ND commissioning procedure: Initial steps & thoughts

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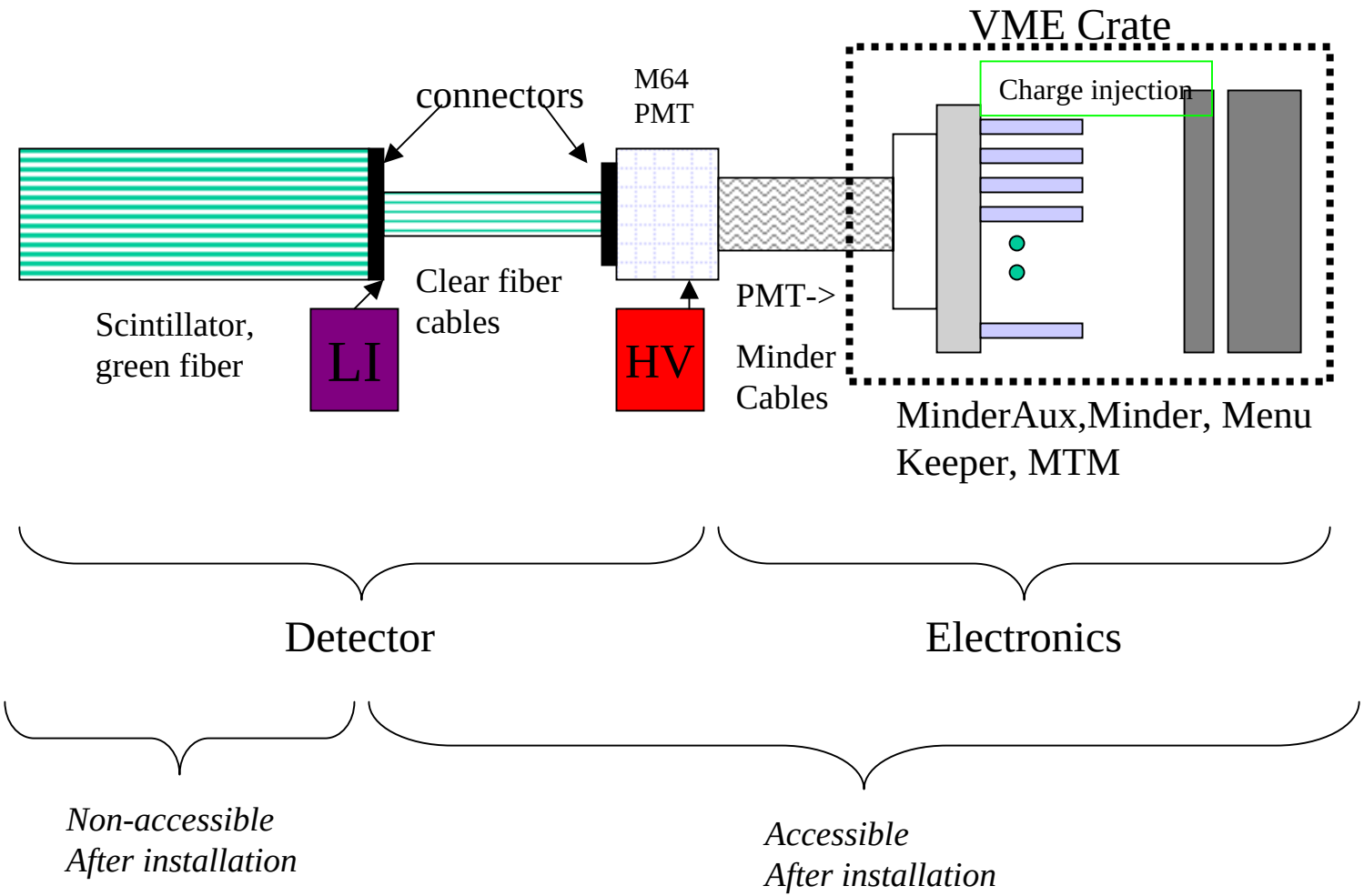
Plane Instrumentation & Data taking

- Procedure for plane instrumentation:
  - Planes Cabled.
  - Planes Light leak checked.
  - Alner box end is light leak tested
  - The LI end is light leak tested as well.
- At the end **of the day** we take:
  - Pedestals runs.
  - QIE Calibration runs.
  - Null trigger runs with lights ON and OFF.
- At the end **of the week** it would be very useful to take Null Trigger Runs with:
  - HV ON for several hours (PMT response stabilized).
  - Either dynode threshold or sparcification threshold high in order to write out and study mostly muons.

