

# The Photon Multiplicity Detector

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(for the STAR-PMD  
group)

## Outline of the talk:

- Motivation
- Principle of Photon Counting
- Results from Test beam
- Design and fabrication
- Front End Electronics and Testing
- Installation
- PMD Data Analysis of RUN-IV
- Summary

**STAR Juniors Meeting: 12 July 2004**

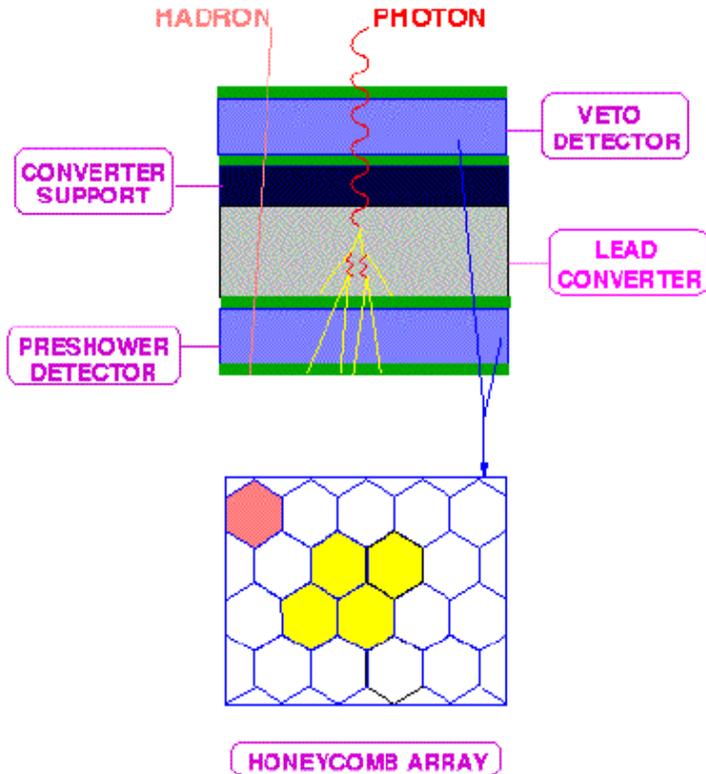
# Study of Multiplicity and Spatial distribution of Photons:

- Study of Photons and Photon multiplicity in relativistic heavy ion collisions is complementary to charged hadron measurements.
- In heavy ion collisions it is important to correlate information obtained from the global observables like ---- charge particle multiplicity, transverse momentum( $p_T$ ) and Transverse Energy ( $E_T$ ).  
**Photon Multiplicity is an additional global observable.**
- Photon Multiplicity provides an extra measure to study the changes in the relative population of the photons and hadrons of the multi-particle final state. This study might indicate the formation of Disoriented Chiral Condensates (DCC).

# Photon Multiplicity Detector in STAR

- ❖ **PMD measures:**
  - Multiplicity of photons in high energy heavy-ion collisions
  - Distribution of photons in eta-phi phase space.
  
- ❖ **Physics Capabilities:**
  - Pseudo-rapidity distribution of photons
  - Multiplicity Fluctuations and Flow.
  
- ✓ This will be studied by the PMD and also in combination with FTPC and other detectors.

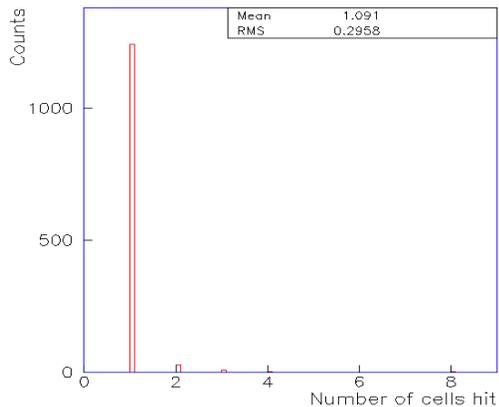
# Principle of photon counting



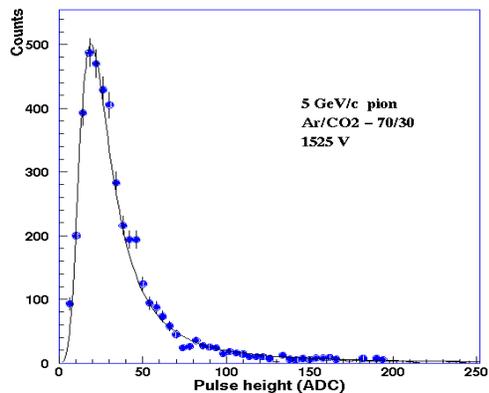
- Hadrons give signal in one cell
- Photons give signal in more than one cell
- Photons can be separated from Hadrons by summing the energies of the connected cells after which a suitable cut is applied on the deposited energy and cluster size

# Results from the tests at test beam facilities, CERN

## Pion beam at 5 GeV/c



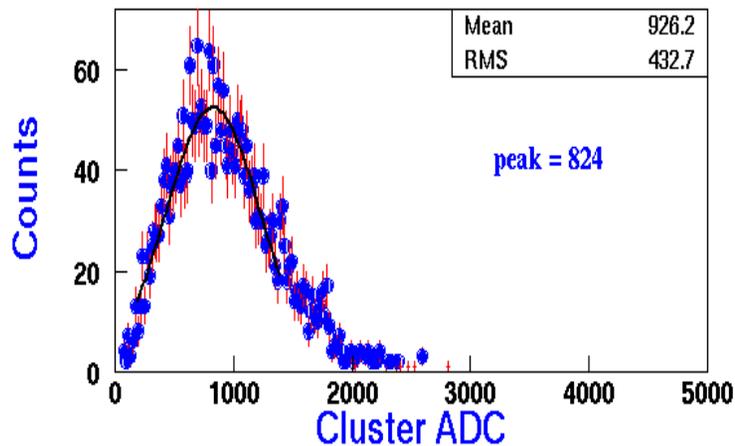
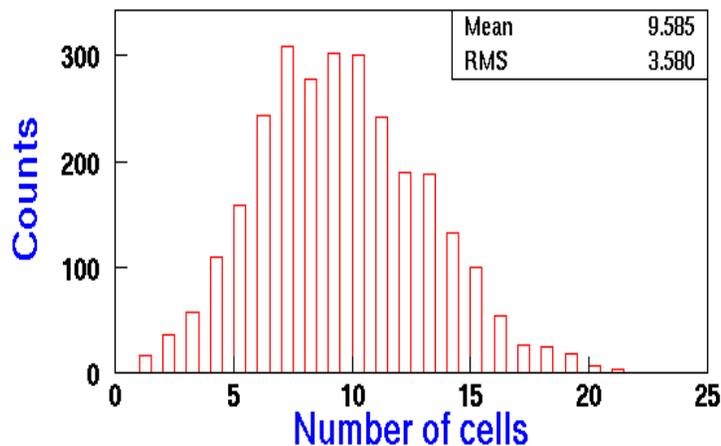
# of cells hit = 1.091



