

## 14.4. Readout systems for innovative calorimeters

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WP 14.4

Paris, April 5, 2017

- **Milestone 58:** Definition of optical and electrical coupling of readout, interface functionality and DIF design
- **Deliverable 14.5:** Common running of calorimeter prototypes
- **Deliverable 14.6:** Adaptation of readout system for operation in compact LC detectors

## **Milestone 58: Definition of optical and electrical coupling of readout, interface functionality and DIF design**

**Verification:** DIF data sheets

**Date:** Months 24

**Comment:** not defined for a specific detector

**Status:** delivered preliminary paper this week to WP14 management

### **IPN Lyon**

**Implementation of a GBT based communication for Roc chips, synergy with development for CMS muon RPCs**

**Status:** on-going

### **DESY**

**Design and production of a new DIF for scintillator readout**

**Status:**

- 20 DIFs produced, used successfully in a 15 layer testbeam in July/August 2016 at DESY without and with power pulsing
- ~30 more will be produced soon for next CALICE AHCAL testbeam prototype

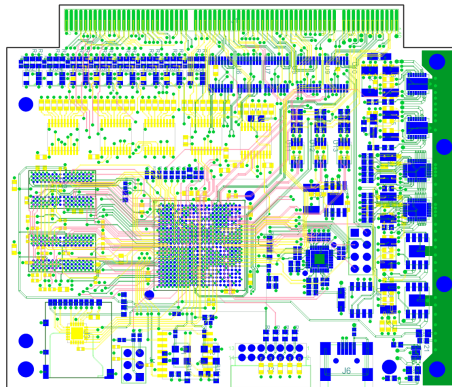
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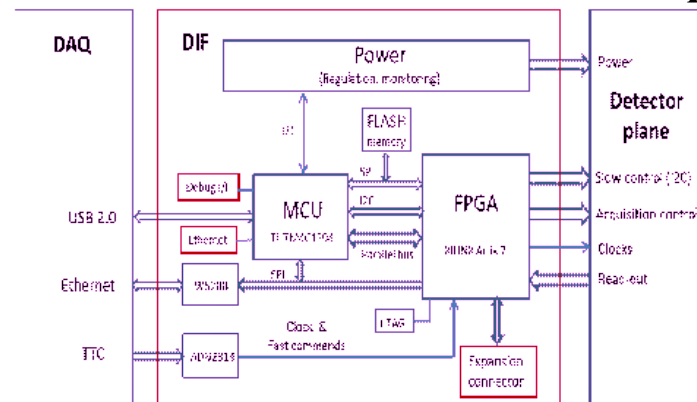


## SDHCAL:

- Control  $\geq 432$  HARDROC
- 2x I2C bus config
- 2x serial links for data
- FPGA+MCU
- Gbit transfer
- First tests performed

## AHCAL

- 3X6 HBU's
- 72 SPIROC2
- Custom protocol to LDA
- FPGA+MC
- Produced and tested



## **Deliverable 14.5: Common running of calorimeter prototypes**

**Description of subtask 14.4.1: “For Linear Collider Detectors system aspects become increasingly important. This includes the interfacing of sub-detectors to a common data acquisition. This task assures the integration of different calorimeter technologies into the DAQ system developed in WP5.”**

**Deliverable:** Data acquisition system to allow for a common data taking of different highly granular calorimeter prototypes in beam tests at CERN and DESY. These tests should provide data files containing events synchronised between the subsystems.

**Date:** Month 36

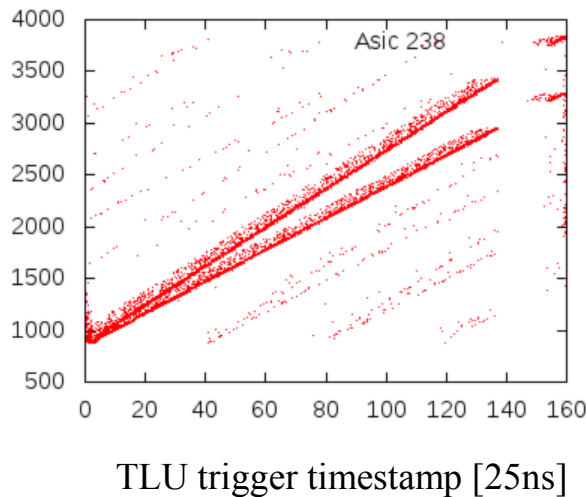
**Status:**

- **within WP5, milestone 25 in July 2016 was document on “HARDWARE AND SOFTWARE INTERFACE SPECIFICATION FOR AIDA-2020 COMMON BEAM TESTS”**
- **first combined testbeam already happened, but not yet with WP5 DAQ system and data files containing synchronised events**
- **more testbeams planned for 2017**

