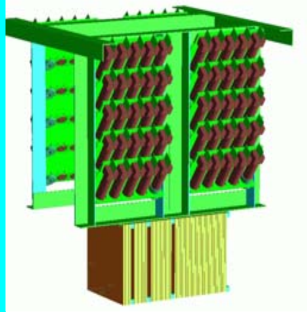
Lccal*: an R&D project for the Electromagnetic barrel Calorimeter



TALK SUMMARY

- Design principles
- Prototype description
- Status of the production
- Beam test results
- Future plans

* Official INFN R&D project, official DESY R&D project PRC R&D 00/02
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Design principles

From the TESLA TDR requirements:

- high granularity,(Energy Flow)
- σ_E O$(10\%/\sqrt{E} \ +1\%)$
- longitudinal segment. (e/π) separation
- working in magnetic field
- high density (25-30 X_0 in $\sim$ 50 cm)

2 solutions:

- **Si W**
- **Shashlik (thanks to CALEIDO)**

Alternative solution:

Keep SiW advantages (flat geometry, high granularity)

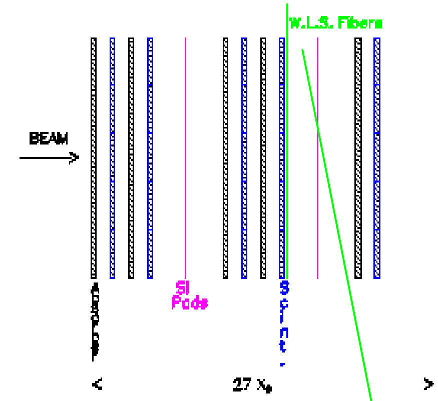
Erec. not from Si but from Scintillator-WLS fibers

Reduce (factor >10) the number of channels

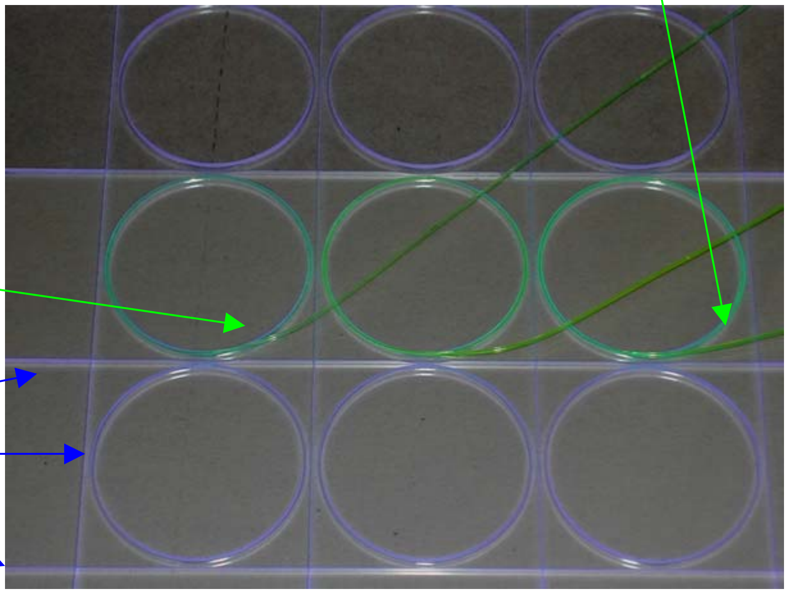
Prototype description

Pb/Sc + Si

- 50 layers:
- $25 \times 25 \times 0.3$ cm^3 Pb
- $25 \times 25 \times 0.3$ cm^3 Scint.: 25 Cells 5×5 cm^2
- 3 planes:
- 625 1×1 cm^2 Si Pads
- at: 2, 6, 12 X_0



(Slightly reduced to cope with budget)



Scintillation light transported with WLS σ tail fibers:

Coupled with clear fibers (to PM):

Cell separation with grooves in Sc. plates with Tyvec strips inside

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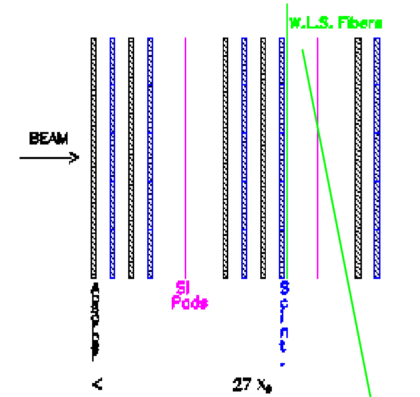

