



# Space Technology Programs



Transformative &  
Crosscutting  
Technology  
Breakthroughs

Pioneering Concepts/  
Developing  
Innovation  
Community

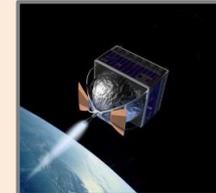
Creating Markets &  
Growing Innovation  
Economy



**Game Changing  
Development Program**



**Technology  
Demonstration  
Missions Program**



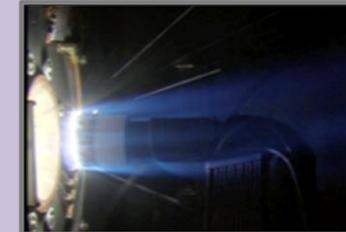
**Small Spacecraft  
Technologies Program**



**Space Technology  
Research Grant Program**



**NASA Innovative  
Advanced Concepts  
(NIAC) Program**



**Center Innovation Fund  
Program**



**Centennial Challenges  
Prize Program**



**Small Business Innovation Research  
& Small Business Technology  
Transfer (SBIR/STTR) Program**



**Flight Opportunities  
Program**



# Why TDM?



Infusing Revolutionary, Crosscutting Technologies to Benefit NASA and the Nation



# Alignment with Technology Areas



## Technology Areas

### ETD: TDM

FY 10    FY 11    FY 12    FY 13    FY 14    FY 15    FY 16    FY 17



Human Exploration Telerobotics (HET)

⑤ ..... → ⑦



Cryogenic Propellant Storage and Transfer (CPST)

⑤ ..... → ⑥



Materials ISS Experiment-X (MISSE-X)

⑤ ..... → ⑧



Green Propellant Infusion Mission

⑤ ..... → ⑦



MSL EDL Instrument (MEDLI)

⑦ ..... → ⑨

## Technology Areas

### CSTD: TDM

FY 10    FY 11    FY 12    FY 13    FY 14    FY 15    FY 16    FY 17



Low Density Supersonic Decelerators (LDSD)

⑤ ..... → ⑥



Laser Communications Relay Demonstration (LCRD)

⑥ ..... →



Deep Space Atomic Clock (DSAC)

⑤ ..... → ⑦



Solar Sail Demonstration (SSD)

⑤ ..... → ⑨

## Technology Areas (TA)

- TA.1. Launch Propulsion
- TA.2. In-Space Propulsion
- TA.3. Space Power/Storage

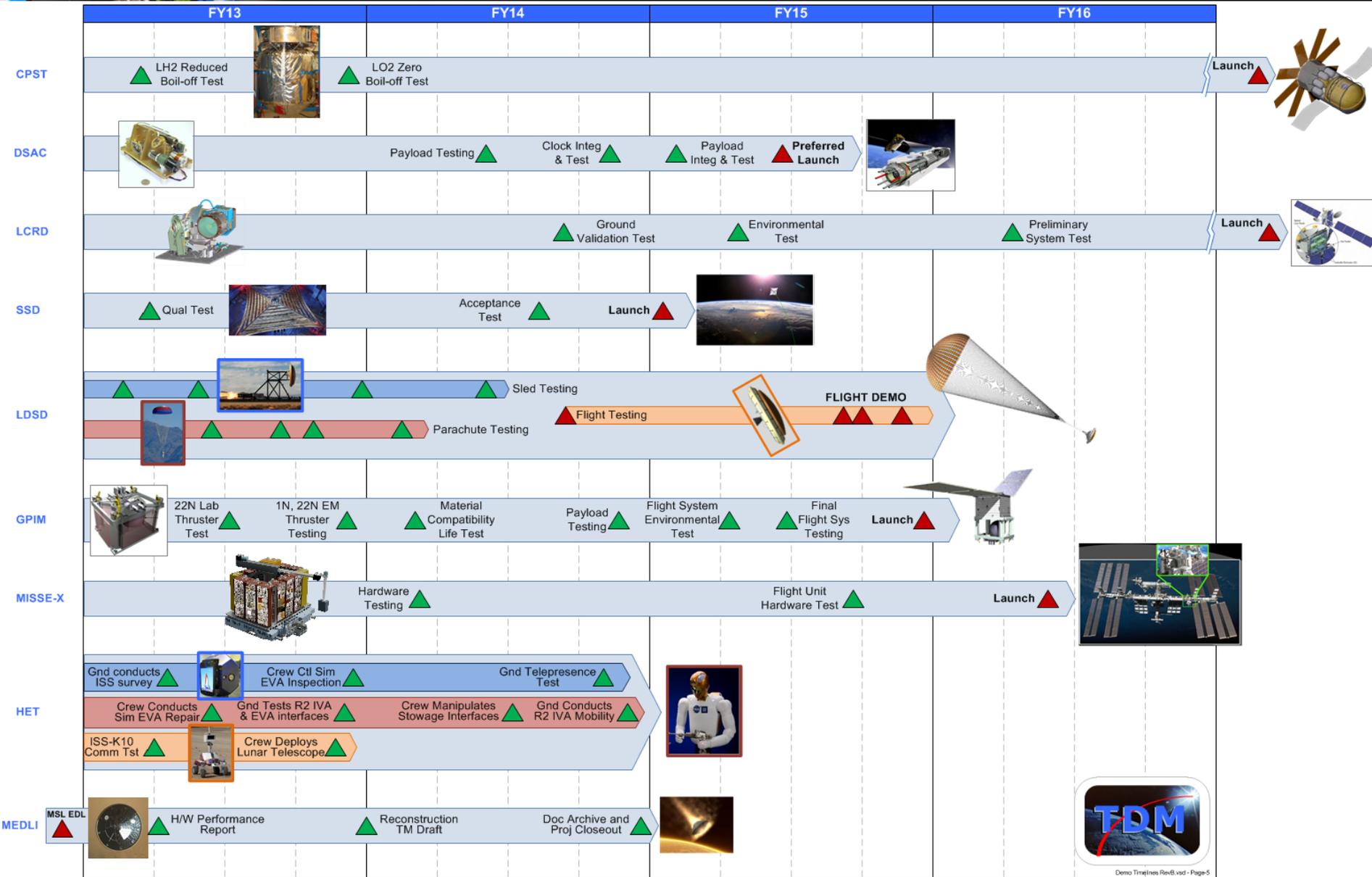
- TA.4. Robotics
- TA.5. Comm./Navigation
- TA.6. Human Health
- TA.7. Human Expl. Dest.

