# EMCAL Offline Status

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Offline Week - 08/April/2008

# Overview

- Completed tasks
- Tasks in progress
- Overdue tasks
- Summary and plans

# Completed Tasks

(since October 2007 Offline Week)

- Alignment (181)
  - Task 1270 (24/10/07): For each alignable volume, creation of the matrix performing the transformation from the coordinate system used in the central tracking to the local coordinate system used in TGeo.
  - Task 256 (24/10/07): Reconstruction code (namely tracking) has to be aware of the current geometry via queries to TGeo; hardcoded parametrization (of the ideal geometry) has to be removed.
  - Tasks 182, 253 (29/02/08): Format of survey data and conversion into alignment objects

# AliEMCALSurvey class

- Followed example of PHOS code to implement AliEMCALSurvey.cxx and *.h
  - Reads text file with survey data and converts it to AliAlignObjParams
  - Dummy data and algorithm until we know what the actual survey points are
    - Only Supermodules will be surveyed/aligned
    - Code currently uses just the central x,y and exterior z position of each supermodule
  - Results can be stored to OCDB
- emcal_survey_data.txt contains dummy “survey” points
- Macros MakeEMCAL_XXX_MisAlignment.C (where _XXX_ stands for “Full”, “Res” and “Zero”) in $ALICE_ROOT/EMCAL updated to use AliEMCALSurvey and emcal_survey_data.txt
- Will be updated
  - Once real survey points are known
  - To read EDMS files

# Completed Tasks

(since October 2007 Offline Week)

- Calibration (186)
  - Task 222 (01/04/08): Provide list of data points to be retrieved by the Shuttle; analysis and storage of DP arrays in the preprocessor

Preliminary ▪ SHUTTLE chain with HistoProducer/ Preprocessor/ CalibData already in place for some time

At last EMCAL Offline meeting (01-Apr-08) we settled on final data elements and a scheme for filling them (see Pending Tasks and D. Silvermyr presentation on Friday in SHUTTLE/DA session) ▪

  - Task 1271 (27/02/08): Implementation of the Detector Application running in the DAQ and producing the calibration data to be collected by the Shuttle
  - Task 1456 (27/02/08): DAQ FXS Output files

# EMCALda class

- EMCALda.cxx

```
/*
  EMCAL DA for online calibration

  Contact: silvermy@ornl.gov
  Run Type: PEDESTAL_RUN or PULSER_RUN
  DA Type: LDC
  Number of events needed: ~100
  Input Files: argument list
  Output Files: RESULT_FILE=EMCALda1.root, to be exported to the DAQ FXS
  fileId:  FILE_ID=EMCALda1
  Trigger types used: CALIBRATION_EVENT (temporarily also PHYSICS_EVENT to
start with)

*/
/*
  This process reads RAW data from the files provided as command line arguments
  and save results in a file (named from RESULT_FILE define - see below).
*/
```

  - Uses AliCaloCalibPedestal
  - Will be updated as calibration algorithms developed

# Completed Tasks

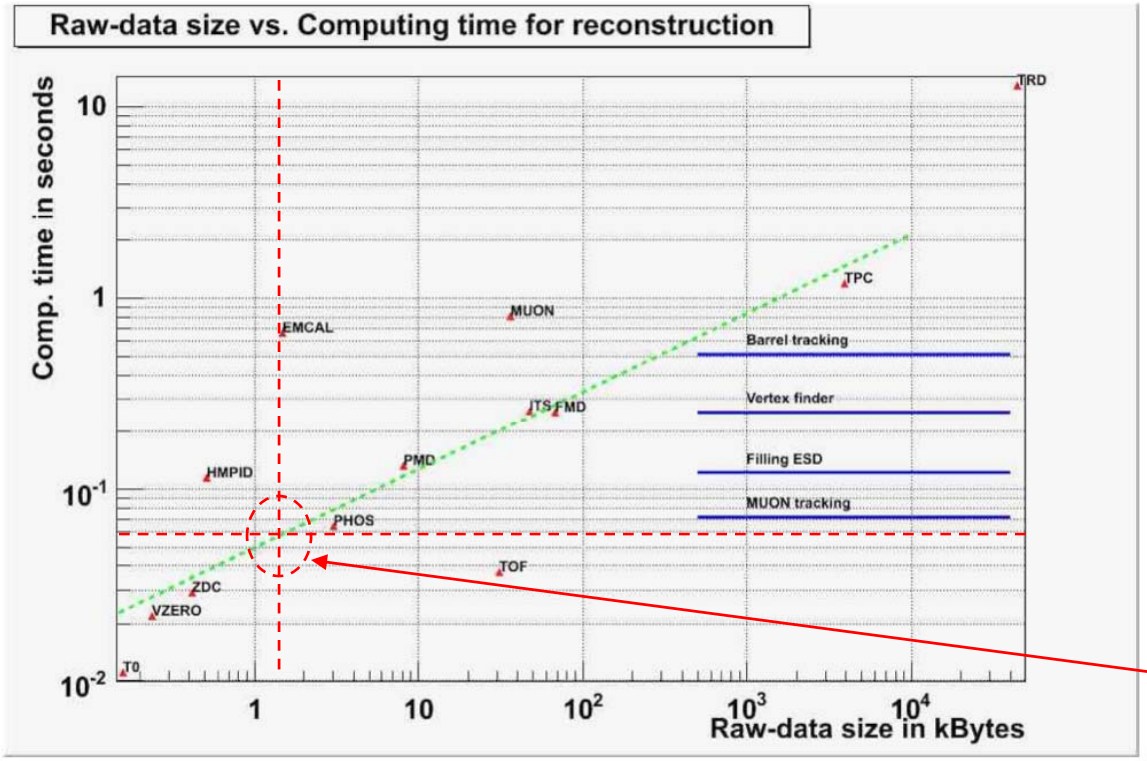
(since October 2007 Offline Week)

- Reconstruction (194)
  - Task 1696 (24/10/07): Derivation of the RecPoint/Cluster class from the new AliCluster with the proper setting of the alignable volume ID.
  - Task 1814 (05/02/08): Benchmark reconstruction, task by task (where is time bottleneck?), report findings/solve problem
    - See presentation at http://indico.cern.ch/conferenceDisplay.py?confId=28177
    - Compared reconstruction time for EMCAL to other detectors and July 2007 benchmarks and found that it already adequately meets the requirements.
  - Task 1813 (20/02/08): Remove TMinuit fitting from AliEMCALRawUtils, implement fast algorithm
    - Evaluated linear fitter for raw signal, but current parametrization cannot be linearized.
    - Investigated fixing 3 of 5 fit parameters. Fixing resulted in a slowdown of 5 ms/event rather than a speedup.
    - Further improvements, if possible, will be made after the completion of analysis from CERN 2007 beam tests.

# Benchmark reconstruction

From Cvetan's Reconstruction benchmarks talk:

## Recent AliRoot HEAD

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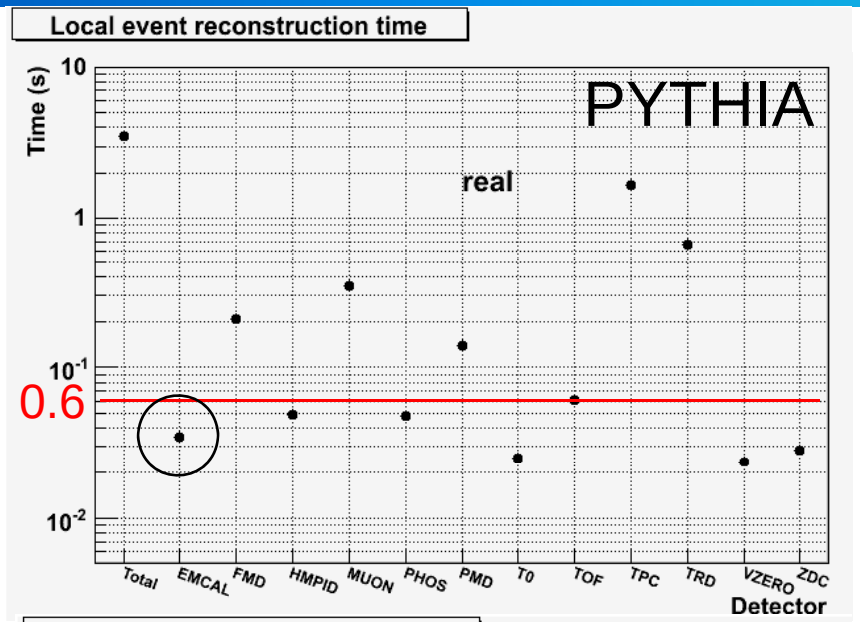
Based on this, we defined a new task:

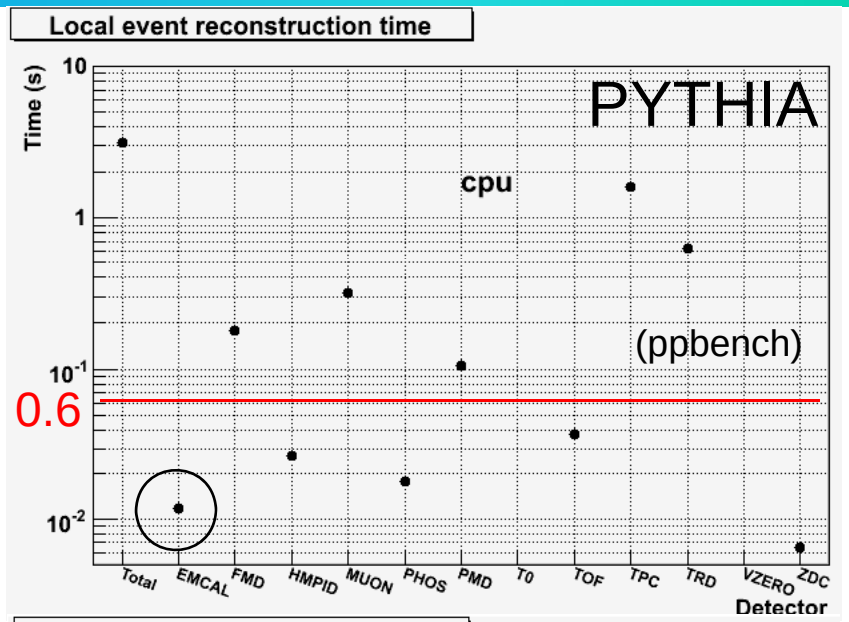
Task 1814: Benchmark reconstruction, task by task (where is time bottleneck?), report findings/solve problem

