CALICE ECAL Status

Jean-Claude BRIENT
LLR – Ecole Polytechnique
IN2P3 – CNRS

Institutes in CALICE ECAL


KNU, EWHA, Yonsei, Sunygk. , SNU


LAL, LAPP, LLR, LPC-Ct, LPSC, PICM


MSU, IHEP, ITEP

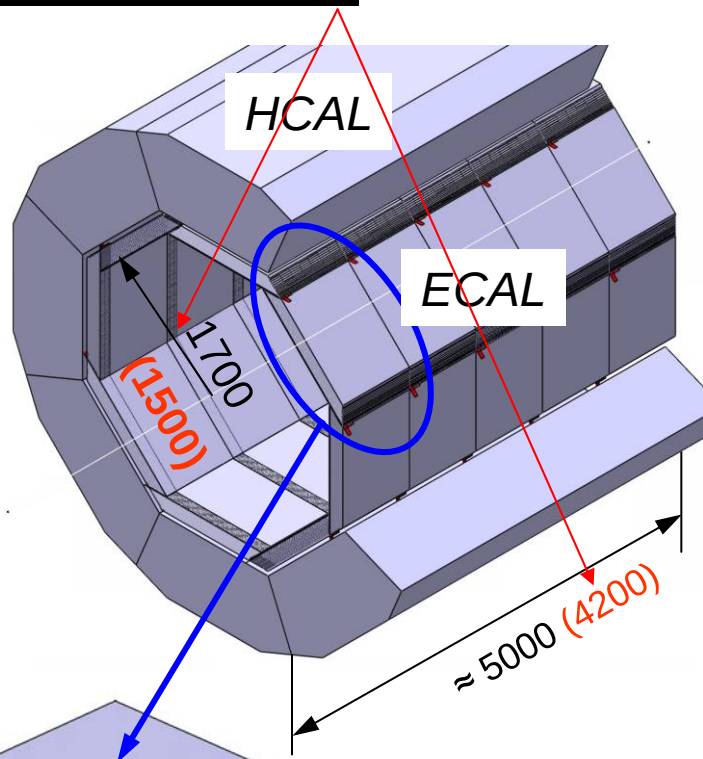

Prague (IOP-ASCR)


Imp. Coll, UCL, Cambridge, Birmingham, Manchester, RAL

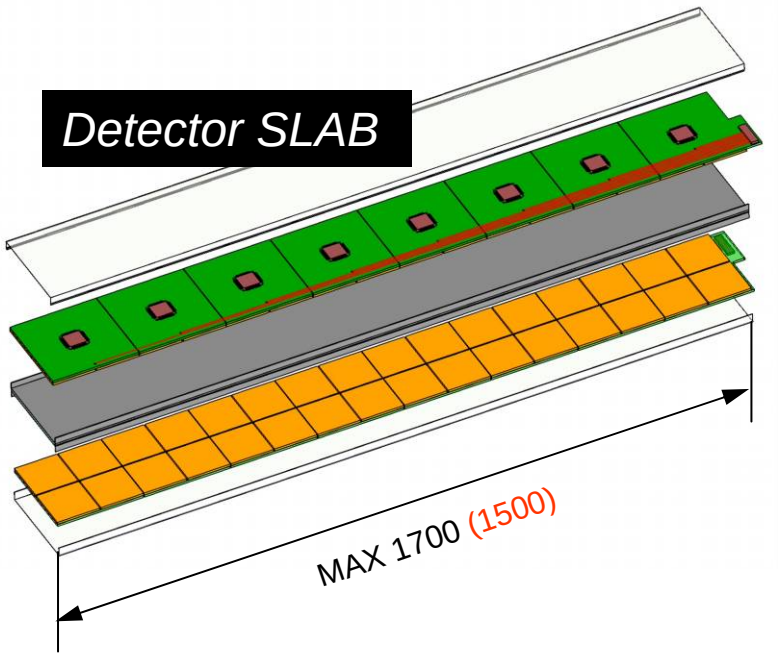
- 20-40 silicon layers (~1500 à 3000 m^2)
- Pad size of ~1x1 cm^2 (~ 16 à 32 10^6 canaux)
- ~130T de tungsten
- An octagonal geometry
- High level of density (20-40 layers, 24X0 in ~150mm)

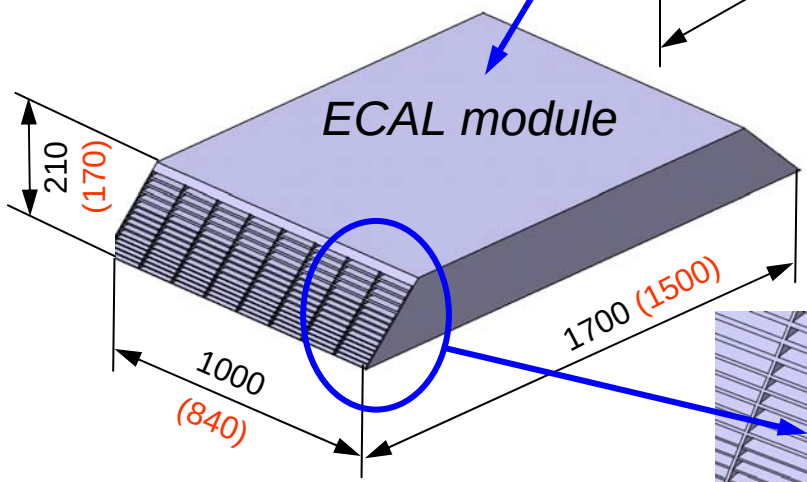
- No large area of dead zone
- All barrel modules are identical (Tungsten wrapped by Cfi)
- The detector slabs would be tested before assembling

