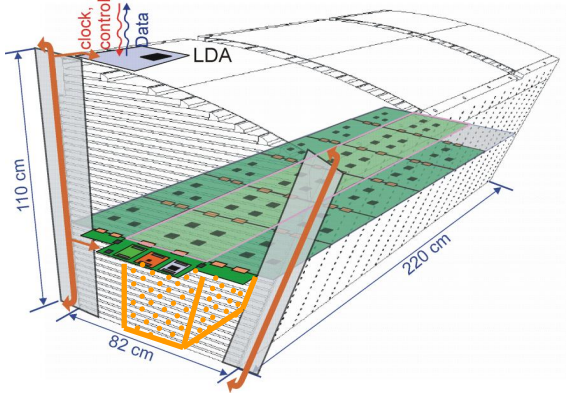
HCAL task status report

Mathias Reinecke
Erika Garutti

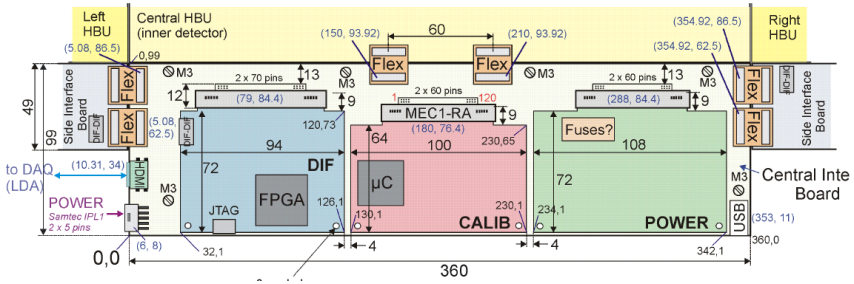
5th EUDET annual meeting
DESY, 30 Oct. 2010

