

115TH CONGRESS
2D SESSION

H. R. 6227

IN THE SENATE OF THE UNITED STATES

SEPTEMBER 17, 2018

Received; read twice and referred to the Committee on Commerce, Science,
and Transportation

AN ACT

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,*

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

2 (a) SHORT TITLE.—This Act may be cited as the
3 “National Quantum Initiative Act”.

4 (b) TABLE OF CONTENTS.—

Sec. 1. Short title; table of contents.

Sec. 2. Definitions.

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TITLE I—NATIONAL QUANTUM INITIATIVE

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Sec. 401. Quantum Information Science Research program.

Sec. 402. National Quantum Information Science Research Centers.

Sec. 403. Spending limitation.

5 **SEC. 2. DEFINITIONS.**

6 In this Act, the following definitions apply:

7 (1) ADVISORY COMMITTEE.—The term “Advisory
8 sory Committee” means the National Quantum Initiative
9 tiative Advisory Committee established under section
10 104(a).

1 (2) COORDINATION OFFICE.—The term “Co-
2 ordination Office” means the National Quantum Co-
3 ordination Office established under section 102(a).

4 (3) INSTITUTIONS OF HIGHER EDUCATION.—
5 The term “institutions of higher education” has the
6 meaning given the term in section 101(a) of the
7 Higher Education Act of 1965 (20 U.S.C. 1001(a)).

8 (4) PROGRAM.—The term “Program” means
9 the National Quantum Initiative Program imple-
10 mented under section 101(a).

11 (5) QUANTUM INFORMATION SCIENCE.—The
12 term “quantum information science” means the
13 storage, transmission, manipulation, or measurement
14 of information that is encoded in systems that can
15 only be described by the laws of quantum physics.

16 (6) SUBCOMMITTEE.—The term “Sub-
17 committee” means the Subcommittee on Quantum
18 Information Science of the National Science and
19 Technology Council established under section
20 103(a).

21 **SEC. 3. PURPOSES.**

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

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

4 (A) expand the number of researchers,
5 educators, and students with training in quan-
6 tum information science and technology to de-
7 velop a workforce pipeline;

8 (B) promote the development and inclusion
9 of multidisciplinary curriculum and research op-
10 portunities for quantum information science at
11 the undergraduate, graduate, and postdoctoral
12 level;

13 (C) address basic research knowledge gaps;

14 (D) promote the further development of fa-
15 cilities and centers available for quantum infor-
16 mation science and technology research, testing
17 and education; and

18 (E) stimulate research on and promote
19 more rapid development of quantum-based tech-
20 nologies;

21 (2) improving the interagency planning and co-
22 ordination of Federal research and development of
23 quantum information science and technology and
24 maximizing the effectiveness of the Federal Govern-

1 ment’s quantum information science and technology
2 research and development programs;

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

5 (4) promoting the development of standards for
6 quantum information science and technology secu-
7 rity.

8 **TITLE I—NATIONAL QUANTUM** 9 **INITIATIVE**

10 **SEC. 101. NATIONAL QUANTUM INITIATIVE PROGRAM.**

11 The President shall implement a 10-year National
12 Quantum Initiative Program. In carrying out the Pro-
13 gram, the President shall, acting through appropriate
14 Federal agencies, councils, working groups, subcommit-
15 tees, and the Coordination Office—

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

20 (2) invest in fundamental Federal quantum in-
21 formation science and technology research, develop-
22 ment, demonstration, and other activities to achieve
23 the goals established in paragraph (1);

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

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

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

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

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

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

13 (1) a Director appointed by the Director of the
14 Office of Science and Technology Policy, in consulta-
15 tion with the Secretary of Commerce, the Director
16 of the National Science Foundation, and the Sec-
17 retary of Energy; and

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

21 (b) RESPONSIBILITIES.—The Coordination Office
22 shall—

23 (1) provide technical and administrative support
24 to—

25 (A) the Subcommittee; and

1 (B) the Advisory Committee;

2 (2) oversee interagency coordination of the Pro-
3 gram, including encouraging and supporting joint
4 agency solicitation and selection of applications for
5 funding of projects under the Program;

6 (3) serve as the point of contact on Federal ci-
7 vilian quantum information science and technology
8 activities for Government organizations, academia,
9 industry, professional societies, State governments,
10 and others to exchange technical and programmatic
11 information;