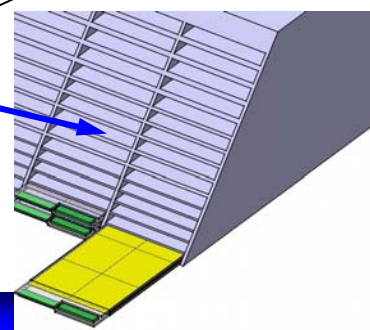
New geometry



Detector SLAB



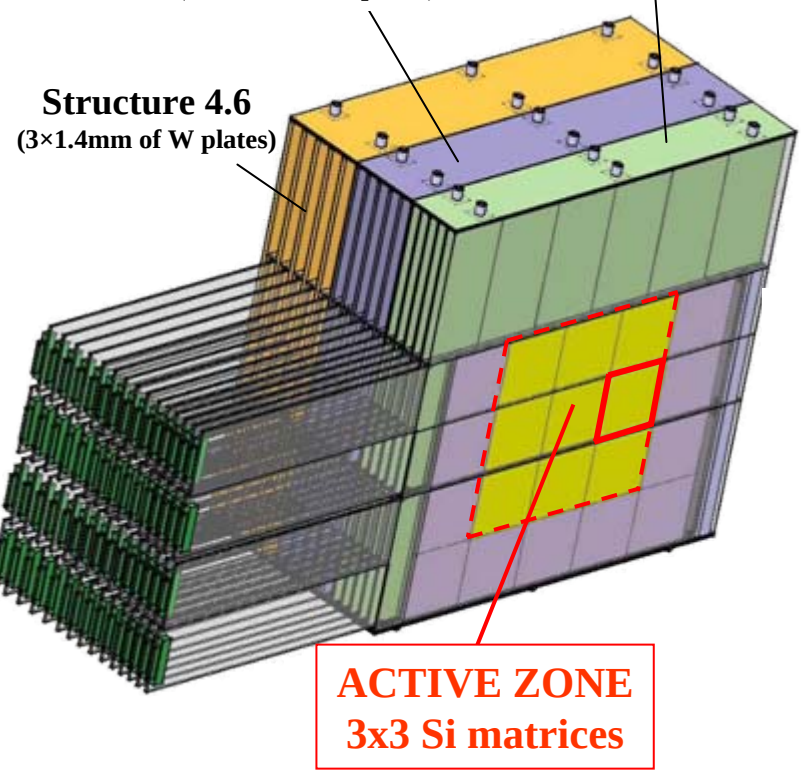




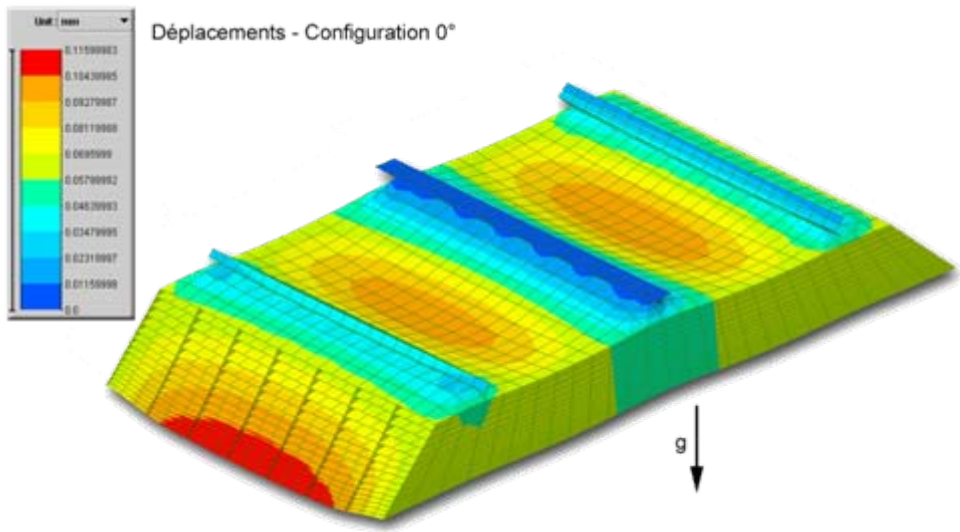
Detector study

Prototype

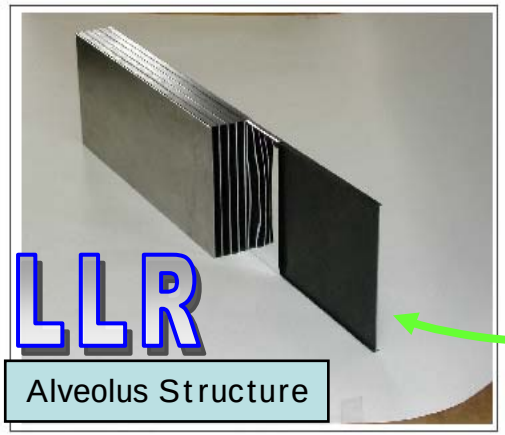
R&D final design

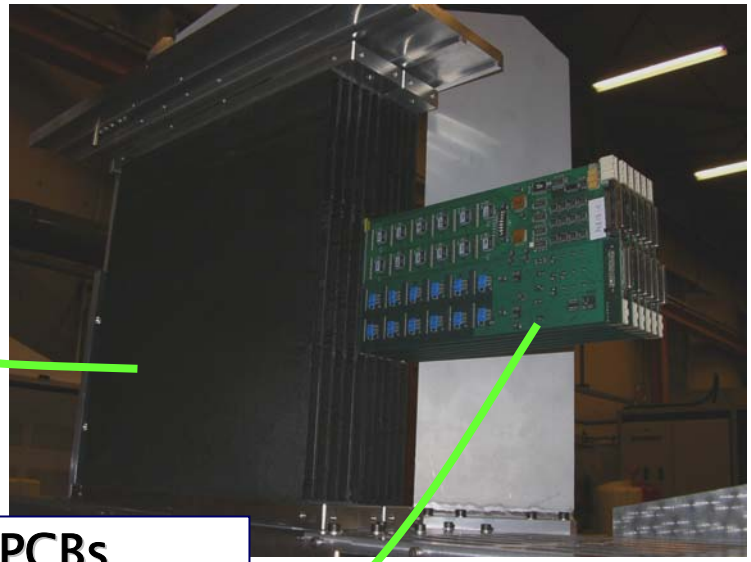


Study of the mechanical deformation for an horizontal barrel module



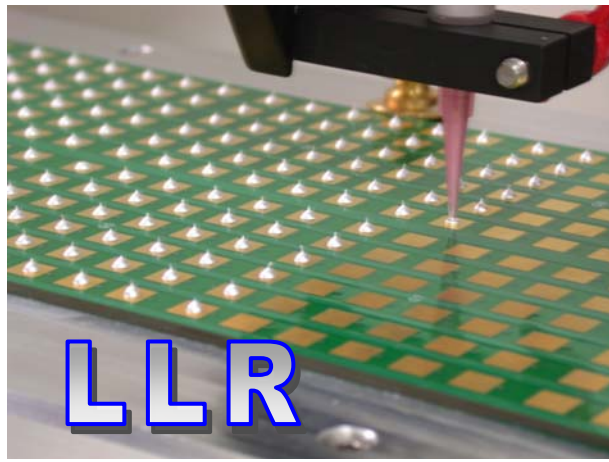
The prototype is in final phase of construction



