§2. Effects of the Resistive Wall on the Growth Rate of Weakly Unstable External Kink Mode in General 3D Configuration

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Formulation of a method for the systematic computation of the growth rate of the weakly unstable resistive wall mode (RWM) in 3D configurations by using results from ideal stability codes was investigated[1]. We obatined that the growth rate of the RWM is approximately given by

$$\gamma_r \tau_w \simeq -\frac{\delta W_p(\alpha) + \delta W_v(\alpha)}{D_w(\alpha)}, \qquad (1)$$

where α symbolizes the equilibrium quantities. Here, $\delta W_p(\alpha)$ and $\delta W_v(\alpha)$ denote the potential energy in the plasma regtion and the vacuum region of the ideal kink mode for the equilibrium parameter α and the wall located at infinity, respectively. The term $D_w(\alpha)$ means the energy dissipation due to the resistivity in the thin wall located at a given position. This formulation means that the growth rate of the RWM is approximately given by the rate at which the available free energy for the ideal external kink mode can be dissipated by the resistive wall. The eigenfunction is also approximated by that of the external kink mode.

We evaluated the growth rate of RWM in low beta LHD plasma carrying net toroidal current by utilizing eq.(1) and the KSTEP code[2]. Figure 1 shows the profiles of the rotational transform. The $\iota = 1$ surface exists in the plasma column for I < 150kA. First we examined the ideal kink mode with m=1 and n=1. Figure 2 shows the dependence of the growth rates on the net toroidal current. for several positions of the conducting wall shown by b/a. This figure shows that the RWM is non-trivial in the range of 130kA $\leq I \leq$135kA, because the ideal kink mode is stable even in the case of $b/a = \infty$ for I <130kA and the internal kind mode is unstable even in the case of $b/a = 1$ for I > 135kA. Thus, we calculated the RWM for the cases of I =130, 133 and 135kA. Figure 3 shows the growth rate. The growth rates are much less than those of the ideal kink modes. There is a tendency that the growth rate increases as b/a and I increases. By using a fully 3D ideal code instead of the KSTEP, we can calculate the growth rate in any 3D configuration.

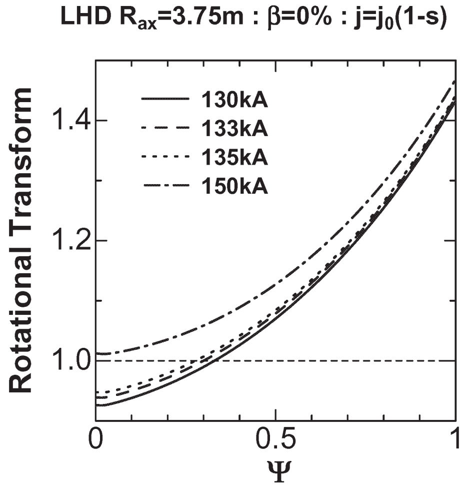

Fig.1 Profiles of rotational transform.

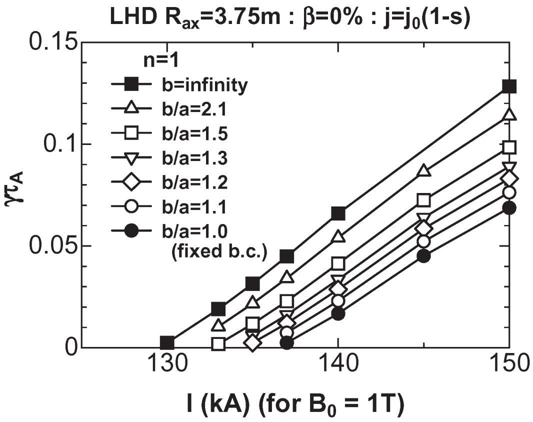

Fig.2 Growth rate of n=1 ideal kink mode.

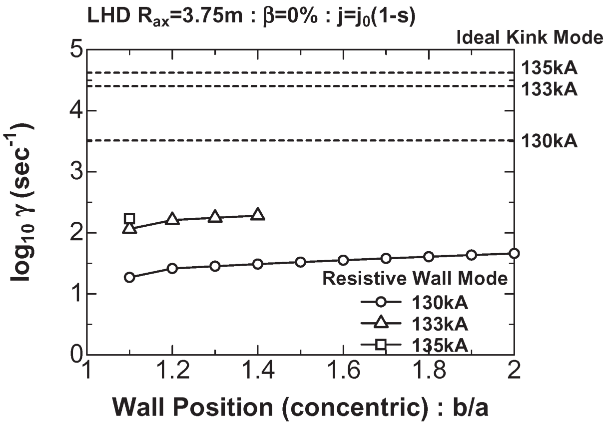

Fig.3 Growth rate of n=1 RWM.

References
1) Chu,M.S., Ichiguchi, K., Nuclear Fusion (to be published).
2) Nakamura,Y., et al., J. Comp. Phys. **128** (1996) 43.