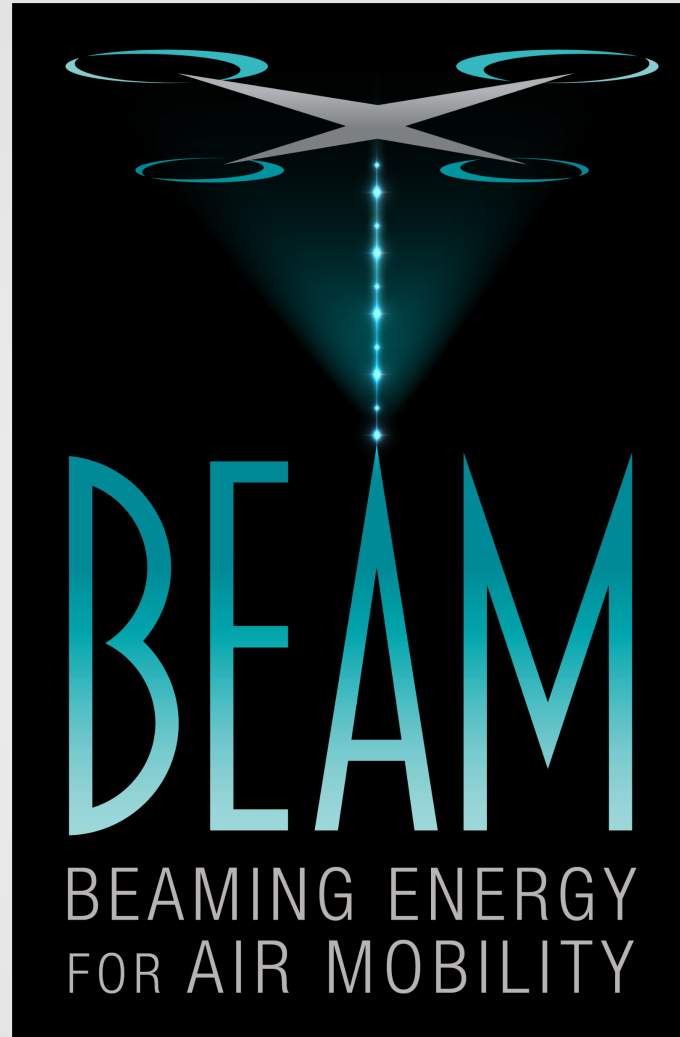






Exploring Safe, Reliable Power for AAM Vehicles



Challenge

Enable “Energy on Demand” service at vertiports to increase safety, endurance payload for electric air taxis

Expected Impacts

- Empower “energy first responders” as a fuel delivery alternative in harsh or remote areas, or areas affected by natural disasters
- Integrate an all-weather backup power system at vertiports for AAM vehicles during emergencies
- Increase AAM range or payload while reducing load and maintenance lifecycle of on-board batteries

Solutions

- Explore how to safely and efficiently transfer energy to vehicles in flight
- Develop methods for resilient energy distribution and logistics for sustainable aerial mobility
- Create power-assisted flight architecture with energy enabled flight operations
 - Emergency landing
 - Holding-Hover
 - Landing
 - Take-off

Results

- Identified the required power profile, top-level design, frequency and operational controls required to operate power beaming within the human environment
- NASA Technical Memorandum (TM) for direct and indirect charging concepts; [August 2023]
- Published “A Concept of Operations for Power Beaming of Electric Air Vehicles”; [Oct. 2023]

Next Steps

- A series of iterative Lab Campaigns (LCs) throughout 2024 verifying prototype design within the mission environment
- Modeling and material testing within the thermal and EM (electromagnetic) environment
- Sub-scale prototyping and testing to verify power efficiency, material performance and safety controls
- Characterization of system efficiency, hazard containment, and mitigations necessary to enhance the power distribution flexibility and resiliency at future AAM vertiports





Advanced Communications Facility Capabilities



CATR

Compact Antenna Test Range

Far-field measurements of electrically large antennas in a shielded anechoic chamber

The Compact Antenna Test Range is a state-of-the-art facility that allows for “far-field” testing of antennas and full communications systems in a compact, indoor, controlled environment. The CATR was designed with flexibility in mind, enabling additional capabilities such as direct far-field measurements and spherical near field scanning capabilities.

Frequency Range	1 GHz to 110 GHz
Range Volume	13×13×44 ft
AUT Size	Up to 1 m



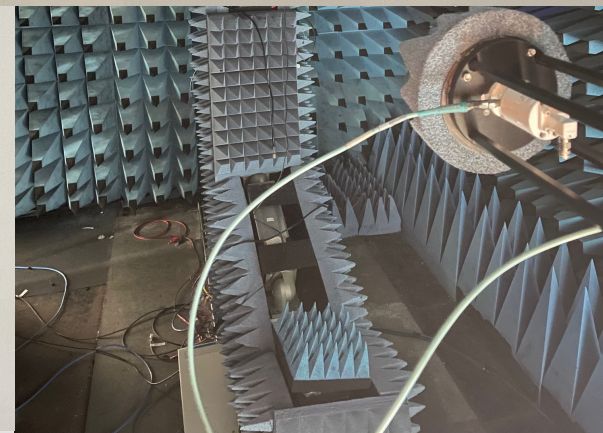
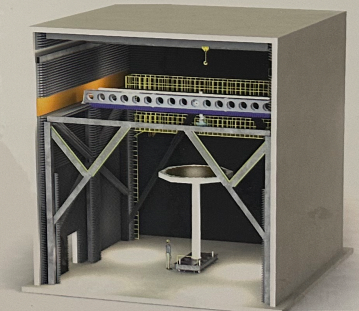
HNF

Horizontal Near Field Antenna Range

Horizontal design minimizes gravitational distortion effects on larger diameter antennas unique within NASA.

