Abstract Submitted
for the SHOCK07 Meeting of
The American Physical Society

Nonmetal-to-metal transition in warm dense hydrogen and helium[1] RONALD REDMER, BASTIAN HOLST, ANDRE KIETZMANN, NADINE NETTELMANN, Institute of Physics, University of Rostock, D-18051 Rostock, MICHAEL P. DESJARLAIS, THOMAS R. MATTSSON, Pulsed Power Sciences Center, Sandia National Laboratories — The precise knowledge of the equation of state of hydrogen and helium, especially at extreme conditions of pressure and temperature, is not only of fundamental interest but also necessary for models of interiors of giant planets such as Jupiter and Saturn. We have performed ab-initio quantum molecular dynamics (QMD) simulations for dense hydrogen and helium to study the thermophysical properties and the nonmetal-to-metal transition at high pressures. We present new results for the equation of state and the Hugoniot curves in the warm dense matter region. The optical conductivity is calculated via the Kubo-Greenwood formula from which the dc conductivity as well as the reflectivity are derived. We compare our results with shock wave experimental data as well as with other theoretical approaches. As a further application and test of the QMD equation of state data, the interiors of Jupiter and Saturn are modelled by solving the hydrostatic equation within a three-layer model.

[1]This work was supported by the Deutsche Forschungsgemeinschaft within the SFB 652.

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Date submitted: 22 Feb 2007 Electronic form version 1.4