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Saclay workshop R&D for new Bulk structure

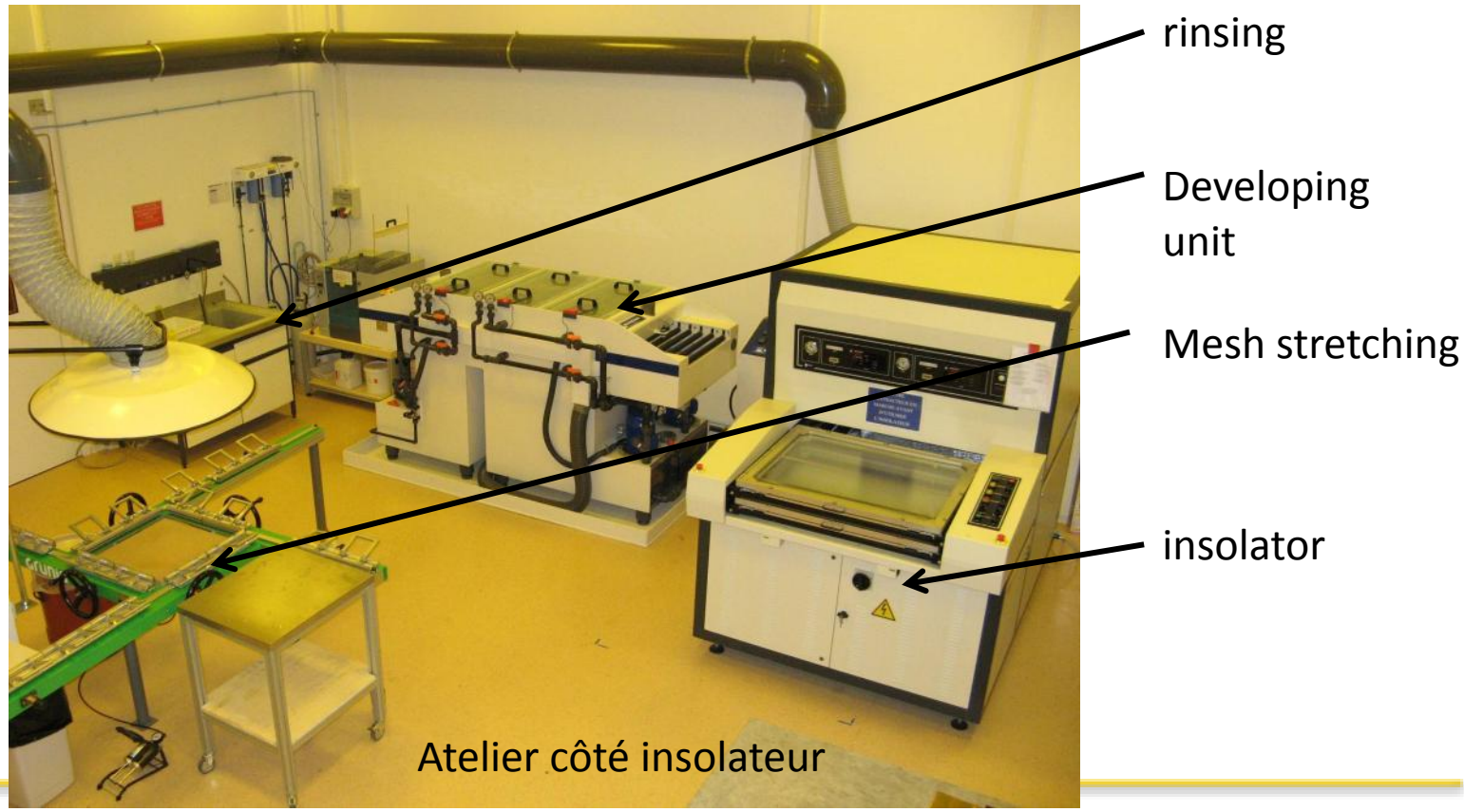
- Saclay MPGD workshop
- BULK R&D
  - Double sided bulk
  - Segmented mesh
  - Thin and thick mesh
  - Thick photoresist gap for multimesh bulk
  - Pillar R&D

Saclay MPGD workshop

The photoresist film (Pyralux PC) are laminated on the PCB. The maximum width is 600 mm. Two thickness can be used, 50 and 64 µm, with several layer to obtain the amplification gap (typically 128 µm). The mesh stretched on a frame is laminated with (under) the last layer. The 128 µm amplification gap is theoretical : depending of the pressure of lamination this gap varies between 110 and 120 µm.

Saclay MPGD workshop

- The goal of the laminator is to polymerize the layers of photoresist that encapsulate the mesh.
- A insulating mask allows to polymerize pillars ,on the active area and , borders and zone for HV contact. The important parameter is the insulation energy (mJ/cm^2)



Atelier côté insolateur

Bulk done (04/2010 to 10/2010)

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	Goal	Dimension PCB	Active area (cm)	number
Lab TESTS				
	PCB Test Equipements	250/280	200/200	12
	PCB RD1	120/140	95/95	18
	PCB Test Mèche Fine	120/140	95/95	5
Projects				
	SLHC	200/280	100/100	4
	MIMAC	180/180	110/110	7
	CLAS 12 (TF10)	250/360	57/100	11
	DETFROST	D=110	D= 90	3
	FORFIRE	D=70	41/41	3
	COSMULTI (2 faces)	340/410	260/260	1
	AT- TPC	290/320	D= 270	4
	Vrai/ Faux 2D	115/130	60/60	2
	Total			70

