DE LA RECHERCHE À L'INDUSTRIE

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LABO BULK : MICROMEGAS PRODUCTION AT SACLAY

RD51 – JUNE 2023

Irfu - CEA Saclay
Institut de recherche sur les lois fondamentales de l'Univers

www.cea.fr

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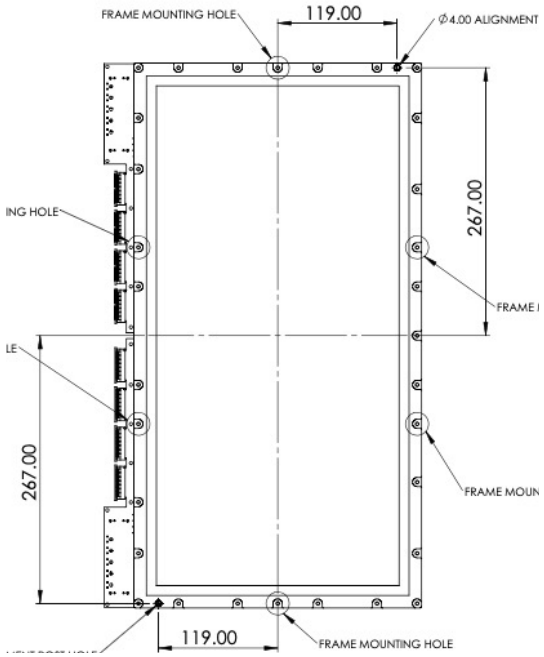
- News and Management
- Spring 2022 – TPOT for sPhenix
- Spring 2023 – RD4 prototypes
- Next steps



LABO BULK AT SACLAY

CEA Saclay MPGD production site

- 100 sq m of clean room
- Screen printing machine for resistive layer
- Machine for bulk process (lamination, insolation, etc …)

- PCB and mecanical CAD on site
- Full mecanical workshop + 3D printers

New team to replace Stephan Aune (chef ing.) and Mariam Kebberi (Chef Tech.)

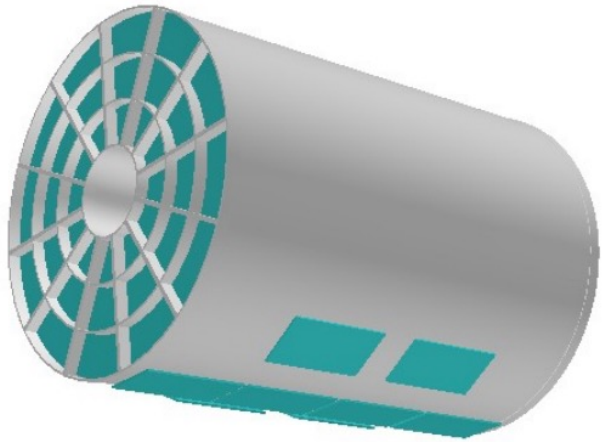
First production with TPOT and RD4

=> A lot to relearn !

TPOT : MICROMEGAS FOR SPHENIX

TPOT : 10 Modules, (20 micromegas) to be produced and tested in 6 months

1 TPOT module is two 1D Micromegas layers (rΦ and Z)
- Design is simple
- 3mm drift
- No R&D on 2D resistive necessary



Resistive layer with strips
- Necessary with heavy ions environment
- Occupancy is high, strips limit cluster size
- Division in 4 HV sectors for reliability (no access after installation)

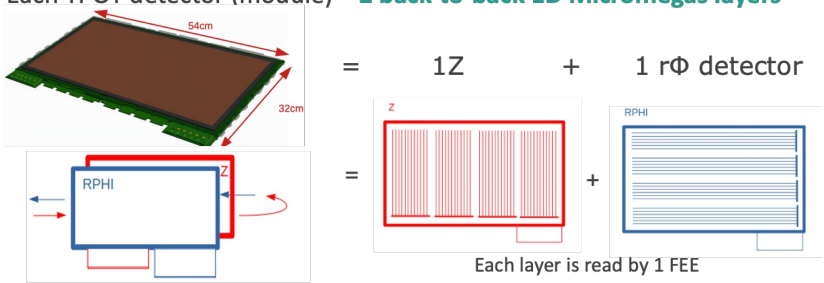
Reuse of TPC services
- **SAMPA FEE** + cooling

