DHCAL activities @ IPNL

- R&D on GRPC
- R&D on electronics connection
- New chip development
- Software development for the 1 m2 readout
- Simulation effort

I.Laktineh

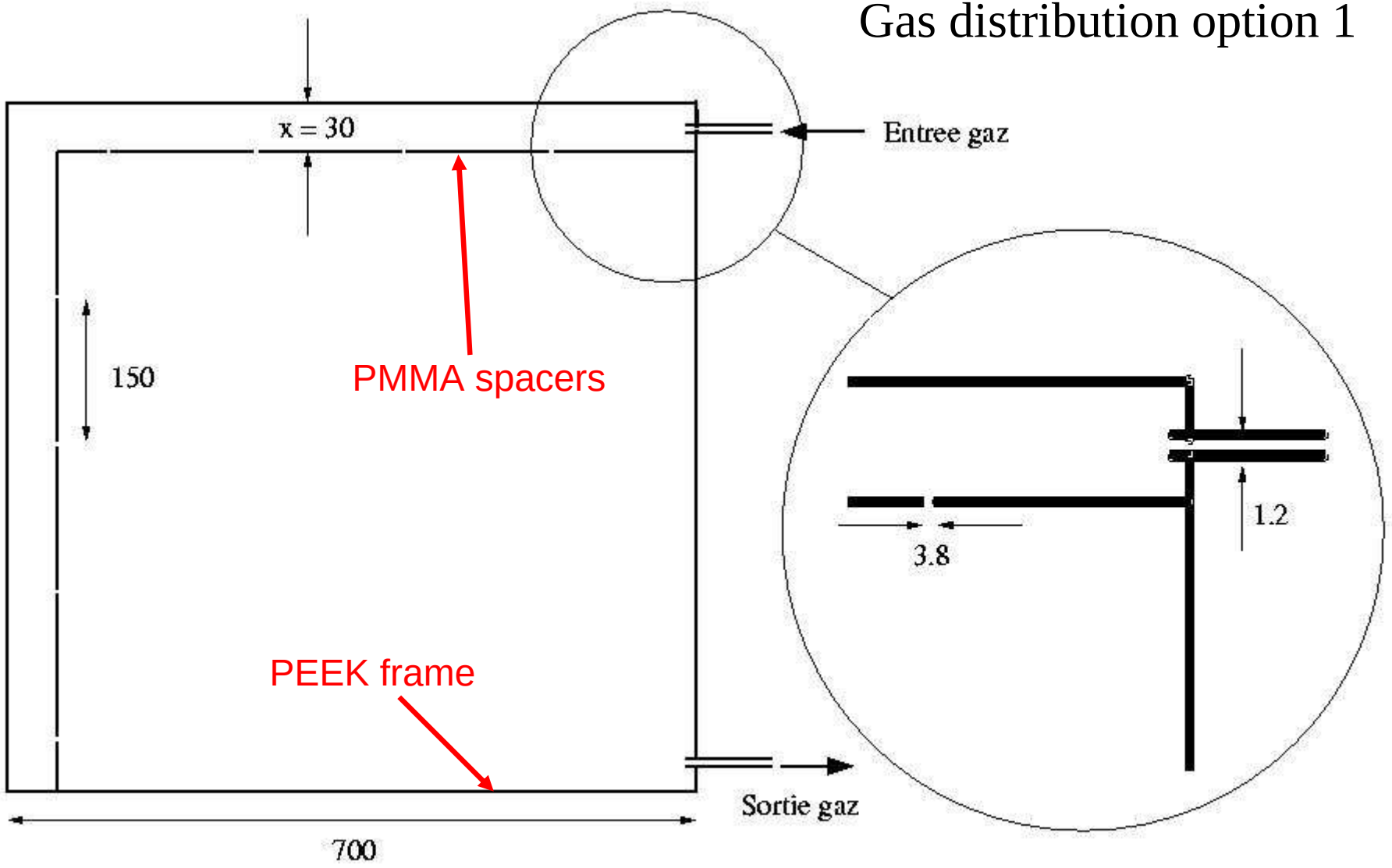
R&D on GRPC

- Aim: to construct a GRPC size 1m x 1m by end September 2008
- Constraints:
  - Max. thickness (incl. readout PCB): 6mm
  - Minimum possible ‘dead’ regions
  - Uniform gas distribution
  - Robust design to avoid breakages
  - Preferably dismountable (no glue between absorber / PCB / glass)
  - Eye to industrialized production (~2500 m^2 of GRPC in final detector)

Detector baseline

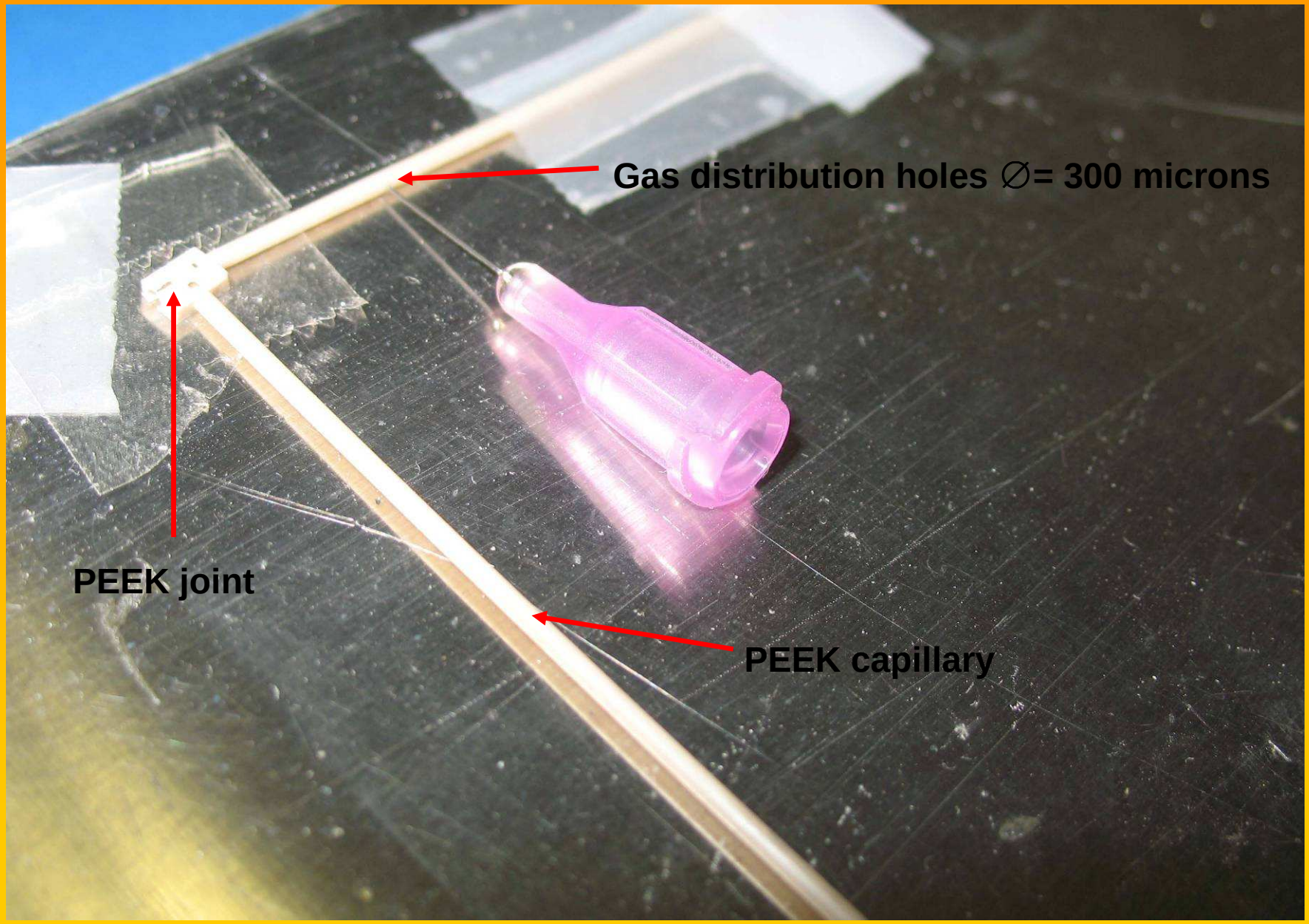
- Glass: borosilicate; anode 0.7mm, cathode 1.1mm
- Glass layer separation: 1.2mm
- Gas-tight frame to separate glass layers
  - PEEK or FR4 (or equivalent)
  - OR: frame constructed of PEEK capillary tubes punctured by holes to distribute gas
- Ceramic balls diam. 1.2 mm to provide mechanical support of gas gap (glass weight + electrostatic forces)
- Semi-conducting anode / cathode layers: ‘Licron’ product
  - Resistivity: ~ 20 MW/□
  - Layer thickness ~ 20 microns

