



## AIR FORCE OFFICE OF SCIENTIFIC RESEARCH BROAD AGENCY ANNOUNCEMENT

### I. OVERVIEW INFORMATION

The Air Force Office of Scientific Research (AFOSR), hereafter generally referred to as “we, us, our, or AFOSR,” manages the basic research investment for the Department of the Air Force (DAF), including both the U.S. Air Force (USAF) and U.S. Space Force (USSF). As a part of the Air Force Research Laboratory (AFRL), our technical experts discover, shape, and champion research within AFRL, universities, and industry laboratories to ensure the transition of research results to support U.S. Air Force and Space Force needs. Using a carefully balanced research portfolio, our research managers seek to foster revolutionary scientific breakthroughs enabling the USAF, USSF and U.S. industry to produce world-class, militarily significant, and commercially valuable products.

To accomplish this task, we solicit proposals for basic research through this general Broad Agency Announcement outlining the U.S. Air Force Defense Research Sciences Program. We invite unclassified proposals that do not contain proprietary information for research in many broad areas. We expect to fund only fundamental research. Our research areas of interest are described in detail in section [A. Program Description](#).

We anticipate many awards in the form of grants, cooperative agreements, contracts, or other transactions. We reserve the right to select and fund for award all, some, part, or none of the proposals received. There is no guarantee of an award. **Please review the entire announcement for full details.**

**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).**

## **II. BASIC INFORMATION**

### **FEDERAL AWARDING AGENCY NAME**

Air Force Office of Scientific Research  
875 North Randolph Street, STE 325, Room 3112  
Arlington, VA 22203

### **FUNDING OPPORTUNITY TITLE**

Research Interests of the Air Force Office of Scientific Research

### **ANNOUNCEMENT TYPE**

Initial Announcement

### **ANNOUNCEMENT NUMBER**

FA955026S0001

### **CATALOG OF FEDERAL DOMESTIC ASSISTANCE (CFDA) NUMBER**

12.800 Air Force Defense Research Sciences Program

The authorization to make awards under this funding opportunity may be found via the Assistance Listing (CFDA) Number on [sam.gov](http://sam.gov).

### **KEY DATES**

This announcement remains open until superseded. We review and evaluate proposals as they are received. You may submit proposals at any time; however, some specific topic instructions may recommend submission by specific dates that align with funding expectations.

### **NORTH AMERICAN INDUSTRY CLASSIFICATION SYSTEM (NAICS) CODE:**

The NAICS code for contracts under this announcement is 541715.

### **LEGAL REQUIREMENTS**

Each award under this announcement will be governed by the general terms and conditions in effect at the time of the award that conform to DoD's implementation of OMB guidance applicable to financial assistance, as follows:

- a. For Universities and Non-Profit Entities, these terms and conditions are identified in Parts 1126 through 1138 of the DoDGARS (2 CFR Parts 1126 through 1138, which comprise 2 CFR 1100 Subchapter D).
- b. For For-Profit Entities, requirements to be included in the general terms and conditions are identified in Part 34 of the DODGARS (32 CFR Part 34).
- c. For All Entities, National Policy Requirements are identified in Part 1122 of the DoDGARS (2 CFR Part 1122).

Any resulting awards will be subject to the DoD Research and Development (R&D) General Terms and Conditions (Ts&Cs), located at: <https://www.nre.navy.mil/work-with-us/manage-your-award/manage-grant-award/grants-terms-conditions>. In addition, the AFRL Addendum to the DoD R&D General Ts&Cs and AFRL Award-Specific Ts&Cs (attached to this FOA) include additional Ts&Cs that may be applicable to any resulting awards. This AFRL document is a supplement to the DoD R&D General Ts&Cs. To understand the entire AFRL requirement for a given article, the DoD R&D General Ts&Cs must be read in tandem with this document.

## **GOLD STANDARD SCIENCE (GSS)**

In accordance with Executive Order (EO) 14303—Restoring Gold Standard Science (May 2025)

GSS is science conducted in a manner that is:

- a. reproducible;
- b. transparent;
- c. communicative of error and uncertainty;
- d. collaborative and interdisciplinary;
- e. skeptical of its findings and assumptions;
- f. structured for falsifiability of hypotheses;
- g. subject to unbiased peer review;
- h. accepting negative results as positive outcomes; and,
- i. without conflicts of interest

With regards to GSS, applications/proposals shall:

- 1) include clear benchmarks for measuring success and progress towards relevant goals and a commitment to achieving GSS;
- 2) identify areas of demonstrating success in implementing GSS; and
- 3) include a commitment to complying with administration policies, procedures, and guidance respecting GSS. By your submission, you explicitly agree to the following statements:

- *Our institution understands the definition of Gold Standard Science as outlined above.*
- *Our institution and all personnel involved in the proposed project will adhere to all administration policies, procedures, and guidance respecting Gold Standard Science in the execution of this project if funded.*

## **NATIONAL PRIORITY**

**In accordance with Executive Order 14332, all technical program descriptions contained in this BAA reflect the basic research priorities for the Department of the Air Force and are defined to advance the administration and agency priorities (c.f., OMB memo M-25-34 “Fiscal Year 2027 Administration Research and Development Budget Priorities and Cross-Cutting Actions”). More information about the Department of the Air Force Priorities can be found at [www.af.mil](http://www.af.mil).**

## **EXECUTIVE SUMMARY**

AFOSR receives Congressionally appropriated funding to support broad-based scientific and engineering research with the potential to profoundly impact future US Air Force and Space Force capabilities. This general Broad Agency Announcement outlines the U.S. Air Force Defense Research Sciences Program to solicit proposals for basic research. Approximately \$200 million is anticipated to be available for support of actions awarded under this announcement, subject to the availability of funds. Research proposals typically are funded between \$100,000 and \$300,000 per year. Most of our awards are three (3) years in duration.

Awards may be proposed for not more than five (5) years. **NOTE: AFOSR will not consider any request for exception above \$10,000,000.**

## **AGENCY CONTACTS**

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## A. PROGRAM DESCRIPTION

Our focus is on research areas that offer significant and comprehensive benefits to our national warfighting and peacekeeping capabilities. These areas are organized and managed in three scientific branches:

- Engineering, Information Science, Mathematics and Collaboration Branch (RESA)
  - ENGINEERING AND COMPLEX SYSTEMS TEAM
  - INFORMATION NETWORKS TEAM
- Physical Sciences Branch (RESB)
- Bio-Cognitive Branch (RESC)

### A.1. AFRL/RESA Engineering and Complex Systems Team

The Engineering and Complex Systems Team Program Officers and topics are:

SECTION	PROGRAM DESCRIPTION	PROGRAM OFFICER
<a href="#">A.1.a.</a>	Energetic Solid-State Physics and Mechanochemistry	Dr. Chiping Li
<a href="#">A.1.b.</a>	Energy, Combustion, and Non- Equilibrium Thermodynamics	Dr. Chiping Li
<a href="#">A.1.c.</a>	Aerodynamic Sciences	Dr. Gregg L. Abate
<a href="#">A.1.d.</a>	High-Speed Aerodynamics	Dr. Amanda Chou
<a href="#">A.1.e.</a>	Aerospace Composite Materials	Dr. Ali Sayir
<a href="#">A.1.f.</a>	Aerospace Structures	Dr. Greg L. Abate
<a href="#">A.1.g.</a>	Propulsion and Power	Dr. Justin Koo
<a href="#">A.1.h.</a>	Agile Science for Test and Evaluation (T&E)	Dr. Brett Pokines

Our research areas of interest are described in detail below:

#### A.1.a. Energetic Solid-State Physics and Mechanochemistry

**Program Description:** The objective of this portfolio is to understand critical chemical and physical behaviors in solid-state energy systems that arise due to compositional complexity under far-from-equilibrium conditions for game-changing advancements in critical DoD expeditionary systems. Research supported by the portfolio will build the foundational scientific knowledge to understand chemistry and

reaction dynamics in heterogeneous solid materials, causal pathways for energy release in mechanochemically-stimulated systems, energy localization and the interplay between continuum-level phenomena and molecular evolution, and the implications of shock dynamics on local state property and chemical behaviors. Solutions will necessarily arise from combined efforts utilizing empirical, numerical, and theoretical treatments to interrogate these uncertainties. Basic science advances supported by this portfolio will transition scientific discoveries that will inform the development of the next generation of Department of the Air Force (DAF) solid-state energy systems with a focus on improved energy and power density, operational reliability, ruggedized response to insult, effect-based optimization, and understanding system behavior as a function of age and operating conditions.

**Basic Research Objectives:** Research proposals are sought that endeavor to elucidate the mechanistic behaviors of energy systems that give rise to emergent property phenomena. Areas of focus include leveraging state-of-the-art capabilities in condensed matter spectroscopy and microscopy to achieve unparalleled resolution into the behavior of solids; advancing numerical techniques to interrogate poorly understood dynamic behaviors of solids under extreme temperatures and pressures; and developing solid-state energy systems with the intent to study the effects of local chemistry, fine-feature, and domain size on dynamic property behavior.

#### Leveraging Solid-state Diagnostic Techniques

Examples of research topics covered under this research focus include but are not limited to: attosecond physics observational techniques for solid-state systems, multi-wave mixing spectroscopy techniques for optically opaque systems, high-energy radiation microscopy and spectroscopy, *in situ* electron and neutron beam techniques, and any diagnostic technique that can causally relate the mechanical condition of a solid system to local chemical evolution.

#### Advancing Numerical Science

Examples of research topics covered under this research focus include but are not limited to: atomistic numerical techniques to understand non-equilibrium effects on reactive chemistry under high temperatures and pressures: physics-informed, lossless continuum level modeling techniques with vastly improved computational efficiency, converged physical and chemical models to describe energetic system response to insult, chemical kinetics-aware phase field modeling, *ab initio* modeling of path dependent reactive mixing in solids, and any non-traditional modeling technique that could be used to study the coupling of chemistry and physics in energetically evolving solid-state systems.

#### Developing Energetic Model Systems

Examples of research topics covered under this research focus include but are not limited to: substances that exhibit chemistry-decoupled energetic behavior, materials with highly non-linear and thermodynamically complex chemical evolution pathways, simplified and instrumentally accessible systems to facilitate understanding of relevant dynamic energetic solids, novel demonstrations of energy system

fabrication processes that allow for atomic precision in the distribution of reducing and oxidizing species, material systems that can be used to study how cycle fatigue and age affect energetic solid performance, any model material system that, through observation, improves the current understanding of mechanochemical coupling.

You are highly encouraged to contact our Program Officer prior to developing a full proposal. Aspiring PIs are strongly recommended to carefully read the program BAA and develop a short summary to explain the basic science questions under contention, the current state-of-the-art, how your research would advance it, and the approximate cost for a three (3) to five (5) year effort. The optimal time frame for inquiring about portfolio needs is November-April, but prospective PIs are invited to reach out during any time of the year.

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### **A.1.b. Energy, Combustion and Non-Equilibrium Thermodynamics**

**Program Description:** Majority of Air and Space Forces' system functions rely on the chemical energy stored in energetic molecules, converted into relevant forms, such as momentum through the combustion for propulsion and electricity from the electrochemical process for information processing, system control, direct energy weapon etc. The program supports efforts to explore, understand, describe, simulate/model, and manipulate/control key underlying physical and chemical phenomena/processes in energy supply and conversion, fostering innovative/unconventional thinking, leading to game-changing capabilities as well as helping with current urgent needs for Air and Space Forces.

**Basic Research Objectives:** This program seeks broad ranges of basic scientific understanding and knowledge of energy storage and conversion, including but not limited to the four following focused areas:

Non-Equilibrium and Ultra-Fast Energy Conversion: detonation and other forms of locally controlled and compact combustion; non-equilibrium/ high- temperature combustion chemistry, ultra-fast electric energy release and delivery mechanism; non-equilibrium electrochemical and related physical processes, especially relevant to SEI, direct-conversion from chemical to mechanical energy; new space energy cycle/concept, non-equilibrium energy-information relation; etc.

- (1) Multi-Functional and Unconventional Energy Storing Molecules, Materials and Processes: endothermic fuels and propellants; molecules, materials and chemical processes functioning thermochemically, electrochemically, and possibly structurally; sodium based and other unconventional battery chemistry/physics with geo-political and cost advantages; safe battery chemistry/physics for aviation and space exploration, including solid electrolytes, etc.
- (2) Phase-Transition of Multi-Component Mixtures: Most Air and Space Forces' energy systems involve the phase-transition of multi-component fluids with many unknowns. These phase-transition

behaviors are governed by the intermolecular force and interaction. The objective here is to understand and characterize the underlying molecular interactions for the multicomponent phase transition to explore vast potentials in energy and material sciences by manipulating and controlling these underlying molecular interactions.

- (3) Diagnostics, Simulation/Modeling and Data Sciences for Energy Research: including approaches and methods across large-scale ranges, with ultra-high local temporal and spatial resolutions to probe, understand and describe underlying energy-related physics and chemical processes mentioned above, particularly in multi-phase regimes; diagnostics: insidious pressure measurements, x-ray based spectroscopy with special interests in x-ray CARS (joint interest with Dynamic Material Interaction program); simulation and modeling: first principle-based multi-physics simulations with special interests in the local refinement and phenomenon capture; advancing data-assimilation science with the focus of using combinations of the data and simulation/modeling to deepen the understanding of the underlying physics and chemistry.

**Contact Information:** Proposers are highly encouraged to contact the Program Officer prior to developing a full proposal, preferably by email, to discuss the current state of understanding, how the research would advance it, the approximate cost for a three (3) to five (5) year effort, and if there are any specific submission target dates.

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#### **A.1.c. Aerodynamic Sciences**

**Program Description:** The Aerodynamic Sciences portfolio supports basic research of fundamental flowfield physics across a range of conditions. Greater understanding of the fundamentals of the flowfield physics is crucial for exploitation into air vehicle performance gains relevant to the USAF. The portfolio is interested in aerodynamic flowfields arising in both internal and external configurations and extending over a wide range of Reynolds numbers. The portfolio seeks to emphasize the characterization, modeling, prediction, and control of flow instabilities, turbulent flows, and aerodynamic fluid-structure/material interactions. A focus on the understanding of the fundamental flow physics, the dynamics and control of aerodynamic shear flows, and interactions of these flows with rigid and flexible surfaces in motion is motivated by an interest in developing physics based predictive models and innovative control concepts for these flows.

**Basic Research Objectives:** Research in this portfolio is focused on a variety of topics including fluid-structure/material interactions, vortex dominated flows, free and wall-bounded shear layer flows, time-dependent flows, and transitional and turbulent flows.

Greater understanding of these and related topics will lead to improved air vehicle performance relevant to USAF air vehicle configurations. The portfolio maintains an interest in the dynamic interaction between steady and unsteady fluid motion, linear

and nonlinear structural deformations, and aerodynamic control effectors for a wide range of flight regimes.

The portfolio seeks to advance fundamental understanding of complex aerodynamic flowfield phenomena through integration of theoretical, numerical, and experimental approaches. Research incorporating these elements that improve understanding of these complex flows are strongly encouraged. Flowfield studies are expected to involve an approach based on fundamental insight into the dynamics of such flows. In cases where that insight may not exist, studies examining fundamental flow physics with a path to enabling control of the flow may be of interest. Flow control efforts integrating modeling, control theory, and advanced sensor and/or actuator technology for application to a flow of interest are also encouraged.

Note that basic research of the variety typically funded by the portfolio may not yet have a clear transition path to an application, but nevertheless should be relevant to U.S. Air Force interests. Proposers are highly encouraged to contact the Program Officer via email prior to developing a full proposal to discuss the current state of the art in their area of interest, how the proposed research would advance it, the approximate cost for a three (3) year effort, and if there are any specific submission target dates.

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#### **A.1.d. High-Speed Aerodynamics**

**Program Description:** The flow field around a high-speed vehicle strongly influences its size, weight, lift, drag and heating loads. Therefore, research in this area is critical to the U.S. Air and Space Force's interest in rapid global and regional response and space operations. This portfolio aims to lay the scientific foundation, through discovery, characterization, prediction and understanding of critical phenomena, for game-changing advancements in our understanding of high-speed, high-temperature non-equilibrium flows around flying vehicles. External and internal transitional and turbulent wall-bounded flows are critical to the cadre of problems studied. Such understanding is a pre-requisite to making hypersonic flight routine.

**Basic Research Objectives:** Proposals are encouraged which leverage recent breakthroughs in other scientific disciplines and foster rapid research advancements in high-speed aerodynamics. It is encouraged that proposed efforts contain a balanced combination of experiments, computations and theoretical efforts. Flight experiments may be sought for obtaining data that cannot be obtained in ground facilities or by state-of-the-art computations. For any experiments proposed, explain how they capture the most sensitive variables for the problem being studied and how they can be used for validation of numerical models or to enhance our understanding of the current gaps in our knowledge of physical processes. The development of new tools and measurement techniques that are necessary to enhance these studies will be considered, but should not be the focal point of a proposed effort. For any numerical efforts explain which variables are the hardest to accurately predict and how the results will be validated with relevant measurements. All proposal submissions should

be driven by a gap in our scientific understanding of high-speed flow phenomenology with carefully identified approaches to closing that gap. Efforts studying the multi-physics or interaction aspects of these flow phenomena are encouraged to include sensitivity analysis to help determine the dominant physical parameters and mechanisms involved.

Innovative research is sought in all aspects of high Mach number (preferably  $M > 2$ ), high temperature, non-equilibrium flows with particular interest in (not in order of priority):

- Turbulence and transition – development, structure and growth, unsteady flow field characterization, – initial value and eigenvalue approaches for transition prediction, reduced-order models/transport equations for implementation of transition prediction into RANS codes, WMLES approaches, and stability analysis for different modes and multimode transition.
  - Enhanced understanding of high-enthalpy/thermochemical nonequilibrium effects
  - Enhanced understanding of the effects of turbulence/particles in free stream, wall roughness, surface discontinuities (steps and gaps), curvature, angle of attack, etc. on this process are desired
  - Enhanced understanding of the physical processes that either promote or delay transition and/or shock unsteadiness in high-speed environments to provide possible avenues of mechanism-based flow control
  - Enhanced understanding of other topics identified in transition-modeling/prediction workshops, such as NASA TM-20240005810
- Fluid-thermal-structure interactions at hypervelocity conditions to include both relevant heating, freestream disturbance environments, and structural boundary conditions
- Development of physics-based models for air ro-vibrational-dissociation and ro-vibrational-translational processes that can be incorporated in CFD solvers without incurring orders of magnitude more time to solve a given problem. Experiments to validate the above models are also sought.
- Characterization of fundamental processes occurring between non-equilibrium flows and reacting surfaces, as well as other ceramic or metallic materials utilized in high-speed flows
- Characterization of naturally occurring atmospheric phenomenology in at high altitudes, receptivity of the flow field to these disturbances, and their effects on high-speed aerodynamics
- Energy transfer mechanisms within high enthalpy flows
- Flight experiments to realize basic science advancement in any of the above areas might be sought.

Ideas that don't strictly fall into the categories above, but are germane to high-speed aerodynamics, are also welcome. You are highly encouraged to contact our Program Officer prior to developing a full proposal, in any sub-area, to briefly discuss the current state-of-the-art, how your research would advance it, and the approximate cost for a three (3) to four (4) year effort.

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#### A.1.e. Aerospace Composite Materials

**Program Description:** This program supports basic research in the design, processing, and characterization of novel composite materials to enable transformative enhancement in their performance through understanding of the chemistry, physics, and mechanics in heterogeneously structured materials. Such materials are aimed to significantly impact the structural design of future U.S. Air Force and Space Force platforms including airframes, space vehicles, satellites, and a multitude of load-bearing systems. Key scientific areas supported by the program include: collective phenomena in heterogeneous materials, interface science, composite age and cycle evolution, dynamic process effects on properties, and information theory for design tools for composite materials.

**Basic Research Objectives:** Proposals are sought to advance the understanding of heterogeneously structured materials and the ability to conceptualize novel materials with collective properties not achievable in monolithic materials. Among the routes to achieving game-changing improvements in compositionally and topologically optimized materials, current emphases within the program are: (1) advanced materials with exceptional temperature capabilities; (2) design and processing of configurationally complex materials with controlled disorder; (3) understanding of interfacial phenomenon in heterogeneous systems; and, 4) computation and characterization methodologies to interrogate the behavior of heterogeneous materials in harsh environments.

On dynamic process effects on properties, the priority is placed on high temperature capabilities in polymer resin, fibers/coatings/reinforcements, and ceramics. Potential approaches include, but are not limited to, new chemistry, processing methodology, and novel microstructural configuration by design. The utilization of topological arrangement (phase distribution on nano- to micro-scale), phase transformation, coupling effects, and material texture to optimize macroscopic properties is of interest. Topics of interest on materials processing include, but are not limited to, dynamic covalent polymers, polymer-derived ceramics, organic-inorganic hybrids, and field-assisted sintering. The proposed research must be based on fundamental understanding of the chemistry, thermodynamics, reaction mechanisms and kinetics, short- and long-range coupling, and/or structure-property relationships of the candidate materials. Metal-based materials, while not excluded, are not a priority for the program.

The understanding of the interface is important in heterogeneously structured materials. Research emphasis is on the intrinsic properties, time-dependent microstructural evolution, as well as nanomechanical and chemical interactions at the reinforcement-matrix interface. The incorporation of coating or interphase materials to manipulate interfacial characteristics for optimal collective behavior is also of interest.

Research ideas on computational modeling that aim to understand and predict the mechanical and chemical evolution of topologically complex materials in harsh environments are sought. Concepts to elucidate and mitigate material degradation under ablative, plasma-rich, oxidative, and/or space radiation-present conditions are of particular interest. Experimental validation of the computational results is highly desirable. Advanced characterization techniques capable of isolating and quantifying material response on proper spatial and time scales are also of interest to the program.

You are highly encouraged to contact the Program Officer prior to developing a full proposal to discuss the current state-of-the-art how your research would advance it, and any submission target dates. To initiate the discussion, submit via email a short research summary that describes the fundamental science to be investigated. Alternatively, you may submit pre-proposal that describes the research concept, objective and approach, scientific significance, and the expected outcome. The pre-proposal is limited to two pages (text and legible graphics). A short budget statement on the approximate cost for a three (3) to five (5) year effort must be provided. A third page containing key references may be included. Presentation viewgraphs are not an acceptable form of pre-proposal. The research focus must be on fundamental science and not on solving an engineering problem. If the concept is considered of interest to the Aerospace Composite Materials program and funding is available, an invitation to submit a full proposal submission may be extended.

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#### **A.1.f. Aerospace Structures**

**Program Description:** The goals of this research program are to integrate newly emerging classes of aerospace structures and materials, novel functional material systems or devices, programmable meta-architectures, intelligent subsystems, stimuli responsive surfaces, structural dynamics, and their combinations into load-carrying and/or multifunctional structures to achieve unprecedented US Air Force and Space Force system performance. The program seeks to establish fundamental understanding required to revolutionize functionality of new aerospace structures and materials to enable futuristic concepts of structural design.

**Basic Research Objectives:** The program seeks the fundamental understanding of critical science for the development of next-generation aerospace vehicle structures by establishing theoretical models, physical models, analytical methods, numerical simulations, and/or predictive methodologies. The program promotes basic research which aims to conceive and implement new aerospace structural and/or material

concepts for revolutionary improvement of performance for future US Air Force and Space Force platforms. This includes the design, development, and integration of emerging classes of materials, subsystems, material-structure interfaces and surfaces into load-carrying and/or multifunctional structures.

