FUNDING OPPORTUNITY ANNOUNCEMENT
OVERVIEW INFORMATION

FISCAL YEAR 2023

"Materials Characterization and Quantum Performance: Correlation and Causation (MQC)"

FOA-AFRL-AFOSR-2023-0010

FULL PROPOSAL DEADLINE

19 JUN 2023, at 11:59 PM Eastern Time

SPECIAL NOTE: The MQC program is a stand-alone opportunity. Applications must be 'VALIDATED' by Grants.gov by the application deadline, which can take up to 48 hours after successful submission. See Timely Receipt Requirements and Proof of Timely Submission.

INQUIRES AND QUESTION DEADLINE

14 APR 2023

OVERVIEW INFORMATION

This is a special Funding Opportunity Announcement (FOA) sponsored by the Air Force Office of Scientific Research (AFOSR), which will hereafter generally referred to as "we, us, our, or AFOSR". AFOSR recognizes that future areas of research may not fall within its existing portfolio structure and has thus initiated the "Materials Characterization and Quantum Performance: Correlation and Causation (MQC)" Program, which is focused on the topic area of Material Science for Quantum Information Science.

AFOSR anticipates awards in the amount of $500,000 to $2,000,000 per year per award for a maximum of four (4) years. All awards are contingent on availability of funds.

Proposers are encouraged to confer with the designated AFOSR Program Officer(s) prior to submitting a full proposal. We will evaluate proposals using an internal review panel. AFOSR reserves the right to select and fund all, some, or none of the proposals from any of the topics below. AFOSR provides no funding for direct reimbursement of proposal development costs. Technical and budget proposals (or any other material) submitted in response to this FOA will not be returned. It is the policy of AFOSR to treat all white papers and proposals submitted under this FOA as sensitive competitive information and to disclose their contents only for the purposes of evaluation.

White papers briefly summarizing the proposers' ideas are highly encouraged but not required. Submit white papers to our whitepaper portal, which is linked below. The topic points of contact (POCs) will coordinate to provide feedback to white papers.

The proposals will need to include a data management plan, outlining how samples and data collected in the program will be stored and managed. This includes but is not restricted to issues such as: standards for data and metadata collection, content and format, data archiving, database management, and data sharing within, and outside the awardee and beyond the lifetime of the grant. This precondition is modeled on the National Science Foundation Data Management Plan requirement (e.g., https://nsf.gov/eng/general/ENG_DMP_Policy.pdf).

IMPORTANT NOTE: Applicants should be alert for any amendments that may modify the announcement. Amendments to the original funding opportunity announcement (FOA) will be posted to the Grants.gov Webpage: https://www.grants.gov/.

Hyperlinks have been embedded within this document and appear as underlined, and or blue-colored words in the midst of paragraphs. The reader may "jump" to the linked section within this document by "clicking" (CTRL + CLICK, or CLICK).

SUMMARY FUNDING OPPORTUNITY INFORMATION

1. FEDERAL AWARDING AGENCY NAME
Air Force Office of Scientific Research
875 North Randolph Street, STE 325, Room 3112
Arlington, VA 22203

2. FUNDING OPPORTUNITY TITLE
Fiscal Year (FY) 2023 "Materials Characterization and Quantum Performance: Correlation and Causation (MQC)"

3. ANNOUNCEMENT TYPE
Initial Announcement

4. FUNDING OPPORTUNITY NUMBER
FOA-AFRL-AFOSR-2023-0010

5. CATALOG OF FEDERAL DOMESTIC ASSISTANCE (CFDA) NUMBER
12.800 Air Force Defense Research Sciences Program

6. KEY DATES
Pre-proposal inquiries and questions must be received in writing by electronic mail to the address(es) listed under section G._AGENCY_CONTACTS of this FOA, not later than **14 APR 2023 at 11:59 PM Eastern Time** to be considered. The Government will respond to any pre-proposal inquiries or questions either directly or via public posting no later than COB on **21 APR 2023**. The Program Officers that are involved in this FOA will be holding a Proposer's Day session to answer questions in real-time and provide answers in real time. This Proposer's Day will be held on **21 APR 2023. Registration for this event is mandatory.** In order to register for this Proposer's Day, please visit the following link: https://afosr.gov1.qualtrics.com/jfe/form/SV_3awUktj83b7PITc

White papers must be received by submitting to https://community.apan.org/wg/afosr/p/submitawhitepaper by **01 MAY 2023 at 11:59 PM Eastern Time** to be considered.

Government will respond on white paper determination on or before COB on **22 MAY 2023**.

Proposals must be received electronically through Grants.gov by **19 JUN 2023 at 11:59 PM Eastern Time** to be considered.

We anticipate that we will notify proposers, via electronic mail, of selection or non-selection for award no later than 17 JULY 2023.

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A. PROGRAM DESCRIPTION

The Air Force Office of Scientific Research (AFOSR) in collaboration with the Laboratory for Physical Sciences (LPS) is soliciting proposals for the "Materials Characterization and Quantum Performance: Correlation and Causation" (MQC) program. The topic areas that we seek to support with this FOA are independent from those described in our open BAA entitled "Research Interests of the Air Force Office of Scientific Research" and do not fall completely within any one research program. We seek to support multidisciplinary research efforts, creating synergies to speed DoD-relevant research and development.

Basic research and applied research are defined in the DoD Financial Management Regulation:

Basic research is systematic study directed toward greater knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications towards processes or products in mind. It includes all scientific study and experimentation directed toward increasing fundamental knowledge and understanding in those fields of the physical, engineering, environmental, and life sciences related to long-term national security needs. It is farsighted high payoff research that provides the basis for technological progress (DoD 7000.14-R, vol. 2B, chap. 5, para. 050201.B).

Applied research is systematic study to understand the means to meet a recognized and specific need. It is a systematic expansion and application of knowledge to develop useful materials, devices, and systems or methods. It may be oriented, ultimately, toward the design, development, and improvement of prototypes and new processes to meet general mission area requirements. Applied research may translate promising basic research into solutions for broadly defined military needs, short of system development. This type of effort may vary from systematic mission-directed research beyond that in Budget Activity 1 to sophisticated breadboard hardware, study, programming, and planning efforts that establish the initial feasibility and practicality of proposed solutions to technological challenges. It includes studies, investigations, and non-system specific technology efforts. The dominant characteristic is that applied research is directed toward general military needs with a view toward developing and evaluating the feasibility and practicality of proposed solutions and determining their parameters. Applied research precedes system specific technology investigations or development. Program control of the applied research program element is normally exercised by general level of effort. Program elements in this category involve pre-Milestone B efforts, also known as Concept and Technology Development phase tasks, such as concept exploration efforts and paper studies of alternative concepts for meeting a mission need (DoD 7000.14-R, vol. 2B, chap. 5, para. 050201.C).

Detailed descriptions and the government point(s) of contact can be found below in Section G.1. The descriptions are intended to provide the applicant a frame of reference and are not meant to be restrictive to the possible approaches and component solutions to achieving the goals of the topic and the program. Innovative ideas addressing these research topics are highly encouraged.

Proposals from an investigator team from multiple university departments and universities are warranted to assemble the expertise necessary to address the topics. Teams are also highly encouraged to leverage industry collaborations, where appropriate, to demonstrate an ability to

develop solutions that can be eventually applied to a specific application. Proposals shall name one Principal Investigator (PI) as the responsible technical point of contact. Similarly, one institution shall be the primary awardee for the purpose of award execution. The PI shall come from the primary institution. The relationship among participating institutions and their respective roles, as well as the apportionment of funds including sub-awards, if any, shall be described in both the proposal text and budget.

1. SUMMARY

The Air Force Office of Scientific Research (AFOSR), in collaboration with the Laboratory for Physical Sciences (LPS), is soliciting proposals for the "Materials characterization and Quantum performance: Correlation and causation" (MQC) program. This program takes a "materials-first" approach to improving stability and reproducibility of state-of-the-art quantum bits (qubits). MQC focuses on solid-state qubits, for use in gate-based quantum computing, built from *semiconductor*- and *superconductor* material systems. Of particular interest are Si-based gate defined quantum dots or Josephson junction-based quantum circuits (see section 3 for more details). More specifically, the goal of the research to-be-funded under this FOA is to identify correlations between qubit performance metrics and material properties (see section 4 for examples), where the main focus is on identifying material properties which can be characterized in a high throughput and precise manner. In addition, an equally important goal is to identify the underlying physical mechanisms giving rise to these correlations. These mechanisms shall be supported by detailed material characterization measurements as well as material micro-structure and device modeling efforts.

To achieve these goals, the primary approach shall be to implement multiple steps in a closed loop (see figure 1), starting with theory and modeling, followed by material synthesis, detailed characterization, device fabrication, final characterization and device measurement, before feeding back to material modeling once more (see section 2 for a more complete description of each step of the loop). The material characterization steps are of particular importance to achieve the goals of this FOA.

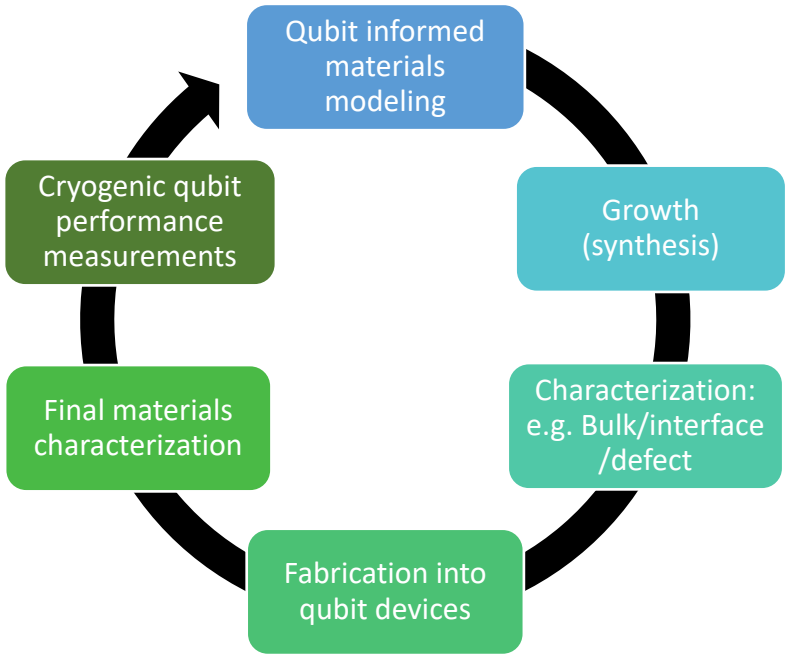

Figure 1: Loop illustrating each step required to correlate qubit performance metrics with material parameters

Material and device modeling shall play an essential part of each step of the loop. If successful and the loop is closed, resulting in the identification of correlations between qubit metrics and material properties along with supporting modeling, it is anticipated that these characterization techniques can be deterministically used as a proxy to predict qubit performance levels, and furthermore, accelerate the identification and elimination of material "bottlenecks" to improve qubit performance. This approach is a departure from empirical methods which aim to improve qubit performance without identification of precise correlations with material properties. To be clear, this program does not aim for incremental qubit performance improvements, but rather seeks to create a fundamental understanding of correlations between qubit performance metrics and material properties, which may originate from disorder and defects within the constituent materials. Hence, one possible approach is to alter the qubit design to be purposefully sensitive to particular material parameters, and thus intentionally degraded by material sources of loss or noise, in order to investigate mechanisms and causes for material-dependent qubit performance. Such methodology would greatly accelerate evaluation and optimization of new materials, fabrication techniques or growth processes without resorting to expensive and time-consuming qubit measurements. An alternative methodology that proposers may utilize, is to build qubit proxies (see next section) which have proven links to qubit metrics but are more easily measurable and thus could provide higher throughput feedback to material characterization techniques.

