NASA SBIR 2015 Phase I Solicitation

S1.05 Particles and Field Sensors and Instrument Enabling Technologies

Lead Center: GSFC

Participating Center(s): ARC, JPL, JSC, MSFC

Advanced sensors for the detection of elementary particles (atoms, molecules and their ions) and electric and magnetic fields in space and associated instrument technologies are often critical for enabling transformational science from the study of the sun's outer corona, to the solar wind, to the trapped radiation in Earth's and other planetary magnetic fields, and to the atmospheric composition of the planets and their moons. Improvements in particles and fields sensors and associated instrument technologies enable further scientific advancement for upcoming NASA missions such as CubeSats, Explorers, IMAP, GDC, DYNAMIC, MEDICI, and planetary exploration missions. Technology developments that result in a reduction in size, mass, power, and cost will enable these missions to proceed. Of interest are advanced magnetometers, electric field booms, ion/atom/molecule detectors, and associated support electronics and materials. Specific areas of interest include:Â

- Self-calibrating scalar-vector magnetometer for future Earth and space science missions. Performance goals: dynamic range: Â±100,000 nT, accuracy with self-calibration: 1 nT, sensitivity: 5 pT - Hz-1/2 (max), max sensor unit size: 6 x 6 x 12 cm, max sensor mass: 0.6 kg, max electronics unit size: 8 x 13 x 5 cm, max electronics mass: 1 kg, and max power: 5 W operation, 0.5 W standby, including, but not limited to "sensors on a chip".
- High magnetic-field sensor that measures magnetic field magnitudes to 16 Gauss with an accuracy of 1 part in 105.
- Low-noise magnetic materials for advanced magnetometer sensors with performance equal to or better than those in the 6-81.3 Mo-Permalloy family.
- Deployable magnetic clean booms up to 50cm.
- Strong, lightweight, thin, rigid, compactly stowed electric field booms possibly using composite materials that deploy sensors (including internal harness) to distances of 10 m or more.
- Long wire boom (â‰¥ 50 m) deployment systems for the deployment of sensors attached to very lightweight tethers or antennae on spinning spacecraft.
- Small satellite rigid electric field booms: for three-axis stabilized spacecraft. Note for Cubesat applications: Full three-component measurement (six booms) must fit inside 6U Cubesat form factor, booms must be thin, rigid, and deploy to lengths >= 2m, including sensors and harness.
- Small satellite wire booms: for spinning spacecraft. Two pairs of sensors attached to lightweight tethers or antennae. Note for Cubesat applications: Must deploy to >= 5m and fit inside a 3U or larger Cubesat form factor.
- Development of tools to study spacecraft charging for the purpose of understanding effects on charged particle measurements, particularly at reduced energies.
- Radiation-hardened >200 Krads ASICs including Low-power multi-channel ADCs, DACs >16-bits and > 100MSPS, and >20 bits and >1MSPS.
- Low-cost, low-power, fast-stepping (â‰¤; 50-Âµs), high-voltage power supplies 1V-6kV. High Voltage

opto coupler components as a control element of HVPS, with >12KV isolation and >100 krad radiation tolerance.

- High efficiency (>2% or greater) conversion surfaces for energetic (1eV to 10KeV) neutral atom conversion to ions.
- High reliability cold electron emitters based on MCP or nano technology with emission surfaces 1-1000mm^2 and life time > 20,000.
- Solar Blind particle detectors less sensitive to light for particle detection in the energy Range 1KeV to 100MeV.
- Developing near real-time data-assimilative models and tools, for both solar quiet and active times, which allow for precise specification and forecasts of the space environment, beginning with solar eruptions and propagation, and including ionospheric electron density specification.Â