U.S. AIR FORCE

USSF

AFRL

AFOSR AIR FORCE OFFICE OF SCIENTIFIC RESEARCH

Basic Research HBCU/MSI/TCU National Science Portals (NSP) Funding Opportunity Announcement (FOA) Informational Webinar

31 MAY 2024

HBCU: Historically Black Colleges and Universities
MSI: Minority-Serving Institution
TCU: Tribal Colleges and Universities

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AFRL NSP FOA Informational Webinar Agenda

	Description/Topic	Speaker
1100	Opening Remarks and Overview of AFRL Basic Research National Science Portals Program	Dr. LaShauna Evans AFRL/AFOSR Program Manager, National Science Portal
1115	Acquisitions Overview for Funding Opportunity Announcement	Mr. Calvin Scott AFRL/AFOSR, Senior Procurement Analyst, Contracting Division
1125	Technical Topic: Quantum Computing	Dr. Grace Metcalfe Dr. Gregg Abate Dr. Fariba Fahroo Dr. Bennett Ibey Dr. Arje Nachman Dr. Andrew Strickrath Dr. Jennifer Talley AFRL/AFOSR Program Officer, Science & Engineering Division
1155	BREAK	
1205	Technical Topic: Unique Advantages to Biologically Based Materials for Space	Dr. Bennett Ibey and Dr. Jennifer Talley AFRL/AFOSR Program Officer, Science & Engineering Division
1220	Technical Topic: Ferrimagnetic Electronics	Dr. Kenneth Goretta and Dr. Arje Nachman AFRL/AFOSR Program Officer, Science & Engineering Division
1235	Final Remarks	Dr. LaShauna Evans AFRL/AFOSR Program Manager, National Science Portal

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Opening Remarks and Overview of AFRL Basic Research National Science Portals

Dr. LaShauna Evans
Program Manager, National Science Portal

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AFRL/AFOSR Mission & Span of Influence

AFOSR's Mission is to Discover, Shape, Champion, and Transition High Risk Basic Research to profoundly impact the future Air and Space Force

Core Mission - With a broad, long-term perspective, we identify areas for investment and collaboration to advance the Department of the Air Force's (DAF) research and development enterprise across the full spectrum of air, space, and cyber operations. We build bridges to the world's most prestigious universities and talented researchers to enhance partnerships and provide revolutionary science and technology discoveries to the Warfighter.

Span of Influence - 60+ World-class Subject Matter Experts manage 1,600+ grants at over 300 leading academic institutions across 50 states and 65 countries, 150 industry-based contracts, and more than 230 internal AFRL research efforts.

Inherent in our mission, we strive to strengthen and shape the Science and Engineering talent pipeline through targeted outreach, research, internships, and fellowship programs to include a focus on Historically Black Colleges and Universities and Minority Serving Institutions. Fund DAF's K-12 STEM Outreach at 30+ bases supporting 500+ competitions!

DAF Link to Academia



Global Footprint and Reach



STEM Outreach Impact



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Science &Technology Portfolios

Engineering and Complex Systems	Information and Networks	Physical Sciences	Chemistry and Biological Sciences	International Office
Dynamic Materials and Interactions	Computational Cognition and Machine Intelligence	Aerospace Materials for Extreme Environments	Biophysics	Asian Office of Aerospace R&D Tokyo
GHz-THz Electronics	Computational Mathematics	Atomic and Molecular Physics	Human Performance and Biosystems	European Office of Aerospace R&D London
Energy, Combustion, and Non-Equilibrium Thermodynamics	Dynamical Systems and Control Theory	Electromagnetics	Mechanics of Multifunctional Materials and Microsystems	Southern Office of Aerospace R&D Santiago
Unsteady Aerodynamics and Turbulent Flows	Dynamic Data and Information Processing	Laser and Optical Physics	Molecular Dynamics and Theoretical Chemistry	North America - Arlington
High-Speed Aerodynamics	Information Assurance and Cybersecurity	Optoelectronics and Photonics	Natural Materials and Systems	
Aerospace Composite Materials	Mathematical Optimization	Plasma and Electro-Energetic Physics	Organic Materials Chemistry	
Multiscale Structural Mechanics and Prognosis	Science of Information, Computation, Learning, and Fusion	Quantum Information Sciences		
Propulsion and Power	Trust and Influence	Physics of Remote Sensing		
Agile Science of Test and Evaluation (T&E)	Complex Networks	Space Science		
	Cognitive and Computational Neuroscience	Ultrashort Pulse Laser-Matter Interactions		
		Condensed Matter Physics		



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RTC Mission Statement

AFRL

Our mission is to **advance discovery in basic science** and **future technologies** for **air, space, and cyber domains**, uniting strategists and investigators from government, academia, and small business to build **collaborative relationships** across the scientific enterprise to benefit the Air Force, Space Force, and Department of Defense.