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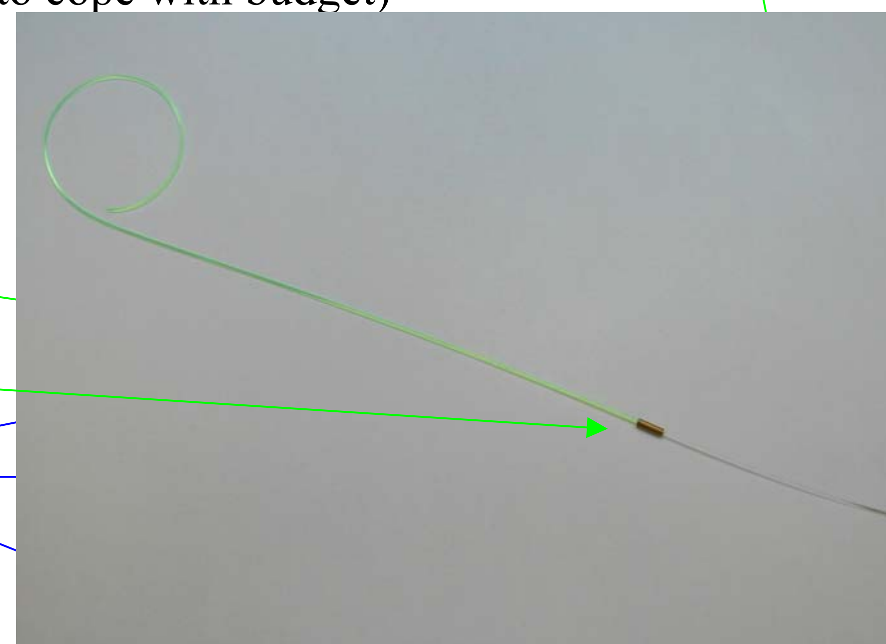
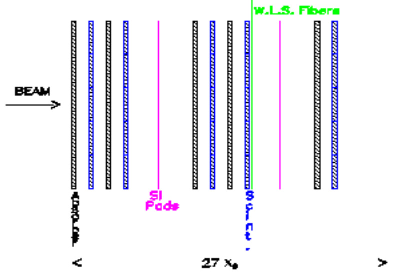


Prototype (cntd)

3 Si planes

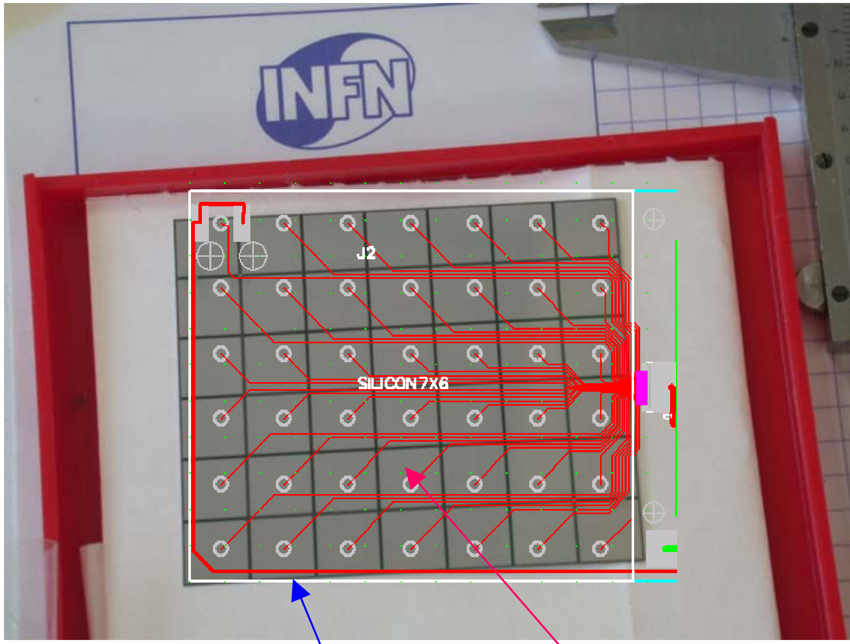


Goal: shower-shower separation:

- **Pad dimension< shower dimension:**
  .9x.9 cm^2
- **Longitudinal sampling:**
  3 planes
- **Analogic RO**
  VA hdr9c from IDEas
- **Next year: shower dimension reduction**
  W absorber

