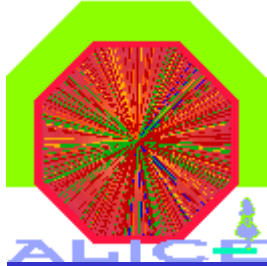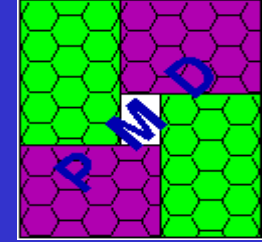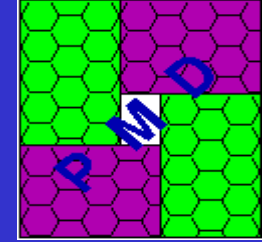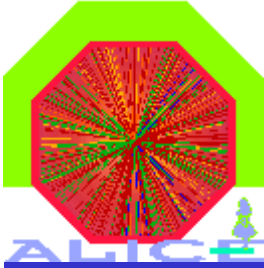# PMD Software Status

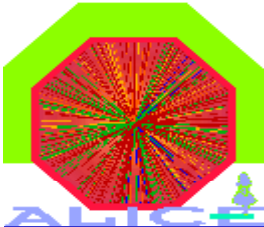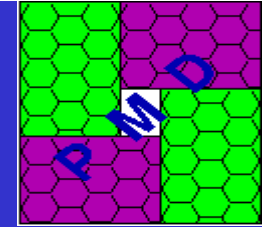### Zubayer Ahammed (For PMD)
VECC, Kolkata

Outline:

- Geometry
- Raw data
- Reconstruction
- ESD/QA
- AOD
- Calibration
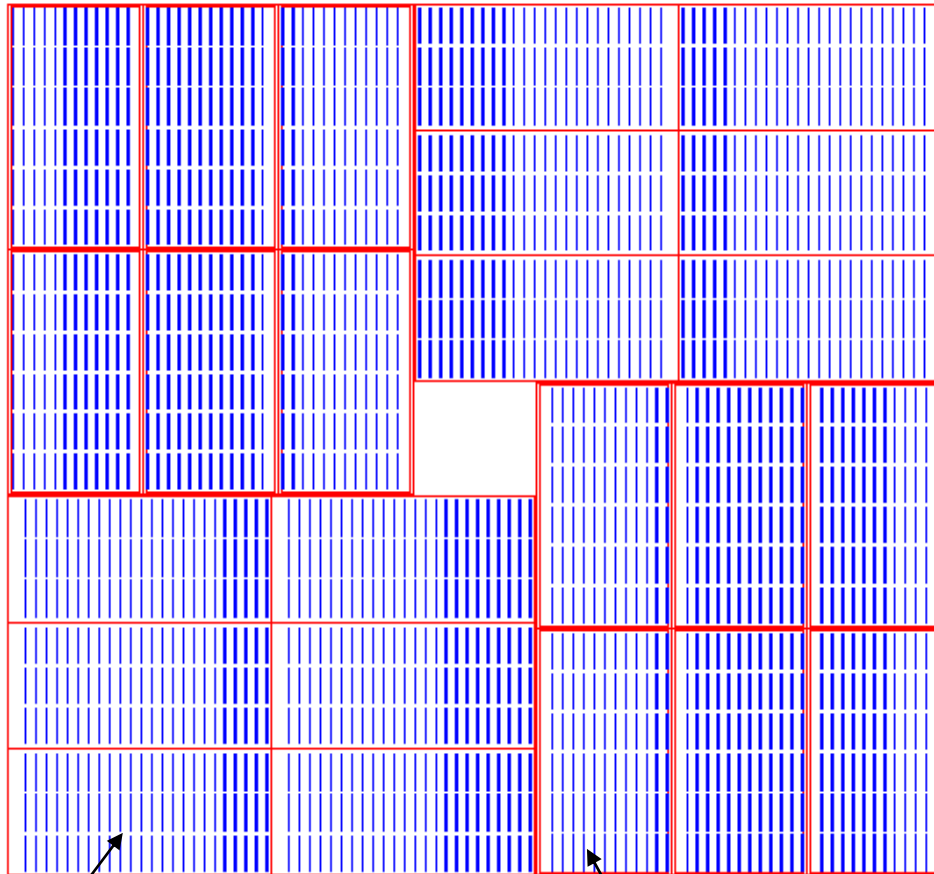- Alignment
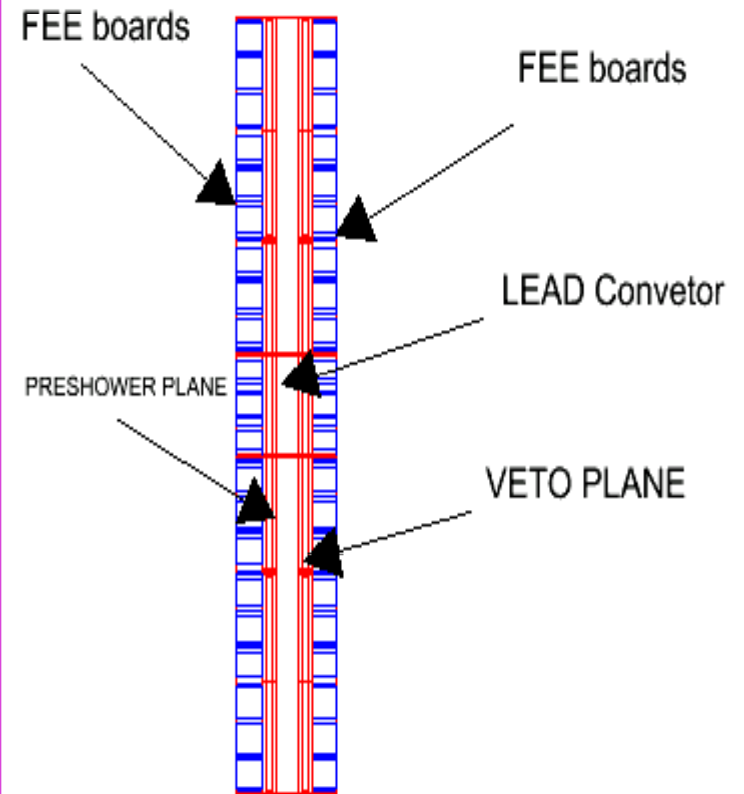- Event Display
- Documentation

Geometry

View from IP

Side view

FEE boards

FEE boards

LEAD Convetor

PRESHOWER PLANE

VETO PLANE

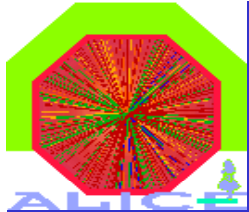Module type B

Module Type A

Code Status:

Code for Geometry with FEE boards exists.

