NASA SBIR 2023-I Solicitation

PROPOSAL NUMBER: 23-1- **A1.04-1156**

SUBTOPIC TITLE: Electrified Aircraft Propulsion

PROPOSAL TITLE: Enhanced Motor Performance via Two-Phase Thermal Management

Small Business Concern

Firm: **Advanced Cooling Technologies, Inc.**
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Principal Investigator:

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Business Official:

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Summary Details:

Estimated Technology Readiness Level (TRL) :

Begin: 2
End: 4
Technical Abstract (Limit 2000 characters):

Thermal management presents a significant constraint on the achievable efficiency and power density of MW-scale electric motors for aircraft propulsion. High temperatures within the windings limit the maximum power density, reduce the lifetime of the winding insulation, and

increase electrical losses lowering efficiency. Innovative thermal management strategies can significantly enhance the performance of motors for electrified aircraft propulsion.

In this SBIR program, Advanced Cooling Technologies, Inc. will develop an innovative two-phase thermal transport system for high power electric motors that will augment traditional cooling solutions by efficiently extracting heat from difficult to cool areas. The two-phase thermal transport system will be fully passive, lightweight and scalable. The proposed technologies will reduce the operating temperature of the motor windings allowing for increased power density and efficiency.

Potential NASA Applications (Limit 550 characters):

The two-phase thermal management technology proposed here is relevant to several strategic thrusts outlined by NASA's Aeronautics Research Mission Directorate: "Ultra-Efficient Commercial Vehicles" and "Transition to Low-Carbon Propulsion". NASA envisions a significant shift in commercial aircraft to ultra-efficient airframes and propulsion concepts utilizing electric or hybrid electric propulsion. Improved thermal management of the proposed technology will enable significant increase in the power and torque density of electric motors.

Potential Non-NASA Applications (Limit 400 characters):

The proposed technology is applicable to various motor architectures and sizes. It will find use in passenger aircraft, unmanned aircraft, and electric vertical takeoff and landing aircraft. In addition to the aviation industry, the need for high-performing motors in electric automobiles is rapidly growing as nearly all sectors of the transportation industry begin to electrify.

Duration: **6**

PROPOSAL NUMBER: 23-1- **S11.01-1346**

SUBTOPIC TITLE: Lidar Remote-Sensing Technologies

PROPOSAL TITLE: CoDLiR: Compact Digitizing Lidar Receiver

Small Business Concern

Firm: **Nalu Scientific, LLC**
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Principal Investigator:

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Summary Details:

Estimated Technology Readiness Level (TRL) :

Begin: 2
End: 4

Technical Abstract (Limit 2000 characters):

A reduction in space and power requirements for each channel of a LiDAR system would allow for a system with significantly more channels and/or a system small enough to fly on CubeSat scale vehicles. The primary method by which the CoDLiR will accomplish this goal is the integration of feature extraction, digital processing, and bias control onto one single low-power chip. For a full-scale detector, multiple channels (up to 64) would be serviced by a single chip. NSL has extensive experience with single-photon detection with extremely high timing resolution through our work with HEP collider and astrophysics experiments. We are currently developing a range of application specific integrated circuits (ASICs) for DOE Office of High Energy Physics (HEP) projects that have channel counts ranging from 4 to 64 per ASIC, which could be modified for this task specifically. These system on chip (SoC) ASICs implement built-in digital signal processing (DSP) and control interfaces that can enable precise time of flight (ToF) measurements of back-scattered laser light pulses with low light for use in orbiting or aerial LiDAR applications.

Potential NASA Applications (Limit 550 characters):

Future NASA scientific missions will require remote sensing equipment with lower power, smaller form factors, increased robustness, and higher sensitivities. Integration of LiDAR systems into a system-on-chip ASIC would achieve these goals and be of interest in numerous applications. Possible uses range from high-beam-count orbital LiDAR imaging systems to high-precision and low-power imaging sensors for planetary missions.

Potential Non-NASA Applications (Limit 400 characters):

A low SWaP-C, accurate LiDAR can be used in autonomous vehicles, both automobile and aerial systems, would benefit significantly from reduced power and size made possible by increased integration, lower return signal power requirements, and increased precision. Our technology would provide a product that could be also utilized by various industries interested in orbital geospatial mapping.