12 (4) ensure coordination between the Multidisci-
13 plinary Centers for Quantum Research and Edu-
14 cation established under section 302(a) and the Na-
15 tional Quantum Information Science Research Cen-
16 ters established under section 402(a);

17 (5) conduct public outreach, including dissemi-
18 nation of findings and recommendations of the Advi-
19 sory Committee, as appropriate;

20 (6) promote access to and early application of
21 the technologies, innovations, and expertise derived
22 from Program activities to agency missions and sys-
23 tems across the Federal Government, and to United
24 States industry, including startup companies; and

1 (7) promote access, through appropriate Gov-
2 ernment agencies, to existing quantum computing
3 and communication systems developed by industry,
4 academia, and Federal laboratories to the general
5 user community in pursuit of discovery of the new
6 applications of such systems.

7 (c) FUNDING.—Funds necessary to carry out the ac-
8 tivities of the Coordination Office shall be made available
9 each fiscal year by the participating agencies of the Sub-
10 committee, as determined by the Director of the Office
11 of Science and Technology Policy.

12 **SEC. 103. SUBCOMMITTEE ON QUANTUM INFORMATION**
13 **SCIENCE.**

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

17 (b) MEMBERSHIP.—The Subcommittee shall in-
18 clude—

19 (1) the National Institute of Standards and
20 Technology;

21 (2) the National Science Foundation;

22 (3) the Department of Energy;

23 (4) the National Aeronautics and Space Admin-
24 istration;

25 (5) the Department of Defense;

1 (6) the Office of the Director of National Intel-
2 ligence;

3 (7) the Office of Management and Budget;

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

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

8 (c) CHAIRS.—The Subcommittee shall be jointly
9 chaired by the Director of the National Institute of Stand-
10 ards and Technology, the Director of the National Science
11 Foundation, and the Secretary of Energy.

12 (d) RESPONSIBILITIES.—The Subcommittee shall—

13 (1) coordinate the quantum information science
14 and technology research and education activities and
15 programs of the Federal agencies;

16 (2) establish goals and priorities of the Pro-
17 gram, based on identified knowledge and workforce
18 gaps and other national needs;

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

21 (4) evaluate opportunities for international co-
22 operation with strategic allies on research and devel-
23 opment in quantum information science and tech-
24 nology.

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

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

17 **SEC. 104. NATIONAL QUANTUM INITIATIVE ADVISORY COM-**
18 **MITTEE.**

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

21 (b) QUALIFICATIONS.—The Advisory Committee es-
22 tablished by the President under subsection (a) shall con-
23 sist of members from industry, academic institutions, and
24 Federal laboratories. The President shall appoint mem-
25 bers to the Advisory Committee who are qualified to pro-

1 vide advice and information on quantum information
2 science and technology research, development, demonstra-
3 tions, education, technology transfer, commercial applica-
4 tion, or national security and economic concerns.

5 (c) MEMBERSHIP CONSIDERATION.—In selecting an
6 Advisory Committee, the President may seek and give con-
7 sideration to recommendations from the Congress, indus-
8 try, the scientific community (including the National
9 Academy of Sciences, scientific professional societies, and
10 academia), the defense community, and other appropriate
11 organizations.

12 (d) DUTIES.—The Advisory Committee shall advise
13 the President and the Subcommittee and make rec-
14 ommendations that shall be considered in reviewing and
15 revising the Program. The Advisory Committee shall pro-
16 vide the President and the Subcommittee with an inde-
17 pendent assessment of—

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

20 (2) progress made in implementing the Pro-
21 gram;

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

1 (4) the management, coordination, implementa-
2 tion, and activities of the Program;

3 (5) the need to revise the Program;

4 (6) whether or not there are opportunities for
5 international cooperation with strategic allies on re-
6 search and development in quantum information
7 science and technology; and

8 (7) whether national security, societal, eco-
9 nomic, legal, and workforce concerns are adequately
10 addressed by the Program.