Multidisciplinary Approach with Interdependency of tasks:

The scientific challenge of understanding the interplay between qubit performance metrics and material properties, is inherently complex and multifaceted. Therefore, a comprehensive multidisciplinary approach to material characterization, theory, modeling, materials synthesis, device fabrication, and quantum device characterization, is an essential aspect of proposals to this FOA. The program structure necessitates a multi-disciplinary multi-PI team with a materials-led approach to cover and integrate the different aspects of loop variation proposed (i.e., material choices, qubit types, modeling approach etc.).

2. BACKGROUND AND FURTHER DETAILS

A critical qubit performance metric is the duration quantum information can persist once encoded. The loss of this encoded information is often described by two parameters, coherence time (T_2) and relaxation time (T_1) (see section 4 for definitions). What's more, noise present during gate operations can limit the accuracy to which this quantum information can be manipulated once encoded, often described by fidelity metrics. These loss and noise limitations may have origins in the surrounding materials and interfaces and their associated microstructure (such as two-level-system defects or other sources of charge or flux noise) that are phenomenologically categorized but not well understood. Currently lacking are direct correlations between specific defects, interface non-idealities, or other material related properties, and their impacts on qubit performance. Once identified, these correlations could lead to the identification of the root causes of performance loss originating from underlying solid-state materials, which in-turn could inform subsequent targeted mitigation for the ultimate goal of improved qubit performance.

Fortunately, there is a significant research history in disorder and material defects that has yielded accumulated know-how for the electronics industry. Such material defects include vacancy agglomerations, dislocations, unbalanced charge regions, sublattice phase boundaries, anti-phase boundaries, stacking faults, and others. Other material properties that also influence performance include electro-magnetic, optical, acoustic, and thermal properties. However, correlating these material properties and their relationship to quantum computing qubit metrics remains elusive. Correlating the broad range of materials properties listed above with semiconductor device performance

has yielded practical advancements for classical electronics technology. This FOA aims to provide such links for solid-state quantum computing systems.

In the quantum realm there have been a few recent examples linking material characterization with qubit performance. For example, linking the oxide on superconducting films with qubit loss[1] has led to a means to optimize the superconductor and resulting oxide, resulting in record lifetimes. This research implemented models that informed device design to be sensitive to specific sources of loss. The research employed materials science characterization tools to study interfaces and used quantum characterization of devices to correlate with materials characterization results.

Qubits are typically measured in low numbers and close to absolute zero at mK temperatures. The ideal material characterization procedure would be high throughput and would occur at easily obtainable environmental conditions. Similarly, qubit proxies may be designed and optimized to provide high-throughput feedback to the material characterization steps.

Device Proxies:

Proxies are defined as test structures that enable the evaluation of specific synthesis techniques, processing methods or device constituent materials and structure (e.g., interfaces) *without having to fabricate and test a full quantum device under appropriate operating conditions*. Proxy performance can then be correlated with material characterization techniques. Frequently used examples include superconducting resonator quality factors (Q) or transport measurements in quantum dots [2]. Avoiding the need to fabricate entire qubit devices, and perhaps avoiding cryogenic testing, could be a valuable means to accelerate the identification of correlations.

Material Development Loop:

The material development loop consists of the following steps:

1. **Qubit-Informed Materials Modeling:** As stated above, a core goal of the research to be funded under this FOA is to uncover the physical root cause of identified correlations between material properties and qubit performance metrics. This requires detailed material-centric modeling and simulation, supporting the data, to link each step of the loop. This program may involve leveraging Density Functional Theory (DFT) as well as the development of new computational tools. Other, examples include, but are not limited to, ab-initio atomistic simulations or quantum Monte Carlo techniques, the propagation of atomistic and electronic information across multiple length scales into a device description of qubits and their errors and spatio-temporal noise modeling. Furthermore, modeling may be required to predict the expected behavior of fabricated qubit and proxy devices, with attention to correlations with materials properties. Note, modeling may apply to any step of the loop but importantly shall aim to link well characterized material properties to the resulting qubit or proxy performance metrics.

2. **Growth (synthesis):** Growth refers to epitaxial and thin film growth of materials or hetero-structures of interest: exploration of various growth techniques, variation of growth parameters, exploration of

[1] https://arxiv.org/pdf/2301.07848.pdf, https://iopscience.iop.org/article/10.1088/0953-2048/29/6/064003, https://journals.aps.org/prxquantum/abstract/10.1103/PRXQuantum.3.020312, https://aip.scitation.org/doi/full/10.1063/1.4893297, https://iopscience.iop.org/article/10.1088/0953-2048/29/4/044001

[2] Mi PRB V92 p035304 (2015), https://journals.aps.org/prb/abstract/10.1103/PhysRevB.92.035304

controlled growth to tailor material composition and dopants, interfaces with differing relative orientations, and material phases. It is expected that technical advances in equipment and processes used to produce these materials may be required; therefore, other approaches not listed here are welcome.

3. **Bulk/interface/defect characterization:** This is a key step and may employ traditional material characterization techniques such as, but not limited to Nuclear Magnetic Resonance/Electron Spin Resonance (NMR/ESR), X-ray or Ultraviolet photoelectron spectroscopy (XPS/UPS), Angle-resolved photoemission spectroscopy (ARPES), Raman Spectroscopy, EDS, Transmission Electron Microscopy/Electron Energy Loss Spectroscopy (TEM/in-situ EELS), Scanning Tunneling Microscopy (STM), Scanning Electron Microscopy (SEM), Photoluminescence Spectroscopy (PL), X-ray diffraction (XRD), X-ray fluorescence (XRF), Atomic Force Microscopy (AFM), Magnetic Force Microscopy (MFM), THz- Electron Paramagnetic Resonance (EPR) ellipsometry, Hard X-ray Photoelectron Spectroscopy (*HAXPES*), Polarized Neutron Reflectometry (PNR), Deep level transient spectroscopy (DLTS), Ellipsometry, 4 point probe, mercury probe, or the development of targeted material characterization techniques. Qubits require a high degree of precision in material thickness and crystal structure; therefore, advancements in fabrication tools with *in-situ* characterization capabilities and characterization tools that extend sensitivity floors beyond the current state-of-the-art are areas of interest. In addition, the development of novel or unconventional characterization techniques targeted to extract specific qubit-relevant parameters is of relevance to this FOA.

4. **Fabrication:** For the purposes of the research contemplated under this FOA, fabrication means any processing which moves from pristine grown substrates, hetero-structures and films to functioning qubit or qubit proxy devices, such as Josephson junctions (JJ) arrays, Metal Oxide Semiconductor (MOS) Capacitors, or Hall bars. Example fabrication steps include, chemical or plasma based etches, optical or e-beam lithography, deposition of metals/oxides, and interface/surface cleaning procedures. Furthermore, characterization techniques deployed throughout the fabrication process (in-line) may be relevant and directly applicable to uncovering correlations with qubit performance metrics introduced by processing in films, interfaces, bulk oxides, etc.

5. **Final materials characterization:** After fabrication, basic material parameters will likely have changed (e.g., surface contamination, oxidation etc.) and new defects and interfaces may be introduced. Final characterization complements step number 3 and these two characterization steps allow comparison of materials properties done before and after fabrication is completed. It is expected that additional characterization techniques will be employed at this step such as destructive testing of completed devices, or targeted characterization of critical circuit elements.

6. **Qubit and/or proxy device performance measurements:** This step involves dicing the wafer, packaging the qubit and/or proxy device and measurement, potentially at cryogenic temperatures. Qubit and/or proxy device metrics are extracted at this stage employing techniques such as lifetime measurements, noise spectroscopy, analysis of spatiotemporal noise and drift as well as randomized benchmarking or other quantum state tomographic techniques. In some cases, devices that have iterated around the loop may undergo further materials characterization in order to perform destructive or non-destructive characterization of devices to further identify correlations between qubit and material properties.

Sub-loops:

While full proposals shall propose to each step of the loop, approaches *initially* involving "sub-loops" are encouraged, where only part of the loop is focused on to prove out a concept or to optimize a step. For full proposals (see next section) information learned during such "sub-loops" shall then be incorporated into later full runs through the loop. For example, only part of the quantum device may be fabricated to focus characterization techniques on certain defects, interfaces, or films in the device structure.

White paper evaluation is meant to initially assess the merits of a proposed effort relative to the goals of this FOA and to provide feedback to the full proposal process. The white paper process is NOT a selection process. White papers must be no more than five (5) pages in length. References and CV/bios will not count against the page limit. White papers should minimally articulate:

1. An initial list of members of the proposed team with a complete bio or CV for each (CVs and/or bios will not count against page limit)
2. Each Bio/CV must include all publications by the proposed member.
3. Current & Pending Support (no page limit; will not count against page limit): Applicants are required to provide information on all current and pending support for ongoing projects and proposals, including subsequent funding in the case of continuing contracts, grants, and other assistance agreements. Applicants shall provide the following information of any related or complementary proposal submissions from whatever sources (e.g., AFOSR, Federal, State, local or foreign government agencies, public or private foundations, industrial or other commercial organizations).
4. The main technical components of the proposed research and how it aligns with the goals of the solicitation.
5. The specific proposed activities with a demonstrated understanding of the basic science needs.

3. GUIDELINES FOR PROPOSALS

Proposals submitted to this program must clearly define the qubit metrics being correlated with as well as targeted material properties and shall provide quantitative milestones to demonstrate progress toward demonstrating reproducible correlations. See section 4 for example lists of such metrics and properties. The proposed milestones must be relevant to gate-based, fault-tolerant approaches to quantum computing. Additionally, a multi-disciplinary multi-PI team is encouraged with expertise in each step of the loop proposed, to minimally include both material science and qubit technology and should also include material modeling, synthesis, characterization, device fabrication, and final characterization and qubit measurements.

Proposal types:
This FOA is soliciting proposals for two different types of projects: **Incubator and Full-Loop**.

Incubator Proposals:

Incubator proposals shall propose targeted proof-of-concept studies over a 1 to 2-year period, aimed at motivating the development of a future full-loop, larger team effort. Example topics include the development of novel material characterization techniques focused on specific material properties, modeling efforts and the validation of such models or novel synthesis techniques of qubit relevant materials. Incubator proposals must propose and motivate a "go/no-go" decision after no more than 2-years of investigation. Theory and simulation incubator proposals will also be considered. Following a

successful incubator proposal that reaches a "go" decision, transition to a full loop proposal will involve organizing a larger multi-disciplinary team and submitting a new proposal when encouraged by AFOSR.

Incubator (sub-loop) proposal requirements:

1. Are limited to a sub-loop
2. Approaches shall be materials focused. Proposals only involving qubit measurements will not be considered.
3. Shall include a proof-of-concept characterization technique, experiment, simulation and/or modeling effort to form the basis of a full-loop proposal later.
4. Shall propose clear performance milestones as "go/no-go" criteria to motivate formation of a full loop proposal. White papers are encouraged to receive feedback from the USG on proposed go/no-go criteria.
5. Limited to $500K/year for up to 2 years. One (1) year efforts will also be considered, if well-motivated.

Full-Loop Proposals:

"Full Loop" proposals shall provide a detailed plan for research along the complete loop from material modeling and synthesis to detailed characterization, device fabrication and qubit measurements. Full loop research is expected to have a performance period of four (4) years. The goal of the first 2 years is to identify fundamental correlations between material properties and qubit performance metrics. The nature of these correlations shall be uncovered, and methods derived to elucidate the microscopic nature of the correlation and to rule out indirect or unanticipated side effects that may be misconstrued as a correlation. Using these correlations and the insight into root causes, the final 2 years shall broaden and capitalize on the identified correlations. Example directions include exploring the material property range over which such correlations persist, their spatio-temporal properties, and could include optimization of materials to improve qubit performance (for full list of interest areas see next paragraph). Proposals must detail not only the plans for establishing correlations but also the directions for research once correlations are found. While the objectives for the first 2 years of the proposal must be detailed and quantitative, the proposing team's objectives for the final 2 years are at the discretion of the proposers, depending on the nature of the correlations uncovered. These objectives must support the overall goals of the research contemplated by this FOA: identification of correlations between qubit performance metric and material properties and developing an understanding of the underlying physical mechanisms. The proposal shall include a risk assessment and mitigation plan.

