

Dimuon Offline Status

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For Dimuon Project

ALICE Offline Week, CERN,
7 - 11 April 2008

Outline

- News from Online
 - Experience from the cosmic run
 - Photogrammetry, GMS
- Shuttle
- News about reconstruction
- QA
- Dimuon Offline shifts
- Experience from Analysis on the Grid
- Project planning

Number of the slides are extracted from the presentations given during the Dimuon Online-Offline meeting in Lyon, 18 – 20 March 2008

Detector Status in Cosmic Run

MUON Tracking

- Detector configuration:
 - St. 1 & 2 : 2 LDC's 7 CROCUS (1 CROCUS St.2 missing)
 - St. 1 & 2, Ch. 5 : 3 LDC's 11 CROCUS tested
 - St. 3 : 1/4 Ch. 5
 - Total : 3 LDC's, 8 CROCUS (over 5 LDC's and 20 CROCUS)
- Magnetic field (L3/Dipole) : Off/On
- DAQ/ECS
 - Global / Local (Standalone, Pedestal, Calibration)
 - Global /Standalone : In zero-suppressed mode
- "final" DA

Detector Status in Cosmic Run

MUON Trigger

- Dipole magnet: OFF
- Trigger electronic status: OK
 - => The MUON_TRG sent trigger to CTP
- Read-out electronic status:
 - Local boards: OK for $\frac{1}{2}$ detector (Inside during the run)
 - Regional boards: not OK
 - Global board: not OK
- RPC status:
 - Inside: 36/36 OK
 - Outside: 31/36 OK



Global run

Including MCH in the global DCS (Feb. 25)

- Detector cycle : standby \Leftrightarrow beam_tuning \Leftrightarrow ready

Starting the global ECS (Feb. 26)

- Starting quite difficult : 24/24 expert asked for each detector

Data history (St. 1 & 2 only[†])

- First track St. 1 & 2 (March 2nd)
- First cluster with muon trigger (March 3rd)
- Data taking with muon trigger @ 0.2 Hz (visible clusters online)
- ITS only with Acorde priority 1 (March 4th-6th)
- Standalone runs : Stability tests
- More data with muon trigger (>March 7th) : run #25985 (9 hours !)
- HLT displays events (big screen in the ACR)

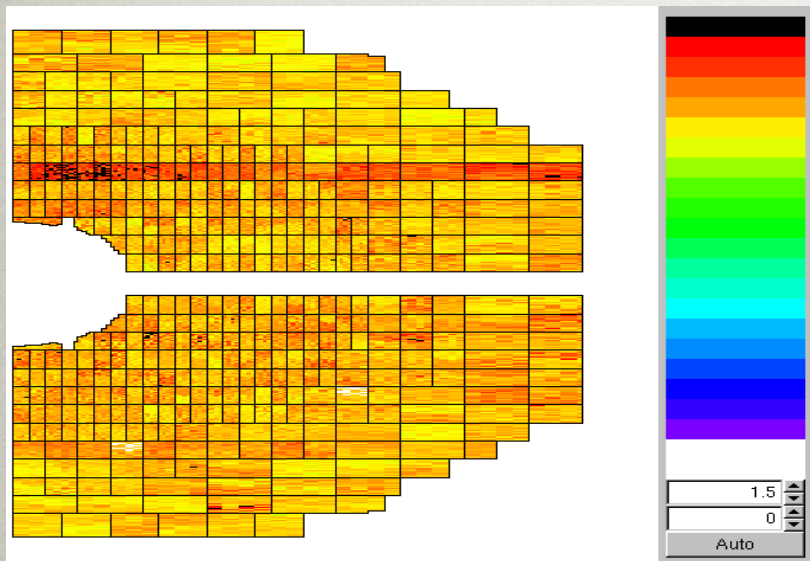
Troubleshooting

- Several DAQ stops: CDH errors (muon and others)
- DCS instabilities after a trip (due to CAEN HV supply), ..



