September 1999 Highlights of the Pulsed Power Inertial Confinement Fusion Program

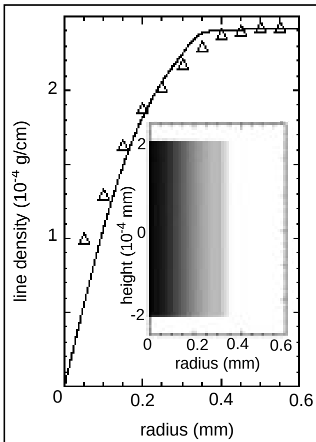

Fig. 1. ALEGRA density profile for 40-µm-dia W wire compared to the Cornell data (Δ). Simulations include radiative cooling and modification of electrical conductivity at high temperature (July 99 *Highlights*). Inset shows simulated shadowgraph from ALEGRA.

Fig. 2. Status of Z/Beamlet installation at Sandia.

We submitted FY00 implementation plans to DOE to assess high yield for z pinches, to support indirect-drive NIF ignition and NIF diagnostics, and to support stockpile stewardship through Campaigns 2, 4, and 7. The Z shot schedule for FY00 will include weapon science applications, measurements of hohlraum energetics and radiation symmetry, z-pinch physics and technology development shots, and tests to improve optical, x-ray, and power flow coupling diagnostics. The weapon science experiments will include qualifying Z for accurate equation-of-state data for D_2 and weapon-primary materials, measuring on-axis, spectrally resolved x-ray output in space and time, and increasing the K-shell x-ray energy at > 6 keV.

We had a total of 173 shots on Z in FY99. In September we measured material properties for non-nuclear components in collaboration with DTRA on 4 shots, tested our ability to increase the Z pulse duration on 2 shots, evaluated the use of large posts on a convolute shot, studied accretion equilibrium on 2 shots with LLNL, assessed z-pinch-driven-hohlraum energetics and radiation symmetry on 2 shots, tested a line velocity interferometer capability on 3 shots, and obtained vacuum insulator stack flashover data on 2 shots.

Understanding wire initiation and merger is important in scaling z-pinch performance to higher currents. We have compared ALEGRA wire initiation simulations with recent Cornell data (July 1999 *Highlights*). Fig. 1 shows that, except for the innermost data point, the simulation of the explosion of a 40-µm-diameter W wire agrees to within a few percent with the experimental density profile.

We developed a new transmission grating spectrometer (TGS) to measure the x-ray flux from a z pinch directly and installed it at the end of the 25-m-long line-of sight pipe in the Z facility. The x-ray emission is observed in 16 energy bins from 0.25 keV to 2.25 keV with an energy resolution ranging from 2% at 0.25 keV to 14% at 2.25 keV. The output from W, stainless steel, Mo, and Ni-coated Ti wires has been measured with the TGS. Our near-term goal for the diagnostic is to measure the flux on Z to an accuracy of 15% via off-line calibrations and comparisons to the existing suite of pinch diagnostics (x-ray diodes, bolometers, and photoconducting diodes). Pinch temperatures of 150 - 200 eV and effective widths of the x-ray emission are inferred. These widths are about what is measured with a pinhole camera at peak compression.

The modifications to the building that will house the Z/Beamlet backlighter diagnostic are now complete, including an isolated concrete pad to protect the laser optics from the Z mechanical shock and new heating, cooling, and ventilating systems to control the temperature to an accuracy of 1˚C. Beamlet, constructed by LLNL as a single-beamlet prototype of the 192-beam NIF laser in 1994, was transferred to Sandia in August 1998. Installation of the laser components in the class 10,000 clean room area of the building is underway, as shown in the photograph in Fig. 2.

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