(2) $1,194,109,500 for fiscal year 2024;
(3) $1,265,275,695 for fiscal year 2025;
(4) $1,340,687,843 for fiscal year 2026; and
(5) $1,420,599,500 for fiscal year 2027.

(Pub. L. 115–246, title III, § 304, Sept. 28, 2018, 132 Stat. 3145; Pub. L. 117–167, div. B, title I, § 10104(a), Aug. 9, 2022, 136 Stat. 1433.)

Editorial Notes

REFERENCES IN TEXT

Section 976 of the Energy Policy Act of 2005, referred to in subsec. (d)(2)(A), enacted section 16316 of this title and amended section 5523 of Title 15, Commerce and Trade.

CODIFICATION

Section is comprised of section 304 of Pub. L. 115–246. Subsec. (b) of section 304 of Pub. L. 115–246 amended sections 16316 of this title, sections 5541 and 5542 of Title 15, Commerce and Trade, and provisions set out as a note under section 5501 of Title 15.

AMENDMENTS

2022—Subsecs. (a), (b). Pub. L. 117–167, § 10104(a)(1), (2), added subsec. (a) and redesignated former subsec. (a) as (b). Former subsec. (b) redesignated (c).

Subsec. (c). Pub. L. 117–167, § 10104(a)(1), (3), redesignated subsec. (b) as (c), designated existing provisions par. (1) and inserted heading, and added par. (2). Former subsec. (c) redesignated (d).

Subsec. (d). Pub. L. 117–167, § 10104(a)(1), (4), redesignated subsec. (c) as (d) and amended it generally. Prior to amendment, text read as follows: ''The Director shall carry out activities to develop, test, and support—

''(1) mathematics, models, and algorithms for complex systems and programming environments; and

''(2) tools, languages, and operating systems for high-end computing systems (as defined in section 5541 of title 15).''

Subsecs. (e) to (k). Pub. L. 117–167, § 10104(a)(5), added subsecs. (e) to (k).

§ 18643. High-energy physics

(a) Sense of Congress

It is the sense of Congress that—

(1) the Director should incorporate the findings and recommendations of the report of the Particle Physics Project Prioritization Panel entitled ''Building for Discovery: Strategic Plan for U.S. Particle Physics in the Global Context'' into the planning process of the Department; and

(2) the nations that lead in particle physics by hosting international teams dedicated to a common scientific goal attract the world's best talent and inspire future generations of physicists and technologists.

(b) Program

As part of the activities authorized under section 7139 of this title, the Director shall carry out a research program in elementary particle physics and advanced technology research and development to improve the understanding of the fundamental properties of the universe, including constituents of matter and energy and the nature of space and time.

(c) High energy frontier research

As part of the program described in subsection (b), the Director shall carry out research using high energy accelerators and advanced detectors, including accelerators and detectors that will function as national user facilities, to create and study interactions of elementary particles and investigate fundamental forces.

(d) International collaboration

The Director shall—

(1) as practicable and in coordination with other appropriate Federal agencies as necessary, ensure the access of United States researchers to the most advanced accelerator facilities and research capabilities in the world, including the Large Hadron Collider;

(2) to the maximum extent practicable, continue to leverage United States participation in the Large Hadron Collider, and prioritize expanding international partnerships and investments in the Long-Baseline Neutrino Facility and Deep Underground Neutrino Experiment; and

(3) to the maximum extent practicable, prioritize engagement in collaborative efforts in support of future international facilities that would provide access to the most advanced accelerator facilities in the world to United States researchers.

(e) Neutrino research

The Director shall carry out research activities on rare decay processes and the nature of the neutrino, which may include collaborations with the National Science Foundation or international collaborations.

(f) Cosmic frontier research

The Director shall carry out research activities on the nature of the primary contents of the universe, including the nature of dark energy and dark matter. These activities shall, to the maximum extent practicable, be consistent with the research priorities identified by the High Energy Physics Advisory Panel or the National Academy of Sciences, and may include—

(1) collaborations with the National Aeronautics and Space Administration, the National Science Foundation, or international partners on relevant projects; and

(2) the development of space-based, land-based, water-based, and underground facilities and experiments.

(g) Facility construction and major items of equipment

(1) Projects

Consistent with the Office of Science's project management practices, the Director shall, to the maximum extent practicable, by incorporating the findings and recommendations of the 2014 Particle Physics Project Prioritization Panel (P5) report entitled ''Building for Discovery'', support construction or fabrication of—

(A) an international Long-Baseline Neutrino Facility based in the United States;

(B) the Proton Improvement Plan II;

(C) Second Generation Dark Matter experiments;

(D) the Legacy Survey of Space and Time camera;

(E) upgrades to detectors and other components of the Large Hadron Collider; and

(F) the Cosmic Microwave Background Stage 4 project; and

(G) other high priority projects recommended in the most recent report of the Particle Physics Project Prioritization Panel of the High Energy Physics Advisory Panel.