- TA.8. Sci. Instr./Sensors
- TA.9. EDL
- TA.10. Nanotechnology
- TA.11. Modeling/Simulation

- TA.12. Materials/Structures
- TA.13. Ground/Launch
- TA.14. Thermal

Technology Readiness Levels (TRL) ① → ⑨

# Timeline of Major Activities



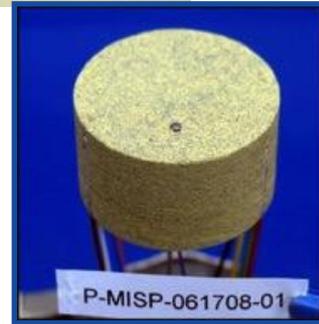


# Curiosity

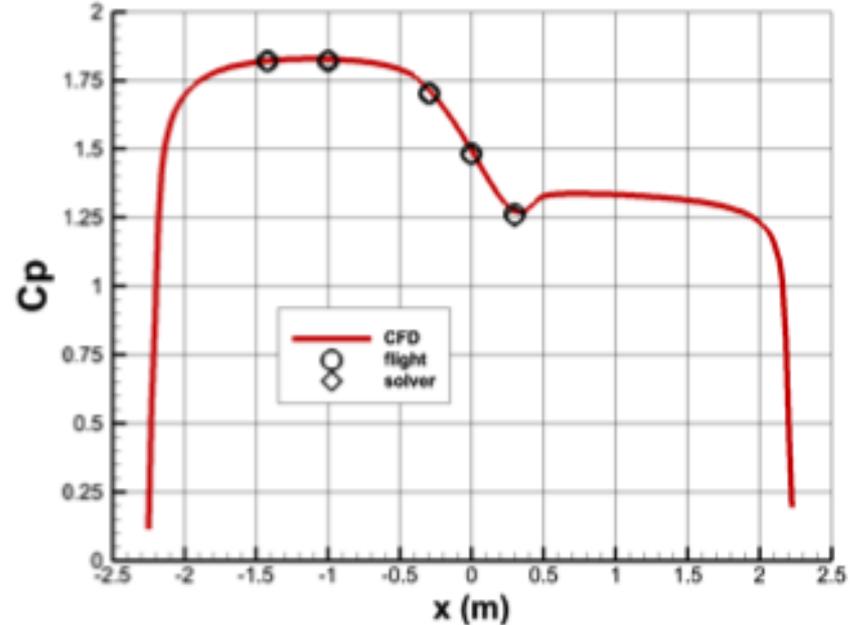
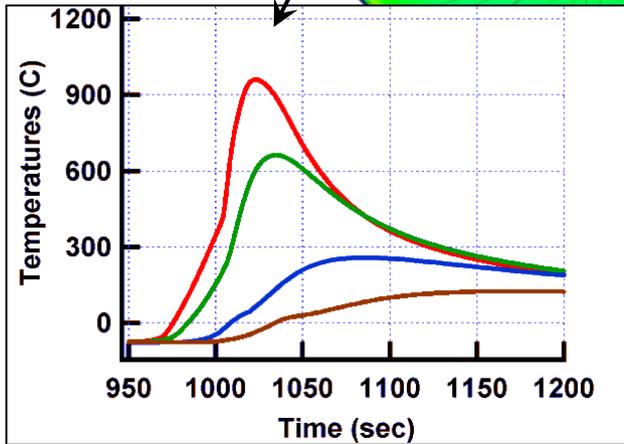
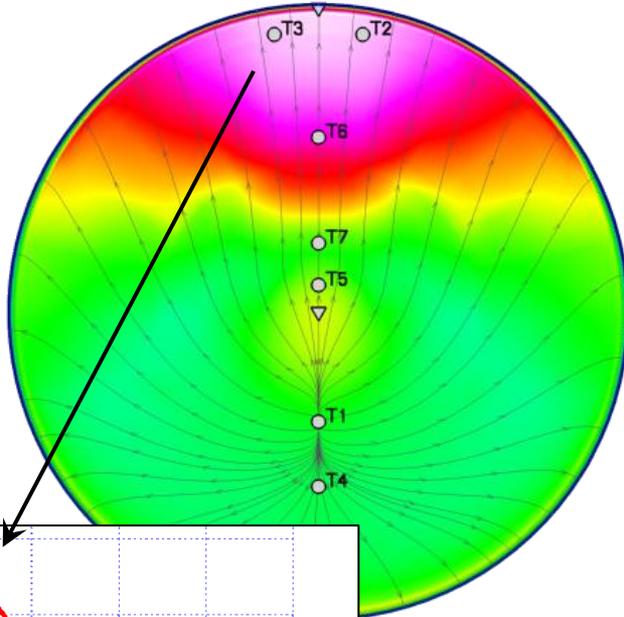


[video]

# Obtaining Needed Atmospheric Entry Data at Mars

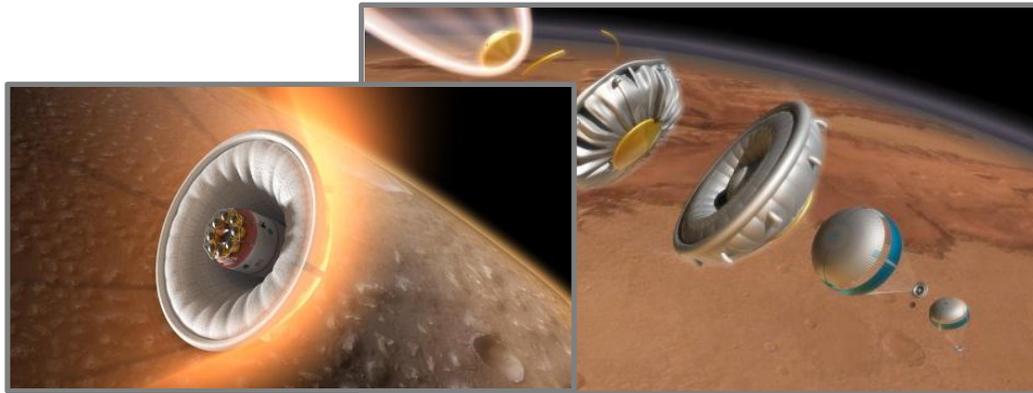
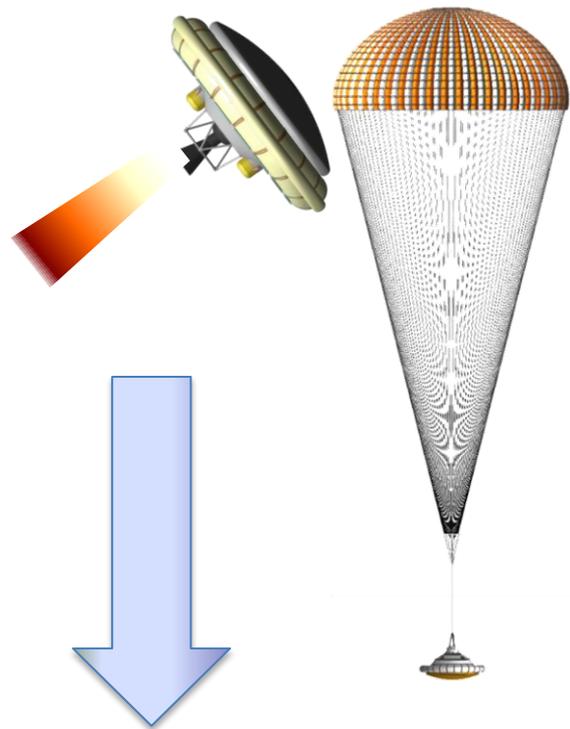
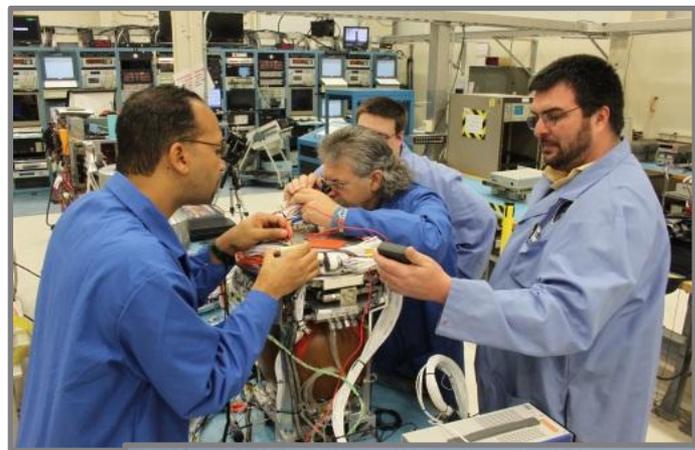


