

Investigating the onset of carbon K-shell ionization from imploding CH and HDC capsules measured at the National Ignition Facility

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Accurately determining the ionization state of warm dense carbon is critical for predictive modeling in high-energy-density physics, particularly for inertial confinement fusion experiments and for advancing the understanding of astrophysical systems such as white dwarf envelopes [1,2]. However, obtaining direct measurements under the relevant extreme conditions remains challenging. To address this, X-ray Thomson scattering (XRTS) provides a powerful diagnostic capable of simultaneously characterizing temperature, density, and ionization state in warm dense matter [3-6]. Here, we report the current status of analyzing XRTS spectra from imploding CH and HDC capsule experiments at the National Ignition Facility (NIF). Utilizing the capsule implosion platform in 120-degree backscatter geometry, this work enables in situ probing of the carbon K-shell ionization state and inferring prevailing plasma conditions during the dynamic implosion. In the probed regime of 0.1 Gbar to 1 Gbar in pressure and up to 100 eV in temperature, our results show significantly higher carbon ionization compared to state-of-the-art ionization models and simulations

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