Bulk done at Saclay by the MPGD workshop team (5 persons for 2 FTE)

Double side bulk

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Micromegas Double sided bulk for cosmic bench

- Fine spatial resolution: 200 µm pitch
- Large active area: 260 x 260 mm
- Low amount of electronic channel: 72

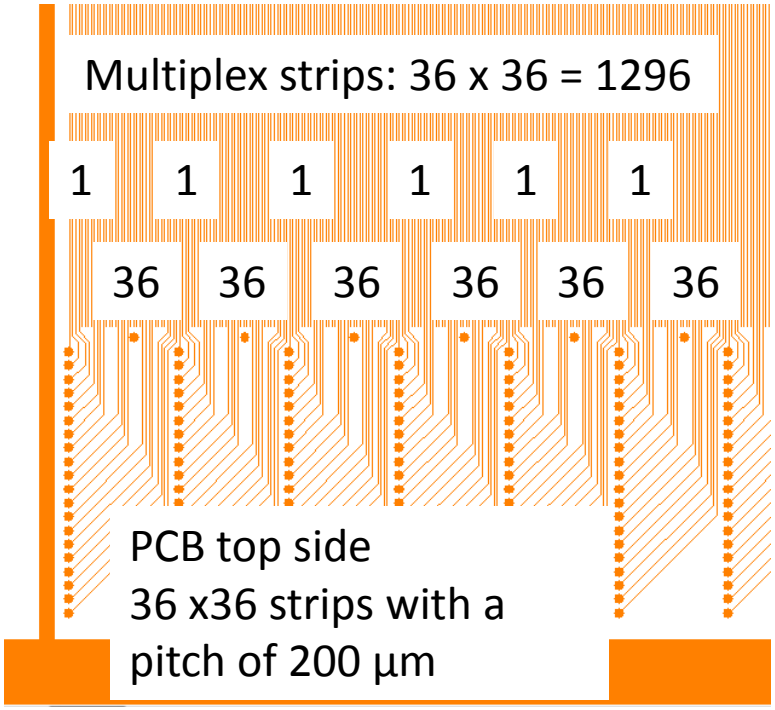
The idea is to multiplex the strips and to remove the ambiguity by doubling the detectors (one thin multiplex strips and one large strips)

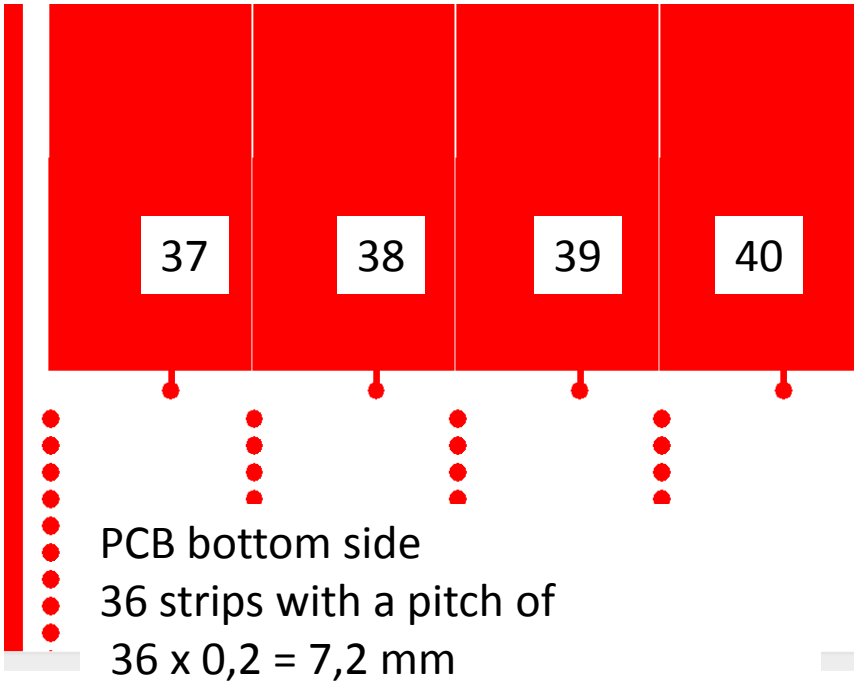
The DS bulk will be used on cosmic test bench to characterize CLAS12 detectors: 2 scintillators + 4 DS (2 XY).

DS Bulk PCB layout

The PCB is a 4 layer with thin strips on top and large strips on bottom. Inner layers for fine strips multiplexing and shielding between active areas.

