LA-UR- 10-01584

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Title: PHELIX for Flux Compression Studies

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Intended for: Abstract for
13th International Conference on
Megagauss Magnetic Field Generation and Related Topics
Shanghai, China
6 – 10 July 2010

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Form 836 (7/06)

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PHELIX for Flux Compression Studies

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A long-standing problem in magnetic flux compression by liner implosion has been the delineation of the magnetic field distribution near the surface of the liner. Typically, surface irregularities and imprecision of implosion can prevent use of simple probes. High-density vapor/plasma can obscure the view and also preclude the use of spectroscopic techniques for field measurement because of absorption and line-broadening. Recently, we have been developing a system known as PHELIX (Precision High Energy-density Liner Implosion eXperiment) for use with proton radiography. This approach requires that we have a portable pulsed power and liner implosion apparatus that can be operated in conjunction with an 800 MeV proton beam at LANSCE (Los Alamos Neutron Science Center). Such proton beams have been previously used to radiograph dynamic events at speeds of a few km/s and dimensions of a few cms. The high resolution (< 100 micron) provided by proton radiography combined with similar precision of liner implosions driven electromagnetically can permit close comparisons of multi-frame experimental data and numerical simulations within a single dynamic event. For example, the development of surface perturbations can be followed for sixteen frames during the same implosion, instead of comparing similar perturbations at different times in separate tests. To achieve a portable implosion system for use at high energy-density in a LANSCE laboratory area requires sub-megajoule energies applied to implosions only a few cms in radial and axial dimension. The associated inductance changes are therefore relatively modest, so a current step-up transformer arrangement is employed to avoid excessive loss to parasitic inductances that are relatively large for low-energy banks comprising only several capacitors and switches. We describe the design, construction and operation of the PHELIX system and discuss applications to liner implosion and magnetic flux compression experiments. For the latter, the ability of strong magnetic fields to deflect the proton beam offers a novel technique for measurement of field distributions near perturbed surfaces.