RD 51 Mini Week

15 June 2012

Gas gain in a single GEM: Charging-up effect at different voltages

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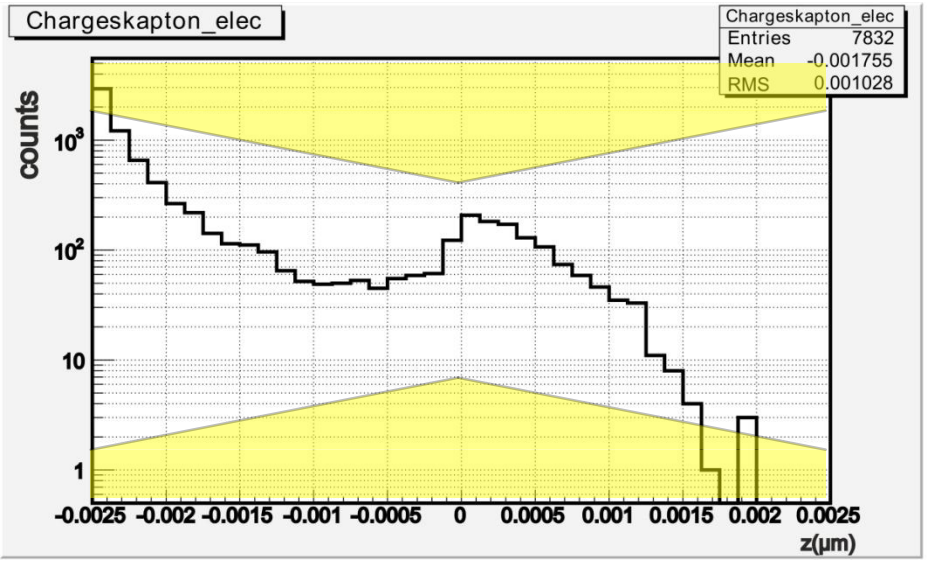
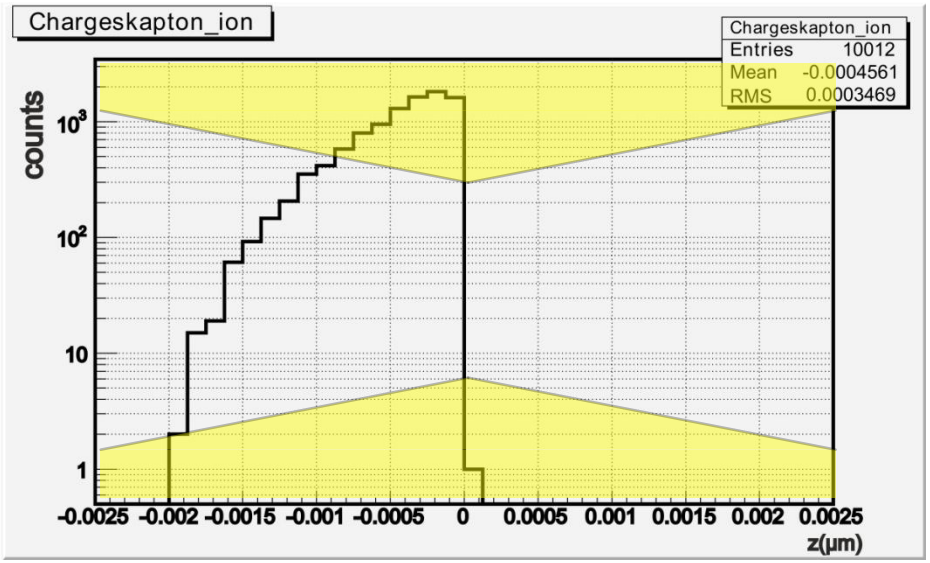
IMPORTANT TOPICS

- Electron and Ion charging-up effect on electric field and on gain - differences on gain
- Simulations for Vgem=200V, 300V and 400V – effective gain and ionization position on z axis
- Conclusions and Future Work

FEBRUARY IMPORTANT RESULTS
CHARGES DEPOSITION ON KAPTON

- First study about the initial deposition of charges on kapton surface
- The kapton surface goes from -25µm to +25µm

