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Direct Measurement of bulk temperature using Inelastic X-ray Scattering at X-ray Free Electron Lasers. ADRIEN DESCAMPS, BENJAMIN OFORI-OKAI, LUKE FLETCHER, JEROME HASTINGS, SLAC National Accelerator Laboratory, Menlo Park, 94025, California, USA, ULF ZASTRAU, European X-Ray Free-Electron Laser Facility GmbH, GREGORI GIANLUCA, Department of Physics, Clarendon Laboratory, Parks Road, University of Oxford, OX1 3PU, UK, SIEGFRIED GLENZER, EMMA MCBRIDE, SLAC National Accelerator Laboratory, Menlo Park, 94025, California, USA, MEV-IXS@EUXFEL TEAM
— Direct and accurate measurements of thermodynamic and transport properties are essential for understanding the behavior of extreme states of matter. While X-ray diffraction measurements at large laser facilities or Free Electron Lasers, such as the LCLS, have allowed *in situ* measurement of structure and density, however, the direct measurement of bulk temperature remains a challenge. Here, we present the development of a platform using inelastic X-ray scattering in a Johann geometry to measure temperature by the use of the principle of detailed balance. A proof-of-principle experiment was conducted at the HED beamline at the European XFEL on resistively heated single crystal diamond at 500 K. This technique was then combined with a cryogenic jet of argon compressed with a short pulse laser at the MEC endstation at LCLS, allowing the direct measurement of the temperature of laser compressed matter.

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