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Propagation of Relativistic Laser Pulses in Cluster Plasmas[1]
BRIAN LAYER, SUNG JUN YOON, JENNIFER ELLE, YU-HSIN CHEN, ANDREW GOERS, GEORGE HINE, HOWARD MILCHBERG, University of Maryland, College Park — As atomic clusters explode and ionize under irradiation by an intense femtosecond laser pulse, a transient positive contribution to the index of refraction can result from the transition from a supercritical to subcritical plasma [1]. This effect has been used to self-focus intense laser pulses[2], but has not yet been examined in the relativistic intensity regime ($I_0 > 10^{18}$ W*cm^{-2}). We observe the propagation of relativistically intense femtosecond laser pulses with a peak power of up to 25 TW in plasma formed in atomic gas cluster targets with an interaction length of up to 15 mm. We observe the dependence of this effect upon the laser pulselength and energy, as well as mean size and density of the atomic clusters. Ionization and propagation dynamics are examined with soft X-ray spectroscopy and electron density profiles extracted from transverse interferometry.

[1] T. Taguchi, T. M. Antonsen, and H. M. Milchberg, "Resonant Heating of a Cluster Plasma by Intense Laser Light," Phys. Rev. Lett. 92(20), 205003 (2004).
[2] I. Alexeev, T. M. Antonsen, K. Y. Kim, and H. M. Milchberg, "Self-Focusing of Intense Laser Pulses in a Clustered Gas," Phys. Rev. Lett. 90(10), 103402 (2003).

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