

# Beam-Driven Plasma Acceleration with Density Downramp Injection at FLASH

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Plasma acceleration exploits extreme electric fields ( $>10$  GV/m) created in a plasma by high-current beams or high-intensity laser pulses, to accelerate charged particles. One of the most important aspects of making plasma acceleration a realistic technology for a wide range of applications is understanding and controlling the process of injecting particles into the plasma wake. Accurate adjustment of injection mechanism allows for high degree of control over phase-space and the overall quality of injected beam. In current studies we explore the possibility of injecting particles into a beam-driven wake by using transitions in plasma density. The parameters of the driver beam and the plasma correspond to the current design for plasma acceleration experiments planned at the FLASH facility at DESY. Studies were performed by means of 3D particle-in-cell simulations with the code OSIRIS. It was shown that the density downramp injection allows for trapping and acceleration of electron beams, with final low emittance and low slice energy spread. Various parameter scans were performed, investigating sensitivity of the injected beam qualities, such its as length, charge, energy spread, and correlations in phase-spaces, to initial parameters of the driver and the plasma ramp.

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