Thickness 0,8 mm. one 72 unique connector for AFTER readout





Clas12 double sided bulk for cosmic bench

DS bulk realization & tests

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- Realization:
  - The top side was first equipped with photoresist and woven mesh.
  - Bottom side equipped with photoresist and woven mesh.
  - UV exposure on both sides and simultaneous development.
  - Realization of DS #2 to #4 end of October et Saclay
- Test
  - test at air OK, test with 5% isobutane under way.
- Cosmic test bench operational in November

Mesh segmentation

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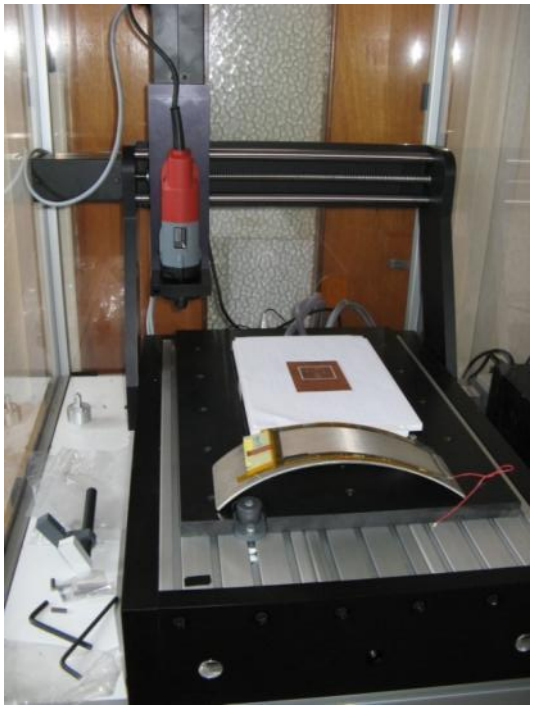
- Segmentation of the mesh on a the active area using a PCB milling machine with 200 to 400 µm diameter tool.
- Possible goal:
  - Lower the capacitance for large bulk surface
  - Divide the “dead time blindness” when sparking
  - Several gain on same detector
  - Read the mesh for XY detection or ambiguity removing when multiplexing

PCB machining

Originally made to create PCB: 600 x 400 x 120 mm

- This machine can first record the planarity of the bulk and then mill following the flatness.
- The milling precision is less than 10 µm
- Optical cameras for toll position