Z Pitch is 2mm, rΦ pitch is 1mm
- Each layer is read by 1 FEE
- Straight strips for simplicity and low capacitance

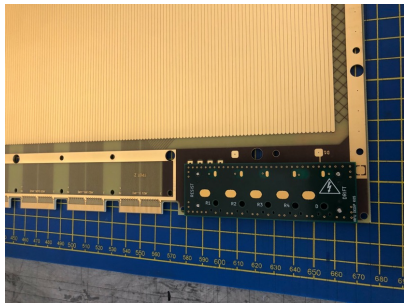
No soldering design
- Mec8 connectors on side of PCB (1.6mm thickness)
- HV card with FSI connectors
- Drift connections through springs in frame

DETECTOR CONFIGURATION

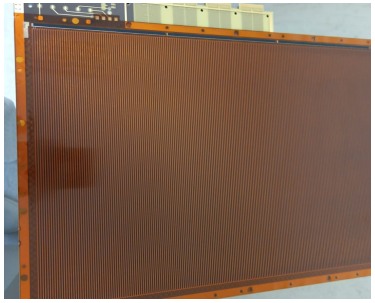
Each TPOT detector (module) = **2 back-to-back 1D Micromegas layers**



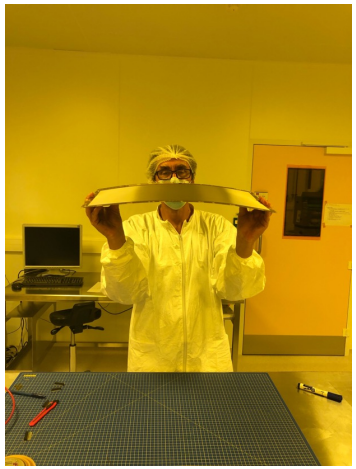
First Prototype



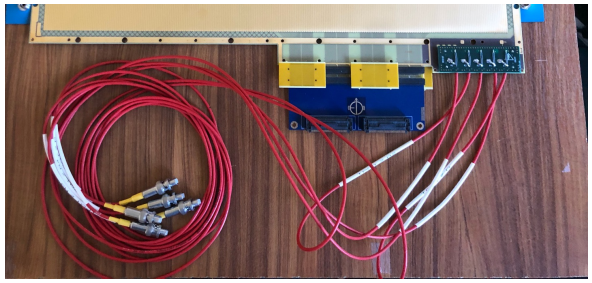
PCB at Saclay

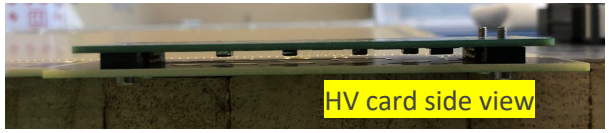


Resistive foil pressed on PCB

