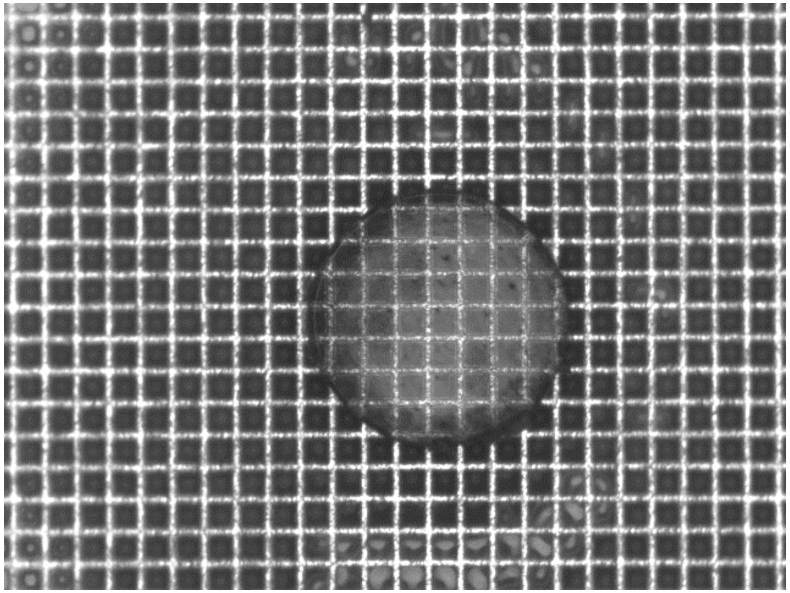
DE LA RECHERCHE À L'INDUSTRIE

Micromegas Bulk
With thin mesh



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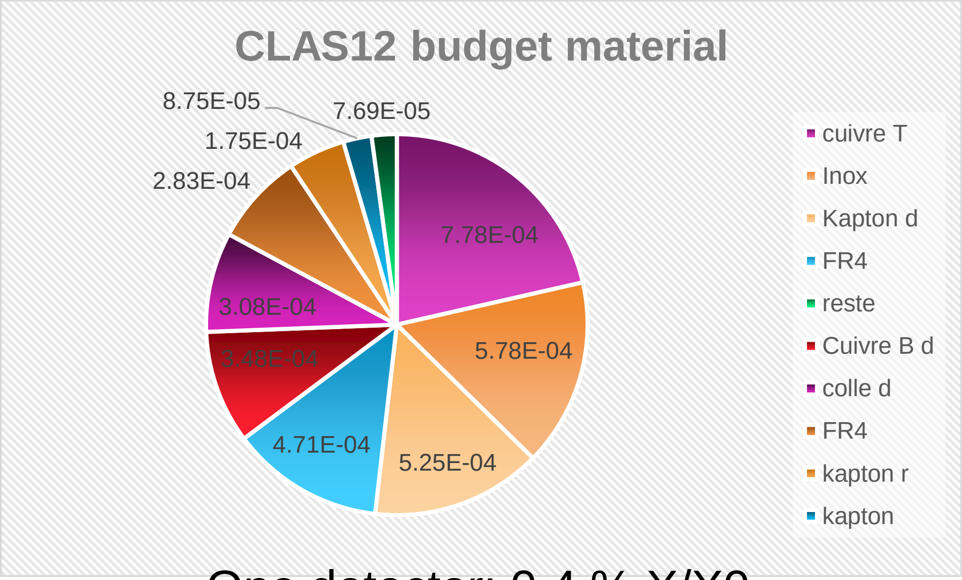
Thin Micromegas Bulk

- Goal: why thin bulk
- Bulk process with thin bulk
- First result with Pico-Second detector
- Result with RD2 detector
- Next detector with larger active area

GOAL 1, REDUCE BUDGET MATERIAL

- Standard Micromegas bulk detector are made with stainless steel woven mesh
  - Most common mesh (thinness available) use SDC 45 18 mesh
    - Wire of 18 µm
    - Opening of 45n µm
- In order to reduce the material budget (X0) we want to investigate thinner meshes (mesh is ~ 15 to 20 % of the detector material).



