Status report on segmented mesh microbulk

RD51 Common fund project

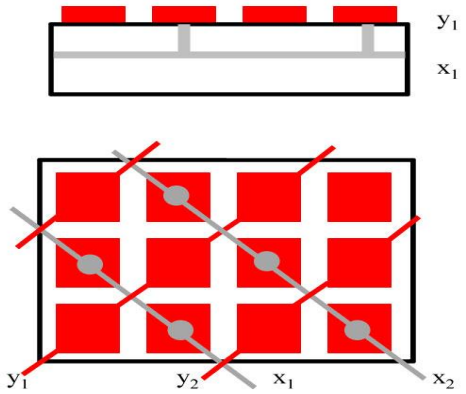
Fransisco Aznar[1], Theopisti Dafni[1], Martyn Davenport[3,]
Rui De Oliveira[3], Esther Ferrer Ribas[2], Serge Ferry[3], Theo Geralis
Fransisco J. Iguaz[1], Thanos Kalamaris, Mariam Kebbiri[2] ,Thomas
Papaevangelou[2]

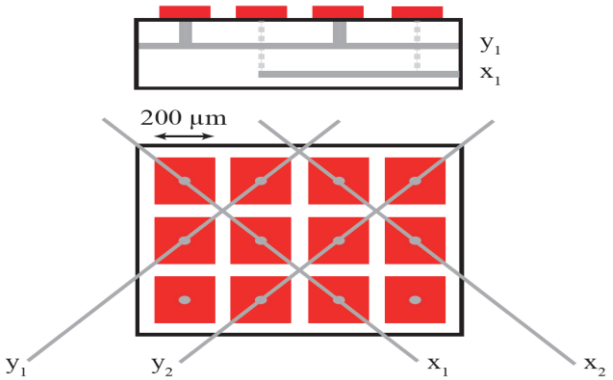
[1]**University of Zaragoza,** [2]**IRFU/CEA,** [3]**CERN,** [4]**NCSR Demokritos**,

6th February 2014, RD51 Collaboration Meeting

Motivations

- Develop a 2D low mass intrinsic X-Y detector
- Strategy used up to now (CAST, MIMAC, NTOF…)

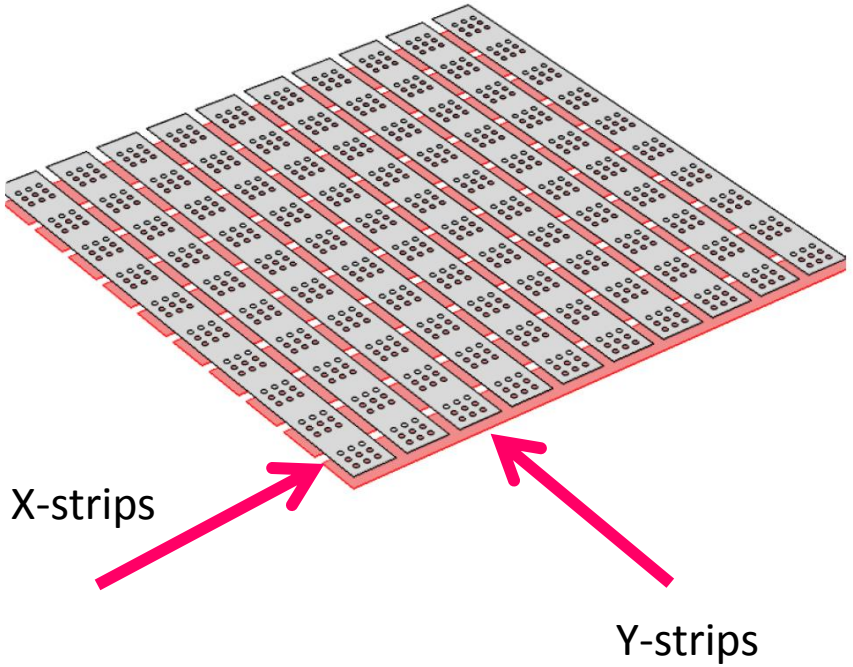




Disadvantages:

- In the limit of no diffussion, the 2D capabilities are lost
- Charge collection in X-Y is not completely equivalent
- Complexity in the manufacturing of a multilayer stack microbulk

