



## NASA SBIR 2011 Phase I Solicitation

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

Lead Center: JPL

Participating Center(s): ARC, GSFC, KSC, 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 for Earth science (<http://www.nap.edu/catalog/11820.html>), planetary science (<http://www.nap.edu/catalog/10432.html>), and astronomy and astrophysics (<http://www.nap.edu/books/0309070317/html/>).

The following technologies are of interest for the Scanning Microwave Limb Sounder (<http://mls.jpl.nasa.gov/index-cameo.php>) on the Global Atmospheric Composition Mission, Single Aperture Far Infrared (SAFIR) Observatory (<http://safir.jpl.nasa.gov/technologies.shtml>), the SOFIA (Stratospheric Observatory for Infrared Astronomy) airborne observatory (<http://www.sofia.usra.edu/>), and Inflation Probe (cosmic microwave background, <http://science.gsfc.nasa.gov/660/research/>):

- Radiation tolerant digital polyphase filterbank back ends for sideband separating microwave spectrometers. Requirements are >5GHz instantaneous bandwidth per sideband, 2 MHz resolution, low power (
- Improved submillimeter mixers for frequencies >2 THz are needed for heterodyne receivers to fly on SOFIA. Minimum noise temperatures for cryogenic operation and instantaneous bandwidths >5 GHz are key parameters.
- Large format (megapixel) broadband detector arrays in the 30 to 300 micron wavelength range are needed for SAFIR. These should offer background limited operation with cooled (5 K) telescope optics, and have minimal power dissipation at low temperatures. Low power frequency multiplexers are also of interest for readout of submm bolometer arrays for SAFIR and Inflation Probe.

High performance sensors and detectors that can operate with low noise under the severe radiation environment (high-energy electrons, =1 megarad total dose) anticipated during the Europa Jupiter System Mission (EJSM) are of interest (see the Jupiter Europa Orbiter Mission Study 2008: Final Report, <http://opfm.jpl.nasa.gov/library/>). Notional instruments include visible and infrared cameras and spectrometers, a thermal imager and laser altimeter. Devices can be radiation hardened by design and/or process:

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- Hardened visible imaging arrays with low dark currents even in harsh radiation environments, line or framing arrays suitable for use in pushbroom and framing cameras. Detectors include CCDs (n or p-channel), CMOS imagers, PIN photodiode hybrids, etc.
  - Hardened infrared imaging arrays with a spectral range of 400 to 5000 nm with high quantum efficiency and low dark current, as well as compatible radiation hardened CMOS readouts. These devices could include substrate removed HgCdTe hybrid focal plane arrays responsive from 400 to 2500 nm and IR only focal plane arrays responsive from 2500 nm to 5000 nm.
  - High-speed radiation hardened avalanche photodiodes that respond to a 1.06 micron laser beam suitable for use in time of flight laser rangefinders. Devices should have high and stable gain with lower dark current in harsh radiation environments.
  - Radiation hardened detectors suitable for use in uncooled thermal imagers that respond to spectral bands ranging from 8 to 100 microns. Detectors could include thermopile or microbolometer small line arrays.

Technologies are needed for active and passive wave front and amplitude control, and relevant missions include Extra solar Planetary Imaging Coronagraph (EPIC), and other coronagraphic missions such as Terrestrial Planet Finder ([http://planetquest.jpl.nasa.gov/TPF/tpf\\_index.cfm](http://planetquest.jpl.nasa.gov/TPF/tpf_index.cfm)) and Stellar Imager (<http://hires.gsfc.nasa.gov/si/>):

- Spatial Filter Array (SFA) consisting of a monolithic array of up to 1200 coherent, polarization preserving, single mode fibers, or custom waveguides, that operate with minimal coupling losses over a large fraction of the spectral range from 0.4 - 1.0 microns. The SFA should have input and output lenslet with each pair mapped to a single fiber or waveguide and such that the lenslets maintain path length uniformity to
- MEMS based segmented deformable mirrors consisting of arrays of up to 1200 hexagonal packed segments with strokes over the range of 0 to 1.0 microns, quantized with 16-bit electronics with segment level stabilities of 0.015 nm rms (1-bit) over 1 hour intervals. Segments should be flat to 2 nm rms or better and the substrate flat to 125 nm or better and high uniformity of coatings (1% rms).

Thermal imaging, LANDSAT, all IR Earth observing missions:

- Development of uncooled or passively cooled detectors with NE $\Delta$ T30% in the 6-14  $\mu$ m infrared wavelength region. Formats ~ 640 x 512 with a goal to exceed 3,000 pixel linear dimension. Also, work in promising new technologies such as InAs/GaSb type-II strain layer superlattices.

The Geo-CAPE Mission

Wide Field 0.26-15 $\mu$ m and Narrow Field 0.35-2.1 $\mu$ m. PanFTS 60 $\mu$ m pixel pitch, 256 X 256 format with in-pixel ADC digitization ROIC, 16-bit precision, 16kHz frame rate.

