Numerical simulation on the flute instabilities in the GAMMA10 magnetic field

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Flute modes are the most dangerous instabilities for open magnetic systems such as GAMMA10 tandem mirror. So that the GAMMA10 contains the non-axisymmetric minimum-B mirror regions in order to suppress the flute instabilities. On the other hand the non-axisymmetric magnetic field enhances the neoclassical radial transport of ions in the central cell, so that the fully axisymmetric tandem mirror is desirable. A divertor magnetic mirror is one of candidate for the axisymmetric tandem mirror stable to the flute modes as a future device. There is a plan to replace one of anchor cell in GAMMA10 with an axisymmetric divertor mirror cell.

We have derived the basic equations to analyze the flute mode fluctuations in the magnetic divertor and have made a computer simulation code[1]. We applied the computer code to the GAMMA10 magnetic field and performed the computer simulation on the flute mode fluctuations and the associated plasma radial transport.

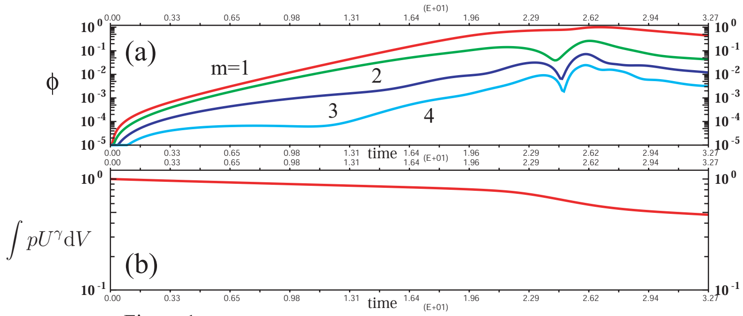

Figure 1

Figure 1 shows the results of simulation on flute instability in GAMMA10 magnetic configuration, where there is not hot ion pressure in the anchor mirror cell in the simulation so that the GAMMA10 is unstable to the flute modes. The time evolution of Fourier components of electrostatic potential ϕ are plotted in Fig.1(a). The time variation of the total stored energy defined $\int pU^\gamma \mathrm{d}V$, where p is plasma pressure, U is the specific volume of magnetic field line and γ is the specific heat index, is plotted in Fig.1(b). The flute modes grows in time and dumps at $t \sim 25.0$ leading to the radial loss and the enhanced anomalous radial loss leads to the large decrease of the total energy in Fig.1(b).

At the presentation we will show the detailed behavior of flute mode fluctuations and the associated plasma transport.

[1] I.Katanuma, V.P.Pastukhov, T.Imai, M.Ichimura, T.Kariya et al., Journal of Plasma and Fusion Research, Vol.84, No.5 (2008) pp.279-292.

[2] M.Inutake, et al., in Plasma Physics and Controlled Nuclear Fusion Research 1992 (*Proc. 14th Int. Conf. Würzburg, 1992*), Vol.2, IAEA, Vienna (1993) 651.