Standard GEM Charging Up Simulation: First test of the approach

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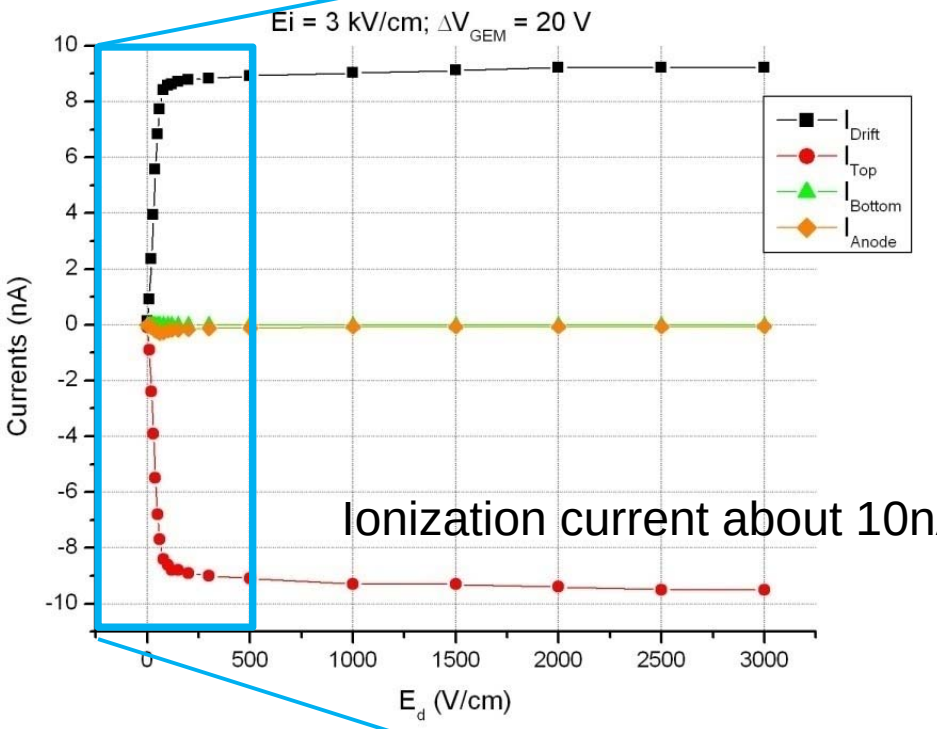
Simulated Setup

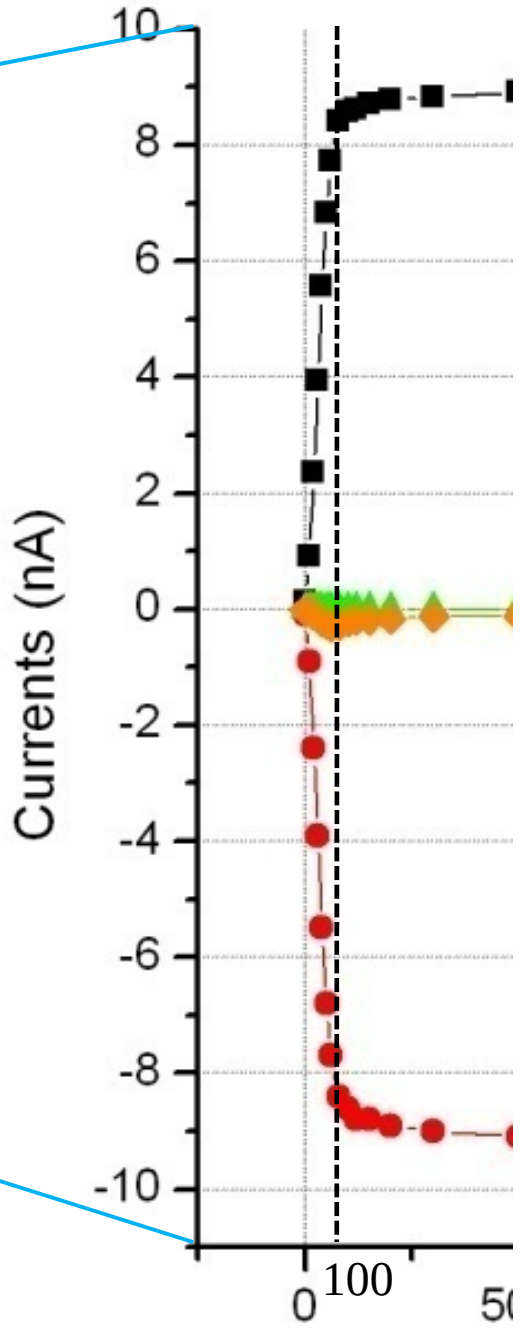
- Standard GEM:
  - Thickness 50 µm kapton + 5 µm copper (up & down)
  - Pitch 140 µm
  - Cu diametre: 70 µm; kapton diametre 50 µm