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Science and Engineering Collaboration Branch Programs

AFRL

Transfer & Transition

- *Small Business Innovation Research (SBIR)/Small Business Technology Transfer (STTR) Program*
- *Office of Research and Technology Applications Liaison*

Basic Research Grants

All qualified, responsible organizational applicants from academia, the non-profit sector, and industry are eligible to submit research proposals.



Strengthening Academic Research Capabilities

- *Multidisciplinary University Research Initiative (MURI) Program*
- *Defense University Research Instrumentation Program (DURIP)*
- *Presidential Early Career Award for Scientists and Engineers (PECASE)*
- *Defense Established Program to Stimulate Competitive Research (DEPSCoR)*

Strengthening Air & Space Force Research Capabilities

- *US Air Force Academy Program (USAFA)*
- *Summer Faculty Fellowship Program (SFFP)*
- *Science & Technology Fellowship Program (STFP)*
- *Air Force Institute of Technology (AFIT)*

Workforce Development

- *Awards to Stimulate and Support Undergraduate Research Experiences (ASSURE)*
- *National Defense Science and Engineering Graduate Fellowship Program (NDSEG)*
- *K-12 STEM & LEGACY*
- *AFRL Scholars*

Expanding Air & Space Force Academic Reach

- *Young Investigator Program (YIP)*
- *Historically Black Colleges & Universities/Minority Serving Institutes (HBCU/MSI) Program*
- ***National Science Portal Program (NSP)***
- *Government University Industry Research Roundtable (GUIRR)*
- *Gordon Research Conference (GRC) Bundle*

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AFRL Basic Research National Science Portal (NSP) Proposal

AFRL

- The Department of the Air Force (DAF) faces unprecedented scientific and technological challenges that require better leveraging of the nation's defense ecosystem to develop innovative solutions.

- Create National Science Portals (NSPs) to
  1) accelerate science in research areas critical to the future DAF, and
  2) build capacity in HBCU/MSI/TCUs to further goal #1

- First portals launched March 2023

- National Academies of Sciences, Engineering, and Medicine Reports
  - 2022 - *Defense Research at Historically Black Colleges and Universities and Other Minority Institutions*
  - 2024 - *Building Defense Research Capacity at Historically Black Colleges and Universities and Other Minority Institutions: A Workshop Series*



Addresses National Academies' Recommendations, Executive Orders, and Congressional Direction

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AFRL Basic Research National Science Portal (NSP) Proposals

AFRL

- Focus investment in ONLY HBCU/MSI/TCUs to address Department of Defense (DoD) scientific challenges for strategic competition

- Expect to be funded with basic research funds
  - Supplement with other programs, such as Defense University Research Instrumentation Program (DURIP) to supply equipment and build laboratories
  - Explore ways to connect NSP institutions with other DoD & DAF Outreach Programs for talent development
  - Explore ways to connect K-12 STEM with the NSP universities

- Piloted first NSP in FY24; explore optimal number of Portals in a given year



Addresses National Academies' Recommendations, Executive Orders, and Congressional Direction

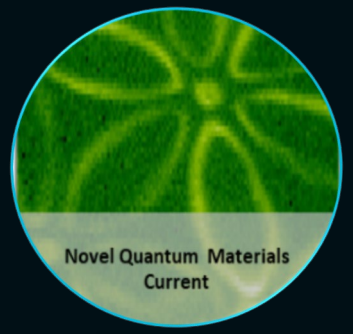
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Potential NSP Research Areas

