Scientific Breakthroughs from the LRO-Lyman Alpha Mapping Project (LAMP). K. D. Retherford (1), S. A. Stern (2), G. R. Gladstone (1), J. C. Cook (2), A. F. Egan (2), P. F. Miles (1), J. Wm. Parker (2), D. E. Kaufmann (2), T. K. Greathouse (1), C. C. C. Tsang (2), M. H. Versteeg (1), J. Mukherjee (1), M. W. Davis (1), A. J. Bayless (1), P. D. Feldman (3), D. M. Hurley (4), W. R. Pryor (5), and A. R. Hendrix (6); (1) Southwest Research Institute, San Antonio, TX (kretherford@swri.edu), (2) Southwest Research Institute, Boulder, CO, (3) Johns Hopkins University, Baltimore, MD, (4) Johns Hopkins University Applied Physics Laboratory, Laurel, MD, (5) Central Arizona University, Coolidge, AZ, (6) Jet Propulsion Laboratory, Pasadena, CA.

Abstract. The Lunar Reconnaissance Orbiter (LRO) Lyman Alpha Mapping Project (LAMP)'s innovative nightside observing technique allows us to peer into the permanently shaded regions (PSRs) near the poles, and determine their UV albedos. LAMP measurements indicate ~1-2% surface water frost abundances in a few PSRs based on spectral color comparisons [1]. A strong water ice absorption edge near 160 nm within LAMP's bandpass presents itself as a relative reddening at the longest far-UV wavelengths. LAMP generally measures darker albedos within PSRs at Lyman-α and other far-UV wavelengths that are consistent with ~30% higher porosity, and consistent with "fairy-castle" structures previously suggested to exist there [1]. Nightside maps of far-UV albedo show relative brightnings associated with the peaks of crater rims and other features indicative of enhanced spaceweathering effects [2]. Dayside far-UV maps and spectra are also being produced using more traditional photometry techniques. Spectral analysis of dayside regions indicate far-UV signatures of surface hydration; this result complements the detections of OH/H_2O hydration at infrared wavelengths by the Chandryaan-1/M^3 team [3]. Lunar helium atmospheric emissions have been detected remotely for the first time, which enables new global investigations of its distribution and variability [4]. Initial variability studies show the lunar helium abundance to vary with solar wind conditions, as expected - including stoppages of helium in-flux during times of Earth magnetotail transits [5]. LCROSS impact plume observations with LAMP detected H_2, CO, Hg, Mg, and Ca constituents, which together with LCROSS shepherding satellite observations revealed a much richer mix of volatiles trapped within the PSRs than previously understood [6,7,8]. A lab study of the UV reflectance properties of lunar simulants and water ice samples is underway [9], and Apollo sample measurements are being planned to help us pioneer these new techniques in UV spectroscopy for investigating lunar volatiles.

Instrument. The LAMP UV spectrograph (Figure 1) covers the 57-196 nm bandpass [10]. Its 6°×0.3° slit, nominally pointed nadir, scans the surface in pushbroom style, similar to other LRO instruments. LAMP routinely observes the Lunar nightside via reflected starlight and interplanetary medium illumination [11], and its mapping resolution of ~240 m x 240 m per pixel is similar to that for LROC/WAC and Diviner on LRO. The lunar dayside is also observed by switching to a pinhole mode after terminator crossings each orbit.

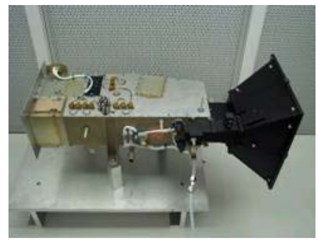

Figure 1: LAMP instrument prior to LRO integration.

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