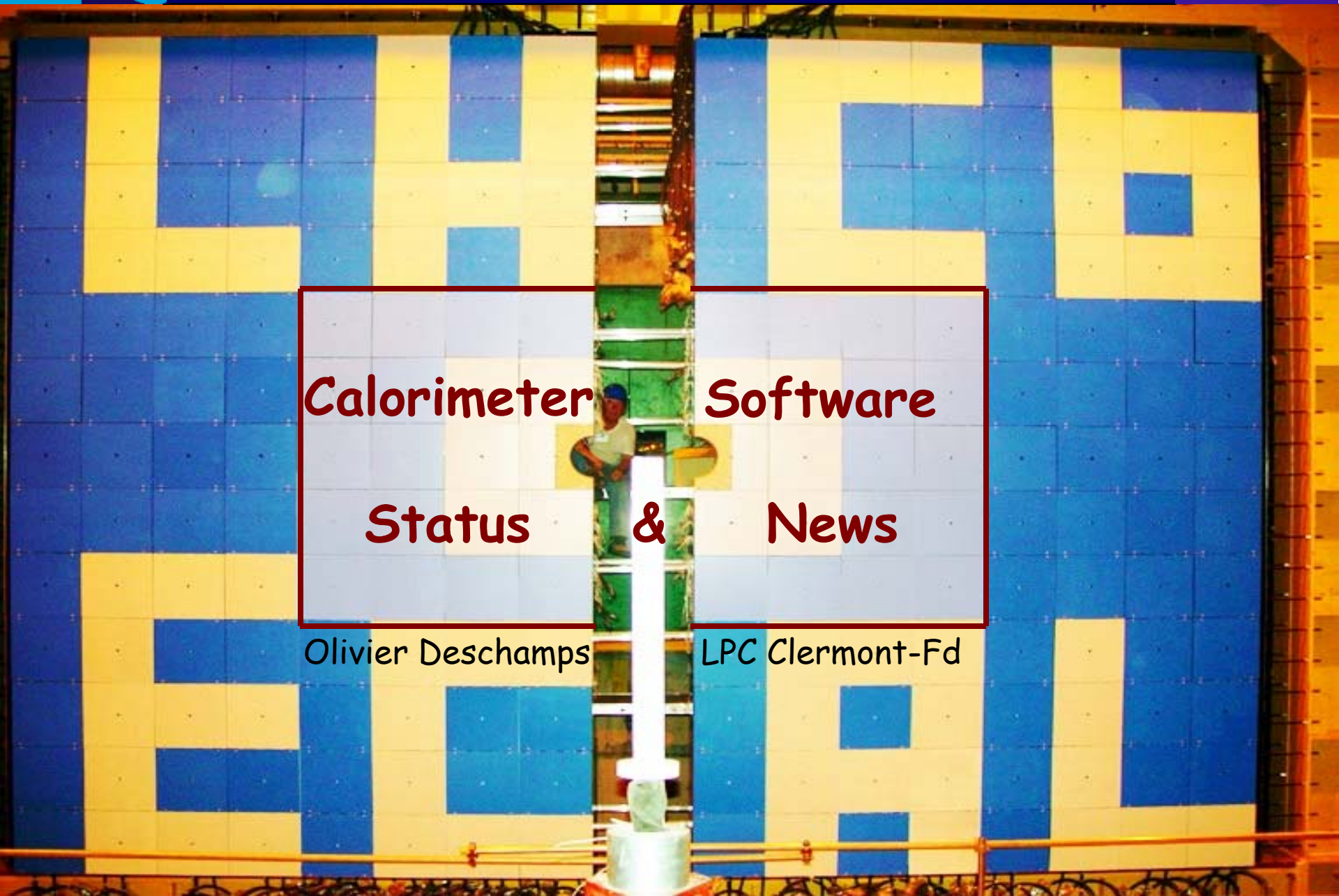


Calorimeter Software Status & News

Olivier Deschamps LPC Clermont-Fd

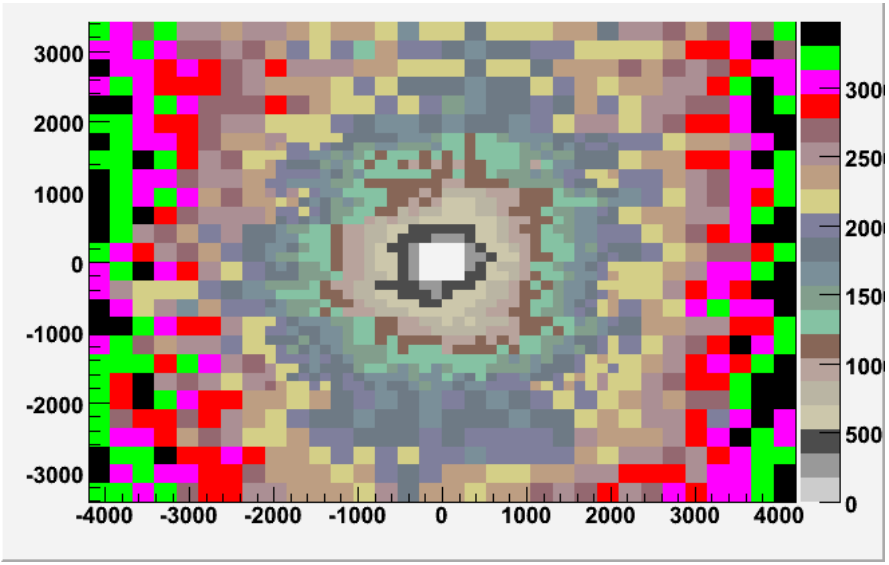
Outline

- News in monitoring/Calibration software
- Condition DataBase content and format update
- Offline absolute calibration
- MC09 Calo event size

