Thune_Substitute (modified)

AMENDMENT NO._____ Calendar No._____

Purpose: In the nature of a substitute.

IN THE SENATE OF THE UNITED STATES—115th Cong., 2d Sess.

S. 3143

To provide for a coordinated Federal program to accelerate quantum research and development for the economic and national security of the United States.

Referred to the Committee on _____ and ordered to be printed

Ordered to lie on the table and to be printed

AMENDMENT IN THE NATURE OF A SUBSTITUTE intended to be proposed by Mr. THUNE (for himself and Mr. NELSON)

Viz:

Strike all after the enacting clause and insert the following:

SECTION 1. SHORT TITLE; TABLE OF CONTENTS.

(a) SHORT TITLE.—This Act may be cited as the "National Quantum Initiative Act".

(b) TABLE OF CONTENTS.—

SEC. 2. DEFINITIONS.

In this Act:

(1) ADVISORY COMMITTEE.—The term "Advisory Committee" means the National Quantum Initiative Advisory Committee established under section 104(a).

(2) COORDINATION OFFICE.—The term "Coordination Office" means the National Quantum Coordination Office established under section 102(a).

(3) INSTITUTION OF HIGHER EDUCATION.—The term "institution of higher education" has the meaning given the term in section 101(a) of the Higher Education Act of 1965 (20 U.S.C. 1001(a)).

(4) PROGRAM.—The term "Program" means the National Quantum Initiative Program implemented under section 101(a).

(5) QUANTUM INFORMATION SCIENCE.—The term "quantum information science" means the utilization of quantum physics for the storage, transmission, manipulation, computing, or measurement

of information in ways that offer advantages to classical capabilities.

(6) SUBCOMMITTEE.—The term ''Subcommittee'' means the Subcommittee on Quantum Information Science of the National Science and Technology Council established under section 103(a).

SEC. 3. PURPOSES.

The purposes of this Act are to ensure the continued leadership of the United States in quantum information science and its technology applications by—

(1) supporting research, development, demonstration, and application of quantum information science and technology in order to—

(A) expand the number of researchers, educators, and students with training in quantum information science and technology to develop a workforce pipeline;

(B) promote the development and inclusion of multidisciplinary curriculum and research opportunities for quantum information science at the undergraduate, graduate, and postdoctoral level;

(C) address basic research knowledge gaps;

(D) promote the further development of facilities and centers available for quantum information science and technology research, testing and education; and

(E) stimulate research on and promote more rapid development of quantum-based technologies;

(2) improving the interagency planning and coordination of Federal research and development of quantum information science and technology and maximizing the effectiveness of the Federal Government's quantum information science and technology research and development programs;

(3) promoting collaboration among government, Federal laboratories, industry, and universities; and

(4) promoting the development of international standards for quantum information science and technology—

(A) to facilitate technology innovation and commercialization; and

(B) to meet economic and national security goals.

TITLE I—NATIONAL QUANTUM INITIATIVE

SEC. 101. NATIONAL QUANTUM INITIATIVE PROGRAM.

The President shall implement a 10-year National Quantum Initiative Program. In carrying out the Program, the President shall, acting through appropriate Federal agencies, councils, working groups, subcommittees, and the Coordination Office—

(1) establish the goals, priorities, and metrics for a 10-year plan to accelerate development of quantum information science and technology applications in the United States;

(2) invest in fundamental Federal quantum information science and technology research, development, demonstration, standards development, and other activities to achieve the goals established in paragraph (1);

(3) invest in activities to develop a quantum information science and technology workforce pipeline;

(4) provide for interagency coordination of Federal quantum information science and technology research, development, demonstration, standards engagement, and other activities undertaken pursuant to the Program;

(5) partner with industry and academia to leverage knowledge and resources; and

(6) leverage existing Federal investments efficiently to advance Program goals and objectives.

SEC. 102. NATIONAL QUANTUM COORDINATION OFFICE.

(a) ESTABLISHMENT.—The President shall establish a National Quantum Coordination Office, which shall have—

(1) a Director appointed by the Director of the Office of Science and Technology Policy, in consultation with the Secretary of Commerce, the Director of the National Science Foundation, and the Secretary of Energy; and

(2) staff that shall be comprised of employees detailed from the Federal agencies that are members of the Subcommittee.