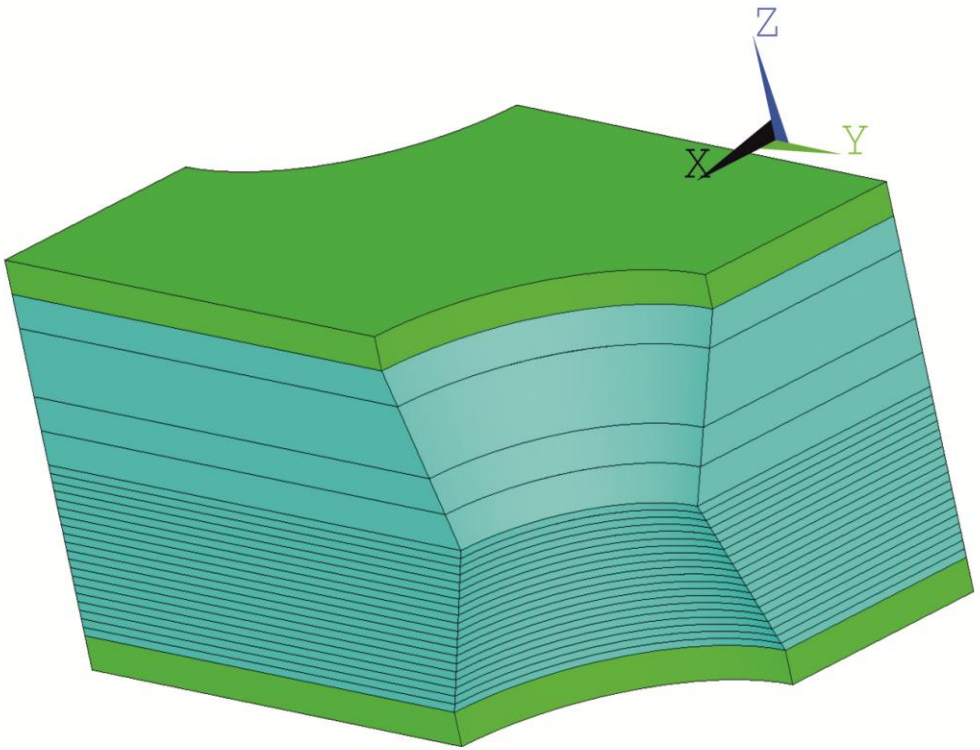




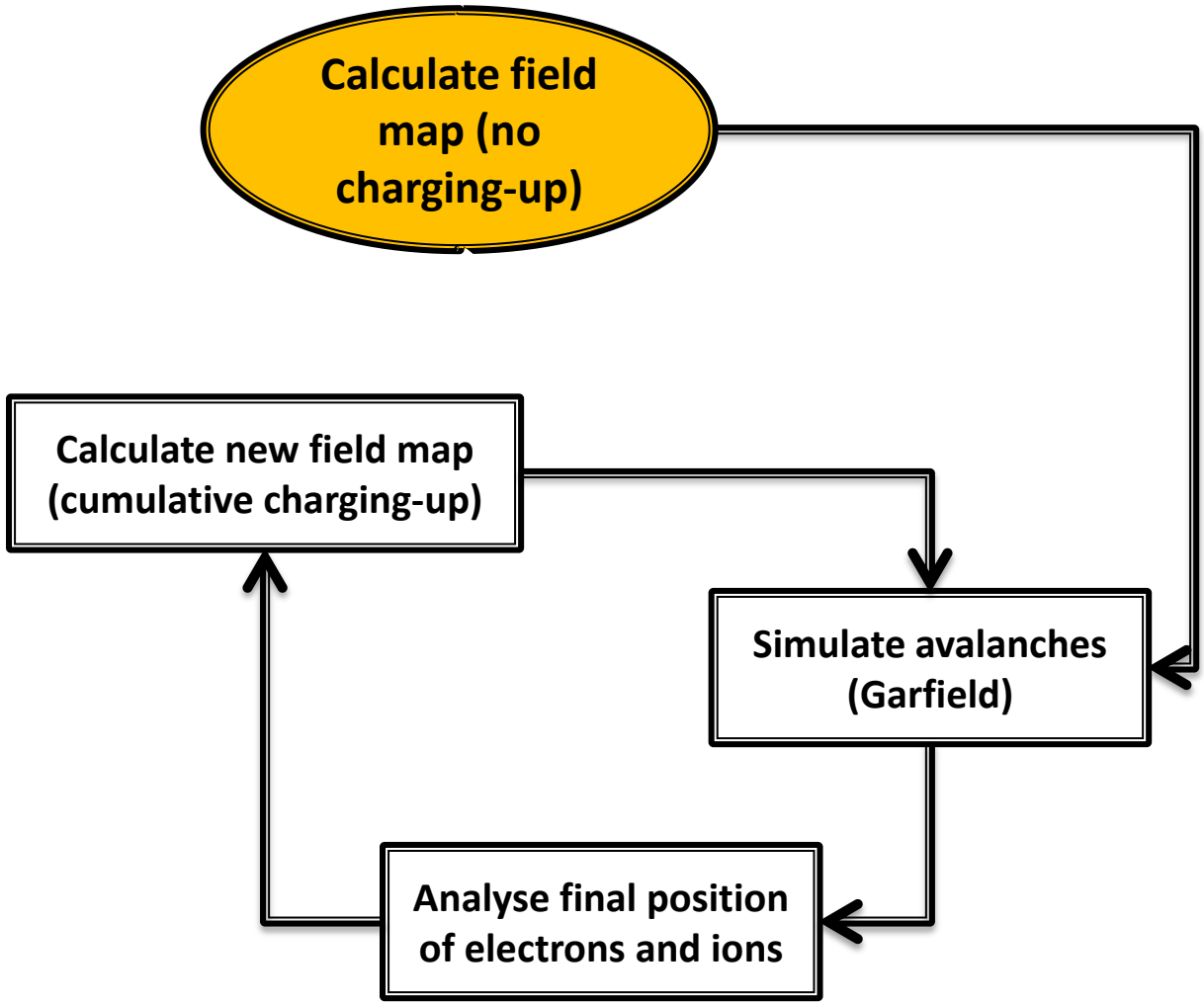
FEBRUARY IMPORTANT RESULTS
NEW UNITARY CELL

- Considering the previous deposition histograms, we decided cut the kapton surface again

- We cut the lower half part of the kapton intro 20 slices and the upper part in 4 slices.