Gas distribution option 1

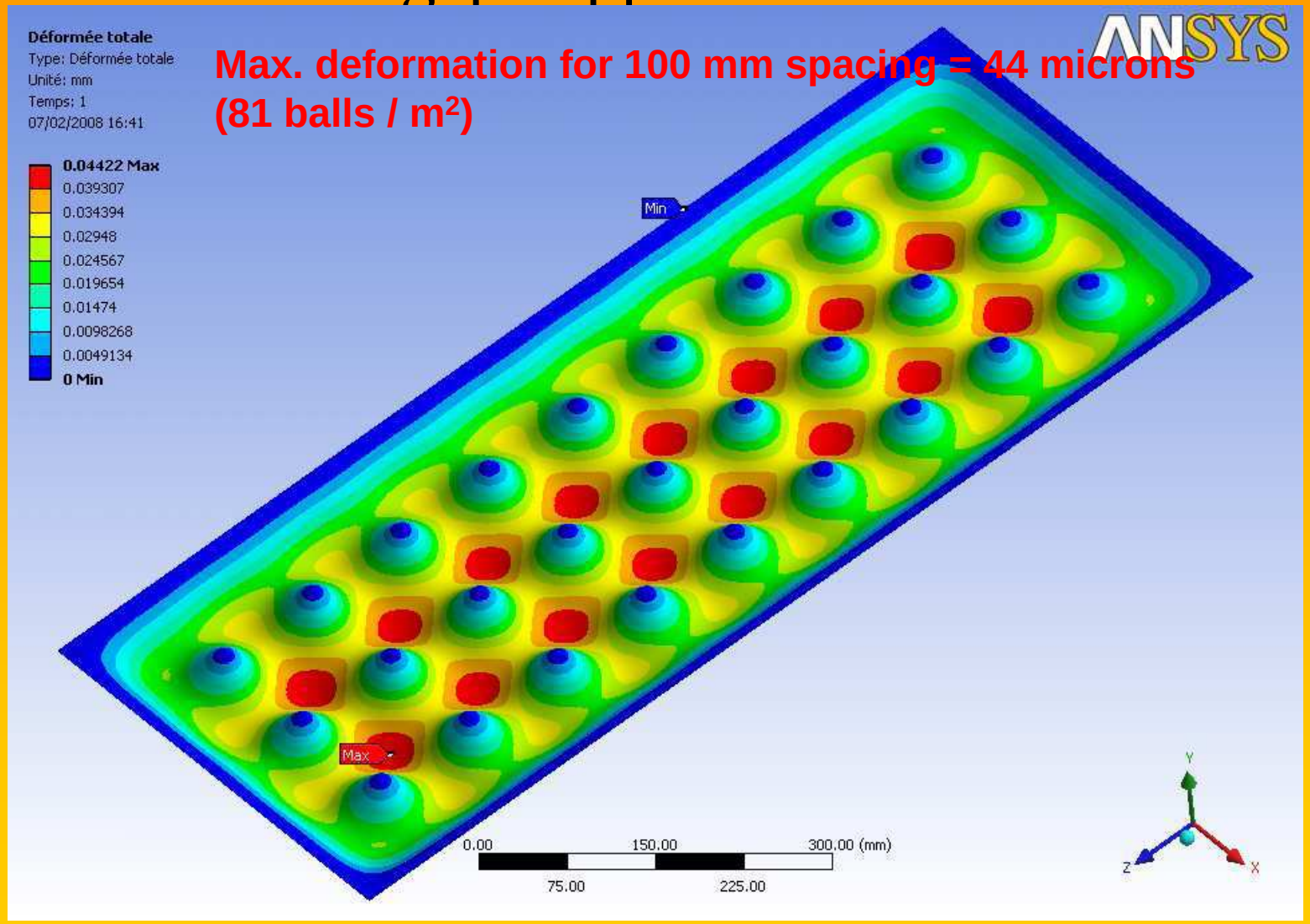


Largeur des piquages = x / (Nombre de piquages)

