

I yield the floor.

I suggest the absence of a quorum.

The PRESIDING OFFICER. The clerk will call the roll.

The bill clerk proceeded to call the roll.

Mr. PETERS. Mr. President, I ask unanimous consent that the order for the quorum call be rescinded.

The PRESIDING OFFICER. Without objection, it is so ordered.

## SPACE WEATHER RESEARCH AND FORECASTING ACT

Mr. PETERS. Mr. President, I rise today to ask for Senate approval of legislation that I sponsored, along with my friend and colleague from across the aisle, Senator CORY GARDNER of Colorado.

Earlier this year, we introduced the Space Weather Research and Forecasting Act with Senators Booker, Wicker, and Klobuchar, and it went on to pass unanimously by the full Senate Committee on Commerce, Science, and Transportation in January.

Space weather, which includes solar flares and coronal mass ejections caused by the constantly changing conditions in the Sun's magnetic fields, regularly hurls ionized gas toward the Earth. This can potentially devastate our infrastructure and significantly disrupt our economy. The chances of Earth being hit by a severe space weather event are roughly the same as a magnitude 8 earthquake striking the United States, but the impact to our way of life would be absolutely catastrophic.

According to NASA, Earth was narrowly missed by a large space weather event in 2012, which could have resulted in a worst-case scenario impact to Earth. A report by Lloyd's of London estimates that a worst-case scenario space weather event could cost up to \$2.6 trillion and impact as many as 40 million people by causing outages at electric utilities, disrupting GPS communication networks, and forcing airlines to reroute air traffic.

The potential disruption to these critical sectors of our economy makes space weather a threat we must understand better. Scientists across the globe, including in my home State of Michigan, are working to improve our understanding of space weather and how outputs from the Sun interact with the Earth's magnetic field and atmosphere. For years, NASA, NOAA, the National Science Foundation, and the Department of Defense have funded this critical research.

The work of scientists and engineers at these agencies and universities across the country will help us better predict solar events and improve our ability to protect the infrastructure of the United States. But as we increasingly realize the magnitude of this threat, we need national leadership to focus our resources, coordinate planning, and prepare for space weather events.

This bipartisan legislation sets national priorities to increase and improve space weather observations,

science, and forecasting abilities. This research will improve our efforts to predict and to mitigate the effects of space weather events on Earth and in space.

Space weather is not science fiction. If we don't prepare ourselves, the impact could be catastrophic. But by learning to make better predictions, issue more effective warnings, and take precautions for when that inevitable day comes to pass, we can prevent space weather from wreaking costly havoc or disrupting our daily lives.

It is imperative that we invest in science and technologies to better understand space weather. It is imperative that we act on that knowledge and understanding to protect our critical infrastructure. It is, therefore, imperative that we move quickly to sign into law the Space Weather Research and Forecasting Act.

As in legislative session, I ask unanimous consent that the Senate proceed to the immediate consideration of Calendar No. 29, S. 141.

The PRESIDING OFFICER. The clerk will report the bill by title.

The bill clerk read as follows:

A bill (S. 141) to improve understanding and forecasting of space weather events, and for other purposes.

There being no objection, the Senate proceeded to consider the bill, which had been reported from the Committee on Commerce, Science, and Transportation, with an amendment to strike all after the enacting clause and insert in lieu thereof the following:

### SECTION 1. SHORT TITLE.

This Act may be cited as the "Space Weather Research and Forecasting Act".

### SEC. 2. SPACE WEATHER.

(a) IN GENERAL.—Subtitle VI of title 51, United States Code, is amended by adding after chapter 605 the following:

#### "CHAPTER 607—SPACE WEATHER

"60701. Space weather.

"60702. Observations and forecasting.

"60703. Research and technology.

"60704. Space weather data.

#### "§ 60701. Space weather

"(a) FINDINGS.—Congress makes the following findings:

"(1) Space weather events pose a significant threat to humans working in the space environment and to modern technological systems.

"(2) The effects of severe space weather events on the electric power grid, satellites and satellite communications and information, airline operations, astronauts living and working in space, and space-based position, navigation, and timing systems could have significant societal, economic, national security, and health impacts.

