

NSF 24-599: Quantum Leap Challenge Institutes (QLCI)

Program Solicitation

Document Information

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U.S. National Science Foundation

Directorate for Biological Sciences
Directorate for Computer and Information Science and Engineering
Directorate for Engineering
Directorate for Mathematical and Physical Sciences
Directorate for STEM Education
Directorate for Technology, Innovation and Partnerships

Letter of Intent Due Date(s) (required) (due by 5 p.m. submitting organization's local time):

February 07, 2025

Preliminary Proposal Due Date(s) (required) (due by 5 p.m. submitting organization's local time):

March 07, 2025

Full Proposal Deadline(s) (due by 5 p.m. submitting organization's local time):

September 17, 2025

By invitation only



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Important Information And Revision Notes

The establishment of new Quantum Leap Challenge Institutes, or the renewal of existing Quantum Leap Challenge Institutes may be proposed in response to this Solicitation. Proposals in both cases will be considered in a single merit review process.

Any proposal submitted in response to this solicitation should be submitted in accordance with the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG) that is in effect for the relevant due date to which the proposal is being submitted. The NSF PAPPG is regularly revised and it is the responsibility of the proposer to ensure that the proposal meets the requirements specified in this solicitation and the applicable version of the PAPPG. Submitting a proposal prior to a specified deadline does not negate this requirement.

Summary Of Program Requirements

General Information

Program Title:

Quantum Leap Challenge Institutes (QLCI)

Synopsis of Program:

Quantum Leap Challenge Institutes are large-scale interdisciplinary research projects motivated by major challenges at the frontiers of quantum information science and technology (QIST). Institutes are expected to catalyze breakthroughs on important problems underpinning QIST, for example in the focus areas of quantum computation, quantum communication, quantum simulation and/or quantum sensing. Successful institutes will coordinate a variety of approaches to specific scientific, technological, and educational goals in these fields, including multiple institutions and building upon multiple disciplines, as motivated by the science and engineering challenges. In so doing, Institutes will nurture a culture of

discovery, provide education, training, and workforce development opportunities in the context of cutting-edge research, and demonstrate value-added from synergistic coordination within the institute and with the broader community. Partnerships, infrastructure, industry engagement, outreach, international collaboration, and new applications for QIST should be fostered by Institutes in support of their research, education, and coordination goals.

The QLCI program can support awards to continue existing Quantum Leap Challenge Institutes or to establish and operate new Quantum Leap Challenge Institutes. In either case, proposers should follow the same guidance for Challenge Institute proposal preparation described in this solicitation. While this is a crosscutting program, proposals responding to this solicitation must be submitted to the Office of Strategic Initiatives (OSI) in the Directorate of Mathematical and Physical Sciences (MPS). They will subsequently be managed by a cross-disciplinary team of NSF Program Directors.

The QLCI program enables *NSF multidisciplinary centers for quantum research and education* as called for in the National Quantum Initiative (NQI) Act¹ and an NQI Advisory Committee report, *Renewing the National Quantum Initiative: Recommendations for Sustaining American Leadership in Quantum Information Science*². In alignment with the NQI Act, Quantum Leap Challenge Institutes shall pursue research at the frontiers of quantum information science, engineering, and technology, and explore solutions to important challenges for the development, application, commercialization, and pioneering use of quantum technologies. QLCI Institutes shall also lead education, training, and workforce development activities as may be needed for sustained leadership in QIST and related topics. Coordination both within each Institute and with new partners and the broader ecosystem should also serve to galvanize the community and catalyze the research and education activities in ways that go beyond what smaller projects could accomplish in isolation.

¹ *National Quantum Initiative Act*, Public Law 115-368, of December 21, 2018.

² <https://www.quantum.gov/wp-content/uploads/2023/06/NQIAC-Report-Renewing-the-National-Quantum-Initiative.pdf>.

Broadening Participation In STEM

NSF recognizes the unique lived experiences of individuals from communities that are underrepresented and/or under-served in science, technology, engineering, and mathematics (STEM) and the barriers to inclusion and access to STEM education and careers. NSF highly encourages the leadership, partnership, and contributions in all NSF opportunities of individuals who are members of such communities supported by NSF. This includes leading and designing STEM research and education proposals for funding; serving as peer reviewers, advisory committee members, and/or committee of visitor members; and serving as NSF leadership, program, and/or administrative staff. NSF also highly encourages demographically diverse institutions of higher education (IHEs) to lead, partner, and contribute to NSF opportunities on behalf of their research and education communities. NSF expects that all individuals, including those who are members of groups that are underrepresented and/or under-served in STEM, are treated equitably and inclusively in the Foundation's proposal and award process.

NSF encourages IHEs that enroll, educate, graduate, and employ individuals who are members of groups underrepresented and/or under-served in STEM education programs and careers to lead, partner, and contribute to NSF opportunities, including leading and designing STEM research and education proposals for funding. Such IHEs include, but may not be limited to, community colleges and two-year institutions, mission-based institutions such as Historically Black Colleges and Universities (HBCUs), Tribal Colleges and Universities (TCUs), women's colleges, and institutions that

primarily serve persons with disabilities, as well as institutions defined by enrollment such as Predominantly Undergraduate Institutions (PUIs), Minority-Serving Institutions (MSIs), and Hispanic Serving Institutions (HSIs).

"Broadening participation in STEM" is the comprehensive phrase used by NSF to refer to the Foundation's goal of increasing the representation and diversity of individuals, organizations, and geographic regions that contribute to STEM teaching, research, and innovation. To broaden participation in STEM, it is necessary to address issues of equity, inclusion, and access in STEM education, training, and careers. Whereas all NSF programs might support broadening participation components, some programs primarily focus on supporting broadening participation research and projects. Examples can be found on the NSF [Broadening Participation in STEM](#) website.

Cognizant Program Officer(s):

Please note that the following information is current at the time of publishing. See program website for any updates to the points of contact.

- QLCI Program Management Team, telephone: (703) 292-5302, email: QLCI@nsf.gov
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- Elizabeth Behrman, telephone: (703) 292-7049, email: ebehrman@nsf.gov
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Applicable Catalog of Federal Domestic Assistance (CFDA) Number(s):

- 47.041 --- Engineering
- 47.049 --- Mathematical and Physical Sciences
- 47.070 --- Computer and Information Science and Engineering
- 47.074 --- Biological Sciences
- 47.076 --- STEM Education
- 47.084 --- NSF Technology, Innovation and Partnerships

Award Information

Anticipated Type of Award: Cooperative Agreement

Estimated Number of Awards: 5 to 10

An estimated 5 to 10 Challenge Institute cooperative agreements will be awarded.

Anticipated Funding Amount: \$200,000,000 to \$300,000,000

The QLCI program will support several Challenge Institute awards, which can be funded at different levels as motivated by the science and engineering challenges and proposed approaches. It is anticipated that individual Challenge Institutes can be funded at a level between \$2,000,000/year and \$7,500,000/year, for up to 6 years. Flexibility in the funding schedule may be allowed to enable ramping up or changing levels of effort as motivated by the Institute research, education, and coordination activities. A variety of Challenge Institute awards with a range of budget sizes and scopes will be considered.

Each proposed Challenge Institute budget is expected to be commensurate with the associated QIST research, education, and coordination activities.

The estimated program budget, number of awards and average award size/duration are subject to the availability of funds.

Eligibility Information

Who May Submit Proposals:

Proposals may only be submitted by the following:

- Institutions of Higher Education (IHEs) - Two- and four-year IHEs (including community colleges) accredited in, and having a campus located in the US, acting on behalf of their faculty members. Special Instructions for International Branch Campuses of US IHEs: If the proposal includes funding to be provided to an international branch campus of a US institution of higher education (including through use of sub-awards and consultant arrangements), the proposer must explain the benefit(s) to the project of performance at the international branch campus, and justify why the project activities cannot be performed at the US campus.

Who May Serve as PI:

There are no restrictions or limits.

Limit on Number of Proposals per Organization: 2

Limitations on the number of proposals per organization do not apply to the Letters of Intent.

Lead organizations are limited to submit no more than two (2) Challenge Institute Preliminary Proposals. Lead organizations are limited to submit no more than two (2) invited Challenge Institute Full Proposals. Multi-institutional Challenge Institute proposals must be submitted as a single proposal by a single lead organization; separately submitted collaborative proposals are not permitted.

Limit on Number of Proposals per PI or co-PI: 2

Letters of Intent: Principal Investigators (PIs) and co-PIs may participate in multiple Letters of Intent. Limits on the number of Challenge Institute Full Proposals do not apply to Letters of Intent.

Preliminary Proposals: Principal Investigators (PIs) and co-PIs may participate in multiple Preliminary Proposals. Limits on the number of Challenge Institute Full Proposals do not apply to Preliminary Proposals.

