SHORT LINE-OF-SIGHT NEUTRON IMAGER DESIGN FOR THE NATIONAL IGNITION FACILITY

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At the National Ignition Facility (NIF), neutron imaging of the 14.1 MeV neutrons from the source provides a measure of the 2D size and shape of the burning DT fuel. Since the current Neutron Imaging System (NIS) [1] provides only one view from the equator, the addition of another equatorial view and a near-polar line of sight would provide a more accurate burn volume and shape measurement. Simply reproducing the current 28-m line-of-sight NIS design on the pole, however, would require drilling through and building additional infrastructure on the roof of the NIF facility, an expensive and impractical solution, so a more compact solution is required.

The 1.1-mm resolution of the current BCF-99-55 plastic scintillating fiber array is the main limitation of the current design, and a detector with improved spatial resolution is required to reduce the length of the line of sight to the ~16.5 m that is available. One possible detector are storage phosphor image plates [2]. In recent experiments at NIF, energy-integrated neutron images have been obtained using a stack of high-density polyethylene converters and storage phosphor image plates. In these detectors, (n,p) interactions produce protons that are recorded on the image plates for later readout. As shown in Fig. 1, the detector is capable of recording the neutrons that pass through the NIS pinhole array. The point-spread function of this detector is ~250 μm with long decay tails, which has allowed reconstruction of the neutron images for lines of sight as short at 12 m.

This work will describe current plans and designs for new neutron imagers at NIF that will use these types of detector as a lower cost initial stage to allow rapid development of neutron imaging on multiple axes. It will also discuss possible future detectors such as deuterated-fiber or liquid scintillators that can be added to the short lines of sight to upgrade the systems and allow energy-resolved neutron imaging.

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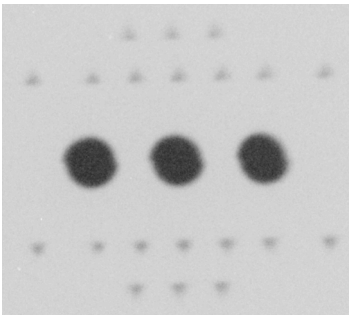

Fig. 1 Neutron image from on a single image plate using a 1-mm polyethylene (n,p) converter.

[1] F. E. Merrill et al., *"The neutron imaging diagnostic at NIF (invited)"*, Rev. Sci. Instrum. 83, 10D317 (2012); doi: 10.1063/1.4739242
[2] N. Izumi, et al., "*X-ray and neutron sensitivity of imaging plates*", *Proc. SPIE* 8850, Target Diagnostics Physics and Engineering for Inertial Confinement Fusion II, 885006 (September 26, 2013); doi:10.1117/12.2024513