Abstract for an Invited Paper
for the DPP05 Meeting of
The American Physical Society

Plasma Wakefield Acceleration at SLAC: Results of the E-167 Experiment[1]

RASMUS ISCHEBECK, Stanford Linear Accelerator Center

Plasma wakefield accelerators are emerging as one of the most promising schemes for future accelerators. Beam-driven plasma wakefield acceleration experiments are carried out in the FFTB beamline at SLAC. The sub-picosecond ultra-relativistic electron bunches field-ionize the lithium vapor. With a plasma density matched to the bunch length, an acceleration of more than one GeV in 10cm of plasma has been observed. A plasma wake can trap electrons and ions out of the plasma, accelerating them to relativistic energies. In previous experiments, signals that could be explained by trapped particles have been noticed. Therefore, we have set up time-resolved devices after the plasma. The bunch length of the trapped particles could be extremely short, and the present setup includes diagnostics to detect coherent emission of radiation at optical wavelengths. Furthermore, the energy gain appears to oscillate as a function of the length of the plasma channel. A lithium oven with a length that can be varied up to 30cm has been set up. After such a distance, numerical models predict that an incoming tilt in the electron beam could be amplified and a transverse instability could develop, leading to the break-up of the beam. In addition, we investigate the possibility to use the high flux of betatron/synchrotron X-Rays emitted in the plasma to create electron-positron pairs. Finally, we are making first steps towards a scheme where one bunch drives the plasma wake and a following bunch samples the accelerating field. To achieve this, a bunch from the SLC accelerator is split horizontally by a notch collimator. Due to an inherent position-time dependence of the particles, a twin bunch is created. In the long run, this concept presents a way to achieve mono-energetic particle bunches.

[1]Work supported by Department of Energy contracts DE-AC02-76SF00515 (SLAC), DE-FG03-92ER40745, DE-FG03-98DP00211, DE-FG03-92ER40727, DE-AC-0376SF0098, and National Science Foundation grants No. ECS-9632735, DMS-9722121 and PHY-0078715.