

# **New models and results for radiation doses on the Lunar surface**

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In view of manned missions targeted to the Moon, 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 and at any point of the lunar surface. With this goal in mind, new models of the Moon radiation environment due to Galactic Cosmic Rays (GCR) and Solar Particle Events (SPE) have been developed. Primary particles reach the lunar surface, and are transported all throughout the subsurface layers, with backscattering patterns taken into account. The surface itself has been modeled as regolith and bedrock, with composition taken from the results of the instruments flown on the Apollo missions, namely on the Apollo 12 from the Oceanus Procellarum landing site. Subsurface environments like lava tubes have been considered in the analysis. Particle transport has been performed with both deterministic and Monte Carlo codes 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 and rock compositions. The spectra will be compared with the data from unmanned lunar orbiter missions in the near future. Doses have been calculated for most kinds of particles for vary different scenarios and shielding patterns above, on and below the surface of the moon.