§23. Effect of Flow Shear on Temperature Gradient Driven Short Wavelength Modes

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Progress in understanding the anomalous transport in magnetically confined plasmas has been connuing for decades. It is now widely accepted that the anomalous transport is induced by turbulent plasma fluctuations with small scales, the so-called microinstabilities. In particular, the temperature gradient (TG) driven instabilities are proposed as the plausible candidates responsible for anomalous thermal transport and have been studied extensively.

Effects of flow shear on the temperature gradient driven short wavelength ion (SWITG) modes and electron temperature gradient (ETG) modes are investigated in a sheared slab. The SWITG mode can be stabilized at arbitrary beta when the $E \times B$ velocity shear, V_E' reaches above a critical value. Since the SWITG modes has a lower frequency, a lower V_E' is needed to stabilize the SWITG mode than to stabilize the conventional ITG mode. However, the critical values of V_E' for stabilization of both SWITG and conventional ITG modes are much less than v_{ti}/L_n , where $v_{ti}(L_n)$ are ion thermal speed and the scale length of density gradient, respectively. Contrastively, the ETG mode can not be stabilized until the V_E' is larger than v_{ti}/L_n. Similarly, a parallel shear with order v_{ti}/L_n has significant effects on the SWITG mode but is too small to influence the ETG mode. The different behavior of flow shear effects on the SWITG and ETG modes may indicate that the ETG mode is more reasonable than the SWITG as the candidate responsible for anomalous electron thermal transport.

In this study, the integral equations for the study of the ITG mode in the presence of sheared flows in arbitrary beta plasmas are upgraded and then employed for the study of SWITG mode in a sheared slab.

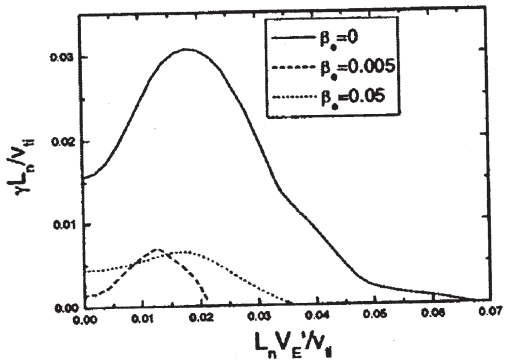

Fig.1 Mode growth rate of the SWITG mode as the functions of V_E'.

The initial rise in V_E' causes an increase of growth rate and it reaches its maximum value. Further increase of V_E' causes a decrease of growth rate Then, the mode is fully stabilized by a large enough velocity shear.

Ref.: Zhe Gao, J. Q. Dong and H. Sanuki, Physics Plasmas, Vol.11, No.6(2004) 3053.