EMCal Offline Status

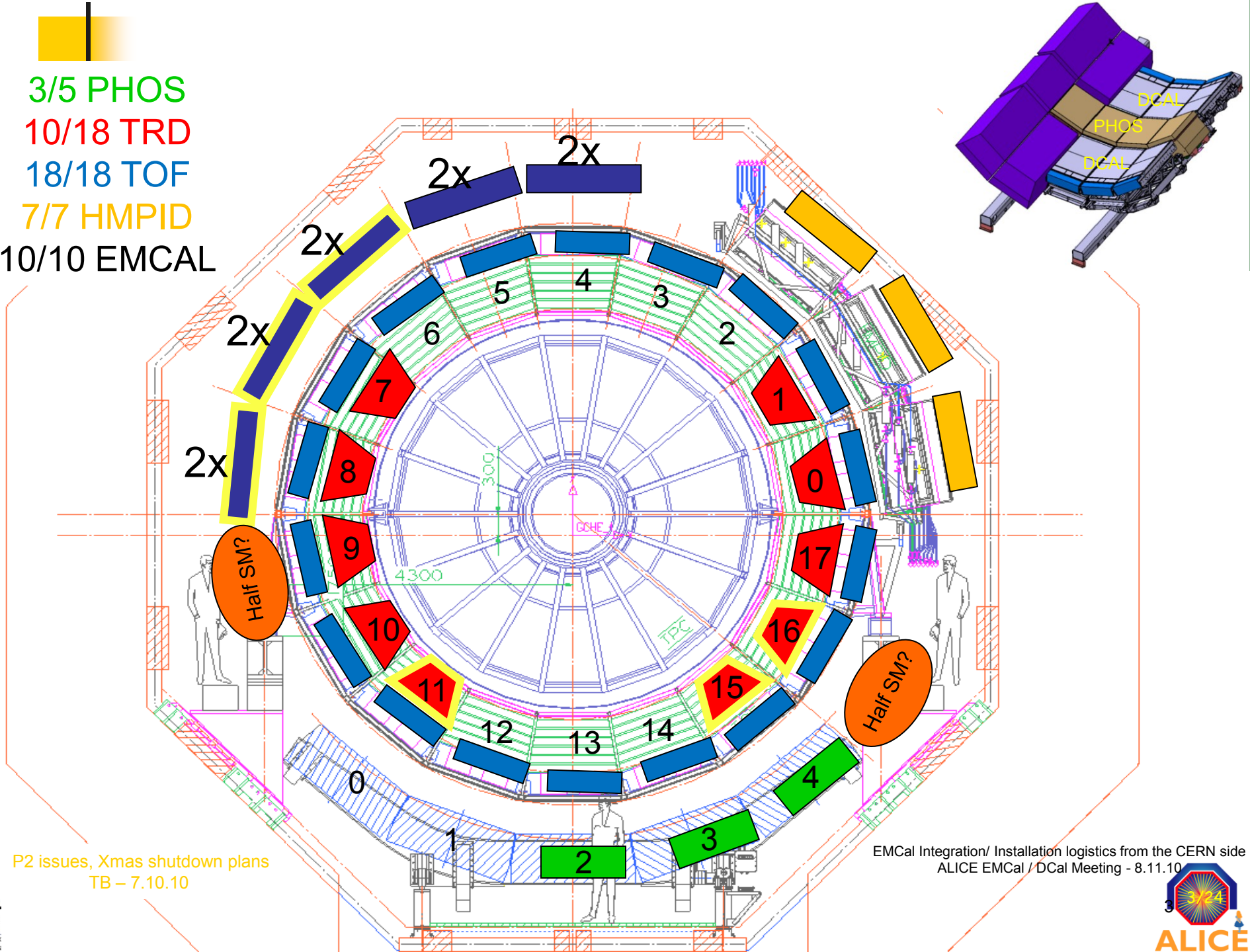
Gustavo Conesa Balbastre

LPSC Grenoble
Laboratoire de Physique
Subatomique et de Cosmologie

Geometry

- Installation
  - From January 6 more SM are installed, in total we have 10 SM, in 2010 we had 4 SM.
  - DCAL to be installed in 2013, 6 more SM,
  - Under discussion, maybe the 2 half SM remaining of EMCAL and/or another 2 half SM in the DCAL, depends on funding and technical issues.
- For this year data taking simulation Config.C and OCDB files have been changed to "EMCAL_COMPLETEV1" that contains 10 SM and the latest changes in geometry reported in the last offline week.
  - 2010 data taking geometry name is "EMCAL_FIRSTYEARV1"
- Alignment tasks
  - Alignment: Task 2533: Finalization of the detector geometry checking for overlaps.
  - Tasks 2630 : Study effect of misalignment in reconstruction.
  - Tasks could be closed for 2010, alignment is finally in place.
  - But, with the new SM we have to start from scratch,
    - Survey results available since a few days, new alignment objects to be produced in next weeks.
    - When done, and we are convinced they are ok, we will close the task.

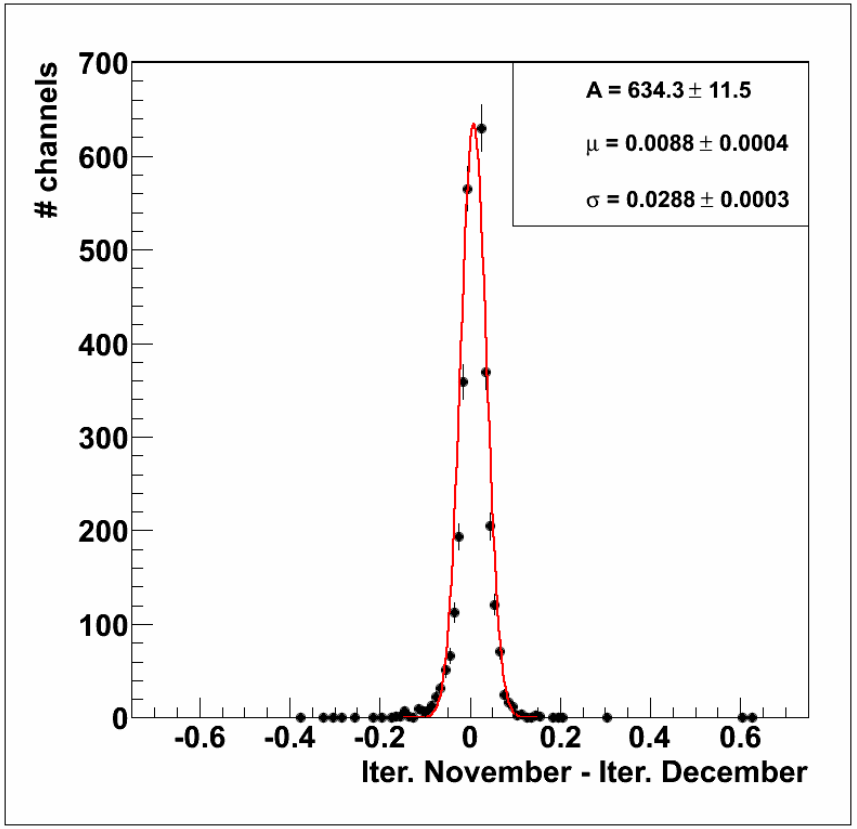
3/5 PHOS
10/18 TRD
18/18 TOF
7/7 HMPID
10/10 EMCAL



Calibration: Channel by channel relative energy calibration

- We rely mostly on pi0 calibration:
  - Get pi0 invariant mass per channel: one of the 2 clusters deposits most of its energy in the channel.
  - Fit distribution, find mass position, shift it to PDG value.
  - Repeat several times.
- Need a lot of Min Bias statistic (full year) or EMCal triggered runs.
  - With triggered runs taken in September we achieved a 2% decalibration.
  - 3-4 iterations needed.
- We have requested an early triggered run to settle the calibration for the full year.
- Decalibration not included in simulations. Need to add a decalibration per channel parameter to be used during simulations.