Deliverables

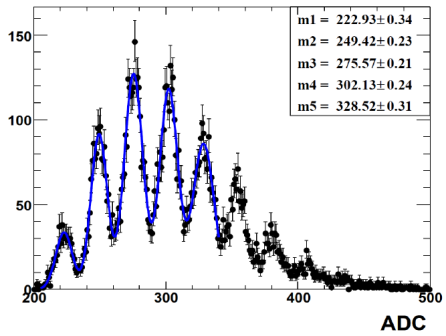
1. HCAL mechanical structure



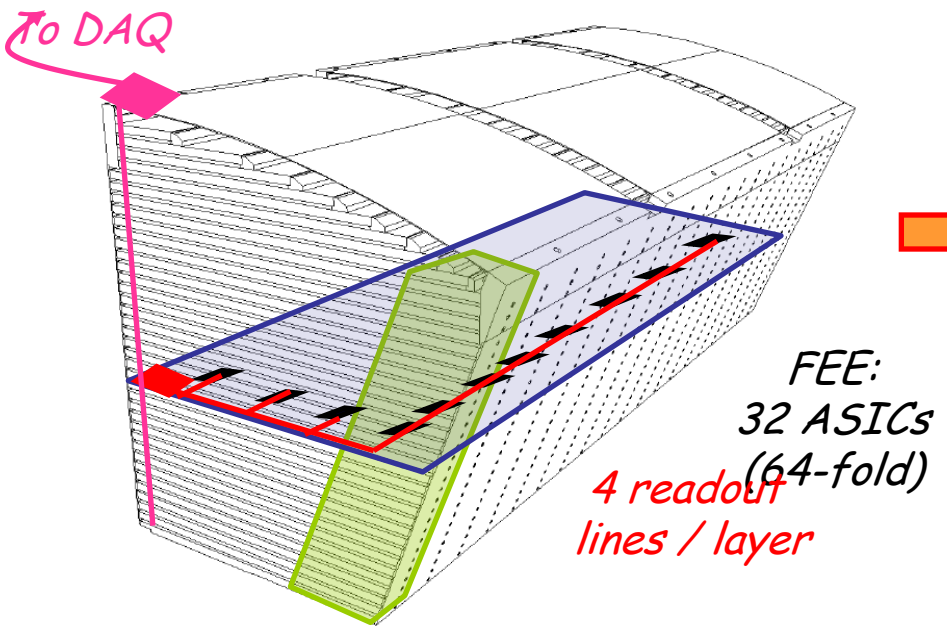
2. HCAL readout integrated electronics



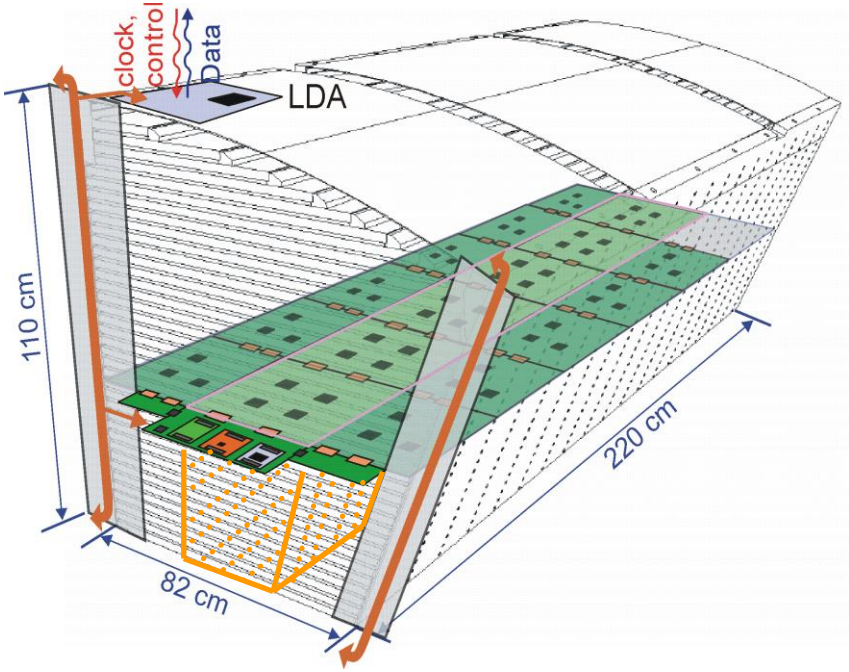
3. HCAL LED calibration system



1. Mechanical structure



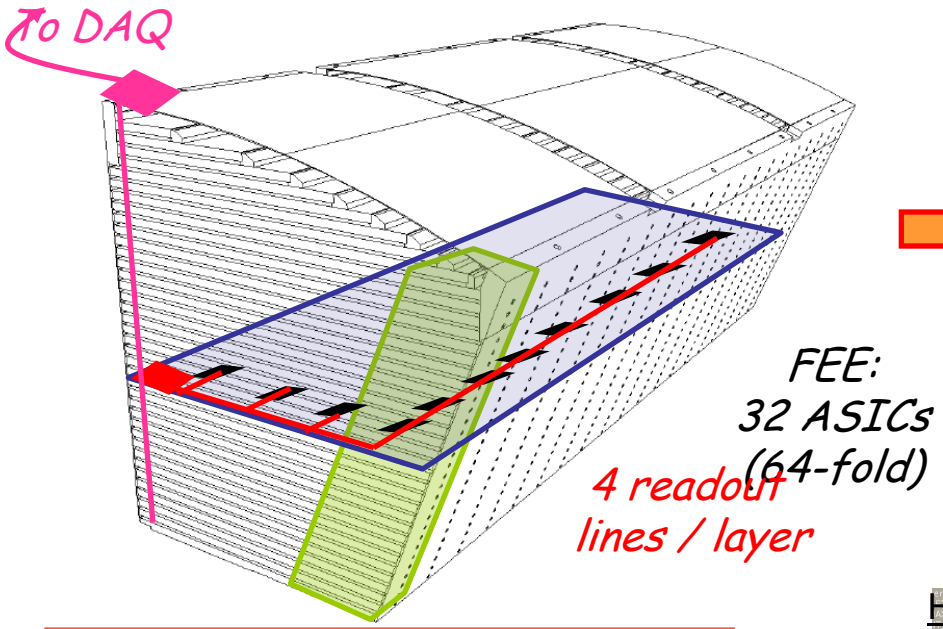
Kickoff meeting 2006: the idea

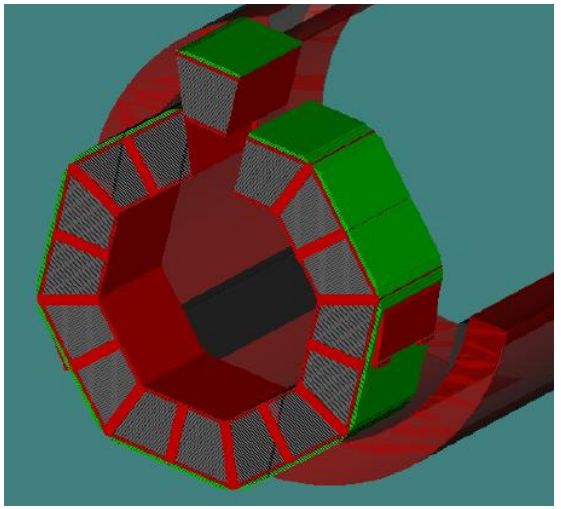


2010: evolution of the design

Mechanical structure

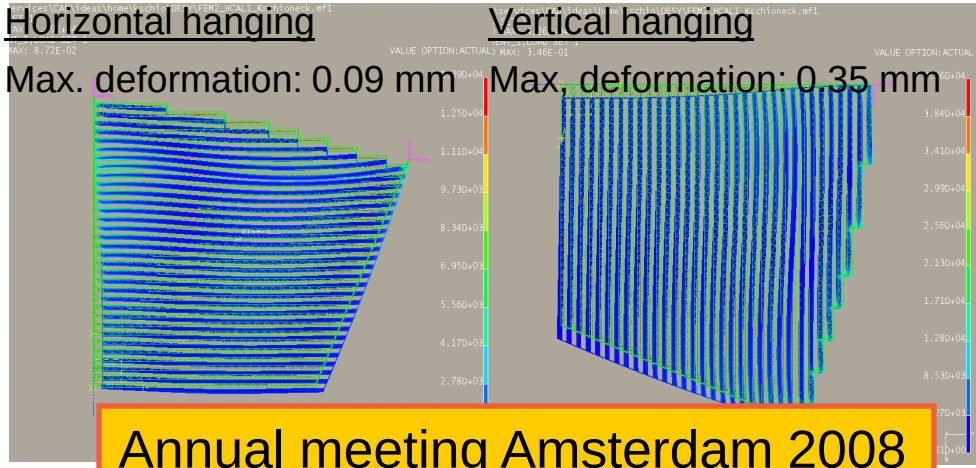
Steps towards module0 of an ILC detector





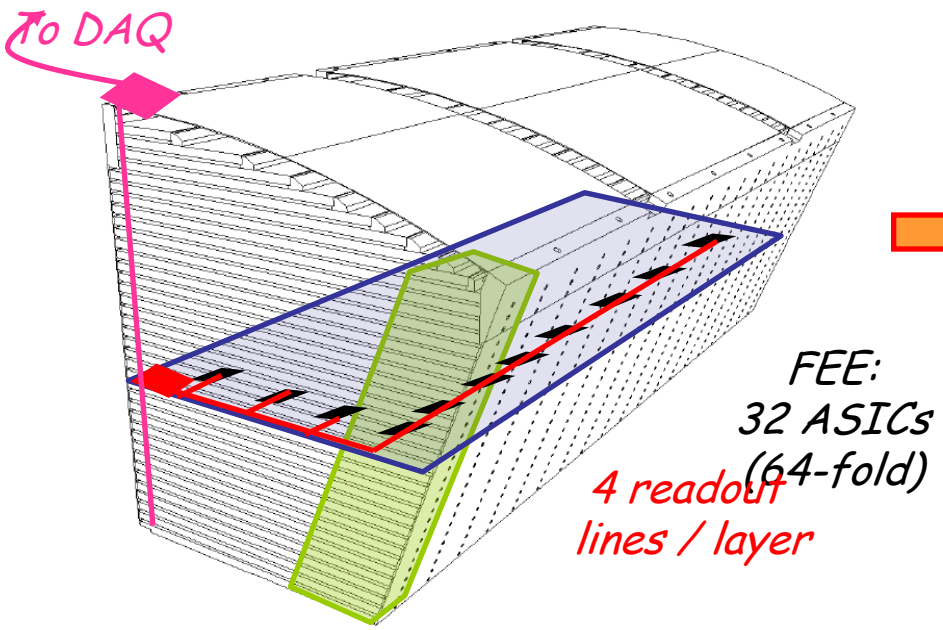
Kickoff meeting 2006: the idea

Challenges:
- prove stability (FE calculation)
- meet tolerance requirements
  (e.g. flatness of absorber plates)



Annual meeting Amsterdam 2008

Mechanical structure

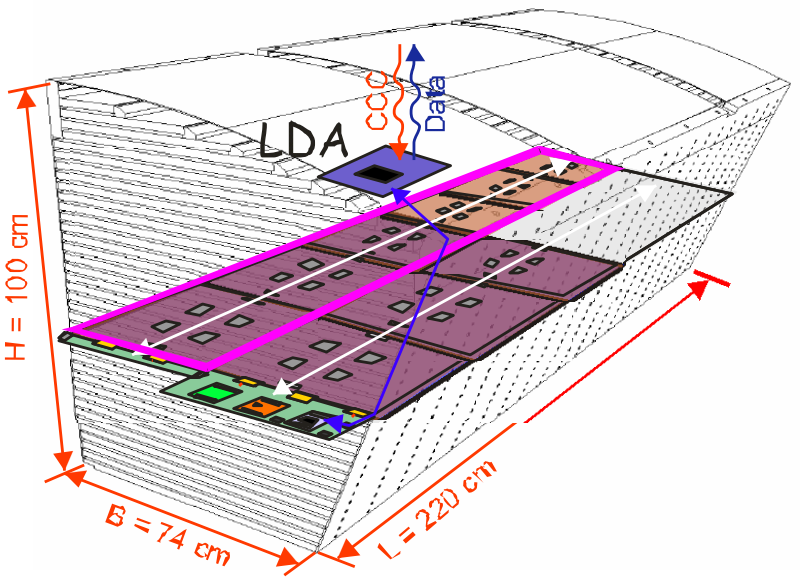


Kickoff meeting 2006: the idea

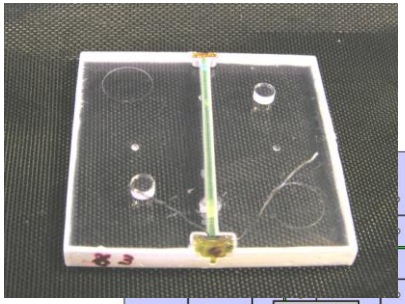
Challenges:
- prove stability (FE calculation)
- meet tolerance requirements
  (e.g. flatness of absorber plates)

2160 mm sub-module plates
after roller leveling
max 1 mm deviation

2. Filling the structure with life



Intermediate design 2008/2009



EUDET tile
MIP at 10p.e.

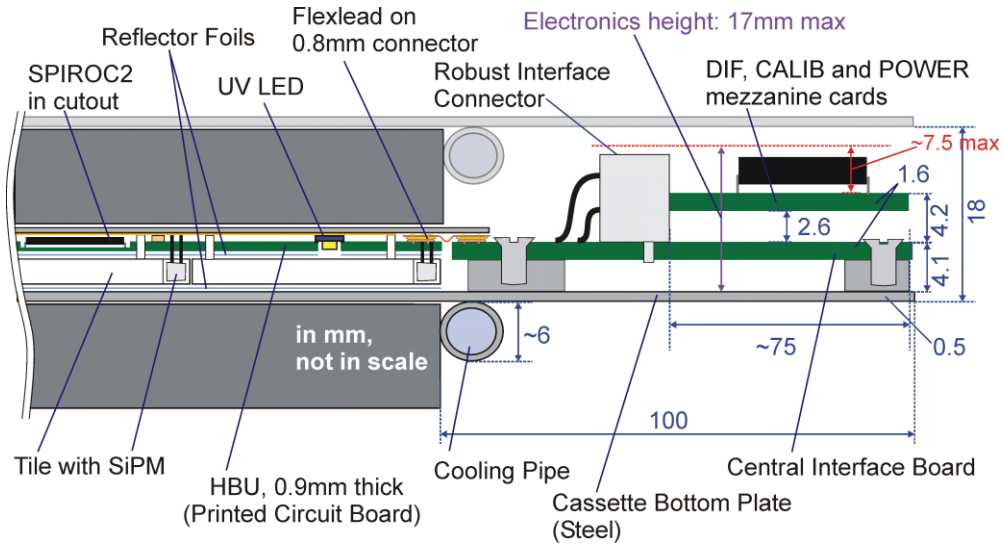
Use scintillator tiles from first user of EUDET infrastructure (ITEP)

