

Tutorial For Running AMORE Online & Offline in HEP Lab A, FIT

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AMORE for SRS Data @ HEP Lab A, FIT

- AMORE is ALICE Data Quality Monitoring Software framework
 - Automatic Monitoring Environment founded on ROOT & DATE Monitoring Library
 - It is based on Publisher/subscriber paradigm with the DAQ publishing the data in a monitoring pool and clients subscribing to the pool to collect data for online event monitoring & offline data analysis.
- Available AMORE package for the SRS/DATE electronics
 - **amoreMTS**: Package for Muon Tomography, has alignment constants and online POCA reconstruction integrated, but designed for $33 \times 33 \text{ cm}^2$ Triple GEMs only
 - **amoreSRS**: More general package with additional upgrades without POCA reconstruction, can run Triple-GEM for any size, improvement of the tracking
 - **amoreTUT**: Same content as amoreSRS but serves as tutorial for amore newcomers (*the package is in /home/AmoreUser/amoreTutorial*)
- Available Functionalities:
 - Decoding of the raw data & “Online” common mode correction, pedestal subtraction, zero suppression ...
 - ROOT histograms of the raw data, the hit, Event Display
 - Mapping, histograms & display parameters set from configuration files
 - Online monitoring and data analysis, alignment constants (**amoreMTS only**) ...
 - Online POCA reconstruction for MTS (**amoreMTS only**)

amoreTUT Configuration file:

amoreTUT/src/publisher/SRSConfiguration.cxx

```
File Edit View Terminal Tabs Help
##### AmoreMTS Package general configuration file #####
MAPFILE      ~/configFileDirSRS/august2011cmsGEMbeamTestMapping.cfg
HISTCFG      ~/configFileDirSRS/august2011cmsGEMbeamTestHistos.cfg

PEDFILE      ~/results/pedestalDir/pedestal_08_2011_cmsGEM_Ar_40_C02_15_CF4_45.root
RAWPEDFILE   ~/results/pedestalDir/rawPedestal_08_2011_cmsGEM_Ar_40_C02_15_CF4_45.root

NBOFSIGMA    3
MAXCLUSTSIZE 10

CYCLEWAIT    0

RUNNAME      muonRawDND0_Ar_40_C02_15_CF4_45

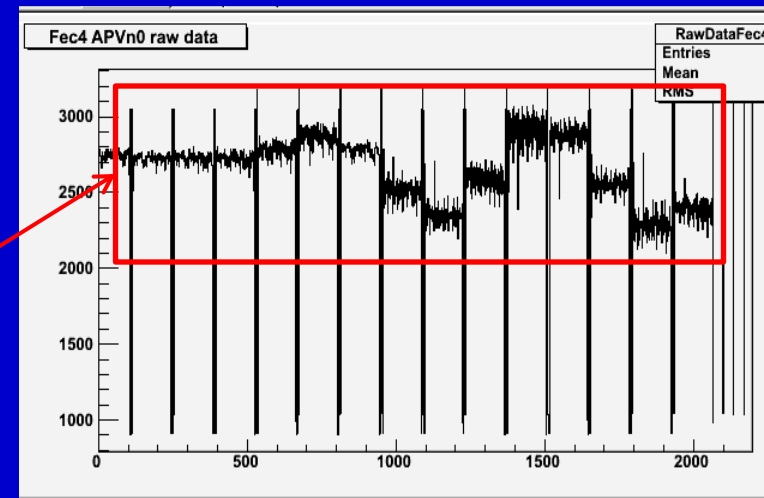
#RUNTYPE      RAWPEDESTAL
#RUNTYPE      PEDESTAL
RUNTYPE      PHYSICS

"amoreConfiuration.cfg" 18L, 573C 1,1 All
```

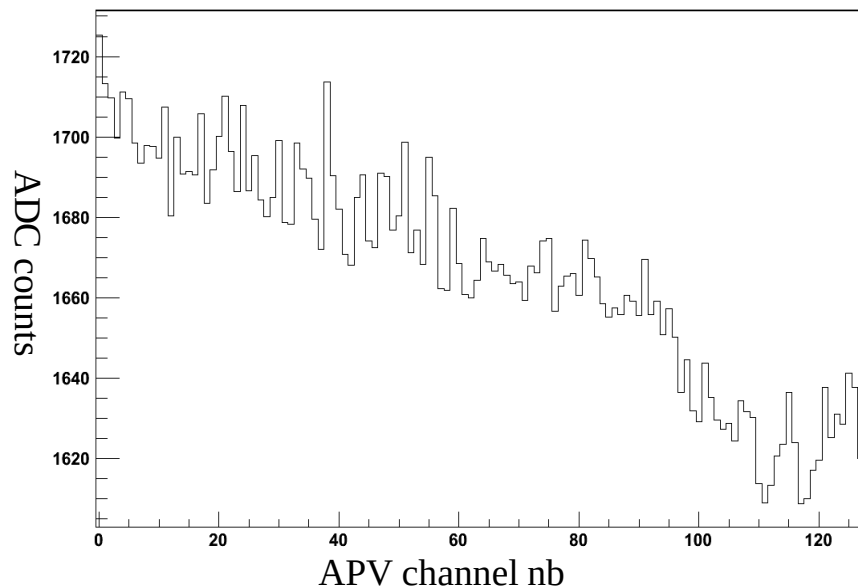
- SRSConfiguration upload only one configuration file at the beginning of the run
- Configuration file: */home/AmoreUser/amoreTutorial/tutorialConfigFileDir/amoreTutorial.cfg*, it contains:
 - The path of all the other configuration file (mapping, histo, display, pedestal data root files ...)
 - The setup and initialization of the run (zero suppression cut, cluster size max, output files ...)
 - The type of run (pedestal, physics, pocaReco, alignment ...)

