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Influences of heavy ion parameters on single event effects in semiconductor devices

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Single event effects (SEEs) in semiconductor devices is a phenomenon of increase importance with the development in device technology. In this work, the SEE tests have been carried out by heavy ions from HIRFL accelerator. The Geant4 simulations have been performed to better understand the experimental results. The test strategies for new technologies of very large-scale integration are studied. The influences of heavy ion parameters on devices are investigated, systematically. The results indicate that some important parameters for SEE testing, such as ion energy, ion range, beam flux, beam angle etc. have effects on the results. The angular dependence of multiple bit upset responses in a series of SRAM devices has been performed. We observed that the differences depend on the ion species and devices. Therefore it is important to select proper test conditions to ensure the experiment performed correctly.

We have done the computational simulation of single event upset (SEU) induced by the passage of heavy ions through the device with Geant4-tool based on Monte Carlo transport code. The key parameters affecting SEU occurrence are examined, and related geometrical construction and critical charge are all quantified. The multi-functional package for SEU analysis has been successfully programmed and applied for SEU occurrence after completion of device geometrical construction, critical charge and SEU cross section calculation.

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