CALICE at FNAL-MTBF

Georgios Mavromanolakis

Cambridge University

and **FERMILAB**

Outline

- **General - Introduction to CALICE**
- **High granularity calorimeters - List of projects**
- **Testbeam program in 2006 - 2007**
- **Testbeam program at FNAL-MTBF for 2008**
- **Current status**

Introduction to CALICE

- **R&D Collaboration for calorimetry**

  : **the main goal**

  highly granular EM and HADR calorimeters to allow very efficient pattern recognition for excellent shower separation and pid within jets to provide excellent jet reconstruction efficiency

  : various technology concepts-prototype modules under study

  Si/W ECAL, scint ECAL, scint analogue HCAL, gaseous digital HCALs

- **Testbeam program**

  : since 2005 several rounds of testbeams conducted at DESY, CERN, FNAL for development studies, technical runs and physics data collection

  : **since spring 2008 the "center-of-gravity" of our program is centered at FNAL-MTBF**

List of projects

- **Si ECAL**

  : Si pads and W absorber, **1 $\times$ 1 cm^2 granularity**,
  prototype with 30 layers, 24 X_0, total: $\sim$ 10000 channels

- **scint.tile HCAL**

  : scintillator tiles and steel absorber, central part with **3 $\times$ 3 cm^2 granularity**,
  1 m^3 prototype with 40 layers, $\sim 4.5\ \lambda_I$, total: $\sim$ 8000 channels
  readout by SiPMs **($\leftarrow$ spin-off)**

- **scintillator strip ECAL**

  : scint.strips and W absorber, **1 $\times$ 1 cm^2 effective granularity**,
  prototype with 27 layers, 27 X_0, total: $\sim$ 2000 channels
  readout by MPPCs **($\leftarrow$ spin-off)**

List of projects (continued)

- **digital HCAL RPC**

  : Resistive Plate Chambers and steel absorber, **1 $\times$ 1 cm^2 granularity**, 1 m^3 prototype with 40 layers, $\sim 4.5\ \lambda_I$, total: **400000 channels**

- **digital HCAL GEM**

  : Gas Electron Multipliers and steel absorber, **1 $\times$ 1 cm^2 granularity**, 1 m^3 prototype with 40 layers, $\sim 4.5\ \lambda_I$, total: **400000 channels**

- **digital HCAL with microMegas**

  : layers equipped with "Micro mesh gaseous structure" chambers, readout by pads or strips

- **Tailcatcher-MuonTracker**

  : scint.strips and steel absorber, 1 m^3 structure $\sim 4.5\ \lambda_I$ readout by SiPMs

CALICE Testbeam Program 2006

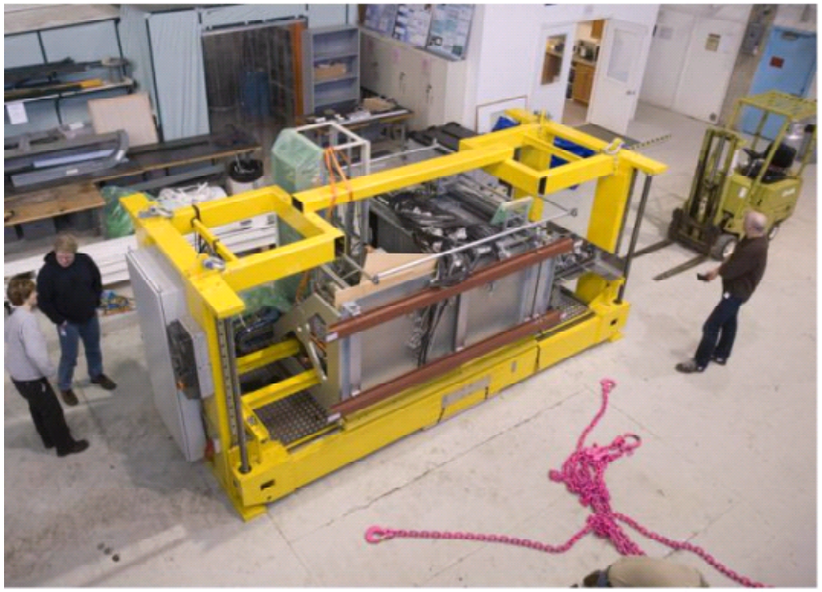
- **DESY, 22 May - 31 May 2006**
  : **ECAL(W/Si)** testbeam with electrons at 1-6 GeV
- **CERN, 24 Aug - 3 Sep 2006**
  : **ECAL(W/Si)** testbeam with electrons at higher energy
  : **AHCAL, TCMT** commissioning
  : **AHCAL** technical run with electrons/pions
- **CERN, 12 Oct - 24 Oct 2006**
  : combined **(ECAL+AHCAL+TCMT)** physics run with electrons/pions

CALICE Testbeam Program 2007

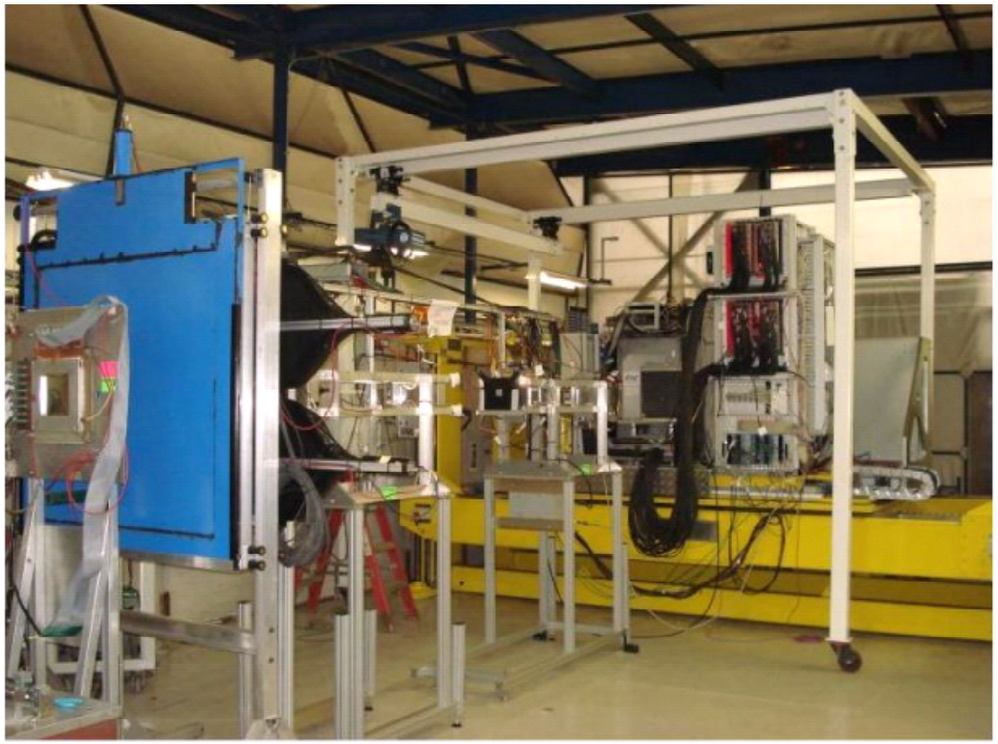
- **DESY, 2 Mar - 26 Mar 2007**
  : **ECAL(W/scint.strip)** testbeam with electrons at 1-6 GeV
- **CERN, Jul - Aug 2007**
  : combined **(Si ECAL+AHCAL+TCMT)** physics run with electrons/pions
- **FNAL, Jul 2007**
  : **RPC-DHCAL** "slice test" with positrons/pions at 1-16 GeV

