Monitoring of LAr raw channels and jets
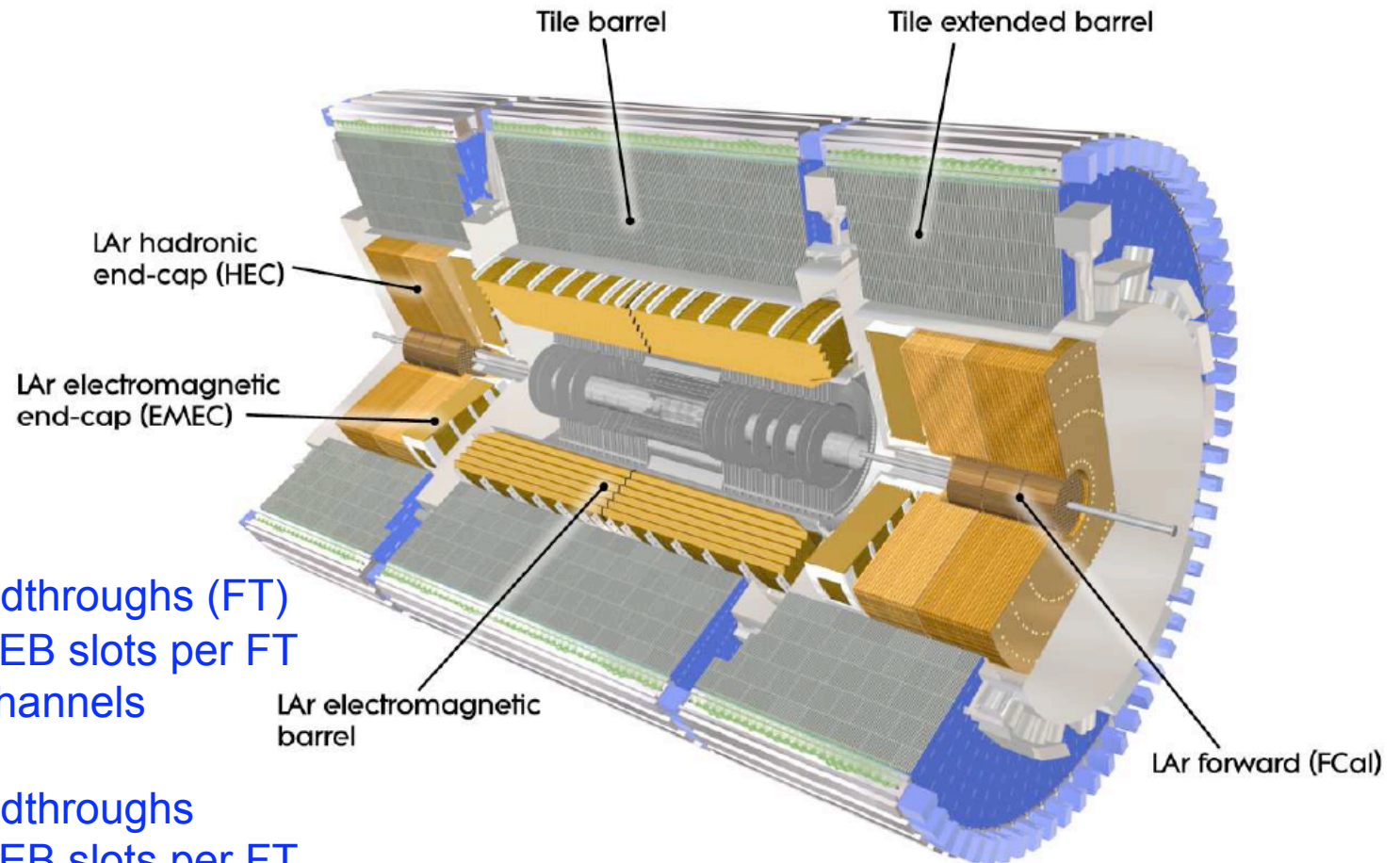
Contributions from
Rolf Seuster
Frank Berghaus
Jean-Raphael Lessard

Michel Lefebvre
Physics and Astronomy
University of Victoria

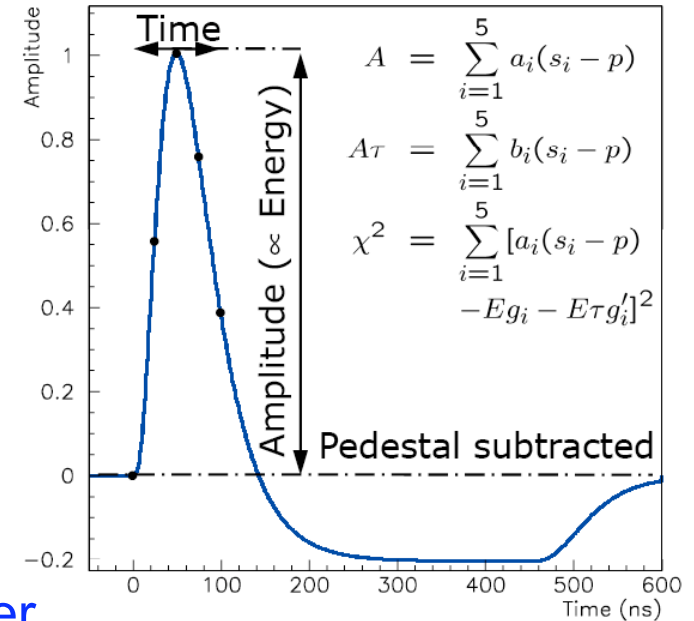# LAr Readout Channels

Tile barrel

Tile extended barrel

LAr hadronic end-cap (HEC)

LAr electromagnetic end-cap (EMEC)

LAr electromagnetic barrel

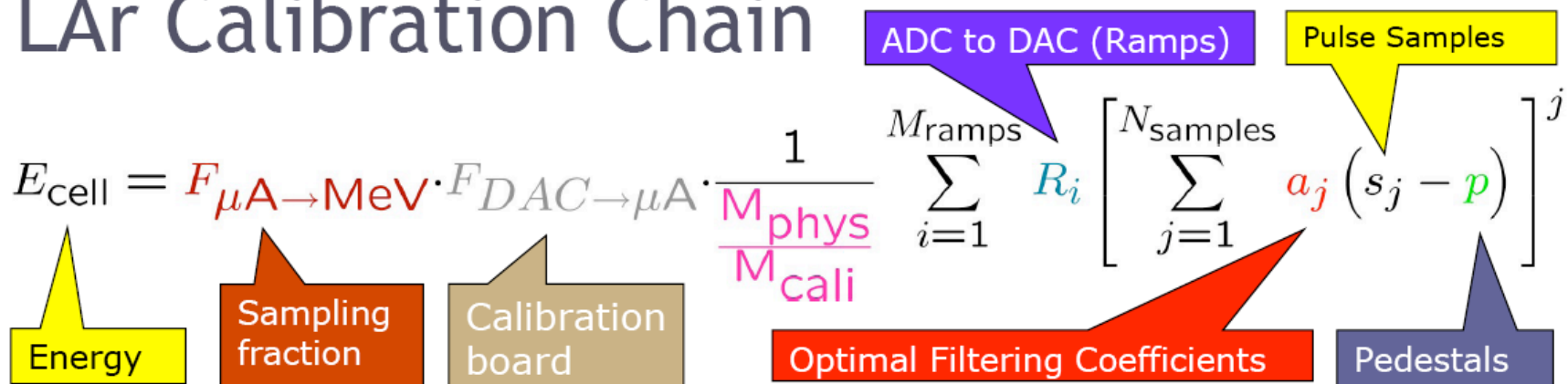LAr forward (FCal)

