

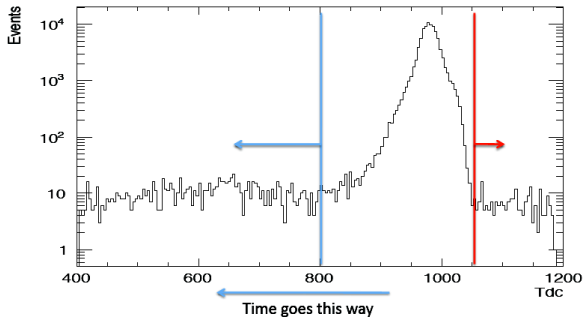
PMT Rolling Gain & Dark Noise

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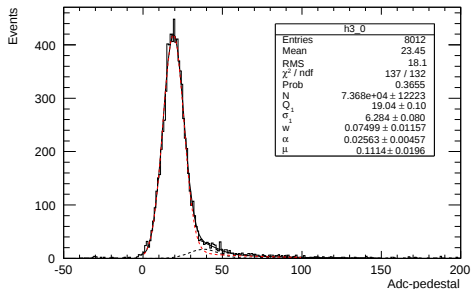
Dayabay Collaboration

Dark noise Method



- Select hits with $Tdc > 1050$ (Dark noise before trigger)
- Require only one hit for each channel.
- Doc 5361 for more details

Gain Fit Model



- The response of an ideal noiseless PMT is simply a convolution of a poisson distribution and a gaussian distribution

$$S_{ideal}(x) = \sum_{n=0}^{\infty} \frac{\mu^n e^{-\mu}}{n!} \frac{1}{\sigma_1 \sqrt{2\pi}} \exp\left(-\frac{(x - nQ_1)^2}{2n\sigma_1^2}\right). \quad (1)$$

- Full model: $S_{ideal} + \text{pedestal} + \text{background}$
- Reference: NIM 339(1994) 468-476

Run 5773 info (elog 266)

The 72 hours statility run5773 with AD#2 at 2e7 gain started at 17:24 09/22 and ended around 17:27 09/25.

(1) Totally it generates about 3.9e8 triggers and ~960GB raw data (3808 files, about 100000 triggers per file);

(2) Event rates: ~1.55kHz; volume per event: 2.3kB; band width: 3.5MB/s; 12+1 FEE boards (≤ 5 hits), 1LTB, 1 FADC

(3) signal source: Muon + noise + LED double pulse

(4) configuration:

Trigger mode: Npmt (>45 , ~80p.e.) || TotalESum (>40 , ~90p.e.)

double pulse: frequency: 200Hz; separation: 20us;

prompt: ACU A, -7.2V, ~400p.e.

delay: ACU B, -7.25V, ~1200p.e.

Till now, the found issues:

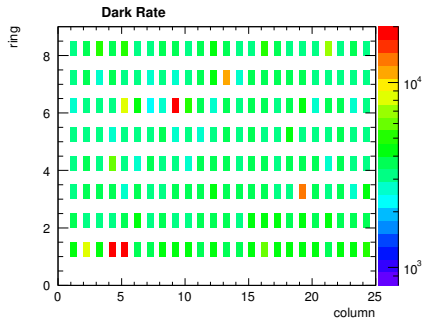
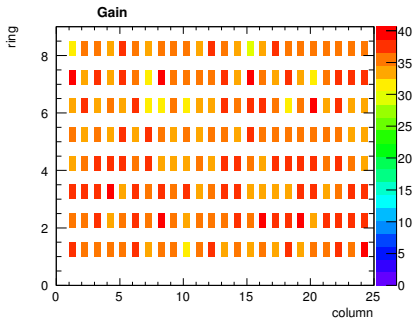
(1) Top C 2'' PMT strange/large signal pulse output, turned off at the end of the test; which need more check for it;

(2) the unix time of CCG shows some "jump", the source are being checking;

...

