Title: Warm dense matter – probing planetary interiors
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Abstract: The behaviour of warm dense matter (pressures up to the TPa region and temperatures up to several eV) is of paramount importance for understanding the interior, evolution, and magnetic field of solar and extrasolar planets. The lightest elements H and He are the main components of gas giants like Jupiter, and mixtures of C-N-O-H are relevant for Neptune-like planets. However, the high-pressure phase diagram of these elements and mixtures is not well known, e.g., the slope of the corresponding melting lines. Furthermore, insulator-to-metal transitions and phase separation may occur in warm dense matter. A detailed knowledge of these high-pressure phenomena is essential for interior, evolution, and dynamo models, but performing corresponding high-pressure experiments and ab initio computations is still demanding.
Here we use molecular dynamics simulations based on density functional theory to calculate equation of state data and transport properties of warm dense matter for a wide range of densities and temperatures as typical for the interior of giant planets. These data are then benchmarked against diamond-anvil-cell and shock-wave experiments. Finally, we predict the corresponding high-pressure phase diagram and consruct interior and evolution models for solar and extrasolar giant planets.

Biographical information: Ronald is Full Professor for Statistical Physics at the University of Rostock, Germany, since 2003. He got his PhD at the University of Rostock with a thesis work on dense alkali plasmas in 1986 and his habilitation in Theoretical Physics in 1992. He was Feodor Lynen Fellow at the Oregon State University in Corvallis 1992-1993. Back in Rostock he initiated research programs on dense metal and hydrogen plasmas using chemical models and later also first-principles methods such as DFT-MD simulations. He extended his research activities to plasma diagnostics using x-ray Thomson scattering and to astrophysics, in particular to planetary physics. Ronald has published more than 250 research papers. He is Chair of the Program Committe of the international conference series on Strongly Coupled Coulomb Systems (SCCS) and Physics of Nonideal Plasmas (PNP). He is Fellow of the APS and Dr. h.c. of the Russian Academy of Sciences.