	II	
100		2738.98	II	
170		2739.39	II	289 – 36783
65		2740.86	II	
35		2741.06	II	
130		2741.75	II	
85	d	2742.60	II	
100		2743.22	II	
100		2743.66	II	
35		2744.27	II	
170		2744.40	II	
130		2746.16	II	1749 – 38152
60		2746.3	II	
50		2747.15	II	
100		2747.36	II	
170		2748.45	II	
100		2749.96	II	
50		2750.13	II	
470		2754.16	II	
130		2755.13	II	
60		2757.55	II	
65	d	2757.92	II	
		2758.18	II	
130		2758.50	II	
150		2758.96	II	
130		2759.79	II	
35		2760.33	II	
27		2761.18	II	
340		2762.85	II	
100		2764.25	II	
200		2765.40	II	0 – 36150
190		2766.88	II	
390		2770.04	II	
95	d	2772.18	II	
190		2772.59	II	
150		2773.61	II	
120		2774.74	II	
120		2775.02	II	
85		2775.22	II	
85		2775.78	II	
85	d	2776.29	II	
75		2778.45	II	9553 – 45533
170		2779.41	II	
190		2780.04	II	0 – 35960
220		2780.77	II	
220		2781.04	II	
190		2781.62	II	
120		2782.07	II	
170	d	2783.29	II	
410		2784.45	II	0 – 35903
170		2784.67	II	
75		2784.92	II	8276 – 44174
60		2785.17	II	
170	d	2787.33	II	
150		2788.13	II	
170		2790.66	II	
120		2791.07	II	
75		2791.26	II	
830		2793.94	II	
190		2795.23	II	
290		2797.14	II	
85		2797.30	II	
85		2797.77	II	
120		2799.12	II	
870		2802.56	II	289 – 35960
120		2803.83	II	
170		2805.24	II	
630		2807.05	II	289 – 35903
440		2808.98	II	
220		2809.95	II	
120	d	2810.35	II	
290		2811.38	II	1749 – 37308
170		2813.04	II	
120		2815.76	II	
170		2815.98	II	289 – 35790
60		2816.74	II	
630		2817.96	II	
120		2818.98	II	
220		2819.84	II	
190		2820.27	II	
870		2821.12	II	
390		2824.37	II	289 – 35685
120		2824.86	II	
190		2825.35	II	
220		2826.19	II	
95		2827.00	II	
680		2828.90	II	

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
190		2829.37	II	
920		2832.06	II	
220		2833.82	II	
95		2834.55	II	
150		2835.80	II	
360		2837.19	II	914 – 36150
220		2837.33	II	
95		2837.73	II	
75		2838.62	II	915 – 36133
460		2839.89	II	289 – 35491
95		2840.47	II	
190	d	2840.62	II	
360		2842.09	II	
95		2842.24	II	
95		2842.48	II	
150		2844.99	II	
190		2845.60	II	
150		2845.96	II	
95		2846.14	II	8510 – 43635
95		2847.34	II	
50		2847.72	II	
60		2848.05	II	
360		2849.48	II	
150		2849.7	II	
95		2849.98	II	
190		2850.49	II	
95		2850.82	II	
120		2851.81	II	
150		2852.09	II	
190		2852.75	II	
50		2852.94	II	
190		2853.42	II	
190		2853.57	II	1749 – 36782
95		2854.92	II	
150		2855.96	I	0 – 35004
95		2857.47	II	
290		2858.90	II	
120		2859.74	II	
390		2860.47	II	0 – 34949
170		2860.80	II	
170		2861.13	II	
120		2862.41	II	
95		2862.62	II	4585 – 39508
75		2862.80	II	
95		2863.44	II	
95		2863.54	II	
150		2864.10	II	
150		2864.28	II	
290		2865.14	II	
970		2865.68	II	0 – 34886
150		2866.16	II	
95		2867.80	II	
190		2868.19	II	
190	d	2869.37	II	
340		2870.97	II	
95		2873.00	II	
220		2874.08	II	
220		2875.20	II	914 – 35685
190	d	2876.43	II	
95		2877.05	II	
50		2877.83	II	
95		2878.87	II	
240	d	2879.59	II	
190		2880.59	II	
95		2882.34	II	
490		2882.74	II	
240		2882.93	II	
85	h	2883.75	II	
150	d	2884.92	II	
95		2885.19	II	
95		2886.05	II	
190	d	2886.45	II	289 – 34924
460		2887.25	II	
150		2887.59	II	9553 – 44174
95		2887.91	II	
410		2888.26	II	0 – 34612
190		2888.74	II	
1200		2889.63	II	289 – 34886
150	d	2891.80	II	
95		2893.76	II	
320		2894.14	II	
410		2894.51	II	
95		2894.84	II	
95		2894.89	II	
190	d	2895.54	II	
240		2896.68	II	
85		2896.96	II	
150		2898.01	II	
150		2898.1	II	
95		2898.37	II	
95		2898.56	II	
150		2898.71	II	2294 – 36782
190		2901.22	II	
150		2902.41	II	
95		2902.81	II	0 – 34439
95		2903.05	II	
150		2903.55	II	
120		2904.02	II	
150		2904.41	II	
240		2904.51	II	289 – 34708
780		2906.80	II	
190		2906.91	II	
780		2908.28	II	
190		2908.41	II	
190		2909.25	II	
170		2910.82	II	
95		2911.55	II	
150		2912.58	II	289 – 34612
95		2912.75	II	
150		2913.44	II	
320		2914.25	II	289 – 34593
360		2914.63	II	
95		2914.84	II	
220	d	2915.54	II	
220		2916.46	II	
95		2918.37	II	
95		2918.68	II	
170		2918.97	II	5260 – 39508
440	d	2921.68	II	
		2921.72	II	
95		2922.06	II	
95		2923.17	II	0 – 34199
270		2923.50	II	
170		2924.58	II	
95		2925.22	II	
270		2925.57	II	
170		2925.98	II	
95		2926.13	I	0 – 34164
95		2926.39	II	
220		2926.59	II	

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
320		2927.38	II	289 – 34439
490		2928.60	II	
170		2929.12	II	
220		2929.64	II	
170		2929.78	II	
190		2930.43	II	
120		2930.59	II	0 – 34112
580		2931.41	I	
220		2931.89	II	
120		2932.18	II	
440		2932.61	II	
340		2933.86	II	
170		2935.62	II	
270		2936.45	II	
95		2936.78	II	1749 – 35790
120		2937.35	II	914 – 34949
220		2939.04	II	
120		2939.49	II	9626 – 43635
95		2940.04	II	
530	d	2940.37	II	
220		2941.34	II	
1300		2941.92	II	5527 – 39508
220		2942.12	II	
270		2942.85	II	915 – 34886
120		2943.18	II	
120		2943.40	II	
830		2943.90	II	
170		2944.19	II	
220		2945.89	II	1749 – 35685
270		2947.43	II	
340		2948.09	II	289 – 34199
95		2948.44	II	
290		2948.94	II	
220		2949.61	II	
95		2949.97	I	
120		2951.93	I	620 – 34486
220		2954.39	II	2295 – 36133
390		2954.77	II	
240		2955.65	II	289 – 34112
580		2956.06	II	
170		2956.78	II	
170	d	2957.74	II	
120		2958.10	II	
240		2959.85	II	
240	d	2962.78	II	1749 – 35491
240		2964.25	II	
460		2965.03	II	
170		2966.12	II	
240		2966.66	II	914 – 34612
580		2967.94	II	289 – 33972
170		2968.40	II	914 – 34593
120		2970.48	II	
580		2971.06	II	
240		2973.08	II	
290		2973.26	II	
240		2975.22	II	
170		2975.64	II	
290		2975.88	II	
410		2976.35	II	289 – 33877
290		2977.27	II	
240		2978.14	II	
120		2980.28	II	
120		2980.69	II	
120		2981.04	II	
320		2982.74	II	
530		2984.61	II	2295 – 35790
95		2985.08	II	
170	d	2985.80	II	
170		2987.80	II	289 – 33749
95		2987.95	II	
290		2988.42	II	
240		2988.71	II	
290		2989.88	II	
95		2990.21	II	
410		2992.72	II	
170		2993.70	II	
120		2994.45	II	
120		2996.10	II	
120		2996.39	II	
120		2998.36	I	0 – 33341
170		2999.03	II	
170		2999.22	II	
170		3000.09	II	
120		3001.21	II	
120		3002.64	II	
240		3003.07	II	
290		3003.32	II	
120		3003.85	II	
240		3004.15	II	
220		3005.10	II	
190		3005.52	II	
360		3007.91	II	5667 – 38903
290		3009.42	II	
120		3010.37	II	
170		3010.75	II	
120		3011.48	I	
95		3012.45	II	289 – 33475
170		3012.71	II	
240		3013.37	II	4420 – 37596
170		3013.44	II	
120		3014.88	II	
120		3015.68	II	
95		3016.05	II	
290		3016.96	II	1749 – 34885
170		3017.35	II	
150		3018.10	II	
120		3018.59	II	
120		3020.24	II	
120		3020.57	II	
120		3020.92	II	
320		3021.22	II	
630		3022.21	II	1749 – 34827
170		3024.38	II	
320		3024.51	II	
190		3026.15	II	
120		3026.43	II	
190		3026.70	II	
240		3027.66	I	620 – 33640
320		3028.19	II	
220		3029.13	II	
120		3029.42	II	
120		3030.83	II	
630		3031.99	II	
490		3033.19	II	1749 – 34708
220		3035.51	II	
120		3035.96	II	1749 – 34678
190		3036.45	II	
120		3036.61	II	
190		3038.05	II	0 – 32906
190		3039.14	II	4663 – 37558

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
240		3039.26	II	5259 – 38152
95		3039.93	II	
120		3040.46	II	914 – 33794
120		3041.25	II	
95		3041.86	II	
95		3041.9	II	
95		3042.73	II	
190		3043.79	II	1749 – 34593
490		3044.16	II	
95		3045.46	II	
190		3046.46	II	289 – 33104
190		3046.57	II	
190		3046.84	II	
240		3047.57	II	
290		3048.64	I	620 – 33412
95		3049.84	II	
580		3050.20	II	0 – 32775
240		3051.14	II	
240		3052.91	II	
120		3054.73	II	
240		3055.59	II	
190		3056.72	II	
630		3057.91	II	
120		3060.06	II	
460		3061.62	II	1749 – 34402
630		3062.54	II	1749 – 34392
95		3063.88	II	2295 – 34924
95		3064.18	II	5526 – 38152
120		3066.87	II	
270		3068.65	II	
95		3072.34	II	
85		3072.45	II	
580		3072.78	II	
190		3073.50	II	
270		3075.04	II	
120		3075.45	II	8510 – 41017
120		3077.33	II	
270		3079.95	II	
290		3080.74	II	2294 – 34745
170		3081.19	II	
270		3082.02	II	
190		3083.61	II	
120		3084.24	II	2295 – 34708
190	d	3086.73	II	
120		3087.11	II	2294 – 34678
240		3088.99	II	1749 – 34112
190		3090.36	II	
95		3090.55	II	
120		3091.25	II	
580		3093.01	II	
120		3094.83	II	
290		3095.04	II	1749 – 34049
190		3095.23	II	2295 – 34593
320		3095.75	II	
120		3096.88	II	
320		3098.01	II	
580		3102.39	II	
150		3102.61	II	
85		3102.90	II	
120		3103.77	II	5259 – 37469
460		3104.16	II	
150		3105.10	II	2294 – 34490
120		3105.65	II	
95		3110.52	II	
150		3110.83	II	
970		3111.62	II	1749 – 33877
240		3112.25	II	289 – 32410
170	d	3114.54	I	0 – 32098
		3114.59	II	2294 – 34392
150		3115.93	II	
150		3119.24	II	
530		3119.35	II	5260 – 37308
150		3120.87	II	
120		3121.09	II	
150		3121.33	II	0 – 32028
190		3124.43	II	
680		3124.90	II	914 – 32906
150		3126.17	II	
170		3126.70	II	4663 – 36637
190		3129.73	II	5526 – 37469
95		3130.73	II	
190		3131.99	II	
95		3133.42	II	2295 – 34199
95		3133.63	II	
150		3133.92	II	
150		3136.89	II	6283 – 38152
120		3138.51	II	
120		3138.83	II	
530		3139.60	II	5716 – 37558
150		3141.95	II	2294 – 34112
410		3144.96	II	
490		3145.56	II	5527 – 37308
190		3146.26	II	
150		3146.75	II	
270		3147.09	I	620 – 32386
150		3148.56	II	0 – 31751
680		3149.21	II	
95		3150.36	II	
150	h	3151.08	II	1749 – 33475
150		3152.31	II	
530		3153.12	II	
95		3155.26	II	
150		3155.41	II	4663 – 36346
270		3155.86	II	2294 – 33972
190		3156.07	II	
150		3157.45	II	
190		3157.86	II	
150		3159.82	II	
190		3160.77	II	
95		3163.73	II	
95		3165.28	II	
220		3165.50	II	2294 – 33876
220		3167.10	II	
150		3170.86	II	
150		3171.37	II	5260 – 36782
95		3173.71	II	0 – 31499
150		3175.36	II	
340		3176.21	II	1749 – 33224
340		3177.33	II	9553 – 41017
220		3179.04	II	289 – 31736
220		3179.83	II	914 – 32353
220		3180.20	II	
75		3182.55	II	
75		3182.83	II	289 – 31698
120		3185.14	II	
270		3185.71	II	1749 – 33130
220		3188.34	II	1749 – 33104
150		3189.02	II	
75		3189.42	II	
150		3190.70	II	

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
75	3190.89	II	
75	3191.76	II	4663 – 35985
220	3193.23	II	
120	3196.74	II	
240	3200.14	II	
340	3206.05	II	914 – 32096
150	3206.23	II	2295 – 33475
75	3211.77	II	
75	3213.09	II	8394 – 39508
75	3214.70	I	0 – 31098
220	3218.34	II	
150	3219.17	II	
240	3224.26	II	
240	3226.17	II	914 – 31902
730	3229.50	II	
680	3232.16	II	289 – 31219
150	3233.34	II	
75	3235.23	II	
75	3238.46	II	914 – 31784
75	3240.35	II	
220	3241.99	II	914 – 31751
440	3244.17	II	
150	3244.79	II	2295 – 33104
220	3246.11	II	
220	3246.39	II	289 – 31084
75	3247.49	II	
95	3248.07	II	
95	3249.14	II	
150	3250.28	II	
150	3253.75	II	5716 – 36441
220	3254.84	II	
75	3257.26	II	0 – 30691
290	3261.72	II	1749 – 32398
120	3263.12	I	0 – 30637
340	3265.81	II	914 – 31526
75	3269.78	II	289 – 30863
440	3270.12	II	289 – 30860
75	3271.45	II	5401 – 35960
75	3279.55	I	
150	3280.00	II	914 – 31393
150	3282.48	II	0 – 30455
190	3283.10	II	914 – 31364
290	3285.22	II	1749 – 32179
220	3287.45	II	
440	3288.21	II	289 – 30691
730	3291.34	II	
75	3293.56	I	0 – 30353
120	3294.44	II	
95	3297.89	II	
270	3299.06	II	
220	3299.70	II	
290	3303.60	II	289 – 30550
1100	3305.90	II	2294 – 32534
75	3307.55	II	
75	3310.50	II	
290	3311.72	II	
290	3313.94	II	289 – 30455
75	3318.79	II	4585 – 34708
150	3319.21	I	3868 – 33987
150	3319.32	II	
220	3322.12	II	4585 – 34678
75	3322.46	II	
150	3325.66	II	0 – 30061
150	3327.50	II	914 – 30958
290	3329.92	II	2294 – 32316
75	3332.42	II	5791 – 35790
150	3336.68	II	2294 – 32255
390	3337.79	II	289 – 30240
150	3338.48	II	915 – 30860
440	3341.66	II	2295 – 32211
290	3342.68	II	1749 – 31656
150	3344.87	II	
95	3345.56	I	0 – 29881
150	3345.89	I	620 – 30499
270	3354.50	II	2294 – 32096
75	3355.11	II	289 – 30086
270	3357.93	II	289 – 30061
150	3360.00	I	0 – 29753
150	3361.73	II	2294 – 32032
150	3367.56	I	
120	3367.90	II	0 – 29683
220	3368.83	II	
75	3368.98	I	0 – 29673
120	3370.13	II	5260 – 34924
290	3371.29	II	
220	3372.01	II	289 – 29936
220	3375.78	II	
120	3376.55	II	2294 – 31902
150	3377.39	II	
75	3378.20	I	4453 – 34046
150	3380.70	II	
150	3381.95	II	
75	3382.68	II	915 – 30469
220	3384.45	II	289 – 29828
220	3386.13	II	914 – 30438
730	3390.39	I	620 – 30107
120	3390.97	I	3800 – 33282
75	3392.99	II	4585 – 34049
290 d	3393.91	II	2294 – 31751
340	3394.78	II	5260 – 34708
290	3395.32	II	1749 – 31193
290 d	3395.52	I	0 – 29442
	3395.58	II	2294 – 31736
75	3397.19	I	4275 – 33703
150	3398.26	II	5259 – 34678
75	3399.01	I	
290	3401.01	II	289 – 29683
150	3401.21	II	
75	3401.87	II	4585 – 33972
290	3403.55	II	
95	3405.72	I	3800 – 33154
220	3406.28	II	915 – 30264
150 d	3407.87	I	3800 – 33136
	3407.97	II	1749 – 31083
290	3411.53	I	
290	3412.10	II	
150	3412.36	II	
120	3413.81	II	5259 – 34544
75	3414.32	I	4453 – 33733
75	3416.12	II	
75	3418.39	I	620 – 29866
220	3421.69	II	8379 – 37596
75	3422.35	II	5401 – 34612
220	3423.05	II	
580	3424.56	II	1749 – 30942
150	3424.81	II	
170	3426.39	II	
50	3430.18	I	3868 – 33013
75	3430.48	II	
150	3431.14	I	4276 – 33412

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
150	3431.54	II	5791 – 34924
75	3433.71	II	
150	3433.90	I	7645 – 36758
270	3434.15	II	1749 – 30860
120	3434.61	I	0 – 29107
150	3435.20	I	3800 – 32902
580	3435.49	I	0 – 29099
150	3436.78	II	4706 – 33794
75	3437.93	II	
150	3440.98	I	
270	3442.95	I	0 – 29036
75	3447.32	II	
150	3448.78	I	0 – 28987
150	3451.21	II	
360	3453.57	II	8521 – 37469
150	3453.78	II	5667 – 34612
320	3454.23	II	
240	3455.74	II	1749 – 30678
320	3457.05	II	6445 – 35363
320	3457.71	II	5526 – 34439
240	3458.17	I	3800 – 32709
75	3458.68	II	
360	3459.92	I	0 – 28894
320	3462.21	I	0 – 28875
460	3463.54	I	620 – 29484
630	3466.30	I	0 – 28840
150	3469.49	I	3800 – 32615
120	3469.78	I	0 – 28811
390	3472.51	II	
150	3472.56	II	2295 – 31084
320	3473.43	I	3868 – 32650
150	3474.54	II	
150	3474.99	II	914 – 29683
150	3476.44	II	
75	3477.50	II	
270	3477.84	II	
120	3479.16	I	
360	3480.36	I	5762 – 34486
680	3482.49	II	1749 – 30455
120	3486.30	II	
150	3488.82	II	
1600	3489.37	I	0 – 28650
220	3489.57	II	5791 – 34439
290	3490.24	II	914 – 29557
120	3491.34	II	
390	3493.33	II	5259 – 33877
340	3493.99	I	620 – 29233
320	3494.84	II	
75	3495.60	II	
75	3495.75	II	1749 – 30347
530	3496.42	II	1749 – 30342
150	3497.26	I	3800 – 32386
150	3497.62	II	
240	3499.33	II	2295 – 30863
630	3500.07	I	0 – 28563
75	3500.33	II	
75	3501.00	I	4453 – 33008
240 d	3502.24	I	3868 – 32413
	3502.24	II	4585 – 33130
320	3504.00	I	3800 – 32331
150	3504.93	I	0 – 28523
320	3505.07	II	5259 – 33781
150	3505.45	II	4585 – 33104
240	3507.05	I	620 – 29126
780	3507.34	I	0 – 28504
320	3508.85	II	1749 – 30240
390	3509.67	II	0 – 28484
240	3511.44	I	0 – 28470
150	3511.58	II	289 – 28758
150	3513.37	II	
320	3513.68	I	620 – 29072
1600	3514.61	I	0 – 28444
120	3515.24	II	4420 – 32860
150	3516.3	II	
150	3516.85	I	3868 – 32294
150	3517.05	II	6283 – 34708
390	3519.96	II	914 – 29316
190	3520.79	II	6283 – 34678
120	3521.48	II	
150	3522.58	I	
150	3522.67	I	3800 – 32180
75	3523.35	II	
240	3523.57	II	
240	3525.14	II	
240	3525.65	I	0 – 28355
75	3525.73	II	9241 – 37596
240	3526.60	II	289 – 28636
240	3528.69	II	
75	3529.77	II	0 – 28322
390	3531.11	II	1749 – 30061
240	3531.64	I	620 – 28927
630	3533.57	II	915 – 29207
320	3534.33	I	0 – 28286
75	3535.84	I	620 – 28894
75	3537.06	I	
240	3537.28	I	0 – 28262
150	3537.44	II	8521 – 36782
120	3538.23	I	620 – 28875
240	3539.65	I	3800 – 32044
530	3540.46	II	5716 – 33953
75	3541.89	II	
320	3542.57	I	4276 – 32496
240	3543.16	II	5260 – 33475
120	3543.73	I	7326 – 35536
150	3544.21	II	6283 – 34490
150	3544.99		
240	3545.44	I	4275 – 32472
240	3545.67	I	4453 – 32648
240	3546.13	I	620 – 28811
240	3546.68	II	1749 – 29936
390	3547.19	II	1749 – 29932
150	3548.62	I	4275 – 32447
320	3549.20	I	
150	3550.17	I	5762 – 33921
1200	3550.82	II	0 – 28154
150	3551.04	II	289 – 28441
320	3552.17	II	2294 – 30438
150	3552.67	II	
75	3552.95	I	4453 – 32590
150	3553.44	I	3800 – 31934
680	3555.32	I	0 – 28119
390	3557.84	I	0 – 28099
150	3560.31	I	5991 – 34070
150	3560.44	II	1749 – 29828
320	3561.41	I	3800 – 31871
1200	3561.80	I	0 – 28067
390	3563.66	I	0 – 28053
120	3564.18	I	620 – 28669
240	3564.59	II	
150	3564.88	II	9553 – 37596

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
150		3565.05	I	4276 – 32318
2300		3566.60	I	620 – 28650
150		3568.82	II	
530		3569.06	II	
75		3570.65	II	
75		3570.93	II	4420 – 32416
150		3571.16	I	620 – 28614
120		3571.56	II	5790 – 33781
150		3571.69	II	4420 – 32410
190		3574.11	I	7005 – 34976
320		3574.76	I	0 – 27966
240		3576.22	II	
150		3577.08	II	
360		3577.92	I	0 – 27941
240		3578.33	I	0 – 27938
630		3578.72	II	
190		3580.25	I	620 – 28543
360		3581.84	II	5716 – 33627
290		3582.02	II	
190		3582.62	I	4275 – 32180
3200		3584.88	I	0 – 27887
240		3585.84	I	620 – 28499
120	d	3587.78	I	4453 – 32318
		3587.84	II	
240		3589.66	I	620 – 28470
240		3589.79	I	3800 – 31649
290		3590.32	II	5260 – 33104
320		3590.50	II	915 – 28758
150		3591.56	II	4420 – 32255
390		3591.74	I	620 – 28454
120		3592.97	I	620 – 28444
240		3593.20	I	4276 – 32098
460		3593.52	II	
120		3593.68	I	5762 – 33580
290		3594.95	II	1749 – 29557
150	d	3596.76	II	
		3596.88	II	
150		3599.84	II	
150		3600.29	I	620 – 28387
75		3601.19	I	8118 – 35879
150		3602.48	I	3801 – 31552
150		3603.36	I	0 – 27744
120		3603.74	I	4276 – 32017
460		3605.28	I	0 – 27729
120		3605.48	II	1749 – 29477
360		3606.32	II	4663 – 32384
150		3608.96	II	
240		3609.68	II	
150		3610.49	II	6283 – 33972
150		3610.69	I	4453 – 32141
75		3611.24	II	2294 – 29978
75		3611.40	I	0 – 27682
190		3612.67	II	915 – 28587
150		3615.54	I	0 – 27650
320		3616.33	I	3801 – 31445
320		3616.76	II	289 – 27930
75		3616.89	I	
75		3617.49	I	7103 – 34739
75		3617.62	I	3800 – 31435
150		3618.49	II	
75		3619.13	II	
320		3620.08	I	0 – 27616
75		3622.04	I	0 – 27600
320		3622.70	I	4275 – 31871
390		3623.06	II	915 – 28508
120		3625.98	II	
75		3628.38	II	289 – 27841
460		3630.73	II	
75		3632.95	II	
190		3633.29	II	
120		3634.56	I	3868 – 31374
150		3635.30	I	3801 – 31301
150		3635.40	II	0 – 27499
120		3637.51	I	5991 – 33474
840		3638.20	I	3801 – 31279
120		3638.65	I	8118 – 35593
310		3640.76	II	
240		3640.95	II	1749 – 29207
160		3642.44	I	4275 – 31722
420		3644.24	I	620 – 28053
50		3644.85	II	
310		3645.03	II	914 – 28341
170	d	3649.51	II	0 – 27393
		3649.58	I	5762 – 33154
660		3651.53	I	3800 – 31178
490		3652.07	I	4275 – 31649
140		3653.21	I	3801 – 31166
140		3654.89	I	3868 – 31221
120		3657.32	II	
170		3659.01	II	4706 – 32028
960		3659.16	I	620 – 27941
170		3659.59	I	620 – 27938
160		3662.33	II	4663 – 31961
170	d	3666.10	II	
		3666.21	II	8521 – 35790
100		3667.13	I	0 – 27261
100		3667.98	II	
120		3669.18	I	5762 – 33008
2800		3670.07	II	915 – 28154
240		3670.53	I	7645 – 34881
190		3672.58	II	
170		3673.06	I	
190		3673.39	II	
190	d	3674.13	I	620 – 27829
190	d	3674.99	II	6445 – 33648
		3675.08	II	5259 – 32462
260		3676.56	II	6283 – 33475
260		3677.39	I	3801 – 30986
190		3677.67	II	
380		3678.75	II	
240		3679.38	I	620 – 27791
280		3679.81	II	
240		3680.88	I	4275 – 31435
230		3682.04	II	5259 – 32410
140		3682.46	I	0 – 27148
180		3683.59	II	
180		3684.62	I	13567 – 40700
150		3685.78	I	620 – 27744
540		3691.92	II	4706 – 31784
330		3693.70	II	7547 – 34612
190		3697.13	I	3800 – 30841
220		3697.93	II	8755 – 35790
540		3700.58	II	915 – 27930
1100		3701.52	II	5527 – 32535
230		3702.62	I	4276 – 31276
230		3703.27	I	620 – 27616
230		3704.09	I	7326 – 34315
180		3705.04	II	
110		3705.98	II	
230	d	3707.29	I	3800 – 30767
		3707.39	I	