Multifunctionality refers to coupling structural performance and as-needed novel functionalities to deliver significant improvements in system-level efficiency. The various visionary concepts for developing multifunctionality include:

- (1) “autonomic” structures which can sense, diagnose, and respond for adjustment with minimum external intervention and self-learning capabilities;
- (2) “adaptive” structures which allow for the reconfiguration or readjustment of shape, functionality, and/or mechanical properties on demand; and,
- (3) “architected” materials and systems which enable revolutionary vehicle capabilities.

The program focuses on new load carrying structural concepts and materials, novel functional material systems or devices, metamaterials and architectures, structural dynamics, and combinations thereof enabling revolutionary macroscale structures that must perform in extreme environments such as electromagnetic, mechanical, thermal and acoustic or any combination thereof. The design and evaluation of such structures may need to be carried out at multiple scales from atoms to continuum to achieve unprecedented system performance. The radical performance sought will require combining several scientific disciplines beyond multiscale mechanics.

Critical, high-risk research opportunities include but are not limited to:

- (1) multiscale/multi-physics characterization and modeling (spatial and temporal) of structural behavior, structural dynamics, failure mechanisms, damage tolerance, and life prediction of aerospace structures;
- (2) non-conventional fabrication of structural components via the integration of dissimilar materials into hybrid structures with multi-material joints and/or multiscale composite interfaces;
- (3) multifunctional structures integrated with emerging classes of structural load carrying materials, novel functional material systems or devices, programmable meta-architectures, stimuli responsive surfaces, and intelligent subsystems;
- (4) emerging computing architectures and artificial intelligence (AI) applied to multifunctional structures to explore properties of novel applications, such as “autonomic” systems which can sense, diagnose, and respond for adjustment with self-learning capabilities;
- (5) exploiting the “sense-assess-respond” feedback loop through novel material-structure-system integration/distribution relying on materials-aware information theory and network science, surrogate modeling for coupled-physics phenomena, and inverse materials design optimization;

(6) revolutionary structural concepts involving novel topologies across scales, controlled-flexibility distributed-actuation, unprecedented flight configurations from morphing of shape, size or local properties of structural components, and self-repair/self-healing/regeneration capabilities; and,

(7) innovative measurement, control, and experimentation techniques of structural components.

Researchers are highly encouraged to contact the Program Officer prior to developing a full proposal to briefly discuss the current state-of-the-art, how the proposed research would advance it, the approximate cost for a nominal three (3) effort, and if there are any specific submission target dates.

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### **A.1.g. Propulsion and Power**

**Program Description:** The Propulsion and Power Portfolio seeks to expand knowledge discovery to enable enhanced maneuver and power capabilities across the aerospace domain. In tandem, this portfolio seeks to pioneer new approaches and research innovations to dramatically accelerate the underlying rate of discovery.

**Basic Research Objectives:** Current research objectives of interest in this technology area include improved understanding of:

- Partially ionized, nonequilibrium molecular plasmas including plasma-surface interactions, space environmental effects, mode transitions, and plasma transport mechanisms;
- Reactive multiphase interfaces where small length scales, short time scales, electric fields, and chemical energy release/capture drive the system state away from equilibrium; and,
- Thermophysical and electrochemical properties of multicomponent mixtures over timescales ranging from operational to lifetime with a focus on extreme environmental conditions.

An underlying motivation to advance potentially disruptive propulsion and power concepts is welcome but the focus of successful proposals will be on identification of impactful knowledge gaps and farsighted, high payoff research approaches. Research outcomes from this proposal will support the future development of DoD-relevant capabilities such as enhanced robustness, improved lifetime assessment, and accelerated performance enhancement for in-space, boost, and missile propulsion and power systems.

Furthermore, given the fundamentally interdisciplinary nature of this portfolio, major opportunities exist for collaboration with researchers from outside this portfolio. Researchers should also consult the programs in Energy, Combustion and Non-Equilibrium Thermodynamics, Energetic Solid State Physics and Mechanochemistry, Aerospace Materials for Extreme Environments, Molecular Dynamics and

Theoretical Chemistry, Dynamical Data and Information Processing, Computational Mathematics, and other programs as described in this announcement to find the best match for the research in question.

Proposers are strongly encouraged to contact the Program Officer prior to developing a full proposal to discuss its relationship to this basic research portfolio, specific details/innovations of the proposed research strategy in the context of the current state of understanding in this field, the approximate cost for a three (3) to five (5) year effort, and if there are any specific submission target dates. Collaborative efforts with the Air Force Research Laboratory are encouraged, but not required.

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#### **A.1.h. Agile Science for Test and Evaluation (T&E)**

**Program Description:** The Agile Science for Test and Evaluation (T&E) program supports basic research inventing and innovating revolutionary capabilities responsive to the Air Force and Space Force T&E community. Crossing scientific frontiers necessitates enhancing and pioneering test and measurement capabilities. The program sponsors basic research in areas enabling metrology and facilitating correct and comprehensive interpretation of test information. Agile science of test and evaluation leads to improving the ability to analyze and model operational environments, pursue science discoveries, and accelerate research & acquisition. The AFOSR T&E program encompasses three (3) broadly-defined, overlapping thrust areas: Autonomy, Hypersonics, and Cyber & Microelectronics. The Program is closely aligned with other AFOSR science areas advancing experimental methodologies and merging scientific disciplines.

**Basic Research Objectives:** The AFOSR T&E program is closely engaged with technical experts at the Air Force Test Center (AFTC) organizations including Arnold, Edwards, Eglin and Holloman Air Force Bases, who help guide the program on basic research objectives. Basic research in areas that advance the science of testing is broadly defined and spans mathematics as well as most disciplines in engineering and the physical sciences. Areas include, but are not limited to:

- Novel measurement techniques, materials, and instruments that enable accurate, rapid, and reliable test data collection of physical, chemical, mechanical, and flow parameters in extreme environments, such as those encountered during transonic flight, hypersonic flight, and the terminal portion of weapons engagement;
- Accurate, fast, robust, integrable models reducing requirements to test or help provide greater understanding of test results;
- Advanced algorithms and computational evaluation techniques that are applicable to new generations of computers, including massively parallel, quantum, and neuromorphic machines;
- Advanced algorithms and test techniques that allow rapid and accurate

assessment of devices and methods to cyber vulnerability;

- New processes and devices that increase bandwidth utilization and allow rapid, secure transfer of test data to control facilities during test;
- Advanced mathematical techniques that improve design of experiment or facilitate confident comparison of similar but disparate tests;
- Advanced models of test equipment and processes that improve test reliability and efficiency;
- New or advanced science that enable revolutionary test and measurement; and,
- Basic research in other T&E areas that advances the science of test and contributes to the development of knowledge, skills, and abilities for the AF T&E community.

You are highly encouraged to contact our Program Officer prior to developing full proposals to briefly discuss program alignment. You should be prepared to explain why your proposed effort should be considered basic research, how it is unique to Test Science, and demonstrate an awareness of the Air Force and Space Force T&E process.

Collaborative efforts with the Air Force Test Center and Air Force Research Laboratory are encouraged, but not required.

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## A.2. AFOSR/RESA INFORMATION AND NETWORKSTEAM

The Information and Networks Team Program Officers and topics are:

SECTION	PROGRAM DESCRIPTION	PROGRAM OFFICER
<a href="#">A.2.a.</a>	Computational Mathematics	Dr. Fariba Fahroo
<a href="#">A.2.b.</a>	Dynamical Systems and Control Theory	Dr. Frederick Leve
<a href="#">A.2.c.</a>	Dynamic Data and Information Processing	Dr. Erik Blasch
<a href="#">A.2.d.</a>	Information Assurance and Cybersecurity	Dr. Tristan N. Nguyen
<a href="#">A.2.e.</a>	Mathematical Optimization	Dr. Warren Adams
<a href="#">A.2.f.</a>	Science of Information, Computation, Learning, and Fusion	Dr. Richard D. (Doug) Riecken
<a href="#">A.2.g.</a>	Complex Networks	Dr. Donald K. Wagner

Our research areas of interest are described in detail below:

### A.2.a. Computational Mathematics

**Program Description:** This program seeks to develop innovative mathematical methods and fast, reliable and scalable algorithms aimed at making radical advances in computational science and large-scale engineering and design. Research in computational mathematics underpins the fundamental understanding of complex physical phenomena and leads to predictive simulation capabilities that are crucial to the design and control of future U.S. Air Force and Space Force systems, and their lifetime expectancy.

Proposals to this program should focus on fundamental scientific and mathematical innovations and should have the potential to address some of the most important computational challenges in science and engineering. Additionally, it is desirable to frame the basic research ideas in the context of applications relevant to the U.S. Air Force and Space Force, which can serve simultaneously to focus the research and to provide avenues for transition of basic research outcomes into practice. Applications of current Air Force and Space Force interest include, but are not limited to, quantum physics and quantum information systems, plasma dynamics, turbulence (e.g., in fluids, combustion, plasma), lasers and directed energy, aero-thermo-dynamics, information science, data analysis (including machine learning), and material and structural sciences.

**Basic Research Objectives:** Research under this program has traditionally emphasized schemes that address the discretization and numerical solution of complex systems of equations, generally partial differential equations derived from physical models.

However, alternative computational approaches are of keen interest, particularly in connection with emerging and multidisciplinary applications. Increased emphasis in this portfolio is placed on approaches that can handle a very high number of dimensions, uncertainty and stochasticity for non-Markovian processes, far from equilibrium conditions, and/or a wide range of scales (space, time, physical parameters, or complexity). Research areas of particular interest currently include:

- Mathematical methods for complexity reduction of high-dimensional, non-linear and multiscale problems, e.g., via projection-based methods and/or new machine-learning concepts. Such systems may have continuous, discrete or mixed representations, and may reside on graphs with evolving topology;
- Mathematical approaches to the modeling of non-equilibrium statistical processes and turbulent dynamics with multiple physical interactions and large parameter spaces; of special interest are methods which effectively allow bi-directional transfer of information across scales, and can simultaneously reduce the computational burden while preserving the correct physics of interaction, including conservation laws and instability regimes;
- Highly efficient and accurate methods for high-dimensional, nonlinear and

stochastic dynamics with constraints; and,

- Traditional computational methods involving high-order spatial and temporal algorithms remain of interest, if they have the potential for significant breakthrough and are able to meet the formidable computational challenges associated with current and future engineering problems of interest to the U.S. Air Force and Space Force.

The list above is not exhaustive and other approaches can be suggested to the Program Officer, who can then determine if a proposal is warranted and of potential interest. All proposed methods must be innovative, have quantifiable measures of fidelity, efficiency and adaptively, must be based on rigorous analysis and preferably demonstrated on canonical challenge and grand challenge problems.

You are encouraged to contact our Program Officer prior to developing a full proposal to briefly discuss the current state-of-the-art, how your research would advance it, the approximate cost for a three (3) to five (5) year effort, and if there are any specific submission target dates.

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#### **A.2.b. Dynamical Systems and Control Theory**

**Program Description:** This program emphasizes the interplay of open dynamical systems and control theories, with the aim of developing innovative synergistic strategies for the design and analysis of controlled systems that enable radically enhanced capabilities, including performance and operational efficiency for future U.S. Air Force and Space Force systems. Only high-risk, and high-impact basic research on the mathematics of analysis and control theory for complex dynamical systems will be considered. Proposals should focus on the fundamental science and mathematics, while having relevance to future Air Force and Space Force systems and operations.

These applications currently include, but are not limited to, cyber/physical systems, biological and neurological systems, quantum systems, as well as autonomous/semi-autonomous aerial vehicles, munitions, and space vehicles. Note that research specifically restricted to an Air Force and Space Force application may not be considered fundamental research; therefore, future Air Force and Space Force applications should only be mentioned as examples or possibly motivations for fundamental theory in dynamical systems and control theory.

The dramatic increase in complexity of Air Force and Space Force systems provides unique challenges for the Dynamical Systems and Control Theory Program. Meeting these challenges may require interdisciplinary approaches as well as deeper studies within single disciplines.

Lastly, note that the Dynamical Systems and Control Theory Program places special emphasis on mathematically rigorous techniques addressing realistic treatment of applications, complexity management, autonomous and semi-autonomous systems, and

real-time operation in stochastic and adversarial environments.

**Basic Research Objectives:** Current research interests include: algebraic, topological, and geometric methods of dynamical analysis of controlled complex systems for the purpose of real-time control; control of ensemble and infinite dimensional systems including PDE control; deterministic time and/or real-time reachability; considering constraints, uncertain, information rich, dynamically changing, networked environments with time-varying topologies; robust and adaptive non-equilibrium control of nonlinear processes where the primary objective is enhanced operability rather than just local stability; new methods for understanding and mitigating the effects of uncertainties in dynamical processes where uncertainty distribution is non-Gaussian; novel theory for control of hybrid systems that can intelligently manage actuator, sensor, and processor communications in a complex, spatially distributed and evolving system of systems; sensor rich, data driven adaptive control; and, applying control concepts motivated by studies of biological systems. Developments from nontraditional areas of applied mathematics such as applied algebra, geometry, and topology for the benefit of analysis and control synthesis of complex dynamical systems is also of interest. Furthermore, mathematical theory that is also applicable to more expressive representations of complex dynamics systems (e.g., hyper- and multi-graphs rather than graphs) is also welcome.

In general, the control of large complex, multi-scale, hybrid, highly uncertain nonlinear systems is of increasing interest. Furthermore, new mathematics in clear support of dynamics and control is of fundamental importance to this portfolio. In this regard, some areas of interest include, but are not limited to, hybrid dynamical systems theory, geometric and algebraic methods of dynamics and control, stochastic and adversarial systems, control of cyber physical systems with formal specifications, emerging areas of control theory, graph theoretic control theory over nonlinear dynamics at nodes of graphs, partial and corrupted information, nonlinear control and estimation, and novel computational techniques specifically aimed at control of systems with large data.

You are highly encouraged to contact our Program Officer prior to developing a full proposal to briefly discuss the current state-of-the-art, how your research would advance it, and the approximate cost for a three (3) to five (5) year effort.

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### **A.2.c. Dynamic Data and Information Processing**

**Program Description:** The portfolio seeks mathematical concepts that dynamically incorporate additional data, whether measured or from models, into an executing application to coordinate dynamic measurement collections, model refinements, and system awareness. Examples include dynamic data driven applications systems (DDDAS), physics-enhanced machine learning (PEML), and physics-based and human-derived information fusion (PHIF). Key developments should harness the use of first-principle models towards real, simulated, or augmented signals, data, and information processing to obtain substantial comparative improvements over existing methods. The portfolio encourages multidisciplinary research, especially synergistic and systematic

collaborations between domain researchers in engineering, mathematics, and computer sciences for multiresolution systems modeling, diagnostics, and analytics.

**Basic Research Objectives:** Foster individual and multidisciplinary research, technology development, and system analysis over emerging science and technology frontiers.

**Domain Modeling:** Methods leveraging large-scale simulations for real-time control, in concert with heterogeneous data collection, model updates, and system processing. Research advances should describe different levels of detail and modalities, invoke appropriate models, and interface with other data systems. For example, ideas to engender an integration of large-scale simulations, models, and data to advance traditional data processing paradigms.

**Mathematical and Statistical Algorithms:** Design methods for stable and robust convergence properties under perturbations induced by time-dependent (periodic and non-periodic, scheduled and event-driven) data inputs, multiple scales and model variations. Address enhanced asynchronous algorithms with stable communication between networked resources, multimodal modeling, and uncertainty quantification. For example, concepts to dynamically invoke models requiring elegant methods of uncertainty quantification, management, and propagation.

**Measurement Systems and Methods:** Innovate instrumentation platforms for collecting data, registering measurements, controlling sampling rates, and multiplexing multisource information. For example, designs to determine heterogeneous and embedded distributed sensor networks architectures, information fusion paradigms, and operationally robust performance.

Areas of interest to the Air Force and Space Force include

- Autonomy (e.g., leveraging large-scale modeling of mission planning, collaborative/cooperative control, and data learning for data analytics);
- Agility (e.g., designing computational methods of sensor-based processing, ad-hoc network configurations, and multi-scale multi-physics simulations for decision support);
- Authority (e.g., coupling high-performance aircraft health monitoring, space situational awareness, and ground operations for command and control); and,
- Activeness (e.g., understanding materials stresses and degradation, embedded diagnostics, complex adaptive systems verification and validation, and cognitive performance augmentation for situational understanding).

New approaches are encouraged for combining computational, empirical, cognitive, theoretical, and analytical methods for interactive testing of multiple scientific and engineering hypotheses. Programmatic activities launched under this initiative will support research in individual areas of interest to the Air Force Research Laboratory, but mostly in the context of multidisciplinary research across the Basic Area Objectives

mentioned above.

You are highly encouraged to contact the Program Officer prior to developing a full proposal to discuss the current state-of-the-art, how your research would advance it, the approximate cost for a two (2) to three (3) year effort, and if there are any specific submission target dates.

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#### **A.2.d. Information Assurance and Cybersecurity**

**Program Description:** Securing cyberspace, i.e. defending against and preventing cyber-attacks are not new challenges but these have become increasingly pressing in the light of technological advancements. Software and protocols are continuously becoming more complex to meet application demands. More flexible computing environments, such as distributed systems, demand new ways of thinking how to ensure secure end-to-end functionalities, even though components are only known to be individually secure. The emergence of nanoscale devices and quantum information processing and communication also portends new technological challenges for cybersecurity. By the same token, these new technologies potentially offer unparalleled security solutions to the existing or future problems.

Although engineering practices continue to provide short-term and temporary relieves to these pressing needs, new scientific ideas are required to address the lack of security and the explosive growth of hostile actions in cyberspace, especially taking into account of emerging technologies. Many fundamental concepts are still eluding precise formulation and awaiting rigorous responses. The goal of this Basic Research program is to explore novel, promising concepts and methodologies that can establish a firm scientific foundation for cybersecurity and potentially tackle the difficult technical hurdles described above.

**Basic Research Objectives:** Recent developments and advances in the following research areas of computer science and mathematics are expected to provide valuable insights into various cybersecurity problems: dependent type theory, cryptographic protocols for interactive computation and communication, interactive and automated theorem proving, language-based techniques in software and hardware for formal specification and verification, secure protocols, game theory with strong security content, obfuscation and fully homomorphic encryption, model categories, formalized mathematics. Broadly speaking, cross-fertilization of mathematical formalisms and logical constructs will likely continue to play a central role in the construction and verification of security invariants, and in the study of security models or security principles.

These scientific advances are expected to contribute fresh ideas to a number of fundamental cybersecurity topics: composition of security properties and protocols in distributed interactive systems without the need of trusted third parties; rigorous techniques to enable persistent and secure operations on unsecure or untrusted systems; information flow security and non-interference in dynamic and distributed settings; new

security invariants that can readily be computed and interpreted, especially for systems endowed with rich geometric dynamics; rigorous proofs and construction of obfuscation techniques for programs and circuits to enhance security; formal verification and certification of the correctness of complex large-scale mathematical proofs and critical computer systems.

Aside from software and secure protocols, nanoscale material properties and quantum effects should offer added security capabilities for future computing devices that cannot be realized by today's technologies. They potentially enable physical construction of cryptographic primitives that are traditionally described by algorithms and typically implemented by software. Random Number Generators and Physical Unclonable Functions are the simplest examples of such construction. At the same time, securing future unconventional technologies will require the introduction of new security principles and security models that may substantially deviate from the traditional approaches. In fact, various concepts in quantum information science and quantum computation such as quantum resources (entanglement, non-locality, contextuality, etc.) and quantum computational/communication complexity are highly relevant to the security of future communication and computing systems in which classical and quantum devices interact.

Research areas of interest to this program include, but are not limited to, the methodologies and topics described above. Highest priority will be given to projects with novel scientific ideas that potentially deliver new DoD/Air Force and Space Force capabilities.

You are highly encouraged to contact the Program Officer prior to developing a full proposal to briefly discuss the current state-of-the-art, how your research would advance it, the approximate cost for a three (3) to five (5) year effort, and if there are any specific submission target dates.

#### **A.2.d.1 Quantum Software Research Program**

**Program Description:** With the advent of industrial quantum computing platforms, there have now been demonstrations of platforms with hundreds [2], or even one thousand [1] qubits suitable for executing gate-based quantum algorithms. Recent experiments using elements of error correction [9, 10] or error mitigation methods [3, 4, 5] have allowed circuits using tens or hundreds of qubits to be executed successfully even in the presence of noise.

However, mapping quantum circuits to hardware efficiently remains a difficult problem. Depending on the available gate set and connectivity of the underlying hardware, the depth of compiled circuits can vary by 3x or more, while the time to compile can vary by orders of magnitude [12, 13]. Small-scale compilers have been developed that are able to map circuits efficiently, but many do not scale to the hundreds or thousands of qubits presently available in commercial systems [11-13]. Moreover, the functionality of current compilers tends to be focused on a single platform [6, 7], without cross-platform functionality, and compilers are often formulated in terms of physical-level level gates with limited opportunities for abstraction.

The present state of quantum compilation stands in contrast to the classical compiling ecosystem. There, robust abstraction layers allow algorithms to be formulated in terms of primitives and basic operations, which can be efficiently mapped to hardware. Key to this is the creation of a compiler ecosystem, with multiple interchangeable compilation components fused together to form a stack. This allows both transparency, wherein the user need not tailor code for the specific processor in use, as well as diverse community of contributors to contribute compatible optimizations.

We are seeking proposals for research in quantum compilation and quantum software targeted at the creation of a compiler ecosystem. Successful proposals should aim to create a foundation for a unified ecosystem for compiling a range of algorithms across many platforms, such as superconducting qubits, spin qubits, photonics systems, and neutral atoms/trapped ions, as well as address the technical areas defined below.

**TA1: Formal Compiler Architecture.** Definition of layers and interfaces in a mathematical framework that allows for unit tests and debugging/verification. This includes:

- A formal definition of all intermediate representations (IRs);
- A mathematical theory of the consistency of these representations, translations and transpilation between them, and benchmarks for their performance on different architectures;
- Methods to verify the performance of individual elements or layers, including unit testing, randomized and probabilistic testing, assertions, or formal verification schemes; and,
- Example data structures.

**TA2: Quantum Computer Architecture.** Data structures for defining architecture elements, including memories and connectivity. This includes:

- Class definitions for high-level abstractions such as quantum memories or Q-RAMs, classical inputs connectivity or I/O bottlenecks;
- Lower-level abstractions such as modular architectures and topology; and,
- Enumeration of utility to formal compiler elements.

**TA3: Compiler Elements.** Seeding initial versions of compiler elements, for example routers or circuit synthesizers, and setting up a framework for open source contributions. This includes:

- The packaging of existing open-source elements into code that can interface with the rest of the stack, or production of new elements;
- Documentation for external contributors to add packages to the framework; and,
- Responsibility for encouraging community contributions to the architecture.

A central metric for this research shall be compiled circuit depth and time-to-compile for a standard benchmark battery [8] on a variety of preprogrammed topologies. Proposing teams shall select an existing benchmark battery, and propose multiple topologies which form reasonable abstractions of multiple common platforms.

Out of scope:

- Testing of specific algorithms, rather than the selected benchmark battery.
- Costing or resource estimation for algorithms.
- Error correction (all qubits should be assumed to be perfect).
- Optimization of gates on physical qubits.
- Unitary synthesis.

Proposals should present a plan for addressing at least two of the three (3) TAs, and include all required expertise such as including classical compilation, programming languages, and quantum computing. Open-source release of software developed is encouraged.

[1] <https://research.ibm.com/blog/quantum-roadmap-2033>

[2] <https://arxiv.org/abs/2306.11727>

[3] <https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.119.180509>

[4] <https://arxiv.org/abs/2201.09866>

[5] <https://journals.aps.org/rmp/abstract/10.1103/RevModPhys.95.045005>

[6] <https://arxiv.org/abs/2306.03487>

[7] <https://arxiv.org/pdf/2207.01964.pdf>

[8] For example, QASMBench or [], but other batteries are acceptable as well.

