

Space Fluids & Ground Test Capabilities at SwRI

SOUTHWEST RESEARCH INSTITUTE®

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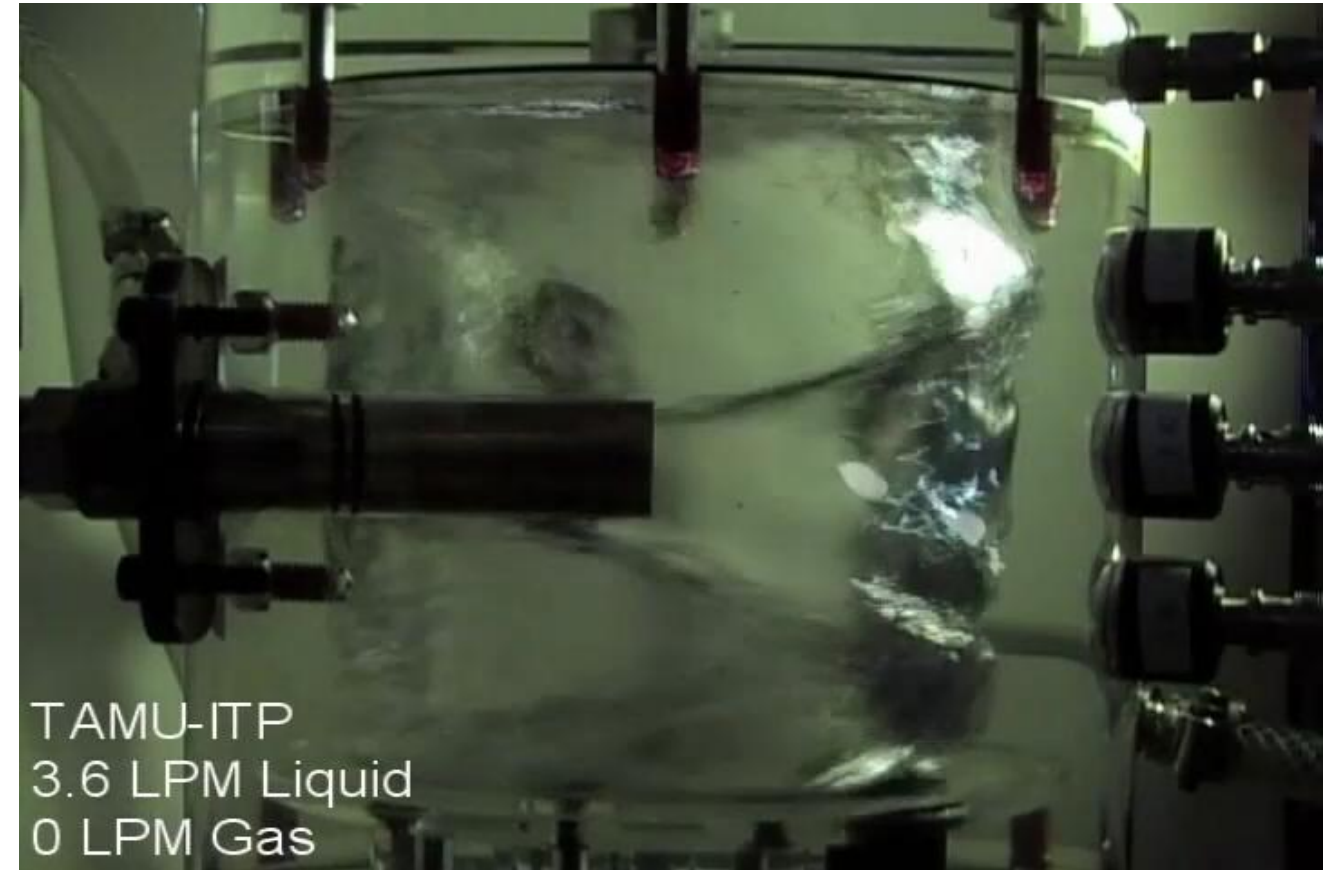
ADVANCED SCIENCE. APPLIED TECHNOLOGY.

Overview

- Personal & SwRI background
- Recent & upcoming projects related to KSQ
- SwRI ground testing
- KSQ suggestions



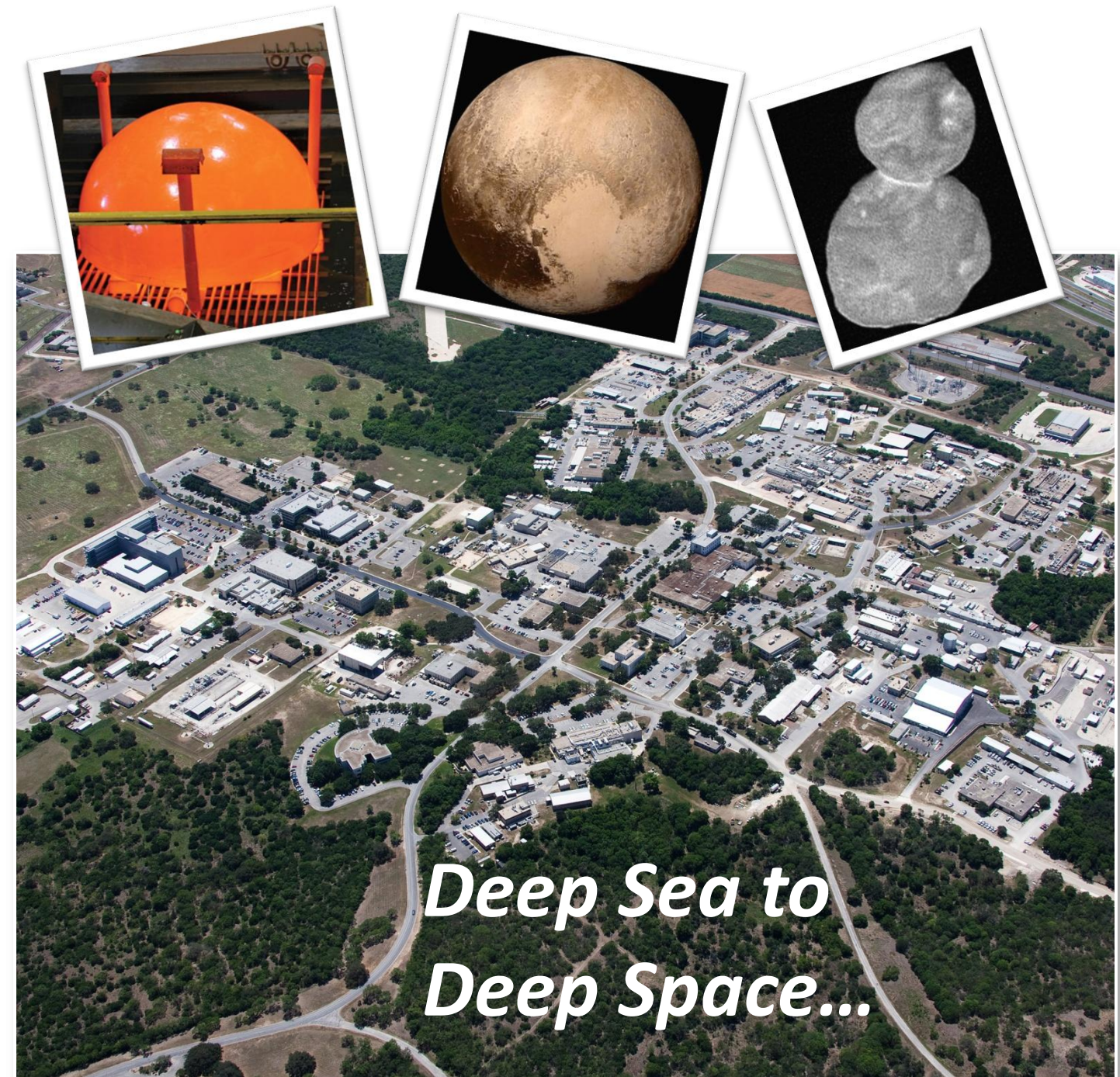
Personal Background



Southwest Research Institute

- Independent, unbiased
- Customer-centric IP policy
- Broad technological base of science & engineering
- 501(c)(3) nonprofit corporation
- Over 2.4M ft² of laboratories
- FY 2025 Revenue > \$930M
- Employees > 3,300

