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Guiding of > 10 TW laser pulses in cm-scale cluster-based plasma channels[1] ANDREW GOERS, SUNG YOON, GEORGE HINE, JENNIFER ELLE, HOWARD MILCHBERG, University of Maryland, College Park — Optical guiding of high intensity laser pulses over many Rayleigh lengths is critical for the realization of many high power laser physics applications, including laser wakefield acceleration of electrons. Clustered gases have been shown to be ideal targets for generating pre-formed plasma channels due to highly efficient absorption of laser pulse energy, even at relatively low densities. We demonstrate stable optical guiding over $\sim$ 1cm at intensities greater than 10^{18} W/cm^2 in a plasma channel formed in an elongated cluster jet. Transverse interferometry of the channel allows experimental observation of channel formation dynamics and subsequent calculation of supported electromagnetic modes. Rapid hydrodynamic expansion of the laser heated cluster plasma creates highly curved plasma channels with shock wall electron densities exceeding 10^{19} cm^{-3} with simultaneous on-axis densities near 10^{18} cm^{-3}. Interferometric measurements of the channel density after passage of a guided femtosecond laser pulse show that these highly curved channels improve the overall waveguide efficiency by decreasing tunneling of electromagnetic modes through the channel walls with peak guided energy throughputs exceeding 80% of the incident laser energy.

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