Full Loop proposal requirements:

1. Proposals must identify a multi-disciplinary team with sufficient expertise to conduct all steps along the complete loop as shown in figure 1, with a materials-science led approach. Expertise required includes material and device modeling, synthesis, characterization, device fabrication, final device characterization, and qubit or proxy measurements.

2. Proposals shall detail how each team member will contribute to a step(s) of the loop and how the team will work together to execute a cohesive research plan to identify correlations by iterating around the loop. Furthermore, the proposal shall describe how data are to be shared and analyzed amongst team members and how data will be used to inform each step of the loop leading to significant advancement in the knowledge of materials impact on qubit performance.

3. Proposals shall adhere to the following yearly guidance:
   a) Years 1 and 2: Identification of correlation(s) and studies (which shall include modeling and/or simulation) to understand causal and physical nature of correlation.

b) Years 3 and 4: Deeper exploration of correlations with "stretch-goals" on improving qubit performance. "Stretch-goals" are not required but will be considered if proposed.
   i) Identification of further correlations or secondary effects
   ii) Exploration of the range of material properties over which correlations persist
   iii) Detailed measurements of time-domain fluctuations of material properties and correlation with qubit metric fluctuations
   iv) Examination of range of material properties (due to uncontrollable variations in the growth and fabrication process) and associated qubit metric spreads
   v) Optimization of material properties to illustrate improved qubit performance levels e.g., growth conditions, interface quality, defect densities etc.
   vi) "Stretch-goal": After deeper exploration of correlations and optimization work, exploration of novel materials, growth, or fabrication methods motivated by discovered correlations to enhance qubit metric are of interest in this FOA.
   vii) "Stretch-goal": If identified correlations are unavoidable and if no known material-based approach can overcome detrimental effects on qubit metrics due to identified material properties, then the development of designs and techniques to reduce sensitivity to such material properties are of interest to this FOA.

4. Full proposals are limited to yearly funding levels of $2,000/1,750/1,500/1,500 K/year for years 1/2/3/4. The majority of equipment purchases, and proposed lab build-up shall be proposed in the first year of the program.
5. Full proposal shall detail how material characterization efforts will be linked with qubit performance metrics. Proposals shall specify which material properties and which qubit metrics the proposal will focus on along with quantitative values/targets. Example metrics and properties are provided in section 4. These lists, however, are by no-means exhaustive. Furthermore, the full proposal shall identify at which step in the loop the proposed characterization occurs and the environmental conditions required for such characterization.
6. Full proposals shall describe how qubits or qubit proxies will be designed to focus on target material, interface, or defect property of interest. Devices shall be designed to emphasize material parameters under investigation. If alternative sensors or proxies are employed instead, full proposals shall describe why sensor sensitivity is a good proxy for qubit performance.
7. Full proposal shall detail which qubit and associated material system is the primary focus, as well as the range of materials applicable to the targeted loop. Furthermore, the proposal shall identify the location(s) in the device (e.g., specific interface), and materials property types of interest. If unknown, the proposal must identify a path to uncovering the leading property (e.g., which interface, what kind of defect, what bulk metric).
8. Examples of qubits and materials of interest include:
   a) Superconducting circuits:
      i) Substrates: Silicon, sapphire, silicon nitride, silicon-on-insulator etc.
      ii) Superconducting material: Aluminum, Niobium, Tantalum, Titanium Nitride, etc.
      iii) Insulators: Aluminum oxide, silicon oxide, etc.
      iv) Interfaces between substrate and superconductor, within a Josephson junction, between substrate and air etc.
      v) Defects in Josephson junction, oxides etc.
   b) Si-based quantum dots:
      i) Heterostructure: SiGe/Si/SiGe; SiGe/Ge/SiGe; metal-on-oxide (Si-MOS)
      ii) Gate Materials: Aluminum, doped-Polysilicon, etc.
      iii) Insulators: Aluminum oxide, silicon nitride, silicon oxide, etc.
      iv) Interfaces: Gate to insulator, insulator to heterostructure, epitaxial interfaces between Si/SiGe, etc.

4. FURTHER PROPOSAL GUIDANCE

Teams must propose quantitative qubit metrics and material properties. This section provides example qubit performance metrics and material properties of particular interest to this FOA. The following lists should not be considered exhaustive, and teams may propose alternative qubit metrics and material properties, along with clear justification for the proposed selection.

Example qubit metrics of interest:

- **Lifetimes**: The longitudinal relaxation time, T_1, is the decay constant for the recovery of qubit state towards its thermal equilibrium value. The transverse relaxation time, T_φ, is the decay constant for a prepared superposition state of a qubit to lose phase coherence.
- **Gate fidelities**: Quantum gate fidelities refer to the accuracy of a control to perform the desired action on a quantum system. Typical fidelities are single and two qubit gate fidelities, which are commonly used for generating superposition states and entangled states respectively.
- **Time fluctuations**: Characteristic qubit properties like T_1, T_2, or intrinsic control parameters such as qubit control frequency, can fluctuate on time scales much longer than T_1. The sources of these fluctuations, or indeed faster fluctuation on time-scales of gate operations, are poorly understood at this time and may have material origins.
- **Spatial fluctuations**: Macro fluctuations in control and/or noise that span many qubits can result in spatially correlated errors across many qubits. Spatial fluctuations could also include spatial material and fabrication variations that cause varying error rates spatially across a chip.

Example material properties of interest:

- **Defects:** Examples include defects at interfaces, surfaces, in the bulk or in specific sub-components e.g. in Josephson junction barrier or in quantum well structures. Properties include type, density, charge interactions, spin, and confinement properties.
- **Surface or interface composition:** Specific interest in buried interfaces with issues such as oxides, intermixing, contaminants etc.
- **Microstructure and crystallinity:** Areas of interest include microstructure at grain boundaries or in domains, morphology, and anisotropy.
- **Spatio-temporal variations**: Time and spatially dependent changes in defects and/or contaminant locations and associated electromagnetic properties.

5. OUT-OF-SCOPE TOPICS FOR THIS FOA:

1. Quantum control techniques to mitigate noise (unless such techniques can be used to understand material source of noise)
2. Qubit systems that have known fundamental limitations to scaling beyond 10 qubits
3. Quantum computing systems based on Majorana Zero Modes or Color Centers
4. Proposals aimed at applications of Quantum Information Science other than gate-based quantum computing, e.g., sensing, communication, networking, and key distribution
5. 2D materials or rare earth materials
6. Isotopic purity/enrichment for spin qubits

**Note that these topics may be appropriate for AFOSR Broad Agency Announcement, which can be found here:

ADMINISTERING AGENCY	HOW TO FIND OUR RESEARCH INTERESTS
Air Force Office of Scientific Research https://www.afrl.af.mil/AFOSR/	Navigate to https://www.grants.gov/web/grants/view-opportunity.html?oppId=345653 to view the "Research Interests of the Air Force Office of Scientific Research," BAA FA9550-23-S-0001.

5. TECHNICAL DETAILS OF PROPOSED RESEARCH

A strong proposal shall outline, as specifically as possible, the technical details of the proposed research. In addition, proposals shall articulate how research goals align with the research topic being addressed. Because of the breadth of research that spans our challenge categories, it is anticipated that groups that submit proposals will include researchers of diverse technical perspectives and technical backgrounds. Finally, efforts integrating a variety of approaches, with a spectrum ranging from basic to applied, are preferred to those using a single approach, especially as these may provide increased opportunities for technology transfer.

A strong proposal should outline, as specifically as possible, the technical details of the proposed research. In addition, proposals should articulate how research goals align with the research topic being addressed. Because of the breadth of research that spans our challenge categories, it is anticipated that groups that submit proposals will include researchers of diverse technical perspectives and technical backgrounds. Finally, efforts integrating a variety of approaches, with a spectrum ranging from basic to applied, are preferred to those using a single approach, especially as these may provide increased opportunities for technology transfer.

a. Access to DoD Resources

Proposals may request access to AFRL facilities or DoD high performance computing resources in order to conduct the proposed research. Proposals should make this request in accordance with the instructions given in the D.4.g. Project Narrative section of this announcement. If authorized, there is no cost to the research for these resources. Applicants are advised that routine access of educational institution researchers to AFRL buildings and facilities is limited to U.S. citizens. Individuals eligible for access are subject to background checks.

B. FEDERAL AWARD INFORMATION

Annual funding per incubator grant will be limited to a maximum of $500,000 per year for up to 2 years. Annual funding per full loop grant will be limited to a maximum of $2,000,000/1,750,000/1,500,00/1,500,000 for years 1/2/3/4. Any proposer wishing to submit a proposal outside of this range should discuss their research plan with the relevant Program Officer

during the whitepaper phase of this FOA. The total amount of funding and resources made available to fund a successful proposal may vary based on the quality of proposals received and funds availability.

The anticipated period of performance is a 1- or 2-year base period for incubator grant, and a four-year base period for full loop grant. Each yearly period will be incrementally funded.

AFOSR reserves the right to select and fund for award all, some, part, or none of the proposals received. There is no guarantee of an award.

Awards are made under the authority of 10 U.S.C. 4001 in the form of grants, or cooperative agreements. We rely on discretionary appropriated funds for this program. We select what kind of award instrument we can use based on requirements in the Federal Grant and Cooperative Agreement Act 31 U.S.C. 6301 – 31 U.S.C. 6308. We discuss regulations, terms, and conditions that generally apply to our awards in Section F. Federal Award

C. ELIGIBILITY INFORMATION

1. ELIGIBLE APPLICANTS

a. Qualified and Responsible United States Institutions

You are eligible to submit an application if you are a qualified and responsible organization from academia, the non-profit sector, or industry. Note however that grants, and cooperative agreements will be the only instrument awarded off of this FOA. As such, if industry or for-profit institutions decide to submit a proposal, they shall not include a fee or profit within their proposal. Without the fee/profit, industry or for-profit institutions will be able to receive a commercial grant. Academia includes educational institutions in the United States as defined at 10 U.S.C. 2194. Educational institution means a local educational agency, college, university, or any other nonprofit institution dedicated to improving science, mathematics, and engineering education.

We review your application, proposal, and Office of Management and Budget (OMB) designated repositories of government-wide public and non-public data, including comments you have made, as required by 31 U.S.C. 3321 and 41 U.S.C. 2313 and described in 2 CFR 200.205 and 32 CFR 22.410 to assess risk posed by applicants, and confirm applicants are qualified, responsible, and eligible to receive an award.

b. HBCU/MI, Tribal College and University Applicants Encouraged

Historically Black Colleges and Universities and Minority Serving Institutions (HBCUs/MSIs) and Tribal Colleges and Universities are encouraged to submit research proposals and join others in submitting proposals. However, no funds under this announcement are reserved or otherwise set-aside for any specific entity type. The Air Force will only use the E.1. Criteria for proposal selection.

c. University Affiliated Research Centers (UARCs)

University Affiliated Research Centers (UARCs) are eligible to submit proposals under this announcement unless their Department of Defense UARC contract precludes the application.

d. Ineligible Entities

None of the following entity types are eligible to submit proposals as primary award recipients under this announcement:

1) Federally Funded Research and Development Centers (FFRDCs)
2) Individual persons or people
3) Federal agencies (to include Military Educational Institutions)

2. COST SHARING OR MATCHING

Cost sharing or matching is neither required nor an evaluation criterion for proposals under this announcement. You may propose voluntary committed or uncommitted cost sharing or matching, for example, additional support for students. Any voluntary committed cost sharing amount will be included in the total award value.

