26pB09

熱源駆動型乱流における輸送障壁形成のジャイロ運動論シミュレーション
Gyrokinetic simulation for transport barrier formation in flux-driven turbulence

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Profile stiffness is a long standing problem, which may limit the overall performance of H-mode plasmas. In the JET experiment, while strong temperature profile stiffness is observed around the nonlinear threshold of ion temperature gradient, it can be greatly reduced by co-current toroidal rotation in weak magnetic shear case [1].

To understand such a mitigation mechanism of the stiffness, we have newly developed a 5D global gyrokinetic code *GKNET* [2]. This enables us to simulate flux-driven ITG turbulence consistently coupled with neoclassical transport mechanism, where mean profiles are governed by radial force balance and can be adjusted to heat and momentum sources.

By means of this code, it is found that a stiff temperature profile is established in the absence of momentum source. The stiffness is identified to result from not only the fast propagation of heat avalanches but also the explosive global transport coupled with the instantaneous formation of radially extended ballooning structure, whose size ranges from mezo ($\sim\sqrt{\rho_{ti}L_T}$) to even macro-scale ($\sim L_T$). The radial mean electric field is found to play an important role in forming such a global structure by recovering the up-down symmetry of the ballooning structure. This indicates that the mean filed can enhance the stiffness.

Then we introduce a momentum source to control the mean field through the radial force balance. Figure 1 shows the radial ion temperature profile without momentum injection and with co/counter momentum injection around $r=90\rho_{ti}$ in weak magnetic shear case. It can be seen that only co toroidal rotation leads to an ITB formation inside the momentum source region, in which the ion thermal diffusivity reduces to the same level as the neoclassical counterpart. We also found that mean field established by the co toroidal rotation can provide negative/positive ballooning angle in inner/outer region, leading to the reduction of momentum diffusion [3]. Since the effect of counter input is opposite, the peaked rotation profiles can be sustained only in co input case. Thus, the direction of toroidal rotation is important in controlling the radial profile of mean field and also the resultant momentum flux.

This work was supported by Grants-in-Aid from JSPS with No. 25800304.

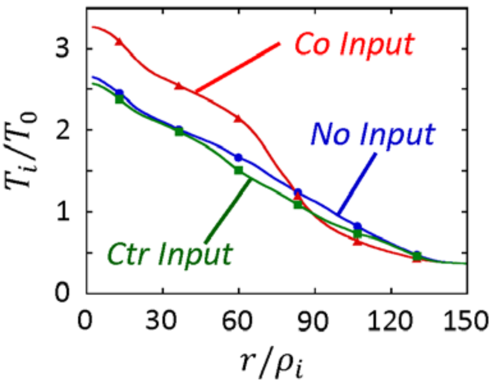

Fig. 1 Radial ion temperature profile without momentum injection and with co/counter momentum injection around $r=90\rho_{ti}$.

Reference
[1] P. Mantica, *et.al.* Phys. Rev. Lett., **107**, 135004 (2011).
[2] K. Imadera, *et.al.* 25th Fusion Energy Conference, TH/P5-8, Oct.16 (2014).
[3] Y. Camenen, *et al.* Nucl. Fusion, **51**, 073039 (2011).