

The Electrostatic Lunar Dust Analyzer (ELDA): data analysis

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Abstract: Continual micrometeoroid bombardment and electrostatic charging are natural mechanisms that can loft micron and sub-micron sized dust particles off the lunar surface. The characteristics of these particles' mobilizations are of great scientific interest to understand the atmospheric environment and engineering importance for the design of future equipment operated on the lunar surface. Traditional methods using momentum transfer or impact energy have difficulty in detection because of the low velocity of the dusts on the lunar surface. Electrostatic Lunar Dust Analyzer (ELDA) utilizes the charge on the dust for detection and analysis. ELDA consists of two Dust Trajectory Sensor (DTS) units combined with an electrostatic-deflection field region (DFR), and measures the mass, charge, and velocity vector of individual dust grains. A full version of the ELDA instrument has been constructed, tested, and characterized in the laboratory. The analysis of DTS data from a dust particle moving a straight line without accelerator has shown that it is possible to achieve very high accuracy of the dust velocity (<1%) and dust direction (< 1 degree). The analysis is based on matching the data to numerical simulations and the best fit yields the particle characteristics. However, the particles in ELDA do not move on straight-line trajectories due to gravitational acceleration. The data analysis algorithm has been extended for applicability to the ELDA instrument. The particle's mass is calculated from the trajectories through the instrument and amount of deflection with the DFR. The results from the laboratory test show that ELDA instrument determines the mass of individual dust particles with a factor of two.