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
110		3707.65	II	
110		3707.95	I	3868 – 30829
110		3709.87	I	5762 – 32709
350	d	3713.56	I	0 – 26921
		3713.65	II	5259 – 32179
230		3714.76	II	2295 – 29207
230		3715.47	I	4275 – 31182
110		3716.14	I	3800 – 30702
300		3717.42	II	
350		3718.11	II	1749 – 28636
160		3718.61	II	5526 – 32410
110		3719.29	I	620 – 27499
230	h	3720.39	I	3800 – 30672
230		3722.68	I	7191 – 34046
110		3724.23	I	
350	d	3724.99	II	1749 – 28587
		3725.07	II	
120		3725.65	II	
350		3729.82	II	5526 – 32330
120		3730.13	II	
95		3731.45	I	0 – 26792
230	d	3731.58	II	
		3731.77	I	7645 – 34434
230		3732.26	I	3801 – 30587
350		3732.62	II	914 – 27697
350		3733.07	II	
230		3733.58	I	6249 – 33025
230		3737.25	II	
600		3738.05	II	5791 – 32535
190		3742.35	I	7005 – 33719
300		3744.24	II	
680		3746.41	II	5527 – 32211
350		3747.12	II	8521 – 35201
950		3748.68	II	5716 – 32384
600		3751.18	I	5762 – 32412
240		3751.72	I	620 – 27267
350		3752.66	II	5526 – 32166
190		3754.31	II	0 – 26628
350		3755.48	II	5790 – 32410
240		3756.66	II	
240		3756.92	II	4706 – 31316
490		3758.36	I	4276 – 30876
350		3759.23	II	
120		3759.88	II	
240		3760.88	II	0 – 26581
160		3761.96	II	
160		3762.11	II	1749 – 28322
330		3763.27	I	7006 – 33571
490		3764.57	II	
270		3765.35	I	0 – 26550
430		3766.89	I	4453 – 30993
240		3768.80	II	5790 – 32316
330		3769.54	II	
190		3772.82	II	8347 – 34845
540		3773.44	I	6249 – 32742
240		3775.99	II	
300		3776.48	I	4275 – 30747
120		3779.05	II	
380		3780.72	II	915 – 27357
120		3781.75	I	7645 – 34080
1900		3782.84	II	289 – 26717
430		3783.84	II	5791 – 32211
120		3786.57	II	8521 – 34923
240		3786.84	I	6249 – 32648
190		3787.23	II	5259 – 31656
190		3788.16	I	5991 – 32381
120		3790.22	II	5790 – 32166
120		3790.33	II	914 – 27290
120		3792.41	I	4275 – 30636
570		3793.10	II	4585 – 30942
380		3793.28	I	6249 – 32604
380		3793.57	II	914 – 27267
220		3795.13	II	2294 – 28636
240		3796.20	I	3868 – 30203
240		3796.54	II	4663 – 30996
240		3796.84	II	6445 – 32775
190		3797.77	I	11308 – 37631
240		3798.84	I	11308 – 37624
240		3799.20	II	8394 – 34708
240		3799.55	II	
240		3801.15	I	620 – 26921
240		3802.27	II	2294 – 28587
120		3803.35	II	0 – 26285
380		3808.93	I	6249 – 32496
380		3809.22	II	5716 – 31961
95		3810.10	I	3868 – 30107
1900		3812.00	I	0 – 26226
120		3812.58	I	
380		3813.79	II	2295 – 28508
380		3814.07	II	915 – 27126
120		3816.61	II	
120		3817.16	II	2294 – 28484
160		3818.06	I	5762 – 31945
120		3818.48	II	1749 – 27930
120		3818.76	II	
120		3819.25	I	4276 – 30451
120		3821.22	II	
240		3821.95	I	3801 – 29958
120		3822.35	I	10347 – 36501
120		3822.56	II	4706 – 30859
750		3826.51	II	289 – 26415
240		3829.03	II	915 – 27023
190		3829.39	II	4585 – 30691
120		3829.79	I	0 – 26104
2000		3831.46	II	4663 – 30756
240		3831.86	I	4275 – 30365
200		3833.02	II	
240		3835.14	II	
120		3835.22	I	0 – 26066
200	h	3835.92	II	7598 – 33660
120		3837.26	I	
200		3838.15	II	2294 – 28341
1200		3839.62	I	3801 – 29838
120		3842.99	II	
120		3844.00	II	
120		3844.23	II	
120	h	3845.12	II	5526 – 31526
380		3845.32	II	
120		3846.24	I	7005 – 32997
240		3846.55	I	3801 – 29791
200		3847.84	I	7021 – 33002
490	d	3848.62	II	5259 – 31235
		3848.72	II	
120		3849.71	II	8522 – 34490
200		3849.85	II	0 – 25968
120		3851.72	I	7021 – 32976
620		3854.22	I	0 – 25938
2400		3854.66	II	4663 – 30599
4900		3859.58	II	289 – 26191

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
490	3861.16	I	
120	3863.09	I	3868 – 29747
240	3864.30	II	4585 – 30455
240	3864.48	II	4663 – 30533
1900	3865.92	II	2295 – 28154
380	3866.80	II	
240	3867.17	I	7021 – 32872
120	3868.42	II	4421 – 30264
240	3870.02	II	5667 – 31499
1500	3871.04	I	0 – 25826
95	3871.88	II	8347 – 34167
620	3874.04	II	289 – 26094
240	3876.13	I	0 – 25792
120	3876.59	II	8755 – 34544
620	3878.09	II	
240	3879.53	I	4453 – 30222
240	3879.71	I	7021 – 32788
1000	3881.46	II	4585 – 30342
490	3882.36	II	1749 – 27499
240	3883.16	II	
380	3883.33	II	
240	3884.68	II	8755 – 34490
180	3887.45	I	7021 – 32737
180	3887.70	II	
2200	3890.36	II	289 – 25986
120	3891.68	II	8510 – 34199
240	3891.80	I	7021 – 32708
240	3892.41	II	8755 – 34439
620	3892.68	II	5260 – 30942
490	3894.12	I	0 – 25672
200	3895.27	II	4421 – 30086
490	3896.78	II	4585 – 30240
240	3897.06	II	6283 – 31936
190	3897.26	I	7021 – 32672
120	3897.71	II	5667 – 31316
190	3899.10	II	4421 – 30061
240	3899.27	I	4275 – 29914
240	3899.48	II	4663 – 30301
620	3899.78	II	2295 – 27930
410	3902.56	II	289 – 25906
460	3904.30	II	8347 – 33953
240	3904.56	II	5260 – 30863
120	3904.85	II	1749 – 27351
380	3906.46	I	3868 – 29459
120	3908.32	I	4453 – 30032
120	3908.47	II	8394 – 33972
120	3909.06	II	5790 – 31364
240	3910.89	I	7021 – 32583
330	3911.67	II	4420 – 29978
190	3914.20	II	
190	3914.27	II	
380	3915.88	II	
120	3916.53	I	7021 – 32546
240	3917.25	I	8119 – 33640
120	3917.82	II	
80	3918.06	II	4421 – 29936
190	3921.55	II	0 – 25492
120	3923.05	II	8394 – 33877
190	3924.27	II	4585 – 30061
330	3926.22	I	0 – 25463
330	3926.73	I	7021 – 32480
240	3927.76	II	6283 – 31736
120	3928.83	I	0 – 25445
160	3930.43	II	
430	3930.98	II	289 – 25720
2000	3932.03	II	289 – 25714
120	3933.03	II	5259 – 30678
490	3935.38	II	2294 – 27697
330	3940.49	II	914 – 26285
190	3942.55	II	8755 – 34112
240	3942.84	I	5762 – 31117
1200	3943.82	I	0 – 25349
240	3944.13	II	4585 – 29932
300	3948.45	I	0 – 25319
95	3951.48	I	4453 – 29753
95	3951.55	II	
300	3953.58	II	2294 – 27581
540	3954.62	II	5716 – 30996
	3954.67	II	8347 – 33627
240	3955.38	I	7103 – 32378
120	3959.20	I	7005 – 32255
190	3962.79	II	4706 – 29934
350	3964.22	I	6249 – 31467
240	3964.67	II	7166 – 32382
160	3964.96	II	0 – 25213
240	3966.40	II	2295 – 27499
600	3966.52	II	289 – 25492
120	3967.47	I	620 – 25818
120	3969.02	II	
120 d	3974.90	I	7645 – 32796
	3974.98	II	
190	3978.80	II	
120 h	3980.80	I	5762 – 30876
230	3983.91	II	
95	3984.18	I	
1200	3985.80	II	5260 – 30342
80	3988.64	II	
190	3988.89	II	2295 – 27357
460	3990.42	II	915 – 25968
380	3992.54	II	5716 – 30756
120	3994.29	II	289 – 25317
230	3994.98	II	
190	3995.97	II	
120	3997.09	I	3800 – 28811
350	3998.24	II	
120	3999.18	I	3801 – 28799
120 d	4001.28	I	7021 – 32005
120	4002.34	II	4706 – 29684
120	4003.20	II	2294 – 27267
350	4004.06	II	1749 – 26717
430	4005.21	I	620 – 25580
190	4005.70	I	620 – 25577
120	4009.17	II	6283 – 31219
110	4011.45	II	5401 – 30323
80	4014.16	II	8755 – 33660
570	4017.72	II	5716 – 30599
300	4018.99	II	289 – 25164
80	4026.02	II	2295 – 27126
160	4031.31	II	914 – 25713
160	4033.43	II	4421 – 29207
190	4033.73	II	7598 – 32382
220	4034.50	I	4453 – 29233
70	4039.75	I	7645 – 32392
150	4039.80	I	
1000	4042.76	I	620 – 25349
520	4044.42	II	5259 – 29978
410	4047.62	I	620 – 25319
1600	4050.04	II	0 – 24684
540	4051.91	II	5260 – 29932
180	4053.03	II	1749 – 26415

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
300	4054.31	II	6283 – 30942
430	4058.19	II	289 – 24923
80	4060.10	II	
80	4061.35	I	620 – 25235
110	4061.74	II	7598 – 32211
880	4062.55	II	0 – 24608
110	4064.16	I	5991 – 30589
110	4066.80	II	8521 – 33104
520	4067.76	II	6283 – 30860
410	4071.11	II	
300	4074.49	II	1749 – 26285
330	4076.69	II	914 – 25437
220	4077.79	I	7021 – 31537
330	4080.61	II	
190 h	4084.93	II	5791 – 30264
270	4088.25	II	0 – 24453
2200	4090.14	II	1749 – 26191
220	4091.52	II	
110	4091.64	I	0 – 24433
80	4094.62	II	11544 – 35960
80	4094.89	II	8276 – 32690
220	4095.75	II	6283 – 30691
220	4096.35	I	7021 – 31426
460	4098.03	II	289 – 24684
200	4101.91	I	8118 – 32490
190	4103.12	I	7326 – 31690
380	4106.28	I	
200	4106.93	II	0 – 24342
70	4108.36	I	0 – 24334
110	4113.11	II	0 – 24306
810	4116.10	II	0 – 24288
55	4116.88	I	3868 – 28151
410	4124.73	II	1749 – 25986
410	4128.34	II	4420 – 28636
140	4132.02	I	4275 – 28470
140	4133.20	II	5790 – 29978
200	4133.50	I	0 – 24186
95	4135.76	II	6283 – 30455
140	4136.81	II	4421 – 28587
95	4138.66	II	9626 – 33781
190	4139.14	II	0 – 24153
460	4141.23	II	8394 – 32535
70	4141.86	I	620 – 24757
150	4144.70	II	2295 – 26415
55	4145.39	II	
55	4146.61	I	7326 – 31435
880	4153.97	I	0 – 24067
270	4155.41	II	6283 – 30342
380	4156.66	I	620 – 24671
70	4160.95	I	0 – 24026
240	4162.43	I	3801 – 27818
350	4163.68	II	0 – 24010
70	4164.79	II	289 – 24293
270	4165.68	II	289 – 24288
70	4166.64	I	620 – 24613
160	4169.06	I	8119 – 32098
1400	4171.59	II	1749 – 25714
140	4172.97	II	6283 – 30240
220	4174.19	II	5527 – 29477
140	4179.00	II	4585 – 28508
80 h	4184.89	II	8521 – 32410
190	4186.96	I	4276 – 28153
190	4188.07	II	289 – 24160
300	4189.28	II	289 – 24153
55	4191.94	I	0 – 23849
180	4197.52	II	8394 – 32211
140	4198.22	I	620 – 24433
55	4200.10	II	6283 – 30086
95	4201.13	I	7645 – 31442
180	4204.37	II	0 – 23778
80	4210.45	II	1749 – 25492
240	4211.66	II	4585 – 28322
140	4212.26	II	4421 – 28154
140	4213.87	I	11308 – 35032
80	4214.28	I	7645 – 31367
80	4214.42	II	289 – 24010
70	4219.97	I	4275 – 27965
350	4222.36	I	3801 – 27478
70	4227.33	II	6283 – 29932
80	4228.76	II	4706 – 28347
220	4231.67	I	7646 – 31270
70	4232.04	II	289 – 23912
160	4236.04	I	620 – 24220
55	4240.59	II	
1000	4241.67	II	4585 – 28154
520	4244.37	II	0 – 23554
260	4246.26	I	0 – 23544
160	4252.43	II	4420 – 27930
55	4266.32	I	0 – 23433
140	4267.30	II	915 – 24342
55	4267.94	I	6249 – 29672
80	4268.85	II	2294 – 25713
160	4269.61	II	1749 – 25164
80	4273.98	II	915 – 24306
80	4276.47	II	5259 – 28636
200	4282.03	II	289 – 23636
160	4282.45	II	4585 – 27930
200	4287.87	II	0 – 23315
200	4288.84	I	6249 – 29559
150	4297.11	II	289 – 23554
120	4301.47	II	0 – 23241
35	4306.73	I	
27	4306.82	I	0 – 23212
55	4310.39	II	6283 – 29477
150	4313.13	I	3801 – 26979
120	4313.88	II	1749 – 24923
40	4319.78	II	2294 – 25437
70	4325.90	II	5526 – 28636
120	4335.73	I	0 – 23058
680	4341.69	II	289 – 23315
150	4347.19	II	915 – 23912
140	4354.55	I	3800 – 26758
430 h	4355.75	I	620 – 23572
430	4362.05	I	0 – 22919
190	4362.26	II	0 – 22917
70	4362.93	II	4585 – 27499
95	4371.76	I	8119 – 30986
160	4372.57	II	915 – 23778
70	4372.76	I	0 – 22862
110	4373.41	II	1749 – 24608
55	4383.27	I	3801 – 26608
330	4393.60	I	0 – 22754
70 d	4402.30	II	9075 – 31784
	4402.44	II	8510 – 31219
140	4415.24	II	0 – 22642
70	4426.68	II	4706 – 27290
70	4426.94	I	0 – 22583
110	4427.65	II	289 – 22868
70	4433.89	II	8394 – 30942
110	4434.53	II	1749 – 24293

559-795 O - 75 - 24 (Pt. 1)

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
40	4440.74	I	3801 – 26313
150	4462.97	II	915 – 23315
70	4465.13	II	2295 – 24684
55	4469.32	I	0 – 22368
600	4472.34	II	289 – 22642
70	4477.71	II	915 – 23241
110	4490.84	II	1749 – 24010
70	4510.32	II	0 – 22165
240	4515.28	II	289 – 22430
70	4516.73	I	620 – 22754
190	4538.19	II	1749 – 23778
620	4543.63	II	915 – 22917
150	4545.58	II	2295 – 24288
45	4551.98	I	620 – 22583
40	4553.86	II	915 – 22868
80	4555.10	II	8394 – 30342
55	4563.95	I	13127 – 35032
95	4567.69	II	1749 – 23636
140	4569.91	II	289 – 22165
40	4570.99	II	6283 – 28154
160	4573.69	II	2295 – 24153
55	4576.64	I	620 – 22464
55	4584.85	II	1749 – 23554
55	4601.13	II	915 – 22642
140	4603.66	II	2295 – 24010
55	4605.15	II	5791 – 27499
40	4609.86	II	289 – 21975
40	4611.44	II	8276 – 29955
300	4620.23	I	6249 – 27887
40	4622.43	II	5260 – 26887
240	4627.08	II	4585 – 26191
210	4631.62	I	0 – 21585
60	4641.66	II	8394 – 29931
220	4646.60	II	915 – 22430
50	4663.75	I	620 – 22056
140	4666.86	II	289 – 21711
100	4671.41	II	4585 – 25986
170	4689.07	II	0 – 21320
45	4700.98	II	289 – 21555
50	4702.05	II	4706 – 25968
100	4702.52	II	2295 – 23554
45	4715.68	I	10208 – 31408
160	4722.73	II	1749 – 22917
120	4731.60	II	4585 – 25714
35	4743.53	I	6249 – 27324
100	4755.73	II	0 – 21021
150	4756.80	I	620 – 21637
35	4768.66	I	620 – 21585
75	4769.26	II	0 – 20962
100	4772.70	II	2295 – 23241
35	4778.10	I	10347 – 31270
50	4779.63	II	914 – 21831
35	4780.19	I	10081 – 30994
35	4785.91	I	3868 – 24757
45	4790.06	I	7645 – 28516
35	4810.90	I	3801 – 24581
50	4819.54	II	4421 – 25164
50	4842.48	I	620 – 21265
75	4847.65	II	2295 – 22917
85	4858.08	II	4585 – 25164
75	4859.68	II	0 – 20572
100	4861.02	II	5402 – 25968
35	4868.86	I	3801 – 24334
45	4883.78	II	2294 – 22764
45	4885.15	I	0 – 20464
28	4886.33	II	5527 – 25986
90	4899.29	II	915 – 21320
45	4910.35	I	6249 – 26608
70	4913.16	II	2295 – 22642
40	4924.64	II	5667 – 25968
40	4928.44	I	4276 – 24560
23	4933.06	I	3801 – 24067
28	4933.66	II	4421 – 24684
28	4950.17	II	5791 – 25986
40	4955.78	I	7646 – 27818
40	4967.33	I	3801 – 23927
40	4972.10	II	915 – 21021
40	4986.90	II	915 – 20962
110	5008.22	II	1749 – 21711
23	5011.42	I	620 – 20569
170	5027.38	I	0 – 19885
23	5047.41	II	2295 – 22101
35	5063.77	I	3801 – 23544
23	5077.82	II	289 – 19977
35	5085.86	II	915 – 20572
21	5088.29	I	0 – 19648
70	5117.25	II	2294 – 21831
18	5137.05	II	6445 – 25906
23	5145.08	II	6283 – 25714
28	5154.04	II	2294 – 21691
80	5160.33	II	5791 – 25164
55	5164.14	I	8119 – 27478
55	5184.59	II	5402 – 24684
45	5204.32	II	6283 – 25492
23	5225.12	II	5790 – 24923
18	5238.61	II	9553 – 28636
18	5247.35	II	5402 – 24453
45	5247.75	II	4585 – 23636
45	5257.04	II	5667 – 24684
16	5272.00	I	7646 – 26608
23	5278.18	II	5402 – 24342
70	5280.38	I	0 – 18933
18	5288.40	II	5402 – 24306
40	5308.54	I	3801 – 22633
21	5310.04	II	0 – 18827
40	5311.88	II	4421 – 23241
16	5312.73	II	5791 – 24608
18	5315.27	I	7646 – 26454
21	5319.38	I	10081 – 28874
16	5321.60	II	5667 – 24453
35	5327.76	II	6283 – 25047
40	5329.26	I	0 – 18759
21	5349.92	II	4420 – 23107
18	5362.40	II	
18	5363.82	II	5667 – 24306
28	5368.43	II	9075 – 27697
11	5373.45	II	1749 – 20353
11	5382.94	I	620 – 19192
11	5385.54	I	13127 – 31690
55	5386.19	II	15392 – 33953
18 d	5389.83	I	10347 – 28895
35	5400.90	I	10288 – 28798
	5400.94	II	5402 – 23912
23	5403.20	II	5790 – 24293
23	5405.98	II	8394 – 26887
14	5410.24	I	4276 – 22754
11	5423.35	I	5762 – 24195
35	5444.48	II	5791 – 24153
18	5449.86	II	4420 – 22764
	5449.93	II	

