

National Aeronautics and
Space Administration



PLANET:

Planetary, Lunar, and Asteroid
Natural Environment Testbed
+ Other Dirty Facilities
at
NASA Marshall Space Flight Center

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September 15, 2022 – LSIC Dust Mitigation Focus



EXPLORE
MARSHALL

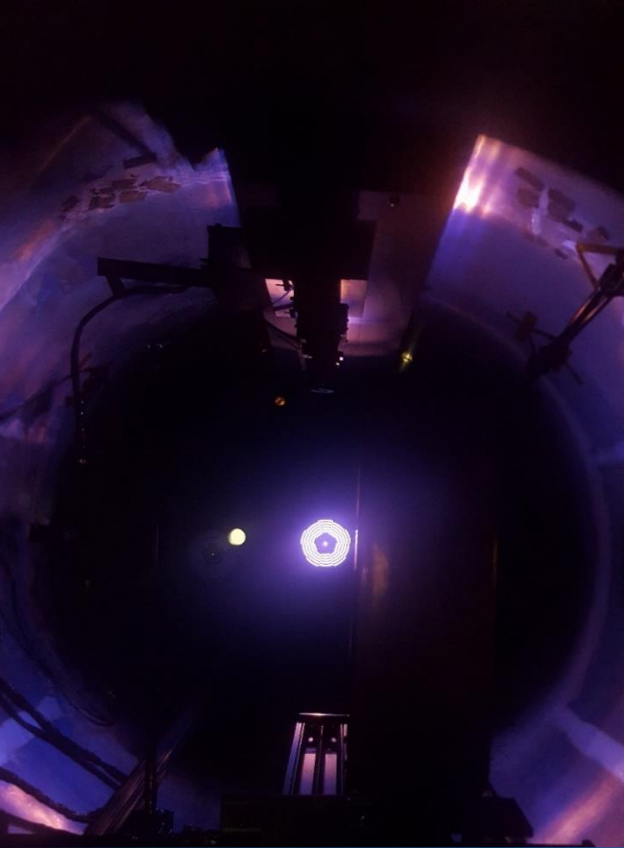
Marshall Space Flight Center is one of 10 NASA Field Centers

Core Areas:

- Propulsion & Rocketry
- Materials & Manufacturing
- Space Transportation Systems
- Space Systems
- Scientific Research

Huntsville, Alabama, USA
aka
“Rocket City”





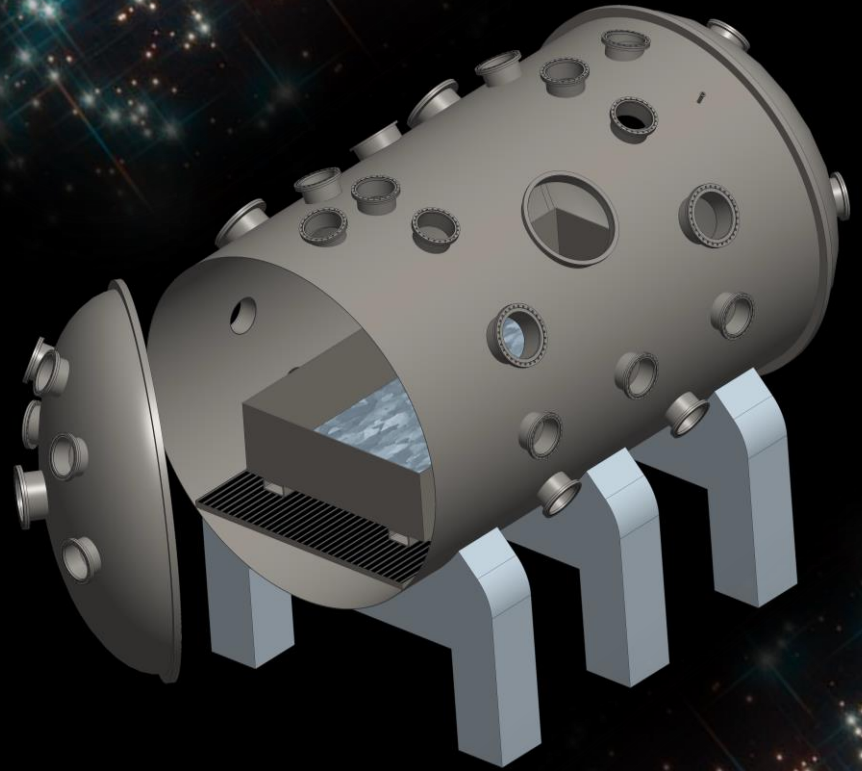
The MSFC Space Environmental Effects team has world-class expertise and test facilities to recreate space environments in the lab

