NASA SBIR 2014 Phase I Solicitation

S3.07 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 cross-cutting thermal control discipline are sought in the following areas:

- Future highly integrated electronics for CubeSat/SmallSat will drastically increase the performance per unit volume, mass and power of electronics systems. High flux heat acquisition and transport devices are required. In addition, high conductivity, vacuum-compatible interface materials are needed in order to reduce interface temperature gradients and facilitate efficient heat removal.
- Components of advanced small spacecraft such as CubeSat/SmallSat will have very small masses (i.e., small thermal capacitance), and their temperatures are highly sensitive to variations in the component power output and spacecraft environmental temperature. Advanced thermal devices capable of maintaining components within their specified temperature ranges are needed. Some examples are:
    - Phase change systems with high thermal capacity, low volume and low mass for endothermic/exothermal thermal management and conditioning.
    - Durable thermal coatings with low absorptance, variable emmittance, and good electrical conductivity.
    - High performance, low cost insulation systems for diverse environments.
    - Passive radiator turn-down devices to enable variation of heat rejection rates.
- Advanced thermal control systems with easily adaptable/reconfigurable thermal management architectures are needed in order to accommodate multiple heat sources and multiple heat sinks, particularly a thermal system that can facilitate heat sharing among on and off components and heat dissipation among multiple radiators placed on various locations on the spacecraft surface. Also needed are improved design and analysis tools for rapid design, integration and testing, and flight operations.
- Thermal control systems for long duration operation are needed, including long life pumps, single-phase and two-phase mechanically pumped fluid systems, components adaptable to distributed heat acquisition and rejection in diverse environments such as high radiation doses (Europa, etc.), and novel heat lift capabilities that enable operation in warm environments.
- Advanced detectors and optical systems at infrared wavelengths require efficient cooling methods to low temperatures. Advanced cryogenic thermal devices for precision temperature measurement and control over much larger sensor areas than currently possible are needed.

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 H3.01 Thermal Control for Future Human Exploration Vehicles, under the Human

Exploration and Operations Mission Directorate, also addresses thermal control technologies. Proposals more aligned with exploration mission requirements should be proposed in H3.01.