

§5. Dynamic Poloidal Field Control for High β Plasmas

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The center of the last closed flux surface (LCFS) moves about 1 cm outward when the plasma beta reaches 2 %. Such shift of plasma position changes both MHD stability characteristics and the confinement. A dynamic poloidal field control during the discharge was made to fix the plasma boundary position unchanged when the plasma beta increases. Benefits of such position control were pointed out from the theoretical point of view in obtaining high-beta plasmas when the plasma beta value approaches the equilibrium limit.

Figure 1 shows a time sequence of high-beta discharge with the poloidal field control. The current settings for the poloidal coils were changed during the discharge from those for the configuration with $R_{ax} = 92$ cm to those for $R_{ax} = 90$ cm in order to push back LCFS to the inward direction. In the three-dimensional equilibrium calculation, the position of the LCFS at $\langle\beta\rangle = 1.5$ % with poloidal field setting for $R_{ax} = 90$ cm is almost the same as the position of the vacuum LCFS for $R_{ax} = 92$ cm configuration.

In order to confirm whether the plasma position control was successful, the position of the plasma boundary was determined by the density profile measurements using a lithium beam probe as well as the VUV profile measurements with rotating mirror system. Figure 2(a) shows the time evolution of the density profile obtained with the lithium beam probe for the discharge with no poloidal field control. When the dynamic poloidal field control was applied, the outward movement of the plasma boundary was suppressed as is shown in Fig. 2(b). The VUV profile measurement gives the same results. When we compare the average beta values of two shots for the same densities, the discharge with poloidal field control gave about 10 % additional beta to that in no control case.

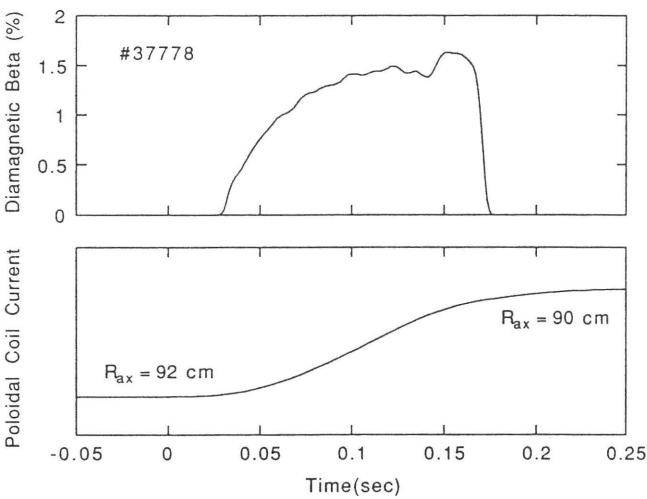


Fig. 1 Relative timing of dynamic poloidal field control to the plasma discharge.

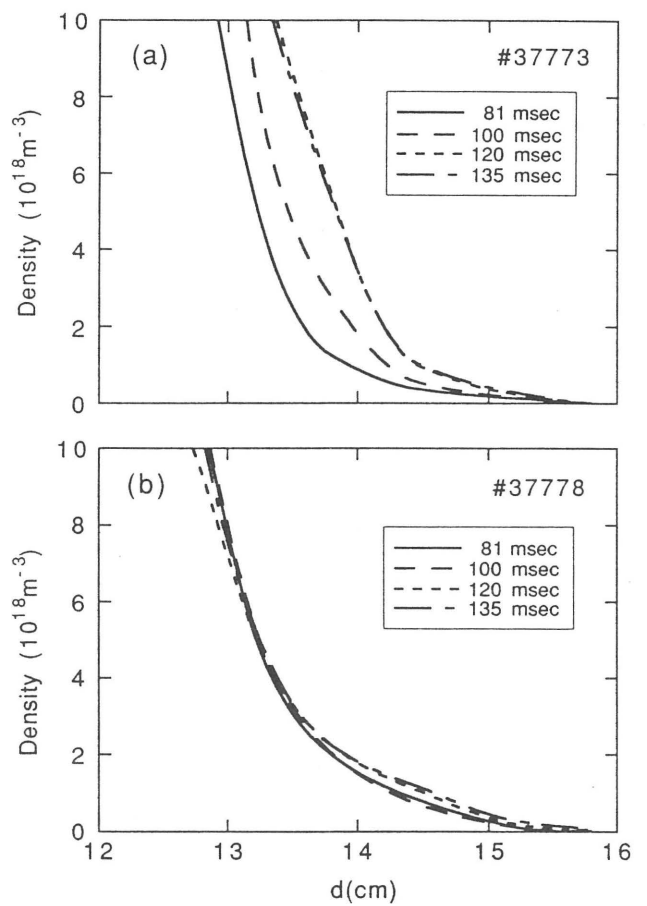


Fig. 2 Time evolutions of edge density profiles measured with lithium beam probe for (a) no poloidal field control and (b) dynamic poloidal field control.