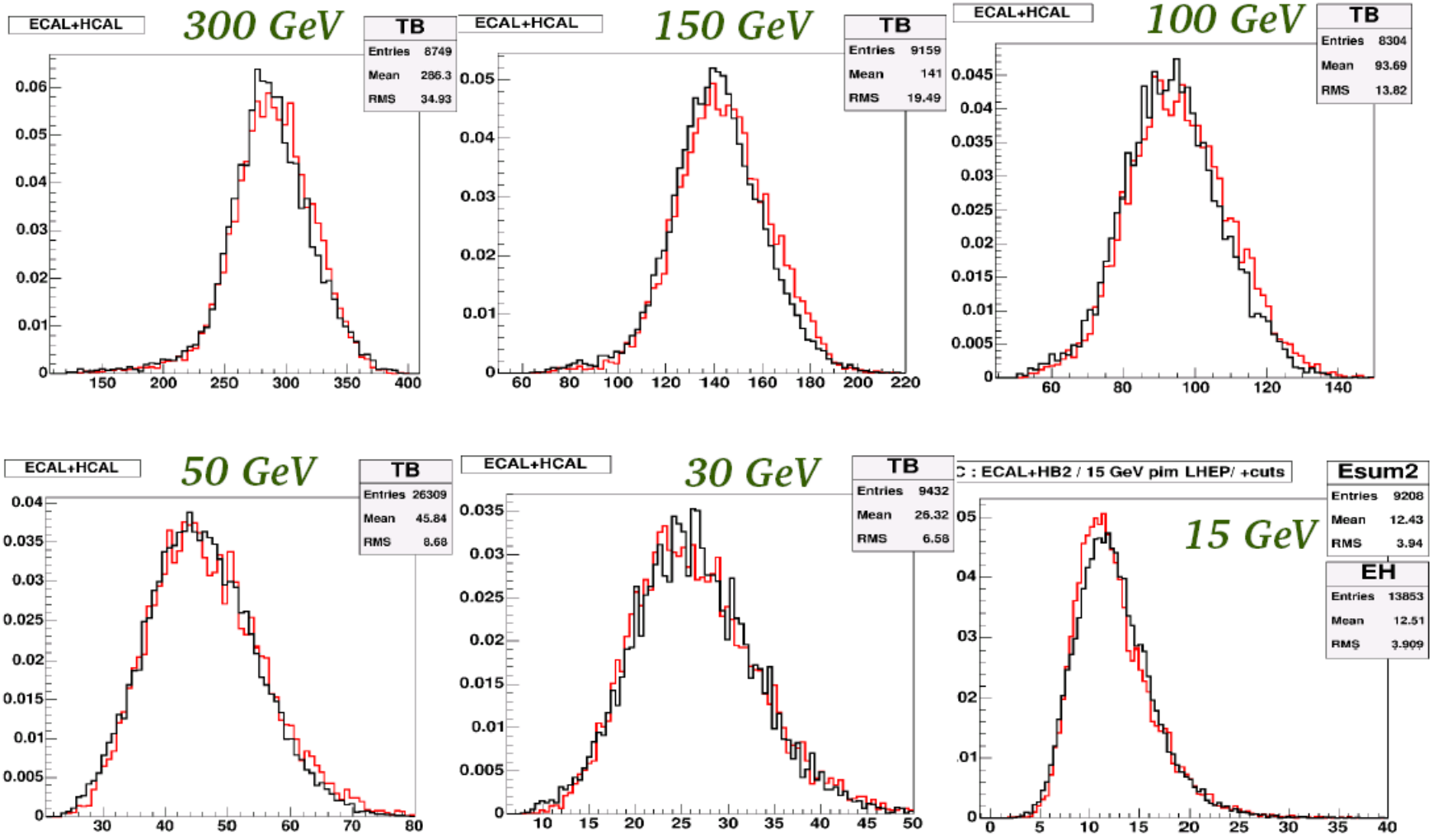
Calorimeter and Muon Summary

- Validation of Geant4
- Si/W Calorimeter
- Scintillators
- Gaseous Calorimeters
- Detector optimisation
- New Ideas
- Muon Identification