[9] <https://arxiv.org/abs/2404.02280>

[10] Bluvstein et al Nature volume 626, pages 58–65 (2024)

[11] <https://arxiv.org/pdf/2306.03487.pdf>

[12] <https://arXiv.org/pdf/2202.14025v1.pdf>

[13] <https://arxiv.org/abs/2306.08629>

**Applicants should submit proposals under the Information Assurance and Cybersecurity portfolio and include “Quantum Software” at the beginning of the submission title.**

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## A.2.e. Mathematical Optimization

**Program Description:** The program goal is to develop novel theory, algorithms, and software for the many classes of Mathematical Optimization problems that arise in support of decision, design, and allocation problems confronting the U.S. Air Force and Space Force. Areas of interest include resource allotment, planning, logistics, interdiction, engineering design, resiliency, and scheduling. Problems can be deterministic in that input parameters and objectives are known with certainty or can have data uncertainty that is addressed using such methods as stochastic programming and robust optimization. The research, while of fundamental importance to such problems, can also profoundly impact related areas of study, including the operation of autonomous vehicles and the effectiveness of machine learning.

**Basic Research Objectives:** The program welcomes basic research in theory, algorithms, and computational methods for continuous and discrete problems, both deterministic and stochastic. Contributions/impacts can be generally applicable to large families of problems or be suitably tailored to exploit specific mathematical structures found within special, important classes. As basic research aimed at having the broadest possible impact, the development of computational methods should include an emphasis on theoretical underpinnings, on rigorous convergence analysis, and on establishing performance guarantees for approximation methods. Areas of interest include, but are not limited to:

- Integer and mixed-integer programming;
- Continuous, nonconvex optimization;
- Multi-level optimization;
- Conic programming;
- Combinatorial optimization; and,
- Stochastic programming.

Methodologies include:

- Cutting plane and polyhedral methods for mixed-integer programs;
- Decomposition methods for large, specially structured problem;
- Global optimization for nonconvex programs; and,
- Interior-point and first- and second order methods for conic/convex/nonconvex optimization.

The application process is as follows. Submit a white paper of length at most four pages to the Program Officer that summarizes the research to be performed, the importance, the approach, a summary of senior personnel qualifications, and an estimate of the total cost. If desired, additional pages can describe further qualifications and include a bibliography.

The white paper should not be overly technical but instead provide a clear description of the problem(s) to be solved, the approach and novelty, and the potential application to DoD missions. Then, depending on such factors as reviews and available budget, select white papers will be chosen for full-proposal development. *A key evaluation criterion is the identification of innovative idea(s) that show promise for advancing the field of mathematical optimization, with reference to the optimization/mathematical programming literature.*

Investigators are encouraged to contact the Program Officer prior to white paper submission to discuss the proposed research and how it will advance the state of the art, the approximate cost, and any specific target dates.

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#### **A.2.f. Science of Information, Computation, Learning, and Fusion**

**Program Description:** The U.S. Air Force and Space Force collects vast amounts of data through various modes at various times in order to extract and derive needed “information” from these large and heterogeneous (mixed types) data sets. Some data, such as those collected from magnetometers, register limited information content which is more identifiable at the sensor level but beyond human’s sensory reception. Other types of data, such as video cameras or text reports, possess more semantic information that is closer to human cognition and understanding. Nevertheless, these are instances of disparate data which encapsulate different types of “information” pertained to, perhaps, the same event(s) captured by different modalities through sensing and collection.

In order to understand and interpret information contained in various data sources, it is necessary to extract relevant pieces of information from these datasets and to make inferences based on prior knowledge and probabilities. This bottom-up processing direction needs conceptually driven reasoning to integrate or fuse the previously extracted snippets of information by leveraging domain knowledge. Furthermore, the top-down processes can offer causal explanation or causal inference, generate new hypotheses, verify or test hypotheses in light of observed datasets. Between the data-driven and conceptually-driven ends, there may reside different levels of abstraction in which information is partially extracted and aggregated based on the nature of applications.

**Basic Research Objectives:** With the rationale and guiding principles outlined in the above paragraph, this program seeks fundamental research that potentially leads to scientific advancements in informatics, computation, and learning that can support processing and making sense of complex disparate information sources. After all, information processing can formally and fundamentally be described as computing and reasoning on various knowledge representations. Successes in addressing the research sub-areas stated below would give the U.S. Air Force and Space Force new capabilities to: (1) shift emphasis from sensing to information awareness; (2) understand the underpinning of autonomy; (3) relieve human’s cognitive overload in dealing with the data deluge problem; and, (4) enhance human-machine interface in information processing.

To accomplish the research objectives, this program focuses on, but is not limited to, new techniques in mathematics, computing science, statistics and logic which have potentials to: (1) cope with various complex disparate data/information types; (2) integrate a diversity of unique reasoning and learning components collaborating simultaneously (e.g., multi-strategy reasoning and learning); (3) bridge correlational with causal discovery; (4) determine solutions or obstructions to local-to-global data-fusion

problems; (5) mechanize reasoning/learning and computing in the same computational environment; (6) yield provably efficient procedures to enable or facilitate data analytics; and, (7) deal with high-dimensional and massive datasets with provably guaranteed performance.

You are highly encouraged to contact our Program Officer prior to developing a full proposal to briefly discuss the current state-of-the-art, how your research would advance it, and the approximate cost for a three (3) to five (5) year effort, and if there are any specific submission target dates.

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### A.2.g. Complex Networks

**Program Description:** Complex networks are pervasive in military, commercial, and civilian operations. Complex networks consist of a graph (directed or undirected) together with a set of attributes. These attributes can include scalar or multi-dimensional weights on the edges or nodes of the graph, topological characteristics of the graph, flows over the graph, and processes that define the dynamics of the graph. Complex networks cut across many scientific disciplines (e.g., mathematics, computer science, engineering, socio-economics, etc.) and many application domains (e.g., communications, sensing, information systems, transportation, etc.). Networks fundamentally describe the structural aspects of interactions between individual agents. Networks can be extremely large and can have multiple characteristic scales. They can be static or dynamic. They can be physical or virtual. Networks can consist of multiple heterogeneous subnetworks (i.e., a network- of-networks), with explicit and implicit interdependencies. For example, transportation networks are intimately coupled to computer and electrical-power networks. Thus, the failure of a critical node or arc in one network can trigger failures in another, which can create a cascade event with catastrophic consequences. All of these characteristics of networks can make the analysis, understanding, and utilization of networks difficult and computationally prohibitive.

This basic-research program is focused on developing fundamental mathematical and algorithmic techniques to design, analyze, utilize, and understand complex networks. The program seeks innovative approaches with far-reaching potential, meaning any mathematical and algorithmic approaches ideally should be applicable to broad classes of problems and not tied to a particular application domain. The networks of interest can have arbitrary topologies, can be static or dynamic, and can be subject to uncertain conditions, ranging from a stochastic environment to deliberate adversarial actions affecting both nodes and links.

**Basic Research Objectives:** This program is aimed at developing mathematical and algorithmic tools for the design, analysis, understanding, and utilization of complex networks. Problems of interest include, but are not limited to:

- Network resilience and robustness: This includes techniques for defining and measuring the resilience of a dynamic network; techniques for predicting,

identifying, and mitigating adversarial actions against a network; techniques for network interdiction.

- Network analytics: This includes algorithmic techniques for solving important classes of problems on networks, such as optimal resource allocation and information dissemination; algorithmic techniques for inference problems on networks that extract global information about network structure and function from local information. The algorithms can be exact or approximate with performance guarantees. Of particular interest are decentralized algorithms and understanding the tradeoff between centralization and decentralization.
- Complexity reduction of networks: This includes techniques for decomposition, sparsification, and dimensionality reduction of networks with the goal of making networks easier to analyze, understand, and visualize; techniques for analyzing and exploiting graph-theoretic structure such as multi-layer networks.
- Extension of network-analysis techniques to more general combinatorial, algebraic, or analytical structures: This includes network-relevant research in submodular functions, hypergraphs, matroids, graphons, etc.

Approaches may draw upon, but are not limited to, techniques from graph theory, optimization, complexity theory, algorithmic game theory, combinatorics, linear algebra, statistics, and probability.

You are highly encouraged to contact the Program Officer, preferably by email, prior to developing a full proposal, to briefly discuss the current state-of-the-art, how your research would advance it, the approximate cost, and if there are any specific submission target dates.

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### A.3. AFRL/RESB PHYSICAL SCIENCES BRANCH

The Physical Science Branch Program Officers and topics are:

SECTION	PROGRAM DESCRIPTION	PROGRAM OFFICER
<a href="#">A.3.a.</a>	Aerospace Materials for Extreme Environments	Dr. Ali Sayir
<a href="#">A.3.b.</a>	Atomic and Molecular Physics	Dr. Boyan Tabakov
<a href="#">A.3.c.</a>	Electromagnetics	Dr. Arje Nachman
<a href="#">A.3.d.</a>	Optoelectronics and Photonics	Dr. Michael Yakes
<a href="#">A.3.e.</a>	High-Energy Radiation-Matter Systems	Dr. Joel Bixler

<a href="#">A.3.f.</a>	Quantum Information Sciences	Dr. Grace D. Metcalfe
<a href="#">A.3.g.</a>	Physics of Sensing	Dr. Michael Yakes
<a href="#">A.3.h.</a>	Space Physics	Dr. Julie J. Moses
<a href="#">A.3.i.</a>	Ultrashort Pulse Laser-Matter Interactions	Dr. Andrew Stickrath
<a href="#">A.3.j.</a>	Condensed Matter Physics	Dr. Jiwei Lu
<a href="#">A.3.k.</a>	Astrodynamics	Dr. Andrew Sinclair
<a href="#">A.3.l.</a>	Molecular Dynamics and Theoretical Chemistry	Dr. Michael R. Berman
<a href="#">A.3.m.</a>	Organic Materials Chemistry	Dr. Michael R. Berman

Our research areas of interest are described in detail below:

### **A.3.a. Aerospace Materials for Extreme Environments**

**Program Description:** The Aerospace Materials for Extreme Environments program aims to provide the fundamental knowledge required to enable revolutionary advances in future U.S. Air and Space Force technologies through the discovery and characterization of materials. Extreme environments are a combination of heat, stress, magnetic, electric, microwave, and acoustic fields, their combined field effects, and activity gradients as they relate back to the performance of the material.

**Basic Research Objectives:** This program seeks to fundamentally shift the paradigm of materials science from serendipitous discovery to materials synthesis by design. The research will establish the foundational scientific understanding required to predict and control the synthesis of materials with unprecedented performance in areas including, but not limited to, extreme environment aerospace systems, next-generation electronics, and quantum information science and technology. This program will pursue its objective through focused research in several interconnected thrusts that together bridge the gap from fundamental science to revolutionary capability.

**Materials Synthesis by Design:** This subtopic seeks to establish the foundational science for bridging the long-standing gap between computational modeling and the physical creation of materials with targeted, revolutionary properties. This research will center on developing a predictive framework that quantitatively links a material's structure to its function. This framework must enable the discovery and understanding of the fundamental mechanisms by which external stimuli—such as electric fields, lasers, or acoustic waves—can guide the formation of desired material structures, which in turn will be represented and validated using novel descriptive metrics. To be truly predictive, a critical requirement is the integration of Uncertainty Quantification (UQ) into all synthesis models. The framework must distinguish between controllable process parameters and inherent stochastic variations, ultimately providing a

predictive confidence level for achieving any target microstructure.

**Novel Materials Functionalities:** This subtopic focuses on establishing the core scientific understanding required to create and manipulate novel functional materials. The research will explore how to tailor material responses—for example, by controlling structural imperfections from the atomic to the micro-scale—in order to discover materials with advanced thermal management, customized RF signatures, pronounced nonlinear or electro-optical characteristics, high-performance cathode materials, ultra-wide bandgap performance, and other unforeseen functionalities critical for next-generation systems.

**Materials for Quantum Information Science:** This subtopic establishes the materials science foundation for the next generation of quantum hardware by addressing two complementary and equally critical goals. The first is the design of novel, robust qubits where the quantum state is intrinsically linked to the material itself. The second is the mitigation of material-induced decoherence, which requires building a quantitative understanding of how unwanted material properties at the structural and interface level degrade quantum performance. To maintain a clear focus, research should prioritize the synthesis, characterization, and fundamental understanding of the core material, rather than device engineering, systems integration, or the exploration of known condensed matter phenomena.

Proposers should note that the program prioritizes research where the primary challenge lies in the synthesis, characterization, and fundamental understanding of novel functional materials, rather than the secondary application or engineering of known materials. For example, proposals focused primarily on structural or organic materials, device engineering, systems integration, or exploring the physics of known condensed matter phenomena—such as those involving High-Critical-Temperature Superconductors or known topological phases—are not a fit for this program.

Researchers are highly encouraged to contact the Program Manager prior to developing full proposals to briefly discuss the current state-of-the-art, how the proposed effort would advance it, and the approximate yearly cost for a three (3) to five (5) year effort.

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### **A.3.b. Atomic and Molecular Physics**

**Program Description:** This program encompasses fundamental experimental and theoretical Atomic and Molecular Physics research that is primarily focused on studies of cold and ultra-cold quantum gases, precision measurement, matter-wave optics, and non-equilibrium quantum dynamics. These research areas support technological advances in application areas of interest to the U.S. Air and Space Force, including precision navigation, timekeeping, remote sensing, metrology, and novel materials for the U.S. Air and Space Force needs in the future.

**Basic Research Objectives:** AMO (Atomic, Molecular and Optical) physics today offers an unprecedented level of coherent control and manipulation of atoms and molecules and their interactions, allowing for significant scientific advances in the areas of cold and ultra-cold matter and precision measurement. Specific research topics of interest in this program include, but are not limited to, the following: physics of quantum degenerate atomic and molecular gases; precision control techniques; strongly-interacting quantum particles; new quantum phases of matter; non-equilibrium dynamics of cold quantum particles; ultra-cold chemistry; precision spectroscopy; and, high-precision techniques for navigation, guidance, and remote sensing.

You are highly encouraged to contact our Program Officer prior to developing a full proposal to briefly discuss the current state-of-the-art, how your research would advance it, and the approximate cost for a three (3) to five (5) year effort, and if there are any specific submission target dates.

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### A.3.c. Electromagnetics

**Program Description:** This portfolio supports basic research (modeling/simulation) in linear/nonlinear Electromagnetics together with research in the general area of signal processing.

**Basic Research Objectives:** Basic research to produce conceptual descriptions of electromagnetic properties of novel materials/composites (such as photonic band gap media, negative index media, Parity-Time symmetry media, etc.) and the simulation of their uses in various operational settings is encouraged. Also of interest is temporal modulation of metamaterials (including time interfaces) and physical parameters of various components. Such a dynamically induced non-reciprocity can lead to a new generation of compact and energy efficient isolators, circulators, phase shifters, and other non-reciprocal optical and microwave devices. Basic research in inverse scattering theory in order to promulgate new methods which recognize and track targets or upgrade efforts to pursue electromagnetic Nondestructive Evaluation is encouraged. Efforts to identify suitable wideband waveforms to penetrate foliage, clouds, buildings, the ionosphere, or other dispersive/random/turbulent media as well as to notionally design transceivers to produce/receive such waveforms are also supported. Research which develops the mathematical underpinning for computational electromagnetic simulation codes (both frequency domain and time domain) that are rapid and whose claims of accuracy are accompanied by rigorous error estimates/controls is encouraged. In the area of nonlinear Maxwell's equations, commonly called nonlinear optics, research pursues descriptions of nonlinear EM phenomena such as the propagation of ultrashort laser pulses through air, clouds, etc. together with any possible exploitation of these pulses is supported. Such mathematical descriptions are anticipated to be a coupled system of nonlinear partial differential equations. Basic research in other nonlinear EM phenomena include the dynamics of the EM field within solid state laser cavities (particularly the modeling/simulation of non-equilibrium carrier dynamics within semiconductor

lasers) and fiber lasers, the propagation of light through various nonlinear crystals (including Graphene), as well as other nonlinear optical media. As regards the signal processing component, an outstanding need in the treatment of signals is to develop resilient algorithms for data representation in fewer bits (compression), image reconstruction/enhancement, and spectral/frequency estimation in the presence of external corrupting factors. These factors can involve deliberate interference, noise, ground clutter, and multi-path effects. This component searches for application of sophisticated mathematical methods, including time-frequency analysis, coherent interferometry, cross-correlation methods, and generalizations of various (e.g. Fourier and wavelet) transforms, that deal effectively with the degradation of signaling transmission across a channel. These methods hold promise in the detection and recognition of characteristic transient features, the synthesis of hard-to-intercept communications links, and the achievement of faithful compression and fast reconstruction for video and multi-spectral data. New combinations of asset/sensor location and navigation are being sought, based on analysis and high-performance computation that bring a force-multiplier effect to command/control capabilities.

Continued upgrade and reliance on Global Positioning System makes it critical to achieve GPS-quality positioning in situations where GPS by itself is not sufficient. Ongoing research in novel navigation methods will bring location precision and reliability to a superlative level.

You are highly encouraged to contact our Program Officer prior to developing a full proposal to discuss alignment of your ideas with our program goals, your proposed methods, and the scope of your proposed effort.

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#### **A.3.d. Optoelectronics and Photonics**

**Program Description:** Optoelectronic and photonic devices support a critical array of current and future Air and Space Force capabilities. Applications include high-capacity communications, secure networking, and advanced optical signal processing and computation. These applications require components capable of recording, reading, and changing data at extremely high speeds while maintaining low power, low weight, and a small footprint suitable for airborne and space platforms. The portfolio advances the understanding of optoelectronics and photonics by exploring fundamental concepts, particularly focusing on how light and matter interact at the nanoscale and the quantum nature of light.

**Basic Research Objective:** While miniaturizing optical components to the nanoscale can provide ultracompact and highly efficient photonics devices, unique scientific challenges arise due to manipulating light at dimensions smaller than its wavelength. In this regime, precise control and manipulation of individual photons and their quantum states are important, including spectral and spatial overlap for coherent coupling with nanophotonic devices, integration of quantum and classical components, and decoherence of quantum information encoded into photons.

This portfolio pursues exploratory fundamental research. It does not support device

prototyping or incremental enhancements of current state-of-the-art systems. Portfolio interests include, but are not limited to:

- Advanced photonic and optoelectronic concepts such as, but not limited to, engineered metamaterials, photonic crystals, negative index materials, strongly nonlinear materials, and incorporation of plasmonics and excitonics;
- Understanding the fundamental physical mechanisms that limit optical and optoelectronic responses in order to significantly overcome the performance of state-of-the-art devices;
- Creative solutions for effective integration of multiple nanophotonic components—including silicon-based and integrated nanophotonics—as well as thermal management of the devices, particularly as they increase in complexity; and,
- Exploration of reconfigurable nanophotonics, chip-scale optical networks, and the implementation of optical logic and optical signal processing at the nanoscale.

You are highly encouraged to contact our Program Officer prior to developing a full proposal to briefly discuss the current state-of-the-art, how your research would advance it, and the approximate cost for a three (3) to five (5) year effort, and if there are any specific submission target dates.

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### A.3.e. High-Energy Radiation-Matter Systems

**Program Description:** This program seeks to provide revolutionary advances in the fundamental understanding of the physical processes involved, and our ability to control and exploit, the interaction of electromagnetic energy and matter. This portfolio seeks to find novel experimental, theoretical, and computational approaches to the nonlinear, multi-scale, and multi-physics scenarios where the kinetic, potential, and electromagnetic field energy are of comparable order. Examples including the opportunity to provide useful work for a variety of applications, including directed energy weapons, high-energy density physics, sensors and radars/lidars, electronic and electro-optical warfare, and novel compact accelerators as well as an improved ability to operate and exploit a range of extreme environment and conditions. High-energy lasers, high-power electromagnetism, pulsed power, plasma physics, nuclear physics, regimes of atomic pressure, radiation damage, and high-energy density EM-matter interactions, including biological interactions, are all of interest to this portfolio.

**Basic Research Objectives:** Ideas for advancing the state-of-the-art in the following areas are strongly encouraged: A) High-energy/power lasers and their associated optics across all wavelengths; B) High-power electromagnetism (HP EM) and high-power microwaves (HPM), especially for high-frequency sources of coherent radiation; C) Laser/Radio-Frequency(RF)-Matter interaction, including focusing and propagation physics; and, D) Non-equilibrium thermodynamics that tracks the flow of energy, charge, species, entropy, and information through high-energy radiation-

matter systems. Associated areas of high-power optics, compact pulsed power, high-power amplifiers, advanced compact accelerator schemes, and high-power terahertz (THz) sources are of interest to the portfolio. New concepts for the theory, modeling, and simulation of these physical phenomena are of interest, and combined experimental/theoretical/simulation efforts that verify and validate innovative models are highly encouraged.

You are highly encouraged to contact the Program Officer prior to developing a full proposal to briefly discuss the current state-of-the-art, how your research would advance it, and the approximate cost for a three (3) to five (5) year effort, and if there are any specific submission target dates.

Collaborative efforts with researchers at the Air Force Research Laboratory are encouraged when appropriate but are not required.

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### **A.3.f. Quantum Information Sciences**

**Program Description:** This program encompasses experimental and theoretical basic research to significantly advance the fundamental understanding, control, and exploitation of non-classical phenomena for the analysis, collection, processing, storage, dissemination and protection of information. Emphasis is on key fundamental research areas that underpin multiple quantum information science and technology areas for novel Air and Space Forces capabilities well beyond what is possible with classical systems.

**Basic Research Objectives:** Quantum mechanics provides the opportunity to utilize non-classical physical resources to develop beyond-classical capabilities in networking, communications, imaging, sensing and precision measurements, information transfer, information processing, and more. Specific research topics of interest in this program include, but are not limited to, the following: generation, measurement, characterization and manipulation of quantum resources; non-traditional quantum resources; comprehension and control of coupling between quantum systems and the environment, including understanding noise sources and decoherence mechanisms; coherent information flow between distinct quantum elements; and, unconventional approaches to quantum information processes.

You are highly encouraged to contact our Program Officer prior to developing a full proposal to briefly discuss the current state-of-the-art, how your research would advance it, and the approximate cost for a three (3) to five (5) year effort, and if there are any specific submission target dates.

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### **A.3.g. Physics of Sensing**

**Program Description:** The Physics of Sensing portfolio investigates the fundamental physical principles governing the remote detection and characterization of objects. Moving beyond incremental improvements, the program discovers revolutionary sensing concepts that offer transformative gains in accuracy, sensitivity, and scalability. While research primarily targets imaging and non-imaging sensors across the electromagnetic (EM) spectrum, the portfolio also explores alternative modalities complementary to EM measurements. Key areas include aligning sensor performance with the underlying physics of electronic and optoelectronic devices, adaptive optics, and novel multimodal sensing for ground-, air-, and space-based platforms.

Research within this portfolio is inherently multidisciplinary, bridging theoretical modeling, computational discovery, and experimental validation. Scientific themes include defining the physical and information-theoretical limits of information acquisition; understanding radiation propagation through stochastic or heterogeneous media; and, the multiscale physics of radiation-matter interactions to define the fundamental limits of information preservation and sensor robustness. A significant objective is developing physics-rooted models to characterize objects from unresolved or degraded signals. By prioritizing new physics, the program enables novel tracking and identification capabilities with vastly reduced size, weight, power, and cost in contested or degraded environments.

This portfolio prioritizes fundamental exploratory research. It does not support device prototyping or incremental enhancements of current state-of-the-art techniques. While artificial intelligence and machine learning techniques may be utilized as tools to achieve research objectives, they are not a primary research goal of this portfolio.

