



NSF Emerging Frontiers in Research and Innovation 2027/2028 – Wave Based Computing (WBC)

Informational Webinar

October 7th, 2026

AGENDA

Welcome from Sohi Rastegar, Office Head, NSF/ENG/EFMA

Meet the Emerging Frontiers in Research and Innovation (EFRI) Team

Overview of the EFRI Wave-Based Computing (EFRI-WBC) Solicitation

Questions

Webinar Housekeeping

1

The webinar is being recorded and the recording will be posted online

2

The webinar slides will be posted online

3

Questions will be addressed using the Q&A function

4

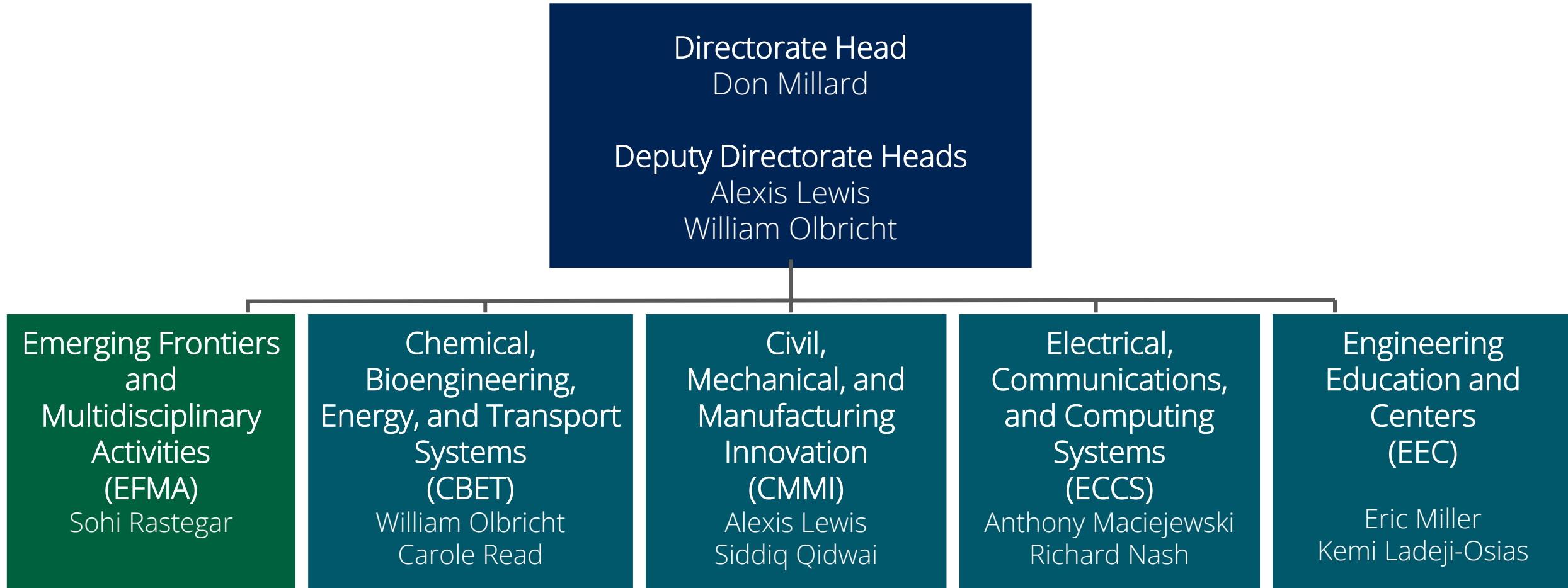
The Chat Function has been disabled

5

Send any questions not addressed in the webinar to efri2027-2028@nsf.gov

For more information, please read solicitation NSF 26-524

NSF Directorate for Engineering



<https://www.nsf.gov/eng/>

Office of Emerging Frontiers and Multidisciplinary Activities

Sohi Rastegar, *Office Head*

Louise R. Howe, *Program Director*

Alias Smith, *Program Director*

Greg Rorrer, *Program Director*

Terria Davis, *Business Operations Analyst (ENG/OAD)*

Wave-Based Computing (WBC): Cognizant Program Officers

- Topic Co-Lead: Nadia A. El-Masry, ENG/EEC
- Topic Co-Lead: Ale Lukaszew, ENG/ECCS
- Peter S. Atherton, TIP/TI
- Louise R. Howe, ENG/EFMA
- Alias Smith, ENG/EFMA

Goals of the Webinar

- To inform the community about the EFRI FY 2027/2028 Program Solicitation
- To respond to questions from potential applicants

Key website

Office of Emerging Frontiers & Multidisciplinary Activities
(EFMA)

<http://www.nsf.gov/eng/efma>

Please refer to this website for up-to-date information.

