§10. The Effects of the Resonant Magnetic Perturbation on Microturbulence in LHD

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The enhancement of particle transport is by using resonant magnetic perturbation (RMP) is observed in LHD [1,2]. The ion scale turbulence, where $k\rho_i$=0.1-1 is likely to play a role on particle transport [3]. Turbulence response was systematically measured in the series of RMP scan experiments [2] by using a two dimensional phase contrast imaging (2D-PCI) [4]. 2D-PCI measures microturbulence, of which is poloidaly dominated wavenumber components. Thus, measured phase velocity is turbulence phase velocity Doppler shifted by E_rxB_t poloidal rotation velocity.

Figure 1 shows n_e, T_e, and fluctuation profiles with and without RMP at R_{ax}=3.6m, B_t = 2.75T. As shown in Fig.1 (b-2), flattening of T_e is observed at m/n=1/1 island position and the width of the island is smaller at reff/a99=+0.9 than the one at reff/a99=-0.9. This corresponds to the smaller island at torus outer position due to m/n=1/1 island as shown in Fig.2(a). The fluctuation amplitude becomes smaller and its asymmetry becomes obvious at upper and lower side with RMP. This asymmetry is likely to be the asymmetrical island structure at PCI cross section as shown in Fig.2(b).

Figure 3 shows dependence of fluctuation level and phase velocity on edge diffusion coefficients (D_{edge}) at around fluctuation peak. The scan of D_{edge} are done from the scan of RMP current [2]. As shown in Fig.3 the asymmetry of lower side and upper side becomes obvious with increase D_{edge} due to increase of RMP current. Both fluctuation level and phase velocity decreases with increase of D_{edge}. Figure 4 shows dependence of fluctuation level and phase velocity on D_{edge} with (I_{RMP}=1.95kA) and without RMP. The scan of D_{edge} are done from the scan of NBI power[2]. As shown in Fig.4, fluctuation level increases with increase of D_{edge} without RMP. This is consistent to the previous results[3], although it decreases with increase of D_{edge} with RMP. The reduction of fluctuation with RMP may be due to the flattening of T_e and possibly T_i and n_e at m/n=1/1 island. The change of phase velocity from electron to ion direction with increase of D_{edge} (with increase of heating power) may indicate the switch from negative to positive Er. The tendency is common with and without RMP. While fluctuation amplitude responds differently with and without RMP. Further investigation is necessary to explain this observation.

1) Tanaka, K., et al. :Plasma Fusion Res. to be published
2) Tanaka, K., et al. : this annual report
3) Tanaka, K., et al. : Tanaka, K. : Fusion Sci. and Tech. **58,** 70 (2010)
4) Tanka, K., et al. :*Rev. Sci. Instrum.* **79**, 10E702 (2008)

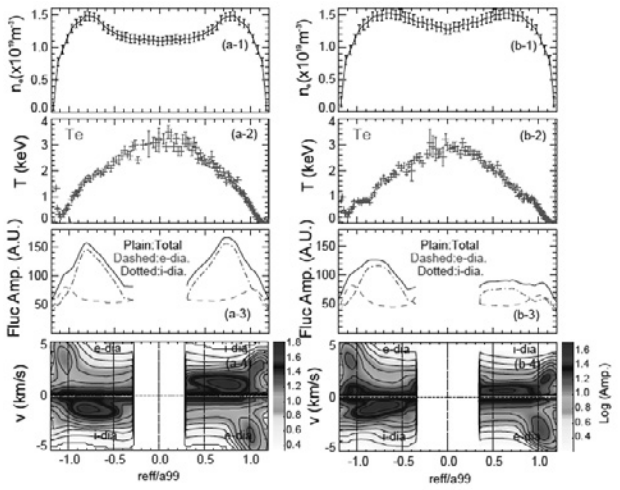

Fig.1 Comparison of profile with RMP1.95kA (a-1)-(a-4) and without RMP (b-1)-(b-4), R_{ax}=3.6m, B_t=2.75T

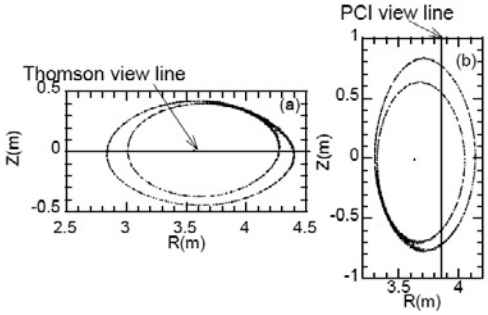

Fig.2Magnetic island at (a) Thomson cross section and (b) PCI cross section

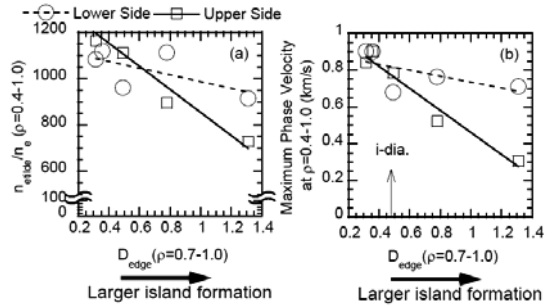

Fig.3 dependence of (a) fluctuation level and (b) fluctuation phase velocity on edge diffusion coefficients under different RMP current

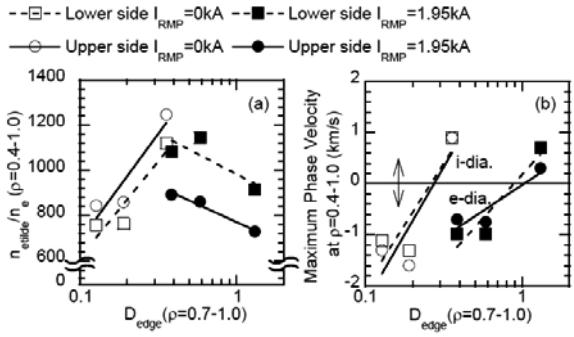

Fig.4 dependence of Fig.3 dependence of (a) fluctuation level and (b) fluctuation phase velocity on edge diffusion coefficients at I_{RMP}=0,1.95kA