

The Colorado Center for Lunar Dust and Atmospheric Studies (CCLDAS)

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CIPS CLASP

Purpose

The Colorado Center for Lunar Dust and Atmospheric Studies (CCLDAS) is a member of the NASA Lunar Science Institute, focused on **experimental and theoretical investigations of the lunar environment**, including dusty plasma and impact processes, the origins of the lunar atmosphere, and the **development of new instrument concepts**, with a complementary program of education and community development.

CCLDAS is conducting a series of laboratory experiments supplemented by state-of-the-art theory and modeling, to determine:

1. The properties of a carefully-simulated **near-surface plasma environment**, and the intense localized electric fields expected to develop due to differential charging near the terminator regions and in localized shadows
2. The **charging of grains** resting on dusty surfaces and stirred by activities, their possible mobilization, lift-off, transport and adhesion
3. The **microphysics of impact phenomena** from hypervelocity micrometeoroids and their interaction with simulated lunar environment. A major component of the experimental program is a **dust accelerator for micron-sized grains**, to closely reproduce the effects of micrometeoroid impacts onto the lunar surface.

lasp.colorado.edu/ccldas

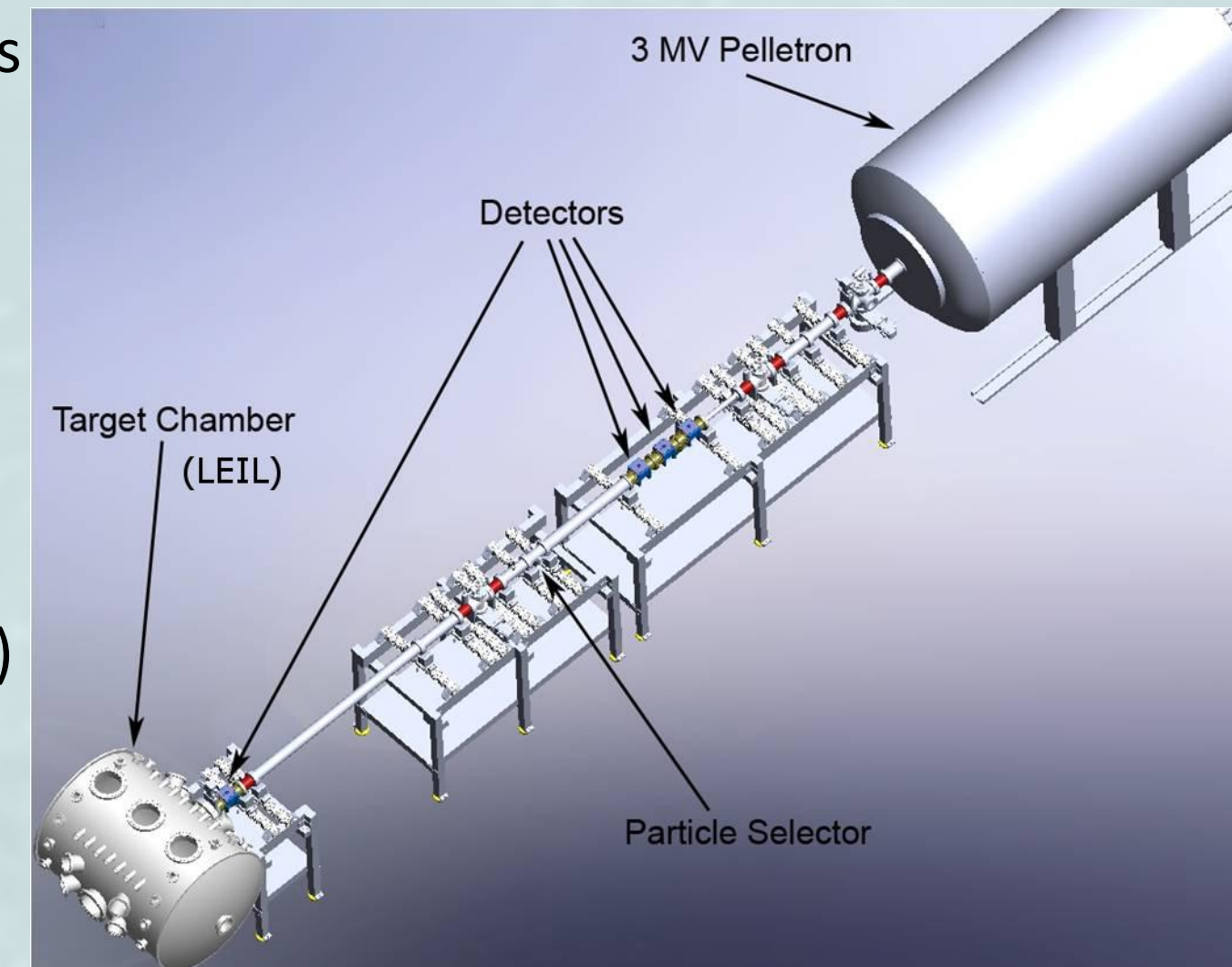
Student Involvement

CCLDAS trains the next generation of lunar and planetary scientists by involving them in **all aspects** of experimental and theory efforts:

- **Four graduate students** working on dust charging/adhesion studies, accelerator development, particle-in-cell dusty plasma sheath models, instrument development
- **Ten undergraduates** working on dusty / UV photoionized plasma creation, accelerator development, instrument electronics, advanced analysis techniques
- **Two CU courses:** experimental projects course and journal seminar

Hypervelocity Dust Accelerator

- Designed to support **science goals** related to dust impacts, on the Moon and elsewhere, and **instrument calibration**
- ***Will be available for community use!***
- Accelerates **0.2-2.5 μm** particles to **1-100 km/sec** via 3 MV electrostatic accelerating voltage
- **Precise, active selection** of particles (size/velocity) admitted to target
- High particle rate (about 10 Hz)
- Under construction, to be commissioned in **Spring 2011**
- Plugs into the Lunar Environment Impact Laboratory (LEIL) chamber, which can also be used as a **stand-alone test environment** for dusty plasma experiments and instrument calibration.



Instrument Development

Dust Telescope / Dust Detection:

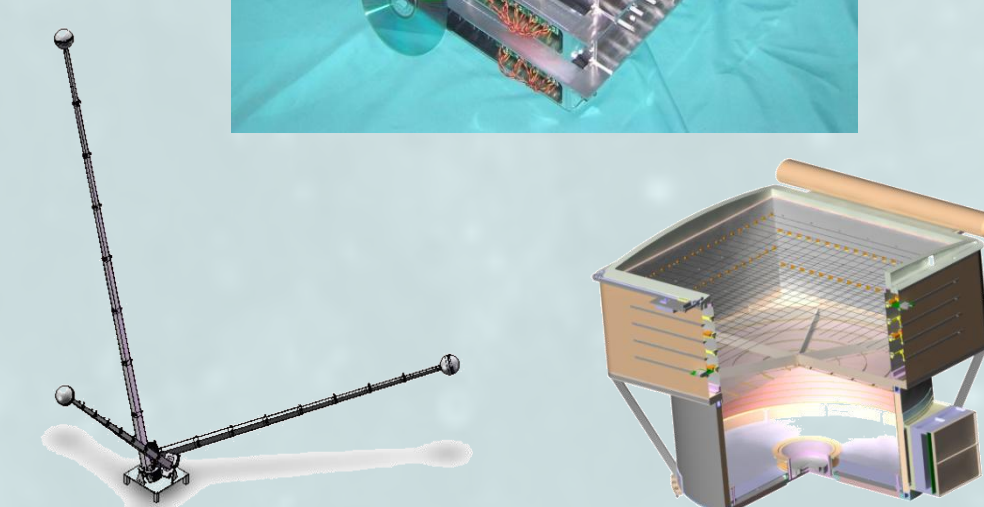
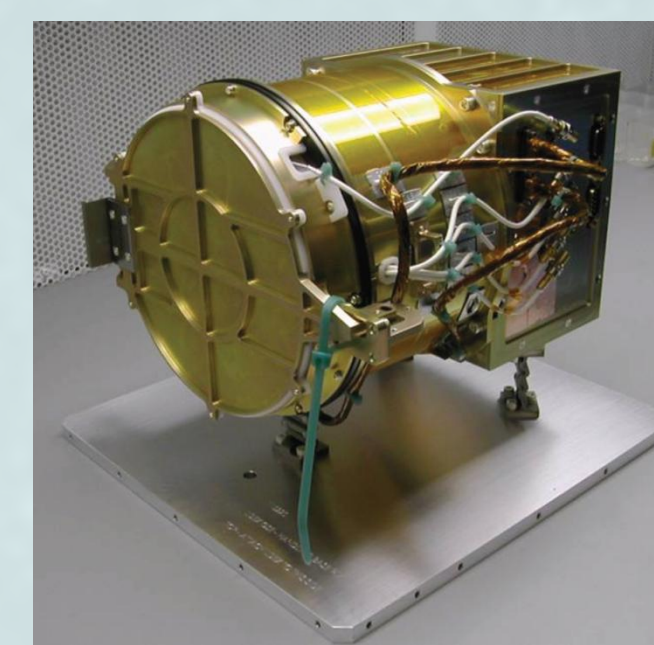
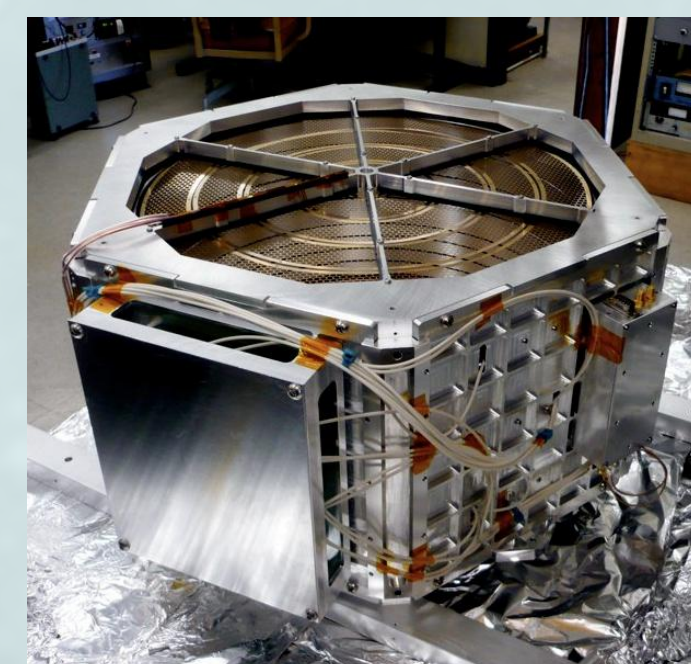
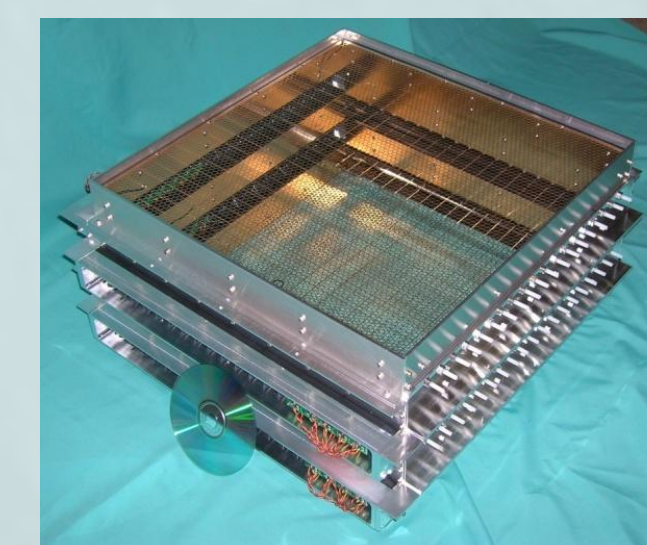
- *Electrostatic Lunar Dust Analyzer (ELDA)*, for detection of dust particles from the lunar surface
- *Large Area Mass Analyzer (LAMA)*, for analysis of dust-grain composition

