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Space Technology

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Agenda

– Disclaimer
– Research Area Objectives
– List of SBIR Topics
– SBIR Topic Overview
– List of STTR Topics
– STTR Topic Overview
– Questions

Disclaimer

- The published SBIR & STTR Solicitations take precedence over anything written, stated, or implied in this briefing.
- Anything in this briefing which conflicts with the published solicitations is an error and should be ignored.

Follow the directions and respond to what is in the published solicitation!

Space Technology Research Area

Objectives

- Solve Technical Issues/Problems/Limiters of BMDS System Concepts/Designs to Enable Space-Basing
  - Can Enable New System Concepts or Significantly Improve Existing Concept Performance/Cost/Producibility/Life
- Provide Subsystem or Component Suppliers to Our System Prime and Payload Contractors

Scope of Research Area

- All Technologies Developed Must Be Capable of Long Term Operation in Space >>>>> **Radiation!**

Relevance to the BMDS

- Space-Basing Provides Enhanced, Persistent, Pervasive Coverage while Minimizing the Geopolitical and Security Issues of Basing on Foreign Soil/Ports

Transition Is Critical!

SBIR Topics

- Payload Thermal Management Technology
- Improvements in Spacecraft Assembly, Integration and Test
- Large Format Space Focal Plane Array Technologies
- Enhanced Spacecraft Survivability
- Space Component Miniaturization
- Radiation Hardened Monolithic Heterogeneous Processors

Topic Overview

Payload Thermal Management Technology

Objective

- Design, develop and demonstrate higher performance thermal management components to reduce jitter, mass, and/or power for electro-optical/infrared (EO/IR) space payloads

Areas of Interest

- Application of improved heat conduction materials in cryocoolers
- Pumped or wicked cryogenic cooling transfer across a two axis gimbal or flexible joint, or to route cooling to multiple locations on a spacecraft
- Thermal control devices for high density microcircuits and laser diodes for lasercom
- Thermal insulation material

Key Performance

- Cooling to temperatures as low as 35K
- Operational life 10 years
- Ability to vary loads (temperature and power) during operation
- Improved mass, input power, efficiency, reliability &/or integration capability

Phase I Goals

- Analytical **&** experimental demonstration of proof-of-principle of the proposed technologies/concepts

Improvements in Spacecraft Assembly, Integration and Test (AI&T)

Objective

- Develop innovative hardware and methodologies to significantly reduce the cost and time required for the Assembly, Integration, and Test of future MDA Space Systems

Capabilities Desired

- Tools to improve the scheduling, planning and work flow management to streamline AI&T processes
- Improved simulators for use during ground test and verification measurement
  - Far field line of sight accuracy and stability determination
  - High fidelity visible/infrared targets
- Improved software integration and test tools and methods

Key Performance

- Target sources should radiate in the visible through long wave infrared bands
  - Knowledge of and the ability to control the irradiance of these sources is critical.
- Line of sight determination to microradian accuracy
- Simulations capable of operating in non-real-time on a general purpose operating system-based platform and on a real-time operating system-based platform for hardware-in-the-loop testing

Phase I Goals

- Conceptual designs of the hardware based on preliminary analysis with sufficient hardware development and testing to verify requirements can be met

Large Format Space Focal Plane Array Technologies

Objective

- Develop innovative solutions to support the development of large format (>25cm^2) focal plane arrays (FPAs) for space sensing

Technology Areas of Interest

- Visible → long wavelength infrared wavelengths of greatest interest
  - Detector materials & processing leading to high quality devices w/low damage
  - Substrate growth, polishing, cleaning and reclamation techniques
  - Characterization tools & techniques that can non-destructively, readily assess step-wise processed material for damage
  - Low-loss hybridization techniques (temporary and permanent) & bump bond architectures
  - FPA planarization and substrate removal techniques
  - FPA butting techniques
  - Innovative approaches to anti-reflective (A/R) coatings
  - Read Out Integrated Circuit (ROIC) design, fabrication and testing

Key Performance

- Meet performance goals post 300Krad (both protons & ionizing radiation) exposure
- Performance ≥ current sensor approaches & sufficient for BMDS strategic sensors

Phase I Goal

- Produce proof-of-concept/principle demonstration articles for radiation testing by the government

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Enhanced Spacecraft Survivability

Objective

- Develop (design, fabricate and demonstrate) innovative approaches to enhance the survivability of MDA Space Systems to spacecraft anomalies occurring from either natural or manmade events

Capabilities Desired

- Sensors and algorithms to detect, characterize (i.e., provide attribution), and report, in near real time, mission critical effects arising from natural and/or manmade origins
- Innovative mechanisms or algorithms to enhance the survivability of optical sensors
- Hardware/algorithm concepts to enable continued operations through anomalies and/or the fast recovery of the system afterward

Key Performance

- Must be capable of 10 years operation in a space environment
  - $\geq$ 300Krad total dose of radiation (ionizing and proton)

