Overview of the Volatiles Investigating Polar Exploration Rover (VIPER)

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MISSION SUMMARY

Background

With the Moon's low obliquity, permanently shadowed regions exist near the poles, which can trap volatile species for an extremely long time. It now appears likely that economically significant amounts of water ice may exist, but the distribution, physical state, and accessibility of this water is still not sufficiently characterized to determine if it would provide an economically viable resource for a variety of uses.

Objectives

To evaluate the potential for lunar polar volatiles to be utilized, VIPER has two primary objectives: (1) Characterize the distribution and physical state of lunar polar water and other volatiles in lunar cold traps and regolith to understand their origin; and (2) Provide the data necessary for NASA to evaluate the potential return of In-Situ Resource Utilization (ISRU) from the lunar polar regions.

Key Points

VIPER will be launched to the Moon in late 2023 as a payload on the Commercial Lunar Payload Services (CLPS) flight provided by Astrobotic's Griffin lander. After landing near Nobile Crater (31.97611 E, 85.39290 S), the VIPER rover will investigate a range of "Ice Stability Regions". VIPER will conduct surface and subsurface assessment of lunar water and other volatiles using three spectrometers and a drill.

VIPER ROVER

Hardware

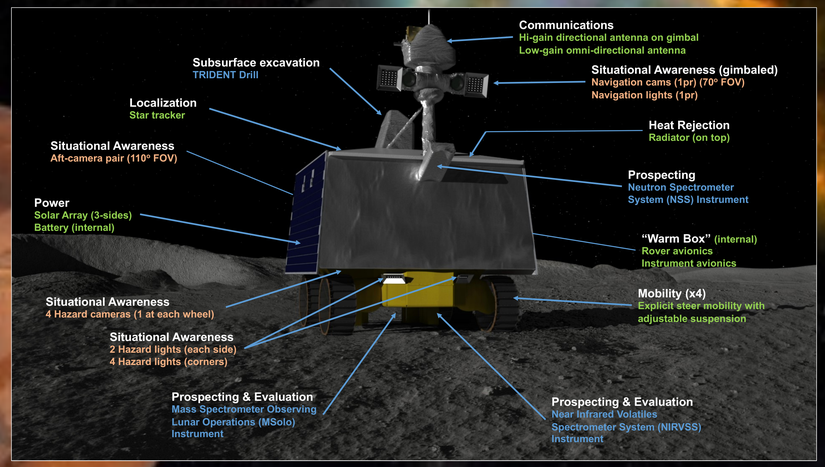
VIPER is a four-wheeled, solar-powered, planetary rover. Active suspension enables changing vehicle ride height, traversing comparatively large obstacles, and controlling wheel load. The rover operates with Direct-to-Earth (DTE) communications using a low-bandwidth omni antenna and a steerable high-gain antenna. Eight cameras, including a stereo pair on a pan/tilt gimbal are used for navigation and remote operations.

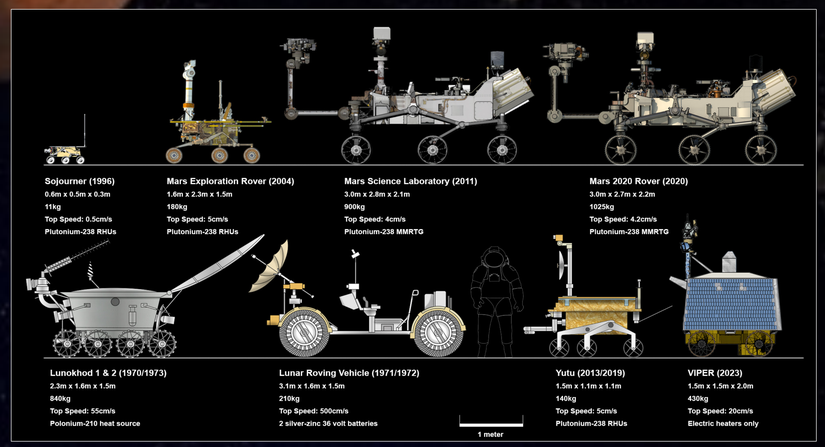
Software

VIPER's Rover Flight Software (RFSW) runs on-board the rover on rad-hard (RAD 750) and rad-tolerant (AiTech SP0-S) avionics. RFSW utilizes NASA's Core Flight System and manages hardware, mobility, and spacecraft services. VIPER's Rover Ground Software (RGSW) runs at mission control on Earth using commodity computing. RGSW is implemented as an ensemble of Robot Operating System 2 (ROS2) nodes and performs navigation, mapping, and driver decision support.

