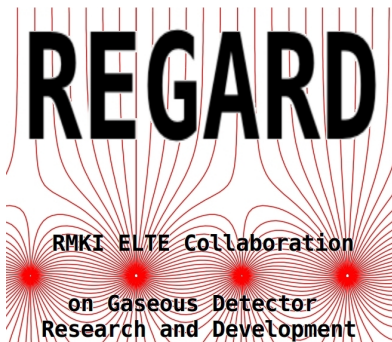


First High Resolution Leopard Scans on a Standard GEM Foil



Gergő Hamar

for the **REGARD** Group from
Wigner RCP, Budapest

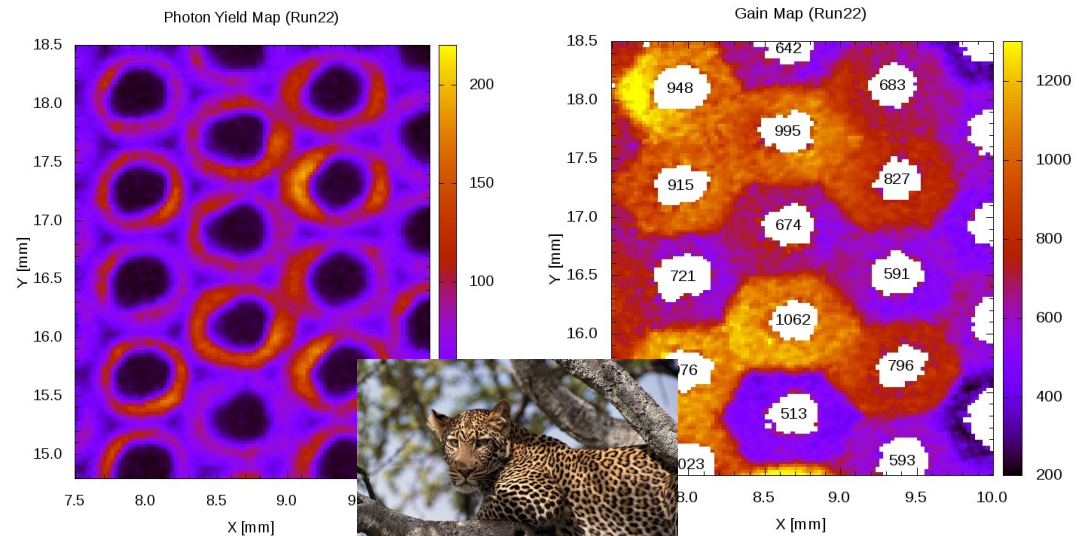
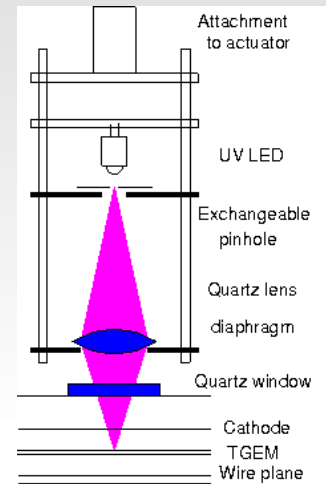


Outline

- Reminder of the LEOPARD System
- Recent upgrades
- Gold plated GEM foil
- Focusing
- First images
- Hole structures
- Edge of the GEM foil
- Outlook

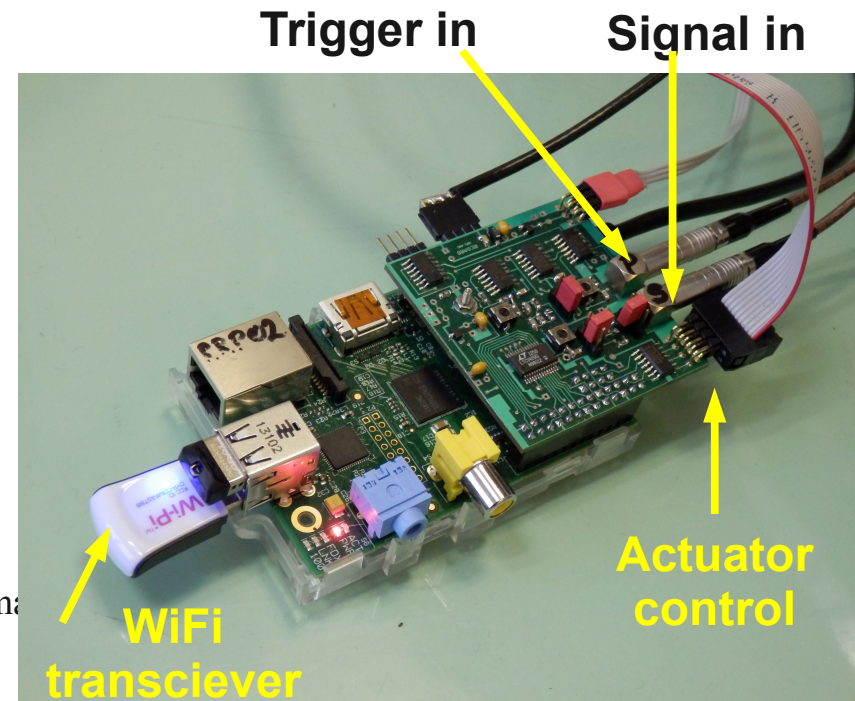
The Leopard System

- To examine TGEM microstructure on photo-electron yield for Cherenkov applications
- Identify hole-by-hole fluctuations
- Input for finetuning simulations
- Pulsed UV light focused onto TGEM surface to emit single electrons (PE yield and gain separable)
- Post amplification stage to test single TGEMs
- Spot size $70\ \mu\text{m}$ => resonable for TGEM
- 3D actuator system

