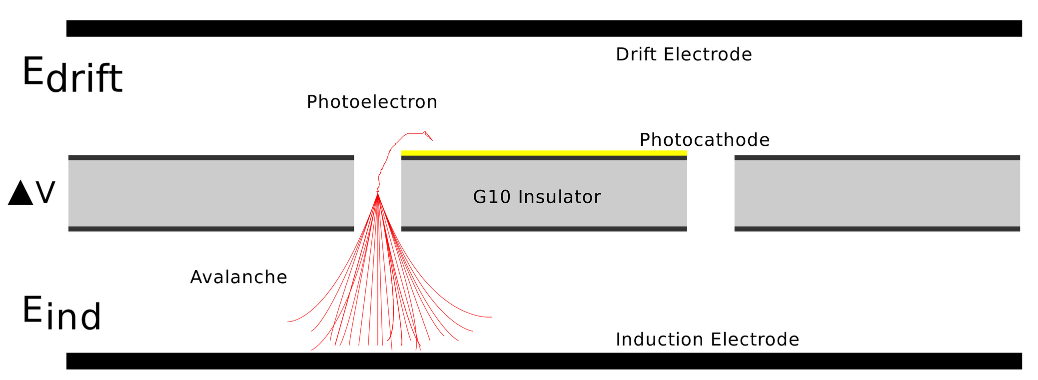
Photon Detection With a Thick GEM

Ramón Martínez (Universidad de Sonora), Guy Paic (UNAM), Rob Veenhof (CERN)

THGEM

Thick GEMs (THGEM) were described in 2004 [4] and are basically a scaled up version of GEM . We present a scheme of the constituents of THGEMs:

- Electrodes
- Photocathode
- G10



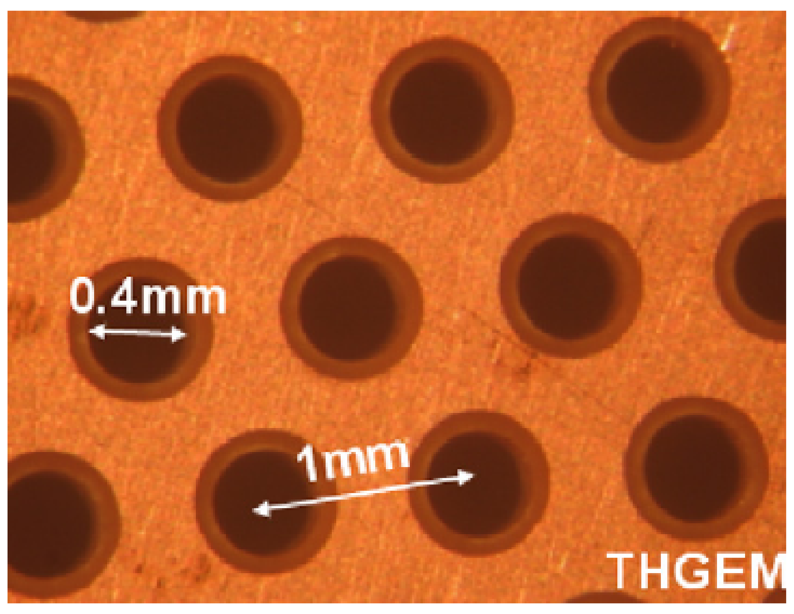
The three most important electrical parameters.

- Drift field E_{drift}
- Difference of potential ΔV
- Induction field E_{ind}

Geometry

The geometry is defined by:

- **Pitch** is defined as the distance between two holes.
- **Diameter**.



Taken from C. Shalem,et al. A 558(2):475 489, 2006 for.

Photoelectron Backscattering

- Since 1955 in a work by L.B Loebe it was recognized that once escaped from a photocathode some electrons diffuse back, even in the presence of electric field, due to the elastic collisions with the gas molecules [1].
- Accordingly to [2] one of the most important parameters contributing to photoelectron backscattering occurrence is **the ratio of elastic collisions versus inelastic collisions**.
- To decrease backscattering effects is to add CH_4, CF_4 or $C0_2$ as proposed in [3].

References

[1] A. Breskin, A. Buzulutskov, R. Chechik, A. Di Mauro, E. Nappi, G. Paic, and F. Piuz. 367(1):342âĂŞ346 *Nucl. Instr. and Meth. A (1995)*

