Abstract Submitted
for the SHOCK19 Meeting of
The American Physical Society

Feasibility Studies of the Use of Inelastic X-ray Scattering as a Temperature Diagnostic of Transiently Compressed Matter[1] OLIVER KARNBACH, DAVID MCGONEGLE, GIANLUCA GREGORI, JUSTIN WARK, University of Oxford — Recent experiments at LCLS have demonstrated the feasibility of using femtosecond x-ray pulses to inelastically scatter from phonons in a solid[1]. In principle, measuring the relative intensities of the Stokes and anti-Stokes peaks could provide a direct measure of the temperature without recourse to needing to know the Debye temperature. However, the number of inelastically scattered photons is low, and thus absolute temperature measurements on laser-compressed samples will need to accumulate data over many shots. We present here simple calculations of the cross section, compare them with the data provided in [1], and comment on the long-term feasibility of using this technique at the European XFEL. We further consider the degree of elastic scattering with which the inelastic signal will need to compete owing to intrinsic and shock-induced defects in samples of interest. Synthetic phonon spectra and scattering signals are calculated in various materials under dynamic compression using large-scale molecular dynamics simulations. [1] E.E. McBride et al., Rev. Sci. Instrum. 89, 10F104 (2018)

[1]AWE plc. and Engineering and Physical Research Council

Oliver Karnbach
University of Oxford

Date submitted: 27 Feb 2019 Electronic form version 1.4