§16. Effect of Plasma Current on MHD Modes in Neutral Beam Heated Plasmas in CHS

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Effects of the net toroidal plasma currents on MHD modes have been investigated in neutral beam heated plasmas with the control of ohmic current in CHS.[1] Figure 1 shows a typical discharge with OH currents. The net current is increased up to 35 kA in the co-direction by ohmic heating. The sum of the Ohkawa and bootstrap currents is estimated to be about 5 kA. Total magnetic fluctuations ($f \leq 100$ kHz) increase with the net current (I_p) and disappear suddenly when I_p reaches 18 kA at 70 ms. After this event, the increase and decrease of the fluctuation level are repeated twice as the net current increases. The change of the coherent component with coherence of more than 0.7 is similar to the trend of the total fluctuation. The primary component before the first event at 70ms is $m/n = 2/1$ mode which is observed as repetitive bursts of fluctuation before 50ms.[2] This mode gradually changes into a continuous fluctuation where two modes with different frequencies and rotating direction appear by turns. The $m/n = 2/1$ mode with high frequency (20 ~ 38 kHz) rotates in the ion diamagnetic direction and that with low frequency (5 kHz) rotates in the electron diamagnetic direction. After extinction of the $m/n = 2/1$ mode, the $m/n = 1/1$ and 3/2 modes appear with the further increase in the net current. The $m/n = 1/1$ mode rotates in the electron diamagnetic direction with 5 ~ 14 kHz while the $m/n = 3/2$ rotates in the ion diamagnetic direction with 20 ~ 38 kHz. The $m/n = 3/2$ mode disappears suddenly at 100 ms when $I_p = 30$kA and is not observed until the end of discharge. Although the $m/n = 1/1$ mode persists until the end of the discharge, the amplitude is dramatically reduced at about 100 ms, at which the L-H transition occurs. In the region of net current of more than 30 kA, the $m/n = 4/3$ mode with 68 ~ 75 kHz appears and increases until the end of the discharge.

Figure 2 shows the change of the resonant surfaces with the increase in the net current in Fig.1. The resonant surfaces move inward in the radial direction as I_p increases because of the increase in central rotational transform. The modes with $m/n = 2/1$ and 3/2 abruptly disappear at the specific current, which is consistent with the extinction of the resonant surfaces.

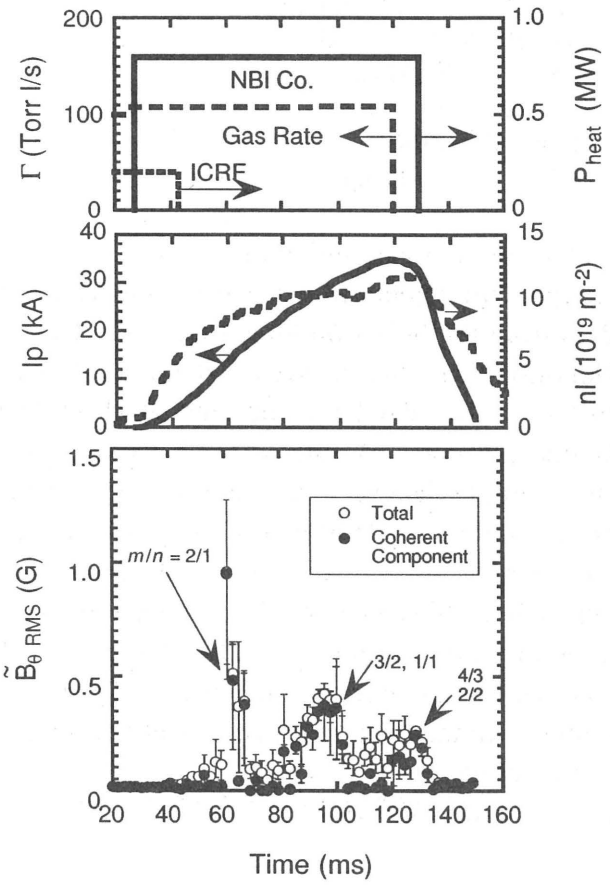

Fig.1. Discharge with the ohmic current in the co-direction.

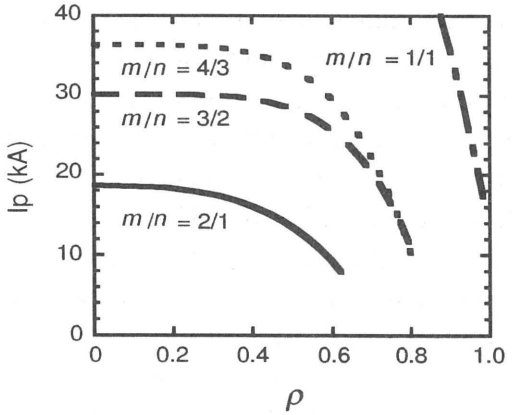

Fig.2. Changes of resonant surfaces as functions of the net current.

References

1) Sakakibara, S. et.al, Jpn. J. Appl. Phys. 34 (1995) 252.
2) Sakakibara, S. et.al, J. Phys. Soc. Jpn. 63 (1994) 4406.