Pedestal Data in amoreTUT

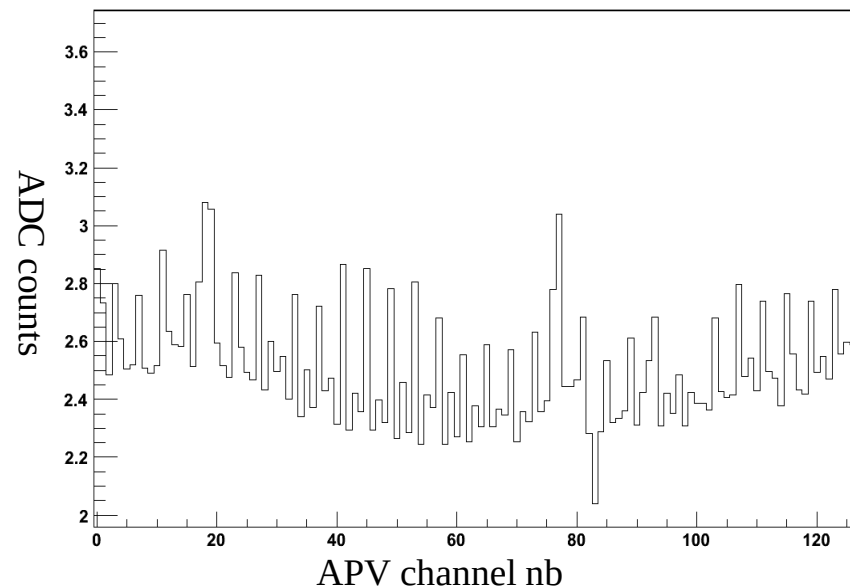
- *amoreTUT/src/publisher/SRSRawPedestal.cxx*
 - Raw pedestal offset are computed online or from the raw data file
 - The raw pedestal data are store in root file
/home/AmoreUser/amoreTutorial/tutorialConfigFileDir/rawPedestalTutorial.root
- *amoreTUT/src/publisher/SRSPedestal.cxx*
 - Raw pedestal data are uploaded from root file and used to correct the common mode before the computation of the pedestal data
 - Pedestal data are stored in root file
/home/AmoreUser/amoreTutorial/tutorialConfigFileDir/pedestalTutorial.root



Pedestal mean (offset) of apvNo



Pedestal rms (noise) of apvNo



Mapping in amoreMTS:

amoreSRS/src/publisher/SRSMMapping.cxx

```
#####
#      DetName      PlaneName      DetNo      Plane      planeSize      nbConnectors      planeOrientation
#####
DET,    GEM1,      GEM1TopX,      0,      0,      102.4,      2,      1
DET,    GEM1,      GEM1TopY,      0,      1,      102.4,      2,      1
DET,    GEM2,      GEM2TopX,      1,      0,      102.4,      2,      -1
DET,    GEM2,      GEM2TopY,      1,      1,      102.4,      2,      1

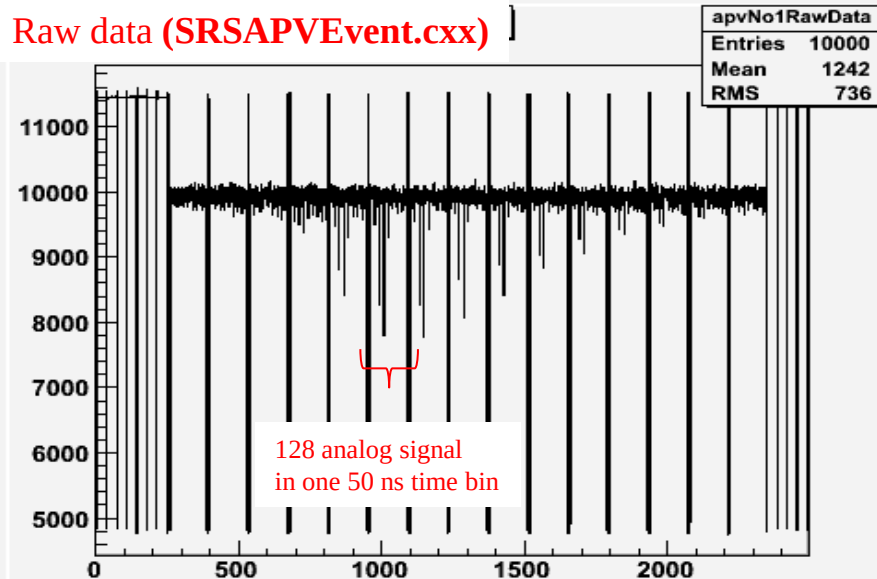
#####
#      FEC Name      APV Name      FEC Id      FEC chNo      APV No      APV Hdr
#####
FEC,    FEC1,      GEM1TopXApv1,      1,      0,      0,      1300
FEC,    FEC1,      GEM1TopXApv2,      1,      1,      1,      1300
FEC,    FEC1,      GEM1TopYApv1,      1,      2,      2,      1400
FEC,    FEC1,      GEM1TopYApv2,      1,      3,      3,      1300
FEC,    FEC1,      GEM2TopXApv1,      1,      4,      4,      1400
FEC,    FEC1,      GEM2TopXApv2,      1,      5,      5,      1300
FEC,    FEC1,      GEM2TopYApv1,      1,      6,      6,      1800
FEC,    FEC1,      GEM2TopYApv2,      1,      7,      7,      1300
```