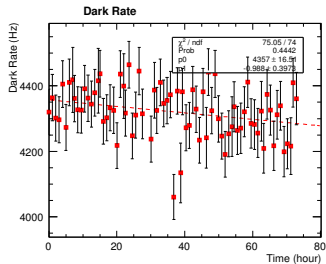
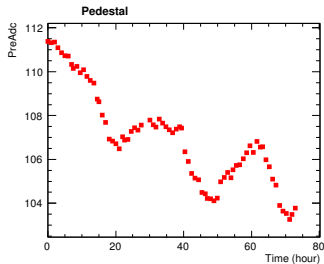
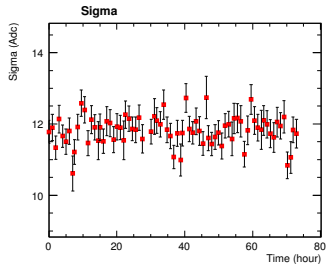
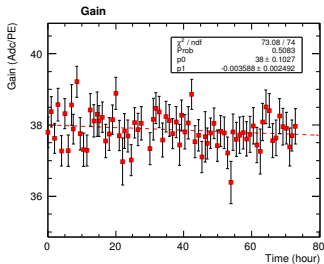
(4) DAQ online monitoring hisgram for trigger rates shows some sudden spikes which should go with some dead time;

Gain & Dark Rate at the first hour

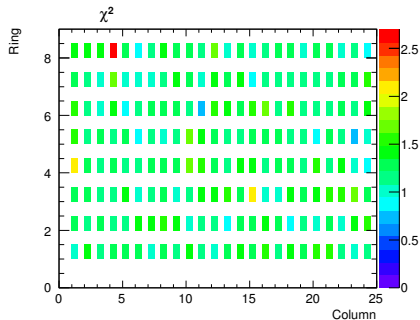
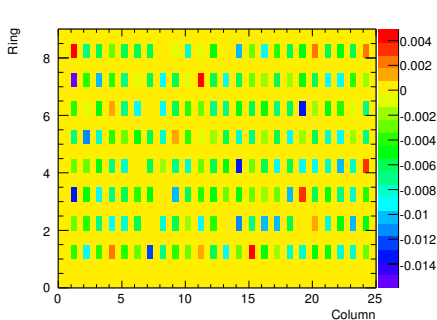


- A few hot channels

Variation with time (Ring1-Column1)

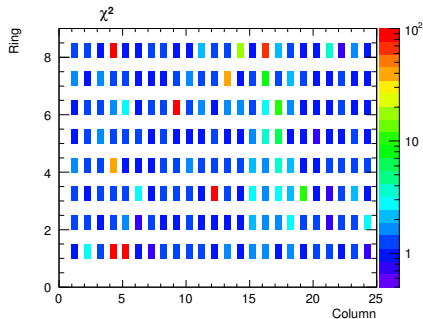
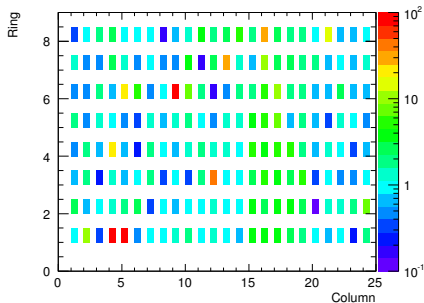


Gain slope



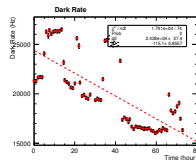
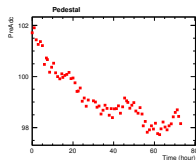
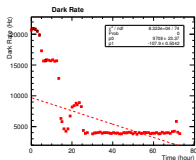
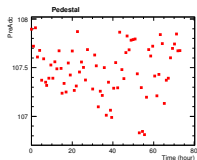
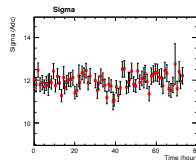
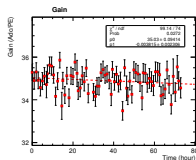
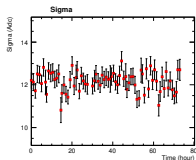
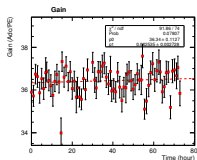
- Fit gain variation with a first order polynomial function.
- Left: Gain slope; Right: χ^2 .
- Most gains is decreasing over time

