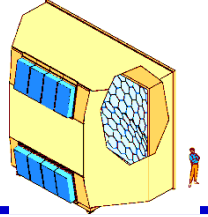


Direct measurements of the properties of Thick-GEM reflective photocathodes

M. Baruzzo[a,1], C. Chatterjee[b], P. Ciliberti[b], S. Dalla Torre[a], S.S. Dasgupta[b,2], B. Gobbo[a], M. Gregori[a], G. Hamar[c,*], S. Levorato[a], G. Menon[a], C. A. Santos[a], F. Tessarotto[a], Triloki[a,3], D. Varga[c], Y. X. Zhao[a]

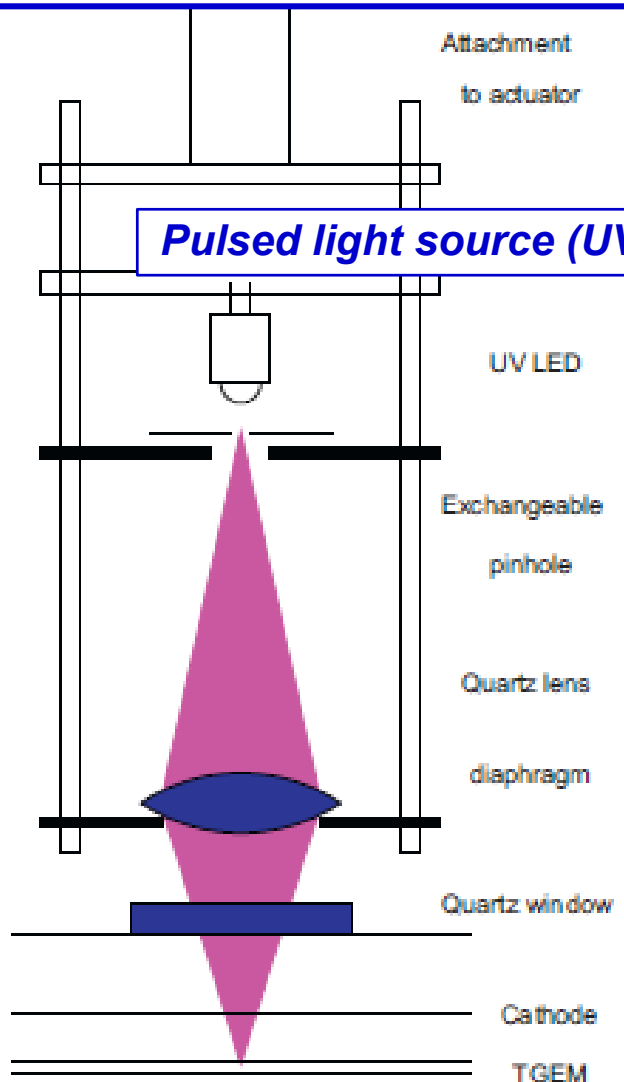
[a] *INFN Sezione di Trieste, Trieste, Italy*
[b] *University of Trieste and INFN Sezione di Trieste, Trieste, Italy*
[c] *Wigner Research Centre for Physics, Budapest, Hungary*
[d] *Physics Department, University of Aveiro, Aveiro, Portugal*

Submitted to NIMA

NEW:
Understanding detectors
using LEOPARD

REMINDER ABOUT LEOPARD

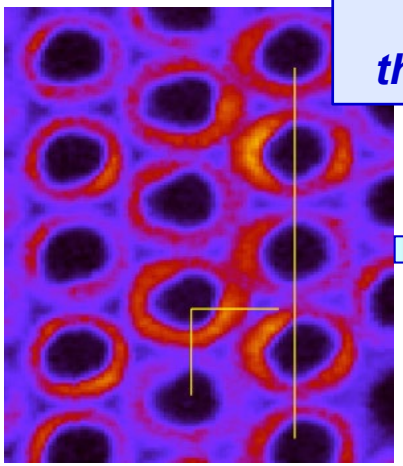
Scanning with this device



Typical light spot-size ≤ 100 μm

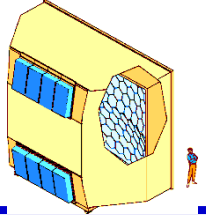
G. Hamar and D. Varga, Nucl. Instr. and Meth. A 694 (2012) 16.

- Operation in "single photon mode"
- At each point an (exponential) amplitude spectrum is collected
- **LEOPARD provides, at the same time:**
  - **Gain maps: mean value of the exponential distribution**
  - **Efficiency maps :**
    - **n_hits / n_pulses (depends on thr. & gain): measured YIELD**
    - **extrapolated including hits regeted by thr. : extrapolated YIELD**