Gas distribution option 2

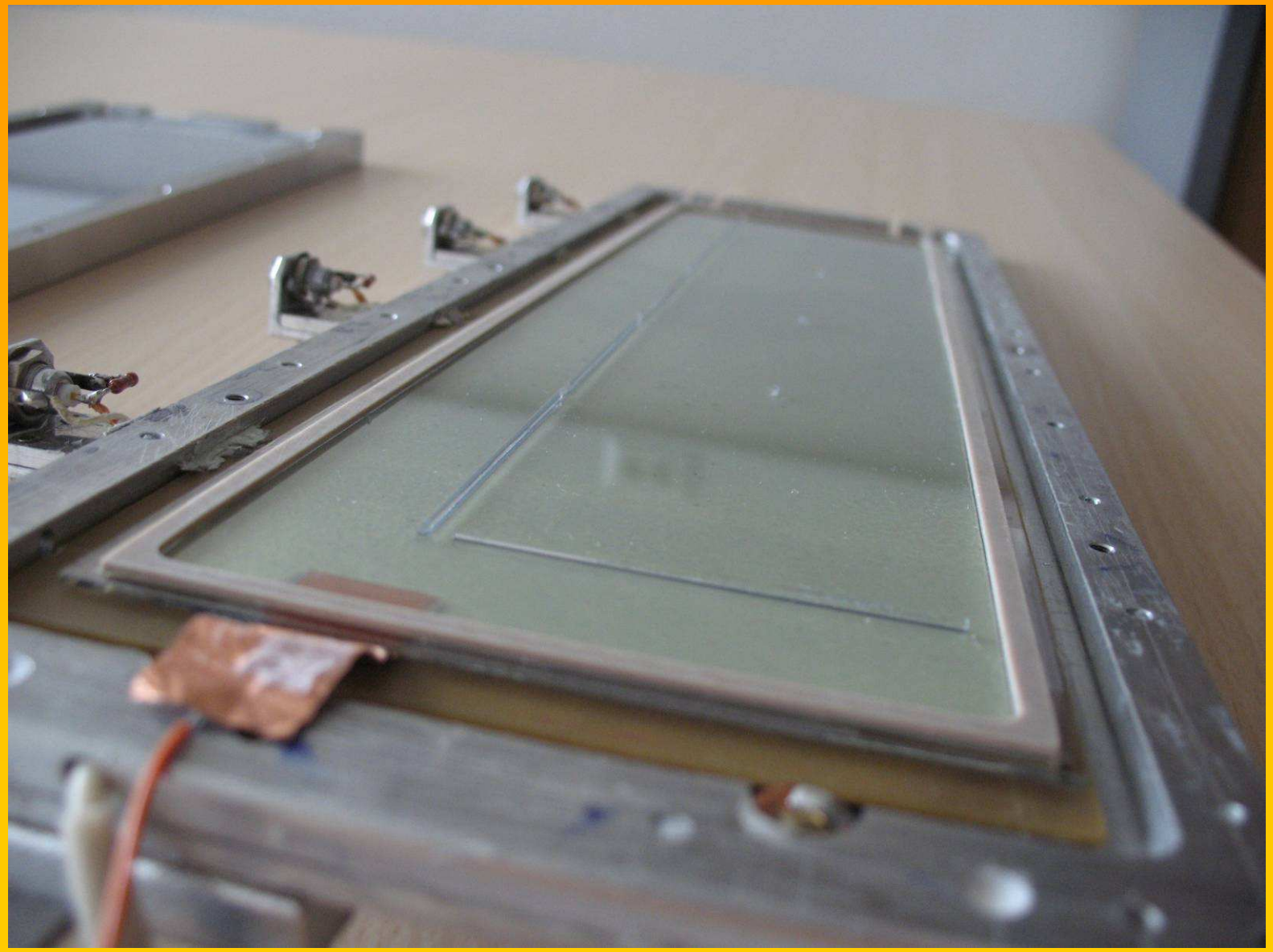


Gas gap support – ceramic balls



Glass + Licron layer + electrical connection (Test chamber 345mm x 85mm)

Test chamber: PEEK frame + PMMA spacers



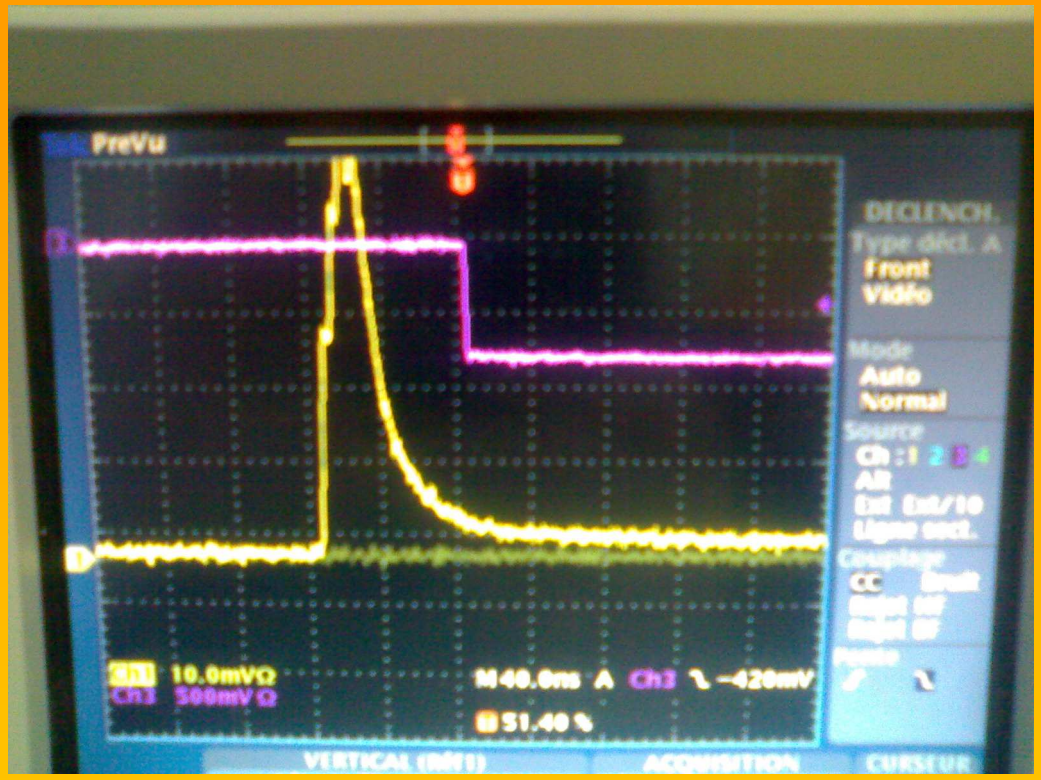


Image of the cathode signal of the Lyon GRPC with peek frame and pmma spacer

Efficiency%Multiplicity to come soon

R&D on Electronics connection

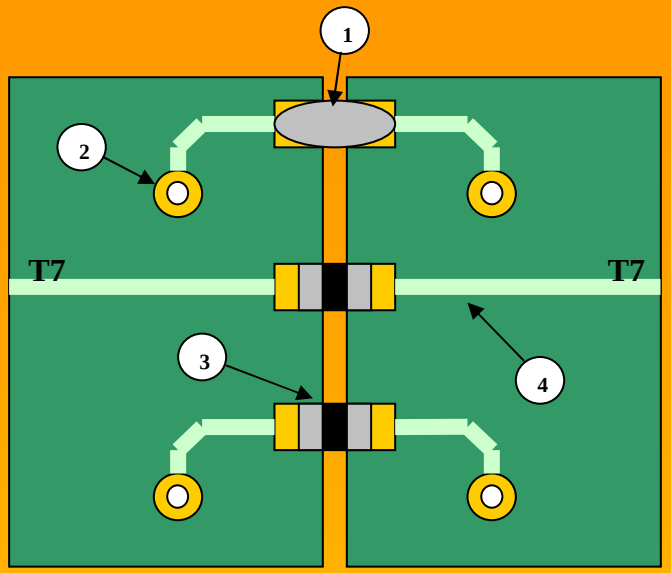
Many factors favor using rather small PCB than very large one : Industrial capacities, chips drawback issues, PCB rigidity problems …

The question is what is the optimized pcb size to chose and how to connect the different PCBs on one detector.