Duration: **6**

PROPOSAL NUMBER: 23-1- **S11.01-1960**

SUBTOPIC TITLE: Lidar Remote-Sensing Technologies

PROPOSAL TITLE: Fiber-based laser transmitter at 0.95 µm band for water vapor LiDAR application

Small Business Concern

Firm: **AdValue Photonics, Inc.**
Address: **2700 East Bilby Road, AZ, AZ 85706**
Phone: **(520) 790-5468**

Principal Investigator:

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Summary Details:

Estimated Technology Readiness Level (TRL) :

Begin: 2
End: 4
Technical Abstract (Limit 2000 characters):

Based on our proprietary award-winning fiber laser technology, AdValue Photonics proposes to develop and demonstrate a novel water vapor LiDAR transmitter at 0.9 µm – a high-energy, high-peak-power, narrow-linewidth, fiber-based laser transmitter – which enables water vapor DIAL measurements in the 0.9 µm band. In the Phase I program, we will focus on the feasibility investigation of such a fiber-based, energy-scalable, pulsed laser transmitter at 935 nm for water vapor DIAL measurements. In the Phase II program, we will experimentally demonstrate this

enabling technology by developing a deliverable prototype transmitter unit of such a high-pulse-energy narrow-linewidth laser at 935 nm laser at the end of the Phase II program.
Potential NASA Applications (Limit 550 characters):

The proposed laser transmitter system in this SBIR program is a fiber-based laser solution for airborne water vapor DIAL measurements – different from the current design of NASA's HALO system – offering many advantages, such as higher efficiency, smaller SWaP, coherent detection capability, wide wavelength selectivity, compactness, and robustness. These advantages are all vital for airborne or spaceborne atmospheric water vapor measurements.

Potential Non-NASA Applications (Limit 400 characters):

In addition to the specific NASA applications for airborne or spaceborne atmospheric water vapor measurements, a high-energy, high-peak-power, fiber-based lasers operating in the NIR spectral range could be an immediate alternative to a bulky Ti:sapphire laser for many spectroscopic applications.

Duration: **6**

PROPOSAL NUMBER: 23-1- **S11.01-2002**

SUBTOPIC TITLE: Lidar Remote-Sensing Technologies

PROPOSAL TITLE: Ozone Lidar Utilizing 308 nm and 355 nm Compact Fiber-Based Lasers

Small Business Concern

Firm: **AdValue Photonics, Inc.**
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Principal Investigator:

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Summary Details:

Estimated Technology Readiness Level (TRL) :

Begin: 2
End: 4
Technical Abstract (Limit 2000 characters):

Both stratospheric ozone and tropospheric ozone significantly affect lifeforms on Earth. They influence the environment, the atmosphere, and the global climate. The science community has spent tremendous efforts for the observation of ozone concentration in the atmosphere. Differential absorption Lidar (DIAL) technology has played a critical role in obtaining range-resolved ozone profiles in the atmosphere. In this proposal, we aim to design and build a compact, robust, reliable, efficient, anti-vibrational, and easy-to-maintain stratospheric ozone Lidar with AdValue Photonics' unique single frequency tunable UV lasers at 308 nm and 355 nm based on all-fiberized master oscillator power amplifier (MOPA). The proposed Lidar will have the advantage of being suitable to various observational platforms with harsh environment and limited resources.

The 308 nm laser will be generated from the frequency mixing of 515 nm and 768 nm laser, which are the second harmonic generation of 1030 nm and 1535 nm laser, respectively. The 355 nm laser will be generated from the third harmonic from AdValue Photonics' 1064 nm IR laser. The amplification of the above-mentioned 1030 nm, 1535 nm, and 1064 nm lasers will utilize AdValue Photonics' proprietary silicate glass high peak power large mode field diameter (MFD) ytterbium (Yb) and erbium (Er) doped fiber amplifiers. Subsequently, we aim to implement an ozone lidar with such fiber-based light sources and obtain preliminary observation data. In Phase I of this SBIR project, we will focus on obtaining ozone observations at nighttime. It is well known that solar background radiation can cause Lidars to have low signal to noise ratio (SNR) at daytime. In Phase II, we plan to boost the power levels of the Lidar Transmitter, and possibly integrate etalons and interference filters in the Lidar Receiver to suppress the solar background to eventually obtain reasonable SNRs in the daytime for ozone observations.
Potential NASA Applications (Limit 550 characters):