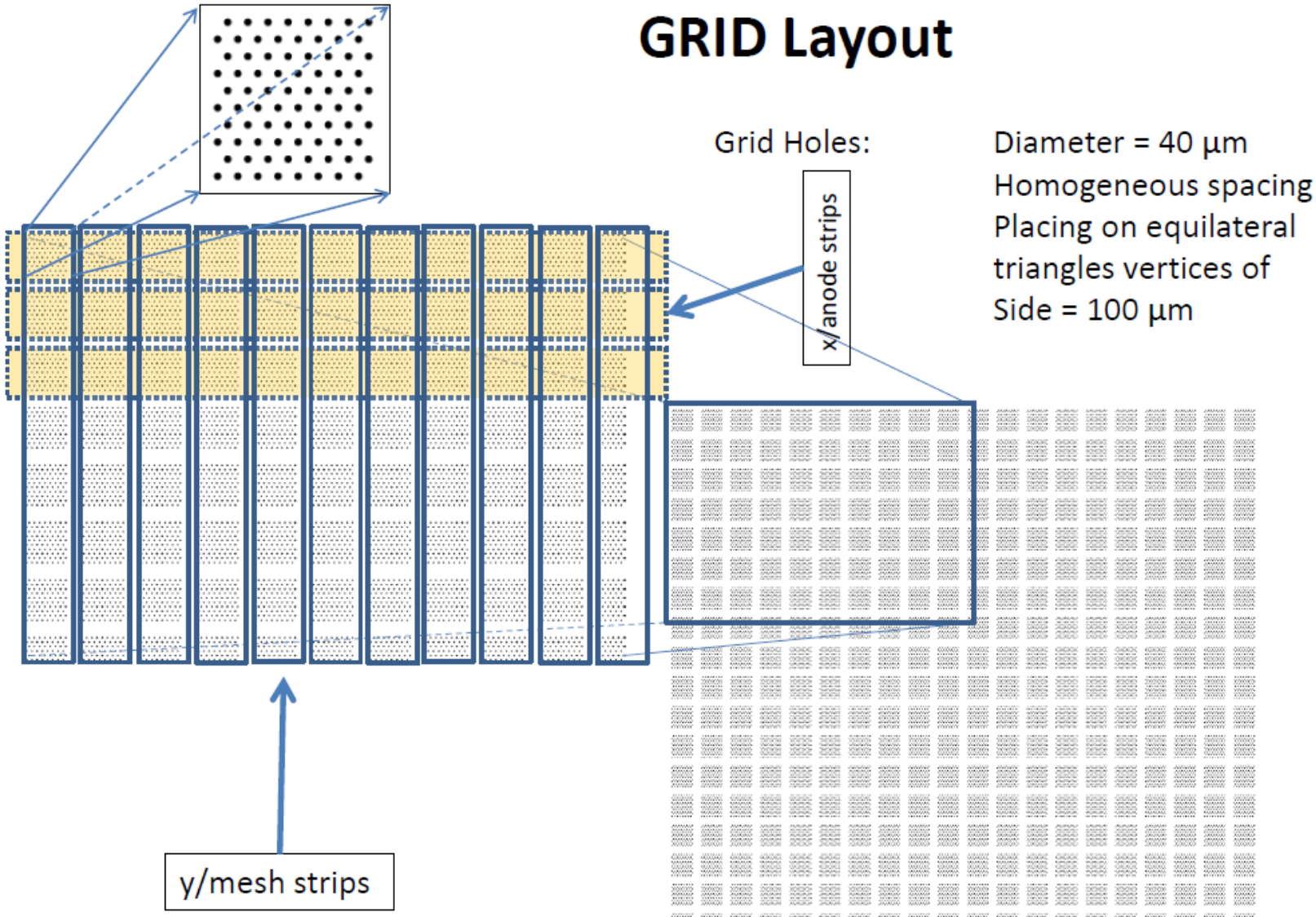
Intrinsic true 2D Microbulks



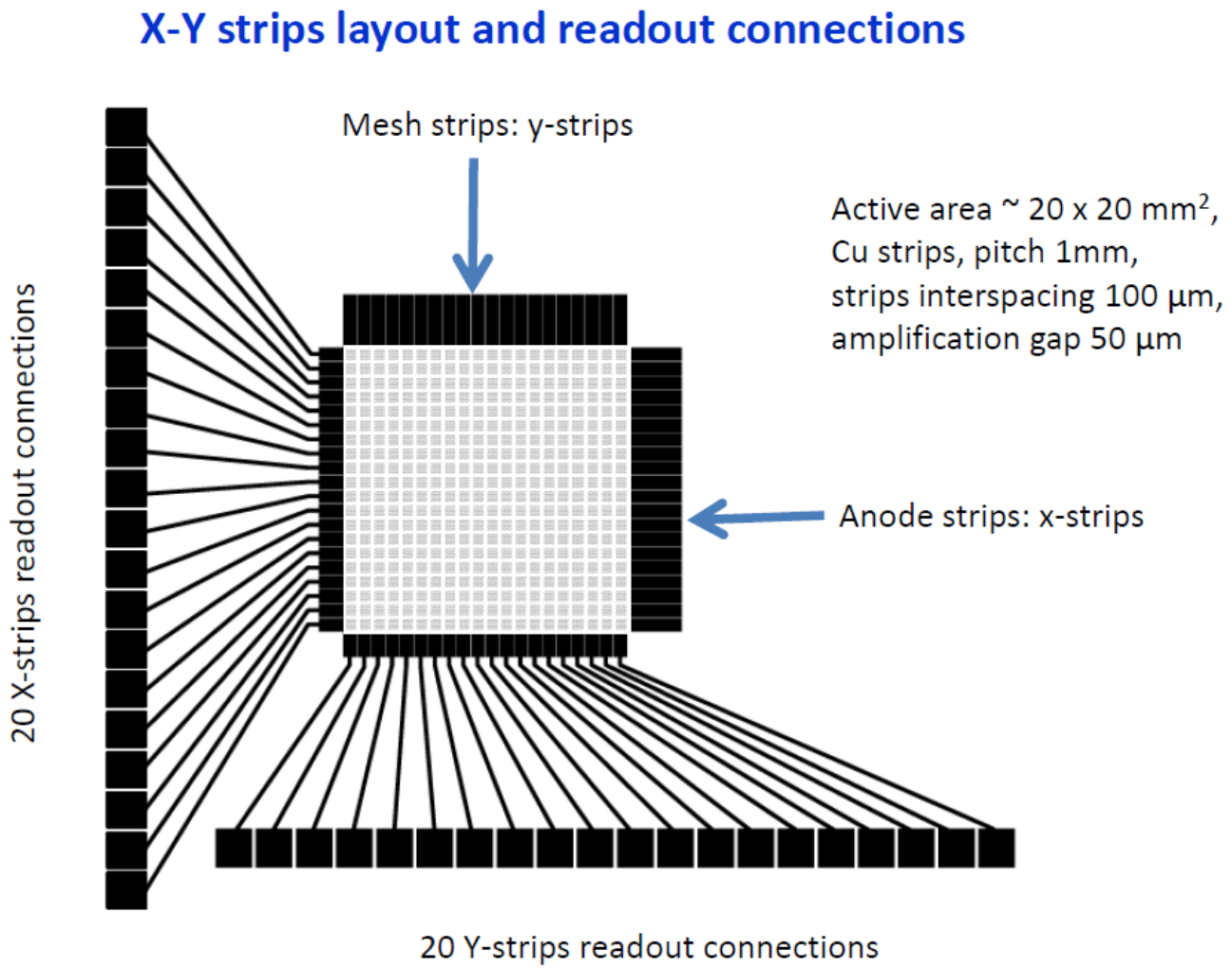
- Signal X-Y completely correlated
- Minimisation of the mass budget
- Coupled to autotrigger electronics ➔ Very low threshold

Interest: rare event detection experiments, neutron beam imagers…

Segmented mesh microbulk



Present design

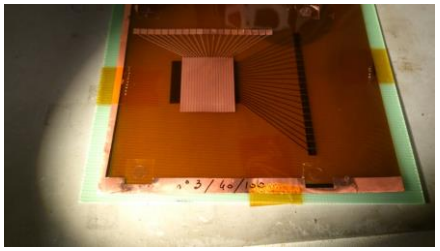


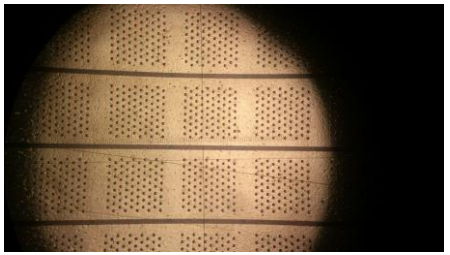
Evolution

1st batch: February 2012

Active area ~ 38 x 38 mm2, Cu strips, pitch 1mm, strips interspacing 100 µm, amplification gap 50 µm➔ could not hold HV, only a few strips were operational

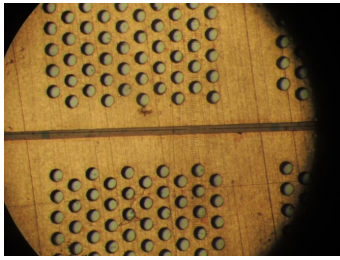
2nd batch: November 2012





New production technique, 4 Micromegas prototypes Hold HV, No spectrum from an 55Fe source, pitch 1mm, strips interspacing 100 µm, amplification gap 50 µm

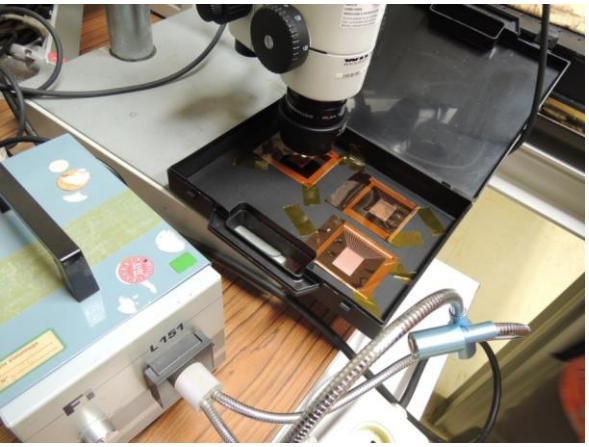
3rd batch: September 2013

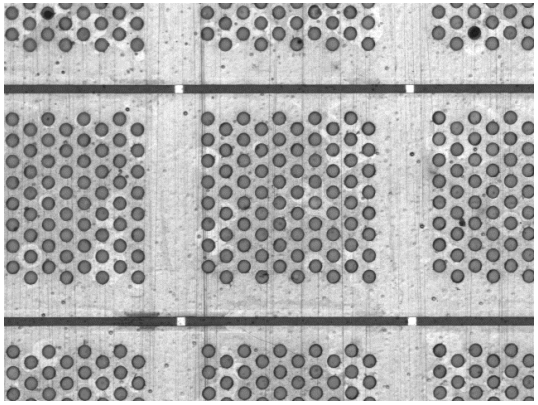


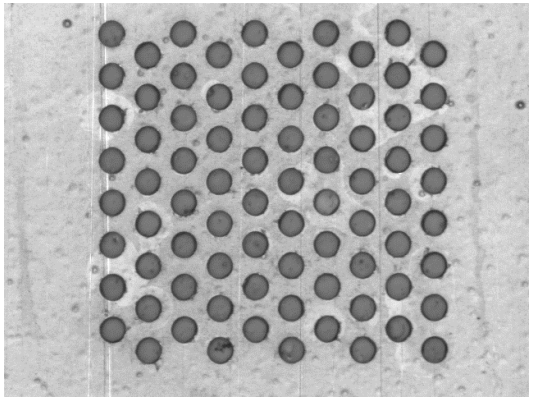
5 Detectors manufactured with different holes diameters: 2 with 45µm and 3 with 60 µm. Pitch is 1 mm and strip interspacing reduced to 40 µm

