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Warm dense hydrogen in the chemical picture RONALD REDMER, HAUKE JURANEK, NADINE NETTELMANN, VOLKER SCHWARZ, University of Rostock, Institute of Physics, D-18051 Rostock, Germany — The properties of hydrogen as the simplest and most abundant element in the universe are of great interest for astrophysical studies and inertial confinement fusion experiments. Thus, a precise knowlegde of the equation of state (EOS) and of the transport properties is needed for a large domain of densities and temperatures, especially for the region of warm dense matter where correlations are very important. We present theoretical results for the EOS and the transport properties of hydrogen, especially for the high pressure domain. Based on the chemical picture, the EOS of hydrogen is determined within fluid variational theory considering dissociation and ionization processes. We compare our new results with available experimental data and other theoretical predictions for the Hugoniot curve and the sound velocity. The EOS data is also used to model interiors of giant planets such as Jupiter. The composition of hydrogen as function of temperature and pressure is derived from the EOS and serves as input in calculations of transport properties such as the electrical conductivity. Using linear response theory, the various scattering mechanisms of free and bound electrons are treated, and the nonmetal-to-metal transition in hydrogen as well as in noble gases can be explained by pressure ionization. Comparison with respective experimental data for the electrical conductivity and the reflectivity shows good overall agreement.

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