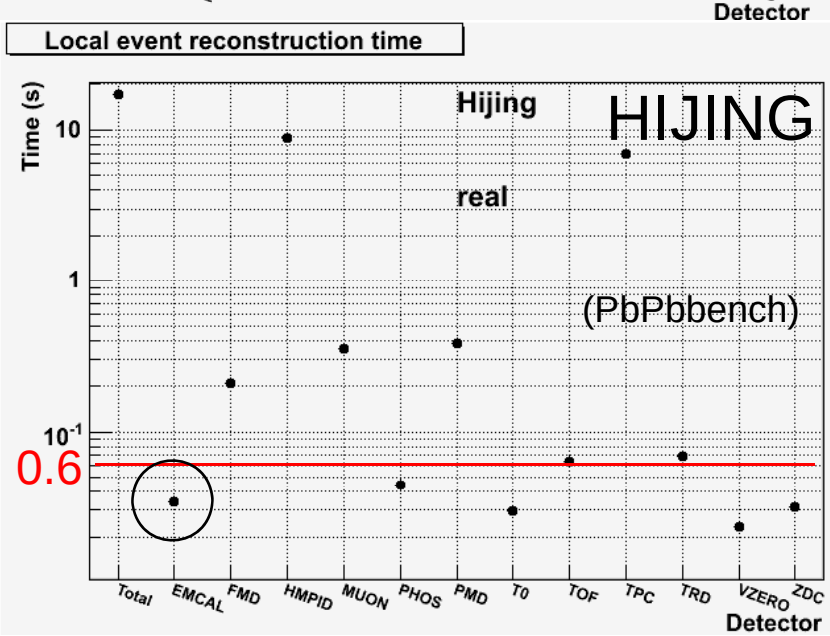
Target: <0.6s/event

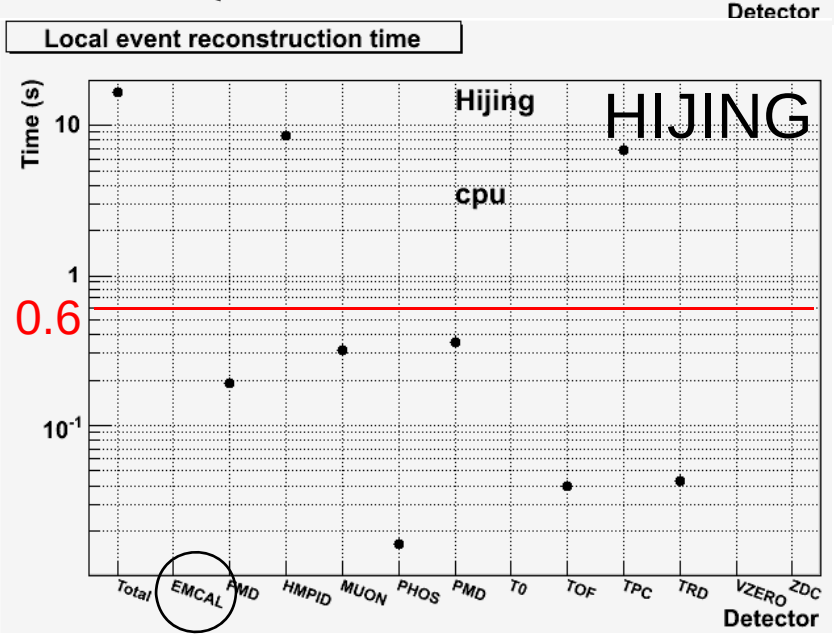
http://indico.cern.ch/conferenceDisplay.py?confId=7104

# Per event reconstruction time



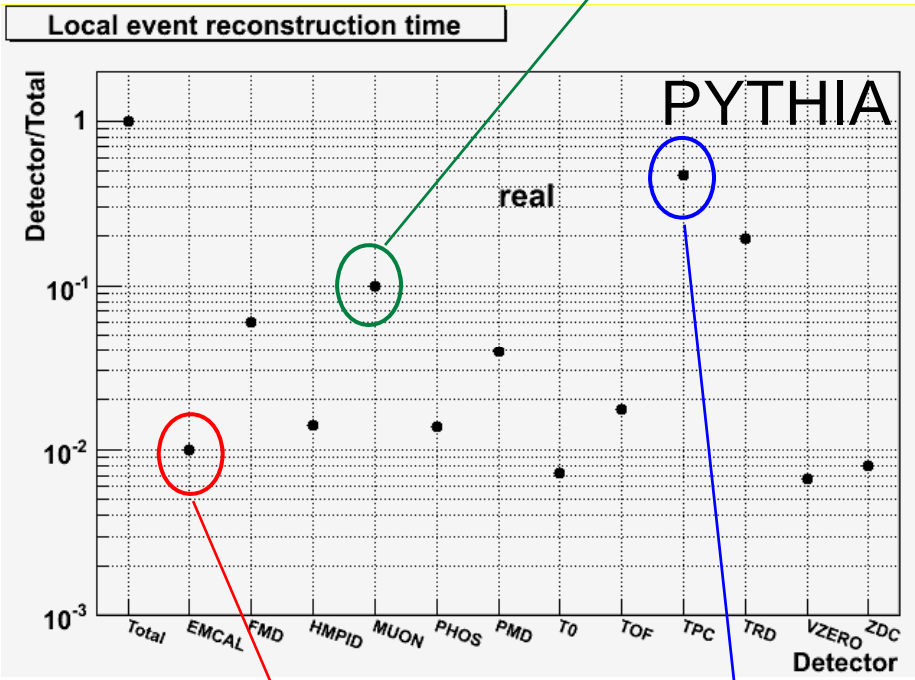



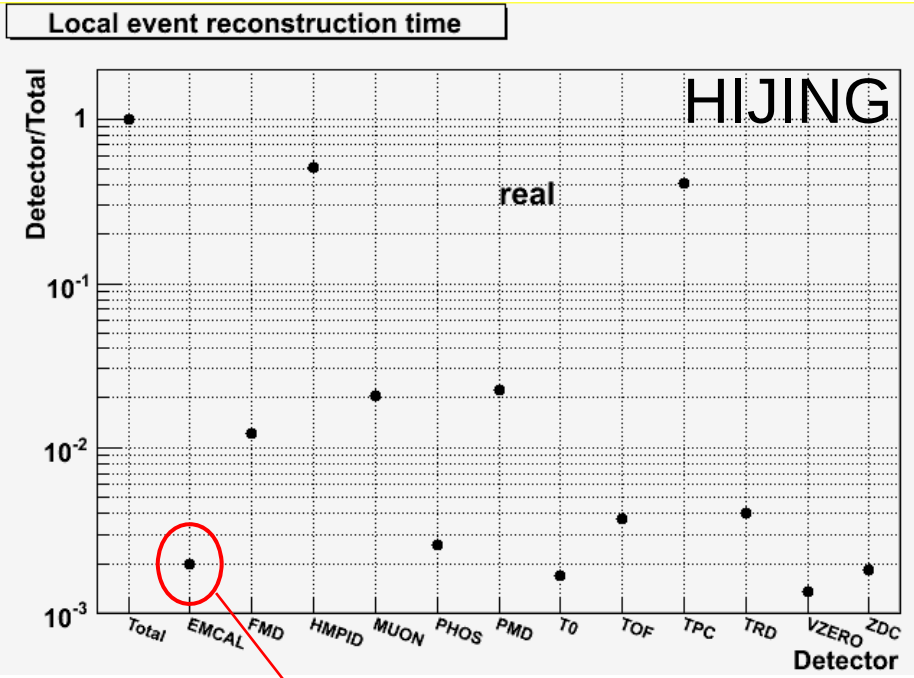

Below graph threshold

# Real time fractions

Per event reconstruction time

MUON is 10%




EMCAL is 1% of total time

TPC is ~50%

EMCAL is 0.2% of total time

# Completed Tasks

(since October 2007 Offline Week)

- Quality Assurance (1347)
  - Task 1454 (27/02/08): Implement C++ coding recommendation and convention

This is ongoing - as new code is introduced, we strive to make sure it meets requirements but…

How do we put a deadline on a moving target?

# Other Updates

- AliESD/AODCaloCells/CaloCluster updates (Nov ‘07)
  - Added new class to store EMCAL ‘digit’ info for jet background subtraction (formerly stored in ‘pseudoclusters’)
  - AOD objects defined
- Updates to AliEMCALClusterizer and AliEMCALClusterizerv1
  - List of changes: 1) pseudo clusters removed, 2) AliESDCaloCells filled, 3) Fill new AliESDCaloCluster methods, 4) Remove debug messages from reconstruction by default
- Testbeam analysis within AliRoot (Dec ‘07)
  - Updated AliEMCALRawUtils with testbeam fit function
  - Defined subdirectory $ALICE_ROOT/EMCAL/beamtest07
    - Included example reconstruction macro for running within AliRoot
    - Included macro to create and store testbeam calibrations to local CDB object

# Other Updates

- AliEMCALRecParam updates (Nov ‘07 and Feb ‘08)
  - Track-matching and PID parameters incorporated
  - One can now set some of the fitting parameters for raw reconstruction via AliEMCALRecParam
    - HighLowGainFactor, order parameter, tau, noise threshold, number of pedestal samples to use
  - Changes to AliEMCALRawUtils to use the updates included
- First version of EMCAL MOOD code checked in (Feb ‘08)
- Global Track-matching
  - Have developer (J. Hamblen) to work on it; in progress

# Tasks in progress

- Calibration (186)

D. Silvermyr, Gustavo, J. Hamblen

  - Task 1809 (15/05/08) : Incorporate LED Calibration code into AliRoot
  - Task 1272 (15/05/08) : Provide the name and the related implementation for the Data Points to be monitored and archived by the DCS Archive Data Base
  - Task 1273 (15/05/08) : Implementation of the Detector Application running in DCS and producing the calibration data to be collected by the Shuttle
  - Task 1274 (15/05/08) : Define the output files produced by DCS, stored in the File eXchange Server and collected by the Shuttle

M. Ploskon

  - Task 1275 (15/05/08) : Implementation of the Detector Application running in the HLT and producing the calibration data to be collected by the Shuttle
  - Task 1276 (15/05/08) : Define the output files produced by HLT, stored in the File eXchange Server and collected by the Shuttle
  - Tasks 220, 221 (31/12/08) : Implementation of access to DAQ and HLT file exchange servers in the preprocessor