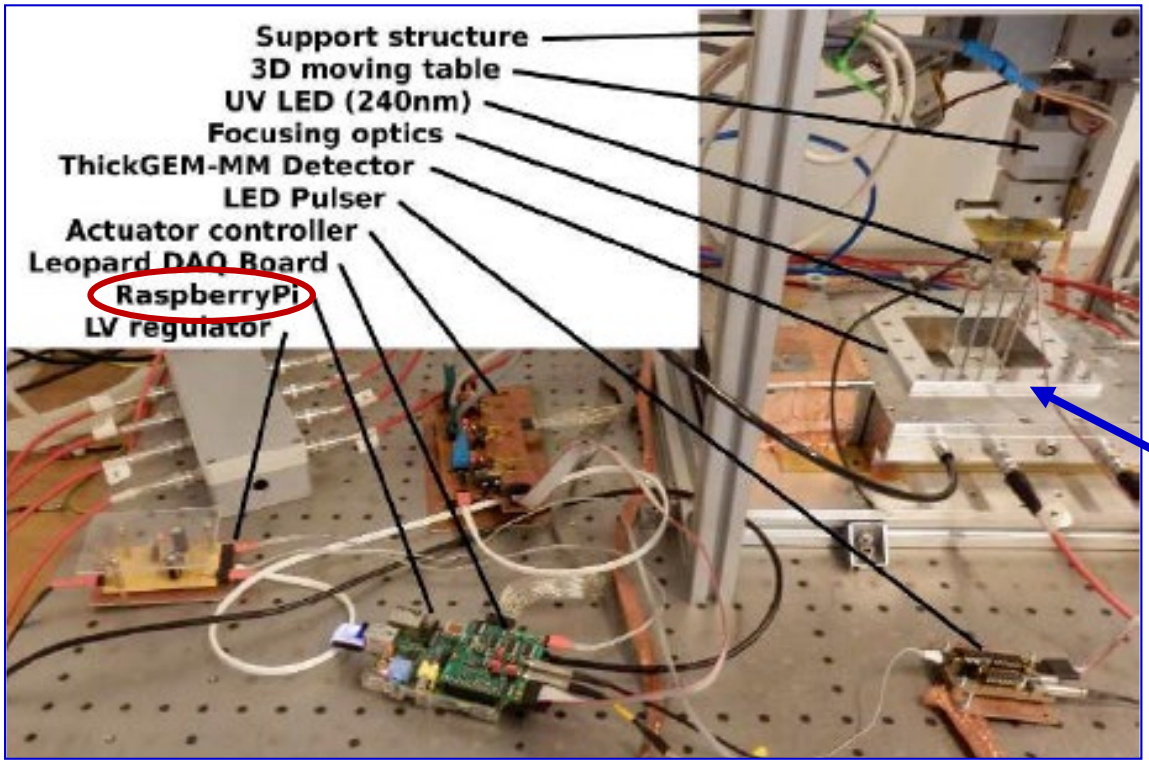


From first images the nickname : LEOPARD

- More recently used for quality control of THGEMS and GEMs (WIGNER activity)



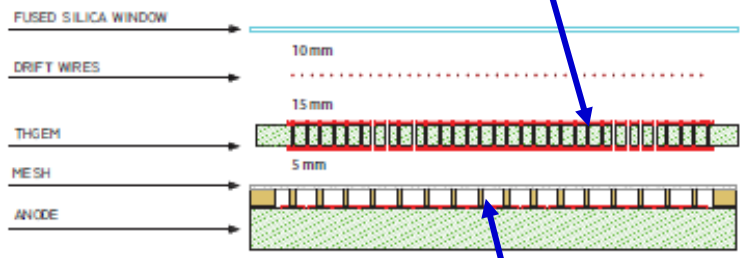
EQUIPMENT & SETUP



THGEM Name	Hole diamter [μm]	Pitch [μm]	Thickness [μm]	Rim [μm]
M1-III	400	800	400	0
DESTRO-I	400	800	400	5
C3HR-II	400	800	400	50
M2.4-G	400	800	600	0
M2.1-II	300	800	400	0

THGEM been studied

$Ar:CH_4 = 30:70$



MM for amplification

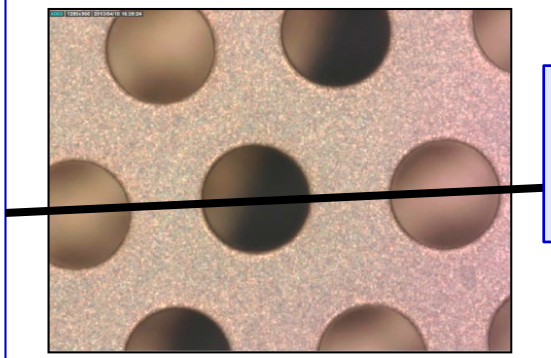
An absolute MUST: high rate DAQ

In fact: for a typical measurement pitch of 100 μm
→ 10k points/cm^2 with 20k triggers/point to collect ~ 1000 entries / spectrum