Calibration results

Bending

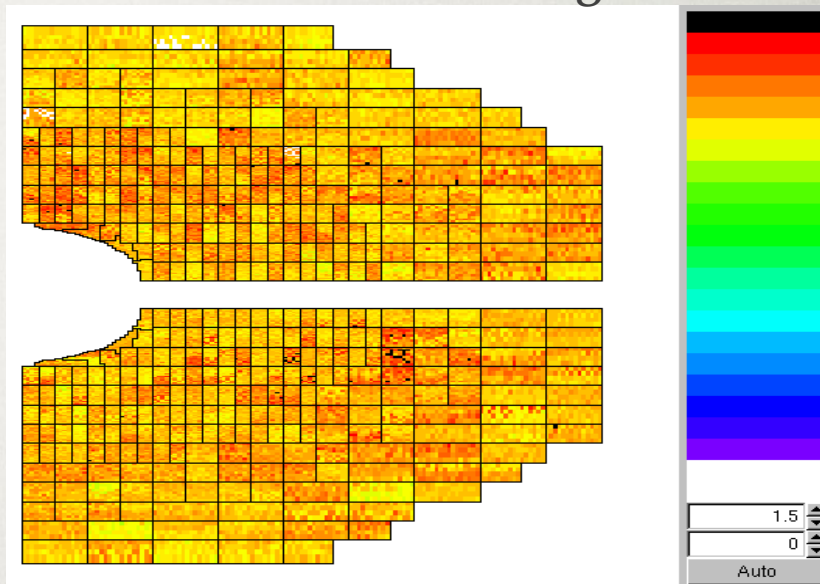


Run 18173

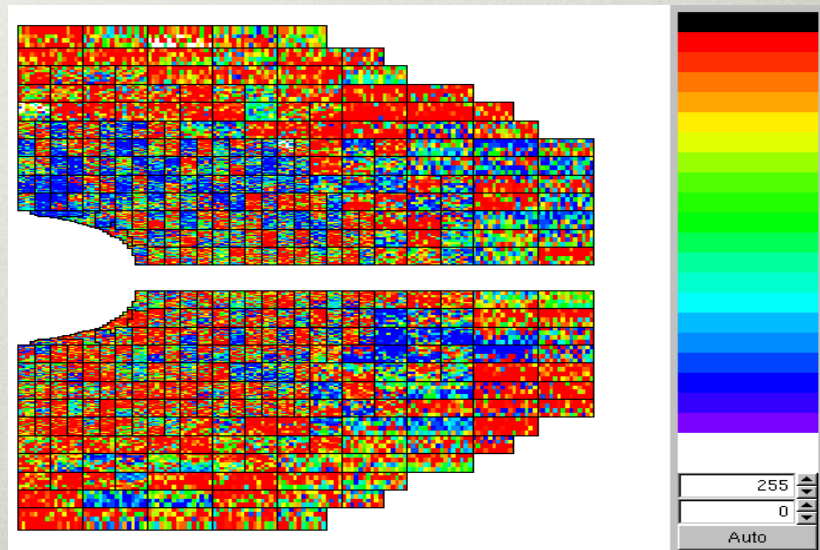
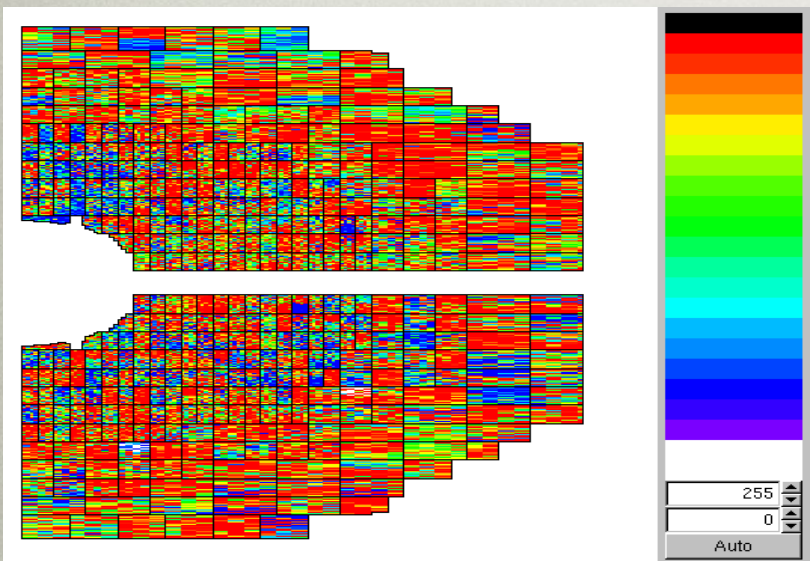
(St. 1)

a1

Non-Bending



Quality



Plots from mchview

From A. Baldisseri's talk: Cosmic Run Status: Muon Tracking



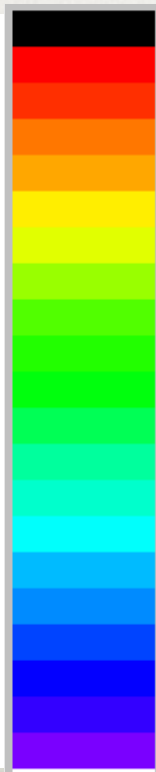
PEDESTALS : St.1,2 & 3

Pedestals : Run 23097 (3 LDC's & 8 DDL's)