Two problems to be solved:

- Electrical issue
- Mechanical issue

Electrical issue



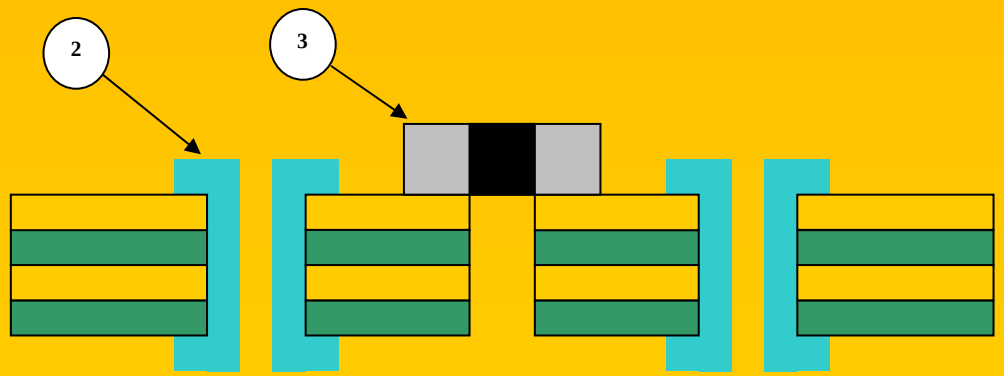
1 weld

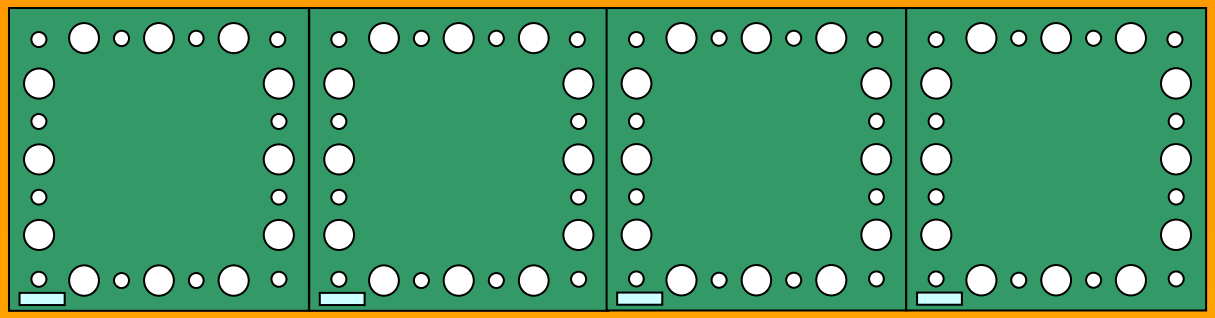
2 Via

3 0 ΩResistance

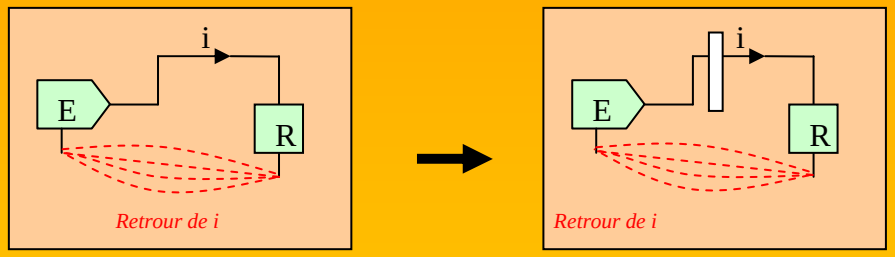
4 Pist

Schematic view of possible connections between two pcb

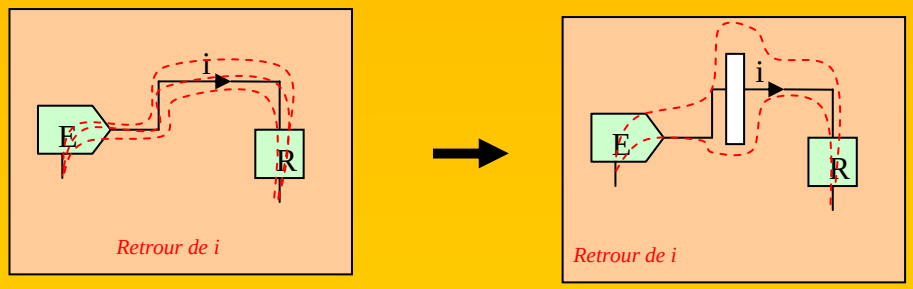




4 PCB with 8X8 pads with the same structure of those used in the 4-Chip ones are built to study the connection and its effect on the signal.



For low frequency the signal is not affected by the discontinuity



For high frequency the signal is affected by the discontinuity (an inductance of 1nH/cm)

The measurements we realized confirm the prediction and give an estimate of the number of discontinuities that we may allow for one detector plan.

Mechanical issue

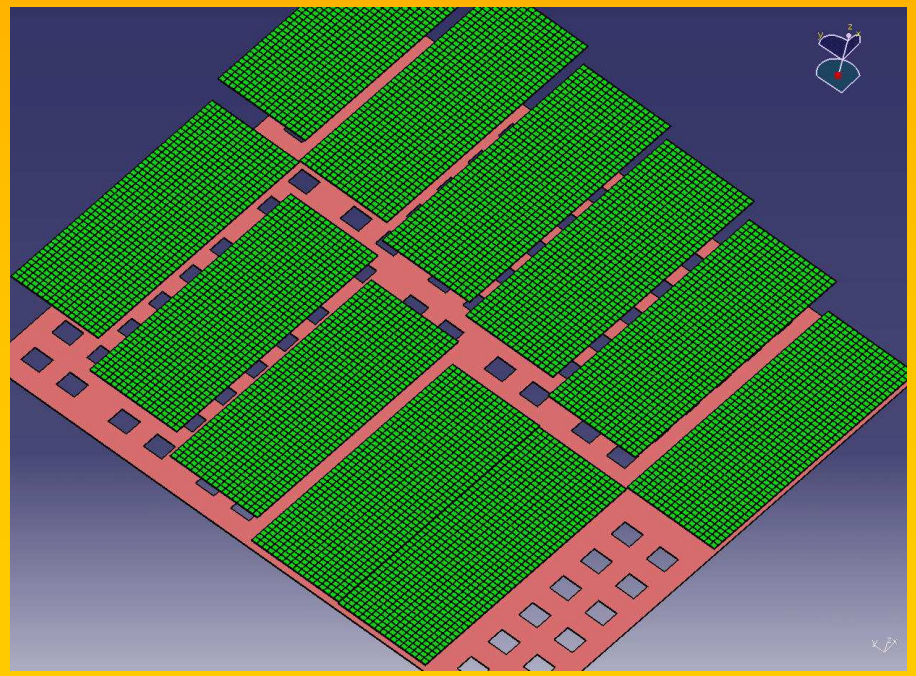
For 1 m2 detector, 12 PCB each with 12 hardrocs can be a good compromise