Actual design

- **Detector: 6x7 pads**
- **Plane: 3x2 detectors**



pcb contact with conductive glue

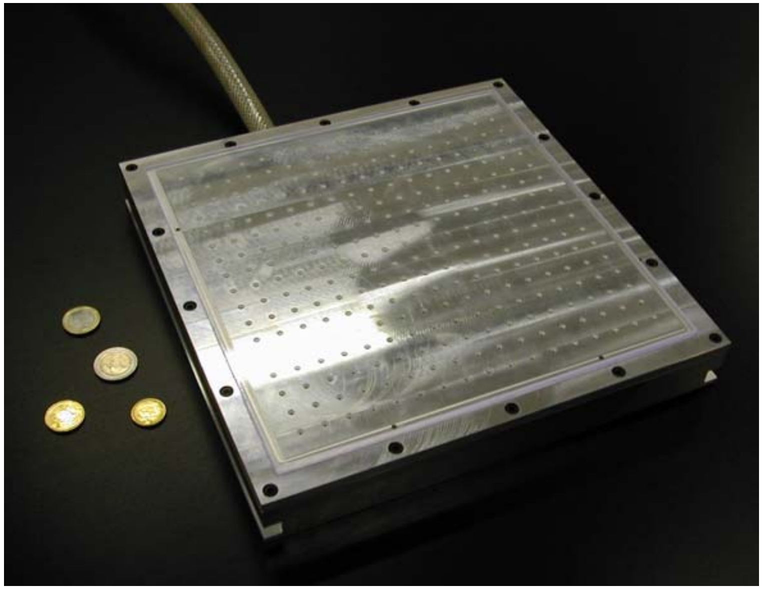
Pad diode ac coupled

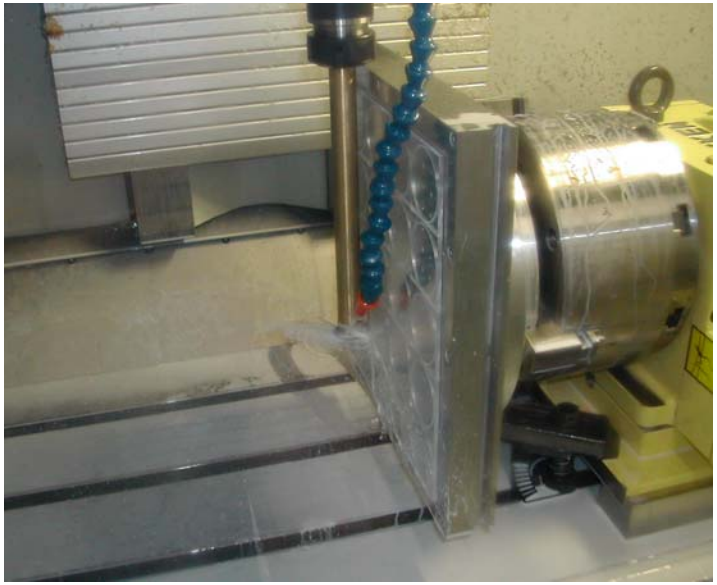
Production status

- **Scintillator tiles:**

- **3 mm Kuraray SCSN-61 (25x25 cm^2)**
- **3 mm Bicron BC-408 (25x25 cm^2)**

Machined with vacuum plate as holder





Whole Production (>50 tiles) done

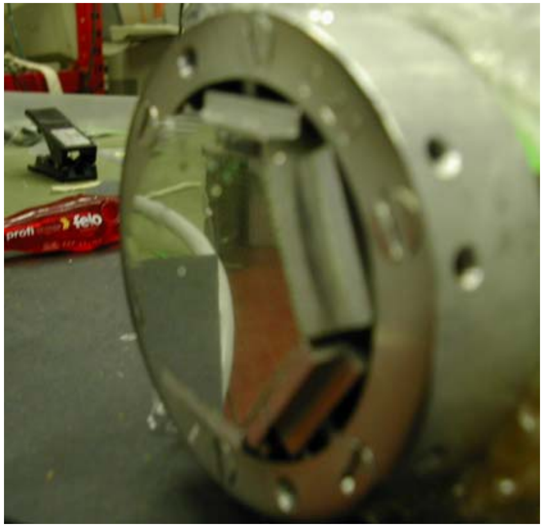
Production status

- **Scintillator tiles:**

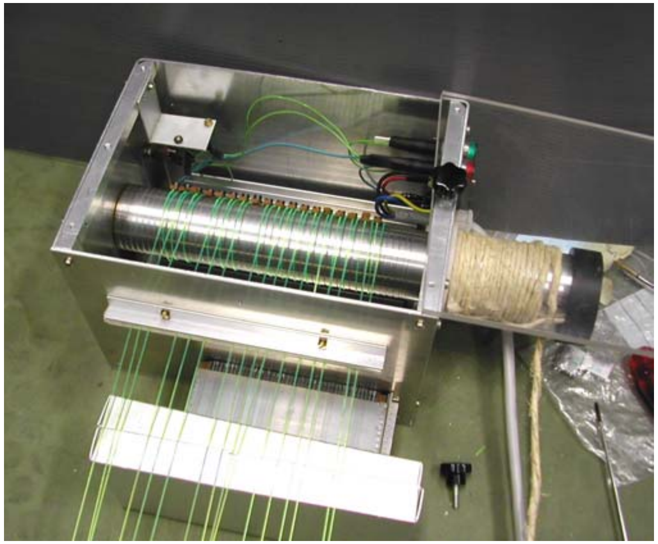
Fibres:

Kuraray 1mm d. Y11 300 ppm multicladding

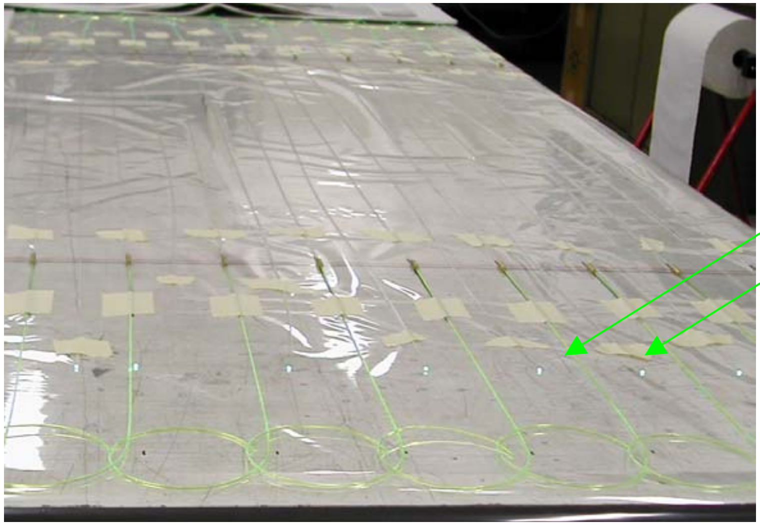
Face polished and aluminized by sputtering



