DPP17-2017-000068

Abstract for an Invited Paper
for the DPP17 Meeting of
the American Physical Society

Experimental realization of underdense plasma photocathode wakefield acceleration at FACET.

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Novel electron beam sources from compact plasma accelerator concepts currently mature into the driving technology for next generation high-energy physics and light source facilities. Particularly electron beams of ultra-high brightness could pave the way for major advances for both scientific and commercial applications, but their generation remains tremendously challenging. The presentation outlines the experimental demonstration of the world's first bright electron beam source from spatiotemporally synchronized laser pulses [1] injecting electrons into particle-driven plasma wakefields at FACET. Two distinctive types of operation - laser-triggered density downramp injection ("Plasma Torch") and underdense plasma photocathode acceleration ("Trojan Horse") [2] – and their intermediate transitions are characterized and contrasted. Extensive particle-in-cell simulations substantiate the presentation of experimental results. In combination with novel techniques to minimize the beam energy spread [3], the acceleration scheme presented here promises ultra-high beam quality and brightness.
[1] A. Knetsch, P. Scherkl, T. Heinemann, et al., to be submitted [2] A. Deng, O. Karger, P. Scherkl, et al., to be submitted [3] G. G. Manahan, A.F. Habib, P. Scherkl, et al. Single-stage plasma-based correlated energy spread compensation for ultrahigh 6D brightness electron beams. Nat. Comm.8:15705, Jun 2017