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Generating high quality ultra-relativistic electrons beams using an evolving electron beam driver[1] THAMINE DALICHAOUCH, University of California, Los Angeles, XINLU XU, Stanford Linear Accelerator Center, FEI LI, ADAM TABLEMAN, FRANK TSUNG, WEIMING AN, WARREN MORI, University of California, Los Angeles — In recent years, Plasma-Based Acceleration (PBA) has attracted a lot of interest in applications involving compact next generation linear colliders and x-ray free-electron-lasers (XFEL). To date, the most promising methods to produce high quality relativistic electron bunches for such applications involve injection triggered by plasma density down ramp or electron ionization. However, numerous challenges remain for the optimization and reproducibility of these methods since they typically require sharp plasma density gradients and multiple drivers to produce high brightness electron beams. In this talk, we propose and demonstrate a new method of controllable injection using a single electron drive bunch to control the wake phase velocity and induce electron trapping in a constant background density plasma. In this scheme, electron injection is determined by the Courant-Snyder parameters and the peak normalized charge per unit length. Injection is demonstrated in two different regimes where the driver vacuum propagation and plasma focusing effects are dominant. Using this approach, Particle-in-cell (PIC) simulations indicate that peak normalized brightnesses of $10^{21} A/m^2/rad^2$ can be achieved with projected energy spreads of 1% and normalized emittances of 5 nm.

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