

# CALICE Collaboration

## Test Beam Status and Plans



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(with much help from Felix Sefkow et al. !)

Vancouver ALCPG, July 2006

# Overview

- Motivation and technologies
- First Electromagnetic Calorimeter results  
(from DESY)
- AHCAL: Hadronic  $1\text{m}^3$  Calorimeter preparation
- CERN Test Beam Area
- Installation and test preparation
- The first week's news !
- CERN schedule/modules/goals
- Fermilab Test Beam program

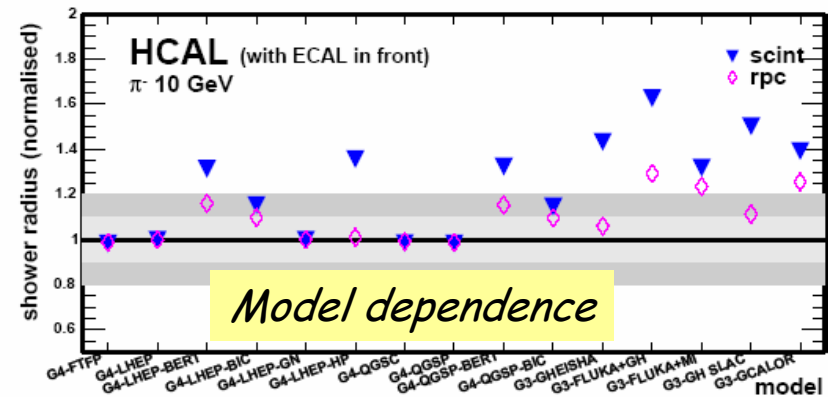
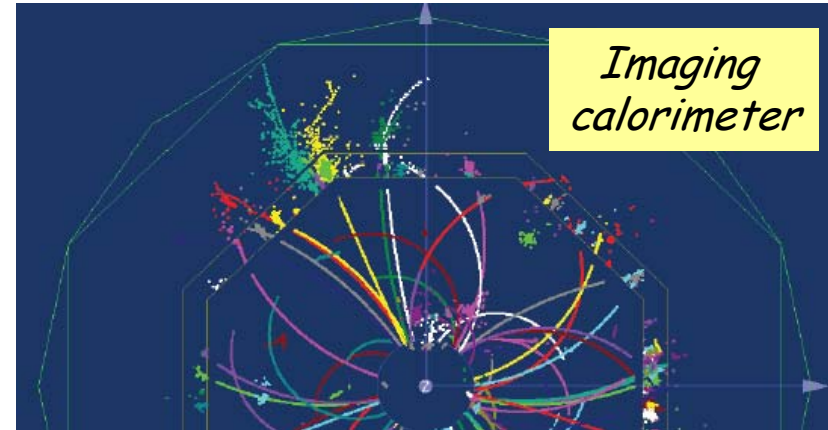


# Testbeam start-up at CERN

Felix Sefkow  
July 14, 2006

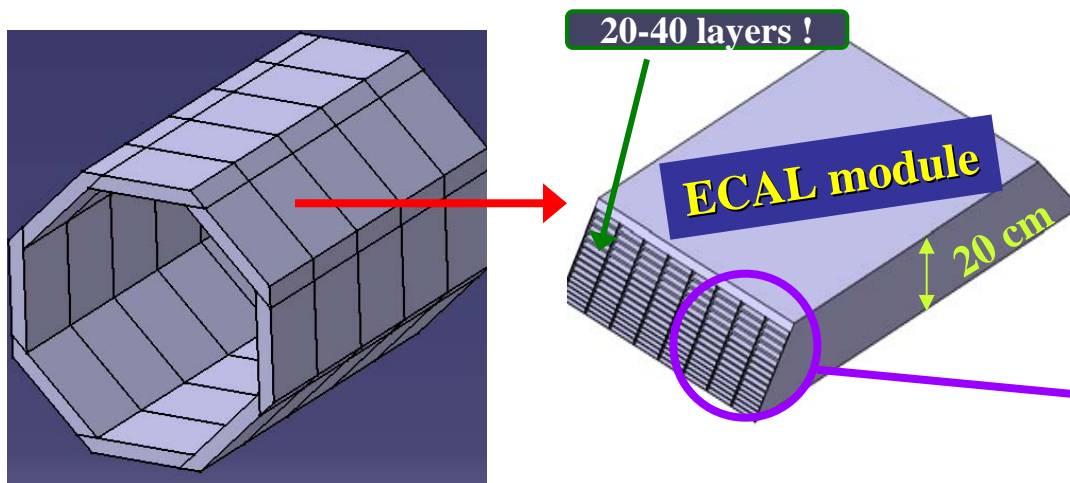
# Testbeam programme

- Calorimetry at the ILC
  - Need 2x better resolution
  - High granularity for individual particle reconstruction
- Physics:
  - Structure of hadron showers
  - Validation of simulation
  - Development of particle flow algorithms
- Technology
  - Establish compact SiW technology
  - gain large scale, long-term experience with a SiPM / RPC / GEM readout detector
- Running at CERN and FNAL from July 2006 on



# CALICE ECAL

- 130T of tungsten
- An octagonal geometry
- A high level of density  
(20-40 layers, 24X0 in ~170mm)



- No large area of dead zone
- All modules are identical (Tungsten wrapped by Cfi)
- The detector slabs would be tested before assembling

## CALICE - ECAL



Ewha Univ., Sungyunkwan Univ.,  
Kangnung NU, Yonsei Univ.



LAL, LLR, LPC-Ct, LPSC, PICM



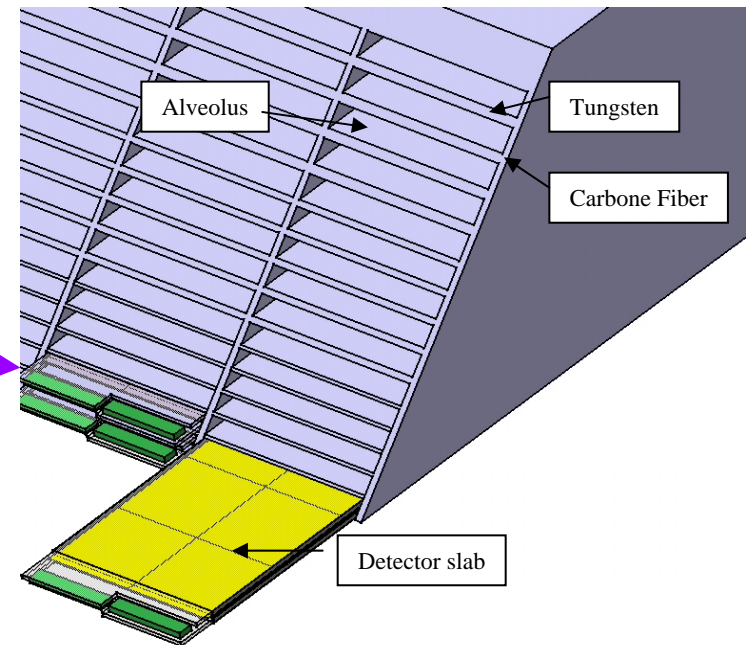
ITEP, IHEP, MSU



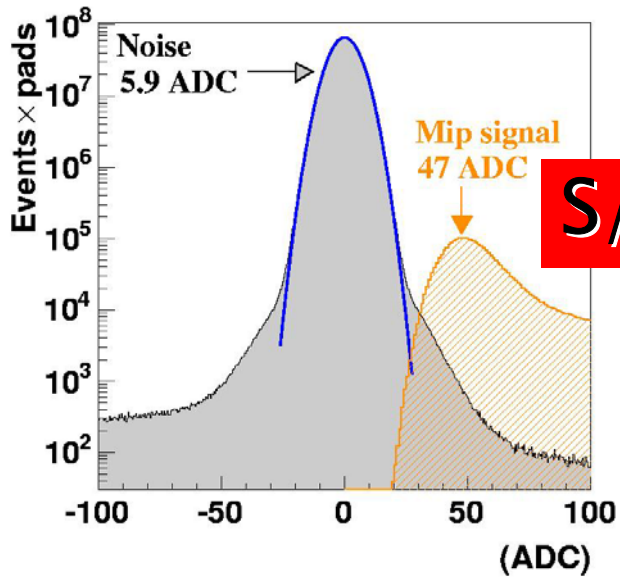
Prague (IP-ascr)