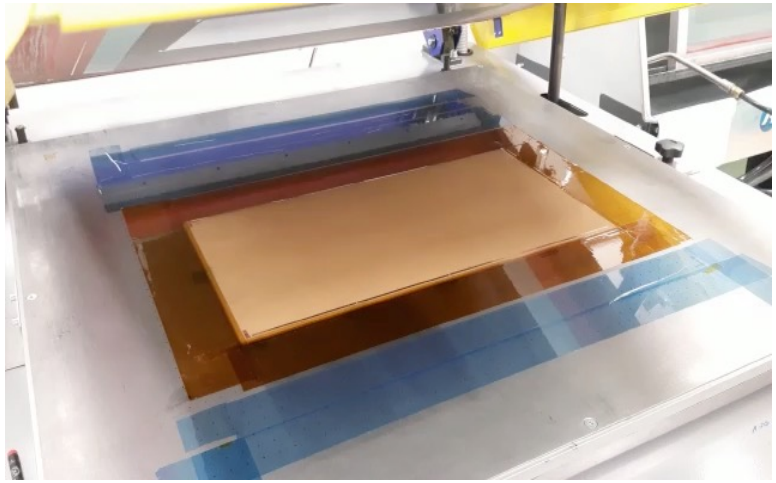


First test process

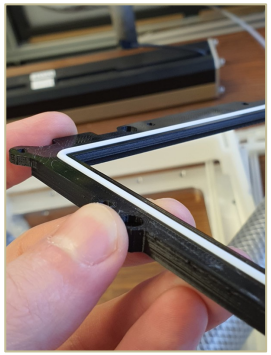




HV card with HV filter on FSI contact connector



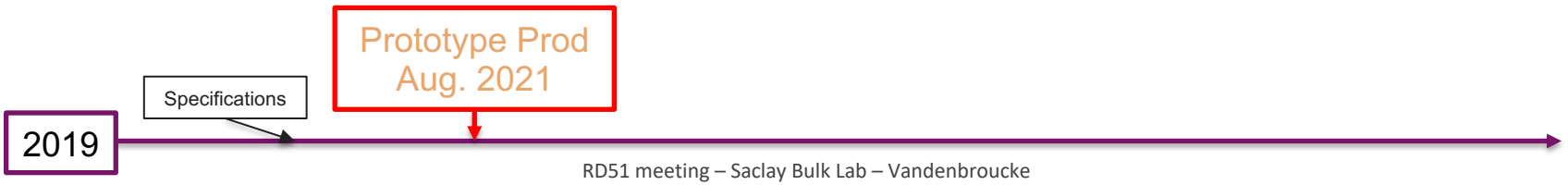
Printing resistive strips at Saclay



3D printed frame

Frist carbon drift

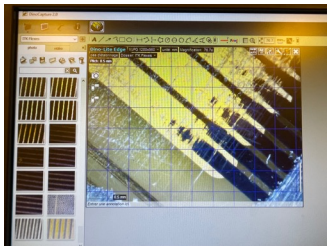
Frist carbon drift + happy Cyril

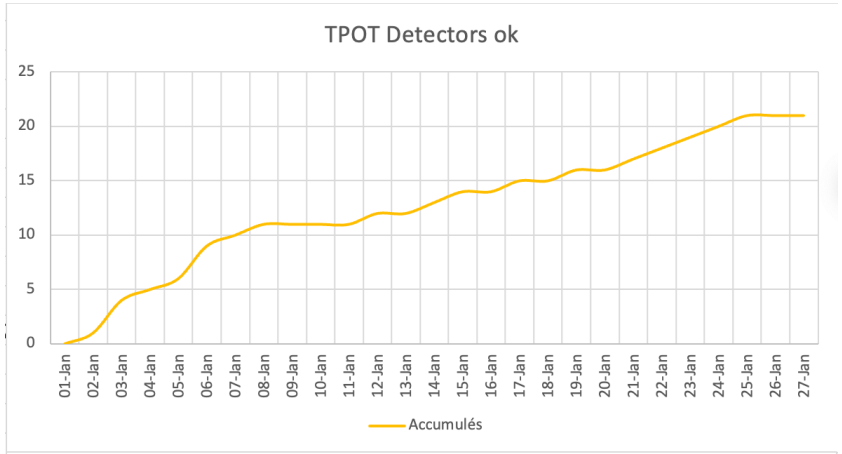


PROCESS PRODUCTION - YIELD

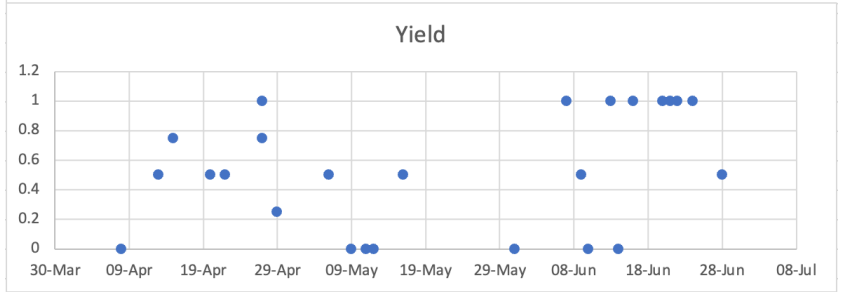
Improvement to fix the poor yield :

- Systematic long HV test
- Debulking
- Resistive layer removal
- Pressing on good press at CERN (thx Rui !)
- Missing pillars on design fixed during production