Invited Full Proposals: The lead PI and up to four additional co-PIs who are named on the Cover Sheet of a Challenge Institute Full Proposal must only participate in one Challenge Institute Full Proposal. Senior/Key Personnel who are not named on the cover sheet of a Challenge Institute Full Proposal may participate in no more than two (2) Challenge Institute Full Proposals.

Proposal Preparation and Submission Instructions

A. Proposal Preparation Instructions

- **Letters of Intent:** Submission of Letters of Intent is required. Please see the full text of this solicitation for further information.
- **Preliminary Proposals:** Submission of Preliminary Proposals is required. Please see the full text of this solicitation for further information.
- **Full Proposals:**

- Full Proposals submitted via Research.gov: *NSF Proposal and Award Policies and Procedures Guide (PAPPG)* guidelines apply. The complete text of the PAPPG is available electronically on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg.
- Full Proposals submitted via Grants.gov: *NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov* guidelines apply (Note: The *NSF Grants.gov Application Guide* is available on the Grants.gov website and on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide).

B. Budgetary Information

- **Cost Sharing Requirements:**

Inclusion of voluntary committed cost sharing is prohibited.

- **Indirect Cost (F&A) Limitations:**

Not Applicable

- **Other Budgetary Limitations:**

Other budgetary limitations apply. Please see the full text of this solicitation for further information.

C. Due Dates

- **Letter of Intent Due Date(s) (required)** (due by 5 p.m. submitting organization's local time):

February 07, 2025

- **Preliminary Proposal Due Date(s) (required)** (due by 5 p.m. submitting organization's local time):

March 07, 2025

- **Full Proposal Deadline(s)** (due by 5 p.m. submitting organization's local time):

September 17, 2025

By invitation only

Proposal Review Information Criteria

Merit Review Criteria:

National Science Board approved criteria. Additional merit review criteria apply. Please see the full text of this solicitation for further information.

Award Administration Information

Award Conditions:

Additional award conditions apply. Please see the full text of this solicitation for further information.

Reporting Requirements:

Standard NSF reporting requirements apply.

I. Introduction

Quantum information science and technology (QIST) uses quantum physics phenomena such as coherence, superposition, wave-particle duality, interference, and entanglement for revolutionary approaches to computing, sensing,

and networking³. Emerging Industries may benefit from new applications of quantum computation, quantum communication, quantum simulation and quantum sensing. However, there are several challenges at the frontiers of quantum information science and engineering that must be overcome before the full potential of quantum information technology can be realized. This is the motivation for the Challenge Institutes.

The goal of the Quantum Leap Challenge Institute (QLCI) program is to support timely and bold research agendas aimed at making breakthroughs on clearly identified and compelling challenges in quantum information science and engineering within a 6-year period. Quantum Leap Challenge Institutes are expected to: engage intellectually diverse communities in pursuit of solutions to major challenges; contribute to education and workforce training in fields underpinning QIST; and demonstrate value added from coordination both within the Institute and with the larger QIST community. As part of their research, education, and coordination activities, Challenge Institutes are expected to enable new and existing partnerships, improve access to infrastructure, facilitate international collaborations, and provide opportunities for technology translation.

Now is an important time to extend the QLCI program, after the first five years of the National Quantum Initiative. The opportunity to strengthen existing Challenge Institutes or establish new Challenge Institutes will leverage recent breakthroughs in science and engineering and catalyze partnerships with industry, national laboratories and an increasingly diverse range of academic institutions. As platforms for quantum technology grow in sophistication and scale, Challenge Institutes will explore new horizons in QIS and pioneer new applications QIST, in partnership with potential end-users from a range of fields.

The QLCI program is part of a diverse portfolio of NSF investments in quantum information science and engineering. The results of these efforts, combined with activities supported by other government agencies and industry, indicate that the community of quantum information scientists and engineers is well-positioned to collaboratively identify new approaches to major challenges whose solution will catalyze breakthroughs. The QLCI program is intended to strengthen such cross-disciplinary research efforts, forge new partnerships between universities, non-profit organizations, industry, and government agencies and thus accelerate foundational discoveries, innovation, and technological developments. The scope of the Quantum Leap Challenge Institutes is aligned with that of *NSF multidisciplinary centers for quantum research and education* as described in the National Quantum Initiative Act⁴. The Quantum Leap Challenge Institutes are expected to connect multiple research approaches, integrating expertise from domains such as physics, materials science, engineering, mathematics, chemistry, computer science, and biological sciences. Challenge Institutes in collaboration with industry partners and other research institutions are also expected to develop and sustain cross-disciplinary approaches for education, training and workforce development. Combining these elements, the Quantum Leap Challenge Institutes will promote a sustainable innovation ecosystem where expertise from various disciplines, research institutions, and industry can be leveraged, as needed, to overcome scientific, technological, and workforce challenges in quantum information science and engineering. The multidisciplinary scope of quantum information science and engineering, in turn, holds promise for the development of radically new and more powerful scientific and technological tools that will open new science and engineering vistas.

³ *National Strategic Overview for Quantum Information Science*, National Science and Technology Council, September 2018.

⁴ *National Quantum Initiative Act*, Public Law 115-368, December 21, 2018.

II. Program Description

The Quantum Leap Challenge Institute (QLCI) program will fund Institutes comprised of multidisciplinary groups of scientists and engineers united by a common challenge theme for advancing the research frontiers in focus areas such as quantum networking, quantum computation, quantum simulation and/or quantum sensing. The Challenge Institutes will

also contribute to the development of a well-trained workforce through cross-disciplinary and collaborative basic research, project-driven training, and innovative curricula. The QLCI program is expected to facilitate research, training, and education through exposure of trainees to theoretical frameworks, algorithmic techniques, experimental platforms and testbeds, and interactions with national laboratories, industry, and international partners. The Challenge Institutes will build on prior investments in quantum information science and engineering and are expected to coordinate and integrate with ongoing and new NSF QIST initiatives, including center-scale, infrastructure, and workforce development activities.

The salient **Characteristics of an Institute** and the **Major Activities** performed by an Institute are next described in Sections II.A and II.B.

A. Characteristics of a Quantum Leap Challenge Institute

The QLCI program will support institutes led by Principal Investigators based at institutions of higher education to pursue major breakthroughs in critical areas at the intellectual and technological frontiers of quantum information science and engineering. Multidisciplinary approaches can be supported, as motivated by the scientific and engineering needs of the proposed research and associated challenges that the Institute seeks to address. The QLCI program is designed to enable new types of joint efforts that may be needed to address the most pressing challenges in QIST. Accordingly, Challenge Institutes may vary in size and exhibit various forms of organization, collaboration and operation suited to their individual needs.

Each Institute will have a director who takes overall responsibility for the effort and provides leadership to develop and lead a diverse interdisciplinary team to fulfill the vision of the Institute. Each Institute must have a strategic plan that reflects the overall vision of the Institute and describes the key elements of the proposed major activities spanning research, education and workforce development, institute coordination. Goals and plans for partnerships, infrastructure, collaborations, and technology translation should be part of this strategic plan, as motivated by the research, education, and coordination activity needs. Each institute must have a management and governance plan to indicate how the institute will operate. The plan must contain information on the overall management and reporting structure, how research projects are chosen, the existence and makeup of any advisory board(s) and the Principal Investigators responsible for different parts of the institute's research, education, and workforce development activities.

Given the rapidly evolving nature of quantum information science and engineering, the Challenge Institutes are expected to have the ability and mechanisms in place to change course, when warranted, to address the changing research and technological needs within the context of the Institute. This may include the exit of certain PIs and organizations and on-boarding of new PIs and organizations.

Through the major activities discussed below, competitive QLCI proposals will demonstrate:

- **Unifying Research Themes**
 - A research challenge at the frontiers of Quantum Information Science and Engineering with compelling goals, milestones, and impacts that can galvanize a community of researchers and partners.
 - A research approach that fosters community engagement and brings together experts and stakeholders from multiple disciplines to overcome important challenges in QIST research, development, and demonstration.
- **Coherent Approaches to Education and Workforce Development**
 - Training and mentoring in the context of cutting-edge research.
 - Innovative and substantive approaches to curricular and professional development, including multidisciplinary and practical activities, as motivated by the research challenges and the associated QIST ecosystem.
 - Community engagement including outreach at all levels and industry engagement in the workforce development activities.
- **Synergistic Coordination Demonstrating Value-Added from an Institute**

- Partnerships that accelerate progress on the research theme and the education and training activities.
- Infrastructure enhancements, including new instrumentation, upgrades, staffing, and access to infrastructure in furtherance of the research and training goals.
- Coordination that unites the institute community, accelerates dissemination of results, facilitates technological innovation and development of new applications for QIST in service to the community and the nation, and justifies the value-added from an institute.

B. Major Activities

Each Challenge Institute is expected to carry out its mission through major activities in three areas: 1) Research, 2) Education and Workforce Development, 3) Coordination. Synergistic Partnerships, Infrastructure Development, and Technological Innovation should be integrated into each of the three areas.