(2) Long-Baseline Neutrino Facility

(A) In general

The Secretary shall support construction of a Long-Baseline Neutrino Facility to facilitate the international Deep Underground Neutrino Experiment to examine the fundamental properties of neutrinos, explore physics beyond the Standard Model, and better clarify the existence and nature of antimatter.

(B) Facility capabilities

The Secretary shall ensure that the facility described in subparagraph (A) will provide, at a minimum, the following capabilities:

(i) A neutrino beam with wideband capability of 1.2 megawatts of beam power and upgradable to 2.4 megawatts of beam power.

(ii) 3 caverns excavated for a 70 kiloton fiducial detector mass and supporting surface buildings and utilities.

(iii) Cryogenic systems to support neutrino detectors.

(C) Start of operations

The Secretary shall, subject to the availability of appropriations, ensure that the start of full operations of the facility described in subparagraph (A) occurs before December 31, 2031.

(D) Funding

Out of funds authorized to be appropriated under subsection (k), there are authorized to be appropriated to the Secretary to carry out construction of the project described in subparagraph (A)—

(i) $180,000,000 for fiscal year 2023;
(ii) $255,000,000 for fiscal year 2024;
(iii) $305,000,000 for fiscal year 2025;
(iv) $305,000,000 for fiscal year 2026; and
(v) $305,000,000 for fiscal year 2027.

(3) Proton Improvement Plan–II accelerator upgrade project

(A) In general

The Secretary shall support construction of the Proton Improvement Plan II, an upgrade to the Fermilab accelerator complex identified in the 2014 Particle Physics Project Prioritization Panel (P5) report entitled ''Building for Discovery'', to provide the world's most intense beam of neutrinos to the international Long Baseline Neutrino Facility and to carry out a broad range of future high energy physics experiments. The Secretary shall work with international partners to enable further significant contributions to the capabilities of that project.

(B) Facility capabilities

The Secretary shall ensure that the facility described in subparagraph (A) will provide, at a minimum, the following capabilities:

(i) A state-of-the-art 800 megaelectron volt superconducting linear accelerator.

(ii) Proton beam power of 1.2 megawatts at the start of LBNF/DUNE, upgradeable to 2.4 megawatts of beam power.

(iii) A flexible design to enable high power beam delivery to multiple users simultaneously and customized beams tailored to specific scientific needs.

(iv) Sustained high reliability operation of the Fermilab accelerator complex.

(C) Start of operations

The Secretary shall, subject to the availability of appropriations, ensure that the start of full operations of the facility described in subparagraph (A) occurs before December 31, 2028.

(D) Funding

Out of funds authorized to be appropriated under subsection (k), there are authorized to be appropriated to the Secretary to carry out construction of the facility described in subparagraph (A)—

(i) $130,000,000 for fiscal year 2023;
(ii) $120,000,000 for fiscal year 2024;
(iii) $120,000,000 for fiscal year 2025;
(iv) $115,000,000 for fiscal year 2026; and
(v) $110,000,000 for fiscal year 2027.

(4) Cosmic Microwave Background Stage 4

(A) In general

The Secretary, in partnership with the Director of the National Science Foundation, shall support construction of the Cosmic Microwave Background Stage 4 project to survey the cosmic microwave background to test theories of cosmic inflation as described in the 2014 Particle Physics Prioritization Panel (P5) report entitled ''Building for Discovery: Strategic Plan for U.S. Particle Physics in the Global Context.''.[1]

(B) Consultation

The Secretary shall consult with the private sector, institutions of higher education, National Laboratories, and relevant Federal agencies to ensure that the project described in subparagraph (A) is capable of meeting Federal research needs in accessing the ultra-high energy physics of inflation and important neutrino properties.

(C) Experimental capabilities

The Secretary shall ensure to the maximum extent practicable that the facility described in subparagraph (A) will provide, at a minimum, 500,000 superconducting detectors deployed on an array of millimeter-wave telescopes with the required range in frequency, sensitivity, and survey speed that will provide sufficient capability to enable an order of magnitude advance in observations of the Cosmic Microwave Background, delivering transformative discoveries in fundamental physics, cosmology, and astrophysics.

(D) Start of operations

The Secretary shall, subject to the availability of appropriations, ensure that the

[1] So in original.

start of full operations of the facility described in subparagraph (A) occurs before December 31, 2030.

