§10. Influence of Closed Divertor on Ion Behavior in the LHD Edge and Divertor Plasmas

Ezumi, N. (Nagano National College of Tech.),
Sawada, K. (Shinshu Univ.),
Ohno, N. (Nagoya Univ.),
Kobayashi, M., Masuzaki, S.

Plasma flow and ion temperature (T_i) are the key parameters for characterizing the heat and particle transport in boundary plasmas So far, plasma flow alternation was found on the experiment using multiple functions probe, which consists of Mach probes and an ion sensitive probe (ISP) in the LHD boundary plasma [1,2]. In this experimental campaign, influences of plasma density on spatial profiles of plasma flow in stochastic magnetic boundary layer and T_i and electron temperature (T_e) in divertor plasma were investigated by a movable multiple functions probe, which consists of Mach probes and an ISP. These results are expected as reference of closed divertor configuration in next campaign.

Mach number profiles for different plasma density have been evaluated experimentally as shown in Fig.1. Mach number in high-density case (#111619) is smaller than that in low-density case (#111620) at the lower Z-position of the hatched region. In the case of high-density plasma, negative Mach number is observed at the higher Z-position of the hatched region. Although the simulated alternation positions, which calculated by EMC3-EIRENE, appeared different position with experiment, the results consistent with the experimental results, qualitatively.

Figure 2 shows density dependence of T_i and T_e in the divertor region measured by the ISP. Decrease of both temperatures with increasing line-averaged density is observed. Moreover, tendency of the temperatures is similar to T_e at the LCFS. Although T_i was higher than T_e in low-density plasma, both temperatures became almost same with increasing the density. The density dependence might be explained by taking into account energy relaxation between ions and electrons. Generally, ion energy losses are caused by charge exchange and elastic collision with the neutral particles. Electron energy is lost by excitation and ionization. Considering the energy balance, density dependence for these processes is canceled. However energy relaxation term for ion and electron remains density dependence. Further qualitative evaluation for the energy balance to explain the density dependence is underway.

1) Ezumi, N., Kobayashi, T., Masuzaki, S. et al.: J. Plasma Fusion Res. Ser. **8** (2009) 429.
2) Ezumi, Todoroki, K., Kobayashi, T. et al.: J. Nucl. Mater. **430-432** (2011) 415.

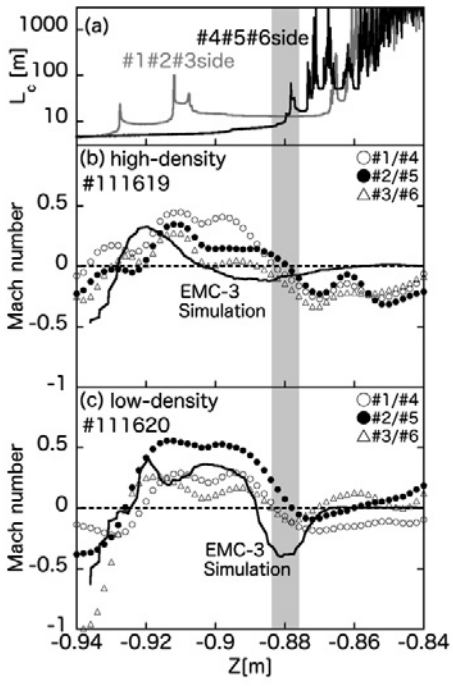

Fig. 1. Spatial profiles of L_c and comparison of experimentally estimated Mach numbers for different density. Open circles, closed circles and open squares indicate the experimental results and solid lines show the results of 3D simulation in #111619 and #111620 cases.

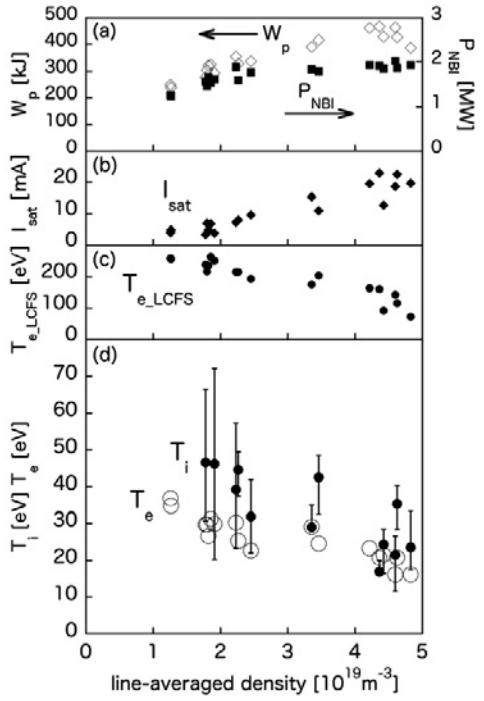

Fig. 2. Dependences of T_i and T_e in the LHD divertor legs on line-averaged density. (a) Plasma stored energy and NBI deposition power, (b) I_{sat} measured by the ISP, (c) T_e at LCFS measured by a YAG Thomson scattering system and (d) T_i and T_e measured by the ISP.