## Colorado Center of Lunar Dust and Atmospheric (CCLDAS) S(IEN(E) N. Horanyi, University of Colorado, Boulder

#### 1. Major Scientific Results:

- *a) Theory:* Successful modeling of the formation of photoelectron plasma sheaths, including the effects of realistic photoelectron energy distributions, and the emergence of electrostatic double-layers.
- *b)* Laboratory Experiments: Demonstrated the role if differential charging due to exposure to UV photons and/or energetic electron beams leading to charging, mobilization and transport of dust.
- *c)* Space Hardware: Completed demonstration units to measure the charge, mass, and velocity vector of slow-moving dust on the lunar surface. Completed testing of the EM version of LADEE/LDEX.

#### 2. Publications:

- a) J.E. Colwell, S.R. Robertson, M. Horanyi, A. Poppe, P. Wheeler, Lunar dust levitation, *J. Aerospace Engineering* 22, 2-9, 2009.
- b) X. Wang, M. Horanyi, S. Robertson, Experiments on dust transport in plasma to investigate the origin of the lunar horizon glow, *J. Geophys. Res., 11*, Issue A5, CiteID A05103, 2009.
- c) M. Horanyi, O. Havnes, G. E. Morfill, Complex Plasmas in the Solar System, *Complex (Dusty) Plasmas*, eds: V. Fortov and G.E. Morfill, CRC Press: Series in Plasma Physics, 2009.
- d) D. James, V. Hoxie, M. Horanyi, Polyvinylidene Fluoride Dust Detector Response to Particle Impacts, *Rev. Sci. Instruments, 81*, 034501, 2010.
- e) A. Poppe, M. Horanyi, Simulations of the Photoelectron Sheath and Dust Levitation on the Lunar Surface, *J. Gephys. Res.*, in press, 2010.
- f) X. Wang, M. Horanyi, S. Robertson, Investigation of dust transport on the lunar surface in a laboratory plasma with an electron beam, *J. Geophys. Res.*, in press, 2010.
- g) A. Poppe, B. Jacobsmeyer, D. James, M. Horanyi, Simulation of Polyvinylidene Fluoride Detector Response to Hypervelocity Particle Impact, *Nucl. Instr. Methods,* in press, 2010.
- h) X. Wang, M. Horanyi, S. Robertson, Dust transport near electron beam impact and shadow boundaries, *Planetary and Space Science*, submitted, 2010.
- i) E. Grun, M. Horanyi, and Z. Sternovsky, The Lunar Dust Environment, *Planetary and Space Science*, submitted, 2010.
- j) F. Postberg, E. Grun, M. Horanyi, S. Kempf, H. Kruger, R. Srama, Z. Sternovsky, and Mario Trieloff, Compositional Mapping of Moon Surfaces by Mass Spectrometry of Dust Ejecta, *Planetary and Space Science*, submitted, 2010.
- k) A. Dove, G. Devaud, X. Wang, M. Crowder, A. Laitzke, C. Haley. Mitigation of lunar dust adhesion by surface modification, *Planetary and Space Science*, submitted, 2010.



# CCLDAS

Publications Published: 4 In Press: 3 In review: 4 Presentations: ~ 40

#### Educating the Next Generation

Undergraduates: 12 Graduate Students: 4 Postdocs: 2 NLSI New Faculty: 2

# LUNAR Colorado Center of Lunar Dust and Atmospheric (CCLDAS)

# 3. Education and Public Outreach

- a) "The Moon as a Field Station: The Science and the Exploration." Media Workshop April 30 May 2, 2010. (Science Now, Physics Today, AP/Denver, Nova, National Geographic, Space News, Odyssey Magazine, + 3 free lance). Talks: J. Ashby, B. Bottke, J. Halekas, M. Horanyi, S. Mojzis, A. Stern, and B. Weiss
- b) "Interdisciplinary Lunar Science Seminar", in collaboration with B. Bottke & J. Burns (15 grads).
- Aerospace Senior Engineering Project: : "Langmuir Probes for the Lunar Surfaces (LPLUS)" (12 undergrads)
- d) Weekly "journal club" style graduate seminar, including lunar and general dusty-plasma issues (<u>http://www.colorado.edu/physics/phys7810\_plasma/phys7810\_plasma\_sp10/</u>)
- e) Graduate plasma physics, the course now includes a segment on dusty plasmas relevant for the lunar surface (<u>http://lasp.colorado.edu/~horanyi/5150/</u>)

#### 4. Partnerships

- a) NASA Johnson Space Flight Center
- b) Tech-X Corporation (Small Business)
- c) Zybek Advanced Products (Small Business)
- d) Max Planck Institute for Extraterrestrial Physics (Garching, Germany)
- e) Max Planck Institute for Nuclear Physics (Heidelberg, Germany)
- f) Katholieke Universiteit (Leuven, Belgium)

### 5. Collaborations

a) NLSI DREAM Team for modeling the lunar plasma environment and develop tools for improved interpretation of the Lunar Prospector measurements of the surface potential of the Moon.

b) NLSI LUNAR and CLOE Teams to direct an interdisciplinary graduate seminar at the University of Colorado.

C) NLSI DREAM and CLOE Teams for the presentations at the CCLDAS Media Workshop,



CCLDAS is focused on: a) experimental and theoretical investigations of dusty plasma processes; b) the development of new instrument concepts for future in situ dust and plasma measurements on the surface and in orbit about the Moon and other airless bodies in the solar system; and c) a complementary program of education and community development. CCLDAS is addressing basic physical and applied lunar science questions, including the longterm usability of mechanical and optical devices on the Moon. CCLDAS is supporting the development of the Lunar Dust Experiment (LDEX), an in situ impact dust detector to be flown on the Lunar Atmosphere and Dust Environment Explorer (LADEE) mission scheduled to be launched in 2013.