Ongoing work:

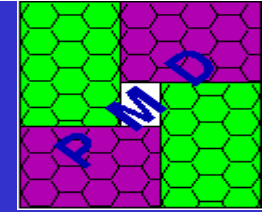Cables will not be in front of the detector.
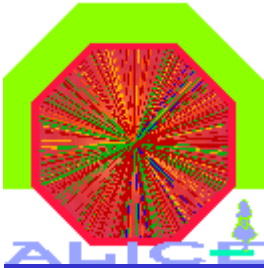Thick cables are always on the sides.
We will have Cables included in geometry.
Work already started and in progress.
PMD Support structure will also be included.

Time : will be finished after installation(20 days).

SDigit and Digit
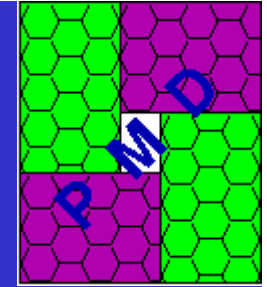
- Taken care of by AliPMDDigitizer.

- Geant Energy deposition is converted into a 12 bit ADC (Information from 2003 and 2006 Test Beam).

ADC Spectra	h1	
	Entries	4011
	Mean	246.8
	RMS	334.9
	χ^2 / ndf	148.3 / 165
	Constant	1273 ± 30.9
	MPV	91.03 ± 1.75
	Sigma	38.04 ± 0.80

ADC from digits

AliPMDDigitizer in CVS

.
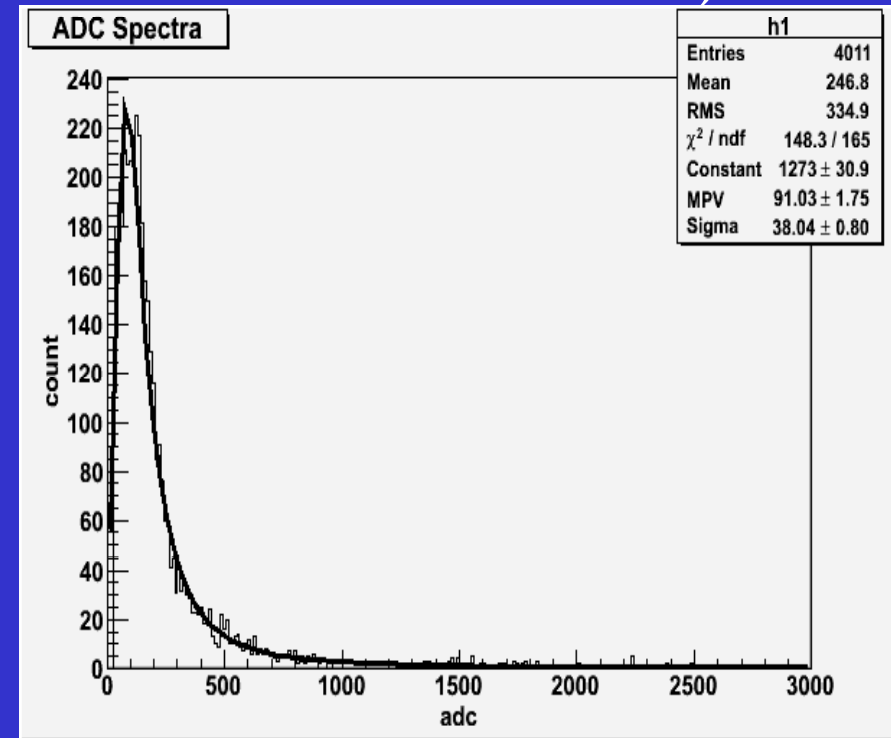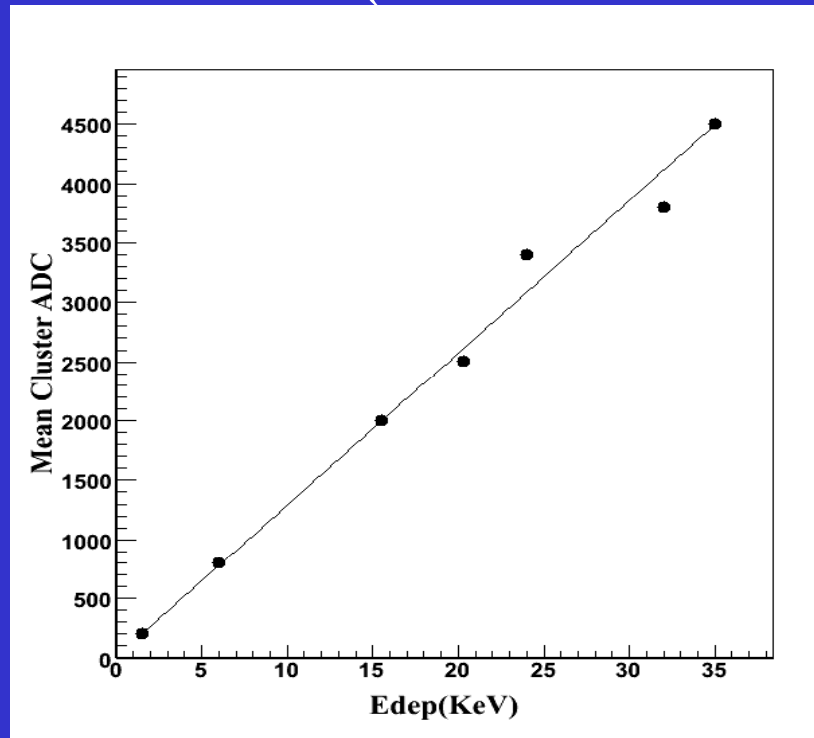
RAW DATA
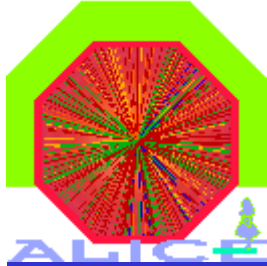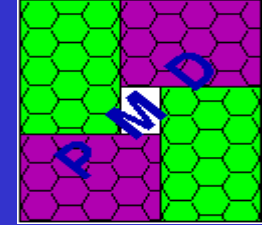
Geant simulation with dN/dη = 4K

Considering 250 words per patch bus
(*read out time and the bus length*)

• *Preshower plane:*
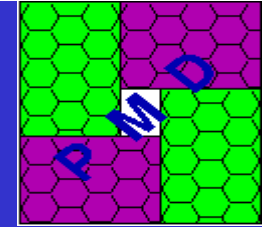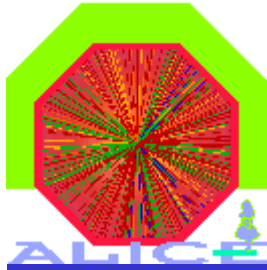
12 FEE boards per chain, 6 chains per Module, 36 chains – 1 crocus
Total number of DDL = 4