# Mars Entry Flight Data



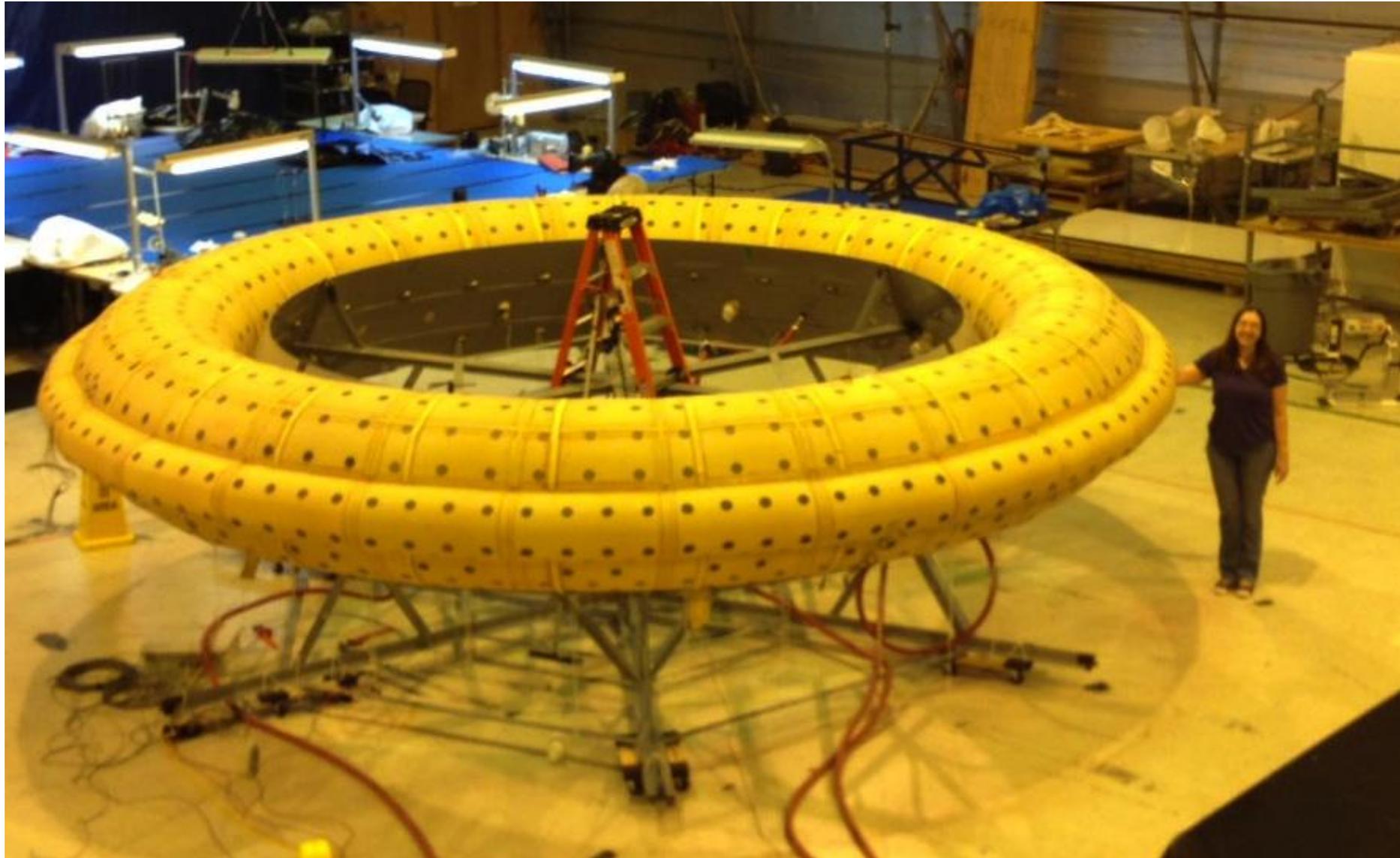


# Enabling New Entry Systems





# Decelerator Inflation





# Decelerator Inflation Test



[video]

# Rocket Sled Development



[video]

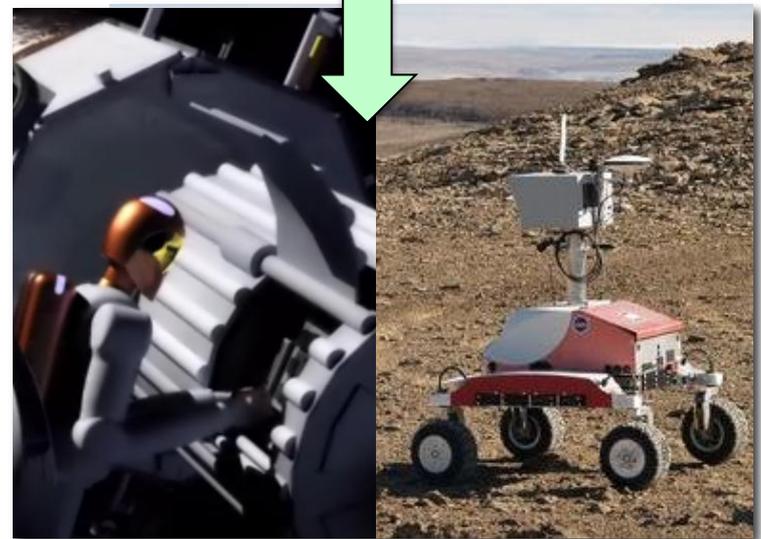
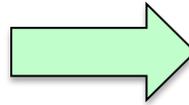
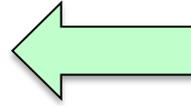