- Capabilities include **individual** and **combined** effects utilizing **multiple unique test systems** for the one of the most complete SEE test capabilities available in the world.
- MSFC's ability to test all effects in one location is critical for minimizing the handling of sensitive material coupons after environmental exposure.
- Test systems can be rapidly adapted and reconfigured to customize tests to meet customers needs.
- The SEE Team provides space-flight technology development programs the ability to elevate their hardware to **TRL-6** "Qualification in a Relevant Environment".
- Part of Materials & Processes Lab, providing access to excellent mechanical, optical, thermal, etc test and analysis.

MSFC Space Environmental Effects (SEE) Team



- PLANET is a new, high-fidelity, combined space environments laboratory current under development
- Based on a 2m diameter x 3m length vacuum chamber
- Significantly enhances NASA's planetary surface simulation capabilities

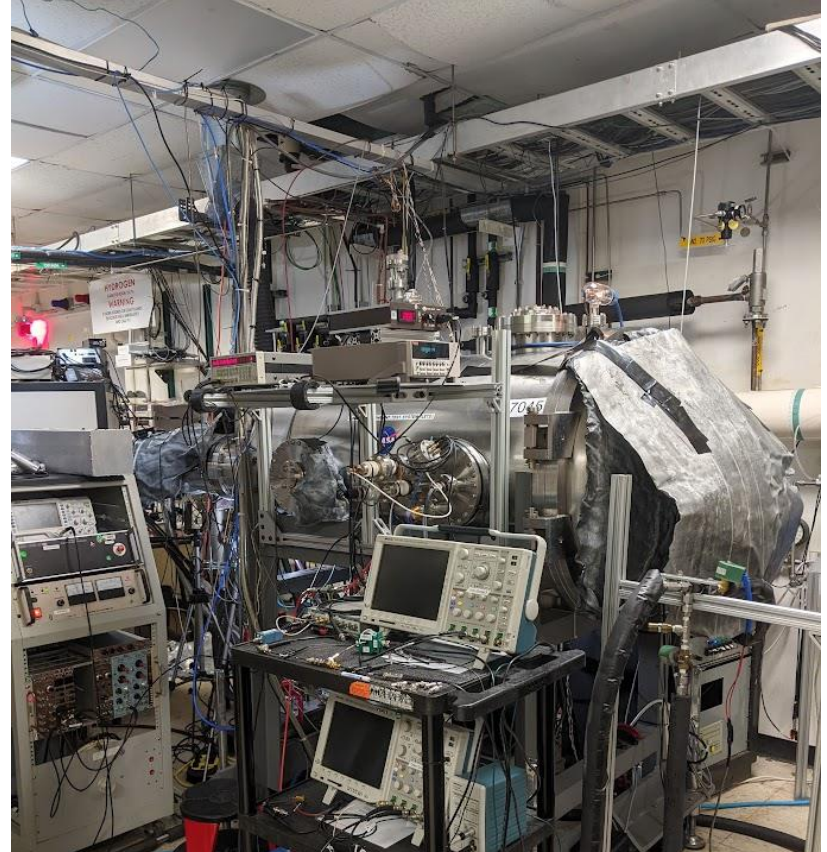


PLANET



There are always trades when designing a new test system!

