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Nonlinear plasma waves and wavebreaking in quantum plasmas
HANS-JOERG KULL, RWTH Aachen University — Large amplitude plasma waves are commonly excited in laser-plasma interactions. One of the basic features of nonlinear plasma waves is wavebreaking when a critical wave amplitude is exceeded. The wavebreaking amplitude was first derived by Dawson for cold plasmas [1]. Later this criterion was generalized to thermal and relativistic plasmas by various authors [2-3]. In the present work, we consider the wavebreaking limit in warm dense matter. The basic quantum kinetic equation is the quantum Vlasov equation. We propose a numerical method that solves the set of quantum Vlasov-Maxwell equations with the same efficiency as classical particle-in-cell (PIC) simulations. The basic concept of this method consists in a representation of the ensemble by a set of carrier-envelope waves and a propagation of these waves in their rest frames by the time dependent Schrödinger equation. Linear dispersion relations and Landau damping rates can be accurately reproduced by this method. Wavebreaking amplitudes in quantum plasmas are obtained and compared to theoretical results.

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