NASA SBIR 2016 Phase I Solicitation

S1.03 Sensor and Detector Technology for Visible, IR, Far IR and Submillimeter

Lead Center: JPL

Participating Center(s): ARC, GSFC, LaRC

NASA is seeking new technologies or improvements to existing technologies to meet the detector needs of future missions, as described in the most recent decadal surveys:

- Earth science - (http://www.nap.edu/catalog/11820.html).
- Planetary science - (http://www.nap.edu/catalog/10432.html).
- Astronomy and astrophysics - (http://www.nap.edu/books/0309070317/html/).

Development of un-cooled or cooled infrared detectors (hybridized or designed to be hybridized to an appropriate read-out integrated circuit) with NE"T<20mK, QE>30% and dark currents <1.5x10-6 A/cm^2 in the 5-14 ¼m infrared wavelength region. Array formats may be variable, 640 x 512 typical, with a goal to meet or exceed 2k X 2k pixel arrays. Evolve new technologies such as InAs/GaSb type-II strained layer super-lattices to meet these specifications.

New or improved technologies leading to measurement of trace atmospheric species (e.g., CO, CH_4, N_2O) or broadband energy balance in the IR and far-IR from geostationary and low-Earth orbital platforms. Of particular interest are new direct, nanowire or heterodyne detector technologies made using high temperature superconducting films (YBCO, MgB_2) or engineered semiconductor materials, especially 2-Dimensional Electron Gas (2-DEG) and Quantum Wells (QW) that operate at temperatures achieved by standard 1 or 2 stage flight qualified cryocoolers and do not require cooling to liquid helium temperatures. Candidate missions are thermal imaging, LANDSAT Thermal InfraRed Sensor (TIRS), Climate Absolute Radiance and Refractivity Observatory (CLARREO), BOReal Ecosystem Atmosphere Study (BOREAS), Methane Trace Gas Sounder or other infrared earth observing missions.

1k x 1k or larger format MCT detector arrays with cutoff wavelength extended to 12 microns for use in missions to NEOs, comets and the outer planets.

Compact, low power, readout electronics for Kinetic Inductance Detector arrays with >8bit ADC at >500MHz sampling rate that channelizes into 1000 readout tones each with >5kHz of bandwidth. This type of readout would be used for photometers and spectrometers for astrophysics focal planes, and earth or planetary remote sensing instruments.

Development of new or improved large-format focal plane array Readout Integrated Circuit (ROIC) architectures to provide advanced detection features for overcoming existing limitations for low background astronomical applications. The main limitations of existing source-follower unit cells include potential image persistence and interpixel capacitance induced crosstalk. These limitations have complicated the use of these ROICs in a number of past missions, and will likely be even more constraining as detector performance improves. An improvement of a factor of 2 or more over current state-of-the-art would be of interest. Ideally, this would be done without compromising any good characteristics, but even in the case of a modest degradation in some parameters (like noise), the new features may prove to be superior for some applications.

Development of a robust wafer-level integration technology that will allow high-frequency capable interconnects and allow two dis-similar substrates (i.e., silicon and GaAs) to be aligned and mechanically 'welded' together. Specially develop ball grid and/or Through Silicon Via (TSV) technology that can support submillimeter-wave arrays. Initially the technology can be demonstrated at the '1-inch' die level but should be do-able at the 4-inch wafer level.

New or improved, lightweight spectrometer operating over the spectral range 350 – 2300 nm with 4 nm spectral sampling and that is capable of making irradiance measurements of both the sun and the moon.