

Enhanced Slip-Stacking Techniques for Particle Accelerators: Analytical, Numerical, and Experimental Investigation

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Particle accelerators employ slip-stacking configurations to store two particle beams with disparate momenta within a single ring. Additionally, A novel slip-stacking configuration employing a harmonic RF cavity was proposed and studied. Anticipated benefits of the harmonic cavity include mitigating parametric resonances, minimizing emittance growth, and significantly expanding the stable longitudinal phase-space area. By surpassing the requirements of PIP-II operation, the harmonic RF cavity will support extending slip-stacking operation for subsequent beam power upgrades of Main Injector, including a proposed cycle rate improvement. Our ongoing research will verify the simulation of harmonic slip-stacking (HSS) operation under RF phase-errors, such as those causes by beam-loading effects.

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