Generation and Stability of Large Scale Magnetic Structures in Electron Drift Turbulence

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The generation of large scale flows by underlying small scale turbulence is a well known phenomenon in different areas of current research. Here, we turn our attention to the magnetic electron drift mode turbulence. The corresponding turbulent magnetic fluctuations are drift-type modes excited in non-uniform, initially non-magnetized plasma, characterized by a frequency range in-between the electron and the ion plasma frequencies. Within the magnetic electron drift mode turbulence, we address the question of generation of large scale magnetic fields by small scale turbulent magnetic fluctuations via turbulent Reynolds stress, as well as their subsequent mutual interactions. For the mathematical description we have to take into account that the total wave energy is conserved and contains both the part stored in small as well as large scale structures. We thus deal with a coupled system of two different parts of the same wave spectrum which cannot be addressed in isolation. This necessitates a nonlinear theory capable of describing magnetic electron drift wave and large scale magnetic fields spectra as interacting parts of one and the same spectrum. Such a self-consistent nonlinear model has been developed via a wave kinetic equation for a suitable action-like invariant. Having the spectral model equations in our hand, we focus on the dynamics of interacting magnetic drift wave - large scale field turbulence. The stability of such large scale structures is investigated in the kinetic regime and an instability criterion similar to the known Nyquist criterion in kinetic wave theory is found. This criterion is then applied to a narrow wave packet, where we find an amplitude threshold due to finite width of the wave spectrum in k-space.