§1. Linear Stability of LHD Plasma with RMP

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The linear stability of the LHD plasma including resonant magnetic perturbation (RMP) is examined numerically[1]. The HINT2 code[2] and the MIPS code[3] are utilized for the equilibrium and the stability calculations. We employ the magnetic configuration with $R_ax = 3.6$m and $\gamma_c = 1.13$. The equilibrium without any RMPs is unstable for the interchange mode resonant at the $\iota = 1$ surface.

Here we impose the horizontally uniform magnetic perturbation. This magnetic perturbation is resonant at the $\iota = 1$ surface and generates an $m = 1/n = 1$ magnetic island in the equilibrium magnetic surfaces. In this equilibrium, the pressure profile is locally flat at the O-point of the magnetic island while the profile is still steep at the X-point. Therefore, the mode structure is changed so as to be localized at the X-point as shown in Fig.1. This localization is due to the fact that the driving force is largest at the X-point.

Figure 2 shows the viscosity dependence of the growth rate. As the viscosity is increased, the growth rate of the pressure driven mode is decreased. The amount of the decrease with the RMP is larger than that without the RMP. This is attributed to the fact that the stabilization of the higher components by the viscosity prevents the localization of the mode structure, Therefore, the mode structure extends to the region of the flat pressure profile and cannot utilize the driving force effectively.

The dependence of the growth rate on the RMP amplitude is also examined. As the amplitude of the RMP is increased, the island width is enhanced. The pressure profile is pushed toward the X-point and therefore, the pressure gradient becomes steeper at the X-point. Therefore, the growth rate is increased by the enhanced driving force as shown in Fig.3.

1) K. Ichiguchi, et al., Proc. IAEA-FEC 2014, St.Petersburg, Russia, TH/6-2.

2) Y. Suzuki, et al., 2006 *Nucl. Fusion* **46** L19.

3) Y. Todo, et al., 2010 *Plasma and Fusion Res.* **5** S2062.

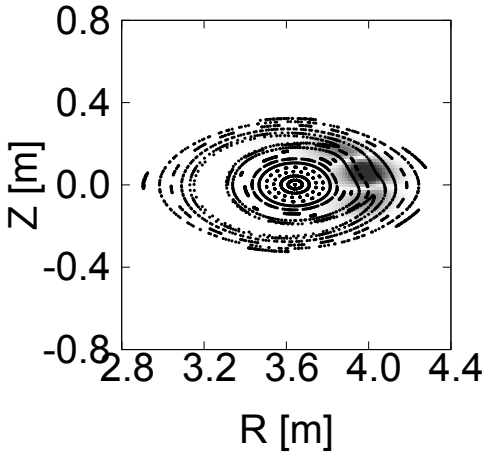

Fig. 1: Linear mode pattern of perturbed pressure (blue and red) in the case with the RMP in the poloidal cross section with the puncture plot of the field lines (black dots).

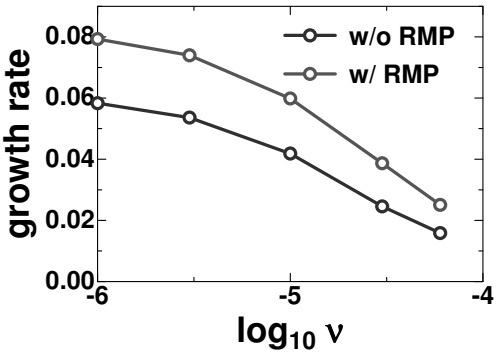

Fig. 2: Viscosity dependence of the growth rate of the pressure driven modes in the cases without (blue line) and with (red line) the RMP.

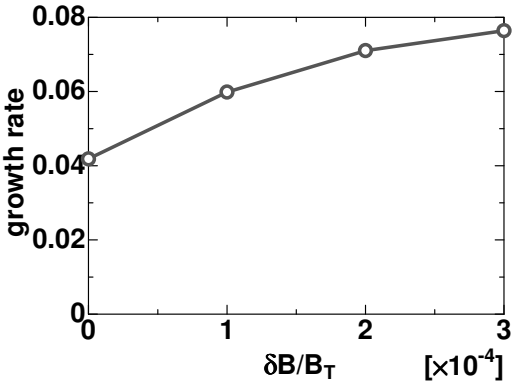

Fig. 3: Dependence of growth rate on the RMP amplitude for $\nu = 1.0 \times 10^{-5}$.