Muon Data Quality Monitoring Procedures

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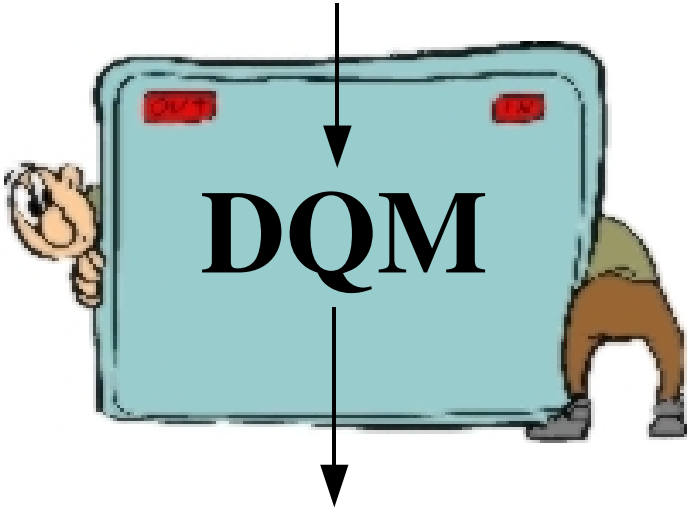
Ilektra Christidi, Dimitris Iliadis, Yiannis Nomidis

Muon DQA flow

Combine all available info to make quick suggestions to experts/community

- ✓ Gnam OR MuonMonitoring package root file with histograms
- ✓ Gnam ascii output and configuration (which chambers are read out)
- ✓ Elog entries
- ✓ DCS configuration for HV/LV
- ✓ Gas monitoring report
- ✓ COOL DB of dead tubes, list of noisy elements



- ✓ Web display of critical histograms and their quality status (alarms)
- ✓ Data Quality entry in COOL DB

Muon DQA structure

Online DQA …*real time monitoring*

Tools used: Gnam, OHP, DQMF

"Fast Offline" DQA …*almost real time monitoring*

Tools used: macros to look at Gnam output, info communicated via twikis

Testing/development with detector commissioning cosmic runs (see Nectarios' talk)

Participation in the shift coordination, development of tools for the shifters, shift taking

Substituted by express stream: Full offline reconstruction & DQM of 10% of the data at Tier0, within 1-2 hours of run

Offline DQA …*after initial processing*

Tools used: macros that run on monitoring histograms, DQMF web display

Testing/development with detector commissioning cosmic runs & FDR data

Development of tools for the visualization of the monitoring quantities, creation of the segment monitoring package, development of the raw and track monitoring packages

Online DQA

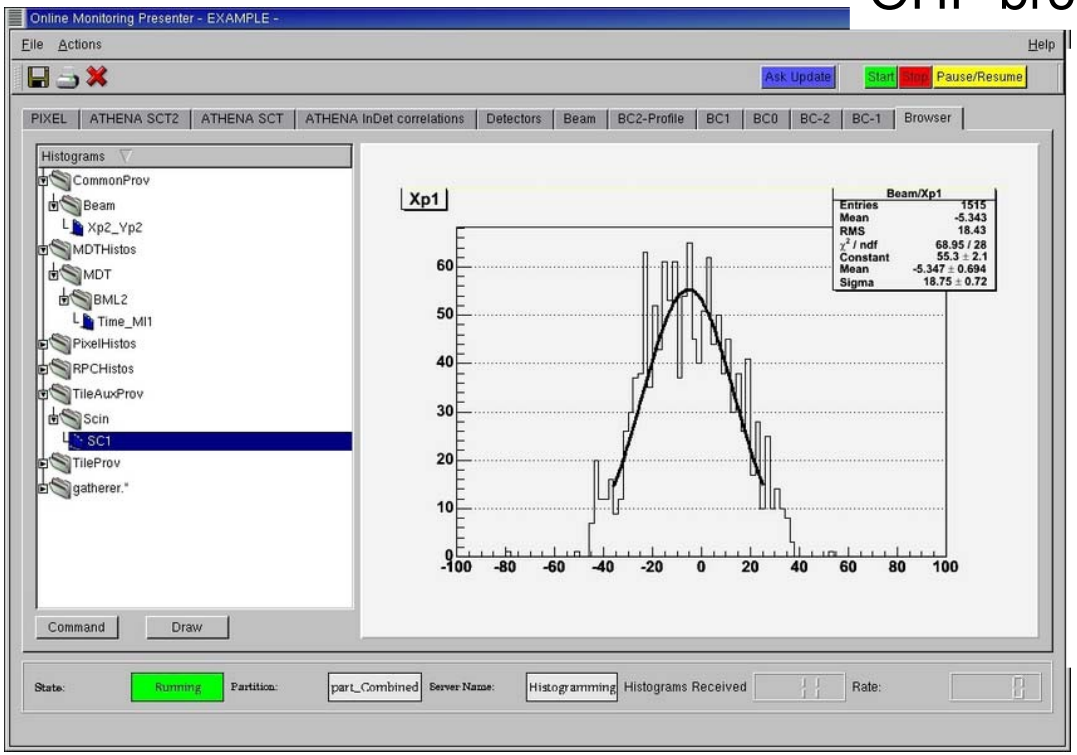
Tools used:

✓ *Gnam*: Runs on P1 machines and fills histograms of quantities of interest during run (updates every X events). At the end of run, it gives a root file and some ascii output.

✓ *Online Histogram Presenter (OHP)*: Used by the DQA shifter to display Gnam histos.

✓ *Data Quality Monitoring Framework (DQMF)*: Display also expert and debug histos, set alarms depending on the quality of the content.

OHP browser



Three levels of detail histograms (same in offline DQA):

✓ *Shift*: Basic interest histos for the shifters to check quickly

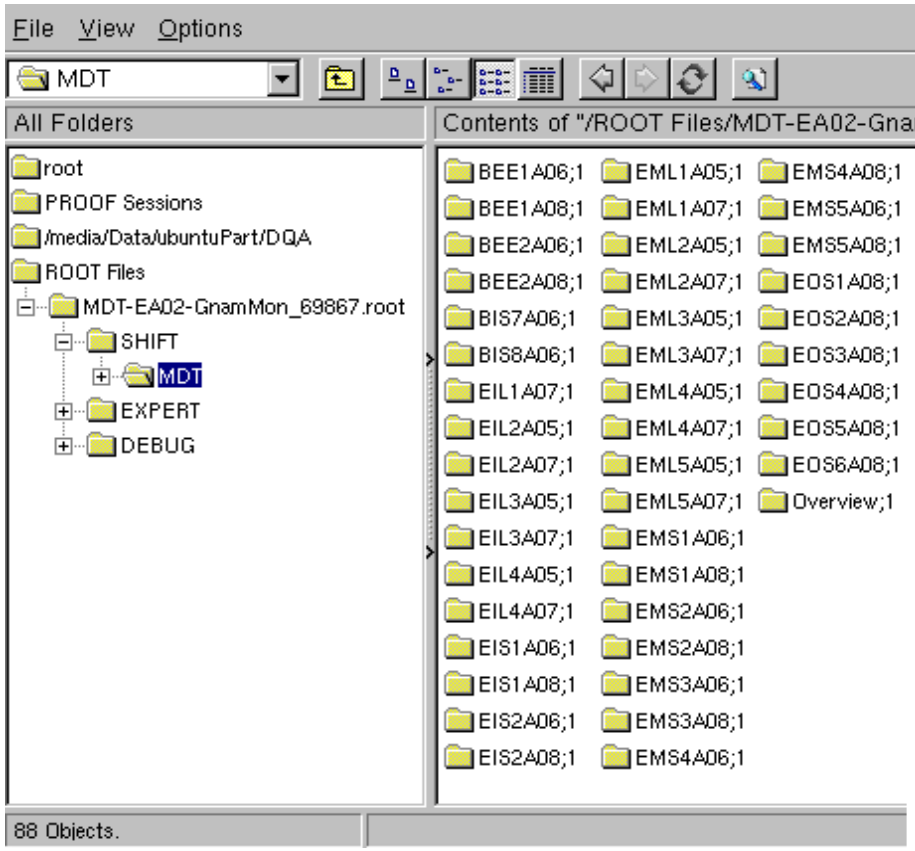
✓ *Expert*: To look further into problems