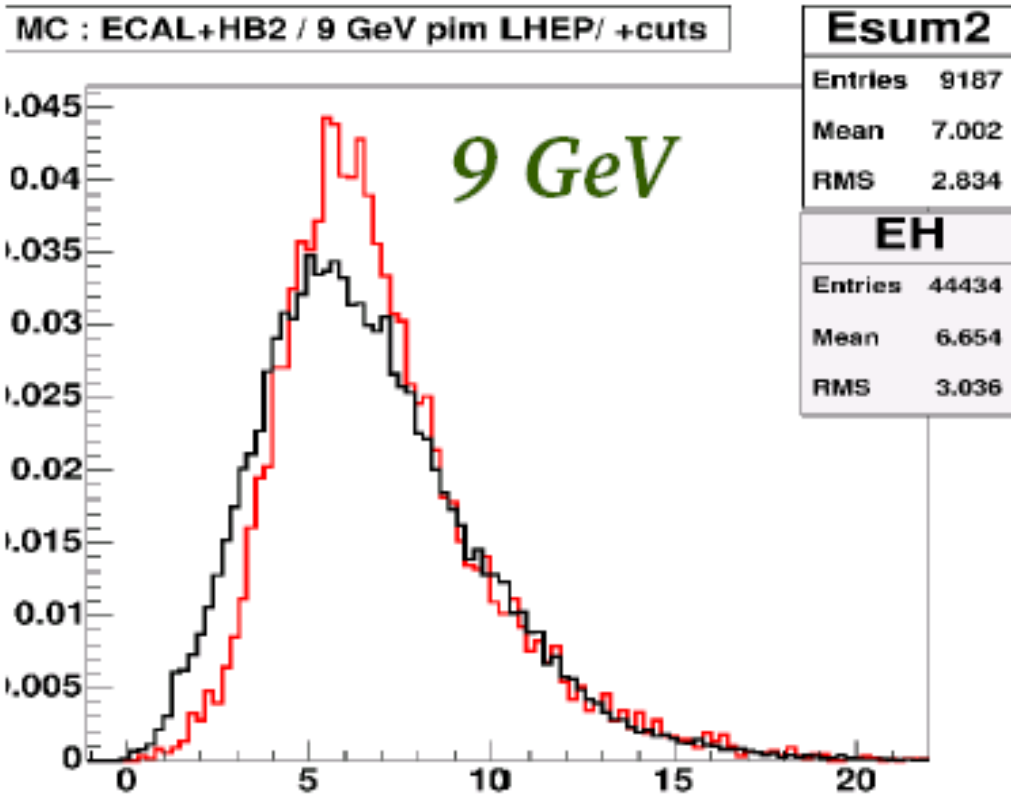
Hadronic Interactions and Geant4

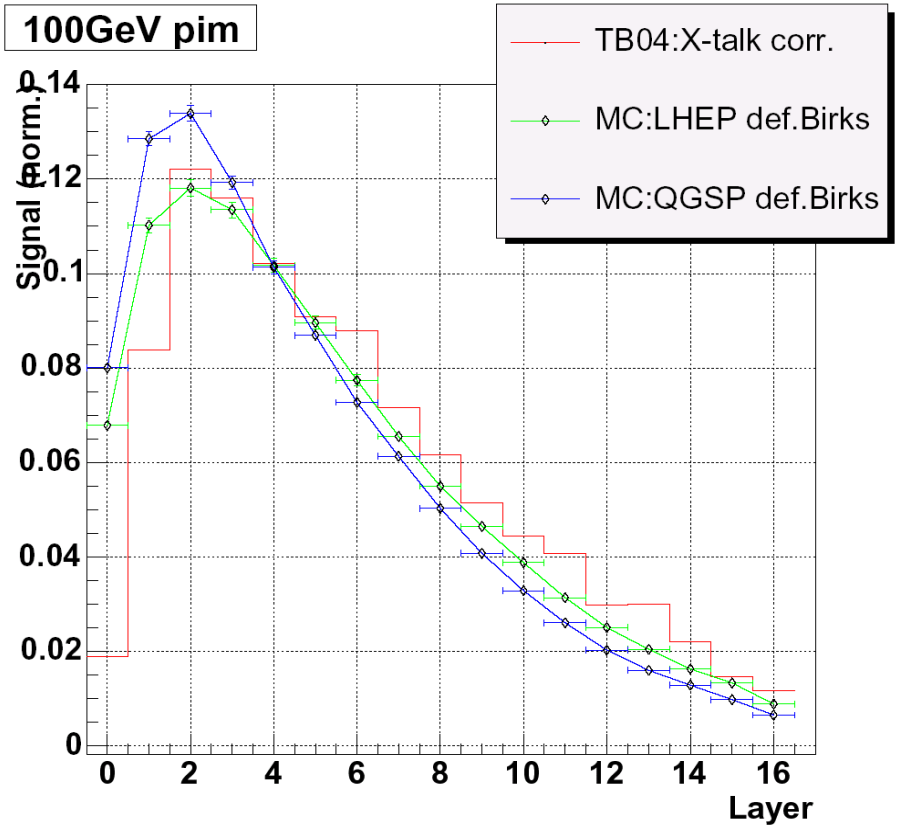
CMS Beam test results



S. Sharma

Hadronic Interactions and Geant4



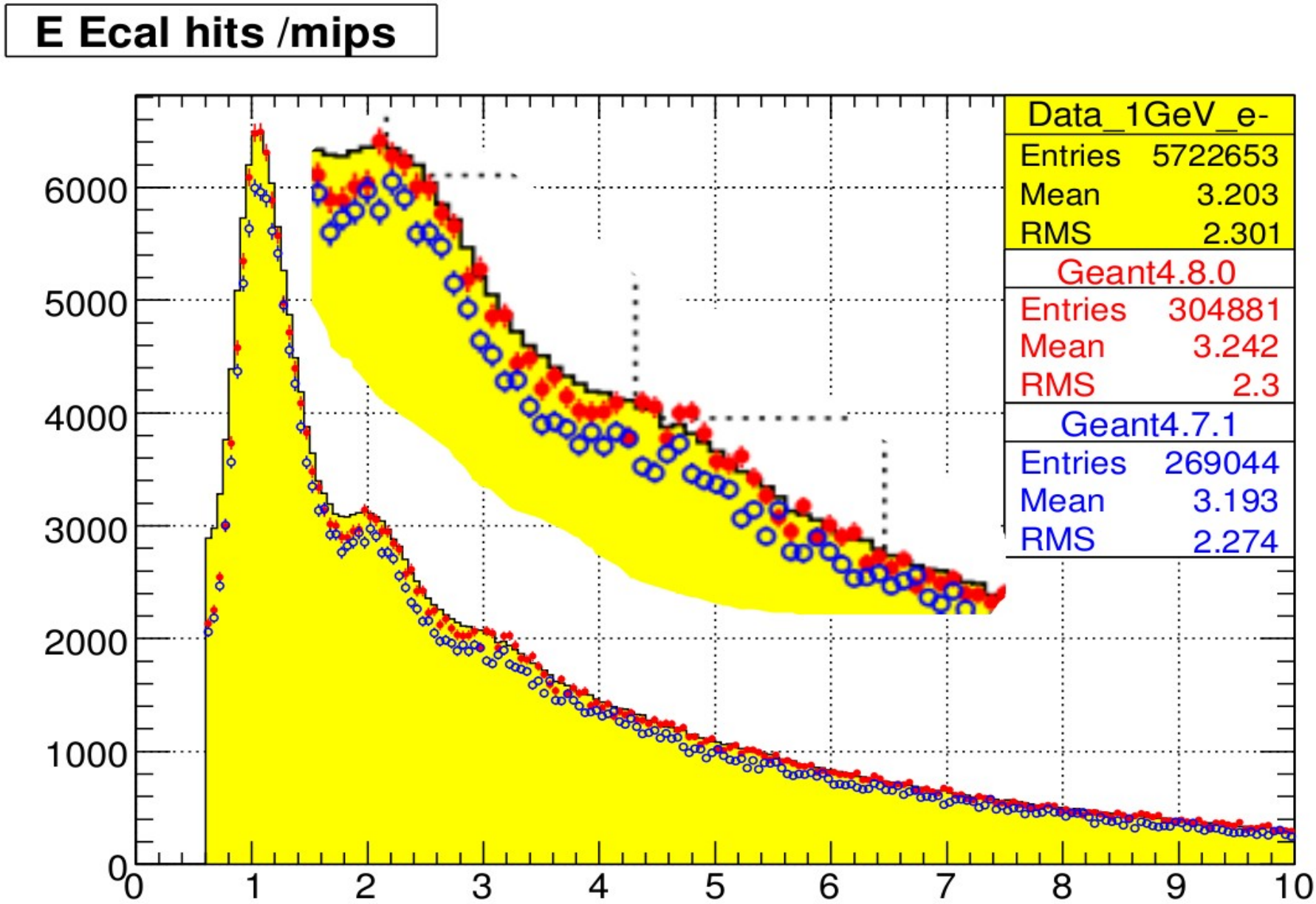


S. Sharma

Disagreement: (LHEP)

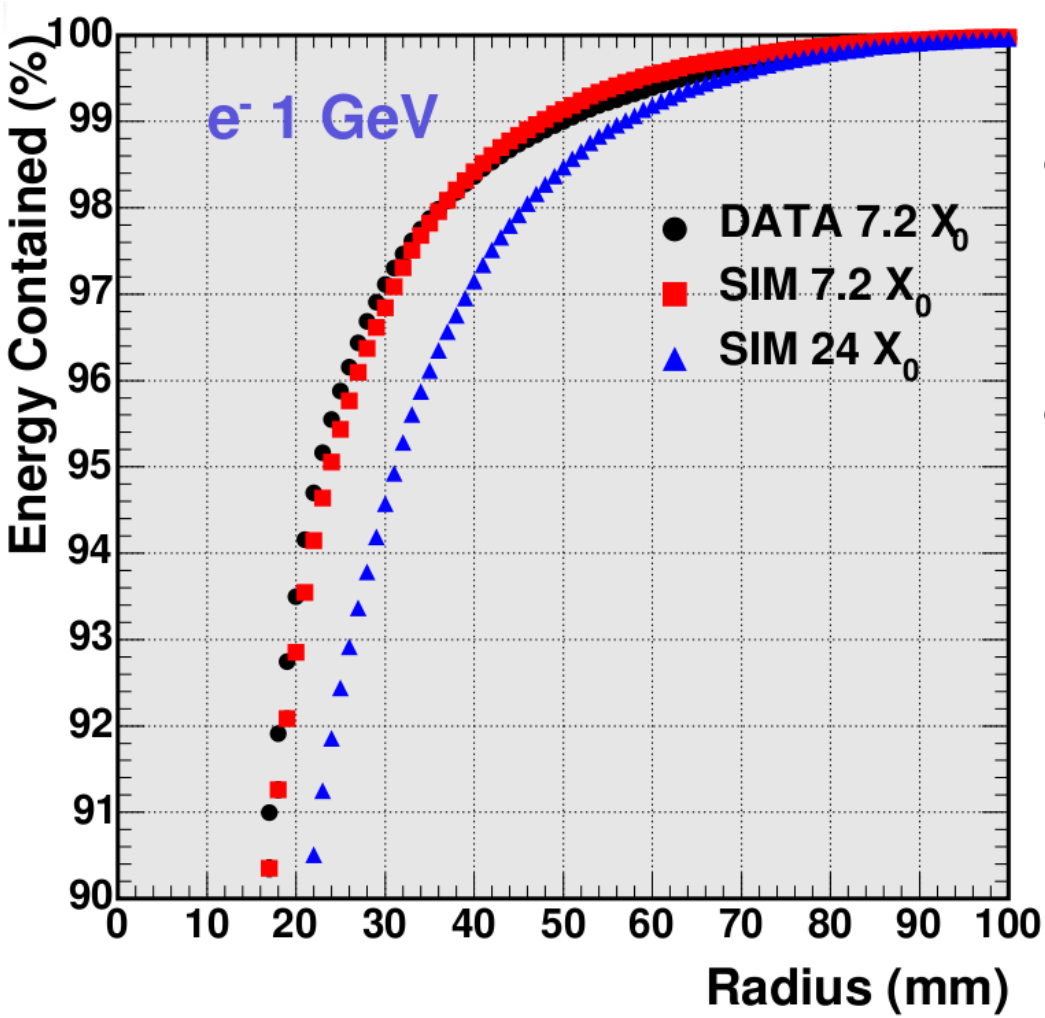
- Longitudinal shower profile
- Transition region from low to high energy parametrisation.

Electromagnetic Interactions and Geant4



G.Mavromanolakis / D.Ward

Molière Radius of the Calice ECAL Prototype



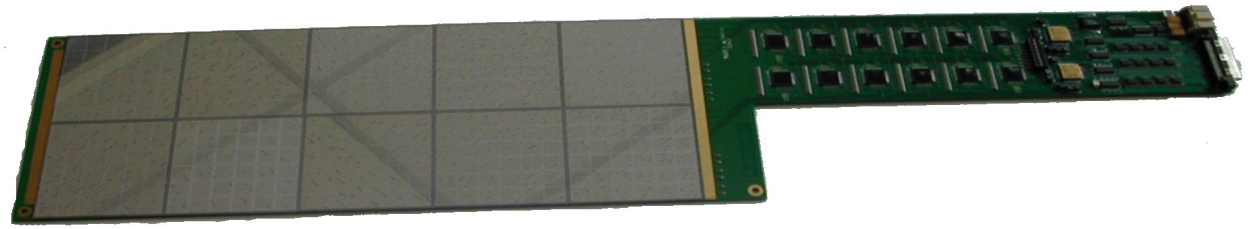
- Equipped with only 7.2 X_0
  (at time of test beam).
- Shower not completely contained

- test beam/simulation with 7.2 X_0 : r_M=1.6mm.
- simulation with 24 X_0 : r_M=2.1mm.

(r_M of tungsten = 10mm)