Imp. Coll, UCL, Cambridge  
Birmingham, Manchester, RAL,  
RHUL

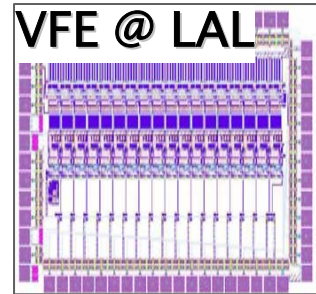
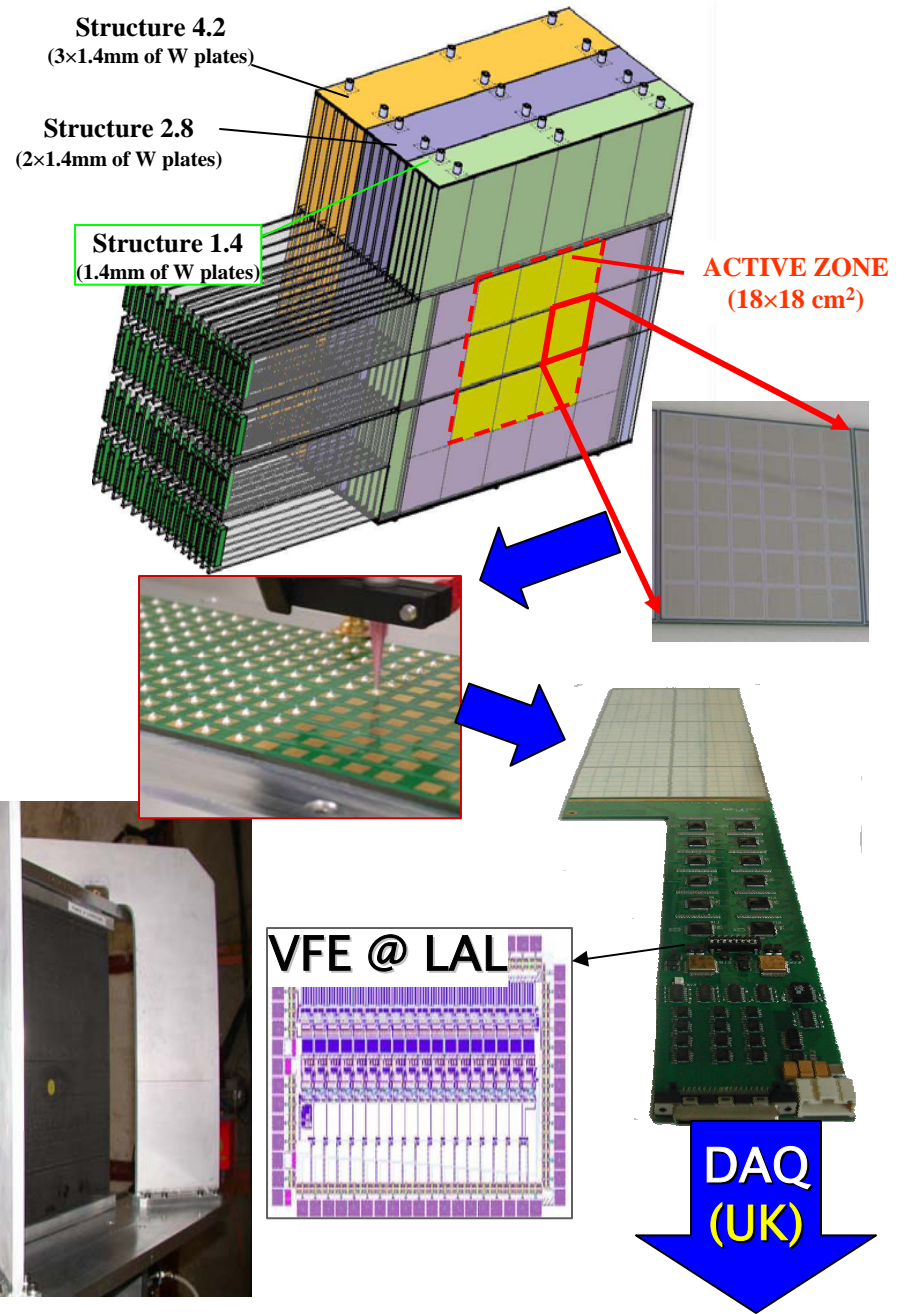