FEBRUARY IMPORTANT RESULTS METHOD



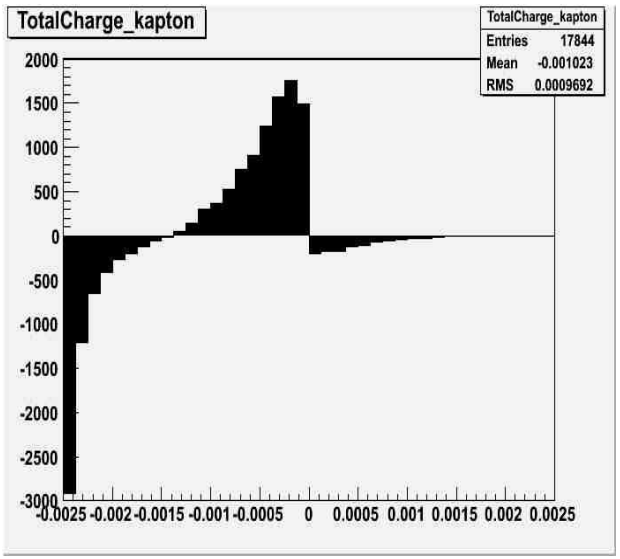
10.000 primary electrons per iteration

Recent work
Initial Conditions

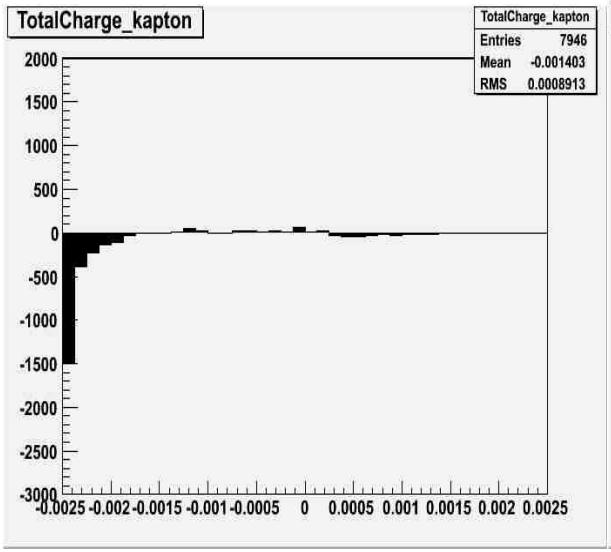
- Standard GEM: Hexagonal Distribution, Edge=140µm, kapton=50µm and metal electrodes=5 µm each
- Gas Mixture: Argon - 70% ; CO_2 - 30%
- Vgem=200,300 and 400 V
- P=760 torr
- T=293 K
- Drift Field=2kV/cm
- Induction Field=3kV/cm