Channel by channel calibration correction variation after calibration using different data samples

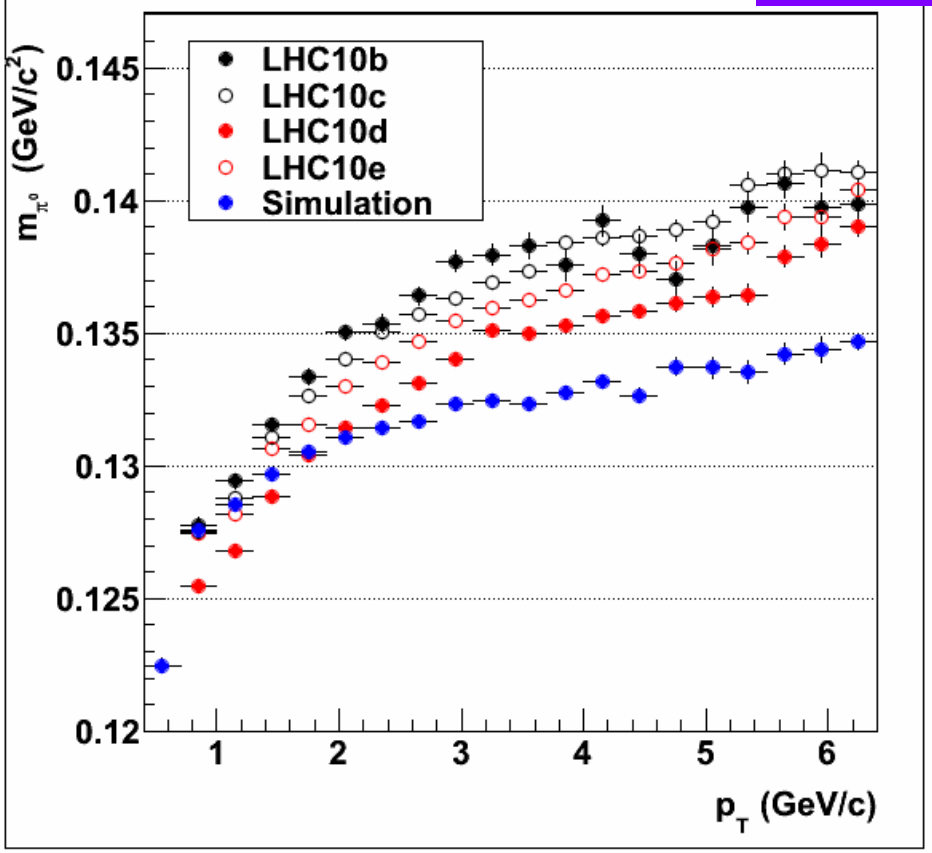


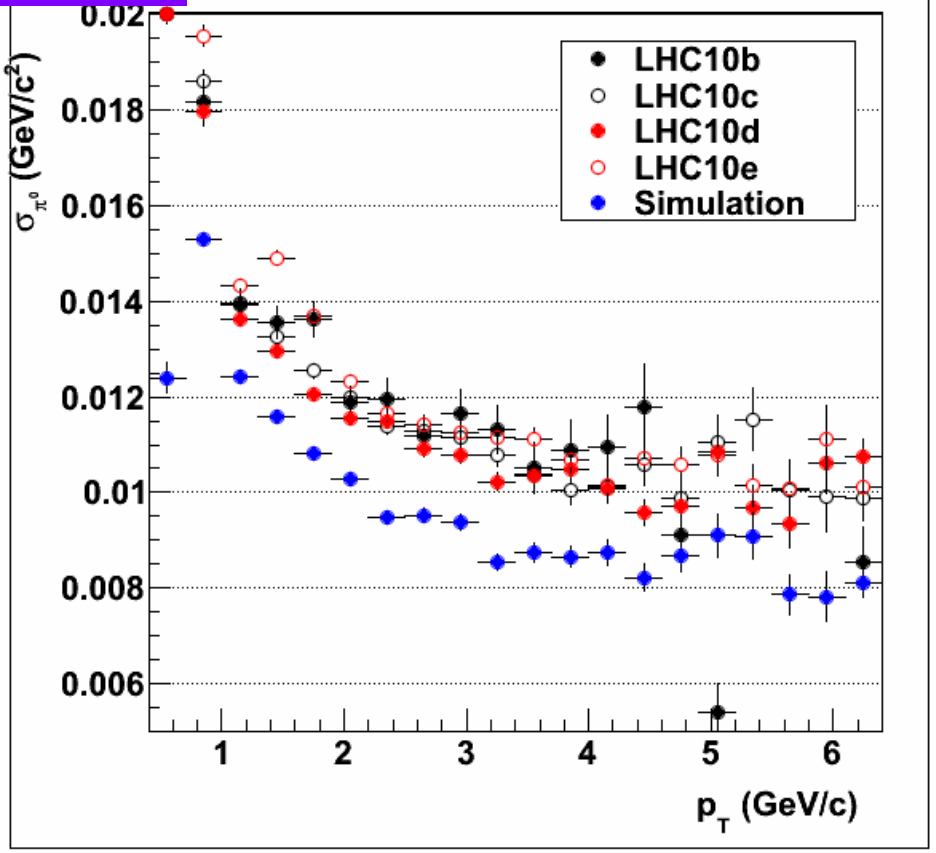
Calibration: Run dependent corrections

- Time dependent energy calibration
  - Temperature variations change the gain of the ADC channel.
  - LED events fired in all runs help to get a correction factor per run
  - Automatic procedure not yet in place, to be done in next weeks.
  - We extracted the run by run variations and used them in the analysis