To make the 2.4 cm radius curvature : middle temperature(50^0-70^0) oven



Splicing going on :



>3 ph e^- /m.i.p./tile obtained

stable in >30 day time

Production status

- **Scintillator tiles:**

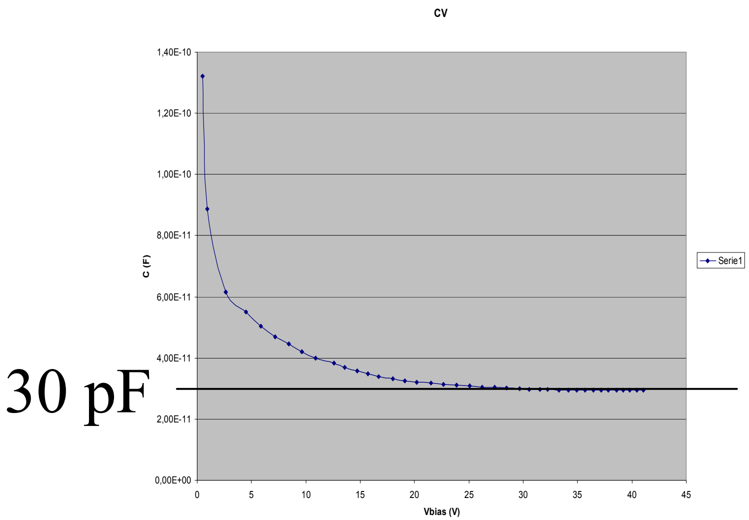
Fibres:

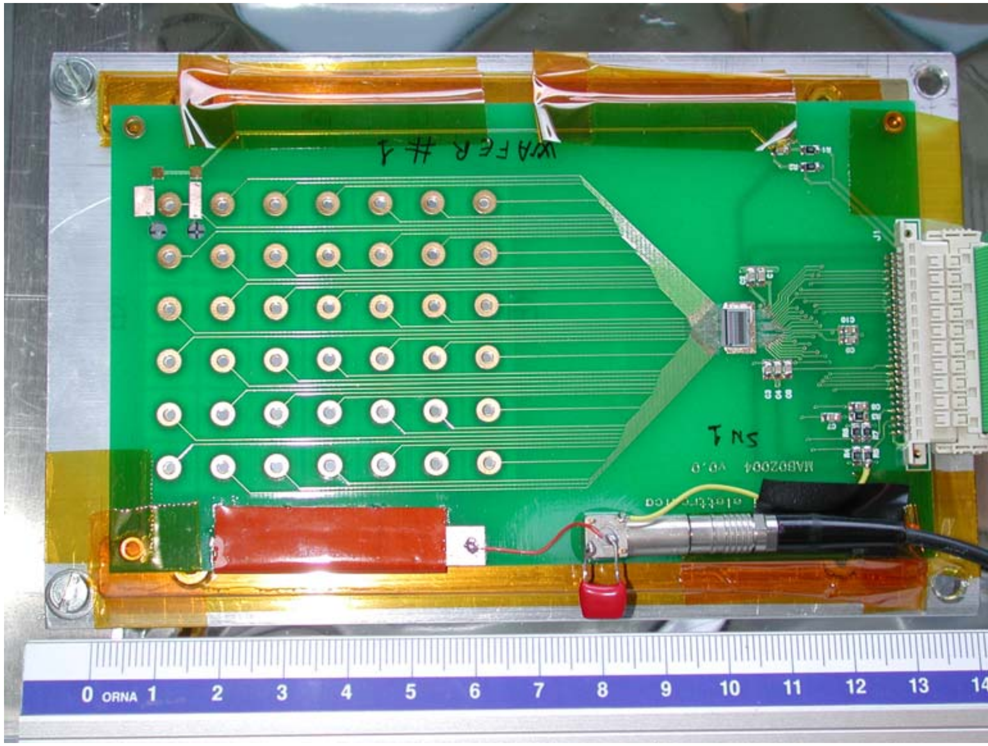
Si pad detectors:

1 detector fully mounted and tested

Full depletion at <30 V

C vs Vbias





20 detectors produced by ITE (Warsaw) with reasonable performance (under test now)

