Broad Agency Announcement

Sources for Ultraviolet Nuclear Spectroscopy of Thorium (SUNSPOT)

DEFENSE SCIENCES OFFICE

HR001125S0008

January 27, 2025

This publication constitutes a Broad Agency Announcement (BAA) as contemplated in Federal Acquisition Regulation (FAR) 6.102(d)(2) and 35.016 and 2 CFR § 200.203. Any resultant award negotiations will follow all pertinent law and regulation, and any negotiations and/or awards for procurement contracts will use procedures under FAR 15.4, Contract Pricing, as specified in the BAA.

OVERVIEW INFORMATION:

- **Federal Agency Name** – Defense Advanced Research Projects Agency (DARPA), Defense Sciences Office
- **Funding Opportunity Title** – Sources for Ultraviolet Nuclear Spectroscopy of Thorium (SUNSPOT)
- **Announcement Type –** Initial Announcement
- **Funding Opportunity Number –** HR001125S0008
- **Assistance Listing Number:** 12.910 Research and Technology Development
- **Dates/Time - All Times are Eastern Time Zone (ET)**
    - Posting Date: January 27, 2025
    - Proposers Day: February 7, 2025
    - Question Submittal Closed: March 3, 2025, at 4:00 p.m.
    - Proposal Due Date: March 13, 2025 at 4:00 PM
- **Anticipated individual awards** - Multiple awards are anticipated.
- **Types of instruments that may be awarded** – *Cooperative Agreements, Procurement Contracts, Other Transaction Agreements for Research, and Other Transaction Agreements for Prototype*
- **NAICS Code**: 541715
- **Agency contact**
    - The BAA Coordinator for this effort may be reached at: SUNSPOT@darpa.mil
    - Technical POC: Dr. Mukund Vengalattore, Program Manager, DARPA/DSO
    - DARPA/DSO
ATTN: HR001125S0008
675 North Randolph Street
Arlington, VA 22203-2114
- **DARPA Opportunities Website:** https://www.darpa.mil/research#research-opportunities

SECTION I: FUNDING OPPORTUNITY DESCRIPTION

The Defense Advanced Research Projects Agency (DARPA) is soliciting innovative proposals in the development of highly coherent sources of vacuum ultraviolet (VUV) radiation for clock-grade spectroscopy of the recently discovered thorium (^{229m}Th) nuclear isomeric transition. Proposed research should investigate innovative approaches that enable revolutionary advances in science, devices, or systems. Specifically excluded is research that primarily results in evolutionary improvements to the existing state of practice.

A. Background

Precision timing technologies underpin essential Department of Defense (DoD) capabilities including positioning, navigation, and communications. The current system of time standards, synchronization, and dissemination of time is based on stabilization of atomic clocks to microwave transitions and microwave-domain time transfer techniques. While such microwave-domain techniques have enabled nanosecond-scale timing stability at high levels of technological maturity, it is unlikely that these techniques will sustain further performance enhancements. Furthermore, the vulnerabilities of such techniques to jamming, spoofing, and other forms of interference are well established.

Ultracoherent optical sources and optical frequency combs brought about a paradigm shift in frequency and time metrology. In conjunction with powerful quantum-state preparation and manipulation techniques, these technologies have enabled precision optical-domain spectroscopy and timekeeping based on narrow-linewidth electronic transitions of various atomic species, with demonstrated precision currently in the 10^{-20} range – orders of magnitude beyond the performance of microwave-domain clocks. Simultaneously, optical time transfer techniques have demonstrated timing stability and synchronization down to a few femtoseconds. In addition to providing much-needed resilience and operability in GPS-denied conditions, the transition from microwave-domain to optical-domain timekeeping augurs a host of disruptive capabilities, including high-bandwidth optical communications and coherent sensor networks beyond the X-band. The superior performance of optical clocks could also support a burgeoning set of commercial applications that require increased connectivity, higher bandwidth, low latency, and beyond-GPS timing precision.

