



NASA STTR 2007 Phase I Solicitation

T4.04 JPL - Communications

Lead Center: JPL

Long Range Optical Telecommunications

The adaptation of current standard laboratory techniques for deployment on planetary missions is a focus. Proposers are strongly encouraged to relate their proposed technology development to future planetary exploration goals. These goals include geochemical, geophysical and astrobiological objectives.

Instruments for in situ investigations are required for NASA's planned and potential solar system exploration missions. Instruments are required for the characterization of the atmosphere, surface and subsurface regions of planets, satellites, and small bodies. These instruments may be deployed for in situ measurements on surface landers and rovers, and airborne platforms. These instruments must be capable of withstanding operation in space and planetary environmental extremes, which include temperature, pressure, radiation, and impact stresses.

This subtopic seeks advances in instruments and critical components in the following areas:

- X-Ray Diffraction and X-Ray Fluorescence (XRD/XRF) instruments, with capabilities beyond those currently planned for the CHEMIN instrument on the Mars Science Laboratory (MSL - 2009), with a focus on elemental and mineralogical analysis in the Venus surface environment (90 bars CO₂, 450°C);
- Scanning electron microscopy with chemical analysis capability;
- Mass spectrometry/Gas chromatography with improved capabilities over the SAM instrument on MSL or applicability to in situ atmospheric measurements on Venus or Titan;
- Geochronology, with a focus on isotopic dating of planetary surfaces in the 100 Ma to 4.5 Ga timeframe with better than 10% accuracy;

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- Gamma-Ray Spectroscopy, with a focus in short duration (
 - X-Ray Photoelectron Spectroscopy (XPS) and Auger Electron Spectroscopy (AES).

Astrobiology includes the study of the origin, evolution, and distribution of life in the universe. New technologies are required to enable the search for extant or extinct life elsewhere in the solar system, to obtain an organic history of planetary bodies, to discover and explore water sources elsewhere in the solar system, and to detect microorganisms and biologically important molecular structures within complex chemical mixtures.

Astrobiology solicits new measurement concepts, advances in existing instrument concepts, and advances in critical components in the following areas:

- Instrumentation focused on assessments of the identification and characterization of biomarkers of extinct or extant life, such as prebiotic molecules, complex organic molecules, biomolecules, or biominerals. At this time we are not soliciting DNA and RNA analysis techniques.
- High sensitivity (femtomole or better) characterization of molecular structure, chirality, and isotopic composition of biogenic elements (H, C, N, O, S) embodied within individual compounds and structures.

In addition, enabling instrument component and support technologies for the above, such as miniaturized pumps, sample inlet systems, valves, integrated bulk sample handling and processing systems, and fluidic technologies for sample preparation, are also solicited. These must be presented in the context of a complete instrument system.

Long Range Space RF Telecommunications

This subtopic seeks innovative technologies for long-range RF telecommunications supporting the needs of space missions. Proposals are sought in the following areas:

- Ultra-small, light-weight, low-cost, low-power, modular deep-space transceivers, transponders and components, incorporating MMThe adaptation of current standard laboratory techniques for deployment on planetary missions is a focus. Proposers are strongly encouraged to relate their proposed technology development to future planetary exploration goals. These goals include geochemical, geophysical and astrobiological objectives.

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landers and rovers, and airborne platforms. These instruments must be capable of withstanding operation in space and planetary environmental extremes, which include temperature, pressure, radiation, and impact stresses.

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In addition, enabling instrument component and support technologies for the above, such as miniaturized pumps, sample inlet systems, valves, integrated bulk sample handling and processing systems, and fluidic technologies for sample preparation, are also solicited. These must be presented in the context of a complete instrument system. ICs and Bi-CMOS circuits;

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- MMIC modulators with drivers to provide large linear phase modulation (above 2.5 rad), high-data rate (10 - 200 Mbps), BPSK/QPSK modulation at X-band (8.4 GHz), and Ka-band (26 GHz, 32 GHz and 38 GHz);
 - High-efficiency (> 60%) Solid-State Power Amplifiers (SSPAs), of both medium output power (10 W - 50 W) and high-output power (150 W - 1 KW), using power combining techniques and/or wide-bandgap semiconductor devices at X-band (8.4 GHz) and Ka-band (26 GHz, 32 GHz and 38 GHz);
 - Epitaxial GaN films with threading dislocations less than 1e6 per cm² for use in wide band-gap semiconductor devices at X- and Ka-Band;
 - Utilization of nanomaterials and/or other novel materials and techniques for improving the power efficiency or reducing the cost of reliable vacuum electronics amplifier components (e.g., TWTAs and Klystrons);
 - Long lifetime, radiation hard SSPAs, modulators and MMICs for 26 GHz Ka-band (lunar communication);
 - TWTAs operating at higher millimeter wave frequencies (e.g., W-Band) and at data rates of 10 Gbps or higher;
 - Ultra low-noise amplifiers (MMICs or hybrid) for RF front-ends (
 - MEMS-based RF switches and photonic control devices needed for use in reconfigurable antennas, phase shifters, amplifiers, oscillators, and in-flight reconfigurable filters. Frequencies of interest include VHF, UHF, L-, S-, X-, Ka-, V-band (60 GHz) and W-band (94 GHz). Of particular interest is Ka-band from 25.5 - 27 GHz and 31.5 - 34 GHz.