Pulse height spectrum

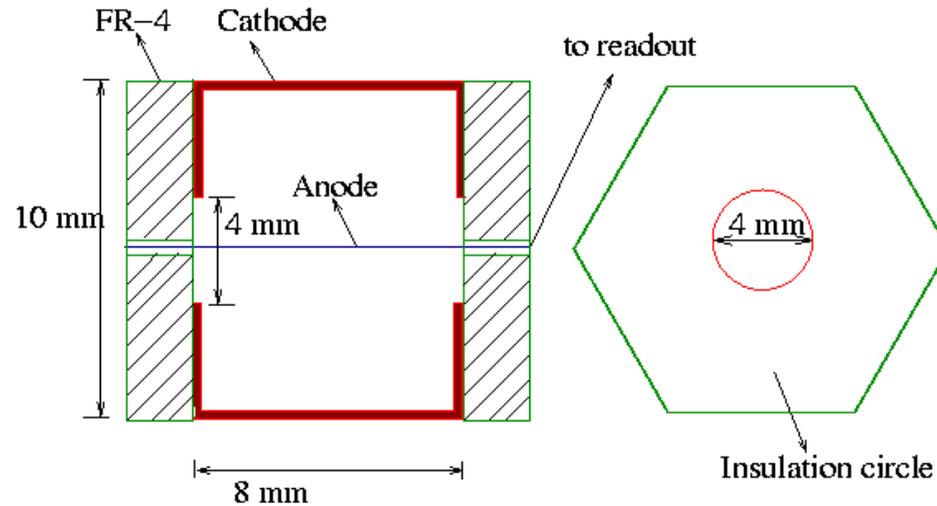
## Electron beam at 4 GeV/c

4GeV e<sup>-</sup>, 3X0 Pb 1525 V



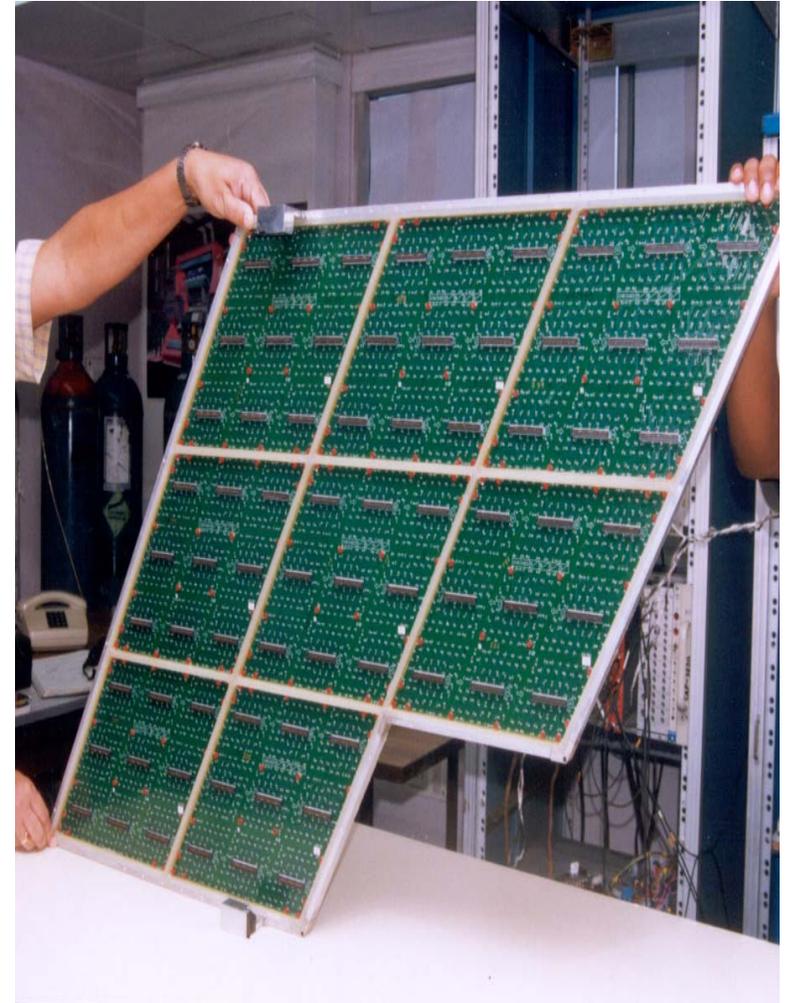
# Design and Fabrication

## UNIT CELL



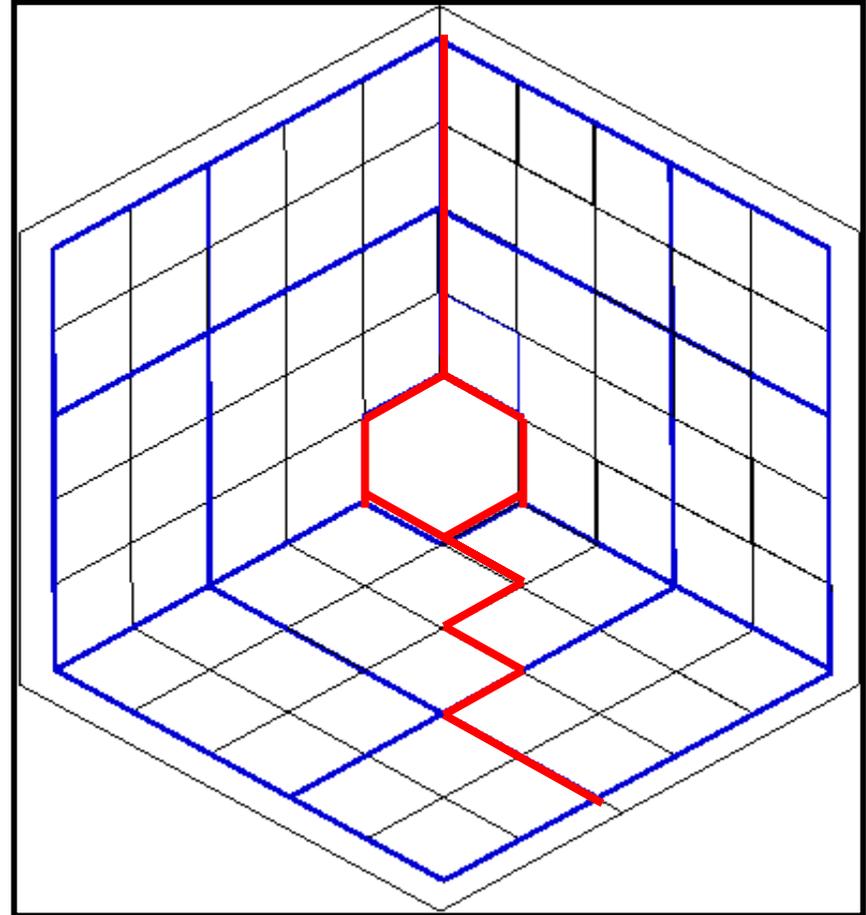
- **Cathode Material: 0.2mm thick copper sheet**
- **Anode wire: 20  $\mu\text{m}$  gold plated Tungsten**
- **Anode wire Tension : 25 grams**
- **End caps: standard 1.6 mm thick FR4 PCB**

- An array of 24x24 cells make an **Unit Module**. Many Unit Modules are integrated together to form a gas tight unit which is called a **Super Module**.
- Super module consists of a FR4 bottom plate and an Aluminum channel boundary wall which also serves as gas inlet/outlet channel.
- Different Super modules have different number of unit modules (4,5,6,8 & 9 ) depending on the position on the detector.
- Each plane has 12 Super modules --→ 72 unit modules in each plane.
- Super modules are HV isolated.



