LhsLsectionRadial profile of the floating potential and plasma density (determination of radial electric field and poloidal plasma velocity) It is widely recognized that the electric probes are important tools for studying edge plasma physics in tokamaks because the required space resolution (in the range of several ion Larmor radii) and a high temporal resolution (of about $1\mu s$ or even better) can be easily achieved. Therefore, they are routinely used on any tokamak facility.

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The rake probe, shown in the figure, is used to measure radial profiles of the edge plasma parameters in a single tokamak discharge. The probe head is composed of 16 tips spaced radially by 2.5 mm. The probe head is inserted into the edge plasma from the top of the torus, 180° toroidally away from the poloidal limiter. The signals are digitized with 1 MHz sampling rate. The tips of the probe array measures either the floating potential or the ion saturation current. Mode of operation can be switched on the shot-to shot basis (on request).LhsLsubsectionMeasurement of the floating potential The floating potential of a tip is measured by the voltage divider 1:100 according the electrical scheme shown in Fig. 2

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The floating potential $Upodtrzitkofl$ is related to the plasma potential Φ according the formula:

$$Upodtrzitkofl = \Phi - \alpha\ Tpodtrzitkoe$$

where $Tpodtrzitkoe$ is the electron temperature and the coefficient α is around 3 in hydrogen plasmas. The gradient of the floating potential is linked to the radial electric field at the plasma edge as

$$LhsLmathsfgrad\ Upodtrzitkofl = Epodtrzitkorad - \alpha\ LhsLmathsfgrad\ Tpodtrzitkoe$$

If the radial profile of the electron temperature is flat, $LhsLmathsfgrad\ Tpodtrzitkoe \sim 0$, which is a reasonable assumption for the edge region of the LhsLhref../../../../Introduction/Tokamak/AAAindexGOLEM tokamak, the gradient of floating potential can be considered as indicative of the radial electric field.

$$Epodtrzitkorad = LhsLmathsfgrad\ Upodtrzitkofl$$

The radial electric field causes the poloidal rotation of the plasma due to the $LhsLmathbfE \times LhsLmathbfB$ drift. The poloidal velocity can be easily calculated as

$$Vpodtrzitkopol = Epodtrzitkorad/Bpodtrzitkotor \quad LhsLmathsf[m/s, V/m, T]$$

Where $Bpodtrzitkotor$ is the toroidal magnetic field, which is routinely measured at the every GOLEM discharge. LhsLsubsectionMeasurement of plasma density The ion saturation current is measured when the probe tip is biased negatively with respect to the reference electrode (the vessel of the GOLEM tokamak). The corresponding electric scheme is shown in Fig. 3

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The value of the ion saturation current is deduced from the voltage drop on the load resistor 50 Ω.

The measured ion saturation current is related to plasma density n, and to the electron temperature according the expression

$$Ipodtrzitkosat^{+} = 0,5\ e\ A\ vpodtrzitkoi = 0,5\ e\ A\ n\ LhsLsqrtLhsLfrac2\ k\ TpodtrzitkoeMpodtrzitkoi$$

where A is the collecting area of the tip. Consequently, the plasma density is

$$n = LhsLfrac2\ Ipodtrzitkosat^{+}e\ A\ vpodtrzitkoiLhsLcong3,7 \cdot 10^{20}\ LhsLfracIpodtrzitkosat^{+}LhsLsqrtTpodtrzi$$

The electron temperature of the edge plasma on GOLEM is typically $\sim 16 - 20$ eV.