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12.32 Soft X-ray backlighter source driven by a short-pulse laser for pump-probe characterization of warm dense matter

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Matter in the warm, dense regime (T˜1-100 eV; ρ˜0.01-10 g/cc) is often challenging to diagnose on the timescales of its evolution. For example, matter isochorically heated by a sub-picosecond laser or laser-driven proton beam can rise in temperature by 100 eV over a timescale of ps to 10s of ps, motivating development of sub-ps time-resolved measurement techniques. Here we describe a pump-probe X-ray absorption spectroscopy temperature measurement technique. It is shown using atomic modeling simulations that the energy and optical depth of bound-bound and bound-free transitions in various low-Z materials are highly sensitive to temperature in the range of 10 to >100 eV. A backlighter source suitable for the technique was developed using a range of laser parameters with pulse duration ≤5 ps and various pure and alloyed materials.This work was performed under the auspices of the Department of Energy through the Fusion Energy Sciences HEDLP program under grant award number DE-SC0014600.

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