The proposed compact, robust, reliable, efficient, and anti-vibrational stratospheric ozone Lidars favors NASA's intention to be able to detect ozone concentration in field observations on a variety of carrying platforms. It meets the standard of being small size, weight, and power (SWaP) so that it can survive harsh environment and consume limited resources.
Potential Non-NASA Applications (Limit 400 characters):

The proposed ozone Lidar will greatly increase the temporal and spatial coverage of ozone observations for the better of the environment, the atmosphere, and the global climate. Such demands have progressively become higher from the public community.
Duration: **6**

PROPOSAL NUMBER: 23-1- **S11.01-2397**

SUBTOPIC TITLE: Lidar Remote-Sensing Technologies

PROPOSAL TITLE: Lightweight, non-mechanical, polarization-independent LiDAR beam steering system

Small Business Concern

Firm: **BEAM Engineering for Advanced Measurements**
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Principal Investigator:

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Business Official:

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Summary Details:

Estimated Technology Readiness Level (TRL) :

Begin: 3
End: 4
Technical Abstract (Limit 2000 characters):

The purpose of this project is to develop techniques that make it possible to reduce the size and weight of non-mechanical LiDAR beam steering systems. Previous work has shown that LiDAR beam steering with diffractive components based on spatial modulation of geometrical phase is feasible and useful. Most previous work with this technology has concentrated on steering techniques that are polarization sensitive. Under the current project, these techniques will be extended to LiDAR beam steering that is polarization-insensitive. This would allow reduced weight and/or size of such steering systems because it would allow the LiDAR receiver to use all of the optical power returned from a target, rather than only returned radiation of one polarization. Since transitioning from a polarization-sensitive beam steering system to a polarization-insensitive beam steering system would require an increase in the number of optical substrates, the most weight benefit of such a transition would be gained if the substrate weight is minimized. Therefore, an analysis of options for lightweight optical substrates will be performed in order to make it possible to further reduce the weight of future LiDAR systems. Another related technical issue with non-mechanical beam steering is the switching speed among pointing directions. Additional system weight reduction may be possible if switching speed of the pointing system is increased beyond the speed of currently-available optical switches. Methods for leveraging recent developments in liquid crystal technology to increase switching speed will be analyzed, thereby enabling the use of higher pulse rates in LiDAR systems, which may further reduce the size and weight of these systems in some applications.

Potential NASA Applications (Limit 550 characters):

Compact, low SWaP, non-mechanical, hence, robust, LiDARs with reliable and fast data acquisition capability that meet requirements for a space landing vehicle could be used for other NASA missions including asteroid flybys, swarms of cubesats, etc. due to higher precision

guidance and navigation systems. An additional potential application of this technology is to transceiver steering for free-space optical communications systems.

Potential Non-NASA Applications (Limit 400 characters):

Numerous non-NASA applications include autonomous navigation systems for cars, drones, and robots, and commercial free-space optical communications.

Duration: **6**

PROPOSAL NUMBER: 23-1- **S11.02-1331**

SUBTOPIC TITLE: Technologies for Active Microwave Remote Sensing

PROPOSAL TITLE: Rydberg Sensor Laser

Small Business Concern

Firm: **Opto-Atomics Corp.**
Address: **1891 North Gaffey Street, Suite 223, San Pedro, CA 90731**
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Principal Investigator:

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Summary Details:

Estimated Technology Readiness Level (TRL) :

Begin: 2
End: 4
Technical Abstract (Limit 2000 characters):

Over the past decade, the Rydberg atom-based RF/microwave sensing technology has emerged as a promising sensing solution for a radar/radio receiver. In the Rydberg-atom-based sensing, highly excited ("Rydberg") atoms are utilized as antennas, which allows sensitive and SI-traceable detection of RF/microwave fields over a wide frequency range (1 MHz to ~100 GHz) with a single probe. However, one of the major hurdles to wide applications and field deployment of the quantum radar/radio technology is its size, weight, and power (SWaP), mostly from its system overhead (e.g., laser subsystem). In particular, the coupling laser driving the "upper" atomic transition in a two-photon excitation scheme of Rydberg atoms is not well-suited for field applications due to its SWaP and vulnerability to environmental perturbations. Furthermore, coupling lasers do not have a compact frequency reference for laser stabilization.