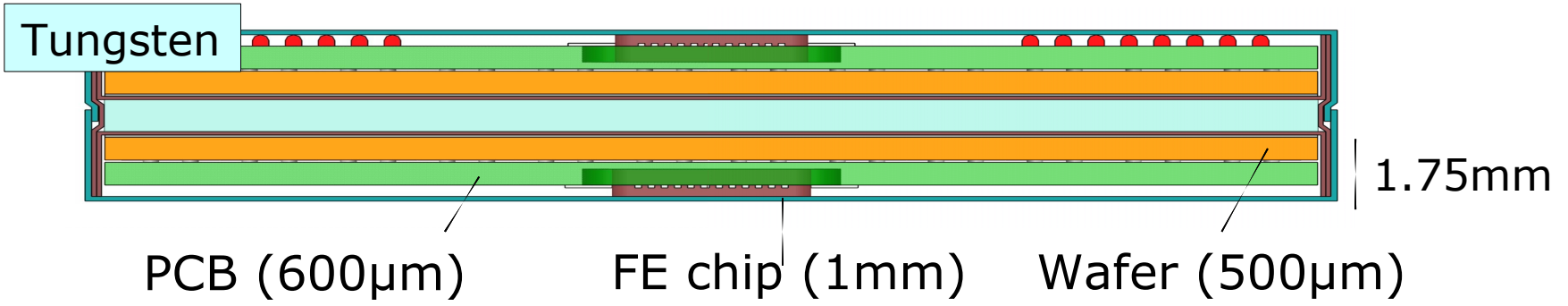
G. Mavromanolakis

Si/W Calorimeter



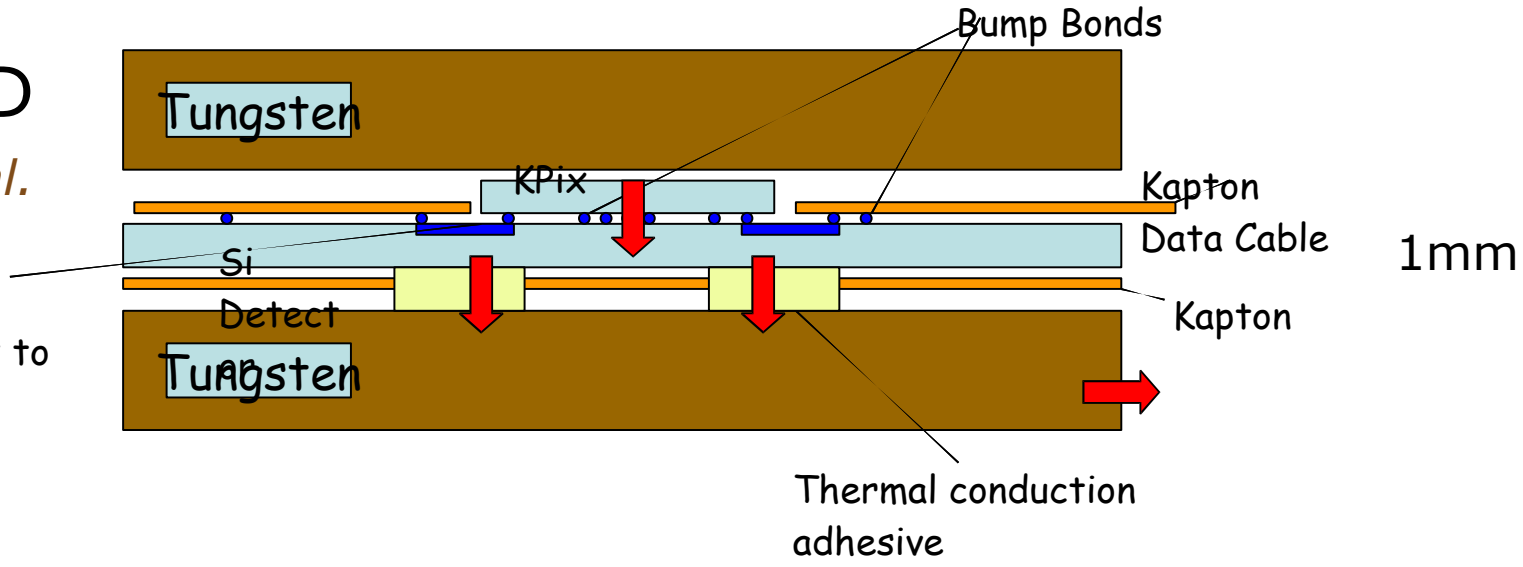
Calice Prototype

Gap width = 2.73mm

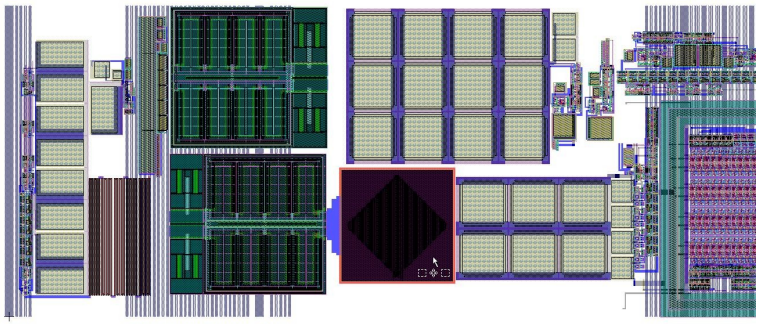


ECAL for SiD

J. Brau, et al.



Readout Chip - SiD ECAL



One KPix Cell

Features of final chip:

- 1k channels
- ADC conversion
- time stamping
- zero suppression
- buffer for one bunch train
- power pulsing (19μW/channel)

- First prototype tested.
- Not everything worked as planned.
- Second submission back from foundry in few weeks.

J.Brau et al

Next Calice ECAL Readout Chip

- Builds up on Prototype readout chip
- 18 channels
- Has integrated ADC
- but also analog readout
- has idle mode for all components
  (needed to achieve 100µW/ch)

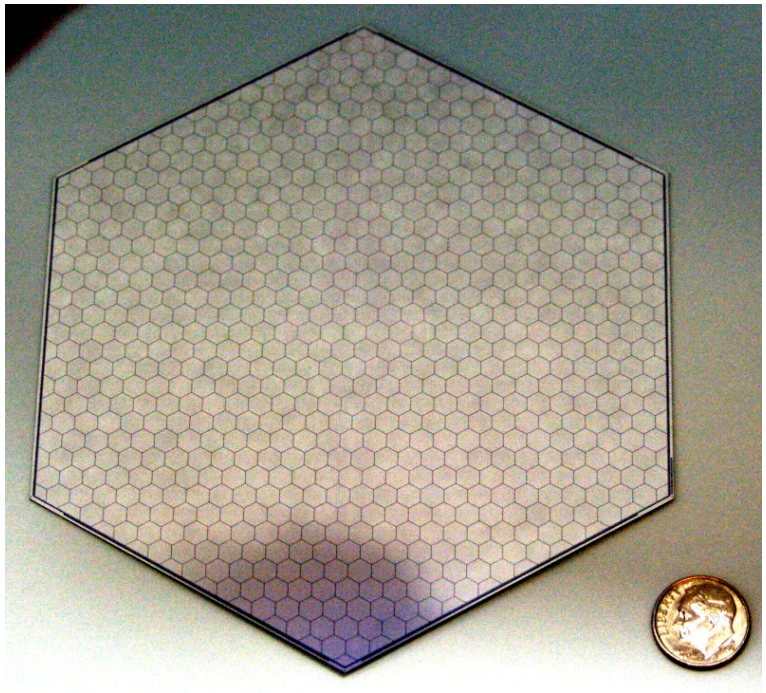
produced, packaged, and placed on a test board
but test board firmware still missing.

J. Fleury

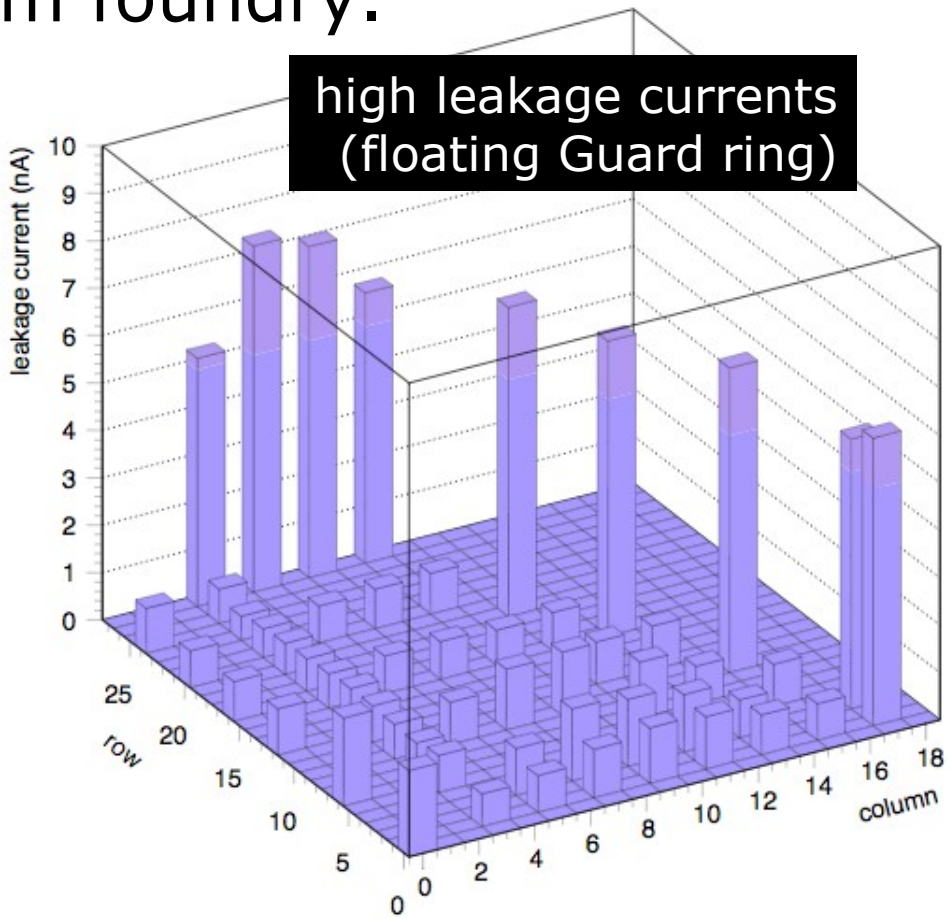
Next steps towards ILC
electronics:
zero suppression
time stamping

Wafer – SiD ECAL

Prototype wafer back from foundry.



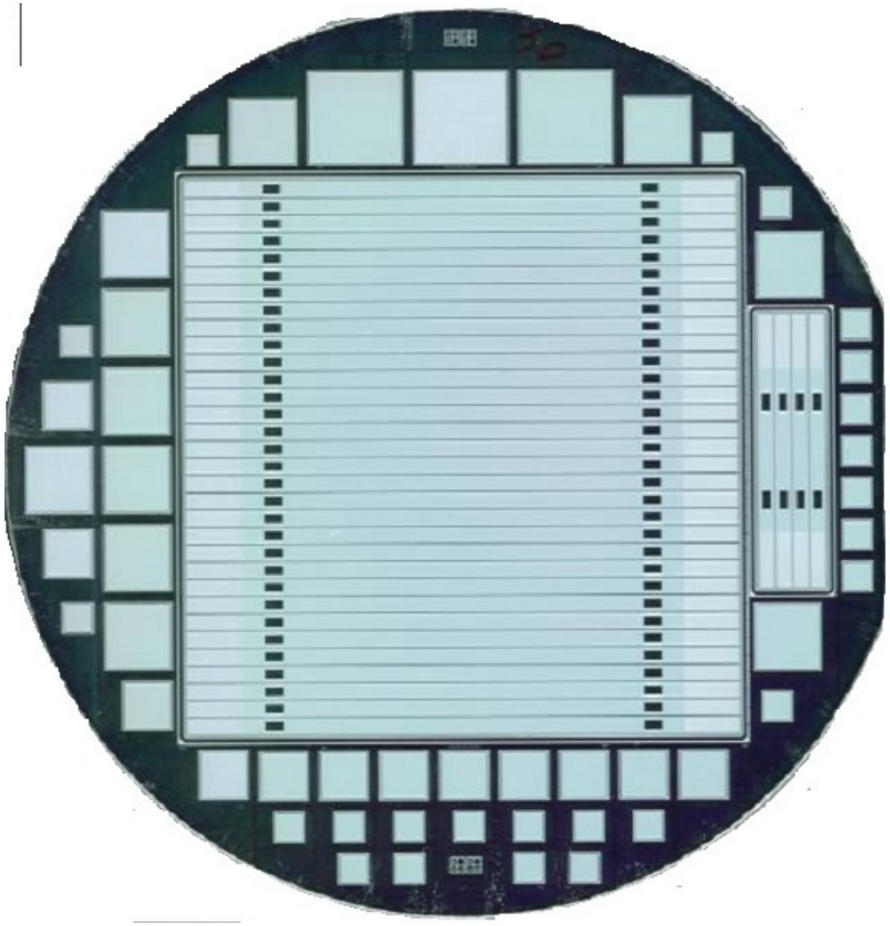
Hexagonal shape to maximise usage of the raw silicon wafer



Leakage currents measured with probe station.

