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Symplecticity of the BeamBeam Element in Bmad

Wednesday 4 June 2025 16:00 (2 hours)

The Bmad library can model a wide range of beam dynamics effects, including the weak-strong beam-beam effect for the interaction of 6D beam distributions. The weak-strong approximation assumes that only the weak beam becomes non-Gaussian, due to single particle dynamics. This is complicated by significant variation in the strong beam along the IP due to beta functions and crabbing angle. First, each particle of the weak beam is then drifted to the center of the IP without interaction. To include previously mentioned variations of beam parameters, Bmad splits the strong beam axially into N slices of equal charge, each with Gaussian properties. Each weak particle is then sequentially drifted to and kicked by each slice, transversely and longitudinally, before finally being drifted back to the IP. As for any map of a Hamiltonian system, it is important that our numerical method preserves symplecticity. A concern comes from the observation that the collision point with each slice has significant dependence on the incoming angle and position of the weak particle. The goal of this paper is to prove that Bmad's method for the beam-beam interaction preserves the map's symplecticity.

Footnotes

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