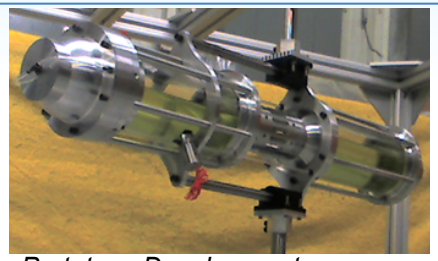
Investigation to Determine Rotational Stability of On-Orbit Propellant Storage and Transfer Systems Undergoing Operational Fuel Transfer Scenarios

STATUS QUO



- *Prototype Development*
  - *Completed*
- *Validation/Ground Testing*
  - *Completed by July 1st, 2011*
- *Parabolic Flight Hardware (TASR)*
  - *Fit Tested/Ready for Flight*
- *sRLV Equipment – Development Stage*

NEW INSIGHTS

Investigation Focus Area:

On-Orbit Propellant Storage and Transfer Technology

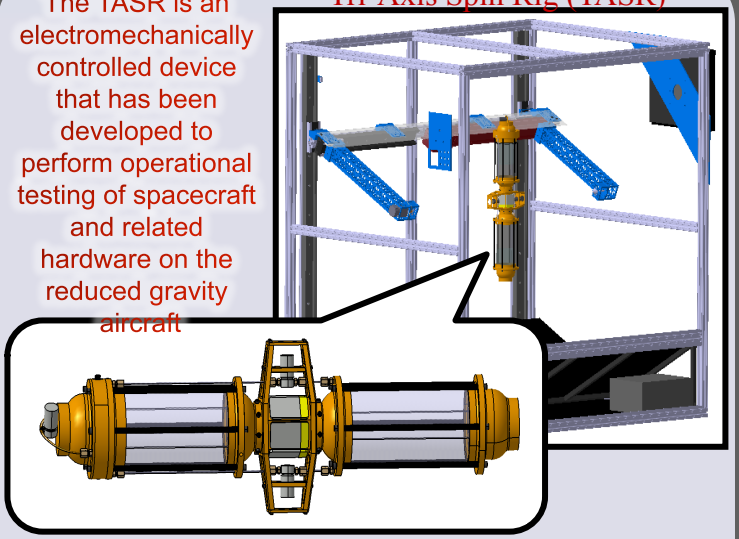
Specific Benefits:

TRL Advancement of On-Orbit Refueling Technology

The advancement of this technology will help enable the aggregation of propellant from multiple launches to enable robust beyond LEO exploration of the Moon, NEO's, Mars and beyond.

Tri-Axis Spin Rig (TASR)

The TASR is an electromechanically controlled device that has been developed to perform operational testing of spacecraft and related hardware on the reduced gravity aircraft



Scaled On-Orbit Propellant Storage and Transfer System

MAIN ACHIEVEMENT: The on-orbit propellant storage and transfer system being tested is derived from the Centaur upper stage of the Atlas launch vehicle. A 1:37 scale mock-up of this system has been developed and is currently being validated through ground testing. Primary test objectives include performing operationally similar propellant transfers between various tanks on the scale system while the system is spun about its minor axis. Secondary objectives include similar transfers between the scale system and an adjacent spacecraft. *Parameters of interest are*: Pressure Gradients between tanks, transfer times, corresponding mass flow rates, and changes in the system's angular acceleration. Liquid propellant slosh as well as capillary effects are expected to develop and are of specific scientific interest.

QUANTITATIVE IMPACT

Quantitative Results:

Results gathered during flight testing will be used to advance the TRL of the proposed technology as well as to validate computational modeling approaches using CFD and mechanical models

Measured/ Parameters:

- Angular Velocity (Spin Rate)
- Angular Acceleration (Changes in system's spin rate)
- Pressure Gradients
- Temperature Changes

END-OF-PHASE GOAL

On-Orbit Refueling of Spacecraft Becomes a Closer Reality

Technology Readiness Level goes from 4 to 6:

- *Testing in relevant environment*
- *Possible Cryogenic testing of operationally similar hardware*
- *Future full scale testing*
- *Prototype development of more advanced systems such as CRYOTE*

Refueling spacecraft on-orbit will be a "Game Changing" technology advancement that will open the door for long term space missions to Near Earth Object's (NEO's) and interplanetary travel.