# AIR FORCE OFFICE OF SCIENTIFIC RESEARCH
# BROAD AGENCY ANNOUNCEMENT

## 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 U.S. Air Force. 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 needs. Using a carefully balanced research portfolio, our research managers seek to foster revolutionary scientific breakthroughs enabling the Air Force and U.S. industry to produce world-class, militarily significant, and commercially valuable products. We expect to fund only fundamental research. Our research a described in detail in section A. Program Description

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We anticipate many awards in the form of grants, cooperative agreements, contracts, technology

colored words in the midst of paragraphs. The reader may "jump" to the linked section within this document by "clicking" (CTRL + CLICK, or CLICK).

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science that advances future air and space flight. The broad goal of the team is to discover and exploit the critical fundamental science and knowledge that will shape the future of aerospace sciences. A key emphasis is the establishment of the foundations necessary to advance the integration or convergence of the scientific disciplines critical to maintaining technological superiority.

A wide range of fundamental research addressing electronics, fluid dynamics, materials, propulsion, and structural mechanics are brought together in an effort to increase performance and achieve unprecedented operational capability. The team carries out its ambitious mission through leadership of an international, highly diverse and multidisciplinary research community to discover, shape, and champion new scientific discoveries that will ensure novel innovations for the future U.S. Air Force.

The central research direction for this team focuses on meeting the basic research challenges related to future air and space flight by leading the discovery and development of fundamental science and engineering in the following research areas.

The Engineering and Complex Systems (AFOSR/RTA1) Program Officers and topics are:

| | AM DESCRIPTION | PROGRAM OFFICER |
|---|---|---|
| A.1.a. | Dynamic | |

heterostructures, and devices that can lead to game

sub-areas:

Fundamental Combustion Understanding in Air Force Relevant Regimes:
Combustion is the primary conversion process to supply energy for propulsion and other functions of aerospace systems such as planes, rockets, hypersonic and UAV systems. In these systems, the fuel combustion process occurs at highly turbulent flow conditions, governed by underlying molecular changes from high-energy states to lower ones, generating usable energy for system functions. The key turbulent combustion attributes are critical indetermining operability, performance, size and weight of such systems. The understanding of these key attributes and the quantification of the inherent rate controlling processes provide the scientific foundation of modeling/simulation capabilities needed for the design of new generations of AF aerospace systems. Based on recent progresses in understanding/modeling key chemical reaction pathways in combusting AF/DOD fuels and in exploring key attributes of turbulent flame structure and dynamics at relevant conditions, the turbulent combustion part of the portfolio currently focuses on exploring, understanding and qualifying the turbulence-chemistry interactions using physical and numerical experiments. This includes but is not limited to:

Effects of turbulence on rate-controlling properties/processes of fuel combustion chemistry;

Turbulent production by the energy release from combustion chemical reactions;

Spatial/temporal scale interactions of turbulence structures and dynamics;

Diagnostics for measuring key properties/processes in turbulent combusting flows.

Multi -Physics, Multi-Scale Modeling/Simulation for Energy Conversion:
Energy conversion processes in AF aerospace systems involves coupled physical phenomena such as chemical reactions, turbulence, radiation, multi-material interactions, etc. in a wide range of spatial and temporal scales. Computationally efficient modeling/simulation capabilities with sufficiently low uncertainties, coupled with measured data, and assisted by artificial intelligence and machine learning will have gamechanging impacts, potentially resulting in new, intelligent development & design tools for future aerospace systems. Such modeling/simulation capabilities may also be used to select and conduct “numerical experiments” to explore underlying physics at conditions where physical experiments are very difficult or impossible. Key focus areas are the physical foundation and numerical approaches for coupling multiple physical phenomena at different spatial and temporal scales, in particular:

Embedded DNS (eDNS) – embedding “direct numerical simulation” (DNS being capable of resolving turbulence scales, down to the dissipative range, and detailed flame structures) into simulations for larger scales such as large-eddy-simulations (LES) to provide needed resolutions/details in both small and large scales computationally efficiently;

Coupling numerical simulations for different physics, e.g. coupling Eulerian fluid computations with Lagrange molecular dynamics calculations to provide information on critical properties needed in the larger-scale fluid calculations;

Numerical techniques and algorithms for assimilating measured data into numerical simulations, to reduce the simulation uncertainty and to obtain quantitative information which is otherwise not available through experimental measurements alone.

Game-Changing Thermodynamics Concepts and Innovative Energy Conversion: Thermodynamics provides insights into energy conversion processes and the foundation to developing potentially game-changing energy-conversion approaches. It also establishes the thermodynamic foundation and framework to analyze the energy requirement and efficiency of propulsion systems and propulsive subsystem functions of increasingly significant energy needs. The following topics are of particular interest:

Learning-based, intelligent thermodynamics framework for analyzing multi-scale, non-equilibrium physical and chemical processes, potentially leading to unconventional, game-changing energy conversion processes that potentially offer significantly higher than normal efficiency and other favorable attributes;

Thermodynamics foundation and energy optimization for information processing systems.

Novel, highly efficient approaches to electric propulsion.

Other non-thermal, reduced-thermal and hybrid energy conversion processes, possibly of non-equilibrium nature, for future propulsion and subsystems, with particular interest in UAVs and robotic platforms;

Combustion at extremely short time-scales, such as detonation

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. For any numerical efforts explain which the hardest variables to accurately predict are and how the results will be validated with relevant measurements.

