FIRST COSMIC RAY ALBEDO PROTON MAP OF THE MOON. J. K. Wilson[1], H. E. Spence[1], A. W. Case[2], J. B. Blake[3], M. J. Golightly[1], J. Kasper[2], M. D. Looper[3], J. E. Mazur[3], N. Schwadron[1], L. W. Townsend[4], C. Zeitlin[5], [1]Space Science Center, University of New Hampshire, Durham, NH, (jody.wilson@unh.edu), [2]High Energy Astrophysics Division, Harvard CFA, Cambridge, MA, [3]The Aerospace Corporation, Los Angeles, CA, [4]Department of Nuclear Engineering, University of Tennessee, Knoxville, TN, [5]Southwest Research Institute, Boulder, CO.

Introduction: High energy cosmic rays constantly bombard the lunar regolith, producing secondary "albedo" particles like protons and neutrons, some of which escape back to space. Two lunar missions, Lunar Prospector and the Lunar Reconnaissance Orbiter (LRO), have shown that the energy distribution of albedo neutrons is modulated by the elemental composition of the lunar regolith[1-4]. Of particular interest is that reduced neutron fluxes near the lunar poles appear to be the result of collisions with hydrogen nuclei in ice deposits[5] 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: 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 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 albedo particles propagating up from the lunar surface.

Summary of Results: We use albedo protons with energies greater than 60 MeV to construct a cosmic ray albedo proton map of the Moon. The yield of albedo protons 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 albedo particles driven by time variations in the primary GCR population, thus revealing any true spatial variation of the albedo proton yield.

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 ~330,000 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.

The fluxes of cosmic rays and albedo protons have been decreasing since late 2009, as expected during a period of increasing solar activity. The "yield" of albedo protons slightly increased, presumably due to a lower fraction of low-energy cosmic rays reaching the inner solar system.

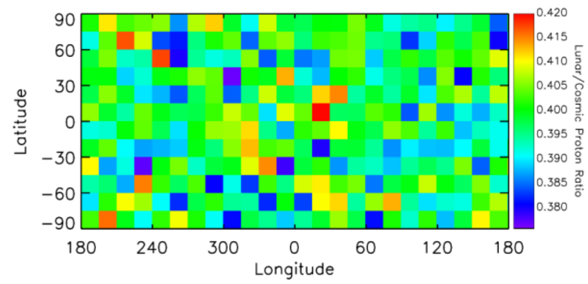

Figure 1. Map of the lunar albedo proton "yield."

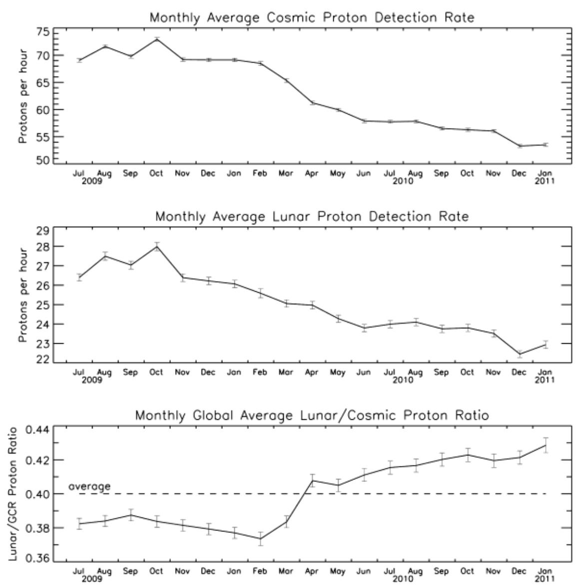

Figure 2. Monthly plots of (*top*) cosmic ray proton detection rate at the Moon, (*middle*) albedo proton detection rate, and (*bottom*) ratio of albedo to cosmic ray protons.

References: [1] Feldman W. C. et al. (1998) *Science, 281*, 1496-1500. [2] Gasnault, O. et al. (2001) GRL, 28, 3797-3800. [3] Maurice, S. et al. (2004) *JGR*, *109*, E07S04. [4] Mitrofanov I. G. et al. (2010) *Science, 330,* 483-486. [5] Feldman W. C. et al. (1997) *JGR, 102,* 25565-25574.