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A new GEANT4 fission physics model for simulation of high energy neutron detection and measurements

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Nuclear fission is a subatomic physical phenomenon in which a nucleus divides into two parts, emitting several light particles and releasing substantial energy. It may occur spontaneously or be induced by incident particles, such as photons and neutrons. Neutrons in a wide energy range can be detected by exploiting nuclear fission, as neutrons may induce fission for neutron energies from thermal to high-energy regions above 20 MeV, depending on nuclides. A fission counter for neutron detection, commonly made of gas ionization counters embedded with fissile nuclides, detects incident neutrons by counting energetic fission fragments. Therefore, considering the dynamics of fission fragments and secondary particles is important in characterizing a fission counter, as the secondary particles may affect the overall detector performance. GEANT4, a simulation toolkit for the passage of particles through matter, has physics models for nuclear fission; however, none of them provides fission observables as detailed as FREYA (Fission Reaction Event Yield Algorithm) or GEF (General description of Fission process) code can describe. A new fission physics model has been developed based on the high-precision particle physics model, and it invokes evaluated nuclear data files (ENDF) and some GEF calculation results for modeling nuclear fission for fissionable and fissile nuclides under the GEANT4 framework. This presentation will introduce the newly developed GEANT4 fission model in detail.

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