Innovative research is sought in all aspects of high Mach number (preferably M>5), high temperature, non-equilibrium flows with particular interest in (not in order of priority):

- Shock/Boundary Layer, Shock/Shock, and Shock/Separation interactions and unsteadiness for both external surfaces and at the inlet and isolators for scramjets
- Turbulence – structure and growth, unsteady flow field characterization, effects of micro/macro particles in free stream, wall roughness, curvature, angle of attack, etc.
- Transition – Initial value and Eigenvalue approaches for transition prediction, stability analysis for different modes and multimode transition
- Diagnostics – to measure both the shock layer and the free stream disturbances
- Flow-structure interactions at hypervelocity conditions
- Development of physics-based models for air ro-vibrational-dissociation and ro-vibrational-translational processes that can: 1) 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 ablative surfaces
- Characterization of naturally occurring disturbances in the atmosphere at high altitudes
- Energy transfer mechanisms within high enthalpy flows
- Identification and characterization of high L/D shapes
- 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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f. Low-Density Materials

Program Description: Reducing the weight of aerospace platforms, while improving robustness and reliability, reduces costs and emissions and increases payload capacity and overall performance. The Low-Density Materials portfolio supports transformative, basic research in materials design and processing to enable weight reductions with concurrent enhancements in performance and function. Such materials can transform the design of future U.S. Air Force aerospace and cyber systems for macaciale an1 (i)4 (vo)1 (n)1 (s6o)1 s, anal( )5 ( (n)1 (g)1 cl(i)-1ud)1 ( cy)e U ua

g. Multiscale Structural Mechanics and Prognosis

Program Description: This fundamental basic research program addresses the U.S. Air Force needs in the following application areas: 1) New and revolutionary flight structures, 2) Multiscale modeling and prognosis and 3) Structural dynamics under non-stationary conditions and extreme environments. Other game-changing and revolutionary structural mechanics problems relevant to the U.S. Air Force are also of interest.

The structural mechanics program encourages fundamental basic research that will generate understanding, models, analytical tools, numerical codes, and predictive methodologies validated by carefully conducted experiments. The program seeks to establish the fundamental understanding required to design and manufacttis mSas

(703) 588-8316

h. Space Propulsion and Power

Program Description: Research activities are focused as multi-disciplinary, multi-physics, multi-scale approach to complex problems, and fall into four areas: Coupled Material and Plasma Processes far from Equilibrium, Nanoenergetics in solid propellant combustion, High Pressure Combustion Dynamics in rocket engines, and multi-functional materials and structures for space power (structural batteries).

Basic Research Objectives: Research in the first area is to significantly advance the state-of-the-art in our ability to understand the fundamental aspects of a coupled plasma/material system in non-equilibrium states, for a variety of potential applications, including plasma-based space propulsion systems and plasma-spacecraft interactions. The typical conditions of interest are characterized by critical phenomena in small spatial and temporal scales which affect the behavior over a much wider range of scales. Detailed understanding and control of non-equilibrium and multiscale effects have the potential to overcome the limitations of traditional plasma in thermodynamic equilibrium, leading to improved system designs; preventing or leveraging dynamic features such as instabilities, coherent structures, and turbulence; and realizing chemical pathways, structural changes or electromagnetic processes for novel devices with unprecedented level of control.

Research in the second area focuses on smart, functional energetic materials for propulsion purposes only. There has been tremendous progress in the synthesis and fabrication of nano-sized reactive materials. With significant advances in quantum

Electromagnetics, Information and Data Management and Fusion, and Enabling Materials. The Program is closely aligned with many other AFOSR program interests, but with special emphasis on aspects of basic research that lead to revolutionary advances in areas such as metrology and test science.

Basic Research Objectives: The Test Science for T&E program is closely engaged with technical experts at the Air Force Test Center (AFTC) organizations located at Edwards, Arnold, and Eglin Air Force Bases, who help advise the program on basic research objectives. Basic research in areas that advance the science of testing is

2. INFORMATION AND NETWORKS (RTA2)

The Information and Networks Team within the Engineering and Information Science Branch is organized to support many U.S. Air Force priority areas including autonomy, space situational awareness, and cyber security. The research programs within this team lead the discovery and development of foundational issues in mathematical, information and network oriented sciences. They are organized along three themes: Information, Decision Making, and Networks.

The information theme addresses the critical challenges faced by the U.S. Air Force which lie at the intersection of the ability to collect, mathematically analyze, and disseminate large quantities of information in a time critical fashion with assurances of operation and security.

Closely aligned with the mathematical analysis of information is the need for autonomous decision making. Research in this theme focuses on the discovery of mathematical laws, foundational scientific principles, and new, reliable and robust algorithms, which underlie intelligent, mixed human-machine decision-making to achieve accurate real-time projection of expertise and knowledge into and out of the battle space.

Information analysis and decision making rarely occur in the context of a single source. The networks theme addresses critical issues involving how the organization and interaction among large collections of information providers and consumers contributes to an understanding of the dynamics of complex information systems.

The Information and Networks (AFOSR/RTA2) Program Officers and topics are:

| SECTION | PROGRAM DESCRIPTION | PROGRAM OFFICER |
|---|---|---|
| A.2.a. | Computational Cognition and Machine Intelligence | Dr. James H. Lawton |
| A.2.b. | Computational Mathematics | Dr. Fariba Fahroo |
| A.2.c. | Dynamics and Control | Dr. Frederick Leve |
| A.2.d. | Dynamic Data Driven Applications Systems (DDDAS) | Dr. Erik Blasch |
| A.2.e. | Information Assurance and Cybersecurity | Dr. Tristan N. Nguyen |
| A.2.f. | Optimization and Discrete Mathematics | Dr. Fariba Fahroo |
| A.2.g. | Science of Information, Computation, Learning, and Fusion | Dr. Richard D. (Doug) Riecken |
| A.2.h. | Trust and Influence | Dr. Benjamin A. Knott |
| A.2.i. | Complex Networks | Dr. Tristan Nguyen (acting) |
| A.2.j. | Computational Social Sciences | Dr. Benjamin A. Knott (acting) |