- Drift Field = 0.1 kV/cm
- GEM Potential Difference = 20 V (NO GAIN)
- Induction Field = 3 kV/cm

The measurements



Ionization current about 10nA

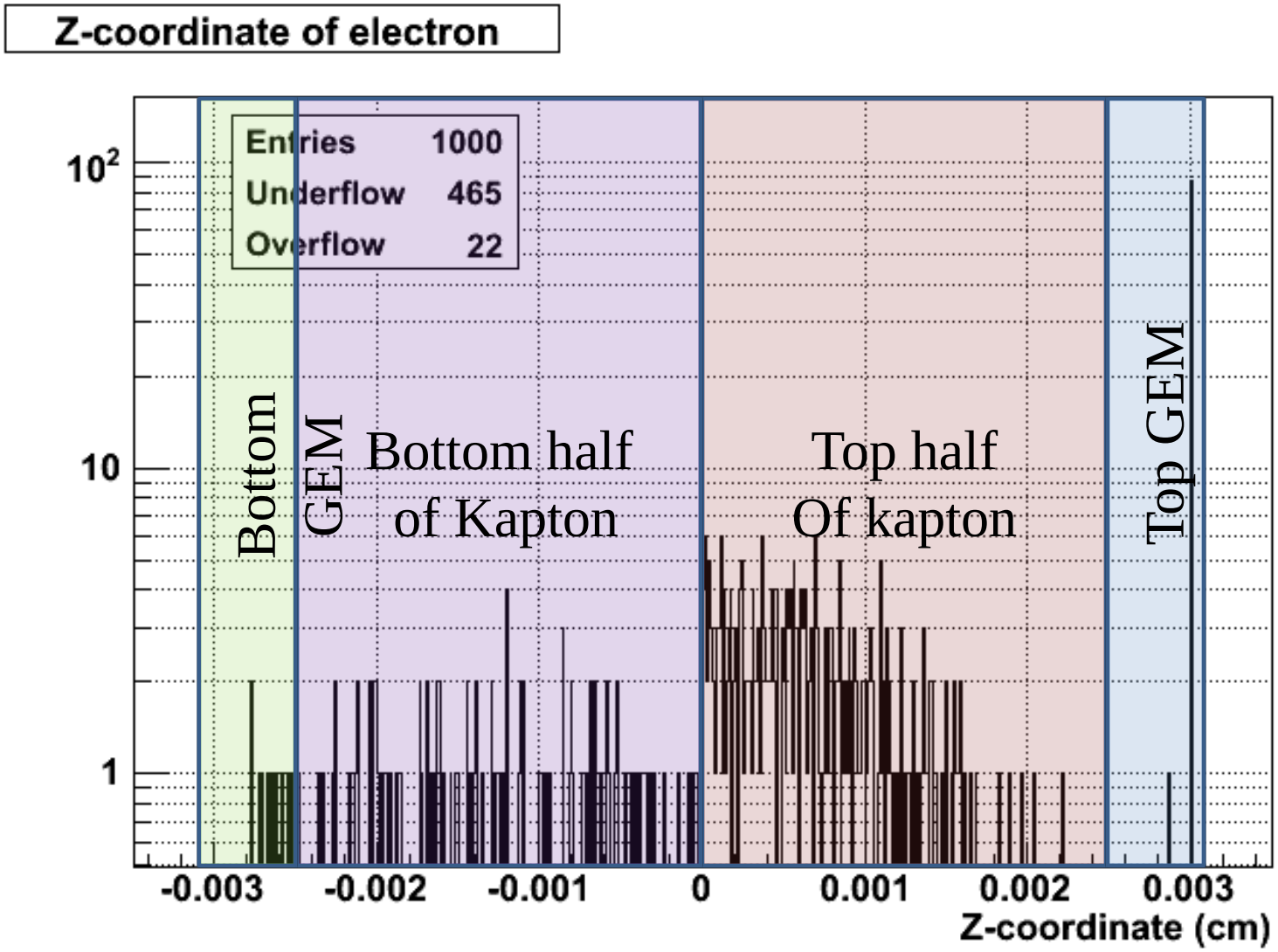


Drift Scan
(current vs drift field)

