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Demonstration of Guiding in a Preformed Periodically Modulated Plasma Waveguide for Quasi-Phase Matching BRIAN LAYER, ANDREW YORK, HOWARD MILCHBERG, University of Maryland, College Park — We report the generation of a periodically modulated plasma channel for the quasi-phase matched guiding of intense laser pulses, as proposed by Milchberg et al [1]. By varying system parameters, we can control the depth and period of the waveguide modulations, as well as the plasma ionization stage, electron density and guided spot size. Our method is highly tunable and extremely stable, and has shown remarkably reproducible modulation periods as short as 35 micrometers and as long as 3 mm. We have demonstrated single-mode guiding in these channels using Argon, Nitrogen, and Hydrogen with exit mode sizes as low as 15 micrometers FWHM and intensities of up to $6*10^{17}$ W/cm^2, limited by our current Ti:Sapphire laser system. This method has a high degree of shot-to-shot consistency previously unattained with gas jets, resulting from improved gas jet design, leading to extremely uniform cluster formation. This technique has applications in direct electron acceleration, wakefield acceleration, high harmonic generation, and terahertz generation.

[1] H.M. Milchberg et al., Phys. Plasmas 3, 2149 (1996).

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