Micromegas R&D for muon imaging activities at Saclay

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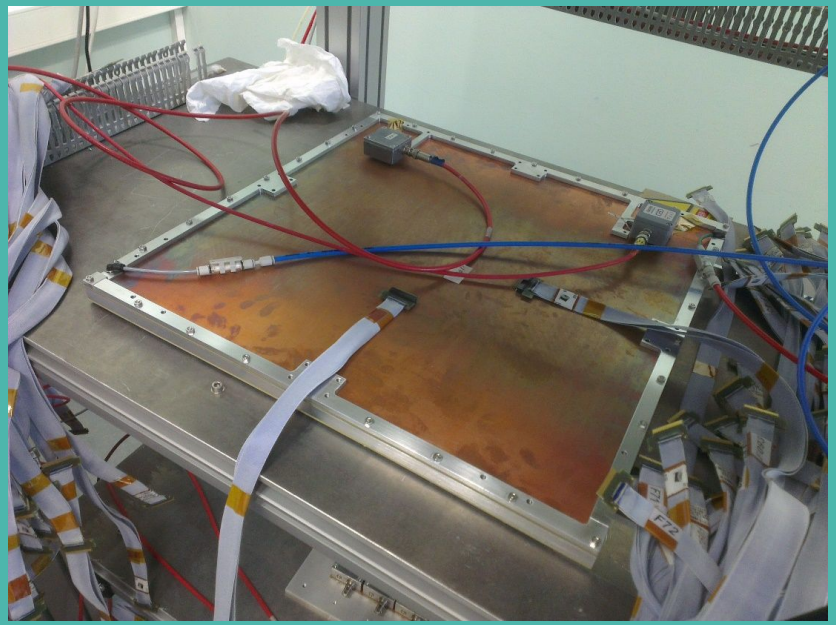
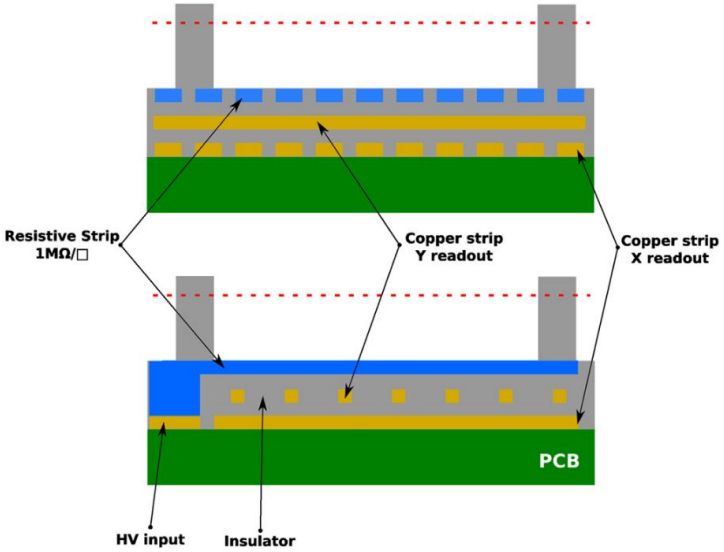
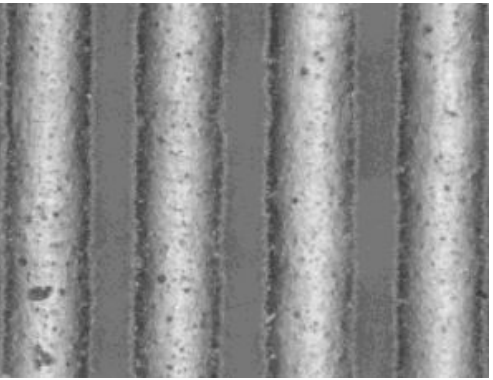
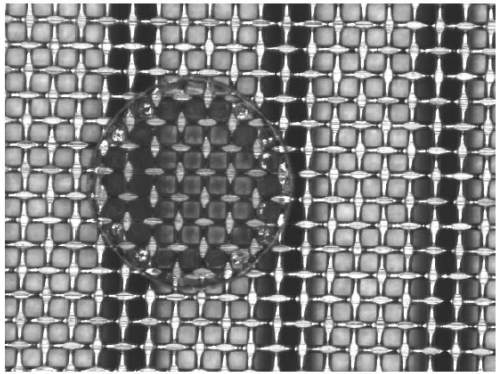
MicroMegas at Saclay



2D Readout bulked resistive Micromegas

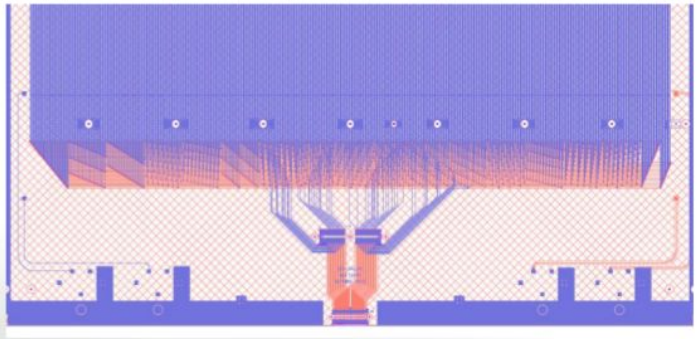






- 50 x 50 cm^2 active surface
- 3 strip layers
  - → resistive (X) (482μm pitch and 380μm strips)
  - → Y readout (482μm pitch and 100μm strips)
  - → X readout (482μm pitch and 380μm strips)
- Bulk technology
- Resistive ink spread on PCB
  - → Serigraphic process
  - → Integrated resistivity ~ few hundred of kΩ

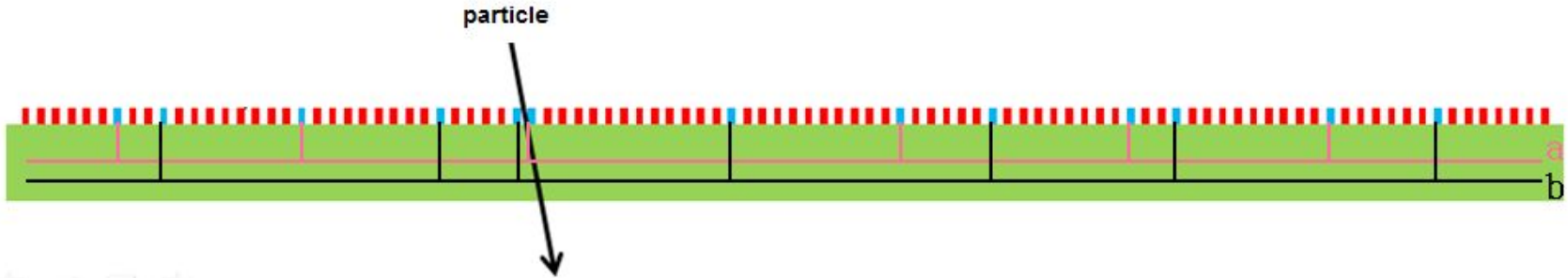
Genetic multiplexing



Multiplexing layout

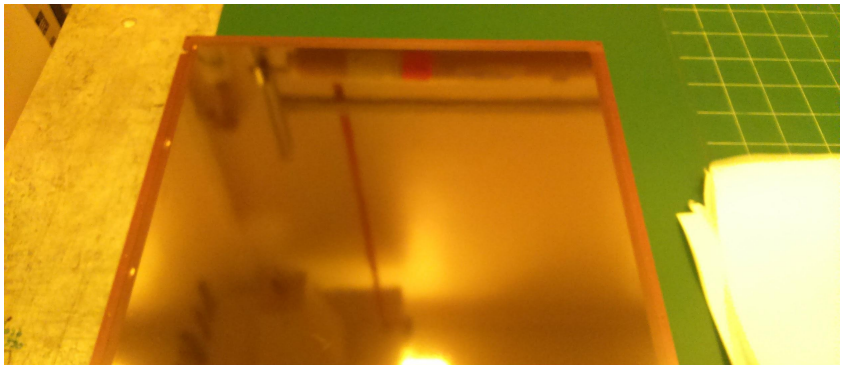
Reduction of costs and simplified electronic output

