NASA SBIR 2008 Phase I Solicitation

A2.06 Aerothermodynamics

Lead Center: LaRC

Participating Center(s): AFRC, ARC, GRC

Development of accurate tools to predict aerothermal environments and their effects on space vehicles is critically important to achieving the goals of current NASA missions. These tools will also enable the development of advanced spacecraft for future missions by reducing uncertainties during design and development.

The large size and high re-entry velocity of the Crew Exploration Vehicle and the conditions encountered in proposed aerocapture missions to Titan, Neptune, and Venus require study of shock layer radiation phenomena, radiative heat transfer, and non-equilibrium thermodynamic and transport properties; these in turn require understanding of the internal structure and dynamics of the constituent gases.

Transition and turbulence effects are particularly complex in hypersonic flows, where unique problems are posed by shocks, real gas effects, body surfaces with complex and possibly time-dependent roughness, nose bluntness, ablation, surface catalyticity, separation, and an unknown free-stream disturbance environment.

At the heating rates encountered during hypersonic re-entry, surface ablation products blowing into the boundary layer introduce new interactions including chemical reactions and radiation absorption, that strongly affect surface heating rates and integrated heat loads.

Proposals suggesting innovative approaches to any of these issues are encouraged; specific research areas of interest include:

- Computational analysis methods for radiation and radiation transport in the shock layer surrounding planetary entry vehicles;
- Advanced physics-based thermal and chemical non-equilibrium models for thermodynamics, transport, and radiation;
- Studies of the interactions of gases in the shock layer with ablating materials from the vehicle thermal protection system;
- Experimental methods and diagnostics to measure the characteristics of hypersonic flow fields, either in flight or in ground-based facilities;
- Software tools coupling radiation, non-equilibrium chemistry, Reynolds-averaged Navier-Stokes, and large eddy simulation codes to enable the design and validation of mission configurations for en-try into planetary atmospheres.