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Warm Dense Matter, Quantum Hydrodynamics, and Shocks

Thursday 15 September 2022 14:30 (45 minutes)

The experimental and computational investigation of equilibrium and non-equilibrium many-body plasmas with partially or fully degenerate electrons is an intellectually challenging and stimulating problem. Warm dense matter is of particular interest since it exists at the intersection of condensed matter and ideal plasmas physics where particle correlations and quantum degeneracy are all important. A wide variety of theoretical methods have been developed and are in routine use for studying warm dense matter. This includes density functional theory, time-dependent density functional theory, kinetic equations and Green functions. Recently, there has been a resurgence in s "simpler"approach based on quantum hydrodynamics (QHD). QHD has a long and interesting history, dating back to Madelung and Bohm. In this talk, we discuss the historical and recent developments in QHD. We will discuss the implementation of a QHD capability in the multi-physics code MIRANDA and its application to shock physics. We use QHD MIRANDA with Fermi pressure, Bohm pressure, exchange, and Poisson to better understand shock propagation and shock structure in degenerate matter. We compare the shock physics described by QHD with that of classical fluid equations.

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