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IN-SITU REGOLITH COHESION QUANTIFICATION VIA ELECTROSTATIC DUST LOFTING

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ABSTRACT

Recent work has shown that cohesion dominates the behavior of regolith and drives the structure of the interiors of small asteroids. However, there remains at least one order of magnitude uncertainty in the magnitude of this force. Cohesion is significant for several asteroid deflection technologies. For deflection via ballistic impact, cohesion may significantly influence the properties of the ejecta plume, thereby influencing the momentum enhancement due to the ejected mass. Additionally, cohesion plays a role in the structural strength of a ‘rubble-pile’ asteroid and may dictate whether or not an asteroid would disrupt in response to a stand-off nuclear explosion. Thus, in order to understand the response of asteroids to deflection techniques, it is necessary to accurately model the cohesion between grains.

We are developing a lander-based technology to measure the cohesion of regolith on the surface of an asteroid via electrostatic dust lofting. Electrostatic dust lofting has long been hypothesized to occur naturally on airless bodies and has been observed in the lab. We are developing a technology to exploit our understanding of the electrostatic dust lofting phenomenon in order to measure cohesion. Cohesion and gravity hold regolith grains on the surface of an asteroid. If the local gravity is

known and the electrostatic force (acting to pull grains off the surface) can be controlled, then, by observing the electrostatic force required to loft grains, the cohesion acting on the grains can be derived. The electrostatic force on the regolith grains can be controlled by varying the electric potential and height of an attractor plate. We will introduce this technology and present preliminary design results.

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