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Controlled injection and multi-GeV LWFA stages for laser wakefield applications C.G.R. GEDDES, E. CORMIER-MICHEL, E. ESAREY, A.J. GONSALVES, D. PANASENKO, G.R. PLATEAU, K. NAKAMURA, C.B. SCHROEDER, CS. TOTH, W.P. LEEMANS, LBNL, D.L. BRUHWILER, B. COWAN, K. PAUL, P. MULLOWNEY, Tech-X, J.R. CARY, Tech-X & U. Colorado — Collider and light source applications of LWFAs will require staging of controlled injection with multi-GeV accelerator modules, which must be optimized for efficient acceleration of both electrons and positrons with minimum emittance degradation. As an injector, control of particle trapping in a laser wakefield accelerator using plasma density gradients experimentally produced stable electron bunches with 0.17 MeV/c FWHM momentum spread and central momenta stable at 0.76 +- 0.2 MeV/c, and with repeatable charge and pointing. Simulations further show that the short bunch length and observed high laser transmission allow the bunches to be post accelerated if the jet is followed by a long uniform plasma, and indicate that this produces beams with 0.2 MeV/c class momentum spread at high energies. Analytic scalings together with simulations have then been used to evaluate stage designs for upcoming PW-class experiments, and for eventual collider modules. These include linear and nonlinear wake structures, laser pulse and plasma density shaping, and beam loading. Results of stage optimization and tools for accurately modeling emittance will be discussed.

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