Calibration coefficient of ball-pen probe measurement

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1 Experimental setup

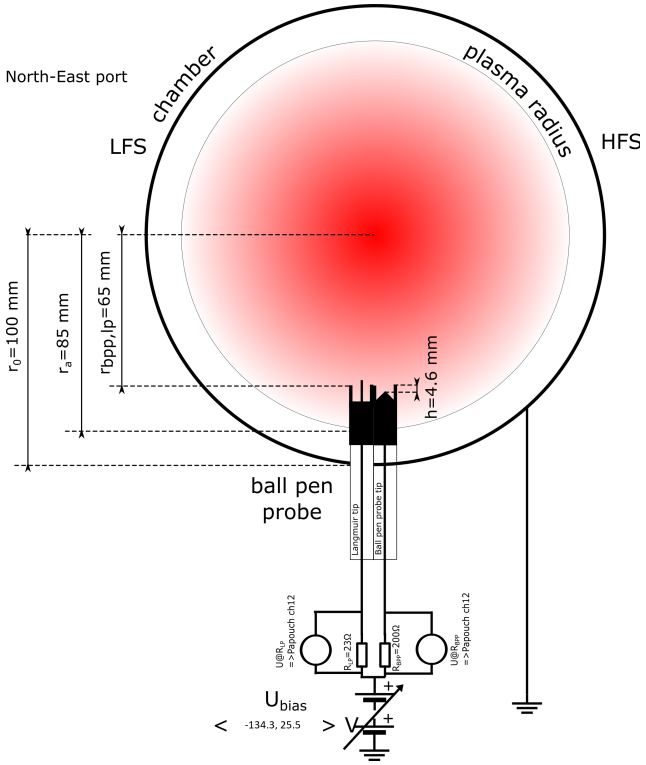


Figure 1: experiment setup.

2 Theory

The aim of this work is to find calibration coefficient of ball-pen probe. To get this coefficitent, we have to use Langmuir probe to construct IV characteristics (shot to shot method) and fit them by equation 1.

$$\alpha = \frac{U_{float}^{bpp} - U_{float}^{lp}}{T_e}, \tag{1}$$

Where U_{float}^{bpp}, U_{float}^{lp}, T_e are parameters via we fit. Going through all the IV characteristics can we find, how calibration coefficient depends on magnetic field.

3 Experiment configuration

1. Gas pressure 0.36 -19.93
2. Working gas: hydrogen
3. Pre-ionization: Upper el. Gun
4. C_{Bt} capacitors charged to: 1300 V, triggered 5.0 ms
5. C_{CD} capacitors charged to: 400 V, triggered 5.0 ms

The numbers of shots, used for measurement are: #25483 to #25490 and #25493 to #25498 using voltage from -134.3 to 25.5 V. Both probes position from the vessel centre is r = 70 mm and resistance on LP was set as R = 20 Ohm.

4 Minutes of the experiment

1. The radial profile was meassured before meassurement to find best position of probes.
2. Resistance on LP was set to 20 Ω
3. Scan via $V_{bias} = \{-12.8, -25.6, -38.3, -51.1, -63.9, -76.7, -89.4, -102.2, -134.3, -12.8, 0, 12.8, 25.5\}\ V$

5 Data analysis

IV characteristics were using equation (1). All fits are included in .zip file. Experiment setup is given in Figure 1. The figure 2 shows that coefficient alpha is eqaual to $\alpha = 2.2\ \pm\ 1.2$.

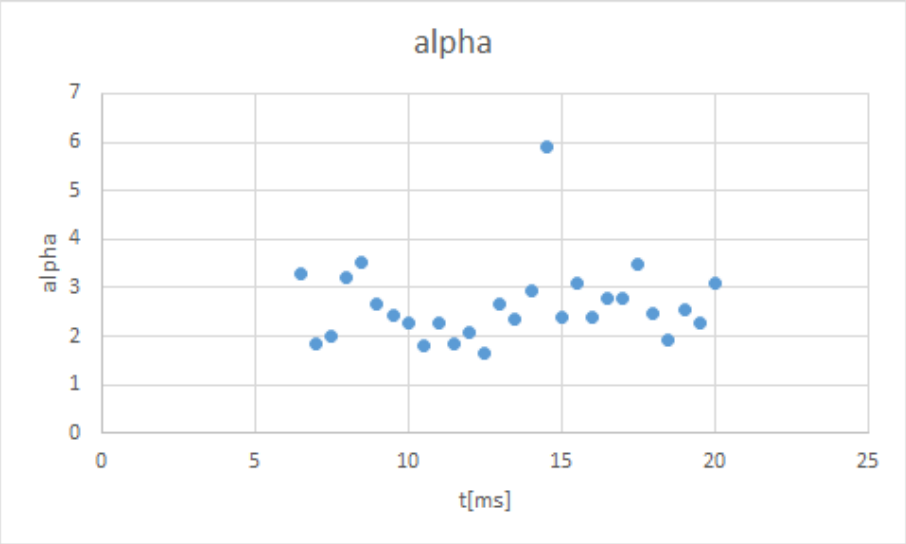


Figure 2: final results of meassurement.