- Desired space environments
- Additional instrumentation
 - Diagnostic, data, power, etc
 - Pumping – cryo vs turbo
- Chamber sizing
- Number and location of ports
- Budget and funding constraints
- Safety
 - Regolith simulant
 - Cryogenics
 - Radiation



Design Choices



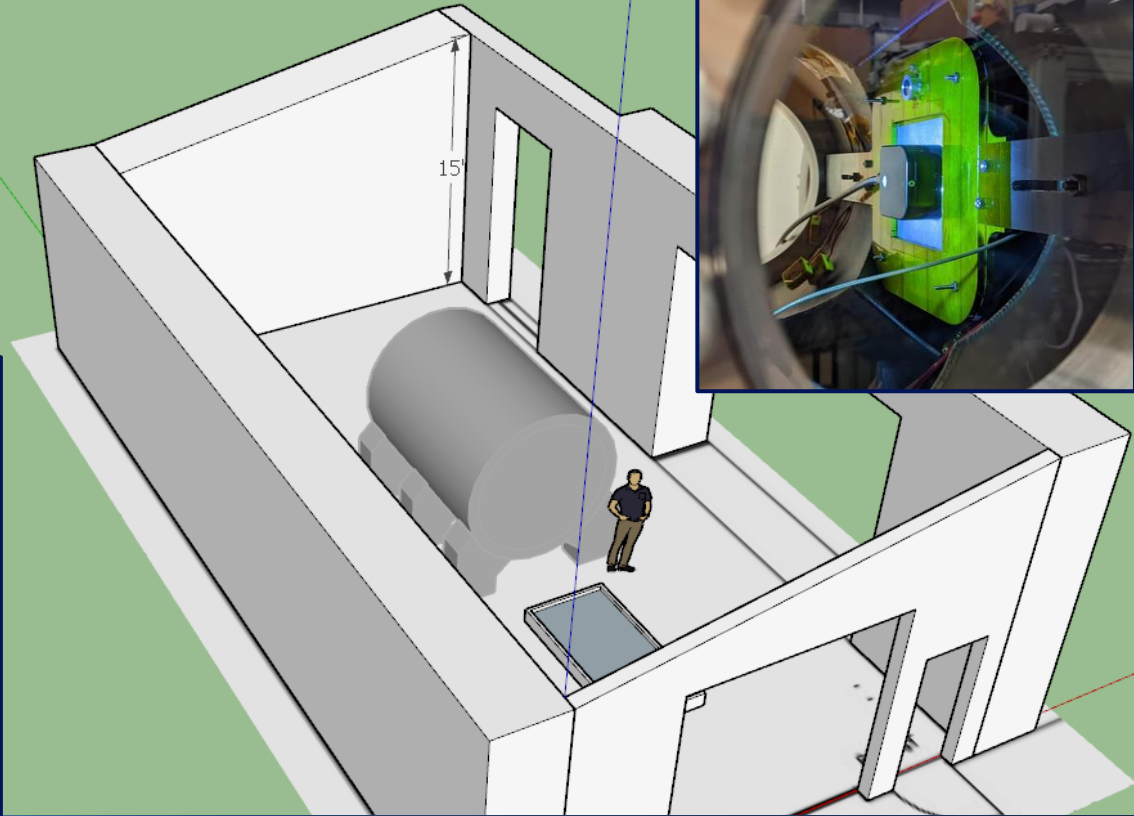
- High vacuum (10^{-7} Torr), low density plasma, or planetary atmosphere
- Charged particle radiation
 - Electrons up to 100 keV
 - Protons up to 20 keV
- Thermal extremes
 - Cryogenic to -180C/95K with LN2 system
 - Potential future upgrade to helium
 - Heating to >140C
- Ultraviolet radiation (NearUV and VacuumUV)
- Regolith simulant bed (lunar mare or highlands, Martian)

Planned Environmental Capabilities



Considerations:

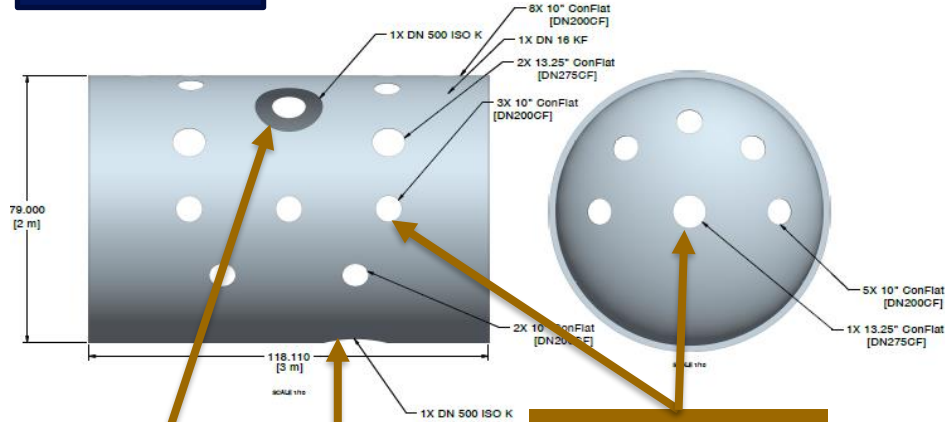
- Delivery of environments
- Customer needs
- Facility constraints



