



NASA SBIR 2009 Phase I Solicitation

X1.03 Radiation Hardened/Tolerant and Low Temperature Electronics and Processors

Lead Center: LaRC

Participating Center(s): GSFC, JPL, MSFC

Constellation projects that are designed to leave low-earth orbit (Orion, Ares V Earth Departure Stage, Altair, Lunar Surface Systems, EVA suits, etc.) require avionic systems, components, and controllers that are capable of operating in the extreme temperature and radiation environments of deep space, the lunar surface, and eventually the Martian surface. Spacecraft vehicle electronics will be required to operate across a wide temperature range and must be capable of enduring frequent (and often rapid) thermal-cycling. Packaging for these electronics must be able to accommodate the mechanical stress and fatigue associated with the thermal cycling. Spacecraft vehicle electronics must be radiation hardened for the target environment. They must be capable of operating through a minimum total ionizing dose (TID) of 100 krads (Si) or more and providing single-event latchup immunity (SEL) of 100 MeV cm²/mg or more.

Considering the extreme environment performance parameters for thermal and radiation extremes, proposals are sought in the following specific areas:

- Low power, high efficiency, radiation-hardened processor technologies;
- Field Programmable Gate Array (FPGA) technologies;
- Innovative radiation hardened volatile and nonvolatile memory technologies;
- Tightly-integrated electronic sensor and actuator modules that include power, command and control, and processing;
- Radiation-hardened analog application specific integrated circuits (ASICs) for spacecraft power management;
- Radiation-hardened DC-to-DC converters and point-of-load power distribution circuits;
- Computer Aided Design (CAD) tools for predicting the electrical performance, reliability, and life cycle for low-temperature and wide-temperature electronic systems and components;

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- Physics-based device models valid at temperature ranging from -230°C to $+130^{\circ}\text{C}$ to enable design, verification and fabrication of custom mixed-signal and analog circuits;
 - Circuit design and layout methodologies/techniques that facilitate improved radiation hardness and low-temperature (-230°C) analog and mixed-signal circuit performance;
 - Packaging capable of surviving numerous thermal cycles and tolerant of the extreme temperatures on the Moon and Mars, which includes the use of appropriate materials including substrates, die-attach, encapsulants, thermal compounds, etc.