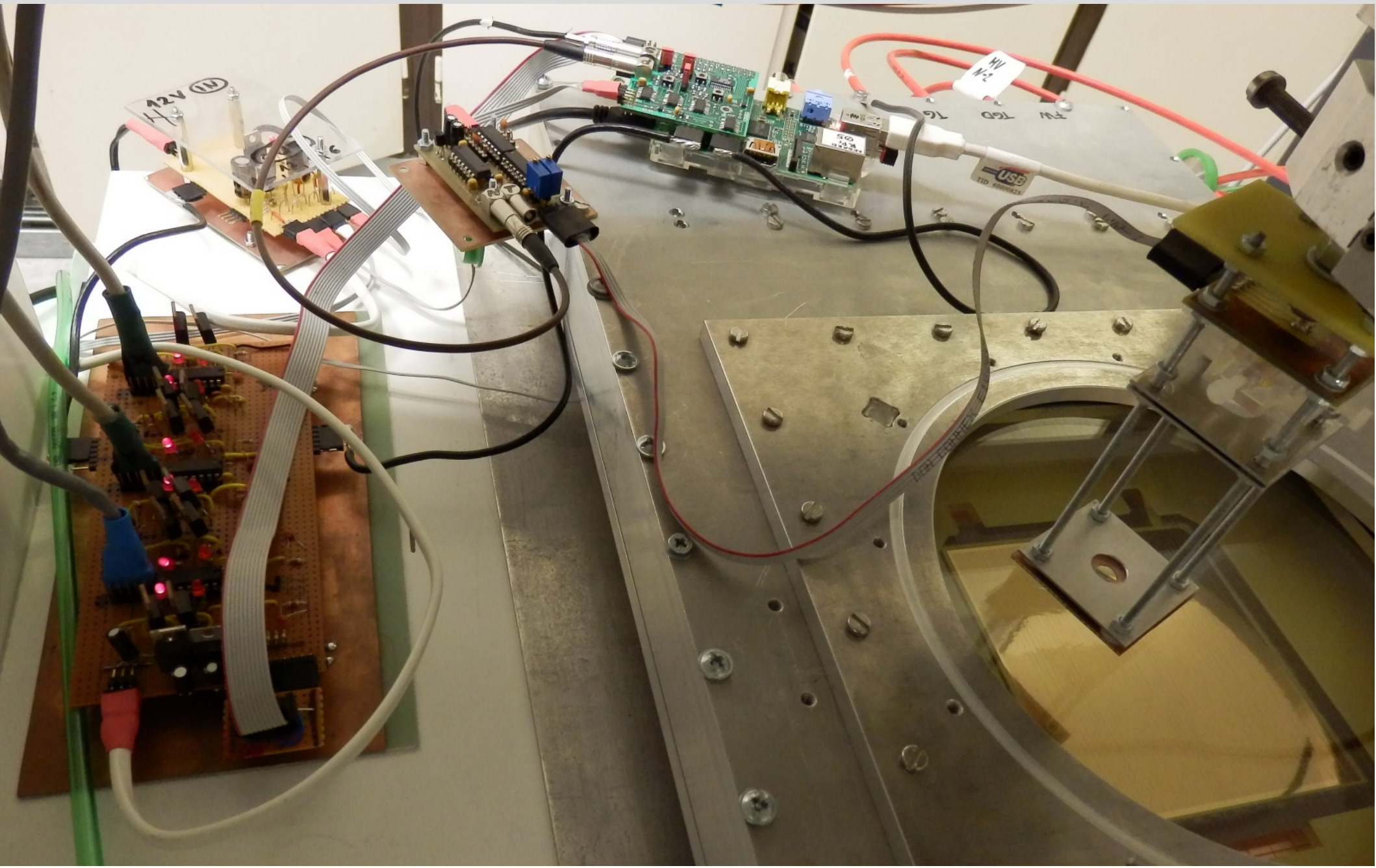


Leopard Upgraded

- RD51 Common Project
See presentation at RD51 Collaboration Meeting at February 2014 by G.Hamar
- DAQ : with Raspberry Pi + additional board
Capability for 120 kHz event rate (single channel)
Command line / GUI; Store spectra; DSP; ...
- Upgraded optical setup :
pinhole 30 μm reachable
- (New actuator system under tests)
- Trieste+Budapest common measurements on TGEMs in February 2014

