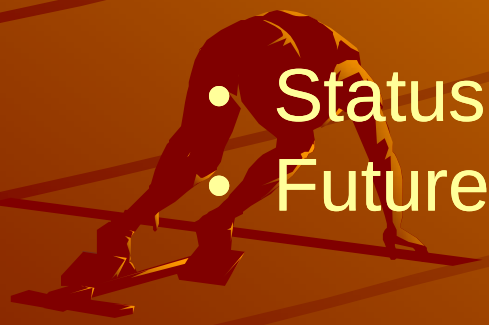
European DHCAL development

CIEMAT,IPNL,LAL, LAPP,LLR, PROTVINO, SACLAY



- Status : detectors, electronics
- Future projects

Imad Laktineh
IPNL

Detector Study

GRPC : **Protvino, IPNL**,…
8X8 pads, 8X32 pads, 1m2
(advanced state)

µMEGAS : **LAPP, IPNL**,….
8X8 pads, 6X16 pads, 50X50 pads…
(need more efforts ⇒ Saclay)

Efficiency, cross-talk, homogeneity studies,
new gas mixtures… : ongoing

Protvino activities

Combined RPC

Protvino results confirm first observation of ANL group about combined RPC – low hit multiplicity, <m> ~ 1.1 at 95% With 400 V plateau.
It seems that the combined RPC is promising option for the DHCAL.
Long term stability study of combined RPC is underway.

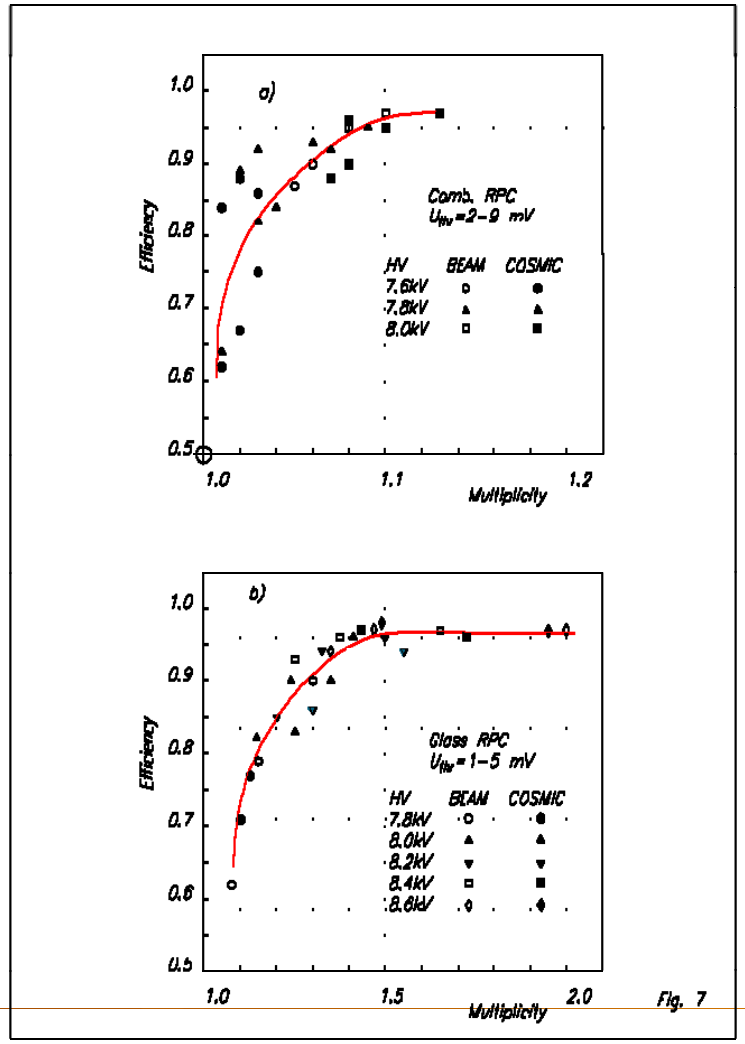
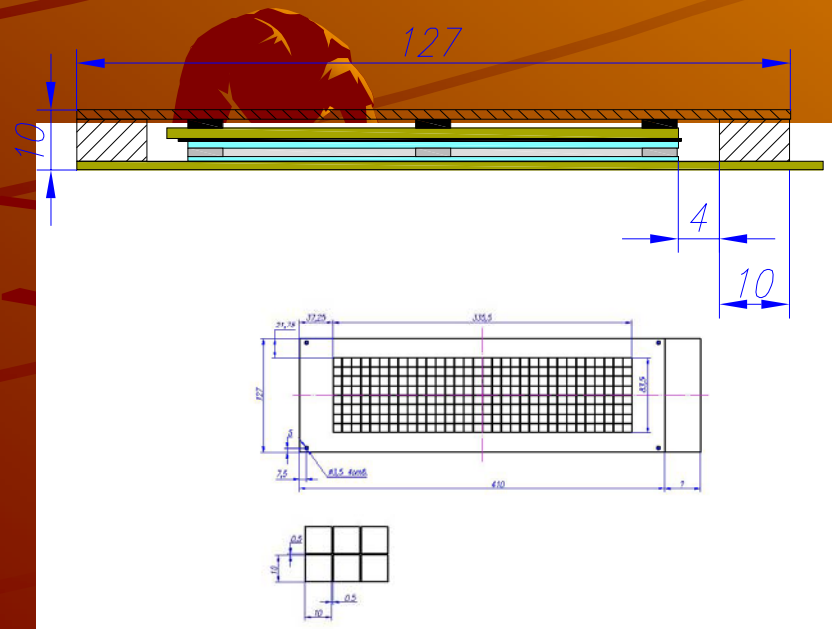


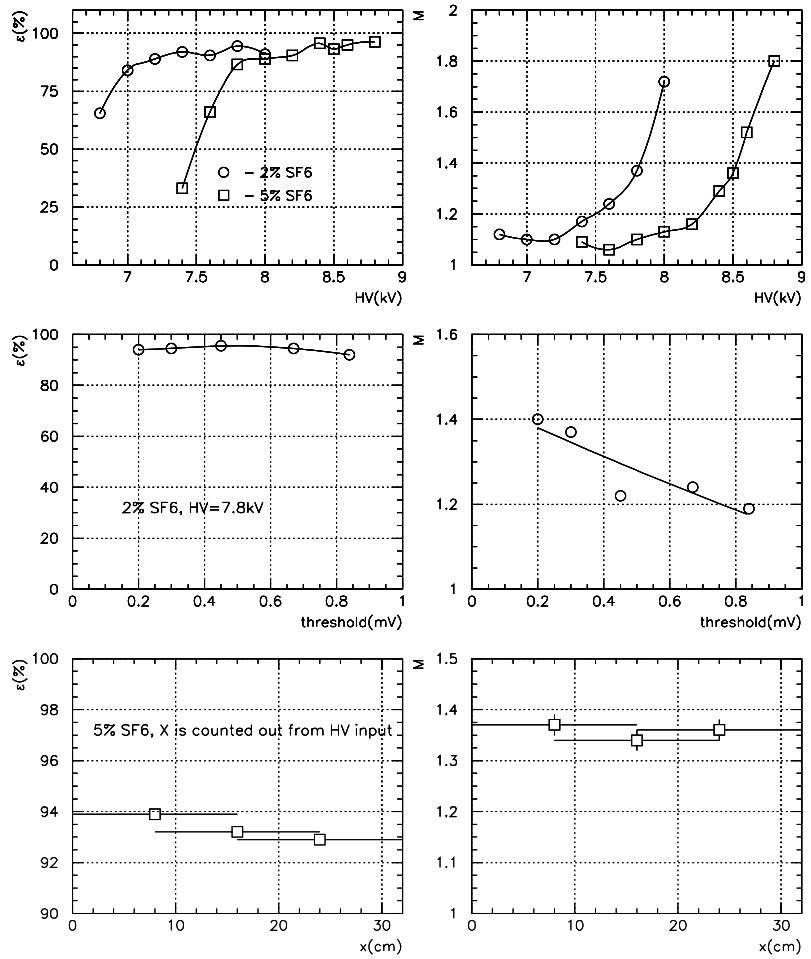
Fig. 7

Protvino activities

8X32 pads RPC

4 RPCs for 8x32 pad read out were produced. One chamber was sent to Lyon.
Chambers are waiting for anode PCBs with hardroc chips





