§28. Langmuir Probe Measurement in CHS

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Edge plasmas are considered to be important in determining the transport of energy and particles in toroidally confined plasmas. Especially, there has been an increasing interest in the measurement of fluctuations in the edge region because of their overall relationship to confinement. Recent studies show that interactions and couplings between spontaneously excited fluctuations can lead to turbulence-induced particle and energy fluxes that dominate the transport in the edge of tokamaks and other toroidal devices [1, 2]. Thus, in CHS, it is of crucial importance to understand and to control the turbulence-induced transport as well as the edge plasma parameters.

A Langmuir probe is adaptable to measurements in edge plasmas in which the density is below 10^{13} cm^{-3}. In plasmas in which the Langmuir probe can survive, this diagnostic remains the easiest and most accurate way to make local measurements. It can obtain electron density, electron temperature, floating potential, and ion saturation current and floating potential fluctuations, and hence, the turbulence-induced particle flux can be calculated using these data.

The preliminary measurements were performed on ECRH plasmas. The Langmuir probe was introduced into the plasma in 0.5 to 1 cm steps while monitoring the electron temperature and the ion saturation current. The final position was estimated to be 1 cm outside the last closed flux surface. At this position, a temperature of about 45 eV and an ion saturation current of about 20 mA were measured with both a single and double Langmuir probe. This implies a density of 4×10^{12} cm^{-3} for the probe tip of $A=2\pi r_p L=4.4$ mm^2 where $r_p=0.35$ mm and L=2mm, as shown in Figs. 1 and 2. Here, the ξ axis is the same as the probe axis. The origin of the ξ axis is located on the last closed flux surface in the vacuum and the ξ direction is pointed to the wall.

On the basis of this preliminary measurement, we are planning to use a floating graphite head probe with at least 5 carbon fiber tips and with 2 mm tip separation. Simultaneous measurement of electron temperature, and ion saturation current and floating potential fluctuations enables calculation of the turbulence-induced particle flux.

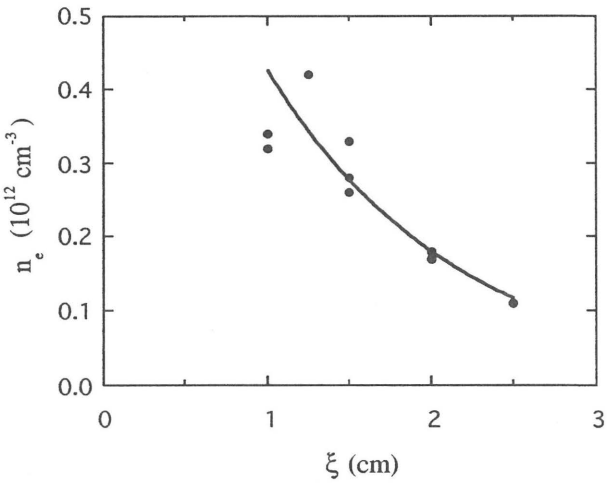

Fig. 1. Electron density profile measured with a Langmuir probe.

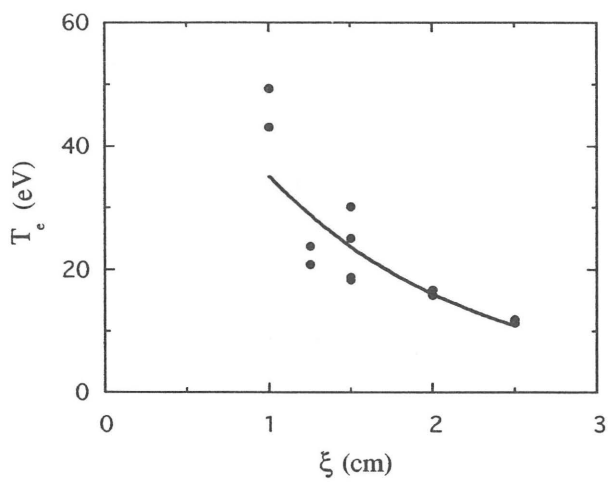

Fig. 2. Electron temperature profile measured with a Langmuir probe.

References

1)Wootton, A. J., et al., Phys. Fluids B 2, 2879 (1990).
2)Tsui, H. Y. W., et al., Phys. Rev. Lett. 70, 2565 (1993).