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Experimental Generation of PWFA-suitable Bunch Current Profiles by Arc-like Bunch Compressors

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Linear accelerators supplying beam-driven plasma-wakefield accelerators (PWFAs) often use chicane bunch compressors to generate the required bunch currents. Higher-harmonic radio-frequency (RF) cavities are typically employed to produce these current profiles, and the parameter range of the RF system might limit the current shaping capabilities. In contrast, arc-like bunch compressors, such as those employed in the MAX IV linac, naturally produce peaked current profiles via passive linearization, not requiring harmonic cavities. The PWFA-relevant capabilities of the linac have previously been investigated theoretically in simulations and experimentally inferred from energy spectra. This work demonstrates the generation of PWFA-suitable ramped current profiles at the MAX IV linac, measured with the recently commissioned transverse deflecting structure. Linearly up-/down-ramped current profiles can enable local flattening of the longitudinal (accelerating) electric field, providing uniform de-/acceleration of the driver and witness, respectively, benefiting final energy spread, gain, and efficiency. These results suggest high suitability of arc-like bunch compressors for future PWFA drivers.

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