Abstract Submitted
for the DPP11 Meeting of
The American Physical Society

X-ray Scattering Measurement of the Heat Capacity Ratio in Shock Compressed Matter[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-α radiation of 8.9 keV energy that scatters from the shock-compressed matter. We observe temperatures of $10\,\mathrm{eV}$ and $15\,\mathrm{eV}$ and mass densities of $5\,\mathrm{g/cm^3}$ and $11\,\mathrm{g/cm^3}$ before and after the shock collision. Applying the Rankine-Hugoniot relations for counterpropagating shocks we then infer γ as a function of density using only the measured mass compression ratios. Our results agree with equation of state models and DFT simulations.

[1]This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344. We acknowledge support from the Alexander von Humboldt- Foundation.

Carsten Fortmann
LLNL

Date submitted: 14 Jul 2011 Electronic form version 1.4