3. OTHER

a. Acknowledgment of Support and Disclaimer Requirements

You must include the F. 3.d. Acknowledgment of Research Support on all materials created or produced under our awards. The F. 3.e. Disclaimer Language must be included on materials as required. The award document may provide additional instructions about specific distribution statements to use when you provide research materials to us. You are not eligible to submit a proposal if you cannot accept these terms.

b. Expectation of Public Dissemination of Research Results

AFOSR expects public dissemination of research results if you receive an award. This is a basic requirement for unclassified research results.

AFOSR intends, to the fullest extent possible, to make available to the public all unclassified, unlimited peer-reviewed scholarly publications and digitally formatted scientific data arising from research and programs funded wholly or in part by the DoD as described in the OUSD, AT&L Memorandum, *"Public Access to Department of Defense-Funded Research"* dated 08 FEB 2019.

AFOSR follows DoD Directive 5230.24 and DoD Instruction 5230.27 policies and procedures to ensure broad dissemination of unclassified research results to the public and within the Government. The DoD Instruction 5230.27 policy and procedures allowing publication and public presentation of unclassified fundamental research results will apply to all research proposed under this competition unless the Program Officer gives you an explicit, written exclusion to these policies with the Grants Officer's advice and consent. All

exclusions must be authorized or required by law and must cite a valid legal authority.

c. Conflict of Interest

This announcement requires that all current and pending research support, as defined by Section 223 of the FY21 National Defense Authorization Act must be disclosed at the time of proposal, for all covered individuals. Such disclosure will be updated annually during the performance of any research project selected for funding, and whenever covered individual are added or identified as performing under this project. Covered Individuals are those who are listed as key personnel on proposals including but not restricted to the principal investigator or co-principal investigator.

Any decision to accept a proposal for funding under this announcement will include full reliance on the applicant's statements. Failure to report fully and completely all sources of project support and outside positions and affiliations may be considered a materials statement within the meaning of the federal False Claims Act and constitute a violation of law.

The funding agency may conduct a pre-award conflict of interest/conflict of commitment review of any proposal selected for funding, as defined in the National Security Strategy for United States Government-Supported Research and Development (NSPM-33). Offerors are advised that any significant conflict of interest/conflict of commitment identified may be a basis for the rejection of an otherwise awardable proposal.

Applicants for assistance are required to comply with 2 CFR 200.318(c), Codes of Conduct, to prevent real or apparent conflicts of interest in the award and administration of any contracts by which a recipient or subrecipient purchases property or services, supported by federal funds.

1) General Requirement for Disclosure

   You and your organization must disclose any potential or actual scientific or non-scientific conflict of interest(s) to us. You must also disclose any potential or actual conflict(s) of interest for any sub recipient you include in your proposal. You must provide enough information for AFOSR to evaluate your disclosure. AFOSR may have to ask you more questions if more information is needed.

   At AFOSR's sole discretion, you may be asked for a conflict-of-interest mitigation plan after you submit your proposal. Your plan is subject to AFOSR approval.

2) Scientific Conflict of Interest

   Scientific collaborations on research and development projects are generally the result of close collaboration prior to the submission of applications for support. Accordingly, virtually all these collaborations might be considered to include a

potential conflict of interest. The potential conflict is mitigated by the disclosure of these collaborations, and the list of current and pending support you provide for senior and key researchers.

You must provide a copy of all peer-reviewed publications developed or produced from research conducted with Air Force funds to the AFOSR Program Officer.

You are not eligible to submit a proposal if you cannot accept these terms.

D. APPLICATION AND SUBMISSION INFORMATION

1. ADDRESS TO REQUEST APPLICATION PACKAGE

All the application forms you need are available electronically on Grants.gov. From the "View Grant Opportunity" page, you can click on the "Application Package" tab to download the application package.

You can find the electronic application package on Grants.gov by searching for the announcement number shown on page one. Paper copies of this announcement will not be issued.

Please contact us at afosr.FOA@us.af.mil to request a reasonable accommodation for any accessibility requirements you may have.

2. CONTENT AND FORM OF APPLICATION SUBMISSION

a. Pre-proposal Inquiries and Questions

You are encouraged to contact the Program Officer listed in section G.1. Technical Inquires and Questions before you submit your proposal.

If you need help with general matters, you should contact the individual listed in G.2. General Announcement Questions.

Your pre-proposal inquiries and questions should be submitted not later than **11:59 PM Eastern Time on 14 APR 2023**. AFOSR may not be able to answer questions received later. This is discussed more in section D.7. Submission Dates and Times. The Government will respond to any pre-proposal inquiries or questions, either directly, or via public posting no later than COB on 21 APR 2023. In an attempt to answer the submitted questions and provide full explanations, the Program Officers that are involved in this FOA will be holding a Proposer's Day session to answer questions in real-time and provide answers in real time. This Proposer's Day will be held on **21 APR 2023. Registration for this event is mandatory.** To register for this Proposer's Day, please visit the following link:
https://afosr.gov1.qualtrics.com/jfe/form/SV_3awUktj83b7PITc

The Program Officer does not have the authority to make commitments for the government. Grants and Contracting Officers acting within their warranted capacity are the only people authorized to make commitments for the Government.

b. The Application as a Whole

You must submit your proposal electronically through Grants.gov. AFOSR will not accept or evaluate any proposal submitted by any means other than through Grants.gov. AFOSR must receive your proposal before the D.7.d. Proposal Submission Deadline.

You must use the electronic Standard Form (SF) 424 Research and Related (R&R) Form Family, OMB Number 4040-0001. The SF 424 (R&R) Application for Federal assistance form must be your cover page. No pages may precede the SF 424 (R&R).

You must mark your application with the announcement number.

A summary of what is required for a complete proposal is summarized below:

- The forms and attachments in bold text are required with all applications
- *Some applications* require the attachments in *italic*
- More instructions are provided in D.4 Component Pieces of the Application.

R&R FORM, OMB No. 4040-0001	FIELD	ATTACHMENT
SF 424 (R&R) Application for Federal Assistance, including an authorized signature	**18.**	**Certification Regarding Lobbying Form or** SF-LLL Disclosure of Lobbying Activities Per instructions in D.4.b
R&R Other Project Information Form	**7.**	**Project Summary / Abstract**
	8.	**Project Narrative**
	9.	**Bibliography & References Cited**
	10.	*Facilities and Other Resources*
	11.	*Equipment*
	12.	*Other Attachments*

R&R Senior / Key Person Profile Form (Expanded)		**Biographical Sketch**
		Current & Pending Support
R&R Personal Data Form		**None**
R&R Budget Form		**Budget Justification**
R&R Subaward Budget Attachments Form		*Subaward Budget*
R&R Project / Performance Site Locations Form		**None**

The SF 424 (R&R) must include the signature of an authorized representative from your organization. The signature is affixed electronically by Grants.gov upon submission. You are still required to submit any documentation, including disclosure of any unpaid delinquent tax liability or a felony conviction under any Federal law (see FAR 52.209-11). This signature is considered the signature for the application as a whole.

c. Proposal Format

- Paper Size – 8.5 x 11-inch paper
- Margins – 1 inch
- Spacing – Single, 1.5, or 2.0-line spacing
- Font – Times New Roman or Garamond, 12 point
- Page Limitation – No more than twenty-five (25) single-sided pages. The cover page, table of contents, list of references, letters of support, curriculum vitae, and list of on-going and pending research support are excluded from the page limitations. The pages of proposals exceeding the page limit may not be included in the evaluation.
- Attachments – Electronic Portable Document Format (PDF)
- Content – As described below

d. Proposal Length

No more than twenty-five (25) single-sided pages. You must not include elaborate brochures, reprints, or presentations beyond those sufficient to present a complete and effective proposal.

AFOSR will not consider more than the maximum number of pages in its evaluation; however, not all pages are counted. This list below is intended to help you understand how to calculate your page count.

NOT INCLUDED IN PAGE COUNT

- SF 424 (R&R) Application for Federal Assistance and all attachments except field 18 representations or disclosures

- R&R Budget and Budget Justification attachments, R&R Other Project Information Form, and all attachments

- R&R Sub award and Budget Justification attachments, R&R Senior / Key Person Profile Form, and all attachments for the personnel

- Documents that support the budget or particular items of cost R&R Project / Performance Site Locations Form

- Optional R&R Personal Data Form
- Budget related information is not included in the page count because AFOSR cannot make an award unless it can determine the cost of your proposal is reasonable and realistic and complies with 2 CFR 200 Subpart E - Cost Principles.

- *Not having enough information in your proposal to understand if your costs are reasonable and realistic is the most common reason awards are delayed.*

e. No Confidential or Proprietary Information

You must not include confidential or proprietary information in your proposal.

AFOSR will not consider your proposal if you include confidential or proprietary information or place restrictive markings on any part of your proposal.

f. Electronic Form and Proposal Attachments

Your application and proposal attachments must be in electronic file formats. You should use the Portable Document Format (PDF) for your attachments.

DO NOT password protect any attachments.

The website https://www.grants.gov/web/grants/applicants/adobe-software-compatibility.html offers a list of file convertors available to convert your documents to the PDF format.

3. GRANTS.GOV APPLICATION SUBMISSION AND RECEIPT PROCEDURES

This section provides the application submission and receipt instructions for AFOSR program applications. Please read the following instructions carefully and completely.

a. Electronic Delivery

AFOSR is participating in the Grants.gov initiative to provide the grant community with a single site to find and apply for grant funding opportunities. AFOSR encourages applicants to submit their applications online through Grants.gov.

b. How to Register to Apply through Grants.gov

Instructions: Read the instructions below about registering to apply for AFOSR funds. Applicants should read the registration instructions carefully and prepare the information requested before beginning the registration process. Reviewing and assembling the required information before beginning the registration process will alleviate last-minute searches for required information.

The registration process can take up to four weeks to complete. Therefore, registration should be done in sufficient time to ensure it does not impact your ability to meet required application submission deadlines.

If individual applicants are eligible to apply for this grant funding opportunity, refer to:

https://apply07.grants.gov/help/html/help/Register/GrantsgovVariationsForIndividualApplicants.htm

Organization applicants can find complete instructions here:

https://www.grants.gov/web/grants/applicants/registration.html

1) ***Obtain a UEI Number*:** All entities applying for funding, including renewal funding, must have a Unique Entity Identifier (UEI) Number. Applicants must enter the UEI number in the data entry field labeled "UEI" on the SF-424 form in Block 5.

   For more detailed instructions for obtaining a UEI number, refer to: https://sam.gov/content/entity-registration

2) ***Register with SAM***: In addition to having a UEI number, organizations applying online through Grants.gov must register with the System for Award Management (SAM). All organizations must register with SAM in order to apply online. Registrations in SAM now include the acceptance of Certifications and Assurances. Entities creating new registrations and existing entities completing their annual registration renewals will be required to review financial assistance representations and certification before their registration can be activated. Failure to register with SAM will prevent your organization from applying through Grants.gov.

   For more detailed instructions for registering with SAM, refer to: https://www.grants.gov/web/grants/applicants/registration.html

3) ***Create a Grants.gov Account***: The next step in the registration process is to create an account with Grants.gov. Applicants must know their organization's UEI number to complete this process. Completing this process automatically triggers an email request for applicant roles to the organization's E-Business Point of Contact (EBiz

POC) for review. The EBiz POC is a representative from your organization who is the contact listed for SAM. To apply for grants on behalf of your organization, you will need the Authorized Organizational Representative (AOR) role.

