

Direct plasma potential measurements by a novel probe

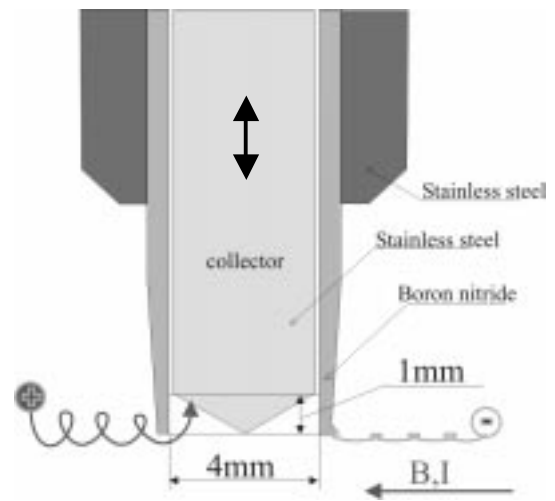
J. Adámek, P. Balan,¹ M. Hron, C. Ioniță,¹ E. Martines,² R. Schrittwieser,¹

J. Stöckel, M. Tichý, G. Van Oost³

Institute of Plasma Physics, Association EURATOM/IPP.CR, Prague, Czech Republic
¹*University of Innsbruck, Austria;* ²*Consorzio RFX, Associazione Euratom-ENEA sulla*
Fusione, Padova, Italy; ³*Ghent University, Belgium.*

For the determination of the plasma potential in tokamaks emissive probes and heavy ion beam probes have been used, but these diagnostics are not still used as a routine technique. In practice the floating potential V_{fl} is usually measured by Langmuir probes. The plasma potential Φ_{pl} is estimated from the simple formula of Langmuir probe theory (without magnetic field): $V_{fl} = \Phi_{pl} - T_e \ln(R_i)$, where T_e is the electron temperature in eV. The quantity R_i represents the ratio of the electron and ion saturation currents: $R_i = I_{sat}^e / I_{sat}^i$. The theoretical value of $\ln(R_i)$ in hydrogen plasma is about 2.5. The basic idea of the direct plasma potential measurements is to adjust R_i equal to one. If this can be achieved the floating potential of the probe is equal to the plasma potential.

This contribution presents the design of a novel probe, by which the value of R_i can be modified. The probe head, shown in Fig. 1, consists of conically shaped collector, which is shielded by an isolating tube of boron nitride. The collector is moveable inside the tube and it is either completely shielded or partially exposed to the plasma. In the ideal case, when the collector is hidden inside the tube, as shown in Fig. 1, only ions with sufficiently large Larmor radius reach



the collector surface. In this case the collecting area for electrons is negligible. When the collector is shifted towards to the plasma the electron current increases.

Experiments at the CASTOR tokamak ($R = 40$ cm, $a = 8.5$ cm, $B_T = 1.3$ T, $I_P \sim 10$ kA) have verified that R_i can indeed be adjusted close to one, when the position of the collector is chosen properly. The floating potential of the probe also varies with the position of the collector. Therefore, such a configuration can be used for a direct determination of the plasma potential in a tokamak environment as an alternative of the emissive probe. However, some experimental results are not yet fully understood.