- **LAr Barrel**
  - 2 X 32 feedthroughs (FT)
  - up to 14 FEB slots per FT
  - 109,568 channels
- **LAr Endcap**
  - 2 X 25 feedthroughs
  - up to 15 FEB slots per FT
  - 2 X 36,450 = 72,900 channels
- **FrontEnd Boards (FEB)**
  - up to 128 used channels

LAr data

- **LArDigits**
  - ADC of time samples
- **LArRawChannel**
  - energy, time, quality factor, hardware identifier
  - produced in the DSP, or offline, from LArDigits
- **CaloCells**
  - energy, time, quality factor, offline identifier
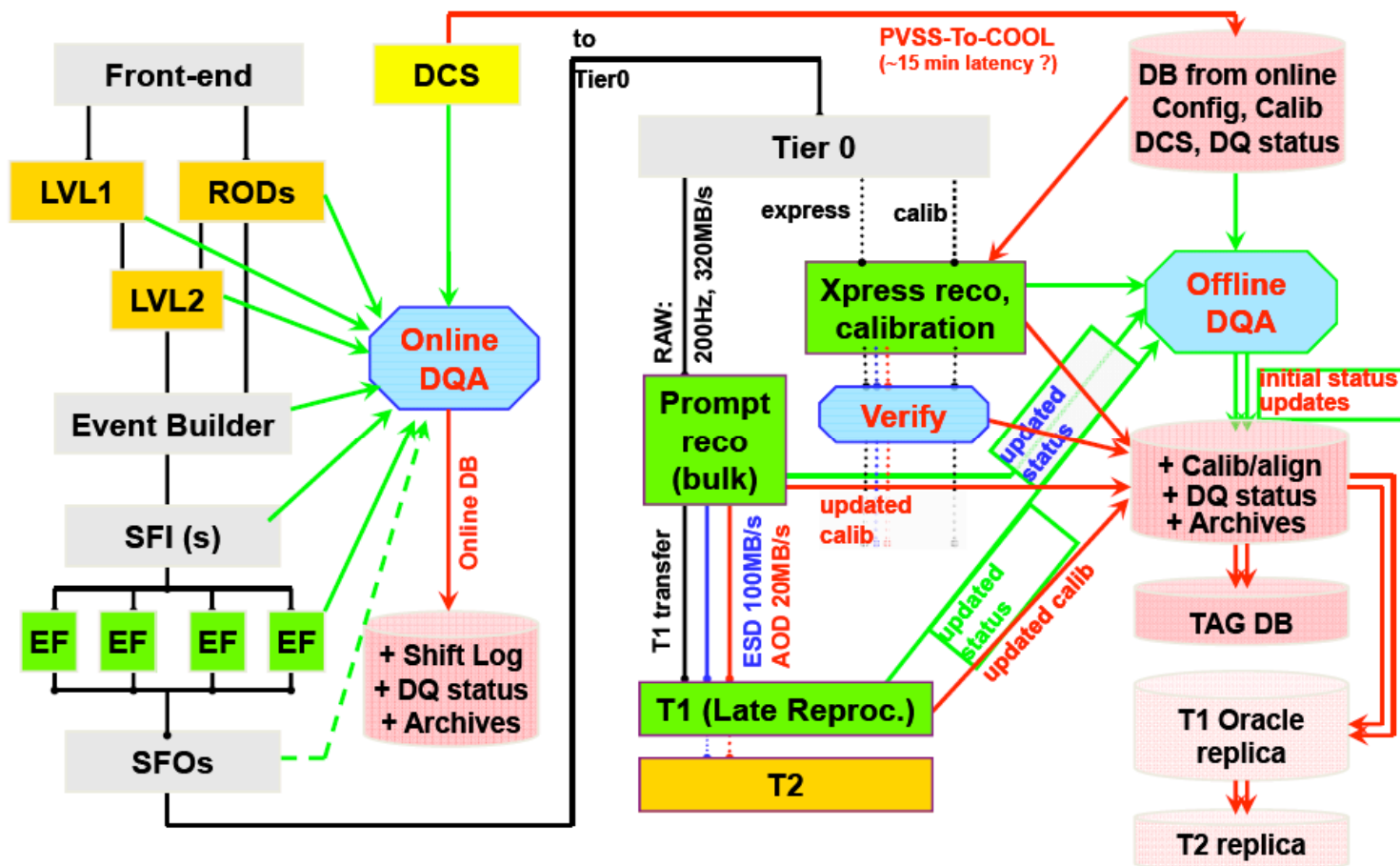 - produced from LArRawChannels offline

$$A = \sum_{i=1}^{5} a_i(s_i - p)$$

$$A_T = \sum_{i=1}^{5} b_i(s_i - p)$$

$$\chi^2 = \sum_{i=1}^{5} [a_i(s_i - p) - Eg_i - E\tau g_i']^2$$

Pedestal subtracted

LAr Calibration Chain

$$E_{cell} = F_{\mu A \to MeV} \cdot F_{DAC \to \mu A} \cdot \frac{1}{\frac{M_{phys}}{M_{cali}}} \sum_{i=1}^{M_{ramps}} R_i \left[\sum_{j=1}^{N_{samples}} a_j(s_j - p) \right]^j$$

Energy — Sampling fraction — Calibration board — $\frac{M_{phys}}{M_{cali}}$ — ADC to DAC (Ramps) — Optimal Filtering Coefficients — Pulse Samples — Pedestals

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Data Quality

- Online and offline event flow, including processing, calibration and data quality monitoring
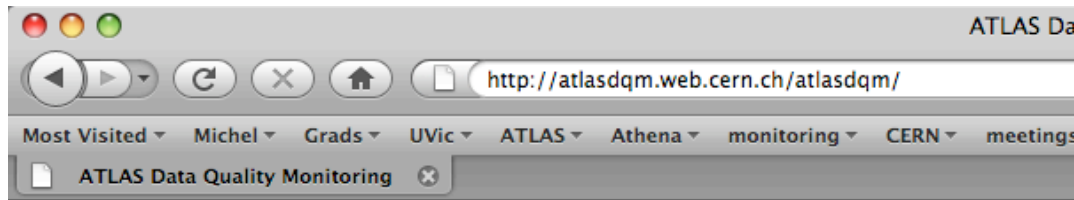
Monitoring LArRawChannel

- Overview:

  - Produced from LarDigits by LarRawChannelBuilder or by the DSP (for "normal" running) for each LarRawChannel

  - Will eventually be the only recorded quantity for most channels

  - Contain: energy, time and quality factor

- Quantities monitored

  - Acceptance: Fraction of events recorded above energy threshold

  - Signal: Average signal recorded in channel for events above threshold

  - Noise: The standard deviation of the signal distribution without threshold

  - Noise Acceptance Fraction of events in channel with negative signal less than negative 3σ

