§10. Simulation Study on Nonlinear Interactions between Plasma Turbulence and MHD

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The neoclassical tearing mode (NTM) has been investigated theoretically and numerically by many researchers. However, most of these models which include the fluctuating bootstrap current are only valid in the collisional regime so that direct comparisons with large Tokamak experiments are questionable. Recently, an extension of the model to the collisionless region was proposed[1]. In addition, a gyro-kinetic simulation of the collisionless tearing mode using a PIC code is still under way[2]. In this study, the drift tearing mode including the fluctuating bootstrap current is investigated numerically based on the two-fluid model[3]. A multi-helicity simulation is performed to investigate the non-local interactions between islands in the collisional drift tearing regime.

The 4-field model is used to simulate neoclassical drift tearing mode[4]. The (2,1) tearing mode is unstable for the initial q profile and grows linearly. Figure 1 shows the time evolution of each Fourier mode of electromagnetic energy.

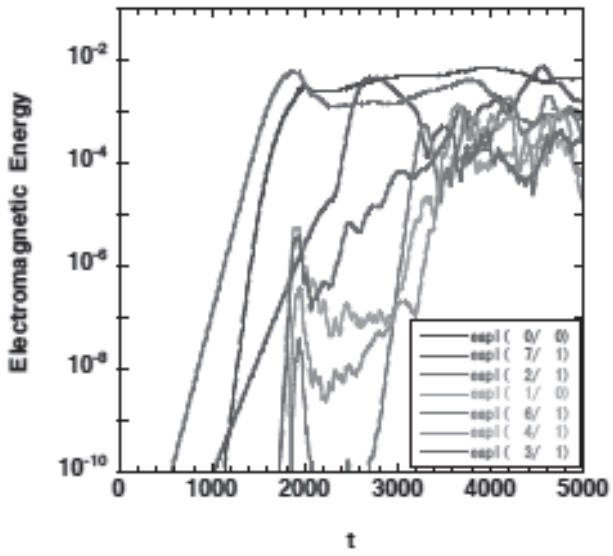

Fig. 1. Time evolution of electromagnetic energy

In this figure, the time is normalized by the poloidal Alfven time. It is seen that the dominant (2,1) mode saturates at t=2000 and remains dominant along with (0,0) mode. The (7,1) mode is nonlinearly excited and interacts with these modes. Figure 2 shows a contour plot of the fluctuating vector potential at t=2000, 2500, 5000. The strong interaction between the (2,1) and (7,1) modes can be observed in these figures. In the single helicity simulation, the collisional drift wave is excited, accelerating the growth of the (2,1) mode[4,5]. It does not occur in this case (See Fig.1). A detail analysis of the simulation results is ongoing on and will be reported on in the near future.

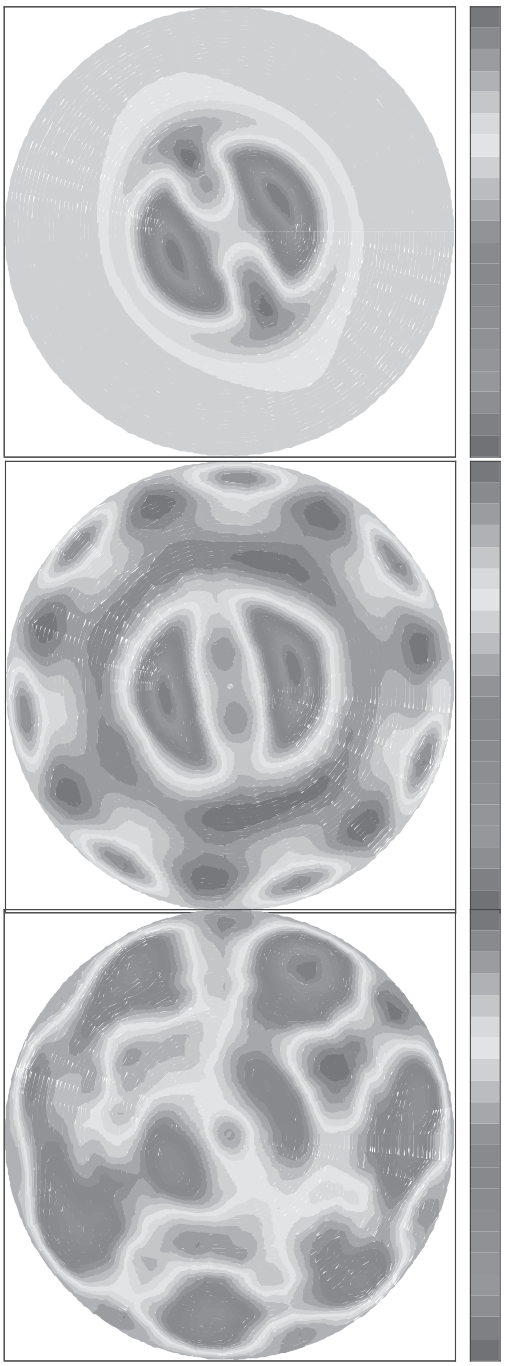

Fig. 2. Contour plots of fluctuating vector potential at t=2000(top), 2500(middle), 5000(bottom)

1) Connor, J. W. et al: Plasma Phys. Control. Fusion **51** (2009) 015009.
2) Naitou, H. et al.: 4th IAEA-TM on the Theory of Plasma Instabilities, Kyoto Univ, (2009) P1-16.
3) Yagi, M. et al.: 22th IAEA Fusion Energy Conference, Geneva, (2008) TH/P9-21.
4) Yagi, M. et al., Nucl. Fusion 45 (2005) 900.
5) Yagi, M. et al., Plasma Fusion Res. 2 (2007) 025