The observation of potential fluctuation with 6 MeV Heavy Ion Beam Probe in LHD

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Heavy Ion Beam Probe (HIBP) is a very powerful diagnostic tool for studying high temperature toroidal plasmas, because it can measure the potential with good spatial/temporal resolution, simultaneously with the density fluctuation. In LHD, a HIBP, of which acceleration voltage is 6 MeV, was installed and has been developed [1,2]. By improving components of this system, such as the ion source, the electro deflector and the beam detector, the signal to noise ratio and the temporal resolution become better. In recent experiments, not only the equilibrium potential profile but also the fluctuation in the central region of plasma was measured [3].

In the duration of the discharge, when electron cyclotron heating is applied to the plasma heated by neutral beams, the negative pulse of potential in the central region was observed in LHD. In this case, the density of plasma was 0.4×10^{19} m^{-3}, the central electron temperature was about 2~3 keV. The potential at the plasma center was similar value of the electron temperature (a few kV). The depth of negative pulse of the potential was a few hundreds volts. The time constant of the potential drop in this negative pulse was 100 μs and 500 μs in the returning phase. In this plasma, the internal transport barrier was observed in the electron temperature profile. It is considered that the negative pulse of potential is related to the collapse of the internal transport barrier. Possible reasons of this phenomenon are the strong gradient of electron temperature or the bifurcation of electric field between two roots, so called electron root and ion root. Detail analysis of this experimental result will be shown in this presentation.

In HIBP, the magnetic field fluctuation in the plasma can be measured as well as the potential and the density. However, the measurement of the magnetic field fluctuation by using HIBP is not a local measurement, because the obtained quantity depends on not only the local fluctuation at a sample volume, but also the path integral of fluctuation over the beam path. This situation is very similar to the density fluctuation measurement with HIBP. We call this effect as "path integral effect". In LHD, it was shown that this "path integral effect" is not large near the local maximum in the fluctuation amplitude profile [4]. The preliminary result of magnetic field fluctuation measurement will be shown and the resolution of obtained fluctuation will be discussed.

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