1. Research

Suggested examples of a unifying research theme for a Challenge Institute may include quantum frontiers such as:

- Expanding Opportunities for Quantum Technologies to Benefit Society
- Building the Discipline of Quantum Engineering
- Targeting Materials Science for Quantum Technologies
- Exploring Quantum Mechanics through Quantum Simulations
- Harnessing Quantum Information Technology for Precision Measurements
- Generating and Distributing Quantum Entanglement for New Applications
- Characterizing and Mitigating Quantum Errors
- Understanding the Universe through Quantum Information
- Exploring Quantum Phenomena in Relevant Environments such as Room Temperature Devices or Biological Systems.

These research themes listed in the Quantum Frontiers Report⁵ are merely examples, not a prescriptive list. The focus of a Challenge Institute may be on one theme area, or it may involve topics in multiple theme areas. Regardless of the focus, the overall unifying challenge research theme for the Institute must be clearly articulated and justified.

The proposed research should identify compelling goals, milestones, and impacts, including sufficient detail on key approaches to enable innovation on physical platforms, theory, devices, and systems. Institutes may organize their research around a few interrelated research challenge (RC) topics that are united by the overall research theme. Use cases and potential end users should be identified to illustrate potential impacts. Transformative advances in both fundamental and applied QIST endeavors are encouraged.

2. Education and Workforce Development

Rapid development of quantum technologies and sustained progress in scientific advances and commercial applications require a growing and qualified workforce with interdisciplinary skill sets. The QLCI program aims to facilitate training of students with the combination of skills required for the conceptualization, development, and translation of new quantum technologies. The QLCI program requires activities to promote the training of students in environments that expose them to a convergent set of disciplines and help them acquire qualifications and skills needed in industry, national laboratories, and academia. New approaches to collaboration with industry are anticipated in a Challenge Institute not only to increase the translational impact of research, but also as a tool to assure the training and generation of a well-qualified workforce in quantum information science and engineering.

The QLCI program also provides opportunities to nurture the growth of a vibrant cross-disciplinary research community through curriculum development, through research projects addressing various topics, as well as their integration. Relevant efforts may include: new degree programs and curriculum development within various academic departments

(e.g., computer science, engineering, physics, chemistry, biology, materials science, and mathematics) and coordination across departments to foster cross-disciplinary research; development of a common basic cross-disciplinary curriculum for potential degree programs to be shared across departments; organization of conferences targeted at critical cross-disciplinary research interfaces; development of experimental prototypes and testbeds for exploring different emerging technology platforms that are accessible to the wider research community; and creation of entrepreneurial opportunities for academia-industry collaboration, technology transfer and commercialization.

Although many quantum technologies are not yet mature enough for broad adoption, the Challenge Institutes are encouraged to address early-stage education, including elementary, middle, and high school levels, in the broad area of quantum science and engineering. Collaboration with organizations such as museums and venues facilitating outreach to broader audiences is also encouraged.

As an integral part of their mission, the Challenge Institute teams are expected to develop new and creative approaches and strategies for cross-disciplinary training and workforce development. Successful teams are expected to provide assessment plans to evaluate effective strategies. The QLCI program also provides an opportunity to engage education scientists to study and evaluate how convergent research teams form and evolve in the context of an Institute aimed at addressing critical cross-disciplinary challenges to accelerate discovery and innovation.

3. Coordination

Challenge Institutes are expected to galvanize the community, facilitate partnerships, and enhance infrastructure in ways that provide value added from the institute approach.

Institute proposals should articulate how the research teams will be organized, and how seminars and seasonal schools may be used in service of the institute goals, along with mechanisms for developing synergistic partnerships with industry, US national laboratories and international partners for advancing the goals and objectives of the Institute.

The Institutes are required to hold internal annual PI meetings. The overall goal of such activities is to facilitate and accelerate discovery and innovation within the core Challenge Institute team, and also to engage the wider research community in areas of relevance to the Challenge Institutes vision. It is expected that such activities will facilitate the growth of a vibrant multi-disciplinary research community, engage a diverse array of institutions and organizations, and foster new cross-cutting and convergent collaborations in various aspects of quantum information science and engineering research and workforce development.

The Challenge Institute teams are expected to coordinate with their constituent organizations and partners to develop a concrete and workable plan for leveraging existing infrastructure resources in support of the Institute goals and objectives, including relevant laboratory facilities, testbeds and cyberinfrastructure to facilitate training and collaboration.

Partnerships should be based on clearly defined objectives that are matched to the vision of the Challenge Institute. Partnerships are not expected to be permanent and partnership agreements may include sunset provisions as appropriate. The partnership ecosystem around a Challenge Institute is expected to be dynamic and matched at each point in time to the then-current needs of the Institute.

Institutes should describe how they will address issues related to intellectual property (IP), so as to facilitate partnerships among multiple entities in academia and industry. This may involve plans to develop and execute agreements with its partners to address IP issues. Research carried out at a Challenge Institute will primarily be pre-competitive, in which case NSF requires that constituent organizations of an Institute must not be preferentially advantaged (or disadvantaged) in terms of IP rights or access to IP as a consequence of an Institute partnership.

Each Challenge Institute must also ensure it is aware of, and complies with, the International Traffic in Arms Regulations (ITAR) and Export Administration Regulations (EAR) in the context of prototype and technology development.

C. Types of Awards

Challenge Institute Awards:

Challenge Institute awards will be funded for 6 years and will enable the establishment and or operation of Quantum Leap Challenge Institutes. The size of these awards as well as the structure of the Institutes will be based, in part, on the targeted community and its research, technology and workforce development needs. Awards are expected to be cooperative agreements between NSF and the recipient institution(s). The release of funding increments will be subject to agreed-upon milestones, periodic project reviews, site visits, approval by NSF and the availability of funds.

Preliminary proposals are required. Preliminary proposals will undergo full merit review. At the end of this process, proposers will be informed whether or not a full proposal is invited for the project. Only full proposals received in response to an invitation will be considered. The review of the invited full QLCI proposals will include a presentation by the proposing team at the NSF headquarters in Alexandria, VA. Additional details are provided in Sec. V (**Proposal Preparation**) and Sec. VI (**Proposal Review**).

QLCI Preliminary proposal: The QLCI preliminary proposal serves as a precursor to the Strategic Plan to be developed in the full proposal. A QLCI preliminary proposal must address the following elements:

- Identification of a compelling challenge research theme, specific research goals and milestones for advancing the frontiers of quantum information science and engineering within six years.
- Identification of the cross-disciplinary and multi-institution research team forming the Challenge Institute.
- An overview of overarching cross-cutting findings, concepts or preliminary results that shape the Challenge Institutes vision.
- Evidence to indicate that the team can effectively collaborate across the different disciplines.
- An overview of the proposed major activities in the three core areas described in Section II.B: research; education and workforce development; and coordination.
- Prior experiences of the team with the key elements and frameworks of quantum information science and engineering identified for the Challenge Institute.
- A summary of key activities undertaken by the proposing team in preparation for the Challenge Institute preliminary proposal submission.

⁵ Quantum Frontiers Report available on <https://www.quantum.gov/>.

III. Award Information

Anticipated Type of Award: Cooperative Agreement

Estimated Number of Awards: 5 to 10

An estimated 5 to 10 Challenge Institute cooperative agreements will be awarded.

Anticipated Funding Amount: \$200,000,000 to \$300,000,000

The QLCI program will support several Challenge Institute awards, which can be funded at different levels as motivated by the science and engineering challenges and proposed approaches. It is anticipated that individual Challenge Institutes can be funded at a level between \$2,000,000/year and \$7,500,000/year, for up to 6 years. Flexibility in the funding schedule may be allowed to enable ramping up or changing levels of effort as motivated by the Institute research, education, and coordination activities. A variety of Challenge Institute awards with a range of budget sizes and scopes will be considered. Each proposed Challenge Institute budget is expected to be commensurate with the associated QIST research, education, and coordination activities.

The estimated program budget, number of awards and average award size/duration are subject to the availability of funds.

IV. Eligibility Information

Who May Submit Proposals:

Proposals may only be submitted by the following:

- Institutions of Higher Education (IHEs) - Two- and four-year IHEs (including community colleges) accredited in, and having a campus located in the US, acting on behalf of their faculty members. Special Instructions for International Branch Campuses of US IHEs: If the proposal includes funding to be provided to an international branch campus of a US institution of higher education (including through use of sub-awards and consultant arrangements), the proposer must explain the benefit(s) to the project of performance at the international branch campus, and justify why the project activities cannot be performed at the US campus.

Who May Serve as PI:

There are no restrictions or limits.

Limit on Number of Proposals per Organization: 2

Limitations on the number of proposals per organization do not apply to the Letters of Intent.