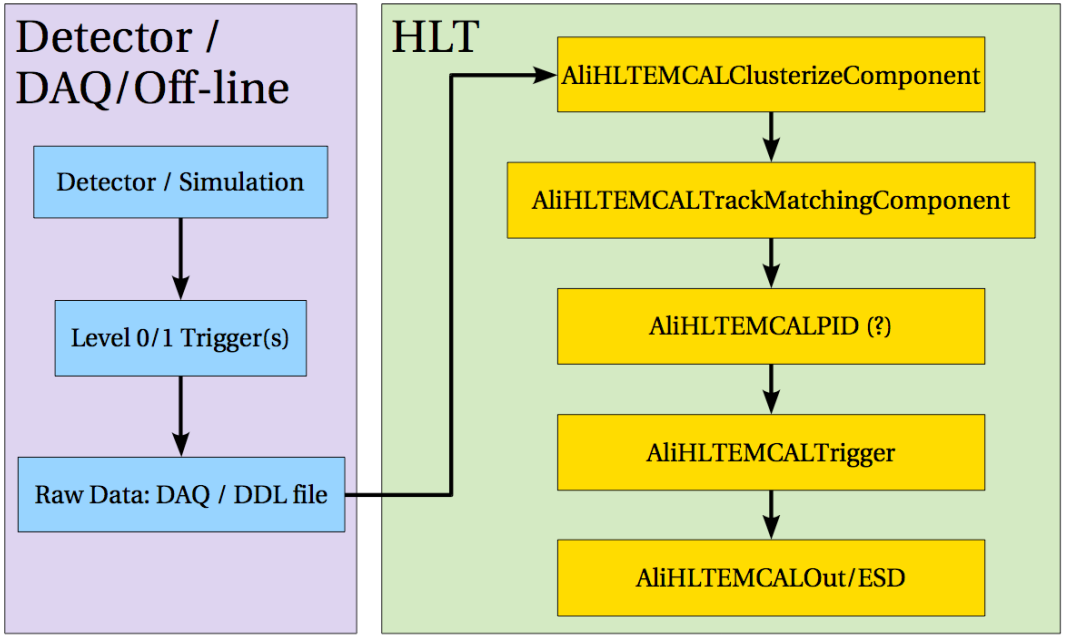
# DCS/Calib Plans

See presentation by D. Silvermyr on Friday for more details

- Separate ‘time-independent’ and ‘time-dependent’ calibrations
- Proposed scheme:
  - For runnumber X at time T, pick up valid time-independent calibration from reference t0
  - Also pick up valid LED and ELMB (temperature) info at both time T and t0
  - Use these pieces to convert ADC amplitude to energy (one combined “conversion factor” per tower in memory)
- Three calibration data objects:
  - Calib (similar to existing AliEMCALCalibData but only time-independent piece of gain normalization)
  - LED (info on amplitudes from LED events)
  - ELMB (temperature sensor data)
- Much of the needed code exists - just needs to be combined into complete algorithm
- Main complication for EMCAL calibrations:
  - physics runs can be up to many hours long, resulting in the need for multiple sets of calibration values for a single runnumber.. (requires more care to get this right; 1h max length would have made our lives much easier)
- Expect to be able to complete by due date (15/05/08)

# HLT Plans

- M. Ploskon (LBNL) HLT expert now working on EMCAL
- Has developed data flow plan and basic reconstruction skeleton
- Concrete implementation in progress
- Expect to be able to complete by due date (15/05/08)

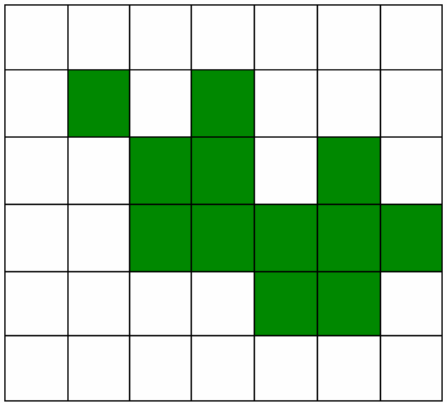


# Tasks in progress

- Reconstruction (194)
  - Task 1815 (15/05/08) : Implement cluster unfolding in AliEMCALClusterizerv1

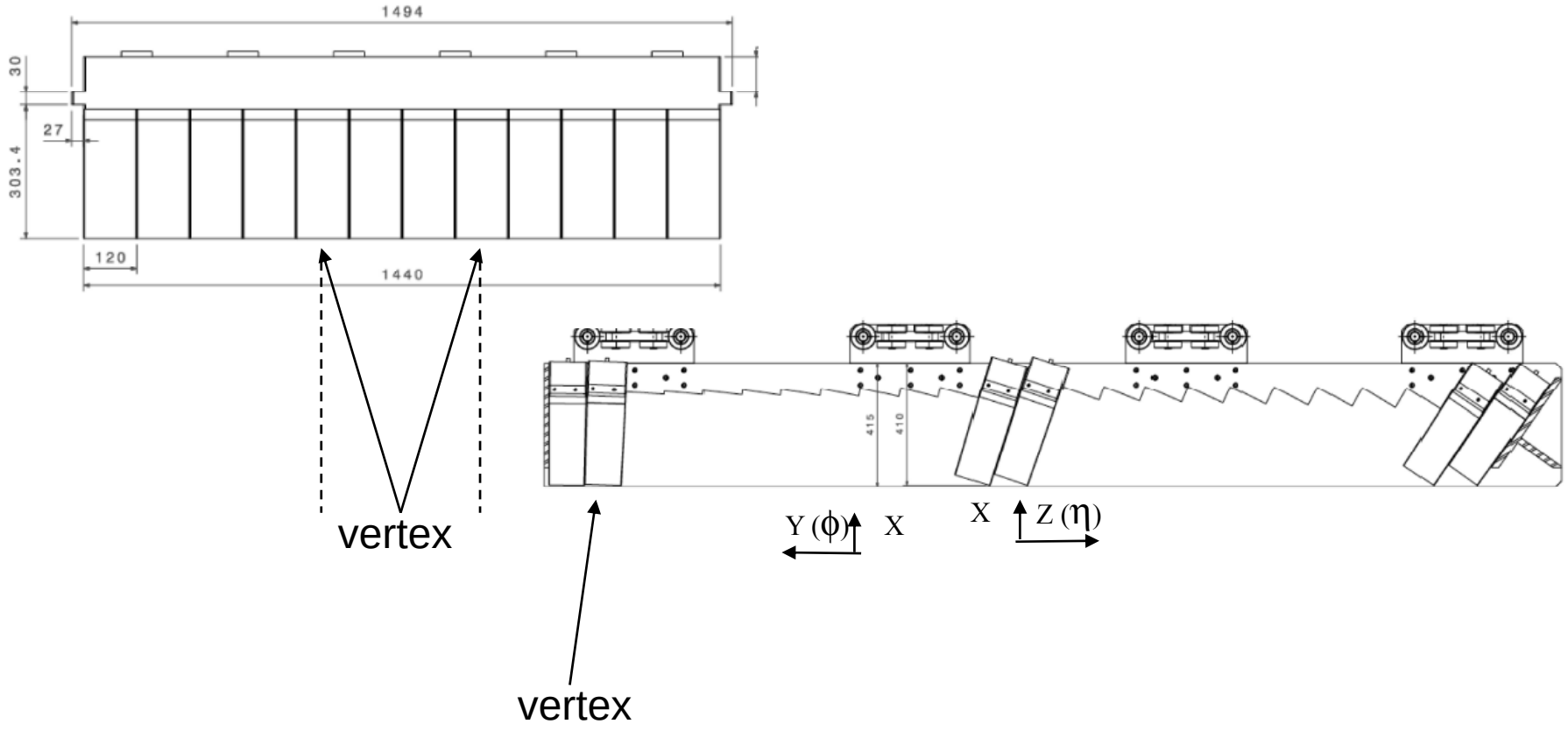
    Developer: Cynthia Hadjidakis, Subatech
    (see http://indico.cern.ch/conferenceDisplay.py?confId=28180)

1. Lateral distribution of the elm shower
   - from simulation
2. Unfolding algorithm:
   - search for local maxima in a cluster
   - unfold several local maxima with the lateral distribution of the shower in hand
3. Test of the algorithm at $\eta=0$



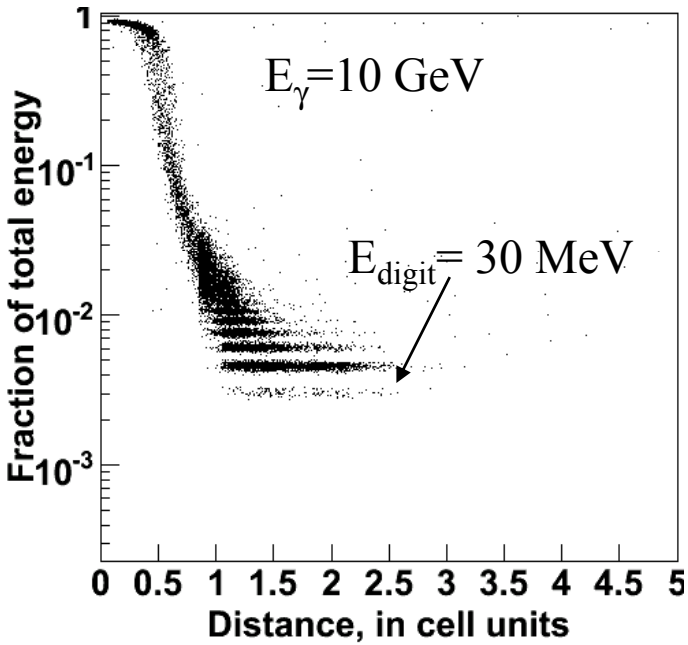
# Cluster unfolding: simulations

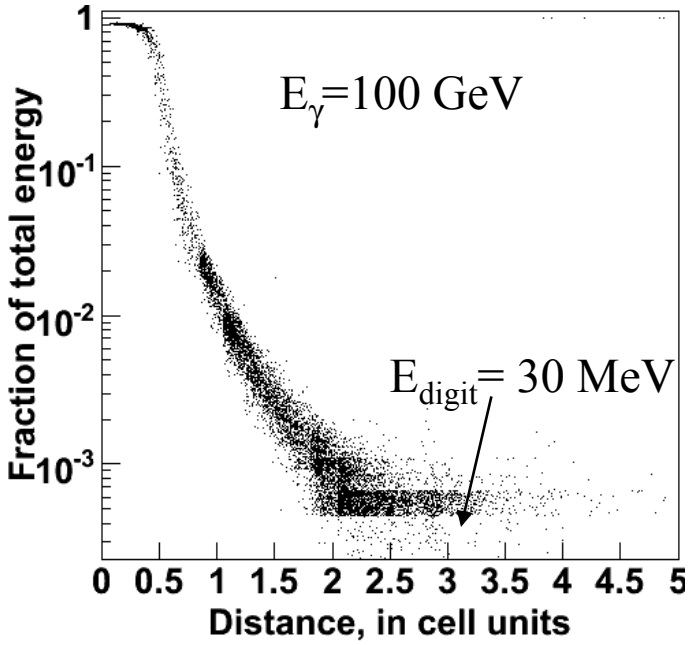
SIMULATIONS: γ E=10, 100 GeV, only EMCAL material, p-p configuration for reconstruction parameters (cell energy 10 MeV, cluster threshold 100 MeV)
η=0.037 (3rd cells row from η=0)
ϕ=[88° –92° ] (5 cells in ϕ)
vertex = (0,0,0) : γ not normal incidence…



