

Spectrum Innovation Initiative: National Center for Wireless Spectrum Research (SII-Center)

PROGRAM SOLICITATION NSF 20-557



National Science Foundation

Directorate for Biological Sciences
Division of Biological Infrastructure

Directorate for Computer and Information Science and Engineering
Division of Computer and Network Systems

Directorate for Education and Human Resources

Directorate for Engineering
Division of Electrical, Communications and Cyber Systems

Directorate for Geosciences
Division of Atmospheric and Geospace Sciences
Office of Polar Programs

Directorate for Mathematical and Physical Sciences
Division of Astronomical Sciences

Directorate for Social, Behavioral and Economic Sciences

SII-Center Planning Grant Proposals*

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

June 12, 2020

* Submission of an SII-Center Planning Grant Proposal is not required to submit an SII-Center Proposal

SII-Center Proposals

- Letter of Intent (required, due by 5 p.m. submitter's local time):

February 01, 2021

- Full Proposal Submission Window

March 01, 2021 - April 01, 2021

The submission window opens on March 1, 2021 and closes at 5 p.m. submitter's local time on April 1, 2021. A Letter of Intent (due by 5 p.m. submitter's local time on February 1, 2021) is a required prerequisite for SII-Center Proposals. SII-Center Proposal submission window dates are subject to revision.

Submission of an SII-Center Planning Grant Proposal is not required to submit an SII-Center Proposal. A Letter of Intent is a required prerequisite for SII-Center Proposals. SII-Center Proposal submission window dates are subject to revision.

IMPORTANT INFORMATION AND REVISION NOTES

Any proposal submitted in response to this solicitation should be submitted in accordance with the revised *NSF Proposal & Award Policies & Procedures Guide* (PAPPG) ([NSF 20-1](#)), which is effective for proposals submitted, or due, on or after June 1, 2020.

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

Synopsis of Program:

The worldwide growth of wireless communication, navigation, and telemetry has provided immense societal benefits including mobile broadband data, Internet of Things (IoT), mobile healthcare, and intelligent transportation systems. These and other applications including 5G and beyond wireless systems call for innovations that can circumvent the challenges of radio spectrum scarcity and interference and foster the growth of ubiquitous, high speed, low latency connectivity. Commercial applications like the above must operate in harmony with scientific uses such as research on radio astronomy, Earth and atmospheric sciences, and must not inhibit weather prediction, polar research, and other nationally vital activities, all of which are dependent upon access to the radio spectrum. The National Science Foundation (NSF) continues to support wireless spectrum research and the scientific uses of the electromagnetic spectrum through multiple programs that enable fast, accurate, dynamic coordination and usage of our limited spectrum resource. These programs have created an opportune ground to build and create a large center-based ecosystem for spectrum research, which is the target of this SII-Center program.

The focus of a spectrum research SII-Center must go beyond 5G, IoT, and other existing or forthcoming systems and technologies and chart out a trajectory to ensure United States leadership in future wireless technologies, systems, and applications in science and engineering through the efficient use and sharing of the radio spectrum. The SII-Center should also seek to foster scientific and technical collaboration and grow the spectrum workforce. The establishment of an SII-Center will have a transformational impact on wireless spectrum research by serving as a connecting point for the biggest and most challenging questions in spectrum management that the nation is facing.

SELECTED LIST OF ACRONYMS

AI	Artificial Intelligence
EARS	Enhancing Access to the Radio Spectrum
EM	Electromagnetic
FCC	Federal Communications Commission
IoT	Internet of Things
IWG	Interagency Working Group
ML	Machine Learning
NITRD	Networking and Information Technology Research and Development Program
NSF	National Science Foundation
PAPPG	NSF Proposal and Award Policies and Procedures Guide
PAWR	Platform for Advanced Wireless Research
RAS	Radio Astronomy Service
RF	Radio Frequency
RR	Radio Regulations
SII	Spectrum Innovation Initiative
SpecEES	Spectrum Efficiency, Energy Efficiency, and Security
SWIFT	Spectrum and Wireless Innovation enabled by Future Technologies
WRC	World Radiocommunications Conference
WSRD	Wireless Spectrum Research and Development

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.

- Bevin A. Zauderer, MPS/AST, telephone: (703) 292-2428, email: SII-Center@nsf.gov
- Mohammod Ali, ENG/ECCS, telephone: (703) 292-4632, email: SII-Center@nsf.gov
- Alexander Sprintson, CISE/CNS, telephone: (703) 292-8950, email: SII-Center@nsf.gov
- Lisa M. Winter, GEO/AGS, telephone: (703) 292-8519, email: SII-Center@nsf.gov
- Jonathan V. Williams, MPS/AST, telephone: (703) 292-2455, email: SII-Center@nsf.gov

Applicable Catalog of Federal Domestic Assistance (CFDA) Number(s):

- 47.041 --- Engineering
- 47.049 --- Mathematical and Physical Sciences
- 47.050 --- Geosciences
- 47.070 --- Computer and Information Science and Engineering
- 47.074 --- Biological Sciences
- 47.075 --- Social Behavioral and Economic Sciences
- 47.076 --- Education and Human Resources

Award Information

Anticipated Type of Award: Standard Grant or Cooperative Agreement

Estimated Number of Awards: 13 to 16

SII-Center Planning Grant Awards:

Approximately 12-15 awards will be made in FY 2020, depending on the availability of funds and the quality of proposals received.

SII-Center Award:

One award will be made in FY 2021, depending on the availability of funds and the quality of proposals received.

Anticipated Funding Amount: \$30,000,000

SII-Center Planning Grant Awards:

Award amount is up to \$300,000 per award for up to one year. SII-Center Planning Grant awards will be made as Standard Grants.

SII-Center Award:

Funding anticipated for the SII-Center award is up to \$5,000,000 per year for five years. The award is potentially renewable for an additional 5-years, depending on performance and the availability of funds. The SII-Center award will be made through a Cooperative Agreement.