• *CPV plane*

For module type A(12 in total):
24 FEE boards per chain, 3 chains per module
For module type B(12 in total):
24 FEE boards for 2 chain,
12 FEE boards for 2 chain
42 chains - 1 CROCUS, Total number of DDL=2
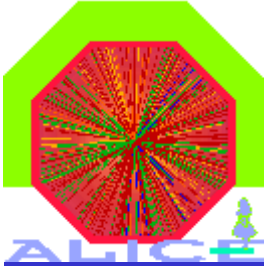
DDL Data
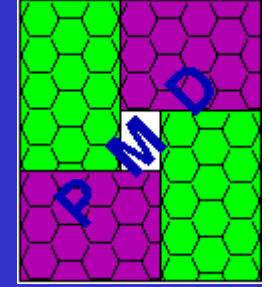
Two blocks of data

Each block of data contains

8 Block Header words

10 DSP Header words

4 PatchBus Header Words

Loop over data words

P	0	0	MCM address	Ch address	Signal
			11bits	6bits	12bits

If the number words are odd, one word is added in the end

Reconstruction

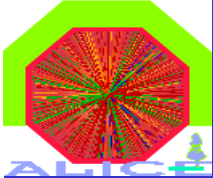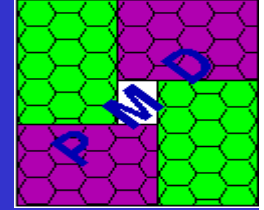- PMD data is not pedestal subtracted
- Needs pedestal subtraction before reconstruction
- There will be a separate pedestal data file
- Extract the mean and rms and put it in OCDB
- Extract the numbers from OCDB and keep it in the memory
- Subtract it channel-wise in every event

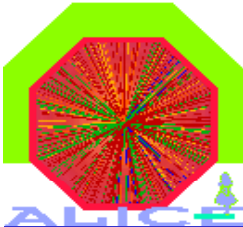We have implemented the pedestal information in AliRoot Framework.
AliPMDPedestal.cxx and AliPMDPedestal.h in cvs.
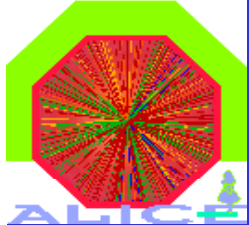
Reconstruction
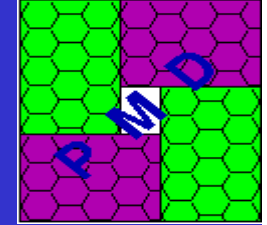
- For PMD, reconstruction is simply doing the clustering on both planes

- Matching the CPV-PRE shower plane information, clusters are identified as hadrons or photons based on edep and number of cells hit.

Flow chart of PMD data reconstruction

Hits

↓

SDigits

↓

KeV-ADC Conversion From Test Beam

→

Digits

↓

Hardware Mapping information

→

RAW DATA

→

Gain Calibration

→

Reconstruction/Clustering

↓

Alignment

↓

Track/Cluster Matching

↓

ESD
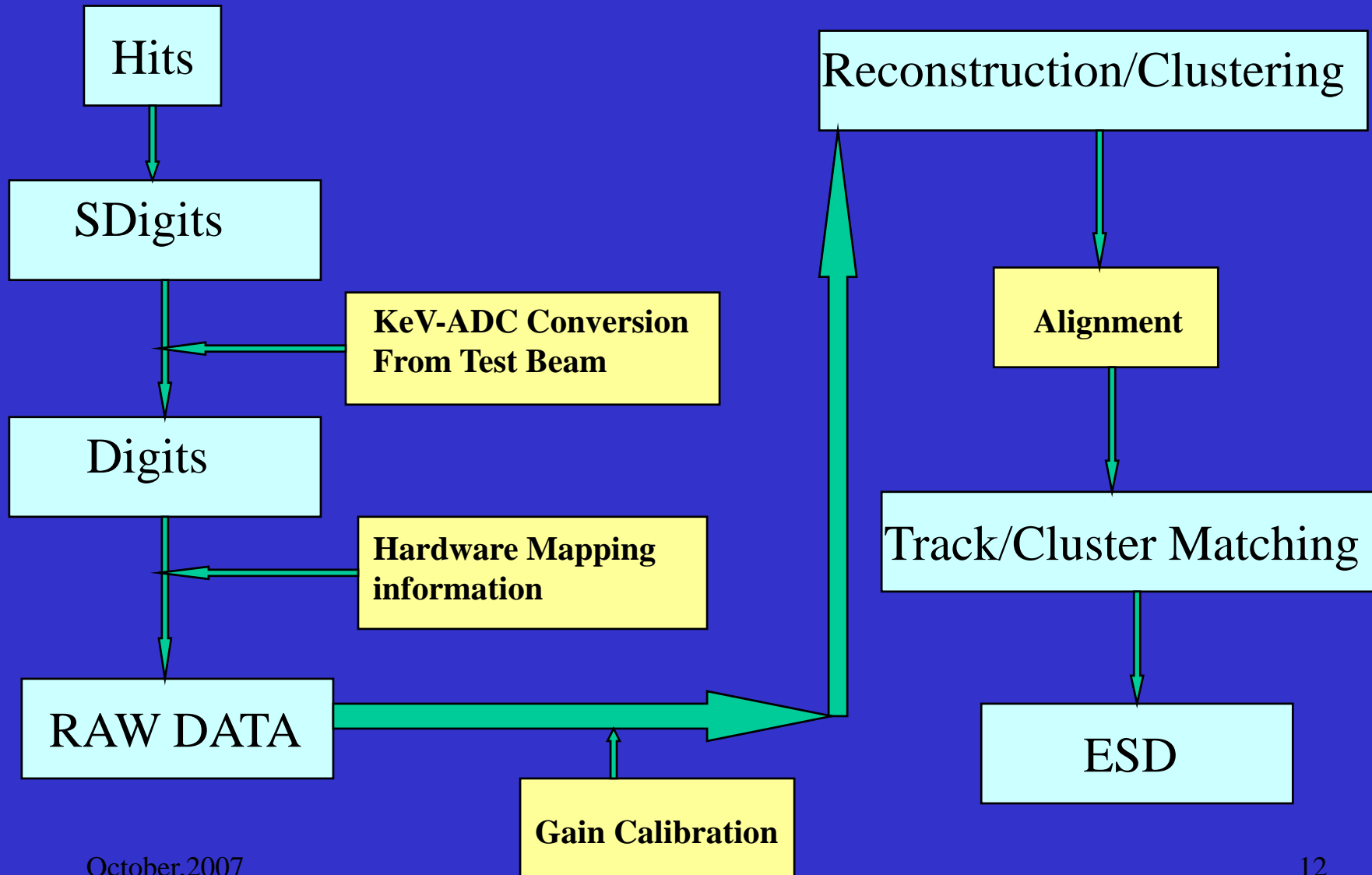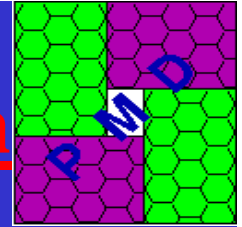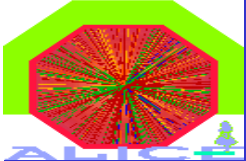
Reconstruction/Clustering

