In situ performance of the CMS Preshower

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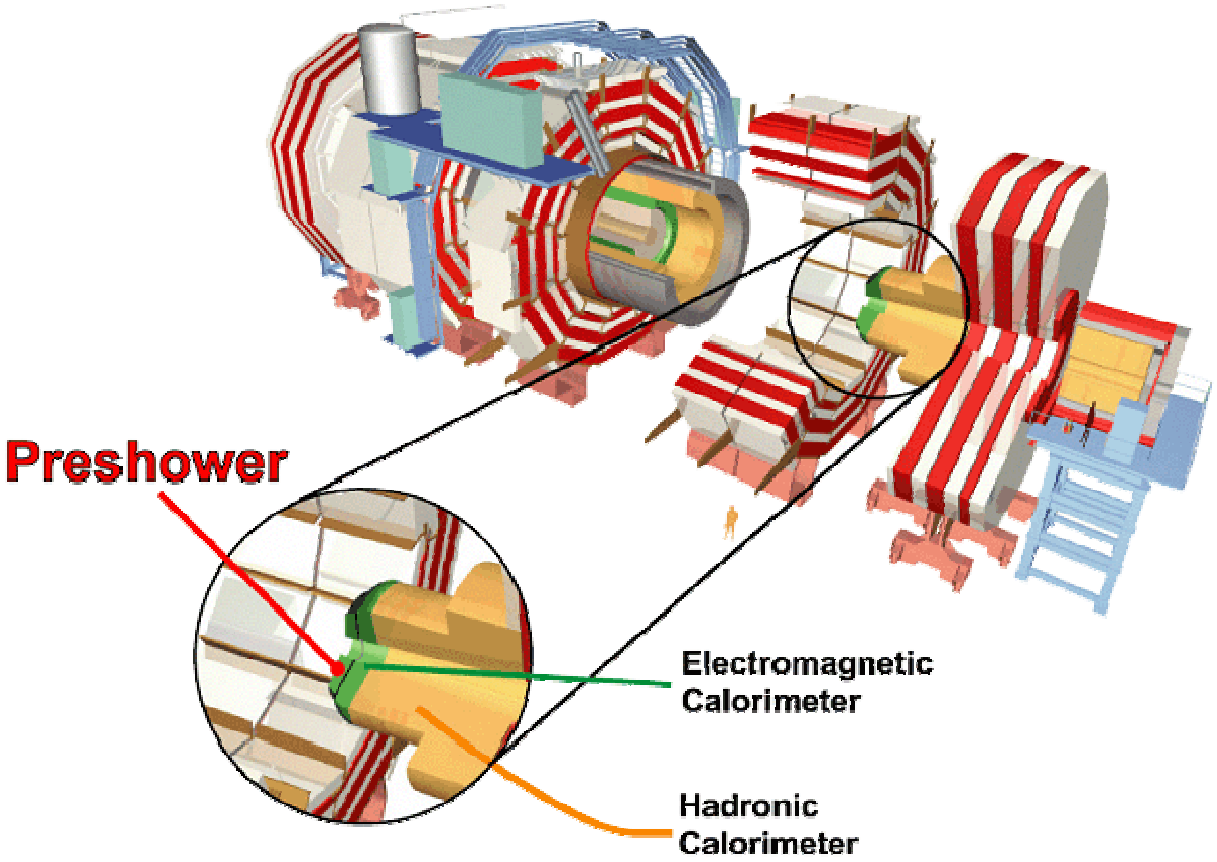
on behalf of CMS ECAL group

Topics

- Location of the CMS Preshower
- Detector assembly & installation
- Commissioning & final sign-off statistics
- Noise & common-mode levels
- B field influence
- Summary

Location of CMS Preshower ("ES")



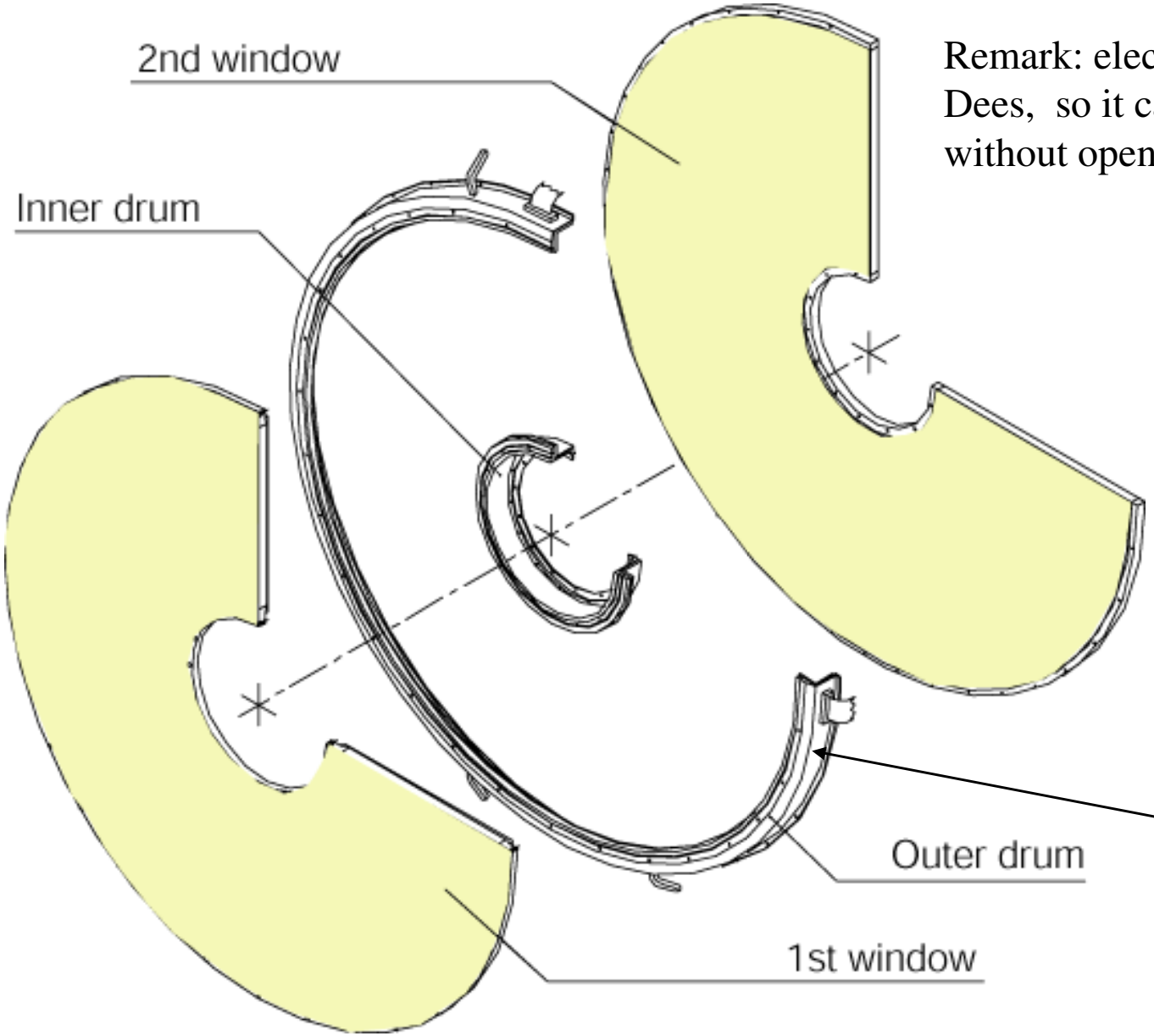
Preshower is part of Electromagnetic Calorimeter
- But is really an independent detector

Only in the endcaps

Slide from D.Barney

see LECC 2005 talk

Preshower disk structure



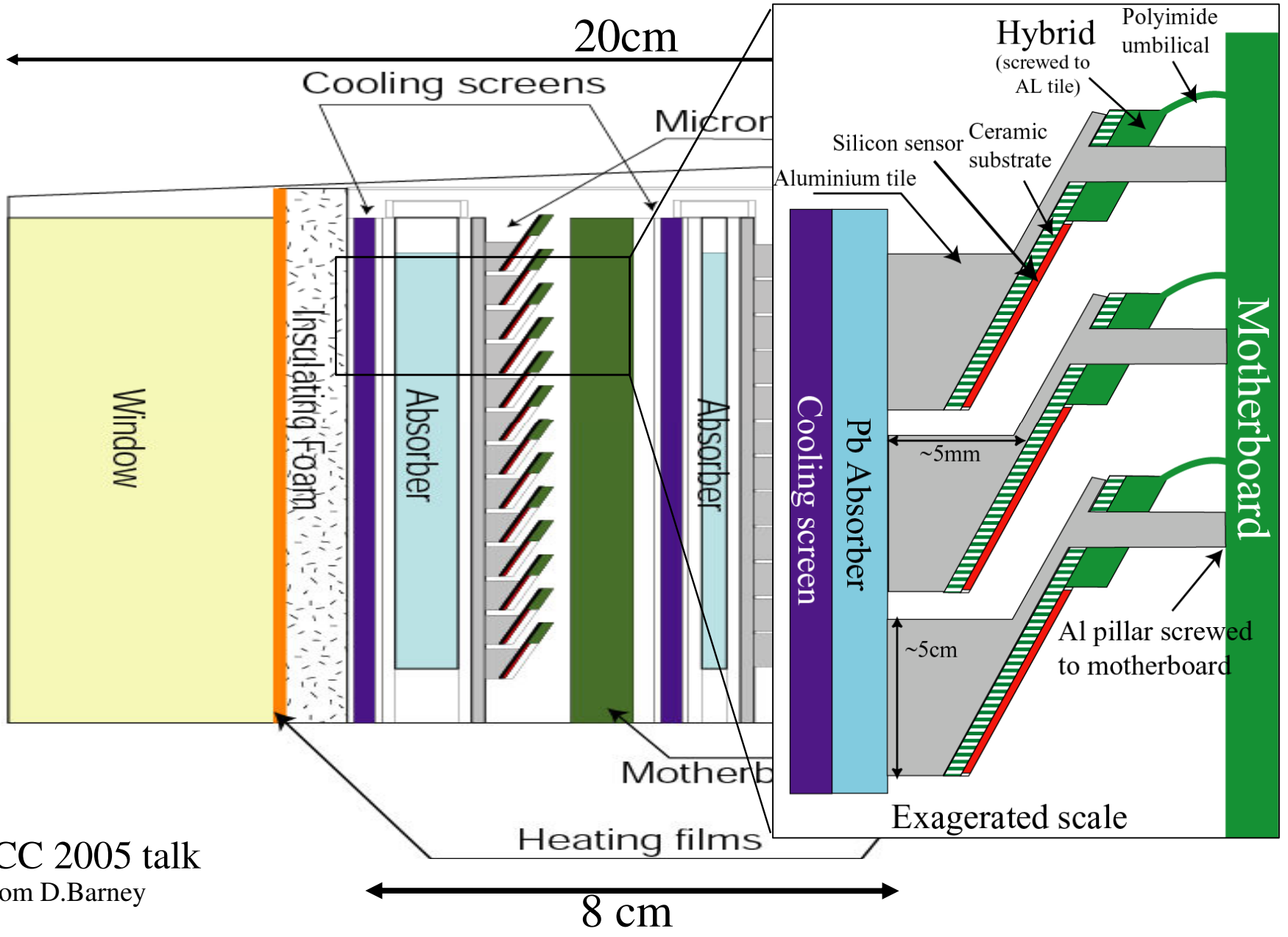
Remark: electronics is divided in two Dees, so it can be mounted, unmounted without opening of beam pipe

