Results from EMCal Test Beam

Paola La Rocca
University & INFN Catania

Outline

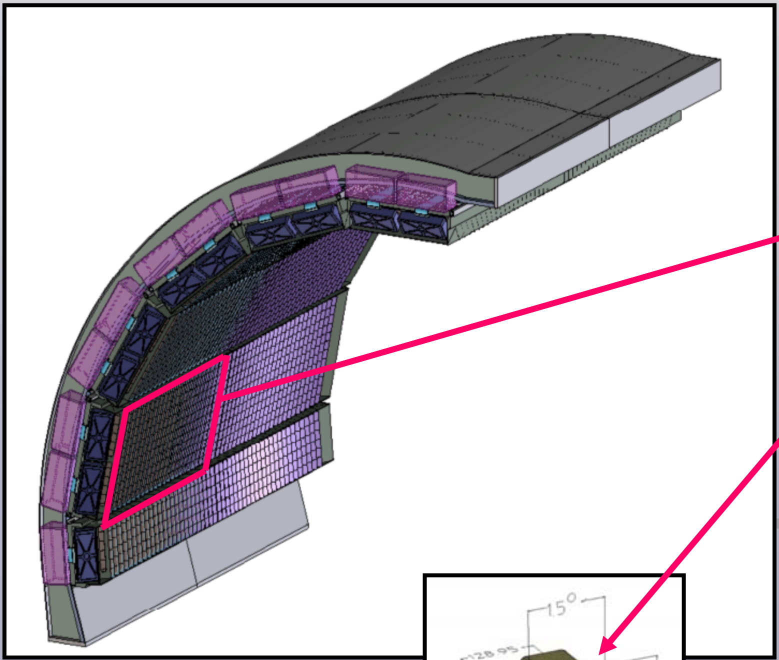
- Results from Test Beam at FNAL (2005)
- Test Beam at CERN