The Emerging Frontiers in Research & Innovation (EFRI) Program

The EFRI Program serves a critical role in helping the Engineering Directorate to focus on important emerging areas in a timely manner.

- **Community Driven** – Engages the research community (through a DCL) as well as NSF Program Directors to identify strategic emerging, interdisciplinary areas that may not be supported through current NSF programs, and in which ENG research plays the leading role.
- Uses **Potentially Transformative / High risk, High reward** and **Interdisciplinary** as criteria for project selection.
- Signature midscale project-funding mechanism in ENG (\$2M / 4 year projects)



EFRI Topics FY07-28

FY07 **ARES:** Autonomously Reconfigurable Engineered Systems
CBE: Cellular and Biomolecular Engineering

FY08 **COPN:** Cognitive Optimization and Prediction
RESIN: Resilient and Sustainable Infrastructures

FY09 **BSBA:** Biosensing and Bioactuation
HyBi: Hydrocarbons from Biomass

FY10 **SEED:** Science in Energy and Environmental Design
RESTOR: Renewable Energy Storage

FY11 **M3C:** Mind, Machines, and Motor Control
MIKS: Engineering based on Multicellular and Interkingdom Signaling

FY12/13 **BioFlex:** Flexible Bioelectronics Systems
PSBR: Photosynthetic Biorefineries
ODISSEI: Origami Design for Integration Of Self-assembling Systems For Engineering Innovation

FY14/15 **2-DARE:** 2-Dimensional Atomic-Layer Research and Engineering

FY16/17 **ACQUIRE:** Advancing Communication Quantum Information Research Engineering
NewLAW: New Light and Acoustic Wave Propagation: Breaking reciprocity and time-reversal symmetry

FY18/19 **CEE:** Chromatin and Epigenetic Engineering
C3 SoRo: Continuum, Compliant and Configurable Soft Robotics Engineering

FY20/21 **DCheM:** Distributed Chemical Manufacturing
E3P: Engineering the Elimination of End-of-life Plastics

FY22/23 **BRAID:** Brain-Inspired Dynamics for Engineering Energy-Efficient Circuits and Artificial Intelligence
ELiS: Engineered Living Systems

FY24/25 **BEGIN OI:** Biocomputing through EnGINEering Organoid Intelligence
PEL: Ideas Lab: Personalized Engineering Learning

FY27/28 **WBC:** Wave-Based Computing (NSF 26-524)

EFRI FY 2027/2028 Topic

The background image is a composite of several elements: a blue-toned landscape with a large, glowing, brain-like structure in the center; mathematical formulas like $E=mc^2$ and $A \frac{dA}{dt}$ floating in the air; a person wearing safety glasses on the right side; and a small whale breaching the water in the lower right. The overall theme is scientific and technological.