# The ECAL prototype



**S/N ~ 8 !!**

**9720 channels in 18 cm<sup>3</sup>  
for this prototype**

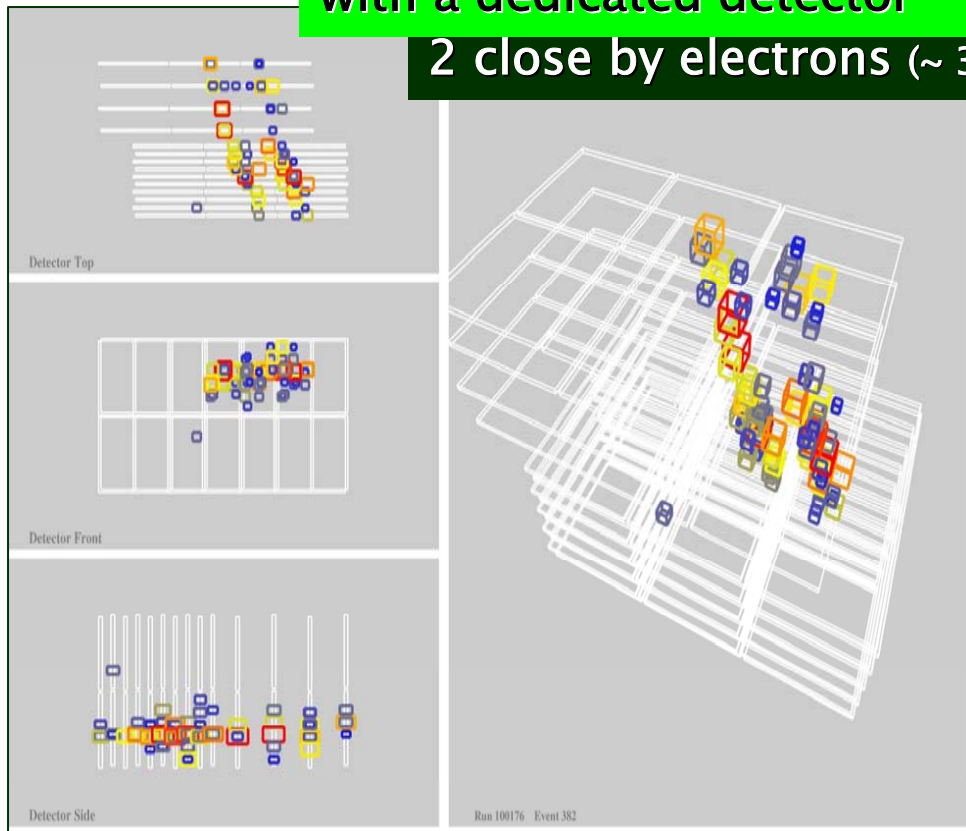


**DAQ  
(UK)**

# ECAL: first testbeam results

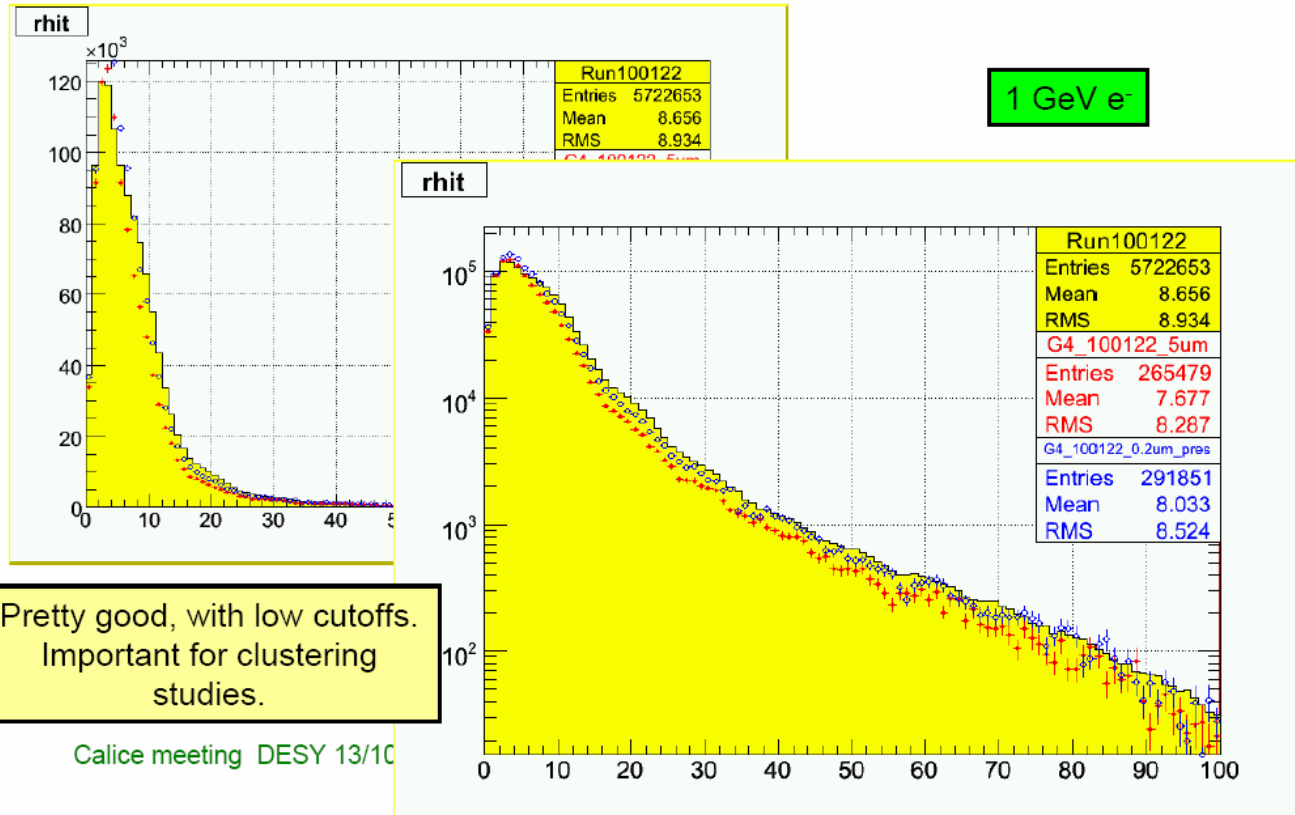
First real test versus  
the « Particle Flow » method  
with a dedicated detector

2 close by electrons ( $\sim 3\text{cm}$ )



# ECAL: first testbeam results

Transverse profile (w.r.t. barycentre)

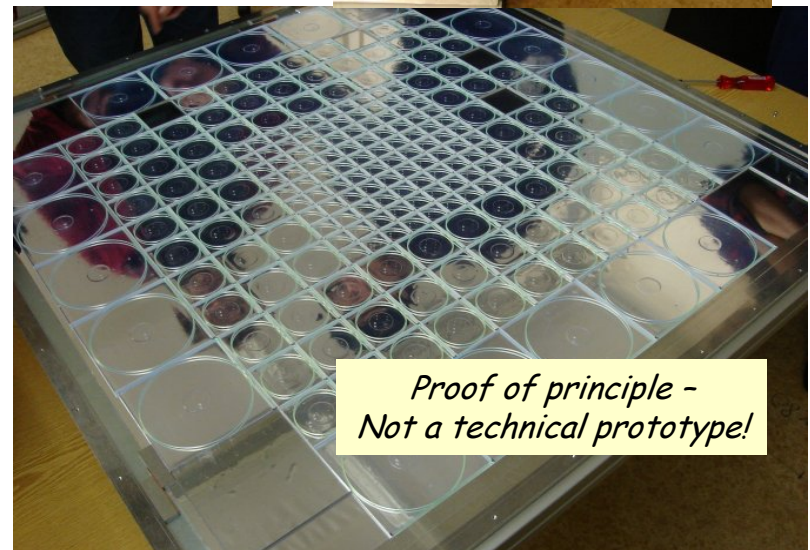
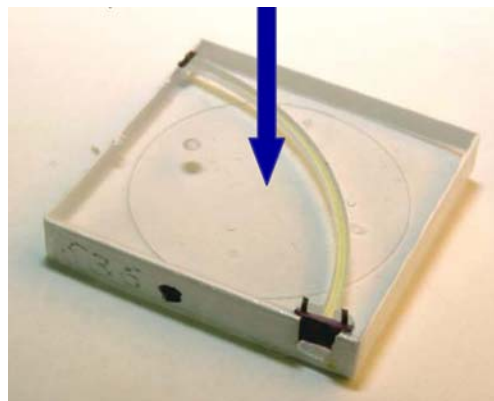
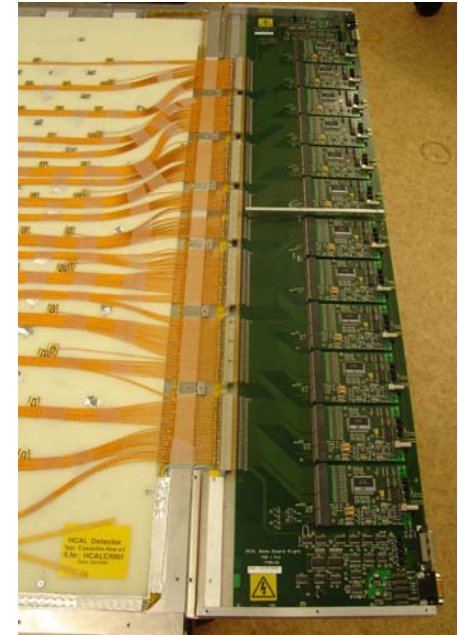




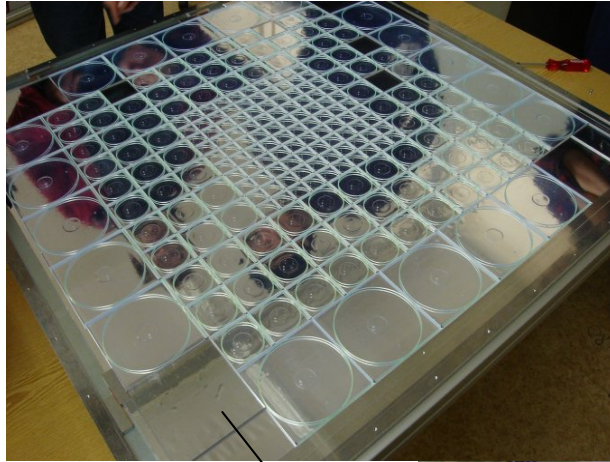
# CALICE HCAL testbeam prototype

Calorimeter for ILC

- Scintillator HCAL construction at DESY
  - Mechanics
    - 1 cubic meter stack, cassettes, calibration light system
    - Assembly (with colleagues from ITEP, LPI, MEPHI)
  - FE electronics
    - With ASICs from LAL
  - Integration
    - 8000 Scintillator tiles and SiPMs (ITEP and MEPHI)
    - Calibration electronics (Prague)
    - DAQ (UK groups)
    - Tail catcher (Northern Illinois)



