

115TH CONGRESS  
2D SESSION

# 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.

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IN THE SENATE OF THE UNITED STATES

JUNE 26, 2018

Mr. THUNE (for himself and Mr. NELSON) introduced the following bill; which was read twice and referred to the Committee on Commerce, Science, and Transportation

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## A BILL

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

1 *Be it enacted by the Senate and House of Representa-*  
2 *tives of the United States of America in Congress assembled,*

3 **SECTION 1. SHORT TITLE; TABLE OF CONTENTS.**

4 (a) **SHORT TITLE.**—This Act may be cited as the  
5 “National Quantum Initiative Act”.

6 (b) **TABLE OF CONTENTS.**—

Sec. 1. Short title; table of contents.

Sec. 2. Definitions.

Sec. 3. Purposes.

### TITLE I—NATIONAL QUANTUM INITIATIVE

Sec. 101. National Quantum Initiative Program.

- Sec. 102. National Quantum Coordination Office.  
 Sec. 103. Subcommittee on Quantum Information Science.  
 Sec. 104. National Quantum Initiative Advisory Committee.  
 Sec. 105. Sunset.

TITLE II—NATIONAL INSTITUTE OF STANDARDS AND  
 TECHNOLOGY QUANTUM ACTIVITIES

- Sec. 201. National Institute of Standards and Technology Activities and Quantum Workshop.

TITLE III—NATIONAL SCIENCE FOUNDATION AND MULTIDISCIPLINARY CENTERS FOR QUANTUM RESEARCH AND EDUCATION

- Sec. 301. Quantum Information Science Research and Education Program.  
 Sec. 302. Multidisciplinary Centers for Quantum Research and Education.  
 Sec. 303. Spending limitation.

1 **SEC. 2. DEFINITIONS.**

2 In this Act:

3 (1) **ADVISORY COMMITTEE.**—The term “Advisory Committee” means the National Quantum Initiative Advisory Committee established under section  
 4  
 5  
 6 104(a).

7 (2) **COORDINATION OFFICE.**—The term “Coordination Office” means the National Quantum Coordination Office established under section 102(a).  
 8  
 9

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

14 (4) **PROGRAM.**—The term “Program” means  
 15 the National Quantum Initiative Program imple-  
 16 mented under section 101(a).

17 (5) **QUANTUM INFORMATION SCIENCE.**—The  
 18 term “quantum information science” means the

1 storage, transmission, manipulation, or measurement  
2 of information that is encoded in systems that can  
3 only be described by the laws of quantum physics.

4 (6) SUBCOMMITTEE.—The term “Subcommit-  
5 tee” means the Subcommittee on Quantum Informa-  
6 tion Science of the National Science and Technology  
7 Council established under section 103(a).

8 **SEC. 3. PURPOSES.**

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

12 (1) supporting research, development, dem-  
13 onstration, and application of quantum information  
14 science and technology in order to—

15 (A) expand the number of researchers,  
16 educators, and students with training in quan-  
17 tum information science and technology to de-  
18 velop a workforce pipeline;

19 (B) promote the development and inclusion  
20 of multidisciplinary curriculum and research op-  
21 portunities for quantum information science at  
22 the undergraduate, graduate, and postdoctoral  
23 level;

24 (C) address basic research knowledge gaps;

1 (D) promote the further development of fa-  
2 cilities and centers available for quantum infor-  
3 mation science and technology research, testing  
4 and education; and

5 (E) stimulate research on and promote  
6 more rapid development of quantum-based tech-  
7 nologies;

8 (2) improving the interagency planning and co-  
9 ordination of Federal research and development of  
10 quantum information science and technology and  
11 maximizing the effectiveness of the Federal Govern-  
12 ment's quantum information science and technology  
13 research and development programs;

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

16 (4) promoting the development of standards for  
17 quantum information science and technology secu-  
18 rity.

