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Optimization of the Korea-4GSR storage ring for increasing the off-momentum dynamic aperture by analyzing resonance driving terms

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The Korea-4GSR is a next-generation diffraction-limited light source designed to provide beam brightness up to 100 times greater than existing facilities. Chromatic aberrations from strong focusing fields in quadrupoles are corrected using sextupoles and octupoles. However, these sextupoles and octupoles introduce nonlinear effects, causing electrons to follow nonlinear trajectories, ultimately reducing beam lifetime. Consequently, these nonlinear elements negatively impact both the dynamic aperture and local momentum aperture. The limitations on local momentum aperture are primarily due to transverse nonlinear dynamics. Recent studies have shown that minimizing one-turn resonance driving terms, reducing their fluctuations, or controlling amplitude-dependent tune shifts (ADTS) can enhance both dynamic aperture and local momentum aperture in various storage ring configurations, including DBA, MBA, and hybrid-MBA lattices. Therefore, we aim to optimize resonance driving terms using a Multi-Objective Genetic Algorithm (MOGA) to expand on- and off-momentum dynamic apertures and improve beam lifetime by increasing local momentum aperture for the Korea-4GSR.

Footnotes

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