Dark Rate slope



- Fit dark rate variation with a first order polynomial function.
- Left: fabs(slope) (in order to show in log scale); Right: χ^2 .
- Almost all dark noise rate is decreasing over time
- Large χ^2 indicate strange behavior of dark rate.

Strange behavior PMTs

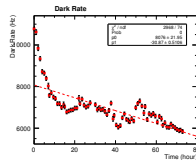
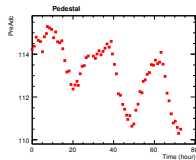
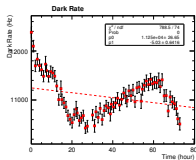
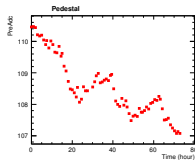
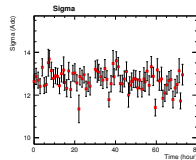
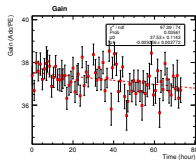
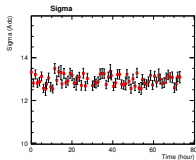
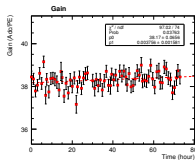


ring01-column04

ring01-column05

- The dark rate of following PMTs vary a lot (ring,column):
 (1,4), (1,5), (3,12), (3,19), (4,4), (6,9), (6,17), (7,13), (8,4),
 (8,14), (8,16)

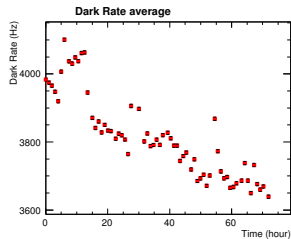
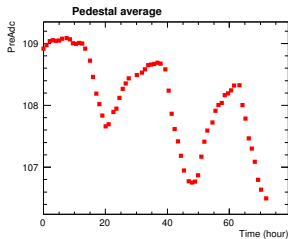
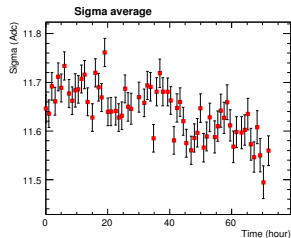
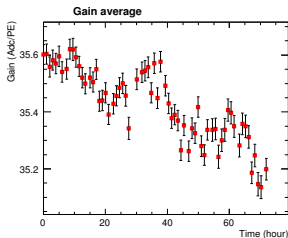
Strange behavior PMTs



ring03-column19

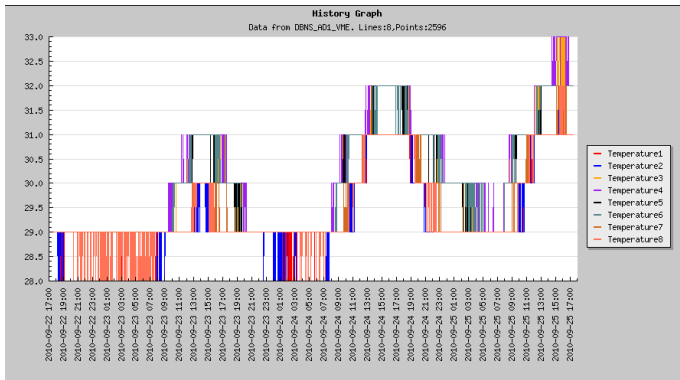
ring07-column13

Average over all PMTs



- Gain, gain width, dark rate have about 1% decreasing over 72 hours
- Pedestal has a day to day pattern, also with a trend of decreasing over time.