*Benefiting government, industry
and the public through innovative
science and technology*



*Deep Sea to
Deep Space...*

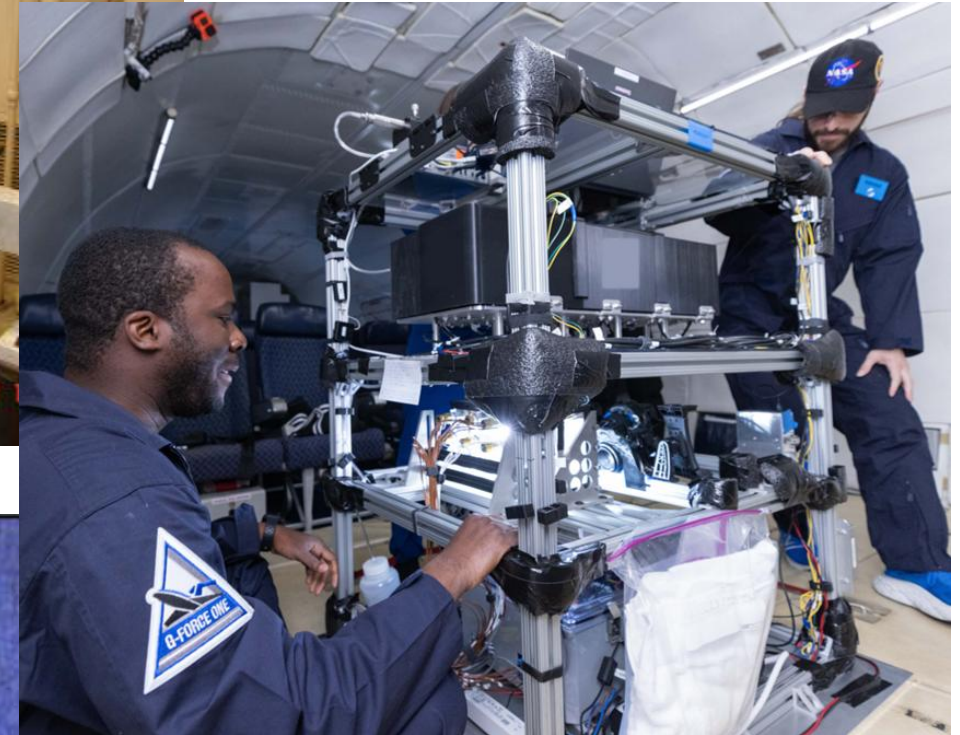
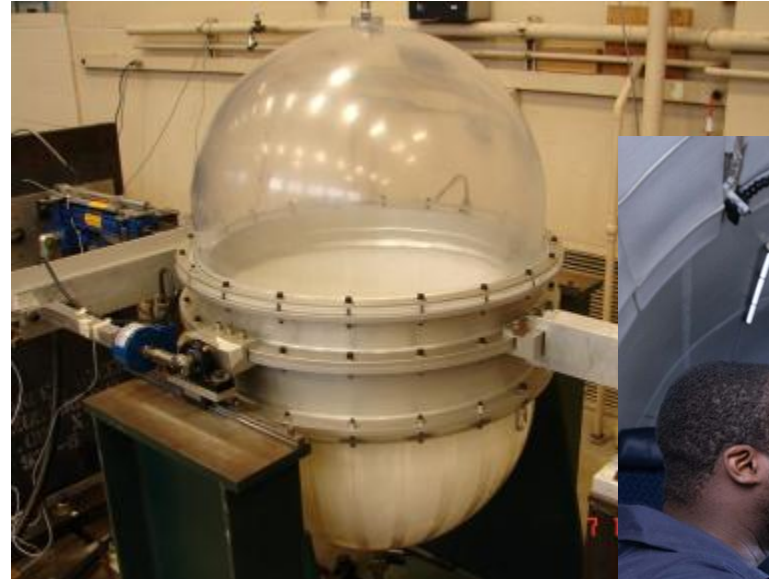
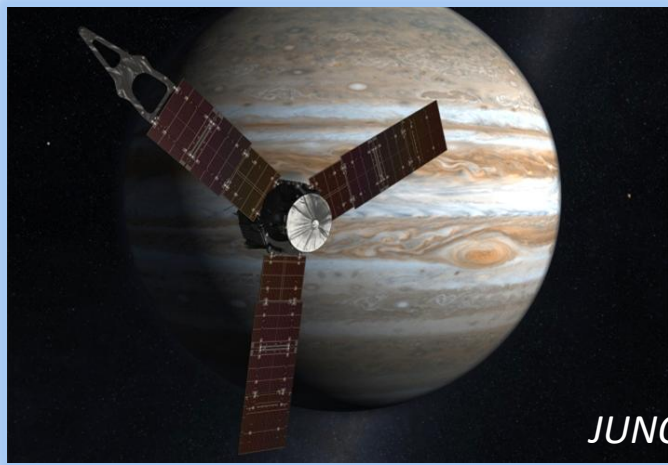
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SwRI Community Partnerships

- Young Engineers and Scientists - YES
 - 20 to 25 high schoolers a summer working with researchers
 - 32-year program
- John Jay High School Engineering Academy
 - Staff mentorship of high school junior and seniors completing design projects
- University Joint Research Programs
 - Instrument development
 - ISRU
 - Etc.



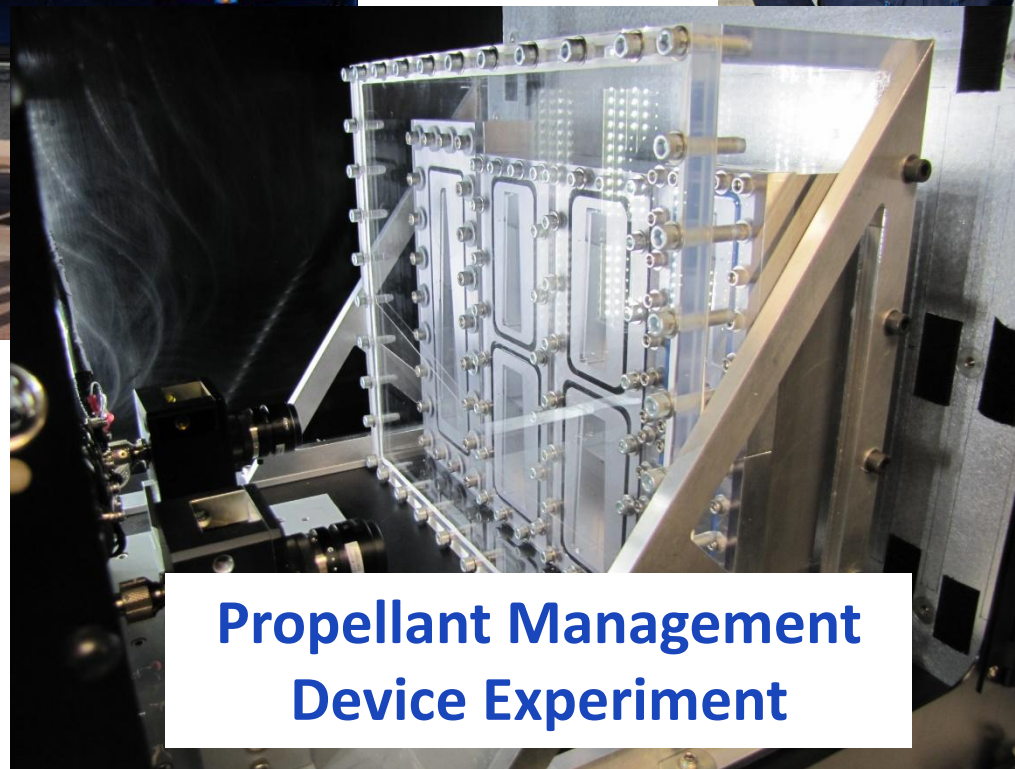
Southwest Research Institute – Space Research



