§10. Rotating Magnetic Islands Driven by External Perturbation Fields in TU-Heliac

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Study of magnetic island effect on the transport in LHD is important, because it leads to the advanced control method of a plasma periphery and generating internal transport barrier. TU-Heliac has advantages that (1) the island formation can be controlled by external perturbation coils, (2) radial profiles and fluctuations can be measured by Langmuir probes, (3) a radial electric field and particle transport can be controlled by the electrode biasing[1, 2]. The experiments in TU-Heliac can compensate the study of magnetic island in LHD. It is expected that the physics of the island will be developed by the observations in LHD and TU-Heliac. It has been known that radial electric field, which generates plasma poloidal rotation by the ***J*** x ***B*** driving force, is important to the transition to the improved confinement modes. In TU-Heliac the transition has been triggered by the hot cathode (made of LaB_6) biasing, for making radial field[3, 4, 5]. In recent experiments the ion viscosity in the plasma with the island was roughly estimated. It is expected that plasma poloidal rotation will be driven by the poloidal rotation of the island. The purposes of this experiment in TU-Heliac are, to study the ability of the poloidal rotation of islands by rotating perturbation fields, and to check experimentally the structure of islands by measurement of plasma radial profiles by Langmuir probe.

In TU-Heliac the profile of a rotational transform can be changeable by selecting current ratios of toroidal, center conductor, and vertical coils, we selected the current ratio to locate a rational flux surface (n/m = 5/3) in the plasma periphery. The efficient configuration of perturbation coils for generating islands (m = 3) has been searched. We decided four pairs of upper and lower coils shown in Fig.1, which generate cusp field at each toroidal angle. We explored the possibility of the poloidal rotation of islands by changing the phase of the each perturbation coils current. We tried the method that, dividing perturbation coils into two groups, (1U, 1D, 3U, 3D) and (2U, 2D, 4U, 4D), changing perturbation current separately, one group's current is $I_{ex} = I_0\sin(\omega t)$ and other is $I'_{ex} = I_0\sin(\omega t - \pi/2)$. The result of calculation suggested that islands rotate to poloidal direction.

To check experimentally the structure of the island (m = 3) generated by perturbation coils, plasma profiles were measured by Langmuir probe. (a) density profile, (b) floating potential profile is shown in Fig.2. The island structure can be seen at the position of the island in the calculation (hatched area).

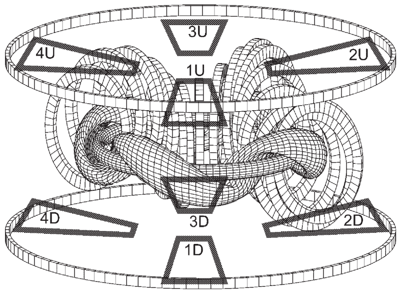

Fig.1. External perturbation coils set-up. Coils are located at toroidal angle ϕ = 0°, 90°, 180°, 270°, upper and lower location of toroidal coils.

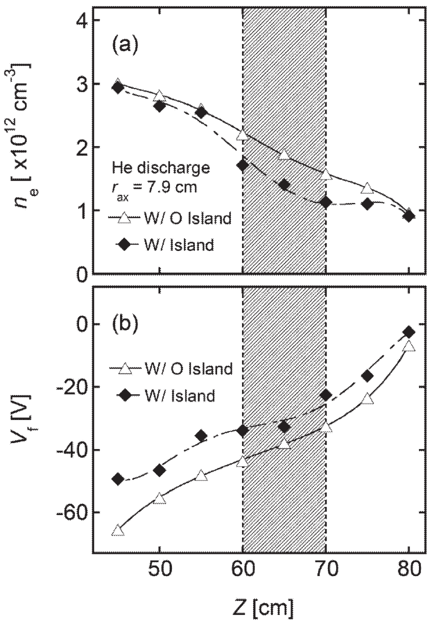

Fig.2. Radial profiles of (a) electron density and (b) floating potential measured by Langmuir probe. In calculation, the island is located Z = 60~70 [cm]

References

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