§1. Effects of Self-Consistent Flow on Island Generation in Interchange Mode

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We investigate the time evolution of the magnetic islands generated by the resistive interchange mode in the straight LHD configuration[1]. The effect of the self-consistent poloidal uniform flow is focused. The NORM code[2] based on the reduced MHD equations is utilized for the study. We examine the nonlinear evolution of the single helicity perturbations with n/m =1/2, where m and n are the poloidal an the toroidal mode numbers, respectively. Fairly large resistivity ($S \sim 10^4$) is used, and the viscosity and the heat conductivity are chosen so that the mode with (m,n)=(2,1) should be dominant. In this case, the magnetic islands are generated spontaneouly in the linear phase because of the cylindrical effect as showin in Fig.1 (a). The number of the island in the poloidal cross section is the same as the poloidal mode number of the dominant mode.

In the nonlinear phase, the dominant mode saturates firstly. The radial flow, which is part of the vortex induced by the interchange mode, pushes the plasma outward at the positions of the O-point of the linear magnetic island. Hence, around these points, the radial curvature of the perturbed flux contour increases and the direction of the radial magnetic field is reversed. Then, the O-points of the linear island changes to the X-points. The number of the newly generated island becomes twice of the poloidal mode number of the dominant mode as shown in Fig.1 (b).

After the saturation of the dominant mode, the (m,n)=(0,0) mode grows self-consistently and saturates, which corresponds to the poloidal uniform flow. The radial flow of the interchange vortex is twisted by the poloidal uniform flow. Then, the curvature of the perturbed flux contour becomes weak and asymmetric with respect to the position of the nonlinearly generated X-point. As a result, the direction of the radial magnetic field is reversed again and the X-points are annihilated. Hence, the number of the resultant island returns to the poloidal mode number of the dominant mode. However, the shape is asymetric with respect to each O-point, as shown in Fig.1 (c). Thus, the X-points are generated or annihilated depending on the growth of the poloidal uniform flow.

(a)
(b)
(c)

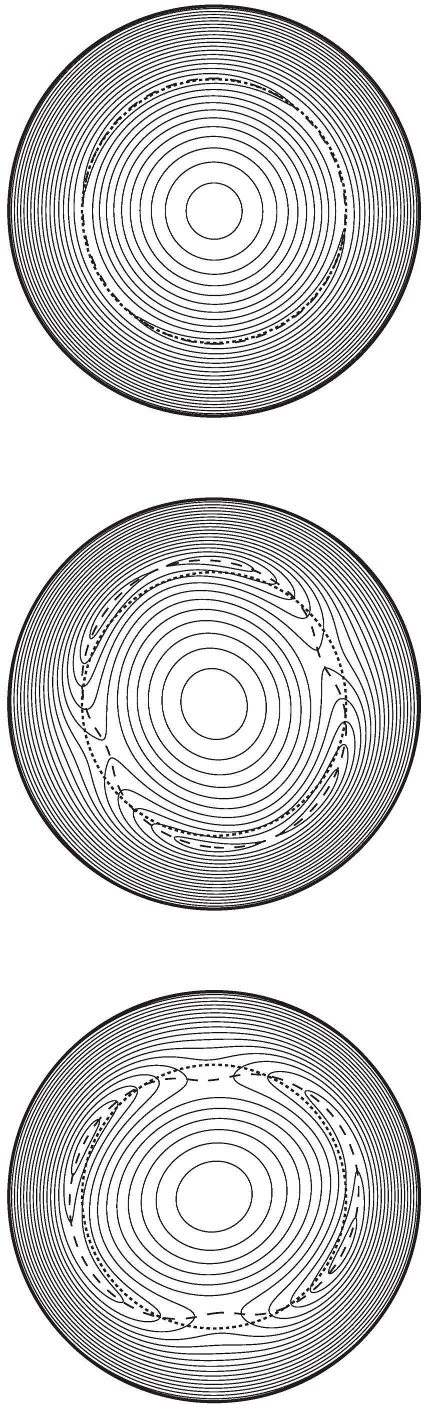

Fig.1 Contour of helical magnetic flux for $r \leq 0.8$ in (a) linear phase, (b) nonlinear phase just after dominant mode saturation and (c) nonlinear phase after uniform flow saturation.

References
1) Ichiguchi,K., Carreras,B.A. J. Plasma Fusion Res. Vol.6 (2004) 589.
2) Ichiguch, K., et al., Nuclear Fusion **43** (2003) 1101.