Quantum hydrodynamic approach for quantum plasmas
Zh. Moldabekov and M. Bonitz

Institut für Theoretische Physik und Astrophysik, Christian-Albrechts-Universität zu Kiel,
Leibnizstraße 15, 24098 Kiel, Germany

Dense quantum plasma is characterized by the manifestation of degeneracy as well as non-ideality effects. Description of such plasma is challenging both theoretically and computationally [1]. Therefore, quantum hydrodynamics (QHD) has become popular as a simplified but not simplistic model [2]. However, the lack of the consistency in the first versions resulted in usage outside the range of applicability and even with incorrect explicit expressions as was shown in Refs. [3, 4]. To this end, a consistent QHD model is developed [5], on the basis of which previous results are revised. This creates solid ground for further improvements of the QHD. As the further development of the theory, the non-local Bohm potential on the basis of the random phase approximation for QHD application is proposed. Consideration of the non-ideality effects is based on the linking of the QHD exchange-correlation potential to local field corrections. As the result, the explicit form of the exchange-correlation potential in relaxation time approximation is given. Generalization of this approximation via introduction of the dynamic collision frequency is discussed. Finally, the range of applicability of QHD is analayzed.

References