6 Reproducibillity

To get best results is it important to have good shots reproducibillity, which is shown in Figures 3, 4

These figures show that the reproducibillity could be better so it influences the results a lot.

7 Fits

At the end of the document, all fits are included.

8 Conclusion

To sum up, the ion saturation current is reach, because the negative voltage goes up to - 134.3, which seems to be enoght. The problem could be with reproducibillity, which is for some of the shots worse.

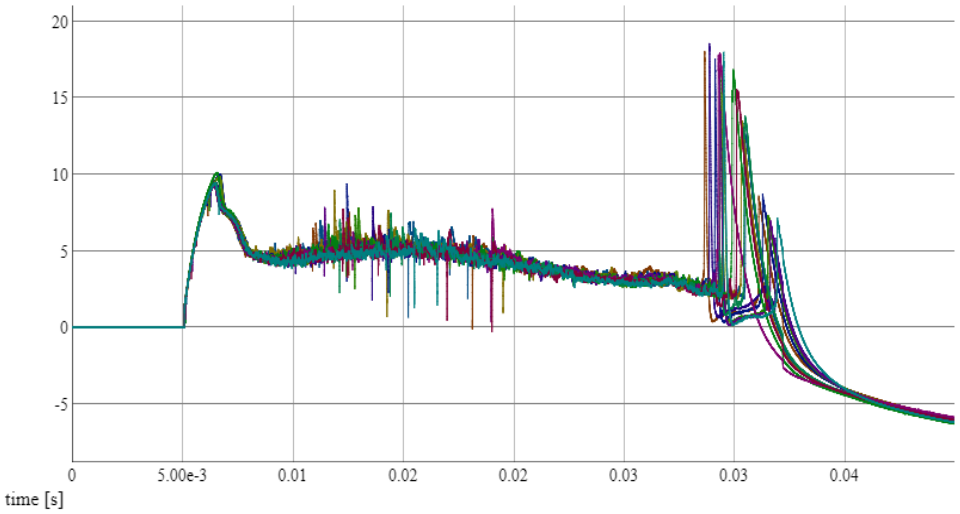


Figure 3: shows loop voltage of each shot.

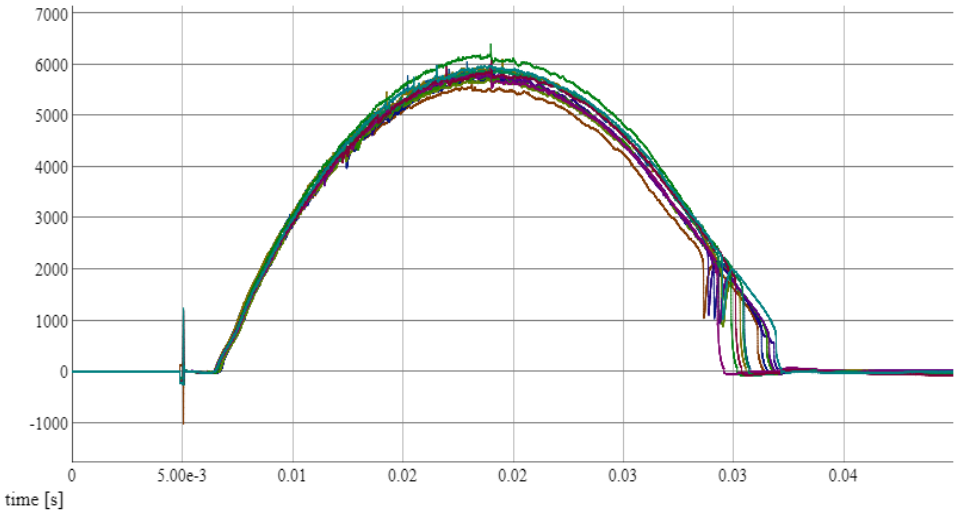
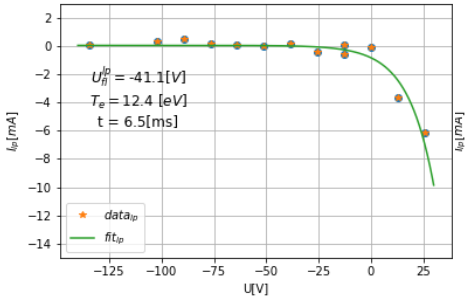
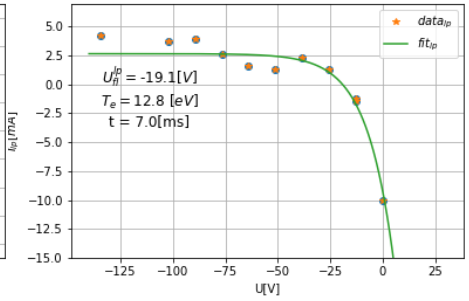