TOTAL CHARGES ON KAPTON VGEM=400V

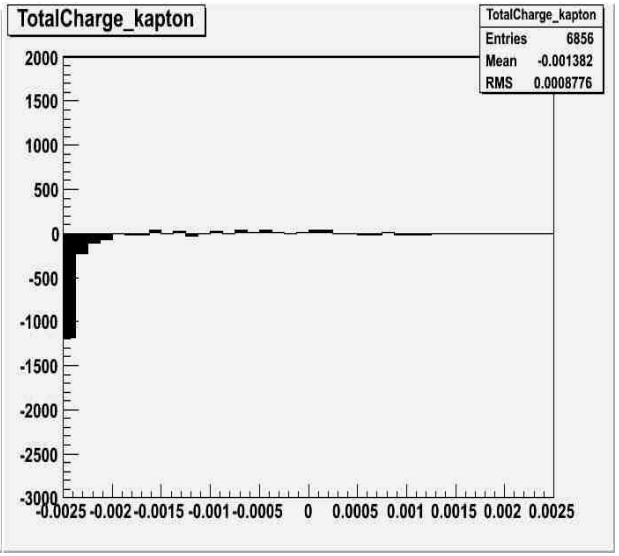
Iter 0



iter 100



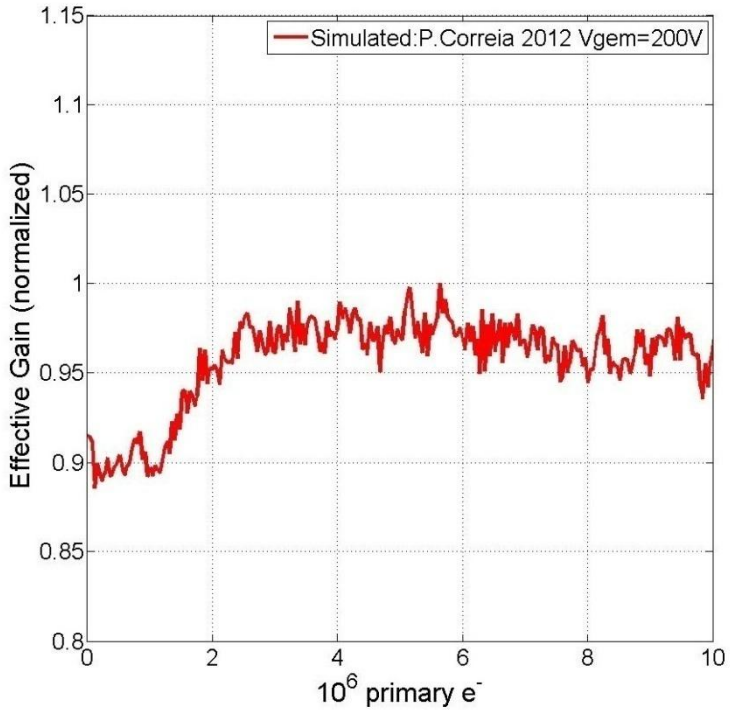
iter 200

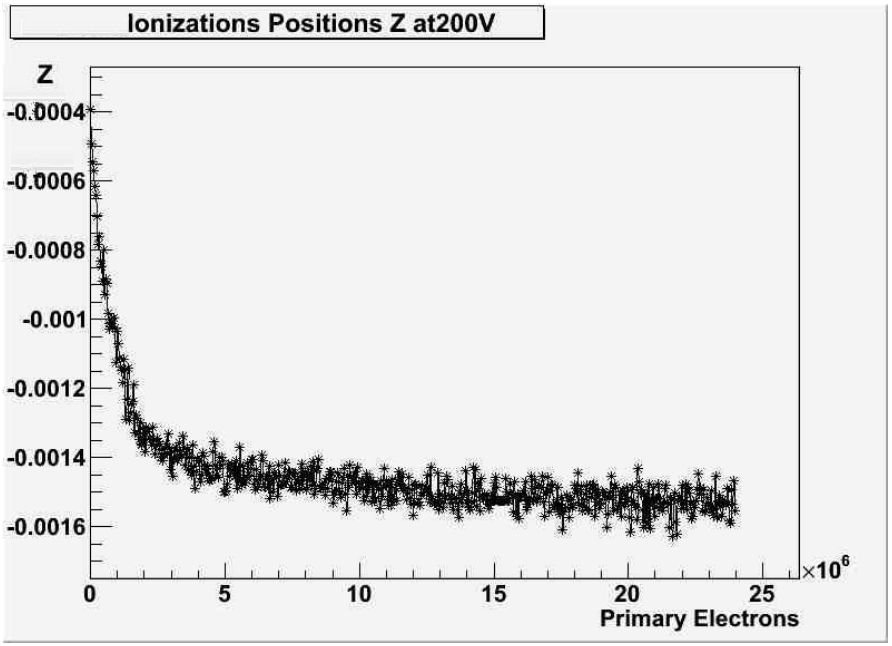


- Net deposited charge (ions-electrons) added to the new field maps.
- For later iterations, we see the compensation between electron and ion deposition in almost all regions of the hole.

Gas Gain

- At 200V, the effective gain (left) and the ionization position (right)