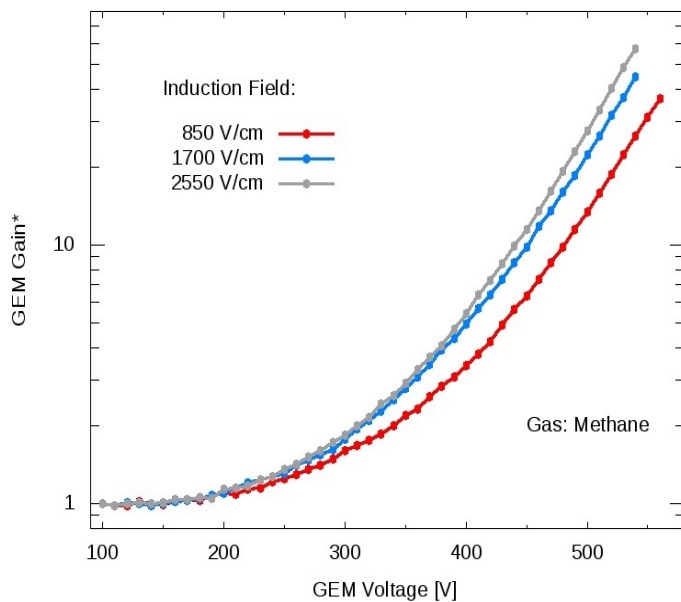


Present Working Setup

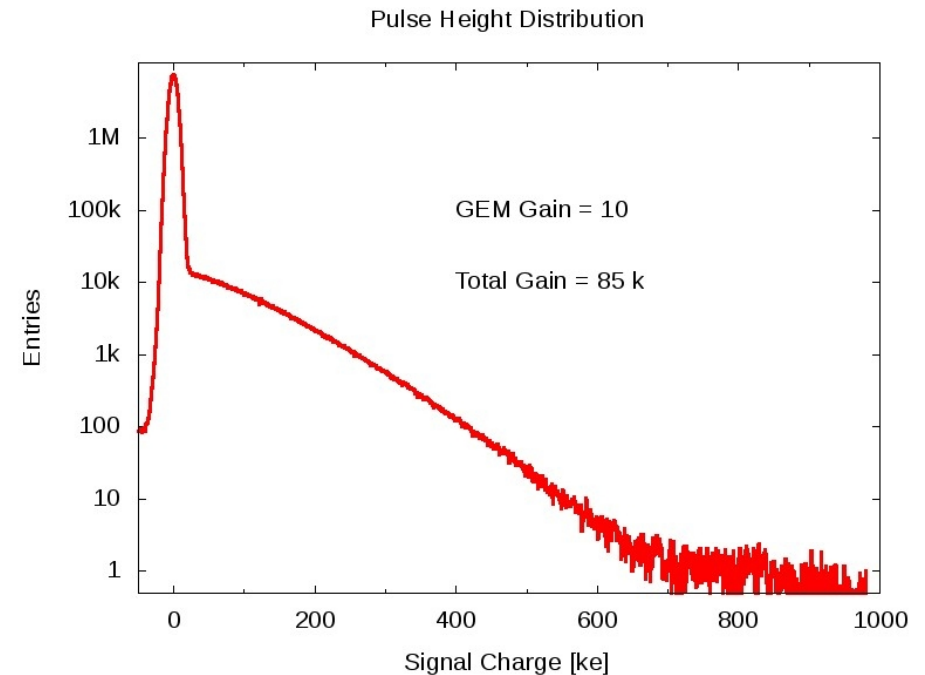


Standard GEM foil

- Standard gold plated GEM from Rui foil worked excellent (no sparks upto now, not even at operation at effective gain 50)
- Resolution better than $20\ \mu\text{m}$ is needed
- Used gas : pure methane

