This subtopic solicits development of advanced instrument technologies and components suitable for deployment on planetary missions which access the widely diverse bodies in our solar system. These instruments must be capable of withstanding operation in space and planetary 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 scientific measurements are solicited. For example missions, see http://science.hq.nasa.gov/missions/solar_system.html. For details of the specific requirements see the Planetary Science Decadal Survey white papers on NASA Assessment Groups websites (OPAG, MEPAG, VEXAG, SBAG) or the National Academy of Science site http://www8.nationalacademies.org/ssbsurvey/publicview.aspx.

Specifically, this subtopic solicits instrument development that provides significant advances in the following areas, broken out by planetary body:

- **Mars**: Sub-systems relevant to current in situ instrument needs (e.g. lasers and other light sources from UV to microwave, X-ray and ion sources, detectors, mixers, mass analyzers, etc.) or electronics technologies (e.g., FPGA and ASIC implementations, advanced array readouts, miniature high voltage power supplies). Technologies that support in situ measurements of elemental, mineralogical, and organic composition of planetary materials. Conceptually simple, low risk technologies for in situ sample extraction and/or manipulation including fluid and gas storage, pumping, and chemical labeling to support analytical instrumentation. Seismometers, mass analyzers, technologies for heat flow probes, and atmospheric trace gas detectors. Improved robustness and g-force survivability for instrument components, especially for geophysical network sensors, seismometers, and advanced detectors (iCCDs, PMT arrays, etc.).

- **Europa**: Technologies, e.g. radiation mitigation strategies, radiation tolerant detectors, and readout electronic components, which enable orbiting instruments to be both radiation hard and undergo the planetary protection requirements of sterilization (or equivalent) for candidate instruments on the Europa-Jupiter System Mission are sought.

- **Titan**: Methods and technologies to achieve much higher resolution and sensitivity orbital instruments with significant improvements over those flown on Cassini. Low mass and power sensors, mechanisms and
concepts for converting terrestrial instruments such as turbidimeters and echo sounders for lake measurements, weather stations, surface (lake and solid) properties packages etc. to cryogenic environments (95K) for use on Titan's surface. Mechanical and electrical components and subsystems that work in cryogenic (95K) environments are particularly sought after. Sample extraction from liquid methane/ethane, sampling from organic 'dunes' at 95K and robust sample preparation and handling mechanisms that feed into mass analyzers are particularly solicited. Balloon instruments, such as IR spectrometers, imagers, meteorological instruments, radar sounders, air sampling mechanisms for mass analyzers, and aerosol detectors are also required.

- **Venus:** Sensors, mechanisms, and environmental chamber technologies for operation in Venus's high temperature, high pressure environment with its unique atmospheric composition. Approaches that can enable precision measurements of surface mineralogy and elemental composition, improved determination of atmospheric and isotopic composition, and external sample acquisition into a pressure vessel are particularly desired. Sample acquisition and processing system for multiple samples that could operate under Venus surface conditions are sought.

- **Small Bodies:** Technologies that can enable sampling from asteroids and from depth in a comet nucleus, improved in situ analysis of comets.

- **Planetary Probes:** Technologies are sought for components, sample acquisition and instrument systems that can withstand the high temperature/pressure of Saturn and Neptune atmospheric probes during entry.

Proposers are strongly encouraged to relate their proposed development to (a) NASA's future planetary exploration goals, and (b) existing flight instrument capability, to provide a comparison metric for assessing proposed improvements. Proposed instrument 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.

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.