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 subawards 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.
- Non-profit, non-academic organizations: Independent museums, observatories, research labs, professional societies and similar organizations in the U.S. associated with educational or research activities.

Who May Serve as PI:

The PI must be a full-time faculty member or staff member at an institution of higher education, or a member of a non-profit, non-academic organization, and have an established record of leading research teams.

Limit on Number of Proposals per Organization:

There are no restrictions or limits.

Limit on Number of Proposals per PI or Co-PI:

SII-Center Planning Grant Proposals: An individual may serve as PI, co-PI, or other senior personnel on no more than two SII-Center Planning Grant proposals. In cases where an individual appears as senior personnel in more than two planning proposals, only the first two submitted proposals will be accepted; all other planning grant proposals involving that individual will be returned without review.

SII-Center Proposals: An individual may serve as PI, co-PI, or other senior personnel on no more than one SII-Center proposal. In cases where an individual appears as senior personnel in more than one SII-Center proposal only the first submitted proposal will be accepted; all other SII-Center proposals involving that individual will be returned without review.

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 Proposal Submission:** Not required
- **Full Proposals:**
 - Full Proposals submitted via FastLane: *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

SII-Center Planning Grant Proposals*

- Full Proposal Deadline (due by 5 p.m. submitter's local time):
June 12, 2020
* Submission of an SII-Center Planning Grant Proposal is not required to submit an SII-Center Proposal

SII-Center Proposals

- Letter of Intent (required, due by 5 p.m. submitter's local time):
February 01, 2021
- Full Proposal Submission Window
March 01, 2021 - April 01, 2021

The submission window opens on March 1, 2021 and closes at 5 p.m. submitter's local time on April 1, 2021. A Letter of Intent (due by 5 p.m. submitter's local time on February 1, 2021) is a required prerequisite for SII-Center Proposals. SII-Center Proposal submission window dates are subject to revision.

Submission of an SII-Center Planning Grant Proposal is not required to submit an SII-Center Proposal. A Letter of Intent is a required prerequisite for SII-Center Proposals. SII-Center Proposal submission window dates are subject to revision.

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:

Additional reporting requirements apply. Please see the full text of this solicitation for further information.

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I. INTRODUCTION

The worldwide growth of wireless communication, navigation, and telemetry has provided immense societal benefits including mobile broadband data, Internet of Things (IoT), mobile healthcare, and intelligent transportation systems. These and other applications including 5G and beyond wireless systems call for innovations that can circumvent the challenges of radio spectrum scarcity and interference and foster the growth of ubiquitous, high speed, low latency connectivity. Active commercial applications like the above must operate in harmony with scientific uses of the spectrum such as research on radio astronomy, Earth and atmospheric sciences, and must not inhibit weather prediction, polar research, and other nationally vital activities. The National Science Foundation (NSF) continues to support wireless spectrum research and the scientific uses of the electromagnetic spectrum through multiple programs that enable fast, accurate, dynamic coordination and usage of our limited spectrum resource. These programs have created an opportune ground to build and create a large center-based ecosystem for electromagnetic spectrum research, which is the target of this SII-Center program.

The focus of the SII-Center must go beyond the efforts of current and past individual NSF programs (such as SWIFT1, PAWR23, and EARS). The goal of this program is to chart out a trajectory to ensure United States leadership in future wireless technologies, systems, and applications in science and engineering through the efficient use and sharing of the radio spectrum. A key expectation is establishing harmony between scientific uses of the electromagnetic spectrum with technological advances for high-speed, low latency, secure connectivity among pervasive devices, autonomous vehicles, and numerous other platforms.

The SII-Center will serve as a focal point for sustained spectrum research in the most challenging areas that are expected to create advanced wireless technologies and systems that benefit society, of which 5G and future cellular networks are an example. The SII-Center is also expected to educate and develop an agile workforce needed to support industries of the future which will rely heavily on wireless technologies and will require new advanced and automated spectrum management techniques. NSF's goal is to promote transformative use and management of the electromagnetic spectrum, with resulting profound benefits for science and engineering, industry, and other national interests.

The successful SII-Center is expected to develop partnerships or arrangements with other universities, colleges, or other institutions, such as national laboratories, private sector research laboratories, federal, state and local government laboratories, and international organizations as appropriate to enable the SII-Center to attain its strategic goals. The SII-Center is expected to make a transformational impact on spectrum research through this community of researchers, by serving as a connecting point for the biggest and most challenging questions in wireless spectrum and spectrum access that the nation faces.

The SII-Center must address pertinent questions relevant to spectrum research, innovation, and workforce development as described in national-level documents, such as the *Presidential Memorandum on Developing a Sustainable Spectrum Strategy for America's Future* and the *interagency response led by the National Science and Technology Council's Wireless Spectrum Research & Development Interagency Working Group (WSRD), Research and Development Priorities for American Leadership in Wireless Communications*⁶.

Two types of proposals are solicited under this program:

- **SII-Center Planning Grant Proposals** - 12-month Planning Grant proposals to develop networking and collaborations among potential partners to conduct research addressing spectrum-related open questions. Such proposals should foster partnerships across academia, industry, government, and non-profits, and describe the initial organizational structure of a future successful SII-Center; and
- **SII-Center Proposals** - 5-year Center proposals that leverage partnerships across a wide-array of stakeholders to act as a national resource addressing far-reaching spectrum research, innovation, and workforce development challenges.