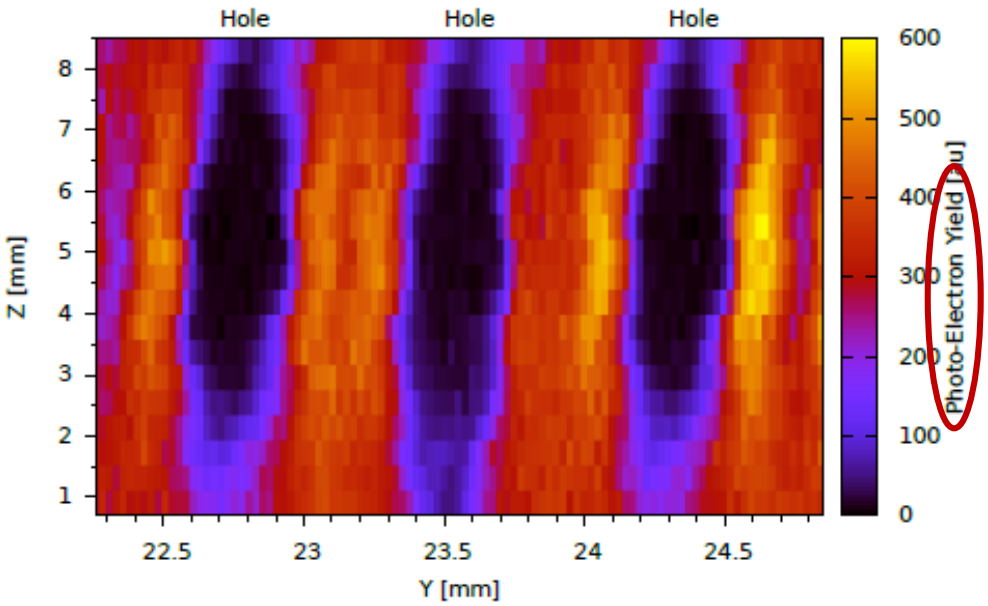
DAQ, collected event rate : 130 kHz

IMAGE FOCUSING

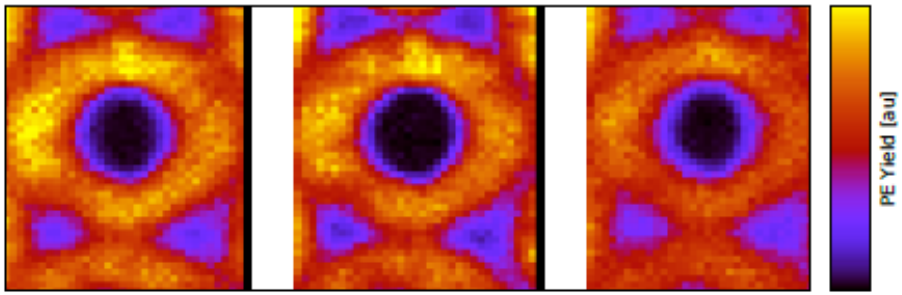
For each THGEM to be studied



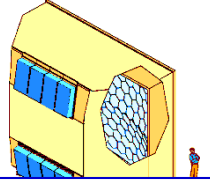
Scanning along this line at different heights



-1 mm ***focus*** ***+ 1 mm***



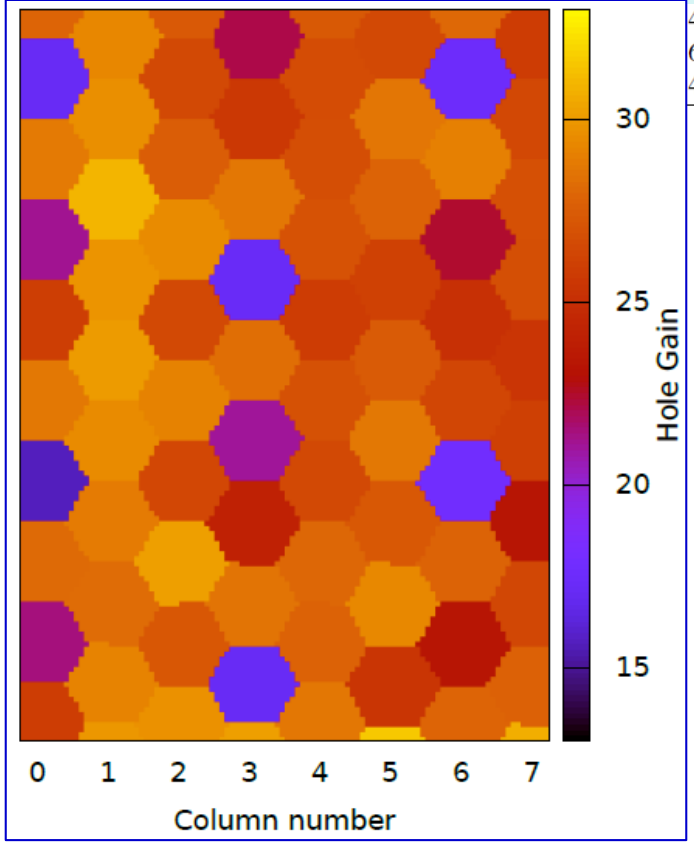
Cross-check scanning in the horizontal plane at different heights