Protvino activities

Long term stability of combined RPC

8x32 pads RPC

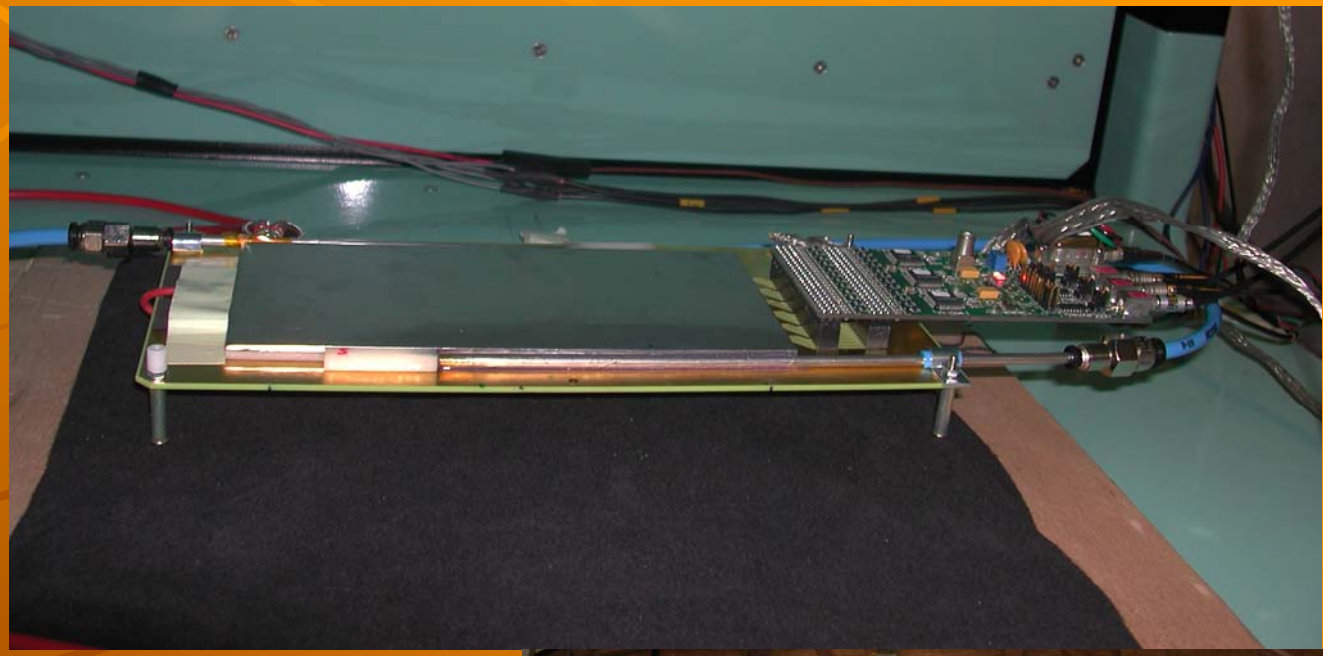
Preparation for the 1m2 RPC production

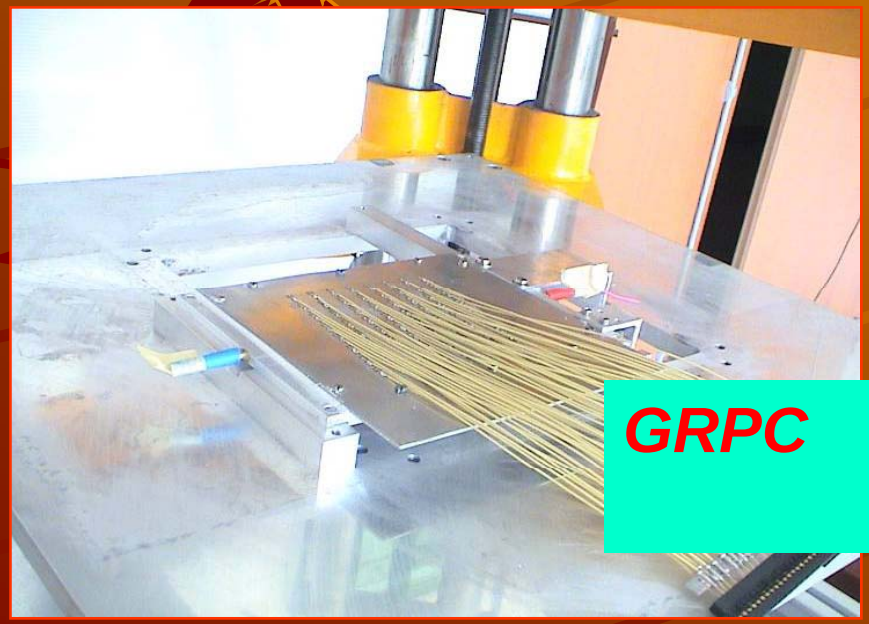
- Facility preparation
- Cosmic stand construction with 1m2 sc. counters and DC
- Decision of technological questions (HV coverage, production of spacers)

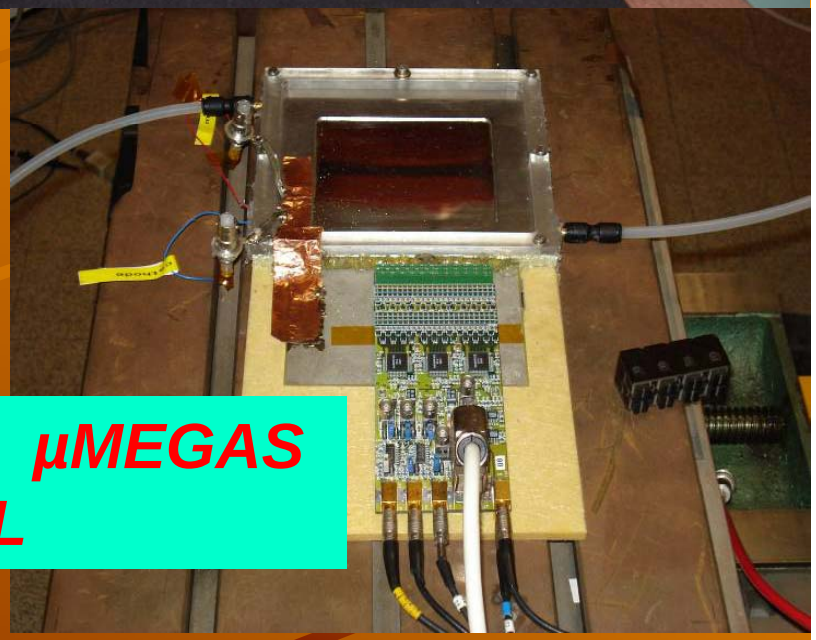
4. Ready to participate in 1m2 RPC assembly, DHCAL installation, beam tests

