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Nuclear imaging of implosions at the National Ignition Facility[1]

GARY GRIM, Los Alamos National Laboratory

The nuclear diagnostic capability at the National Ignition Facility (NIF), includes: neutron imaging, providing images of where neutrons are produced and scattered; gamma reaction history, providing bang time and burn width; neutron time-of-flight and spectrometry, providing directional information on yield, ion temperature, and scattering; and nuclear activation, providing directional yield information. The set provides a self-consistent, nuclear picture of the fuel assembly during burn. Recent experiments indicate in a typical implosion the hot core is approximately 50 μm in diameter and enveloped by a dense shell $\sim$15 μm thick. The burn width, yield, and volume of the core indicate pressures of 75 to 100 Gbar are being achieved. Further, image, time-of-flight, and activation data indicate the shell is thicker on the poles than the equator by approximately 40%. Comparison of the shell geometry data with time-of-flight scattering ratios indicate the density of the shell may be at least 40% lower than would be obtained using the initial fuel payload, indicative of instability growth at the fuel-ablator interface, or possibly density gradients within the shell. We present a review of the current data and the status of fuel-assembly analyses based on these data.

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