Control of Neoclassical Tearing Mode by Electron Cyclotron Current Drive and Non-Resonant Helical Field Application in ITER

S. Taniguchi, K. Yamazaki, T. Oishi, H. Arimoto, T. Shoji

Department of Materials, Physics and Energy Engineering, Nagoya University, Furo-cho, Chikusa-ku, Nagoya 464-8603, Japan

e-mail : taniguchi.satoshi@c.mbox.nagoya-u.ac.jp

1. Introduction

Neoclassical tearing mode (NTM) is known as instability that creates magnetic island in tokamak plasmas. Confinement property is reduced by the magnetic island inside which heat and particle transports are enhanced. Methods for stabilizing NTM are electron cyclotron current drive (ECCD), non-resonant static external helical field application (NRHF),plasma flow shear and so on. ECCD has strongly stabilizing effect; however ECCD needs a lot of input power. On the other hand, NRHF needs less input energy, but is not fully stabilizing. In this study, time evolution of NTM has been calculated by the modified Rutherford Equation in the 1.5-dimensional (1.5-D) equilibrium -transport simulation code (toroidal transport linkage code TOTAL).to analyze stabilization effect of ECCD and NRHF against m/n=3/2 and 2/1 modes in ITER plasma.

2. Numerical model

The time evolution of NTM has been calculated using 1.5-D equilibrium-transport code (toroidal transport linkage code TOTAL). The plasma equilibrium is solved by the free-boundary Apollo code, and the plasma transport is evaluated including the impurity dynamics. The anomalous transport model used here is the GLF23 that can simulate H-mode plasmas. The time evolution of NTM magnetic island width, W, is calculated according to the modified Rutherford equation.

$$\frac{dW}{dt} = \Gamma_{\Delta'} + \Gamma_{BS} + \Gamma_{GGJ} + \Gamma_{pol} + \Gamma_{EC} + \Gamma_{RHF}$$

Here, W is normalized by plasma minor radius a. The right-hand terms $\Gamma_{\Delta'}$, Γ_{BS}, Γ_{GGJ}, Γ_{pol}, Γ_{EC} and Γ_{RHF} are the classical tearing mode stability index, the effect due to lack of bootstrap current, the effect of the field line curvature, the effect of ion polarization current, the effect of EC current and Γ_{RHF} and the effect of resonant external helical field, respectively.

3. Numerical results

Figure.1 shows that time evolution of magnetic island width where 2/1 and 3/2 island are assumed to be generated at the same time without NRHF or with NRHF application. This shows that 2/1 NTM is not stabilized by only NRHF but 3/2 NTM can be stabilized. The detailed numerical results will be shown in the poster.

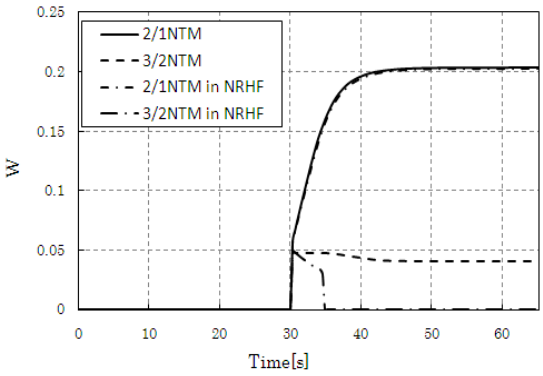

Fig.1 Temporal evolution of the normalized magnetic island width of 2/1 and 3/2 NTMs without and with NRHF application.