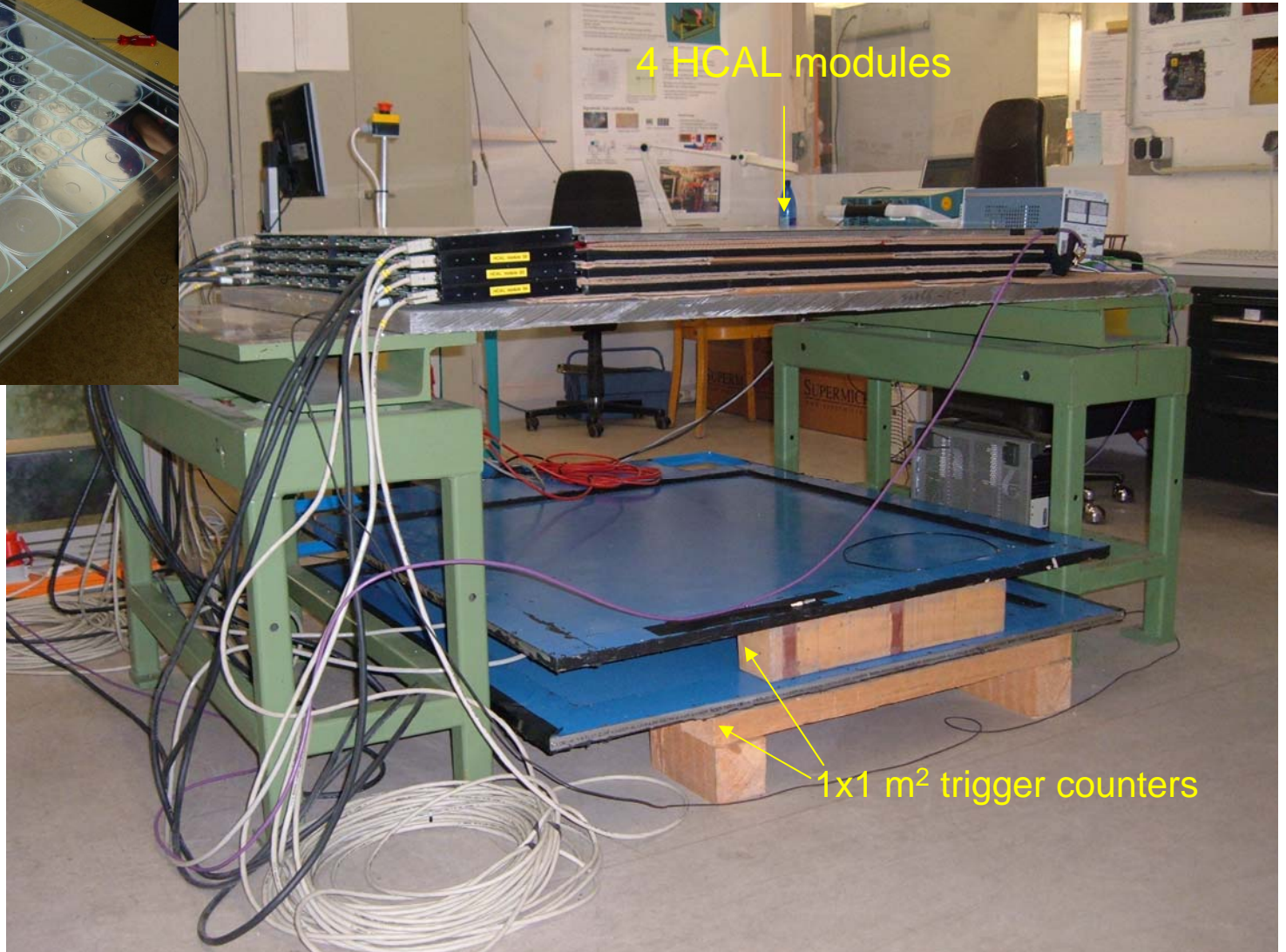
# Commissioning at DESY



Cosmics set up

1x1 m<sup>2</sup> trigger plates  
in coincidence

requires >3 modules  
for telescopic cuts  
analysis



4 HCAL modules

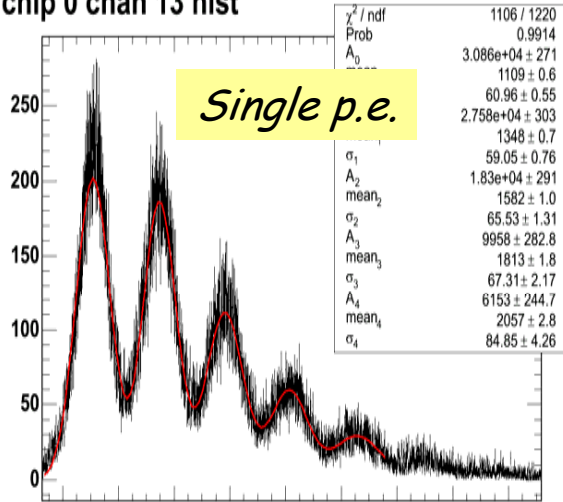
1x1 m<sup>2</sup> trigger counters

# Commissioning at DESY

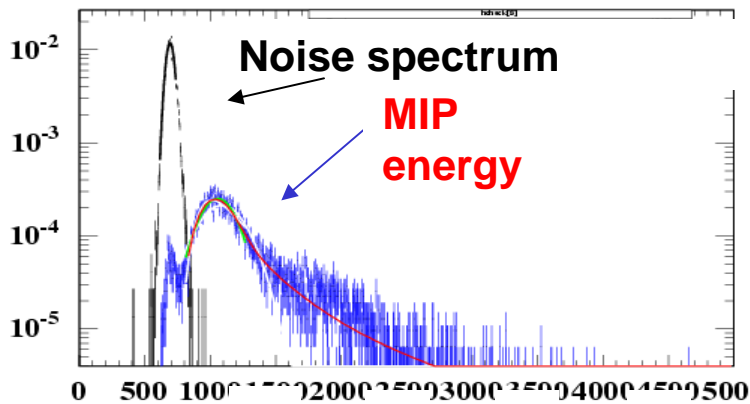


# HCAL test results

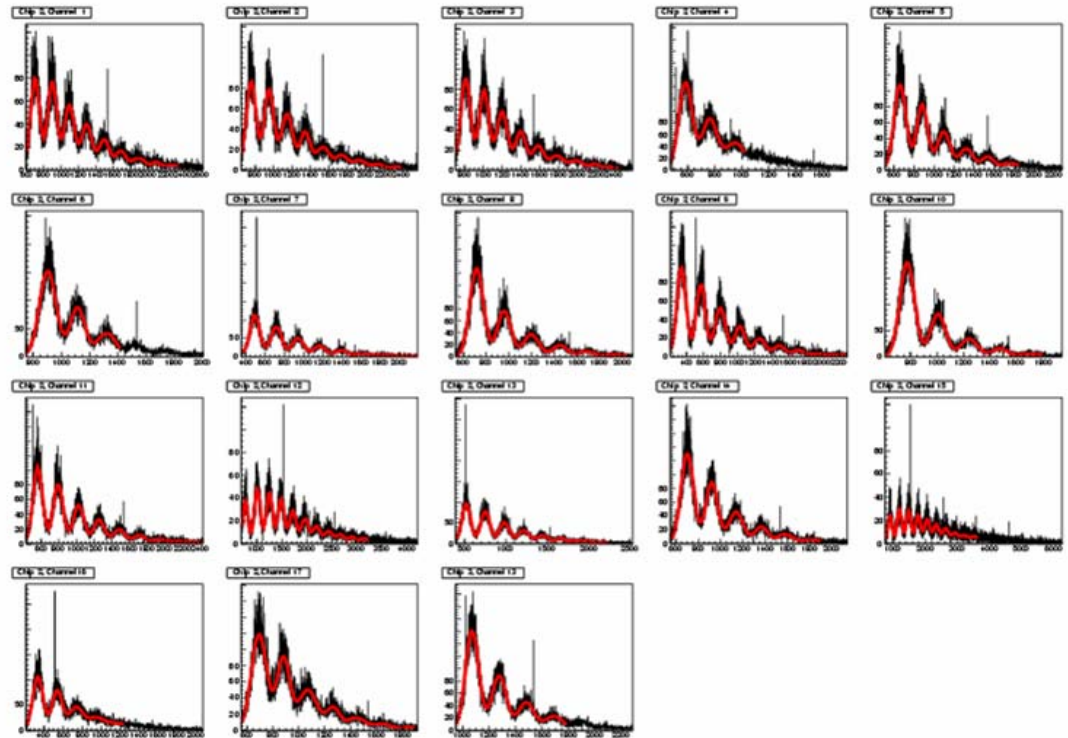
FE 0 chip 0 chan 13 hist



- From test bench to multi-channel system



Run 201353 - LED 2 - SER013, Slot 12, FE3 - Entries vs. ADC channels

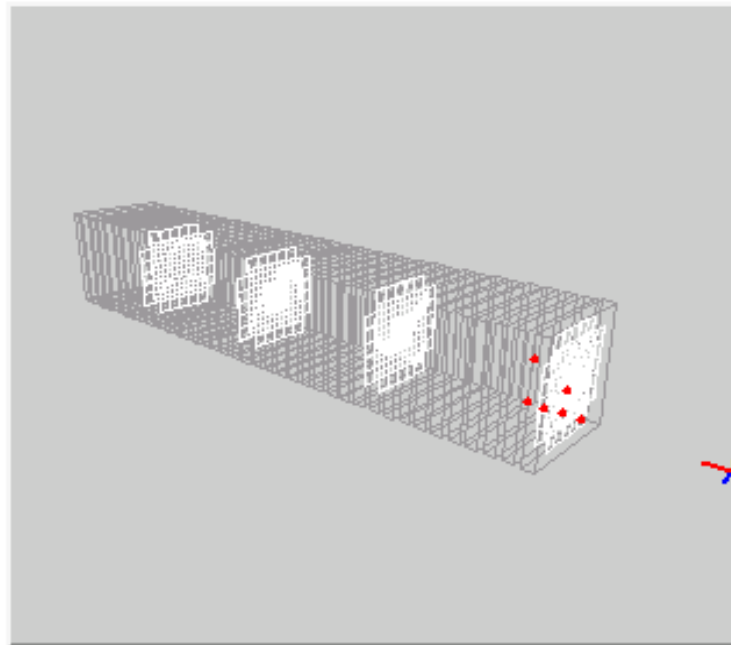
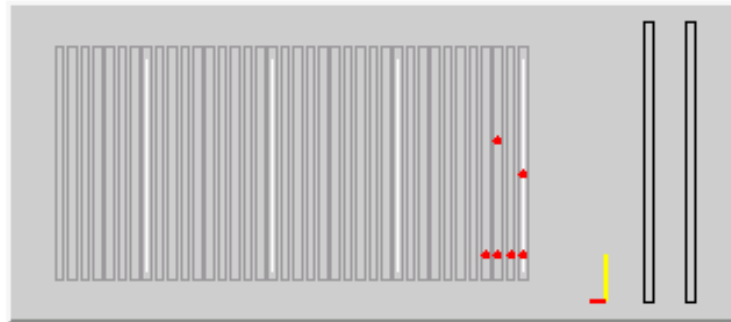