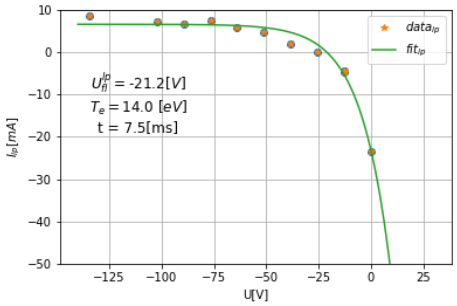
Figure 4: shows plasma current of each shot.



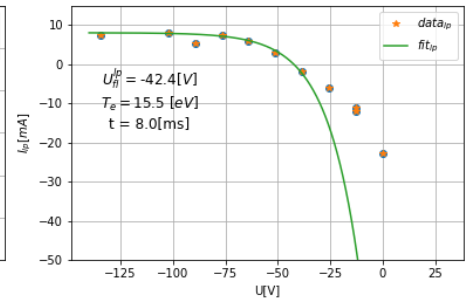
(a) Fit t = 6.5 ms



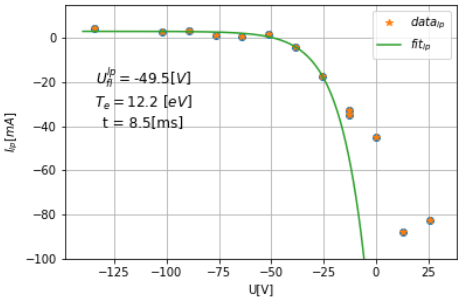
(b) Fit t = 7 ms



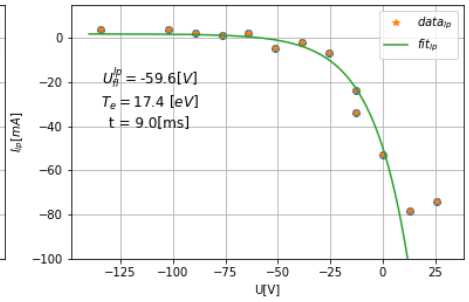
(c) Fit t = 7.5 ms



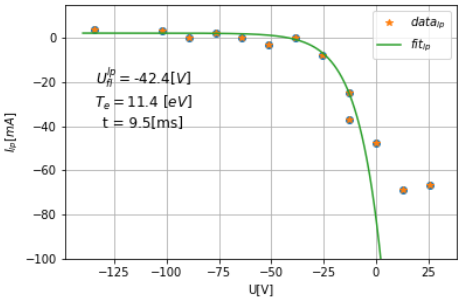
(d) Fit t = 8 ms



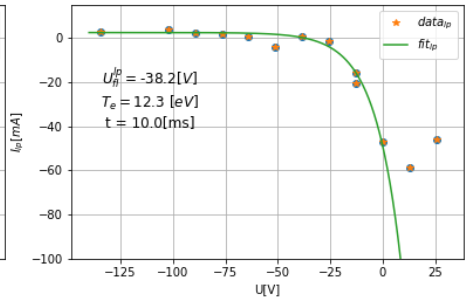
(e) Fit t = 8.5 ms



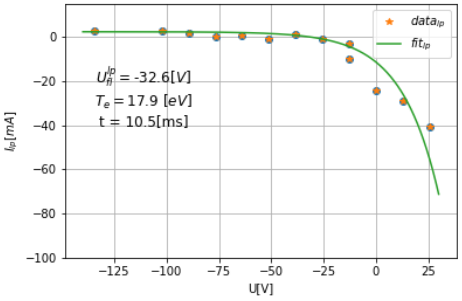
(f) Fit t = 9 ms



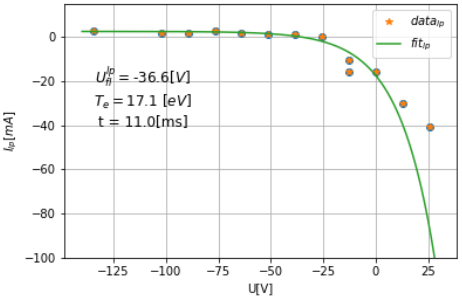
(g) Fit t = 9.5 ms