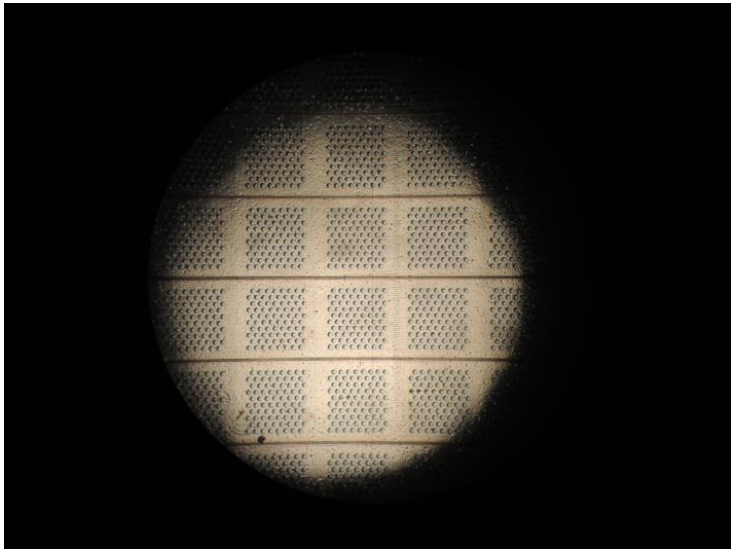
Manufacturing: first the x-strips then the mesh holes and finally the y strips. No holes on top of the x-strips gaps.

