February 1999 Highlights of the Pulsed Power Inertial Confinement Fusion Program

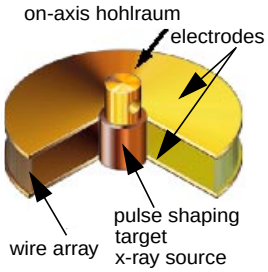

Fig. 1. Arrangement for the single-sided static-walled experiments. In shots this month, nested arrays were used and two diagnostic holes were present: one off-axis as shown and one at the top of the hohlraum (not shown).

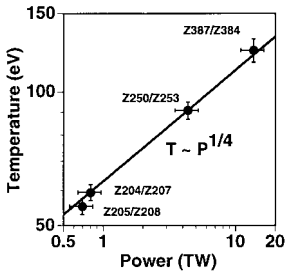

Fig. 2. Hohlraum temperature T vs x-ray power P for static-walled shots. Data, labeled by shot number, were obtained Feb. 98, May 98, and Feb. 99. Temperature follows expected $T \sim P^{1/4}$ relation.

There were 18 Z shots: ten to investigate the long pulse mode, one to evaluate isentropic compression of copper, five with a static-walled hohlraum, and two with a z-pinch-driven hohlraum. We measured 124 eV in a single-sided-drive static-walled hohlraum; the previous record for this type hohlraum was 90 eV.

In the static-walled hohlraum concept, radiation is transported from the z-pinch source region to an on-axis hohlraum containing an ICF capsule through radiation entrance holes at either end of the hohlraum. The imploding z pinch strikes a pulse shaping cylinder, composed of copper-coated, low-density foam, and produces a 10 - 15 ns, low-power "foot" x-ray pulse that will provide initial compression of a cryogenic DT fuel layer in the capsule. The peak x-ray pulse is produced when the z pinch and pulse-shaping cylinder stagnate on axis. Figure 1 shows a single-sided version of the static-walled hohlraum being tested on Z. The x-ray power to this hohlraum increased by a factor of ~15 over the past year (Fig. 2). This corresponds to an increase in the measured (hole closure corrected) hohlraum temperature from 55 3 eV to 124 5eV in the 6-mm-diameter, 7-mm-long hohlraum. The 38% increase obtained this month represents the first time the temperature in a hohlraum proposed to contain a fusion capsule in the static-walled hohlraum configuration has exceeded 100 eV on Z. Moreover, if the two large diagnostic holes had been closed, we predict that the hohlraum temperature would be ~134 eV. The configuration has not yet been optimized. However, the hohlraum temperature obtained is close to that required to produce an x-ray hot spot that can be imaged and a detectable number of neutrons above background from a capsule implosion.

The long pulse mode experiments on Z introduced some unexpected pulsed power issues. The voltage pulse width at the insulator stack was 30 ns shorter than predicted because of electrical arcing in the water section. As a consequence, the peak current at the wire array was reduced, peak x-ray powers were lower, and the rise time of the x-ray pulse was slower. The slow exponential-like fall that followed the rapid rise in radiation output that was observed in the Saturn long pulse data (see May 1998 *Highlights*) is not seen on Z, perhaps because the Z long pulse mode allows 50% more time for hole closure to occur. Pulsed power changes are being implemented to eliminate the arcing and to reduce A-K gap closure; these methods should increase the total energy available by 40%.

Demolition in the building directly south of the Z facility that will house the Z/Beamlet backlighter laser has been completed in order to accommodate new vibration-isolated foundations. The contract to transform the building into a laser lab began this month and should be completed by August 1. The laser bay space will be a class 100,000 clean room with smaller included areas rated at class 100. The temperature control will be 1˚F. Modifications will include a new ceiling, new heating, ventilating, and air conditioning systems, electrical upgrades, and a mezzanine. Other modifications, in FY 2000, will include a beam enclosure between the Z/Beamlet building and the Z facility and modifications within the Z facility to deliver the laser beam into the center of the accelerator.

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