[1] Spectrum and Wireless Innovation enabled by Future Technologies (SWIFT), https://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf20537

[2] Platforms for Advanced Wireless Research, see <https://advancedwireless.org/>

[3] Spectrum Efficiency, Energy Efficiency, and Security (SpecEES): Enabling Spectrum for All, (NSF 19-529)

[4] Enhancing Access to the Radio Spectrum (EARS), (NSF 16-537)

[5] <https://www.ntia.doc.gov/category/national-spectrum-strategy>

[6] <https://www.whitehouse.gov/wp-content/uploads/2019/05/Research-and-Development-Priorities-for-American-Leadership-in-Wireless-Communications-Report-May-2019.pdf>

II. PROGRAM DESCRIPTION

The SII-Center should be comprised of multidisciplinary groups of scientists and engineers united by a common vision that addresses basic research challenges that face the wireless spectrum research community including commercial applications and scientific enterprises such as radio astronomy and atmospheric sciences. An SII-Center is also expected to educate and develop a spectrum-aware technical workforce by exposing trainees to open questions and challenges in wireless spectrum research in collaboration with national laboratories, industry and international partners.

A. Center Scope

The SII-Center is a multidisciplinary research endeavor that advances the frontiers of knowledge and practice in the access, use and measurement of the wireless spectrum. Research conducted at the SII-Center will span all areas of relevant radio spectrum bands. Example topics include, but are not limited to: (a) innovative methods for interference mitigation to allow dynamic sharing, especially with existing and future passive and active uses for scientific research and operations (e.g. Radio Astronomy Service (RAS), weather radar); (b) materials, devices, circuits, manufacturing and algorithmic innovations that will be needed for large scale deployments of low-cost pervasive systems and/or sensors. e.g., reconfigurable antennas, filters, amplifiers; RF and analog security; novel transceiver designs, medium-access and network protocols, wireless network architectures, signal and image processing approaches for fast, accurate analysis and decision making; (c) economic models and cognitive/behavioral models to enable better sharing of spectrum at different time-scales as well as over a variety of topographically diverse regions; (d) spectrum management; and (e) assessment of the cumulative electromagnetic (EM) noise floor.

The SII-Center envisioned by this program will bring together all the relevant stakeholders under one umbrella as a center of excellence, involving multiple areas of expertise working together (e.g. engineering, computer science, natural sciences including but not limited to astronomy and geosciences, economics, law and biology as appropriate) and in partnership with industry, non-profits, federal/state/local agencies, and international organizations.

A fully successful SII-Center should incorporate these aspects:

- o Formulate a coherent and clear research agenda addressing fundamental long-term spectrum research challenges.
- o Engage in cohesive, collaborative, and national-scale spectrum research and education.
- o Innovate in educational curricula and pedagogy reflecting the complexity of spectrum research and facilitate its replication by other institutions.
- o Elevate the visibility of spectrum management and research issues in the national discourse through well-planned outreach activities.
- o Involve an intellectually diverse community that includes all major stakeholders (government, industry, academic, and non-profit) in the pursuit of identified spectrum challenges.
- o Identify infrastructure needs and leverage widely accessible infrastructure for spectrum research, innovation and workforce development.

B. Major Activities

1. Research

The SII-Center proposal must focus on a coherent and clear research agenda that identifies the most significant knowledge gaps on wireless spectrum and related research challenges. Proposers are encouraged to review current and past NSF programs including SWIFT, PAWR, SpecEES, and EARS to understand the range of NSF-funded spectrum-related research initiatives. Additional information on spectrum-related topics is also available in the national discourse, e.g., Federal Communications Commission (FCC) proceedings, World Radio Conference (WRC) deliberations, and subsequent changes to the Radio Regulations (RR).

It is expected that the SII-Center proposal will address fundamental long-term spectrum research challenges by engaging a team of collaborating researchers from academia, industry, government labs, as well as federal and state agencies. The SII-Center must address research along multiple dimensions, e.g.,

- **Foundations:** Foundational spectrum research will focus on new methods and tools for interference mitigation, fast and accurate signal and image processing techniques, other communication theoretical approaches, medium-access and network protocols, innovative Machine Learning (ML) and/or Artificial Intelligence (AI) techniques tailored for efficient spectrum access and sharing, protection of passive users, the assessment of cumulative effects of electromagnetic (EM) exposure to humans, and socio-economic models.
- **Hardware:** Materials, devices, circuits, manufacturing, and algorithmic innovations that will be needed for large scale deployments of low-cost pervasive systems and/or sensors including reconfigurable and beam forming antennas, tunable filters, amplifiers etc., better control of undesired emissions, receiver technologies to enable tighter packing of applications, and fast, accurate and low-cost wideband RF sensing with high speed and low latency.
- **Networking; software and data:** This dimension focuses on software for managing the sensing data to allow robust and secure access to spectrum, as well as on developing software-defined wireless and network architectures that enable dynamic programmability across all layers of the network protocol stack. It also will focus on collecting and disseminating appropriately labeled datasets and semantic meta-data to help guide validation and assessment at-scale.
- **Security and privacy:** The spectrum research should address security and privacy considerations, and the tools and techniques for spectrum monitoring and enforcement.
- **Test and measurement:** The proposals should include a detailed plan for validation of theoretical models including new proposed designs or techniques. There currently exists a mismatch between theoretical evaluation and system performance in real-life scenarios, due for example to simplified assumptions in propagation models. The SII-Center should leverage existing theoretical models and experimentation platforms and develop new models and platforms as appropriate.
- **Spectrum Management:** Spectrum management encompasses several aspects, both technical and regulatory. Research in this dimension could address improvement in both areas.
- **Economic and social mechanisms:** Methods for allocating scarce spectrum resources across competing uses. Research in this dimension includes work in mechanism design, and may also address issues in regulatory policies.

Proposers should demonstrate a keen awareness of current spectrum issues, especially those raised at the 2019 World Radiocommunications Conference (WRC-19), and in the large array of FCC proceedings relevant to spectrum allocations over the last 5 years. The SII-Center should conduct activities to engage the community and coordinate research relevant to current questions, such as the items for study identified for the 2023 World Radiocommunications Conference (WRC-23). Proposers are encouraged to

consider the challenges and research dimensions identified in relevant reports of multiple workshops convened by the federal Networking and Information Technology Research and Development (NITRD) Program's Wireless Spectrum Research and Development (WSRD) Interagency Working Group (IWG), available at <<https://go.usa.gov/xRV8Q>>.

