***LUNAR VERTEX*: A PRISM MISSION TO A MAGNETIC ANOMALY.** D.T. Blewett[1,*], J. Halekas[2], G. Ho[3], B.T. Greenhagen[1], B.J. Anderson[4], L. Regoli[4], S.K. Vines[4], J.-M. Jahn[5], P. Kollmann[4], B.W. Denevi[1], H.M. Meyer[1], R.L. Klima[1], J.T.S. Cahill[1], L.L. Hood[6], S. Tikoo[7], X.-D. Zou[8], S. Fatemi[9], M. Lemelin[10], M.A. Wieczorek[11], J.D. Boldt[3], and A.L. Cox[12]. [1]Planetary Exploration Group, Johns Hopkins University Applied Physics Lab, Laurel, USA. [2]Dept. of Physics & Astronomy, University of Iowa, Iowa City, USA. [3]Science and Space Instrumentation, JHU-APL. [4]Space Physics Group, JHU-APL. [5]Southwest Research Institute, San Antonio, USA. [6]Lunar & Planetary Lab, University of Arizona, Tucson, USA. [7]Dept. of Geophysics, Stanford University, Stanford, USA. [8]Planetary Science Institute, Tucson, USA. [9]Dept. of Physics, Umeå University, Umeå, Sweden. [10]Dépt. de Géomatique Appliquée, Université de Sherbrooke, Sherbrooke, Canada. [11]Observatoire de la Côte d'Azur, Nice, France. [12]Space Science Mission and Instrument Management, JHU-APL. (*david.blewett@jhuapl.edu)

Introduction: In April 2020, the NASA Science Mission Directorate released a Request for Information (RFI) for the Payloads and Research Investigations on the Surface of the Moon (PRISM) program. The RFI asked responders to provide information on scientific instruments or suites that could be delivered to the Moon by a Commercial Lunar Payload Services (CLPS) lander. In November 2020, an announcement of opportunity was published via a PRISM appendix to the Research Opportunities in Space and Earth Science (ROSES 2020) solicitation. The appendix specifically designated Reiner Gamma and the Schrödinger basin as target sites, with one lander to be sent to each location.

The Johns Hopkins Applied Physics Laboratory submitted a proposal for the Reiner Gamma (PRISM-1a) mission entitled *Lunar Vertex*: Exploring the Intersection of Geoscience and Space Plasma Physics. On 10 June 2021 NASA announced that *Lunar Vertex* had been selected for the PRISM-1a delivery [1].

Science at Reiner Gamma: Reiner Gamma (~7.5° N, 59° W) is the most famous example of a region where the Moon's crust is magnetized, known as a magnetic anomaly. The origins of the magnetic anomalies are unclear, and a variety of hypotheses for their origin have been put forth [2–7]. The local magnetic fields modify the Moon's interaction with the solar wind [e.g., 8, 9], creating structures described as "mini-magnetospheres". The crustal magnetic anomalies are frequently correlated with lunar swirls, unusual markings with high reflectance at visible wavelengths [e.g., 10–14]. A lunar magnetic anomaly is a unique natural laboratory for addressing a wide range of questions that touch on planetary magnetism, lunar geology, space plasma physics, and space weathering.

Mission Overview: The PRISM-1a suite is limited to 50 kg, with a $30M mission cost cap (including 20% reserves). The mission duration on the surface is one lunar daylight period (i.e., no night survival).

The *Lunar Vertex* mission 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 Reiner Gamma magnetic anomaly.
4. Evaluate the importance of micrometeoroid bombardment vs. ion/electron exposure in the space weathering of silicate regolith.
5. Provide data related to certain strategic knowledge gaps (SKGs) for human exploration.

The *Lunar Vertex* suite consists of instruments on a lander, plus a small instrumented rover. The lander instruments include a fluxgate vector magnetometer, an ion-electron plasma spectrometer, and a camera array. The rover carries a vector magnetometer and a multispectral microscope with active LED illumination.

The landing site will be near the edge of the central Reiner Gamma bright swirl, allowing the rover to traverse from the high-reflectance surface into the adjacent "dark lane".

Mission Name: The mission's name adopts the Latin word "vertex", which can mean "swirl". The English word "vertex" invokes an intersection – the crossroads of geoscience and the particles-and-fields domain of space physics. This intersection is the theme of the interdisciplinary *Lunar Vertex* mission.

References: [1] https://www.nasa.gov/press-release/nasa-selects-new-science-investigations-for-future-moon-deliveries. [2] L.L. Hood et al. (2001), *JGR 106,* 27825. [3] M.A. Wieczorek et al. (2012), *Science 335*, 1212. [4] M.B. Syal and P. Schultz (2015), *Icarus 257*, 194. [5] I. Garrick-Bethell et al. (2009), *Science 323*, 356. [6] M.E. Purucker et al. (2012), *J. Geophys. Res. 117*, E05001. [7] D.J. Hemingway and S.M. Tikoo (2018), *J. Geophys. Res. 123*. [8] C.T. Russell and B.R. Lichtenstein (1975), *J. Geophys. Res. 80*, 4700. [9] C. Lue et al. (2011), *Geophys. Res. Lett. 38*, L03202. [10] F. El-Baz (1972), *Apollo 16 Prelim. Sci. Rept.*, NASA SP-315, 29-93. [11] P.H. Schultz and L.J. Srnka (1980), *Nature 284*, 22. [12] D.T. Blewett et al. (2011), *JGR 116*, E02002. [13] B.W. Denevi et al. (2016), Icarus 273, 53–67. [14] J. Cahill et al. (2019), *JGRP 124*, 294.