Lead organizations are limited to submit no more than two (2) Challenge Institute Preliminary Proposals. Lead organizations are limited to submit no more than two (2) invited Challenge Institute Full Proposals. Multi-institutional Challenge Institute proposals must be submitted as a single proposal by a single lead organization; separately submitted collaborative proposals are not permitted.

Limit on Number of Proposals per PI or co-PI: 2

Letters of Intent: Principal Investigators (PIs) and co-PIs may participate in multiple Letters of Intent. Limits on the number of Challenge Institute Full Proposals do not apply to Letters of Intent.

Preliminary Proposals: Principal Investigators (PIs) and co-PIs may participate in multiple Preliminary Proposals. Limits on the number of Challenge Institute Full Proposals do not apply to Preliminary Proposals.

Invited Full Proposals: The lead PI and up to four additional co-PIs who are named on the Cover Sheet of a Challenge Institute Full Proposal must only participate in one Challenge Institute Full Proposal. Senior/Key Personnel who are not named on the cover sheet of a Challenge Institute Full Proposal may participate in no more than two (2) Challenge Institute Full Proposals.

V. Proposal Preparation And Submission Instructions

A. Proposal Preparation Instructions

Letters of Intent (*required*):

A Letter of Intent for a Challenge Institute preliminary proposal should be submitted via Research.gov no later than the date specified in this solicitation. A Letter of Intent should be no more than two pages, and it should include the following information:

- **Proposal Title** - Title must be preceded by the letters "QLCI:".
- **Team** - Names, departmental and organizational affiliation of all team members, including the Principal Investigator, co-Principal Investigators, and other Senior/Key Personnel.

- **Synopsis** - Please briefly describe the expertise of the Principal Investigator and at least two co-Principal Investigators. Provide a brief description of the challenge research theme and the specific goals of the proposal.
- **Other Comments** - Continue Synopsis as needed in this section.

Letter of Intent Preparation Instructions:

When submitting a Letter of Intent through Research.gov in response to this Program Solicitation please note the conditions outlined below:

- Submission by an Authorized Organizational Representative (AOR) is not required when submitting Letters of Intent.
- A Minimum of 1 and Maximum of 4 Other Senior Project Personnel are permitted
- A Minimum of 1 and Maximum of 10 Other Participating Organizations are permitted
- Submission of multiple Letters of Intent is permitted

Preliminary Proposals (required): Preliminary proposals are required and must be submitted via Research.gov, even if full proposals will be submitted via Grants.gov.

Preliminary Proposal Set-Up:

Select "Prepare New Preliminary Proposal" in Research.gov. Search for and select this solicitation title in Step One of the Preliminary Proposal wizard. The information in Step 2 is pre-populated by the system. In Step 3 select "Single proposal (with or without sub-awards)". Separately submitted collaborative preliminary proposals will be returned without review.

Preliminary Proposal Title:

The title of the preliminary proposal must be preceded by the letters "**QLCI Preliminary Proposal:**". The rest of the title should describe the project in concise, informative language that is understandable to a technically-literate reader.

The required components of the preliminary proposal are given below. Page limitations given here will be strictly enforced. Proposers should review the most current PAPPG for specific information and format for the required sections. No other sections are required or may be included in the preliminary proposal.

Cover Sheet

Preliminary Proposal Project Summary:

The Project Summary consists of an overview, a statement on the intellectual merit of the proposed activity and a statement on the broader impacts of the proposed activity. Include a concise overview of the proposed major Institute activities, including the unifying challenge, specific research focus areas, workforce development activities, and plans for coordination both across the institute and with the larger community.

Preliminary Proposal Project Description:

Project Descriptions are limited to 15 pages in length. The page numbers listed (in parentheses, which add up to 13) for the different sections are only suggested guidelines; the actual page numbers for different sections may deviate from the guidelines, provided the total number of pages does not exceed the limit of 15 pages.

In addition to the PAPPG requirements, including the required section labeled "Broader Impacts", the Project Description for a Challenge Institute preliminary proposal must include the following clearly-marked sections:

- a. A description of the cross-disciplinary and multi-institution research team, including a list of the PI, any co-PIs, and each participating Senior/Key Personnel (faculty level and equivalent) by full name, institutional affiliation and departmental affiliation. It is expected that all participating members will have an active role in institute activities, including research, workforce development, research coordination and partnerships. This list should be clearly labeled and made the first item in the Project Description. **(1 page)**.

- b. A brief overview of the proposed Challenge Institute, including the challenge research theme and the focus research areas, key cross-cutting concepts or findings that shape the vision of the cross-disciplinary institute. **(2 pages)**.
- c. A brief overview of the state-of-the-art to provide a context and motivation for the proposed Challenge Institute. What makes the proposed challenge research theme compelling and timely? **(1 page)**.
- d. Intellectual Merit: A description of the proposed major activities in the research challenge areas. **(2 pages)**.
- e. Broader Impacts: A description of the proposed major activities in education, training, and workforce development. **(1 page)**.
- f. A description of proposed activities and mechanisms for Institute coordination and community engagement. **(1 page)**.
- g. A brief description of proposed major partnerships and infrastructure development activities. **(1 page)**.
- h. Milestones and evaluation mechanisms: An overview of the key milestones in major activities and the mechanisms for evaluation of success. **(1 page)**.
- i. A brief description of pertinent achievements under prior NSF support from the PI and the co-PIs listed on the cover sheet. It is optional to include a summary of pertinent achievements under prior NSF support for other Senior/Key Personnel named in the proposal **(2 pages)**.
- j. A summary of key activities undertaken by the team in preparation for collaborating on the proposed Challenge Institute. This should provide evidence showing how the team can effectively work together on carrying out the proposed Challenge Institute activities. provide. **(1 page)**.

Preliminary Proposal References Cited:

List only references cited in the Project Description.

Budget and Budget Justification:

See the Section V.B. (**Budgetary Information**) for instructions on how to prepare these documents.

Facilities, Equipment and Other Resources:

A brief description of key facilities, equipment, and other resources such as infrastructure should be included.

Senior/Key Personnel Documents: The following information must be provided for all individuals designated as Senior/Key Personnel, including the PI, all co-PIs, and any additional senior/key personnel at all participating organizations.

- Biographical Sketches
- Current and Pending (Other) Support
- Collaborators and Other Affiliations (COA) Information
- Synergistic Activities

Data Management and Sharing Plan:

All preliminary proposals must include a Data Management and Sharing Plan that describes how the project will provide open and rapid access to quality-controlled and fully documented data and information during and after the project. This plan must be consistent with NSF's policy on dissemination and sharing of research results (<https://www.nsf.gov/bfa/dias/policy/dmp.jsp>) and also NSF's PAPPG.

Mentoring plan:

Each preliminary proposal that requests funding to support postdoctoral scholars or graduate students must upload a description of the mentoring activities that will be provided for such individuals.

Preliminary Proposal Supplementary Documents:

- **Synopsis of Institutional Support.** A one page synopsis of institutional commitments to support the proposed Challenge Institute should be included. The synopsis should be narrative in nature and must not include any quantifiable financial information.
- **Management and Integration Plan.** A one-page overview of the Institute leadership and management is required for all preliminary proposals. The Management and Integration Plan should: a) describe how the group effort will be coordinated; and b) describe how the disciplinary components will be integrated.
- **Letters of Collaboration.** The Project Description must fully detail any substantial collaborations and engagements (included or not included in the budget) with partner organizations. Letters of Collaboration should be provided in the Supplementary Documents section of the proposal and follow the format instructions specified in the NSF PAPPG.

Full Proposal Preparation Instructions: Proposers may opt to submit proposals in response to this Program Solicitation via Research.gov or Grants.gov.

- Full Proposals submitted via Research.gov: Proposals submitted in response to this program solicitation should be prepared and submitted in accordance with the general guidelines contained in the *NSF Proposal and Award Policies and Procedures Guide* (PAPPG). The complete text of the PAPPG is available electronically on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg. Paper copies of the PAPPG may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-8134 or by e-mail from nsfpubs@nsf.gov. The Prepare New Proposal setup will prompt you for the program solicitation number.
- Full proposals submitted via Grants.gov: Proposals submitted in response to this program solicitation via Grants.gov should be prepared and submitted in accordance with the *NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov*. The complete text of the *NSF Grants.gov Application Guide* is available on the Grants.gov website and on the NSF website at: (https://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide). To obtain copies of the Application Guide and Application Forms Package, click on the Apply tab on the Grants.gov site, then click on the Apply Step 1: Download a Grant Application Package and Application Instructions link and enter the funding opportunity number, (the program solicitation number without the NSF prefix) and press the Download Package button. Paper copies of the Grants.gov Application Guide also may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-8134 or by e-mail from nsfpubs@nsf.gov.

See PAPPG Chapter II.D.2 for guidance on the required sections of a full research proposal submitted to NSF. Please note that the proposal preparation instructions provided in this program solicitation may deviate from the PAPPG instructions.

