NASA SBIR 2010 Phase I Solicitation

S3.10 Earth Entry Vehicle Systems

Lead Center: LaRC

Participating Center(s): ARC

This subtopic seeks innovations to meet Science Mission Directorate (SMD) requirements for Earth Entry Vehicles (EEV). Advancements in materials, structures, and systems related to sample return missions to the Moon, planetary bodies (e.g., Mars and Venus), small bodies (e.g., asteroids, comets, and Near-Earth Objects) and outer planet bodies are desired.

EEVs provide several challenges to current material and structural designs in several areas. New classes of structure and impact materials are needed which are lightweight and versatile, remaining stiff during impact with soft surfaces while providing low impact loads when crushing with impact to hard surfaces. Lightweight structures that are suitable for thermal protection system (TPS) substructures, including serving as a thermal barrier or sink, are also desired. Current EEV concepts are blunt-body vehicles (60-degree sphere cones) that are 0.5 to 2.0 meters in diameter, entering Earth's atmosphere at 11-16 km/s.

This subtopic also seeks proposals that explore new technologies in several key vehicle systems that include:

- **Low mass/cost/complexity**, high reliability impact attenuation systems capable of keeping peak impact loads below 1500 g's under nominal conditions, or 2500 g's under off-nominal conditions (i.e. impact with a rock or hard man-made surface, e.g. concrete road). Payload stroke resulting from compression of candidate impact foam must not exceed 2.5% of the vehicle overall diameter.
- Lightweight structures that are suitable for TPS substructures (i.e., lightweight, stiff, good insulator).
- Mid-density robust ablator systems that can be tailored to entry heating for a range of missions from high speed to low speed, and are easy to manufacture across the range of possible vehicle scales.
- Adhesives that are compatible with lightweight structures and TPS.
- Passive (or nearly passive), self-contained methods of determining whether a micrometeoroid strike (of the TPS) has occurred.
- Low mass, low power, reliable self-contained beacon for EEV retrieval.
- Candidate beacon mass must not exceed 100g (including power and activation) and must provide a reliable signal for up to 2 days after landing/impact.
- Low mass, low power, reliable, self-contained GPS with broadcast system and the antenna to beam the trajectory and landing location information to IRIDIUM or other easily accessible commercial global communication systems as an aid to locating the landed EEV.
- Thermal control system technologies for EEVs will be covered under sub-topic S3.02 Thermal Control Systems.
- EEV closing and locking mechanism(s) that are reliable and easily verifiable.

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.

Other subtopics that could be soliciting entry, descent, and landing related technology developments include S5.01 Entry, Descent and Landing Technologies, X9.01 Ablative Thermal Protection Systems, and X9.02 Advanced Integrated Hypersonic Entry Systems. Proposals more aligned with exploration mission requirements should be proposed in X9.