Station 1

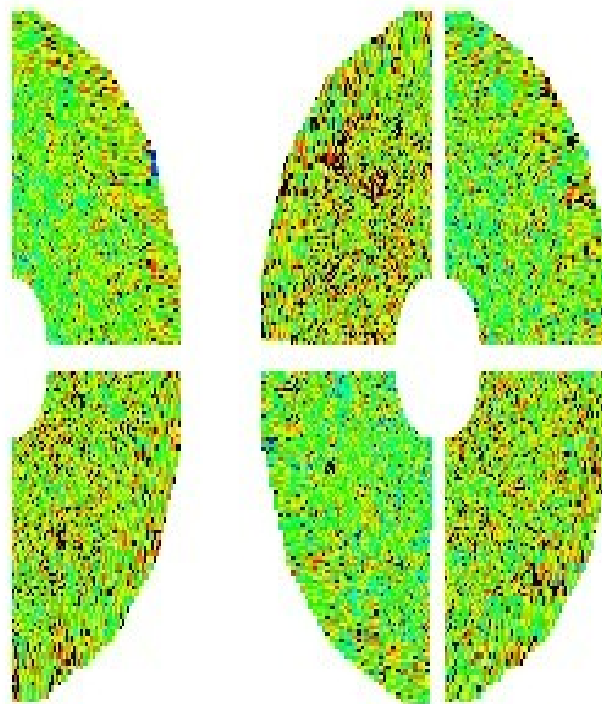


300

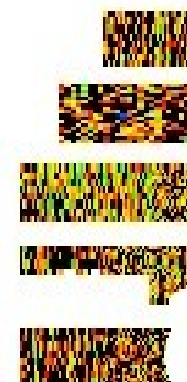


0

Station 2



Station 3



$\frac{1}{4}$ Ch. 5

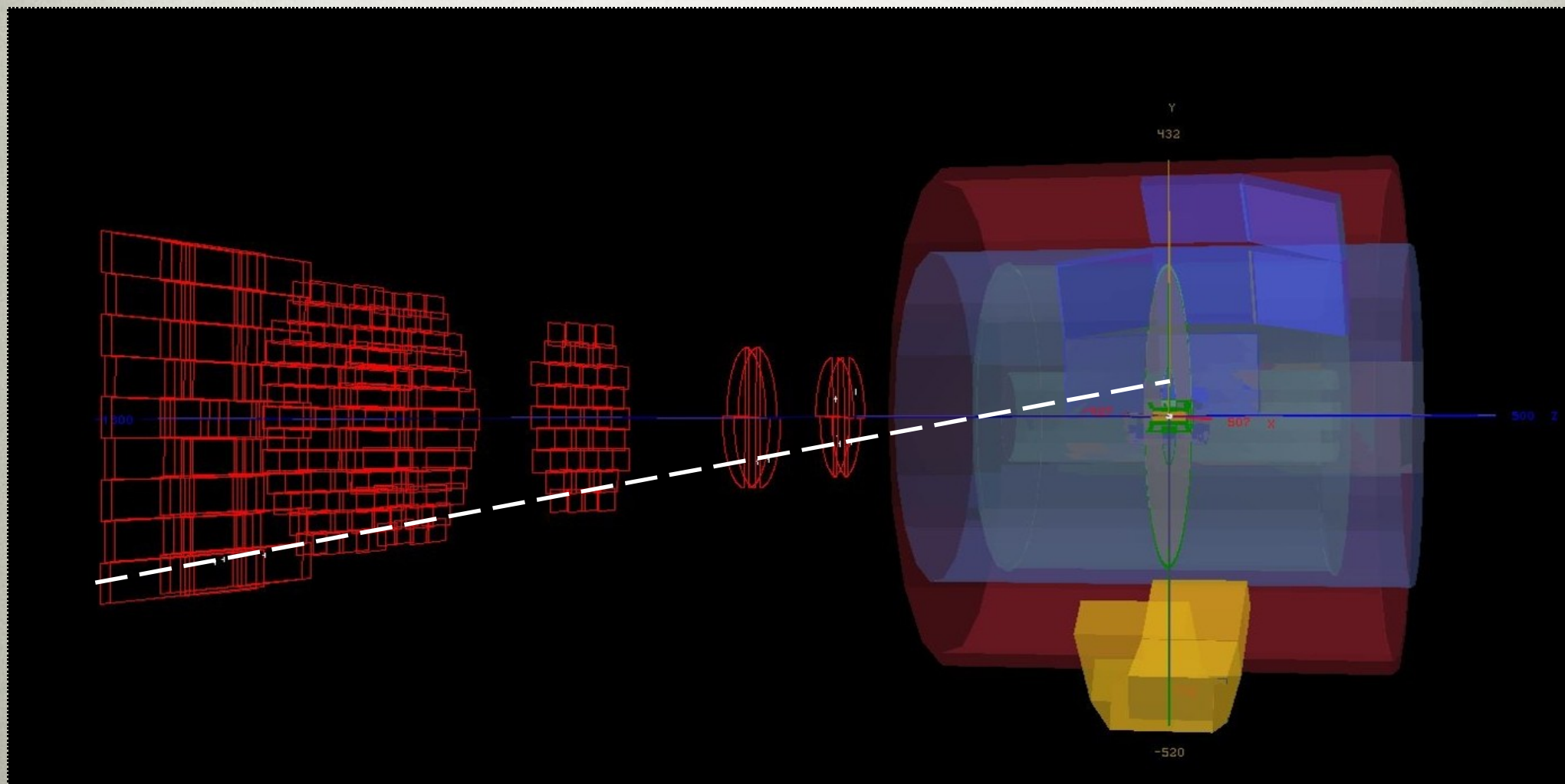
Plots from mchview

From A. Baldisseri's talk: Cosmic Run Status: Muon Tracking

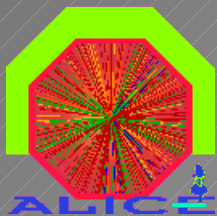


A Cosmic Track

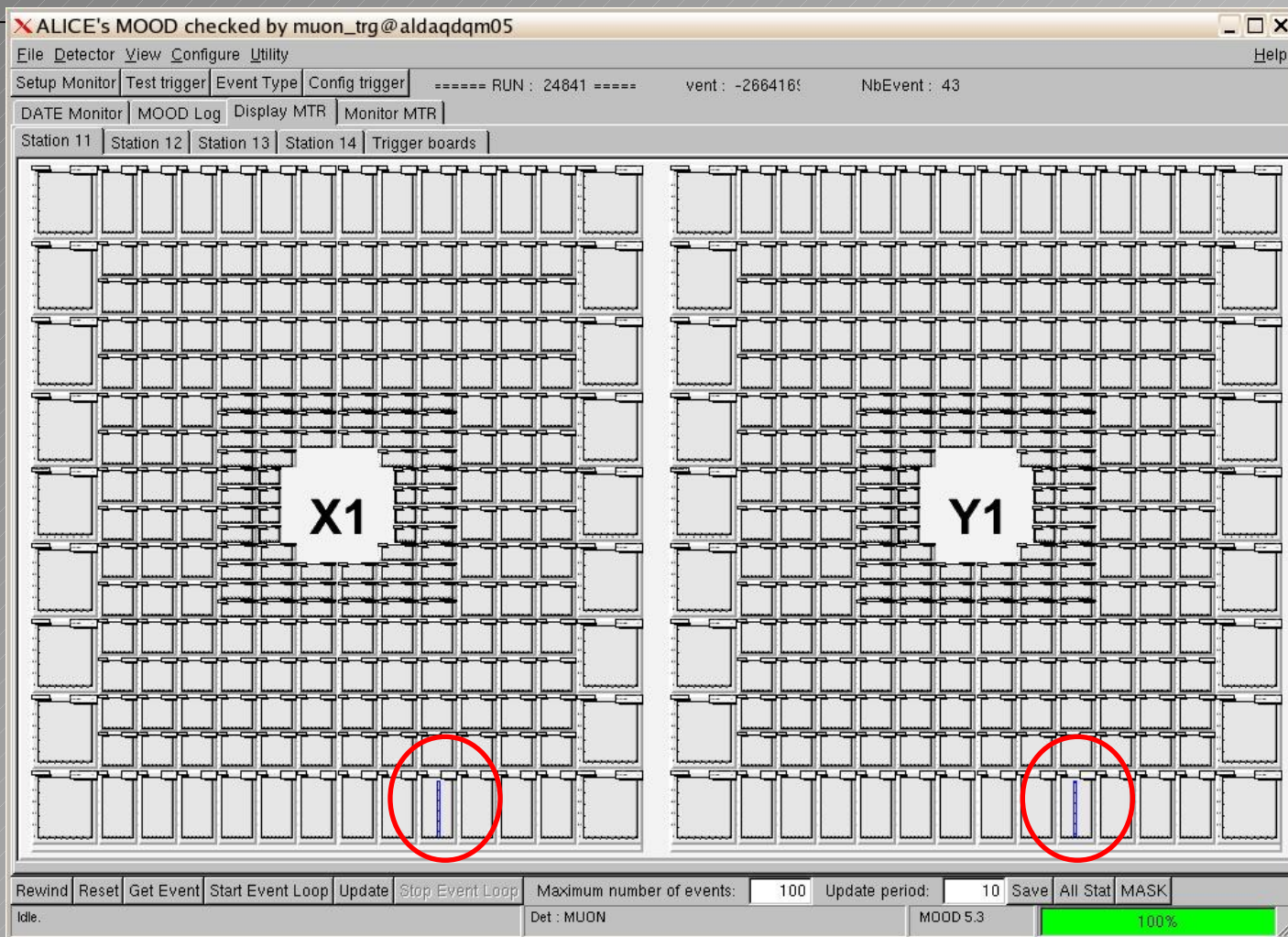
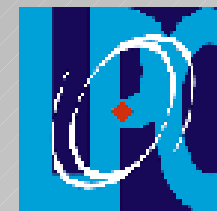
Run 24841 (HLT analysis, I.Das)
Muon trigger



From A. Baldisseri's talk: Cosmic Run Status: Muon Tracking



First muons



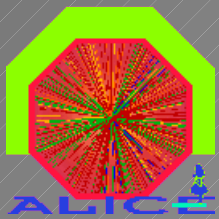
- The first cosmic muons have been observed.
- The drawing shows the display of the 1st MUON TRG plane for an event of run 24841.
- A hit (in X and Y coordinates) is found in each of the 4 MUON TRG planes (Local Board RC3L1B12).