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
18		5459.27	I	620 – 18933
35		5465.68	II	9626 – 27917
80		5475.72	II	9241 – 27499
70		5480.27	II	12513 – 30756
70		5481.21	II	6445 – 24684
45		5482.54	II	15392 – 33627
11		5484.55	II	1749 – 19977
35		5487.00	II	5791 – 24010
28		5488.91	I	
35		5491.22	II	8510 – 26716
160		5492.97	II	0 – 18200
28		5494.66	II	4420 – 22615
35		5496.43	I	4276 – 22464
16		5500.69	I	620 – 18794
16		5501.49	II	9553 – 27725
40		5504.13	II	6445 – 24608
35		5510.41	I	13127 – 31270
45		5511.49	I	620 – 18759
16		5513.39	I	7326 – 25458
70		5527.83	II	12513 – 30599
16		5531.26	I	7864 – 25938
16		5535.78	II	2294 – 20353
23		5538.53	II	9075 – 27126
28		5544.81	II	4585 – 22615
16		5548.05	II	12513 – 30533
28		5551.42	II	6445 – 24453
18		5552.60	II	6283 – 24288
16	h	5555.77	II	
23		5557.87	I	620 – 18607
70		5564.17	I	3801 – 21768
40		5570.66	II	9553 – 27499
14		5573.07	I	10347 – 28286
11		5573.59	I	6249 – 24186
21		5580.81	II	5402 – 23315
28		5581.23	II	914 – 18827
45		5581.61	II	289 – 18200
11		5587.17	II	8521 – 26415
28		5597.37	II	6445 – 24306
23		5602.90	II	6445 – 24288
14		5603.97	II	5401 – 23241
14		5608.86	I	15720 – 33544
55		5610.89	I	6249 – 24067
14		5616.58	I	8119 – 25918
55		5620.78	I	620 – 18406
28		5621.51	I	3801 – 21585
14		5628.02	II	5791 – 23554
14		5629.46	I	
14		5632.47	I	10069 – 27818
28		5634.38	I	7646 – 25389
9		5636.78	I	7005 – 24741
14	h	5638.00	II	
14		5640.30	I	5762 – 23486
9		5644.21	II	12629 – 30341
9		5648.38	I	10557 – 28256
23		5653.77	II	2294 – 19977
23		5654.39	II	4421 – 22101
18		5658.26	I	3868 – 21536
14	h	5664.86	II	5667 – 23315
28		5669.42	I	620 – 18254
9		5674.88	II	9882 – 27499
14		5680.37	I	6249 – 23849
18		5683.33	II	9553 – 27143
14		5685.19	I	4453 – 22038
40		5691.40	II	6445 – 24010
23		5704.07	II	8379 – 25906
11		5705.66	I	10819 – 28341
21		5706.99	II	9626 – 27143
11		5709.49	I	7103 – 24613
21		5716.87	I	4453 – 21941
11		5722.23	I	13535 – 31005
40		5723.63	II	5401 – 22868
23		5733.21	II	8276 – 25714
23		5736.38	I	7006 – 24433
23		5737.27	I	
21		5748.10	II	0 – 17392
11		5748.44	II	
21		5750.54	I	8856 – 26241
23		5758.14	I	0 – 17362
11		5758.35	I	4276 – 21637
9		5761.88	I	16244 – 33595
11	h	5763.63	I	7326 – 24671
		5763.63	I	7103 – 24449
11	h	5765.41	I	8118 – 25458
11		5767.43	I	5991 – 23325
11		5771.05	I	6249 – 23572
11		5776.87	II	
11		5777.77	I	12362 – 29665
70		5780.59	I	6249 – 23544
23		5788.59	II	6283 – 23554
		5788.59	II	4420 – 21691
23		5791.74	II	9626 – 26887
11		5796.51	I	17091 – 34338
70		5798.54	II	5401 – 22642
40		5802.11	I	8119 – 25349
11		5805.20	I	5991 – 23212
21		5811.27	II	8510 – 25714
11		5813.83	I	5991 – 23187
9		5814.41	I	3868 – 21062
11		5816.79	I	10288 – 27475
9		5819.01	I	7006 – 24186
18		5827.99	II	4706 – 21860
18		5832.37	II	9882 – 27023
45		5836.03	I	10347 – 27478
55		5837.70	II	4585 – 21711
11		5839.04	II	7166 – 24287
18		5841.82	II	8379 – 25492
23		5843.29	II	6445 – 23554
11		5843.82	II	
35		5845.25	II	289 – 17392
11		5852.01	I	4453 – 21536
28		5853.91	II	1749 – 18827
11		5859.16	II	
7		5863.41	I	
35		5870.93	II	5402 – 22430
11		5886.93	II	8510 – 25492
23		5895.32	II	6283 – 23241
21		5898.78	I	6249 – 23197
23		5902.50	I	3868 – 20805
230		5915.40	I	0 – 16900
23	h	5925.47	I	7646 – 24517
21		5929.33	I	3801 – 20662
16		5932.44	II	5791 – 22642
16		5933.82	I	620 – 17468
10		5934.46	II	8510 – 25356
10		5942.77	I	5762 – 22584
14		5948.57	I	7646 – 24452
21		5952.05	II	6445 – 23241
21		5956.86	I	3868 – 20651
55		5971.50	I	620 – 17362
100		5976.32	I	3801 – 20529

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
28	5986.10	I	3868 – 20569
45	5997.31	I	6249 – 22919
16	5997.96	I	4276 – 20943
23	5999.41	I	3801 – 20464
21	6000.19	I	11308 – 27969
21	6004.83	II	
21	6008.87	I	10254 – 26892
21	6010.86	I	10347 – 26979
21	6014.07	I	14845 – 31468
10	6016.73	I	5762 – 22378
28	6017.39	II	4706 – 21320
21	6017.57	I	6249 – 22862
16	6019.19	I	4453 – 21062
23	6028.13	I	3868 – 20452
7	6035.54	I	7191 – 23755
21	6039.60	I	8119 – 24671
9	6050.48	I	3868 – 20392
9	6050.67	I	7326 – 23849
55	6051.74	II	914 – 17434
16	6056.80	I	0 – 16506
16	6057.07	I	6249 – 22754
18	6059.73	II	5667 – 22165
18	6062.30	I	4276 – 20766
45	6067.23	II	914 – 17392
90	6077.29	I	620 – 17070
28	6087.34	II	6445 – 22868
16	6089.19	I	3801 – 20219
18	6101.77	I	6249 – 22633
9	6110.91	II	2294 – 18654
16	6127.77	I	8119 – 24433
28	6129.72	I	620 – 16930
21	6132.61	I	11308 – 27609
9	6138.54	I	10685 – 26971
9	6152.25	I	4275 – 20525
8	6164.50	I	7326 – 23544
16	6164.77	II	
40	6171.85	I	7646 – 23844
35	6175.38	I	4276 – 20464
8	6181.37	II	8510 – 24684
16	6215.37	I	3801 – 19885
16	6234.30	I	4276 – 20312
16	6246.53	I	5762 – 21766
16	6254.22	II	6445 – 22430
14	6268.66	I	8119 – 24067
11	6279.64	II	5791 – 21711
28	6280.20	II	5402 – 21320
7	6291.48	II	
14	6292.03	I	8133 – 24022
21	6293.32	I	620 – 16506
18	6298.53	I	4275 – 20148
14	6322.37	II	0 – 15812
9	6330.77	II	914 – 16706
7	6336.55	II	8510 – 24287
7	6346.27	II	5401 – 21154
28	6359.28	I	0 – 15721
55	6372.43	I	3801 – 19489
6	6372.97	I	5762 – 21448
11	6374.78	II	10285 – 25967
6	6375.98	II	0 – 15679
28	6378.52	II	289 – 15962
23	6379.64	II	
8	6383.59	I	4453 – 20114
11	6386.84	II	5667 – 21320
23	6389.77	I	5991 – 21637
6	6391.32	II	8510 – 24152
28	6392.74	I	0 – 15638
90	6395.42	I	0 – 15632
18	6397.14	I	7006 – 22633
8	6400.36	II	5402 – 21021
9	6411.59	I	7326 – 22919
11	6424.89	II	5402 – 20962
8	6430.93	I	5991 – 21536
5	6448.04	II	
110	6449.17	I	620 – 16122
35	6465.00	I	7326 – 22790
5	6470.55	II	10740 – 26191
5	6481.72	I	5762 – 21185
5	6485.38	II	6445 – 21860
9	6488.35	I	13535 – 28943
5	6495.23	II	4585 – 19977
16	6503.62	I	4276 – 19648
5	6506.32	II	
16	6518.94	I	6249 – 21585
5	6520.98	I	8133 – 23464
7	6526.08	I	7645 – 22964
5	6527.04	I	5762 – 21079
5	6534.60	II	18654 – 33953
11	6535.46	II	914 – 16211
7	6536.58	II	5667 – 20962
9	6542.98	I	10347 – 25626
7	6549.88	II	7166 – 22429
3	6552.75	I	7326 – 22583
14	6555.01	I	3868 – 19119
7	6557.58	II	10740 – 25986
3	6582.78	I	7864 – 23051
7	6587.83	II	5526 – 20702
6	6590.05	II	5402 – 20572
3	6601.39	I	7646 – 22790
1	6602.68	I	
3	6603.34	II	2294 – 17434
6	6603.98	I	7326 – 22464
16	6620.52	I	620 – 15721
16	6621.77	II	2294 – 17392
7	6622.82	II	7547 – 22642
7	6625.29	I	5762 – 20852
4	6628.65	I	11677 – 26758
3	6640.50	II	9553 – 24608
5	6647.79	I	3800 – 18839
5	6656.81	I	620 – 15638
3	6671.21	II	
9	6676.92	II	18654 – 33627
3	6681.15	II	
12	6683.38	I	3801 – 18759
3	6691.21	I	10686 – 25627
3	6700.83	I	
4	6701.68	II	9690 – 24608
5	6707.59	II	5667 – 20571
5	6710.57	II	914 – 15812
8	6717.45	II	7547 – 22429
5	6720.76	II	6445 – 21320
5	6726.89	II	8379 – 23241
3	6727.96	I	5762 – 20621
9	6736.80	I	0 – 14839
3	6742.47	II	5526 – 20353
4	6754.93	I	8119 – 22919
3	6768.64	I	7864 – 22634
4	6771.03	II	914 – 15679
5	6776.89	II	10740 – 25492
3	6780.62	I	8118 – 22862
3	6782.70	I	3868 – 18607

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
3		6782.85	I	4453 – 19192
13		6790.30	I	7646 – 22368
3		6796.43	II	6445 – 21154
3	d	6808.76	II	
1		6812.98	I	4453 – 19127
3	d	6813.75	I	11677 – 26349
		6813.81	I	11633 – 26305
7		6818.29	I	3868 – 18531
23		6820.76	I	4276 – 18933
8		6824.45	I	7103 – 21753
90		6826.93	I	0 – 14644
4		6832.71	I	7006 – 21637
7		6846.25	I	6249 – 20852
16	h	6869.07	I	19761 – 34315
35		6876.75	II	8379 – 22917
8		6887.74	I	8119 – 22633
5		6902.55	I	4276 – 18759
5		6915.31	I	5762 – 20219
11		6917.05	I	3801 – 18254
11		6948.58	II	16211 – 30599
5		6987.72	II	10740 – 25047
5		7015.70	I	8119 – 22368
14		7020.71	II	10444 – 24684
5		7030.69	I	620 – 14839
11		7033.84	I	10347 – 24560
5		7073.61	II	4663 – 18796
23		7074.78	I	4276 – 18406
11		7082.11	II	5401 – 19517
27		7101.61	I	4453 – 18531
30		7128.89	I	620 – 14644
5	h	7130.05	I	5762 – 19783
16		7147.87	I	10347 – 24334
9		7164.87	I	4453 – 18406
5		7172.10	I	14845 – 28784
9		7183.47	II	2294 – 16211
9		7194.63	I	10685 – 24581
5		7196.66	I	10081 – 23972
5		7205.42	I	10686 – 24560
7		7210.28	I	6249 – 20114
7		7218.04	II	5667 – 19517
16		7254.44	I	7645 – 21426
5		7371.95	I	5991 – 19552
14		7379.63	II	10740 – 24287
5		7390.99	I	10208 – 23734
5		7392.11	I	13127 – 26652
14		7396.98	I	4453 – 17969
5		7416.57	I	10081 – 23560
23		7425.50	I	0 – 13463
11		7454.03	II	10740 – 24152
5		7510.08	II	8379 – 21691
5		7517.39	I	16040 – 29339
9		7528.70	I	19103 – 32381
45		7533.91	I	3801 – 17070
11		7550.23	I	10685 – 23926
7		7580.91	II	7166 – 20353
3		7587.55	II	
5		7590.52	I	5762 – 18933
5		7595.04	I	10686 – 23849
4		7600.27	I	16040 – 29194
9		7609.16	I	7326 – 20464
16		7619.34	I	7646 – 20766
7		7621.95	I	
11		7631.72	I	3801 – 16900
7		7634.74	I	7326 – 20420
14		7639.54	I	4276 – 17362
4		7653.62	I	8878 – 21940
4		7668.73	II	5790 – 18827
4		7669.69	II	9882 – 22917
7		7748.19	I	16040 – 28943
7		7754.18	I	7326 – 20219
7		7759.87	I	7646 – 20529
11		7761.84	I	7006 – 19885
14		7784.13	I	620 – 13463
7	h	7802.40	II	10740 – 23553
7		7816.32	I	13128 – 25918
3		7832.02	I	14845 – 27609
2		7835.71	I	5991 – 18749
9		7837.71	II	9075 – 21831
9		7844.71	I	16040 – 28784
14		7868.75	I	3801 – 16506
14		7875.36	I	11308 – 24002
50		7881.94	I	6249 – 18933
9		7900.43	I	4276 – 16930
6		7904.28	I	8119 – 20766
6	h	7907.96	I	7006 – 19648
9		7918.80	I	4276 – 16900
6		7959.96	I	7326 – 19885
14		7963.96	I	10081 – 22634
18		7970.46	I	8119 – 20662
3		7974.66	I	7103 – 19640
9		7975.08	I	11308 – 23843
3		7975.47	I	18933 – 31468
9		7976.88	II	5667 – 18200
6		7991.30	I	6249 – 18759
9		7998.60	I	13128 – 25627
3		8012.96	I	4453 – 16930
5		8019.38	I	7006 – 19472
9		8034.79	I	10347 – 22790
3		8040.10	II	
6		8055.61	I	8119 – 20529
9		8065.47	I	10069 – 22464
3		8065.84	I	3800 – 16195
9		8074.03	II	6445 – 18827
9		8097.62	I	8118 – 20464
5		8126.23	I	10081 – 22383
6		8137.21	I	10347 – 22633
6		8153.71	I	13128 – 25389
16		8174.30	I	4276 – 16506
6		8175.84	I	16040 – 28268
9		8188.20	II	6445 – 18654
6		8210.27	II	10740 – 22917
6		8230.83	I	5762 – 17908
3		8240.51	I	5762 – 17894
18		8262.05	I	8119 – 20219
4		8307.56	II	1749 – 13783
7		8310.69	I	11457 – 23486
16		8318.34	I	4275 – 16294
6		8329.74	I	7645 – 19647
16		8337.50	II	5401 – 17392
11		8346.74	I	5991 – 17969
6		8357.07	I	3868 – 15831
18		8381.86	I	7006 – 18933
7		8387.19	I	4275 – 16195
11		8389.16	I	5991 – 17908
7		8396.76	I	
4		8402.58	I	
16		8441.20	I	7646 – 19489
35		8445.35	I	3801 – 15638
18		8450.02	I	3801 – 15632
7		8496.09	I	8119 – 19885

Uranium—all observed lines—Continued

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
7	8504.53	I	11457 – 23212	9	8641.12	I	16040 – 27609
11	8540.19	I	5762 – 17468	7	8659.57	I	10208 – 21753
4	8542.32	I	10254 – 21958	23	8691.28	I	0 – 11502
7	8557.32	I	10686 – 22368	5	8702.08	II	2294 – 13783
7	8567.71	I	4453 – 16122	18	8710.77	I	5991 – 17468
16	8570.51	I	8119 – 19783	18	8753.68	I	10347 – 21768
7	8574.59	I	6249 – 17908	30	8757.77	I	620 – 12035
75	8607.96	I	0 – 11614	8	8787.37	II	4585 – 15962
4	8618.96	II	914 – 12513	9	8816.56	I	7191 – 18530

Vanadium

V, $Z=23$, $M=50.941$, Ratio $\frac{V}{Cu}=0.8016$

V I Normal state of valence electrons $3d^3 4s^2\ {}^4F_{1\,1/2}=0$. I.P. $=54361$ cm^{-1}.
V II Normal state of valence electrons $3d^4\ {}^5D_0=0$. I.P. $=118200$ cm^{-1}.

References

Wavelengths:
G. R. Harrison, Massachusetts Institute of Technology Wavelength Tables (John Wiley & Sons, New York, 1939).
Supplemented above 6700 Å by the following:
W. F. Meggers and C. C. Kiess, Sci. Papers BS **16**, 51 (1920).
W. F. Meggers and H. N. Russell, J. Research NBS **17**, 125 (1936) RP 906.

Classification:
V I, W. F. Meggers and H. N. Russell, J. Research NBS **17**, 125 (1936) RP 906.
C. E. Moore, Phys. Rev. **55**, 710 (1939).
V II, W. F. Meggers and C. E. Moore, J. Research NBS **25**, 83 (1940) RP 1317.

Strong lines of vanadium

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
12000	4379.24	I	2425 – 25254	3000	3855.84	I	553 – 26480
8900	4111.78	I	2425 – 26738	2800	4099.80	I	2220 – 26605
7000	4384.72	I	2311 – 25112				
5300	3183.98	I	323 – 31722	2800	4105.17	I	2153 – 26506
		I	0 – 31398	2800	4407.64	I	2311 – 24993
				2600	3110.71	II	2809 – 34947
4800	4389.97	I	2220 – 24993	2600	3840.75	I	323 – 26353
4600	4408.51	I	2153 – 24830	2400	2908.82	II	3163 – 37531
		I	2112 – 24789				
4300	4115.18	I	2311 – 26605	2400	2924.02	II	3163 – 37352
3800	3093.11	II	3163 – 35483	2400	3066.38	I	553 – 33155
				2400	3902.25	I	553 – 26172
3800	3185.40	I	553 – 31937	2300	4109.79	I	2112 – 26438
3800	3703.58	I	2425 – 29418	2300	4134.49	I	2425 – 26605
3600	4395.23	I	2153 – 24899				
3600	4408.20	I	2220 – 24899	2300	4406.64	I	2425 – 25112
3200	3183.41	I	137 – 31541	2100	2092.44	I	553 – 48329
				2000	3118.38	II	2687 – 34746
3100	4128.07	I	2220 – 26438	2000	4123.57	I	2153 – 26397
3100	4132.02	I	2311 – 26506	2000	4460.29	I	2425 – 24839
3000	3102.30	II	2968 – 35193				

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
2100	2092.44	I	553 – 48329	130	2642.21	II	14556 – 52392
40	2384.00	II	8842 – 50775	45	2643.16	I	137 – 37960
40	2384.28	I	0 – 41928	45	2644.36	II	34746 – 72551
60	2386.96	I	10892 – 52774	150	2645.26	I	323 – 38116
60	2388.92	I	11101 – 52948	85	2645.84	II	14462 – 52246
75	2390.87	I	137 – 41950	90	2647.71	I	0 – 37757
75	2391.26	I	2220 – 44026	140	2651.90	I	137 – 37835
85	2392.90	I	2425 – 44203	45	2652.92	I	15265 – 52948
70	2397.78	I	553 – 42246	45	2653.83	I	15104 – 52774
70	2398.27	I	553 – 42237	55	2655.68	II	35193 – 72837
70	2399.96	I	0 – 41655	150	2656.22	I	323 – 37960
120	2406.75	I	323 – 41861	30	2658.98	II	14656 – 52253
110	2407.90	I	137 – 41655	30	2659.61	II	17911 – 55499
90	24I2.69	I	323 – 41758	180	2661.42	I	553 – 38116
70	2413.03	I	0 – 41429	30	2665.96	I	0 – 37499
120	24I5.33	I	0 – 41389	30	2671.67	I	137 – 37556
120	2416.75	I	553 – 41918	290	2672.00	II	107 – 37521
90	2417.35	I	137 – 41492	40	2673.23	II	
100	2420.12	I	553 – 41861	380	2677.80	II	36 – 37369
100	2421.06	I	137 – 4I429	270	2678.57	II	209 – 37531
100	2421.98	I	323 – 41599	380	2679.32	II	209 – 37521
40	2423.38	I	137 – 4I389	180	2682.87	II	107 – 37369
110	2428.28	I	323 – 41492	180	2683.09	II	0 – 37259
75	2432.02	I	323 – 41429	45	2685.14	I	9637 – 46868
110	2435.52	I	553 – 41599	70	2685.69	II	36 – 37259
55	2439.10	I	553 – 41539	45	2686.36	I	9637 – 46851
30	244I.89	I	553 – 41492		2686.51	I	553 – 37765
70	2479.05	II	13543 – 53869	1I00	2687.96	II	339 – 37531
45	2479.52	II	13609 – 53927	I70	2688.72	II	339 – 37521
45	2482.3I	II	11908 – 52181	150	2689.88	II	36 – 37201
140	2501.61	I	0 – 39962	230	2690.24	II	209 – 37369
60	2503.02	II	8640 – 48580	240	2690.79	II	107 – 37259
75	2503.30	I	0 – 39935	120	2696.99	I	10893 – 47960
70	2506.22	II	8842 – 48731	120	2697.74	I	11101 – 48158
150	2506.90	I	0 – 39878	45	2698.73	I	9825 – 46868
240	2507.78	I	137 – 40001	30	2699.11	I	9825 – 46863
I80	2511.65	I	323 – 40126	680	2700.94	II	339 – 37352
180	2511.95	I	137 – 39935	380	2702.19	II	209 – 37205
75	2514.64	II	9098 – 48853	45	2705.22	II	0 – 36955
70	2515.15	I	I37 – 39884	530	2706.17	II	209 – 37151
180	2517.14	I	323 – 40039	I50	2706.70	II	107 – 37041
240	2519.62	I	323 – 40000	I10	2707.86	II	36 – 36955
410	2526.22	I	553 – 40I26	170	2711.74	II	339 – 37205
210	2527.90	II	12706 – 52253	60	2713.05	II	107 – 36955
120	2528.47	II	12545 – 52083	120	2714.20	II	209 – 37041
150	2528.84	II	12622 – 52154	640	2715.69	II	107 – 36919
240	2530.18	I	553 – 40064	150	2722.56	I	10893 – 47612
30	2534.52	II	11296 – 50739	30	2723.22	II	209 – 36919
60	2545.98	I	0 – 39267	240	2728.64	II	36 – 36674
60	2548.69	II	11515 – 50739	180	2731.35	I	I1I0I – 47702
110	2549.28	II	11908 – 51123	40	2733.90	II	107 – 36674
120	2552.65	I	137 – 39300	100	2739.71	II	0 – 36489
90	2552.96	II	13609 – 52767	90	2742.41	II	36 – 36489
40	2553.67	II	11515 – 50662	30	2742.67	II	3163 – 39613
55	2554.86	I	137 – 39267	60	2747.48	II	19113 – 55499
40	2558.90	I	323 – 39391	I40	2753.40	II	19192 – 55499
210	2562.13	I	323 – 39342	60	2760.12	II	13512 – 4973I
75 h	2564.23	I	15265 – 5425I	90	2760.70	II	19192 – 55403
110	2564.82	I	323 – 39300	140	2765.67	II	12706 – 48853
40	2568.39	I		60	2766.46	II	13595 – 49731
230	2574.02	I	553 – 39391	85	2768.56	II	12622 – 48731
45	2577.29	I	553 – 39342	45	2773.68	I	11101 – 47143
90	2620.29	I	8716 – 46868	90	2774.28	II	12545 – 48580
140	2630.67	II	14656 – 52658	45	2774.72	II	19113 – 55142
40	2640.69	I	9825 – 47683	45	2775.76	II	I9192 – 55207

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
140		2777.73	II	13742 – 49731
55		2783.78	I	13811 – 49723
26		2785.54	I	14515 – 50404
55		2785.69	I	13802 – 49689
70		2797.02	II	16341 – 52083
75		2797.80	II	16422 – 52154
85		2798.76	II	16533 – 52253
90		2799.45	II	13491 – 49202
90		2802.80	II	13543 – 49211
120		2803.47	II	13609 – 49269
30		2805.54	II	18294 – 53927
90		2810.16	II	18294 – 53869
90		2810.27	II	18354 – 53927
60		2817.50	II	18269 – 53751
60		2836.52	II	13609 – 48853
30		2838.06	I	0 – 35225
60		2841.04	II	13543 – 48731
30		2844.93	I	14549 – 49689
45		2845.24	II	20363 – 55499
120		2846.57	I	
110		2847.57	II	20242 – 55350
70		2848.77	I	0 – 35092
30		2849.05	II	13491 – 48580
70		2849.18	I	137 – 35225
75		2850.69	II	22274 – 57343
		2850.77	II	14656 – 49724
140		2852.87	I	13802 – 48845
140		2854.34	II	20280 – 55304
200		2855.22	I	0 – 35013
60	h	2857.94	I	9637 – 44617
180		2859.97	I	137 – 35092
240		2864.36	I	323 – 35225
75		2866.42	I	9825 – 44701
170		2866.59	I	15104 – 49978
210		2868.10	I	15265 – 50121
140		2869.13	II	20363 – 55207
30		2869.96	II	2687 – 37521
210		2870.55	I	553 – 35379
110		2877.69	II	14462 – 49202
110		2879.16	II	2809 – 37531
350		2880.03	II	2809 – 37521
380		2882.50	II	2687 – 37369
380		2884.78	II	2605 – 37259
140		2888.25	II	14656 – 49269
380		2889.62	II	2605 – 37201
900		2891.64	II	2687 – 37259
530		2892.44	II	2968 – 37531
900		2892.66	II	2809 – 37369
1400		2893.32	II	2968 – 37521
60		2894.58	I	0 – 34537
360		2896.21	II	2687 – 37205
90		2899.20	I	137 – 34620
110		2899.60	I	0 – 34477
360		2903.08	II	2605 – 37041
60		2903.70	I	0 – 34429
85		2904.13	I	323 – 34747
150		2906.13	I	137 – 34537
900		2906.46	II	2809 – 37205
490		2907.47	II	2968 – 37352
45		2908.44	II	20343 – 54716
2400		2908.82	II	3163 – 37531
710		2910.02	II	2687 – 37041
530		2910.39	II	2605 – 36955
560		2911.06	II	2809 – 37151
55		2914.30	I	16573 – 50876
380		2914.93	I	323 – 34620
			I	16729 – 51026
60		2915.33	I	137 – 34429
45	h	2916.02	I	10893 – 45176
120		2917.37	II	2687 – 36955
60		2917.93	I	11101 – 45361
210		2919.99	II	2968 – 37205
380		2920.38	II	2687 – 36919
710		2923.62	I	553 – 34747
2400		2924.02	II	3163 – 37352
1700		2924.64	II	2968 – 37151
60		2926.26	I	323 – 34487
55		2930.13	II	14462 – 48580
710		2930.81	II	2809 – 36919
70		2932.32	II	20623 – 54716
210		2934.40	II	2605 – 36674
110		2935.87	I	323 – 34375
90		2937.69	I	137 – 34168
30	h	2938.25	II	14556 – 48580
900		2941.37	II	3163 – 37151
450		2941.49	II	2687 – 36674
230	d	2942.33	I	553 – 34530
		2942.35	I	0 – 33976
230		2943.20	I	0 – 33967
1100		2944.57	II	2968 – 36919
110		2946.53	I	137 – 34066
60		2949.17	II	22274 – 56171
230		2949.63	I	137 – 34030
300		2950.35	II	2605 – 36489
640		2952.08	II	2809 – 36674
120		2954.33	I	137 – 33976
90		2955.80	I	553 – 34375
85		2957.33	I	323 – 34128
260		2957.52	II	2687 – 36489
410		2962.77	I	323 – 34066
600		2968.38	II	13742 – 47420
120		2972.25	II	19133 – 52767
45		2974.22	I	9637 – 43249
90		2975.65	II	13512 – 47108
120		2976.20	II	13512 – 47102
380		2976.52	II	13595 – 47181
240		2977.54	I	553 – 34128
60		2981.20	II	19166 – 52700
90		2988.02	II	13595 – 47052
45		2989.60	II	13742 – 47181
75		2994.54	II	30673 – 64057
75		2996.00	II	13512 – 46880
45		2999.24	I	9637 – 42969
260		3001.20	II	13742 – 47052
90		3003.46	II	13595 – 46880
45		3008.61	II	13512 – 46740
90		3013.10	II	13512 – 46690
140		3014.82	II	13595 – 46755
75		3016.16	I	9825 – 42969
180		3016.78	II	13742 – 46880
70		3031.01	I	10893 – 43875
270		3033.45	II	20363 – 53320
290		3033.82	II	14656 – 47608
45		3041.42	II	16341 – 49211
90		3042.26	II	16341 – 49202
230		3043.12	I	137 – 32989
230		3043.56	I	0 – 32847
230		3044.94	I	323 – 33155
230		3048.22	II	20280 – 53077
90		3048.89	II	16422 – 49211