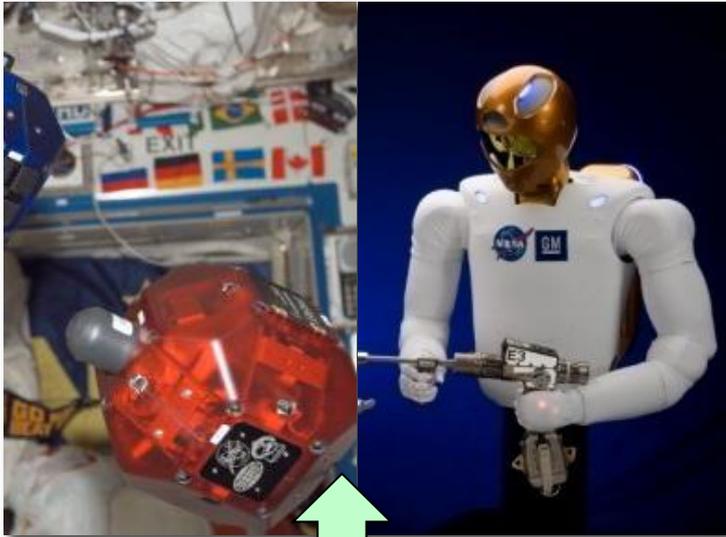


# Sled Track Testing



[video]

# Robotic Operations with Humans





# Telerobotic Systems



## Robonaut 2 (R2)

- **Humanoid robot**  
(42 DOF, human-scale/safe)
- Perform dexterous IVA/EVA **manipulation** tasks
- Share **astronaut tools** and **workspaces**