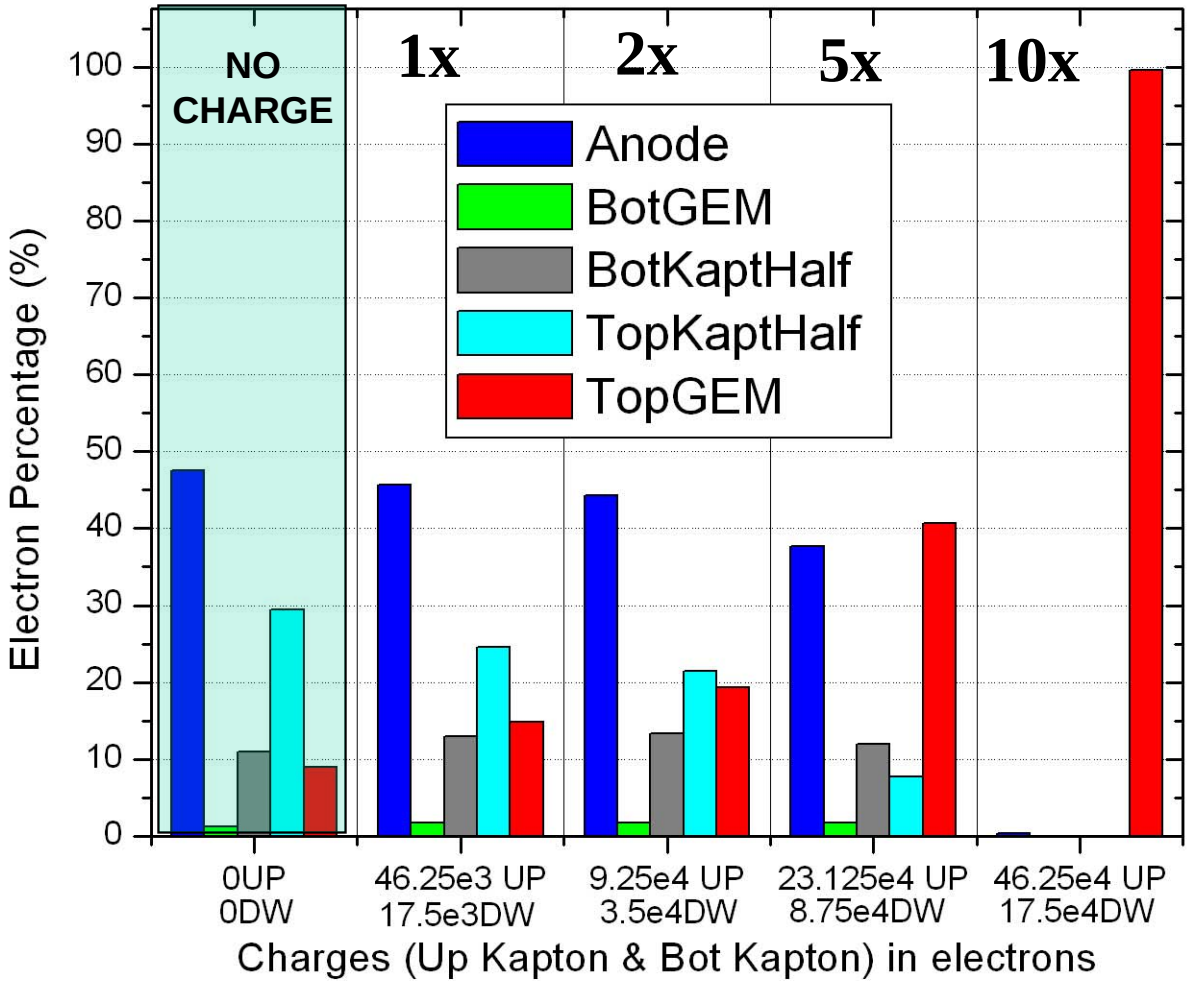
Method

a) Start with map without charges on kapton
b) Simulate 2000 electrons starting 500 µm above the top copper and record their end position (x-end,y-end,z-end). Simulation uses new *microavalanche* procedure introduced last year by Rob Veenhof
c) Calculate the number of electron ending on Anode, Bottom Electrode, Bottom Half Kapton, Top Half Kapton, Top Electrode (%)
d) From previous measurements we measured a ionization current of 10 nA
e) We calculated which is the current per hole taking into account all the irradiated area (we shot from the side)
f) Using 10 nA and different time steps (1ms, 0.1,0.2,0.5,1 sec) we estimate which is the total charge for each step that involves the holes.
g) We distribute these charges according to the percentage obtained in c) on the different places in the hole
h) We restart another simulation of 2000 electrons considering the charge deposited