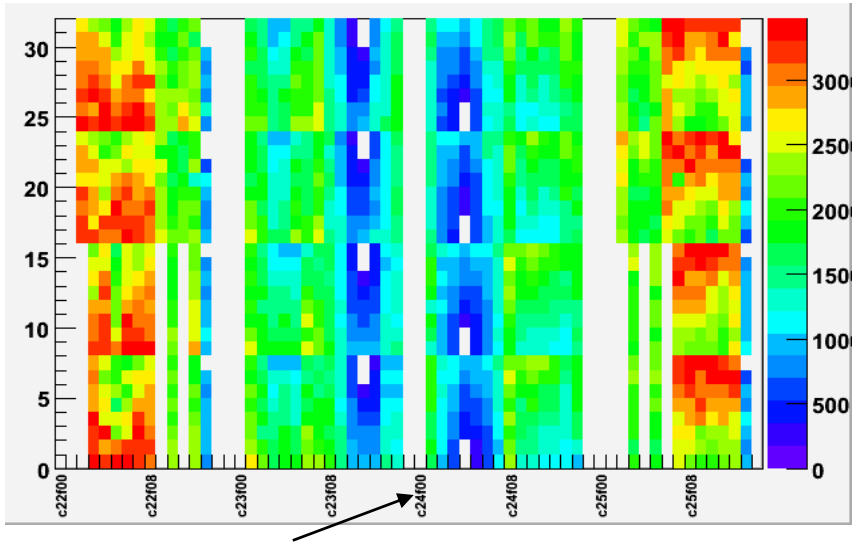
Software status and news

- New features in Calo2Dview
  - usually used to produce monitoring geometrical histo2D with 'variable' cell sizes
    - Ecal/Prs/Spd view needs 100k bins to mimics the 3 areas granularity !!
    - Also used in Brunel monitoring (but currently desactivated)
  - New : possibility to produce separate histo per region (14k bins in total for Ecal)
    - tool to merge the 3 regions in a single histogram exists in the OMALib package
    - use separate histo for DIM transport and re-merge histo in the presenter
    - still some problems when merging (due boundaries rounding) but should work soon.
  - New : possibility to produce a 'readout' 2D view : crate/feb versus channel

Hcal geometrical view :



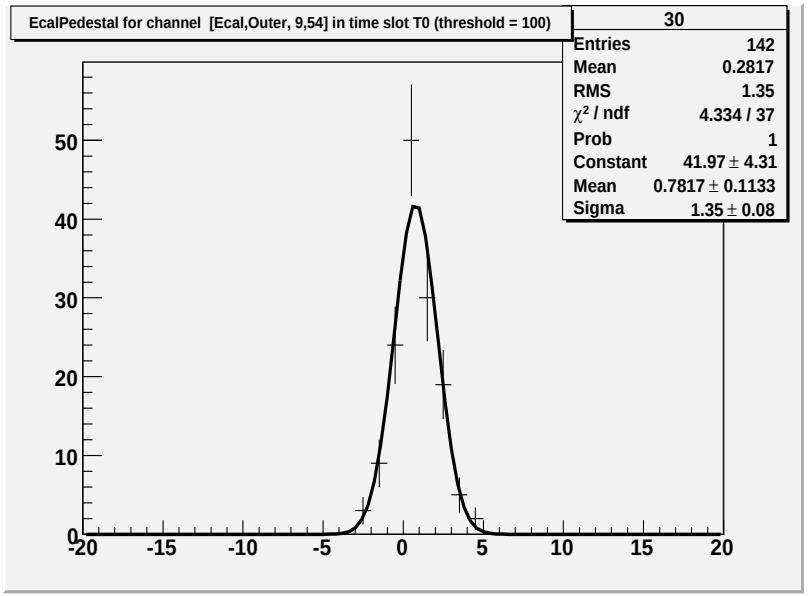
Hcal 'readout' view :

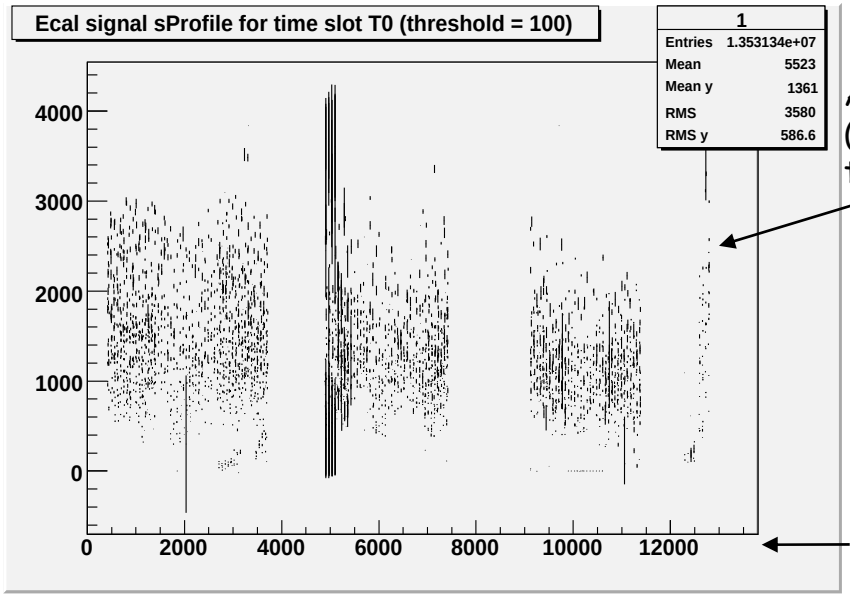


c24f00 means Crate#24 FEB#0 (automatic labeling)

Calibration Farm processing

- Online monitoring of Calorimeter behaviour based on Calibration data
  - LED data at ≈ 100 Hz processed in Calibration Farm
    - Relative gain variation (PIN-diode monitored LED data)
    - dead channels, noisy channels, pedestal following
- ORWELL project handles online calibration (and part of monitoring) software
- CaloCalib algorithms can produce a lot of calibration histograms
  - ≈ 50k histograms in full detailed mode (distributions per channels)
  - few histograms in summary mode (averages versus channel)





Histo Analysis

- Saveset of histograms stored every N seconds (current value 600s)
  - with 100 Hz calibration trigger → 60 k events per Saveset
- Ecal/Hcal LED flashing sequence :
  - 1/8 of the detector flashed per calibration trigger
  - 100 Hz calibration trigger -> ~ 10 Hz LED per channel (+ ~ 1 Hz pedestal)
    - ~ 6k LED events + 1k pedestal /channels/SaveSet
- New algorithm for automatic Saveset analysis : OMACaloAnalysis
  - based on the analysis package OMAlib from Giacomo Graziani
- OMACaloAnalysis handles several « Monitor » instances
  - Each instance is built via an options-driven tool : CaloMonitor
  - generic syntax :

```
ApplicationMgr.TopAlg += { "OMACaloAnalysis/EcalAnalysis"};
EcalAnalysis.Monitors  += { " Monitor1 ", " Monitor2  ", . . . };
EcalAnalysis.Monitor1.Data =  { [DataType] , [DataValue], [DataSource] };
EcalAnalysis.Monitor1.ExpectedRange = { [min] , [max] }
EcalAnalysis.Monitor1.AlarmLevels     = {   10     : " Warning" , 100   : "Alarm" , 1000 : "Fatal " };
EcalAnalysis.Monitor2. . . .
```

