Petawatt laser guiding and electron beam acceleration to 7.8 GeV in a laser heated capillary discharge waveguide at BELLA

C. Benedetti1, A. J. Gonsalves1, K. Nakamura1, J. Daniels1, C. Pieronek1,2, T. C. H. de Raadt1, S. Steinke1, J. H. Bin1, S. S. Bulanov1, J. van Tilborg1, C. G. R. Geddes1, C. B. Schroeder1,2, Cs. Toth1, K. Swanson1,2, L. Fan-Chiang1,2, W. P. Leemans1,2(*), G. Bagdasarov3,4, N. Bobrova3, V. Gasilov3,4, G. Korn5, P. Sasorov,3,5 and E. Esarey1

1Lawrence Berkeley National Laboratory, Berkeley, CA, 94720, USA
2University of California, Berkeley, CA, 94720, USA
3Keldysh Institute of Applied Mathematics RAS, Moscow 125047, Russia
4National Research Nuclear University MEPhI (Moscow Engineering Physics Institute),
Moscow 115409, Russia
5Institute of Physics ASCR, v.v.i. (FZU), ELI-Beamlines Project, 182 21 Prague, Czech Republic

We present modeling and experimental results concerning the guiding of relativistically intense laser pulses with peak power of 0.85 PW over a distance of 15 diffraction lengths. Laser guiding was achieved by increasing the focusing strength of a capillary discharge waveguide using laser inverse Bremsstrahlung heating. This allowed for the production of electron beams in a laser-plasma accelerator with quasi-monoenergetic peaks up to 7.8 GeV, double the energy that was previously demonstrated. Charge was 5 pC at 7.8 GeV and up to 62 pC in 6 GeV peaks, and typical beam divergence was 0.2 mrad.

(*) Now at Deutsches Elektronen-Synchrotron DESY, D-22607 Hamburg, Germany