

Abstract Submitted
for the DPP20 Meeting of
The American Physical Society

Meter-scale non-axisymmetric waveguides for laser wakefield acceleration¹ J.E. SHROCK, B. MIAO, L. FEDER, H.M. MILCHBERG, University of Maryland, College Park — We present a new method for forming long plasma waveguides using modified Bessel beams and an extended gas jet. In recent work [1], we demonstrated a two pulse method for forming plasma waveguides: a J_0 Bessel beam ionizes a plasma column via optical field ionization which expands outwards, then a high order J_q Bessel beam follows at a delay, ionizing a ring at the edge of the expanded plasma, forming a plasma guiding structure with on axis densities as low as $5 \times 10^{16} \text{ cm}^{-3}$ and attenuation lengths up to several meters. High-power guiding was demonstrated in a 5 cm long gas jet, but for longer jets the guide quality was significantly limited by obstruction of the focusing J_q beam by the gas nozzle. Here, we demonstrate mitigation of this problem using a modified binary J_q formed with a π -step phase plate [2], which generates a non-axisymmetric Bessel-like focal line with resistance to focal deterioration in the presence of beam obstructions. Using such a beam in our two-pulse waveguide formation technique can generate plasma waveguides in gas jet targets several tens of cm long. [1] Miao, B., et al. arXiv preprint arXiv:2005.14389 (2020). [2] Shutova, M., et al., J. Opt. Soc. Am. B 36, 1313-1319 (2019)

¹Work funded by the US Dept. of Energy (DESC0015516) and the National Science Foundation (PHY1619582).

Jaron Shrock
University of Maryland, College Park

Date submitted: 29 Jun 2020

Electronic form version 1.4