Abstract Submitted
for the DPP11 Meeting of
The American Physical Society

Laser Ion Acceleration Using Few Times Critical Density Plasma[1]

MICHAEL HELLE, DANIEL GORDON, DMITRI KAGANOVICH, ANTONIO TING, NRL — The generation of high energy ions by means of high intensity laser irradiation of solid targets has been a subject of active research for over a decade. More recently, experimental groups at both Brookhaven National Laboratory and UCLA have shown ion acceleration using CO_2 lasers interacting with gas jets that, when ionized, yield plasma densities that are a few times critical density. The advantages of such targets are that they are relatively simple and can be easily operated at high repetition rates. The physics that drive this type of acceleration is not yet well understood. Of particular interest is the scaling of such acceleration to various laser pulse parameters (including multiple pulses) and the effect of the longitudinal plasma density profile on the acceleration process. Additionally, since the plasma is only a few times critical density, frequency upshifted radiation is able to propagate deeper into the target which could lead to interesting new physics in itself. We will discuss various methods of extending this type of acceleration to optical wavelength and present fully 3D simulations as well as preliminary experimental results conducted at the Naval Research Laboratory.

[1]This work is supported by the Department of Energy and Office of Naval Research

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Date submitted: 15 Jul 2011 Electronic form version 1.4