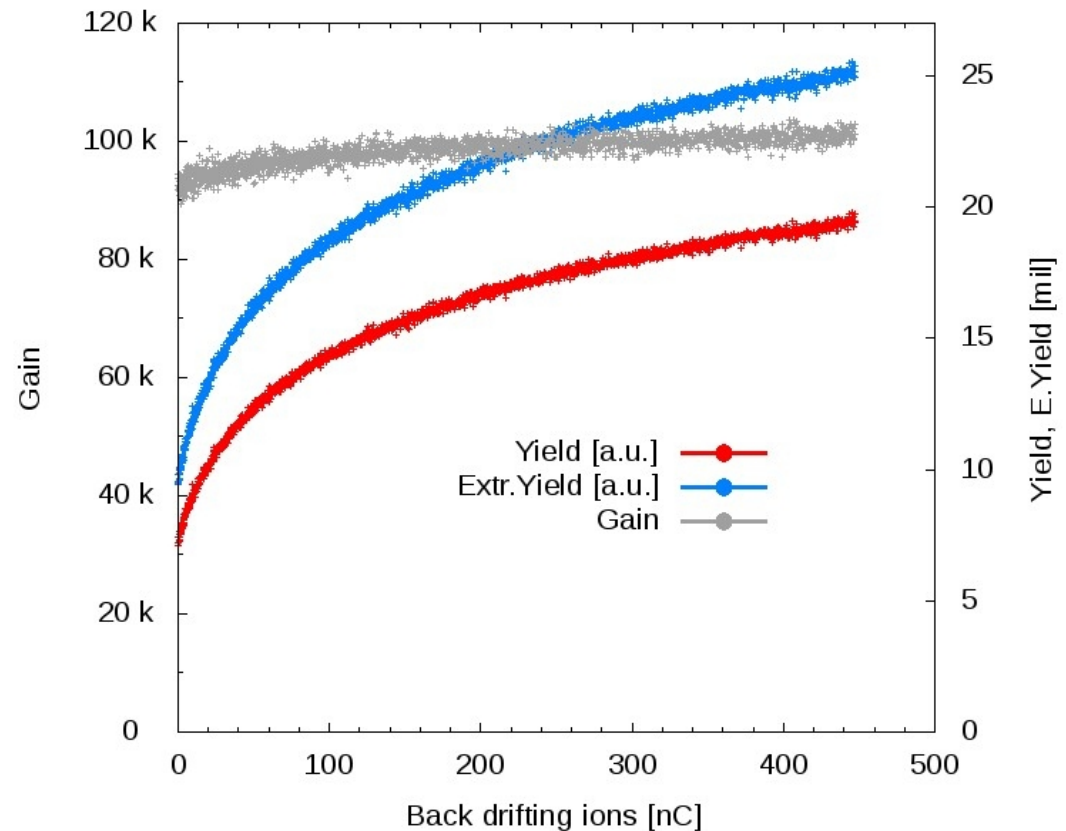


Leopard on GEM



Charge Up

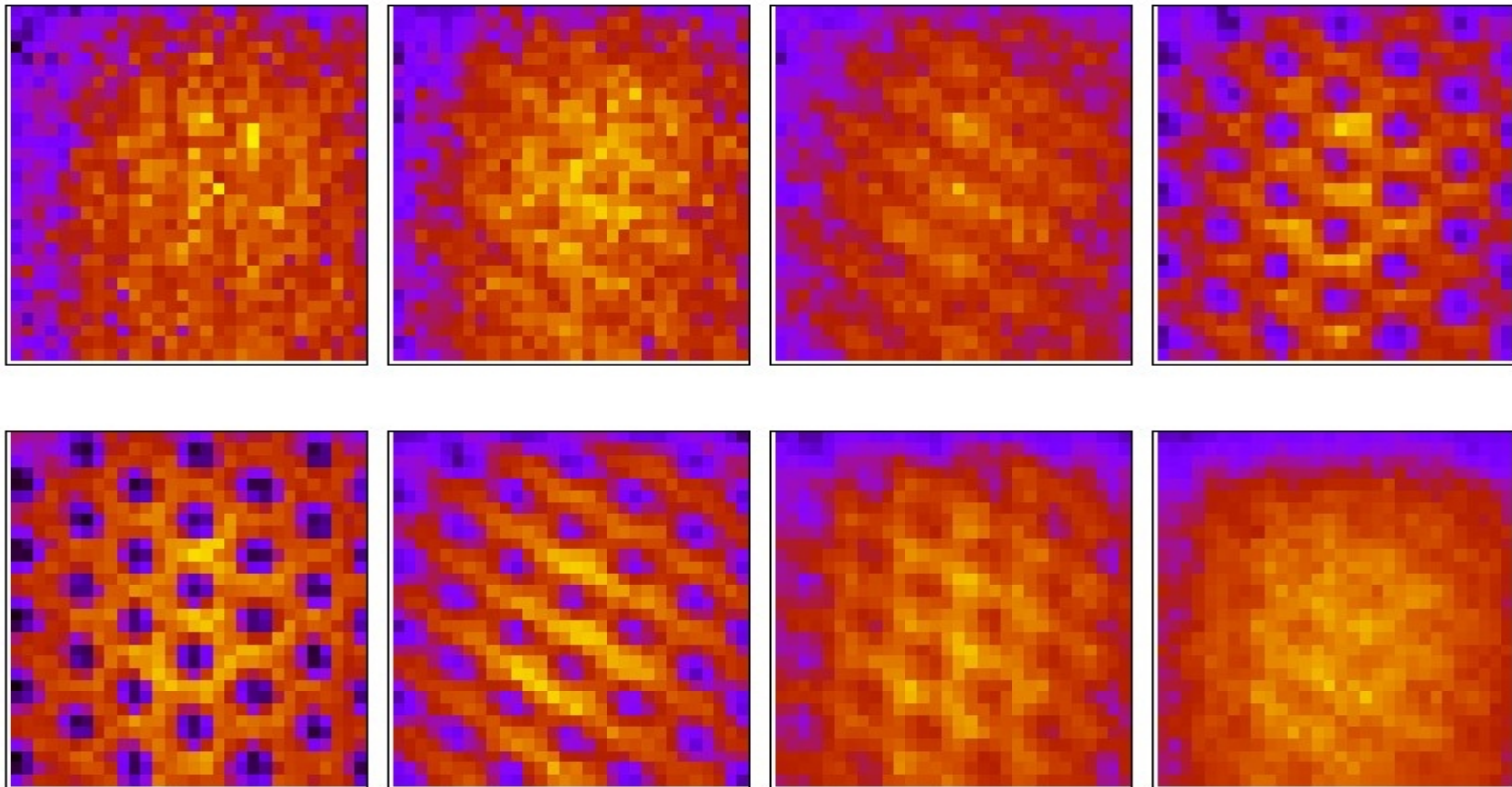
- Serious charge-up effects in TGEMs with both gain and yield variations
- GEM illumination with UV LED
- Photoelectron yield increases (Au vs CsI ?)
- Similar effects during scans (observed)



Focal Scans

- Focal plane : fine tuning directly from data
- 2+1 dim scan in large steps
+ later fine steps around the focus

Focal Scan Maps with $dZ = 1.0$ mm

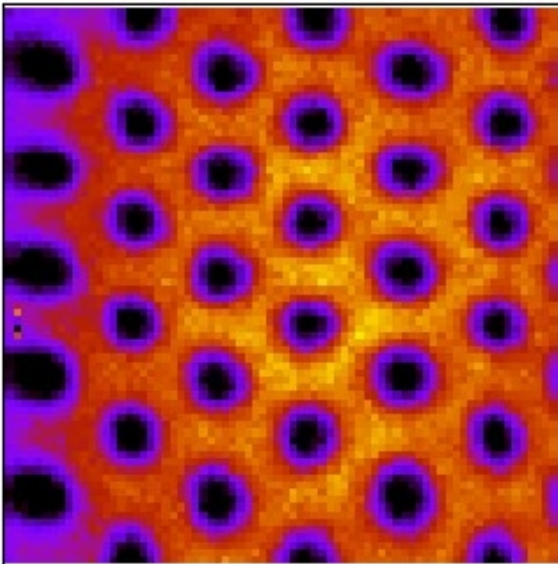


PE Yield Maps

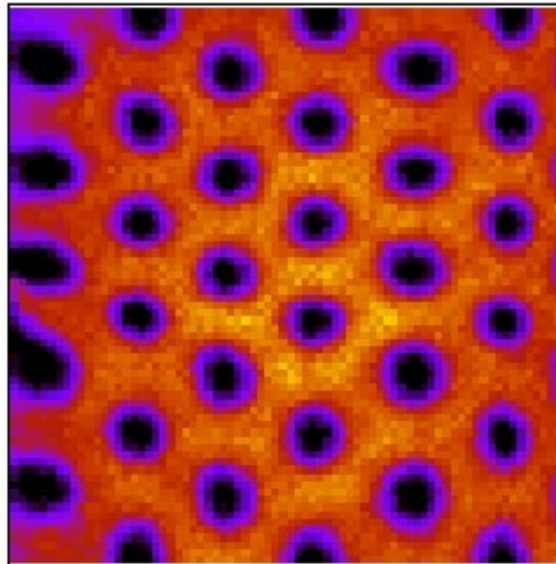
- Successful high resolution scan on GEM foil !
steps of $10\ \mu\text{m}$ in both directions
- Uniform yield distribution

