§35. Observation of the Shift of Magnetic Axis Due to the Plasma Net Current on LHD

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The major radius of magnetic axis has been derived by choosing the magnetic flux surface, which gives the best fit to the tangential x-ray image measured with x-ray CCD camera on LHD [1-4]. Although the time resolution determined by mechanical shutter is poor (0.1s), the system has good spatial resolution (1242x576 pixels in image area). The accuracy of the measurement of the magnetic axis is a few mm to 10mm at most (1% to 3% of a Shafranov shift at high beta), which is generally better than the estimate by the equilibrium code calculation based on the T_e and n_e profiles measured with YAG TS and FIR. During the 5th LHD experiment campaign, the shift of magnetic axis due to the plasma net current has been observed in the low beta NBI unbalance-heated plasmas, which generally agrees to the prediction from equilibrium calculation.

Figure 1 shows the time evolution of the shift of magnetic axis measured with x-ray CCD camera and the plasma net current. In this experiment, the magnetic axis in vacuum is 3.5m, and the magnetic field is 2.854T. The direction of NBI is switched from Co- to Ctr- at 2.4s. The maximum value of the averaged beta is 0.09%. It is clearly shown that the magnetic axis shifts outward when the plasma net current is in the direction increasing rotational transition by Co-injection NBI beam, while magnetic axis shifts inward when the plasma net current is in the direction decreasing the rotational transform (Ctr-injection). The shift of magnetic axis at zero plasma net current is 15mm, which is the shift of magnetic axis due to the thermal and beam pressure.

Figure 2 shows the shift of magnetic axis as a function of the plasma net current during the exchange of NBI direction on LHD. The direction of beam is exchanged from Co- to Ctr-injection and Ctr- to Co-injection during the discharge. The shift of magnetic axis in the transient phase of Ctr- to Co-injection is much larger than that in the transient phase of Co- to Ctr-injection even for the zero net current. It is considered that this difference in the shift of magnetic axis is mainly due to a difference of the radial profile of plasma net current on LHD.

These observations suggest the possibility to estimate the radial profile of net current from the accurate measurement of shift of magnetic axis by taking account of the shift of magnetic axis due to net current as well as thermal and beam pressure.

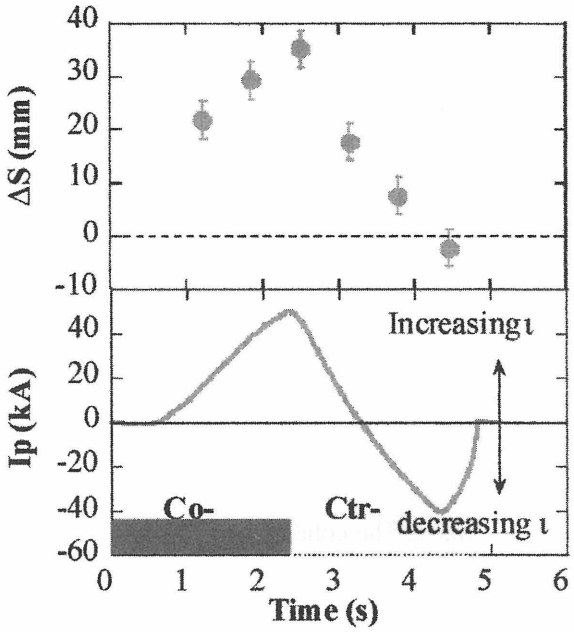

Fig. 1 Time evolution of the shift of magnetic axis and net current for the plasma, where the direction of beam is exchanged during the discharge in LHD.

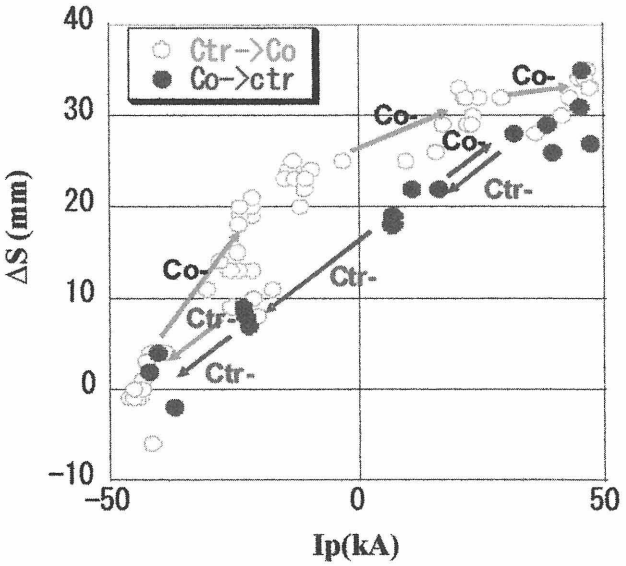

Fig. 2 The shift of magnetic axis as a function of plasma net current for the plasma with Co- to Ctr- injection and Ctr- to Co- injection.

References

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