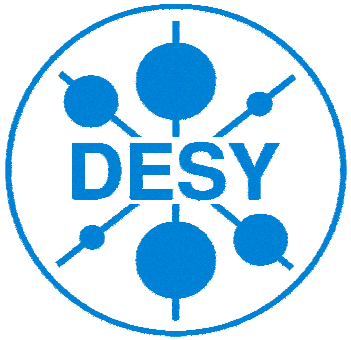
# HCAL task status report


Erika Garutti





4th EUDET annual meeting
Geneva, 19-21 October 2009

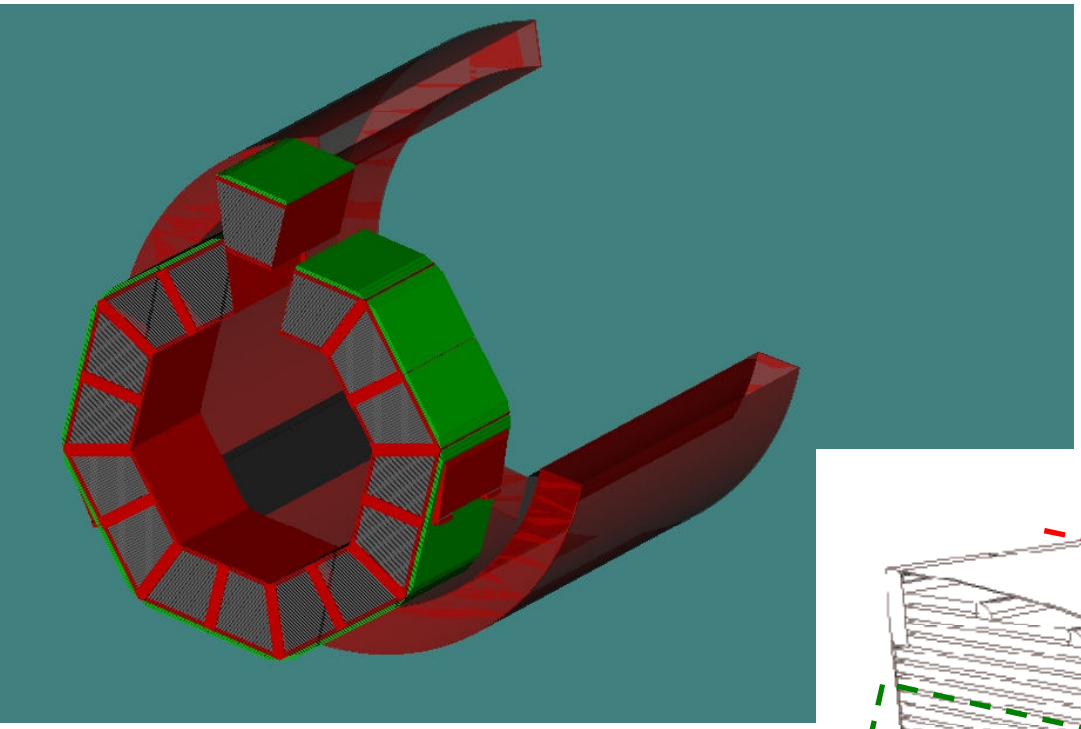
# Deliverables

- HCAL mechanical structure
- HCAL calibration system
- HCAL readout integrated electronics

# Mechanics

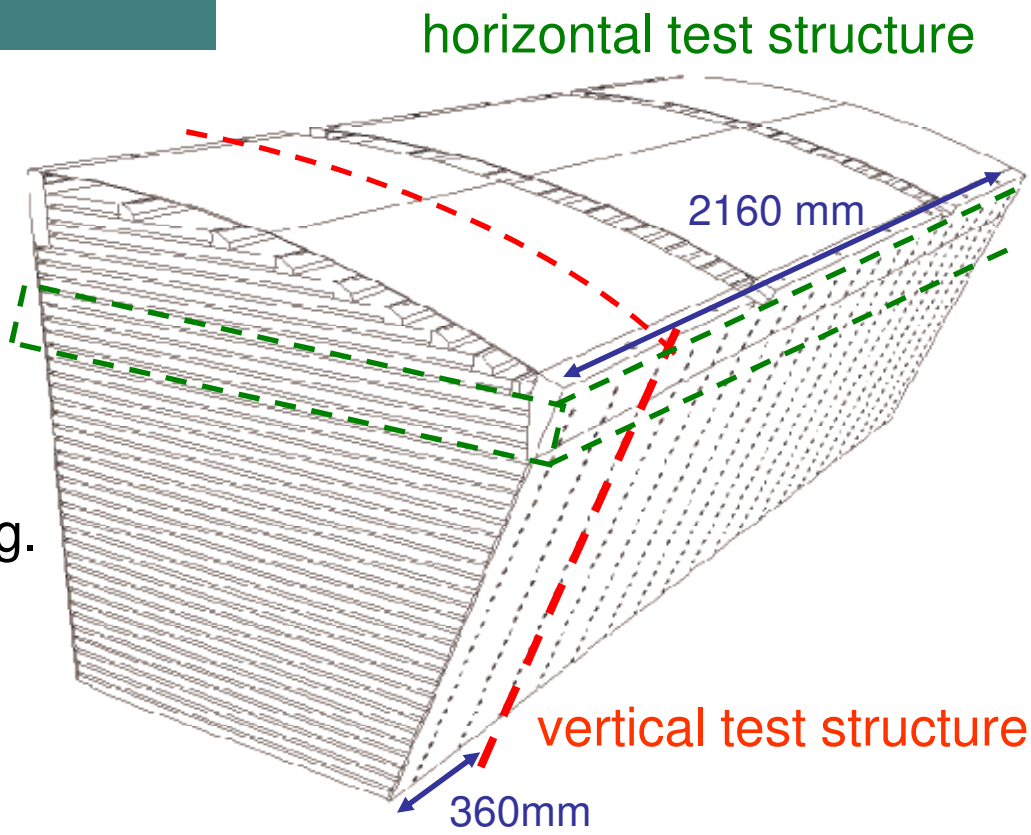
- Goal: a realistic absorber structure for tests of novel readout techniques
- Realistic: compact and scalable (& ILD-like)
- No full cubic metre needed, but should be extendible

# Calorimeter module



Advantage

- Slim support structure (small amount of φ-cracks)

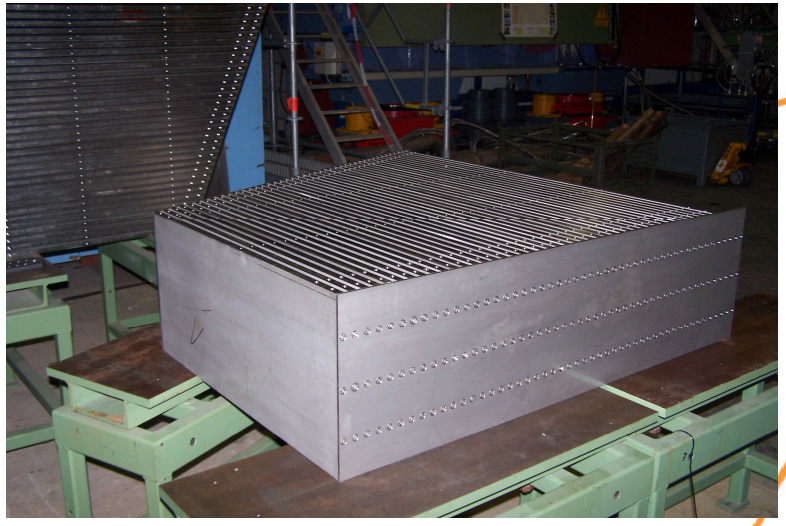



Disadvantages

- Uncertainties regarding stability
- High tolerance requirements (e.g. holes for screws, flatness of absorber plates)

# Mechanical structure: vertical test

## 360 mm sub-module



Sub-module Nr.2 in horizontal position

gap size measured (front)

all layers can be equipped with cassettes!