feedthrough(s)

see LECC 2005 talk

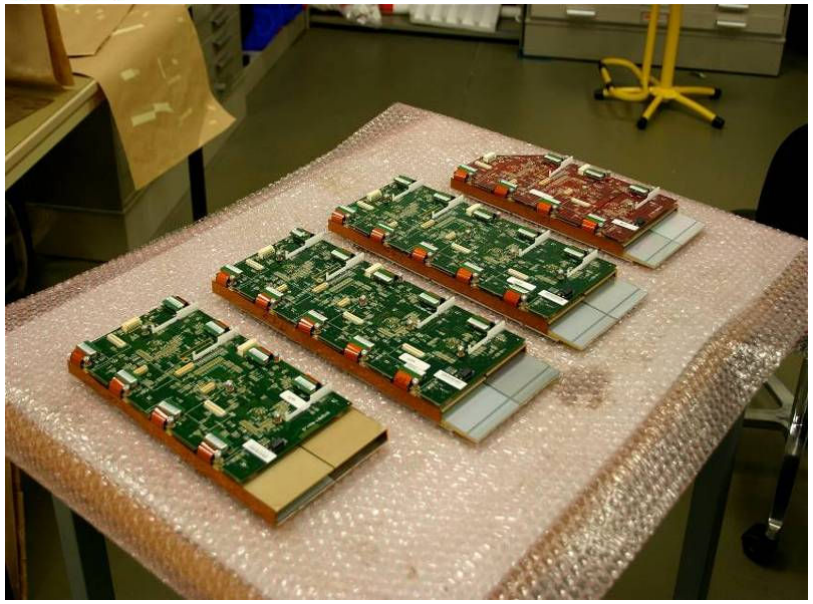
remark: all services/readout/power go through very confined space

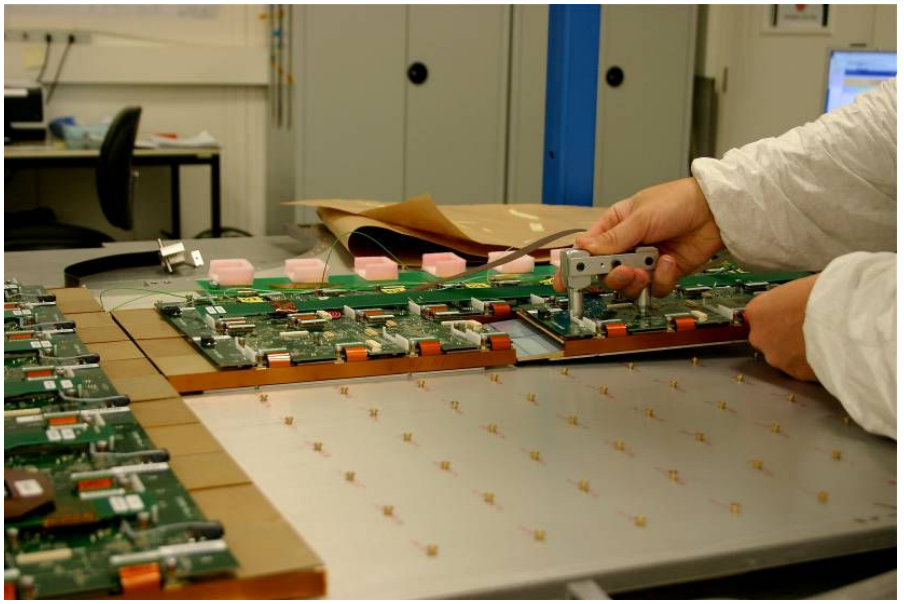
Transverse structure of CMS Preshower

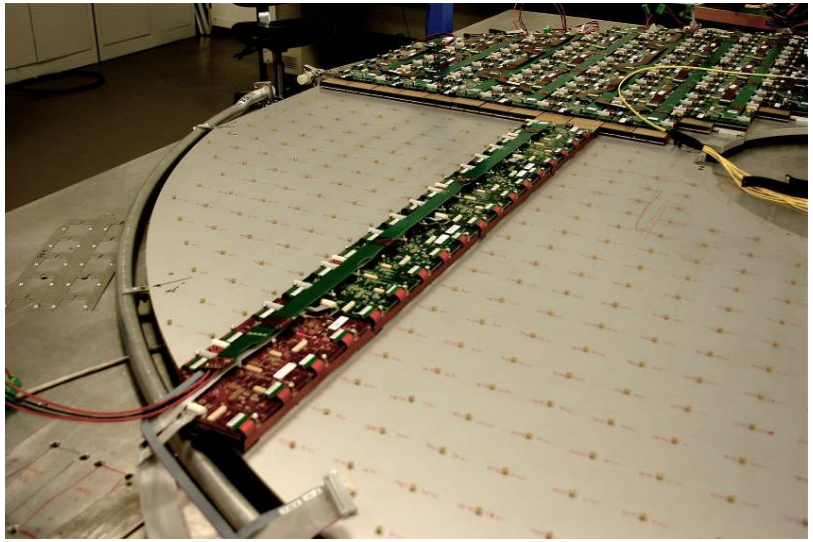


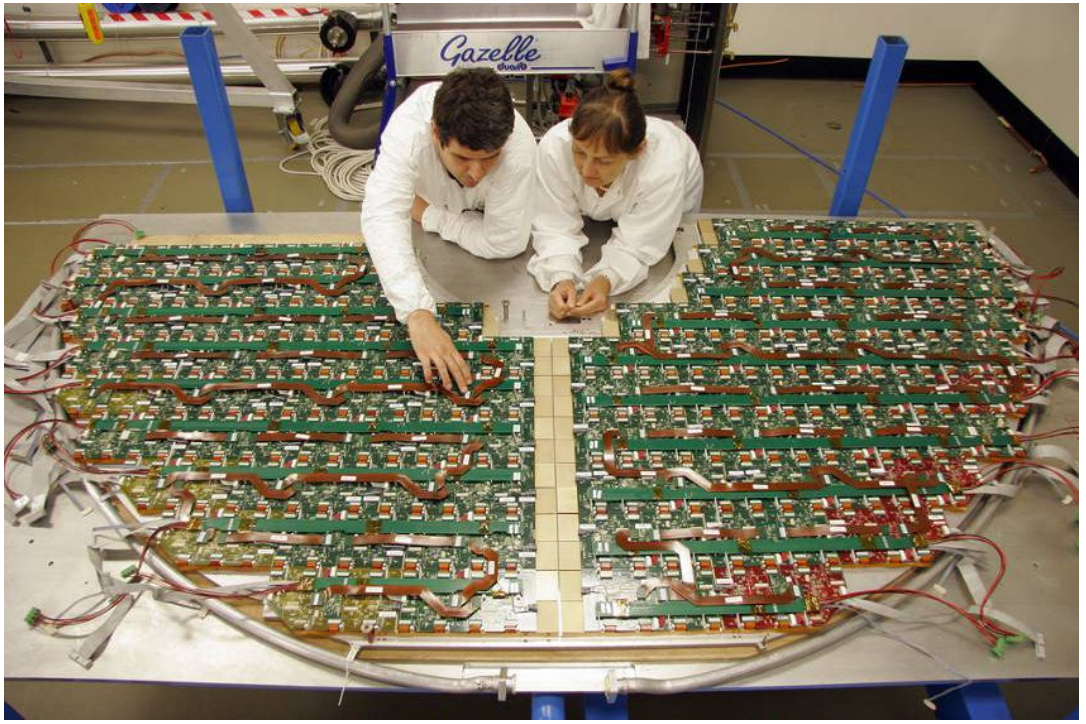
see LECC 2005 talk
Slide from D.Barney

Detector assembly (at CERN)

