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Plasma Density Evolution Background to the Ion-motion Recovery in a Beam-driven Plasma-wakefield Accelerator — •Judita Beinortaite[1,2], Jonas Björklund Svensson[1], James Chappell[3], Matthew James Garland[1], Harry Jones[1], Carl A. Lindstrøm[1], Gregor Loisch[1], Felipe Peña[1,4], Sarah Schröder[1], Stephan Wesch[1], Matthew Wing[2], Jens Osterhoff[1], and Richard D'Arcy[1] — [1]Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany — [2]University College London, London, UK — [3]University of Oxford, Oxford, UK — [4]Universität Hamburg, Hamburg, Germany

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)). The duration of this ion motion could vary with the mass of the plasma ions, thus significantly decreasing in lighter gas species. To observe this, the understanding of the background processes, such as microsecond-level plasma density evolution of different gases in a capillary, is needed. Here we present the first steps of exploring this plasma evolution.

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