Calibration: Run dependent corrections

Pi0 analysis

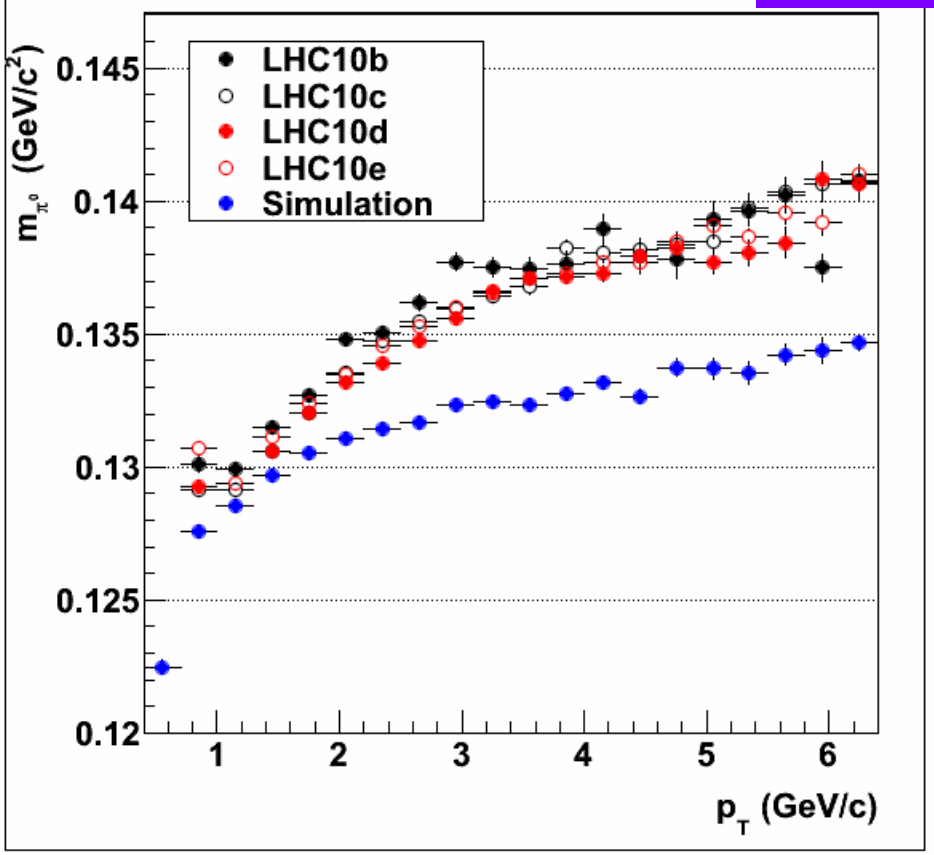


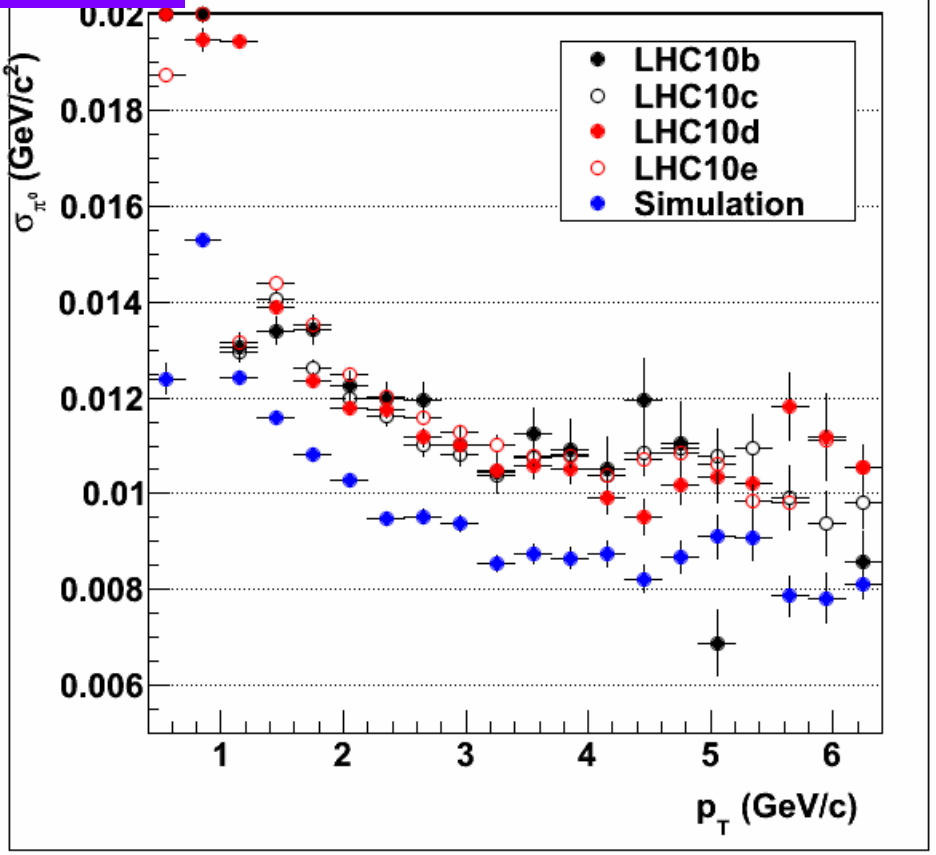


- No analysis cuts, just avoid borders.
- Best calibration used.
- NO run dependent corrections applied.

Calibration: Run dependent corrections

Pi0 analysis

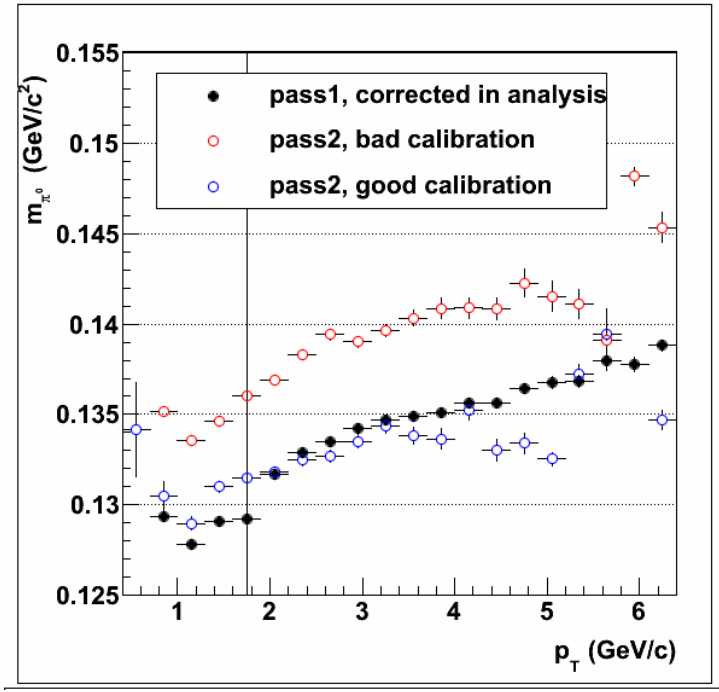


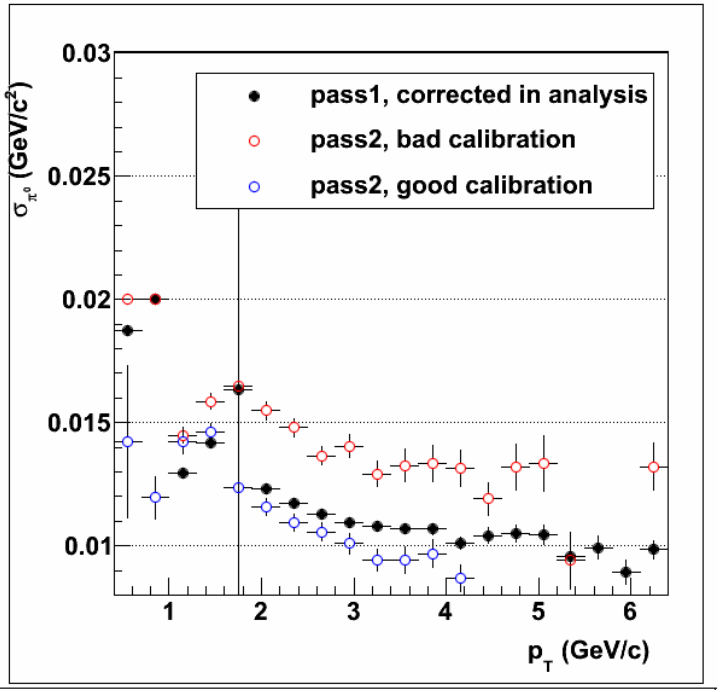


- No analysis cuts, just avoid borders.
- Best calibration used.
- WITH run dependent corrections applied.

