Modern dust instruments for the exploration of the Moon and small bodies

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Abstract. We have developed a variety of instruments for the detection and analysis of micron sized dust particles in the near-surface environment of the Moon, or small bodies. Dust can be elevated from the surface as secondary ejecta due to micrometeoroid bombardment, by electrostatic charging, or by mechanical activity. The characterization of the dust environment is critical for the understanding of fundamental process, such as the impact ejecta production from rocky surfaces in space, or the near-surface plasma environment. Furthermore, by the chemical analysis of ejecta particles from orbit, it becomes possible to map the elemental composition of the lunar surface. The Lunar Dust EXperiemnt (LDEX) instrument is a sensitive and compact dust detector developed for the upcoming Lunar Atmosphere and Dust Environment Explorer (LADEE) mission. LDEX operates on the basis of impact ionization and can detect particles larger than about 0.3 micron in radius. LDEX will be launched in 2013 and will map the dust ejecta cloud around the Moon, and its temporal variability. Under development is a prototype of an improved capability instrument, which can also measure the chemical composition of the dust by measuring the time-of-flight spectra of the ions generated by the dust impact. The Electrostatic Lunar Dust Analyzer (ELDA) instrument is developed for the lunar surface to detect dust particles released with low velocity. ELDA uses an array of wire electrodes to detect the transition of the charged dust particle through the instrument. The induced charge on the electrodes is recorded, and the numerical analysis of the data yields the charge and velocity vector of individual dust particles. The mass (size) of the dust particles is determined by measuring the deflection of their trajectory in a region with a strong electrostatic field.