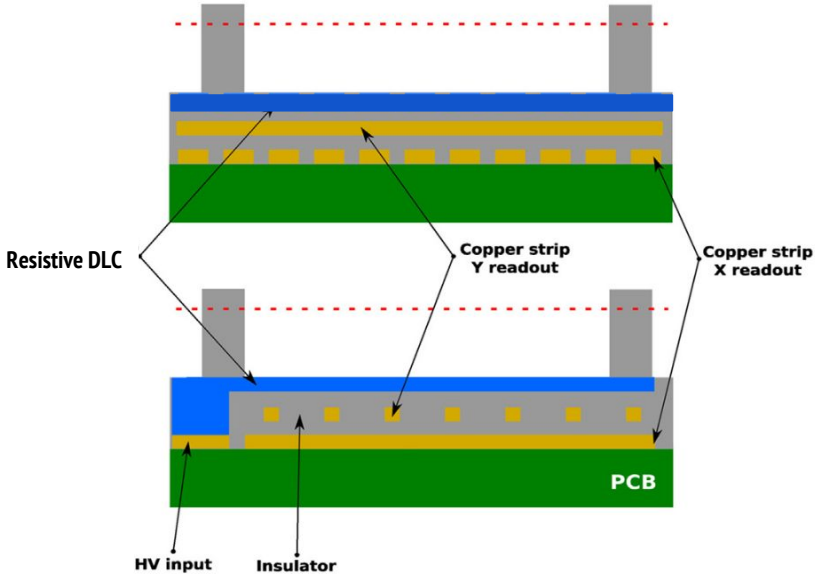
- 1037 strips read by 61 channels (reduction factor 17)
- Doublet of channel are connected to a unique doublet of consecutive strips
- Use signal spread over strips
- Multiplexing factor is adjustable w.r.t. flux inside the detector



Micromegas R&D

Diamond Like Carbon (DLC) Micromegas

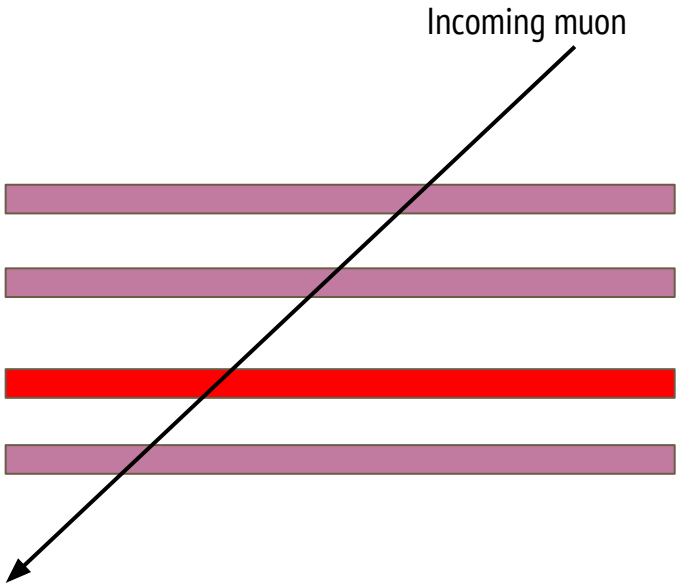




- 50 x 50 cm^2 active surface
- Resistive DLC
  - → Chemical deposition technique
  - → No alignement needed
  - → More homogeneous than strips
  - → Pressed and glued by Rui de Oliveira at CERN
  - → Bulked at Saclay
- Integrated resistivity ~ 50MΩ
  - → higher than resistive strips
  - → Clusters' size are expected to be equal in X/Y readout

Characterization of DLC Micromegas

Experimental set up (1)