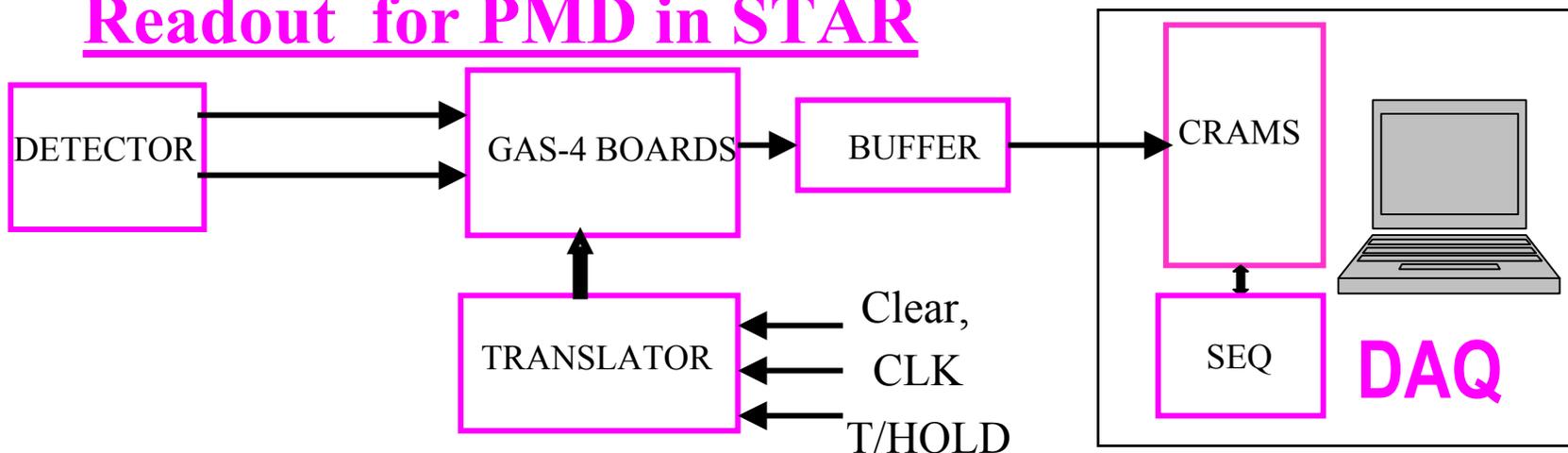
# The Parameters of PMD

- Two planes CPV+Preshower
- Gas detector of hexagonal cells
- Cell cross section :  $1.0 \text{ cm}^2$
- Cell depth :  $0.8 \text{ cm}$
- Gas used: Ar+CO<sub>2</sub> in 70:30
- Total number of cells : 82,944
- Area of the detector :  $4.2 \text{ m}^2$
- Distance from vertex :  $542 \text{ cm}$
- $\eta$  coverage:  $-2.3$  to  $-3.8$  with full  $\Phi$
- Whole detector can be separated in two halves



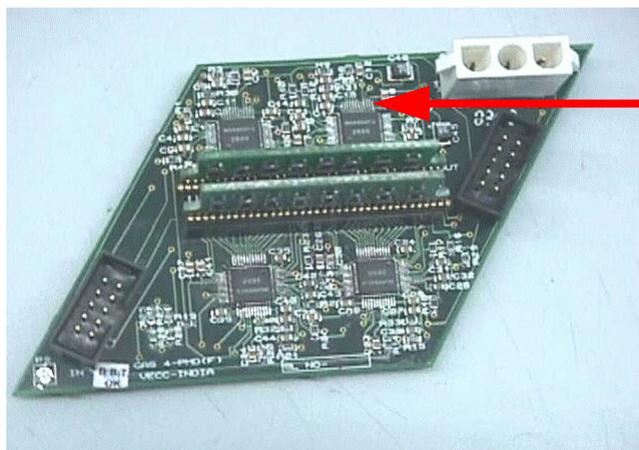
Ref: M.M.Aggarwal et al, Nucl.Instrum. Meth A 499,751(2003)

## Readout for PMD in STAR



Detector signals read by **GASSIPLEX** (16 channels) chips.  
 Entire Readout consists of 48 chains for 82944 cells or channels.

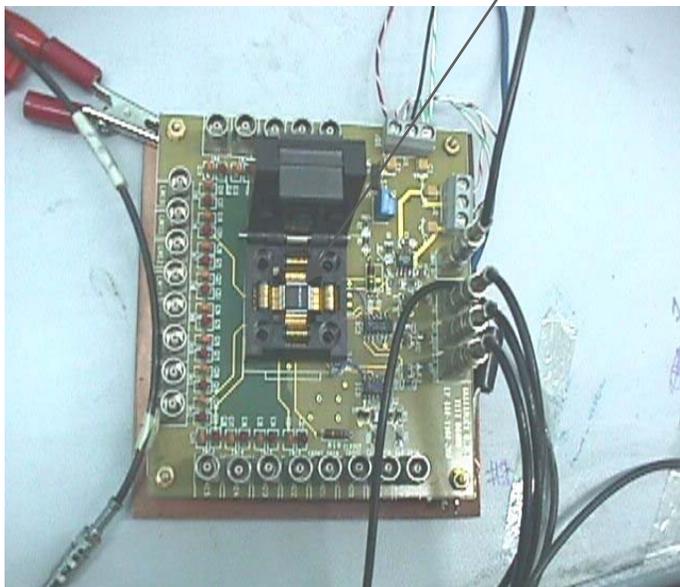
### Front-end Electronics:



The Gas-4 Boards with 4 **Gassiplex** chips  
 for signal processing

# Testing of Gassiplex chips

## Gassiplex chip

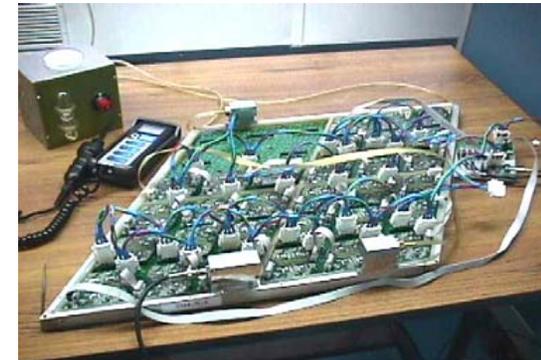
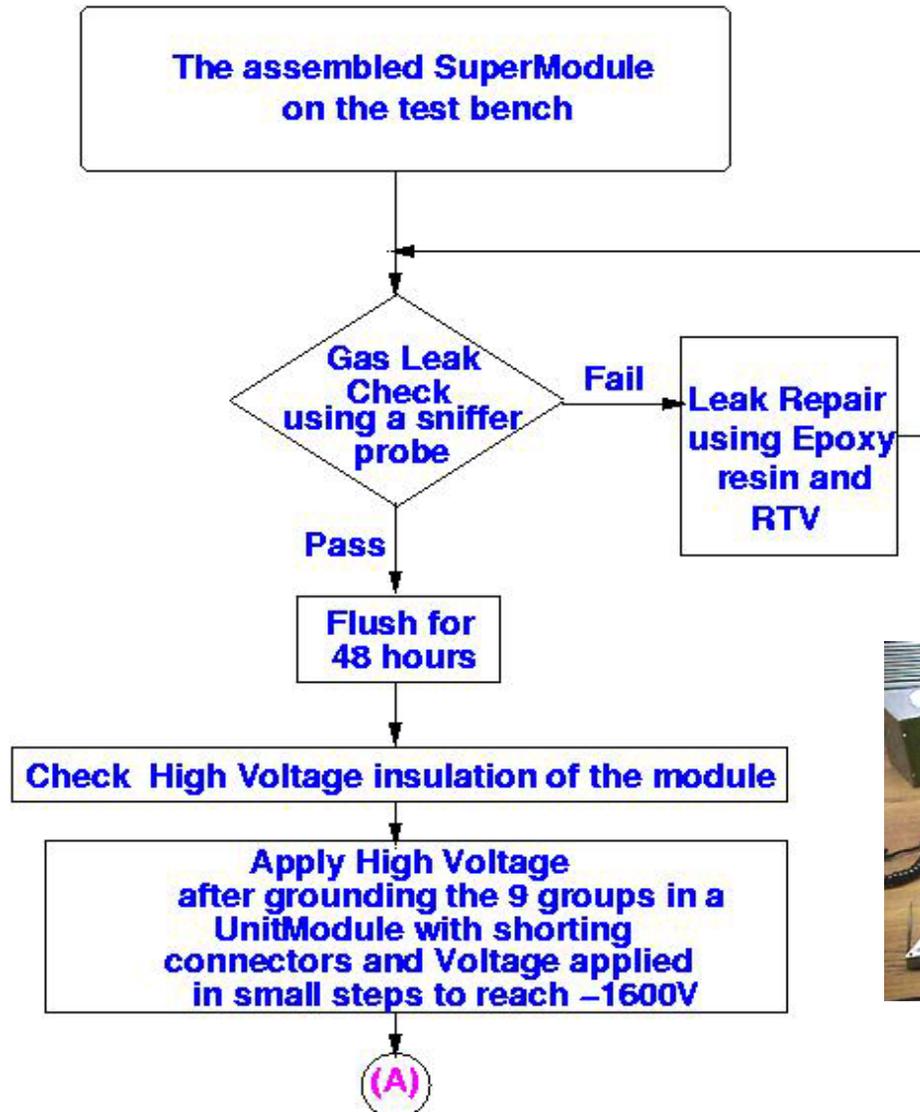


## Test board for GASSIPLEX

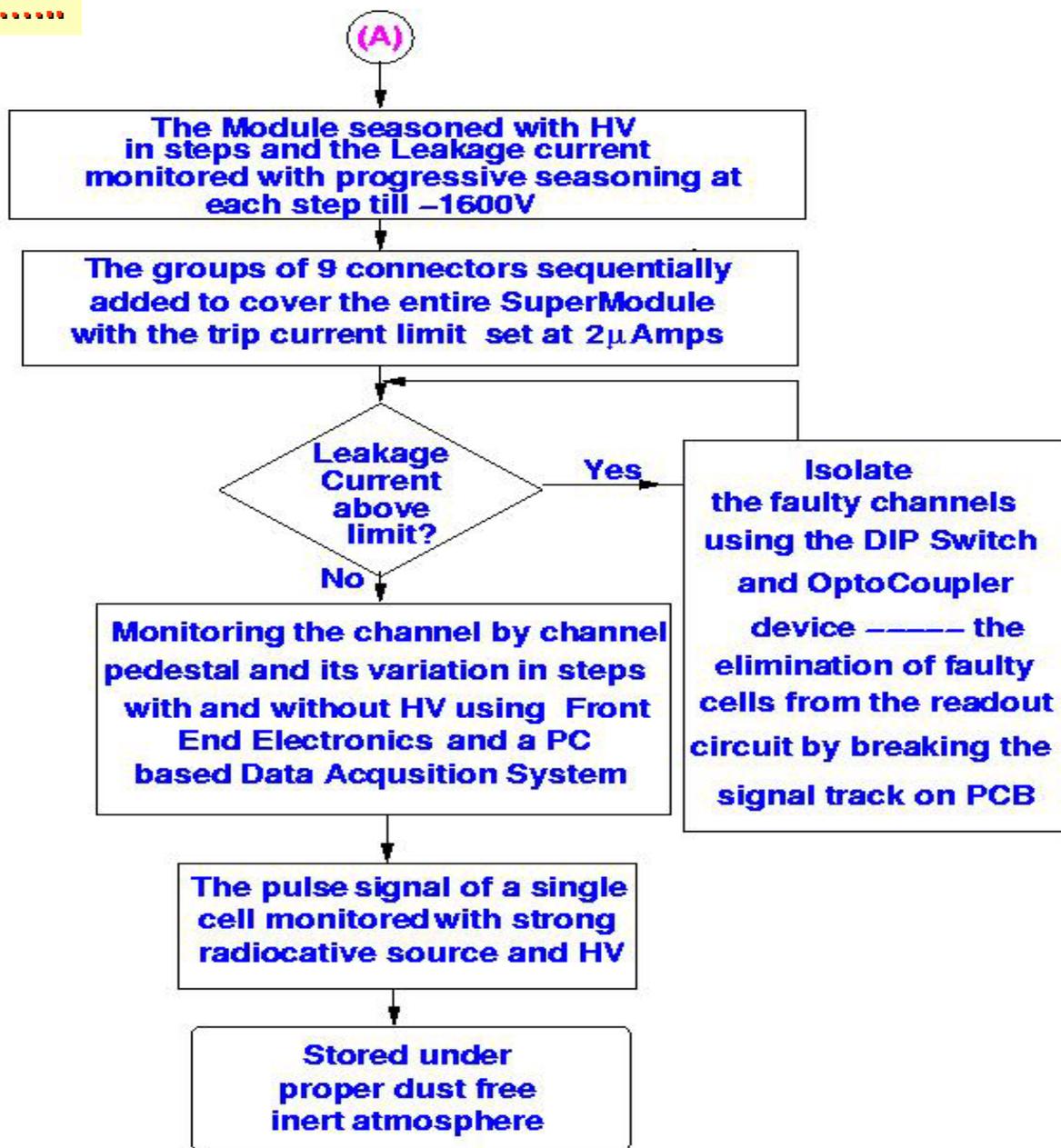
- ❖ 10000 GASSIPLEX chips inspected.
- ❖ Tested manually for
  - Current drawn per chip
  - Functionality of all channels
  - CLK OUT
  - Pedestal Min and Max values
- ❖ Tested with DAQ
  - Pedestal values and RMS

Ref: J.C Santiard, K. Marent for ALICE collaboration, ALICE-PUB-2001-49 version 1.0