Analyzing the Saveset

- According to the 'CaloMonitors' configuration OMACaloAnalysis algorithm
  - loop over channels
  - get the given data value (e.g. 'mean') for the given data type (e.g. 'pedestal') from the given histo source (e.g. 'Profile')
  - Count channels outsides the expected range
  - Provide alarm report and summary histo
    - 3 alarm levels : Warning, Alarm, Fatal
  - Provides 1D and 2D histo for each monitored quantity
  - Provide location of problematic channels
  - and few more functionalities
- Few example next slides …
  - based on Ecal and Hcal LED data
  - run 45498, 45396 (~ 30k events Ecal C-side) and 46046 (~ 30k events Hcal)

CaloMonitor : Pedestal Mean

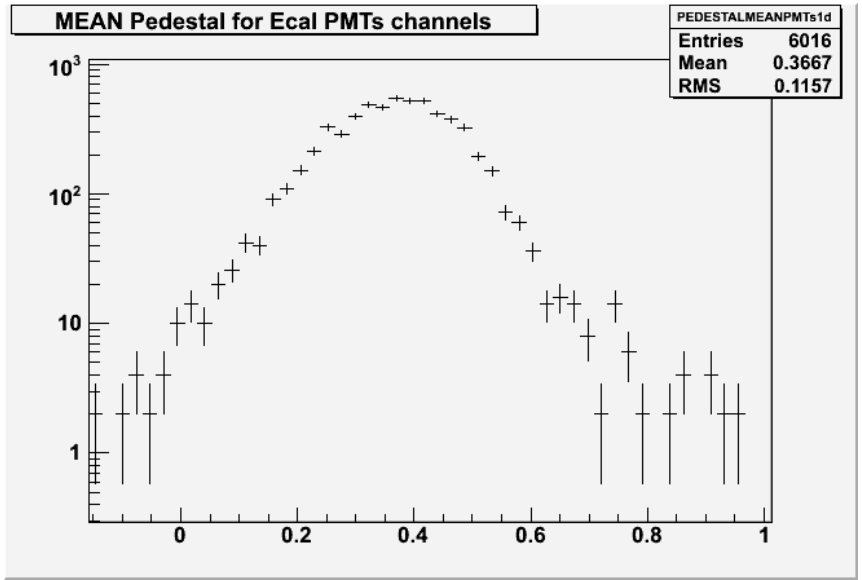
- Pedestal follower
- configuration :

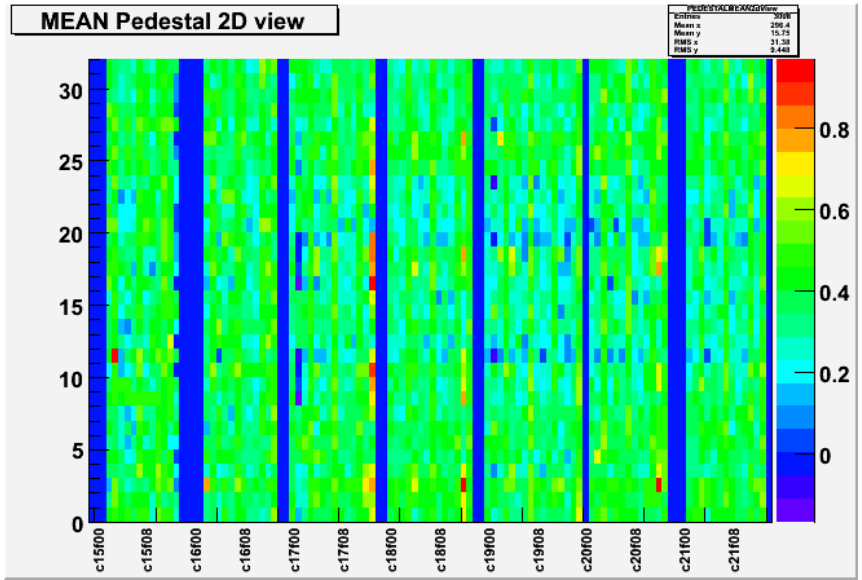
```
EcalAnalysis.Monitors    += { "PedestalShift"};
EcalAnalysis.PedestalShift.Data           = {"Pedestal" , "Mean" , "Profile" };
EcalAnalysis.PedestalShift.ExpectedRange  = {-0.3 , 1.0} ;
EcalAnalysis.PedestalShift.AlarmLevels    = { 10   : "Warning",
                                              100  : "Alarm"   ,
                                              1000 : "Fatal"  };
```

- Alarm logger :

```
+-------------------------------------------------------------------------------+
|                          monitor : EcalAnalysis.PedestalShift                 |
|                'Pedestal Mean for  PMTs channels  outside the [-0.3 , 1] range'|
|      NO Associated condDB Quality mask - report only NEW problems             |
|        analyzing the Profile histo '/EcalCalib/Profile/Pedestal/1'            |
+--------+----------------------------------------------------------------------+
|     OK |     0 /  3008          NEW Ecal          PMT  channels  outside the expected range|
|        |             average over  3008  PMT :      0.366                      |
|        |              spread over  3008  PMT :      0.116                      |
|        |      spread/average over  3008  PMT :     31.613 %                    |
+--------+----------------------------------------------------------------------+
```

- Pedestal Mean histos :





CaloMonitor : Pedestal RMS

- Noise follower
- configuration :

```
EcalAnalysis.Monitors    += {  "Noise"};
EcalAnalysis.Noise.Data          = { "Pedestal",  "RMS ,  " Profile"};
EcalAnalysis.Noise.DBQualityMask = 4;
EcalAnalysis.Noise.ExpectedRange  = { 0.8 , 2.0} ;
EcalAnalysis.Noise.ExpectedPINRange  = { 0.0 , 30.0} ;
EcalAnalysis.Noise.AlarmLevels   = { 10   : "Warning", 100  : "Alarm" , 1000 : "Fatal"  };
```