France activities

µMEGAS LAPP

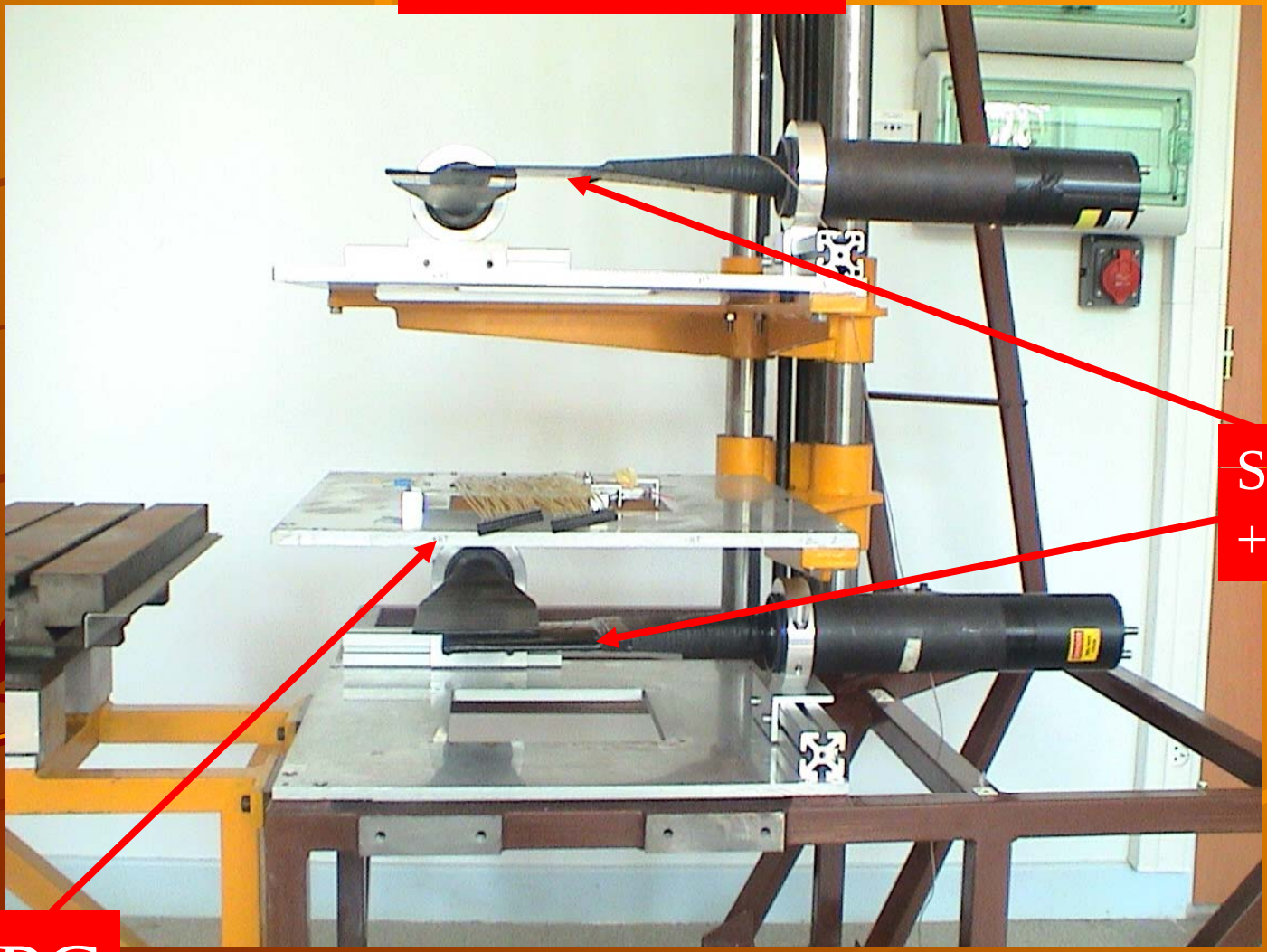




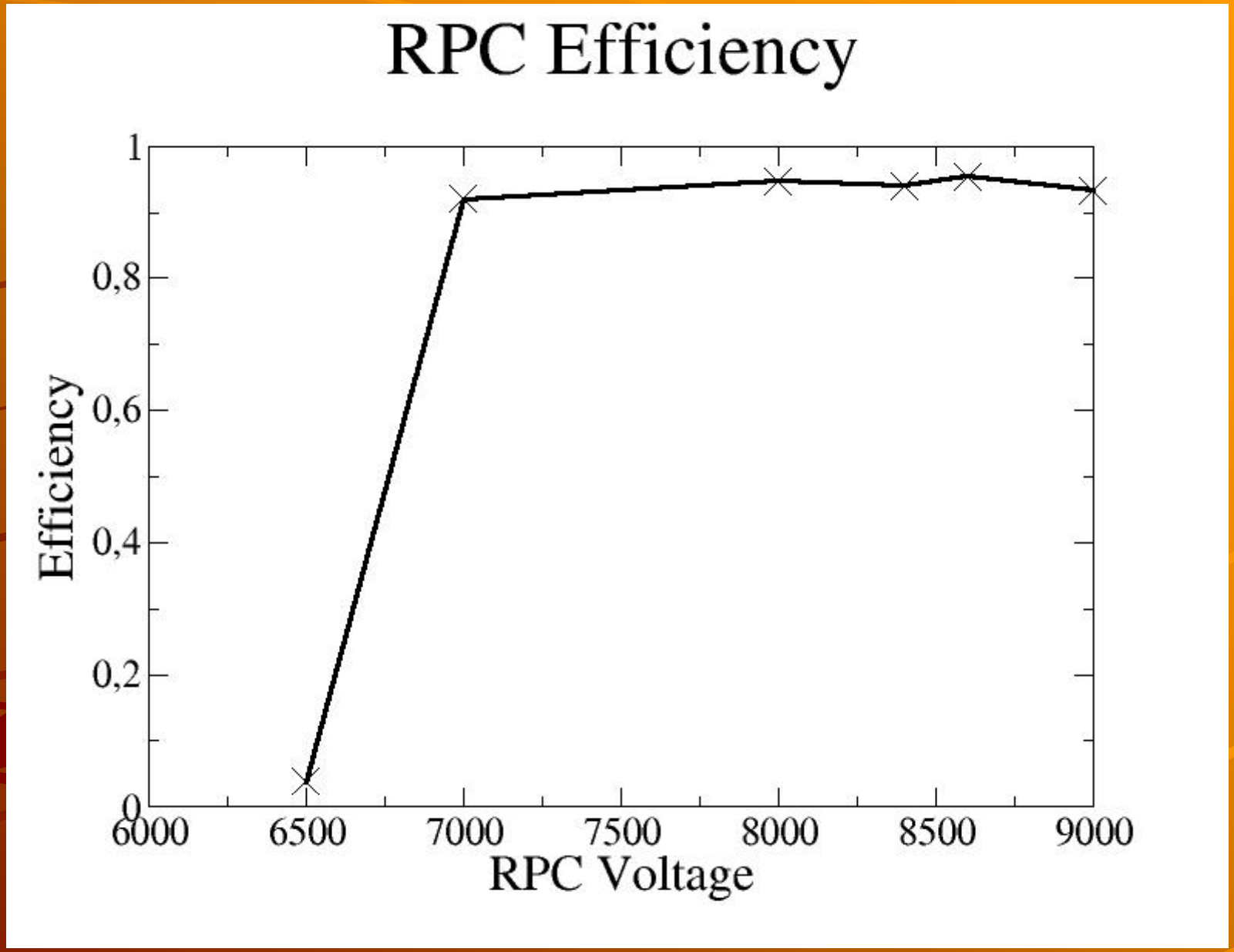


GRPC + µMEGAS
IPNL

Test Bench IPNL



Acquisition : ADC (V 792)



Preliminary results obtained for one of the two 8X8 pads protvino RPC's tested at IPNL.

