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X-ray scattering measurements of the structure of strongly coupled plasmas at x-ray free electron lasers PAUL NEUMAYER, GSI, TILO DÖPPNER, LLNL, LUKE FLETCHER, LBNL, ERIC GALTIER, LCLS, DIRK GERICKE, Warwick, SIEGFRIED GLENZER, SLAC, GIANLUCA GREGORI, NICHOLAS HARTLEY, U. Oxford, DIMITRI KHAGHANI, GSI, HAE JA LEE, LCLS, TAMMY MA, LLNL, BOB NAGLER, LCLS, ART PAK, LLNL, RONALD REDMER, U. Rostock, ULF ZASTRAU, U. Jena — Laser-plasma x-ray sources have been an indispensable probe to diagnose and characterize plasmas in the warm-dense matter regime. The latest generation of bright x-ray free-electron lasers now enables such diagnostic techniques to be implemented at FEL facilities. Even more, FEL parameters, such as collimation, pulse duration, focusability, bandwidth, or repetition rate, are far superior compared to laser-driven sources, enabling measurements of unprecedented resolution and accuracy. As an example, we present measurements of the static structure factor in high energy density matter. Angle-resolved x-ray scattering was performed at the Matter at Extreme Conditions (MEC) instrument at the Linac Coherent Light Source (LCLS). Strongly coupled warm-dense aluminium was produced by laser shock compression. Covering a wide range of scattering angles with unprecedented angular resolution the correlation peak of the ion-ion structure factor could be well resolved. The exceptional collimation of the LCLS beam enabled measurements at small scattering angles, thus approaching the long wavelength limit.

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