The Horizontal Near Field Antenna Test Range is a state-of-the-art facility capable of characterizing a broad range of antenna classes, from large aperture deployable antennas to smaller sub-meter class antennas that can be mounted to a telescoping pedestal. The space itself can be repurposed to support unique antenna characterization or over-the-air activities.

Frequency Range	1 GHz to 110 GHz
Range Volume	44×44×60 ft
AUT Size	Up to 10 m

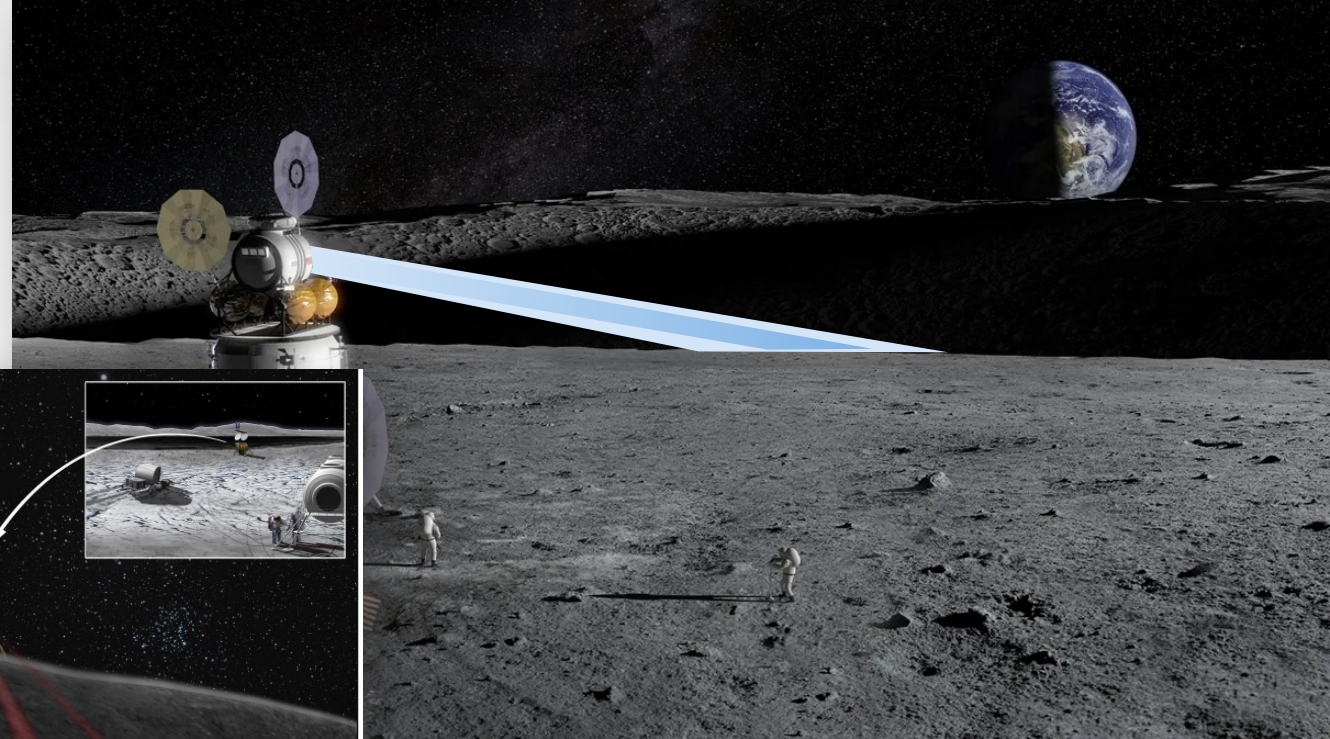


Spherical Antenna Range

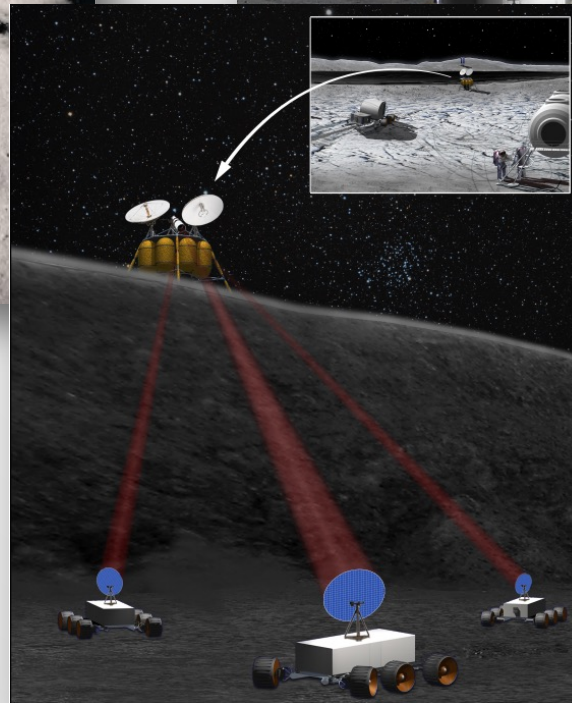
- Used for antenna characterization.
- Support Near field Theta-phi scans and produces 3D plots of converted far field data



Transition Planning: Lunar Applications



- Use of microwaves power beaming to rectenna array allows power to be sent to regions with no sunlight inside **permanently shadowed craters** near the lunar poles
 - Incremental development toward larger scale power beaming



- Future application: *In Situ Resource Utilization* requires power to produce oxygen and hydrogen from lunar polar water
 - Power required 100 kW and up
 - Power transmission distance 2-20 km
 - Long term plan is industrialization and commercialization of the moon