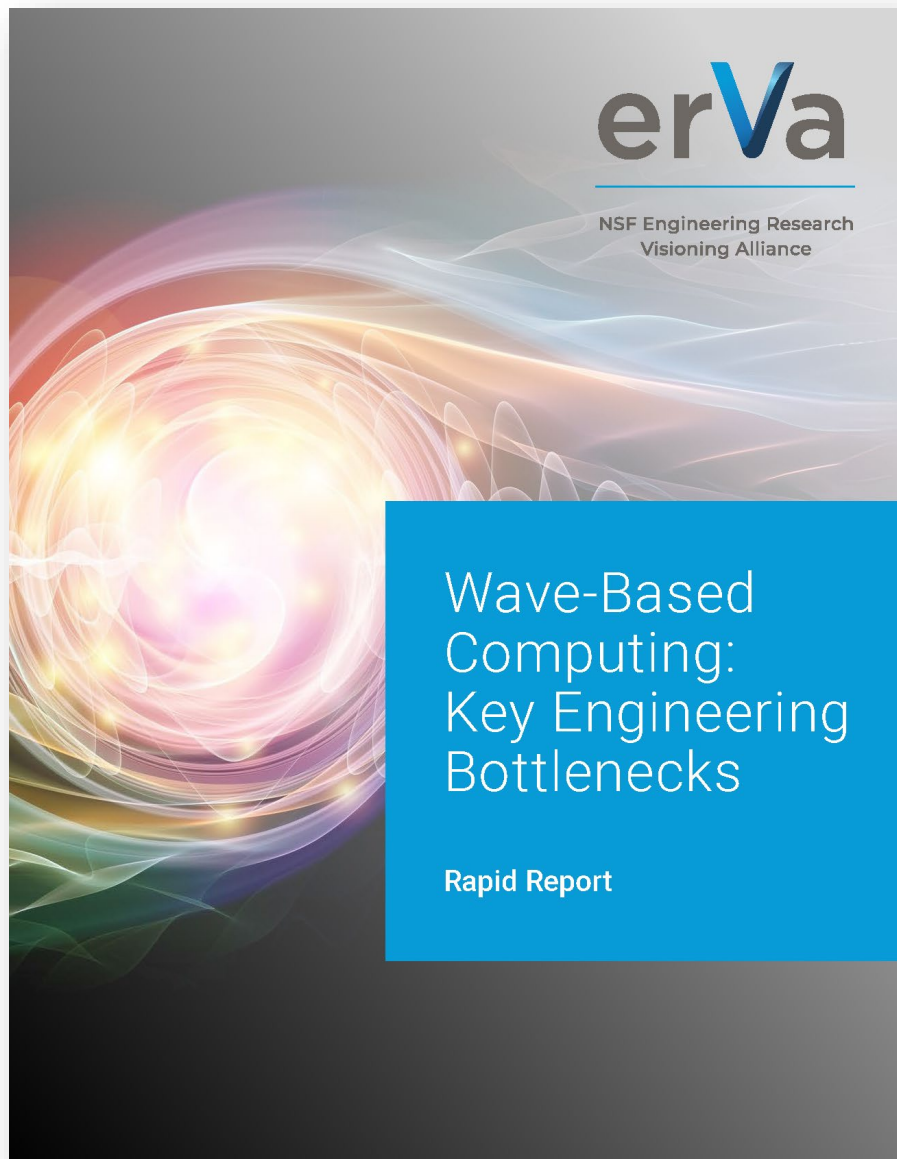
**EMERGING FRONTIERS IN RESEARCH
AND INNOVATION (EFRI): Wave-Based
Computing (WBC) (EFRI-WBC)**

[View guidelines](#)

[NSF 26-524](#)

What is Wave-Based Computing (WBC)?

- WBC processes information using wave dynamics (optical, EM, acoustic); operates on continuous analog wavefields.
- WBC devices have the potential to provide higher throughput with much lower energy use than traditional digital electronics.
- Advances in materials, transducers, and design concepts should make it increasingly feasible to miniaturize and thus integrate WBC units within compact, chip-scale systems.
- WBC may reshape information technology architectures, creating alternatives to current computing architectures with increased computing speed yet decreased power consumption, and thus supporting the continuing expansion of U.S. super intelligence (SI) and machine learning (ML) capabilities.