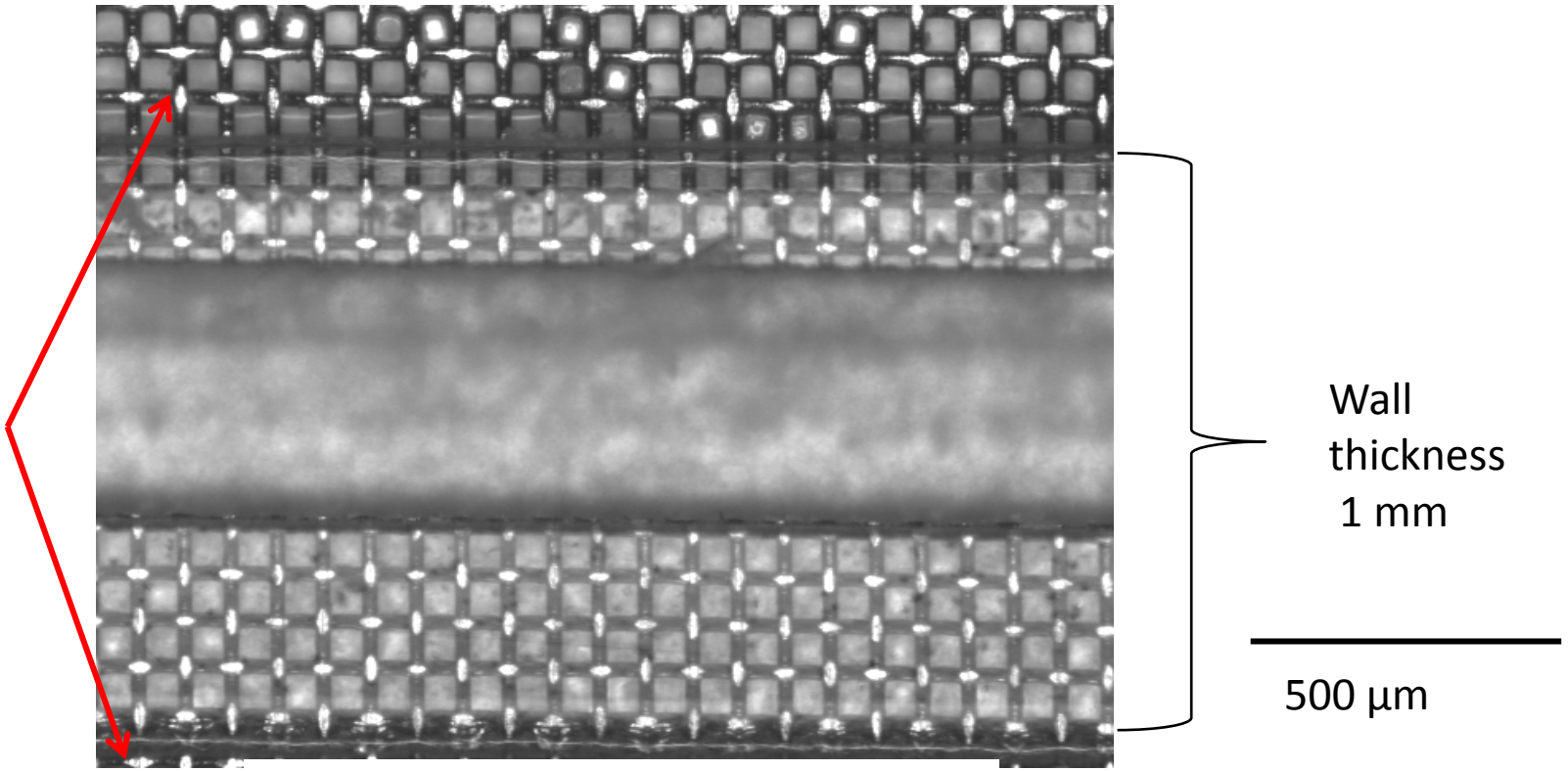
Machine and control PC



Machine clas12 prototype

Mesh segmentation

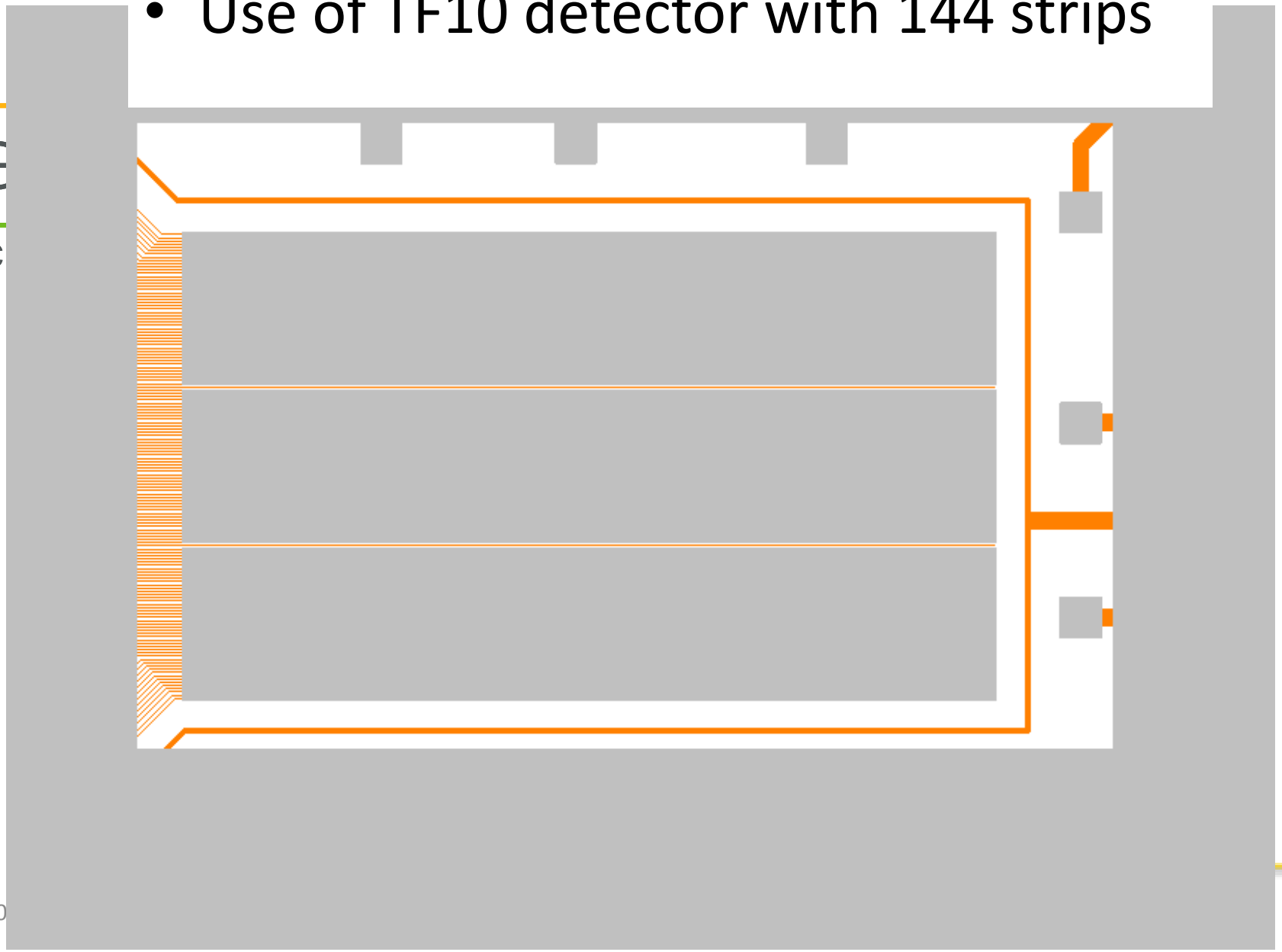
- The bulk is created with wall of photoresist were the mesh will be cut.
- The thinner wall made to work are 500 µm
- The strips are not damage (milling deepness of 80 µm) on 10 cm active area



