



Prioritized Technology: Heat Shield Technologies for Planetary Entry and Sample Return – Deployable Aeroshells

Technical Goal

- Advanced entry system architectures are required to enable NASA's ambitious planetary surface missions.
 - The state of the art is high ballistic coefficient aeroshells with metallic substructures and rigid thermal protection system (TPS) resulting in heavy systems constrained by the size of the launch vehicle shroud.
 - Traditional aeroshell technologies are currently at the size limit for Mars payload mass capability (one metric ton).
- Inflatable/deployable aeroshells offer several benefits as compared to traditional, rigid, fixed-shape aeroshells.
 - Reduced entry system mass fraction and improved payload packaging flexibility.
 - Low deceleration loads for the safe delivery of sensitive scientific instruments.
 - May eliminate the need for supersonic parachutes at Mars
 - Higher-altitude deceleration results in increased planetary surface access and allows more time for precision landing sensor acquisition.
 - Elimination of launch-shroud constraints on aeroshell diameter.
 - Flexible thermal control and communications during interplanetary cruise.

Technical Status

Current and Next Steps:

- Two successful hypersonic inflatable aerodynamic decelerator (HIAD) 3-m scale sounding rocket tests (latest in 2012).
 - Six-meter ground article built and tested.
 - Twelve-meter-scale inner toroids manufactured.
 - Six-meter article test from Earth orbit planned for FY21.
- Aerodynamic and arcjct testing complete for a 0.7-m scale mechanical deployable (ADEPT)
 - ADEPT sounding rocket test funded and scheduled for FY18.
- There are several key challenge areas that must be addressed in advance of mission infusion (challenges vary with scale and environment).
 - Development and demonstration of flexible thermal protection system (TPS) materials at large scale.
 - Demonstration of thermostructural stability for high temperatures and high structural loads.
 - Management of load transfer and aeroshell shape stability/control with scale-up.
 - Reliability of deployable/inflatable Entry, Descent, and Landing (EDL) architectures.

Mission Applications

- Deployable aeroshells are applicable to both Aerocapture and EDL for Venus, Earth return, Mars, and Titan missions.
- Deployable aeroshells may enable secondary aerocapture or entry probe payloads for Discovery-class missions or Technology Demonstration Opportunities.

