# Current Research Topics for the U.S. Army Space and Missile Defense Command (USASMDC), Space and Missile Defense Technical Center (SMDTC) Broad Agency Announcement (BAA) for Science, Technology, and Test and Evaluation Research

# BAA Number: W9113M-24-R-BAA1

Disclaimer

All current SMDTC topics of interest can be found at: <u>https://www.smdc.army.mil/ORGANIZATION/TC/</u>. Changes to these topics will be made using the website on an as needed basis. This document is a printed copy of the current SMDTC topics of interest as of the noted print date. Interested parties are encouraged to continually browse the SMDTC webpage and review the SMDTC BAA for instructions on submissions.

The SMDTC Broad Agency Announcement for Science, Technology, and Test and Evaluation Research, W9113M-24-R-BAA1, is available on https://www.grants.gov/ and https://sam.gov/.

# **Available SMDTC Topics of Interest**

# USASMDC SPACE AND MISSILE DEFENSE COMMAND TECHNICAL CENTER TOPIC OF INTEREST

**Title:** Development of Multiscale Electromagnetic Models for Susceptibility and Thermal Analysis

Announcement ID: TCBAA001

**SMDTC Office:** SMDC-TCT-R **SMDTC Competencies:** Test and Evaluation, Strategic Weapon Technologies, and Hypersonic Defeat **Key Words:** HPM, modeling, electromagnetic

# **Description:**

The USASMDC high-powered microwave (HPM) Team is interested in the development of Novel electromagnetic (EM) models to support our HPM susceptibility testing in both the macro and micro scale regions. It should have the ability to provide methods which promote self consistently in the transition between areas of scale such as the transition from submicron solid state to circuit level scale features. They should facilitate the calculation of emergent behaviors and aid in the discovery of new system behaviors.

Models should enable the calculation of effects at the system, device, and connection scales and allow for the modeling of dynamic thermal effects. Effects include things such as thermal stacking, energy storage considerations, and non-equilibrium thermodynamics should be capabilities of the modeling tools. The code should have the ability to aid in the design of experiments for model validation.

## USASMDC SPACE AND MISSILE DEFENSE COMMAND TECHNICAL CENTER TOPIC OF INTEREST

**Title:** Development of New Electronic Warfare and RADAR Algorithms, Systems, and Models.

Announcement ID: TCBAA002

**SMDTC Office:** SMDC-TCT-R **SMDTC Competencies:** Test and Evaluation, Strategic Weapon Technologies, and Hypersonic Defeat **Key Words:** None.

## **Description:**

The USASMDC radio frequency (RF) Technologies Team is interested in the development of novel new Electronic Warfare and RADAR techniques utilizing multi-aperture transmitters and receivers to promote battlefield survivability and anonymity.

As the Army prepares for the battlefield of 2040 in which denial of asset location to the enemy becomes problematic, there exists a need for the development of new, inexpensive multi-aperture radar and electronic warfare systems where the transmission and reception of the transmitted signal is distributed over a wide geographical area. This work would include the development of new algorithms to enable better utilization of the capabilities, development of the hardware systems themselves, and creation of digital twins for simulation and evaluation purposes. Proposers do not have to address all 3 areas but should submit to their areas of expertise.

# USASMDC SPACE AND MISSILE DEFENSE COMMAND TECHNICAL CENTER TOPIC OF INTEREST

Title: Development of Novel Antenna Concepts

Announcement ID: TCBAA003

**SMDTC Office:** SMDC-TCT-R **SMDTC Competencies:** Test and Evaluation, Strategic Weapon Technologies, and Hypersonic Defeat **Key Words:** HPM, antenna, wide band, time response

# **Description:**

The USASMDC Team is interested in the development of novel high-powered microwave (HPM) antennas. The antennas should be capable of handling gigawatts of peak radio frequency (RF) input power and kilowatts of average RF input power. It should be capable of transmitting wide band signals and designed using time-based antenna modeling methods.

