DPP14-2014-001621

Abstract for an Invited Paper
for the DPP14 Meeting of
the American Physical Society

Multi-dimensional Vlasov Simulations and Modeling of Trapped-Electron Sideband and Filamentation Instabilities of Non-Linear Electron Plasma Waves[1]

RICHARD BERGER, Lawrence Livermore National Laboratory

Vlasov simulations of large amplitude electron plasma waves (EPWs), which play an essential role in laser-fusion relevant plasmas, have been carried out in 1D and 2D and compared with theoretical models [1]. The electrons trapped in the wave troughs are shown to be well described by an "adiabatic" distribution with a corresponding frequency shift of the EPW [2]. Trapped particles play an essential role in the mechanisms underlying sideband instabilities that may affect the EPW, in particular longitudinal instabilities of trapped particle instability (TPI) type, as well as transverse instabilities of kinetic filamentation type. A systematic study of the spectrum of linearly unstable modes in 1D and 2D systems, including their growth rates and wavevectors, has been completed by scanning the amplitude and wavenumber of the initial wave. Simulation results for the TPI are successfully compared with Kruer's reduced model [3] and are also analyzed for the development of the "negative mass instability" [4]. In the non-linear phase, both the TPI and filamentation instabilities are shown to lead to a rapid loss of field energy and an associated increase in electron kinetic energy. Saturation of the instabilities is reached in conjunction with the development of significant regions in phase space where trajectories of particles, resonant with the initial wave, become chaotic.

[1] J. W. Banks *et al*, Phys. Plasmas **18**, 052102(2013); R. L. Berger, *et al*, Phys. Plasmas **20**, 032107 (2013); B. J. Winjum, *et al*, Phys. Rev. Lett. **111**, 105002 (2013)**;** S. Brunner, *et al*, "Kinetic Simulations and Reduced Modeling of Longitudinal Sideband Instabilities in Non-Linear Electron Plasma Waves," submitted to Phys. Plasmas
[2] R. L. Dewar, Phys. Fluids **15**, 712 (1972)
[3] W. L. Kruer, *et al*, Phys. Rev. Lett. **23**, 838 (1969)
[4] I. Y. Dodin *et al,* Phys. Rev. Lett. **110**, 215006 (2013)

[1]This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344 and funded by the Laboratory Research and Development Program at LLNL under project tracking code 12-ERD