THE LUNAR ATMOSPHERE AND DUST ENVIRONMENT EXPLORER (LADEE): NEW MISSION, LONGSTANDING QUESTIONS. R. C. Elphic[1], G. T. Delory[2], E. J. Grayzeck[3], T. Colaprete[1], M. Horanyi[5], P. Mahaffy[4], B. Hine[1], D. Boroson[6], and J. S. Salute[3], [1]Planetary Systems Branch, NASA Ames Research Center, MS 245-3, Moffett Field, CA, 94035-1000, [2]Space Sciences Laboratory, University of California, Berkeley CA 94720, [3]Planetary Science Division, Science Mission Directorate, NASA, Washington, DC 20546, [4]NASA Goddard Space Flight Center, Greenbelt, MD, 20771, [5]Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder, CO 80309, [6]Lincoln Laboratory, Massachusetts Institute of Technology, Lexington MA 02421

Introduction: Nearly 40 years have passed since the last Apollo missions investigated the mysteries of the lunar atmosphere and the question of levitated lunar dust. The most important questions remain: what is the composition, structure and variability of the tenuous lunar exosphere? What are its origins, transport mechanisms, and loss processes? Is lofted lunar dust the cause of the horizon glow observed by the Surveyor missions and Apollo astronauts? How does such levitated dust arise and move, what is its density, and what is its ultimate fate?

National Research Council decadal surveys and the recent "Scientific Context for Exploration of the Moon" (SCEM) report have identified studies of the pristine state of the lunar atmosphere and dust environment as among the leading priorities for future lunar science missions. These measurements have become particularly important since recent observations by the Lunar Crater Observation and Sensing Satellite (LCROSS) mission point to significant amounts of water and other volatiles sequestered within polar lunar cold traps. Moreover Chandrayaan (M^3), EPOXI and Cassini (VIMS) have identified H_2O and OH on surface regolith grains. Variability in concentration suggest these species are likely to be present in the exosphere, and thus constitute a source for the cold traps.

The LADEE Mission: The Lunar Atmosphere and Dust Environment Explorer (LADEE) is currently under development to address these goals. LADEE will determine the composition of the lunar atmosphere and investigate the processes that control its distribution and variability, including sources, sinks, and surface interactions. LADEE will also determine whether dust is present in the lunar exosphere, and reveal its sources and variability. LADEE's results are relevant to surface boundary exospheres and dust processes throughout the solar system, will address questions regarding the origin and evolution of lunar volatiles, and will have implications for future exploration activities.

The LADEE Payload: LADEE employs a high heritage instrument payload: a Neutral Mass Spectrometer (NMS), an Ultraviolet/Visible Spectrometer (UVS), and the Lunar Dust Experiment (LDEX). It will also carry a space terminal as part of the Lunar Laser Communication Demonstration (LLCD) which is a technology demonstration. LLCD will also supply a ground terminal. LLCD is funded by the Space Operations Mission Directorate (SOMD), managed by GSFC, and built by MIT Lincoln Lab. NMS was directed to the Goddard Space Flight Center (GSFC) and UVS to Ames Research Center (ARC). LDEX was selected through the Stand Alone Missions of Opportunity Notice (SALMON) Acquisition Process, and is provided by the University of Colorado at Boulder.

The LADEE NMS covers a m/z range of 2-150 and draws its design from mass spectrometers developed at GSFC for the MSL/SAM, Cassini Orbiter, CONTOUR, and MAVEN missions. The UVS instrument is a next-generation, high-reliability version of the LCROSS UV-Vis spectrometer, spanning 250-800 nm wavelength, with high (<1 nm) spectral resolution. UVS will also perform dust occultation measurements via a solar viewer optic. LDEX senses dust impacts in situ, at LADEE orbital altitudes of 50 km and below, with a particle size range of between 100 nm and 5 μm. Dust particle impacts on a large hemispherical target create electron and ion pairs. The latter are focused and accelerated in an electric field and detected at a microchannel plate. The overall LADEE payload configuration is shown below.

Where LADEE Fits In: LADEE is an important part of NASA's portfolio of near-term lunar missions; launch is planned for March, 2013. The lunar atmosphere is the most accessible example of a surface boundary exosphere, and may reveal the sources and cycling of volatiles. Dynamic dust activity must be accounted for in the design and operation of lunar surface habitats.