§3. Dependence of Power Threshold on Magnetic Field Configuration

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The magnetic field configuration can be changed by the shift of the magnetic axis location through the control of the poloidal field coil currents in CHS. The magnetic well, the orbit of trapped particles, the plasma viscosity and the distance of the last closed flux surface from the wall can be controlled by the magnetic axis shift. The inward shifted configuration is favorable for drift orbit optimization, and provided stable plasma discharge in spite of the expected instabilities from the Mercier criterion. The CHS plasma contacts the inner wall, when the magnetic axis location is smaller than ~ 98 cm, and the contact area increases by the inward shift. The low viscosity of the inward shift is favorable for the plasma rotation.

Clear dependence of the normalized threshold power on the magnetic configuration has been found, as shown in figure 1. The magnetic axis location of 92.1cm is the standard configuration to realize good plasma performance in CHS. The formation of the ETB has been observed for the magnetic axis locations between 89.9 cm and 94.9 cm, as shown in figure 1 (a). When the magnetic axis is inside 89.9 cm or outside 94.9 cm, the ETB formation has not been observed. The experiments are performed for different port-through NBI powers and densities controlled by the gas-puffing. We have not found the formation of the ETB below the lowest threshold value denoted by the dotted line. The threshold power shows the minimum around $R_{ax} = 93.5cm$. The lowest power decreases as the R_{ax} increases, however, the formation of the ETB has not been observed outside 94.9 cm.

The same characteristics as the power threshold have been observed for the delay time of the ETB formation from the NBI injection. Figure 1 (b) shows the delay time as a function of the magnetic axis location. The delay time gets longer by the inward shift. The minimum delay time is found in the same location of 93.5 cm as the power threshold.

The increase of the power threshold and the delay time for the inward shifted configuration suggests that the contact area to the inner wall is important for the barrier formation. The contact area affects the neutral particles and the amount of the impurity in the edge region. The relation of the ETB formation to the effect of the drift orbit optimization and the decrease of the viscosity by the inward shift is not clear. However, the ETB has not been observed for the outward shifted configuration with > 96.9 cm, and , moreover, has not been observed under the divertor configuration when $R_{ax} > 98cm$.

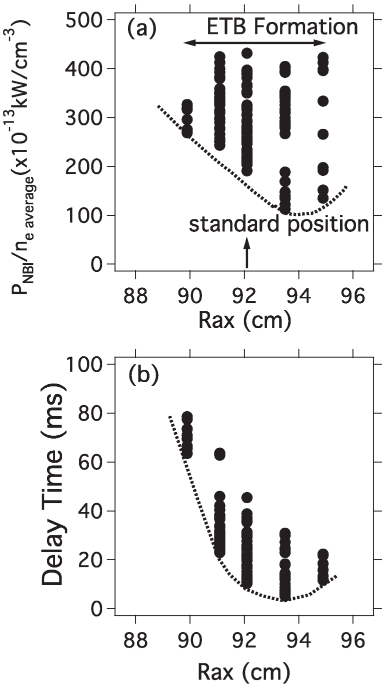

Fig. 1: **(a) NBI power values normalized by densities at L-H transition on various magnetic configurations (magnetic axis locations). (b) Delay times from the beam injection. Dotted curves denote the power threshold.**

These results might be contradictive to the results of inward shifted configurations.

It is noted that in these experiments whether the ETB is formed or not is judged by the observation of the transition phenomena: the observation of the spontaneous drop of the H_α emission. If the ETB is formed from the start of the discharge, the confirmation of the ETB formation is difficult because of no existence of the transition phenomena during the discharge. When the magnetic axis is shifted to the outer direction, the threshold power becomes decrease, on the other hand, it becomes difficult to sustain the NBI plasma because the injection NB power becomes lower. The threshold power for the ETB formation is close to the minimum power for maintaining the plasma discharge at R_{ax} of 94.9 cm. Accordingly, it is possible to form the ETB just after the start of the discharge when the plasma axis shift to the outer direction from 96.9 cm, however, the judgment whether the ETB is formed or not is difficult..

Consequently, these results suggest that the ETB formation relate to the neutral particles profile around the edge region. The further investigations such as the neutral particle measurement for the edge region are required to clear physical mechanism.