January 2000 Highlights of the Pulsed Power Inertial Confinement Fusion Program

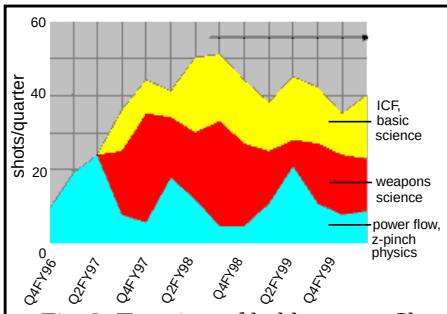

Fig. 1. Z usage since start of operations.

Fig. 2. Top view of hohlraum on Shot 515 with Al step and streak image from active shock breakout diagnostic.

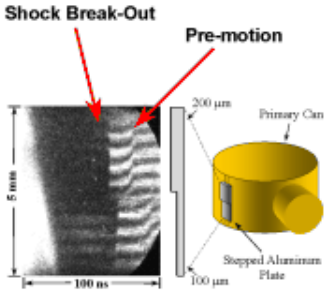

Fig. 3. Streak image of shock breakout and initial material motion using line-imaging VISAR on hohlraum shot.

Highlights this month include the use of an active shock breakout diagnostic at 150-eV temperatures, the new control monitor system on Z, and spatially-resolved velocity data from an isentropic compression experiment (ICE). We held a one-day review of the progress on the Z/Beamlet backlighter in mid January. Z is not being fully utilized because of budget limitations, but the fraction of shots devoted to weapon science and ICF has increased since Z began operating (Fig. 1). Our shot allocation for FY00 is 150, although more than 400 were requested and Z has the potential for 240 shots (1 shot/day in a single shift).

During the first 6 work days a new line-3 prepulse shield was installed on Z to reduce power and current loss in the long pulse mode. There were 6 experimental shots, after 3 days of short-circuit tests at reduced voltage: 2 short-circuit shots to measure current in the long-pulse mode with two distinct diagnostics (a Bdot monitor and a velocity interferometer), 1 shot to test a new "hangdown" design of two independently-loaded wire arrays for the z-pinch-driven hohlraum, 2 wire-array preheating shots, and 1 LANL weapon physics shot.

A new system to control and monitor the charging and firing of Z was implemented on Shot 524 in December. The new control monitor system has a new host computer, programmable logic controllers, a new graphical user interface, and new software code specific to Z operation. It adopts modern industrial control technology in place of the 1984 system, which had been developed in-house because a commercial system was unavailable when the predecessor of Z (PBFA II) was built. The control monitor upgrade was designed, built, tested, and implemented without interrupting the Z operating schedule.

We analyzed November static-walled-hohlraum shots on which an active shock breakout (ASBO) diagnostic was prototyped as a NIF diagnostic. The diagnostic measures the shock arrival at the back surface of a reflective material (Fig. 2). The hole-closure-corrected hohlraum temperature of 150 eV on Shot 515 is the highest at which an ASBO diagnostic has worked. In August we tried unsuccessfully to use the diagnostic at these temperatures. In the new experiments, we added gold barriers to verify the continuation of reflectivity throughout the pulse and to prevent plasma motion from affecting the reflectivity data. Extra shielding in front of the optical mirrors also prevented surface melting. At higher temperatures (e.g., after the first two steps of the NIF-like pulse), a passive shock breakout diagnostic will probably be used.

A line-imaging velocity interferometer (VISAR) can provide temporally- and spatially-resolved velocity data along a 1-D line across a surface. We have fielded this diagnostic on Z. On an ICE short-circuit shot, the uniformity of pressure loading of a flat sample over a 1.2-cm length in the horizontal direction was better than 1.5% (the line VISAR resolution). On a second ICE shot, the pressure loading uniformity was just as good over 1.2 cm in the vertical direction. The diagnostic was also used on Z shots to detect radiation-driven shock breakout and initial motion (Fig. 3). The line VISAR enhances our ability to characterize material behavior in support of stockpile stewardship and non-weapon-related applications. In late February, we plan to use this diagnostic to monitor the synchrony between the top and bottom pinches that are providing the radiation drive for the z-pinch-driven hohlraum and to determine the hohlraum temperature gradient.

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