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Exploring warm dense water by using Free-Electron-Laser[1] P. SPERLING, J. KIM, Z. CHEN, SLAC National Accelerator Laboratory, M. FRENCH, University of Rostock, C. CURRY, J. KORALEK, M. MO, SLAC National Accelerator Laboratory, M. NAKATSUTSUMI, European XFEL GmbH, R. RODEL, Friedrich-Schiller-University Jena, R. REDMER, University of Rostock, S. TOLEIKIS, Deutsches Elektronen-Synchrotron, DESY, P. ZALDEN, European XFEL GmbH, S. H. GLENZER, SLAC National Accelerator Laboratory — Warm dense water is predicted in the interior of giant planets and has an important impact on planetary evolutions. As such, the electrical and thermal properties in this regime are critically important for modelling astrophysical objects. We present electrical property measurements in warm dense water by using a novel planar water jet compatible with high repetition rate studies. The liquid density water is isochorically and uniformly heated to non-equilibrium warm dense matter by FLASH free-electron laser irradiation (5.5 nm, $0.1 - 20$ μJ). The dielectric function can be extracted from optical transmission and reflection measurements on the picosecond timescale before significant expansion and subsequent relaxation occurs. The time-dependent dielectric function reveals the electronic properties of water at different temperatures of the electronic and ionic subsystem during the heating and relaxation process, that allow to infer the electron-ion energy coupling. Comparison with 2-temperature density-functional-theory molecular-dynamic simulations show good agreement, that can not be achieved by standard theories of plasma physics.

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