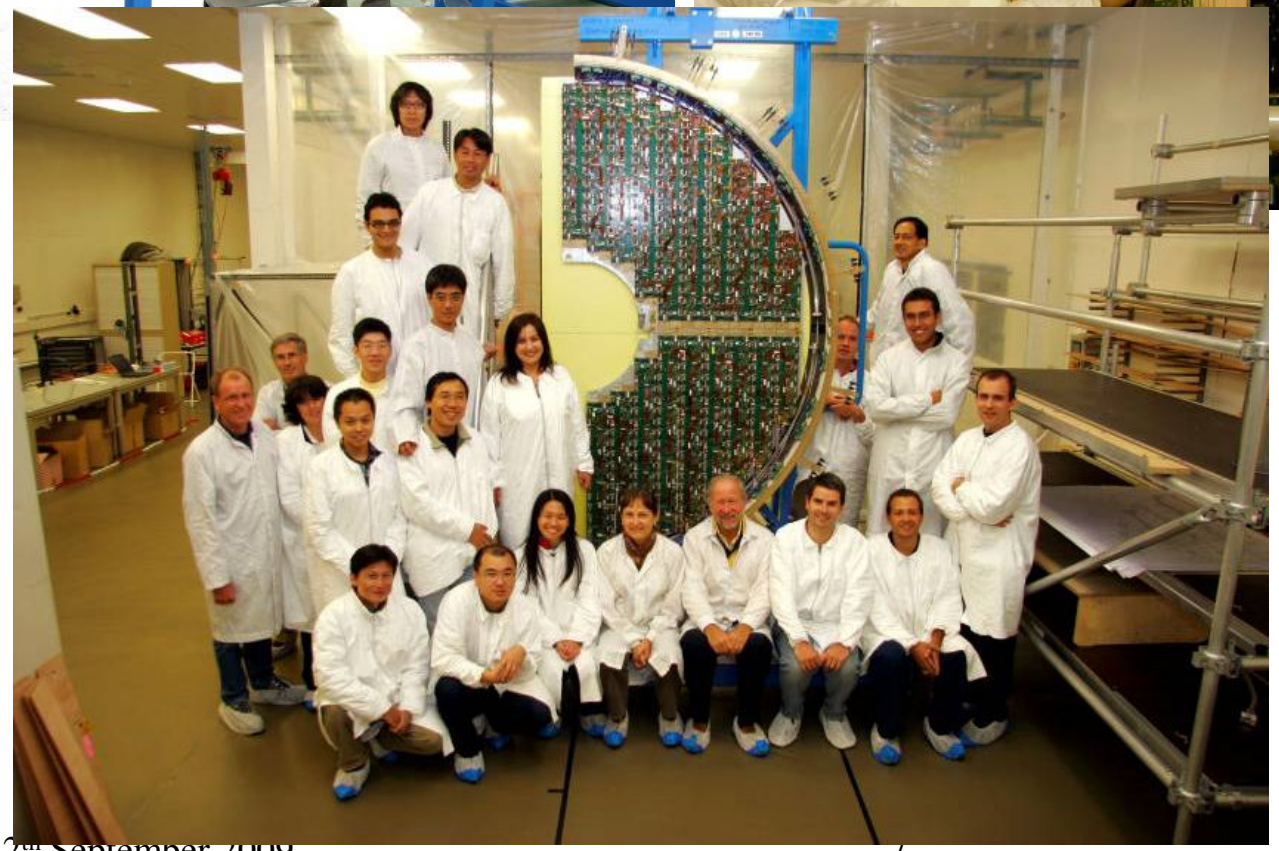








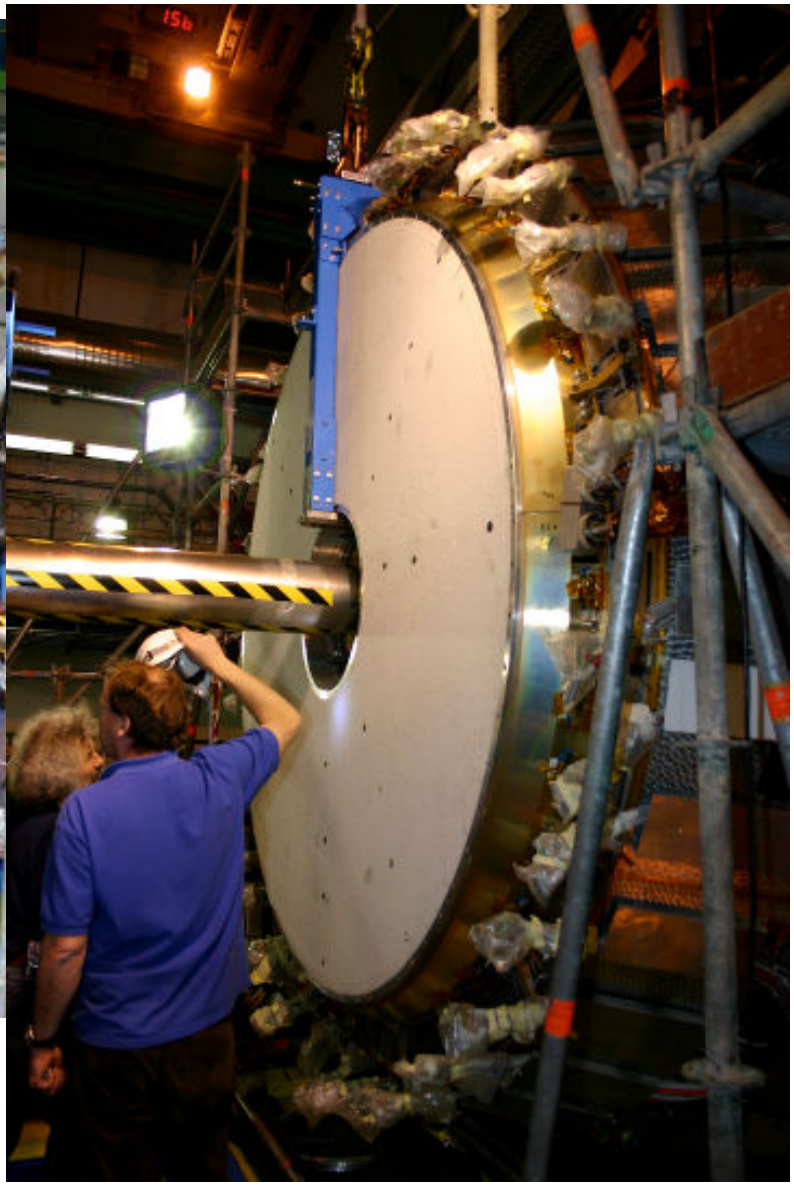
Detector assembly (at CERN)



Transport from CERN (Meyrin) to CMS (Cessy)

Transport in winter:
Protective atmosphere

Installation



Very limited time slot.
Preshower is only CMS detector to be assembled in place

Tight schedule

Mechanical installation:

- ES+: moving Dees to platform: 5/3, ES in final position: 13/3: **7 working days**
- ES-: moving Dees to platform: 19/3, ES in final position: 27/3: **7 working days**

Services connection and testing fibres (reflection):

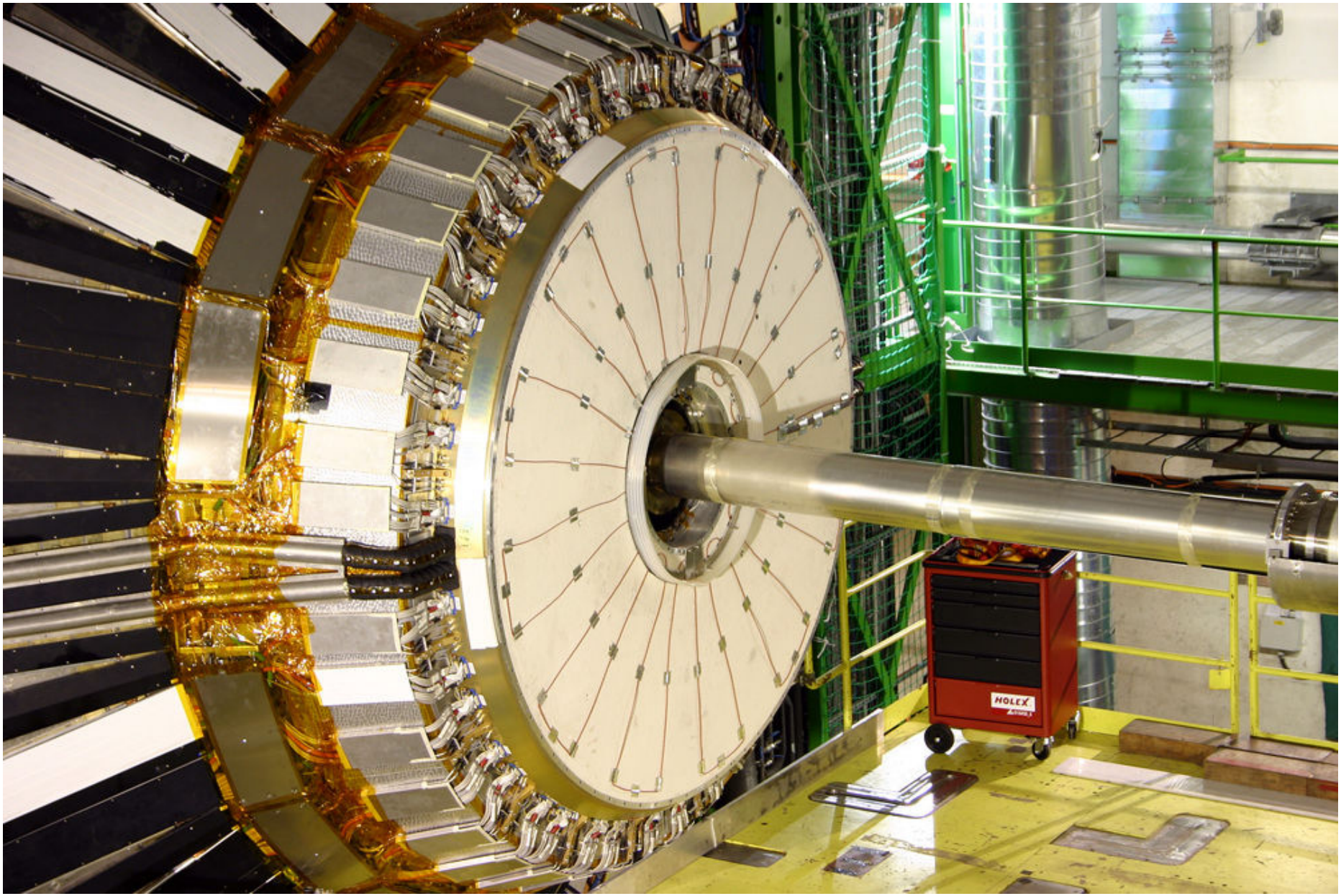
- ES+: 18/3 to 26/3: **9 working days**
- ES-: 19/3 to 3/4: **5 working days**

First commissioning:

- ES+: 26/3 to 6/4: **9 working days**
- ES-: 6/4 to 8/4: **3 working days**

slide from Wolfgang Funk

All ready



Last CMS detector installed

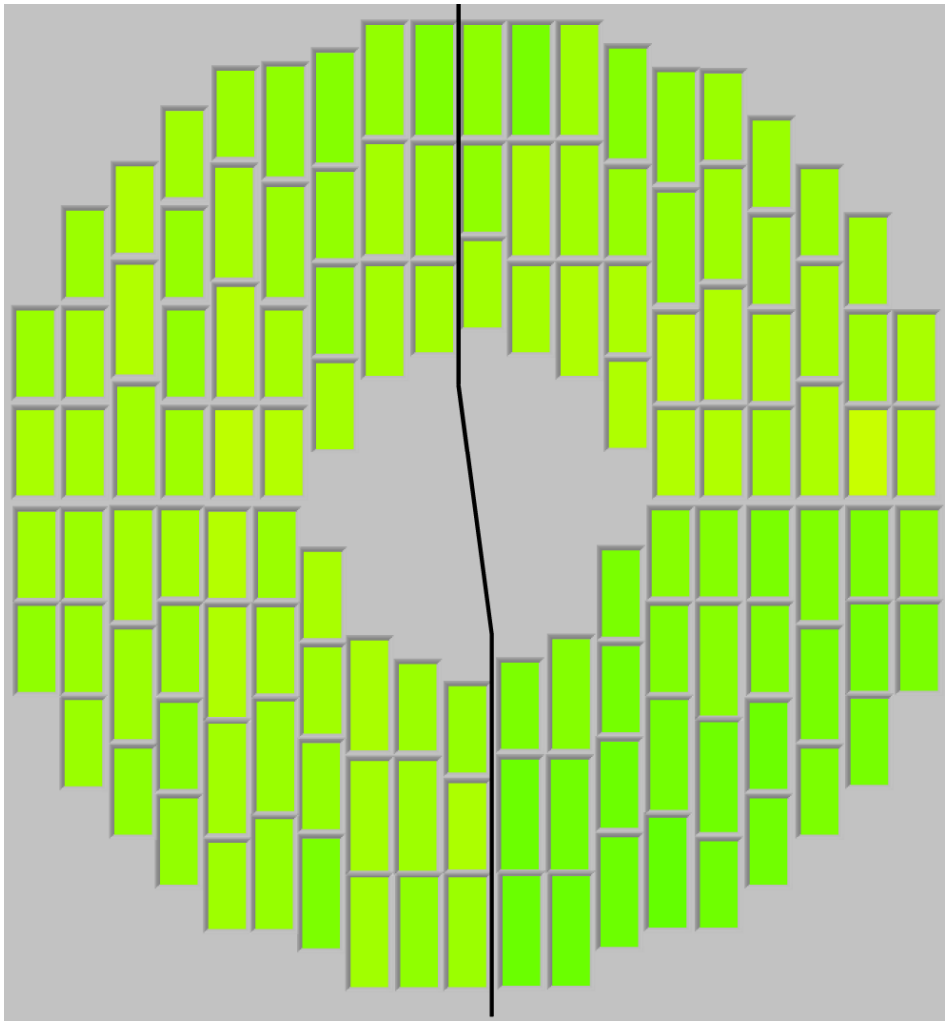
Commissioning – 1st phase, immediately after installation

1. Commissioning of Detector Control System: Temperature- & humidity-monitoring.
2. Commissioning of N_2 system
3. Interlock tests to LV/HV
4. Commissioning of cooling system
5. Commissioning of LV system (sense wires, regulator inhibits)
6. Commissioning of HV system (dark currents)
7. Start local DAQ read-out and problem finding/solving (control-rings, data)
8. Test of channel B token rings.
9. Commissioning of heating and its monitoring (windows, drums, pipes)
10. Final check-out after all mechanical work around Preshower is finished (e.g. w.r.t ECAL-Endcap).

slide from Wolfgang Funk

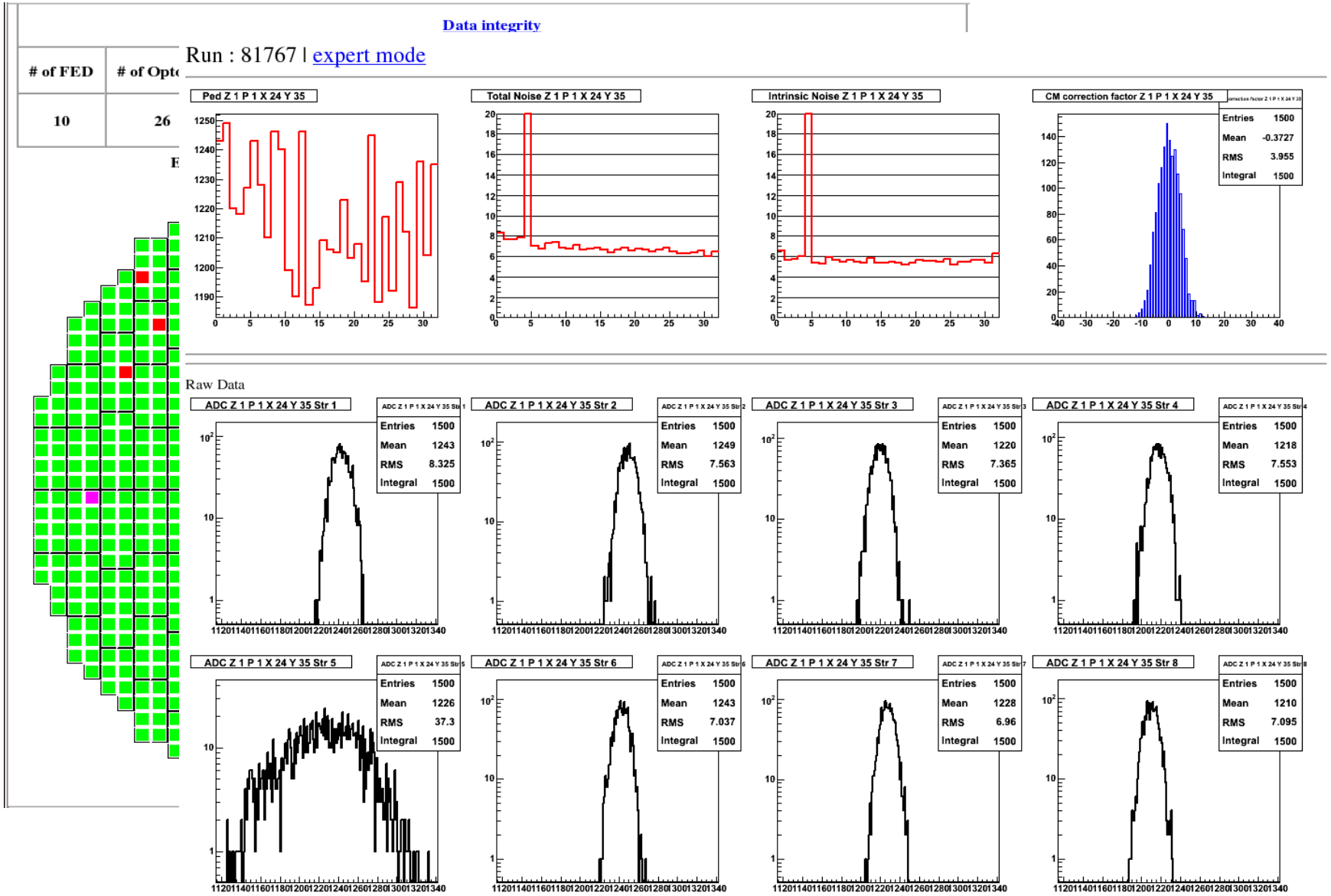
Temperature map

- Readout all DCU's on board for temperature map.
- Plot shows ladder temp after 2 hours power-on
- Temperature low to high : Dark-Green, light green, yellow, orange then red
- Average at 25.9°C with spread of 0.8 °C



slide from Rong-Shyang LU

Commissioning - 2nd phase



Commissioning - summary local DAQ

ES+: Out of 68608 strips, 64 strips are not biased and 66 strips are slightly noisy (RMS > 15 ADC = 2.5 x average noise):

99.81% is working perfectly

ES-: Out of 68608 strips, 1 strip is not connected to PACE (already like this in assembly) and 33 are slightly noisy (RMS > 15 ADC):

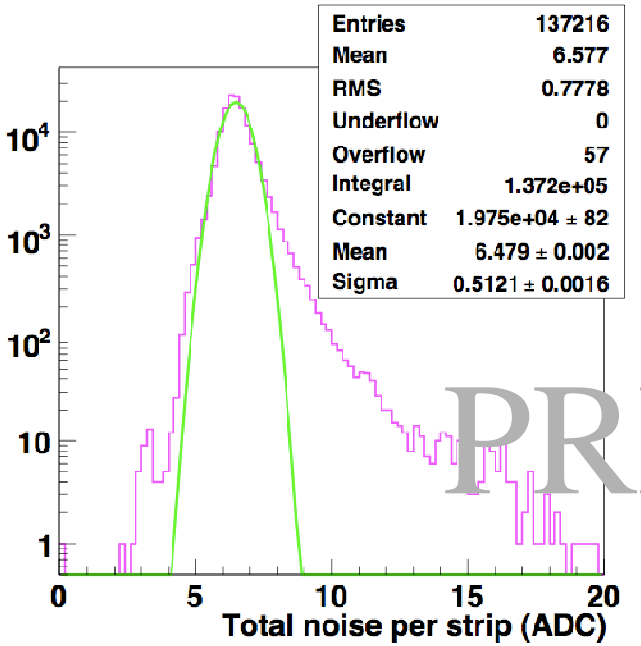
99.95% is working perfectly

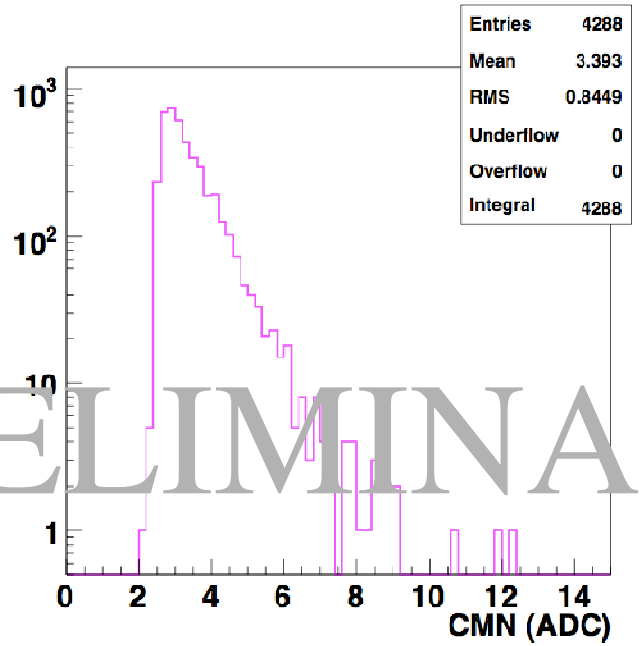
Combined: 99.88% is working perfectly!