Calibration: LHC10e pass1 vs pass2a vs pass2b

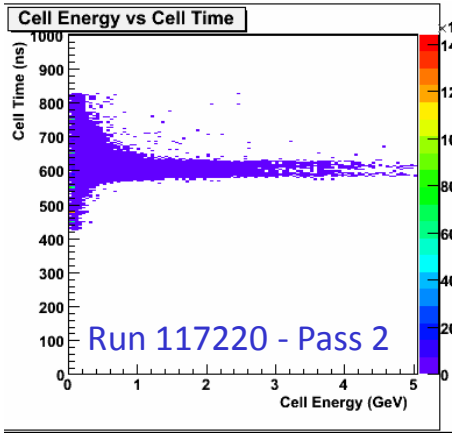
- I made a mistake when the calibration was ported to OCDB before Christmas
  - Recalibration factors were applied to a calibration file version which was not used for the calibration (triggered) runs.
  - This affected first pass2 of LHC10e and LHC10h pass1 reconstructed after Christmas
- This was corrected for newer pass2

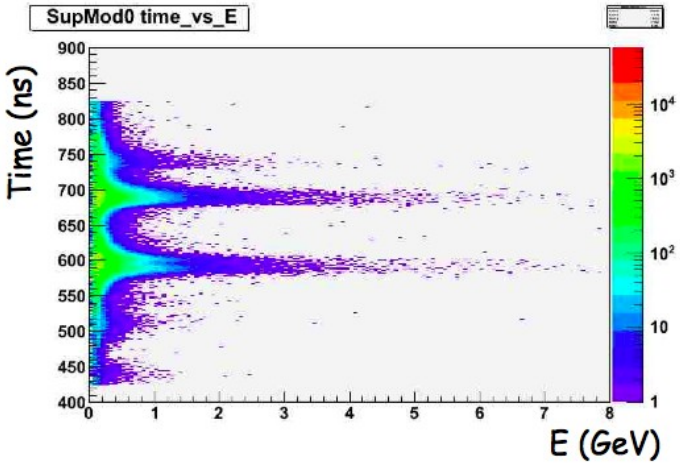




Calibration: Channel by channel relative time calibration

- We also measure the time of arrival of particles
  - Needed for example for low energy, high mass particles identification.

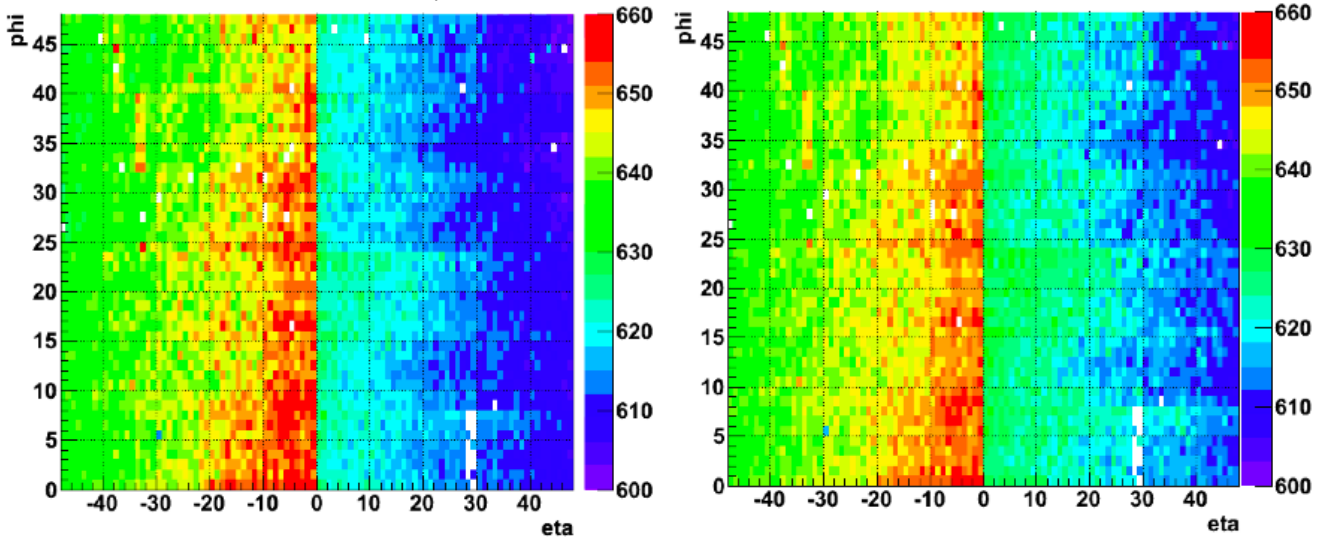




- Complications: Bunch crossing, we know how to correct
  - But, is there a way to simulate this?
- Procedure under development:
  - Align with respect a reference run
  - Produce a map with the average time per channel in the reference run.
  - Use the map to correct other runs.

Calibration: Channel by channel relative time calibration

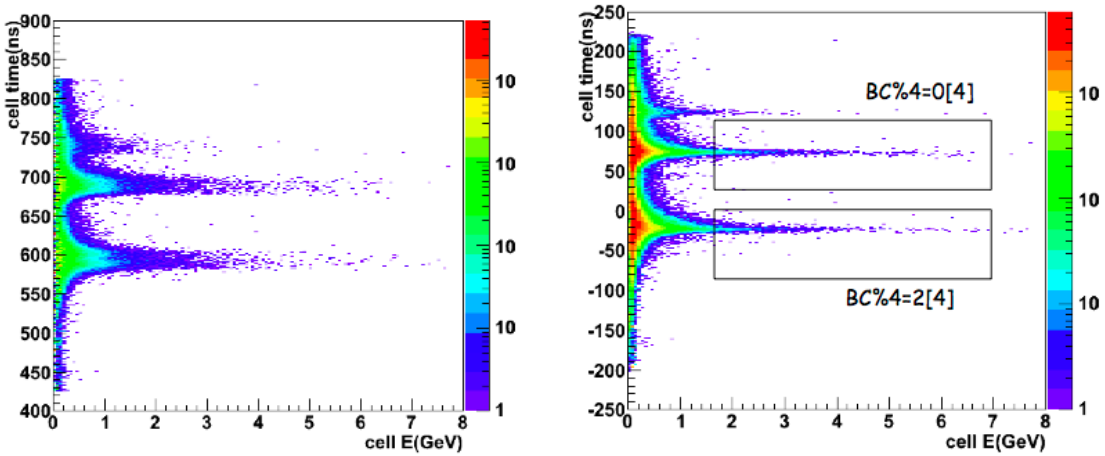
Reference runs 1260-04-97



BC%4=0[4]

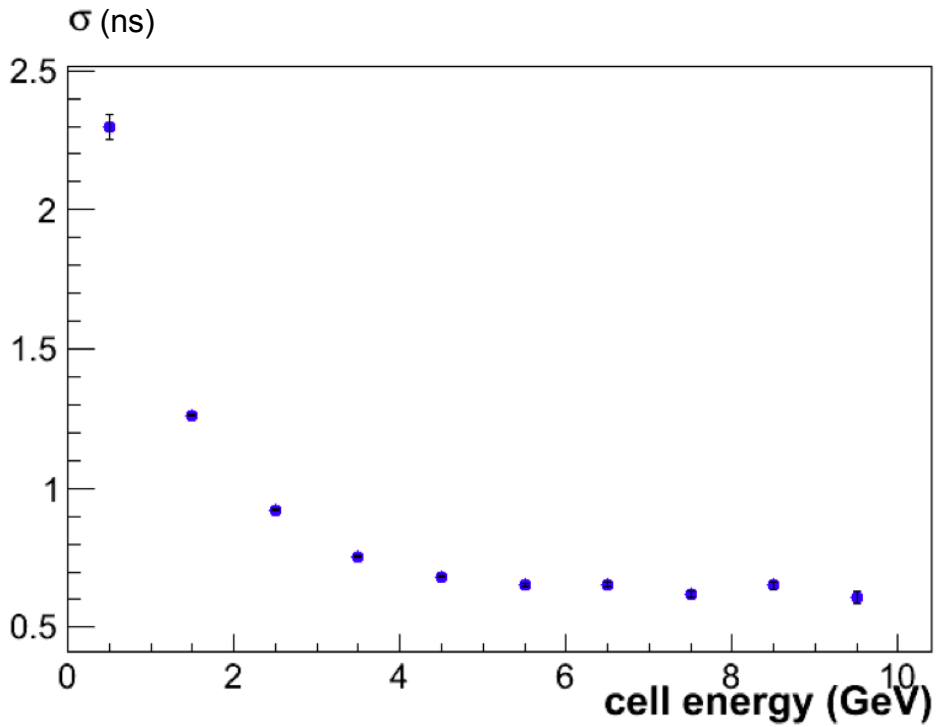
BC%4=2[4]