However, despite extensive efforts to enhance their technology readiness level (TRL), the most stable and accurate optical clocks still have significantly inferior environmental resilience, system-level integration, and size, weight, and power (SWaP) requirements than do microwave-domain timekeeping technologies. In broad strokes, this SWaP-performance tradeoff owes its origins to the extraordinarily high levels of isolation, quantum coherence, and shielding from environmental perturbations required to measure and stabilize optical clocks to narrow-linewidth electronic transitions at the fundamental limits of precision. These conditions are traditionally addressed by electromagnetic confinement and optical cooling of atomic ensembles to sub-microKelvin temperatures within ultrahigh-vacuum (UHV) chambers, followed by intermittent spectroscopic measurements to determine the clock frequency. Strategies to reduce the SWaP metrics of such systems usually come with tradeoffs like reduced levels of environmental isolation (and correspondingly degraded clock accuracy) and/or fewer atoms available for measurement (and correspondingly lower clock stability).

An alternate path to resilient, low-SWaP optical-domain timekeeping may be offered by the recent discovery of an optically addressable nuclear isomeric transition in thorium-229 (^{229m}Th) at the VUV wavelength of 148.382 nm. In contrast to electronic transitions, nuclear transitions benefit from orders of magnitude enhanced intrinsic isolation from external electromagnetic perturbations owing to the much smaller size of the nucleus and correspondingly smaller dipole and quadrupole moments. For similar reasons, large ensembles of "clock atoms" can be directly embedded as dopants within a suitable crystal host at room temperature without a significant degradation of the quality factor of the clock transition due to crystal-induced inhomogeneous shifts or broadening effects. In principle, such an all-solid-state implementation of a nuclear clock can circumvent the need for ultralow temperatures, UHV chambers, and sophisticated forms of environmental shielding.

Preliminary spectroscopic measurements and theoretical modeling of an all-solid-state nuclear clock suggest fractional clock instability in the 10^{-16}-10^{-17} range. However, precision optical spectroscopy of this nuclear transition is an essential next step to rigorously assess the viability and potential performance of a thorium-based nuclear clock. A key enabling technology for such spectroscopic studies, i.e., a high-coherence VUV optical source at the thorium wavelength, does not currently exist. This solicitation seeks to fill this technological void by developing such a coherent VUV optical source. It is anticipated that the optical sources developed during this program will enable high-resolution spectroscopy of the ^{229m}Th nuclear transition and an assessment of the potential performance of a thorium-based solid-state optical clock.

B. Program Description/Scope

Thorium-229 has attracted attention as a promising candidate for a nuclear clock[1] owing to its unique attributes, including (i) a low-energy isomeric transition that is within reach of state-of-the-art optical interrogation techniques, and (ii) a long radiative lifetime (estimated to be in the range of 10^3 – 10^4 seconds) and a correspondingly large quality factor for the clock transition (see Figure 1). After several years of research, this isomeric transition was recently measured at a VUV wavelength of 148.382 nm in ^{229}Th-doped crystals by several groups.[2] These studies have also enabled nascent inroads toward characterization of the radiative lifetime of the transition and crystal-induced energy shifts, line splittings, and inhomogeneous broadening mechanisms.[3] While currently limited by technical shortcomings such as inadequate optical power and poor

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[1] See, for example, E. V. Tkalya, *Excitation of the low-lying isomer level of the nucleus ^{229}Th by optical photons*, JETP Lett. 55, 211 (1992); E. V. Tkalya et al, *Processes of the nuclear isomer ^{229m}Th(3/2$^+$,3.5+/-1.0 eV) resonant excitation by optical photons*, Phys. Scr. 53, 296 (1996); E. Peik and C. Tamm, *Nuclear laser spectroscopy of the 3.5 eV transition in ^{229}Th*, Eur. Phys. Lett. 61, 181 (2003); P. G. Thirolf et al, *The thorium isomer ^{229m}Th: review of status and perspectives after more than 50 years of research*, Eur. Phys. J. Spec. Top. 233, 1113 (2024) and references therein; L. von der Wense and B. Seiferle, *The ^{229}Th isomer: prospects for a nuclear optical clock*, Eur. Phys. J. A 56, 277 (2020) and references therein.

