Wave-Particle Interactions in the Transition Between the Linear and Non-Linear Regimes of the Landau Damping

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Abstract: Landau damping is originally a plasma phenomenon where electrostatic fluctuations damp even in the absence of collisions between charged particles. However, analogues of Landau Damping can also be found in gravitating systems, quark-gluon plasmas, and in some biological systems [1]. The most accepted interpretation for the mechanism for Landau damping is that electrons slower than the electrostatic wave front are accelerated by the wave, and faster electrons are slowed down by transferring their energy to the wave [2]. This results in arresting of damping and subsequent non-linear growth of the electrostatic wave, in a process with characteristics of a phase-transition [3]. In this work, we test the validity of these interpretations through Vlasov simulations and the use of field-particle correlation diagnostics [4], and we show that there exists some cases in which Landau damping occurs even if no energy transfer between waves ad particles are present.

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