

## ***In the Senate of the United States,***

*December 13, 2018.*

*Resolved*, That the bill from the House of Representatives (H.R. 6227) entitled “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.”, do pass with the following

### **AMENDMENT:**

Strike all after the enacting clause and insert the following:

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

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

4       (b) *TABLE OF CONTENTS.*—*The table of contents of this*  
5 *Act is as follows:*

*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 consortium.*

*TITLE III—NATIONAL SCIENCE FOUNDATION QUANTUM ACTIVITIES*

Sec. 301. *Quantum information science research and education program.*

Sec. 302. *Multidisciplinary Centers for Quantum Research and Education.*

*TITLE IV—DEPARTMENT OF ENERGY QUANTUM ACTIVITIES*

Sec. 401. *Quantum Information Science Research program.*

Sec. 402. *National Quantum Information Science Research Centers.*

1 **SEC. 2. DEFINITIONS.**

2 *In this Act:*

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

6 (2) *APPROPRIATE COMMITTEES OF CONGRESS.*—  
7 *The term “appropriate committees of Congress”*  
8 *means—*

9 (A) *the Committee on Commerce, Science,*  
10 *and Transportation of the Senate;*

11 (B) *the Committee on Energy and Natural*  
12 *Resources of the Senate; and*

13 (C) *the Committee on Science, Space, and*  
14 *Technology of the House of Representatives.*

15 (3) *COORDINATION OFFICE.*—*The term “Coordi-*  
16 *nation Office” means the National Quantum Coordi-*  
17 *nation Office established under section 102(a).*

1           (4) *INSTITUTION OF HIGHER EDUCATION.*—*The*  
2           *term “institution of higher education” has the mean-*  
3           *ing given the term in section 101(a) of the Higher*  
4           *Education Act of 1965 (20 U.S.C. 1001(a)).*

5           (5) *PROGRAM.*—*The term “Program” means the*  
6           *National Quantum Initiative Program implemented*  
7           *under section 101(a).*

8           (6) *QUANTUM INFORMATION SCIENCE.*—*The term*  
9           *“quantum information science” means the use of the*  
10          *laws of quantum physics for the storage, trans-*  
11          *mission, manipulation, computing, or measurement*  
12          *of information.*

13          (7) *SUBCOMMITTEE.*—*The term “Subcommittee”*  
14          *means the Subcommittee on Quantum Information*  
15          *Science of the National Science and Technology Coun-*  
16          *cil established under section 103(a).*

17 **SEC. 3. PURPOSES.**

18          *The purpose of this Act is to ensure the continued lead-*  
19          *ership of the United States in quantum information science*  
20          *and its technology applications by—*

21                 (1) *supporting research, development, demonstra-*  
22                 *tion, and application of quantum information science*  
23                 *and technology—*

24                         (A) *to expand the number of researchers,*  
25                         *educators, and students with training in quan-*

1            *tum information science and technology to de-*  
2            *velop a workforce pipeline;*

3            *(B) to promote the development and inclu-*  
4            *sion of multidisciplinary curriculum and re-*  
5            *search opportunities for quantum information*  
6            *science at the undergraduate, graduate, and*  
7            *postdoctoral level;*

8            *(C) to address basic research knowledge*  
9            *gaps, including computational research gaps;*

10           *(D) to promote the further development of*  
11           *facilities and centers available for quantum in-*  
12           *formation science and technology research, test-*  
13           *ing and education; and*

14           *(E) to stimulate research on and promote*  
15           *more rapid development of quantum-based tech-*  
16           *nologies;*

17           *(2) improving the interagency planning and co-*  
18           *ordination of Federal research and development of*  
19           *quantum information science and technology;*

20           *(3) maximizing the effectiveness of the Federal*  
21           *Government's quantum information science and tech-*  
22           *nology research, development, and demonstration pro-*  
23           *grams;*

1           (4) *promoting collaboration among the Federal*  
2           *Government, Federal laboratories, industry, and uni-*  
3           *versities; and*

4           (5) *promoting the development of international*  
5           *standards for quantum information science and tech-*  
6           *nology security—*

7                   (A) *to facilitate technology innovation and*  
8                   *private sector commercialization; and*