[2] J. Thielking et al, *Laser spectroscopic characterization of the nuclear-clock isomer ^{229m}Th,* Nature 556, 321 (2018); B. Seiferle et al, *Energy of the ^{229}Th nuclear clock transition*, Nature 573, 243 (2019); S. Kraemer et al, *Observation of the radiative decay of the ^{229Th} nuclear clock isomer,* Nature 617, 706 (2023); J. Tiedau et al, *Laser excitation of the Th-229 nucleus*, Phys. Rev. Lett. 132, 182501 (2024); R. Elwell et al, *Laser excitation of the ^{229}Th nuclear isomeric transition in a solid-state host*, Phys. Rev. Lett. 133, 013201 (2024); C. Zhang et al, *Dawn of a nuclear clock*: *Frequency ratio of the ^{229Th} nuclear isomeric transition and the ^{87}Sr atomic clock,* Nature 633, 63 (2024); C. Zhang et al, *$^{229}ThF_4$ thin films for solid-state nuclear clocks*, Nature 636, 603 (2024)

[3] J. S. Higgins et al, *Temperature sensitivity of a Thorium-229 solid-state nuclear clock*, arXiv:2409.11590 (2024)

optical coherence, these preliminary measurements are sufficiently compelling to merit further development and characterization of this isomeric transition as a potential nuclear clock.

A number of essential questions remain to be answered before the potential performance of a solid-state thorium nuclear clock can be rigorously evaluated. While benefiting from a high degree of intrinsic isolation from external perturbations, the nuclear isomeric transition is nevertheless weakly susceptible to crystal-induced modifications of the transition energy. Broadly speaking, these modifications can lead to systematic errors in the clock frequency measurement that degrade the stability and accuracy of the clock.[4]