## Smart SPHERES

- **Free-flying robot**  
(6 axis, cold-gas propulsion)
- Perform IVA/EVA remote **mobile sensor** tasks
- Improve **ground control** situation awareness

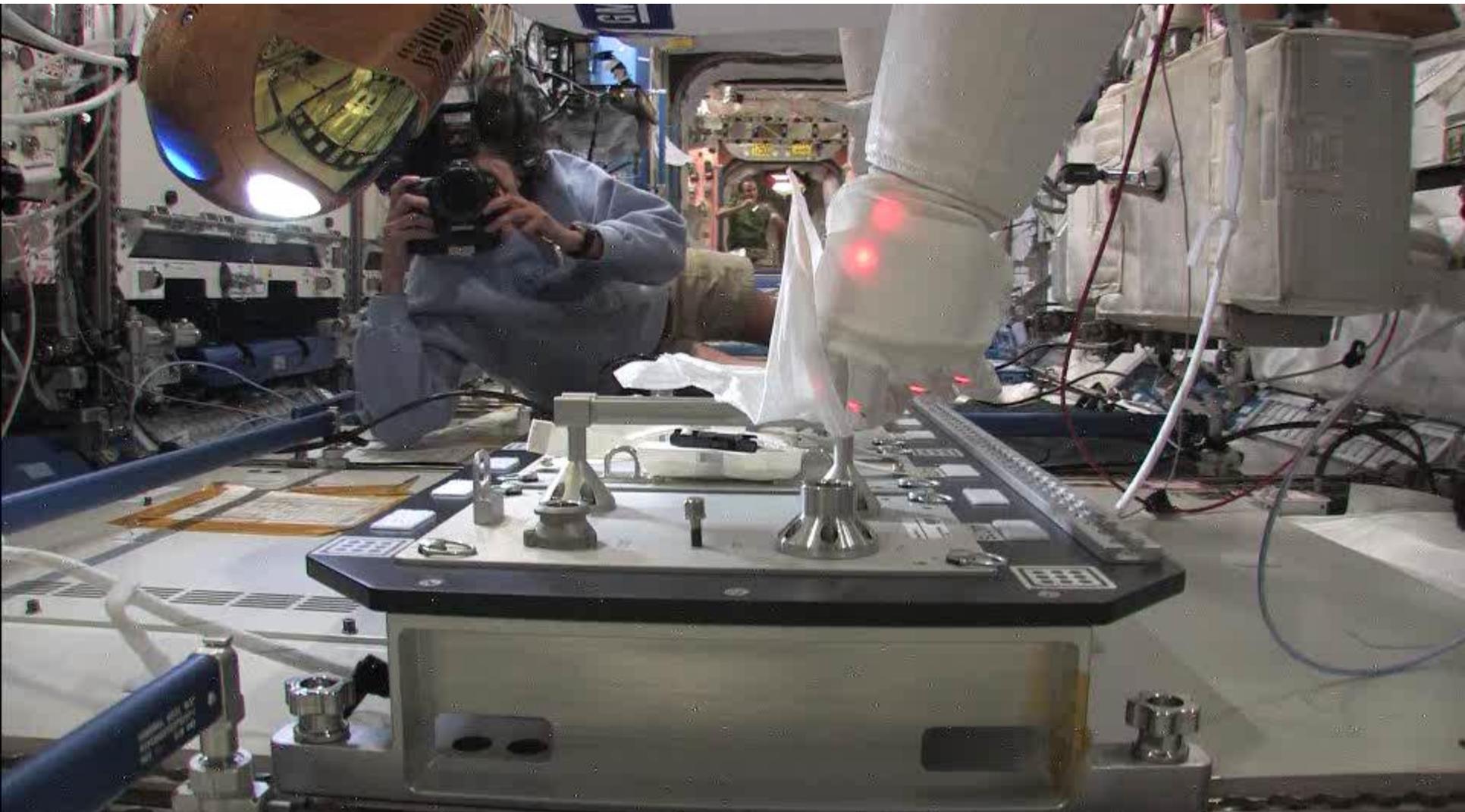


## Surface Telerobotics

- **Mobile robot on surface**  
(Moon, asteroid, Mars)
- Perform **surface activities** before/support/after crew
- **Crew centric operations** from inside flight vehicle



