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Eddy current shielding of the magnetic field ripple in the EIC electron storage ring vacuum chambers

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The EIC electron storage ring has very tight tolerances for the amplitude of electron beam position and size oscillations at the interaction point. The oscillations at the proton betatron frequency and its harmonics are the most dangerous because they could lead to unacceptable proton emittance growth from the oscillating beam-beam kick from the electrons. To estimate the amplitude of these oscillations coming from the magnet power supply current ripple we need to accurately account for the eddy current shielding by the copper vacuum chamber with 4-mm thick wall. At the frequencies of interest, the skin depth is a small fraction of the wall thickness, so the commonly used single-pole expressions for eddy current shielding transfer function do not apply. In this paper we present new (to the best of our knowledge) analytical formulas that adequately describe the shielding for this frequency range and chamber geometry and discuss the implications for the power supply ripple specifications at high frequency.

Footnotes

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Primary author: PODOBEDOV, Boris (Brookhaven National Laboratory)

Co-authors: WITTE, Holger (Brookhaven National Laboratory); BLASKIEWICZ, Michael (Brookhaven National Laboratory)

Presenter: PODOBEDOV, Boris (Brookhaven National Laboratory)

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