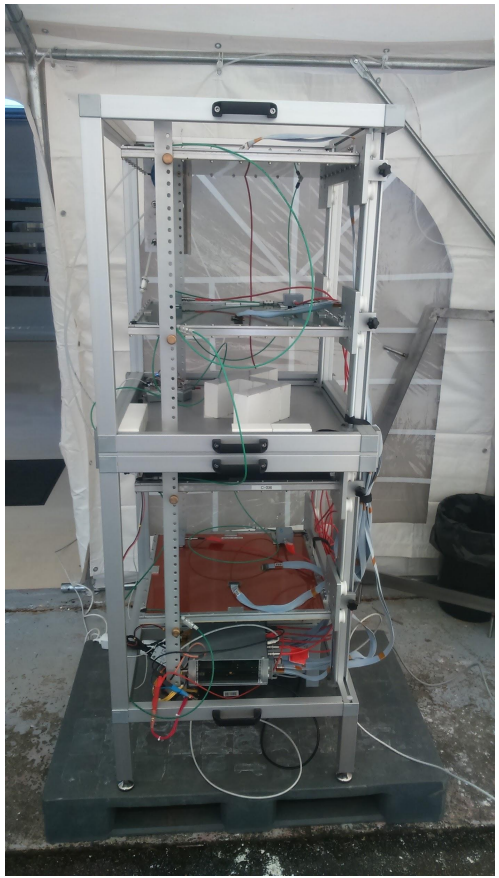


DLC S041

DLC Micromegas

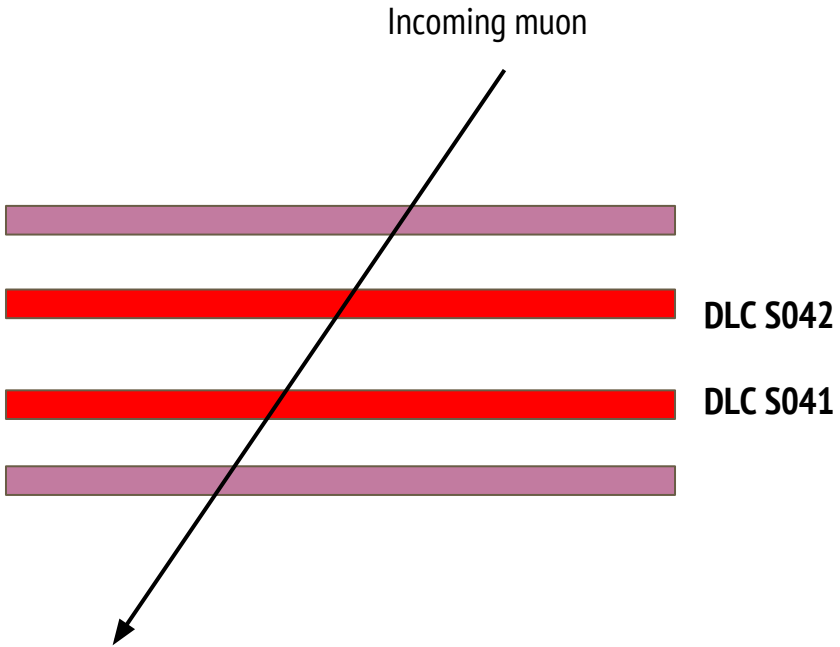
Serigraphic Micromegas

DLC characterised in TomoMu

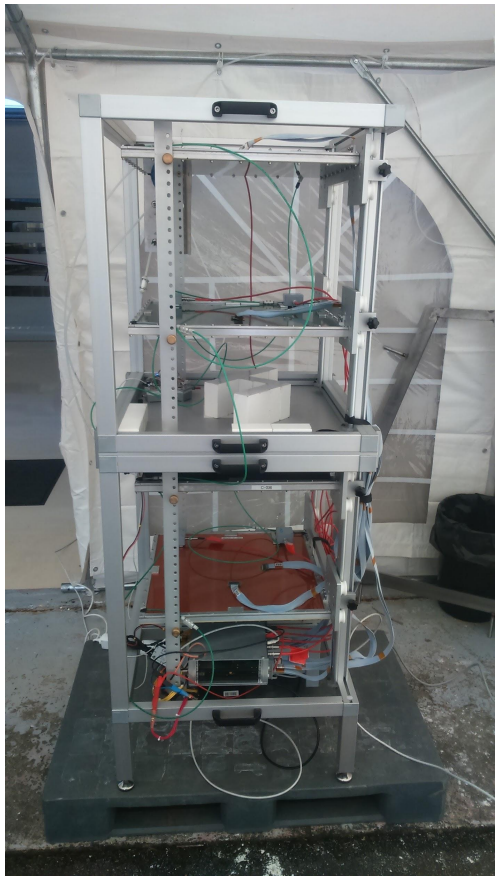


Characterization of DLC Micromegas

Experimental set up (2)

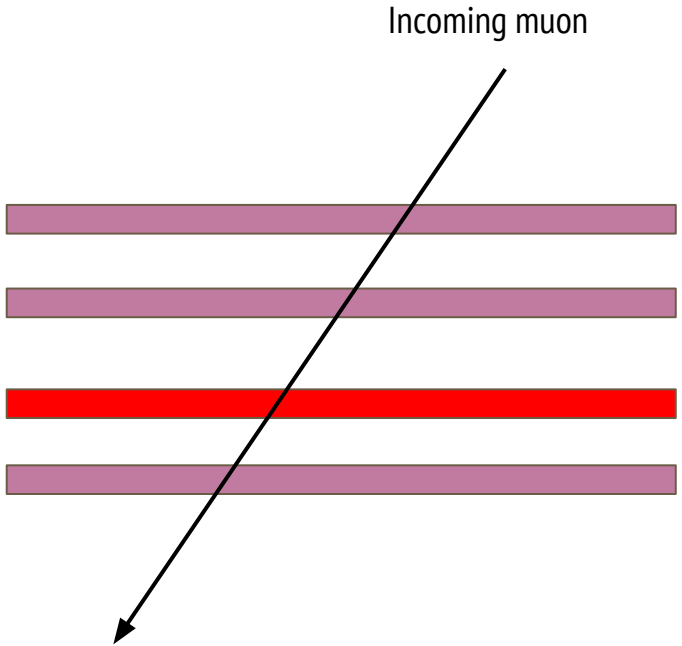


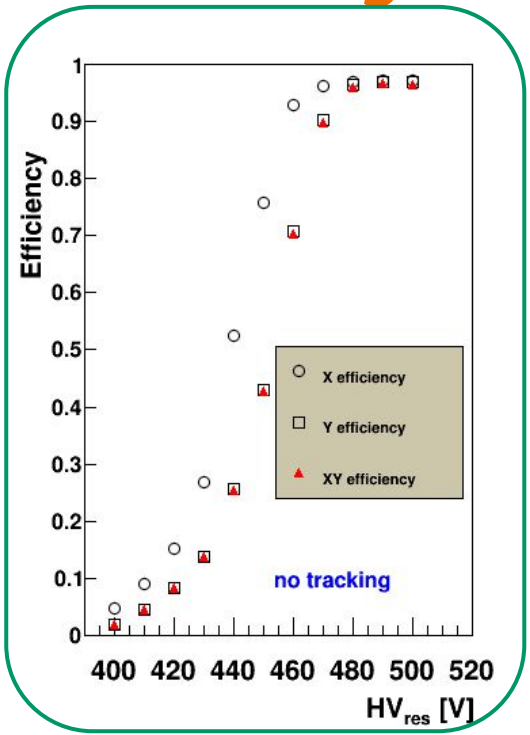
DLC characterised in TomoMu

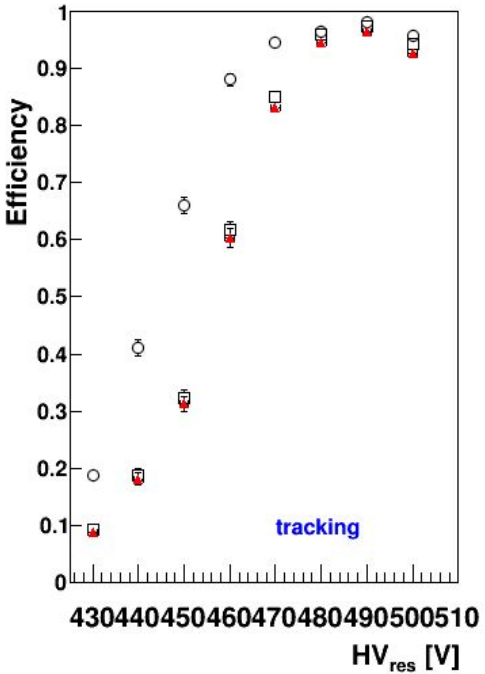


Characterization of DLC Micromegas

Efficiency plateau







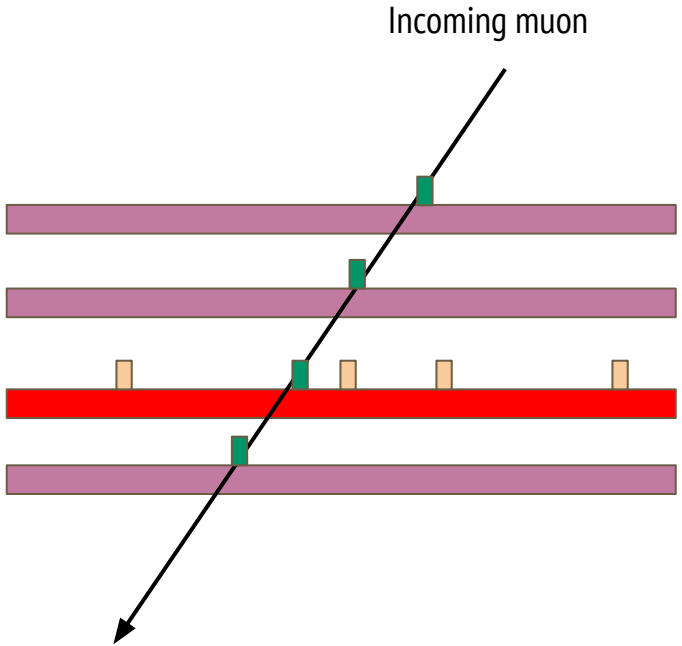
Nb of events on the DLC / Total nb of events