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SwRI Reduced Gravity Fluid Testing



Propellant Management Device Experiment

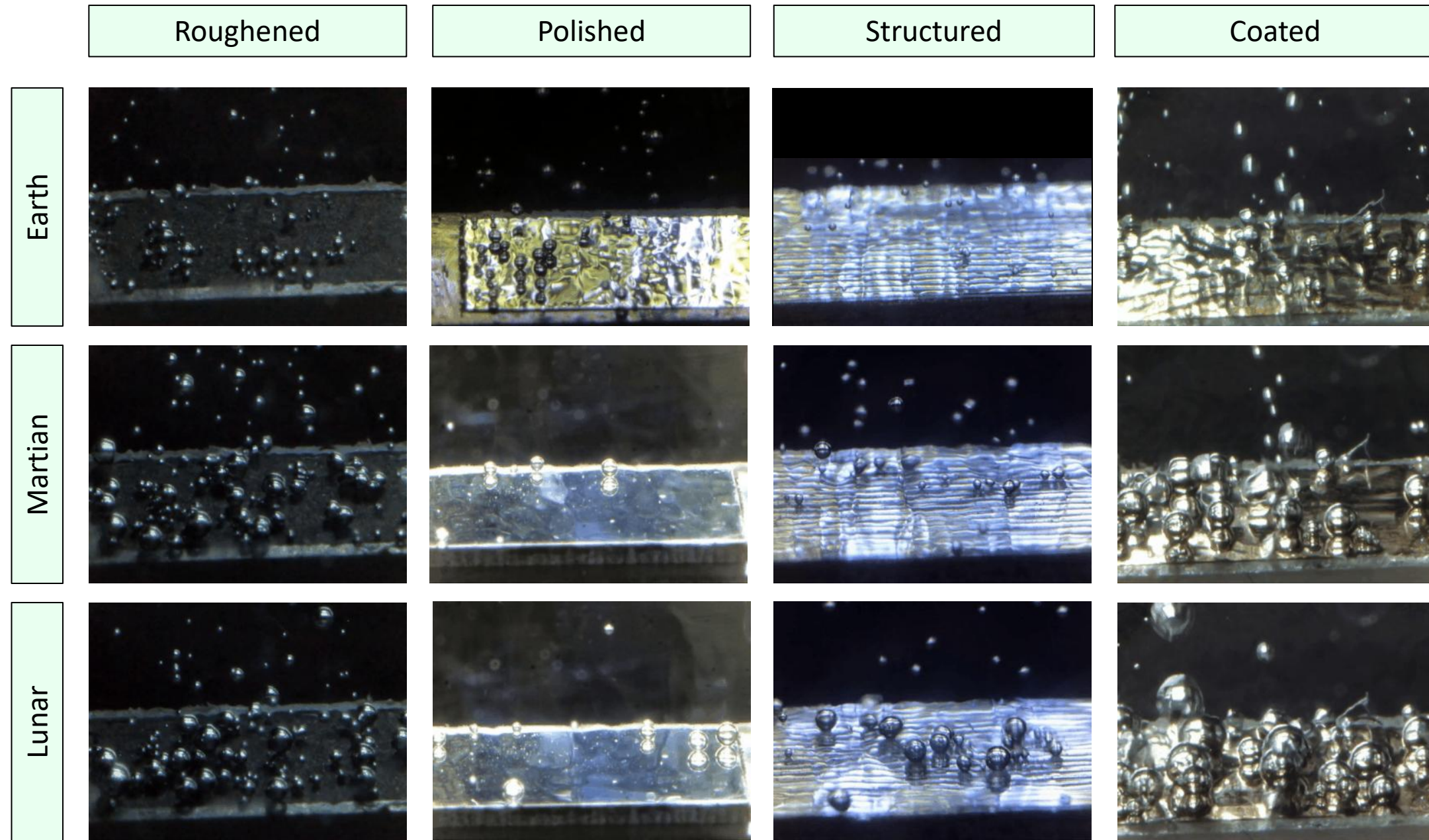
Lunar Boiling Experiment for ISRU, Surface Power