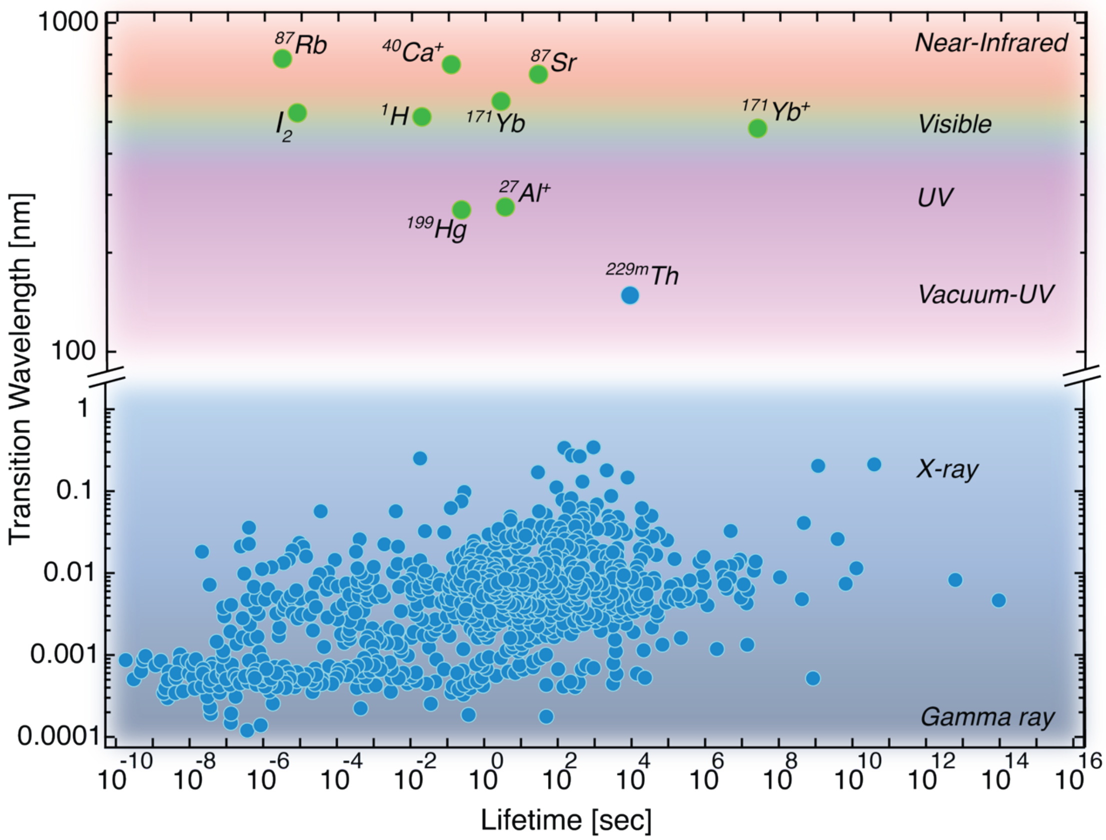

Fig 1: Optical transition wavelengths versus estimated radiative lifetimes for demonstrated optical clocks based on electronic transitions (green) in comparison to nuclear isomeric transitions (blue). The recently measured ^{229m}Th nuclear isomeric transition at an excitation wavelength of 148.382 nm is also shown. This solicitation seeks to develop coherent VUV optical sources to enable high-resolution spectroscopy of the ^{229m}Th nuclear transition for performance assessments of an all-solid-state implementation of a thorium-based optical clock.

While it is likely that such crystal-induced effects will preclude the use of a solid-state thorium nuclear clock as an absolute frequency standard, a compact portable clock with a fractional instability beyond the 10^{-16} range, especially if enabled by low-SWaP and integrated optical

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[4] See, for example, W. G. Rellergert et al, *Constraining the evolution of the fundamental constants with a solid-state optical frequency reference based on the ^{229}Th nucleus*, Phys. Rev. Lett. 104, 200802 (2010); G. A. Kazakov et al, *Performance of a ^{229}Th solid-state nuclear clock*, New J. Phys. 14, 083019 (2012); K. Beeks et al, *Fine-structure constant sensitivity of the Th-229 nuclear clock transition*, arXiv:2407.17300 (2024)

sources, would be a disruptive advance far beyond our current optical clock technologies. As such, these effects need to be accurately measured to enable performance estimates and mitigation schemes needed in a future thorium nuclear clock. As previously stated, this solicitation seeks proposals for the development of coherent VUV optical sources that can enable the first high-resolution spectroscopic measurements of the ^{229m}Th nuclear transition. Key aspects of clock-related measurements that need to be enabled by the proposed VUV optical sources include, but are not limited to:

- Energy shifts and splitting of the nuclear isomeric transition due to the interaction between the thorium nuclear quadrupole moment and the local crystal-induced electric field gradients
- Effects of local magnetic fields in inducing energy shifts, spin relaxation, and other line-broadening effects
- Isomeric energy shifts and quadrupole shifts arising from temperature variations (and the resulting crystal expansion and local strain variations) of the host crystal, and hence, the requisite levels of temperature stability to attain beyond-SoA clock performance
- Optimal spectroscopic interrogation and stabilization protocols that account for the large separation of scales between the intrinsic radiative lifetime of ^{229m}Th ($\gamma_r \sim 10^{-3}$ - 10^{-4} s^{-1}) and the crystal-induced decoherence rate ($\Gamma_c \sim 1000$ s^{-1})

Each of the aforementioned measurements can be enabled by a coherent VUV source that meets the SUNSPOT program metrics listed below. It is anticipated that DARPA will arrange for the proposed VUV sources to be calibrated and tested against appropriate Th-doped crystals. It is also anticipated that DARPA will arrange for the aforementioned spectroscopic measurements to be performed as part of a companion effort. As such, proposers are not required to include the intended spectroscopic studies as part of their proposal. However, proposers are encouraged to suggest potential collaborators who can aid in the spectroscopic evaluation of their VUV sources.

The need for compact sources of coherent VUV radiation goes beyond the context of this solicitation. Such sources can find immediate utility in diverse applications including high-resolution material studies, molecular spectroscopy, biomedicine, and nanolithographic systems for microelectronics. However, generating VUV radiation requires overcoming formidable challenges arising from the strong absorption, phase-matching limitations, and poor nonlinear conversion efficiencies of most nonlinear optical materials at these wavelengths. A variety of architectures have been proposed for VUV generation, including high harmonic generation in waveguide-confined rare gas vapors, cascaded frequency doubling or tripling in nonlinear optical materials, and metasurface-based nonlinear conversion processes.[5] The focus of SUNSPOT is to address the challenge posed by the combination of adequate optical power for excitation of the thorium ensemble and a sufficiently narrow linewidth to enable spectroscopic resolution commensurate with the intrinsic crystal-induced decoherence rates. Successful proposals must

