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The Lunar Dust Exosphere as Observed by LDEX

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Abstract

During close flybys of the Galileo spacecraft on the Jovian moon Ganymede, the onboard dust detector discovered that the moon is wrapped in a faint dust cloud [8, 7]. The generation of these dust clouds is a general phenomenon - all airless bodies in the solar system are expected to maintain a dusty, surface bound exosphere due to the continual bombardment by micrometeoroids of interplanetary or even interstellar origin [2]. The Galilean moons Europa and Callisto were found to have dust atmospheres as well [6]. The Cassini dust detector CDA provided some evidence for dust exospheres around Saturn's ice moons Enceladus [10, 3] and Rhea, and even Pluto and its moon Charon [13, 9] were proposed to have a dusty atmosphere.

Impacts of fast interplanetary meteoroids with the satellites' surfaces produce ejecta particles which populate tenuous, approximately isotropic clouds around the moons [5, 12, 11]. This process is very efficient: a typical interplanetary 10^{-8} kg micrometeoroid impacting the Earth' Moon produces a large number of dust particles, whose total mass is about 650 times that of the impactor. The ejecta particles move on ballistic trajectories, most of which have lower initial speeds than the moon's escape velocity and re-collide with the surface, while particles ejected fast enough to escape from the moon's gravity may form tenuous dust rings such as Jupiter's gossamer rings [1, 4].

The Lunar Dust EXperiment (LDEX) on the Lunar Atmosphere and Dust Environment Explorer (LADEE) is the first instrument flown in the vicinity of the Moon, which is sufficiently sensitive to observe the lunar dust exosphere. The spacecraft was launched in September 2013 and orbits the Moon on a low altitude orbit between October 2013 and April 2014. The transmitted data set is already larger than any other existing observation of a dust exosphere by orders of magnitudes and deepened our insight into the physics of this important phenomenon.

This talk will report about first insights into the properties of the Lunar dust exosphere based on a in-depth analysis of the LDEX data. The observed scaling of the impact rate with the distance to the Lunar surface is in rough agreement with mean field models of planetary dust exospheres.

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