LUNAR CRATER OBSERVATION AND SENSING SATELLITE (LCROSS) MISSION: RESULTS FROM THE NADIR NEAR-INFRARED SPECTROMETER ABOARD THE SHEPHERDING SPACECRAFT. D.H. Wooden[1], A. Colaprete[1], K. Ennico[1], M.H. Shirley[1], J.L. Heldmann[1], and the LCROSS Science Team, [1]NASA Ames Research Center, Moffett Field, CA, 94035

Introduction: A primary science goal of the LCROSS (Lunar Crater Observation and Sensing Satellite) Mission is to evaluate the composition of the reservoir of excess H atoms in the regolith of the floors of permanently shadowed craters at the lunar poles [1]. On October 9, 2009, impact excavation of regolith occurred by the kinetic impact of the ~2300 kg Atlas V Centaur Earth departure upper stage of the launch vehicle. The impact created an ejecta plume whos properties were observed by the LCROSS Shepherding Space Craft (S/SC) as the S/SC also descended towards the floor of the permanently shadowed crater Cabeus, and itself impacted ~4 minutes after the Centaur. During these 4 minutes, the instruments on board the LCROSS S/SC collected data on the impact plume and ejecta curtain. Here we discuss preliminary analysis of the nader-viewing (down-looking) near-infrared spectrometer.

Science goals included investigating the presence or absence of water on the Moon as well as furthering our understanding of other species contributing ot the H atom budget trapped in these permanently shadowed regions. The detection of excess H atoms by the Lunar Prospector neutron spectrometer [2,3,4,5] is now enhanced by higher spatial sampling of the Lunar Reconnaissance Orbiter (LRO) LEND instrument [6].

Spacecraft Instrumentation: All science instruments aboard the LCROSS shepherding spacecraft successfully collected data during the final descent to the lunar surface. The LCROSS S/SC included nine science instruments including a nader-viewing Near-Infrared Spectrometer (NSP) provided by Polychromix. The NSP is a hadamard transform spectrometer with spectral range from λλ 1.17–2.45 μm and spectral resolution of 0.01366 μm/resolution element for 100 resolution elements. The hadamard-transform spectrometer utilizess a dynamic mask generated by a MEMS spatial light modulator following a grating. The hadamard transform produces an instrument profile that is steeper than a Gaussian profile between the half-max and zero intensity. Laboratory calibration of the NSP in the Ames Airborne Sensor Laboratory contributed to understanding its performance characteristics.

Results: This paper will focus on results from analysis of the nadir NSP data during its final descent above and through the impact plume created by the Centaur impact. The nader NSP detected the absorption bands of gas phase species against the continuum. The continuumn consists of scattered sunlight 1.17 μm $\leq \lambda \leq$ 1.9 μm plus thermal emission at ~1.9 μm $\leq \lambda \leq$ 2.45 μm. The median color temperature of the thermal emission is 800 K. This color temperature is consistent with the detection at 90 sec after impact by LRO's thermal mapping DIVINER instrument [7]. The spectra are complex with overlapping spectral bands of volatile gases in addition to water vapor. The temporal evolution of the spectra also is complex, with features evolving on time scales of several to tens of seconds. Groups of features evolve together. The identification and modeling of the nadir NSP is work in progress. The volatile content of the permanently shadowed regions appears to hold water [8] and other volatiles.

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