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Dust charging and dynamics on the surfaces of airless planetary bodies

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Our recent laboratory experiments have advanced our understanding of a long-standing problem of dust charging and transport on the surfaces of airless planetary bodies, leading us to eventually explain several observed planetary phenomena and to understand how electrostatic dust transport changes the surface processes. A new "patched charge model", developed on our experimental results, predicts that particles forming micro-cavities on a dusty surface can attain large negative charges from the collection of photo- and/or secondary electrons emitted by their neighbouring particles due to exposure to ultraviolet (UV) radiation and/or energetic electrons. These unexpectedly large negative charges, and the resulting repulsive forces between them, are suggested to be responsible for electrostatic dust transport on surfaces. The predictions of this new model are verified with our new charge measurements, showing 1) the negative charge polarity of dust, even under UV radiation; and 2) large charge magnitudes, two orders larger than those predicted by previous customary charging models. Subsequent dust dynamics are also analysed with the imaging data, showing that the plasma sheath electric field modifies the dust lofting. Computer simulations are under development to study the dynamics of charged dust with the initial conditions, including both the dust charge and launch speed, provided from our laboratory results.