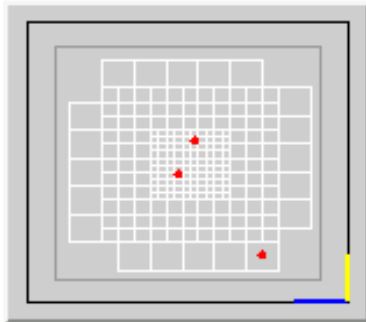


# HCAL test results

Run 220124 Event 2630

Time: 20:03:03:734:556 Fri May 5 2006

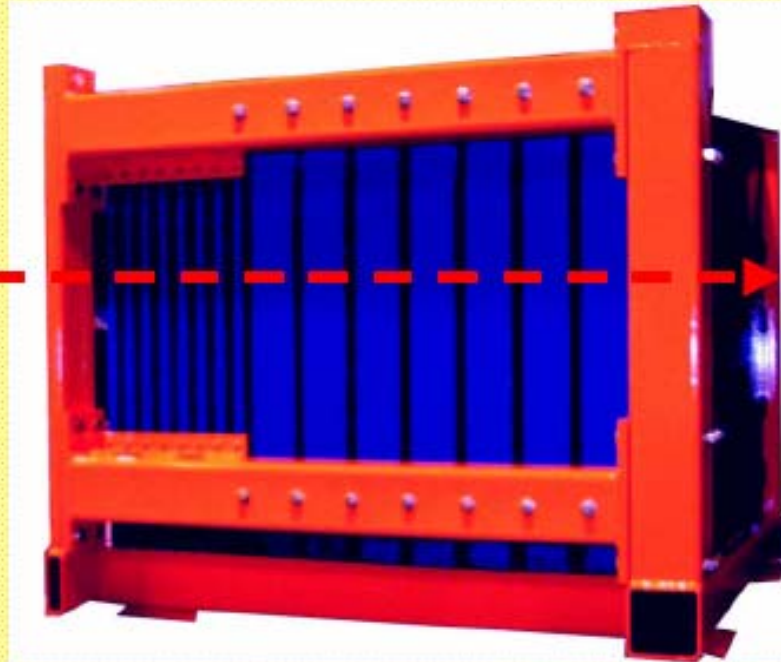
DaqEvent info ...



# Tail Catcher (NIU)

The absorber has 8 layers of 2 cm thick and 8 layers of 10 cm thick steel. Length is 142 cm. Height is 109 cm. Weight is about 10 tons.

TCMT has 16 cassettes with about 1x1 m<sup>2</sup> active area, made from 5 cm extruded scintillator strips in alternating x-y orientation.



- All elements of the readout chain were fully tested, including common readout with AHCAL and electron beam test at DESY in November 2005.

