Electrostatic Dust Analyzer (EDA) for Characterizing Dust Transport on Lunar Regolith

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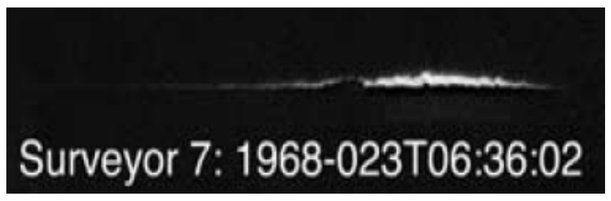
IMPACT

LASP University of Colorado

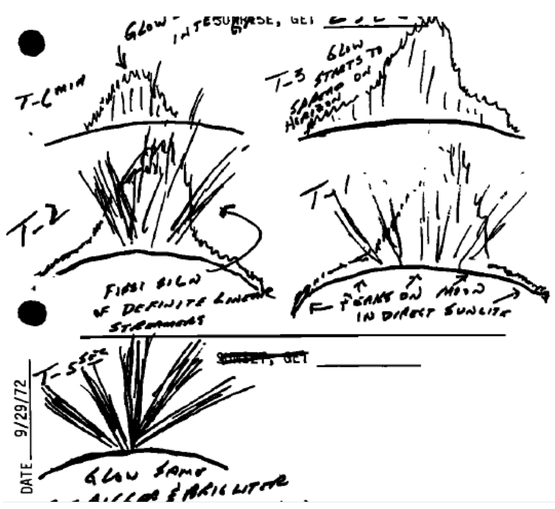
Motivation

Electrostatic dust lofting and transport, as a long-standing problem, has been suggested to explain a number of observations on airless bodies, including the Moon.