Chamber “Right-Sizing”



Side view

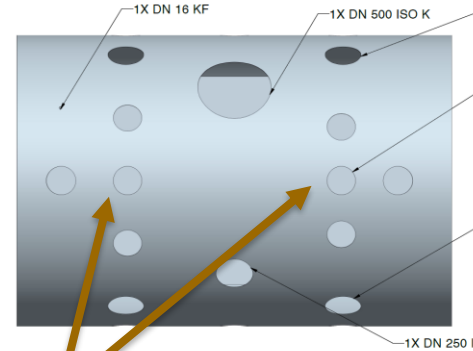


Cryopump port

Bottom port for deep regolith studies

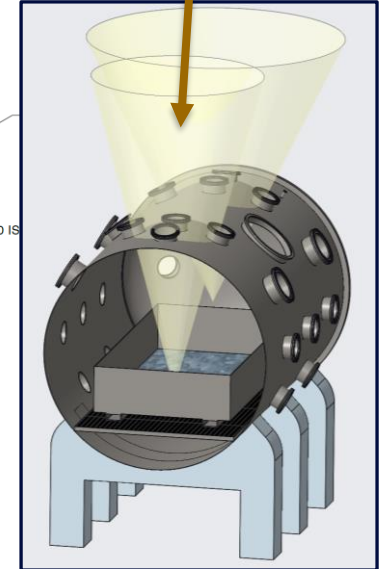
Instrumentation and viewports

Top view



Primary environmental introduction ports

2 Zones with different focal points



36 ports total (mostly ConFlat)

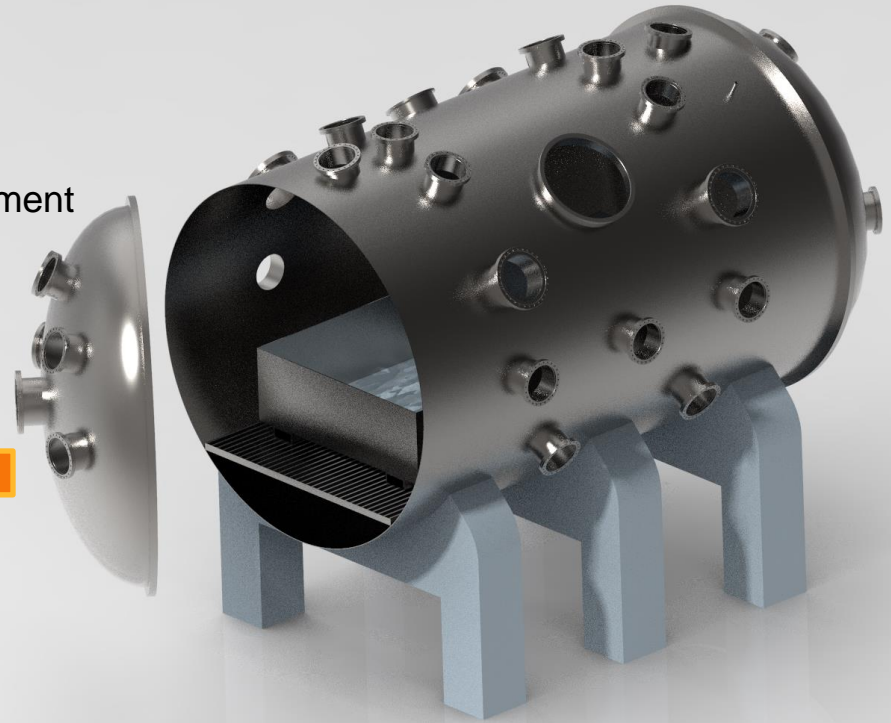
Port Arrangement & Zones



- Planetary surface ConOps
- Basic materials property changes & aging
- Charging (and discharging!) behavior
- Thermal balance, performance, cycling
- Regolith and dust adherence in a space environment
- Dusty mechanism operations and wear
- Synergistic/combined effects