# Tail Catcher (NIU)

**Beam Test at Fermilab in February 2006**

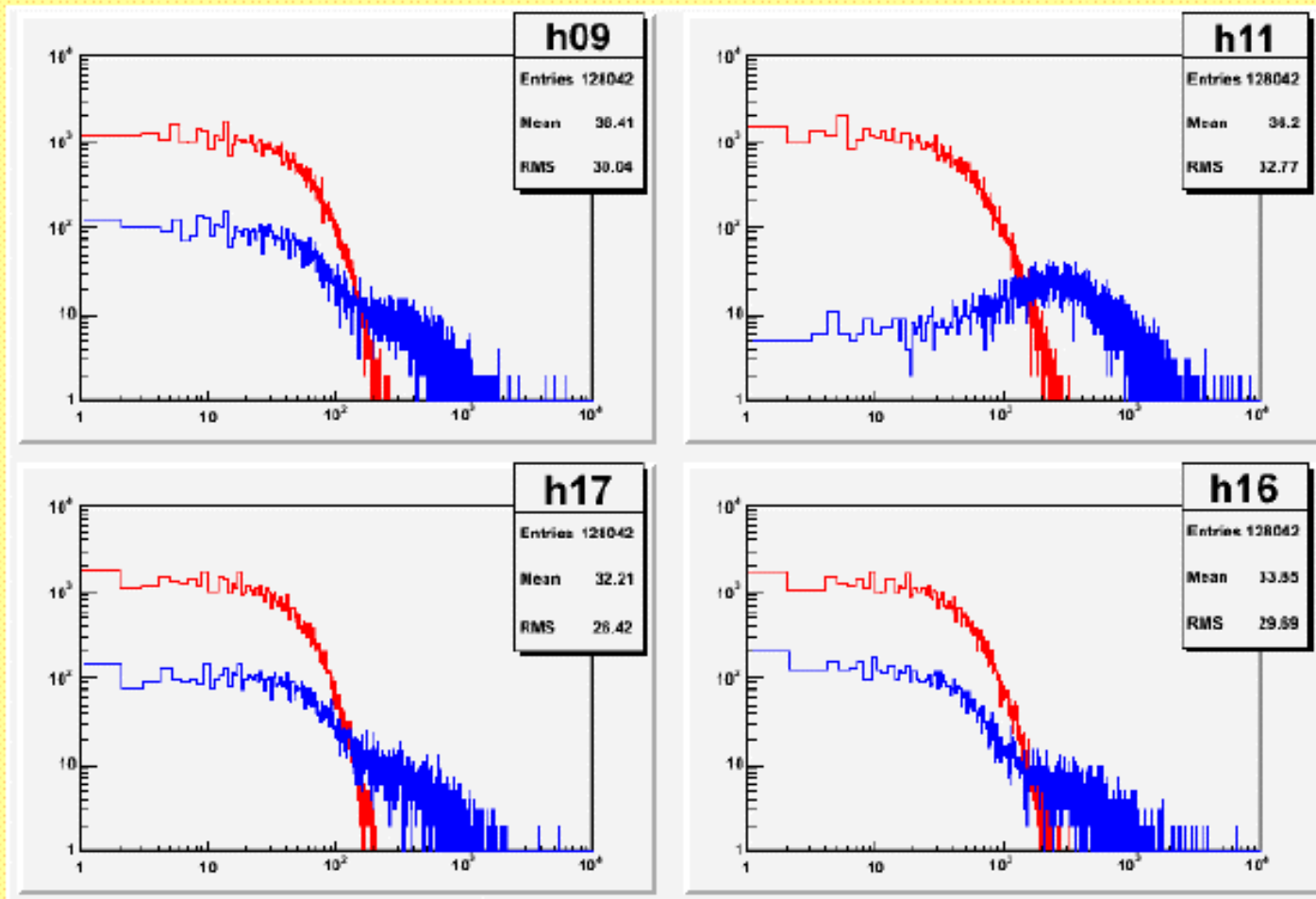
Finger  
counters  
(trigger)



*The test involves DESY, NICADD at NIU, ICL, and Fermilab.*

# Tail Catcher (NIU)

## Response to 120 GeV/c Protons



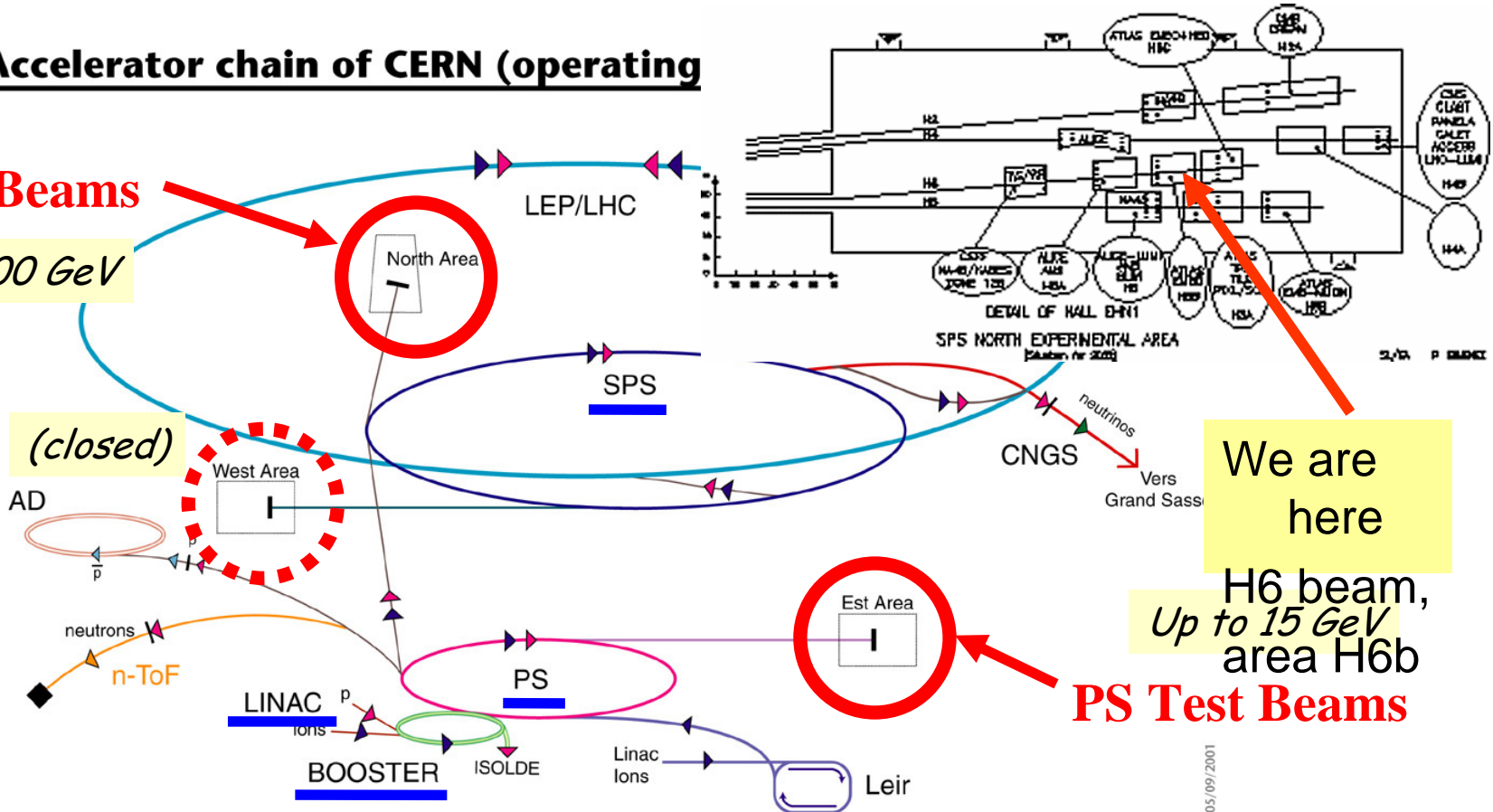


# CERN SPS North Area

## Accelerator chain of CERN (operating)

**SPS Test Beams**

Up to 400 GeV



▶ p (proton)  
▶ ion  
▶ neutrons

▶  $\bar{p}$  (antiproton)  
▶ proton/antiproton conversion  
▶ neutrinos

AD Antiproton Decelerator  
PS Proton Synchrotron  
SPS Super Proton Synchrotron

LHC Large Hadron Collider  
n-ToF Neutrons Time of Flight  
CNGS Cern Neutrinos Grand Sasso