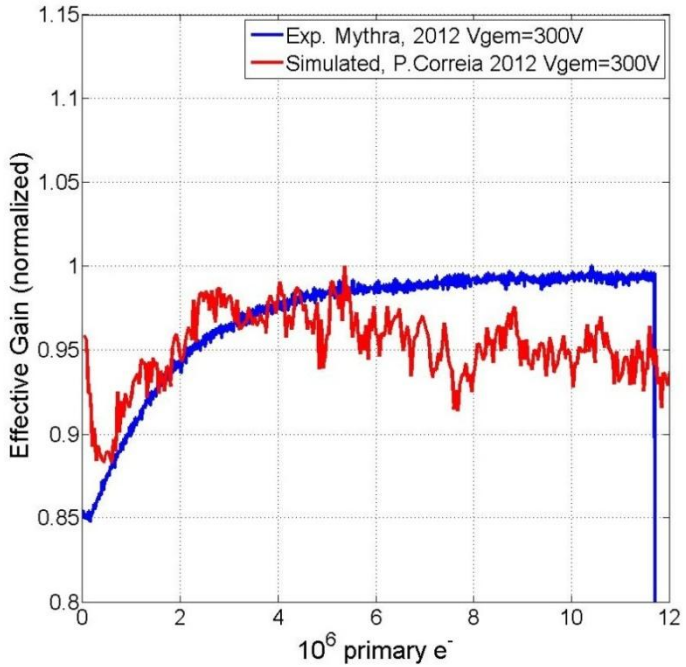


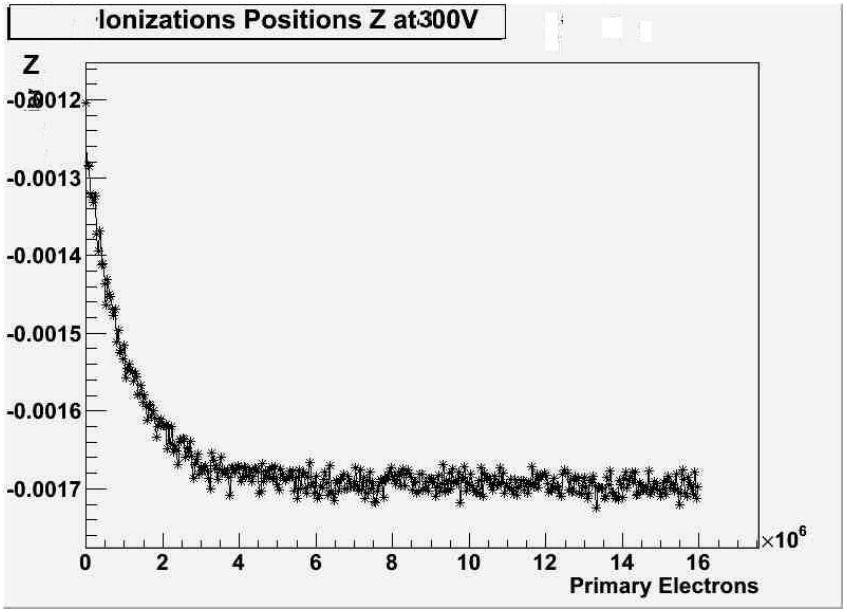


- Gain increase ⟷ Ionizations position decrease
- Simulated gain start to decrease at some point

Gas Gain

- At 300V, the effective gain (left) and the ionization position (right)

