**COSMIC RAY ALBEDO PROTON YIELD CORRELATED WITH LUNAR ELEMENTAL ABUNDANCES.** 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" or "splash" 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], with reduced neutron fluxes near the lunar poles being the result of collisions with hydrogen nuclei in ice deposits[5] in permanently shadowed craters. Here we investigate an analogous phenomenon with high energy (~100 MeV) lunar albedo *protons*.

**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.

Our current map is a significant improvement over the proof-of-concept map of Wilson et al.[6]. In addition to including twelve more months of CRaTER data here, we use more numerous minimum ionizing GCR protons for normalization, and we make use of all six of CRaTER's detectors to reduce contamination from spurious non-proton events in the data stream.

We find find that the flux of lunar albedo protons is indeed correlated with elemental abundances at the lunar surface. In general the yield of albedo protons from the maria is 1.1% ± 0.4% higher than the yield from the highlands. In addition there appear to be localized peaks in the albedo proton yield that are co-located with peaks in trace elemental abundances as measured by the Lunar Prospector Gamma Ray Spectrometer.

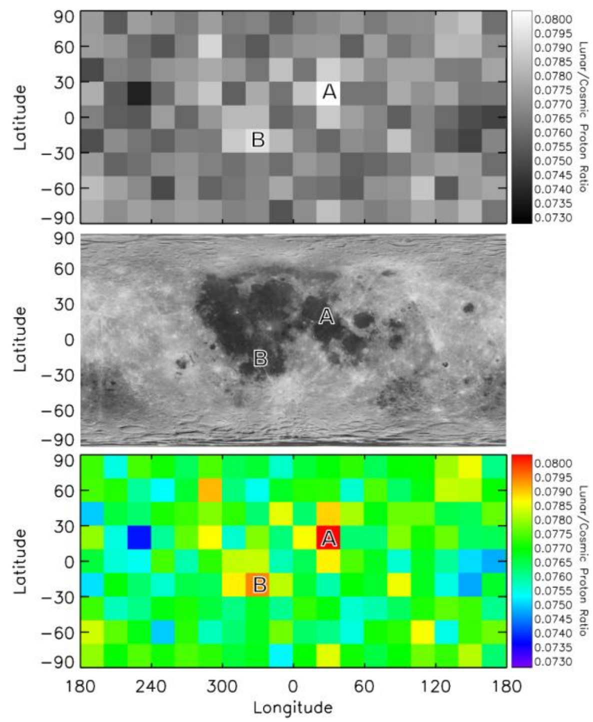


**Figure 1**. Grayscale (*Top*) and color-coded (*Bottom*) lunar albedo proton maps. *Middle*: Clementine white-light mosaic of lunar surface.

**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. [6] Wilson, J. K. et al. (2012) *JGR, 117*, E00H23.