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Full simulations of beam dynamics of crystal-based extraction from the DESY II Booster Synchrotron using BDSim simulation code boosted with G4ChannelingFastSimModel

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In order to perform full simulations of crystal-based extraction from an accelerator, a combination of simulation codes for beam dynamics in an accelerator and channeling physics in crystals is required. Our solution exploits the Beam Delivery Simulation (BDSIM) [1], an extensive library that contains thick lens accelerator tracking routines and a wide variety of accelerator components and magnets. BDSIM utilizes the Geant4 toolkit [2] to simulate both the transport of particles in an accelerator and their interactions with accelerator materials. Additionally, BDSIM provides an easy way to implement new accelerator components through a user interface. We have utilized this interface to create a bent crystal as a new component and integrated Geant4 version 11.2.1, which includes the G4ChannelingFastSimModel [3], to incorporate channeling physics into this crystal.

We have developed a complete BDSIM simulation model of the DESY II Booster Synchrotron to simulate the crystal-based extraction process of 6 GeV electrons using BDSIM combined with G4ChannelingFastSimModel. We simulate the setup [4] that has already been published and compare the simulation results. We also discuss the feasibility of conducting the first proof-of-principle experiment.

- [1] L.J. Nevay et al., CPC 252 107200 (2020).
- [2] J. Allison et al., Nucl. Instrum. Meth. A 835, 186-225 (2016).
- [3] A. Sytov et al., JKPS 83, 132–139 (2023).
- [4] A. Sytov, G. Kube et al. Eur. Phys. J. C 82, 197 (2022).

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