Production status

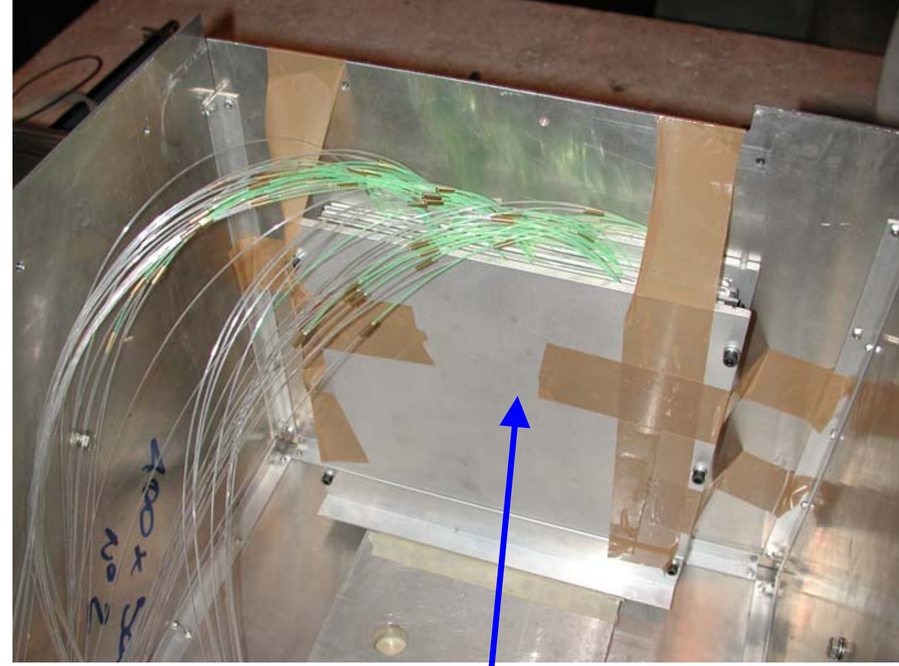
- **Scintillator tiles:**

Fibres:

Si pad detectors:

Detector assembling:

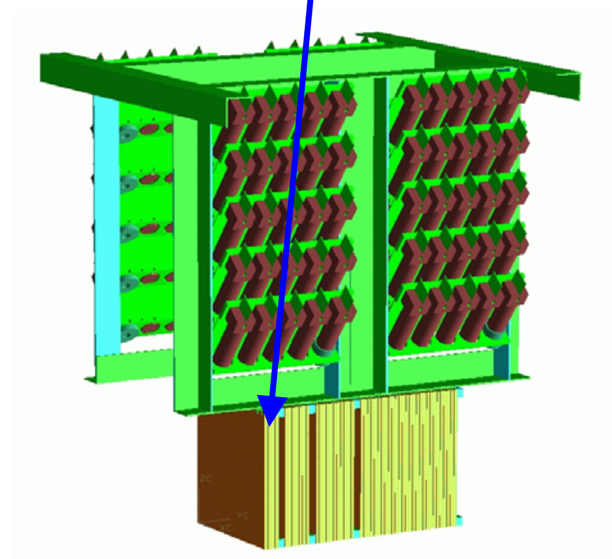
First segment ($2\ X_0$) completed



Pb plates produced (>50)

Fiber insertion , tile assembling up to 45 Pb/Sc layers: starts in september

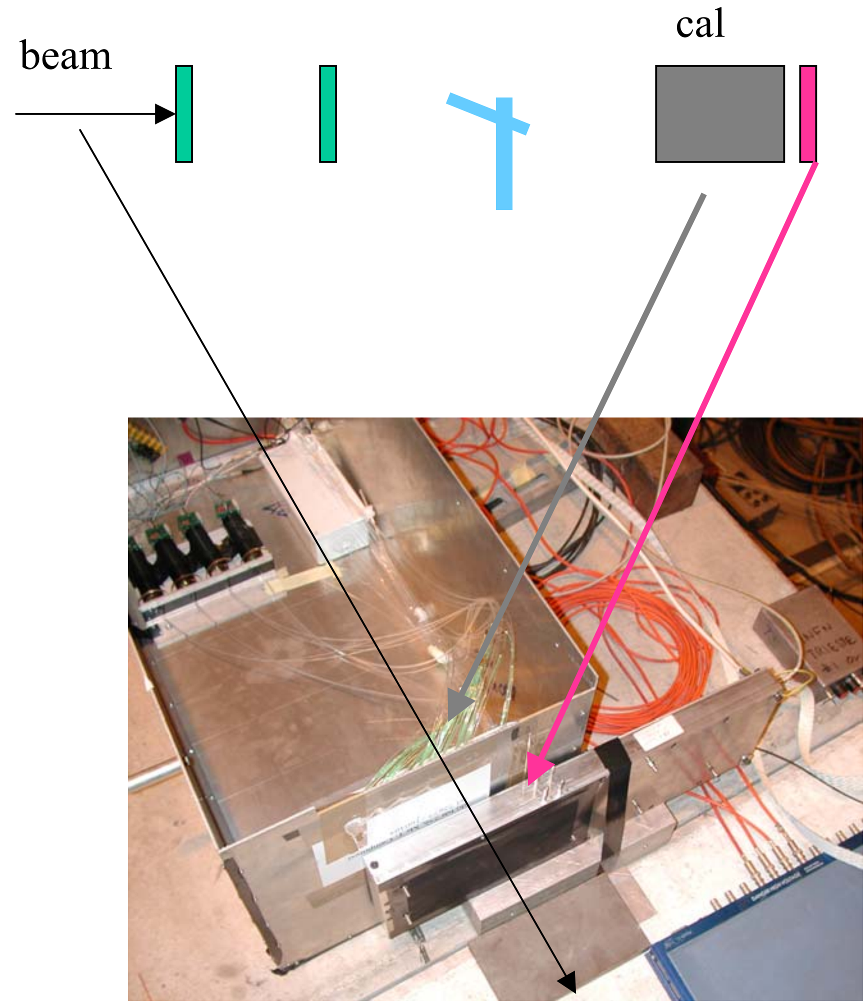
Mechanical support for beam test to be builded in Frascati



Test beam* results

Set up:

- **2 planes Si μstrip telescope**
- **2 trigger Scintillators**
- **Calorimeter first segment (2 X_0) read by PM**
- **1 Si pad detector**



e^- 40 / 50 GeV

π 50/150 GeV (used as m.i.p.)