**Basic Research Objectives:** At a fundamental level, the function of every sensor could be described by three component mechanisms: Detection (initial stimulus interaction), Processing (signal refinement), and Interpretation (extracting actionable information). Research within this portfolio targets the discovery of new physics across these three mechanisms. The following themes represent potential research areas of interest, though they are not intended as an exclusive list.

Detection: Research focuses on the primary interface between the environment and the sensor, investigating the physical boundaries of how information is first captured.

- Exploration of novel sensor configurations to circumvent standard statistical noise floors and approach ultimate sensitivity.
- Investigation of aperture constraints, structured illumination techniques, and photon-capture statistics to define the information-theoretical boundaries of signal acquisition, particularly in photon-starved regimes.
- Characterization of atomic and device-scale dynamics, such as carrier transport and recombination kinetics, for radiation-tolerant and robust detection.
- Identification and interpretation of the optical and electronic characteristics of emergent material platforms—such as low-dimensional or meta-refractive structures—to enable enhanced sensor properties.

Processing: Research explores the mechanisms that govern signal integrity and the extraction of information before final interpretation.

- Characterization of the physics governing wavefront propagation and information preservation through turbulent, stochastic, or heterogeneous media utilizing adaptive optics and wavefront sensing. Note: Purely theoretical concepts should be directed to the Electromagnetics portfolio.
- Investigation of radiation-induced physical effects and their impact on signal stability to discover paradigms for maintaining sensor integrity in extreme environments.
- Discovery of physical pathways for information recovery from multiscale scattering phenomena, enabling imaging through clouds, fog, and other obscured or non-line-of-sight environments.
- Integration of physical constraints into computational frameworks to optimize measurement processes and maximize the information extracted per detected photon.

Interpretation: Research targets the high-level logic and physical modeling required to transform refined signals into actionable information and characterization.

- Development of physics-rooted models describing intrinsic spectral, thermal, and polarimetric signatures to enable the characterization of objects from both imagery and unresolved signals.
- Exploration of the physics governing signature evolution in dynamical environments to determine the number and physical state of remote objects.
- Exploitation of pathlength diversity in heterogeneous media to identify physical states and material identities.

You are highly encouraged to contact our Program Officer prior to developing a full proposal to briefly discuss the current state-of-the-art, how your research would advance it, and the approximate cost for a three (3) to five (5) year effort, and if there are any specific submission target dates.

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### A.3.h. Space Physics

**Program Description:** The AFOSR Space Physics program supports basic research on the solar-terrestrial environment extending from the Sun through Earth's magnetosphere and radiation belts to the mesosphere and lower thermosphere region. This geospace system is subject to solar radiation, particles, and eruptive events, variable interplanetary magnetic fields, and cosmic rays. Perturbations to the system can disrupt the detection and tracking of aircraft, missiles, satellites, and other targets; distort communications and navigation signals; interfere with global command, control, and surveillance operations; and negatively impact the performance and longevity of U.S. Air and Space Force space assets.

Fundamental research focused on improving understanding of the physical processes in the geospace environment is encouraged. Particular goals are to improve operational forecasting and specification of solar activity, thermospheric neutral densities, and ionospheric irregularities and scintillations. Activities that support these goals may include validating, enhancing, or extending solar, ionospheric, or

thermospheric models; investigating or applying data assimilation techniques; and developing or extending statistical or empirical models. An important aspect of the physics is understanding the coupling between regions, such as between the solar corona and solar wind, between the near-lunar environment and the solar wind/magnetotail, between the magnetosphere and ionosphere, between the lower atmosphere and the thermosphere/ionosphere, and between the equatorial, middle latitude, and Polar Regions.

**Basic Research Objectives:** Research goals include, but are not limited to:

- The structure and dynamics of the solar interior and its role in driving solar eruptive activity;
- The mechanism(s) heating the solar corona and accelerating it outward as the solar wind;
- The triggers of coronal mass ejections (CMEs), solar energetic particles (SEPs), and solar flares;
- The coupling between the solar wind, the magnetosphere, and the ionosphere;
- The origin and energization of magnetospheric plasma;
- The triggering and temporal evolution of geomagnetic storms;
- Dusty plasmas in the space environment;
- Characterizing the near-Lunar environment;
- The variations in solar radiation received at Earth and its effects on satellite drag;
- The impacts of geomagnetic disturbances on the thermosphere and ionosphere;
- Electron density structures and ionospheric scintillations;
- Ionospheric plasma turbulence and dynamics; and,
- The effects of neutral winds, atmospheric tides, and planetary and gravity waves on the neutral atmosphere densities and on the ionosphere.

You are highly encouraged to contact our Program Officer prior to developing a full proposal to briefly discuss the current state-of-the-art, how your research would advance it, and the approximate cost for a three (3) to five (5) year effort, and if there are any specific submission target dates.

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### **A.3.i. Ultrashort Pulse Laser-Matter Interactions**

**Program Description:** The Ultrashort Pulse Laser-Matter Interactions program is focused on one of the most fundamental process in nature, the interaction of light with the basic constituents of matter. The objective of the program is to explore and understand the broad range of physical phenomena accessible via the interaction of ultrashort pulse (USP) laser with matter in order to further capabilities of interest to the U.S. Air and Space Forces, including directed energy, remote sensing, communications, diagnostics, and materials processing. The portfolio explores research opportunities accessible by means of the three (3) key distinctive features of USP laser pulses: high peak power, large spectral bandwidth and ultrashort temporal duration

**Basic Research Objectives:** The Ultrashort Pulse Laser-Matter Interactions program seeks innovative science concepts in the research focus areas of high-field laser physics, frequency combs and attosecond science described below:

**High-field laser physics:** Over the last two decades, progress in laser pulse amplification techniques has resulted in a six orders of magnitude increase in achieved focused intensities. The interaction of such intense radiation with matter results in rapid electron ionization and a rich assortment of subsequent interaction physics, which are a focus of investigation for this program. Topics of interest in this area include, but are not limited to: techniques for ultrafast- laser processing (e.g., machining, patterning), mechanisms to control dynamics of femtosecond laser propagation in transparent media (e.g., filamentation), concepts for monochromatic, tunable laser-based sources of secondary photons (e.g., extreme ultraviolet, terahertz, X-rays) and particle beams (e.g., electrons, protons, neutrons), laser-based compact particle accelerators and concepts for high peak power laser architectures, and technology that efficiently scale up to high repetition rates and/or new wavelengths of operation.

**Optical frequency combs:** The large coherent spectral bandwidths intrinsic to USP lasers make them especially suitable for applications requiring high temporal and spectral precision such as telecommunications, optical clocks, time, and frequency transfer, precision spectroscopy and arbitrary waveform generation. Research topics in this thrust area include, but are not limited to: dispersion management techniques to increase the spectral coverage to exceed an octave while maintaining high powers per comb, new concepts to extend frequency combs from the extreme ultraviolet into the mid-wave and long-wave infrared spectral regimes, development of novel resonator designs (e.g., micro-resonator based), and ultra-broadband pulse shaping.

**Attosecond science:** The development of intense light pulses with attosecond durations has resulted in stroboscopic probes with the unprecedented ability to observe atomic-scale electron dynamics with attosecond temporal resolution. This highly exploratory thrust of the program is interested in developing research aimed at resolving electron dynamics in complex systems of interest to DOD (i.e., such as solid- state semiconductor, magnetic, and plasmonic systems). Topics of interest in this area include, but are not limited to, new concepts for improved attosecond sources (e.g., increased efficiency, higher flux, shorter pulses, and higher photon energy), development of pump-probe methods that investigate interactions with systems ranging from isolated atoms / molecules to condensed matter, attosecond pulse propagation, novel concepts for attosecond experiments and fundamental interpretations of attosecond measurements.

You are highly encouraged to contact our Program Officer prior to developing a full proposal to briefly discuss the current state-of-the-art, how your research would advance it, and the approximate cost for a three (3) to five (5) year effort, but not required.

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### **A.3.j. Condensed Matter Physics**

**Program Description:** The Condensed Matter Physics program seeks to investigate fundamental physics of condensed matter, which can ultimately be exploited for unprecedented performance in both classical and quantum applications. The central goal is to discover new quantum phases and phase transitions, as well as to understand new physical phenomena-, specifically, extraordinary macroscopic physical properties in solid state materials. These quantum materials can host combinations of multiple phenomena or a plethora of quasi-particles, exhibit distinctive functionalities, and be engineered to create new platforms for disruptive capabilities for US. Air and Space Force, ranging from sensing and communications to computation.

**Basic Research Objectives:** The objective of this portfolio is to discover, understand and engineer new matter states and phase transitions in both equilibrium and non-equilibrium conditions. This is achieved through deliberate design and manipulation of electronic structures, symmetry, many body interaction, and other properties in quantum materials. This program focuses on gaining a fundamental understanding of intrinsic macroscopic physical properties through innovative experimental investigations and theoretical predictions for realistic, technologically relevant materials.

The following topics of interest represent key areas where proposals are expected to integrate experimental characterization and with theoretical predictions to reveal the mechanisms behind their dynamics and interactions:

**Quantum Geometry:** The primary objective of this subtopic is to develop experimental techniques to observe quantum geometry and apply gained insights to the design and prediction of extraordinary physical properties. Open questions include how to probe and describe fundamental geometry of quantum wave functions and quantum metric, and how these relate to long-range entanglement, topology, and electron interactions as well as other phenomena in quantum materials.

**Strongly correlated systems:** Strongly correlated systems exhibit complex types of ordering and multifunctional properties arising from the subtle interplay between competing degrees of freedom in a near degenerate energy landscape. Interests within this subtopic include prediction and realization of correlated electronic topological phases, control and modulation of electronic correlation in heterostructures, probing of emergent phenomena associated with strong correlation. This subtopic also seeks to utilize innovative experimental approaches to characterize and control the behaviors of exotic quasiparticles in strongly correlated systems, thereby acquiring knowledge of fundamental mechanisms driving their dynamics, interactions, and control.

**Unconventional superconductivity:** This subtopic aims to understand, induce, or manipulate unconventional superconducting states through experimental means. Areas of interest include electron pairing mechanisms and symmetries of superconductivity, as well as their interfacing with other exotic quantum materials.

This program does not emphasize synthesis and optimization of quantum materials, optical properties of point defects, metamaterials, conventional semiconductors or device physics.

You are strongly encouraged to contact our Program Officer before developing a full proposal to discuss your ideas, your proposed methods, the scope of your proposed effort, as well as the resources required in the period of three (3) to five (5) years.

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### A.3.k. Astrodynamics

**Program Description:** This program seeks to provide revolutionary advances in the fundamental understanding of the physical processes that impact the motion and control of both natural and artificial objects moving in the gravity fields associated with the Earth/Moon/Sun system. Allied questions of precision navigation and timing, logistics, and sensing associated with maneuvering spacecraft also inform this portfolio, especially where they impact our understanding of dynamics associated with current and future United States Space Force (USSF) missions.

**Basic Research Objectives:** The future utilization of space is anticipated to involve increasing operations beyond Geostationary Earth Orbit (XGEO) and growing use of In-Space Servicing, Assembly, and Manufacturing (ISAM). Space also continues to be increasingly congested and contested. These trends will result in more intensive utilization of complex orbital mechanics and more intensive interactions between spacecraft.

The fundamental physics and mathematics associated with spacecraft dynamics need to be re-examined in order to enable Space Situational Awareness (SSA) and Guidance, Navigation, and Control (GNC) for future missions. Improved fundamental understanding of space robotics and in-space logistics are also needed. Specific attention will be paid to proposals focusing on challenges to dynamic operations that will be faced by USSF missions, such as dealing with large uncertainties, acting on responsive timescales, allowing autonomous operations, and handling adversarial scenarios.

Researchers are highly encouraged to contact the Program Officer prior to developing full proposals to briefly discuss the current state-of-the-art, how the proposed effort would advance it, and the approximate yearly cost for a three (3) to five (5) year effort. Collaborative efforts with researchers at the Air Force Research Laboratory are encouraged when appropriate but are not required.

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### A.3.l. Molecular Dynamics and Theoretical Chemistry

**Program Description:** This program seeks a molecular-level description of reaction mechanisms and energy transfer processes related to the efficient storage and utilization of energy. The program supports cutting-edge experimental and joint theory-experiment studies that address key, fundamental questions in these areas.

There are four major focus areas in the program:

- Catalytic Reactivity and Mechanisms;
- Novel Energetic Material Concepts;

- Dynamics of Energy Transfer and Transport; and,
- Chemistry in Extreme Environments.

**Basic Research Objectives:** The molecular dynamics program seeks to understand, predict, and control the reactivity and flow of energy in molecules in many areas of interest to the U.S. Air Force and Space Force. Thus, the program encourages novel and fundamental studies aimed at developing basic understanding and predictive capabilities for chemical reactivity, bonding, and energy transfer processes. Some of the program's current interests focus on molecular clusters and nanoscale systems in catalysis, and as building blocks for creating novel materials. Understanding the catalytic mechanisms needed to produce storable fuels from sustainable inputs and to improve propulsion processes are also topics of interest, as are novel properties and dynamics of ionic liquids. Work in this program addresses areas in which control of chemical reactivity and energy flow at a detailed molecular level is of importance. These areas include hyper-thermal and ion-chemistry in the upper atmosphere and space environment, plasma-surface interactions, the identification of novel energetic materials for propulsion systems, and the discovery of new high-energy laser systems. The coupling of chemistry and fluid dynamics in high-speed reactive flows, and in particular, dynamics at gas-surface interfaces, is also of interest. The program is also interested in utilizing plasmonics, and laser excitation to control reactivity.

### **Theoretical Chemistry**

**Program Description:** The theoretical chemistry program supports research to develop new methods that can be utilized as predictive tools for designing new materials and improving processes important to the U.S. Air Force and Space Force. These new methods can be applied to areas such as the structure and stability of molecular systems that can be used as advanced propellants; molecular reaction dynamics; and, the structure and properties of nanostructures and interfaces. We seek new theoretical and computational tools to identify novel energetic molecules or catalysts for their formation, investigate the interactions that control or limit the stability of these systems, and help guide synthesis by identifying the most promising synthetic reaction pathways and predicting the effects of condensed media on synthesis.

**Basic Research Objectives:** The program seeks new methods in quantum chemistry to improve electronic structure calculations to efficiently treat increasing larger systems with chemical accuracy. These calculations will be used, for example, to guide the development of new catalysts and materials of interest. New approaches to treating solvation and condensed phase effects will also be considered. New methods are sought to model reactivity and energy transfer in molecular systems. Particular interests in reaction dynamics include developing methods to seamlessly link electronic structure calculations with reaction dynamics, understanding the mechanism of catalytic processes and proton-coupled electron transfer related to storage and utilization of energy, and using theory to describe and predict the details of ion-molecule reactions and electron-ion dissociative recombination processes relevant to ionospheric and space effects on U.S. Air Force and Space Force systems. Interest in molecular clusters, nanostructures and materials includes work on catalysis and surface-enhanced processes mediated by plasmon resonances. This program also encourages the development of new methods to

simulate and predict reaction dynamics that span multiple time and length scales.

You are highly encouraged to contact our Program Officer prior to developing a full proposal to briefly discuss the current state-of-the-art, how your research would advance it, and the approximate cost for a three (3) to five (5) year effort, and if there are any specific submission target dates.

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### A.3.m. Organic Materials Chemistry

**Program Description:** The goal of this research area is to achieve novel and useful properties and behaviors from polymeric and organic materials, and their organic-inorganic hybrids based on deep understanding of their chemistry, physics, and processing conditions. This understanding will lead to development of advanced organic, hybrid, and polymeric materials for future U.S. Air Force (USAF) and U.S. Space Force (USSF) applications. This program's approach is to study the chemistry and physics of these materials through synthesis and characterization, processing control, validated theoretical approaches, and establishment of structure-property relationships. Research ideas involving fundamental inorganic chemistry may be considered. While there are no restrictions on the types of properties to be investigated, there are priority areas that change. Heavy emphasis is on unconventional and novel functional properties.

This program seeks innovative, high risk, high impact fundamental materials chemistry basic research ideas that push scientific frontiers and not follow-up or extensional projects, or incremental advancements in an already on-going area. The research should be relevant in the broadest sense to the AFOSR mission to foster scientific discoveries that will ensure technological innovations and provide novel capabilities for future USAF and USSF systems to achieve global awareness, global mobility, and space operations.

**Basic Research Objectives:** Proposals with innovative research concepts that develop and extend fundamental understanding of material structure-property relationships, discover previously unknown properties, bring properties with active control and tunability, and/or achieve significant property improvement over current state-of-the-art materials are sought.

Current interests are in materials that emphasize novel, controllable and tunable photonic and/or electronic properties that are achieved through designing, synthesizing, and characterizing organic-based materials (i.e., small molecules, oligomers and polymers, nanostructures, and functional organic-inorganic hybrid materials).

Organic-based materials are to be a central focus of proposed research. In addition, the research may involve investigation of functional hybrid materials where the organic has been modified with an inorganic through chemical bonding, layering, or blending in a way that generates unique or significantly enhanced or tunable properties that result from synergistic interactions (i.e., the sum is greater than individual components). Fundamental inorganic chemistry is also of interest and should center on emerging areas

involving synthesis and reactivity of highly novel main group, transition metal, organometallic, and cluster compounds with a focus on novel material properties or highly selective and active catalytic behavior.

Targeted synthesis of novel organic-based structures and their hybrids leading to new and unique material properties and/or enhanced multi-functionality will be considered.

Research investigations that probe reaction mechanism or theory as they relate to targeted synthesis or method development (i.e., understanding of reaction course/outcome) will also be considered. Precision synthesis of highly controlled, exact structures is desired.

Inorganic polymers that lead to unique properties are of interest in compelling cases. When done in conjunction with experiment to verify predictive capabilities, theory may be developed and/or used to probe such hybrid structures to understand their properties, and to suggest potential synthetic targets. Novel processing approaches that lead to deep, detailed understanding of property-process relationships are of interest, especially for on-demand processes (e.g., additive manufacturing). Investigation of bulk material properties (e.g., electronic, photonic, phononic) generated during such processes and understanding of their fundamental interfacial chemistry and physics is of interest.

In the area of photonics, research emphasis is on materials where refractive index can be actively tuned or controlled (e.g. third order nonlinear optical materials, electro-optic polymers, liquid crystals, photorefractive polymers, and magneto-optical polymers). In the area of electronic materials, research emphasis is on controlling properties (e.g., conductivity, charge transport and mobility, and stretchable/bendable electronic materials). Controlled growth and/or self-assembly of nanostructures into well-defined structures (e.g. modified into functionally hybrids) or hierarchical and complex structures are of interest.

Research aimed at being able to control/tune two or more material properties independently through creative, precision chemistry is sought. In addition to research involving material concepts for power management, power generation, and storage applications, there are also application needs for organic materials in extreme environments (e.g., space operation).

Nanotechnology approaches are encouraged to address all the above-mentioned issues. Approaches and concepts involving excited state engineering to control the flow of energy within a material are of interest.

Research ideas are particularly encouraged that address long-standing or unanswered organic-based materials chemistry challenges that will have significant impact on advancing basic understanding behind property creation and control if successful.

You are highly encouraged to contact the Program Officer prior to developing a full proposal to understand any specific submission target dates and to submit one or more idea paragraphs (3-5 sentences plus a title and descriptive figure) that describe the essence of the idea and the fundamental science to be investigated. Alternatively, one two-page (maximum) white paper pre-proposal can be submitted that includes the objective and approach of the proposed effort, research aims with the current state-of-

the-art, a brief rationale why the approach can achieve the goals, the anticipated outcomes if the research is successful; a third page can contain two or three (3) key references and a one sentence budget detailing the approximate yearly cost for a three (3) to five (5) year effort.

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#### A.4. AFOSR/RESC Bio-Cognitive Branch

The Bio-Cognitive Program Officers and topics are:

SECTION	PROGRAM DESCRIPTION	PROGRAM OFFICER
<a href="#">A.4.a.</a>	Biophysics	Dr. Sofi Bin-Salamon
<a href="#">A.4.b.</a>	Human Performance and Biosystems	Dr. Patrick O. Bradshaw
<a href="#">A.4.c.</a>	Natural Materials and Systems	Dr. Bennett Ibey
<a href="#">A.4.d.</a>	Space Biosciences	Dr. Jennifer Talley
<a href="#">A.4.e.</a>	Symbiotic Systems	Dr. Nandini Iyer
<a href="#">A.4.f.</a>	Computational Cognition and Machine Intelligence	Dr. Ben Robinson
<a href="#">A.4.g.</a>	Trust and Influence	Dr. Laura Steckman
<a href="#">A.4.h.</a>	Cognitive and Computational Neuroscience	Dr. Hal S. Greenwald

Our research areas of interest are described in detail below:

##### A.4.a. Biophysics

**Program Description:** This program encompasses fundamental experimental and theoretical Biophysics research that is primarily focused on studies of bio-molecular and atomic imaging below the diffraction limit, bioelectricity, electromagnetic stimulation, and quantum biology. We are concerned then, with the study of physical biology with the aim of answering fundamental and basic physics questions through the application of the principles and methods of physical sciences to achieve novel and innovative solutions in biology and physics. The relatively recent emergence of biophysics as a scientific discipline may be attributed to the spectacular success of biophysical tools born out of physics that have allowed us to unravel the complex atomic/molecular structures found in DNA and RNA. More recently areas of interest in Biophysics include but are not limited to: bio-molecular imaging while preserving structure and functionality, electromagnetic bioeffects, and quantum biology. These research areas are selected for their potential to support technological advances in application areas of interest to the United States Air

and Space Forces including biologically inspired new innovative and novel materials, autonomy, human performance, Directed Energy, and enhanced computational development for future Air and Space Force needs.

**Basic Research Objectives:** This is a multidiscipline collaborative basic research effort that meets scientifically meritorious rigor in the area of Biophysics. We seek to directly or indirectly support the efforts of the Air Force Research Laboratories ongoing in-house research in Biophysics and Human Performance. We seek to explore new areas in applied mathematics, physics, optics and biology by working in the sub- areas of bio-molecular imaging, electromagnetic bioeffects, and quantum biology.

New emerging scientific areas may enable precise excitation modulation of distinct atoms and molecules associated with living material to track activity of molecular processes; for controlling cellular signaling processes. Functional projections of intracellular signal pathways at the atomic/molecular level within mammalian cells, with high temporal accuracy and reversible neuromodulation are of fundamental interest in this portfolio.

Electromagnetic bioeffects associated with Directed Energy Weapons remains at the forefront of Air and Space Force science and technology interest associated with emerging new technologies, development, and deployment. The interest here is to understand fundamental atomic/molecular mechanisms associated with electromagnetic perturbation that occur below damage thresholds and may give insight into new novel means of human performance enhancement, biological control, and man machine interface. Recent work has found that rapid change in temperature from the IR laser stimulation reversibly alters the electrical capacitance of the plasma membranes of a cell and depolarization of the membrane can results in real measurable action potentials.

This capacitance is established by the spatial distributions of ions near the plasma membrane surface and underlies the mechanism responsible for the voltage waves in the Soliton theory of action potentials. This program coordinates multi-disciplinary experimental research with mathematical, neuromorphic, and computational modeling to develop the basic scientific foundation to understand and emulate sensory information systems in natural acoustic, visual, and sensorimotor systems. Proposers are welcome to explore competitive research ideas that may include collaborations in the Americas, Asia Pacific, the European Union and others.

You are highly encouraged to contact our Program Officer prior to developing a full proposal to briefly discuss the current state-of-the-art, how your research would advance it, and the approximate cost for a three (3) to five (5) year effort, and if there are any specific submission target dates.

