EPSC Abstracts
Vol. 13, EPSC-DPS2019-1643-1, 2019
EPSC-DPS Joint Meeting 2019

EPSC
EPSC-DPS Joint Meeting 2019
15–20 September 2019 | Geneva, Switzerland

Lunar Polar Sunlit Peaks in the UV with LAMP's New Observing Mode

Akbar Whizin (1), Kurt Retherford (1), Ben Byron (2, 1), Lizeth Magaña (2, 1), Thomas Greathouse (1), Anthony Egan (3), Amanda Hendrix (4), and Paul Hayne (5).

(1) Southwest Research Institute, San Antonio, TX, USA; (2) University of Texas San Antonio, San Antonio, TX, USA; (3) Southwest Research Institute, Boulder, CO, USA; (4) Planetary Science Institute, Tucson, AZ, USA; (5) University of Colorado, Boulder, CO, USA. (author contact: awhizin@swri.edu)

Abstract

The new observing mode on the Lunar Reconnaissance Orbiter's (LRO) Lyman Alpha Mapping Project (LAMP) spectrograph has allowed for an overall increase in signal to noise by a factor of ~35 for dayside observations, and ~1.1 for nightside. Capitalizing on this we are exploring the north and south polar regions by comparing the high-latitude polar terrain to highly weathered regions with sunlit peaks in near-permanent illumination. Additional comparisons will be made with permanently shadowed regions (PSR) and diurnal hydration variability from previous PSR and hydration studies by Hayne *et al*., (2015) and Hendrix *et al*., (2019), respectively.

1. Introduction

Temperature variations drive the temporal fluctuations in hydration on the lunar surface [1], especially at equatorial regions (low-mid latitudes). The lunar poles harbor colder temperatures and deep craters, but also nearby regions with >90% illumination conditions. LAMP's UV observations allow us to "see" into PSR crater floors with reflected starlight. Several bright features in the nightside/PSR UV maps are evident at locations where sunlight peaks are known to exist. In the UV, water has an absorption feature near 165 nm [1]. By taking the Off-Band/On-Band ratios of the UV albedo (see Figure 1), which has been found to correlate with temperature and water ice concentrations [2, 3], observations can be compared to spectral mixing models (see Magaña *et al*., *this meeting*) and laboratory UV reflectance measurements to help infer ice abundances and surface properties [4]. Retherford *et al*., (*this meeting*) gives a detailed overview of the recent LAMP findings and their applicability to planetary processes and future discoveries.

2. Fail Safe Door Mode

LAMP's new operational mode, the opening of the Fail-Safe Door (FDO) at the end of 2016, has allowed a 35 times improvement in the dayside sensitivity. This has dramatically increased the signal to noise of the UV spectrograph instrument and will allow extensive new science observations in ESM4. We have begun to create dayside polar maps (Figure 2) using the data from this new observing mode.

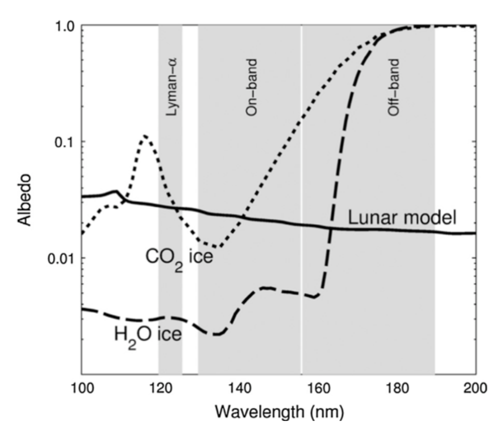

Figure 1: Fig 13 from [2] showing the CO2 and H2O ice spectrum compared to lunar regolith computed from a directional-reflectance model.

With this new capability and sensitivity in LRO's ESM3, LAMP is performing dayside observations to identify water sources by constraining surface hydration variability. Nightside maps including sunlit peaks with high signal levels can be compared with these dayside maps to determine their UV spectral properties for the first time. By mapping the lunar surface and volatile contents and finding regions of interest, the LAMP instrument will aid in site selection for future landed missions, characterization of lunar volatile inventories, trapping and migration, and potentially In-Situ Resource Utilization (ISRU).

3. Future Work

We are working on creating dayside and nightside maps like those in Figure 2 for the entire observable lunar surface, including large high-resolution global mosaics that will be available on the PDS, following final touches on the calibration of this new mode. In ESM4 we will obtain many more detailed observations of the lunar poles giving great high-resolution, high-signal to noise data of the PSRs and high-latitude regions, as well as excellent global spatial coverage.

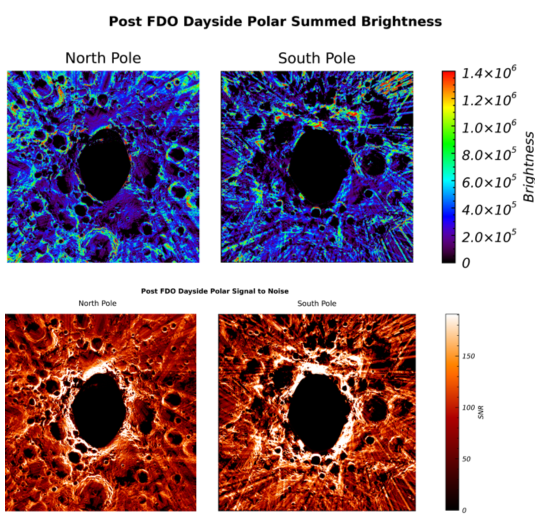

Figure 2: Dayside summed brightness (top) and extrapolated signal to noise (bottom) for LAMP's post-FDO observing mode at the lunar poles.

Acknowledgements

We would like to thank the LRO project, NASA, and the entire LAMP Science team for their continuing contributions in understanding the far-UV spectrum's dependence on the physical and chemical properties of the lunar surface, without which, work like this would not be possible. This LRO LAMP project is funded under NASA contract NNG05EC97C.

References

[1] Hendrix, A. R., et al.: Diurnally-Migrating Lunar Water: Evidence from Ultraviolet Data. *Geophysical Research Letters*, https://doi.org/10.1029/2018GL081821, 2019.

[2] Hayne, P., et al.: Evidence for exposed water ice in the Moon's south polar regions from LRO UV albedo and temperature measurements, Icarus, Vol. 255, pp. 58-69, 2015.

[3] Gladstone, G. R., et al.: Far-ultraviolet reflectance properties of the Moon's permanently shadowed regions. *Journal of Geophysical Research: Planets,* 117.E12, 2012.

[4] Raut, U., et al.: Far-ultraviolet photometric response of Apollo soil 10084. Journal of Geophysical Research: Planets, Vol. 123, pp. 1221–1229, 2018.