✓ *Debug*: Even more detailed

➔ *Concentrate in Shift histograms here*

Online DQA: Gnam

Gnam root file



Quantities of interest per chamber:

- ✓ Tube, mezzanine, chamber occupancy
- ✓ Noise frequency
- ✓ Electronics errors
- ✓ TDC vs ADC
- ✓ ADC
- ✓ TDC for each multilayer, after ADC>50 cut
- ✓ t0 and t(max) stability for each multilayer

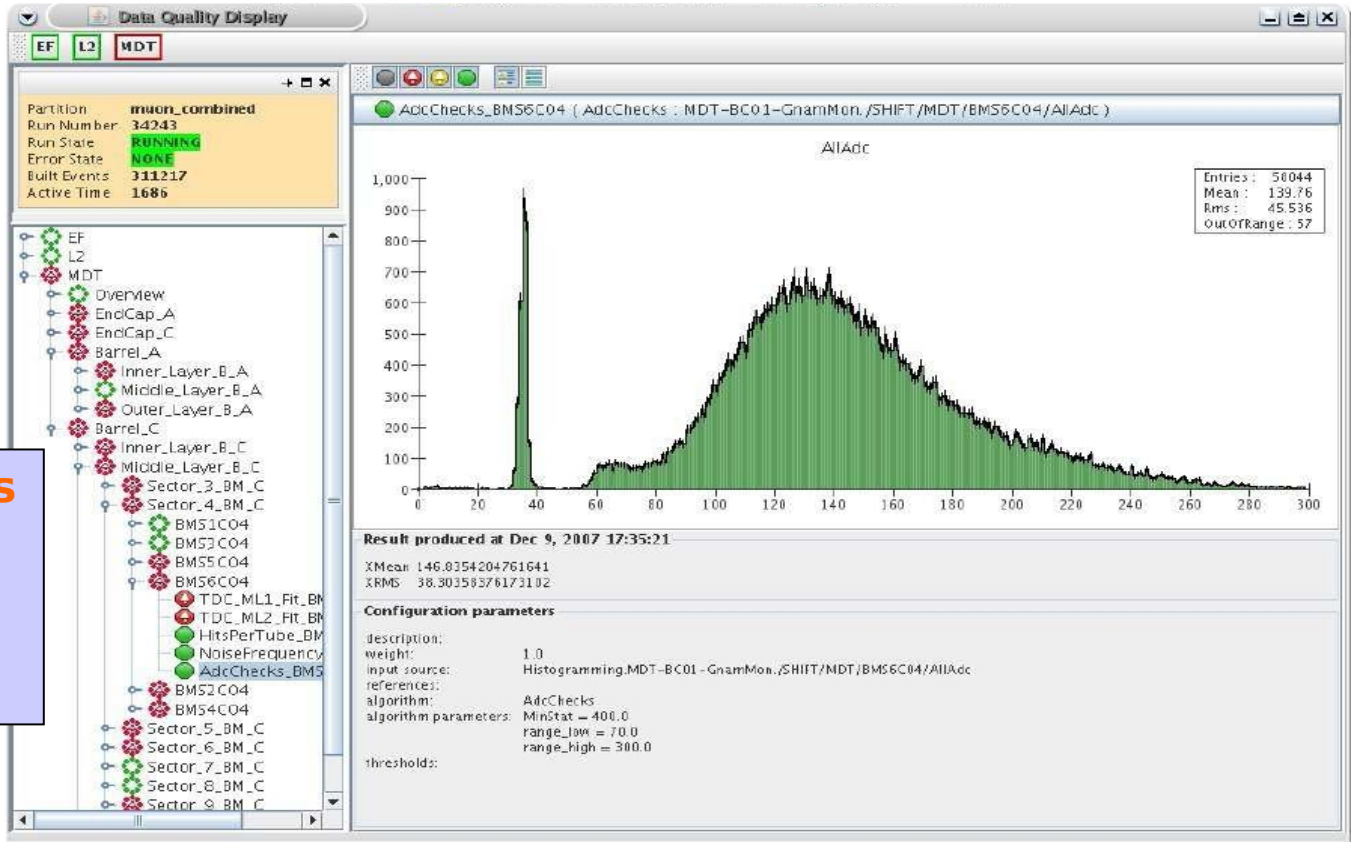
Overview quantities:

- ✓ Total errors
- ✓ Noise per chamber
- ✓ Hit occupancy for every MROD
- ✓ Hits per chamber for every sector
- ✓ t(max) per chamber
- ✓ Triggers per MROD

Online DQA: DQMF

Assess the quality of histograms with automated algorithms or with comparison to reference histograms, and set quality flags.