300 µm cut on 90 µm deepness

Mesh segmentation layout

- Use of TF10 detector with 144 strips



Mesh segmentation test

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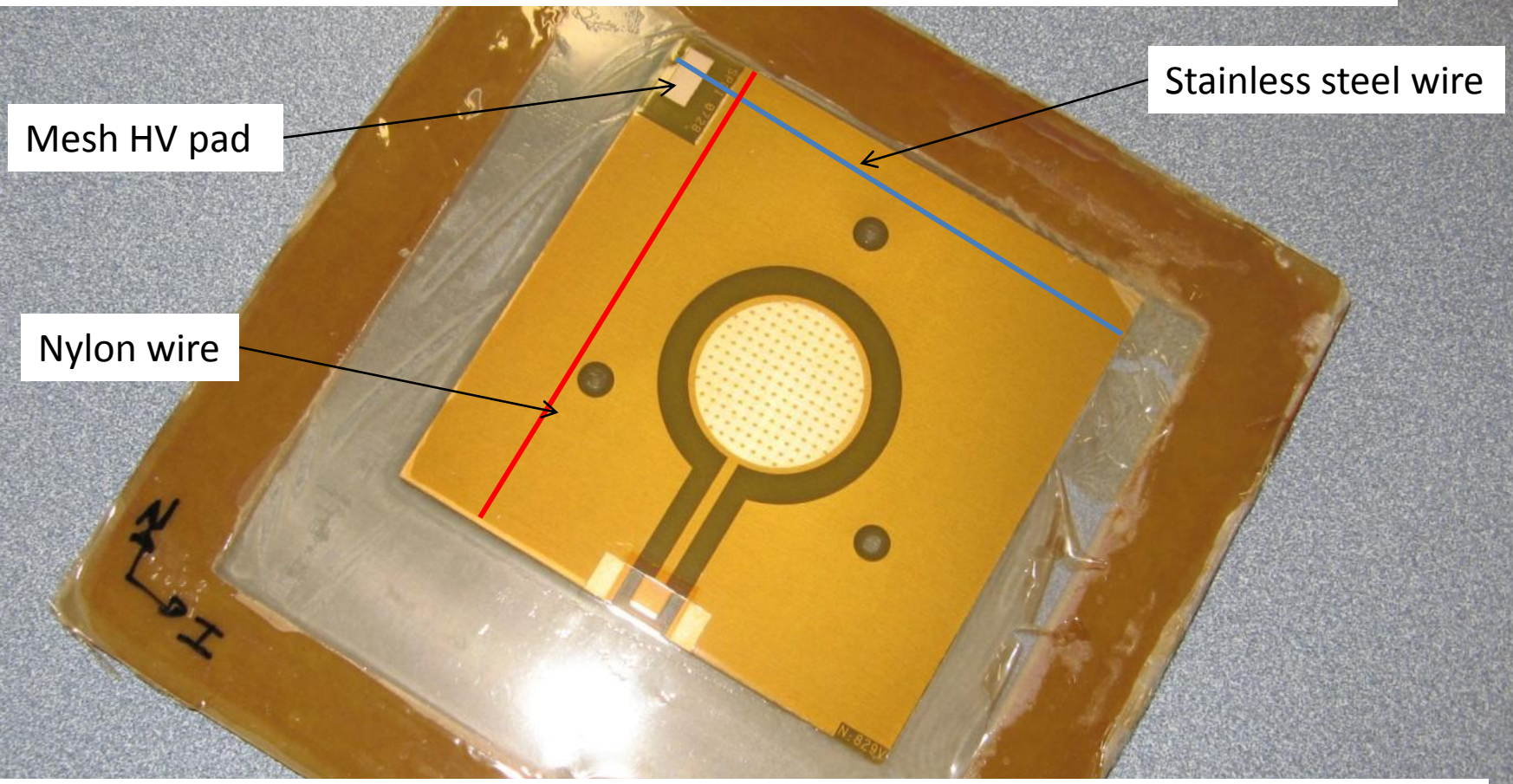
- The mesh was divided in 3 sectors A, B and C.
  - Mesh B and strip from B region were tested (ORTEC 142b and AFTER) with Fe55 while different tuning on mesh A and C were done
  - NO effect seen (counting rate, gain, DE/E,…) when mesh A and C are sparking (600 V with 5 µA limitation)
- Future realization and test:
  - Segmentation on larger detector
  - With thinner photoresist wall
  - Mesh segmented, perpendicular to anode strip, in 1 mm “mesh strips” for mesh readout (AFTER adaptation for positive charge): XY detector !!!

Bulk with exotic woven mesh (stainless steel and nylon) for GANIL test (J. PANCIN)



The mesh HV pad allowed voltage only on several wire out of the active area !!! ☹ ☺ ☺ ☺

Tested after removing the photoresist on one side.

No positive test for nylon charging issue. To be continued.

Bulk with thin mesh (A . GIGANON)

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- Goal: make a bulk detector with thin electroformed mesh
  - Several detector were made with 5 µm nickel mesh taken from old compass detector
  - After two tentative we succeeded in obtaining a bulk with no default. The mesh was not stretched yet at this stage.
  - Further test with Veco mesh (10 µm Al) in coming month

Gain curve

Bulk with thin mesh (thickness:5 microns)

