Contribution ID: **158** Type: **not specified**

Three stage model of LWFA drive pulse evolution in meter-scale plasma waveguides

Tuesday, 23 July 2024 14:10 (20 minutes)

Recently developed techniques for optical generation of low density (≤10^17 cm^(-3)), meter-scale hydrodynamic plasma waveguides in extended supersonic gas jets [1-3] have already enabled a new class of fully-optical multi-GeV laser wakefield accelerators [4,5]. Optimization of the laser wakefield acceleration (LWFA) process in these types of waveguides and plans for future, single-stage 100 GeV accelerators [6] require detailed understanding of drive laser pulse evolution over meter-scale propagation lengths. Here, we show that guided relativistically intense pulses in long, low-density plasma waveguides, appear to have a universal nonlinear behaviour, independent of whether the injected pulse is linearly mode matched to the waveguide. This behaviour can strongly influence the structure of multi-GeV electron spectra [7]. We describe key pieces of the model including plasma waveguide modal dispersion and a new mode-beating effect arising from wake excitation within narrow plasma channels.

Work supported by U.S. Department of Energy (DE-SC0015516, LaserNetUS DE-SC0019076/FWP#SCW1668, DE-SC0011375), National Science Foundation (PHY2010511), and Defense Advanced Research Projects Agency (DARPA) under the Muons for Science and Security Program. E. Rockafellow supported by NSF Graduate Research Fellowship (DGE 1840340).

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Working group

WG1 : Laser-driven plasma wakefield acceleration

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Session Classification: WG1