August 1999 Highlights of the Pulsed Power Inertial Confinement Fusion Program

A draft of the program plan for high yield assessment with z pinches was submitted to DOE. During the month, we had a third shot to assess a double z-pinch capability on Z, four shots to assess use of the static-walled hohlraum for weapon physics, a power flow shot, two shots to develop a line velocity interferometer (VISAR) diagnostic, two shots to assess the effect of wire opacity on z-pinch output, and six shots to study material properties of weapon components in collaboration with DTRA.

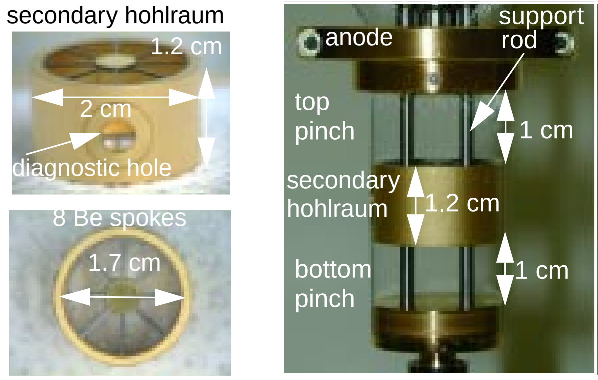

Fig. 1. Double pinch configuration for z-pinch-driven-hohlraum shot on Z. The two pinches are fed from a single current feed and the outside diameter of the secondary hohlraum is part of the power flow surface feeding the upper pinch. Support rods are removed prior to shot. Primary hohlraums are not shown.

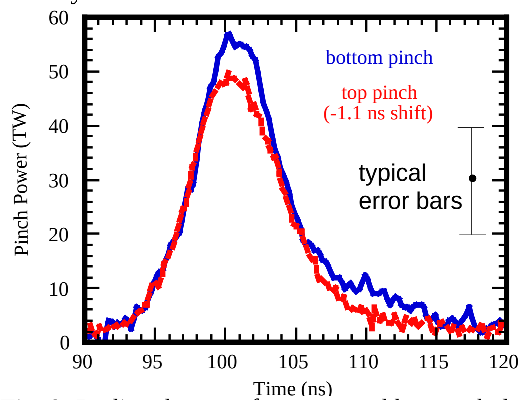

Fig. 2. Radiated power from top and bottom halves of double pinch vs time on Z Shot 454.

The reproducibility and simultaneity of the x-ray output from a z pinch and the hohlraum geometry is critical in radiating a capsule symmetrically in a z-pinch-driven hohlraum (ZPDH). We are assessing a two-sided, or double, z pinch, which can potentially meet the symmetry requirements for ICF applications. In previous Z experiments, a foam ball was illuminated by x rays from a single z pinch. In the new geometry, one pinch is above and another below a high-yield-sized ICF secondary hohlraum (Fig. 1). The measured currents in the vicinity of the pinch are consistent with the measurement of about ~50 TW per pinch, based on scaling from our single pinch results. Predictions of 0-D and 3-D hohlraum energetics models show consistency between the measured powers and temperatures. The measured implosion times for the two pinches were within 1 ns of each other (Fig. 2), indicating no currrent loss between the top and bottom pinches. In future experiments, we will optimize the x-ray output and hohlraum temperature by reducing the load inductance and the wall area of the two primary hohlraums.

We recently completed a ten-month series of tests of the First Article NIF Test Module (FANTM) for the power conditioning system of the National Ignition Facility and then transferred the test module to LLNL. The Sandia-designed system was validated in over 17,200 shots (~7,200 into a resistive load and ~10,000 into flashlamps). When the NIF is fully operational, 216 of these modules will occupy 50,000 ft^2 in four capacitor bays. For each module, ~1.7 MJ will be stored in 20 300-mF capacitors and three pulses will be delivered: a triggering test pulse, a preionization pulse to prepare the flashlamps ~300 ms before the primary discharge, and a primary pulse to the main and auxiliary flashlamps. The energy in each module will be switched through a single 500-kA, triggered, air-insulated switch and transmitted through 20 coaxial cables. During the FANTM tests at Sandia, operational, component lifetime, and fault mode data were obtained, and high-energy-density capacitors from different vendors were tested. The development and selection of the primary switch was a major part of the power conditioning system effort before the testing began. As part of the module tests, we varied the number of capacitors from 20 to 24, identified the sensitivity to charge voltage and inter-pulse delay time, and evaluated the effect of different cable lengths.

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