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
45	3050.40	I	11101 – 43874
170	3050.89	I	0 – 32768
70	3052.19	I	137 – 32891
180	3053.39	II	14556 – 47297
450	3053.65	I	0 – 32738
70	3053.89	II	16533 – 49269
1200	3056.33	I	137 – 32847
1400	3060.46	I	323 – 32989
140	3063.25	II	20242 – 52878
2400	3066.38	I	553 – 33155
200	3067.12	II	14462 – 47056
140	3069.64	I	323 – 32891
170	3073.82	I	323 – 32847
100	3075.27	I	15104 – 47612
150	3082.11	I	553 – 32989
45	3087.06	I	9545 – 41928
90	3088.11	I	9637 – 42010
45	3089.13	I	9637 – 41999
3800	3093.11	II	3163 – 35483
200	3094.20	II	16422 – 48731
55	3094.69	I	9545 – 41848
180	3100.94	II	16341 – 48580
3000	3102.30	II	2968 – 35193
2600	3110.71	II	2809 – 34947
90	3113.57	II	23391 – 55499
2000	3118.38	II	2687 – 34746
75	3120.73	II	20623 – 52658
380	3121.14	II	3163 – 35193
150	3122.90	II	23391 – 55403
1500	3125.28	II	2605 – 34593
260	3126.22	II	2968 – 34947
530	3130.27	II	2809 – 34746
410	3133.33	II	2687 – 34593
210	3134.93	II	20363 – 52253
150	3136.51	II	20280 – 52154
150	3139.74	II	20242 – 52083
200	3142.48	II	17911 – 49724
150	3145.34	II	3163 – 34947
55	3145.97	II	2968 – 34746
45	3146.23	II	20617 – 52392
40	3151.32	II	20522 – 52246
40	3164.83	II	8842 – 40430
55	3168.14	II	8640 – 40196
3200	3183.41	I	137 – 31541
5300	3183.98	I	323 – 31722
		I	0 – 31398
3800	3185.40	I	553 – 31937
410	3187.71	II	8640 – 40002
530	3188.51	II	8842 – 40196
750	3190.68	II	9098 – 40430
55	3193.92	I	15063 – 46363
530	3198.01	I	137 – 31398
55	3199.82	I	15001 – 46244
750	3202.38	I	323 – 31541
450	3205.58	I	10893 – 42079
450	3207.41	I	553 – 31722
75	3208.35	II	8842 – 40002
410	3212.43	I	11101 – 42221
75	3214.75	II	9098 – 40196
210	3217.11	II	16533 – 47608
		I	323 – 31398
40	3218.87	I	10893 – 41950
55	3233.19	I	11101 – 42021
150	3237.87	II	16422 – 47297
55	3249.57	I	553 – 31318
55	3250.78	II	23391 – 54144
40	3251.87	II	20343 – 51086
140	3254.77	II	16340 – 47056
40	3255.65	I	8716 – 39423
140	3263.24	I	0 – 30636
1100	3267.70	II	8640 – 39234
900	3271.12	II	8842 – 39404
90	3271.64	I	137 – 30694
75	3273.03	I	10893 – 41437
750	3276.12	II	9098 – 39613
110	3279.84	II	19113 – 49593
55	3282.53	II	19113 – 49568
90	3283.31	I	323 – 30771
55	3284.36	I	11101 – 41539
90	3289.39	II	8842 – 39234
140	3298.14	I	553 – 30864
90	3298.74	II	9098 – 39404
55	3309.18	I	9637 – 39847
55 d	3321.54	II	19113 – 49211
	3321.68	I	15265 – 45361
110	3329.86	I	9825 – 39847
90	3356.35	I	9637 – 39423
110	3365.55	I	9545 – 39249
55	3376.06	I	9637 – 39249
55	3377.39	I	9637 – 39237
110	3377.62	I	9825 – 39423
170	3400.40	I	8716 – 38116
55	3402.57	I	8579 – 37960
55	3417.06	I	8579 – 37835
45	3418.52	I	8716 – 37960
110	3425.07	I	
110	3485.92	II	8842 – 37521
45	3489.47	I	17242 – 45892
55	3493.17	II	8640 – 37259
90	3497.03	II	20981 – 49568
40	3500.82	I	19145 – 47702
210	3504.44	II	8842 – 37369
55	3505.69	I	13802 – 42318
560	3517.30	II	9098 – 37521
150	3520.02	II	8640 – 37041
110	3524.72	II	8842 – 37205
230	3529.74	I	9637 – 37960
230	3530.77	II	8640 – 36955
560	3533.68	I	9825 – 38116
110	3543.50	I	9545 – 37757
560	3545.20	II	8842 – 37041
110	3553.27	I	9825 – 37960
55	3556.25	I	17242 – 45354
560	3556.80	II	9098 – 37205
55	3560.60	II	8842 – 36919
110	3566.18	I	8579 – 36612
		II	8640 – 36674
55	3568.94	I	17055 – 45067
55	3571.04	I	17242 – 45237
90	3571.65	I	17117 – 45107
90	3573.52	I	17182 – 45158
55	3577.87	I	17117 – 45059
55	3582.81	I	17242 – 45145
560	3589.76	II	8640 – 36489
490	3592.02	II	8842 – 36674
560	3592.53	I	
270	3593.33	II	9098 – 36919
45	3605.59	I	
110	3606.69	I	10893 – 38611
55	3616.72	I	

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
45	3637.76	I	
110	3639.02	I	14549 – 42021
55	3643.86	I	14515 – 41950
110	3644.71	I	11101 – 38530
90	3648.97	I	16450 – 43847
90	3656.71	I	16573 – 43912
250	3663.59	I	16361 – 43649
75	3665.14	I	16729 – 44005
250	3667.74	I	16450 – 43707
110	3669.41	II	20363 – 47608
170	3671.20	I	10893 – 38124
95	3672.40	I	16917 – 44140
280	3673.40	I	16573 – 43788
280	3675.70	I	2220 – 29418
170	3676.68	I	17136 – 44327
300	3680.11	I	16729 – 43894
570	3683.13	I	2153 – 29296
190	3686.26	I	11101 – 38221
470	3687.47	I	16917 – 44028
1300	3688.07	I	2311 – 29418
1000	3690.28	I	2112 – 29203
1500	3692.22	I	2220 – 29296
450	3695.34	I	17136 – 44190
1000	3695.86	I	2153 – 29203
3800	3703.58	I	2425 – 29418
1800	3704.70	I	2311 – 29296
570	3705.04	I	2220 – 29203
95	3706.04	I	15104 – 42079
130	3708.72	I	15265 – 42221
40	3713.96	I	553 – 27471
320	3715.47	II	12706 – 39613
45	3718.91	I	
45	3722.00	I	15001 – 41861
45	3722.20	I	18198 – 45057
250	3727.34	II	13609 – 40430
45	3728.34	II	20242 – 47056
55	3729.04	I	14949 – 41758
280	3732.76	II	12622 – 39404
150	3734.43	I	15078 – 41848
45	3737.99	I	14910 – 41655
85	3738.76	I	15270 – 42010
40	3740.24	I	15270 – 41999
95	3741.50	I	18438 – 45158
230	3745.80	II	12545 – 39234
40	3747.98	I	15572 – 42246
210	3750.87	II	13543 – 40196
40	3751.78	I	8579 – 35225
40	3753.27	I	13802 – 40437
40	3755.70	I	18302 – 44921
40	3759.32	I	20830 – 47423
45	3761.44	I	15270 – 41848
85	3763.14	I	15572 – 42138
40	3769.07	I	13802 – 40326
210	3770.97	II	13491 – 40002
40	3774.11	I	13811 – 40300
40	3775.19	I	15270 – 41752
40	3775.72	I	18680 – 45158
40	3776.16	I	15771 – 42246
270	3778.68	I	2311 – 28768
45	3779.65	I	10893 – 37343
40	3781.39	I	15572 – 42010
65	3787.14	I	15104 – 41501
520	3790.32	I	2220 – 28596
95	3793.61	I	0 – 26353
1100	3794.96	I	2425 – 28768
570	3799.91	I	2153 – 28462
570	3803.47	I	2311 – 28596
85 d	3803.78	I	10893 – 37175
	3803.90	I	323 – 26605
190	3806.80	I	11101 – 37362
300	3807.50	I	2112 – 28369
520	3808.52	I	0 – 26249
230	3809.60	I	2220 – 28462
1000	3813.49	I	137 – 26353
95	3815.51	I	2112 – 28314
140 d	3817.84	I	553 – 26738
	3817.98	I	11101 – 37285
1300	3818.24	I	0 – 26183
230	3819.96	I	2425 – 28596
230	3821.49	I	2153 – 28314
570	3822.01	I	323 – 26480
450	3822.89	I	2311 – 28462
300	3823.21	I	2220 – 28369
65	3823.99	I	8476 – 34620
45	3826.77	I	8413 – 34537
1700	3828.56	I	137 – 26249
45	3830.27	I	
28	3832.84	I	13802 – 39884
280	3834.22	I	13811 – 39884
75	3835.56	I	8413 – 34477
75	3836.05	I	8476 – 34537
160	3839.00	I	8579 – 34620
110	3839.38	I	14549 – 40587
75	3840.14	I	10893 – 36926
570	3840.44	I	8716 – 34747
2600	3840.75	I	323 – 26353
110	3841.89	I	323 – 26345
380	3844.44	I	0 – 26004
320	3847.33	I	137 – 26122
110	3849.32	I	
75	3851.17	I	8579 – 34537
40	3852.10	I	8476 – 34429
1200	3855.37	I	0 – 25931
3000	3855.84	I	553 – 26480
65	3858.68	I	8579 – 34487
75	3859.34	I	8716 – 34620
150	3862.22	I	137 – 26022
130	3863.87	I	10893 – 36766
1300	3864.86	I	137 – 26004
230	3867.60	I	323 – 26172
40	3870.58	I	15771 – 41599
170	3871.08	I	11101 – 36926
65	3873.64	I	10893 – 36701
1500	3875.08	I	323 – 26122
420	3875.90	I	137 – 25931
570	3876.09	I	553 – 26345
130	3878.71	II	14656 – 40430
40	3883.89	I	15689 – 41429
90	3886.59	I	11101 – 36823
700	3890.18	I	323 – 26022
90 h	3891.12	I	
460	3892.86	I	323 – 26004
90	3894.04	I	18174 – 43847
90	3896.16	I	8716 – 34375
90	3897.08	I	18259 – 43912
280 h	3898.02	I	18680 – 44327
140	3899.13	II	14556 – 40196
140 h	3900.18	I	18372 – 44005
140 h	3901.15	I	18513 – 44140
2400	3902.25	I	553 – 26172

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
50	3903.26	II	11908 – 37521	230		4104.40	I	17242 – 41599
50	3904.47	I	14515 – 40119	260		4104.78	I	15771 – 40126
100	3906.75	I	8579 – 34168	2800		4105.17	I	2153 – 26506
700	3909.89	I	553 – 26122	65		4107.49	I	9637 – 33976
100	3910.79	I	8413 – 33976	120		4108.22	I	17055 – 41389
220	3912.21	I	8413 – 33967	2300		4109.79	I	2112 – 26438
50	3912.89	I	8579 – 34128	8900		4111.78	I	2425 – 26738
140	3914.33	II	14462 – 40002	120		4112.33	I	17182 – 41492
100	3916.41	II	11515 – 37041	230		4113.52	I	9825 – 34128
100	3920.49	I	8476 – 33976	65		4114.53	I	15665 – 39962
100	3921.90	I	8476 – 33967	4300		4115.18	I	2311 – 26605
230	3922.43	I	8579 – 34066	1800		4116.47	I	2220 – 26506
240	3924.66	I	15063 – 40536	180		4118.18	I	15724 – 40000
150	3925.24	I	19026 – 44495	180		4118.64	I	8716 – 32989
200	3927.93	I	15001 – 40452	230		4119.46	I	8579 – 32847
260	3930.02	I	11101 – 36539	180		4120.54	I	8476 – 32738
150	3931.34	I	14949 – 40379	180		4123.19	I	15689 – 39935
260	3934.01	I	8716 – 34128	2000		4123.57	I	2153 – 26397
150	3935.14	I	14910 – 40315	120		4124.07	I	9825 – 34066
100	3936.28	I	8579 – 33976	3100		4128.07	I	2220 – 26438
50	3937.53	I	15063 – 40452	120		4128.86	I	15665 – 39878
50	3938.20	I	19078 – 44463	3100		4132.02	I	2311 – 26506
50	3939.33	I	15001 – 40379	2300		4134.49	I	2425 – 26605
40	3941.25	I	14949 – 40315	65		4136.11	I	15078 – 39249
90	3942.01	I	11101 – 36461	65		4139.26	I	15270 – 39423
150	3943.66	I	8716 – 34066	45		4150.67	I	
100	3950.23	I		45		4152.66	I	
140	3951.97	II	11908 – 37205	150		4159.69	I	2311 – 26345
90	3963.63	I		65		4171.30	I	15270 – 39237
50	3968.09	II	11296 – 36489	100		4174.01	I	13802 – 37753
100	3973.64	II	11515 – 36674	230		4179.42	I	2425 – 26345
50	3979.14	I	20768 – 45892	150		4182.59	I	2220 – 26122
50	3979.42	I	19023 – 44146	180		4189.84	I	2311 – 26172
50	3980.52	I		180		4191.56	I	2153 – 26004
50	3984.34	I	14910 – 40001	65		4197.60	I	15265 – 39081
90	3984.60	I	14949 – 40039	65		4198.61	I	2311 – 26122
90	3988.83	I	15001 – 40064	50		4200.19	I	2220 – 26022
540	3990.57	I	14949 – 40001	230		4209.86	I	2425 – 26172
260	3992.80	I	15001 – 40038	65		4218.71	I	2425 – 26122
50	3997.12	II	11908 – 36919	65		4224.14	I	15724 – 39391
430	3998.73	I	15063 – 40064	120		4226.62	I	15689 – 39342
170	4005.71	II	14656 – 39613	50		4227.74	I	13811 – 37458
50	4023.17	I	15270 – 40119	50		4229.69	I	15665 – 39300
120	4023.39	II	14556 – 39404	360		4232.46	I	15771 – 39391
120	4031.83	I	19078 – 43874	180		4232.95	I	15724 – 39342
150	4035.63	II	14462 – 39234	180		4234.00	I	15689 – 39300
120	4042.64	I	15270 – 40000	50		4234.52	I	0 – 23609
50	4048.62	I	137 – 24830	120		4235.76	I	15665 – 39267
360	4050.96	I	17182 – 41861	50		4240.36	I	15724 – 39300
360	4051.35	I	17242 – 41918	100		4257.37	I	15001 – 38483
50	4053.26	I	15270 – 39935	120		4259.31	I	137 – 23609
280	4057.07	I	17117 – 41758	120		4262.16	I	14949 – 38405
130	4057.82	I	15689 – 40326	50	h	4265.17	I	
230	4063.93	I	17055 – 41655	560		4268.64	I	15063 – 38483
230	4071.54	I	15572 – 40126	50		4269.76	I	14910 – 38324
65	4082.93	I	9545 – 34030	50		4270.32	I	14549 – 37960
1100	4090.58	I	8716 – 33155	460		4271.55	I	15001 – 38405
50	4091.94	I	9545 – 33976	460		4276.96	I	14949 – 38324
180	4092.41	I	9637 – 34066	45		4282.91	I	15063 – 38405
1800	4092.69	I	2311 – 26738	430		4284.06	I	14910 – 38246
120	4093.50	I	9545 – 33967	50		4286.42	I	15001 – 38324
65	4094.28	I	17242 – 41660	45		4287.81	I	
890	4095.49	I	8579 – 32989	40		4291.30	I	14949 – 38246
2800	4099.80	I	2220 – 26605	330		4291.82	I	17242 – 40536
590	4102.16	I	8476 – 32847	220		4296.11	I	17182 – 40452

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
170		4297.68	I	17117 – 40379
170		4298.03	I	17055 – 40315
170		4306.21	I	137 – 23353
140		4307.18	I	0 – 23211
170		4309.80	I	323 – 23520
40		4313.89	I	14949 – 38124
460		4330.02	I	0 – 23088
510		4332.82	I	137 – 23211
40		4334.09	I	9825 – 32891
760		4341.01	I	323 – 23353
50		4342.83	I	15104 – 38124
1000		4352.87	I	553 – 23520
130		4354.98	I	15265 – 38221
150		4355.94	I	137 – 23088
50		4363.52	I	2220 – 25131
50		4364.22	I	17055 – 39962
150		4368.04	I	323 – 23211
50		4368.60	I	17117 – 40001
140	d	4373.23	I	21603 – 44463
75		4373.83	I	17182 – 40039
100		4375.30	I	21646 – 44495
12000		4379.24	I	2425 – 25254
100		4380.55	I	17242 – 40064
7000		4384.72	I	2311 – 25112
4800		4389.97	I	2220 – 24993
90		4392.07	I	2153 – 24915
45		4393.09	I	15078 – 37835
45		4393.84	I	8476 – 31229
3600		4395.23	I	2153 – 24899
1400		4400.58	I	2112 – 24830
75		4403.67	I	15063 – 37765
90	h	4406.15	I	8579 – 31268
2300		4406.64	I	2425 – 25112
2800		4407.64	I	2311 – 24993
3600		4408.20	I	2220 – 24899
4600		4408.51	I	2153 – 24830
			I	2112 – 24789
140		4412.14	I	2112 – 24771
45		4415.06	I	15001 – 37644
640		4416.47	I	2153 – 24789
120		4419.94	I	2220 – 24839
640		4421.57	I	2220 – 24830
90		4423.21	I	8716 – 31318
30		4423.91	I	20813 – 43411
45		4424.56	I	11101 – 33695
90		4425.71	I	14910 – 37499
460		4426.00	I	2311 – 24899
120		4427.31	I	21603 – 44184
310		4428.52	I	2153 – 24728
230		4429.80	I	2425 – 24993
30		4430.50	I	15270 – 37835
90		4434.60	I	15572 – 38116
430		4436.14	I	2112 – 24648
640		4437.84	I	2311 – 24839
830		4441.68	I	2220 – 24728
90		4443.34	I	21646 – 44146
640		4444.21	I	2153 – 24648
65		4449.57	I	10893 – 33360
65		4450.90	I	19078 – 41539
610		4452.01	I	15063 – 37518
25		4452.70	I	14910 – 37362
40	h	4456.50	I	
410		4457.48	I	2220 – 24648
120		4457.76	I	15104 – 37530
1000		4459.76	I	2311 – 24728
2000		4460.29	I	2425 – 24839
75		4460.99	I	19026 – 41437
610		4462.36	I	15001 – 37404
40		4464.27	I	19145 – 41539
40		4464.75	I	15724 – 38116
40		4465.50	I	15572 – 37960
120		4468.01	I	14910 – 37285
40		4468.76	I	15104 – 37475
380		4469.71	I	14949 – 37316
120		4474.04	I	15771 – 38116
200		4474.71	I	15265 – 37606
25		4475.89	I	14949 – 37285
75		4480.04	I	15001 – 37316
380		4488.89	I	14910 – 37181
75		4490.80	I	14949 – 37211
100		4496.06	I	15724 – 37960
65		4496.85	I	14949 – 37181
40		4497.40	I	21646 – 43875
120		4501.95	I	11101 – 33307
75		4514.19	I	15689 – 37835
140		4524.22	I	15265 – 37362
40		4525.16	I	15665 – 37757
40		4527.99	I	
40		4529.30	I	15270 – 37343
75		4529.59	I	15104 – 37175
40		4530.79	I	
40		4533.92	I	
40		4537.66	I	14549 – 36580
40		4540.01	I	15265 – 37285
360		4545.39	I	15771 – 37765
100		4549.65	I	
25		4551.84	I	14515 – 36478
90		4553.05	I	19023 – 40981
280		4560.71	I	15724 – 37644
65		4570.42	I	15771 – 37644
200		4571.78	I	15689 – 37556
510		4577.17	I	0 – 21841
140		4578.73	I	15665 – 37499
30		4579.19	I	15724 – 37556
640		4580.40	I	137 – 21964
50		4583.78	I	15689 – 37499
830		4586.36	I	323 – 22121
170		4591.22	I	19145 – 40920
1300		4594.11	I	553 – 22314
100		4606.15	I	137 – 21841
30		4609.65	I	11101 – 32788
25		4611.74	I	15665 – 37343
230		4619.77	I	323 – 21964
65		4624.41	I	8476 – 30095
50		4626.48	I	8413 – 30022
100		4635.18	I	553 – 22121
65		4640.07	I	8476 – 30022
65		4640.74	I	8579 – 30121
130		4646.40	I	8579 – 30095
30		4648.89	I	19189 – 40694
30		4666.14	I	15270 – 36695
160		4670.49	I	8716 – 30121
24		4684.45	I	15270 – 36612
35		4686.92	I	15078 – 36408
55		4706.16	I	15572 – 36815
80		4706.57	I	17242 – 38483
80		4710.56	I	17182 – 38405
65		4714.12	I	17117 – 38324
35		4715.89	I	19026 – 40225
55		4717.69	I	17055 – 38246