Detector schematic

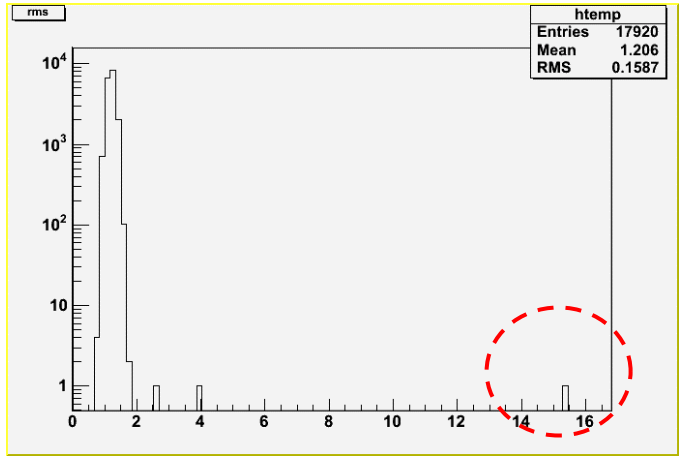
- Gina made a nice schematic of the detector subsystems:



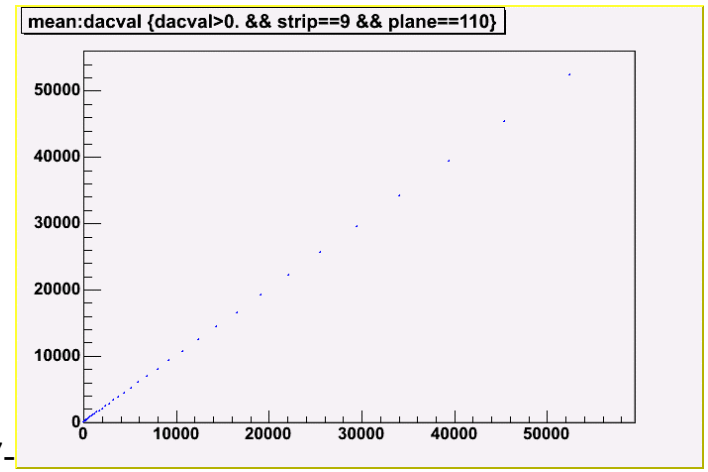
Pedestals & QIE calibration

- **Pedestals should be**
  - Stable (need to perform study at the end of the week with all Pedestal runs?)
  - Show small RMS (check every day).
- **QIE response in charge injection runs should be:**
  - Stable (need to perform study at the end of the week with all NCC runs)
  - Show small RMS (check every day)
  - Show Linear response (check every day)
  - Have no missing entries (256 is the nominal number of entries)
  - Have no missing points (37 is the nominal number of points)

