DPP05-2005-000296

Abstract for an Invited Paper
for the DPP05 Meeting of
the American Physical Society

Single and nested tungsten-wire-array dynamics and applications to inertial confinement fusion[1]

MICHAEL CUNEO, Sandia National Laboratories

Wire array z-pinches show great promise as x-ray sources for indirect-drive inertial confinement fusion (ICF). The double z-pinch hohlraum, for example, has produced capsule radiation drive symmetric to within 3%. This ICF concept will require that each of two 20-mm-diam arrays scale to x-ray powers $\sim$1 PW, to drive high-yield (>0.2 GJ) capsules to ignition. High-yield fusion will also require a temporally shaped radiation pulse to drive a low-entropy capsule implosion. Recently, improved understanding of high current (11-19 MA) single and nested wire-array dynamics has enabled significant progress towards these goals. As at lower currents, a single wire array (and both the outer and inner arrays of a nested system) shows a wire ablation phase, axial modulation of the ablation rate, a larger ablation rate for larger diameter wires, trailing mass and trailing current. These processes and others produce a broad mass profile that may impact the optimization of x-ray output for single and nested arrays. Our new insights into wire array physics have led to 20-mm-diam single and nested arrays with peak powers of 150-190 TW at implosion times of 55-90 ns, increased from 60-120 TW at 95-110 ns, improving power scaling. Radiation pulse shapes required for 3-shock isentropic compression of high-yield ICF capsules have also been demonstrated with nested wire arrays operating in current-transfer mode. In collaboration with: D.B. Sinars, R.A. Vesey, E.M. Waisman, W.A. Stygar, D.E. Bliss, S.V. Lebedev, J.P. Chittenden, P.V. Sasorov, R.W. Lemke, E.P. Yu, B.B. Afeyan, G.R. Bennett, M.G. Mazarakis, M.R. Lopez, M.E. Savage, J.L. Porter, T.A. Mehlhorn.

[1]Sandia is a multi-program laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the US DOE under Contract DE-AC04-94AL85000.