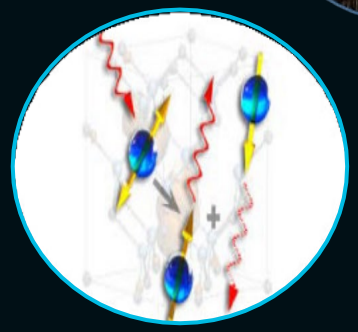
AFRL



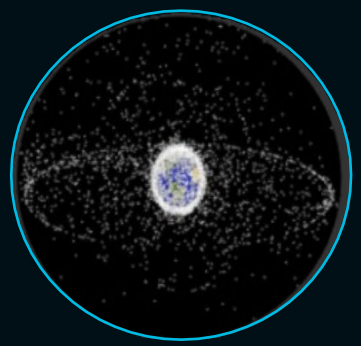


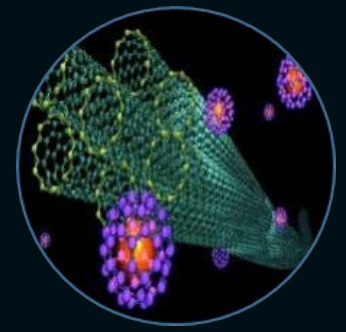












- Cislunar Space
- Non-traditional propulsion
- Synthetic Biology
- Int'l Polar/Arctic Initiative
- Data Analytics
- Autonomy for "Internet of Things" terrestrial/space
- Next Gen Software
- Digital Engineering
- Quantitative Biology
- Microelectronics

- Directed Energy
- 5G
- Biotechnology
- Hypersonics
- Fully Networked Command and Control
- Organic Electronics
- Quantum
- Artificial Intelligence
- Cyber

Match DoD Needs and HBCU/MSI Expertise using Data Analytics and Institution Input

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AFRL Basic Research National Science Portal

AFRL

- Published AFRL NSP Funding Opportunity Announcement (FOA) in May 2024 on Grants.gov (See funding opportunity number (FOAAFRLAFOSR20240008)
- Funding several teams of HBCU/MSI/TCU researchers in three topic areas:
  - ***Quantum Computing***
  - ***Unique Advantages to Biologically Based Materials for Space***
  - ***Ferrimagnetic Electronics***
- **Encourages applicants to also view OSD Defense University Research Instrumentation Program (DURIP) FOA for relevant instrumentation to further build capacity**
- Expecting at least three awards of $750K - $1.5M per year per award for a maximum of three years

Bolstering MSIs will attract more students to STEM and increase U.S. minority STEM graduates FLOODING THE U.S. WITH DIVERSE STEM TALENT

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Acquisitions Overview for Funding Opportunity Announcement

Mr. Calvin Scott
AFRL/AFOSR Senior Procurement Analyst, Contracting Division

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FOA Important Dates

Event	Date
White Papers Due	10 June @5pm EDT
Notifications of White Paper Evaluations	25 June
Last Day to Submit Questions for Grants Officer	2 July
Proposals Due	26 July

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Budget Justification

- Proposals must include a detailed budget justification for all work to be performed containing a breakout of the proposed costs
- You should itemize labor, materials, supplies, travel, equipment (include quote), or any cost proposed
- Proposals including request to purchase equipment must include equipment quotes or vendor agreements
  - "Equipment" is nonexpendable, tangible personal property with a unit cost of $5,000 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

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Agency Point of Contacts

Quantum Computing	Select the appropriate POC that aligns with the technical area above under "Objective" (a) Drs. Gregg Abate (gregg.abate@us.af.mil) and Fariba Fahroo (fariba.fahroo@us.af.mil) (b) Dr. Bennett Ibey (bennett.ibey@us.af.mil) (c) Drs. Arje Nachman (arje.nachman@us.af.mil) and Andrew Stickrath (andrew.stickrath@us.af.mil) (d) and (e) Dr. Jennifer Talley (jennifer.talley.1@us.af.mil) QIS support: Dr. Grace Metcalfe (grace.metcalfe@us.af.mil)
Unique Advantages to Biologically Based Materials for Space	Dr. Jennifer Talley jennifer.talley.1@us.af.mil Dr. Bennett Ibey bennett.ibey@us.af.mil
Ferrimagnetic Electronics	Dr. Kenneth Goretta kenneth.goretta@us.af.mil Dr. Arje Nachman arje.nachman@us.af.mil
General Inquiries and Questions	Ms. Denise Johnson, Grants Officer denise.johnson.19@us.af.mil

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Technical Topic: Leveraging Quantum Computing to Explore Computational Challenges

AFOSR Program Officers

Dr. Gregg Abate, Unsteady Aerodynamics and Turbulent Flows

Dr. Fariba Fahroo, Computational Mathematics

Dr. Bennett Ibey, Natural Materials and Systems

Dr. Arje Nachman, Electromagnetics

Dr. Andrew Stickrath, Ultrashort Pulse Laser-Matter Interactions

Dr. Jennifer Talley, Space Biosciences

support: Dr. Grace Metcalfe, Quantum Information Science

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Leveraging Quantum Computing to Explore Computational Challenges