# Robonaut





# Surface Telerobotics



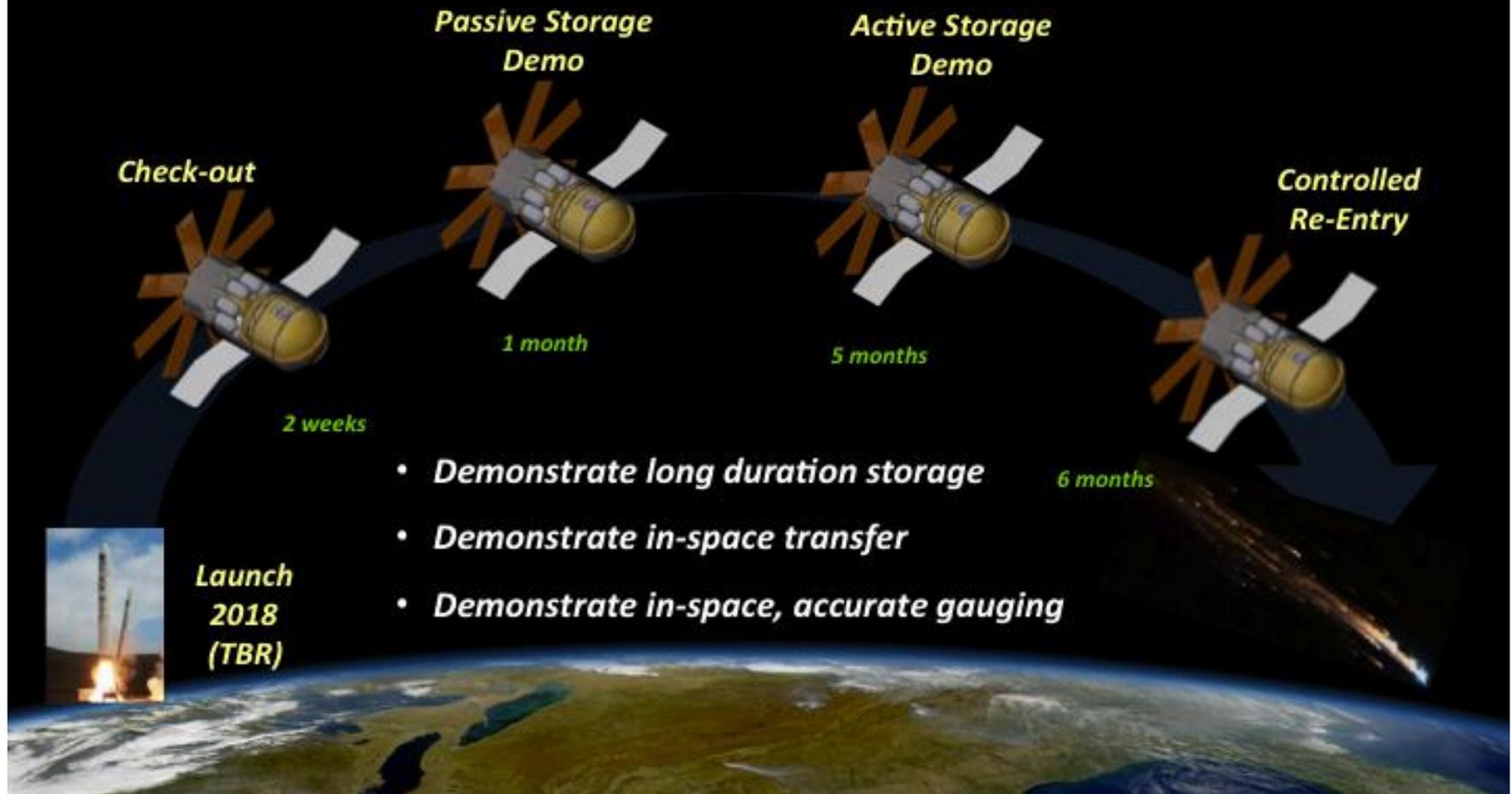
[video]



# Enabling Future Extended In-Space Missions



NASA is undertaking a demonstration mission to advance cryogenic propellant storage and transfer technologies that will enable exploration beyond Low-Earth Orbit