Note: Full proposals may be submitted only by projects that, following the review of a preliminary proposal, have received an invitation to submit a full proposal. For submissions involving multiple organizations, the proposal must be submitted from only one (lead) institution, with funding for participating organizations made through sub-awards. Proposals should not be submitted as separately submitted collaborative proposals.

The following provides additional guidance beyond that contained in the PAPPG or NSF Grants.gov Application Guide. Proposals that exceed the total page limitations specified below will be ineligible for consideration and will be returned without review.

Full Proposal Title:

The title of the proposal must begin with the letters "QLCI:" The rest of the title should describe the project in concise, informative language that is understandable to a technically-literate reader.

Full Proposal Project Summary:

The Project Summary consists of an overview, a statement on the intellectual merit of the proposed activity and a statement on the broader impacts of the proposed activity. Include an overview of the challenge research theme and

focus research areas and proposed major activities in the four core components of research, workforce development, research coordination and partnerships and infrastructure.

Full Proposal Project Description:

Including the required section labeled "Broader Impacts", the Project Description must include the following clearly-marked sections and is limited to no more than 35 pages. The number of pages (listed in parentheses) for each section are only suggested guidelines; the actual page numbers may deviate from the guidelines, provided the total number of pages does not exceed 35 pages.

- a. List of participants. List the PI, any co-PIs, and each participating Senior/Key Personnel (faculty level or equivalent), including institutional and departmental affiliation. (Additional biographical information should be inserted in the Biographical Sketch section.) **(1 page)**.
- b. Overview of the key cross-cutting concepts, findings, or initial results that guide the proposed major cross-disciplinary activities. Describe in detail the key cross-cutting concepts and any associated initial results that build on disciplinary advances and under-pin the proposed convergent cross-disciplinary activities. **(1 page)**.
- c. Intellectual Merit: Major activities in research. Describe the proposed major activities in the various focus research areas, how they relate to the challenge research theme, and what makes them potentially transformative. **(10 pages)**.
- d. Evidence of cross-disciplinary engagement and synergy. Provide information to support the cross-disciplinary engagement and synergy of the team in carrying out the proposed work. **(1 page)**.
- e. Broader Impacts: Major activities in education, training and workforce development. **(3 pages)**.
- f. Major activities in research coordination and wider community engagement. **(3 pages)**.
- g. Major activities for strategic partnerships and infrastructure development. **(3 pages)**.
- h. Strategic plan. Please see the list of Strategic Plan Elements at the end of these Proposal Preparation Instructions. Provide a clear rationale for and description of the proposed Challenge Institute, its challenge research theme and its potential impact on the frontiers of quantum information science and engineering. Briefly describe the institutional setting of the Challenge Institute unit, its organization, leadership, and management structure. Provide a brief overview of the major activities in focus research areas, training and workforce development, research coordination and partnerships and infrastructure development. Provide an overview of the prior cross-disciplinary activities of the team that lay the foundations for the proposed Challenge Institute. **(5 pages)**.
- i. Leadership and management plan. A description of: (a) the overall leadership structure and responsibilities; b) how the group effort will be coordinated; c) how the disciplinary components will be integrated; d) how collaborations and partnerships will be integrated with the project; and e) mechanisms for evolution and adaptation of the Institute. **(3 pages)**.
- j. Milestones, evaluation mechanisms, and deliverables. A description of key year-by-year milestones in major activities, personnel responsibility, and the mechanisms for evaluation of success. A clear description of the final milestones targeted for a 6-year period and how the prior milestones lead up to them. **(2 pages)**.
- k. Results from prior NSF support. Describe achievements under prior NSF support that pertain to the present proposal. **(3 pages)**.

Full Proposal Budget and Budget Justification: See the Section V.B. (**Budgetary Information**) for instructions on how to prepare these documents.

Facilities, Equipment, and Other Resources: Describe all facilities, equipment, and other resources, such as shared infrastructure, that are critical to the proposed Institute.

Data Management and Sharing Plan:

All proposals must include a Data Management and Sharing Plan that describes how the project will provide open and rapid access to quality-controlled and fully documented data and information during and after the project. This plan must

be consistent with NSF's policy on dissemination and sharing of research results (<https://www.nsf.gov/bfa/dias/policy/dmp.jsp>) and also NSF's PAPPG. In addition to the PAPPG requirements regarding the management and sharing of data products resulting from QLCI activities, and in alignment with the National Science and Technology Council report on "Guidance for Implementing National Security Presidential Memorandum 33 (NSPM-33)" and the National Security Memorandum 10 (NSM-10), QLCI proposals should also include in the Data Management and Sharing Plan a description of how any proprietary information or intellectual property will be managed. This description may include a discussion of how data will be shared with project partners and affiliates, how access to the data will be managed, and how the sensitivity of various data sets will be assessed. Research security concerns are relevant for QLCI projects because quantum technologies have the potential to impact U.S. economic and national security interests.

Full Proposal Supplementary Documents:

- **Statement on Challenge Institute Roles:** A one-paragraph statement (not to exceed one-half page) from each of those listed as participating Senior Personnel outlining how they view their role in the Challenge Institute. This must be specific and not a general statement of support.
- **Letters of Collaboration:** The Project Description must fully detail any substantial collaborations and engagements (included or not included in the budget) with partner organizations. Letters of Collaboration should be provided in the Supplementary Documents section of the proposal and follow the recommended format instructions specified in the NSF PAPPG.
- **Institute Ramp-Up Plan:** Proposals for a new institute should include a description of implementation activities necessary to establish the institute and to have it fully operational within six months of the start of the project. The ramp-up plan should include: A list of concrete tasks, personnel responsible, milestones and timeline for the ramp-up phase; Plans for creation of an Institute website; Plans for staffing and recruitment of personnel, including students, postdoctoral researchers, and scientists; Identification of key activities for establishing partnerships and associated agreements; Identification of any significant elements that may become fully operational after the ramp-up phase, including justification and estimated time-frame.

Important Information when Preparing the Collaborators and Other Affiliations (COA) document: PIs should carefully follow the instructions regarding preparation of the COA form provided at <https://www.nsf.gov/bfa/dias/policy/coa.jsp>. A COA form in .xlsx format must be submitted as a Single Copy Document for each individual identified as senior/key personnel of the QLCI team. For large collaborations or authorships, the form should only list those people with whom the senior personnel have collaborated in a direct and substantive way. Senior/Key personnel with questions regarding whom they should list in their COA form should contact the cognizant QLCI Program Officer(s). Note in this context that listing a collaboration name or providing a collaboration URL is not sufficient.

Strategic Plan Elements:

Each Challenge Institute team is expected to develop a Strategic Plan that will guide the establishment, operation, and evolution of the Institute. In the Strategic Plan section of the Project Description, the Strategic Plan should include the following elements:

Challenge Research Theme, Focus Research Areas, and Research Community:

- A concise description of the Institutes challenge research theme and its specific research goals for advancing the state-of-the-art of quantum information science and engineering in one or more frontiers within a 6-year period.
- Identification of the cross-disciplinary research community that the institute will serve and grow.
- Identification of major milestones targeted for a six-year period and year-by-year milestones and corresponding evaluation mechanisms to measure progress in the different major activities.

Institute Management and Sustainability:

- The overall staffing requirements and appropriate recruitment and strategies.

- The leadership and management structure, including any external board of advisors.
- The specific metrics and oversight mechanisms designed to evaluate, whether and how the Institute is meeting its stated goals, including ongoing evaluation of projects.
- Mechanisms to enable course correction in research directions as well as team members.
- Identification of the principal risks the institute may encounter in its establishment, operations and achievement of goals, and contingency plans for mitigating the risks.
- Plans for long-term sustainability after expiration of NSF funding under the QLCI program.

Education, Training and Workforce Development:

- Short-term and long-term objectives and mechanisms for cross-disciplinary education, training, and workforce development.
- Plans to facilitate integration of research and education.
- Plans for assessing the effectiveness of the activities in growing a convergent and collaborative workforce in quantum information science and engineering.
- Mechanisms for disseminating novel and effective educational and workforce development practices.

Partnerships and Infrastructure Development:

- Plans for synergistic partnerships and links with local organizations, national laboratories, government agencies, industry, and international partners to leverage expertise in quantum information science, education and workforce development and technology transfer.
- Plans for creating an innovation ecosystem for working with industry, national laboratories, and other agencies to translate research into applications.
- Established and planned linkages within and across research communities that would enhance impact, including but not limited to complementary laboratory facilities and testbed capabilities and complementary components of community infrastructure.
- Specific mechanisms for outreach to the local community and the nation.

Cross-Disciplinary Research Coordination and Growth:

- Mechanisms for promoting active collaboration between researchers from multiple disciplines involved in quantum information science, including physics, engineering, mathematics, computer science, chemistry, materials science, and biological sciences.
- Mechanisms for exchanges among participating organizations by research team members and external visitors.
- Mechanisms for growing the community involved in both research and workforce development.
- Mechanisms for research community integration and coordination of efforts.

