MFP47

[1st] Asia-Pacific Conference on Plasma Physics, 18-23, 09.2017, Chengdu, China

Experimental evaluation of Langmuir probe sheath potential coefficient

L Nie[1], M Xu[1], R Ke[1,2], F W Yi[1,3], J Cheng[1], T Lan[4], Y Yu[3], H G Shen[4], R J Hong[5], H Liu[6], Z Y Chen[6], Z P Chen[6] ,HL-2A team[1] and J-TEXT team[6]

[1]Southwestern Institute of Physics, Chengdu, China

[2]Department of Engineering Physics, Tsinghua University, Beijing, China

[3]School of Nuclear Science and Technology, USTC, Hefei, China

[4]Key Laboratory of Basic Plasma Physics and Department of Modern Physics, USTC, Hefei, China

[5]Center for Momentum Transport and Flow Organization, UCSD, California, USA

[6]College of Electrical and Electronic Engineering, HUST, Wuhan, China

Systematic calibration experiment of Langmuir probe sheath potential coefficient Λ, which is a critical coefficient for estimating plasma sheath potential $V_p = V_f + \Lambda T_e$, has been carried out in the HL-2A and J-TEXT tokamak deuterium plasmas. Flat carbon probe was used in order to obtain good I-V characteristics. The voltage swept frequency are 1 kHz for equilibrium measurement and 30 kHz for fluctuation measurement. Three kinds of sheath potential coefficient, $\Lambda_t == 2.8$, $\Lambda_p = (V_p - V_f)/T_e$ and $\Lambda_I = \ln(|I_{se}/I_{si}|)$, were compared.

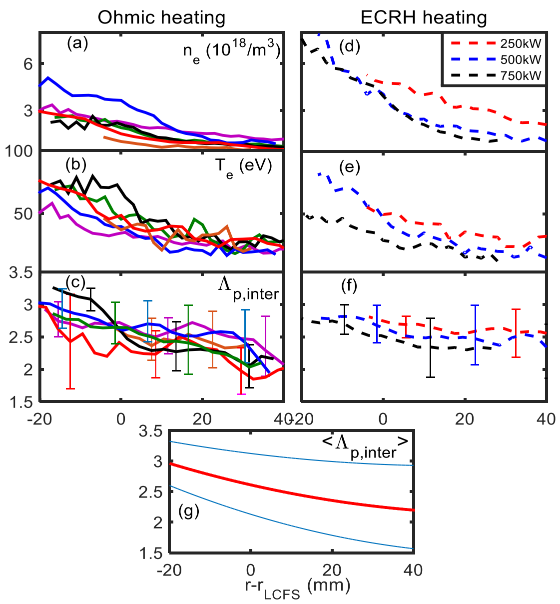

Figure 1 The statistics of 6 Ohmic discharges (left) and 3 ECRH L-mode discharges (right). (a) and (d) plasma density; (b) and (e) electron temperature; (c) and (f) Λ_p and (g) the statistical average $< \Lambda_p >$, the two dotted lines show the region of error bar.

Figure 1 shows the 10 shots' statistics in equilibrium measurement, including Ohmic and ECRH heating discharge. It was found that the estimated Λ_p coefficient, which is calculated by plasma potential measured by the V-I characteristic directly and is most credible, monotonically increased from ~2.2 to ~2.9 while Langmuir probe is moved from 40 mm outside last-closed-flux-surface (LCFS) to 20 mm inside LCFS. This measured coefficient is closed to the commonly used value $\Lambda_t == 2.8$ for hydrogen plasmas, which is often assumed to be a constant throughout plasma. Further analysis indicated that the alpha coefficient correction only affected the quantity of radial electric field but had little impact on the trends of it and its shear.

Figure 2 shows the time evolution of fluctuation (1-10 kHz) of plasma potential and floating potential which are measured from V-I characteristic. It is different from the equilibrium situation, the fluctuation of floating potential seems similar to the plasma potential. Which implies that the temperature correction term, ΛT_e, may be not so important as we though before, and we can use floating potential to replace the plasma potential[1-3] when we measure the fluctuation of plasma, such as turbulence, Reynolds stress and so on.

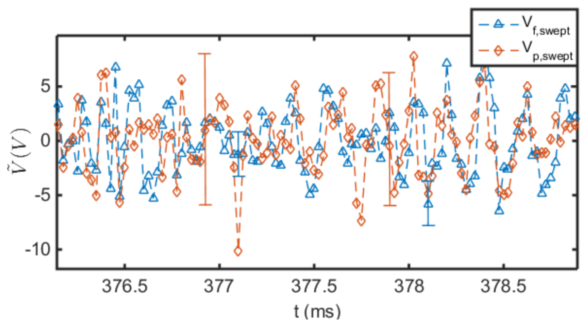

Figure 2 Time evolution of fluctuation of plasma potential and floating potential which are measured from V-I characteristic, error bars come from fitting error.

Reference

1. R. A. Moyer, et al., Phys. Plasmas 2, 2397 (1995).
2. H. Y. W. Tsui, et al., Rev. Sci. Instrum. 63, 4608 (1992).
3. H. Lin, et al., Phys. Fluids B: Plasma Physics 1, 2027 (1989).