Our research areas of interest are described in detail below:

a. Computational Cognition and Machine Intelligence

Program Description: This program supports innovative basic research on the fundamental principles and methodologies needed to enable intelligent machine behavior, particularly in support of mixed-initiative (i.e., human-machine teaming) systems. The overall vision of this program is that future computational systems will achieve high levels of performance, adaptation, flexibility, self-repair, and other forms of intelligent behavior in the complex, uncertain, adversarial, and highly dynamic environments faced by the U.S. Air Force. This program covers the full spectrum of computational and machine intelligence, from cognitively plausible reasoning processes that are responsible for human performance in complex problem-solving and decision-making tasks, to non-cognitive computational models of intelligence -1 (s)ss 001 T
computational.w1 (vi)aki.eino a3 (or1x)-etm (o non)]TJ

computational models based on human and animal performance in perception, attention, memory, learning, reasoning, and decision making in order to improve machine performance.
This subarea does NOT, however, support statistical approaches to machine learning (e.g., “Deep Learning”), or related variants, as fundamental science in that

optimal transport problems, and inverse problems for highly complex

of ensemble and infinite dimensional systems, deterministic time and/or real-time reachability set calculation and verification and validation of hybrid systems, distributed and decentralized decision making and control for coordinated autonomous/semi-autonomous aerospace vehicles considering constraints, uncertain, information rich, dynamically changing, networked environments with time-varying topologies; understanding how to optimally account for humans in the design space; novel schemes that enable challenging multi-agent aerospace tracking in complex, cluttered scenarios; robust and adaptive non-equilibrium (e.g., set-based) 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, physically distributed and evolving system of systems; sensor rich, data driven adaptive control; and applying control concepts motivated by studies of biological systems. In general, interest in the control of large, complex, multi- scale, hybrid, highly uncertain nonlinear systems is increasing. Further, new mathematics in clear support of dynamics and control is of fundamental importance.

In this regard, some areas of interest include, but are not limited to, hybrid dynamical systems theory, geometrical and algebraic methods of dynamics and control, stochastic and adversarial systems, control of cyber physical systems, emerging areas of control theory, graph theoretic control theory over nonlinear dynamics, partial and corrupted information, max-plus and idempotent methods, 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, and if there are any specific submission target dates.

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d. Dynamic Data Driven Applications Systems (DDDAS)

Program Description: The DDDAS concept entails the ability to dynamically incorporate additional data into an executing application, and in reverse, the ability for an application to dynamically steer the measurement components. Key developments are sought to improve the modeling of systems under dynamic conditions, achieve effective instrumentation management, and architect control of dynamic and heterogeneous resources, including networks of models, sensors, and embedded resources. DDDAS encourages multidisciplinary research, especially synergistic and systematic collaborations between domain researchers in mathematics and statistics, computer sciences, and the design and implementation of measurement and control systems for modeling, diagnostics, and analytics.

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

Domain modeling: Methods are sought to leverage 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 include interfaces of applications to measurements and other data systems. Solutions will, for example, engender an integration of large scale simulations, models, and data to advance traditional controls 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. Solutions will, for example, dynamically invoke models requiring elegant methods of uncertainty quantification, management, and propagation.

research across the Basic Area Objectives mentioned above.

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.

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e. Information Assurance and Cybersecurity

Program Description:

performance, operational efficiency, and optimal control of dynamical systems, and in artificial intelligence and information technology applications.

Basic Research Objectives: There will be a focus on the development of new nonlinear, integer, and combinatorial optimization algorithms, including those with stochastic components. Techniques designed to handle data that are uncertain, evolving, incomplete, conflicting, or overlapping are particularly important.

As basic research aimed at having the broadest possible impact, the development of new computational methods will include an emphasis on theoretical underpinnings, on rigorous convergence analysis, and on establishing provable bounds for (meta) heuristics and other approximation methods.

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, if there are any specific submission target dates.

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g. Science of Information, Computation, Learning, and Fusion

Program Description: The U.S. Air 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.

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

foundational concepts of effective influence, deterrence, trust building, trust calibration, and counter-terrorism operations. Multidisciplinary and transdisciplinary approaches are encouraged, to include contributions from cognitive science, neuroscience, anthropology, sociology, linguistics, economics, computer science and mathematics. Research designs that incorporate laboratory studies, modeling or field research leading to transformative novel theories are encouraged.

Basic Research Objectives: The research interests under this program can be defined broadly by three areas: trust in autonomous systems, socio-digital influence, and computational methods in social science. In the area of trust in autonomous systems there is particular interest in (1) empirical studies to examine drivers of trust between humans and intelligent, autonomous or robotic agents, (2) laboratory and field studies to examine the impact of socially designed cues or physical features such as appearance, voice, personality, and other social elements on human trust and system performance, (3) development of trust metrics and other relevant constructs in human-machine teaming with a particular focus on real-time and dynamic assessment, and (4) modeling of human-machine teaming that supports adaptive and continuous improvement of joint performance in complex environments. In the area of socio-digital influence, research is needed towards understanding how social and digital media are used to influence populations, spread ideas and change beliefs. The portfolio is concerned with behavioral effects, but also the cognitive processes that give rise to behavior and the neural underpinnings of those cognitive processes. There is a need for (1) laboratory and field studies to reveal sources of influence and persuasion in social media and across different cultural groups, (2) social, cognitive, and neural mechanisms of influence and persuasion (3) modeling and measuring the relationship between online and real-world behaviors, and (4) empirical studies to discover new theories of influence as it pertains to the cyber domain. In the area of computational social science, there is interest in (1) developing methods employing computational and data sciences to further understanding of human behavior, social and cultural processes, 2) computational analysis of social networks and social media content, leading to new theories and metrics of behavior and intent, (3) understanding how online or virtual communities affect politics and violence and the role social media plays in popular movements (4) research to understand the psychological and behavioral effects of new weapons systems such as armed drones, directed energy weapons, and cyber-based operations.