B. Budgetary Information

Cost Sharing:

Inclusion of voluntary committed cost sharing is prohibited.

Other Budgetary Limitations:

Challenge Institute Proposals: six-year awards are expected to range in size between \$2,000,000/year and \$7,500,000/year. The total budget for the full proposal may not be larger than the total budget listed in the preliminary proposal.

Budget Preparation Instructions:

Challenge Institute Proposal Budgets: Complete budgets for each year (1-6) of support and a six-year summary budget justification are required (this pertains to both preliminary proposals and full proposals.).

Challenge Institute Preliminary Proposals: Budgets are required for each of the six years. The summary budget table described below should be included in the budget justification section. Detailed sub-award budgets are not required at the preliminary proposal stage. The sub-award totals should be added in line G.5 to the lead institution total. While budgets for the separate years may change between the preliminary proposal and the full proposal, the six-year budget total in the full proposal must be the same as in the preliminary proposal.

Challenge Institute Full Proposals: Provide separate budgets for the Challenge Institute as a whole and for each participating organization. In the summary budget table described below provide the overall support levels planned for each of the major activities and components of the Challenge Institute as a whole (only year 1 and six-year totals are required.). This should be included as part of the budget justification narrative. This information augments but does not replace the official NSF budget. Travel budgets for a representative from each participating organization in a Challenge Institute for attending annual QLCI PI meetings should also be included.

Important information for Grants.gov users: Grants.gov supports proposal budgets for up to five years. After the invited full proposal is submitted to NSF via Grants.gov and successfully transferred to NSF for processing, Grants.gov applicants should use the Proposal File Update feature in Research.gov to enter the proposal budget for the 6th year.

Summary Table of Requested NSF Support:

Activity	Year One Total	Six Year Total
Research (add rows for each research focus area)		
Education (add rows for each major education, workforce development, training, and outreach activity)		
Coordination (include administration, management, evaluation, and travel support for exchanges and visitors programs)		
Total		

For each entry in the Table, include indirect costs. Column totals should equal the total budget requested from NSF for the period shown. Include major capital equipment, infrastructure development, and shared facilities under the most appropriate category (Research, Education, or Coordination). Support for graduate students should normally be included under research, with the understanding that they will be engaged in other aspects as well as part of their professional development. Support for graduate students and/or postdoctoral researchers may be included under education, if education and workforce development activities are part of their research focus.

C. Due Dates

- **Letter of Intent Due Date(s) (required)** (due by 5 p.m. submitting organization's local time):
February 07, 2025
- **Preliminary Proposal Due Date(s) (required)** (due by 5 p.m. submitting organization's local time):
March 07, 2025
- **Full Proposal Deadline(s)** (due by 5 p.m. submitting organization's local time):
September 17, 2025
By invitation only

D. Research.gov/Grants.gov Requirements

For Proposals Submitted Via Research.gov:

To prepare and submit a proposal via Research.gov, see detailed technical instructions available at: https://www.research.gov/research-portal/appmanager/base/desktop?_nfpb=true&_pageLabel=research_node_display&_nodePath=/researchGov/Service/Desktop/ProposalPreparation
For Research.gov user support, call the Research.gov Help Desk at 1-800-381-1532 or e-mail rgov@nsf.gov. The Research.gov Help Desk answers general technical questions related to the use of the Research.gov system. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this funding opportunity.

For Proposals Submitted Via Grants.gov:

Before using Grants.gov for the first time, each organization must register to create an institutional profile. Once registered, the applicant's organization can then apply for any federal grant on the Grants.gov website. Comprehensive information about using Grants.gov is available on the Grants.gov Applicant Resources web page: <https://www.grants.gov/applicants>. In addition, the NSF Grants.gov Application Guide (see link in Section V.A) provides instructions regarding the technical preparation of proposals via Grants.gov. For Grants.gov user support, contact the Grants.gov Contact Center at 1-800-518-4726 or by email: support@grants.gov. The Grants.gov Contact Center answers general technical questions related to the use of Grants.gov. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this solicitation.

Submitting the Proposal: Once all documents have been completed, the Authorized Organizational Representative (AOR) must submit the application to Grants.gov and verify the desired funding opportunity and agency to which the application is submitted. The AOR must then sign and submit the application to Grants.gov. The completed application will be transferred to Research.gov for further processing.

The NSF [Grants.gov Proposal Processing in Research.gov informational page](#) provides submission guidance to applicants and links to helpful resources including the NSF [Grants.gov Application Guide](#), [Grants.gov Proposal Processing in Research.gov how-to guide](#), and [Grants.gov Submitted Proposals Frequently Asked Questions](#). Grants.gov proposals must pass all NSF pre-check and post-check validations in order to be accepted by Research.gov at NSF.

When submitting via Grants.gov, NSF strongly recommends applicants initiate proposal submission at least five business days in advance of a deadline to allow adequate time to address NSF compliance errors and resubmissions by 5:00 p.m. submitting organization's local time on the deadline. Please note that some errors cannot be corrected in Grants.gov. Once a proposal passes pre-checks but fails any post-check, an applicant can only correct and submit the in-progress proposal in Research.gov.

Proposers that submitted via Research.gov may use Research.gov to verify the status of their submission to NSF. For proposers that submitted via Grants.gov, until an application has been received and validated by NSF, the Authorized Organizational Representative may check the status of an application on Grants.gov. After proposers have received an e-mail notification from NSF, Research.gov should be used to check the status of an application.

VI. NSF Proposal Processing And Review Procedures

Proposals received by NSF are assigned to the appropriate NSF program for acknowledgment and, if they meet NSF requirements, for review. All proposals are carefully reviewed by a scientist, engineer, or educator serving as an NSF Program Officer, and usually by three to ten other persons outside NSF either as *ad hoc* reviewers, panelists, or both, who are experts in the particular fields represented by the proposal. These reviewers are selected by Program Officers charged with oversight of the review process. Proposers are invited to suggest names of persons they believe are especially well qualified to review the proposal and/or persons they would prefer not review the proposal. These suggestions may serve as one source in the reviewer selection process at the Program Officer's discretion. Submission of such names, however, is optional. Care is taken to ensure that reviewers have no conflicts of interest with the proposal. In addition, Program Officers may obtain comments from site visits before recommending final action on proposals. Senior NSF staff further review recommendations for awards. A flowchart that depicts the entire NSF proposal and award process (and associated timeline) is included in PAPPG Exhibit III-1.

A comprehensive description of the Foundation's merit review process is available on the NSF website at: https://www.nsf.gov/bfa/dias/policy/merit_review/.

Proposers should also be aware of core strategies that are essential to the fulfillment of NSF's mission, as articulated in *Leading the World in Discovery and Innovation, STEM Talent Development and the Delivery of Benefits from Research - NSF Strategic Plan for Fiscal Years (FY) 2022 - 2026*. These strategies are integrated in the program planning and implementation process, of which proposal review is one part. NSF's mission is particularly well-implemented through the integration of research and education and broadening participation in NSF programs, projects, and activities.

One of the strategic objectives in support of NSF's mission is to foster integration of research and education through the programs, projects, and activities it supports at academic and research institutions. These institutions must recruit, train, and prepare a diverse STEM workforce to advance the frontiers of science and participate in the U.S. technology-based economy. NSF's contribution to the national innovation ecosystem is to provide cutting-edge research under the guidance of the Nation's most creative scientists and engineers. NSF also supports development of a strong science, technology, engineering, and mathematics (STEM) workforce by investing in building the knowledge that informs improvements in STEM teaching and learning.

NSF's mission calls for the broadening of opportunities and expanding participation of groups, institutions, and geographic regions that are underrepresented in STEM disciplines, which is essential to the health and vitality of science and engineering. NSF is committed to this principle of diversity and deems it central to the programs, projects, and activities it considers and supports.

A. Merit Review Principles and Criteria

The National Science Foundation strives to invest in a robust and diverse portfolio of projects that creates new knowledge and enables breakthroughs in understanding across all areas of science and engineering research and education. To identify which projects to support, NSF relies on a merit review process that incorporates consideration of both the technical aspects of a proposed project and its potential to contribute more broadly to advancing NSF's mission "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense; and for other purposes." NSF makes every effort to conduct a fair, competitive, transparent merit review process for the selection of projects.