# Lateral distribution of em shower

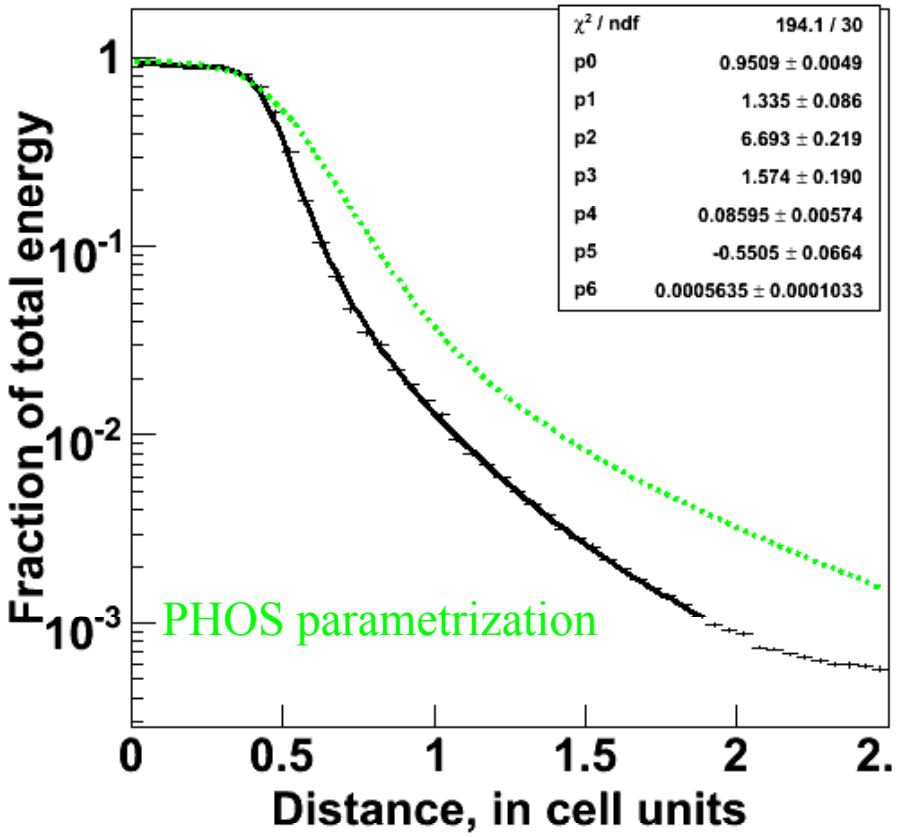
Response in one cell relative to the total energy vs the distance cell-incident particle in cell units




- $E_{digit}$ = 30 MeV : threshold in digitization
- No energy dependence (as expected from GEANT)

# Parametrized lateral distribution



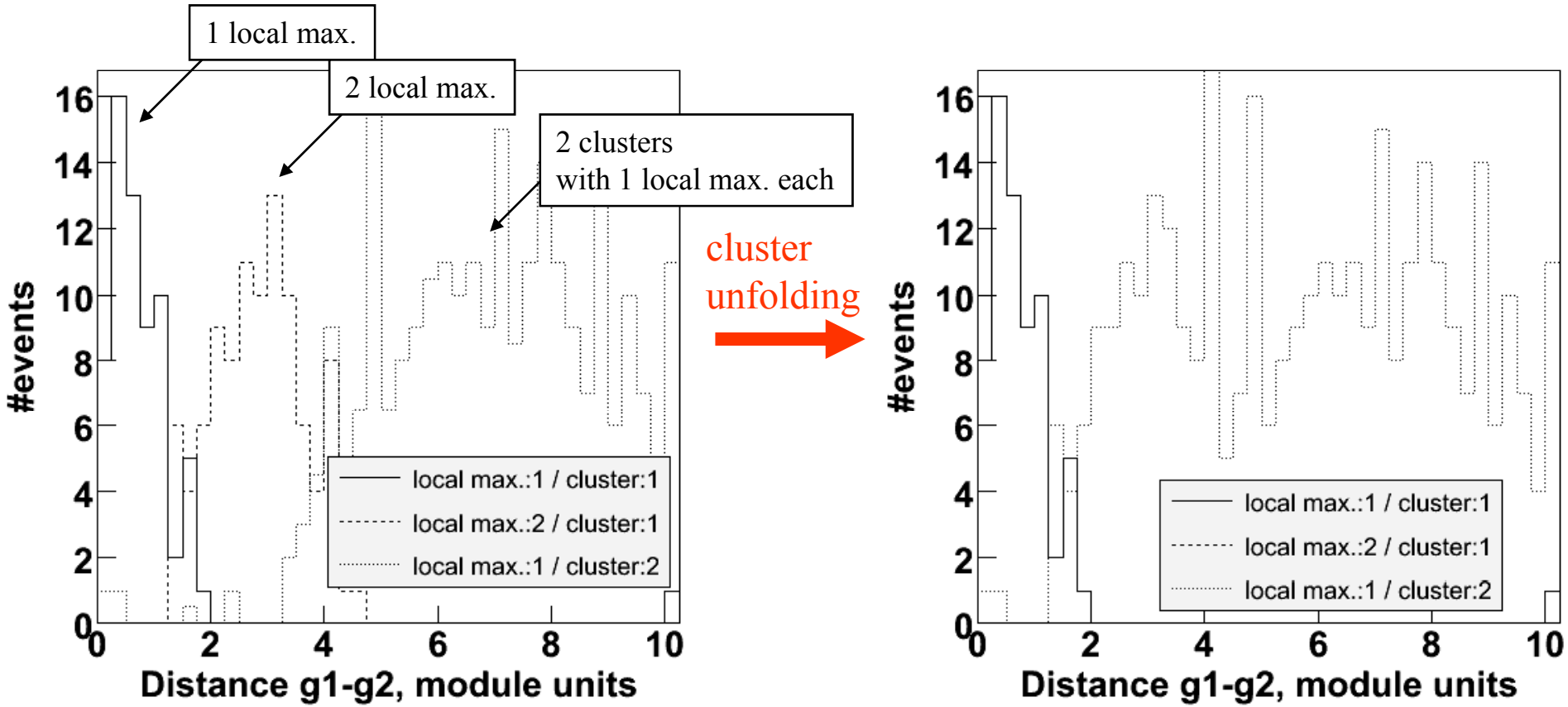

• Cell (tower) Size = 6 cm, Moliere Radius $R_M$=3.2 cm
→ plateau up to d ~ ½ cell size
→ 50% of the energy is deposited at d = ½ cell size (case of 1 incident γ between 2 cells)
→ 99% of the energy is deposited at d = 1 cell size

• Comparison with PHOS (Cell size = 2.2 cm, $R_M$ = 2. cm)

Parametrization : $p0 \exp(-\alpha.r^{p1})$ with r = distance in cm
$\alpha = 1/(p3+p4.r^{p1})+p5/(1+p6.r^{p2})$

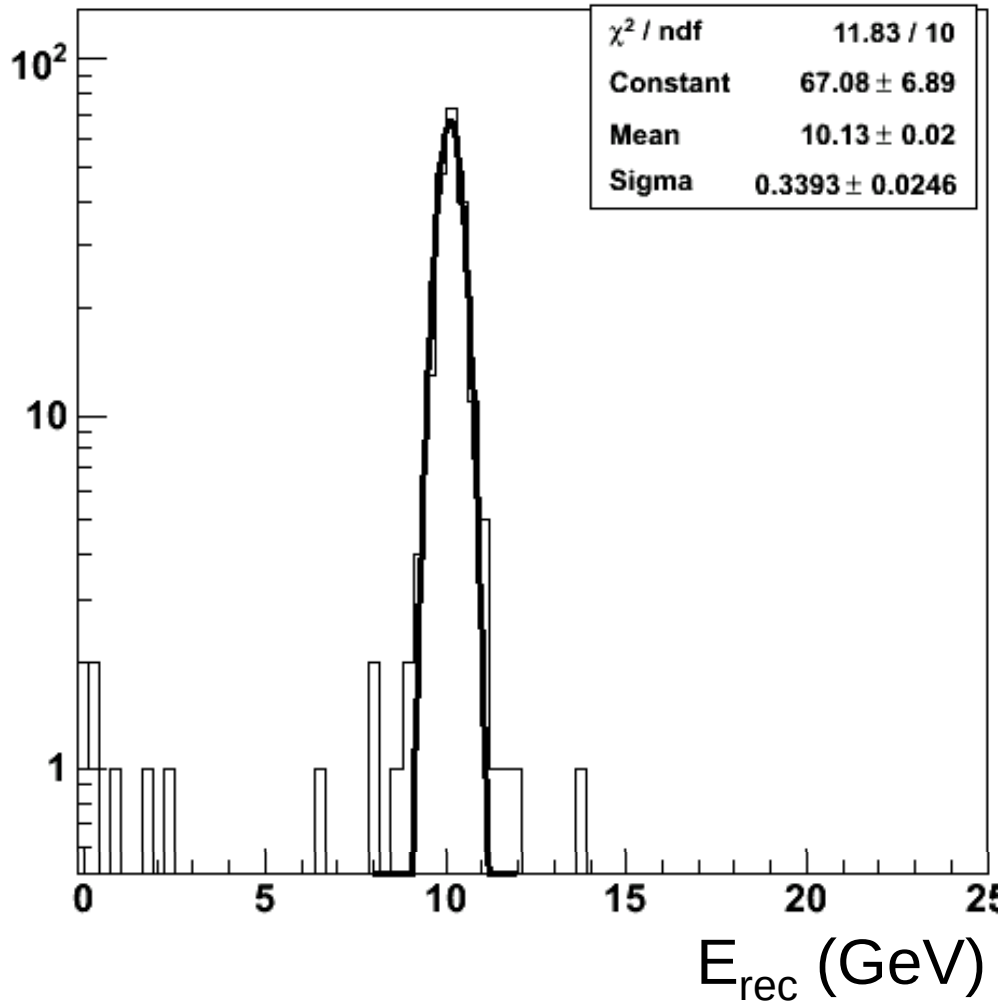
# Search for local max, apply unfolding

**simulation:10 GeV $\gamma_1+\gamma_2$ with $\eta$=0.037 $\phi$=[80° –90° ]**




Algorithm currently works for $\eta$=0 only: 3D cell's position in supermodule not implemented (all cells are supposed to be in y-z local plane as for $\eta$~0)

# Energy resolution




- Good energy reconstruction from cluster unfolding with resolution of 3.4% (resolution for resolved γ at 10 GeV = 3.1%)

# When will code be ready?

- After implementing
  - lateral shape with normal incident photon

    $\eta$=0 case for different configurations

    $\eta$!=0 case
- Testing algorithm with $\pi^0$
- Expect to be able to complete by due date (15/05/08)

# Tasks in progress

- Quality Assurance (1347)
  - Tasks 1349,1350 (15/05/08) : ESD and Digit QA

New developer - Sevil Salur (LBNL) working on adapting PHOS code. She's a new ALICE user, progress is slow during learning curve (Mateusz providing aid)

  - Task 1423 (15/07/09) : Pre-production validation - validate the entire detector software (geometry, alignment, simulation, calibration, reconstruction) on the set of data produced with day-1 version of AliRoot
    - Since EMCAL will not be part of the day-1 geometry of ALICE (except for the support rails), no reconstruction will be possible. Full EMCAL QA will be done when we prepare for first prodution with EMCAL installed.