One detector: 0,4 % X/X0

Goal 2: reduce energy resolution

- Standard Micromegas bulk detector with SDC 45 18 mesh have an energy resolution of ~ 18 % at 5.9 Kev. Those mesh are around 400 LPI.
- Standard MicroBulk can go down to ~ 14 % at 5.9 Kev

- The thinner the mesh, the lower will be the energy resolution

Can the bulk technics used with thin mesh ?

The bulk technics allows to obtain detectors with large seize (~50x50 cm²) with a very good level of ratability, detector are robust and can be curved.

Thin meshes ?

There are at least two different type of thin mesh (not woven)

- Electroformed mesh
  - Made out different material (Ni mesh use in compass experiment) the thickness is around **4 µm**.
  - The maximum seize found today is **~40x40 cm²**
  - Very fragile !

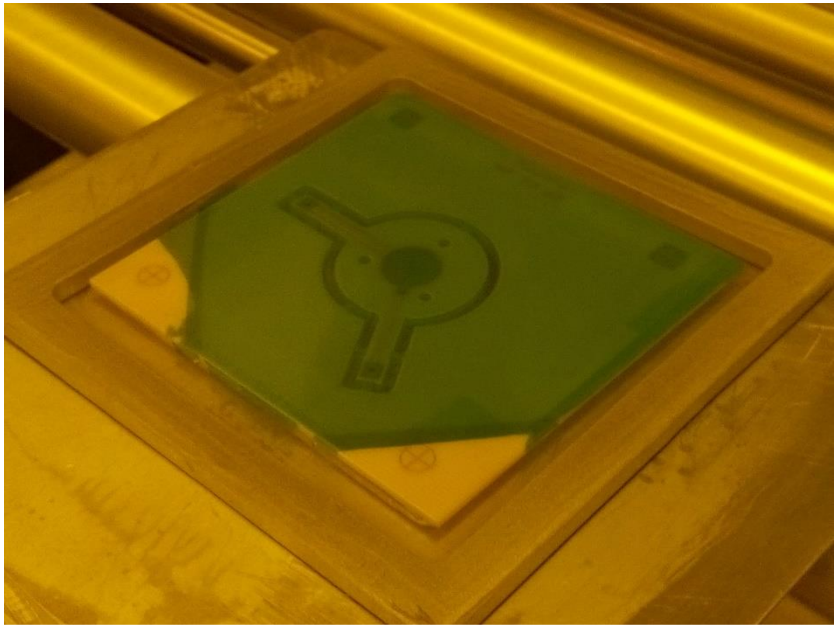
- Etched mesh
  - Made by etching material, i.e. copper
  - The standard is made by CERN out of kapton+5 µm copper
  - Result is a **5 µm** copper mesh ((used on CAST experiment)
  - Very fragile !

- An other advantage of thin mesh: pattern can be adjusted, depending on technics we can go higher in the density of mesh
  - Up to 1000 LPI could be obtain.
  - Pattern of mesh could fit a pattern of strips

Bulk of Thin meshes on small detector

- For the **Pico-second** project we compared thin mesh with standard mesh.
  - The anode is ~ 10 mm diameter. One central anode, no strip
  - The PCB is relatively small, ~50x50 mm
- We used 200 lpi Ni, 4 µm thick, meshes from compass old drift meshes

- The first step is to stretch the mesh. We used two frame (main and counter frame) in order to have ~ 3 kg of weight on the stretching tool.
- Then we apply the bulk technics…



