May 1999 Highlights of the Pulsed Power Inertial Confinement Fusion Program

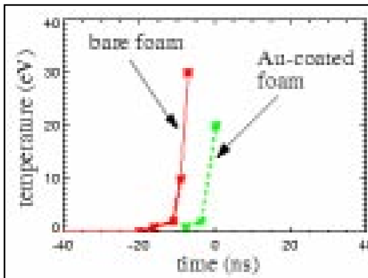

Fig. 1. Preheat of uncoated (Shot 255) and Au-coated (Shot 256) foam. t=0 is time of peak foam temperature. Without coating, temperature rises 8 ns earlier.

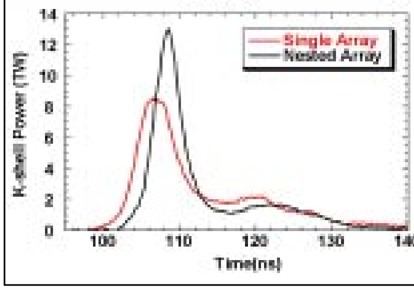

Fig. 2. X-ray powers for single and nested titanium wire arrays on Z.

About 50 scientists from Sandia, Livermore, Los Alamos, AWE, and the University of Wisconsin attended a Sandia workshop on May 6 and 7 to review progress in designing z-pinch-driven ICF targets. The presentations and discussions reflected significant progress in the last year in single-issue and integrated-target design. The integrated target design calculations are being used to evaluate the coupling between the z-pinch source and the hohlraum and between the hohlraum and the capsule. The critical issues for the three major hohlraum configurations (dynamic, static-walled, and z-pinch-driven) were identified, and future plans to validate the design of each were summarized. The goal of the overall effort is to define integrated z-pinch-driven target experiments that will give high confidence in achieving high yield on an advanced pulsed-power accelerator. A summary of the major workshop conclusions and a proceedings are being prepared and will be made available to all participants and interested parties.

This month we had five Defense Threat Reduction Agency (DTRA) radiation shots, a flux compression shot, five shots to compare the energetics of nested wire arrays to that on Shot 179 (our highest x-ray power shot to date), three LANL weapon physics shots, and two shots to study wire opacity effects.

Spectroscopic measurements have been made on Z almost since the first shots in the fall 1996. We have been adding new capabilities to study hohlraum physics. An important measurement is the time-dependent temperature within the hohlraum. These data are critical because design simulations indicate that capsule performance is significantly affected by the preheat level and the time-dependent details of the radiation pulse shape. Here, we describe recent progress in obtaining preheat data; in June we will describe a technique that may provide a passive way to measure hohlraum temperature without a diagnostic hole. We are measuring the preheat of the foam in a dynamic hohlraum target prior to the impact of the tungsten wire plasma using an absolutely-calibrated, time-resolved optical spectrograph. Since the capsule is embedded within the foam in a dynamic hohlraum, the preheat must be less than 1 eV prior to the temperature rise that occurs when the imploding wire plasma impacts the foam. Data from Z shots (Fig. 1) are encouraging and show that the preheat can be kept below 1 eV until 7 - 8 ns prior to the peak foam temperature by coating the foam with gold. The measurements also suggest that the early radiation from the imploding wire array ablates the foam so that the imploding wire plasma impacts a gradual density profile rather than a sharp boundary. This may help to explain why the full width at half maximum of the x-ray pulse is narrower with foam targets.

Five Z shots with DTRA studied the reproducibility of Ni-clad titanium K-shell sources (4.8 keV) and verified that nested arrays increase x-ray powers, and potentially the energy yields, from these sources. Two identical shots that were repeats of Shot 311 produced x-ray energies and powers within 15% of each other. With nested arrays, the K-shell x-ray powers were as much as 50% higher (Fig. 2), although the yields were the same. Candidate materials for the neutron generator program were tested during the shots. Twelve samples per shot were fielded, with four material samples at three different incident fluences. Sandia's test and systems groups are analyzing the samples and the results.

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