9                   (B) *to meet economic and national security*  
10                  *goals.*

## 11           **TITLE I—NATIONAL QUANTUM** 12           **INITIATIVE**

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

14           (a) *IN GENERAL.*—*The President shall implement a*  
15           *National Quantum Initiative Program.*

16           (b) *REQUIREMENTS.*—*In carrying out the Program,*  
17           *the President, acting through Federal agencies, councils,*  
18           *working groups, subcommittees, and the Coordination Of-*  
19           *fice, as the President considers appropriate, shall—*

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

24                   (2) *invest in fundamental Federal quantum in-*  
25                   *formation science and technology research, develop-*

1 *ment, demonstration, and other activities to achieve*  
2 *the goals established under paragraph (1);*

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

5 *(4) provide for interagency planning and coordi-*  
6 *nation of Federal quantum information science and*  
7 *technology research, development, demonstration,*  
8 *standards engagement, and other activities under the*  
9 *Program;*

10 *(5) partner with industry and universities to le-*  
11 *verage knowledge and resources; and*

12 *(6) leverage existing Federal investments effi-*  
13 *ciently to advance Program goals and priorities es-*  
14 *tablished under paragraph (1).*

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

16 *(a) ESTABLISHMENT.—*

17 *(1) IN GENERAL.—The President shall establish*  
18 *a National Quantum Coordination Office.*

19 *(2) ADMINISTRATION.—The Coordination Office*  
20 *shall have—*

21 *(A) a Director appointed by the Director of*  
22 *the Office of Science and Technology Policy, in*  
23 *consultation with the Secretary of Commerce, the*  
24 *Director of the National Science Foundation,*  
25 *and the Secretary of Energy; and*

1           (B) staff comprised of employees detailed  
2           from the Federal departments and agencies de-  
3           scribed in section 103(b).

4       (b) *RESPONSIBILITIES.*—The Coordination Office  
5 shall—

6           (1) provide technical and administrative support  
7       to—

8                   (A) the Subcommittee; and

9                   (B) the Advisory Committee;

10           (2) oversee interagency coordination of the Pro-  
11       gram, including by encouraging and supporting joint  
12       agency solicitation and selection of applications for  
13       funding of activities under the Program;

14           (3) serve as the point of contact on Federal civil-  
15       ian quantum information science and technology ac-  
16       tivities for Federal departments and agencies, indus-  
17       try, universities professional societies, State govern-  
18       ments, and such other persons as the Coordination  
19       Office considers appropriate to exchange technical  
20       and programmatic information;

21           (4) ensure coordination among the collaborative  
22       ventures or consortia established under section 201(a),  
23       Multidisciplinary Centers for Quantum Research and  
24       Education established under section 302(a), and the

1     *National Quantum Information Science Research*  
2     *Centers established under section 402(a);*

3             (5) *conduct public outreach, including the dis-*  
4     *semination of findings and recommendations of the*  
5     *Advisory Committee, as appropriate;*

6             (6) *promote access to and early application of*  
7     *the technologies, innovations, and expertise derived*  
8     *from Program activities to agency missions and sys-*  
9     *tems across the Federal Government, and to industry,*  
10    *including startup companies; and*

11            (7) *promote access, through appropriate Federal*  
12    *Government agencies, and an open and competitive*  
13    *merit-reviewed process, to existing quantum com-*  
14    *puting and communication systems developed by in-*  
15    *dustry, universities, and Federal laboratories to the*  
16    *general user community in pursuit of discovery of the*  
17    *new applications of such systems.*

18            (c) *FUNDING.—Funds necessary to carry out the ac-*  
19    *tivities of the Coordination Office shall be made available*  
20    *each fiscal year by the Federal departments and agencies*  
21    *described in section 103(b), as determined by the Director*  
22    *of the Office of Science and Technology Policy.*



1 **SEC. 103. SUBCOMMITTEE ON QUANTUM INFORMATION**  
2 **SCIENCE.**

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

6 (b) *MEMBERSHIP.*—*The Subcommittee shall include a*  
7 *representative of—*

8 (1) *the National Institute of Standards and*  
9 *Technology;*

10 (2) *the National Science Foundation;*

11 (3) *the Department of Energy;*

12 (4) *the National Aeronautics and Space Admin-*  
13 *istration;*

14 (5) *the Department of Defense;*

15 (6) *the Office of the Director of National Intel-*  
16 *ligence;*

17 (7) *the Office of Management and Budget;*

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

19 *and*

20 (9) *such other Federal department or agency as*  
21 *the President considers appropriate.*

