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Electron trapping in a plasma wake field accelerator by an ultra relativistic electron beam in the presence of ionization ERDEM PZ, University of Southern California, USC COLLABORATION, UCLA COLLABORATION, SLAC COLLABORATION — An ultra relativistic (28.5 GeV) ultra short (∼30 fs) electron beam produced at the Stanford linear accelerator center creates a plasma wave with very large accelerating gradients (>30 GeV/m). Although 1D theories of wave breaking for highly relativistic waves predict that the wave breaking and trapping would require fields on the order of TV/m, we observed self trapped plasma electrons. We also observed a clear onset for the particle trapping which was done by controlling the plasma wave amplitude by controlling the drive bunch length. We attribute this lower trapping threshold to effect of self ionizing plasma which causes electrons to be born in a more favorable place inside the wake for trapping. The trapping occurs in the boundary regions of a lithium column confined by a helium gas. the Lithium electrons support the wake however, the higher ionization potential Helium electrons are born inside the wake in the transition region the measured trapping threshold of 32 GV/m is in excellent agreement with predictions of an analytical model and detailed PIC code simulations of the experiment. Other optical diagnostics supported by PIC simulations showed that the trapped electrons reach multi GeV energies, are produced in multiple buckets and has ultra short features (∼2fs) emitting visible coherent light.

Erdem Pz
University of Southern California

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