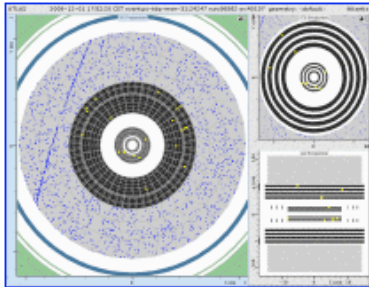   Also possible to monitor time and quality factor

LArRawChannel Monitoring Views

- All views adapted to COOL database folders
  - EMBA, EMBC, EMECC, HECA, HECC, FCALA, FCALC
- Detector view 2D histograms
  - FEB channel vs feedthrough slot
- Feedthrough view 2D histograms
  - FEB vs FEB channel
- FrontEndBoard view 1D histograms
  - vs FEB channel
- Physics View
  - channel phi vs chanel eta per detector per sampling

LArRawChannel Monitoring

LArRawChannel Monitoring

Cosmics08 Monitoring

***Indicates reconstruction is in progress; histograms represent accumulated statistics and are temporary.

Run Number	T0 Iteration	Streams
97249	1	[physics_L1Calo] [physics_L1CaloEM] [physics_MBTS_BCM_LUCID]
97240	1	[calibration_LArCells] [physics_L1Calo] [physics_L1CaloEM] [physics_MBTS_BCM_LUCID]
91860	1	[physics_CosmicDownwardMuons] [physics_CosmicMuons] [physics_IDCosmic] [physics_L1Calo] [physics_L1CaloEM] [physics_MBTS_BCM_LUCID] [physics_RNDM] [physics_RPCwBeam] [physics_TGCwBeam]

Run 91860, 1/physics_L1Calo

LAr – Red

--select subdirectory--

... or display directories at current level

[Back]

Run 91860, 1/physics_L1Calo

Entire Run	10 Minute Block 1
	10 Minute Block 2

Last Update: 2008-10-16 23:39 UTC

- LAr: **Red**
  - All_LAr_GLOBAL: Undefined
  - EMBA: **Red**
    - Data_Integrity: **Green**
      - DB_Conditions: Undefined
      - FEB_Readout: **Green**
    - High_Energy_Digits: **Red**
    - MisBehaving_Channels: **Red**
      - CaloCells: **Red**
        - 1dOccupancy: **Red**
        - 2dNoise: **Red**
        - 2dOccupancy: **Red**
      - LArDigits: **Yellow**
      - LArRawChannels: **Red**
    - Physics: Undefined
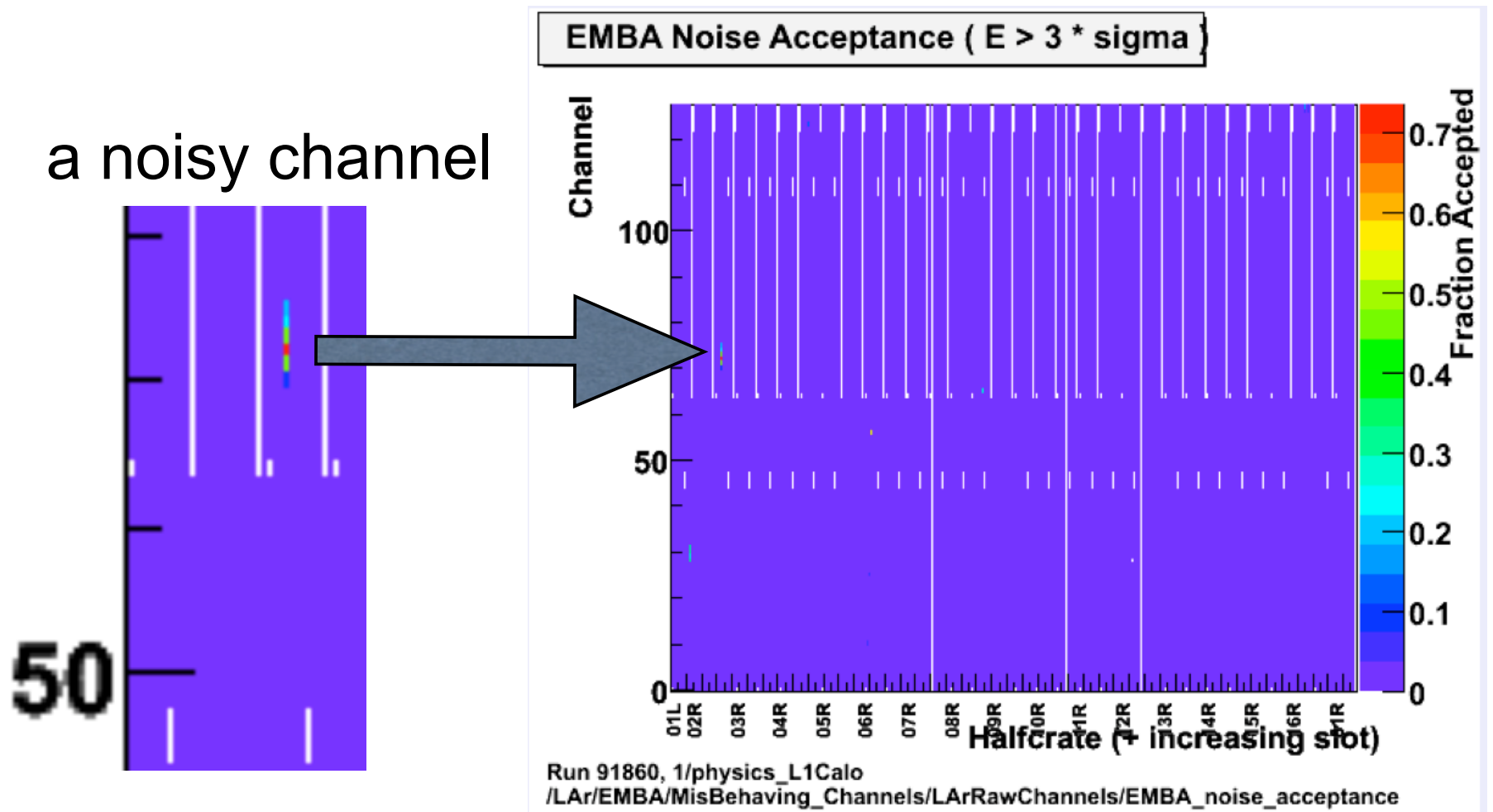
All LAr detectors:
EMBA, EMBC, EMECA, EMECC, FCALA, FCALC, HECA, HECC

shift histograms

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detector view EMBA noise acceptance

Cosmic run 91860 2008-10-16

a noisy channel

EMBA Noise Acceptance (E > 3 * sigma)

Channel

Fraction Accepted

Halfcrate (+ increasing slot)

