MTCC Data-Analysis

Analysis of data taken during the MTCC phase 1

25th of July to 28th of August 2006

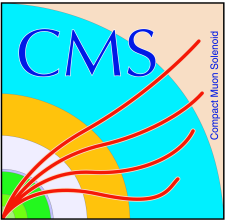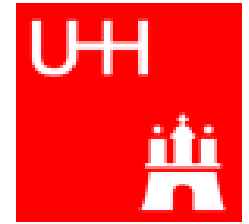Sebastian Fricke University of Hamburg
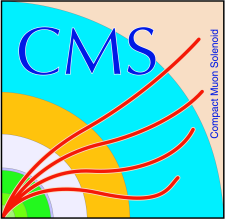
MTCC Data-Analysis

Outline

- MTCC phase 1
- Accessing data
- TEC Performance
- Outlook

MTCC phase 1

- Magnet test goals: Closing yoke for first time, coil commissioning and field mapping

- Therefore loading vac-tank with HCAL-barrel and installation of ECAL-barrel supermodule

- Slice test: Commissioning tests of sections using local trigger and DAQ

- Combined to **M**agnet **T**est and **C**osmic **C**hallenge (MTCC): Running 1/20 of CMS with parts of all detectors (ex. Pixel) with central controls, trigger and readout system
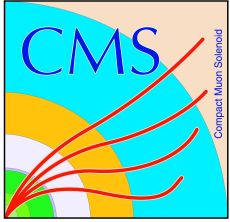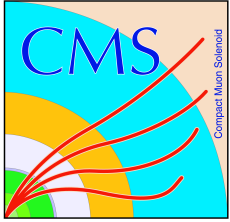
MTCC phase 1

- ## MTCC split into two phases:

  - First phase: Tracker inside coil (25th of July to 28th of August)

B(Tesla)	# events	# filtered evts	# of tracks
0.0	11,443,427	6096	4123
3.8	13,765,676	3661	3335
4.0	1,715,550	459	413

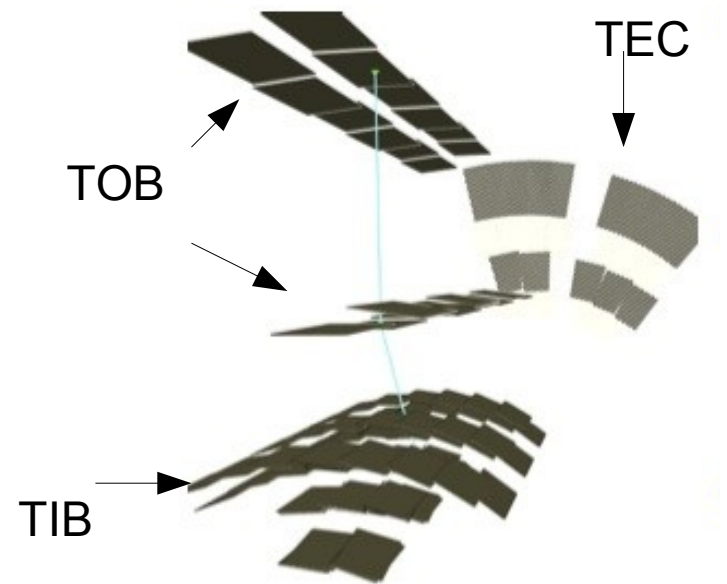Filter: N(hits) ≥ 3 (different layers)

  - Second phase: Magnetic field mapping (tracker is removed and field mapper is inside the coil)

  - Started 2nd of October
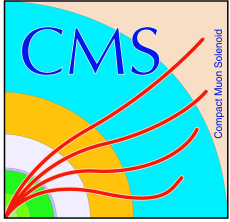
  - Ended 3rd of November

MTCC phase 1

- Tracker-layout during MTCC
- Trigger provided by muon systems: DT, CSC, RPC
- Detectors:
  - TOB: 24 modules, 4 rods
  - TIB: 75 modules (L2 + L3)
  - TEC: 34 modules (2 petals (disk 9, ring 4 to 7))
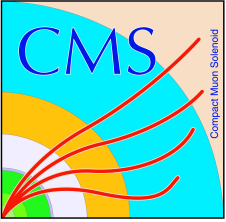

TEC

TOB

TIB

Accessing data

- Use files located at DESY (not reprocessed, need to run the whole RECO-chain)

- Use reprocessed data from FNAL (reconstruction done up to clusters or even up to tracks) $\longrightarrow$ pass 1,2 or 3 available (different clusterizer, tracking algorithms, even alignment....)

- Now it should be possible to process MTCC data via the GRID and CRAB (Carsten Hof)
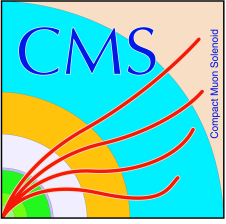
TEC-performance

TEC-Performance during MTCC phase 1

- Teamwork with PhD-student Gordon Kaussen from RWTH Aachen

- TIB and TOB were already covered (see talk by L.Shabalina from 3rd of November, CPT-MTCC)

- We decided to contribute by having a close look at TEC-performance during MTCC phase 1

- We cannot use the reprocessed data from FNAL to study TEC-performance because:

1.) in full reco there is a huge bias due to requirement of 3 hits in 3 different layers $\longrightarrow$ nearly no remaining hits in TEC

TEC-performance contd.

2.) in cluster reco all events are stored without any filter ➤ files are very big and analyzing takes a lot of time
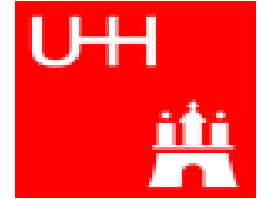
Proposal:

Reprocess data at FNAL with a special TEC filter that requires at least one hit in TEC without any additional cut ➤ special data stream for TEC
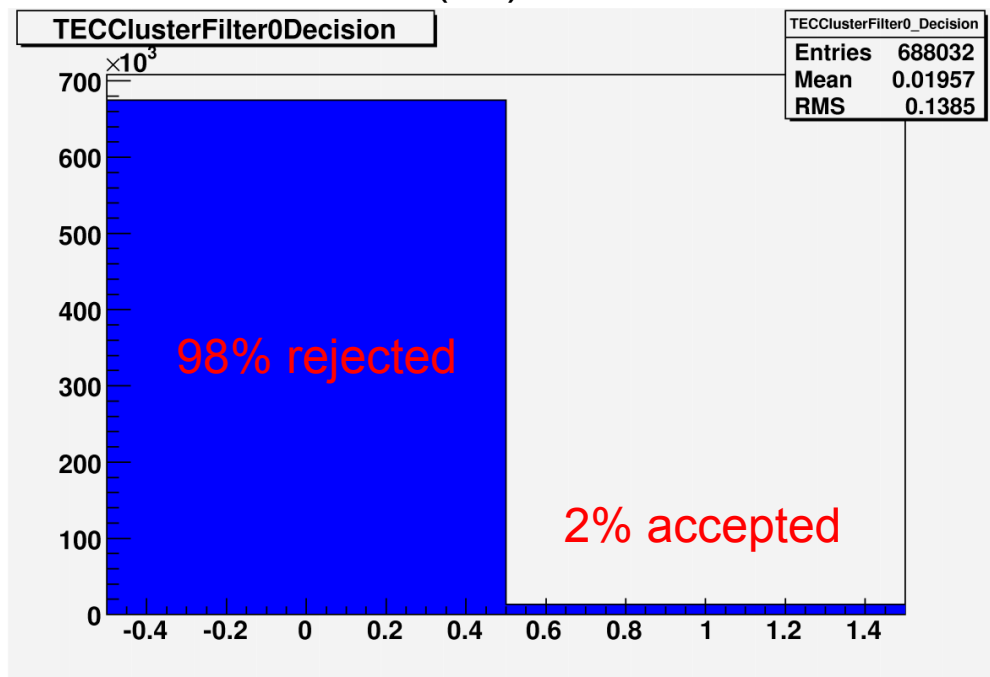
- This reduces the number of events by around 95%