- Clustering done module by module

- First all connected cells are grouped

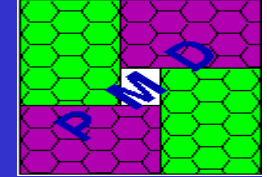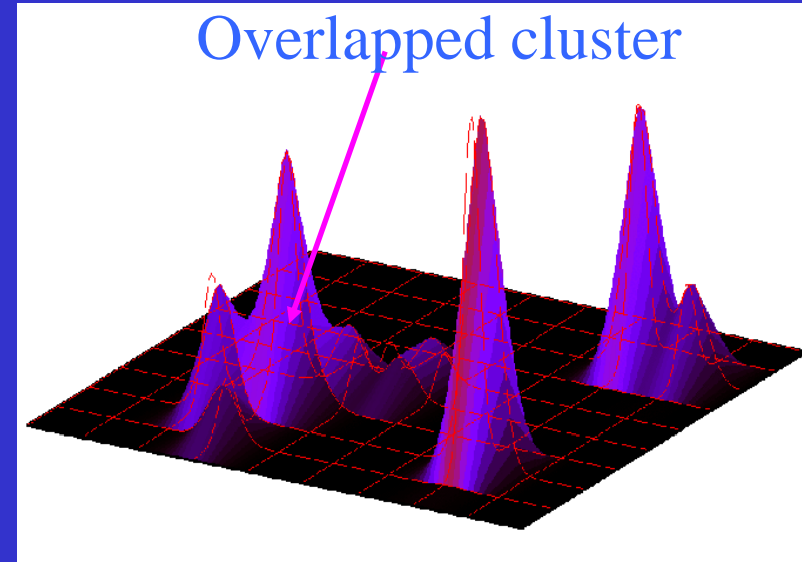- Gaussian unfolding is used to find out the Edep and No. of cells for overlapping clusters
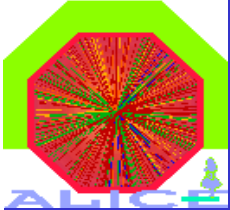
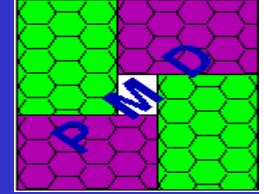

Overlapped cluster

AliPMDClustering   : base class
AliPMDClusteringV1 All codes in CVS.
AliPMDClusteringV2
Recently we found that the clustering code is crashing for hijing central events. We have fixed the bug .

Discrimination/Cluster Matching

- Clusters of CPV plane and PRE shower plane are matched
- PID is assigned depending on this and a threshold on energy deposition.
- After assigning the PID, variables are stored in the ESD for physics analysis
- Out of these clusters, a set of clusters are identified as Gamma-like clusters
- For these samples efficiency and purity to be determined

AliPMDDiscrimination   : base class
AliPMDEmpDiscrimination : takes care of the cluster matching
Codes in CVS
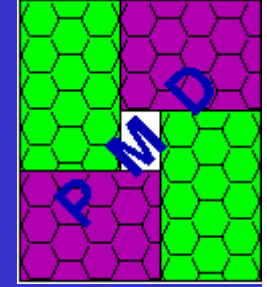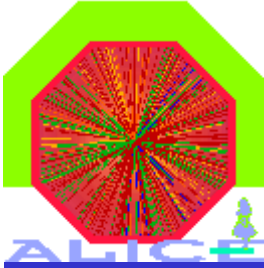
ESD/QA

ESD

- Following variables are being stored for Physics Analysis
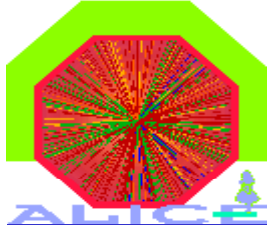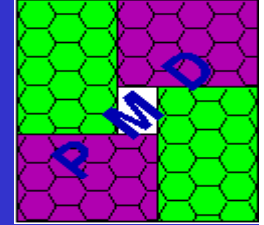   - Detector plane (PRE:0, CPV:1)
    - Cluster X
    - Cluster Y
    - Cluster Z (without vertex correction)
    - Cluster ADC
    - Number of cells in a cluster
    - Cluster PID

AliESDPMDTrack : code in CVS

AOD information will be added soon.
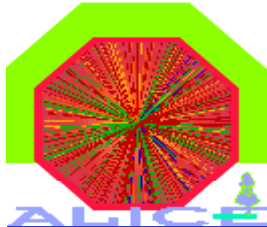
ESD/Quality Assurance

PMD QA codes are in CVS.

Further work:

Comparing the produced histograms with the standard histograms.

Write into a log file.