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#### **A.4.b. Human Performance and Biosystems**

**Program Description:** The U.S. Air Force and U.S. Space Force are currently interested in improving human capabilities through the development of advanced human-machine interfaces and the establishment of direct methods used to augment human performance. The primary goal for this program is to gain a better understanding of the biophysical,

biochemical, and physiological mechanisms responsible for the behavioral, genetic, cellular, tissue and systems changes resulting from various forms of perturbation.

Additionally, a sensory systems focus has been added to this program and the emphasis is on developing the basic scientific foundation to understand and emulate sensory information systems. Emphasis is on (a) acoustic information analysis, especially in relation to human auditory perception, and (b) sensory and sensorimotor systems that enable 3-D airborne navigation and control of natural flight, e.g., in insects or bats, especially in relation to capabilities of autonomous biological systems not yet emulated in engineered flight.

**Basic Research Objectives:** This program is interested in defining the mechanisms (biological, cognitive, genetic, neural, physiological, etc.) associated with enhancing human capabilities as well as understanding the associated biomarkers, bio-circuits, bioelectric and connection pathways involved with increasing performance capabilities especially as they relate to aircrew member performance. In addition, this program aims to explore natural and synthetic processes, mechanisms and/or pathways for understanding energy production in Biosystems. We are also interested in understanding the variables of fatigue and toxicology as they relate to performance decrement in the aviation environment, i.e., exploring the bio-circuitry, biochemical and molecular pathways and processes that generate signals associated with fatigue or performance changes. We wish to define and understand the biomarkers and genetic changes associated with human performance after the administration of toxicological agents, specific interest in toxicology mechanisms that may or may not exhibit toxic effects at a minimal dose level and toxicological effects of flight line equipment.

Proposals aimed at understanding synthetic biological processes as they relate to energy production in Biosystems will be accepted. We have a specific interest in understanding organelles, cells, tissues or systems perturbed with Acoustic, Photo, Electric or Magnetic energy.

For the sensory systems portion of the portfolio a goal is to pursue new capabilities in acoustic analysis, to enhance the intelligibility and usefulness of acoustic information. The primary approach is to discover, develop, and test principles derived from an advanced understanding of cortical and sub-cortical processes in the auditory brain.

Included are efforts to model and control effects of noise interference and reverberation, understand the psychoacoustic basis of informational masking, develop new methods for automatic speech detection, classification, and identification, and enable efficient 3-D spatial segregation of multiple overlapping acoustic sources.

Signal analysis methods based upon purely statistical or other conventional “blind source” approaches are not as likely to receive support as approaches based upon auditory system concepts that emphasize higher-level neural processes not yet fully exploited in engineered algorithms for acoustic information processing. Applicants are encouraged to develop collaborative relationships with scientists in the Air Force Research Laboratory (AFRL).

Another program goal is to deepen the scientific understanding of the sensory and

sensorimotor processes that enable agile maneuvering and successful spatial navigation in natural flying organisms. Emphasis is on the discovery of fundamental mechanisms that could be emulated for the control of small, automated air vehicles, yet have no current analogue in engineered systems. Recent efforts have included investigations of information processing in wide field-of-view compound eye optics, receptor systems for linear and circular polarization sensing, and mathematical modeling of invertebrate sensorimotor control of path selection, obstacle avoidance and intercept/avoidance of moving targets. All of these areas link fundamental experimental science with neuromorphic or other mathematical implementations to generate and test hypotheses.

Current efforts also include innovations in control science to explain and emulate complex behaviors, such as aerial foraging and swarm cohesion, as possible outcomes of simpler sensory-dominated behaviors with minimal cognitive support.

You are highly encouraged to contact our Program Officer prior to developing a full proposal to briefly discuss the current state-of-the-art, how your research would advance it, the approximate cost for a three (3) to five (5) year effort, and if there are any specific submission target dates.

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#### **A.4.c. Natural Materials and Systems**

**Program Description:** The technological dominance of the United States Air Force and Space Force is contingent upon the development of advanced materials. These materials must deliver new functionality, reduce cost, expand operational range, and resist degradation in austere environments. Nature, through millennia of evolution, has generated a vast array of unique materials and molecules that provide a blueprint for the next generation of military technology.

Natural materials are produced with exceptional efficiency, utilize locally sourced components, are engineered for multiple functions, and are hierarchically assembled from the atomic to the macroscale. Their performance often surpasses that of synthetic materials, fueling interest in fundamental research that unlocks the chemical, biological, and physical principles governing their creation, maintenance, and disposal. The Natural Materials and Systems program aims to understand and harness these principles to create the next generation of advanced materials.

**Basic Research Objectives:** The Natural Materials and Systems program aims to uncover how natural systems create and maintain materials, enabling the development of novel solutions for the United States Air and Space Force. The program is focused on three key areas:

**Biomaterials:** Understanding the form and function of unique materials found in nature. Specific areas of interest include extremophiles and organisms that leverage electromagnetic energy for survival.

**Biomolecular Engineering:** Discovering how biomolecules can be used to create novel materials and systems that surpass the performance of both natural and synthetic materials in terms of manufacturing cost, function, and life cycle. Of particular interest are optical and structural materials that improve performance or provide new functions for military technology.

**Bioproduction and Bioassembly:** Exploring how biological systems produce, assemble, survey, and dispose of materials. Specific areas of interest include knowledge that can increase the speed, lower the cost, or improve the performance of biomanufacturing, as well as developing engineered living materials for austere environments.

It is highly recommended that prospective proposers contact the Program Officer before submitting a full proposal to ensure topic alignment, discuss estimated cost, and confirm preferred submission dates. The program is open to both single and multiple investigator proposals. Proposals spanning up to five (5) years that require collaborative, multidisciplinary teams with the goal of significantly advancing knowledge in one of the key program areas are highly encouraged. All proposals must be hypothesis-driven basic science focusing on filling fundamental knowledge gaps that prohibit the realization of nature-inspired materials. Proposals focused on medical applications, use-cases, or needs (e.g., diagnostic, therapeutic, pharmaceutical) will not be considered.

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#### **A.4.d. Space Biosciences**

**Program Description:** As activities in the space domain increase, the Department of the Air Force (DAF) and United States Space Force (USSF) require innovations that transcend traditional supply chain logistics and provide a decisive advantage in austere environments. The vision of this program is "Bio-Informed Superiority"—harnessing the power of biotechnology, synthetic biology, and bio-inspired design to move beyond Earth-dependent supply chains toward self-sustaining, resilient space architectures. This portfolio seeks discovery research that leverages the fundamental mechanisms of biological systems—from the micro to macro scale—to solve logistical challenges, reduce launch mass, and create adaptive capabilities that can manufacture fuel, materials, and resilience at the point of need.

**Basic Research Objectives:** The space environment presents a complex array of stressors which change drastically with geodetic height, including microgravity, ionizing radiation, extreme temperature fluctuations, and vacuum, which challenge both biological and abiotic systems. Research is needed to understand how these stressors influence the fundamental rules of life, how living systems adapt, and how synthetic biological platforms can be engineered to maintain homeostasis and functionality within them. Proposals should address fundamental knowledge gaps supporting the following areas:

**Logistics and Biomanufacturing:** There is a critical gap in our understanding of how the combined stressors of the space environment—specifically microgravity, ionizing

radiation, and extreme resource scarcity—alter the fundamental metabolic, transcriptomic, and physiological pathways of organisms. Research is sought to elucidate the mechanisms of microbial mechanosensing, altered fluid dynamics, and non-equilibrium thermodynamics in space, which dictate the kinetic rates of bio-catalysis and phase transitions. Understanding these fundamental biological and physical rules of life is necessary to predict how extremophilic and xerophilic organisms process in-situ resources (such as space waste, carbon dioxide, and regolith). Closing this knowledge gap will provide the foundational science required for "near solid-state" biomanufacturing of energetics, fuels, and mission-critical chemicals to untether military logistics from Earth and enable Dynamic Space Operations.

**Asset Resilience and Bio-Inspired Materials:** We lack a fundamental understanding of the principles that govern the self-assembly, structural organization, and phase transitions of complex biological and bio-hybrid materials (such as soft and active matter) in the space environment. There are critical scientific gaps regarding how the absence of gravity-driven convection and sedimentation affects cellular force generation, biomineralization, and the formation of radiation-attenuating biopolymers (e.g., melanin). Proposals should investigate the fundamental biophysics and materials science of these interactions to uncover how biological systems naturally shield against radiation, maintain homeostasis, and self-repair damage under space extremes. This fundamental knowledge is essential to eventually engineering autonomous, threat-resilient space architectures and protective engineered living materials for the contested space domain.

**Predictive Modeling and Guardian Resilience:** A fundamental scientific gap exists in accurately predicting the behavior of complex biological systems, materials, and biomanufacturing processes under the compounded stressors of the space environment. Because continuous flight testing is prohibitively expensive and time-consuming, research is needed to develop advanced physical models, high-fidelity Earth analogues of the space environment, and mathematical "digital twins" of biological materials and systems. These digital and physical models are required to reliably predict non-equilibrium behaviors, phase transitions, and biological outputs to enable scalable in-space manufacturing. Furthermore, this area seeks to leverage the space domain as an accelerated testing ground for disease modeling and intervention experiments. By exposing biological models—such as tissue chips, organoids, and other non-human analogues—to the unique stressors of space, researchers can uncover hidden mechanisms of cellular degradation, fatigue, and stress. Resolving these knowledge gaps through advanced modeling will accelerate the discovery of novel therapeutic targets, mapping the underlying "bio-circuitry" of stress to optimize terrestrial Guardian resilience and cognitive performance, while providing the predictive power necessary to advance bio-informed materials and manufacturing.

Researchers are highly encouraged to contact the Program Officer prior to developing a full proposal to briefly discuss the current state-of-the-art and what is truly new or innovative about the proposed new work, the approximate cost for one (1) to three (3) year effort to (5) year efforts, and if there are any specific submission target dates.

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#### A.4.e. Symbiotic Systems

**Program Description:** and transformative basic research dedicated to optimizing the performance of the human within a system-of-systems (SoS) framework. In modern environments, a human isn't just a standalone operator; they are a dynamic node whose performance is inseparable from the technological and organizational layers they inhabit. Research will use experimental, theoretical and modeling techniques to shift the focus from the individual as a static component to the individual as a dynamic, interconnected node, where performance is not just an individual metric, but rather, it is viewed as a metric that influences—and is influenced by—technological, biological chemical, mechanical, or physical systems.

**Basic Research Objectives:** The program funds fundamental research in augmenting and improving human performance within a system of systems framework. Some potential topics that would be of interest to the program include but are not limited to the topic areas below. Innovative ideas that may not fit into these categories but are central to the portfolio's general objectives are also welcomed.

- Characterizing the emergent behaviors that manifest when humans function as integrated nodes within a System of Systems, developing the metrics and sensing modalities required to track these non-linear states in real-time, and establishing a formal taxonomy to differentiate between desirable systemic synergies and undesirable failure modes
- Defining the fundamental mechanisms of meaningful human control within symbiotic architectures, specifically establishing the mathematical and physiological thresholds required to quantify when an automated system's processing speed or complexity overwhelms human judgment.
- Determining how the temporal disparity between AI decision-making speeds and human neurobiological processing affects the dynamic stability of a mixed team, specifically identifying the "phase-shift" where machine latency or acceleration causes a breakdown in human situational awareness and systemic control.
- Fundamental science of multimodal bio-digital sensing to continuously map a human's real-time physical, physiological, and psychological states, enabling the system to provide targeted, closed-loop augmentation.
- Defining the fundamental relationship of reciprocal plasticity, establishing how a human and an AI can undergo simultaneous, closed-loop co-learning.
- Identifying the fundamental biomarkers and neuro-behavioral signatures that provide the highest fidelity and reliability for real-time state sensing, establishing a precise physiological and psychological map that can autonomously trigger targeted biochemical interventions or adaptive cognitive augmentation within a closed-loop symbiotic system.
- Characterizing the fundamental mechanisms of bidirectional communication at the biotic-

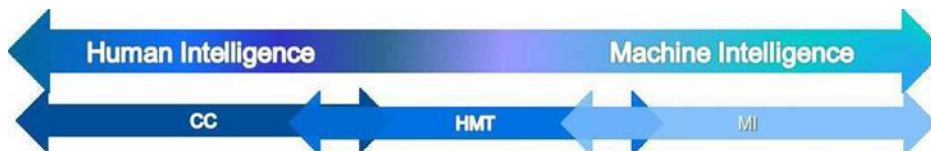
abiotic interface, focusing on the molecular and cellular transitions between living tissue and synthetic substrates to enable the engineering of bio-hybrid materials and high-fidelity architectures that sustain long-term functional integration.

- Real-time bio-digital transduction without significant latency.
- Exploration of fundamental neurobiological mechanisms of cognitive offloading, seeking to define the "decision rules" the brain uses to delegate specific functions—such as spatial navigation or high-order calculation—to a symbiotic partner, and quantifying the resulting biological costs.

Proposers are highly encouraged to contact the Program Officer prior to developing a full proposal to discuss the current state of the art, how the proposed research would advance it, the approximate cost for a three (3) to five (5) year effort, and if there are any specific submission target dates.

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#### A.4.f. Computational Cognition and Machine Intelligence



**Program Description:** This program supports radical basic research aimed at transformatively advancing the mathematical and computational foundations of machine intelligence and human-machine alignment. Systems with varying degrees of autonomy in the US Air Force and Space Force face resource-limited, adversarial, uncertain, and highly dynamic conditions in missions requiring time-critical decision-making. To ensure system integrity against algorithmic subversion, an ideal machine component should provably ensure system robustness by providing real-time, falsifiable recommendations that fully communicate its degree of uncertainty.

Proposals should aim to develop pathfinding new theories and frameworks rather than incremental engineering improvements to existing ones. While research should be framed in the context of applications relevant to the Air Force and Space Force, proposals should have the potential to broadly impact many areas of science and engineering. Applications of interest include autonomous systems, mission planning, wargaming, autonomous knowledge discovery, and adaptivity to any intelligent adversary---all under harsh time, compute, data, and reliability requirements.

Due to the need for reliable machine agents, this program places the utmost emphasis on fundamental mathematical underpinnings and mathematical rigor, including asymptotic

complexity bounds, rates of information-theoretic convergence, and formal verification---while excluding purely empirical black-box approaches lacking practical convergence guarantees or interpretable foundations. Further, while cognitive models may draw biological inspiration, they must have a quantifiable impact on machine intelligence to be of interest. We highly encourage cross-disciplinary teams in cognitive science, computational psychology, computer science, mathematics, statistics, econometrics, business/management, operations research, and game theory to apply.

**Basic Research Objectives:** The vision of this program is to pursue algorithmic approaches to artificial intelligence that are as transparent as possible, explicitly including “white-box” approaches. Nevertheless, theoretically justified prescriptions for how to use less transparent deep-learning systems and their compositions with other algorithms are also of interest. Either way, proposed approaches must ultimately include formal analyses against well-defined mathematical, computational, and scientific success criteria---at a minimum, accuracy, computational/sample complexity, and reproducibility. This foundational requirement is implicit across solutions targeting any of the program’s three main sub-topics: Computational Cognition, Machine Intelligence, and Human-Machine Teaming.

**Computational Cognition:** Modeling human (or animal) cognitive processes to provide a computational or information-theoretic advantage. Some challenges relating to human-like reasoning include debuggable and self-modifying modular architectures, unified modeling of various logics (modal, propositional, linear-temporal, probabilistic, causal), systems that can self-repair faulty arguments in finite time, models of rationality beyond expected utility theory, heuristic reasoning with quantifiable advantages, and actionable geometric interpretations of statistics.

**Machine Intelligence:** Identifying capabilities and limitations of machine-algorithmic knowledge creation, in particular for reliable mathematical/scientific discovery, for reasoning, and for real-time strategy in game-theoretic settings where adversaries may have full algorithmic access and where information may be corrupted, denied, or manipulated. Some challenges include time-to-completion bounds for joint neural-and-symbolic systems, bounding high-performance regions for machine-learning algorithms, scaling laws and convergence rates, formal methods/verification, distributed reinforcement learning, causal analysis, and automating theorem proving. To address issues of undecidability in automated verification, potential non-termination could be signaled using early detection of high computational complexity, whereas increasingly powerful verification algorithms could arise from developments in fields like dependent and homotopy type theory.

**Human-Machine Teaming:** This sub-area is concerned primarily with the machine side of teaming. While the human side is addressed mainly by the “Trust and Influence” portfolio, described elsewhere in this BAA, compositional models of human-machine teaming that exhibit stable dynamic properties are also of interest. Other challenges of interest include determining models of human teammates (capture of intent, degree of rationality, or preferences), how to prevent cognitive overload, and dynamic uncertainty propagation in teams.

The list above is not exhaustive and other approaches can be suggested to the Program Officer, who can then determine if a proposal is warranted and of potential interest.

You are encouraged to contact our Program Officer prior to developing a full proposal to briefly

discuss the current state-of-the-art, how your research would advance it, the approximate cost for a three (3) to five (5) year effort, and if there are any specific submission target dates.

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#### **A.4.g. Trust and Influence**

**Program Description:** The Trust and Influence program funds interdisciplinary high risk, transformative basic research that (1) elucidates the social and cognitive principles and processes surrounding the establishment, maintenance, and repair of trust between and among humans and intelligent agents, machines, algorithms, and/or other emergent technologies, with particular interest in situations where these concepts apply to heterogeneous, distributed teams or teaming constellations (i.e. teams of teams); and (2) advances the science of social influence to enhance understanding of how the phenomena and/or associated processes shape or affect human beliefs, perceptions, attitudes, and/or behaviors. The program encourages multidisciplinary and transdisciplinary approaches, which may include contributions from sociology, anthropology, computer and information science, psychology, cognitive science, linguistics, mathematics, economics, computational social science, and other social or behavioral sciences, among other disciplines. It further encourages research designs that utilize laboratory studies, modeling, and/or field research intended to develop novel, transformative theories, frameworks, or evaluative measures. Projects that aim to successfully consider the interplay of trust and influence in any of the contexts described below are welcomed.

**Basic Research Objectives:** The program's research themes can be defined broadly by two areas: trust in autonomous systems, human-machine teaming, and emergent technologies; and influence. In the area of trust in autonomous systems, human-machine teaming, and emergent technologies, there is particular interest in research that covers one or more of the following:

- (1) Empirical studies to examine drivers of trust between/among humans and intelligent, autonomous agents that operate in various configurations of heterogeneous, distributed teams or constellations;
- (2) Laboratory and field studies to examine the impact of socially-designed and/or culturally-specific cues or physical features such as appearance, voice, personality, and other social elements related to human-machine trust and enhancing system performance;
- (3) Development of trust metrics, evaluative frameworks, and other relevant constructs in human-machine or human-agent teaming with a particular emphasis on real-time evolving and dynamic assessment;
- (4) Modeling and measuring of human-machine or human-autonomy teaming or joint action that supports adaptive and continuous improvement of joint performance in complex environments;
- (5) Efforts that advance the state of the science surrounding AI and ethics,

and/or responsible AI (RAI) in regard to human-technology interaction/teaming and trust, with a preference for research examining understudied ethical principles and theories; and,

- (6) New constructs or theories of trust that may be required when considering non-maleficence and/or psychological safety.

In the area of influence, research is needed to understand how vectors of information, such as but not limited to social and digital media channels, contribute to short- and long-term campaigns intended to influence populations, shape perceptions, spread ideas, alter or diffuse narratives, and change beliefs. Further, there is interest in projects that consider multiple vectors of information that strategically influence beliefs and actions at multiple levels, layers, and scales. The portfolio is concerned with sociobehavioral, technosocial/sociotechnical effects and the interplay between cognitive and affective processes that give rise to behavior and actions, as well as those that contribute to how populations either become more susceptible or resilient to influence over time and how this occurs. The program does not fund projects that examine disinformation unless they are appropriately situated within the larger information ecosystem and/or multi-vector informational influence campaign(s). Specific areas of interest include research that considers one or more of the following:

- (1) Effects of influence and persuasion that occur within the information environment through multiple vectors of information (e.g. via campaigning), such as social, digital, and analog media, and across different cultural groups, with consideration of the associated second and third order effects;
- (2) Social/sociocultural, cognitive, and neural mechanisms of influence and persuasion;
- (3) New or revised theories of resonance, to include research that considers it in conjunction with associated concepts such as dissonance, alienation, and others that might be revealed through investigation;
- (4) Modeling and measurement of the relationship between online and offline real-world behaviors; and,
- (5) Novel measurements of social influence and persuasion, with an interest in efforts that consider multiple levels and scales.

Proposers are highly encouraged to contact the Program Officer prior to developing a full proposal, preferably by email, to discuss: the current state of understanding in the field(s); how the research would advance it; proposed or potential research questions or hypotheses; definitions of major concepts, such as trust and/or influence; the approximate cost for a three (3) to five (5) year effort; and specific submission target dates. If a white paper is available, it should be included with the initial email.

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#### A.4.h. Cognitive and Computational Neuroscience

**Program Description:** The Cognitive and Computational Neuroscience program funds high-risk, high-potential basic research that uses experimental and computational modeling techniques from systems neuroscience, cognitive neuroscience, computational/theoretical neuroscience, cellular and molecular neuroscience, cognitive science, and cognitive psychology to: understand the neural mechanisms responsible for perception, cognition, and behavior/motor control. The program also supports brain-inspired algorithm and hardware development provided these are grounded in neurobiology and are useful for testing proposed neuroscience theories and/or enabling novel capabilities in computing, artificial intelligence, or autonomous systems.

**Basic Research Objectives:** The program funds basic research in cognitive and computational neuroscience and at the intersection of neuroscience and artificial intelligence as described above. Potential topics that would be of interest to the program include but are not limited to the following examples. Innovative ideas that may not fit into these categories but are germane to the program's general objectives are also welcomed.

- **Neural Information Representation:** It is well established that neurons communicate information via action potentials (“spikes”), but understanding how neurons represent information has remained a long-standing challenge. Debates continue regarding whether neurons use precise spike timing or frequency to encode information, the functions of noisy, probabilistic population codes, and whether every spike carries signal. Proposed research projects should characterize neural activity with the aim of reliably decoding information. Proposers should describe how their research, if successful, will advance our ability to test hypotheses regarding neural mechanisms and functions and/or enable greater sophistication for applications such as sensory and sensorimotor prosthetics, brain-machine interfaces, and deception detection.
- **Bio-inspired Sensing:** To process sensory information, recognize and locate objects, and navigate in real-world environments, humans and other animals often use strategies that outperform current man-made systems. Artificial systems featuring such strategies could augment human capabilities while enhancing or maintaining situational awareness. Proposals should describe a species' sensory function in which the sensor, environment, and behavior align with the proposed application(s), hypotheses about the associated neural information processing mechanisms, and a research plan that culminates in a proof-of-concept demonstration.
- **Brain-inspired Machine Learning:** Current machine learning algorithms excel at identifying statistical features in complex data sets, yet computers lack the robustness and generalizability associated with human learning. Specifically, humans can leverage previously learned knowledge to avoid needing large training sets, transfer knowledge from one task to other related tasks or contexts to accelerate learning, continuously update their learned knowledge, and adapt to time-varying contexts and environments. We are interested in brain-inspired or biomimetic algorithms that advance the state of the art and

have the potential for revolutionary progress on these or related research challenges.

- **Brain-inspired Computing:**Recent examples of commercially-developed neuromorphic hardware have focused on power consumption and density advantages over conventional hardware, but brain-inspired circuits also hold promise for novel computing architectures that can address problems that traditional von Neumann architectures cannot (or at least not within polynomial time or better). Research proposals on brain-inspired computational capabilities should describe how the research will fill gaps in computing or how it will enable novel artificial intelligence algorithms.