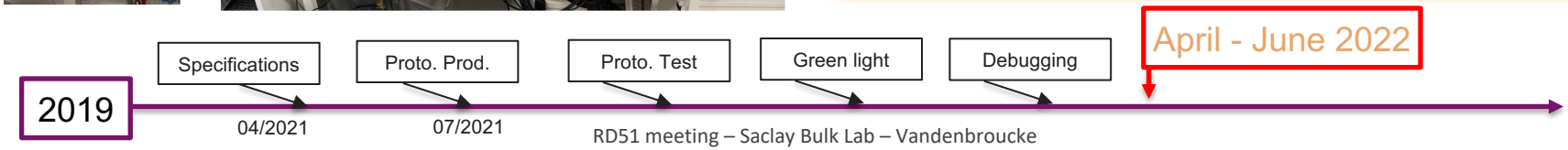




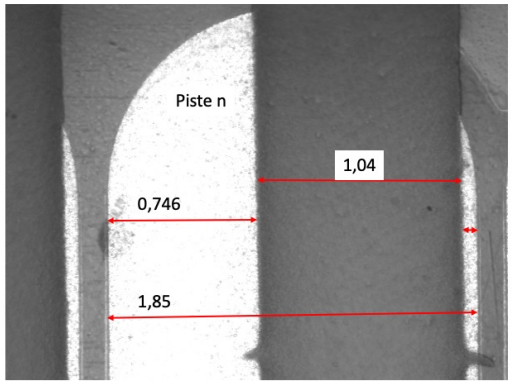
HV station with 48 HV channels + monitoring developed for NSW



+> at the end we had ~90% success on the first try

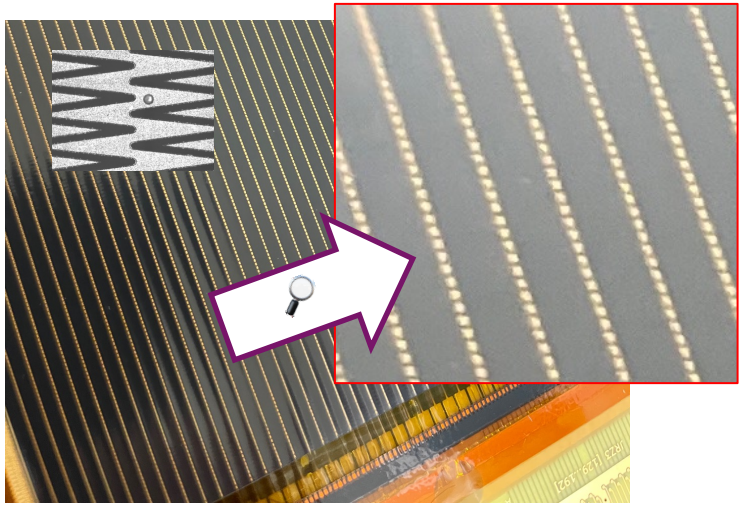


TPOT RESISTIVE STRIPS



+> Prototype to test resistive layer :

- Efficiency OK 98%
- Zigzag strips too high in resistivity
- Resolution pitch dependent : ~**650um** for 0.5mm res. pitch



Large resistive strips over zigzag strips

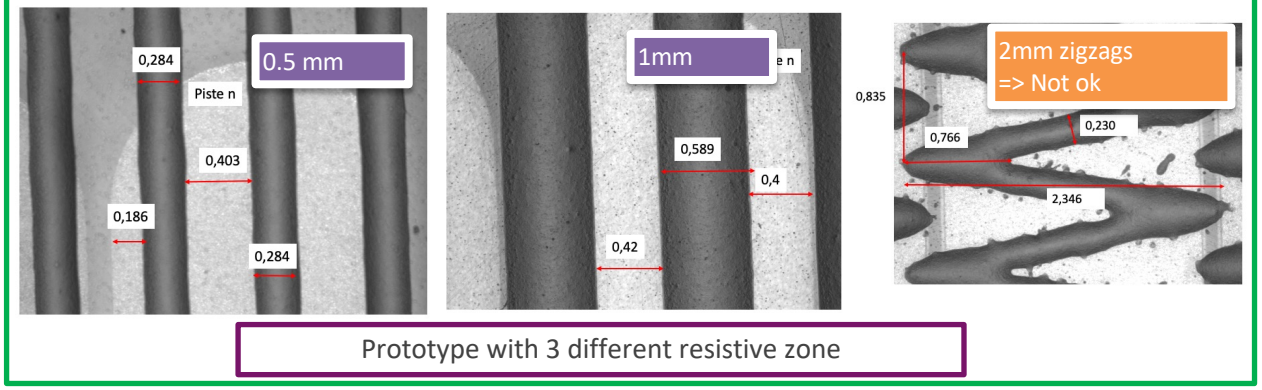
02/2022 : New TPOT Z Zigzag (ZZZ)