For more detailed instructions about creating a profile on Grants.gov, refer to: https://www.grants.gov/help/html/help/index.htm#t=LoginandMyAccount%2FAddProfile.htm

4) ***Authorize Grants.gov Roles***: After creating an account on Grants.gov, the EBiz POC receives an email notifying them of your registration and request for roles. The EBiz POC will then log in to Grants.gov and authorize the appropriate roles, which may include the AOR role, thereby giving you permission to complete and submit applications on behalf of the organization. You will be able to submit your application online any time after you have been approved as an AOR.

   For more detailed instructions about creating a profile on Grants.gov, refer to: https://www.grants.gov/help/html/help/Register/AddProfile.htm

5) ***Track Role Status***: To track your role request, refer to: https://www.grants.gov/web/grants/applicants/registration.html
6) ***Electronic Signature***: When applications are submitted through Grants.gov, the name of the organization's AOR that submitted the application is inserted into the signature line of the application, serving as the electronic signature. The EBiz POC **must** authorize individuals who are able to make legally binding commitments on behalf of the organization as an AOR; **this step is often missed, and it is crucial for valid and timely submissions**.

c. How to Submit an Application to AFOSR via Grants.gov

Grants.gov applicants can apply online using Workspace. Workspace is a shared, online environment where members of a grant team may simultaneously access and edit different web forms within an application. For each funding opportunity announcement (FOA), you can create individual instances of a workspace.

Below is an overview of applying on Grants.gov. For access to complete instructions on how to apply for opportunities, refer to: https://www.grants.gov/web/grants/applicants/apply-for-grants.html.

Create a Workspace

Creating a workspace allows you to complete it online and route it through your organization for review before submitting.

Complete a Workspace

Add participants to the workspace, complete all the required forms, and check for errors

before submission.

1) Adobe Reader: If you decide not to apply by filling out web forms you can download individual PDF forms in Workspace so that they will appear similar to other Standard or administering agency forms. The individual PDF forms can be downloaded and saved to your local device storage, network drive(s), or external drives, then accessed through Adobe Reader.

   NOTE: Visit the Adobe Software Compatibility page on Grants.gov to download the appropriate version of the software at: https://www.grants.gov/web/grants/applicants/adobe-software-compatibility.html.

2) Mandatory Fields in Forms: In the forms, you will note fields marked with an asterisk and a different background color. These fields are mandatory fields that must be completed to successfully submit your application.

3) Complete SF-424 Fields First: The forms are designed to fill in common required fields across other forms, such as the applicant's name, address, and UEI number. To trigger this feature, an applicant must complete the SF-424 information first. Once it is completed, the information will transfer to the other forms.

Submit a Workspace

An application may be submitted through workspace by clicking the Sign and Submit button on the Manage Workspace page, under the Forms tab. Grants.gov recommends submitting your application package at least 24-48 hours prior to the close date to provide you with time to correct any potential technical issues that may disrupt the application submission.

Track a Workspace

After successfully submitting a workspace package, a Grants.gov Tracking Number (GRANTXXXXXXXX) is automatically assigned to the package. The number will be listed on the Confirmation page that is generated after submission.

For additional training resources, including video tutorials, refer to: https://www.grants.gov/web/grants/applicants/applicant-training.hml

Applicant Support: Grants.gov provides applicants 24/7 support via the toll-free number 1-800-518-4726 and email at support@grants.gov. For questions related to the specific grant opportunity, contact the number listed in the application package of the grant you are applying for.

If you are experiencing difficulties with your submission, it is best to call the Grants.gov Support Center and get a ticket number. The Support Center ticket number will assist the administering agency with tracking your issue and understanding background information on

the issue.

4. COMPONENT PIECES OF THE APPLICATION

a. SF 424 (R&R) Application for Federal Assistance

You must use the electronic SF 424 (R&R) Application for Federal Assistance Form as your application cover page. No pages may precede the SF 424 (R&R). This form **is not** included in your page count.

You must use 01 SEP 2023 as the anticipated start date in your proposal and budget, however, the actual effective date is not final until an award is made.

Complete all required fields in accordance with the "pop-up" instructions on the SF 424 (R&R) form. The completion of most fields is self-explanatory. You can turn on Grants.gov "Help Mode" to provide additional instructions for forms. "Help Mode" is turned on by the icon with the pointer and question mark at the top of the form.

Below are AFOSR special instructions for completion of several SF 424 (R&R) form fields in your application:

FIELD	INSTRUCTION
2.	You may leave "Applicant Identifier" blank
3.	You may leave "Date Received by State" and "State Application Identifier" blank
9.	You must list Air Force Office of Scientific Research as the reviewing agency if Grants.gov has not pre-populated this answer
11.	Enter a descriptive title for your project. Using one phrase or sentence, title the proposal so that it is MQC Program oriented.
16.	You should check "No." and "Program is Not Covered by Executive Order 12372"
17.	Select "I Agree" to certify that all statements in the proposal and Internal Confidentiality Agreements, written or otherwise, are true, complete, and accurate to the best of your knowledge. *See section F.3. Administrative and National Policy Requirements for more information and links to the full text of these items.* **Additionally, this provides the certification regarding lobbying that is required by 31 U.S.C. 1352 as implemented by the DoD in 32 CFR Part 28.** **The full text of this certification may be found in Appendix A to Part 28 of 32 CFR at https://www.ecfr.gov/ or we will provide you a copy if you ask for one.**

18.	You must attach the completed D.4.b SFLLL Disclosure of Lobbying Activities Form if you have lobbying activity that you must disclose under 31 U.S.C. 1352 as implemented by the DoD in 32 CFR Part 28.

b. SFLLL Disclosure of Lobbying Activities Form

When required, attach this disclosure to field 18 of the R&R Other Project Information Form. This attachment is not included in your page count.

If you have lobbying activity that you must disclose under https://uscode.house.gov/view.xhtml?req=granuleid:USC-prelim-title31-section1352&num=0&edition=prelim as implemented by the DoD at 32 CFR Part 28, you must attach the completed SFLLL Disclosure of Lobbying Activities.

You can find instructions for completing this form at https://www.gsa.gov/forms-library/disclosure-lobbying-activies.

c. R&R Other Project Information Form

Complete this form as indicated. You must include all necessary attachments described below. This form is included in your page count.

FIELD INSTRUCTIONS	
1, 1a.	You must address all prospective human subject involvement by answering these questions. Additional documentation pursuant to National Policy and U.S. Air Force standards is required for all proposals with human research or involvement.
2, 2a.	You must address all prospective animal subject and/or recombinant deoxyribonucleic acid (rDNA) involvement by answering these questions. Additional documentation pursuant to National Policy and U.S. Air Force standards is required for all proposals with animal or rDNA research or involvement.
4a.	For any proposal that has an actual or potential impact on the environment, answer yes and provide the answers and attachments required for fields 4b, 4c, and 4d. Additional documentation in accordance with National Policy and U.S. Air Force standards is required for any proposal with an actual or potential impact on the environment. We will not consider any application for conference or workshop support that requires any form of environmental impact study.
7.	Attach your D.4.d. Publicly Releasable Abstract
8.	Attach your D.4.e. Project Narrative
9.	Attach your D.4.f Bibliography and Reference Cited if necessary

10.	Attach a Facilities and Other Resources description document here if you need to supplement your D.4.e.4 Project Narrative Your Facilities section.
11.	You may supplement your D.4.j. Budget Justification by attaching an Equipment Justification here. Do not duplicate information included on your budget justification.
12.	You may supplement your D.4.j Budget Justification by attaching quotes for materials and supplies, local travel, etc.

d.R&R Publicly Releasable Project Summary / Abstract

You must attach the Project Summary / Abstract to field 7 of the R&R Other Project Information form. This attachment is included in your page count.

1) You must provide a concise abstract of 300 words or less with your proposal. You must mark this abstract publicly releasable. Your abstract should use terms the public can understand to describe the research objective, technical approach, anticipated outcome, and potential impact of the specific research.
2) Your abstract header should include the Program Officer's name and office symbol from section G.1. Technical Inquiries and Questions below.

3) If you receive an award, AFOSR must publish your abstract to a searchable website available to the general public in accordance with Public Law 113-235. The website address is https://dodgrantawards.dtic.mil/grants.

e. Project Narrative

You must attach the Project Narrative to field 8 of the R&R Other Project Information Form. The narrative must be complete and self-contained to qualify for review. This attachment is included in your page count.

You must clearly describe the research, including the research objective and approach. Your project narrative will be evaluated using the criteria listed in section E.1. Criteria. You should show strength in as many of the evaluation and selection areas as practicable to demonstrate maximum competitiveness.

You shall describe any environmental impacts of your research outside the laboratory in any appropriate narrative section, including how you will ensure compliance with environmental statutes and regulations.

Your narrative shall include the following elements:

1) **Statement of Objectives**

You must describe your proposed research on a single page titled "Statement of

Objectives." AFOSR may decide to incorporate your statement of objectives into the award instead of incorporating the whole technical proposal.

You should use active verbs when you prepare the statement of objectives, e.g., "conduct" research in a subject area, "investigate" a problem, "determine" to test a hypothesis.

2) **Research Effort**

(a) You should describe the research you plan in detail. State the research objectives and approach, and the relationship and comparable objectives to research progress elsewhere. Describe your research team's knowledge in the field and provide a bibliography and list of literature citations. Discuss the nature of the expected results.

(b) The adequacy of this information will influence the overall evaluation in accordance with the criteria and procedures specified in section E. Application Review Information.

3) **Principal Investigator (PI) and Senior Personnel Time**

(a) You must provide estimate of time the principal investigator and other senior professional personnel will devote to the research. Your estimate must include information pertaining to the proportion of time anticipated devoted to this research, to other research, and to other commitments of time such as sabbatical, extended leave, and teaching duties.

(b) State the number of graduate students for whom each senior staff member is responsible.

(c) If your principal investigator or other key personnel have current, pending, or expected research supported by other sponsors or agencies during the period you seek our support, state the title of the other research, the proportion of time to be devoted to it, the amount of support, name of agency, dates, etc.

You must attach a list of Current and Pending Support for each person listed on the D.4.g. R&R Senior / Key Person Profile Form. Each abstract should include research title, objectives, approach, and budget for both present and pending research projects.

Send any changes to this information to us as those changes become known.

4) **Your Facilities**

(a) Describe the facilities available for performing the proposed research, and any additional facilities or equipment the organization proposes to acquire at its own expense for the work.

(b) Indicate any government-owned facilities that will be used. Indicate any government-owned equipment possessed presently that will be used. The facilities contract number, or in absence of a facilities contract, the specifics of the facilities or equipment, and the number of the award under which they are accountable are required.

5) **Government Furnished Equipment**

You may list any special Government-owned property or test equipment required to complete the research. When possible and practicable, give a description or title for each item, the current location, and an estimated cost as applicable. If you do not have information about individual items, group items you require by class and provide an estimate of values.

6) **High-Performance Computing Requirements**

You may be eligible to use DOD high-performance computing resources at no cost to your research. You should address utilization of this program if you need high-performance computing cycles to meet the needs of your research. This program provides access to a range of state-of-the-art high-performance computing assets and user training opportunities that can be used in some of our awards; special terms and conditions apply. You can review the details, capabilities, and requirements of the program at http://www.hpc.mil.

AFOSR Program Officers will help you establish an account if your proposal is selected for an award and can answer questions before you submit your proposal.

f. Bibliography and References Cited

You must attach your narrative Bibliography and References to field 9 of the R&R Other Project Information Form. This attachment is included in your page count. If you are unsure if you need to include this attachment, please contact the agency contact to make sure.