Run 91860, 1/physics_L1Calo
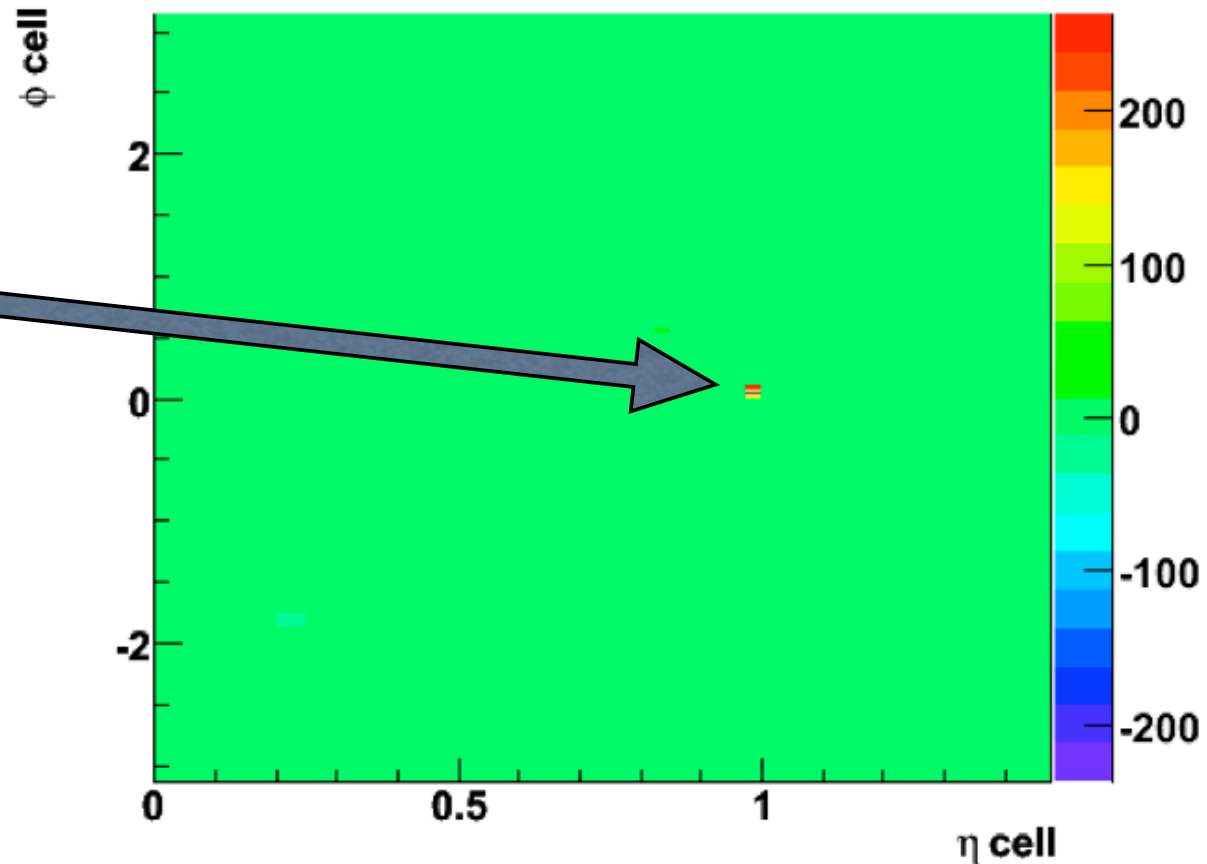/LAr/EMBA/MisBehaving_Channels/LArRawChannels/EMBA_noise_acceptance

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physics view EMBA sampling 2 signal

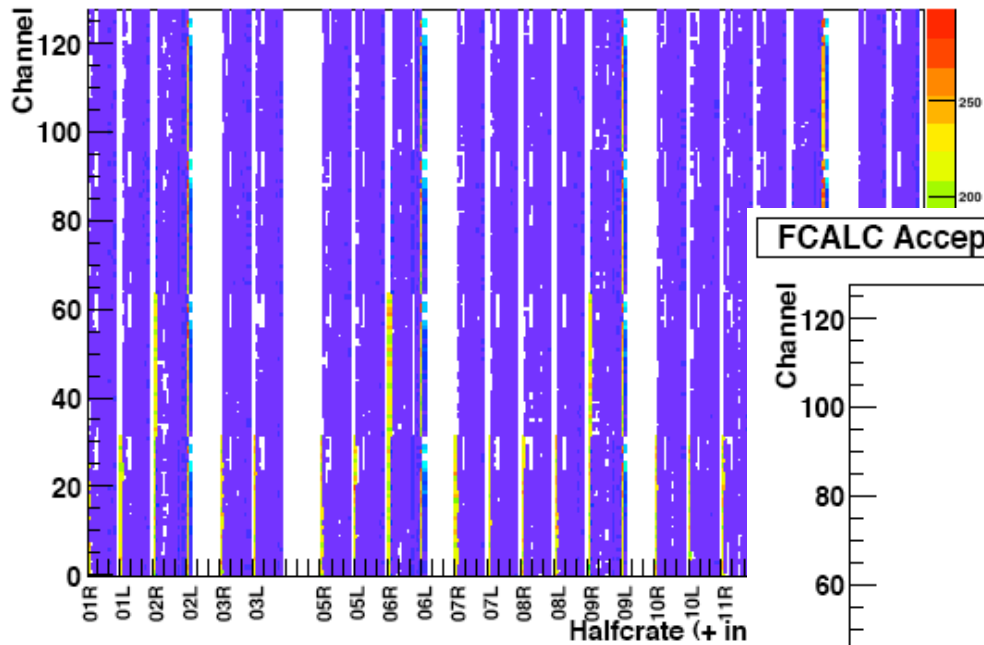Cosmic run 91860 2008-10-16

Mean Energy [MeV] - Sampling 2 - EMBA

same noisy
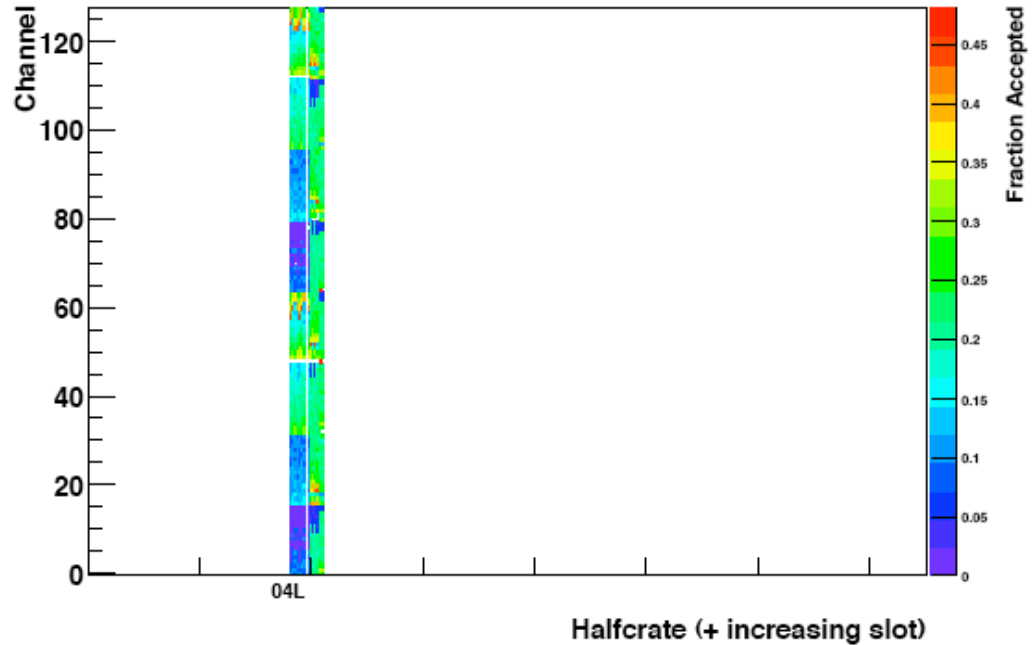channel.
Also visible
in noise plot