You are 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, the scope of your proposed effort, and if there are any specific submission target dates.

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(703) 696-1142

i. Complex Networks

Program Description: Networks are pervasive to the U.S. Air Force and DOD operations. They occur at multiple hierarchies of scale (networks-of-networks), and

involve multiple types of structure, data, and functionality. For example, communication and computer networks are intimately coupled to logistical and resource networks; depending on the topology, failure of critical nodes in one can trigger failure in the other, and a cascade event with potentially catastrophic consequence. Networks describe the fundamentally structural aspect of interactions between individual agents, and network science possesses universal qualities that allows it to analyze dynamics, stability, and design optimization for a wide variety of problems, e.g.: cyber-networks, logistics, complex engineered systems, socio-economic behavior, epidemiology, ecology, etc. Even individual platforms such as modern aircrafts are very complex assemblies of a large number of components, interacting with each other via physical coupling or information exchange, in a network. The software system in these platforms is, on its own, a complex network. Multiple aircrafts operating in synchrony with each other and coupled to global communication and ISR platforms form a higher-level network. As operational strategies increasingly shift towards un-manned platforms with increasing levels of autonomy, the network complexity increases and its scalability, optimization, stability and robustness become even more critically important considerations for the Air Force. This portfolio is aimed at fundamental, mathematical approaches to study, understand, analyze and design complex networks at multiple scales. Only innovative approaches with far-reaching potential, agnostic to the information content or specifics of the information processing, will be considered of interest. The networks of interest will have arbitrary topologies and heterogeneous nodes and data types, will have dynamical properties on multiple time scales, and will be subject to uncertain conditions, ranging from a stochastic environment to deliberate adversarial actions affecting both nodes and links. Applications range from any type of complex, engineering network to natural, physical, chemical, socio-economical, biological and neurological networks

Basic Research Objectives: The mathematical methods of interest should aim at solving one or more of the following problems of interest: rapid design and reconfiguration of optimal networks, rigorous analysis of stability, robustness and resilience, and optimal information recovery from multi-scale variability of topology,

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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.
We are currently searching/hiring a new Program Officer, but there is a temporary custodian until a new one is selected. Emails sent to the email address below will go to the temporary custodian indicated below.

(ACTING) DR. TRISTAN NGUYEN, AFOSR/RTA2
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(703) 696-7796

j. Computational Social Sciences

Program Description: There is an increased interest in the ability to better understand and predict social behavior, driven mostly by the availability of new mathematical methods and computer capabilities, combined with the explosive growth of data on social networks. Commercial applications, for consumer marketing and trend analysis for example, have been a major factor behind both the interest in the field, and the progress made in developing analysis tools. The computational modeling of social behavior also finds its use in economics and urban planning, but also in areas that are directly relevant to issues of interest to national security. In epidemiology, for example, the prediction of crowd behavior is directly linked to the ability to control the spread of disease amongst the population at large. Similarly, crowd response to catastrophic events, natural or due to human intervention (e.g. attacks), or even the mere threat of

hypersonic that require understanding and managing the linear response of materials to combined loads (i.e., thermal, acoustic, chemistry, shear or pressure fields) under high energy density non-equilibrium extremities. The ultimate goal is to exploit these phenomena and design future materials, sensors and components for hypersonic environments.

Combined External Fields: This subtopic also stresses a fundamental understanding of external fields and energy through the materials microstructure at a variety of time scales and in a variety of conditions of extreme fields; i.e., dielectric breakdown at high temperatures. The aim is to link an effective property to relevant local fields weighted with certain correlation functions that statistically exemplify the structure and demonstrate scientific pathway to design new materials with tailorable properties.

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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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 ultracold 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 Force, including precision navigation, timekeeping, remote sensing, metrology, and novel materials for the U.S. Air 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 ultracold 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; strongly interacting quantum gases; new quantum phases of matter; non-equilibrium dynamics of cold quantum gases; cold/ultracold plasmas; ultracold chemistry; precision spectroscopy; novel clocks; 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. Also, if there are any specific submission target dates.

applications, as are compact sources of monochromatic x-rays and gamma rays. More broadly, the Laser and Optical Physics program will consider any cutting-edge and potentially transformational idea, and is especially interested in interdisciplinary research, within the broad confines of its portfolio. With this in mind, researchers should also consult the programs in Ultrashort Pulse Laser-Matter Interactions, Plasma and Electro-Energetic Physics, Remote Sensing and Imaging Physics, and Optoelectronics and Photonics described in this Broad Area Announcement. New concepts for the computational modeling of light and laser devices, including thermal effects, are also of interest. Combined theory, simulation, and experimental efforts designed to verify and validate innovative models are welcome.

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. Collaborative efforts with the researchers at the Air Force Research Laboratory are encouraged, but not required. We are currently searching/hiring a new Program Officer, but there is a temporary Custodian until a new PO is selected. Emails sent to the email address below will go to the temporary custodian:

(ACTING) DR. GERNOT S. POMRENKE, AFOSR/RTB1
E-mail: laser.optics@us.af.mil
(703) 696-8426

e. Optoelectronics and Photonics

Program Description: This program supports Air Force requirements for information dominance by increasing capabilities in image and data capture, processing, storage, and transmission for applications in surveillance,

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, if there are any specific submission target dates.

