Test of SEPS as plasma instrument

Credit:

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- SEPS instrument
- Sample of test results in plasma chamber
- Modelling needs
- Modelling grid current collection effect
- Modelling grip potential effect
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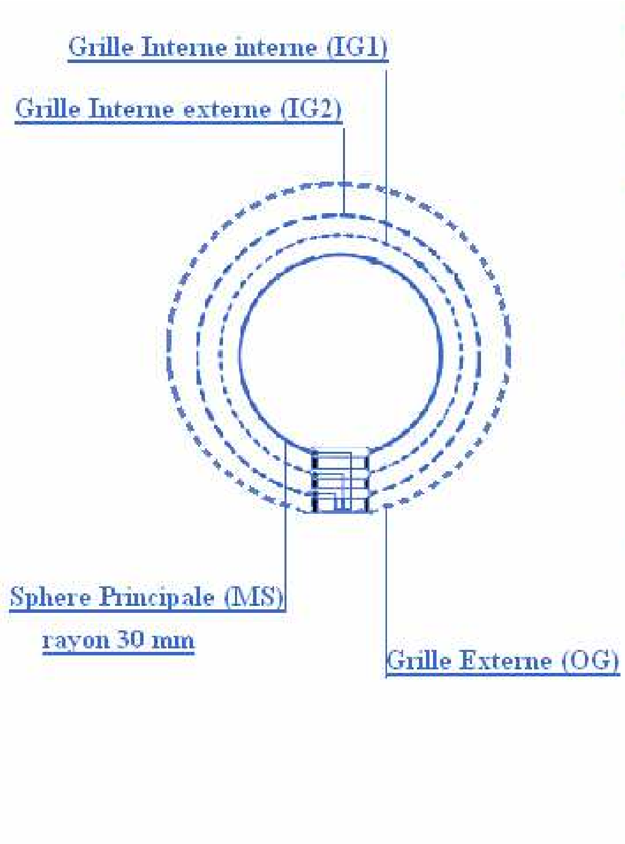
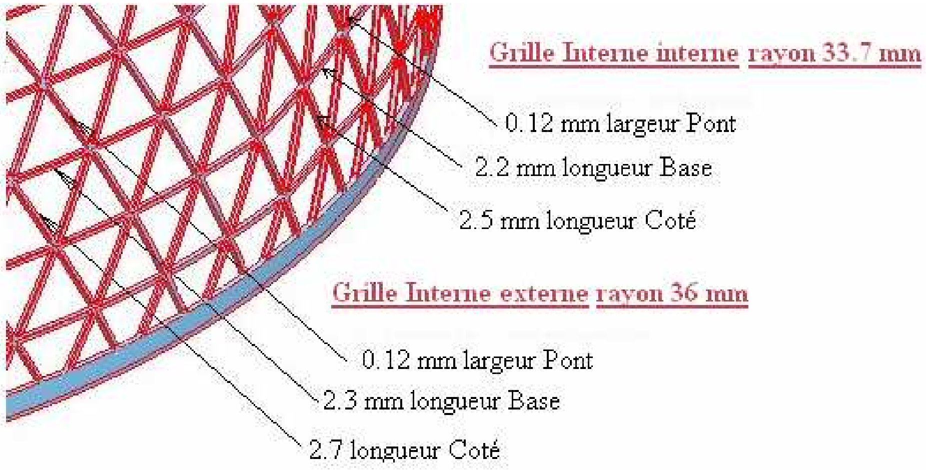
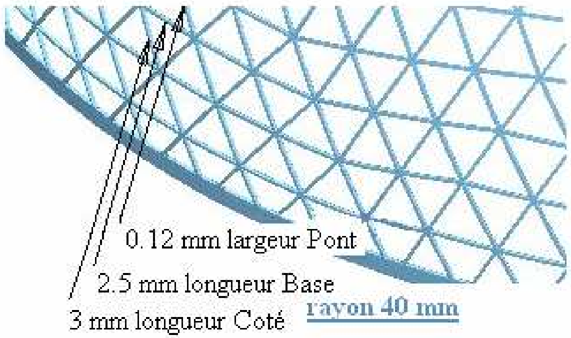
SEPS instrument