Detector Study

GRPC : **Protvino, IPNL**,…
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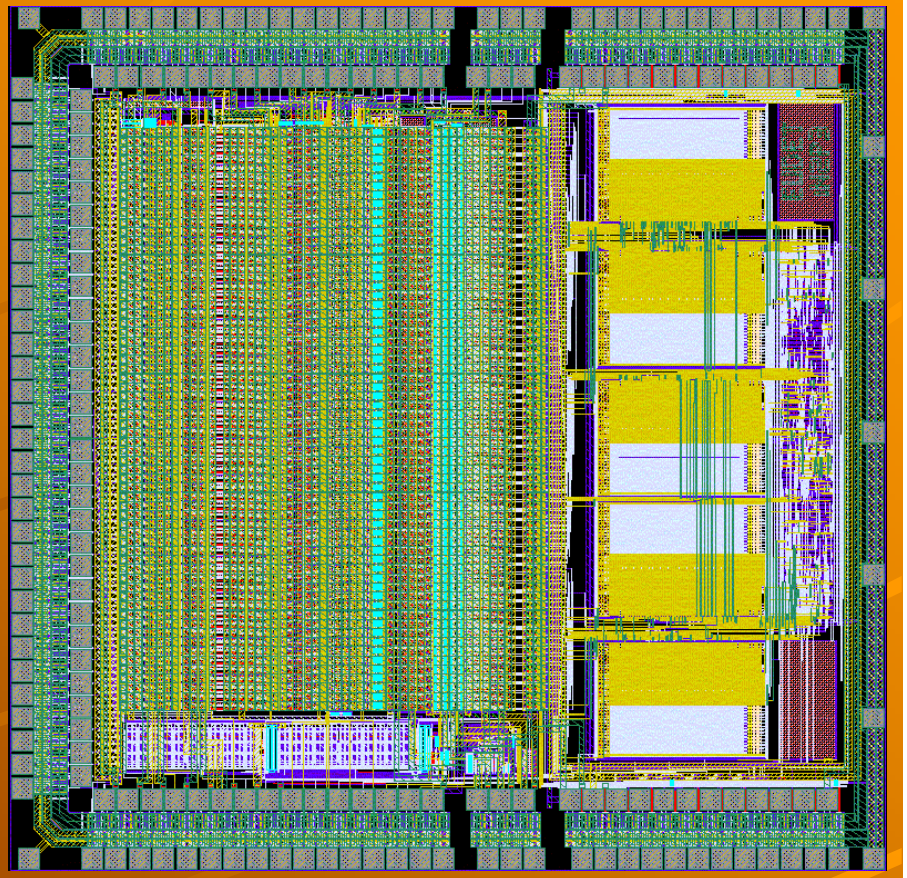
Electronics

LAL, IPNL, LLR

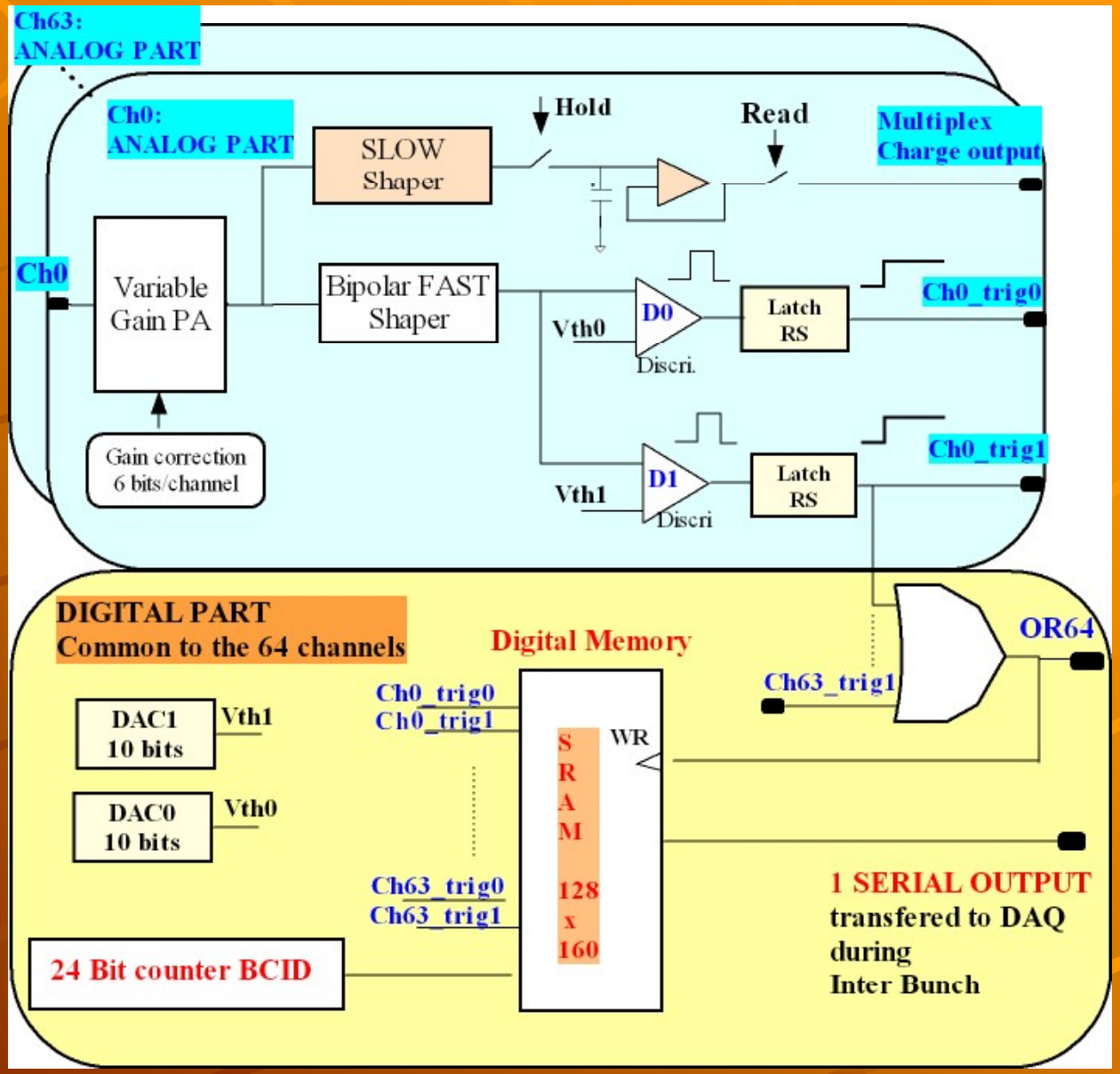
HARDROC

- 64 channels chip
- Semi-digital output, readout conceived to be compatible With the 2d generation DAQ
- Low consumption, full power pulsing