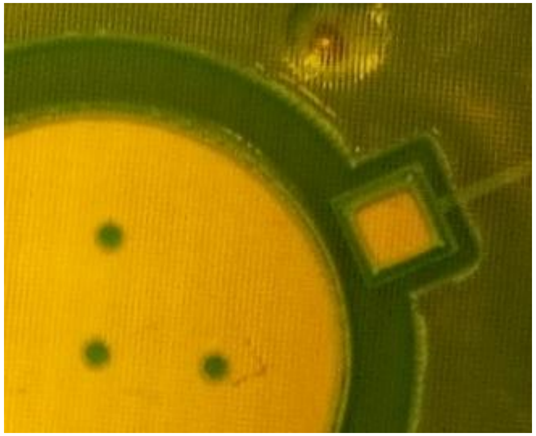
- Picture prior the mesh lamination

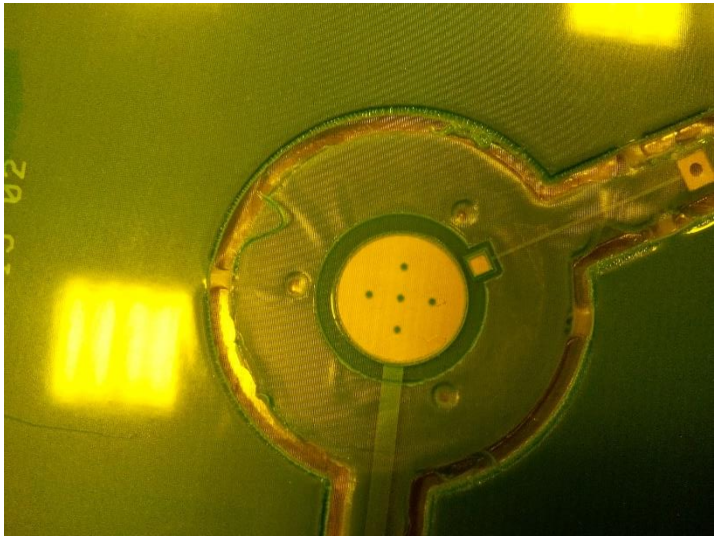
BULK OF THIN MESHES ON SMALL DETECTOR

- Standard bulk technics are too “aggressive” for such fragile mesh
  - Adjust the pressure of the lamination unit (4 bar to 2 bar)
  - Adjust the pressure of the development unit (5 bar to 1.5 bar)

- We obtain good result for 128 µm gap (mesh well stretched)

- We obtain “bad” result for 64µm gap (mesh wrinkle)

