SPECTROSCOPY OF THE LCROSS EJECTA PLUME FROM KECK, GEMINI, AND NASA IRTF OBSERVATORIES ON MAUNA KEA. D.H. Wooden[1], E. F. Young[2], M. S. Kelley[3], C.E. Woodward[4], D.E. Harker[5], M. A. DiSanti[6], P. G. Lucey[7], R. B. Hawke[7], D. B. Goldstein[8], D. Summy[8], A. R. Conrad[9], T. R. Geballe[10], J. T. Rayner[11], A. Colaprete[1], J. L. Heldmann[1], [1]NASA Ames Research Center, MS 245-3, Moffett Field CA 94035, Diane.H.Wooden@nasa.gov, dwooden@mac.com, [2]SwRI, Boulder, CO, [3]UMD, College Park, MD, [4]UMN, Minneapolis, MN, [5]UCSD/CASS, San Diego, CA, [6]NASA GSFC, [7]HIGP, Honolulu, HI [8]UT, Austin, TX, [9]W. M. Keck Observatory, [10]Gemini Observatory, [11]Institute for Astronomy, Honolulu, HI

Introduction: Our LCROSS Ground-Based Observation Campaign (GBOC) Mauna Kea Spectroscopy Team will observe the LCROSS impact event with three complementary ground-based instruments: Gemini North's Near-Infrared Integral Field Spectrometer (NIFS), Keck Observatory's NIRSPEC spectrometer, and the NASA IRTF SpeX spectrometer, chosen specifically to achieve the LCROSS mission Science Goals, as follows:

• NIRSPEC will acquire high-resolution spectra (R = 25,000) of non-resonant fluorescent water vapor emission lines between 3380 and 3530 cm-1. Of the three proposed observations, NIRSPEC is uniquely sensitive to water vapor and is our most diagnostic experiment for the presence of water in the permanently shadowed regolith.

• SpeX will acquire the widest contiguous spectral range (2 - 4 µm, although saturation is possible longward of 3.4 µm). This range is expected to characterize the shape of the non-H2O-ice continuum as a function of ejecta grain size and mineralogical composition. SpeX will also sample the H2O-ice fundamental band at 3.0 µm.

• NIFS will acquire infrared spectra (1.9 - 2.3 µm) over a 3"x3" (6 km x 6 km) field of view, encompassing the entire ejecta plume for the first 30 seconds after impact and resolving the dense core of the plume (where the highest column of H2O-ice would be seen). NIFS records the ejecta plume as a function of time and distance from the impact, with some sensitivity to the presence of H2O-ice grains through the 2 µm absorption band. NIFS provides the critical spatial and temporal context for the SpeX and NIRSPEC observations. Unlike the LCROSS downward-looking spectral observations (the spacecraft will peer through the plume from above), the sideways-looking NIFS observations will capture the height dependence of the ejecta plume spectra. The height dependence is expected to be diagnostic of the size distribution, since smaller particles will have faster post velocities and be lofted higher.

Together, these three data sets will address 3 of the 4 LCROSS Science Goals, including (a) experiments to look for water, both as vapor (NIRSPEC) and as ice grains (SpeX and NIFS); (b) experiments to measure the non-water vs. water composition of the ejecta plume, and (c) experiments to characterize the grain size and mineralogy of the impacted regolith. The fourth goal, identifying the form/state of hydrogen observed by Lunar Prospector, may also be obtainable if there is a non-water hydrocarbon or hydrated mineral constituent that is observable in the NIRSPEC, SpeX or NIFS spectra.

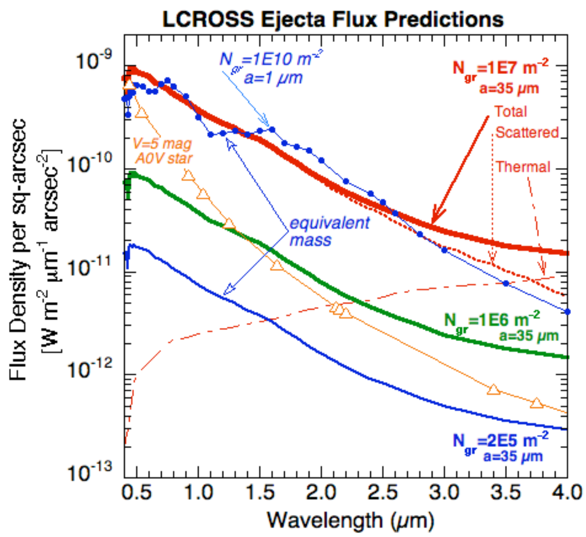

FIGURE: LCROSS Ejecta Plume Flux Predictions. Flux density per square-arcsec (Total = Scattered + Thermal) for a grain column density of 35 µm-radius grains of N=1E7 m-2 and Ngr=2E5 m-2, representing post-impact intervals of 4 to 30 s and 60 to 90 s (Goldstein model, [1]), respectively. If a column density of Ngr=2E5 m-2 of 35 µm grains are disaggregated to 1 µm grains, the flux density is much brighter (because a unit mass of ejecta has greater surface area as smaller grains, and because smaller grains have higher albedos at near-IR wavelengths) and the shape of the spectrum better reveals the composition. In the figure, if the mass-equivalent of N=2E5 m-2 of 35 µm radii grains disaggregate to N=1E10 m-2 of 1 µm grains, the flux density is approximately the same as if the the case for N=1E7 m-2 of 35 µm grains except for the discernment of mineral bands. Preliminary flux calculations use pyroxene (Mg0.5,Fe0.5)SiO3 grains to mimic regolith composition.

References: [1] Goldstein D.B., et al. (2008) *AIP, 1084,* 1061.

Additional Information: For impact observation tools, please contact dwooden@mac.com