22 (c) *CHAIRPERSONS.*—*The Subcommittee shall be joint-*  
23 *ly chaired by the Director of the National Institute of*  
24 *Standards and Technology, the Director of the National*  
25 *Science Foundation, and the Secretary of Energy.*

26 (d) *RESPONSIBILITIES.*—*The Subcommittee shall—*

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

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

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

11           (4) *assess the status, development, and diversity*  
12 *of the United States quantum information science*  
13 *workforce;*

14           (5) *assess the global outlook for quantum infor-*  
15 *mation science research and development efforts;*

16           (6) *evaluate opportunities for international co-*  
17 *operation with strategic allies on research and devel-*  
18 *opment in quantum information science and tech-*  
19 *nology; and*

20           (7) *propose a coordinated interagency budget for*  
21 *the Program to the Office of Management and Budget*  
22 *to ensure the maintenance of a balanced quantum in-*  
23 *formation science research portfolio and an appro-*  
24 *priate level of research effort.*

1       (e) *STRATEGIC PLANS.*—*In order to guide the activi-*  
2 *ties of the Program and meet the goals, priorities, and an-*  
3 *ticipated outcomes of the Federal departments and agencies*  
4 *described in subsection (b), the Subcommittee shall—*

5           (1) *not later than 1 year after the date of enact-*  
6 *ment of this Act, develop a 5-year strategic plan;*

7           (2) *not later than 6 years after the date of enact-*  
8 *ment of this Act, develop a subsequent 5-year strategic*  
9 *plan; and*

10          (3) *periodically update each plan, as necessary.*

11       (f) *SUBMITTAL TO CONGRESS.*—*The chairpersons of*  
12 *the Subcommittee shall submit to the President, the Advi-*  
13 *sory Committee, and the appropriate committees of Con-*  
14 *gress each strategic plan developed under subsection (e) and*  
15 *any updates thereto.*

16       (g) *ANNUAL PROGRAM BUDGET REPORT.*—

17           (1) *IN GENERAL.*—*Each year, concurrent with*  
18 *the annual budget request submitted by the President*  
19 *to Congress under section 1105 of title 31, United*  
20 *States Code, the chairpersons of the Subcommittee*  
21 *shall submit to the appropriate committees of Con-*  
22 *gress and such other committees of Congress as the*  
23 *chairpersons deem appropriate a report on the budget*  
24 *for the Program.*

1           (2) *CONTENTS.*—*Each report submitted under*  
2           *paragraph (1) shall include the following:*

3                   (A) *The budget of the Program for the cur-*  
4                   *rent fiscal year, for each Federal department and*  
5                   *agency described in subsection (b).*

6                   (B) *The budget proposed for the Program*  
7                   *for the next fiscal year, for each Federal depart-*  
8                   *ment and agency described in subsection (b).*

9                   (C) *An analysis of the progress made to-*  
10                   *ward achieving the goals and priorities estab-*  
11                   *lished under subsection (d)(2).*

12 **SEC. 104. NATIONAL QUANTUM INITIATIVE ADVISORY COM-**

13                   **MITTEE.**

14           (a) *IN GENERAL.*—*The President shall establish a Na-*  
15           *tional Quantum Initiative Advisory Committee.*

16           (b) *QUALIFICATIONS.*—*The Advisory Committee shall*  
17           *consist of members, appointed by the President, who are*  
18           *representative of industry, universities, and Federal labora-*  
19           *tories and are qualified to provide advice and information*  
20           *on quantum information science and technology research,*  
21           *development, demonstrations, standards, education, tech-*  
22           *nology transfer, commercial application, or national secu-*  
23           *rity and economic concerns.*

24           (c) *MEMBERSHIP CONSIDERATION.*—*In selecting the*  
25           *members of the Advisory Committee, the President may seek*