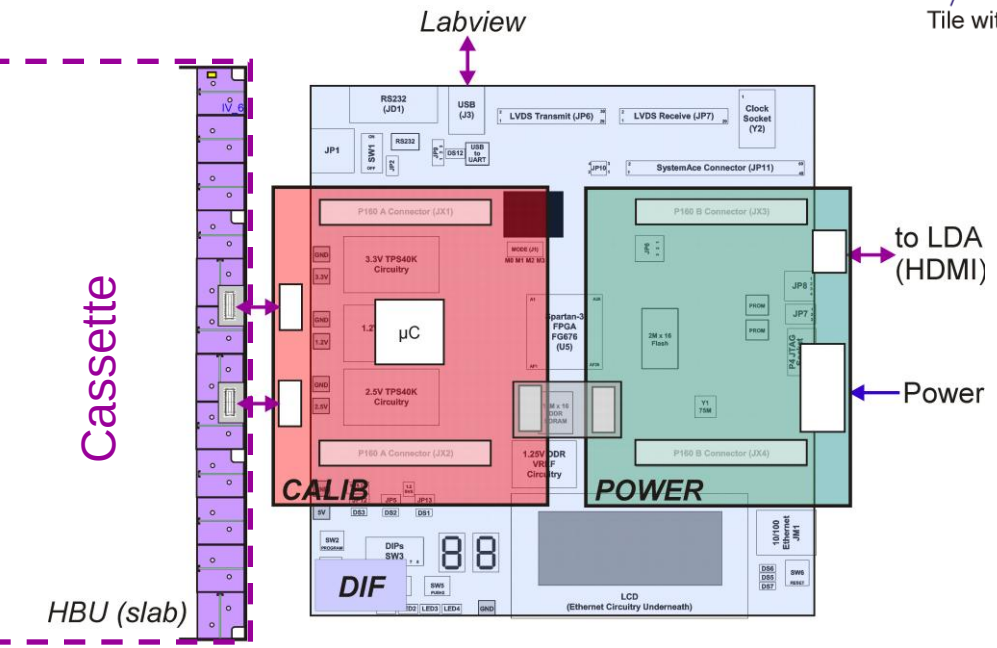
Layout of the cassette for the first EUDET module (HBU0)

Design of EUDET module (HBU)

Cross-section:

- each calo layer 18 mm including Fe
- 3 mm scintillator tiles
- one SMD-LED mounted on each tile
- flex-lead connection between boards





Prototype zero (EUDET module):

- Not official detector interface, calibration and power boards
- use commercial products instead
- not compatible in size, but available

Design of EUDET module (HBU)

Cross-section:

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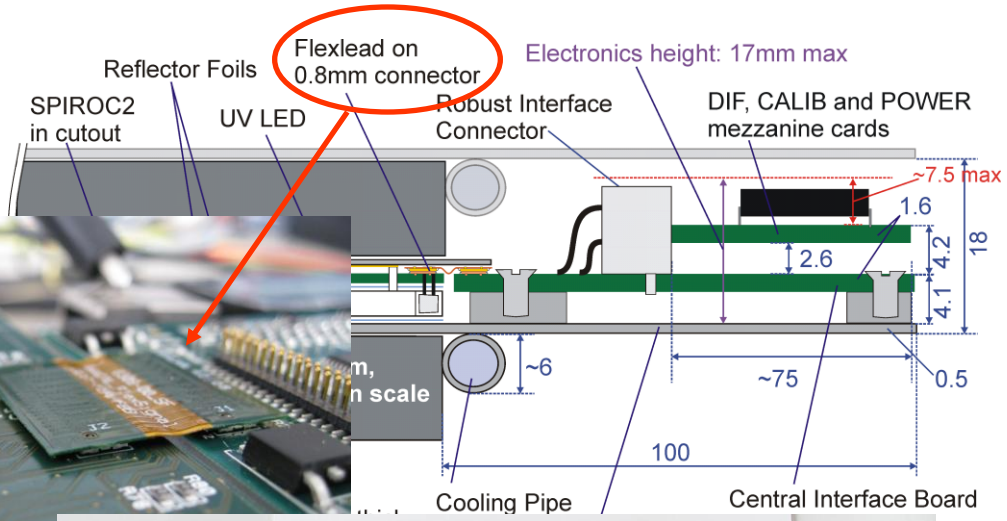
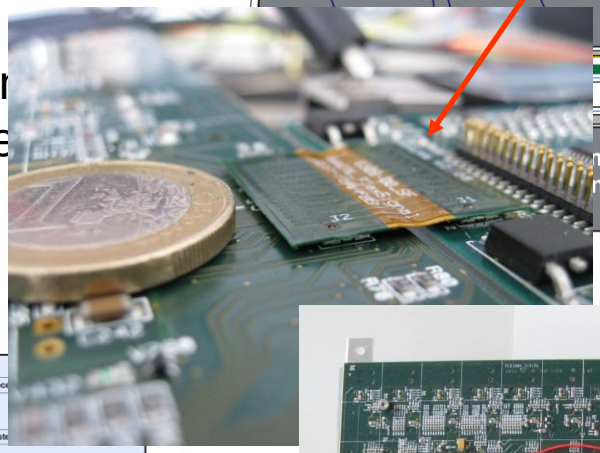
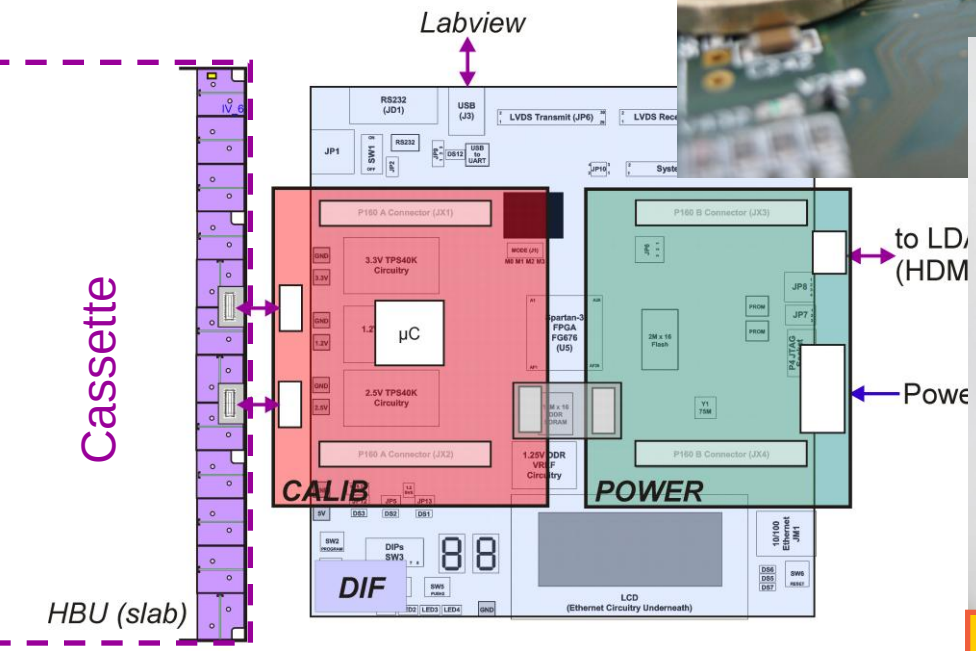
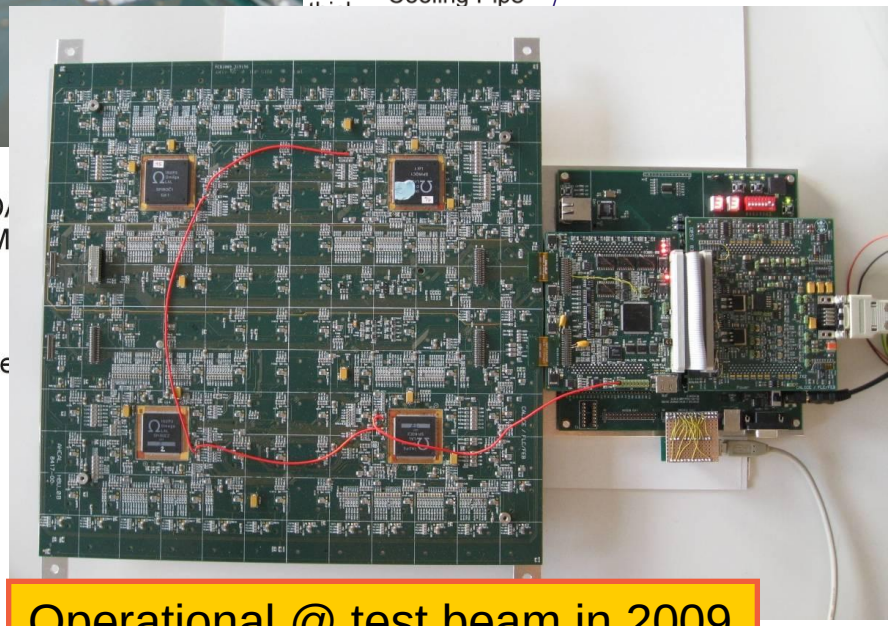
- 3 mm scintillator tiles
- one SMD-LED mounted on
- flex-lead connection betwe