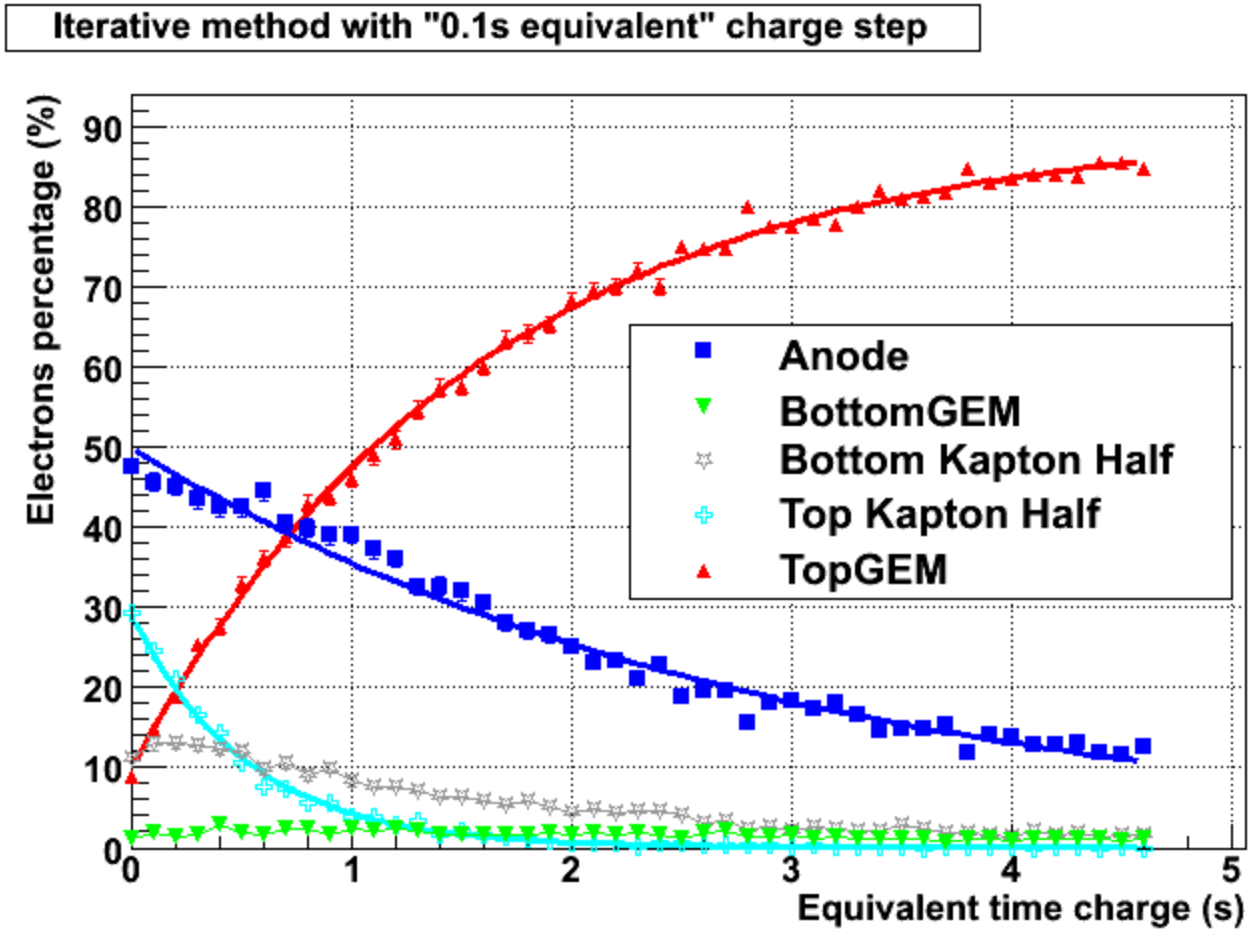
Example of z-end histogram



Which is the optimum *iteration step*?



First iterative method