(b) RESPONSIBILITIES.—The Coordination Office shall—

(1) provide technical and administrative support to—

(A) the Subcommittee; and

(B) the Advisory Committee;

(2) oversee interagency coordination of the Program, including encouraging and supporting joint

agency solicitation and selection of applications for funding of projects under the Program;

(3) serve as the point of contact on Federal civilian quantum information science and technology activities for Government organizations, academia, industry, professional societies, State governments, and others to exchange technical and programmatic information;

(4) ensure coordination between the Multidisciplinary Centers for Quantum Research and Education established under section 302(a) and the National Quantum Information Science Research Centers established under section 402(a);

(5) conduct public outreach, including dissemination of findings and recommendations of the Advisory Committee, as appropriate;

(6) promote access to and early application of the technologies, innovations, and expertise derived from Program activities to agency missions and systems across the Federal Government, and to United States industry, including startup companies; and

(7) promote access, through the appropriate government agencies and an open and competitive merit-reviewed process, to existing quantum computing and communication systems developed by in-

dustry, universities, and national laboratories to the general user community, in pursuit of discovery of the new applications of such systems.

(c) FUNDING.—Funds necessary to carry out the activities of the Coordination Office shall be made available each fiscal year by the participating agencies of the Subcommittee, as determined by the Director of the Office of Science and Technology Policy.

SEC. 103. SUBCOMMITTEE ON QUANTUM INFORMATION SCIENCE.

(a) ESTABLISHMENT.—The President shall establish, through the National Science and Technology Council, a Subcommittee on Quantum Information Science.

(b) MEMBERSHIP.—The Subcommittee shall include—

(1) the National Institute of Standards and Technology;

(2) the National Science Foundation;

(3) the Department of Energy;

(4) the National Aeronautics and Space Administration;

(5) the Department of Defense;

(6) the Office of the Director of National Intelligence;

(7) the Office of Management and Budget;

(8) the Office of Science and Technology Policy; and

(9) any other Federal agency as considered appropriate by the President.

(c) CHAIRS.—The Subcommittee shall be jointly chaired by the Director of the National Institute of Standards and Technology, the Director of the National Science Foundation, and the Secretary of Energy.

(d) RESPONSIBILITIES.—The Subcommittee shall—

(1) coordinate the quantum information science and technology research, information sharing about international standards development and use, and education activities and programs of the Federal agencies;

(2) establish goals and priorities of the Program, based on identified knowledge and workforce gaps and other national needs;

(3) assess and recommend Federal infrastructure needs to support the Program; and

(4) evaluate opportunities for international cooperation with strategic allies on research and development in quantum information science and technology.

(e) STRATEGIC PLAN.—Not later than 1 year after the date of enactment of this Act, the Subcommittee shall

develop a 5-year strategic plan, and 6 years after enactment of the Act develop an additional 5-year strategic plan, with periodic updates as appropriate to guide the activities of the Program, meet the goals, priorities, and anticipated outcomes of the participating agencies.

(f) REPORTS.—The Chairs of the Subcommittee shall submit to the President, the Advisory Committee, the Committee on Science, Space, and Technology of the House of Representatives, the Committee on Commerce, Science, and Transportation and the Committee on Energy and Natural Resources of the Senate, and other appropriate committees of Congress the strategic plans developed under subsection (e) and any updates to such plans.

SEC. 104. NATIONAL QUANTUM INITIATIVE ADVISORY COMMITTEE.

(a) IN GENERAL.—The President shall establish a National Quantum Initiative Advisory Committee.

(b) QUALIFICATIONS.—The Advisory Committee established by the President under subsection (a) shall consist of members from industry, academic institutions, and Federal laboratories. The President shall appoint members to the Advisory Committee who are qualified to provide advice and information on quantum information science and technology research, development, demonstra-

tions, standards, education, technology transfer, commercial application, or national security and economic concerns.

(c) MEMBERSHIP CONSIDERATION.—In selecting an Advisory Committee, the President may seek and give consideration to recommendations from the Congress, industry, the scientific community (including the National Academy of Sciences, scientific professional societies, and academia), the defense community, and other appropriate organizations.