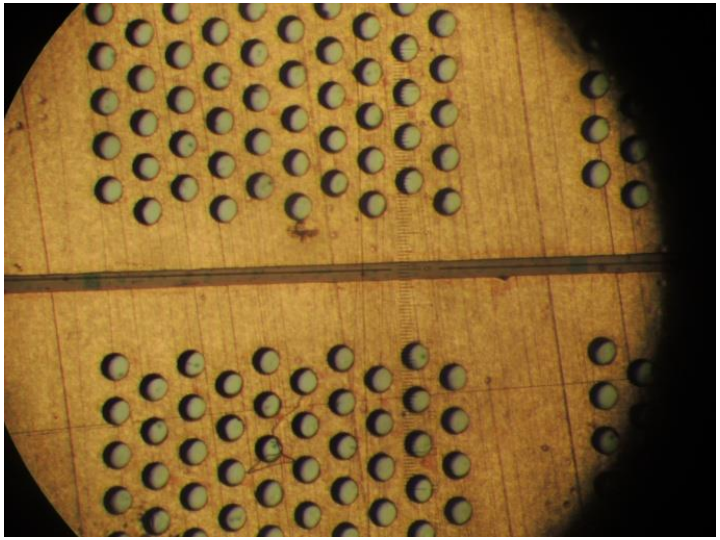
3rd Batch



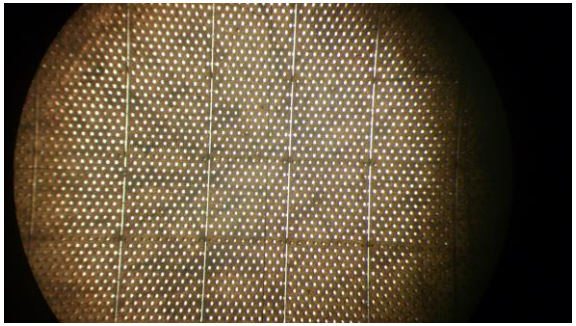


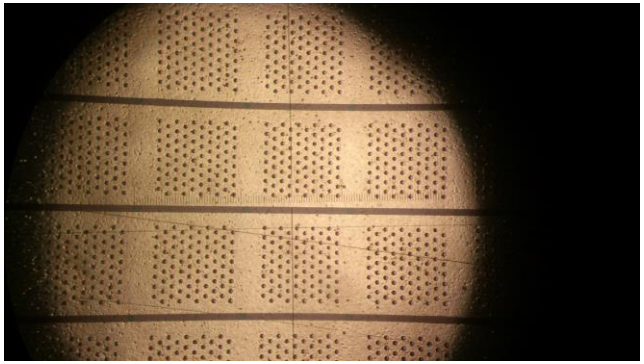


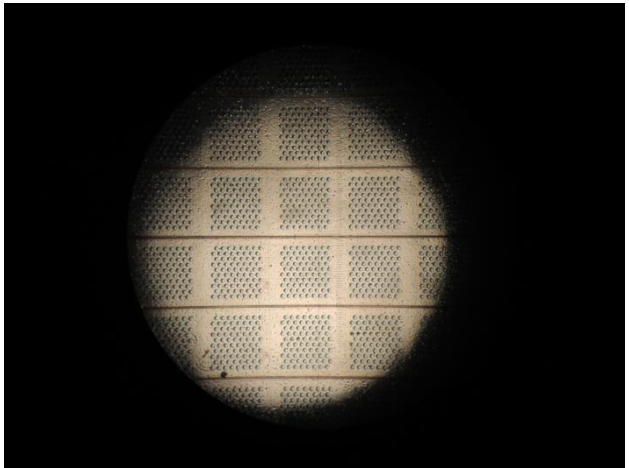




Evolution

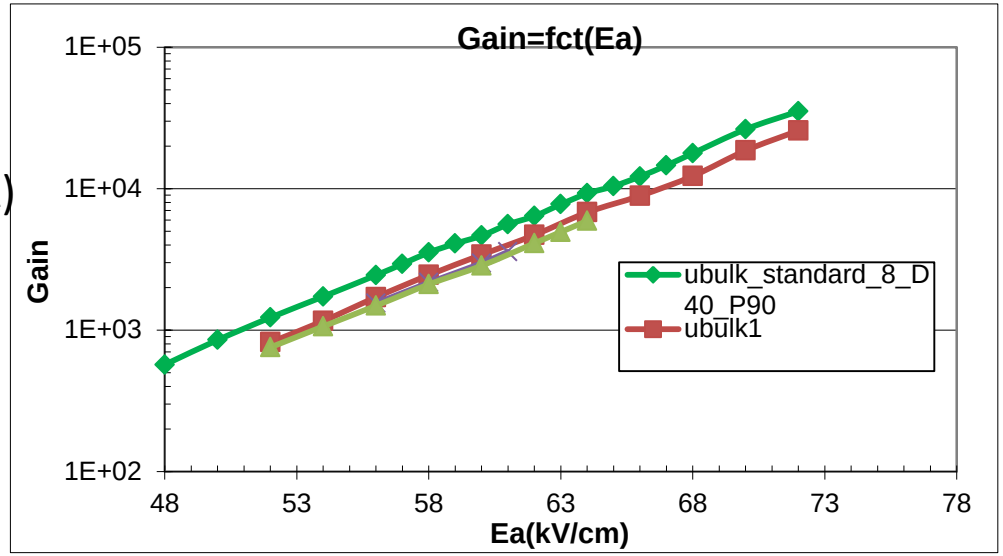


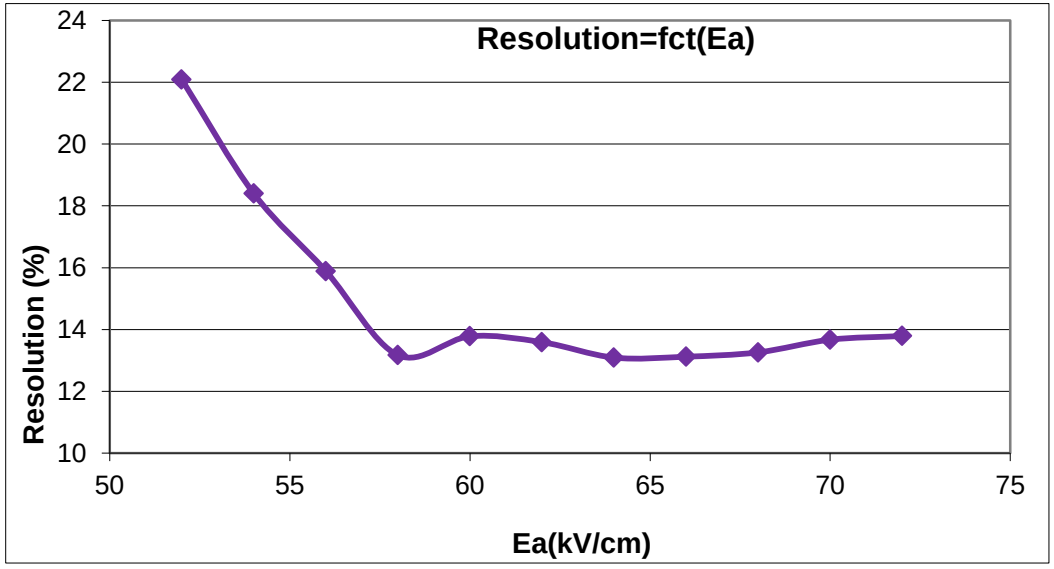




First characterisations (3rd batch)

Ar + 5% Isobutane
Reading the mesh (PA Ortec+ Shaper+MCA)
^{55}Fe source

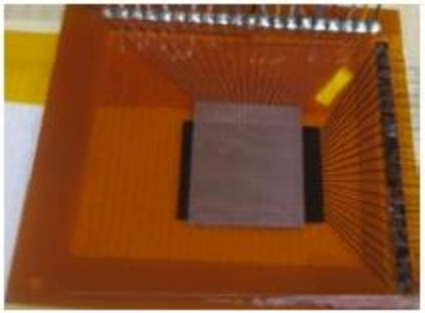




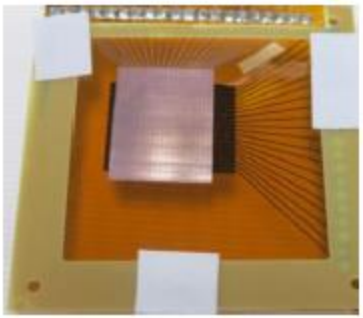
Detector Mounting for reading out the strips

Raw detector

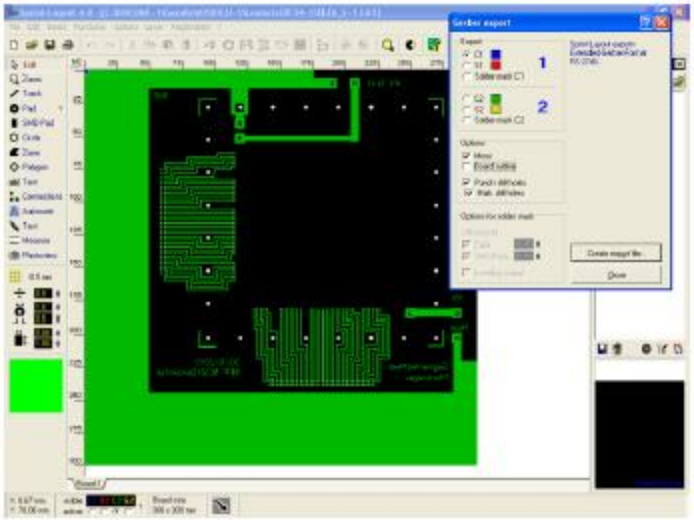
Y-strips side (Mesh)



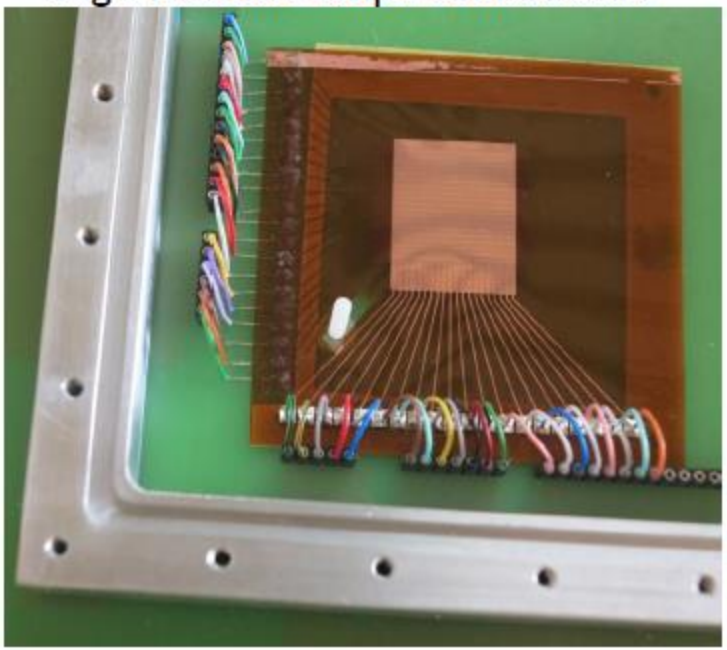
X-strips side (anode)