To address the need, Opto-Atomics Corp. (OAC) proposes to develop a Rydberg Sensor Laser (RySL), which will provide a high-power (> 0.5 W), tunable (range > 3 nm) coupling-laser output. One of the main advantages of RySL is that its output is stabilized to a built-in frequency standard, thereby allowing reliable electrometry operation with long-term stability. In addition, RySL design significantly reduces free-space optical components, making the system more compact, reliable, and less sensitive to misalignment and environmental disturbances. In Phase I, OAC will design and assemble key system components of RySL, evaluate their performance, and perform feasibility demonstrations. We will also conduct a preliminary design of the fully-packaged RySL system for future development.

Potential NASA Applications (Limit 550 characters):

In the remote sensing of Earth's surface topography and vegetation, RF/microwave sensing over a wide radio spectral range with high sensitivity may allow enhanced characterization of the surface conditions. Other than the target NASA application in microwave sensing, Rydberg sensors can be adopted in other NASA applications such as RF-field metrology (characterization and calibration), RF communication, nondestructive inspection, characterization of blackbody radiation, and others.

Potential Non-NASA Applications (Limit 400 characters):

RF/microwave fields are heavily utilized in many commercial and military applications. For example, a scanned array radar made of Rydberg sensors can provide a performance breakthrough in radar technologies, which will be extremely useful in many military applications. Rydberg atom-based RF/microwave sensors can also be highly useful in industrial applications using RF/microwave.

Duration: **6**

PROPOSAL NUMBER: 23-1- **S11.02-2261**

SUBTOPIC TITLE: Technologies for Active Microwave Remote Sensing

PROPOSAL TITLE: Ultra-Efficient UHF Band Power Amplifiers

Small Business Concern

Firm: **Recon RF, Inc.**

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Principal Investigator:

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Summary Details:

Estimated Technology Readiness Level (TRL) :

Begin: 1
End: 3
Technical Abstract (Limit 2000 characters):

•In support of NASA's Ecosystems SAR (EcoSAR) Mission, which is to enable unprecedented two- and three-dimensional fine scale measurements of terrestrial ecosystem and biomass, this project will develop a state-of-the-art (SOA) UHF Band monolithic microwave integrated circuit (MMIC) Power-Amplifier for the EcoSAR instrument's 32 radar electronics units. This project will significantly advance Power Added Efficiency beyond present day commercial off the shelf offerings operating on the UHF Band, and specifically 335-535 MHz, achieving a TRL 3-4 MMIC power amplifier with over 25 Watts output power, power added efficiency (PAE) of greater than 70%, and power gain of over 35 dB with less than 1 dB gain flatness over the band; consistent with the requirements of EcoSAR. This UHF-band GaN MMIC SSPA performance will be at the very forefront of present-day technology. The efficiency advantages resulting from this project's custom developed >70% PAE UHF MMIC 25-watt power amplifiers will be multiplied across 32 polarimetric (dual) transmit/receive (T/R) modules which reside inside the aircraft fuselage within a radar electronics unit (REU).
Potential NASA Applications (Limit 550 characters):

The proposed UHF MMIC capable of PAE >70% will enhance NASA's communication and navigation for SWaP-C conscious applications such as:

- NASA Mission/Program: Ecosystems SAR (EcoSAR)
- Electra UHF Navigation Package
- Mars Perseverance Rover
- Mars Curiosity Rover

Potential Non-NASA Applications (Limit 400 characters):

Non-NASA commercial and DOD applications stand to benefit from Recon-RF's advancements in UHF MMIC technology, such as:

- Tactical Radio (Ground, Shipborne, Handheld)
- FirstNet Network
- Commercial 5G New Radio FR1
- UHF Air Traffic Control and Wind Profile Radar

Duration: **6**

PROPOSAL NUMBER: 23-1- **S11.03-1175**

SUBTOPIC TITLE: Technologies for Passive Microwave Remote Sensing

PROPOSAL TITLE: Ultra-low-loss Millimeter-Wave Holographic Antennas for CubeSat Remote Sensing

Small Business Concern

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Principal Investigator:

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Business Official:

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Summary Details:

Estimated Technology Readiness Level (TRL) :

Begin: 2
End: 4
Technical Abstract (Limit 2000 characters):