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
40		4721.51	I	15724 – 36898
40		4722.86	I	15771 – 36938
40		4729.53	I	15270 – 36408
27		4730.38	I	15689 – 36823
27		4742.63	I	18805 – 39884
24		4746.63	I	16361 – 37423
40		4748.52	I	16450 – 37503
45		4750.98	I	16573 – 37615
35		4751.56	I	15572 – 36612
40		4753.93	I	16729 – 37758
65		4757.48	I	16361 – 37375
55		4766.63	I	16450 – 37423
130		4776.36	I	16573 – 37503
		4776.52	I	19189 – 40119
110		4786.51	I	16729 – 37615
130		4796.92	I	16917 – 37758
19		4799.77	I	0 – 20828
130		4807.53	I	17136 – 37931
130		4827.45	I	323 – 21033
150		4831.64	I	137 – 20828
120		4832.43	I	0 – 20688
19		4833.02	I	13802 – 34487
19		4848.81	I	21603 – 42221
320		4851.48	I	0 – 20606
35		4862.61	I	20830 – 41389
480		4864.74	I	137 – 20688
21		4871.26	I	17242 – 37765
620		4875.48	I	323 – 20828
55		4880.56	I	9637 – 30121
740		4881.56	I	553 – 21033
27		4891.60	I	
21		4894.21	I	17055 – 37481
55		4900.62	I	17117 – 37517
95	d	4904.29	I	9637 – 30022
		4904.34	I	17242 – 37626
85		4925.65	I	9825 – 30121
35		4932.03	I	9825 – 30095
23		4966.12	I	23935 – 44066
70		5002.33	I	19023 – 39009
85		5014.62	I	19145 – 39081
28		5051.63	I	21646 – 41437
35		5064.12	I	
35		5105.14	I	
110		5128.53	I	18438 – 37931
110		5138.42	I	18302 – 37758
25		5139.53	I	19078 – 38530
70		5148.72	I	18198 – 37615
40		5159.35	I	18126 – 37503
23		5169.94	I	18086 – 37423
70		5176.77	I	
20		5192.01	I	18120 – 37375
110		5192.99	I	18680 – 37931
23		5193.62	I	18174 – 37423
110		5194.83	I	18259 – 37503
55		5195.36	I	18372 – 37615
20		5206.61	I	18174 – 37375
40		5216.59	I	18259 – 37423
35		5225.77	I	18372 – 37503
35		5233.75	I	18513 – 37615
110		5234.07	I	19023 – 38124
20		5240.20	I	18680 – 37758
110		5240.87	I	19145 – 38221
17		5260.98	I	18438 – 37441
40		5353.41	I	19078 – 37753
35		5383.43	I	20828 – 39399
40		5385.14	I	21033 – 39597
14		5388.30	I	20688 – 39241
11		5397.87	I	20606 – 39127
100		5401.93	I	19023 – 37530
140		5415.26	I	19145 – 37606
28		5418.09	I	19023 – 37475
50		5424.08	I	19026 – 37458
40		5434.18	I	19078 – 37475
11		5437.66	I	19145 – 37530
17		5458.12	I	19026 – 37343
13		5471.33		
25		5487.22	I	14549 – 32768
85		5487.92	I	19145 – 37362
25		5489.94	I	14515 – 32725
28		5504.87	I	13802 – 31962
70		5507.75	I	19023 – 37175
14		5511.18	I	19145 – 37285
23		5545.93	I	8579 – 26605
70		5547.07	I	8716 – 26738
35		5558.75	I	13802 – 31786
28		5561.66	I	13811 – 31786
140		5584.50	I	8579 – 26480
23		5586.00	I	15001 – 32898
100		5592.42	I	8476 – 26353
28		5601.38	I	19078 – 36926
70		5604.94	I	8413 – 26249
13		5624.20	I	18805 – 36580
200		5624.60	I	8579 – 26353
70		5624.89	I	8476 – 26249
55		5626.01	I	8413 – 26183
400		5627.64	I	8716 – 26480
13		5632.46	I	553 – 18302
10		5633.90	I	19078 – 36823
13		5635.51	I	19026 – 36766
85		5646.11	I	8476 – 26183
110		5657.44	I	8579 – 26249
110		5668.36	I	8716 – 26353
310		5670.85	I	8716 – 26345
20		5683.22	I	
1200		5698.52	I	8579 – 26122
920		5703.56	I	8476 – 26004
570		5706.98	I	8413 – 25931
11		5708.95	I	19189 – 36701
11	h	5716.21	I	
70		5725.64	I	19078 – 36539
850		5727.03	I	8716 – 26172
170		5727.66	I	8476 – 25931
230		5731.25	I	8579 – 26022
40		5734.01	I	19026 – 36461
230		5737.06	I	8579 – 26004
110		5743.45	I	8716 – 26122
17		5747.70	I	19145 – 36539
40		5748.87	I	15270 – 32660
17		5752.74	I	15078 – 32456
17		5761.41	I	8579 – 25931
70		5772.42	I	15572 – 32891
35		5776.64	I	8716 – 26022
11		5782.61	I	8716 – 26004
11		5783.50	I	21841 – 39127
40	h	5784.38	I	22314 – 39597
55	h	5786.16	I	21964 – 39241
23		5788.56	I	15078 – 32349
35	h	5807.14	I	24899 – 42114
23		5817.06	I	15270 – 32456
35	h	5817.53	I	24993 – 42177

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
55	h	5830.72	I	25112 – 42257
85	h	5846.30	I	25254 – 42353
11		5850.32	I	15572 – 32660
40		5924.57	I	15063 – 31937
28		5978.91	I	15001 – 31722
20		5980.78	I	9637 – 26353
28		6002.31	I	9825 – 26480
55		6002.63	I	8476 – 25131
28		6016.12	I	21603 – 38221
20		6025.41	I	14949 – 31541
450		6039.73	I	8579 – 25131
100		6058.14	I	8413 – 24915
20		6067.26	I	21646 – 38124
480		6081.44	I	8476 – 24915
1300		6090.22	I	8716 – 25131
28		6106.98	I	11101 – 27471
280		6111.67	I	8413 – 24771
600		6119.52	I	8579 – 24915
20		6128.34	I	8476 – 24789
280		6135.38	I	8476 – 24771
180		6150.15	I	2425 – 18680
85		6170.36	I	2311 – 18513
23		6189.35	I	2220 – 18372
450		6199.19	I	2311 – 18438
130		6213.87	I	2425 – 18513
450		6216.37	I	2220 – 18302
28	h	6218.31	I	23520 – 39597
130		6224.50	I	2311 – 18372
430		6230.74	I	2153 – 18198
100		6233.20	I	2220 – 18259
55		6240.13	I	2153 – 18174
170		6242.81	I	2112 – 18126
710		6243.10	I	2425 – 18438
280		6251.82	I	2311 – 18302
85		6256.90	I	2220 – 18198
85		6258.57	I	2112 – 18086
55		6261.22	I	2153 – 18120
85		6266.32	I	2220 – 18174
130		6268.82	I	2425 – 18372
170		6274.65	I	2153 – 18086
17	h	6282.33	I	17242 – 33155
200		6285.16	I	2220 – 18126
200		6292.83	I	2311 – 18198
170		6296.49	I	2425 – 18302
28	h	6311.50	I	26738 – 42578
14		6324.66	I	17182 – 32989
70		6326.84	I	15063 – 30864
55		6339.09	I	15001 – 30771
50		6349.48	I	14949 – 30694
14		6355.58	I	17117 – 32847
50		6357.30	I	14910 – 30636
25		6358.82	I	17242 – 32964
35		6361.27	I	17182 – 32898
23		6379.36	I	17117 – 32788
14		6393.28	I	17055 – 32692
35		6430.47	I	15771 – 31318
23		6431.63	I	15724 – 31268
14		6433.18	I	15689 – 31229
11		6435.16	I	15665 – 31200
70		6452.34	I	9637 – 25131
11		6488.05	I	19078 – 34487
55		6504.17	I	9545 – 24915
110		6531.43	I	9825 – 25131
28		6543.51	I	9637 – 24915
17		6558.02	I	11101 – 26345
11		6565.88	I	9545 – 24771
50		6605.97	I	9637 – 24771
15		6607.83	I	10892 – 26022
10		6623.54	I	15771 – 30864
50		6624.85	I	9825 – 24915
13		6633.26	I	11101 – 26172
13		6643.79	I	15724 – 30771
8		6693.66	I	21603 – 36539
8		6708.07	I	9825 – 24728
65	c	6753.00	I	8716 – 23520
10		6760.12	I	
50	c	6766.49	I	8579 – 23353
40		6784.98	I	8476 – 23211
15		6786.32	I	
26		6812.40	I	8413 – 23088
9	c	6829.94	I	8716 – 23353
15		6832.44	I	8579 – 23211
12		6839.58	I	19023 – 33640
12		6841.90	I	8476 – 23088
10	c	6870.88	I	19145 – 33695
8		6871.56	I	15572 – 30121
7		6894.00	I	19026 – 33528
12		6974.50	I	19026 – 33360
21		7026.07	I	19078 – 33307
7		7063.69	I	11101 – 25254
11	h	7092.08	I	
6		7102.58	I	17242 – 31318
24		7148.15	I	
7		7151.36	I	20768 – 34747
7		7182.08	I	18805 – 32725
14		7264.29	I	20768 – 34530
8		7321.44	I	17117 – 30771
40		7338.92	I	17242 – 30864
35		7356.54	I	17182 – 30771
11		7358.66	I	20789 – 34375
24		7361.39	I	17054 – 30636
12		7362.49	I	19189 – 32768
24		7363.16	I	17117 – 30694
9		7385.95	I	19189 – 32725
6	h	7393.49		
12	h	7485.90	I	20813 – 34168
12	h	7488.08	I	15270 – 28621
12	h	7492.44		
12	h	7578.75	I	24915 – 38106
9	h	7591.24	I	24771 – 37940
14	h	7596.92	I	19189 – 32349
12	h	7598.28	I	18805 – 31962
24		7624.81	I	25131 – 38242
5		7701.37	I	18805 – 31786
8		7704.81	I	25131 – 38106
8	h	7851.18		
14	bl	7865.51	VO	
12		7896.40		
14	h	7898.81		
24		7937.92	I	24728 – 37322
29	c	8027.39	I	8579 – 21033
14		8028.13	I	
14	h	8035.38		
14	h	8045.71		
12		8051.89		
14		8093.48	I	8476 – 20828
8		8102.44	I	
12		8108.59	I	25112 – 37441
9	h	8109.07	I	24899 – 37227
120	cw	8116.80	I	8716 – 21033

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
11	h	8136.79	I	24830 – 37117	5	h	8280.39	I	25931 – 38004
29		8144.59	I	8413 – 20688	19		8282.37	I	26172 – 38242
9		8154.55	I	24899 – 37158					
70	c	8161.07	I	8579 – 20828	8		8324.42	I	25931 – 37940
14		8171.35	I	24993 – 37227	14	h	8331.23	I	26004 – 38004
					14		8342.03	I	26122 – 38106
7		8180.21	I	20768 – 32989	7		8402.81	I	
35		8186.71	I	8476 – 20688	12		8499.52	I	26480 – 38242
24		8187.33	I	25112 – 37322					
29		8198.87	I	8413 – 20606	6		8534.49	I	21646 – 33360
35		8203.07	I	25254 – 37441	6	bl	8624.86	VO	
24		8241.61	I	8476 – 20606	60	c	8919.85	I	9824 – 21033
29	c	8253.51	I	8716 – 20828	29	c	8932.93	I	9637 – 20828
29		8255.88	I	8579 – 20688	12		8971.62	I	9545 – 20688

Ytterbium

Yb, $Z=70$, $M=173.0$, Ratio $\frac{\text{Yb}}{\text{Cu}}=2.723$

Yb I Normal state of valence electrons $6s^2\ {}^1S_0=0$. I.P. $=50441\ \text{cm}^{-1}$.
Yb II Normal state of valence electrons $6s\ {}^2S_{1/2}=0$. I.P. $=98150\ \text{cm}^{-1}$.
Yb III Normal state of valence electrons $4f^{14}\ {}^1S_0=0$. I.P. $=201900\ \text{cm}^{-1}$.

References

Wavelengths:
W. F. Meggers and C. H. Corliss, J. Res. Nat. Bur. Stand. (U.S.), **70A** (Phys. and Chem.), No. 1, 63–106 (Jan.–Feb. 1966).

Classification and Spectrum Assignments:
Yb I, W. F. Meggers, unpublished material (1965).
Yb II, W. F. Meggers, J. Res. Nat. Bur. Stand. (U.S.), **71A** (Phys. and Chem.), No. 6, 396–544 (Nov.–Dec. 1967).
Yb III, B. W. Bryant, J. Opt. Soc. Am. **55**, 771 (1965).

Strong lines of ytterbium

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
32000	3694.19	II	0 – 27062	990	2653.75	II	21418 – 59090
32000	3987.99	I	0 – 25068	930	3990.88	I	19710 – 44760
18000	3289.37	II	0 – 30392	920	3031.11	II	0 – 32982
3600	2891.38	II	0 – 34575	850	2185.71	II	0 – 45737
3000	2126.74	II	0 – 47006	750	7699.48	I	19710 – 32695
2500	2116.67	II	0 – 47229	710	4935.50	I	19710 – 39966
2400	3464.37	I	0 – 28857	690	6799.60	I	17992 – 32695
2400	5556.47	I	0 – 17992	640	4576.21	I	17992 – 39838
2000	2970.56	II	0 – 33654	640	2224.46	II	0 – 44941
1300	2750.48	II	21418 – 57765				

559-795 O - 75 - 25 (Pt. 1)

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
2500	2116.67	II	0 – 47229	21		2734.09	II	34390 – 70954
3000	2126.74	II	0 – 47006	55		2741.71	II	33494 – 69957
370	2161.60	II		55		2747.58	II	32371 – 68756
850	2185.71	II	0 – 45737	18		2748.04	II	34575 – 70954
640	2224.46	II	0 – 44941	230		2748.66	II	31568 – 67939
140	2320.81	II	0 – 43075	1300		2750.48	II	21418 – 57765
50	2362.89	II	21418 – 63727	85		2751.45	II	30224 – 66558
170	2390.74	II	21418 – 63234	21		2759.00	II	37516 – 73751
18	2398.02	II	0 – 41688	65		2760.78	II	35059 – 71270
28	2421.35	II	32371 – 73658	65		2761.37	II	35019 – 71222
25	2447.26	II	28758 – 69608	35		2764.41	II	35059 – 71222
28	2460.25	II	30224 – 70858	85		2771.32	II	34785 – 70858
460	2464.50	I	0 – 40564	170		2776.28	II	34785 – 70794
14	2484.89	II	30563 – 70794	100		2784.66	II	33494 – 69395
70	2502.02	II	21418 – 61374	18		2787.96	II	30224 – 66082
28	2505.48	II	31568 – 71469	45		2793.28	II	33654 – 69444
11	2508.07	II	24332 – 64191	25		2794.44	II	35019 – 70794
140	2512.06	II	21418 – 61215	21		2795.07	II	37516 – 73283
18	2516.35	II	33052 – 72780	18		2795.29	II	32371 – 68135
50	2522.44	II	21418 – 61051	35		2797.80	II	40917 – 76649
65	2537.65	II	30563 – 69957	100		2798.21	II	30224 – 65951
270	2538.67	II	0 – 39379	45		2799.38	II	22960 – 58672
14	2550.06	II	22960 – 62163	50		2800.00	II	33052 – 68756
70	2552.15	II	30224 – 69395	35		2800.06	II	28758 – 64461
55	2552.70	II	31632 – 70794	14		2810.72	II	32371 – 67939
21	2565.57	II	34785 – 73751	65		2814.53	II	30563 – 66082
28	2571.36	II	31980 – 70858	28		2816.32	II	33052 – 68549
13	2573.15	II	32371 – 71222	140		2821.15	II	31980 – 67416
18	2596.16	II	34784 – 73291	100		2824.97	II	30563 – 65951
28	2596.32	II	31632 – 70136	190		2830.99	II	30563 – 65876
21	2615.26	II	30224 – 68450	18		2832.20	II	28758 – 64056
100	2617.01	II	21418 – 59619	28		2834.97	II	37516 – 72780
55	2634.31	II	22960 – 60910	14		2842.59	II	32982 – 68150
45	2639.45	II	31568 – 69444	230	h	2847.18	II	27062 – 62174
85	2641.89	II	21418 – 59259	100		2848.44	II	33052 – 68149
80	2642.56	III	34656 – 72487	21		2849.34	II	44498 – 79583
110	2644.31	II	33052 – 70858	360		2851.13	II	26759 – 61822
28	2646.44	II	33494 – 71270	55		2851.86	II	33494 – 68549
28	2647.46	II	35019 – 72780	21		2853.41	II	46170 – 81205
28	2648.80	II	33052 – 70794	18		2853.68	II	34575 – 69608
50	2649.79	II	33494 – 71222	55		2854.14	II	35832 – 70858
28	2650.73	II	30224 – 67939	45		2854.49	II	40036 – 75058
990	2653.75	II	21418 – 59090	45		2858.33	II	30224 – 65200
35	2656.12	II	28758 – 66396	45		2858.46	II	32982 – 67955
21	2659.27	II	28758 – 66351	100		2859.39	II	35832 – 70794
200	2665.04	II	31568 – 69080	430		2859.80	II	21418 – 56376
85	2666.13	III	34991 – 72486	55		2860.39	II	38342 – 73291
85	2666.99	III	34656 – 72140	140		2861.21	II	31632 – 66571
55	2668.75	II	33494 – 70954	100		2861.34	II	35019 – 69957
390	2671.96	I	0 – 37415	200		2867.06	II	30224 – 65093
390	2672.66	II	21418 – 58823	25		2870.06	II	42915 – 77747
21	2680.40	II	26759 – 64056	45		2873.49	I	
14	2683.42	II	44438 – 81693	28		2885.97	II	33494 – 68135
70	2684.75	II	32371 – 69608	70		2886.26	II	30563 – 65200
25	2687.98	II	30224 – 67416	200		2888.04	II	26759 – 61374
28	2695.43	II	31632 – 68720	3600		2891.38	II	0 – 34575
14	2696.62	II	32371 – 69444	45		2893.62	II	35059 – 69608
18	2700.80	II	44497 – 81512	28		2896.90	II	46170 – 80679
21	2708.84	II	33052 – 69957	85		2899.70	II	28758 – 63234
65	2710.54	II	31568 – 68450	18		2902.41	II	33494 – 67939
25	2711.78	II	21418 – 58284	21		2902.92	II	38342 – 72780
55	2712.66	II	30563 – 67416	21		2906.88	II	37078 – 71469
170	2718.35	II	31980 – 68756	28		2908.33	II	30224 – 64598
21	2722.20	II	34390 – 71114	35		2909.19	II	33052 – 67416
110	2732.74	II	31568 – 68150	55		2909.48	II	30563 – 64923

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
85	2911.52	II	35059 – 69395	55		3116.70	II	31980 – 64056
18	2912.86	II	31568 – 65888	190		3117.81	II	26759 – 58823
170	2914.21	II	35832 – 70136	50		3136.76	II	33052 – 64923
140	2915.28	II	26759 – 61051	230		3140.94	II	28758 – 60586
18	2916.43	II	39379 – 73658	80		3141.73	II	34575 – 66396
280	2919.35	II	31632 – 65876	80		3145.06	II	34785 – 66571
55	2921.12	II	32982 – 67205	28		3145.54	II	30392 – 62174
45	2924.24	II	32371 – 66558	28		3153.18	II	33494 – 65200
25	2927.85	II	37078 – 71222	90		3153.88	II	40917 – 72615
35	2934.36	I	27315 – 61384	50		3155.18	II	32371 – 64056
55	2935.11	II	34390 – 68450	28		3162.29	I	
21	2937.19	II	37078 – 71114	70		3163.80	II	33494 – 65093
45	2939.53	II	31568 – 65577	50		3165.21	II	35832 – 67416
45	2940.52	II		120		3169.06	II	33052 – 64598
28	2942.04	II	32371 – 66351	120		3180.92	II	33494 – 64923
140	2945.91	II	34785 – 68720	390		3192.88	II	30563 – 61874
45	2946.30	II	40036 – 73967	70		3198.65	II	31980 – 63234
18	2946.76	II	43956 – 77882	240		3201.16	II	31632 – 62861
28	2950.33	II	35059 – 68944	80		3217.18	II	32982 – 64056
45	2955.32	II	26759 – 60586	50		3218.32	II	35019 – 66082
18	2957.63	II	28757 – 62559	50		3225.88	II	30224 – 61215
65	2962.52	II	34390 – 68135	45		3239.20	II	32371 – 63234
21	2963.26	II	35019 – 68756	35		3239.58	I	30524 – 61384
45	2963.46	II		35		3246.06	II	
130	2964.76	II	30224 – 63944	130		3261.51	II	30563 – 61215
2000	2970.56	II	0 – 33654	18000		3289.37	II	0 – 30392
45	2982.49	II	33052 – 66571	130		3305.25	I	
21	2982.66	II	32371 – 65888	140		3305.73	II	31632 – 61874
28	2983.70	II	33052 – 66558	50		3315.10	II	
200	2983.99	II	30224 – 63727	80		3319.41	I	
90	2985.08	II	35059 – 68549	50		3333.06	II	33654 – 63648
35	2985.88	II	32982 – 66463	240		3337.17	II	
45	2990.37	II	35019 – 68450	280	d	3342.93	II	
65	2991.87	II	32982 – 66396			3343.07	II	35019 – 64923
28	2993.94	II	35059 – 68450	80		3346.50		
170	2994.80	II	30563 – 63944	50		3347.54	II	35059 – 64923
28	2995.86	II	32982 – 66351	35		3351.09	II	44438 – 74270
70	3000.46	II	42915 – 76233	50		3351.26		
25	3002.61	II	41679 – 74973	100		3352.49	II	
310	3005.77	II	31632 – 64891	100		3362.44	II	
100	3009.39	II	31980 – 65200	50		3363.64	II	
65	3010.62	II	32371 – 65577	240		3375.48	II	26759 – 56376
55	3014.43	II	30563 – 63727	50		3376.62	II	
160	3017.56	II	35019 – 68149	28		3382.54		
160	3026.67	II	33052 – 66082	140		3387.50	I	
920	3031.11	II	0 – 32982	50		3390.25	II	
55	3034.64	II	31980 – 64923	28		3390.42	II	
25	3037.99	II	32982 – 65888	50		3391.10	II	37078 – 66558
55	3039.67	II	35832 – 68720	50	h	3394.44	II	32371 – 61822
80	3042.65	II	33494 – 66351	50		3401.01	II	30224 – 59619
21	3044.00	II	30392 – 63234	35		3404.10	II	35832 – 65200
45	3046.48	II	34390 – 67205	50		3412.45	I	
35	3047.05	II	33654 – 66463	140		3418.39	I	28184 – 57429
45	3063.12	II	30224 – 62861	360		3426.04	I	
21	3063.67	II	34785 – 67416	80		3428.46	II	34785 – 63944
110	3065.04	II	28758 – 61374	240		3431.11	I	
18	3076.01	II	26759 – 59259	45		3434.61	II	22960 – 52067
100	3089.10	II	28758 – 61120	50		3438.71	II	34575 – 63648
70	3093.87	II	31632 – 63944	100		3438.85	II	31980 – 61051
28	3100.74	I		35		3443.59		
45	3101.36	II	33654 – 65888	35		3446.89	II	32371 – 61374
28	3102.07	II	32371 – 64598	85		3452.40	I	29774 – 58732
55	3107.76	II	34390 – 66558	500		3454.08	II	26759 – 55702
170	3107.90	II	40036 – 72202	190	d	3458.29	II	40036 – 68944
85	3115.34	II	32371 – 64461			3458.39	I	

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
360		3460.27	I	17992 – 46883
35		3462.34	II	
2400		3464.37	I	0 – 28857
500		3476.30	II	0 – 28758
500		3478.84	II	30224 – 58961
50		3482.56	II	
85		3485.76	II	32371 – 61051
85		3488.43	II	
100	hw	3495.90	II	64598 – 93194
85		3507.83	II	37078 – 65577
50		3517.00	I	19710 – 48136
230		3520.29	II	30563 – 58961
50		3545.72	II	43075 – 71270
100		3549.82	II	33052 – 61215
35		3559.03	I	17992 – 46082
200		3560.33	II	21418 – 49498
170		3560.70	II	34785 – 62861
50	h	3563.94	II	31568 – 59619
85		3570.57	II	33052 – 61051
50		3572.50	II	34575 – 62559
50		3574.58	II	
360		3585.47	II	21418 – 49301
130		3606.48	II	33494 – 61215
50		3610.23	II	31568 – 59259
70		3611.30	II	37516 – 65200
200		3619.80	II	28758 – 56376
110		3634.52		
240		3637.76	II	21418 – 48900
70		3648.15	I	27314 – 54718
90		3655.73	I	17992 – 45339
240		3669.69	II	27062 – 54304
50		3670.69	II	38342 – 65577
140		3675.08	II	30563 – 57765
50		3690.56	II	34785 – 61874
32000		3694.19	II	0 – 27062
70		3698.60	II	35832 – 62861
70		3700.58	I	25859 – 52874
50		3710.34	II	28758 – 55702
60		3724.21	II	31980 – 58823
180		3734.69	I	17992 – 44760
550		3770.10	I	17288 – 43805
80		3774.32	I	
60	h	3791.74	I	17992 – 44357
170		3839.91	I	23188 – 49223
340		3872.85	I	17992 – 43805
340		3900.85	I	19710 – 45339
50		3904.81	II	38342 – 63944
140		3911.27	I	27314 – 52874
32000		3987.99	I	0 – 25068
930		3990.88	I	19710 – 44760
50		4007.36	I	23188 – 48135
70		4052.28	I	19710 – 44380
85		4077.28	II	38342 – 62861
440		4089.68	I	17992 – 42436
120	h	4119.25	II	
70		4135.09	II	34785 – 58961
470		4149.07	I	19710 – 43805
120		4174.56	I	17992 – 41939
340		4180.81	II	30392 – 54304
150	d	4218.56	II	37516 – 61215
		4218.69	I	24752 – 48449
120		4231.97	I	17992 – 41615
70		4277.74	I	24489 – 47859
120		4305.97	I	25270 – 48487
70		4316.95	II	30563 – 53721
60	h	4393.69	I	25068 – 47822
60	h	4430.21	I	24489 – 47055
440		4439.19	I	17288 – 39809
85	h	4482.42	I	24752 – 47055
85		4515.16	II	26759 – 48900
35		4553.58	II	30563 – 52517
85	h	4563.95	I	19710 – 41615
640		4576.21	I	17992 – 39838
200		4582.36	I	17992 – 39809
70		4589.21	I	25271 – 47055
140		4590.83	I	25859 – 47636
40		4598.36	II	31980 – 53721
35		4683.81	II	32371 – 53715
40		4684.27	I	27446 – 48788
190		4726.08	II	26759 – 47912
170	h	4781.87	I	
170		4786.61	II	31632 – 52517
35		4816.43	I	
40		4820.24	II	28758 – 49498
35		4836.96	II	33052 – 53721
40		4837.46	I	24489 – 45155
17		4851.15	II	24333 – 44941
40	h	4894.60	I	
27		4912.36	I	19710 – 40062
710		4935.50	I	19710 – 39966
24		4937.22	II	37516 – 57765
140		4966.90	I	19710 – 39838
24		5009.52	II	32982 – 52938
17		5067.30	II	34575 – 54304
30		5067.80	I	28184 – 47911
70		5069.14	I	27314 – 47036
220		5074.34	I	24752 – 44453
50		5076.74	I	25068 – 44760
20		5135.98	II	33052 – 52517
14		5147.02	II	38342 – 57765
20		5184.15	II	33654 – 52938
60		5196.08	I	27314 – 46554
85		5211.60	I	25271 – 44453
35		5240.51	II	30224 – 49301
100		5244.11	I	24752 – 43816
40		5257.49	II	34390 – 53405
150	h	5277.04	I	24489 – 43434
35		5279.53	II	34785 – 53721
17		5300.94	II	37516 – 56376
170		5335.15	II	30563 – 49301
30	d	5345.66	II	35019 – 53721
		5345.83	II	40918 – 59619
60		5347.22	II	35019 – 53715
30	h	5351.29	I	24752 – 43434
150		5352.95	II	30224 – 48900
30		5358.64	II	35059 – 53715
30		5363.66	I	23188 – 41827
17		5389.84	II	34390 – 52938
14		5432.71	II	47680 – 66082
40		5449.27	II	35059 – 53405
14		5478.50	II	40036 – 58284
60		5481.92	I	24489 – 42726
40		5505.49	I	24489 – 42648
17		5524.54	I	27314 – 45410
85	h	5539.05	I	
2400		5556.47	I	0 – 17992
35		5562.09	I	24752 – 42726
20		5568.11	I	25859 – 43814
20		5586.36	I	24752 – 42648
40		5588.45	II	35832 – 53721

