

Charge Magnitude of Electrostatically Lofted Dust Grains over the Lunar Terminator

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The interaction with the solar wind has several consequences on the lunar surface, and one of them can be described as electrostatic transportation of the lunar dust grains. It has been proposed that the emitted electrons within micro-cavities between the neighboring dust grains can produce strong repulsion to detach the dust particles from the loose upper layer of the lunar regolith, and this mechanism has been demonstrated in several laboratory experiments. In order to launch a charged dust particle from the lunar surface, the electrostatic repulsion should overcome the forces of contact and gravity. In this study, the charge magnitude requirement of the lofted dust particles in the range of $0.1 \mu\text{m}$ – $10 \mu\text{m}$ in radius is investigated through a function of (1) specific gravity that is determined by the particle type such as agglutinates, basalt, or breccia, (2) inter-particle contact forces, (3) the surface electric field that is controlled by the solar wind, (4) the launch angle based on the experimental results, and (5) the characteristic size of micro-cavity that is related to the regolith configuration. It has been observed that the charge magnitude variation increases with the particle size, and the particles with $5\text{-}6 \mu\text{m}$ radius can gain sufficient charges to loft and produce the near-surface lunar horizon glow.

Keywords: lunar regolith, lunar dust charging, electrostatic dust lofting, lunar horizon glow