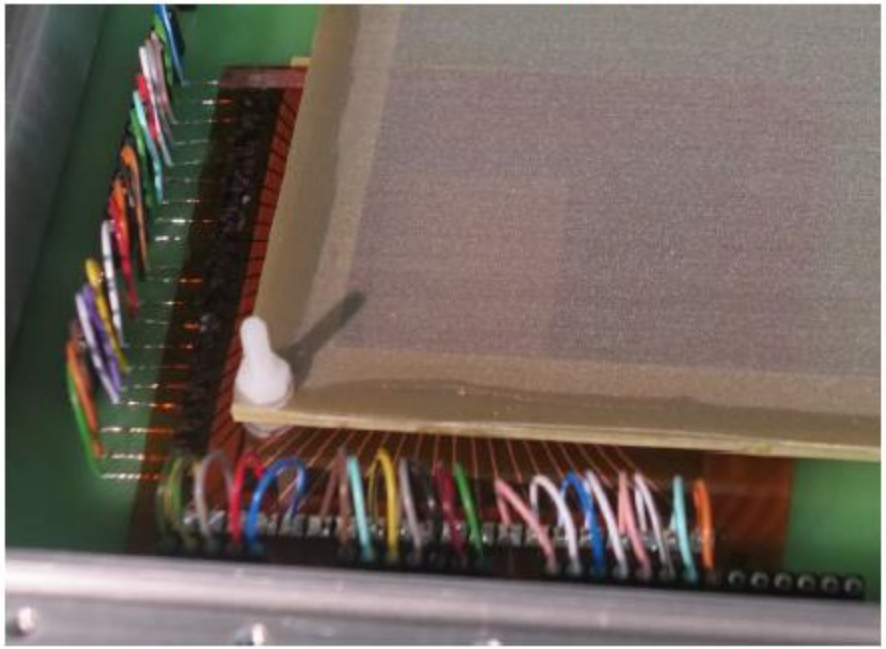
PCB design to host the Microbulk



Segmented Microbulk placed in the Cage with the strips connections



The drift electrode at 5mm



The mesh y-strips FE electronics

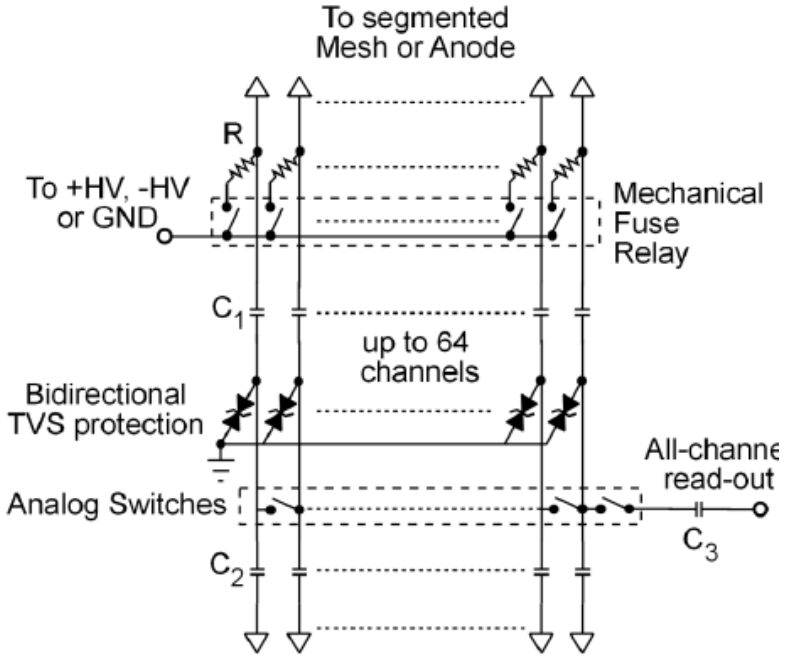
Design, build by Francisco Aznar Zaragoza

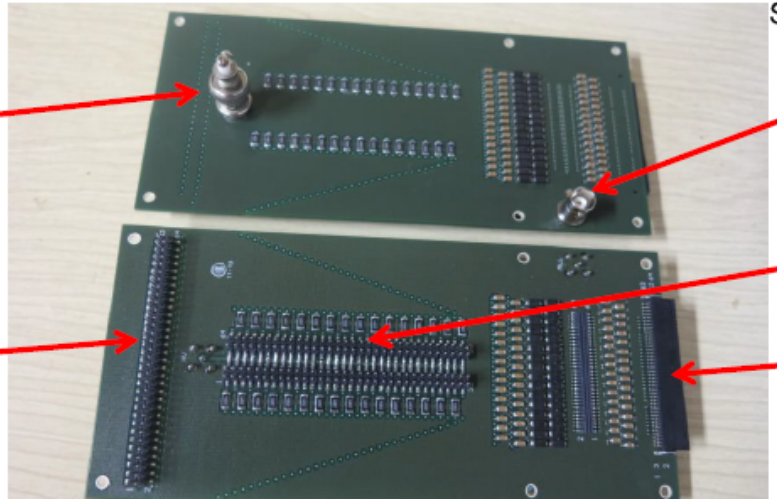
The mesh y-strips FE electronics

y-strips need to be supplied by the bias HV and be readout at the same time to provide the y information. A special Front End readout card was designed.

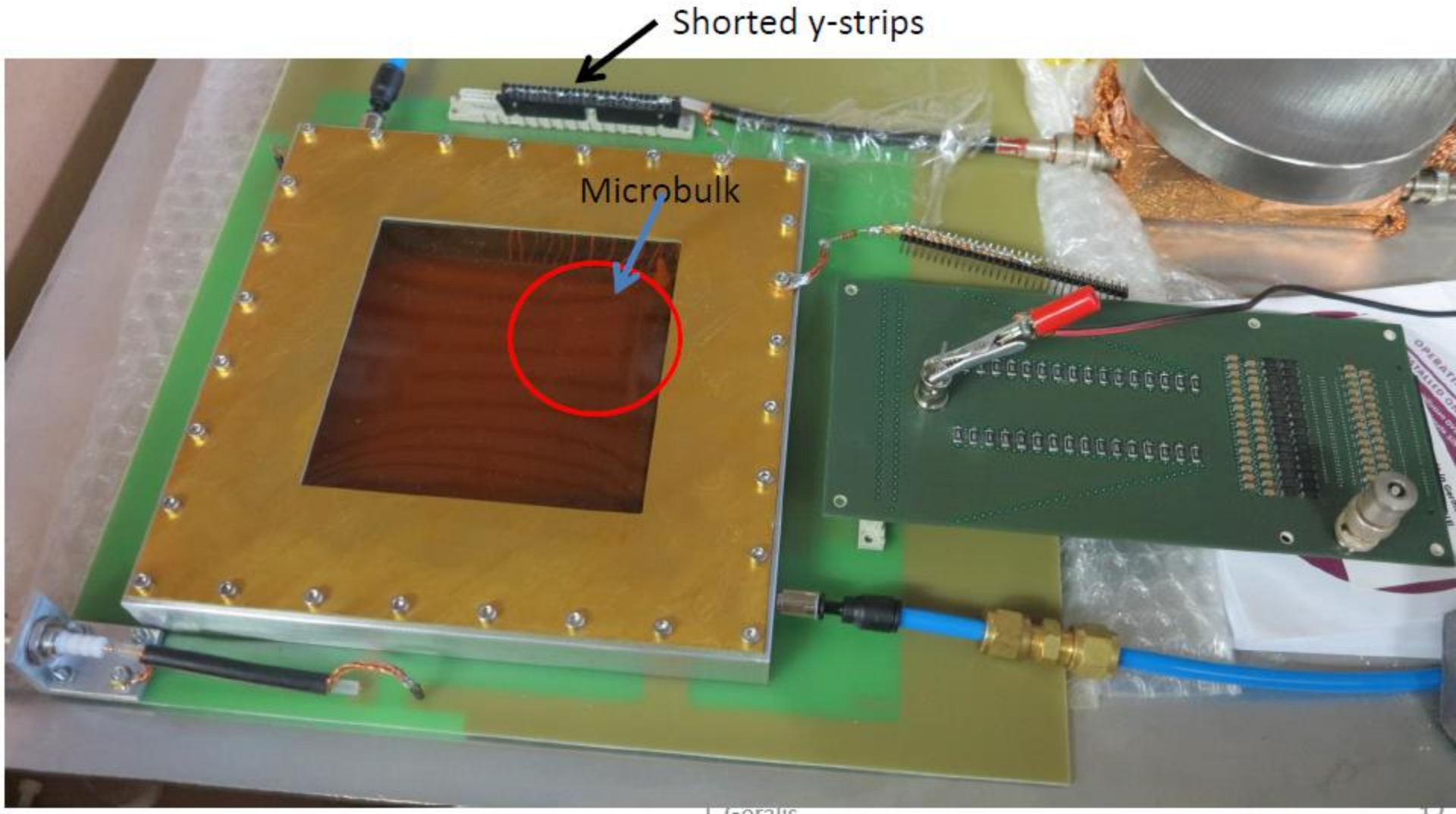
The circuit has the following characteristics:

1) **Readout up to 64 strips,**
2) **HV supply for every strip independently,**
3) **Selection of HV supplied strips individually,**
4) **Transient voltage suppression (TVS) protection and**
5) **Single-channel read-out and all-channel read-out.**

