NATIONAL SCIENCE FOUNDATION
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ALEXANDRIA, VIRGINIA 22314

NSF 21-039

Dear Colleague Letter: Funding Opportunity - Light and Warm Superconductors

January 27, 2021

Dear Colleague:

Recent advances in achieving room temperature superconductivity under pressure offer new challenges and lead to new fundamental questions. Motivated by predictions based on theory and computation, record high temperature superconductivity in hydrogen rich compounds has been discovered continuing a trend of increasing highest transition temperatures.

NSF has provided continuous funding for research programs investigating metallization of lightest elements and light element-based superconductivity over the last decades resulting in foundational discoveries in the search for metallization and superconductivity in light elements, notably hydrogen, under high pressure. High pressure induced hydrogen metallization and light-element-based superconductivity is an expanding and active field of research.

Building on this increasing momentum, this Dear Colleague Letter (DCL) challenges researchers to explore new research directions in the search for superconductivity at normal temperatures and pressures by: i) understanding the recently announced observation of superconductivity at room temperature and high pressure, and ii) extending this understanding to predict and explore promising routes to room temperature superconductivity at normal temperatures and pressures. **The expected outcome is to establish a clear pathway towards light and warm superconductivity: light-element superconductivity at normal temperature and pressure.**

This DCL invites Research Concept Outlines (RCOs) describing the high risk - high payoff projects addressing this challenge. Based on evaluation of the transformative potential and quality of the RCOs, and available resources, proposers may be invited to submit Early-concept Grants for Exploratory Research (EAGER) proposals, with award size and duration limited to no more than $300,000 over maximum of two years, focusing on one or more of the following challenges:

1. Characterization: determination of atomic and electronic structures of light and warm superconductors, as well as of co-existing and competing phases, exploration of the superconducting transition and of superconducting properties (e.g., magnetic, tunneling, optical etc.) in these materials, and the evolution of structures and properties with varying pressure, temperature, laser irradiation, etc.
2. Materials: designing and testing novel or alternative synthesis pathways, and adapting existing synthesis methods to expand the range of available candidate superconducting compounds,
3. Superconductivity: developing and testing theoretical models with the aim of understanding the nature and physical origin of light and warm superconductivity under pressure,
4. Future: exploring experimental and theoretical pathways to realize light and warm superconductivity by exploring other physical parameters, such as chemical doping or alternative pathways to reduce or eliminate the external pressure needed to achieve light and warm superconductivity.

Priority will be given to research based on close collaboration between experiment and theory, and/or to novel, unconventional, and risky ideas or strategies, particularly ones that involve crossing disciplinary boundaries, to address key scientific challenges, including those identified above.

Submission of EAGER proposals is by invitation only; the process is initiated by the submission of a RCO describing the proposed idea. All correspondence, inquiries and RCOs need to be submitted to the following email address: super@nsf.gov.

The RCO must clearly describe the idea with a clear explanation of why it is innovative, potentially transformative, or otherwise potentially impactful. Reasons why this project is appropriate for EAGER funding must be provided. RCOs are strictly limited in length to 2 pages plus a half-page justification of the proposed budget, for a total of 2.5 pages.

RCOs responsive to this DCL and received on or before March 22nd, 2021 may be invited to submit EAGER proposals for funding consideration in FY 2021.

EAGER proposals submitted without prior submission of a corresponding RCO and subsequent invitation will be returned without review. The email invitation from an NSF Program Officer serves as documentation and must be uploaded in the Supplementary Documentation section of the invited EAGER proposal. The RCO and proposal titles must begin with "EAGER: SUPER:". An investigator may be included in only one RCO and subsequent EAGER proposal submission pursuant to this DCL.

Complete guidance on submitting an EAGER proposal may be found in Chapter II.E.2 of the NSF Proposal and Award Policies and Procedures Guide.

This opportunity is managed by the following programs within the Division of Materials Research (DMR): Condensed Matter Physics (CMP) program, Condensed Matter and Materials Theory (CMMT) program, and Solid State and Materials Chemistry (SSMC) program. The PI should indicate a primary program, and a secondary program if applicable.

Key contacts:
CMP: Tomasz Durakiewicz, Tom Oder
CMMT: Daryl Hess, David Rabson
SSMC: Birgit Schwenzer, Robert Meulenberg

Sincerely,

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