§24. Short Wavelength Ion Temperature Gradient Instability in Toroidal Plasmas

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Recently, intensive research attention is paid on understanding the anomalous electron transport in magnetically confined plasmas. Experimental evidence shows that this anomalous electron transport is governed by short wavelength turbulence, after the stabilization of the long wavelength turbulence.

Observation of electron temperature profile stiffness in most experiments indicates that the short wavelength instability responsible for electron transport should have a threshold in electron temperature gradient.

In this study we employ a set of integral eigenvalue equation for the further study of toroidal short wavelength ion temperature gradient (SWITG) modes. The magnetic curvature and gradient drift, the transit effect, and the finite Larmor radius effect are retained in the model for both electrons and ions. Also, the electron response is easily switched to be adiabatic. Using this model, we investigate the SWITG modes in detail. The physical driving mechanism in the toroidal geometry will be discussed with comparison with that in the sheared slab configuration. Higher order modes will be introduced and parameter dependence of the toroidal SWIYG modes will be investigated in wide parameter regions. From that point, this study is an essential preparation for estimating the critical temperature gradient and possible transport driven by the SWITG instability.

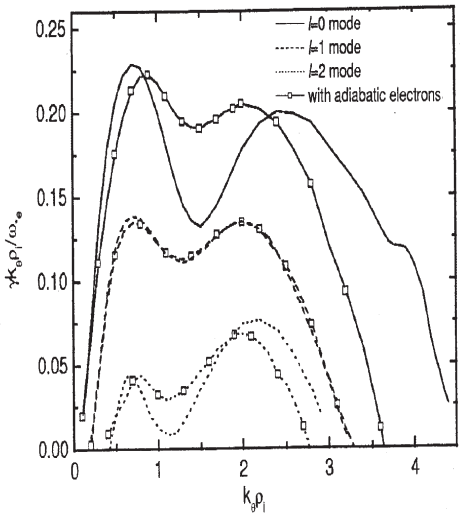

Fig.1 Normalized growth rate vs. $k_\vartheta \rho_i$. The solid, dashed, dotted lines denote the different harmonic modes with l=0, 1, and 2, respectively. The lines with squares are the corresponding results when electron is assumed adiabatic.

In Fig.1, three unstable branches are presented with and without nonadiabatic electron effects consideration, respectively. As $k_\vartheta \rho_i$ increases, the growth rate behaves double humps: the first peak is the conventional ITG mode and the second peak is the SWITG.

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