Roving

During surface operations, the rover follows a specific surface traverse plan, primarily via individual position (waypoint) commands up to 8 m ahead. The rover operates with constant DTE communications while in the Sun and in shadows. All-wheel steering enables the vehicle to point arbitrarily while roving, e.g., to keep the solar array pointed at the sun.

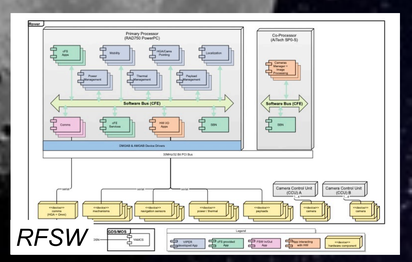




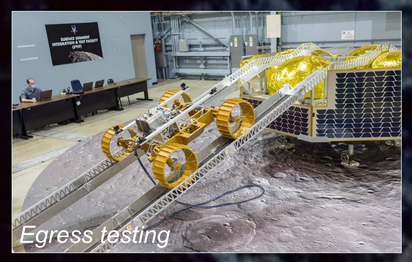

Mobility prototype

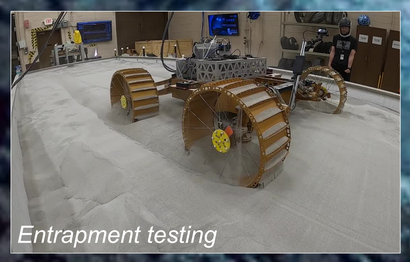

Slip testing

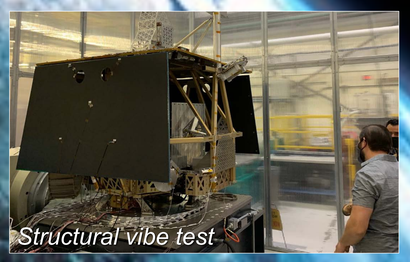

Navigation light testing

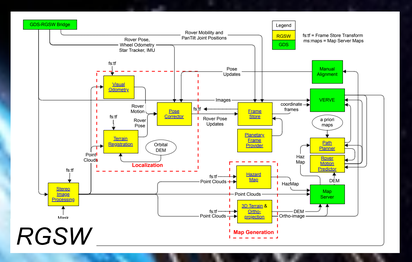


RFSW


Egress testing

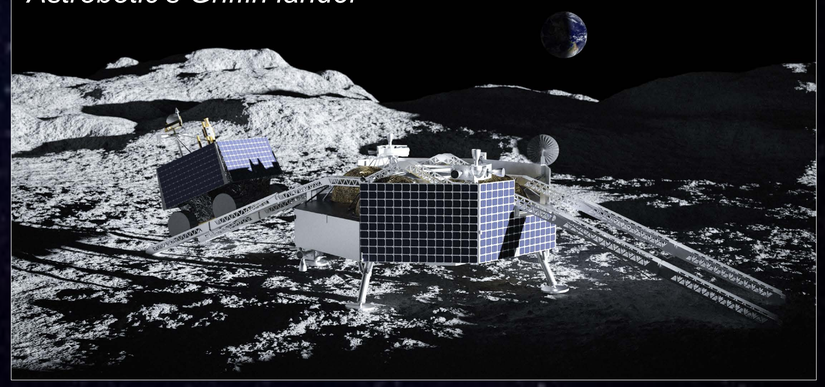

Entrapment testing


Structural vibe test



RGSW

VIPER will egress via ramps from Astrobotic's Griffin lander



www.nasa.gov/viper