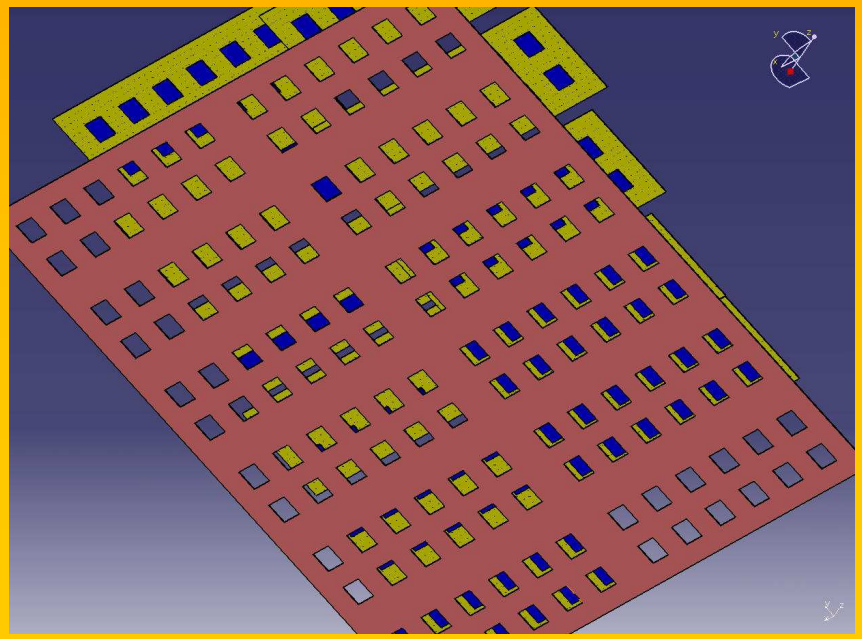
To fixe them, a support made of dummy low density rigid material Epoxy/FR4/Carbon fiber can be used (CIEMAT). Thickness is that of the chip box.

This support contains holes to host the chips boxes.

The PCB could be fixed on the support either by glue or by screws(M1).

The screws option is rather temporary



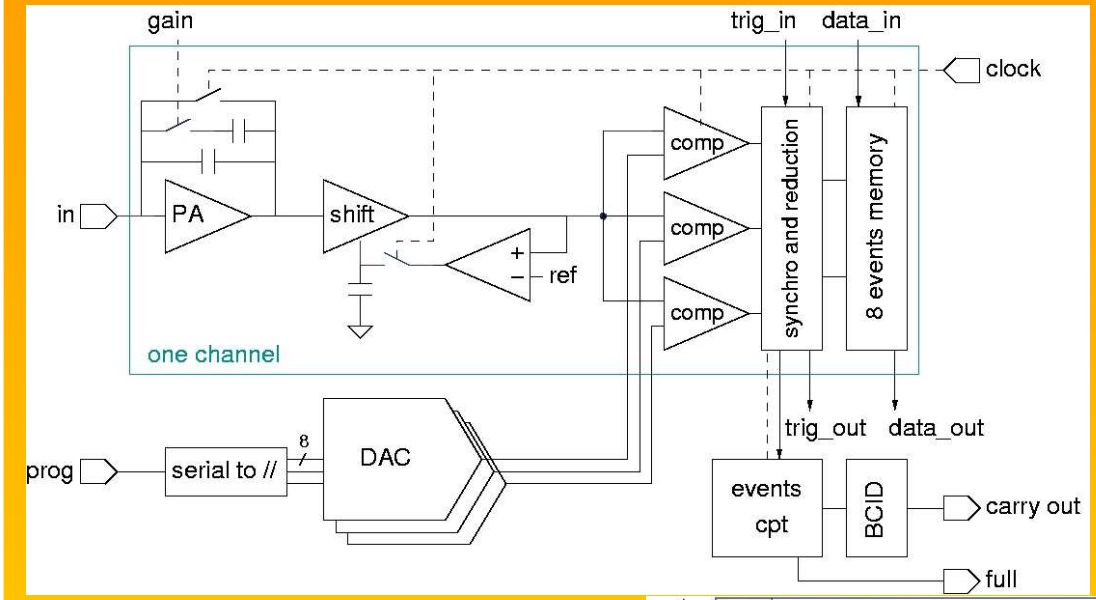


Other DHCAL activities @IPNL

- New chip development
- Readout software activities
- Detector Simulation

Electronics activities @ IPNL

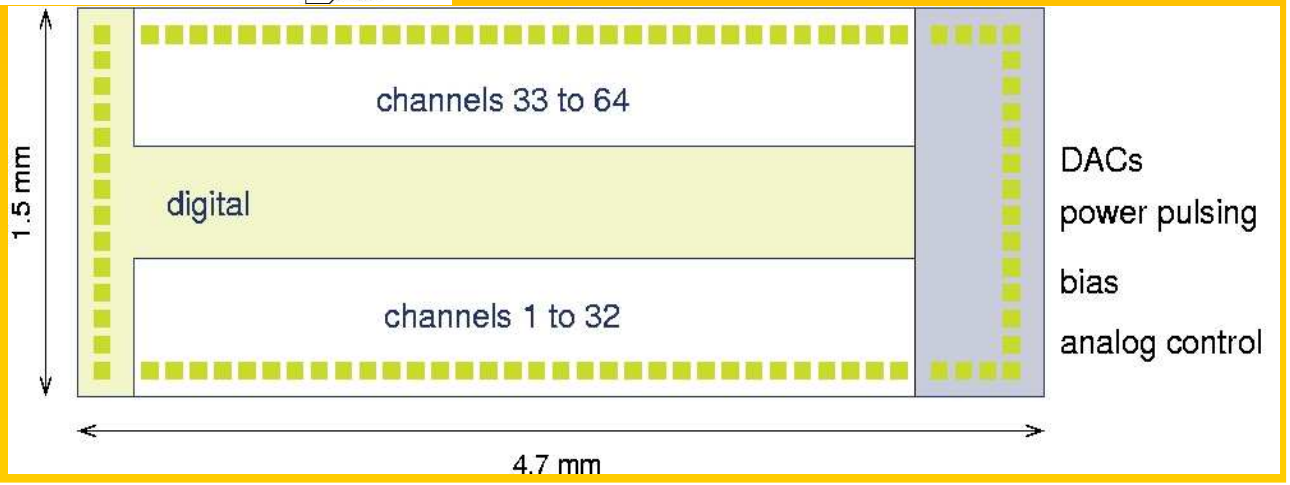
A new chip able to cover a large dynamic range (GRPC&μMEGAS) is under development @IPNL