"(3) Earth and space observations provide crucial data necessary to predict and warn about space weather events.

"(4) Clear roles and accountability of Federal departments and agencies are critical for an efficient and effective response to threats posed by space weather.

"(5) In October 2015, the National Science and Technology Council published a National Space Weather Strategy and a National Space Weather Action Plan seeking to integrate national space weather efforts and add new capabilities to meet increasing demand for space weather information.

"(b) FEDERAL AGENCY ROLES.—

"(1) FINDINGS.—Congress finds that—

"(A) the National Oceanic and Atmospheric Administration provides operational space weather forecasting and monitoring for civil applications, maintains ground and space-based

assets to provide observations needed for forecasting, prediction, and warnings, and develops requirements for space weather forecasting technologies and science;

"(B) the Department of Defense provides operational space weather forecasting, monitoring, and research for the department's unique missions and applications;

"(C) the National Aeronautics and Space Administration provides increased understanding of the fundamental physics of the Sun-Earth system through space-based observations and modeling, develops new space-based technologies and missions, and monitors space weather for NASA's space missions;

"(D) the National Science Foundation provides increased understanding of the Sun-Earth system through ground-based measurements, technologies, and modeling;

"(E) the Department of the Interior collects, distributes, and archives operational ground-based magnetometer data in the United States and its territories, and works with the international community to improve global geophysical monitoring and develops crustal conductivity models to assess and mitigate risk from space weather induced electric ground currents; and

"(F) the Federal Aviation Administration provides operational requirements for space weather services in support of aviation and for coordination of these requirements with the International Civil Aviation Organization, integrates space weather data and products into the Next Generation Air Transportation System, and conducts real-time monitoring of the charged particle radiation environment to protect the health and safety of crew and passengers during space weather events.

"(2) OFFICE OF SCIENCE AND TECHNOLOGY POLICY.—The Director of the Office of Science and Technology Policy shall—

"(A) coordinate the development and implementation of Federal Government activities to improve the Nation's ability to prepare, avoid, mitigate, respond to, and recover from potentially devastating impacts of space weather events; and

"(B) coordinate the activities of the space weather interagency working group established under subsection (c).

"(c) SPACE WEATHER INTERAGENCY WORKING GROUP.—In order to continue coordination of executive branch efforts to understand, prepare, coordinate, and plan for space weather, the National Science and Technology Council shall establish an interagency working group on space weather.

"(d) MEMBERSHIP.—In order to understand and respond to the adverse effects of space weather, the interagency working group established under subsection (c) shall leverage capabilities across participating Federal agencies, including—

"(1) the National Oceanic and Atmospheric Administration;

"(2) the National Aeronautics and Space Administration;

"(3) the National Science Foundation;

"(4) the Department of Defense;

"(5) the Department of the Interior;

"(6) the Department of Homeland Security;

"(7) the Department of Energy;

"(8) the Department of Transportation, including the Federal Aviation Administration; and

"(9) the Department of State.

"(e) INTERAGENCY AGREEMENTS.—

"(1) SENSE OF CONGRESS.—It is the sense of Congress that the interagency collaboration between the National Aeronautics and Space Administration and the National Oceanic and Atmospheric Administration on terrestrial weather observations provides—

“(A) an effective mechanism for improving weather and climate data collection while avoiding unnecessary duplication of capabilities across Federal agencies; and

“(B) an agency collaboration model that could benefit space weather observations.

“(2) **INTERAGENCY AGREEMENTS.**—The Administrator of the National Aeronautics and Space Administration and the Administrator of the National Oceanic and Atmospheric Administration shall enter into one or more interagency agreements providing for cooperation and collaboration in the development of space weather spacecraft, instruments, and technologies in accordance with this chapter.

#### “§60702. Observations and forecasting

“(a) **POLICY.**—It is the policy of the United States to establish and sustain a baseline capability for space weather observations.

“(b) **INTEGRATED STRATEGY.**—

“(1) **IN GENERAL.**—The Director of the Office of Science and Technology Policy, in coordination with the Administrator of the National Oceanic and Atmospheric Administration, the Administrator of the National Aeronautics and Space Administration, the Director of the National Science Foundation, and the Secretary of Defense, and in consultation with the academic and commercial communities, shall develop an integrated strategy for solar and solar wind observations beyond the lifetime of current assets, that considers—

“(A) the provision of solar wind measurements and other measurements essential to space weather forecasting; and

“(B) the provision of solar and space weather measurements important for scientific purposes.