Typical minimum pulse widths to be supported should be 10ps or longer with an input voltage of 30kV. Typical feed line impedances should be 50 ohms with consideration to other impedances on a case-by-case basis. The desired features include high tolerance of repetition rates, frequency, and the use of Institute of Electrical and Electronics Engineers Standards Association (IEEE) standard or commercial off the shelf interfaces.

# USASMDC SPACE AND MISSILE DEFENSE COMMAND TECHNICAL CENTER TOPIC OF INTEREST

Title: Development of Novel RF Component Technologies

Announcement ID: TCBAA004

**SMDTC Office:** SMDC-TCT-R **SMDTC Competencies:** Test and Evaluation, Strategic Weapon Technologies, and Hypersonic Defeat **Key Words:** HPM, connectors, microwave, high voltage

## **Description:**

The USASMDC Team is interested in the development of novel high-powered microwave (HPM) components, cables, and connectors. The offeror should not be bound by traditional 50 Ohm architectures but instead look at component impedances that maximize performance. Of particular importance is increasing the working alternating current (AC) and direct current (DC) voltages of components and connectors to allow for the safe use of connectors above 20 kV.

As the Army prepares to field HPM capabilities, the need arises to be able to connectorized subsystems in a manner that the Soldier can perform field maintenance, without requiring a proprietary component, cable, or connector. What is required is a series connectors and components that can be Government-owned and published as IEEE or mil-spec standards for the production of commercial off the shelf interfaces. Additionally, cabling that can support the higher electrical stresses are needed (50-100 kV) as well as high voltage components.

## USASMDC SPACE AND MISSILE DEFENSE COMMAND TECHNICAL CENTER TOPIC OF INTEREST

**Title:** Development of Novel RF Transmitter Systems

Announcement ID: TCBAA005

**SMDTC Office:** SMDC-TCT-R **SMDTC Competencies:** Test and Evaluation, Strategic Weapon Technologies, and Hypersonic Defeat **Key Words:** None.

## **Description:**

The USASMDC radio frequency (RF) Technologies Team is interested in the development of high-powered microwave (HPM) and Standard RF Transmitter systems for outdoor testing. The offeror should be prepared to develop full-scale demonstration systems based upon a variety of solid-state technologies. It should also include provisions for adding discrete and integrated receiver modules.

As the Army prepares to field HPM capabilities, the need arises to build test systems for use in assessing the outdoor survivability and usefulness of RF technologies. These test systems should include integrated prime power and cooling, antenna pointer tracker systems such that range assessments and effects can be established into a variety of targets, sensors for establishing fine track and target verification. Additionally, if the need arises, they should possess the ability to receive the transmitted signal via either integrated sensors or using remote sensors to aid in target track and location. Frequency/waveform diversity and wide bandwidth are desired.

# USASMDC SPACE AND MISSILE DEFENSE COMMAND TECHNICAL CENTER TOPIC OF INTEREST

Title: Development of Novel Solid State HPM Sources

Announcement ID: TCBAA006

**SMDTC Office:** SMDC-TCT-R **SMDTC Competencies:** Test and Evaluation, Strategic Weapon Technologies, and Hypersonic Defeat **Key Words:** HPM, solid state, high repetition rate

# **Description:**

The USASMDC high-powered microwave (HPM) Team is interested in the development of novel solid state HPM sources based upon Non-Linear Transmission Line (NLTL), Diamond, Gallium Nitride (GaN), Germanium Sulfide (GeS) or other solid-state technologies. Of particular interest to USASMDC are NLTL and diamond direct conversion technologies.

The desired source features include high repetition rates coupled frequency, pulse width and power tunability, and the use of IEEE standard interfaces. Minimum pulse repetition rates should be greater than 100 kHz with a minimum/maximum frequency of 3 GHz. High average power coupled with high peak power are desirable. Minimum source output power should be 1 megawatt with a clear path to combine multiple sources for powering a phased array antenna.