J. Brau, et al.

Silicon Wafer Production in India



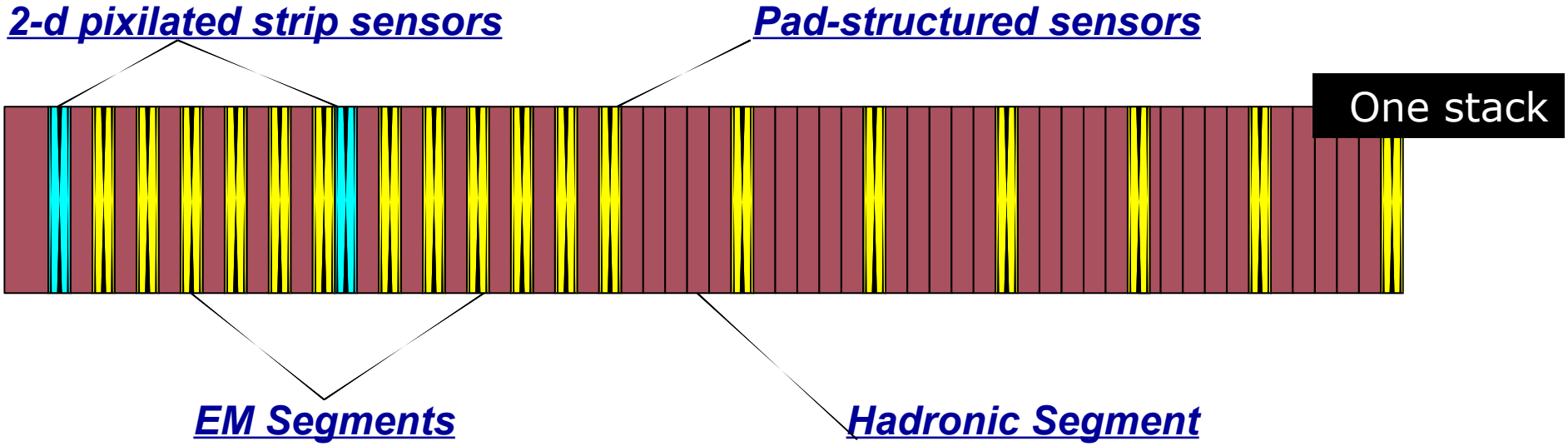
- thickness 525 µm
- Average leakage current 10-20 nA/cm^2 per strip.
- Total leakage current 200 µA at 300 V.
- Breakdown above 500 V.
- Dicing accuracy ~25 µm.
- Yield 50%

Would be available for ILC productions when done with CMS.

A. Topkar.

Phenix Si/W Calorimeter

Important Goal to measure pi0.

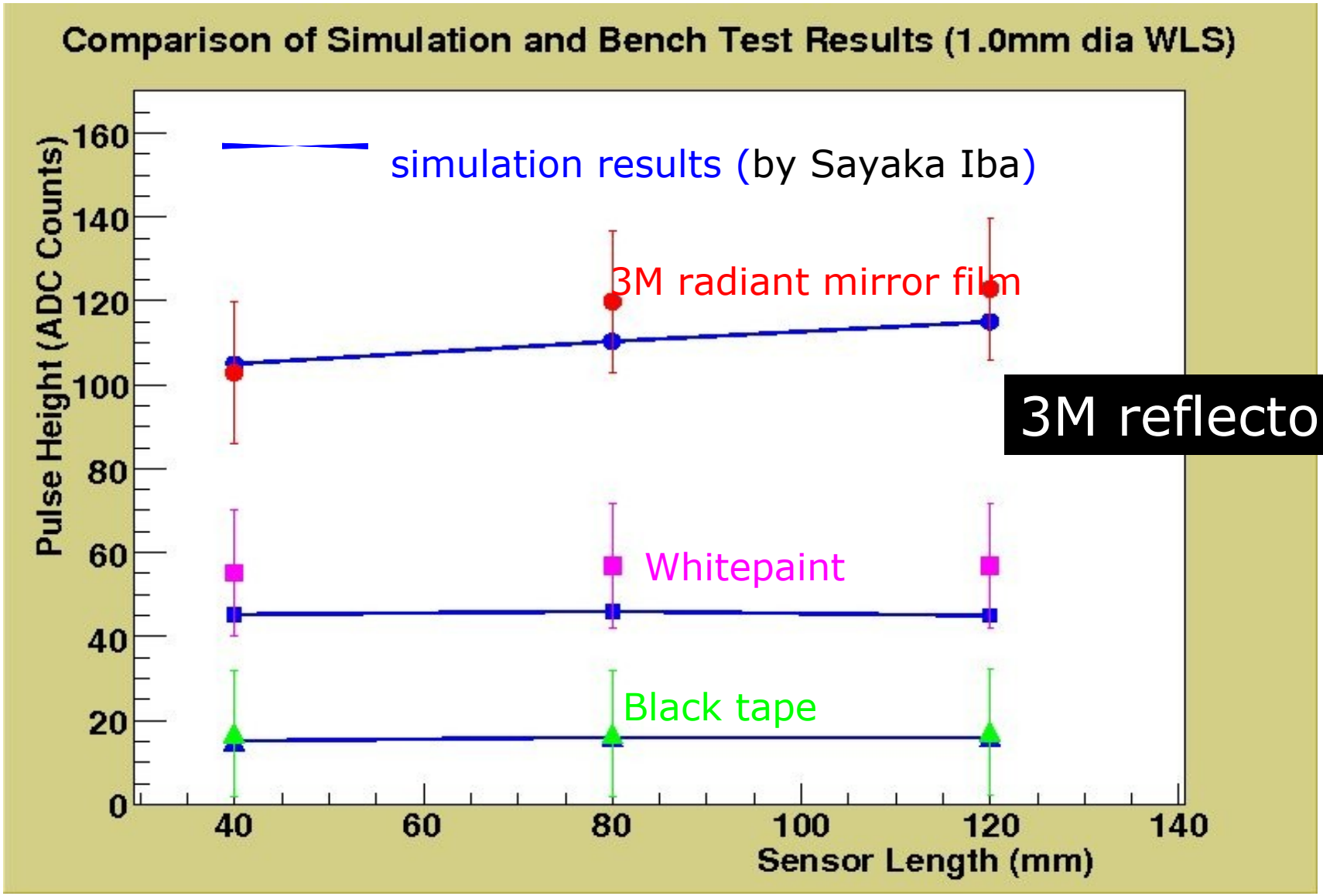


Simulations show:

- resolution: $\sigma/E=18\%/\sqrt{E}+4\%$ (E in GeV)
- pi0 can be distinguished.
- Test beam on going to proof claims.

W. Cooper for the Phenix Collaboration

Systematic Study of Small Scintillators



3M reflector best

100% Light yield increase from 1 to 1.6 mm diameter.
Similar for block type scintillator.

E. Jacosalem

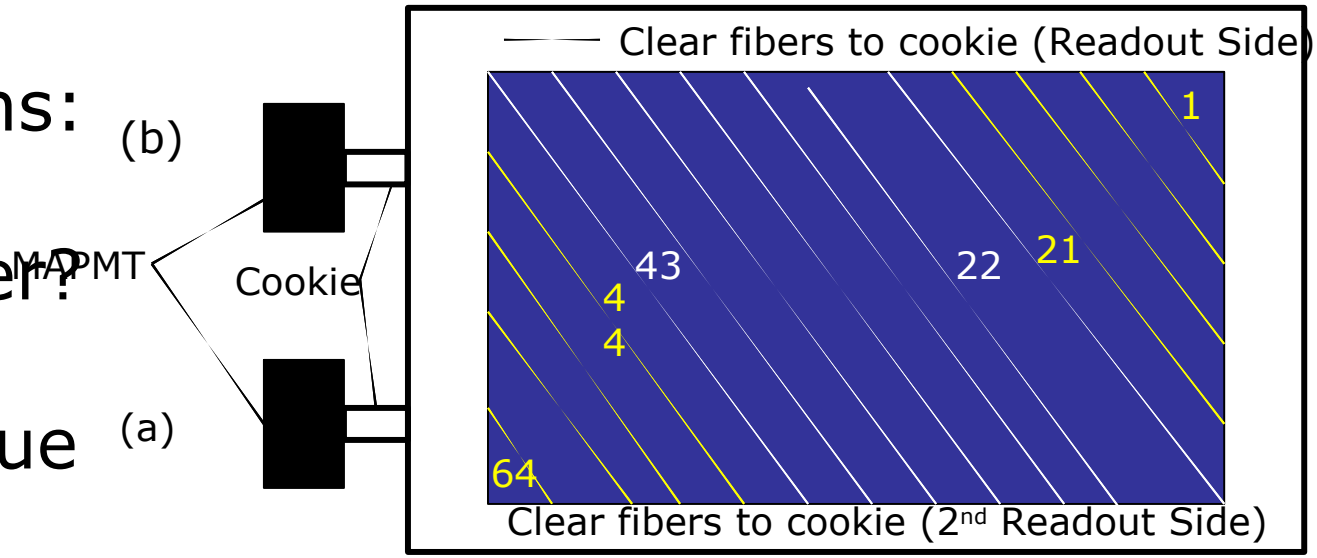
ILC Prototype Muon Scintillation Counter

First test:

- 4 planes installed in FNAL test beam
- 24 channels connected
- 3 adjacent strips at a time
- Clearly visible pedestal peak, 1,2,3 ... photoelectron peaks.

Prelim.Conclusions:

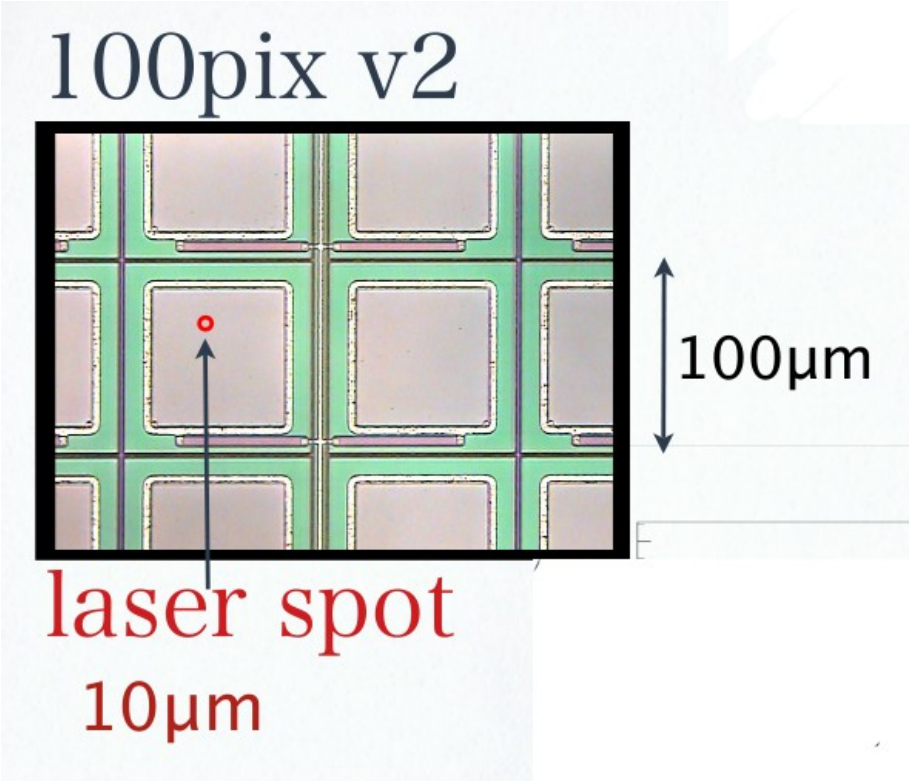
- Need e.g. ADC
- Faster WL shifter?
- SiPM/MPPC?
- Improvement due to readout at both ends.