DQMF browser



Quality flags

GREEN

YELLOW

RED

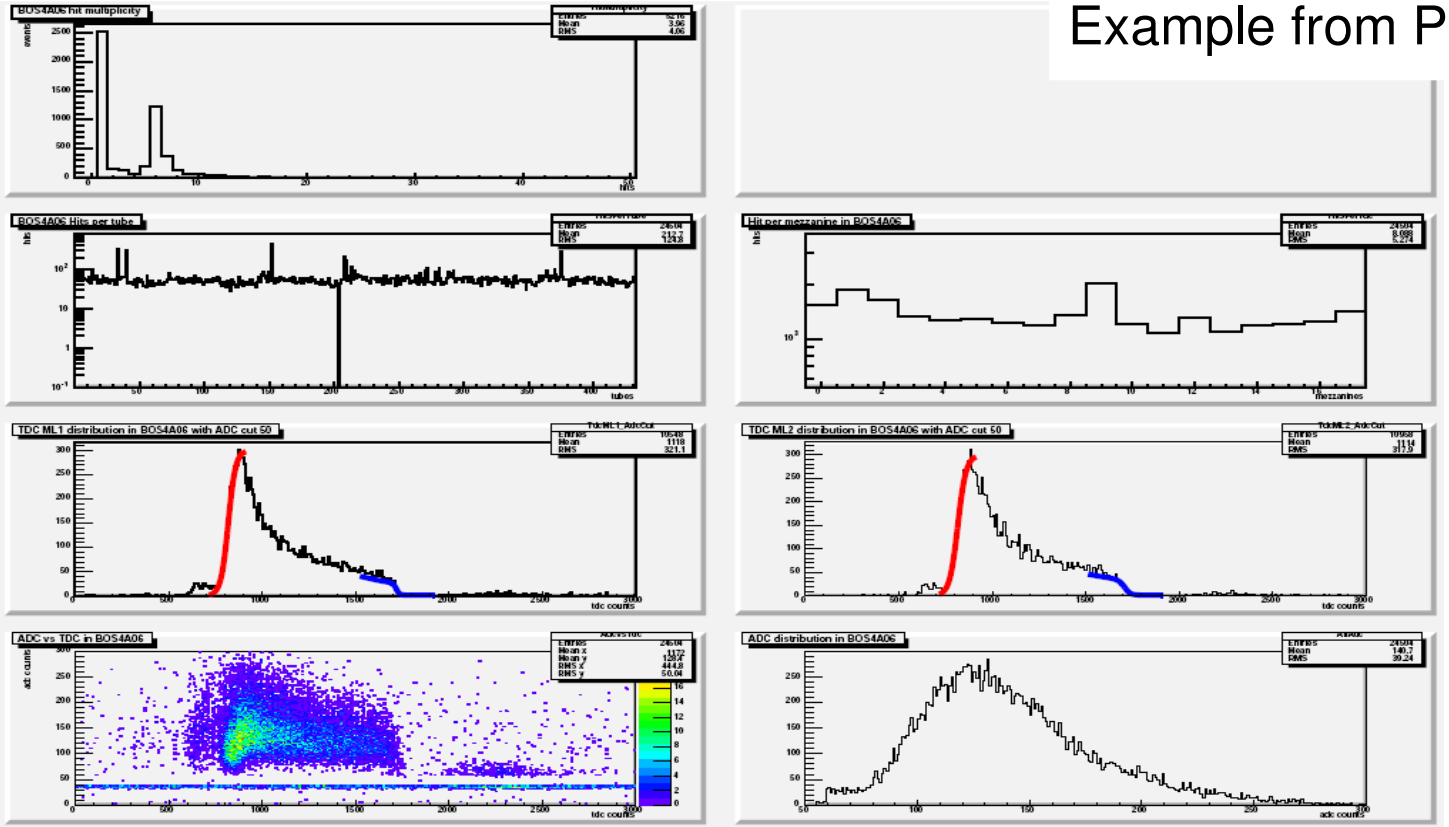
More on Gnam output

GOAL:

Develop automatic procedures (macros that parse Gnam output and plot crucial histograms for easy viewing) to spot

- ✓ **Dead and noisy tubes**, mezzanines, (multi)layers, chambers
- ✓ Electronics error rates
- ✓ *Look at the plots to spot more non-trivial problems*

Example from P6



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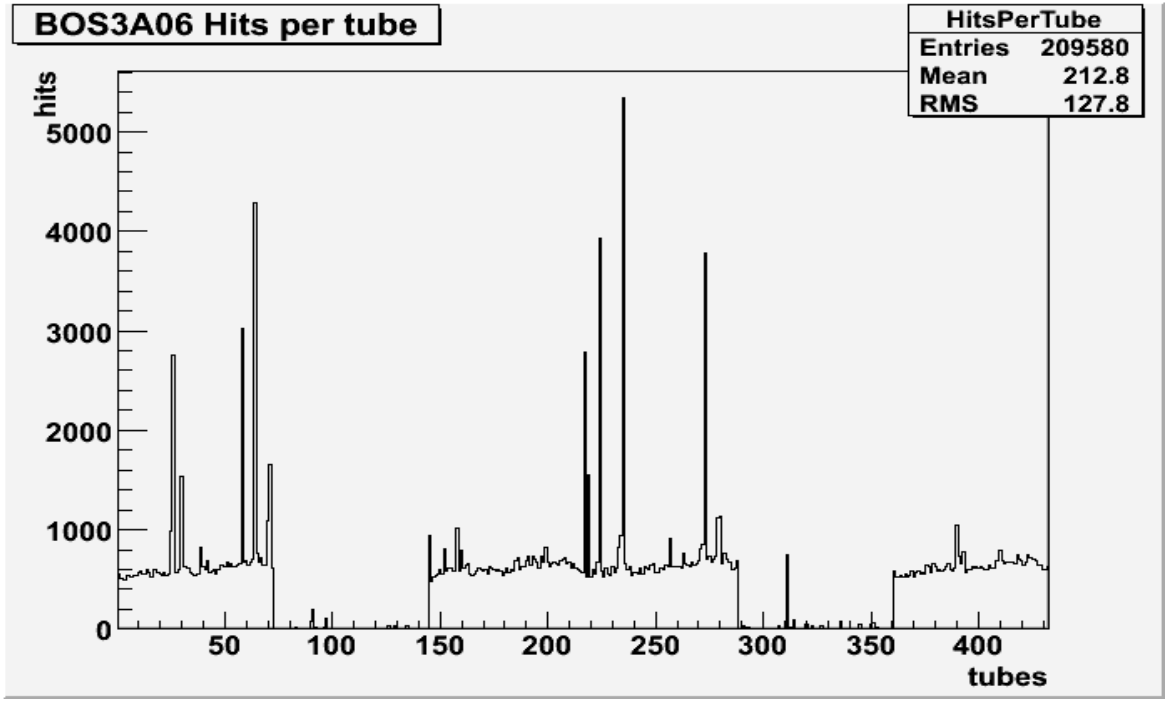
Example from P3



More on Gnam output

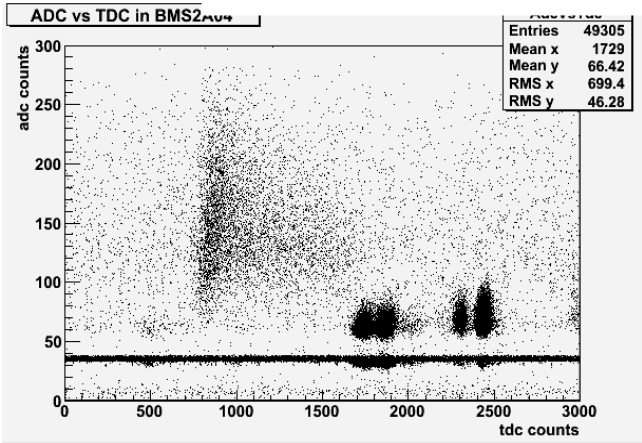
Examples from P3

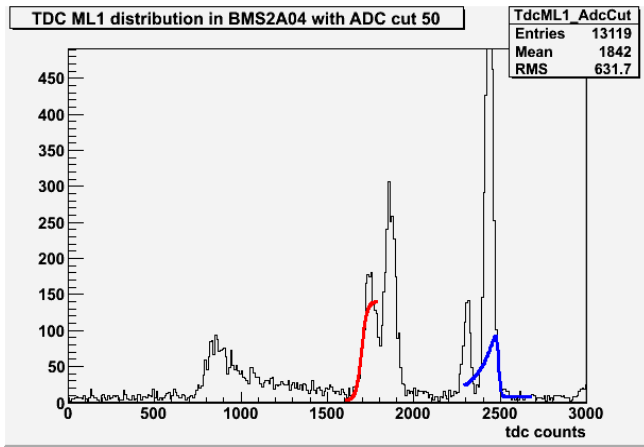
GOAL:

Develop automatic procedures (macros that parse Gnam output and plot crucial histograms for easy viewing) to spot