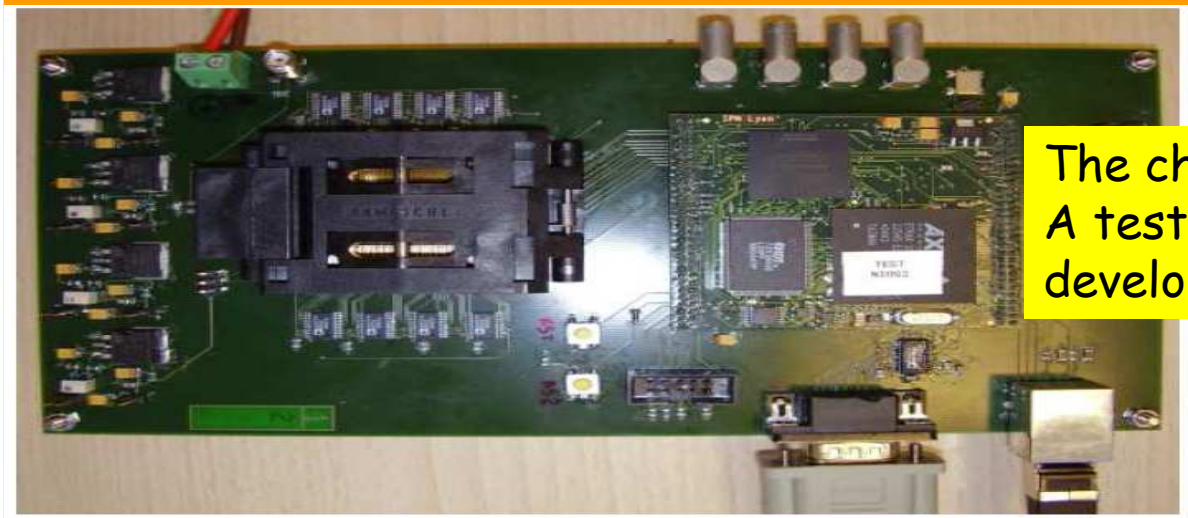


3 DACs (8 bits each)
BCID = 12 bits
memory depth= 8 ev.

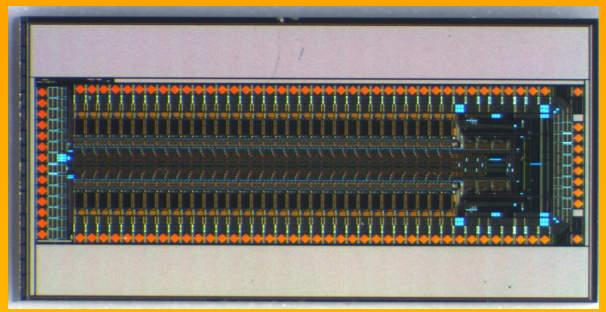
64-ch chip
CMOS tech
power pulsed

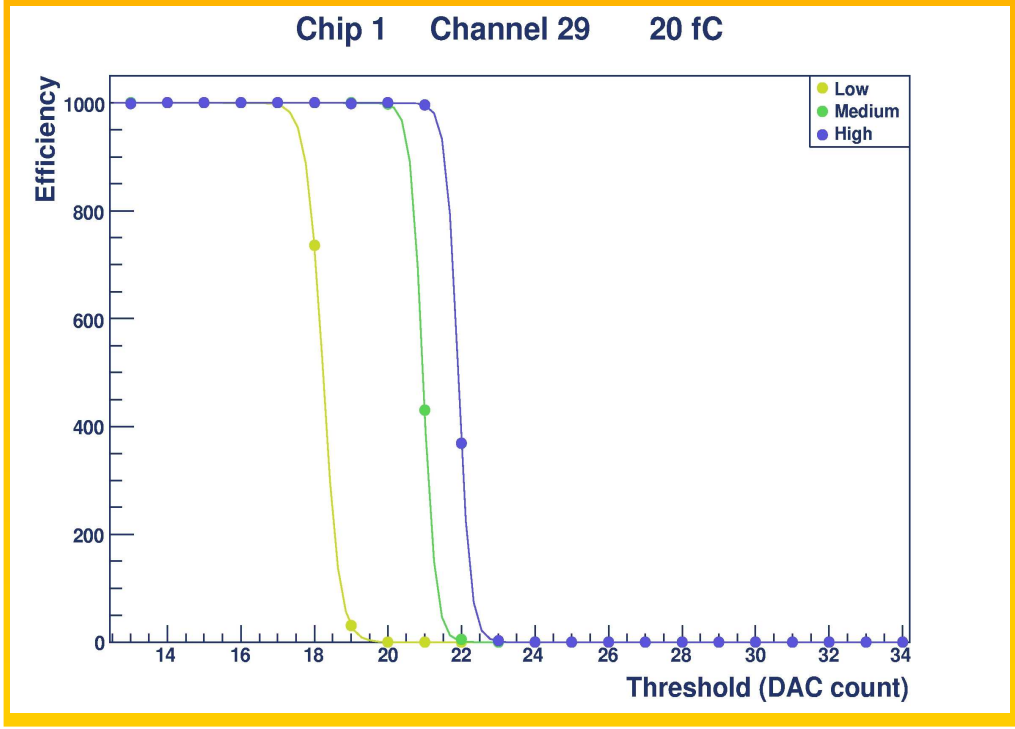
Simple geometry





The chip was designed and produced.
A test board using OPERA DAQ developed @IPNL was used.