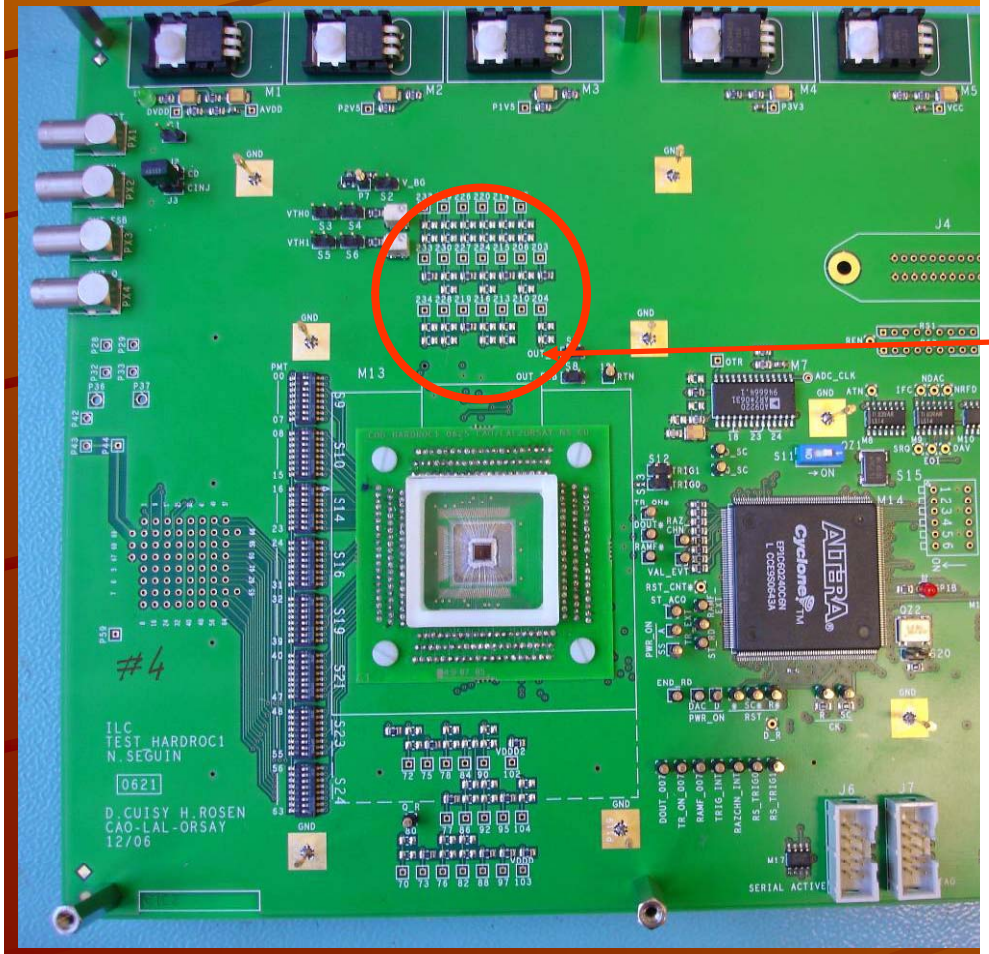


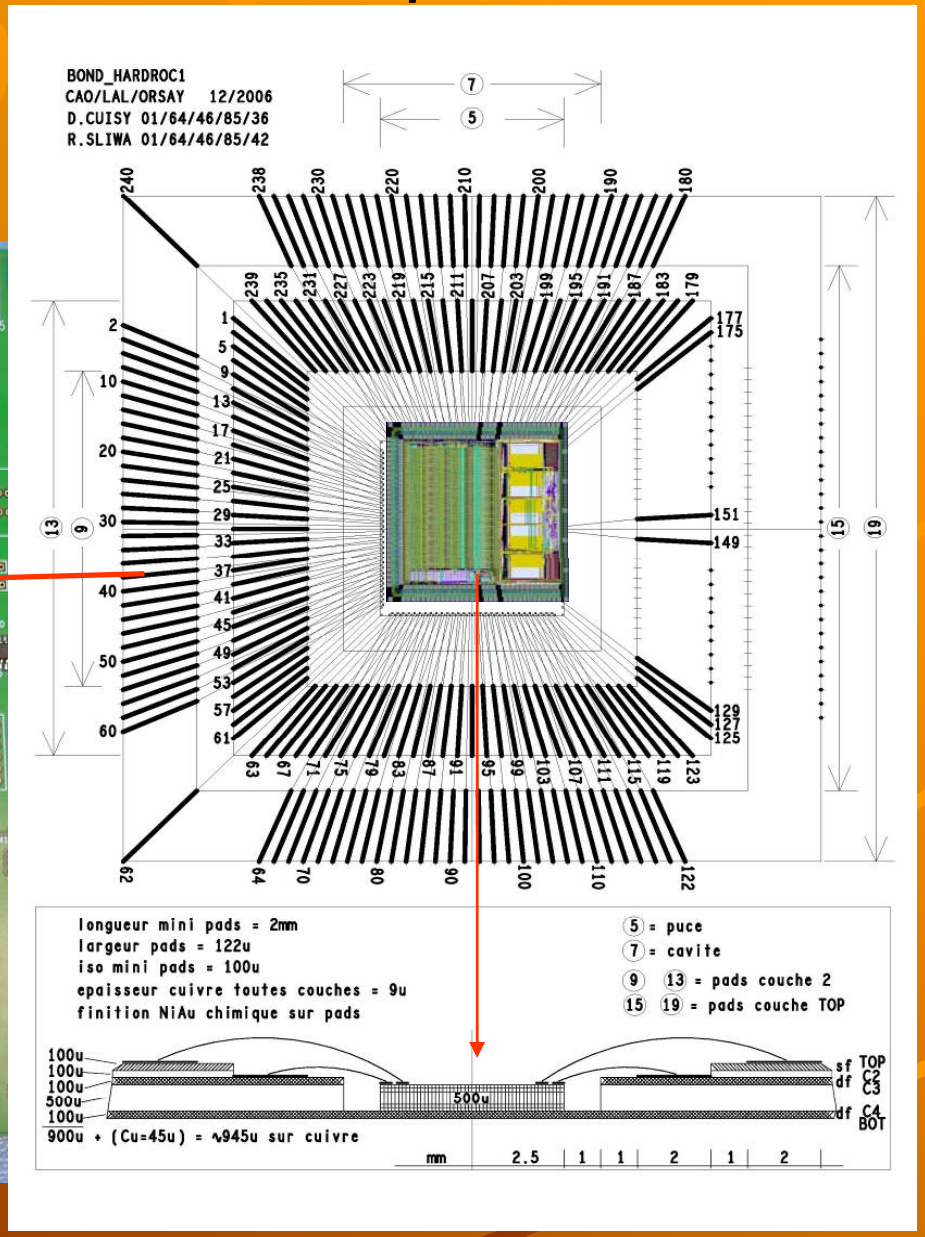
HARDROC1 Architecture

- Full power pulsing
- Digital memory: Data saved during bunch train.
- Only one serial output @ 5MHz
- Store all channels and BCID for every hit. Depth = 128 bits
- Data format : 128(depth)*[2bit*64ch+24bit(BCID)+8bit(Header)] = 20kbits
- Based on MAROC ASIC, but several design changes

