§12. Density Pump-out by ECRH Applied on the Different Position at the Same Magnetic Flux Surface on LHD

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It is observed that the electron density decreases during high power electron cyclotron resonance heating (ECRH). One of the possible mechanisms for density pump-out by ECRH is the production of trapped electrons by the magnetic ripple due to acceleration of electrons perpendicular to the magnetic field line by ECRH.

In order to clarify effects of the magnetic ripple on plasma responses, ECRH is applied on the bottom of the ripple of the magnetic field strength and the position where trapped electrons are produced less than the magnetic ripple bottom (in this report, we call it 'Near top') on a given magnetic flux surface of the Large Helical Device (LHD). 77 GHz EC wave is injected to the minor radius $\rho \sim 0.3$. Figure 1 shows the EC heating position on the cross section of torus and the magnetic field strength at the position along the magnetic field line on $\rho \sim 0.3$. X2-mode ECRH is used because X2-mode ECRH accelerates electrons perpendicularly more directly than O-mode. ECRH is modulated as 50 ms on, 55 ms off. Plasmas are sustained by NBI heating. Experimental conditions are as follows; the electron line average density is about 0.6×10^{19} m^{-3}, the central electron temperature is 1.5 ~ 3.5 keV, the major radius is 3.6 m.

The electron flux Γ_e is calculated by the equation (1) with the local electron density estimated by Abel inversion of the line integral density measured by multi-channel FIR laser interferometer and neglecting source term.

$$\Gamma_e = -\frac{1}{r}\int r' \frac{\partial n_e}{\partial t} dr' \qquad (1)$$

Figure 2 shows the temporal evolution of the electron flux profile. The local and fast outward flux has been enhanced near the heating position for some milliseconds after the start of EC heating in both the near top ECRH case and the bottom ECRH case. After that, the inward flux has been observed in the core region.

The electron flux caused by the production of trapped electrons is considered to be driven at the heating position abruptly after ECRH injection. Fig. 3 shows the dependence of the electron flux at EC heating position 3 ms after ECRH injection on the ECRH absorption power. The outward electron flux is proportional to the ECRH absorption power. Appreciable differences are not observed between such abrupt outward fluxes for both of the near top and bottom ECRH cases in contrast to the single particle prediction[1]. This may indicate that anomalous transport and/or neoclassical transport are much larger than the transport caused by the production of trapped electrons in this experiment. Further investigation is necessary to clarify effects of the production of trapped electrons quantitatively.

1) K. Itoh *et al.*: J. Phys. Soc. Japan **58**, 482 (1989).

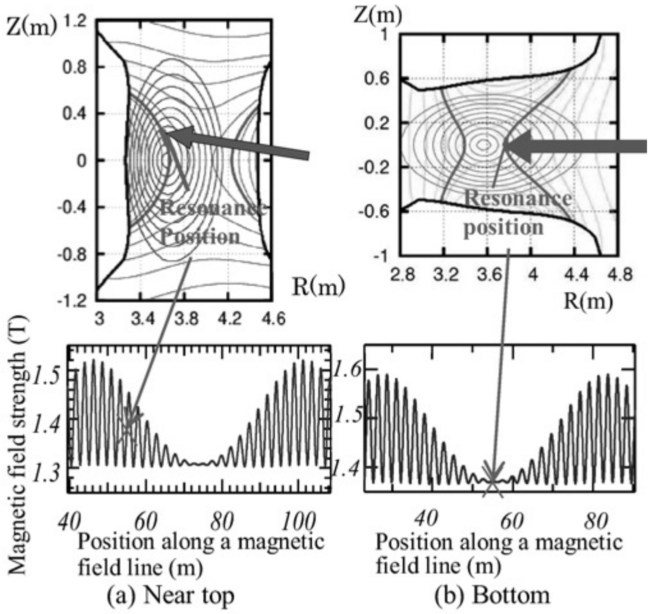

Fig. 1. Cross section of torus and the magnetic field strength at the position along a magnetic field line on $\rho = 0.3$. ECRH is applied on the magnetic ripple (a) Near top and (b) Bottom.

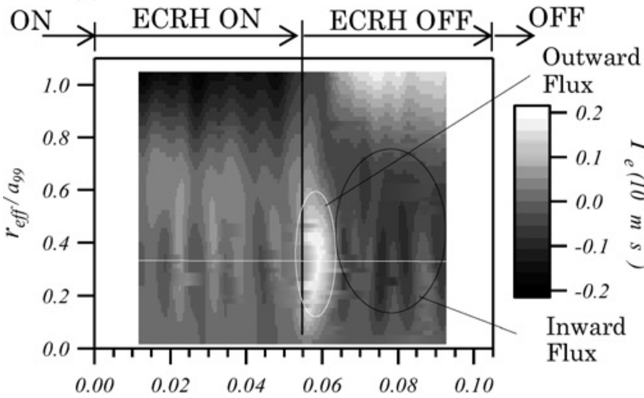

Fig. 2. The temporal evolution of the electron flux profile. EC heating position is $\rho \sim 0.3$ at Near top.

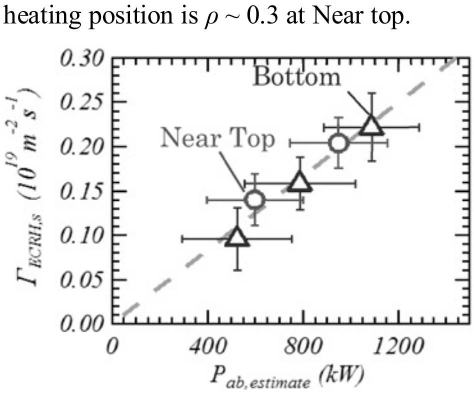

Fig. 3. The dependence of the electron flux at the heating position shortly after the ECRH on the estimated ECRH absorption power.