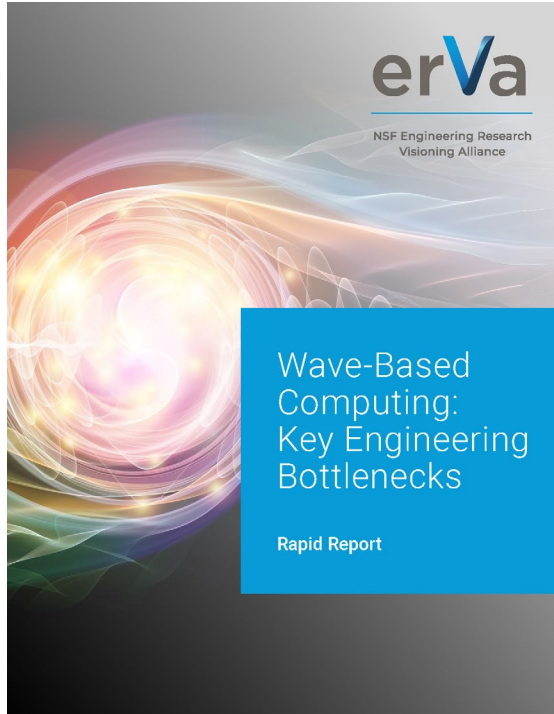
Engineering Research Visioning Alliance (ERVA)

ERVA Visioning Event: Wave-Based Computing

- Held February 24-25, 2026
- Focused on **Key Engineering Bottlenecks** for realizing Wave-Based Computing
- Rapid Report released May 1, 2026



ERVA WBC: Six Key Engineering Bottlenecks



Nonlinearities

Storage and Memory (including Compute-in-Memory)

Reconfigurability and Programmability

Incoherent Waves and Modal Diversity

Error Correction, Noise, and Precision

Practical and Fundamental Limits



EFRI-WBC Program

- The objective of EFRI-WBC is to support foundational and transformative research that advances the development of computing approaches that harness the principles of wave dynamics to improve the performance and efficiency of information processing tasks.
- While WBC is unlikely to replace digital computing, wave-based computational accelerators could work alongside traditional programmable digital computers.
- The EFRI-WBC program outcomes are expected to build on recent advances with the goal of producing use-inspired foundational research discoveries that will help realize novel technologies with substantially improved computational power and efficiency.
- Collaboration with industry is highly encouraged to promote research translation.

EFRI-WBC Solicitation

The EFRI WBC solicitation will support **two tracks**.

- **Track 1:** WBC–Exploratory Research (WBC-ER). Exploratory approaches may be funded through **EArly-concept Grants for Exploratory Research (EAGER)** awards – **up to two years (\$100,000 - \$400,000)**.
- **Track 2:** Multidisciplinary Research (WBC-MR). Larger multidisciplinary projects may be supported through four-year awards of up to \$2,000,000. Track 2 proposals require a minimum of three PI/co-PIs.

PLEASE NOTE: Research areas proposed by applicants are NOT limited to those identified in the ERVA report.

Technical requirements for EFRI WBC proposals are articulated in the following **research thrusts**.

Research Thrust 1:

Physical Principles of Integrated WBC

GOAL: Advance foundational physical principles of integrated Wave-Based Computing

- Design systems to exploit the high speed, massive parallelism, low latency, low power usage, and high efficiency of WBC in a selected band of the broad frequency spectrum of electromagnetic waves.
- Projects may explore the use of acoustic waves for performing or augmenting other WBC tasks (e.g. analog acoustic computing, microwave signal filtering, compact delay lines, and quantum hardware interfaces).
- Both linear and non-linear processes may be used to facilitate wave interaction.
- Quantum phenomena may help in designing WBC systems.
- Proposed research may develop or use a variety of emerging optical materials; including non-linear optical materials, phase change materials, reconfigurable materials, chiral, photochromic, and other functional low-loss optical materials.

Research Thrust 2: Information Processing with Waves

GOAL: Design the computational aspects of WBC for information/signal processing.

- Potential architectures for integrated wave information processing include analog, digital, mixed signal, neuromorphic and quantum approaches. Combinations of these approaches that optimize information processing for specific problem solving may be proposed.
- Areas of Interest:
 - Resilience against noise and interference causing errors in data is critical
 - Development of learning algorithms integrated with reconfigurable intelligent metasurfaces and other device structures may improve integration of machine learning
 - *In situ* training of coherent neural networks using physics-informed principles and applied mathematics in combination with integrated WBC hardware is also of interest.

EXPECTATION: Realize enhanced performance and problem-solving ability through integrated computational and physical designs.

Research Thrust 3: Proof-of-Concept Testbeds

GOAL: Develop testbeds that validate the early-stage research and novel concepts developed under the prior thrusts.