- SRSMMapping upload the mapping configuration file and performs the mapping
 - Configuration file: */home/AmoreUser/amoreTUT/tutorialConfigFileDir/mappingTutorial.cfg*
- Mapping keywords
 - Line beginning with keyword “FEC” is processed to generate the mapping the apv25 hybrids with the SRS H/W (FEC cards) for the data decoder and apv hit
 - Line beginning with keyword “DET” is processed to generate the mapping the apv25 hybrids with the GEM detector’s plane X/Y for reconstruction, detector analysis ...

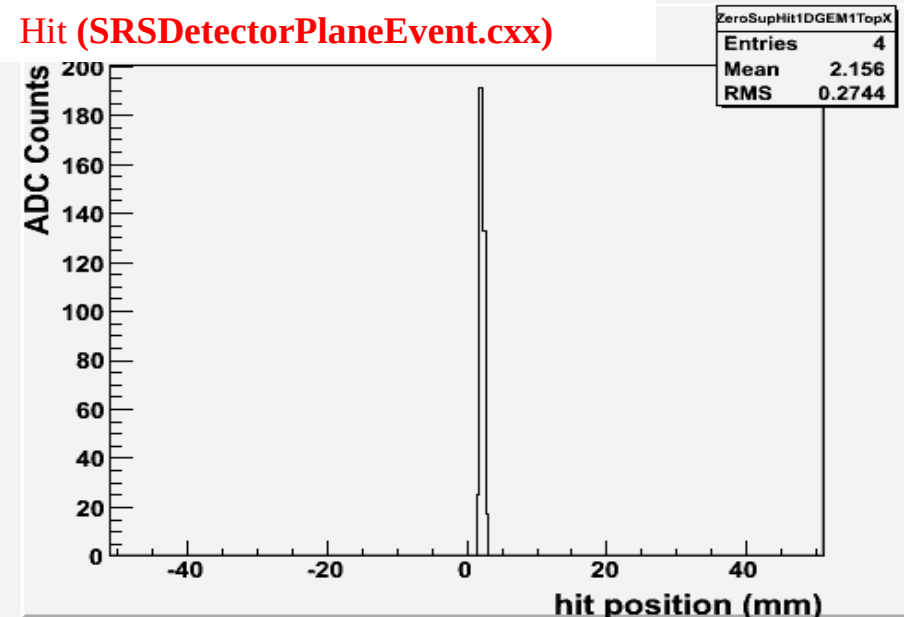
Decoding SRS Data with amoreTUT

- *amoreTUT/src/publisher/SRSFECEventDecoder.cxx*
 - Decodes the data coming from the SRS H/W and encapsulated in DATE format, at the FEC level
 - Create an SRSAPVEvent data object associated to the apv and upload the data into it
- *amoreTUT/src/publisher/SRSEventBuilder.cxx*
 - Builds the event by assembling the decoded data from all the FEC cards
- *amoreTUT/src/publisher/SRSAPVEvents.cxx*
 - Process the data at the apv25 hybrid level (128 channels)
 - Pedestal subtraction, zero suppression, common mode correction ...
- *amoreTUT/src/publisher/SRSDetectorPlaneEvent.cxx*
 - Detector hit on the detector plane (X/Y strips)

Raw data (SRSAPVEvent.cxx)



Hit (SRSDetectorPlaneEvent.cxx)



Histogram in amoreTUT:

amoreTUT/src/publisher/SRSHistoManager.cxx

- MTSHistoManager.cxx uploads the histogram configuration

file, book and fill histograms

- */home/AmoreUser/amoreTutorial/tutorialConfigFileDir/
histogramTutorial.cfg*

- Histogram keywords

- There is a keywords at the beginning of each line used by HistoManager.cxx to book the histograms.

- **Example1:** keyword “HITZEROSUP” means that an histogram ZeroSupHit1DGEM1TopX is booked to be filled with hit from the X-strips of GEM1TopX of the top station

- **Example2:** Keyword “HITMAP” means that an 2D histogram Hit2DColZGEM1Top is booked to be filled with the position (x and y) of the hit on GEM1Top and displayed in ROOT ColZ format.