Blanc Aurélien, LPC Clermont-Ferrand, March 2008

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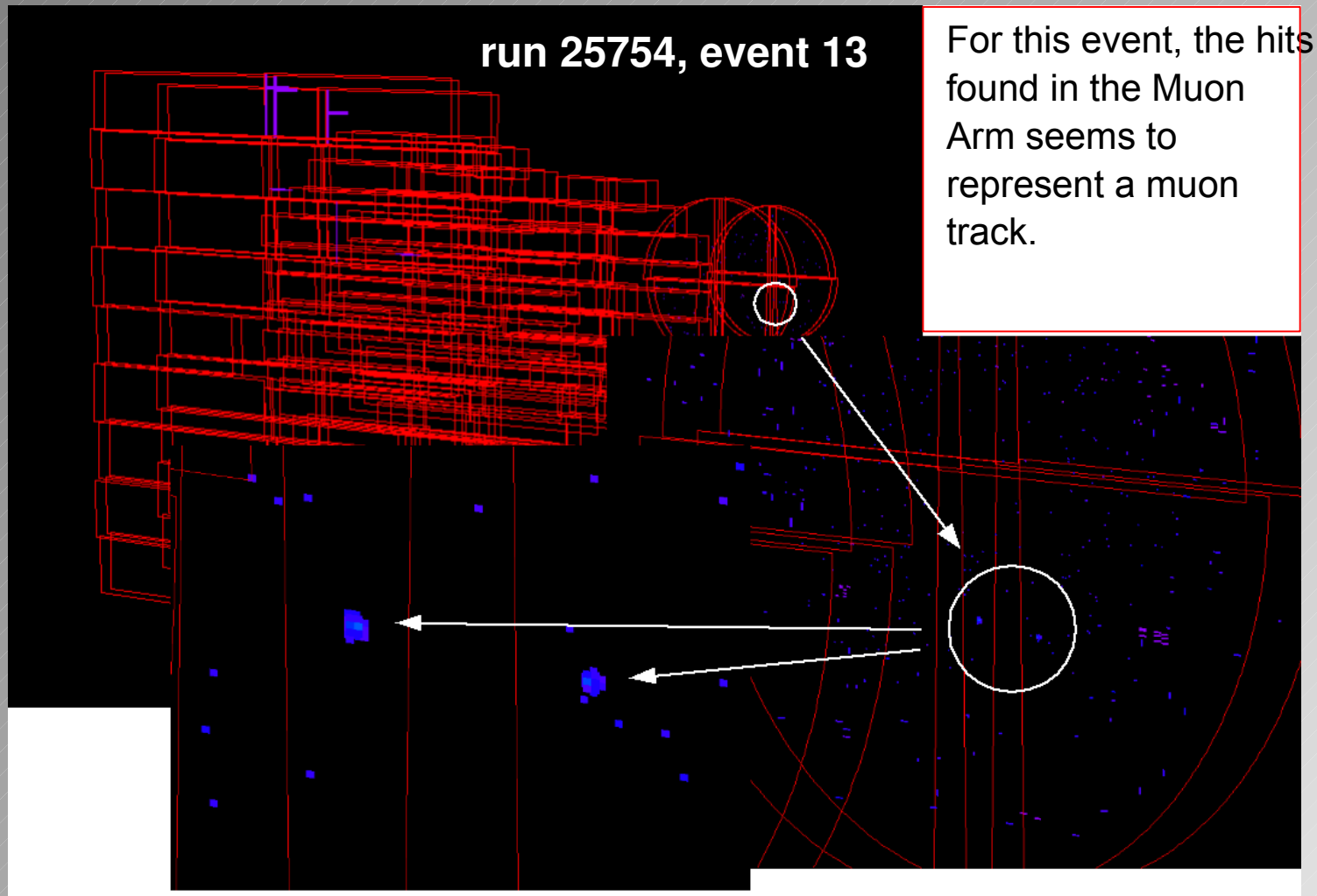
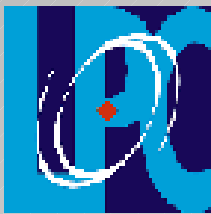
Plots from MOOD

From A. Blanc's talk: Muon trigger in the cosmic run



First offline analysis

Event display: muon track

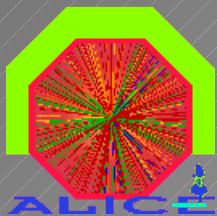


Blanc Aurélien, LPC Clermont-Ferrand, March 2008

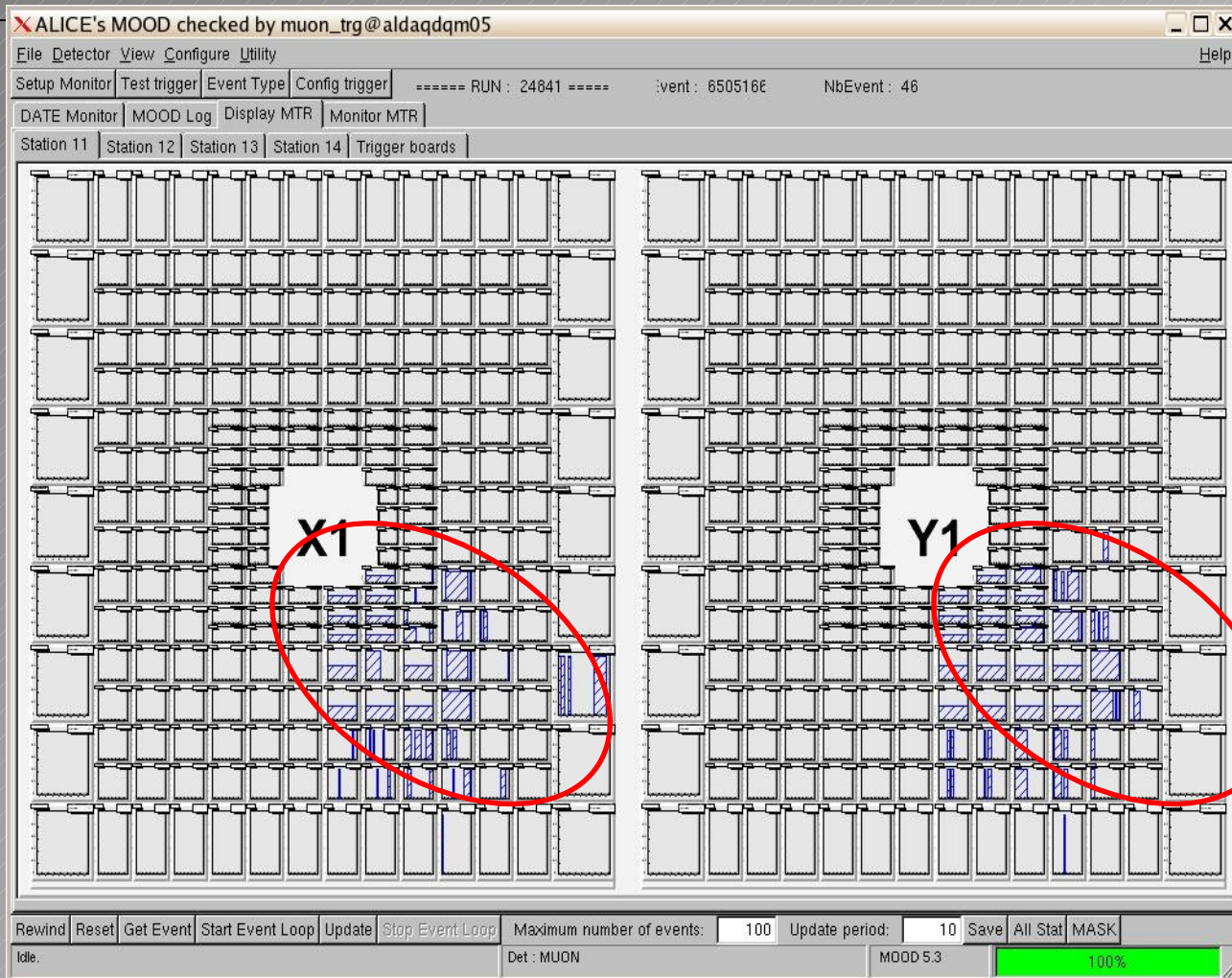
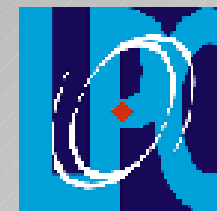
10