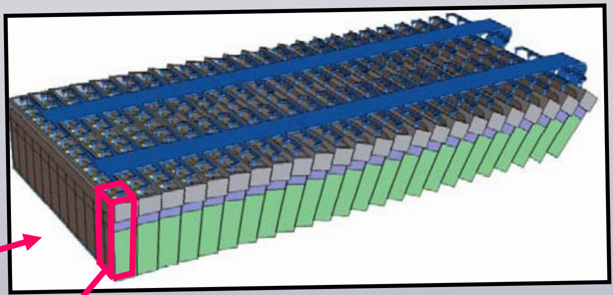
  - Setup description

  - Goals

  - Results

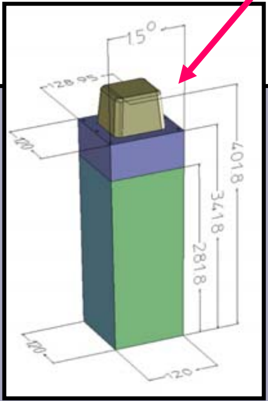
EMCal Project





- **10 supermodules of 12 x 24 modules**
- **2 supermodules of 6 x 24 modules**

Installation of the 1st SM in January 2009

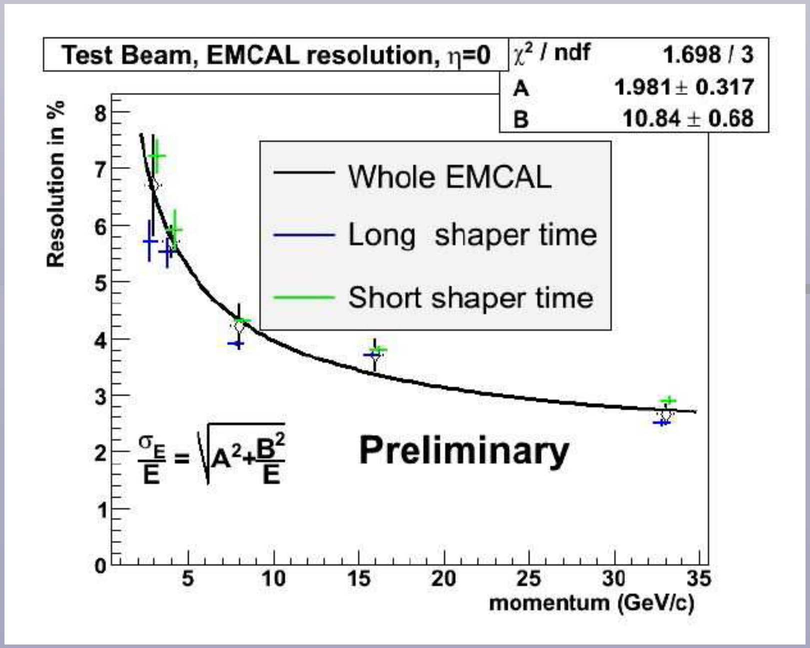


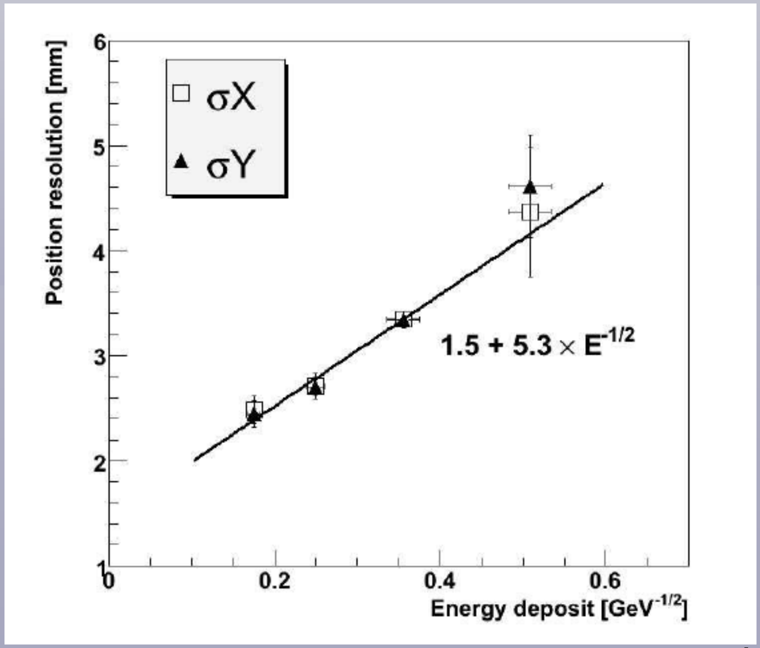
Module

2 x 2 towers

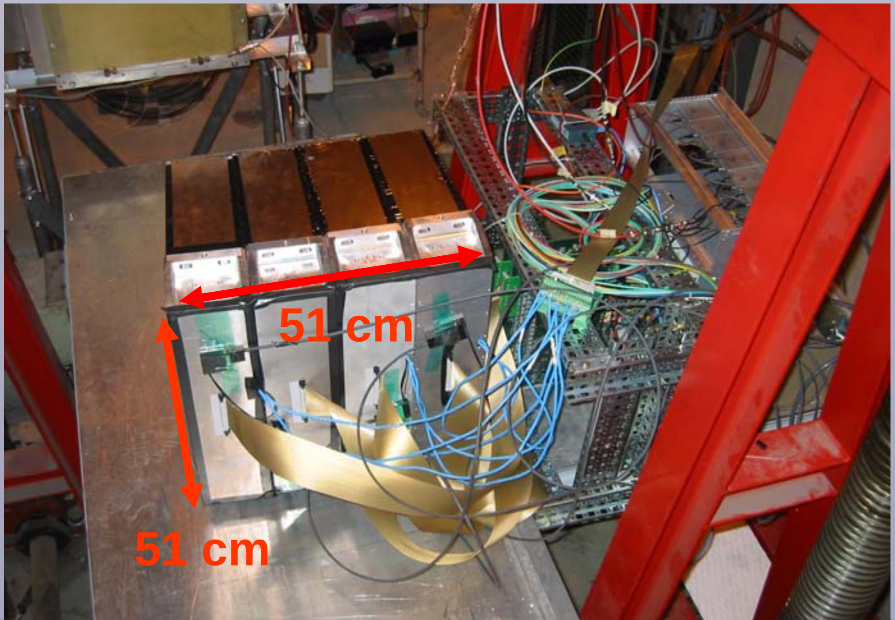
Test Beam FNAL 2005

Mixed beam (e/π/p) in the momentum range 4-66 GeV/c





Test Beam CERN 2007: Setup...



- **4x4 modules**
- **MWPCs for tracking**
- **Scintillator paddles for trigger**
- **Cerenkov for e/pion discrimination**

… and goals

- Quantify the performance characteristics of EMCal
- Energy resolution
- Position resolution
- Electron/hadron discrimination by shower shape
- Dependence on position of incidence - uniformity
- Working gain monitoring system (LED)

Measurements

SPS phase : electrons (5-100 GeV/c) /hadrons (20-100 GeV/c)

- Electron runs in all towers for absolute calibrations (@80 GeV)
- Hadron runs for relative calibration comparison using the MIP peak
- Position scans to check uniformity
- Energy scans with electrons at 14 different positions
- Hadron data to measure the energy deposition distributions and shower shapes
- Large Z geometry and phi angle scanning at 9° and 6°

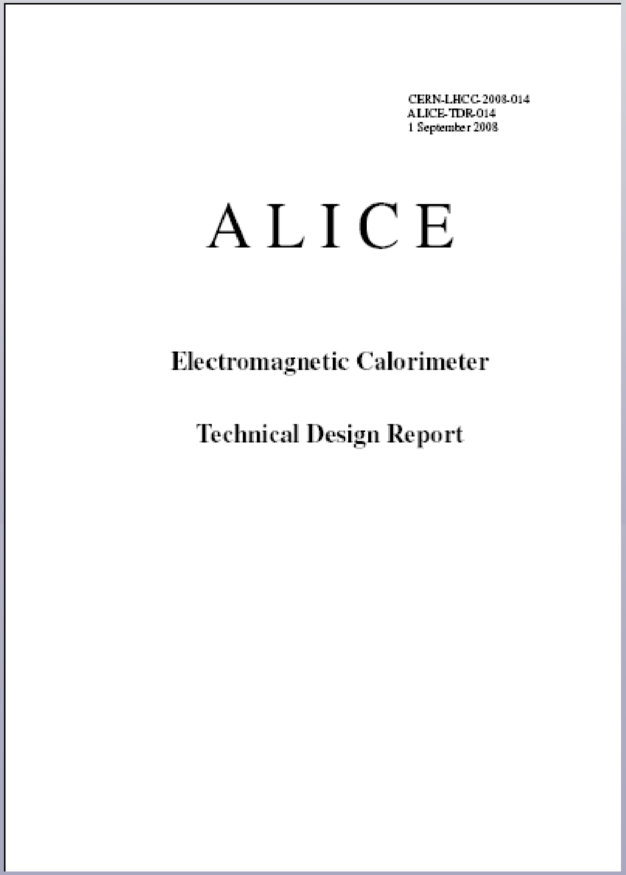
PS phase : electrons and hadrons (0.5 – 6.5 GeV/c)

- Electron and hadron runs at 3 GeV/c in all towers (calibration and uniformity)
- Electron and hadron momentum scans at 6 different locations
- Large Z geometry and phi angle scanning at 9°, 6° and 3°

Cosmic Runs

Data analysis

- **A very large data set to be analyzed**
  - **More than 1100 runs, 525 GB of data from SPS+PS**
  - **A large number of people interested to analyze data**
    - **Grenoble, Nantes, Catania, Frascati, CERN, WSU, Houston, Tennessee**
  - **EMCal TDR writing (2008, Sept 1st)**
    - **Chapter 7: Test Beam Results (coordinator Delia Hasch)**
  - **Working on a NIM paper**