DR. GERNOT S. POMRENKE, AFOSR/RTB1
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f. Plasma and Electro-Energetic Physics

Program Description: This program seeks to provide revolutionary advances in the fundamental understanding of underlying physical processes necessary to control the interaction of electromagnetic energy and charged particles to 1) produce useful work for a variety of applications, including directed energy weapons, sensors and radar, electronic warfare, communications, and novel compact accelerators, or to 2) improve our ability to operate in a range of extreme environments and conditions. The focus of this portfolio is split between exploratory plasma physics and the basic science associated with the generation and collective interaction of electromagnetic fields and plasmas. This includes efforts directed toward an understanding of the basic principles associated with compact pulsed power and research increasing the scientific understanding required to predict energy transfer across a broad range of temporal and spatial scales.

Basic Research Objectives: Ideas for advancing the state-of-the-art in the following areas are strongly encouraged: 1) strongly coupled coulomb systems including ultra cold plasmas, novel approaches to study the physics of complex and/or dusty ionospheric plasmas, and those that address open questions regarding how plasmas involving potential states such as plasma “liquids,” “glasses,” and “crystals,” come to equilibrium and partition their energy between various thermodynamic states; 2) non equilibrium plasmas including high energy density plasmas (i.e. plasmas far from equilibrium), certain aspects of laser plasma/matter interaction, and particle-field interaction physics. Also of primary interest are proposals for basic research associated with the development of 1) highly efficient electron beam-driven sources for high-frequency microwave, millimeter-wave, and sub-millimeter coherent radiation (high power electromagnetic [HPEM] and/or vacuum electronics), 2) high power amplifiers, 3) novel dispersion engineering via metamaterials and photonic band gap structures, 4) novel sources of relativistic particle beams, and 5) compact pulsed power. New concepts for the theory, modeling, and simulation of these physical phenomena are of interest, & combined experimental/theoretical/simulation efforts that verify and validate innovative models are highly encouraged. Theory, modeling, and simulation proposals should focus on improved descriptions of physical systems of interest, physical accuracy, and complexity of simulations, and

development of models to solve difficult, but realistic problems. Proposals focusing on physical systems considered of primary interest to the portfolio will receive priority, although others will be considered if generally applicable to a class of problems that meet those interests. Efforts to develop new numerical methods for difficult but theoretical problems with a focus on numerical accuracy and speed should consult the Computational Mathematics program as described in this announcement. Researchers should consult the program in Aerospace Materials for Extreme Environments to find the best match for research concerning materials, thermal physics and other areas of potential overlap. Although ideas relating to plasmas and electron energetic physics in space are of potential interest to this program, researchers should also consult the programs in Space Power and Propulsion and in Space Sciences to find the best match for the research in question. Additionally, laser plasma/matter interaction, while of interest to this portfolio, is generally limited to the non-equilibrium physics of plasmas; other concepts related to laser-matter interactions should consult the Ultrashort Pulse Laser Matter Interactions or Laser and Optical Physics programs. Propagation of electromagnetic energy through, and it's interaction with, plasmas is of interest to this portfolio, however proposers should also consult the Electromagnetics and Space Sciences programs to ensure their research is considered accordingly. Nuclear batteries, nuclear fission and/or nuclear fusion for large-scale energy production are not of primary interest to this portfolio.

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

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

DR. JASON A. MARSHALL, AFOSR/RTB1
E-mail: plasma@us.af.mil
(703) 696-7721

g. Quantum Electronic Solids

Program Description: This program focuses on materials that exhibit cooperative

(703) 696-8572

h. Quantum Information Sciences

Program Description: This program encompasses fundamental experimental and theoretical research in the field of Quantum Information Science (QIS). The primary focus is on understanding, controlling, and exploiting classical phenomena for

distort communications and navigation signals; interfere with global command, control, and surveillance operations; and negatively impact the performance and longevity of U.S. Air Force space assets.

Fundamental research focused on improving understanding of the physic 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 and represents the coupling between regions, such as between the solar corona and solar wind, 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;
- 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 a c t t r u s i 0 ionosphere (Ì)-1 (em) 9 Ä (p)-Ä (o) 1 P 2 3 0 5 U 0 0 0 2 Tt T/w±(Ì)Tj j 0.'0 Ôs.56 0

focusedon 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 Force, including directed energ[

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

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 sensorimotor 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.

and performance of multifunctional materials and structures at multiple scales from atoms to continuum.

When subjected to a variety of multiphysics environments such as thermal, mechanical, electrical or magnetic fields, multifunctional materials will undergo

understand how nature's sensors are so exquisite and technologically superior to our current capabilities. For example nature has used evolution to build materials and sensors that outperform current sensors such as a spider's haircells capable of detecting air flow at low levels even in a noisy background. Nature is very good at solving the problem of working in a noisy environment. The intent of this program is to study/understand the mechanism of existing natural sensory systems, to utilize existing biomaterials, or to add additional capabilities to current systems. The research will encompass four general areas: biomimetics, biomaterials (non-medical only), biointerfacial sciences, and extremophiles.

Basic Research Objectives: Biomimetics research attempts to study the mechanisms and design rules of novel systems that organisms use in their daily lives, and to learn engineering processes and mechanisms for understanding and control of those systems. The intent of this program is to study: natural chromophores and photoluminescent materials (found in microbial and protein-based systems), sensor denial systems, (active and passive camouflage, structural coloration), and protective systems developed in certain organisms to more fully address the predator-prey mechanisms.

The non-medical Biomaterials area is focused on understanding how organisms synthesize materials and their properties. The intent is to understand the properties and structural relationship within the biomaterial to enable synthetic methods to be developed or to modify existing biomaterials genetically. Additionally, we would like to understand how organisms disrupt or deny a material function or synthesis.

The Biointerfacial Sciences area is focused on the fundamental science at the biotic and abiotic interface of a biomaterial or organism with a natural material such as with proteins and metals (i.e., biotemplating). The nanotechnology and mesotechnology sub-efforts under this area are focused on surface structure and new architectures using nature's idea of directed assembly at the nanoscale to mesoscale to create desired effects, such as quantum electronics or three dimensional sensor structures. The use of these structures is in the design of patterned and templated surfaces, new catalysts, and natural materials based optics/electronics (biophotonics).

