NASA SBIR 2017 Phase I Solicitation

Z10.01 Cryogenic Fluid Management

Lead Center: GRC

Participating Center(s): JSC, MSFC

Technology Area: TA14 Thermal Management Systems

This subtopic solicits technologies related to cryogenic propellant (such as hydrogen, oxygen, and methane) storage, and transfer to support NASA's exploration goals. This includes a wide range of applications, scales, and environments consistent with future NASA missions. Such missions include but are not limited to a Methane Upper Stage and In-Situ Resource Utilization in cooperation with Mars Landers in support of the Evolvable Mars Campaign.

Specifically, listed in order of importance:

- Analysis of cryogenic systems for improved modeling of turbulence effects on heat and mass transfer across the liquid/gas interface. Of particular interest are improved models for turbulent heat transfer and mass transfer across the liquid/gas interface that can be applied to Unsteady Reynolds Averaged Navier-Stokes (URANS) simulations using Eulerian-based two-phase models, such as Volume of Fluid. Data to guide modeling efforts such as NASA-TM-2003-212926 or NASA-TM-105411.
- Mars surface cryogenic storage requires a vacuum jacket in order to reduce heat leak and power requirements. A lightweight vacuum jacketed system may be possible, where the vacuum jacket is designed for Mars atmospheric pressure (5-7 torr). The vacuum jacket may be launched purged, evacuated upon reaching orbit, and then sealed prior to Mars entry. The vacuum jacketed system would then have to retain a vacuum for several years while on the surface of Mars.
- New and improved technologies that provide for the densification (or sub-cooling) of cryogenic propellants. Propellant conditioning systems that allow for the production and maintenance of densified propellants that support operations including transfer and low-loss storage are of prime interest for future space vehicle and ground launch processing facilities.
- Analysis of cryogenic systems sometimes requires computational fluid dynamics, especially when significant deformation or breakup of the liquid/gas interface occurs. For many components, or for settled conditions, a simpler fluid and thermal network approach may be sufficient. Of interest is the capability to tightly couple CFD and fluid/thermal network approaches, such as a fluid-thermal network analysis of an active pressure control system coupled to a CFD simulation of the fluid and thermodynamics occurring in a cryogenic storage tank.