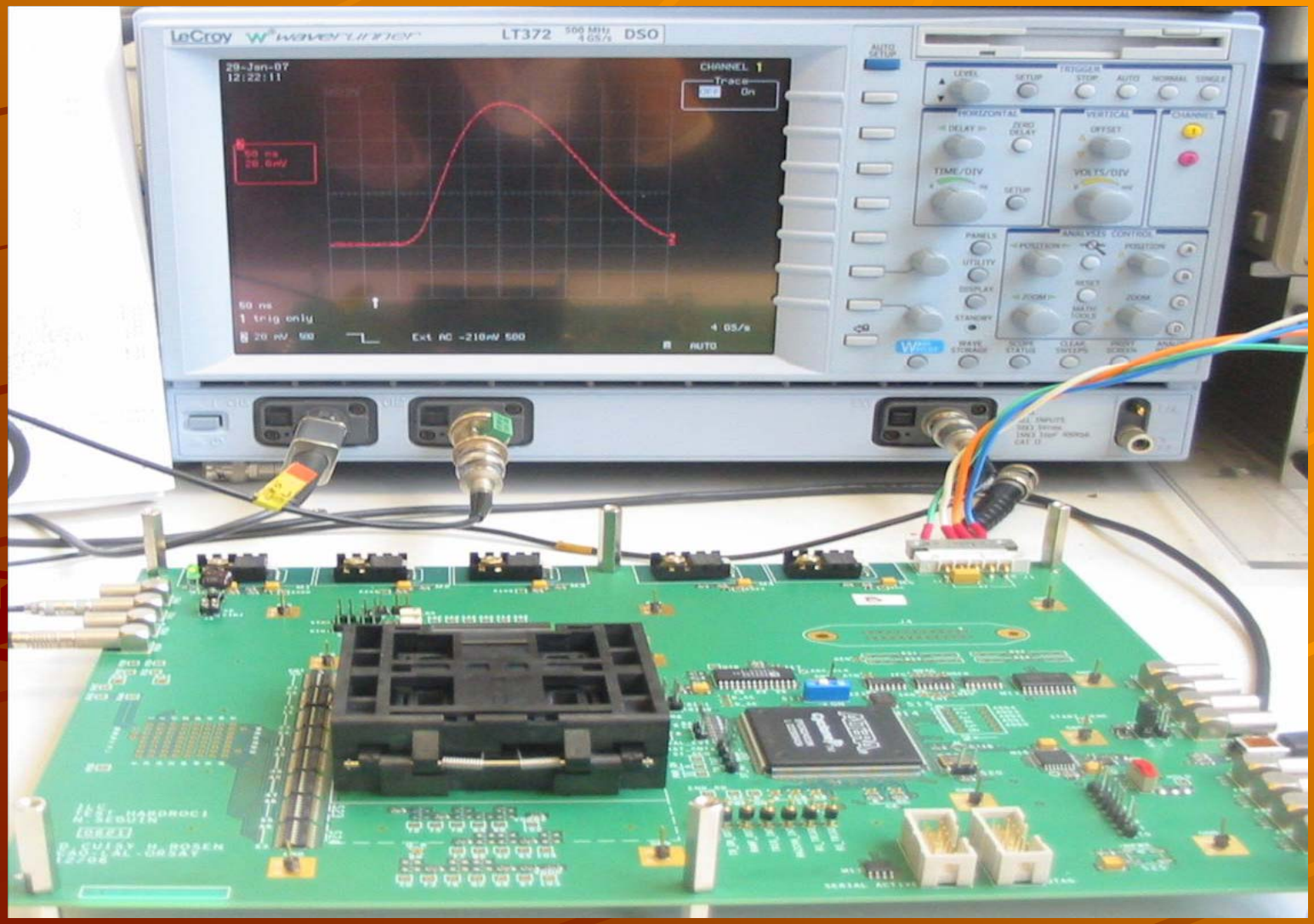


HARDROC1: TESTBOARD with Chip On Board





HARDROC1: TESTBOARD with a packaged chip LAL,IPNL…



2007 Project

Realization of 8X32 pads detectors fully instrumented:

- **8X32 pads detector RPC: already built**
- **4 HARDROC:** already produced and tested
- **8-layers PCB** designed and optimized to reduce cross-talk with two schemes on the same pcb. Now realized

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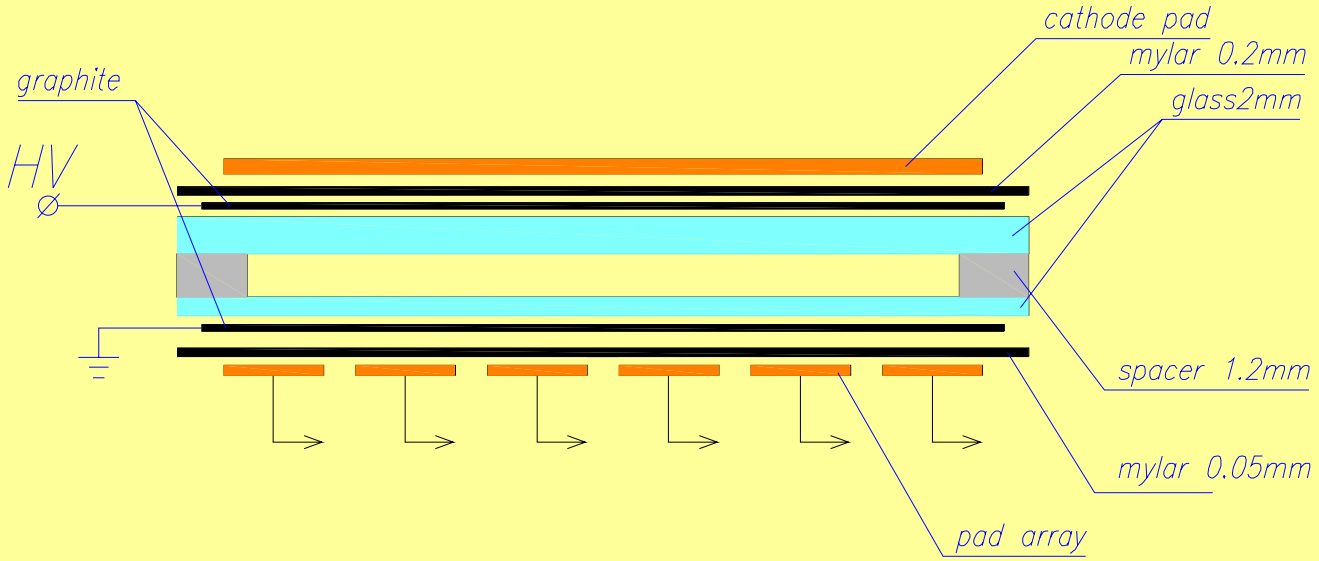
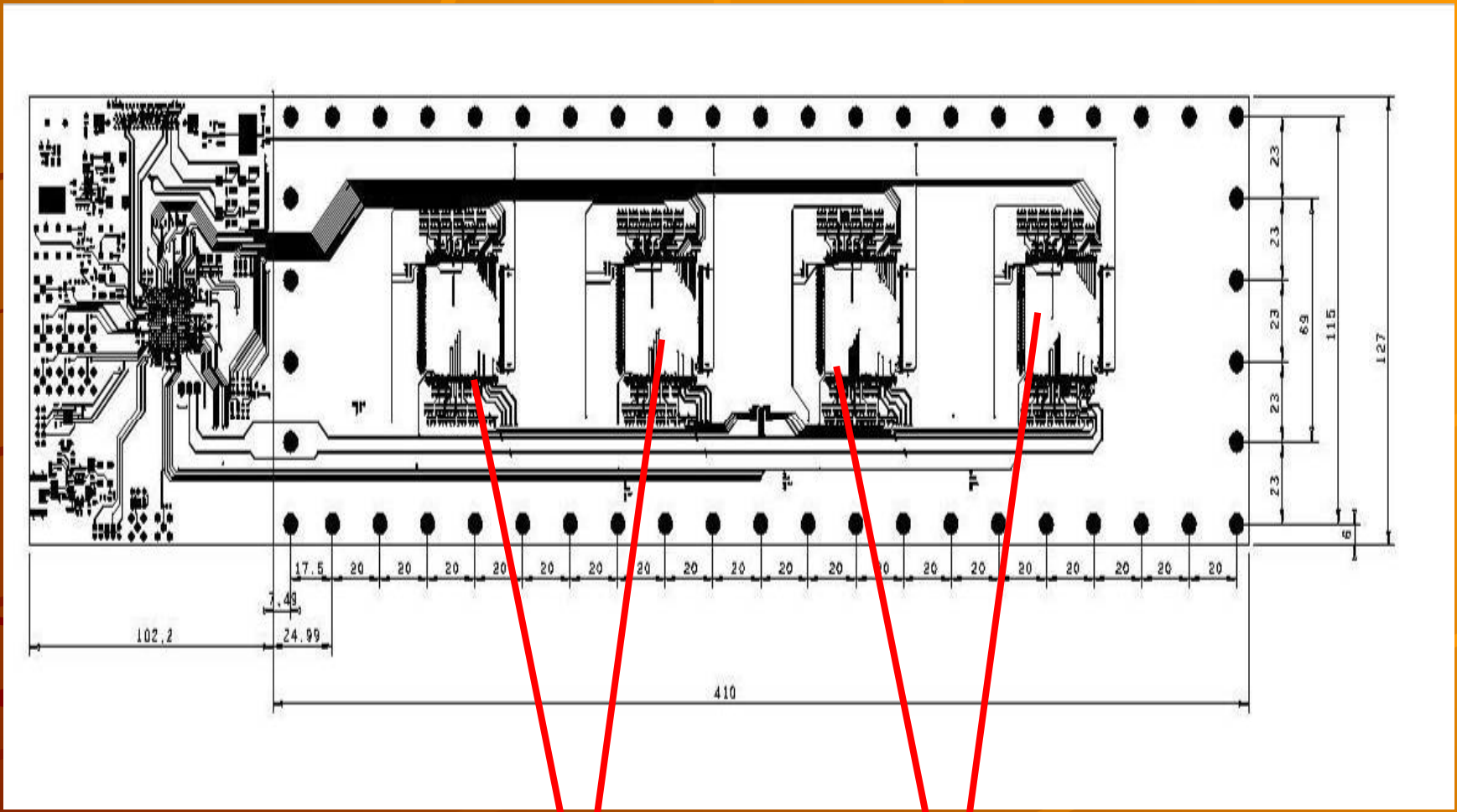
- **Readout** USB + FPGA realized