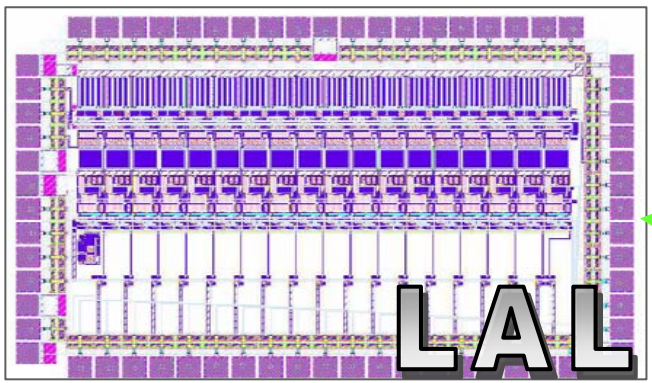


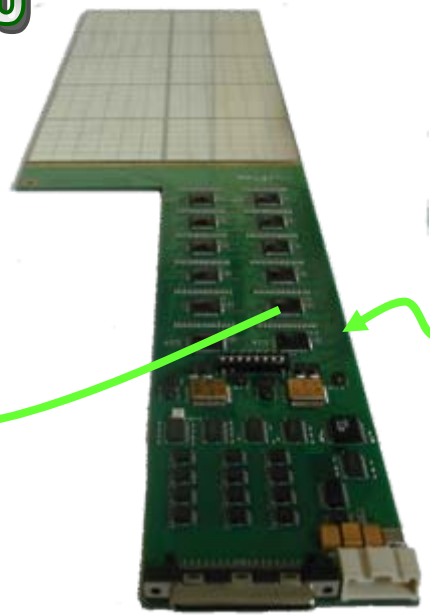
PCBs

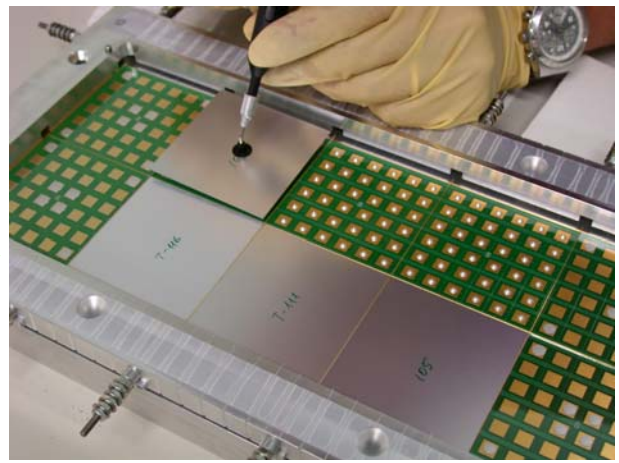
LAL KNU

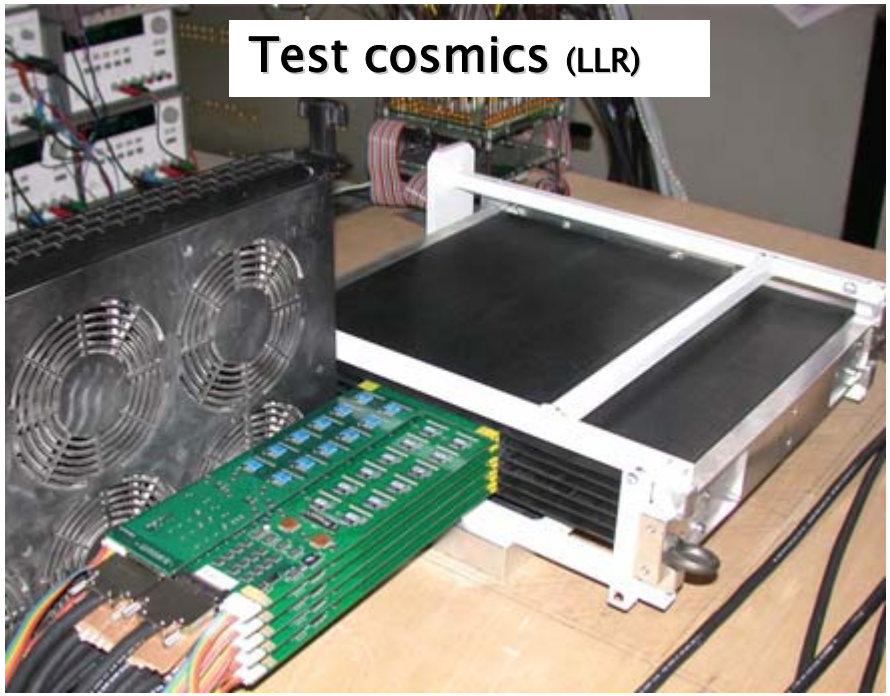


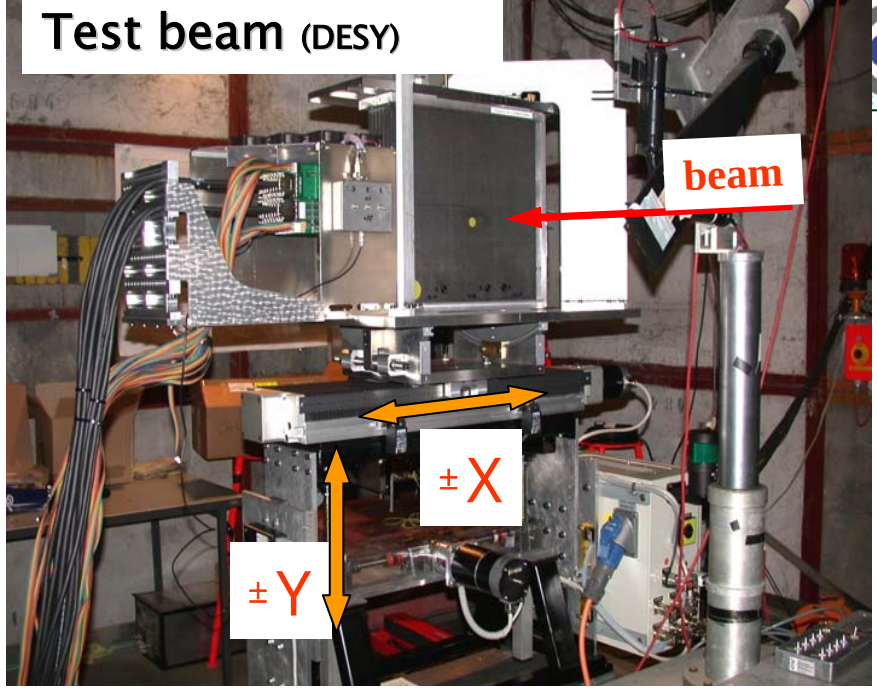
Front-end electronic analog part

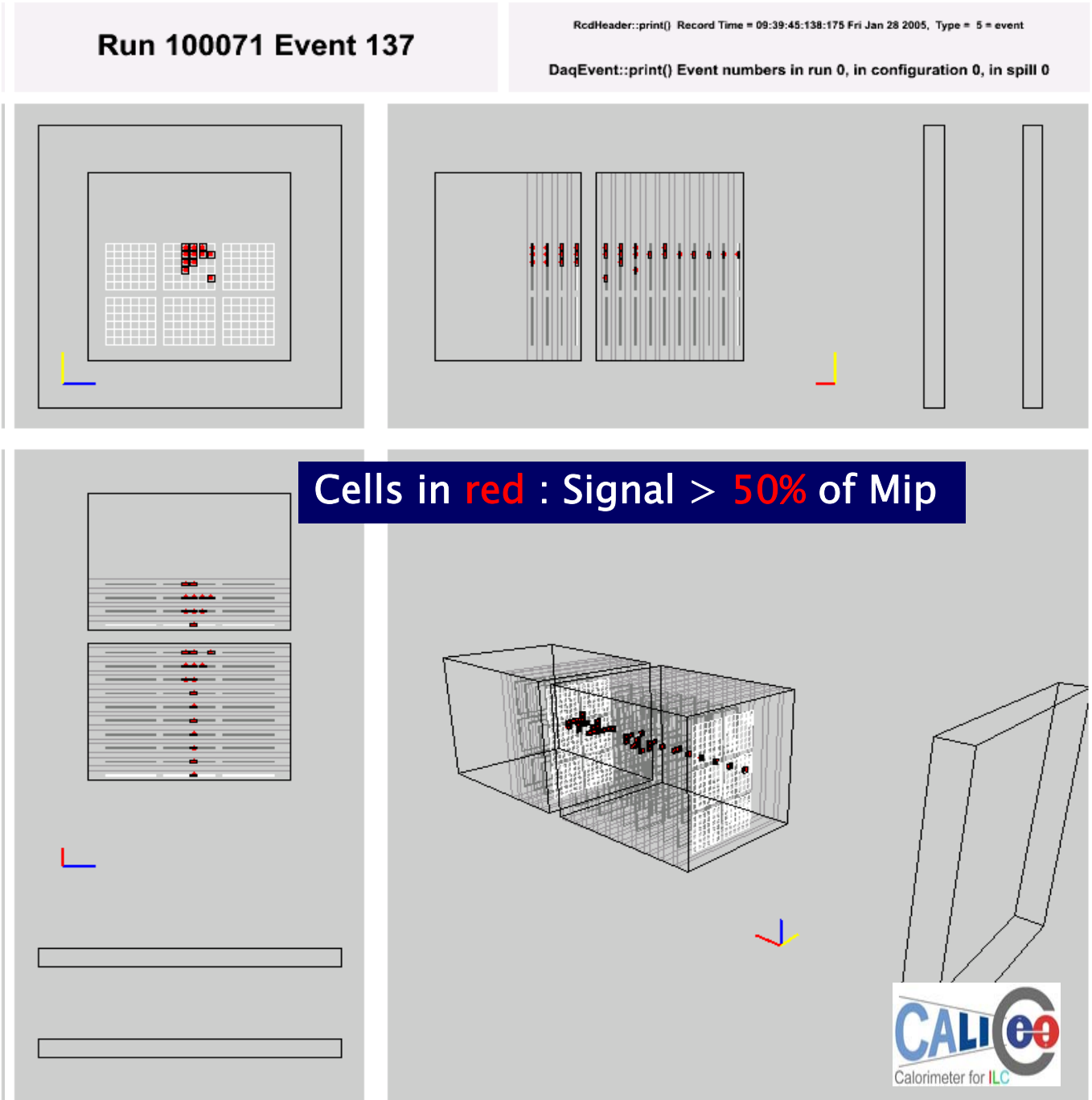




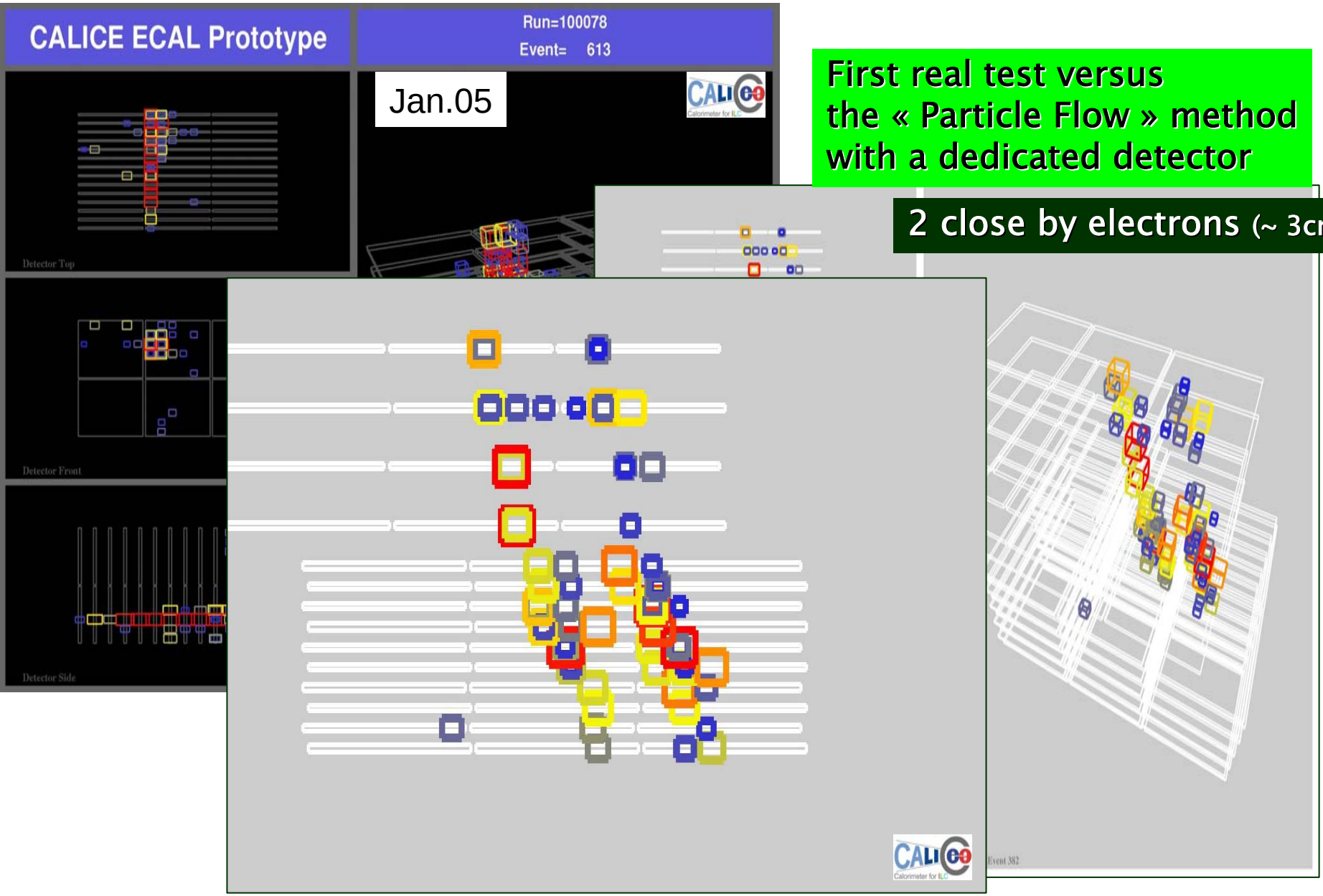



Test cosmics (LLR)


Test beam (DESY)
beam
± X
± Y


Run 100071 Event 137
RcdHeader::print() Record Time = 09:39:45:138:175 Fri Jan 28 2005, Type = 5 = event
