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GeV electron beams from cm-scale laser driven plasma based accelerators.[1]

WIM LEEMANS, LBNL

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 be discussed on the dependence of the electron beam characteristics on capillary properties, plasma density and laser parameters.

[1] S.P.D. Mangles et al., *Nature* **431**, 535-538 (2004).
[2] C.G.R. Geddes et al., *Nature* **431**, 538-541 (2004).
[3] J. Faure et al., *Nature* **431**, 541-544 (2004).
[4] D.J. Spence and S.M. Hooker, *Phys. Rev. E* **63**, 015401 (2001).
[5] W.P. Leemans et al., submitted for publication.

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