1. Merit Review Principles

These principles are to be given due diligence by PIs and organizations when preparing proposals and managing projects, by reviewers when reading and evaluating proposals, and by NSF program staff when determining whether or not to

recommend proposals for funding and while overseeing awards. Given that NSF is the primary federal agency charged with nurturing and supporting excellence in basic research and education, the following three principles apply:

- All NSF projects should be of the highest quality and have the potential to advance, if not transform, the frontiers of knowledge.
- NSF projects, in the aggregate, should contribute more broadly to achieving societal goals. These "Broader Impacts" may be accomplished through the research itself, through activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to, the project. The project activities may be based on previously established and/or innovative methods and approaches, but in either case must be well justified.
- Meaningful assessment and evaluation of NSF funded projects should be based on appropriate metrics, keeping in mind the likely correlation between the effect of broader impacts and the resources provided to implement projects. If the size of the activity is limited, evaluation of that activity in isolation is not likely to be meaningful. Thus, assessing the effectiveness of these activities may best be done at a higher, more aggregated, level than the individual project.

With respect to the third principle, even if assessment of Broader Impacts outcomes for particular projects is done at an aggregated level, PIs are expected to be accountable for carrying out the activities described in the funded project. Thus, individual projects should include clearly stated goals, specific descriptions of the activities that the PI intends to do, and a plan in place to document the outputs of those activities.

These three merit review principles provide the basis for the merit review criteria, as well as a context within which the users of the criteria can better understand their intent.

2. Merit Review Criteria

All NSF proposals are evaluated through use of the two National Science Board approved merit review criteria. In some instances, however, NSF will employ additional criteria as required to highlight the specific objectives of certain programs and activities.

The two merit review criteria are listed below. **Both** criteria are to be given **full consideration** during the review and decision-making processes; each criterion is necessary but neither, by itself, is sufficient. Therefore, proposers must fully address both criteria. (PAPPG Chapter II.D.2.d(i). contains additional information for use by proposers in development of the Project Description section of the proposal). Reviewers are strongly encouraged to review the criteria, including PAPPG Chapter II.D.2.d(i), prior to the review of a proposal.

When evaluating NSF proposals, reviewers will be asked to consider what the proposers want to do, why they want to do it, how they plan to do it, how they will know if they succeed, and what benefits could accrue if the project is successful. These issues apply both to the technical aspects of the proposal and the way in which the project may make broader contributions. To that end, reviewers will be asked to evaluate all proposals against two criteria:

- **Intellectual Merit:** The Intellectual Merit criterion encompasses the potential to advance knowledge; and
- **Broader Impacts:** The Broader Impacts criterion encompasses the potential to benefit society and contribute to the achievement of specific, desired societal outcomes.

The following elements should be considered in the review for both criteria:

1. What is the potential for the proposed activity to
 - a. Advance knowledge and understanding within its own field or across different fields (Intellectual Merit); and
 - b. Benefit society or advance desired societal outcomes (Broader Impacts)?
2. To what extent do the proposed activities suggest and explore creative, original, or potentially transformative concepts?

3. Is the plan for carrying out the proposed activities well-reasoned, well-organized, and based on a sound rationale? Does the plan incorporate a mechanism to assess success?
4. How well qualified is the individual, team, or organization to conduct the proposed activities?
5. Are there adequate resources available to the PI (either at the home organization or through collaborations) to carry out the proposed activities?

Broader impacts may be accomplished through the research itself, through the activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to, the project. NSF values the advancement of scientific knowledge and activities that contribute to achievement of societally relevant outcomes. Such outcomes include, but are not limited to: full participation of women, persons with disabilities, and other underrepresented groups in science, technology, engineering, and mathematics (STEM); improved STEM education and educator development at any level; increased public scientific literacy and public engagement with science and technology; improved well-being of individuals in society; development of a diverse, globally competitive STEM workforce; increased partnerships between academia, industry, and others; improved national security; increased economic competitiveness of the United States; and enhanced infrastructure for research and education.

Proposers are reminded that reviewers will also be asked to review the Data Management and Sharing Plan and the Mentoring Plan, as appropriate.

Additional Solicitation Specific Review Criteria

Preliminary Proposals and Full Proposals should address the points listed below. Reviewers will be asked to assess each of these points.

- Vision: To what extent does the proposal present a compelling long-term vision to address a major challenge at the frontiers of QIST, and explain why an Institute is needed to address the challenge?
- Research: To what extent are the major research activities critical for addressing the challenge theme, supported by specific research goals that can advance the state-of-the-art of quantum information science and engineering in one or more frontiers within a 6-year period, and associated with corresponding evaluation mechanisms that are well-defined and actionable for measuring progress?
- Education and Workforce Development: To what extent are the proposed activities in education and workforce development meaningful, compelling, well-integrated with the Challenge Institute theme, and associated with corresponding evaluation mechanisms that are well-defined and actionable for measuring progress?
- Coordination: To what extent does the proposal present a convincing and meaningful plan to coordinate activities, both within the institute and the larger QIST community, to demonstrate value-added from an institute?
- Team: To what extent does the team make a compelling case for its readiness to operate a Challenge Institute, with cross-disciplinary expertise needed to lead all the proposed activities?
- Strategic Plan: To what extent does the plan provide a convincing road map for the operation of the Challenge Institute in pursuit of its vision? To what extent does the plan describe roles and responsibilities for Senior/Key personnel, strategies for course correction, and options for sustainability beyond the QLCI funding?

B. Review and Selection Process

Proposals submitted in response to this program solicitation will be reviewed by Ad hoc Review and/or Panel Review, or Reverse Site Review.

Proposals submitted in response to this program solicitation will be reviewed by panel review, ad hoc review and/or reverse site review.

Reviewers will be asked to evaluate proposals using two National Science Board approved merit review criteria and, if applicable, additional program specific criteria. A summary rating and accompanying narrative will generally be

completed and submitted by each reviewer and/or panel. The Program Officer assigned to manage the proposal's review will consider the advice of reviewers and will formulate a recommendation.

After scientific, technical and programmatic review and consideration of appropriate factors, the NSF Program Officer recommends to the cognizant Division Director whether the proposal should be declined or recommended for award. NSF strives to be able to tell proposers whether their proposals have been declined or recommended for funding within six months. Large or particularly complex proposals or proposals from new recipients may require additional review and processing time. The time interval begins on the deadline or target date, or receipt date, whichever is later. The interval ends when the Division Director acts upon the Program Officer's recommendation.

Projects under this this solicitation are subject to research security policies as outlined by the NSF Office of the Chief of Research Security Strategy and Policy (OCRSSP) regarding the [Trusted Research Using Safeguards and Transparency \(TRUST\)](#) framework. The evaluation under the TRUST framework will be separate from the merit review process. If necessary, NSF may contact the proposer for additional information to inform the risk evaluation and identify mitigation measures to address potential risks.

After programmatic approval has been obtained, the proposals recommended for funding will be forwarded to the Division of Grants and Agreements or the Division of Acquisition and Cooperative Support for review of business, financial, and policy implications. After an administrative review has occurred, Grants and Agreements Officers perform the processing and issuance of a grant or other agreement. Proposers are cautioned that only a Grants and Agreements Officer may make commitments, obligations or awards on behalf of NSF or authorize the expenditure of funds. No commitment on the part of NSF should be inferred from technical or budgetary discussions with a NSF Program Officer. A Principal Investigator or organization that makes financial or personnel commitments in the absence of a grant or cooperative agreement signed by the NSF Grants and Agreements Officer does so at their own risk.

Once an award or declination decision has been made, Principal Investigators are provided feedback about their proposals. In all cases, reviews are treated as confidential documents. Verbatim copies of reviews, excluding the names of the reviewers or any reviewer-identifying information, are sent to the Principal Investigator/Project Director by the Program Officer. In addition, the proposer will receive an explanation of the decision to award or decline funding.

VII. Award Administration Information

A. Notification of the Award

Notification of the award is made to *the submitting organization* by an NSF Grants and Agreements Officer. Organizations whose proposals are declined will be advised as promptly as possible by the cognizant NSF Program administering the program. Verbatim copies of reviews, not including the identity of the reviewer, will be provided automatically to the Principal Investigator. (See Section VI.B. for additional information on the review process.)

B. Award Conditions

An NSF award consists of: (1) the award notice, which includes any special provisions applicable to the award and any numbered amendments thereto; (2) the budget, which indicates the amounts, by categories of expense, on which NSF has based its support (or otherwise communicates any specific approvals or disapprovals of proposed expenditures); (3) the proposal referenced in the award notice; (4) the applicable award conditions, such as Grant General Conditions (GC-1)*; or Research Terms and Conditions* and (5) any announcement or other NSF issuance that may be incorporated by reference in the award notice. Cooperative agreements also are administered in accordance with NSF Cooperative Agreement Financial and Administrative Terms and Conditions (CA-FATC) and the applicable Programmatic Terms and Conditions. NSF awards are electronically signed by an NSF Grants and Agreements Officer and transmitted electronically to the organization via e-mail.

*These documents may be accessed electronically on NSF's Website at https://www.nsf.gov/awards/managing/award_conditions.jsp?org=NSF. Paper copies may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-8134 or by e-mail from nsfpubs@nsf.gov.