Scaled Yield at Different GEM Gains

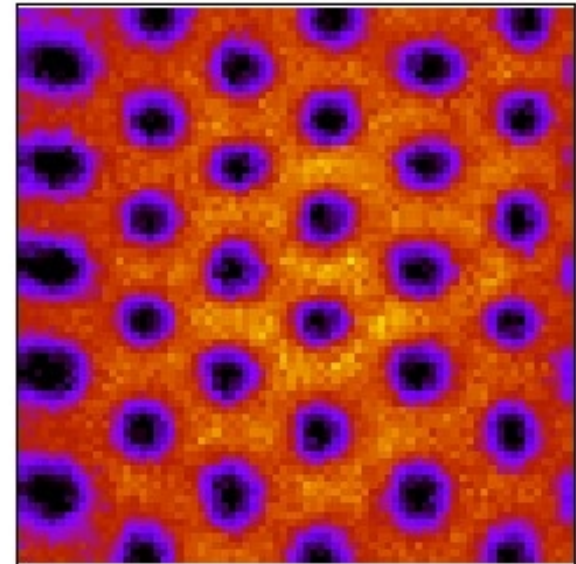
Gain = 30



Gain = 10



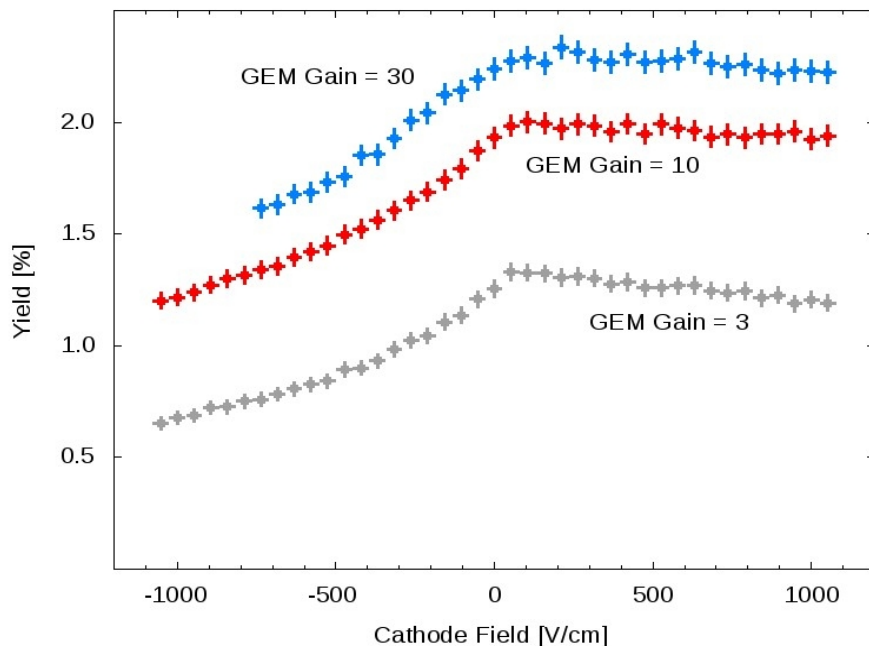
Gain = 2



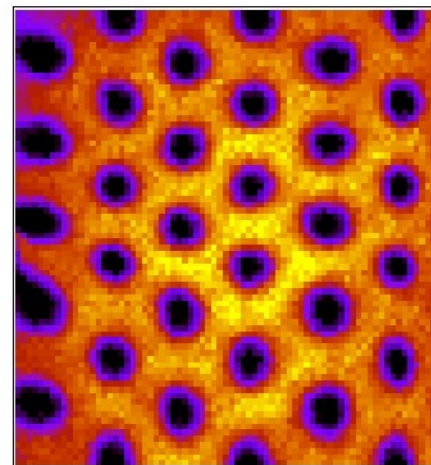
Effect of the Drift Field

- GEM vs ThickGEM
- Nice plateau with normal drift
- Critical points appear only at high reverse fields

