Modeling Solar Wind Interaction With Surface Dipole Magnetic Fields. J. R. Szalay[1,2], A. Likhanskii[3], X. Wang[1,2], and M. Horanyi[1,2]. [1]University of Colorado at Boulder Department of Physics (jamey.szalay@colorado.edu), [2]Coloardo Center for Lunar Dust and Atmospheric Studies, [3]Tech-X Corporation

Overview: Many airless bodies in the solar system such as the Moon have a tenuous atmosphere and no global magnetic field. However, many of these bodies have local crustal magnetic fields which modify the local behavior of the solar wind in these regions. Lunar crustal magnetic fields have been observed as high as 100's of nT at the surface [1].

As the solar wind impinges upon a crustal magnetic field, ions and electrons behave differtly due to their relative mass ratios. As the lighter electrons enter regions of strong local magnetic fields, they get picked up by the magnetic field and gyrate around magnetic field lines. If these electrons are captured outside the loss cone and have sufficiently small gyroradii, they will mirror about the dipole mirror points and remain captured in the mini-magnetosphere generated by the crustal dipole field. The heavier ions, however, have much larger gyroradii and may therefore stay largely unmagnetized. This discrepancy in ion/electron behavior in a crustal magnetic field will lead to a complex potential and surface chage structure [2]. Shown in Figure 1 are the results from a laboratory experiment in which an Argon plasma impinges on an insulating surface with an embedded dipole field. Notice the complex and non-monotonic potential structure.

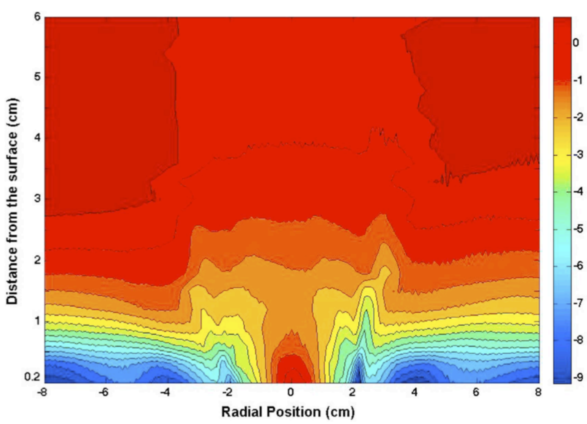

Figure 1. Potential contours above the surface along the dipole axis. Color bar shows potential in volts. [2]

Model: To model this scenario, a three dimensional Particle-In-Cell plasma simulation code, VORPAL [3], is used. In the model, a two species plasma is injected at the upper boundary with an average drift velocity towards the surface. A fixed dipole field is embedded in the surface with a magnitude strong enough such that the electrons become magnetized while the ions remain unmagnetized and may freely impact the surface. Mini-magnetospheric effects are observed where electrons are captured along magnetic field lines and mirror accordingly, while ions reach the surface unobstructed by the magnetic field structure.

References: [1] Halekas, J. S., et al. (2001), Mapping of crustal magnetic anomalies on the lunar nearside by the Lunar Prospector electron reflectometer, *J. Geophys. Res.,* 106, 27, 841-852 [2] Wang, X., M. Horanyi, and S. Robertson (2012), *J. Geophys. Res.,* 117, A06226 [3] Nieter, C., Cary, J.R., 2004. VORPAL: A versatile plasma simulation code. *J. Comp. Phys*. 196, 448-473