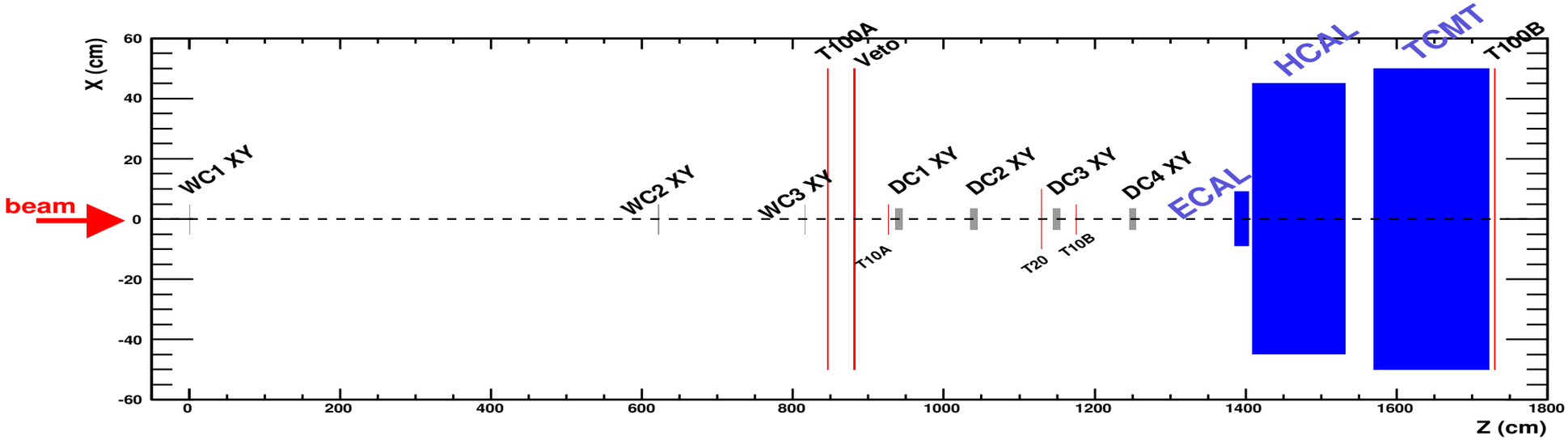
Installation at FNAL-MTBF

(1 container out of 3)



Installation at FNAL-MTBF

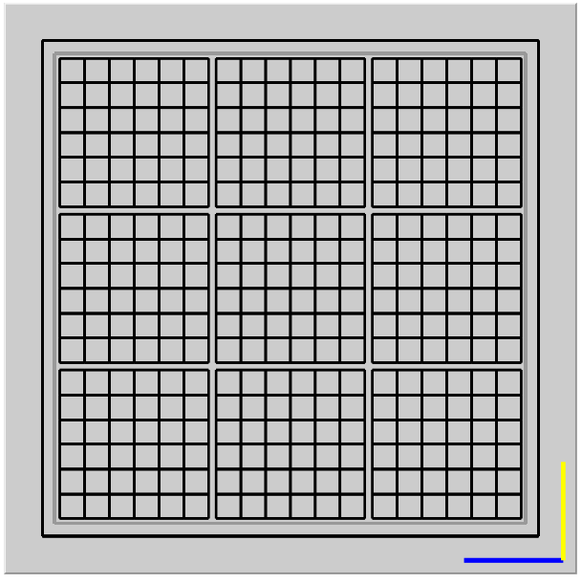




Transverse/longitudinal granularity

ECAL 18$\times$18 cm^2

Si cells of 1$\times$1 cm^2
(216 cells per layer)



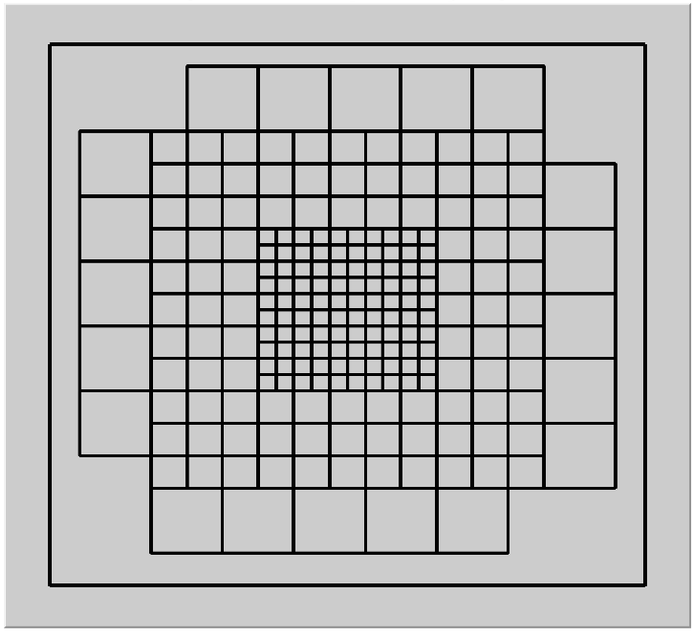
W/Si ECAL

30 layers of W = 24 X_0

#channels = 9720

HCAL 90$\times$90 cm^2

scint.tiles of 3$\times$3, 6$\times$6, 12$\times$12 cm^2
(216 tiles per layer)



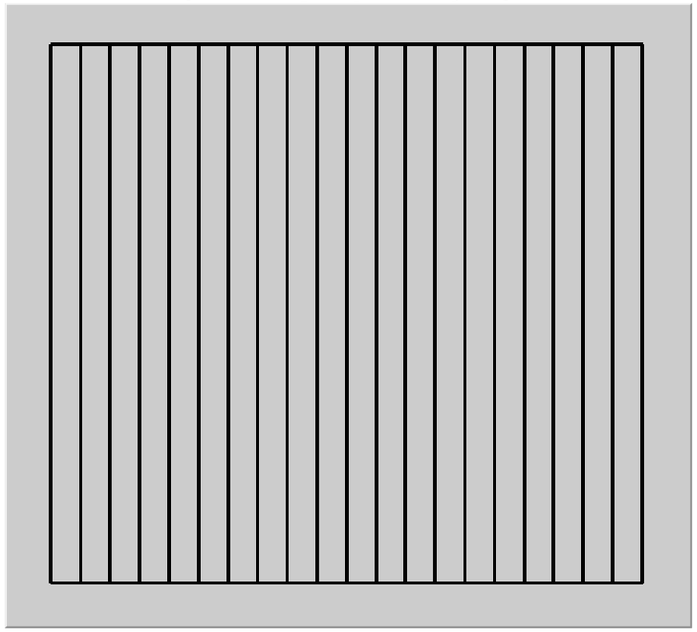
scint.tile HCAL

38 layers of steel $\sim 4.5\ \lambda_I$

#channels = 7608

TCMT 100$\times$100 cm^2

scint.strips X or Y of 5$\times$100 cm^2
(20 strips per layer)

