ELECTROSTATIC DUST ANALYZER (EDA) FOR MEASURING DUST TRANSPORT ON THE LUNAR SURFACE. X. Wang[1], Z. Sternovsky[1], M. Horányi[1], J. Deca[1], I. Garrick-Bethell[2], W. M. Farrell[3], J. Minafra[4] and L. Bucciantini[5]. [1]University of Colorado, Boulder, USA, [2]University of California at Santa Cruz, USA, [3]NASA Goddard Space Flight Center, Greenbelt, Maryland, USA, [4]NASA Ames Research Center, Moffett Field, California, USA, and [5]French National Center for Scientific Research (CNRS), Paris, France (xu.wang@colorado.edu)

Introduction: Electrostatic dust charging and transport on the lunar surface is a longstanding problem. This electrostatic process has been suggested to explain several unresolved observations, including Apollo-era observations [1] of the lunar horizon glow, the high-altitude streamers, and the low-speed dust detections during terminator crossings by LEAM, as well as a recent observation of dust deposition on lunar rocks by Chang'e 3 [2].

However, a fundamental question of how dust particles obtain enough charge to become mobilized and lofted on the lunar surface remained unsolved for decades long. Recent laboratory studies [3-6] have revolutionized our understanding of this physical process and provided strong support for its occurrence on the surface of the Moon.

Dedicated in-situ measurements on the lunar surface are needed to unambiguously determine the ground truth of this electrostatic phenomenon. The Electrostatic Dust Analyzer (EDA), which is currently under development through the NASA DALI program, is aimed to quantify characteristics of electrostatically lofted lunar dust. The expected results from EDA measurements will provide insights into the role of electrostatic dust transport in shaping the surface physical properties of the Moon. Importantly, EDA measurements will assess potential risks posed by mobilized/lofted dust to human exploration, especially the long-term presence, on the lunar surface, and guide the development of dust mitigation strategies and methods.

Additionally, the expected lunar results will advance our understanding of this electrostatic process on all airless bodies across the solar system.

EDA Instrument Development: EDA measures the charge, size (mass), velocity and flux of lofted dust particles on the lunar surface. The instrument inherited the design from the Electrostatic Lunar Dust Analyzer (ELDA) [7]. The instrument sensor consists of two identical Dust Trajectory Sensor (DTS) units and a Deflection Field Electrodes (DFE) unit lying in-between the two DTS units (Fig. 1). The DTS consists of two wire electrode planes, each has seven wires. The DFE consists of three biased electrodes.

When a charged dust particle enters the instrument into a DTS unit, its charge is measured from induced charges on all the wires, and its velocity is determined from the time-shift of the charge signals between the two wire planes (Fig. 1). The dust particle will be then deflected by the electric field created in the DFE and exit through the second DTS on the other end of the instrument. The mass-to-charge ratio of the dust particle is then determined from its deflected trajectory, which can be reconstructed from measured charge signals as the particle passes through all four wire planes.

The instrument sensor with electronic boards is housed in a metal enclosure (Fig. 2). EDA can be titled to optimized angles for dust collection. Depending on the relative position to the Sun, one of the doors will be opened to allow dust particles to enter the instrument. The EDA instrument has completed its final design and is currently in the production phase and to be tested in relevant environments to meet TRL 6 by early 2022.

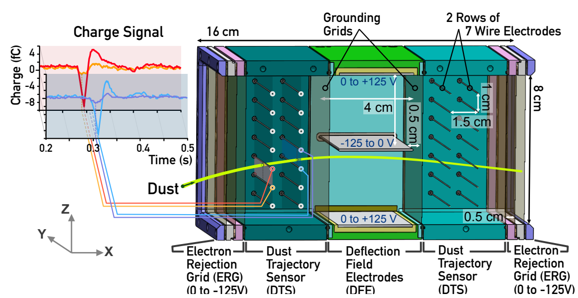

Fig. 1 Cut-view of the EDA sensor module with examples of measured charge signals.

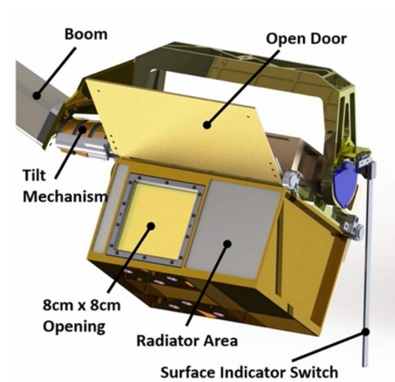

Fig. 2 Overall view of the EDA instrument.

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