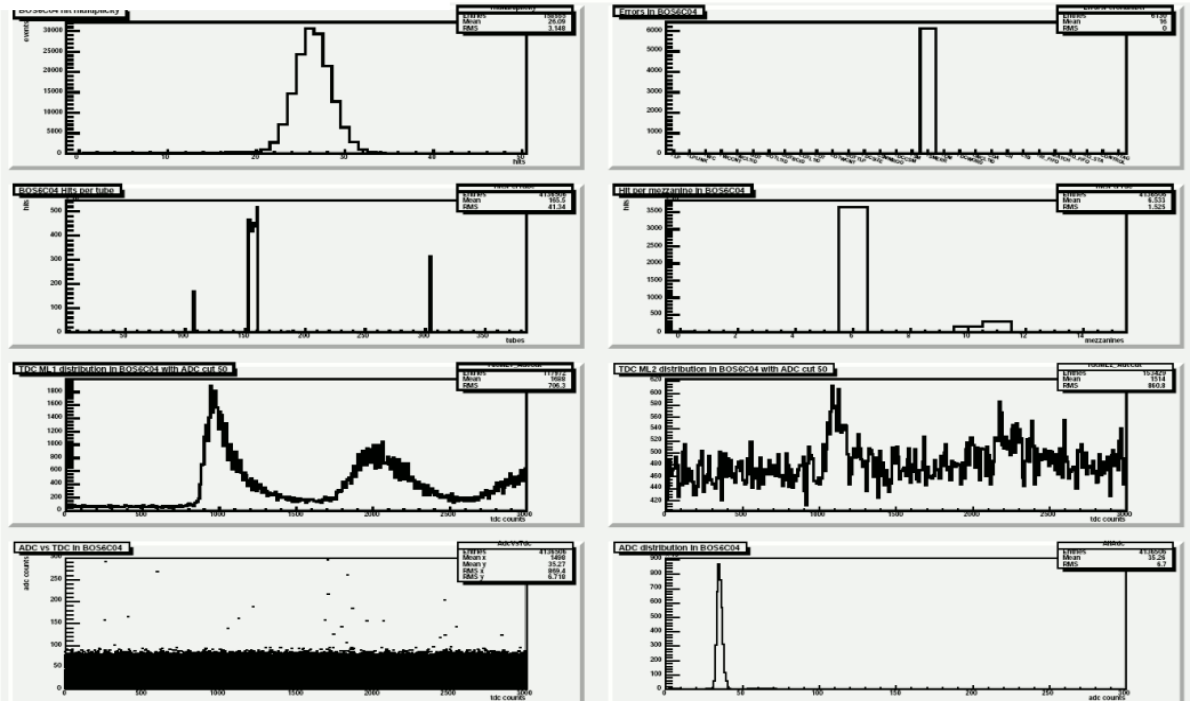
- ✓ Dead and noisy tubes, mezzanines, (multi)layers, chambers
- ✓ Electronics error rates
- ✓ ***Look at the plots to spot more non-trivial problems***

Run 40300





Run 40479



More on Gnam output

Examples from P3

GOAL:

Develop automatic procedures (macros that parse Gnam output and plot crucial histograms for easy viewing) to spot

- ✓ Dead and noisy tubes, mezzanines, (multi)layers, chambers
- ✓ Electronics error rates
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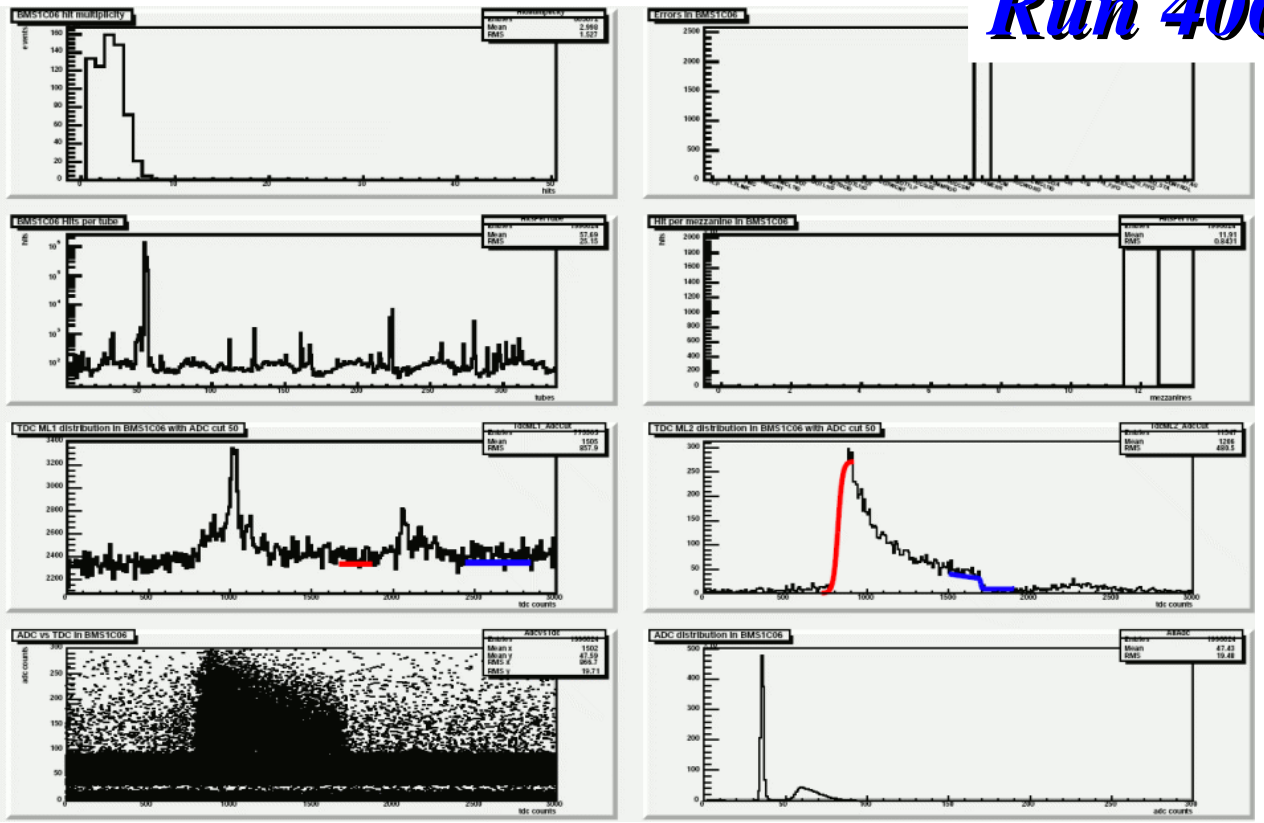
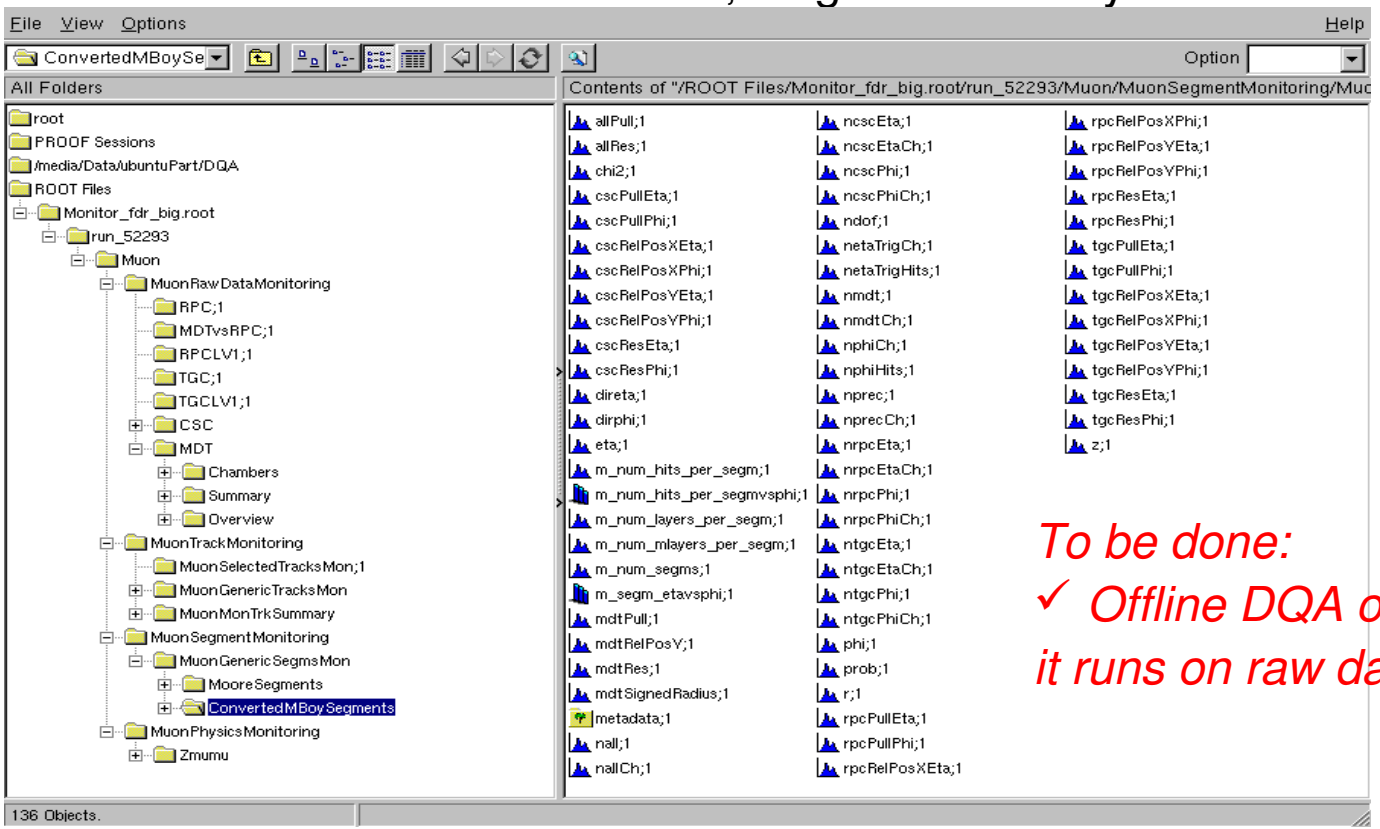
Run 40650