## USASMDC SPACE AND MISSILE DEFENSE COMMAND TECHNICAL CENTER TOPIC OF INTEREST

**Title:** Digital Transformation for Directed Energy Weapon Systems

Announcement ID: TCBAA007

SMDTC Office: TCE-ES SMDTC Competencies: Strategic Weapon Technologies Key Words: digital transformation, directed energy

## **Description:**

This program emphasizes applied research focused on defining and developing standard interfaces for directed energy weapons and utilizing digital tools for hardwarein-the-loop analysis of plug and play components. For the past 10 years there have been great strides made in directed energy technologies and applications of directed energy to defeat current and emerging threats. High energy laser (HEL) systems are capable of focusing an immense amount of power into a single, focused beam. Though these technologies exist and are nearing a transition point, there is still much work to be done with respect to the affordability of the technologies and closely related to that, the modularity of components.

HEL weapons, with their low cost-per-shot ratio, have been promoted as an affordable way to defeat certain known and emerging threats; however, these HEL weapon systems are often made up of expensive, proprietary components with non-standard interfaces. This makes interchangeability difficult and costly. There is an immediate need to develop cost-effective, standard interfaces to enable modular component upgrades to existing systems. Once fully defined, developed, and demonstrated in a laboratory setting, the technical data for these interfaces needs to be published in digital format. New components can then be developed to plug and play with the standard interfaces. Electronic versions of new components can be incorporated into the existing digital models of the interfaces and fully analyzed prior to prototype component builds. This digital transformation will also allow for enhanced hardware-in-the-loop testing of new and upgraded components. This will in turn reduce program cost and schedule risk, while enhancing the technical performance and speeding the transition of these technologies to the warfighter.

# USASMDC SPACE AND MISSILE DEFENSE COMMAND TECHNICAL CENTER TOPIC OF INTEREST

**Title:** Energy Based Weapon Systems and the Application of the Tactical Microgrid Standard

Announcement ID: TCBAA008

#### SMDTC Office: TCT-R

**SMDTC Competencies:** Strategic Weapon Technologies, and Hypersonic Defeat **Key Words:** High Power Microwave (HPM), Laser, Energy, Microgrid

## **Description:**

The emergence of directed energy weapon systems (DEWS) presents a shift in modern warfare, offering unparalleled precision, scalability, and sustainability compared to conventional kinetic weapons. To successfully integrate DEWS, there must be robust power management solutions and seamless integration with existing and new infrastructure. In this context, Tactical Microgrid Standards (TMS) offer a framework for optimizing power distribution, enhancing resilience, and facilitating interoperability within military environments. The TMS has emerged as a key enabler for enhancing energy flexibility and optimizing power distribution in military settings. This topic aims to explore the integration of TMS principles into emerging DEWS platforms, focusing on power management and the development of standardized interfaces to streamline energy weapon deployment and maximize operational effectiveness.

The TMS is currently being researched and designed for various military platforms. USASMDC would invite white papers on TMS-based power systems for transportable directed energy weapons (HPM and Light Amplification by Stimulated Emission of Radiation [LASER]). The proposed systems should be able to handle large random loads with extreme variations of output power being able to handle the sudden turn on of the directed energy loads (maximum dP/dt).

# USASMDC SPACE AND MISSILE DEFENSE COMMAND TECHNICAL CENTER TOPIC OF INTEREST

**Title:** Short and Ultrashort Pulsed Laser Research for Directed Energy Applications

Announcement ID: TCBAA009

**SMDTC Office:** TCT-MDD-DER **SMDTC Competencies:** Hypersonic Defeat **Key Words:** laser directed energy, ultrashort pulse lasers, laser ablation, spectroscopy

# **Description:**

The Pulsed Laser Lab (PuLL) in the Directed Energy Research Division seeks to discover innovative concepts for the application of short and ultrashort pulsed lasers (pulse durations less than a microsecond) to counter future threats. Given the recent rapid increases in the capabilities of these classes of lasers, novel engagements are emerging in the realm of practicability that would lead to technological overmatch.

General areas of interest in this topic include:

- Novel pulsed laser sources reaching new levels of average power, wide range of wavelengths, and increased repetition rates including burst mode operation;
- Nonlinear atmospheric propagation with ultrashort pulse lasers;
- Short and ultrashort pulsed laser ablation and surface modification;
- Advanced beam control techniques for improved beam quality and propagation of pulsed lasers over a wide range of powers levels and wavelengths; and
- Next generation diagnostic concepts for ultrashort pulse laser measurements.

