§11. Lost Fast Ion Probe in CHS

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A probe which measures escaping fast ions was developed and applied to neutral beam (NB)-heated CHS plasmas. The objective of this study is to investigate a single particle behavior and an effect of instabilities on fast ion loss in CHS. Another objective is to obtain experience and knowledge of handling this probe toward LHD experiment.

The conceptional view of fast ion detection is illustrated in Figure 1. A very thin ZnS(Ag) scintillator on a quartz plate(1"×1") is mounted inside the light-tight detector box having a unique pinhole aperture and vertically inserted into the vacuum vessel from the upper diagnostic port of CHS. As is seen in Fig. 1, it is possible to estimate the energy and pitch-angle of escaping fast ions by measuring the position of light spot. The 2-dimensional scintillation image is guided out of the vacuum vessel via a light-tight cylindrical probe tube having a lens inside and optically coupled to an image-intensifier (I.I.) combined with a CCD camera. The image is stored in a personal computer via a video grabber board and a video-recorder with the sampling frequency of 60 Hz. Because of the requirement of fast measurement, the scintillation light is split in front of I.I. and measured with photomultipliers(PM) with the frequency up to 200 kHz. The principal design of this probe originates in that which has been developed by Zweben in TFTR[1].

The ordinary operation of CHS is that the toroidal magnetic field B_T is directed to CCW and the plasma is heated by co-injected NB (NBI#1). The direction of aperture was set such that fast ions can be detected under the condition mentioned above. Figure 2 shows the typical time trace of PM signal in an NB-heated plasma. The timing of the signal completely corresponds to that of NB. When B_T was reversed from CCW to CW, no PM signal was observed. This is a clear evidence that the signals are due to fast ions generated by co-injected NB.

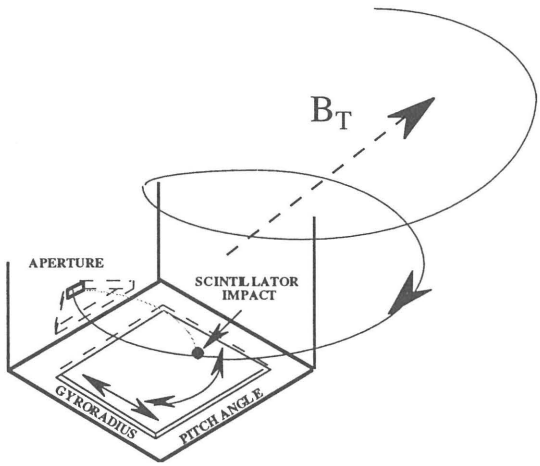

Fig. 1. Conceptional view of detection of energetic ion in the probe head.

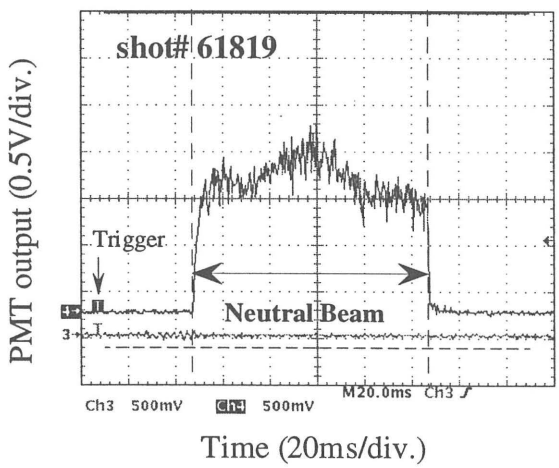

Fig. 2. Time evolution of escaping fast ions. The plasma conditions were :B_T=0.88 T (CCW), R_{ax}=97.4 cm and co-injected neutral beam heating.

Reference

1) Zweben, S.J. et al., Nucl. Fusion 30 (1990) 1551.