*CERN SPS H4

Test beam results CALORIMETER (2.1 X_0)

4 layers

m.i.p.→check light output and uniformity in Light collection:

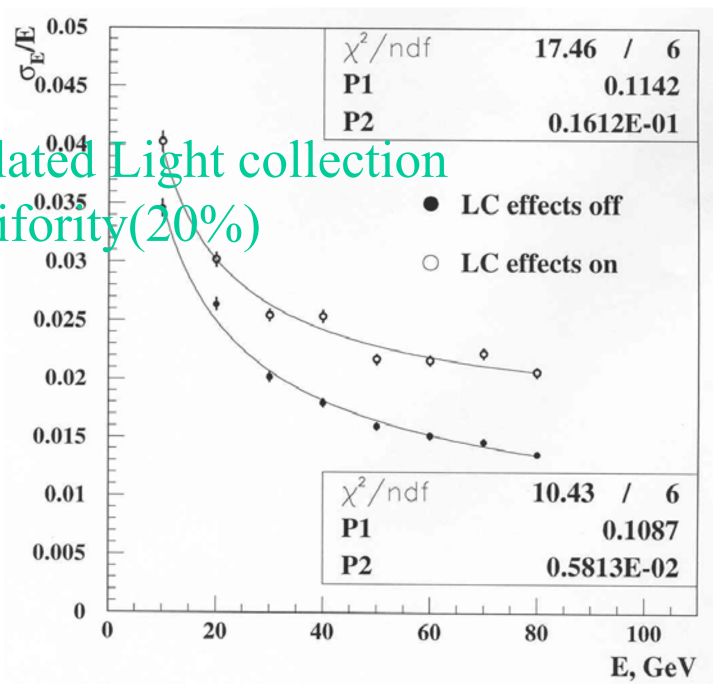
Ratio signal/sigma →lower limit for photoelectrons

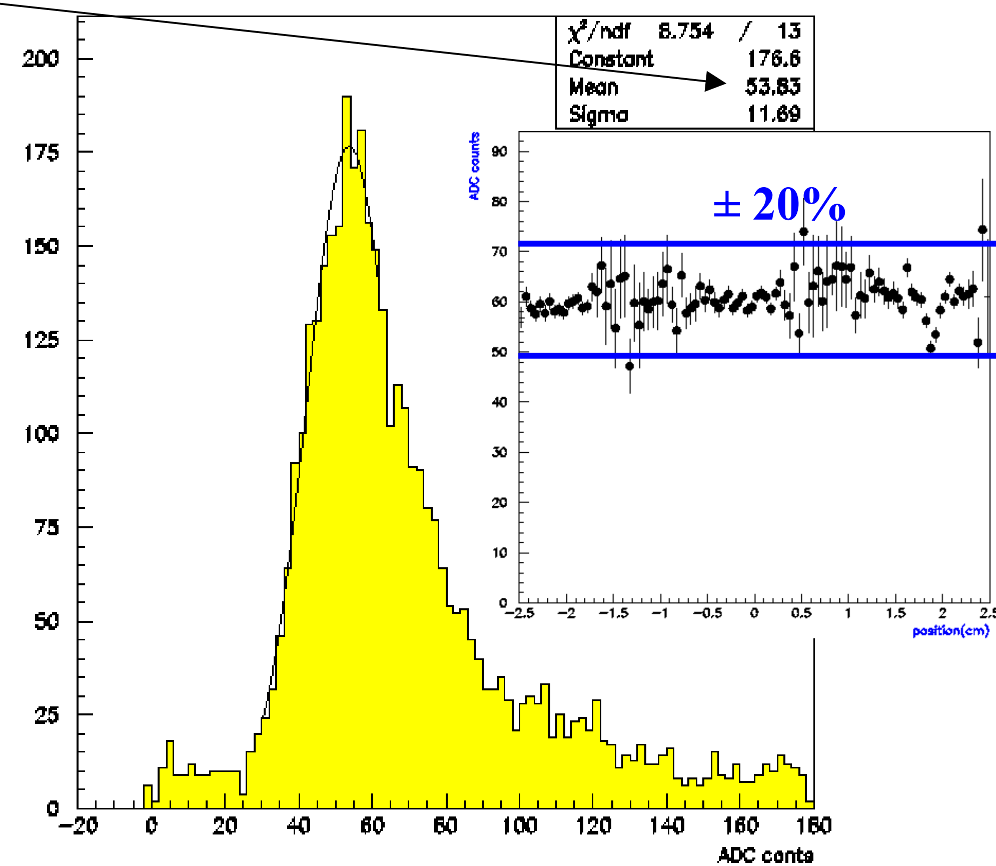
N_{phe}>5.1 /layer

→ cal(45layers):>220 phe/m.i.p.

