Abstract Submitted
for the SHOCK11 Meeting of
The American Physical Society

Equation-of-state measurements of laser-shocked liquid hydrogen

TAKAYOSHI SANO, NORIMASA OZAKI, TATSUHIRO SAKAIYA, KEISUKE SHIGEMORI, Osaka University, MASAHIRO IKOMA, Tokyo Institute of Technology — The properties of hydrogen at high pressure and high density are of great scientific interest. The equation of state (EOS) of hydrogen at these conditions is essential for modeling of the interior structure of gas giant planets. The large diversity in the estimation of Jupiter's core mass is resulted from the uncertainty in the EOS data especially in the region around the insulator-to-metal transition. Chemical free-energy models and ab initio simulations have been used to predict the properties of warm dense hydrogen, but the results vary widely and have not converged yet. Therefore, accurate experimental data for the hydrogen EOS are required for evaluation of the theoretical models. In this work, the principal Hugoniot for liquid hydrogen was obtained up to 55 GPa under laser-driven shock loading. The pressure and density of compressed hydrogen were determined by impedance-matching to a quartz standard. The shock temperature was independently measured from the brightness of the shock front. Hugoniot data of hydrogen provide a good benchmark to modern theories of condensed matter. The initial number density of liquid hydrogen is lower than that for liquid deuterium, and this results in shock compressed hydrogen having a higher compression and higher temperature than deuterium at the same shock pressure.

Takayoshi Sano
Osaka University

Date submitted: 18 Feb 2011 Electronic form version 1.4