§ 15. Study on High Energy Particles Escaped from LHD Using Scintillator Probe

Nishiura, M., Isobe, M.
Saida, T., Sasao, M. (Tohoku Univ.)
Darrow, D.S. (PPPL)

Pitch angle and energy of high energy particles escaped from confined plasma give the important information on plasma confinement and physics. Such particles were successfully measured by a scintillator detector mounted inside a probe in TFTR.1) In the Compact Helical System(CHS), neutral beam ion loss has been studied in details using the scintillator detector with certain modifications.2) This probe is proposed for lost ion particle measurements and recently has been installed into the 6-T port of the Large Helical Device(LHD) during the 4th cycle.3) Figure 1 shows the preliminary observed signal of lost ion particles in the 4th cycle of the LHD.

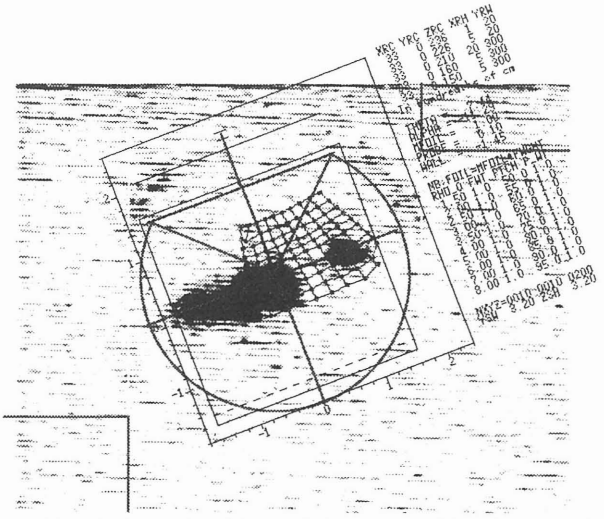

Fig. 1 Typical grid overlaid on the video image of the scintillator probe. Two dimensional grid indicates the pitch angle(upper right direction) and energy distribution(lower right direction). The contrast-emphasis is carried out to be clear.

In the 5th cycle, the trouble on vacuum leakage at that time, which is considered to be due to the melt of vacuum seal of quartz window by ECH, was encountered.

From the lessons of the past, the scintillator probe was newly built, and the following points were improved;

- The probe shaft can be pulled out from the LHD just in case. If it has some air leakage, the gate valve of 5-O port can be closed within a few minutes.
- The commercial sapphire window is used for the heat resistance up to 450 °C and the thermal gradient up to 25 °C/min.
- Against heating up by ECH stray wave, all the spaces reaching from the vacuum vessel to the sapphire window are closed.

At the end of the 6th cycle, as is shown in Fig. 2, the probe system was newly installed into 5-O port of the LHD. Although the vacuum system of the probe was started to pump down, it did not achieve the pressure of less than 10^{-7} Torr, because of the bad conductance inside the probe shaft.

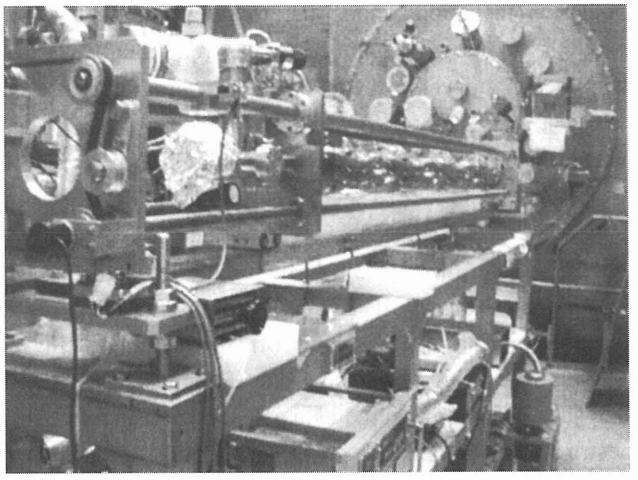

Fig. 2 Photograph of movable scintillator probe system installed into the 5-O port of the LHD.

For the next 7th cycle of LHD experiments, further improvements have been treated as the follows;

- For the better vacuum the probe shaft will have holes of 1 mm in diameter, which is determined from the ECH wavelength.
- The thermocouples are prepared to measure the temperatures at the positions of the sapphire window and the scintillator plate.

In addition to these promising equipments,

- The water cooling system will be provided for to cool the sapphire window directly. It prevents from heat load of glow discharge, neutral beam, ECH, divertor, and so on.

References

1) Darrow, D. S., et al., Rev. Sci. Instrum. **66,** (1995) 476.
2) Kondo, T., et al., Nuclear Fusion **40,** (2000) 1.
3) Saida, T., *et al., Proceedings of Advanced Diagnostics for Magnetic and Inertial Fusion(2002).*