Abstract Submitted
for the APR21 Meeting of
The American Physical Society

Plasma Wakefield Accelerators with Ion Motion and the E-314 Experiment at FACET-II[1] CLAIRE HANSEL, University of California Los Angeles, MONIKA YADAV, University of Liverpool, WEIMING AN, PRATIK MANWANI, WARREN MORI, JAMES ROSENZWEIG, University of California Los Angeles — A future plasma based linear collider has the potential to reach unprecedented energies and transform our understanding of high energy physics. The extremely high brightness beams in such a device would cause the plasma ions to collapse into the beam volume forming a beam-ion quasi-equilibrium. This quasi-equilibrium is characterized by a thin dense ion column inside of the beam. Using a combination of Particle-in-Cell (PIC) simulations and analytical work we investigated the rich physics of the beam-ion interaction. We derived analytical expressions for the equilibrium beam and ion density profiles. We studied beam matching in order to mitigate emittance growth due to the strong nonlinear focusing fields. We developed a 2D symplectic tracking code with Monte Carlo scattering based on Moliere's theory of small angle multiple scattering in order to quantify emittance growth due to scattering and chaotic diffusion. The planned E-314 experiment at the FACET-II facility at SLAC National Accelerator Laboratory aims to demonstrate ion motion experimentally. Work is ongoing at UCLA to develop beam radiation diagnostics and focusing optics for E-314.

[1]DOE DE-SC0009914, STFC ST/P006752/1, NSF PHY-1549132

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Date submitted: 08 Jan 2021 Electronic form version 1.4