The Extremophiles area is focused on understanding the way nature protects biosystems from the extremes of environment such as radiation, heat, cold, acid, pressure, and vacuum. The program wants to understand the mechanism involved in these protective schemes and to try to transfer some of those properties to other biosystems that don't have that protective scheme present.

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

relate to targeted synthesis or method development (i.e., understanding of reaction

research is successful; a third page can contain a few key references and a one sentence budget detailing the approximate yearly cost for a three (3) to five (5) year effort.

DR. KENNETH C. CASTER, AFOSR/RTB2
Email: organic@us.af.mil
(703) 588-8487

5. INTERNATIONAL STUDENT EXCHANGE PROGRAM (ISEP)

Program Description: The International Student Exchange Program is an opportunity for the AFOSR Program Officers to give a funded Principal Investigator's (PI) graduate student the opportunity to work with an overseas collaborator for a short term, or the opportunity for an overseas collaborator to send their graduate student to work with the AFOSR funded PI here for a short term. For approval of use of the ISEP, it would have to enhance the grant with something like unique equipment access, sharing/learning new techniques, etc. which would further enable significant advances towards Air Force Science & Technology (AF S&T) objectives and could further help identify advances in emerging opportunities within the international scientific community. This program could also further assist AFOSR leadership a means to evaluate highly promising new international research, and direct additional funding towards areas of strategic Air Force importance.

If your future grant might benefit from additional funding from this program, it would be prudent to indicate so in your grant proposal by identifying them as

Your supplemental student exchange program funding request will be evaluated using the section E.1. Criteria for proposals submitted under this announcement.

incorporation of increasingly sophisticated physics-based models can dramatically lower uncertainties on the scenario outcomes, and can turn the games into a radically new design optimization tool. We are seeking new approaches towards the development of such a capability, purely machine-based, with the potential for scaling towards highly complex games.

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.

DR. JEAN-LUC CAMBIER, AFOSR/RT
E-mail: specialtopic2@us.af.mil
(703) 426-1141

Sub-area 3: Constructive Mathematics

In recent years, new links between mathematics and theoretical computer science have emerged out of constructive type theory. In particular, new breakthr0bo6l8 (t)-1 (i)bre

Government and the recipient when carrying out the activity contemplated by the grant.

- No fee of 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

Technology Investment Agreement (TIA). Assistance Transaction other than a Grant or a Cooperative Agreement (see 32 CFR Part 37). A legal instrument, consistent with 10 U.S.C. 2371, which may be used when the use of a contract, grant, or cooperative agreement is not feasible or appropriate for basic, applied, and advanced research projects. The research covered under a TIA shall not be duplicative of research being conducted under an existing DoD program. To the maximum extent practicable, TIAs shall provide for a 50/50 cost share between the Government and the applicant. An applicant's cost share may take the form of cash, independent research and development (IR&D), foregone intellectual property rights, equipment, access to unique facilities, and/or other means. Due to the extent of cost share, and the fact that a TIA does not qualify as a "funding agreement" as defined at 37 CFR 401.2(a), the intellectual property provisions of a TIA can be negotiated to provide expanded protection to an applicant's intellectual property. No fee or profit is allowed on TIAs.

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

Historically Black Colleges and Universities and Minority institutions (HBCU/MI), 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. 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 22.420 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.

d. Ineligible Entities

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

(1) Federally Funded Research and Development Centers (FFRDCs)

(2) Individual persons or people

(3) Federal agencies

2. COST SHARING

We do not require cost sharing for proposals under this announcement. Cost sharing is not an evaluation or selection criterion.

3. OTHER

a. Acknowledgement of Support and Disclaimer Requirements

You must include the F.3.d. Acknowledgement of Research Support on all materials created or produced under our awards.

You must include the F.3.e. 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.

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 DoD as described in the OUSD, 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 funds to our Program Officer.

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

c. Representation for Tax Delinquency and Felony Conviction

You must complete the "Representation for Tax Delinquency Felony Conviction" provided with the Grants.gov package. We provide more specific information about this requirement in section D.14.

We cannot determine you are eligible for funding unless we receive this form.

d. Conflict of Interest

(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 altogether a 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.

D. APPLICATION AND SUBMISSION INFORMATION

1. ADDRESS TO REQUEST APPLICATION PACKAGE

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

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

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

2. CONTENT AND FORM OF APPLICATION SUBMISSION

a. Pre-proposal Inquiries and Questions

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 G.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 G.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.

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 italic.
We provide more instructions in D.3. Component Pieces of the Application.

| R&R FORM, OMB No. 4040-0001 | FIELD | ATTACHMENT |
|---|---|---|

| | |
|---|---|
| SF 424 (R&R) Application for Federal Assistance, including an authorized signature | 18. Representation for Tax Delinquency, Felony Conviction<br>18. SF-LLL Disclosure of Lobbying Activities |
| R&R Other Project Information Form | 7. Project Summary / Abstract<br>8. Project Narrative<br>9. Bibliography & References Cited<br>10. Facilities and Other Resources<br>11. Equipment<br>12. Other Attachments |
| R&R Senior / Key Person Profile Form (Expanded) | Biographical Sketch<br>Current & Pending Support |
| R&R Personal Data Form | None |

e. Marking Requirements for Confidential or Proprietary Information

You must mark your proposal and proposal sections that contain proprietary or confidential information. You must use the protective legend found at 52.215-1(e) Instructions to Offerors -- Competitive Acquisition (Jan 2017) 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.

f. Electronic Form and Proposal Attachments

Your application and proposal attachments must be in electronic file formats. You should use the Portable Document Format (PDF) for your attachments. DO NOT password protect any attachments. The website http://www.grants.gov/web/grants/applicants/adobe-software-compatibility.html provides additional important instructions.

