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Proton polarization in RHIC with partial Siberian Snakes

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In December 2021, damage to RHIC helical magnets forced one of two Siberian Snakes in the Blue ring to operate as a partial Siberian Snake and with a different snake axis of rotation. Quite surprisingly, the time-averaged polarization for that run actually ended higher than in the Yellow ring, after casting the undamaged snake as a partial snake as well to optimize polarization parameters. In this work, we simulate polarization transmission through a series of increasingly realistic models of the Blue ring in the “dangerous region” of polarization loss. At first the bare lattice has a perfect closed-orbit and ideal magnet strengths. Then the measured magnet-to-magnet field strength variations were added to the lattice. Finally, the six Interaction Region 5 mm closed-orbit bumps were implemented. Each of these model lattices compared the use of a pair of partial snakes against a pair of a full snakes. In simulations with realistic emittances, realistic polarization losses were only reproducible with nonzero RMS lattice misalignments. Even in the most realistic models, a clearly verifiable reason for better performance of partial snakes in RHIC could not be established. It therefore is reasonable to continue HSR designs with full Siberian Snakes. Using the realistic RHIC model with misalignments, we show scans for maximum polarization transmission over a set of allowed snake axes, known as snake matching, to demonstrate benefits of this technique for the HSR design.

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