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Lyman Alpha Mapping Project (LAMP) Detections of LCROSS Impact Plume Gas

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The Lyman Alpha Mapping Project (LAMP) is an ultraviolet (UV) spectrograph on the Lunar Reconnaissance Orbiter (LRO) that is designed to map the lunar albedo at far-UV wavelengths. LAMP's spectral range of 57.5 nm to 196.5 nm includes emission line features from several known and expected lunar atmosphere constituents, including resonantly scattered Lyman-alpha (121.57 nm) emissions from hydrogen atoms and argon atom emissions at 104.82 nm and 106.67 nm. The LCROSS impact on 9 October 2009 elevated and exposed water ice and other volatiles trapped near the lunar surface (Colaprete et al., submitted, 2010). Observations with LRO/LAMP detected enhancements of volatile species in the plume shortly after impact (Gladstone et al., submitted, 2009). The plume of rapidly expanding gas includes molecular hydrogen gas seen by sunlit fluorescence. Resonantly scattered emissions from atomic Hg, Mg, and Ca in sunlight are also likely detected in a feature near 185 nm. The molecular hydrogen content within permanently shadowed regions (PSRs) is higher than possible through dissociation of water alone, which indicates that trapped hydrogen gas likely contributes to the hydrogen content of the PSRs in addition to the water detected there. The concentration of mercury in PSRs has implications for future exploration and in situ resource utilization in these regions. This investigation addresses how water and other volatiles arrive (or form) at the lunar surface, are transported through the lunar atmosphere, and are deposited within PSRs (or elsewhere), which is closely related to LAMP's primary objectives.