- Zigzag from LDRD program

⇒**Efficiency OK 98%**

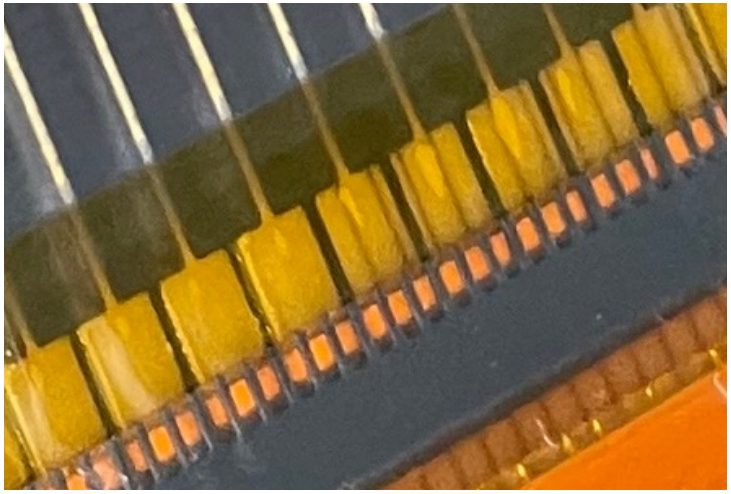
⇒**Resolution ~650µm**

Z (2mm) Resolution issue



Prototype with 3 different resistive zone

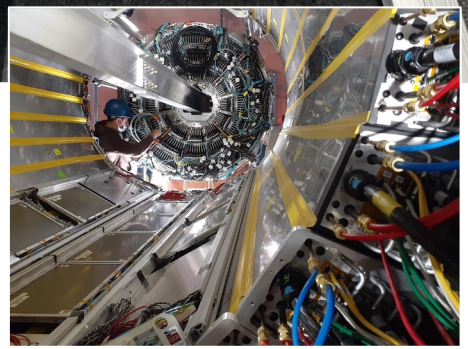
+> Resistive strips need to be the smallest possible (no resolution within a strip)



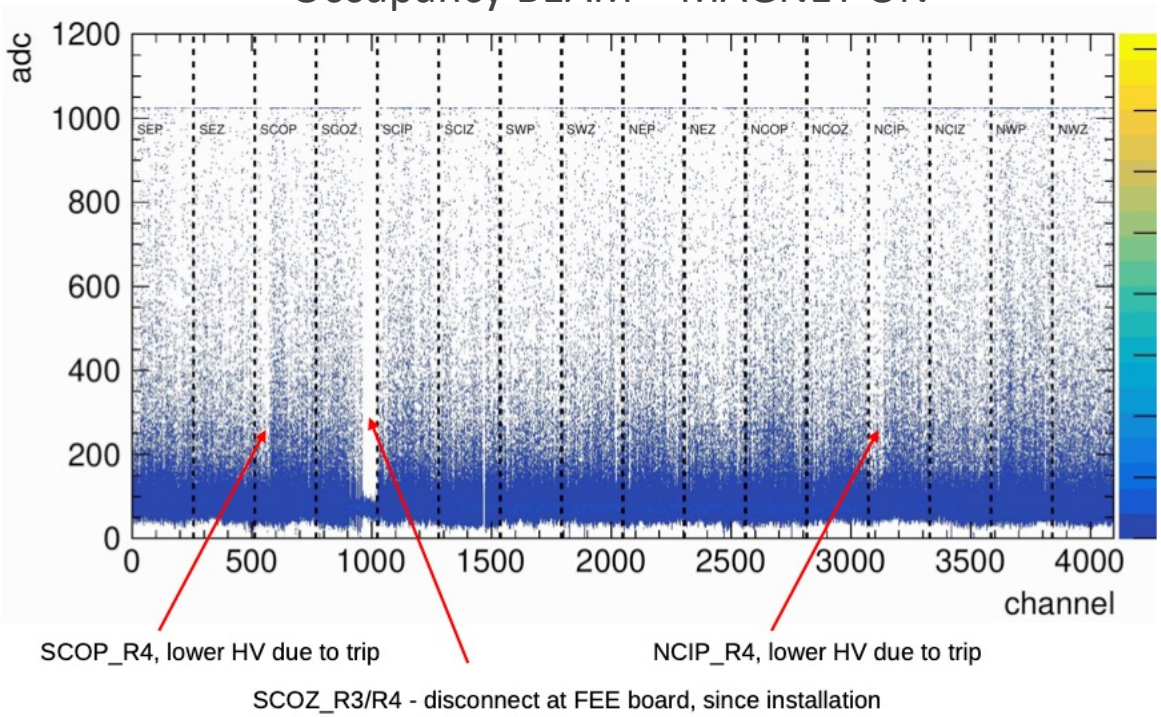
"Taille de guèpe"