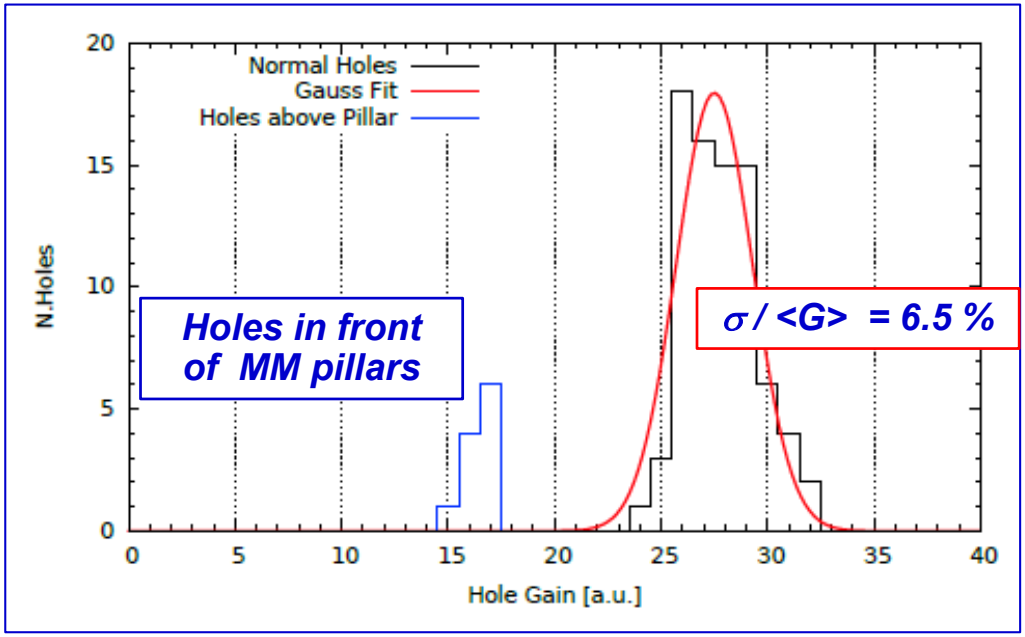


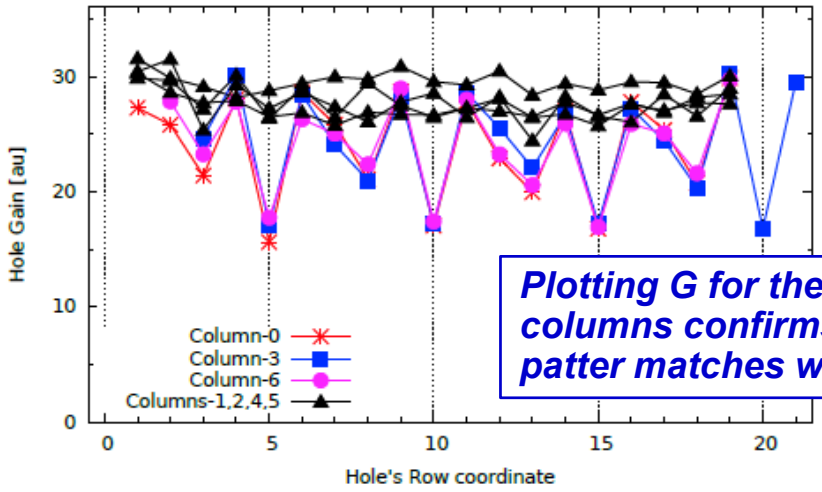
GAIN UNIFORMITY

GAIN UNIFORMITY IN A GOOD INDUSTRIAL THGEM

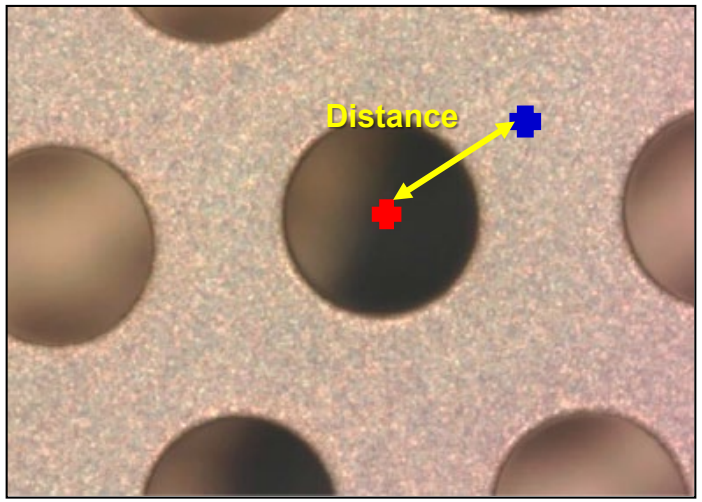
THGEM Name	Hole diamter [μm]	Pitch [μm]	Thickness [μm]	Rim [μm]
M1-III	400	800	400	0
DESTRO-I	400	800	400	5
			400	50
			600	0
			400	0