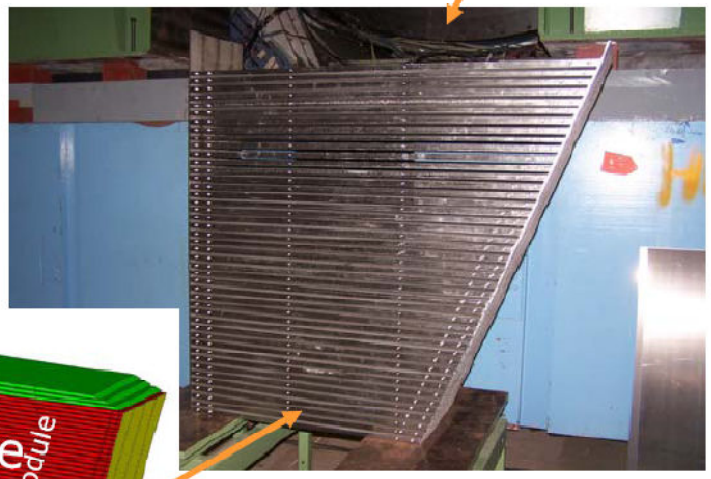
sub-module Nr.1 turned vertical

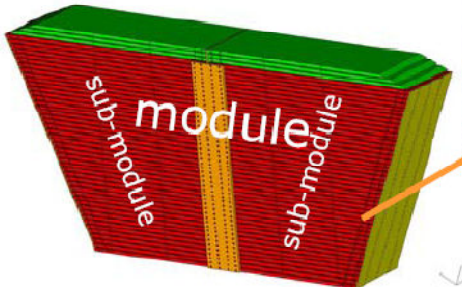
gap size checked by cassette prototype:

2 positions where the cassette does not fit into the gap

gaps must be measured also in depth

plate position must be measured






➔ **available**

***Slides from K. Gadow***

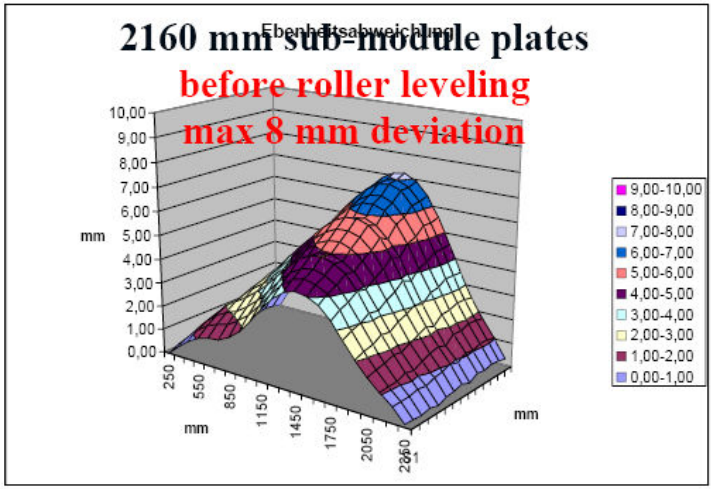
# Mechanical structure: large module

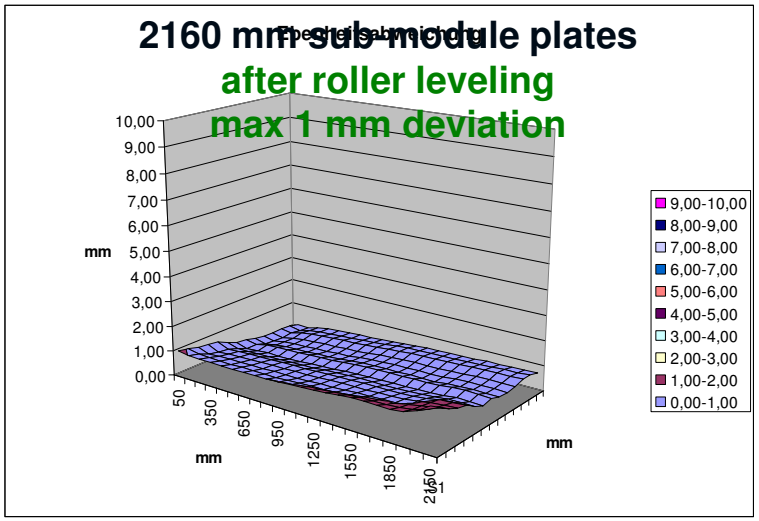
2160 mm sub-module plates
layer 43 to 46

roller leveling done

flatness measurement done

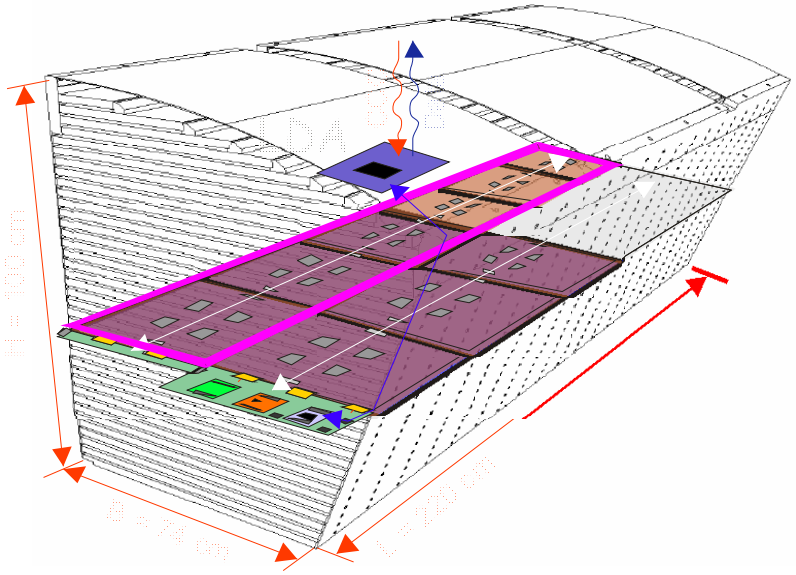
➔ **available**



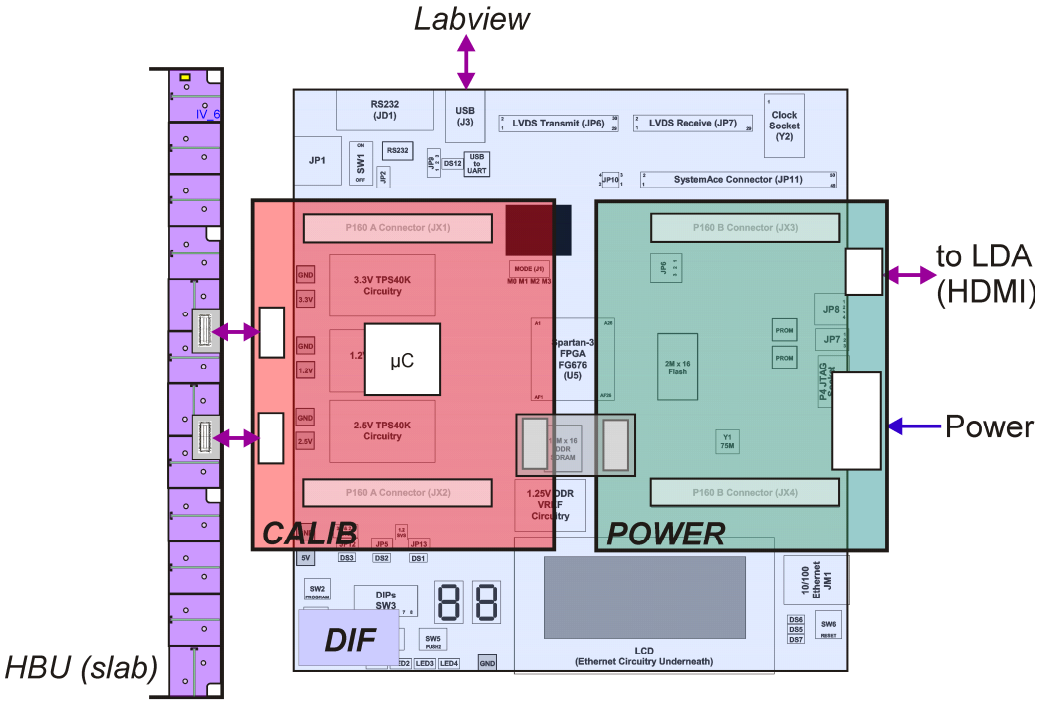
# Next prototype: Architecture

the future …



***Slides from M.Reinecke***

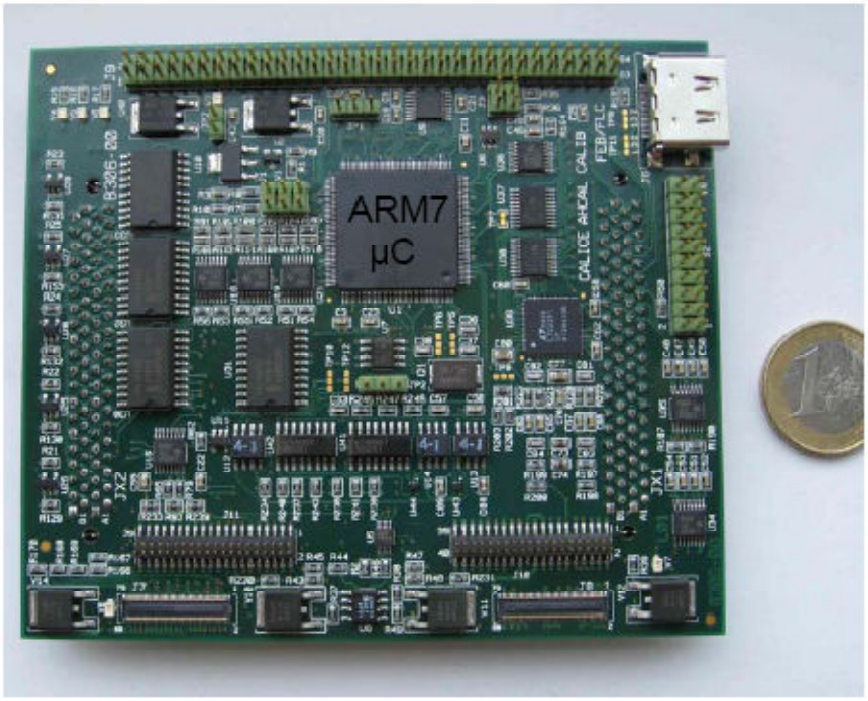
**1st** EUDET Prototype (**1st step**)