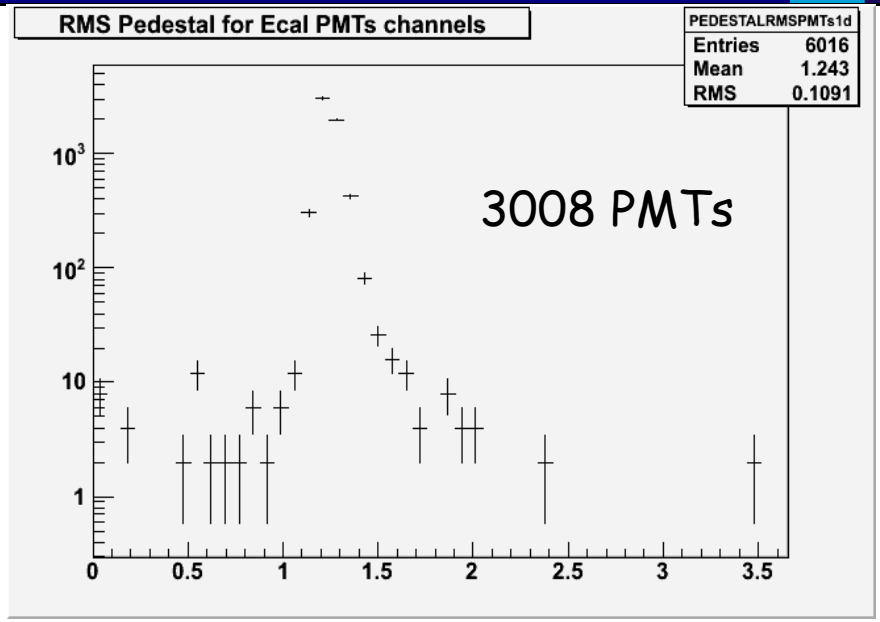
indicate which condDB quality bit is associated to the monitor (here 'Noisy channel' bit)

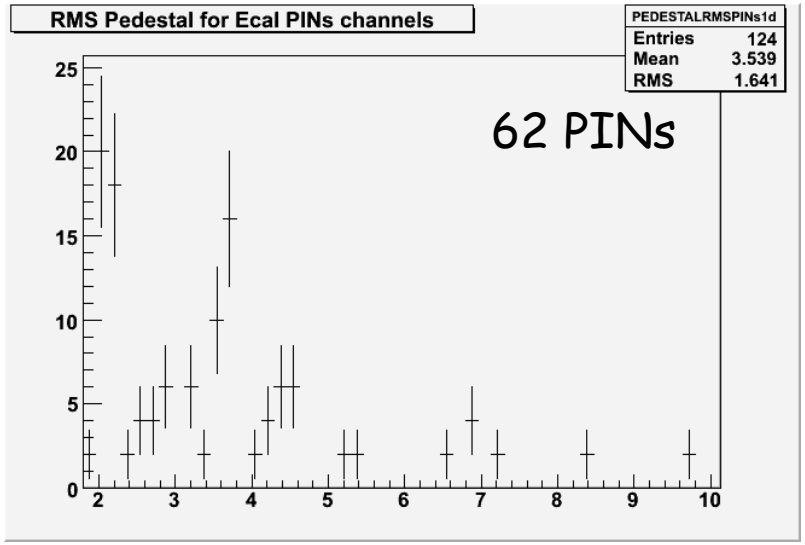
- When condDB relation is given, the CaloMonitor counts :
  - NEW problematic channels (e.g. not tagged as noisy in the condDB)
  - RESSURECTED channels (noisy tag in condDB but OK from the analysis)
  - KNOWN channels (found as noisy in both condDB and in the analysis)
- Alarm to be launched for NEW and RESURRECTED problematic channels only
  - i.e. : alarm when something change wrt condDB content

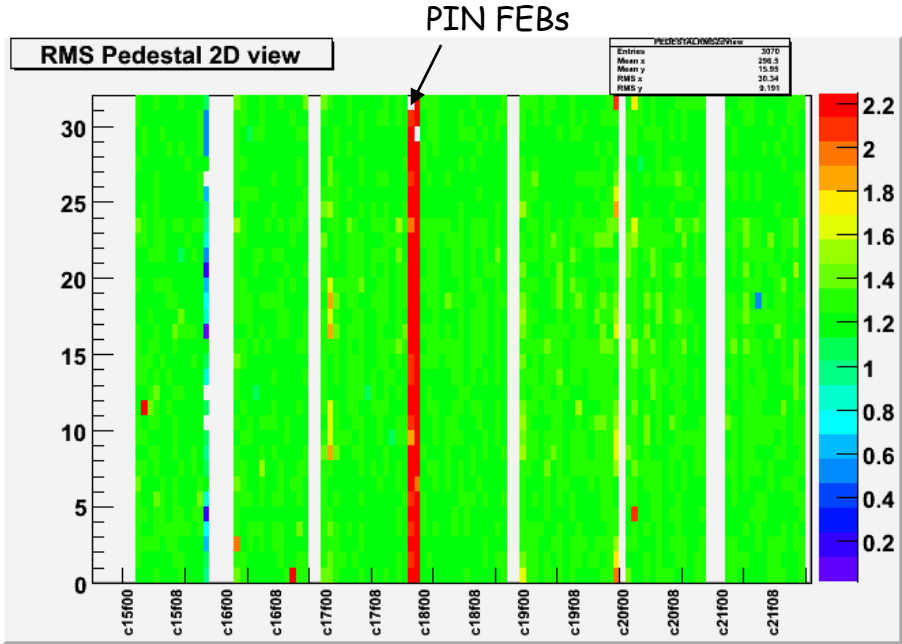
```
+-------------------------------------------------------------------------------------------+
|                                        monitor : EcalAnalysis.Noise                       |
|        'Pedestal RMS for  PMT channels  outside the [0.8 , 2] range' ( [0 , 30] for PINs)'|
|                              Associated condDB Quality mask : 0x0004                      |
|            analyzing the Profile histo '/EcalCalib/Profile/Pedestal/1'                    |
+--------+----------------------------------------------------------------------------------+
|Warning |     20 /  3070          NEW Ecal  PMT or PIN  channels  outside the expected range|
|     OK |      0 /  3070        KNOWN Ecal  PMT or PIN  channels  outside the expected range|
|     OK |      0 /  3070  RESURRECTED Ecal  PMT or PIN  channels  whithin the expected range|
|        |              average over  3008  PMT :      1.244    (  62 PIN :      3.537   )  |
|        |               spread over  3008  PMT :      0.108    (  62 PIN :      1.636   )  |
|        |      spread/average over  3008  PMT :      8.658 %  (  62 PIN :     46.263 %)  |
+--------+----------------------------------------------------------------------------------+
```