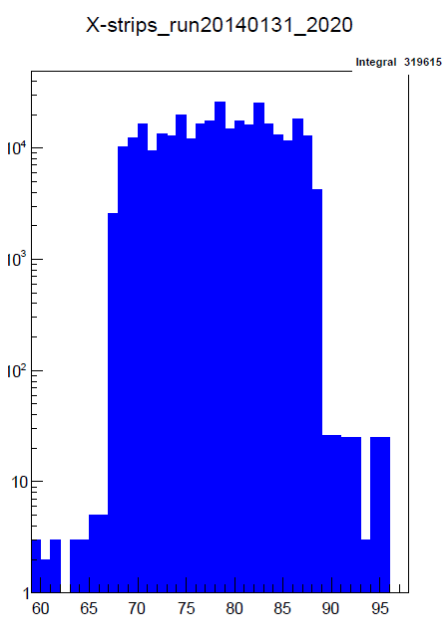


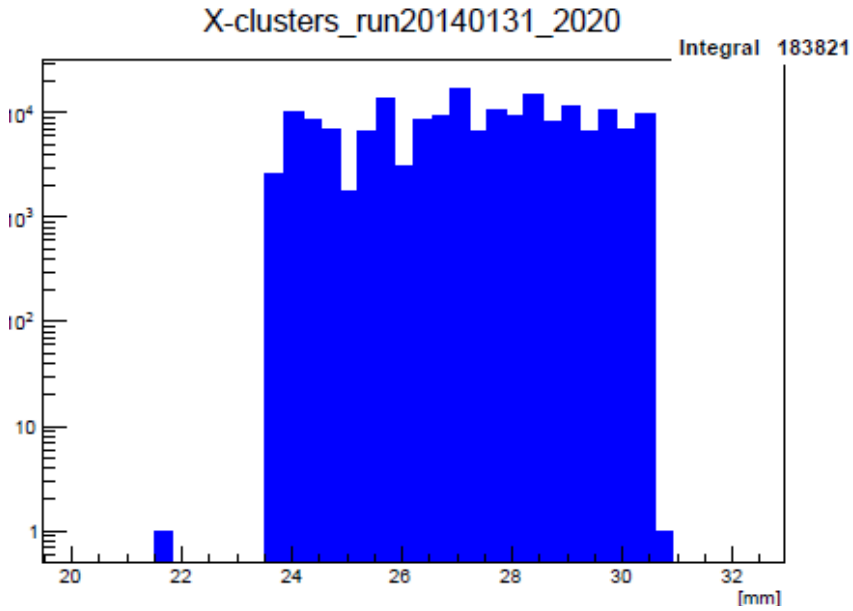


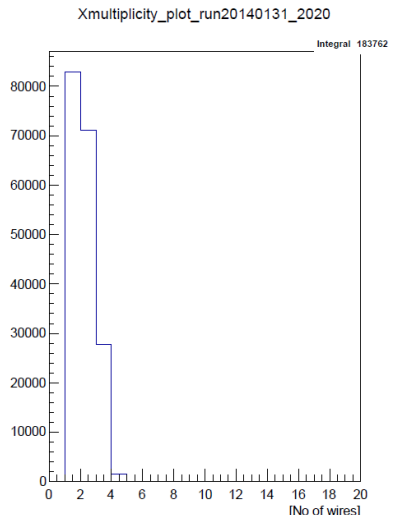
Segmented Microbulk mounted
HV Front-end Readout card connected

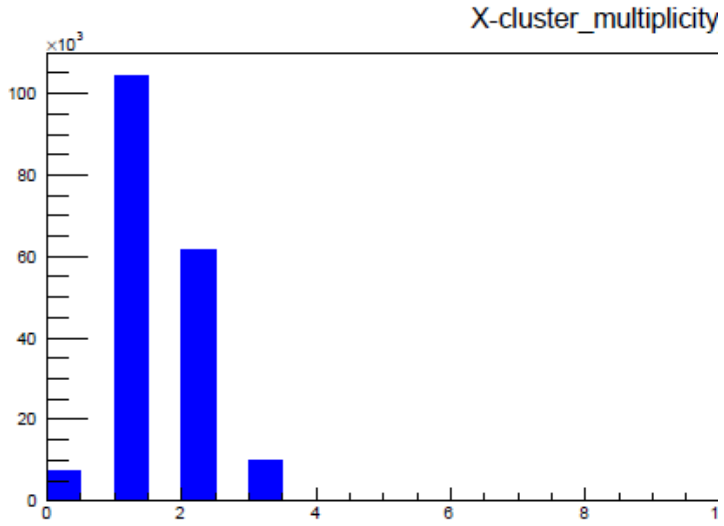


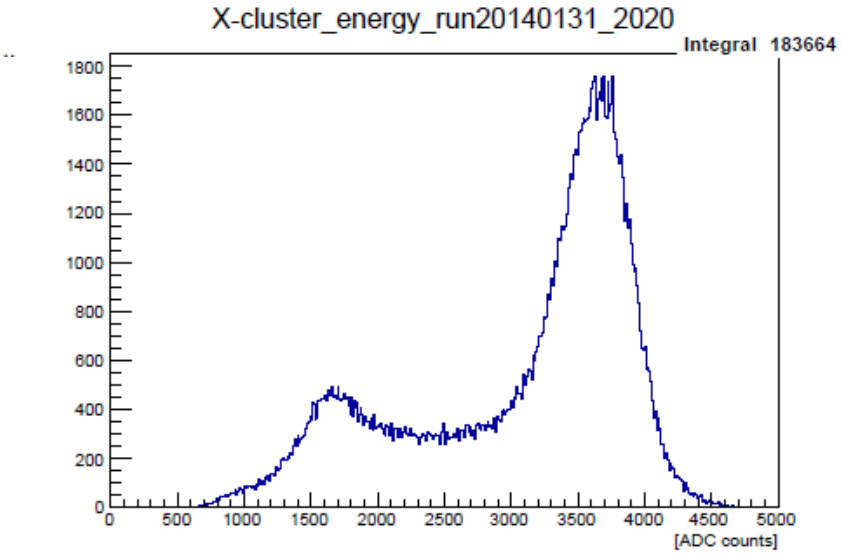
Testing the x-strips with Gassiplex electronics