simulation with “0.1s equivalent” charge step



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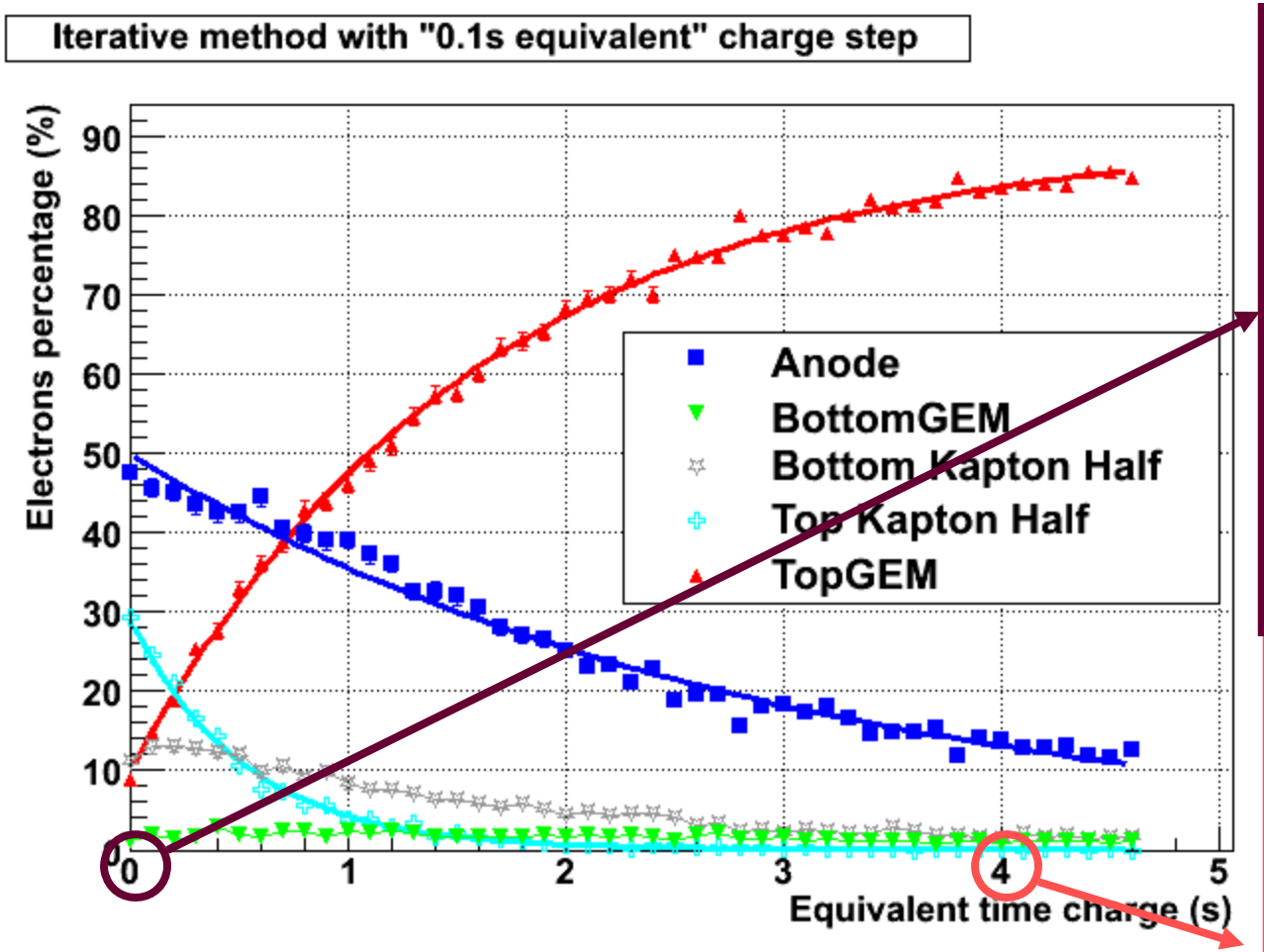