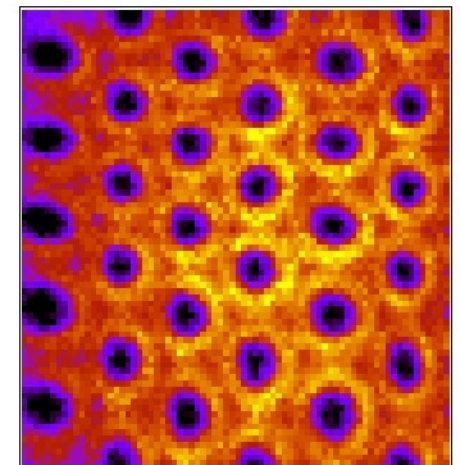
Scaled Yield at Different Drift Fields



Zero Drift



Large Reversed Drift



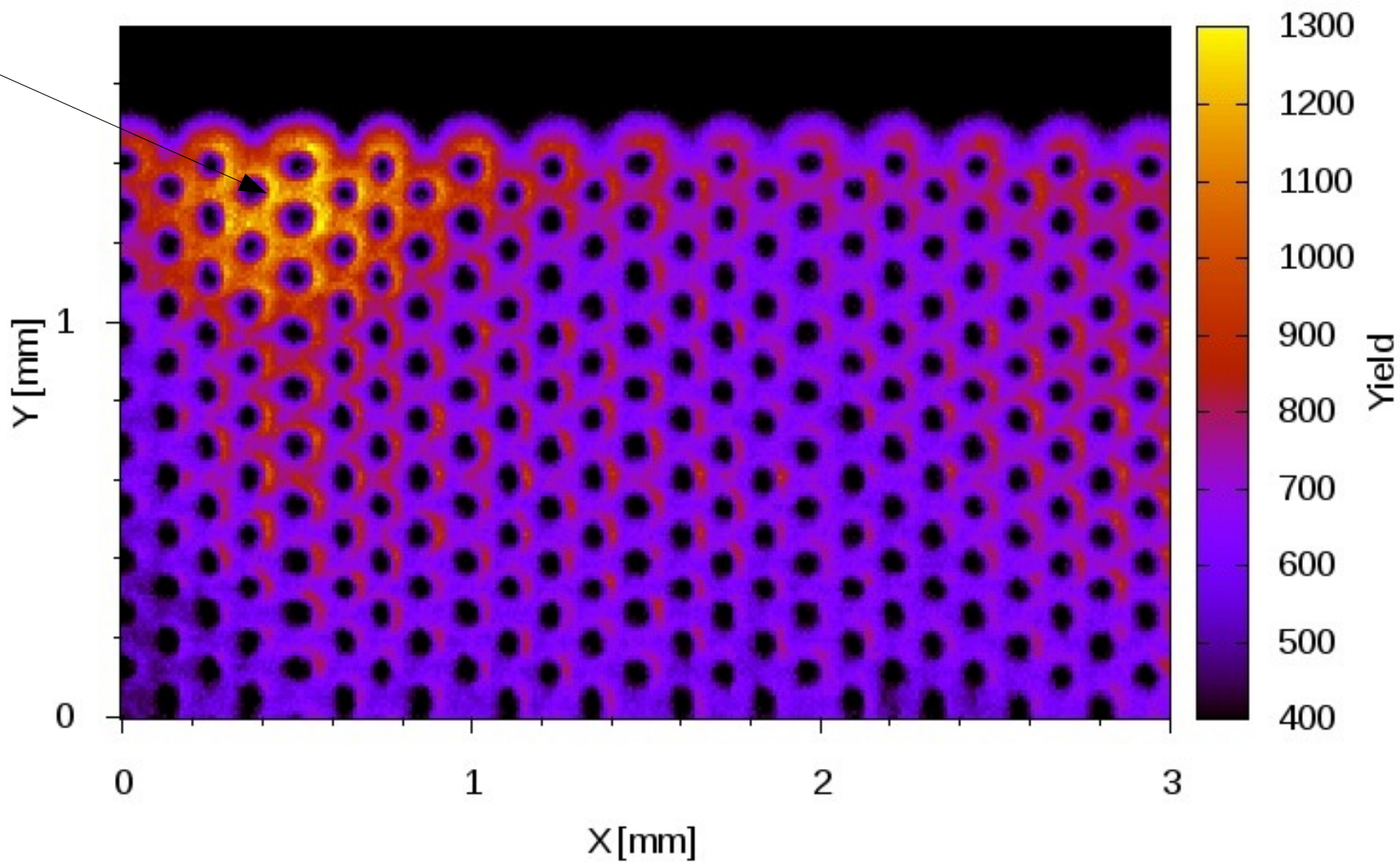
Edge of the GEM

- First checks on non-trivial structures
(would be nice to check around glitches)
Still need for optical check,
however by eye Rui's GEM was too good :)
- Examine area around the edge of the GEM foil
- Hole-level quantities (like for TGEMs) ?
- Thin metal band around the active hole-covered area

