LUNAR CRATER OBSERVATION AND SENSING SATELLITE (LCROSS) MISSION: OPPORTUNITIES FOR OBSERVATIONS OF THE IMPACT PLUMES FROM GROUND-BASED AND SPACE-BASED TELESCOPES. J.L. Heldmann[1], A. Colaprete[1], D. Wooden[1], E. Asphaug[2], P. Schultz[3], C.S. Plesko[2], L. Ong[2], D. Korycansky[2], K. Galal[1], and G. Briggs[1], [1]NASA Ames Research Center, Moffett Field, CA, 94035, [2]University of California at Santa Cruz, Santa Cruz, CA, 95064, [3]Brown University, Providence, RI, 02912

Introduction: The primary objective of the LCROSS (Lunar Crater Observation and Sensing Satellite) mission is to investigating the presence or absence of water on the Moon. The LCROSS mission, which is a comanifested payload launching with the Lunar Reconnaissance Orbiter, will use the Atlas V Centaur Earth departure upper stage of the launch vehicle as a 2300 kg kinetic impactor. The impact creates an ejecta plume whose properties, including water ice and vapor content, will be observed a shepherding spacecraft (S-S/C) plus Earth- and space-based telescopes. Following a similar trajectory of the Centaur, the S-S/C will fly through the Centaur impact plume and then the 700 kg S-S/C will also impact the Moon. The S-S/C impact will likely also be observable to ground-based and space-based telescopes.

Impact Characterization: The LCROSS mission uses the impact of the Centaur to excavate and eject lunar surface material from a permanently shadowed region into sunlight where the ejecta can be imaged and spectroscopically studied at visible through mid-IR wavelengths by the LCROSS S-S/C and from the UV (HST) through radio (ODIN). Modeling the impact facilitates effective planning and execution of the observational campaign.

Models for the LCROSS impact are based on numerical hydrodyanamic codes, impact experiments with the NASA Ames vertical gun, and analytical models using semi-empirical scaling relations derived from laboratory experiments. All approaches contribute information to the task of guiding the design of the LCROSS mission and observational campaign. Such a variety of approaches and the corresponding ranges of results will very likely prove more useful in bracketing the expected outcomes.

To aid in the formulation of the LCROSS mission and measurement design, a compilation of model results has been built which summarizes the current best estimate for the impact event. This summary, called the Current Best Estimate Impact Model (CBEIM), includes both high and low values for a variety of relevant physical quantities including crater dimensions and ejecta velocities. In most cases the "current best estimate" was used for design purposes, however, on a case-by-case bases additional "margin" was allowed for by using the model results between the best estimate and the modeled low estimate (e.g., often the values closer to the low-end expectation for the total ejected mass above 2 km were used in order to build in margin). To date, models for the impact indicate that the impact flash will evolve in tens of milliseconds and the impact ejecta will rise into sunlight and fall back to the lunar surface in less than about 2 minutes, thereby motivating the use of rapid measurement techniques for ground- and space-based telescopes. Only the temporal evolution of the OH^- exosphere is expected to persist for more than tens of minutes.

Observational Support: Ground-based and orbital observatories can observe the dust and water vapor plume caused by the two impacts into the lunar surface. The longer time scale evolution of the OH^- exosphere can be followed by telescopes around the world. The timing of the two impacts may allow for simultaneous observations from Hawaii, the Continental US, and from South America (e.g. Chile). We encourage astronomers to consider observing these impact events and the LCROSS team will make all efforts to provide the necessary information regarding the impacts to interested observers in a timely manner. This paper will review planned observations for the LCROSS impacts.

Please contact Jennifer Heldmann at NASA Ames Research Center for further information and plans for the ground and space-based impact observation campaign (Jennifer.Heldmann@nasa.gov).