RMS ‘s for channels that read the V planes 118 & 120

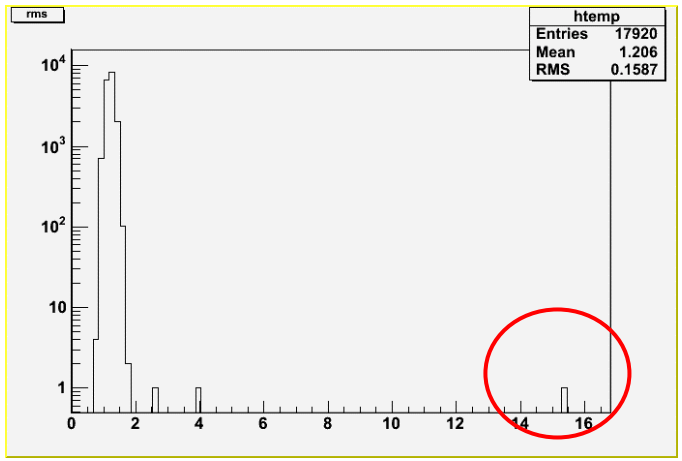


Mean vs DAC value for a healthy channel

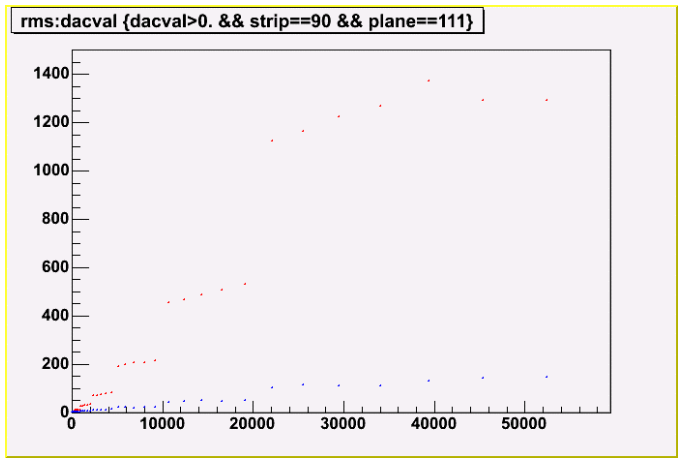


Pedestals & QIE calibration PATHOLOGIES

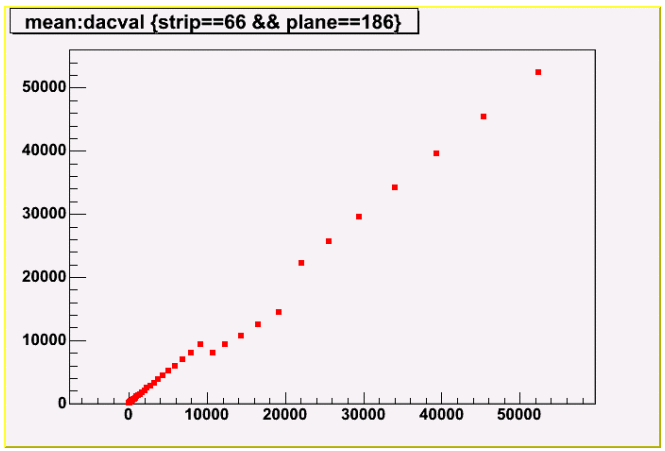
Pedestals Large RMS



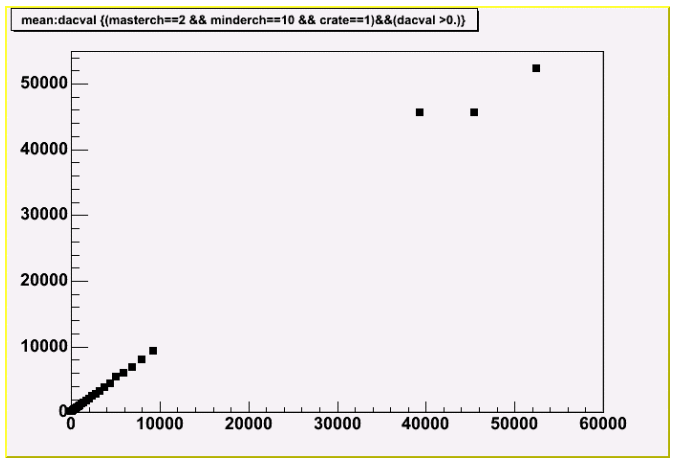
QIE Large RMS



QIE Non Linearity



QIE Missing Data Points



“Bad” QIE channels

- Use modified the QieCalibration Module (initial code by J. Hartnell, S.Murgia and A. Cabrera, current code includes all my analysis on QIE response) that generates (apart from the tree) 5 text files :

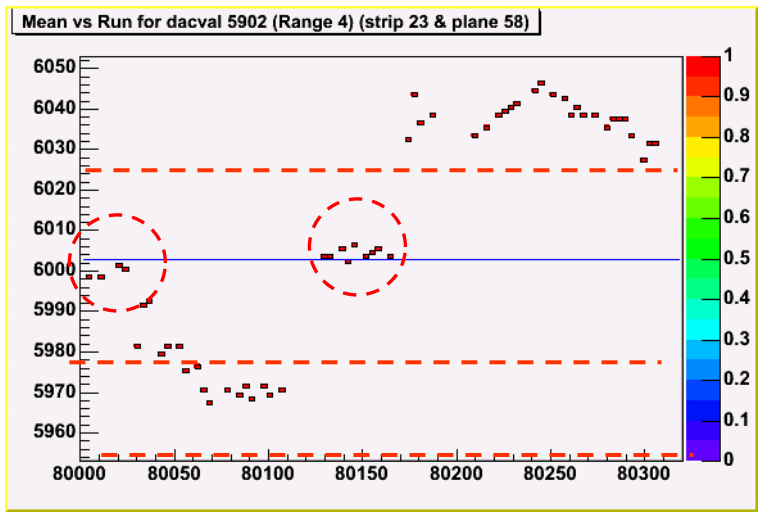
  - **bad_channels_rmsxx.dat** — **Large RMS in most 37 DAC values**
  - **suspicious_channels_xx.dat** — **Large RMS anywhere**
  - **bad_channels_chisqxx.dat** — **Large chi-square**
  - **bad_channels_entriesxx.dat** — **Missing Entries**
  - **bad_channels_dataxx.dat** — **Missing Calibration Points**

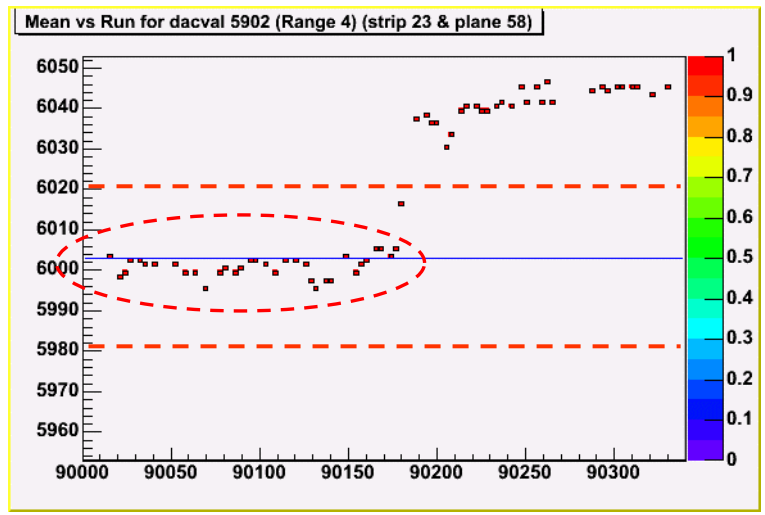
- These files contain :
  - master
  - minder channel
  - master channel
  - crate
  - module
  - Strip & Plane
  - DAC value
  - **PATHOLOGY RELATED INFO (rms, chi-square, entries, calibration points)**