Hope to finish by November, 2007

Digits
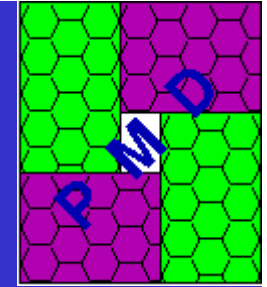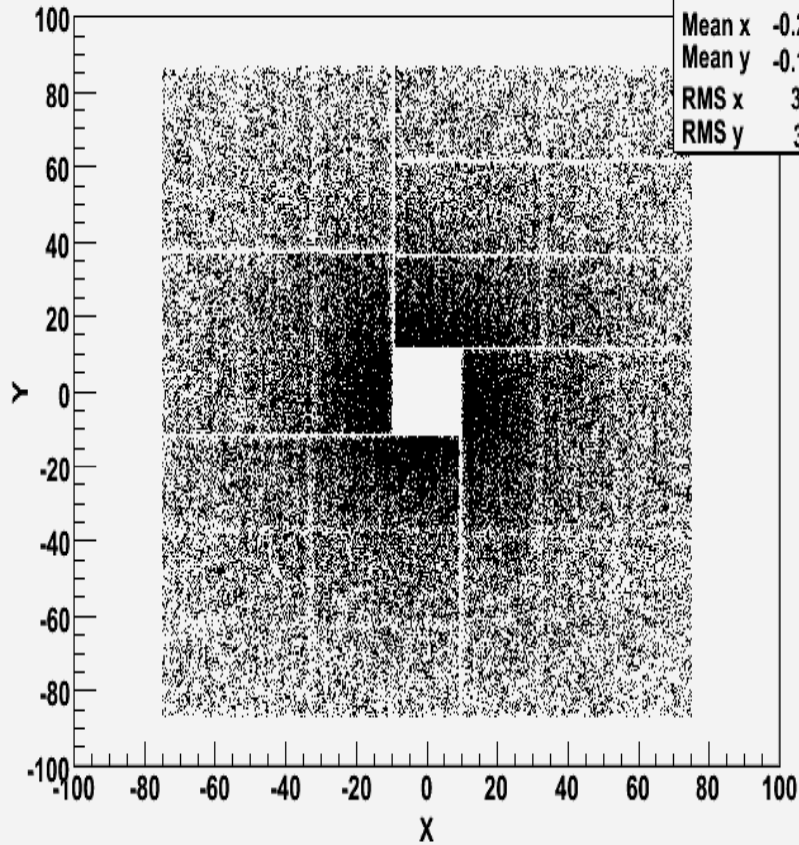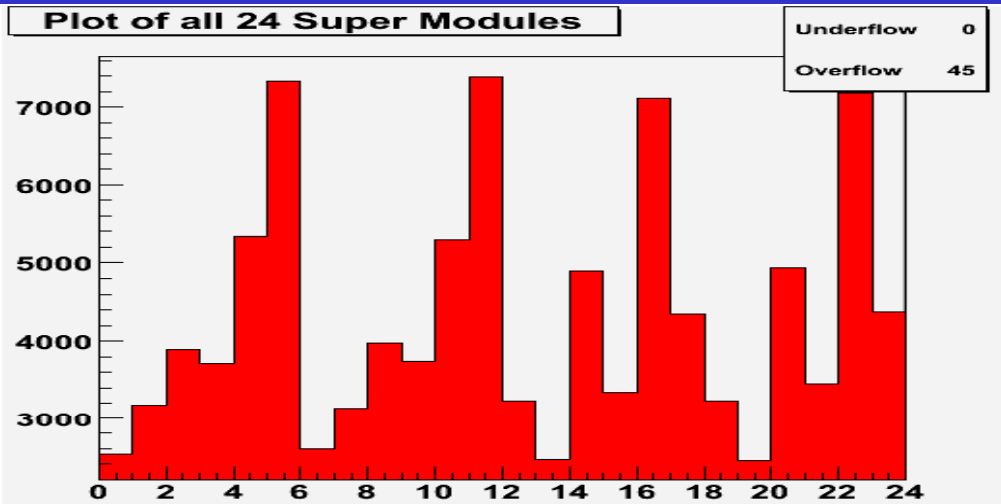
ESD
X-Y position of clusters in pre-shower plane

	h2	
Entries	98806	
Mean x	-0.2789	
Mean y	-0.1356	
RMS x	35.45	
RMS y	39.01	

Y vs. X

PRE Cluster XY

0	0	0
0	5048	0
0	0	0

Cluster Y

Cluster X

Plot of all 24 Super Modules

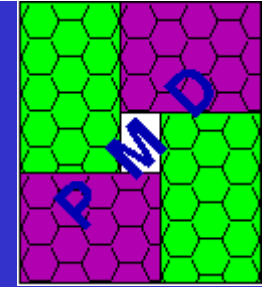| Underflow	0
Overflow	45

X-Y position of hits in CPV plane

October,2007
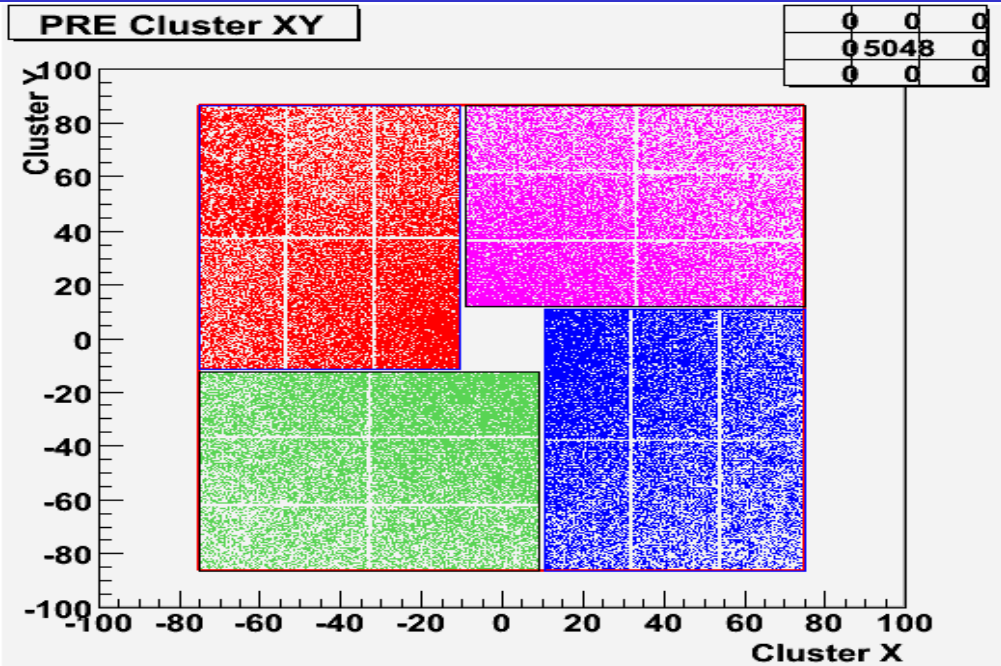
Module wise cluster distribution
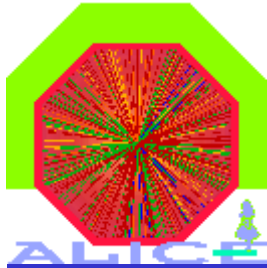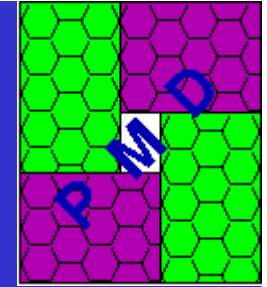
Calibration

Variables needed for calibration:

MEAN, MPV of isolated cell spectra

Each cell will have a gain factor

These gain factors would be for
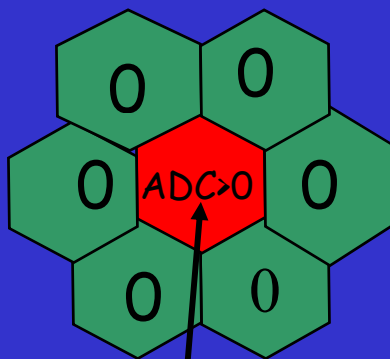a period of runs depending upon statistics