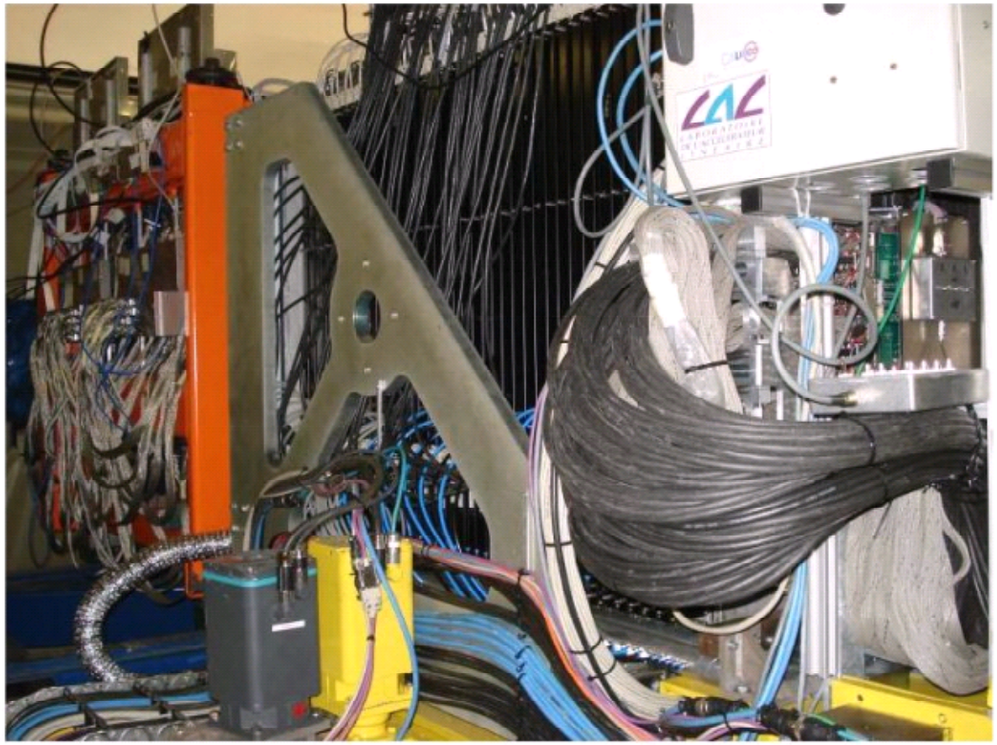


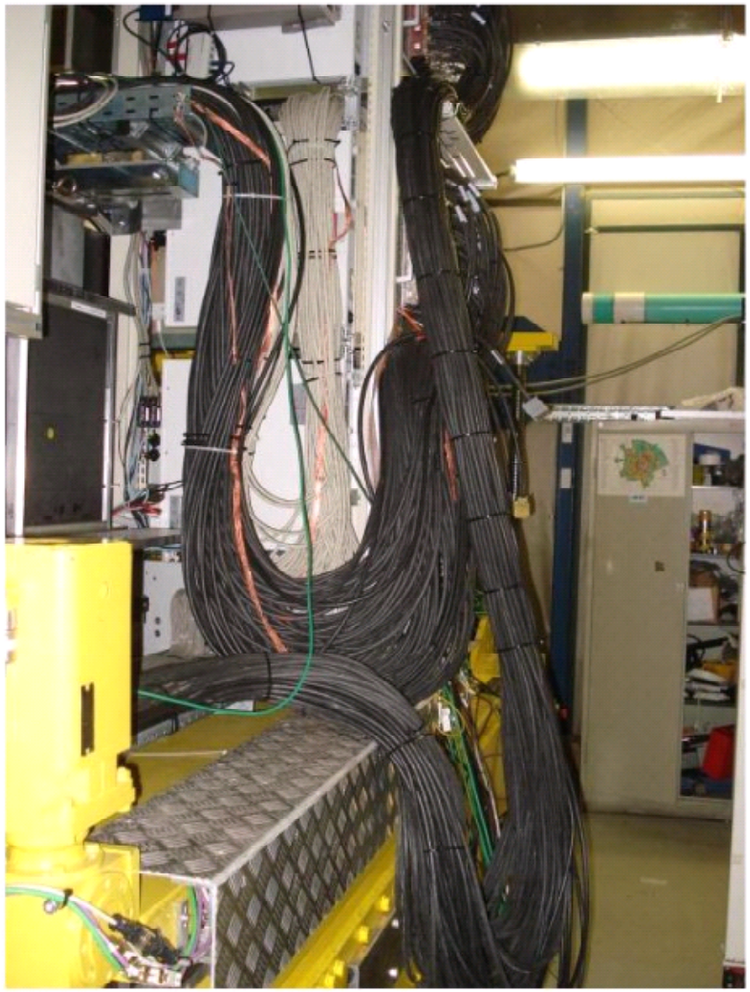
Tail Catcher - Muon Tracker

16 layers of steel $\sim 4.5\ \lambda_I$

#channels = 320

A lot of cables to route and check



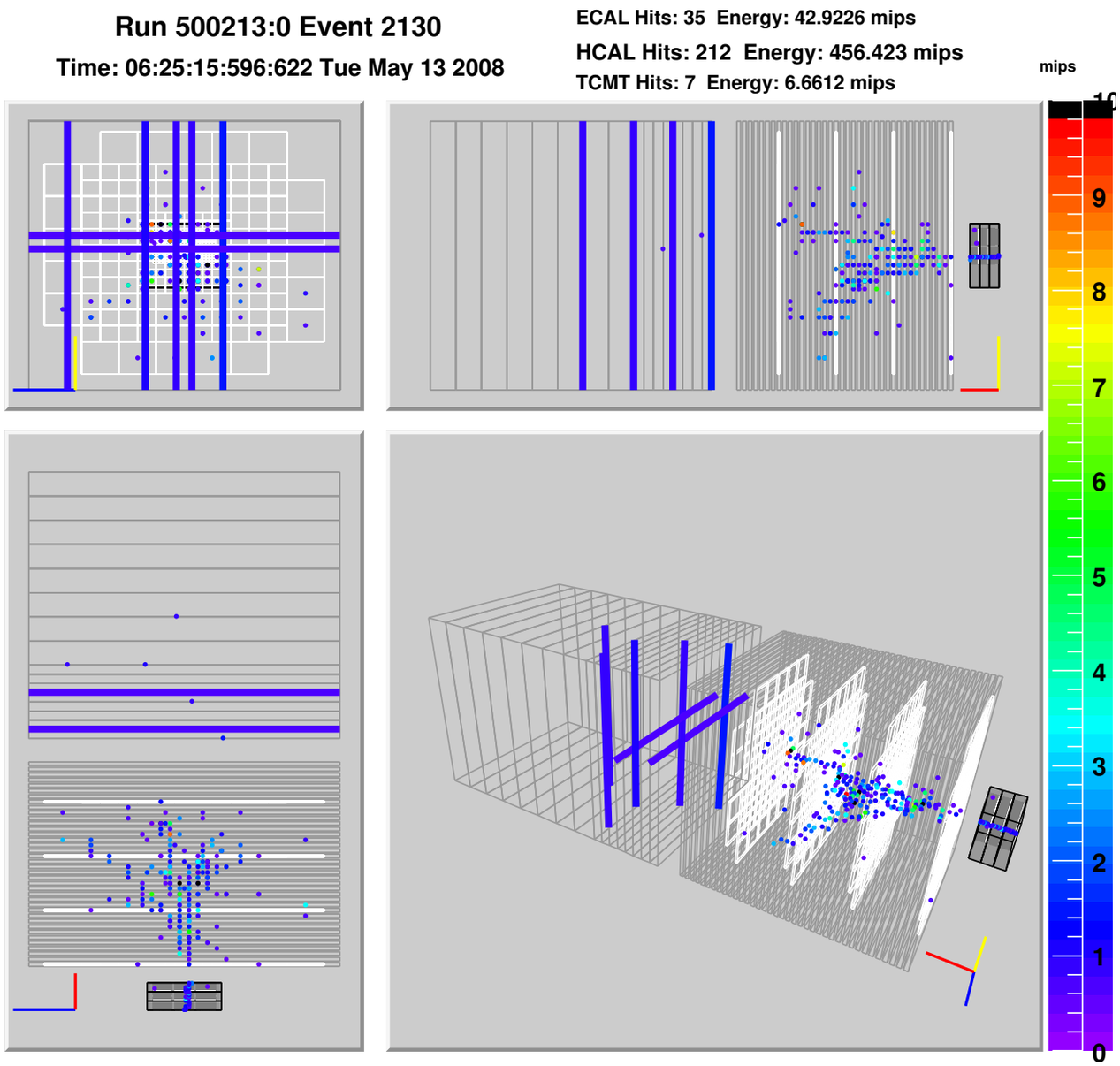


CALICE Testbeam Program for 2008

- **the "center-of-gravity" of our program is moved to FNAL**
  - May 7-27, combined test of Si/W ECAL + scint HCAL + TailCatcher
  - Jul 7-29. combined test of Si/W ECAL + scint HCAL + TailCatcher
  - Sep 1-26, combined test with scint.strip ECAL

- **main goals**
  - data collection with complete instrumentation
  - scans with incidence angle variation
  - increase statistics at low energies (around 10 GeV)
  - extension of the energy range towards smaller energies (down to $\sim$ 2 GeV)
  - (2009+) direct comparison with gaseous HCALs under identical beam conditions
  - ... ...

