§35. Dependence of Local Transport on Beta and Configurations in $\gamma = 1.20$ Plasmas

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High-beta plasmas of more than 5 % of $\langle\beta\rangle$ were produced in a magnetic configuration with the optimal aspect ratio $A_{\rm p} = 6.6$ ($\gamma = 1.20$) [1], while the usual $A_{\rm p}$ value is 5.8 ($\gamma = 1.254$) in the low-beta plasmas on LHD. From the results of the previous local transport analysis for the high-beta plasmas with $A_{\rm p} = 5.8$, the local transport property, which is evaluated by referring to ISS04, is preserved or improved in the core region, while it is degraded in the peripheral region in the $A_{\rm p} = 5.8$ configuration [2]. In this study, the local transport analysis for the high-beta plasmas with $A_{\rm p} = 6.6$ are made and the results are compared with those of the $A_{\rm p} = 5.8$ case. In order to evaluate the degradation in the local transport which is caused from reasons other than the change of the magnetic configuration, a new factor $g^{\rm int}_{{\rm ren}\chi}$ is introduced. This factor is derived by interpolating the renormalization factor for the local transport at each ρ. Since the effects of the change of the magnetic configurations on the local transport coefficients in the high beta region are represented by $g^{\rm int}_{{\rm ren}\chi}$, the effects of the beta increment or the increment in gradient beta are appear in $\chi^{\rm eff}/(g^{\rm int}_{{\rm ren}\chi}\chi^{\rm ISS04})$. Here, $\chi^{\rm ISS04}$ is the model transport coefficient which has the same non-dimensional parameter dependence as ISS04.

Figures 1 and 2 show the beta dependences of the normalized local transport coefficient $\chi^{\rm eff}/\chi^{\rm ISS04}$ in the $A_{\rm p} =$ 5.8 and 6.6 configurations at (a) $\rho = 0.5$ and (b) $\rho = 0.9$, respectively. The outlines of the data region more than 1 % of $\langle\beta\rangle$ in the configuration of $A_{\rm p} = 5.8$ are shown by the dashed lines in Figs 1 (a) and (b). In Fig. 1 (b), as $\chi^{\rm eff}/(g^{\rm int}_{{\rm ren}\chi}\chi^{\rm ISS04})$ becomes large with the increment in $\langle\beta\rangle$, transport degradation due to effects other than the change of the magnetic configuration exists at $\rho = 0.9$. The results in the $A_{\rm p} = 6.6$ configuration are shown in Fig. 2. The dashed lines in Figs 2 (a) and (b) are the same as those in Fig. 2 (a) and (b), respectively. Figure 2 (b) shows that the degradation of the local transport is larger than the effect of the change of the configuration in the $\langle\beta\rangle > 1\,\%$ region at $\rho = 0.9$. However, it is different from the case of $A_{\rm p} = 5.8$ that the ratio $\chi^{\rm eff}/(g^{\rm int}_{{\rm ren}\chi}\chi^{\rm ISS04})$ seems to decrease in $\langle\beta\rangle > 2\,\%$. As shown in Fig. 2 (a), $\chi^{\rm eff}/(g^{\rm int}_{{\rm ren}\chi}\chi^{\rm ISS04})$ also seems to be improved in the $\langle\beta\rangle > 2\,\%$ region at $\rho = 0.5$ in $A_{\rm p} = 6.6$.

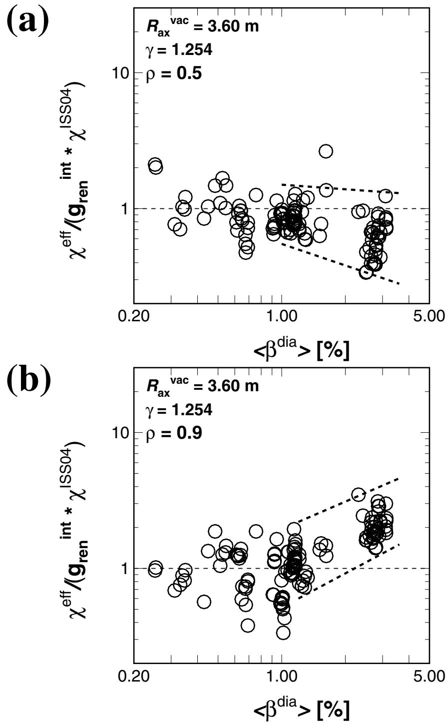

Fig. 1. Beta dependence of the normalized local transport coefficient in the $A_{\rm p} = 5.8$ configuration at (a) $\rho = 0.5$ and (b) $\rho = 0.9$.

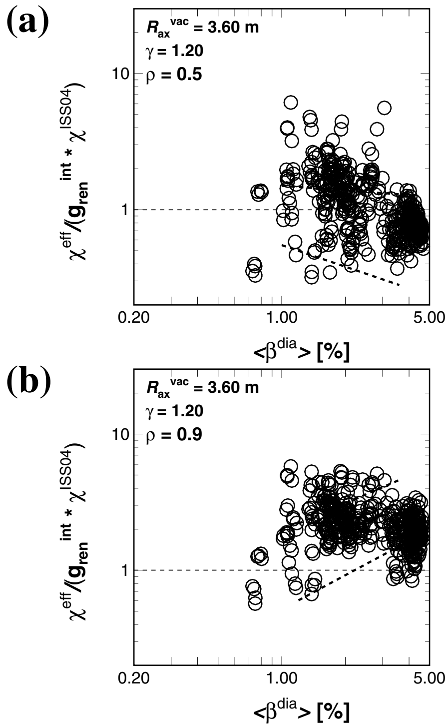

Fig. 2. Beta dependence of the normalized local transport coefficient in the $A_{\rm p} = 6.6$ configuration at (a) $\rho = 0.5$ and (b) $\rho = 0.9$.

[1] S.Sakakibara, *et al.*, Plasma Phys. Control. Fusion **50** (2008) 124014.

[2] H.Funaba, K.Y.Watanabe, *et al.*, Plasma Fusion Res. **3** (2008) 022.