(d) DUTIES.—The Advisory Committee shall advise the President and the Subcommittee and make recommendations that shall be considered in reviewing and revising the Program. The Advisory Committee shall provide the President and the Subcommittee with an independent assessment of—

(1) trends and developments in quantum information science and technology;

(2) progress made in implementing the Program;

(3) whether the Program activities, priorities, and technical goals developed by the Subcommittee are helping to maintain United States leadership in quantum information science and technology;

(4) the management, coordination, implementation, and activities of the Program;

(5) the need to revise the Program;

(6) whether or not there are opportunities for international cooperation with strategic allies on research and development in, and the development of open standards for, quantum information science and technology; and

(7) whether national security, societal, economic, legal, and workforce concerns are adequately addressed by the Program.

(c) REPORTS.—The Advisory Committee shall report, not less frequently than once every 2 years, to the President on the assessments required under subsection (d) and any recommendations to improve the Program. The first report under this subsection shall be submitted not later than 6 months after the date of enactment of this Act. The Director of the Office of Science and Technology Policy shall transmit a copy of each report under this subsection to the Committee on Science, Space, and Technology of the House of Representatives, the Committee on Commerce, Science, and Transportation of the Senate, the Committee on Energy and Natural Resources of the Senate, and other appropriate committees of the Congress.

(f) TRAVEL EXPENSES OF NON-FEDERAL MEMBERS.—Non-Federal members of the Advisory Committee, while attending meetings of the Advisory Committee or while otherwise serving at the request of the head of the Advisory Committee away from their homes or regular places of business, may be allowed travel expenses, including per diem in lieu of subsistence, as authorized by section 5703 of title 5, United States Code, for individuals in the Government serving without pay. Nothing in this subsection shall be construed to prohibit members of the Advisory Committee who are officers or employees of the United States from being allowed travel expenses, including per diem in lieu of subsistence, in accordance with existing law.

(g) EXEMPTION.—The Advisory Committee shall be exempt from section 14 of the Federal Advisory Committee Act (5 U.S.C. App.).

SEC. 105. SUNSET.

(a) IN GENERAL.—Except as provided for in subsection (b), the authority to carry out sections 101, 102, 103, and 104 shall terminate on the date that is 11 years after the date of enactment of this Act.

(b) EXTENSION.—The President may continue the activities under such sections if the President determines

that such activities are necessary to meet national economic or national security needs.

TITLE II—NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY QUANTUM ACTIVITIES

SEC. 201. QUANTUM STANDARDS AND MEASUREMENT ACTIVITIES.

(a) NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY ACTIVITIES.—As part of the Program described in title I, the Director of the National Institute of Standards and Technology shall—

(1) continue to support and expand basic and applied quantum information science and technology research and development of measurement and standards infrastructure necessary to advance commercial development of quantum applications;

(2) use its existing programs, in collaboration with other agencies, as appropriate, to train scientists in quantum information science and technology to increase participation in the quantum fields;

(3) establish or expand collaborative ventures or consortia with other public or private sector entities, including academia, National Laboratories, and in-

dustry for the purpose of advancing the field of quantum information science and engineering; and

(4) have the authority to enter into and perform such contracts, including cooperative research and development arrangements and grants and cooperative agreements or other transactions, as may be necessary in the conduct of the work of the Institute and on such terms as the Director considers appropriate, in furtherance of the purposes of this Act.

(b) QUANTUM CONSORTIUM.—

(1) IN GENERAL.—Not later than 1 year after the date of enactment of this Act, the Director of the National Institute of Standards and Technology shall convene a consortium of stakeholders to discuss the future measurement, standards, cybersecurity, and other appropriate needs for supporting the development of a robust quantum information science and technology industry in the United States. The goals of the consortium shall be to—

(A) assess the current research on the issues described in this paragraph;

(B) evaluate the research gaps relating to such issues; and

(C) provide recommendations on how the National Institute of Standards and Technology

and the Program can address the research needs identified.

(2) REPORT TO CONGRESS.—Not later than 2 years after the date of enactment of this Act, the Director of the National Institute of Standards and Technology shall transmit to the Committee on Science, Space, and Technology of the House of Representatives and the Committee on Commerce, Science, and Transportation of the Senate a summary report containing the findings of the consortium convened under this section.

(c) FUNDING.—There is authorized to be appropriated to the National Institute of Standards and Technology to carry out the activities under this section $60,000,000 for each of fiscal years 2019 through 2023.