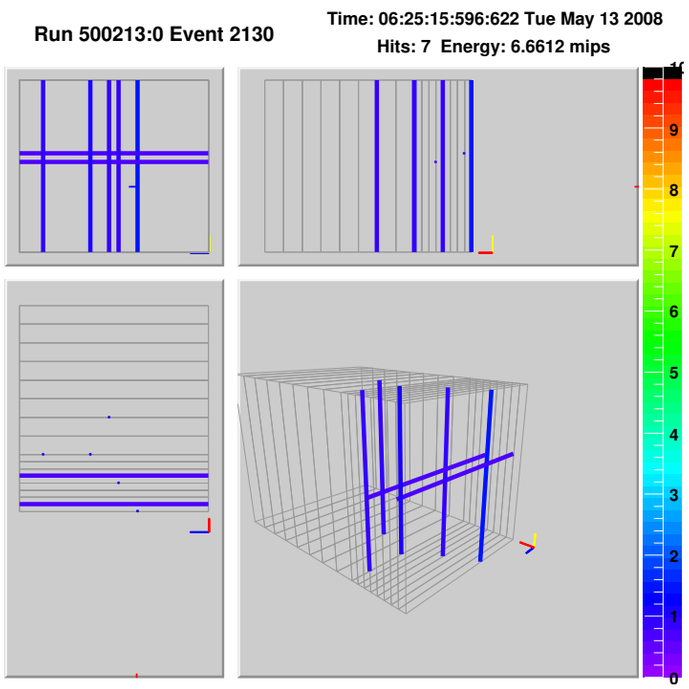
CALICE testbeam at FNAL 2008



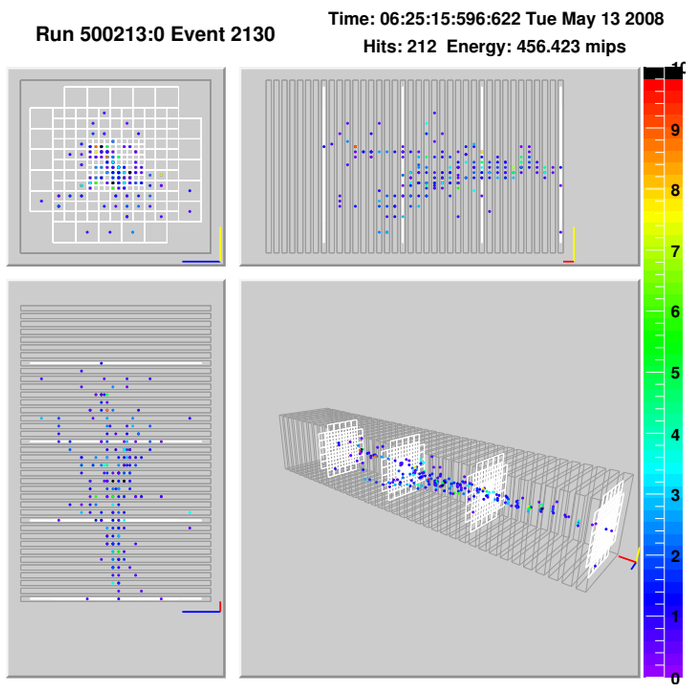
π^- 15 GeV

ECAL threshold = 0.5 mip
HCAL threshold = 0.5 mip
TCMT threshold = 0.7 mip

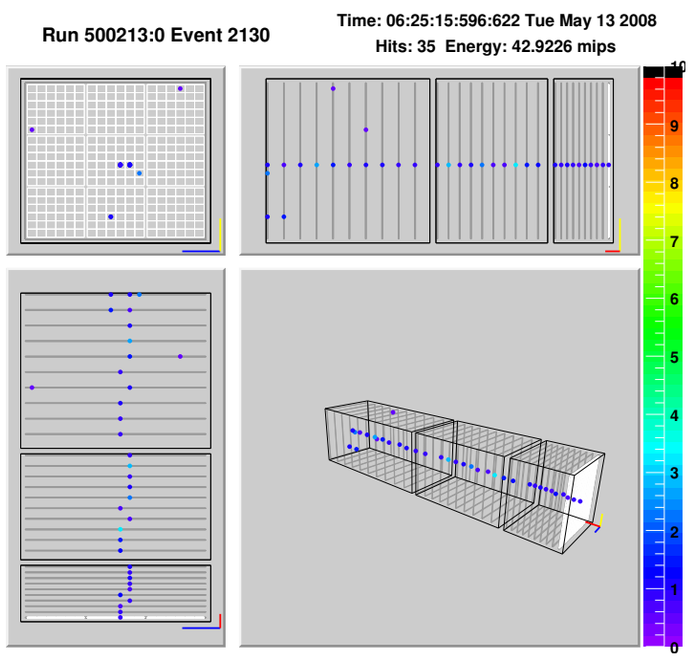