1 *and give consideration to recommendations from the Con-*  
2 *gress, industry, the scientific community (including the Na-*  
3 *tional Academy of Sciences, scientific professional societies,*  
4 *and universities), the defense community, and other appro-*  
5 *prate organizations.*

6 (d) *DUTIES.—*

7 (1) *IN GENERAL.—The Advisory Committee shall*  
8 *advise the President and the Subcommittee and make*  
9 *recommendations for the President to consider when*  
10 *reviewing and revising the Program.*

11 (2) *INDEPENDENT ASSESSMENTS.—The Advisory*  
12 *Committee shall conduct periodic, independent assess-*  
13 *ments of—*

14 (A) *any trends or developments in quantum*  
15 *information science and technology;*

16 (B) *the progress made in implementing the*  
17 *Program;*

18 (C) *the management, coordination, imple-*  
19 *mentation, and activities of the Program;*

20 (D) *whether the Program activities and the*  
21 *goals and priorities established under section*  
22 *103(d)(2) are helping to maintain United States*  
23 *leadership in quantum information science and*  
24 *technology;*

1           (E) whether a need exists to revise the Pro-  
2           gram;

3           (F) whether opportunities exist for inter-  
4           national cooperation with strategic allies on re-  
5           search and development in, and the development  
6           of open standards for, quantum information  
7           science and technology; and

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

11          (e) *REPORTS.*—Not later than 180 days after the date  
12          of enactment of this Act, and at least biennially thereafter,  
13          the Advisory Committee shall submit to the President, the  
14          appropriate committees of Congress, and such other com-  
15          mittees of Congress as the Advisory Committee deems ap-  
16          propriate a report on the findings of the independent assess-  
17          ment under subsection (d), including any recommendations  
18          for improvements to the Program.

19          (f) *TRAVEL EXPENSES OF NON-FEDERAL MEMBERS.*—  
20          Non-Federal members of the Advisory Committee, while at-  
21          tending meetings of the Advisory Committee or while other-  
22          wise serving at the request of the head of the Advisory Com-  
23          mittee away from their homes or regular places of business,  
24          may be allowed travel expenses, including per diem in lieu  
25          of subsistence, as authorized by section 5703 of title 5,

1 *United States Code, for individuals in the Government serv-*  
2 *ing without pay. Nothing in this subsection shall be con-*  
3 *strued to prohibit members of the Advisory Committee who*  
4 *are officers or employees of the United States from being*  
5 *allowed travel expenses, including per diem in lieu of sub-*  
6 *sistence, in accordance with existing law.*

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

10 **SEC. 105. SUNSET.**

11 (a) *IN GENERAL.—Except as provided in subsection*  
12 *(b), the authority to carry out sections 101, 102, 103, and*  
13 *104 shall terminate on the date that is 11 years after the*  
14 *date of enactment of this Act.*

15 (b) *EXTENSION.—The President may continue the ac-*  
16 *tivities under such sections if the President determines that*  
17 *such activities are necessary to meet national economic or*  
18 *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 CONSOR-**  
7 **TIUM.**

8 (a) NATIONAL INSTITUTE OF STANDARDS AND TECH-  
9 NOLOGY ACTIVITIES.—As part of the Program, the Director  
10 of the National Institute of Standards and Technology—

11 (1) shall continue to support and expand basic  
12 and applied quantum information science and tech-  
13 nology research and development of measurement and  
14 standards infrastructure necessary to advance com-  
15 mercial development of quantum applications;

16 (2) shall use the existing programs of the Na-  
17 tional Institute of Standards and Technology, in col-  
18 laboration with other Federal departments and agen-  
19 cies, as appropriate, to train scientists in quantum  
20 information science and technology to increase par-  
21 ticipation in the quantum fields;

22 (3) shall establish or expand collaborative ven-  
23 tures or consortia with other public or private sector  
24 entities, including industry, universities, and Federal



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

3 *(4) may enter into and perform such contracts,*  
4 *including cooperative research and development ar-*  
5 *rangements and grants and cooperative agreements or*  
6 *other transactions, as may be necessary in the con-*  
7 *duct of the work of the National Institute of Stand-*  
8 *ards and Technology and on such terms as the Direc-*  
9 *tor considers appropriate, in furtherance of the pur-*  
10 *poses of this Act.*

11 *(b) QUANTUM CONSORTIUM.—*

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

20 *(2) GOALS.—The goals of the consortium shall*  
21 *be—*

22 *(A) to assess the current research on the*  
23 *needs identified in paragraph (1);*

1           (B) to identify any gaps in the research  
2           necessary to meet the needs identified in para-  
3           graph (1); and

4           (C) to provide recommendations on how the  
5           National Institute of Standards and Technology  
6           and the Program can address the gaps in the  
7           necessary research identified in subparagraph  
8           (B).