Objective: This topic seeks to explore the viability of novel quantum algorithms relevant for the DoD and DAF and build QIS research capabilities in technical disciplines outside the usual framework of QIS. Technical sub-areas of interest include:

Drs. Gregg Abate & Fariba Fahroo

(a) plasma and turbulent flow problems, wall-bounded turbulent flows, fluid-structure interaction, and/or turbulent combustion;

Dr. Bennett Ibey

(b) biomolecular-based material design (e.g., protein, DNA, and RNA);

Drs. Arje Nachman & Andrew Stickrath

(c) innovative computational approaches to improving upon or bypassing Density Functional Theory (DFT) (e.g., determination of accurate exchange-correlation functionals from electron density for input into DFT calculations, non-adiabatic quantum mechanics, etc.);

Dr. Jennifer Talley

(d) biochemical processes design (e.g., catalyst efficiency or selectivity);

(e) and novel neural network representations (e.g., non-binary output units).

Proposers do not have to address multiple topic sub-areas within a submission.

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Leveraging Quantum Computing to Explore Computational Challenges

Research Concentration Areas: Suggested research areas include, but are not limited to:

1. Appropriate translation of classical computational challenges into algorithms that can be processed by quantum computers with a computational speedup. Both purely quantum and hybrid quantum-classical algorithms are of interest.
2. Assessment of the trade-off between the computational cost and the speed and accuracy of the quantum or hybrid algorithm relative to state-of-the art classical computational approaches
3. No-go theorems or proofs of computational gains of quantum computers for the proposed computational challenge.

- Projects should be supported by but not led by QIS experts.
- While proposed efforts can include employing quantum cloud computers, proposed budgets should not include access to quantum cloud computing costs. Purely theoretical proposals are acceptable.

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BREAK

Return at 1205

Technical Topic: Unique Advantages to Biologically Based Materials for Space

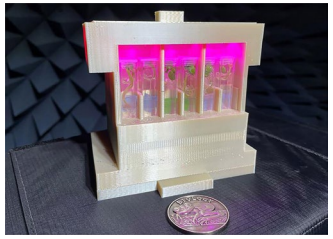
Identifying distinct advantages of biologically-derived materials for use in space-specific applications.

AFOSR Program Officers
Dr. Bennett Ibey, Natural Materials and Systems
Dr. Jennifer Talley, Space Biosciences

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Space Biosciences

- A biological system or product will be uniquely advantageous in the space domain if it provides a new capability, extends the operational life of existing capabilities, or a new efficiency that reduces launch upmass.
- The goal of the Space Biosciences program is to identify these unique opportunities for existing and future biological systems/products/processes to improve or extend operations or increase efficiency and discover how they can operate in the uniquely challenging space environment.



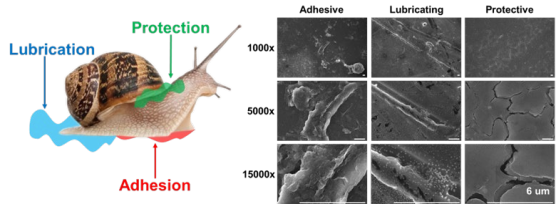
- **Biological processes/products/mechanisms/materials** uniquely advantageous in the Space Domain through increased capability or reduced upmass.
- **Living systems in the space environment** providing continuing operations including Biotic-Abiotic Teaming, Autonomous Maintenance.
- **Simulation/Modeling/Testing/Evaluation** improving high-throughput biological experiments in space like environments.



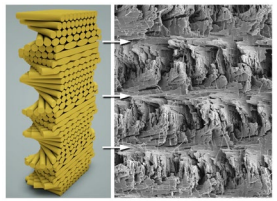
Dr. Jennifer Talley

Natural Materials and Systems

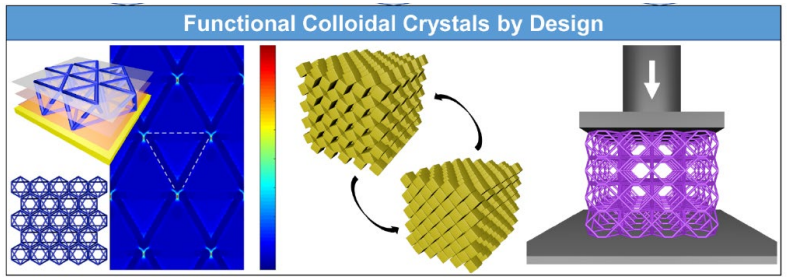
- **Mission:** To discover and exploit the evolutionarily-tested engineering and scientific principles of biological systems/biomolecules to realize better materials for the USAF and US.
- **Biomaterials (Non-Medical)** – Understanding biological material synthesis and function within a complex living organism