2. Education, Public Outreach and Workforce Development

Sustained progress, rapid development and real-world deployments of novel technologies and policies that enhance spectrum utilization requires a skilled workforce. The demands on the workforce in spectrum management and wireless technologies are challenging, requiring an interdisciplinary skill set encompassing knowledge on the fundamentals of electromagnetic principles, RF design, wireless communications, signal and image processing, protocols, and the changing regulatory landscape to name a few. Along with research, innovation, and collaboration, a key goal of this program will be the creation of education, training, and workforce development programs as an integral part of the SII-Center. Proposers should present plans to develop innovative educational curricula and pedagogy reflecting the complexity of spectrum research and facilitate its replication by other institutions.

3. Research Coordination and Community Engagement

The SII-Center should serve as a significant national resource for spectrum-related issues and a key hub for community engagement. The activities of the SII-Center should promote organizational collaborations and linkages within and between academic campuses, schools, federal agencies, industry, and other relevant organizations to advance spectrum-related research, education, and knowledge transfer activities through a network of partners and affiliates. Links to other NSF investments are especially encouraged, including for example NSF's National Center for Atmospheric Research (NCAR), NSF's National Radio Astronomy Observatory (NRAO), and PAWR. A successful SII-Center may also include new infrastructure development, including hardware, software, computing resources, etc. which can be used by the larger community. The SII-Center should also work collaboratively to leverage widely accessible infrastructure for spectrum research, innovation and workforce development.

C. Proposal Types

Two types of proposals are solicited under this program:

SII-Center Planning Grant Proposals - Planning Grant proposals to enable networking and develop collaborations among potential partners, in pursuit of the creation of a larger well-organized team that can submit a SII-Center proposal. The program will support planning grants for durations of up to one year, up to \$300,000 each. It is anticipated that such planning activities might include workshops designed to enhance collaboration, further development of partnerships, preliminary research and analysis, and engagement of stakeholders most appropriate for the SII-Center vision. These activities may also include exploratory collaborative research needed to demonstrate a basis of confidence for new convergent approaches central to the SII-Center vision.

Planning Grant proposals are expected to demonstrate a clear plan and potential to develop a research vision and team for a SII-Center proposal. Successful Planning Grant proposals will reflect concrete plans for development of integrative and multidisciplinary research teams and meaningful stakeholder engagement. Proposals must present a clear strategy for a successful research, education and workforce development agenda.

At least one PI or a Co-PI is required to attend a two-day awardee workshop to be held in Fall 2020 during the duration of the award, the intent of which is to encourage the sharing of ideas for further work.

SII-Center Proposals – The program will consider proposals for an award made through a cooperative agreement, of up to \$25M in total, over a five-year period. SII-Center proposals must convey clear and concrete plans for foundational spectrum research, use-inspired motivation and technology transition opportunities, the education and workforce development activities to be undertaken, and plans for multidisciplinary research and community-building appropriate to the proposed SII-Center's vision and mission. Subject to the SII-Center satisfactorily meeting its objectives and goals, as well as the availability of funds, a potential renewal for a similar amount and period may be considered at the end of the initial award period.

Letters of Intent are required only for SII-Center proposals. Letters of Intent help NSF identify potential reviewers for the SII-Center proposals. No feedback will be given on the Letters of Intent submissions. An SII-Center Planning Grant proposal or award is not a requirement to submit an SII-Center proposal.

D. Webinar Information

NSF will hold an informational webinar in April 2020 for SII-Center Planning Grant Proposals. NSF may also choose to conduct additional webinars in the period preceding the SII-Center proposal submission window in Spring 2021. Additional information about the webinar will be announced on the program page.

III. AWARD INFORMATION

This solicitation supports two types of awards:

- i. Multiple SII-Center Planning Grant awards funded at a level of up to \$300,000 for up to 12 months.
- ii. One SII-Center award funded at a level of up to \$5,000,000/year for 5 years.

The budget should be commensurate with the scope of work and complexity of the proposal.

This solicitation offers the opportunity for a one-year SII-Center Planning Grant, recognizing the challenges of establishing a national SII-Center. The SII-Center Planning Grants are aimed at facilitating the formation of appropriate teams with representation from multiple stakeholders to prepare a compelling and comprehensive SII-Center proposal. Submission of an SII-Center Planning Grant Proposal is not required in order to submit an SII-Center Proposal.

Support for each year of the cooperative agreement of a funded SII-Center will be contingent upon a satisfactory annual review by NSF of the SII-Center's progress and future plans, with an emphasis on the quality of the research, collaborative and networking activities, and workforce development

including broadening participation.

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 subawards 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.
- Non-profit, non-academic organizations: Independent museums, observatories, research labs, professional societies and similar organizations in the U.S. associated with educational or research activities.

Who May Serve as PI:

The PI must be a full-time faculty member or staff member at an institution of higher education, or a member of a non-profit, non-academic organization, and have an established record of leading research teams.

Limit on Number of Proposals per Organization:

There are no restrictions or limits.

Limit on Number of Proposals per PI or Co-PI:

SII-Center Planning Grant Proposals: An individual may serve as PI, co-PI, or other senior personnel on no more than two SII-Center Planning Grant proposals. In cases where an individual appears as senior personnel in more than two planning proposals, only the first two submitted proposals will be accepted; all other planning grant proposals involving that individual will be returned without review.

SII-Center Proposals: An individual may serve as PI, co-PI, or other senior personnel on no more than one SII-Center proposal. In cases where an individual appears as senior personnel in more than one SII-Center proposal only the first submitted proposal will be accepted; all other SII-Center proposals involving that individual will be returned without review.

Additional Eligibility Info:

Support for non-lead collaborating organizations should be requested as subawards. Separately submitted collaborative proposals are not allowed. Subawardee institutions are subject to the same eligibility restrictions as those noted above.