- **Example3:** keyword “RAWDATA” means that an histogram *apvNo0RawData* is booked at the beginning of the run to be filled with data coming from apvno0 connected to channel0 of FEC1

```
##### HIT #####
#Type,      Histo Name,      Histo Title,      GEM Plane1
HITZEROSUP, ZeroSupHit1DGEM1TopX, Triple-GEM1 zero sup Hit on X, GEM1TopX
HITZEROSUP, ZeroSupHit1DGEM1TopY, Triple-GEM1 zero sup Hit on Y, GEM1TopY
HITRAWDATA, RawDataHit1DGEM1TopX, Triple-GEM1 raw Hit on X, GEM1TopX
HITRAWDATA, RawDataHit1DGEM1TopY, Triple-GEM1 raw Hit on Y, GEM1TopY
HITPEDOFFSET, PedSubHit1DGEM1TopX, Triple-GEM1 ped Hit on X, GEM1TopX
HITPEDOFFSET, PedSubHit1DGEM1TopY, Triple-GEM1 ped Hit on Y, GEM1TopY
PLANETIMEBIN, timeLego2DHit1DGEM1TopX, Triple-GEM1 timing on X, GEM1TopX

##### HIT & ENERGY MAP #####
#Type,      Histo Name,      Histo Title,      GEM Plane1  GEM Plane2
HITMAP,      Hit2DColZGEM1Top, Triple-GEM1 2D Hit Position Map, GEM1TopX, GEM1TopY
CHARGES_SH, ChargeSh2DColZGEM1Top, Triple-GEM1 Charge sharing, GEM1TopX, GEM1TopY

##### HIT DISTRIBUTION #####
#Type,      Histo Name,      Histo Title,      Ener      GEM Plane1
HITDIST,      HitDistGEM1TopX, Triple-GEM1 X-axis Hit Distribution, GEM1TopX
HITDIST,      HitDistGEM1TopY, Triple-GEM1 Y-axis Hit Distribution, GEM1TopY
CLUSTSIZE, ClustSizeGEM1TopX, Triple-GEM1 X-axis Cluster Size, GEM1TopX
CLUSTSIZE, ClustSizeGEM1TopY, Triple-GEM1 Y-axis Cluster Size, GEM1TopY
SPECTRUM, SpectrumGEM1TopX, Triple-GEM1 X-axis Cluster Charge Distribution, GEM1TopX
SPECTRUM, SpectrumGEM1TopY, Triple-GEM1 Y-axis Cluster Charge Distribution, GEM1TopY

##### RAW DATA #####
RAWDATA,      apvNo0RawData, Fec1 ch0 APVn0, 1, 0
RAWDATA,      apvNo1RawData, Fec1 ch1 APVn1, 1, 1
RAWDATA,      apvNo2RawData, Fec1 ch2 APVn2, 1, 2
RAWDATA,      apvNo3RawData, Fec1 ch3 APVn3, 1, 3

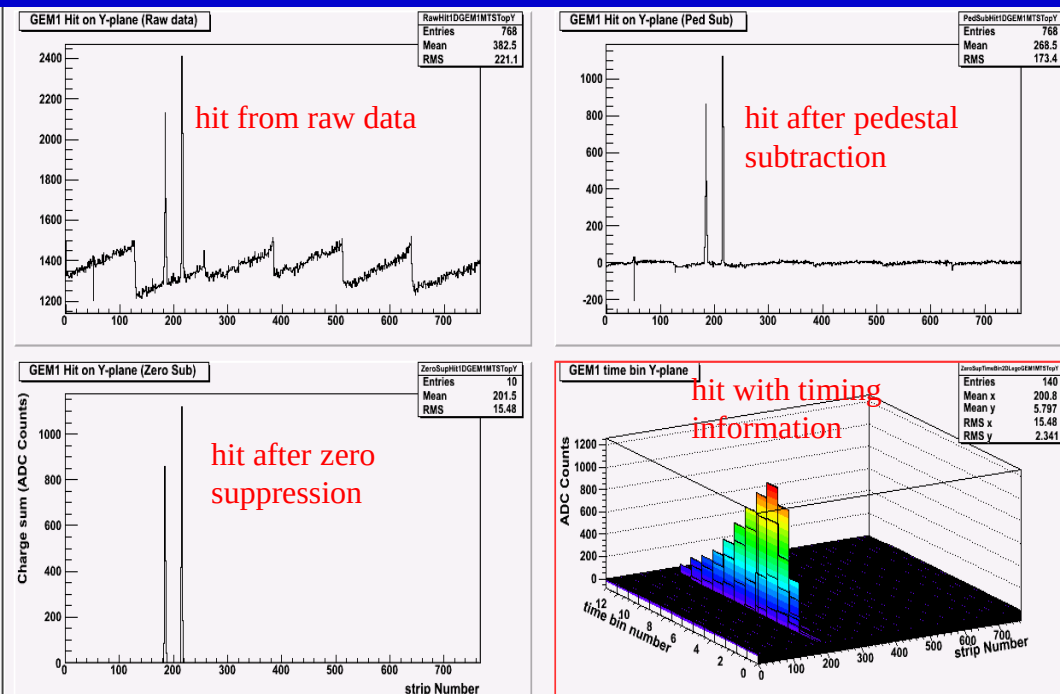
##### PEDESTALS OFFSET #####
PEDESTALS,      apvNo0PedestalMean, Fec1 ch0 APVn0, 1, 0
PEDESTALS,      apvNo1PedestalMean, Fec1 ch1 APVn1, 1, 1
PEDESTALS,      apvNo2PedestalMean, Fec1 ch2 APVn2, 1, 2
PEDESTALS,      apvNo3PedestalMean, Fec1 ch3 APVn3, 1, 3
PEDESTALS,      apvNo0PedestalRMS, Fec1 ch0 APVn0, 1, 0
PEDESTALS,      apvNo1PedestalRMS, Fec1 ch1 APVn1, 1, 1
PEDESTALS,      apvNo2PedestalRMS, Fec1 ch2 APVn2, 1, 2
PEDESTALS,      apvNo3PedestalRMS, Fec1 ch3 APVn3, 1, 3

#####
# Quadrant, Detector Name, Plane 1, Plane 2, X Offset, Y Offset, Z Offset
#####
TRACKS, TOP, tracker, GEM1, 0., 0., 0
```


