§23. Experimental Study of H-mode Like Hydrogen Plasma in the Outward Shifted LHD Configuration

Tokuzawa, T., Tanaka, K., Yamada, I.,
Lee, J.H. (NFRI, Korea)

In the upcoming deuterium experimental series, one of the important study issues is the isotope effect. Several tokamak experiments showed the isotope effect is appeared in the H-mode plasma. In LHD plasma, H-mode like plasma has been observed[1]. For the future comparison study, the data of hydrogen H-mode plasma is obtained in 18th LHD experimental campaign.

The experiments are carried out in the magnetic configuration where R_{ax}=3.9 m, B_t =1.0 T, γ = 1.197, and B_q= 100 %. Figure 1 shows the n_e-T_e diagram at the pedestal. The data points are located below the dotted line which the electron pressure is P_e=0.5 kPa. In future deuterium experiments it will be updated.

Typical temporal behavior of H-mode plasma is shown in Fig. 2. In this discharge, the plasma is heated by neutral beam injectors (NBI). H_α signal is a good indicator to notify onset of H-mode phase and the ELM event. Turbulence study is also important issue and some diagnostics such as microwave reflectometer, beam emission spectrometer, laser phase contrast imaging, etc. has been installed and applied simultaneously. In Fig. 2, the fluctuation amplitudes both 20-200 kHz and 200-500 kHz frequency component signal measured by PCI is plotted in the bottom. It is found that the higher frequency component reduces at the beginning of H-mode (t ~ 3.8 s) and then it bursts with ELM. Around the H-mode beginning time, both the electron pressure gradient at the pedestal and the neutral pressure decrease similarly shown in Fig. 3. It might be the evidence of the relationship between the plasma peripheral

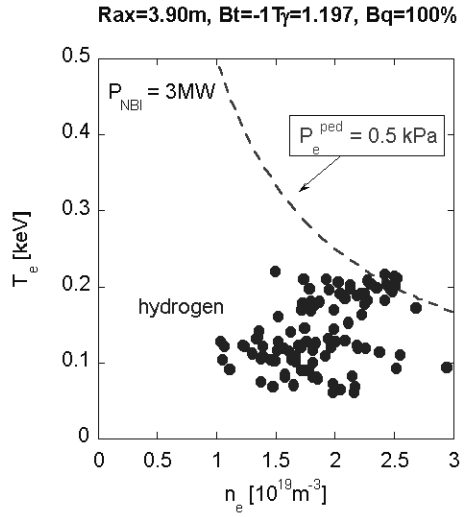

Fig. 1. n_e-T_e diagram in hydrogen experiments in the magnetic field configuration that R_{ax}=3.90m, B_t=1T, γ=1.197, B_q=100%

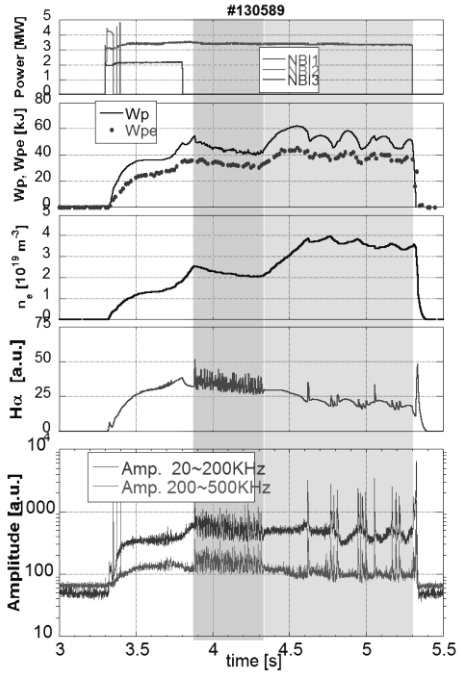

Fig. 2. Temporal behavior of input NBI power, stored energy, electron density, Hα signal, and fluctuation amplitude (from top to bottom). From t ~ 3.8s the plasma changes to H-mode. From t ~ 3.9s to ~ 4.3s, it is in ELMy H-mode phase. Then, at t ~ 4.3s the ELM free phase is appeared.

region and the wall surface as a sink. The deuterium is heavier than hydrogen and the interaction might be increased. Therefore, these plasma edge phenomena need to study more carefully.

Also, the active heat transport experiment is carried in H-mode plasma by using 3rd harmonic ECH of 77 GHz gyrotron. However, there is no obvious effect of ECH currently. It seems that other technique is needed for heat transport study.

1) Toi, K. et al.: Fusion Sci. Tech. **58**, 1, 61 (2010)

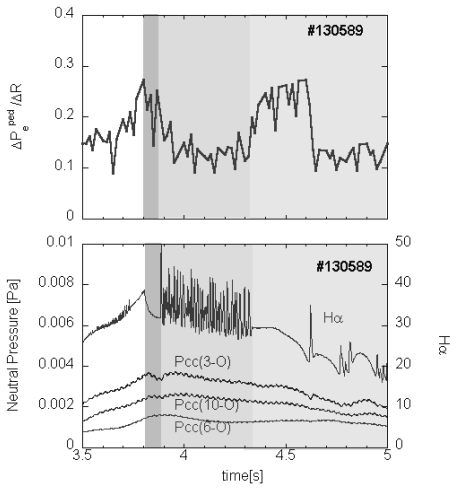

Fig. 3. Time evolutions of pressure gradient at the pedestal (top), Hα and neutral pressure signals (bottom).