New Perspectives on the Lunar Far-UV Albedo: Implications of LRO Lyman Alpha Mapping Project (LAMP) Results for Future Exploration. K. D. Retherford[1], T. K. Greathouse[1], G. R. Gladstone[1], A. R. Hendrix[2], K. E. Mandt[1], P. F. Miles[1], A. F. Egan[3], D. E. Kaufmann[3], M. A. Bullock[3], S. A. Stern[3], J. Wm. Parker[3], M. W. Davis[1], P. D. Feldman[4], D. M. Hurley[5], W. R. Pryor[6], C. Grava[1], J. Mukherjee[1], P. O. Hayne[7], E. Mazarico[8], P. Mokashi[1], C. M. Seifert[1,9], P. L. Karnes[1,9], C. J. Seifert[1,9], and M. H. Versteeg[1]; [1]Southwest Research Institute, San Antonio, TX (kretherford@swri.edu), [2]Space Sciences Institute, Tucson, AZ, [3]Southwest Research Institute, Boulder, CO, [4]Johns Hopkins University, Baltimore, MD, [5]Johns Hopkins University Applied Physics Laboratory, Laurel, MD, [6]Central Arizona University, Coolidge, AZ, [7]Jet Propulsion Laboratory, Pasadena, CA, [8]NASA Goddard Space Flight Center, Greenbelt, MD, [9]St. Mary's University, San Antonio, TX.

Abstract. Far ultraviolet (far-UV) albedo maps are obtained using the Lunar Reconnaissance Orbiter (LRO) Lyman Alpha Mapping Project (LAMP)'s innovative nightside observing technique [1]. Similar dayside FUV maps obtained using the more traditional photometry technique with the Sun as the illumination source are very complementary. After ~4 years in orbit, LRO-LAMP measurements provide a new perspective on the lunar far-UV albedo. We discuss the implications of several LAMP findings and suggest new investigations for future missions.

Introduction. The LRO-LAMP is a UV spectrograph that addresses how water is formed on the Moon, transported through the lunar atmosphere, and deposited in permanently shaded regions (PSRs)[2,3]. Importantly, the nightside technique allows us to peer into the permanently shaded regions (PSRs) near the poles, and determine their UV albedos. LAMP data products include nightside brightness maps of polar regions over specific wavelength ranges, and similarly constructed albedo maps (i.e., brightness maps normalized by the varying illumination). Lyman-α, on-band and off-band maps (i.e., on and off an absorption band for water frost) are useful for constraining the abundance of surficial water frost [1,4].

Key Results. LAMP FUV albedo maps are used to investigate the intriguing albedo differences that occur within PSRs. LAMP measurements indicate ~1-2% surface water frost abundances in a few PSRs based on spectral color comparisons, and we find that many PSRs may have porosities of ~0.7 based on relatively low albedos at Lyman-α [1]. The FUV albedo maps reveal lower albedo regions within craters. The lower albedo regions are roughly correlated with the coldest PSR regions, and Hayne et al., *this meeting*, will present correlative analyses with Diviner maps. Mandt et al., *this meeting*, will present updated analyses of the PSR water frost abundances including a search for changes on monthly timescales.

New dayside FUV albedo maps will also be presented. Comparisons between the nightside and dayside photometry techniques help validate the use of Lyman-α and starlight as illumination sources. Analysis of dayside spectra for selected regions complement the dayside maps, and are used to investigate space weathering and hydrated surface signatures [5]. Hendrix et al., *this meeting*, report that the Compton-Belkovich region presents a relatively red spectral slope in the LAMP dataset, and discuss the potential for surface hydration in this region. A lab study of the FUV reflectance properties of Apollo samples, lunar simulants, and water ice is underway to further characterize the UV reflectance techniques. The far-UV spectral inversion property of the lunar albedo discovered by the Apollo 17 UVS is confirmed with the LAMP dataset, and Seifert et al., *this meeting*, investigate further the contrast of UV-bright mare versus UV-dark highlands region features as a function of wavelength.

Implications for Future Missions. We plan to capitalize and expand upon these recent discoveries through Sept. 2016 in an upcoming second extended science mission for LRO. More surface reflectance data (60-190 nm) at a variety of incident and emission angles is needed to improve signal, spectral, and photometric quality and further develop our innovative nightside UV reflectance technique for identifying surficial water frost and determining surface porosity. We plan to continue targeting UV-interesting regions and focus on key PSRs identified by LRO/LEND and MiniRF as potentially water-rich, which provides improved sensitivity for these crucial data. Global searches of water signatures outside of PSRs with LAMP confirms and elucidates the findings of surface water/hydroxyl and its variability with infrared Chandryaan-M3/Cassini-VIMS/EPOXI data. This legacy dataset will influence planning for future missions to investigate and/or utilize lunar volatiles.

References [1] Gladstone, G. R. et al., Far-Ultraviolet Reflectance Properites of the Moon's Permanently Shadowed Regions, *J. Geophys. Res., 117*, E00H04, 2012. [2] Gladstone, G. R., et al. LAMP: The Lyman Alpha Mapping Project on NASA's Lunar Reconnaissance Orbiter Mission, *Space Sci. Rev., 150*, 161-181, 2010. [3] Gladstone, G. R. et al., LRO-LAMP Observations of the LCROSS Impact Plume, *Science, 330,* 472-476, 2010. [4] Retherford, K. D., et al., LRO/LAMP Far-UV Albedo Maps, *in prep*, 2014. [5] Hendrix, A. R., et al., Lunar Albedo in the Far-UV: Indicator of Hydrated Materials and Space Weathering, *J. Geophys. Res.*, 117, E12001, 2012.