Time stability of the QIE response in Near Cal Check runs (CalDet)

- It would be useful to monitor the QIE response (and stability of calibration) as a function of time.
- Below there is an example of an unstable channel from CalDet (mean fluctuating as a function of time).
- The same study could (and should) be performed at the ND channels maybe after Dave Reyna finishes with the commisioning of the electronics and we are in a more stable state.

MEAN vs RUN (time) (strip 23 & plane 58 DAC value 5902)



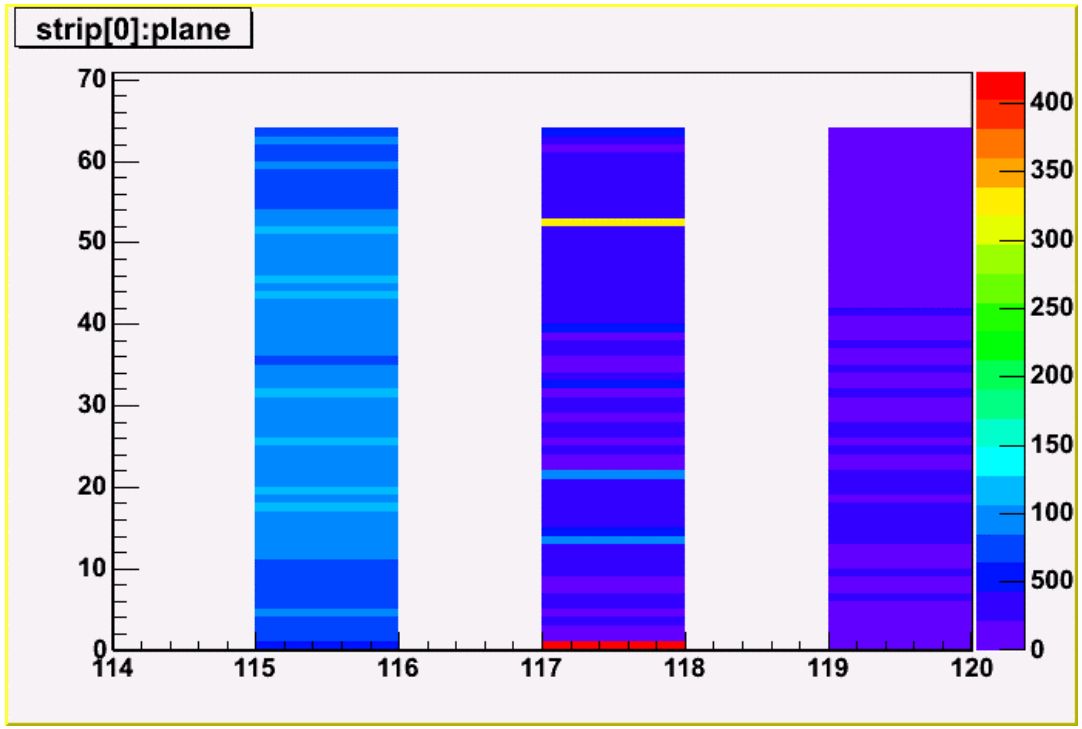


Null Trigger Runs

- With Null Trigger Runs (light ON-OFF) we can check (using output tree from Peters or Ginas code) :
  - If there are any dead strips, dead planes (!), holes in the readout "chain"
  - Light leaks in Scintillator Plane (usually should appear as a high rate in a particular strip **that CHANGES with lights ON lights OFF)**
  - Light leaks on the connectors (usually should appear as high rate for a particular group of strips corresponding to the particular connector **that CHANGES with lights ON lights OFF)**
  - Light leaks on the LI system (usually should appear as a high rate affecting the hole plane with maybe a similar pattern for different planes **that CHANGES with lights ON lights OFF)**
  - Problems with the PMT's (should appear as a higher rate or strange strip occupancy that **DOES NOT CHANGE with lights ON lights OFF)**
  - **Other Problems that we have not seen yet…**