CALICE testbeam at FNAL 2008



TCMT

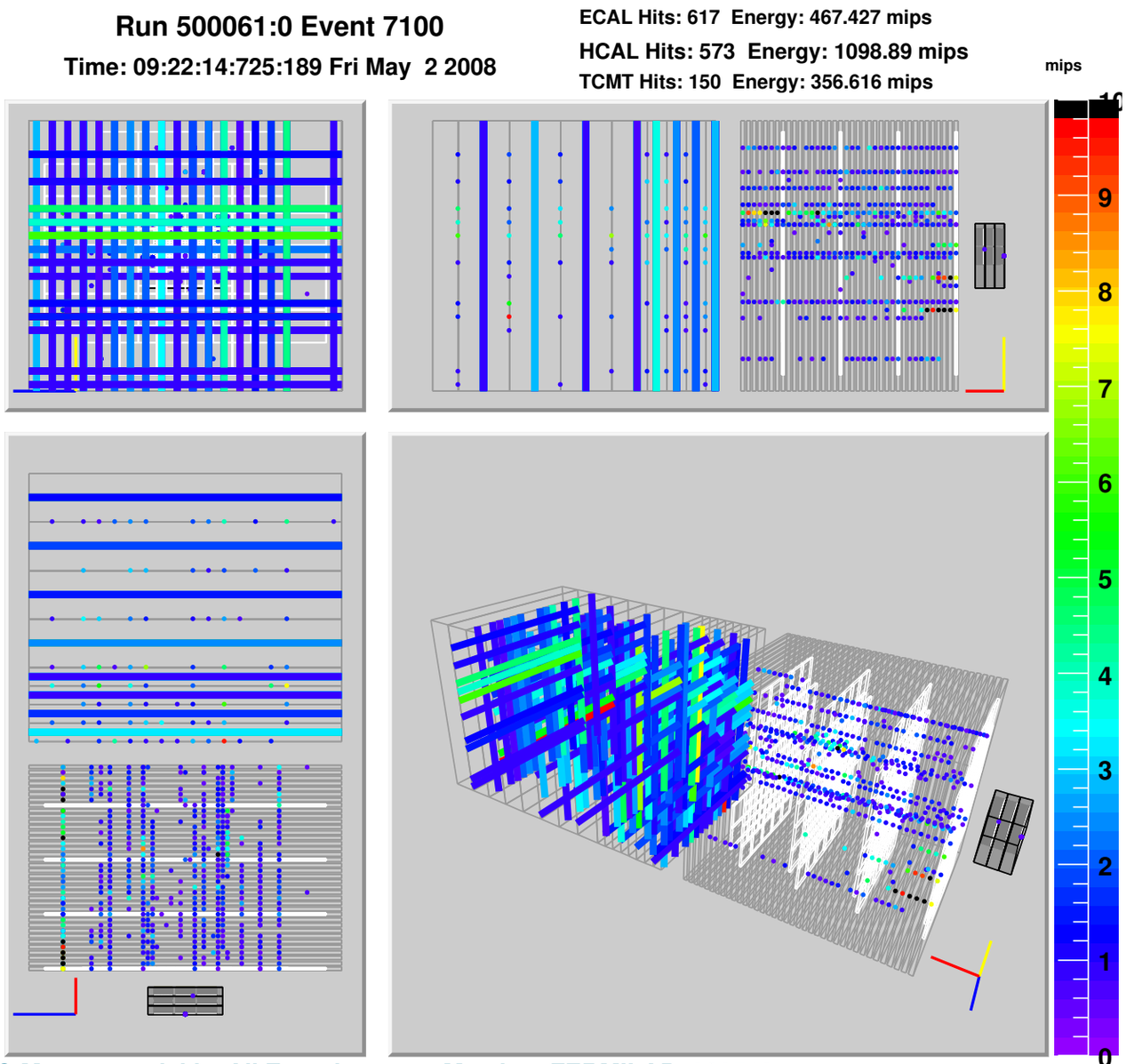


HCAL



ECAL

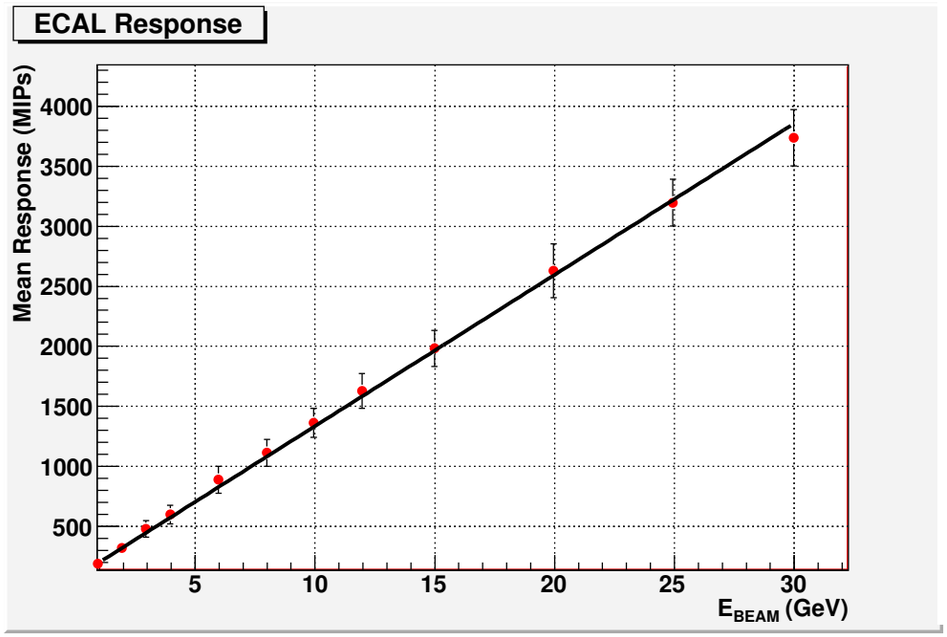
CALICE testbeam at FNAL 2008

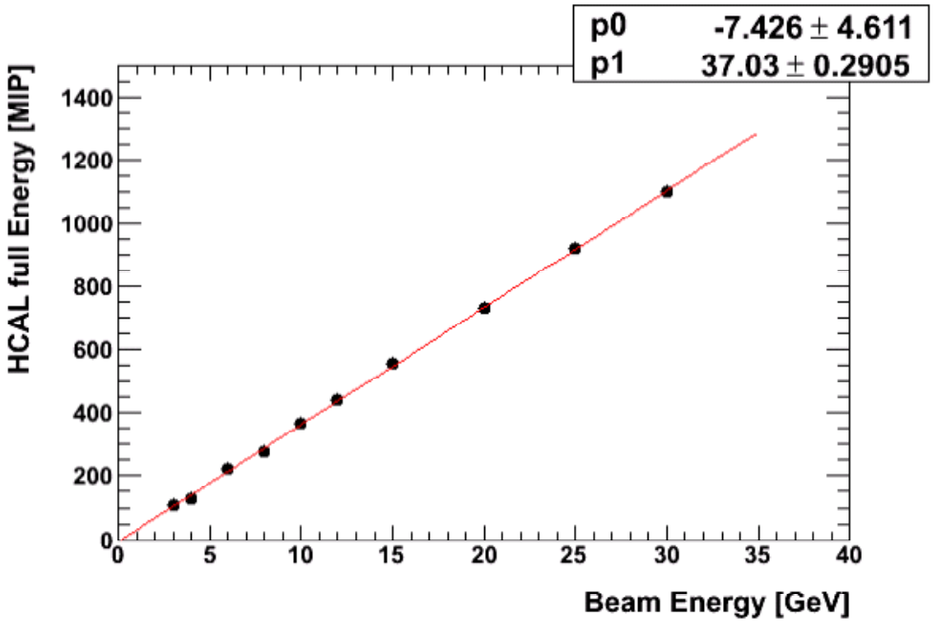


muons

ECAL threshold = 0.5 mip