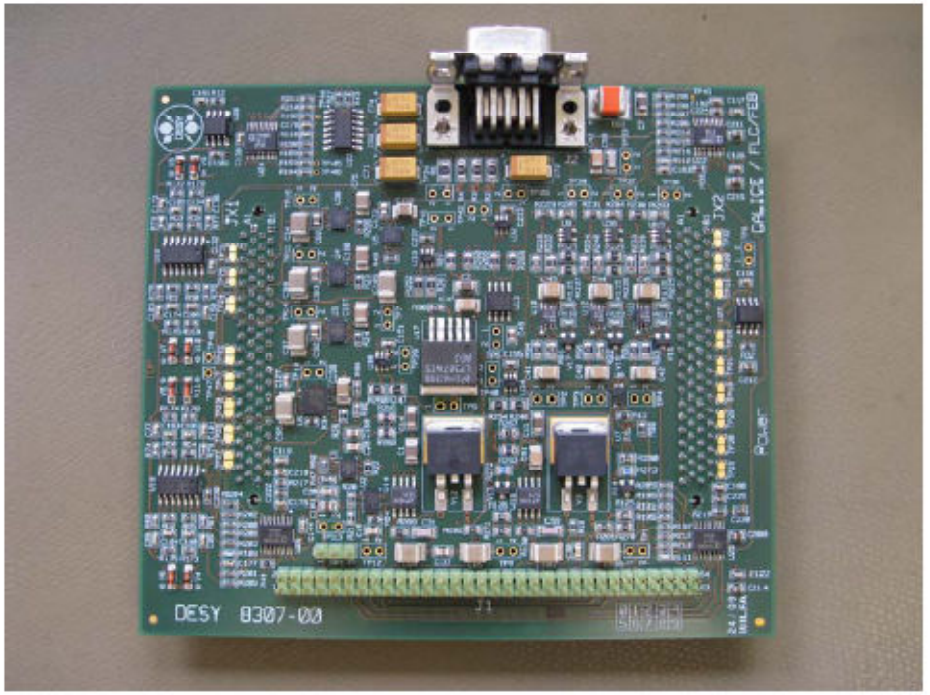

Commercial DIF, new mezzanine (CALIB, POWER), 1HBU (later: 6)

# Power and calibration modules

**CALIB** module: 11 x 10 cm²




**POWER** module: 12.5 x 11 cm²



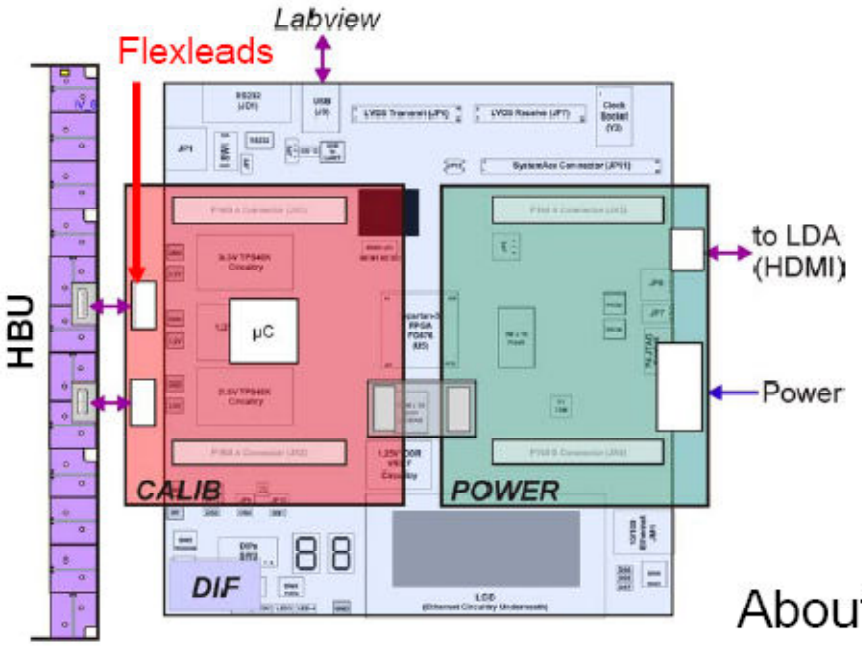

- 4 Modules finished, in operation.
- First tests successful.

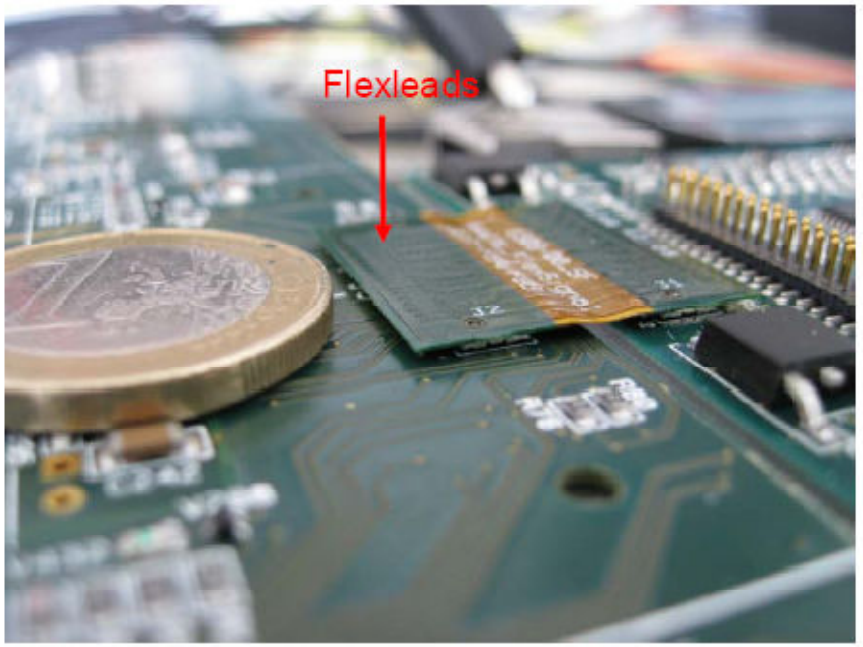
- 4 Modules arrived at DESY.
- Tests will start now.

Sizes and heights: To be adapted to ILC mechanics later.

# Power and signal connection

## ‘old-fashioned overview’




About 40 connection cycles up to now - still ok.

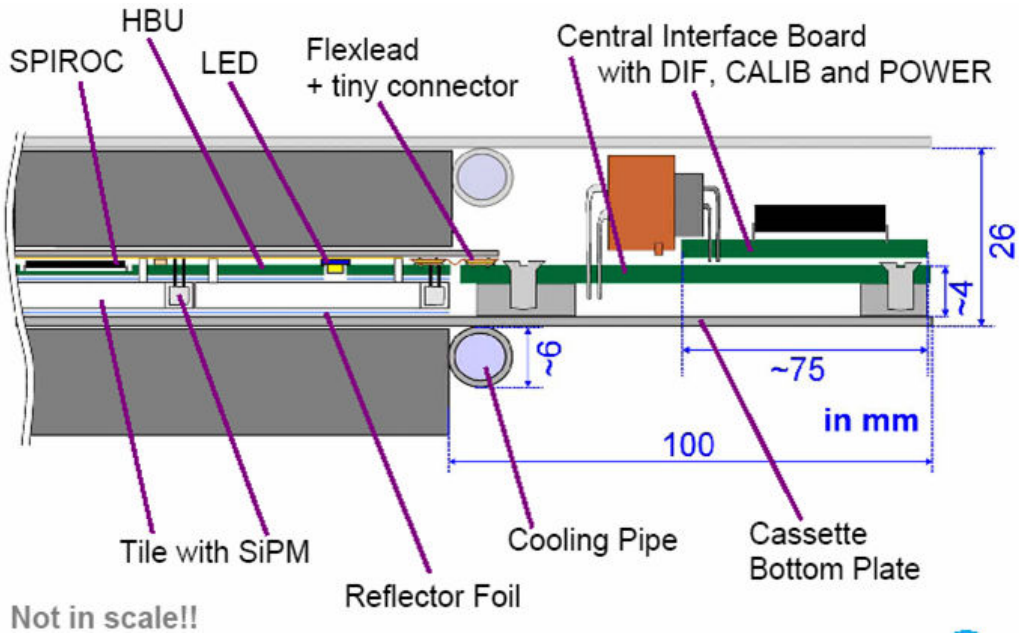
Compensate HBU misalignments in distance.