amoreTUT Display:

amoreTUT/src/ui/TUTUI.cxx

- TUTUI.cxx upload the display configuration file Configuration file:
/home/AmoreUser/amoreTUT/tutorialConfigFileDir/displayTutorial.cfg
 - Line starting by “CANVAS”: a canvas with name, nb of tabs, and size
 - All other lines call an histogram to be displayed. All lines with the same keywords will place updated histograms in the same canvas.
 - Example: we created a canvas of size 1000 × 800, named “HIT” with 2 × 2 tabs and plotted 4 hits histograms with keyword “HIT”



```
##### WAY TO ORGANIZE THE HISTOS TO DISPLAY #####
# CANVAS,      NAME,      NTABX,  NTABY,  SIZEX,  SIZEY
#####
CANVAS,        RAWDATA,    2,      2,      1000,  800
CANVAS,        PEDESTAL,   2,      4,      1000,  800
CANVAS,        HIT,        2,      2,      1000,  800
CANVAS,        ANALYSIS,   2,      3,      1000,  800

##### HISTOGRAMS TO DISPLAY #####
# CANVAS,      NAME,      NTABX,  NTABY,  SIZEX,  SIZEY
#####
RAWDATA,       apvNo0RawData,  Fec1 APVn0 raw data
RAWDATA,       apvNo1RawData,  Fec1 APVn1 raw data
RAWDATA,       apvNo2RawData,  Fec1 APVn2 raw data
RAWDATA,       apvNo3RawData,  Fec1 APVn3 raw data

PEDESTAL,      apvNo0PedestalMean, Fec1 APVn0 raw data
PEDESTAL,      apvNo1PedestalMean, Fec1 APVn1 raw data
PEDESTAL,      apvNo2PedestalMean, Fec1 APVn0 raw data
PEDESTAL,      apvNo3PedestalMean, Fec1 APVn1 raw data
PEDESTAL,      apvNo0PedestalRMS,  Fec1 APVn2 raw data
PEDESTAL,      apvNo1PedestalRMS,  Fec1 APVn3 raw data
PEDESTAL,      apvNo2PedestalRMS,  Fec1 APVn2 raw data
PEDESTAL,      apvNo3PedestalRMS,  Fec1 APVn3 raw data

HIT,           RawDataHit1DGEM1TopX,  GEM
HIT,           PedSubHit1DGEM1TopX,    GEM1 Hit on X-plane
HIT,           ZeroSupHit1DGEM1TopX,   GEM1 Hit on Y-plane
HIT,           timeLego2DHit1DGEM1TopX, GEM1 Hit on X-plane

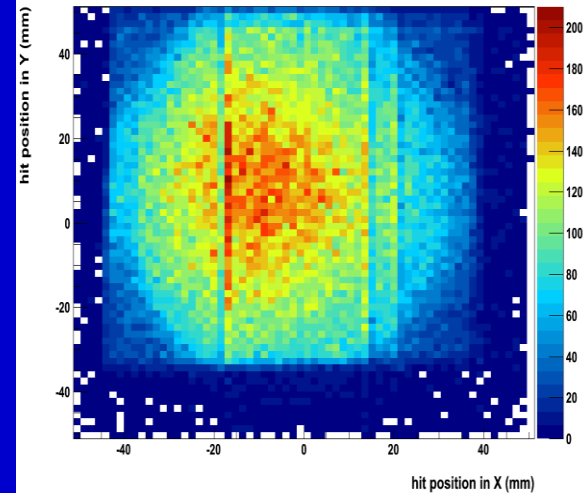
ANALYSIS,      Hit2DColZGEM1Top,      GEM1 2D Hit
ANALYSIS,      HitDistGEM1TopX,       GEM1 X-Hit Distribution
ANALYSIS,      ClustSizeGEM1TopX,     GEM1 X-Cluster strip count
ANALYSIS,      ClustSizeGEM1TopY,     GEM1 Y-Cluster strip count
ANALYSIS,      SpectrumGEM1TopX,      GEM1 X Pulse Height X
ANALYSIS,      SpectrumGEM1TopY,      GEM1 Y Pulse Height X

"display.cfg" 37L, 1762C                                     1,1
```

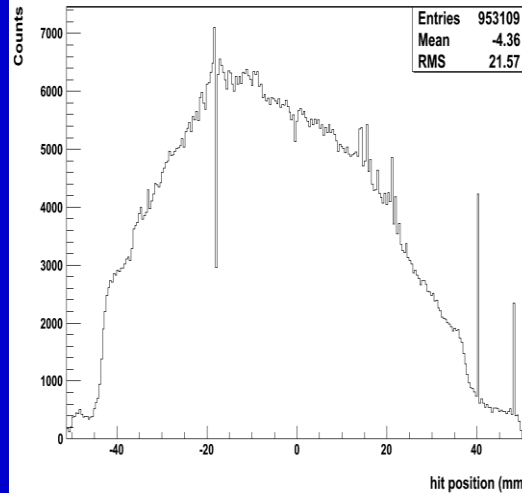

Commissioning of Triple-GEM in amoreTUT

A few possibility for detector characterization: Data from CMS GE11 Test Beam Run in August 2011 @ CERN

