

Spin decoherence in electron storage rings with Siberian Snakes

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Abstract

Although Siberian Snakes are essential for preserving proton spin polarization during acceleration to high energy and can help to stabilize spin motion at the top energy, snakes can be inappropriate for high energy electron storage rings, where the beam self-polarizes via the Sokolov–Ternov effect or where a prepolarized beam is injected at the full energy, and where, in both cases, synchrotron radiation leads to depolarization. For example, snakes can, in effect, “switch off” the Sokolov–Ternov effect and at high energy a single snake, installed to constrain the equilibrium polarization direction to the machine plane can lead to a prohibitive increase in depolarization.

The latter point will be demonstrated with a simple, exactly solvable model of spin diffusion and the result will be compared with that from the standard Derbenev–Kondratenko–Mane (DKM) calculation based on an exact expression for the invariant spin field. The model is a useful pedagogical tool for demonstrating the meaning and limitations of the DKM approach.

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