- There is not much bias from TEC point of view because all cuts are performed later in the analysis
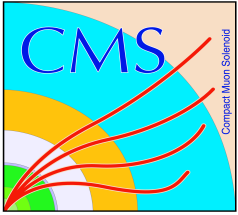
Special TEC-stream

- Committed TECClusterFilter.cc in CVS in package EventFilter/SiStripChannelChargeFilter

- Tested for run 2532 (0T):

1 hit in TEC without threshold-cuts

- Preliminary plots shown on the following slides are based on runs 2532, 2549 and 2550 (all with 0T)

How do we select „good" events?

Problems:

- For TIB and TOB „fake" clusters are suppressed by using specially adapted filters (for run 2532 16 clusters are left in TEC, when TIB/TOB-filters are applied)

BUT for TEC:

- We cannot ask for clusters in different layers because petals are arranged side by side

- We cannot use clusters belonging to a track because there are hardly any tracks reconstructed in the tracker passing through the TEC

- We have to start for TEC with ALL clusters including „noisy/fake" clusters

Possible solutions:

- Cut on signal to noise

- Cut on cluster charge

- Look at trigger bits

- any other ideas are welcome......
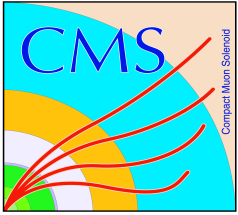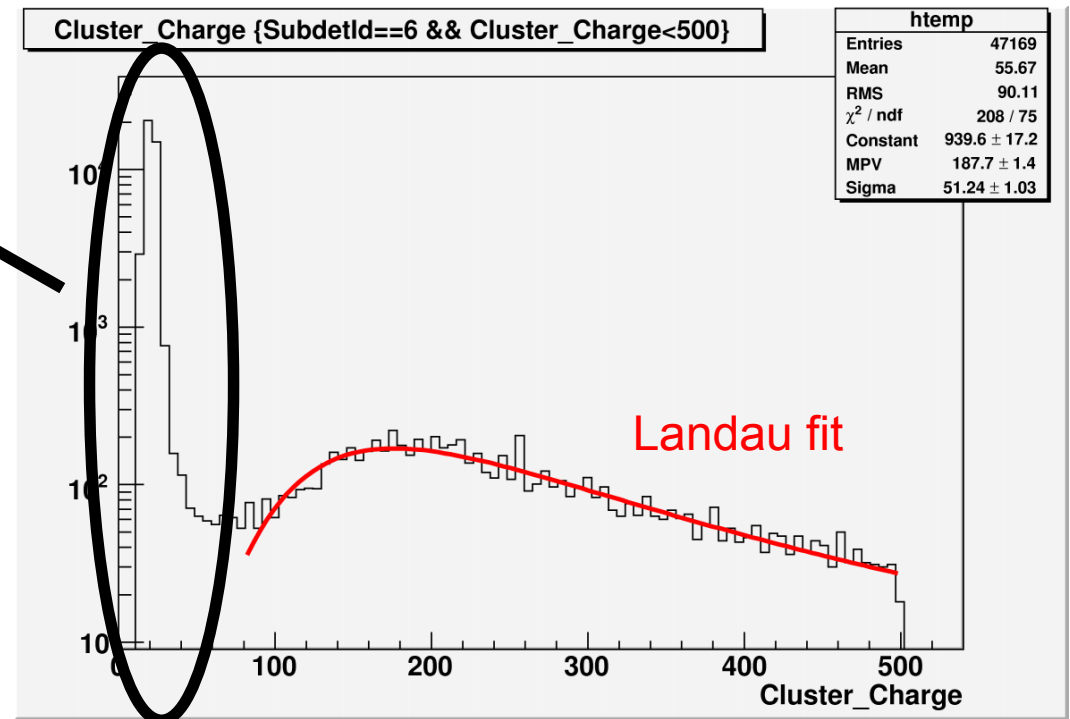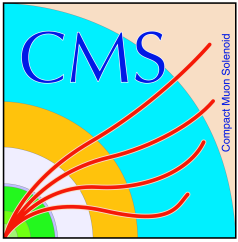
Cluster Charge Distribution
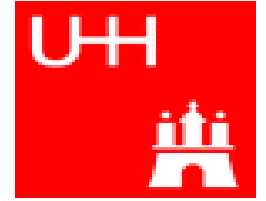
ALL clusters for TEC with cluster charge < 500

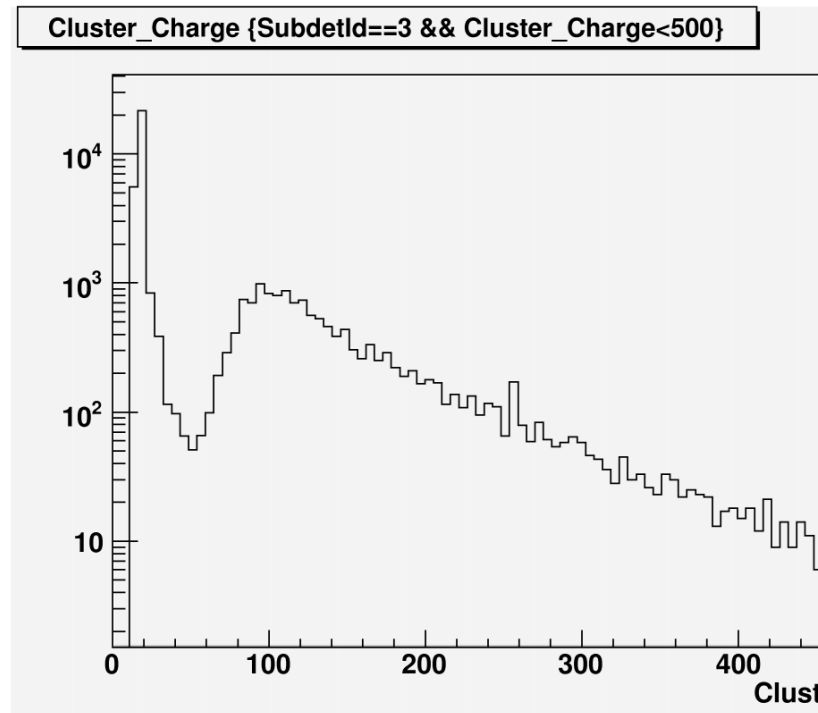What is the peak at cluster charge ~ 30 ADC?

