

Application of the Geant4 radiation transport toolkit to space radiation effects studies

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Geant4 is a new-generation toolkit for Monte Carlo simulation, intended primarily for high-energy physics detectors. It is however projected to also satisfy the requirements of other physics fields including the study of space radiation shielding and effects. Such tools potentially provide significant benefits in the design and optimisation of future X-ray and gamma-ray instruments. This report reviews the simulation and analysis requirements for the assessment of radiation effects on spacecraft and their payloads, or the efficacy of remote-sensing techniques from space which are based on induced nuclear/X-ray emissions. The comprehensive physical processes that are currently modelled by Geant4 are reviewed, and the ESA-sponsored enhancements to the toolkit presented. The latter include the extension of lepton, hadron and ion electromagnetic interactions with materials to (250 eV using Lawrence Livermore databases (EPDL97, EEDL, and EADL), and the treatment of induced radioactive decay (e.g. following spallation interactions). Other developments include facilities to import geometries created by commercial CAD tools and associated materials definitions using a spacecraft materials database, allowing rapid specification of the geometry to be simulated.