CERN-LHCC-2008-014
ALICE-TDR-014
1 September 2008

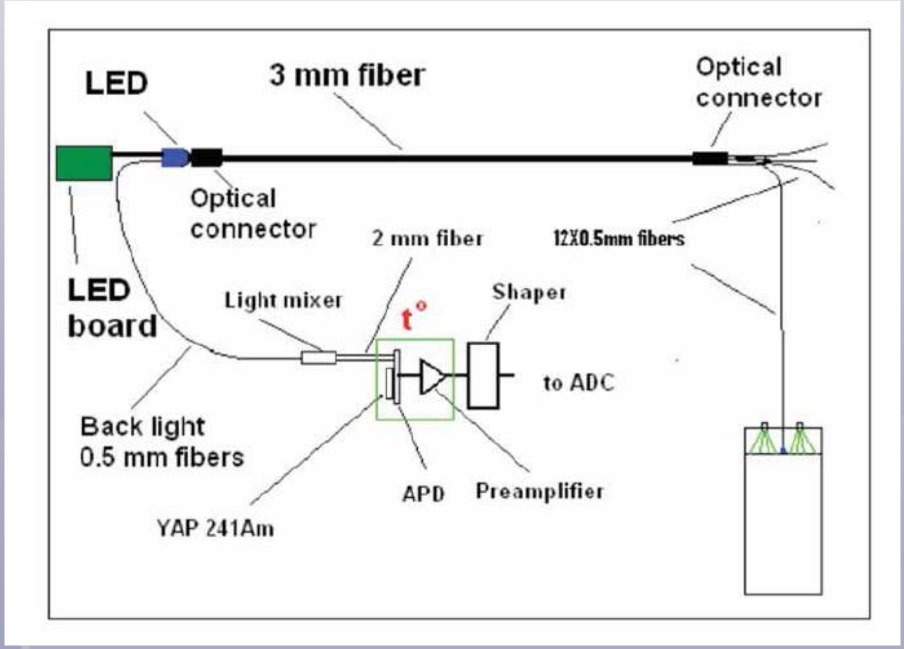
ALICE

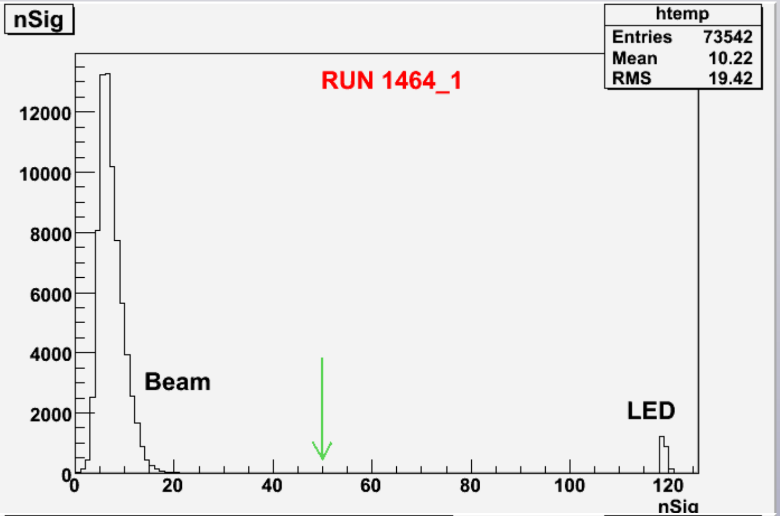
Electromagnetic Calorimeter

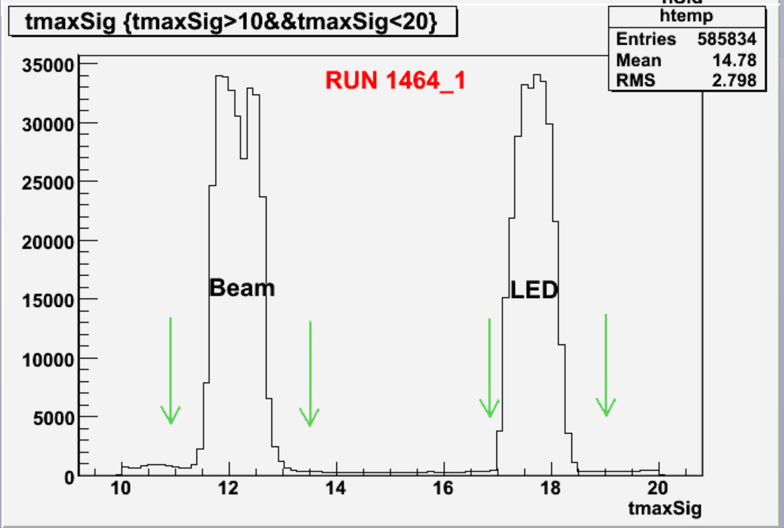
Technical Design Report

LED Monitoring System