8X32 pads RPC

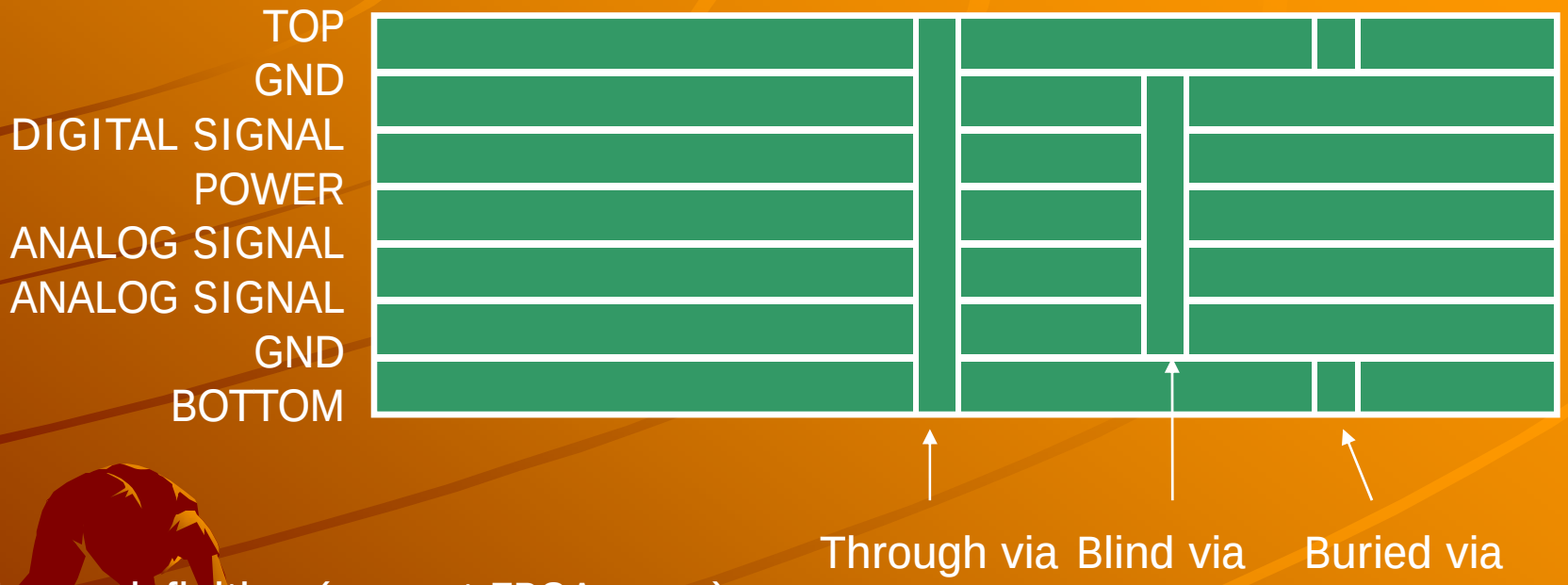




6-Layers scheme

8-Layers scheme

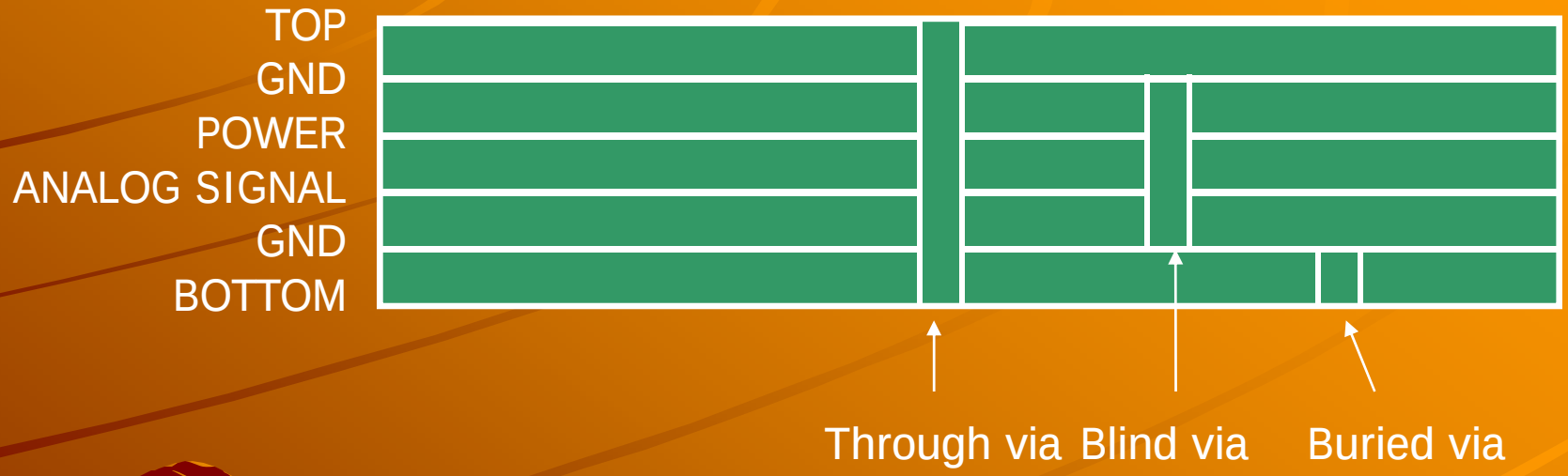
Layout in 8 layers (solution1)



Layer definition (except FPGA area)

TOP LAYER	: Component layer
GND	: Ground layer and access to internal layers
DIGITAL SIGNAL	: Layer to interconnect between hardroc and FPGA
POWER	: Power to hardroc
ANALOG SIGNAL	: Layer to interconnect pad signals
BOTTOM	: RPC pads layer