The NASA Science Mission Directorate has a critical need for advanced deployable antenna apertures operating at millimeter-wave frequencies from CubeSat platforms. This proposal is to fulfill the technology gap and develop a novel type of ultra-low-loss millimeter-wave metasurface holographic antennas to support a wide range of passive remote sensing applications beyond Ka-band up to 200 GHz. Enabled by a breakthrough dielectric substrate material that is electrically low-loss, thermally high-conductive, and mechanically robust, the proposed holographic antennas will be designed, synthesized, and verified including CubeSat platform effects. Mechanical feasibility, radiometer system architectures, integration with antenna feeds, and fabrication flow will be studied and evaluated in the project. The Phase 1 project goal is to demonstrate the design concept of compact-size, deployable, low-profile, lightweight, easy-to-fabricate and high-performance metasurface antennas, which are also cost-effective and can be an excellent fit for NASA remote sensing and other commercial wireless applications.
Potential NASA Applications (Limit 550 characters):

NASA Science Mission Directorate missions can greatly benefit from adopting and integrating the proposed millimeter-wave metasurface holographic antennas on CubeSat platform for remote sensing applications including weather forecasting, oceanography, ozone, soil moisture measurements, and astrochemistry. The unique attributes (low profile, light weight, ultra-low-loss, easy-to-fabricate) make it an excellent technology to enable cost-effective high-performance antennas beyond Ka-band for CubeSat applications.
Potential Non-NASA Applications (Limit 400 characters):

The technology developed in this Phase 1 project can be adopted as a critical antenna solution to support the increasing demand for high-capacity, high-speed point-to-point wireless backhaul communication, for example, operating at FCC designated D-band to enable beyond 5G (B5G) and 6G high-throughput links in dense urban environments.
Duration: **6**

PROPOSAL NUMBER: 23-1- **S11.04-1934**

SUBTOPIC TITLE: Sensor and Detector Technologies for Visible, Infrared (IR), Far-IR, and Submillimeter

PROPOSAL TITLE: Combining InP and SiGe Technologies for Low Noise, Low Power Cryogenic Amplifiers suitable for Radio Astronomy Arrays and Quantum Applcations.

Small Business Concern

Firm: **Cosmic Microwave Technology, Inc.**
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Summary Details:

Estimated Technology Readiness Level (TRL) :

Begin: 2
End: 4

Technical Abstract (Limit 2000 characters):

Future earth science and planetary science missions will require large pixels, highly sensitive radio astronomy receiver arrays. Recent breakthroughs in detector technology are leading this growth. To achieve the required sensitivities, the large number of pixels (thousands) in a receiver requires low noise, low power cryogenic amplifier arrays. Lower noise amplifiers result in higher sensitivity arrays. The capacity of cryogenic coolers is limited, requiring amplifiers to have a low power dissipation. Producing cryogenic amplifiers that has both low noise and low power is difficult. Today, cryogenic amplifiers are manufactured using either Indium Phosphide (InP) HEMT devices or Silicon Germanium (SiGe) BJTs. Amplifiers based on InP technology have noise temperatures as low as 1.5K with a power dissipation of 10 mW. SiGe based amplifiers have noise temperatures of 3-4K with a power dissipation of 300 uW. The noise temperature of an amplifier is primarily set by the first stage. The subsequent stages contribute very little to the noise of the amplifier. Therefore, combining InP and SiGe will result in the ultimate low noise, low power cryogenic amplifier. The ideal amplifier will have a InP first stage for low noise and a SiGe 2nd and 3rd stage for low power. The InP stage will be a discrete design for optimum performance. The SiGe stages will be MMIC based design for ease of manufacturing and low cost. Combining these two technologies will result in an amplifier with 2K or less noise with a power dissipation of 500uW or less. Imagine an antenna array of 1028 elements that has a power dissipation of 514 mW. This performance is possible with this innovation. Phase 1 will result in a design of a low noise, low power amplifier based on both theoretical and empirical measurements

Potential NASA Applications (Limit 550 characters):

The 2020 Decadal Review recommended increased funding levels for several of NASA's future missions. The Origins Space Telescope, Lynx Telescope, IR imagers and polarimeters are included in the recommendations. Low-cost infrared detector arrays for space and ground radio astronomy receivers are currently available. These detectors require a low noise, low power cryogenic amplifier. These instruments will greatly benefit from a low power, low noise amplifier array.

Potential Non-NASA Applications (Limit 400 characters):

Several companies (Google, Microsoft, IBM etc) are developing Quantum Computers (QC). The quantum processors operate at milli-Kelvin temperatures. Extremely low noise cryogenic amplifiers operating in the 4-8 GHz band are required. A Quantum Computer with 1 million Qbits will require 100K cryogenic amplifiers. A low noise, low power cryogenic amplifier will allow QC to become a reality.