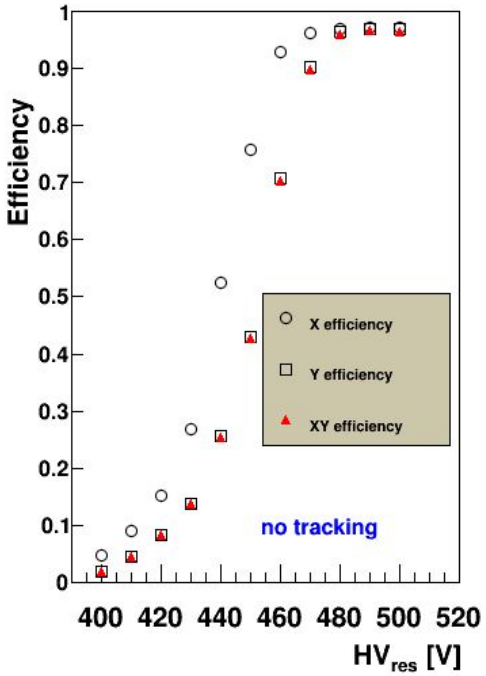
DLC Micromegas

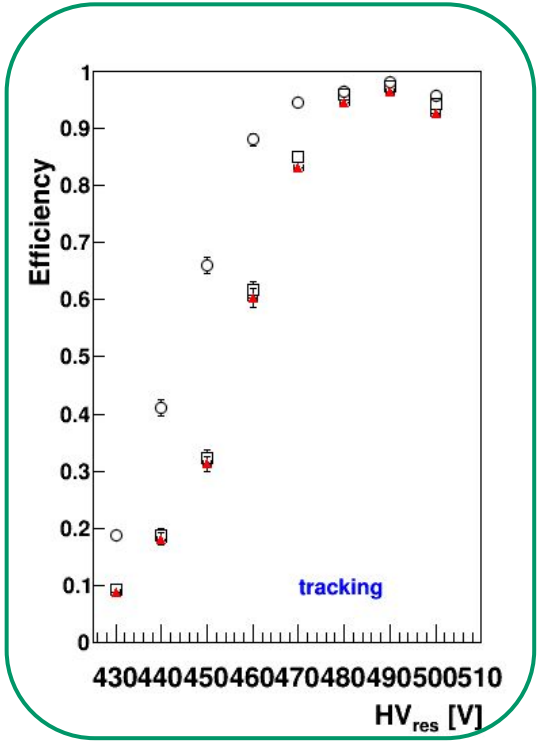
Serigraphic Micromegas

Characterization of DLC Micromegas

Efficiency plateau







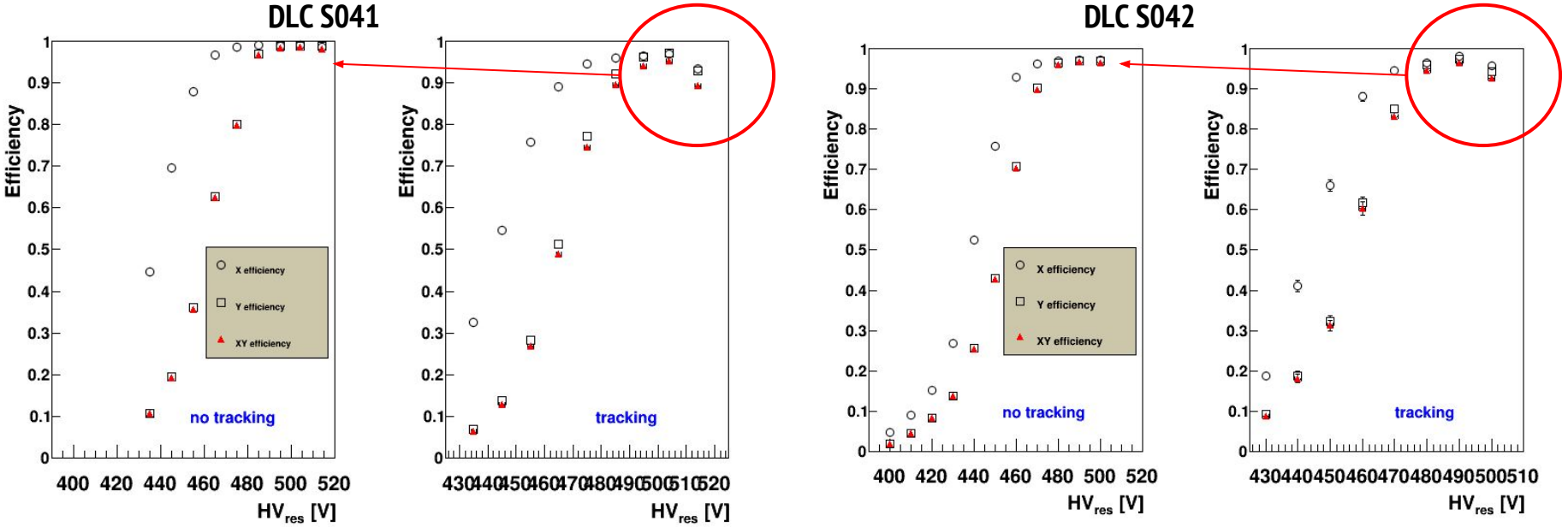
Nb of well reconstructed events on the DLC (Cluster near the reconstructed track)/ Total nb of reconstructed events

DLC Micromegas

Serigraphic Micromegas

Characterization of DLC Micromegas

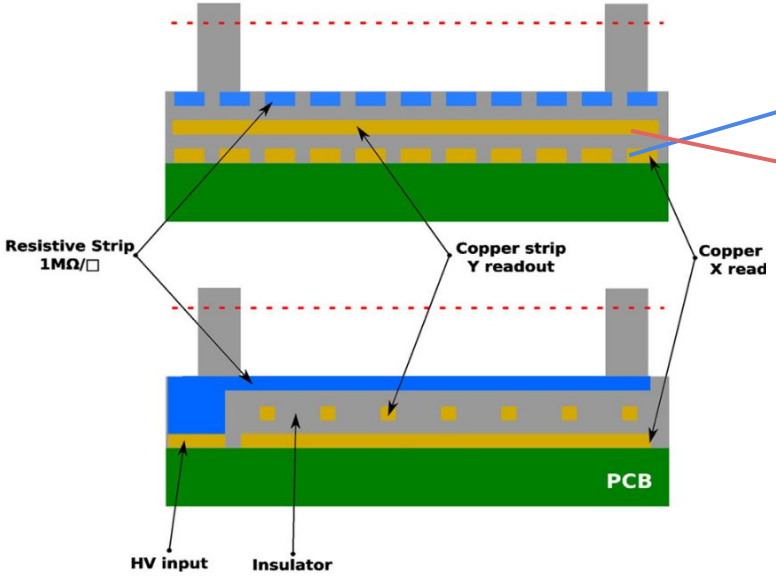
Efficiency plateau (gas Ar:95 iC_4H_{10}:5)

