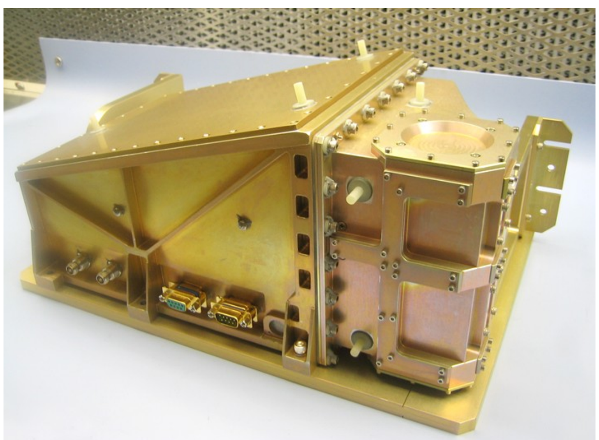
AN OVERVIEW OF RESULTS FROM THE LUNAR RECONNAISSANCE ORBITER (LRO) COSMIC RAY TELESCOPE FOR THE EFFECTS OF RADIATION (CRaTER). H. E. Spence[1] and the CRaTER Science Team, [1]Space Science Center, Institute for the Study of Earth, Oceans, and Space, University of New Hampshire, 8 College Road, Durham, NH, 03824, harlan.spence@unh.edu.

Introduction: We present an overview of science results from the Cosmic Ray Telescope for the Effects of Radiation (CRaTER) [1] obtained during its first year of operations aboard the Lunar Reconnaissance Orbiter (LRO) [2] at the Moon. CRaTER has been immersed in the ionizing radiation environment of the Moon since its launch on NASA's LRO in June 2009. CRaTER measures the linear energy transfer (LET) of energetic particles traversing the instrument, a quantity that describes the rate at which particles lose kinetic energy as they pass through matter. A significant portion of the kinetic energy converts into deleterious ionizing radiation through the interactions with matter, thus posing a major radiation risk for human and robotic space explorers subjected to deep space energetic particles. CRaTER employs strategically placed solid-state detectors and tissue equivalent plastic (TEP), a synthetic analog for human tissue, to quantify radiation effects pertinent to astronaut safety.



Background: The Sun has experienced a remarkable period of inactivity, including an absence of explosive solar events capable of accelerating charged particles to energies above a threshold of radiobiological importance (> 10 MeV/nucleon), both before LRO's launch and until at least to date. However, the prolonged and deep solar minimum also produces solar interplanetary conditions that maximize another powerful source of ionizing radiation, galactic cosmic rays (GCR), which reached record high levels in the inner solar system in early 2010. CRaTER LET measurements taken during the first six months of operation therefore provide a measure of the worst-case lunar radiation environment seen during the space age. The ionizing radiation resulting from all GCR ion species and over all incident energies of radiobiological interest (10 MeV/nucleon to > 1 GeV/nucleon) is greater than best model predictions.

Results: In this presentation, we present science highlights resulting from CRaTER research; each study in some way provides understanding needed to enable safe, future lunar exploration. These CRaTER science results include: radiation dose rate estimates during the current deep, prolonged solar minimum; lunar orbit dose rate comparisons with Apollo-era estimates; assessment of variability of galactic cosmic rays and their sources; first direct observations of albedo protons from the lunar regolith and comparison with models; and detection of first, weak solar-related energetic particle event of the new solar cycle. These results will be discussed in the context of lunar exploration.

References:

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[2] Chin G., et al. (2007) *Space Sci. Rev*., 129, 391–419.