- Noise, noisy strips

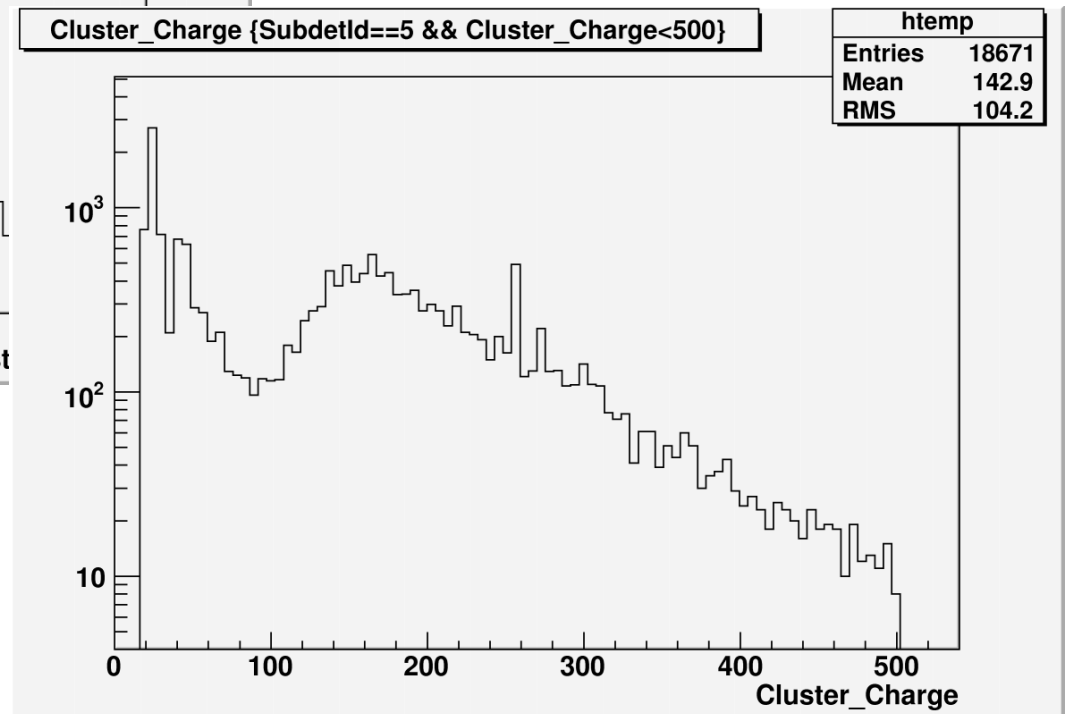This peak is also seen for TIB and TOB under the same conditions (all clusters without cuts)
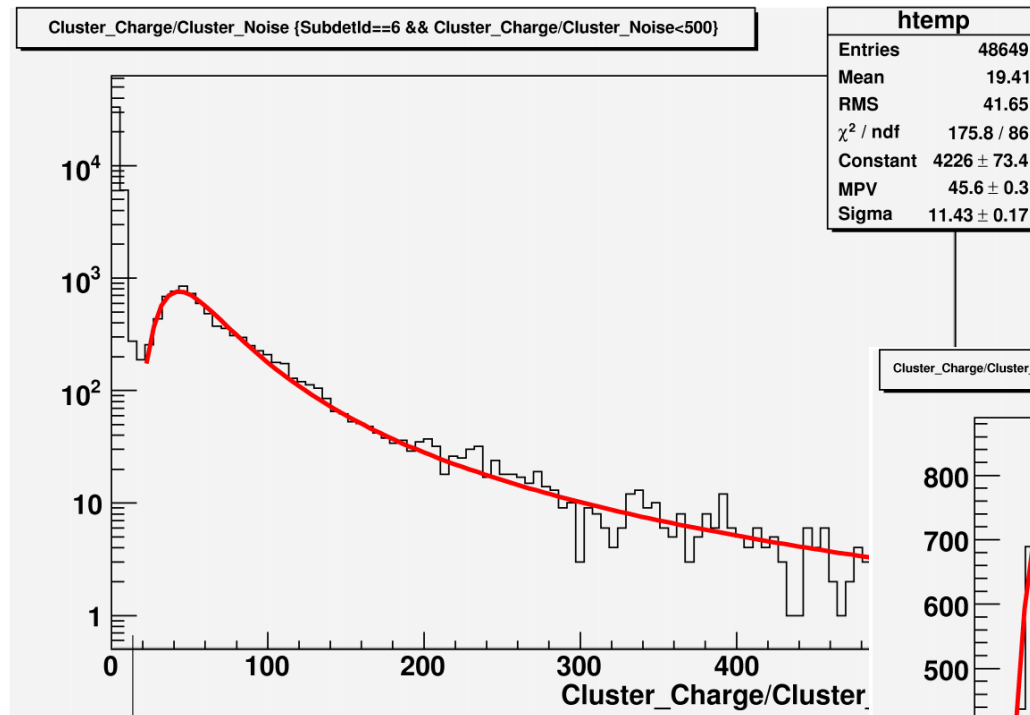
Cluster charge
TIB and TOB