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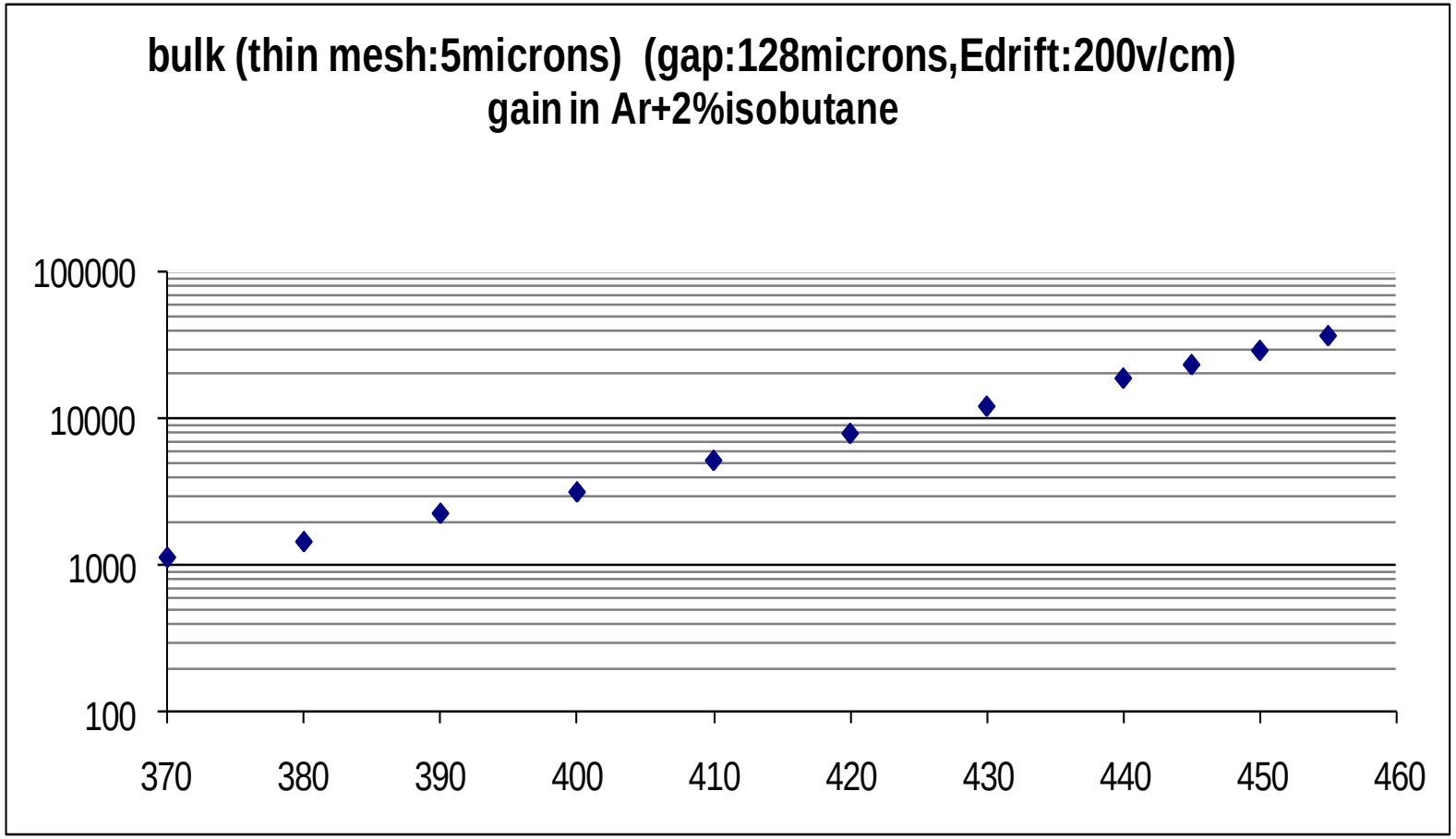

Thin mesh

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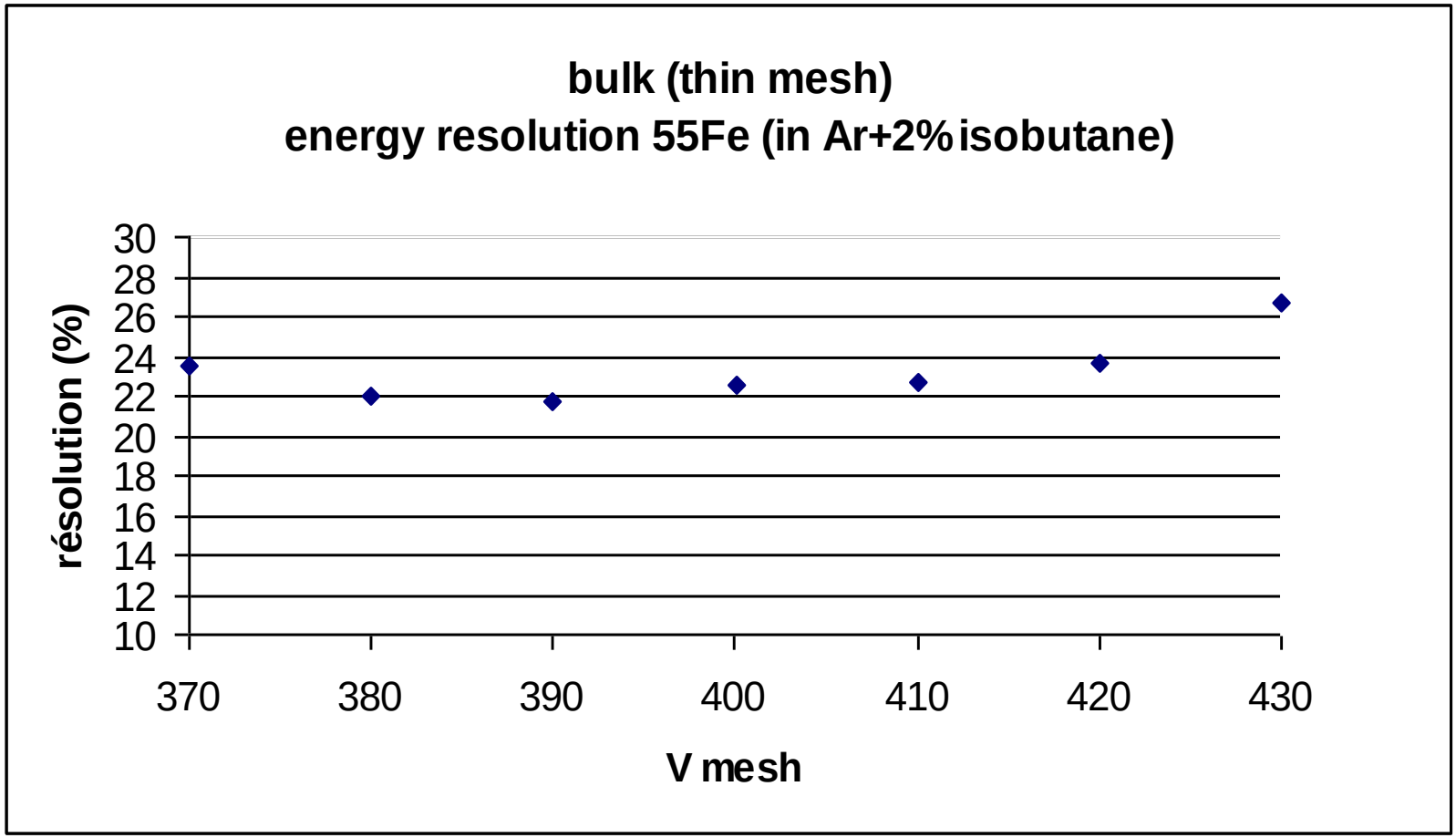
Energy resolution (55Fe) with non streched mesh