Run 91860, 1/physics_L1Calo
/LAr/EMBA/MisBehaving_Channels/LArRawChannels/PedesSampling2EMBARawChan

detector view FCALC and EMECA noise acceptance

FDR2 run 52301 2008-06-13

EMECA Occupancy (E > 100 MeV)

FCALC Acceptance (E > 700 MeV)

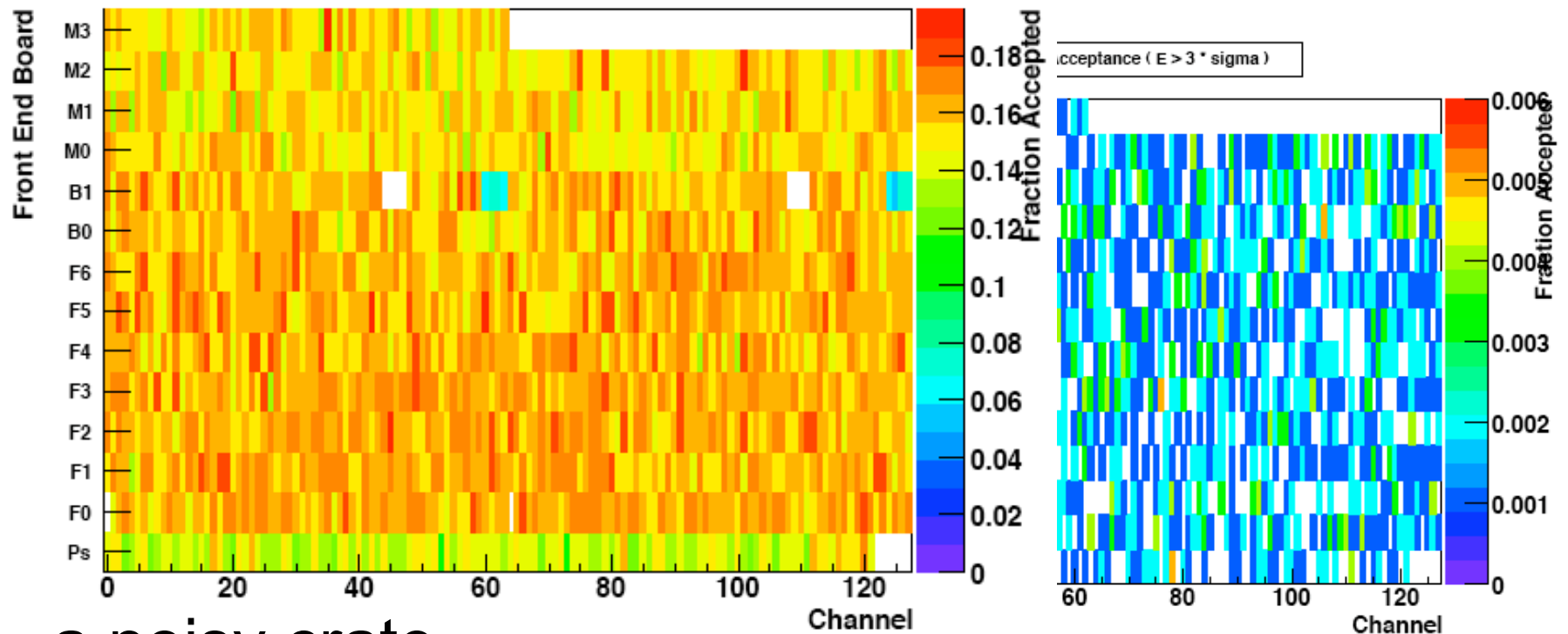# feedthrough view EMBA
noise acceptance

FDR2 run 52301 2008-06-13

Fraction of events below negative 3σ in a channel
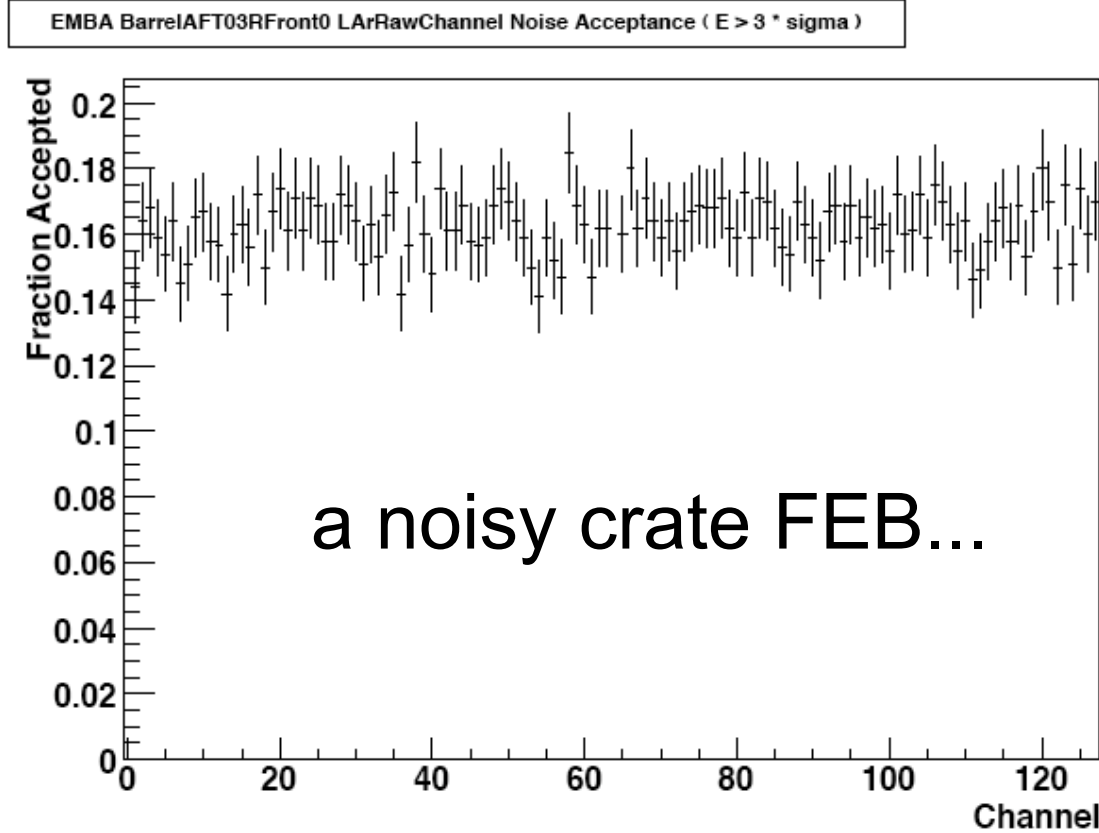expect about 0.0027

a noisy crate...

a normal crate...

