§30. Study of Interaction between Plasma Flow and Magnetic Island in Helical Plasmas with Various Magnetic Configurations

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Plasma flow effect on magnetic island dynamics has been studied as a collaboration study between LHD and TJ-II [1]. In both experimental devices, a common phenomenon in which a magnetic island is suppressed (self-healing) after the increase in a poloidal flow was observed despite the opposite directed poloidal flow, different magnetic shear and value of rotational transform. In addition to those experiments, joint research with the Heliotron-J is expected to lead the wide understand from the view point of the wide range rotational transformation and magnetic shear. Namely, the effect of the poloidal flow on the magnetic island dynamics can be understood in the helical system which has various magnetic configurations. The purpose of this study is to clarify the interaction between plasma flow and magnetic island in Helical plasmas with various magnetic configurations. The experimental observation in Heliotron-J was examined. The Heliotron-J has a saddle type flux loop system which can detect weak normal field components. A resonant magnetic perturbation (RMP) coils are also installed, which imposes the perturbation field to produce the magnetic island with m/n=2/1 Fourier component. In the finite beta plasma on the magnetic configuration with magnetic island produced by RMP coil, the flux loop system can detect the plasma response magnetic field as the magnetic flux δϕ. The generation mechanism of δϕ is thought to be a magnetic field produced by the island-modified Pfirsch-Schlüter current, which depends on the magnetic island width. The absolute value of the δϕ increases with the plasma beta as shown in Fig.1, which means that the magnetic island width increases with plasma beta [2]. The similar behavior of magnetic island had been observed in the LHD experiment in low beta plasmas. The RMP field with m/n=1/1 mode is imposed to make the magnetic island. The plasma response field was detected by saddle loop array and planar flux loop array. Figure 2 shows the relationship between the plasma response field and the plasma beta. In this range of beta, magnetic islands do not show the self-healing [3]. The plasma response field increases with beta. These experimental results show that common phenomenon in the Heliotron-J and LHD.

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1) Y. Narushima, et al., (2011) Nucl. Fusion **51** 083030
2) S. Yamamoto, et al., et al., "*Studies of Magnetic Island using RMP and Optimized Magnetic Measurement in Heliotron J Plasmas*" ITC-22 Toki Japan
3) Y. Narushima, et al., (2008) Nucl. Fusion **48** 075010

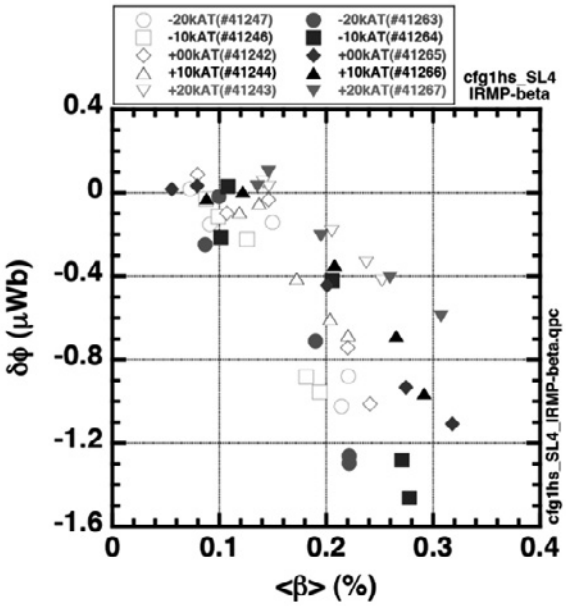

Fig. 1 (Heliotron-J) Relationship between plasma response field δϕ and plasma beta <β> under conditions of various RMP coil current. |δϕ| increases with <β>

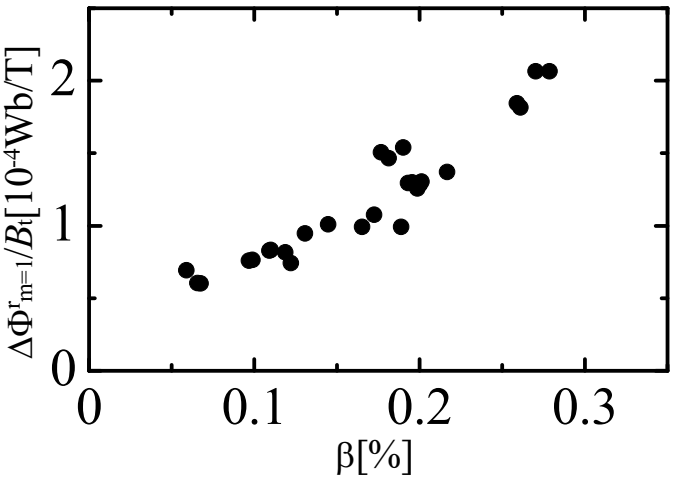

Fig. 2 (LHD) Relationship between plasma response field and plasma beta. In this beta range (relatively low), self-healing does not occur. Plasma response field increases with plasma beta.