§7. Multipoint Measurement of Helical Divertor Characteristics

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For accurate extrapolation toward helical reactor design, it is essential task to complete LHD's datasets that can be acquired. Particularly outside the stochastic layer, each physical phenomenon behaves unsymmetrically in the toroidal and poloidal direction. Magnetic structures localize in narrow region due to strong magnetic shear near the helical coils; in addition, surrounding neutral particles are directly influenced from the non-uniform wall shape and condition. Therefore, multipoint measurement is crucially important inside the peripheral of the helical device.

In 16 cycle experiment, we have newly prepared several measurement systems in time with installation of closed helical divertor component to inboard side of #2, 4, 6, 8, and 10 toroidal sections. Figure 1 depicts locations of divertor tiles with a Langmuir probe array or thermocouple. They are axisymmetrically positioned around a line drawn through I- and O-ports for each section. Thus, we can access global information about divertor particle and heat fluxes from ion saturation current (I_{sat}) and tile temperature (T_t).

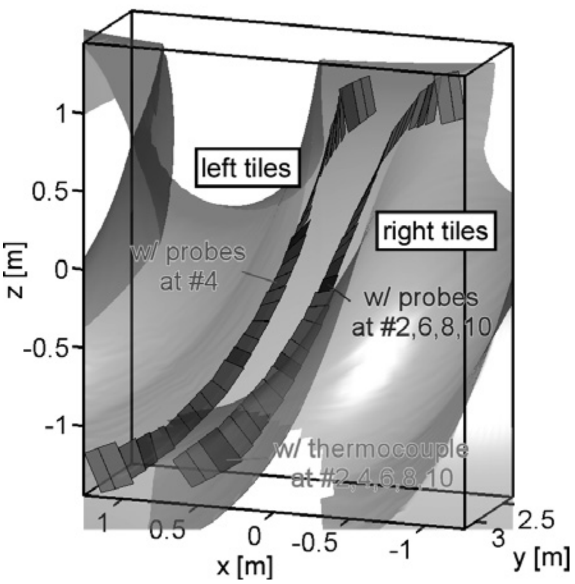

Fig. 1. Newly-installed measurement systems on closed helical divertor tiles in 16 cycle experiment. Several tiles equip a Langmuir probe array (blue and green) or thermocouple (red).

Figure 2 shows toroidal distribution of I_{sat} during flat-top phase. Magnetic axis position (R_{ax}) was 3.6 m and toroidal magnetic field (B_t) pointed to reversed direction. Amplitudes of I_{sat} at the right tiles are clearly higher than those at the left tiles in all measured sections. Such a magnitude relation inverted during normal B_t discharge; thus, it would be attributed to **ExB** flow inside the private region. Similar phenomenon was also reported in tokamaks between inboard and outboard divertor fluxes[1]. Further, it was found that the ratio becomes approximately one under outward shifted configuration (R_{ax} = 3.75, 3.9 m). The critical R_{ax} seems to have a relationship with thickness of the divertor leg that connects to the measuring divertor probes.

Figure 3 shows T_t measured during a steady state discharge (#117208). Because of normal B_t and R_{ax} ~ 3.65 m, T_t of the left tiles were larger than those of right tiles. In addition, dispersion of T_t at different tiles was observed. It reflects poloidal asymmetry of the divertor leg, insertion angle of magnetic field into the tiles, and trajectory of high-energy particles accelerated by the ICH.

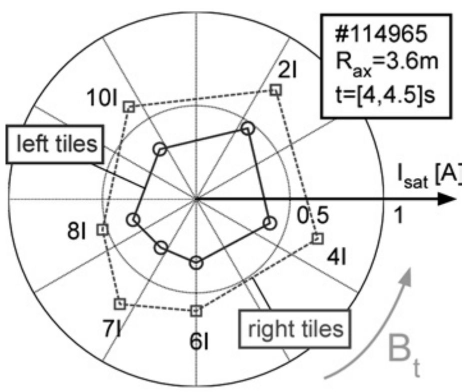

Fig. 2. Toroidal distributions of I_{sat} measured at left (blue line) and right tiles (green dashed line) during R_{ax} = 3.6m discharge with reversed B_t.

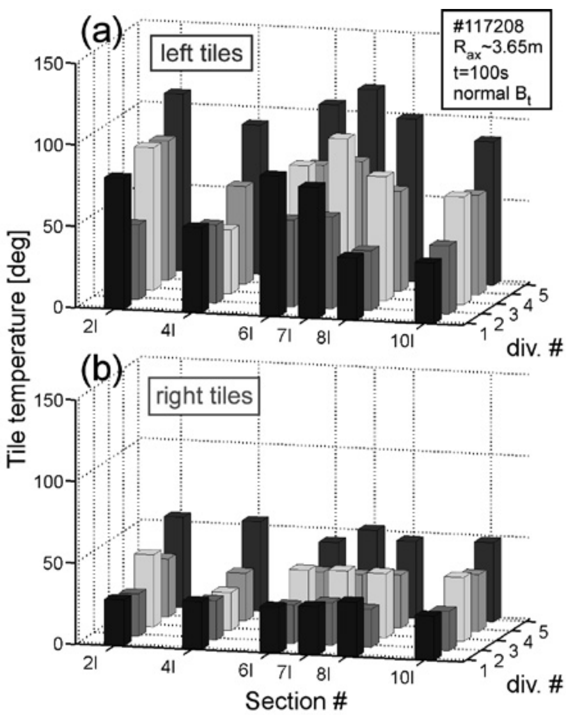

Fig. 3. Tile temperatures measured at (a) left and (b) right tiles at t = 100 s in a steady state discharge.

1) Boedo, J. A. et al.: Phys. Plasmas **7** (2000) 1075.