Finite Amplitude Drift Wave Dynamics and Drift Turbulence in Plasma Sheared Flows

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In magnetic fusion theory, drift turbulence and possibility of the turbulent transport dumping are of a grate importance. Many theoretical and experimental studies deal with this complex problem. In the present study we consider some non-linear phenomena in plasma sheared flow across the lines of the magnetic field. Main goal of our work is the estimation of the absolute values of the plasma density (and temperature) perturbations in such flows for different ratios of shear strength and typical growth rate of the gradient drift instabilities. It is assumed that Ion Temperature Gradient (ITG) instability induces the turbulence and corresponding transport. In some cases, Trapped Electron Mode (TEM) or Electron Temperature Gradient (ETG) instability can be essential. Non-linear analysis is focused on the following stages of the mode dynamics: linear grow of the small initial perturbation, deformation under the action of the sheared flow, decay, and formation of the local fluctuations. Results of the modeling allow to consider relations between turbulent perturbations and main physical parameters such as plasma density and temperature gradients, instability growth rate, flow shear strength, etc.

At the initial stage, small ITG wave is assumed to be sinusoidal (unperturbed approximation). Modeling of the wave dynamics composes the exponential growth and sheared flow action (perturbation of the wave profile). The growth rate is assumed to be equal the linear growth rate. It is calculated using ITG/ETG/TEM dispersion relationship [1, 2]. Note other assumption is that density and temperature are constant at the wave profile surfaces.

The following results are presented. i) The dependence of the absolute amplitude of the density and temperature perturbations on linear growth rate and velocity shear. ii) The influence of the local hydrodynamic quantities (density, temperature, their radial gradients, etc.) on the perturbation dynamics. iii) An agreement of the modeling results with experimental data [2, 3].

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