Your bibliography and references should encompass your recruitment plan.

g. R&R Senior / Key Person Profile Form

You must attach a short biographical sketch and list of significant publications (vitae) for each Senior / Key Person. You must also attach a list of current and pending support as discussed in Principal Investigator (PI) and Senior Personnel Time. This form is not included in your page count.

You must list all key persons proposed for the research on the R&R Senior/Key Person Profile Form. Key persons are generally the PI, any Co-PIs, and senior staff. This information is used to evaluate the qualifications of you and your research team.

To evaluate compliance with Title IX of the Education Amendments of 1972 (20 U.S.C. A subsection 1681 Et. Seq.), the DoD is collecting certain demographic and career information to be able to assess the success rates of women who are proposed for key roles in applications in STEM disciplines. In addition, the National Defense Authorization Act (NDAA) for FY 2019, Section 1286, directs the Secretary of Defense to protect intellectual property, controlled information, key personnel, and information about critical technologies relevant to national security and limit undue influence, including foreign talent programs by countries that desire to exploit United States' technology within the DoD research, science and technology, and innovation enterprise. To enable this assessment, each applicant must include this form completed as indicated.

The Degree Type and Degree Year Fields will be used by DoD as the source for career information. In addition to the required fields on the form, applicants must complete these two fields for all individuals that are identified as having the project role of PD/PI or Co-PD/PI on the form. Additional senior/key persons can be added by selecting the "Next Person" button.

h. R&R Budget Form

This form is not included in your page count.

You must include a budget that identifies the program administration costs per item, and the total cost. Cite the proposed sources of the program management on the budget justification attachment. You shall provide all information requested. You must estimate the total research project cost. This form is not included in your page count.

Your costs should be based on recent quotations for manufacturers or distributors. You must categorize funds by year and provide separate annual budgets for projects lasting more than one year.

A budget justification must be attached.

You must include enough budget related information in your proposal to support your costs as reasonable and realistic, and in compliance with 2 CFR 200 Subpart E - Cost Principles.

Not having enough information in your proposal to understand if your costs are reasonable and realistic is the most common reason awards are delayed.

i. R&R Sub award Budget Form

This form is not included in your page count. Attachments to this form are not included in your page count.

If you plan any sub award(s), you must provide a budget and budget justification using the same requirements established for your prime budget and budget justification.

AFOSR cannot make an award to you unless we can determine the sub award cost is reasonable and realistic and complies with 2 CFR 200 Subpart E – Cost Principles. Not having enough information in your sub award budget(s) or budget justification(s) can cause significant delays for awards.

j. Budget Justification

This attachment is not included in your page count.

You must provide a detailed budget justification for each year that clearly explains the need for each item. The entire budget justification and supporting documentation must be combined into a single file and attached to field K of the R&R Budget Form.

1) You should itemize travel. State the purpose of each trip proposed, the number of trips, the number of travelers, the destination, the duration, and the basis for calculating costs such as airlines and hotels.

   Below is a sample of the travel portion:

TRAVEL	Unit	Trips	Travelers	Nights	Days	Unit Cost	Total Travel
Airfare	Round trip	1	1			$900.00	$900.00
Lodging	day	1	1	3		$75.00	$225.00
Per Diem	day	1	1		3	$40.00	$120.00
Automobile Rental	day	1	1		3	$45.00	$135.00
Subtotal Travel		**4**	**4**	**3**		**$1,060**	**$1,380.00**

2) You should itemize materials, supplies, and equipment. List all material/equipment by type and kind with associated costs. Indicate what your costs are based on, such as vendor quotes, historical data and/or engineering estimates. **You should include vendor quotes and/or catalog pricing data when applicable**.

3) If you have any sub award(s), you should describe how you determined sub award costs were determined fair and reasonable. Your business office usually makes this determination.

4) If you use a government rate agreement to propose indirect cost rates and/or fringe benefit rates, you should attach a copy of the agreement you used (**DHHS or ONR Rate Agreement**).

5) Helpful Cost Principal Reference Information

   a. 2 CFR 200, Subpart E – Cost Principles

   b. General Provisions for Selected Items of Cost in 2 CFR 200.420 through 2 CFR 200.475

k. R&R Project / Performance Site Locations Form

This form is not included in your page count.

You shall complete all information as requested. You must include the ZIP+4 for each performance location you list.

l. Data Management Plan (Required)

A Data Management Plan is required with your application. Attach your Data Management Plan to field 12 of the R&R Other Project Information Form.
Your "Data Management Plan" should be two (2) pages or less in length and discuss:

- The types of data, software, and other materials to be produced in the course of the project and include a notation marking items that are publicly releasable.
- How the data will be acquired.
- Time and location of data acquisition if they are scientifically pertinent.
- How the data will be processed.
- The file formats and the naming conventions that will be used.
- A description of the quality assurance and quality control measures during collection, analysis, and processing.
- If existing data are to be used, a description of their origins.
- A description of the standards to be used for data and metadata format and content.
- Plans and justifications for archiving the data.
- The timeframe for preservation; and
- If for legitimate reasons the data cannot be preserved, the plan must include a justification citing such reasons.

m. R&R Personal Data Form

This attachment is not included in your page count.

To evaluate compliance with Title IX of the Education Amendments of 1972 (20 U.S.C. A subsection 1681 Et. Seq.), The DoD is collecting certain demographic and career information to be able to assess the success rates of women who are proposed for key roles in applications in STEM disciplines. To enable this assessment, each applicant must include this form completed as indicated.

This form will be used by DoD as the source of demographic information, such as gender, race, ethnicity, and disability information for the Project Director/Principal Investigator and all other persons identified as Co-Project Director(s)/Co-Principal Investigator(s). Each application must include this form with the name fields of the Project Director/Principal Investigator and any Co-Project Director(s)/Co-Principal Investigator(s) completed; however, provisions of the demographic information in the form is voluntary. If completing the form for multiple individuals, each Co-Project Director/Co-Principal Investigator can be added by selecting the "Next Person" button. The demographic information, if provided, will be used for statistical purposes only and will not be made available to merit reviewers. Applicants who do not wish to provide some or all of this information should check or select the "Do not wish to provide" option.

5. INFORMATION YOU MUST SUBMIT IF SELECTED FOR POSSIBLE AWARD

The AFOSR Grants Officer may request additional necessary information from you during negotiations, or as required to inform their consideration for award.

You must respond promptly.

If you do not fully comply with our information requests by the time AFOSR is ready to make an award, AFOSR may determine that you are not qualified to receive an award and use that determination as a basis for making an award to another applicant.

Foreign national personnel may be asked to provide a copy of the front and back of their green card by secure means such as https://safe.apps.mil/.

If your proposal includes human, animal, or rDNA use or involvement, you must submit all documentation requested during negotiations or you may not receive an award.

6. UNIQUE ENTITY IDENTIFIER (UEI), COMMERICIAL AND GOVERNMENT ENTITY (CAGE), AND SYSTEM FOR AWARD MANAGEMENT (SAM)

a. SAM Registration Required

As required in 2 CFR 25.110 all applicants, unless exempted, must:

1) Be registered in sam.gov before submitting its application,

2) Provide a valid UEI unique entity identifier.

3) Continue to maintain an active SAM registration with current information at all times any Federal award is active, or any application is under consideration by a federal awarding agency.

A Commercial and Government Entity (CAGE) code is obtained or specified as part of the SAM registration process. A CAGE code is required.

b. SAM Exemption or Exceptions Not Available Under This Announcement

AFOSR will not issue an Agency level exemption to SAM registration under 2 CFR 25.110(d)(1) for applicants under this announcement.

You must comply with SAM registration requirements and include a UEI and CAGE code on your application or AFOSR cannot make an award.

c. Questions about SAM Registrations and Updates

You can get questions about SAM registration and entity updates answered by live chat at https://www.fsd.gov/gsafsd_sp and telephone at (866) 606-8220 or (324) 206-7828. Top help topics for SAM.gov are available at https://www.fsd.gov/fsd-gov/learning-center-system.do?sysparm_system=SAM.

d. Consequences of Non-Compliance with SAM Registration Requirements

AFOSR cannot make an award to you unless you comply with SAM requirements. If you are non-compliant, AFOSR may determine you are not qualified to receive an award and use that determination to make an award to someone else as authorized by 2 CFR 25.205(b). You cannot receive payments without an active SAM record and CAGE code.

7. SUBMISSION DATES AND TIMES

a. Pre-Proposal Inquiries and Questions Deadline

You must submit all pre-proposal inquiries and questions not later than **14 APR 2023** at 11:59 PM Eastern Time. Responses will be provided by **21 APR 2023** at 11:59 PM. You should submit your questions in writing by electronic mail. You should include the announcement number in the subject line. You may contact the administering agency contacts by telephone, but email is preferred. We discuss this again in section G. Agency Contacts.
Our replies will be provided as soon as practicable. We estimate all our answers will be provided not later than 21 APR 2023. AFOSR and LPS program managers will host a virtual meeting on 21 APR 2023 and the link to register for this meeting is as follows: https://afosr.gov1.qualtrics.com/jfe/form/SV_3awUktj83b7PITc this virtual meeting, an overview of the FOA will be provided, government representatives will provide presentations

about potential quantum measurement support capabilities, and program managers will be available for Q&A. If you wish to attend this virtual meeting, please plan to pre-register.

b. How Submission Time for Pre-Proposal Inquiries and Questions is Determined

AFOSR uses the date and time stamp on your email to determine when you submitted pre-proposal correspondence. These emails should be directed to the contact listed at the end of this FOA for general inquiries and questions.

c. Effect of Missing Pre-Proposal Inquiries and Questions Deadline

AFOSR will not provide responses or answers to late inquires or questions.

d. Proposal Submission Deadline

AFOSR must receive your white paper by **01 MAY 2023** at 11:59 PM Eastern time for it to be considered. AFOSR will provide white paper responses no later than **22 MAY 2023**.

AFOSR must receive your validated proposal electronically through Grants.gov not later than **19 JUN 2023** at 11:59 PM Eastern time to be considered for selection. This is the final due date. AFOSR recommends that you submit applications early.

You are responsible for making sure your application is submitted, received, and validated by Grants.gov before the application deadline. If you submit your application late, your proposal is not eligible for consideration.

(1) Timely Receipt Requirements and Proof of Timely Submission

Online Submission: All applications must be **validated** by Grants.gov by **19 JUN 2023 at 11:59 PM Eastern Time.** Proof of timely submission is automatically recorded by Grants.gov. The applicant AOR will receive an acknowledgement of receipt and a tracking number (GRANTXXXXXXXX) from Grants.gov with the successful transmission of their application. Applicant AORs will also receive the official date/time stamp and Grants.gov tracking number in anemail.

A second confirmation is provided by email when your application has passed Grants.gov validation and the status is updated from received to validated. **Your application is not complete until you receive the validation confirmation.** Your submission must be validated before the submission deadline.

When the administering agency successfully retrieves the application from Grants.gov, and acknowledges the download of submissions, Grants.gov will provide an electronic acknowledgement of receipt of the application to the emailaddress of the applicant with the AOR role.

Applications received by Grants.gov after the established due date will be

counted as late and will not be considered for funding by the administering agency.

(2) Applicants using slow internet, such as dial-up connections, should be aware that transmission can take some time before Grants.gov receives your application. Again, Grants.gov will provide either an error or a successfully received transmission in the form of an email sent to the applicant with the AOR role. The Grants.gov Support Center reports that some applicants end the transmission because they think that nothing is occurring during the transmission process. Pleasebe patient and give the system time to process the application.

e. How Proposal Submission Time is Determined

AFOSR uses the system generated Grants.gov time stamp to determine when you submitted your successfully validated proposal. Grants.gov policies and procedures for application submission and processing apply. ***AFOSR will only accept applications submitted electronically through Grants.gov.***

f. Grants.gov Tracking Number is Application Receipt

Grants.gov generates a confirmation page when you submit your application. A second confirmation is provided by email when your application has passed Grants.gov validations and the status is updated from received to validated.

