

Abstract Submitted
for the DPP13 Meeting of
The American Physical Society

Exploring matter in extreme conditions at the LCLS x-ray laser¹

SIEGFRIED GLENZER, SLAC National Accelerator Laboratory, HIGH ENERGY DENSITY SCIENCE TEAM — The Matter of Extreme Conditions end station at the SLAC National Accelerator Laboratory offers the unique combination of the LCLS x-ray beam with high-power nanosecond and femtosecond laser beams for precision pump-probe studies of high-energy density plasmas. The first x-ray Thomson scattering measurements on shock-compressed matter have recently shown unprecedented spectral, wavenumber and temporal resolution proving densities and temperatures in megabar shocks. When two shocks, driven from opposite sides into solid aluminum, coalesce the scattering angle of the ion-ion correlation peak significantly increases indicating 3x times compressed solid matter. In parallel, plasmons have been clearly resolved using a seeded x-ray beam. These proof-of-principle studies show great promise for future discoveries in high-intensity laser-plasma interaction physics. For this purpose, we are building a new 200 TW laser system allowing interaction experiments with ultrahigh temporal resolution and with very high data throughput. In this talk, we will present and discuss the first experimental results and provide an outlook for future studies using these emerging capabilities.

¹This work is supported by U.S. Department of Energy, Office of Basic Energy Sciences and Fusion Energy Sciences.

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Date submitted: 12 Jul 2013

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