§8. Study on High Energy Particles Escaped from LHD Using Lost Ion Probe

Nishiura, M., Isobe, M.
Kubo, N., Sasao, M. (Tohoku Univ.)
Murakami, S. (Kyoto Univ.)
Darrow, D.S. (PPPL)

For lost ion measurements, a scintillator type lost ion probe is installed into the 5-O port of the LHD. The lost ion probe has measured the loss signals of fast ions out side the last closed flux surface (LCFS) throughout the 8 campaign.

The lost ion probe measures the pitch angles and the gyro radii of fast ions directly and simultaneously by observing the ion strike points on the scintillator plate passing through the entrance slit and the collimator slit. The emitted light from the scintillator plate is detected by a CCD camera for relatively slow signals of 33 msec/frame and by a 3x3 photomultiplier array for fast signals from dc to 20 kHz. Figure 1 shows that the gyro radius estimated from the peaks of striking points on the scintillator plate becomes small as the toroidal magnetic field increases. As a reference, both energies for negative ion based neutral particles (N-NB) and thermal ions are plotted in the same figure. The observed signals do not exceed the gyro radius estimated from the energies of N-NB, and thus the signals consider to be valid. The small difference would come from the slowing down of fast ions and the error of the probe position.

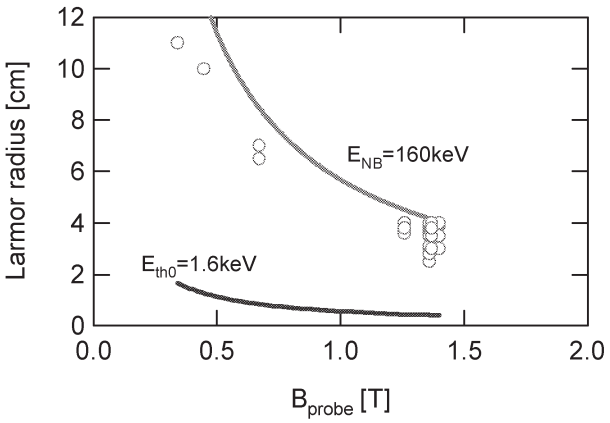

Fig. 1. Gyro radii are plotted with the magnetic field at the probe position. Gyro radii are calculated from the N-NB energy and thermal ion temperature.

The spatial distribution of lost fast ions is measured in the vicinity of the LHD plasmas, shown in Fig. 2. The intensities of the lost fast ions are plotted in Fig. 3. At 5100 mm, the decrease of the intensities of lost fast ions is observed. These data are important, and can use the estimation of deposition profile of NB with the combination of HFREYA code.

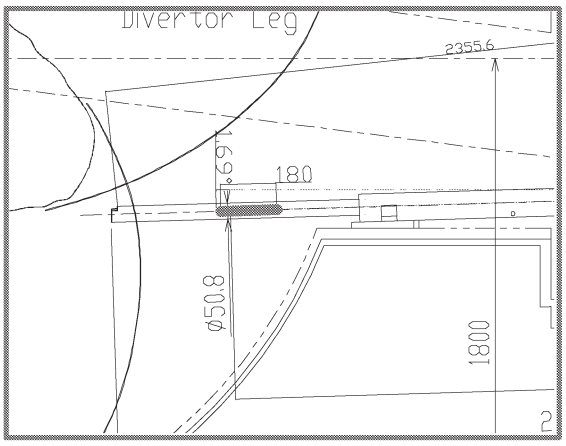

Fig. 2. Spatial distribution of lost fast ions is measured in the region of bold line on the probe shaft axis in the figure.

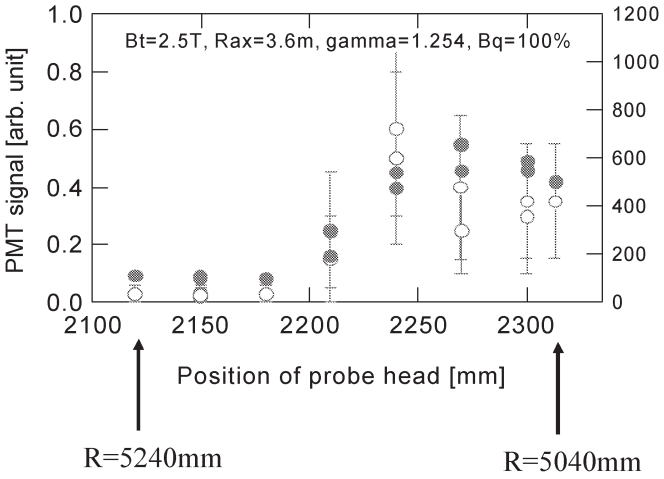

Fig. 3. The intensities of spatial distribution of lost fast ions. The electron density and temperature are Ne(FIR)=0.6-0.8x10^{19} m^{-3}, and Te=2keV, respectively.

In the high density plasma experiments, the fluctuation signals are detected with the frequency of 5 kHz before the detached plasmas phase. Under the detached plasmas, the fluctuation and intensity of lost fast ions are disappeared immediately. This phenomena would mean the changes of the deposition of NBs.

The degradation of emission light is not appeared clearly throughout this cycle, although the scintillator plate increased the temperature of up to about 190°C. Further endurance test of scintillator would be performed for severe conditions.

References

1) Nishiura, M., Isobe, M., Saida, T., Sasao, M., and Darrow, D. S., Rev. Sci. Instrum. **75**(2004)3646.