



## NASA SBIR 2009 Phase I Solicitation

### S1.02 Active Microwave Technologies

Lead Center: JPL

Participating Center(s): GSFC, LaRC

NASA employs active sensors (radars) for a wide range of remote sensing applications (<http://www.nap.edu/catalog/11820.html>). These sensors include low frequency (less than 10 MHz) sounders to G-band (160 GHz) radars for measuring precipitation and clouds and for planetary landing. We are seeking proposals for the development of innovative technologies to support future radar missions. The areas of interest for this call are listed below:

**High-density low-loss millimeter-wave packaging and interconnects** for advanced cloud and precipitation radars or Mars landing radars. These packing and interconnect technologies are critical to achieving the density and RF signal performance required for scanning millimeter-wave array radars. Desired performance specifications include:

- Frequency: 35 - 160 GHz
- Performance at 35 GHz:
  - Interconnect loss:
  - Line loss:

**High-speed, low-power analog-to-digital converters (ADCs) and digital-to-analog converters (DACs)** for advanced SAR, advanced interferometer for surface monitoring, ice topography or hydrology. Digital beam forming (DBF) systems require an array of ADCs. The power consumption of current ADC chips prohibits implementation of large DBF arrays. Furthermore, large arrays require true time delays, which are easily implemented using low-power, high speed ADCs and DACs. Desired performance specifications include:

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- Analog Input Bandwidth: 1.3 GHz
  - Sampling rate: 500 MS/s
  - Resolution 12 bits
  - Power consumption: 100 mW

**High performance miniature bandpass filters** for SMAP, Aquarius follow-on, DESDynI, or Advanced L-band SAR and interferometers. The size of current filters allows for implementation of near-term missions with (with volume and mass penalties) but filter size constrains RF system architectural choices. Desired performance specifications include:

- Center Frequencies: 1.2 - 36 GHz
- Bandwidth: 1%
- Loss:
- Isolation: >30 dB
- Volume: 3

**High-performance mm-wave integrated circuits (MMICs)** for Advanced SAR, advanced interferometer for surface monitoring, ice topography, hydrology, advanced cloud and precipitation radars or Mars landing radars. Besides packaging, performance of MMICs is the main road block to development of electronically scanned arrays at 94 GHz and higher. Desired specifications/technologies include:

- Frequencies: 94 - 350 GHz
- Device types: Lower Noise Amplifiers, Power Amplifiers, Mixers, Oscillators, Phase Shifters, Switches

**Ultra-high efficiency L-band power amplifiers** for Advanced SAR/Interferometers or geosynchronous SAR for earthquake monitoring. Using lower efficiency amplifiers in large arrays leads to much higher power system requirements and thermal management challenges. Desired performance specifications include:

- Frequency: 1.2 - 1.3 GHz
- Efficiency: >85%

**P-band stretch processing imaging radar antennas and transceivers with bandwidth > 100 MHz** for airborne

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SAR applications for Biomass/ecosystems. Wideband P-band radar systems require low power transmitters with high processing gain to avoid interference with other services. Furthermore, achieving fine range resolution will require novel wideband airborne antennas.

**Small radar packaging concepts for Unmanned Aerial Systems (UAS)** for Biomass (P), soil moisture and ocean salinity (L, and C), or snow water equivalent (X, Ku, and Ka). Miniaturization of radar and radiometer components while maintaining power and performance is a requirement for UAV science. Desired performance specifications include:

- Mass: 1.5 lb - 35 lb
- Frequency: P-band, L-band, C-band, X-band, Ku -band, and Ka-band
- High Efficiency SSPAs: > 70% efficiency (P, L and C), > 20% (ka)

**High power/high efficiency Ka-band and W-band solid state and TWT amplifiers** for Aerosol/Cloud/Ecosystems (ACE) Mission. Spaceborne applications require higher power and efficiency than currently available. Desired performance specifications include:

- SSPA power: > 10 W (Ka-band) and > 2 W (W-band)
- TWT power: > 1kW (Ka-band) and > 200 W (W-band)
- Efficiency: > 20%.
- Phase Linearity:

**Simultaneous, multi-frequency U-band transceivers, frequency converters, and amplifiers** for airborne/spaceborne applications for barometric pressure measurements in support of NASA/NOAA hurricane science, NWS/aviation weather or decadal survey missions. Currently available airborne and space-qualified U-band (50 - 60 GHz) transceiver and components do not support simultaneous operation at multiple frequencies within the band.

**Wide bandwidth, U-band antennas for airborne/spaceborne applications** for barometric pressure measurements in support of NASA/NOAA hurricane science, NWS/aviation weather, or decadal survey missions. Currently available antennas do not compensate for wide bandwidth (50 - 60 GHz) operation; consequently, main beam characteristics (e.g., beamwidth, gain, pointing angle, polarization, etc.) vary according to frequency. The need is for a light-weight, aviation/space-qualifiable antenna capable of operating over 50 - 60 GHz without significant variation in main beam characteristics.

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**Membrane materials for large inflatable membrane antennas** for remote sensing applications for earth and planetary science missions. Reflectors manufactured from polymer films could enable greater packaging efficiencies due to their low mass, high packaging efficiencies, solar radiation resistance, and cryogenic flexibility. However, these polymer films must also exhibit near zero CTE and stability in the space environment, as well as be deployable wrinkle free. Innovative intrinsically electroactive polymer membrane actuation mechanisms that can reduce the bulk of traditional active control systems are also of interest. Proposals for remote sensing antenna membrane materials technology are being solicited and should be submitted to subtopic "O1.02 - Antenna Technologies" in the Space Operations portion of this solicitation. Such proposals should indicate that they are applicable to remote sensing antennas.

**Composite materials for large deployable antenna reflector structures** for remote sensing applications for earth and planetary science missions. These antennas will require high specific stiffness composite materials that can be packed compactly and deployed multiple times for ground evaluation of the antenna structure prior to launch and deployment in space. The deployment of these materials should require low energy. Proposals for remote sensing antenna composite materials technology are being solicited and should be submitted to subtopic "O1.02 - Antenna Technologies" in the Space Operations portion of this solicitation. Such proposals should indicate that they are applicable to remote sensing antennas.

Proposals should show an understanding of one or more relevant science needs, and present a feasible plan to fully develop a technology and infuse it into a NASA program.