HCAL threshold = 0.5 mip
TCMT threshold = 0.7 mip

CALICE testbeam at FNAL 2008



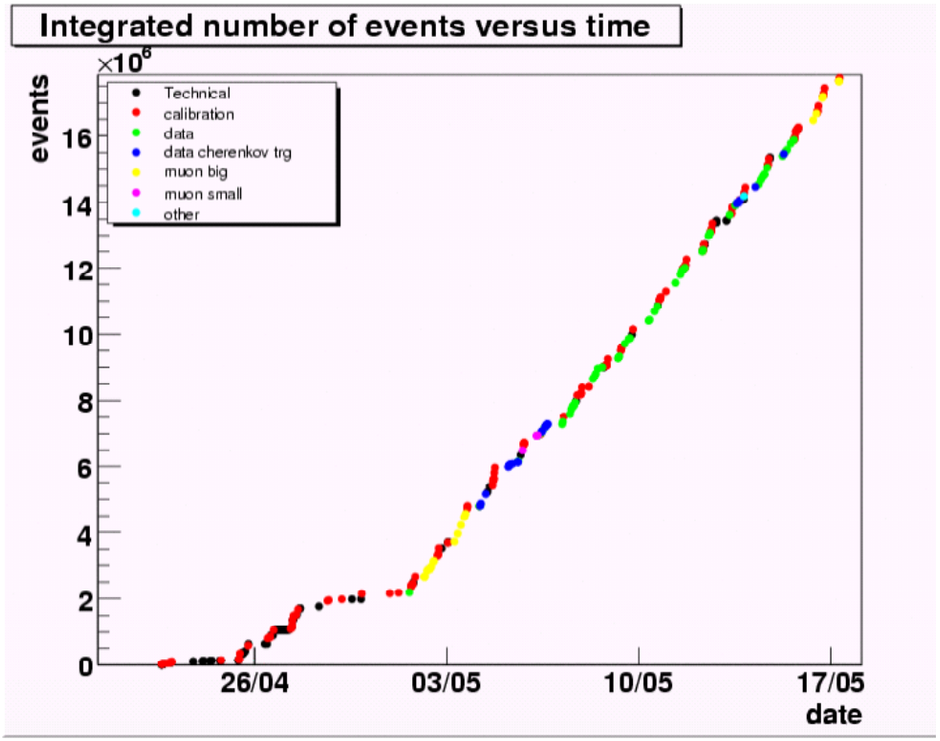


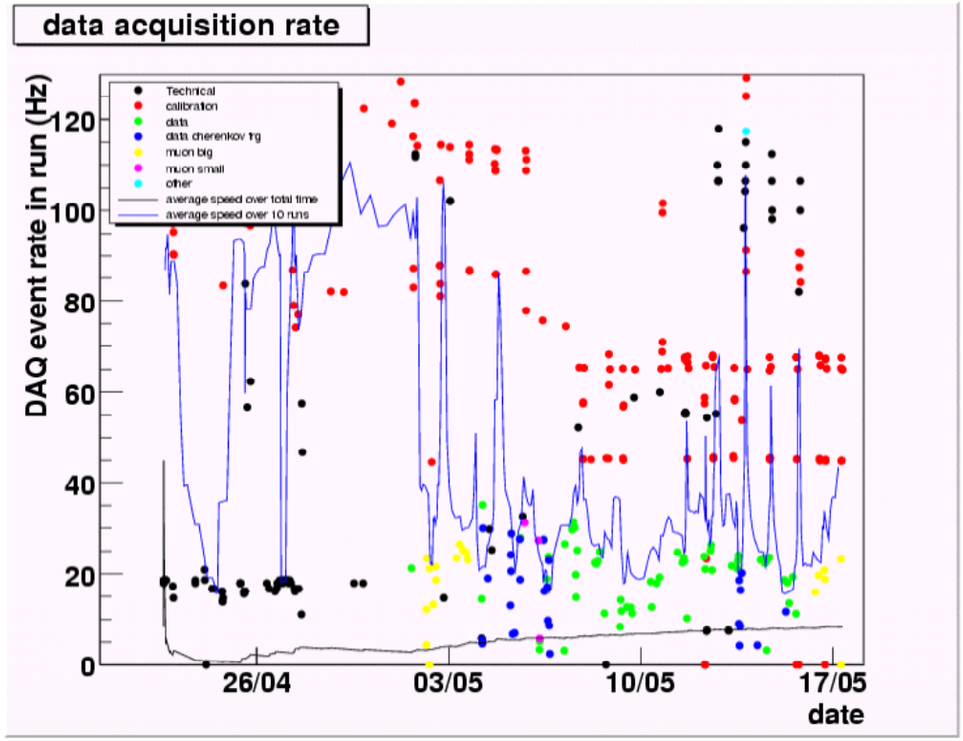
ECAL response to e^-

HCAL response to π^-

(very preliminary - plots from online monitor)

