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Applications of Monte Carlo Radiation Transport Simulations Techniques for Predicting Single Event Effects in Microelectronics

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MRED (Monte Carlo Radiative Energy Deposition) is Vanderbilt University's Geant4 application for simulating radiation events in semiconductors. Geant4 is comprised of the best available computational physics models for the transport of radiation through matter. Geant4 is a library of c++ routines for describing radiation interaction with matter assembled by a large and diverse international collaboration. Generally, MRED is structured so that all physics relevant for radiation effects applications are available and selectable at run time.

The underlying physical mechanisms for Single Event Effect (SEE) response are: 1) ionizing radiation-induced energy deposition within the device, 2) initial electron-hole pair generation 3) the transport of the charge carriers through the semiconductor device and 4) the response of the device and circuit to the electron-hole pair distribution and subsequent transport. Each of these occur on a different time scale and they are often assumed to be sequential, i.e., energy deposition determines the initial electron-hole pair generation, which in-turn impacts device and circuit response. In this discuss the current application of MRED that are intended to address emerging technology issues as they relate to the mechanisms listed above.

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