More comprehensive information on NSF Award Conditions and other important information on the administration of NSF awards is contained in the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG) Chapter VII, available electronically on the NSF Website at https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg.

Administrative and National Policy Requirements

Build America, Buy America

As expressed in Executive Order 14005, [Ensuring the Future is Made in All of America by All of America's Workers](#) (86 FR 7475), it is the policy of the executive branch to use terms and conditions of Federal financial assistance awards to maximize, consistent with law, the use of goods, products, and materials produced in, and services offered in, the United States.

Consistent with the requirements of the Build America, Buy America Act (Pub. L. 117-58, Division G, Title IX, Subtitle A, November 15, 2021), no funding made available through this funding opportunity may be obligated for infrastructure projects under an award unless all iron, steel, manufactured products, and construction materials used in the project are produced in the United States. For additional information, visit NSF's [Build America, Buy America](#) web page

Special Award Conditions:

In addition to annual reports, each Challenge Institute will be reviewed periodically through site visits to track progress, based on the goals of the QLCI program and based on the specific goals, objectives and milestones identified by the Challenge Institute team.

C. Reporting Requirements

For all multi-year grants (including both standard and continuing grants), the Principal Investigator must submit an annual project report to the cognizant Program Officer no later than 90 days prior to the end of the current budget period. (Some programs or awards require submission of more frequent project reports). No later than 120 days following expiration of a grant, the PI also is required to submit a final annual project report, and a project outcomes report for the general public.

Failure to provide the required annual or final annual project reports, or the project outcomes report, will delay NSF review and processing of any future funding increments as well as any pending proposals for all identified PIs and co-PIs on a given award. PIs should examine the formats of the required reports in advance to assure availability of required data.

PIs are required to use NSF's electronic project-reporting system, available through [Research.gov](#), for preparation and submission of annual and final annual project reports. Such reports provide information on accomplishments, project participants (individual and organizational), publications, and other specific products and impacts of the project. Submission of the report via [Research.gov](#) constitutes certification by the PI that the contents of the report are accurate and complete. The project outcomes report also must be prepared and submitted using [Research.gov](#). This report serves as a brief summary, prepared specifically for the public, of the nature and outcomes of the project. This report will be posted on the NSF website exactly as it is submitted by the PI.

More comprehensive information on NSF Reporting Requirements and other important information on the administration of NSF awards is contained in the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG) Chapter VII, available electronically on the NSF Website at https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg.

VIII. Agency Contacts

Please note that the program contact information is current at the time of publishing. See program website for any updates to the points of contact.

General inquiries regarding this program should be made to:

- QLCI Program Management Team, telephone: (703) 292-5302, email: QLCI@nsf.gov
- Peter S. Atherton, telephone: (703) 292-8772, email: patherto@nsf.gov
- Elizabeth Behrman, telephone: (703) 292-7049, email: ebhrman@nsf.gov
- Alexander Cronin, telephone: (703) 292-5302, email: acronin@nsf.gov
- Dominique M. Dagenais, telephone: (703) 292-2980, email: ddagenai@nsf.gov
- Tingyu Li, telephone: (703) 292-4949, email: tli@nsf.gov
- Rosa Lukaszew, telephone: (703) 292-8103, email: rlukasz@nsf.gov
- Matthew McCune, telephone: (703) 292-2906, email: mamccune@nsf.gov
- Bogdan Mihaila, telephone: (703) 292-8235, email: bmihaila@nsf.gov
- Engin Serpersu, telephone: (703) 292-7124, email: eserpers@nsf.gov

For questions related to the use of NSF systems contact:

- NSF Help Desk: 1-800-381-1532
- Research.gov Help Desk e-mail: rgov@nsf.gov

For questions relating to Grants.gov contact:

- Grants.gov Contact Center: If the Authorized Organizational Representatives (AOR) has not received a confirmation message from Grants.gov within 48 hours of submission of application, please contact via telephone: 1-800-518-4726; e-mail: support@grants.gov.

General inquiries regarding this program should be made to:

- Quantum Leap Challenge Institutes email: QLCI@nsf.gov

IX. Other Information

The NSF website provides the most comprehensive source of information on NSF Directorates (including contact information), programs and funding opportunities. Use of this website by potential proposers is strongly encouraged. In addition, "NSF Update" is an information-delivery system designed to keep potential proposers and other interested parties apprised of new NSF funding opportunities and publications, important changes in proposal and award policies and procedures, and upcoming NSF [Grants Conferences](#). Subscribers are informed through e-mail or the user's Web browser each time new publications are issued that match their identified interests. "NSF Update" also is available on [NSF's website](#).

Grants.gov provides an additional electronic capability to search for Federal government-wide grant opportunities. NSF funding opportunities may be accessed via this mechanism. Further information on Grants.gov may be obtained at <https://www.grants.gov>.

About The National Science Foundation

The National Science Foundation (NSF) is an independent Federal agency created by the National Science Foundation Act of 1950, as amended (42 USC 1861-75). The Act states the purpose of the NSF is "to promote the progress of science; [and] to advance the national health, prosperity, and welfare by supporting research and education in all fields of science and engineering."

NSF funds research and education in most fields of science and engineering. It does this through grants and cooperative agreements to more than 2,000 colleges, universities, K-12 school systems, businesses, informal science organizations and other research organizations throughout the US. The Foundation accounts for about one-fourth of Federal support to academic institutions for basic research.

NSF receives approximately 55,000 proposals each year for research, education and training projects, of which approximately 11,000 are funded. In addition, the Foundation receives several thousand applications for graduate and postdoctoral fellowships. The agency operates no laboratories itself but does support National Research Centers, user facilities, certain oceanographic vessels and Arctic and Antarctic research stations. The Foundation also supports cooperative research between universities and industry, US participation in international scientific and engineering efforts, and educational activities at every academic level.

Facilitation Awards for Scientists and Engineers with Disabilities (FASED) provide funding for special assistance or equipment to enable persons with disabilities to work on NSF-supported projects. See the *NSF Proposal & Award Policies & Procedures Guide* Chapter II.F.7 for instructions regarding preparation of these types of proposals.

The National Science Foundation has Telephonic Device for the Deaf (TDD) and Federal Information Relay Service (FIRS) capabilities that enable individuals with hearing impairments to communicate with the Foundation about NSF programs, employment or general information. TDD may be accessed at (703) 292-5090 and (800) 281-8749, FIRS at (800) 877-8339.

The National Science Foundation Information Center may be reached at (703) 292-5111.

The National Science Foundation promotes and advances scientific progress in the United States by competitively awarding grants and cooperative agreements for research and education in the sciences, mathematics, and engineering.

To get the latest information about program deadlines, to download copies of NSF publications, and to access abstracts of awards, visit the NSF Website at <https://www.nsf.gov>

- **Location:** 2415 Eisenhower Avenue, Alexandria, VA 22314
- **For General Information** (NSF Information Center): (703) 292-5111
- **TDD (for the hearing-impaired):** (703) 292-5090
- **To Order Publications or Forms:**
 - Send an e-mail to: nsfpubs@nsf.gov
 - or telephone: (703) 292-8134
- **To Locate NSF Employees:** (703) 292-5111

Privacy Act And Public Burden Statements

The information requested on proposal forms and project reports is solicited under the authority of the National Science Foundation Act of 1950, as amended. The information on proposal forms will be used in connection with the selection of qualified proposals; and project reports submitted by proposers will be used for program evaluation and reporting within the Executive Branch and to Congress. The information requested may be disclosed to qualified reviewers and staff assistants as part of the proposal review process; to proposer institutions/grantees to provide or obtain data regarding the proposal review process, award decisions, or the administration of awards; to government contractors, experts, volunteers and researchers and educators as necessary to complete assigned work; to other government agencies or other entities needing information regarding proposers or nominees as part of a joint application review process, or in order to coordinate programs or policy; and to another Federal agency, court, or party in a court or Federal administrative proceeding if the government is a party. Information about Principal Investigators may be added to the Reviewer file and used to select potential candidates to serve as peer reviewers or advisory committee members. See [System of Record Notices, NSF-50](#), "Principal Investigator/Proposal File and Associated Records," and [NSF-51](#), "Reviewer/Proposal File and

Associated Records." Submission of the information is voluntary. Failure to provide full and complete information, however, may reduce the possibility of receiving an award.

An agency may not conduct or sponsor, and a person is not required to respond to, an information collection unless it displays a valid Office of Management and Budget (OMB) control number. The OMB control number for this collection is 3145-0058. Public reporting burden for this collection of information is estimated to average 120 hours per response, including the time for reviewing instructions. Send comments regarding the burden estimate and any other aspect of this collection of information, including suggestions for reducing this burden, to:

Suzanne H. Plimpton
Reports Clearance Officer
Policy Office, Division of Institution and Award Support
Office of Budget, Finance, and Award Management
National Science Foundation
Alexandria, VA 22314

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[Plain language](#) |



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