CaloMonitor : pedestal RMS

1D and 2D distributions for the pedestal RMS





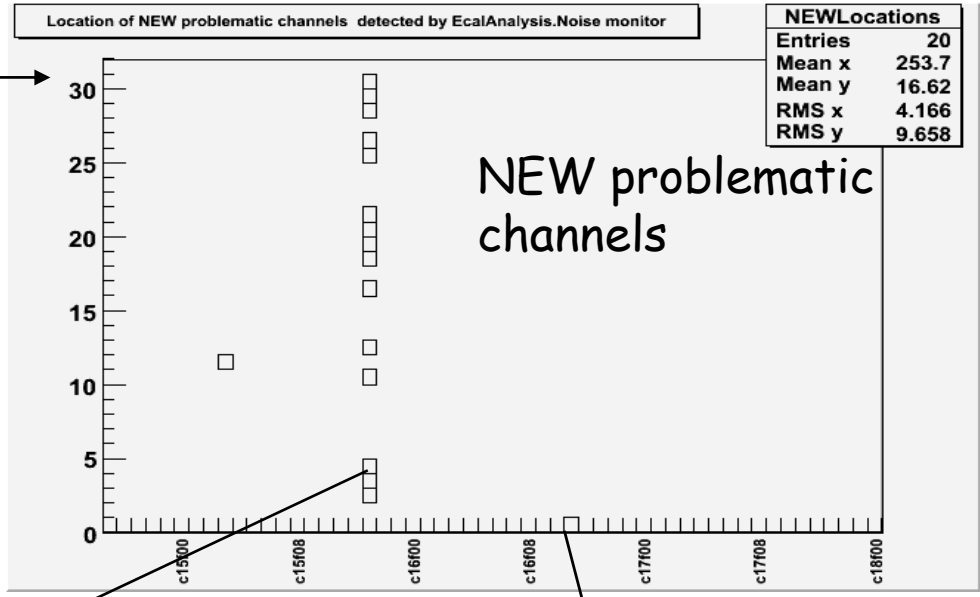


CaloMonitor : pedestal RMS

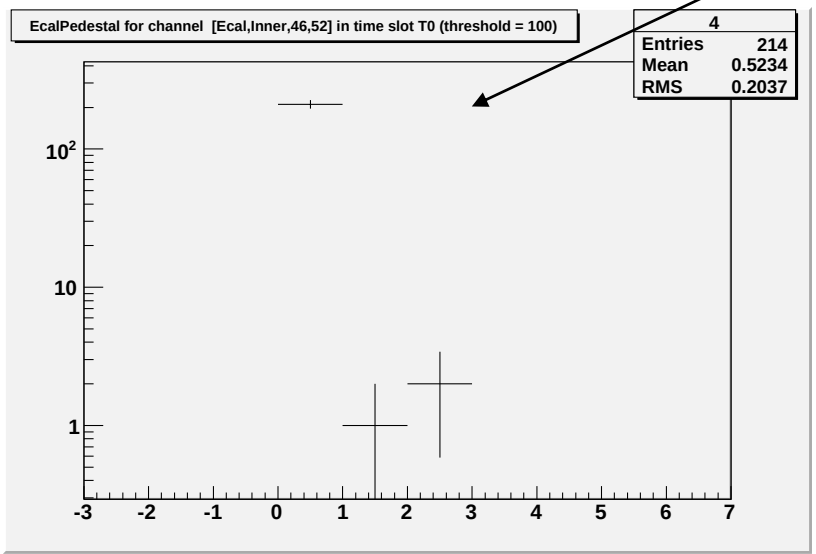
Location of the 20 NEW problematic channels.

- Similar view is also produced for KNOW and RESURRECTED channels (but empty so far as the condDB Quality flag per channel is not yet filled)

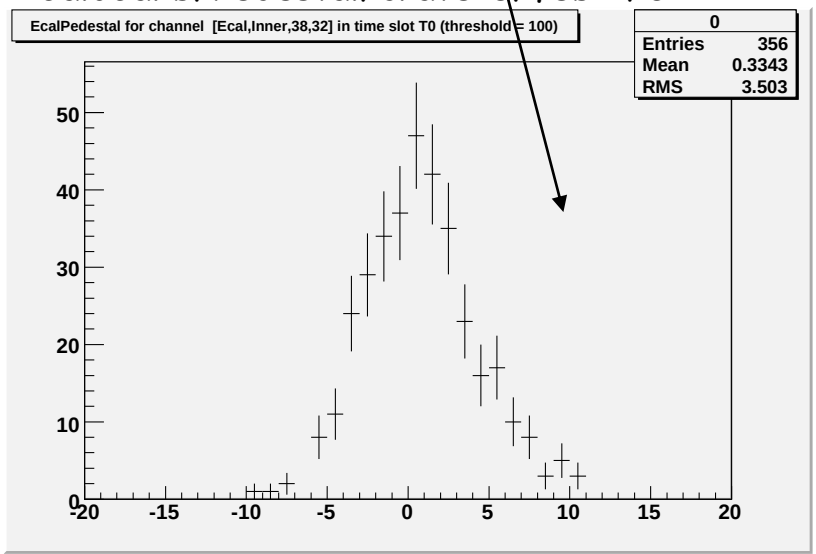
- From this 2D view it is easy to retrieve the individual channels distribution