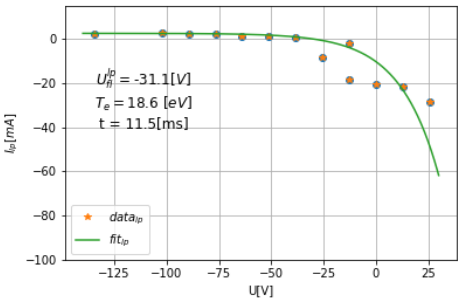
(h) Fit t = 10 ms



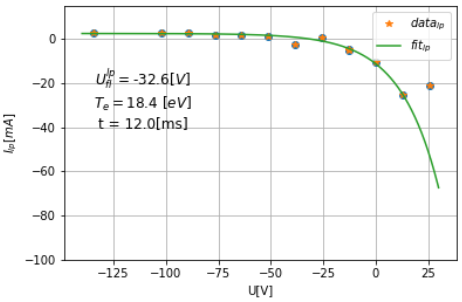
(a) Fit t = 10.5 ms



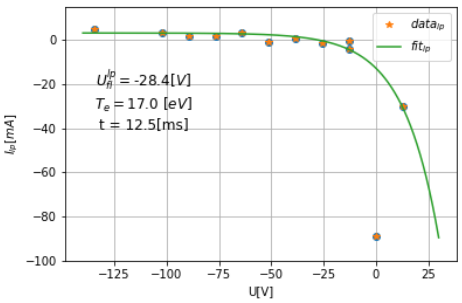
(b) Fit t = 11 ms



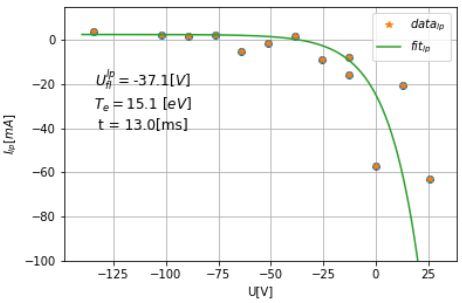
(c) Fit t = 11.5 ms



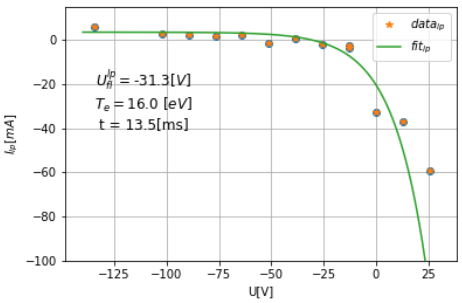
(d) Fit t = 12 ms



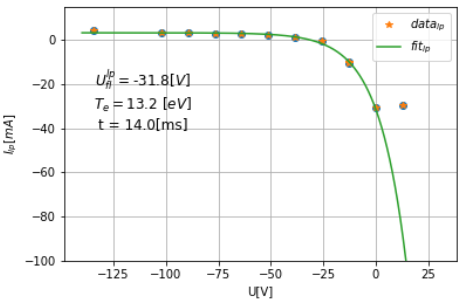
(e) Fit t = 12.5 ms



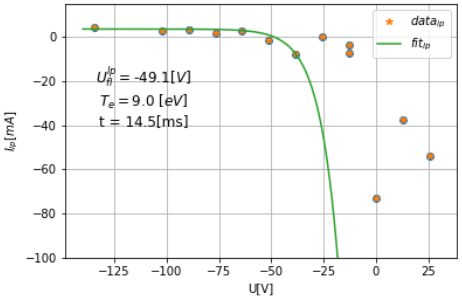
(f) Fit t = 13 ms



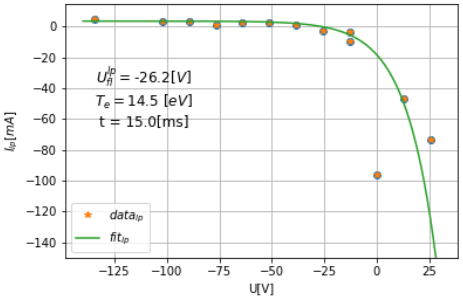
(g) Fit t = 13.5 ms



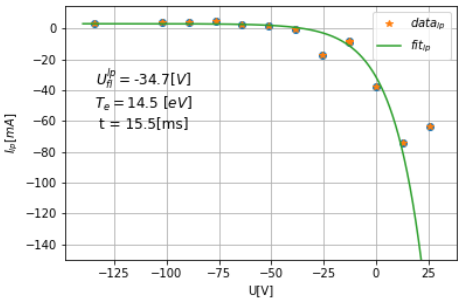