(E) Funding

Out of funds authorized to be appropriated under subsection (k), there are authorized to be appropriated to the Secretary to carry out construction of the facility described in subparagraph (A)—

(i) $10,000,000 for fiscal year 2023;
(ii) $25,000,000 for fiscal year 2024;
(iii) $60,000,000 for fiscal year 2025;
(iv) $80,000,000 for fiscal year 2026; and
(v) $80,000,000 for fiscal year 2027.

(h) Accelerator and detector upgrades

The Director shall upgrade accelerator facilities and detectors, as necessary and appropriate, to increase beam power, sustain high reliability, and improve precision measurement to advance the highest priority particle physics research programs. In carrying out facility upgrades, the Director shall continue to work with international partners, when appropriate and in the United States' interest, to leverage investments and expertise in critical technologies to help build and upgrade accelerator and detector facilities in the United States.

(i) Accelerator and detector research and development

As part of the program described in subsection (b), the Director shall carry out research and development in particle beam physics, accelerator science and technology, and particle and radiation detection with relevance to the specific needs of the High Energy Physics program, in coordination with the Accelerator Research and Development program authorized under section 18648 of this title.

(j) Underground science

The Director shall—

(1) support an underground science program consistent with the missions of the Department and the scientific needs of the High Energy Physics program, including those articulated in the most recent report of the Particle Physics Project Prioritization Panel of the High Energy Physics Advisory Panel, that leverages the capabilities of relevant underground science and engineering facilities;

(2) carry out a competitive grant program to award scientists and engineers at institutions of higher education, nonprofit institutions, and National Laboratories to conduct research in underground science and engineering; and

(3) submit to the Committee on Energy and Natural Resources of the Senate and the Committee on Science, Space, and Technology of the House of Representatives a report on the inventory of underground mines in the United States that may be suitable for future development of underground science and engineering facilities and any anticipated challenges associated with repurposing, repair, facility siting, or construction.

(k) Authorization of appropriations

Out of funds authorized to be appropriated for the Office of Science in a fiscal year, there are authorized to be appropriated to the Secretary to carry out the activities described in this section—

(1) $1,159,520,000 for fiscal year 2023;
(2) $1,289,891,200 for fiscal year 2024;
(3) $1,428,284,672 for fiscal year 2025;
(4) $1,499,881,752 for fiscal year 2026; and
(5) $1,554,874,657 for fiscal year 2027.

(Pub. L. 115–246, title III, §305, Sept. 28, 2018, 132 Stat. 3147; Pub. L. 117–167, div. B, title I, §10106, Aug. 9, 2022, 136 Stat. 1445.)

Editorial Notes

AMENDMENTS

2022—Subsecs. (b), (c). Pub. L. 117–167, §10106(a)(2), added subsecs. (b) and (c). Former subsecs. (b) and (c) redesignated (d) and (e), respectively.

Subsec. (d). Pub. L. 117–167, §10106(a)(1), (b), redesignated subsec. (b) as (d), struck it out, and added a new subsec. (d). Prior to amendment, text read as follows: ''The Director, as practicable and in coordination with other appropriate Federal agencies as necessary, shall ensure the access of United States researchers to the most advanced accelerator facilities and research capabilities in the world, including the Large Hadron Collider.'' Former subsec. (d) redesignated (f).

Subsec. (e). Pub. L. 117–167, §10106(a)(1), redesignated subsec. (c) as (e).

Subsec. (f). Pub. L. 117–167, §10106(a)(1), (c), redesignated subsec. (d) as (f), struck it out, and added a new subsec. (f). Prior to amendment, text read as follows: ''The Director shall carry out research activities on the nature of dark energy and dark matter, which may include collaborations with the National Aeronautics and Space Administration or the National Science Foundation; or international collaborations.''

Subsecs. (g) to (k). Pub. L. 117–167, §10106(d), added subsecs. (g) to (k).

§ 18644. Biological and environmental research

(a) Program

As part of the duties of the Director authorized under section 7139 of this title, and coordinated with the activities authorized under sections 18641 and 18642 of this title, the Director shall carry out a program of research and development in the areas of biological systems science and climate and environmental science, including subsurface science, relevant to the development of new energy technologies and to support the energy, environmental, and national security missions of the Department.

(b) Biological systems

The Director shall carry out research and development activities in genomic science including fundamental research on plants and microbes to increase systems-level understanding of the complex biological systems, which may include activities—

(1) to provide a fundamental understanding of the biology of plants, fungi, and microbes as a basis for developing innovative processes for bioenergy and bioproducts and accelerate breakthroughs and new knowledge that would enable the cost-effective, sustainable production of—

(A) advanced biofuels;
(B) bioenergy; and
(C) biobased materials;

(2) to conduct foundational functional systems biology research—