Null Trigger Runs: Dead strips, planes, holes in readout chain

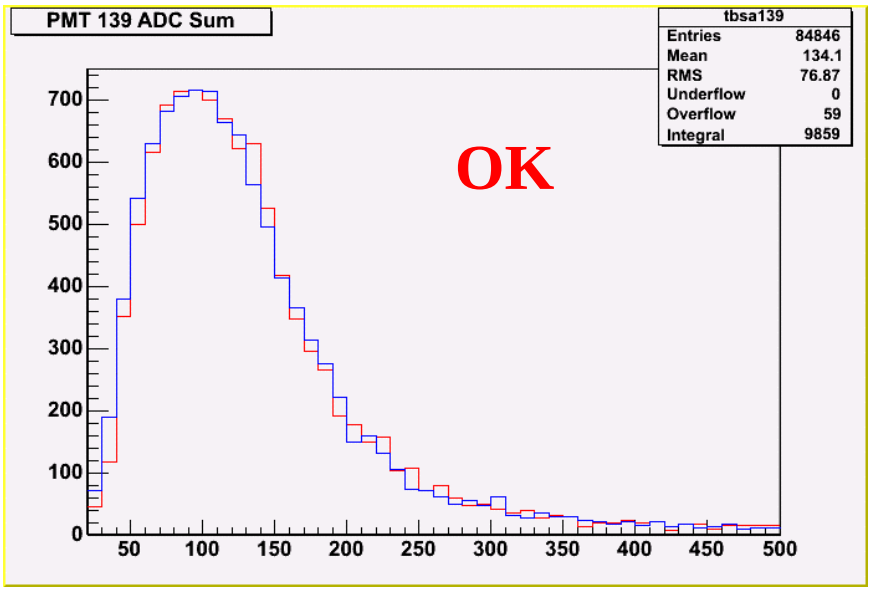
- Check if there are any dead strips, dead planes (!), or holes in the readout “chain” by looking at the strip vs plane plots

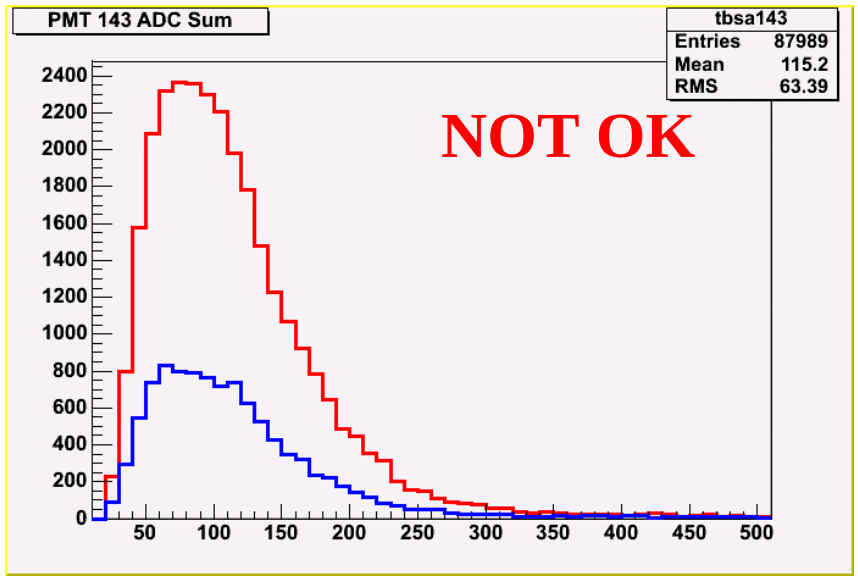


If there were strip with no entries at all, that would be a problem

Null Trigger Runs: Light Leaks

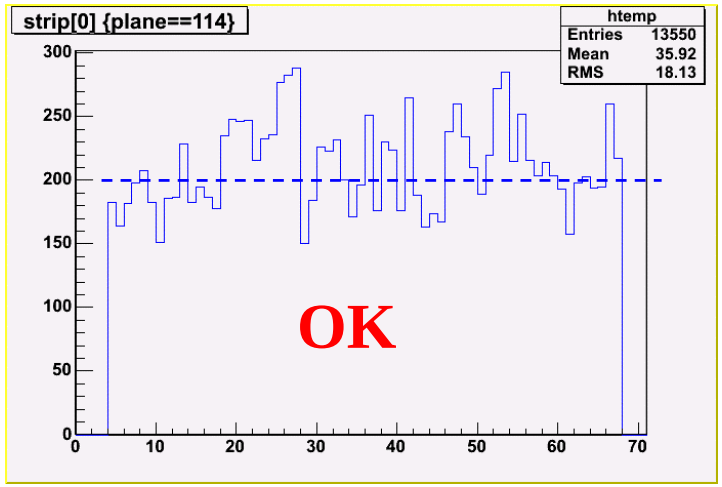
- Check if there are any light leaks by comparing ADC distribution of each PMT with lights ON - OFF

