NASA SBIR 2008 Phase I Solicitation

S1.07 Cryogenic Systems for Sensors and Detectors

Lead Center: GSFC

Participating Center(s): ARC, JPL, MSFC

Cryogenic cooling systems are often enabling technologies for cutting edge science from infrared imaging and spectroscopy to x-ray calorimetry. Improvements in cryogenic technologies enable further scientific advancement at lower cost, lower risk, reduced volume, and/or reduced mass. Lifetime, reliability, and power requirements of the cryogenic systems are critical performance concerns. Of interest are cryogenic technologies for cooling detectors for scientific instruments and sensors on advanced telescopes and observatories (http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20070018750_2007018830.pdf) as well as on instruments for lunar and planetary exploration such as missions to Europa, Titan, or Enceladus (http://sci.esa.int/science-e/www/object/index.cfm?fobjectid=42337). Active coolers should have long life, low vibration, low mass, low cost, and high efficiency. Specific areas of interest include:

- Essentially vibration-free cooling systems such as Pulse Tube or reverse Brayton cycle cooler technologies with cooling capability of 20 mW at 4K.
- Low temperature cooling systems, operating and rejecting heat at 150K, providing 0.3W of cooling at 35K with input power on the order of 10W.
- Distributed cooling systems using circulators for larger systems including helium circulators. The temperature range is 20-100K, with flowrates of up to 1 gram/sec and a maximum pressure drop of 50 psi.
- Heat switches for redundant cryocoolers with a temperature range of 20-100K and a capacity of 20W.
- Highly efficient magnetic and dilution cooling technologies under 1 Kelvin.
- Components for advanced magnetic coolers (adiabatic demagnetization refrigerators) including:
  - Small (few cm bore), lightweight, low current (under 10A, goal under 5A) superconducting magnets capable of producing at least 3 Tesla central field while operating at least 10 Kelvin. Higher temperature superconductor (HTS) magnets operating at significantly higher temperatures are of particular interest.
  - Lightweight (relative to standard ferromagnetic flux guides) active and/or passive magnetic shielding for 3 to 4 Tesla magnets that reduces the stray field to tens of microTesla at a distance of several cm from the outside of the shield.
  - Large (>1 cubic cm) single crystal or polycrystalline magnetocaloric materials.
  - Superconducting current leads operating between 90 Kelvin down to 10 Kelvin, capable of carrying up to 10 amperes while allowing only approximately 1 mW of heat to be conducted.
  - Compact, accurate, easy to use thermometers that operate down to 10 milliKelvin.

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.