Models of brain structures and functions should be biologically plausible and demonstrate consistency with the current understanding of the structure and function of the brain components being modeled. Brain-inspired algorithms or hardware need not remain entirely faithful to the biological details where other approaches are more reasonable, but neuroscience evidence should be used for benchmarking and theoretical guidance. Proposals should provide a definition of success based on specific metrics and/or one or more challenge problems.

Prospective proposers are highly encouraged to email a white paper (pre-proposal) to the Program Officer prior to developing a full proposal. The white paper should be approximately three to five pages and describe the proposed research, including the research questions/hypotheses and approach, how it will advance scientific understanding, approximate cost and anticipated duration, and any specific submission target dates.

DR. HAL S. GREENWALD, AFOSR/RESC  
Email: [neuroscience@us.af.mil](mailto:neuroscience@us.af.mil)  
(703) 588-8441

## **A.5. AFOSR INTERNATIONAL OFFICES**

**Program Description:** AFOSR has international program offices in London, Tokyo, Melbourne, Sao Paulo, and Santiago. International Program Officers (IPOs) at these offices fund basic research grants at foreign institutions across Europe, Africa, Asia, Australia and Central and South America. Research areas of interest include all listed topics for the four scientific teams given above as well as other innovative research concepts listed below in section A.6.

Principal Investigators at research institutions outside the US are highly encouraged to contact the international program office in their region prior to developing a full proposal, preferably by email, to discuss the current state of the art in his/her area of interest, how the proposed research would advance current understanding, the approximate cost of an initial effort, and if there are target submission dates.

SECTION	INTERNATIONAL OFFICE	BRANCH CHIEF
<a href="#">A.5.a.</a>	European Office of Aerospace Research and Development (EOARD)	Lt Col Grant Thomas
<a href="#">A.5.b.</a>	Asian Office of Aerospace Research and Development (AOARD)	Dr. Chris Drew
<a href="#">A.5.c.</a>	Southern Office of Aerospace Research and Development (SOARD)	Lt Col Grant Thomas

**A.5.a. European Office of Aerospace Research and Development (EOARD), London, United Kingdom**

For enquiries, email [EOARD.ORGBOX@US.AF.MIL](mailto:EOARD.ORGBOX@US.AF.MIL)

**A.5.b. Asian Office of Aerospace Research and Development (AOARD), Tokyo, Japan and Melbourne, Australia**

For enquiries, email [AFOSR.AOARD@US.AF.MIL](mailto:AFOSR.AOARD@US.AF.MIL)

**A.5.c. Southern Office of Aerospace Research and Development (SOARD), Santiago, Chile and Sao Paulo, Brazil**

For enquiries, email [AFOSR.IOS.SOARD@us.af.mil](mailto:AFOSR.IOS.SOARD@us.af.mil)

**A.6. OTHER INNOVATIVE RESEARCH CONCEPTS**

**Program Description:** We are also always looking for new basic research ideas and are open to considering unique and revolutionary concepts which do not fall into the portfolios described above. If you have an exciting idea that doesn't seem to fit within one of the more specific topic descriptions of this Broad Agency Announcements (BAA) detailing our current technical programs, you may submit it under this section of the BAA. Research should investigate truly new and unique approaches and techniques that may enable revolutionary concepts with potentially high-payoff relevant to Air and Space Forces. Pre-coordination with the points of contact listed below is, however, very strongly encouraged before submitting a proposal.

DR. VAN BLACKWOOD, AFOSR/RES

Email: [SPECIALTOPIC1@US.AF.MIL](mailto:SPECIALTOPIC1@US.AF.MIL)

(703) 588-8618

**B. FEDERAL AWARD INFORMATION**

Approximately \$200 million is anticipated to be available for support of actions awarded under this announcement, subject to availability of funds. Research proposals funded between \$100,000 and \$300,000 per year are encouraged. Most of our awards are three (3) years in duration. Awards may be proposed for not more than five (5) years.

All applications received under this announcement will be considered applications for new awards,

including any application marked renewal. Applications to supplement an existing project with additional funding may be considered on a case-by-case basis post-award but are not anticipated to compete with new award funding.

Awards may start any time during the year. The actual start date is determined at the time of award and may be different than the date you propose. We discuss this more in section [G. AWARD NOTICES](#).

[Awards](#) are made under the authority of [10 U.S.C. 4001](#) in the form of grants, cooperative agreements, or contracts. We rely on discretionary appropriated funds for this program. We can only make awards if enough funds are made available. 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](#). Awards may take the form of contracts, grants, cooperative agreements, technology investment agreements and other transaction agreements as appropriate. The following provides a brief description of potential instrument types:

- Grant. A legal instrument consistent with 31 U.S.C. 6304, is used to enter into a relationship:
  - The principal purpose of which is to transfer a thing of value to the recipient to carry out a public purpose of support or stimulation authorized by a law of the United States, rather than acquire property or services for the Federal Government's direct benefit or use.
  - In which substantial involvement is not expected between the Federal Government and the recipient when carrying out the activity contemplated by the grant.
  - No fee or profit is allowed.
- Cooperative Agreement. A legal instrument which, consistent with 31 U.S.C 6305, is used to enter into the same kind of relationship as a grant, except that substantial involvement is expected between the Federal Government and the recipient when carrying out the activity contemplated by the cooperative agreement. No fee or profit is allowed.
- Other Transaction for Research (OTR). A legal instrument, consistent with 10 U.S.C. 4021, which may be used when the use of a contract, grant, or cooperative agreement is not feasible or appropriate for prototype projects directly relevant to enhancing the mission effectiveness of military personnel and the supporting platforms, systems, components, or materials proposed to be acquired or developed by the Department of Defense, or for improvement of platforms, systems, components, or materials in use by the armed forces. The effort covered under an OTR shall not be duplicative of effort being conducted under an existing DoD program (please refer to the DoD Other Transactions Guide for Research Projects dated November 2018). This document along with other OTR resources may be accessed at the following link: [Contract Policy | ACQ OSD](#).

We reserve the right to select and fund for award all, some, part, or none of the proposals received in response to this announcement. There is no guarantee of an award.

## **C. ELIGIBILITY**

### **C.1. ELIGIBLE APPLICANTS**

#### **C.1.a. General**

All qualified, responsible organizational applicants from academia, the non-profit sector,

and industry are eligible to submit research proposals. This includes University Affiliated Research Centers unless precluded from submitting a proposal by their Department of Defense operating contract.

### **C.1.b. HBCU/MSI, Tribal College and University, and Small Business Applicants Encouraged**

Historically Black Colleges and Universities and Minority Serving Institutions (HBCU/MSI), Tribal Colleges and Universities, and HBCU/MI affiliated medical centers are encouraged to submit research proposals and join others in submitting proposals. Small business concerns are also encouraged to submit proposals and join others in submitting proposals. **However, no funds under this announcement are reserved or otherwise set-aside for any specific entity type.**

### **C.1.c. Eligibility Notice for All Applicants**

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. If we cannot determine you or your organization qualified and responsible, you are not eligible to receive an award.

### **C.1.d. Ineligible Entities**

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

- Federally Funded Research and Development Centers (FFRDCs)
- Individual persons or people
- Federal agencies

## **C.2. COST SHARING**

We do not require cost sharing for proposals under this announcement (except as may be required for transactions other than contracts, grants, and cooperative agreements entered into under 10 U.S.C. 4021). Cost sharing is not an evaluation or selection criterion.

## **C.3. Gold Standard Science**

### **C.3.a. Definition of Gold Standard Science**

Gold Standard Science (GSS): IAW EO 14303; GSS is science conducted in a manner that is:

- (1) reproducible;
- (2) transparent;
- (3) communicative of error and uncertainty;
- (4) collaborative and interdisciplinary;
- (5) skeptical of its findings and assumptions;

- (6) structured for falsifiability of hypotheses;
- (7) subject to unbiased peer review;
- (8) accepting negative results as positive outcomes; and,
- (9) without conflicts of interest.

### **C.3.b. Expectation of Adherence to Gold Standard Science**

AFOSR expects the highest standards of scientific rigor, integrity and adherence to appropriate tenets of GSS. For more on these standards and DoW expectations, see <https://www.cto.mil/gold-standard-science-implementation-plan/>.

To meet GSS, applications/proposals shall:

- (1) Include clear benchmarks for measuring success and progress towards relevant goals and a commitment to achieving GSS;
- (2) Identify areas of demonstrating success in implementing GSS; and
- (3) Include a commitment to complying with administration policies, procedures, and guidance respecting GSS.

By responding to this BAA, you explicitly agree to the following statements:

- (1) Our institution understands the definition of Gold Standard Science as outlined above.
- (2) Our institution and all personnel involved in the proposed project will adhere to all administration policies, procedures, and guidance respecting Gold Standard Science in the execution of this project, if funded.

## **C.4. OTHER**

### **C.4.a. Acknowledgement of Support and Disclaimer Requirements**

You must include the [G.2.g. Acknowledgement of Research Support](#) on all materials created or produced under our awards.

You must include the [G.2.h. Disclaimer Language](#) on materials as required.

Our 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.

### **C.4.b. Expectation of Public Dissemination of Research Results**

We expect research funded by this announcement will be fundamental. We expect public dissemination of research results if you receive an award. This is a basic requirement for unclassified research results.

We intend, 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 DoW as described in the OUSW, AT&L Memorandum, "[Public Access to Department of Defense-Funded Research](#)" dated 09 Jul 2014.

We follow [DoD Instruction 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 or Contracting Officer's advice and consent. All exclusions must be authorized or required by law and must cite a valid legal authority.

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

***You are not eligible to submit a proposal if you cannot accept these terms, and by your submission, you agree to the terms set forth herein.***

#### **C.4.c. Disclosure of Conflict of Commitment and 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 material 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.

##### **(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 subrecipient you include in your proposal.

You must provide enough information for us to evaluate your disclosure. We may have to ask you more questions if we need more information.

At our discretion, we may ask you for a conflict-of-interest mitigation plan after you submit your proposal. Your plan is subject to our 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 of 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.

**C.5. AFOSR-SPECIFIC FUNDAMENTAL RESEARCH SECURITY REVIEW (FRSR) INFORMATION**

**(1) Security Risk Review.** Each proposal submission will be subject to a risk-based Security Review, (FRSR), prior to selection for award. The FRSR is applied to federally funded research designed to help protect Department of the Air Force Science and Technology (S&T) by identifying possible vectors of undue foreign influence. AFRL will follow all policy and procedures outlined in Air Force Research Laboratory (AFRL) Instruction AFRLI 61-113, Science and Technology Protection for the Air Force Research Laboratory and Department of the Air Force Instruction DAFI 63-101/20-101, Integrated Lifecycle Management. The FRSR will be conducted in accordance with OUSD(R&E)'s "Policy for Risk Based Security Reviews of Fundamental Research."

**(2) Covered Individual.** An individual who contributes to a substantive, meaningful way to the scientific development or execution of a research and development project proposed to be carried out with a research and development award from a federal research agency; and is designated as a covered individual by the federal research agency concerned. AFOSR further defines that all positions identified in the proposal are Covered Individuals and thereby subject to disclosure requirements and should have a corresponding Standard Disclosure Forms for Biosketch, Current and Pending (Other) Support, and Collaborators and Other Affiliations. *See* 42 U.S.C. § 6605, Definitions. (Note: For purposes of a Notice of Funding Opportunity (NOFO) solicitation, "covered individuals" are all Senior/Key Personnel.)

**(3) Security risk review for these subject proposals will be developed for all proposed Senior/Key personnel and "Covered Individuals".** These risk reviews will be based on information disclosed in a Research and Related Senior and Key Person Profile and Security Questionnaire. In addition, any accompanying or referenced documents, and publicly available information, will be utilized in risk reviews. Nationality or citizenship is not a factor in the security risk reviews.

**(4) External Engagements.** When considering all external engagements, AFRL incorporates a holistic decision-making process that encompasses technical and security factors. The security review method implemented by AFRL measures risk factors to identify the appropriate Risk Acceptance Level (RAL) within the organization. The objective analysis of the security risk factors is conducted to empower AFRL's S&T leaders to make risk-informed decisions. The review process looks at the risk factors indicated in the most up to date DoD Decision Matrix.

**C.5.a. Actions Required by Applicants/Recipients at Proposal Submission**

In accordance with AFRLI 61-113, S&T Protection, Applicants/Recipients are required

to submit the following documentation with their proposal:

- (1) Standard Form 424, “Research and Related Senior and Key Person Profile (Expanded) (Included in Application Package for all Covered Individuals);
- (2) Common Disclosure Forms: Biosketch, Current and Pending (Other) Support, and Collaborators and Other Affiliations (to be submitted with SF-424);
- (3) Security Program Questionnaire (*See Appendix 1*);
- (4) “Privacy Act Statement” consent form for each Covered Individual that is also signed by the Applicants/Recipients as the Individual’s Sponsors (*See “Covered Individual” section below and Appendix 2*);
- (5) Certification(s) of Covered Individual’s Research Security Training. AFOSR accepts and recommends the Research Security Training module on National Science Foundation (NSF) SECURE website; however, Universities may submit certifications from substantially similar training(s). AFOSR requires all Covered Individuals listed on the application for a research and development award to take the training in the 12 months prior to proposal submission. Upon acceptance of proposal, Covered Individuals must submit and maintain annual certifications showing this course was taken yearly.
- (6) Compliance Attestation. You must certify your institution’s compliance with OUSW’s Research Protection policies as articulated in the most up to date OUSW DoD Component Decision Matrix to Inform Research Proposal Mitigation Decisions on official university letterhead, and attest for the duration of the grant that the recipient confirms that the Covered Individuals participating in the grant are:
  - (1) not actively participating in a malign foreign talent recruitment program (MFTRP); and,
  - (2) not involved in active collaboration on fundamental research with a Section 1286 Prohibited Entity or employee of a Prohibited Entity.

*For example: [The University] certifies that the information provided is current, accurate, and complete. This includes, but is not limited to, information related to current, pending, and other support (both foreign and domestic) as defined in 42 U.S.C. §6605.*

*[The University] also certifies that, at the time of submission, no Covered Individual listed is a party in a [malign foreign talent recruitment program](#).*

*[The University] understands that misrepresentations and/or omissions may be subject to prosecution and liability pursuant to, but not limited to, 18 U.S.C. §§287, 1001, 1031 and 31 U.S.C. §§3729-3733 and 3802.*

*Signature<sup>3</sup>: [Business Office, Provost, Dean, or someone with the authority to legally obligate the University]*

*Date:*

In the event a security risk is identified, and the Government has determined the security risk exceeds the acceptable threshold and cannot be mitigated, the Applicant/Recipient will be notified and informed of the decline of award. The Government will provide an unclassified rationale for any rejection of a proposal due to security risks.

By submission of the required forms, the Applicant/Recipient agrees to comply with the following: To certify that each covered individual who is listed on the application has been made aware: 1) of all relevant disclosure requirements, including the requirements of 42 U.S.C. § 6605; and, 2) that false representations may be subject to prosecution and liability pursuant to, but not limited to, 18 U.S.C. §§287, 1001, 1031 and 31 U.S.C. §§ 3729-3733 and 3802. *See* National Science and Technology Council Guidance for Implementing National Security Presidential Memorandum 33 (NSPM-33) on National Security Strategy for United States Government-Supported Research and Development (January 2022).

**C.5.b. Actions Required by Covered Individuals. Federal law requires that all current and pending research support, as defined by 42 U.S.C. §6605, must be disclosed at the time of proposal submission, for all covered individuals.**

- (1) Research and Related Senior/Key Personnel Profile (Expanded) to include:
  - Biosketch Form; and,
  - **Current and Pending (Other) Support.** AFOSR requires information on all current and pending support for ongoing projects and proposals. AFOSR accepts NSF's Current and Pending (Other) Support, <https://www.nsf.gov/policies/nspm-33/common-form-cps>. This document contains a list of an individual's proposed and active projects and sources of support. It is used by AFOSR to assess:
    - The capacity of the individual to carry out the proposed research.
    - Any potential scientific and budgetary overlap or duplication across projects.
    - The potential the individual is overcommitting themselves with the proposed project.

What to include in your Current and Pending (Other) Support document:

- A brief outline of the information you will need to include is provided below.
- Identifying information.
- Organization and location.

- Projects/proposals, including the following:
- Project/proposal title.
- Status of support.
- Source of support.
- Primary place of performance.
- Start date.
- End date.
- Total award amount.
- Person-months (or partial person-months) per year committed to the project/proposed project.
- Overall objectives.
- Statement of potential overlap.
- In-kind contributions.
- Certification that the information you've provided is current, accurate and complete.
- Senior/key personnel are required to certify that the information is current, accurate and complete. This includes, but is not limited to, information related to current, pending and other support (both foreign and domestic).

(2) **Collaborators and Other Affiliations.** AFOSR accepts the template format required by NSF applicants, [https://nsf-gov-resources.nsf.gov/files/coa\\_template.xlsx?VersionId=uaz022di3.2KKDC7uauIadw7yeI3Xf.1](https://nsf-gov-resources.nsf.gov/files/coa_template.xlsx?VersionId=uaz022di3.2KKDC7uauIadw7yeI3Xf.1), for identifying this information. AFOSR uses Collaborators and Other Affiliations information during the merit review process to help manage reviewer selection. To expedite identification of potential reviewers, having a standard, searchable format for this information is essential. If you are using a Microsoft Excel document, you must submit it as a PDF document through Grants.gov. A brief outline of the information you will need to include is provided below.

- Your name and organizational affiliation.
- The names of anyone whose relationship to you precludes their service as a reviewer — including personal, family or business relationships — and what type of relationship you have with them.
- Names and organizational affiliations of your Ph.D. advisor and Ph.D. thesis advisees.
- Names and organizational affiliations of any co-authors or project collaborators in the last 48 months. Names of editorial boards, editors-in-chief and co-editors you have interacted with in the last 24 months.

Do not list editors or reviewers you have interacted with because of a paper submission.

- (3) Certification(s) of Research Security Training. *See* above, C.4.a(5).
- (4) The Government will require an updated disclosure whenever Covered Individuals are added or identified as performing under the funded project.

**The Government may require an updated disclosure during the performance of any research project selected for funding.**

- (5) Covered Individuals are also required to sign the “Privacy Act Statement” and provide such signed statement to the Applicant/Recipient for submission with the proposal. (*See* Appendix 2).

Any decision to accept a proposal for funding under this announcement will include full reliance on the individual’s statements. Failure to report fully and completely all sources of project support and outside positions and affiliations may be considered a material statement within the meaning of the False Claims Act, 31 U.S.C. 3729, and constitute a violation of Federal law.

#### **C.5.c. Actions required by Applicants/Recipients during period of performance**

- (1) Applicant/Recipient will utilize a section of the Research Progress Performance Report (RPPR) to provide disclosure updates for Senior/Key Research Personnel and Covered Individuals. In addition, whenever a new covered individual(s) is to be added or identified as performing under the funded project, a new Research and Related Senior and Key Personal Profile (Expanded), Biosketch, Current and Pending (Other) Support, and Collaborators and Other Affiliations forms and disclosures will be required prior to continued performance.

**If, at any time, during performance of this award, the Applicant/Recipient learns that its Senior/Key Research Personnel and/or Covered Individual (including any sub awardee personnel who receive this designation) are or are believed to be participants in a Foreign Government Talent Program or have Foreign Components with a strategic competitor or country with a history of targeting U.S. technology for unauthorized transfer, the Applicant/Recipient will notify the Contracting/Grants/Agreements Officer within five (5) business days of awareness. Foreign Component is defined as performing any significant scientific aspect of a project outside the United States. This applies whether the activity is conducted by the recipient or a researcher at a foreign organization, regardless of whether grant funds are used.**

- (2) This disclosure must include specific information as to the personnel involved and the nature of the situation and relationship. The Government will review this information and conduct any necessary fact-finding or discussion with the Applicant/Recipient. The Government’s determination on disclosure may include acceptance, mitigation, or termination of the award.

**The Applicant/Recipient will be required to flow down this provision to all sub awardees who have personnel designated as Senior/Key Research Personnel or Covered Individual as a result of their involvement in the performance of the research.**

Type of activity	Documents requiring information
Professional preparation (e.g., education and training).	<ul style="list-style-type: none"> <li>• Biographical Sketch</li> </ul>
Academic, professional or institutional appointments and positions, whether or not remuneration is received, and whether full-time, part-time or voluntary.	<ul style="list-style-type: none"> <li>• Biographical Sketch</li> </ul>
A list of products that demonstrate the individual's qualifications to carry out the project as proposed.	<ul style="list-style-type: none"> <li>• Biographical Sketch</li> </ul>
<p>Current and pending (other) support:</p> <ol style="list-style-type: none"> <li>a. All resources made available, or expected to be made available, to an individual in support of the individual's research and development efforts, regardless of <ol style="list-style-type: none"> <li>1. whether the source is foreign or domestic;</li> <li>2. whether the resource is made available through the entity applying for a research and development award or directly to the individual; or</li> <li>3. whether the resource has monetary value; and</li> </ol> </li> <li>b. includes in-kind contributions requiring a commitment of time and directly supporting the individual's research and development efforts, such as the provision of office or laboratory space, equipment, supplies, employees or students.</li> </ol>	<ul style="list-style-type: none"> <li>• Current and Pending (Other) Support</li> </ul>
In-kind contributions with an estimated dollar value of \$5,000 or more that support the research activity for use on the project/proposal being proposed.	<ul style="list-style-type: none"> <li>• Current and Pending (Other) Support</li> </ul>
<p>In-kind contributions:</p> <ol style="list-style-type: none"> <li>i. with an estimated dollar value of \$5,000 or more,</li> <li>ii. not intended for use on the project/proposal being proposed, and</li> <li>iii. have an associated time commitment.</li> </ol>	<ul style="list-style-type: none"> <li>• Current and Pending (Other) Support</li> </ul>
Current or pending participation in, or applications to, programs sponsored by foreign governments, instrumentalities, or entities, including foreign government sponsored talent recruitment programs.	<ul style="list-style-type: none"> <li>• Biographical Sketch</li> <li>• Current and Pending (Other) Support</li> </ul> <p><i>(Appropriate placement in each document may be contract dependent)</i></p>

Type of activity	Documents requiring information
<p>Consulting activities under the proposals and active projects section of the form when any of the following scenarios apply:</p> <ol style="list-style-type: none"> <li>1. The consulting activity will require the senior/key person to perform research as part of the consulting activity;</li> <li>2. The consulting activity does not involve performing research, but is related to the senior/key person's research portfolio and may have the ability to impact funding, alter time or effort commitments, or otherwise impact scientific integrity; or</li> <li>3. The consulting entity has provided a contract that requires the senior/key person to conceal or withhold confidential financial or other ties between the senior/key person and the entity, irrespective of the duration of the engagement.</li> </ol>	<ul style="list-style-type: none"> <li>• Current and Pending (Other) Support</li> </ul>
<p>Postdoctoral scholars, students or visiting scholars who are supported by an external entity, whose research activities are not intended for use on the project/proposal being proposed and have an associated time commitment.</p>	<ul style="list-style-type: none"> <li>• Current and Pending (Other) Support</li> </ul>
<p>Travel supported/paid by an external entity to perform research activities with an associated time commitment.</p>	<ul style="list-style-type: none"> <li>• Current and Pending (Other) Support</li> </ul>
<p>Startup company based on non-organization-licensed intellectual property (IP).</p>	<ul style="list-style-type: none"> <li>• Current and Pending (Other) Support</li> </ul>
<p>Startup packages from other than the proposing organization.</p>	<ul style="list-style-type: none"> <li>• Current and Pending (Other) Support</li> </ul>

## D. APPLICATION CONTENTS AND FORMAT

### D.1. ADDRESS TO REQUEST APPLICATION PACKAGE

All the application forms you need are available electronically on [Grants.gov](https://www.grants.gov). From the “View Grant Opportunity” page, you can click on the “Package” tab to download the application package.

