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Recent Progress on Plasma-Based Accelerators[1]

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The physics, research status, and challenges of plasma-based accelerators will be discussed. In 2004, three groups reported the production of high quality electron bunches from laser plasma accelerators in the 100 MeV range with narrow divergence and narrow energy spread [S.P.D. Mangles et al.; C.G.R. Geddes et al.; and J. Faure et al.; Nature, Sep 2004]. These results were obtained using multi-ten TW lasers interacting with few-mm diameter gas jet targets. High quality electron bunches were generated by exciting plasma wakefields to sufficient amplitudes so as to self-trap electrons from the background plasma and accelerate these electrons over distances near the dephasing length. Recent results include production of high quality electron beams at the 1 GeV level, obtained by extending the plasma channel length to a few cm by using a capillary discharge [W.P. Leemans et al., Nature Physics, Oct 2006], as well as controlled injection of electrons using colliding laser pulses to produce stable beams at the 100 MeV level [J. Faure, Nature, Dec 2006]. Also presented will be recent results on plasma wakefield accelerators using the 42 GeV electron beam at SLAC, in which the wakefield driven by the front of the bunch led to energy doubling of electrons in the back of the bunch [I. Bloomfield et al., Nature, 2007].

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