+> Thinner strip at the beginning of the strips to avoid low resistivity and NSW-like instabilities

RUNNING AT RHIC



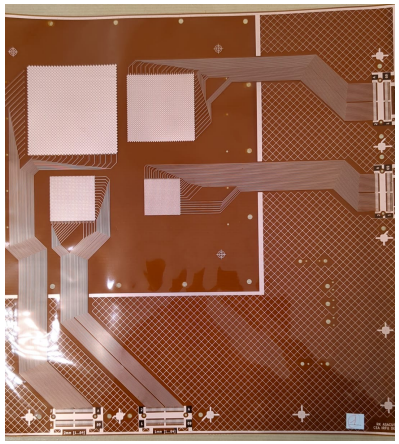
Occupancy BEAM + MAGNET ON



Preliminary results from H. Peirera

EIC / P2 PROTOTYPES

~ 15 10x10cm Micromegas with different readout / amplification

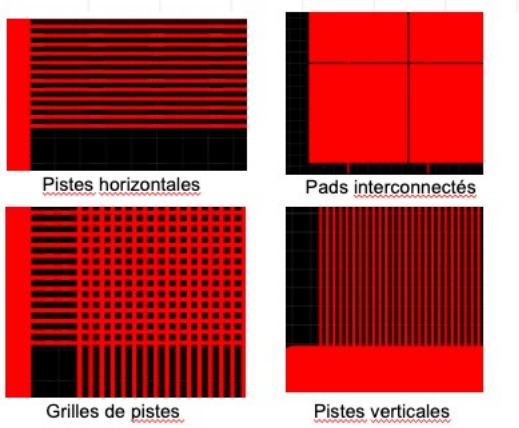


- **Common platform for light weight MGPDs with :**
  Different readouts : 2D pads, strips, 2D strips
  Different MPGD : plain resistive mm, strips resistive mm, URWELL, metallic mm

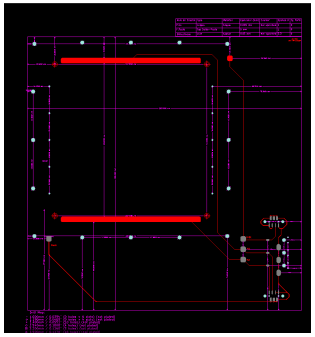
- **Micromegas on single Kapton Foil feasible :**
  After a few test, good yield with 3/3 ok for metallic MM (with a few features)
  Works on pressed Resistive Layer on readout (2x Kapton foils)
  All kapton done at CERN

With this, we get 0.2% of X0 per layer (Gas and Drift made of Mylar foil)