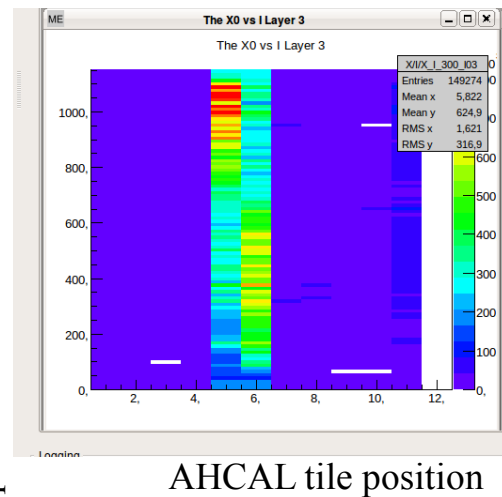
## Deliverable 14.5: Common running of calorimeter prototypes

### combined AHCAL + beam telescope running

- 2 times 1 week of beam time in October and December 2016 at DESY
- 6 small AHCAL layers + EUDET beam telescope
- combined DAQ:
  - synchronisation of externally triggered (telescope) and auto-triggered (AHCAL) detector
  - synchronisation based on trigger time stamps and handling of BUSY signals by EUDET TLU
  - common DAQ based on EUDAQ1.6
  - (quasi-)online monitoring with DQM4HEP
- in October observed some inefficiencies in AHCAL data taking, solved in December



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## **Deliverable 14.5: Common running of calorimeter prototypes**

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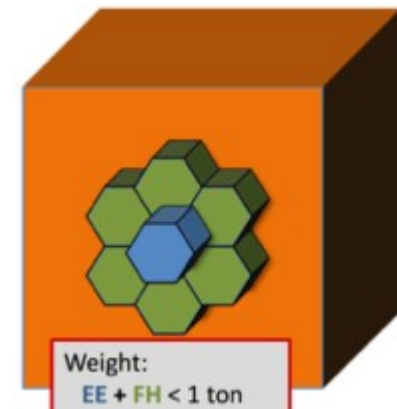
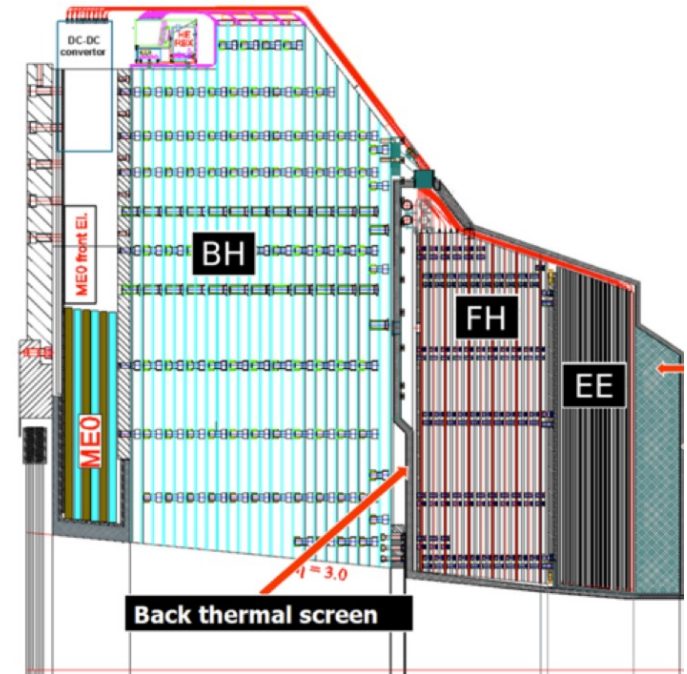
### **tests with EUDAQ2 (development within **WP5** see talk by **Katja**):**

- **running with EUDAQ2 works**
- **tested:**
  - **two data collectors**
  - **higher rate of recorded events**