Data accumulated



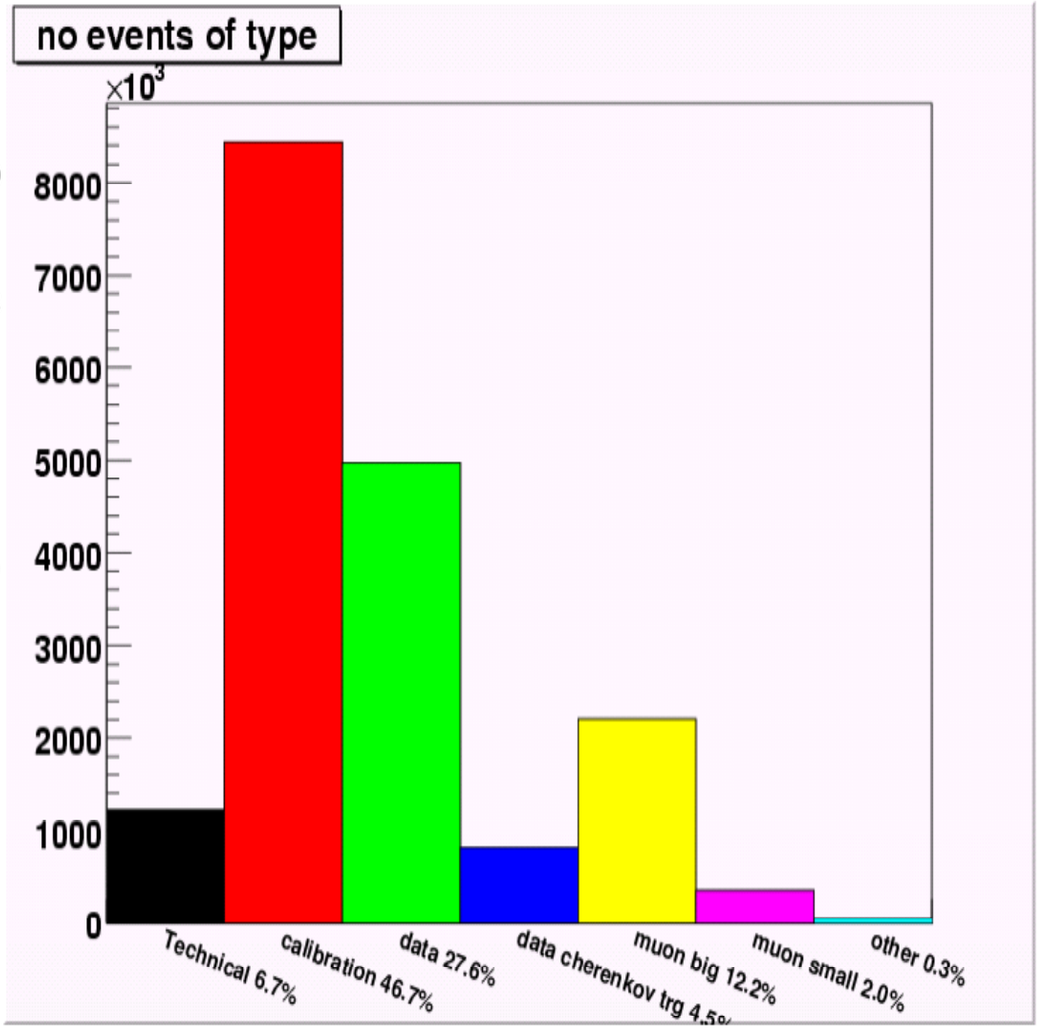


Data status

Last combined run taken: 500300
Number of combined runs: 300
Current number of combined runs saved to GRID: 238 (79%)
Current number of converted runs in GRID: 214 (71%)
GRID disk space used by combined runs: 581 GB
GRID disk space used by converted combined runs: 383 GB
GRID disk space used by all combined data: 0 TB 964 GB

Last HCAL run taken: 520159
Number of HCAL runs: 159
Current number of HCAL runs saved to GRID: 153 (96%)
Current number of converted HCAL runs in GRID: 132 (83%)
GRID disk space used by HCAL runs: 102 GB
GRID disk space used by converted HCAL runs: 57 GB
GRID disk space used by all HCAL data: 0 TB 159 GB