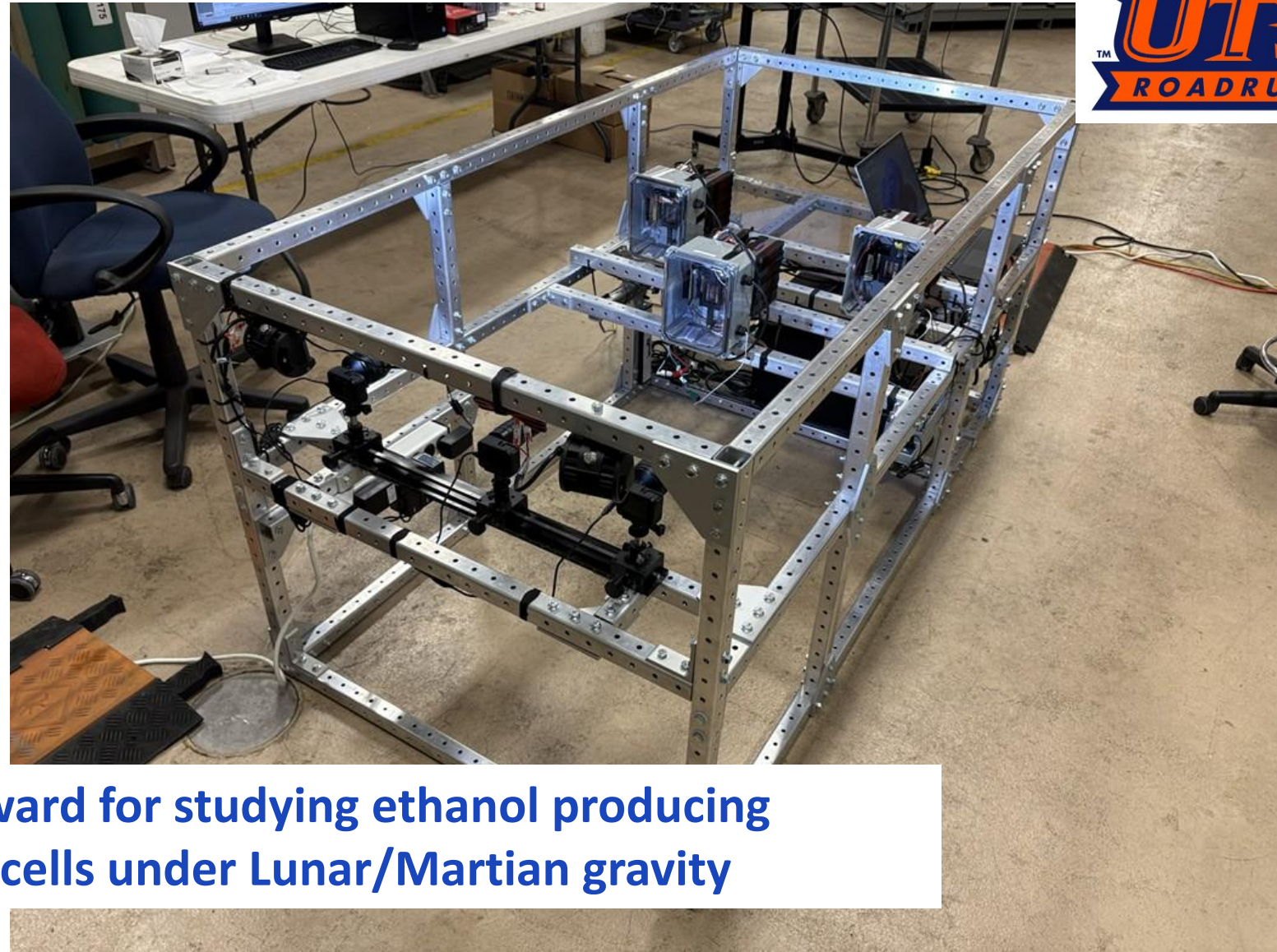
Tapered LADs – Suborbital Test

Nucleate Boiling at Various Gravitational Conditions

Increasing G. Level

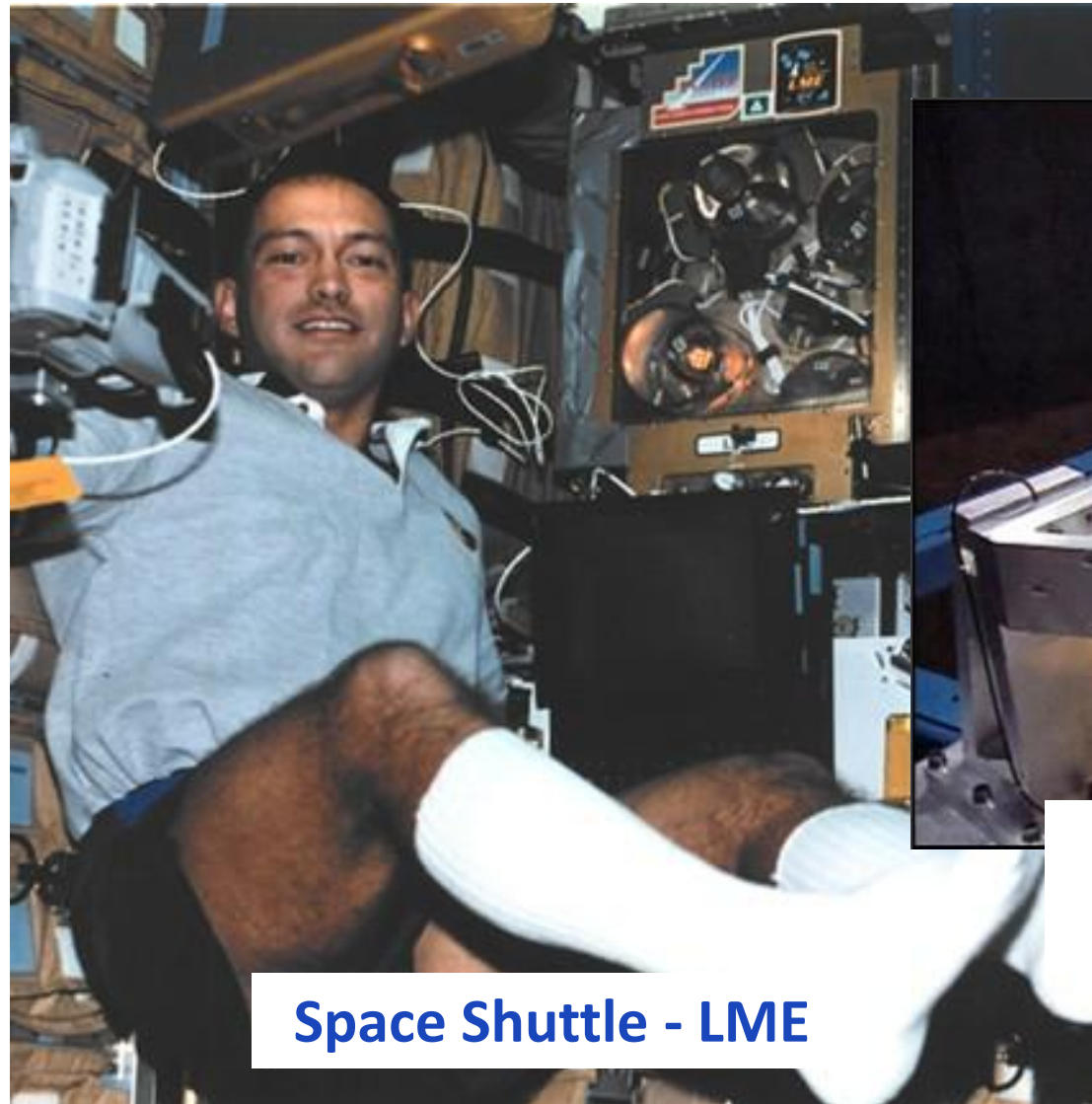


ISRU Parabolic Flight Test

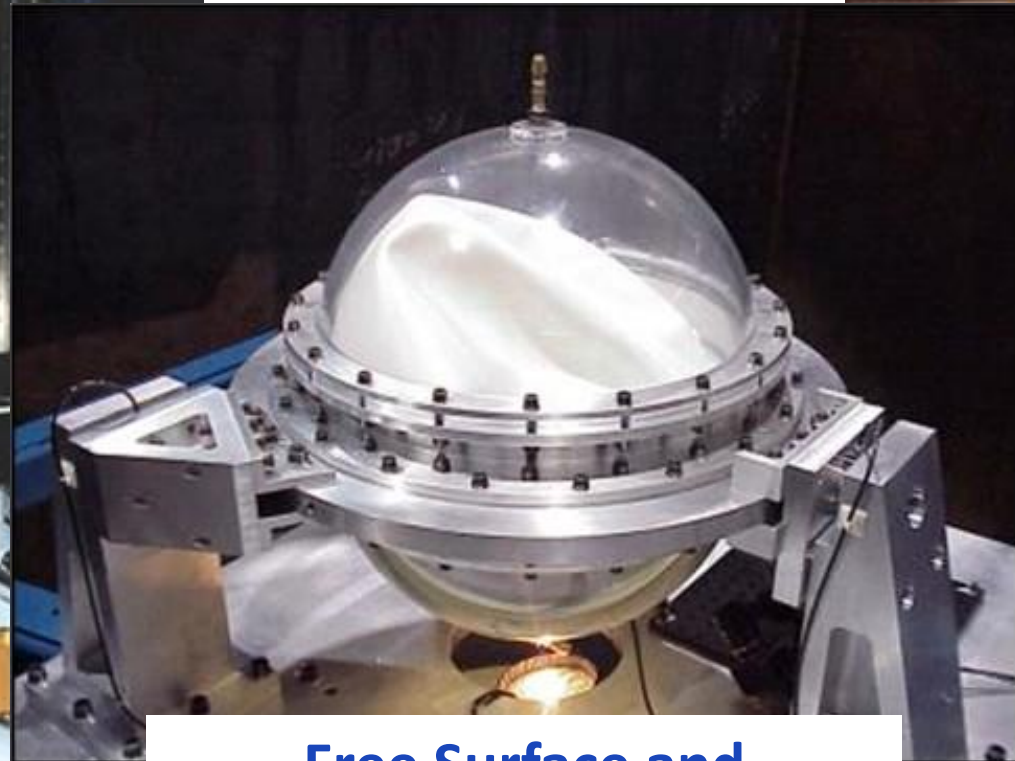


NASA TechLeap award for studying ethanol producing electrochemical cells under Lunar/Martian gravity