**not common running of calorimeter prototypes, but important steps in operation of common DAQ system**

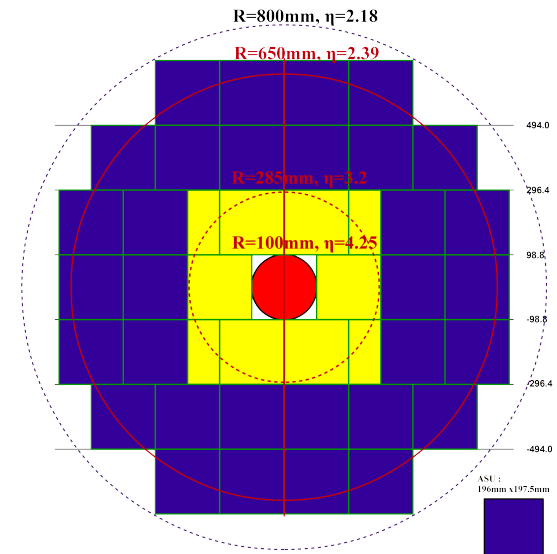
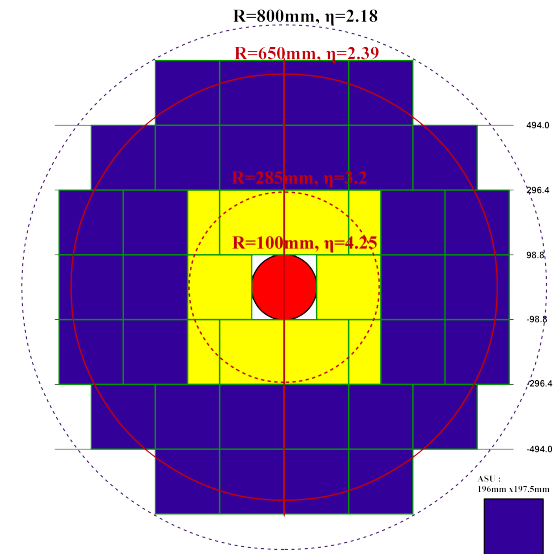
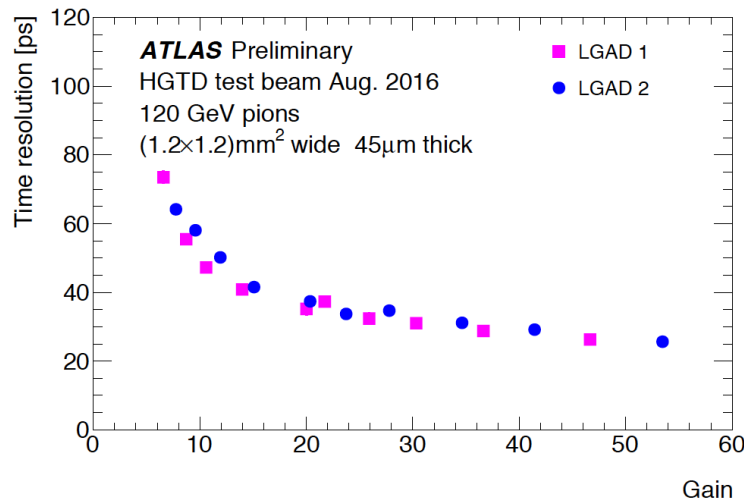
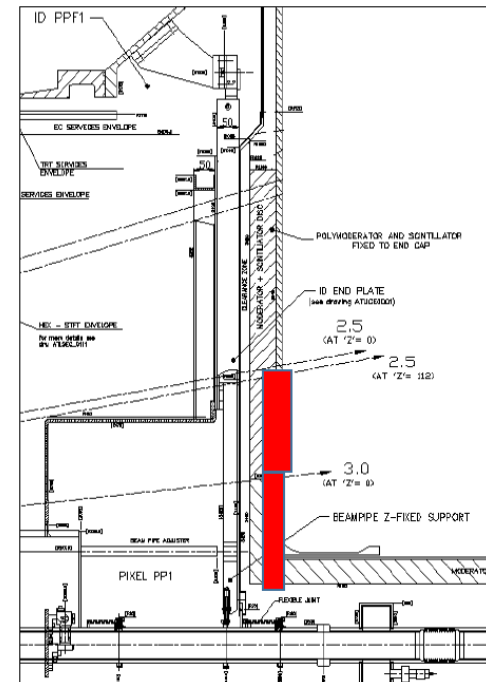
# Common running of CMS HGAL and CALICE AHCAL prototypes

- CMS HGAL TDR planned for Nov. 2017
- HGAL prototype for silicon part (EE and FH) exists or being built
- HGAL scintillator part (BH) design similar to CALICE AHCAL
- evaluate performance by combined beam test
  - HGAL EE and FH prototypes
  - 12 layer AHCAL prototype
- combined DAQ:
  - needs synchronisation of externally triggered and auto-triggered detector
  - learn from synchronisation of beam telescope and AHCAL
  - discussions started
- beam time at SPS for 2017: July