## 19 **TITLE I—NATIONAL QUANTUM** 20 **INITIATIVE**

### 21 **SEC. 101. NATIONAL QUANTUM INITIATIVE PROGRAM.**

22 The President shall implement a 10-year National  
23 Quantum Initiative Program. In carrying out the Pro-  
24 gram, the President shall, acting through appropriate

1 Federal agencies, councils, working groups, subcommit-  
2 tees, and the Coordination Office—

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

7 (2) invest in fundamental Federal quantum in-  
8 formation science and technology research, develop-  
9 ment, demonstration, and other activities to achieve  
10 the goals established in paragraph (1);

11 (3) invest in activities to develop a quantum in-  
12 formation science and technology workforce pipeline;

13 (4) provide for interagency coordination of Fed-  
14 eral quantum information science and technology re-  
15 search, development, demonstration, and other ac-  
16 tivities undertaken pursuant to the Program;

17 (5) partner with industry and academia to le-  
18 verage knowledge and resources; and

19 (6) leverage existing Federal investments effi-  
20 ciently to advance Program goals and objectives.

21 **SEC. 102. NATIONAL QUANTUM COORDINATION OFFICE.**

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

1           (1) a Director appointed by the Director of the  
2 Office of Science and Technology Policy, in consulta-  
3 tion with the Secretary of Commerce, the Director  
4 of the National Science Foundation, and the Sec-  
5 retary of Energy; and

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

9           (b) RESPONSIBILITIES.—The Coordination Office  
10 shall—

11           (1) provide technical and administrative support  
12 to—

13                   (A) the Subcommittee; and

14                   (B) the Advisory Committee;

15           (2) oversee interagency coordination of the Pro-  
16 gram, including encouraging and supporting joint  
17 agency solicitation and selection of applications for  
18 funding of projects under the Program;

19           (3) serve as the point of contact on Federal ci-  
20 vilian quantum information science and technology  
21 activities for Government organizations, academia,  
22 industry, professional societies, State governments,  
23 and others to exchange technical and programmatic  
24 information;

1 (4) ensure coordination between the Multidisci-  
2 plinary Centers for Quantum Research and Edu-  
3 cation established under section 302(a) and the Na-  
4 tional Quantum Information Science Research Cen-  
5 ters established under section 402(a);

6 (5) conduct public outreach, including dissemi-  
7 nation of findings and recommendations of the Advi-  
8 sory Committee, as appropriate; and

9 (6) promote access to and early application of  
10 the technologies, innovations, and expertise derived  
11 from Program activities to agency missions and sys-  
12 tems across the Federal Government, and to United  
13 States industry, including startup companies.

14 (c) FUNDING.—Funds necessary to carry out the ac-  
15 tivities of the Coordination Office shall be made available  
16 each fiscal year by the participating agencies of the Sub-  
17 committee, as determined by the Director of the Office  
18 of Science and Technology Policy.

19 **SEC. 103. SUBCOMMITTEE ON QUANTUM INFORMATION**  
20 **SCIENCE.**

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

24 (b) MEMBERSHIP.—The Subcommittee shall in-  
25 clude—

1           (1) the National Institute of Standards and  
2           Technology;

3           (2) the National Science Foundation;

4           (3) the Department of Energy;

5           (4) the National Aeronautics and Space Admin-  
6           istration;

7           (5) the Department of Defense;

8           (6) the Office of the Director of National Intel-  
9           ligence;

10          (7) the Office of Management and Budget;

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

12          and

13          (9) any other Federal agency as considered ap-  
14          propriate by the President.

15          (c) CHAIRS.—The Subcommittee shall be jointly  
16          chaired by the Director of the National Institute of Stand-  
17          ards and Technology, the Director of the National Science  
18          Foundation, and the Secretary of Energy.

19          (d) RESPONSIBILITIES.—The Subcommittee shall—

20                 (1) coordinate the quantum information science  
21                 and technology research and education activities and  
22                 programs of the Federal agencies;

23                 (2) establish goals and priorities of the Pro-  
24                 gram, based on identified knowledge and workforce  
25                 gaps and other national needs;



1           (3) assess and recommend Federal infrastruc-  
2           ture needs to support the Program; and

3           (4) evaluate opportunities for international co-  
4           operation with strategic allies on research and devel-  
5           opment in quantum information science and tech-  
6           nology.

7           (e) STRATEGIC PLAN.—Not later than 1 year after  
8           the date of enactment of this Act, the Subcommittee shall  
9           develop a 5-year strategic plan, and 6 years after enact-  
10          ment of the Act develop an additional 5-year strategic  
11          plan, with periodic updates as appropriate to guide the  
12          activities of the Program, meet the goals, priorities, and  
13          anticipated outcomes of the participating agencies.

