LUNAR VERTEX: A LOW-COST LANDER-ROVER INVESTIGATION OF REINER GAMMA.

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Introduction: NASA designated Reiner Gamma as the destination for the first Payloads and Research Investigations on the Surface of the Moon (PRISM) delivery (known as PRISM-1a). Reiner Gamma (RG) is home to a magnetic anomaly, a region of magnetized crustal rocks. The RG magnetic anomaly, on the western nearside, is co-located with the type example of a class of unusual high-reflectance markings known as lunar swirls.

PRISM payloads will be carried on commercial landers as part of NASA's Commercial Lunar Payload Services (CLPS) program. The RG lander and PRISM-1a payload are designed for operation during one lunar daylight period. NASA selected APL's *Lunar Vertex* proposal for the PRISM-1a mission in June of 2021. APL is providing overall management of *Lunar Vertex*, systems engineering, safety and mission assurance, two magnetometer instruments, and rover integration and testing. The *Lunar Vertex* Science Operations Center will be at APL.

***Lunar Vertex* Goals:** A lunar magnetic anomaly is a natural laboratory for addressing a wide range of questions in planetary science [e.g., 1, 2]. *Lunar Vertex* has the following goals: 1) Investigate the origin of lunar magnetic anomalies; 2) Investigate the origin of lunar swirls; 3) Determine the structure of the mini-magnetosphere that forms over the RG magnetic anomaly. These goals are traceable to the Planetary Decadal Survey [3] and other community guiding documents [4-7]. The mission goals will be accomplished by payload elements on the CLPS lander and on a *Lunar Vertex* rover.

Lander Instruments: The lander suite includes three elements. The Vertex Camera Array (VCA) is a set of fixed-mounted cameras. VCA images will be used to (a) survey landing site geology, and (b) perform photometric modeling of regolith characteristics. VCA is being built by Redwire Aerospace of Littleton, Co., USA. The Vector Magnetometer-Lander (VML) is a suite of fluxgate magnetometers. VML will operate during cruise and descent and on the surface to measure the in-situ magnetic field at multiple altitudes and through varying upstream conditions. Built by APL, VML has a dual ring-core fluxgate sensor mounted at the end of a mast. VML also has four commercial miniature magnetometers arrayed in a tetrahedron near the base of the mast. Gradiometry allows for separation of the natural field from that of the lander. The Magnetic Anomaly Plasma Spectrometer (MAPS) measures the energy, flux, and direction of ions and electrons that reach the surface. MAPS is provided by the Southwest Research Institute of San Antonio, Tx., USA.

Rover. The CLPS lander will deploy the *Lunar Vertex* rover, which conducts a traverse reaching ≥500 m distance, obtaining measurements outside the zone disturbed by the lander rocket exhaust. Measurements of undisturbed regolith are key to testing hypotheses for the origin of swirls. Determination of the magnetic field strength and direction along the traverse will help to constrain the nature of the magnetic source. The rover provider is Lunar Outpost (Golden, Co., USA).

Rover Instruments. The rover carries two instruments. The Rover Multispectral Microscope (RMM) will collect images at wavelengths ~0.37–0.94 μm using active LED illumination. RMM (from Canadensys Aerospace of Bolton, On., Canada) will reveal the composition, texture, and particle-size distribution of the regolith beneath the rover. The APL Vector Magnetometer-Rover (VMR) is a copy of a portion of VML: the array of four mini-magnetometers. VMR magnetic measurements will be correlated with changes in regolith properties documented by RMM.

Lander Selection. In November 2021, NASA selected Intuitive Machines of Houston, Tx., USA as the provider of the CLPS lander that will deliver *Lunar Vertex* to the Moon. Launch is planned for April 2024.

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