DaqEvent::print() Event numbers in run 0, in configuration 0, in spill 0
Cells in red : Signal > 50% of Mip
CALICE
Calorimeter for ILC

ECAL prototype – first test at DESY (FNAL/CERN 2006…)

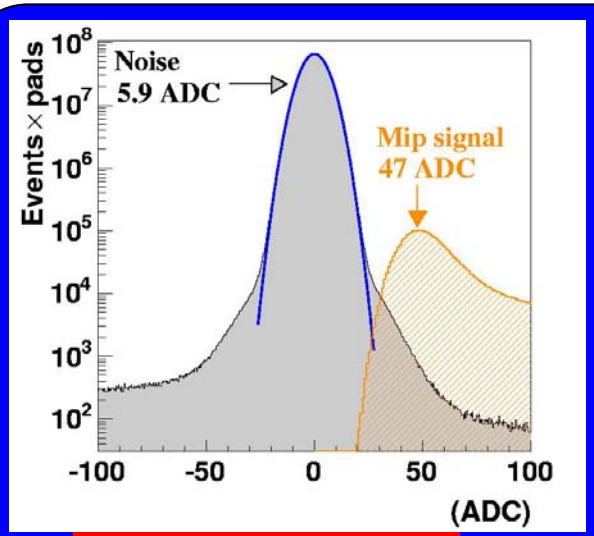


First real test versus the « Particle Flow » method with a dedicated detector

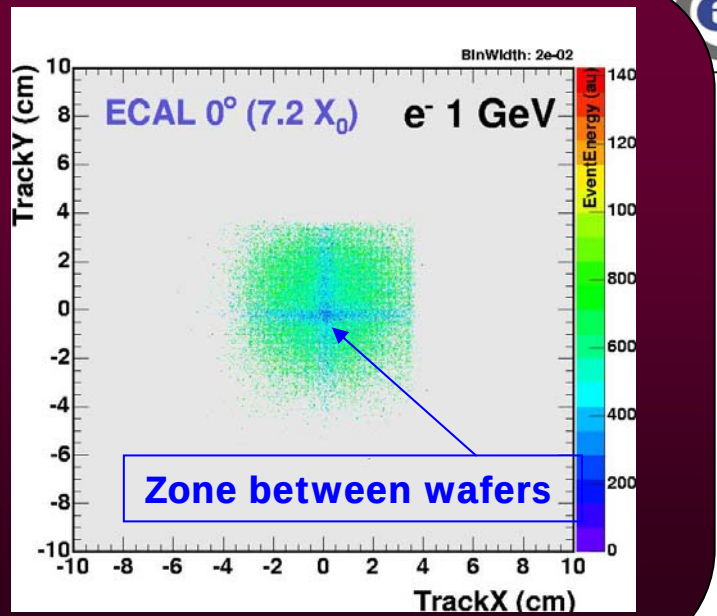
2 close by electrons (~ 3cm)

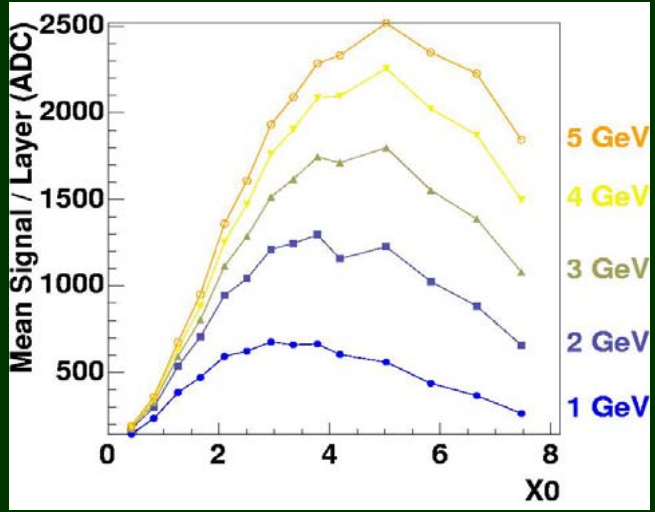
First results of the DESY Test beam with ECAL prototype