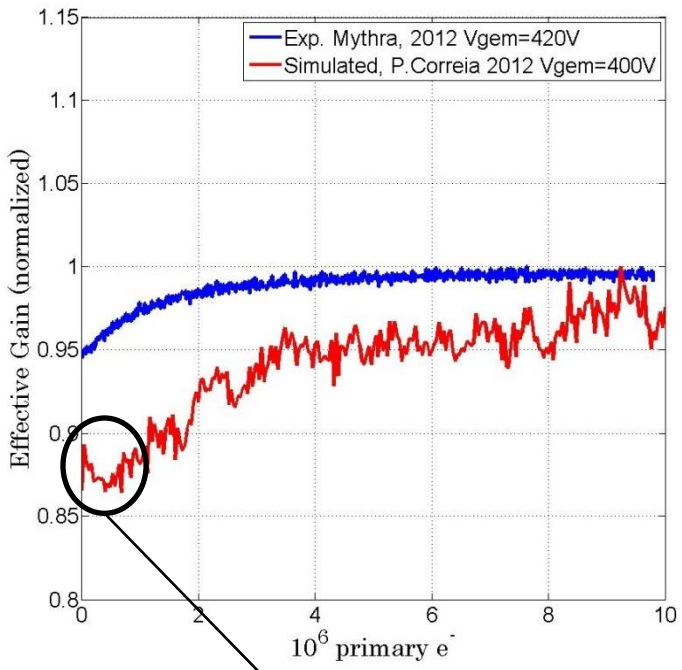


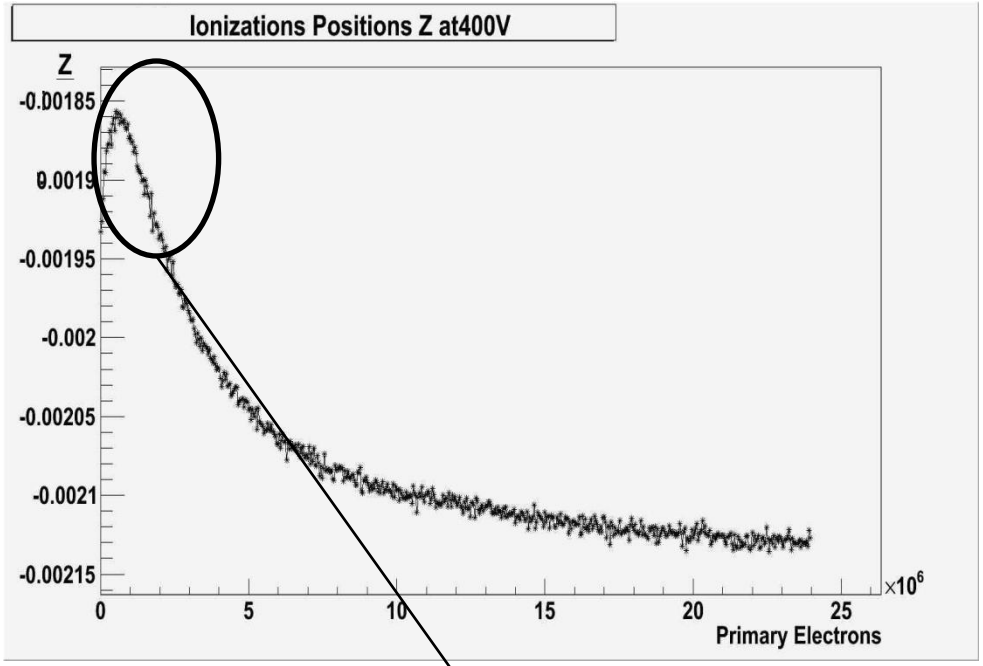


- Gain increase ⟷ Ionizations position decrease
- Simulated gain start to decrease at some point

Gas Gain

- At 400V, the effective gain (left) and the ionization position (right)





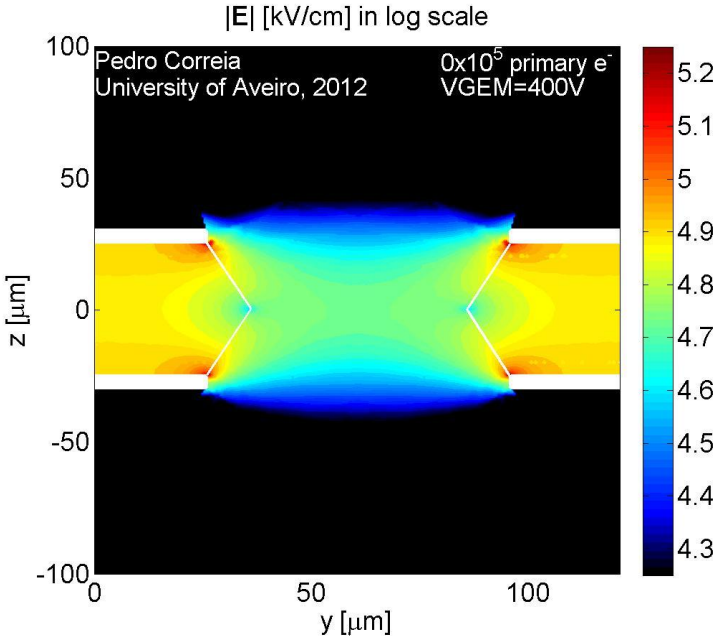
- Initial decrease on gain, correspondent with increase on ionization position - statistical fluctuation or something else?
- Stabilization on gain(same as experimental data) and ionization positions

VARIATION OF ELECTRIC FIELD

- Considering ions and electrons deposition, the simulated gain will tend to equilibrium. The variation on Electric Field was represented on an animation (see attach file .wmv)

- On the firsts iterations, we see fast changes on the Electric field.

- With aniquilation of the electrons and ions contribution on the kapton surface, the Electric field will tend to an equilibrium stage – the gain will stabilize



ACTUAL AND FUTURE WORK

- Try to reduce the statistical variation of gain, simulating more primary electrons for each field map (this will increase the time of the simulation)
- The inclusion of the charges movement on the kapton surfaces will give a more correct approach for our simulation, we expect stop seeing the small drop on gain for later iterations, at 200V and 300V
- Due to electron mobility, the electrons deposited near the bottom electrode can be collected faster, and therefor the continuously increasing of negatives charges on that surface will not occur.
- We will try soon to apply this to other Micro-Pattern Gaseous Detectors (Korean GEM, THGEM, MHSP, etc)

END

- Any suggestions are welcome.

- Thank you for your attention.