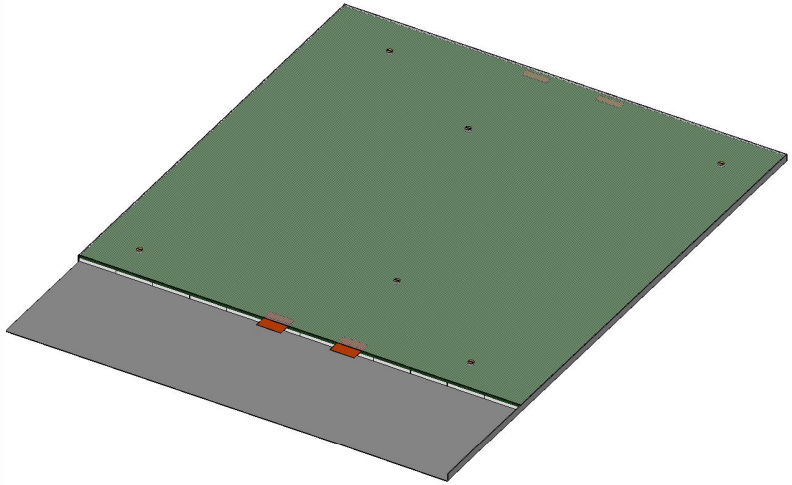
Fulfill AHCAL height requirements.

Tests ok concerning:

- Signal allocation
- Signal quality
- Resistance for power

# AHCAL Slab Interface: Mechanics



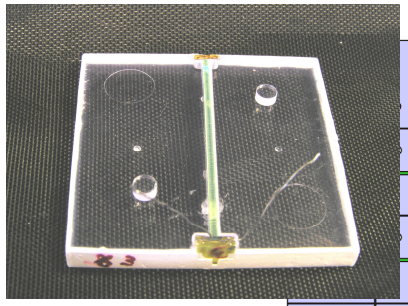
- Mechanical proposal (cassette, interface to DIF) has been set up for the AHCAL prototype (HBU0, DIF as commercial board)

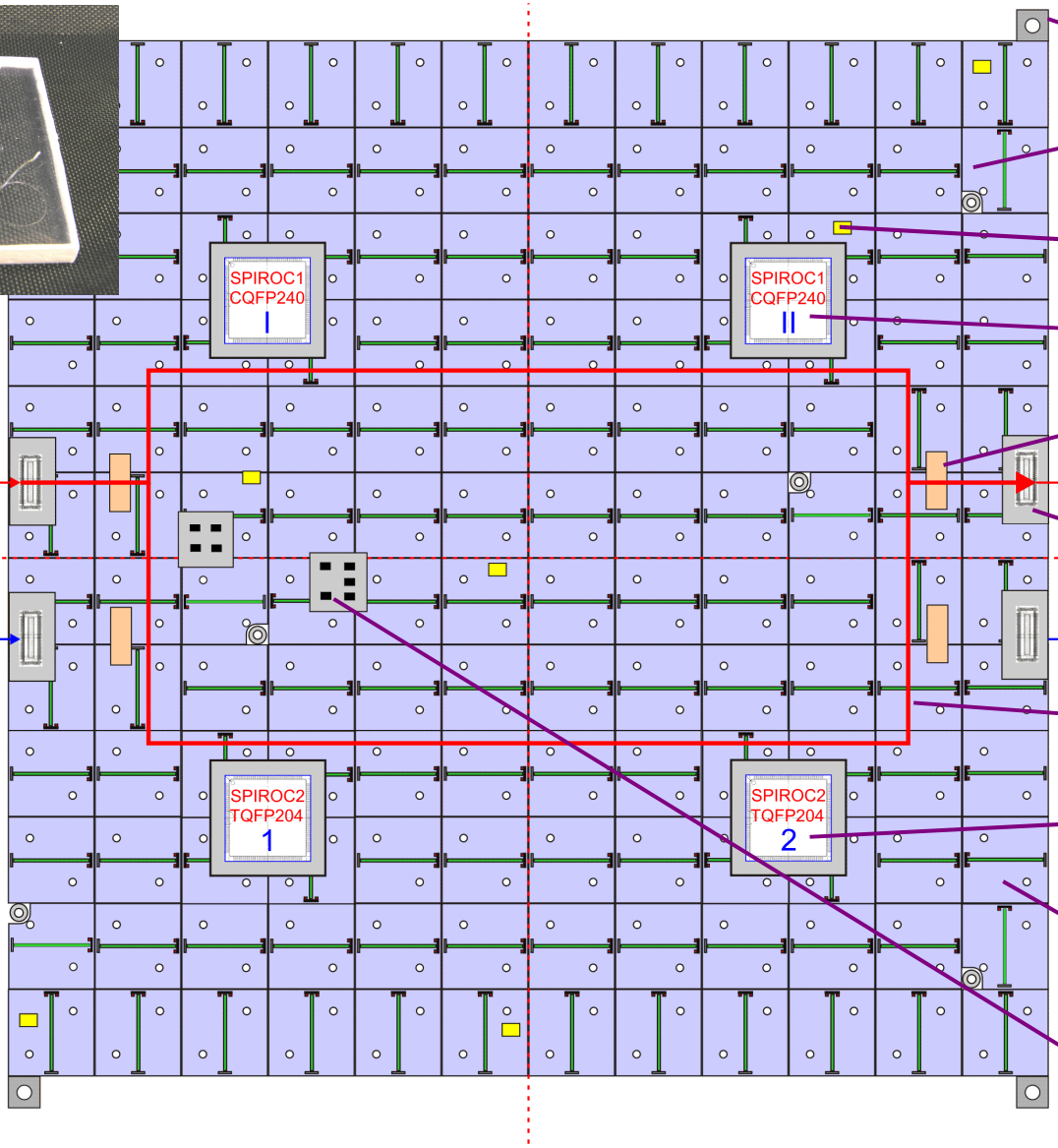
- Prototype housing ready

1HBU and 2HBU standard width housing prototypes available

# HCAL Base Unit (HBU0)

EUDET tile
MIP at 10p.e.






Signal IN

Power IN

Cassette fixation

Mechanics Tile

Temp. Sensor

**SPIROC1**

Debug Conn.

Flexlead Conn.