FEB view EMBA
noise acceptance

FDR2 run 52301 2008-06-13

Fraction of events below negative 3σ in a channel expect about 0.0027

EMBA BarrelAFT03RFront0 LArRawChannel Noise Acceptance (E > 3 * sigma)

a noisy crate FEB...

LArRawChannels monitoring to-do list

- Develop hardware oriented DQMF view

- Documentation

- Optimize default job options

  - minimize CPU and memory usage

  - some useful histograms may have to be produced only for specific runs offline

Jet Monitoring

- **Monitoring of reconstructed calorimeter objects**
  - CaloCells, E_T^{miss}, Jets
  - aim at both online and offline
- **Jet monitoring helps identify detector problems**
  - clearly established during Full Dress Rehearsals
    - simulated detector failures were injected in data
    - test of full processing chain
    - jet monitoring first to identify simulated calorimeter failures
- **Software developed by UVic and UofArizona**
- **Recent development**
  - automatic histogram checks
  - Data Quality Monitoring Framework (DQMF) displays (collisions, cosmics)
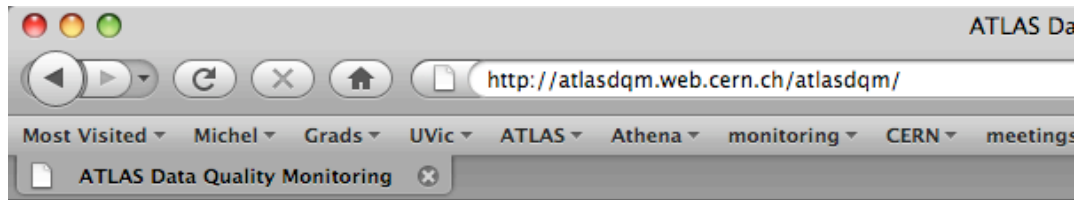
Jet Monitoring

■ Collections monitored during FDR

- Overall Status: **Red**
  - Jets: **Red**
    - Cone4H1TopoJets: **Red**
      - Expert: **Yellow**
      - Shift: **Red**
    - Cone4H1TopoJets_EF_J200: **Green**
      - Expert: **Green**
      - Shift: **Green**
    - Cone4H1TowerJets: **Red**
      - Expert: **Yellow**
      - Shift: **Red**
    - Cone4H1TowerJets_EF_J200: **Yellow**
      - Expert: **Yellow**
      - Shift: **Green**

There are currently 4 jet collections monitored. Number of histograms multiplied by 4.

Jet Monitoring
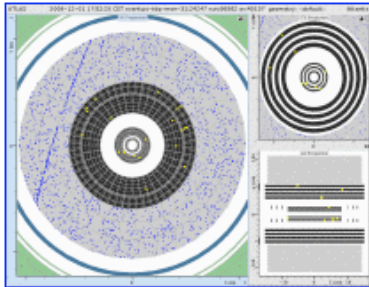
Jet Monitoring

FDR2c Monitoring

***Indicates reconstruction is in progress; histograms represent accumulated statistics and are temporary.

Run Number	T0 Iteration	Streams					
52300	1	[physics_Express]	[NoStream]	[physics_Bphys]	[physics_Egamma]	[physics_Jet]	[physics_Muon]
	2	[physics_Express]					
52283	1	[physics_Express]	[physics_Bphys]	[physics_Egamma]	[physics_Jet]	[physics_Muon]	
	2	[physics_Express]					
52280	1	[physics_Express]	[physics_Bphys]	[physics_Egamma]	[physics_Jet]	[physics_Minbias]	[physics_Muon]
	2	[physics_Express]					

Run 52300, minutes10_1, 1/physics_Exp

--select directory--

... or display directories at current level

- Overall Status: **Red**
  - Jets: **Red**
    - Cone4H1TopoJets: **Red**
      - Expert: Undefined
      - Shift: **Red**
    - Cone4H1TopoJets_EF_J200: **Red**
      - Expert: Undefined
      - Shift: **Red**
    - Cone4H1TowerJets: **Red**
      - Expert: Undefined
      - Shift: **Red**
    - Cone4H1TowerJets_EF_J200: **Red**
      - Expert: Undefined
      - Shift: **Red**

Run 52300, 1/physics_Express

Entire Run

10 Minute Block 1
10 Minute Block 5
10 Minute Block 4
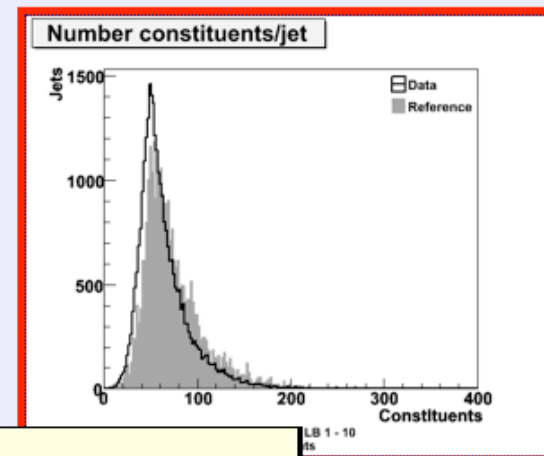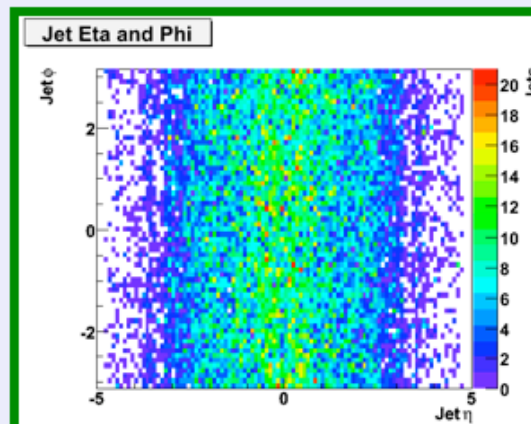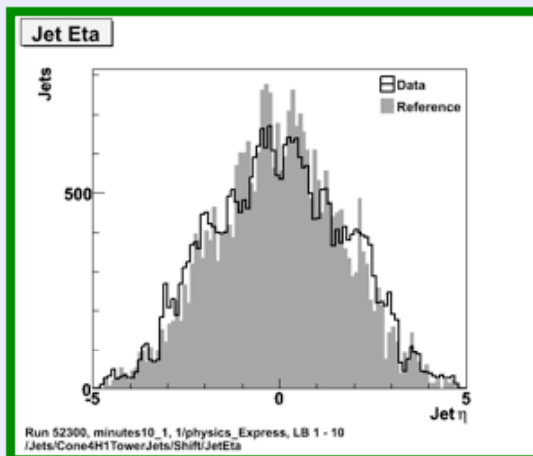10 Minute Block 2
10 Minute Block 3