9           (3) *REPORT TO CONGRESS.*—Not later than 2  
10          years after the date of enactment of this Act, the Di-  
11          rector of the National Institute of Standards and  
12          Technology shall submit to the Committee on Com-  
13          merce, Science, and Transportation of the Senate and  
14          the Committee on Science, Space, and Technology of  
15          the House of Representatives a report summarizing  
16          the findings of the consortium.

17          (c) *FUNDING.*—The Director of the National Institute  
18          of Standards and Technology shall allocate up to  
19          \$80,000,000 to carry out the activities under this section  
20          for each of fiscal years 2019 through 2023, subject to the  
21          availability of appropriations. Amounts made available to  
22          carry out this section shall be derived from amounts appro-  
23          priated or otherwise made available to the National Insti-  
24          tute of Standards and Technology.

1 **TITLE III—NATIONAL SCIENCE**  
2 **FOUNDATION QUANTUM AC-**  
3 **TIVITIES**

4 **SEC. 301. QUANTUM INFORMATION SCIENCE RESEARCH**  
5 **AND EDUCATION PROGRAM.**

6 (a) *IN GENERAL.*—*The Director of the National*  
7 *Science Foundation shall carry out a basic research and*  
8 *education program on quantum information science and*  
9 *engineering, including the competitive award of grants to*  
10 *institutions of higher education or eligible nonprofit organi-*  
11 *zations (or consortia thereof).*

12 (b) *PROGRAM COMPONENTS.*—

13 (1) *IN GENERAL.*—*In carrying out the program*  
14 *under subsection (a), the Director of the National*  
15 *Science Foundation shall carry out activities that—*

16 (A) *support basic interdisciplinary quan-*  
17 *tum information science and engineering re-*  
18 *search; and*

19 (B) *support human resources development*  
20 *in all aspects of quantum information science*  
21 *and engineering.*

22 (2) *REQUIREMENTS.*—*The activities described in*  
23 *paragraph (1) shall include—*

24 (A) *using the existing programs of the Na-*  
25 *tional Science Foundation, in collaboration with*

1            *other Federal departments and agencies, as ap-*  
2            *propriate—*

3                    *(i) to improve the teaching and learn-*  
4                    *ing of quantum information science and en-*  
5                    *gineering at the undergraduate, graduate,*  
6                    *and postgraduate levels; and*

7                    *(ii) to increase participation in the*  
8                    *quantum fields, including by individuals*  
9                    *identified in sections 33 and 34 of the*  
10                   *Science and Engineering Equal Opportuni-*  
11                   *ties Act (42 U.S.C. 1885a, 1885b);*

12                   *(B) formulating goals for quantum infor-*  
13                   *mation science and engineering research and*  
14                   *education activities to be supported by the Na-*  
15                   *tional Science Foundation;*

16                   *(C) leveraging the collective body of knowl-*  
17                   *edge from existing quantum information science*  
18                   *and engineering research and education activi-*  
19                   *ties;*

20                   *(D) coordinating research efforts funded*  
21                   *through existing programs across the directorates*  
22                   *of the National Science Foundation; and*

23                   *(E) engaging with other Federal depart-*  
24                   *ments and agencies, research communities, and*

1           *potential users of information produced under*  
2           *this section.*

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

9   **SEC. 302. MULTIDISCIPLINARY CENTERS FOR QUANTUM RE-**  
10                                   **SEARCH AND EDUCATION.**

11           (a) *IN GENERAL.*—*The Director of the National*  
12 *Science Foundation, in consultation with other Federal de-*  
13 *partments and agencies, as appropriate, shall award grants*  
14 *to institutions of higher education or eligible nonprofit or-*  
15 *ganizations (or consortia thereof) to establish at least 2, but*  
16 *not more than 5, Multidisciplinary Centers for Quantum*  
17 *Research and Education (referred to in this section as*  
18 *“Centers”).*

