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Positron transport and acceleration in beam-driven plasma wakefield accelerators using a plasma column

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The transport and acceleration of positron beams is a crucial challenge on the path towards plasma-based particle colliders. We propose a scheme that allows for the simultaneous acceleration and transport of positron beams in plasma wakefield accelerators. A finite-radius plasma column is employed, leading to a reduction of the restoring force acting upon the plasma electrons forming the plasma wake, which results in an elongation of the on-axis return point of the electrons and, hence, creating a long, high-density electron filament. As demonstrated by means of 3D PIC simulations, this filament induces the formation of a wakefield region that enables the acceleration and quality-preserving transport of 100 pC-scale positron beams for a range of plasma densities and drive beam parameters.

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