Joint DESY and University of Hamburg Accelerator Physics Seminar

Tuesday, February 06, 2007

(16:00 in Room 459/30b)

GeV Electron Beams from a cm–Scale Laser Wakefield Accelerator

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Abstract

GeV electron accelerators are essential to synchrotron radiation facilities and free electron lasers, and as modules for high-energy particle physics. Radiofrequency–based accelerators are limited to relatively low accelerating fields (10-50 MV/m) requiring tens to hundreds of metres to reach the multi–GeV beam energies needed to drive radiation sources, and many kilometres to generate particle energies of interest to high-energy physics. Laser-wakefield accelerators (LWFA) produce electric fields of order 10-100 GV/m enabling compact devices. Previously, the required laser intensity was not maintained over the distance needed to reach GeV energies, and hence acceleration was limited to the 100 MeV scale[1–3]. In this talk, results will be presented on the first demonstration of the generation of GeV–class beams using an intense laser beam. Laser pulses with peak power ranging from 10-50 TW were guided by a hydrogen filled capillary discharge waveguide[4]. Production of high–quality electron beams with 1 GeV energy by channelling a ≈40 TW peak power laser pulse in a 3.3 cm long gas–filled capillary discharge waveguide was observed[5]. Results will also be presented on the dependence of the electron beam characteristics on capillary properties, plasma density and laser parameters. The prospect of using these beams for radiation generation will be discussed, including intense THz generation and driving a compact free electron laser.

[1]: Mangles, S.P.D. et al., Nature 431, 535-538 (2004)
[2]: Geddes, C.G.R. et al., Nature 431, 538-541 (2004)
[3]: Faure, J. et al., Nature 431, 541-544 (2004)
[4]: Spence, D.J. & Hooker, S.M., Phys. Rev. E 63, 015401 (2001)
[5]: W.P. Leemans et al., Nature Physics 2, 696 - 699 (2006)

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