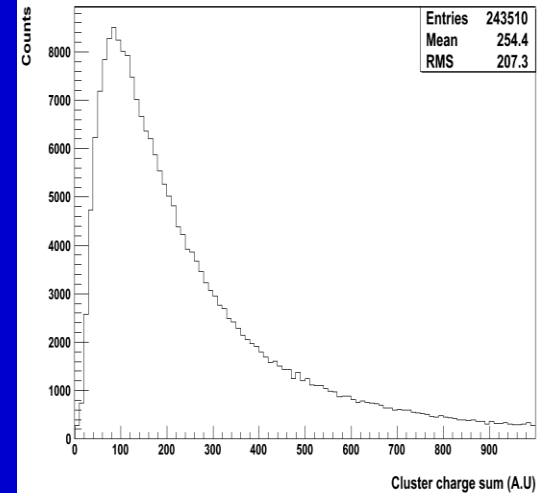
CMS GEM Muon Beam 2D Profile



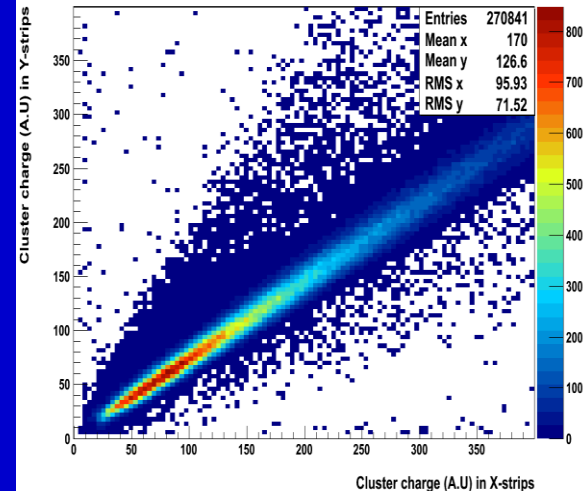
CMS GEM Muon Beam Profile in X



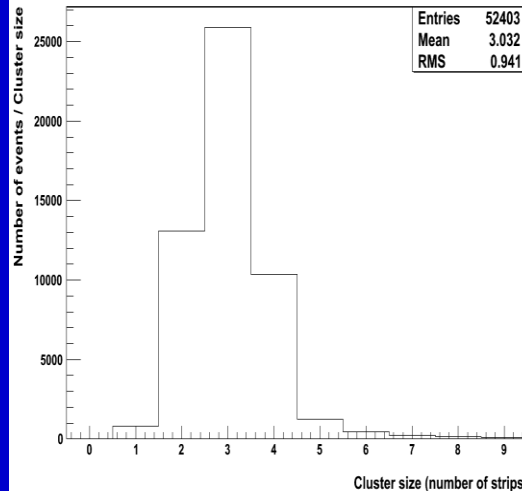
Cluster Charge distribution



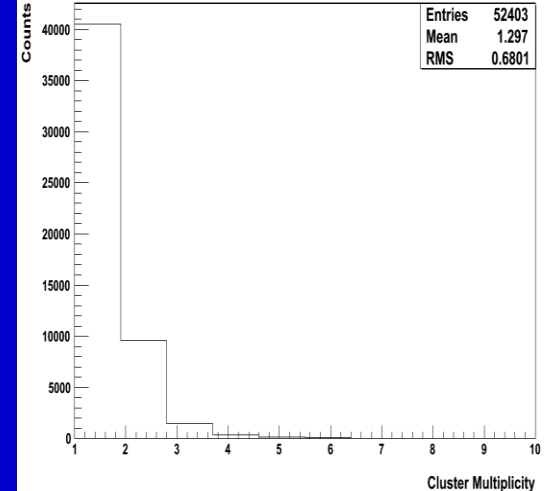
Cluster charge sharing correlation x vs.y



