AN OVERVIEW OF THE LUNAR CRATER OBSERVATION AND SENSING SATELITE (LCROSS) MISSION – AN ESMD MISSION TO INVESTIGATE LNAR POLAR HYDROGEN. A. Colaprete[1], G. Briggs[1], K. Ennico[1], D. Wooden[1], J.L. Heldmann[1], L. Sollitt[2], E. Asphaug[3], D. Korycansky[3], P. Schultz[4], A. Christensen[2], K. Galal[1], G. D. Bart[5] and the LCROSS Team, [1]NASA Ames Research Center, Moffett Field, CA, Anthony.Colaprete-1@nasa.gov, [2] Northrop Grumman Corporation, Redondo Beach, CA, [3]University of California Santa Cruz, [4]Brown University, [5]University of Idaho.

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 human 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 a 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 or absence of water ice in a permanently shadowed polar region. This mission uses a 2300 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 and Earth-based assets. The impact is achieved by steering the launch vehicle's spent Centaur upper stage into a permanently shadowed polar region. The Centaur is guided to its target by a Shepherding Spacecraft (S-S/C), which after release of the Centaur, 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 (Figure 1). The S-S/C then becomes a 700 kg impactor itself, to provide a second opportunity to study the nature of the Lunar Regolith.

Impact Target: The specific impact site for LCROSS depends on the exact launch date for LRO. The current launch date of April 25, 2009 results in a 3.5 month cruise and an impact in the north. The impact site is selected based on a number of requirements including solar illumination of ejecta, visibility to earth (specifically observatories in Hawaii), and target properties (e.g., slopes and roughness). The targeting capability of the LCROSS S-S/C, <1 km (3σ), allows for a fairly precise selection of impact point. The exact final impact point can be adjusted up until 30 days prior to impact, allowing LRO observations, made during the first two months of the LCROSS cruise period, to be considered in the final selection of the LCROSS impat site.

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 rationale and goals for the mission, impact expectations and the mission design.

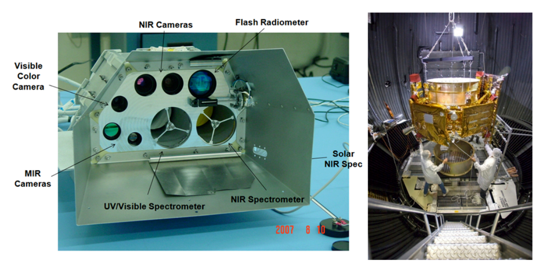

Figure 1. Left: The LCROSS Payload Observation Deck and its eight nadir viewing instruments (an additional solar occultation spectrometer is to the side). Right: The LCROSS spacecraft entering thermal vacuum testing at Northrop Grumman.