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Acceleration of Ions from a near critical density gaseous target[1]

MICHAEL HELLE, DANIEL GORDON, DMITRI KAGANOVICH, ANTONIO TING, U.S. Naval Research Laboratory — Efficient acceleration of ions by means of high power laser radiation requires electron plasma densities at or in excess of the critical density. For optical wavelengths where most of the world's high intensity lasers operate, the critical density is $n_{CRIT} \approx 2*10^{21}$ cm^{-3}. This value lies between gaseous and solid like densities making it difficult to obtain. In order to reach these densities a "gas foil" target has been developed at the Naval Research Laboratory. The target is created by igniting an optically driven hydrodynamic shock into the gas flow of a gas jet in vacuum. Experiments have shown that a laser-ignited shock is capable of producing <10 μm gradients, thicknesses ≈ 100 μm, and peak densities >4 times ambient. 3D PIC simulations of the interaction of an intense laser pulse with this type of thin, near critical density target have shown characteristics of the recently purposed Magnetic Vortex Acceleration mechanism. This mechanism takes advantage of an inductive accelerating field at the rear of the target. This field is generated by the strong azimuthal magnetic field produced by electrons accelerating through the target. Simulations and preliminary experimental results using the TFL laser system at NRL will be discussed.

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