# SUPER MODULE TESTING FLOWCHART

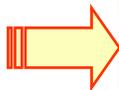


**Ref: Debasish Das et al , DAE Symp on Nuclear Physics 46B, 520(2003)**



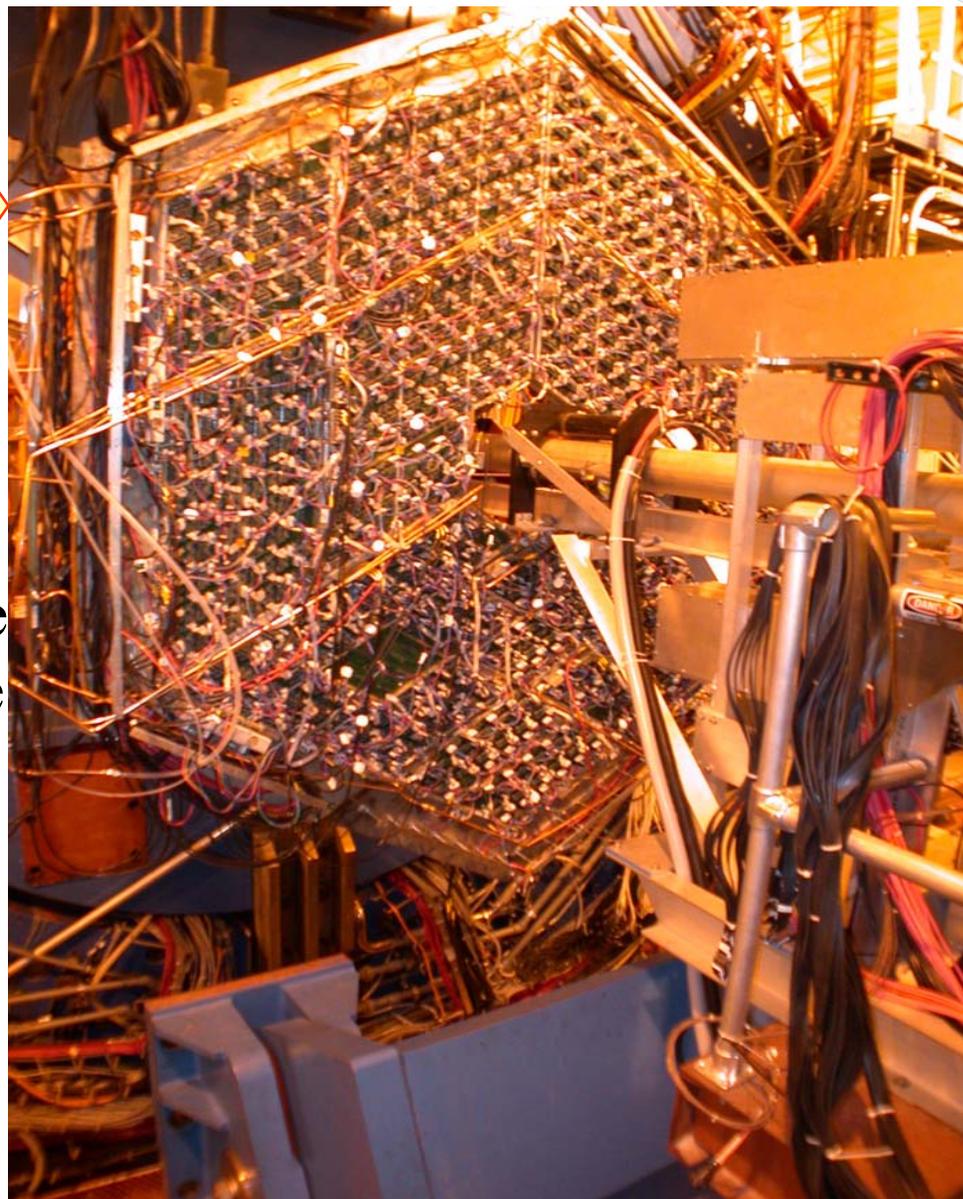
# INSTALLATION

## View of the Pre-Shower Plane of PMD from the tunnel side



## Run-time control

- Slow Control of Low Voltage
- Slow control of High Voltage
- Slow control of all the crates
- Online Monitoring of data
- Panitkin plots
- Periodic checking of gas
- DAQ Monitoring for PMD