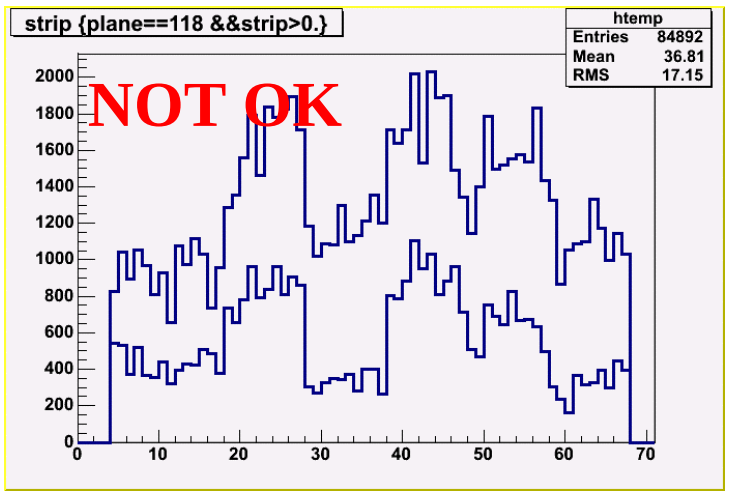


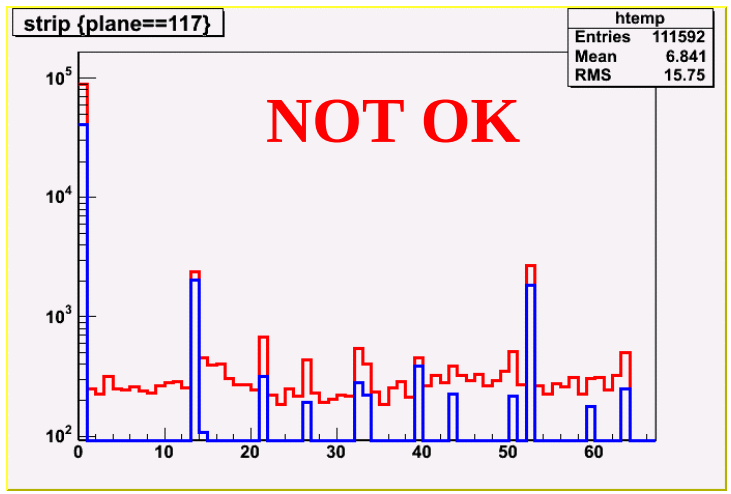


Null Trigger Runs: Light Leaks cont'd

- If a light leak is found check strip vs plane distribution to see if:
  - 1) All strips (or groups of strips) are ~ equally affected
  - 2) A particular strip (or isolated strips) are affected.