Operational @ test beam in 2009

First look at test beam results

First cassette of AHCAL engineering prototype exposed to 3 GeV e^- beam at DESY

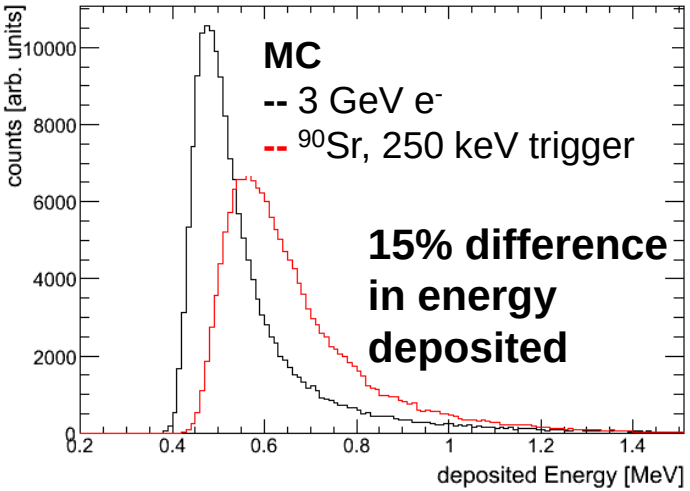
(no absorber plates)

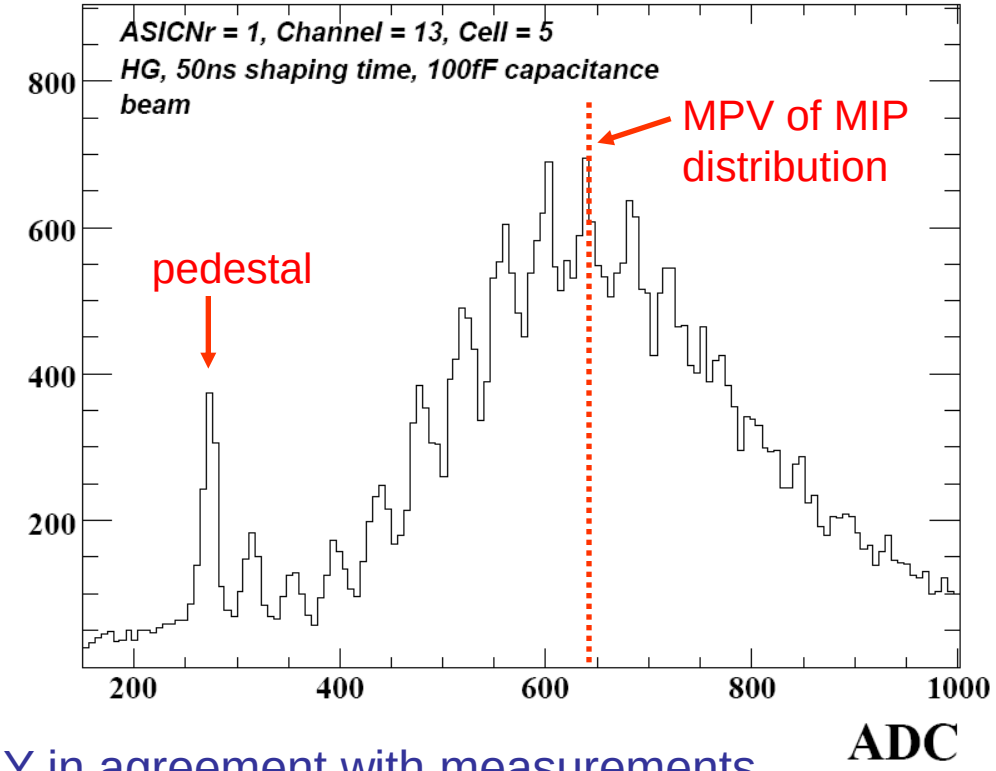
- At MIP level S/N ~ 45
- Single p.e. spectrum visible in MIP energy distribution
- SiPM gain: $G_{LED} = G_{MIP}$ (~42 ADC ch.)

- LY = 9 pix / MIP (3 Gev e^-)

Characterization from producer

LY = 10.3 pix / MIP (1-3 MeV e^-, ^{90}Sr)

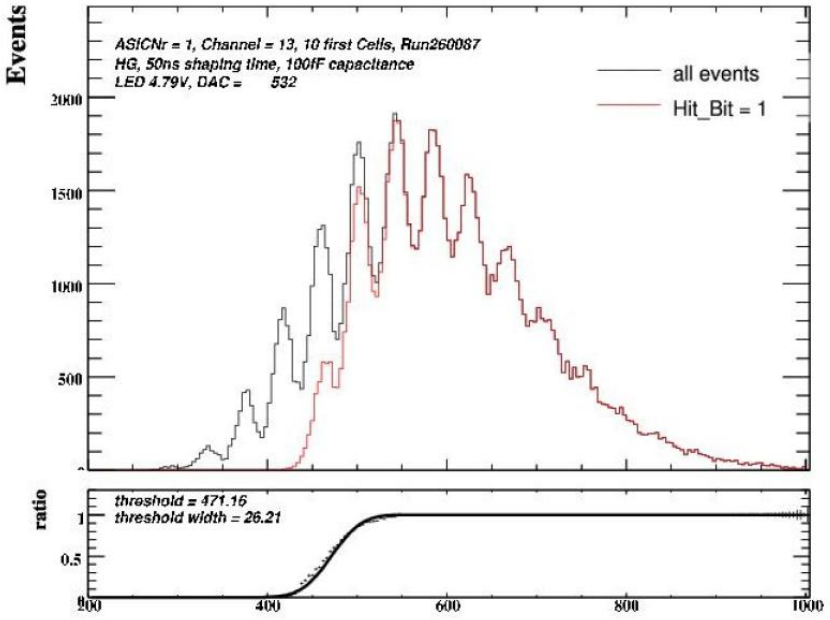


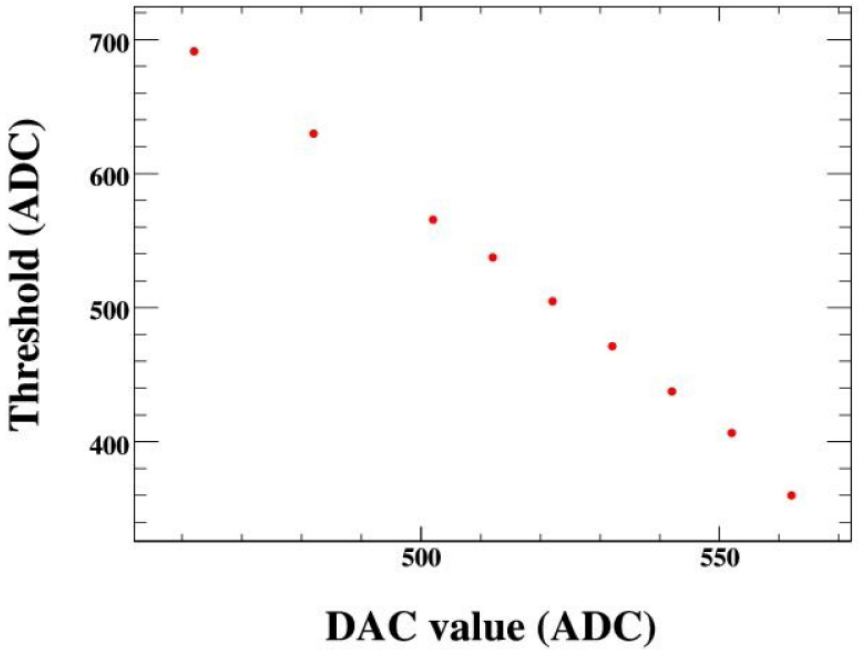


➔ LY in agreement with measurements from producer, considering different energy deposited by reference e-