# USASMDC SPACE AND MISSILE DEFENSE COMMAND TECHNICAL CENTER TOPIC OF INTEREST

**Title:** Development of Novel Technologies for HPM and Hypersonic Systems and Testing.

# Announcement ID: TCBAA010

SMDTC Office: SMDC-TCT-R

**SMDTC Competencies:** Test and Evaluation, Strategic Weapon Technologies, and Hypersonic Defeat

**Key Words:** HPM, RF, hypersonic, radar, AI/ML, quantum sensors, light gas gun, hypervelocity

# **Description:**

The USASMDC Weapons and Protective Technologies Division (WPTD) Team is interested in the development of high-powered microwave (HPM), radio frequency (RF), hypersonic, quantum sensor, and hypervelocity research, technology, and components. Technology development can be applicable to new or improved components, systems, and test facilities, and can include processes, and techniques. All aspects of the technology life cycle can be considered including design, development, manufacturing, testing and evaluation, insertion, sustainment, maintenance, and supply chain management.

Of particular interest to USASMDC are the following:

- HPM capabilities such lethality, destructive, and non-destructive (e.g. electromagnetic warfare);
- Hypersonic capabilities such as individual components and non-kinetic defeat capabilities;
- Quantum sensor technology;
- Light gas gun research such as hypervelocity research on impact and ballistics;
- Advanced manufacturing for components related to radar and HPM sources and components;
- Artificial intelligence and machine learning (AI/ML) algorithms, tools, and M&S related to all areas of research listed above and other WPTD relevant technologies; and
- Technology specific to WPTD test facilities including the HPM Effects Laboratory (HPMEL), the Aero-physic Research Facility (ARF), and the Hot Air Tunnel (HAT).

# USASMDC SPACE AND MISSILE DEFENSE COMMAND TECHNICAL CENTER TOPIC OF INTEREST

**Title:** Advancements in Beam Control for Increased Power and Extended Range Performance

Announcement ID: TCBAA011

SMDTC Office: TCT-MDD-DET SMDTC Competencies: Beam Control, Laser Quality Track Key Words: Directed Energy, High Energy Lasers, Beam Control, Adaptive Optics,

## **Description:**

The USASMDC Missile Defeat Team seeks groundbreaking beam control technologies to significantly enhance the range and effectiveness of next-generation high-energy lasers. We welcome proposals for both innovative applications of existing concepts and revolutionary technologies that redefine the state-of-the-art. Of particular interest are solutions that can be rapidly developed and deployed to address emerging mission needs.

This effort seeks advancements in the following key areas:

- High Irradiance Adaptive Optics: Novel components and architecture designed for high-power laser systems, pushing the boundaries of performance in challenging environments;
- Large Aperture Beam Directors: Innovative beam director assemblies capable of precision pointing over extended ranges, enabling engagement of threats at greater distances;
- Enhanced Target Detection Sensors: Novel sensor systems designed to significantly improve signal-to-noise ratio (SNR), enabling reliable target detection in complex and contested environments;
- Adaptive Dynamic Tracking Architectures: Agile and adaptable tracking architectures capable of responding to rapidly evolving missions and dynamic targets;
- Advanced Beam Control: Cutting-edge beam stabilization and pointing control algorithms, coupled with innovative optical designs, to maximize beam accuracy and effectiveness; and
- SWaP Optimization for Power and Thermal Management: Breakthrough technologies focused on reducing system size, weight, and power (SWaP) for improved mobility and operational flexibility.

# USASMDC SPACE AND MISSILE DEFENSE COMMAND TECHNICAL CENTER TOPIC OF INTEREST

Title: High Energy Laser System Modularization and Battlefield Decision Aids

Announcement ID: TCBAA012

SMDTC Office: TCT-MDD-DET SMDTC Competencies: Beam Control Key Words: Directed Energy, High Energy Lasers, Beam Control, Adaptive Optics,

## **Description:**

The USASMDC Missile Defeat Team is pursuing the development of concepts that will guide the definition and modularization of high-energy laser weapon systems, aligning with and advancing the principles of Modular Open Systems Approach (MOSA).

