ELECTROSTATIC DUST MOTION ON ASTEROIDS: CURRENT UNDERSTANDING. C. M. Hartzell[1], D. J. Scheeres[1] and X. Wang[2], [1]Aerospace Engineering Sciences, University of Colorado at Boulder, 431 UCB, Boulder, CO, USA 80309, christine.hartzell@colorado.edu or scheeres@colorado.edu. [2] Laboratory for Atmospheric and Space Physics, 392 UCB, Boulder, CO USA 80309.

Introduction: Electrostatic dust motion has been hypothesized to occur on the Moon since the Lunar Horizon Glow was observed [1]. It was natural to extend the hypothesis of electrostatic dust motion to asteroids, since they have a much lower gravity [2]. The Eros dust ponds were the first observations suggesting electrostatically dominated dust motion on asteroids [3]. However, no observational data, from the Moon or asteroids, definitively proves the existence of electrostatic dust lofting or levitation. In recent years, electrostatic dust motion has garnered attention due to its potential observability, implications for asteroid surface evolution, and challenges posed to exploration missions.

Dust Lofting: It has been hypothesized that if electrostatic forces are large enough, they will cause regolith particles to separate from the surface [1,2]. However, prior studies of electrostatic dust lofting neglected the cohesion between grains [2]. Cohesion is very important for small grains (up to cm-sized grains on asteroids) [4]. Considering cohesion, we see that intermediate-sized grains (mm-cm sized for asteroids) require the smallest electric field to loft [5]. Thus, it is not the smallest, submicron grains that will experience electrostatic lofting. We have also experimentally demonstrated the preferential lofting of intermediate sized grains in a plasma environment [6].

The size of lofted dust grains is important for the interpretation of future asteroid limb observations. For instance, if only very small grains are observed, then these are particles are either launched through mechanisms other than electrostatic lofting or they are the remnants of larger grains that have disintegrated. Additionally, understanding the grains likely to be electrostatically lofted can inform our hypotheses of the creation mechanisms for the Eros dust ponds.

Dust Levitation: Although there is no absolute evidence that electrostatic lofting occurs, it is known that dust particles will have a non-zero charge while resting on the surface. Additionally, dust particles can be launched off the surface through other mechanisms such as micrometeoroid bombardment and spacecraft-surface interactions. It is necessary to understand the dynamics of dust particles once they are separated from the surface, both in order to understand the evolution of these bodies, as well as to understand spacecraft-surface interactions and observations. Using a model of the non-monotonic plasma sheath near the surface of an airless body given by Nitter *et al.* [7], we have identified the equilibria about which dust particles could stably levitate [8]. Additionally, by calculating the timescales of the dust motion (either in oscillation about the stable equilibrium or approaching the equilibrium), we have seen that the behavior of levitating particles is dictated by the size of the particles, rather than the mass of the central body. From the timescales in our 1D analysis and a 2D analysis, we have seen that dust levitation is possible about a rotating asteroid [9].

Our predictions of the equilibria about which dust levitation can occur will allow observations of specific altitudes where levitated grains should be observed. Additionally, if a horizon glow is observed at a specific altitude, then, from our observations, the charge to mass ratio of the grains can be calculated. There are also implications for spacecraft surface observations. Specifically, spacecraft should avoid launching dust grains from the surface at speeds that are predicted by our model to result in dust levitation.

Conclusions: We have made detailed calculations to increase the observability of dust whose dynamics of dominated by electrostatics. Although it is not presently known if either electrostatic lofting or levitation occurs *in situ*, it is now possible to make observations that will help resolve this uncertainty. Additionally, our increased understanding will aid in determining the significance of electrostatic dust motion as a surface alteration process, the interpretation of future spacecraft observations, and the design of spacecraft on-surface operations.

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