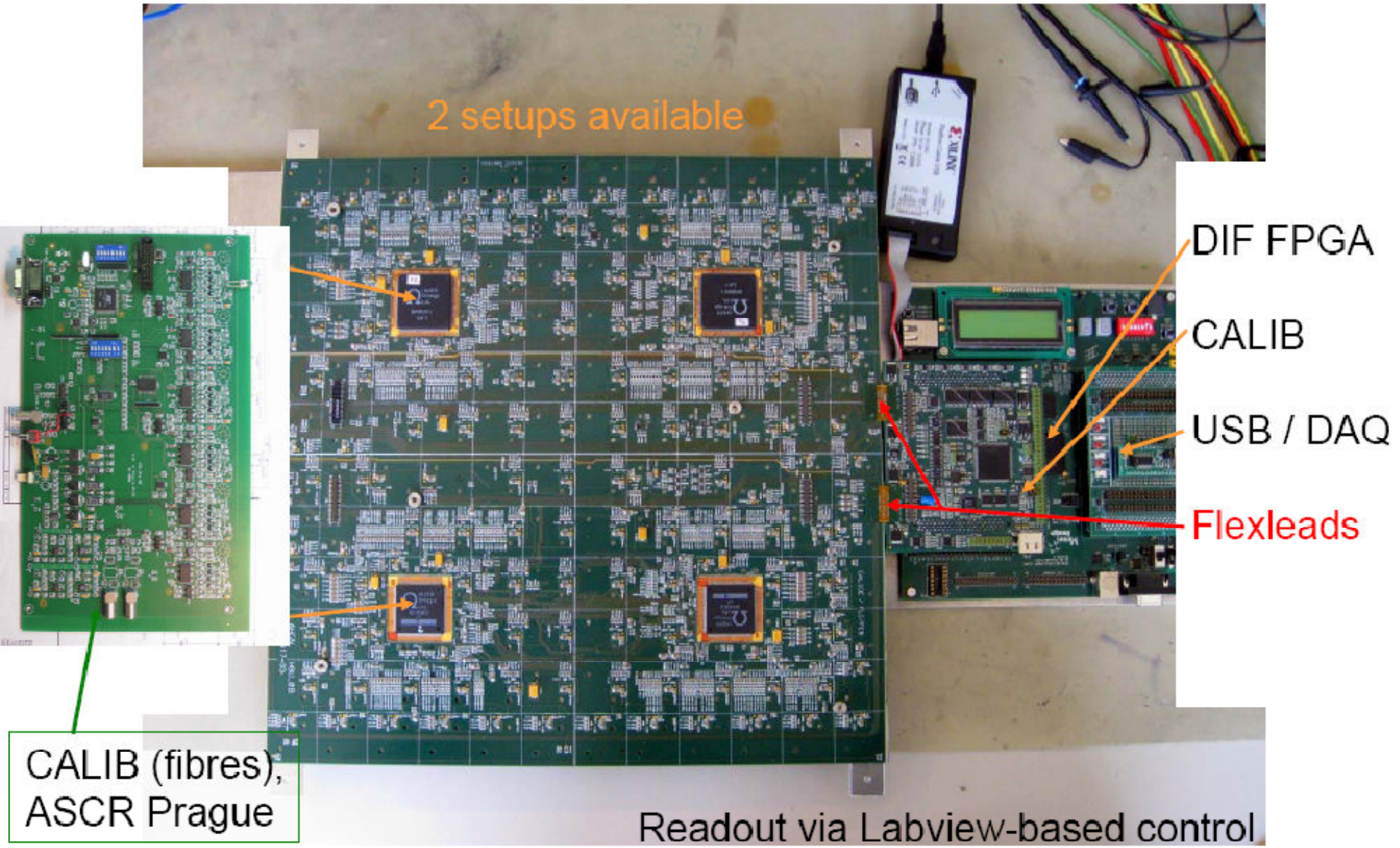
Two signal paths

**SPIROC2**

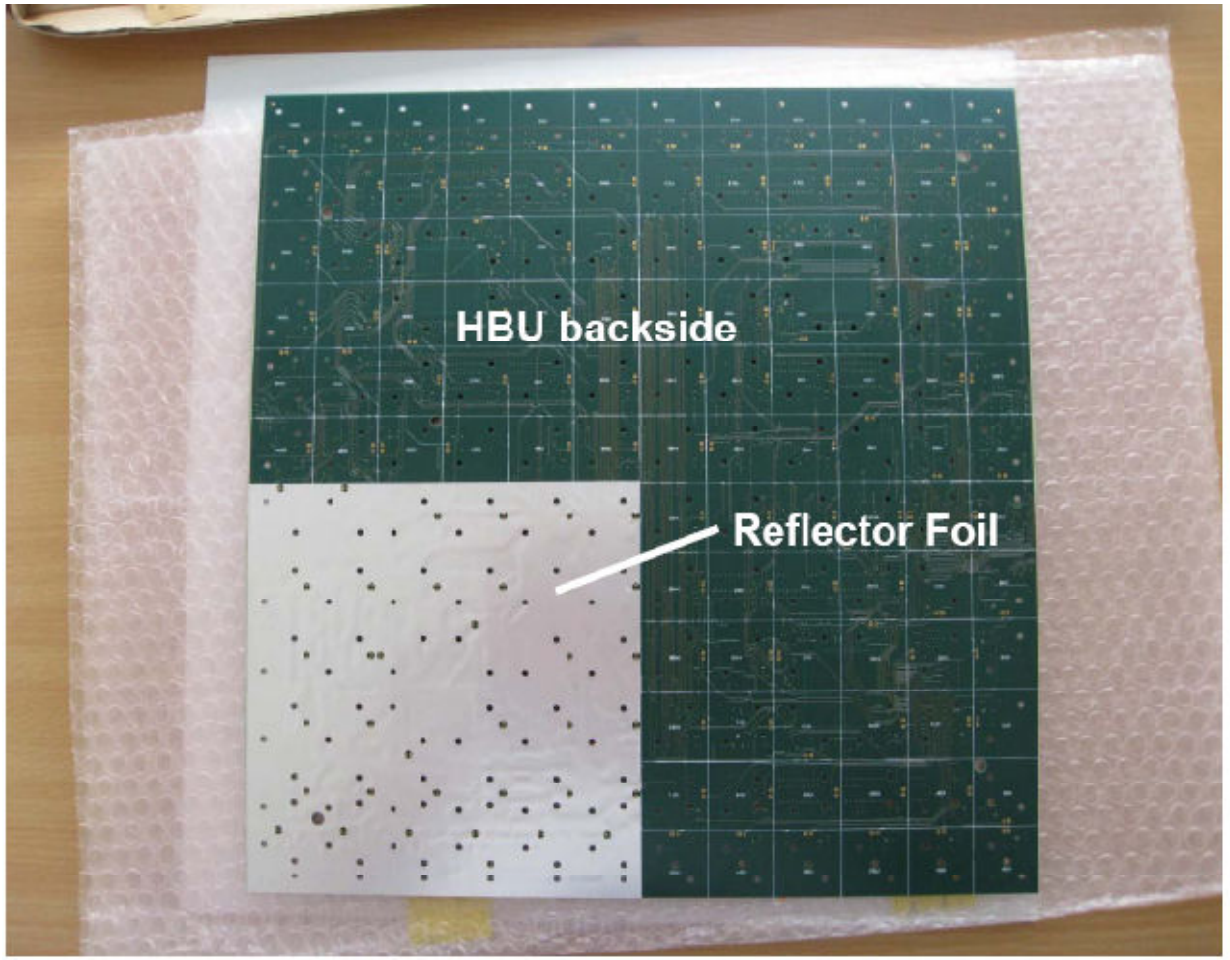
Prototype Tile

Calibration Electr.
(LED + Charge Inj)

# HBU status: electronics

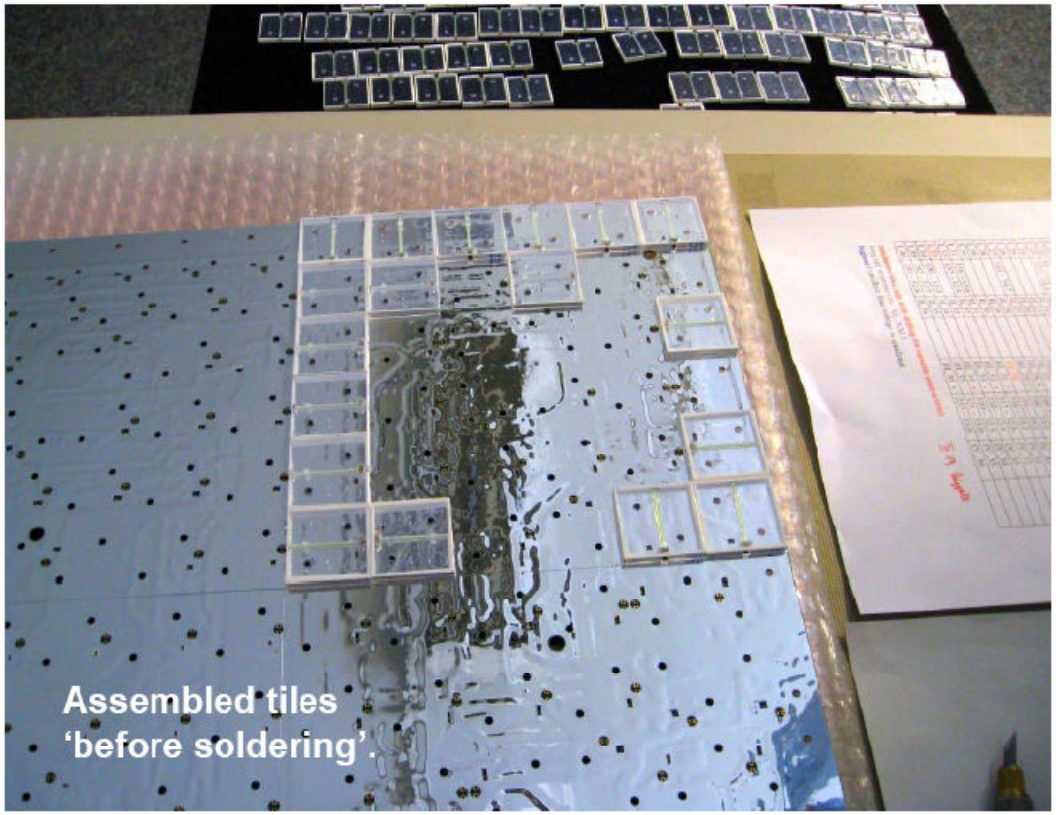


# HBU status: reflector foil




Cover back side with reflector foil in 4 pieces for better precision in alignment with holes

# HBU status: tile assembly




18 tiles connected and electronically checked
All tiles available to equip full HBU