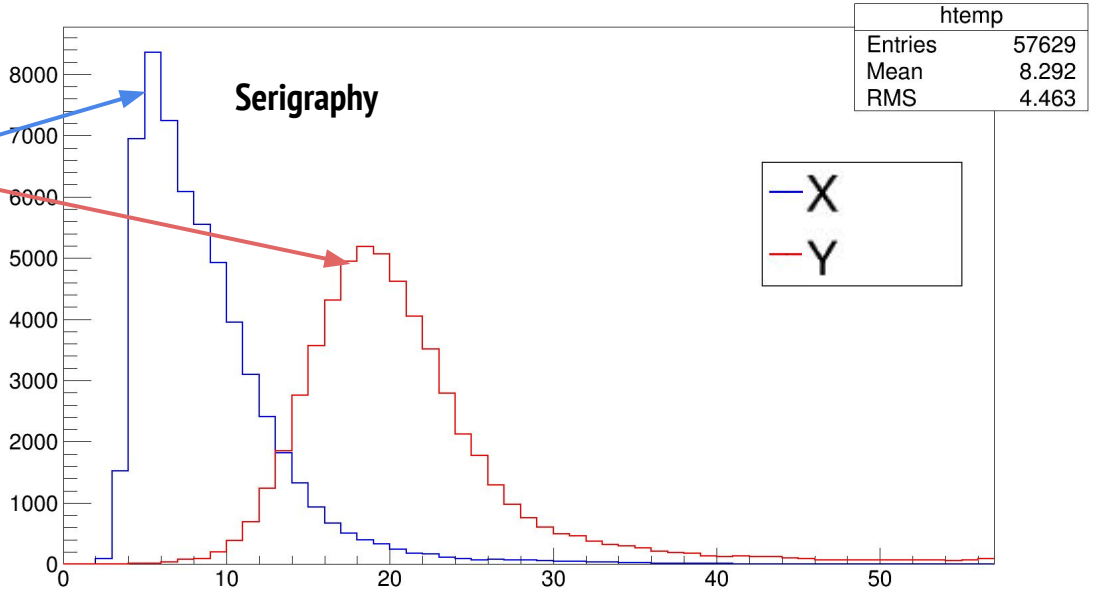


Observable differences between tracking and no tracking efficiency plateau -> Need more investigations

Characterization of DLC Micromegas

Cluster size distribution

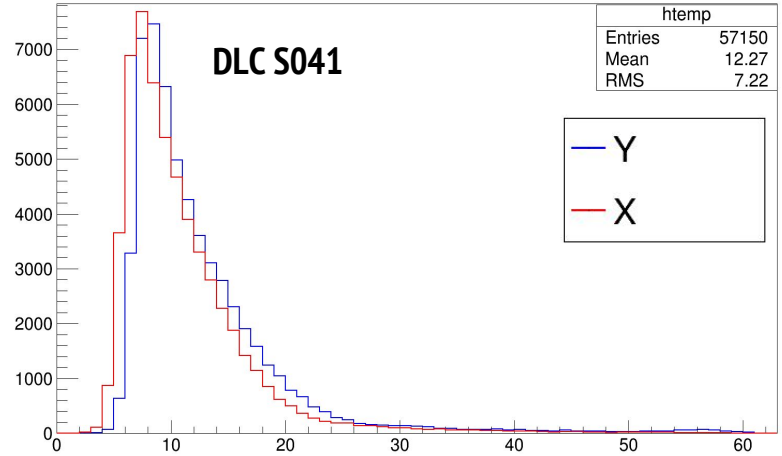


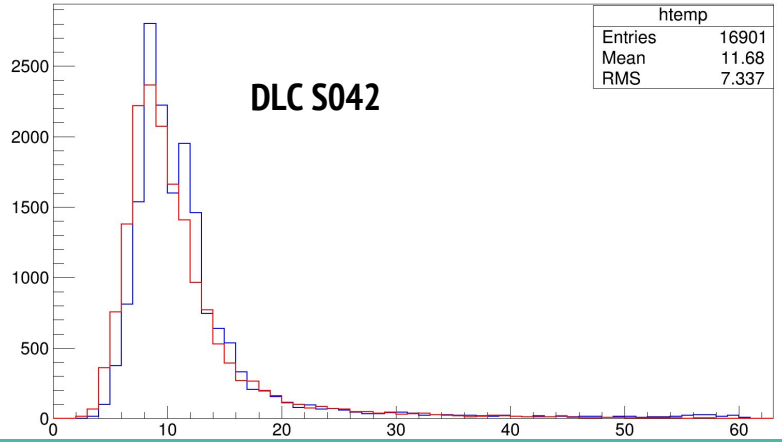


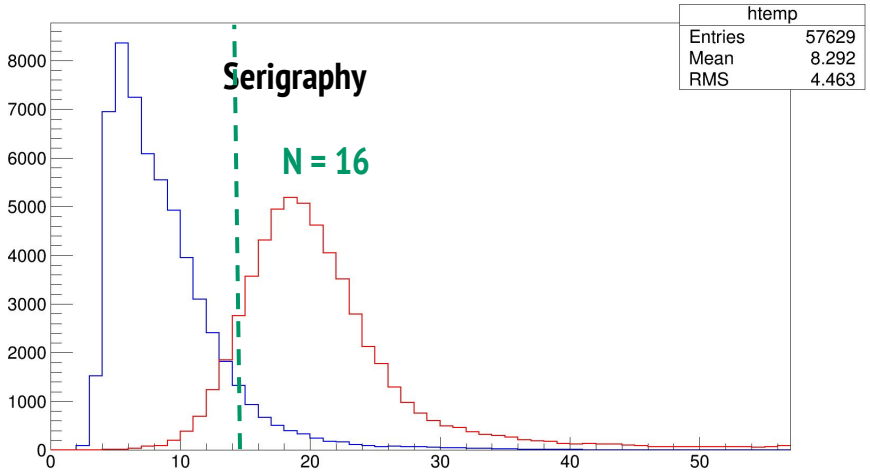
- Increasing of clusters' size due to the position of Y strips (Charge collection along the resistive strips)