# Mechanical installation at CERN

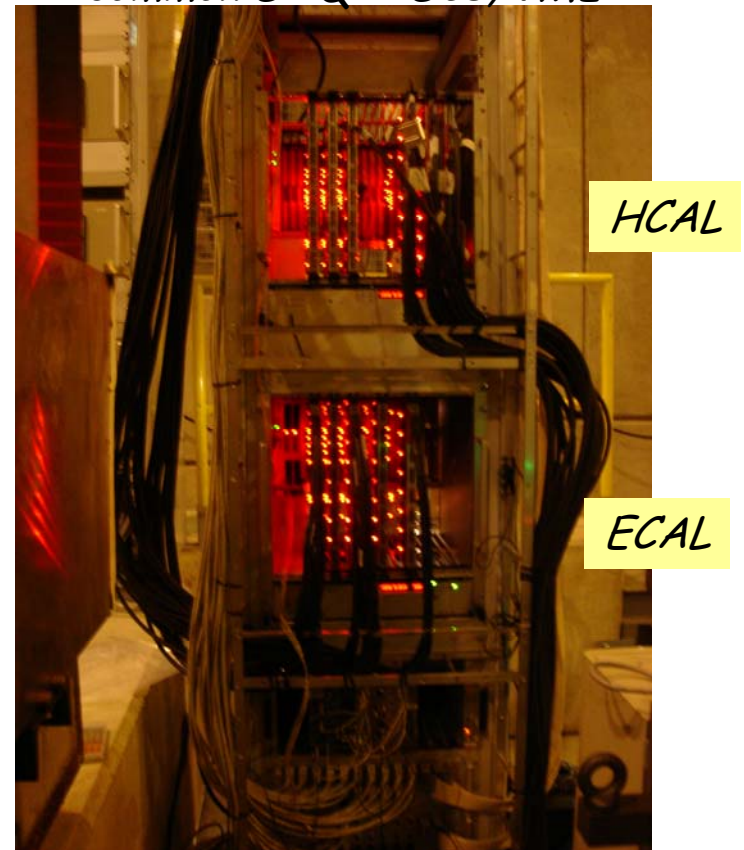


# HCAL, common DAQ

- HCAL looks like a real calorimeter for the first time



*common DAQ: ADCs, VME*



# Overview, beam instrumentation



- 3 delay wire chambers added (HV and non flammable gas connected)
- Cerenkov being cabled



# First week (July 3-7) Summary

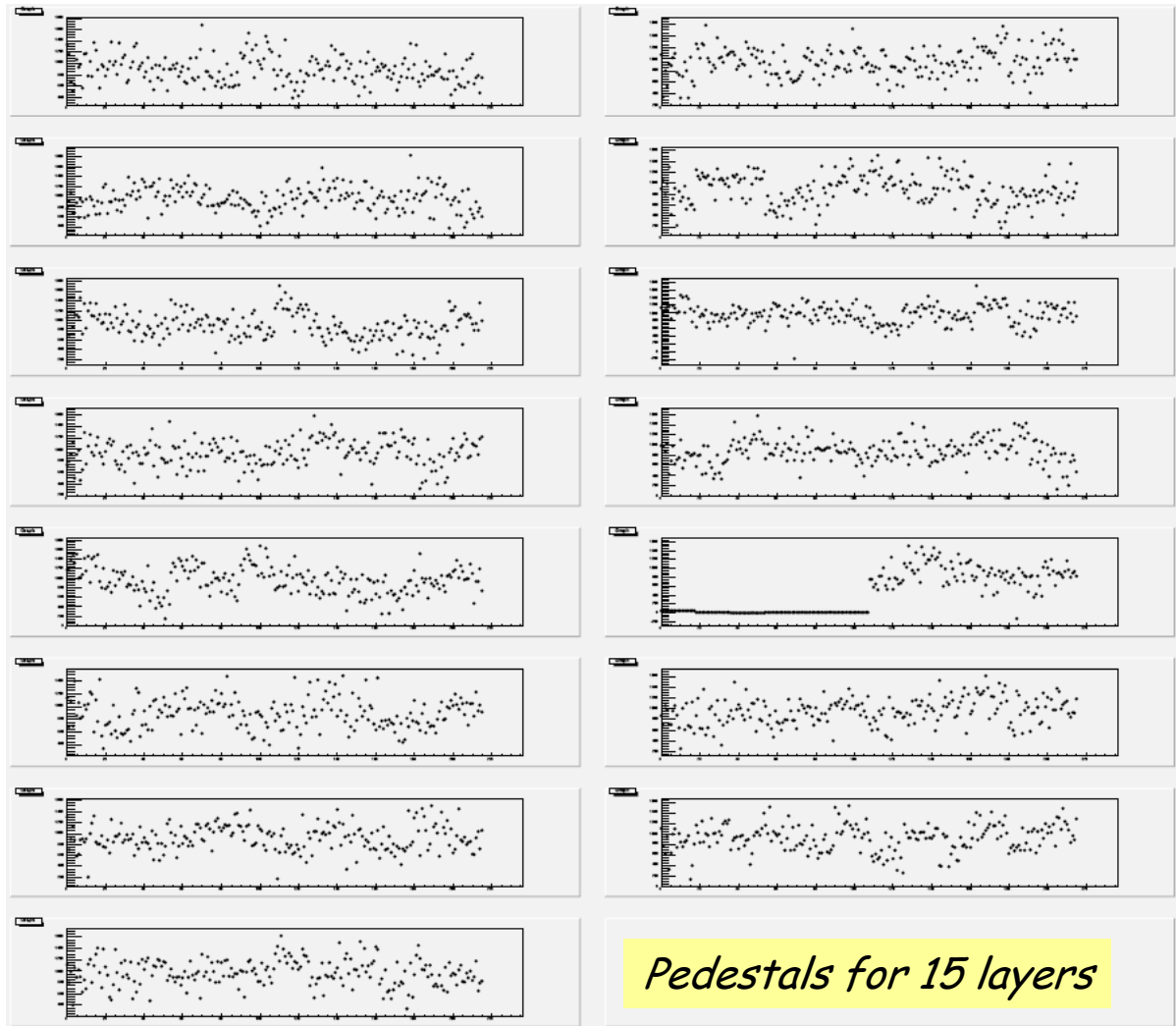
- Monday: mechanical installation of ECAL, HCAL and racks, *power*
- Tuesday: DAQ tests, voltage supply, cable supports, *first channels r/o*
- Wednesday: DCs installed, *full detector cabled and read out*
- Thursday: trigger counters, r/o debugging, *first LED signals seen*
- Friday: *Gigabit switch installed*
  
- Already now: a fantastic success
  - See <http://www-flc.desy.de/hcal/cerntestbeam/>