CaloCalib/Pedestal/crate15/feb13/4



CaloCalib/Pedestal/crate16/feb11/0



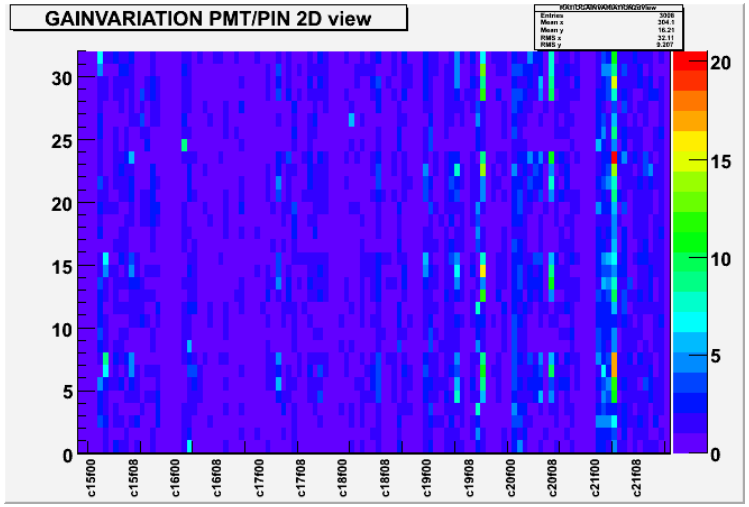
CaloMonitor : gain variation

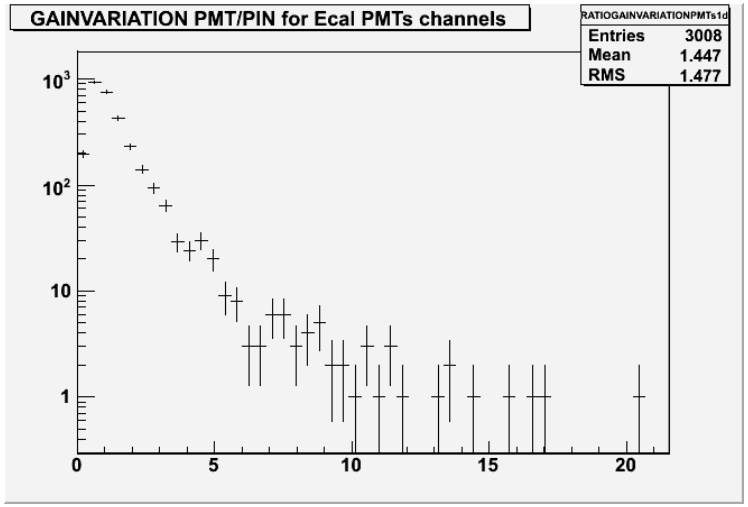
- Gain follower
- config :

```
EcalAnalysis.Monitors    += {  "GainVariation"};
EcalAnalysis.GainVariation.Data          = {"PMT/PIN", "GainVariation","Profile"};
EcalAnalysis.GainVariation.ExpectedRange  = {0.98 , 1.02} ;
EcalAnalysis.GainVariation.AlarmLevels   = { 10 : "Warning",100 : "Alarm"  ,1000 :  "Fatal"  };
```

- GainVariation 'data value' : compare PMT/PIN with value stored in condDB

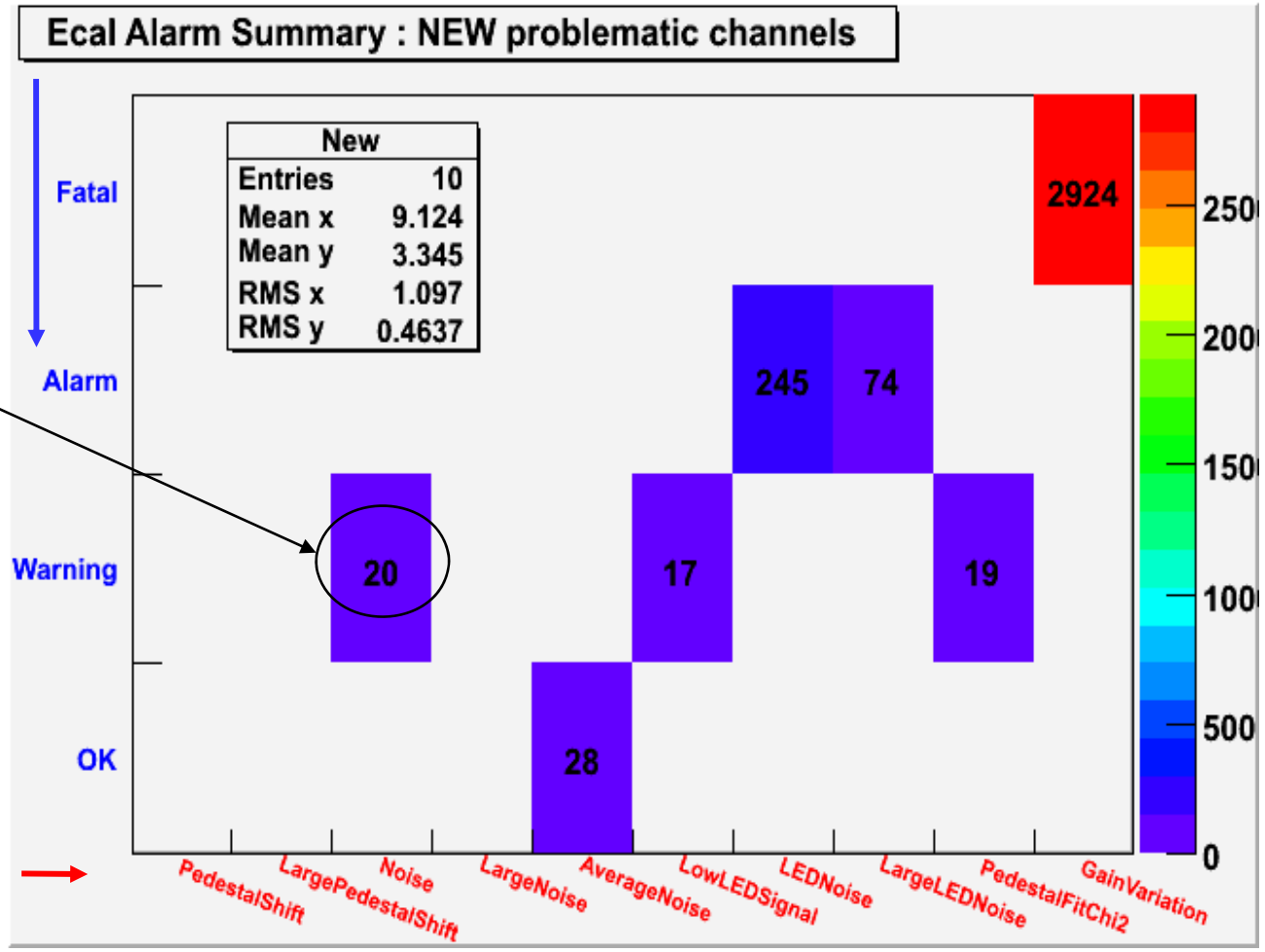
```
+-------------------------------------------------------------------------------------------+
|                                monitor : EcalAnalysis.GainVariation                       |
|            'PMT/PIN GainVariation for  PMTs channels  outside the [0.98 , 1.02] range'    |
|          NO Associated condDB Quality mask - report only NEW problems                     |
|              analyzing the Profile histo '/EcalCalib/Profile/Ratio/1'                     |
+---------+---------------------------------------------------------------------------------+
|  Fatal  |  2924 /  3008          NEW Ecal          PMT  channels  outside the expected range|
|         |              average over  3008  PMT  :      1.444                                |
|         |               spread over  3008  PMT  :      1.476                                |
|         |      spread/average over  3008  PMT  :    102.246 %                              |
+---------+---------------------------------------------------------------------------------+
```