Synergistic collaborations or partnerships with industry or non-NSF government labs are encouraged where appropriate. Such partnerships are beneficial for their potential to enable technology and knowledge transfer, reduce duplication of effort, and improve efficiency of resource use. These partners may not receive NSF support.

Researchers from foreign academic institutions who contribute essential expertise to the project may participate as senior personnel or collaborators but may not receive NSF support.

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

Letters of Intent (required):

A one-page Letter of Intent is required for the SII-Center proposals. The letter should be submitted via FastLane, Research.gov, or Grants.gov no later than the date specified in this solicitation. The subject heading of the letter should include a brief title of the proposal and the name of the lead institution. The Letter of Intent should include the following:

- Proposal title – Title must be preceded by the letters "SII-Center: ";
- Team – Names, departmental and organizational affiliation of all team members, including the Principal Investigator, co-Principal Investigators and other Senior Personnel; expertise of the Principal Investigator and at least two co-Principal Investigators.
- Synopsis – Brief description of the specific goals of the proposal.

Letters of Intent are required only for SII-Center proposals. Letters of Intent help NSF identify potential reviewers for the SII-Center proposals. No feedback will be given on the Letters of Intent submissions. An SII-Center Planning Grant proposal or award is not a requirement to submit an SII-Center proposal.

Letter of Intent Preparation Instructions:

When submitting a Letter of Intent through FastLane 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 0 and Maximum of 4 Other Senior Project Personnel are permitted
- A Minimum of 0 and Maximum of 25 Other Participating Organizations are permitted
- Proposal Title is required when submitting Letters of Intent
- Team is required when submitting Letters of Intent
- Synopsis is required when submitting Letters of Intent
- Submission of multiple Letters of Intent is not permitted

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

- Full proposals submitted via FastLane: Proposals submitted in response to this program solicitation should be prepared and submitted in accordance with the general guidelines contained in the *NSF Proposal & Award Policies & 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=papppg. 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. Proposers are reminded to identify this program solicitation number in the program solicitation block on the NSF Cover Sheet For Proposal to the National Science Foundation. Compliance with this requirement is critical to determining the relevant proposal processing guidelines. Failure to submit this information may delay processing.
- 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.C.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.

A. SII-Center Planning Grant Proposal Additional Preparation Instructions

1. **Cover Sheet:** For SII-Center Planning Grants, August 1, 2020 should be set as the start date. The title of the proposal must be preceded by the letters "SII Planning:".
2. **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 activities, including exploration of research theme areas, identification and coordination of research communities, training and workforce development initiatives and development of partnerships and infrastructure. (Limit: 1 page).
3. **Project Description:** Project Descriptions are limited to 15 pages in length. The page numbers listed (in parentheses) for the different sections are suggested guidelines; the actual page numbers for different sections may deviate from the guidelines, provided the total number of pages does not exceed 15 pages. In addition to the guidance in the PAPPG, the Project Description for a Planning Grant proposal must include the following clearly marked sections:

Overview: A clear description of the objectives and a summary of major activities in pursuit of the development of a compelling SII-Center proposal. (1 page).

Research Agenda and Team Selection: A discussion of the potential research areas to be explored in the Planning Grant project; names and affiliations for the team members and rationale for their selection for the project. (3 pages).

Research Coordination and Community Engagement: Identification of the various research communities to be engaged in the project. A description of the planned major activities to engage and coordinate relevant research communities in pursuit of the project goals. (3 pages).

Partnerships and Infrastructure: A description of the planned major activities to explore strategic and synergistic partnerships with industry, national labs and any international partners. A description of the planned major activities to identify and refine the infrastructure needs. (3 pages).

Education and Workforce Development: A description of the planned major activities for exploring and refining the scope of education, training and workforce development needs. (2 pages).

Readiness Milestones: A description of the milestones for the Planning Grant project to assess the readiness of the team for submitting a compelling SII-Center proposal. (1 page).

Prior Experience and Results: A description of the most relevant prior experience of the project team members, including results from prior NSF support. (2 pages).

4. **References Cited:** List only references cited in the Project Description.
5. **Budget and Budget Justification:** See the NSF PAPPG Chapter II.C.2.g (Budget and Budget Justification) for instructions on how to prepare these documents. Each SII-Center Planning Grant budget must include funding for at least one PI or co-PI to attend a two-day workshop in the Washington, D.C. area.
6. **Supplementary Documents:**

Management and Integration Plan (required): A Management and Integration Plan up to 2 pages in length is required for all SII-Center Planning Grant proposals. The Management and Integration Plan should: a) list all PIs, co-PIs and Senior Personnel on the project; b) describe how the group effort will be coordinated; c) describe how the disciplinary components will be integrated; and d) describe collaborations and partnerships and their integration with the project. Information must also be provided on who from the research team will be responsible for the execution of the tasks described in the Management and Integration Plan. A clear timeline of expected outcomes or milestones should be included. Proposals lacking the Management and Integration Plan may be returned without review.

Documentation of Collaborative Arrangements. The Project Description must fully detail any substantial collaborations and engagements with partner organizations. Letters confirming these arrangements may be provided in the Supplementary Documents section of the proposal.

Data Management Plan (required): All proposals must include a Data Management 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 the NSF PAPPG.

Postdoctoral Mentoring Plan: One-page document describing the postdoctoral mentoring plan is required if funding for postdoctoral researchers is included.

List of Project Personnel and Partner Organizations (required): Provide current, accurate information for all personnel and organizations involved in the project. NSF staff will use this information in the merit review process to manage reviewer selection. The list must include all **Personnel:** PIs, co-PIs, Senior Personnel, paid/unpaid Consultants or Collaborators, Subawardees, and Postdocs. This list should be numbered and include (in this order) Full name, Organization(s), and Role in the project, with each item separated by a semi-colon. Each person listed should start a new numbered line.