Calibration

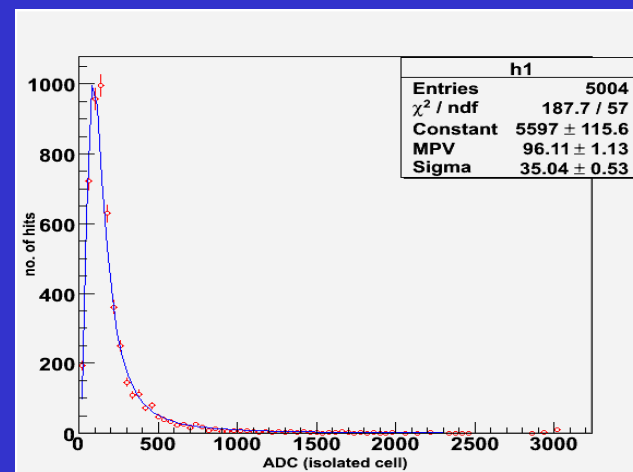Response of each cell be uniform through out the detector.

From test beam result we know that charged hadrons typically hit single cell while photons hit more than one cell.

We look for hit cell whose surrounding six neighbors are not hit. These isolated cells are assumed to be hadrons.
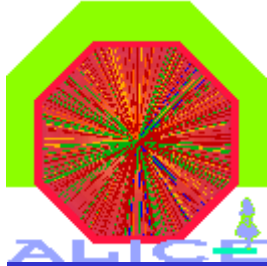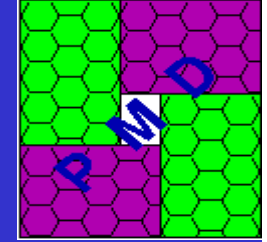

isolated cell

Typical spectra

October,2007

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Calibration Status(Offline):

Calibration Class: AliPMDCalibrator

Calibration Object: AliPMDCalibData

Data member: GainFact[Int_t][Int_t][Int_t][Int_t]

All codes are   committed in CVS.

De-calibration and calibration tests with dummy gain factors done
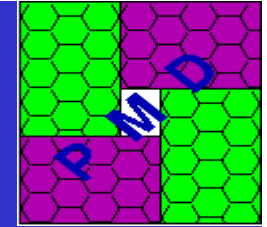- Also tested with simulated data.

Calibration algorithm includes isolated cell search method.
- Cell-to-cell normalisation factors exits(in CVS)
- Module-module nomalisation factors included
- Cleanup for hot cell included in calib. algorithm
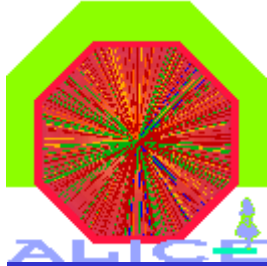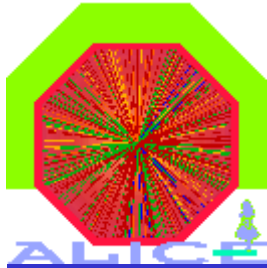
Status (online):

PreProcessor for SHUTTLE

AliPMDPreprocessor.cxx and AliPMDPreprocessor.h
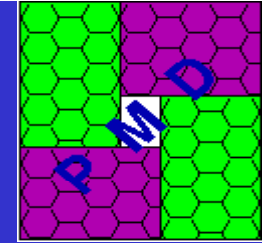
Pedestal information included.

Codes are written, Checked using dummy gain files(in CVS)
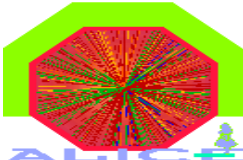
Codes are in CVS

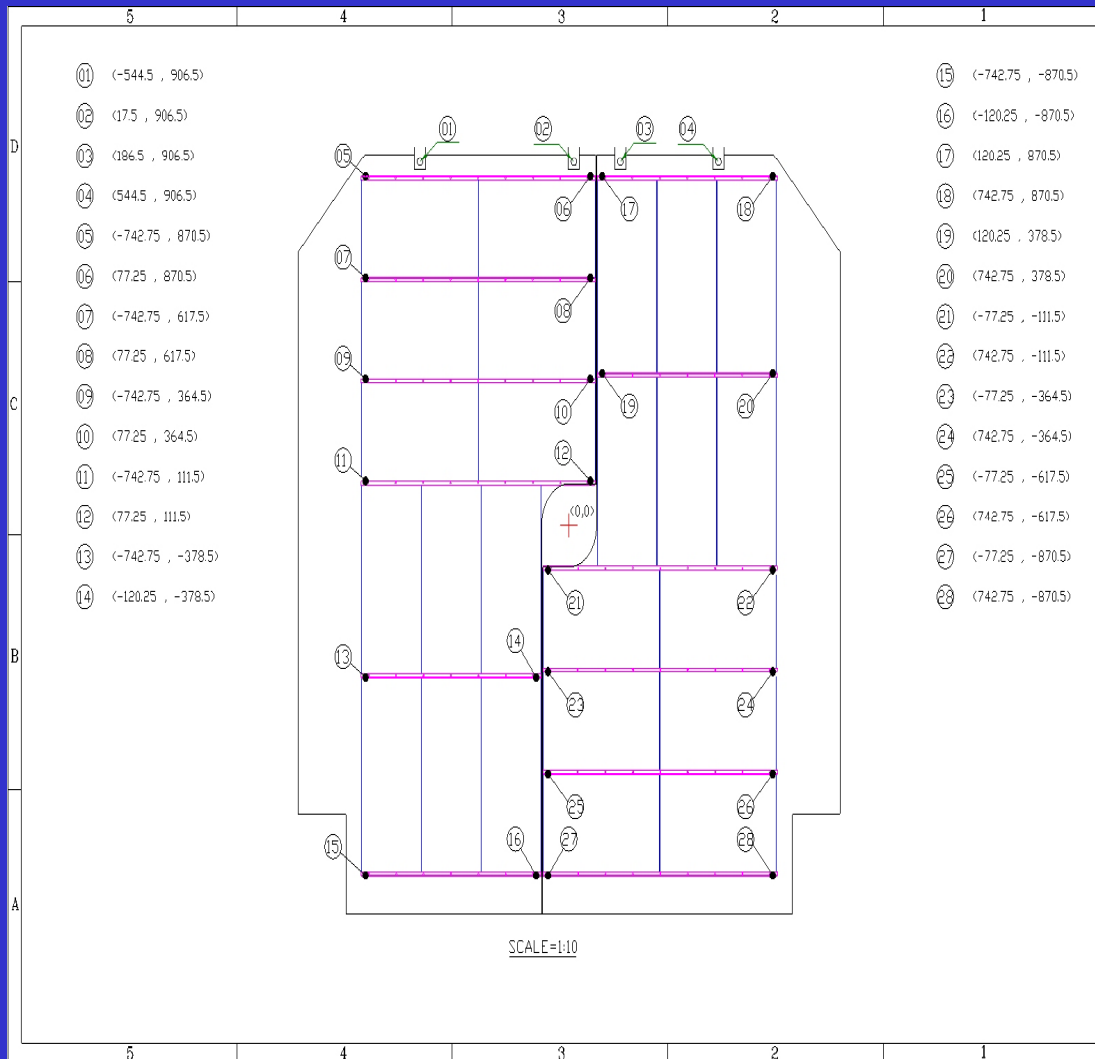DA: 1st version in CVS. Further work in progress (October End)

Alignment Database

✓ Each plane has 24 modules which will be mounted separately on steel plates.The precision of distances between modules mounted on the steel plates is well controlled .