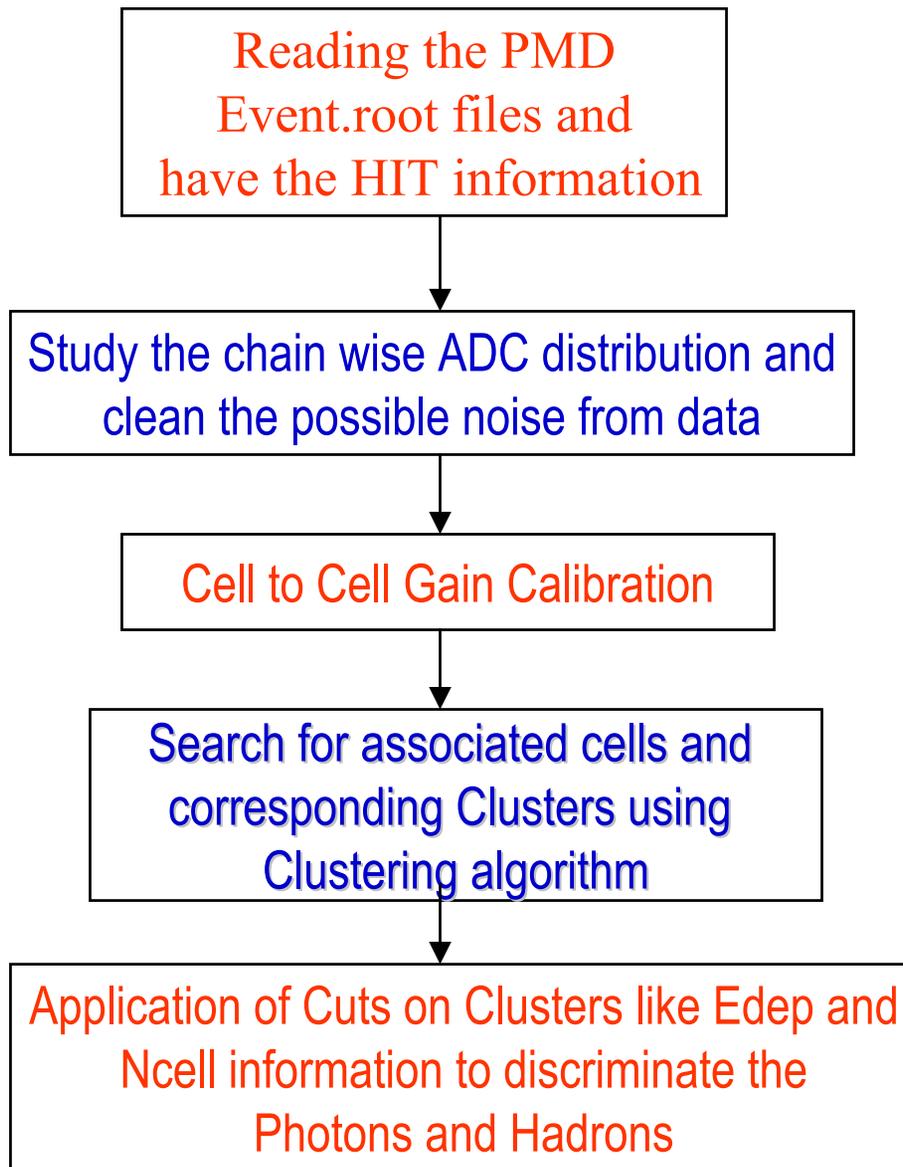


# Run4 Data Taking and Analysis

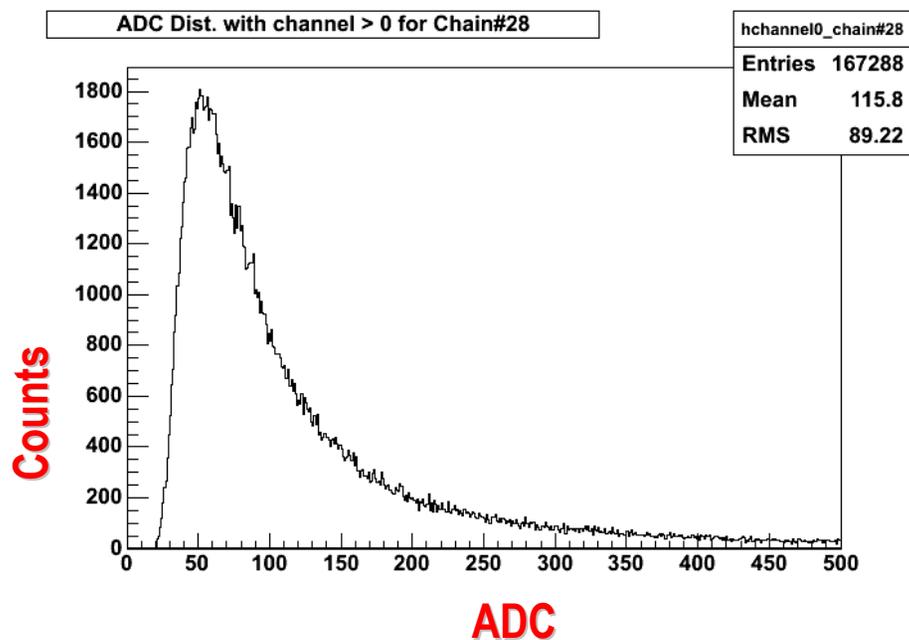
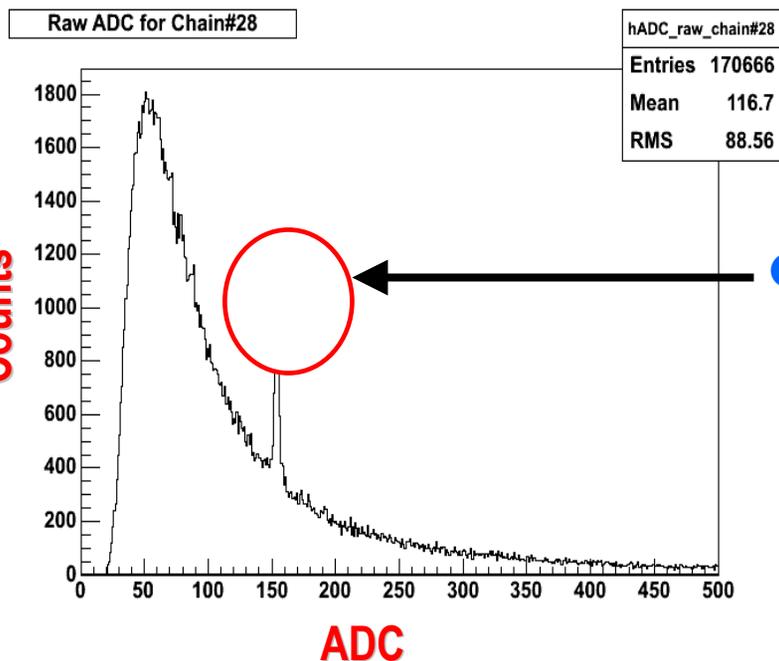
- First time data taking for PMD for both 63 GeV and 200 GeV Au+Au beam.
- Whole of Preshower plane and part of the CPV plane was used in the data taking.
- During Run4 some supermodules and chains had problems. We are now working during the shutdown period to get ready for Run5.

Analysis of the acquired data is being done by my scholar friends and me:

Dipak, Raghu, Supriya, Pawan, Sudhir,  
Monika, Ajay, Sunil, HansRaj, Vikas

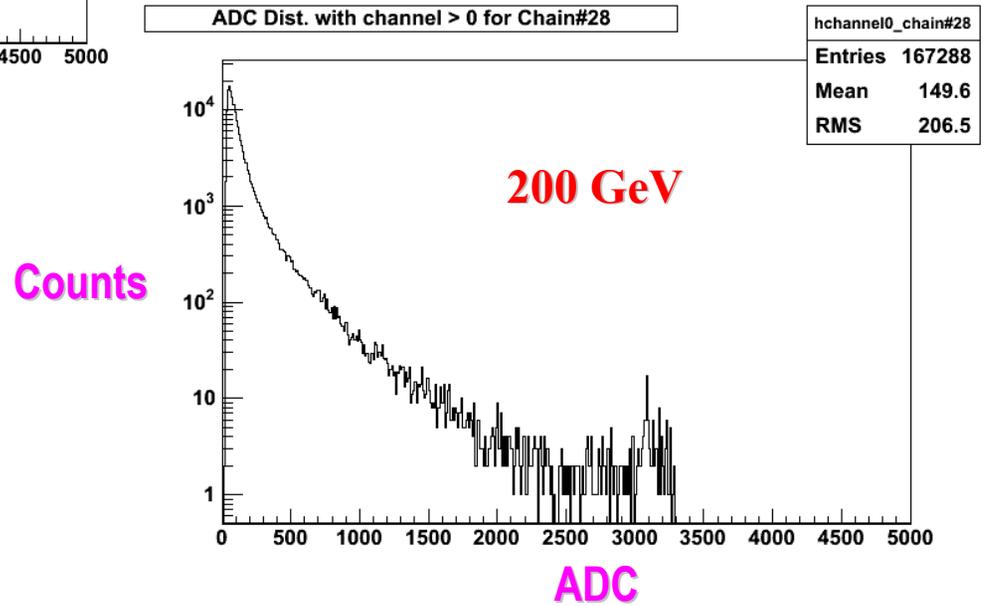
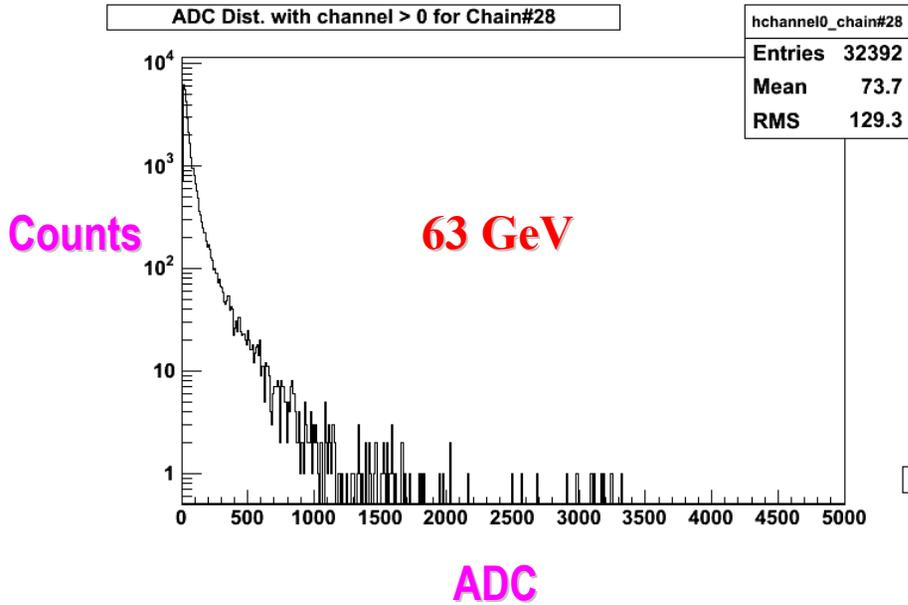


