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Femtosecond probing around the K-edge of a laser heated plasma using X-rays from betatron oscillations in a laser wakefield accelerator KEEGAN BEHM, TONY ZHAO, ANATOLY MAKSIMCHUK, VICTOR YANOVSKY, JOHN NEES, Univeristy of Michigan, STUART MANGLES, Imperial College of London, KARL KRUSHELNICK, ALEXANDER THOMAS, Univeristy of Michigan, CENTER FOR ULTRAFAST OPTICAL SCIENCE TEAM, PLASMAS GROUP TEAM — Presented here are data from a two-beam pump-probe experiment. We used synchrotron-like X-rays created by betatron oscillations to probe a thin metal foil that is pumped by the secondary laser beam. The Hercules Ti:Sapph laser facility was operated with a pulse duration of 34 fs and a power of 65 TW split to drive a laser wakefield accelerator and heat the secondary target. We observed opacity changes around the K-edge of thin foils as they were heated by an ultrafast pump laser. To understand how the opacity is changing with heating and expansion of the plasma, the delay between the two laser paths was adjusted on a fs and ps time scale. Experimental data for polyvinylidene chloride (PVDC) and aluminum show variations in opacity around the Cl and Al K-edges with changes in the probe delay. The transmitted synchrotron-like spectrum was measured using single photon counting on an X-ray CCD camera and was available on a shot-by-shot basis. The success of this work demonstrates a practical application for X-rays produced from betatron oscillations in a wakefield accelerator. The compact size of these "table-top" accelerators and the ultrashort nature of the generated X-ray pulses allows pump-probe experiments that can probe events that occur on the femtosecond time scale.

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