Test of the auto-trigger mode of SPIROC

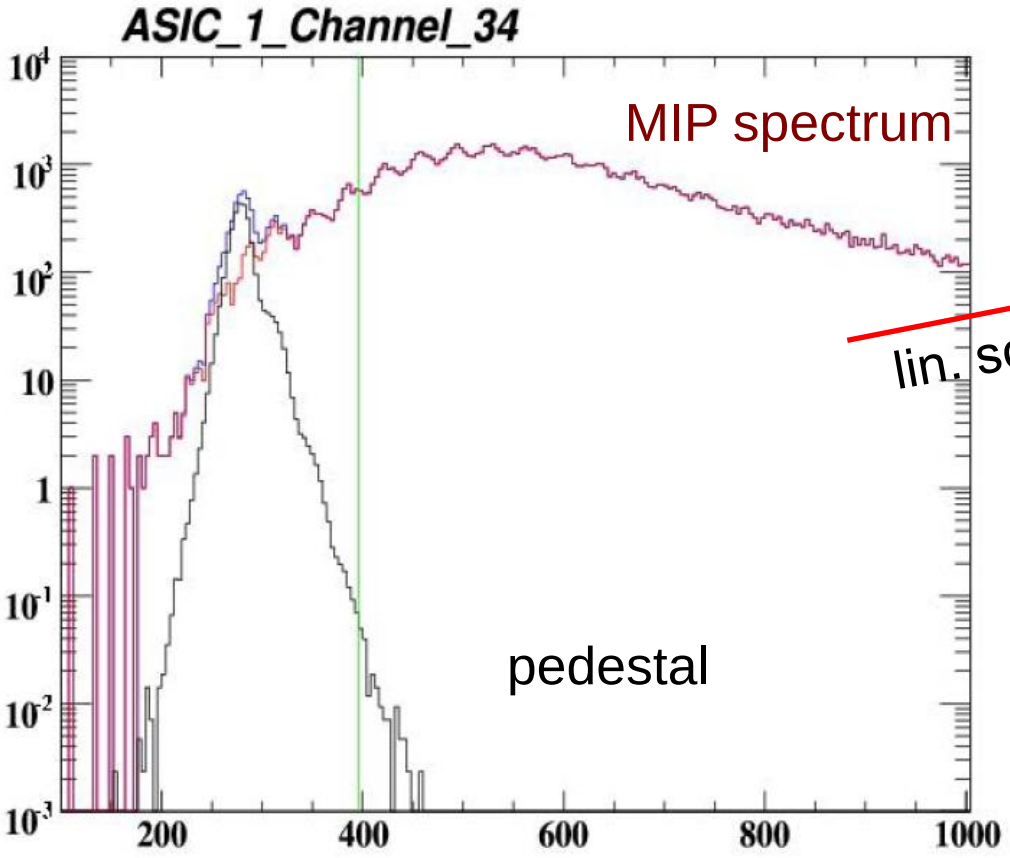
Aim: understand how to set the auto-trigger threshold (DAC) for an input MIP signal, and study the auto-trigger behavior



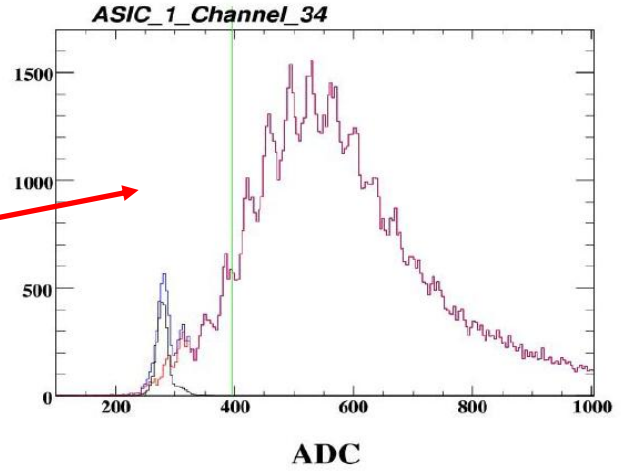


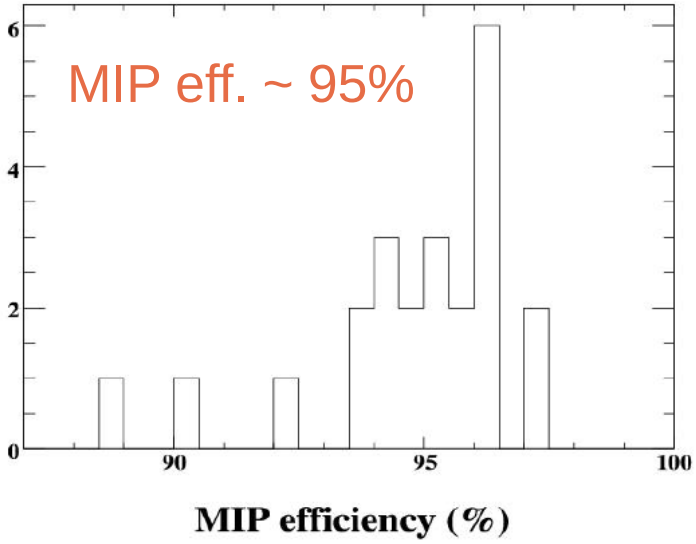
Auto-trigger threshold curve extracted

Noise above threshold



lin. scale



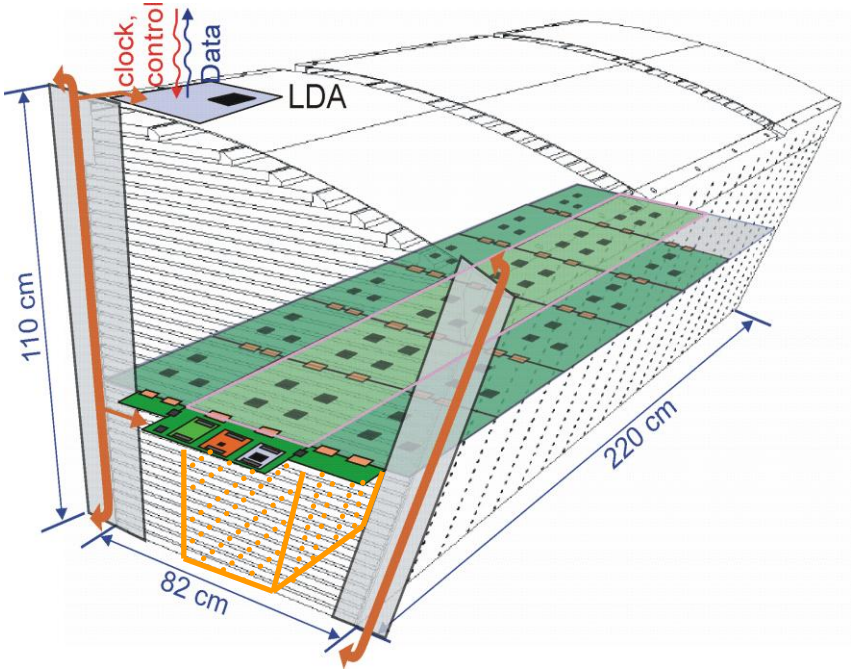


- fix threshold to have 10^{-4} hits / events above threshold
- adjust individual DAC threshold (not possible in current chip)

