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One-dimensional, axially resolved and time-integrated neutron images from MagLIF experiments at Sandia's Z Pulsed Power Facility

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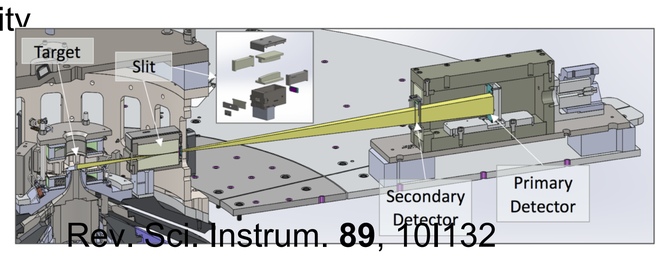
Inertial confinement fusion (ICF) experiments conducted on the Z-Facility at Sandia present an extreme environment for neutron diagnostics with large amounts of radiation due to electromagnetic pulses and Bremsstrahlung radiation in addition to X-rays emitted from fusion processes in the experiments. The one-dimensional imager of neutrons (ODIN) has been used in ICF experiments to collect time-integrated axially resolved neutron images of the imploding targets. CR-39 track-etch detectors have used in ODIN due
to their proven ability to detect neutrons in environments with harsh x-ray backgrounds. Recently, in collaboration with MIT, the ability to etch and scan CR-39 has been established at Sandia's Z-facility. Data from ODIN collected from a subset of MagLIF experiments is shown that illustrate this capability.



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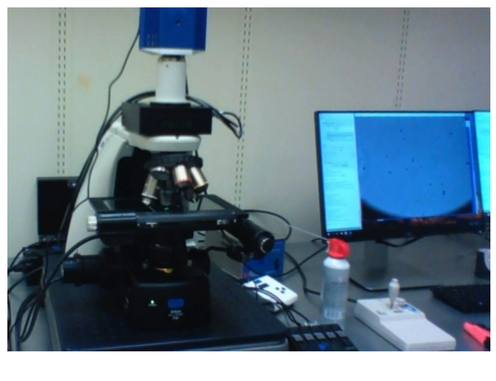
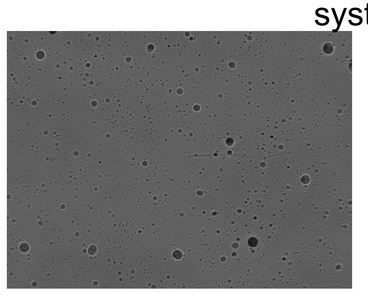
The MagLIF source is imaged by ODIN using the geometry shown above. Neutrons are axially resolved by a pair of rolled edge slits. Neutrons that pass through the slit are projected at the detector housing. The neutrons first interact with a proton convertor, where neutrons colliding with protons eject
the recoil proton, which then impact the CR-39 causing latent tracks that are revealed in post processing consisting of an etching process.

As part of an ongoing collaboration between Sandia National Laboratories and MIT, CR-39 detector post-processing methods have been successfully transferred from MIT to Sandia. These methods are the same as those used at the NIF and Omega facilities and consist of chemical etching and track scanning.

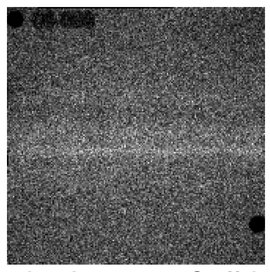
Etched CR-39 detectors are scanned using an automated optical microscope scanning system developed by MIT. As each position of the CR-39 is imaged, the scanning systems data collection software determines location of each tract and its contrast, eccentricity, and diameter.



CR-39 scanning system.



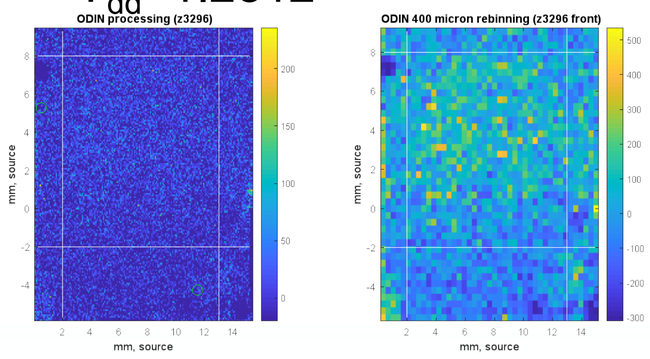
A single image taken by the scanning microscope.