This effort seeks advancements in the following key areas:

- Model-Based Systems Engineering (MBSE): Develop comprehensive digital models to serve as the foundation for subsystem identification, integration, and overall system architecture for high-energy laser weapon systems;
- Modular Fire Control Architecture: Develop a common software architecture and messaging scheme for fire control systems. This modular approach will enable interoperability across diverse HEL missions, facilitate the integration of new software functionalities, and streamline the development of advanced decision aids; and
- Cognitive Load Reduction for Warfighters: Develop novel measurement systems and software-based decision aids designed to reduce the cognitive burden on warfighters, enabling faster and more effective decision-making in complex operational environments.

# USASMDC SPACE AND MISSILE DEFENSE COMMAND TECHNICAL CENTER TOPIC OF INTEREST

Title: Development & Application of Radio Frequency (RF) Photonics Technologies

Announcement ID: TCBAA013

SMDTC Office: SMDC-TCT-R SMDTC Competencies: Sensing, Strategic Weapon Technologies, Space Control Key Words: RF Photonics, Beam Forming, Microwave

## **Description:**

The USASMDC Research Directorate is interested in the development and application of new technologies and integration of RF Photonics to support innovative projects that explore beam forming through optical processing, distributed aperture, and millimeter wave coherence to implement new and novel technologies to shape the future of RF systems. The USASMDC Technical Center is seeking research that investigates and demonstrates photonic approaches that can enhance wave coherence in millimeter-wave systems, enabling more robust signal transmission and reception of sensing and active electronic warfare systems.

As the Army continues to prepare for execution on the Army space vision, new lower cost solutions must be employed that can address how optical technologies can reduce latency, improve synchronization, phase noise, and transmission loss to enhance adaptability for multiple apertures in a fielded dynamic environment. Research should investigate how integrated miniaturized optical processing can enable precise, high-speed beam forming, leveraging wide bandwidth, low loss, and predictable minimal phase noise. Efforts should focus on beam forming using optical processing as a transformative approach to RF and millimeter applications. Beam forming is essential for directing energy efficiently to achieve high resolution performance. New low loss amplification techniques and thermal noise control are areas of interest within the RF Photonics research. Frequencies of interest are primarily in the 30 – 300 Gigahertz range where precision and efficiency are challenging using traditional approaches.

# USASMDC SPACE AND MISSILE DEFENSE COMMAND TECHNICAL CENTER TOPIC OF INTEREST

Title: Demonstration of Novel Direct Diode Lasing Technologies Through Development of New Diode Emitter Materials and Beam Combination Approaches

## Announcement ID: TCBAA014

SMDTC Office: SMDC-TCT-D SMDTC Competencies: Novel Laser emitter maturation, Direct Diode lasing technologies, Laser module integration Key Words: Direct Diode, Laser module Size Weight Power & Cost (SWaP-C) optimization

## **Description:**

The USASMDC Technical Center Directed Energy Research division is interested in the development of new optimized diode designs and methods of beam combination for direct diode applications. These optimizations in lasing technology are crucial to push laser efficiencies past current 40% theoretical limitations in electrical optical efficiency. The Direct Diode approach provides an accelerated path to achieve the ruggedized and cost-effective laser weapon modules with the weight/size reductions necessary to support the Army's current requirements for mobile high energy laser weapon systems.

Of particular interest to USASMDC are the following:

- Custom diode design and optimization;
- Design and demonstration of 50-watt to 100-watt diode emitters exhibiting high beam quality;
- Demonstrate scalability to 100+kW class laser weapon modules;
- Integration and demonstration of high energy laser systems;
- Beam Quality: Power in the Bucket of 80%;
- Electrical Optical (E-O) Efficiency: 60%; and
- 50+killoWatts class HEL demonstration.