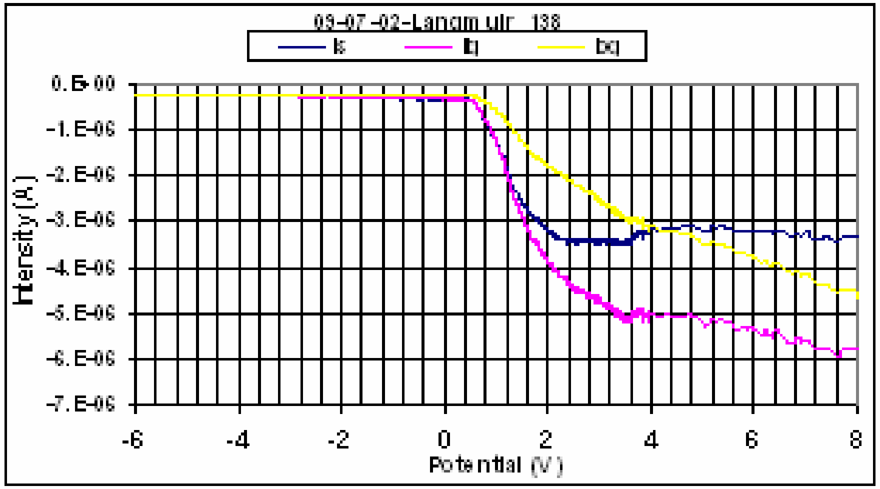


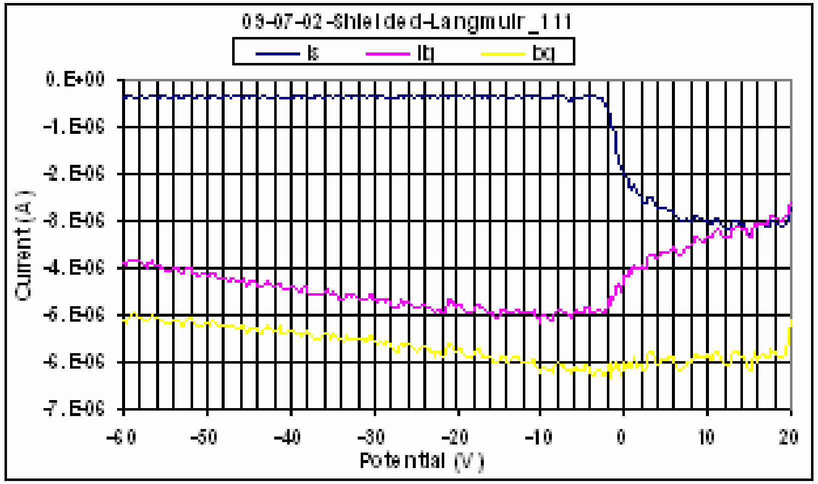




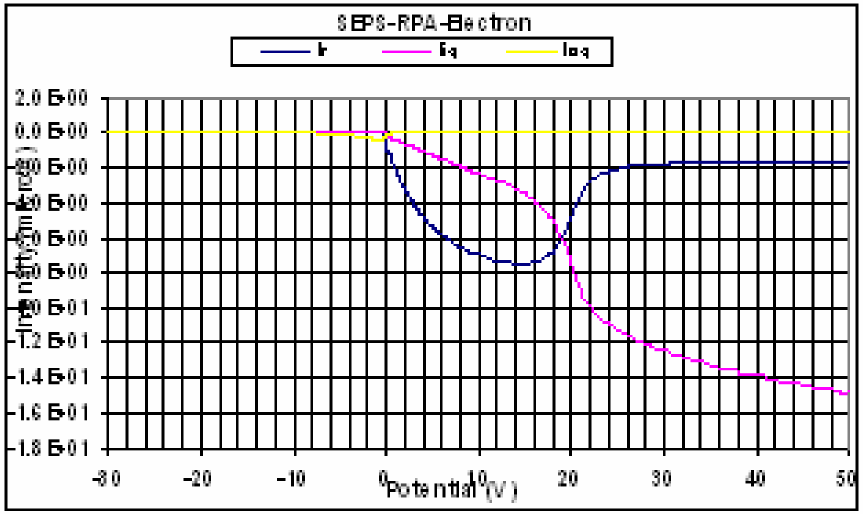
Test results in a plasma chamber

Shielded Langmuir probe mode





RPA electron mode

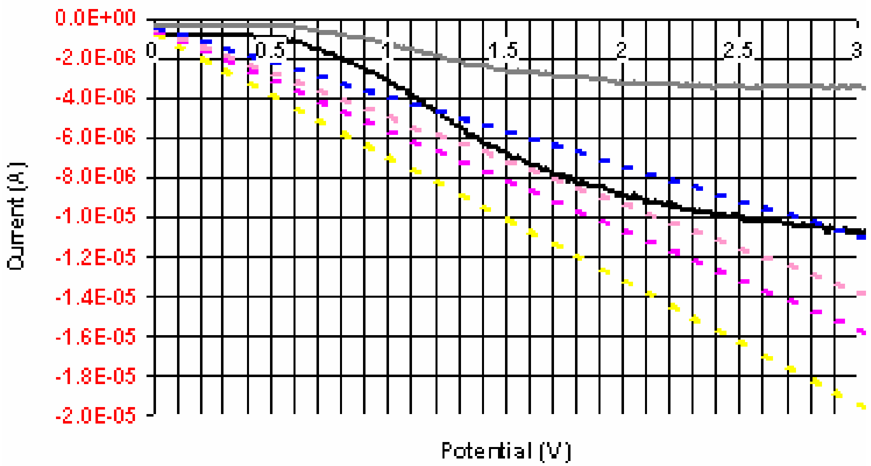


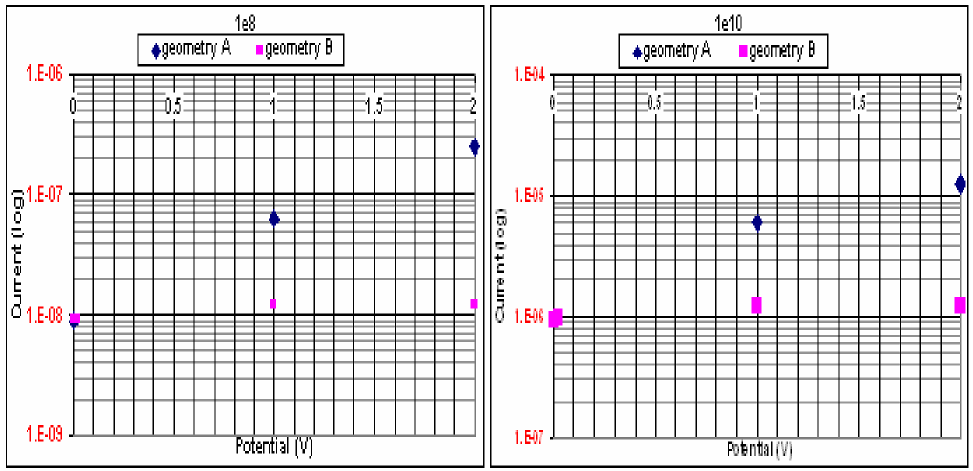
Different plasma measurements mode can be defined depending on grid potential configuration.

Measured signal show evidence not only of effect of grid potential but also of effect of current collection by the grids.

Modelling grid potential effect

- Challenges:
  - Model of local potential near the grid requires fine resolution => huge number of cells
- First order approximation: Assimilate grids as non material equipotential surfaces
  - => OML model predicts that:
    - Langmuir probe mode signal is equivalent to standard spherical Langmuir probe
    - Shielded Langmuir probe mode saturates for potential beyond V=(kT/e)*((Rig1/Rms)^2-1) and is equivalent to standard spherical Langmuir probe below.
  - Only mode that can be modelled today with SPIS: shielded Langmuir probe mode

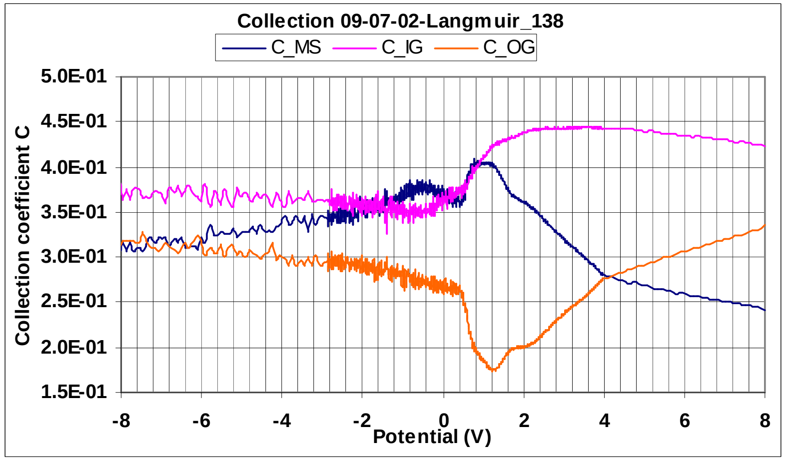




Modelling current collection effect

- Challenges:
  - Need a priori model of fine details of the grids (0.1 mm) together with full acceleration region (~10 cm).
- First order approximation:
  - Model the flow arriving on grid through Mott-Smith-Langmuir expression for a sphere and the part of the current collected through Mott-Smith-Langmuir expression for cylinder and compute the relevant current in a sequence on each grid.

