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Direct Temperature Measurement of Laser-compressed Matter using inelastic X-ray Scattering[1]

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Although vital, the direct measurement of temperature at extreme conditions, in particular in the warm dense matter regime is challenging. We combine a cryogenic jet with a chirped short pulse laser to generated a laser-driven shock-wave with a setup for performing high-resolution inelastic X-ray scattering measurement at the Linac Coherent Light Source (LCLS) to directly measure the evolution of temperature of laser-compressed argon. We use the principle of detailed balance to determine temperature directly, frysom the bulk sample probed by the X-ra. In addition, we measure the sample density using X-ray diffraction, and estimate the sound speed at extreme conditions from a direct measurement of the dispersion curve. The techniques described are applicable across a wide range of fields of plasma and warm dense matter science.

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