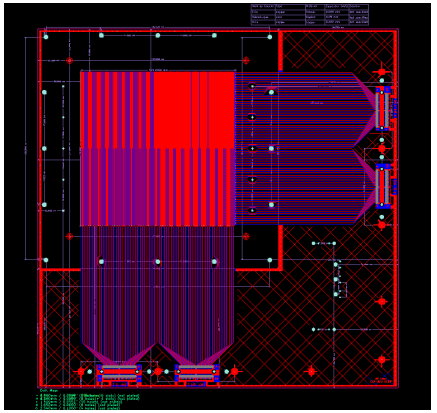
Resistive Patterns



Amplification Kapton

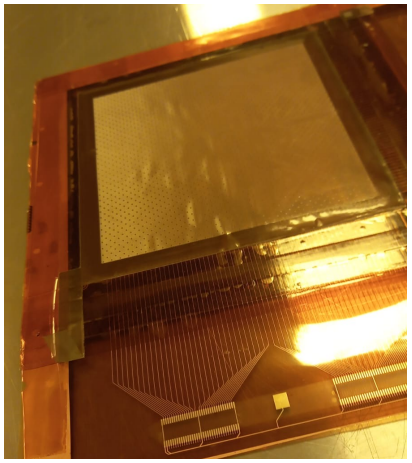


Readout Kapton

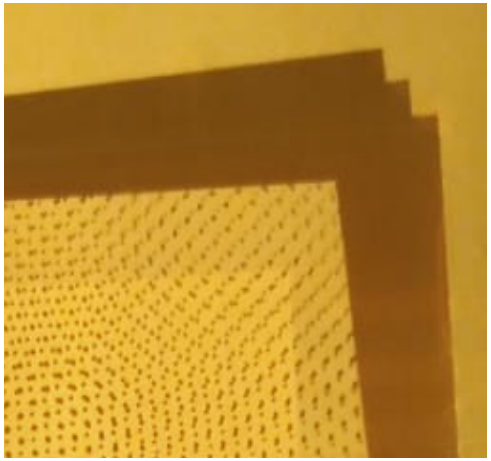


EIC / P2 PROTOTYPES ISSUES

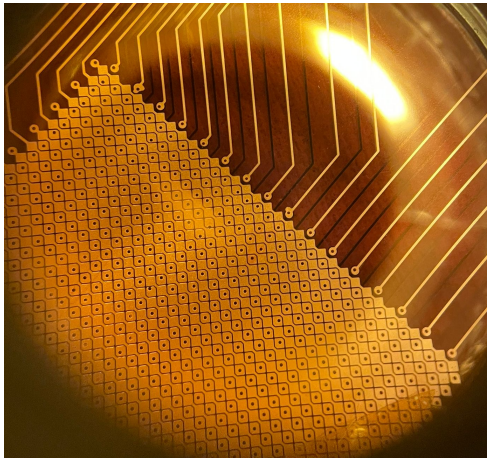
First Bulk tests :



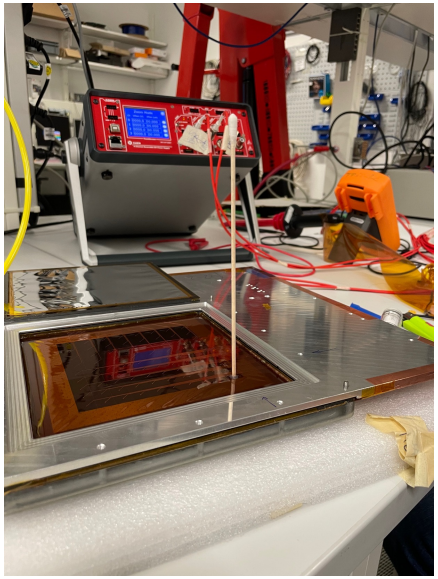
Mask misalignments



Broken vias

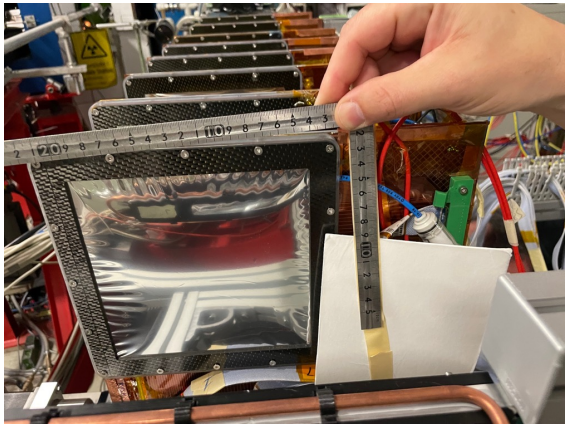


Un-bending metallic mm



RD4 assembled

RD4 installed



EIC / P2 PROTOTYPES ISSUES

Test beam @Mainz :

+> RD4 production (2 weeks)