- The proposed testbeds should include novel device/system components and algorithms developed under Thrusts 1 and 2.
- All testbeds should address at least one key computing performance metric (e.g., latency, throughput, bandwidth, energy efficiency, scalability, or error rate).
- Testbeds that include specifically designed components or stages that facilitate information processing, such as the implementation of specific algorithms, are especially encouraged.
- Proposers should explain how newly developed wave-based systems will work with current technologies, and should consider the associated software ecosystem in their designs.

EXPECTATION: Demonstrate new computing paradigms with system-level platforms

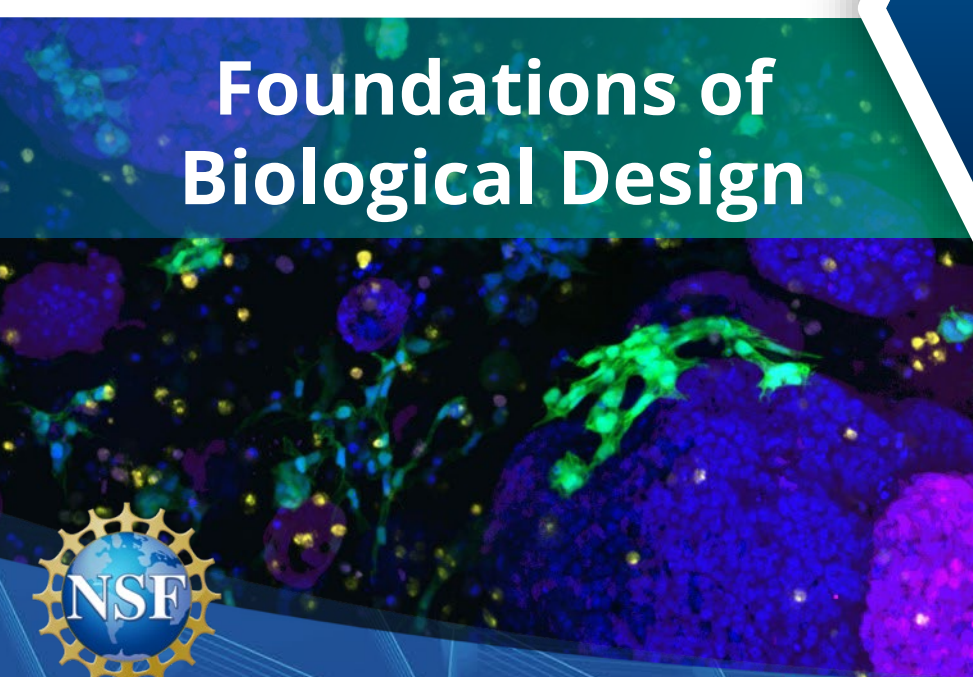
EFRI-WBC Program:

Exclusions

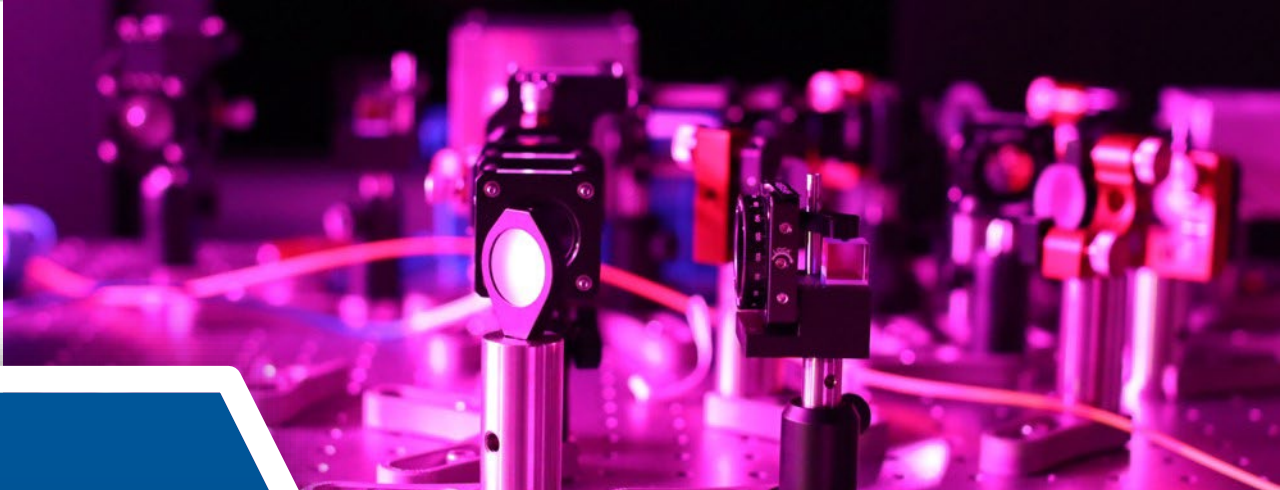
- Proposals focusing purely on development of optical components such as optical switches or mixers coupled to GPUs would not be considered responsive to this solicitation.
- Proposals focusing specifically on spin-wave computing are not considered within scope for the purposes of this solicitation.