3. GRANTS.GOV APPLICATION SUBMISSION AND RECEIPT PROCEDURES

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

a. Electronic Delivery

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

b. How to Register to Apply through Grants.gov

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

6) Electronic Signature: When applications are submitted through Grants.gov, the name of the organization's AOR that submitted the application is inserted into the signature line of the application, serving as the electronic signature. The EBiz POC must authorize individuals who are able to make legally binding commitments on behalf of the organization as an AOR; this step is often missed and it is crucial for valid and timely submissions.

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

Grants.gov applicants can apply online using Workspace. Workspace is a shared, online environment where members of a grant team may simultaneously access and edit different web forms within an application. For each funding opportunity announcement (FOA), you can create individual instances of a workspace.
Below is an overview of applying on Grants.gov. For access to complete instructions on how to apply for opportunities, refer to:
https://www.grants.gov/web/grants/applicants/apply-for-grants.html

Create a Workspace

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

Complete a Workspace

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

(1) Adobe Reader: If you decide not to apply by filling out web forms you can

provide you with time to correct any potential technical issues that may disrupt the application submission.

Track a Workspace

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

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

Applicant Support: Grants.gov provides applicants 24/7 support via the toll-free number 1-800-518-4726 and email at support@grants.gov. For questions related to the specie Q(44 (w))ink <

17. Select “I Agree” to:

    Provide the certification regarding lobbying that is required by 31 U.S.C. 1352 as implemented by DoD 32 CFR Part 28.

    Certify that all statements in the proposal, your Representation for Tax Delinquency, Felony Conviction, and Internal Confidentiality Agreements are true, complete, and accurate to the best of your knowledge.

    See section F.3. Administrative and National Policy Requirements for more information and links to the full text of these items.

18. You must attach the completed D.3.b. Representation for Tax Delinquency / Felony Conviction

    You may have to attach the completed D.3.c. LLL SF-LLL Disclosure of Lobbying Activities if you have lobbying activity that you must disclose.

b. Representation for Tax Delinquency / Felony Conviction

You must attach this representation to field 18 of the SF 424 (R&R).

You must complete and attach the “Representation for Tax Delinquency / Felony Conviction” provided with the Grants.gov package. We cannot fund an award if this information is not provided.

If you answer “is” a corporation with a felony conviction and/or “is” a corporation with a felony conviction on this representation, you may not be eligible for an award if your proposal is selected. You should contact us to discuss your situation to find out if you can submit your application.

If you do not attach this form to the SF 424, we may request the representation after you submit your application, but we are not required to do so. We may deem your application ineligible for selection by citing an authority listed or referenced in FAR 52.209-11, and make an award to another applicant. This applies to all applicants.

c. SF-LLL Disclosure of Lobbying Activities Form

When required, attach this disclosure to field 18 of the R&R Other Project Information Form.

If you have lobbying activity that you must disclose under 31 U.S.C. 1352 as implemented by the DoD in 32 CFR Part 28, you must attach the completed SF-LLL Disclosure of Lobbying Activities. You can find instructions for completing this form at http://www.whitehouse.gov/sites/default/files/omb/grants/sflllin.pdf

d. Certification Regarding Lobbying Form

Grant awards require a certification of compliance with a national policy mandate concerning lobbying. Grant applicants shall provide this certification by electronic submission of SF424 (R&R) as a part of the electronic proposa

e. 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 standards is required for all proposals with hu use or involvement. Your inquiries about our requirements should be sent by email directly to our Research Protections Officer at afosrharpo@us.af.mil with a copy to the Program Officer for the announcement topic. |
| 2, 2a. | You must address all prospective animal subject and/or recombinant deoxyribonucleic acid (rDNA) involvement by answering these questions. Additional documentation |

10. Attach a Facilities and Other Resources description document here if you need to supplement your D.3.f. Proposal Narrative facilities and resources section.

11. You may supplement your D.3.j. Budget Justification 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. Attach the D.3.k R&R Subaward Budget Attachments Form if applicable and not attached elsewhere. You should have budgets for all subawards proposed attached within this form before attachment.

    Attach all D.3.l Subaward Budget Justifications as applicable. Attach your D.3.o Data Management Plan here if applicable.

f. Publicly Releasable Project Summary / Abstract

You must attach the Project Summary / Abstract to field 17 of the R&R Other Project Information form.

You must provide a concise abstract of 300 words or less with your proposal. You must mark this abstract publically 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.

Your abstract header should include the Program Officer's name and office symbol from section G.1. Technical Inquiries and Questions below.

If you receive an award, we must publish your abstract to a searchable website and on hniY17-2 ( )5

(b)

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-

this determination.

DHHS/ONR Rate Agreement:

(4) 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

of the project, and include a notation marking items that are publicly releasable;

(b) How the data will be acquired;

(c) Time

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.

charge to any award under this announcement. 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.

b. Pre-Award Costs for Grants

You must request our prior approval if your research requires a specific date pre award costs become allowable, or if you need more than ninety (90) days pre-award cost authorization as described in 2 CFR 200.308(d)(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 or 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(d)(1). We are under no obligation to reimburse your costs if for any reason you do not receive an award, or if your award is less than anticipated and inadequate to your pre-award costs.

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submit your request to your Program Officer and Grants Officer for initial review and a recommendation.

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

(a) Definition. As used in this provision--

"Internal confidentiality agreement or statement", "subcontract", and "subcontractor" are defined in the clause at 52.203-19, Prohibition on Requiring Certain Internal Confidentiality Agreements or Statements.

