LAWRENCE
LIVERMORE
NATIONAL
LABORATORY

LLNL-CONF-405197

# Progress Towards Plasma Pulse Compression of High Energy, Long Pulse Laser Beams

R. K. Kirkwood, Y. Ping, R. Rygg, S. Wilks, N. Meezan, C. Niemann, O. Landen, N. Fisch, V. Malkin, E. Valeo, J. Wurtele

July 8, 2008

13th Workshop on Advanced Accelerator Concepts
Santa Cruz, CA, United States
July 27, 2008 through August 2, 2008

Invited Abstract Prepared for the 13th Workshop on Advanced Accelerator Concepts
July 27th to Aug. 2nd
Santa Cruz Ca.

# Progress Towards Plasma Pulse Compression of High Energy, Long Pulse Laser Beams

R. K. Kirkwood, Y. Ping, R. Rygg, S. C. Wilks, N. Meezan. C. Niemann, O. L. Landen
Lawrence Livermore National Laboratory
N. J. Fisch, V. M. Malkin and E. O. Valeo, Princeton University
J. Wurtele, Univeristy of California, Berkeley

This work was performed under the auspices of the U. S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344

Abstract

Compression of laser pulses to < ~ 1-10 ps duration using stimulated Raman scattering (SRS) in a plasma promises to provide unprecedented power and intensity for a variety of applications, by avoiding the limits to fluence and intensity that are needed to avoid damage to the solid state optics that are used in conventional approaches. In particular, the ability to compress pump beam pulses of ~ ns duration will allow present facilities with 10's kJ to over a MJ of energy to produce ultra short pulses efficiently, advancing applications in; fusion by fast ignition, x-ray production of high energy density experiments, as well as laser driven particle accelerators. We will discuss a series of experiments to demonstrate the needed beam amplification rate, and focal spot quality in a < 3mm plasma with the properties needed for compression of these pulses ($n_e$ ~ $10^{19}/cm^3$, $T_e$ 200 to 300 eV) when the plasma is extended. The experiments use He plasmas produced with a 300 J, 1 ns, beam at the Jupiter Laser facility to amplify a counter-propagating, ultra-short pulse (USP) seed by a factor of 10x to 37x and study the dependence of the amplification, the associated non-linear wave response, and the resulting beam quality and energy, on the intensity of both seed and pump beam. In particular, a regime in which amplification of USP beams is achieved while maintaining a low angular divergence of the beam consistent with good focal spot quality will be discussed.