A NEUTRON TEMPORAL DIAGNOSTIC FOR HIGH-YIELD DT CRYOGENIC IMPLOSIONS ON OMEGA

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A next-generation neutron temporal diagnostic capable of recording high-quality data for the highest anticipated yield cryogenic DT implosion experiments (cryoNTD) was recently installed at the Omega Laser Facility [1]. The neutron production width is a very important measurement to determine the hot-spot pressure achieved in cryogenic inertial confinement fusion experiments—a key metric in assessing the quality of these implosions.

The design of cryoNTD is based on the original neutron temporal diagnostics (NTD) [2], which uses a fast rise time, commercially available plastic scintillator. Neutron collisions with the scintillator convert neutron kinetic energy to 350- to 450-nm-wavelength light. The scintillator is shielded against hard x rays using a high-*Z* Hevimet nose cone. The light from the scintillator inside the nose cone assembly is relayed ~16 m to a ROSS streak camera [3] located in the OMEGA EP [4] plenum area. The OMEGA EP plenum area is behind the main OMEGA shield wall and therefore well protected against neutrons. An ~200× reduction in neutron background was observed during the first high-yield DT cryogenic implosions compared to the current unshielded NTD installation on OMEGA.

The lower background reduces the error associated with determining the neutron temporal width, which is obtained by subtracting the instrument response, the broadening resulting from the finite thickness of the scintillator, and the temperature broadening of the signal at the scintillator location from the measured full width at half maximum (FWHM).

The impulse response of the cryoNTD instrument of ~40±10 ps—which includes contributions from the scintillator rise time, the optical relay, and the streak camera—was measured in a dedicated experiment using hard x rays from a planar target irradiated with a 10-ps short pulse from the OMEGA EP laser.

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