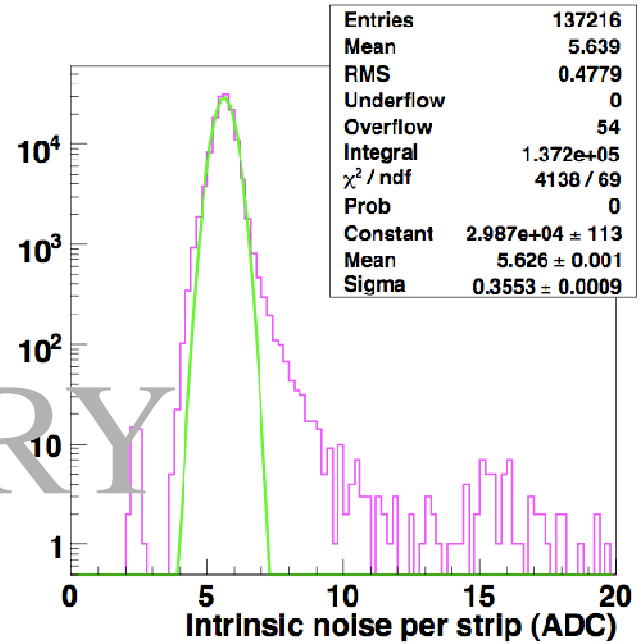
1. Most of the front-ends are in the same good state as during assembly phase
2. One pair of the sensors can't be biased, perhaps due to short circuit between sensor and ground or HV channel connectivity failure

Noise level in high gain mode (HG)

Preshower operates in high gain mode for in-situ calibration with minimum-ionizing particles (MIPs)
The total noise is around 6.6 ADC counts (intrinsic noise ~5.6 ADC counts)
The MIP value is around 50 ADC counts in this mode

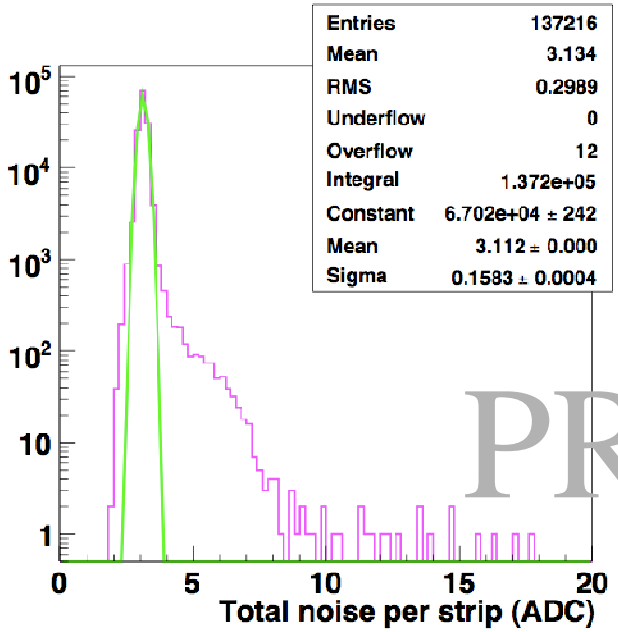


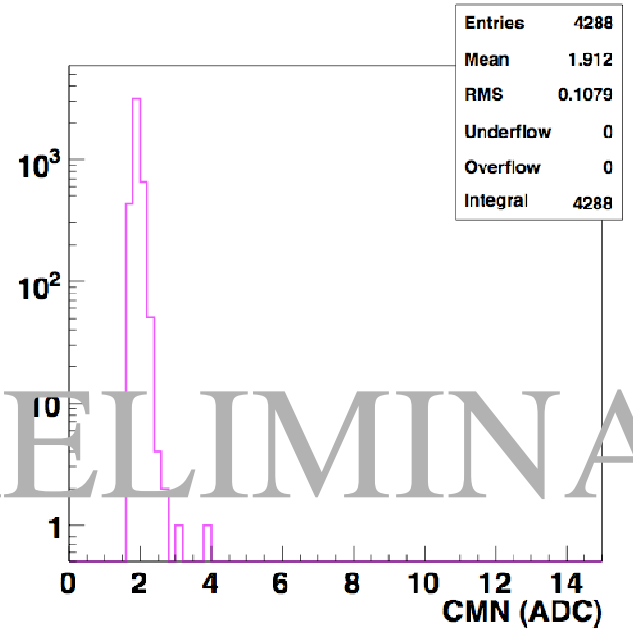


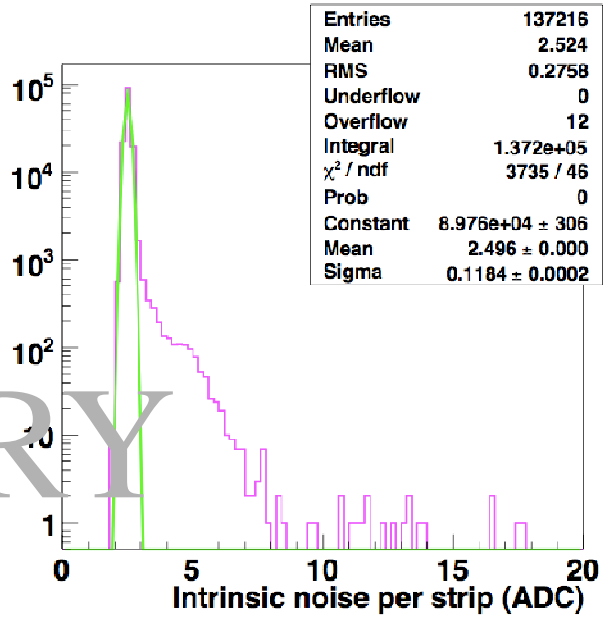


Noise levels in low gain mode (LG)

Preshower operates in high gain for normal CMS physics data taking
The total noise is around 3.1 ADC, while intrinsic noise around 2.5 ADC
The MIP value is around 9 ADC in this mode

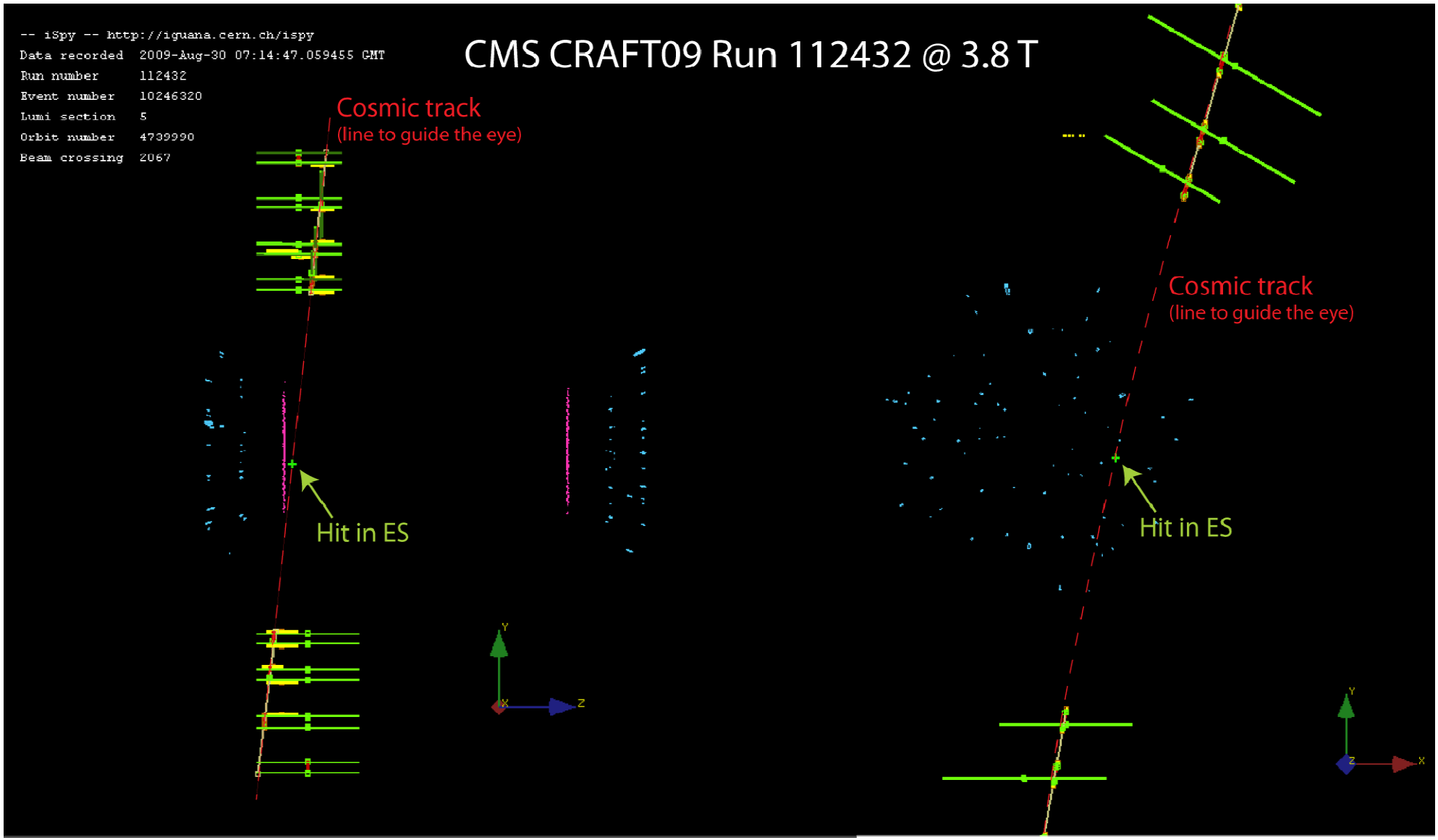






Preshower recorded cosmic particles (Aug. 09)

