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Simulation of orientational coherent effects via Geant4 (15' + 5')

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Simulation of orientational coherent effects via Geant4 Beam manipulation of high- and very-high-energy particle beams is a hot topic in accelerator physics. Coherent effects of ultra-relativistic particles in bent crystals allow the steering of particle trajectories thanks to the strong electrical field generated between atomic planes. Recently, a collimation experiment with bent crystals was carried out at the CERN-LHC [1], paving the way to the usage of such technology in current and future accelerators. Geant4 [2] is a widely used object-oriented tool-kit for the Monte Carlo simulation of the interaction of particles with matter in high-energy physics. Moreover, its areas of application include also nuclear and accelerator physics, as well as studies in medical and space science. We present the first Geant4 extension for the simulation of orientational effects in straight and bent crystals for high energy charged particles [3]. The model allows the manipulation of particle trajectories by means of straight and bent crystals and the scaling of the cross sections of hadronic and electromagnetic processes for channeled particles. Based on such a model, an extension of the Geant4 toolkit has been developed. The code and the model have been validated by comparison with published experimental data regarding the deflection efficiency via channeling and the variation of the rate of inelastic nuclear interactions.

[1] CERN Bulletin 11 November 2015, Crystals channel high-energy beams in the LHC (2015). [2] S. Agostinelli et al., Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment 506, 250 (2003). [3] Bagli, E., Asai, M., Brandt, D., Dotti, A., Guidi, V., and Wright, D. H., Eur. Phys. J. C 74, 2996 (2014).

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