Last Update: 2008-8-26 10:9 UTC
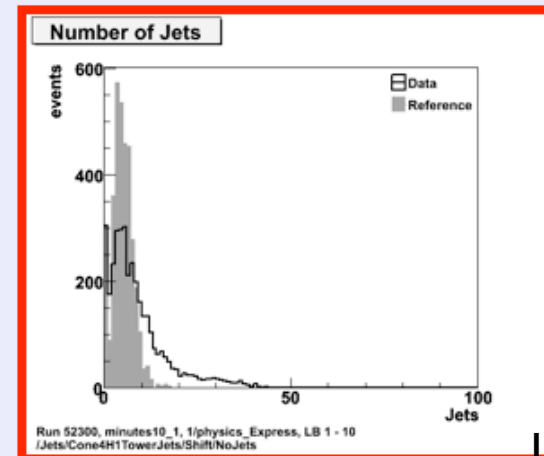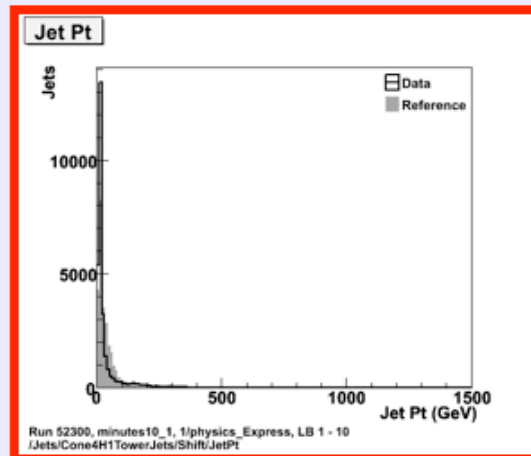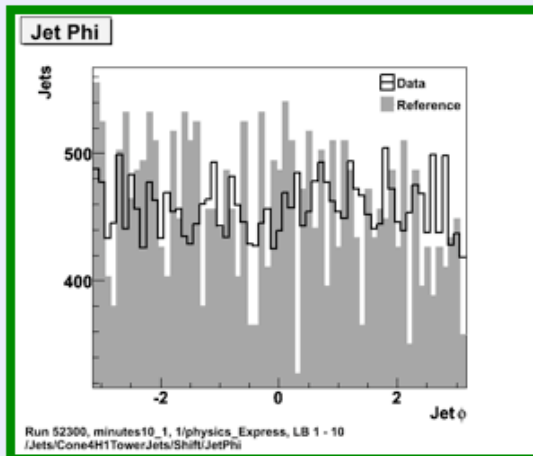
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Jet Monitoring: shift histograms
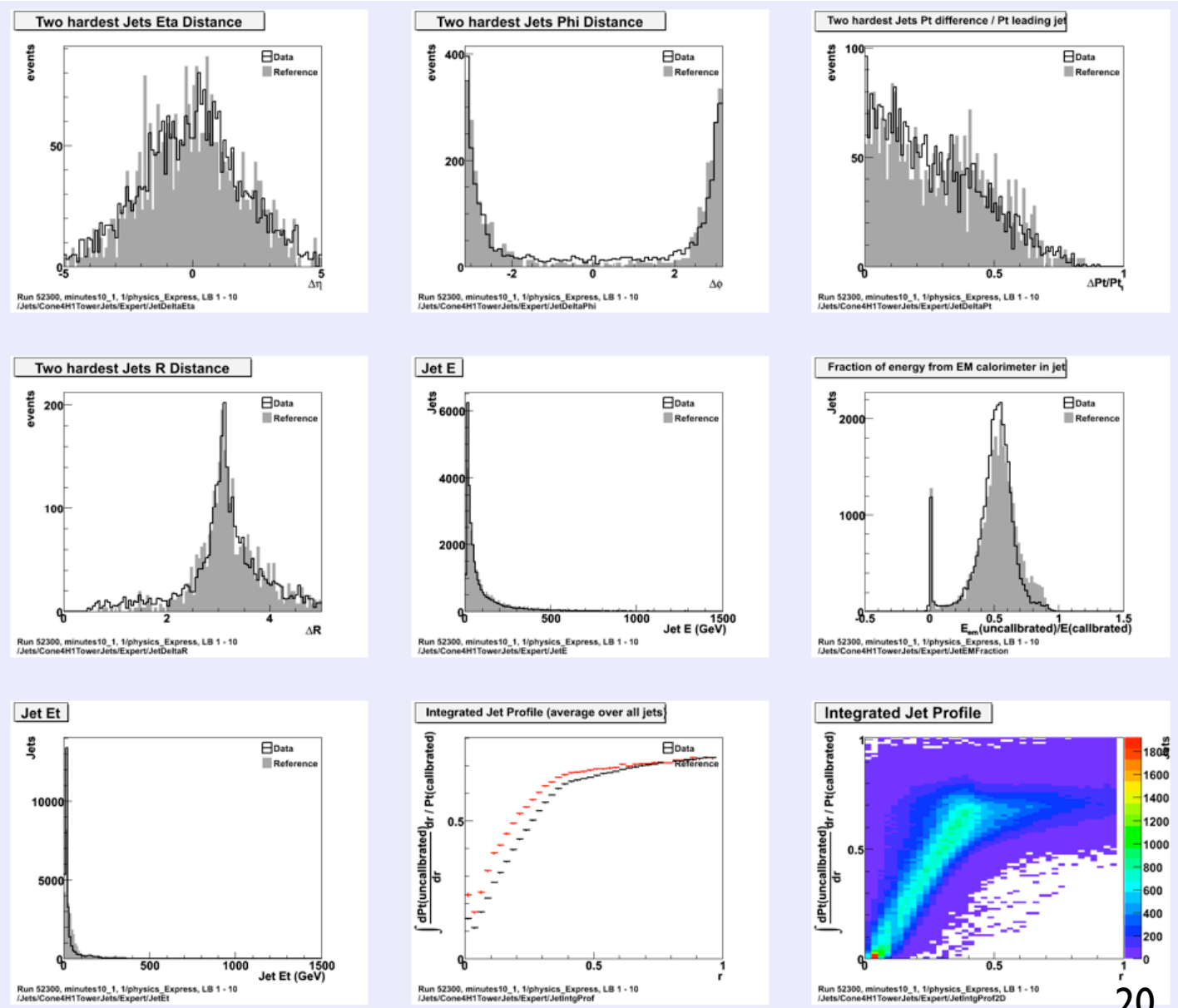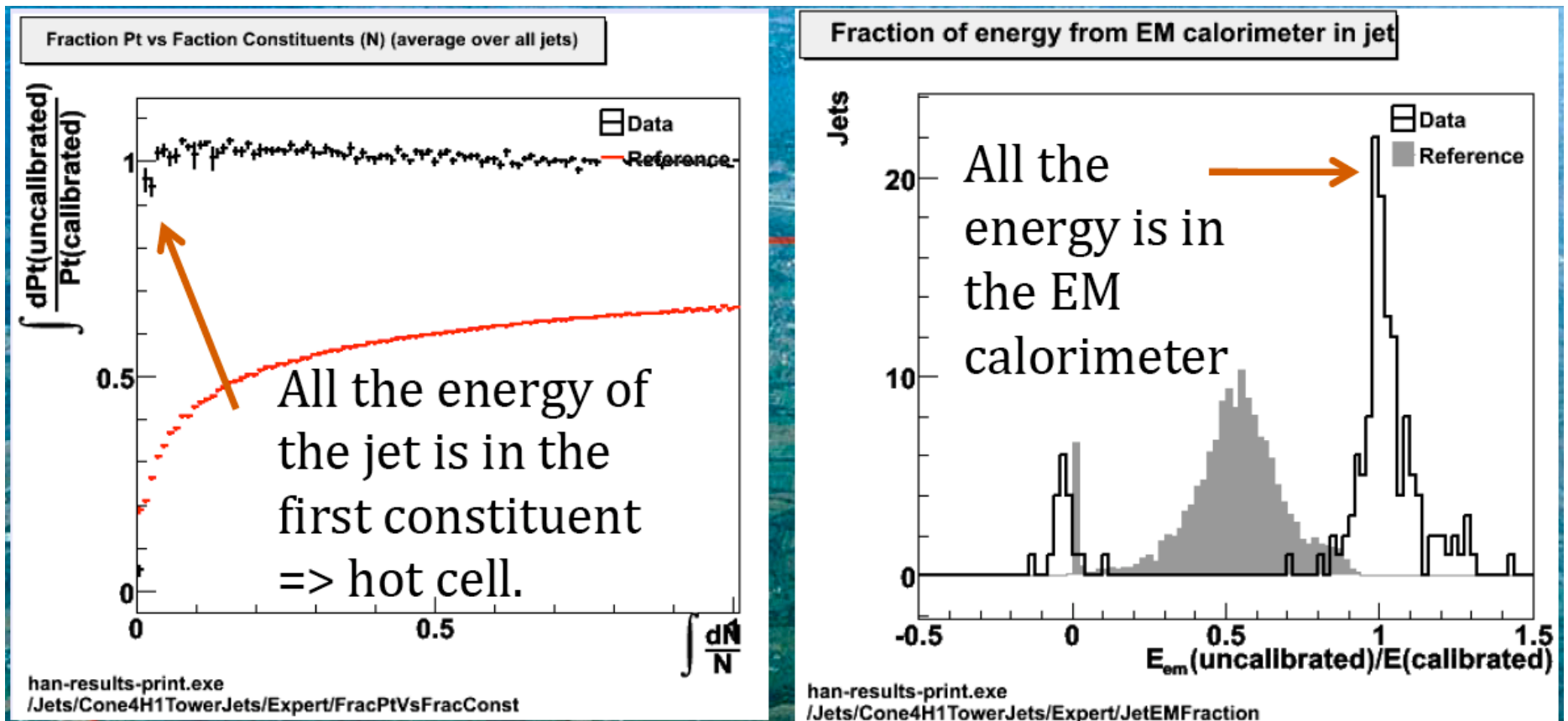
Jet Monitoring: expert histograms