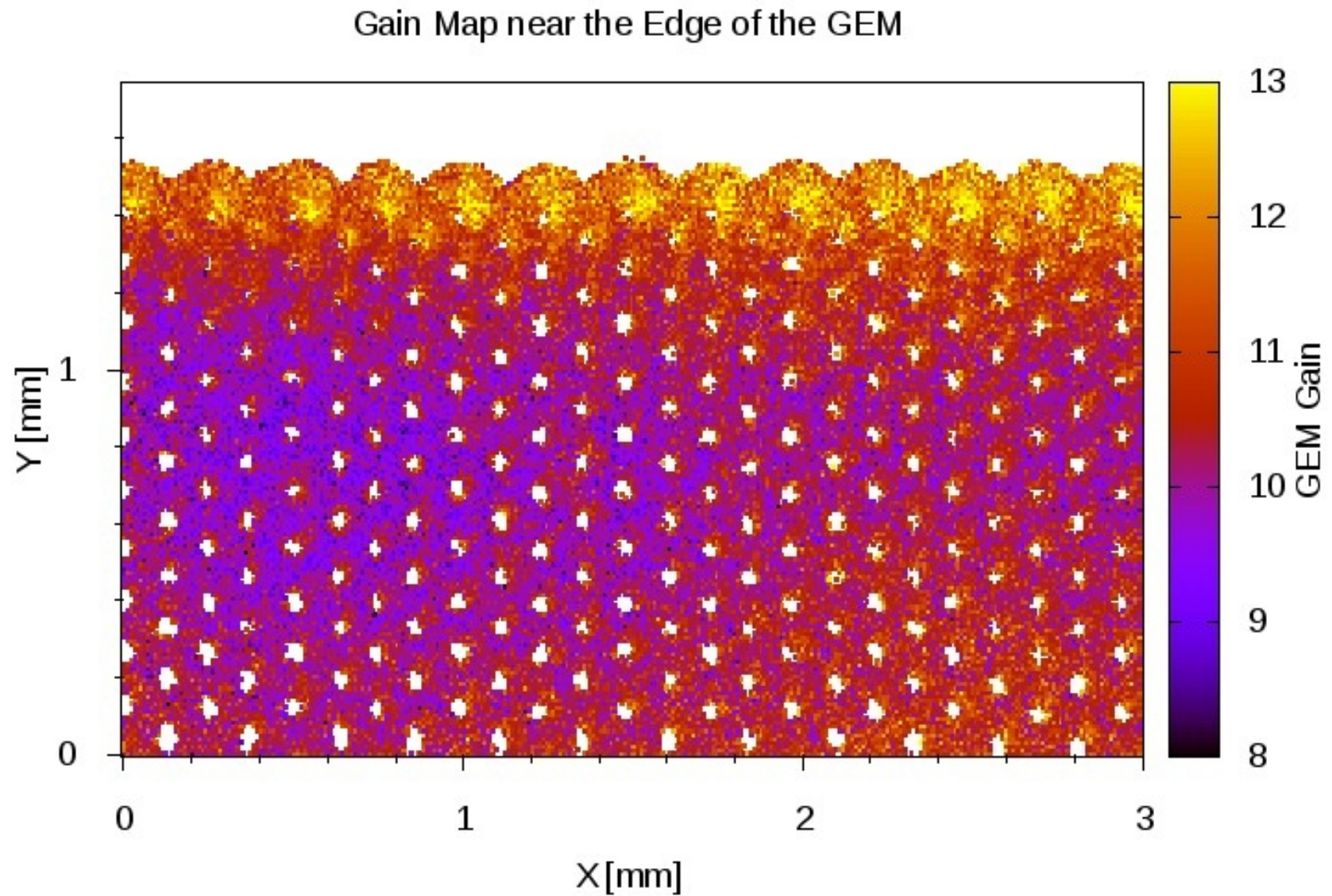
Edge of the GEM

PE Yield Map near the Edge of the GEM

charge up
effect

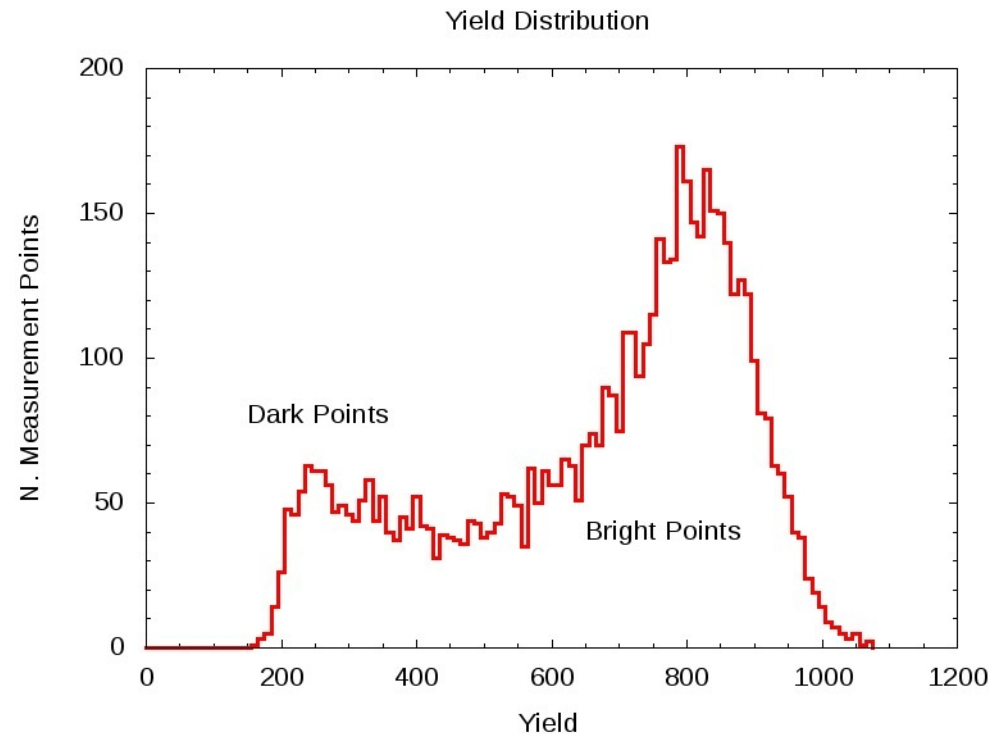


Edge of the GEM

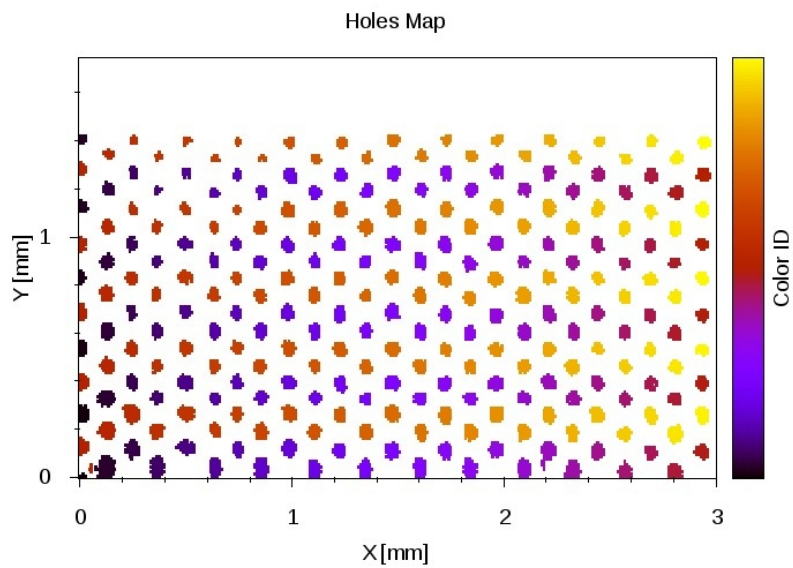
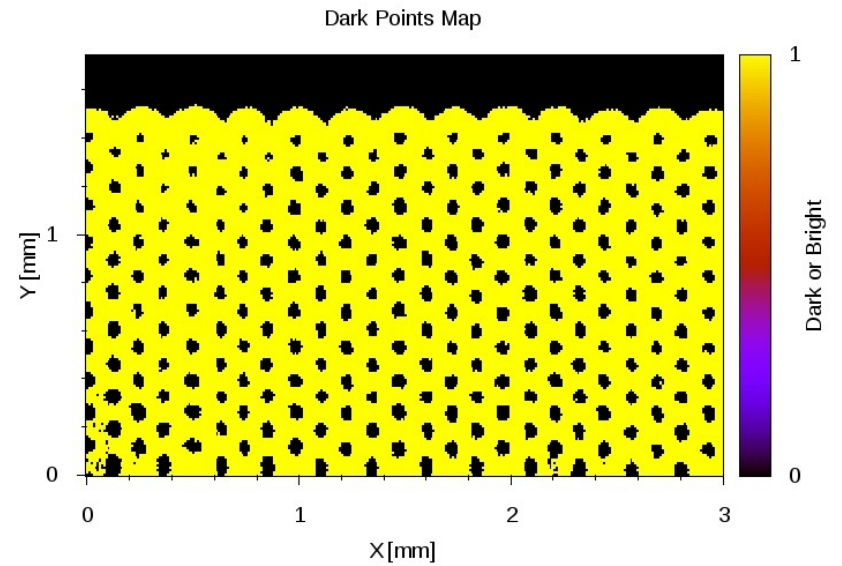
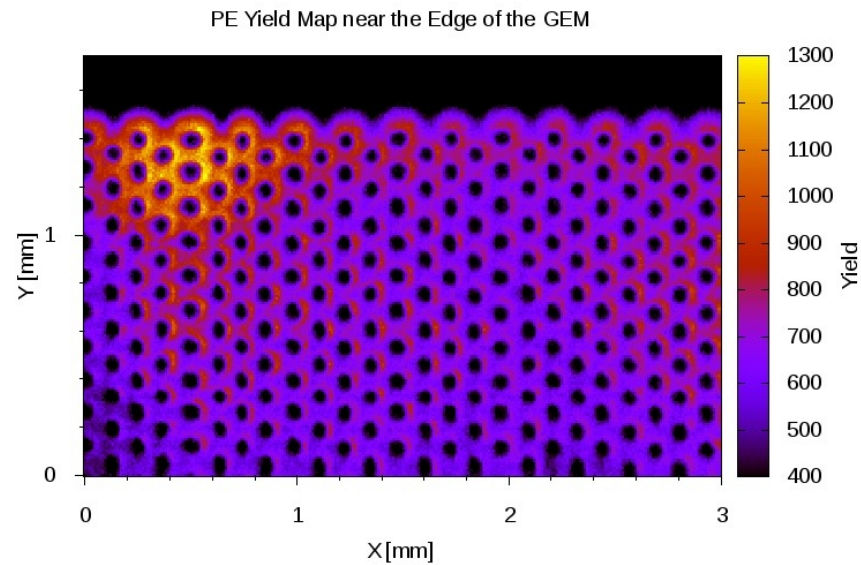


