FIRST COSMIC RAY PROTON ALBEDO MAP OF THE MOON. J. K. Wilson[1], H. E. Spence[1], 6, J. Kasper[2], M. J. Golightly[1], J. B. Blake[3], J. E. Mazur[3], L. Townsend[4], A. Case[5], M. D. Looper[3], [1]Space Science Center, University of New Hampshire, Durham, NH, United States (jody.wilson@unh.edu), [2]High Energy Astrophysics Division, Harvard CFA, Cambridge, MA, United States, [3]The Aerospace Corporation, Los Angeles, CA, United States, [4]Department of Nuclear Engineering, University of Tennessee, Knoxville, TN, United States, [5]Center for Space Physics, Boston University, Boston, MA, United States, [6]Institute for the Study of Earth, Oceans, and Space, University of New Hampshire, Durham, NH, United States.

Introduction: High energy cosmic rays are constantly bombarding the lunar regolith, producing secondary particles like protons and neutrons, some of which escape back to space. Two lunar missions, Lunar Prospector and LRO, have shown that the energy distribution of secondary neutrons in particular is modulated by the elemental composition of the lunar regolith[1], [2]. In particular, reduced neutron fluxes near the lunar poles appear to be the result of collisions with hydrogen nuclei in ice deposits[3] in permanently shadowed craters. We explore the possibility that the flux of escaping lunar protons might also be dependent on regional compositional variations, either due to spallation yields or to energy loss in secondary collisions.

CRaTER Instrument: The Lunar Reconnaissance Orbiter (LRO) has been observing the surface and environment of the Moon since June of 2009. The CRaTER instrument (Cosmic Ray Telescope for the Effects of Radiation) on LRO is designed to characterize the lunar radiation environment and its effects on simulated human tissue. CRaTER's multiple solid-state detectors can be used to discriminate the different elements in the galactic cosmic ray (GCR) population above ~10 MeV/nucleon, and can also distinguish between primary GCR protons arriving from deep space and secondary particles backscattered from the lunar surface (i.e., “albedo”).

Summary of Results: We use backscattered protons coming up from the lunar surface with energies greater than 60 MeV to construct a cosmic ray proton albedo map of the Moon. The relative albedo is proportional to the rate of lunar proton detections divided by the rate of incoming GCR detections. The map accounts for time variation in the secondary particles driven by time variations in the primary GCR population, thus revealing any true spatial variation of the proton albedo.

We find no obvious albedo features corresponding to regional differences in elemental composition of the regolith, such as between maria and highlands. The distribution of albedo values resembles the Poisson distribution that is expected for ~310,000 detected protons, meaning the map is consistent with a spatially uniform albedo. More data will improve the counting statistics and lower the detection threshold for any proton albedo features.

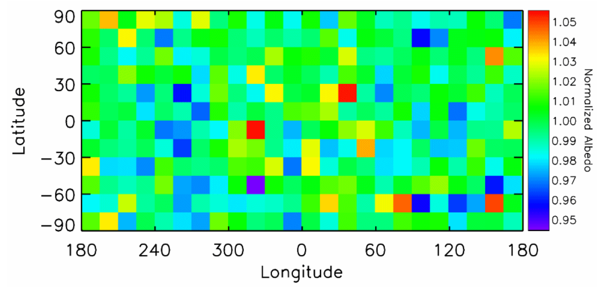

Figure 1. Lunar proton albedo map. We cannot yet compute an absolute albedo; the map has been normalized to the average albedo value.

References: [1] Feldman W. C. et al. (1998) *Science, 281*, 1496. [2] Mitrofanov I. G. et al. (2010) *Science, 330*, 483. [3] Feldman W. C. et al. (1997) *JGR, 102*, 25565.