Thin mesh

Energy resolution 55Fe (scanning)

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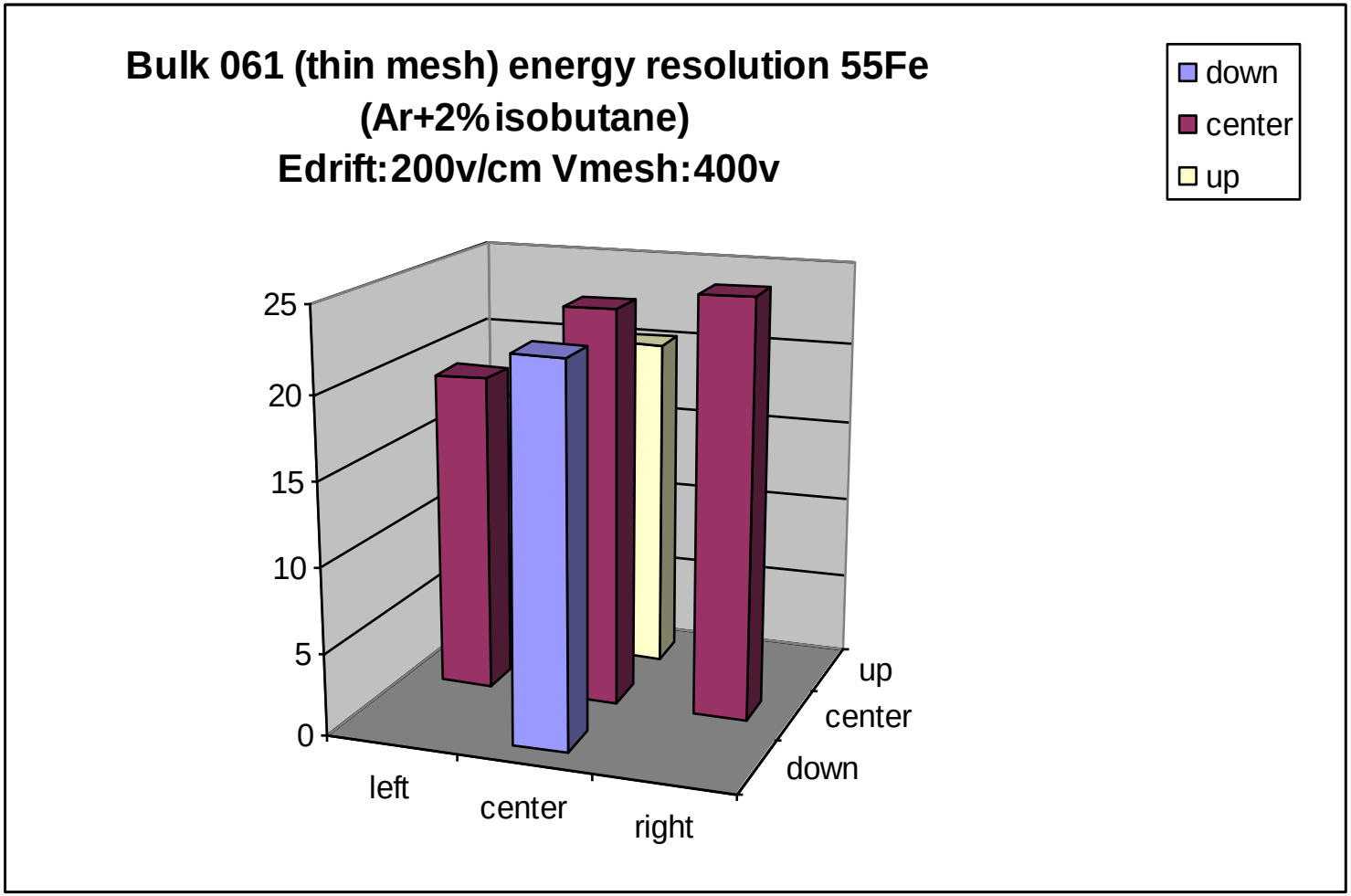

