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Full simulation model of crystal-based extraction from an accelerator using BDSim and Geant4 G4ChannelingFastSimModel

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Oriented bent crystal planes can deflect charged particles as strongly as a magnetic field exceeding 100 T. As a result, beam extraction from an accelerator using oriented crystals offers significant opportunities for diverse applications, ranging from beam tests for particle detector R&D to high-energy fixed-target experiments. However, designing these applications requires a universal simulation tool that accurately describes the physics of crystals, beam dynamics in an accelerator, and particle interactions with materials.
We present a new simulation model realized using the BDSIM * , built on the Geant4 toolkit ** , to simulate particle transport in accelerators and their interactions with materials. The model includes a bent crystal as a new BDSIM accelerator component, leveraging the latest Geant4 features, G4ChannelingFastSimModel *** and G4BaierKatkov, to incorporate channeling physics and radiation losses, respectively.
This model was applied to simulate the crystal-based extraction of 6 GeV electrons from the DESY II Booster Synchrotron ****. We present the calculated parameters of the extracted beam and discuss the feasibility of a proof-of-principle experiment.

Footnotes

- L.J. Nevay et al., CPC 252 107200 (2020). ** J. Allison et al., NIM A 835, 186 (2016). *** A. Sytov et al., JKPS 83, 132 (2023). **** A. Sytov, G. Kube et al. Eur. Phys. J. C 82, 197 (2022).

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