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Probing Ion-motion Recovery in a Beam-driven Plasma-wakefield Accelerator

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Beam-driven plasma-wakefield acceleration is a promising avenue for the future design of compact linear accelerators with applications in high-energy physics and photon science. Meeting the luminosity and brilliance demands of current users requires the delivery of thousands of bunches per second –many orders of magnitude beyond the current state-of-the-art of plasma-wakefield accelerators, which typically operate at the Hz-level. As recently explored at FLASHForward, a fundamental limitation for the highest repetition rate is the long-term motion of ions that follows the dissipation of the driven wakefield (R. D'Arcy, et al. Nature 603, 58–62 (2022)). Studying the dynamics of plasma recovery in greater detail is an essential first step in advancing beam-driven plasma-wakefield acceleration towards meaningful application in future high-energy-physics and photon-science facilities. Here we present the measurement methodology, the data processing, and discuss latest experimental results.

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