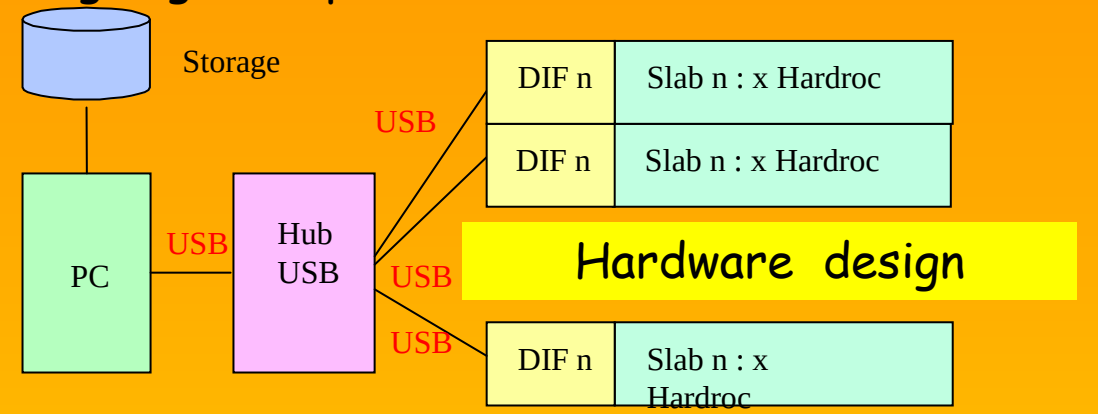


First results:
Mode µMEGAS
0.8 fc/DAQ
Resolution < 2.5 fc

Tests and improvement are going on

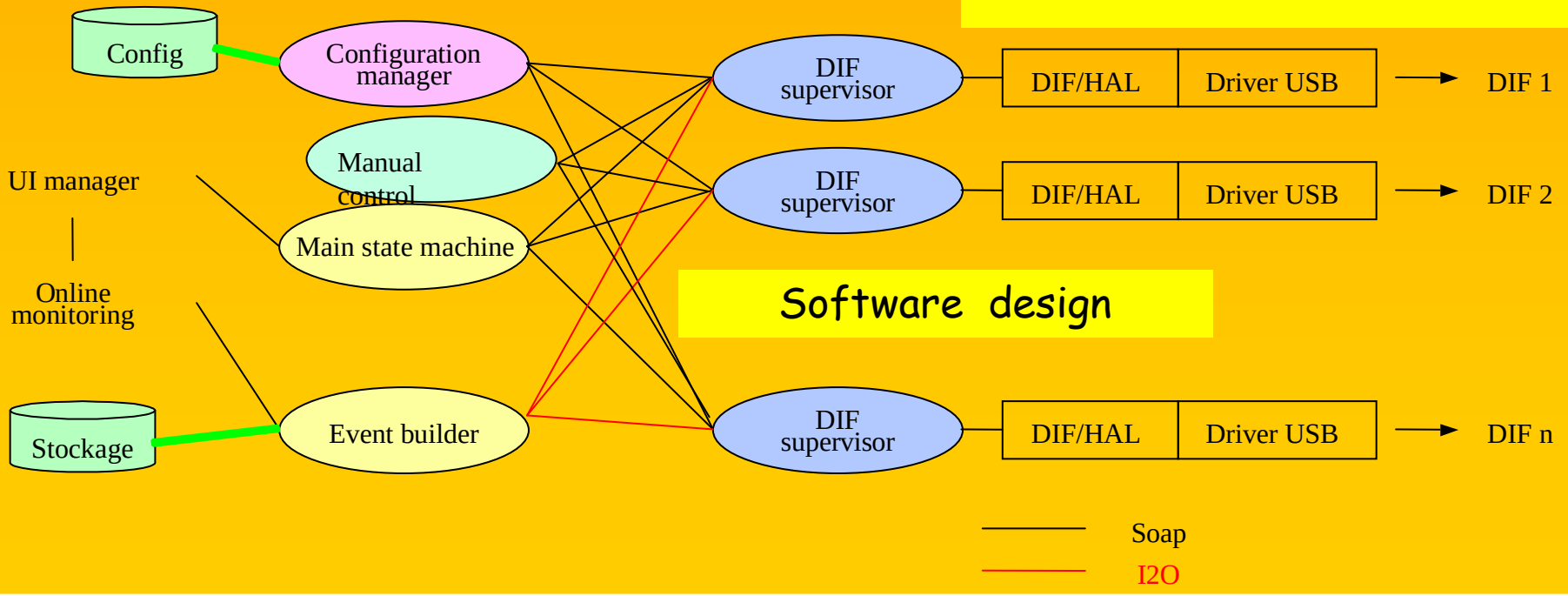
Readout activities @ IPNL

Software development for the 1 m2 readout based on USB is going on in parallel with the DHCAL-DIF development.



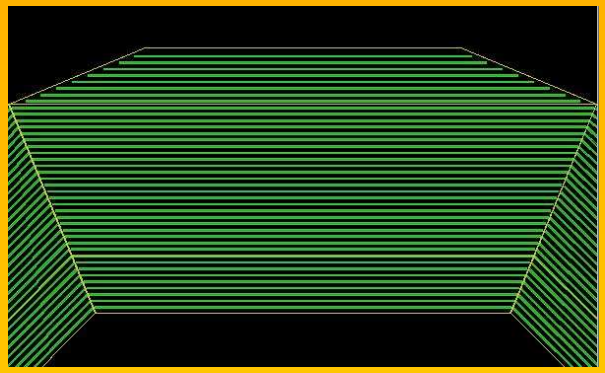
Hardware design

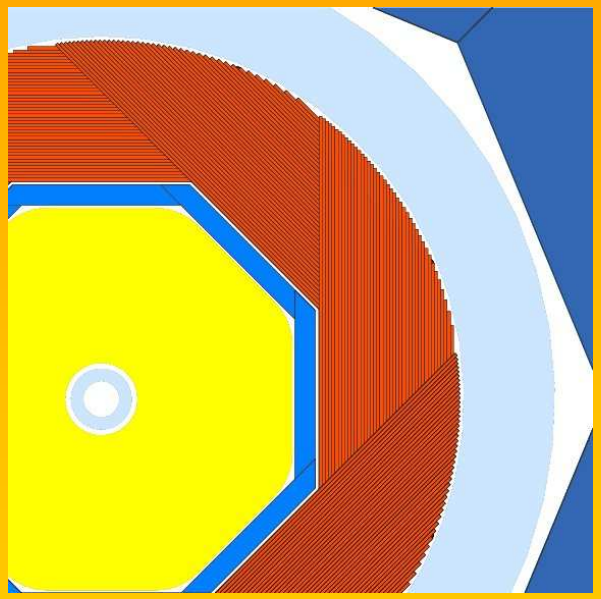
User interface through a web browser (OS-independant)PC(s) running Scientific Linux 4



Simulation activities @ IPNL
in collaboration with LLR

Aim: Introducing the DHCAL in MOKKA with:
1- Realistic detector design as close as possible to the final detector (dead zones …etc)
2- New geometry (Videau proposal) :