last update Sun May 18 13:04:47 CDT 2008

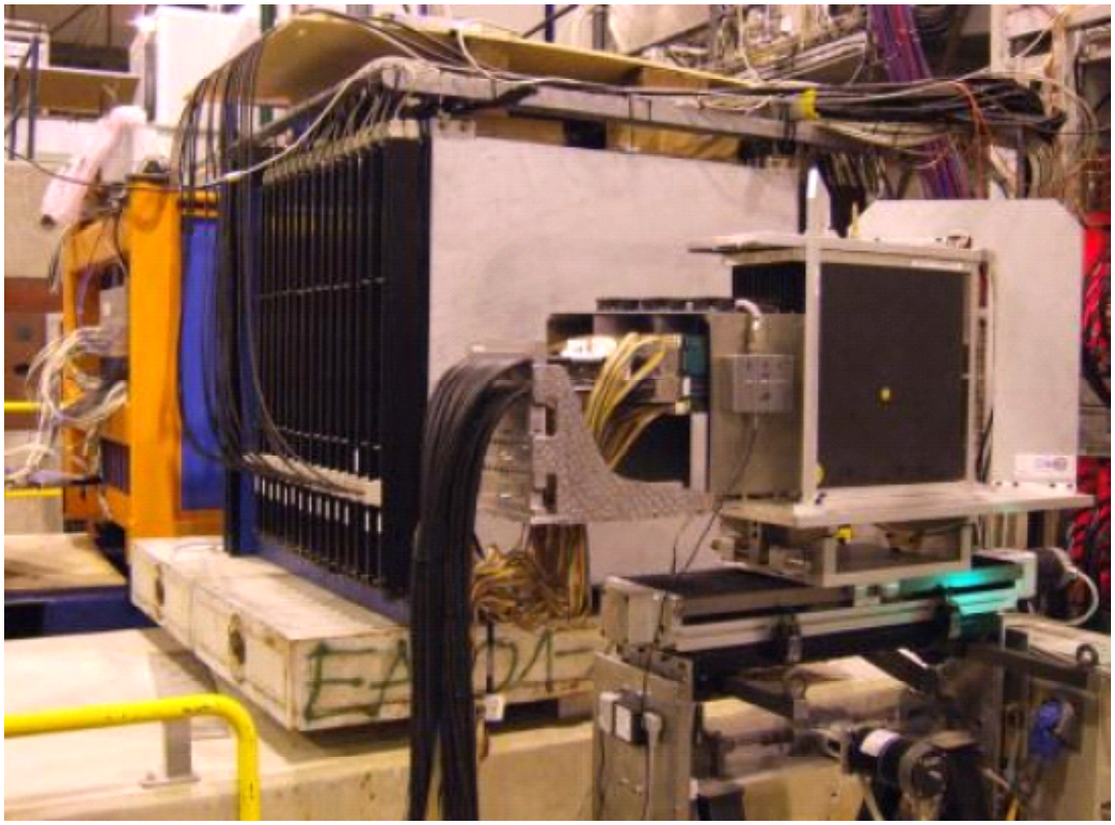


Special thanks to

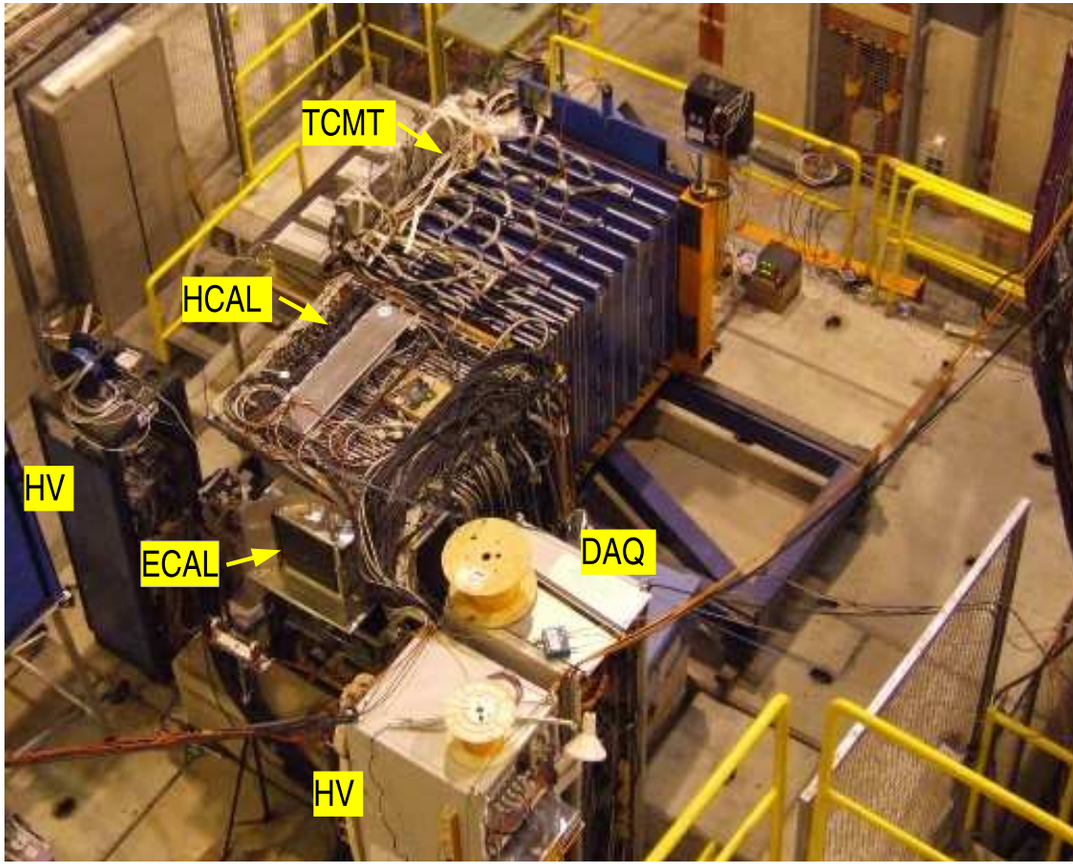
- .
  - : Erik Ramberg, Rick Coleman and the Accelerator Division
  - : Joe Howell and John Voirin for the installation

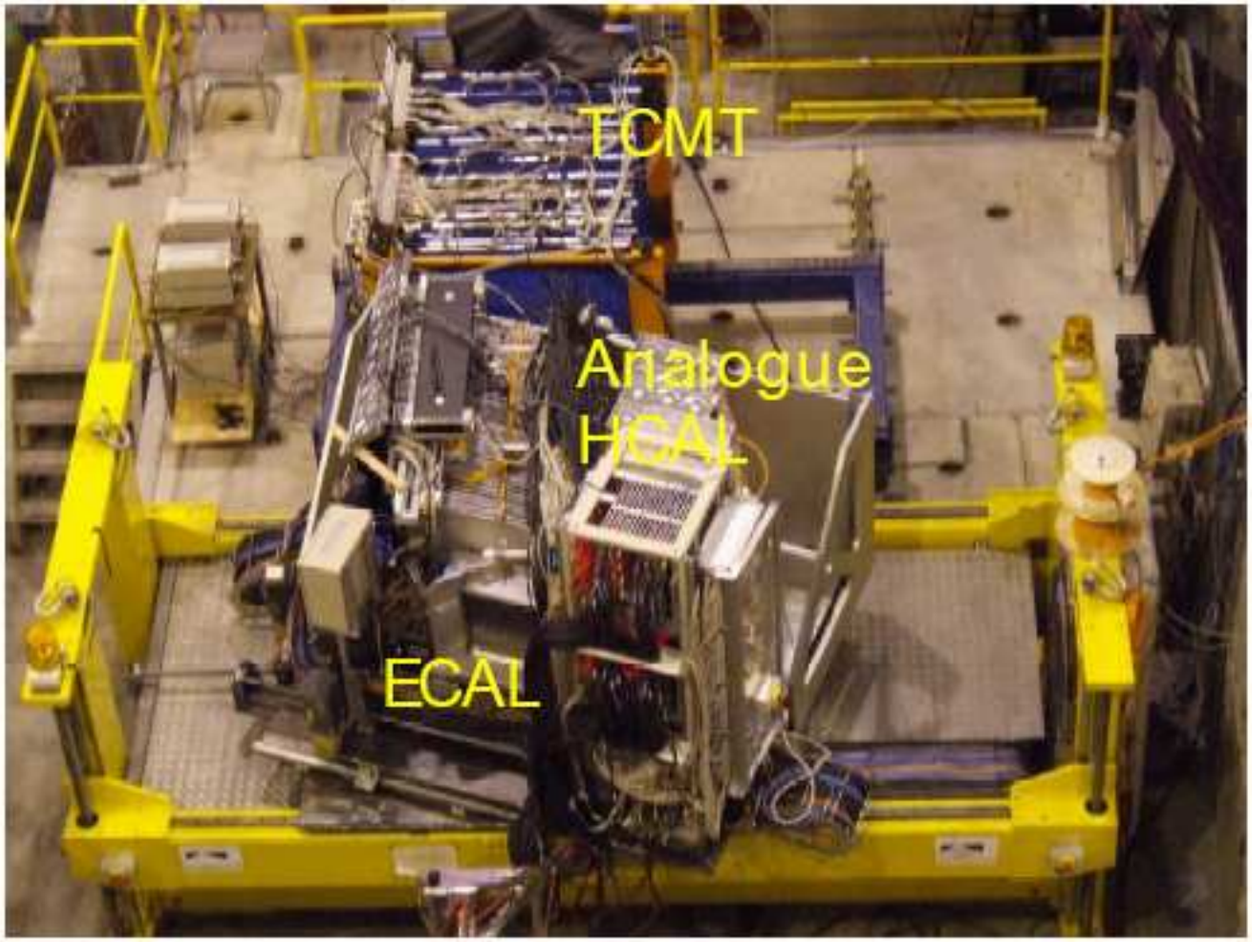
extra slides

CALICE Testbeam at CERN 2006



(perspective view)



(top view)

Testbeam Setup at CERN 2007