Duration: **6**

PROPOSAL NUMBER: 23-1- **S11.04-2023**

SUBTOPIC TITLE: Sensor and Detector Technologies for Visible, Infrared (IR), Far-IR, and Submillimeter

PROPOSAL TITLE: Adaptive Thermal Infrared Band ROIC for Planetary Science Missions

Small Business Concern

Firm: **SAAZ Micro Inc.**
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Principal Investigator:

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Business Official:

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Summary Details:

Estimated Technology Readiness Level (TRL) :

Begin: 2
End: 4
Technical Abstract (Limit 2000 characters):

Electro-Optical and Infrared (EO/IR) detectors sensing in the 400nm to 13 micron waveband are extensively employed in planetary science space instruments. These detectors can be divided into two distinctive subgroups, namely the visible through shortwave infrared (SWIR) band detectors (400nm – 2500nm), and the mid-wave infrared (MWIR – 3um to 5um) and long-wave infrared (LWIR 8um – 13um) thermal bands detectors. Each of these two categories requires a readout integrated circuit (ROIC) optimized for the specific subgroup to efficiently multiplex and readout the photocurrent from the photodiodes.

The first ROIC type optimized for shorter wavelength bands needs to have the following characteristics:

1. Smaller pixel pitch (near 10um) optimized for Nyquist spatial sensing of shorter wavelengths.
2. High gain (smaller well size) to provide good SNR for low flux sensing since these bands have lower irradiance and typically use a narrower bandwidth filter.

The second ROIC type optimized for longer thermal wavelength bands needs to have the following characteristics:

1. Larger pixel pitch (near 20-25um) to match the blur spot size for Nyquist sampling of longer wavelengths.
2. Lower gain (large well size) to provide good SNR for high flux sensing since these bands have higher irradiance and typically use a wider bandwidth filter.

There is an established need to develop a novel ROIC for thermal bands being used for planetary science. Our team has extensive space mission experience to provide NASA with an optimal solution. The proposed ROIC will provide the desired high well capacity, a high frame rate, a large format, space qualifiable design, while simultaneously keeping the cold space power very low. Such as ROIC will be suitable for all typical detector types used for these bands, such as (but not limited to) quantum well IR photodetectors (QWIP), HgCdTe (MCT), and strained-layer superlattices (SLS).

Potential NASA Applications (Limit 550 characters):

. Some of the key NASA applications being addressed by this technology include:

- Landsat upgrade
- Utilizing in SBG type of science missions
- Any NASA planetary science mission requiring MWIR or LWIR bands

Potential Non-NASA Applications (Limit 400 characters):

Some of the key non-NASA applications being addressed by this technology include:

- Overhead Persistent IR (OPIR) space system platforms for DoD
- “New Space” commercial payloads
- Other agency missions, e.g., ISRO missions such as Cartosat and Resourcesat upgrades

Duration: **6**

PROPOSAL NUMBER: 23-1- **S11.04-2312**

SUBTOPIC TITLE: Sensor and Detector Technologies for Visible, Infrared (IR), Far-IR, and Submillimeter

PROPOSAL TITLE: Scalable Data Acquisition System for MKID Detectors

Small Business Concern

Firm: **Alphacore, Inc.**

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Principal Investigator:

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Summary Details:

Estimated Technology Readiness Level (TRL) :

Begin: 2
End: 3
Technical Abstract (Limit 2000 characters):

Alphacore will develop a **low cost**, **radiation-hardened** *Scalable Data Acquisition System (SDAS)* based on an innovative application-specific integrated circuit (ASIC) for Microwave Kinetic Inductance Detectors (MKIDs). The proposed SDAS ASIC will have 4-8 channels for 14-bit accurate Analog to Digital Conversion (ADC) and Digital to Analog Conversion (DAC, for carrier tone generation) with each channel handling >4GHz of bandwidth (instantaneous bandwidth of > 8GHz at 4GS/s per ASIC and tunable bandwidth range of 16GHz) while consuming less than 40 mW per detector readout chain. The SDAS will also have a low power I/O (input/output) user interface with a programmable LVDS. The SDAS ASIC will have several programmable operation modes, with bandwidths of operation of more than 4GHz. In addition, the SDAS will also include flexible intermediate frequency (IF) electronics with a loopback mode for IQ autocalibration and dynamic range measurements. The combination of the digital signal processing and integrated I/O and flexible IF electronics will enable it to serve many millimeter to sub-millimeter-wave experiments.

