NASA SBIR 2020 Phase I Solicitation

S1.12 Remote Sensing Instrument Technologies for Heliophysics

Lead Center: GSFC

Participating Center(s): HQ, MSFC

Technology Area: TA8 Science Instruments, Observatories & Sensor Systems

Scope Description

The 2013 National Research Council's, Solar and Space Physics: A Science for a Technological Society (http://nap.edu/13060) motivates this subtopic: "Deliberate investment in new instrument concepts is necessary to acquire the data needed to further solar and space physics science goals, reduce mission risk, and maintain an active and innovative hardware development community." This subtopic solicits development of advanced remote sensing instrument technologies and components suitable for deployment on heliophysics missions. These technologies must be capable of withstanding operation in space environments, including the expected pressures, radiation levels, launch and impact stresses, and range of survival and operational temperatures. Technologies that reduce mass, power, volume, and data rates for instruments and instrument components without loss of scientific capability are of particular importance. In addition, technologies that can increase instrument resolution and sensitivity or achieve new and innovative scientific measurements are solicited. For example missions, see https://science.nasa.gov/missions-page?field_division_tid=5&field_phase_tid=All. For details of the specific requirements see the Heliophysics Decadal Survey. Technologies that support science aspects of missions in NASA's Living With a Star and Solar-Terrestrial Probe programs are of top priority, including long-term missions like Interstellar Probe mission (as called out in the Decadal Survey).

Remote sensing technologies are being sought to achieve much higher resolution and sensitivity with significant improvements over existing capabilities. Remote sensing technologies amenable to CubeSats and SmallSats are also encouraged. Specifically, this subtopic solicits instrument development that provides significant advances in the following areas:

- Light Detection and Ranging (LIDAR) systems for high-power, high frequency geospace remote sensing, such as sodium and helium lasers
- Technologies or components enabling auroral, airglow, geospace, and solar imaging in the visible, far-ultraviolet and soft x-ray (e.g., mirrors and gratings with high-reflectance coatings, multi-layer coatings, narrow-band filters, and blazed gratings with high ruling densities)
- Technologies that enable the development of dedicated solar flare sensors with intrinsic ion suppression and sufficient angular resolution in the extreme UV (EUV) to soft x-ray wavelength range such as fast cadence charge-coupled devices, complementary metal-oxide semiconductor devices
- Technologies that enable x-ray detectors to observe bright solar flares in x-ray from 1 to hundreds of keV without saturation
- Technologies that attenuate solar x-ray fluences by flattening the observed spectrum by a factor of 100 to 1000 across the energy range encompassing both low and high energy x-rays – preferably flight

programmable
- X-ray optics technologies to reduce the size, complexity, or mass or to improve the point spread function of solar telescopes used for imaging solar x-rays in the ~1 to 300 keV range
- Technologies that allow polarization and wavelength filtering without mechanical moving parts

Proposers are strongly encouraged to relate their proposed development to NASA's future heliophysics goals as set out in the Heliophysics Decadal Survey (2013-2022) and the NASA Heliophysics Roadmap (2014-2033). Proposed instrument components and/or architectures should be as simple, reliable, and low risk as possible while enabling compelling science. Novel instrument concepts are encouraged particularly if they enable a new class of scientific discovery. Technology developments relevant to multiple environments and platforms are also desired. Proposers should show an understanding of relevant space science needs, and present a feasible plan to fully develop a technology and infuse it into a NASA program. Detector technology proposals should be referred to the S116 subtopic.

References

For example missions, see https://science.nasa.gov/missions

For details of the specific requirements see the National Research Council's, Solar and Space Physics: A Science for a Technological Society (http://nap.edu/13060).

For details of NASA's Heliophysics roadmap, see the NASA Heliophysics Roadmap: https://smd-prod.s3.amazonaws.com/science-red/s3fs-public/atoms/files/2014_HelioRoadmap_Final_Reduced_0.pdf

Expected TRL or TRL range at completion of the project: 3 to 5

Desired Deliverables of Phase II

Prototype, Analysis, Hardware, Software

Desired Deliverables Description

Remote sensing instruments in TRL 3 - 5 for heliophysics science purpose

State of the Art and Critical Gaps

Remote sensing instruments and technologies are essential bases to achieve Science Mission Directorate's (SMD) Heliophysics goals summarized in National Research Council's, Solar and Space Physics: A Science for a Technological Society. These instruments and technologies play indispensable roles for NASA's LWS and STP mission programs, as well as a host of smaller spacecraft in the Explorers Program. In addition, there is growing demand for remote sensing technologies amenable to CubeSats and SmallSats. To narrow the critical gaps between the current state of art and the technology needed for the ever increasing science/exploration requirements, remote sensing technologies are being sought to achieve much higher resolution and sensitivity with significant improvements over existing capabilities, and at the same time with lower mass, power and volume.

Relevance / Science Traceability

Remote sensing instruments and technologies are essential bases to achieve SMD's Heliophysics goals summarized in National Research Council's, Solar and Space Physics: A Science for a Technological Society. These instruments and technologies play indispensable roles for NASA's Living with a Star (LWS) and Solar Terrestrial Probe (STP) mission programs, as well as a host of smaller spacecraft in the Explorers Program. In addition, there is growing demand for remote sensing technologies amenable to Cubesats and Smallsats. NASA SMD has two excellent programs to bring this subtopic technologies to higher level: Heliophysics Instrument Development for Science (H-TIDeS) and Heliophysics Flight Opportunities for Research and Technology (H-FORT). H-TIDeS seeks to advance the development of technologies and their application to enable investigation of key heliophysics science questions. This is done through incubating innovative concepts and development of prototype technologies. It is intended that technologies developed through H-TIDeS would then be proposed to H-FORT to mature by demonstration in a relevant environment. The H-TIDeS and H-FORT programs are in addition to Phase III opportunities.