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Injection dynamics in hybrid LWFA-PWFA plasma photocathodes

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Plasma photocathodes, also known as Trojan Horse injectors, utilise a comparatively low-intensity laser pulse to ionise and release electrons at defined locations directly inside a plasma wakefield. Provided a sufficiently strong wakefield, these electrons are initially compressed, trapped and subsequently accelerated. The trapped bunch characteristics are thereby largely determined by the initial electron release locations, which are in turn defined and tunable via the injector laser parameters, its position and delay with respect to the wake, as well as the injector geometry. Trojan Horse scenarios, typically realised in particle-driven plasma wakefield accelerators (PWFAs), promise to deliver electron beams with exceptionally high (slice) brightness. High peak-current electron drivers generating wakefields with adequate plasma photocathode trapping conditions can be provided by laser-driven wakefield accelerators (LWFAs) in a compact setup. Such hybrid LWFA-PWFA plasma photocathodes offer unique operating modes at high plasma densities. Based on simulations, aspects of plasma photocathode injection dynamics under different injector geometries and their implementation in hybrid LWFA-PWFA scenarios are discussed.

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