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Spin Transparency Mode in JLEIC

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An Electron-Ion Collider (EIC) is proposed as the first lepton-hadron collider in the world with both beams polarized. The nuclear physics program requires high polarizations, long polarization lifetimes, and unique capabilities of polarization control in both collider rings. The electron polarization must be longitudinal at the interaction points in the whole energy range of 3 to 10 GeV while the light ion polarization must be adjustable to transverse and longitudinal directions in the whole energy range of up to 100 GeV. The figure-8 configuration of the collider rings allows for control of the electron and ion polarizations in a spin transparency mode. In this mode, when a particle is moving along the closed orbit in an ideal collider lattice, any spin direction repeats every turn. The spin tune is energy independent and is equal to zero. To stabilize the beam polarization, it is sufficient to use weak solenoids with small field integrals. A universal scheme for control of the polarization using weak solenoids provides an elegant solution to the problem of ion acceleration completely eliminating resonant beam depolarization. It allows one to easily adjust the polarization of any ion species (including deuterons) in any direction at any orbital location, which becomes necessary when transferring the beam from one ring into another or when measuring the polarization by polarimeters. It also allows for an easy manipulation of the spin direction at an interaction point during an experiment. The latter feature allows one to set up a stable spin-flipping system with a spin reversal time of less than a second. This presentation discusses the option of increasing the maximum ion energy to 200 GeV in the existing collider lattice. In the original design, the electron ring is flat and the doglegs for stacking the electron and ion arcs are placed in the ion ring and occupy about 200 m of the experimental straights. Since the ion energy is an order of magnitude greater than the electron one, the doglegs in the ion ring require significantly higher field integrals and better element setup and alignment accuracy to maintain the beam collision mode. This talk also presents an optimized design of the electron spin rotator, which combines the functions of a dogleg and a universal spin rotator that allows one to save space both in the electron and ion collider rings.

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