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[5] See, for example, R. J. Jones et al, *Phase-coherent frequency combs in the Vacuum Ultraviolet via High-Harmonic generation inside a femtosecond enhancement cavity*, Phys. Rev. Lett. 94, 193201 (2005); T. Allison et al, *Extreme Ultraviolet radiation with coherence time beyond 1 second*, APS Div. At. Mol. Opt. Phys. (2014); J. Seres et al, *All-solid-state VUV frequency comb at 160 nm using high-harmonic generation in nonlinear femtosecond enhancement cavity*, Opt. Exp. 27, 6618 (2019); D. E. Couch et al, *Ultrafast 1 MHz vacuum-ultraviolet source via highly cascaded harmonic generation in negative-curvature hollow-core fibers*, Optica 7, 832 (2020); M. L. Tseng et al, *Vacuum ultraviolet nonlinear metalens*, Sci. Adv. 8, eabn5644 (2022)

present compelling analyses and justify that their proposed VUV source can meet the following metrics[6] for output power and linewidth:

Table 1: SUNSPOT program metrics

VUV source parameter	Program Metric
Output power (at ^{229m}Th transition wavelength of 148.382 nm)	>1μW
Linewidth	<30 Hz

Proposals must consider the program objectives, the desired spectroscopic studies that are required to be enabled by their proposed solution, and the program metrics listed in Table 1 when justifying their proposed approach. Proposers must provide a description of their approach, the architecture of their VUV source, and proof-of-concept data (as applicable). Proposals must include sufficient detail to enable assessment of the validity of their approach and the experimental feasibility of the proposed photonic architecture to meet SUNSPOT program metrics. At a minimum, proposals must include:

- A description of the proposed approach, the required research and development efforts, and a description of what will be developed and demonstrated during the period of the program. This description should be accompanied by a schedule of tasks and milestones that will be accomplished during the period of performance.
- Substantiation of the proposed VUV source and a detailed justification based on theoretical analysis, modeling, and proof-of-concept data (as applicable) that the proposed source can meet the program metrics.
- Identification of risks associated with the fabrication, development, and demonstration of the proposed VUV source in meeting program metrics. Risk mitigation strategies must be adequately described with clear statements of how the proposed research plan addresses the dominant risks early in the program.
- A detailed discussion of the SWaP metrics of the proposed VUV source, the dominant contributors to the SWaP budget, and the potential avenues for future reductions in these SWaP metrics via the use of nanophotonic nonlinear optical elements, miniaturization, and system-level integration of the components of the proposed VUV source. While quantitative SWaP metrics are not part of this solicitation, proposers must justify that their proposed VUV source, via such future system-level integration, can be made sufficiently compact as to be readily incorporated into a high-performance Th-based portable optical clock.

C. Schedule/Milestones

The SUNSPOT program is a 24-month effort consisting of a 12-month base period and a 12-month option. Proposers should specify the research and technology development schedule for the full period of performance. The Statement of Work (SoW) must provide a detailed task

[6] The program metrics were calculated based on the assumption of conventional fluorescence spectroscopy with interleaved periods of direct near-resonant optical excitation of the isomeric transition followed by fluorescence detection. Using a combination of estimated dielectric-enhanced radiative decay rates and crystal-induced decoherence rates, recently demonstrated parameters for ^{229}Th dopant concentrations ($3 \times 10^{19}/cm^3$) in a large bandgap crystal host, and conservative estimates for fluorescence collection efficiency and temperature stability, these metrics should enable an excitation rate $R \sim 50\ \gamma_r$, a spectroscopic resolution below the crystal-induced decoherence rates, and a fractional frequency instability in the $10^{-16} - 10^{-17}$ range over 1 h of measurement.

breakdown, citing specific tasks and their connection to interim milestones and metrics as applicable. Proposers should provide a technical and programmatic strategy conforming to the entire program schedule and present an aggressive plan to fully address all program goals, metrics, milestones, and deliverables. The task structure must be consistent across the proposed schedule, SoW, and cost volume.

Schedules will be synchronized across performers, as required, and monitored/revised as necessary throughout the program. A target start date of September 2025 may be assumed for planning purposes. The following metrics will serve as evaluation points during the course of the program, along with any additional metrics included in the proposal; proposers should incorporate these into the SoW. Performers' progress will be measured against the metrics shown in Table 1. Program reviews will take place at months 10 and 20 to assess performer progress against these metrics.