# Understanding of data and possible amendments:



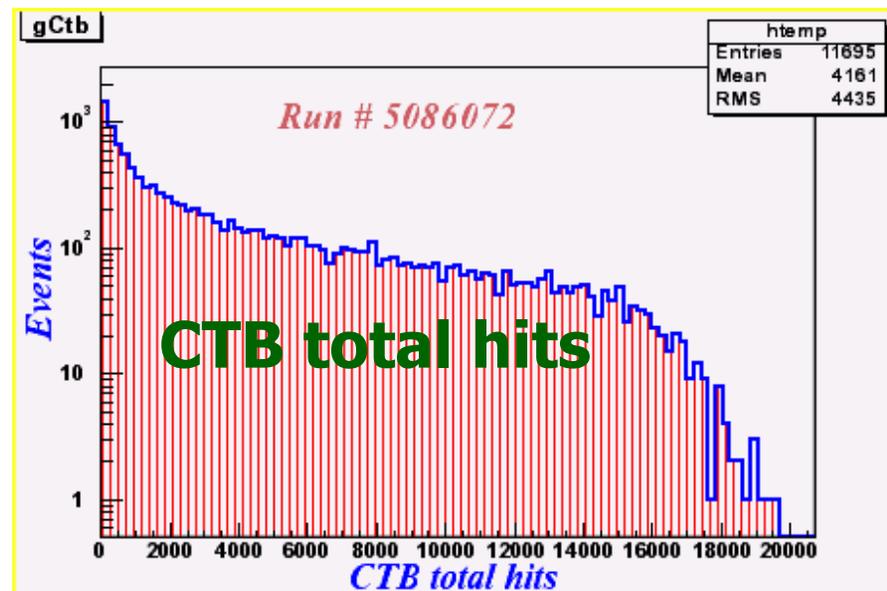
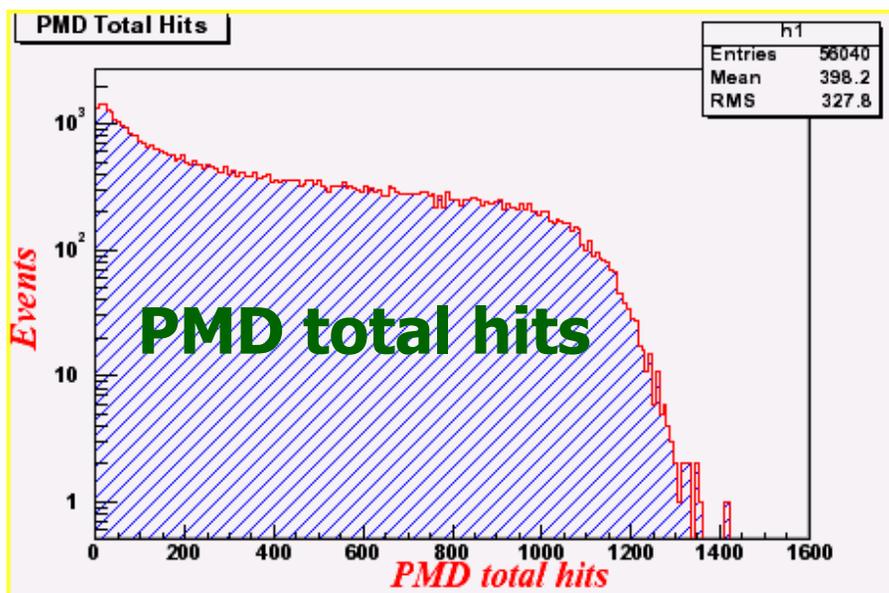
**Channel Zero effect Removed**