Analyzing the saveset : global summary

- The only plot the shifter will have to look at (when alarm is raised)



Number of channels outside the expected range

- The piquet/expert will have to look to the detailed CaloMonitor information in order to take a decision (fix the hardware configuration/update condDB/…)

Condition Data Base

- CondDB content and format updated according to CaloMonitor scheme

- 'Quality' condition :

To define calibration histo ranges

x N channels (incl. PIN-diodes)

[CellID]	<PMT>(T)	RMS(PMT)(T)	<PMT/PIN>(T)	RMS[PMT/PIN]	Quality flag

- Quality flag content according to defined CaloMonitors (i.e. 1 bit → 1 CaloMonitor)

...	Large Ped. shift	Pedestal Shift	Very Noisy	Noisy	Dead LED	Dead

- add a global calo quality flag (average noise over channels outside expected range for instance)

Automatic analysis : summary

- The OMACaloAnalysis algorithm is available on the online system at pit
  - essentially tested offline but not yet commissioned online
  - to be tested in full online mode as soon as possible.
  - Should provide calo status on many parameters every 10 minutes or so

- The algorithm is generic and can be used to monitor histo from physics data
  - some analysis already implemented in the Monitoring Farm

- Many things still missing to have a complete calibration/monitoring scheme

  - condDB update :
    - should not be too difficult from the information stored in the CaloMonitors to built a new condition table ready for condDB update.
    - Expert will have to validate the condDB update via some PVSS panel (to be built).

  - Trending plot
    - analyze several consecutive Savesets and study the time evolution of noise, gain …
    - Useful to define what will be our standard 'stability' range for each parameter.
    - trending plot to be produced but not so trivial (20k channels).

  - Define default page in presenter

Absolute energy calibration

- Absolute calibration factor be extracted from physics data offline
- Several concurrent procedure being studied
  - 'Energy flow' method ('pre-calibration') : smooth according to neighbor channel average
    - reach ≈ 5% inter channel calibration
  - e/p from 'pure' electron sample (RICH identified or conversion in Velo selected w/ dE/dx)
  - pi0 mass distribution (calo standalone method)
    - reach <≈ 1% inter channel calibration but require large statistics

- 'Calibration' condition contains absolute calibration information per channel

The calibrated energy is obtained with :

nominal Gain

Offline (Physics) Absolute calibration

Online (LED) Variation following

'Quality' condition param

'Calibation' condition param

$$E = G_{ref} \times \delta_G \times \frac{<PIN>(ref)}{<PMT>(ref)} \times \frac{<PMT>(T)}{<PIN>(T)} \times (ADC - 256 - PedShift)$$

$$G_{ref} = \frac{E_T^{Max}(\theta = 0) + E^{Slope} \times \sin(\theta)}{ADCMax}$$

Producing mis-calibrated events

- The Calo group would like to produce a large sample (100-200 Mevts) of miscalibrated data
  - purpose : exerise the various calibration methods on full scale
    define the best strategy
  - would also like to perform some FEST-like test (identify miscalibrated data online)

- Software in place
  - condDB content updated with missing parameters for digitizations
  - CaloDet adapted to provide all condDB parameters
  - specific tag of condDB with miscalibration factor (10% gaussian) + ≈ 15 dead channels in place
  - post-MC09 Boole version

- Production request to be sent to PPG
  - other sub-detectors could be interested in large production of miscalibrated/misaligned sample
  - joint request will have more weight to PPG

- Also possible to re-process existing FEST data
  - faster production
  - but reprocessing already digitized data gives approximate miscalibration
    - not possible with the 1bit Spd
    - 0-suppression/saturation effect
  - Software also in place
  - will be done for preliminary tests

Calo bank size

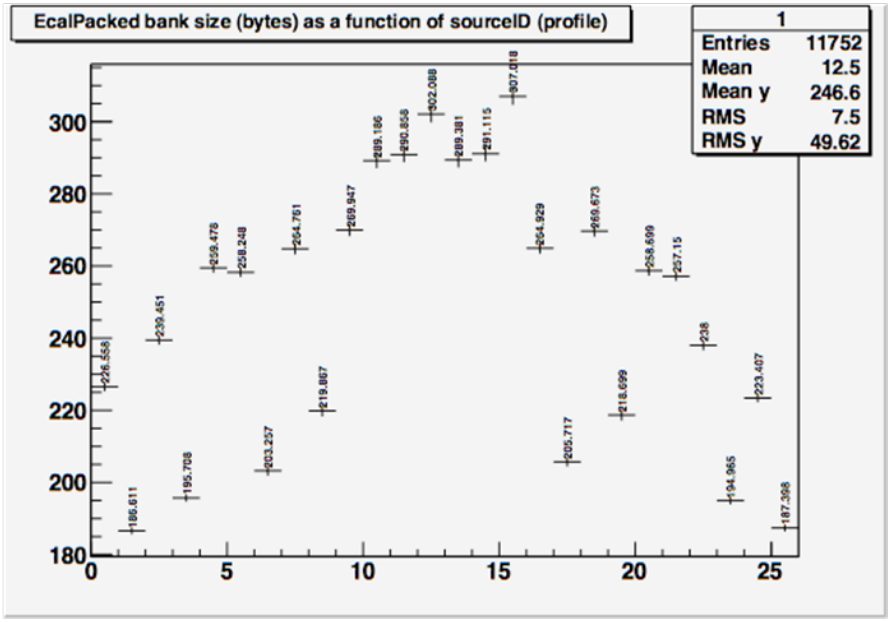
- Information requested by Niko to defined the number of links / TELL1
- Bank size re-evaluated with MC09 (FEST data)
  - new MC, change in Prs TELL1 cabling , 0-sup threshold lowered in Prs (from 15 to 5 ADC) wrt DC06
- Standard L0-selection applied

