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Controlled injection of plasma electrons into a laser-driven wakefield using a variable lenght gas target

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Plasma wakefields can support very high field gradients (~ 100 GV/m) which makes particle acceleration to ultra-relativistic energies possible within a few millimeters. Precise control over the electron bunch phasespace during the process of injection into the accelerating wakefield is needed for the production of high-quality electron beams. Shaping of the longitudinal plasma-density profile, e.g. through the use of downramps, has been proposed as a possible controlled injection mechanism [1,2, e.g.].
In this report the study of density down-ramp injection into a plasma wakefield using gas target of variable length is presented.
Suitable target density profiles, with a short down ramp length, preceded by a high-density peak are of crucial importance. The target is a gas cell with variable length of peak and plateau regions and was operated with a helium.
The goals and first preliminary results of the experiment are presented, including hydrodynamic simulations of the tailored target, performed using OpenFOAM.
[1] S. Bulanov et al., Phys. Rev. E 58, R5257 (1998)
[2] H. Suk et al., Phys. Rev. Lett. 86, 1011–1014 (2001)

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