Cluster_Charge {SubdetId==3 && Cluster_Charge<500}

htemp	
Entries	43470
Mean	61.75
RMS	74.52

Cluster charge TIB

Cluster_Charge {SubdetId==5 && Cluster_Charge<500}

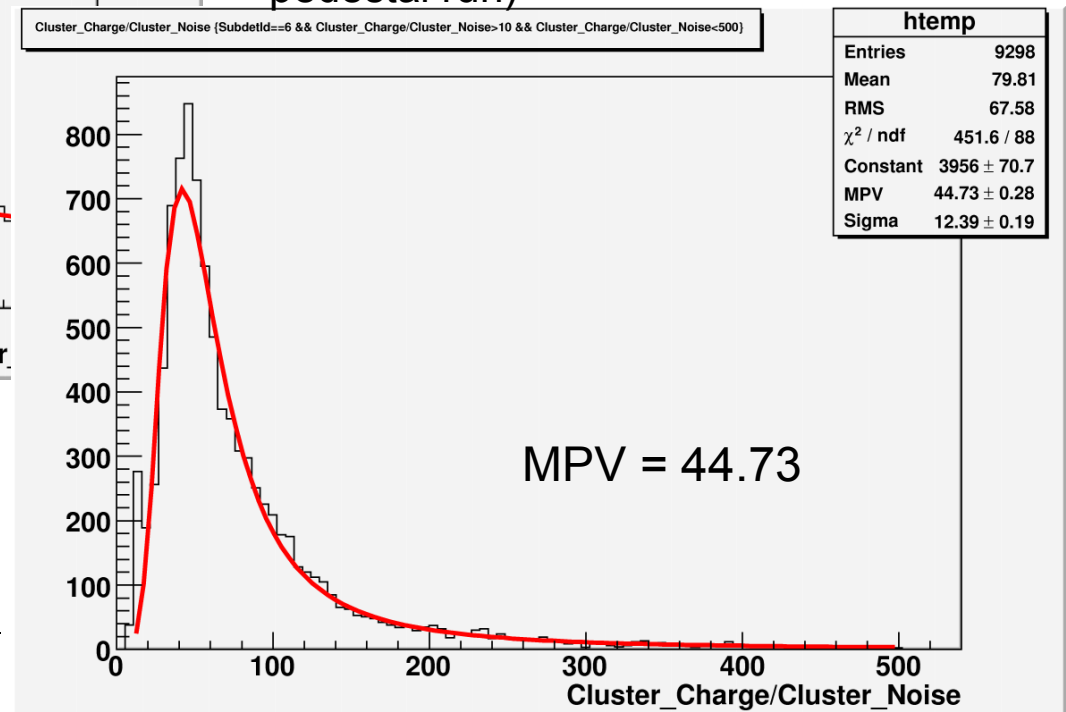| htemp	
Entries	18671
Mean	142.9
RMS	104.2

Cluster charge TOB

Signal over Noise

Cluster_Charge/Cluster_Noise {SubdetId==6 && Cluster_Charge/Cluster_Noise<500}

htemp	
Entries	48649
Mean	19.41
RMS	41.65
χ^2 / ndf	175.8 / 86
Constant	4226 ± 73.4
MPV	45.6 ± 0.3
Sigma	11.43 ± 0.17

Cluster_Charge/Cluster_
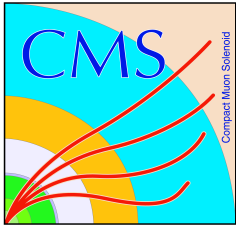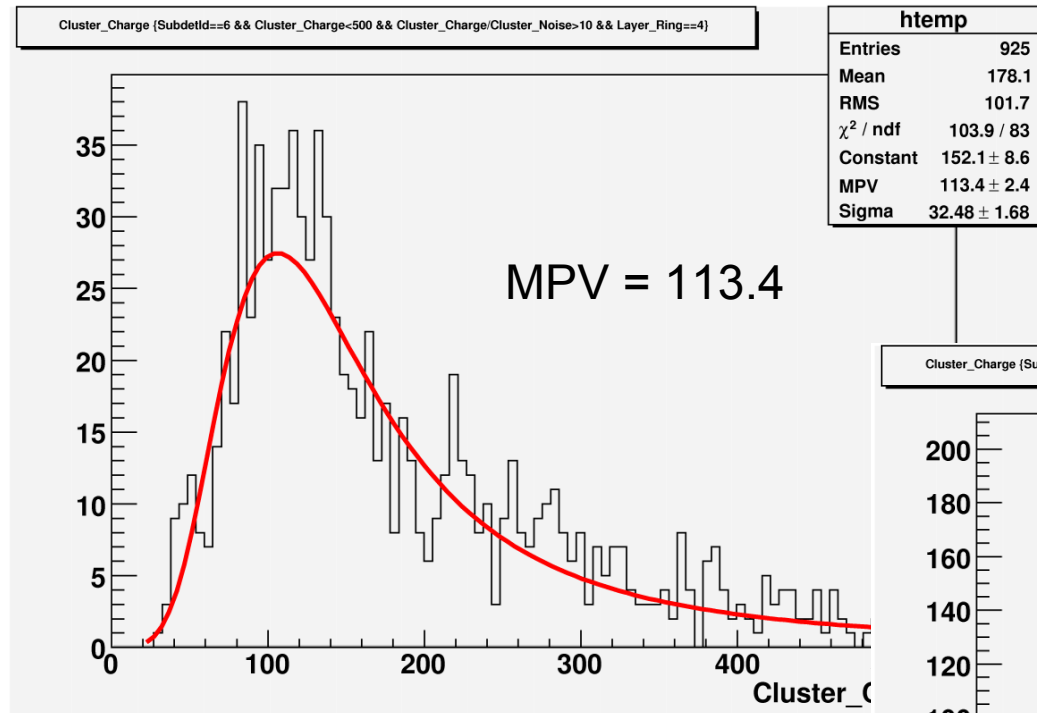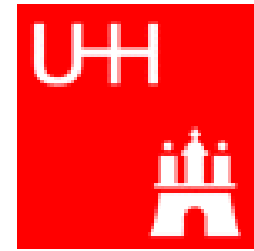
ClusterCharge/ClusterNoise < 500