You can find the electronic application package on [Grants.gov](https://www.grants.gov) by searching for the announcement number shown on page one. We will not issue paper copies of this announcement.

*Please contact us at [afosr.baa@us.af.mil](mailto:afosr.baa@us.af.mil) to request a reasonable accommodation for any accessibility requirements you may have.*

## D.2. APPLICATION CONTENTS

### D.2.a. Pre-proposal Inquiries and Questions

If you need help with technical matters, you should email the individual listed for your topic of interest in section [A. Program Description](#). We provide a list of all the programs and Program Officers listed in this announcement again in section [I.1. Technical Inquires and Questions](#).

If you have general questions about this announcement or administrative matters, you must submit your question in writing by email to the contact listed in section [I.2. General Inquiries and Questions](#).

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

### D.2.b. The Application as a Whole

You must submit your proposal electronically through Grants.gov. We will not accept or evaluate any proposal submitted by any means other than through Grants.gov.

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 may submit a proposal for one or more topics, or for a specific portion of a topic. You may submit different proposals on any number of topics, or different proposals on the same topic. We may not make awards in every topic area.

You must mark your application with the announcement number.

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

- We require the forms and attachments in bold text with all applications
- Some applications require the attachments in italics
- We provide more instructions in D.4. Component Pieces of the Application

<b>R&amp;R FORM, OMB No. 4040-0001</b>	<b>FIELD</b>	<b>ATTACHMENT</b>
<b>SF 424 (R&amp;R) Application for Federal Assistance, including an authorized signature</b>	<b>18.</b>	<i><a href="#">If applicable, SF- LLL Disclosure of Lobbying Activities Per instructions in G.2.a.</a></i>
<b>R&amp;R Other Project Information Form</b>	<b>7.</b>	<b>Project Summary / Abstract</b>

	8.	<b>Project Narrative</b>
	9.	<b>Bibliography &amp; References Cited</b>
	10.	<b>Facilities and Other Resources</b>
	11.	<b>Equipment</b>
	12.	<b>Other Attachments</b>
<b>R&amp;R Senior / Key Person Profile Form (Expanded) for all Covered Individuals</b>		<b>Biographical Sketch</b>
		<b>Current &amp; Pending Support</b>
		<b>Collaborators and Other Affiliations</b>
		<b>Training Certification(s)</b>
		<b>Compliance Attestation</b>
		<b>Privacy Act Disclosure Form (See Appendix 2)</b>
<b>R&amp;R Personal Data Form</b>		<b>None</b>
<b>R&amp;R Budget Form</b>		<b>Budget Justification</b>
<b>R&amp;R Subaward Budget Attachments Form</b>		<b>Subaward Budget</b>
<b>R&amp;R Project / Performance Site Locations Form</b>		<b>None</b>

The SF 424 (R&R) must include the signature of an authorized representative from your organization. The signature is affixed electronically by [Grants.gov](https://www.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.

**D.2.c. Proposal Format**

- i. Paper Size – 8.5 x 11-inch paper
- ii. Margins – 1 inch

- iii. Spacing – Single, 1.5, or 2.0-line spacing
- iv. Font – Times New Roman or Garamond, 10, 11, or 12point
- v. Page Limitation – None. However, unnecessarily elaborate or lengthy proposals are not desirable
- vi. Attachments – Electronic Portable Document Format (PDF)
- vii. Content – As described below

#### **D.2.d. Proposal Length**

We do not limit the length of your proposal for this competition; however, you must not include elaborate brochures, reprints, or presentations beyond those sufficient to present a complete and effective proposal.

#### **D.2.e. Marking Requirements for Confidential or Proprietary Information**

You must mark your proposal and any proposal sections that contain proprietary or confidential information. You must use the protective legend found at [FAR 52.215-1\(e\)](#) Instructions to Offerors -- Competitive Acquisition (Nov 2021) modified to permit release to our outside evaluators.

We make every effort to protect the confidentiality of proposals, including any proposal evaluations; however, under Freedom of Information Act (FOIA) requirements, some or all proposal information may be subject to release.

Your entire proposal, or any portions thereof, without protective markings or otherwise identified as requiring protection will be considered voluntarily furnished to us without restriction and will be treated as such for all purposes.

#### **D.2.f. Use of Generative Artificial Intelligence (GenAI) Tools**

While the use of GenAI Tools is not prohibited, AFOSR strongly encourages disclosure the use of such tools in your proposal.

Any use of GenAI tools is at your own risk, and you are responsible for ensuring the use of GenAI tools in your proposal does not result in plagiarism, unauthorized use of intellectual property, or presentation of misinformation.

Please note that external reviewers are prohibited from using GenAI tools in the review process, and AFOSR Program Officers (POs) are prohibited from sharing proposal information with external GenAI tools. AFOSR POs have access to an approved firewalled internal GenAI tool (e.g., GenAI.mil) which they may use for internal proposal processing.

#### **D.2.g. 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 [Adobe Software Compatibility | Grants.gov](#) provides additional important instructions.

### D.3. GRANTS.GOV APPLICATION SUBMISSION

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

#### D.3.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.

#### D.3.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: [Applicant Registration | Grants.gov](#)

Organization applicants can find complete instructions here: [Organization Registration | Grants.gov](#)

(1) ***Obtain and maintain ORCID for all key personnel***

**All individuals listed on the Senior/Key Person form must have an Open Researcher and Contributor ID (ORCID). Please enter this information in the Research and Related Senior/Key Personnel Form (Expanded) under “Credential, e.g., agency login:” field.**

As of September of 2024, the DoD is requiring all proposers to include a digital persistent identifier (DPI) for each senior/key person listed in a proposal and Covered Individual. The DoD will require proposers to include the ORCID number for each senior/key person and Covered Individual listed in a proposal for an assistance award for R&D and requires that you maintain your profile by keeping it updated with the most recent information/publications. ORCID numbers will be used since ORCID is currently the only DPI provider that meets the requirements for DPI common or core standards in the NSTC NSPM-33 implementation guidance.

For more detailed instructions for obtaining an ORCID number, refer to: [How do I register for an ORCID ID? | ORCID](#)

(2) ***Obtain a UEI Number***

All entities applying for funding, including renewal funding, must have a Unique

Entity Identifier (UEI).

As of April of 2022, the federal government stopped using the DUNS number to uniquely identify entities registered in the System for Award Management (SAM). Entities doing business with the federal government will use a Unique Entity Identifier (UEI) created in SAM.gov. They will no longer have to go to a third-party website to obtain their identifier. Active registrants will have their UEI assigned and viewable within SAM.gov; there is no action for registered entities to take at this time.

This transition allows Federal Agencies to streamline the entity identification and validation process, making it easier and less burdensome for entities to do business with the federal government.

For more detailed instructions for obtaining a UEI number, refer to: [Entity Registration | SAM](#)

(3) ***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. Failure to register with SAM will prevent your organization from applying through Grants.gov.

For more detailed instructions for obtaining a UEI number, refer to: [Entity Registration | SAM](#)

(4) ***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: [Add Profile | Grants.gov](#)

(5) ***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: [Add Profile | Grants.gov](#)

(6) ***Track Role Status***

To track your role request, refer to: [Track Profile Role Status | Grants.gov](#)

(7) ***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.**

### **D.3.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: [Submit Application | Grants.gov](#)

(1) **Create a Workspace**

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

(2) **Complete a Workspace**

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

- 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: [Adobe Software Compatibility | Grants.gov](#)

- 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.
- Complete SF-424 Fields First: The forms are designed to fill in common required fields across other forms, such as the applicant 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. **Note: The applicant name is the Entity that is registered with SAM.gov.**

(3) **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.

(4) **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: [Applicant Training | Grants.gov](#)

**Applicant Support:** Grants.gov provides applicants 24/7 support via the toll-free number 1- 800-518-4726 and email at [support@grants.gov](mailto: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.

#### **D.4. COMPONENT PIECES OF THE APPLICATION**

##### **D.4.a. SF 424 (R&R) Application for Federal Assistance Form**

The SF 424 (R&R) Application for Federal assistance form must be your cover page. No pages may precede the SF 424 (R&R).

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.

We have special instructions for completion of several SF 424 (R&R) form fields in your application.

Our instructions are:

<b>FIELD</b>	<b>INSTRUCTION</b>
2.	You may leave “Applicant Identifier” blank
3.	You may leave “Date Received by State” and “State Application Identifier” blank

9.	You must list <b>Air Force Office of Scientific Research</b> as the Federal Agency if Grants.gov has not pre-populated this answer
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, your, and Internal Confidentiality Agreements are true, complete, and accurate to the best of your knowledge.  <i>See section <a href="#">G.2. Administrative and National Policy Requirements</a> for more information and links to the full text of these items.</i>
18	You must attach the completed <a href="#">SF-LLL Disclosure of Lobbying Activities</a> if your grant amount exceeds \$100,000 and have lobbying activity to disclose.  <i>See section <a href="#">G.2. Administrative and National Policy Requirements</a> for more information and links to the full text of these items.</i>

**D.4.b. R&R Other Project Information Form**

*Complete this form as indicated. You must include all necessary attachments.*

FIELD	INSTRUCTION
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 and Space Force standards is required for all proposals with human use research or involvement.
2, 2a.	You must address all prospective animal research 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 and Space Force standards is required for any proposal with an actual or potential impact on the environment.
7.	Attach your <a href="#">D.4.c. Publicly Releasable Abstract</a>
8.	Attach your <a href="#">D.4.d. Project Narrative</a>
9.	Attach your <a href="#">D.4.e. Bibliography and References Cited</a>

10.	Attach a Facilities and Other Resources description document here if you need to supplement your <a href="#">D.4.d. Proposal Narrative</a> facilities and resources section.
11.	You may supplement your <a href="#">D.4.h. Budget Justification</a> by attaching an Equipment Justification here. Do not duplicate information included on your budget justification. If you attach an Equipment Justification, make sure you reference the attachment in your budget justification.
12.	<p>Attach the <a href="#">D.4.i R&amp;R Subaward Budget Attachments Form</a> if applicable and not attached elsewhere. You should have budgets for all subawards proposed attached within this form before attachment.</p> <p>Attach all <a href="#">D.4.j Subaward Budget Justifications</a> as applicable <u>Attach your</u> <a href="#">D.4.i. Data Management Plan</a> here if applicable</p>

#### D.4.c. Publicly Releasable Project Summary / Abstract

***You must attach the Project Summary / Abstract to field 7 of the R&R Other Project Information form.***

You must submit the “AFOSR Abstract” as an attachment with the proposal submission, this form’s located on the “Related Documents” tab of grants.gov. You must provide a concise abstract of 300 words or less with your proposal (no more than 2000 characters). 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.

Enter the Project Summary / Abstract on the form as a single block of plain text. Do not use special formatting such as line breaks, tables, or superscript/subscript. Do not use special characters or symbols such as  $\mu$ ,  $\lambda$ ,  $\gamma$ ,  $\pi$ , &, :, /, \, , “, or ?.

Your abstract header should include the ***Program Officer's name and office symbol*** from section [I.1. Technical Inquiries and Questions](#) below.

If you receive an award, we 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://discover.dtic.mil/submit-documents/>

#### D.4.d. 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.***

You must clearly describe your research, including your research objective and approach. Your project narrative will be evaluated using the section [F.1. Criteria](#). You should show strength in as many of the evaluation and selection areas as practicable to demonstrate maximum competitiveness.

You must 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 should include the following elements:

(1) **Statement of Objectives**

You must summarize your proposed research on a single page titled “Statement of Objectives.” We may decide to incorporate your statement of objectives into the award as a description of the work 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 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 [F. Application Review Information](#) below.

(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, Collaborators and Other Affiliations, Training Certification(s), and Compliance Attestation for each Covered Individual listed on the [D.4.f. R&R Senior/Key Person Profile \(Expanded\) Form](#). Each abstract should include research title, objectives, approach, and budget for both present and pending research projects. Send any changes as they

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.

(c) **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.

(5) **Your Demonstrated Success Implementing Gold Standard Science**

Describe your key personnel's and institution's demonstrated success in implementing Gold Standard Science, as defined in Section A.3 and in accordance with Executive Order 14303.

(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 [www.hpc.mil](http://www.hpc.mil).

Our 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.

**D.4.e. Bibliography and References Cited**

*You must attach your narrative Bibliography and References to field 9 of the R&R Other Project Information Form.*

**D.4.f. R&R Senior/Key Person Profile (Expanded) 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, Collaborators and Other Affiliations, Training Certification(s), and Compliance Attestation as discussed in [Principal Investigator \(PI\) and Senior Personnel Time](#).*

You must list all key persons proposed for the research on the R&R Senior/Key Person Profile (Expanded) Form. Key persons are generally the PI, any Co-PIs, and senior staff; however, our agency requires this form for all research personnel positions being funded by the grant. If a position is identified in the proposal, and hiring has not yet taken place, please do not leave areas of the form blank. Do not submit the additional name and corresponding forms until the individual has been identified or hired for the position. We use this information 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. To enable this assessment, each applicant must include this form completed as indicated.

The “Credential, e.g., agency login” field will be used by DoD to track ORCID for each researcher. In addition to the required fields on the form, applicants must complete this field for all individuals that are identified on the form.

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 and Covered Individuals can be added by selecting the “Next Person” button.

#### **D.4.g. R&R Budget Form**

***You must provide all information requested. You must estimate the total research project cost. You must categorize funds by year and provide separate annual budgets for projects lasting more than one year. A budget justification must be included.***

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.*

#### **D.4.h. Budget Justification**

*You must provide a detailed budget justification for each year that clearly explains the need for each item.*

*Note: If you have any subaward(s), you should describe how you determined the subaward costs are fair and reasonable.*

The entire budget justification and supporting documentation must be combined into a single file and attached to field L of the R&R Budget Form. The budget narrative submitted with the application must match the dollar amounts on all required forms. Please explain each calculation and provide a narrative that supports each budget category. This detailed budget justification must match the proposed budget categories. Each year of the budget justification narrative must stand alone; lump sum budget justifications are not allowed. If options are proposed, option detailed budget justifications must stand alone as well, no lump sum justifications allowed.

- (1) You must itemize travel. Estimate the cost and 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	Traveler	Nights	Days	Unit Cost	Total Travel
Airfare	roundtrip	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		<b>4</b>	<b>4</b>	<b>3</b>		<b>\$1,060</b>	<b>\$1,380.00</b>

- (2) You must itemize materials/supplies. 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.**
- (3) Proposals including request to purchase **equipment** must include equipment quotes or vendor agreements. "Equipment" is nonexpendable, tangible personal property with a unit cost of \$10,000 or more having a useful life of more than 1 year, unless determined otherwise by recipient's internal policy. Items that do not meet the "equipment" definition can be included under supplies. List each piece of equipment to be purchased and provide description of how it will be used in the project. Budget narrative should explain why the equipment is necessary for successful completion of the project. Provide quotes in English Language (US Dollars) if

available, or indicate the basis of equipment cost. If you have any subaward(s), you should describe how you determined subaward costs were determined fair and reasonable. Your business office usually makes this determination.

- (4) **DHHS/ONR Rate Agreement:** If you use a Government rate agreement to propose indirect cost rates and/or fringe benefit rates, you must attach a signed DHHS or ONR copy of the agreement you used to not delay the negotiation process.
- (5) Helpful Cost Principle Reference Information
  - (a) Grant Applicants
    - (i) [2 CFR 200, Subpart E – Cost Principles](#)
    - (ii) General Provisions for Selected Items of Cost in [2 CFR 200.420 through 2 CFR 200.475](#)
  - (b) Contract Applicants
    - (i) [FAR Part 31](#) Contract Cost Principles and Procedures
    - (ii) [FAR 31.205](#) Selected Costs
    - (iii) [FAR Subpart 30.2](#) CAS Program Requirements if your organization does not have an exemption to CAS as described in [48 C.F.R. 9903.201-1](#) CAS applicability

#### **D.4.i. R&R Subaward Budget Attachments Form**

*You must attach all subaward budgets to field 12 of the R&R Other Project Information Form.*

You must provide a budget at the same level of detail as your Prime budget for each proposed subaward. A subaward budget justification must be attached.

#### **D.4.j. Subaward Budget Justification**

*You must attach all subaward budget justifications to field 12 of the R&R Other Project Information Form.*

You must provide a subaward budget justification at the same level of detail as your D.4.h. prime budget justification for each proposed subaward.

*If you have any subaward(s), in accordance with section D.4.h, you should describe how you determined the subaward costs are fair and reasonable.*

#### **D.4.k. R&R Project / Performance Site Locations Form**

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

#### **D.4.l. Data Management Plan**

*If your effort generates scientific data, you must include a Data Management Plan with your application. If you do, 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:

- (1) 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;
- (2) How the data will be acquired;
- (3) Time and location of data acquisition if they are scientifically pertinent;
- (4) How the data will be processed;
- (5) The file formats and the naming conventions that will be used;
- (6) A description of the quality assurance and quality control measures during collection, analysis, and processing;
- (7) If existing data are to be used, a description of their origins;
- (8) A description of the standards to be used for data and metadata format and content;
- (9) Plans and justifications for archiving the data;
- (10) The timeframe for preservation; and,
- (11) If for legitimate reasons the data cannot be preserved, the plan must include a justification citing such reasons.

#### **D.4.m. R&R Personal Data Form**

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.

#### **D.5. INFORMATION YOU MUST SUBMIT IF SELECTED FOR POSSIBLE AWARD**

We may request additional necessary information from you during negotiations, or as required for award considerations. You must respond promptly.

If you do not fully comply with our information requests by the time we are ready to make an award, we 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.

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

Foreign recipients must complete a payment information form to receive wire transfer payments.

If selected for a contract award, a [Section K Representations, certifications, and other statements of offerors or respondents](#) will be provided for your completion, signature, and return. The document will include representations and certifications that your organization has not completed as part of the SAM registration, representations and certifications required by DoD Class Deviation(s), or that must be requested with each acquisition. The completed Section K will be incorporated into any resultant contract.

## **D.6. UNIQUE ENTITY IDENTIFIER (UEI), CAGE, AND SYSTEM FOR AWARD MANAGEMENT (SAM)**

### **D.6.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; and
- (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.

### **D.6.b. SAM Exemption or Exceptions Not Available Under This Announcement**

We 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 we cannot make an award.

### **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](https://www.fsd.gov/gsafsd_sp) and telephone at (866) 606-8220.

### **D.6.c. Consequences of Non-Compliance with SAM Registration Requirements**

We cannot make an award to you unless you comply with SAM requirements. If you are non-compliant, we 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.

## **E. SUBMISSION DATES AND TIMES**

### **E.1. PROPOSAL SUBMISSION**

**This announcement remains open until superseded.** We review and evaluate proposals as they are received. You may submit proposals at any time; however, some specific topic instructions may recommend submission by specific dates that align with funding expectations. Funding is limited.

#### **E.1.a. How Proposal Submission Time is Determined**

We use the system-generated Grants.gov time stamp to determine when you submitted your successfully validated proposal and the announcement your submission was associated with. Grants.gov policies and procedures for application submission and processing apply. *We will only accept applications submitted electronically through Grants.gov.*

#### **E.1.b. 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 [Track My Application | Grants.gov](#)

#### **E.1.c. Effect of Superseding Announcement**

This announcement is open until superseded. We generally allow approximately thirty (30) days for you to submit a proposal started under the announcement that is superseded before we close the previous announcement.

Grants.gov will not accept your proposal after we close a superseded announcement.

#### **E.1.d. INTERGOVERNMENTAL REVIEW**

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

### **E.2. FUNDING RESTRICTION**

#### **E.2.a. Proposal Preparation Costs**

Your proposal or application preparation costs are not considered an allowable direct charge to any award under this announcement. Your costs are, however, an allowable expense to the normal bid and proposal indirect cost as specified in [2 CFR 200.460](#)

Proposal costs if you receive a grant or cooperative agreement, or [FAR 31.205-18](#) Independent Research and Development and Bid and Proposal Costs for contracts.

#### **E.2.b. Pre-Award Costs for Grants**

You must request our approval prior if you need more than ninety (90) days pre-award cost authorization as described in [2 CFR 200.308\(e\)\(1\)](#) and [2 CFR 200.458](#). **Your business office must provide this request in writing.** You must document why pre-award costs are necessary and essential for the research in the request, and identify a specific date for our Grants Officer to consider. We will only consider approval of a specific date of more than ninety days pre-award costs before an award is made.

Our grants include up to ninety (90) calendar days pre-award costs; however, the actual date costs become allowable is not final until an award is made. We recommend you ask for a specific date as described above to prevent misunderstandings.

**All costs incurred before a grant or cooperative agreement award are at the recipient's risk as described in [2 CFR 200.308\(e\)\(2\)](#).** 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 your pre-award costs.

#### **E.2.c. Pre-Contract Costs under FAR Cost-Reimbursement Contract Awards Not Available**

You will not get reimbursed for any costs you incur before the effective date of a contract award.

#### **E.2.d. Air Force Office of Scientific Research No-Cost Extension (NCE) Guidance**

We require prior written approval to extend the period of performance, whether with or without additional funds, beyond the expiration date of the grant. We only grant no-cost extensions when they are truly warranted and properly documented. For an extension to be granted, all NCE requests must be received at least 30 days prior to the expiration of the grant's period of performance.

All Principal Investigators (PIs) business offices must submit NCE requests through the following website: [https://afosr.gov1.qualtrics.com/jfe/form/SV\\_4UcsVbwxSaoic8S](https://afosr.gov1.qualtrics.com/jfe/form/SV_4UcsVbwxSaoic8S). AFOSR will no longer accept NCE requests via email. All requests that are submitted through other avenues will have to be re-routed through the above website.

The NCE request must include:

- (1) Request letter from the business office on University's or Institute's Letterhead;
- (2) Compelling reason(s) for the extension beyond using unexpended balances;
- (3) Original end date and requested extension length;
- (4) SF 425 Federal Financial report showing the unexpended funds remaining or the most recent SF 270 Request for Advance or Reimbursement; and,

- (5) Statement indicating all required previous annual reports have been provided to AFOSR.

In no event will the period of performance be extended merely for the purpose of using unexpended balances. Every effort should be made to ensure work is completed on time.

#### **E.2.e. Air Force Office of Scientific Research Additional Funding Request**

Recipients are required to receive written approval for Additional Funding request to a grant, cooperative agreement, or contract to pay for essential items or activities that fall within the scope of that award, but were unanticipated at the time of award.

Supplemental funds can be requested for emergencies or other situations which result in unforeseen costs. For an additional funding request to be granted, you must provide notice in writing to the Program Officer using the appropriate email, at least sixty (60) days prior to the expiration of the award or prior to start of additional work to be performed. You must include a detailed budget justification for all additional work to be performed containing a breakout of the proposed cost. You should itemize labor, materials, supplies, travel, equipment (include quote), or any additional cost proposed.

Additionally, there may be an opportunity for short-term efforts called "Sprints", to be held at AFRL or other DoW facilities. If Sprints are proposed, there should be a Sprint Phase section to include specifics as to what would be accomplished during the "Sprint Phase" and specific travel duration/location explicitly stated in the proposal. "Sprints" are defined as an opportunity to showcase basic research impact performing grant relevant research and development activities within the context of DoW or sub-component experiments and initiatives at AFRL or other DoW facilities. Sprints will be evaluated the same as an additional funding action, whereas it must fall within the scope of the current awarded grant. In addition, the Sprint were unanticipated at the time that the new or competing extension request was submitted.

