Dust Lift-off and Transport on Surfaces in Plasma

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The evidence from the Surveyor images and from in situ dust detection by the Lunar Ejecta and Meteorite (LEAM) experiment (deployed during the Apollo 17 mission) shows significant dust lift-off and subsequent dust transport on the lunar surface. These near surface observations have been suggested to be directly connected to the dusty lunar exosphere that was indicated by Apollo astronaut sketches and the photometry of images taken from orbit. These observations remained largely controversial mainly due to the lack of our understanding of the physical processes responsible for dust mobilization. We have conducted a series of laboratory experiments to investigate the physics of dusty surfaces in a low-density plasma in order to investigate the possible mechanisms that can lead to dust lift-off and mobilization on the Moon. We report on dust transport experiments on a conducting plate. We found that when the plate is biased sufficiently negative, an initially small patch of grains spreads into a larger ring with a void at the center. Dust grains are also observed to spread over thick insulating plates, indicating that a 'hopping' mechanism is involved. Measured electrostatic potential distributions above the dusty conducting surface show an outward electric field near the dust/surface boundary, which causes the positively charged dust particles to spread on the surface. A non-monotonic potential dip is measured in the sheath above an insulating disc substituted for the insulating dust pile, which shows an upward electric field above the disc creating a force against the gravity and thus causing the dust to lift off the surface.