§8. Experiments on *m*/*n*=2/1 Magnetic Island Dynamics Based on ECCD

López-Bruna, D., Castejón, F. (CIEMAT Spain),
Narushima, Y., Yoshimura, Y., Takemura, Y.

The control of magnetic island by ECCD has been studied for two years to clarify its method in the LHD[1]. In the FY 2013, we have attempted to drive the ECCD current in the configuration with magnetic island of *m*/*n*=2/1, in which the ECCD was applied in whole duration of the discharge[2]. In the FY 2014, the ECCD was imposed in the middle part of the duration to clarify its effect in a single discharge. The ECCD position on the O/X-point can be controlled by changing the polarity of the resonant magnetic perturbation (RMP) field even though the ECCD position does not change in the laboratory frame, as shown in Fig. 1. The behavior of the magnetic island can be detected by the magnetic diagnostics. Typical waveforms of the plasma response field of the m = 2 (the amplitude of the plasma response field $\Delta\Phi^{r}_{m=2}$ and the phase difference between the RMP field and the plasma response field $\Delta\theta_{m=2}$) are shown in Fig. 2. The ECCD is applied to the ECH plasma from t = 4.5s to 6.5s. When the ECCD is applied on the X-point (shaded area in Fig.2 left), the $\Delta\Phi^{r}_{m=2}$ increases and $\Delta\theta_{m=2}$ shifts to in-phase ($\Delta\theta_{m=2}$ = 0), which implies that the magnetic island tends to be enlarged. On the other hand, in case of the O-point ECCD (Fig. 2 right), the $\Delta\Phi^{r}_{m=2}$ decreases and $\Delta\theta_{m=2}$ shifts to in-phase when the ECCD is applied, which means that the magnetic island tends to be small. From the viewpoint of the plasma response field, it is found that the X-point ECCD makes the magnetic island enlarge while O-point ECCD tends to make it small. It should be noted, however, that the magnetic island could not be healed completely in the O-point ECCD case. The magnetic configurations taking into account the RMP and plasma response field are shown in Fig. 3. Upper figures show the configuration without plasma response field. Middle and bottom figures show the configuration at t = 4.4s (without ECCD) and t = 5.5s (with ECCD), respectively. In spite of the significant temporal change of the plasma response field $\Delta\Phi^{r}_{m=2}$, as shown in Fig. 2, it does not strongly affect to the RMP because the $\Delta\Phi^{r}_{m=2}$ is fairly smaller than the RMP. Therefore, the remarkable difference cannot be seen in the Poincaré plot between the without ECCD (Middle of Fig. 3) and with ECCD (Bottom of Fig. 3). Larger ECCD may be required for the significant modification of the magnetic island. This work is supported by NIFS/NINS under the project of Formation of International Scientific Base and Network.

1) D. López-Bruna, *et al*., Annual report of NIFS (2014)
2) D. López-Bruna, *et al*., Informe Técnico Ciemat No 1333, Nov. 2014

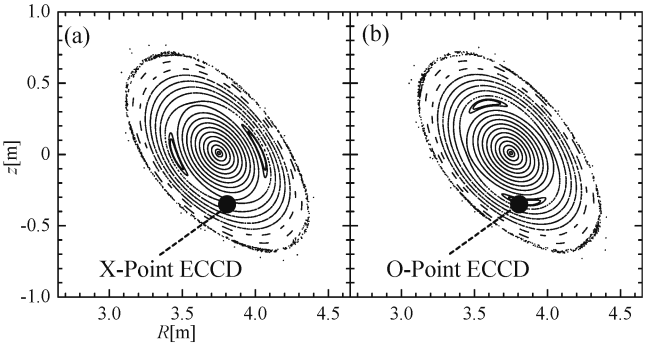

Fig. 1 Poincaré plot of magnetic configuration with *m*/*n*=2/1 magnetic island. Black dot indicates the position of ECCD at (a) X-point and (b) O-point.

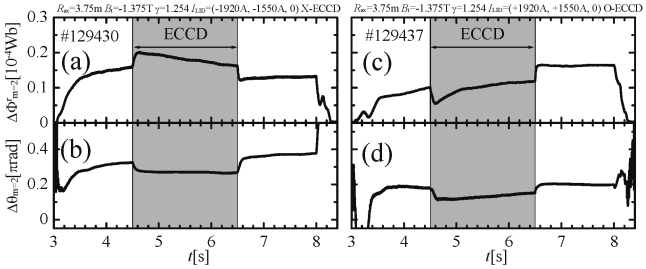

Fig.2 Time evolution of (a, c) plasma response field with *m*/*n*=2/1 mode and (b, d) phase difference between RMP and plasma response field. (Left) X-point ECCD. (Right) O-point ECCD

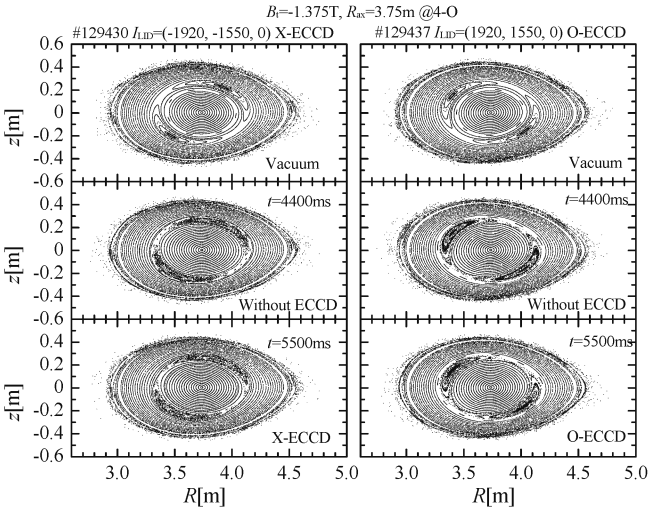

Fig.3 Poincaré plot of magnetic configuration. (Left) X-Point ECCD. (Right) O-point ECCD. (Top) Vacuum. (Middle) Without ECCD. (Bottom) with ECCD.