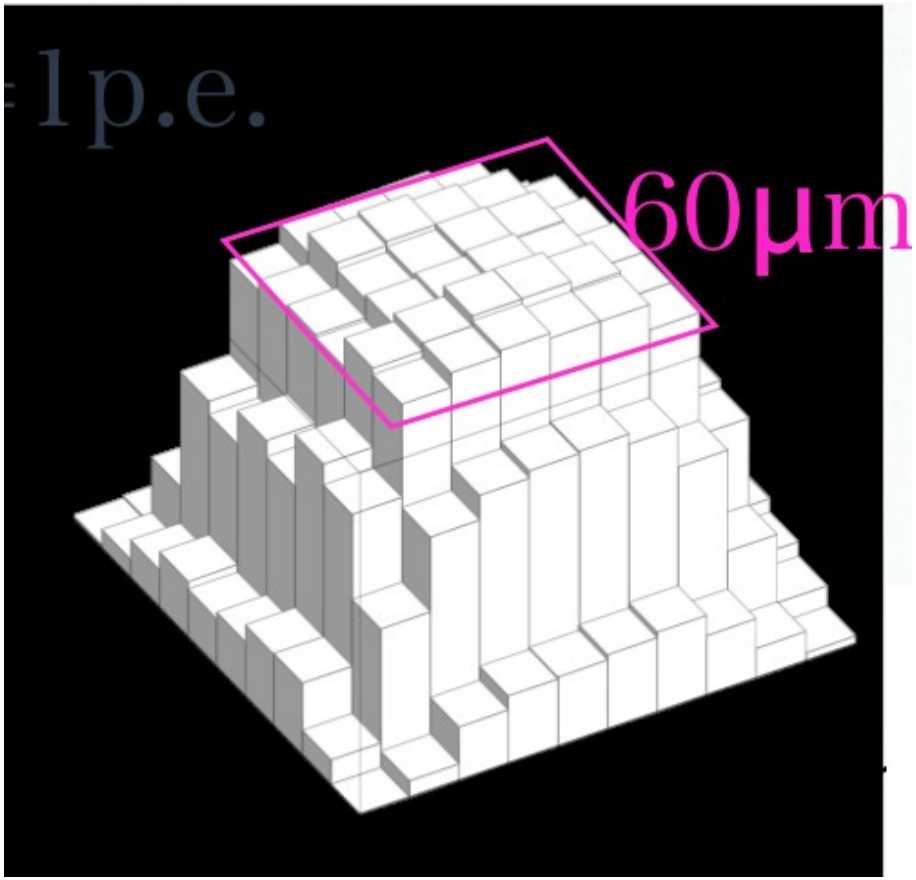
B. Abrams

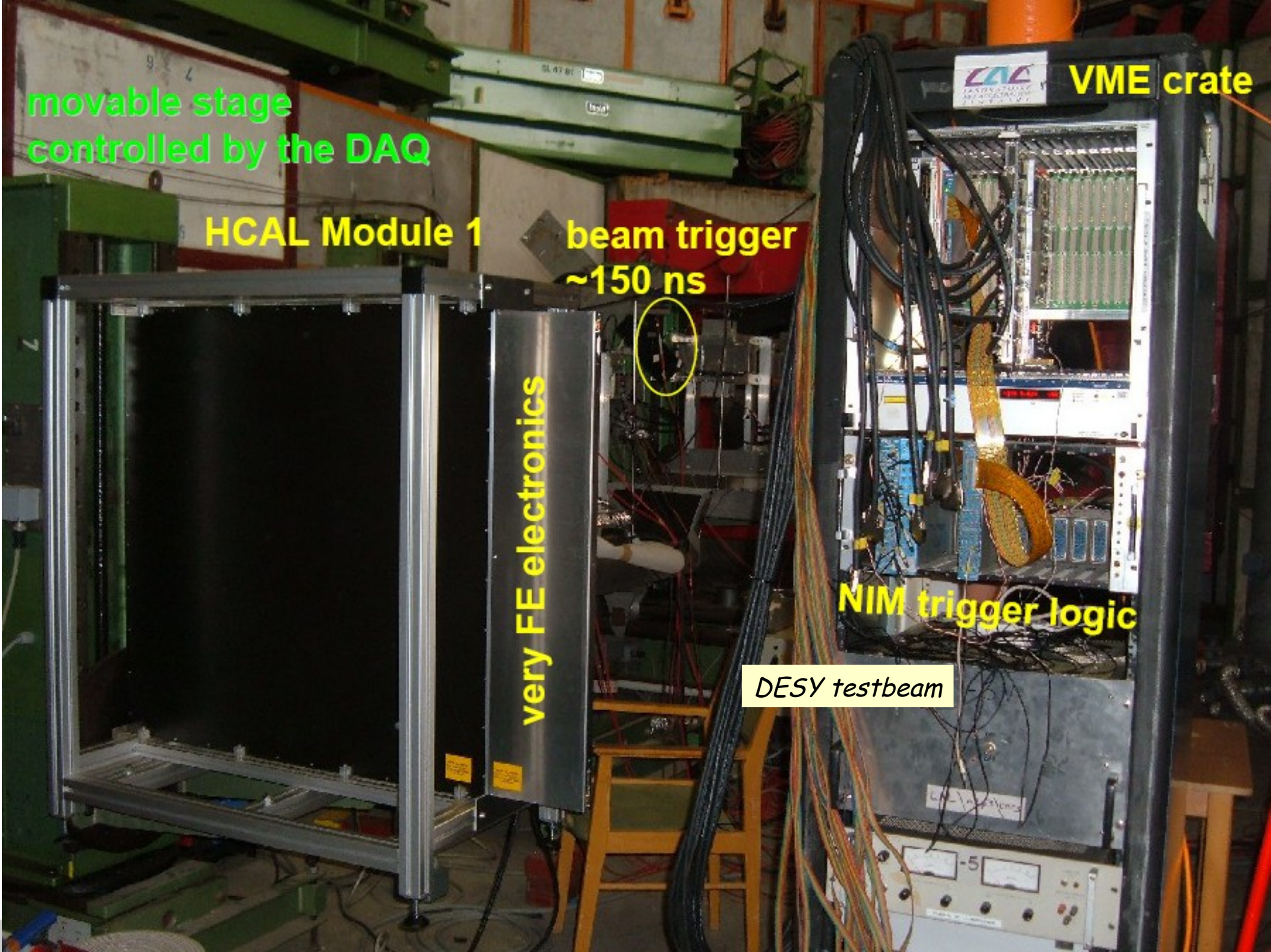
MPPC (SiPM)

- MPPC of Hamamatsu with 100, 400 and 1600 pixel
- Noise rate < 1MHz
- Twice the efficiency of PMT (shown for 400 pixel MPPC)
- No sensitivity in between pixels.



T. Takeshita

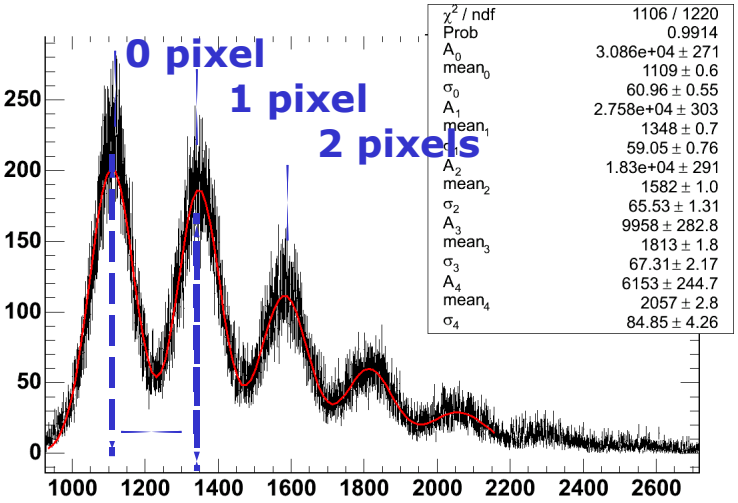



movable stage
controlled by the DAQ
HCAL Module 1
beam trigger
~150 ns
very FE electronics
VME crate
NIM trigger logic
DESY testbeam

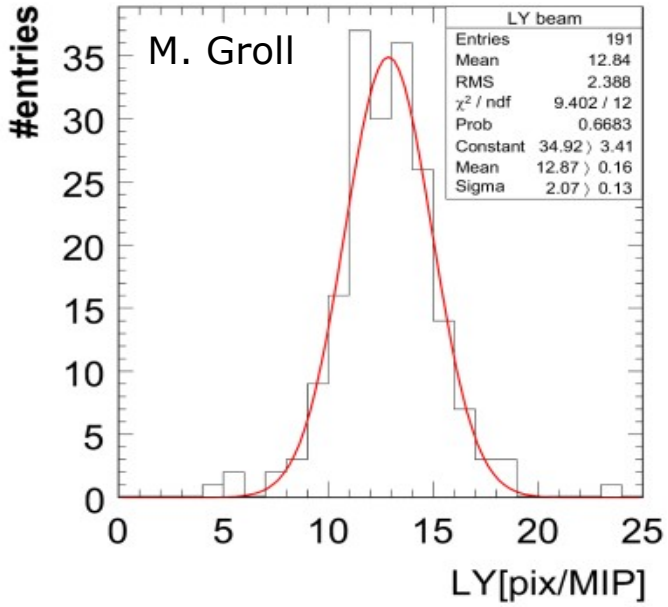

cosmics: Calice ECAL + HCAL

Calice Tile-HCAL

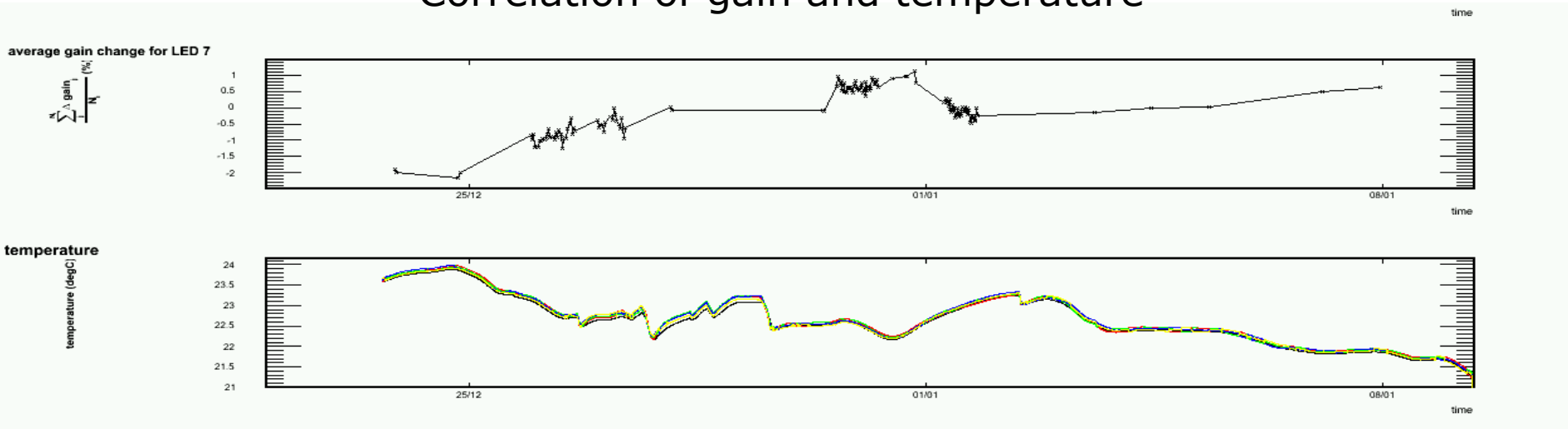
Beam test and cosmics results:



0, 1, 2, ... photon response

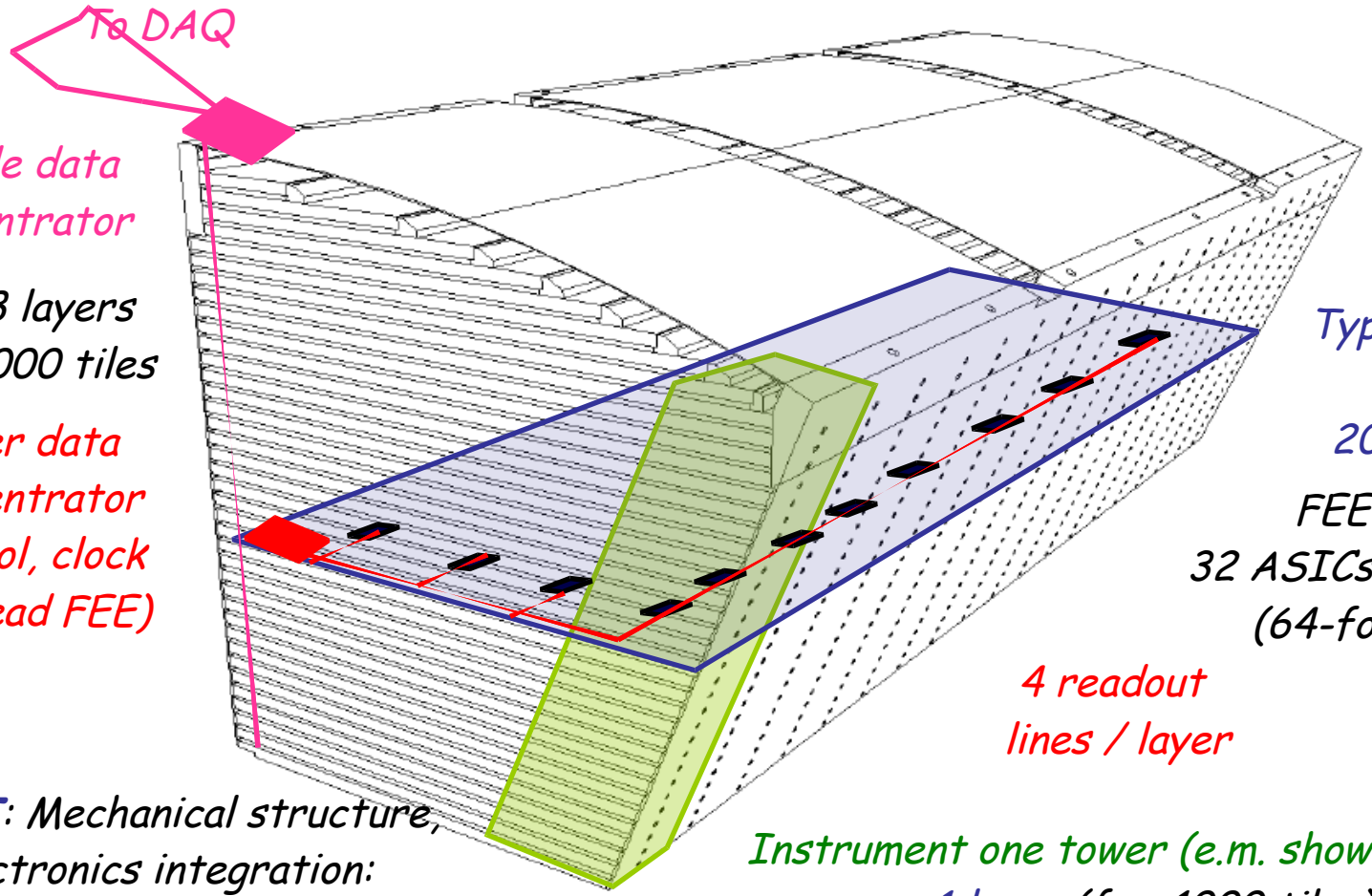


Correlation of gain and temperature



J. Cvach

Towards a Final Tile-HCAL Design



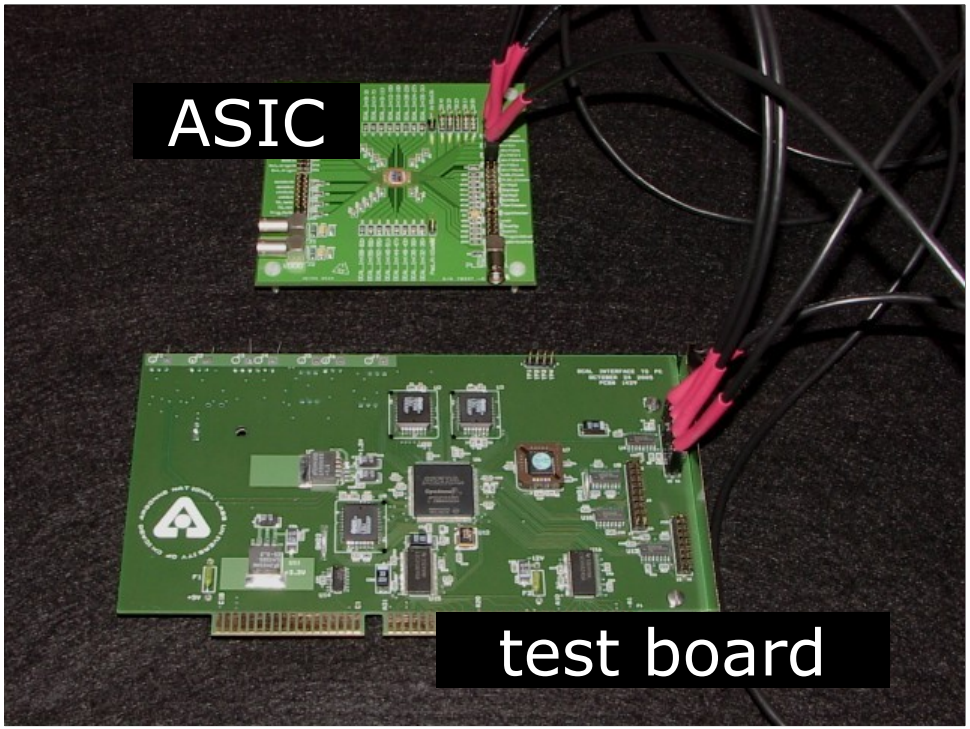
Calibration:

Simple Light injection system needed.

But for every tile? - Beam test will tell.

F. Sefkow

Digital HCAL Readout Chip

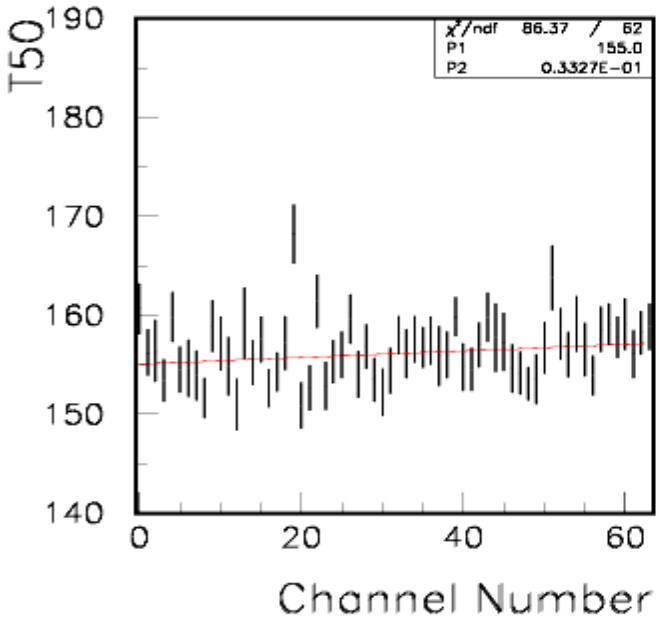


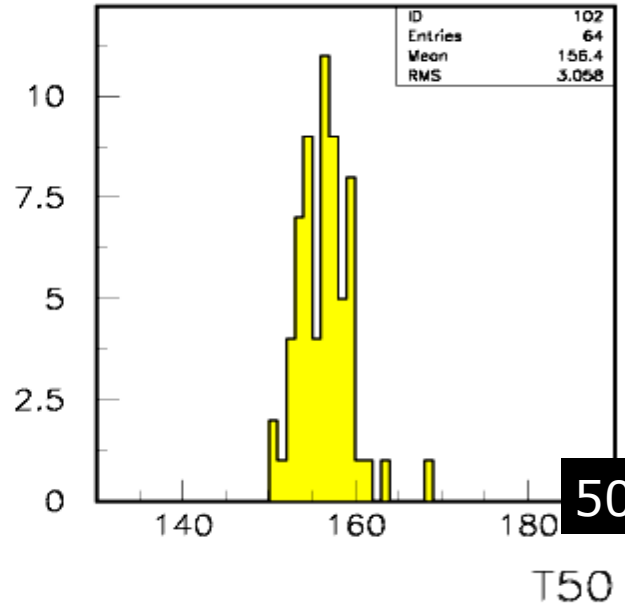
- 64 inputs
- several gains (RPC/GEM)
- Trigger(less)
- hit pattern + time stamp

J. Hoff, et al. (FNAL)

Too sensitive.
2. submission with 1/10 - 1/20 the gain.