# ADC Distributions

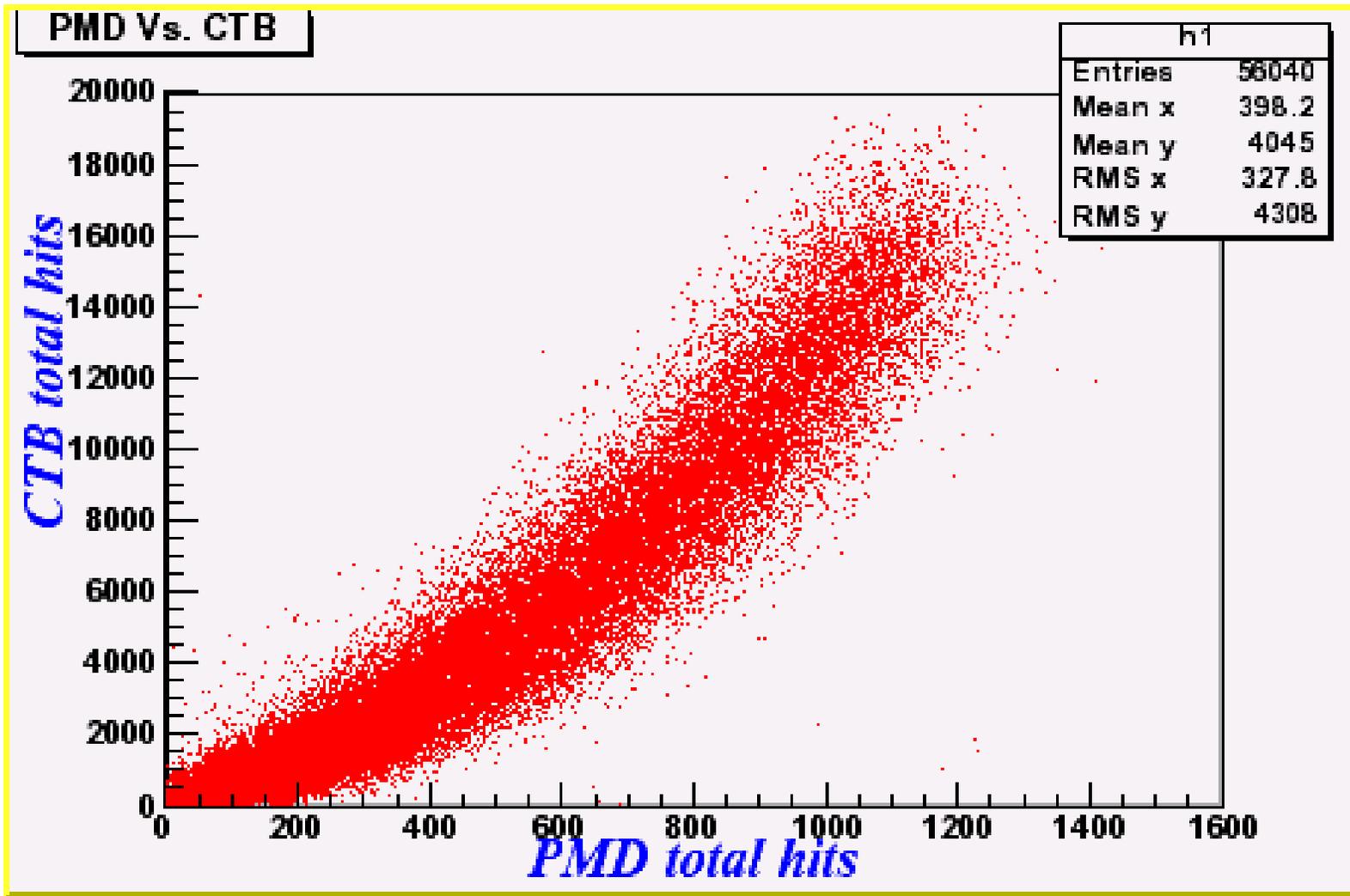


# Preliminary plots of PMD Data In RUN-IV

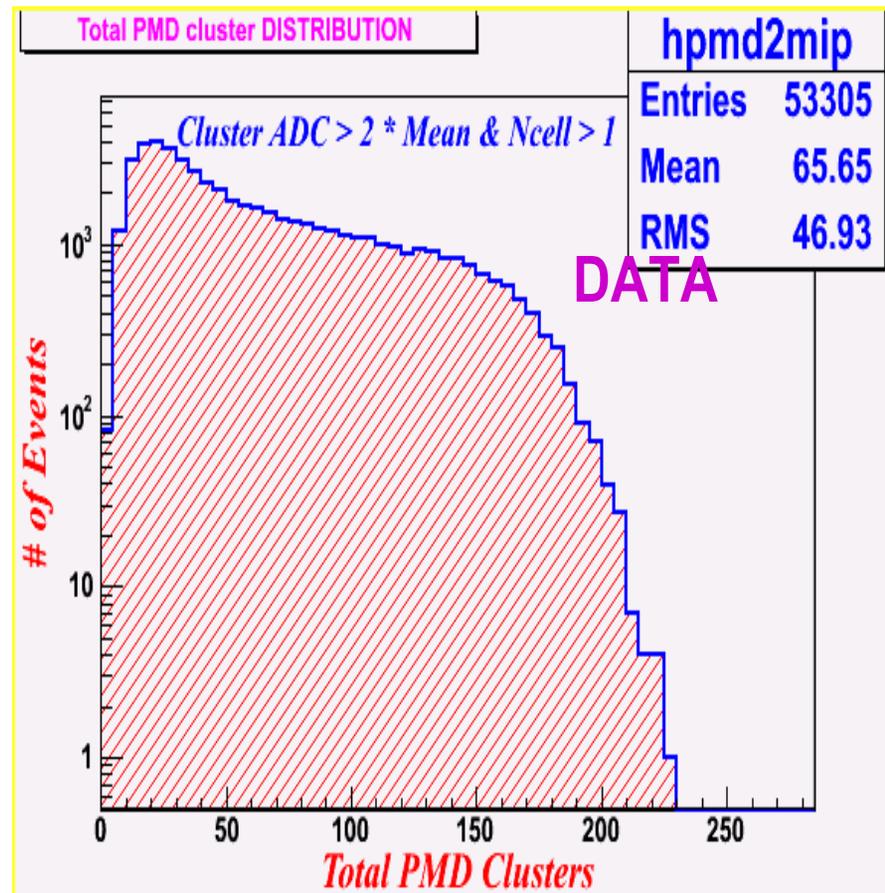
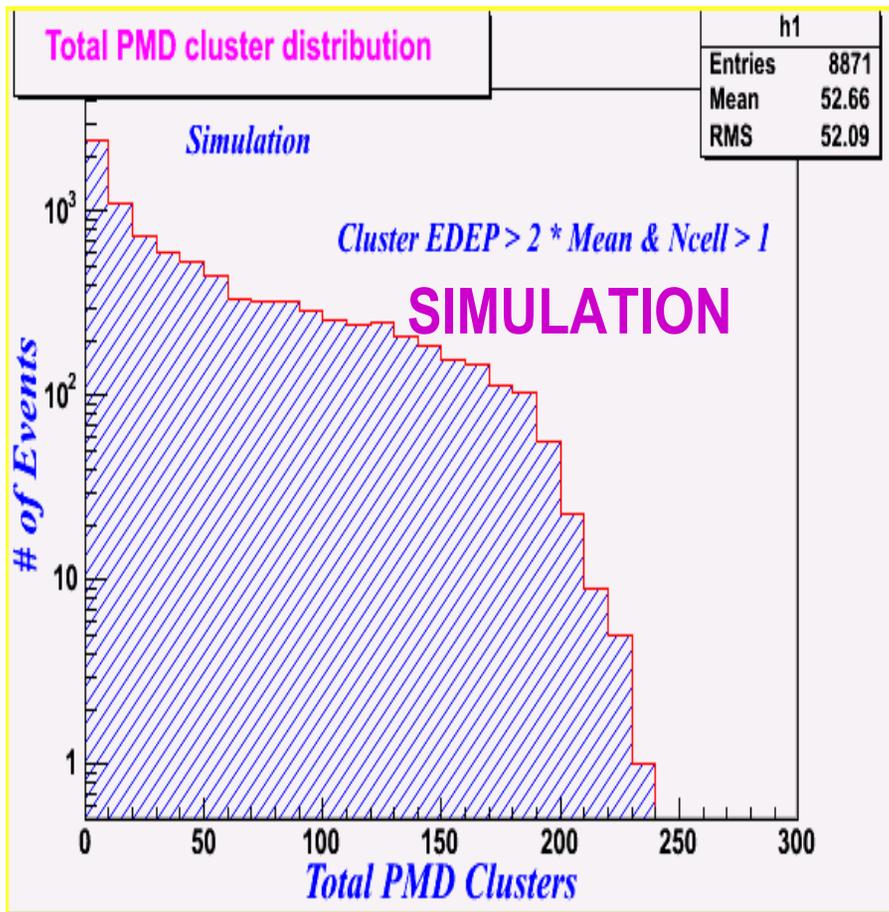
## HIT DISTRIBUTION in 63 GeV DATA Minimum bias trigger



# PMD Hits vs. CTB Hits



# Comparison with simulation: PMD Cluster distribution



- The Photon Multiplicity Detector took data for the first time in RUN4 for both 200 GeV and 63 GeV AuAu beams.
- 22 Supermodules out of 24 were installed. Most of the preshower Plane modules worked quite fine. Only part of the CPV modules Worked during the beamtime.
- 63 GeV data analysis is in full swing. Processing of the 200 GeV .daq files is now going on to prepare for the STAR-wise data production.
- First plots for the pseudo-rapidity distribution will be available within next months..