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4.48 Velocity correction for nuclear activation detectors at the NIF

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The velocity distribution of the hotspot in an Inertial Confinement Fusion (ICF) implosion changes the spectra of fusion neutrons emitted from the experiment as a function of viewing angle. These velocity-induced spectral changes affect the response of nuclear activation detectors (NADs) positioned around the experiment, and must be accounted for to correctly extract information about areal density (ρR) asymmetry from the data. Three mechanisms through which average hotspot velocity affects NAD activation are addressed: change in activation cross-section due to Doppler shift of the mean neutron energy, kinematic increase in neutron fluence, and change in scattering cross-section due to Doppler shift. Using the hotspot velocity inferred from NTOF measurements of D-T and D-D fusion neutrons, the hotspot velocity is shown to account for 80% of the observed NAD activation asymmetry in a calibration shot with negligible fuel ρR. A robust method to evaluate uncertainties in spherical-harmonic fits to the NAD data due to the velocity correction and detector uncertainty is presented.

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