DPP09-2009-000242
Abstract for an Invited Paper
for the DPP09 Meeting of
the American Physical Society

Compressing Magnetic Fields with High-Energy Lasers

J.P. KNAUER, Laboratory for Laser Energetics, U. of Rochester

Laser-driven, magnetic-field compression producing a magnetic field of many tens of megagauss (MG) is reported for the first time. A shock wave formed during the implosion of a cylindrical target traps an initial magnetic field that is amplified via conservation of magnetic flux. Such large fields are expected to magnetize the electrons in the hot central plasma leading to a cyclotron frequency exceeding the collision frequency. The Omega Laser Facility was used to implode cylindrical CH targets filled with deuterium gas and seeded with an external field (>50 kG) from a magnetic pulse generator. This seed field is trapped and rapidly compressed by the imploding shell, minimizing the effect of resistive flux diffusion. The compressed field was predicted to achieve values of several tens of MG and was probed via proton deflectrometry using the 14.7-MeV protons from the D + ^{3}He fusion reaction emitted by an imploding glass microballoon. Protons crossing the hot spot of the imploded cylindrical target undergo the largest deflection since the compressed field peaks within the hot spot. Line-averaged magnetic fields of the imploded core were measured to between 30 and 40 MG. Experimental data were analyzed with both an MHD version of the 1-D hydrocode *LILAC* and the particle propagation code Geant4. This work supported by the U.S. DOE Office of FES under Grants DEFG02-04ER54768 and DE-FC02-ER54789 and by the Office of ICF under Cooperative Agreement No. DE-FC52-08NA28302. In collaboration with O.V. Gotchev, P.Y. Chang, R. Betti, D.D. Meyerhofer, O. Polomarov (LLE), F.H. Séguin, J.A. Frenje, C.K. Li, M.J.-E. Manuel, R.D. Petrasso (MIT), and J.R. Rygg (LLNL).