Cluster size in x-axis

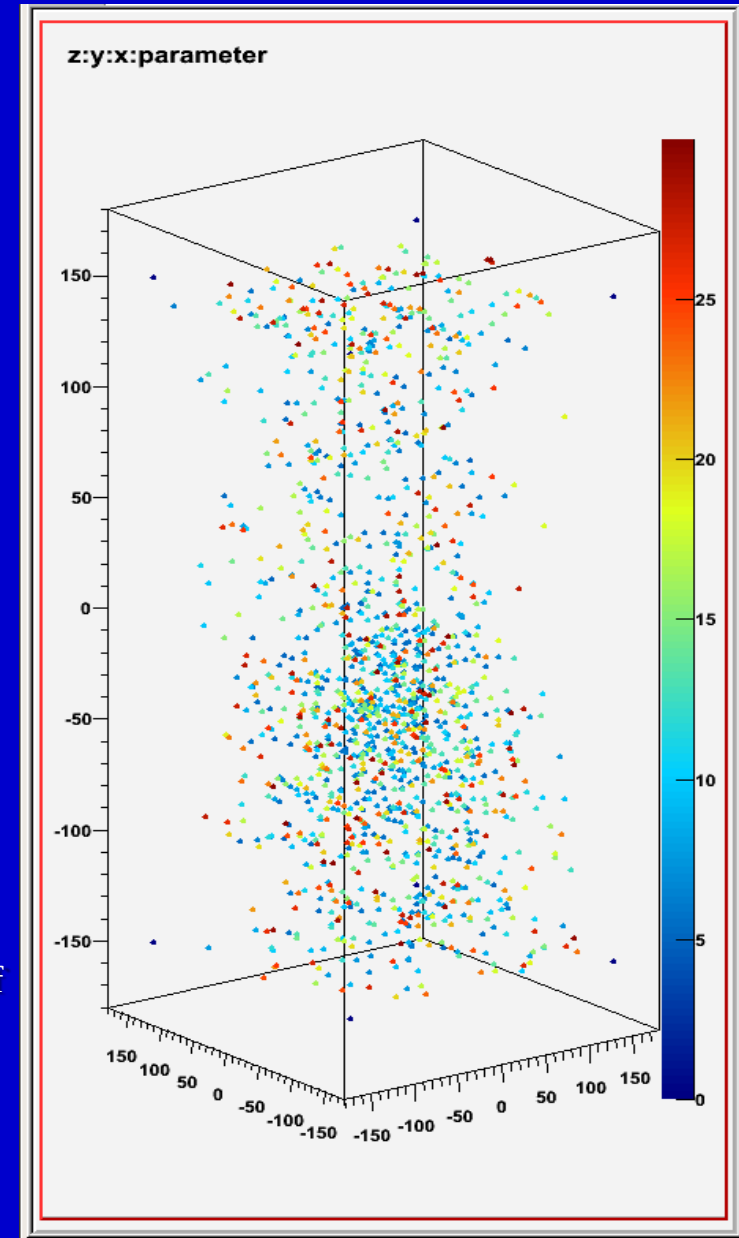


Cluster Multiplicity



MTS Online POCA Reconstruction in amoreMTS (only)

- **MTSAlignment:**
 - Alignment constants from geometry using the track of an empty station
- **MTSTrack.cxx:**
 - Performs the tracking for each station of the MTS
 - Apply a selection criteria for a good event
- **MTSTrackFit.cxx:**
 - Fit the track into a straight line
- **MTSPoca.cxx:**
 - Perform the poca point and the angle calculation for an good event
- **MTSReco.cxx:**
 - MTS reconstruction point that will fill nTuple for 3D display of the MTS volume
 - saved in text file for offline reconstruction



How to Run amoreTUT

- Log as AmoreUser on amore PC (Hostname: host206-117.physci.fit.edu)
 1. Go to the tutorial directory

```
> cd amoreTutorial/
```
 2. Launch the following command to run the amore tutorial agent from the data from the RD51 GEM tracker 08/2011 Testbeam