The confirmation page includes a system generated Grants.gov tracking number; this serves as your receipt. You should keep a copy of all confirmations.

You can verify the submission time and application status with your tracking number through Grants.gov at https://www.grants.gov/applicants/track-my-application.html.

g. Effect of Missing the Proposal Submission Deadline

Grants.gov will not accept your proposal after the submission deadline. AFOSR will not accept proposals submitted other than electronically through Grants.gov.

8. INTERGOVERNMENTAL REVIEW

N/A - This program is excluded from coverage under Executive Order (E.O.) 12372.

9. FUNDING RESTRICTIONS

a. Proposal Preparation Costs

AFOSR will not reimburse proposal or application costs under this FOA. Your proposal or application preparation costs are not considered an allowable direct charge to any award under this announcement.

b. Award Value Limits and Exceptions

With few exceptions, a MQC award provides between $500,000 and $2,000,000 in annual funding to support the award recipient's research. Section A.3.Guidelines for Proposals, contains this information as well.

c. Anticipated Announcement and Award Dates

(1) We expect to announce our selection in Summer 2023 followed by acceptance/declination letters or emails to applicants. These notices are not an authorization to commit or expend funds.

(2) We anticipate awards should be in place by **01 SEP 2023**, subject to availability of funds. You must use 01 SEP 2023, as the anticipated start date in your proposal and budget. The actual effective date is not final until a grant is awarded.

d. Pre-Award Costs

(1) Grants include up to ninety (90) days calendar days pre-award costs in accordance with 2 CFR 200.308(3) and/or the DoD Research and Development General Terms and Conditions, January 2023 (DoD T&C).

(2) The date pre-award costs become allowable is determined by subtracting ninety (90) days from the beginning of the period of performance listed on the awarded grant unless your grant specifies otherwise.

(3) All costs incurred before grant award are at the recipient's risk as described in 2 CFR 200.308(e)(1). We are under no obligation to reimburse your costs if for any reason you do not receive an award, or if your award is less than anticipated and inadequate to reimburse your pre-award costs.

(4) Our prior written approval is required by 2 CFR 200.308(e) for more than ninety (90) days pre-award costs. Approval of more than ninety (90) days pre-award costs will only be considered before award is made. Requests for more than one hundred-eighty (180) days pre-award costs will not be considered.

Your business office must request prior approval of more than ninety (90) days pre-award costs during negotiations. This request must be in writing and include a specific date you want us to consider.

You are responsible for documenting why pre-award costs are necessary and essential to the effort.

If we approve your request, the date pre-award costs become allowable will be the specific date specified in the grant document.

e. Air Force Office of Scientific Research No-cost Extension (NCE) Policy

AFOSR grants NCE's only in situations in which the extension is truly warranted and properly documented. AFOSR requires prior written approval to extend the period of performance, without additional funds, beyond the expiration date of the grant. For an extension to be granted recipients are to provide notice in writing, and with the supporting reasons, and revised expiration date, at least **thirty (30)** days prior to the expiration of the

award, and Standard Form (SF) 425 Federal Financial Report with amount of remaining funds. In no event will the period of performance be extended merely for the purpose of using unobligated balances. Institutions should make every effort to ensure work is completed on time. If an institution deems an NCE is truly warranted, it should submit its request for an extension and supporting reasons to the relevant Program Officer. You should make every effort to ensure work is completed on time.

f. Prohibition on Contracting with Entities that Require Certain Internal Confidentiality Agreements or Statements--Representation

a) *Definition*. As used in this provision—
"Internal confidentiality agreement or statement", "subcontract", and "subcontractor", are defined in the clause at 52.203-19, Prohibition on Requiring Certain Internal Confidentiality Agreements or Statements.

b) In accordance with section 743 of Division E, Title VII, of the Consolidated and Further Continuing Appropriations Act, 2015 (Pub. L. 113-235) and its successor provisions in subsequent appropriations acts (and as extended in continuing resolutions), Government agencies are not permitted to use funds appropriated (or otherwise made available) for agreements with an entity that requires employees or sub recipients of such entity seeking to report waste, fraud, or abuse to sign internal confidentiality agreements or statements prohibiting or otherwise restricting such employees or sub recipients from lawfully reporting such waste, fraud, or abuse to a designated investigative or law enforcement representative of a Federal department or agency authorized to receive such information.

c) The prohibition in paragraph (b) of this provision does not contravene requirements applicable to Standard Form 312, (Classified Information Nondisclosure Agreement), Form 4414 (Sensitive Compartmented Information Nondisclosure Agreement), or any other form issued by a federal department or agency governing the nondisclosure of classified information.

d) Representation. By submission of its offer, the Grantor represents that it will not require its employees or sub recipients to sign or comply with internal confidentiality agreements or statements prohibiting or otherwise restricting such employees or sub recipients from lawfully reporting waste, fraud, or abuse related to the performance of a Government agreement to a designated investigative or law enforcement representative of a Federal department or agency authorized to receive such information (e.g., agency Office of the Inspector General).

e) Agreement with the representation above will be affirmed by checking the "I agree" box in block 17 of the SF424 as part of the electronic proposal submitted via Grants.gov.

g. Other Submission Requirements

If Grants.gov rejects your electronic application submission for any reason, you must correct all errors and resubmit your application before the D.7.d. Proposal submission deadline.

E. APPLICATION REVIEW INFORMATION

1. CRITERIA

You should show strength in as many of the evaluation and selection areas as practicable to demonstrate maximum competitiveness.

a. Principal Evaluation and Selection Criteria

The two (2) principal selection criteria are specified in 32 CFR 22.315(c). The principal selection criteria are of equal importance to each other. The combined principal selection criteria are more important than the additional evaluation and selection criterion. The principal selection criteria are:

(1) The technical merits of the proposed research.
(2) Potential relationships of the proposed research and development to Department of Defense missions. This will be assessed based on the merits of the proposed collaboration plan and the potential for transition to AFRL development efforts.

Additional Evaluation criterion is shown below. This criterion is less important than the combined principal selection criteria.

(3) The applicant, principal investigator, team leader, and key personnel qualifications, capabilities, related experience, facilities, and research techniques considered individually and in combination that are integral to achieving DoD objectives for this program.

b. No further criteria or criterion will be used for proposal selection

2. REVIEW AND SELECTION PROCESS

a. Merit-based, Competitive Procedures

Proposals will be subjected to a peer or programmatic review. The peer review will use internal and external reviewers to assess technical merit and Air Force relevance of the proposal.

The programmatic review assesses the technical quality of the proposal, relevance of the proposed research to the portfolio descriptions in this FOA, relevance of the work to Air Force and DoD needs, and the potential of the research balanced against the available

funding resources of a given portfolio. Selection for award consideration will be made based on the outcome of these reviews.

AFOSR anticipates selecting proposals for possible funding on a competitive basis according to 10 USC 4141, and 10 USC 4024 using the merit-based, competitive procedures described in 32 CFR 22.315, incorporated here by reference.

You should show strength in as many of the evaluation and selection areas as practicable to demonstrate maximum competitiveness.

b. Cost Analysis for Reasonableness and Realism

If your proposal is selected for possible award, AFOSR will analyze the cost of the work for realism and reasonableness. The cost of your proposal is considered but is not an evaluation factor or criterion.

AFOSR must make sure the costs you propose are reasonable, realistic, and allocable to this work before AFOSR can make an award. All costs must be allowable to be reasonable. AFOSR may analyze your technical and cost information at the same time.

3. DISCLOSURE OF ADMINISTRATIVE PROCESSING BY CONTRACTOR PERSONNEL

AFOSR use support contractor personnel to help it with administrative proposal processing. The contractor personnel are employees of commercial firms that have a contract with AFOSR. AFOSR makes sure all of its support contracts include nondisclosure agreements that prohibit disclosure of any information you submit to other parties.

4. NO GUARANTEED AWARD

AFOSR does not guarantee that any award will be made under this competition.

F. FEDERAL AWARD ADMINISTRATION INFORMATION

1. SELECTION NOTICES

a. Electronic Notification

If your proposal is selected for possible award, you will receive a notice.

b. Selection for Possible Award Does Not Authorize Work

Our selection notice **is not** an authorization to start work and **is not** an award guarantee.

AFOSR will contact your business office to get answers to any questions it has about your proposal and negotiate specific award terms. Negotiations may result in funding levels that are less than those in the proposal. If the administering agency does not have specific questions relating to the proposal, negotiations may not take place. AFOSR may take no exception to the proposed costs, and make award, without communications.

2. AWARD NOTICIES

a. Federal Award Document

A grant or contract signed by a warranted Grants or Contracting Officer is the only official notice that an award has been made.

b. Electronic Federal Award Distribution

AFOSR sends award documents to your business office by email. This is called award distribution. AFOSR always ask your business office to forward the award to the Principal Investigator indicated on the award document. Proposers should provide an email address for the distribution notices, one that is not to a specific person, who may be unavailable when award is made.

3. ADMINISTRATIVE AND NATIONAL POLICY REQUIREMENTS

a. Reporting of Matters Related to Recipient Integrity and Performance

You must report recipient integrity and performance information as required by Appendix XII to 2 CFR Part 200 – Award Term and Condition for Recipient Integrity and Performance Matters, incorporated here by reference. You should read the full text of this award term now using the link above to make sure you understand our requirements. You can also find this term at http://www.ecfr.gov.

b. Agency Review of Risk Posed by Applicants

1) AFOSR must review information available about you and entities included in your proposal through the Office of Management and Budget (OMB) designated repositories of government- wide eligibility qualification and financial integrity information. Our risk review is required by 31 U.S.C. 3321 and 41 U.S.C. 2313 and includes both public and non-public information. You must be qualified as described at 32 CFR 22.415 Standards to receive an award.

2) AFOSR must consider the non-public segment of the Federal Awardee Performance and Integrity Information System (FAPIIS) for all awards exceeding the current simplified acquisition threshold of $250,000.

3) At a minimum, the information in the system for a prior Federal award recipient must demonstrate a satisfactory record of executing programs or activities under Federal grants, cooperative agreements, or procurement awards, and integrity and business ethics. We will consider any comments you provide, in addition to the other information in the designated integrity and performance system, when making our risk judgment about your integrity, business ethics, and record of performance under Federal awards.

a. AFOSR may make an award to a recipient who does not fully meet our standards as described at 2 CFR 200.205(a)(2) if it is determined that the information is not relevant to the current Federal award under consideration or there are specific conditions that can appropriately mitigate the effects of the non- Federal entity's risk in accordance with 2 CFR 200.207 Specific conditions.

4) AFOSR must comply with the guidelines on government-wide suspension and debarment described in 2 CFR 200.213 and must require you to comply with these provisions for all work AFOSR funds.

   These provisions restrict Federal awards, sub-awards and contracts with certain parties that are debarred, suspended or otherwise excluded from or ineligible for participation in Federal programs or activities.

c. Cross-Cutting National Policy Requirements

You must comply with all applicable national policy requirements as a condition of award. Key national policy requirements may be found in the DoD Research and Development General Terms and Conditions (DoD T&C); and, Appendix B to 32 CFR Part 22 – Suggested Award Provisions for National Policy Requirements that Often Apply, incorporated here by reference. The full internet address for the DoD T&Cs is provided in section F.3.g below.

d. Acknowledgment of Research Support

You must acknowledge support provided by the Government in all materials based on or developed under our awards. The requirement extends to copyrighted and non-copyrighted materials published or displayed in any medium.