Realistic electronics design

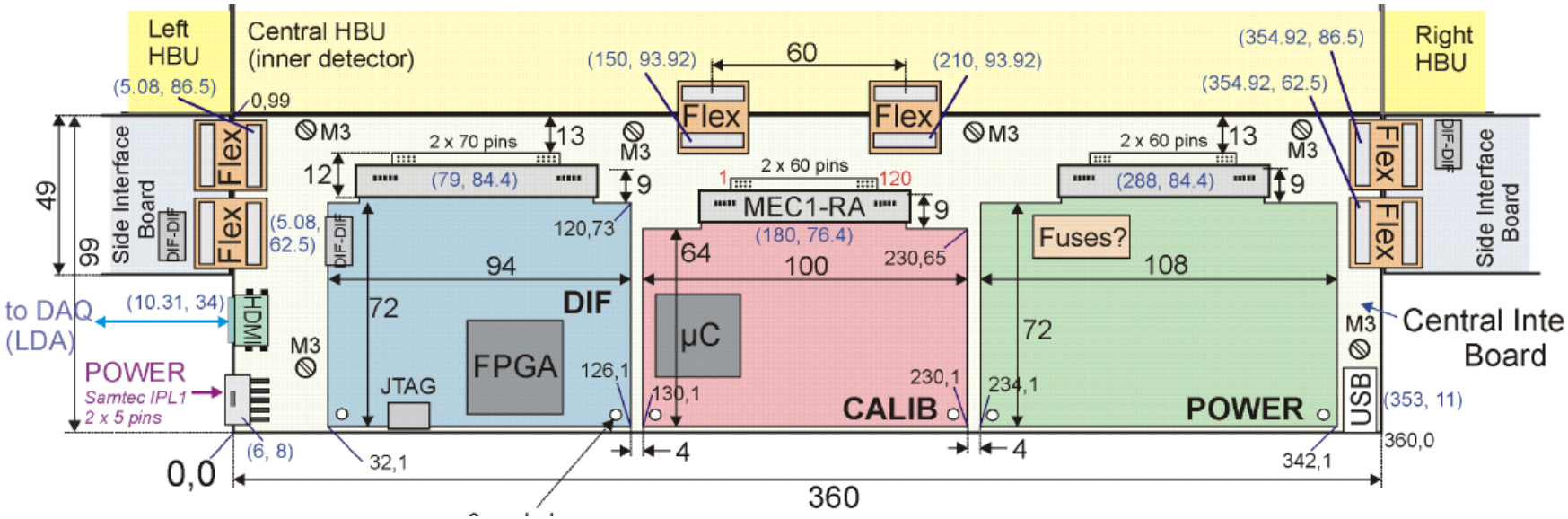
Full scale area integration (slab) (2.2 m calorimeter layer) requires redesign of HBU

Multi-layer integration (tower) requires re-design of end-face components (DIF, CALIB, POWER,PCB support for all cards)



2010: evolution of the design

Status of electronics redesign



X done

X in preparation

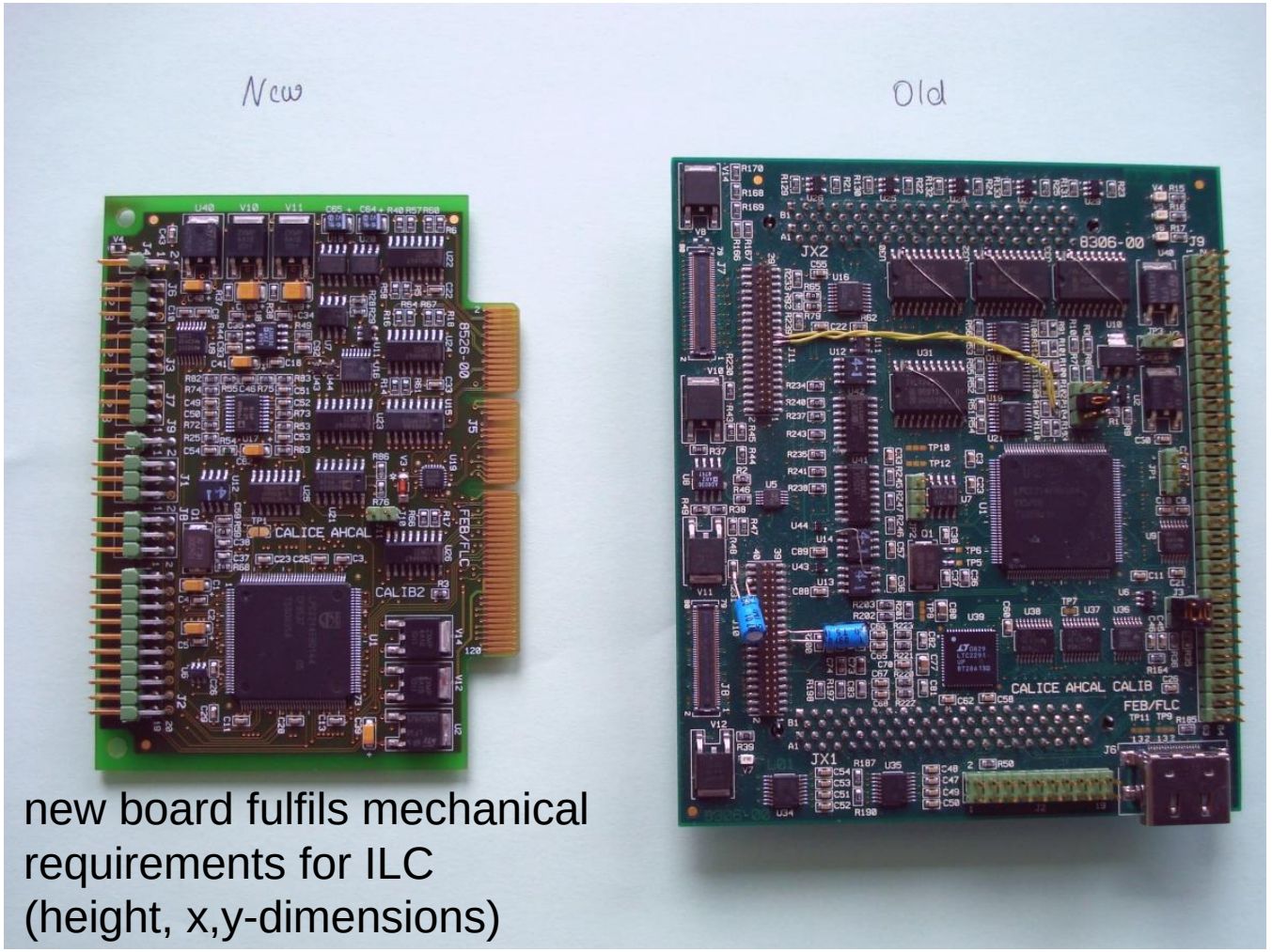
X not started yet

	DIF	CALIB2	POWER2	HBU2	CIB	SIB	Flexleads
concept dev., circuit design	X	X	X	X	X	X	X
schematic entry	NIU X	X	X	X	X	X	X
Layout	NIU X	X	X	X	X	X	X
Production	NIU X	X	X	X	X	X	X

Not needed for one slab test

DESY Redesigns: module.
M. Zeribi, H. Wentzlaff,
M. Reinecke

CALIB2 module vs CALIB1 module



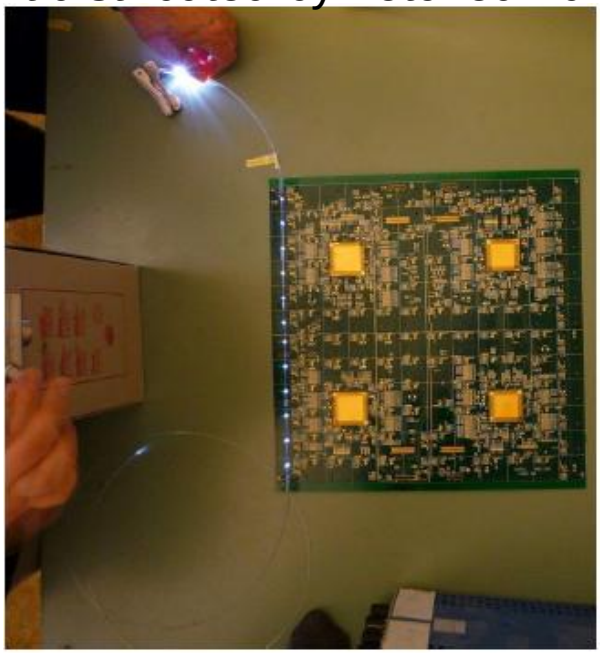
new board fulfils mechanical requirements for ILC (height, x,y-dimensions)

3. LED monitoring system(s)

System task: SiPM gain calibration via single photoelectron peak spectra (~1-2 p.e.)
long term stability via response @ medium light (~20-100 p.e.)
measure SiPM saturation level (~2000 p.e.)