- **Bio-Interfacial Sciences** – Understanding the interaction(s) between biotic/living systems and abiotic materials.
- **Engineering Biology for Materials** – Utilizing living systems to generate materials
- **Biomolecular Engineering** – Using Biological Components (DNA/Proteins) to construct materials at the nano and mesoscale





Dr. Bennett Ibey

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Unique Advantages to Biologically Based Materials for Space

Objective: The objective is to advance the understanding and potential applications of biologically- derived materials for space exploration. Specifically, to evaluate synthetic biological materials, bio- manufactured products, and traditional engineered alternatives in space launch applications in the context of the space environment.

Research Concentration Areas: Suggested research areas include, but are not limited to:

(1) Mechanical Strength at Low Weight: Explore the mechanical strength of biologically derived materials at low-weight, with a focus on applications in spacecraft design and construction.

(2) Self-healing materials: Explore the capacity of living biological materials to self-heal with a focus on extension into the space environment.

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Unique Advantages to Biologically Based Materials for Space

References

1. SPACE FORCE WASHINGTON DC. “Space Capstone Publication: SPACE POWER. Doctrine for Space Forces.” (2020).

2. Averesch, Nils JH, et al. “Microbial biomanufacturing for space-exploration—what to take and when to make.” Nature Communications 14.1 (2023): 2311.

3. Santomartino, Rosa, et al. “Toward sustainable space exploration: a roadmap for harnessing the power of microorganisms.” Nature communications 14.1 (2023): 1391.

4. Chen, Po-Yu, Joanna McKittrick, and Marc André Meyers. “Biological materials: functional adaptations and bioinspired designs.” Progress in Materials Science 57.8 (2012): 1492-1704.

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Technical Topic: Ferrimagnetic Electronics

AFOSR Program Officers
Dr. Kenneth Goretta, GHz-THz Electronics
Dr. Arje Nachman, Electromagnetics

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GHz-THz Electronics Portfolio

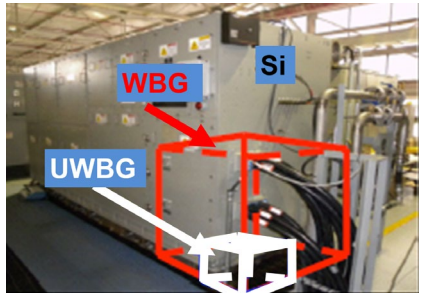
Objective: Understanding fundamental processing/structure/property relations; **direct observations of well-made** materials, structures, and devices, coupled with study of properties and theory and modeling/simulation for electronics relevant to USAF and USSF missions.

Approach: (1) Focus portfolio to a handful of topics ⟹ 70% turnover of subjects since 2016; (2) build confederated teams across AFRL, various agencies, and selected countries.

Major decisions made 2015-2023: (1) **retain** semiconductor basics, 2-D materials, magnetics, THz sciences, reconfigurability, and fundamental studies; (2) **reduce** sensors/detectors; (3) **add** ultrawide-bandgap semiconductors and superconductors; **expand** radiation damage.

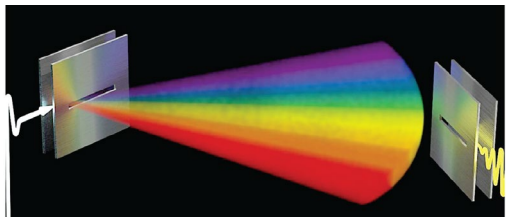
Science and Engineering for High Power

- Ultrawide-bandgap (UWBG) semiconductors/prototype devices
- Thermal properties



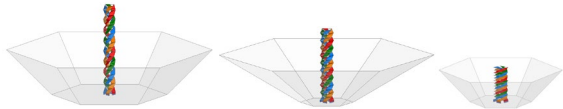
Science and Engineering for Low Power, Very High Speed

- 2-D devices & 2-D/3-D integration
- **Spin- or valley-based devices**
- **Novel THz-speed devices**
- Superconductors



Fundamental Science and Engineering for Electronics

- Electromagnetic surfaces
- Fundamentals, including defects, interfaces, and radiation damage





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Ferrimagnetic Electronics

Motivation: Ferrimagnets composed of antiferromagnetically coupled magnetic elements exhibit promise for applications such as spintronics, memory, and neuromorphic computing. Unlike in an antiferromagnet, each sublattice in a ferrimagnet has its own magnetic moment…. The two magnetic sublattices react independently to changes of external parameters, and so the magnetization and magnetic dynamics of a ferrimagnet can be readily manipulated by tuning chemical composition or temperature. Optimizing magnetization switching is crucial to, for example, realizing write operations in spintronic devices. Stimulation for such switching has been accomplished light, current, or voltage. This topic focuses only on electronic means.

