NASA SBIR 2007 Phase I Solicitation

S1.04 Sensor and Detector Technology for Visible, IR, Far IR and Submillimeter

Lead Center: JPL

Participating Center(s): GSFC, LaRC

Advances in detectors, readout electronics, and other technologies enabling polarimetry and large format imaging arrays for the visible, near IR, IR and far IR/submm and spectroscopy with unprecedented sensitivity are sought. These advances may enable future mission concepts such as the Single Aperture Far Infrared (SAFIR) Observatory (http://safir.jpl.nasa.gov/technologies.shtml), Space Infrared Telescope for Cosmology and Astrophysics (SPICA) (http://www.ir.isas.ac.jp/SPICA/), Cosmic Microwave Background Polarization (CMBPol), and Supernova/ Acceleration Probe (SNAP) (http://snap.lbl.gov).

Research should be conducted to demonstrate technical feasibility during Phase 1 and show a path toward a Phase 2 prototype demonstration. Innovations are sought in detector capability for the following wavelength ranges:

- 0.1-1 µm: Increased sensitivity and larger array size. Improved silicon response in the UV and NIR, smart pixel arrays, solar blind response detector arrays, energy resolving calorimeter arrays.

- 1-4 µm: Increased sensitivity and larger array size. Large format cryogenic readout multiplexers, large format (>1000x1000) array hybridization techniques.

- 4-40 µm: Increased sensitivity and larger array size (megapixels). Low power cryogenic multiplexers, new sensor materials (e.g., novel dopants for extrinsic Si detectors).

- 40-200 µm: Increased sensitivity and larger array size (megapixels). Monolithic focal plane arrays (BiB technologies, new sensor materials).

- 200 µm - 1 mm: Noise equivalent power (NEP) of $10^{-20}$ W Hz$^{-1/2}$ in a 1,000 pixel spectroscopic array with low-power readout electronics, and NEP $10^{-18}$ W Hz$^{-1/2}$ in a 10,000 pixel photometric imaging array. Capabilities for photon counting, polarimetry, and energy resolving detection. Heterodyne receiver arrays operating near the quantum limit.
In addition to technologies specific to the astrophysics mission concepts above, NASA is seeking technologies and improvements to technologies leading to successful measurement of carbon monoxide, methane, nitrous oxide and other related trace species from geostationary and low-Earth orbital platforms. Of particular interest are new techniques in gas filter correlation spectroscopy, Fabry-Perot spectroscopy, or better component technologies for these. The following technologies are also of interest for the Scanning Microwave Limb Sounder Earth science instrument concept (http://mls.jpl.nasa.gov/index-cameo.php):

- Efficient, flight qualifiable, spur free, local oscillators for SIS mixers operating in low Earth orbit. Two bands: (1) tunable from 200 to 250 GHz, and (2) tunable from 610 to 650 GHz. Phase-locked to or derived from ultra-stable 5 MHz reference.
- Technologies for calibrating millimeter wave spectrometers for spaceborne missions, including:
  - Low power, flight qualifiable comb generators for gain, linearity, and sideband calibration of microwave spectrometers covering the bands from 180 to 270 GHz and from 600 to 660 GHz;
  - Flight qualifiable low noise diodes for the bands from 180 to 270 and 600 to 660 GHz;
  - Very low return loss (70 dB or better) calibration targets;
  - Techniques for quantifying and calibrating out the impact of standing waves in broadband heterodyne submillimeter spectrometers.
- Low power, stable, linear, spectrometers covering the band from 6-18 GHz with 100 MHz resolution.