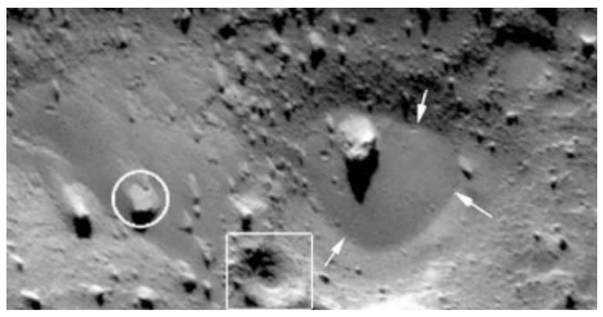
Lunar Horizon Glow



High-altitude streamers

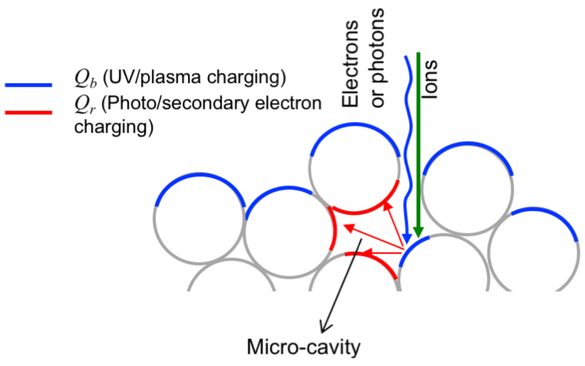


Dust pond on asteroid Eros

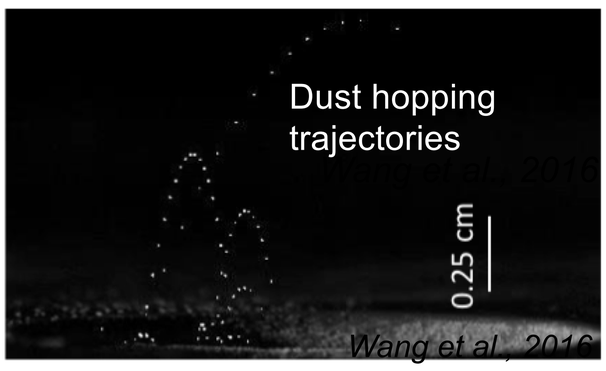


Recent Advancement on Understanding Electrostatic Dust Lofting

Patched Charge Model



UV or Plasma Exposure

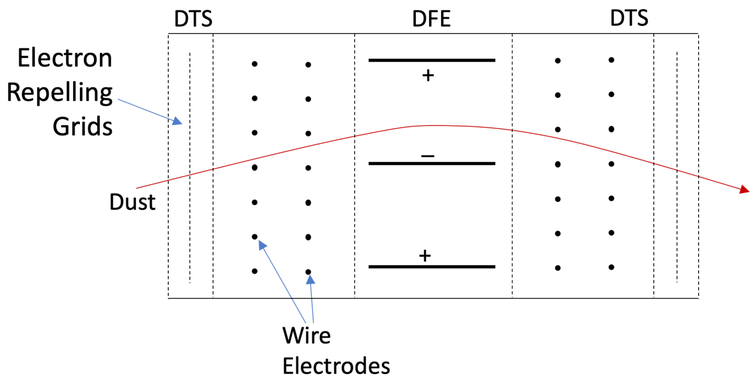


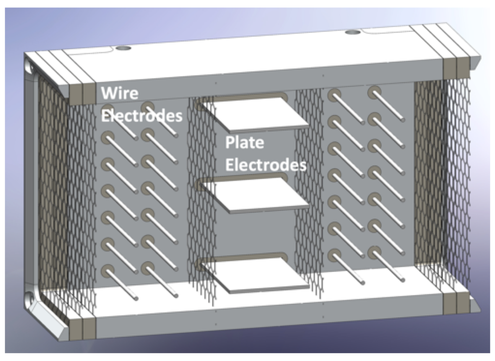
- A Patched Charge Model suggests that photoelectrons and/or secondary electrons emitted from the regolith surface are absorbed by microcavities between dust particles, resulting in large negative charges on the surrounding dust particles which inter-particle repulsive forces cause them to be lofted or mobilized.
- Recent laboratory studies demonstrated dust lofting due to exposure to UV or plasma, and revealed several key characteristics of lofted dust, including the initial charge and velocity, the lofting rate and size distributions.

EDA Science Goals

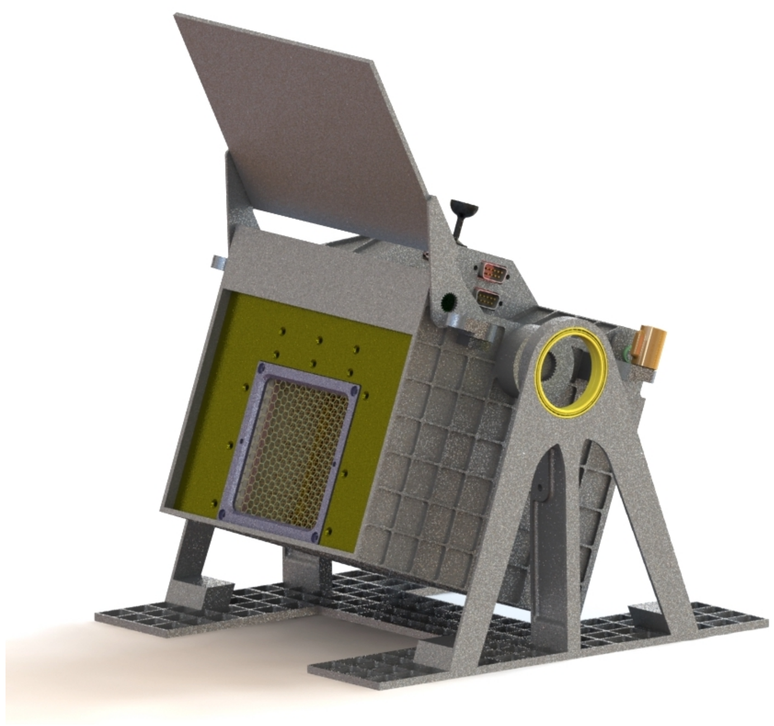
- Explore the electrostatic dust transport phenomenon on the lunar surface in order to understand its role in shaping the properties of the lunar regolith.
- Provide enhanced knowledge about potential hazards posed by electrostatically lofted dust and critical inputs for developing mitigation strategies for future lunar robotic and human exploration.

EDA Design





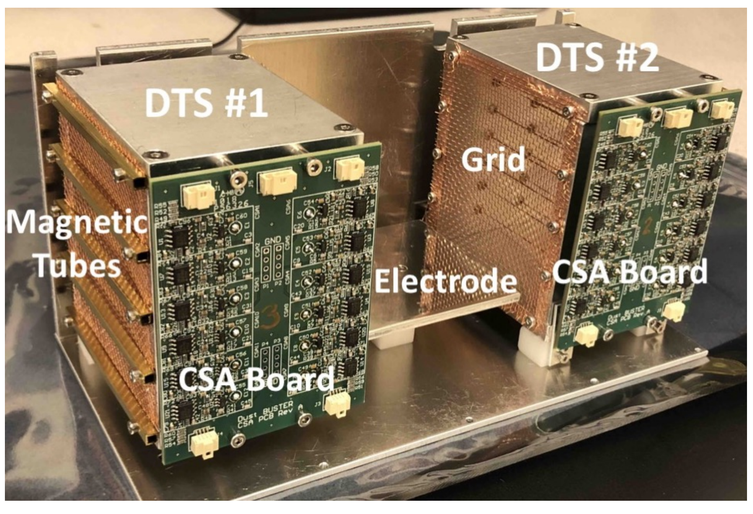
- The analyzer consists of two identical Dust Trajectory Sensors (DTS) on both ends with a Deflection Field Electrodes unit lied in between.
- DTS consists of two wire electrode planes where the charge and velocity of a dust particle are measured.
- DFE deflects the dust particle which deflection angle determines the charge-to-mass ratio.
- EDA measures low-speed (< 20 m/s) dust.



- The analyzer will be housed in a metal box with two doors on both ends. When taking measurements, one of the doors will be opened.
- EDA can be titled to an optimized angle for the dust collection.

EDA Development Status

EDA is currently at Technology Readiness Level (TRL) 4 (right figure) and under development to achieve TRL 6.



Acknowledgements

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