Electron injection by colliding laser pulses in plasmas

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The LBNL l'OASIS Group is pursuing electron acceleration in plasma with colliding pulse injection (CPI) [E. Esarey et al., Phys. Plasmas 6, 2262 (1999)]. In CPI, an intense pump pulse (duration equal to the plasma period) excites a large amplitude plasma wakefield. Two counter-propagating injection pulses collide some distance behind the pump pulse and generate a beat wave with a slow phase velocity. This slow beat wave can trap plasma electrons and inject them into the fast wake for acceleration to high energy. This results in an ultrashort bunch (few fs) with a small energy spread (few percent). The initial set of LBNL experiments using a 10 TW, 40 fs laser system (upgrade to 100 TW underway) will rely on two laser pulses: a pump pulse to excite the wake and a single backward injection pulse. Injection results from the slow beat wave produced by the backward pulse colliding with the pump pulse. Simulations of CPI will be presented using particle codes that include the effects of finite crossing angles, equal pulse frequencies, and density gradients. Preliminary experimental data will also be presented.

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