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Experimental longitudinal emittance manipulation using laser-based photoionization in the Fermilab Linac

Sunday 25 August 2024 16:00 (2 hours)

A series of simulations and beam studies were conducted at Fermilab's linear accelerator to evaluate the effectiveness of longitudinal emittance control via laser-induced photoionization. While similar laser techniques have been employed at Fermilab to enhance injection and extraction efficiency into the Booster, the work presented here focuses on extending these methods to bunch-by-bunch manipulation. This approach utilizes fine-scale correction of the H- bunches'longitudinal spatial distribution. In theory, loosely confined particles in longitudinal phase space contribute to emittance growth during acceleration. By selectively removing these outlying particles through laser scraping (H- + $\gamma \longrightarrow$ H + e-), this growth can be reduced. This report presents experimental results from both symmetric and asymmetric longitudinal scraping of H^- bunches in the Fermilab linac, which were subsequently injected into Booster, and evaluates the broader applicability of this method for future high-intensity accelerator operations.

Footnotes

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