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
60		5651.98	II	30224 – 47912
7		5686.53	II	41678 – 59259
220		5719.99	I	27678 – 45155
10		5749.91	II	49009 – 66396
10	h	5755.89	I	25068 – 42436
27		5771.66	II	31980 – 49301
10		5803.44	I	28184 – 45410
10		5819.41	II	46548 – 63727
35		5833.99	II	
35		5837.14	II	32371 – 49498
27		5854.51	I	25859 – 42935
8		5897.21	II	48923 – 65876
20		5908.36	II	31980 – 48900
17		5989.33	I	23188 – 39880
40		5991.51	II	35832 – 52517
10		6052.88	II	32982 – 49498
10		6054.57	I	30524 – 47036
60		6152.57	II	33052 – 49301
30		6246.97	II	33494 – 49498
60		6274.78	II	31980 – 47912
14		6308.15	II	33052 – 48900
35	h	6400.35	I	27678 – 43298
35	h	6417.91	I	27678 – 43255
20		6432.73	II	32371 – 47912
17	h	6463.15	II	46354 – 61822
340		6489.06	I	17288 – 32695
20		6643.55	I	27678 – 42726
180		6667.82	I	25068 – 40062
15		6678.17	I	27678 – 42648
25		6727.61	II	33052 – 47912
25		6768.70	I	25068 – 39838
690		6799.60	I	17992 – 32695
18		6934.05	II	33494 – 47912
20		6999.88	II	35019 – 49301
10		7043.78	II	47680 – 61873
9	h	7244.41	I	24752 – 38552
8	h	7305.22	I	24489 – 38174
10	h	7313.05	I	24752 – 38422
16	h	7350.04	I	24489 – 38091
25		7448.28	I	24752 – 38174
30	h	7527.46	I	25271 – 38552
750		7699.48	I	19710 – 32695
7		7895.08	I	24752 – 37415
70	h	8922.56	II	44498 – 55702

Yttrium

$$Y,\ Z = 39,\ M = 88.9059,\ \text{Ratio}\ \frac{Y}{Cu} = 1.399$$

Y I Normal state of valence electrons $5s^2 4d\ ^2D_{1\,1/2} = 0$. I.P. = 52000 cm^{-1}.
Y II Normal state of valence electrons $5s^2\ ^1S_0 = 0$. I.P. = 99000 cm^{-1}.
Y III Normal state of valence electrons $4d\ ^2D_{1\,1/2} = 0$. I.P. = 165000 cm^{-1}.

References

Wavelengths:
A. Gatterer and J. Junkes, Spektren der Seltenen Erden (Specola Vaticana, Vatican, 1945), below 7350 Å.
G. R. Harrison, Massachusetts Institute of Technology Wavelength Tables (John Wiley & Sons, New York, 1939), above 7350 Å.

Classification:
Y I, Y II, and Y III, W. F. Meggers and H. N. Russell, J. Research NBS **2**, 733 (1929) RP 55.

Molecular Spectra:
YO, W. F. Meggers and J. A. Wheeler, J. Research NBS **6**, 239 (1931) RP 273.

Strong lines of yttrium

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
13000	3710.30	II	1450 – 28394	6200	3601.92	II	840 – 28595
12000	4374.94	II	3296 – 26147	4700	3327.89	II	3296 – 33337
10000	3600.73	II	1450 – 29214				
10000	3774.33	II	1045 – 27532	4400	3950.36	II	840 – 26147
9900	4102.38	I	530 – 24900	4300	3620.94	I	530 – 28140
				4000	3832.88	II	1450 – 27532
9400	4077.38	I	0 – 24519	3900	3216.69	II	1045 – 32124
8900	4128.31	I	530 – 24747	3900	3549.01	II	1045 – 29214
8000	4177.54	II	3296 – 27227				
7800	3611.05	II	1045 – 28730	3600	3982.60	II	1045 – 26147
7800	3633.12	II	0 – 27517	3300	3584.52	II	840 – 28730
				3000	3664.61	II	1450 – 28730
7500	4142.85	I	0 – 24131	2800	3592.92	I	0 – 27824
7400	3788.70	II	840 – 27227	2800	4309.63	II	1450 – 24647
6200	3242.28	II	1450 – 32284				

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
350		2243.06	II	0 – 44568
50		2354.20	I	530 – 42995
200		2367.25	III	725 – 42955
30		2373.83		
50		2385.24		
25		2413.93	II	23776 – 65189
240		2414.68	III	0 – 41401
560		2422.20	II	3296 – 44568
60		2460.61	II	24647 – 65275
25		2490.42	I	530 – 40672
12		2540.28		
14		2547.57		
10		2550.17		
20		2681.65	I	0 – 37279
60		2694.21		
26		2695.39	I	530 – 37620
95		2723.00	I	530 – 37244
22		2730.08	I	0 – 36618
22		2734.85	II	24647 – 61200
70		2742.53	I	0 – 36452
140		2760.10	I	530 – 36751
30		2785.21	II	23776 – 59670
12		2785.59	II	24647 – 60535
12		2791.20	I	0 – 35817
30		2800.11	II	23445 – 59147
26		2813.64	I	530 – 36061
390		2817.01	III	7466 – 42955
18		2818.86	I	10529 – 45994
45		2822.56	I	10529 – 45948
22		2825.37	II	29214 – 64597
45		2826.38	II	23776 – 59147
70		2854.43	II	24647 – 59670
26		2856.30	II	23776 – 58776
11		2857.87		
95		2886.48	I	11360 – 45994
18		2897.69	II	24647 – 59147
14		2898.82	II	23776 – 58262
160		2919.05	I	0 – 34248
18	h	2930.03	II	27532 – 61650
280	h	2945.94	III	7466 – 41401
390		2948.40	I	0 – 33907
350		2964.96	I	530 – 34248
18		2973.91	II	24647 – 58262
480		2974.59	I	0 – 33608
30		2980.55	II	28394 – 61934
750		2984.26	I	530 – 34030
70		2995.26	I	530 – 33907
140		2996.94	I	0 – 33358
70		3005.26	I	0 – 33265
55		3018.95	I	10529 – 43644
130		3021.73	I	530 – 33614
90		3022.28	I	530 – 33608
26		3026.49	II	26147 – 59179
30		3036.59	II	28730 – 61650
45		3044.84	I	
190		3045.37	I	530 – 33358
22		3047.11	I	
60		3055.22	II	29214 – 61934
60		3086.85	II	26147 – 58533
55	h	3091.70	I	
22		3093.76	II	32284 – 64597
95		3095.88	II	1045 – 33337
45		3111.81	I	10529 – 42656
55		3112.04	II	0 – 32124
22		3114.28	I	
60		3128.77	II	27227 – 59179
80		3129.93	II	27532 – 59472
95		3135.17	II	1450 – 33337
110		3173.06	II	28394 – 59900
220		3179.41	II	840 – 32284
70		3191.31	I	11360 – 42686
2300		3195.62	II	840 – 32124
2200		3200.27	II	1045 – 32284
2200		3203.32	II	840 – 32049
3900		3216.69	II	1045 – 32124
6200		3242.28	II	1450 – 32284
310		3280.91	II	14098 – 44568
19		3308.47	II	28730 – 58947
4700		3327.89	II	3296 – 33337
55		3340.38	I	16066 – 45994
160		3362.00	II	14833 – 44568
85		3388.59	I	15246 – 44748
45		3397.04	I	16234 – 45664
85		3412.47	I	15712 – 45008
200		3448.82	II	3296 – 32284
70		3450.95	I	16234 – 45204
110		3467.88	II	3296 – 32124
170		3485.73	I	17116 – 45796
1700		3496.09	II	0 – 28595
80		3521.53	I	14949 – 43338
45		3546.01	II	
3900		3549.01	II	1045 – 29214
130		3551.80	I	14949 – 43096
540		3552.69	I	0 – 28140
170		3558.76	I	15246 – 43338
190		3571.43	I	15712 – 43704
260		3576.05	I	16234 – 44190
3300		3584.52	II	840 – 28730
300		3587.75	I	
100		3589.69	I	15246 – 43096
2800		3592.92	I	0 – 27824
10000		3600.73	II	1450 – 29214
6200		3601.92	II	840 – 28595
7800		3611.05	II	1045 – 28730
4300		3620.94	I	530 – 28140
1900		3628.71	II	1045 – 28595
7800		3633.12	II	0 – 27517
3000		3664.61	II	1450 – 28730
45		3668.49	II	28394 – 55645
170		3692.53	I	17116 – 44190
13000		3710.30	II	1450 – 28394
60		3718.12	I	16817 – 43704
60		3738.61	I	16597 – 43338
1200		3747.55	II	840 – 27517
50		3749.89	I	16436 – 43096
10000		3774.33	II	1045 – 27532
1400		3776.56	II	1045 – 27517
50		3782.30	II	29214 – 55645
7400		3788.70	II	840 – 27227
1300		3818.35	II	1045 – 27227
4000		3832.88	II	1450 – 27532
70		3847.87	II	
80		3876.82		
480		3878.28	II	1450 – 27227
30		3887.77	I	11360 – 37074
60	h	3904.59	I	
50	h	3918.25	I	10937 – 36452
60	h	3930.11	I	
240		3930.66	II	3296 – 28730
4400		3950.36	II	840 – 26147

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
150		3951.60	II	3296 – 28595
60	h	3955.09	I	
3600		3982.60	II	1045 – 26147
40		3987.50	I	11360 – 36431
940		4039.83	I	0 – 24747
2400		4047.64	I	0 – 24699
9400		4077.38	I	0 – 24519
90	h	4081.22	I	18499 – 42995
2000		4083.71	I	0 – 24481
9900		4102.38	I	530 – 24900
60	h	4106.39	I	18512 – 42858
80		4110.81	I	15246 – 39565
320		4124.92	II	3296 – 27532
8900		4128.31	I	530 – 24747
7500		4142.85	I	0 – 24131
100	h	4157.63	I	15712 – 39758
2400		4167.52	I	530 – 24519
2000		4174.14	I	530 – 24481
8000		4177.54	II	3296 – 27227
120		4199.28	II	840 – 24647
380		4204.70	II	0 – 23776
80		4213.02	I	16234 – 39964
40		4213.54	I	14949 – 38675
160		4217.80	I	10529 – 34231
280	h	4220.63	I	14949 – 38636
80		4224.25	I	
600		4235.73	II	1045 – 24647
2200		4235.94	I	530 – 24131
300		4251.20	I	15246 – 38762
360	h	4302.30	I	15712 – 38949
2800		4309.63	II	1450 – 24647
50		4316.30	I	11360 – 34521
110		4330.78	I	10529 – 33613
30		4337.29	I	15712 – 38762
60		4344.65	I	16436 – 39446
440	h	4348.79	I	16234 – 39223
60		4352.33	I	11278 – 34248
60		4352.70	I	16597 – 39565
120		4357.73	I	16817 – 39758
800		4358.73	II	840 – 23776
120		4366.03	I	11360 – 34257
12000		4374.94	II	3296 – 26147
150	h	4375.61	I	17116 – 39964
80		4379.33	I	11079 – 33907
30		4385.48	I	11360 – 34156
100		4387.74	I	
30		4394.01	I	11278 – 34030
30		4394.67	I	16817 – 39565
1800		4398.02	II	1045 – 23776
890		4422.59	II	840 – 23445
80		4437.34	I	11079 – 33608
100		4443.66	I	11532 – 34030
130		4446.63	I	11360 – 33842
20		4465.27	I	
40		4473.89	I	
170		4475.72	I	11278 – 33614
180		4476.96	I	11278 – 33608
160		4477.45	I	10937 – 33265
110		4487.28	I	11079 – 33358
300		4487.47	I	10937 – 33215
30		4491.75	I	11532 – 33789
25		4492.42	I	11360 – 33613
500		4505.95	I	11079 – 33265
50		4513.58	I	15327 – 37476
80		4514.01	I	15329 – 37476
40	h	4522.05	I	16436 – 38544
890		4527.25	I	11532 – 33614
440		4527.80	I	11278 – 33358
100		4544.32	I	15477 – 37476
100		4559.37	I	15222 – 37148
30		4564.39	I	
60	h	4573.56	I	16817 – 38675
35		4581.32	I	15327 – 37148
30		4581.77	I	15329 – 37148
130		4596.55	I	17116 – 38866
95		4604.80	I	15329 – 37040
40		4613.00	I	15477 – 37148
2000		4643.70	I	0 – 21529
200	h	4658.32	I	16159 – 37620
70		4658.89	I	
85		4667.47	I	15994 – 37413
60		4670.82	I	
2000		4674.84	I	530 – 21915
60		4678.35	I	19148 – 40517
260		4682.32	II	3296 – 24647
85		4689.77	I	16159 – 37476
180		4696.81	I	15994 – 37279
35		4708.85	I	15222 – 36452
60		4725.85	I	15994 – 37148
170		4728.53	I	10529 – 31672
60	h	4732.37	I	15327 – 36452
85		4741.40	I	16159 – 37244
160		4752.79	I	15327 – 36361
410		4760.98	I	530 – 21529
17		4780.18	I	15222 – 36136
120		4781.04	I	11278 – 32188
160		4786.58	II	8328 – 29214
170		4786.89	I	15477 – 36361
180		4799.30	I	11079 – 31909
50		4804.31	I	15327 – 36136
70		4804.81	I	15329 – 36136
85	bl	4817.38	YO	
140	bl	4818.20	YO	
140		4819.64	I	10937 – 31680
120		4822.13	I	15329 – 36061
190		4823.31	II	8003 – 28730
60		4839.15	I	15477 – 36136
770		4839.87	I	11532 – 32188
550		4845.68	I	11278 – 31909
410		4852.69	I	11079 – 31680
120		4854.25	I	15222 – 35817
890		4854.87	II	8003 – 28595
50		4856.70	I	15477 – 36061
330		4859.84	I	10937 – 31508
50		4879.65	I	15329 – 35817
1900		4883.69	II	8743 – 29214
50		4886.28	I	16159 – 36618
40		4886.65	I	15994 – 36452
95		4893.44	I	11079 – 31508
1100		4900.12	II	8328 – 28730
100		4906.11	I	11532 – 31909
45		4909.00	I	16066 – 36431
150		4921.87	I	11360 – 31672
35		4930.93	I	16146 – 36420
45		4950.66	I	
120		4974.30	I	18499 – 38597
120		4982.13	II	8328 – 28394
100		5006.97	I	18512 – 38479
75		5070.21	I	19148 – 38866
75		5072.19	I	

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
1100		5087.42	II	8743 – 28394
30		5088.18	I	19028 – 38675
210		5119.11	II	8003 – 27532
450		5123.21	II	8003 – 27517
180		5135.20	I	18499 – 37967
120		5196.43	II	14098 – 33337
960		5200.41	II	8003 – 27227
1500		5205.72	II	8328 – 27532
180		5240.81	I	18512 – 37588
60		5289.82	II	8328 – 27227
45		5320.78	II	8743 – 27532
75		5380.62	I	15327 – 33907
220		5402.78	II	14833 – 33337
24		5417.03	I	16066 – 34521
90		5424.37	I	15477 – 33907
190		5438.24	I	15864 – 34248
710		5466.46	I	11532 – 29820
100		5468.47	I	15327 – 33608
90		5473.39	II	14018 – 32284
90		5480.74	II	13883 – 32124
60		5493.17	I	14949 – 33148
35		5495.59	I	16066 – 34257
240		5497.41	II	14098 – 32284
300		5503.45	I	15864 – 34030
250		5509.90	II	8003 – 26147
60		5513.64	I	15477 – 33608
120		5521.63	I	15327 – 33432
		5521.70	II	14018 – 32124
24		5526.76	I	16159 – 34248
740		5527.54	I	11278 – 29364
35		5541.63	I	15712 – 33753
120		5544.61	I	15327 – 33358
			II	14018 – 32049
90		5546.02	II	14098 – 32124
75		5556.43	I	15246 – 33238
60		5567.75	I	15477 – 33432
180		5577.42	I	15864 – 33789
24		5581.08	I	15994 – 33907
620		5581.87	I	11079 – 28989
21		5590.96	1	15477 – 33358
21		5594.12	I	16159 – 34030
120		5606.33	1	11532 – 29364
15		5623.91	1	16066 – 33842
560		5630.13	1	10937 – 28694
24		5632.25	1	15864 – 33614
21		5632.89	I	16159 – 33907
120		5644.69	I	11278 – 28989
120		5648.47	I	15712 – 33412
740		5662.94	II	15683 – 33337
90		5675.27	1	11079 – 28694
18		5693.63	I	16597 – 34156
160		5706.73	I	16234 – 33753
24		5720.61	I	16436 – 33912
75		5728.89	II	14833 – 32284
150	bl	5730.12	YO	
21		5732.09	I	16817 – 34257
90		5743.85	I	17116 – 34521
18	bl	5746.93	YO	
24	bl	5764.22	YO	
75		5765.64	I	16817 – 34156
35		5773.95	I	16597 – 33912
100		5781.69	II	14833 – 32124
15	bl	5800.00	YO	
15	bl	5818.58	YO	
30		5821.87	1	16066 – 33238
21		5832.27	I	17116 – 34257
9	b	5838.07	YO	
15		5858.83	YO	
15		5871.83	I	16817 – 33842
24		5876.14	YO	
24		5879.96	I	16146 – 33148
24	b	5893.94	YO	
35		5902.96	I	16817 – 33753
24	b	5912.19	YO	
24	b	5931.10	YO	
90	bl	5939.08	YO	
45		5945.72	I	16597 – 33412
24		5950.02	I	16436 – 33238
75	b	5956.41	YO	
1300	bl	5972.04	YO	
50		5981.86	I	16436 – 33148
1000	bl	5987.64	YO	
740	bl	6003.60	YO	
120		6004.65		
120		6009.19	I	17116 – 33753
620	bl	6019.87	YO	
120		6023.41	I	0 – 16597
500	bl	6036.60	YO	
420	bl	6053.81	YO	
130	bl	6072.78	YO	
50		6088.00	I	16817 – 33238
210	bl	6089.35	YO	
160	bl	6096.78	YO	
130	bl	6107.82	YO	
130	bl	6114.73	YO	
75	bl	6127.38	YO	
1400	bl	6132.06	YO	
120		6135.04	I	17116 – 33412
150		6138.43	I	530 – 16817
1100	bl	6148.36	YO	
120		6151.72	YO	
820	bl	6165.08	YO	
560	bl	6182.23	YO	
1200		6191.73	I	0 – 16146
590	bl	6199.82	YO	
450	bl	6217.96	YO	
300		6222.59	I	0 – 16066
270	bl	6236.72	YO	
45		6251.05	1	
120	bl	6275.01	YO	
60	b	6295.46	YO	
24	b	6316.20	YO	
24	b	6338.10	YO	
15	b	6359.48	YO	
15		6369.87	YO	
75		6402.01	I	530 – 16146
1000		6435.00	I	530 – 16066
24		6437.18	I	18499 – 34030
18	h	6501.23	YO	
18	h	6518.33	YO	
18	h	6535.84	YO	
90		6538.60	I	18499 – 33789
12	h	6553.84	YO	
70		6557.39	I	0 – 15246
12	h	6572.58		
35		6576.85	I	19238 – 34438
23		6584.87	I	530 – 15712
95		6613.75	II	14098 – 29214
14		6622.49	I	18512 – 33608
19	h	6636.49	I	28989 – 44053

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
40		6650.61	I	19406 – 34438
21		6664.40	I	29364 – 44366
150		6687.58	I	0 – 14949
14	h	6691.83	I	29820 – 44760
7		6694.75	I	18499 – 33432
16	h	6699.26	I	
70		6700.71	I	18512 – 33432
35		6713.20	I	21529 – 36420
40		6735.99	I	19406 – 34248
190		6793.71	I	530 – 15246
70	h	6795.41	II	14018 – 28730
12	h	6803.15	I	19148 – 33842
21		6815.16	I	19238 – 33907
14		6832.49	II	14098 – 28730
45		6845.24	I	19148 – 33753
14		6858.24	II	14018 – 28595
29		6887.22	I	21915 – 36431
21		6896.00	II	14098 – 28595
9		6908.26	I	14949 – 29420
14		6933.52	I	530 – 14949
24	h	6950.31	I	19028 – 33412
10		6951.68	II	14833 – 29214
10		6958.04	I	15246 – 29614
24		6979.88	I	14949 – 29272
13	h	7008.97	I	19148 – 33412
10		7009.93	I	18976 – 33238
19	h	7035.18	I	19028 – 33238
29		7052.94	I	15246 – 29420
13	h	7054.28	I	18976 – 33148
9		7075.13	I	15712 – 29843
11		7127.92	I	15246 – 29272
35		7191.66	I	15712 – 29614
10	h	7195.93	I	36361 – 50254
35		7264.17	II	14833 – 28595
9	h	7293.08	I	15712 – 29420
9	h	7330.62		
5		7332.96	II	13883 – 27517
50		7346.46	I	16234 – 29843
11	h	7398.77	I	15477 – 28989
29		7450.30	II	14098 – 27517
17		7494.88	I	19028 – 32366
7	h	7536.71	I	
35		7563.13	I	19148 – 32366
8	h	7617.72	I	
19	h	7622.94	I	18976 – 32091
7		7652.89	I	19028 – 32091
5		7689.49	I	18976 – 31978
8	h	7698.00	I	
19		7719.89	I	19028 – 31978
19		7724.08	I	19148 – 32091
13		7788.42	I	16436 – 29272
13		7796.32	I	16597 – 29420
6		7802.52	I	15327 – 28140
17		7812.16	I	16817 – 29614
29		7855.52	I	17116 – 29843
110		7881.90	II	14833 – 27517
10	h	7999.33	I	17116 – 29614
9		8329.61	I	32188 – 44190
24		8344.43	I	16159 – 28140
8	h	8365.64	I	24481 – 36431
17		8450.36	I	15994 – 27824
8	h	8528.94	I	24699 – 36420
95		8800.62	I	0 – 11360
19	h	8835.85	II	14833 – 26147

Zinc

$$\text{Zn},\ Z = 30,\ M = 65.4,\ \text{Ratio}\ \frac{\text{Zn}}{\text{Cu}} = 1.029$$

Zn I Normal state of valence electrons $3d^{10}4s^2\ {}^1S_0 = 0$. I.P. = 75768 cm^{-1}.
Zn II Normal state of valence electrons $3d^{10}4s\ {}^2S_{1/2} = 0$. I.P. = 144893 cm^{-1}.

References

Wavelengths:
G. R. Harrison, Massachusetts Institute of Technology Wavelength Tables (John Wiley & Sons, New York, 1939).

Classification:
Zn I, C. W. Hetzler, R. W. Boreman, and K. Burns, Phys. Rev. **48**, 656 (1935).
Zn II, W. C. Martin and V. Kaufman, J. Res. Nat. Bur. Stand. (U.S.), **74A** (Phys. and Chem.), No. 1, 11–22 (Jan.–Feb. 1970).

