## §88. The Effect of Magnetic Configuration on the Distribution of Divertor Plasma Flows in Heliotron-E

Voitsenya, V., Chechkin, V. (IPP, Kharkov)
Mizuuchi, T., Nagasaki, K., Okada, H., Hayakawa, A., Funaba, H., Hamada, T., Sano, F., Obiki, T. (IAE, Kyoto University)
Zushi, H., Nakasuga, M., Bessho, S., Kondo, K. (GSES, Kyoto University)
Masuzaki, S., Motojima, O.

In the Heliotron E (H-E) heliotron/torsatron device [1] a currentless plasma is produced by ECH and then heated by NBI or NBI+ECH. To study the divertor plasma, a set of 50 collecting plates (CPs), serving as electric probes, is used. The plates are distributed into 8 arrays, which are arranged poloidally on rounded parts of the vacuum chamber in 4 poloidal cross sections with the 1/8 field-period interval. The position of any array is determined by the poloidal angle Θ of the center: Θ=0°, 45°, 90°, 135°, 180°, 225°, 270°, 315°. Therefore, it is possible to detect plasma flows to be incident on the wall in 8 positions within one field period. For a fixed regime of machine operation the whole divertor flow (DF) distribution over the field period can be obtained in 8 reproducible discharges.

For any regime of plasma production and heating, the positions of DF (ion saturation current) maxima on CPs always coincide with the calculated positions of connection length maxima for open magnetic field lines intercepted by CPs.

The utilization of three groups of windings in H-E allows to vary the characteristics of magnetic surfaces in a very wide range. Recently, a quite full study of DFs, their distributions Γ(Θ), has been carried out for different experimental conditions, including variation of magnetic configuration. It was found that any change of experimental conditions results in a redistribution of DFs both within a certain array and over the whole field period.

Fig. 1 shows an example of what influence the ΔR=3cm magnetic axis inward shift has on Γ(Θ) measured at the initial phase of the discharge (fundamental ECH, 53GHz). It is seen that the shift almost does not influence the up/down asymmetry characterized by Γ(90°)/Γ(270°) ratio. However, it significantly changes the in/out asymmetry: the Γ(180°)/Γ(0°) ratio increases from 0.27 (no shift) to 1.8 (ΔR=3cm). The data for other values of ΔR are presented in Table 1 for ECH plasma and for the start of NBI phase. The addition of a toroidal field, on the contrary, results mainly in a change of the vertical asymmetry inducement, Γ(90°)/Γ(270°), as is shown in the Table 2 for NBI plasma. The up/down asymmetry practically vanishes in cases with strongly shrunk OMS and with changing the direction of the confining magnetic field.

[1] T. Obiki, et al., Fusion Technol. 17 (1990) 101.

Table 1. Γ(180°)/Γ(0°) ratio versus ΔR

| Phase of discharge | 0 cm | - 2 cm | - 3 cm | - 4 cm |
|---|---|---|---|---|
| ECH | 0.27 | 1.02 | 1.79 | 2.23 |
| NBI | 0.25 | 0.80 | 1.10 | 1.20 |

Table 2. Γ(90°)/Γ(270°) ratio for some values of additional toroidal field

| Magnetic axis shift | - 1 T | 0 | 0.4 T | 1.8 T |
|---|---|---|---|---|
| ΔR= 0cm | 0.18 | 0.16 | 0.18 | 1.04 |
| ΔR=-2cm | 0.027 | 0.19 | | |
| ΔR=-3cm | | 0.08 | | |
| ΔR=-4cm | 0.037 | 0.11 | | |

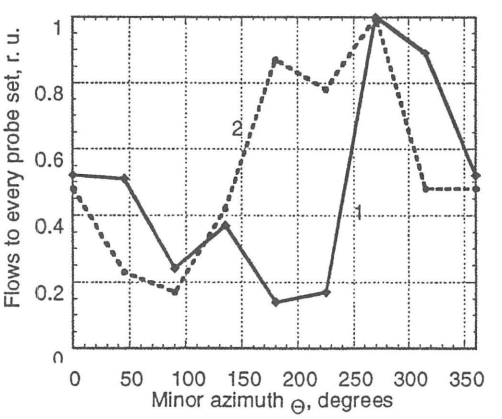


Fig. 1. DF distribution vs minor azimuth Θ.
1: ΔR = 0, 2: ΔR = - 3 cm