Plots from Alieve

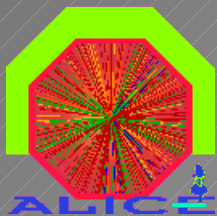
From A. Blanc's talk: Muon trigger in the cosmic run



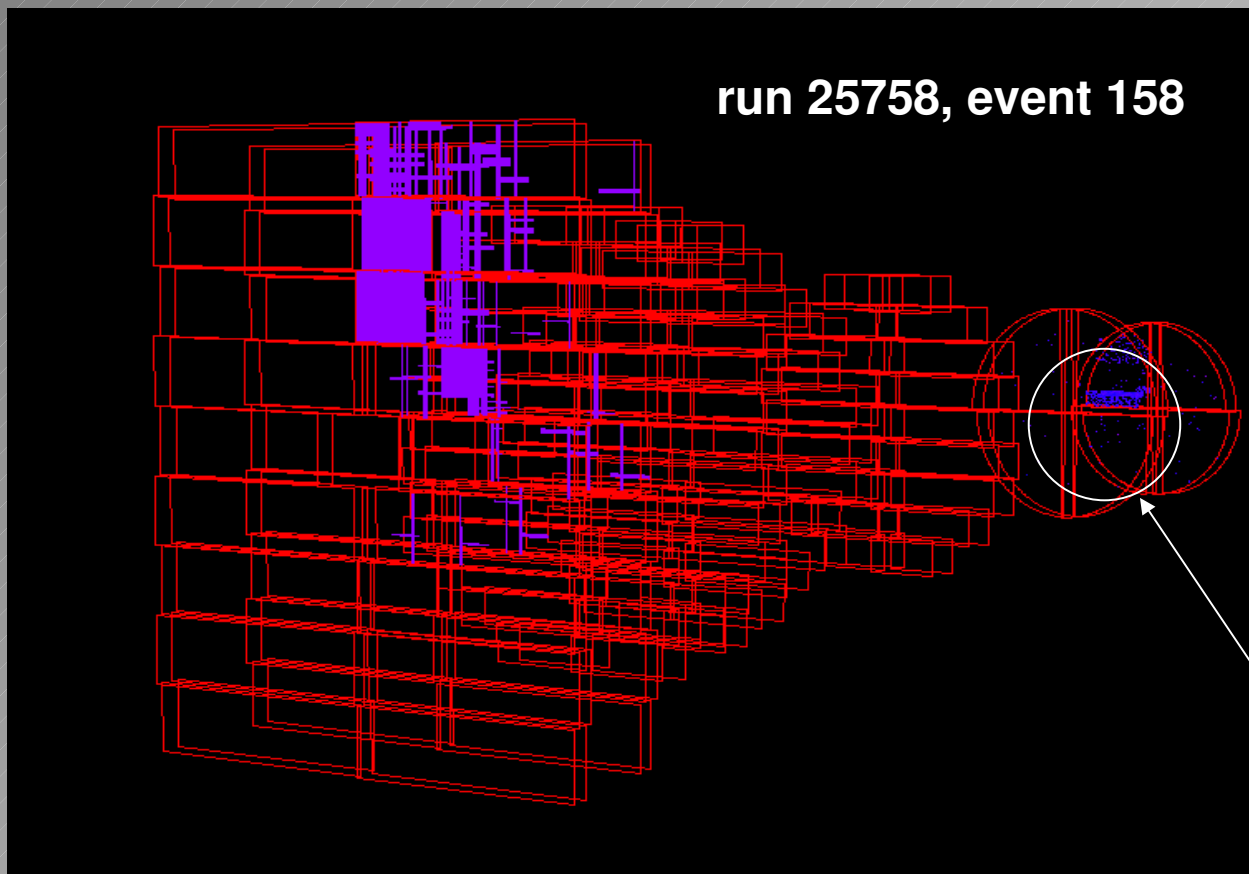
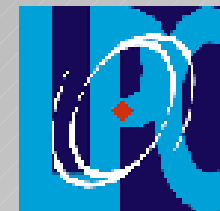
"Shower" events



- Most of events look like showers.
- The drawing shows the display for the 1st MUON_TRG plane for an event of run 24841.
- The center of the events moves versus the MUON_TRG plane number.



Event display: shower



The « Shower » events can also be found with the display.

Noise (now understood)

Electronic noise or part of a large shower?

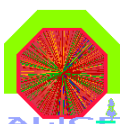
- As expected, the first analysis shows that the cosmic rate (“shower” + muons) is very low and it should not be present during physics runs.

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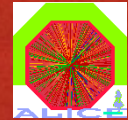
Plots from Alieve

Photogrammetry and Survey

- From J. Castillo
- Should provide initial misalignment for
 - Survey: Support structures (half-chambers) with respect to ALICE with $\sim 1\text{mm}$ resolution
 - Photogrammetry: Detection elements with respect to support structures with $\sim 100\mu\text{m}$ ($300\mu\text{m}$ for Station 2) resolution
- Measurements are done as installation and commissioning proceeds. Already done:
 - Survey + Photogrammetry: Ch1, Ch2, Ch3, Ch4
 - Photogrammetry test: Ch5O, CH5I, CH8O
- Reports are being stored in the Survey Depot DB as they become available
- Software development
 - Use AliSurveyObj and AliSurveyPoint to read and handle survey data
 - Get misalignment from a best local to global transformation fit approach
 - Create a misalignment file in OCDB
 - Working code exist in SVN
 - Being ported into a more modular code to easier the final handling of 16 reports for as many support structures and 156 detection elements
- Most results are within mechanical expectation or have helped to identify and correct errors in theoretical geometry. Few remaining issues to be sorted out with experts

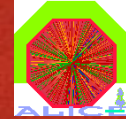


GMS: Installation status

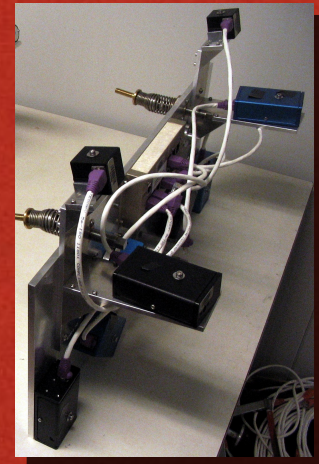


- Stations 1 and 2:
 - Fully equipped and tested, ready for operation and ... operated during last cosmic run
- Station 3:
 - GMS installed and commissioned on Chamber 5.
 - Halves plans have been relatively aligned in order to have supports parallel to each other.