Zinc—all observed lines

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
3000	2025.48	II	0 – 49355	200	3282.33	I	32311 – 62769
10000 -	2062.00	II	0 – 48481	900	3302.59	I	32501 – 62772
10000 -	2138.56	I	0 – 46745	280	3302.94	I	32501 – 62769
35 h	2756.45	I	32311 – 68579	1400	3345.02	I	32890 – 62777
60 d	2770.86	I	32501 – 68581	300	3345.57	I	32890 – 62772
	2770.98	I	32501 – 68579	60	3345.93	I	32890 – 62769
90 d	2800.87	I	32890 – 68583	400	4680.14	I	32311 – 53672
	2801.06	I	32890 – 68581	1000	4722.16	I	32501 – 53672
100 h	3072.06	I	32890 – 65432	1400	4810.53	I	32890 – 53672
260	3075.90	I	0 – 32502	120 hl	6362.35	I	46745 – 62458

Zirconium

$$\text{Zr},\ Z=40,\ M=91.22,\ \text{Ratio}\ \frac{\text{Zr}}{\text{Cu}}=1.435$$

Zr I, Normal state of valence electrons $4d^2 5s^2\ {}^3F_2=0$. I.P. $=56077\ \text{cm}^{-1}$.
Zr II, Normal state of valence electrons $4d^2 5s\ {}^4F_{1\ 1/2}=0$. I.P. $=113175\ \text{cm}^{-1}$.

References

Wavelengths:
G. R. Harrison, Massachusetts Institute of Technology Wavelength Tables (John Wiley & Sons, New York, 1939).

Classification:
Zr I, C. C. Kiess and H. K. Kiess, J. Research NBS **6**, 621 (1931) RP 296.
Zr II, C. C. Kiess and H. K. Kiess, J. Research NBS **5**, 1205 (1930) RP 255.

Molecular Spectra:
ZrO, C. C. Kiess, Sci. Papers BS **22**, 47 (1927).

Strong lines of zirconium

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
5700	3391.98	II	1323 – 30796	1800	2678.63	II	1323 – 38644
4700	3438.23	II	763 – 29840	1800	3547.68	I	570 – 28750
4100	3496.21	II	315 – 28909				
3500	3601.19	I	1241 – 29002	1800	3551.95	II	763 – 28909
2900	3863.87	I	570 – 26444	1600	2568.87	II	1323 – 40239
				1500	3885.42	I	0 – 25730
2900	3890.32	I	1241 – 26938	1500	4064.16	I	5249 – 29847
2300	4687.80	I	5889 – 27215	1400	2734.86	II	315 – 36869
2200	3835.96	I	0 – 26062				
2100	2571.39	II	763 – 39640	1400	4739.48	I	5249 – 26343
2100	3556.60	II	3758 – 31866	1300	2722.61	II	1323 – 38041
				1300	3279.26	II	763 – 31249
2100	3572.47	II	0 – 27984	1300	3481.15	II	6468 – 35186
2000	3519.60	I	0 – 28404	1300	3576.85	II	3300 – 31249
2000	3891.38	I	1241 – 26931				
2000	4072.70	I	5541 – 30087	1300	3836.76	II	4506 – 30562
2000	4081.22	I	5889 – 30385	1200	3479.39	II	5753 – 34485
				1200	3929.53	I	570 – 26012
2000	4227.76	I	5889 – 29535	1200	4149.20	II	6468 – 30562
2000	4239.31	I	5541 – 29123	1200	4241.69	I	5249 – 28818
1900	4710.08	I	5541 – 26766				

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
60	2374.42	I	0 – 42103
60	2384.17	I	
50	2388.01	I	570 – 42434
50	2389.21	I	
45	2405.52	I	1241 – 42799
60	2419.41	II	4248 – 45568
150	2449.85	II	4248 – 45055
21	2457.44	II	4506 – 45186
75	2487.29	II	8153 – 48345
45	2496.48	II	7838 – 47882
180	2532.46	II	763 – 40239
90	2539.65	I	570 – 39934
220	2542.10	II	315 – 39640
45	2550.51	I	570 – 39766
220	2550.74	II	0 – 39192
45	2556.43	I	1241 – 40346
60	2567.45	I	1241 – 40178
570	2567.64	II	0 – 38934
1600	2568.87	II	1323 – 40239
2100	2571.39	II	763 – 39640
75	2583.40	II	4506 – 43202
130	2589.07	II	4248 – 42861
22	2589.65	I	570 – 39174
45	2609.43	I	570 – 38882
150	2630.91	II	4506 – 42504
80	2635.42	I	1241 – 39174
210	2639.09	II	763 – 38644
70	2643.40	II	315 – 38134
55	2647.78	I	570 – 38327
110	2650.38	II	763 – 38483
70	2658.69	I	4186 – 41788
180	2667.80	II	315 – 37788
55	2669.49	II	5753 – 43202
		II	7736 – 45186
120	2670.96	II	4248 – 41677
1800	2678.63	II	1323 – 38644
35	2681.76	II	763 – 38041
90	2687.75	I	1241 – 38436
90	2692.60	II	8058 – 45186
22	2692.92	I	0 – 37123
160	2693.53	II	315 – 37430
180	2694.06	II	5753 – 42861
70	2695.43	II	4248 – 41337
95	2699.60	II	315 – 37346
750	2700.13	II	763 – 37788
90	2706.17	I	0 – 36942
70	2709.33	I	570 – 37469
280	2711.51	II	0 – 36869
140	2712.42	II	315 – 37171
140	2714.26	II	4506 – 41337
12	2717.48	I	4186 – 40974
1300	2722.61	II	1323 – 38041
140	2725.47	I	1241 – 37921
800	2726.49	II	763 – 37430
60	2727.02	I	570 – 37230
490	2732.72	II	763 – 37346
1400	2734.86	II	315 – 36869
35	2737.89	I	
70	2740.35	II	3758 – 40239
110	2740.51	II	4248 – 40727
140	2741.55	II	1323 – 37788
1100	2742.56	II	0 – 36452
660	2745.86	II	763 – 37171
660	2752.21	II	315 – 36639
530	2758.81	II	0 – 36237
12	2759.48	I	1241 – 37469
70	2761.91	II	0 – 36197
90	2763.03	I	4376 – 40558
200 d	2768.73	II	1323 – 37430
	2768.85	II	763 – 36869
170 d	2774.04	I	570 – 36608
	2774.16	II	6468 – 42504
80	2786.86	I	5102 – 40974
200	2790.14	I	5102 – 40932
120	2792.04	I	0 – 35806
90	2793.39	I	
30	2795.13	I	570 – 36336
160	2796.90	II	5724 – 41468
110	2799.15	II	5753 – 41468
90	2806.78	I	4186 – 39804
35	2808.16	II	315 – 35915
180	2810.91	II	6112 – 41677
620	2814.90	I	0 – 35515
390	2818.74	II	7736 – 43202
70	2819.56	I	5102 – 40558
55	2821.56	I	570 – 36001
530	2825.56	II	7513 – 42894
90	2827.50	II	6112 – 41468
	2827.54	I	1241 – 36597
60	2829.81	I	4376 – 39704
110	2833.91	II	7513 – 42789
80	2834.40	II	6468 – 41738
35	2836.49	I	5102 – 40346
710	2837.23	I	570 – 35806
55	2838.02	II	6112 – 41337
120	2839.34	II	6468 – 41677
130	2843.52	II	7736 – 42894
660	2844.58	II	8058 – 43202
210	2848.19	II	5753 – 40853
350	2848.52	I	1241 – 36336
350	2851.97	II	7736 – 42789
70	2854.43	II	7838 – 42861
27	2856.06	II	5724 – 40727
95	2860.85	I	570 – 35515
55	2865.10	II	2895 – 37788
90	2865.60	II	3758 – 38644
340	2869.81	II	8058 – 42894
35	2872.53	II	8058 – 42861
490	2875.98	I	1241 – 36001
90	2877.55	II	3300 – 38041
35	2880.83	I	5102 – 39804
35	2882.09	II	4248 – 38934
55	2883.80	II	7838 – 42504
90	2888.04	II	6112 – 40727
45	2889.43	II	2572 – 37171
120	2892.26	I	1241 – 35806
90	2898.71	II	3300 – 37788
60	2901.62	II	13428 – 47882
55	2901.82	II	2895 – 37346
160	2905.23	II	6468 – 40878
70	2907.38	II	6468 – 40853
90	2910.25	II	8153 – 42504
300	2915.99	II	3758 – 38041
27	2916.25	I	570 – 34851
110	2916.64	II	2895 – 37171
270	2918.24	II	8153 – 42410
70	2923.85	I	570 – 34762
45	2924.64	II	14163 – 48345
320	2926.99	II	14190 – 48345
160	2934.61	II	2572 – 36639

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
160	2936.31	II	3300 – 37346
90	2945.46	II	7736 – 41677
320	2948.94	II	7838 – 41738
210	2951.48	II	3300 – 37171
95	2952.24	II	1323 – 35186
320	2955.78	II	14060 – 47882
320	2960.87	I	0 – 33764
320	2962.68	II	2895 – 36639
320	2968.96	II	3758 – 37430
120	2969.19	I	570 – 34240
230	2969.63	II	2572 – 36237
130	2976.61	II	8153 – 41738
320	2978.05	II	3300 – 36869
230	2979.18	II	2895 – 36452
160	2981.02	II	4506 – 38041
820	2985.39	I	0 – 33487
25	2987.80	II	9743 – 43202
50	2991.41	II	0 – 33419
320	3003.74	II	4506 – 37788
100	3005.37	I	4186 – 37450
160	3005.50	I	8057 – 41320
820	3011.75	I	570 – 33764
100	3013.32	II	4506 – 37682
65	3014.44	I	0 – 33164
160	3019.84	II	315 – 33419
350	3020.47	II	4248 – 37346
500	3028.04	II	7838 – 40853
880	3029.52	I	1241 – 34240
180	3030.92	II	0 – 32984
350 d	3036.39	II	4506 – 37430
	3036.50	II	4248 – 37171
30	3043.25	I	570 – 33420
100	3045.83	I	4186 – 37008
70	3049.33	I	4186 – 36971
690	3054.84	II	8153 – 40878
70	3057.22	II	8153 – 40853
100	3060.11	II	315 – 32984
90	3061.35	II	763 – 33419
70	3063.57	I	4376 – 37008
100	3064.63	II	4248 – 36869
50	3065.21	II	0 – 32615
110	3085.34	I	570 – 32972
55	3090.44	I	5102 – 37450
110	3094.80	I	4186 – 36489
250	3095.07	II	315 – 32615
110	3095.82	I	4197 – 36489
280	3099.23	II	0 – 32257
690	3106.58	II	8058 – 40239
110	3108.37	I	4376 – 36538
210	3110.88	II	763 – 32899
350	3120.74	I	4186 – 36220
70	3125.19	II	4248 – 36237
320	3125.92	II	0 – 31981
500	3129.18	II	4248 – 36197
500	3129.76	II	315 – 32257
140	3131.11	I	4197 – 36125
350	3132.07	I	4376 – 36295
110	3133.23	I	5102 – 37008
350	3133.48	II	7736 – 39640
180	3136.96	I	5102 – 36971
690	3138.68	II	763 – 32615
140	3139.80	I	5102 – 36942
180	3148.82	I	4376 – 36125
290	3155.67	II	7513 – 39192
150	3157.00	II	4248 – 35915
320	3157.82	I	4376 – 36035
		I	5102 – 36760
540	3164.31	II	5753 – 37346
150	3165.45	II	8058 – 39640
880	3165.97	II	1323 – 32899
150	3166.26	II	6468 – 38041
190	3178.09	II	7736 – 39192
190	3181.58	II	7513 – 38934
150	3181.92	II	5753 – 37171
880	3182.86	II	4506 – 35915
540	3191.21	I	0 – 31327
210	3191.90	II	6468 – 37788
75	3197.04	I	4186 – 35456
25	3204.35	II	7736 – 38934
95	3204.90	I	5102 – 36295
540	3212.01	I	570 – 31695
45	3212.58	I	5102 – 36220
75	3212.85	II	5753 – 36869
760	3214.19	II	763 – 31866
110	3222.47	II	14163 – 45186
200	3228.81	II	6468 – 37430
630	3231.69	II	315 – 31249
630	3234.12	I	1241 – 32152
110	3236.58	II	14299 – 45186
760	3241.05	II	315 – 31160
320	3250.39	I	570 – 31327
	3250.46	II	14299 – 45055
200	3254.28	I	16978 – 47698
200	3260.11	I	4186 – 34851
40	3264.81	II	7513 – 38134
190	3269.66	I	4186 – 34762
150	3271.13	II	4248 – 34810
540	3272.22	II	0 – 30551
1000	3273.05	II	1323 – 31866
1300	3279.26	II	763 – 31249
320 d	3282.73	I	1241 – 31695
	3282.83	II	14733 – 45186
880	3284.71	II	0 – 30435
140	3285.88	II	8058 – 38483
150	3288.80	II	763 – 31160
		II	7736 – 38134
75	3296.40	II	7736 – 38063
75	3302.67	II	9969 – 40239
		II	17614 – 47882
540	3305.15	II	315 – 30562
880	3306.28	II	315 – 30551
40	3309.89	II	7838 – 38041
40	3311.34	II	5724 – 35915
150	3313.70	II	7513 – 37682
210	3314.50	II	5753 – 35915
75	3318.51	II	6112 – 36237
150	3319.02	II	315 – 30435
380	3322.99	II	6112 – 36197
40	3326.41	I	4186 – 34240
380	3326.80	II	12360 – 42410
380	3334.25	II	8058 – 38041
210	3334.62	II	4506 – 34485
190	3338.41	II	7736 – 37682
760	3340.56	II	1323 – 31249
380	3344.79	II	8153 – 38041
130	3353.66	I	1241 – 31050
180	3354.39	II	6112 – 35915
760	3356.09	II	763 – 30551
540	3357.26	II	0 – 29778
180	3359.96	II	11984 – 41738

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
150	3360.46	I	5102 – 34851
95	3362.68	II	8058 – 37788
150	3363.82	II	2895 – 32615
150	3367.82	II	2572 – 32257
25	3368.64	I	0 – 29677
40	3369.26	II	9969 – 39640
150	3370.59	I	5102 – 34762
180	3373.42	II	8153 – 37788
380	3374.73	II	8058 – 37682
110	3376.27	II	7736 – 37346
150	3377.46	II	3300 – 32899
55	3378.30	II	7838 – 37430
55	3379.92	I	17556 – 47135
570	3387.87	II	7838 – 37346
760	3388.30	II	0 – 29505
5700	3391.98	II	1323 – 30796
570	3393.12	II	315 – 29778
160	3396.33	II	7736 – 37171
40	3396.66	II	13429 – 42861
40	3397.92	I	18277 – 47698
380	3399.35	II	2572 – 31981
150	3402.87	II	12360 – 41738
190	3403.68	II	8058 – 37430
570	3404.83	II	2895 – 32257
190	3408.08	II	7838 – 37171
40	3408.78		
760	3410.25	II	3300 – 32615
40 h	3411.79	I	17833 – 47135
380	3414.66	I	570 – 29847
		II	8153 – 37430
75	3419.11	II	1323 – 30562
110	3419.66	I	4186 – 33420
160	3424.82	II	315 – 29505
25	3426.93	I	8057 – 37230
65	3430.29	I	1241 – 30385
1000	3430.53	II	3758 – 32899
110	3431.57	II	7736 – 36869
140	3432.41	II	7513 – 36639
110	3433.91	II	8058 – 37171
380	3437.14	II	5724 – 34810
4700	3438.23	II	763 – 29840
180	3440.45	I	0 – 29058
120	3443.57	II	7838 – 36869
190	3446.61	I	4186 – 33192
600	3447.36	I	0 – 28999
200	3455.91	I	4186 – 33114
110	3457.18	I	4197 – 33114
410	3457.56	II	4506 – 33419
200	3458.93	II	7736 – 36639
160	3461.09	I	8057 – 36942
820	3463.02	II	11984 – 40853
95	3465.63	I	1241 – 30087
40	3469.94	II	8058 – 36869
600	3471.19	I	0 – 28801
25	3472.90	I	4186 – 32972
130	3478.30	II	763 – 29505
65	3478.50	II	9743 – 38483
200	3478.79	I	4376 – 33114
180	3479.02	II	4248 – 32984
1200	3479.39	II	5753 – 34485
150	3480.41	II	7513 – 36237
1300	3481.15	II	6468 – 35186
190	3482.81	I	570 – 29275
190	3483.01	I	8057 – 36760
760	3483.54	II	6112 – 34810
130	3485.32	II	7513 – 36197
45	3495.37	I	11956 – 40558
4100	3496.21	II	315 – 28909
190	3499.58	II	3300 – 31866
130	3501.35	I	570 – 29123
80	3501.49	I	8057 – 36608
350	3505.48	II	12360 – 40878
820	3505.67	II	1323 – 29840
80	3506.05	II	9969 – 38483
45	3507.67	II	7736 – 36237
1000	3509.32	I	570 – 29058
200	3510.46	II	4506 – 32984
2000	3519.60	I	0 – 28404
130	3520.87	II	4506 – 32899
440	3525.81	II	2895 – 31249
90	3530.22	I	5102 – 33420
70	3530.85	II	14190 – 42504
440	3533.22	I	1241 – 29535
210	3535.16	I	8057 – 36336
110	3536.94	II	2895 – 31160
45	3539.01	II	13429 – 41677
630	3542.62	II	14190 – 42410
1800	3547.68	I	570 – 28750
130	3549.51	II	9969 – 38134
210	3549.74	I	8057 – 36220
630	3550.46	I	0 – 28157
1800	3551.95	II	763 – 28909
130	3554.07	II	9553 – 37682
2100	3556.60	II	3758 – 31866
150	3558.96	I	5102 – 33192
1100	3566.10	I	1241 – 29275
90	3568.14	II	6468 – 34485
210	3568.88	I	5102 – 33114
2100	3572.47	II	0 – 27984
210	3573.08	II	2572 – 30551
1100	3575.79	I	570 – 28528
1300	3576.85	II	3300 – 31249
180	3577.55	I	8057 – 36001
150	3578.23	II	9743 – 37682
880	3586.29	I	0 – 27876
440	3587.98	II	2572 – 30435
180	3588.32	II	3300 – 31160
70	3591.72	I	570 – 28404
45 h	3593.13	I	17060 – 44882
90	3599.90	II	14733 – 42504
3500	3601.19	I	1241 – 29002
160	3607.38	II	9969 – 37682
690	3611.89	II	14060 – 41738
1100	3613.10	II	315 – 27984
140	3613.70	I	4186 – 31851
1100	3614.77	II	2895 – 30551
1100	3623.86	I	570 – 28157
180	3630.02	II	2895 – 30435
140	3633.49	II	14163 – 41677
320	3634.15	I	1241 – 28750
180	3636.45	II	3758 – 31249
30	3638.72	I	4376 – 31851
30	3655.56	II	7838 – 35186
260	3661.20	I	570 – 27876
95	3662.14	II	13429 – 40727
1100	3663.65	I	1241 – 28528
160	3668.45	II	3300 – 30551
390	3671.27	II	5753 – 32984
800	3674.72	II	2572 – 29778
140	3678.90	II	14163 – 41337

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
55		3680.37	I	1241 – 28404
390		3697.46	II	3758 – 30796
960		3698.17	II	8153 – 35186
90		3706.63	I	1241 – 28212
720		3709.26	II	6468 – 33419
190		3714.13	I	1241 – 28157
190		3714.78	II	4248 – 31160
65		3718.84	II	2895 – 29778
270		3731.26	II	14060 – 40853
50		3737.39	I	5102 – 31851
50		3738.11	II	4506 – 31249
560		3745.98	II	14190 – 40878
80		3750.64	II	4506 – 31160
880		3751.60	II	7838 – 34485
50		3754.79	I	14349 – 40974
95		3757.79	II	14733 – 41337
480		3764.39	I	0 – 26557
480		3766.72	I	12342 – 38882
340		3766.82	II	3300 – 29840
24		3767.88	II	5724 – 32257
720		3780.54	I	0 – 26444
50		3782.22	II	6468 – 32899
95		3786.61		
560		3791.40	I	570 – 26938
90		3792.40	I	570 – 26931
130		3796.48	II	8153 – 34485
95		3808.20		
210		3817.58	II	4248 – 30435
560		3822.41	I	0 – 26154
			I	5541 – 31695
55		3827.27	II	
2200		3835.96	I	0 – 26062
1300		3836.76	II	4506 – 30562
160		3838.28	II	4506 – 30551
550		3843.02	II	2895 – 28909
550		3847.01	I	570 – 26557
550		3849.25	I	0 – 25972
110		3855.43	II	4506 – 30435
2900		3863.87	I	570 – 26444
770		3864.34	I	1241 – 27111
990		3877.60	1	8057 – 33839
200		3879.05	1	570 – 26343
1500		3885.42	1	0 – 25730
2900		3890.32	I	1241 – 26938
2000		3891.38	1	1241 – 26931
100	h	3892.03	I	15201 – 40888
75	h	3893.84	I	12761 – 38436
160		3896.53	I	570 – 26227
			I	17143 – 42799
75		3897.66	I	14697 – 40346
400		3900.52	I	0 – 25630
40		3914.34	II	19515 – 45055
310		3915.94	II	4248 – 29778
160		3916.64	I	1241 – 26766
610		3921.79	I	570 – 26062
75	h	3926.78	I	15720 – 41179
1200		3929.53	I	570 – 26012
200		3934.12	II	2572 – 27984
200		3934.79	II	5753 – 31160
65		3936.06	II	6468 – 31866
100		3941.62	I	8057 – 33420
40		3951.33	I	11641 – 36942
40		3956.79		
940		3958.22	II	4248 – 29505
75	h	3963.80	I	16317 – 41538
490		3966.66	I	1241 – 26444
990		3968.26	I	1241 – 26434
40		3972.30	I	15720 – 40888
110		3973.39	I	12761 – 37921
660		3973.50	I	570 – 25730
200		3975.29	I	12773 – 37921
65		3977.34	I	5249 – 30385
160		3977.48	I	8057 – 33192
40		3978.25	I	
100		3978.74	I	12342 – 37469
200	h	3981.60	I	11017 – 36125
			I	16978 – 42087
100		3982.16	I	10885 – 35990
160		3984.75	I	4186 – 29275
65		3986.80	I	570 – 25646
100		3988.68	I	5023 – 30087
75		3989.29	I	570 – 25630
160		3989.50	I	15120 – 40178
770		3991.13	II	6112 – 31160
770		3998.97	II	4506 – 29505
40		4001.09	I	1241 – 26227
75		4002.55	I	4871 – 29847
140		4003.10	I	11017 – 35990
75		4004.40	I	12503 – 37469
75	h	4004.87	I	16978 – 41941
200		4007.60	I	14989 – 39934
200		4012.25	I	15720 – 40637
160		4016.98	I	12342 – 37230
120		4018.38	II	7736 – 32615
400		4023.98	I	5541 – 30385
120		4024.44	II	8058 – 32899
770		4024.92	I	5249 – 30087
990		4027.20	I	5023 – 29847
240		4028.95	I	4186 – 28999
400		4029.68	II	5753 – 30562
490		4030.04	I	4871 – 29677
40		4034.09	II	6468 – 31249
400		4035.89	I	1241 – 26012
40		4040.24	II	7513 – 32257
100		4041.64	I	15201 – 39937
240		4042.22	I	11258 – 35990
610		4043.58	I	4186 – 28910
490		4044.56	I	4871 – 29588
400		4045.61	II	5724 – 30435
610		4048.67	II	6468 – 31160
200		4050.33	II	5753 – 30435
200		4050.48	I	4376 – 29058
120		4054.43	I	1241 – 25898
770		4055.03	I	5023 – 29677
600		4055.71	I	12773 – 37422
330		4061.53	I	4186 – 28801
1500		4064.16	I	5249 – 29847
75		4068.72	I	10885 – 35456
2000		4072.70	I	5541 – 30087
310		4074.93	I	4376 – 28910
200		4076.53	I	4186 – 28710
240		4078.31	I	4197 – 28710
2000		4081.22	I	5889 – 30385
65		4082.30	I	1241 – 25730
120		4083.08	I	11641 – 36125
160		4084.30	I	14697 – 39174
160		4085.66	I	12761 – 37230
75		4087.69	I	12773 – 37230
160		4090.51	II	6112 – 30551
160		4090.79	I	12503 – 36942