# Tasks in progress

- Event Display (1289)
  - Task 1818 (15/06/08): Incorporate EMCAL to eve in compiled code

M. Estienne has volunteered to work on this. EMCAL already present in EVE via macros; should not be difficult to do, but there is a learning curve

- Geometry (1318)
  - Task 2209 (15/05/08): Please send the due date for this task by email to R. Grosso and Alina Grigoras (Done 29/02/08); Provide in the geometry necessary clearance around alignable volumes required in order not to introduce overlaps when applying the foreseen misalignment.

JLK to investigate and implement if necessary

# Tasks in progress

- Geometry continued (1318)
  - Task 1817 (01/09/08): Include space frame and strongback in geometry definition

Ryan Ward (Cal Poly student) will work on this as a summer project. Should be completed on schedule.

  - Task 1319 (31/03/09): Geometry as installed

# Other projects in progress

- Testbeam/Cosmics analysis
  - Tracking (J. Hamblen, etc.)
  - LED vs. temperature (F. Riggi and Catania group, R. Guernane, A. Pavlinov, etc.)
  - Isolation studies (S. Gadrat, etc.)
  - Pulse shape fitting (R. Ichou, etc.)
  - MIP Calibration with hadrons (M. Germain, etc.)
  - Data analysis (R. Guernane, A. Pavlinov, Yale group, etc.)
- JETAN/Jet analysis
  - M. Estienne, J. Putschke
- PWG4/Gamma Analysis Code
  - G. Conesa

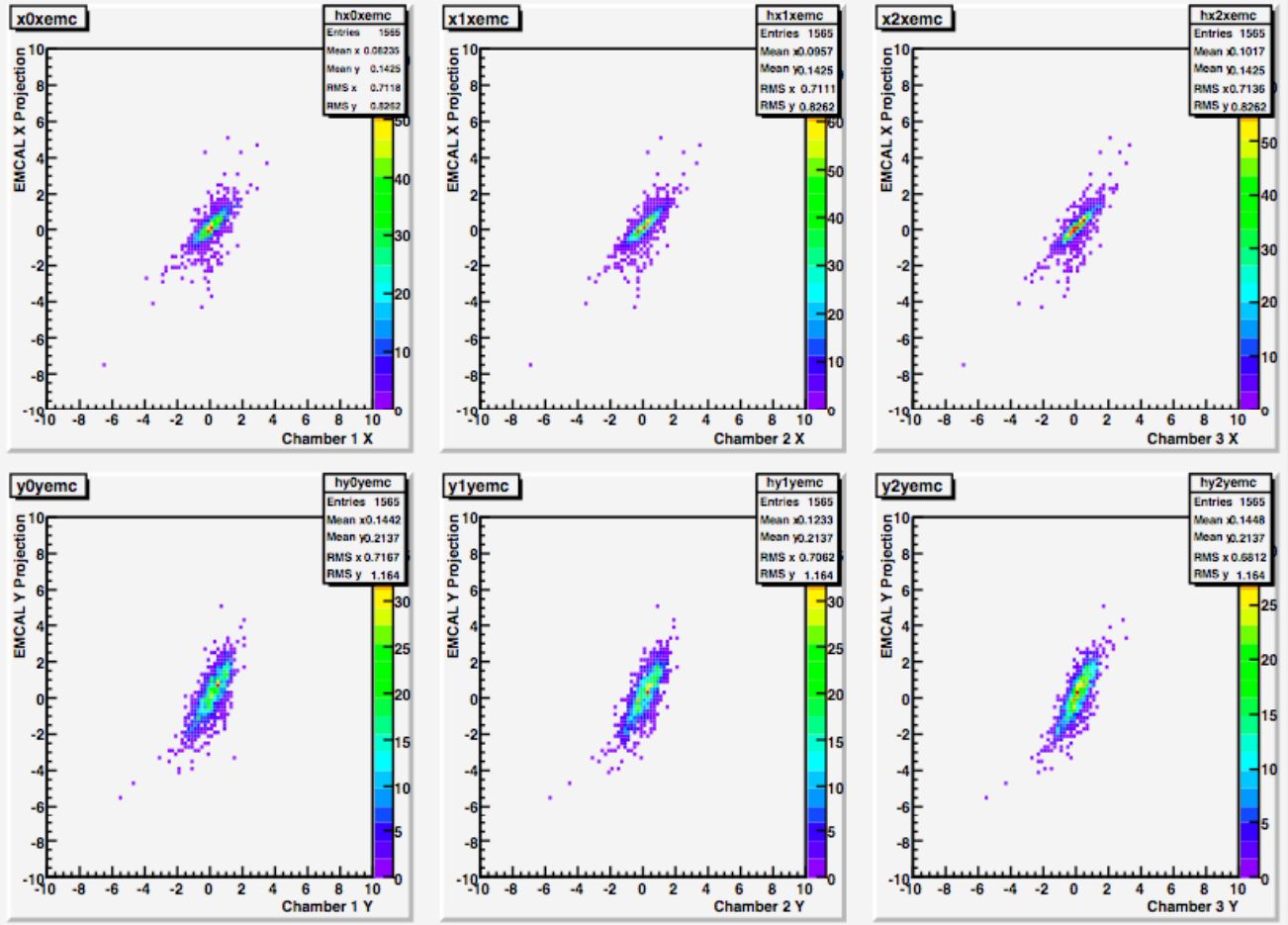
Note: Names next to tasks only denote developers who have given recent updates on specific topics at meetings; my apologies if I missed someone

# Testbeam analysis: Tracking

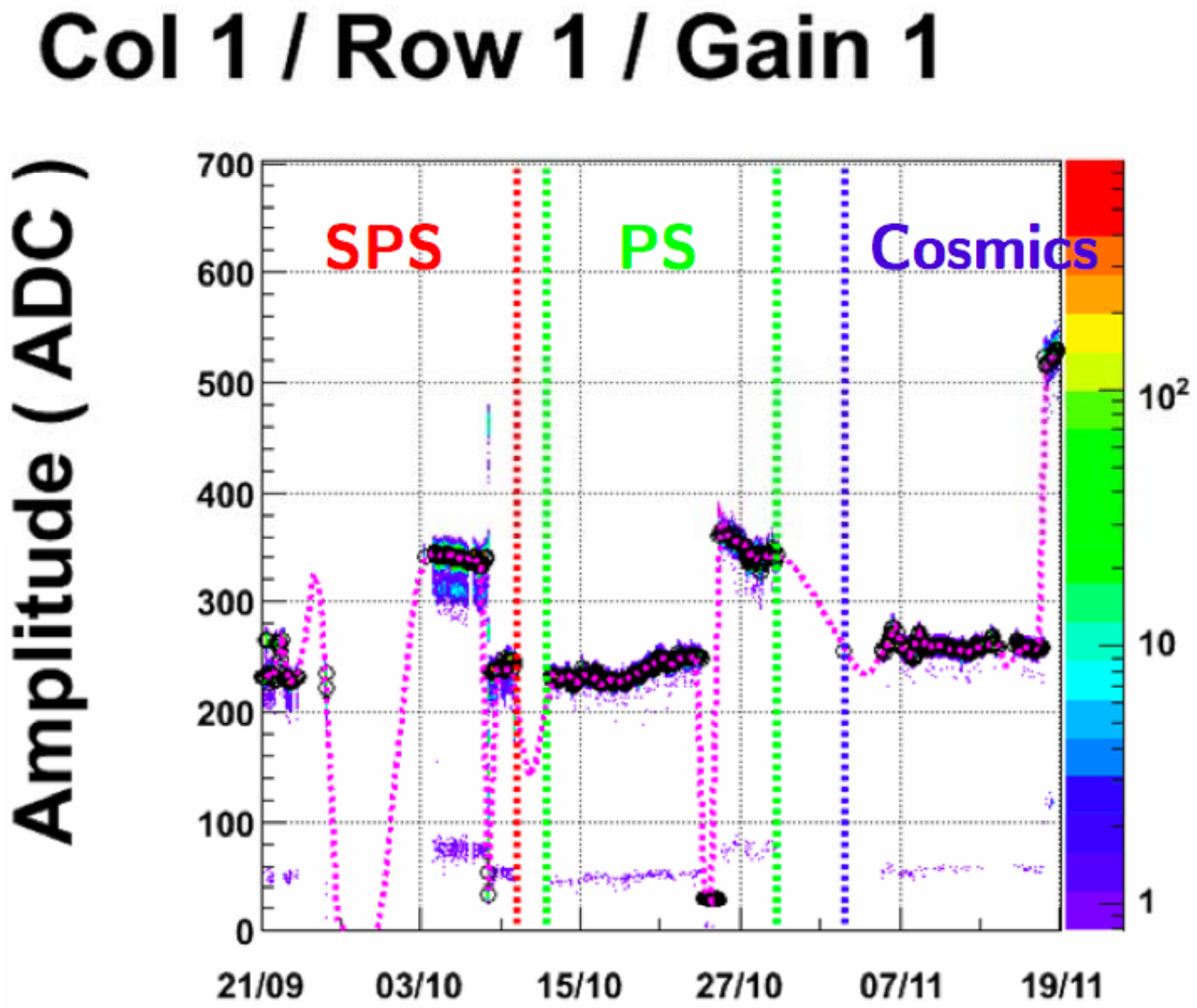
Projected track position at EMCAL vs. MWPC position

To-do:

- Check track residuals with tracking chambers
- Optimize track quality cuts
- Off-diagonal noise still to be addressed