Offline DQA

Different levels for offline DQA

- "Low level", hit related quantities (occupancies, correlations, …)
  → Check condition of chambers and readout chain from online to offline
- "Mid level", reconstructed quantities (track multiplicity, residuals, …)
  → Check reconstruction chain, calibration constants, chamber efficiencies, alignment
- "High level", physics quantities (cross sections, mass peaks, …)
  → Check calibration constants, long-term stability



To be done:

✓ *Offline DQA on ESD (for the moment it runs on raw data)*

“Low level” monitoring

Quantities being monitored for every chamber:

- ✓ Tube, mezzanine, (multi)layer occupancy
- ✓ TDC vs ADC
- ✓ ADC
- ✓ TDC (also separated by trigger type)
- ✓ Noise frequency
- ✓ RPC-MDT spatial correlations

To be done:

- ✓ *Memory problem: number and binning of histograms (especially 2D) has to be decreased urgently -> rethink what we really need to monitor*

Quantities monitored for every sector/partition:

- ✓ Occupancy vs eta station for every r and phi station

Overview quantities:

- ✓ Hit map in xy & rz, for Barrel, EC & overlap
- ✓ Total hits per event (also separated by trigger type)
- ✓ Hits per chamber (& top 10 chambers)
- ✓ Hit chambers per event
- ✓ Total TDC, ADC and TDC vs ADC

“Low level” monitoring

Example from M7

File Edit View History Bookmarks Tools Help

Muon MuonSegments/Gener... | Muon

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Muon: Monitoring and Automatic Checks

- Overall Status: **Red**
  - InnerDetector: Undefined
    - Global: Undefined
  - LAr: Undefined
    - RawChannelNoiseMon: Undefined
  - MissingEt: Undefined
  - MuonDetectors: **Red**
    - L1_RPC: **Red**
      - PAD-CM-ROI_vsSectorLogic: **Red**
      - TriggerConditions: **Red**
      - TriggerHits: **Green**
    - MDT: **Red**
    - MDTvsRPC: **Red**
    - RPC: **Green**
      - Overview: **Green**
      - PhivsEta: **Green**
        - Atlas: **Green**
        - Sectors: **Green**
    - TGC: **Red**
    - TGCLV1: **Red**
      - Multiplicity: **Red**
      - Timing: **Red**
  - MuonSegments: **Red**
    - Generic: **Red**
      - ConvertedMBoy: **Red**
      - Moore: **Red**
  - MuonTracks: **Red**
    - Generic: **Red**
      - ConvertedMBoy: **Red**
        - EF_2mu10: Undefined
        - EF_mu10: Undefined
        - EF_mu20: Undefined
        - EF_mu40: Undefined
        - NoMuonTriggerSelection: **Red**
      - Moore: **Green**
        - EF_2mu10: Undefined
        - EF_mu10: Undefined
        - EF_mu20: Undefined
        - EF_mu40: Undefined
        - NoMuonTriggerSelection: **Green**
    - Selected: **Red**
      - AllRegions: **Red**
        - ConvertedMBoy: **Red**
          - EF_2mu10: Undefined

File Edit View History Bookmarks Tools Help

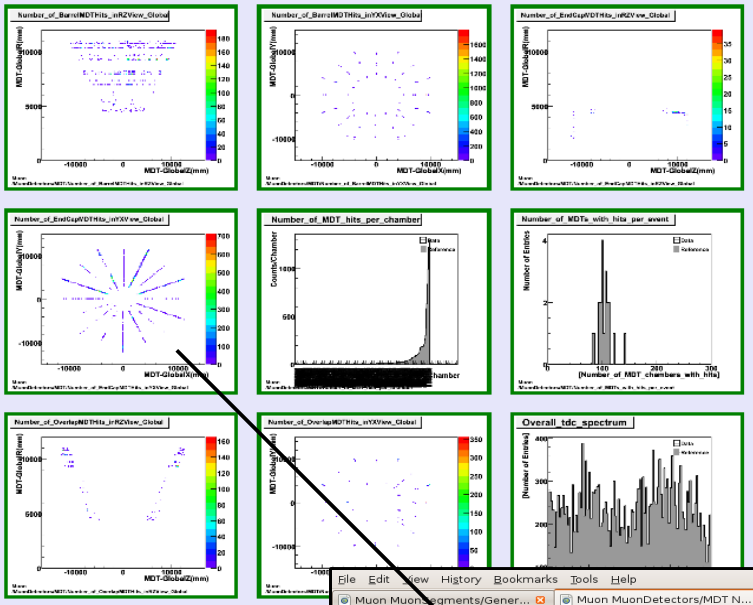
Muon MuonSegments/Gener... | Muon MuonDetectors/MDT

[Back]

Click on images for details and full size.

