NASA SBIR 2017 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). While other concepts will be entertained, specific technology innovations of interest are listed below.

A radiometer-on-a-chip of either a switching or pseudo-correlation architecture with internal calibration sources is needed. Designs with operating frequencies at the conventional passive microwave bands (X, K, Ka) with dual-polarization inputs. Interfaces include waveguide input, power, control, and digital data output. Design features allowing subsystems of multiple (tens of) integrated units to be effectively realized.

A low-power, radiation tolerant, spectrometer back end capable of sampling a 4 GHz bandwidth with up to 16k channels desired.

Microwave integrated photonic components to demonstrate feasibility and utility for future microwave instruments. Components used in spectometers, beam forming arrays, correlation arrays and other active or passive microwave instruments are sought.

Microwave to mm wave blackbody calibration target with a 65 dB return loss, an aperture of 8 cm, and performance from 50 GHz to 1 THz.

A focal plane array antenna design to enable large aperture microwave radiometers conical scanning reflector antennas fed by focal plane arrays are needed. Designs are desired for 4-to-12-meter apertures operating at K and Ka band are needed.

Development of microwave-on-wafer probe station for cryogenic circuit characterization. Proposed capability should support test and validation of normal metals and superconductors. Device under test temperature <2.2K desired, with control over the radiant environment and parasitic heat paths through probes. Demonstration from 0-50 GHz with a 2.4 mm compatible interface desired; however, proposed thermal design should define path forward or enable extension to application at millimeter wavelengths

Components for addressing gain instability in LNA based radiometers from 100 and 600 GHz.

Low power RFI mitigating receiver back ends for broad band microwave radiometers.

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. 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.

Laser-based THz local-oscillator (LO) ultra-broadband heterodyne mixers for remote sensing.