Radiation Damage by Low Energy Neutrons with Geant4: A Review of Current Approaches and Results

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Abstract

Geant4 is a Monte Carlo based simulation toolkit utilized for the geometry and tracking of particles transport through matter. Geant4 offers variety of geometrical constructions, visualization, and multi-threading features, which are hard to find in simulating codes such as MCNP, FLUKA and FISPACTII. Evaluation of neutron radiation damage by means of Primary Knock-out Atoms (PKAs) and Displacements Per Atom (dpa) has been used to estimate damages in metals and semiconductor materials in which results have shown good agreement with experimental data. Recent evolution in Geant4 to include G4TENDL files especially with the enrichment of the Hadronic Physics List, promises improved results for low energy neutrons, making the toolkit more robust especially for simulating nuclear processes at low neutron energies (< 20 MeV) found in fission reactors. This work therefore reviews the radiation damage creation by low energy neutrons with Geant4, presenting it as a viable simulation tool for nuclear processes, considering the numerous advantages of this toolkit regarding speed, flexibility in data handling, geometry and its use of future programming languages in the simulation codes.

Keywords: Geant4, Radiation Damage, Neutron, Review.