good uniformity:

Simulated Light collection disuniformity(20%)

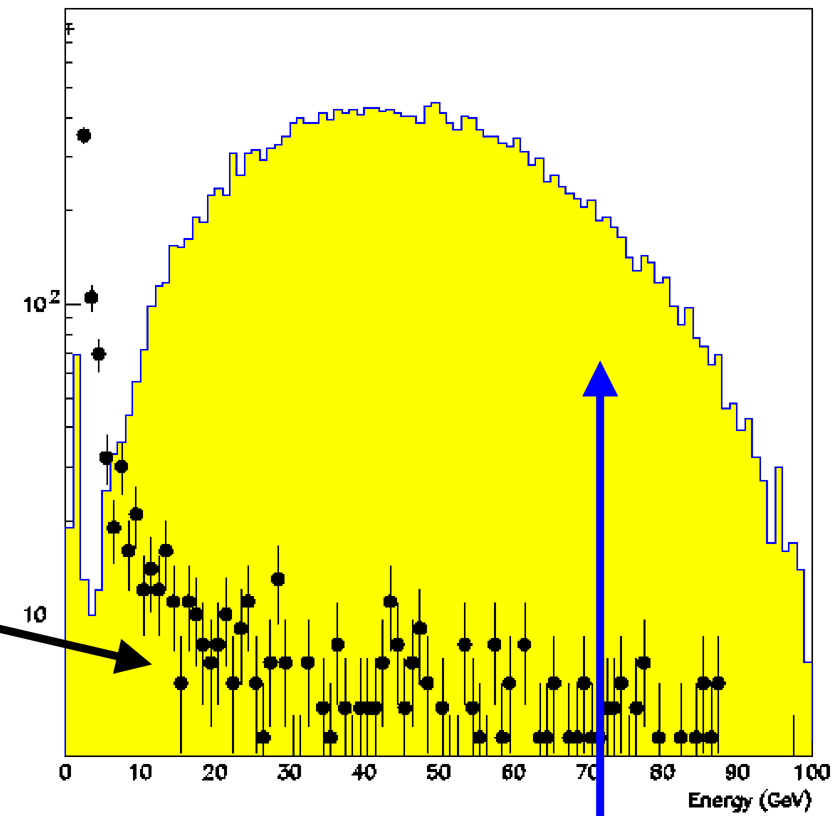




Test beam results: CALORIMETER (2.1 X_0)

Too few layers to give Energy resolution but enough to show e/π separation

150 GeV π

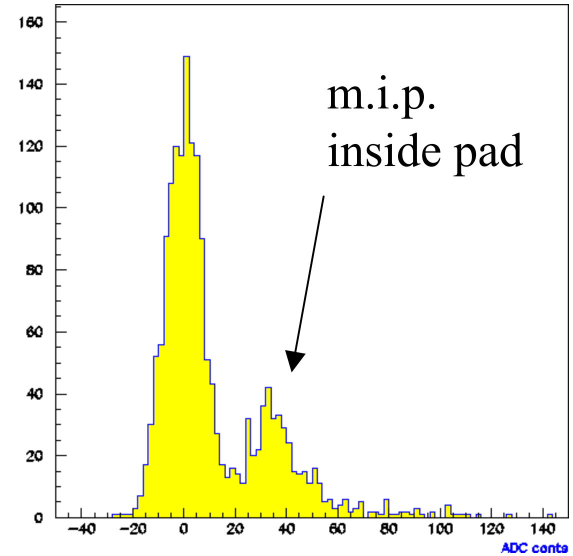


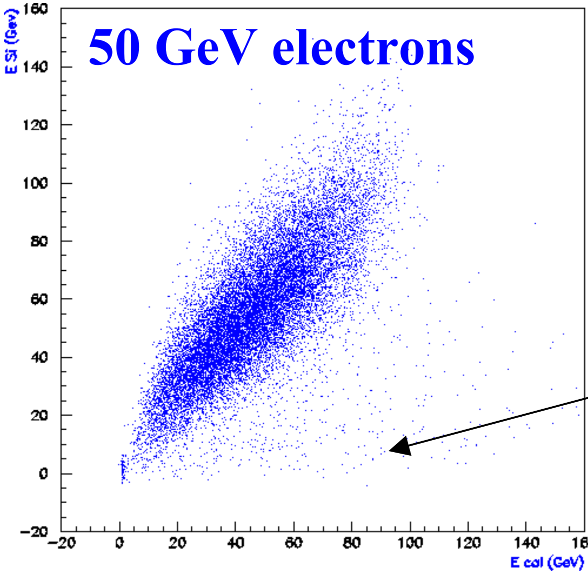
50 GeV electrons

Test beam results: Si pad detector

m.i.p. signal >4 sigmas

(coherent noise subtraction not optimized)

