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Laboratory measurements of initial conditions of electrostatically lofted dust

Xu Wang, Noah Hood, Anthony Carroll, Ryan Mike, Hsiang-Wen Hsu, and Mihaly Horanyi
University of Colorado - Boulder, LASP, Boulder, United States (xu.wang@colorado.edu)

Recent laboratory experiments and the new "patched charge model" have greatly advanced our understanding of dust charging, and subsequent mobilization and transport on the surfaces of airless planetary bodies. Initial launch conditions of lofted dust particles are critical to understand their electrostatic dynamics in various near-surface plasma environments. Here we report results of a series of laboratory experiments about the charge, size, velocity, and rate of lofted dust particles. All lofted dust particles are charged negatively, even under UV radiation, due to the microcavity charging effect described in the patched charge model. The charge is several orders of magnitude larger than values predicted from previous charge models. In addition to single-sized particles, large aggregates are also lofted with the size up to 140 microns in diameter. Preliminary experiments show that the launch velocity is on the order of 1 m/s for particles tens of microns, and smaller particles are lofted with higher velocities. Due to large variations in cohesive force, the launch velocity has a wide distribution. Recent experiments show that dust lofting is a time-dependent process, which begins fast and slows down as time progresses. The transient lofting rate can be as high as several particles per square cm per second, fast enough to supply the lunar horizon glow. These results will advance future studies to explain the existing and future observations on airless bodies that relate to electrostatic dust transport.