NASA SBIR 2011 Phase I Solicitation

S3.02 Thermal Control Systems

Lead Center: GSFC

Participating Center(s): ARC, GRC, JPL, JSC, MSFC

Future Spacecraft and instruments for NASA's Science Mission Directorate will require increasingly sophisticated thermal control technology. Innovative proposals for the crosscutting thermal control discipline are sought in the following areas:

- New generations of electronics used on numerous missions have higher power densities than in the past. High conductivity, vacuum-compatible interface materials that minimize losses across make/break interfaces are needed to reduce interface temperature gradients and facilitate heat removal.
- Sensitive instruments and electronics drive increased requirements for high electrical conductivity on spacecraft surfaces. This has increased the need for advanced thermal control coatings, particularly those with low absorptance, high emittance, and good electrical conductivity. Also, variable emittance surfaces to modulate heat rejection are needed.
- Exploration science missions beyond Earth orbit present engineering challenges requiring systems that can withstand extreme temperatures ranging from high temperatures on Venus to the cryogenic temperatures of the outer planets. High performance insulation systems, which are more easily fabricated than traditional multi-layer (MLI) systems, are required for both hot and cold environments. Potential applications include traditional vacuum environments, low-pressure carbon dioxide atmospheres on Mars, and high-pressure atmospheres found on Venus. Systems that incorporate Micro-meteorite and Orbital Debris protection (MMOD) are also of interest.
- Future high-powered missions, some possibly nuclear powered, may require active cooling systems to efficiently transport large amounts of heat. These include single and two-phase mechanically pumped fluid loop systems which accommodate multiple heat sources and sinks; and long life, lightweight pumps which are capable of generating a high pressure head. It also includes efficient, lightweight, oil-less, high lift vapor compression systems or novel new technologies for high performance cooling up to 2 KW.
- Phase change systems are needed for Mars, Venus, or Lunar applications. Reusable phase change systems are desired which can be employed to absorb transient heat dissipations during instrument operations. Technology is sought for phase change systems, typically near room temperature, which can then either store this energy or provide an exothermic process that would provide heat for instrument power-on after the dormant phase.

Research should be conducted to demonstrate technical feasibility during Phase I and show a path toward a Phase II hardware demonstration. Phase II should deliver a demonstration unit for NASA testing at the completion of the Phase II contract.

Note to Proposer: Subtopic X3.04 Thermal Control Systems for Human Spacecraft, under the Exploration Mission Directorate, also addresses thermal control technologies. Proposals more aligned with exploration mission requirements should be proposed in X3.04.