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Radiation Fields, Effects and Risks in Human Space Missions (5)

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DYASTIMA: SIMULATING AIR SHOWERS IN THE ATMOSPHERE OF A PLANET

Abstract

As primary cosmic rays interact with the upper layers of the atmosphere of a planet, air showers of secondary cosmic ray particles are created. The modelling of these secondary cascades is of great importance for Space Weather studies. DYASTIMA (DYnamic Atmospheric Shower Tracking Interactive Model Application) is a Monte Carlo simulation of the cascades produced in the atmosphere of a planet due to cosmic ray propagation. It is a standalone software application, based on a very friendly graphical user interface (GUI) and is implemented in Geant4 by the Athens Cosmic Ray Group. In order to perform a simulation, the primary cosmic ray spectra, the solar activity, the characteristics of the planet, the composition of the planet's atmosphere as well as the atmospheric profile are taken into account. As a result, DYASTIMA output provides all the necessary information about the secondary particles. DYASTIMA simulations have been used successfully for the atmospheres of Earth and Venus. Moreover, DYASTIMA-R, which is an additional simulation integrated into DYASTIMA software, performs radiation dosimetry calculations in the different atmospheric layers. More specifically, DYASTIMA-R provides the dose rate and the equivalent dose rate for various flight scenarios during different solar activity conditions and Space Weather phenomena. The simulations are being validated according to the recommendations set forth in ICRP 137 and ICRU 84 documents. These results are very useful for the aviation community for the determination of the biological effects of the ionizing space radiation on aircrews and passengers. The application of DYASTIMA and DYASTIMA-R on other planets can provide useful insights for the radiation accumulation of space crews during missions. It is foreseen that DYASTIMA will be provided through the European Space Agency Space Situational Awareness (ESA SSA) Space Radiation Expert Service Centre (http://swe.ssa.esa.int/space-radiation) as a federated product. The Athens Cosmic Ray Group and the Athens Neutron Monitor Station (A.Ne.Mo.S.) (http://cosray.phys.uoa.gr/) participates as an expert group in the ESA SSA Programme providing many federated products and tools for the research of Space Weather effects.