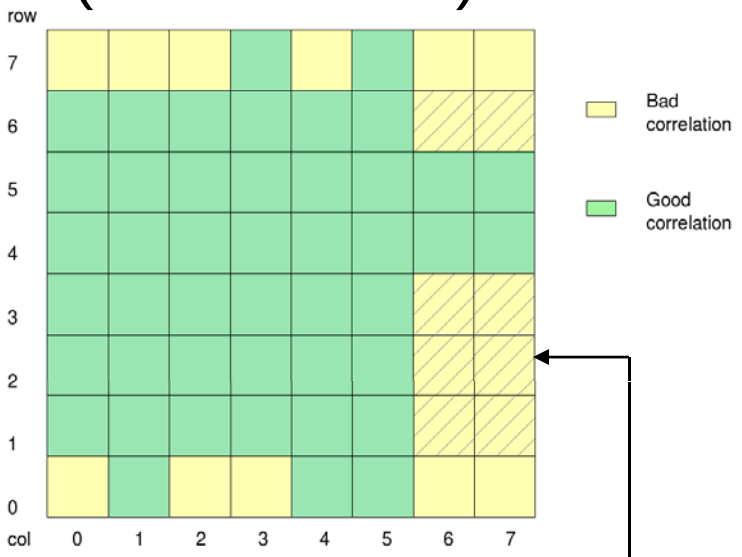


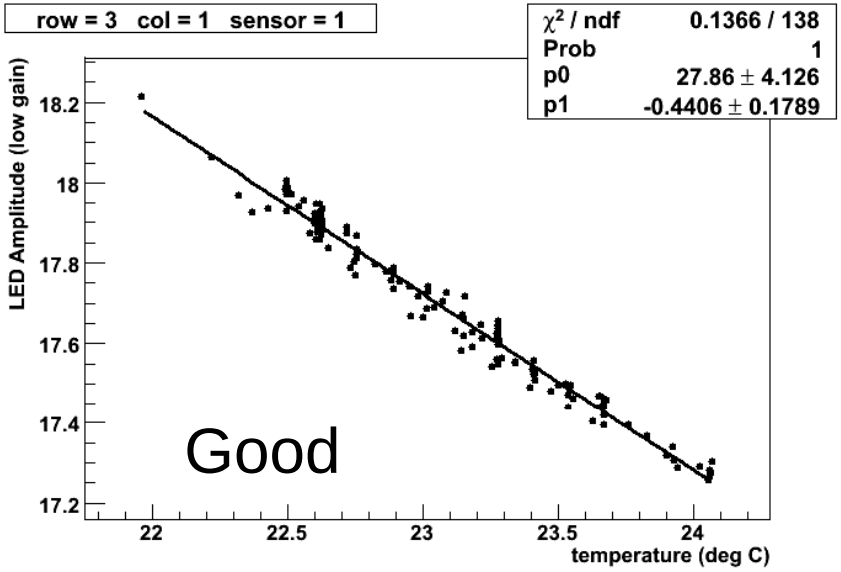
# Monitoring LED Amplitude vs. time

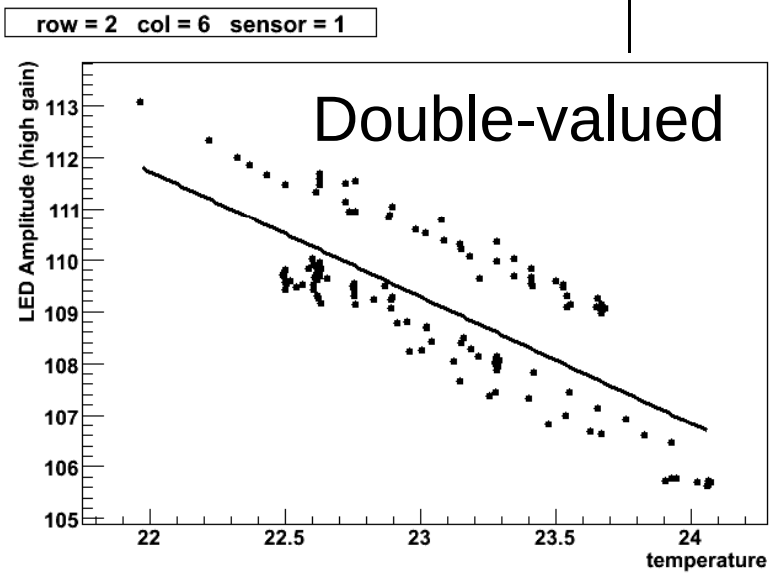


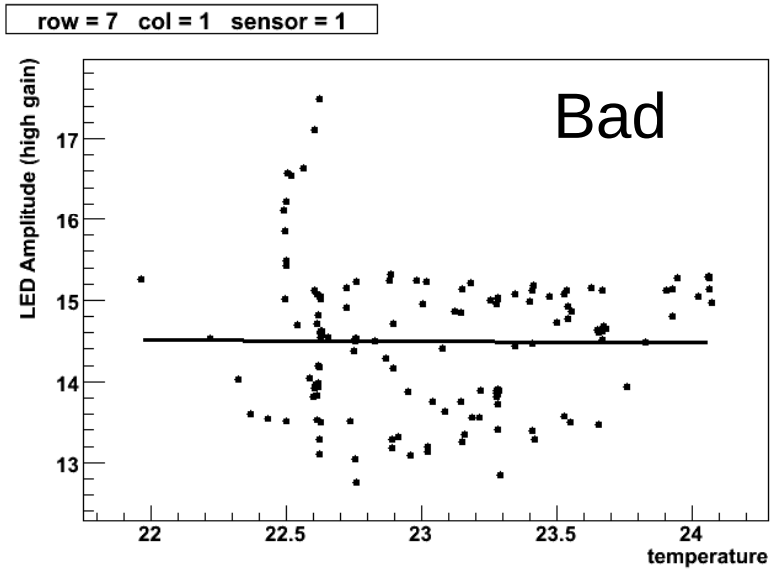
# Testbeam analysis: LED vs. T

(From PS run)



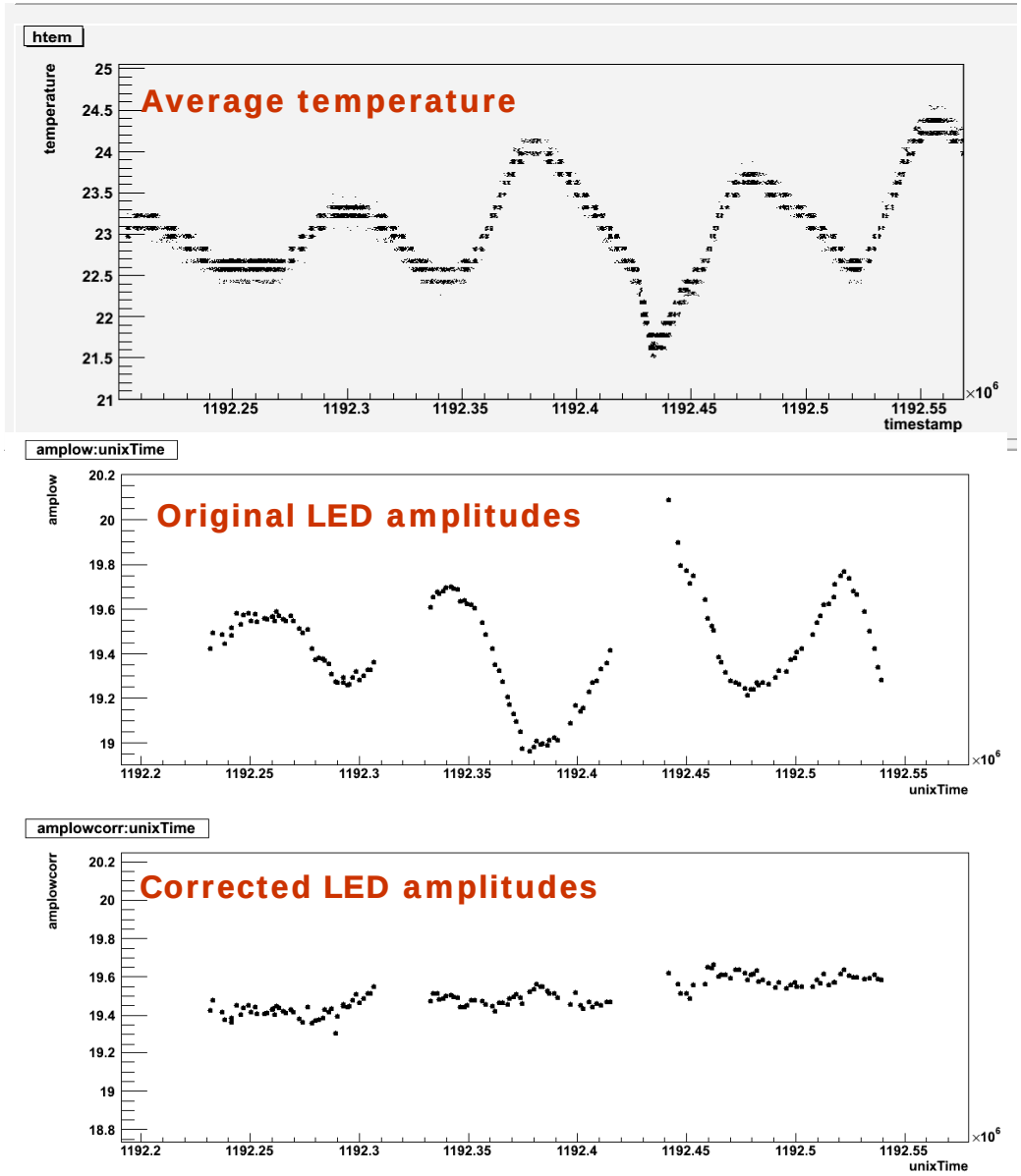



# Testbeam analysis: LED vs. T

- Temperature profile for individual sensors, averages and % variations for first PS data
- Analysis of LED amplitude-temperature correlation in all 64 towers (run 1010-1205)
- Check of the temperature-corrected LED amplitudes

## Work in progress…

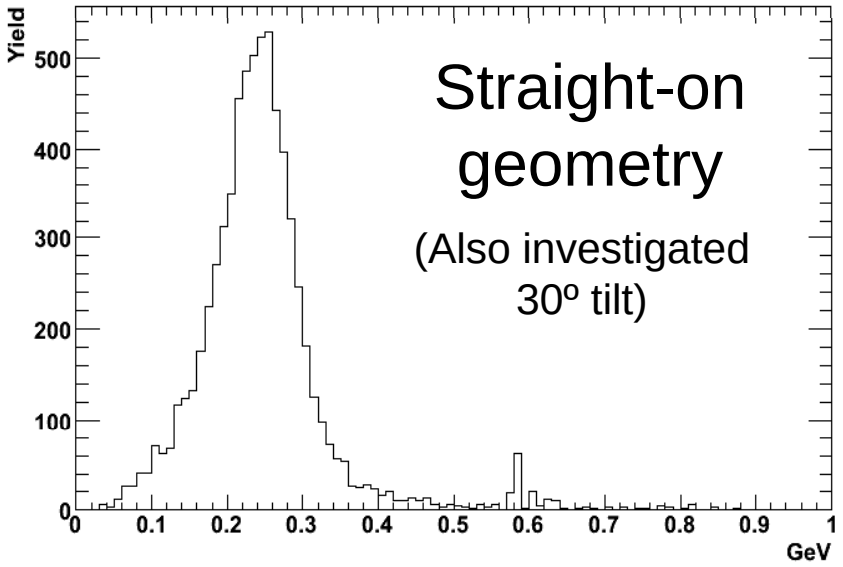
- Comparison of temp. coefficients with values obtained during APD characterization in Catania
- Correction matrix for all 64 towers by LED/LED$_{ref}$ ratios
- Isolation of MIP peaks in all towers (data @ 3 GeV)
- Intercalibration and evaluation of energy resolution @ 3 GeV