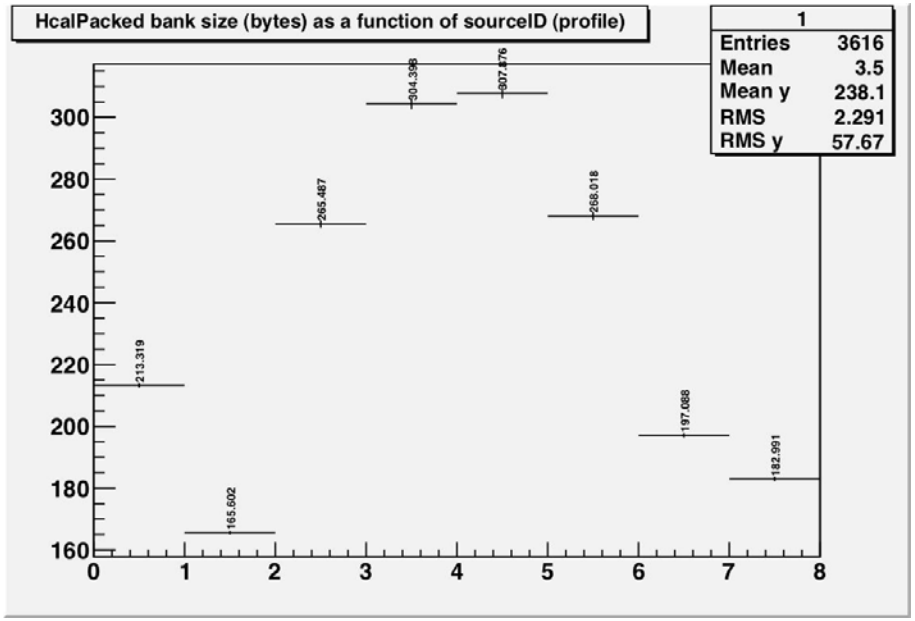
	Online format E/HCal non 0-suppressed 1 bank per TELL1			**Offline format** 0-suppressed data 2 banks (XCalE + XCalTrig)
	Nbanks	Average TELL1 size (min/max)	**Total event Size**	**Total event Size**
Ecal	26	250 (190/310) Bytes	**6.4 kB**	**2.9 + 1.9 = 4.8 kB**
Hcal	8	240 (170/310) Bytes	**1.9 kB**	**0.7 + 0.8 = 1.5 kB**
Prs/Spd	8	150 (80/230) Bytes	**1.2 kB**	**1.1 + 0.4 = 1.5 kB**

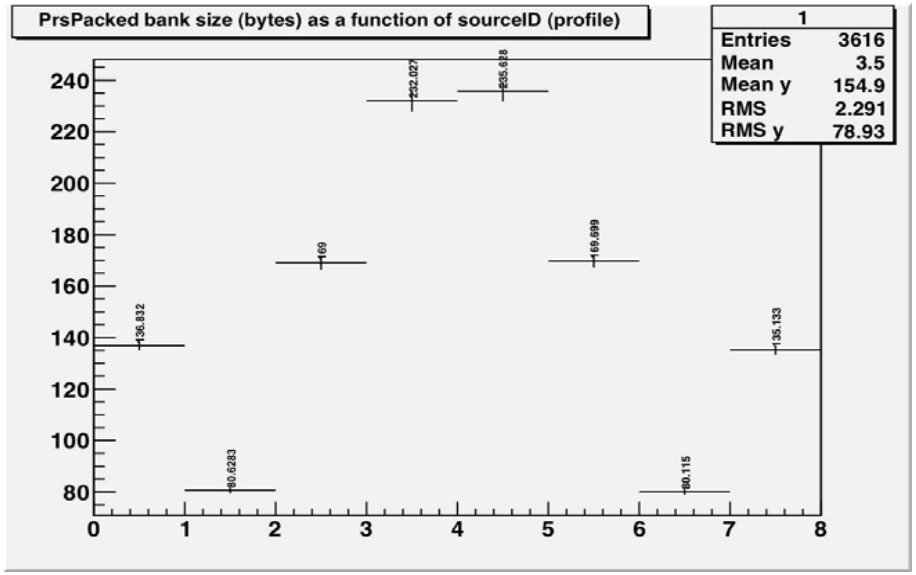
- Total Calo online size : 9.5 kB/evt – Total offline size : 7.8 kB/evt (≈ 20% gain with the conversion)
- Prs offline is heavier than online !
  - adopt online format everywhere is easy and transparent → gain 0.3 kB/evt
- MC09 Calo event size found a bit lower (-15%) than in DC06 for Ecal and Hcal (maybe due to <μ>)
  - MC09 Prs with 5ADC 0-sup ≈ DC06 with 15 ADC threshold
- Without L0-selection (≈ minibias trigger) the event size decreases by a factor 1.5-2
- Requested the 4 links perTell1
  - link load from 20% to 60 %
  - different from inital scheme (2 or 3 links per TELL1 were foreseen) → load > 80% in hottest region
  - https://lbtwiki.cern.ch/bin/view/Online/Tell1PortNum?sortcol=table;table=up#ECal_HCal_Prs

Event size

- Bank size is monitored online :







Conclusions/Summary

- Some progress with online calibration/monitoring
- Many other issues in the pipeline or almost ready not shown today :
  - Software for 'Energy flow' calibration method implemented (Aurelien Martens)
  - new CaloPID monitoring (Dmitry)
  - new Orwell version to be released this week (v1r8)
  - Some effort to improve the timing of the calo reconstruction sequence for HLT2
    - Factor 2.5 improvement with only technical changes → ~ 11ms/event
    - Further improvement possible by applying Et cut on cluster, removing some part of the full offline reconstruction, … to be studied
  - Updated PhotonId (Frédéric, Marie-Noelle)
- but still a lot to do

CaloReco tuning for MC09 : to do

- More completeMDC09 re-tuning in preparation
  - re-tune energy correction dependency on cluster position and energy
  - S-shape parameters re-evaluation
- Strategy to extract parameters from real data under study
  - e.g. : based on reconstructed electron and/or pi0 mass width
- Merged Pi0 reconstruction parameters to be checked
  - require more stat than available with the current validation samples.
- New re-tuning can be re-processed within DaVinci if needed
  - as it was done for DC04 and DC06.
  - CaloReco sequence quite fast.