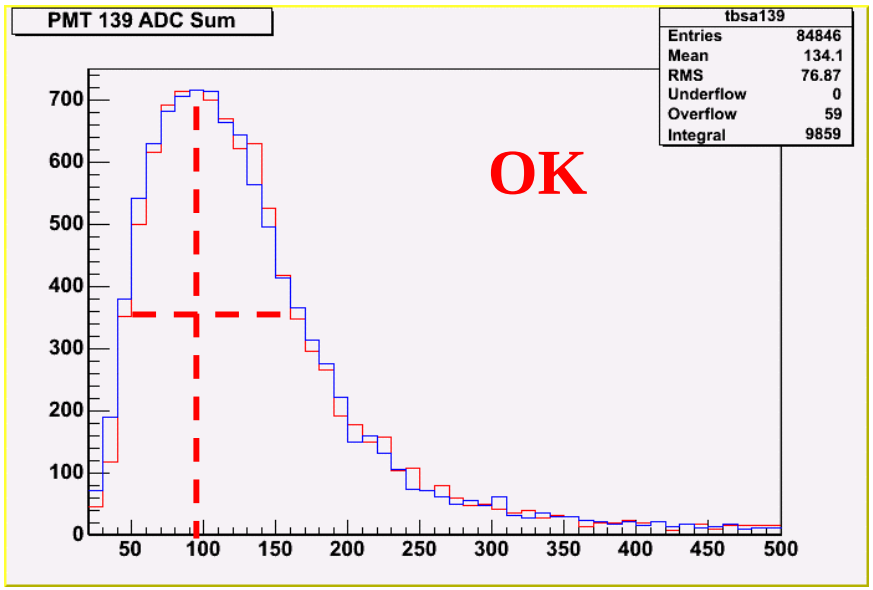


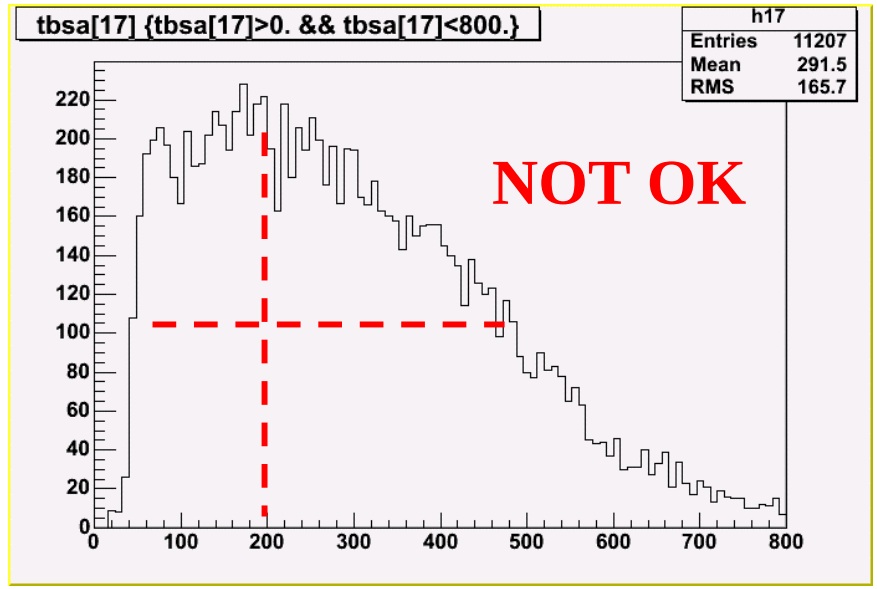


PROBLEM with LI SYSTEM

BAD PMT

Null Trigger Runs: PMT sanity

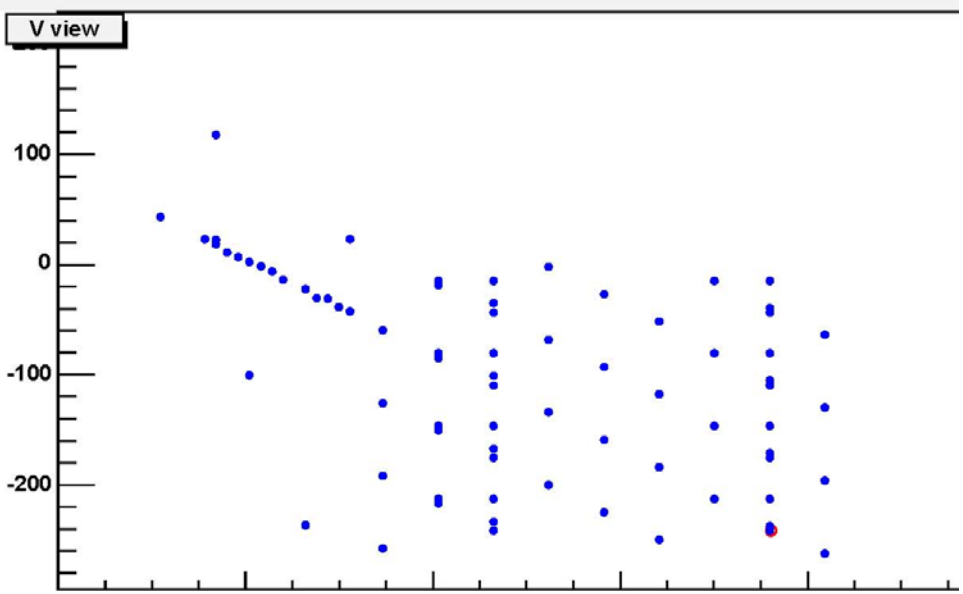


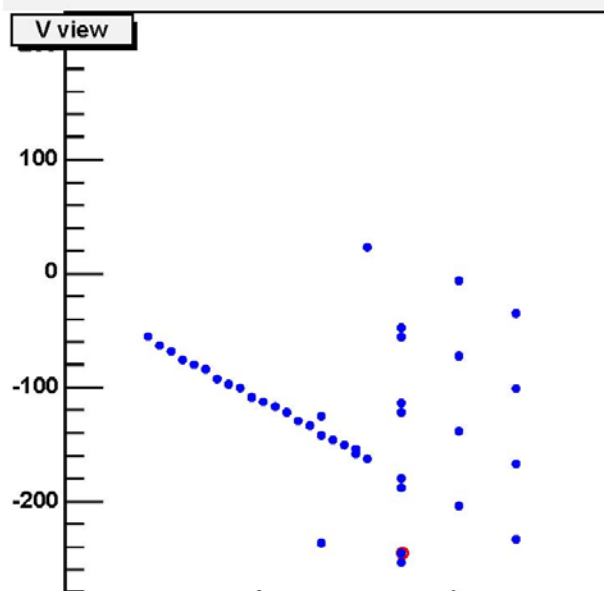


A “normal” PMT should have :

- MEAN (for singles) : ~ 100 ADC counts (80-120 ADC counts)
- SIGMA : ~ 50 ADC counts
- RATE >> : ~ 1KHz (0.8-1.4KHz)

Cosmic Muons (only 2D so far)