“(2) **CONSIDERATIONS.**—In developing the strategy under paragraph (1), the Director of the Office of Science and Technology Policy shall consider small satellite options, hosted payloads, commercial options, international options, and prize authority.

“(c) **CRITICAL OBSERVATIONS.**—In order to sustain current space-based observational capabilities, the Administrator of the National Aeronautics and Space Administration shall—

“(1) in cooperation with the European Space Agency, maintain operations of the Solar and Heliospheric Observatory/Large Angle and Spectrometric Coronagraph (referred to in this section as ‘SOHO/LASCO’) for as long as the satellite continues to deliver quality observations; and

“(2) prioritize the reception of LASCO data.

“(d) **ADDITIONAL CAPABILITY FOR SOLAR IMAGING.**—

“(1) **IN GENERAL.**—The Administrator of the National Oceanic and Atmospheric Administration shall secure reliable secondary capability for near real-time coronal mass ejection imagery.

“(2) **OPTIONS.**—The Administrator of the National Oceanic and Atmospheric Administration, in coordination with the Secretary of Defense and the Administrator of the National Aeronautics and Space Administration, shall develop options to build and deploy one or more instruments for near real-time coronal mass ejection imagery.

“(3) **CONSIDERATIONS.**—In developing options under paragraph (2), the Administrator of the National Oceanic and Atmospheric Administration shall consider commercial solutions, prize authority, academic and international partnerships, microsatellites, ground-based instruments, and opportunities to deploy the instrument or instruments as a secondary payload on an upcoming planned launch.

“(4) **COSTS.**—In implementing paragraph (1), the Administrator of the National Oceanic and Atmospheric Administration shall prioritize a cost-effective solution.

“(5) **OPERATIONAL PLANNING.**—The Administrator of the National Oceanic and Atmospheric Administration shall develop an operational contingency plan to provide continuous space

weather forecasting in the event of a SOHO/LASCO failure.

“(6) **BRIEFING.**—Not later than 120 days after the date of enactment of the Space Weather Research and Forecasting Act, the Administrator of the National Oceanic and Atmospheric Administration shall provide a briefing to the Committee on Commerce, Science, and Transportation of the Senate and the Committee on Science, Space, and Technology of the House of Representatives on the options for building and deploying the instrument or instruments described in paragraph (2) and the operational contingency plan developed under paragraph (5).

“(e) **FOLLOW-ON SPACE-BASED OBSERVATIONS.**—The Administrator of the National Oceanic and Atmospheric Administration, in coordination with the Secretary of Defense, shall develop requirements and a plan for follow-on space-based observations for operational purposes, in accordance with the integrated strategy developed under subsection (b).

“(f) **REPORT.**—Not later than 180 days after the date of enactment of the Space Weather Research and Forecasting Act, the Director of the Office of Science and Technology Policy shall submit to the Committee on Commerce, Science, and Transportation of the Senate and the Committee on Science, Space, and Technology of the House of Representatives a report on the integrated strategy under subsection (b), including the plans for follow-on space-based observations under subsection (e).

“(g) **GROUND-BASED OBSERVATIONS.**—The National Science Foundation, the Air Force, and where practicable in support of the Air Force, the Navy shall each—

“(1) maintain and improve, as necessary and advisable, ground-based observations of the Sun in order to help meet the priorities identified in section 60703(a); and

“(2) provide space weather data by means of its set of ground-based facilities, including radars, lidars, magnetometers, radio receivers, aurora and airglow imagers, spectrometers, interferometers, and solar observatories.

“(h) **GROUND-BASED OBSERVATIONS DATA.**—The National Science Foundation shall—

“(1) provide key data streams from the platforms described in subsection (g) for research and to support space weather model development;

“(2) develop experimental models for scientific purposes; and

“(3) support the transition of the experimental models to operations where appropriate.