Be advised that the inclusion of the Sprint Phase in the proposal does not guarantee that the Government will award. Notification of incorporating the Sprint Phase will occur within 30 days to the start of the Sprint.

#### **E.2.f. Equipment Vesting**

In accordance with 2 CFR 200.313 and the DoW Terms and Conditions PROP Article I. Section A., equipment title will be vested with the non-Federal entity upon purchase without further obligation to the government unless the terms and conditions of your award specify otherwise. If a contract is awarded the applicable FAR Property Clauses will apply.

### **E.3. OTHER SUBMISSION REQUIREMENTS**

If Grants.gov [rejects](#) your electronic application submission for any reason, you must correct all errors and resubmit your application.

## **F. APPLICATION REVIEW INFORMATION**

## F.1. CRITERIA

You should show strength in as many of the evaluation and selection areas as practicable to demonstrate maximum competitiveness. Merit-based, competitive procedures will be used, in accordance with [32 CFR 22.315](#).

All proposals will be evaluated according to the weight of scientific evidence. “Weight of scientific evidence” means an approach to scientific evaluation in which each piece of relevant information is considered based on its quality and relevance, and then transparently integrated with other relevant information to inform the scientific evaluation prior to making a judgment about the scientific evaluation. Quality and relevance determinations, at a minimum, should include consideration of study design, fitness for purpose, replicability, peer review, and transparency and reliability of data (cf. Executive Order 14303, “Restoring Gold Standard Science”).

## F.2. REVIEW AND SELECTION PROCESS

### F.2.a. Principal Evaluation and Selection Criteria

The Selection Review process will contain a 2-Step Evaluation/Review Process. A preliminary “Go/No-Go” review will be conducted to ensure the application/proposal meets the key submission requirements specified in the NOFO (EO 14332). If the application/proposal meets these requirements, it will proceed to the 2<sup>nd</sup> step, if it does not, it will be removed from consideration. The 2<sup>nd</sup> Step Evaluation will encompass the full evaluation consistent with DODGARS 22.315.

#### **Step 1: Initial Screening (Go/No Go Criteria)**

- (1) Proposal demonstrates success in implementing Gold Standard Science in addition to making a commitment to complying with administration policies, procedures, and guidance respecting Gold Standard Science.
- (2) Proposal produces immediately demonstrable results.
- (3) Selection should consider speed and accountability through demonstration of meaningful performance or deliverable milestones to accelerate the development of emerging technology for timely delivery to the warfighter.
- (4) Consider the possibility for potentially longer-term, breakthrough results, in a manner consistent with the funding opportunity announcement.
- (5) Proposals should include clear benchmarks for measuring success and progress towards relevant research and development goals.
- (6) Proposal demonstrably advances the President’s policy priorities.
- (7) Proposal does not promote, encourage subsidize, or facilitate: (a) racial preferences or other forms of racial discrimination by the grant recipient, including activities where race or intentional proxies for race will be used as a selection criterion for employment or program participation; (b) denial by the

grant recipient of the sex binary in humans or the notion that sex is a chosen or mutable characteristic; (c) illegal immigration; or (d) any other initiatives that compromise public safety or promote anti-American values.

Step 2: Full Evaluation/Review (Selection Criteria):

**Primary Selection Criteria:** Subject to funding availability, all applications/proposals will be reviewed using the following two primary criteria listed below, which are of equal importance. These evaluations will entail a “weight of scientific evidence” approach (EO 14303):

- (1) Technical merits of the proposed research and development.
- (2) Potential relationship of the proposed research and development to DOD missions.

**F.2.b. Additional Evaluation and Selection Criterion**

Less important than the primary criteria but of equal importance to each other:

- (1) The applicant’s capabilities integral to achieving U.S. Air Force and Space Force objectives. This includes principal investigator’s, team leaders, or key personnel’s qualifications, related experience, facilities, or techniques or a combination of these factors integral to achieving U.S. Air Force and Space Force objectives, and the potential risk of this effort to the U.S. Air Force and Space Force.
- (2) Strength of the Data Management Plan.

**F.2.c. Other Selection Criteria: Cost/Price:** While of less importance to the Primary and Additional Evaluation criteria above, the realism of the proposed cost (to include cost sharing (if applicable), consideration of proposed budgets, and funding profiles), will be evaluated.

**F.2.d. Risk Assessment.** Risk assessments are performed prior to award with regards to Science & Technology (S&T) Protection and assessments IAW 2 CFR 200.206.

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

**F.2.e. Merit-based, Competitive Procedures**

Proposals will be subjected to a peer and programmatic review.

The peer review will use external reviewers to assess technical merit and Air Force and Space Force relevance of the proposal.

The programmatic review will use AFOSR Program Officers and subject matter experts to assess the technical quality of the proposal, relevance of the proposed research to the portfolio descriptions in this BAA, relevance of the work to Air Force, Space Force and DoW needs, consistency with administration priorities, and the potential of the research balanced against the available funding resources of a given portfolio.

Programmatic review evaluates demonstrated success in implementing Gold Standard Science in addition to the proposal's commitment to complying with administration policies, procedures, and guidance respecting Gold Standard Science.

Programmatic review evaluates that the proposal does not promote, encourage subsidize, or facilitate: (a) racial preferences or other forms of racial discrimination by the grant recipient, including activities where race or intentional proxies for race will be used as a selection criterion for employment or program participation; (b) denial by the grant recipient of the sex binary in humans or the notion that sex is a chosen or mutable characteristic; (c) illegal immigration; or (d) any other initiatives that compromise public safety or promote anti-American values.

Selection for award consideration will be made based on the outcome of these reviews.

We select proposals for possible funding on a competitive basis according to Public Law 98-369, the Competition in Contracting Act of 1984, 10 U.S.C. 4141, and 10 U.S.C. 4023 using the merit-based, competitive procedures described in [32 CFR 22.315](#), incorporated here by reference.

### **F.3. DISCLOSURE OF ADMINISTRATIVE PROCESSING BY CONTRACTOR PERSONNEL**

We use support contractor personnel to help us with administrative proposal processing. Our contractor personnel are employees of commercial firms that have a contract with us. We make sure all of our support contracts include nondisclosure agreements that prohibit disclosure of any information you submit to other parties.

### **F.4. NO GUARANTEED AWARD**

We do not guarantee that any award will be made under this competition.

## **G. AWARD NOTICES**

### **G.1. SELECTION NOTICES**

#### **G.1.a. Electronic Notification**

If your proposal is selected for possible award, an email will be sent to the principal investigator.

#### **G.1.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. We will contact your business office to get answers to any questions we have about your proposal and negotiate specific award terms.

#### **G.1.c. Federal Award Document**

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

### **G.1.d. Electronic Federal Award Distribution**

We send award documents to your business office by email. This is called award distribution. We always ask your business office to forward the award to the Principal Investigator indicated on the award document.

## **G.2. ADMINISTRATION AND NATIONAL POLICY REQUIREMENT**

### **G.2.a. Certification to Lobbying Activity**

By checking "I Agree" on the SF 424 (R&R) block 17 you agree to fully comply with the Lobbying Disclosure Act of 1995, 2 U.S.C. § 1601 et seq. If your grant amount exceeds \$100,000 you are certifying that you do not have lobbying activity to disclose. If you **have lobbying activity** that you must disclose under [31 U.S.C. 1352](#) as implemented by the DoD in 32 CFR Part 2 you must attach the completed [SF-LLL Disclosure of Lobbying Activities](#). You can find instructions for completing this form at [Forms | Grants.gov](#).

### **G.2.b. Unpaid Delinquent Tax Liability or a Felony Conviction under Any Federal Law – DoD Appropriations**

By checking "I Agree" on the SF 424 (R&R) block 17 you represent that you are not a corporation that has any unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted or have lapsed, and that is not being paid in timely manner pursuant to an agreement with the authority responsible for collecting the tax liability; and, that you represent that you are not a corporation that was convicted of a felony criminal violation under any Federal law within the preceding 24 months.

*Note: If you do not represent to this you are ineligible to receive an award unless a Federal agency suspension and debarment official (SDO) has considered suspension or debarment and determined that further action is not required to protect the Government's interests.*

*The applicant therefore should provide information about its tax liability or conviction to the agency's SDO as soon as it can do so, to facilitate completion of the required consideration before award decisions are made.*

### **G.2.c. Certification Regarding Disclosure of Funding Sources (Supplement to SF424 (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)."

#### **G.2.d. Certification of Gold Standard Science**

By checking "I Agree" on the SF 424 (R&R) block 17, you agree to full comply with the administration policies, procedures, and guidance respecting Gold Standard Science, as specified in Executive Order 14303, "Restoring Gold Standard Science" and Executive Order 14332, "Improving Oversight of Federal Grantmaking."

#### **G.2.e. 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>.

#### **G.2.f. Agency Review of Risk Posed by Applicants**

- (1) We 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 and responsible as described at [32 CFR 22.415](#) Standards to receive a grant award. Contract applicants must be responsible based on the requirements in [FAR Subpart 9.1](#) Responsible Prospective Contractors.
- (2) We 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.
- (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) We may make an award to a recipient who does not fully meet our standards as described at [2 CFR 200.206\(a\)\(2\)](#) 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 200.208](#) Specific conditions.
- (4) We 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 we fund.

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.

#### **G.2.g. 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 [Grant Terms and Conditions | Office of Naval Research](#) and [2 CFR Part 1122 - NATIONAL POLICY REQUIREMENTS: GENERAL AWARD TERMS AND CONDITIONS](#)

#### **G.2.h. Acknowledgement of Research Support**

In accordance with the COST Act, 10 U.S.C. 4027, you must acknowledge support provided by the Department of Defense in all materials based on or developed under our awards and provide a clear statement indicating the dollar amount of funds received from the Department of Defense. The requirement extends to copyrighted and non-copyrighted materials published or displayed in any medium above 280 characters.

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 FAXXXX-XX-X-XXXX, in the amount of [\$ Value].”*

You must require any sub-recipients or sub-contractors under your award to include this acknowledgement too. You may apply for a waiver of the acknowledgement requirement through your Grants Officer and requests for waiver will be considered on a case-by-case basis.

#### **G.2.i. 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.”*

You must require any sub-recipients or sub-contractors under your award to include this acknowledgement too.

#### **G.2.j. Grants and Cooperative Agreements - Uniform Administrative Requirements, Cost Principles, and Audit Requirements**

Our grants are governed by OMB guidance, codified at 2 CFR 200 "Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards. These regulations are incorporated by reference into this announcement.

## **G.2.k. Grants and Cooperative Agreements - DoD Research and Development General Terms and Conditions**

Our Grants and Cooperative agreements are subject to the current (at time of award) “DoD Research and Development General Terms and Conditions” (DoD T&C) found at [Grant Terms and Conditions | Office of Naval Research](#). These terms and conditions are incorporated by reference into this announcement. We can provide a generic model grant or cooperative agreement upon request.

Any resulting awards will be subject to the DoD Research and Development (R&D) General Terms and Conditions (Ts&Cs), located at: <https://www.nre.navy.mil/work-with-us/manage-your-award/manage-grant-award/grants-terms-conditions>.

In addition, the AFRL Addendum to the DoD R&D General Ts&Cs and AFRL Award-Specific Ts&Cs (attached to this FOA) include additional Ts&Cs that may be applicable to any resulting awards. This AFRL document is a supplement to the DoD R&D General Ts&Cs. To understand the entire AFRL requirement for a given article, the DoD R&D General Ts&Cs must be read in tandem with this document.

We may award commercial grants to for-profit organizations.

## **G.2.l. Contract Award Terms and Conditions**

Our cost reimbursement contracts incorporate [FAR](#), and [DFARS](#) clauses plus descriptive text tailored to the particulars of each procurement that combine as the terms and conditions of the contract. We can provide a generic model contract upon request.

## **G.2.m. Other Transaction (OT) Awards - OT Award Terms and Conditions**

Our Other Transaction (OT) awards, executed under the statutory authority of 10 U.S.C. 4021, are subject to the current (at the time of award) OT Award Terms and Conditions. These terms and conditions are incorporated by reference into this announcement. We can provide a generic model OT agreement and specific articles upon request.

## **G.2.n. 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.

## **G.2.o. Contract Solicitation Provisions and Clauses Incorporated by Reference**

The full text of [FAR](#), and [DFARS](#), provisions and clauses may be accessed using the website at <https://www.acquisition.gov>. The full text of Department of Defense (DoD) Class Deviations from the FAR and DFARS may be accessed at [http://www.acq.osd.mil/dpap/dars/class\\_deviations.html](http://www.acq.osd.mil/dpap/dars/class_deviations.html). Any contract award will include all clauses required by FAR and DFARS at the time of award.

We always include the full text of [DFARS 252.227-7017](#) Identification and Assertion of Use, Release, or Disclosure Restrictions in your Section K. We have to understand any data restrictions before negotiations. You should read the full text of this provision now

at [https://www.acquisition.gov/dfars/part-252-solicitation-provisions-and-contract-clauses#DFARS\\_252.227-7017](https://www.acquisition.gov/dfars/part-252-solicitation-provisions-and-contract-clauses#DFARS_252.227-7017)

For purposes of illustration, the following provisions and clauses may be applicable to AFOSR contracts:

- 52.203-16 Preventing Personal Conflicts of Interest (Jun 2020)
- 52.203-18 Prohibition on Contracting with Entities that Require Certain Internal Confidentiality Agreements or Statements - Representation (Jan 2017)
- 52.204-27 Prohibition on a ByteDance Covered Application (June 2023)
- 52.209-11 Representation by Corporations Regarding Delinquent Tax Liability or a Felony Conviction under any Federal Law (Feb 2016)
- 52.219-8 Utilization of Small Business Concerns (Jan 2025)
- 52.222-90 Addressing DEI Discrimination by Federal Contractors
  
- 52.245-1 Government Property (Sep 2021)
- 252.204-7007 Alternate A, Annual Representations and Certifications (Oct 2025)
  
- 252.204-7009, Limitations on the Use or Disclosure of Third-Party Contractor Reported Cyber Incident Information
- 252.204-7012 Safeguarding Covered Defense Information and Cyber Incident Reporting (May 2024)
- 252.204-7025, Notice of Cybersecurity Maturity Model Certification Level Requirements
- 252.209-7004 Subcontracting with Firms that are Owned or Controlled by the Government of a Country that is a State Sponsor of Terrorism (May 2019)
- 252.227-7013 Rights in Technical Data—Other Than Commercial Products and Commercial Services (Aug 2025)
- 252.227-7014 Rights in Other Than Commercial Computer Software and Other Than Commercial Computer Software Documentation (Aug 2025)
- 252.227-7017 Identification and Assertion of Use, Release, or Disclosure Restrictions (Jan 2025)
  
- 252.235-7010 Acknowledgement of Support and Disclaimer (May 1995)
- 252.235-7011 Final Scientific or Technical Report (Dec 2019)
- 252.239-7010 Cloud Computing Services (Jan 2023)
  
- 252.240-7997 NIST SP 800-171 DoD Assessment Requirements
  
- 252.244-7001 Contractor Purchasing System Administration-Basic (Jan 2025)
- 252.245-7003 Contractor Property Management System Administration (Jan 2025)
- 252.245-7005 Management and Reporting of Government Property (Jan 2024)

## **G.2.p. NOTICE OF CYBERSECURITY MATURITY MODEL CERTIFICATION LEVEL REQUIREMENTS**

The Air Force Office of Scientific Research (AFOSR) anticipates that the majority of grants and cooperative agreements awarded under this Broad Agency Announcement (BAA) will involve fundamental research. Consequently, it is expected that most awards will not require the generation, access, or safeguarding of Controlled Unclassified Information (CUI).

However, should a specific proposal or subsequent award require the handling, transmission, or protection of CUI, the appropriate Cybersecurity Maturity Model Certification (CMMC) level will be determined at the time the CUI is formally identified. If CUI is identified as a requirement for the performance of the research, the applicable CMMC level and corresponding compliance clauses—specifically referencing DFARS 252.204-7012 (Safeguarding Covered Defense Information and Cyber Incident Reporting) and DFARS 252.204-7021 (Cybersecurity Maturity Model Certification Requirements)—will be explicitly incorporated into the resulting award documentation prior to execution.

## **G.2.q. 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 200.334](#), incorporated here by reference. Contract awards have similar requirements.

# **H. POST-AWARD REQUIREMENTS AND ADMINISTRATION**

## **H.1. 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 may 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

<https://www.gsa.gov/reference/forms/report-documentation-page>

## **H.2. REPORTS**

### **H.2.a. Technical Performance Report Format**

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. Annual RPPRs must articulate than awardee's (substantial) progress including a summary of work accomplished, which should include negative and positive results. The reporting requirements will be detailed in the grant award documents.

In addition to annual submission of RPPR, awardees will be required to annually re-certify their commitment to complying with the administration policies, procedures and guidance respecting Gold Standard Science and to report updates to their Conflicts of Interest and disclosures of all co-authors and collaborators.

#### **H.2.b. 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 <http://www.dtic.mil/whs/directives/forms/eforms/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>.

#### **H.2.c. 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.gsa.gov/forms-library/federal-financial-report#>.

- (1) If you request any advance payment(s) under your award or have scheduled payments, you must submit quarterly SF 425 reports for the life of the award. Our awards include specific instructions.
- (2) You do not have to submit quarterly SF 425 reports if you only request payments by reimbursement.

#### **H.2.d. Electronic Payment Requests and Electronic Payment**

You must register to use Wide Area Workflow (WAWF) for payment. Payment requests shall be made electronically using an SF270 through the WAWF application in the Procurement Integrated Enterprise Environment (PIEE) e-Business Suite at <https://piee.eb.mil/>. The website includes registration instructions. All payments must be made using the electronic funds transfer (EFT) method.

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 the website

<https://piee.eb.mil/xhtml/unauth/web/homepage/vendorCustomerSupport.xhtml>.

## H.2.e. Other Reports

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

## H.2.f. 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.

Note that the guidance and instructions for submitting technical reports will change in October of 2025. This is due to a new PI portal coming on-line. At that time, we will disseminate instructions detailing how to create a portal account and submit reports, which will require a [login.gov](https://login.gov) account. For those who are unable to create a [login.gov](https://login.gov) account, a backup method will be available. More information will be provided at a later date.

# I. OTHER INFORMATION

## I.1. TECHNICAL INQUIRES AND QUESTIONS

You should submit your questions in writing by electronic mail to the Program Officer responsible for your topic(s) of interest from section [A. Program Description](#). You should include the announcement number in the subject line.

The technical contacts for this announcement by program description are as follows:

SECTION	PROGRAM DESCRIPTION	PROGRAM OFFICER
<a href="#">A.1.a.</a>	Energetic Solid-State Physics and Mechanochemistry	Dr. Chiping Li
<a href="#">A.1.b.</a>	Energy, Combustion, and Non-Equilibrium Thermodynamics	Dr. Chiping Li
<a href="#">A.1.c.</a>	Aerodynamic Sciences	Dr. Gregg L. Abate
<a href="#">A.1.d.</a>	High-Speed Aerodynamics	Dr. Amanda Chou
<a href="#">A.1.e.</a>	Aerospace Composite Materials	Dr. Ali Sayir

<a href="#">A.1.f.</a>	Multiscale Multifunctional Structures and Systems	Dr. Greg L. Abate
<a href="#">A.1.g.</a>	Propulsion and Power	Dr. Justin Koo
<a href="#">A.1.h.</a>	Agile Science for Test and Evaluation (T&E)	Dr. Brett Pokines
<a href="#">A.2.a.</a>	Computational Mathematics	Dr. Fariba Fahroo
<a href="#">A.2.b.</a>	Dynamical Systems and Control Theory	Dr. Frederick Leve
<a href="#">A.2.c.</a>	Dynamic Data and Information Processing	Dr. Erik Blasch
<a href="#">A.2.d.</a>	Information Assurance and Cybersecurity	Dr. Tristan N. Nguyen
<a href="#">A.2.e.</a>	Mathematical Optimization	Dr. Warren Adams
<a href="#">A.2.f.</a>	Science of Information, Computation, Learning, and Fusion	Dr. Richard D. (Doug) Riecken
<a href="#">A.2.g.</a>	Complex Networks	Dr. Donald K. Wagner
<a href="#">A.3.a.</a>	Aerospace Materials for Extreme Environments	Dr. Ali Sayir
<a href="#">A.3.b.</a>	Atomic and Molecular Physics	Dr. Boyan Tabakov
<a href="#">A.3.c.</a>	Electromagnetics	Dr. Arje Nachman
<a href="#">A.3.d.</a>	Optoelectronics and Photonics	Dr. Michael Yakes
<a href="#">A.3.e.</a>	High-Energy Radiation-Matter Systems	Dr. Joel Bixler
<a href="#">A.3.f.</a>	Quantum Information Sciences	Dr. Grace D. Metcalfe
<a href="#">A.3.g.</a>	Physics of Sensing	Dr. Michael Yakes
<a href="#">A.3.h.</a>	Space Physics	Dr. Julie J. Moses
<a href="#">A.3.i.</a>	Ultrashort Pulse Laser-Matter Interactions	Dr. Andrew Stickrath
<a href="#">A.3.j.</a>	Condensed Matter Physics	Dr. Jiwei Lu
<a href="#">A.3.k.</a>	Astrodynamics	Dr. Andrew Sinclair
<a href="#">A.3.l.</a>	Molecular Dynamics and Theoretical Chemistry	Dr. Michael R. Berman
<a href="#">A.3.m.</a>	Organic Materials Chemistry	Dr. Michael R. Berman
<a href="#">A.4.a.</a>	Biophysics	Dr. Sofi Bin-Salamon
<a href="#">A.4.b.</a>	Human Performance and Biosystems	Dr. Patrick O. Bradshaw
<a href="#">A.4.c.</a>	Natural Materials and Systems	Dr. Bennett Ibey

<a href="#">A.4.d.</a>	Space Biosciences	Dr. Jennifer Talley
<a href="#">A.4.e.</a>	Symbiotic Systems	Dr. Nandini Iyer
<a href="#">A.4.f.</a>	Computational Cognition and Machine Intelligence	Dr. Ben Robinson
<a href="#">A.4.g.</a>	Trust and Influence	Dr. Laura Steckman
<a href="#">A.4.h.</a>	Cognitive and Computational Neuroscience	Dr. Hal S. Greenwald
<a href="#">A.5.a.</a>	European Office of Aerospace Research and Development (EOARD)	Lt Col Grant Thomas
<a href="#">A.5.b.</a>	Asian Office of Aerospace Research and Development (AOARD)	Dr. Chris Drew
<a href="#">A.5.c.</a>	Southern Office of Aerospace Research and Development (SOARD)	Lt Col Grant Thomas
<a href="#">A.6.</a>	Other Innovative Research Concepts	Dr. Van Blackwood

*If you submit a question by telephone call, fax message, or other means you may not receive a response.*

## **I.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. We may provide an individual response by email if your question does not apply to anyone else.

JENNIFER BROWN, AFRL/AFOSR/REZH  
Contract Specialist Email: [afosr.baa@us.af.mil](mailto:afosr.baa@us.af.mil)

## **I.3. OMBUDSMAN**

- (1) 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.
- (2) 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).

- (3) If resolution cannot be made by the GO, concerned parties may contact the AFRL Ombudsman, Technical Director, 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](mailto:afrl.pk.workflow@us.af.mil) with the subject of "Ombudsman".
- (4) The ombudsman has no authority to render a decision that binds the agency.
- (5) 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.

#### **I.4. GRANTS AND CONTRACTING OFFICERS AUTHORITY**

- (1) Grants and Contracting Officers acting within their warranted capacity are the only individuals legally authorized to make commitments or bind the Government.
- (2) No other individuals are authorized to make commitments or otherwise bind us.

#### **I.5. FUNDING OPPORTUNITIES**

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