Dear Colleagues:

The electromagnetic spectrum is a key enabler for modern technology and scientific discovery. The ongoing growth in use of wirelessly connected devices has led to spectrum congestion that impacts a broad range of national, economic, and social activities. This creates a critical need to train a future workforce with proficiency in the fundamentals of science, technology, engineering, and mathematics that enable further development of the electromagnetic spectrum as a resource (hereafter, "spectrum STEM"). This workforce must also have an awareness of interconnected spectrum-related technical, policy, regulatory, management, economic, and application issues needed to make effective decisions in a broad range of occupations. Through this Dear Colleague Letter (DCL), NSF seeks to encourage the STEM and policy-making communities to develop innovative education and workforce development plans to address the nation's future spectrum workforce needs. This DCL invites supplemental funding requests from PIs of existing awards in the following programs: Spectrum Efficiency, Energy Efficiency, and Security: Enabling Spectrum for All (SpecEES - NSF 19-529), NSF/Intel Partnership on Machine Learning for Wireless Networking Systems (MLWiNS - NSF 19-591), Spectrum and Wireless Innovation enabled by Future Technologies (SWIFT - NSF 20-537, NSF 21-539, NSF 22-571), Spectrum Innovation Initiative: National Center for Wireless Spectrum Research (SII-Center - NSF 21-558), Resilient and Intelligent NextG Systems (RINGS - NSF 21-581), and Spectrum Innovation Initiative: National Radio Dynamic Zones (SII-NRDZ - NSF 22-579). In addition, if you have a relevant award in a core program of any directorate participating in one of the above-listed programs, you may reach out to the SII team (sii@nsf.gov) and your cognizant Program Officer for guidance as to whether a supplement may be supported for your award as well.

BACKGROUND

This DCL is issued as part of NSF’s Spectrum Innovation Initiative, begun in 2019, which
seeks to support and focus national efforts in spectrum STEM around collaborative activities in four areas: (1) a National Center for Wireless Spectrum Research; (2) Planning and establishing National Radio Dynamic Zones; (3) Integrative spectrum research activities; and (4) Education and Workforce Development. More information is available at https://www.nsf.gov/mps/oma/spectrum_innovation_initiative.jsp.

This DCL uses the term "spectrum workforce" to refer to workplace roles in subject areas including, but not limited to:

- Spectrum management, planning, regulation, and policy-making
- Research on spectrum-related topics including radio science, spectrum science, and spectrum-dependent applications
- Design, production, acquisition, and operation of devices, algorithms, or systems that use or enhance the efficient use of the electromagnetic spectrum
- Management, planning, and leadership of organizations or missions affected by spectrum access constraints or spectrum regulations
- Training the spectrum workforce and communicating on spectrum-related topics to the public

FOCUS AREAS

NSF invites supplemental funding requests in the following areas related to spectrum workforce development.

Workforce definition studies

The spectrum workforce is understood by many companies, academic groups, and federal agencies to be a key component of the future national workforce. However, the present composition of the spectrum workforce remains unclear. In many cases, members of the spectrum workforce are not clearly identified as such by title. To provide information essential to appropriately train and prepare the spectrum workforce of the future, studies are encouraged to answer questions such as the following for the current spectrum workforce and/or to project answers for the future spectrum workforce.

- What set of roles make up the spectrum workforce?
- What skills are most critical for each of those roles?
- How many staff are employed in each of those roles?
- Where are the staff employed, and under what titles?
- What is the demand for the different roles, and in what organizations or organization types does the demand exist?
- How do staff acquire the necessary skills for their roles?
What career paths do staff follow?

In all cases, supplemental funding requests to perform workforce studies must clearly describe and justify the methods that will be used.

Training opportunities

A wide range of research groups across a variety of disciplinary areas may be well-positioned to provide training to undergraduate and graduate students in spectrum STEM. Some of these groups may focus specifically on spectrum-related technical research, but others may connect to the spectrum research ecosystem less directly (in fields such as public policy, astronomy, and economics). This DCL encourages the broadest possible consideration of experiences that can help prepare trainees for the full variety of future careers in spectrum across all government, academic, and industrial stakeholders. The participation of trainees from groups, institutions, and geographic regions that are underrepresented in STEM disciplines is strongly encouraged.

