Comparison of Martian Surface Radiation Predictions to the Measurements of Mars Science Laboratory Radiation Assessment Detector (MSL/RAD)

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For the analysis of radiation risks to astronauts and planning exploratory space missions, detailed knowledge of particle spectra is an important factor. Detailed measurements of the energetic particle radiation environment on the surface of Mars have been made by the Mars Science Laboratory Radiation Assessment Detector (MSL-RAD) on the *Curiosity* rover since August 2012, and particle fluxes for a wide range of ion species (up to several hundred MeV/u) and high energy neutrons (8 - 1000 MeV) have been available for the first 200 sols. Although the data obtained on the surface of Mars for 200 sols are limited in the narrow energy spectra, the simulation results using the Badhwar-O'Neill galactic cosmic ray (GCR) environment model and the high-charge and energy transport (HZETRN) code are compared to the data. For the nuclear interactions of primary GCR through Mars atmosphere and *Curiosity* rover, the quantum multiple scattering theory of nuclear fragmentation (QMSFRG) is used, which includes direct knockout, evaporation and nuclear coalescence. Daily atmospheric pressure measurements at *Gale* Crater by the MSL Rover Environmental Monitoring Station are implemented into transport calculations for describing the daily column depth of atmosphere. Particles impinging on top of the Martian atmosphere reach the RAD after traversing varying depths of atmosphere that depend on the slant angles, and the model accounts for shielding of the RAD by the rest of the instrument. Calculations of stopping particle spectra are in good agreement with the RAD measurements for the first 200 sols by accounting changing heliospheric conditions and atmospheric pressure. Detailed comparisons between model predictions and spectral data of various particle types provide the validation of radiation transport models, and thus increase the accuracy of the predictions of future radiation environments on Mars. These contributions lend support to the understanding of radiation health risks to astronauts for the planning of various mission scenarios.