An Overview of The Lunar Crater Observation and Sensing Satellite (LCROSS) Mission – A Mission to Investigate Lunar Polar Hydrogen A. Colaprete[1], G. Briggs[1], K. Ennico[1], D. Wooden[1], J. Heldmann[1], L. Sollitt[2], E. Asphaug[3], D. Korycansky[3], P. Schultz[4], A. Christensen[2], K. Galal[1], and the LCROSS Team, [1]NASA Ames Reasearch Center, Moffett Field, CA, Anthony.Colaprete-1@nasa.gov, [2] Northrop Grumman Corporation, Redondo Beach, CA, [3]University of California Santa Cruze, [4]Brown University.

Introduction: Interest in the possible presence of water ice on the Moon has both scientific and operational foundations. It is thought that water has been delivered to the Moon over its history from multiple impacts of comets, meteorites and other objects. The water molecules migrate in the Moon's exospheric type atmosphere though ballistic trajectories and can be caught in permanently shadowed polar cold traps that are cold enough to hold the water for billions of years. Verification of its actual existence would help science constrain models of the impact history of the lunar surface and the effects of meteorite gardening, photo-dissociation, and solar wind sputtering. Measurements of the ice distribution and concentrations would provide a quantitative basis for studies of the Moon's history.

Deposits of ice on the Moon could have practical implications for future human activities on the Moon. A source of water could enable long duration human activities and serve as a source of oxygen, another vital material that otherwise must be extracted by melting and electrolyzing the lunar regolith. Hydrogen derived from lunar ice could be used as a rocket fuel. These attractive considerations influence the architecture and plans for manned activities on the Moon. Thus, the determination of the *non*-existence of water ice at the poles may cause a re-alignment of the architecture and plans. Operations from an lower latitude near side base would lead to substantially simpler communications approach, would focus exploitation on regolith processing instead of ice processing and would negate the challenge of developing robotic technologies capable of working in cryo-craters and nearly perpetual darkness.

The LCROSS Mission: The primary objective of the Lunar Crater Observation and Sensing Satellite (LCROSS) is to confirm the presence of water ice at the Moon's South Pole. This mission uses a 2200 kg kinetic impactor with more than 200 times the energy of the Lunar Prospector (LP) impact to excavate more than 250 metric tons of lunar regolith. The resulting ejecta cloud will be observed from a number of Lunar-orbital, Earth-based assets, and the dedicated LCROSS spacecraft. The impact is achieved by steering the launch vehicle's spent Centaur Earth Departure Upper Stage (EDUS) into a permanently shadowed polar region (Figure 1). The EDUS is guided to its target by a Shepherding Spacecraft (S-S/C), which after release of the EDUS, flies toward the impact plume, sending real-time data and characterizing the morphology, evolution and composition of the plume with a suite of cameras and spectrometers. The S-S/C then becomes a 700kg impactor itself, to provide a second opportunity to study the nature of the Lunar Regolith. LCROSS provides a critical ground-truth for Lunar Prospector and LRO neutron and radar maps, making it possible to assess the total lunar water inventory, as well as provide significant insight into the processes that delivered the hydrogen to the lunar poles in the first place. This paper will overview the rational and goals for the mission, impact expectations and the mission design.

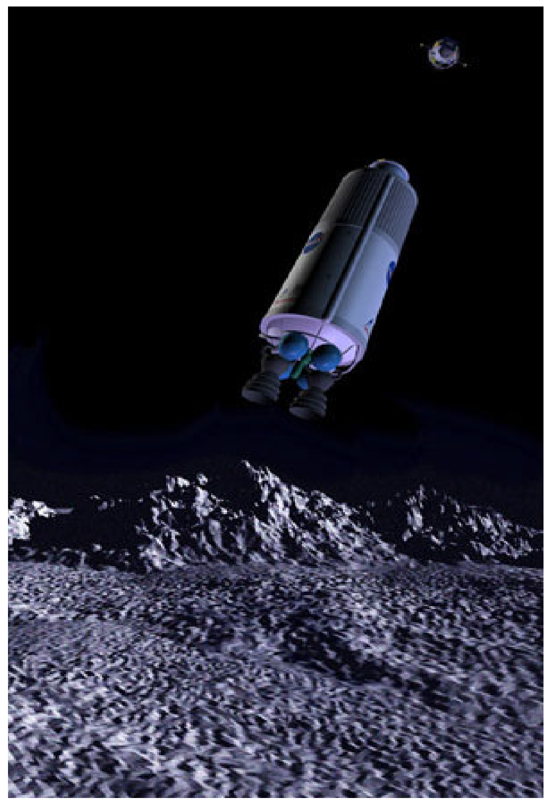

Figure 1. Artist concept of the EDUS (a Centaur upper stage) on its final descent toward the moon. The smaller Shepherding Spacecraft (S-S/C) is shown in the upper right hand corner of the image. The S-S/C will characterize the morphology, dynamics and composi-tioin of the ejecta plume using nine instruments, including five cameras (1 visible, 2 NIR, 2 thermal), three spectrometers (1 UV/Visible, 2 NIR) and a flash radiaometer.