Nearly 40 histograms:

Very useful for expert diagnostics

Jet Monitoring: expert histograms

- example of problem finding using two expert histograms (also visible in other histograms)

Fraction Pt vs Faction Constituents (N) (average over all jets)

All the energy of the jet is in the first constituent => hot cell.

han-results-print.exe
/Jets/Cone4H1TowerJets/Expert/FracPtVsFracConst

Fraction of energy from EM calorimeter in jet

All the energy is in the EM calorimeter

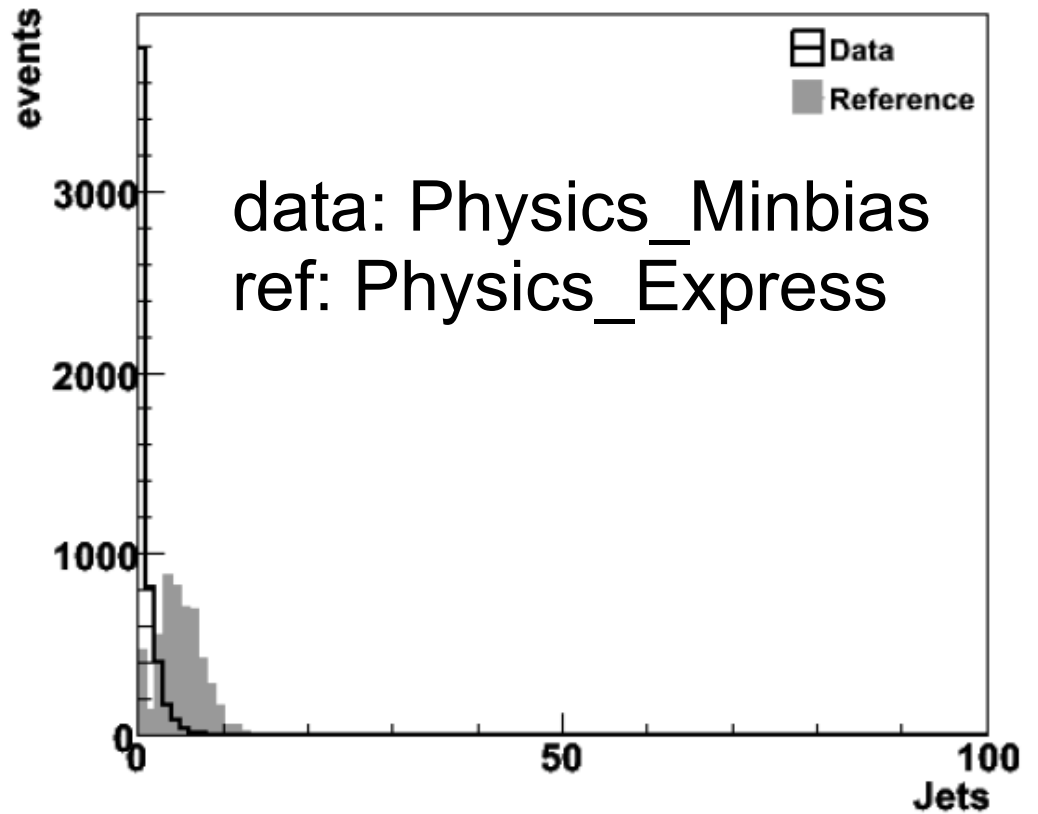han-results-print.exe
/Jets/Cone4H1TowerJets/Expert/JetEMFraction

Can conclude that there is a hot cell in the EM calorimeter at phi = -2 and eta = -1.5

Jet Monitoring

■ Stream issues

- one reference file for all streams...

Number of Jets

data: Physics_Minbias
ref: Physics_Express

Run 52280, minutes10_5, 1/physics_Minbias, LB 41 - 50
/Jets/Cone4H1TowerJets/Shift/NoJets

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Jet Monitoring to-do list

- Online jet monitoring
  - interested people identified
- COOL database for DQ jet flags
  - currently divided in EA, B, EC
  - not the same as monitoring folder structure
- Coordination with other monitoring groups
  - LAr, Tile, trigger, inner detector
- Stream issue and reference files
- Cosmics and jets
  - need different plots than for collisions?
- Summary histograms
- Add a few histograms
  - focus on jet problems, not detector problems
- Twiki for jet monitoring

Summary

- **Monitoring activities**
  - LAr raw channel data
  - Jets
  - others (not presented here) include LAr noise
- **Data Quality Monitoring Framework**
  - displays
  - automatic checks
  - shift histograms
    - experts histograms for LArRawChannels
- **Basically ready**
  - cosmic, FDR, single beam exercises
  - a few improvements still to come