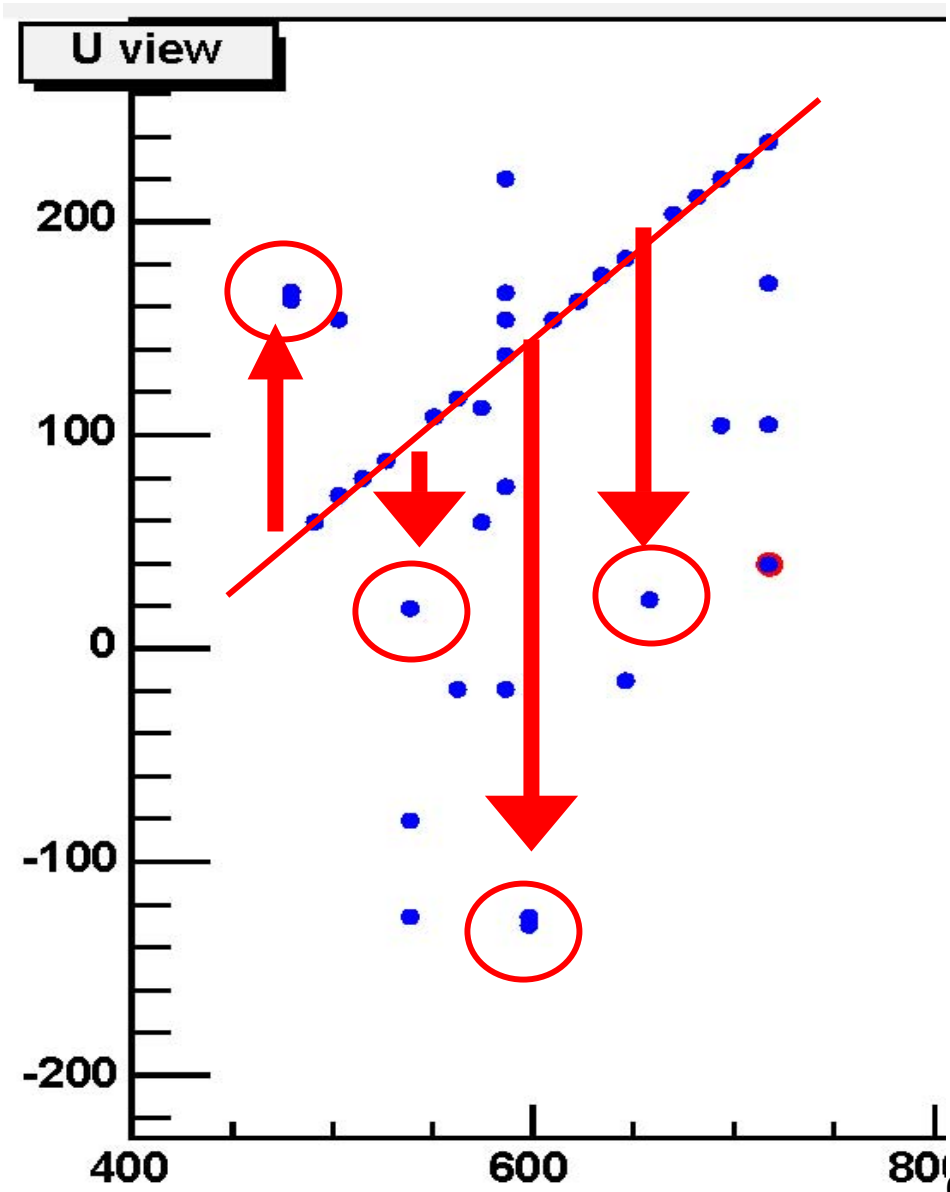




- I have started looking at 2D muons (for the moment) using Phil's Offline Trigger and then the standard reconstruction software and Gina using her own code.
- Studying them more systematically we will be able to look at the details of :

- Timing system
- Energy deposition (ADC counts per hit)
- Magnetic field (for stopping muons)
- Plane & strips efficiencies
- General detector "pathologies" (i.e PLEX problems)

Cosmic Muons (U View PLEX problem)



- Trying to resolve another problem (potentially dead strips) we found that the PLEX for the U view full calorimeter planes is wrong.

- Looking at a few 2D muon tracks we were indeed able to verify the PLEX problem which appeared as “missing & misplaced” hits.

Summary

- Looking at :
  - RMS of Pedestals
  - QIE text files with
    - RMS of QIE in NCC runs
    - Linearity
    - Missing Entries
    - Missing points
  - STRIP vs PLANE distributions (with lights ON-OFF)
  - PMT ADC distributions (with lights ON-OFF)

we can detect and correct on a **daily basis** pathologies related with our electronics, the scintillator planes and the PMT's and thus check the integrity of the entire detector as the installation progresses .

- On a weekly basis it would be useful (and necessary) to test the stability of the pedestals, the electronics and the PMT's as a function of time.

- Also a systematic study of Cosmic muons (as soon as the DAQ can read out both views together) is necessary in order to look more carefully at details related with the timing system, the energy deposition, the plane/strip efficiencies, later the magnetic field and also various detectors pathologies.