## §8. Modification of Edge Plasma with a Polarized Electrode

Ohdachi, S., Toi, K., JIPPT-IIU Group,
Kitachi, K.
(Dep. Energy Engeneering, Nagoya Univ.)

The radial electric field observed in the edge region of the H-mode plasma is supposed to be connected with the improved confinement. There has been several biased limiter experiments to aim at the active control of the radial electric field. However, the spatial structure of the electric field formed was not understood completely, since the transverse electrical conductivity and the current diffusivity are anomalous.

We studied the modification of the potential in the edge/SOL plasma when we apply the voltage to the small movable limiter on JIPP TII-U tokamak. The electrode(made of C/C composite with 20% boron) is 30mm in diameter and 50mm in length and is inserted from the upper port(P8). Since the shaft is covered by a ceramic tube, we can apply voltage(-800V to +800V) to the limiter head only.

The current from the limiter head(electrode) flows along the magnetic field line towards the main limiter of JIPP TII-U. In positive(or negative) biased case, the current are determined by the ion saturation current $I_{is}$ at the main limiter(or at the electrode). $I_{is}$ is balanced out at the other side of the current channel $I_e$, which depends on the floating potential $V_f$; $I_e^n = I_{is}^n \times (1 - \exp(\frac{v - V_f}{T_e^n}))$, where $v$ and $T_e$ are the applied voltage and the electron temperature in the channel,respectively. Upper script represents the position (1:electrode, 2:main limiter). We can obtain $V_f$ using $I_{is}^1 = -I_e^2$ (1). If we assume $T_e^1 = T_e^2$ and $I_{is}^2 = \alpha I_{is}^1$ (The surface of the main limiter is $\alpha$ times larger than that at biased limiter), Eq.(1) leads to $\exp(\frac{(v - V_f)}{T_e}) + \alpha \exp(\frac{-V_f}{T_e}) = \alpha + 1$. In the limit $v \ll -T_e$, we obtain $V_f$ = const and if $v \gg T_e$, $V_f \propto \exp(\frac{v}{T_e})$. Therefore, one can see that a positive floating potential can be achieved easily. These results agree well with the measured potential near the electrode (Fig. 1).

The potential formed by a small biased limiter can not produce a homogeneous potential when it is set in the SOL region where the magnetic field lines are not closed. Floating potential at a Langmuir probe 180° away from the limiter poloidally shows that $V_f$ depends on the safety factor $q_a$(Fig. 2); the potential changes only when the magnetic field lines connect to the electrode. The width of the current channel(dx) is estimated; $dx = 2\pi a d\theta = 2\pi a \frac{a}{Rq^2} dq$. In this case $dx$ = 0.04 m. This is about as same as the size of the limiter head. The current in the SOL does not diffuse poloidally. The effect on the main plasma is small because very small area is affected by the biasing. When the limiter is set fully inside the LCFS, the effect of the biasing is still small except for the rapid edge cooling by the release of impurities. The change of the electrostatic fluctuation will be discussed in the next article.

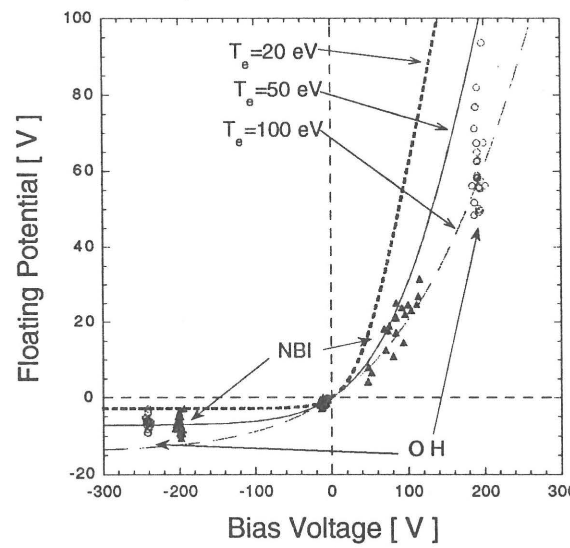


Fig.1: The floating potential is the SOL as a function of the bias voltage. $B_t$=2.8 T, $I_p$=180kA, $\overline{n_e} = 1 - 3 \times 10^{19} m^{-3}$. Lines in the figure show the expected potential by Eq. (1) with $\alpha = 6.5$.

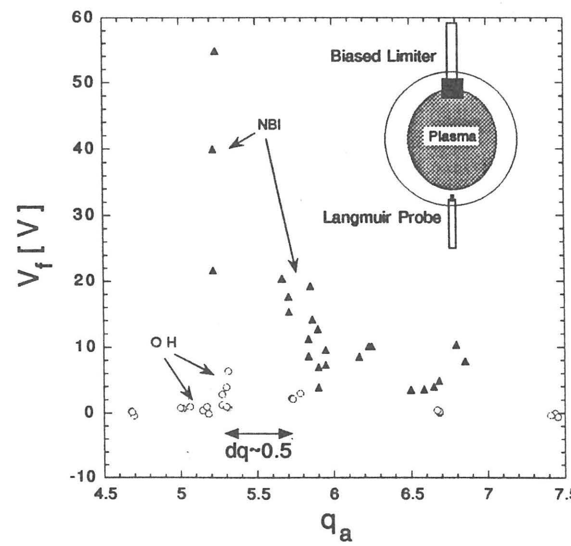


Fig.2: The floating potential measured by a Langmuir probe as a function of the safety factor.