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 Solar Sentinels, GEC, MAGCON, ITSP 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:

- Self-calibrating scalar-vector magnetometer for future Earth and space science missions. Performance goals: dynamic range: +/-100,000 nT, accuracy with self-calibration: 1 nT, sensitivity: 5 pT / sqrtHz, 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 105.
- Strong, lightweight, thin, compactly-stowed electric field booms possibly using composite materials that deploy sensors to distances of 10m or more.
- Cooled (-60°C) solid state ion detector capable of operating at a floating potential of -15 kV relative to ground.
- Low noise magnetic materials for advanced magnetometer sensors with performance equal to or better than those in the 6-81.3 Mo-Permalloy family.
- Radiation hardened ASIC spectrum analyzer module that determines mass spectra using fast algorithm deconvolution to produce ion counts for specific ion species.
- Low cost, low power, high voltage power supplies 5-15 kV.
- Low power charge sensitive preamplifiers on a chip.

- High efficiency (5% or greater) conversion surfaces for low energy neutral atom conversion to ions possibly based on nanotechnology.

- Long wire boom (>= 50 m) deployment systems for the deployment of very lightweight tethers or antennae on spinning spacecraft.

- Systems to determine the orthogonality of a deployed electric field boom system in flight (for use with three-axis rigid 10-m booms) accurate to 0.1 degrees dynamic.