Characterization of DLC Micromegas

Cluster size distribution





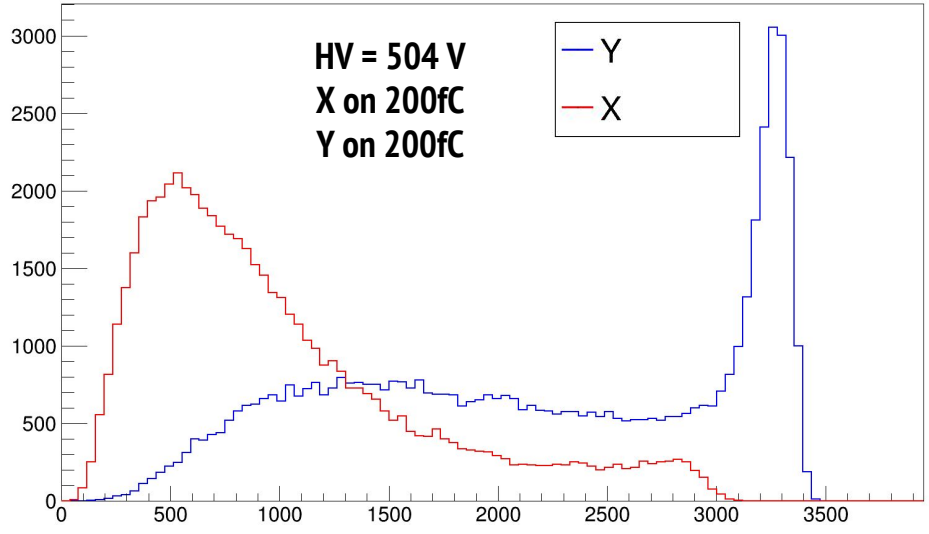


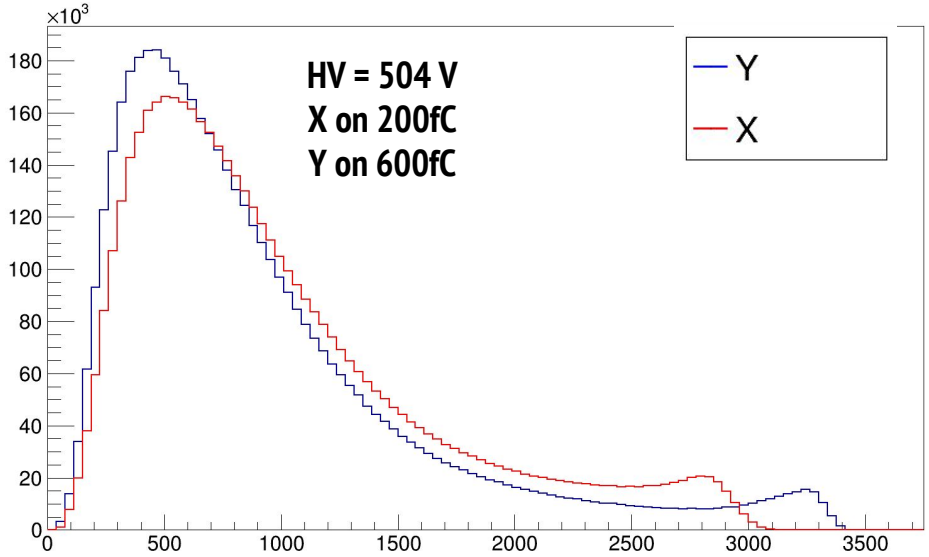
- For cluster size >16
  - → Ambiguities can appear
  - → Spatial resolution degraded
  - → Need to improve X coordinate

- Higher resistivity for DLC + no strips structure
  - → Less spreading
  - → DLC Clusters' size are equal in X/Y

Characterization of DLC Micromegas

Amplitude distribution S041

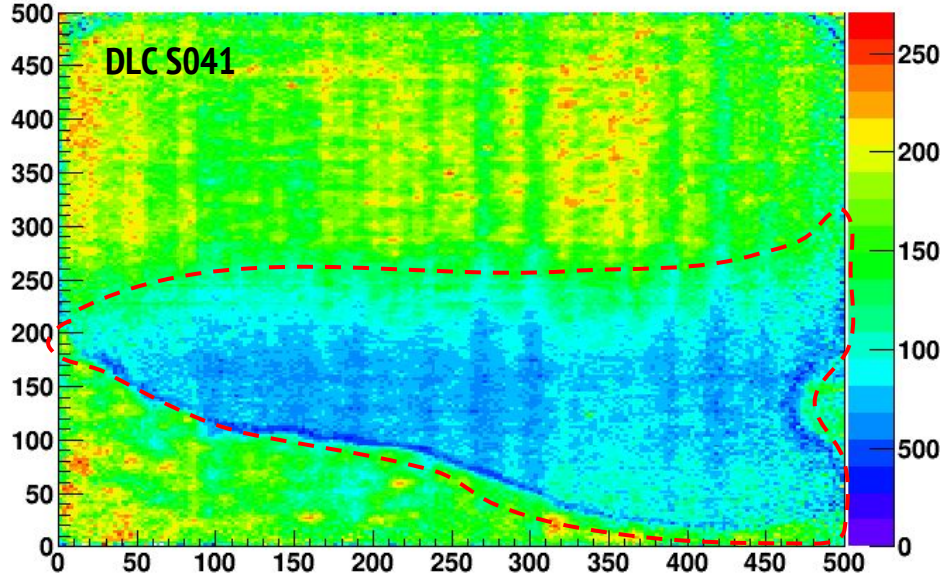




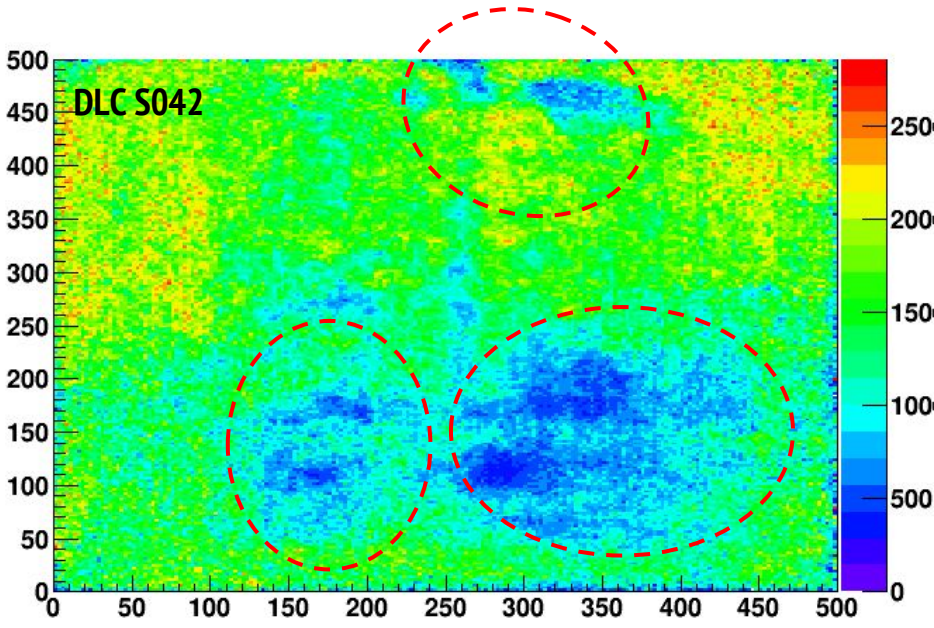
- Charge mostly received by upper strips
  → Factor 3 between Y (up) and X (down) strips

