

Initial Results from the Lyman Alpha Mapping Project (LAMP) Instrument on the Lunar Reconnaissance Orbiter (LRO) Mission. G. R. Gladstone¹ and the LAMP Team, ¹Southwest Research Institute, 6220 Culebra Road, San Antonio, TX 78238 (rgladstone@swri.edu)

Introduction: The Lyman Alpha Mapping Project (LAMP) [1] is a far-ultraviolet (FUV) imaging spectrograph on NASA's Lunar Reconnaissance Orbiter (LRO) mission [2]. Its main objectives are to (i) identify and localize exposed water frost (and possibly other volatiles) in permanently shadowed regions (PSRs), (ii) characterize landforms and albedos in PSRs, (iii) demonstrate the feasibility of using natural starlight and skyglow illumination for future lunar surface mission applications, and (iv) characterize the lunar atmosphere and its variability (including transients resulting from the LCROSS impact). As a by-product, LAMP will map the Moon at FUV wavelengths, allowing new studies of the microphysical and reflectance properties of the regolith. LAMP does this by measuring the signal reflected from the nightside lunar surface and in PSRs using both interplanetary Ly α and FUV starlight as light sources. Both these light sources provide fairly uniform, faint illumination.

With the expected LAMP sensitivity, by the end of the primary 1-year LRO mission, the SNR for a Ly α albedo map will be >100 in polar regions $>1 \text{ km}^2$, allowing the FUV characterization of subtle compositional and structural features. Dayside observations of reflected FUV sunlight will also be made, using a pin-hole in the aperture door. The LAMP instrument is based on the Alice spectrographs flying on the Rosetta comet mission and the New Horizons Pluto mission.

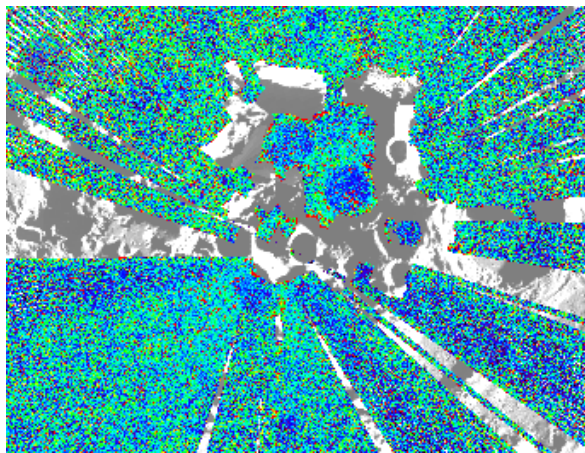


Fig. 1. LAMP preliminary nightside brightness map of the south polar region using data obtained during 9/15-11/11, 2009. Most ($>90\%$) of the FUV photons seen on the nightside are interplanetary medium Ly α photons reflected from the surface.

Far-Ultraviolet Surface Mapping: In the >5 months since the LRO Mapping Orbit Insertion on 9/15/2009, LAMP has spent most of the time accumulating UV photon lists from nadir-pointed observations, with only occasional off-Moon pointings for monthly stellar calibrations, limb atmosphere observations, and LCROSS support. Even so, the typical night side count rates of only ~ 500 counts/s require that many months of data collection are needed before acceptably accurate albedo maps can be obtained. However, even with just a few weeks of data it may be seen (cf. Fig. 1) that the LAMP mapping data will be useful for characterizing PSRs. While uncorrected for illumination conditions that will affect final albedo maps, the preliminary brightness maps such as shown in Fig. 1 indicate that PSR regions have lower FUV reflectivities than non-PSR regions.

Atmosphere Observations: Atmosphere studies are not part of the primary 1-year mission for LRO supported by NASA's Exploration Systems Mission Directorate (ESMD), although some very useful data will be obtained serendipitously. More directed atmospheric observations and campaigns are expected to occur in the planned extension of the LRO mission that will be supported by NASA's Science Mission Directorate (SMD). Central to these studies will be frequent targeted limb observations, e.g., along the dawn terminator, where the diurnal concentrations of atmosphere are largest, and where horizon glow can be studied for the relative contributions of dust and sodium emissions. Possible campaigns include focused studies of transient phenomena, such as certain meteor showers and crossings of Earth's magnetotail, where atmospheric source rates would be expected to increase.

LCROSS Support: LAMP successfully observed a plume containing H_2 , Hg, Ca, and Mg that was generated by the LCROSS Centaur impact into Cabeus crater. The species detected by LAMP underscore the fact, realized long ago [3], that water is not the only volatile likely to be found in abundance in the PSRs.

References:

- [1] Gladstone G. R. et al. (2010) *Space Sci. Rev.*, in press.
- [2] Chin, G. et al. (2007) *Space Sci. Rev.*, 129 391-419.
- [3] Reed, G. W., Jr. (1999) *Meteoritics & Planet. Sci.*, 34, 809-811.