LED system needed for gain adjustment and gain monitoring





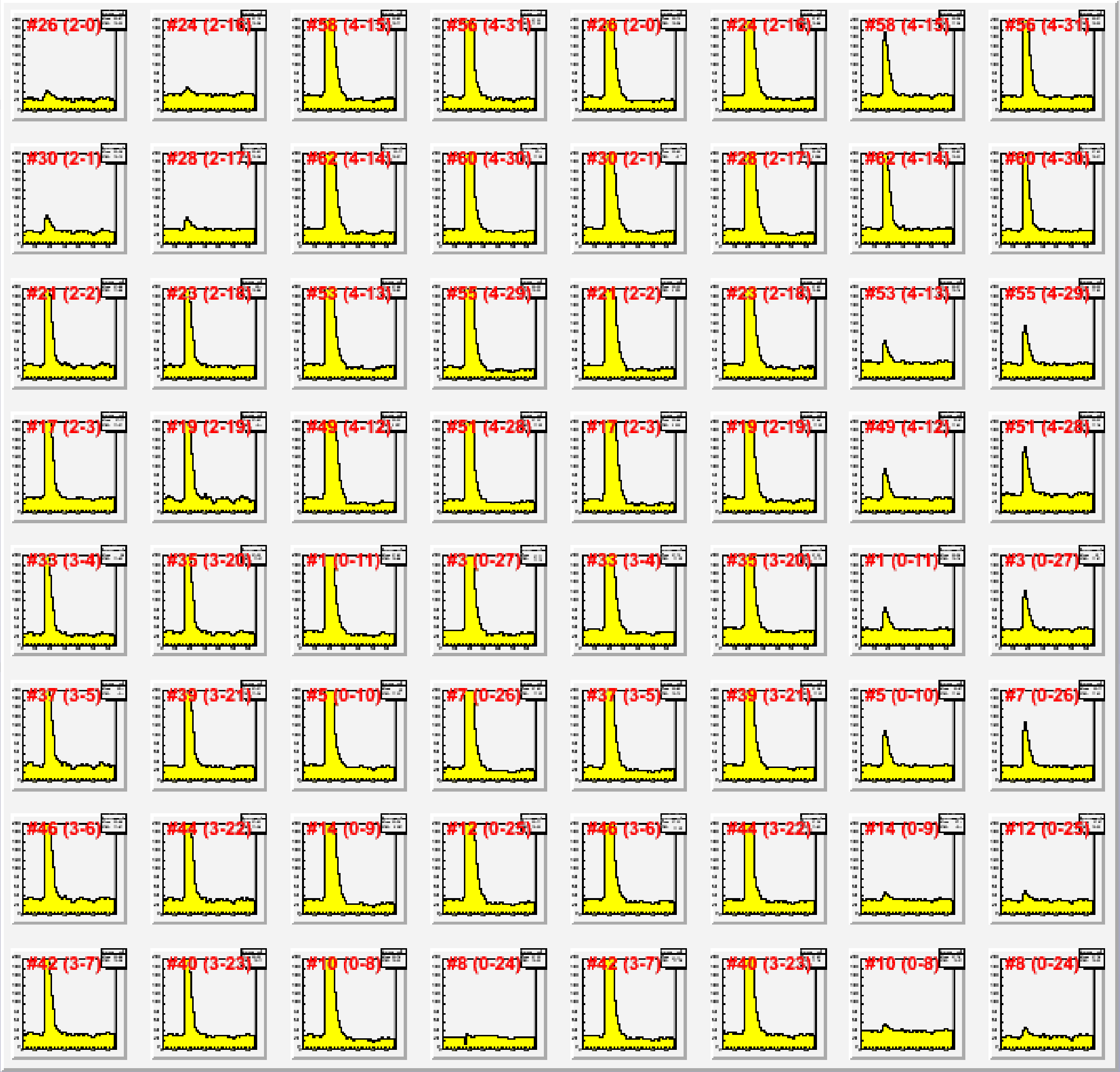


LED triggers collected in parallel with the beam particle events

Typical LED event in 8x8 towers

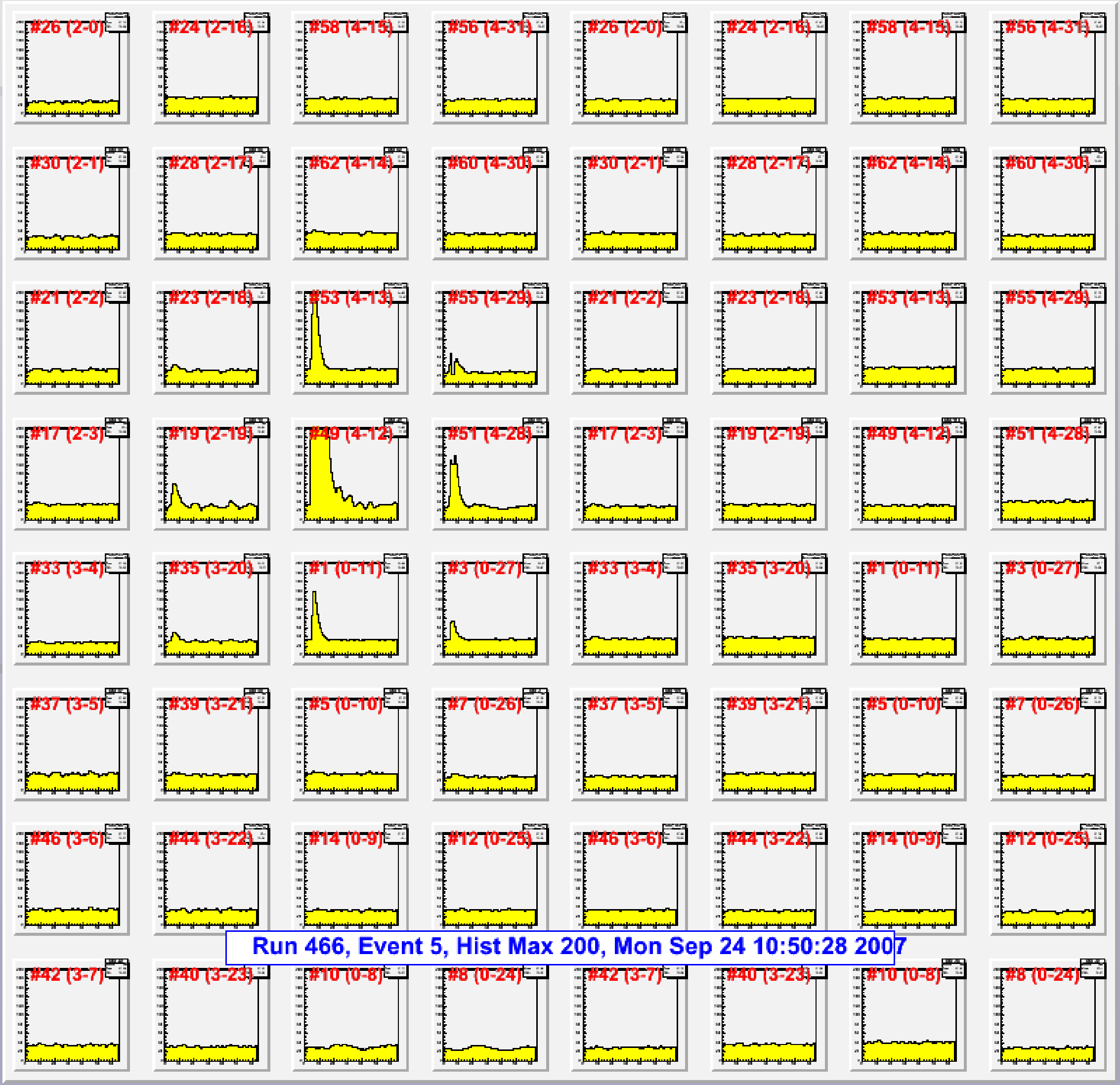
LED system gives enough light (~30 GeV equivalent)