# ATLAS HGTD

- in small gap between tracker and LAr calo
- coverage:  $2.4 < \eta < 4.2$
- **LGAD** silicon sensors
- 4 silicon sensor layers w/o tungsten
- goal: 30ps time resolution
- tested radiation hardness and time resolution of **LGAD** sensors
- 3 testbeam periods planned
- downselecting of HGTD-Si versus HGTD-SiW planned this year





## **Deliverable 14.6: Adaptation of readout system for operation in compact LC detectors**

**Adaptation of readout system for operation in compact LC detectors implying optimisation of space and power consumption. Demonstration of concept with existing calorimeter prototypes and proposal of extrapolation to full size detector.**

**Date: Month 44**

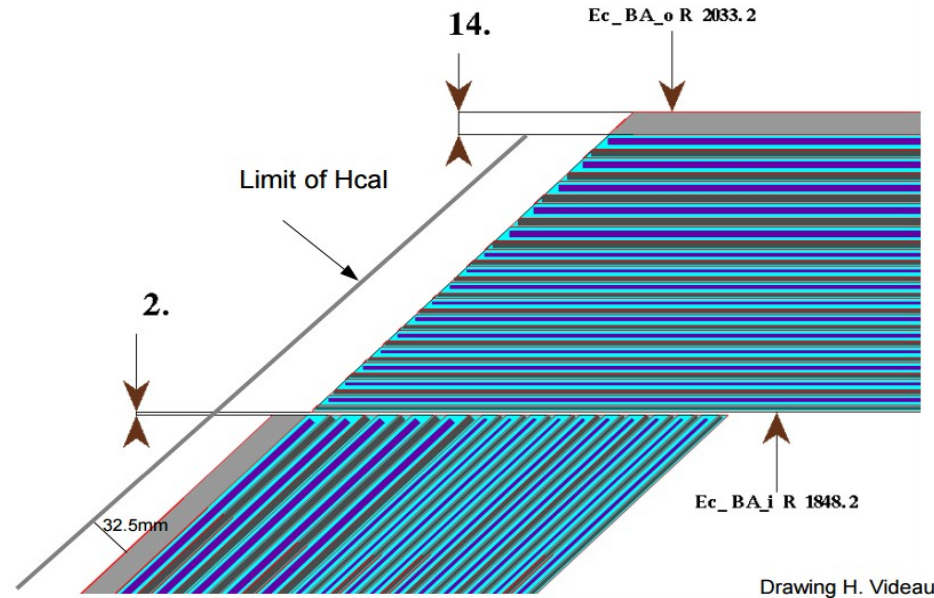
**Status:**

- **LC size and detector layout under discussion**

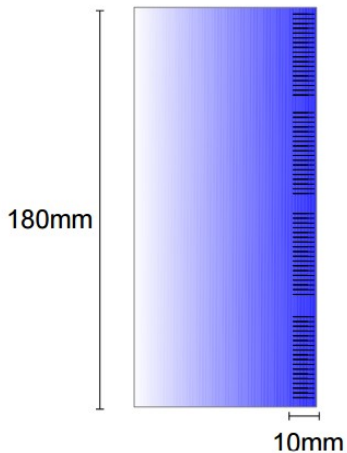
# Deliverable 14.6: Adaptation of readout system for operation in compact LC detectors

## Definition of space and functionality on going:

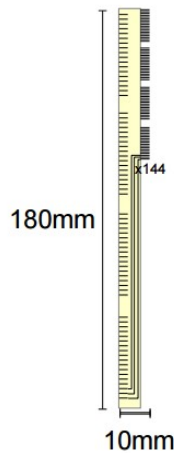
- Uniformity calls for electronics in gap to HCAL
- Separation in R small, even-odd readout
- Separate fully detector and readout or not



