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Constraining low-altitude lunar dust from the LADEE/UVS data

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Abstract

Dust-sized particles have been observed above the Moon's surface by a variety of remote-sensing and in-situ instruments. These particles could be launched by micrometeorite impacts and/or levitated by electrostatic forces. We derive new constraints on the lunar dust densities at low altitudes (1-10 km) using remote-sensing data from the UVS instrument onboard the LADEE spacecraft.

1. Background

Dust above the lunar surface was first clearly detected in remote-sensing data by the Surveyor spacecraft, which observed a bright glow along the western lunar horizon following local sunset [1]. This Horizon Glow is forward-scattered sunlight by small dust grains. Later, evidence for high-altitude dust was inferred from Apollo 15 coronal photography. However, upper limits obtained using the LAMP UV spectrometer were at least two orders of magnitude below the expected levels from the Apollo-era measurements [2]. In-situ measurements by the LDEX instrument onboard the LADEE spacecraft confirmed the low densities of high-altitude dust around the moon, and found an asymmetric dust cloud [3].

The dust population seen by LADEE-LDEX are consistent with micron and submicron particles ejected by hypervelocity impacts [3]. However, the near-surface dust seen by Surveyor and in-situ Apollo experiments could represent material levitated by electrostatic forces near the terminator. The dynamic dust grain fountain model allows for grains to be lofted up to 100 km [4].

2 LADEE-UVS observation of low-altitude dust

LADEE included an Ultraviolet Spectrometer (UVS) instrument that obtained high spectral resolution measurements at near-ultraviolet and visible wavelengths (≈231–826 nm). During a series of 14 "Almost-limb" observations, LADEE/UVS viewed the lunar limb from within the shadow of the Moon, providing a good geometry to observe dust at altitudes below 10 km, where LDEX data is limited. We have analyzed the LADEE/UVS data and found variations in the signal that have a board, blue spectral signature as consistent with scattering by sub-micron grains. To determine whether these are real dust signals or instrumental artifacts, we have cross-correlated these signals with lunar topography and meteor showers on the moon. This analysis should yeild new constraints on the low altitude dust above the lunar surface.

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