Abstract *(paper not available)*

Experimental and Numerical Investigations of Dusty Spacecraft Charging

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While spacecraft charging for “clean” surfaces has been a subject of extensive research over the past decades, few studies have been made on how dust may affect spacecraft surface charging. This paper presents an investigation on the effects of dust accumulation on surface charging while a spacecraft is within a dusty environment by comparing experimental results obtained within a simulated dusty-plasma environment with numerical models. Spacecraft surfaces can be covered by a layer of dust in many situations, such as while around a comet, on the surface of the Moon, or near an asteroid. Previous studies on dust grain charging and dust interactions with charged surfaces have mostly considered single, isolated dust grains (“dust-in-plasma” condition), where the dust grain is electrically isolated from neighboring grains. When a dust layer accumulates on spacecraft surfaces (“dusty surface” condition), however, the charge on individual dust grains is strongly affected by that of neighboring grains and the spacecraft surface, and a single sheath forms over the surface. As a result, the spacecraft surface potential is dependent on both current balance as well as the dust layer capacitance. This paper considers the charging of a surface covered by a layer of dust grains. We present experimental and modeling results of dusty surface charging under ambient plasma conditions found at the lunar terminator and investigate the effects of dust coverage, dust layer thickness, and dust grain size. The current-voltage characteristics of a dusty surface are measured, and numerical simulations are created to compare and validate experimental results. The difference between charging of a single, isolated dust grain and a grain within a dusty layer will also be discussed.

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