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New Geant4 model of channeling in crystals and its applications in modern physics

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We present the new simulation model of channeling of electrons and positrons implemented into Geant4. Geant4 [1] is a toolkit for the simulation of the passage of particles through matter. Channeling effect [2] is the effect of the penetration of charged particles through a monocrystal parallel to its atomic axes or planes. Coulomb scattering introduced in the model and based on the CRYSTALRAD [3] code makes it possible to simulate complicated trajectories of channeling electrons and positrons.

We present a Geant4 simulation example of an experimental setup including channeling physics inside and standard physics outside the crystal volume. We validate the model with the experimental data and CRYSTALRAD simulations. We discuss the following possible applications of our channeling model: beam steering, crystal-based extraction/collimation of leptons and hadrons in an accelerator, a fixed-target experiment on magnetic and electric dipole moment measurement, X-ray and gamma radiation source for radiotherapy and nuclear physics and a positron source for lepton and muon colliders.

[1] J.Allison et al., NIM A 835, 186-225 (2016).
[2] J. Lindhard, Mat. Fys. Medd. Dan. Vid. Selsk. 34 (14), 64 (1965).
[3] A. I. Sytov, V. V. Tikhomirov, and L. Bandiera, PRAB 22, 064601 (2019).

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Yes

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