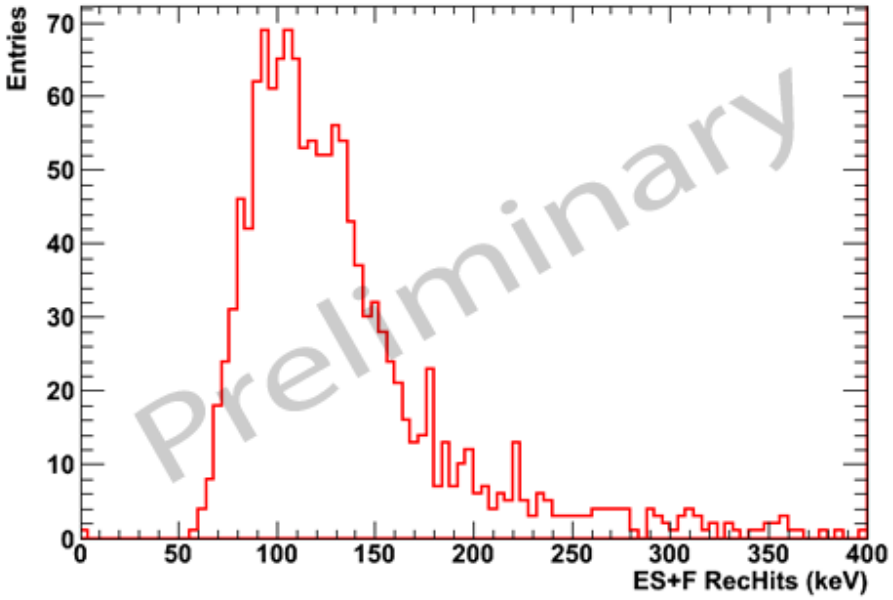
One cosmic trigger event

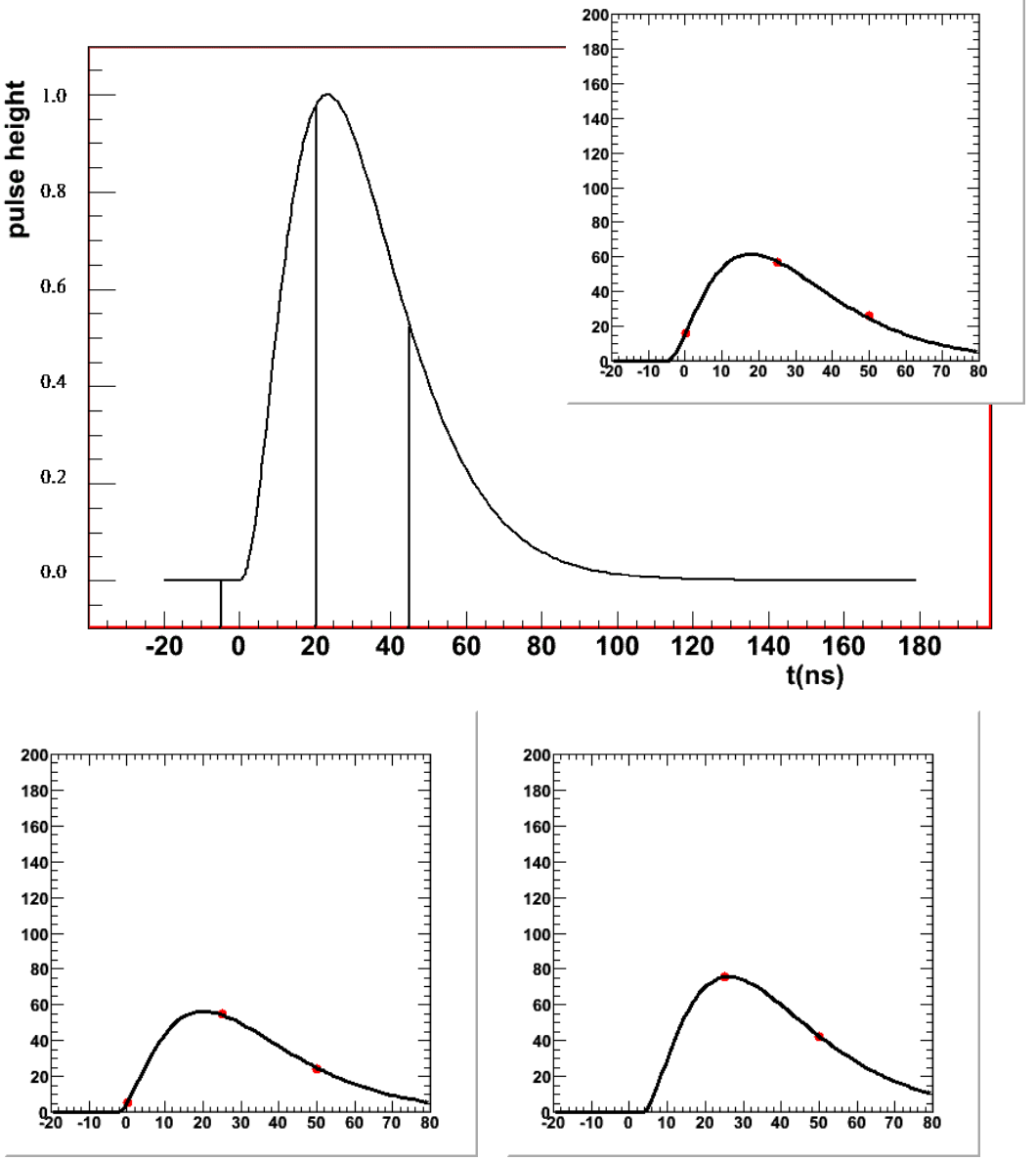


Energy deposit of MIP in the detector

Cosmic particles come asyncronously to machine clock i.e. in 25 ns window

1. Use thoeretical pulse shape to fit 3 samples per event
2. Extract and histogram peak value



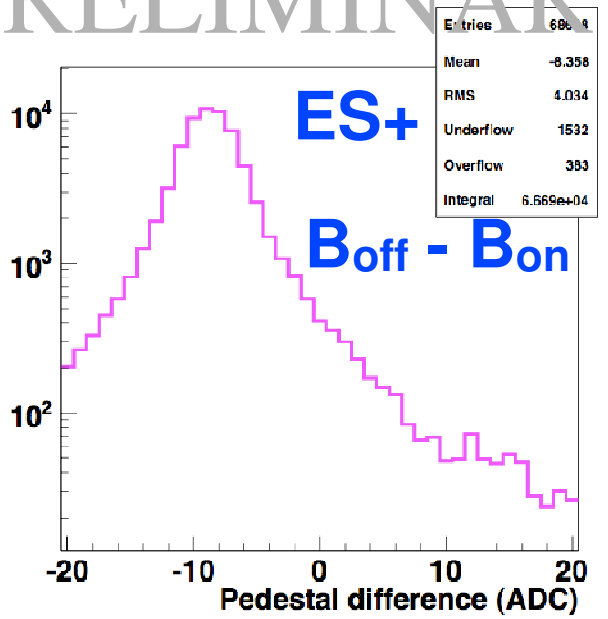


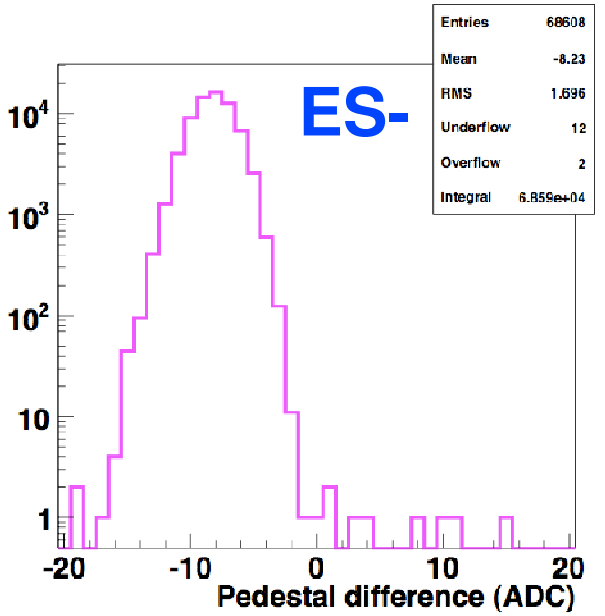
Preshower Si active sensor depth is around 320 um

B field infuence

PRELIMINARY

- Apart from a short-circuited sensor, we have masked 68 channels when B=0 and 126 channels when B=3.8T. (ES has total of 137,216 channels)
- A channel is masked in HG if total-noise > 15 ADC. (1 MIP ~ 50 ADC)
- We have also observed pedestal change with B-on. Therefore, we will need to maintain 2 set of pedestals values.

