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MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Space Environmental Effects and Spacecraft Protection (6)

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MODELLING AND LABORATORY TESTING OF RADIATION EFFECTS ON SPACE BORNE ELECTRONIC COMPONENTS

Abstract

Outer space is a hazardous environment for satellites, which are continuously exposed to harsh radiation from various sources. This radiation comes in the form of highly energetic electrically charged particles (protons, electrons, alpha particles) from solar cosmic rays, galactic cosmic rays, or trapped radiation around the Earth. Mission-critical electronic components are susceptible to several kinds of radiation-induced faults from these charged particles.

In order to ensure proper functioning of a satellite once in orbit, its electronics are carefully selected, radiation-shielded and rigorously tested prior to deployment. As part of the testing procedure, the space environment in which a given component will be flying needs to be fully understood and characterised. This involves consulting a reliable space environment model, such as the ones found in SPENVIS. However, there are various models to choose from, as well as many different input parameters that will alter the output of these models, all of which modify the characterisation of the environment, and therefore the conclusions that one can draw from the radiation tests. This project aims to use ground-based laboratory experiments to evaluate the fidelity of the environmental modelling process that is adopted when one conducts radiation hardness assurance tests for electronic components in order to obtain an accurate estimation of the error rate.

Modelled radiation values are used in relevant laboratory radiation tests at a particle accelerator (iThemba Labs) on selected electronic components. The suitability of the tested components for space use is evaluated by, inter alia, comparing test results with published proton cross-section profiles for selected or similar components. On the basis of these tests, a report on the appropriateness and correct use of relevant space radiation models will be presented, as well as notable discrepancies between the outputs from these models.