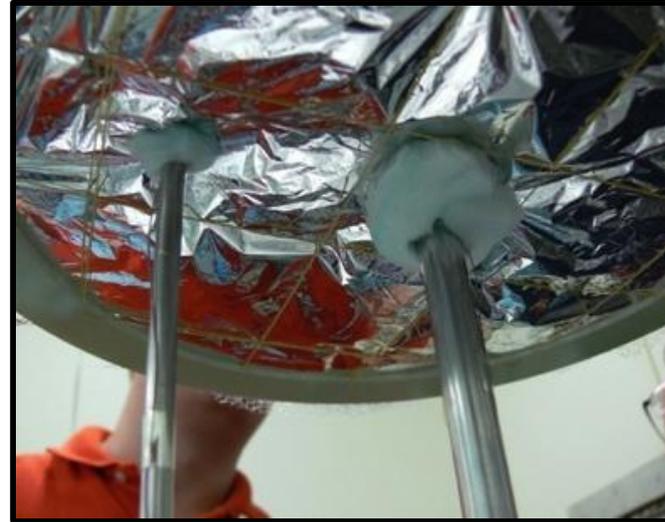




# CPST Testing



**Liquid Hydrogen  
Active Cooling Test**



**Penetration  
Heat Leak Test**



**Mass Gauge Low-g Aircraft Test**



**Composite Tank Strut Structural Test Configuration  
Composite Strut Structural Test**



# CPST Demonstration Status



- NASA plans to develop payload
- Looking for industry partners for the spacecraft bus, integration, and operations (~March 2013)
- Developing a plan for technology transfer to openly share data
- **CPST Project manager will present strategy tomorrow during TDM open session (10:30am)**

# Optical Communications



[video]



# Solar Sailing





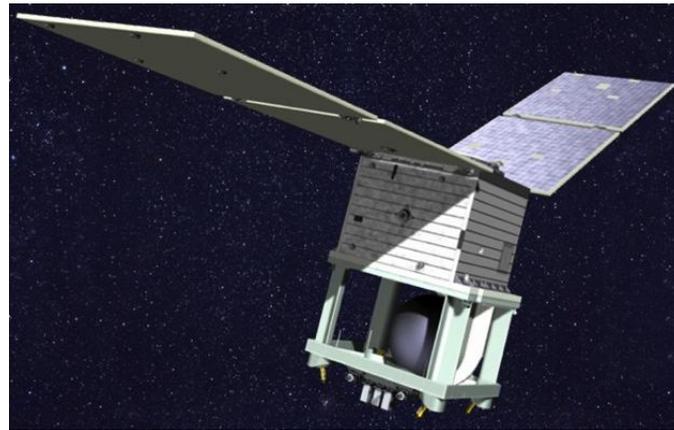
# Other TDM Projects



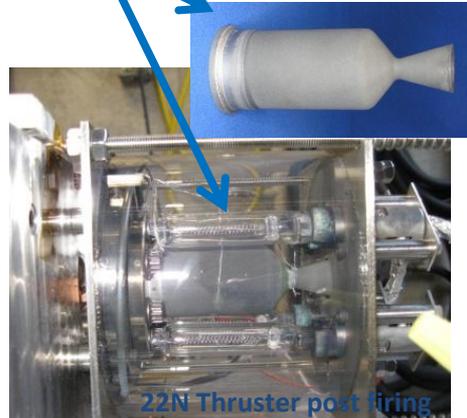
## Deep Space Atomic Clock (DSAC)



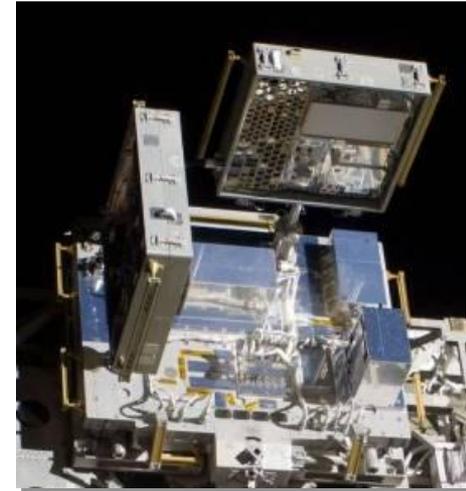
## Green Propellant Infusion Mission (GPIM)



22N Engineering Model Thrust Chamber



## MISSE-X



# Get Involved



- Goal to have annual solicitation for new demos
  - 2011 & 2012 – selected 4 demonstrations
  - 2013 – Plan uncertain anticipating extended CR
- Follow TDM during the year (<http://www.nasa.gov/tdm>)
- Contact: Randy Lillard/HQ (randy.lillard-1@nasa.gov) or John McDougal/MSFC (john.m.mcdougal@nasa.gov)





# More TDM at Tech Days



- Please sign up one-on-one time with TDM management...
- Second session tomorrow, open session to answer questions
- Please see TDM projects exhibiting at Tech Days this week:
  - Laser Comm booth #601
  - Solar Sail booth #602
  - MISSE-X booth #603

