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Plasma formation via electron-beam driver ionization at SLAC FACET-II

Wednesday, 24 September 2025 19:00 (1h 30m)

Electron-driven plasma wakefield accelerators offer an advantageous environment for realizing advanced ionization-injection schemes, such as “Trojan Horse” plasma photocathodes [1]. Plasma photocathodes utilize a synchronized laser pulse to release electrons from a dopant species directly inside the wake structure. In comparison to laser drivers, the substantially lower peak electric field of electron drivers facilitates the retention of a dopant species that can, in turn, be accessed for injection already with comparatively low-power laser pulses. Plasma photocathodes therefore promise to generate ultra-cold electron beams with emittances on the order of ~ 10 nm-rad.

The “E310: Trojan Horse-II” experiment at the Facility for Advanced Accelerator Experimental Tests II (FACET-II) at SLAC National Accelerator Laboratory utilizes a 10 GeV electron driver and employs a gas mixture of hydrogen and helium. The hydrogen component can either be pre-ionized by a dedicated laser pulse or self-ionized by the FACET drive beam, however, ideally without compromising the helium dopant reservoir for selective ionization injection.

We present results from first systematic ionization tests in the context of the E310 experiment and discuss the employed experimental methods. An overview of the E310 program is given in a talk.

[1] A. F. Habib et al. “Plasma Photocathodes”. Ann. Phys. 2023

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