GMS: Installation status



- Stations 4 and 5:
 - GMS installed, alignment of GMS platforms done for each half plan.
 - Need to align halves plans of each chamber together (Week 14)
- Longitudinal links:
 - Calculation of geometry as soon as we have the photogrammetry results
- Cavern walls: Installation current April

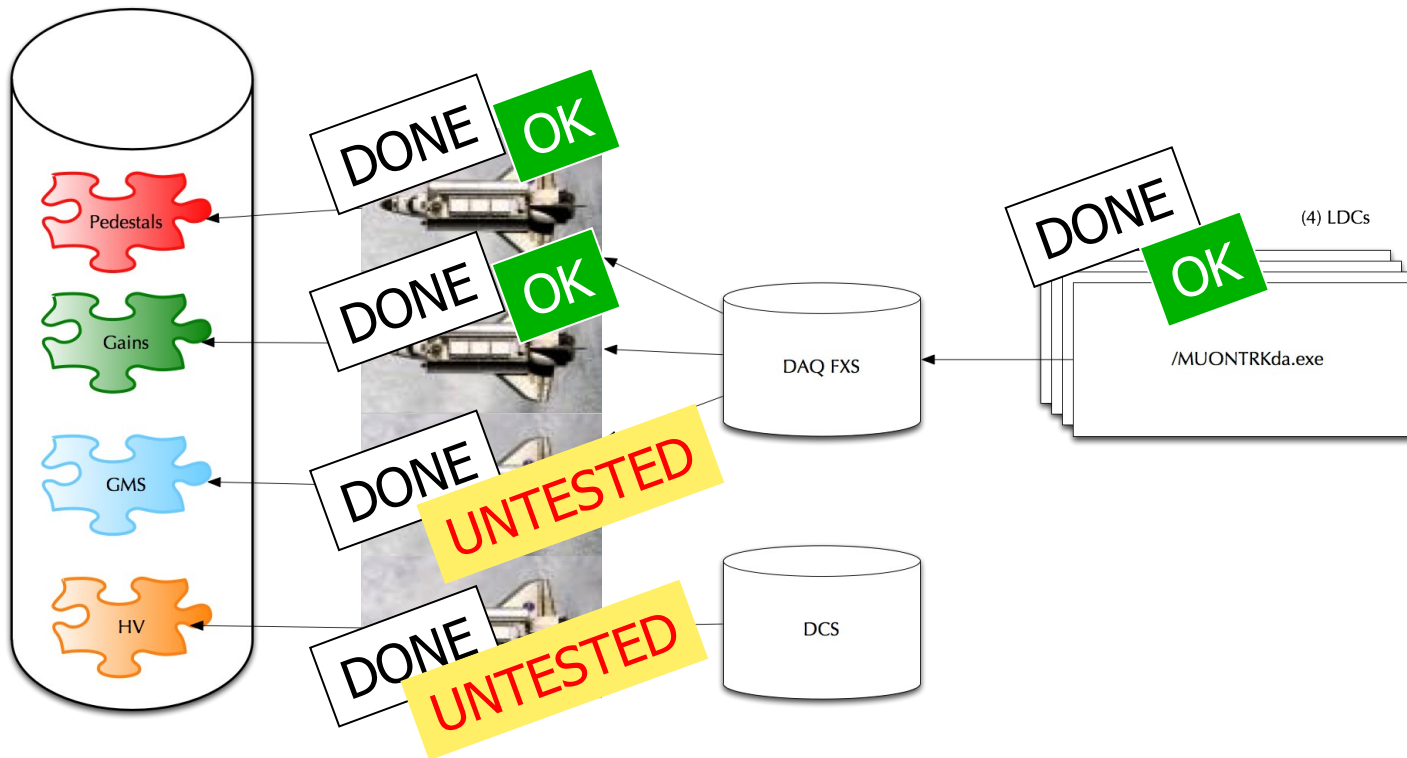


GMS: Conclusion

- Hardware installation:
 - GMS missing on CH06 and cavern's walls
 - Longitudinal parts for St345
- Software:
 - Link to ECS → Possibility to operate the shuttle
- Results from cosmics run:
 - Cradle's positions sensible to temperature
 - L3 magnet imply movement of the order of 100 μm



Shuttle Status: MCH



UNTESTED... = During dec and/or feb cosmic run

Shuttle Status:MCH issues

- Some concern about inability to test DCS HV preprocessor in two consecutive cosmic runs...
 - December : it was our fault (missing and/or incorrect DCS aliases), but it would have failed anyway, because :
 - February : it is probably not our fault: the SOR is incomplete and so DCS does not start archiving (HV) values
 - MUST work in April or we'll be in trouble
- Should get GMS in the game as well...



Shuttle Status:MTR

- Pas de bras, pas de chocolat
- No DA, No Shuttle
- DA MUST be implemented for next run !



News about clustering / tracking

- Combined clustering/tracking (i.e. clustering now driven by the tracking)
= New option in runReconstruction.C:
 - station 4 and 5 (used to build primary track candidates) fully clusterized
 - station 1, 2 and 3 clusterized only around the extrapolated position of tracks
 - clusters no more stored into MUON.RecPoints.root
- New classes from Sasha (with simplified algorithm, i.e. no splitting):
 - AliMUONClusterFinderPeakCOG, AliMUONClusterFinderPeakFit
- Simplified algorithm to face problems with real data while keeping reasonable resolution and efficiency (MLEM is the official algorithm)
- Combined clustering/tracking allow to reduce the CPU time consumption (by a factor ~ 2)
- Removed AliMUONHitForRec:
- Use directly AliMUONVCluster store everywhere
- Solved a problem in the tracking of low momentum muons

News about ESD

■ Added track parameters at DCA:

- obtained by extrapolated track parameters to the vertex plane through absorber
- corrected for energy loss but not for multiple coulomb scattering

(**void** AliMUONTrackExtrap::ExtrapToVertexWithoutBranson(...);)

```
Double32_t fInverseBendingMomentumAtDCA; ///< charge * 1/pYZ  
Double32_t fThetaXAtDCA;                ///< Angle  $\theta_x$  at vertex  
Double32_t fThetaYAtDCA;                ///< Angle  $\theta_y$  at vertex  
Double32_t fBendingCoorAtDCA;            ///< bending coordinate  
Double32_t fNonBendingCoorAtDCA;         ///< non bending coordinate
```

■ Recovered information lost by removing MUON.Tracks.root:

- added information about clusters attached to the track (AliESDMuonCluster)
- added information about digits attached to the cluster (AliESDMuonPad) and more information about clusters (q , χ^2) on demand:

muonRecoParam->SaveFullClusterInESD(kTRUE,100.);

