



Contribution ID: 188

Type: **not specified**

Benchmarking of hydrodynamic plasma waveguides for multi-GeV laser-driven electron acceleration

Hydrodynamic plasma waveguides initiated by optical field ionization (OFI) have recently become a key component of multi-GeV laser wakefield accelerators [1–4]. We present comprehensive experimental and simulation-based characterization, applicable both to current multi-GeV experiments and future 100 GeV-scale laser plasma accelerators. Crucial to the simulations is the correct modeling of intense Bessel beam interaction with meter-scale gas targets [4], the results of which are used as initial conditions for hydrodynamic simulations [5,6]. The simulations are in good agreement with our experiments measuring plasma and neutral hydrogen density profiles using two-color short pulse interferometry, enabling realistic determination of the guided mode structure for application to laser-driven plasma accelerator design [7].

The authors thank Scott Wilks and Brendan Reagan for useful discussions. This work was supported by the U.S. Department of Energy (DE-SC0015516, LaserNetUS DE-SC0019076/FWP#SCW1668, and DE-SC0011375), the National Science Foundation (PHY2010511), and the Defense Advanced Research Projects Agency (DARPA) under the Muons for Science and Security Program. E. Rockafellow is supported by a NSF Graduate Research Fellowship (DGE 1840340).

- [1] N. Lemos et al, Phys. Plasmas 20, 063102 (2013).
- [2] R. J. Shalloo et al, Phys. Rev. E 97, 053203 (2018).
- [3] B. Miao et al, Phys. Rev. Lett. 125, 074801 (2020).
- [4] L. Feder et al, Phys. Rev. Res. 2, 43173 (2020).
- [5] D. Gordon et al, NRL Memo. Rep. 6706 (2006).
- [6] S. M. Mewes et al, Phys. Rev. Res. 5, (2023).
- [7] B. Miao et al., Under review, arXiv:2404.13632(2024)

Working group

WG1 : Laser-driven plasma wakefield acceleration

Primary authors: MIAO, Bo (University of Maryland, College Park); ROCKAFELLOW, Ela (University of Maryland); SHROCK, Jaron (University of Maryland); HANCOCK, Scott (University of Maryland College Park); GORDON, Daniel (Naval Research Laboratory); MILCHBERG, Howard (University of Maryland)

Presenter: MIAO, Bo (University of Maryland, College Park)

Session Classification: WG1