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A fully plasma based electron injector for a linear collider or XFEL

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We demonstrate through high-fidelity particle-in-cell simulations a simple approach for efficiently generating 20+ GeV electron beams with the necessary charge, energy spread, and emittance for use as the injector for an electron arm of a future linear collider or a next generation XFEL. The self-focusing of an unmatched, relatively low quality, drive beam results in self-injection by elongating the wakefield excited in the nonlinear blowout regime. Over pump depletion distances, the drive beam dynamics and self-loading from the injected beam leads to extremely high quality and high energy output beams.For plasma densities of 10^18 cm-3, PIC simulation results indicate that self-injected beams with 0.52 nC of charge can be accelerated to ~20 GeV energies with projected energy spreads < 1% within the beam core, slice normalized emittances as low as 110 nm, peak normalized brightnesses > 10^19 A/m^2/rad^2, and energy transfer efficiencies of >54%.

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Working group

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