Characterization of DLC Micromegas

2D Map of amplitude



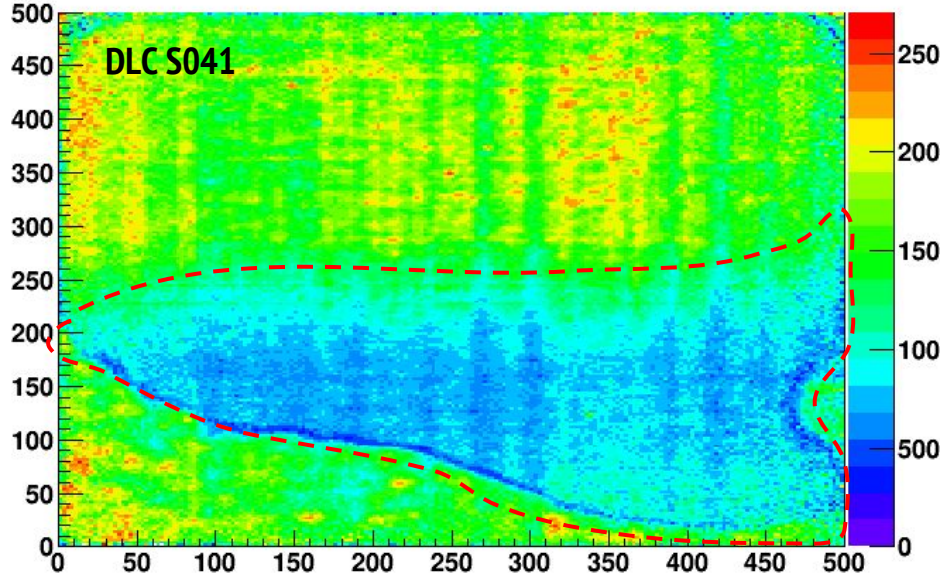
- Problem during bulk process
  - → Unstuck pillars zone
- Nevertheless, the unstuck zone is still efficient when the HV increases



- No problem with pillars
- Inhomogeneous zone of gain
- Problem during cleaning process
  - → Development bath
  - → Remnant of photoresist film

Characterization of DLC Micromegas

2D Map of amplitude



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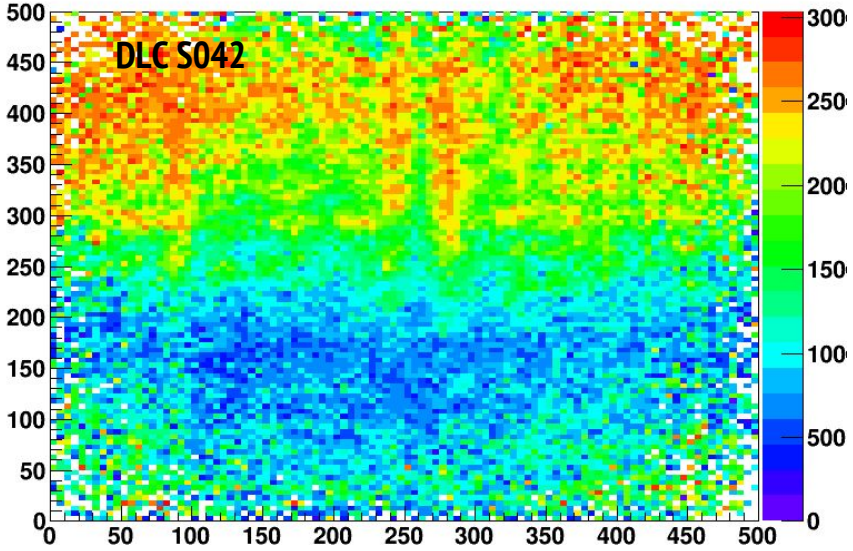
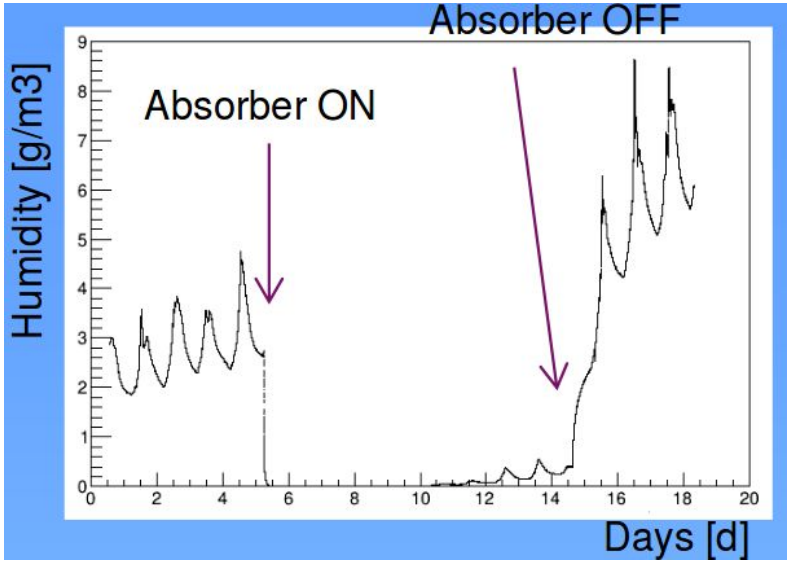


- Still Inhomogeneous zone of gain after alcool + karcher

- Deposit of photoresist film ?(change of mesh color observed)