GAIN UNIFORMITY vs e GENERATION POINT



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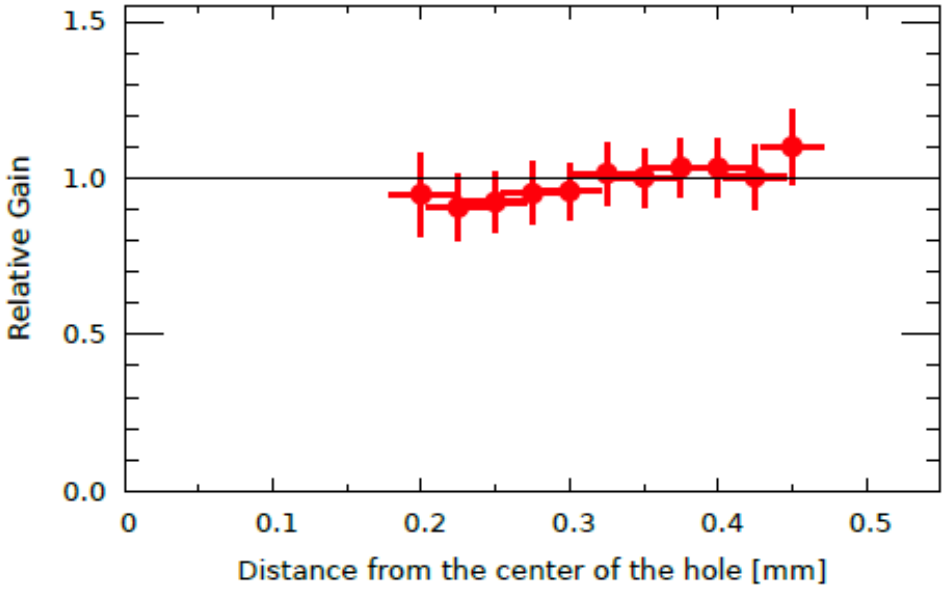
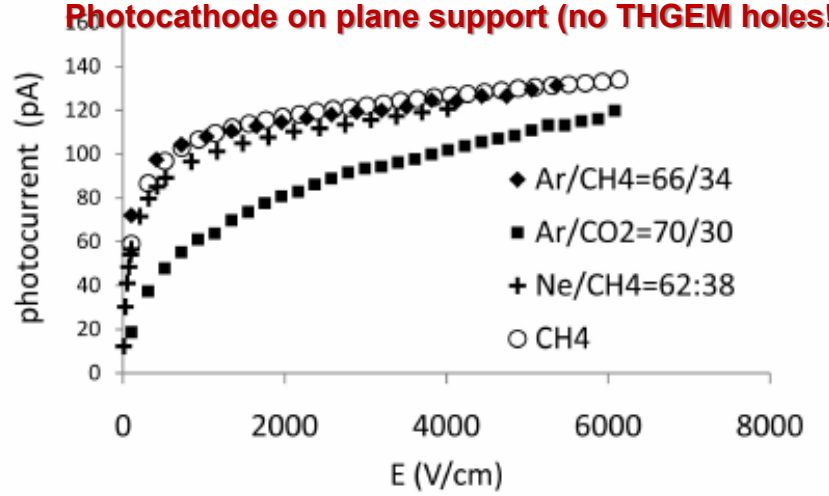
M2.4-G	400	800	600	0
M2.1-II	300	800	400	0



PHOTOELECTRON EXTRACTION

- **A few introductory elements to understand the issue**

Photocathode on plane support (no THGEM holes!)



