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Generation of arbitrary bunch shapes using a multileaf collimator and emittance exchange

Wednesday, 24 July 2024 12:00 (30 minutes)

Precision shaping of the phase space of beams is essential for advanced acceleration methods, such as enhancement of the transformer ratio in beam driven wakefield concepts. We have experimentally demonstrated a method to generate arbitrary bunch profiles, with high precision, in a rapid, "on-demand" manner. The approach is based on a multileaf collimator (MLC) with independently actuated tungsten strips which selectively scatter unwanted particles to create high-fidelity transverse beam distributions. In conjunction with an emittance exchange beamline (EEX) at the Argonne Wakefield Accelerator, the MLC-generated transverse profiles are transformed into longitudinal bunch profiles that are highly variable, including ramped profiles with adjustable features. Enabled by novel features such as magnetically coupled actuation without lubricants, this MLC operates in ultrahigh vacuum environments. Engineering improvements of the MLC, based on a stack of shaped rotors, will also be introduced, in addition to an algorithm for mask setting. The many degrees of freedom of the MLC enable the optimization of experimental figures of merit using feed-forward control and advanced machine learning techniques.

Working group

invited speaker

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