#### “§60703. Research and technology

“(a) **USER NEEDS.**—

“(1) **IN GENERAL.**—The Administrator of the National Oceanic and Atmospheric Administration, the Secretary of the Air Force, and where practicable in support of the Air Force, the Secretary of the Navy, in conjunction with the heads of other relevant Federal agencies, shall conduct a comprehensive survey to identify and prioritize the needs of space weather forecast users, including space weather data and space weather forecast data needed to improve services and inform research priorities and technology needs.

“(2) **CONTENTS.**—In conducting the comprehensive survey under paragraph (1), the Administrator of the National Oceanic and Atmospheric Administration, the Secretary of the Air Force, and where practicable in support of the Air Force, the Secretary of the Navy, at a minimum, shall—

“(A) consider the goals for forecast lead time, accuracy, coverage, timeliness, data rate, and data quality for space weather observations;

“(B) identify opportunities to address the needs identified under paragraph (1) through collaborations with academia, the private sector, and the international community;

“(C) identify opportunities for new technologies and instrumentation to address the needs identified under paragraph (1); and

“(D) publish a report on the findings under subparagraphs (A) through (C).

“(3) **PUBLICATION.**—Not later than 1 year after the date of enactment of the Space Weather Research and Forecasting Act, the Administrator of the National Oceanic and Atmospheric Administration, the Secretary of the Air Force, and where practicable in support of the Air Force, the Secretary of the Navy, shall—

“(A) make the results of the comprehensive survey publicly available; and

“(B) notify the Committee on Commerce, Science, and Transportation of the Senate and the Committee on Science, Space, and Technology of the House of Representatives of the publication under subparagraph (A).

“(b) **RESEARCH ACTIVITIES.**—

“(1) **BASIC RESEARCH.**—The Director of the National Science Foundation, Administrator of the National Aeronautics and Space Administration, and Secretary of Defense shall continue to carry out basic research activities on heliophysics, geospace science, and space weather and support competitive, merit-based, peer-reviewed proposals for research, modeling, and monitoring of space weather and its impacts, including science goals outlined in Solar and Space Physics Decadal surveys conducted by the National Academy of Sciences.

“(2) **MULTIDISCIPLINARY RESEARCH.**—

“(A) **FINDINGS.**—Congress finds that the multidisciplinary nature of solar and space physics creates funding challenges that require coordination across scientific disciplines and Federal agencies.

“(B) **MULTIDISCIPLINARY RESEARCH.**—The Director of the National Science Foundation, the Administrator of the National Oceanic and Atmospheric Administration, and the Administrator of the National Aeronautics and Space Administration shall pursue multidisciplinary research in subjects that further our understanding of solar physics, space physics, and space weather.

“(C) **SENSE OF CONGRESS.**—It is the sense of Congress that the Administrator of the National Aeronautics and Space Administration and Director of the National Science Foundation should support competitively awarded Heliophysics Science Centers.

“(c) **SCIENCE MISSIONS.**—The Administrator of the National Aeronautics and Space Administration shall seek to implement missions that meet the science objectives identified in Solar and Space Physics Decadal surveys conducted by the National Academy of Sciences.

“(d) **RESEARCH TO OPERATIONS.**—

“(1) **IN GENERAL.**—The Administrator of the National Aeronautics and Space Administration, the Director of the National Science Foundation, the Administrator of the National Oceanic and Atmospheric Administration, the Secretary of the Air Force, and where practicable in support of the Air Force, the Secretary of the Navy, shall—

“(A) develop a formal mechanism to transition National Aeronautics and Space Administration, National Science Foundation, Air Force, and Navy research findings, models, and capabilities, as appropriate, to National Oceanic and Atmospheric Administration and Department of Defense space weather operational forecasting centers; and

“(B) enhance coordination between research modeling centers and forecasting centers.

“(2) **OPERATIONAL NEEDS.**—The Administrator of the National Oceanic and Atmospheric Administration and the Secretary of Defense, in coordination with the Administrator of the National Aeronautics and Space Administration and the Director of the National Science Foundation, shall develop a formal mechanism to communicate the operational needs of space weather forecasters to the research community.