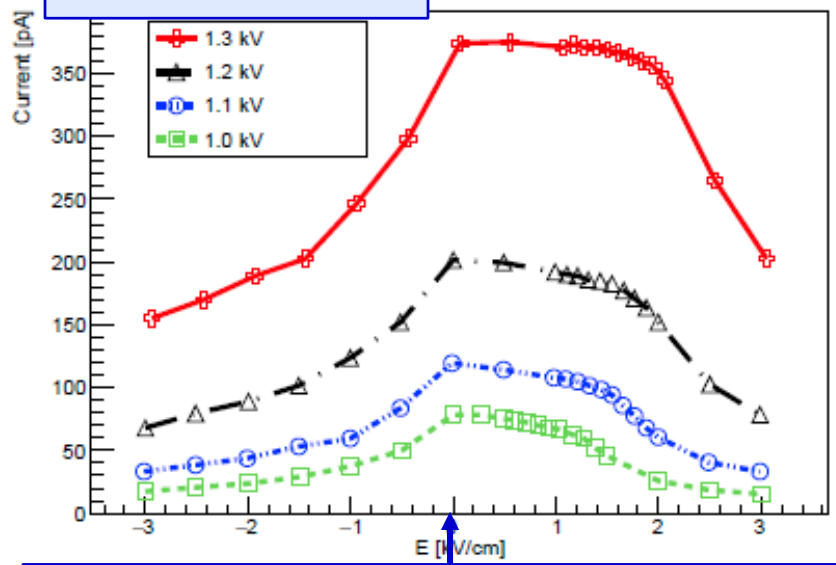
KEY point for gaseous PDs

Preliminary measurements on THGEM

Here E is the sum of the field from biasing voltage + drift field

In this preliminary exercise the anode current has been measured

THGEM Bias ΔV



Reversed drift field | ***Direct drift field***

PHOTOELECTRON EXTRACTION

- ***A picture of the detailed behavior by LEOPARD***

THGEM Name	Hole diamter [μm]	Pitch [μm]	Thickness [μm]	Rim [μm]
M1-III	400	800	400	0
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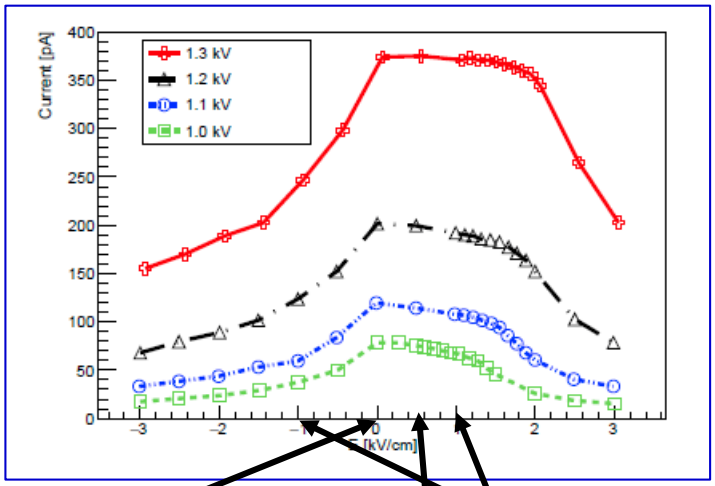
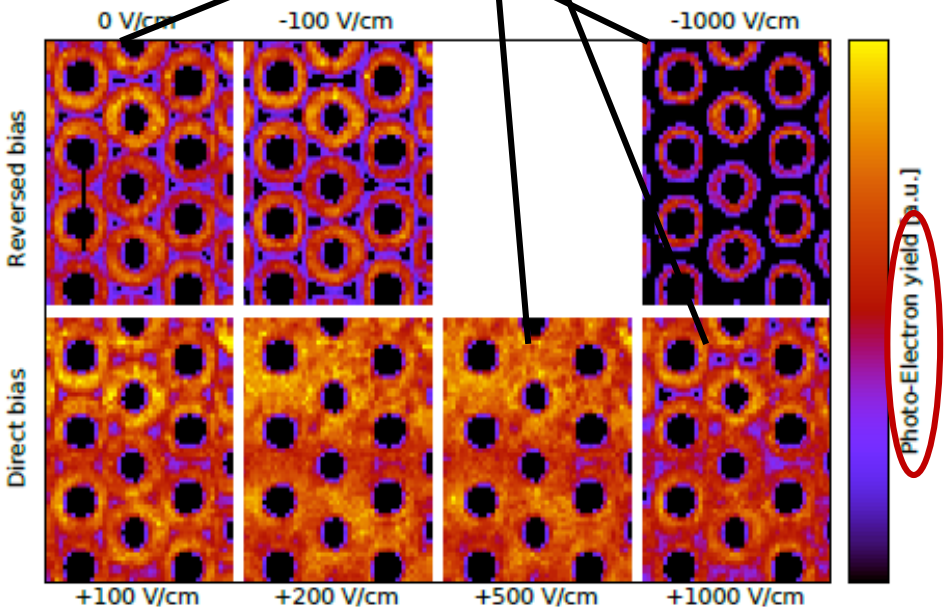
M2.1-II	300	800	400	0

Photoelectron extraction vs Drift field





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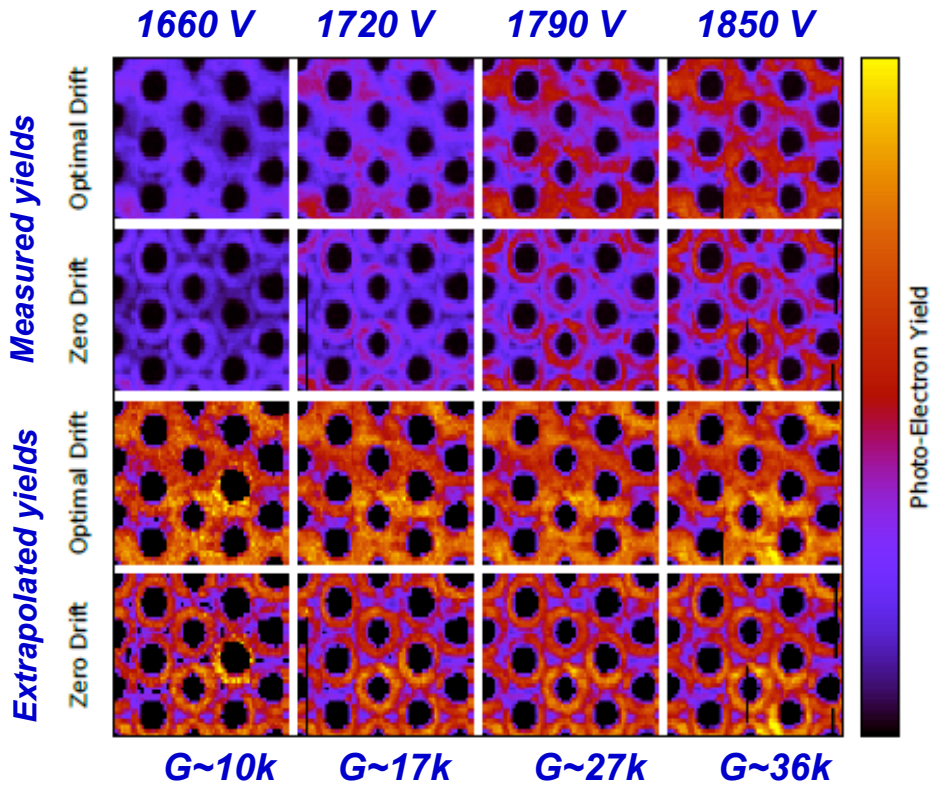
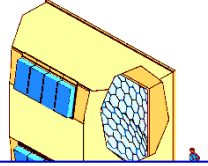
M2.4-G	400	800	600	0
M2.1-II	300	800	400	0