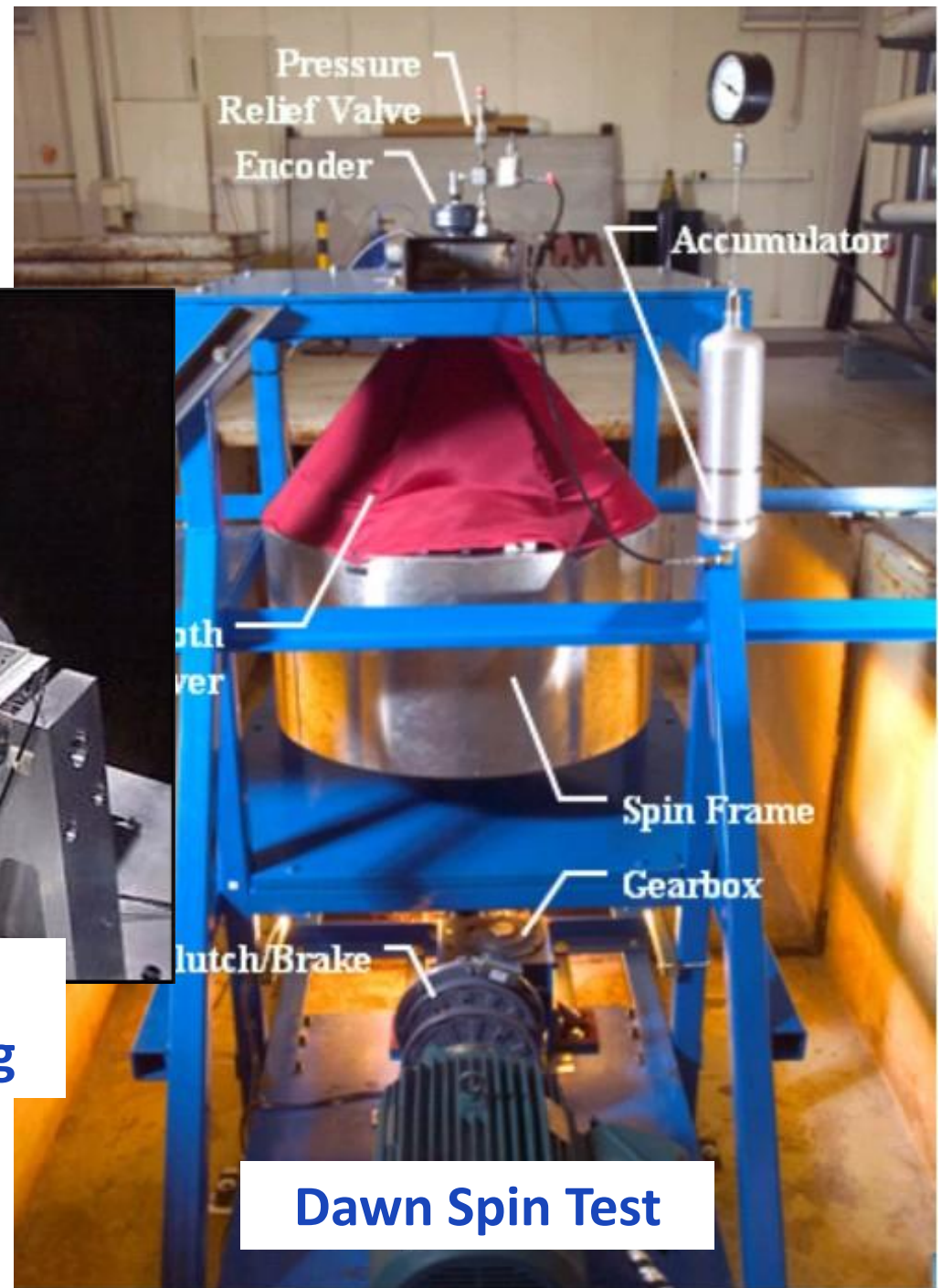
Tank Fluid Dynamics



Space Shuttle - LME



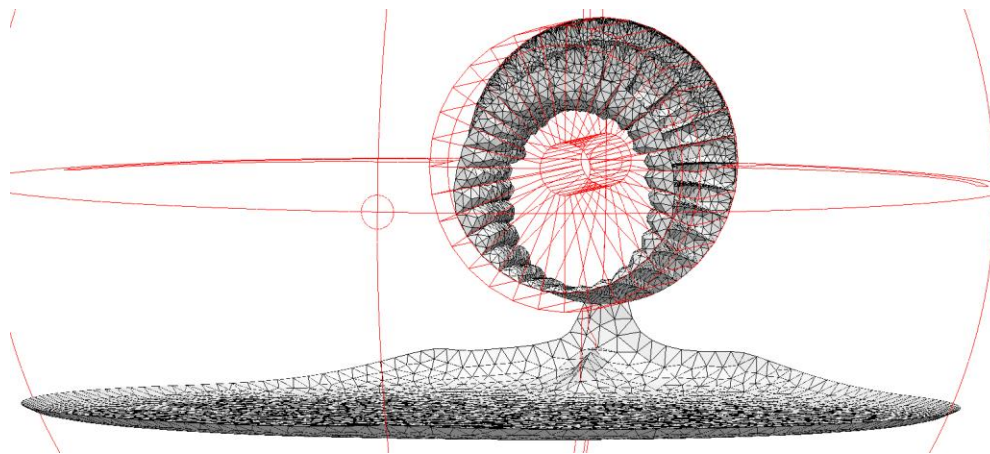
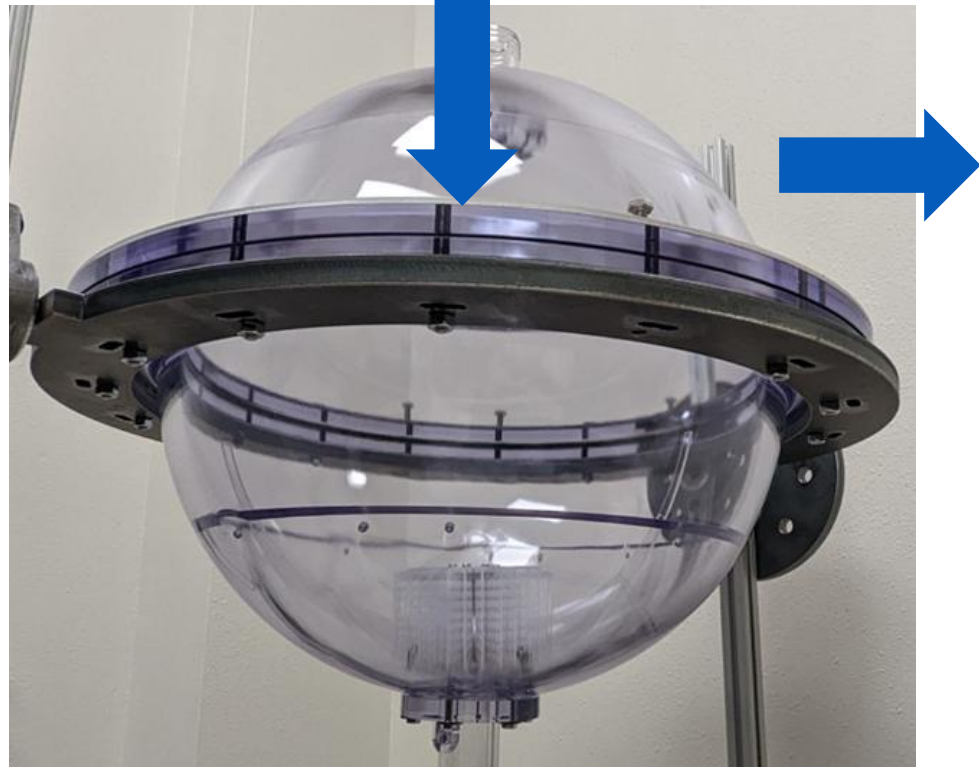
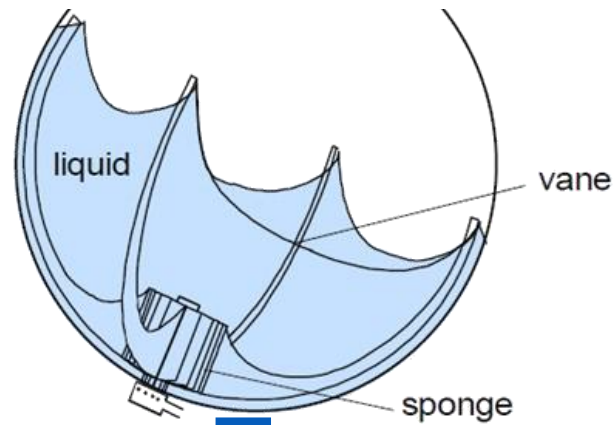
Free Surface and Diaphragm Slosh Testing