**Future of
Intelligence**



**Foundations of
Biological Design**



**Frontier of Quantum
Phenomena**



**NSF
Frontier
Initiatives**



**Advanced Materials
and Matter**

Solicitation Requirements

EFRI-WBC Proposal Tracks:

Track 1, WBC-ER

- WBC–Exploratory Research (WBC-ER). Exploratory projects may be supported using EARly-concept Grants for Exploratory Research (EAGER) awards ([PAPPG Chapter 2.F.3](#)).
- EAGER proposals may request \$100,000 to \$400,000 for up to two years.
- EAGER proposals must address at least one of Thrusts 1 and 2 and should also include a testbed unless the proposed research is purely theoretical.

EFRI-WBC Proposal Tracks:

Track 2, WBC-MR

- WBC–Multidisciplinary Research (WBC-MR). Larger multidisciplinary projects may be supported through four-year awards of up to \$2,000,000.
- Track 2 proposals require a minimum of one PI and two co-PIs.
- Track 2 proposals must address all three Thrusts.

Eligibility: Organizations

Organization Limit:

- EFRI proposals may be submitted by a single organization or by a group of organizations consisting of a lead organization in partnership with one or more partner organizations.
- Proposals may be submitted by:
 - Institutions of Higher Education: universities and two- and four-year colleges (including community colleges) accredited in, and having a campus located in the United States, acting on behalf of their faculty members.
 - 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.
- Only U.S. organizations are eligible to be the lead organization.

No Collaborative Proposals

- For each proposed project, a single proposal should be submitted by the lead institution with subawards to partner institutions.
- No “Collaborative Proposals” are permitted.

Eligibility: PIs and co-PIs



Tracks 1 and 2:

- Lead Principal Investigators (PI) must be full-time tenured, or tenure-track faculty as determined by the submitting organization; or meet requirements described in the solicitation if the proposal is submitted by a non-profit, non-academic organization.
- **At least one PI or co-PI must be full-time faculty in a College or Department of Engineering**

Track 2:

- A minimum of one PI and two co-PIs must participate

Limit on Number of Proposals per Organization: **None Specified**

Limit on Number of Proposals per individual (PI or co-PI): **One per fiscal year**

An individual may participate as either PI or co-PI in only one proposal submitted to this solicitation in a single fiscal year. It is the responsibility of the submitting organization to ensure that the PI and all co-PIs are participating only in one proposal as either PI or co-PI and not in any others submitted in response to this solicitation in a single fiscal year.

EFRI-WBC Proposal Tracks 1 and 2

- Up to \$30M total for awards in FY 2027 and FY 2028 combined, subject to availability of funds
- Collaboration with industry is highly encouraged.
 - NSF GOALI proposals ([PAPPG Chapter II.F.5](#)) provide one mechanism for academia-industry collaboration.
 - Proposals responding to Thrust 3 should consider how choices in key performance metric(s) map to the challenges in manufacturing and scaling future systems.

