Abstract Submitted
for the DPP10 Meeting of
The American Physical Society

Theoretical understanding of record proton energies from laser acceleration with cone targets and future prospects THOMAS KLUGE, S.A. GAILLARD, K. FLIPPO, M. BUSSMANN, T. BURRIS, B. GALL, M. GEISSEL, T. LOCKARD, J. METZKES, D.T. OFFERMANN, J. RASSUCHINE, M. SCHOLLMEIER, U. SCHRAMM, Y. SENTOKU, K. ZEIL, T.E. COWAN, FZD, U. Missouri, Sandia NL, U. Nevada, Los Alamos NL — The laser-acceleration of protons to 67.5 MeV has recently been observed at the LANL Trident laser using novel cone targets [1]. The measured enhancement in proton energy is understood from collisional Particle in Cell simulations, which show that the hot electron temperature, responsible for the Target Normal Sheath Acceleration at the cone-top, is significantly increased when the laser grazes the cone wall. This is due to the extraction of electrons from the cone wall by the laser electric field, and their boost in the forward direction by the vxB term of the Lorentz force. This is in contrast to previous predictions of optical collection and wall-guiding of electrons in angled cones [2]. This new mechanism should enable new and more robust target designs for reaching high laser-accelerated proton energies.

[1] S.A. Gaillard, invited talk NI3.00004.
[2] Y. Sentoku et al, Phys. Plasmas 11, 3083 (2004).

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Date submitted: 17 Sep 2010 Electronic form version 1.4