VME temperature



- Low pedestal corresponding high temperature(?)

A problem with run 5773

- Sometimes, the trigger time is not in time order (Latter readout trigger time is earlier than previous readout trigger time).
- An example:

Trigger time: (1306454413, 146587048).

Trigger time: (1306454413, 147163723).

Trigger time: (1306454411, 158275).

Trigger time: (1306454411, 636150).

Trigger time: (1306454411, 694412).

Trigger time: (1306454411, 1116762).

Trigger time: (1306454411, 1593412).

Trigger time: (1306454411, 2018650).

...

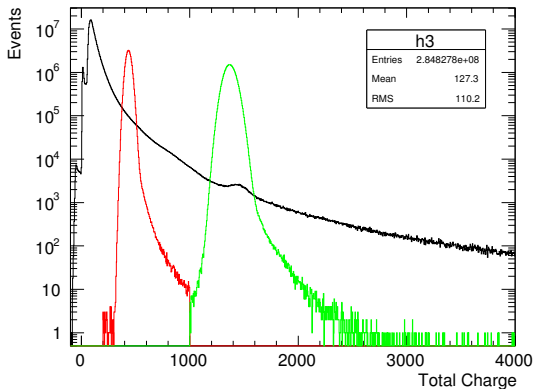
Trigger time: (1306454411, 9103375).

Trigger time: (1306454413, 157537960).

Trigger time: (1306454413, 158774885).

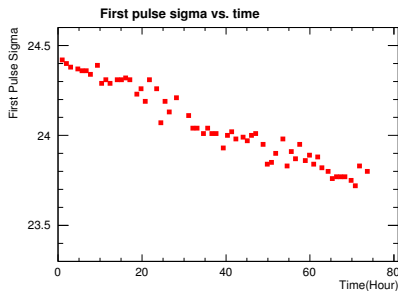
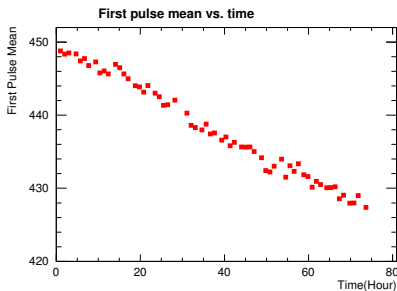
- 0.58% triggers not in time order
- First happen at around hour 30 (same time the system clock jumped)

Total charge



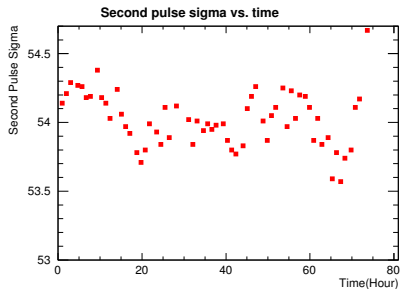
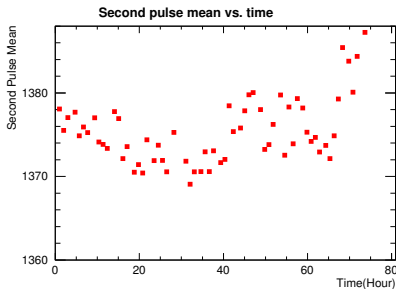
- Red: first pulse of LED, Green: second pulse of LED
- Black: muon events

LED first pulse



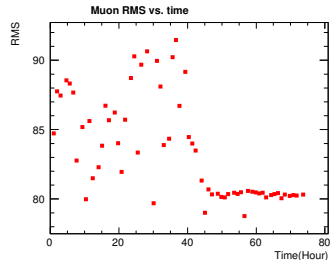
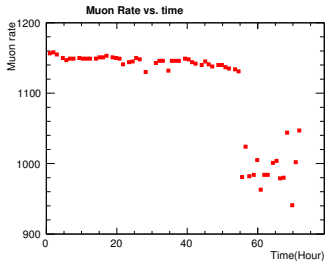
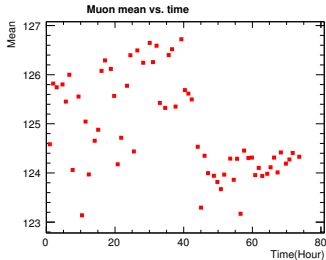
- LED first pulse is decreasing with time (4%)