Event Display: ADC vs Time-Sample #

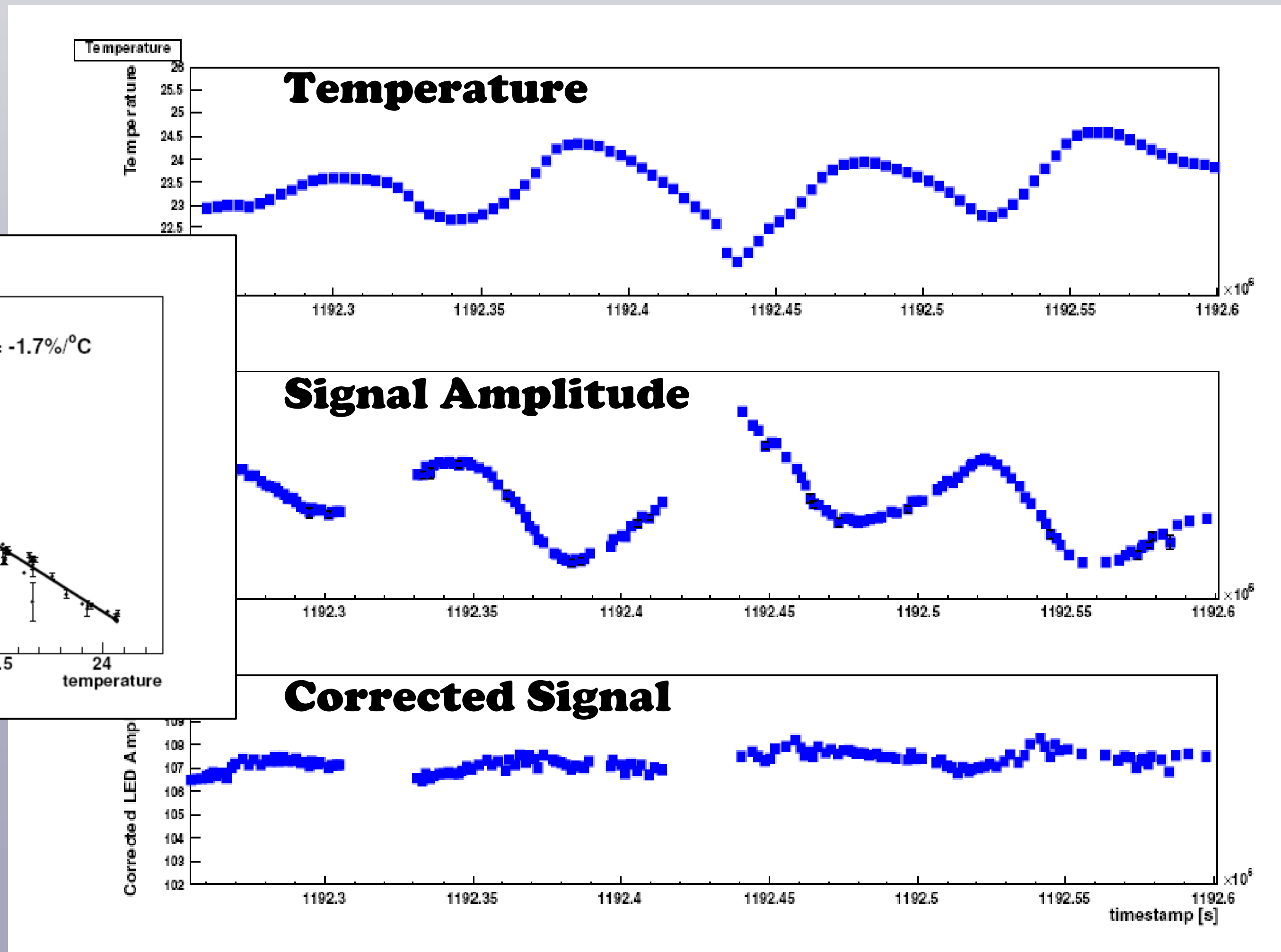


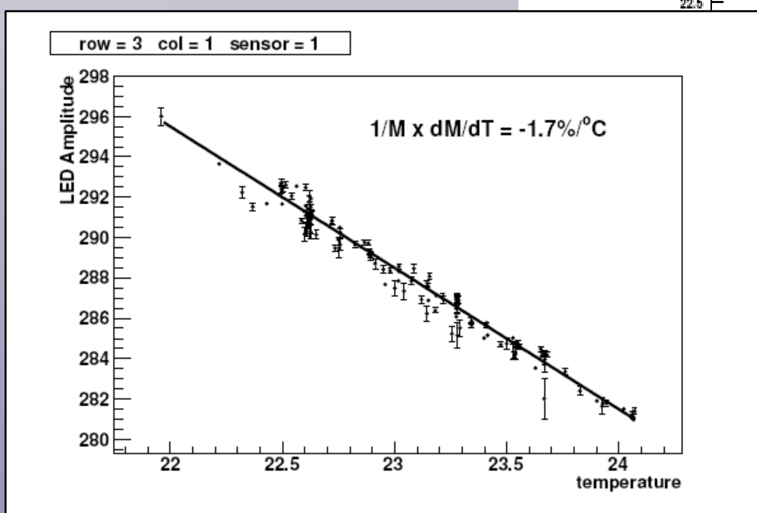
Event Display: ADC vs Time-Sample

Typical beam event in 8x8 towers (80 GeV)



Temperature Corrections





Energy Reconstruction

E(I) = A * c_I *AmpSig(I) * LED(I,J) / LED(I,Ref)

A → Absolute energy factor

c_I → Inter-calibration scale factors

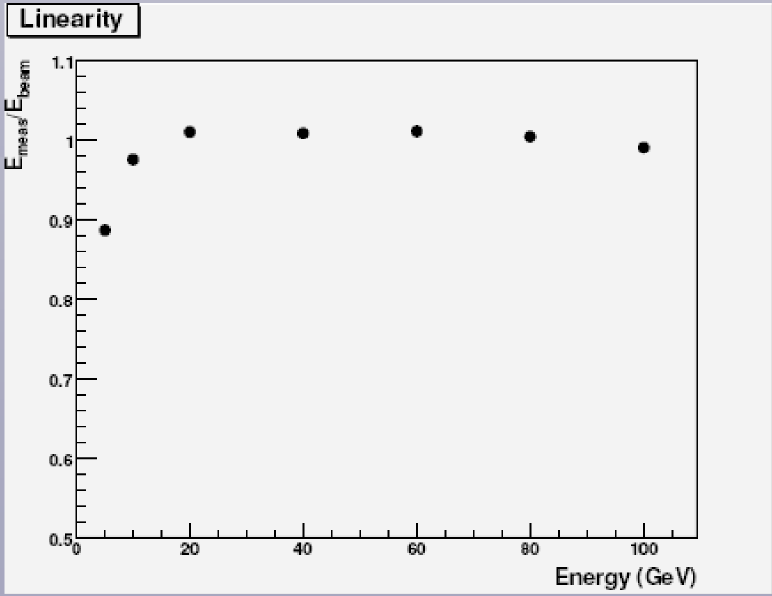
LED(I,J) / LED(I,Ref) → Temperature Correction

Calibration procedure:

- Calibration from MIPs
- Minimization approach

Caveat:

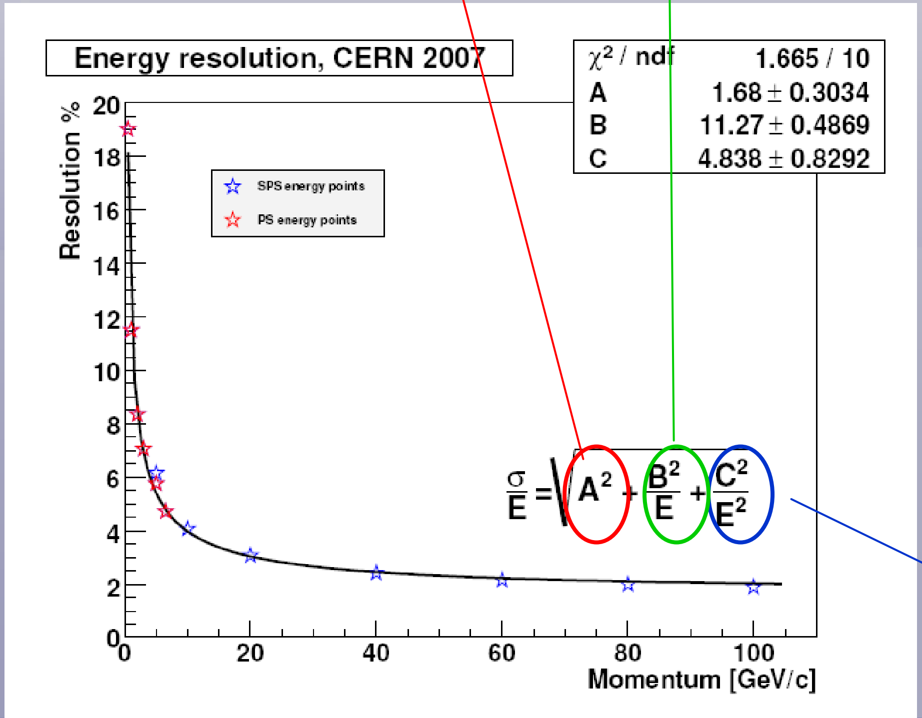
- Energy lateral losses
- Signal below threshold