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
55	4093.16	I	4376 – 28801
120	4094.27	I	12342 – 36760
65	4096.63	II	4506 – 28909
110	4099.31	I	0 – 24388
160	4107.50	I	11956 – 36295
200	4108.40	I	4376 – 28710
110	4119.83	I	12342 – 36608
400	4121.46	I	4376 – 28633
75 h	4127.96	I	4186 – 28404
		I	4376 – 28595
75	4134.31	I	12761 – 36942
160	4135.68	I	5102 – 29275
40	4140.01	I	14123 – 38271
65	4147.37	I	12503 – 36608
1200	4149.20	II	6468 – 30562
160	4150.97	II	6468 – 30551
200	4152.64	I	11017 – 35091
75	4153.75	I	12773 – 36841
290	4156.24	II	5724 – 29778
400	4161.21	II	5753 – 29778
400	4166.36	I	5541 – 29535
75	4169.36	I	14349 – 38327
120	4171.48	I	10885 – 34851
75	4179.81	II	13429 – 37346
200	4183.32	I	5102 – 28999
100	4186.69	II	14163 – 38041
660	4187.56	I	11641 – 35515
120	4191.79	I	11956 – 35806
40	4192.10	I	12761 – 36608
40	4194.01	I	12761 – 36597
400	4194.76	I	11258 – 35091
75	4196.13	I	12773 – 36597
610	4199.09	I	5102 – 28910
610	4201.46	I	5023 – 28818
610	4208.98	II	5753 – 29505
75	4211.34	I	14697 – 38436
200	4211.88	II	4248 – 27984
75	4212.62	I	10885 – 34617
400	4213.86	I	4871 – 28595
120	4218.45	I	5102 – 28801
40	4220.65	I	5023 – 28710
65	4225.46	I	12342 – 36001
2000	4227.76	I	5889 – 29535
40	4231.63	II	14163 – 37788
160	4234.63	I	5102 – 28710
200	4236.06	I	11017 – 34617
65	4236.55	I	0 – 23597
100	4237.43	I	11258 – 34851
2000	4239.31	I	5541 – 29123
770	4240.34	I	4871 – 28447
770	4241.20	I	5023 – 28595
1200	4241.69	I	5249 – 28818
75	4253.57	I	11258 – 34762
75	4256.44	I	4186 – 27673
180	4258.04	II	4506 – 27984
75	4261.21	I	5541 – 29002
75	4261.42	I	12761 – 36220
310	4268.02	I	5023 – 28447
75	4273.52	II	6112 – 29506
90	4274.77	I	4186 – 27573
120	4276.72	I	4197 – 27573
75	4282.03	I	17833 – 41179
550	4282.20	I	5249 – 28595
40	4286.51	II	7838 – 31160
110	4291.20	I	4376 – 27673
110	4291.35	I	4186 – 27482
550	4294.79	I	5541 – 28818
40	4296.74	II	14163 – 37430
310	4302.89	I	5889 – 29123
190	4304.68	I	14697 – 37921
40	4309.82	I	4376 – 27573
75	4317.31	II	5753 – 28909
75	4319.05	I	1241 – 24388
75	4321.17	I	1241 – 24376
110	4324.03	I	14349 – 37469
180	4325.44	I	5889 – 29002
40	4329.56	I	570 – 23661
40	4333.26	II	19433 – 42504
550	4341.13	I	11258 – 34287
40	4343.04	I	0 – 23019
65	4346.52	I	14123 – 37123
35	4347.22	I	570 – 23567
1000	4347.89	I	8057 – 31050
35	4348.93	I	5541 – 28528
65	4358.74	I	4186 – 27122
290	4359.74	II	9969 – 32899
310	4360.81	I	4186 – 27111
350	4366.45	I	11017 – 33912
130	4370.95	II	9743 – 32615
35	4373.07	I	5889 – 28750
240	4379.78	II	12360 – 35186
35	4394.50	I	570 – 23320
130	4394.94	I	10885 – 33632
100	4395.21	I	4376 – 27122
90	4400.24	I	5889 – 28609
65	4402.95	I	4197 – 26902
65	4403.34	II	9553 – 32257
190	4413.04	I	11258 – 33912
35	4414.14	I	1241 – 23889
65	4414.54	II	9969 – 32615
240	4420.46	I	11017 – 33632
120	4427.24	I	18739 – 41320
55	4429.11	I	5102 – 27673
160	4431.49	I	10885 – 33445
90	4438.05	I	4376 – 26902
75	4440.46	II	9743 – 32257
140	4443.00	II	11984 – 34485
28	4444.33	I	11956 – 34451
28	4448.95	I	5102 – 27573
90	4450.28	I	10885 – 33350
55	4455.43	I	14791 – 37230
55	4456.30	I	14989 – 37422
110	4457.43	I	11017 – 33445
		II	9553 – 31981
28	4460.34	I	5102 – 27515
90	4461.22	II	8153 – 30562
110	4466.91	I	5102 – 27482
28	4468.22	I	11258 – 33632
45	4468.79	I	4186 – 26557
110	4470.31	I	12342 – 34706
190	4470.56	I	12773 – 35135
35	4480.77	I	14697 – 37008
45	4482.50	I	15120 – 37422
28	4491.56	I	4186 – 26444
55	4494.42	II	19433 – 41677
28	4494.94	I	14989 – 37230
200	4496.97	II	5753 – 27984
550	4507.12	I	4376 – 26557
28	4523.13	I	17753 – 39855
610	4535.75	I	4186 – 26227

559-795 O - 75 - 26 (Pt. 1)

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
75		4539.98	I	5102 – 27122
490		4542.22	I	5102 – 27111
200		4553.01	I	4197 – 26154
45		4553.97	II	19515 – 41468
200		4555.13	I	12503 – 34451
140		4555.52	I	12760 – 34706
45		4558.04	I	11258 – 33192
			I	12773 – 34706
22		4562.12	I	
45		4565.47	I	12342 – 34240
20		4574.50	II	19614 – 41468
490		4575.52	I	0 – 21849
40		4576.20	I	11641 – 33487
100		4582.29	I	14791 – 36608
75		4584.24	I	11956 – 33764
20		4590.16	I	11641 – 33420
140		4590.55	I	4376 – 26154
350		4602.57	I	15120 – 36841
140		4604.42	I	4186 – 25898
22		4609.15	I	12761 – 34451
22		4609.29	I	5249 – 26938
22		4609.83	I	4871 – 26557
22		4610.11	I	4376 – 26062
22	bl	4619.85	Zr O	
210		4626.41	I	14989 – 36597
22		4627.72	I	11956 – 33559
40		4629.07	II	20080 – 41677
700		4633.98	I	570 – 22144
23		4634.64	I	5541 – 27111
23	bl	4637.78	Zr O	
70		4640.13	I	14791 – 36336
210		4644.83	I	14697 – 36220
			I	11641 – 33164
35		4654.38	I	12761 – 34240
95		4657.64	I	11956 – 33420
35		4659.49	I	5102 – 26557
70		4667.14	I	5023 – 26444
260		4683.42	I	12342 – 33688
70		4684.25	I	5102 – 26444
23		4685.19	II	19515 – 40853
23		4686.57	I	11641 – 32972
2300		4687.80	I	5889 – 27215
510		4688.45	I	1241 – 22564
23		4691.73	I	5249 – 26557
23		4695.04	I	17143 – 38436
45	h	4700.11	I	
		4700.18	I	4376 – 25646
110		4707.79	I	11956 – 33192
1900		4710.08	I	5541 – 26766
160		4711.92	I	12342 – 33559
70		4713.43	I	14791 – 36001
120		4717.62	I	4871 – 26062
210		4719.12	I	14989 – 36173
23		4731.14	I	5023 – 26154
300		4732.33	I	5102 – 26227
35		4734.36	I	18739 – 39855
1400		4739.48	I	5249 – 26343
35		4742.94	I	12342 – 33420
40		4751.91	I	5023 – 26062
60		4753.05	I	15120 – 36153
190		4762.78	I	14791 – 35782
870		4772.31	I	5023 – 25972
210		4784.92	I	5541 – 26434
160		4788.67	I	5889 – 26766
40		4789.11	I	5023 – 25898
35		4793.28	I	14349 – 35206
29		4794.96	I	12342 – 33192
260		4805.87	I	5541 – 26343
35		4806.68	I	12761 – 33559
140		4809.47	I	12773 – 33559
190		4815.04	I	5249 – 26012
700		4815.63	I	4871 – 25630
280		4824.29	I	5249 – 25972
190		4828.04	I	5023 – 25730
110		4838.78	I	12503 – 33164
60		4838.98	I	12761 – 33420
19		4841.45	I	5249 – 25898
19		4846.35	I	5102 – 25730
210		4851.36	I	5023 – 25630
160		4866.06	I	5889 – 26434
			I	17556 – 38101
110		4881.24	I	5249 – 25730
110		4883.60	I	5541 – 26012
45		4893.12	I	12761 – 33192
20		4905.08	I	5249 – 25630
30		4930.87	I	15201 – 35476
75		4933.64	I	14784 – 35047
50		4948.76	I	4186 – 24388
30		4962.30	I	14989 – 35135
35		4963.72	I	15720 – 35861
22		4987.82	I	16317 – 36360
100		4994.76	I	15120 – 35135
85		4996.33	I	15201 – 35210
30		5011.46	I	17060 – 37008
250		5046.58	I	12342 – 32152
85		5060.39	I	15720 – 35476
360		5064.91	I	11956 – 31695
110		5065.22	I	18739 – 38476
100		5070.26	I	14989 – 34706
75		5073.98	I	4186 – 23889
470		5078.25	I	11641 – 31327
85		5085.26	I	14791 – 34451
50		5112.27	II	13428 – 32984
140		5115.24	I	16317 – 35861
50		5120.42	I	15932 – 35456
85		5133.40	I	4186 – 23661
300		5155.45	I	12761 – 32152
200		5158.00	I	16978 – 36360
35		5158.67	I	12773 – 32152
75		5160.99	I	11956 – 31327
85		5165.96	I	12342 – 31695
17		5178.99	I	4186 – 23489
100		5183.70	I	5102 – 24388
30		5187.03	I	15932 – 35206
100		5191.60	II	14163 – 33419
100		5201.15	I	4376 – 23597
85		5209.30	I	12503 – 31695
85		5224.93	I	4186 – 23320
30		5243.47	I	17060 – 36125
120		5277.41	I	4376 – 23320
75		5280.05	I	12761 – 31695
60		5294.82	I	8057 – 26938
120		5296.79	I	8057 – 26931
60		5301.97	I	17753 – 36608
110		5311.40	I	4197 – 23019
25		5321.26	I	5102 – 23889
22		5330.84	I	570 – 19324
12		5338.43	I	4871 – 23597
30		5350.09	II	14299 – 32984
30		5350.35	II	14733 – 33419

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
25		5350.90	I	18739 – 37422
25		5351.92	I	
75		5362.56	I	4376 – 23019
12		5363.35	I	5249 – 23889
17		5369.39	I	4871 – 23489
20		5382.37	I	5023 – 23597
270		5385.14	I	4186 – 22751
30		5386.65	I	5102 – 23661
17		5391.18	I	5023 – 23567
17		5395.88	I	17833 – 36360
25		5405.13	I	5102 – 23597
85		5407.62	I	5889 – 24376
17		5413.93	I	5541 – 24006
20		5421.86	I	17422 – 35861
15		5426.36	I	16787 – 35210
25		5428.42	I	17060 – 35476
25		5437.76	I	1241 – 19626
15		5440.41	I	4871 – 23246
35		5448.57	I	5541 – 23889
10		5474.92	I	16787 – 35047
10		5477.40	I	4871 – 23122
35		5478.33	I	17753 – 36001
35		5480.83	I	5249 – 23489
10		5481.16	I	
30		5486.09	I	5023 – 23246
140		5502.12	I	8057 – 26227
25		5507.87	I	17060 – 35210
30		5517.11	I	5541 – 23661
10		5518.05	I	5889 – 24006
75		5528.41	I	18277 – 36360
20		5532.30	I	5249 – 23320
45		5537.46	I	17422 – 35476
50		5545.32	I	17833 – 35861
22	bl	5551.75	Zr O	
25	bl	5553.17	Zr O	
12		5612.11	I	0 – 17814
120		5620.14	I	4186 – 21974
35		5623.53	l	4197 – 21974
25	bl	5629.02	Zr O	
25	bl	5629.58	Zr O	
160		5664.51	I	5102 – 22751
20		5666.28	I	17833 – 35476
120		5680.90	I	4376 – 21974
15		5685.42	I	18277 – 35861
30		5708.89	I	0 – 17512
75	bl	5718.21	Zr O	
120		5735.70	I	0 – 17430
35	bl	5748.17	Zr O	
17	bl	5778.57	Zr O	
160		5797.74	l	570 – 17814
30		5847.32	l	17143 – 34240
50		5868.27	l	1241 – 18277
110		5869.50	I	15120 – 32152
340		5879.80	I	1241 – 18244
85		5885.62	I	570 – 17556
50		5901.09	l	570 – 17512
30	bl	5908.61	Zr O	
140		5925.13	I	5102 – 21974
100		5935.20	l	0 – 16844
110		5955.35	l	0 – 16787
30	bl	5977.80	Zr O	
100		5984.23	l	14989 – 31695
17		5995.37	l	5889 – 22564
50		6001.05	I	12342 – 29002
30		6025.36	I	1241 – 17833
85		6032.61	I	11956 – 28528
170		6045.85	I	14791 – 31327
100		6049.24	I	19834 – 36360
140		6062.84	I	570 – 17060
50		6120.83	I	4186 – 20519
170		6121.91	I	8057 – 24388
85		6124.84	I	4197 – 20519
680		6127.44	I	1241 – 17556
340		6134.55	I	0 – 16297
100		6140.46	I	4186 – 20467
440		6143.20	I	570 – 16844
30		6155.61	I	12761 – 29002
75		6157.71	I	19626 – 35861
25		6160.20	I	12773 – 29002
35		6189.40	I	19324 – 35476
60		6192.96	I	4376 – 20519
85		6213.05	I	4376 – 20467
100		6214.69	I	17753 – 33839
170	bl	6226.51	Zr O	
100		6257.26	I	12773 – 28750
50	b	6261.05	Zr O	
35		6267.06	I	11956 – 27908
45	bl	6292.84	Zr O	
120		6299.66	I	12342 – 28212
15		6304.34	I	4376 – 20234
300		6313.02	I	12773 – 28609
30		6314.71	I	8057 – 23889
50		6321.35	I	12342 – 28157
22		6340.36	I	12761 – 28528
50	bl	6345.10	Zr O	
75		6345.22	I	12773 – 28528
75	bl	6378.56	Zr O	
35		6407.00	I	1241 – 16844
50	b	6412.39	Zr O	
12		6426.17	I	22144 – 37701
35		6434.33	I	22564 – 38101
60		6445.74	I	8057 – 23567
20		6451.62	l	5023 – 20519
20		6457.63	I	11641 – 27122
110		6470.21	I	12761 – 28212
60	bl	6473.79	Zr O	
11		6484.35	I	5102 – 20519
110		6489.64	I	12503 – 27908
22		6493.10	I	12761 – 28157
50		6503.26	I	12503 – 27876
50		6506.36	I	5102 – 20467
50	bl	6508.15	Zr O	
30	bl	6542.90	Zr O	
35		6550.54	I	11641 – 26902
30		6569.43	I	5249 – 20467
20		6576.56	I	0 – 15201
30	b	6578.06	Zr O	
50		6591.99	I	11956 – 27122
10		6596.71	I	11956 – 27111
10		6598.84	I	570 – 15720
50		6603.27	I	12342 – 27482
15		6620.56	I	18739 – 33839
11		6678.01	II	19515 – 34485
22		6688.18	I	4376 – 19324
11		6702.12	I	11641 – 26557
17		6709.61	I	4197 – 19097
27		6717.88	I	11017 – 25898
40		6752.73	I	8057 – 22862
75		6762.38	I	0 – 14784
85		6769.16	I	12342 – 27111

Intensity and Character		Wavelength in Å	Spectrum	Energy levels in cm^{-1}
27		6772.89	I	10885 – 25646
15		6787.15	II	20080 – 34810
35		6790.85	I	12761 – 27482
8		6796.68	I	14349 – 29058
45		6828.78	I	11258 – 25898
45		6832.89	I	570 – 15201
7		6833.67	I	11017 – 25646
13		6845.33	I	10885 – 25490
17		6846.34	I	5023 – 19626
100		6846.97	I	11956 – 26557
27		6849.26	I	12342 – 26938
13		6852.56	I	12342 – 26931
9		6854.63	I	5249 – 19834
4		6857.90	I	14697 – 29275
6		6883.23	I	5102 – 19626
120		6888.29	I	11641 – 26154
29		6900.59	I	11956 – 26444
20		6904.36	I	1241 – 15720
29		6907.37	I	11017 – 25490
20		6916.87	I	4871 – 19324
6		6922.23	I	12773 – 27215
16		6932.38	I	11641 – 26062
29		6948.46	I	11258 – 25646
150		6953.84	I	5249 – 19626
60		6966.44	I	12761 – 27111
10		6975.91	I	11641 – 25972
150		6990.84	I	5023 – 19324
80		6994.32	I	5541 – 19834
10		7005.46	I	11956 – 26227
100		7027.40	I	4871 – 19097
25		7057.36	I	12773 – 26938
14		7057.96	I	
140		7087.30	I	4871 – 18976
25		7089.43	I	12342 – 26444
35		7094.46	I	12342 – 26434
50		7095.59	I	11641 – 25730
540		7097.70	I	5541 – 19626
280		7102.91	I	5249 – 19324
170		7103.72	I	5023 – 19097
140		7111.68	I	4186 – 18244
40		7112.82	I	11956 – 26012
18		7113.52	I	12503 – 26557
12		7132.95	I	11956 – 25972
8		7138.28	I	12761 – 26766
16		7140.74	I	12342 – 26343
12		7144.47	I	12773 – 26766
590		7169.09	I	5889 – 19834
50		7201.62	I	15120 – 29002
12		7258.17	I	11956 – 25730
35		7264.76	I	14989 – 28750
8		7284.69	I	12503 – 26227
20		7306.21	I	12761 – 26444
6	h	7307.32	I	
25		7311.62	I	12761 – 26434
35		7313.72	I	12342 – 26012
90		7318.08	I	12773 – 26434
10		7327.82	I	
50		7335.97	I	4186 – 17814
50		7343.96	I	14791 – 28404
20		7373.50	I	12503 – 26062
8		7374.80	I	12342 – 25898
25		7383.63	I	14989 – 28528
8	h	7399.30	I	
14		7400.90	I	12503 – 26012
10		7411.39	I	15120 – 28609
8	h	7417.89	I	14123 – 27600
10		7422.75	I	12503 – 25972
10		7433.10	I	14123 – 27573
110		7439.86	I	4376 – 17814
18		7467.57	I	12342 – 25730
16		7479.58	I	14791 – 28157
9		7502.92	I	14349 – 27673
9		7506.51	I	
14	h	7515.70	I	15700 – 29002
12		7517.95	I	17753 – 31050
9	h	7521.03	I	15457 – 28750
20	h	7540.62	I	15146 – 28404
20		7544.59	I	12761 – 26012
29		7551.46	I	12773 – 26012
7	h	7553.00	I	4186 – 17422
40		7554.70	I	4197 – 17430
25		7558.45	I	12503 – 25730
12		7560.09	I	14349 – 27573
7		7560.31	I	14989 – 28212
12		7562.12	I	5023 – 18244
80		7607.15	I	5102 – 18244
8		7610.83	I	4376 – 17512
14		7612.08	I	14349 – 27482
20		7621.17	I	11258 – 24376
5		7621.61	I	14791 – 27908
29		7658.60	I	4376 – 17430
18		7690.83	I	14123 – 27122
14		7704.27	I	14697 – 27673
10		7708.42	I	12761 – 25730
6		7722.48	I	22145 – 35091
9		7723.95	I	4871 – 17814
8		7765.70	I	4186 – 17060
10		7766.55	I	11017 – 23889
6		7800.74	I	21801 – 34617
12		7816.32	I	5023 – 17814
110		7819.35	I	14697 – 27482
35		7822.94	I	14123 – 26902
40		7826.72	I	14349 – 27122
90		7849.35	I	5541 – 18277
35		7869.99	I	5541 – 18244
14		7876.25	I	22398 – 35091
16		7882.18	I	4376 – 17060
10		7897.98	I	4186 – 16844
16		7908.46	I	4871 – 17512
6		7924.20	I	22145 – 34762
20		7940.47	I	4197 – 16787
160		7944.61	I	5249 – 17833
80		7956.66	I	5249 – 17814
80		7959.98	I	4871 – 17430
20		7963.63	I	14349 – 26902
160		8005.27	I	5023 – 17512
7		8015.26	I	11017 – 23489
4	h	8040.10	I	14123 – 26557
25		8046.05	I	14697 – 27122
16		8053.06	I	14697 – 27111
20		8055.29	I	4376 – 16787
20		8055.76	I	5102 – 17512
60		8058.08	I	5023 – 17430
150		8063.09	I	5023 – 17422
790		8070.08	I	5889 – 18277
10		8114.28	I	5102 – 17422
20		8120.17	I	18739 – 31050
390		8132.99	I	5541 – 17833
20		8152.58	I	5249 – 17512
12		8188.77	I	14349 – 26557

Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}	Intensity and Character	Wavelength in Å	Spectrum	Energy levels in cm^{-1}
40	8194.73	I	10885 – 23085	40	8498.44	I	5023 – 16787
60	8201.73	I	4871 – 17060	5	8513.78	I	5102 – 16844
280	8212.53	I	5249 – 17422	5	8515.06	I	17060 – 28801
20	8240.37	I	17143 – 29275				
40	8283.81	I	11017 – 23085	8	8568.54	I	5889 – 17556
				7	8571.05	I	12342 – 24006
7	8299.81	I	12342 – 24388	18	8584.21	I	15120 – 26766
140	8305.90	I	5023 – 17060	7	8587.84	I	11956 – 23597
7	8309.50	I	14123 – 26154	5	8610.24	I	11956 – 23567
7	8320.16	I	5541 – 17556				
14	8332.44	I	17060 – 29058	5	8641.01	I	
				10	8734.86	I	14989 – 26434
50	8370.23	I	5889 – 17833	12	8749.48	I	4871 – 16297
120	8389.41	I	4871 – 16787	6	8762.93	I	
70	8414.00	I	5541 – 17422	10	8786.23	I	11641 – 23019
50	8453.17	I	11258 – 23085				
6	8457.48	I	5023 – 16844	16	8804.98	I	14989 – 26343
				70	8836.09	I	15120 – 26434
50	8464.65	I	5249 – 17060	60	8899.52	I	12773 – 24006
9	8495.98	I	17143 – 28910				

NBS-114A (REV. 7-73)

U.S. DEPT. OF COMM. BIBLIOGRAPHIC DATA SHEET	1. PUBLICATION OR REPORT NO. NBS-MN-145, Part I	2. Gov't Accession No.	3. Recipient's Accession No.

4. TITLE AND SUBTITLE

Tables of Spectral-Line Intensities, Part I
Arranged by Elements

5. Publication Date: May 1975

6. Performing Organization Code

7. AUTHOR(S) William F. Meggers, Charles H. Corliss, and Bourdon D. Scribner

8. Performing Organ. Report No. 232.01

9. PERFORMING ORGANIZATION NAME AND ADDRESS

NATIONAL BUREAU OF STANDARDS
DEPARTMENT OF COMMERCE
WASHINGTON, D.C. 20234

10. Project/Task/Work Unit No. 2320110 232.01

11. Contract/Grant No.

12. Sponsoring Organization Name and Complete Address (Street, City, State, ZIP)

Same as Number 9.

13. Type of Report & Period Covered: N/A

14. Sponsoring Agency Code

15. SUPPLEMENTARY NOTES

Supersedes NBS Monograph 32, Parts I and II and its Supplement.
Library of Congress Catalog Card Number: 74 - 16256

16. ABSTRACT (A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.)

The relative intensities, or radiant powers, of 39 000 spectral lines with wavelengths between 2000 and 9000 Angstroms have been determined on a uniform energy scale for seventy chemical elements. This was done by mixing 0.1 atomic percent of each element in powdered copper, pressing the powder-mixture to form solid electrodes which were burned in a 10 ampere, 220 volt direct-current arc, and photographing the spectra with a stigmatic concave grating while a step sector was rotating in front of the slit. The sectored spectrograms facilitated the estimation of intensities of all element lines relative to copper lines which were then calibrated on an energy scale provided by standardized lamps, and all estimated line intensities were finally adjusted to fit this calibration. Comparisons with other intensity measurements in individual spectra indicate that the National Bureau of Standards spectral-line intensities may have average errors of 20 percent, but first of all they provide uniform quantitative values for the seventy chemical elements commonly determined by spectrochemists. These data are presented by element in part I, and all 39 000 observed lines are given in order of wavelength in part II.

17. KEY WORDS (six to twelve entries; alphabetical order; capitalize only the first letter of the first key word unless a proper name; separated by semicolons)

Classification of spectral lines; intensities of spectral lines; spectral-line intensities; tables of spectral-line intensities; wavelengths of spectral lines.

18. AVAILABILITY

[X] Unlimited

[ ] For Official Distribution. Do Not Release to NTIS

[X] Order From Sup. of Doc., U.S. Government Printing Office Washington, D.C. 20402, SD Cat. No. C13.44:145/I

[ ] Order From National Technical Information Service (NTIS) Springfield, Virginia 22151

19. SECURITY CLASS (THIS REPORT): UNCLASSIFIED

21. NO. OF PAGES: 405

20. SECURITY CLASS (THIS PAGE): UNCLASSIFIED

22. Price: $8.55