§23. Interaction between the Trapped Electrons and Magnetic Field gradient and Curvature-Driven Drift Waves in the Toroidal Plasmas

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It has been realized that the turbulence in plasma is a multiple-length-scale structure. In addition to the long wavelength turbulence, it has been an interesting subject to explore the short wavelength one. Recently, it becomes especially attractive to study the interaction between the different length scale structures. Thus, it is desired to obtain a turbulence structure from zero to infinity wave number.

In the previous work, we have presented a new kind of instability in the toroidal plasmas: magnetic filed gradient and curvature (MFGC)-driven one. The MGFC instability is the long wavelength dominant one. It possesses the finite growth rate even if the plasma pressure gradient vanishes. In addition, no matter what magnitude the plasma pressure gradient is, the instability can be stabilized as long as the magnetic field gradient and curvature is zero.

In this work, we study the interaction between MFGC modes and trapped electrons. In addition to the MFGC instability of long wavelength, a new unstable branch of short wavelength is excited after the trapped electrons are included. Thus, there exist the multi-mode interactions, e.g., those between the two unstable branches and between the stable and unstable branches. As a result, they lead to the present hybrid instabilities with the wave number spectrum of growth rate from zero to infinity. Subsequently, the effects of the electron-wave resonance on the instabilities and associated transport are emphasized. A typical result for χ_e, χ_i, D_e versus $k_\perp \rho$ are plotted in Fig.1.

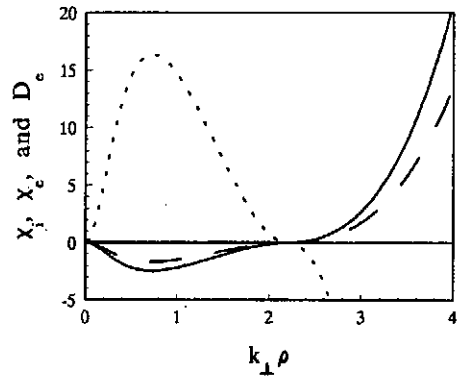

Fig.1 χ_i (solid line), χ_e (dashed line), and D_e (dotted line).