LED second pulse

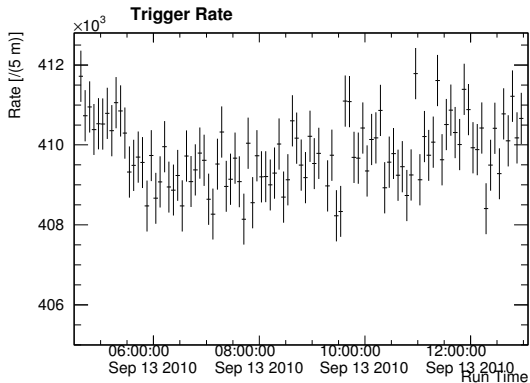


- LED second pulse is different from first pulse

Muon mean & RMS & rate

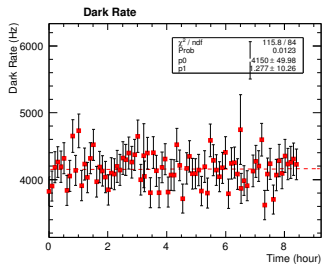
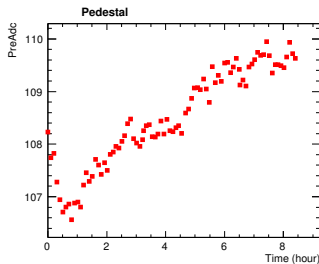
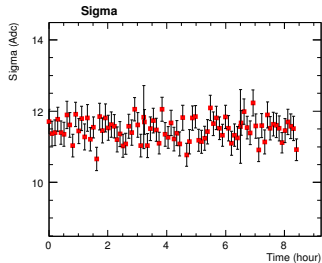
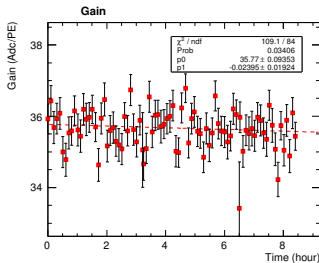


- Suddenly a drop of muon rate at around hour 55.(?)
- Muon mean has a drop at around hour 45.

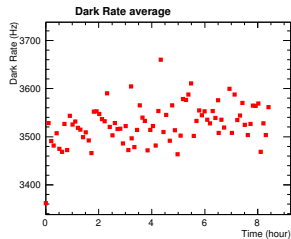
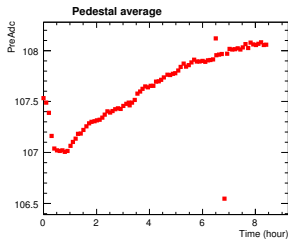
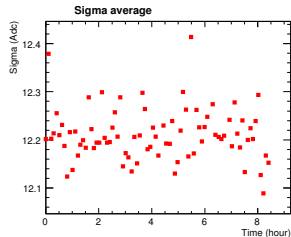
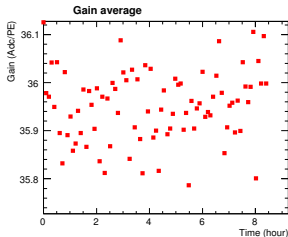


- Start Time: 2010-09-13 17:32:35
- Physics run, NHit threshold: 40, Esum Threshold: 40

An example (ring01-column10)



Average



- No obvious drift for gain and dark rate.
- Pedestal has some pattern.

- Gain & dark rate seem have a cool down effect with time, decrease by about 1% over 72 hours.
- Pedestal have a day to day pattern.
- There are a few channels with strange dark rate behavior.
- There is unexplained muon rate drop in run 5773.