with ClusterNoise = $\sqrt{\dfrac{\Sigma_i\, n_i^{\,2}}{nr_{strips}}}$

Strip noise is taken from Domenico Giordano's new sqlite-file (noise from pedestal run)
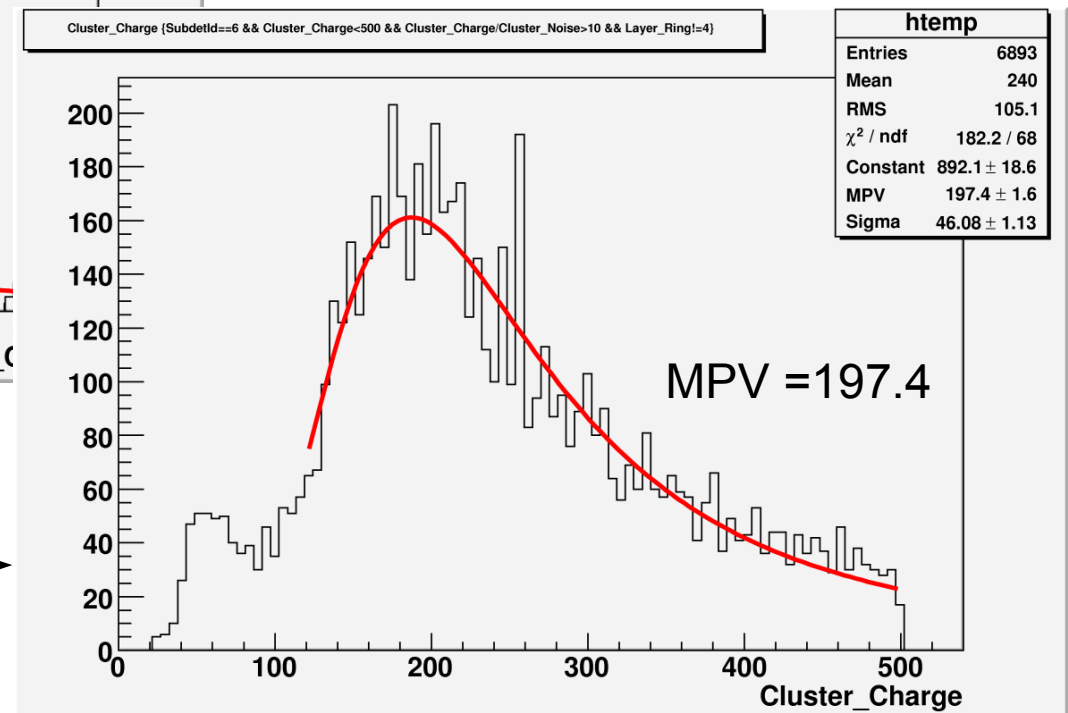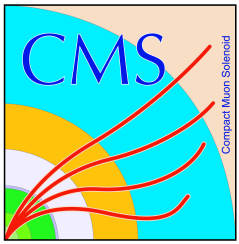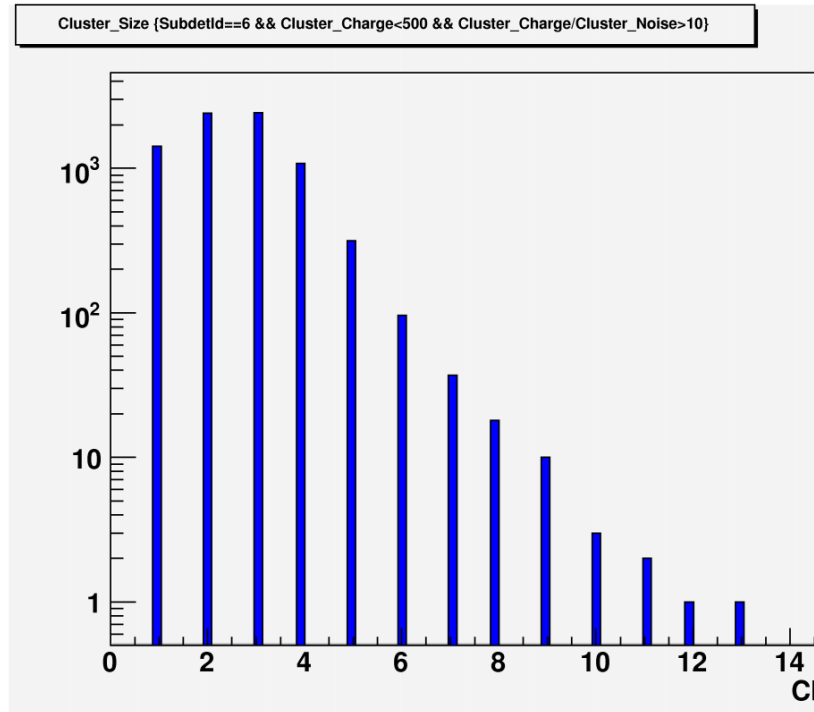
Cluster_Charge/Cluster_Noise {SubdetId==6 && Cluster_Charge/Cluster_Noise>10 && Cluster_Charge/Cluster_Noise<500}

htemp	
Entries	9298
Mean	79.81
RMS	67.58
χ^2 / ndf	451.6 / 88
Constant	3956 ± 70.7
MPV	44.73 ± 0.28
Sigma	12.39 ± 0.19

MPV = 44.73

Cluster_Charge/Cluster_Noise

➤ Cut on S/N >10 ➤

Problem of ClusterNoise: divided by $\sqrt{nr_{strips}}$ gives better S/N-values
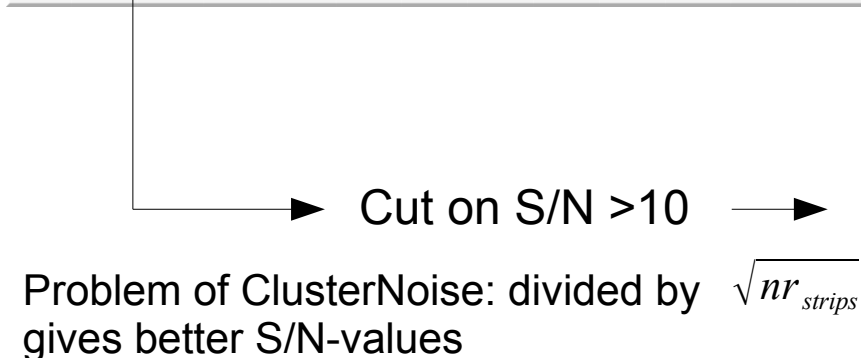
Cluster charge with S/N cut

Cluster_Charge {SubdetId==6 && Cluster_Charge<500 && Cluster_Charge/Cluster_Noise>10 && Layer_Ring==4}

htemp	
Entries	925
Mean	178.1
RMS	101.7
χ^2 / ndf	103.9 / 83
Constant	152.1 ± 8.6
MPV	113.4 ± 2.4
Sigma	32.48 ± 1.68

← Ring 4 with 320 μm thickness

MPV = 113.4

Cluster_Charge {SubdetId==6 && Cluster_Charge<500 && Cluster_Charge/Cluster_Noise>10 && Layer_Ring!=4}

htemp	
Entries	6893
Mean	240
RMS	105.1
χ^2 / ndf	182.2 / 68
Constant	892.1 ± 18.6
MPV	197.4 ± 1.6
Sigma	46.08 ± 1.13

MPV = 197.4

Ring 5 to 7 with 500 μm thickness →

Cluster size

Cluster_Size {SubdetId==6 && Cluster_Charge<500 && Cluster_Charge/Cluster_Noise>10}