Meetings and Travel

- To foster collaboration between teams and disseminate program developments, a two-day Principal Investigator (PI) meeting will be held approximately every six months with locations split between the East and West Coasts of the United States. For budgeting purposes, plan for five two-day meetings over the course of 24 months: three meetings in the Washington, DC, area and two meetings in the San Francisco, CA, area.
- All proposals must also include the following meetings in the proposed schedule and costs:
    - Regular teleconference meetings will be scheduled with the Government team for progress reporting as well as problem identification and mitigation.
    - Proposers should anticipate at least one site visit per year by the DARPA Program Manager, during which they will have the opportunity to demonstrate progress toward agreed-upon milestones.

D. Deliverables

Performers will be expected to provide at a minimum the following deliverables:

- Comprehensive quarterly technical reports due within 10 days of the end of each quarter, describing progress made on the specific milestones as laid out in the SoW.
- A phase completion report submitted within 30 days of the end of each phase, summarizing the research done.
- Other negotiated deliverables specific to the objectives of the individual efforts. These may include registered reports; experimental protocols; publications; a data management plan; intermediate and final versions of software libraries, code, and APIs, including documentation and user manuals; and/or a comprehensive assemblage of design documents, models, modeling data and results, and model validation data.

SECTION II: EVALUATION CRITERIA

Proposals will be evaluated using the following criteria listed in **descending order of importance**.Overall Scientific and Technical Merit; Potential Contribution and Relevance to the DARPA Mission; and Cost and Schedule Realism.

- **Overall Scientific and Technical Merit**: The proposed technical approach is innovative, feasible, achievable, and complete. Detailed technical rationale is provided delineating why the proposed approach can achieve the program goals and metrics. The proposed technical team has the expertise and experience to accomplish the proposed tasks. Task descriptions and associated technical elements provided are complete and logically sequenced with all proposed deliverables clearly defined so the final outcome of the award's work achieves the goal. The proposal identifies major technical risks and planned mitigation efforts are clearly defined and feasible.

- **Potential Contribution and Relevance to the DARPA Mission**: The potential contributions of the proposed effort bolster the national security technology base and support DARPA's mission to make pivotal early technology investments that create or prevent technological surprise. The proposed intellectual property restrictions (if any) will not significantly impact the Government's ability to transition the technology.

- **Cost and Schedule Realism**: The proposed costs and schedule are realistic for the technical and management approach and accurately reflect the technical goals and objectives of the solicitation. All proposed labor, material, and travel costs are necessary to achieve the program metrics, consistent with the proposer's statement of work, and reflect a sufficient understanding of the costs and level of effort needed to successfully accomplish the proposed technical approach. The costs for the prime proposer and proposed sub-awardees are substantiated by the details provided in the proposal (e.g., the type and number of labor hours proposed per task, the types and quantities of materials, equipment and fabrication costs, travel, and any other applicable costs and the basis for the estimates). The proposed schedule aggressively pursues performance metrics in an efficient time frame that accurately accounts for the anticipated workload. The proposed schedule identifies and mitigates any potential schedule risk. It is expected that the effort will leverage all available, relevant, prior research to obtain the maximum benefit from the available funding. For proposals containing cost share, the proposer has provided sufficient rationale regarding the appropriateness of the cost share arrangement, relative to the objectives of the proposed solution (e.g., high likelihood of commercial application, etc.).

Unless otherwise specified in this announcement, for additional information on how DARPA reviews and evaluates proposals through the Scientific Review Process, please visit: Proposer Instructions: General Terms and Conditions.

SECTION III: SUBMISSION INFORMATION

- This announcement allows for multiple award instrument types to be awarded to include Procurement Contracts, Cooperative Agreements, and Other Transaction Agreements (Research and Prototype OTs). Some award instrument types have specific cost-sharing requirements. The following websites are incorporated by reference and contain additional information regarding overall proposer instructions, general terms and conditions, and each specific award instrument type.