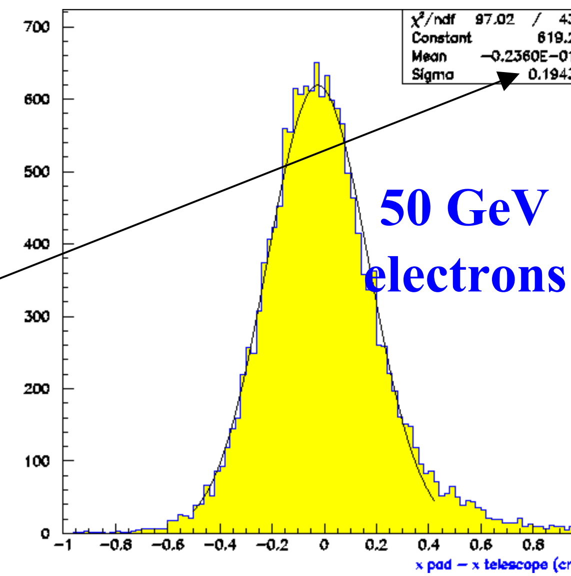




No saturation!

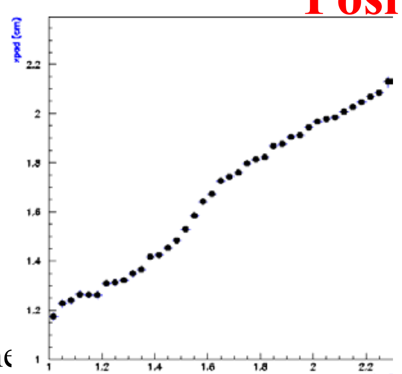
Out of detector

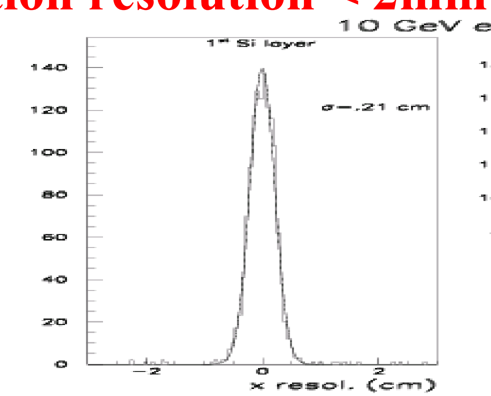
(6.3x 5.4 cm^2)



Position resolution < 2mm

Correction for pad dimention not included:

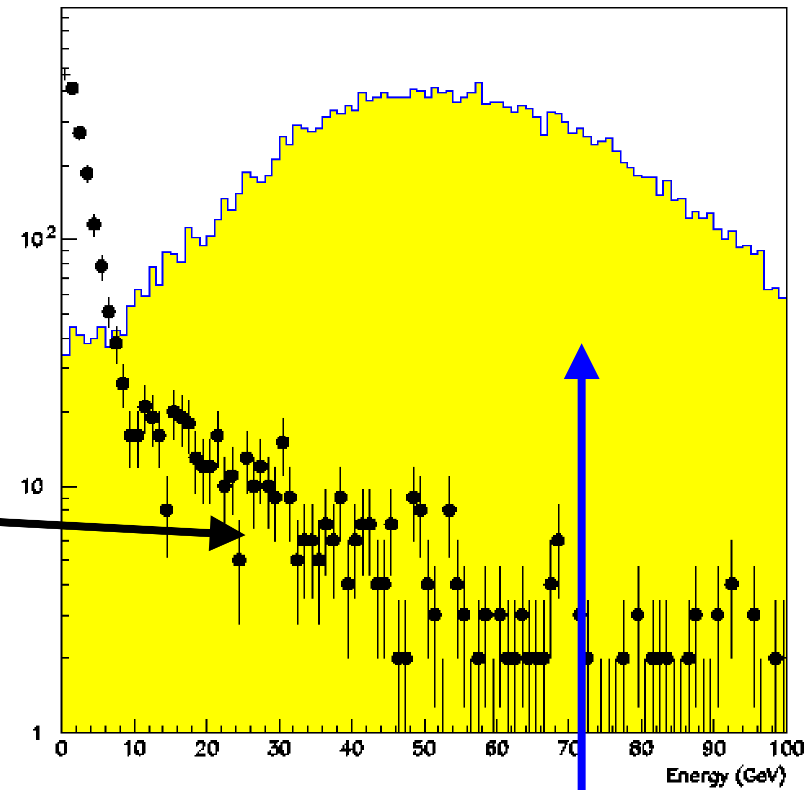




Test beam results: Si pad detector

e/π behaviour clearly different

150 GeV π



50 GeV electrons

Future Plans

- **complete the detector (next month)**
- **go to test beam (low energy Frascati, high energy DESY/CERN)**
- **analyse two particle impact**
- **substitute the absorber: Pb to W (next year)**
- **study new optical device (i.e. multianod PM's)**
- **collaborators are wellcome**

Conclusions

- The proposed prototype is going to be completed (all the production problems are solved)
- A preliminar beam test at CERN with a partial set up gave reasonable and incouraging results
- Tests with the complete detector are necessary to answer to all questions
- …. but it they will be successfully answered, why do not include a calorimeter made following this technique into the general LC simulation and Pattern recognition?