February 2000 Progress Report on the Laboratory for Laser Energetics Inertial Confinement Fusion Program Activities

Inner-Shell-Mix Diagnostic: A novel diagnostic method was developed to study shell mixing. This method uses targets with D_2 or D^3He gas contained in shells with inner and offset CD layers overcoated by CH (see Fig. 1). The tritons from primary DD fusion reactions originating from the gas "hot spot" interact with the CD layer and produce secondary neutrons that are detected by the single hit detector array *MEDUSA*. The tritons slow down quickly in the cold shell material and penetrate <1 μm of initial inner-shell thickness. There should be few secondary neutrons from the CD layer offset by more than 1 μm of CH unless there is mixing between the inner CH and CD layers. The secondary neutron yield is dominated by triton–CD interactions. The triton interactions in the target gas produce about 10% of the secondary yield of the gas–CD combination and can be measured in experiments with pure-CH shells. By measuring the ratio of secondary to primary neutron yields from the targets with inner CD layers and offset CD layers, it is possible to estimate the mix fraction (Fig. 2).

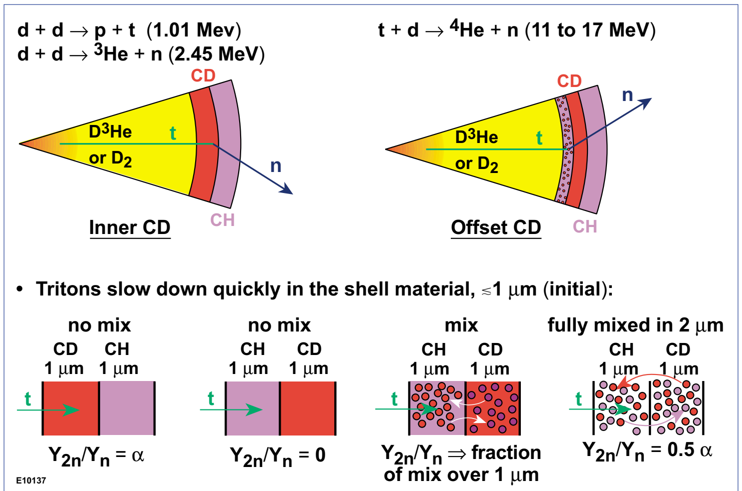

Figure 1. Schematic illustrating the basis of the inner-shell-mix diagnostic.

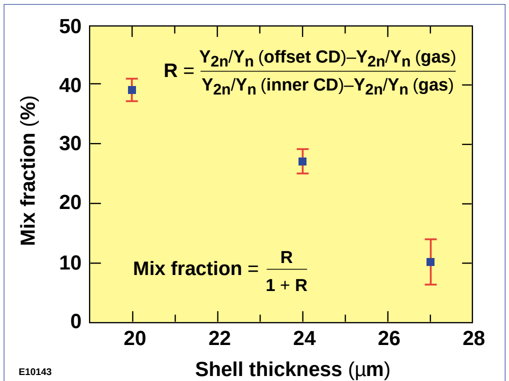

Figure 2. Estimated mix fraction of CD into CH layer.

OMEGA Power Balance: Efforts to improve the energy and power balance of OMEGA are underway. Currently, there is a wide variation in the optical transmission of the frequency-conversion crystals because they are in the process of being recoated to reduce scattering losses. By changing the gain of the final amplifiers, the losses in the converters can be compensated while minimizing the impact on power balance. This, however, does reduce output energy since the gain of many of the final amplifiers is reduced to match the worst performing crystals. In recent experiments, the beam-to-beam UV energy imbalance on target was less than 4% rms. The IR output of the system was balanced to less than 1% rms. The system is able to maintain this level of performance over multiple shot days without adjustment. To obtain this performance, new blast shields were installed and beam timing and transport measurements were made. The on-target energy (or power) imbalance, including beam overlap, had most of the nonuniformity in ℓ-modes 1 to 4 with the typical value of ~1% per mode. Streak-camera-based power measurements of 30 beams show that throughout most of the pulse (a 1-ns super-Gaussian) the power imbalance was less than 6% (see Fig. 3). Power balance is degraded during the early rising edge of the pulse roughly as expected, but we are still resolving issues of beam timing and streak camera performance, which significantly affect the power measurement of the initial portion of the pulse.

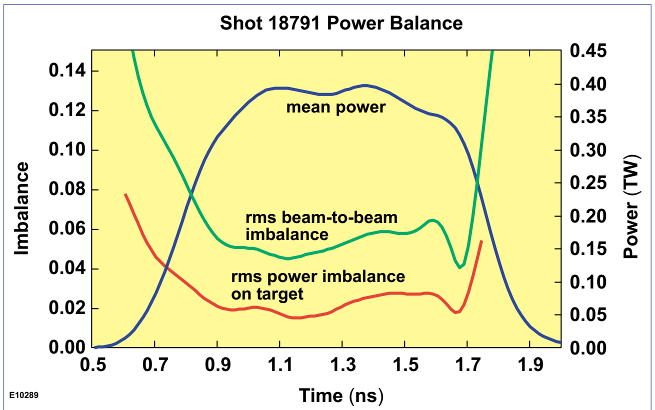

Figure 3. Mean power (blue), beam-to-beam power imbalance (green), and on-target power imbalance (red).

OMEGA Operations Summary: During February OMEGA shots were divided among three experimental campaigns and a maintenance week. During the maintenance week the Aperture-Coupled-Stripline (ACSL) Pulse Shaping System was installed and the Cryogenic Target Handling System's (CTHS) fast retraction linear motor was installed and tested. A total of 76 target shots for the month included 25 for LLE's Rayleigh-Taylor instability (RTI) experiments, 23 for integrated spherical experiments (ISE), and 28 for five campaigns for LLNL and SNL combined.

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