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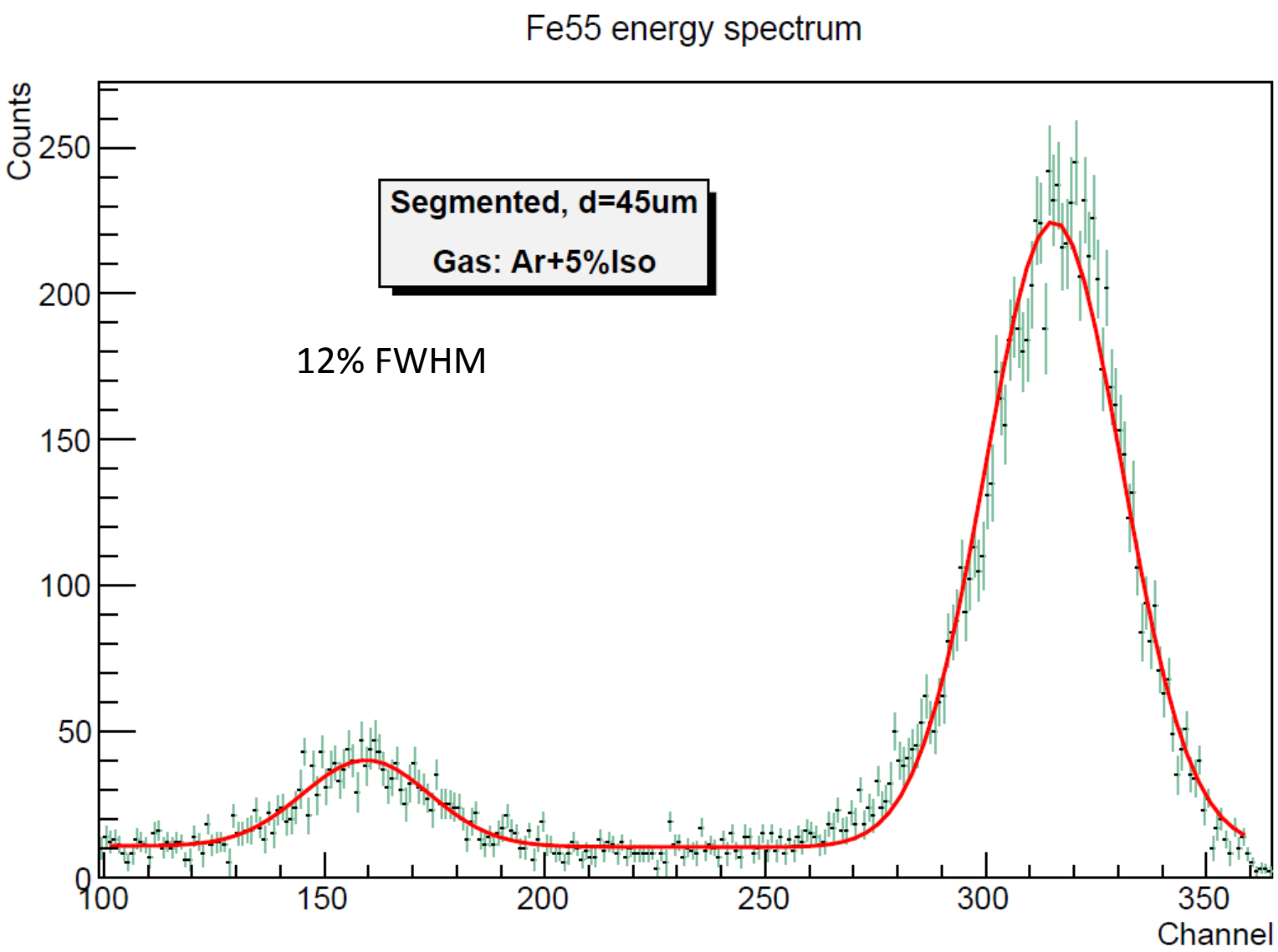


Conclusions and perspectives

•First operational segmented microbulks have been produced: they behave as standard microbulks (high gains, Eres=12% reached)

• Differences of behaviour (Eres) between 40 and 60 µm holes: in the 60 µm there was an alignment problem during manufaturing.

•HV front end card has been validated

•Characterisation on going

Next steps:

•Read Y signals with Gassiplex electronics

•Test with autotrigger electronics: VMM1/AGET

•Optimise design

•Built a large detector with connector: NTOF neutron beam profiler

BACK UP

New Microbulk strip method

Serge FERRY-TE/MPE/EM
28/09/2012

1 Base material 50 µm polyimide foil copperclad

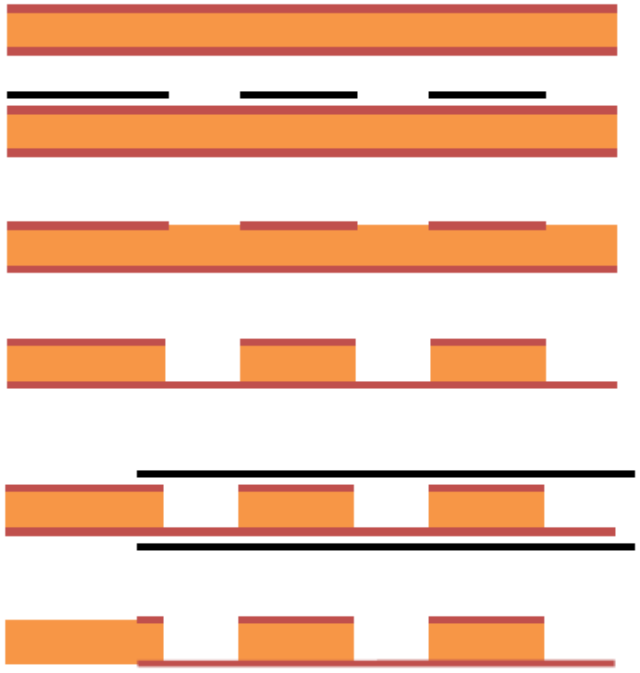
2 Photoresist liquid spinning, masking, exposure, development in clean room

3 Chemical etching of copper grid of holes

4 Polyimide etching by sprayer Fig:microbulkstrip grille.pdf

5 Photoresit lamination on top and bot for making strip,X and Y , masking,exposure, development

6 Chemical etching of copper top and bot + chemical etching of chromium



7 Cleaning + passivation, electrical test at 600v

Improvements:

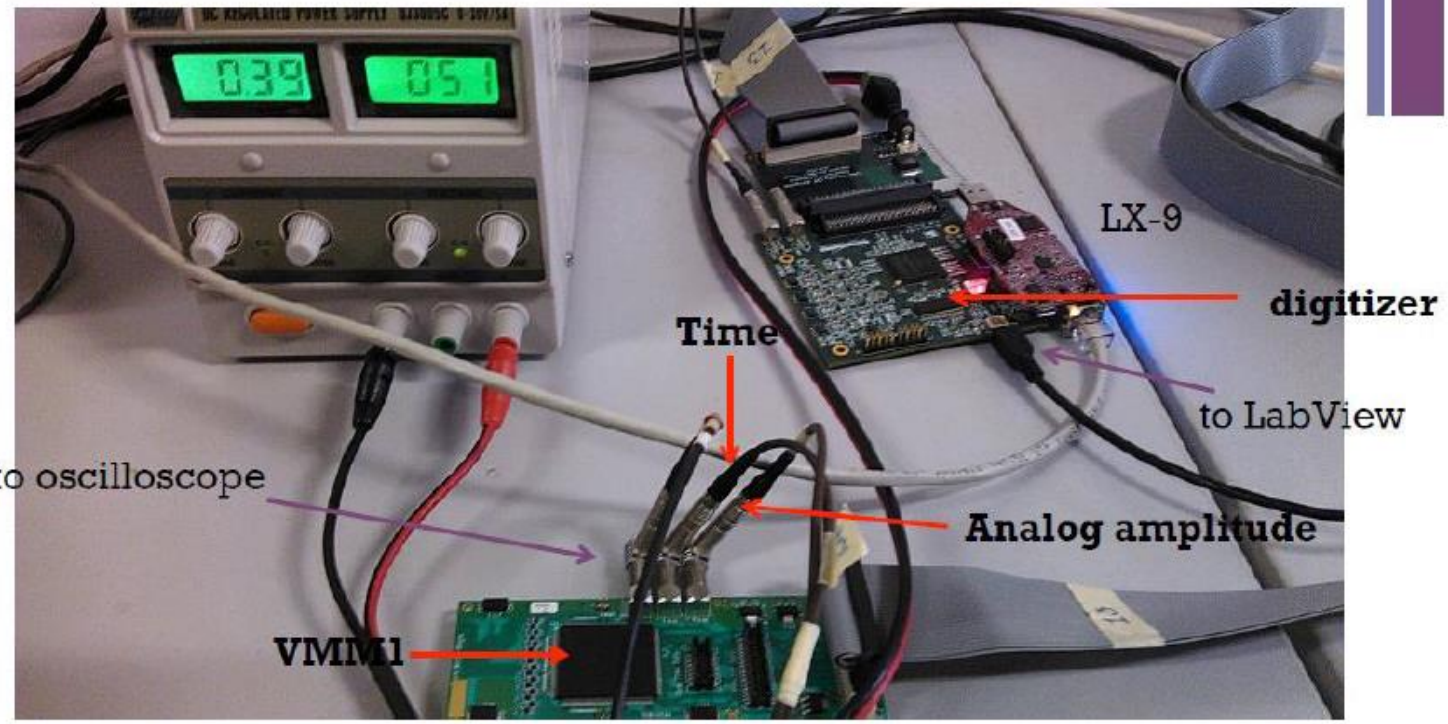
2nd Batch : Develop first the mesh holes and then the x and y strips

