NASA SBIR 2007 Phase I Solicitation

S3.02 Thermal Control Systems

Lead Center: GSFC

Participating Center(s): GRC, JPL, MSFC

Future Spacecraft and instruments for NASA’s Science Mission Directorate will require increasingly sophisticated thermal control technology. Research should be conducted to demonstrate technical feasibility during Phase 1 and show a path toward a Phase 2 demonstration, and when possible, deliver a demonstration unit for functional and environmental testing at the completion of the Phase 2 contract. Innovative proposals for thermal control technologies are sought in the following areas:

- Optical systems, lasers, and detectors require tight temperature control, often to better than +/- 1°C. Some new missions such as CON-X and LISA require thermal gradients held to micro-degree levels. Methods of precise temperature measurement and control to this level are needed.

- Heat flux levels from lasers and other high power devices are increasing, with some projected to go as high as 100 W/cm², especially for proposed wind/Lidar missions. They will require thermal technologies such as spray and jet impingement cooling. Also, high conductivity, vacuum-compatible interface materials will be needed to minimize losses across make/break interfaces.

- Future missions such as TPF will use large structures, like mirrors and detector arrays, at both ambient and cryogenic temperatures. Some anticipated technology needs include: advanced thermoelectric coolers capable of providing cooling at ambient and cryogenic temperatures, high conductivity materials to minimize temperature gradients and provide high efficiency light-weight radiators, and advanced thermal control coatings such as variable emittance surfaces and coatings with a high emissivity at ambient and cryogenic temperatures.

- Future advanced spacecraft present engineering challenges requiring systems which are more self-sufficient.

Some of the technology needs are:
• Single and two-phase mechanically pumped fluid loop systems which accommodate multiple heat sources and sinks, and long life, lightweight pumps for these systems;

• Efficient, lightweight vapor compression systems for cooling up to 2 KW;

• Advanced thermal modeling techniques that can be easily integrated into existing codes, emphasizing inclusion of two-phase system and mechanically pumped system models;

• Integration of standardized formats into existing codes for the representation and exchange of Thermal Network Models and Thermal Geometric Models and results.