Photoelectron extraction vs GAIN

A comment: non-ideal noise and threshold (~ 11k e equivalent) for these tests





PHOTOELECTRON EXTRACTION

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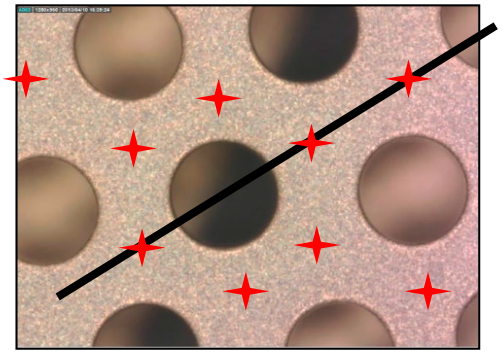
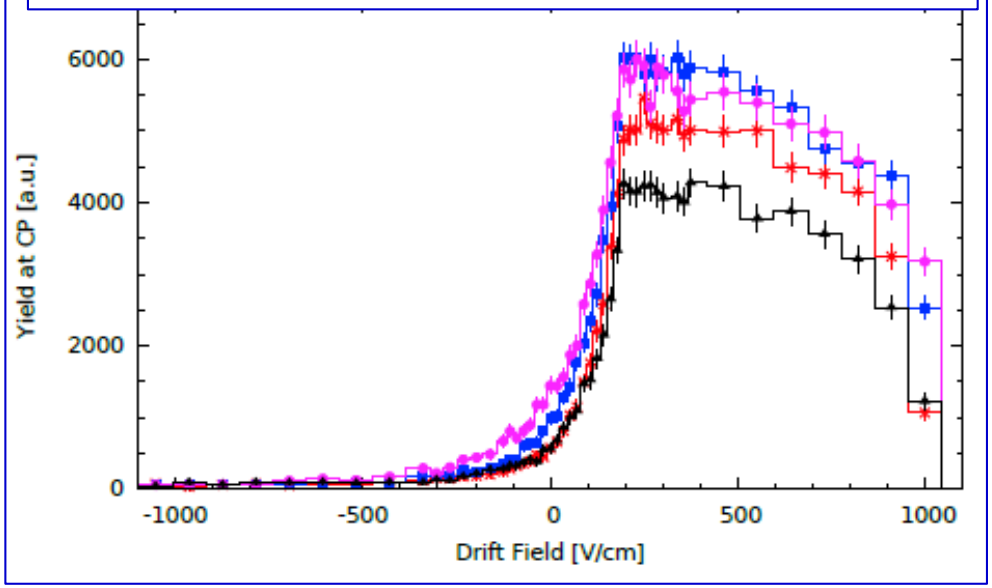
M2.1-II	300	800	400	0

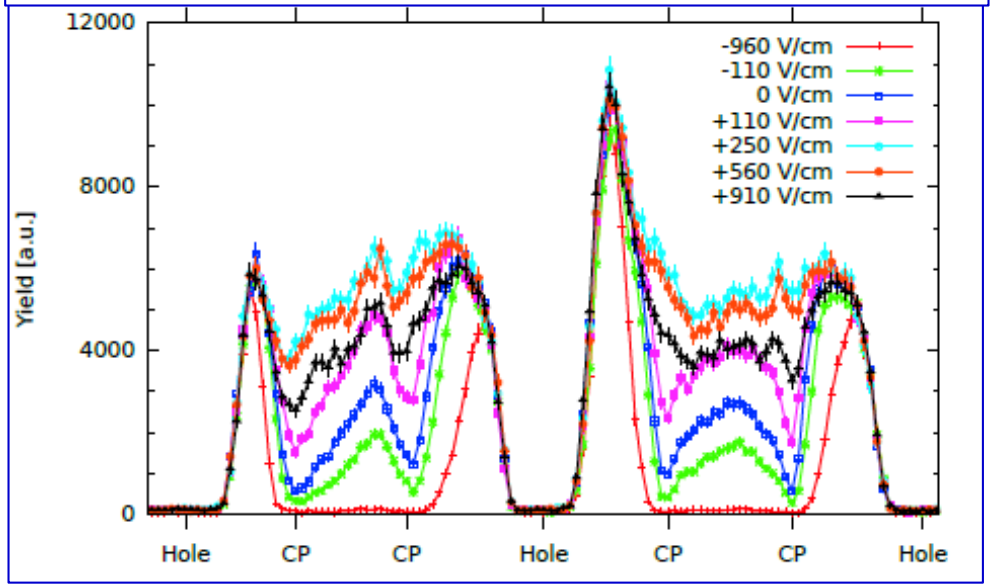
Critical Point (CP) & Critical Line (CL): A faster approach for more studies