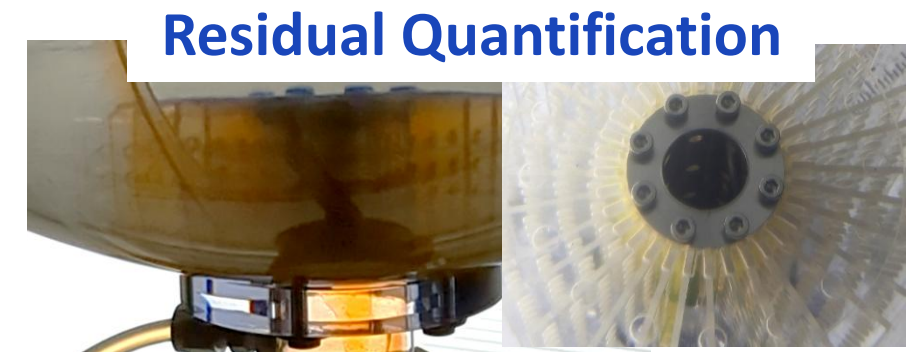
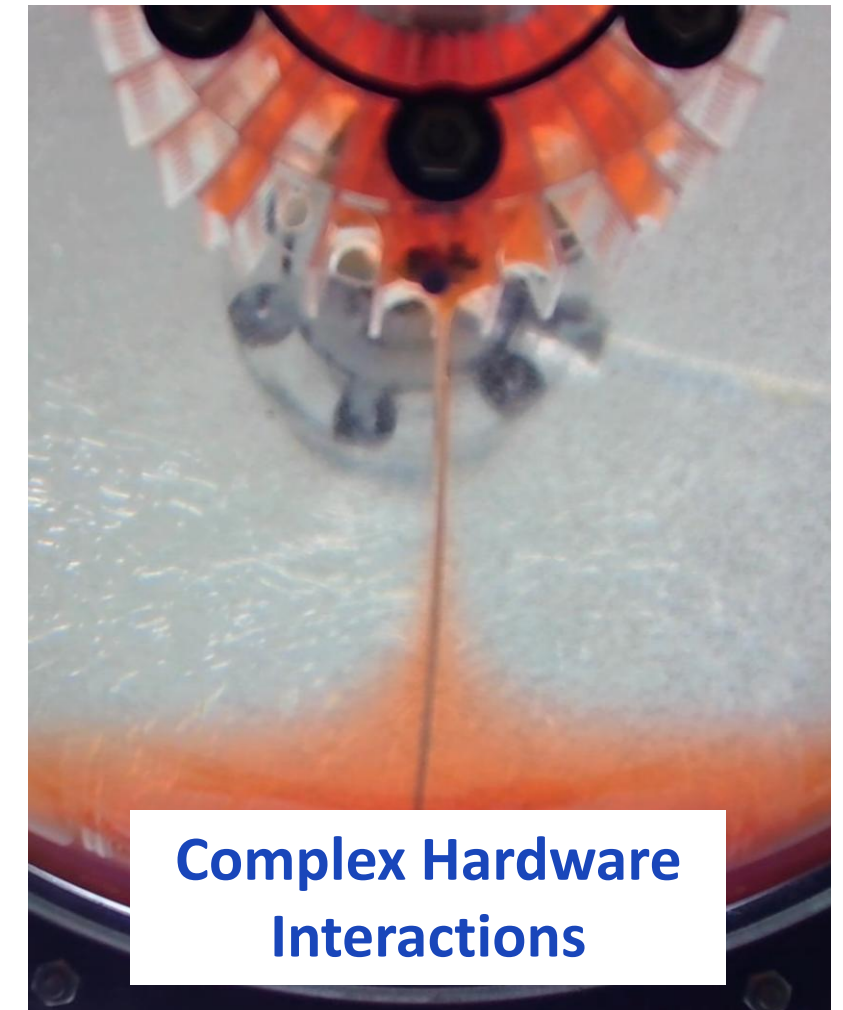
Dawn Spin Test