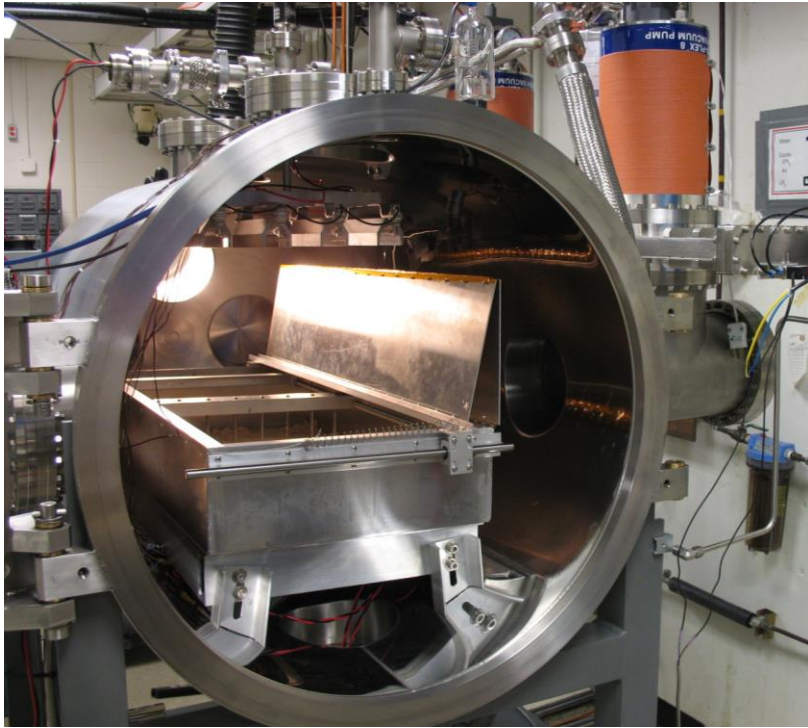
PLANET will be fully online and available for customer use by mid-2024.



What kind of planetary surface testing capability does your technology need?

Testing Enabled





- Lunar Environment Test System – LETS
- Operational since 2008
- **30” diameter**
 - Materials, components, and small mechanisms
- Combined effects:
 - High vacuum
 - Cryogenic shroud
 - IR heating
 - Low energy electrons & protons
 - UV (NUV/VUV)
 - Particle Imaging Velocimeter
 - Simulant box with cover
- POC: Mary Nehls or Erin Hayward

Other Facilities @ MSFC: LETS





- High vacuum, newly converted to DTVAC (dirty thermal vacuum) from clean
- 20' (6m) diameter, 28' (8.5m) length
 - Full-scale hardware test & qual
- Huge simulant beds available, including shallow and deep options
- Cryogenic (LN2) shroud and heating
- POC: Patrick Lynn

Other Facilities @ MSFC: V20





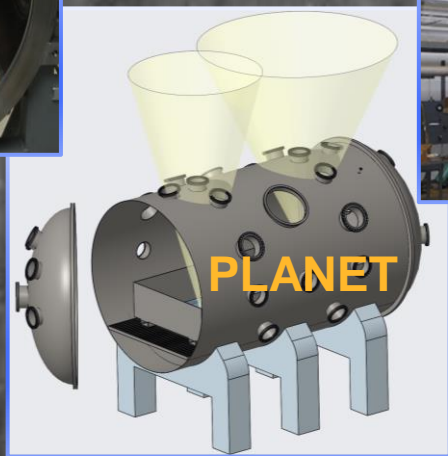
Mike tests the KNaCK (Kinetic Navigation and Cartography Knapsack)

- New capability as of August 2022
- 125 x 125' with 8-12" depth
- Simulant from Merriam Crater in Arizona (feedstock for JSC-1)
- Movable obstacles & boulders
- Potential uses:
 - Terrain relative navigation and cartography
 - Rover & swarm behavior
 - Field testing of mechanisms
- POC: Alex Summers / Mike Zanetti