htemp	
Entries	7818
Mean	2.633
RMS	1.261

← TEC with S/N > 10

Cluster_Size {SubdetId==3 && Cluster_Charge<500 && Cluster_Charge/Cluster_Noise>10}
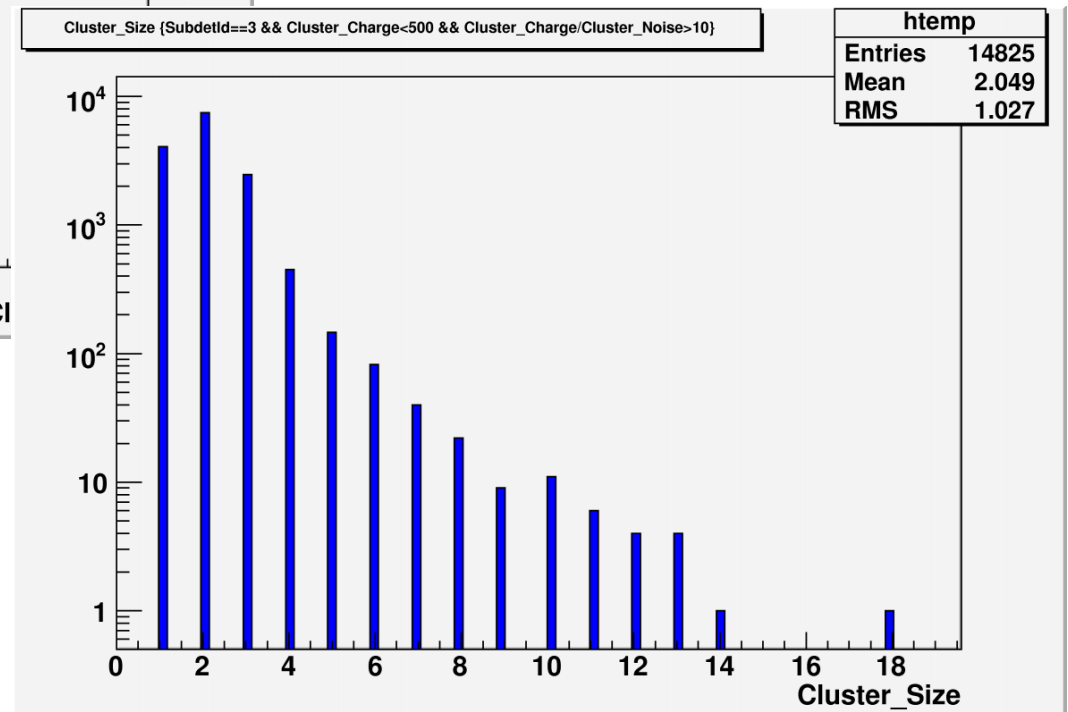
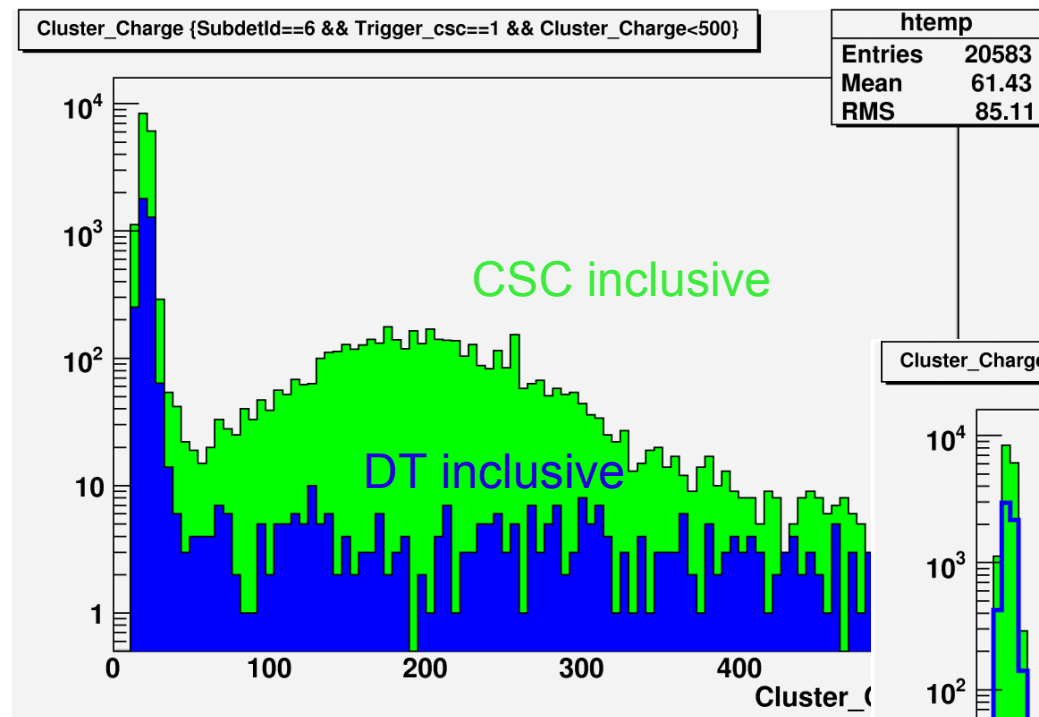| htemp	
Entries	14825
Mean	2.049
RMS	1.027

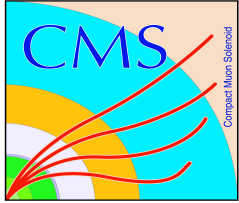TIB with S/N > 10 →

Cluster_Size
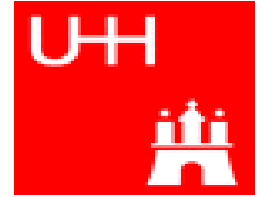
Trigger statistics
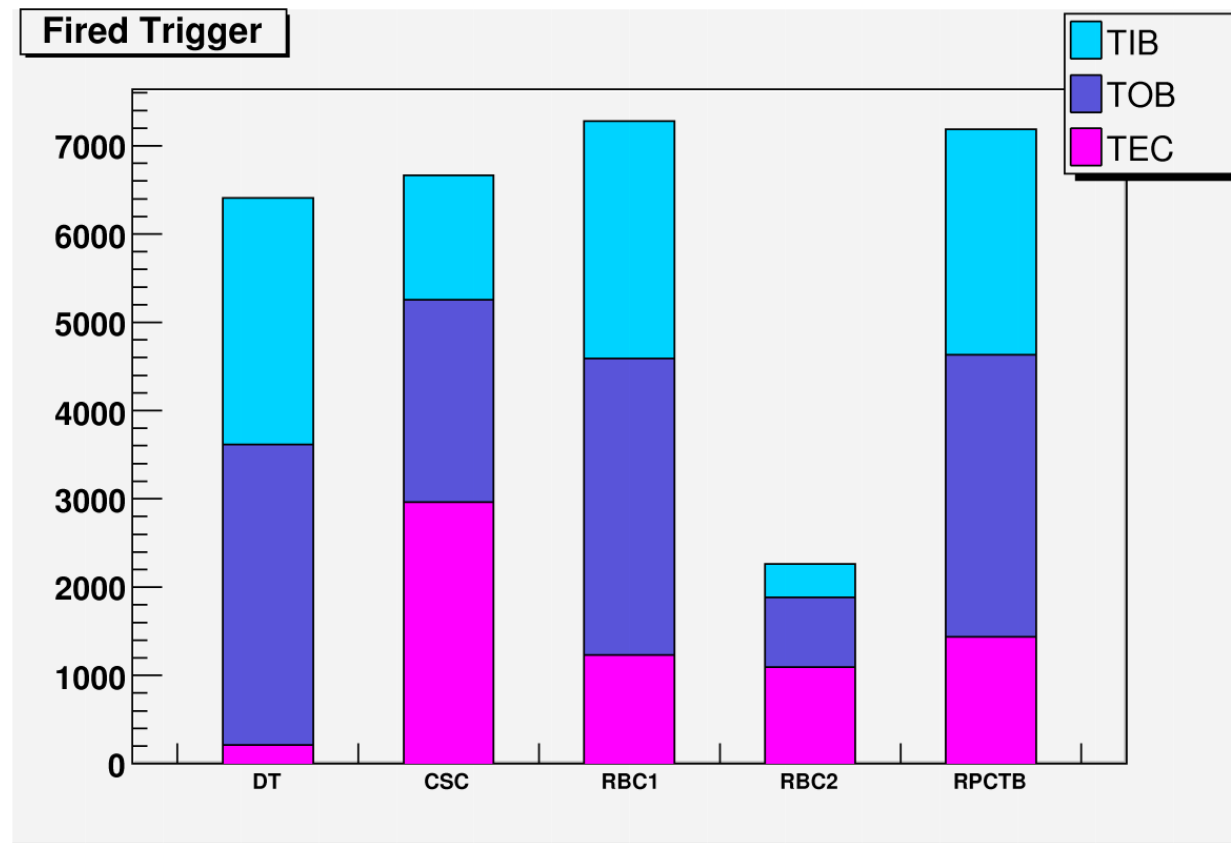
- All triggers are inclusive

