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Nonlinear coupling resonances in the EIC electron storage ring

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The 18 GeV Electron Storage Ring (ESR) lattice of the Electron-Ion Collider (EIC) showed various undesirable effects in nonlinear Monte Carlo tracking, including a vertical core emittance exceeding radiation-integral predictions and a low asymptotic polarization. These problems were resolved in a newer lattice where dispersion in the solenoidal spin rotators was set to zero. Here we identify the cause of the effects as a 2nd order synchro-beta resonance which is driven by vertical dispersion in the quadrupoles of the rotators. The 5 and 10 GeV ESR lattices have small but nonzero dispersion in the rotators, and misalignments in the 18 GeV case will inevitably create some dispersion, so care must be taken that this 2nd order resonance is not excited. Zero dispersion in the spin rotators may therefore not be the best solution, and a new working point is sought that is not close to this resonance. The implications of this result on the design of the ESR –including achieving a longitudinal spin match –are explored.

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Footnotes

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Primary author: SIGNORELLI, Matthew (Cornell University (CLASSE))

Co-authors: SAGAN, David (Cornell University (CLASSE)); HOFFSTAETTER, Georg (Cornell University (CLASSE))

Presenter: SIGNORELLI, Matthew (Cornell University (CLASSE))

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