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Electron Injection and Acceleration with Petawatt Laser Driven Wakefield Accelerator in 10^{17}cm^{-3} Plasma X. WANG, R. ZGADZAJ, W. HENDERSON, S.A. YI, S. KALMYKOV, V. KHUDIK, P. DONG, N. FAZEL, R. KORZEKWA, Y.-Y. CHANG, H.-E. TSAI, G. DYER, E. GAUL, M. MARTINEZ, M. DONOVAN, A. BERNSTEIN, G. SHVETS, T. DITMIRE, M.C. DOWNER, Dept of Physics UT Austin — Here we report observation of self-injected laser-plasma acceleration of electrons up to $\sim$ 350 MeV in a tenuous plasma ($\sim 10^{17}$ cm^{-3}) driven by the Texas Petawatt laser (TPL). The generated electron beam contains a charge of over 30 pC, and is well collimated (< 10 mrad divergence). Electrons generated by TPL are not quasi monoenergetic and do not reach GeV level. This is likely due to imperfect PW laser quality. Simulations have shown that, driven by a high-Strehl-ratio TPL pulse, the laser plasma accelerator (LPA) can self-inject electrons and accelerate them to 3 GeV in such a tenuous plasma. The continuous electron energy spectrum also indicates that electron injection into plasma structure is continuous. Nevertheless, the observation of efficient self-injection at such low plasma density is a promising first step toward achieving multi-GeV LPAs in tenuous plasma. Simulations show that mild nonlinear plasma waves ($a_0 \sim 1$) are generated and a trapped electron can be accelerated up to $\sim$350MeV in this 5cm long tenuous plasma. Possible electron injection mechanisms are also discussed.

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