Proposals containing items other than those described above will be returned without review. Proposals submitted without the required Supplementary Documents will be returned without review (Management and Integration Plan, Data Management Plan, List of Project Personnel and Partner Organizations). Letters of Collaboration are not required. A Postdoctoral Mentoring Plan is required if postdoctoral fellows will be included in the project.

B. SII-Center Proposal Additional Preparation Instructions

The Project Description must contain, as a separate section of less than a page, a section labeled "Addressing SII-Center Solicitation Specific Review Criteria". This section should provide a description of how the SII-Center solicitation specific review criteria are addressed in the proposal and include references to other relevant sections in the proposal for additional details.

As a multi-organization activity, the proposal must be submitted as a single, integrated proposal by the lead organization, with proposed subawards to the other partner organizations. Linked collaborative proposals from multiple organizations will be returned without review.

1. **Cover Sheet:** The title of the proposal must be preceded by the letters "SII-Center: ", and should describe the project in concise, informative language that is understandable to a technically literate reader.
2. **Project Summary (1-page limit):** 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. It should include an overview of the SII-Center description and rationale, its research objectives, education and workforce development activities, and community building activities.
3. **Project Description:** The Project Description must include Sections (3.a) through (3.f) described below and cannot exceed 25 pages including tables and illustrations for SII-Center proposals. In addition to the guidance in the PAPPG, the Project Description for a SII-Center proposal must include the following clearly marked sections:

3a. Overview and Rationale for Center Approach: Provide a description of the challenge that engendered the proposal and the importance of specific aspects of this challenge that you aspire to solve. Include timeliness of addressing this problem. Discuss why the SII-Center program is particularly suited to support this effort. Discuss the long-term strategic goals and potential impact of an SII-Center.

3b. Description of the Research Plan of the Center: State the overall vision and long-range research goals of the SII-Center. Describe the proposed research areas, how this plan both advances foundational research and leverages use-inspired research, and how these efforts will be integrated in service of the SII-Center's research vision. Provide a five-year timeline for the implementation activities. Indicate the specific role of each partner organization or participant in each area. The research plan should provide sufficient detail to allow assessment of the scientific merit and to justify the necessity for the proposed mode of operation. Explain how the proposed research relates to other state and national research capabilities (including related centers, institutes, testbeds, facilities and national laboratories) as well as international programs in the proposed fields of research. If the SII-Center plans include the development of shared research facilities, describe plans to build, manage and sustain such facilities.

3c. Education and Workforce Development: With the goal of advancing spectrum knowledge and education, present plans to actively build the next generation of talent for a diverse well-trained workforce through new and innovative approaches to education and workforce development. Participants may include undergraduate and graduate students, community college and post-doctoral researchers, skilled technical workforce, high-school students as well as professionals looking to shift career focus. Describe plans for the mentoring and professional development of participants involved in SII-Center activities. Describe how the SII-Center will integrate research and education. Describe all proposed activities in sufficient detail to allow assessment of their intrinsic merit, potential effectiveness, and their anticipated contribution toward a highly competent new generation workforce. Plans may also include mechanisms to engage participants in informal settings (e.g., museums, nature centers, libraries; TV/film; crowdsourcing and citizen science; on-line experiences).

3d. Broadening Participation Plans: Describe the broadening participation objectives and outline evidence-based strategies for achieving them, based on relevant literature. Describe plans for increasing diversity through the participation of underrepresented groups, including women, minorities, and persons with disabilities, in all organizational levels of SII-Center activities, and cite the relevant literature on effective practices. This could, for example, intentionally target specific combinations of groups (e.g., by race/ethnicity, gender and/or disability) with an analysis of how SII-Center activities impact their participation in the spectrum workforce. Describe the contribution/role of partner organizations in the broadening participation plans. Describe plans, if appropriate, for partnerships with minority-serving institutions, women's colleges, and organizations that primarily serve persons with disabilities. Explain why these organizations were selected and what they will contribute to the project. Indicate the role of students and faculty from these organizations and how they will be fully integrated and engaged into SII-Center activities. Explain how progress will be measured and how strategies will be adapted, if necessary. Describe the proposed activities in sufficient detail to allow assessment of their intrinsic merit and potential effectiveness.

3e. Collaboration and Knowledge Transfer: Describe how the SII-Center will be a nexus point for collaborative efforts, including plans to link organizations, people, ideas, problems, and technical approaches for maximum impact. Present plans to integrate partner organizations and participants into a diverse SII-Center that is more than just the sum of its parts. Include here plans to effect knowledge transfer. Knowledge transfer involves the exchange of scientific and technical information between the SII-Center and external non-academic stakeholders (such as industrial partners) with the objective of applying that knowledge. State the specific goals for knowledge transfer and the expected impact of the activities. Linkages should involve significant intellectual exchange and could involve, for example, mechanisms such as internships or novel use of cyberinfrastructure to enhance connections.

3f. Key Personnel, Management and Integration Plan: Describe the multidisciplinary group of scientists, engineers and educators comprising

the SII-Center and their most relevant prior experience in conducting large-scale, long-term research agendas for the advancement of spectrum research and wireless innovation in application sectors of national importance, such as 5G. Describe the network of organizations comprising the SII-Center and their relationships to one another. Include a diagram to explain the organizational relationships and reporting structure among the key areas of responsibility. Identify key members of the SII-Center Management Team and explain their specific roles and areas of responsibility. Describe the relevant experience and qualifications of the lead PI, Managing Director/Project Manager (if different), and other key members of the management team to lead and manage a complex, multifaceted, and innovative enterprise that integrates research, education, broadening participation, and knowledge transfer. Describe the processes to be used to prioritize SII-Center activities; to select and integrate research projects with one another and with other SII-Center activities; to allocate funds and equipment across SII-Center activities and among partners; resolve conflict; and to select a replacement for key leaders if needed. An External Advisory Board is required. Your plan may describe your plan to form the board, but potential members should not be approached or identified unless the SII-Center is funded. A timeline with key milestones should be included.