“(e) **TECHNOLOGY DEVELOPMENT.**—

“(1) **FINDINGS.**—Congress finds that observations and measurements closer to the Sun and advanced instrumentation would provide for

more advanced warning of space weather disturbances (as defined in section 3 of the Space Weather Research and Forecasting Act).

“(2) **TECHNOLOGY AND INSTRUMENTATION DEVELOPMENT.**—The Administrator of the National Aeronautics and Space Administration and the Director of the National Science Foundation shall support the development of technologies and instrumentation to improve space weather forecasting lead-time and accuracy to meet the needs identified by the Administrator of the National Oceanic and Atmospheric Administration.

**“§60704. Space weather data**

“(a) **IN GENERAL.**—The Administrator of the National Aeronautics and Space Administration and the Director of the National Science Foundation shall—

“(1) make space weather related data obtained for scientific research purposes available to space weather forecasters and operations centers; and

“(2) support model development and model applications to space weather forecasting.

“(b) **RESEARCH.**—The Administrator of the National Oceanic and Atmospheric Administration shall make space weather related data obtained from operational forecasting available for scientific research.”.

(b) **TECHNICAL AND CONFORMING AMENDMENTS.**—

(1) **REPEAL OF SECTION 809.**—Section 809 of the National Aeronautics and Space Administration Authorization Act of 2010 (42 U.S.C. 18388) and the item relating to that section in the table of contents under section 1(b) of that Act (124 Stat. 2806) are repealed.

(2) **TABLE OF CHAPTERS.**—The table of chapters of title 51, United States Code, is amended by adding after the item relating to chapter 605 the following:

“607. Space weather ..... 60701”.

**SEC. 3. SPACE WEATHER METRICS.**

(a) **DEFINITIONS.**—In this section:

(1) **SPACE WEATHER DISTURBANCE.**—The term “space weather disturbance” includes geo-electric fields, ionizing radiation, ionospheric disturbances, solar radio bursts, and upper atmospheric expansion.

(2) **SPACE WEATHER BENCHMARK.**—The term “space weather benchmark” means the physical characteristics and conditions describing the nature, frequency, and intensity of space weather disturbances.

(b) **BENCHMARKS.**—

(1) **PRELIMINARY.**—Not later than 90 days after the date of enactment of this Act, the Space Weather Interagency Working Group, established under section 60701 of title 51, United States Code, in consultation with academic and commercial experts, shall—

(A) assess existing data, the historical record, models, and peer-reviewed studies on space weather; and

(B) develop preliminary benchmarks, based on current scientific understanding and the historical record, for measuring solar disturbances.

(2) **FINAL.**—Not later than 18 months after the date the preliminary benchmarks are developed under paragraph (1), the Space Weather Interagency Working Group shall publish final benchmarks.

(3) **REVIEW.**—The Administrator of the National Aeronautics and Space Administration shall contract with the National Academy of Sciences to review the benchmarks established under paragraph (2).

(4) **REVISIONS.**—The Space Weather Interagency Working Group shall update and revise the final benchmarks under paragraph (2), as necessary, based on—

(A) the results of the review under paragraph (3);

(B) any significant new data or advances in scientific understanding that become available; or

(C) the evolving needs of entities impacted by solar disturbances.

**SEC. 4. PROTECTION OF CRITICAL INFRASTRUCTURE.**

(a) **IN GENERAL.**—The Administrator of the National Oceanic and Atmospheric Administration, in consultation with the heads of other relevant Federal agencies, shall provide information about space weather hazards to the Secretary of Homeland Security for purposes of this section.

(b) **CRITICAL INFRASTRUCTURE.**—The Secretary of Homeland Security, in consultation with sector-specific agencies, the Administrator of the National Oceanic and Atmospheric Administration, and the heads of other relevant agencies, shall—

(1) include, in meeting national critical infrastructure reporting requirements, an assessment of the vulnerability of critical infrastructure to space weather events, as described by the space weather benchmarks under section 3; and

(2) support critical infrastructure providers in managing the risks and impacts associated with space weather.

(c) **PROHIBITION ON NEW REGULATORY AUTHORITY.**—Nothing in subsection (b) may be construed to grant the Secretary of Homeland Security any authority to promulgate regulations that was not in effect on the day before the date of enactment of this Act.

