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Two-temperature equilibration in warm dense hydrogen measured with x-ray scattering from the LCLS[1] LUKE FLETCHER, SLAC - Natl Accelerator Lab, HIGH ENERGY DENSITY SCIENCES COLLABORATION — Understanding the properties of warm dense hydrogen plasmas is critical for modeling stellar and planetary interiors, as well as for inertial confinement fusion (ICF) experiments. Of central importance are the electron-ion collision and equilibration times that determine the microscopic properties in a high energy density state. Spectrally and angularly resolved x-ray scattering measurements from fs-laser heated hydrogen have resolved the picosecond evolution and energy relaxation from a two-temperature plasma towards thermodynamic equilibrium in the warm dense matter regime. The interaction of rapidly heated cryogenic hydrogen irradiated by a 400 nm, 5x1017 W/cm2, 70 fs-laser is visualized with ultra-bright 5.5 kev x-ray pulses from the Linac Coherent Light (LCLS) source in 1 Hz repetition rate pump-probe setting. We demonstrate that the energy relaxation is faster than many classical binary collision theories that use ad hoc cutoff parameters used in the Landau-Spitzer determination of the Coulomb logarithm.

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