14          (f) REPORTS.—The Chairs of the Subcommittee shall  
15          submit to the President, the Advisory Committee, the  
16          Committee on Science, Space, and Technology of the  
17          House of Representatives, the Committee on Commerce,  
18          Science, and Transportation and the Committee on En-  
19          ergy and Natural Resources of the Senate, and other ap-  
20          propriate committees of Congress the strategic plans de-  
21          veloped under subsection (e) and any updates to such  
22          plans.

1 **SEC. 104. NATIONAL QUANTUM INITIATIVE ADVISORY COM-**  
2 **MITTEE.**

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

5 (b) **QUALIFICATIONS.**—The Advisory Committee es-  
6 tablished by the President under subsection (a) shall con-  
7 sist of members from industry, academic institutions, and  
8 Federal laboratories. The President shall appoint mem-  
9 bers to the Advisory Committee who are qualified to pro-  
10 vide advice and information on quantum information  
11 science and technology research, development, demonstra-  
12 tions, education, technology transfer, commercial applica-  
13 tion, or national security and economic concerns.

14 (c) **MEMBERSHIP CONSIDERATION.**—In selecting an  
15 Advisory Committee, the President may seek and give con-  
16 sideration to recommendations from the Congress, indus-  
17 try, the scientific community (including the National  
18 Academy of Sciences, scientific professional societies, and  
19 academia), the defense community, and other appropriate  
20 organizations.

21 (d) **DUTIES.**—The Advisory Committee shall advise  
22 the President and the Subcommittee and make rec-  
23 ommendations that shall be considered in reviewing and  
24 revising the Program. The Advisory Committee shall pro-  
25 vide the President and the Subcommittee with an inde-  
26 pendent assessment of—

1           (1) trends and developments in quantum infor-  
2           mation science and technology;

3           (2) progress made in implementing the Pro-  
4           gram;

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

9           (4) the management, coordination, implementa-  
10          tion, and activities of the Program;

11          (5) the need to revise the Program;

12          (6) whether or not there are opportunities for  
13          international cooperation with strategic allies on re-  
14          search and development in quantum information  
15          science and technology; and

16          (7) whether national security, societal, eco-  
17          nomic, legal, and workforce concerns are adequately  
18          addressed by the Program.

19          (e) REPORTS.—The Advisory Committee shall report,  
20          not less frequently than once every 2 years, to the Presi-  
21          dent on the assessments required under subsection (d) and  
22          any recommendations to improve the Program. The first  
23          report under this subsection shall be submitted not later  
24          than 6 months after the date of enactment of this Act.  
25          The Director of the Office of Science and Technology Pol-

1 icy shall transmit a copy of each report under this sub-  
2 section to the Committee on Science, Space, and Tech-  
3 nology of the House of Representatives, the Committee on  
4 Commerce, Science, and Transportation of the Senate, the  
5 Committee on Energy and Natural Resources of the Sen-  
6 ate, and other appropriate committees of the Congress.

7 (f) TRAVEL EXPENSES OF NON-FEDERAL MEM-  
8 BERS.—Non-Federal members of the Advisory Committee,  
9 while attending meetings of the Advisory Committee or  
10 while otherwise serving at the request of the head of the  
11 Advisory Committee away from their homes or regular  
12 places of business, may be allowed travel expenses, includ-  
13 ing per diem in lieu of subsistence, as authorized by sec-  
14 tion 5703 of title 5, United States Code, for individuals  
15 in the Government serving without pay. Nothing in this  
16 subsection shall be construed to prohibit members of the  
17 Advisory Committee who are officers or employees of the  
18 United States from being allowed travel expenses, includ-  
19 ing per diem in lieu of subsistence, in accordance with ex-  
20 isting law.

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

1 **SEC. 105. SUNSET.**

2 (a) IN GENERAL.—Except as provided for in sub-  
3 section (b), the authority to carry out sections 101, 102,  
4 103, and 104 shall terminate on the date that is 11 years  
5 after the date of enactment of this Act.

6 (b) EXTENSION.—The President may continue the  
7 activities under such sections if the President determines  
8 that such activities are necessary to meet national eco-  
9 nomic or national security needs.

