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Generation of a spectrally two-component electron beam in a laser-wakefield accelerator

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A new take on ionization-assisted shock-front injection was used to create spectrally two-component beams in a laser-wakefield accelerator, with the goal of investigating the possibilities for such an injection scheme for beam-driven plasma-wakefield acceleration. Ionization injection was combined with shock-front injection to provide characteristic spectra with a broadband, continuous part from the ionization injection and a quasi-monoenergetic, spectrally separated peak at higher energies from the shock-front injection. This beam was subsequently sent into a second gas jet, which was pre-ionized by the laser pulse. As a result, electron beam divergence increase and deceleration was observed in the ionization-component and transverse focusing was observed for the shock-component. Under certain circumstances, an energy increase was also observed for the shock-component. These interactions were also typically accompanied by very collimated betatron X-ray beams with divergences of only a few mrad RMS, which suggests emission from an oscillation with a corresponding undulator K -parameter on the order of 1.

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