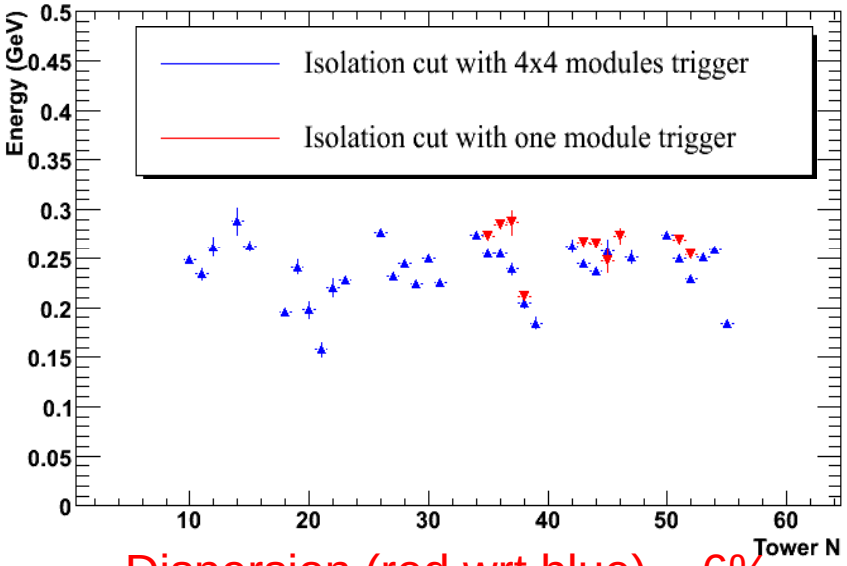


# Testbeam analysis: Isolation

Look for isolated EMCAL digits in cosmic events

- RMS/Mean ratio to estimate precision ~ 11%
- Looking at isolation cut to improve result
- Scanning over data to assess systematics



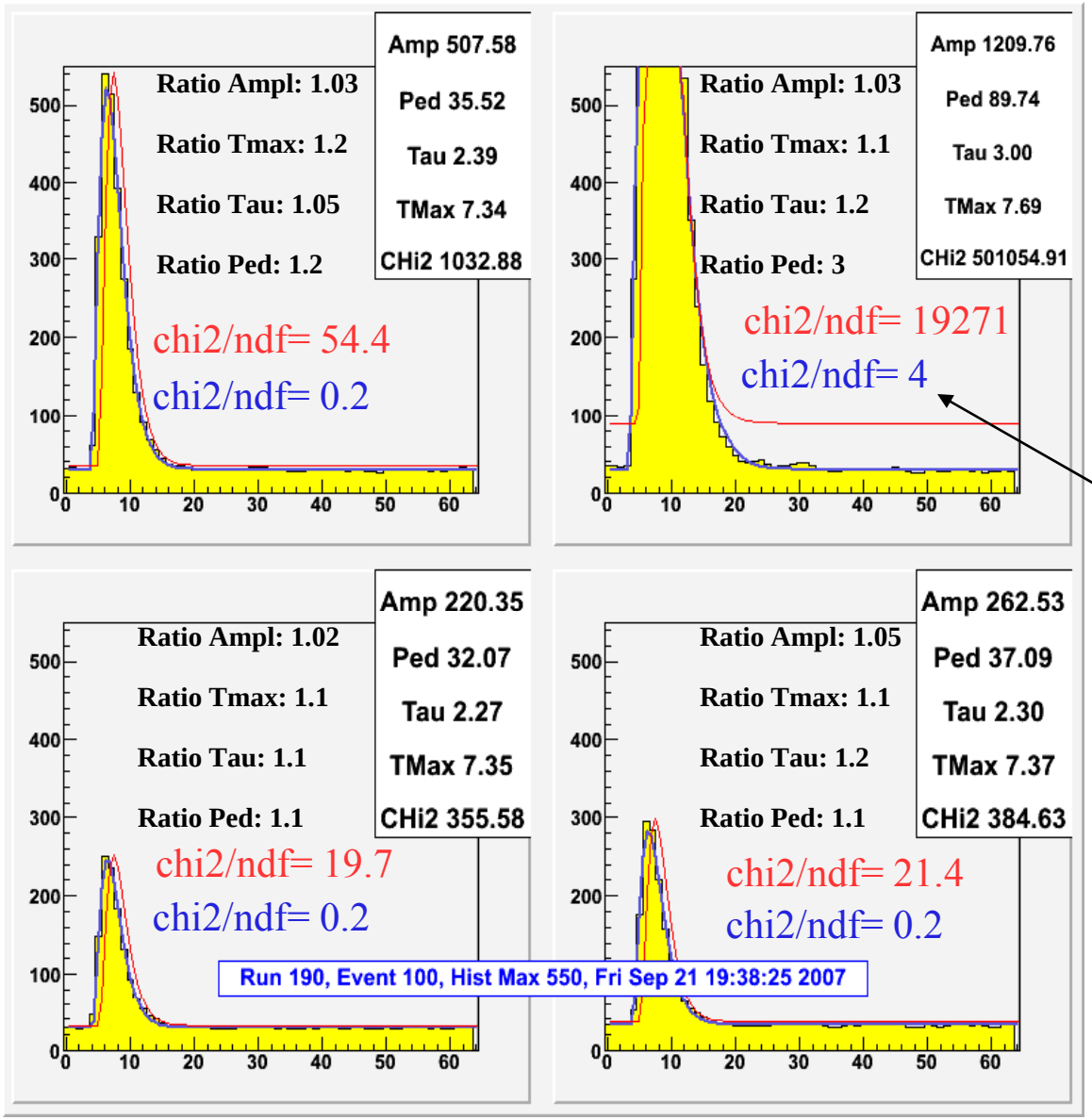




4x4 modules trigger = large scintillator panels covering the whole detector

One module trigger = overlap of thin panels of scintillators which select only one module (i.e. 4 towers).

Dispersion (red wrt blue) ~ 6%

# Pulse shape fitting in testbeam




red : reconstructed fit from ESD

blue : new fit, gamma2 function, initial conditions set to ESD parameters (optimized)

Chi2 test for the blue fit:

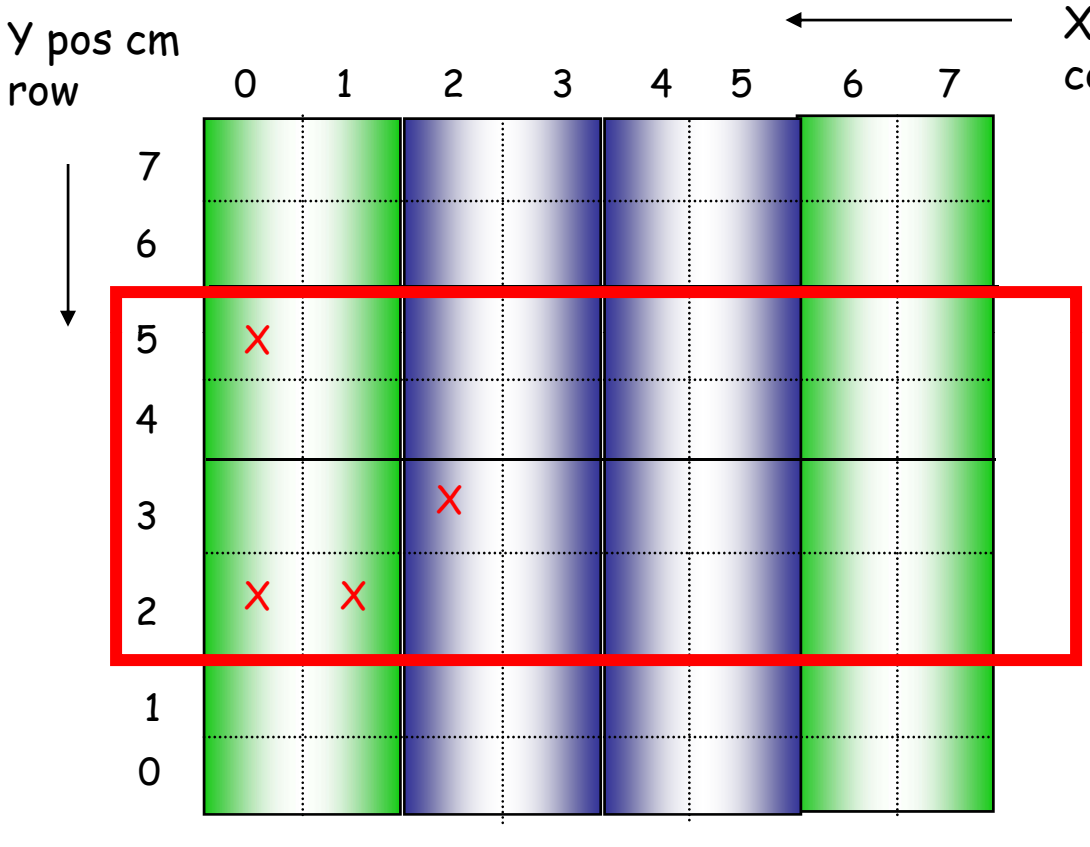
Good fit : Chi2/ NDF ~ 1

Here: Chi2/NDF (blue fit)=4 >>1 (because of saturated signal)

## Conclusions:

- Chi2 / ndf better for blue fit in high gain (low gain has some issues)
- Difference between the 2 fit:
  ~1% for Amplitude
  ~10% for Tmax and Tau

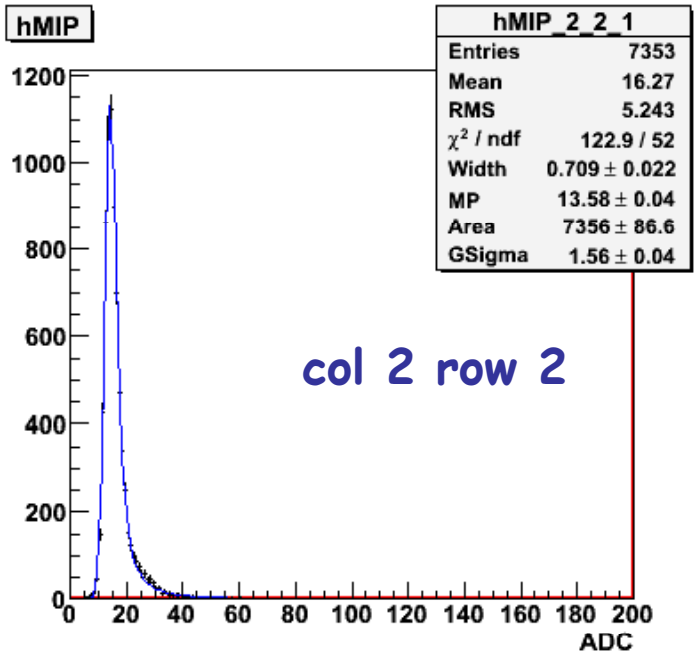
# MIP Calibration with hadrons

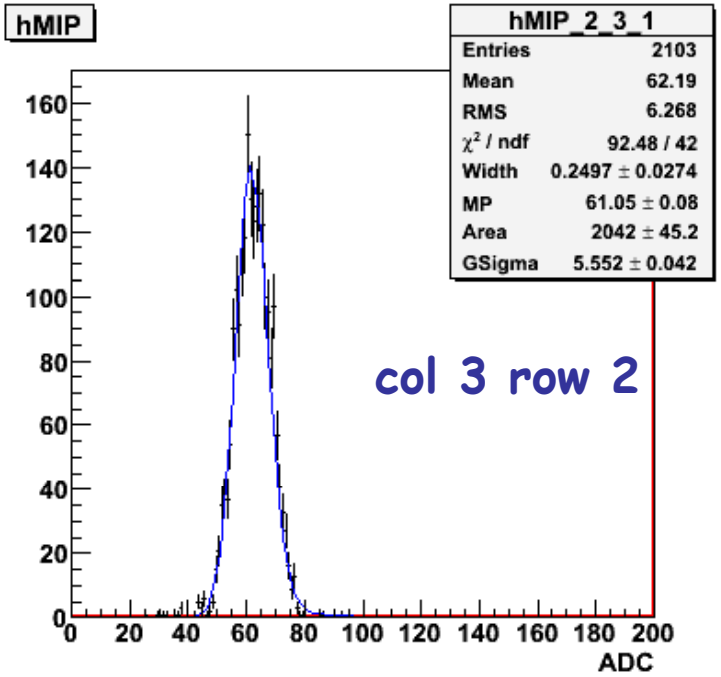



- 1rst test: 28 towers (32-4) (1 run/ tower)
- « Ideal event » selection: ESD 1rst pass (StandAlone Code) with 1 single fit in the event: i.e. 1 tower