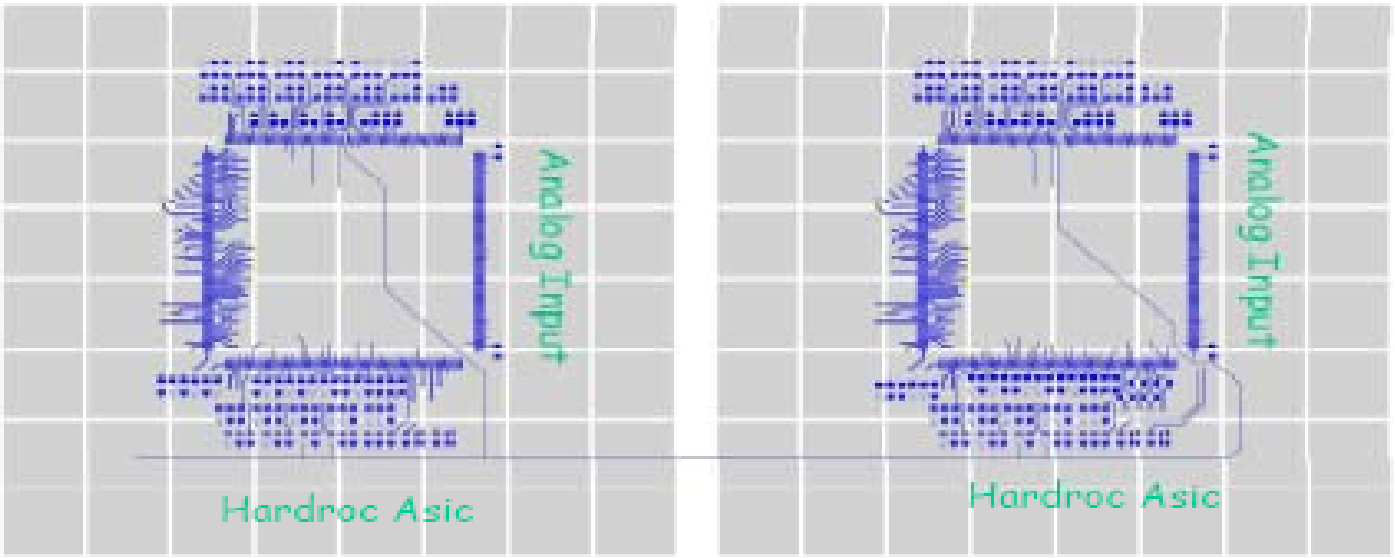
Layout in 6 layers (solution2)

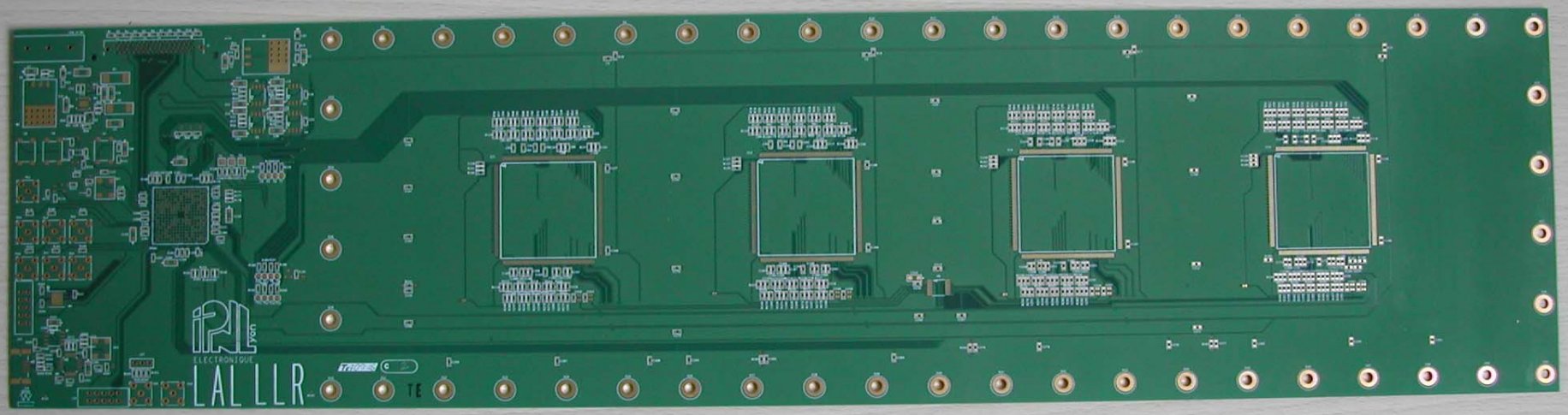


Layer definition (except FPGA area)

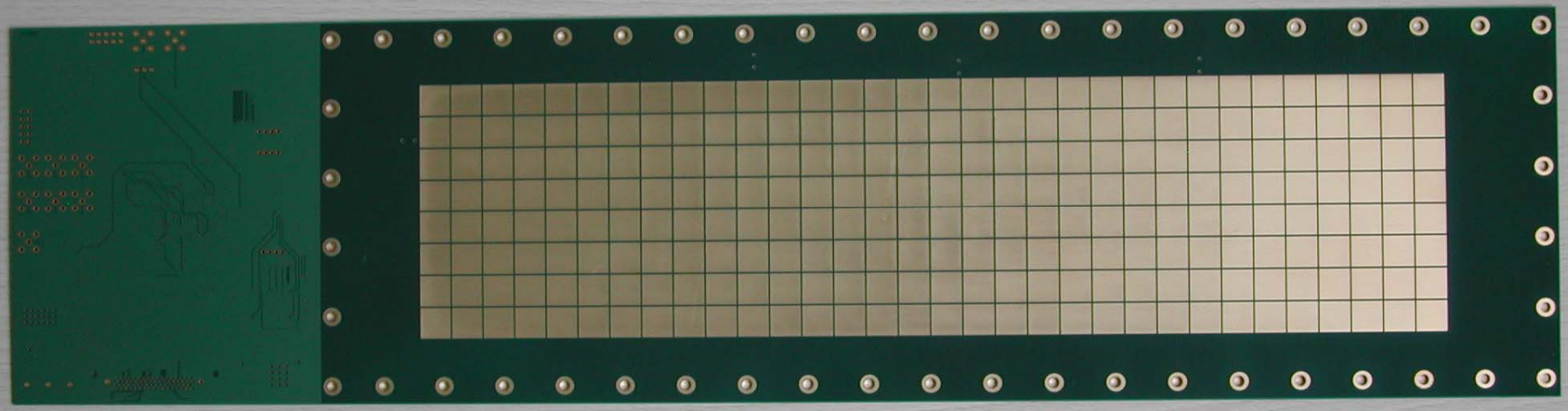
TOP LAYER	: Component layer+interconnect between hardroc and FPGA
GND	: Ground layer and access to internal layers
POWER	: Power to hardroc
ANALOG SIGNAL	: Layer to interconnect pad signals
BOTTOM	: RPC pads layer

Top layer and Pads (8 layers)





Thickness = 800 µ



1 cm2 pads
500 μ separation

Next steps

- Test the pcb performance : cross-talk Ongoing
- Assembly the different electronics components MAY
- Check the whole system without the detector MAY
- Develop/adapt a DAQ for both digital and analog output (see Vincent talk) Ongoing
- Put the electronics on the RPC detector June
- Cosmics data June
- Test beam at DESY > July

N.B : The pcb was conceived to be compatible with µMEGAS detector as well.

Future project

First step (2007-2008):

- 70X70 cm2 GRPC plane fully equipped
- 70X70 cm2 µMEGAS plane fully equipped

Using

1) Calice acquisition for the analog output
2) Standalone acquisition for digital output

Using

The desy mechanical structure

Extensive study and comparison between the two detectors

Second step(2008-2009) :

A prototype of 40 of 70X70 cm2 planes with steel planes and mechanical structure (ciemat)

Future project

- **Budget**
  300 K euros were requested for the 2007-2009 period (ANR).
  Equivalent demand for the same period will be submitted to IN2P3.
  This to fund the electronics and detectors of the prototype
  The mechanical structure can be funded by CIEMAT ?

- **Acquisition**
  By 2009 the second generation DAQ should be ready otherwise a solution should e found (Vincent talk)

Conclusions

- Many efforts on DHCAL are going on in Europe
- European DHCAL project has the ambition to be as close as possible to ILC detector.
- European project is complementary to the American one
- The two projects should become one in the future.

POSSIBLE LAYOUT DESIGN
for 1 m2 detector