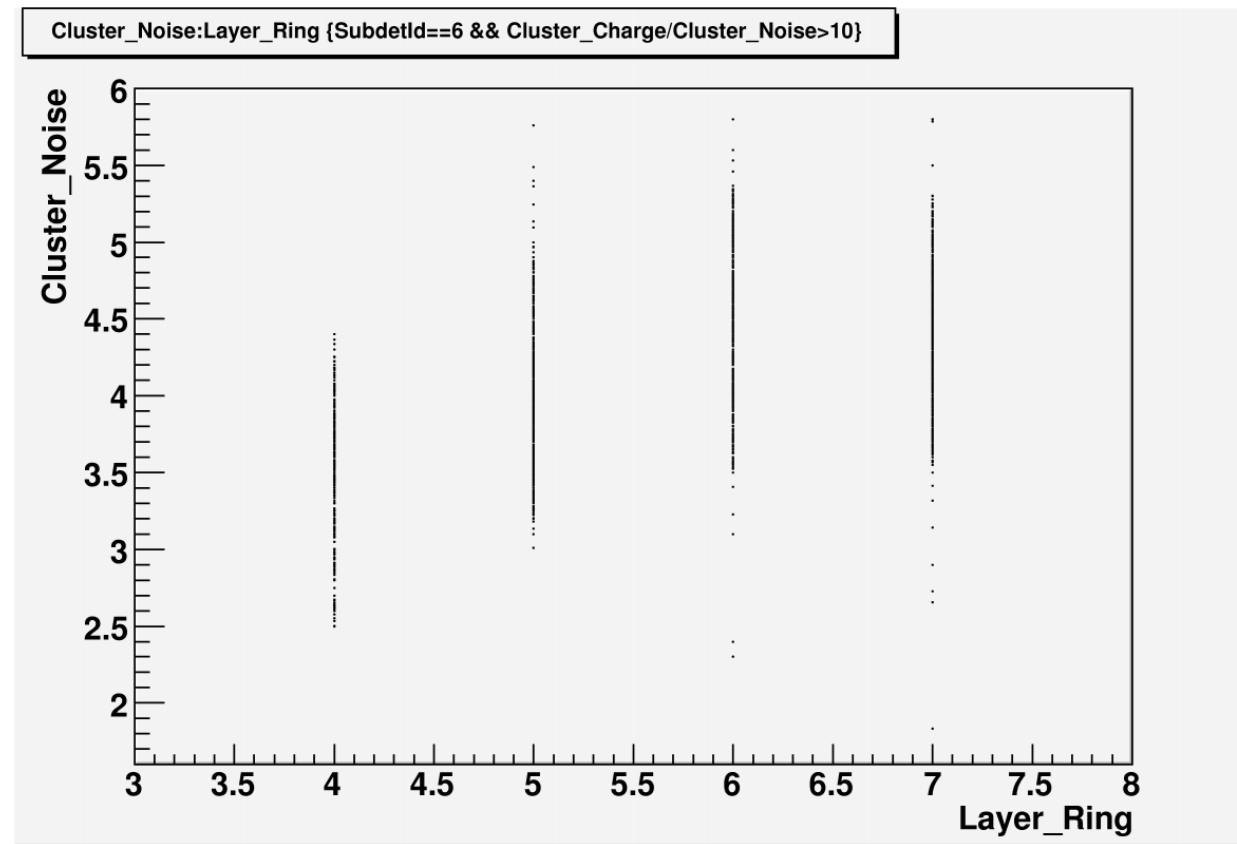- Trigger is counted if the event contains at least one cluster with S/N>10
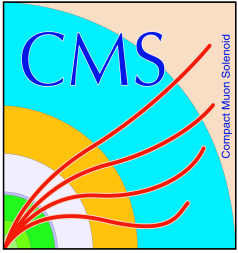
Cluster charge
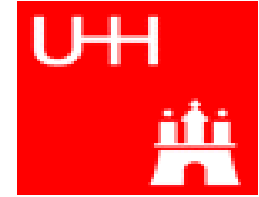# for trigger...
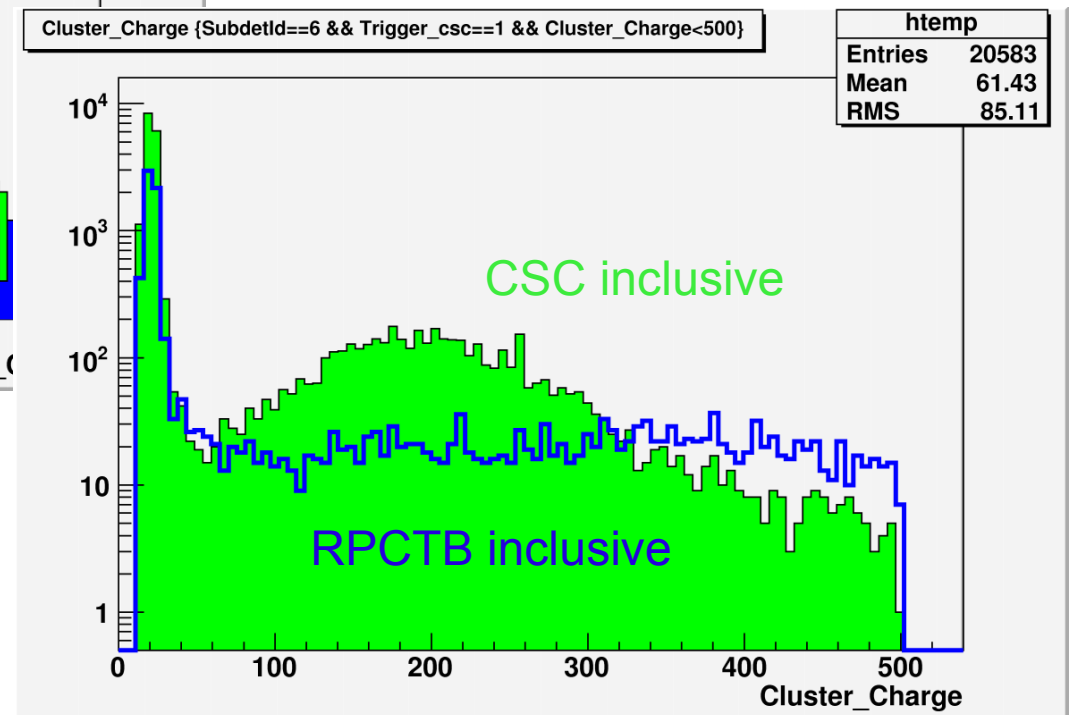
Cluster noise