- Exemple: run 133419: FillingScheme: 150ns_104b_93_8_93



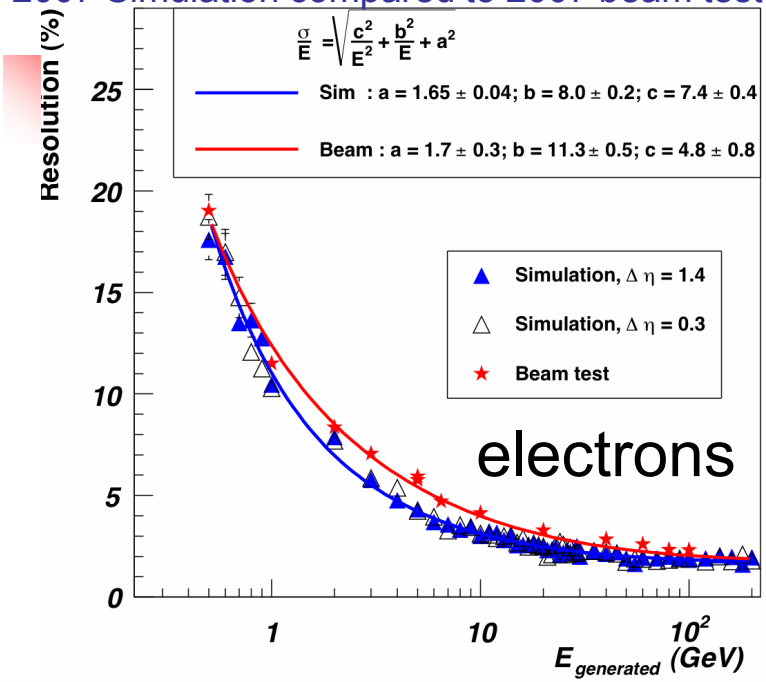
- Improved time resolution

Calibration: Channel by channel relative time calibration



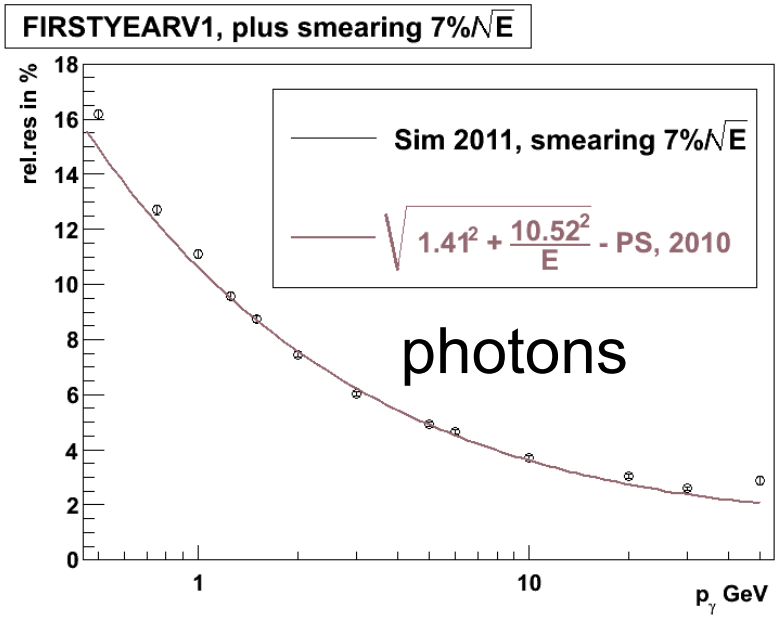
- Resolution after calibration 0f 0.6 ns at high energy.
- We have to prepare the reconstruction code to include this kind of calibration.
- Task 2535: Implement realistic time resolution in digits.
  - Old task. In the code, we have a fixed time resolution of 0.6 ns
  - We have to implement a resolution depending on the amplitude.

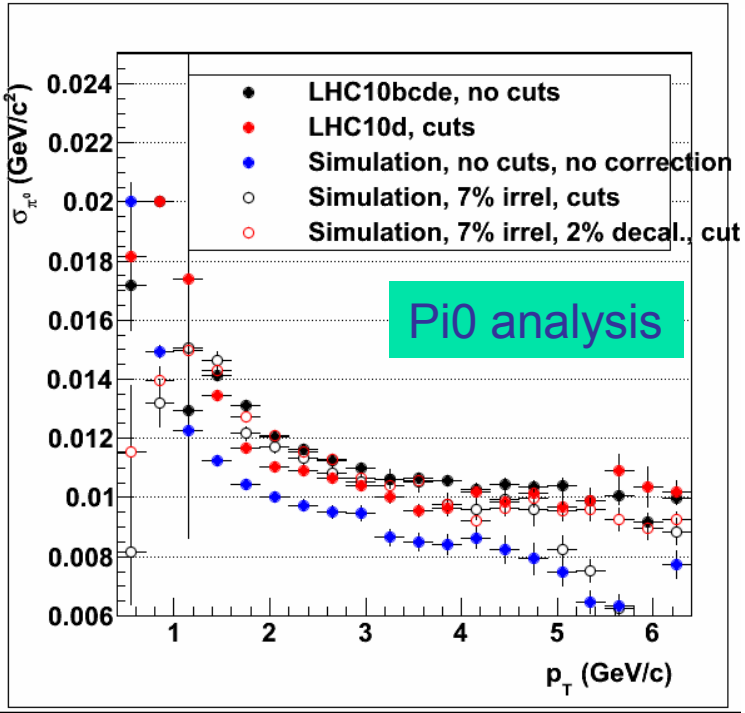
2007 Simulation compared to 2007 beam test.