19           (b) *COLLABORATIONS.*—*A collaboration receiving an*  
20 *award under this subsection may include institutions of*  
21 *higher education, nonprofit organizations, and private sec-*  
22 *tor entities.*

23           (c) *PURPOSE.*—*The purpose of the Centers shall be to*  
24 *conduct basic research and education activities in support*

1 of the goals and priorities established under section  
2 103(d)(2), including by—

3           (1) continuing to advance quantum information  
4 science and engineering;

5           (2) supporting curriculum and workforce devel-  
6 opment in quantum information science and engi-  
7 neering; and

8           (3) fostering innovation by bringing industry  
9 perspectives to quantum research and workforce devel-  
10 opment, including by leveraging industry knowledge  
11 and resources.

12       (d) *REQUIREMENTS.*—

13           (1) *IN GENERAL.*—An institution of higher edu-  
14 cation or an eligible nonprofit organization (or a con-  
15 sortium thereof) seeking funding under this section  
16 shall submit an application to the Director of the Na-  
17 tional Science Foundation at such time, in such man-  
18 ner, and containing such information as the Director  
19 may require.

20           (2) *APPLICATIONS.*—Each application under  
21 paragraph (1) shall include a description of—

22                   (A) how the Center will work with other re-  
23 search institutions and industry partners to le-  
24 verage expertise in quantum science, education

1           *and curriculum development, and technology*  
2           *transfer;*

3           *(B) how the Center will promote active col-*  
4           *laboration among researchers in multiple dis-*  
5           *ciplines involved in quantum research, including*  
6           *physics, engineering, mathematics, computer*  
7           *science, chemistry, and material science;*

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

11          *(D) how the Center can support an innova-*  
12          *tion ecosystem to work with industry to translate*  
13          *Center research into applications; and*

14          *(E) a long-term plan to become self-sus-*  
15          *taining after the expiration of funding under*  
16          *this section.*

17        *(e) SELECTION AND DURATION.—*

18            *(1) IN GENERAL.—Each Center established under*  
19            *this section is authorized to carry out activities for a*  
20            *period of 5 years.*

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

24            *(3) TERMINATION.—Consistent with the authori-*  
25            *ties of the National Science Foundation, the Director*

1       *of the National Science Foundation may terminate*  
2       *an underperforming Center for cause during the per-*  
3       *formance period.*

4       (f) *FUNDING.*—*The Director of the National Science*  
5       *Foundation shall allocate up to \$10,000,000 for each Center*  
6       *established under this section for each of fiscal years 2019*  
7       *through 2023, subject to the availability of appropriations.*  
8       *Amounts made available to carry out this section shall be*  
9       *derived from amounts appropriated or otherwise made*  
10       *available to the National Science Foundation.*

11       ***TITLE IV—DEPARTMENT OF***  
12       ***ENERGY QUANTUM ACTIVITIES***

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

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

18       (b) *PROGRAM COMPONENTS.*—*In carrying out the pro-*  
19       *gram under subsection (a), the Secretary of Energy shall—*

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

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



1           (3) *provide research experiences and training for*  
2 *additional undergraduate and graduate students in*  
3 *quantum information science, including in the fields*  
4 *of—*

5                   (A) *quantum information theory;*

6                   (B) *quantum physics;*

7                   (C) *quantum computational science;*

8                   (D) *applied mathematics and algorithm de-*  
9 *velopment;*

10                  (E) *quantum networking;*

11                  (F) *quantum sensing and detection; and*

12                  (G) *materials science and engineering;*

13           (4) *coordinate research efforts funded through ex-*  
14 *isting programs across the Department of Energy, in-*  
15 *cluding—*

16                   (A) *the Nanoscale Science Research Centers;*

17                   (B) *the Energy Frontier Research Centers;*

18                   (C) *the Energy Innovation Hubs;*

19                   (D) *the National Laboratories;*

20                   (E) *the Advanced Research Projects Agency;*

21           *and*

22                   (F) *the National Quantum Information*  
23 *Science Research Centers; and*