(h) Fit t = 14 ms



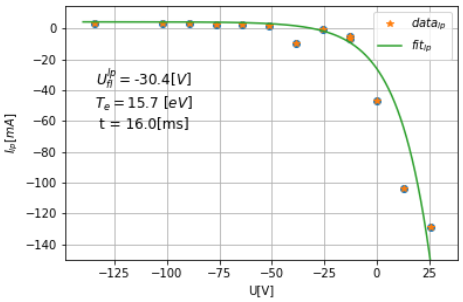
(a) Fit t = 14.5 ms



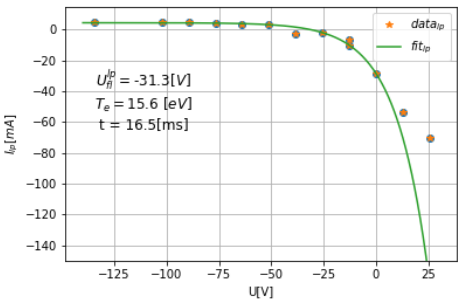
(b) Fit t = 15 ms



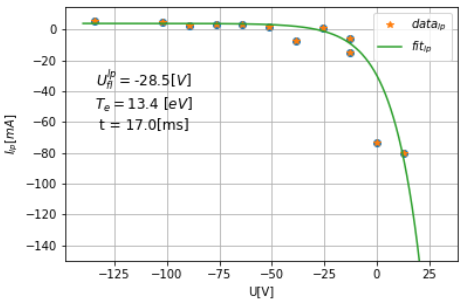
(c) Fit t = 15.5 ms



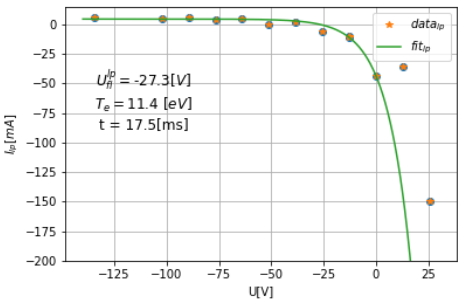
(d) Fit t = 16 ms



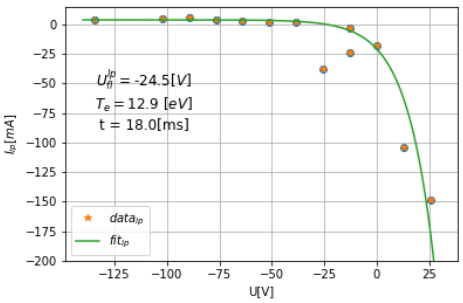
(e) Fit t = 16.5 ms



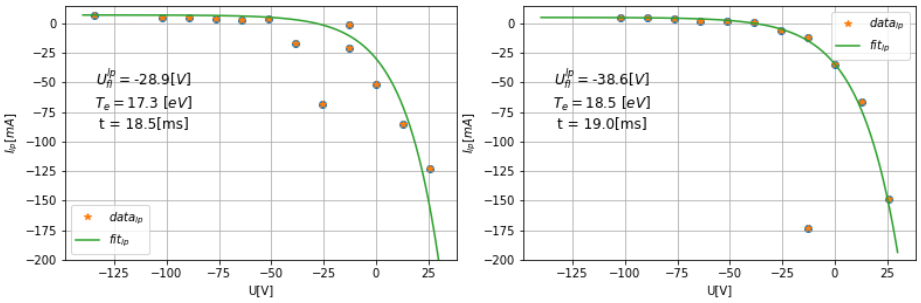
(f) Fit t = 17 ms



(g) Fit t = 17.5 ms



(h) Fit t = 18 ms



(a) Fit t = 18.5 ms

(b) Fit t = 19 ms

Figure 8: plots of....