(d) **DEFINITION OF SECTOR-SPECIFIC AGENCY.**—In this section, the term “sector-specific agency” has the meaning given the term in Presidential Policy Directive-21 of February 12, 2013 (Critical Infrastructure Security and Resilience), or any successor.

**SEC. 5. PROTECTION OF NATIONAL SECURITY ASSETS.**

(a) **IN GENERAL.**—The National Security Council, in consultation with the Office of the Director of National Intelligence, the Secretary of Defense, and the heads of other relevant Federal agencies, shall—

(1) assess the vulnerability of the national security community to space weather events, as described by the space weather benchmarks under section 3; and

(2) develop national security mechanisms to protect national security assets from space weather threats.

(b) **COOPERATION.**—The Secretary of Defense, in consultation with the heads of other relevant Federal agencies, shall provide information about space weather hazards to the National Security Council, Director of National Intelligence, and heads of Defense Agencies for purposes of this section.

**SEC. 6. ENSURING THE SAFETY OF CIVIL AVIATION.**

(a) **IN GENERAL.**—The Administrator of the Federal Aviation Administration, in consultation with the heads of other relevant Federal agencies, shall—

(1) assess the safety implications and vulnerability of the national airspace system by space weather events, as described by the space weather benchmarks under section 3;

(2) assess methods to mitigate the safety implications and effects of space weather on aviation communication systems, aircraft navigation systems, satellite and ground-based navigation systems, and potential health effects of radiation exposure; and

(3) assess options for incorporating space weather into operational training for pilots, cabin crew, dispatchers, air traffic controllers, meteorologists, and engineers.

(b) **SPACE WEATHER COMMUNICATION.**—The Administrator of the Federal Aviation Administration, in consultation with the heads of other relevant Federal agencies, shall develop methods to increase the interaction between the aviation community and the space weather research and service provider community.

Mr. PETERS. Mr. President, I ask unanimous consent that the committee-reported substitute amendment be considered and agreed to; that the

bill, as amended, be considered read a third time and passed; and that the motion to reconsider be considered made and laid upon the table.

The PRESIDING OFFICER. Without objection, it is so ordered.

The committee-reported amendment in the nature of a substitute was agreed to.

The bill (S. 141), as amended, was ordered to be engrossed for a third reading, was read the third time, and passed.

Mr. PETERS. Mr. President, I yield the floor.

I suggest the absence of a quorum.

The PRESIDING OFFICER (Mr. STRANGE). The clerk will call the roll. The senior assistant legislative clerk proceeded to call the roll.

Mr. ALEXANDER. Mr. President, I ask unanimous consent that the order for the quorum call be rescinded.

The PRESIDING OFFICER (Mr. JOHNSON). Without objection, it is so ordered.

**EXECUTIVE CALENDAR—Continued**

**NATIONAL CHARTER SCHOOLS WEEK**

Mr. ALEXANDER. Mr. President, I am here today to celebrate the 18th Annual National Charter Schools Week and thank the students, parents, and teachers from charter schools across the United States for their ongoing contributions to education. Senator BENNET of Colorado and I introduced a resolution marking this event, which the Senate approved yesterday.

Let me tell you my favorite story about charter schools. It was 24 years ago, 1992. I was in my last month as U.S. Secretary of Education, and as my last official act, I wrote a letter to every school superintendent in the country asking them to consider replicating the early success of the State of Minnesota in creating charter schools. There were about a dozen of them then, and they were created by the Democratic-Farmer-Labor Party of Minnesota. That was consistent with what President George H.W. Bush and I had been encouraging, which was what we called start-from-scratch schools—schools that gave teachers more freedom and parents more choices. We thought that could improve education in the country and might lead to what we call new American schools.

The first charter schools were created in the State of Minnesota nearly a quarter of a century ago, led by the Democratic-Farmer-Labor Party, and there were about a dozen of them. Since then, there has been broad bipartisan, mainstream support for charter schools.

Let's remember that charter schools are public schools. They are simply public schools which are freer from government rules, Federal rules, State rules, and union rules and which give teachers more freedom to teach the children who are presented to them and parents more freedom to choose those public schools.