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The Response of an Airless Body Surface to Meteoroid Impacts

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Airless bodies throughout the solar system are continually bombarded by interplanetary meteoroids. While meteoroids turn into shooting stars at Earth due to our thick atmosphere, airless surfaces like the Moon's are completely exposed to meteoroid impacts. Each impact produces orders of magnitude more mass compared to the primary impactor mass, making the ejecta response of an airless body a very efficient "amplifier" of its local meteoroid environment. These ejecta clouds carry information both about the composition of the airless body surface in the ejected material as well as reflecting the instantaneous state of meteoroid bombardment to that body.

Impact ejecta is ubiquitous throughout the solar system, yet, the response of an airless body to high velocity meteoroid bombardment has remained difficult to characterize. While laboratory experiments have been performed to determine the yield of an incident meteoroid given certain target materials, recreating realistic impact conditions for airless bodies in space is challenging. However, recent impact ejecta measurements allow us to effectively use the Moon as a laboratory to investigate the response of a regolith surface to intense meteoroid bombardment.

In this presentation, we will discuss measurements from the Lunar Dust Experiment (LDEX), an impact ionization dust detector onboard the Lunar Atmosphere and Dust Environment Explorer (LADEE) mission, designed to measure impact ejecta around the Moon. LDEX observed a permanently present dust cloud engulfing the Moon generated from the continual bombardment of the lunar surface by interplanetary dust particles. The ejecta cloud was very sensitive to changes in the impactor fluxes and we use these variations to characterize the response of the lunar surface to meteoroid bombardment. These results may be extended to other airless bodies in the solar system, allowing us to better understand the sources of interplanetary dust particles and the evolution of airless bodies in the solar system.