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Use of Geant4 simulations in understanding LRO/CRaTER observations

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The Cosmic Ray Telescope for the Effects of Radiation (CRaTER) has been in orbit around the moon aboard NASA's Lunar Reconnaissance Orbiter (LRO) for over a year. The purpose of CRaTER is to measure the radiation environment that will be experienced, in particular, by astronauts on and near the lunar surface; to that end, CRaTER consists of a stack of six silicon solid state detectors arranged in three pairs, with two large blocks of Tissue-Equivalent Plastic between pairs to represent the shielding provided by the human body. The data we have collected to date are complex; in comparison with a simple stack of active elements observing cosmic radiation in free space, we see effects from the large volume of inert material between active elements, from albedo particles produced by cosmic-ray impacts on the nearby (50 km nominal altitude) lunar surface, and from cosmic-ray albedo particles produced on the LRO spacecraft itself. Understanding the observations has required extensive Geant4 modeling of the response of the sensor to many kinds of particles and of the lunar and spacecraft albedo environment. We will show how these modeling efforts have come together to help us understand the details of our observations to date.

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