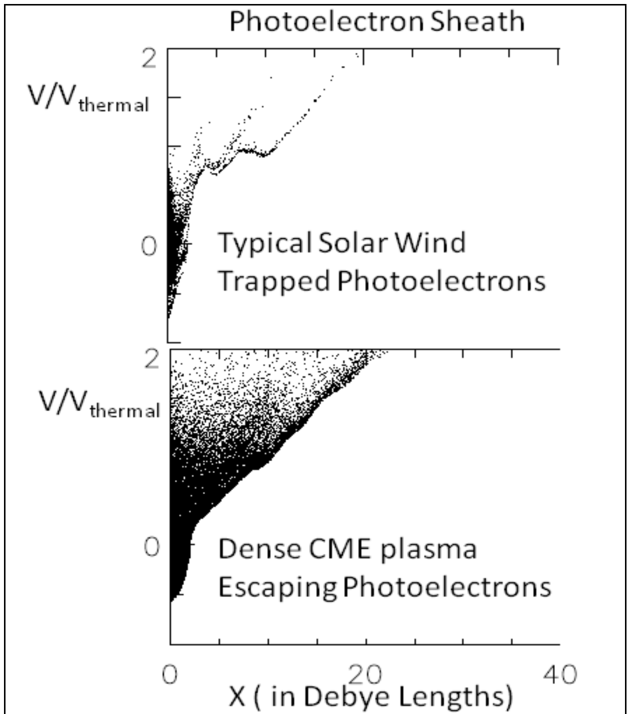
THE LUNAR PHOTOELECTRON SHEATH: A CHANGE IN TRAPPING EFFICIENCY DURING A SOLAR STORM

W. M. Farrell[1,3], M. A. Zimmerman[1,3], A. Poppe[2,3], J. S. Halekas[2,3], G. T. Delory[2,3],
[1] NASA/Goddard Space Flight Center, Greenbelt, MD (William.M.Farrell@nasa.gov); [2] University of California at Berkeley, Berkeley, CA; [3] NASA Lunar Science Institute, NASA Ames Research Center, Moffett Field, CA.

Abstract: On the lunar dayside, photoelectron emission is quasi-constantly occurring and this electron emission acts to charge the dayside lunar surface a few volts positive. In arriving at an equilibrium surface potential, the surface will charge to balance the two primary currents: the outgoing photoelectron flux, J_p, against the incoming solar wind electron thermal flux, J_e[1]. In nominal solar wind conditions, $J_p > J_e$ and the surface charges positive, trapping most (all but 6%) of the photoelectrons in the first few Debye lengths from the surface. We demonstrate via particle-in-cell plasma simulations that the morphology of the lunar photoelectric sheath during a coronal mass ejection (CME) passage by the Moon is very different than in the case of the nominal solar wind. Specifically, during the passage of the plasma associated with a CME, the solar wind electron thermal flux will greatly increase (by a factor of 5-10), making $J_e > J_p$. We find that during these times, there is substantially less near-surface electrostatic trapping of the photoelectrons. The photoelectron population has almost direct access to upstream regions with photoelectron escape in excess of 50%.

References. [1] Poppe, A., and M. Horányi (2010), *J. Geophys. Res.*, 115, A08106.



Simulation of photoelectron sheath electron phase space configuration (V_x vs X) after 12 plasma periods. For nominal solar wind conditions (top), $J_p > J_e$, and the surface charges to large enough values to actually deflect the trajectory of the photoelectrons and force their return to the surface However, during a CME passage, there is enough incoming electron current flow to offset the surface charging. Since $J_p < J_e$, the surface potential is small: the potential barrier is reduced and photoelectrons are thus allowed to liberally flow upstream (bottom).