Still to be analysed

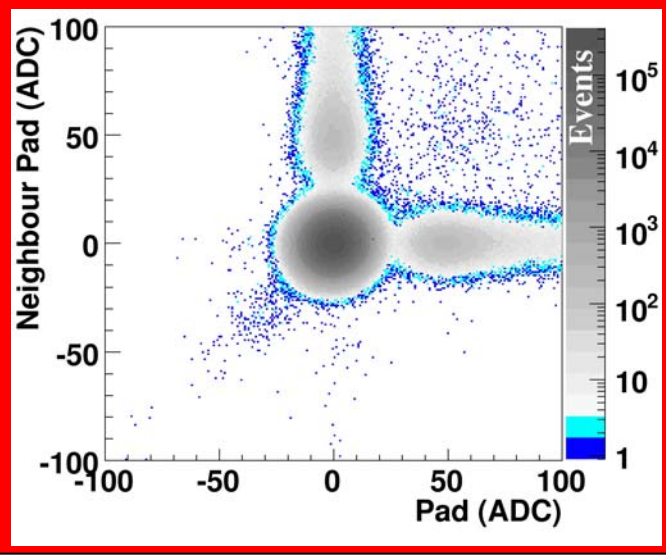


S/N ~ 8 !!



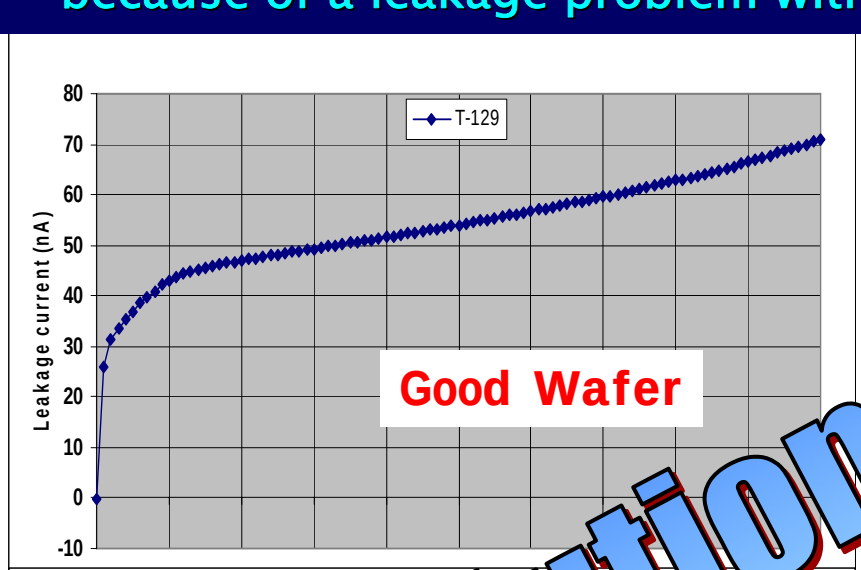


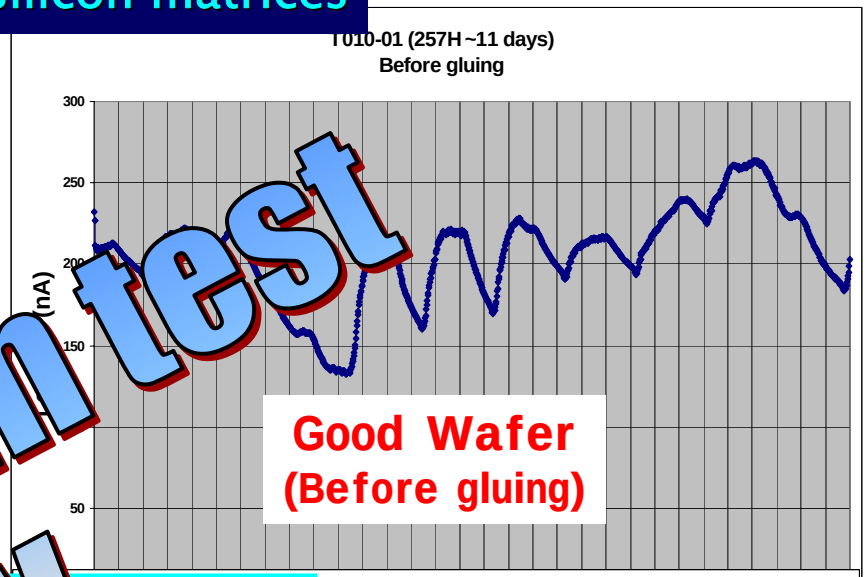
Study of the coherent noise



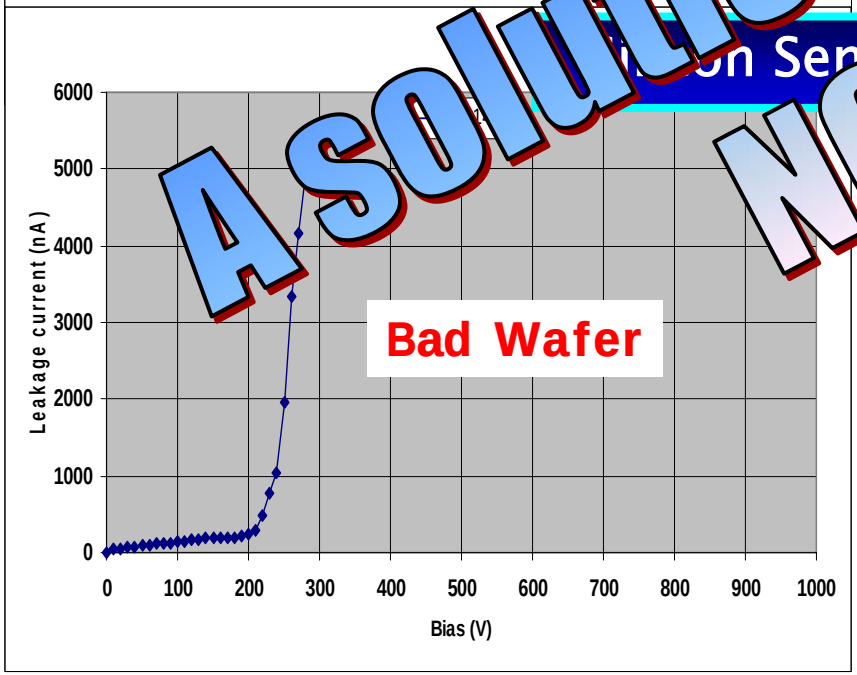
Why there is only 14 layers (instead of 30) !!