Multi layer bulk (A. GIGANON)

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- In order to make R&D on bulk with multistage mesh we have made tests to polymerize several layer of photoresist.
  - 8 layers of photoresist were laminated to obtain 500 µm pillars.
  - Next step will be integration of 2 meshes on a bulk prototype (one mesh at 128 µm and one at 600 µm).
    - Two possible techniques:
      - Insulation at once of all layers
      - Insulation before and after each mesh deposition

Bulk with thick mesh

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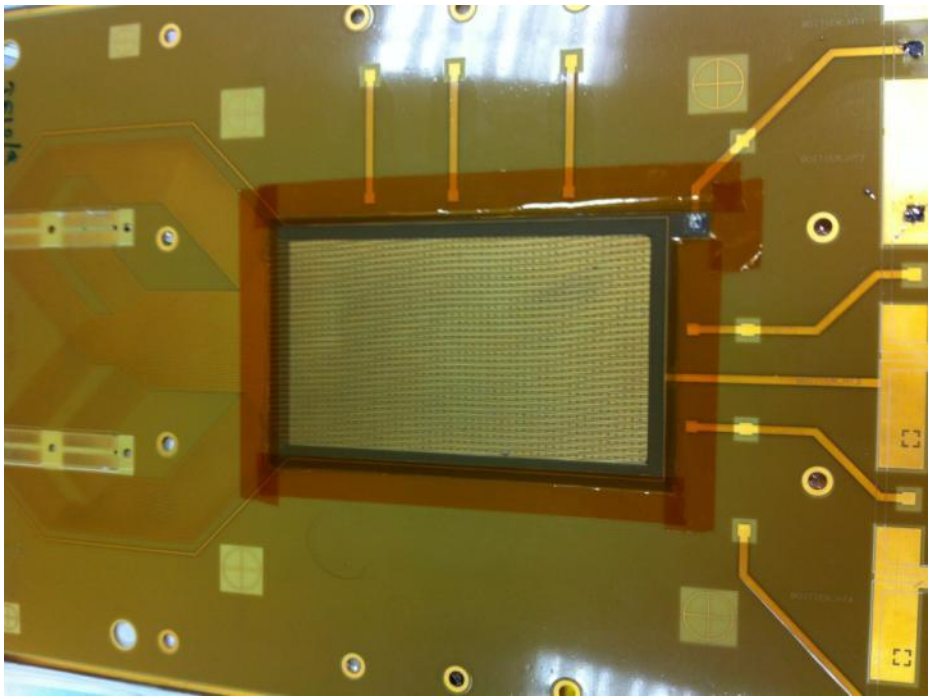
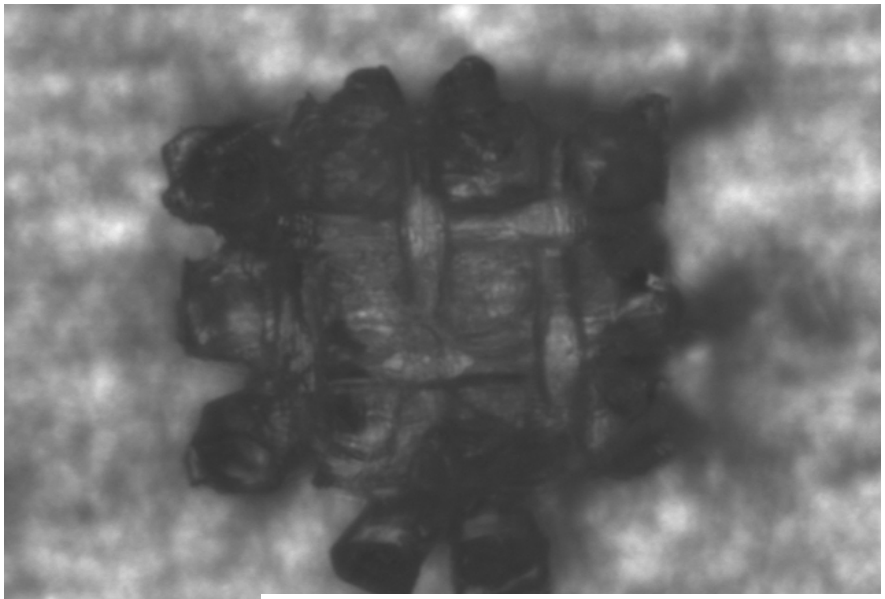
- A bulk was made using 265/50 Bopp mesh (thickness 50 µm after lamination (special order thanks to RD51)). This mesh is 10 time less expensive than SDC 45/18
  - The amplification gap was 192 µm
  - Gain lower than “normal” bulk
  - Tests no yet concluding for spark region due to defect while making the bulk



Pillar R&D

When polymerize through the mesh the pillar under the mash are equipped with “pods”. This could explain the sparking issue when first HV cooking (up to 900 V in air)

Test with double insulation are under way.



Albert retourné avec ses pod en l’air (partie de pod en l’air…)
Albert possède 8 à 9 pods

Summary

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- The Saclay MPGD workshop allows us to have plenty R&D underway
- Ideas can become reality and tested in some 48 hours
- The workshop is open for R&D to the RD51 collaboration.
- Contact person:
  - Stephan AUNE. saune@cea.fr