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Quantum hydrodynamics for plasmas–quo vadis?[1] MICHAEL BONITZ, HANNO KHLERT, Kiel University, ZHANDOS MOLDABEKOV, TLEKKABUL RAMAZANOV, Al Farabi Kazakh National University — Quantum hydrodynamics (QHD) has become popular for modeling of quantum plasmas and warm dense matter, following Ref. 1. While QHD is quite successful for describing Bose-Einstein condensates and plasmonic excitations in metallic nanoparticles, the application of the model of Ref. [1] to dense plasmas has lead to oversimplified fluid equations. These equations neiter reproduce the correct plasmon dispersion (except for 1D models) nor the screened potential of an ion in a quantum degenerate plasma [2, 3] and have led to astonishing predictions that have been controversially discussed. Here we present a systematic derivation, starting from quantum statistical theory, that leads to microscopic QHD equations that are in agreement with time-dependent DFT and quantum kinetic theory and which serve as a basis for deriving improved QHD models for plasmas [3].
[1] G. Manfredi and F. Haas, Phys. Rev. B 74, 075316 (2001)
[2] Zh. Moldabekov, M. Bonitz, and T. Ramazanov, Phys. Plasmas 25, 031903 (2018)
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