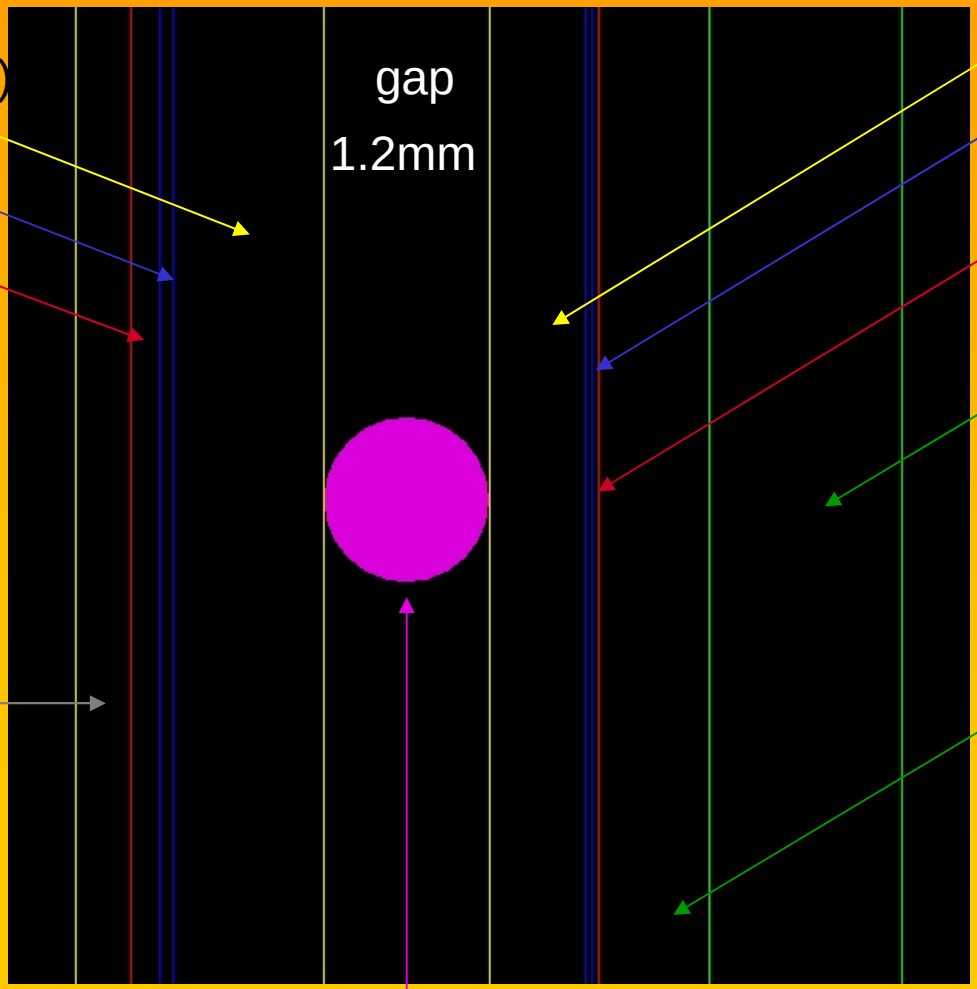




Barrel: 5 sectors. sector = 8 modules
1 module = 40 (detector-absorber) plan

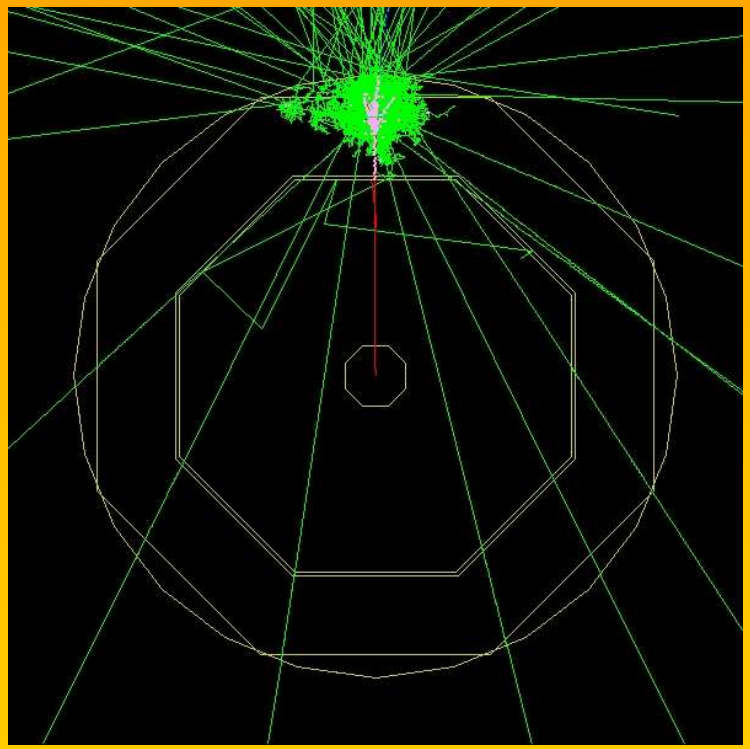
No crack, gas and HV issues solved

Cross section

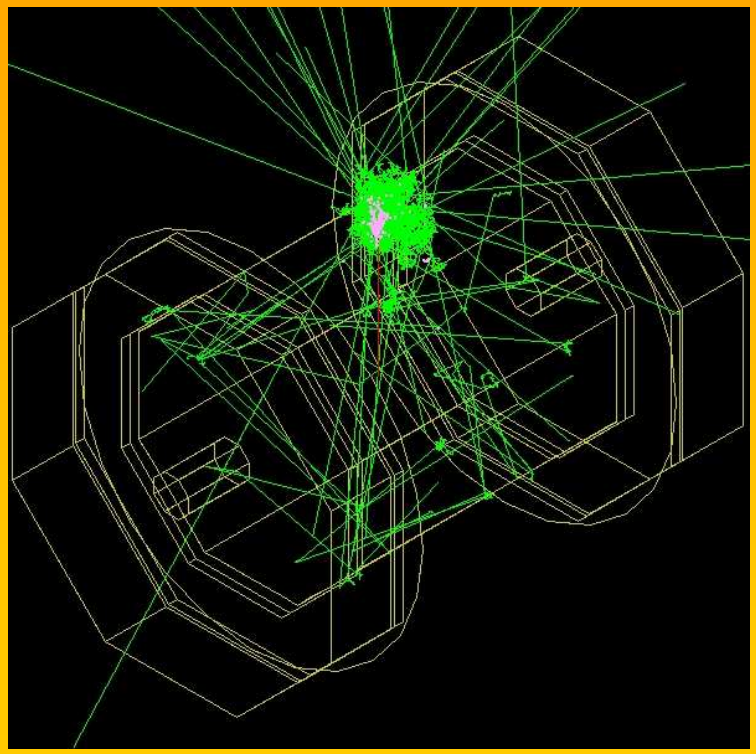


Example of full DHCAL

Event with a 20 GeV π



Normal to z-axis



Normal to (1,1,1) axis

The endcap geometry is kept as before

Outline

- Many activities are followed @IPNL in collaboration with the European groups.

- Good results are already obtained but many efforts still to be done for the technological prototype.