M. Zimmerman Talk

Doubly-shadowed regions in lunar polar craters: hydrogen accumulation in the presence of recursive plasma wakes

Permanently shadowed regions (PSRs) of the Moon have been identified as unique environments of extreme cold and comprise a natural cold trap for sequestering volatiles [Paige et al. 2010]. The diverse chemical composition of the LCROSS impact plume provided evidence for a volatile-rich and chemically-complex PSR environment [Colaprete et al. 2010, Schultz et al. 2010]. Additionally, the polar electrostatic environment is highly complex, with the possibility of strong, localized electric fields that divert solar wind ions directly into polar cold traps [Farrell et al. 2010, Zimmerman et al. 2011]. Thus, regional plasma physics processes couple directly with volatile sequestration. In the present work, kinetic simulations show that recursive plasma wake structure arises in the presence of step-like topographic features (i.e. doubly-shadowed craters). Combining the plasma code with a numerical sputtering model demonstrates that solar wind protons can be either a hydrogen source via implantation or a volatile loss mechanism via sputtering, depending on properties of the regolith and solar wind. The present model provides a novel theoretical pathway toward understanding the lunar surface/solar wind physical and chemical interactions for complex topography near the poles.