Iron L-shell opacity in solar-relevant conditions using ultra-high-intensity lasers

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Abstract

We present experimental results aimed at measuring the L-shell opacity of iron under conditions relevant to the Sun's radiative zone. Iron opacity plays a crucial role in the Sun's internal energy flux and structure, but remains a subject of debate due to discrepancies between experimental results and theoretical models (Bailey et al. 2015).

In an attempt to understand these differences, we conducted an experiment using a different approach: a short-pulse (25 femtoseconds) ultra-high-intensity laser irradiated a few-micron-thin plastic foil containing a sample of solid iron. The electrons accelerated by the laser induced a fast isochoric heating of the solid-density iron sample, reaching temperatures of more than 200 eV. The front surface of the target, heated at much higher temperatures, produced a backlight of broadband soft X rays for the iron L-shell absorption spectroscopy.

We describe the experimental results and compare to atomic simulations.