Growth of electron hole in 1D Vlasov plasma and 4D gyro and bounce averaged kinetic Vlasov simulation

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Electron holes (EH) are frequently observed in collisionless electrostatic and magnetized plasmas. Once formed, such structures can grow by extracting free energy and by momentum exchange, or velocity scattering by other species. In the first part, the growth/stability of electron hole in the subcritical [1] and supercritical regimes, are investigated using a 1D Vlasov-Poisson simulation. At cold ion temperature the stability of electron holes are accompanied by an ion compression that yields phase velocity of electron holes above C_s (ion acoustic velocity) and accelerates them, forcing a jump over a forbidden velocity gap, and settle on the high velocity tail of the electron distribution. This acceleration is observed both in subcritical and supercritical regime of plasma instability. Therefore inside the supercritical regime, two stages of evolution of electron-hole's growth are observed (Fig. 1). In the first stage EH accelerates to higher velocity, and in the second stage EH starts to grow in amplitude due to the presence of sufficient free energy.

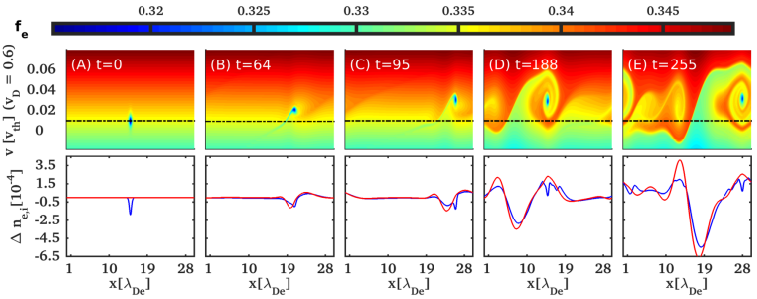

Figure 1: *Evolution of distribution f_e, n_e (blue) and n_i (red).*

In the second part a brief study on electron and ion-hole like coherent structures formation in a 4D $(\alpha, \psi, \kappa, E)$ gyrophase and bounce-motion averaged kinetic model [2] of trapped electron and ion modes (TEM and TIM) simulations of magnetically confined tokamak plasmas using TERESA code is presented. From a very small amplitude initial density perturbation, unstable TEM and TIM are excited due to resonance with the electron and ion precessional frequency of the banana-centric motion in presence of temperature inhomogeneity. Initially these modes grow and finally saturate due to energy cascading through turbulent mode-mode interactions and particle trapping in the potential profile of TEM/TIM. These trapped particle coherent-structures accelerate along the energy E direction.

References

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