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Inertial confinement fusion neutron images

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Neutron images of DT-filled capsules are now routinely acquired with a 20-micron spatial resolution for direct drive implosions performed at the Laboratory for Laser Energetics. Images are recorded using a novel detector based on an array of 85-micron -diam capillary tubes filled with a liquid scintillator. Detector resolution of 650 micron is limited by track length of the elastically-scattered recoil protons. Replacing the hydrogen in the scintillator with deuterium improves detector spatial resolution to 325 micron, and makes a 6-7 micron source resolution achievable at the NIF and LMJ facilities. Detector sensitivity allows individual neutron events to be recorded. Coded ring apertures were recently implemented at LLE, and appear to be the most promising technique to achieve high signal-to-noise ratio. The technique reliability is established by comparing the experimental images acquired with penumbral and ring apertures. A signal-to-noise ratio near 30 at a yield of 3 x 10^{13} 14-MeV neutrons confirms annular imaging capabilities with a 10 micron resolution filter. Images of DD filled capsules yielding 3 x 10^{11} neutrons (2.45 MeV) have also been recorded. The consistency of the hot fuel burning area and the capsule shell revealed by the x-rays images is also discussed.