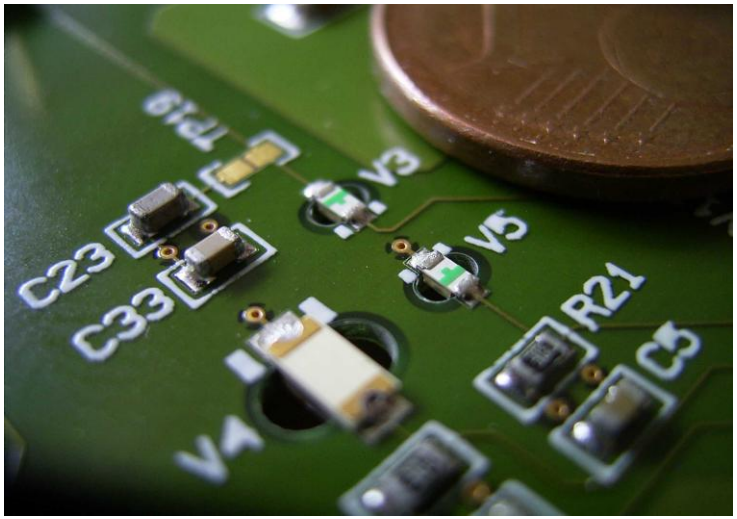
Two technological solutions:

Light distributed by notched fibres



Prague

Light directly on tile by SMD-LED
- distributed LED



DESY / Wuppertal

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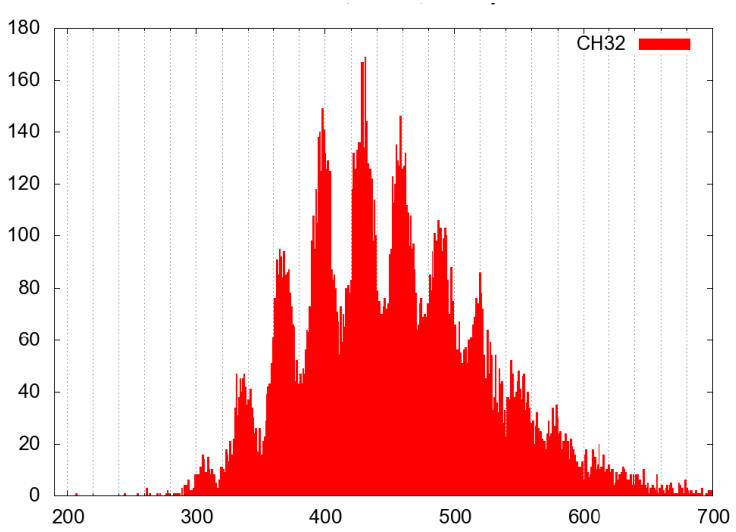

Light directly on tile by SMD-LED
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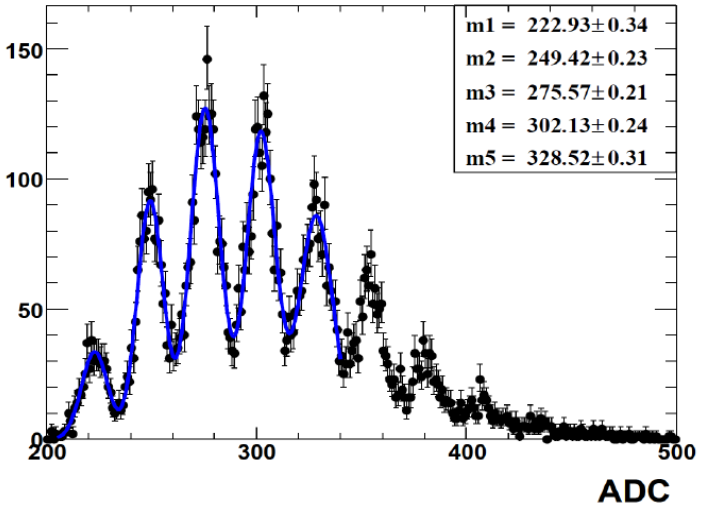
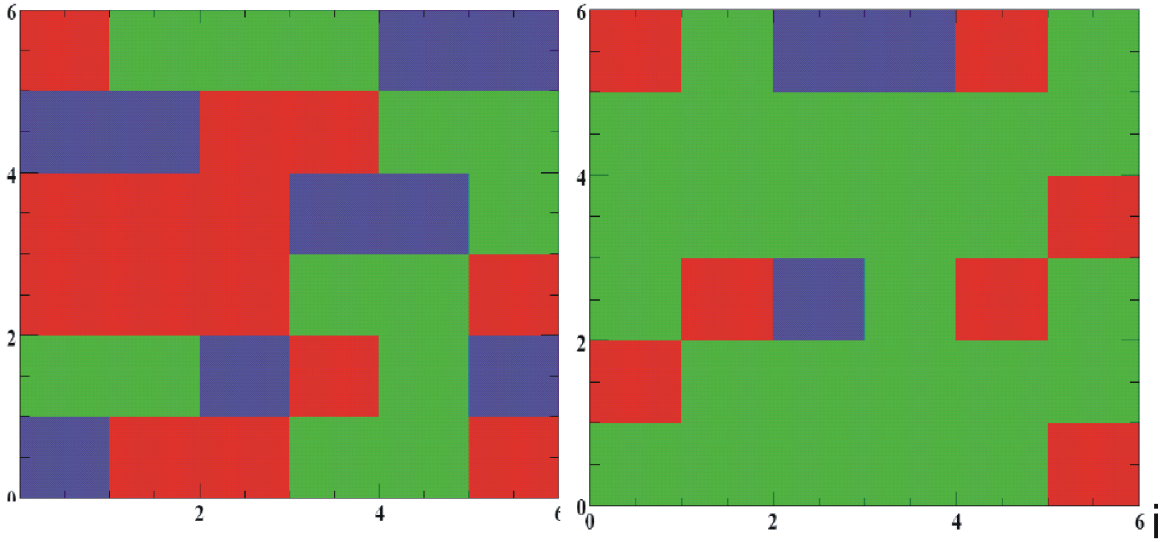


Both systems commissioned ➔ SiPM gain calibration achievable
Next step ➔ reduce spread in light intensity between channels