4. **References Cited:** List only references cited in the Project Description. See PAPPG for format instructions.
5. **Biographical Sketches** (2-page limit per person): Biographical sketches are required for the PI, any co-PIs, and each of the participating Senior Personnel listed in the Project Description.
6. **Budget and Budget Justification:** Provide a budget for each of the five years. FastLane or Grants.gov will automatically provide a cumulative budget. The proposed budget should be consistent with the needs and complexity of the proposed activity. The budget and budget justification should reflect start-up activities at the commencement of the SII-Center activities. Funds allocated for research, education, workforce development, collaboration, broadening participation, and knowledge transfer areas must be discernible. Funds also should be included for attendance at up to three site visits (and/or reverse site visits) as well as other meetings. For collaborations with foreign organizations, see PAPPG Chapter II.C.2.j. Budgets for other participating organizations should be included in the lead organization's budget as subawards. Each organization that receives a subaward must also submit a separate budget and budget justification (not to exceed five pages).
7. **Facilities, Equipment and Other Resources:** Provide a synopsis of organizational resources that will be available to the SII-Center (dedicated space, access to facilities and instrumentation, faculty and staff positions, access to programs that assist with curriculum development or broadening participation, or other organizational programs that could provide support to the SII-Center). In order for NSF, and its partners, to assess the scope of a proposed project, all resources (including those from collaborating organizations) available to the project, must be described in this section. Note that inclusion of voluntary committed cost sharing is prohibited. The description should be narrative in nature and must not include any quantifiable financial information.
8. **Special Information and Required Supplementary Documents:**

- o **Ethics Plan** (required, up to one page). Provide a clear statement of the proposed SII-Center's policies on ethics training, responsible conduct of research, and intellectual property rights. Discussion should address the nature of the research, methodologies used, ownership of research and ideas, and roles and responsibilities regarding intellectual property. A program of training in ethics and responsible conduct of research within the cross-disciplinary and multi-organizational context of the SII-Center, for all SII-Center and subawardee staff, including faculty, visiting faculty, industrial fellows, postdoctoral researchers, and graduate and undergraduate students is required. Training topics should include the nature of the research, methodologies used, ownership of research and ideas, and roles and responsibilities regarding privacy and intellectual property. Proposers are encouraged to address the relationship between the SII-Center's ethics plan and the broader consideration of ethics in spectrum.
- o **Data Management Plan** (required, up to two pages). In addition to the general elements of the data management plan described in the PAPPG, SII-Center proposals should address their plans for data-sharing across the team.
- o **Postdoctoral Researcher Mentoring Plan** (up to two pages). In addition to the general elements of the postdoctoral mentoring plan described in the PAPPG, address how the activities of the SII-Center will especially enhance the professional development of postdoctoral researchers, if applicable.
- o **Documentation of Collaborative Arrangements.** The Project Description must fully detail any substantial collaborations and engagements with partner organizations. Letters confirming these arrangements may be provided in the Supplementary Documents section of the proposal.
- o **A list of Project Personnel and Partner Organizations** (required):

Provide current, accurate information for all personnel and organizations involved in the project. NSF staff will use this information in the merit review process to manage reviewer selection. The list **must** include all PIs, co-PIs, Senior Personnel, paid/unpaid Consultants or Collaborators, Subawardees, and Postdocs. This list should be numbered and include (in this order) Full name, Organization(s), and Role in the project, with each item separated by a semi-colon. Each person listed should start a new numbered line.

- o **Coordination plan** (required, 2-page limit): Include a clearly labeled "Coordination Plan", which includes: 1) identification of the specific coordination mechanisms that will enable cross-organization and/or cross-expertise scientific integration and achieve synergy within the team and externally; and 2) pointers to the budget line items that support these coordination mechanisms.

9. Single Copy Documents

Required:

- o Collaborators and Other Affiliations Information:

Proposers should follow the guidance specified in Chapter II.C.1.e of the NSF PAPPG.

Note the distinction from the fifth item under Supplementary Documents above: the listing of all project participants is collected by the project lead and entered as a Supplementary Document, which is then automatically included with all proposals in a project. The Collaborators and Other Affiliations are entered for each individual identified as Senior Personnel within each proposal and, as Single Copy Documents, are available only to NSF staff.

Optional:

- A list of suggested reviewers (strongly encouraged) and/or reviewers not to include (with a brief explanation or justification for why the reviewer should be excluded);
- Identification of proprietary or privileged information (if applicable).

Proposals containing items other than those described above will be returned without review. Proposals submitted without the required Supplementary Documents and Single Copy Documents will be returned without review (Ethics Plan, Management and Coordination Plan, Data Management Plan, List of Project Personnel and Partner Organizations, Collaborators and Other Affiliations Information). Letters of Collaboration are not required. A Postdoctoral Mentoring Plan is required if postdoctoral fellows will be included in the project. The process for officially naming the SII-Center will be discussed with the awardee after the SII-Center award is made as a part of the cooperative

agreement.

B. Budgetary Information

Cost Sharing:

Inclusion of voluntary committed cost sharing is prohibited.

Other Budgetary Limitations:

- Proposal budgets must not exceed \$300,000 for SII-Center Planning Grants.
- Proposal budgets must not exceed \$5,000,000 per year for SII-Centers.
- Funding requests can be for durations of up to 1 year for SII-Center Planning Grants and up to 5 years for SII-Centers.
- Each SII-Center Planning Grant budget must include funding for at least one PI of co-PI to attend a two-day workshop in the Washington, D.C. area.
- Budgets for participating organizations must be included as subawards to the budget of the submitting organization. Only the budget of the submitting organization may include subawards (i.e., no subawards may appear in the budgets of subawardee organizations). Each subaward must include a separate budget justification of no more than five pages (see PAPPG Chapter II section 2.g).

