

Space-charge Simulation of Integrable Rapid Cycling Synchrotron

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Integrable optics is an innovation in particle accelerator design that enables strong nonlinear focusing without generating parametric resonances. We consider an integrable Rapid-Cycling Synchrotron (iRCS) design for a hypothetical replacement of the Fermilab Booster. We show this iRCS is compatible with other modern features of RCS design, including long dispersion-free drifts, six-fold periodicity, acceleration without transition crossing, and chromaticity with harmonically canceling sextupoles. We use Synergia to perform high-intensity space-charge simulations of this highly nonlinear lattice and demonstrate beam stability with large betatron tune spreads. Experimental tests of the efficacy of integrable optics in controlling high-intensity beams will take place over the next several years at the Fermilab Integrable Optics Test Accelerator (IOTA) and the University of Maryland Electron Ring (UMER).

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