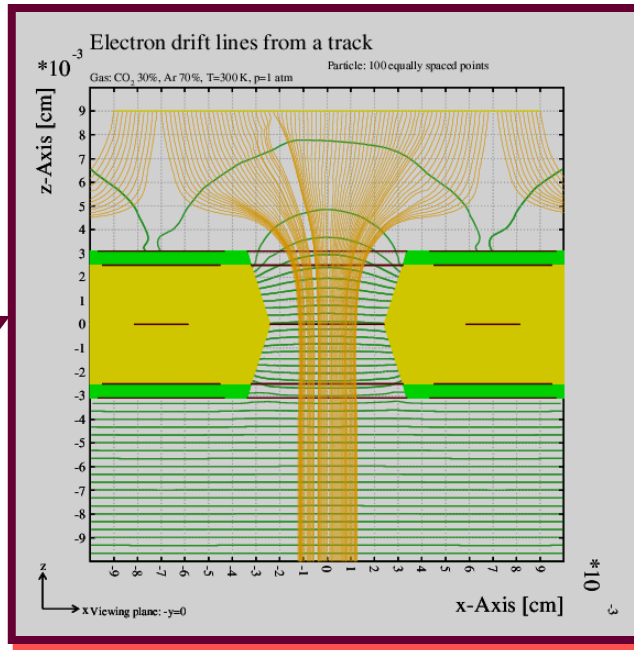

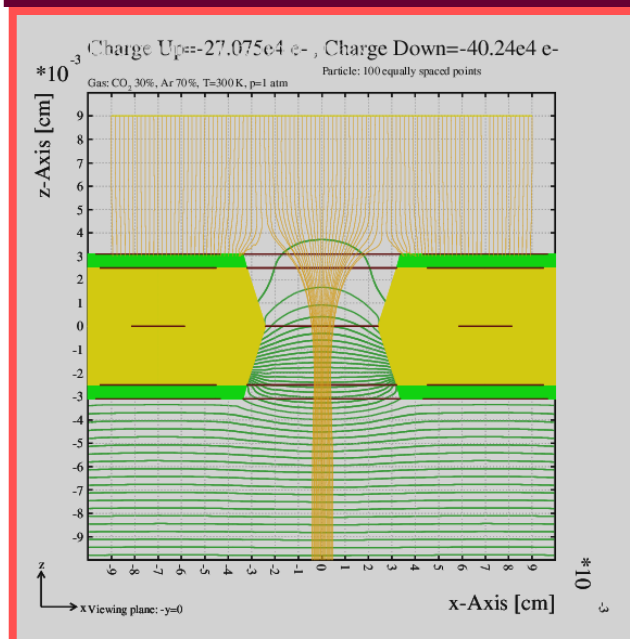

