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Stability of high-brightness electron beam foci for precision coupling to small aperture structures using different LPA injection mechanisms

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Laser plasma accelerator (LPA) electron beams need to be controllably transported and focused for applications requiring coupling of high-brightness charge beams into small apertured structures, such as free-electron lasers (FEL) or high-gradient wakefield structures. A critical challenge faced by LPAs is the intrinsic shot-to-shot fluctuations in generated electron beam pointing, transverse position, and emittance, and coupling the energy-spread beams into a chromatic transport line. The BELLA Center's HTU beamline supports variable LPA injection mechanisms and boasts an advanced beam transport system capable of precision energy filtering and controlled electron delivery to a high-brightness focus. Here we present a study of electron beam stability at a downstream focus using variable electron energy filtering and two injection mechanisms: ionization injection and shock-induced down-ramp injection. Furthermore, we discuss a scheme for precision coupling of LPA beams into small aperture structures.

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