Neutral Buoyancy Testing

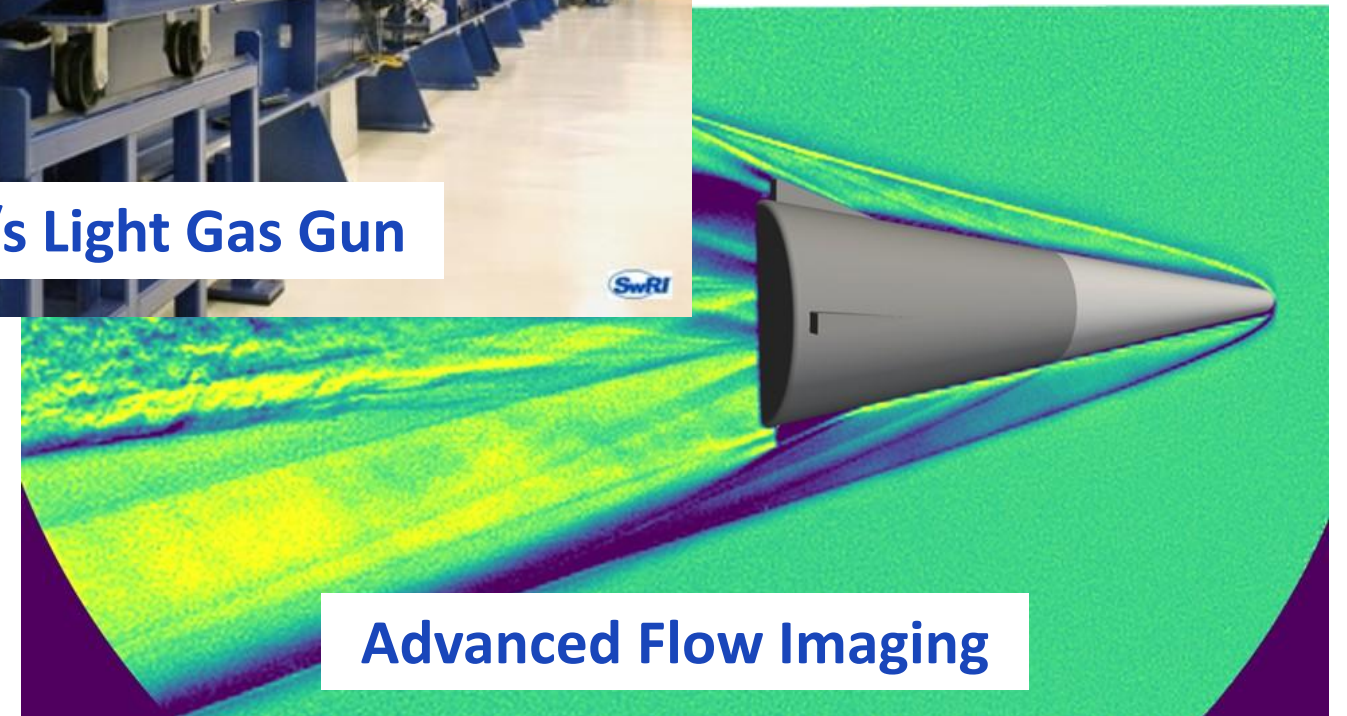
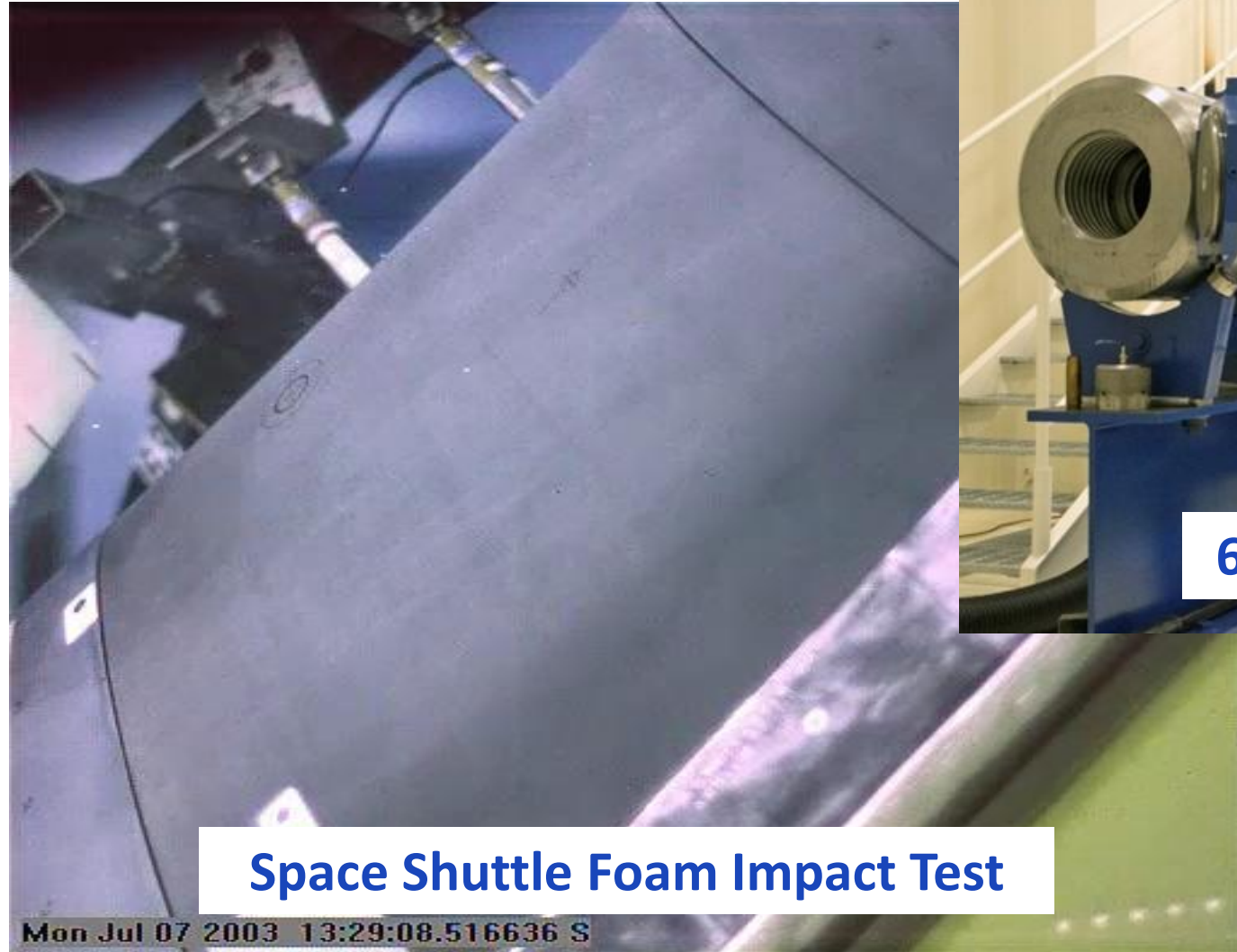
PMD Model



