

LUNAR VERTEX: PRISM-1a PROJECT STATUS. David T. Blewett^{1,*}, Jasper Halekas², George C. Ho¹, Benjamin T. Greenhagen¹, Brian J. Anderson¹, Sarah K. Vines¹, Leonardo Regoli¹, Jörg-Micha Jahn³, Peter Kollmann¹, Brett W. Denevi¹, Heather M. Meyer¹, Rachel L. Klima¹, Joshua T. S. Cahill¹, Lon L. Hood⁴, Sonia Tikoo⁵, Xiao-Duan Zou (邹小端)⁶, Mark Wieczorek⁷, Myriam Lemelin⁸, Shahab Fatemi⁹, Edward A. Cloutis¹⁰, Dany Waller¹, Ann L. Cox¹, Scott A. Cooper¹, and William F. Ames¹. ¹Johns Hopkins University Applied Physics Laboratory, Laurel, MD 20723, USA. ²Univ. of Iowa, Iowa City, IA. ³Southwest Research Inst., San Antonio, TX. ⁴Univ of Arizona, Tucson, AZ. ⁵Stanford Univ., Stanford, CA. ⁶Planetary Science Inst., Tucson, AZ. ⁷Obs. de la Côte d'Azur, France. ⁸Univ. de Sherbrooke, Canada. ⁹Umeå Univ., Sweden. ¹⁰Univ. of Winnipeg, Canada. (*david.blewett@jhuapl.edu)

Introduction: Reiner Gamma (RG) is home to a magnetic anomaly, a region of magnetized crustal rocks. The RG magnetic anomaly is co-located with the type example of a class of irregular high-reflectance markings known as lunar swirls. NASA designated Reiner Gamma as the destination for the first Payloads and Research Investigations on the Surface of the Moon (PRISM) delivery (PRISM-1a). PRISM payloads will be carried on commercial landers as part of NASA's Commercial Lunar Payload Services (CLPS) program.

Lunar Vertex was selected as the PRISM-1a investigation 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.

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].

Lander Instruments: The mission goals will be accomplished by payload elements on a lander and on a small rover. The lander suite includes:

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 has heritage from the *Rosetta* IES, and is provided by the Southwest Research Institute of San Antonio, Tx., USA.

Rover. The 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, and 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 will carry two instruments. The Rover Multispectral Microscope (RMM) will collect images at wavelengths $\sim 0.40\text{--}1.0$ μm using active LED illumination. RMM is supplied by Canadensys Aerospace of Bolton, On., Canada. RMM 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 field measurements will be correlated with changes in regolith properties documented by RMM.

Project Status. *Lunar Vertex* passed PDR in May 2022. We will provide updates on the mission and instruments.

References: [1] D. Blewett et al. (2021), *Bull. Am. Astron. Soc.* 53(4), DOI: 10.3847/25c2cfb.9295af86. [2] M. Robinson et al. (2020), Lunar Intrepid PMCS report. [3] NRC (2022), *Planetary Science and Astrobiology Decadal Survey 2023-2032*, National Academies Press. [4] NRC (2007), *The Scientific Context for Exploration of the Moon*, National Academies Press. [5] SSERVI (2018), Transformative-Lunar Science white paper. [6] LEAG (2018), NEXT SAT report. [7] E. Jawin et al. (2019), *Earth Space Sci.* 6. DOI: 10.1029/2018EA000490.