Installation of the OMEGA Arbitrary Waveform Generator Pulse-Shaping System: The new OMEGA arbitrary waveform generator (OAWG) was installed and activated in November. Temporal pulse shapes are produced in the OMEGA laser as shown schematically in Fig. 1. A series-connected pair of $LiNbO_3$ Mach–Zehnder modulators [dual-amplitude modulators (DAM's)] gate and carve a temporal shape from a continuous-wave fiber-laser source. The modulators' transmissions are determined by a high-bandwidth electrical signal applied to one arm of each modulator. Previously, the high-bandwidth electrical signal was generated using aperture-coupled striplines (ACSL's)—two (input and output) closely stacked striplines with an intervening aperture. The physical shape of the intervening aperture determined the temporal shape of the electrical pulse coupled to the output stripline. While the ACSL's were sturdy and reliable, they required the fabrication of new, non-modifiable hardware for every new shape.

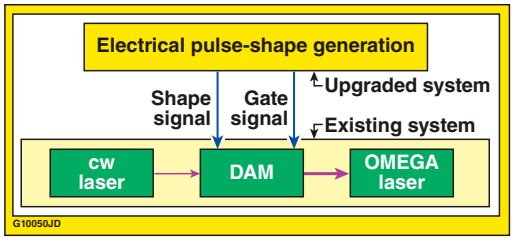

Figure 1. Schematic of temporal pulse shaping on the OMEGA laser. $LiNbO_3$ Mach–Zehnder modulators [dual-amplitude modulators (DAM's)] gate and carve a temporal shape from a continuous-wave fiber-laser source. The electrical pulse-shape–generation system was upgraded from the ACSL system (square-pulse generators and aperture-coupled striplines) to the new OMEGA arbitrary-waveform-generator (OAWG) system. cw: continuous wave.

The OAWG installed on the OMEGA smoothing by spectral dispersion (SSD) driver replaces 11 ACSL system components with one commercially available arbitrary waveform generator [Tektronix AWG70000 (50 GS/s)] and two internally developed radio-frequency amplifiers to generate the high-bandwidth signals that are used to drive the modulators. The required electrical output signal is loaded into the AWG as a flat file and no hardware fabrication is required. Picket pulses are similarly added into the flat file instead of requiring the wiring in of any additional hardware. Software tools have been and continue to be developed to permit shot-day adjustment of the temporal shape.

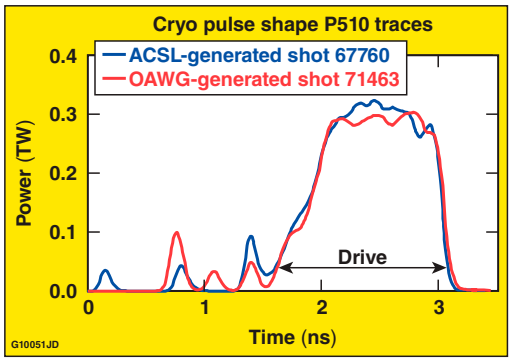

Figure 2. Comparison of the ACSL and OAWG pulse-shaping performance for two cryogenic target pulse shapes. The design of the picket timing and amplitude was different for the two shots but the drive pulse was designed to be identical. The OAWG system produces cryogenic target pulses with improved picket shape uniformity, a higher contrast between pickets and the drive, and greater definition of the leading edge of the drive.

Full laser-system testing on OMEGA confirmed that the OAWG system matches or improves on the subnanosecond pulses produced with the ACSL system while offering improved flexibility. Figure 2 shows two picket-pulse shapes used for cryo implosions—one generated by the ACSL and one by the OAWG. Both shapes were measured in the UV at the output of the laser; although the picket timing and picket amplitudes were intentionally different, the design of the "drive" portion of the pulse shapes is identical. The OAWG-generated pickets have the same, well-controlled width and the contrast between the final picket and the drive is improved. (Note that with the OAWG system, there is no jitter between pickets and the drive.) The features of the drive of the pulse shape are better controlled: the drive step (foot) is flatter and lower (by design), the rising edge is steeper, and the top is more square.

The installation of the OAWG improves the production of the challenging, precision-adaptable picket-pulse shapes required for cryogenic implosions.

Omega Facility Operations Summary: During November, the Omega Facility conducted 113 target shots with an average experimental effectiveness of 86.3%. Seventy five of the target shots were carried out on the OMEGA laser with an average experimental effectiveness of 91.3%, while OMEGA EP conducted 38 target shots with an average experimental effectiveness of 76.3%. The ICF campaign accounted for 28 of the shots for experiments led by LLE scientists, while 45 target shots were carried out for the HED campaign by LANL, LLE, and LLNL scientists. Collaborative teams led by Princeton University, the University of New Hampshire, and the University of California at San Diego, respectively, carried out 32 NLUF program target shots. One LLNL and one LLE LBS experiment accounted for eight target shots. In addition to these target shots, 14 other shots were carried out on OMEGA EP for other purposes, including beam timing, beam pointing, and VISAR diagnostic setup.

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