Informal Education and Public Outreach

The key role that the electromagnetic spectrum plays in our daily lives, the extent of its use in modern technology, and the opportunity for spectrum careers are not well-known among pre-college students. Even at the college level, only a select few students in certain career paths (electrical engineering, physics, radio frequency engineering, telecommunications) may be aware of spectrum-related work as a possible career path. NSF invites supplemental funding requests to raise public awareness of the role of the spectrum in daily, technologically-connected life and of potential career paths in the spectrum workforce.

Workshops

Because many companies, agencies, and institutions have begun to recognize the importance of a well-trained spectrum workforce, several groups have begun activities aimed at understanding their own spectrum needs and identifying and developing talent in these areas. Many of these activities continue to take place "in silos" and may benefit from dissemination and sharing of knowledge and prior work in this area. NSF encourages supplemental funding requests for workshops, seminars, career fairs, or conferences, with a focus on bringing together representatives from various stakeholder groups engaged in defining, identifying, and training the future spectrum workforce. These activities may help define the common spectrum workforce, help refine needs of various stakeholder groups, and help brainstorm curriculum development plans, career engagement tools, and
career pathway definition.

Projects that establish new collaborations between academia and industry, that promote collaboration between domain experts in various fields with spectrum, and that broaden participation are also encouraged.

**MECHANISMS FOR REQUESTING SUPPORT**

Supplemental funding requests to support one of the focus areas outlined above may be submitted in three ways: (1) as a supplemental funding request to an existing disciplinary award as described in Chapter VI.E.5 of the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG), (2) in response to a previously published supplemental funding opportunity, or (3) as a SII-Graduate Research Supplement (SII-GRS), described below.

(1) Supplemental funding requests to existing NSF awards should extend or expand the scope of the project to include spectrum workforce development or enhance previously-funded spectrum workforce development activities. These additional or enhanced activities could include new collaborations that strengthen a team's ability to impact workforce development. Supplemental funding requests submitted prior to July 11 will be considered for funding in the current fiscal year (e.g., FY22 for proposals submitted prior to July 11, 2022). Funding decisions on supplement requests submitted after July 11 in a given year may be delayed.

(2) Previously published supplemental funding opportunities that may be relevant for spectrum workforce development support include the following.

A. Research Experiences for Undergraduates (REU) supplements, described in the *Research Experiences for Undergraduates (REU)* solicitation (NSF 22-601), provide appropriate and valuable educational experiences for undergraduate students through participation in research. This DCL invites REU supplemental funding requests of two kinds: (1) Requests for supplements to existing NSF awards to support 1-2 undergraduates in ongoing NSF-sponsored research that relates to spectrum; and (2) supplemental funding requests from existing NSF REU sites to host an additional 1-2 students each year who will focus specifically on spectrum-related topics within the broader research area of the existing REU site. This DCL strongly encourages PIs to exert special efforts to recruit members of groups that are underrepresented in STEM and whose involvement will help increase diversity in the research program. PIs should note such activities in the REU supplement request. Preparation of an REU supplement request should follow the directions outlined in the REU solicitation. Please contact the cognizant Program Officer (PO) of the NSF grant or cooperative agreement that would be supplemented for further guidance and regarding appropriate submission deadlines.
B. INTERN (Non-Academic Research Internships for Graduate Students) supplements provide up to six additional months of support for graduate students to gain knowledge, skills and experiences that will augment their preparation for a successful long-term career through an internship in a non-academic setting. Total funding requests are limited to a maximum of $55,000 per student per six-month period. Additional guidance for INTERN supplements can be found in NSF 21-013. The target date for submission of INTERN supplemental funding requests is April 15th of each year.

