The Lunar Dust Experiment (LDEX)

M. Horányi (1,2) and J. Szalay (3)
(1) LASP and Department of Physics, University of Colorado, Boulder, CO 80304, USA (horanyi@colorado.edu)
(2) NASA/SSERVI Institute for Modeling Plasmas, Atmospheres, and Cosmic Dust (IMPACT)
(3) Southwest Research Institute, San Antonio, TX 78238, USA (jszalay@swri.edu)

Introduction

NASA's Lunar Atmosphere and Dust Environment Explorer (LADEE) mission was launched on September 7, 2013 and it operated untill April 18, 2014 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. In addition to a Ultraviolet and Visible Light Spectrometer (UVS) and a Neutral Mass Spectrometer (NMS) [1], LADEE also carried the Lunar Dust Experiment (LDEX), an impact ionization dust detector, to map the spatial and size distribution of dust particles [2]. LDEX detected a total of 140,000 dust hits during 80 days of cumulative observing time [3].

Summary of the results

LDEX recorded average impact rates of ≈ 1 hit/minute of particles with radii of ≈ 0.3 μm (1), and it 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 [3]. 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. Its response to the local meteoroid environment provides a valuable resource for understanding the meteoroid population at 1 AU [4]. 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 [5].

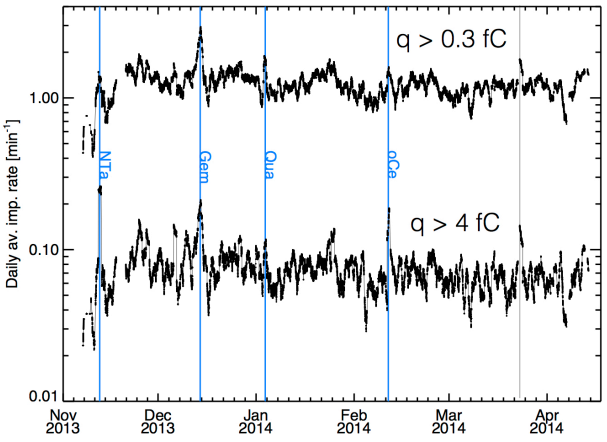

Figure 1: The daily running average of impacts per minute of particles that generated an impact charge of $q \geq 0.3$ fC (radius $a \gtrsim 0.3$ μm) and $q \geq 4$ fC (radius $a \gtrsim 0.7$ μm) recorded by LDEX. Four of the several annual meteoroid showers generated elevated impact rates lasting several days. The labeled annual meteor showers are: Northern Taurids (NTa); Geminids (Gem); Quadrantids (Qua); Omicron Centaurids (oCe). The observed enhancement peaking on March 25, 2014 (grey vertical line) does not coincide with any of the prominent showers. During the Leonids meteor shower around November 17, 2013 the instrument remained off due to operational constraints [3].

References

[1] R.C. Elphic, G.T. Delory, Butler P. Hine, P.R. Mahaffy, M. Horányi, A. Colaprete, M. Benna, S.K. Noble, *Space Sci. Rev. 185*, 3 - 25, 2014.

[2] M. Horányi, Z. Sternovsky, M. Lankton, C. Dumont, S. Gagnard, D. Gathright, E. Grün, D. Hansen, D. James, S. Kempf, B. Lamprecht, R. Srama, J. R. Szalay, G. Wright, *Space. Sci. Rev. 185*, 93 -113, 2014.

[3] M. Horányi, J. R., Szalay, S. Kempf, J. Schmidt, E. Grün, R. Srama, Z. Sternovsky, *Nature 255*, 324 - 326, 2015.

[4] J. R. Szalay, M. Horányi, *Geophys. Res. Lett., 42*, 10,580-10,584, 2015.

[5] J. R. Szalay, M. Horányi, *Icarus*, in review, 2016.