49th IAA SYMPOSIUM ON SAFETY, QUALITY AND KNOWLEDGE MANAGEMENT IN SPACE ACTIVITIES (D5)
Prediction, Measurement and Effects of space environment on space missions (3)

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ELECTRON INDUCED SEUS IN ADVANCED TECHNOLOGIES

Abstract

Embedded electronics are naturally vulnerable to the space radiation, and particularly to Single Event Effects (SEEs) induced by particles such as protons or heavy ions. These particles can trigger logic errors when they deposit ionizing energy exceeding the SEE threshold of the devices. Historically, such phenomena were observed under heavy ions beams (E.L. Petersen 1997). Those particles have ionizing stopping power (LET: Linear Energy Transfer) greater than LET threshold of the devices. But, it can also be produced in integrated technologies (65 nm or 45 nm) by direct ionization of incident protons (D. F. Heidel 2008). More recently, it has been shown that electrons can also produce this kind of phenomenon on advanced technologies. Events have been recorded following X-ray irradiation of both 28 nm and 45 nm SRAM (M. P. King 2010, 2013). The incident X-rays produce a spectrum of secondary electrons of some tens of keV capable to deposit enough energy and initiate some events (A. Samaras, 2014). Some Single Event Upsets (SEU) have also been recorded following direct irradiation with incident energetic electrons having energies of some tens of MeV [5]. In addition to direct ionization processes two other kinds of physical interaction processes can be at the origin of the observed events. Both the coulombic electron/ion and electro-nuclear interactions are able to produce recoil nuclei that are in turn capable to generate enough ionization to trigger upsets. This new phenomena has not been yet studied in detail. The ability of the electrons to produce SEUs in the latest component generations is investigated in this paper with a special focus on the potential role of electron/coulombic interaction.