- 3/3 P2 metallic
- 3/3 Urwell (really easy)
- 3/5 Resistive mm

=> Not perfect prod done in full panic mode, next detectors should be better

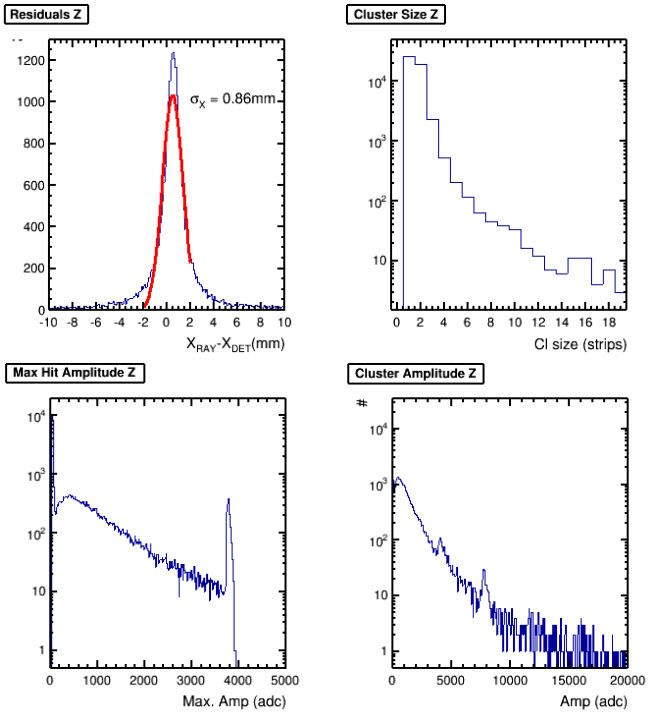
As a conclusion

- Saclay bulk lab is up and running after a team change
- New engineer should arrive in September at 50%
- Next production : mulitgen for tomography and NBLM

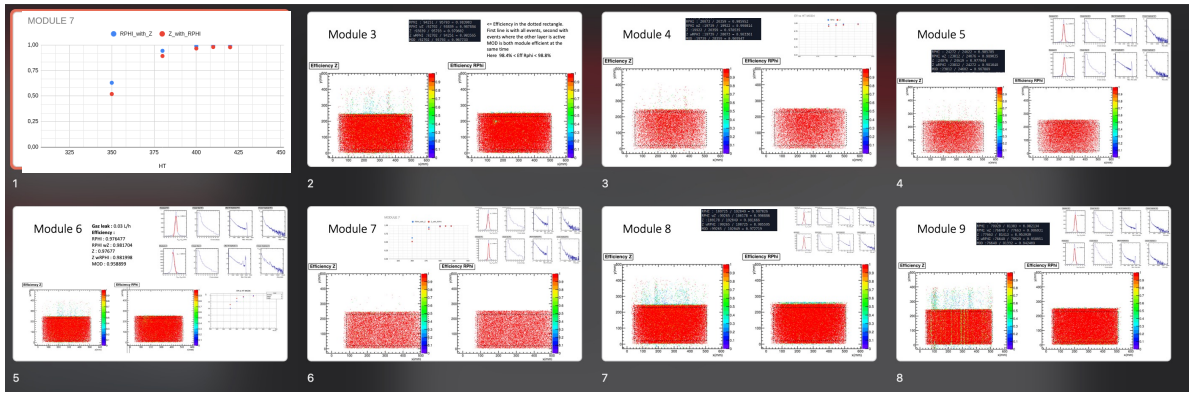
On the R&D side

- Waiting for the test beam analysis
- Try to bulk on DLC layer
- Kapton includes amplification layer to avoid pressing

Production Module QC with Cosmic rays



Module 7 monitoring plots



Module	1	2	3	4	5	6	7	8	9
RPHI eff		98 %	98 %	99 %	99 %	98 %	99 %	99 %	99 %
Z eff		98 %	98 %	98 %	99 %	98 %	98 %	98 %	98 %
Module eff		97 %	97 %	97 %	97 %	96 %	97 %	97 %	97 %
Gas leak	0.03L/h (detection limit of the setup)								

Operating points for testing:
Ar/iC4H10 95/5
Drift HV: -200V
Amplification HV: +420V

+> Shipping to BNL in two batches in August 2022