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

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

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

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

11. **eTHeEReIuSSIu8eN(" )]TJ 0 TcgsTs1 (ubm)8 (i)-2 (t)0.42 3.965 0REQeUIuRnEMuENTnS(" )]TJ**

Our overriding purpose in supporting research is to advance the state of the art in areas related to the technical problems the U.S. Air Force encounters in developing and maintaining a superior U.S. Air Force; lowering cost and improving the performance, maintainability, and supportability of U.S. Air Force weapon systems; and creating and preventing technological surprise.

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

a. Principal Evaluation and Selection Criteria

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

Our principal evaluation and selection criteria are:

(1) The technical merits of the proposed research and development; and,

(2) Potential relationship of the proposed research and development to Department of Defense missions.

b. Additional Evaluation and Selection Criterion

Our sole additional evaluation and selection criterion for research proposals, which is of lesser importance than the primary evaluation and selection criteria combined is:

(1) The applicant's capabilities integral to achieving U.S. Air Force objectives. This includes principal investigator's, team leader's, or key personnel qualifications, related experience, facilities, or techniques or a combination of these factors integral to achieving U.S. Air Force objectives, and the potential risk of this effort to the U.S. Air Force.

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

2. REVIEW AND SELECTION PROCESS

a. Merit-based, Competitive Procedures

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

The programmatic review assesses the technical quality of the proposal, relevance of the proposed research to the portfolio descriptions in this BAA, relevance of the work to Air Force and DoD needs, and the potential of the research balanced against the available funding resources of a given portfolio. Selection for award consideration will be made based on the outcome of these reviews

We select proposals for possible funding on a competitive basis according to Public Law 98-369, the Competition in Contracting Act of 1984, 10 USC 2361, and 10 USC

3. ADMINISTRATIVE AND NATIONAL POLICY REQUIREMENTS

a. Reporting of Matters Related to Recipient Integrity and

Development General Terms and Conditions, September 2017 (DoD T&C); and,

Appendix B to 32 CFR Part 22 – Suggested Award Provisions for National Policy Requirements that Often Apply, incorporated here by reference.

d. Acknowledgement of Research Support

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

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

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

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

e. Disclaimer Language for Research Materials and Publications

Some materials based on or developed under our awards must include special disclaimer language. You must include this language in all materials except scientific articles or papers published in scientific journals unless your award document provides different instructions:

"Any opinions, findings and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the U.S. Department of Defense."

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

f. Grants and Cooperative Agreements - Uniform Administrative Requirements, Cost Principles, and Audit Requirements

Our grants are governed by the guidance in Title 2, Code of Federal Regulations (CFR) Part 200, "Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards" as modified and supplemented by the Department of Defense's (DoD) interim implementation in 2 CFR Part

Government of a Country that is a State Sponsor of Terrorism (Oct 2015)

252.227-7013 Rights in Technical Data – Noncommercial Items (Feb 2014)

252.227-7017 Identification and Assertion of Use, Release, or Disclosure Restrictions (Jan 2011)

252.235-7010 Acknowledgement of Support and Disclaimer (May 1995)

252.235-7011 Final Scientific or Technical Report (Jan 2015)

252.244-7001 Contractor Purchasing System Administration – Basic (May 2014)

l. Foreign Entities and For-Profit Organizations Not Generally Eligible for Equipment Vesting

We cannot vest title to equipment with for-profit organizations, foreign public entities, or foreign organizations unless there is a specific statutory or regulatory authority that allows us to do so.

If you are applying for a contract award, you should contact us before you propose purchasing equipment.
If you are applying as a foreign public entity or foreign organization, please contact the Program Officer listed with your topic before you propose equipment.

m. Minimum Record Retention Requirements

You must keep records related to our awards for at least three years after completion

(1) ANSI Standard Z39.18-2005

Use the AFRL Scientific & Technical Reports – Preparation, Presentation and Preservations Format Guidelines (June 2010) for your final report unless your award states different requirements. You can download the AFRL standard guide from the Related Documents tab in Grants.gov for this announcement.

(2) Institutional Formats for Thesis and Dissertations

If your institution has a format for thesis and dissertations, you can use that format unless your award states different requirements.

(3) Pending Federal-wide Research Progress Performance Report (RPPR) Format

We are working on a Federal-wide Research Progress Performance Report (RPPR) for interim, annual, and final research performance reports. You do not have to use the RPPR right now. DoD plans to use the report in the future.

A.2.b.

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|---|---|---|
| A.2.h. | Trust and Influence | Dr. Benjamin A. Knott |
| A.3.k. | Ultrashort Pulse Laser Matter Interactions | Dr. Riq Parra |

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

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.

MELISSA A. CAMPBELL, AFOSR/PKC
Procurement Analyst
Email: afosr.baa@us.af.mil

DANIEL P. SMITH, AFOSR/PKC
Contract Specialist
Email: afosr.baa@us.af.mil

H. OTHER INFORMATION

1. OMBUDSMAN

(a) An ombudsman has been appointed to hear and facilitate the resolution of concerns from offerors, potential offerors, and others for this acquisition. When requested, the ombudsman will maintain strict confidentiality as to the source of the concern. The existence of the ombudsman does not affect the authority of the program officer, grants officer, contracting officer, and

or AFISRA level, may be brought by the concerned party for further consideration to the U.S. Air Force ombudsman, Associate Deputy Assistant Secretary (ADAS) (Contracting), SAF/AQC, 1060 Air Force Pentagon, Washington DC 20330-1060, phone number (571) 256-8395, facsimile number (571) 256-2431.

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

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

2. GRANTS AND CONTRACTING OFFICERS AUTHORITY
Grants and Contracting Officers acting within their warranted capacity are the only individuals legally authorized to make commitments or bind the Government.
No other individuals are authorized to make commitments or otherwise bind us.

3. ADDITIONAL FUNDING OPPORTUNITIES

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