(3) SII Graduate Research Supplements (SII-GRS): Eligible grantees (see "Eligibility for SII-GRS Supplement Requests" below) may submit a request for supplemental funding to support the costs for stipend, tuition, benefits, and applicable indirect costs for an identified, newly recruited graduate student who will work on spectrum-related research. SII-GRS supplements are one-year supplements to a currently active award and provide support for a MS or PhD student with the possibility for annual renewal for a total support period of up to 3 years contingent upon the duration and satisfactory progress of the associated award. Grantees eligible for SII-GRS supplements may request up to $75,000 per graduate student. Up to $60,000 is expected to cover costs of stipend, tuition, benefits, and applicable indirect costs related to these items. The remaining $15,000 may be budgeted for equipment, materials, faculty mentorship support, and applicable indirect costs related to these items, as appropriate to the graduate research project. Supplemental funding requests submitted prior to July 11 will be considered for funding in the current fiscal year (e.g., FY22 for proposals submitted prior to July 11, 2022). Funding decisions on supplement requests submitted after July 11 in a given year may be delayed.

FUNDING AMOUNT

The total amount of funding requested must not exceed the amounts listed below for each activity:

- Workforce studies: $50,000 over a maximum 2-year period of support.
- REU supplements: typical undergraduate student support levels are expected not to exceed $1,350 per student per week (including all direct and indirect costs) for a 10-week summer activity or a comparable pro rata amount for an academic-year activity. For further details of support levels for the NSF REU program, see solicitation NSF 22-601.
- INTERN supplements (Non-Academic Research Internships for Graduate Students): Total funding requests are limited to a maximum of $55,000 per student per six-month period; see DCL NSF 21-013.
- SII-GRS Supplements: $75,000 per student per year to cover costs of stipend, tuition, research materials, mentorship support, and applicable indirect costs.
- Informal Education and Outreach: $50,000 over a maximum 2-year period of support.
- Conferences and Workshops: $100,000 over a maximum 1-year period of support.
Supplemental funding requests to an existing NSF award should be submitted in accordance with the guidelines found in Chapter VI.E.5 of the PAPPG and if applicable, the relevant supplemental funding opportunity. When preparing a supplemental funding request for a conference or workshop, grantees should refer to Chapter II.E.9 of the PAPPG for guidance on the information to include in the Summary of Proposed Work Section (Project Description) and the types of costs to include in the budget. This DCL invites supplement requests from PIs of existing awards in the following programs: Spectrum Efficiency, Energy Efficiency, and Security: Enabling Spectrum for All (SpecEES - NSF 19-529), NSF/Intel Partnership on Machine Learning for Wireless Networking Systems (MLWiNS - NSF 19-591), Spectrum and Wireless Innovation enabled by Future Technologies (SWIFT - NSF 20-537, NSF 21-539, NSF 22-571), Spectrum Innovation Initiative: National Center for Wireless Spectrum Research (SII-Center - NSF 21-558), Resilient and Intelligent NextG Systems (RINGS - NSF 21-581), and Spectrum Innovation Initiative: National Radio Dynamic Zones (SII-NRDZ - NSF 22-579). In addition, if you have a relevant award in a core program of any directorate participating in one of the above-listed programs, you may reach out to the SII team (sii@nsf.gov) and your cognizant Program Officer for guidance as to whether a supplement may be supported for your award as well.

Each funding request must include this SII-WFD DCL title "Dear Colleague Letter: Workforce Development in Spectrum STEM" in the summary section of the supplementary request.

Eligibility for SII-GRS Supplement Requests: A SII-GRS supplement may be submitted by the PI of a currently active NSF award. To be eligible for a renewal of a SII-GRS supplement for a second or third year, a student must be in good academic standing. The SII-GRS supplement renewal request must include a report on the student's progress towards the MS or Ph.D. By submitting a supplemental funding request, the grantee organization is certifying that the nominated student meets the eligibility requirements. SII-GRS supplement renewals are subject to availability of funds in the program and should be submitted at least three months in advance of the expiration date for the previous supplement.

For further detail on any of the supplemental funding opportunities discussed here, contact SII@nsf.gov or one of the cognizant POs listed below:

- MPS/AST: Jonathan Williams (jonwilli@nsf.gov)
- GEO/AGS: Lisa Winter (lwinter@nsf.gov)
- CISE/CNS: Alex Sprintson (asprints@nsf.gov)
- ENG/ECCS: Jenshan Lin (jenlin@nsf.gov)
- EHR/DGE: Li Yang (lyang@nsf.gov)
- SBE/SES: Nancy Lutz (nlutz@nsf.gov)
• BIO/DBI: Robert Fleischmann (rfleisch@nsf.gov)

Sincerely,

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