11 (e) REPORTS.—The Advisory Committee shall report,
12 not less frequently than once every 2 years, to the Presi-
13 dent on the assessments required under subsection (d) and
14 any recommendations to improve the Program. The first
15 report under this subsection shall be submitted not later
16 than 6 months after the date of enactment of this Act.
17 The Director of the Office of Science and Technology Pol-
18 icy shall transmit a copy of each report under this sub-
19 section to the Committee on Science, Space, and Tech-
20 nology of the House of Representatives, the Committee on
21 Commerce, Science, and Technology of the Senate, the
22 Committee on Energy and Natural Resources of the Sen-
23 ate, and other appropriate committees of the Congress.

24 (f) TRAVEL EXPENSES OF NON-FEDERAL MEM-
25 BERS.—Non-Federal members of the Advisory Committee,

1 while attending meetings of the Advisory Committee or
2 while otherwise serving at the request of the head of the
3 Advisory Committee away from their homes or regular
4 places of business, may be allowed travel expenses, includ-
5 ing per diem in lieu of subsistence, as authorized by sec-
6 tion 5703 of title 5, United States Code, for individuals
7 in the Government serving without pay. Nothing in this
8 subsection shall be construed to prohibit members of the
9 Advisory Committee who are officers or employees of the
10 United States from being allowed travel expenses, includ-
11 ing per diem in lieu of subsistence, in accordance with ex-
12 isting law.

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

16 **SEC. 105. SUNSET.**

17 (a) IN GENERAL.—Except as provided for in sub-
18 section (b), the authority to carry out sections 101, 102,
19 103, and 104 shall terminate on the date that is 11 years
20 after the date of enactment of this Act.

21 (b) EXTENSION.—The President may continue the
22 activities under such sections if the President determines
23 that such activities are necessary to meet national eco-
24 nomic or national security needs.

1 **TITLE II—NATIONAL INSTITUTE**
2 **OF STANDARDS AND TECH-**
3 **NOLOGY QUANTUM ACTIVI-**
4 **TIES**

5 **SEC. 201. NATIONAL INSTITUTE OF STANDARDS AND TECH-**
6 **NOLOGY ACTIVITIES AND QUANTUM WORK-**
7 **SHOP.**

8 (a) NATIONAL INSTITUTE OF STANDARDS AND
9 TECHNOLOGY ACTIVITIES.—As part of the Program de-
10 scribed in title I, the Director of the National Institute
11 of Standards and Technology shall—

12 (1) continue to support and expand basic quan-
13 tum information science and technology research
14 and development of measurement and standards in-
15 frastructure necessary to advance commercial devel-
16 opment of quantum applications;

17 (2) use its existing programs, in collaboration
18 with other agencies, as appropriate, to train sci-
19 entists in quantum information science and tech-
20 nology to increase participation in the quantum
21 fields;

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

1 industry for the purpose of advancing the field of
2 quantum information science and engineering; and

3 (4) have the authority to enter into and per-
4 form such contracts, including cooperative research
5 and development arrangements and grants and coop-
6 erative agreements or other transactions, as may be
7 necessary in the conduct of the work of the Institute
8 and on such terms as the Director considers appro-
9 priate, in furtherance of the purposes of this Act.

10 (b) QUANTUM WORKSHOP.—

11 (1) IN GENERAL.—Not later than 1 year after
12 the date of enactment of this Act, the Director of
13 the National Institute of Standards and Technology
14 shall convene a workshop of stakeholders to discuss
15 the future measurement, standards, cybersecurity,
16 and other appropriate needs for supporting the de-
17 velopment of a robust quantum information science
18 and technology industry in the United States. The
19 goals of the workshop shall be to—

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

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

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

1 and the Program can address the research
2 needs identified.

3 (2) REPORT TO CONGRESS.—Not later than 2
4 years after the date of enactment of this Act, the
5 Director of the National Institute of Standards and
6 Technology shall transmit to the Committee on
7 Science, Space, and Technology of the House of
8 Representatives and the Committee on Commerce,
9 Science, and Transportation of the Senate a sum-
10 mary report containing the findings of the workshop
11 convened under this section.

12 (c) FUNDING.—The Secretary of Commerce shall de-
13 vote \$400,000,000 to carry out this section, which shall
14 include \$80,000,000 for each of fiscal years 2019 through
15 2023, subject to the availability of appropriations, to come
16 from amounts made available for the National Institute
17 of Standards and Technology. This section shall be carried
18 out using funds otherwise appropriated by law after the
19 date of enactment of this Act.