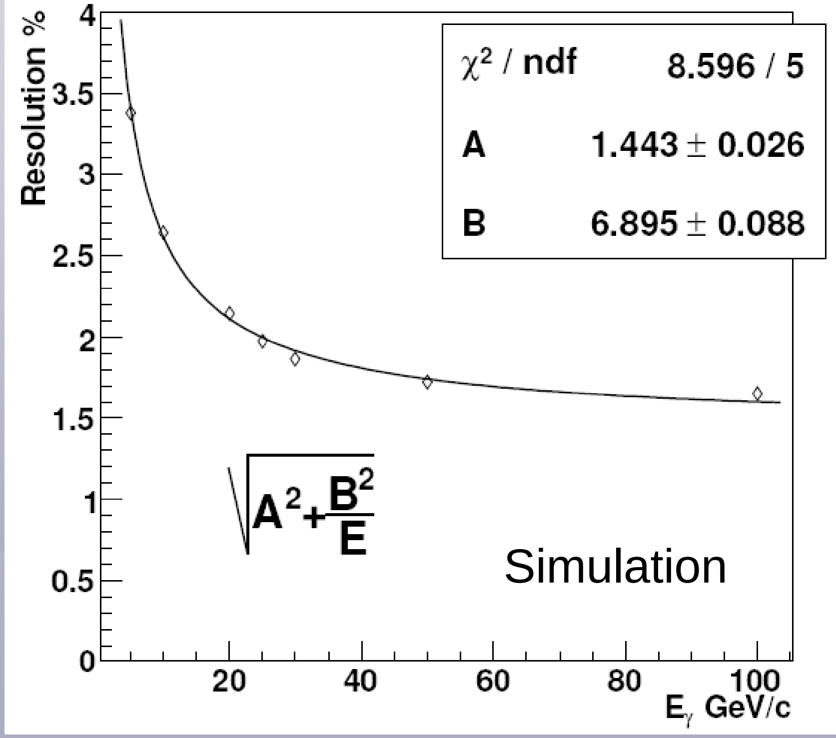


Energy Resolution

Stochastic fluctuations

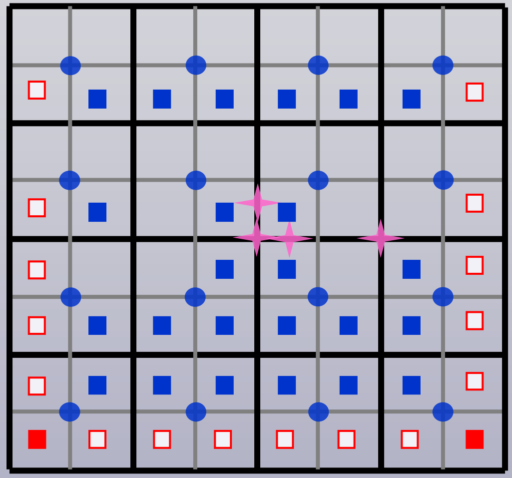
Systematic effects

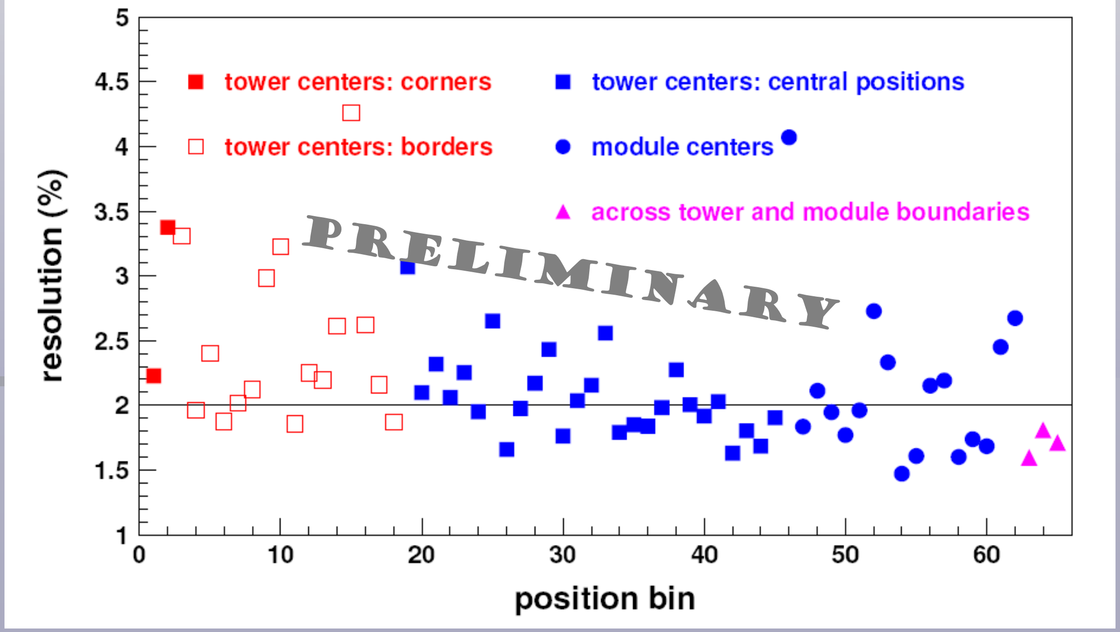




Electronic noise

Uniformity of the energy response

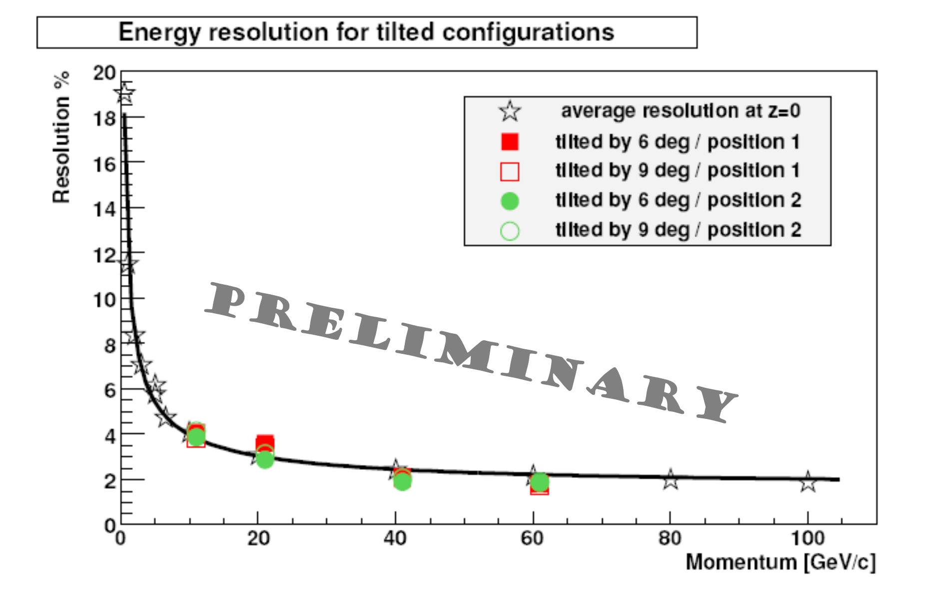


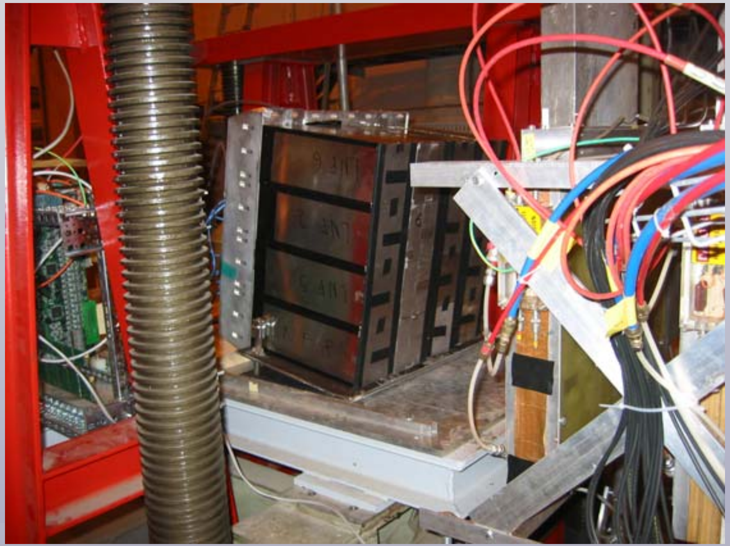


Energy resolution for 80 GeV electrons runs

Tilted configuration

Phi-Tilt configurations - 3,6,9°



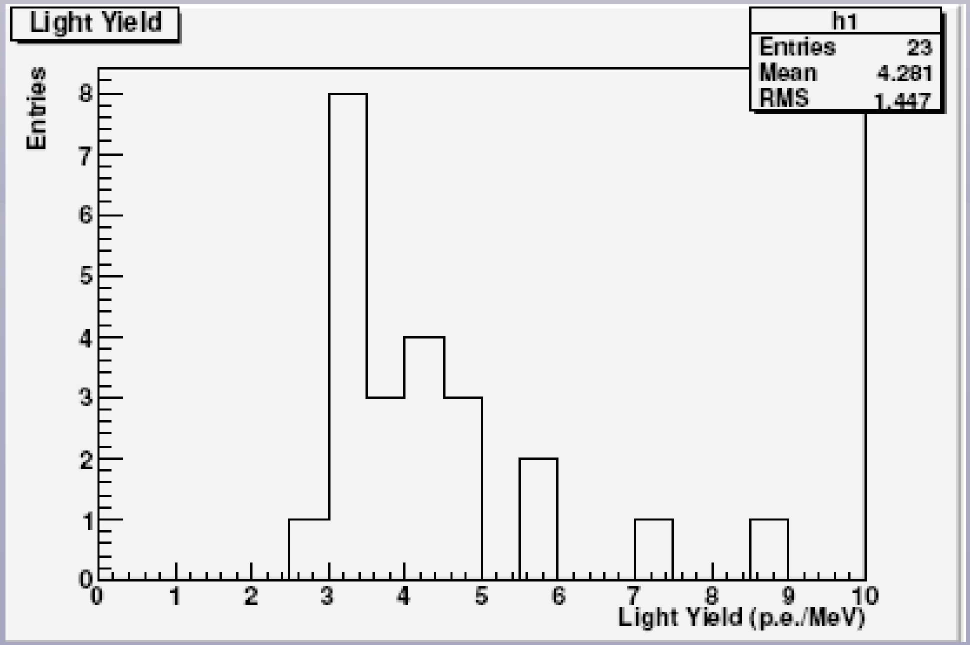


No significant difference with the average resolution at phi = 0° position was observed

Light Yield

Number of photoelectrons /MeV (for APD gain = 1)