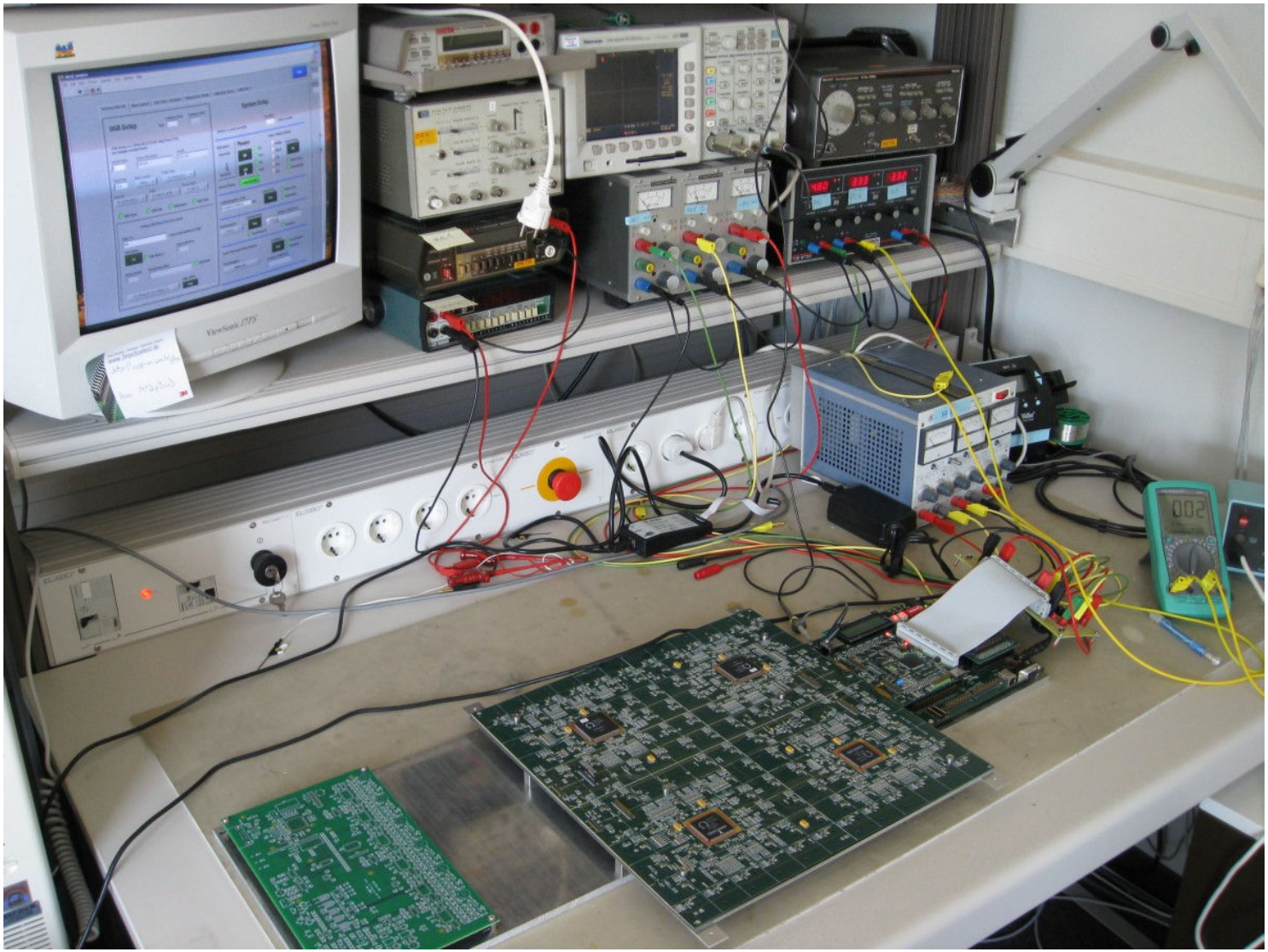
# Prototype commissioning: status

- System tested using commercial DIF board + USB connected Labview readout.
- Labview software is still under debugging: trigger cycle option implemented

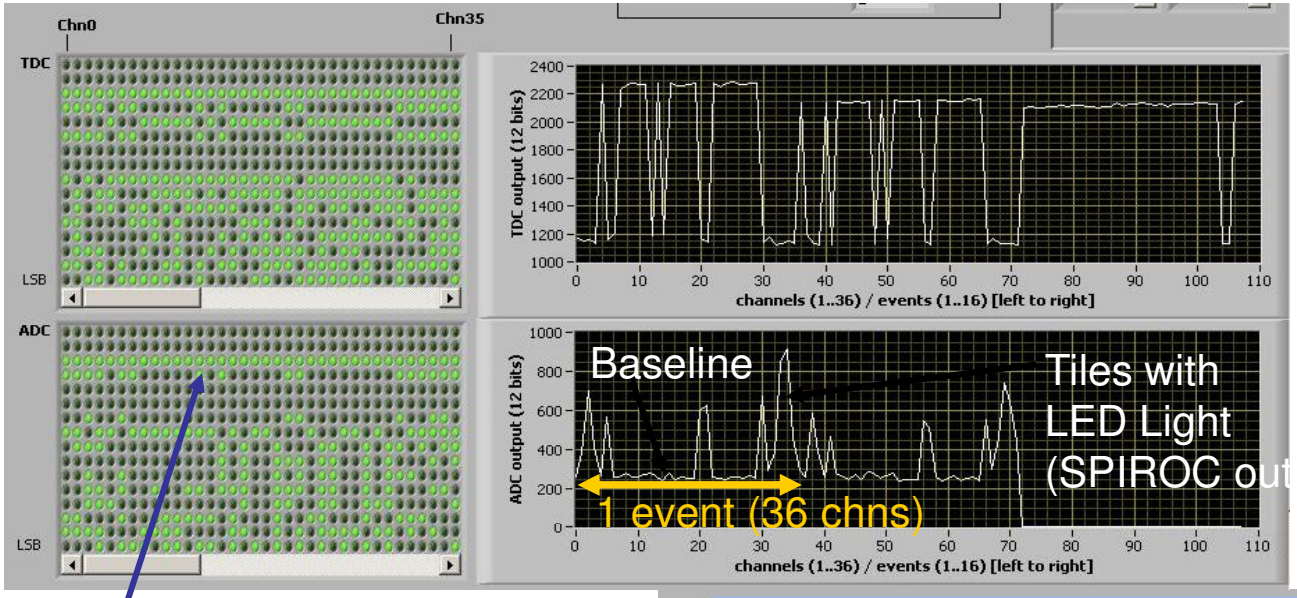
- Both SPIROC1 and SPIROC2 connected and functional
- The readout/operation is fully established. SPIROC ASICs (generation 1 and 2) can be fully operated, switch between the two by hardware jumpers.
- Due to an error in the SPIROC1 probe register, only one SPIROC1 can be used at a time. Both SPIROC2s can be used in parallel

Next: test of tiles signals readout ➔ ongoing

# Prototype system commissioning



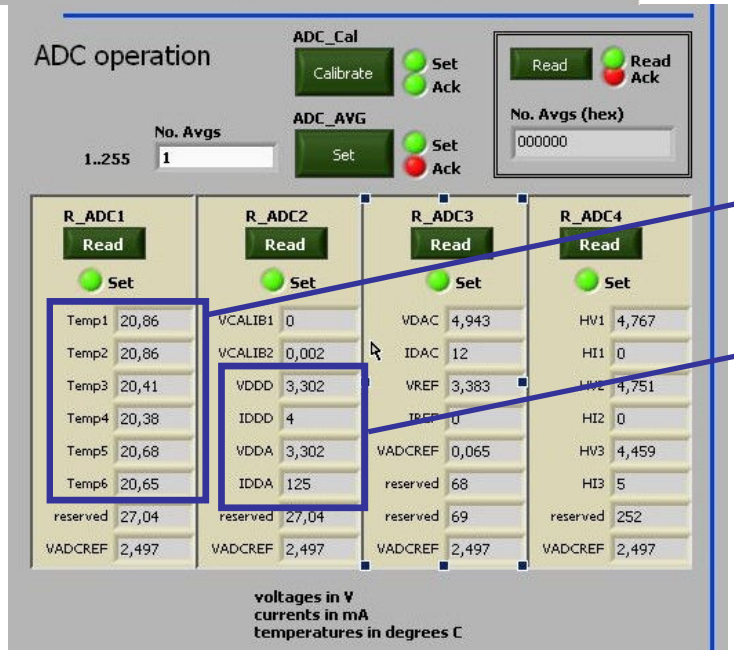
# System commissioning: snap-shots




Hit Bit (internal channel trigger)

LabView based DAQ: readout & slow control

**SPIROC\2 output: LEDs firing, 3 events (triggers), 18 tiles assembled**




HBU temperature profile

VDDA, VDDD and currents

**Slow Control : Read detector's temperatures, voltages, currents**

**Slow-Control: Still under test**

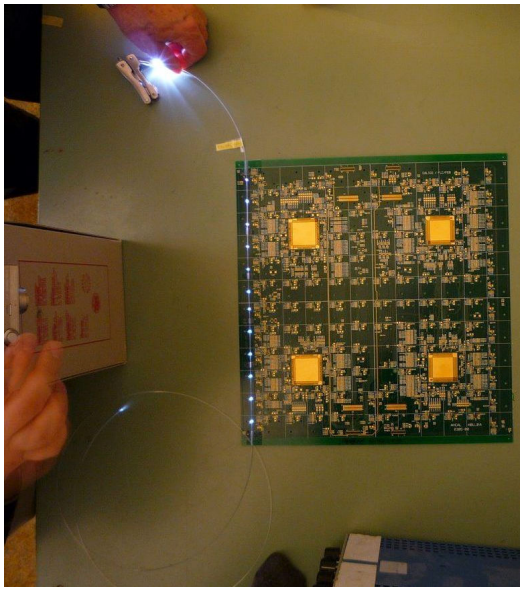
# Calibration system

- Goal: scalable system addressing the needs we determine in the ongoing test beam experiment
- Many procedures developed during last year's analysis, but not finally proven yet
- Stability of saturation still an issue → need dynamic range