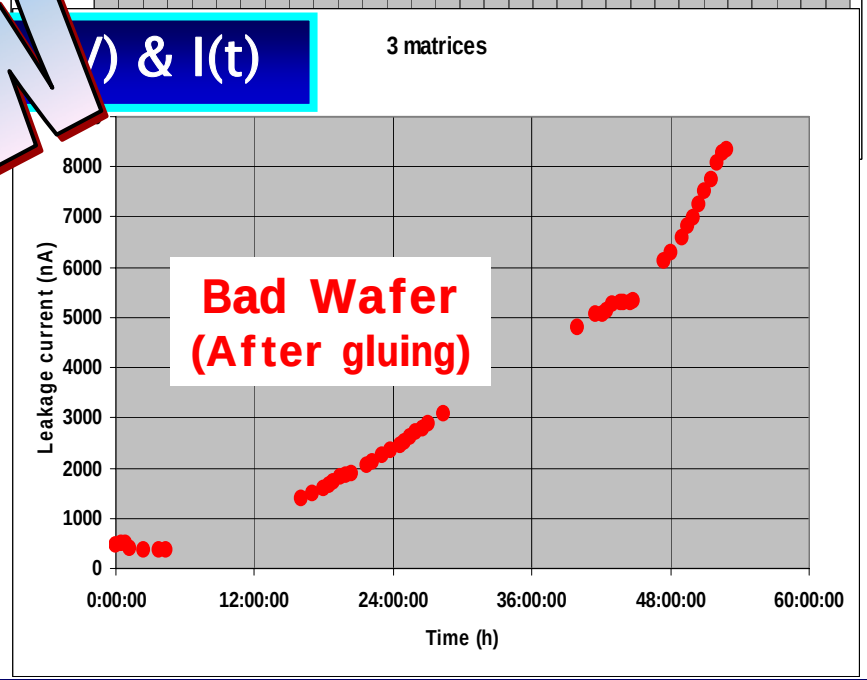
because of a leakage problem with the silicon matrices





A Solution in test NOW

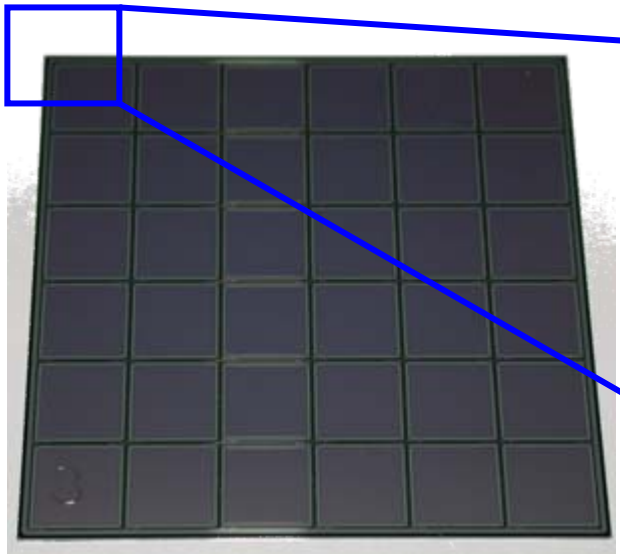




PLEASE, note the effort to be as simple as possible

DETECTOR MATRICES

Relatively **crude object** when compared to a microstrip matrix for a tracker (or to the ALCPG-SiW matrix)



- Number of mask ~ 4-5
- Industrial yield ~ 85%
- Use of large wafer 8" ?

If the goal is

< 2 $/cm^2

Keep it crude !!

Contraints on the ECAL calorimeter

- **Small Moliere radius** → small thickness for non-W material
- **Threshold <mip** → large mip signal ⇒ wafer not too thin (500µm)
- **S/N at mip > 10** → small noise
- **Weak coherent noise** → pick-up, ground, power supply etc…
- **Large dynamics** (14-16bits) → bi-gain two times 10 bits
- **Low power dissipation** (electronics) → power cycling
- **Behavior of the VFE chip when 500-600 GeV em shower goes through**
- **Keep the silicon cost under control** → labos in contact with private companies

Next steps for the prototype

Test with electrons (may be small energy hadrons)

DESY, FNAL-MTBF, CERN/H4(H6) for 2006 ?

- standard test for ECAL (direction/energy resolution,..)
- Measurement of the constant term (expected to be small)
- Test of the coherent noise, with running in-situ,etc..
- test of running with the VFE chip INSIDE the detector
- Test beam with AHCAL+ECAL for debugging