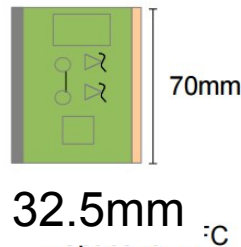
Last ASU of Ecal layer



Adapter card 1:  
180mm -> 70 mm



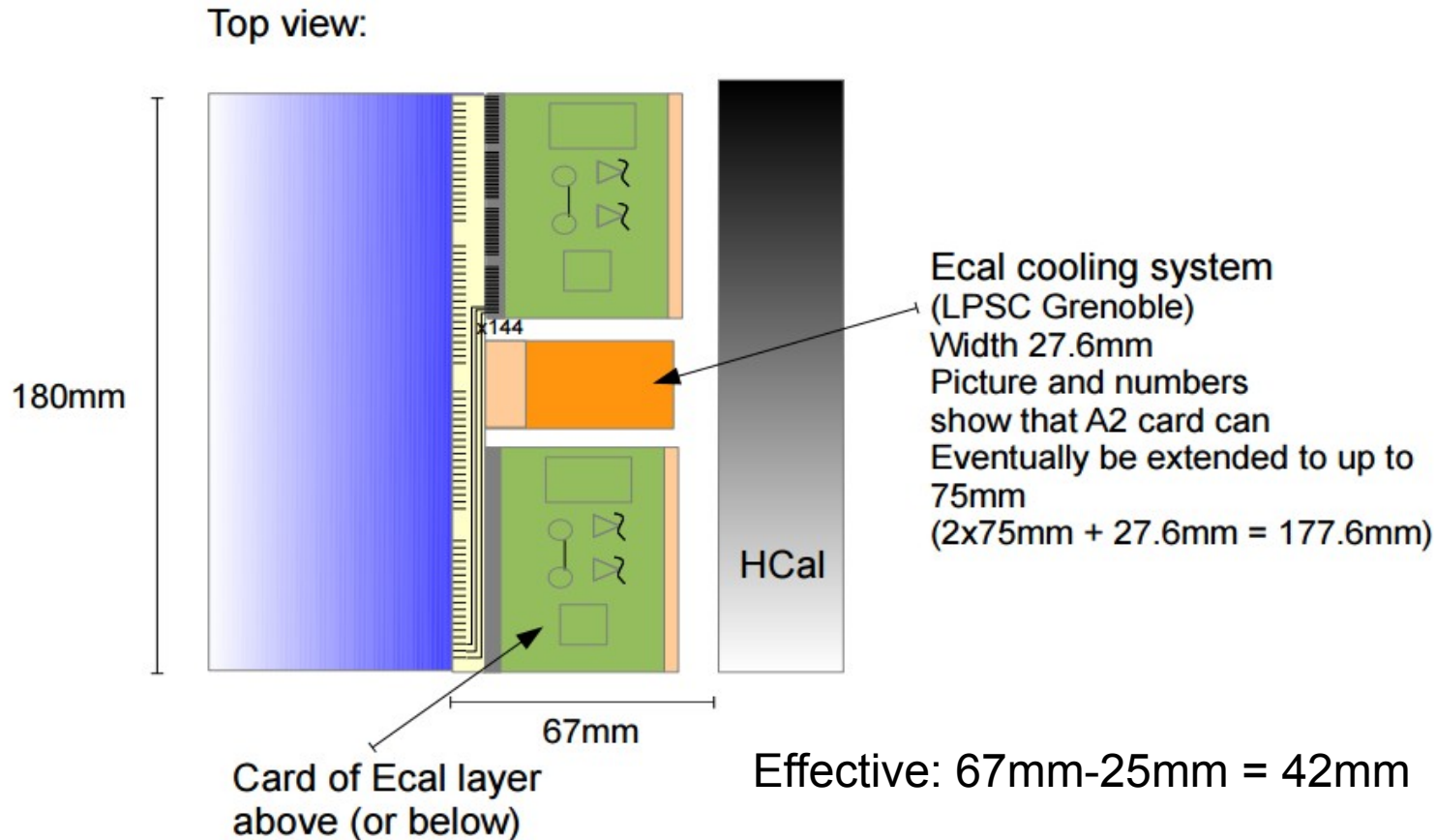
Adapter card 2:  
Carrying services as  
Power regulators, switch,  
capacitance (0.1 – 1 mF) and FPGA,  
Flat Flexible Cable for connection to Hub2



## Examples:

- ASU+ Adapter1 + Adapter2
- ASU+ Adapter12
- ASUspecial

## Deliverable 14.6: Adaptation of readout system for operation in compact LC detectors



## Test bench for ASIC tests

**Description of subtask 14.4.2: “This activity includes test benches for front-end ASICs of highly granular calorimeters as e.g. those developed in WP4. The test bench is a prototype for mass tests for LC Experiments capable to serve experiments with similar front-end electronics.”**

**No deliverable/milestone!**

### **Status:**

- **testboard for next AHCAL ASIC (SPIROC2E) in BGA package designed and built, first version of test firmware and software exists**
- **will be used for “mass” testing (~1000 pieces) of ASICs for next AHCAL testbeam prototype, **first batch of 400 on the way****