A Concept Outline is Required for both tracks



Due Dates: FY27: November 19, 2026; FY28: November 16, 2027

Format:

1. **TITLE** - Title of the EFRI proposal (see Solicitation for instructions on prefix)
2. **TEAM** - Names, departmental and organizational affiliation, of the PI and co-PIs
3. **SYNOPSIS (GOALS)** - Brief description of the core idea and specific goals of the proposed project (maximum 500 words)

Submission:

- Submit Concept Outline via email to EFRI2027-2028@nsf.gov by Fiscal Year due date.
- Prospective PIs will receive an email from the cognizant NSF program officer that specifies whether a full proposal may be submitted.
- Submission of multiple Concept Outlines by a PI is NOT permitted
- All proposals submitted without the requisite "Program Officer Concurrence Email" supplementary document will be returned without review.

Proposal Submission



Due Dates:

FY27: February 11, 2027; FY28: February 10, 2028

- Follow NSF Proposal & Award Policies & Procedures Guide or Grants.gov Application Guide
- Project Summary (**one page limit**)
 - **Proposals that do not separately address both intellectual merit and broader impacts in the Project Summary will be returned without review**
- Project Description (*Track 1: **8-page limit**; Track 2: 15-page limit*)
 - Include under Broader Impacts: How will the proposed project lead to a significant shift in foundational engineering knowledge and have strong potential for significant impact on a strategic technology priority and/or national Science & Technology mission.
- Proposed budget must include funds for travel by at least one PI and one graduate student or researcher to attend an annual EFRI grantees' meeting. Awardees will be required to attend and present their research annually at an EFRI grantees' meeting for the duration of the award.

Full Proposal Supplementary Documentation

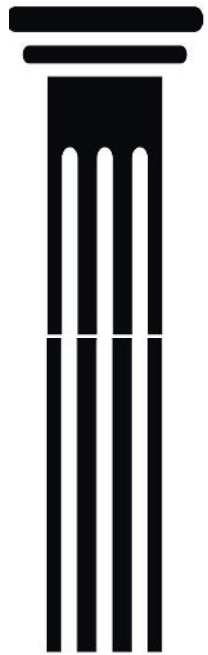
Supplementary Documentation:

- Mentoring Plan, describing mentoring activities for student and postdoctoral trainees
- Data Management and Sharing Plan (2 pages max)
- PO Concurrence email: Upload the Concept Outline PO Concurrence email that indicates PO permission to submit a full proposal
- List of Key Personnel: Provide a succinct description of what each person uniquely brings to the project and how their expertise will be integrated to foster synergy (3 pages max)
- Mechanisms for sharing the outcomes of the research with the scientific community (2 pages max)
- Single PowerPoint slide summarizing the vision of the EFRI proposal
- Management Plan (Track 2 only): 1) Plans for team coordination, personnel management, and project management; 2) Plan for management of intellectual property resulting from the project; 3) a detailed project schedule. (3 pages max)

NSF Merit Review Criteria

Intellectual Merit

Advance knowledge
& understanding



Broader Impacts

Benefit society;
advance desired
societal outcomes



Both **Intellectual Merit** and **Broader Impacts** consider these elements:

- ☐ Creative, original, potentially transformative concepts
- ☐ Well-reasoned plans for proposed activities based on sound rationale
- ☐ Qualifications of the investigator, team, and/or organization
- ☐ Resources available to support proposed activities

Review Criteria

EFRI Solicitation-Specific

- **THRUSTS** - Does the proposal address the **required thrusts**?
- **TRANSFORMATIVE** - Does the proposed research represent an opportunity for a significant leap or paradigm shift in foundational engineering knowledge?
- **NATIONAL NEED** - Is there potential for making significant progress on a strategic technology priority and/or national Science & Technology mission listed in the Administration's FY2028 R&D Budget Priorities Memorandum?
- **Mentoring Plan** – If involvement of trainees is planned (i.e., postdoctoral scholars, graduate students, undergraduates, other students), does the proposal include a description of the mentoring activities that will be provided for such supported trainees?
- Effectiveness of the proposed **Management Plan** (Track 2)

EFRI-2027/2028 (NSF 26-524)

Important Solicitation Dates

	Concept Outline Due Required	Full Proposal Due
FY 27	November 19, 2026	February 11, 2027
FY 28	November 16, 2027	February 10, 2028

Questions

efri2027-2028@nsf.gov