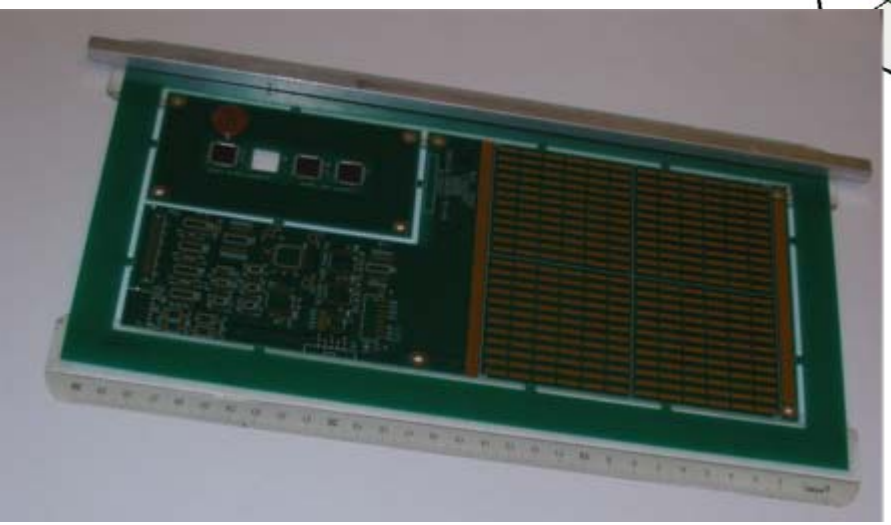
Test with Hadrons

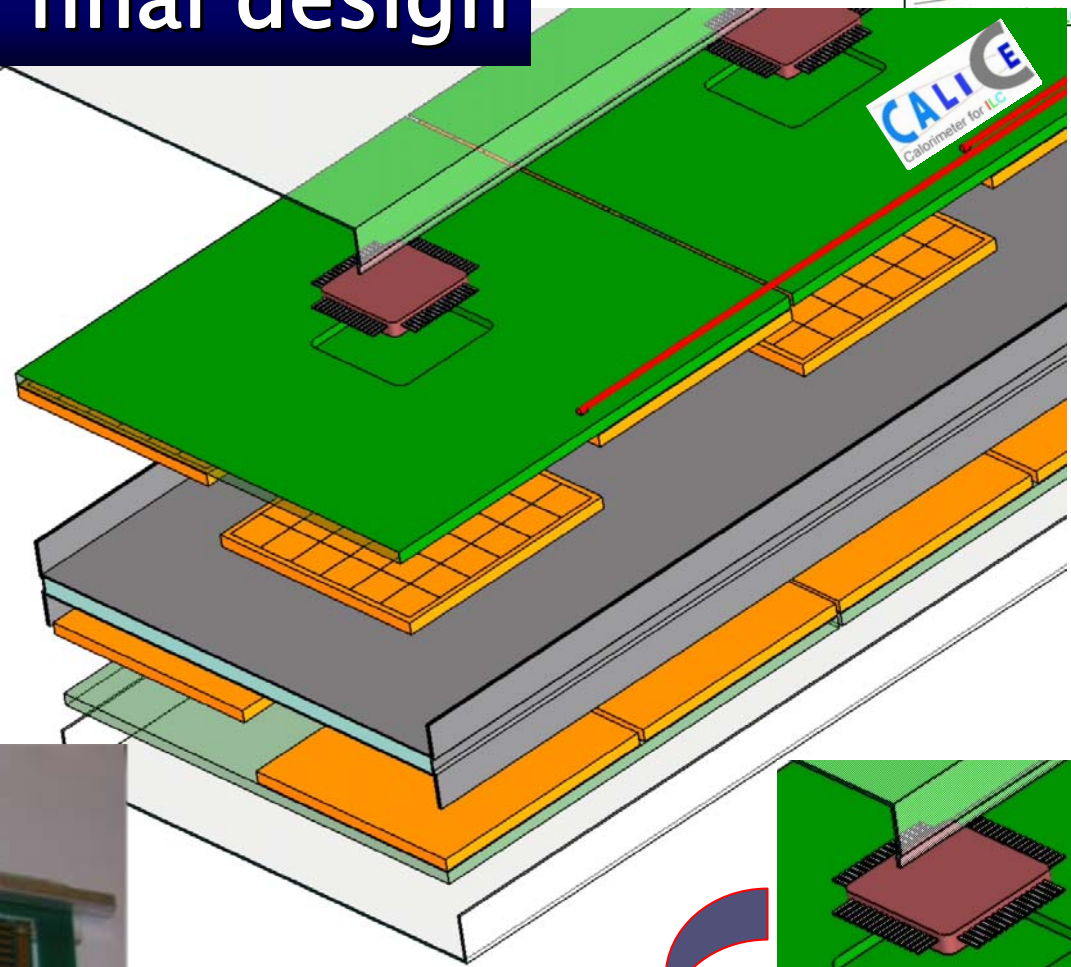
CERN / MTBF ?? mid 2006 – mid 2008

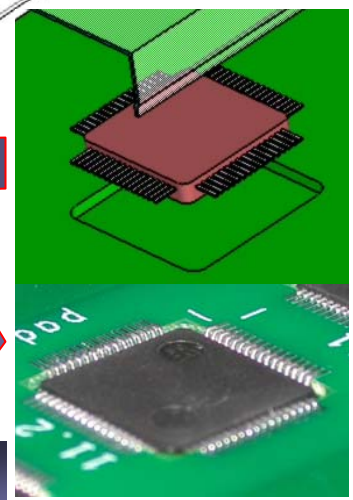
R&D for the final design

NEW DESIGN
for the
ECAL Detector Slab

- Better for mech. behavior
- Better Moliere radius
- Better for indust. assembling
- DAQ based on FPGA
- better for VFE
- etc…





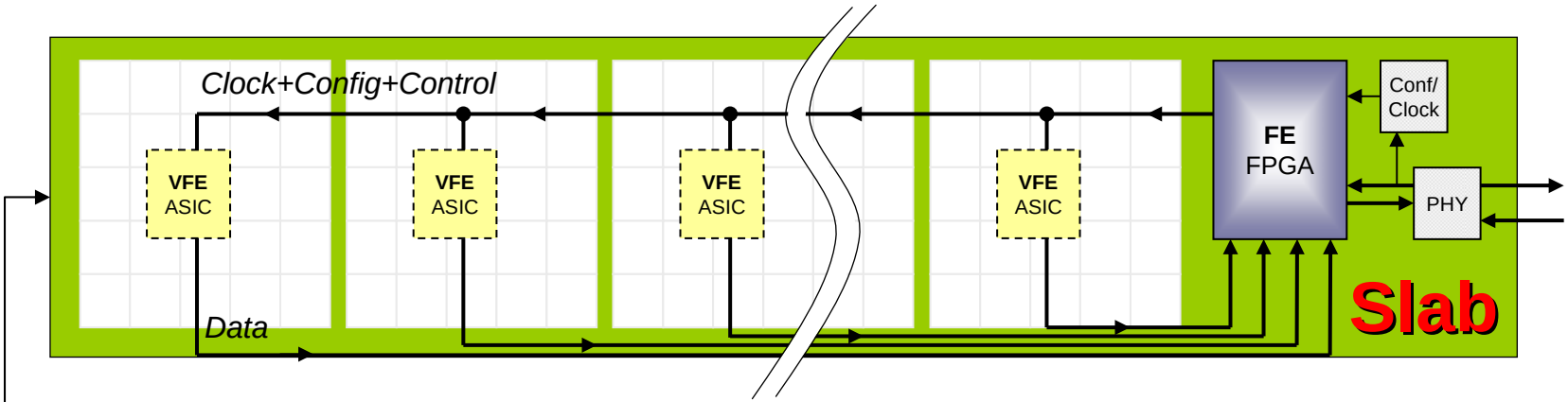


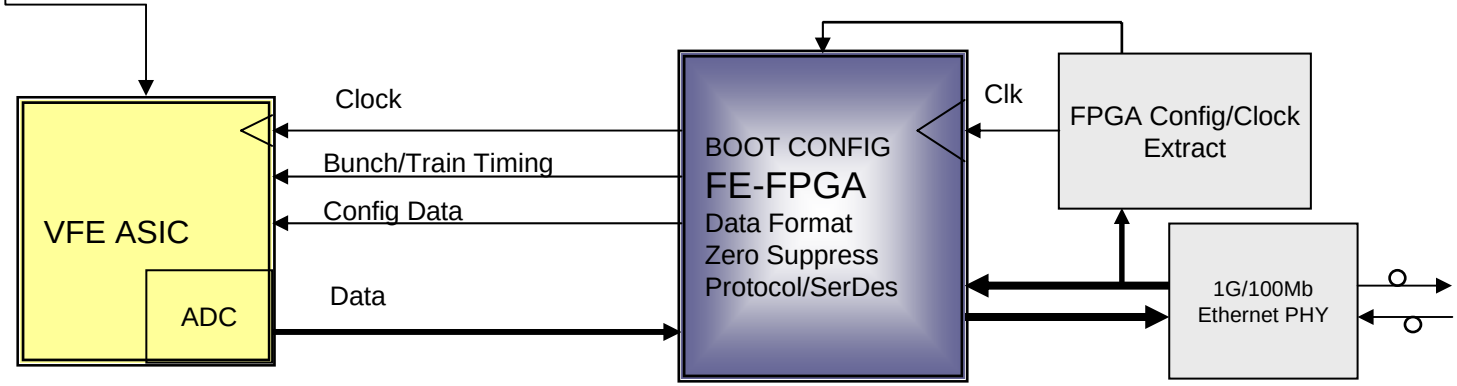
Tested at industrial level

R&D for the final design

ECAL,
AHCAL,
DHCAL

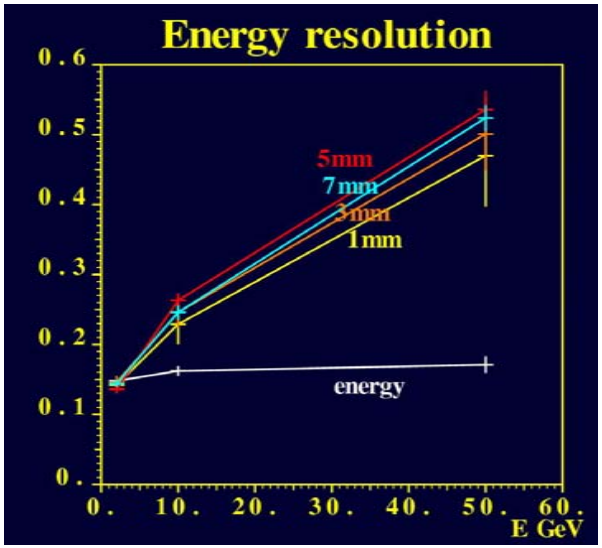
A common R&D for calorimeters : the detector readout