TITLE III—NATIONAL SCIENCE FOUNDATION QUANTUM ACTIVITIES

SEC. 301. QUANTUM INFORMATION SCIENCE RESEARCH AND EDUCATION PROGRAM.

(a) IN GENERAL.—The Director of the National Science Foundation shall carry out a basic research and education program on quantum information science and engineering.

(b) PROGRAM COMPONENTS.—In carrying out the program required under subsection (a), the Director of the National Science Foundation shall carry out activities that continue to support basic interdisciplinary quantum information science and engineering research, and support human resources development in all aspects of quantum information science and engineering. Such activities shall include, at a minimum—

(1) using the existing programs of the National Science Foundation, in collaboration with other Federal agencies, as appropriate, to—

(A) improve the teaching and learning of quantum information science and engineering at the undergraduate, graduate, and postgraduate levels; and

(B) increase participation in the quantum fields, including by individuals identified in sections 33 and 34 of the Science and Engineering Equal Opportunities Act (42 U.S.C. 1885a; 42 U.S.C. 1885b);

(2) formulating goals for quantum information science and engineering research and education activities to be supported by the National Science Foundation;

(3) leveraging the collective body of knowledge from existing quantum information science and engineering research and education activities;

(4) coordinating research efforts funded through existing programs across the directorates of the National Science Foundation; and

(5) engaging with other Federal agencies, research communities, and potential users of information produced under this section.

SEC. 302. MULTIDISCIPLINARY CENTERS FOR QUANTUM RESEARCH AND EDUCATION.

(a) MULTIDISCIPLINARY CENTERS FOR QUANTUM RESEARCH AND EDUCATION.—

(1) IN GENERAL.—The Director of the National Science Foundation, in consultation with other Federal agencies as appropriate, shall award grants to institutions of higher education or eligible nonprofit organizations (or consortia thereof) to establish up to 5 Multidisciplinary Centers for Quantum Research and Education.

(2) COLLABORATIONS.—A collaboration receiving an award under this subsection may include institutions of higher education, eligible nonprofit organizations, and private sector entities.

(3) PURPOSE.—The purpose of the Centers shall be to conduct basic research and education activities in support of the goals and priorities of the Program as determined in title I, to—

(A) continue to advance quantum information science and engineering;

(B) support curriculum and workforce development in quantum information science and engineering; and

(C) foster innovation by bringing industry perspectives to quantum research and workforce development, including by leveraging industry resources and research capacity.

(4) REQUIREMENTS.—An institution of higher education or an eligible nonprofit organization (or a consortium thereof) seeking funding under this section shall submit an application to the Director at such time, in such manner, and containing such information as the Director may require. The application shall include, at a minimum, a description of—

(A) how the Center will work with other research institutions and industry partners to leverage expertise in quantum science, education and curriculum development, and technology transfer;

(B) how the Center will promote active collaboration among researchers in multiple disciplines involved in quantum research including physics, engineering, mathematics, computer science, chemistry, and material science;

(C) how the Center will support long-term and short-term workforce development in the quantum field;

(D) how the Center can support an innovation ecosystem to work with industry to translate Center research into applications; and

(E) a long-term plan to become self-sustaining after the expiration of Foundation support.

(5) SELECTION AND DURATION.—

(A) IN GENERAL.—The Centers selected and established under this section are authorized to carry out activities for a period of 5 years.

(B) REAPPLICATION.—An awardee may reapply for an additional, subsequent period of 5 years on a competitive, merit-reviewed basis.

(C) TERMINATION.—Consistent with the existing authorities of the Foundation, the Director of the National Science Foundation may

terminate an underperforming Center for cause during the performance period.

(6) FUNDING.—There is authorized to be appropriated to the National Science Foundation to carry out this section for each of fiscal years 2019 through 2023 an amount equal to the number of Multidisciplinary Centers for Quantum Research and Education (as provided in the National Science Foundation budget request for the fiscal year) multiplied by $10,000,000.

(b) GRADUATE TRAINEESHIPS.—The Director of the National Science Foundation may establish a program to provide traineeships to graduate students at institutions of higher education within the United States who are citizens of the United States and who choose to pursue masters or doctoral degrees in quantum information science.