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Background simulations for the SuperCDMS experiment –Efficient GEANT4 simulations using Importance Biasing

Monday 28 August 2023 15:00 (15 minutes)

SuperCDMS is a direct detection dark matter (DM) experiment currently being constructed at the SNOLAB underground laboratory in Sudbury, Canada. A complementary approach of cryogenically cooled Ge and Si crystals together with different sensor designs enables a broadband DM search for particles with masses ≤ 10 GeV/c^2.

In order to reach this sensitivity, it is crucial to understand the background composition of the measured energy spectra. For this purpose, GEANT4 based simulations are performed in which all detector, cryostat, shielding and structural components are contaminated according to their known radioactive impurities from screening measurements. The subsequent decays and particle emissions are propagated through the setup and can create energy deposits in the sensitive Ge and Si crystals. Simulations for components located far away from the detectors are very inefficient and even with an extremely high number of primary events on the order of 10^{12} the detected energy spectra are lacking in statistics which propagates into large uncertainties in the background composition.

GEANT4 offers a mechanism called Importance Biasing which can increase the amount of detector hits by orders of magnitude for the same number of primary events. This talk will present the challenges of implementing Importance Biasing in our GEANT4 application and will discuss the achieved efficiency boost of the respective background simulations.

Submitted on behalf of a Collaboration?

Yes

Author: Dr ZATSCHLER, Birgit (University of Toronto)

Presenter: Dr ZATSCHLER, Birgit (University of Toronto)

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