# First week summary



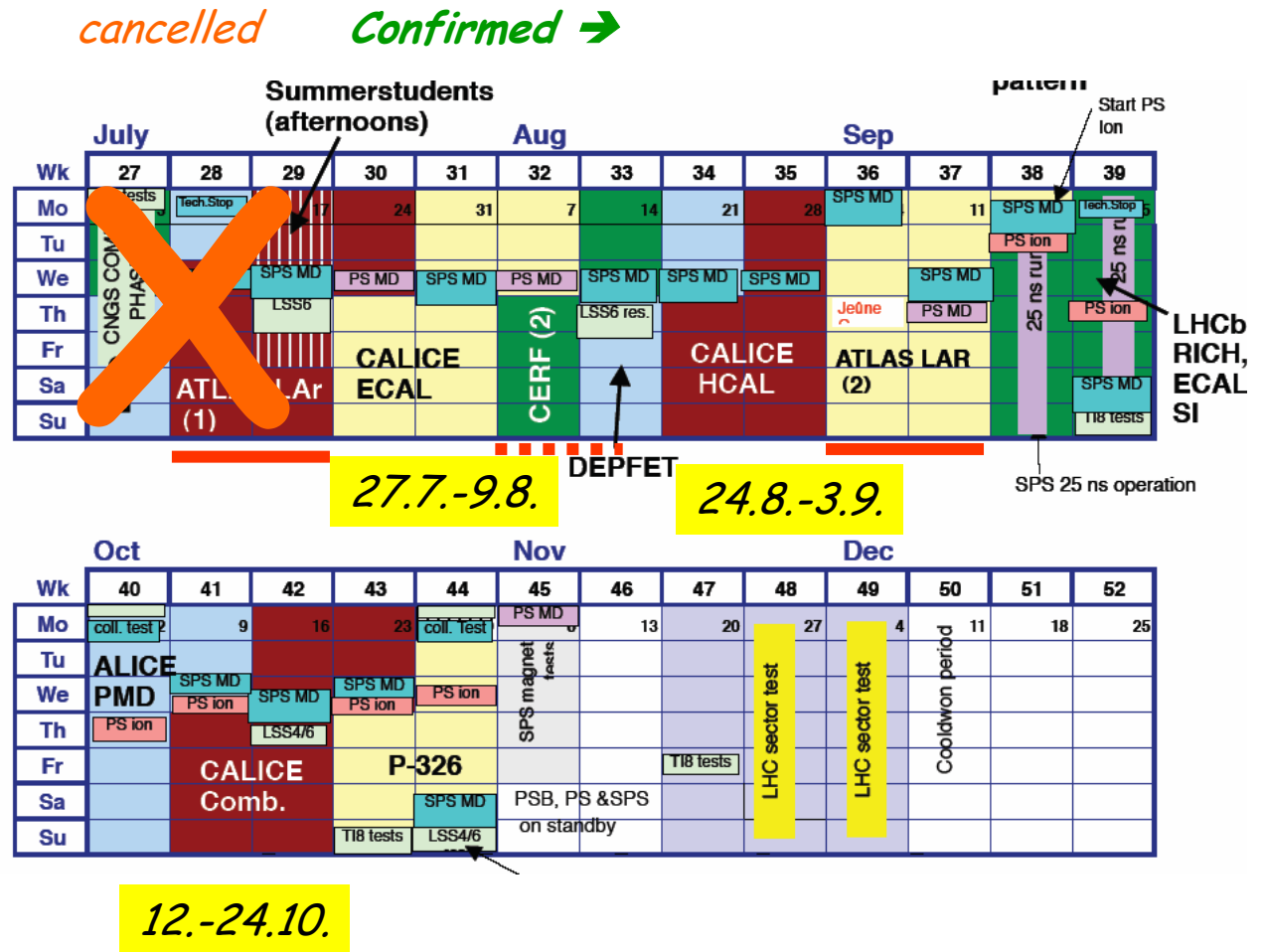
# Analysis feedback

- Data transfer to DESY dCache
- using GRID tools



# Preliminary testbeam schedule

- Draft schedule for CERN North Area beam line H6
- 3x main user
- Parasitic muon running
- SPS: smooth start-up after major repair
  - First beams in exp areas next week
  - Physics starts July 24th







# Equipment

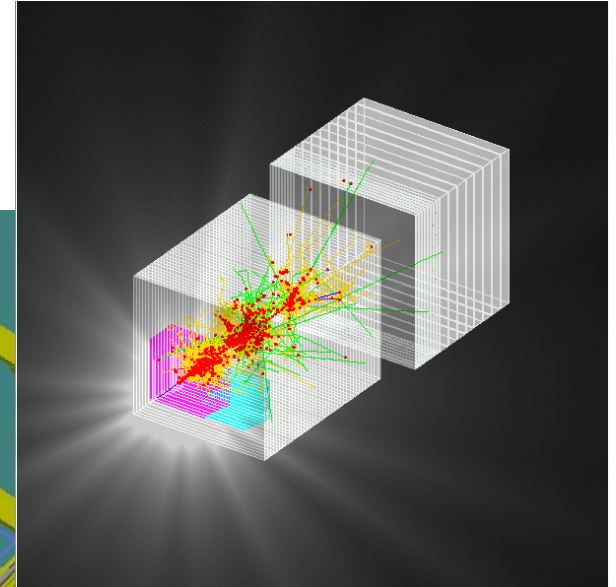
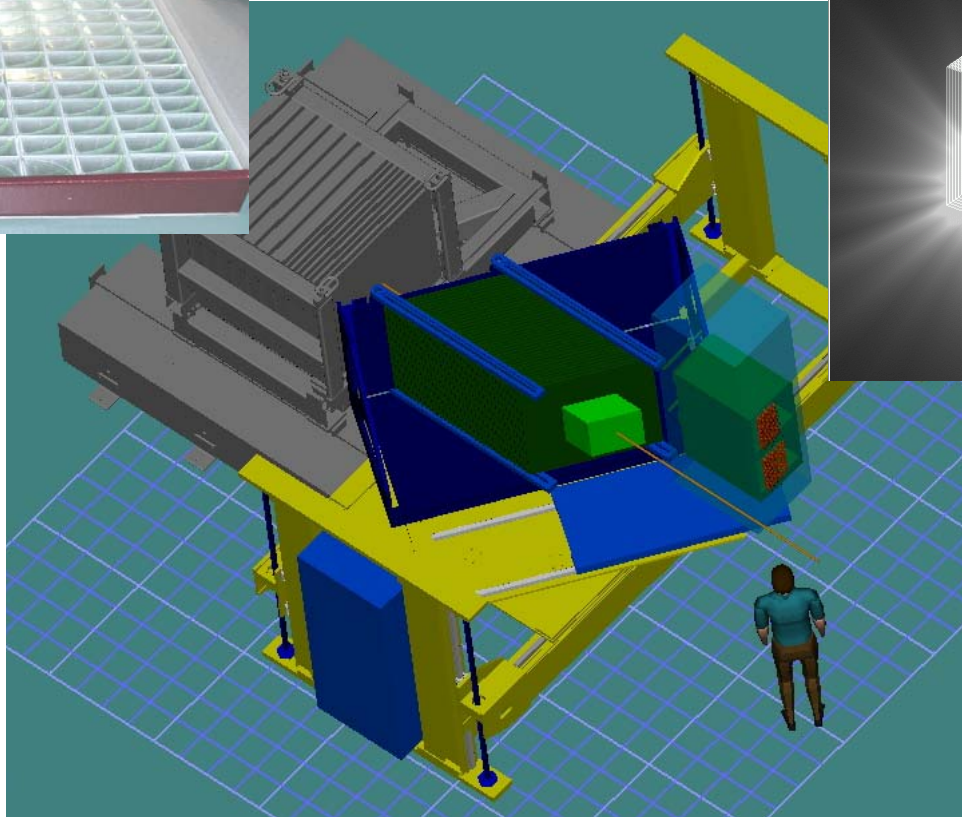
- ECAL: 27 of 30 layers in central part, almost full depth
- HCAL: 15 layers, every 2<sup>nd</sup> gap in  $3.5 \lambda$ , 25-30 in October
- TCMT: 50% of channels, first (fine) section ( $1\lambda$ )



# Goals

- "CALICE ECAL":
  - 6-50 GeV electrons and pions
  - ECAL: data MC comparisons
  - HCAL: establish detector system and calibration
- "CALICE HCAL":
  - 6-100 GeV electrons and pions (+, -)
  - HCAL: First coarse data MC comparisons with HCAL only
  - TCMT: establish system and calibration
- "CALICE combined":
  - 6-100 GeV electrons and pions (+,-)
  - ECAL + HCAL +TCMT: data MC comparisons
  - Possibly some HCAL standalone with more layers and inclined incidence

# Outlook



# Outlook

## Fermilab Test Beam - the next step!

(see next talk by Jose Repond)

- Move of ECal, AHCAL and TCMT from CERN to FNAL
- Repeat some of the CERN electron, hadron running
- Extend to low energy (1-5 GeV) running
- Stand alone tests with RPC 1m<sup>3</sup> and GEM 1m<sup>3</sup> DHCAL
- Comparison of AHCAL and DHCAL(s)
- Combination HCal ⊕ ECal running
- Tagged protons, anti-protons, neutrons ??