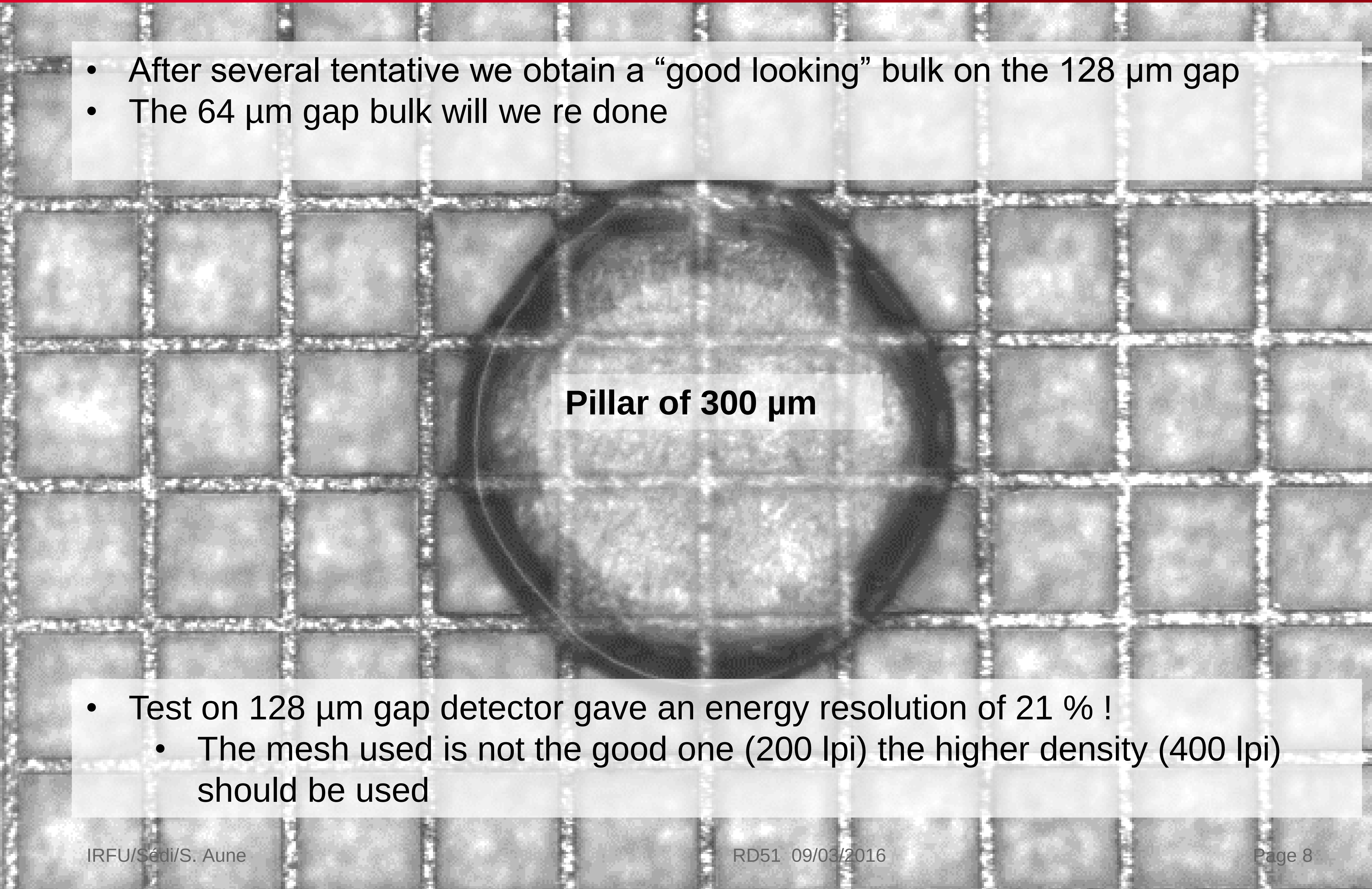




- Picture after development

BULK OF 200 LPI MESHES ON SMALL DETECTOR

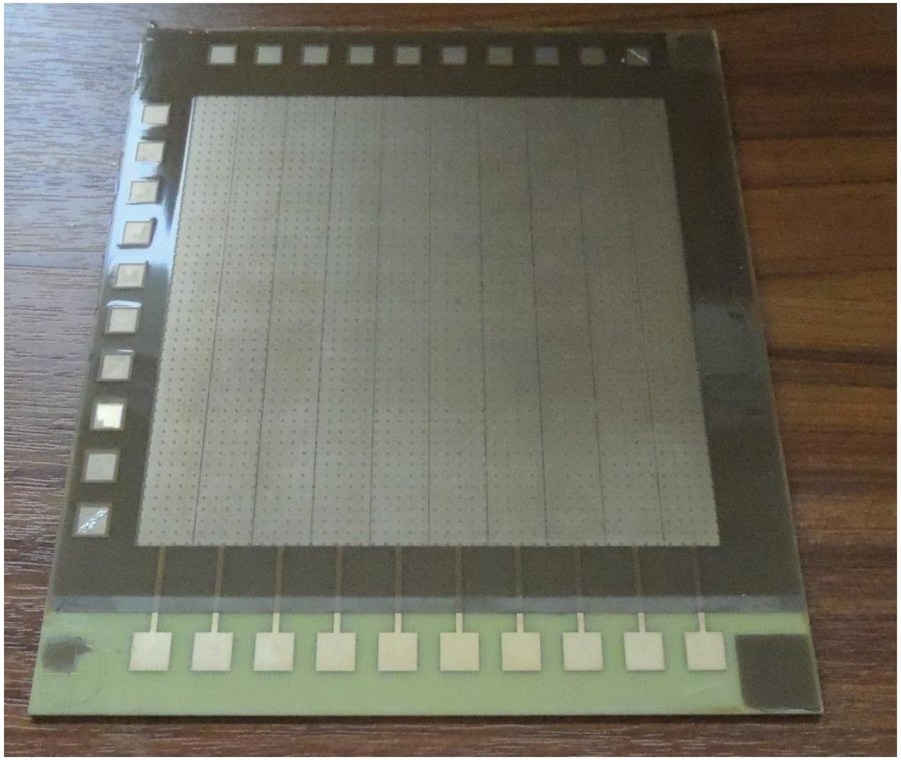
- After several tentative we obtain a “good looking” bulk on the 128 µm gap
- The 64 µm gap bulk will we re done



- Test on 128 µm gap detector gave an energy resolution of 21 % !
    - The mesh used is not the good one (200 lpi) the higher density (400 lpi) should be used

Bulk of 400 Thin meshes on RD2 detector

- RD2 detector are 10x10 cm² anode with 10 strip (design for bulk R&D)
- The first try we obtain detector with 50 % of the strips OK
  - Problems with fragility of the mesh = adaptation of bulk technics and precaution when handling fragile items.