Alphacore's proposed ultra-low power, rad-hard SDAS system will provide exceptional value to NASA by delivering a combination of performance, robustness, and flexibility with the minimum size, weight and power (SWaP). Alphacore's SDAS will include a high-performance DDS (Direct Digital Synthesizer), an integral part of any KID array readout system needed to provide the gigahertz stimulus to the detectors. Alphacore's key innovations include 1) silicon proven innovative calibration methodologies for ADCs operating in harsh (radiation) environments, 2) small area, ultra-low power polyphase filter bank using re-quantization technique, 3) Low power programmable-*eye*-LVDS based SERDES, and 4) silicon proven ultra-low power all-digital DDS. Alphacore's **existing circuit** blocks can be leveraged in this work to mitigate risk in designing a complex high-performance ASIC.
Potential NASA Applications (Limit 550 characters):

Alphacore's Rad-Hard, Low-Power SDAS ASIC for MKID/TES detectors will support NASA radiometer microwave sensors for a wide range of Earth observation applications and future missions described in decadal surveys. The developed ASIC can be easily scaled to support larger kinetic inductance detector arrays. The SDAS ASIC can be used in instrument upgrades on NASA's current millimeter-wave and submillimeter-wave balloon programs such as EXCLAIM and TIM, and future proposed missions PICO (CMB probe mission) and the Origins Space Telescope (OST).
Potential Non-NASA Applications (Limit 400 characters):

Non-NASA applications for this technology include scientific experiments, such as future cosmic microwave background (CMB) experiments, axion searches and weakly interreacting massive particle searches. On the commercial side, SDAS can support readout for large array MKIDs used to provide visibility through degraded visual environments such as dense fog in many applications.
Duration: **6**

PROPOSAL NUMBER: 23-1- **S11.05-1627**

SUBTOPIC TITLE: Suborbital Instruments and Sensor Systems for Earth Science Measurements

PROPOSAL TITLE: The Airborne Multiangle Aerosol Size Spectrometer: A next generation aerosol probe

Small Business Concern

Firm: **CloudSci, LLC**
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Summary Details:

Estimated Technology Readiness Level (TRL) :

Begin: 3
End: 4
Technical Abstract (Limit 2000 characters):

Atmospheric aerosol have important impacts on climate and air quality and affect efforts to retrieve information regarding the Earth's surface, including oceans. Airborne measurements of aerosol size are critical to understanding physical drivers over time and space, and to validate satellite and other remotely sensed observations. The current state of the art instrument for measuring aerosol size on aircraft is now almost 50 years old, and a replacement is badly needed. We propose development of a next-generation aerosol probe that leverages two scattering measurement techniques to reduce uncertainties -- the Airborne Multiangle Aerosol Size Spectrometer. Integrated side scattering provides sizing information for submicron particles and small angle light scattering provides sizing information for supermicron particles. In this project, we will also determine if the complementary techniques can provide additional information regarding particle shape and refractive index. The goal is to provide a near aircraft ready prototype instrument capable of supporting aerosol measurement requirements for the next decade, integrating modern flow control, electronics, and data processing/output capabilities.

Potential NASA Applications (Limit 550 characters):

The airborne probe would be core measurement instrumentation for suborbital aircraft campaigns examining air quality, climate, and aircraft emissions, and satellite validation. Specific missions with relevance include PACE Satellite mission (ocean biology, aerosols, clouds), the upcoming ACCP Mission (aerosols, clouds, convection, precipitation), TEMPO (geostationary air quality observations), and CAMP2Ex (tropical meteorology and aerosol science).

Potential Non-NASA Applications (Limit 400 characters):

A next-generation aerosol sizing probe would be a core component on research aircraft operated by other US and non-US agencies, including DOE, NCAR, NOAA, DLR (Germany), FAAM (UK), and SAFIRE (France). The optical technology at the heart of the probe could be adapted for ground/laboratory use, opening more applications: air quality monitoring, clean room monitoring, and academic aerosol research.

Duration: **6**

PROPOSAL NUMBER: 23-1- **S12.01-1988**

SUBTOPIC TITLE: Exoplanet Detection and Characterization Technologies

PROPOSAL TITLE: Radiation Resistance Enhanced Class AB Amplifiers for Space Coronagraphic Instruments

Small Business Concern

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Summary Details:

Estimated Technology Readiness Level (TRL) :

Begin: 1
End: 3
Technical Abstract (Limit 2000 characters):