No holes above the anode strips gaps

1st Batch: Reverse development order, holes everywhere in the mesh strips

Waiting for the AGET electronics,
we plan to use the VMM1 readout

VMM1 read-out chip setup

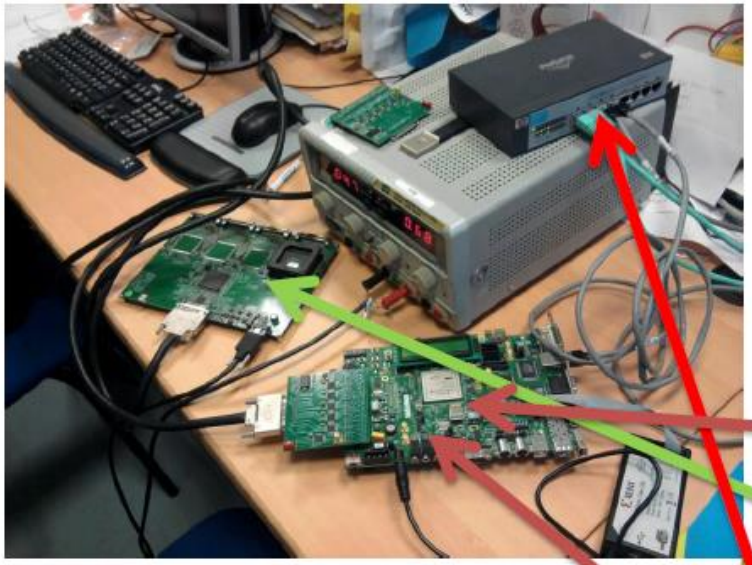


We currently work to adapt the VMM1 electronics to readout the Segmented microbulk
We possess one card with the capacity to readout 64 channels

VMM1 (ATLAS ASIC for MAMMA): Auto trigger, amplitude and timing information,
neighbor channel logic.

We were planning to use the AGET Readout, but it is not yet available

AGET TestBench

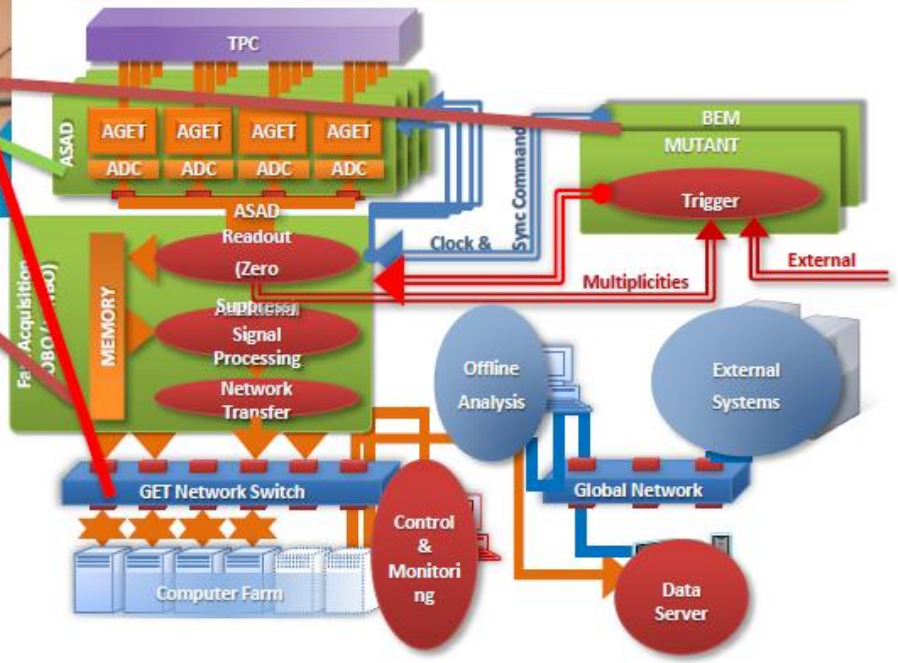


→ **Reduced Get**
- → 1 AsAd
- → 1 R-CoBo (ML507)

GET Status from F. Druillole

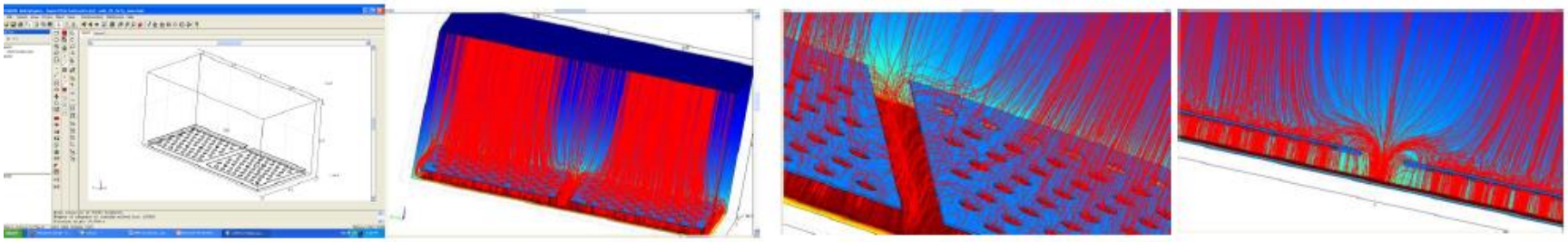
- Actual system : Aget testBench – R-CoBo + 1 AsAd + 1(4) AGET -

1800000 evts in 14h
→ 35 evt/s



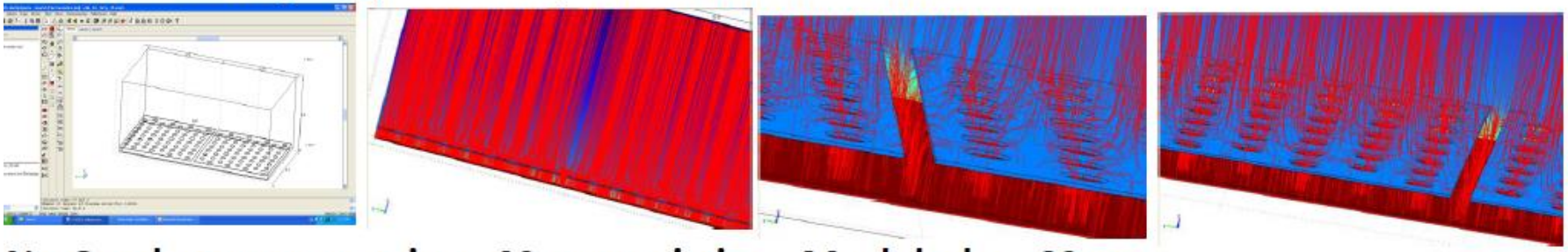
Layout Optimization using Comsol

Gap between y-strips: 100 um, Mesh holes: 50 um



Gap between y-strips: 40 um, Mesh holes: 60 um

Electric Field



No Gap between y-strips: 40 um resistive, Mesh holes: 60 um