10 **TITLE II—NATIONAL INSTITUTE**  
11 **OF STANDARDS AND TECH-**  
12 **NOLOGY QUANTUM ACTIVI-**  
13 **TIES**

14 **SEC. 201. NATIONAL INSTITUTE OF STANDARDS AND TECH-**  
15 **NOLOGY ACTIVITIES AND QUANTUM WORK-**  
16 **SHOP.**

17 (a) NATIONAL INSTITUTE OF STANDARDS AND  
18 TECHNOLOGY ACTIVITIES.—As part of the Program de-  
19 scribed in title I, the Director of the National Institute  
20 of Standards and Technology shall—

21 (1) continue to support and expand basic quan-  
22 tum information science and technology research  
23 and development of measurement and standards in-  
24 frastructure necessary to advance commercial devel-  
25 opment of quantum applications;

1           (2) use its existing programs, in collaboration  
2 with other agencies, as appropriate, to train sci-  
3 entists in quantum information science and tech-  
4 nology to increase participation in the quantum  
5 fields;

6           (3) establish or expand collaborative ventures or  
7 consortia with other public or private sector entities,  
8 including academia, National Laboratories, and in-  
9 dustry for the purpose of advancing the field of  
10 quantum information science and engineering; and

11           (4) have the authority to enter into and per-  
12 form such contracts, including cooperative research  
13 and development arrangements and grants and coop-  
14 erative agreements or other transactions, as may be  
15 necessary in the conduct of the work of the Institute  
16 and on such terms as the Director considers appro-  
17 priate, in furtherance of the purposes of this Act.

18 (b) QUANTUM WORKSHOP.—

19           (1) IN GENERAL.—Not later than 1 year after  
20 the date of enactment of this Act, the Director of  
21 the National Institute of Standards and Technology  
22 shall convene a workshop of stakeholders to discuss  
23 the future measurement, standards, cybersecurity,  
24 and other appropriate needs for supporting the de-  
25 velopment of a robust quantum information science

1 and technology industry in the United States. The  
2 goals of the workshop shall be to—

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

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

7 (C) provide recommendations on how the  
8 National Institute of Standards and Technology  
9 and the Program can address the research  
10 needs identified.

11 (2) REPORT TO CONGRESS.—Not later than 2  
12 years after the date of enactment of this Act, the  
13 Director of the National Institute of Standards and  
14 Technology shall transmit to the Committee on  
15 Science, Space, and Technology of the House of  
16 Representatives and the Committee on Commerce,  
17 Science, and Transportation of the Senate a sum-  
18 mary report containing the findings of the workshop  
19 convened under this section.

20 (c) FUNDING.—The Secretary of Commerce shall de-  
21 vote \$400,000,000 to carry out this section, which shall  
22 include \$80,000,000 for each of fiscal years 2019 through  
23 2023, subject to the availability of appropriations, to come  
24 from amounts made available for the National Institute  
25 of Standards and Technology. This section shall be carried

1 out using funds otherwise appropriated by law after the  
2 date of enactment of this Act.

3 **TITLE III—NATIONAL SCIENCE**  
4 **FOUNDATION AND MULTI-**  
5 **DISCIPLINARY CENTERS FOR**  
6 **QUANTUM RESEARCH AND**  
7 **EDUCATION**

8 **SEC. 301. QUANTUM INFORMATION SCIENCE RESEARCH**  
9 **AND EDUCATION PROGRAM.**

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

14 (b) PROGRAM COMPONENTS.—In carrying out the  
15 program required under subsection (a), the Director of the  
16 National Science Foundation shall carry out activities that  
17 continue to support basic interdisciplinary quantum infor-  
18 mation science and engineering research, and support  
19 human resources development in all aspects of quantum  
20 information science and engineering. Such activities shall  
21 include—

22 (1) using the existing programs of the National  
23 Science Foundation, in collaboration with other Fed-  
24 eral agencies, as appropriate, to—



1 (A) improve the teaching and learning of  
2 quantum information science and engineering  
3 at the undergraduate, graduate, and post-  
4 graduate levels; and

5 (B) increase participation in the quantum  
6 fields, including by individuals identified in sec-  
7 tions 33 and 34 of the Science and Engineering  
8 Equal Opportunities Act (42 U.S.C. 1885a; 42  
9 U.S.C. 1885b);

10 (2) formulating goals for quantum information  
11 science and engineering research and education ac-  
12 tivities to be supported by the National Science  
13 Foundation;

14 (3) leveraging the collective body of knowledge  
15 from existing quantum information science and engi-  
16 neering research and education activities;

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

20 (5) engaging with other Federal agencies, re-  
21 search communities, and potential users of informa-  
22 tion produced under this section.