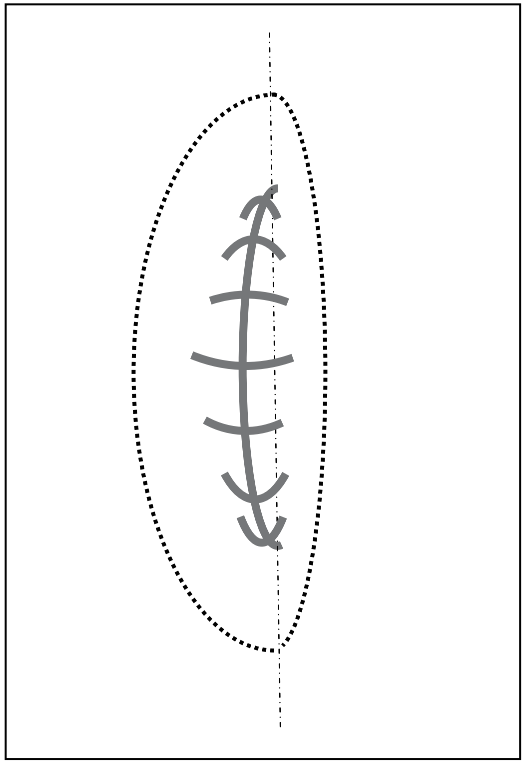
	MS	IG1	IG2	OG
Surface $S = 4\pi r^2$, m^2	-	$1.4*10^{-2}$	$1.6*10^{-2}$	$2.0*10^{-2}$
Surface of triangle $S_t = \frac{b*h}{2}$, m^2	-	$2.8*10^{-6}$	$3*10^{-6}$	$3.4*10^{-6}$
Contour of triangle $P = 2*l + b$, m	-	$7.2*10^{-3}$	$7.7*10^{-3}$	$8.5*10^{-3}$
Number of triangles $N = \frac{S}{St}$	-	5000	5333	5882
Lengh of wire $L = \frac{N*P}{2} = \frac{4\pi r^2 2(2l+b)}{b\sqrt{l^2+(\frac{b}{2})^2}}$, m	-	18	20.5	25
Surface of string $S_s = L*d$, m^2	-	$4.2*10^{-3}$	$4.1*10^{-3}$	$4.3*10^{-3}$
Currents i_{coll}, A, $qV<0$				
1V	$-6*10^{-8}$	$-3.1*10^{-8}$	$-2.1*10^{-8}$	$-3.2*10^{-8}$
2V	$-1.3*10^{-7}$	$-6.5*10^{-8}$	$-7*10^{-8}$	$-6.8*10^{-8}$
Thermal current i_{th}, A	$-9.6*10^{-9}$	$-1.2*10^{-8}$	$-1.4*10^{-8}$	$-1.7*10^{-8}$
Geometrical Transmission $T_{geo} = \frac{S_S}{S}$	-	0.3	0.26	0.22
Collection ratio $C = \frac{i_{collected}}{\Sigma i_{collected}}$	$4.1*10^{-1}$	$2.2*10^{-1}$	$1.5*10^{-1}$	$2.3*10^{-1}$



	MS	IG	OG
Collection ratio $C = \frac{i_{collected}}{\Sigma i_{collected}}$	$2.55*10^{-1}$	$2.95*10^{-1}$	$3.49*10^{-1}$

Modelling current collection effect

- Difficulty with SPIS:
  - Manpower requirement to generate such a geometric model with so many fine details
  - Memory requirement to handle the expected huge number of tetrahedrons
  - Algorithm requirement to ensure that trajectory calc in the vicinity of the wires is accurate enough
  - Use of symmetry plans may help but first tests failed.



Conclusion on modelling requirements

- There are effects of grid potential and grid particle collection on SEPS plasma measurements modes.
- Corresponding modelling requirements for SPIS are:
  - Ability to easily generate fine details model with regular pattern
  - Ability to generate associated mesh and handle it in memory
  - Ability to track particles in the vicinity of the smallest cells
  - Ability to define equipotential surfaces possibly:
    - with semi or full transparency
    - with electrical connection to other objects
  - good behaviour of symmetry plans (To be verified)
- Other modelling requirements relates to:
  - Photo-emission by sphere and grid
  - Drifting plasma effects: Ram/Wake)