A New Neutron Time-of-Flight Line of Sight on OMEGA: A set of experiments has recently been performed on OMEGA to generate a short impulse of x rays that allowed for the semi-annual calibration of the neutron temporal diagnostic (NTD), as well as the first measurements of the instrument response function (IRF) on a new 22-m neutron time-of-flight (nTOF) diagnostic. The NTD calibration is required to keep the uncertainties of the neutron production rate in cryogenic implosions below 50 ps. In addition, calibrating the newly built nTOF diagnostic line of sight (LOS) with x rays from the short impulse completes the calibration of the third nTOF detector that can measure hot-spot motion and the second nTOF detector that can measure fuel areal density.

In these experiments, 3 to 60 of the OMEGA beams directed onto an ~900-μm gold target for ~100 ps. This generated a short impulse of x rays that are incident on the NTD and nTOF detectors. For the nTOF detectors this short pulse of x rays well approximates a delta function in time, so the measured signal represents the detector IRF. NTD has a high enough temporal resolution to record the temporal evolution of the x-ray pulse. Since the x-ray pulse follows the incident laser pulse very closely, the signals registered on NTD were used to verify the timing of the instrument with respect to the laser pulse arriving at the target.

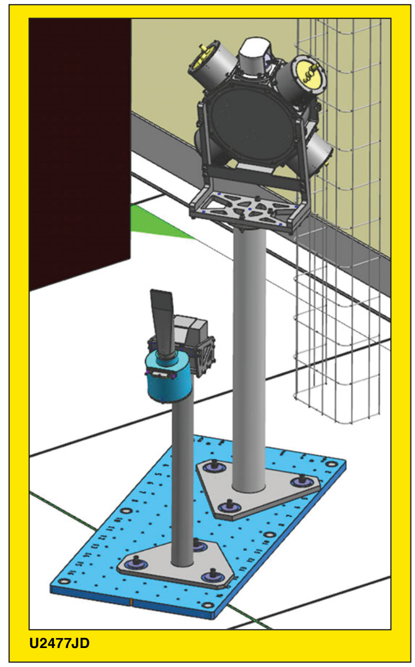

Figure 1. The newly built nTOF detectors consist of a small plastic scintillator (petal detector) placed in front of a larger liquid scintillator (xylene detector).

The newly built neutron nTOF detectors, shown in Fig. 1, have been fielded on OMEGA in a well-collimated LOS 22 m from the target chamber center (TCC). This LOS uses proven technology from another LOS on OMEGA located 13 m from TCC and consists of a small plastic scintillator detector and a larger liquid scintillator. The larger liquid scintillator is used to measure the down-scattered neutron spectrum, which provides information about the fuel areal density in cryogenic implosions, while the smaller plastic scintillator is used to measure the primary DT neutron spectrum, which provides information on the hot-spot temperature and motion.

These experiments enabled the first measurements of the new detectors' IRF's. This characteristic response of the detectors is necessary for the analyzing measured neutron spectra. The measured IRF's are shown in Fig. 2 along with the previously measured IRF from the 13-m LOS.

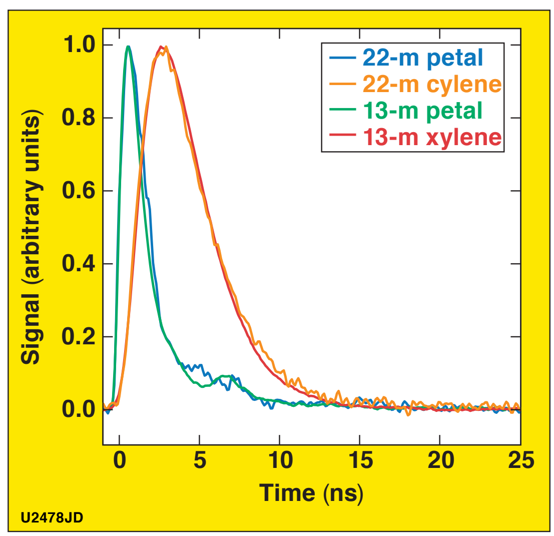

Figure 2. The instrument response functions measured along the 22-m LOS against the previously measured response functions along the 13-m LOS.

The newly built LOS completes the third axis required for measurements of the hot-spot velocity vector. This will be crucial in diagnosing residual kinetic energy in cryogenic implosions and will provide a new lens to view implosion performance. Additionally, this LOS is the second nTOF LOS capable of measuring the down-scattered neutron spectrum and will provide additional coverage of the shell areal density.

Omega Facility Operations Summary: The Omega Laser Facility conducted 163 shots with an average experimental effectiveness (EE) of 95.1%. Ninety-eight of these shots were taken on the OMEGA laser with an EE of 100% and 65 shots were taken using the OMEGA EP laser with an EE of 87.7%. The ICF Program carried out 24 shots for experiments led by LLE and LLNL while the HED program accounted for 96 target shots led by LLNL, LANL, SNL, and LLE. Thirty-five target shots were taken for four NLUF experiments led by the University of California Berkeley/LLNL, the University of Chicago/Oxford University, the University of Michigan, and Johns Hopkins University, respectively. One LLNL-led LBS experiment had 8 target shots.