§8. Angular Distribution of Enegetic Particle at CDC and SDC Phases

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The neutral particle distribution can be measured by the 20-channel Angular Resolved Multi-Sightline neutral particle analyzer (ARMS) [1]. This analyzer is prepared for investigating the loss region by measurement of the spatial (=pitch angle) resolved energetic ion distribution in order to find the most suitable energetic particle confinement. In this cycle, two different ARMS system of perpendicular and tangential (14 sight lines) can be operated same time. Here we study the phenomena during the IDB (Internal Diffusion Barrier) and CDC (Core Density Collapse) by measuring the neutral flux.

In LHD, the extreme high-density plasma can be easily obtained because there is a few macroscopic instabilities due the current-less plasma. When the repetitive fuel pellet is injected to the plasma located on the outer magnetic axis, the plasma density can be increased until the pellet can be completely evaporated by NBI. At that time, the diffusion barrier seems to be appeared. We have no idea whether it is a real transport barrier or only transient phenomena. However the different approach to reach Lawson’s criterion (low temperature, high density) can be expected by utilizing the super dense core.

The Compact Neutral Particle Analyzer (CNPA) signals, which are line integration of the neutral fluxes, increase when IDB is appeared as shown in Fig. 1(a). CNPA signals are integration of the ion amount (mainly thermalized in low energy region) and the background neutrals from the wall. Usually the signal decreases due to the screening of the background neutrals when the plasma density increases. Signal enhancement after the IDB is larger than the signal before the IDB in spite of the same plasma density. This means that the difference of the flux cannot be explained by the screening of the background neutral. After IDB, ion amount may increase due to the plasma instability. From the time history of each energy flux, the increase of flux seems to transport from the low energy range to the high-energy range as shown in Fig. 1(b). Usually the low energy ion is located near the peripheral region. Therefore the instability may grow from the peripheral region to the core, and on the way CDC may appear.

CDC is appeared after the break of IDB. At that time, the density and the temperature at the peripheral region where the neutral particle is mainly generated, are drastically changed. Before IDB, the background neutral is penetrated toward the plasma core because the density and temperature keep low at the peripheral region. Therefore transit particles originated from NBI and located near the core, can be observed by ARMS because the background can reach the core. However the neutral particle cannot be observed after IDB and the loss region near the perpendicular direction can be observed. This loss region becomes maximum at the end of IDB. The background neutral cannot penetrate into the plasma because much warm core plasma moves to the plasma peripheral region after IDB (CDC phase). Therefore the low energy and the uniform neutral flux can be observed in ARMS.

In the next campaign, we prepare all twenty channels in perpendicular and tangential ARMS. The precise diagnostics can be expected

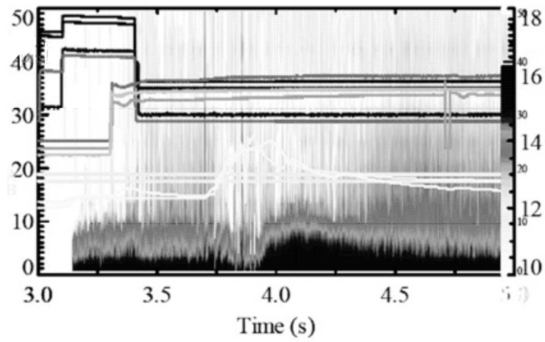

Fig.1(a). CNPA signals,
Time history of neutral flux

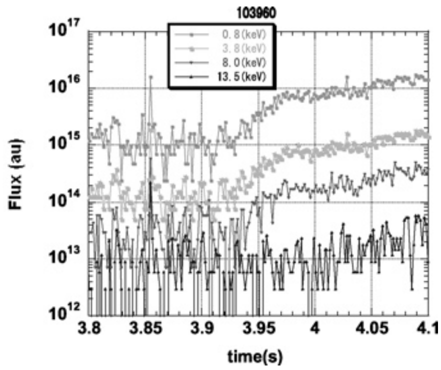

Fig.1(b). CNPA signals,
Time history of neutral in low energy range.

[1] E. Veshchev et. al, RSI 79, 10E310(2008).