§26. Fluctuation Measurements with the CHS Heavy Ion Beam Probe

Crowley,T.P. (Rensselaer Polytechnic Institute), Iguchi,H., Lee,S., Fujisawa,A., Hamada,Y

Fluctuation diagnostics yield important information about plasma instabilities and transport. A Heavy Ion Beam Probe (HIBP) diagnostic has the unique ability to measure potential fluctuations in a hot (> 100 eV) plasma. HIBPs have also been used to measure density fluctuations in several machines. The CHS HIBP has been used to measure fluctuations in plasmas with and without significant MHD activity.

Figure 1 shows raw signals from a magnetic loop and the HIBP diagnostic during an m/n = 2/1 mode burst in a low density neutral beam heated plasma. This type of burst occurs in low beta discharges.[1] A mode with a frequency of about 25 kHz grows and reaches a maximum at t = 101 ms. After that the mode frequency quickly drops to about 5 kHz. The HIBP up-down signal in the middle graph is used to determine the electric potential fluctuations. The HIBP sum signal in the bottom graph is used to determine density fluctuations. As can be seen in the figure, both of the HIBP signals respond to the 25 kHz phase of the burst while the sum signal responds more strongly to the 1 kHz phase than the up-down signal. In addition to the burst, there is a newly identified, relatively continuous 115 kHz narrow band mode that is present at all times except for the latter half of the burst. The mode appears strongest in the up-down signal and is the cause of the thickness of the signal line before and after the burst.

Frequency spectra of fluctuation data from plasmas without significant MHD activity are shown in Figure 2. This data was taken during an ECH heated discharge. A broadband spectrum with a width of order 30-100 kHz is typically observed. (The decrease in amplitude above 100 kHz is due to filtering of the signal). This is similar in many ways to observations of turbulent fluctuations in tokamaks such as JIPPT-IIU. These measurements have only been made at relatively low densities, but within this range, the density fluctuation level decreases as the density is increased. Sum signal fluctuation levels are of order a few percent. At the higher densities, the fluctuations levels are comparable, although a little larger than is typical in the tokamak experiments.

For both the MHD and broadband fluctuation data, there are some possible problems in simply interpreting the HIBP up-down signal as the electric potential and the HIBP sum signal as the density. Further work is being done to resolve this issue.

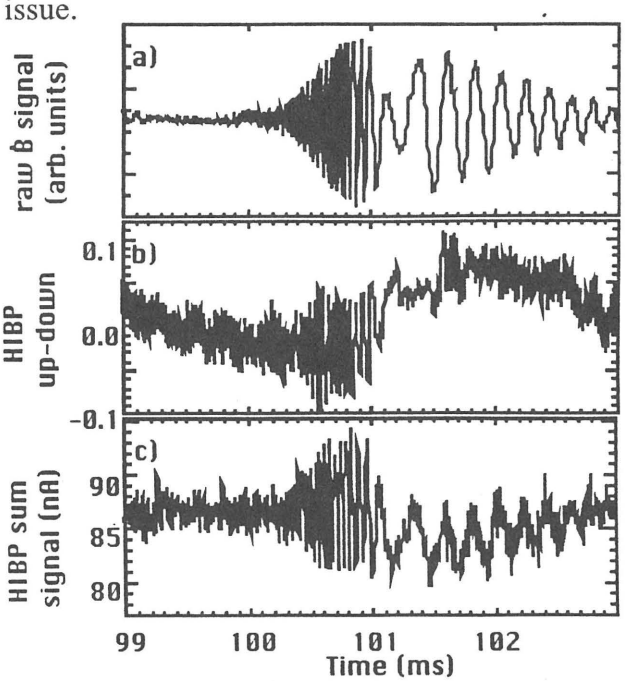

Fig. 1. Magnetic loop [a)] and HIBP signals [b) and c)] during an m/n = 2/1 mode burst

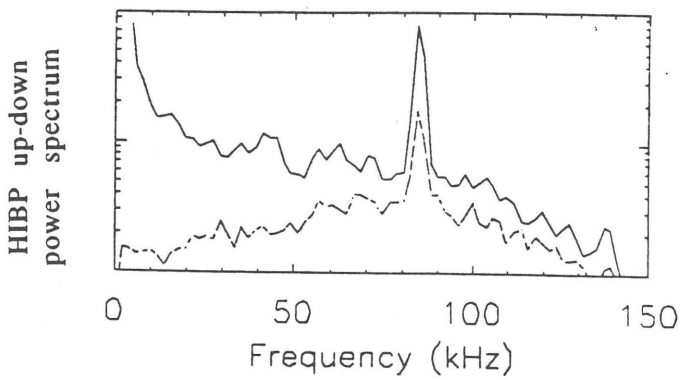

Fig. 2 Frequency spectra of HIBP signals during a plasma without large MHD activity. Dashed lines are an estimate of electronic noise.

References

1) Sakakibara,S. et al., J. Phys. Soc. Japan, 63 (1994) 4406.