✓ Align-able parts of the PMD are
(i) steel plates
(ii) distance between the two planes
(iii) Cells of two planes

Possible survey points for PMD co-ordinates and alignment

Some alignment possible by adjusting the align-able screws

Planarity problems and shift in steel frame in one direction possible.

Alignment :(Chitrasen Jena)

➢ To regenerate the whole geometry after some misalignment we need to calculate six delta transformations [three orthogonal shifts (dx , dy & dz) and three Euler angles (θ , ϕ & ψ)] .

➢Some fiducial marks on the detector to be surveyed only after the final installation. That will give us coordinates of misaligned   positions in global reference system.
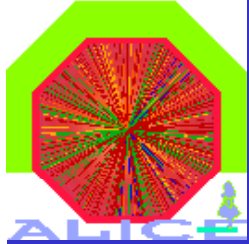
Transformation Matrix

$$L=\begin{vmatrix} r11 & r12 & r13 & tx \\ r21 & r22 & r23 & ty \\ r31 & r32 & r33 & tz \\ 0 & 0 & 0 & 1 \end{vmatrix}$$
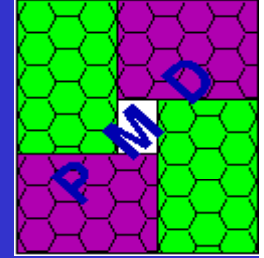
$$L=\begin{vmatrix} AB(0) & BC(0) & N(0) & O(0) \\ AB(1) & BC(1) & N(1) & O(1) \\ AB(2) & BC(2) & N(2) & O(2) \\ 0 & 0 & 0 & 1 \end{vmatrix}$$
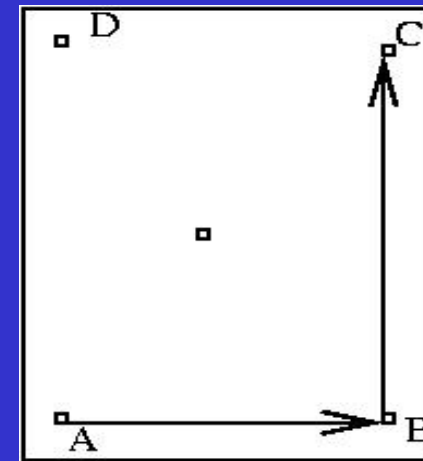
In the Transformation matrix, the elements of rotational part are the components of the normalized vectors AB, BC and N. where vector N is the normal to the plane containing AB and BC.

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Alignment ....

Reconstruction is independent of alignment
Clustering is done locally (row and col independent of alignment)