  Proposers must review the following links:

  - **Proposer Instructions: General Terms and Conditions**: https://www.darpa.mil/work-with-us/proposer-instructions
  - **Procurement Contracts**: https://www.darpa.mil/work-with-us/procurement-contracts
  - **Assistance (Cooperative Agreements)**: https://www.darpa.mil/work-with-us/grant-cooperative-agreements
  - **Other Transaction agreements**: https://www.darpa.mil/work-with-us/other-transaction-agreements

  - Full proposals are due: March 13, 2025 at 4:00 PM as stated in the Overview section.

  - **Attachments A, B, C, and D** contain specific instructions and templates and constitute a full proposal submission for proposers requesting either Procurement Contracts or Other Transaction Agreements for Prototype.

  - **Attachments A, B, and D** contain specific instructions and templates and constitute a full proposal submission for proposers requesting a Cooperative Agreement or Other Transaction Agreement for Research.

  - Please visit Proposer Instructions: General Terms and Conditions for general Terms and Conditions for all requested contract types. Visit Proposer Instructions: Procurement Contracts for submission instructions for proposers requesting Procurement Contracts. Visit Proposer Instructions: Other Transactions for submission instructions for proposers requesting Other Transactions. Visit Proposer Instructions: Grants/Cooperative Agreements for submission instructions for proposers requesting Cooperative Agreements. (Proposers requesting Procurement Contracts or Other Transaction Agreements must submit proposals through the Broad Agency Announcement Tool. For proposers requesting a Cooperative Agreement, proposals must be submitted through grants.gov.)

  - **Model Other Transaction (OT) Agreement**: If an OT is proposed, proposers must complete and submit the Model Other Transaction (OT) for Prototype **(Attachment E)** or OT for Research **(Attachment F)**. Please complete/redline/edit the blue text within the model to the best of your knowledge.

- **BAA Attachments**:
  - **(required) Attachment A**: Proposal Summary Slide Template
  - **(required) Attachment B**: Proposal Instructions and Volume I Template (Technical and Management)

- **(required for proposers requesting Procurement Contracts or Other Transaction Agreements for Prototype) Attachment C**: Proposal Instructions and Volume II Template (Cost)
- **(required) Attachment D**: MS Excel™ DARPA Standard Cost Proposal Spreadsheet
- **(required for proposers requesting Other Transaction Agreements for Prototype) Attachment E:** Sample/Model OT(P) – Fixed Support Nontraditional
- **(required for proposers requesting Other Transaction Agreements for Research) Attachment F:** Sample/Model OT(R) – Fixed Support Company

SECTION IV: SPECIAL CONSIDERATIONS

- This announcement, stated attachments, and websites incorporated by reference constitute the entire solicitation. In the event of a discrepancy between the announcement, attachments, or websites, the announcement takes precedence.
- All responsible sources capable of satisfying the Government's needs, including both U.S. and non-U.S. sources, may submit a proposal that shall be considered by DARPA. Historically Black Colleges and Universities, Small Businesses, Small Disadvantaged Businesses and Minority Institutions are encouraged to submit proposals and join others in submitting proposals; however, no portion of this announcement will be set aside for these organizations' participation due to the impracticality of reserving discrete or severable areas of this research for exclusive competition among these entities. Non-U.S. organizations and/or individuals may participate to the extent that such participants comply with any necessary nondisclosure agreements, security regulations, export control laws, and other governing statutes applicable under the circumstances.
- As of the time of publication of this solicitation, all proposal submissions are anticipated to be unclassified.
- DARPA encourages technical solutions from all responsible sources capable of satisfying the government's needs. To ensure fair competition across the ecosystem, DARPA prohibits contractors/performers from concurrently providing Systems Engineering Technical Assistance (SETA), Advisory and Assistance Services (A&AS), or similar support services and being a technical performer, unless the DARPA Deputy Director grants a written waiver. DARPA extends this prohibition to University-Affiliated Research Centers (UARCs) and Federally Funded Research and Development Centers (FFRDCs) including National Labs, who as a result of their specialized expertise and areas of competencies, are able to accomplish integral tasks that cannot be met by government or contractor resources. Therefore, these entities are highly discouraged from proposing against this solicitation as award to a UARC or FFRDC will only be made by exception. UARCs and FFRDCs interested in this solicitation, either as a prime or a subcontractor, should contact the Agency Point of Contact (POC) listed in the Overview section prior to the proposal (or abstract) due date to discuss potential participation as part of the government team or eligibility as a technical performer.
- As of the date of publication of this solicitation, the Government expects that program goals as described herein may be met by proposers intending to perform fundamental research and does not anticipate applying publication restrictions of any kind to individual awards for fundamental research that may result from this solicitation. Notwithstanding this statement of expectation, the Government is not prohibited from considering and selecting research proposals that, while perhaps not qualifying as fundamental research under the foregoing definition, still meet the solicitation criteria for submissions. If proposals are selected for award that offer other than a fundamental research solution, the Government will either work with the proposer to modify the proposed statement of work to bring the research back into line with fundamental research or else the proposer will agree to restrictions in order to receive an award. For additional information on fundamental research, please visit Proposer Instructions: General Terms and Conditions.

