PROBE MEASUREMENTS OF PLASMA INHOMOGENEITIES IN THE SCRAPE-OFF LAYER OF ASDEX DURING LH

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Electron temperature and density have been measured routinely at the edge of the ASDEX main plasma by means of a Langmuir triple probe /1/ which gives the saturation current and T_e on-line. Therefore one can get with a fast radially moved triple probe a complete $n_e(r)$ and $T_e(r)$ profile in one shot. The probe installed in ASDEX can be moved from a preset position 100 mm radially inward and backward within 200 msec. It is placed 22.50° toroidally away from the LH launching grill and 5° poloidally above the equatorial plane; the tips are arranged in the form of a triangle with distances of 7 mm. For a proper function of triple probes it is necessary that the deviations between the floating potentials of the 3 tips are small compared to T_e/e. In ohmic discharges this is fulfilled while during LH application we observed differences of the order of T_e/e. We have investigated this under different plasma and LH parameters as shown in Table 1.

Table 1

Series	LH		Plasma				Measurements
	Power (kW)	$n_{\parallel}$	$B_T(T)$	$I_p(kA)$	$\bar{n}_e(cm^{-3})$	Species	
I	770	2	2.37	300	1.4×10^{13}	D_2	profiles of float.pot. diff.
II	750	2	"	"	2.7×10^{13}	"	" "
III	370	4	2.18	"	2.1×10^{13}	"	" "
IV	275	4	"	380	2.7×10^{13}	"	" "
V	500	2	"	300	1.4×10^{13}	"	" , I-V-charact., combined double probes
VI	"	2	"	"	2.9×10^{13}	"	" "
VII	"	2	"	"	1.4×10^{13}	D_2+He	I-V-charact., independent double probes
VIII	"	2	"	"	2.9×10^{13}	"	explorative, independent double probes

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From the floating potential differences we have constructed the electric field vector. The direction and absolute value of this show a strong radial dependence (Fig. 1, 2). In the series I, II, V, VI we found a large component parallel to the magnetic field at the innermost radial position. At the radial position of the grill the absolute value of the vector is much smaller. Despite of the different main plasma density in the series V and VI we found a very similar radial dependence of the direction. The same we got for the two series III and IV with lower RF power, for which the absolute value of the vector was always rather small. The reason for the deviations in floating potentials may be local inhomogeneities in electron temperature or in plasma potential or in flux of suprathermal eletrons. These can arise from effects connected to decay processes inbetween the grill and the separatrix described e.g. by Derfler /2/ or by Motley and Glanz /3/.

In order to distinguish between these possible explanations we operated for the series V, VI, VII and VIII couples of tips of the triple probe as double probes. The fast movement was modified in such a way that the probe stays for about 100 msec at the innermost position where the I-V characteristics were taken. In series V and VI we measured with two combined double probes with tip 3 as common reference tip. Under these conditions tip 3 has to carry the sum of the currents of tip 1 and 2 and from the characteristics one cannot find floating potential differences. They have to be measured independently. The characteristics (Fig. 3, 4) show only small differences between high and low main plasma density (corresponding to the ion-RF and the electron-RF interaction regime resp.) and indicate for couple 1-3 a lower temperature than for couple 2-3. This is in agreement with the direct floating potential measurements (Fig. 1,2), but not with the relative shift of the two characteristics.

For series VII with parameters like series V but with a changed plasma composition we have increased the voltage range to 0 - 600 V in order to reach well the saturation. We have used the two couples 1-3 and 2-3 alternatively and not connected. In this case we find again a lower temperature for the couple 1-3 than for couple 2-3 (Fig. 5) (67 and 80 eV resp.). Now the floating potential difference derived from the shift of the characteristics (30 V) is within 30 % in agreement with the temperature difference.

In addition to this series in the electron regime we have done also some explorative measurements in the ion regime but otherwise under the same conditions (series VIII). We have found again no significant difference between high and low density. This may indicate that a plasma exists inbetween the LH-grill and the separatrix dominated by the LH-wave or by any decay waves and decoupled from the main plasma.

In other explorative measurements we have investigated for comparison purpose ohmically heated discharges with plasma parameters like series VI and VIII. We have found much lower electron temperature (15 eV instead of 65-80 eV) and higher electron densities ($2.5 - 3 \times 10^{12}$ cm^{-3}) (Fig. 6). This is at least for the electron regime in agreement with mesurements done by Pericoli on FT /4/ and El Shaer on ASDEX /5/ who found a strong redution of the density in front of the LH grill during RF application.