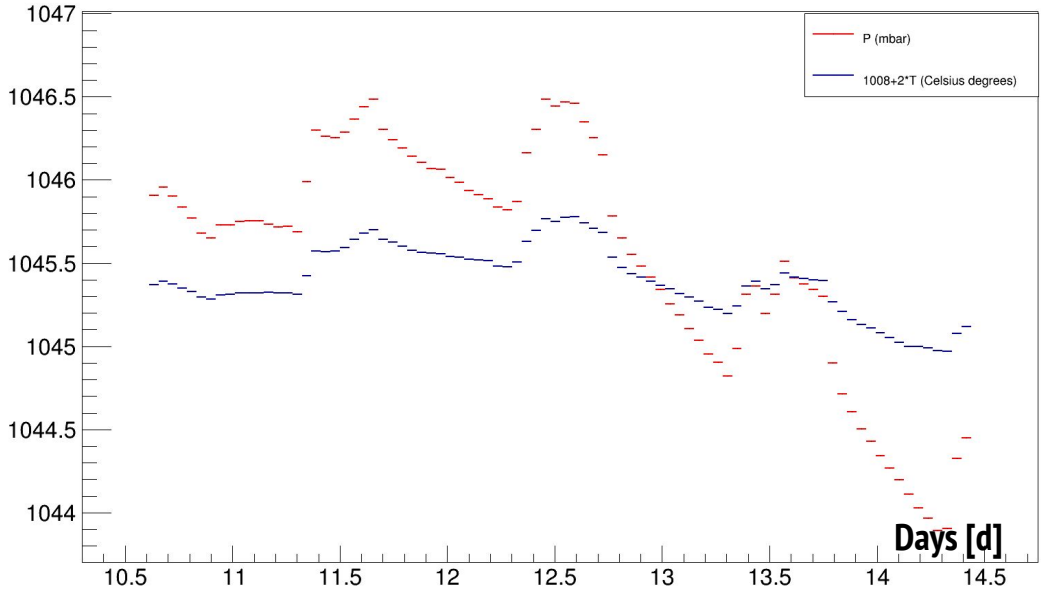
Gas R&D

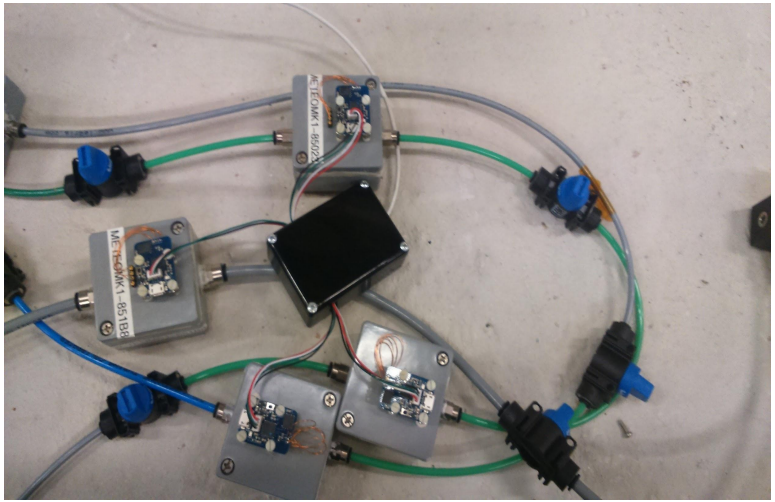
Problem of outgassing



- PCB outgassing issue
  - ➞ Humidity + gaseous pollutant through the outgassing of PCB
  - ➞ Degradation of gas : Recirculation + purification system
  - ➞ To be tested : Heated process for PCB (à la HARPO) or protected PCB with varnish
  - ➞ New vacuum chamber to make tests

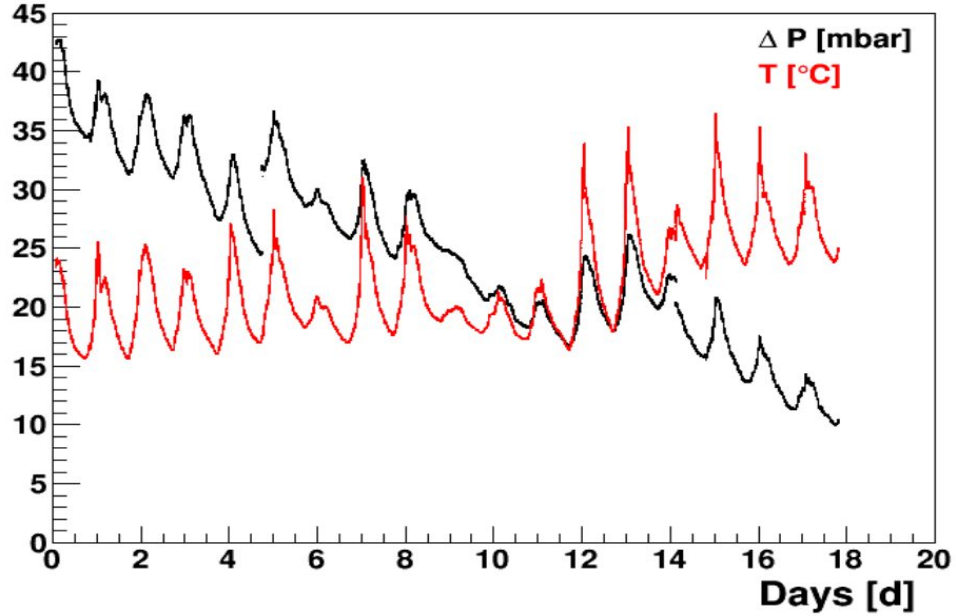
Reducing gas leaking (sensors' box)

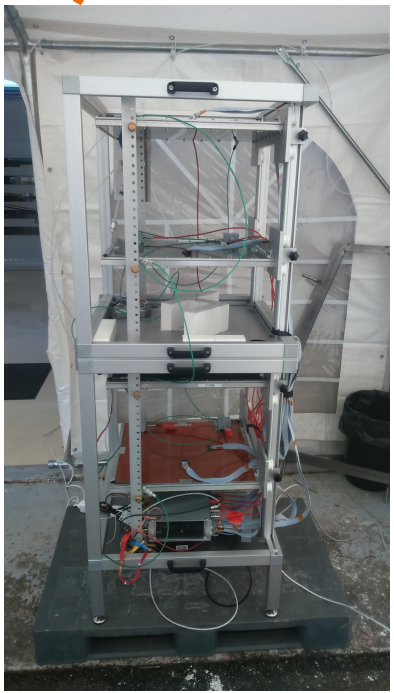




- Test of valves + flexible pipes + boxes containing H/P/T sensors
  - → 7 sensors, each in independent box
  - → 14 days of data taking (not continuously)
  - → Volume = 5*5*2.5 = 62.5cm^3
  - → Overpressure = 50 mbar
  - → Leak = 9.3 10^{-4} mL/h < 1 μL/h

Reducing gas leaking (detector)





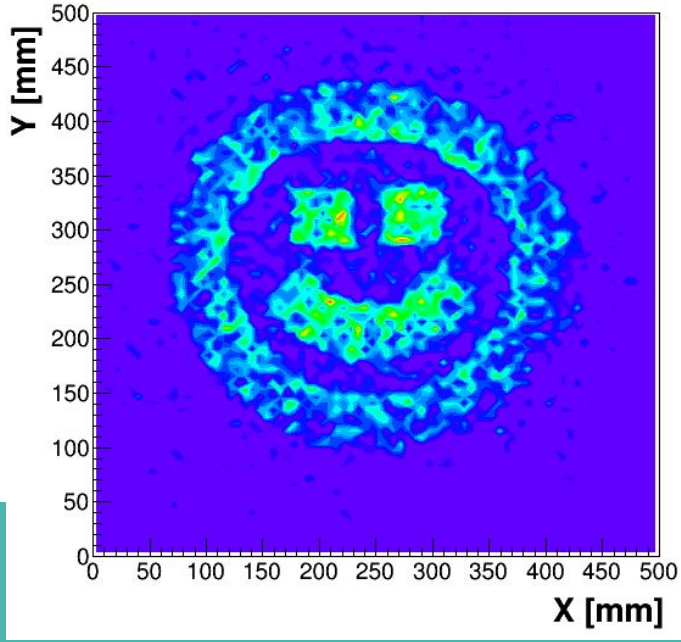
- Best detectors = 0.3ml/h
- Idea : Sealed detector to reduce drastically the leak of gas
- Need to controle T
- Electronic control of gas consumption (2 to 3 times less)

Recap

- **More R&D on DLC**
  - → Understand the inefficiency zones which appeared on the DLC (glue, remnant of photoresist ?)
  - → Choose between two technologies (serigraphy or DLC)
  - → Make sure the spatial and time resolution are improved to plan μTPC algorithm

- **Prospectives**
  - → Build 4 layers telescope with reduced gas leaking + electronic gas management
  - → Build 4 layers telescope in a sealed mode (eg: geophysics applications), after outgassing R&D

THANKS



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