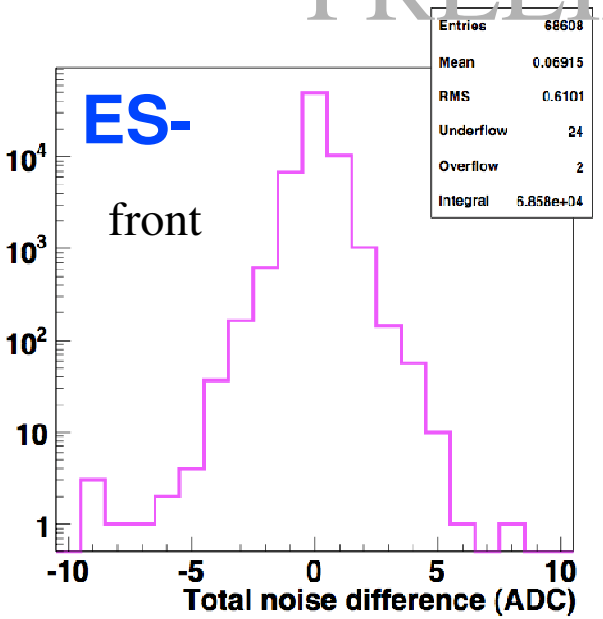


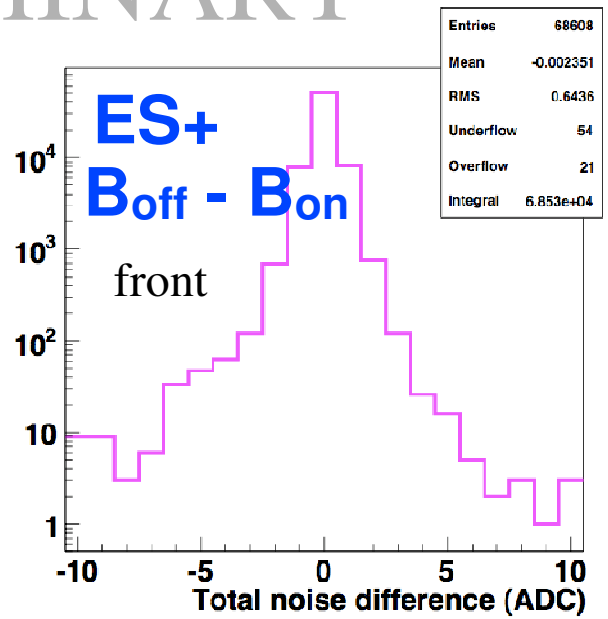


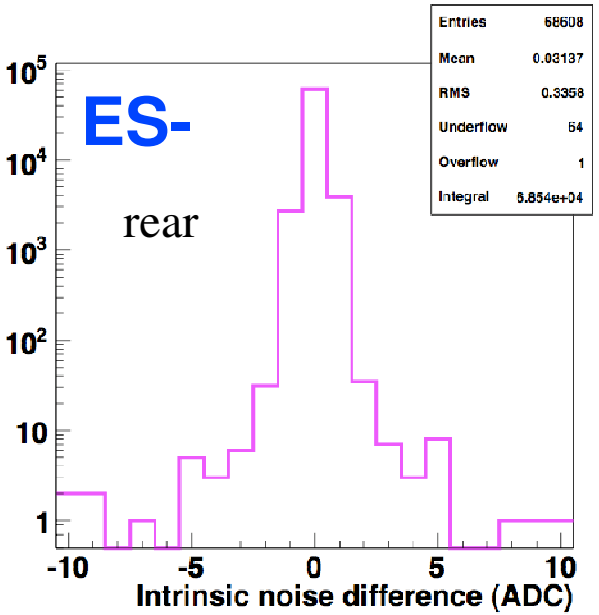
slide from Rong-Shyang LU

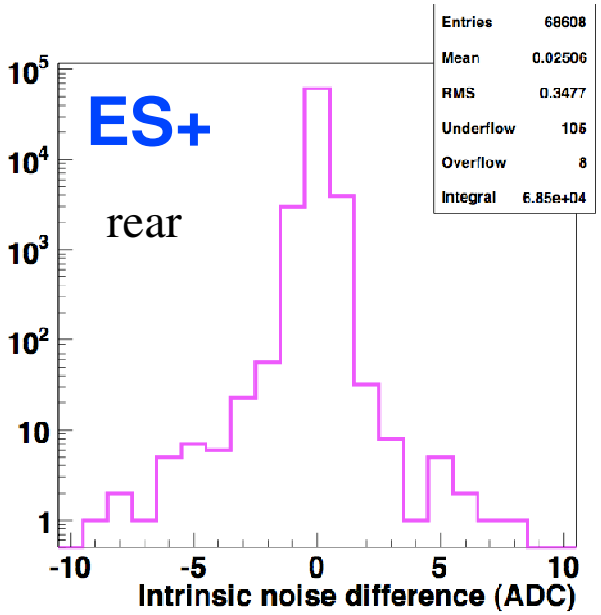
B field influence – no change of noise

PRELIMINARY









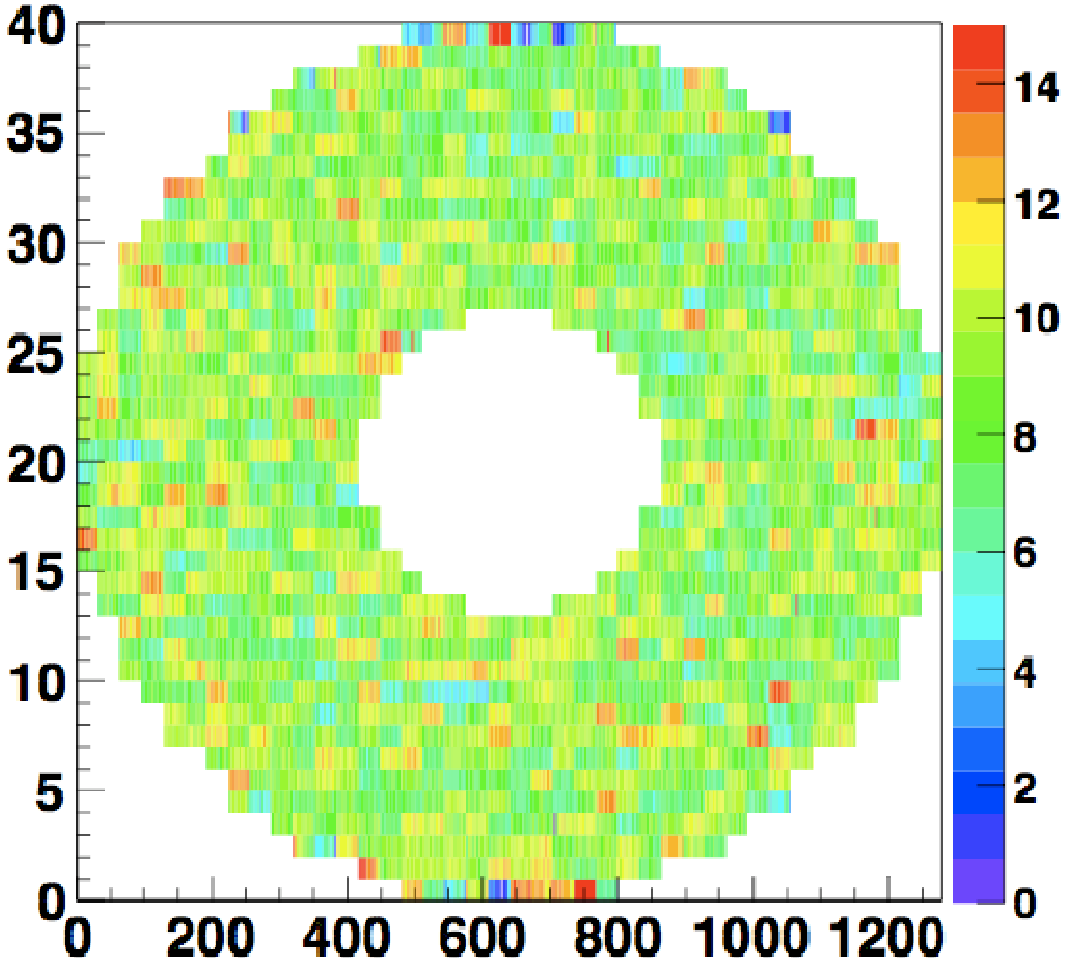
Summary

- CMS Preshower detector successfully installed and commissioned
- Measurement results shows performance as expected, fulfilling specification requirements
- Detector is ready for LHC re-start
- More studies are need for :
- B field influence, long term stability, calibration and optimalisation of front-end parameters, timing-in with particles from LHC

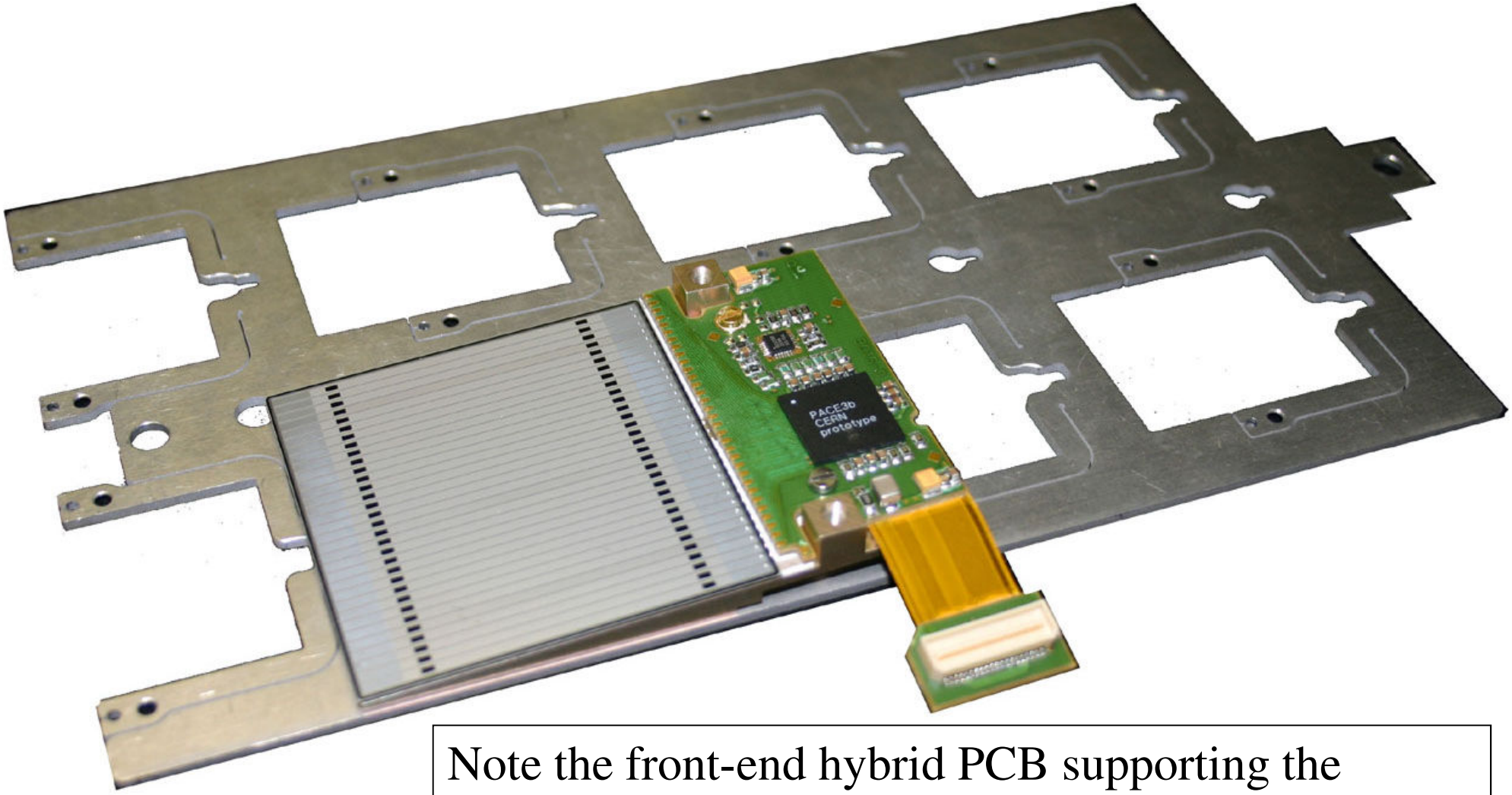
Backup slides

B field influence

- Pedestal change shown in geometry of ES+ endcap.

