Dust Transport in the Near-Surface Lunar Plasma Environment

M. Piquette,[1,3] A. R. Poppe,[4] M. Horányi,[2,3] P. Messmer,[5] A. Lihkanski[5]

[1] *Dept. of Astrophysical and Planetary Science, University of Colorado, Boulder CO*
[2] *Physics Department, University of Colorado, Boulder CO*
[3] *Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder CO*
[4] *Space Science Laboratory, University of California, Berkeley CA*
[5] *Tech-X Corporation, Boulder CO*
Marcus.Piquette@Colorado.EDU

Abstract. Due to interactions with the solar wind and solar ultraviolet radiation, the lunar surface develops a complex plasma environment, especially around geological features like craters. Various phenomenon have been observed taking place in this dusty plasma environment including dust levitation and even horizontal dust transport [1,2,3]. The Surveyor 5, 6 and 7 cameras that show a 'horizon glow', has recorded observations of such phenomena. This glow has been explained as forward-scattered light off of levitating dust particles. Dust levitation and transport could also result in dust ponding, as has been observed on asteroid 433 Eros [4,5,6]. To understand these phenomena a three-dimensional particle-in-cell (PIC) code was ran using the commercial code, VORPAL©. The plasma was modeled above a 6.5 m diameter crater with the solar zenith angle varying by 15° intervals from the surface normal. By changing the solar zenith angle for each simulation we were able to effectively obtain a full day of plasma conditions for the lunar surface. To model dust dynamics within the near-surface lunar plasma environment, we developed a two dimensional dust tracing code, based on earlier work where individual dust grains are introduced into a PIC-modeled plasma environment [7]. To look for any net dust transport we simulated multiple lunar days of dust dynamics by interpolating between the modeled plasma environments to match the local plasma conditions at a given time. In order to establish any dependence on the initial distribution of dust, two separate cases of the simulation was ran. The first simulation was the case where the dust is initially spread randomly over the entire surface of the crater. The second simulation was the case where the dust is given a rectangular initial distribution well outside of the crater. In doing this we were able to see if the ending distribution of dust, after multiple lunar days, is at all dependent on the initial distribution. [1]

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[1] Berg, O. et al., Preliminary Results of a Cosmic Dust Experiment on the Moon, *Geophys. Res. Lett.,* 1 (7), 1974.
[2] Rennilson, J. and D. Criswell, Surveyor Observations of Lunar Horizon-Glow, *The Moon*, 10, 1974.
[3] Colwell, J. et al., Lunar Surface: Dust Dynamics and Regolith Mechanics, *Rev. Geophys.*, 45, 2007.
[4] Veverka, J. et al., Imaging of Small Scale Features on 433 Eros from NEAR: Evidence for a Complex Regolith, *Science*, 292 (484), 2001.
[5] Colwell, J. et al., Dust transport in photoelectron layers and the formation of dust ponds on Eros, *Icarus,* 175, 2005.
[6] Hughes, A. et al., Electrostatic dust transport on Eros: 3-d simulations of pond formation, *Icarus,* 195, 2008.
[7] Poppe, A., Horányi, M., Simulations of the Photoelectron Sheath and Dust Levitation on the Lunar Surface, J. Geophys. Res. 115 (A08106), 2010.