Detector response

Simulation 2011 with latest changes

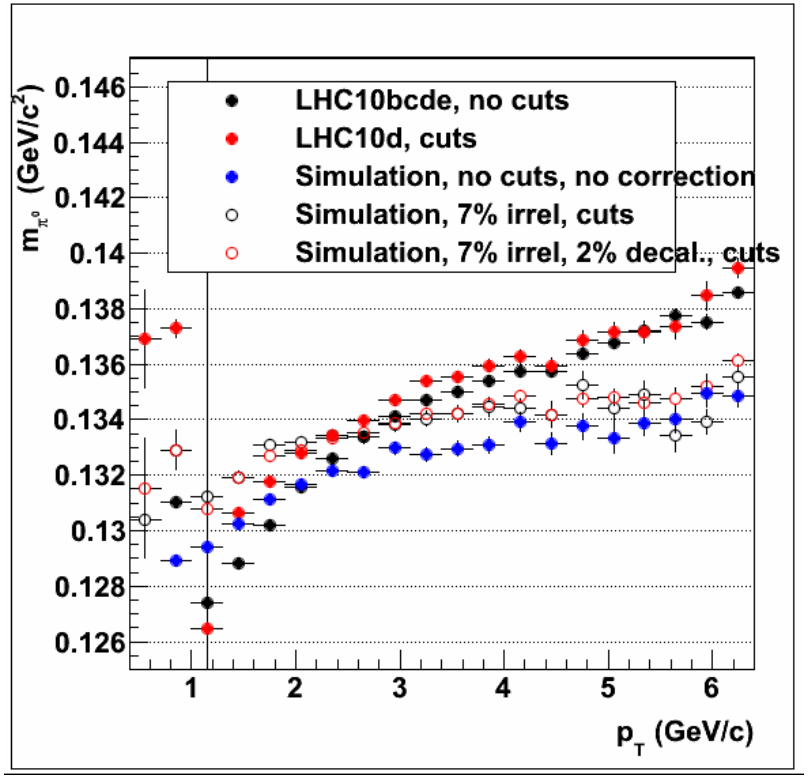




- Task 2627 : Correct detector response, GEANT and FLUKA.
  - Changes in geometry reported last offline week do not improve much.
  - We are trying to understand.
  - There is a 7%*sqrt(energy) irresolution.
    - For now, analysis with simulated data should smear the energy like this.
  - All plots with Geant3. Geant4 (Fluka) produces smaller reconstructed energy.

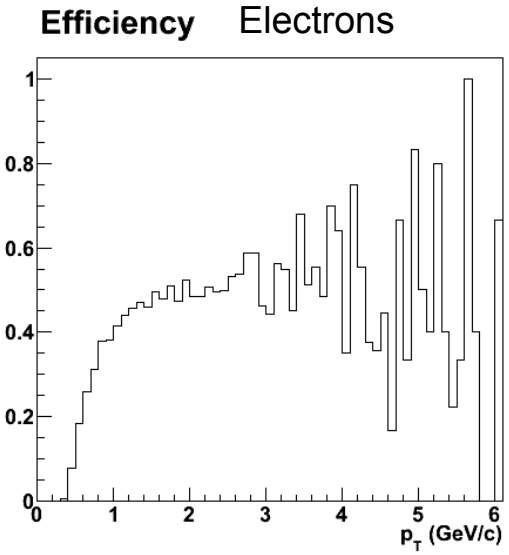
Detector response: Non linearity

- No non linearity correction is applied yet during the reconstruction.
- Simulation and Data show a different non linearity.
  - Need to understand origin of discrepancy.
  - Now we have 2 corrections one for MC and other from data (close to final).
  - Data correction must be extracted from beam test … but there was material between electron beam and prototype … not straightforward.



Track Matching

- Task 2632: Track matching improvement
  - Extrapolation of tracks is not proper in case of electrons.
    - Underestimation of energy loss in the material - Bremsstrahlung
    - Problem inside TPC is not important (gas) but between TPC and EMCAL there is a lot of material (and much more over the new 6 SM)
  - We are working with TPC experts in a correction: Look up table
    - 4-dimTHnSparse's with{delta,theta,phi,1/pT}, delta is theresidual.
    - A look up table from distribution of delta for each bin of theta, phi, 1/pT(like particle gun)
    - Foreverymatchedtrack,according to its theta,phi and 1/pT,acorrection coefficient could be found in this look-up table.
    - A task used to fill this table will join the TPC calibration train
  - A remark: We try to understand matching in analysis … but AODs cannot be used!!! No way to extrapolate.



- Standard matching cuts: $|\Delta x|<6$cm, $|\Delta y|<6$cm, $|\Delta z|<6$cm, $\Delta R<10$cm
- Size of cell side is 6 cm

Raw fitting

Old slide

- We have implemented different fitters,
  - Slow fitters (truth for benchmarking comparisons):
    - kStandard: default fitter used until now, Minuit fit, too slow.
    - kLMS: refined version of kStandard
  - Fast Fitters
    - kFastFit
    - kNeuralNet
    - kPeakFinder
    - kCrude: Takes the maximum bin.
- but we have still not using them, currently we reconstruct with the standard fitter.
  - Except for runs reconstructed with first versions of aliroot 4.20, a bug was introduced and kLMS was used by default.
  - No change in resolution or cluster energies, but number of cells much much larger.
- We are doing benchmarking tests with all the fitters with the last summer beam test data.
- Fit quality (to be studied):
  - The calculation of the raw signal fit Chi2 and NDOF can give an idea of the quality of the amplitude fit obtained.
  - Digits include these 2 parameters, but they are not used, right now in reconstruction.

Old slide

Redefinition of digits and related tasks

- Task 2538: Correct treatment of detector signal in sdigits correct event merging implementation
  - A digit is an amplitude and time per channel
  - This approach does not take into account in simulation:
    - Fitting problems of the different algorithms.
    - Samples with different time arrival, pile-up.
  - How can we improve it: Produce a raw time sample from the energy lost and get the final amplitude from the fit of this sample.
  - What needs to be done:
    1) Modify AliEMCALDigitizer::Digitize() so that it takes the Sdigit energy, converts it in a time sample and then fits it. The sample and the fitted energy/time is kept in the digit.
    2) In order to have a realistic performance, we need to implement a more realistic shaper : energy to time sample. The actual shaper is not realistic at low amplitudes.
- Task 2537: Verification of event merging procedures
  - Event merging of simulated data with the actual definition of Digits works.
    - Need to revisit when previous task is in place.
  - Need to implement the embedding (merging of real data+simulated data).
    - Should we merge the time samples or the fitted values?
    - For the moment we are going to implement the first order approach used f the mixing, sum of digits.

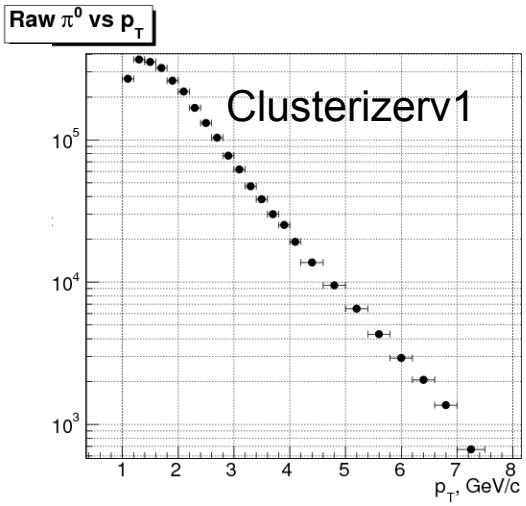
Clusterization

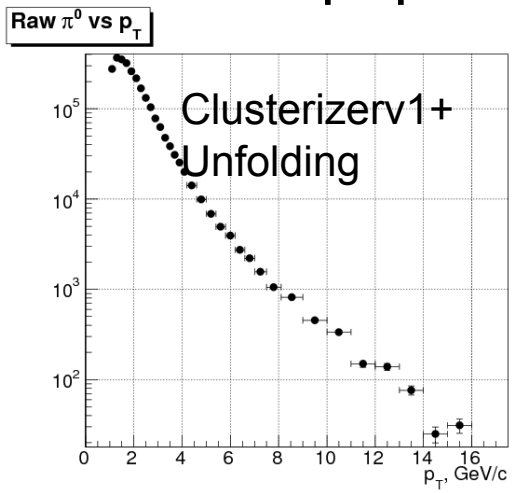
- EMCAL cell size is such that pi0 decay photons start to strongly merge already at 6 GeV with the current clusterizer, which does not have a limit in the cluster size.
- We have to put some restrictions to the cluster size or develop efficient splitting algorithms.
- Unfolding
  - Still not in production since we need to do more tests, we are using afterburners in the analysis.
  - Problems:
    - Fitting paramters extracted from shower shape in simulation. Need to check with Beam Test Data.
    - Fit done with TMinuit.
- New clusterizer: NxN
  - Limit the size for the cluster, right now hardcoded 3x3 in release 4.20
  - We will move to a more flexible size NxM, depending if there are two consecutive towers with a significant amount of the energy.
  - Problems
    - 3x3 is relatively small, cluster energy leakage at moderate cluster energies
    - Increasing to 5x5 might give the same results as current clusterizer in p+p
  - Not used in p+p, currently under test using afterburners, but it is the clusterizer used for Pb+Pb
- We might have to combine the two methods

