Abstract Submitted
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Ab initio equation of state data and interior structure of giant planets[1] RONALD REDMER, NADINE NETTELMANN, ULRIKE KRAMM, WINFRIED LORENZEN, BASTIAN HOLST, MARTIN FRENCH, University of Rostock — We have performed quantum molecular dynamics simulations using finite-temperature density functional theory (FT-DFT-MD) to calculate accurate equation of state data for the most abundant materials in giant planets hydrogen, helium, and water in the warm dense matter region. We discuss the phase diagram of water up to ultra-high pressures and identify the location of the superionic phase which might occur in the deep interior of Neptune, Uranus or even in Saturn. These ab initio data sets were used to calculate the interior structure models of solar giant planets within the standard three-layer model and to determine their core mass and metallicity. We have also determined possible compositions of extrasolar giant planets such as GJ 436b for which the mass-radius relation and the surface temperature are measured. We discuss also the impact of high-pressure effects such as the nonmetal-to-metal transition in hydrogen and the demixing of hydrogen and helium on the interior structure of giant planets.

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