- Proposers should indicate in their proposal whether they believe the scope of the research included in their proposal is fundamental or not. While proposers should clearly explain the intended results of their research, the Government shall have sole discretion to determine whether the proposed research shall be considered fundamental and to select the award instrument type. Appropriate language will be included in resultant awards for non-fundamental research to prescribe publication requirements and other restrictions, as appropriate. This language can be found at http://www.darpa.mil/work-with-us/additional-baa.

- For certain research projects, it may be possible that although the research to be performed by a potential awardee is non-fundamental research, its proposed sub-awardee's effort may be fundamental research. It is also possible that the research performed by a potential awardee is fundamental research while its proposed sub-awardee's effort may be non-fundamental research. In all cases, it is the potential awardee's responsibility to explain in its proposal which proposed efforts are fundamental research and why the proposed efforts should be considered fundamental research.

- DARPA's Fundamental Research Risk-Based Security Review Process (formerly CFIP) is an adaptive risk management security program designed to help protect the critical technology and performer intellectual property associated with DARPA's research projects by identifying the possible vectors of undue foreign influence. DARPA will create risk assessments of all proposed senior/key personnel selected for negotiation of a fundamental research grant or cooperative agreement award. The DARPA risk assessment process will be conducted separately from the DARPA scientific review process and adjudicated prior to final award. For additional information on this process, please visit Proposer Instructions: Grants/Cooperative Agreements.

- The APEX Accelerators program, formerly known as the Procurement Technical Assistance Program (PTAP), focuses on building strong, sustainable, and resilient U.S. supply chains by assisting a wide range of businesses that pursue and perform under contracts with the DoD, other federal agencies, state and local governments, and government prime contractors. See www.apexaccelerators.us/ for more information.

  APEX Accelerators helps businesses:
  - Complete registration with a wide range of databases necessary for them to participate in the government marketplace (e.g., SAM).
  - Identify which agencies and offices may need their products or services and how to connect with buying agencies and offices.
  - Determine whether they are ready for government opportunities and how to position themselves to succeed.
  - Navigate solicitations and potential funding opportunities.
  - Receive notifications of government contract opportunities on a regular basis.
  - Network with buying officers, prime contractors, and other businesses.
  - Resolve performance issues and prepare for audit, only if the service is needed, after receiving an award.

- Project Spectrum is a nonprofit effort funded by the DoD Office of Small Business Programs to help educate the Defense Industrial Base (DIB) on compliance. Project Spectrum is vendor-neutral and available to assist businesses with their cybersecurity and compliance needs. Their mission is to improve cybersecurity readiness, resilience, and compliance for small/medium-sized businesses and the federal manufacturing supply chain. Project Spectrum events and programs will enhance awareness of cybersecurity threats within the manufacturing, research and development, and knowledge-based services sectors of the industrial base. Project Spectrum will leverage strategic partnerships within and outside of the DoD to accelerate the overall cybersecurity compliance of the DIB.

www.projectspectrum.io is a web portal that will provide resources such as individualized dashboards, a marketplace, and Pilot Program to help accelerate cybersecurity compliance.

- DARPAConnect offers free resources to potential performers to help them navigate DARPA, including “Understanding DARPA Award Vehicles and Solicitations”, “Making the Most of Proposers Days”, and “Tips for DARPA Proposal Success”. Join DARPAConnect at www.DARPAConnect.us to leverage on-demand learning and networking resources.
- DARPA has streamlined our Broad Agency Announcements and is interested in your feedback on this new format. Please send any comments to DARPAsolicitations@darpa.mil.