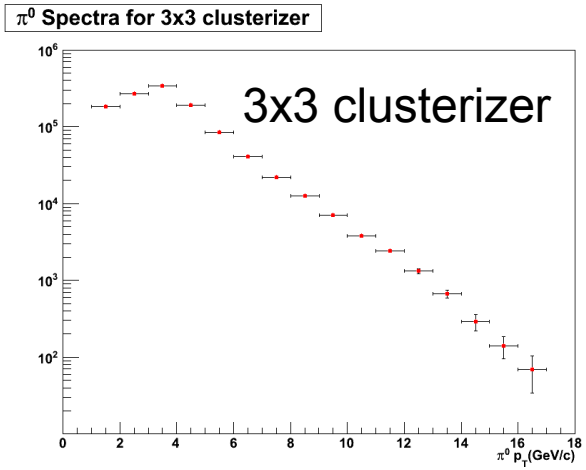
Clusterization

- Both clusterizations unfolding+standard clusterizer and 3x3 clusterizer extend the reach of the pi0 measurement via invariant mass.
- Current situation:
  - p+p: All data reconstructed with Clusterizer v1
  - LHC10h:
    - Pass 1: Due to a bug Clusterizer v1 with p+p parameters used
    - Pass 2: 3x3 clusterizer used with p+p parameters.

Pi0 in p+p







Pi0 in LHC10h pass2: 0-10 %

Pi0 starts to show up at 4? GeV

Nothing can be seen in pass1

QuickTime™ and a decompressor are needed to see this picture.

Pi0 in LHC10h pass2: 10-20 %

Pi0 starts to show up at 3? GeV

Nothing can be seen in pass1

QuickTime™ and a decompressor are needed to see this picture.

Pi0 in LHC10h pass2: 20-30 %

QuickTime™ and a
decompressor
are needed to see this picture.

Pi0 starts to show up at 2? GeV

Nothing can be seen in pass1

Need to play still with clusterization and cuts in analysis to optimize the result.

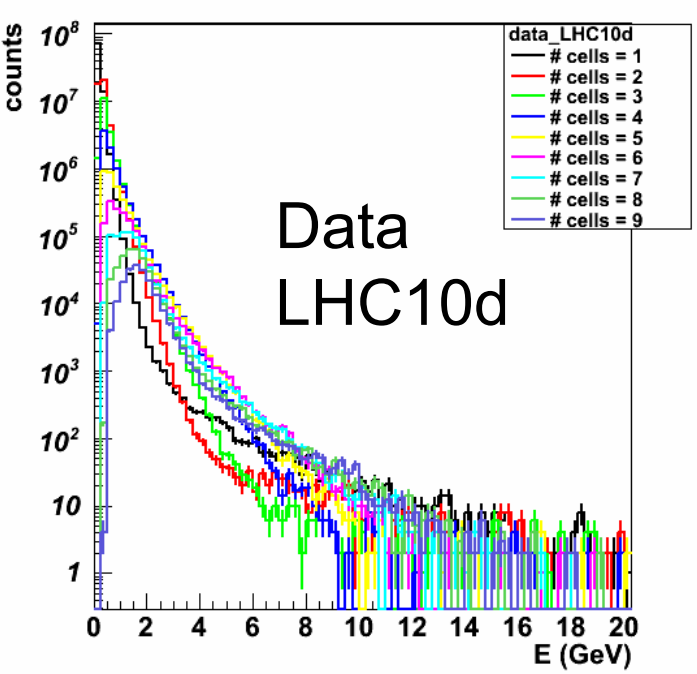
Exotic clusters

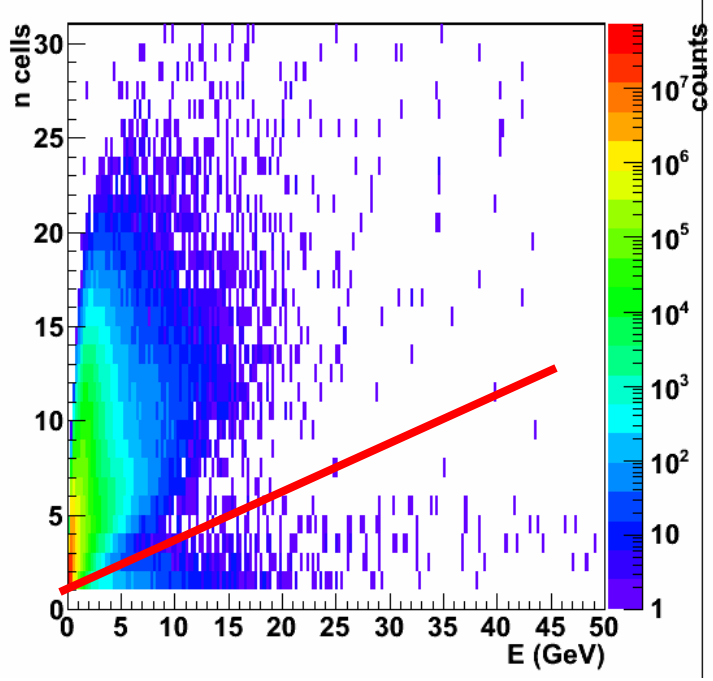
Triggered run 134908

QuickTime™ and a
decompressor
are needed to see this picture.

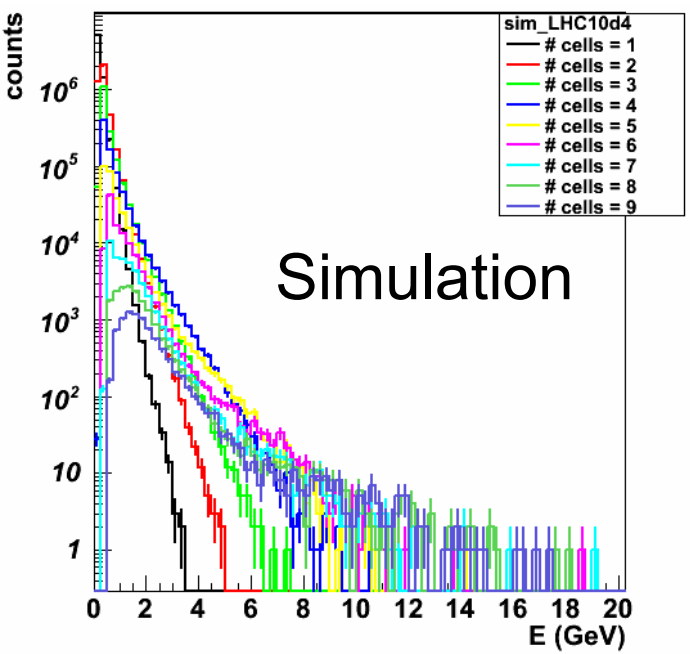
- Data contains lots of clusters with small number of cells.
- High energy clusters can be of this type.
- What is this?
  - Similar effect observed at CMS, PHOS and even Phenix
  - Neutrons, anti nucleons depositing their energy directly in the APD …

