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Shock compression of D2 to 500 GPa along the principal Hugoniot

A. FERNANDEZ-PAELLA, D. FRATANDUONO, M. MILLOT, G. W. COLLINS, P. CELLIERS, Lawrence Livermore National Laboratory, M. GREGOR, T. R. BOEHLY, Laboratory for Laser Energetics — Impedance-match measurements along the principal Hugoniot of deuterium using an Al standard were carried out about 10 years ago at the OMEGA and the Z facilities. The data at the highest pressures (near 200 GPa) suggest a systematically softer response than current equation of state (EOS) models, although the measurement uncertainties are too large to confirm a disagreement with the models. More recent data sets from shock timing experiments on the National Ignition Facility for the inertial confinement fusion program, and a reanalysis of old OMEGA data to extract the sound speed suggest that the deuterium Hugoniot may indeed be softer than the models predict above 150 GPa. We have investigated this issue with recent experiments at the OMEGA laser facility, and we present new impedance-match data along the deuterium principal Hugoniot in the 250-500 GPa range obtained with higher measurement accuracy using quartz as the impedance match standard. This work was performed under the auspices of the U.S. Department of Energy by LLNL under contract DE-AC52-07NA27344.

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