# Hadron peak fitting

- Signal amplitude for « 1 tower events ». ( condition in ESD output tree: nSig==1)
- High gain information only (hadrons 100 Gev/c )
- Search for the Most probable value via a fit with Landau*gauss
  http://root.cern.ch/root/html/examples/langaus.C.html



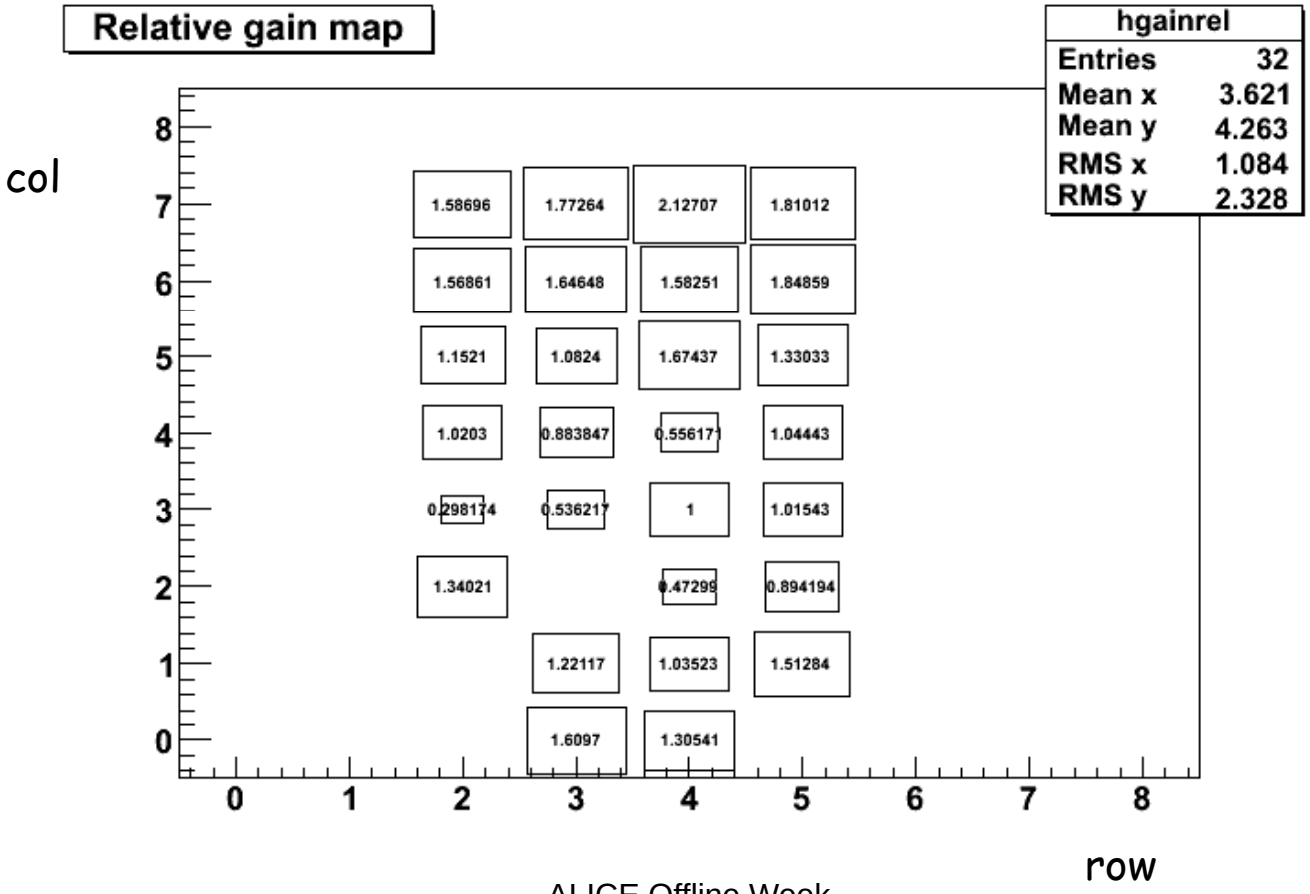




Shape indicates that adjacent towers signal missing (threshold too high?)

# Relative calibration

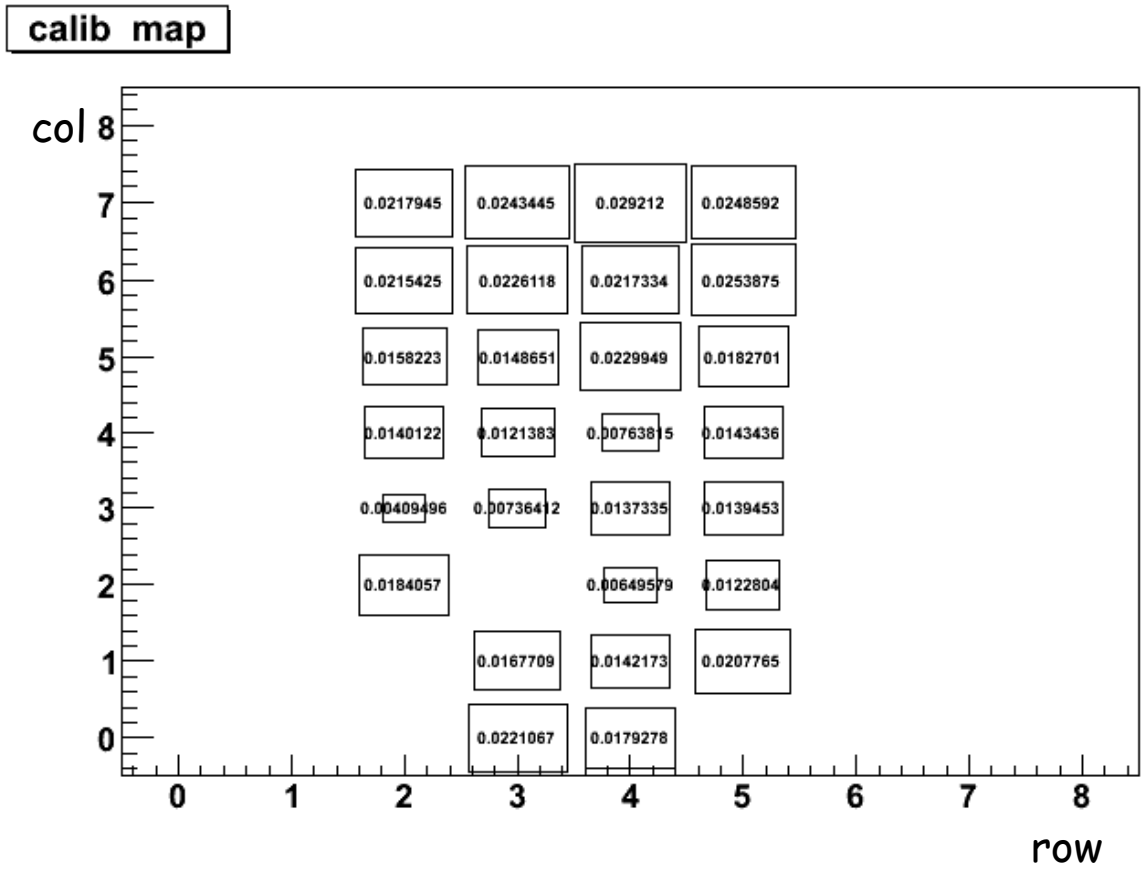
-(tower/tower): - 1 reference tower REF (col3 raw 4)
- gain (tower) = Max probable Value REF/ Max probable Value(tower)
- associated gain error(tower) calculated from the errors on fit parameters.

The obtained relative gain map has to be compared to the one obtained from LED.



# Hadron MIP calibration

-Absolute: calibcoeff(tower) (GeV/ADC) = 0,250 (1rst approx)/ MPV(tower)




TO-DO:

-Apply obtained coefficients to hadron testbeam data with clusterisation.

-Comparison to results obtained with LED relative calibration.

-Apply them to electrons (low momenta) .

- Study of isolation cut instead of 1 single tower:
  - Cf cosmic runs (S. Gadrat).
  - Repass of raw data probably needed
  - Because of high thresholds in ESD pass 1.

-Same study in PS: complete scan of towers.

# JETAN Updates

- Jet reconstruction from full simulation with calorimetry
  - Background at level of cells under study
  - Check background area calculation recently modified to take into account the dN/dη
  - e/p electron cut to be implemented
  - On going activity for 2008

# Overdue tasks

- Simulation (198)
  - Task 199 (29/02/08) : Need to add APD and FEE parameters to go from hits to digits. Final parameters to be implemented after electronics design final and tests performed.

JLK to implement interim solution following AliPHOSSimParam and results presented at EMCAL Review (http://indico.cern.ch/conferenceDisplay.py?confId=30605)

- Geometry (1318)
  - Task 1816 (15/03/08) : Re-write AliEMCALGeometry for final design

JLK in progress

- FDR (1737) → 1st Phase (1773) → Detectors(1832) → EMCAL(1841)
  - Task 1882 (21/12/07) : Commissioning Exercise - Summary of the data taking program (test beam, in PIT)

What is this task?

# Summary and Plans

- Many people working hard on EMCAL code
  - 11 Completed tasks
    - Additional updates on 4 projects not in planning tool also improve EMCAL code
  - 16 (Planning Tool) Tasks in progress
    - Plus lots of activity on testbeam/cosmic analysis
      - Very useful for DCS/Calib completion
    - EMCAL incorporation to JETAN
  - 3 Overdue tasks
    - JLK working to get two of these done asap (days overdue providing addition motivation)
    - One task unknown; requesting clarification
- Many tasks in progress and overdue tasks will be (hopefully) complete by July offline week