NASA SBIR 2018 Phase I Solicitation

S1.03 Technologies for Passive Microwave Remote Sensing

Lead Center: GSFC

Participating Center(s): JPL

Technology Area: TA8 Science Instruments, Observatories & Sensor Systems

NASA employs passive microwave and millimeter-wave instruments for a wide range of remote sensing applications from measurements of the Earth's surface and atmosphere to cosmic background emission. Proposals are sought for the development of innovative technology to support future science and exploration missions MHz to THz sensors. Technology innovations should either enhance measurement capabilities (e.g., improve spatial, temporal, or spectral resolution, or improve calibration accuracy) or ease implementation in spaceborne missions (e.g., reduce size, weight, or power, improve reliability, or lower cost). Specific technology innovations of interest are listed below, however other concepts will be entertained:Â

- Microwave integrated photonic components to demonstrate feasibility and utility for future microwave instruments. Components used in spectrometers, beam forming arrays, correlation arrays and other active or passive microwave instruments are sought.
- A focal plane array antenna design to enable large aperture microwave radiometers (e.g., 6 meters operating at 37 GHz), conical scanning reflector antennas fed by focal plane arrays are needed. Designs are desired for 4,6, or 12-meter apertures operating at 36.5 GHz and 18.7/23.8 GHz.Â
- Low power RFI mitigating receiver back ends for broad band microwave radiometers.Â NASA requires a low power, low mass, low volume, and low data rate RFI mitigating receiver back-end that can be incorporated into existing and future radiometer designs. The system should be able to channelize up to 1 GHz with 16 sub bands and be able to identify RFI contamination using tools such as kurtosis.
- Calibration Targets for water vapor radiometers operating in the frequency range from 18 to 37 GHz.Â Return loss of > 40 dB and relative emission characterized over physical temperature to 0.1%.
- Components for addressing gain instability in LNA based radiometers from 100 and 600 GHz.Â NASA requires low insertion loss solutions to the challenges of developing stable radiometers and spectrometers operating above 100 GHz that employ LNA based receiver front ends.Â This includes noise diodes with ENR>10dBm with better than â‰¤ 0.01 dB/Â° C thermal stability, Dicke switches with better than 30 dB isolation, phase modulators, and low loss isolators along with fully integrated state-of-art receiver systems operating at room and cryogenic temperatures.
- Technology for low-power, rad-tolerant broad band spectrometer back ends for microwave radiometers. Includes: digitizers starting at 20 Gsps, 20 GHz bandwidth, 4 or more bit and simple interface to FPGA; ASIC implementations of polyphase spectrometer digital signal processing with ~1 Watt/GHz.
- 5-GHz bandwidth polarimetric-spectrometer with 512 channels. Two simultaneously sampled ADC inputs. Spectrometer filterbanks and either polarization combiners or cross correlators for computing all four Stokes parameters (any Stokes vector basis is acceptable: e.g., IQUV, vhUV, vhpmlr). Kurtosis detectors on at least the two principal channels. Rad-hard and minimized power dissipation.

- Local Oscillator technologies for THz instruments. This can include: GaN based frequency multipliers that can work in the 200-400 with better than 30% efficiency GHz range (output frequency) with input powers up to 1 W.Â Graphene based devices that can work as frequency multipliers in the frequency range of 1-3 THz with efficiencies in the 10% range and higher.
- Low DC power correlating radiometer front-ends and low 1/f-noise detectors for 100-700 GHz.Â Correlating radiometers and low 1/f-noise tunnel diode detectors have been demonstrated at frequencies below 100 GHz. 180 GHz correlating radiometer with high DC power LO system demonstrated.
- A radiometer-on-a-chip of either a switching or pseudo-correlation architecture with internal calibration sources is needed.Â Designs with operating frequencies at the conventional passive microwave bands of 36.6 GHz (priority) and 19.7/22.3 GHz enabling dual-polarization inputs.Â Interfaces include, waveguide input, power, control, and digital data output.Â Design features allowing subsystems of multiple (10â€™s of) integrated unites to be efficiently realized.
- GaAs based Schottky diode with low junction capacitance and finger inductance to operate in the 2-5 THz. The diodes should be integrated with waveguide coupling probes and other circuitries to develop 2-5 THz harmonic-mixers with low conversion loss and noise temperature.