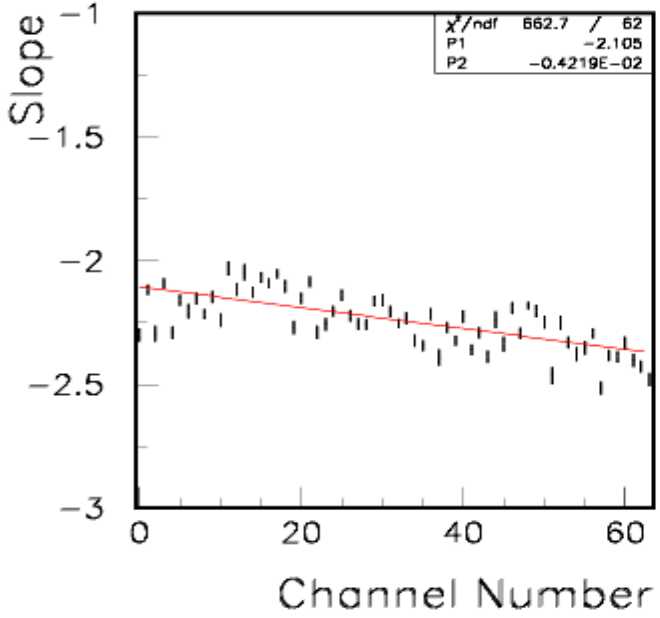
Digital HCAL Readout Chip Performance

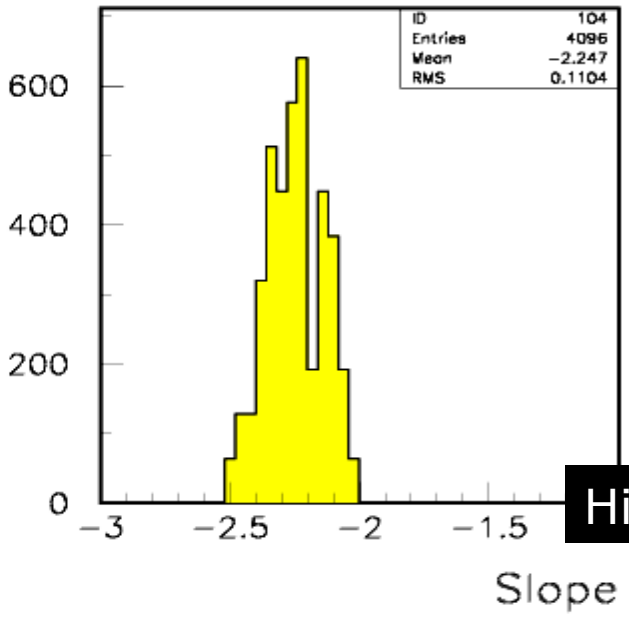




Tests with injected charge

50 % Efficiency threshold



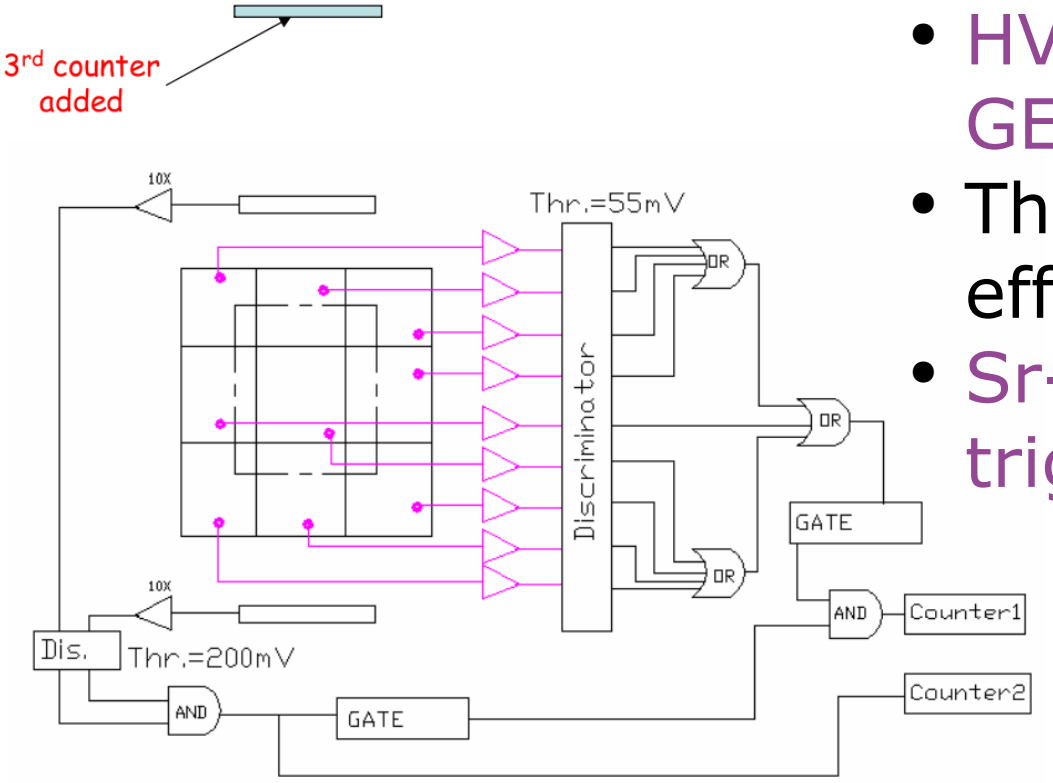


Hits/treshold slope

J. Repond

GEM - Digital HCAL

3x3-pad double GEM, Ar/C02 80:20

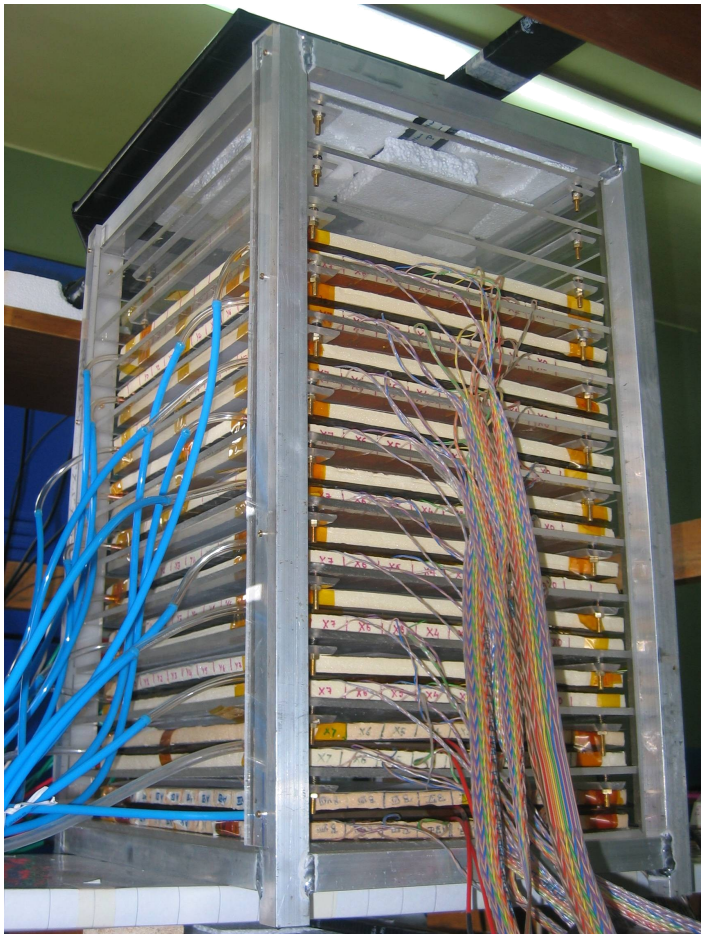


- HV = 409V across each GEM foil
- Threshold 40mV -> 95% efficiency
- Sr-90 source/scintillator trigger

Result:Average multiplicity = 1.27 (RPC: ~1.6)

Lower multiplicity helps reduce the confusion term in a Particle Flow Algorithm.

RPC R&D at TIFR



New RPC test laboratory at TIFR

RPC ageing:

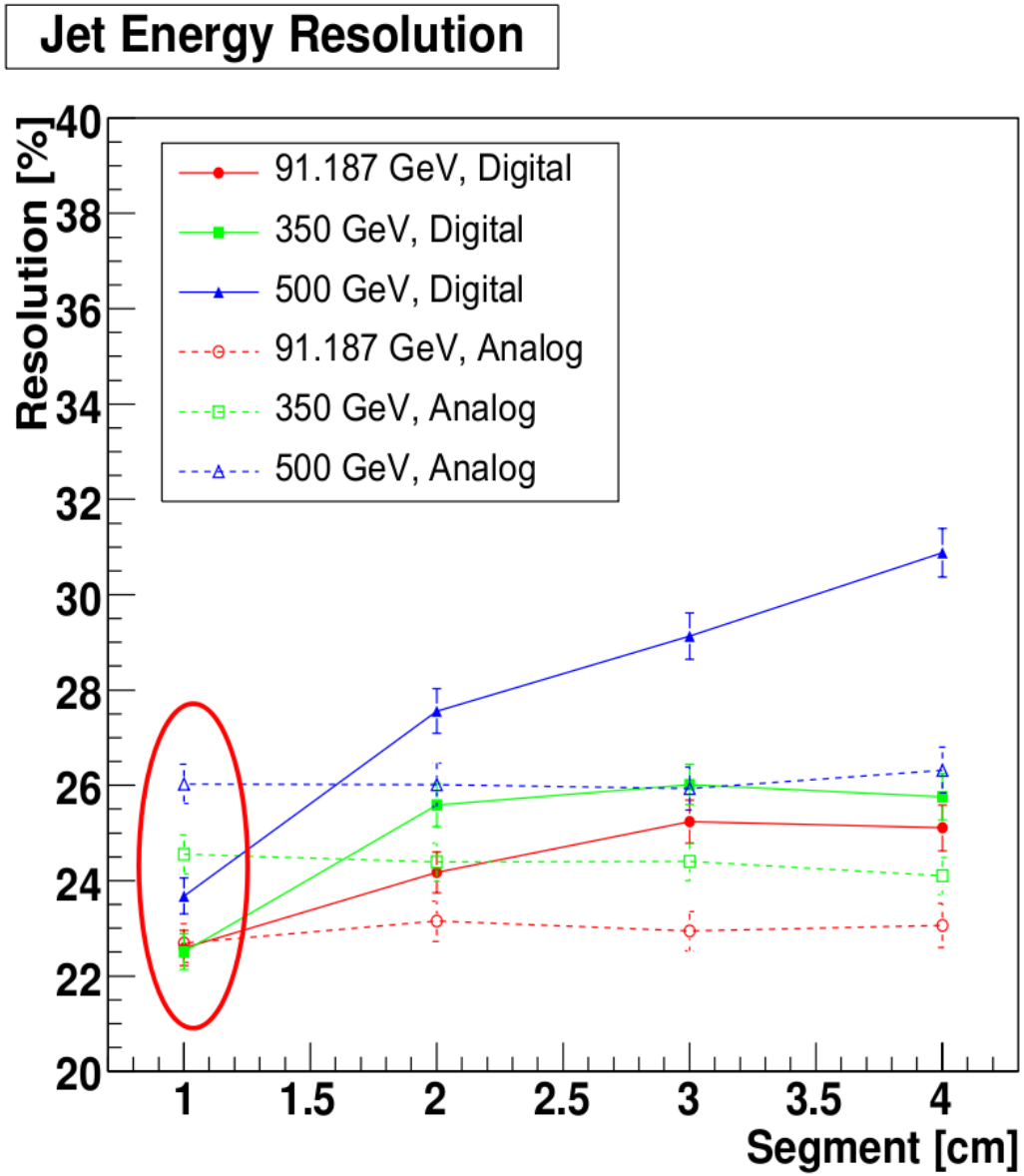
- when using locally made glass (Fluorine?),
- no problems with Glass made in Japan (after 5 month).