Need the alignment object at the time of calculating global x,y,z
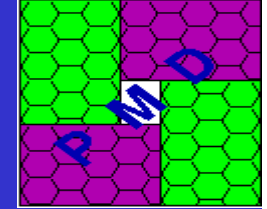
Need to be applied before writing the cluster in ESD.
Macro to generate the Alignment object exists
Macro to generate the misalignment from the survey data is developed. Some work ongoing for inclusion in AliRoot framework.
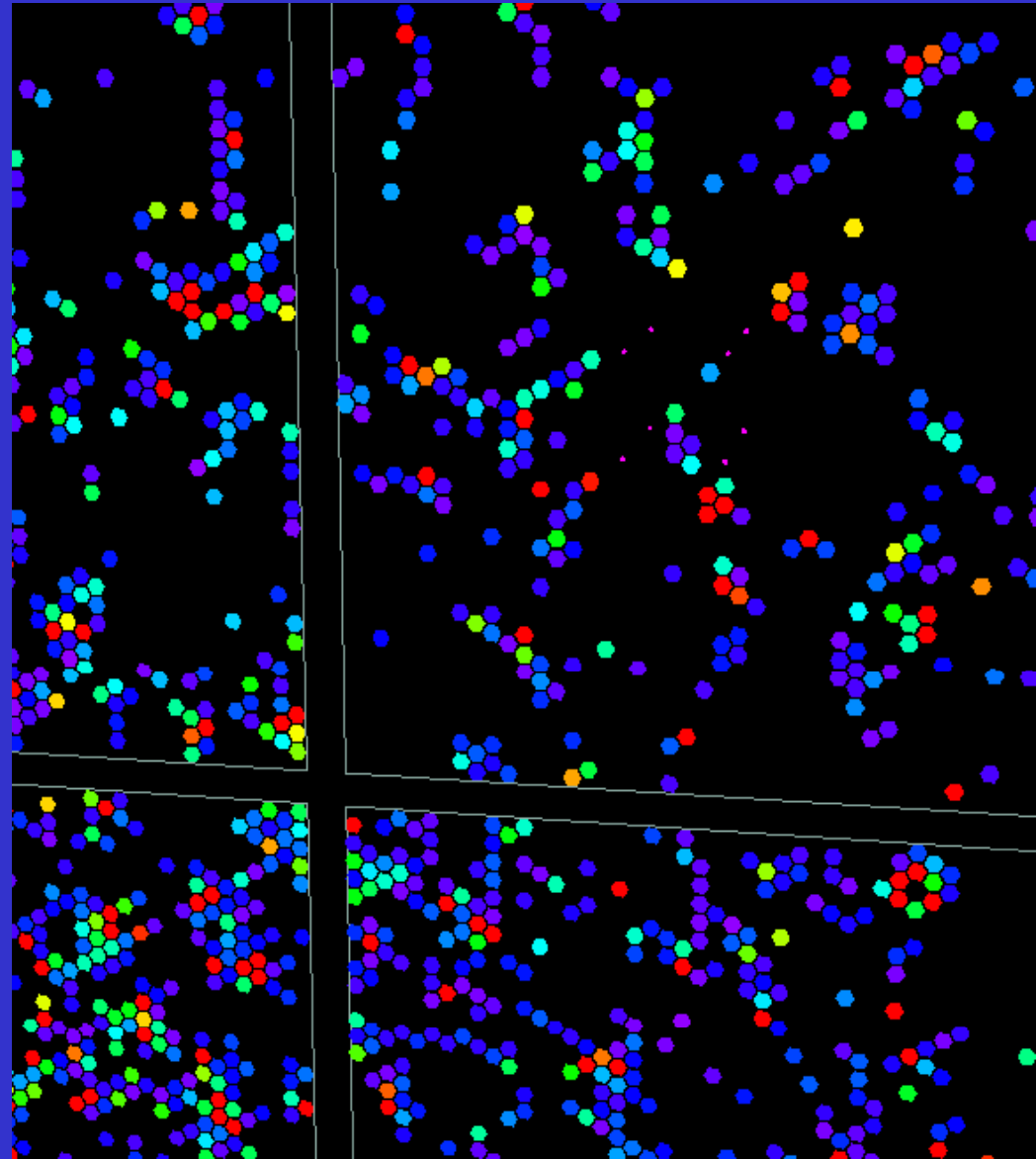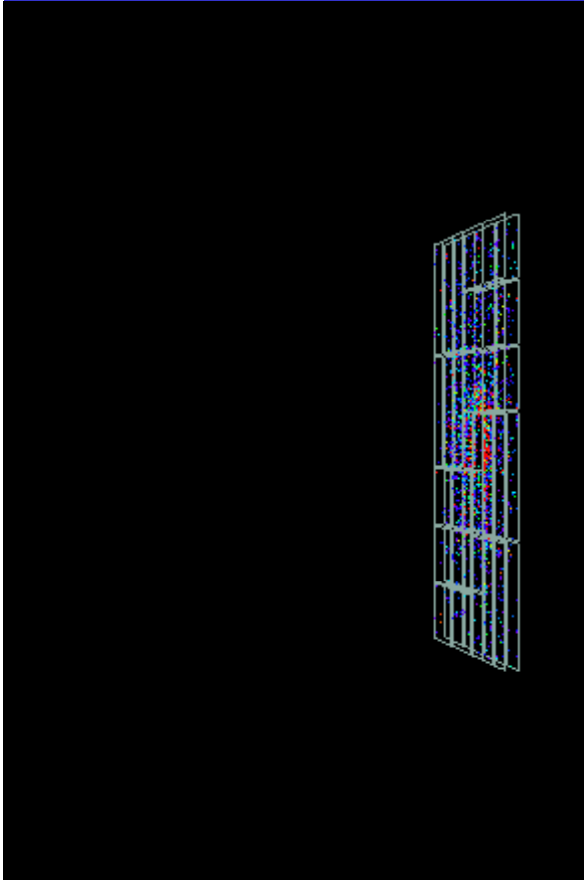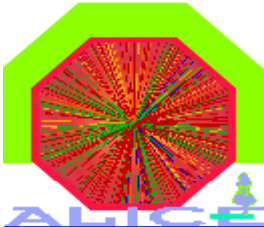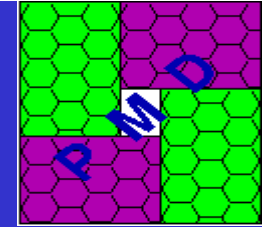
Time line to complete – End of October.
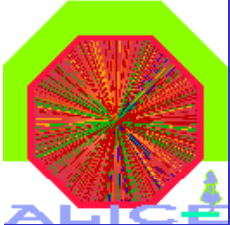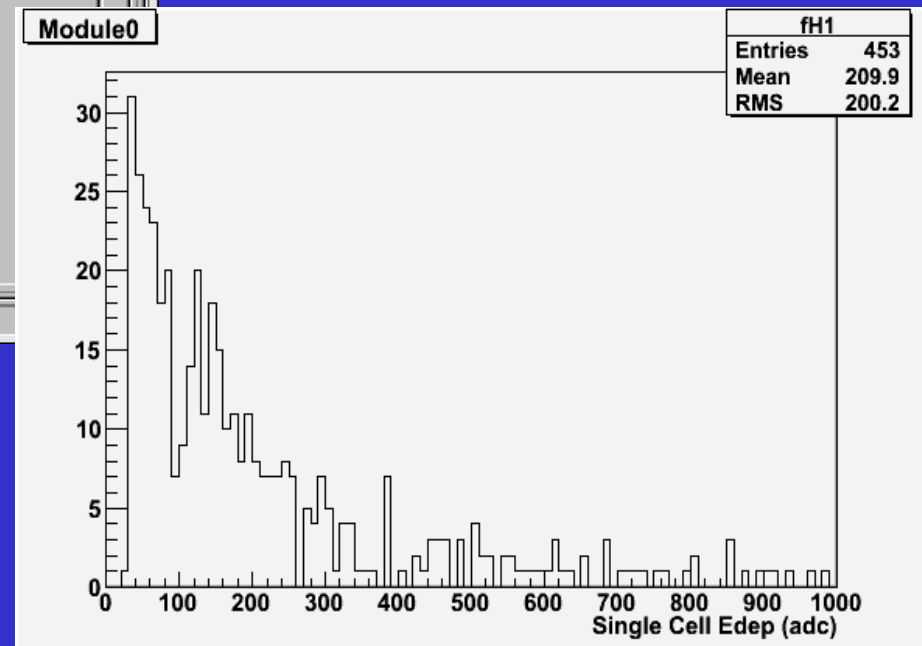
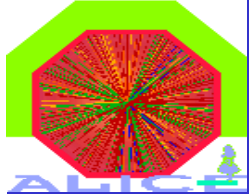# Visualization

Event Display

October,2007

Visualization

Implemented reading digits as well as raw data

Codes in CVS

October, 2007

Documentation

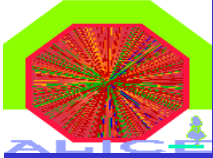Present documentation available at:

http://www.veccal.ernet.in/~pmd/ALICE/software.html
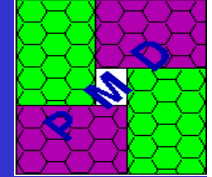
The page is updated regularly.

Summary

- We have added electronics to the Geant.
- Geometry code is written in CVS.
    Cables and Support structure would be added.
- We have estimated the no. of DDL required.
- Clustering/Reconstruction codes in CVS.
- Variables to be stored in ESD is finalised (Code in CVS).
- Coding for Calibration Database (Offline) is done
        tested with dummy gain factors
        tested with simulated data
        code (in CVS).
- Preprocessor ready and tested (in CVS)
- DAQ DA in CVS. I
- Macro for Alignment Database in CVS. Another macro to convert survey
     data points into alignment object is complete and under testing.
- Event display codes in CVS
- Documentation page exists.