§28. Observation of Magnetic Field for Disappearance of Magnetic Island in LHD

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From a viewpoint of MagnetoHydroDynamics(MHD) stability and plasma confinement, magnetic islands have interesting characteristics. The extreme growth of the magnetic island sometimes leads the MHD instabilities. On the other hand, the suitable size island contributes the stabilization for pressure driven mode via the locally flattening of the pressure profile at a resonant surface. In the LHD experiment, the disappearance of the seed island is observed by Thomson scattering measurement[1,2]. The 4-pairs of perturbation coils produce a seed island. For a change of the structure of the magnetic island without a temporally varying external magnetic field, some kinds of current layer should flow inside the plasma which makes a magnetic field with some structures. This means that a magnetic field may appears if the seed island produced by the perturbed field[3] disappears. The toroidal array of flux loops detects the magnetic field. Figure 1 shows the magnetic field profiles for that (a)the width of seed island ($w_{\rm vac}$) does not change(dw/dt=0), (b)the w becomes larger(dw/dt>0), (c)the island disappears (dw/dt<0, $w \simeq -w_{\rm vac}$). For (a), the flux loops detect zero field $\tilde{b}_1$, which is correspond to that the seed island does not change. In the case of (b), the finite field $\tilde{b}_1$ appears. Even in the disappearance of a magnetic island case(c), the finite $\tilde{b}_1$ is indicated and $\phi_{\rm n=1}$ shifts by about 180[deg] from that of the increasing case(b). This means that some kinds of current layer inside plasma produce $\tilde{b}_1$ suppressing the seed island in the LHD. When the island disappears, the normalized amplitude $\tilde{b}_1/B_{\rm t}$ increases with the $w_{\rm vac}$ as shown in Fig.2. Further study is intended to reveal the formation mechanism of the current layer producing $\tilde{b}_1$ which affects the behaviors of the magnetic island.

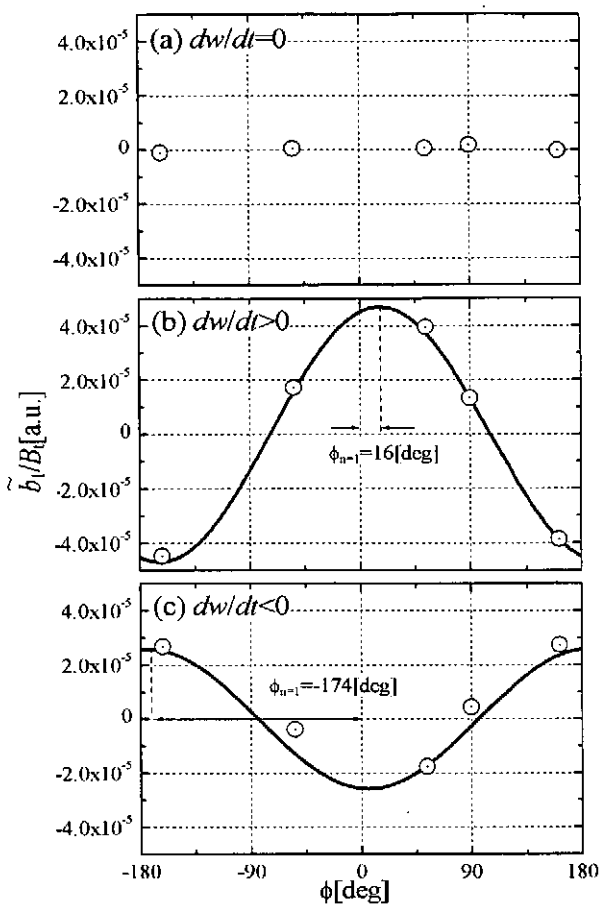

Fig. 1: Toroidal profile of normalized magnetic field. (a)Seed island does not change. (b)Island grows. (c)Island disappears.

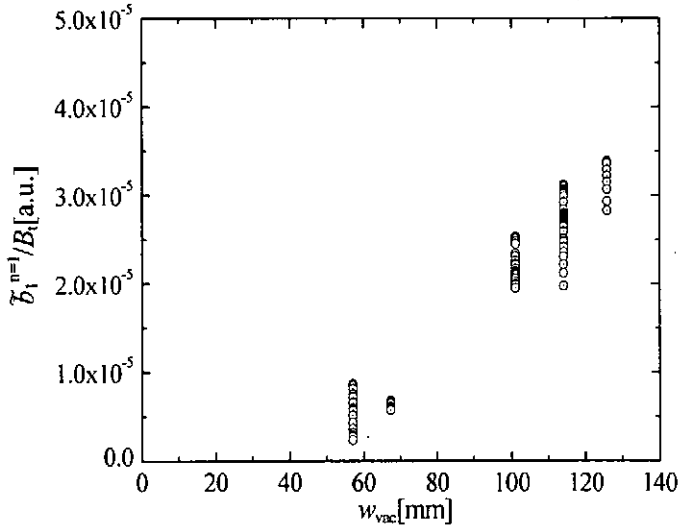

Fig. 2: Relationship betwen the normalized magnetic field and $w_{\rm vac}$ for disappearance of magnetic island.

References

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3) T.Morisaki et al., Fus. Eng. Des. 65,475-781 (2003)