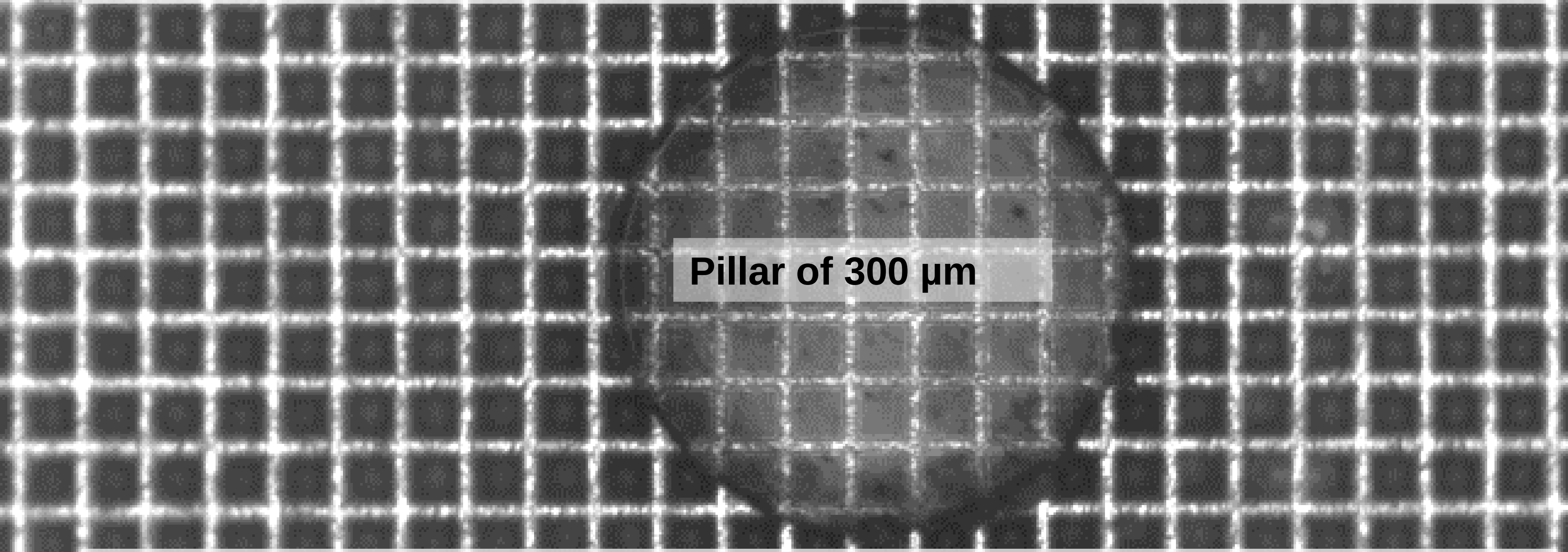


- Bulk RD2 with 400 lpi mesh

- With larger area we upgrade our stretching technics with frames and ~5 kg weight.
- Then we apply the bulk technics…

BULK OF 400 LPI MESHES ON SMALL DETECTOR

- We obtain a “good looking” bulk on the 128 µm gap and on 64 µm gap
  - Mesh used is 4 µm Ni 400 LPI electroformed mesh



- Test in dry air are ok: 930 V for 128 µm gap with less than 5 nA
  - Spark does not kill the mesh !
- Test in gas are under way now (result when Isobutene available…)
  - Energy resolution, gain, mesh transparency

SUMMARY

In conclusion one can say that:

Bulk technics is compatible with thin electroformed meshes

In the coming month more Pico-second and RD2 detector will be made to have more statistic and improve the tooling to handle thin meshes.

Also test with thin etched copper meshes from CERN (CAST meshes)

For summer 2016 the goal is to make ~ 30x30 cm² thin mesh bulk on thick PCB (1.6 mm)

For Fall 2016 the goal is to make ~ 30x30 cm² thin mesh bulk on thin stretched PCB (Kapton of ~50 µm)

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