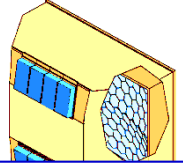


EXTRAPOLATED YIELS @ 4 different CPs vs DRIFT FIELD



EXTRAPOLATED YIELS along a CL varying the DRIFT FIELD





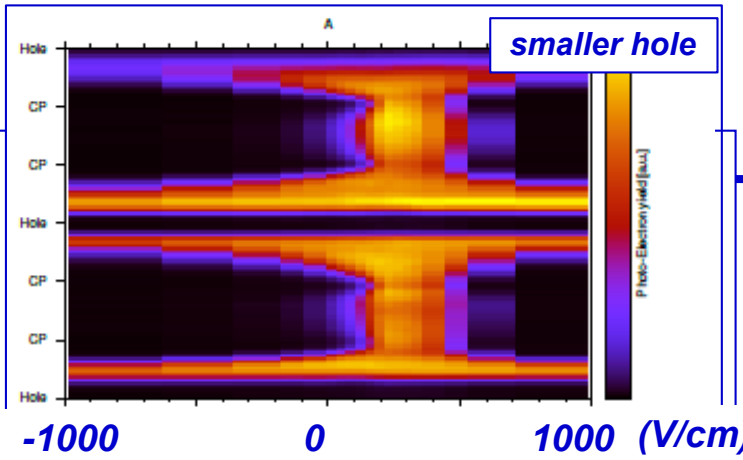
PHOTOELECTRON EXTRACTION

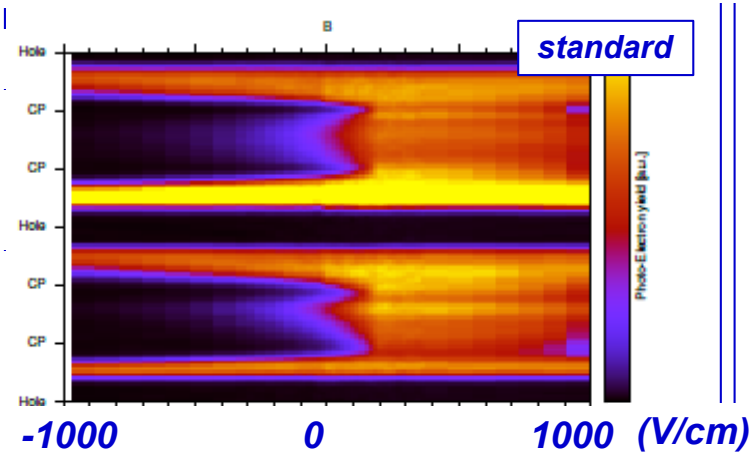
- **A picture of the detailed behavior by LEOPARD**

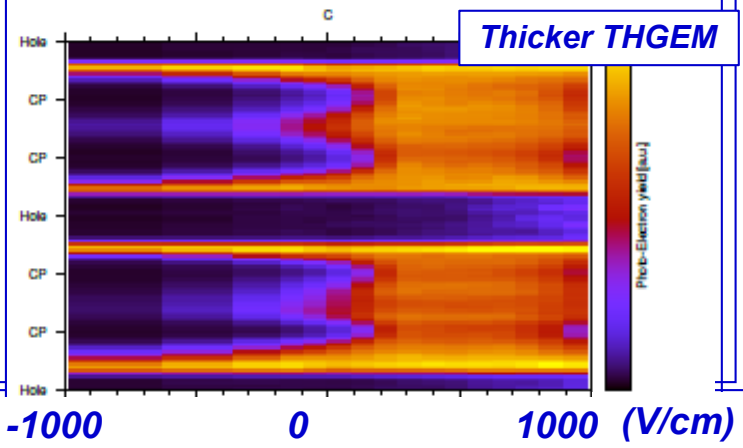
Comparing different THGEM geometries:

Extrapolated yields in 2D plots

x-axis – drift field
y-axis – location along a CL







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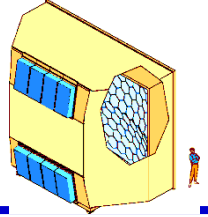
M2.4-G	400	800	600	0
M2.1-II	300	800	400	0

Standard (used at COMPASS)

Thicker THGEM: higher gain !

smaller hole: more active surface ! (78% → 87%)

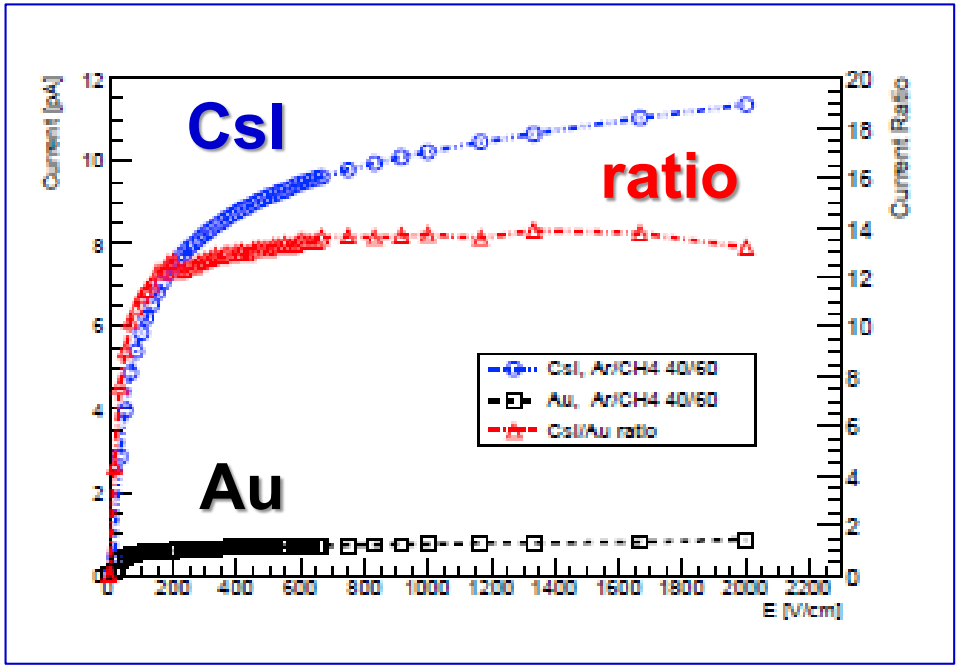


PHOTOELECTRON EXTRACTION

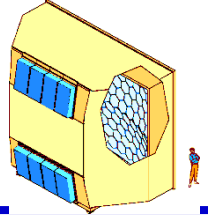
All this extracting from gold (UV LEDs below 245 nm not available)

Is it valid for CsI ?

Photocurrent in gas from different photoconverters



$Ar:CH_4=60:40$



(SHORT) CONCLUSIONS

- To progress you need
  - Clever tools
  - Well defined questions that can be address with good tools
- We had both and, therefore, we have learned a lot

THANK YOU FOR YOUR ATTENTION