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Investigating ICF target conditions through spectroscopy[1]

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The fuel in inertial confinement fusion (ICF) targets is heated and compressed to extreme conditions, reaching multi-keV temperatures and higher-than-solid densities in a neutron- producing core with strong gradients and high velocities in the surrounding plasma. Measuring these conditions is an important step in understanding, accurately simulating, and, ultimately, controlling ICF target performance, whether the target is indirectly driven by laser-heated hohlraum emission or directly driven by lasers or magnetic fields. While neutron signals provide information about the core plasma, the emission and absorption spectra of high-energy x-rays can provide detailed information about core conditions, mix, gradients, velocities, and fields. We present modeled spectroscopic signatures of these quantities, demonstrate the importance of photon energy in diagnosing high-temperature core regions, and show how traditional atomic models must be modified to accurately describe x-ray emission from plasma at extreme densities.

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