X-ray Scattering Measurement of the Heat Capacity Ratio in Shock Compressed Matter\textsuperscript{1} C. FORTMANN, LLNL, H.J. LEE, SLAC, TILO DOEPPNER, A.L. KRITCHER, O.L. LANDEN, LLNL, R.W. FALCONE, UC Berkeley, S.H. GLENZER, LLNL — We developed accurate x-ray scattering techniques to measure properties of matter under extreme conditions of density and temperature in intense laser-solid interaction experiments. We report on novel applications of x-ray scattering to measure the heat-capacity ratio $\gamma = c_p/c_v$ of a Be plasma which determines the equation of state of the system. Ultraintense laser radiation is focussed onto both sides of a Be foil, creating two counterpropagating planar shock waves that collide in the target center. A second set of lasers produces Zn He-\(\alpha\) radiation of 8.9 keV energy that scatters from the shock-compressed matter. We observe temperatures of 10 eV and 15 eV and mass densities of $5\,\text{g/cm}^3$ and $11\,\text{g/cm}^3$ before and after the shock collision. Applying the Rankine-Hugoniot relations for counterpropagating shocks we then infer $\gamma$ as a function of density using only the measured mass compression ratios. Our results agree with equation of state models and DFT simulations.

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