§12. Measurement of Edge Plasma and Its Fluctuations by 5-pin Langmuir Probe

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Since the electrostatic fluctuation plays an important role in anomalous transport, it is important to measure the level of density  $\tilde{n_e}$ , potential  $\tilde{\phi}$  and electron temerature  $\tilde{T_e}$  fluctuation and the phase difference among them. There are few methods to obtain time development of these plasma parameters simultaneously. In the edge regeon where we can insert Langmuir probe into plasmas, we can use triple probe technique[1]. But triple probe technique has some restriction. Triple probe work well when the three electrodes contact with same condition of plasma. Since the wavelength of electrostatic fluctuations is small and is typically 1-5 cm in the edge region of tokamaks the distance between the electrodes cause the measurement fail.

We now try to a new arrange that triple probes are set perpendicular to the toroidal magnetic field[2]. The arrangement of the probe system is shown in Fig.1. We measure two floating potentials  $V_{f1}$  and  $V_{f2}$  at electrode 3 and 3', respectively. If a wave with the wavenumber kand the angular frequency  $\omega$  propergates,  $V_{f1}$  =  $V_{fc}e^{ik2d}, V_{f2} = V_{fc}e^{-ik2d}$ , where  $V_{fc}$  is floating potential at the center and d is the separation between electrode. The  $V_{fc}$  can be estimated from averaging like  $(V_{f1} + V_{f2})/2 \sim (1 + 2(kd)^2)V_{fc}$  if the  $kd \ll 1$ . A DC bias voltage are applied electrodes 2 and 2' for electrode 1. The ion saturation current  $I_s$  and the potential of the positively biased electrode  $V_+$ are also measured. From  $V_{f1}$ ,  $V_{f2}$ ,  $V_{+}$  and  $I_s$  we can calculate time evolution of the space potential Vs, the electron temperature  $T_e$  and the density n as

$$V_{fc} = (V_{f1} + V_{f2})/2,$$
 (1)

$$T_e = 1.71(V_+ - V_{fc}), \qquad (2)$$

$$n = I_s / (0.61 A e \sqrt{\frac{kT_e}{m_i}}),$$
 (3)

$$V_s = V_{fc} + \frac{1}{2} [\ln(\frac{1}{2\pi} \frac{m_i}{m_e}) + 1] T_e$$
 (4)

, where A and  $m_i(m_e)$  are the surface area of a electrode and the mass of the ion(electron), respectivly. The geometry of the head of our system is shown in Fig.2. This probe is set at the upper port (P9U). The preliminary measurement of the profile of the SOL plasma are show in Fig.3. We are analyzing the charaterisitics of the fluctuation about the limiterbias experiments and AC-helical experiments.



Fig.1: Schematic drawing of the measuring system of the probe.



Fig.2: Schematic drawing of the probe head.



Fig.3: Measured profiles of the floating potential, the electron temperature and density. Plasma current and toridal magnetic field are 190kA and 2.9T, respectively. Closed circle are data from Ohmic heating plasma and closed triangle are NBI heated plasma.

Reference

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