A COMPARISON BETWEEN MODELS OF THE MOON RADIATION ENVIRONMENT AND THE DATA FROM THE RADOM EXPERIMENT ONBOARD THE INDIAN CHANDRAYAAN-1 SATELLITE

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Introduction: Radiation protection is one of the two NASA highest concerns and priorities [1]. In view of manned missions targeted to the Moon [2], for which radiation exposure is one of the greatest challenges to be tackled [3], it is of paramount importance to be able to determine radiation fluxes and doses at any time on, above and below the lunar surface [4]. With this goal in mind, models of radiation environment due to Galactic Cosmic Rays (GCR) and Solar Particle Events (SPE) on the Moon have been developed, and fluxes and spectra hereby computed [5]. The work is described [6] as models of incoming cosmic ray [7-9] and solar primary particles [6] impinging on the lunar surface, transported through the subsurface layers, with backscattering taken into account, and interacting with some targets described as material layers. Time dependent models for incoming particles for both GCR and SPE are those used in previous analyses as well as in NASA radiation analysis engineering applications [10]. The lunar surface and subsurface has been modeled as regolith and bedrock (see discussion in [4-6], [10]). The lunar-like atmosphereless body surface models are used to develop models for the surfaces of Martian satellite Phobos [11]. These results for the Moon Radiation Environment have been compared with data from the RADOM investigation onboard the ISRO CHANDRAYAAN-1 spacecraft.

Results: In order to compare results from different transport techniques, particle transport computations have been performed with both deterministic (HZETRN) [12] and Monte Carlo (FLUKA) [13] codes with adaptations for planetary surfaces geometry for the soil composition and structure of the Apollo 12 Oceanus Procellarum landing site [14,15], with a good agreement between the results from the two techniques [6,10]. GCR-induced backscattered neutrons are present at least up to a depth of 5 m in the regolith, whereas after 80 cm depth within regolith there are no neutrons due to SPE [6,10]. Moreover, fluxes, spectra, LET and doses for many charged particles and neutrons for various other lunar soil and rock compositions have been obtained with the deterministic particle transport technique [6]. Results have in particular been obtained for orbital scenarios, for surface (i.e. landers, habitats and rover) scenarios, for subsurface scenarios, and for lunar polar locations, with regards to ways to infer and detect locally the presence of water and/or volatiles. The results from this work can only be compared in literature with previous versions of the same models or with very simplistic models [4-6,10], as also mentioned in [16]. These models have been then rescaled to be tested against spacecraft instruments data (e.g. RADOM onboard the CHANDRAYAAN-1 spacecraft from ISRO). The models have been set to 100 km and 200 km altitude circular orbits, to the actual mission time frame (both punctual and averaged data), and to the actual environmental shielding inside the spacecraft. The detailed comparative analysis between models and data is currently underway, along with better trajectory analyses, with preliminary comparisons giving quite satisfactory results.

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