Conclusion

We have observed during LH application on ASDEX with a Langmuir probe having 3 tips strong poloidal and toroidal deviations in the floating potential. The probe was positioned roughly 1 m away from the LH-grill in a magnetic flux bundle directly connected to the space in front of the RF-coupler. These deviations exist at all plasma and LH conditions investigated until now and can inhibit the operation of a triple probe at all. But other fast moved elctrostatic probes may also be disturbed too, since the radial dependence of the floating potential differences acts like a temporal change of the probe potential which cannot be controlled. The most important reasons for these deviations are changes in the electron temperature of typically 10 - 20 eV over a distance of 7 mm. But some findings like an additional shift in the I-V characteristic or large components of the floating potential differences parallel to the magnetic field lines cannot be explained by temperature differences. One has to assume also locally inhomogeneous fluxes of suprathermal electrons and differences in the plasma potential.

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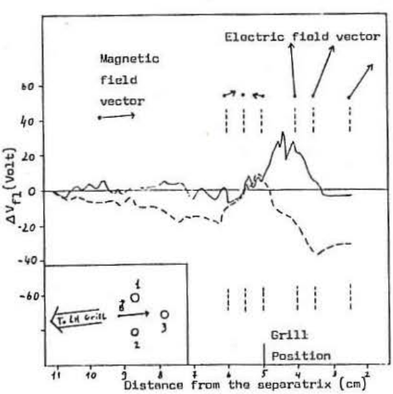

Fig. 1: Radial profiles of floating potential differences. SERIES VI
——— tips 1-3
------- tips 2-3

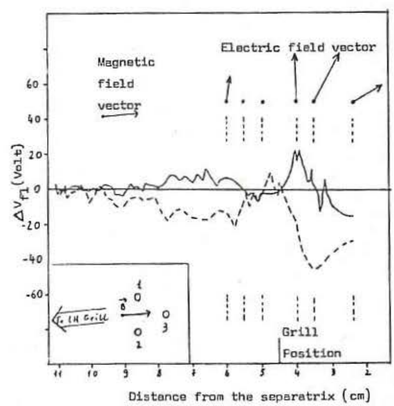

Fig. 2: Radial profiles of floating potential differences. SERIES V
——— tips 1-3
------- tips 2-3

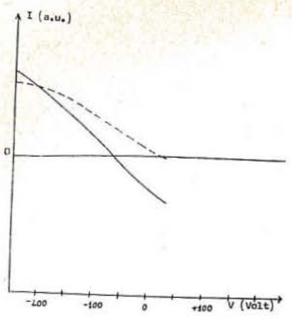

Fig. 3: I-V characteristics SERIES VI

——— Tips 1-3

------- Tips 2-3

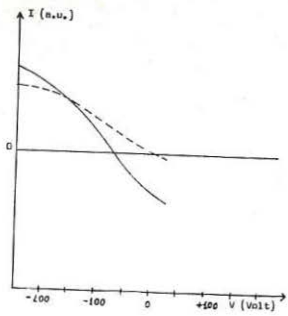

Fig. 4: I-V characteristics SERIES V

——— Tips 1-3

------ Tips 2-3

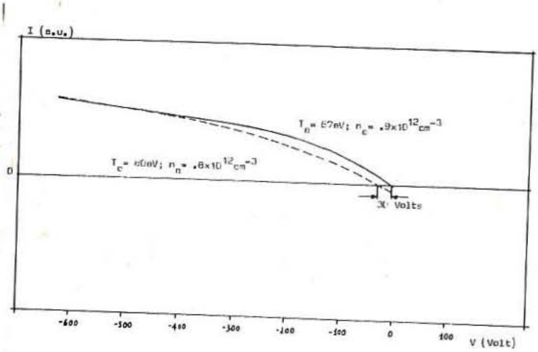

Fig. 5: I-V characteristics SERIES VII

——— Tips 1-3

------- Tips 2-3

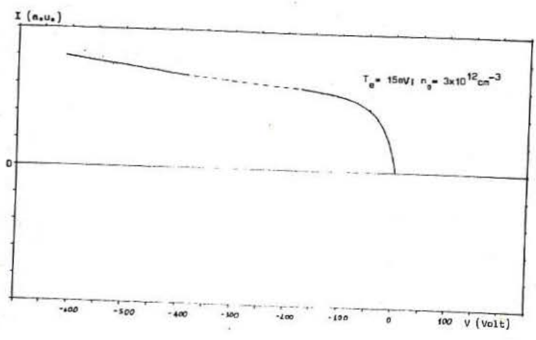

Fig. 6: I-V characteristics OH-discharge

$\bar{n}_e = 2.9 \times 10^{13}\ cm^{-3}$