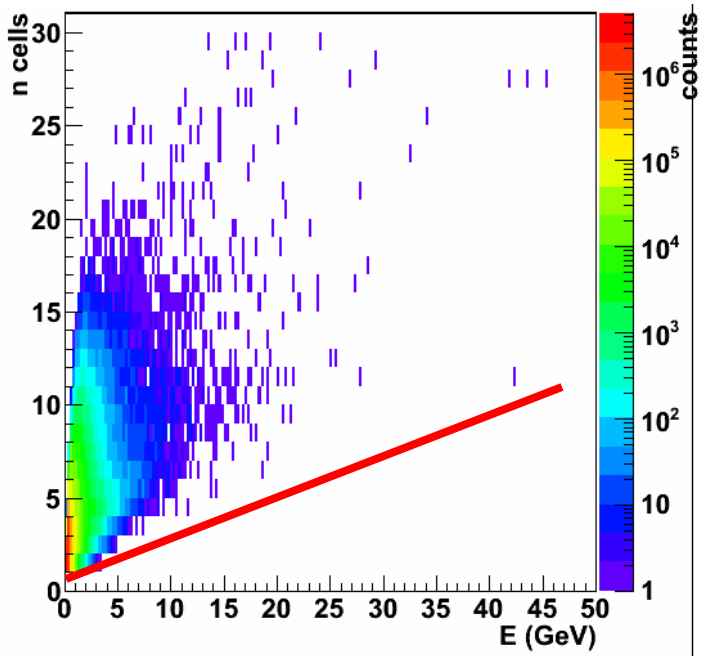
Exotic "clusters"



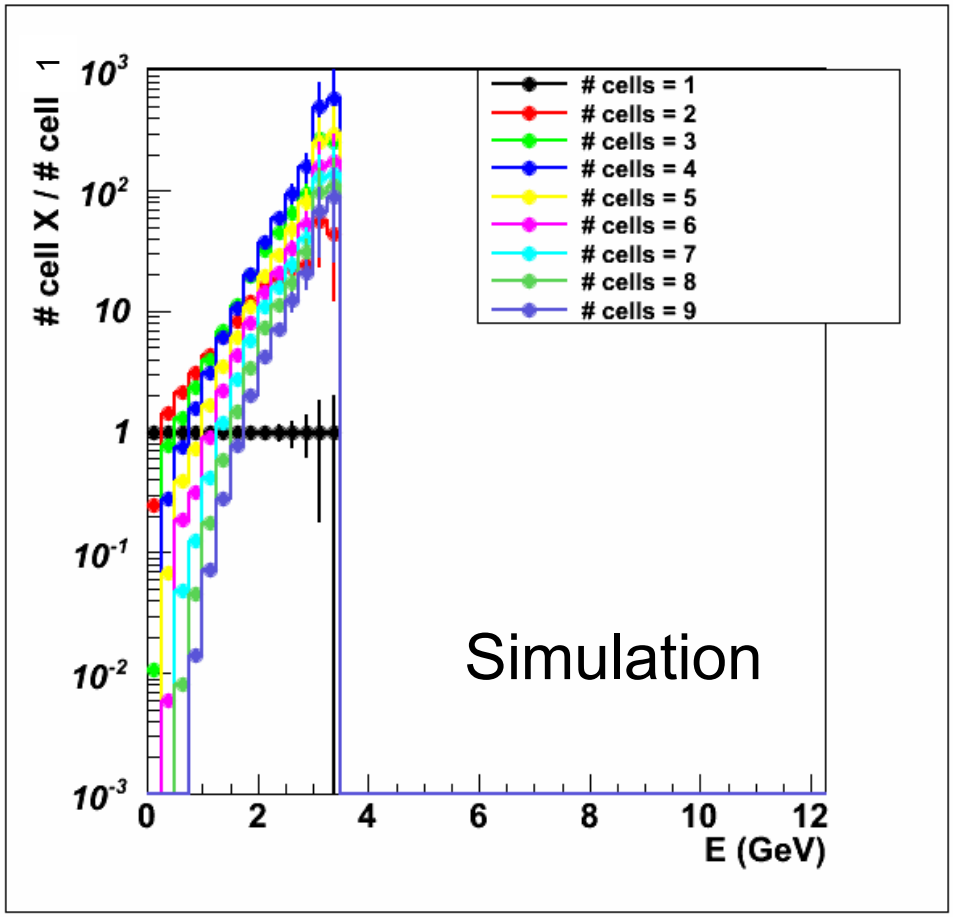


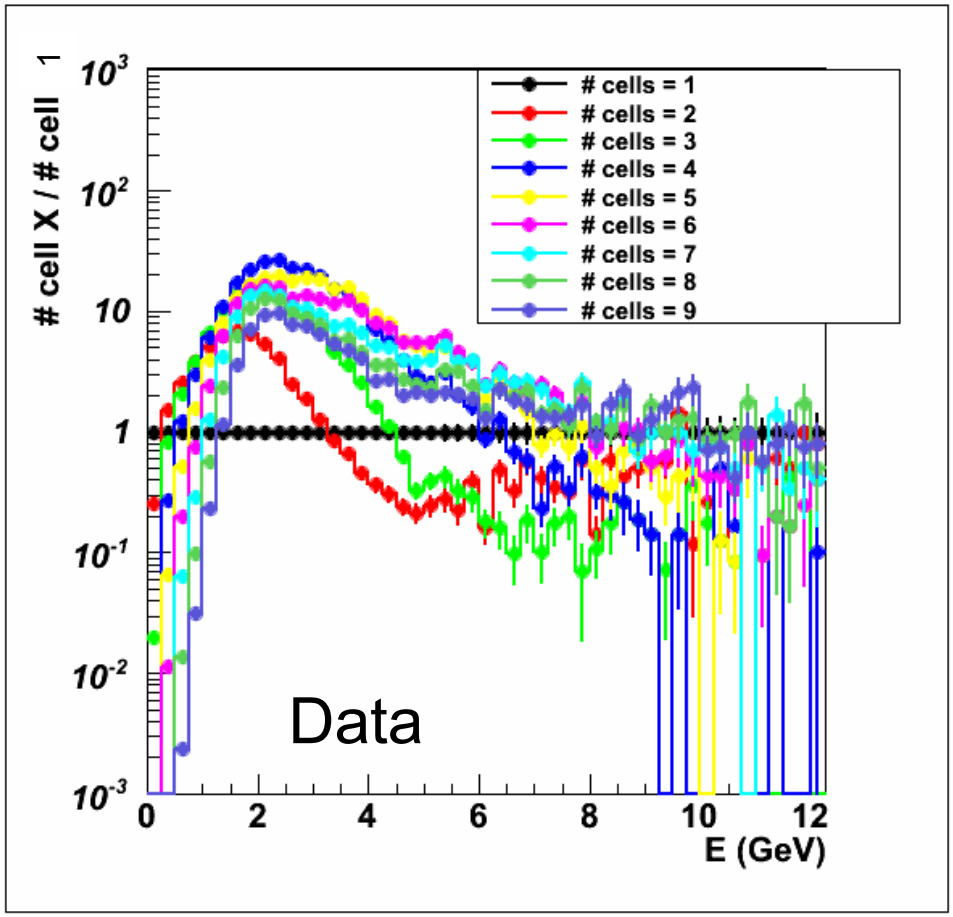
- Similar thing observed with a smaller data sample LHC10b





Cluster with N cells / Cluster with 1 cell





- Small clusters start to dominate again at high energy in data to the bigger clusters.
- Up to 2 GeV distribution for 1 cell clusters is kind of normal, but then it increases.
- Need to remove such clusters in reconstruction or analysis properly
  - Under investigation: remove clusters with one cell having more than 90% of the energy of the cluster, or similar procedures.