- Two approaches: optical or electrical signal distribution
  - Central driver plus fibres, or one LED / tile
- LED on board looks promising, further optimization in the hands of Wuppertal group

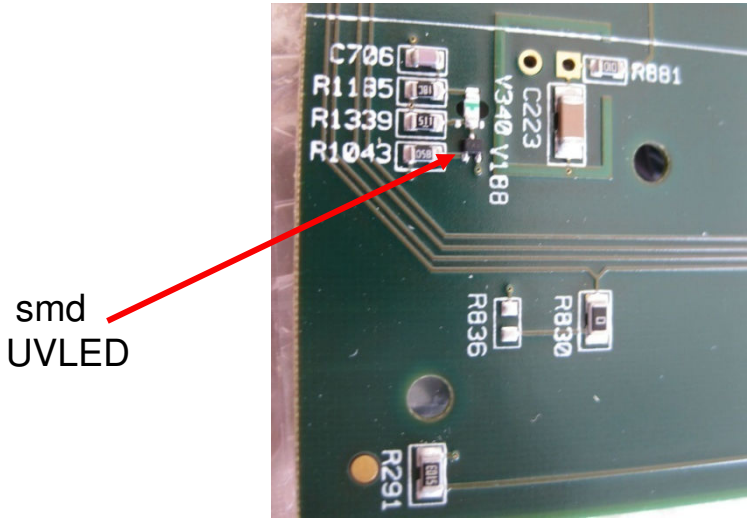
# Flashing UVLED - 2 methods

- Light distributed by notched fibres



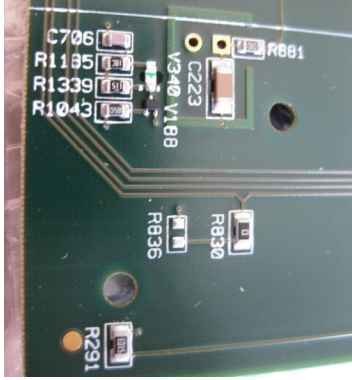
Institute of Physics ASCR, Prague
Kobe University

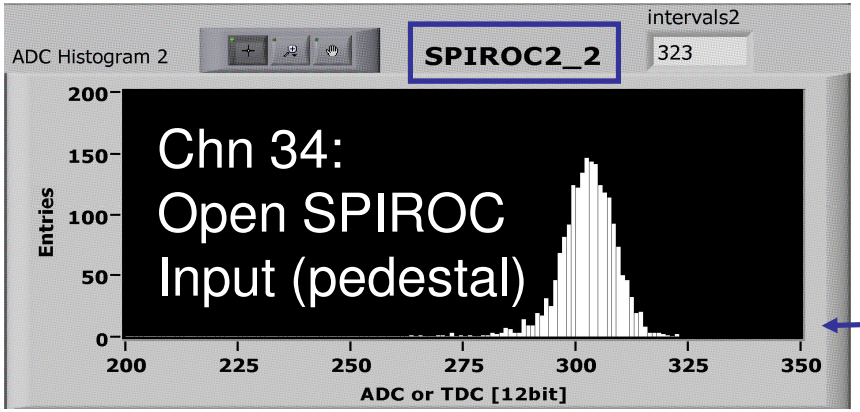
- Light distributed by microLED above scintillator distributed LEDs

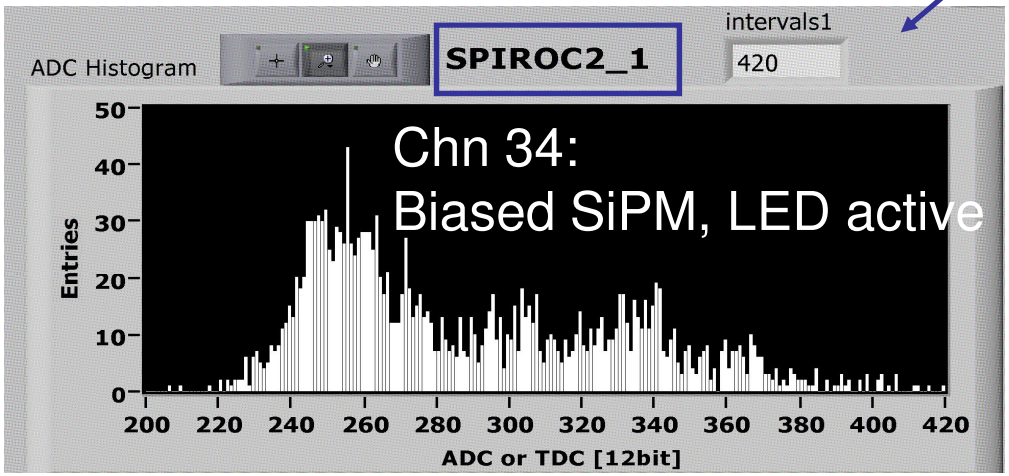



DESY Hamburg
UNI Wuppertal

# Integrated LED system



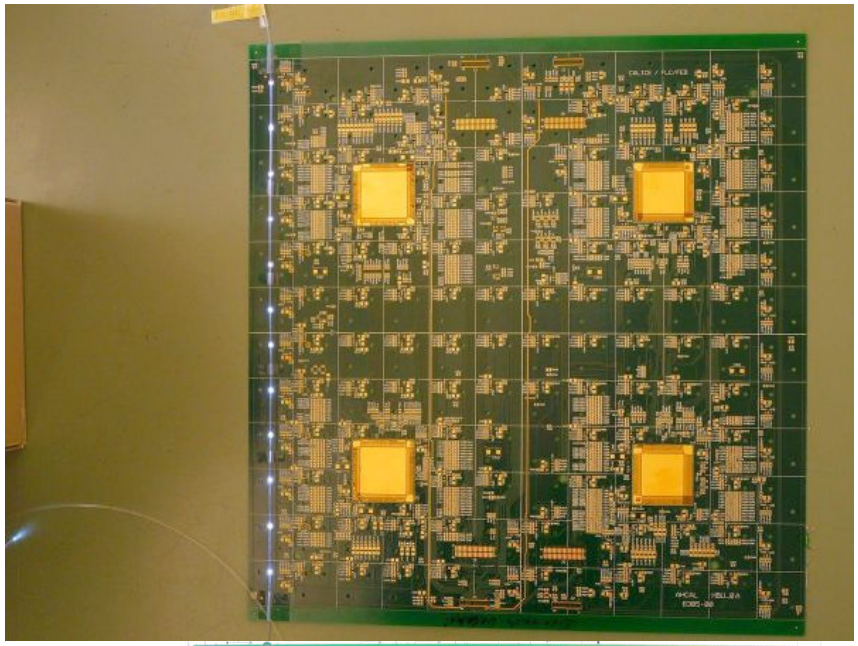



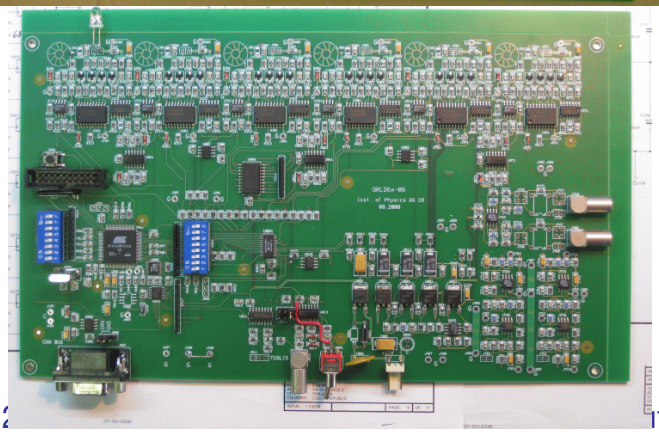

Labview Software extended to multi-cycle data taking => **histograms**

Work ongoing to obtain single peak spectra

- Integrated LED multi-channel calibration system works
- <5ns LED light pulses measured on the HBU with PMT H9858-01
- Remaining problem: spread in the output intensity LED-to-LED