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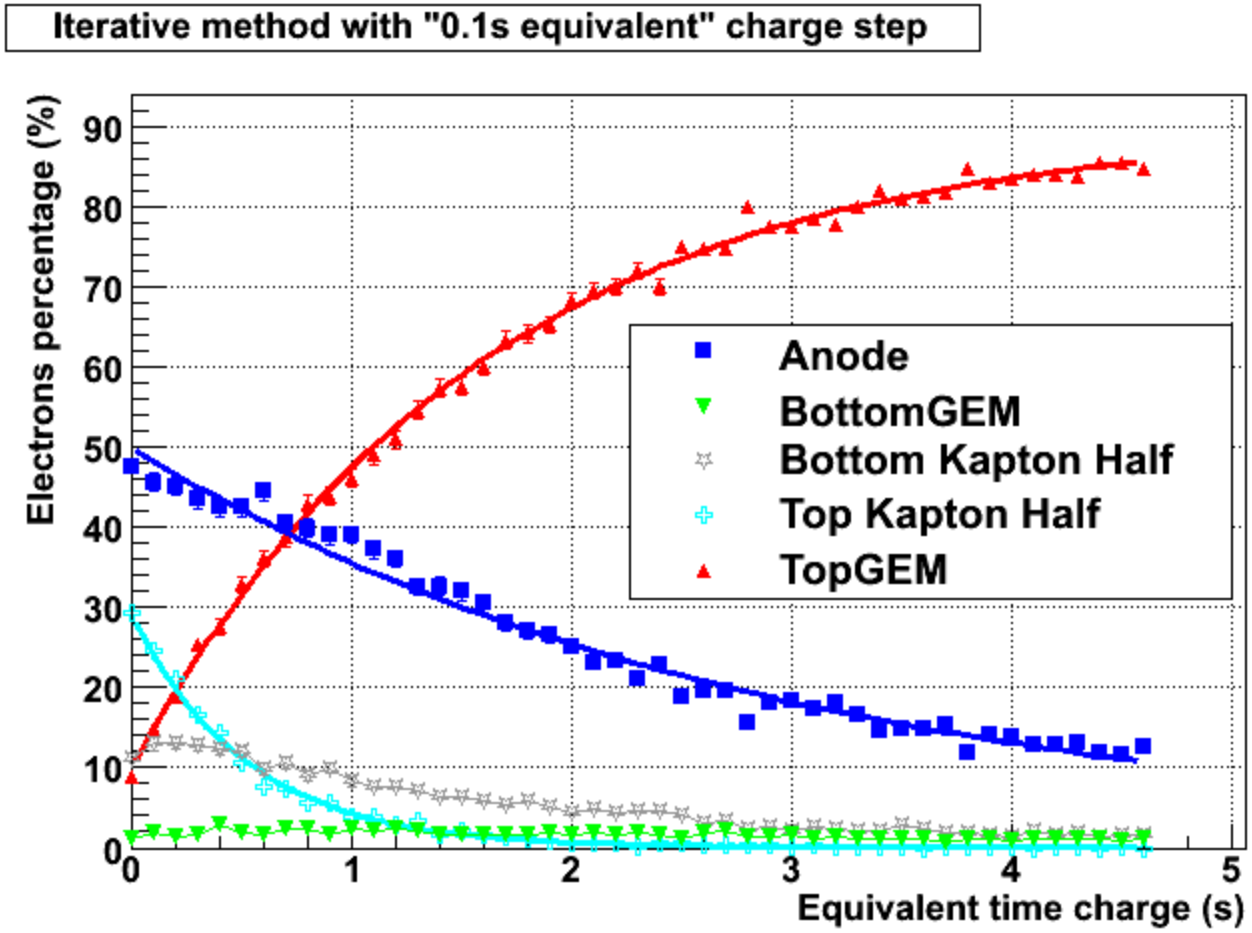