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

6 **SEC. 301. QUANTUM INFORMATION SCIENCE RESEARCH**
7 **AND EDUCATION PROGRAM.**

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

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

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

23 (A) improve the teaching and learning of
24 quantum information science and engineering

1 at the undergraduate, graduate, and post-
2 graduate levels; and

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

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

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

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

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

21 **SEC. 302. MULTIDISCIPLINARY CENTERS FOR QUANTUM**
22 **RESEARCH AND EDUCATION.**

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

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

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

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

16 (A) continue to advance quantum informa-
17 tion science and engineering;

18 (B) support curriculum and workforce de-
19 velopment in quantum information science and
20 engineering; and

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

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

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

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

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

21 (D) how the Center can support an innova-
22 tion ecosystem to work with industry to trans-
23 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 **TITLE IV—DEPARTMENT OF EN-**
10 **ERGY RESEARCH AND NA-**
11 **TIONAL QUANTUM INFORMA-**
12 **TION SCIENCE RESEARCH**
13 **CENTERS**

14 **SEC. 401. QUANTUM INFORMATION SCIENCE RESEARCH**
15 **PROGRAM.**

16 (a) IN GENERAL.—The Secretary of Energy shall
17 carry out a basic research program on quantum informa-
18 tion science.

19 (b) PROGRAM COMPONENTS.—In carrying out the
20 program required under subsection (a), the Secretary
21 shall—

22 (1) formulate goals for quantum information
23 science research to be supported by the Department
24 of Energy;

1 (2) leverage the collective body of knowledge
2 from existing quantum information science research;

3 (3) coordinate research efforts funded through
4 existing programs across the Office of Science; and

5 (4) engage with other Federal agencies, re-
6 search communities, and potential users of informa-
7 tion produced under this section.

8 **SEC. 402. NATIONAL QUANTUM INFORMATION SCIENCE RE-**
9 **SEARCH CENTERS.**

10 (a) IN GENERAL.—The Secretary of Energy shall en-
11 sure that the Office of Science carries out a program, in
12 consultation with other Federal agencies, as appropriate,
13 to establish and operate up to five National Quantum In-
14 formation Science Research Centers to conduct basic re-
15 search to accelerate scientific breakthroughs in quantum
16 information science and technology and to support re-
17 search conducted under section 401. Such centers shall
18 be established through a competitive, merit-reviewed proc-
19 ess, and consider applications from National Laboratories,
20 institutions of higher education, research centers, multi-
21 institutional collaborations, and other appropriate entities.

22 (b) COLLABORATIONS.—A collaboration receiving an
23 award under this subsection may include multiple types
24 of research institutions and private sector entities.

1 (c) REQUIREMENTS.—To the maximum extent prac-
2 ticable, the Centers developed, constructed, operated, or
3 maintained under this section shall serve the needs of the
4 Department of Energy, industry, the academic commu-
5 nity, and other relevant entities to create and develop
6 processes for the purpose of advancing basic research in
7 quantum information science and improving the competi-
8 tiveness of the United States.

9 (d) COORDINATION.—The Secretary shall ensure the
10 coordination of, and avoid unnecessary duplication of, the
11 activities of each Center with the activities of—

12 (1) other research entities of the Department,
13 including the Nanoscale Science Research Centers,
14 the Energy Frontier Research Centers, and the En-
15 ergy Innovation Hubs; and

16 (2) industry.

17 (e) SELECTION AND DURATION.—

18 (1) IN GENERAL.—The centers selected and es-
19 tablished under this section are authorized to carry
20 out activities for a period of 5 years.

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

24 (3) TERMINATION.—Consistent with the exist-
25 ing authorities of the Department, the Secretary

1 may terminate an underperforming Center for cause
2 during the performance period.

3 (f) **FUNDING.**—The Secretary of Energy shall devote
4 \$625,000,000 to carry out this section, which shall include
5 \$125,000,000 for each of fiscal years 2019 through 2023,
6 subject to the availability of appropriations, to come from
7 amounts made available for the Office of Science. This
8 section shall be carried out using funds otherwise appro-
9 priated by law after the date of enactment of this Act.

10 **SEC. 403. SPENDING LIMITATION.**

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

 Passed the House of Representatives September 13,
2018.

Attest:

KAREN L. HAAS,

Clerk.