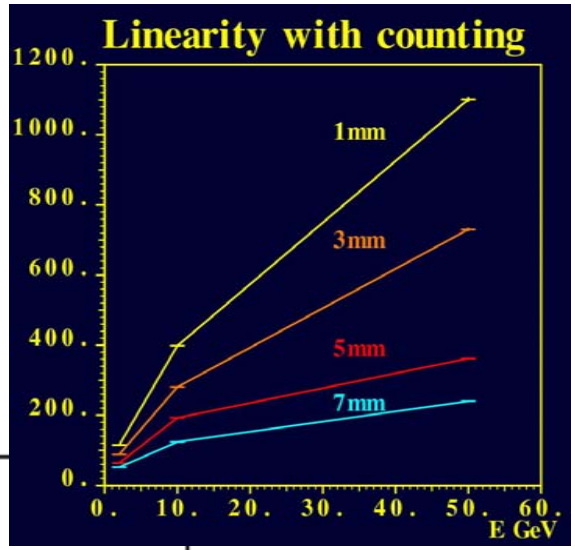




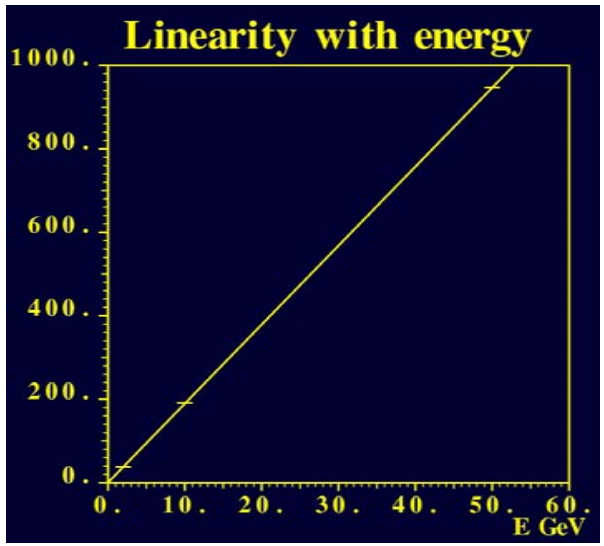
Study by H.Videau

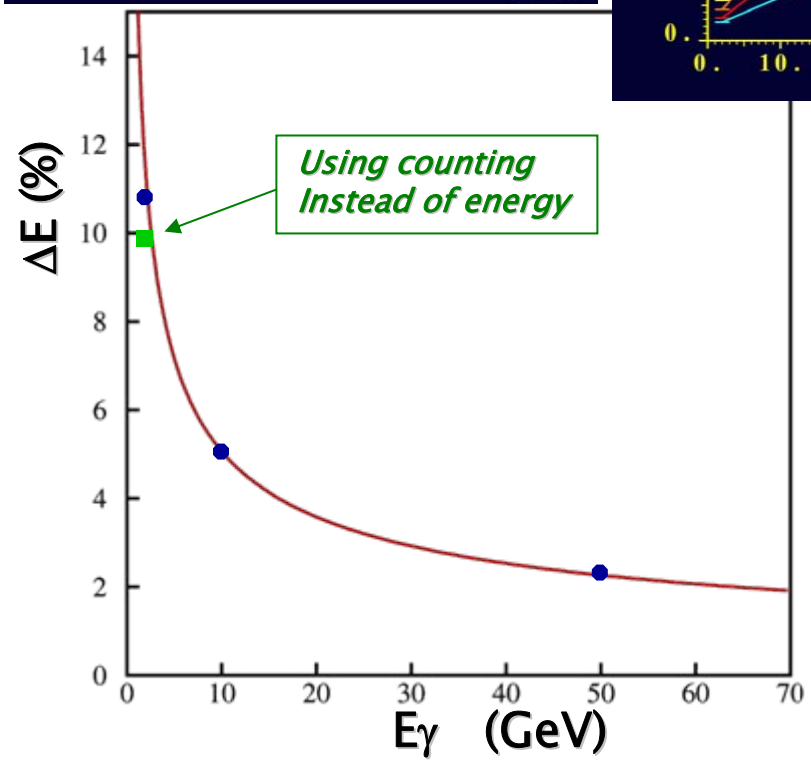
Single particle performances





ECAL with 20 + 10 layers





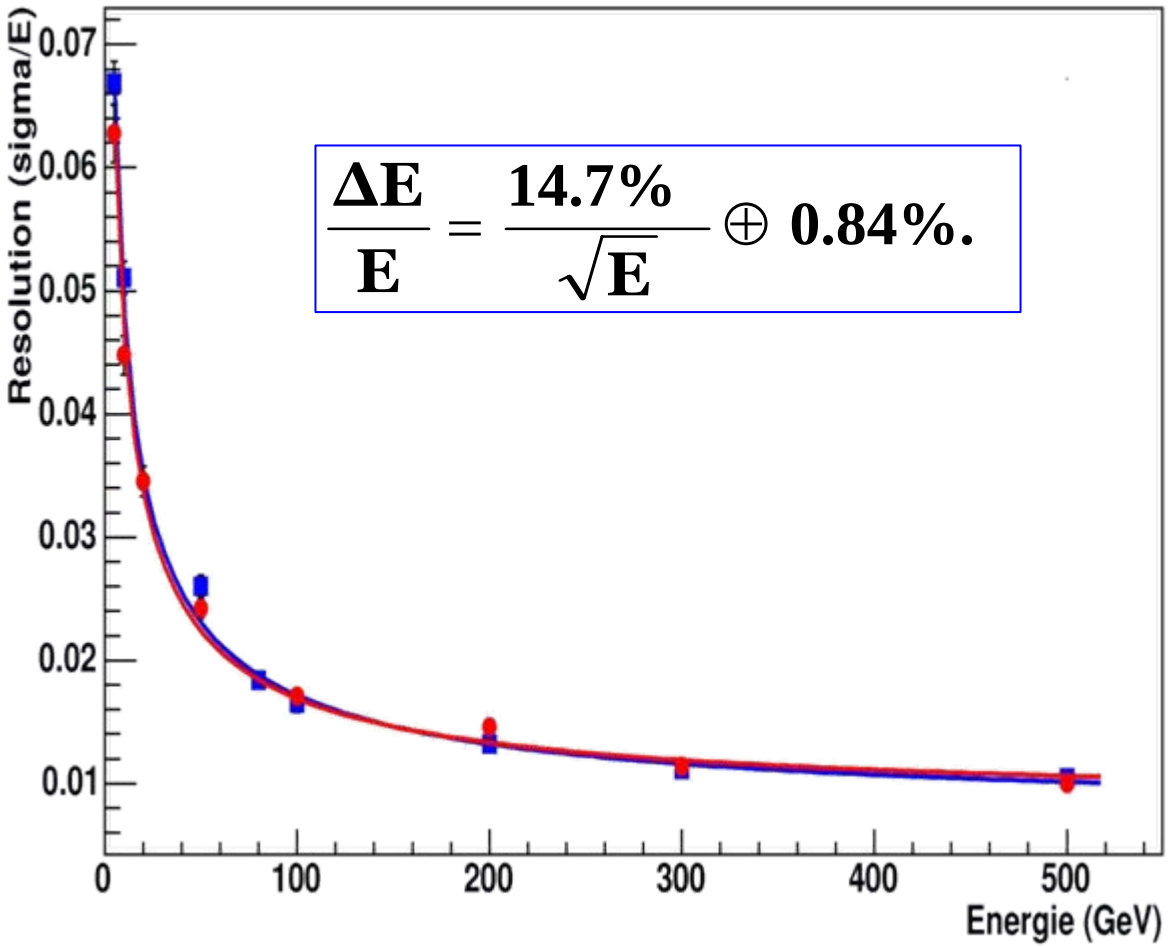
Study of pad size from 1 to 7 mm

- Energy $\frac{\Delta E}{E} = \frac{\sim 16\%}{\sqrt{E}} \oplus \sim 0$
- Position $\Delta X = \frac{0.84 - 0.94\text{mm}}{\sqrt{E}}$
- Direction $\Delta\theta = \frac{55\text{mrad}}{\sqrt{E}}$

Study by J.Y.Hostachy, (LPSC) M.Krim, D.Benchekroun (Univ. Casablanca)

Theta = 21,80 degres

ECAL with 30+10 layers



$$\frac{\Delta E}{E} = \frac{14.7\%}{\sqrt{E}} \oplus 0.84\%.$$

Conclusion

- The prototype is under completion
- The first results are very encouraging
- The R&D on final design are going on

A warning comes from the matrices production (only handmade now)

We are NOT at the minimal industrial level !!!
Any help is welcome