Objective: The objectives of this topic are (1) to advance fundamental understanding of materials properties and spin-charge dynamics in films and heterostructures of ferrimagnets; (2) to identify ferrimagnetic films with properties suitable for applications.

Suggestion: Discuss the basic-research questions to be addressed, why they are important, how they are to be addressed, and what will be learned.



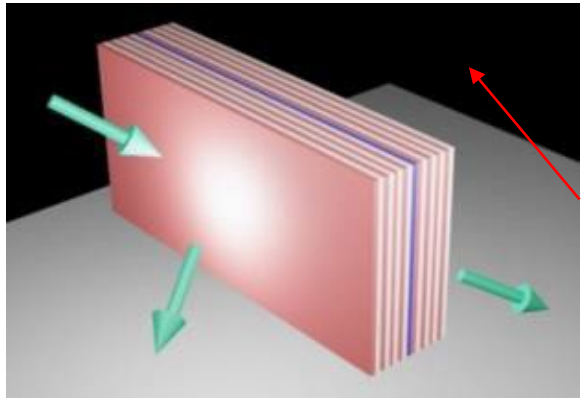
Dr. Kenneth Goretta

Electromagnetics Portfolio Objectives

Interrogate (Model/Simulate) Linear/Nonlinear Maxwell's Equations together with Signal Processing

Wave Propagation Through Complex Media

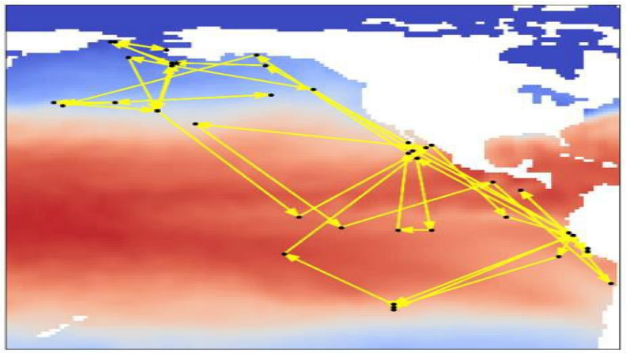
- random/turbulent media
- dispersive/conductive media
- cluttered surfaces (multipathing)
- metamaterials



Dr Ilya Vitebsky (AFRL/RYDHC)
AFOSR Lab Task
Metamaterial Nonsacrificial Sensor Protector

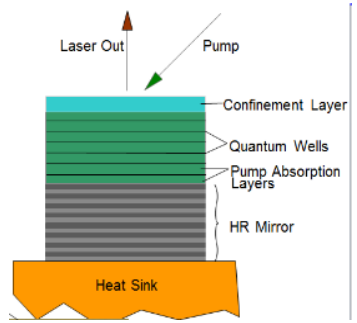
Signal Processing

- correlation-based radar processing
- moving sensor methods (SAR and drones)



Theoretical Nonlinear Optics

- First-principles design of semiconductor lasers
- propagation of ultrashort, intense laser pulses



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Final Remarks

Dr. LaShauna Evans
Program Manager, National Science Portal

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AFRL Basic Research National Science Portal

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- Published AFRL NSP FOA in May 2024 on Grants.gov (See funding opportunity number (FOAAFRLAFOSR20240008 or search “National Science Portal)
- **Due Dates – White Paper 10 June (submission optional), Proposal 26 July**
- Funding several teams of HBCU/MSI/TCU researchers in three topic areas:
  - ***Quantum Computing***
  - ***Unique Advantages to Biologically Based Materials for Space***
  - ***Ferrimagnetic Electronics***

- **Encourage applicants to also view OSD Defense University Research Instrumentation Program (DURIP) FOA for relevant instrumentation to further build capacity**
- Expecting at least three awards of $750K - $1.5M per year per award for a maximum of three years

Bolstering MSIs will attract more students to STEM and increase U.S. minority STEM graduates FLOODING THE U.S. WITH DIVERSE STEM TALENT

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Connect with AFRL/AFOSR!

AFRL Opportunities Students & Faculty

Air Force & Space Force Tech Connect

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Questions?

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