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X-Ray Opacity Measurements of Solid Density Plasmas JUSTIN WARK, THOMAS PRESTON, ORLANDO CIRICOSTA, SAM VINKO, PATRICK HOLLEBON, University of Oxford, HYUN-KYUNG CHUNG, IAEA, Vienna, THOMAS BURIAN, JAROMIR CHALUPSKY, VOJTECH VOZDA, IOP, Prague, FRANK HALL, CHRISTOPHER SPINDLOE, Rutherford Appleton Laboratory, ULF ZASTRAU, European XFEL, GEORGI DAKOVSKI, MICHAEL MINITTI, SLAC — Accurate opacity measurements of dense plasmas are scarce, in part owing to the difficulty in creating samples that are uniform in density and temperature, and the associated undertaking of an opacity measurement on a time-scale short compared with disassembly. Here we demonstrate that x-ray opacity information can be obtained from emissivity measurements of solid-density targets of varying but known thickness, irradiated by a sub-100-fsec x-ray pulse from LCLS. As the emission is generated by the creation of core-holes created by the FEL, and they are rapidly filled on a femtosecond time-scale, information is gleaned before any hydrodynamic motion. Comparision with simulations based on the SCFLY atomic-kinetics code reveal that the time-integrated emission data can provide a strong constraint on the opacity under well-defined conditions of density and temperature, and further demonstrate that the technique is relatively insensitive to x-ray pulse-length and spatial distribution. As an example we present measurements of the K-shell opacity of a solid-density magnesium plasma for all ion stages up to helium-like.

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