# **6**-LED **Q**R driver **M**ain **B**oard = **QMB6**

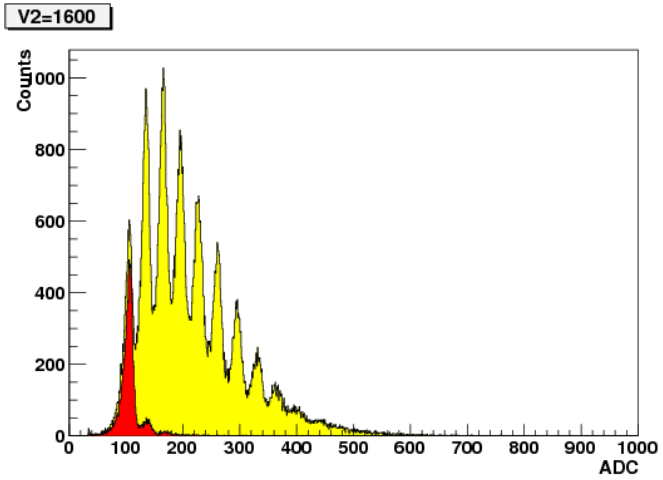




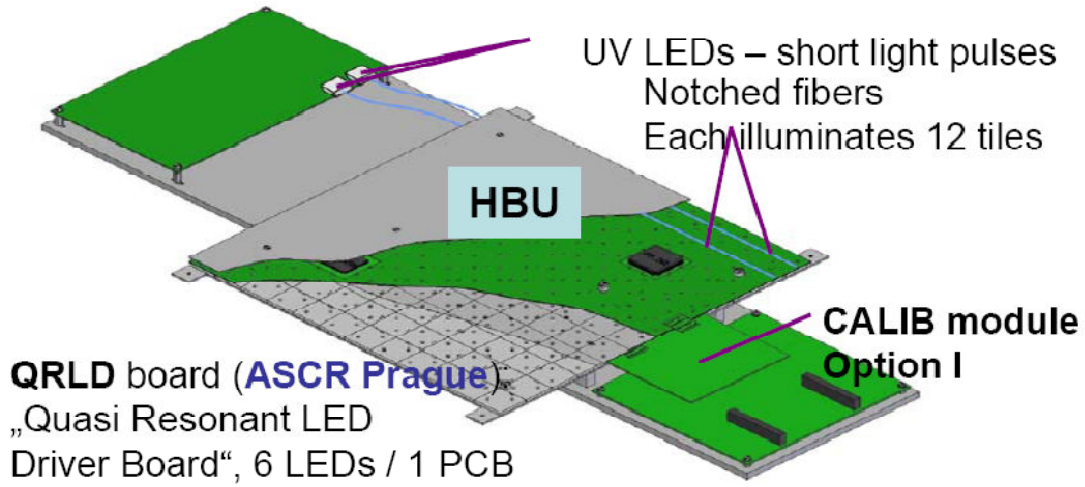
Board available consisting of:

6 QR LED drivers
2 PIN PD preamps
CPU + commun. module CANbus
Voltage regulators
temperature and voltage monitoring

Low light intensity provides single photo-electron peak spectra on SiPM



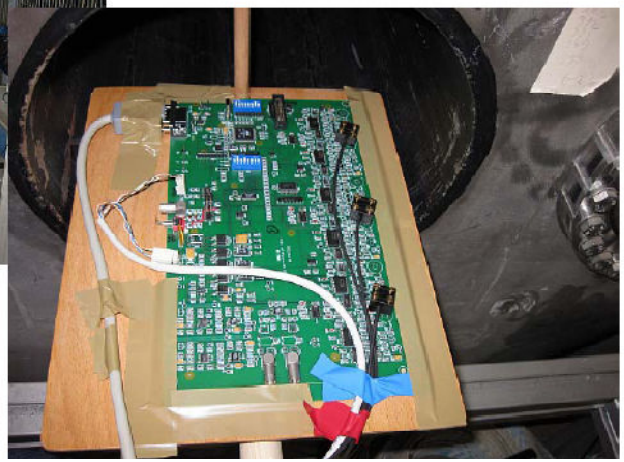
# QRLD board: Magnetic field test




**QRLD** board (**ASCR Prague**):
„Quasi Resonant LED
Driver Board“, 6 LEDs / 1 PCB

- Electronics: multi-channel prototype complete reasonably works incl. Slow control interfaces
  ➔ can be implemented into EUDET AHCAL prototype
- Characteristics and function described in public paper
  EUDET report 2008-7

- Optical part: notched fibres in preparation
  → promising results

➔ System successfully tested in 4T magnetic field at DESY

relative light amplitude change <3‰ @ 1 T

extrapolated to CMS solenoid max. relative light amplitude change $<3\times10^{-4}$

# Conclusions

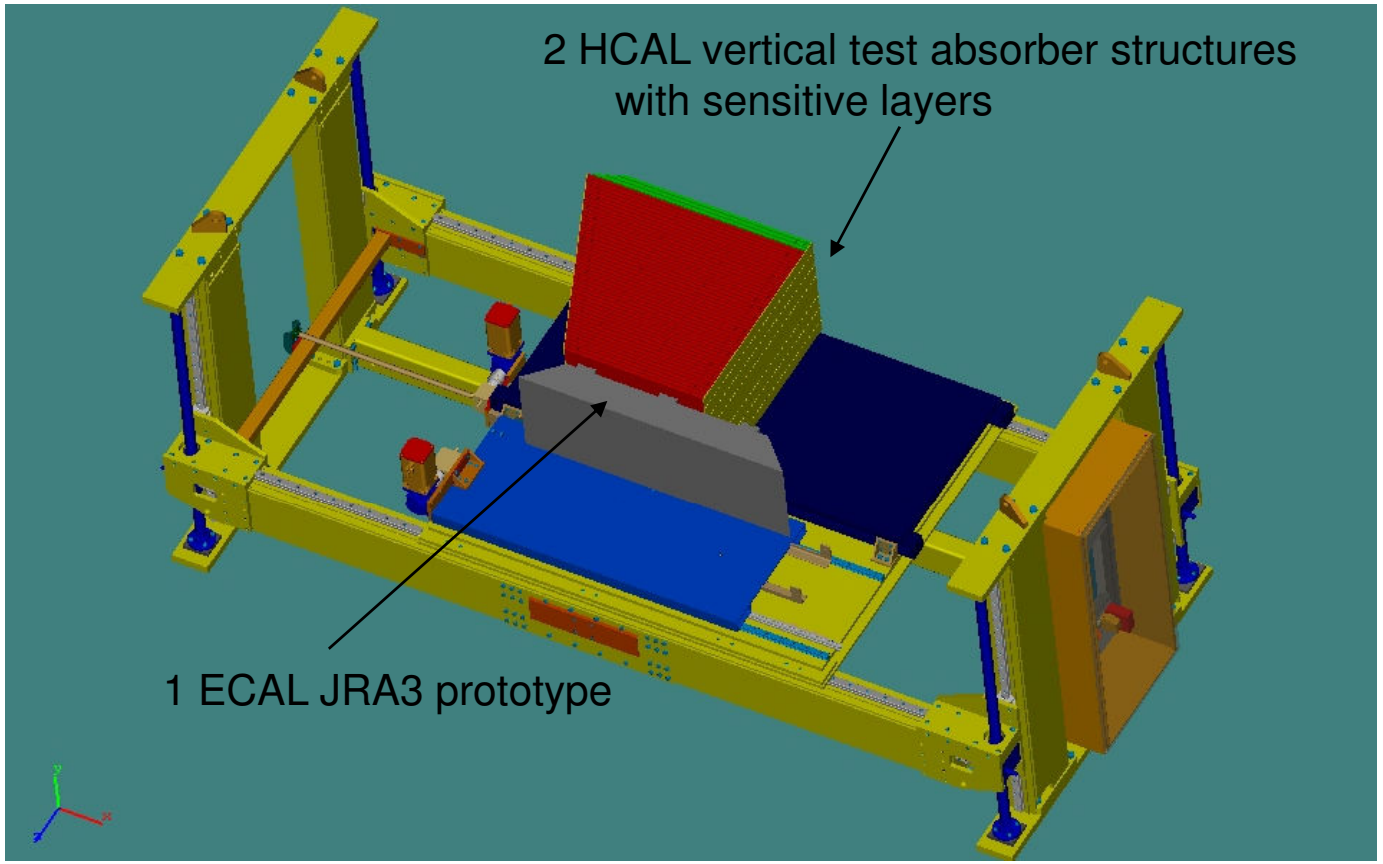
- Full system integration (electronics + mechanics) incorporating tiles and SiPMs from first user is ongoing

- First prototype is being assembled and tested. All components delivered:
  - CALIB and POWER modules: available
  - Calibration multi-channel prototype: both options available
  - Mechanical structure: available

Outlook: AHCAL integration prototype to DESY test beam in 11/09

- Full scale area integration requires redesign of HBU
- Multi-layer integration requires redesign of end-face components (DIF, CLIB, POWER)

# Future HCAL project




- Mechanical structure assembled together with ECAL for test beam experiment
- Test in magnetic filed also under discussion