LED Calibration System – Current Activities

SPIROC2_2 SPIROC2_1

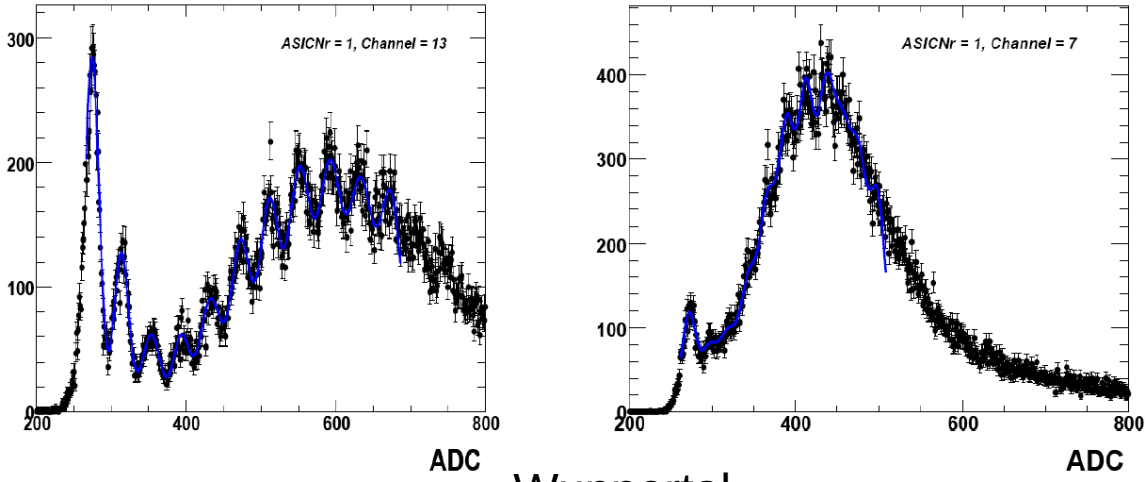


HBU-wide charact. of SiPM single-pixel spectra

green: good single-pixel spectrum

red: SiPM does not show single-pixels

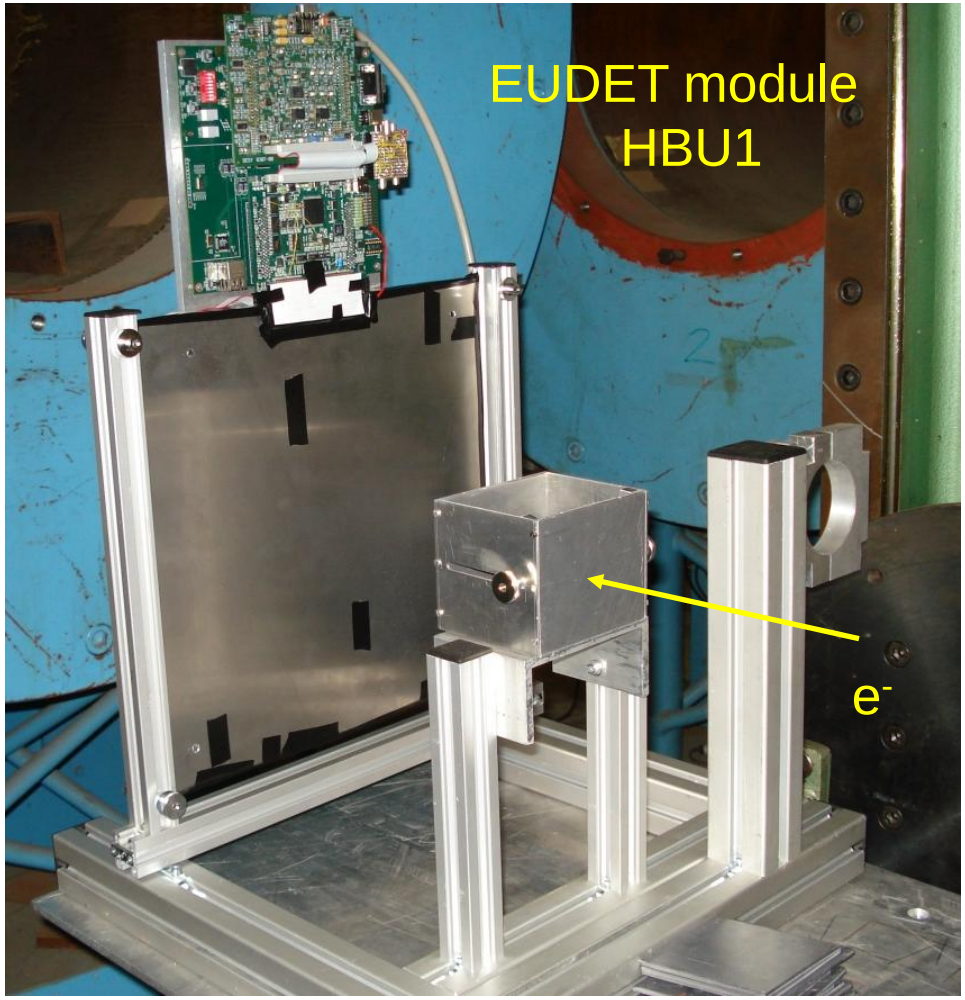
blue: LED or SIPM dead (to be analyzed …..)



Development of:
Automatic fit and gain extraction routines (here: for testbeam MIP signals)

Wuppertal

First transnational access in DESY TB21



First user of EUDET module:

ITEP tiles-SiPM systems

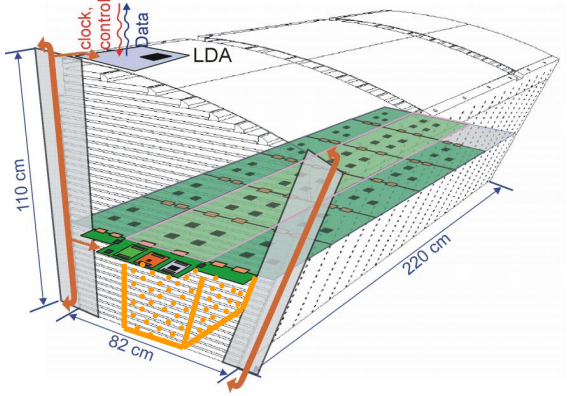
in the DESY TB21.

As part of the program, compare the performance of the two LED systems:

-Prague distribution system
-DESY LED on tile

Conclusions

1. HCAL mechanical structure



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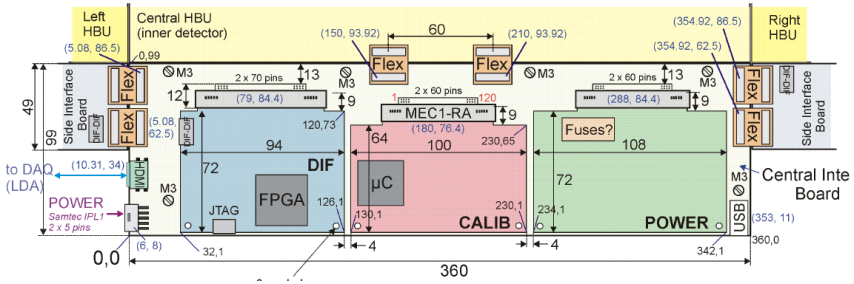

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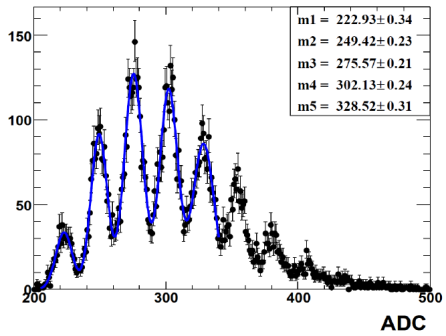
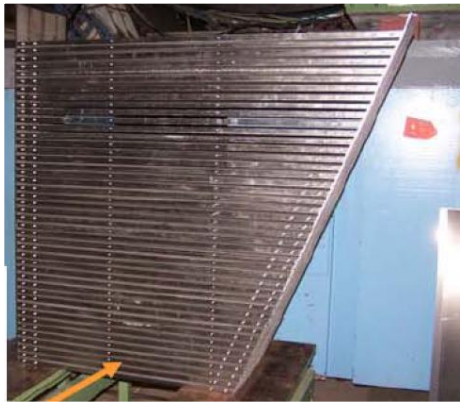
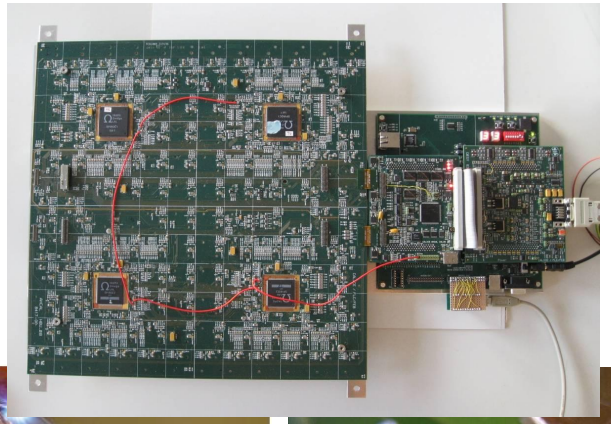


Conclusions

1. HCAL mechanical structure
   delivered
   ➔ stress measurements to come



2. HCAL readout integrated electronics
   delivered
   ➔ first user test completed
   ➔ re-design for next generation ready



3. HCAL LED calibration system
   delivered (two systems)
   ➔ comparison of performance
   ongoing