↑
Percent of events where these additional data are saved

News about ESD

```
class AliESDMuonTrack : public TObject
...
mutable TClonesArray* fClusters; ///< Array of clusters attached to the track
...
```

```
class AliESDMuonCluster : public TObject

UInt_t fUniqueID;    ///< unique id inherited from TObject
                    ///< contains chamber id and det. element id
Double32_t fXYZ[3];  ///< cluster position
Double32_t fErrXY[2]; ///< transverse position errors
Double32_t fCharge;   ///< cluster charge
Double32_t fChi2;     ///< cluster chi2

mutable TClonesArray* fPads; ///< Array of pads attached to the cluster
```

```
class AliESDMuonPad : public TObject

UInt_t fUniqueID;    ///< unique id inherited from TObject
                    ///< contains det. element id, manu id
                    ///< manu channel and cathode
Int_t   fADC;        ///< ADC value
Double32_t fCharge;   ///< Calibrated charge
```

New ESD interface

New class (**AliMUONESDInterface**) concentrating everything to convert MUON objects (track/cluster/digit) into ESD objects (track/cluster/pad) and vice versa:

Two ways of using that interface:

- 1) **Convert the objects one by one** by using the static methods
- 2) **Load an entire ESD event**, from which the ESDMuon objects are extracted, converted and stored in the relevant stores, and **use the provided methods to access MUON objects**

ESD cluster/track refitting

New class **AliMUONRefitter**:

- Connect to an ESD interface containing data to refit

```
AliMUONRefitter refitter;  
refitter.Connect(&esdInterface);
```

- Re-reconstruct clusters and/or tracks (using the standard reconstruction code):
 - re-clusterize the ESD clusters using the attached ESD pads (several new clusters can be reconstructed per ESD cluster)

```
AliMUONVClusterStore* clusterStore = refitter.ReClusterize(iTrack, iCluster);  
AliMUONVClusterStore* clusterStore = refitter.ReClusterize(clusterId);
```

- re-fit the ESD tracks using the attached ESD clusters

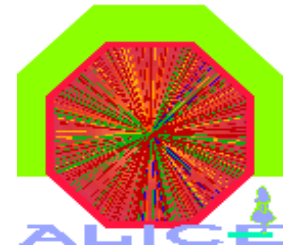
```
AliMUONTrack* track = refitter.RettrackFromClusters(iTrack);  
AliMUONVTrackStore* trackStore = refitter.ReconstructFromClusters();
```

- reconstruct the ESD tracks from ESD pads (i.e. re-clusterize the attached clusters).
Consider all the combination of clusters and return only the best one

```
AliMUONTrack* track = refitter.RettrackFromDigits(iTrack);  
AliMUONVTrackStore* trackStore = refitter.ReconstructFromDigits();
```




MUON QA



► QA MUON Sim:

- Hits : DetElemId and momentum distribution
- SDigits : DetElemId and charge distribution
- Digits : DetElemId and ADC distribution

⇒ Only few histo implemented, need further discussion

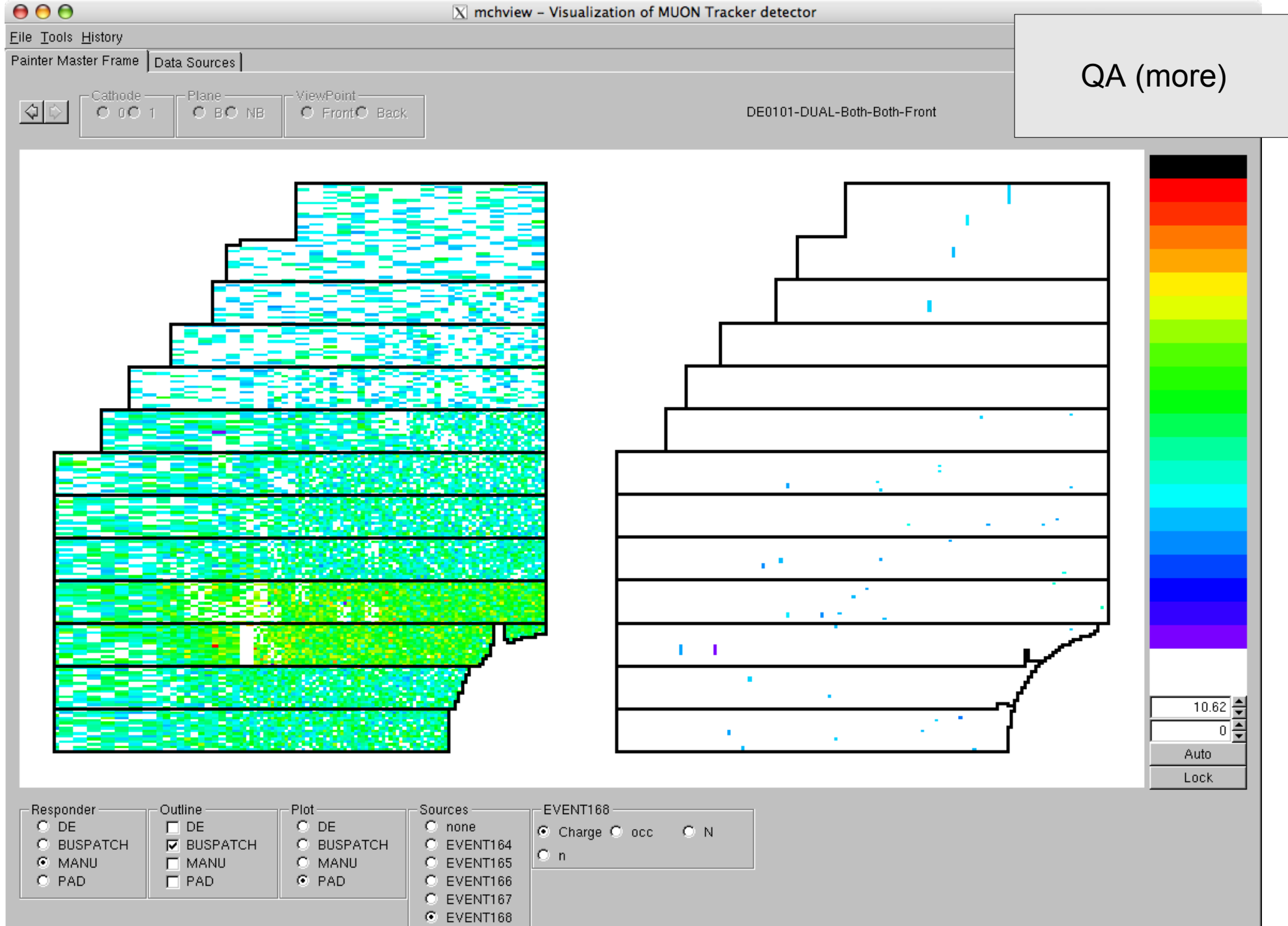
► QA MUON Rec:

- Raw : buspatch hit distribution per DDL, charge distribution
- RecPoints : trigger efficiency plots (Diego)
- ESD : tracks, P, Pt, rapidity distribution

⇒ Only trigger efficiency implemented

QA trigger response check needed !