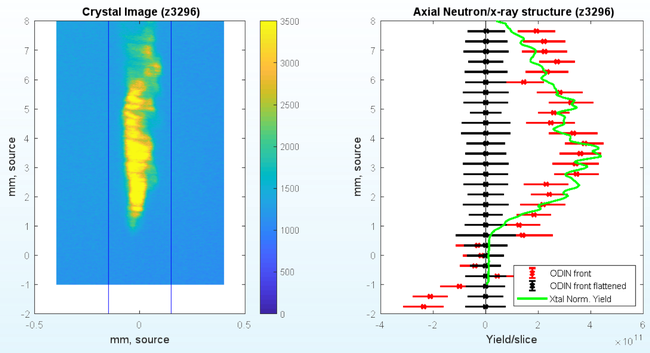


A composite image of all images taken of a single CR-39 detector.

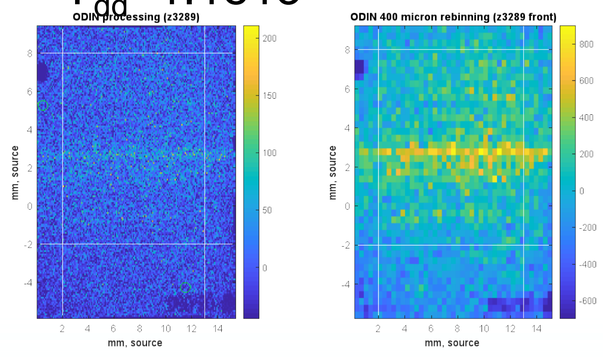
One-dimensional neutron images from three MagLIF experiments.

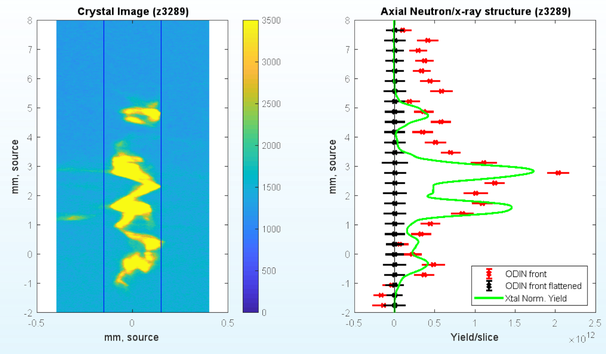
Shot Z3296:
Y_{dd}=1.2e12



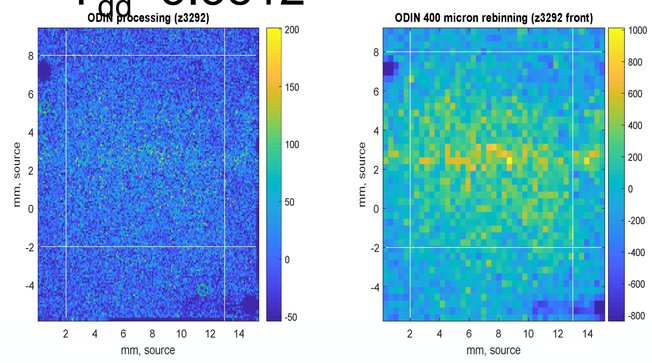


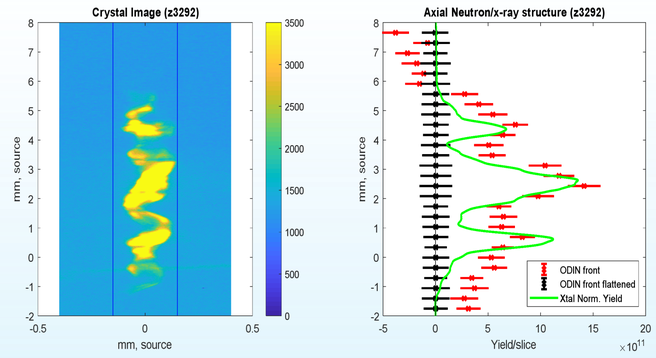
Shot Z3289:
Y_{dd}=1.1e13





Shot Z3292 :
Y_{dd}=5.3e12





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National Nuclear Security Administration

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