Modeling of the Martian radiation environment

G. De Angelis (1,2,3), F.F. Badavi (3,4), S.R. Blattnig (3), M.S. Clowdsley (3), G.D. Qualls (3), R.C. Singleterry (3), R.K. Tripathi (3), J.W. Wilson (3)

(1) Istituto Superiore di Sanita', Rome, I-00161, Italy, (2) Old Dominion University, Norfolk, VA 23508, USA, (3) NASA Langley Research Center, Hampton, VA 23681, USA, (4) Christopher Newport University, Newport News, VA 23606, USA
(FAX:++39-06-4990-4285/e-mail: giovanni.deangelis@iss.it)

In view of manned missions targeted to Mars, for which radiation exposure is one of the greatest challenges to be tackled, it is of fundamental importance to have available a tool, which allows the determination of the particle flux and spectra at any time at any point of the Martian surface. With this goal in mind, a new model for the radiation environment to be found on the planet Mars due to Galactic Cosmic Rays (GCR) and Solar Particle Events (SPE) has been developed. Primary particle environments computed for Martian conditions are transported within the Mars atmosphere, with temporal properties modeled with variable timescales, down to the surface, with topography and backscattering patterns taken into account. The atmospheric chemical and isotopic composition has been modeled over results from the in-situ Viking Lander measurements for both major and minor components. The surface topography has been reconstructed with a model based on the data provided by the Mars Orbiter Laser Altimeter (MOLA) instrument on board the Mars Global Surveyor (MGS) spacecraft. The surface itself has been modeled in both the dry ('regolith') and volatile components. Mars regolith composition has been modeled based on the measurements obtained with orbiter and lander spacecraft from which an average composition has been derived. The volatile inventory (e.g. CO2 ice, H2O ice) properties, both in the regolith and in the seasonal and perennial polar caps, has been taken into account by modeling the deposition of volatiles and its variations with geography and time all throughout the Martian year. Particle transport has been performed with the HZETRN heavy ion code with an adaptation for planetary surface geometry. Results are given in terms of fluxes, doses and LET, for most kinds of particles, namely protons, neutrons, alpha particles, heavy ions, pions, and muons for various soil compositions. The spectra will be compared with the data from unmanned Martian orbiter and lander missions in the near future.