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Large-scale modeling of high-energy density plasmas from first principles: Dynamic Density Response Properties

Recent promising results from inertial fusion energy (IFE) facilities, such as the National Ignition Facility in the USA, have sparked a strong interest in IFE technologies. Because it is a multiscaled problem from a simulation standpoint, significant effort is required to accurately model the dense plasmas on various length and time scales, which is crucial for developing IFE technology. One of the main challenges in modeling is creating reliable simulation tools to study the dynamic dielectric and transport properties of dense plasmas across different temperature and density ranges. Quantum many-body theory is crucial in developing a dependable method for computing these properties, provided the density response function of plasmas is known. This presentation discusses the advanced simulation methods being used and developed at the Center of Advanced Systems Understanding [1-4] for this property and the associated computational and work expenses.

[1] Tobias Dornheim, Zhandos A. Moldabekov, Kushal Ramakrishna, Panagiotis Tolias, Andrew D. Baczewski, Dominik Kraus, Thomas R. Preston, David A. Chapman, Maximilian P. Böhme, Tilo Döppner, Frank Graziani, Michael Bonitz, Attila Cangi, Jan Vorberger, *Electronic density response of warm dense matter*, Phys. Plasmas 30, 032705 (2023).
[2] Zhandos Moldabekov, Jan Vorberger, Tobias Dornheim, *Density Functional Theory Perspective on the Nonlinear Response of Correlated Electrons across Temperature Regimes*, J. Chem. Theory Comput. 2022, 18, 5, 2900–2912
[3] Zhandos A. Moldabekov, Michele Pavanello, Maximilian P. Böhme, Jan Vorberger, and Tobias Dornheim, *Linear-response time-dependent density functional theory approach to warm dense matter with adiabatic exchange-correlation kernels*, Phys. Rev. Research 5, 023089 (2023)
[4] Maximilian Böhme, Zhandos A. Moldabekov, Jan Vorberger, and Tobias Dornheim, *Static Electronic Density Response of Warm Dense Hydrogen: Ab Initio Path Integral Monte Carlo Simulations*, Phys. Rev. Lett. 129, 066402 (2022)

Speed talk:

I am unwilling/unable to present a speed talk

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