Multi-Phase Flow Experiment for Suborbital Testing (MFEST)

Problem Statement

- Multi-phase flow systems (like those used for water processing) are gravity sensitive; MFEST is designed to operate under Earth-normal and near-zero gravity; testing will evaluate system stability throughout the flight profile to support future space missions.
- Suborbital flight would allow long-duration, continuous operational testing with variable gravity over a wide range.
- NASA and other government agencies (e.g., DARPA), and commercial companies (e.g., ACT, Inc. (see below).

Technology Development Team

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- Partner: Space Engineering Research Center (SERC) at Texas A&M; Charles Hill; hill@tamu.edu
- Expected Partner: Advanced Cooling Technologies, Inc.; Mike Ellis; Mike.Ellis@1-act.com

Proposed Flight Experiment

Experiment Readiness:

- Experiment being prepared for September parabolic flight campaign. Targeting to be ready for Suborbital Flight in 2013.

Test Vehicles:

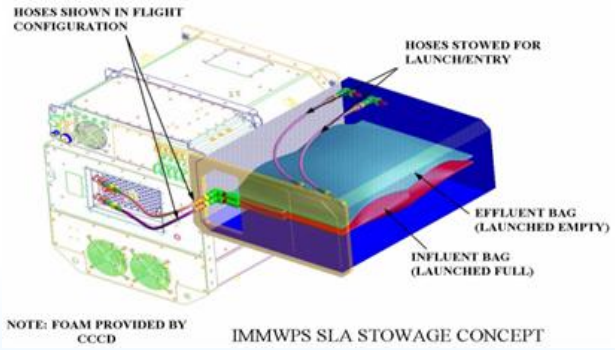
- Parabolic aircraft for early checkout of payload and data collection. SpaceShip Two requested for suborbital testing, due to size of payload.

Test Environment:

- Payload has not flown as an integrated test package prior, but component(s) like the multi-phase flow separator have been flown successfully on parabolic aircraft to obtain basic flow data (e.g., pressure drop). Requesting both parabolic and suborbital flight, to allow longer-duration, continuous operational testing with variable gravity over a wider range, for both the unique separator concept and two-phase flow system design.

Test Apparatus Description:

- MFEST is a modified version of a previous flight experiment that was originally designed for the Space Shuttle mid-deck, but was never flown due to mass, crew time, and other mission limitations. A paper by Hurlbert et al., (2002) fully describes the hardware completed, tested, and certified as ready for flight nearly a decade ago. The experiment is expected to operate autonomously through the flight.



Technology Maturation

- The current MFEST is TRL 5, but the hardware will require checkout, refurbishment, and/or modification prior to suborbital flight.
- Suborbital testing will advance MFEST to TRL 6/7, as it will provide testing in the relevant future mission environment.

Objective of Proposed Experiment

- The primary objectives of the parabolic flight campaign for MFEST are to conduct precursor testing of the integrated experiment in a simulated environment, to checkout the hardware and procedures prior to suborbital flight, and to obtain basic flow systems data in preparation for the suborbital flight(s).
- The primary objective of the suborbital flight for MFEST is to conduct a pathfinder, suborbital flight experiment that focuses on two-phase fluid flow and separator operations through a representative launch, suborbital, and entry profile.
- The test program would verify functional operations of the multi-phase flow system and unique separator for a relatively long duration with variable gravity, in support of future space vehicle designs and missions.

The proposed experiment can be applicable to technologies designated in multiple draft OCT Space Technology Roadmaps: TA02, In-Space Propulsion Technologies; TA03, Space Power and Energy Storage; TA06, Human Health, Life Support and Habitation Systems; TA07, Human Exploration Destination Systems; and TA14, Thermal Management Systems.