Tracker chamber efficiency under progress (Nicolas)



*More on QA in Laurent's presentation in QA session on Thursday:
mchview: MUON tracker GUI for QA*

Summary of the Offline Shifts

- Offline shifts = Dimuon Offline Shifts
- 17 volunteers in total
 - 2 groups for preparing macros
 - Group I: Mercedes, Andry, Nicole: Macros and scripts for running reconstruction
 - Group II: Diego, Bruce, Indra: Macros for looking at the rec points
 - 3 groups for offline shifts:
 - Week # 9: Diego, Andry, Antonio, Indra
 - Week #10: Roberta, Bogdan, Danish, Smbat
 - Week #11: Enrico, Bruce, Mercedes, Maria
- Week by week:
 - <http://ivana.home.cern.ch/ivana/muon/READMEtesting.html>
 - Link to runs recommended to look at by Christophe
 - Installation instructions & macros for each week
 - Table with reconstructed data by shifters

Offline Shifts: Software

- New macros committed in SVN
 - **runDataReconstruction.C**
 - Run reconstruction for the selected raw data file accessed via alien
 - **MUONOfflineShift.C**
 - Reads raw data once again and process it several times
 - Produces root output files that can then be displayed using the mchview program and a text file with the occupancy numbers per detection elements
 - **TestRecPoints.C**
 - Performs the clusterization on the fly and analyses data.
 - Produces a root output file (outTestRecPoints.root): cluster multiplicity vs charge, cluster size, ...
- New macros not yet committed in SVN
 - **submitRec.jdl, aliroot.sh, runReconstruction.C**
 - The files for submitting reconstruction on Grid
 - For their use we had to wait when our fixes in MUON will get into a release tag

Offline Shifts: Bug fixes

- Several bug fixes were committed in SVN (most fixes during the first two weeks):
 - Fix in Gain shuttle sub-processor needed due to a change of gain files format
 - AliFatal from AliMUONDigitCalibrator::CalibrateDigit: Got a null gain object
 - Fix in Trigger raw data decoding (AliMUONLocalStruct.h)
 - AliFatal in case of too big number of maxima in the AliMUONClusterFinderMLEM class
 - Fix in mapping: corrected the list of bus patches with reverted manus for st1
- This required to work with AliRoot tagged version + MUON from SVN trunk
 - Several versions used during the exercise:
 - AliRoot: v4-10-Rev-01, v4-10-Rev-02, v4-11-Rev-01
 - Root: v5.18/00, v5.18/00a

Offline Shifts: Outcome

- Locally reconstructed runs shipped to alien
- Table of all reconstructed data during the shifts:
 - <http://ivana.home.cern.ch/ivana/muon/OfflineShifts.html>
- New READMEcosmics.txt added to code documentation
 - Summary of all macros developed for the processing cosmic run data
 - http://aliceinfo.cern.ch/static/Offline/dimuon/muon_html/README_cosmics.html
- The exercise turned out to be very useful
 - Prompt bug fixing
 - Training of shifters in using code
- The reconstructed runs are available on alien for further inspecting
 - But some runs are reconstructed with code not yet containing all fixes
 - For some run, not all macros were processed

Offline Shifts: Outcome (2)

- Problems encountered:
 - Missing or corrupted GRID certificate
 - 3 persons could not participate on the shifts due to this reason
 - Problems with installation of alien
 - 2 persons delayed
 - Problems with time schedule
 - 1 person could not finally participate due to another urgent task
 - Finally, only 7 from 12 shifters really participated on the testing



Analysis on the grid: my experience



Some points from J. Faivre

- It is not easy to get things running, it's difficult and frustrating but at the end (some) things run and what runs runs smoothly
 - Tutorials should be updated
 - More details are needed (why I have to do what I have to do)
 - Example macros are useful, but they should be updated as the code changes
- Data accessibility: jungle
 - No clear information of where the data is, what's staged, what's not...
 - Aim of simulating (prods) should be analyzing data
 - **Impossible** to analyze data that is not staged. Staged data is a very small percentage of the produced data (no more space available). **This will also happen with real data** (I see this as a big problem)
- User should be informed of whatever happens
 - Storage elements are turned down without notice
 - Data is moved around without notice
 - Code disappears without notice
- Once everything is installed and working, if everything in alien is stable and if the data is staged, it takes less than 12 hours to analyze 2.5M events ("standard" analysis). **But this happens rarely**

Calibration Programs

- Most important aspects of the muon computing model are already included in the ALICE computing model:
 - Data reconstruction
 - Model for muon analysis
- This discussion will mainly focus on **the model for calibration programs** (required for launching the official reconstruction):
 - Alignment, pedestals subtraction, electronic calibration, dead-map and trigger-masks
- This calibration will require raw-data on disk, some CPU time, and some iterations
- Evaluation of the requirements is needed:
 - input data type, size, CPU time x iteration number, responsible

Calibration Programs

Requirements for Alignment

- From J. Castillo:
- Size of raw data (muon stream) to be copied on disk: 25 G
- Access to OCDB:
 - During raw data reconstruction to all relevant entries: MUON, ITS(SPD), FMD, ...
 - During alignment phase to MUON/Align
- Need of AliRoot reconstruction: Yes
- Needed CPU:
 - Reconstruction of raw data up to ESDs level:
12 CPU days *2 (minimum number of reconstruction passes)
 - Reading ESDs and running alignment code : ~10h (include various test for optimization)
- Output size
 - ESDs from reconstruction :
8.5 G *2 (at least 1 extra pass to validate alignment)
 - Alignment output for monitoring/validation : 3 G

Model for Calibration Programs

- The calibration tasks needed are crucial to be ready for the official reconstruction production
- Tools:
 - Alice Grid (~5000 machines & several Pbytes)
 - Cern Analysis Facility
 - Shall we foresee other Analysis Facilities?
- Strategy about the tool we plan to use
 - If CAF is the right tool, the access to raw data, OCDB and AliRoot installation will be necessary
 - At least 2 reconstruction passes on the same data should be run, the second one to test and validate the found alignment parameters. For the first ever alignment we will expect 3 passes to be needed as we may start from very far away
 - The MUON contribution to the above sizes is quite small, the sizes are dominated by other detectors and the container structures
 - All the above work is to be repeated for each B=0 run

Project Schedule

- Geometry outside active zone (support)
 - Shifted date to 30/04/2008
 - The support structures have to be completed by Orsay group
- Clearance around alignable volumes
 - Shifted date to 30/04/2008
 - The output from `TGeoManager::CheckGeometryFull()` sent to geometry developers and they were asked to correct overlaps
 - Problem in TGeo when checking mis-aligned geometry, a fix available in the Root trunk

Conclusions

Lessons learned from processing cosmic data:

- The code was not robust enough and crashed when unpredicted conditions happened
- The fast combined tracking not suitable for inspecting cosmic data: clustering is driven by tracking starting from St 4 5 (missing in cosmic run), so no clustering whatsoever !
- An update in the release branch to get rec points in the reconstruction output in the second pass on the cosmic data