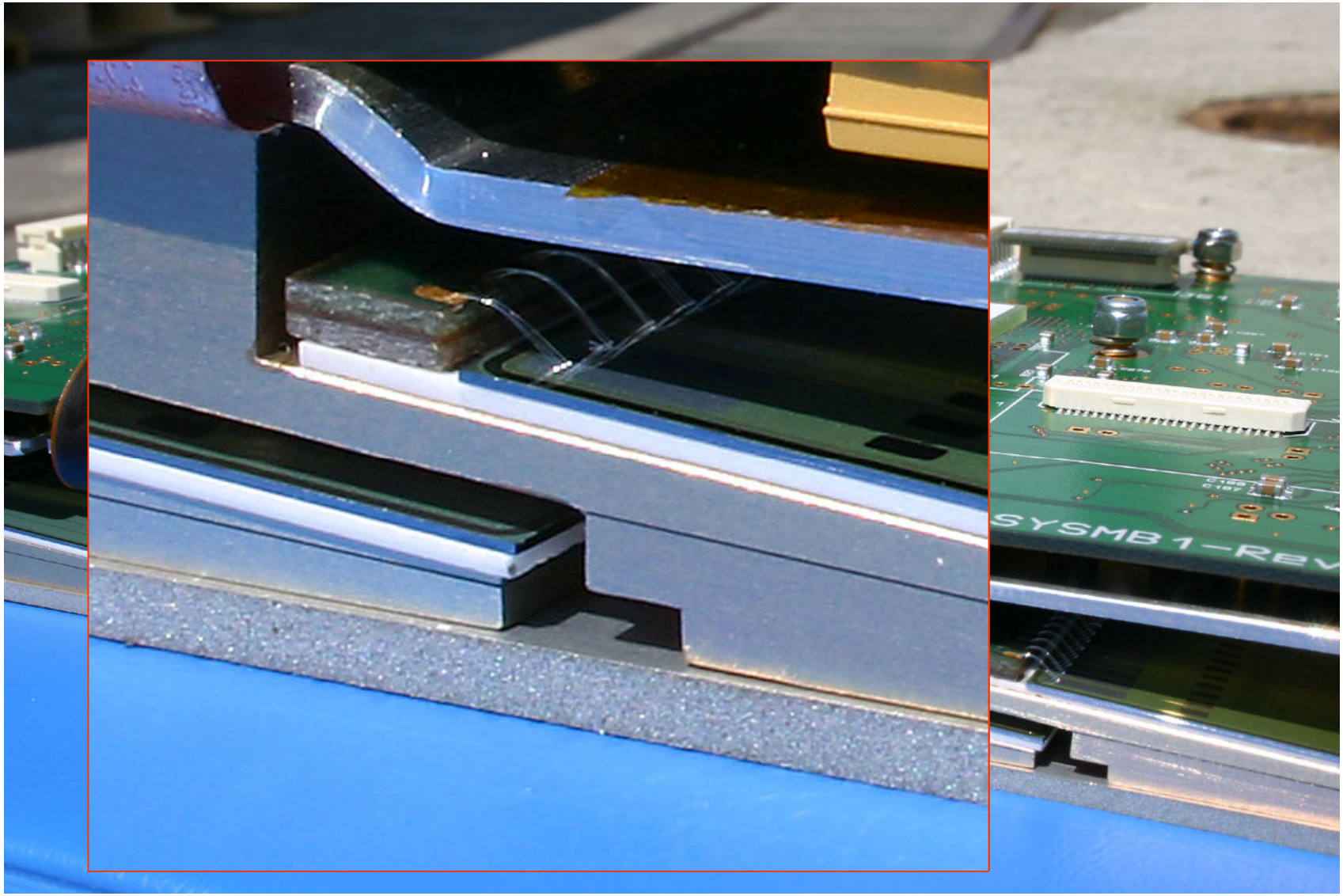


one micro-module on baseplate

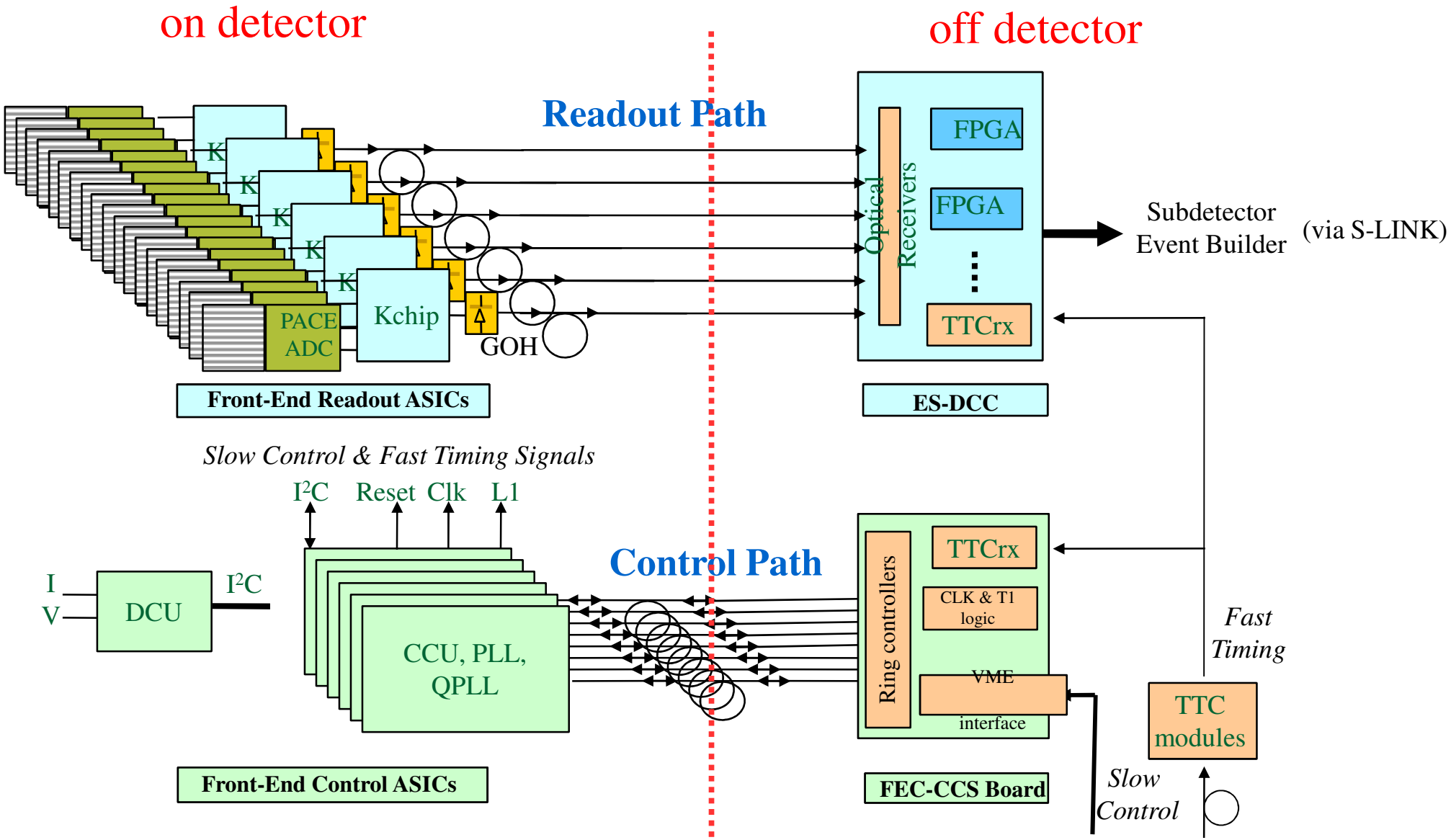


Note the front-end hybrid PCB supporting the PACE3, a DCUF for PACE3 calibration purposes and an embedded polyimide cable containing all connectivity (analogue, digital, powering)

cross-section



Readout and Control Architecture



slide from K.Kloukinas

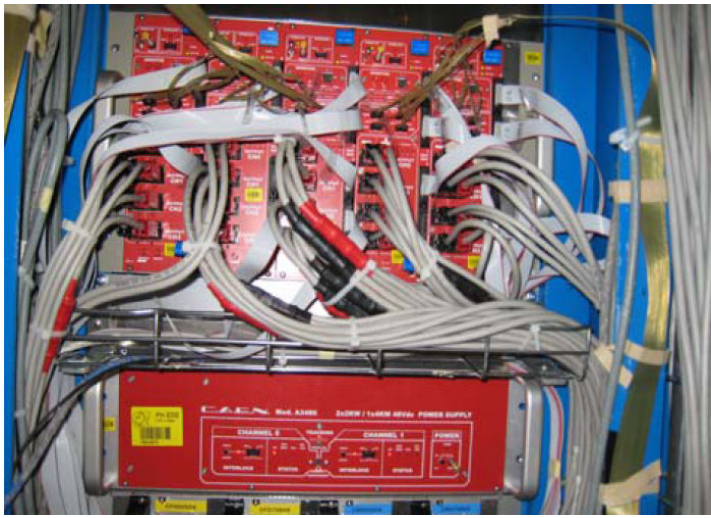
re-use as much of others development as possible

Readout/Control

- Readout/Control (on detector)
  - 4288 micromodules
  - 502 system motherboards (4 types)
- Readout (off detector)
  - 1208 optical fibres @ 800Mbit/s
  - 40 ES Data Concentrator Cards
- Control (off detector)
  - 16 FEC-CCS cards (populated with 3x FEC-mezzanine)
  - 48 control rings (384 control optical fibers)
- TTC (timing, trigger and control)
  - 1 LTC card + 2 TTCci cards + 1 TTCex (inside ECAL TTC crate)

Low voltage system

- Power supplies based on CAEN EASY system
- Separate power distribution for analog and digital parts, 50 pieces of A1025 per Dee, ie 200 in total
- Straight (no twisted), no shielded cables in cable trays
- Voltage sensing up to feedthroughs (cables twisted)
- Separate inhibit lines for analog and digital part ST voltage regulators for all motherboards



- No low imp. DC paths to Preshower vessel, all board connected to protective earth via 470 ohm resistor (starpoint)
- One Control Ring motherboards share common DGND at feedthrough level to minimize CM between motherboards, that may cause control ring to malfunction