1           (5) *coordinate with other Federal departments*  
2           *and agencies, research communities, and potential*  
3           *users of information produced under this section.*

4 **SEC. 402. NATIONAL QUANTUM INFORMATION SCIENCE RE-**  
5           **SEARCH CENTERS.**

6           (a) *ESTABLISHMENT.*—

7           (1) *IN GENERAL.*—*The Secretary of Energy, act-*  
8           *ing through the Director of the Office of Science (re-*  
9           *ferred to in this section as the “Director”), shall en-*  
10           *sure that the Office of Science carries out a program,*  
11           *in consultation with other Federal departments and*  
12           *agencies, as appropriate, to establish and operate at*  
13           *least 2, but not more than 5, National Quantum In-*  
14           *formation Science Research Centers (referred to in*  
15           *this section as “Centers”) to conduct basic research to*  
16           *accelerate scientific breakthroughs in quantum infor-*  
17           *mation science and technology and to support re-*  
18           *search conducted under section 401.*

19           (2) *REQUIREMENTS.*—

20           (A) *COMPETITIVE, MERIT-REVIEWED PROC-*  
21           *ESS.*—*The Centers shall be established through a*  
22           *competitive, merit-reviewed process.*

23           (B) *APPLICATIONS.*—*An eligible applicant*  
24           *under this subsection shall submit to the Director*  
25           *an application at such time, in such manner,*

1           *and containing such information as the Director*  
2           *determines to be appropriate.*

3           (C) *ELIGIBLE APPLICANTS.*—*The Director*  
4           *shall consider applications from National Lab-*  
5           *oratories, institutions of higher education, re-*  
6           *search centers, multi-institutional collaborations,*  
7           *and any other entity that the Secretary of En-*  
8           *ergy determines to be appropriate.*

9           (b) *COLLABORATIONS.*—*A collaboration that receives*  
10          *an award under this section may include multiple types*  
11          *of research institutions and private sector entities.*

12          (c) *REQUIREMENTS.*—*To the maximum extent prac-*  
13          *ticable, the Centers developed, constructed, operated, or*  
14          *maintained under this section shall serve the needs of the*  
15          *Department of Energy, industry, the academic community,*  
16          *and other relevant entities to create and develop processes*  
17          *for the purpose of advancing basic research in quantum in-*  
18          *formation science and improving the competitiveness of the*  
19          *United States.*

20          (d) *COORDINATION.*—*The Secretary of Energy shall*  
21          *ensure the coordination, and avoid unnecessary duplica-*  
22          *tion, of the activities of each Center with the activities of—*

23                  (1) *other research entities of the Department of*  
24                  *Energy, including—*

25                          (A) *the Nanoscale Science Research Centers;*

1                   (B) *the Energy Frontier Research Centers;*

2                   (C) *the Energy Innovation Hubs; and*

3                   (D) *the National Laboratories;*

4                   (2) *institutions of higher education; and*

5                   (3) *industry.*

6           (e) *DURATION.*—

7                   (1) *IN GENERAL.*—*Each Center established under*  
8 *this section is authorized to carry out activities for a*  
9 *period of 5 years.*

10                   (2) *REAPPLICATION.*—*An awardee may reapply*  
11 *for additional, subsequent periods of 5 years. The Di-*  
12 *rector shall approve or disapprove of each reapplica-*  
13 *tion on a competitive, merit-reviewed basis.*

14                   (3) *TERMINATION.*—*Consistent with the authori-*  
15 *ties of the Department of Energy, the Secretary of*  
16 *Energy may terminate an underperforming Center*  
17 *for cause during the performance period.*

18           (f) *FUNDING.*—*The Secretary of Energy shall allocate*  
19 *up to \$25,000,000 for each Center established under this*  
20 *section for each of fiscal years 2019 through 2023, subject*  
21 *to the availability of appropriations. Amounts made avail-*  
22 *able to carry out this section shall be derived from amounts*

1 *appropriated or otherwise made available to the Depart-*  
2 *ment of Energy.*

Attest:

*Secretary.*

115<sup>TH</sup> CONGRESS  
2<sup>D</sup> SESSION

**H.R. 6227**

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**AMENDMENT**