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Simulation of 1 GeV laser wakefield accelerator experiments and scaling to 10 GeV[1] ESTELLE CORMIER-MICHEL, C.G.R. GEDDES, W.A. ISAACS, N. STINUS, E. ESAREY, C.B. SCHROEDER, W.P. LEEMANS, LBNL, D.L. BRUHWILER, J.R. CARY, Tech-X — Recent laser-plasma accelerator experiments at LBNL have demonstrated the production of high quality 0.5 and 1.0 GeV electron beams.[2] In these experiments, the 10-40 TW laser pulse was guided in a 3 cm long capillary discharge plasma channel. Particle-In-Cell (PIC) simulations provide information not accessible from experiments on the nonlinear laser-plasma interaction that governs the accelerator internal dynamics. Simulations show that high quality electron bunches are formed by self-trapping of electrons in the wake, followed by loading of the wake by the trapped bunch, creating a bunch of electrons isolated in phase space. A narrow energy spread beam is then obtained by extracting the bunch as it outran the accelerating phase of the wake. Simulations in 2D and 3D showing details on the electron bunch, wakefield, and laser evolution are presented and compared to experimental results. Simulations on scaling these experiments to the 10 GeV level are also presented.

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[2]W.P. Leemans et al., Nature Physics 2, 696 (2006)

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