Phase I Goals

- Preliminary design of the hardware/software
- Modeling, Simulation, and Analysis (MS&A) of the concept/design demonstrating how near-term goals will be met
- Proof of concept hardware/software development and test is highly desirable
  - Subscale, non-rad hard (with traceability) acceptable

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Space Component Miniaturization

Objective

- Design, develop and demonstrate miniaturized, lightweight, space qualified components to support future MDA space missions

Technology Areas of Interest

- Prime area of interest: telescopes, optics and mirrors
- Other technologies that meet overall objective will also be considered
  - Strongly suggest talking to authors before proposing

Key Performance

- Proposed solutions must demonstrate they meet government near-term goals
- Must demonstrate path to space qualification
- Operational life ≥ 10 years; 300 Krad (Si) total dose
- Reduce mass, volume, & cost, &/or increase precision (compared to current state of the art)

Phase I Goals

- Develop preliminary design of concept
- Proof of concept hardware development and testing to prove concept feasibility highly desirable

Radiation Hardened Monolithic Heterogeneous Processors

Objective

- Identify design architectures and methodologies for developing radiation hardened, monolithic, heterogeneous processors (MHP) to support data processing from sensors in MDA space systems

Technology of Interest

- Multi-processor array optimized for processing and aggregating sensor data
- Capabilities must include
  - ≥ 4 parallel processing channels for digital filtering and/or signal conditioning
  - On-chip general processing element(s) for aggregation of data from each of the processing channels
  - Memory management, data synchronization, and inter-processor communication and control

Key Performance

- Radiation hardness $\geq$ 300Krad (both protons & ionizing radiation)
- Highly resistant to single event effects

Phase I Goal

- Develop an architecture and demonstrate it via simulation

STTR Topics

- Technology Improvements for Multi Junction Solar Cells for Satellite Applications, and Radiation Protection of Solar Cells
- Development for Radiation Hardened Applications of Advanced Electronics Materials, Processes, and Devices
- Solid State Cooling of Infrared Focal Plane Arrays

Development for Radiation Hardened Applications of Advanced Electronics Materials, Processes, and Devices

Objective

- Design, develop and demonstrate advanced electronics materials, processes, and devices to meet the need for radiation hardened, high performance electronics for MDA space and missile requirements

Technologies of Interest

- Include, but not limited to: molecular electronics, chalcogenide based electronics, vacuum microelectronics, carbon nanotube based electronics, silicon carbide based electronics, 3-D electronics

Key Performance

- Total Dose radiation hardness $\geq$ 300Krad (both protons & ionizing radiation)
- Immunity to catastrophic single event effects (e.g., single event latch-up) for particles with Linear Energy Transfer levels up to 100 Mev-cm**2/mg
- Single event upset hardness for memory and registers less than 1.0E-10 errors/bit/day

Phase I Goal

- Analyze and design a proof-of-concept medium scale integration device
- Develop a viable plan and schedule for demonstrating radiation hardness of the proposed concept

Technology Improvements for Multi Junction Solar Cells for Satellite Applications, and Radiation Protection of Solar Cells

Objective

- Improve solar cell performance/life for satellite applications

Technologies of Interest

- Multi-junction solar cells
- Quantum dots/Quantum wells

Key Performance

- Efficiency ≥ current generation multi-junction scales (~33-35%) after experiencing 300Krad (Si) total dose and 10 years of vacuum exposure

Phase I Goal

- Design and develop a representative proof of concept model for a multi-junction solar cell that incorporates quantum technologies

Solid State Cooling of Infrared Focal Plane Arrays

Objective

- Establish feasibility of Solid State Cooling of space sensor EO/IR payloads at 35 K

Technologies of Interest

- Advanced materials
- Advanced design concepts

Key Performance goals

- Cooling temperature: 35 K
- Cooler may be multi-stage with all but the last being mechanical
- Last stage of refrigeration, across ≥15 K of cooling must be solid state cooling
- Cooling load of 2 W at 35 K
  - Threshold: net positive cooling at 35K
- Objective thermodynamic efficiency: 12% of Carnot
  - Threshold: positive absolute efficiency

Phase I Goals

- Perform theoretical calculations & modeling to support selection of new materials or design concepts enabling a solid state device capable of reaching 35K
- Actual testing of potential solid state materials in Phase I of high interest

Helpful Hints

- Respond to solicitation!
  - Address all evaluation criteria!
- Transition is as important as innovation!
  - Do your homework on the BMDS problem/system you are proposing against
  - To solve a BMDS problem, you have to get your product into a BMDS system
- Watch out for ITAR problems!
  - Do your homework on ITAR!
  - Foreign persons will, in almost all cases, be prohibited from working on critical BMDS space technologies
    - When in doubt, don’t use foreign nationals
    - Establish citizenship status of key personnel in proposal
- Where a topic is broader/multiple concepts/technologies are of interest, focus a proposal on one concept
  - > 1 award/contractor in A topic RARE
- Target your audience (the evaluators)!
  - Proposal is not a scientific paper or journal article

Questions?