Muon MuonDetectors/MDT

[Only Red] [Only Yellow] [Only Green]



Done

File Edit View History Bookmarks Tools Help

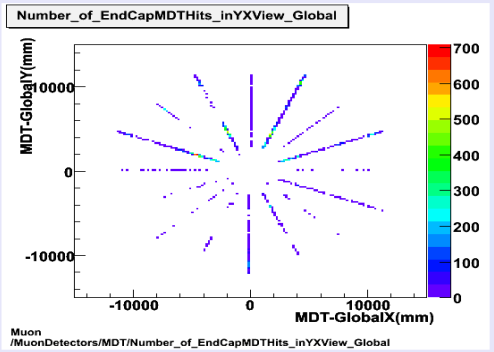
Muon MuonSegments/Gener... | Muon MuonDetectors/MDT N...

[Back]

Muon MuonDetectors/MDT
/Number_of_EndCapMDTHits_inYXView_Global

Assessment Details:

Name: Number_of_EndCapMDTHits_inYXView_Global
Status: Green
Algorithm: Histogram_Not_Empty
Num. of Entries: 22286



Last Update: 2008-7-1 14:22 UTC

“Mid level” monitoring

Track and Segment Monitoring, for both MuonBoy and Moore

Quantities being monitored for the whole detector (totals and per technology):

- ✓ Number of tracks/segments per event, also vs η and φ
- ✓ Number of hits, chambers and (multi)layers per track/segment
- ✓ Number of holes and scatters on track
- ✓ χ^2 and NDOF of track/segment
- ✓ η, φ, z, d_0 (impact parameter) of track in perigee, Pt, q/p and charge of track
- ✓ η, φ, r, z of track/segment in crossing point, η, φ direction of track/segment
- ✓ η vs φ of hits associated with tracks/segments
- ✓ Residuals, pulls, local positions of hits

Same histograms for different triggers as well (only for tracks)

Quantities being monitored for every sector or partition (EA, EC, BA, BC):

- ✓ Residuals, pulls, local positions of hits (for segments)
- ✓ Number of tracks, hits per track, track parameters

To be done:

- ✓ Track/segment finding efficiency (need to associate segments with tracks)
- ✓ Tube/chamber efficiency
- ✓ Trigger-aware segment monitoring

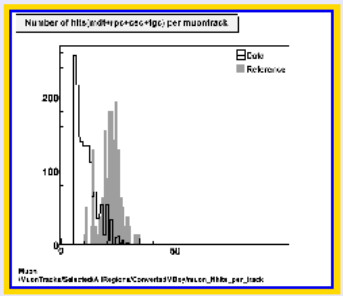
“Mid level” monitoring

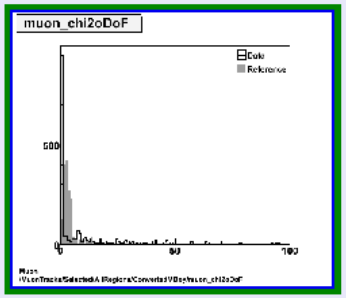
Track Monitoring

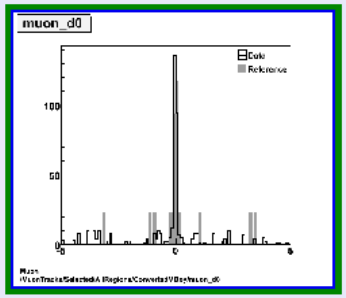
Example from P3

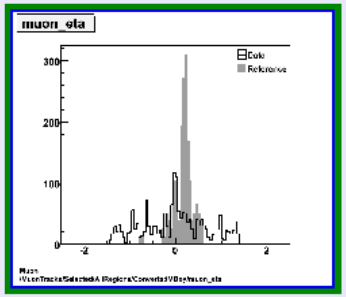
MuonTracks/Selected/AllRegions/ConvertedMBoy

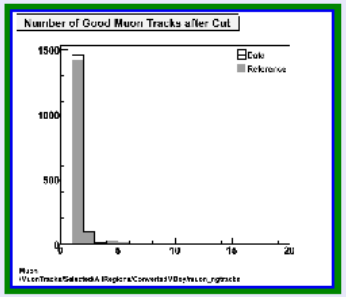
[Only Red] [Only Yellow] [Only Green]

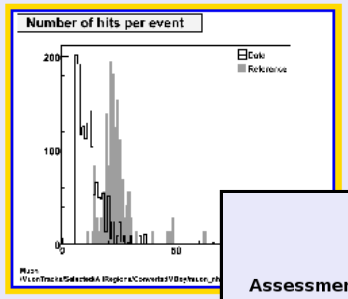


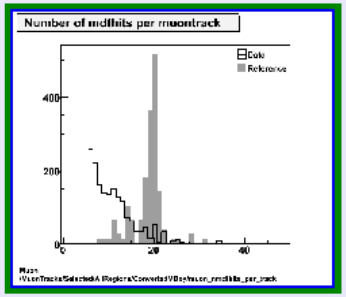


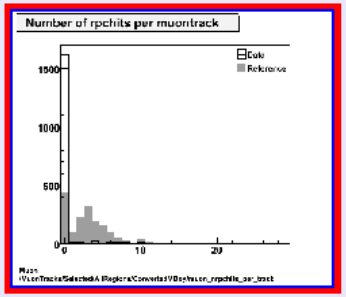


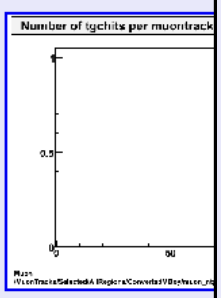












Muon
MuonTracks/Generic/ConvertedMBoy/All_Pull

Assessment Details:

Name: All_Pull
Status: Red
Algorithm: BinContentComp
Num. of Entries: 18704

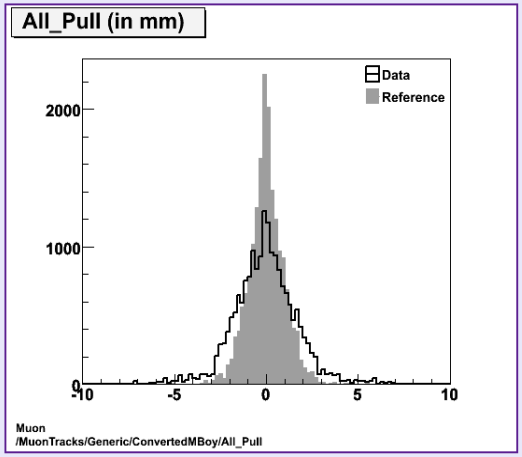
Configuration Parameters:

Ignore0: 10
NSigma: 5

NBins
XXXXXXX| XXXXXXX| XXXXXXX
10 30

Results:

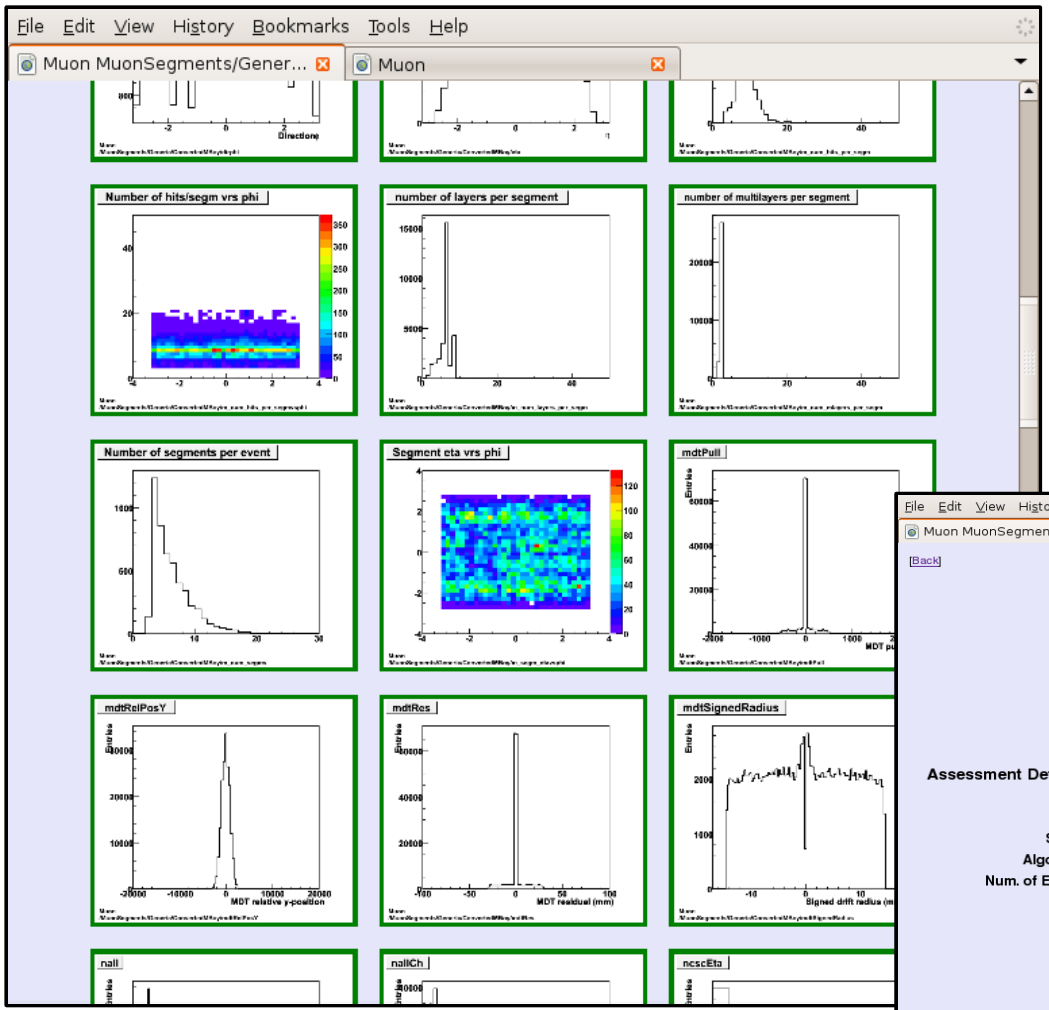
NBins: 46

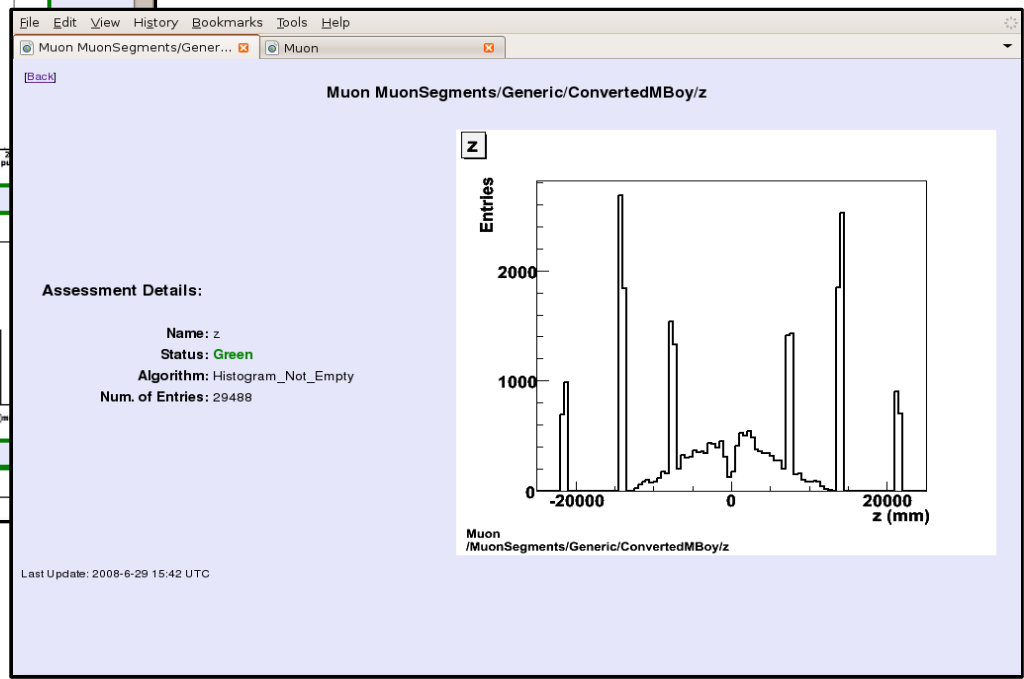


“Mid level” monitoring

Segment Monitoring

Example from FDR2





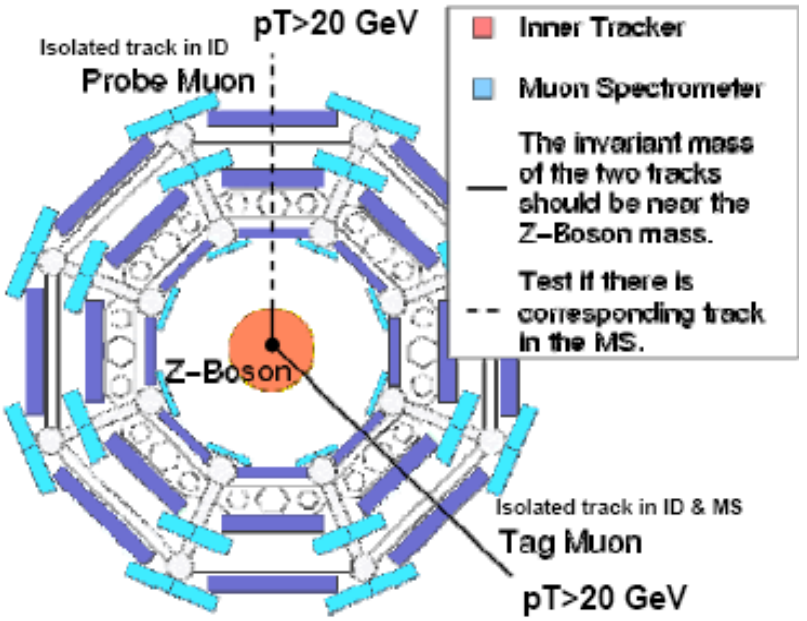
"High level" monitoring

Z→μμ *"tag-and-probe" method:*

✓ Require good reconstruction (both ID and MS) for the tag muon

✓ Loose selection (only ID) for probe muon

✓ Reconstruct Z→μμ, then check whether probe muon has a track in the MS



This way, we can measure

✓ ID efficiency

✓ MS efficiency

✓ Muon trigger efficiency

✓ Overall muon isolation efficiency

With the reconstructed Z

✓ Absolute momentum scale

✓ Momentum resolution of its decay muons, using the reconstructed mass peak

✓ Check alignment of MS and with respect to ID

- vs Pt, η, φ
- for all reconstruction algorithms

✓ *This package still under development*

✓ *Do the same for low-Pt muons with J/Ψ→μμ*

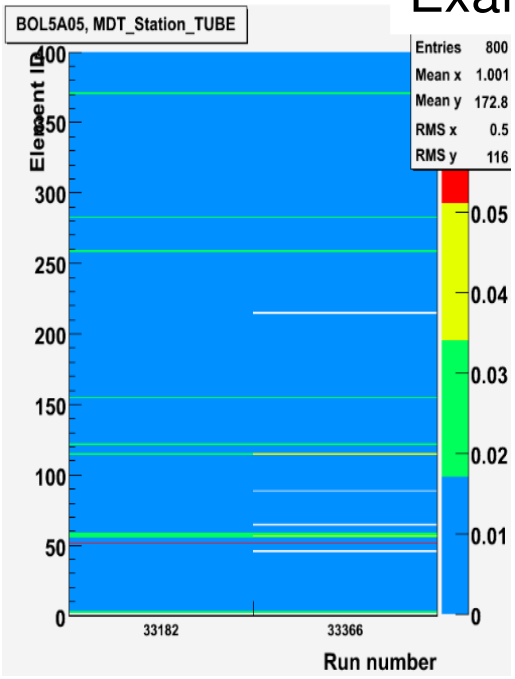
Visualization of monitoring parameters

- ✓ Development of user-friendly tools for all monitoring levels
- ✓ Integration of Muon DQM into DQMF