Other Facilities @ MSFC: Outdoor Regolith Field

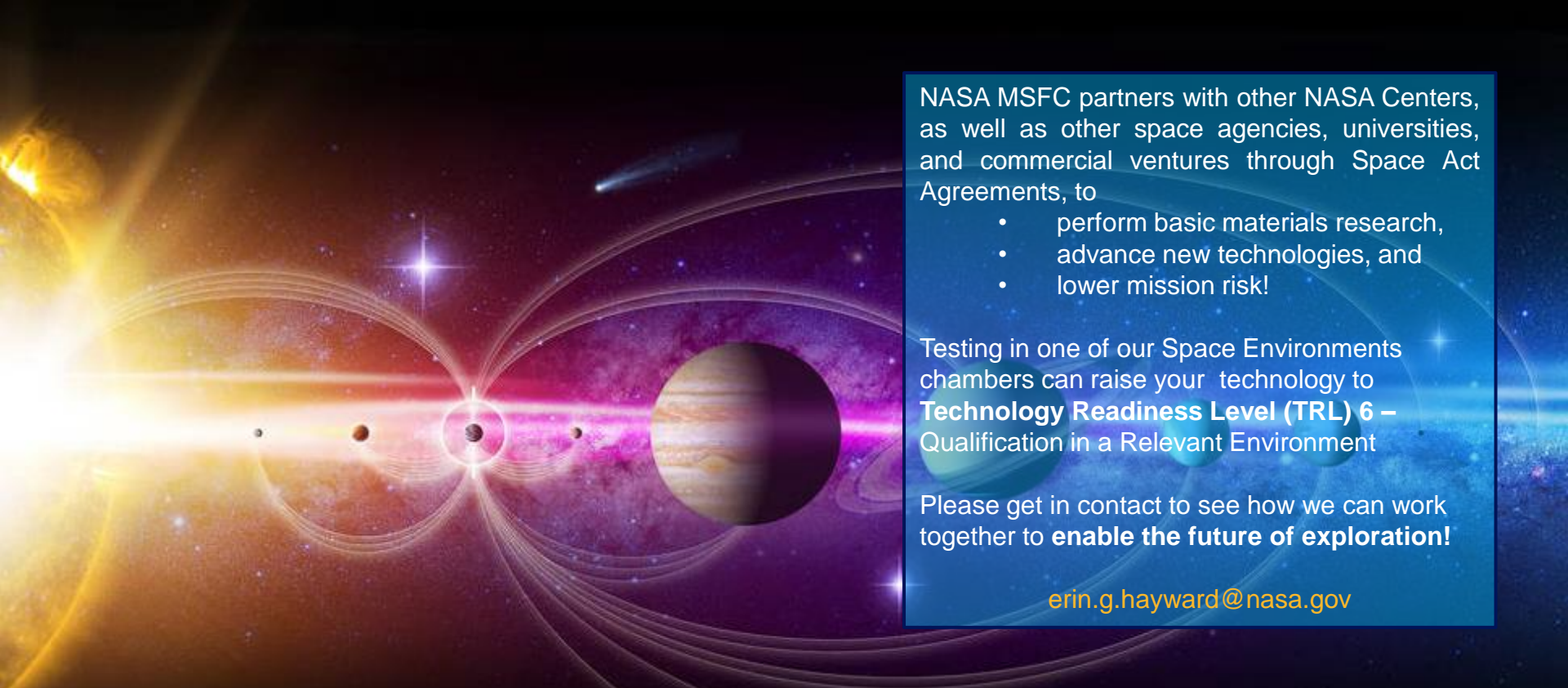


MSFC has multiple complementary planetary surface test capabilities, providing solutions for projects of different sizes, budgets, and development levels



MSFC Lunar Testing Ecosystem





NASA MSFC partners with other NASA Centers, as well as other space agencies, universities, and commercial ventures through Space Act Agreements, to

- perform basic materials research,
- advance new technologies, and
- lower mission risk!

Testing in one of our Space Environments chambers can raise your technology to **Technology Readiness Level (TRL) 6 – Qualification in a Relevant Environment**

Please get in contact to see how we can work together to **enable the future of exploration!**

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Working with MSFC