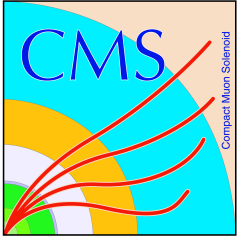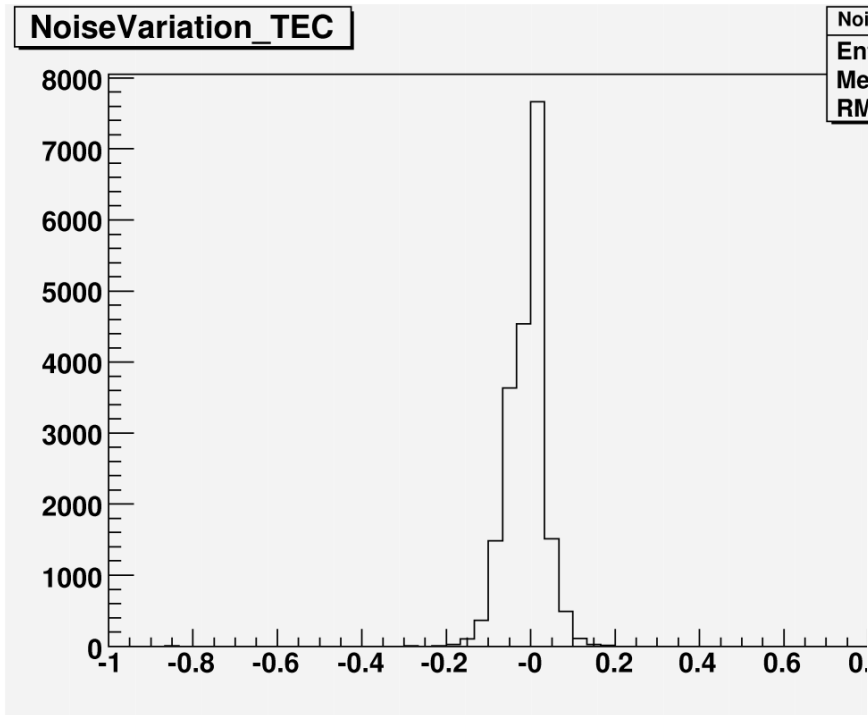Cluster_Noise:Layer_Ring {SubdetId==6 && Cluster_Charge/Cluster_Noise>10}

- Cluster noise increases with increasing strip length from ring 4 to ring 7
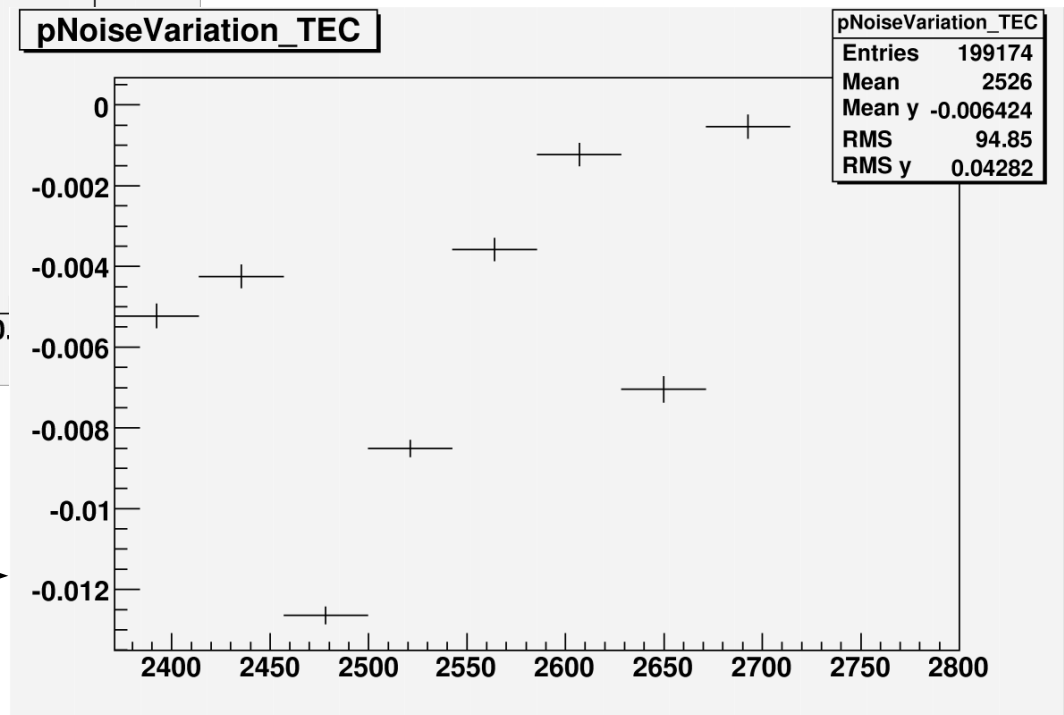- Striplength: 4>115.2 / 5>144.4 / 6>181.0 / 7>201.7 (active length in mm)
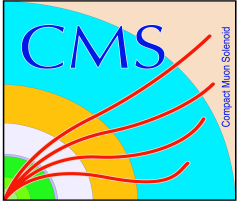
Noise Evolution TEC

Noise variation for commissio-
ning run 2475 (ref.run is 2354)

$$Stripnoise_{variation} = \frac{Stripnoise_i}{Stripnoise_{ref}} - 1$$

Noise variation for all commis-
sioning runs

Outlook

Partly done:

- Have a look at the noise evolution for TEC

- Increase statistics with reprocessed data from FNAL

- Filter events triggered by CSC with at least one hit in TEC

- Have a look if then there are hits in TIB and TOB as well, so that maybe some kind of tracking will be possible

Future-plans:

- Use CSC and Muon-data to try to do some „global" tracking

- Tracking with hits in TIB and TEC?
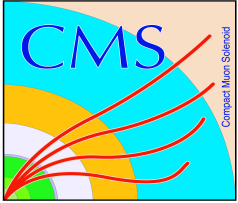
Summary
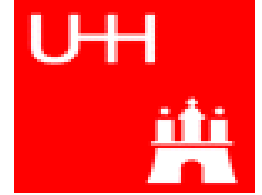
- Analysis of TEC performance during MTCC has started

- Usage of a special TEC cluster filter to have a collection of all events that are interesting for TEC

- Find criteria to select „good" events out of the full sample:

  - Cut on signal to noise

  - Cut on cluster charge

  - Cut on special trigger bits (CSC)

  - ....

- Plots seem to be reasonable (increasing noise with increasing strip-length, Landau-fits possible, CSC-trigger.....)

- Still some problems, but we are in contact wth the experts (Digi-charge, peak.....)

- Work on TEC performance continues (CSC, Muon, tracking....)