1 **SEC. 302. MULTIDISCIPLINARY CENTERS FOR QUANTUM**  
2 **RESEARCH AND EDUCATION.**

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

5 (1) IN GENERAL.—The Director of the National  
6 Science Foundation, in consultation with other Fed-  
7 eral agencies as appropriate, shall award grants to  
8 institutions of higher education or eligible nonprofit  
9 organizations (or consortia thereof) to establish up  
10 to 5 Multidisciplinary Centers for Quantum Re-  
11 search and Education.

12 (2) COLLABORATIONS.—A collaboration receiv-  
13 ing an award under this subsection may include in-  
14 stitutions of higher education, eligible nonprofit or-  
15 ganizations, and private sector entities.

16 (3) PURPOSE.—The purpose of the Centers  
17 shall be to conduct basic research and education ac-  
18 tivities in support of the goals and priorities of the  
19 Program as determined in title I, to—

20 (A) continue to advance quantum informa-  
21 tion science and engineering;

22 (B) support curriculum and workforce de-  
23 velopment in quantum information science and  
24 engineering; and

25 (C) foster innovation by bringing industry  
26 perspectives to quantum research and workforce

1 development, including by leveraging industry  
2 resources and research capacity.

3 (4) REQUIREMENTS.—An institution of higher  
4 education or an eligible nonprofit organization (or a  
5 consortium thereof) seeking funding under this sec-  
6 tion shall submit an application to the Director at  
7 such time, in such manner, and containing such in-  
8 formation as the Director may require. The applica-  
9 tion shall include, at a minimum, a description of—

10 (A) how the Center will work with other  
11 research institutions and industry partners to  
12 leverage expertise in quantum science, edu-  
13 cation and curriculum development, and tech-  
14 nology transfer;

15 (B) how the Center will promote active col-  
16 laboration among researchers in multiple dis-  
17 ciplines involved in quantum research including  
18 physics, engineering, mathematics, computer  
19 science, chemistry, and material science;

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

23 (D) how the Center can support an innova-  
24 tion ecosystem to work with industry to trans-  
25 late Center research into applications; and

1           (E) a long-term plan to become self-sus-  
2           taining after the expiration of Foundation sup-  
3           port.

4           (5) SELECTION AND DURATION.—

5           (A) IN GENERAL.—The Centers selected  
6           and established under this section are author-  
7           ized to carry out activities for a period of 5  
8           years.

9           (B) REAPPLICATION.—An awardee may  
10          reapply for an additional, subsequent period of  
11          5 years on a competitive, merit-reviewed basis.

12          (C) TERMINATION.—Consistent with the  
13          existing authorities of the Foundation, the Di-  
14          rector of the National Science Foundation may  
15          terminate an underperforming Center for cause  
16          during the performance period.

17          (6) FUNDING.—The Director of the National  
18          Science Foundation shall devote \$250,000,000 to  
19          carry out this section, which shall include  
20          \$50,000,000 for each of fiscal years 2019 through  
21          2023, subject to the availability of appropriations, to  
22          come from amounts made available for Research and  
23          Related Activities and Education and Human Re-  
24          sources. This section shall be carried out using

1 funds otherwise appropriated by law after the date  
2 of enactment of this Act.

3 (b) GRADUATE TRAINEESHIPS.—The Director of the  
4 National Science Foundation may establish a program to  
5 provide traineeships to graduate students at institutions  
6 of higher education within the United States who are citi-  
7 zens of the United States and who choose to pursue mas-  
8 ters or doctoral degrees in quantum information science.

9 **SEC. 303. SPENDING LIMITATION.**

10 No additional funds are authorized to be appro-  
11 priated to carry out this Act and the amendments made  
12 by this Act, and this Act and such amendments shall be  
13 carried out using amounts otherwise available for such  
14 purpose.

○