§3. MHD Activities in High-β Plasmas of CHS

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The beta value dependence of the magnetic fluctuations with the frequency f ≤ 100kHz in NBI heated plasmas has been investigated. Since the finite beta effect is large in CHS due to its aspect ratio as low as 5, magnetic configurations (rotational transform, magnetic shear and magnetic well) significantly change with increase in the beta value. In the region with normalized radius $\rho > 0.7$ where rational surfaces ($\iota \geq 0.5$) exist, magnetic shear contributes to the stability with the increase in the beta value. However, the region remains in the magnetic hill even if $<\beta_{dia}>$ reaches 2%.

Figure 1(a) shows the fluctuation level in the entire frequency range (3-100kHz) as a function of the beta value. The fluctuation level is a root mean square of the fluctuation amplitude at the probe position in the time window of 2ms and normalized by the equilibrium poloidal field $B_p = a\,\iota\,(a)\,B_t / R$, and the maximum values are plotted for the burst type oscillation. The envelope of the fluctuation level seems to saturate when the beta value exceeds about 1%. Figure 1(b) shows the change of fluctuation levels of the modes with m ≤ 2. This analysis is done only when the coherent modes are clearly observed. Therefore, the behavior illustrated in Fig.1 (b) shows the upper limit of the amplitude of the coherent modes. The coherent mode in the co-injection case with a low beta value is only the burst type of the m/n = 2/1 mode which accounts for almost one hundred percent of the total fluctuation level. Although the m/n = 2/1 mode is also observed in the case of counter or balanced injection with a low beta value, the level is much smaller and the ratio to the total fluctuation level is several percents. When the beta value exceeds 0.5%, the m/n = 1/1 mode appears predominantly and the m/n = 3/2 and 4/3 modes with a small amplitude are observed simultaneously. In the region above $<\beta_{dia}> >$ 1.4%, only the m/n = 1/1 (2/2) mode is observed. The level of the m/n = 2/1 mode other than the burst type has the maximum value around $<\beta_{dia}>$ of 1% and disappears when $<\beta_{dia}> > 1.4\%$. On the other hand, the level of the m/n = 1/1 (2/2) mode increases when $<\beta_{dia}>$ reaches 1% and then saturates at a certain level.

The change of the frequency of each coherent mode is shown in Fig.1 (c). The modes rotate in the electron diamagnetic direction with a relatively low frequency except for the burst type m/n=2/1 mode. If the plasma rotation due to E×B drift is subtracted from the mode rotation like the Doppler shift, the net rotation is supposed to have the frequency almost equal to the ion diamagnetic frequency. The frequency range of the burst type m/n=2/1 mode decreases with the increase in the beta value.

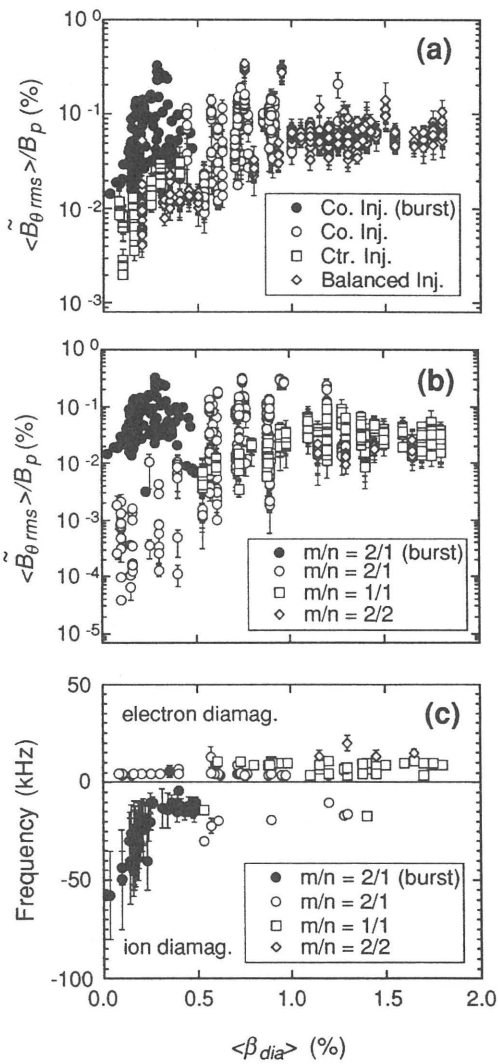

Fig.1 (a) The fluctuation level in the frequency range (3-100kHz) and (b) the amplitude of coherent mode and (c) the frequency of each coherent mode as a function of the beta value.