



# Characterizing the Beam at the CCLDAS Dust Accelerator

P. Northway, S. Auer, K. Drake, E. Grün, M. Horányi, A. Mocker, T. Munsat, A. Shu, Z. Sernovsky, E. Thomas, J. Xie

University of Colorado, Boulder; Max-Planck-Institut für Kernphysik; NASA Lunar Science Institute;

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Colorado Center for Lunar Dust and Atmospheric Studies; A&M Associates, Basye, VA

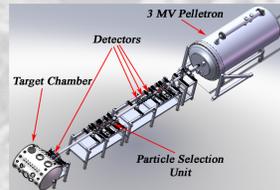
Contact: paige.northway@colorado.edu



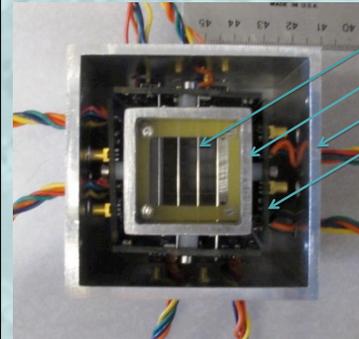
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## Accelerator

The Colorado Center for Lunar Dust and Atmospheric Studies (CCLDAS) has recently assembled a 3MV dust particle accelerator. The accelerator and dust source together are designed to accelerate particles with a range of sizes and velocities which simulate the hypervelocity micrometeorites that regularly impact the lunar regolith. Studying these impacts will give insight on mechanisms involved in sustaining the surface-bound exosphere (SBE) which makes up the lunar atmosphere. This will also influence the understanding of Mercury, icy satellites, the rings of Saturn, large asteroids, and Kuiper Belt objects, which have similar SBEs. Detectors giving the velocity, charge, and mass will also allow for the calibration of instruments. The focusing and alignment of the beamline and accelerator ensure that the particles reach the desired impact site.



## Inner detector



## Detector Design

- Wire electrodes
- Inner shielding
- Outer shielding
- Circuit boards
- Grounded mesh
- Power wires
- Signal wires
- Mounting arm
- Feed-through flange

## Full assembly



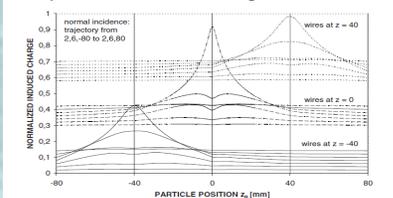
## Introduction

With flexible bellows, small apertures, and a multitude of possible settings, it is difficult to know exactly what the beam profile looks like within the beamline, and how it reacts to changes in settings. Imaging the beamline with a camera is one way to compensate for this, but requires long exposure time and disassembling the beamline. To avoid this delay in productivity, a detector has been designed and installed which can be placed in the beamline without obstructing the beam, and gives the XY position of each particle flying within the 1 inch opening in real time. This allows for a quick beam profiling and immediate numeric feedback on the result of a change in settings.

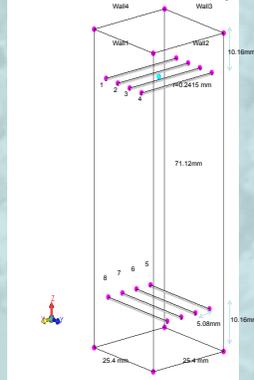
## Operation

- Grids of 4 wires in X and Y directions, 1 square inch open area
  - Fits inside beam line with > 85% transparency to a centered, focused beam
  - Incident charged particles generate image charge on wires
  - Image charge picked up by charge sensitive amplifiers
  - Sensitivity of  $\sim 1.22 \cdot 10^{13}$  V/C
  - Signal heights compared to simulation gives X-Y position
  - Modeled after larger Dust Trajectory Sensor (DTS)
- (Auer, et al., 2008; Xie, poster P13D-1719)

### Computer models for DTS signals



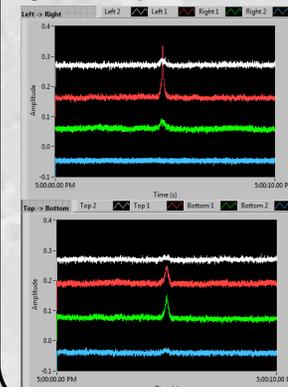
### Coulomb simulation setup



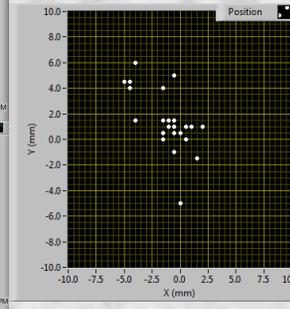
## Initial Results

- LabView program plots particle positions in real time
- Positions written to file to create surface plot of beam profile
- Current resolution set to .05mm for high speed calculations
- Minimum signal sensitivity  $\sim 3,000e-$
- Use of full waveform rather than just peak heights improves accuracy and precision at the expense of DAQ requirements and overall speed

### Signals from a particle left of center



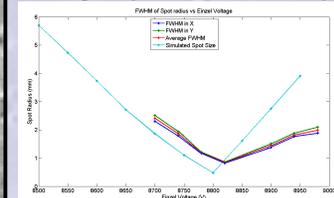
### LabView position plot of 29 particles (some overlap)



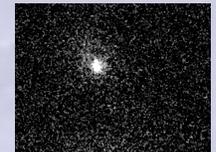
## Future Work

- Characterize the beam in a position prior to the 1cm aperture of the detectors for a variety of settings of the accelerator, dust source, focusing and steering voltages.

### Focusing comparison: simulation, experiment



### Camera generated image of the beam focusing



- Placing the dust coordinate sensor at the entrance to the target chamber could enable correlation between impact sites and the characteristics of the individual particles that created each of them. This greatly expands the scope of impact experiments which can be conducted at the facility.