# §15. Development of Magnetic Island Detector by Magnetics Measurement

Okada, H., Yamamoto, S. (IAE, Kyoto Univ.),
Sakakibara, S., Suzuki, Y.

In magnetically confined plasmas, a magnetic island, which interrupts the structure of nested magnetic surface, would lead to the degradation of plasma confinement. The *m*=2/*n*=1 and *m*=1/*n*=1 (*n* and *m*: toroidal and poloidal mode number) magnetic islands generated by the miss alignment of helical coil winding are observed in LHD plasmas due to the profile measurement of electron temperature. High performance plasmas are archived by the shrinkage of low-*n* magnetic islands using the external perturbation coil named as LID coil. However, the physics of magnetic island and its effect on plasma confinement have little understanding. The aim of our study is to develop the magnetic island detector using magnetic measurements (magnetics) having high spatial and time resolution and to clarify the physics and effect of magnetic island in helical plasmas. We study in Heliotron J, which is smaller and more flexible device than LHD. In order to clarify the structure of magnetic island including position and width, we will investigate the differences of magnetic field structure in the toroidal direction using optimized magnetics. For this investigation, we developed the optimization method of magnetics location and shape due to the combined calculation of HINT2 [1] MHD equilibrium solver and JDIA [2] external magnetic field solver for helical plasmas.

The experimental result of magnetic surface measurements in vacuum shows that low-*n* magnetic island does not exist in Heliotron J plasma. The low-*n* magnetic island might be produced by the existence of external magnetic body near the plasma and/or the miss alignment of helical coil winding. We designed the external perturbation coils in order to actively control the *m*=2/*n*=1 magnetic island shown in Fig. 1. The perturbation coil consists of four coils having rectangular shape and can produce the quadrupole magnetic field which resonates with the *m*=2/*n*=1 magnetic island. Fig. 2 shows the *m*=2/*n*=1 magnetic island in vacuum excited by the external perturbation coil where each coil current is 5kAT. We can control the magnetic island width and phase due to the change of coil current. Moreover, MHD equilibrium would change the magnetic island width and position due to the change of rotational transform profile. It seems that we can correctly identify the magnetic island, which are externally controlled, using magnetic island detector. We will design the optimized magnetics and study the magnetic island using both external perturbation coil and optimized magnetics.

[1] Y. Suzuki, et al., Nucl. Fusion, **46**, L19 (2006).
[2] T. Yamaguchi, et al., Plasma Fusion Res., **1**, 011-1 (2006).

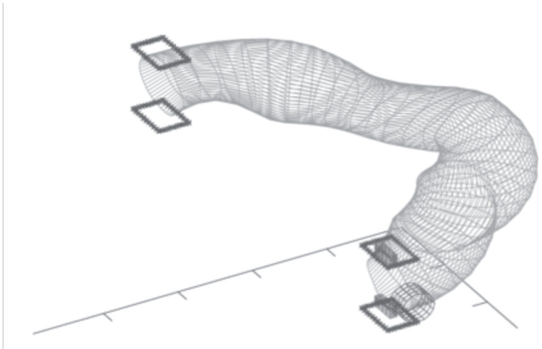

Fig. 1. External perturbation coil.

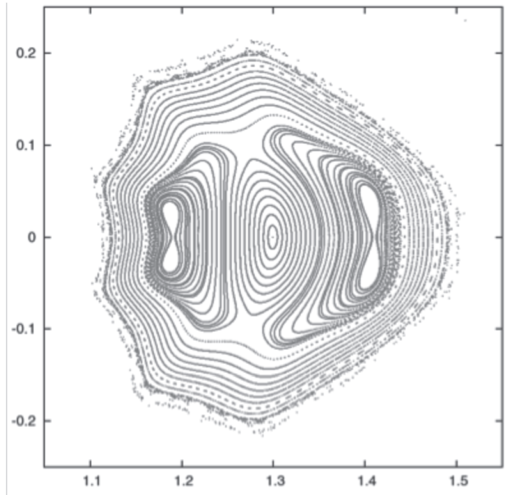

Fig. 2. m=2/n=1 magnetic island in Heliotron J plasma