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Dynamic properties of the warm dense electron gas: an ab initio path integral Monte Carlo approach PAUL HAMANN, Kiel University, Germany, TOBIAS DORNHEIM, Center for Advanced Systems Understanding, Germany, JAN VORBERGER, Helmholtz-Zentrum Dresden-Rossendorf, Germany, ZHANDOS MOLDABEKOV, Al-Farabi Kazakh National University, Kazakhstan, MICHAEL BONITZ, Kiel University, Germany — While being ubiquitous in astrophysics and highly compressed laboratory plasmas, warm dense matter is very difficult to describe theoretically, due to the intricate interplay of quantum degeneracy, correlations and thermal excitations. Ab-initio thermodynamic results for the electronic component were obtained only recently [Dornheim et al., Phys. Reports 744, 1–86 (2018)], using novel path integral Monte Carlo (PIMC) methods. These, however, are limited to static quantities. The investigation of dynamic properties, such as density correlation functions, leading to the dynamic structure factor $S(q, \omega)$ – a key quantity measured in x-ray Thomson scattering experiments – is only feasible in terms of an imaginary time. By carrying out extensive PIMC simulations and developing a new reconstruction method, based on stochastic sampling of the dynamic local field correction, we have recently obtained the first exact quantum Monte Carlo results for the dynamic structure factor [Dornheim et al., Phys. Rev. Lett. 121, 255001 (2018)]. Here we extend this approach to other dynamical quantities of the warm dense electron gas, including the dynamic susceptibility, optical conductivity, and dielectric function.

Paul Hamann
Kiel University, Germany

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