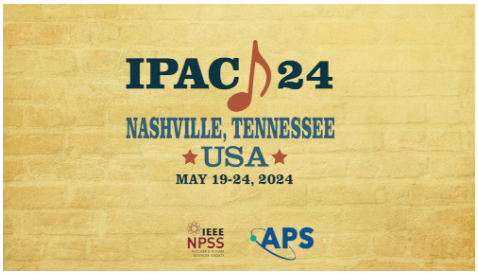

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Differentiable modeling of Siberian Snakes in BNL's AGS: nonlinear maps, symplectic tracking, and optical compensation

Sunday, 19 May 2024 16:00 (2 hours)

Meaningful prediction and enhancement of spin-polarization in the RHIC and EIC accelerators relies on accurate modeling of each sub-component. While nonlinear beam propagation and symplectic tracking is well established for common accelerator components, it has hitherto not been established for Siberian Snakes, which are essential for the acceleration of polarized protons in storage rings. Here we describe the first differentiable model, applied to both snakes of the AGS, which injects polarized beam into RHIC and the HSR of the EIC. This enables the full power of nonlinear maps to be applied to the AGS, including normal form theory and symplectic tracking. We show how important this is for long-term beam motion in the AGS: without the symplectic representations, simulated particle motion destabilizes during about 1000 turns spent close to injection energy. Including the new snake representations, the Bmad toolkit was used to optimize the closed orbit and the optics between injection and extraction, including corrections to the coupling and to the vertical dispersion that the snakes currently create. Finally, we use simulation results to compare randomly generated lattice misalignments with surveying data measurements.

Footnotes

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