In preparation INO Prototype:

- 12 x 1m^2 RPCs
- 1000 channels
- Absorber: 6cm Iron plates

A. Satyanarayana

GLD resolution studies



- GLD geomtry.
- e^+e^- -> uds at $\sqrt{s}$=91, 350, 500 GeV
- Energy measurement with perfect PFA

Digital HCAL with 1cm tiles achieves similar performance.

H. Matsunaga

Sampling of digital HCAL

Baseline:

2 cm **steel** = 1 X_0 sampling
40 layers → 4 λ_I at 90^0
→ **104cm** (assuming 6mm chamber + electronics)

Simulation studies show better PFA performance:

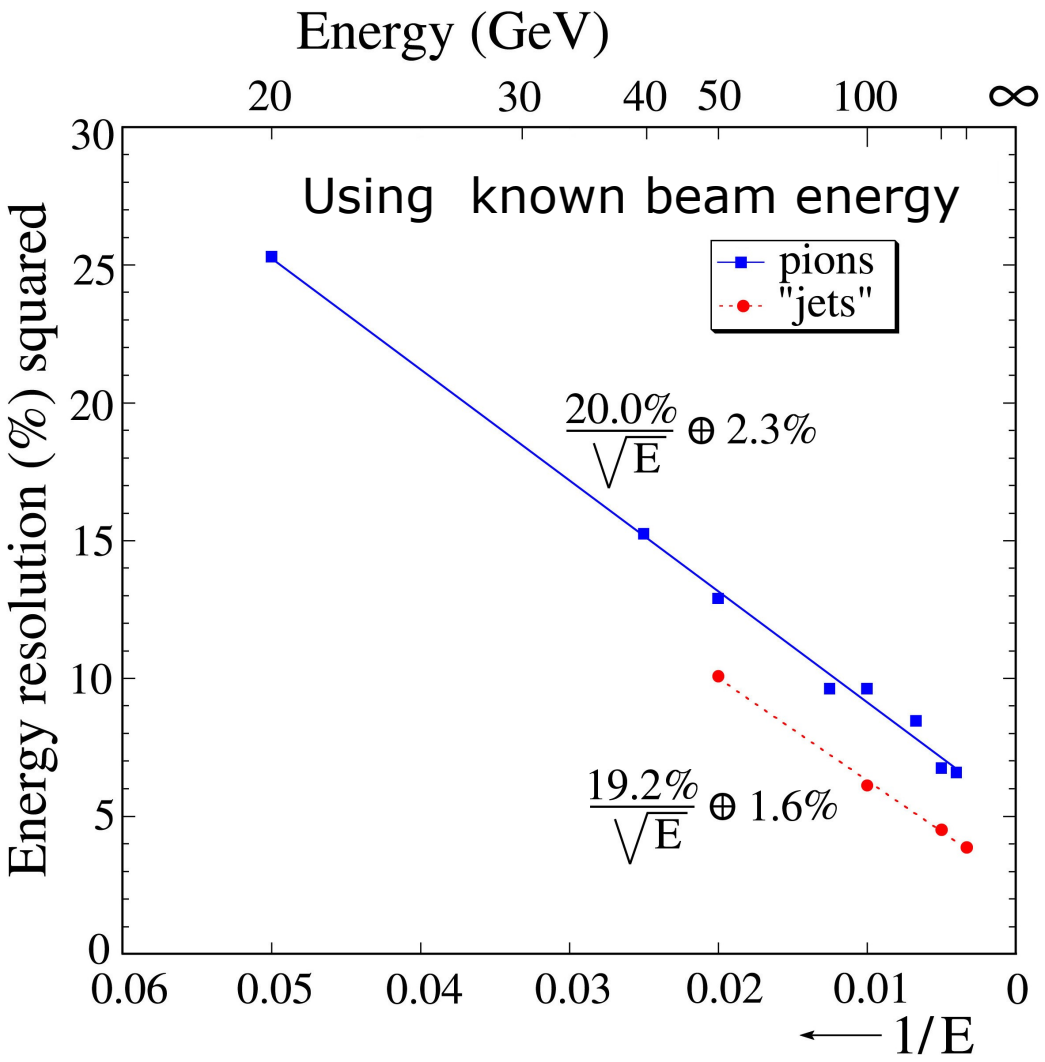
0.7 cm **tungsten** = 2 X_0 sampling
58 layers → 4 λ_I at 90^0
→ **75cm**

... and save on cost of coil.

J. Repond

Also saves on total cost?

Dual Readout Calorimeter (DREAM)



Test beam result:

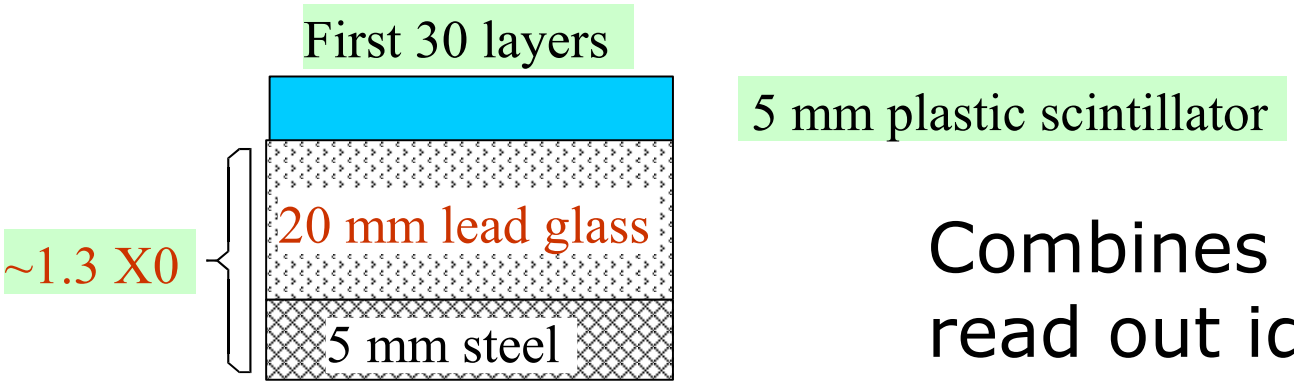
- Jets are mimicked with 10cm thick polyethylene target (1-30 part.)
- After "(Q+S)/E" correction.

Future:

- Add third fibre to measure neutrons?
- long. segmentation?

Dual Readout Sampling Calorimeter

Tile E/H-Cal, but replace absorber with active elements e.g. lead glass + fibre.



Combines dual read out idea with pflow capability.

Disadvantage:
longer interaction length

- lead glass: λ=30cm
- iron: λ=17cm

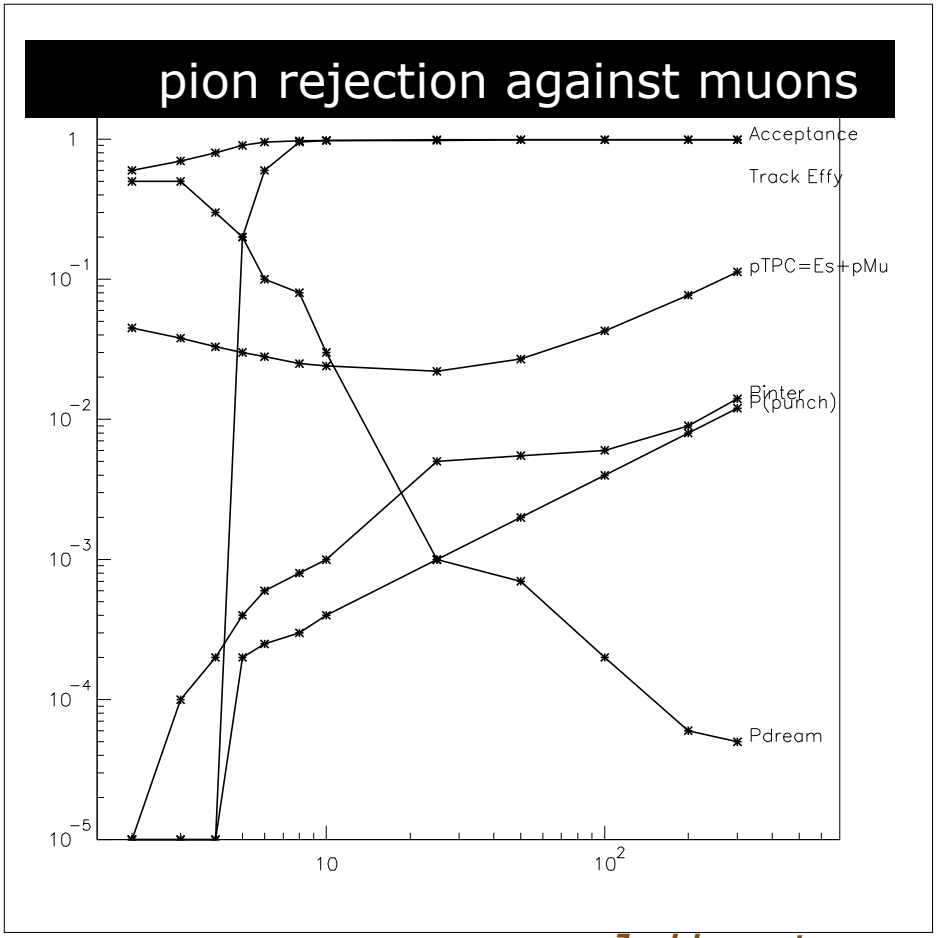
lead glass is expensive

T. Zhao

Muon Identification

DREAM:

- 10 λ absorber
- Probability of muons to punch through is small



J. Hauptman

SiD: Muons (in b b-bar) can be identified with HCAL alone: efficiency=86% and purity=69%
+12 layers muon: eff.=95% and purity=86%

H. E. Fisk et al.

Very active field:

- prototype development
- prototype commissioning
- beam tests
- steps towards technical protypes
- new ideas /concepts