MEASUREMENT OF LOW- MODE ASYMMETRY OF THE COMPRESSED CORE WITH X-RAY AND NEUTRON SELF-EMISSION IMAGING AT THE NATIONAL IGNITION FACILITY

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To achieve the high compression required for thermonuclear ignition in inertial confinement experiments, control of low-mode asymmetries is crucial. Imaging of the hot core region is one of the most useful tools to evaluate the uniformity of the implosion and requires the use of radiation which has enough penetrability through the surrounding high density region. For this purpose, x-ray and neutrons produced by nuclear reactions in the hot core have been used.

Images of self-emission x-ray and neutron are different in details because of different production mechanisms and sensitivity to the imploded DT/CH shell upon their escape. X-ray production reflects the density and temperature of the electrons and the atomic number of the material; while the neutron production reflects the density and temperature of the deuterium-tritium ions.

Current experiments at the NIF have two x-ray cameras, one on the pole and another one on the equator, along with one neutron camera at a different equatorial direction. Because x-ray and neutron images are obtained from different directions, we cannot compare those images directly. We therefore developed a model which infers the shape of the emitting volume from two x-ray images. By doing a Radon transform, the model generates the x-ray image expected along the third observation angle of the neutron image. By using this tool, we compared the size of inferred x-ray images to the experimental neutron images. In the case of shots with DT ice layers, the size of x-ray image was similar to that of neutron images. However, the inferred x-ray image of DT- filled plastic shell implosions were larger than the neutron image. The observed difference is suggesting the x-ray production in the DT-filled plastic shell is dominated by carbon ions near the gas-shell boundary.

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