LRO-LAMP MEASUREMENTS OF FAR-ULTRAVIOLET ALBEDOS IN PERMANENTLY SHADOWED REGIONS. G. R. Gladstone[1], K. D. Retherford[1], S. A. Stern[2], A. F. Egan[2], P. F. Miles[1], M. H. Versteeg[1], D. C. Slater[1], M. W. Davis[1], J. Wm. Parker[2], D. E. Kaufmann[2], T. K. Greathouse[1], A. J. Steffl[2], J. Mukherjee[1], D. Horvath[1], P. D. Feldman[3], D. M. Hurley[4], W. R. Pryor[5], and A. R. Hendrix[6], [1]Southwest Research Institute, 6220 Culebra Rd., San Antonio, TX 78238, [2]Southwest Research Institute, 1050 Walnut St., Boulder, CO 80302, [3]Johns Hopkins University, 3400 N. Charles St., Baltimore, MD 21218, [4]Johns Hopkins University Applied Physics Laboratory, 11100 Johns Hopkins Rd., Laurel, MD 20723, [5]Central Arizona University, [6]Jet Propulsion Laboratory, Pasadena, CA.

Introduction: The Lyman Alpha Mapping Project (LAMP) [1] is a far-ultraviolet (FUV) imaging spectrograph on NASA's Lunar Reconnaissance Orbiter (LRO) mission [2]. During LRO's nominal mission for NASA's Exploration Systems Mission Directorate (ESMD), i.e., during 9/15/2009–9/14/2010, the LAMP instrument observed FUV brightnesses on the nightside of the Moon to search for indications of water frost and other surface volatiles in permanently shadowed regions (PSRs) near each pole. LAMP accomplished this by measuring the signal reflected from the nightside lunar surface and in PSRs using interplanetary medium (IPM) Lyα and FUV starlight as light sources. Both these light sources provide fairly uniform, faint illumination and were estimated using model fits of SOHO/SWAN data for the IPM Lyα illumination and IUE data for stellar fluxes (plus LOLA topography for sky visibility) in order to convert the LAMP-observed brightnesses into albedos.

Observations: LRO's polar orbit provides for repeated observations of PSRs, enabling accumulation of the faint reflected UV signal with the photon-counting LAMP instrument. The LAMP instrument covers an FUV passband of 57-196 nm, and its 6°×0.3° slit is nominally pointed at the nadir.

At LAMP's sensitivity the nightside count rate due to reflected IPM Lyα light is ~200-300 counts/s over the entire slit, which from ~50-km altitude amounts to >150 counts/km^2 from each ~5-km wide orbit swath. The background count rate is very low (~20 counts/s), so the signal-to-noise ratio (SNR) for a Lyα albedo map is approximately the square root of the number of counts per bin, e.g., >10 in polar regions for 240-m bins.

Results: The Lyα albedos of PSRs are quite variable, as shown in Figure 1. Most PSRs (e.g., Haworth, Shoemaker, Faustini) are considerably less reflective at Lyα wavelengths (A~0.03) than are their surroundings (A~0.04). However, some PSRs (e.g., Shackleton, and a similar-sized crater on the southern rim of Nobile) are no less reflective than their surroundings. The lower albedo regions are roughly correlated with the coldest regions reported in Diviner temperature maps.

In this presentation we will investigate some possible causes of this albedo darkening at Lyα wavelengths, e.g. the presence of UV-absorbing volatiles at the surface and/or changes in surface properties (e.g., roughness) at these interesting locations. Note that because of the (nearly) uniform illumination by the IPM Lyα, the LAMP surface albedos are directly related to the single-scattering albedo (ω_o) of the surfaces particles [3], with ω_o~4A.

References:

[1] Gladstone, G. R. et al. (2010) *Space Sci. Rev.*, *150*, 161-181. [2] Chin, G. et al. (2007) *Space Sci. Rev.*, *129* 391-419. [3] Hapke B. (1993) *Theory of Reflectance and Emittance Spectroscopy*, Cambridge, 455 pp. [4] Mazarico, E. et al. (2011), Icarus, 211, 1066-1081.

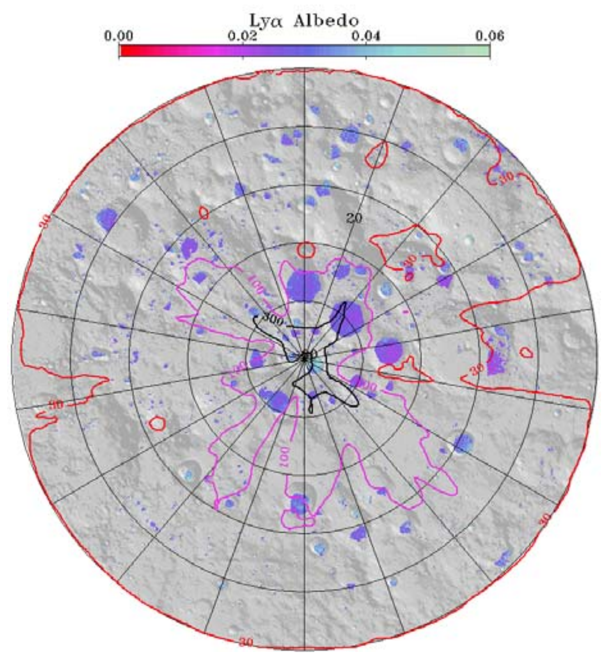

Fig. 1. LAMP nightside Lyα albedos of LOLA-determined PSRs [4] near the south pole, overplotted on a shaded relief map of a LOLA 240m DEM. Both data sets are from the nominal ESMD mission. The contours show accumulated LAMP counts in counts/240-m pixel, which is approximately SNR^2. Note the considerable variation in PSR albedo.