Lunar Dust Experiment (LDEX):

- Dust impact detector for LADEE

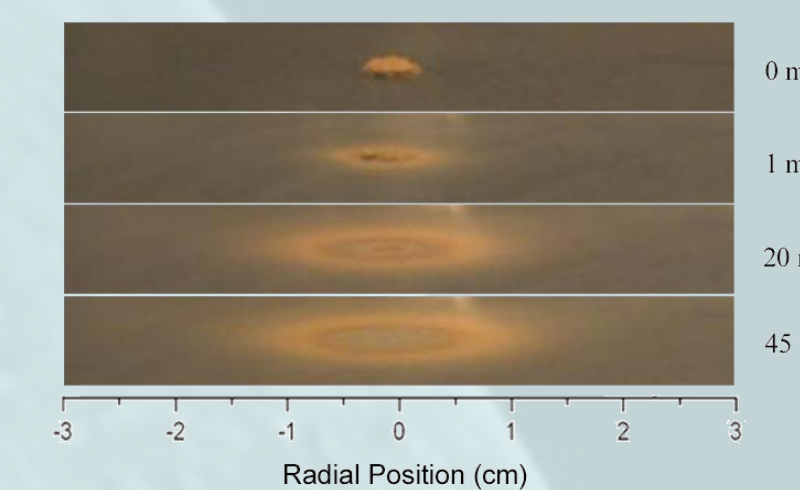
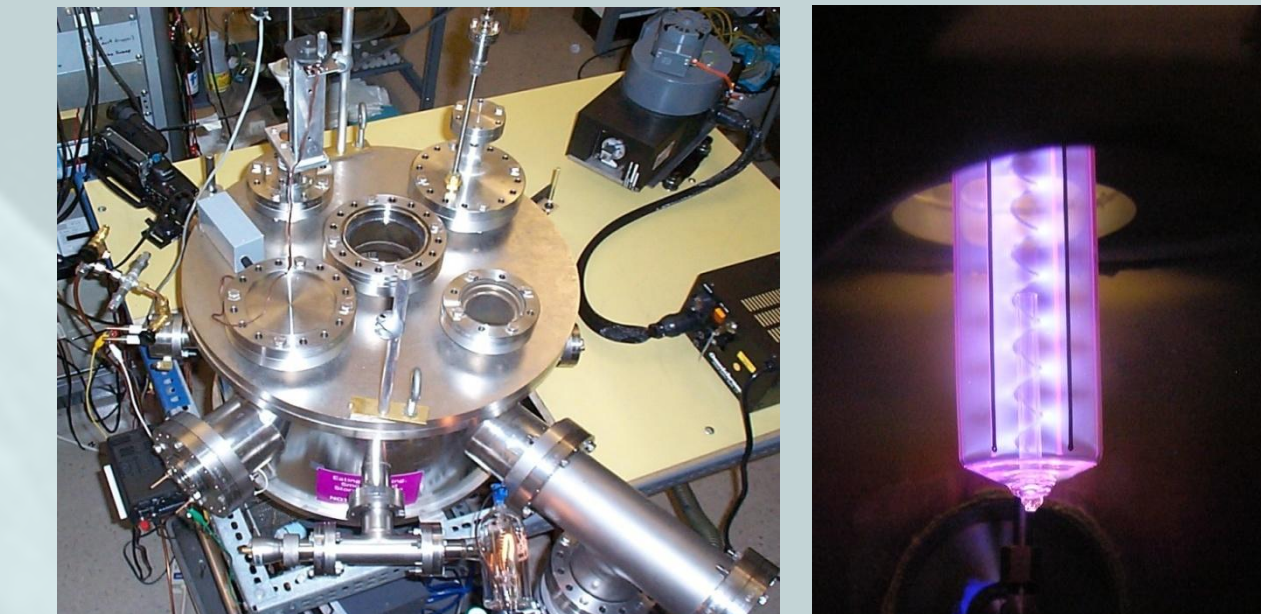
Lunar Dust Transport Package:

- Integrated pkg. for analyzing dust levitation, transport, lunar plasma



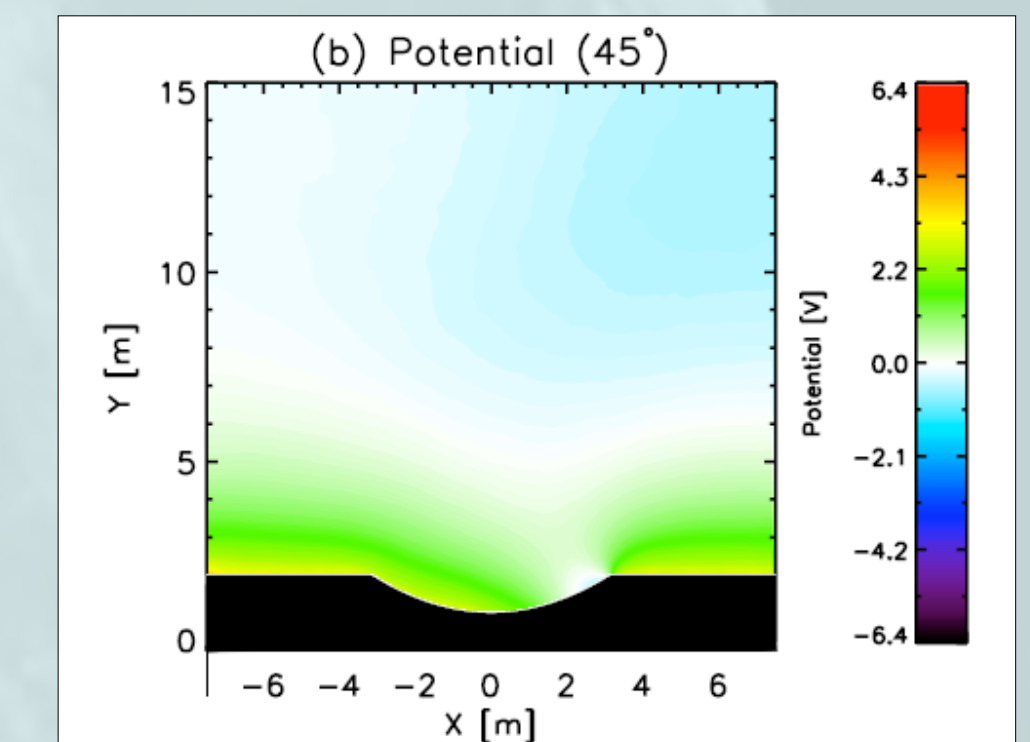
Lab Experiments

- UV photoionized plasma
 - Dust charging experiments
 - Dust transport / levitation
 - Supercharging with moving shadow boundary
- New high-intensity UV lamps:
 - 1 $\mu\text{A}/\text{cm}^2$.
 - 9W of UV emission
 - sheath scale length $\sim 5\text{cm}$



Theory / Computation

- UV photoionized plasma near photoemitting surface
- Realistic velocity distribution of photoemitted electrons
- Nonmonotonic ϕ profile observed
- 3-D kinetic simulations of lunar plasma / shadow effects
- VORPAL PIC code



Industrial Partners

Ball Aerospace

Coating technologies
Electrostatic adhesion experiments

Zybek Advanced Products

Realistic lunar simulants
Versatile production technology
Custom grains down to micron level

Tech-X

Sheath-scale modeling
2-D models / crossover with local expts.