C. Due Dates

SII-Center Planning Grant Proposals*

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

June 12, 2020

* Submission of an SII-Center Planning Grant Proposal is not required to submit an SII-Center Proposal

SII-Center Proposals

- Letter of Intent (required, due by 5 p.m. submitter's local time):

February 01, 2021

- Full Proposal Submission Window

March 01, 2021 - April 01, 2021

The submission window opens on March 1, 2021 and closes at 5 p.m. submitter's local time on April 1, 2021. A Letter of Intent (due by 5 p.m. submitter's local time on February 1, 2021) is a required prerequisite for SII-Center Proposals. SII-Center Proposal submission window dates are subject to revision.

Submission of an SII-Center Planning Grant Proposal is not required to submit an SII-Center Proposal. A Letter of Intent is a required prerequisite for SII-Center Proposals. SII-Center Proposal submission window dates are subject to revision.

D. FastLane/Research.gov/Grants.gov Requirements

For Proposals Submitted Via FastLane or Research.gov:

To prepare and submit a proposal via FastLane, see detailed technical instructions available at: <https://www.fastlane.nsf.gov/a1/newstan.htm>. 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/ProposalPreparationandSubmission.html. For FastLane or Research.gov user support, call the FastLane and Research.gov Help Desk at 1-800-673-6188 or e-mail fastlane@nsf.gov or rgov@nsf.gov. The FastLane and Research.gov Help Desk answers general technical questions related to the use of the FastLane and Research.gov systems. 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 webpage: <https://www.grants.gov/web/grants/applicants.html>. 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 the NSF FastLane system for further processing.

Proposers that submitted via FastLane or 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 acknowledgement 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 *Building the Future: Investing in Discovery and Innovation - NSF Strategic Plan for Fiscal Years (FY) 2018 – 2022*. 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.C.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.C.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 underrepresented minorities 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 Plan and the Postdoctoral Researcher Mentoring Plan, as appropriate.

Additional Solicitation Specific Review Criteria

In addition to the National Science Board merit review criteria, reviewers will be asked to specifically consider the following questions when reviewing proposals:

A. SII-Center Planning Grant Proposals

1. How likely is it that the proposed plan will lead to the development of a viable SII-Center excelling in the areas described in the Program Description (See Section II.A), especially in the areas of research, spectrum workforce development, and synergistic collaboration?
2. To what extent does the proposed plan describe forming a team of PIs with complementary expertise to execute the project?

B. SII-Center Proposals

1. How well does the proposed SII-Center **advance foundational spectrum research** and identify the areas in clear need of a larger-scale, more integrated, and concerted effort over a longer timeframe?
2. How well does the proposed SII-Center **leverage application-inspired research** to inform foundational research priorities and address the key challenges?
3. How well does the proposed SII-Center **nurture and grow the next generation of talents** for a diverse, well-trained workforce?
4. To what extent are the proposed SII-Center activities **comprised of a multidisciplinary group of scientists, engineers, and educators** appropriate for the project?
5. How well does the proposed SII-Center serve as a **nexus point for collaborative efforts** meaningfully integrated into a diverse center that is more than just the sum of the parts?

B. Review and Selection Process

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

See Management Plan.

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 applicants whether their proposals have been declined or recommended for funding within six months. Large or particularly complex proposals or proposals from new awardees 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.

After programmatic approval has been obtained, the proposals recommended for funding will be forwarded to the Division of Grants and Agreements 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 a Grants Officer in the Division of Grants and Agreements. 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.

Special Award Conditions:

SII-Center Planning Grant awards will require attendance of at least one PI or co-PI at a two-day workshop in the Washington D.C. area during the duration of the grant, at a date to be communicated at the time of award.

The SII-Center award will be made in the form of a cooperative agreement. The SII-Center cooperative agreements will have an extensive section of Special Conditions relating to the period of performance, statement of work, awardee responsibilities, NSF responsibilities, joint NSF-awardee responsibilities, funding and funding schedule, reporting requirements, key personnel, naming and branding of the SII-Center, and other conditions. NSF has responsibility for providing general oversight and monitoring of the SII-Center to help assure effective performance and administration, as well as facilitating any coordination among the SII-Center participants as necessary to further the objectives of the SII-Center program. Within the first 90 days of the Award, a retreat of the SII-Center's key personnel to address strategic planning of the SII-Center may be required.

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 project report, and a project outcomes report for the general public.

Failure to provide the required annual or final 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 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.

The SII-Centers awarded under a cooperative agreement will be required to submit annual reports on progress and plans, in addition to site visits, which will be used as a basis for performance review and determining the level of continued funding. To support this review and the management of a center, the SII-Center will also be required to develop a set of management and performance indicators for submission annually to NSF via an NSF evaluation technical assistance contractor. Part of this reporting may take the form of a database that will be owned by the awardee and eventually made available to an evaluation contractor. This database will capture specific information to demonstrate progress towards achieving the goals of the program. Such

reporting requirements may be included in the cooperative agreement which is binding between the awardee and NSF

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:

- Bevin A. Zauderer, MPS/AST, telephone: (703) 292-2428, email: SII-Center@nsf.gov
- Mohammad Ali, ENG/ECCS, telephone: (703) 292-4632, email: SII-Center@nsf.gov
- Alexander Sprintson, CISE/CNS, telephone: (703) 292-8950, email: SII-Center@nsf.gov
- Lisa M. Winter, GEO/AGS, telephone: (703) 292-8519, email: SII-Center@nsf.gov
- Jonathan V. Williams, MPS/AST, telephone: (703) 292-2455, email: SII-Center@nsf.gov

For questions related to the use of FastLane or Research.gov, contact:

- FastLane and Research.gov Help Desk: 1-800-673-6188
FastLane Help Desk e-mail: fastlane@nsf.gov.
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.

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>.

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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 (FASSED) 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.E.6 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.

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- **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: nspubs@nsf.gov
 - or telephone: (703) 292-7827
- **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 awardees 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 applicants 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
Office of the General Counsel
National Science Foundation
Alexandria, VA 22314

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