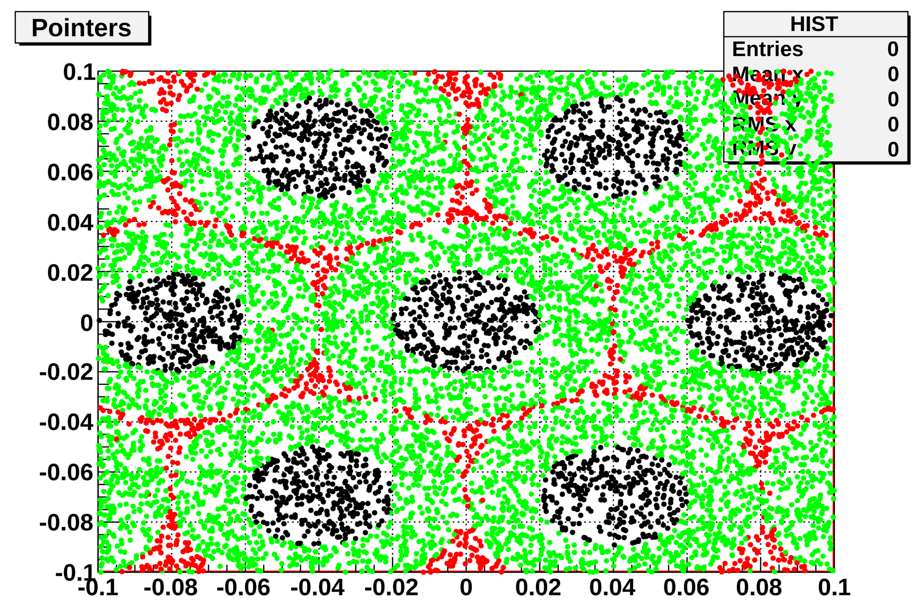
[2] A. Di Mauro, E. Nappi, F. Posa, A. Breskin, A. Buzulutskov, R. Chechik, SF Biagi, G. Paic, and F. Piuz. 371(1):137âĂŞ142 *Nucl. Instr. and Meth. A (1996)*

[3] J. Escada, LCC Coelho, T. Dias, JAM Lopes, J.M.F. Santos, and A. Bre- skin. 4:P11025 *JINST (2009).*

[4] R. Chechik, A. Breskin, C. Shalem, and D. M ĬĽrmann. 535(1):303âĂŞ308 *Nucl. Instr. and Meth. A (2004)*

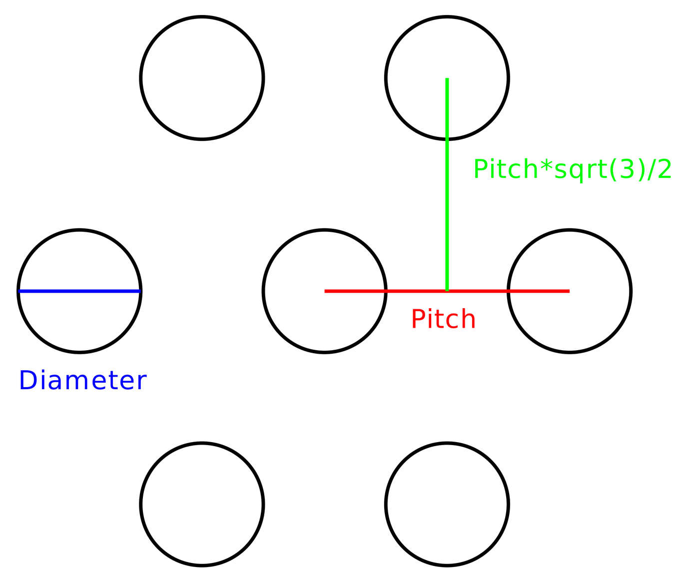
Simulation I

- **Ansys Software** Allowed us to create the geometry of the THGEM and calculate the electrical field using **Finite element analysis**.
- At this stage we did not take into account neither the quantum efficiencies or the backscattering effects.
- Some electrons produced in the photocathode don't make it to the collector electrode. We call the area from where this are generated **Unusuable area**.
- The total area minus the unusable area minus the holes is what we call **Effective area**, and are the points in which the electrons produced make it to the collector electrode.
- We create electrons in random positions and drift them with **Garfield**. we paint the **Effective area** green and the **Unusable area** red



- We can search systematically for the values of the Unusable area and Effective area under a given set of parameters.
- We approximate the unusable area by calculating the proportion of all the produced electrons that do not make it to the collector space.
- We approximate the effective area by calculating the proportion of produced electrons that make it to the collector electrode.
- We present the results for distinct values of the **pitch** and **diamater** . The value of the right represents the percentage of unusable area where the value of the right represents the respective effective area's percentage.

$\frac{Pitch(mm)}{Dia(mm)}$	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0.8	•	•	•	•	•	•	•	•	36/8
0.7	•	•	•	•	•	•	•	35/11	48/6
0.6	•	•	•	•	•	•	17/3	43/14	56/8
0.5	•	•	•	•	•	0/64	17/42	42/25	56/16
0.4	•	•	•	•	31/21	0/64	21/5	43/34	57/24
0.3	•	•	•	57/29	44/25	23/53	12/7	38/47	53/35
0.2	•	•	64/0	77/0	56/28	89/0	89/0	91/0	95/0
0.1	•	•	90/0	94/0	67/29	97/0	98/0	98/0	99/0



Simulation II

- We graph the approximate gain between the two holes as a function of position with different drift fields to investigate the dependence of efficiency as a function of this parameter
- In the left we have from up to down a drift field of $170\frac{V}{mm}$, $83\frac{V}{mm}$ and $17\frac{V}{mm}$. In the right we have the same value of the parameters but with reversed signs also in $\frac{V}{mm}$
- In this simulation we take into account quantum efficiencies as well as extraction efficiencies.
- We observe a symmetric behaviour and also we can notice that with a fewer drift field more area becomes usable.