- ✓ Automatization of histogram quality assessment

macro for stability check

Monitors stability of dead/noisy channels or other parameters over runs for a given subdetector

Example from P2

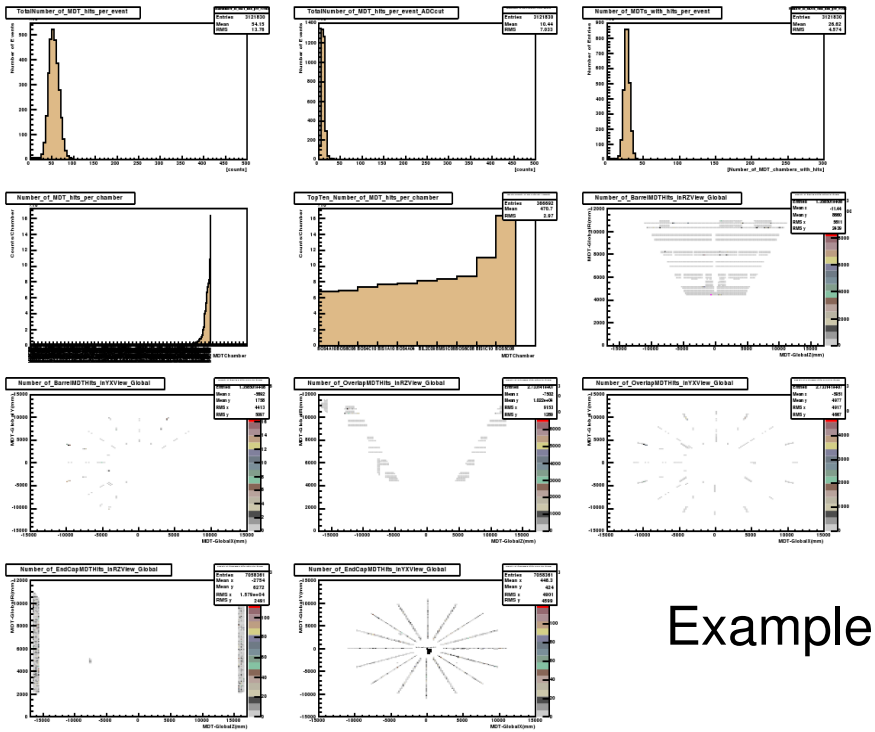


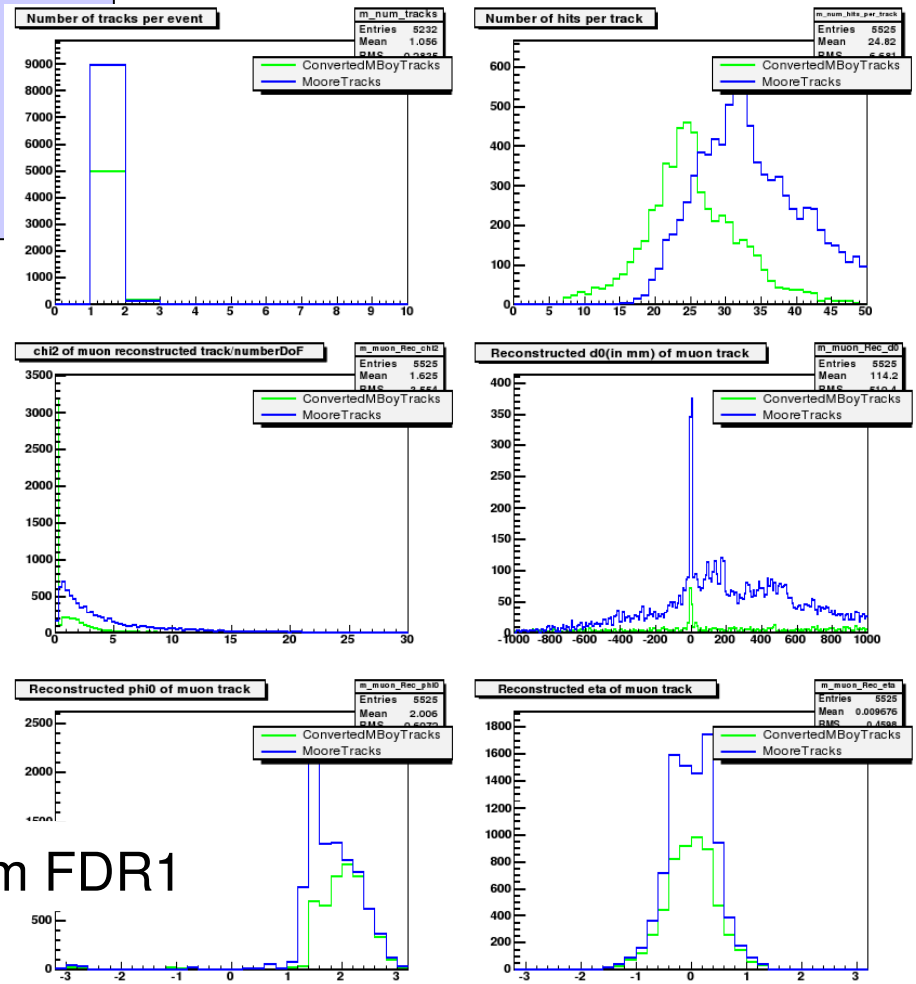
Visualization of monitoring parameters

Displays shift, expert and debug histograms from hit, track and segment monitoring in a pdf file, to streamline monitoring

Superimposes histos of different reconstruction algorithms

PDF display macro





Examples from FDR1

Conclusion-Summary

- ✓ Muon Data Quality Monitoring software under heavy development
- ✓ Online part in pretty good condition for MDTs, integration of other subsystems ongoing
- ✓ In offline
  - Raw Data and Track Monitoring almost done (under optimization)
  - Segment Monitoring is under development
  - Physics Monitoring is now starting (but not from scratch!)
- ✓ Artemis members involved mostly in the Offline Track, Segment and Physics monitoring, but also contributing on online shifts and tools