THE DUST ENVIRONMENT OF THE MOON. M. Horányi[1,2], J. Szalay[3], E. Grün[1,2], D. Glenar[4], X. Wang[1,2], A. Zakharov[5], [1]Laboratory for Atmospheric and Space Physics, U. of Colorado, Boulder; [2] Solar System Exploration ResearchVirtual Institue (SSERVI) Institue for Modeling Plasmas, Atmospheres, and Comsic Dust (IMPACT), [3]Southwest Research Institute, San Antonio, TX; [4]University of Maryland, Baltimore, MD; [5]Space Research Institute, Moscow, Russia

Introduction: The dust environment of the Moon remained a controversial subject since the Apollo era. The near surface dust populations are thought to include: a) particles generated by the continual bombardment of interplanetary dust particles; and b) the putative population of electrostatically mobilized particles. We will briefly review the history of the observations by the Surveyor cameras, the Apollo imaging, the Lunar Ejecta and Meteoroid (LEAM) experiment, and the UV observations by Clementine and LRO, but will mainly focus on the results of the Lunar Dust Experiment (LDEX) onboard the Lunar Atmosphere and Dust Environment Mission (LADEE)[1]. The talk will also briefly summarize the recent laboratory experimental results on the charging and mobilization of dust particles on regolith surfaces [2].

The LADEE Mission: LADEE was launched on September 7, 2013, and started its 150 days of science observations in the typical altitude range of 20 - 100 km, following a near-equatorial retrograde orbit, with a characteristic orbital speed of 1.6 km/s. LDEX, an impact ionization dust detector [3], detected a total of ~140,000 dust hits during ~80 days of cumulative observing time by the end of the mission on April 18, 2014.

Summary of the Results: LDEX recorded average impact rates of ~ 1 hit/minute of particles with radii of ~ 0.3 μm (Fig. 1). Using the data taken over many months of operation, LDEX was able to characterize the dust density distribution of the lunar dust cloud as a function of time, altitude, and local-time (LT). LDEX discovered a permanently present, asymmetric dust cloud [4]. The lunar dust cloud was found to be generated by the very same meteoroid fluxes observed at Earth, namely the helion, apex, and anti-helion sources. The ejecta cloud was found to be sensitive to small changes in impactor fluxes and velocities, solidifying that the Moon is an efficient large area dust detector. Its response to the local meteoroid environment provides a valuable resource for understanding the meteoroid population at 1 AU [5]. LDEX measurements were also used to characterize meteoroid showers. Approximately once a week, LDEX observed bursts of 10 to 50 particles in a single minute. By analyzing these bursts during meteoroid showers, the radiants for known showers was extracted from LDEX measurements [6]. LDEX did not find density enhancement over the terminators [7], or any evidence of electrostatic mobilization of very small particles above the surface (h > 1 km)

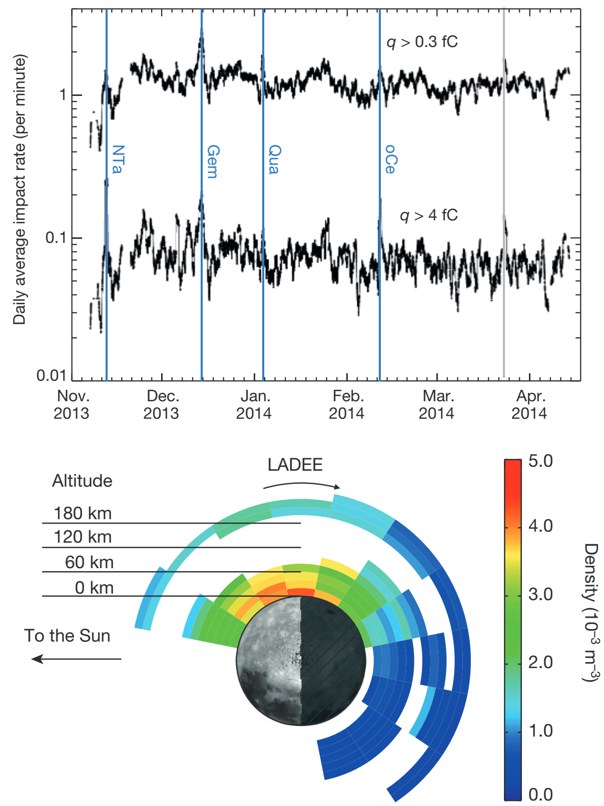

Fig.1 (*top*) The daily running average of impacts per minute of particles recorded by LDEX.
(bottom) The top-down view of the dust projected onto the lunar equatorial plane.

LDEX measurements can be used to improve our models of the spatial, size, and speed distribution of interplanetary meteoroids. Similar measurements near the moons Phobos and Deimos have been suggested to map the dust flux near Mars. An LDEX type instrument sent to any airless body in the solar system would gather critical information about its local meteoroid environment, and potentially its plasma environment.

[1] Elphic, R. C., et al., (2014) *Space Sci. Rev.* 185, 3–25. [2] Wang, X. , et al., (2016), *GRL*, in review, [3] Horányi, M. et al. (2014) *Space Sci. Rev.* 185, 93–113, [4] Horányi et al., (2015) *Nature*, 522, 324-326, [5] Szalay and Horányi (2015), *Geophys. Res. Lett.*, 42(24) [6] Szalay and Horányi, *Icarus*, in review [7] Szalay and Horányi, *Geophys. Res. Lett.*, 42(13)