The following language must be used unless the award document provides different instructions:

"This material is based upon work supported by the Air Force Office of Scientific Research under award number FA9550-XX-X-XXXX".

You must require any sub-recipients or subcontractors under your award to include this acknowledgment, too.

e. Disclaimer Language for Research Materials and Publications

Some materials based on or developed under our awards must include special disclaimer language. You must include this language in all materials except scientific articles or papers published in scientific journals unless your award document provides different instructions: *"Any opinions, findings and conclusions or recommendations expressed in this material are*

those of the author(s) and do not necessarily reflect the views of the U.S. Department of Defense."

f. Uniform Administrative Requirements, Cost Principles, and Audit Requirements

Our grants are governed by the guidance in Title 2, Code of Federal Regulations (CFR) Part 200, "Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards" as modified and supplemented by the Department of Defense's (DoD) interim implementation in 2 CFR Part 1103 [79 FR 76047, December 19, 2014] and 2 CFR Part 1125. Provisions of Chapter 1, Subchapter C of Title 32, CFR, "DoD Grant and Agreement Regulations" other than parts 32 and 33 continue to be in effect and apply as stated.

These regulations are incorporated by reference into this announcement.

g. DoD Research and Development General Terms and Conditions

Our domestic grants are subject to the current (at time of award) "DoD Research and Development General Terms and Conditions" (DoD T&C) found at DoD Research and Development General Terms and Conditions.

These terms and conditions are incorporated by reference into this announcement. We can provide a generic model grant or cooperative agreement upon request.

If we publish updated terms and conditions, the updated terms and conditions may apply to any grant made under this announcement.

h. Conditions of Award for Recipients Other Than Individuals

You must agree to comply with the requirements at 2 CFR Part 182, Subpart B "Requirements for Recipients Other Than Individuals" as a condition of award.

i. Minimum Record Retention Requirements

You must keep records related to our awards for at least three (3) years after completion and the final Federal Financial Report is submitted. This requirement is described further in 2 CFR 200.333, incorporated here by reference. The DoD T&C OAR Article II. Records retention and access describes additional requirements.

Sometimes records must be retained for more than three years.

j. Section 889 of the National Defense Authorization Act (NDAA) for Fiscal Year (FY) 2019

Section 889 of the National Defense Authorization Act (NDAA) for Fiscal Year

(FY)2019 (Public Law 115-232) prohibits the head of an executive agency from obligatingor expending loan or grant funds to procure or obtain, extend, or renew a contract to procure or obtain, or enter into a contract (or extend or renew a contract) to procure orobtain the equipment, services, or systems prohibited systems as identified in section 889 of the NDAA for FY 2019.

(3) In accordance with 2 CFR 200.216 and 200.471, all awards that are issued on or after August 13, 2020, recipients and subrecipients are prohibited from obligating orexpending loan or grant funds to:

1. Procure or obtain;

2. Extend or renew a contract to procure or obtain; or,

3. Enter into a contract (or extend or renew a contract) to procure or obtain equipment, services, or systems that uses covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system. As described in Public Law 115- 232, section 889, covered telecommunications equipment is telecommunicationsequipment produced by Huawei Technologies Company or ZTE Corporation (orany subsidiary or affiliate of such entities).

   (a) For the purpose of public safety, security of government facilities, physicalsecurity surveillance of critical infrastructure, and other national security purposes, video surveillance and telecommunications equipment producedby Hytera Communications Corporation, Hangzhou Hikvision Digital Technology Company, or Dahua Technology Company (or any subsidiaryor affiliate of such entities).

   (b) Telecommunications or video surveillance services provided by such entitiesor using such equipment.

   (c) Telecommunications or video surveillance equipment or services producedor provided by an entity that the Secretary of Defense, in consultation withthe Director of the National Intelligence or the Director of the Federal Bureau of Investigation, reasonably believes to be an entity owned or controlled by, or otherwise connected to, the government of a covered foreign country.

(4) In implementing the prohibition under Public Law 115-232, section 889, subsection(f), paragraph (1), heads of executive agencies administering loan, grant, or subsidyprograms shall prioritize available funding and technical support to assist affected businesses, institutions and organizations as is reasonably necessary for those affected entities to transition from covered communications equipment and services, to procure replacement equipment and services, and to ensure that communications service to users and customers is sustained.

(5) See Public Law 115-232, section 889 for additional information.

COVERED FOREIGN COUNTRY means the People's Republic of China.

k. Certification Regarding Disclosure of Funding Sources (Supplement to SF42 (R&R), block 17, Financial Assistance Certifications and Representations)

By checking "I Agree" on the SF 424 (R&R) block 17 you agree to abide by the following statement: "By signing this application, I certify the proposing entity is in compliance with Section 223(a) of the William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021 which requires that: (a) the PI and other key personnel certify that the current and pending support provided on the proposal is current, accurate and complete; (B) agree to update such disclosure at the request of the agency prior to the award of support and at any subsequent time the agency determines appropriate during the term of the award; and (c) the PI and other key personnel have been made aware of the requirements under Section 223(a)(1) of this Act. I am aware that any false, fictitious, or fraudulent statements or claims may subject me to criminal, civil, or administrative penalties. (U.S. code, Title 18, Section 1001)."

4. REPORTING

a. Monitoring and Reporting Program Performance

All of our awards require at least annual and final technical performance reports as required in 2 CFR 200.328. The DoD T&C REP Article I. Performance reporting will apply to grant or cooperative agreement awards. Some of our awards require more frequent technical reports.

You must provide your reports on time. Our awards include a schedule specifying the latest date for submission of each required report. Failure to provide required reports, or providing reports after required due dates, could lead to being considered ineligible for future awards.

You must use a SF 298 Report Documentation Page for interim progress reports.
You must use a completed SF 298 Report Documentation Page as the first page of the final report. You can download an electronic SF 298 from
http://www.gsa.gov/portal/forms/download/116146.

b. Technical Performance Report Format

(1) Federal-wide Research Progress Performance Report (RPPR) Format (All grant awards). We now use the Federal-wide Research Progress Performance Report (RPPR) for annual and final research performance reports. The reporting requirements will be detailed in the grant award documents.

(2) ANSI Standard Z39.18-2005 (all non-grant awards)

Use the AFRL Scientific & Technical Reports – Preparation, Presentation and

Preservations Format Guidelines (June 2010) for your final report unless your award states different requirements. You can download the AFRL standard guide from the Related Documents tab in Grants.gov for this announcement.

c. Department of Defense (DD) Form 882 Report of Inventions and Subcontracts

(1) Invention Reports

(a) You must provide at least a final invention report on DD Form 882. We may ask for annual reports. Our award documents specify the due date. You can get the form at https://www.esd.whs.mil/Portals/54/Documents/DD/forms/dd/dd0882.pdf

(b) You must submit invention reports even if you do not have a patent to report.

(2) Sub-Award and Subcontract Reporting

You must use the DD Form 882 to tell us about any subawards or subcontracts. Your award will provide specific instructions. You can get the form at http://www.dtic.mil/whs/directives/forms/eforms/dd0882.pdf.

d. Standard Form (SF) 425 Federal Financial Report

Our awards require a final SF 425 Federal Financial Report. You can get the form at https://www.grants.gov/forms/post-award-reporting-forms.html.

1) If you request any advance payment(s) under your award, you must submit quarterly SF 425 reports for the life of the grant. Our awards include specific instructions.

2) You do not have to submit quarterly SF 425 reports if you only request payments by reimbursement.

e. Electronic Payment Requests and Electronic Payment

You must submit payment requests electronically using the Invoicing, Receipt, Acceptance, and Property Transfer (iRAPT) application unless your award specifies different instructions. Domestic grant payments must be made using the electronic funds transfer (EFT).
To submit electronic payment requests, you must register to use iRAPT in the Wide Area Workflow (WAWF) e-Business Suite at https://piee.eb.mil. The website includes registration instructions.

If you have WAWF or iRAPT questions or problems, you can get help by telephone at (866) 618-5988 or (801) 605-7095, by electronic mail at disa.ogden.esd.mbx.cscassig@mail.mil, or the website https://wawf.eb.mil/xhtml/unauth/web/homepage/vendorCustomerSupport.xhtml.

f. Property Reports

If AFOSR furnishes any property owned by the Government under an award, you must submit periodic property status reports as described in 2 CFR 200.329 and further implemented by the DoD T&C REP Article III. Reporting on Property.

g. Other Reports

Our Program Officers may ask for informal technical reports as needed. AFOSR uses these informal reports for program purposes, such as preparation for meetings and other technical purposes. AFOSR highly recommends you provide this information in a timely manner by electronic mail directly to the Program Officer.

h. Electronic Submission of Reports

You must plan on submitting reports electronically. **You must submit most reports through the internet application detailed in the grant award document**. Some reports must be sent using electronic mail. Our award documents provide specific instructions that you must follow.

G. AGENCY CONTACTS

1. TECHNICAL INQUIRES AND QUESTIONS

You should submit all questions in writing by electronic mail. You should include the FOA number in the subject line.
If you submit a question by telephone call, fax message, or other means, you may not receive a response.

You should include the announcement number in the subject line.

DR. ALI SAYIR, AFOSR/RTB
Email: ali.sayir.2@us.af.mil

DR. MICHAEL YAKES, AFOSR/RTB
Email: michael.yakes@us.af.mil

DR. JIWEI LU, AFOSR/RTB
Email: jiwei.lu@us.af.mil

2. GENERAL INQUIRIES AND QUESTIONS

You must send all general questions about this announcement to us by email. Your questions will generally be consolidated with other questions and posted on Grants.gov so everyone gets the same information. AFOSR may provide an individual response by email if your question does not apply to anyone else.

Ms. Julia Carrico
Grant and Contracting Officer
Julia.carrico@us.af.mil

H. OTHER INFORMATION

1. OMBUDSMAN

(a) An ombudsman has been appointed to hear and facilitate the resolution of concerns from offerors, potential offerors, and others for this acquisition. When requested, the ombudsman will maintain strict confidentiality as to the source of the concern. The existence of the ombudsman does not affect the authority of the program officer, grants officer, contracting officer, or source selection official. Further, the ombudsman does not participate in the evaluation of proposals, the source selection process, or the adjudication of protests or formal grant or contract disputes. The ombudsman may refer the party to another official who can resolve the concern.

(b) Before consulting with an ombudsman, interested parties must first address their concerns, issues, disagreements, and/or recommendations to the grants or contracting officer for resolution. Consulting an ombudsman does not alter or postpone the timelines for any other processes (e.g., agency level bid protests, GAO bid protests, requests for debriefings, employee-employer actions, contests of OMB Circular A-76 competition performance decisions).

(c) If resolution cannot be made by the GO, concerned parties may contact the AFRL Ombudsman, Director of Contracting, HQ AFRL/PK. The AFRL Alternate Ombudsman is the Deputy Director of Contracting, HQ AFRL/PK. Please send an email to afrl.pk.workflow@us.af.mil with the subject of "Ombudsman".

(d) The ombudsman has no authority to render a decision that binds the agency.

(e) Do not contact the ombudsman to request copies of the solicitation, verify offer due date, or clarify technical requirements. Such inquiries shall be directed to the grants or contracting officer.

2. GRANTS AND CONTRACTING OFFICERS AUTHORITY

Grants and Contracting Officers acting within their warranted capacity are the only individuals legally authorized to make commitments or bind the Government.

No other individuals are authorized to make commitments or otherwise bind us.

3. ADDITIONAL FUNDING OPPORTUNITIES

AFOSR posts new funding opportunities throughout the year looking for today's breakthrough science for tomorrow's Air Force. You can find more information about Air Force Office of Scientific Research interests and funding opportunities on our website at http://www.wpafb.af.mil/afrl/afosr.

Thank you for your interest in this announcement.