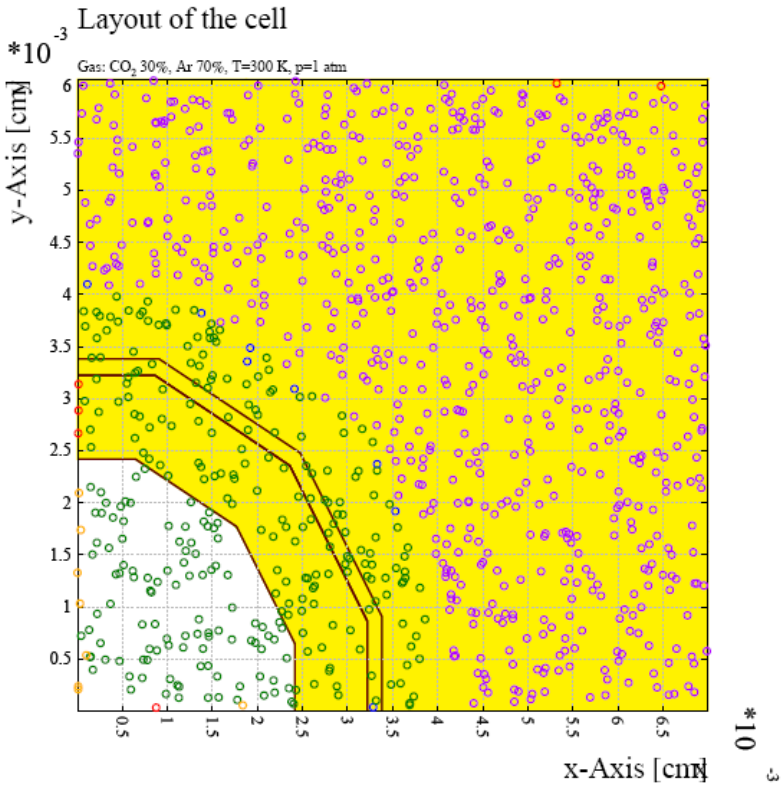
Equ Sec	Kapt Top Half Charge (e-)	Kapt Bot Half Charge (e-)
0.1	4.625e4	1.75e4
0.5	18.39e4	11.8e4
1	23.2e4	19.32e4
2	26.26e4	29.1e4
3	26.85e4	35.14e4
4	27.04e4	38.63e4

Place	Fit Function	P0	P1	P2
TopGEM	P0 – P1*exp(-x*P2)	90.1± 0.5	80.3± 0.5	0.634 ± 0.013
Anode	P0 + P1*exp(-x*P2)	0.646 ± 0.02	49.4 ± 1.1	0.344 ± 0.02
Top Kapt Half	P0 + P1*exp(-x*P2)	0.07 ± 0.02	29.4 ± 0.6	1.93 ± 0.04

Future plans

- All these simulations took about 2 weeks
- We would like to write a script that:
  - automate the simulation procedure in all the required passages (map creation→ simulation → analysis → new map creation ….)
  - Can be submitted to lxbatch (or other batch systems)
- Study of the effect of the mesh size
- Think about how to simulate a low GEM gain setup

Backup slides



Electrons starting points shown.
Z-start = 500 µm
Color represents the ending place

- Anode → 0.8 %
- Bottom GEM → 29.3 %
- Kapton→ 0.8 %
- Top GEM → 68.5 %
- Other → 0.6 %