Free Surface Simulation



Ballistic, Impact, & Hypersonic Testing



Spacecraft and Payload Processing Facility

Vibration Testing



Thermal Vacuum Chambers



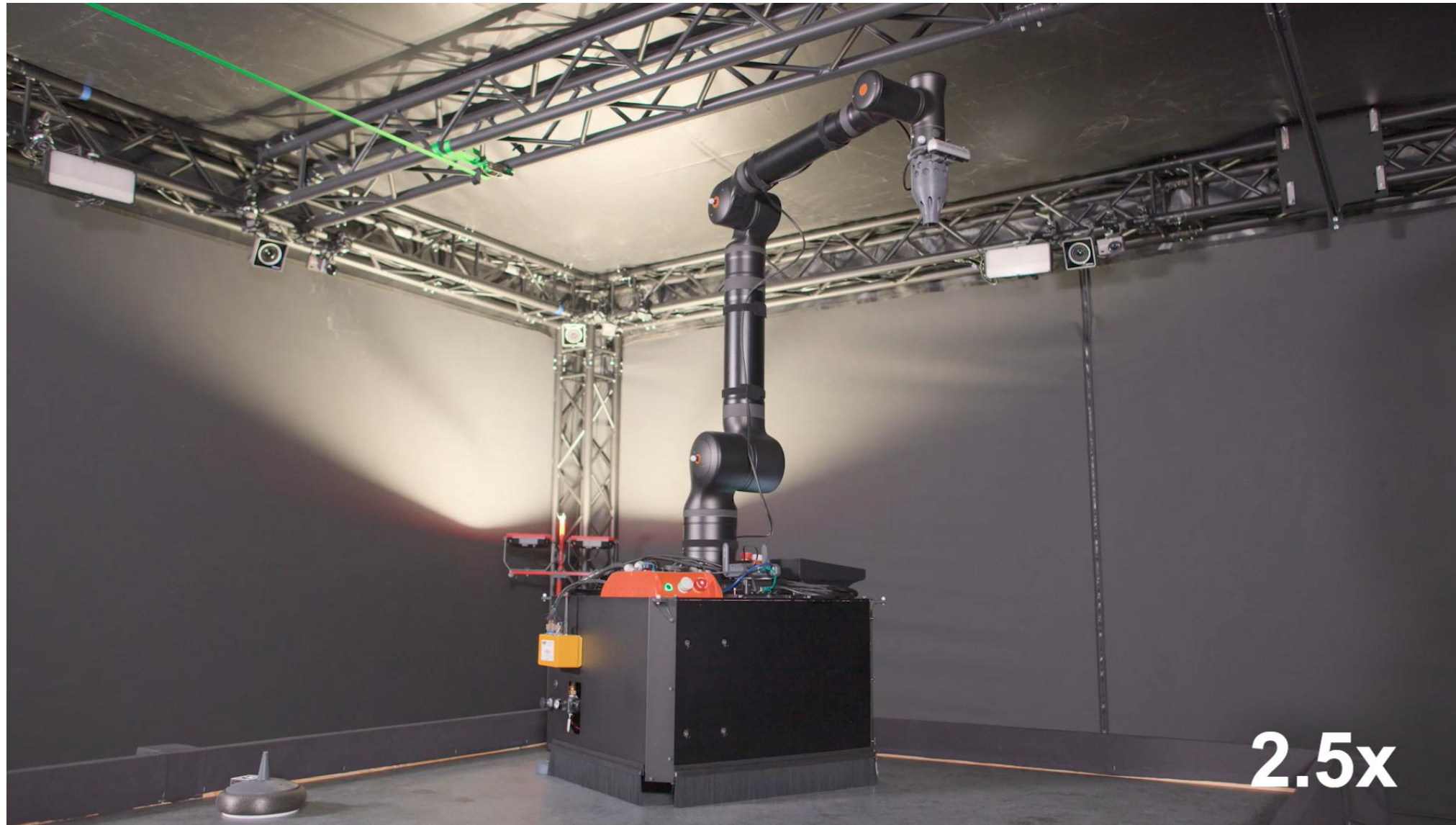
Acoustic Testing



EMI Chambers



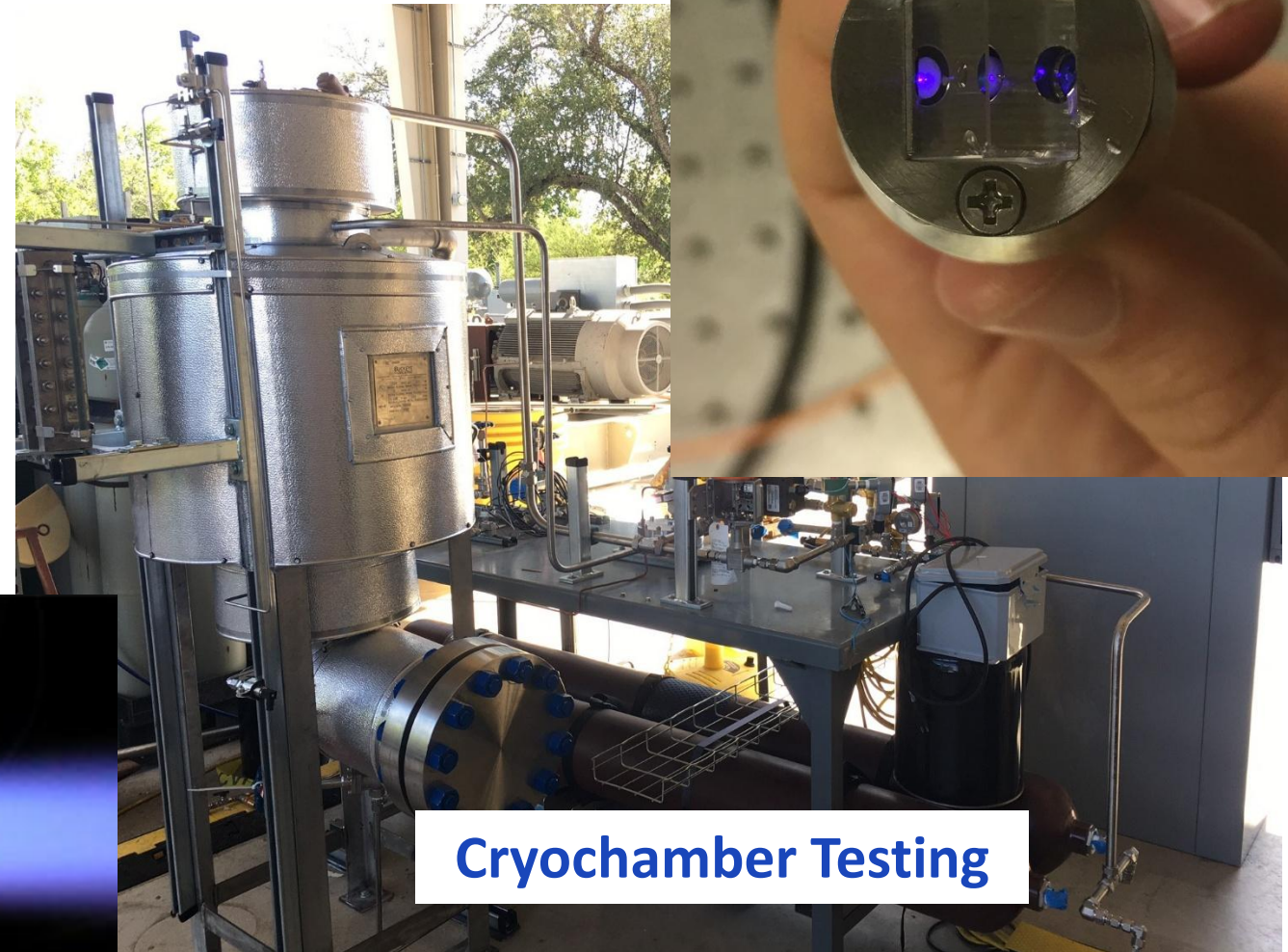
Zero-G Ground Test Bed for Robotic Spacecraft



Other Ground Test Capabilities



Pogo Evaluation



Cryochamber Testing



Cryo Sensor Development



Combustion Testing

What are key needs for space fluids research?

▪ Lunar / Martian Fluid Behavior

- Survive the night transients (freezing / thawing)
- Partial gravity multiphase flow, heat transfer, mass transfer, critical heat flux
- Demonstrations of ISRU limited only to MOXIE
 - High viscosity fluid behavior – Molten Regolith Electrolysis
 - Overpotential risk related to gas buildup for electrochemical technology
- “Permanent” settlements will require significant investment and acceleration of chemical production technology



What are key needs for space fluids research?

▪ Propellant Fluid Management

- Low-g slosh dynamics (cryo and storables)
- Cryogenic & hypergolic propellant transfer / filling demonstrations
- Long-term storage of cryogenic propellant - zero boiloff, cryocoolers, insulation

▪ Thermal and Power

- Data centers in space - novel thermal solutions required
- Power cycles in space (Brayton, ORC, etc.)

