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ECCDによる*m*/*n* = 2/1の磁気島制御
Control of *m*/*n* = 2/1 magnetic island by ECCD in LHD

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The experiment of the ECCD imposing on magnetic island with $m/n = 2/1$ has been done. The experimental observation shows that the magnetic island of $m/n = 2/1$ is modified by the ECCD. The magnetic islands, however, are not still able to be controlled externally. The resonant magnetic perturbation (RMP) field produces a locked $m/n = 2/1$ magnetic island. The Poincaré plot of the magnetic island is shown in Fig. 1 The ECCD is applied to the X-point. In this study, the X-point ECCD makes the magnetic island growth if the current is predictably driven. The base plasma is produced only by the ECH, the typical electron density n_e and electron temperature T_e are $n_e = 0.3 \sim 1.0\times10^{19}$ m^{-3} and $T_e = 5 \sim 8$ keV, respectively. The ECCD is superimposed for 2 s in the plasma sustained for 5 s. Figure.2 shows the time evolution of the amplitude $\Delta\Phi_{m=2}$, the phase difference $\Delta\theta_{m=2}$ of the perturbed field, and the electron density n_e. The electron density during the ECCD is almost constant. If $\Delta\theta_{m=2} = 0$ (0.5π) rad, the vector of the perturbed field is the same as (opposite to) the RMP. In the case of the lower n_e (red lines in Fig.2), the $\Delta\theta_{m=2}$ indicates $\Delta\theta_{m=2} = 0$ just before the end of ECCD ($t = 6.49$s), which means the growth of the magnetic island. In the case of the higher n_e (black lines in Fig.2), the $\Delta\theta_{m=2} = 0.5\pi$ rad implies the healing. Figure 3 shows the plasma response field structure ($\Delta\Phi_{m=2}$, $\Delta\theta_{m=2}$) at $t = 6.49$s plotted in the polar coordinates with the color map indicating the electron density. It can be seen that for the lower density ($n_e \sim 0.3\times10^{19}$ m^{-3}), plasmas tend to be grew at around ($\Delta\Phi_{m=2}$, $\Delta\theta_{m=2}$) ~ (10×10^{-5}Wb, 0), whereas the plasma response field implies the healing of the magnetic island ($\Delta\Phi_{m=2}$, $\Delta\theta_{m=2}$) ~ (0.2×10^{-5}Wb, 0.5π) in the higher density ($n_e \sim 1.0\times10^{19}$ m^{-3}). In conclusion, X-point ECCD can be considered to affect magnetic islands in an appropriate density region. In the future study, it is necessary to consider the plasma response affecting to the magnetic island.

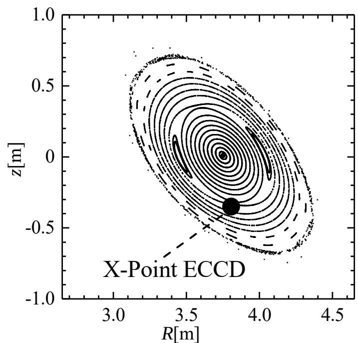

Fig. 1 Poincaré plot with magnetic island of m/n = 2/1. The ECCD is superimposed to the X-point.

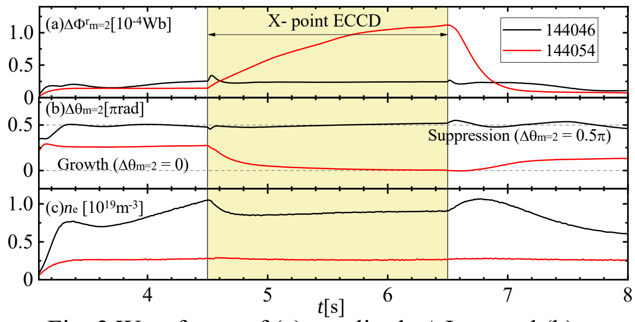

Fig. 2 Waveforms of (a) amplitude $\Delta\Phi_{m=2}$ and (b) phase difference $\Delta\theta_{m=2}$ of the perturbed field. Black (red) lines mean the higher (lower) electron density discharge. ECCD is superimposed for $t = 4.5 \sim 6.5$s.

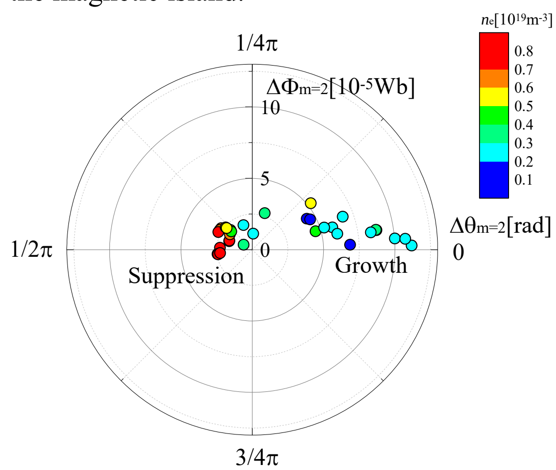

Fig. 3 Polar plot of ($\Delta\Phi_{m=2}$, $\Delta\theta_{m=2}$). Plasmas in lower electron density tends to be grown plotted around ($\Delta\Phi_{m=2}$, $\Delta\theta_{m=2}$) = (10×10^{-5}Wb, 0)