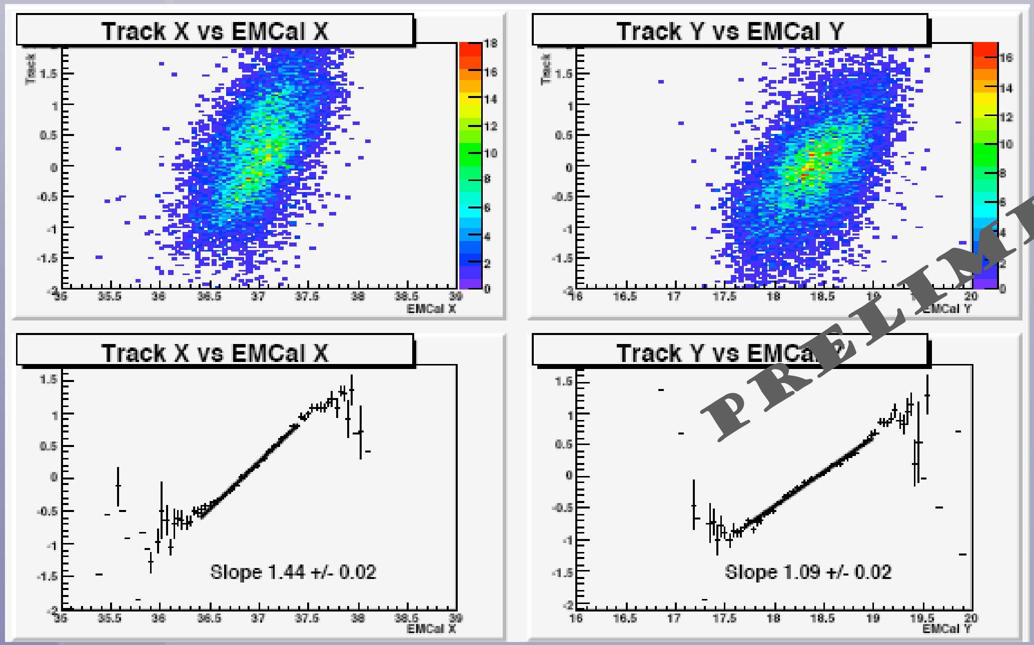
$$LightYield(p.e./MeV) = (channels/MeV) \cdot (1/G_A) \cdot (1/P_G) \cdot (1/ADC_{conv})$$

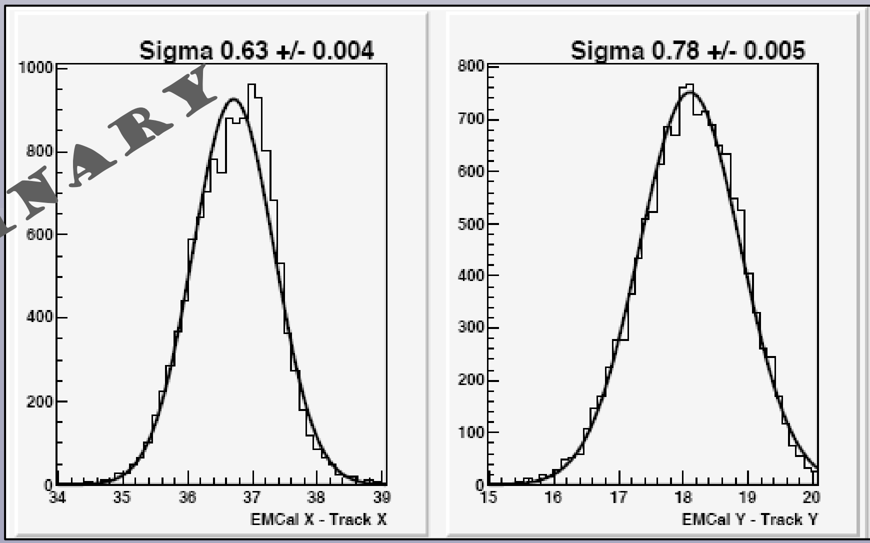


LY = (4.3 ± 0.3) p.e./MeV

Position resolution

- Signals are summed in 3 by 3 window centered on tower with maximum amplitude
- Hit positions are determined by averaging the log weighted sum of the tower signals





Conclusions

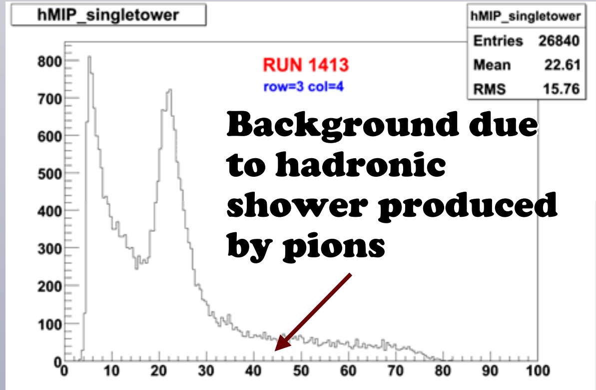
- **Analysis of EMCal TestBeam data is almost at the end**
- **Large contribution from Italian groups**
- **Main results already inserted in 2008 TDR**
- **Additional improvements for a NIM paper**

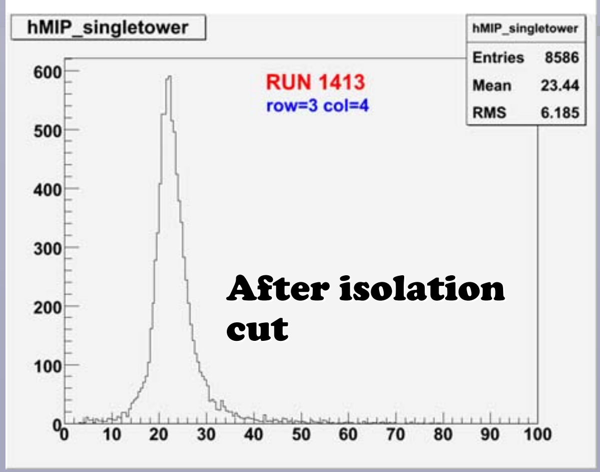
Back-up slides

Calibration

1. MIP SELECTION

→ Isolation cut





2. MINIMIZATION PROCEDURE

Calibration factors αi calculated by the minimization of the quantity:

$$F(\alpha) = \sum_{j=1}^{N} \left(\sum_{i} \alpha_i A_{ij} - E_e \right)^2$$

where index i runs over the towers, index j over all calibration events