Defining Holes

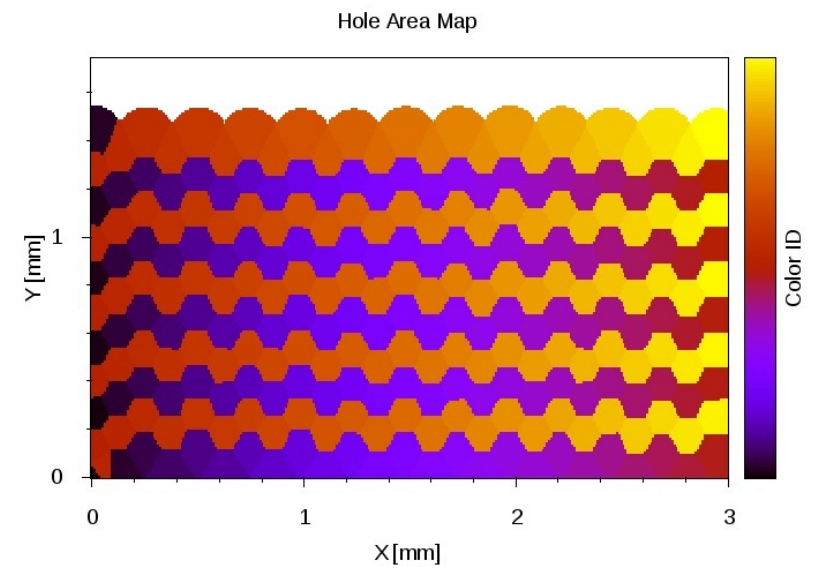
- Same methods as for TGEMs
- Define dark points
(dark yield is shifted due to non negligible background)
- Clusterize dark points (hole candidates)
- Define hole area
(closest point)
- Compute "hole-gain"
and/or other
hole-level quantities



Defining Holes



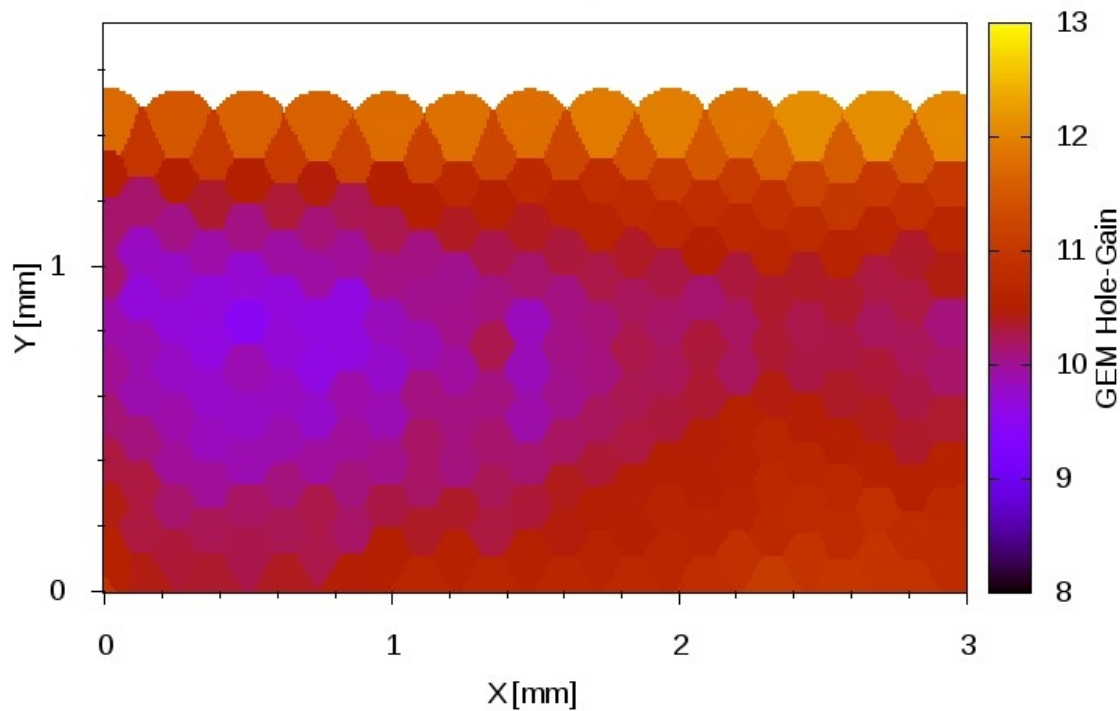
n GEM



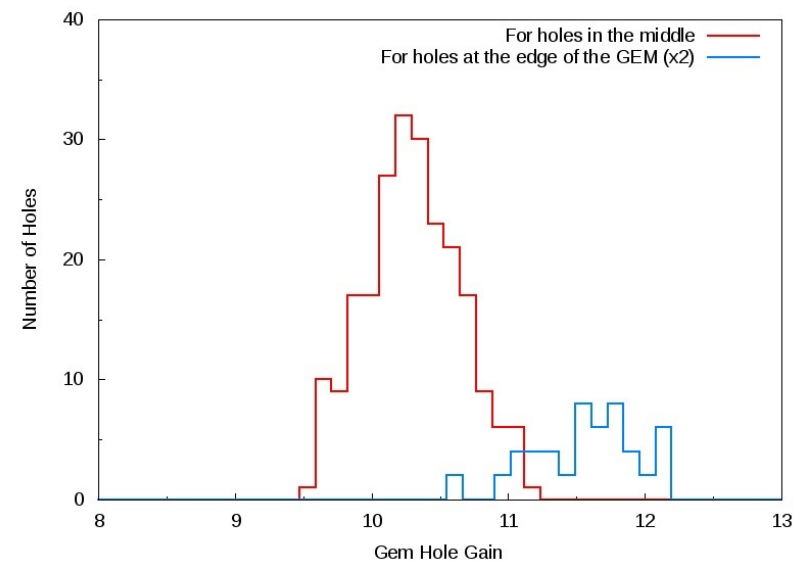
Hole-gain

- Hole-gain distribution : $\sigma < 5\%$ in the sample
- Larger gain along the edge
(higher surface charge on the metal border?)

Hole-Gain near the Edge of the GEM



Hole-Gain Distribution



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Summary

- Successful **Leopard** scan on **GEM foil**
 - Microstructure became visible
 - **Hole-level quantities** can be defined
 - Edge effect and critical points checked
-
- Correlate with optical inspection
 - Larger area scans
 - LargePitch / SmallPitch could be studied for operation, variations, Cherenkov applicability...
 - Ideas / tasks are welcome