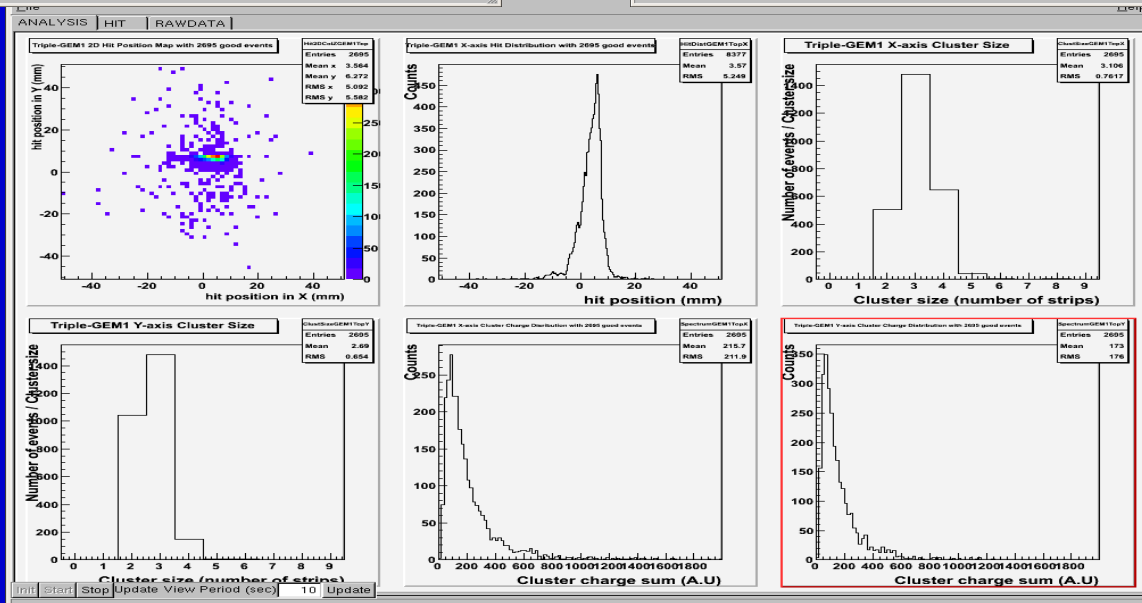
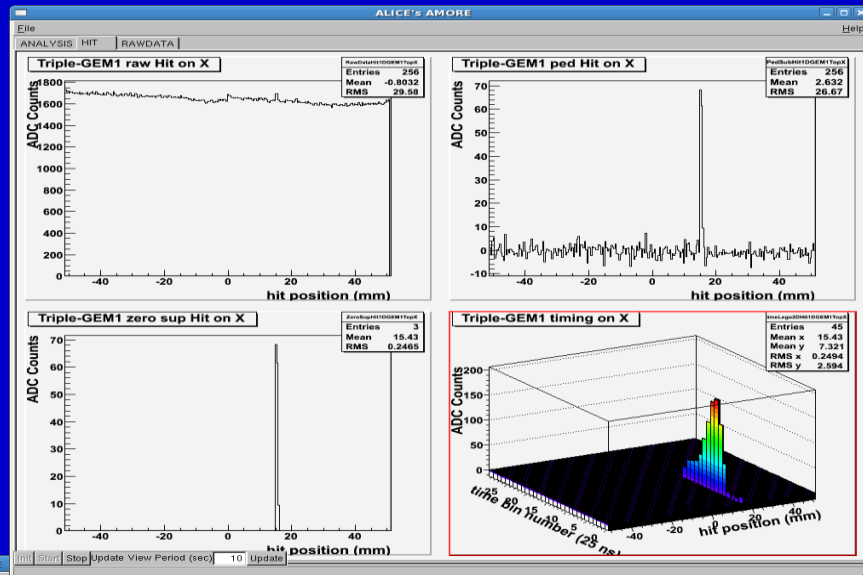
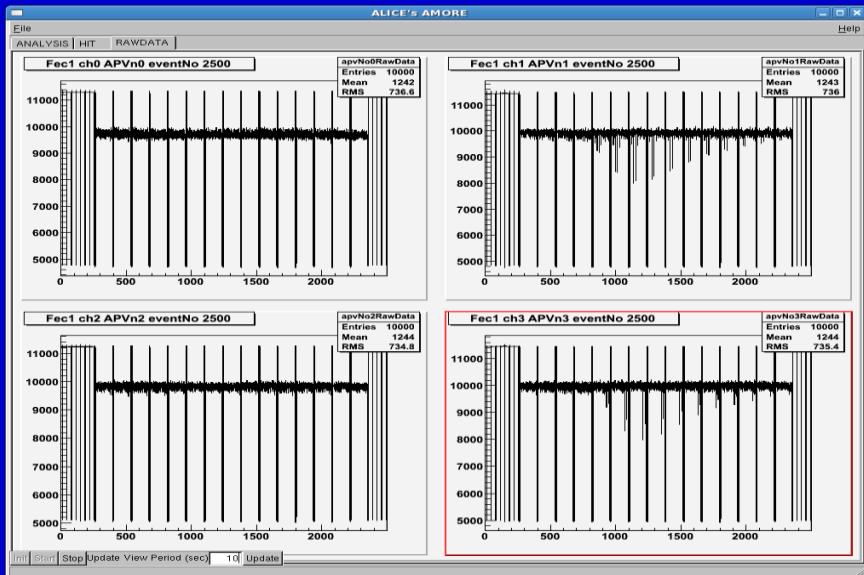
```
> amoreAgent -a TUT01 -s tutorialConfigFileDir/dataTutorial.raw -e 100
```
 3. now type the command below in a new window to open the display

```
> amoreTUTGUI
```
 4. Study the configuration files `amoreTutorial.cfg`, `histogramTutorial.cfg` and `displayTutorial.cfg` in `tutorialConfigFileDir/`.
 5. Delete the pedestal root files (`rawPedestalTutorial.root` and `pedestalTutorial.root`) from `tutorialConfigFileDir`
 6. Stop the amore run that was launched earlier (step2) as well as the display (Cntrl X)
 7. Launch again the run (step 2).

The run will crash → Normal, you deleted the pedestal files → So don't panic

Display

The plots displayed at step 3



How to Run amoreTUT

8. Uncomment the line “RUNTYPE RAWPEDESTAL” from `amoreTutorial.cfg` and comment “RUNTYPE PHYSICS” and launch the command below to run the raw pedestal

```
> amoreAgent -a TUT01 -s tutorialConfigFileDir/PedestalTutorial.raw -e 200 -c 10
```

9. When the run is done, repeat the same process with the RUNTYPE PEDESTAL uncommented
Follow the order for running rawPedestal before pedestal run
10. When the pedestal run is done, come back to steps 2 and 3 for the data run
11. Play with `displayTutorial.cfg`, modify the arrangement of the plots in the canvas and the type of histo you want to plot, stop and restart amoreGUI (step 3) to see the changes
12. Do the same with histogramTutorial and stop and start the run (step 2).
13. Be careful not modifying the mappingTutorial.cfg file. At this point you should not play with it
14. If you have any other questions. I am sure Mike will be happy to help

Data Source for Running AMORE

- Running amoreMTS online with DATE running on host206-118.physci.fit.edu
> amoreAgent -a MTS01 -s @host206-118.physci.fit.edu: -e 500
- Running amoreMTS with data from a raw data file located on the PC where amore is running (example host206-117.physci.fit.edu)
> amoreAgent -a MTS01 -s /mnt/raid/bigLeadCylinderScenario/bigLeadCylinder6.raw -e 500
- Running amoreMTS with data from a raw data file located on a remote PC (example on DATE PC)
*> amoreAgent -a MTS01 -s /mnt/raid/bigLeadCylinderScenario/bigLeadCylinder6.raw
@host206-118.physci.fit.edu -e 50*

HAVE FUN