

CEDAR Report 2018

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Analog Signals of PMTs

Analog signals of the photo cathode of the PMTs (differential)

Observed signals of the order of 10-20mV.

Some of them show signs of ringing.

→ Amplifier in the PMT bases looking fine

Analog signals of the summation output of the discriminators

Observed signals of the order of several 100mV

Also this signals are fine and feeded into the CERN electronics.

→ Also these signals are as expected

Discriminator

We checked the discriminator outputs of all PMTs for CEDAR2

We can see a clear Signal with a length of about 8ns for all of them.

→ They are working as expected ... but:

- Depending on the threshold level we observe a rate of about 100Mhz (TH to low) or the dark counting rate of 100-200Hz.

The border between these two regions is very low (5 digit)

- For some of the channels we observed two pulses shortly behind each other (≈ 10 ns apart).

→ TH too low we detecting also the ringing/undershoot of the PMT signals.

Read out electronics

The new iFTDC development are used as read out

- Each iFTDC has 64ch (16ch possible with CEDAR firmware):
 - 4 iFTDC are used for the timestamp (each 4 PMTs)
 - 2 iFTDC are foreseen for time over threshold (not used at the moment)
- on the iFTDC 8ch share common architecture on the FPGA
- All iFTDCs are connected to a DMC module which is used as multiplexer towards the DAQ (SRCid 250)

Work on monitoring tools

Added some more debug info to the CEDAR_monitor tool by Vladimir

I rewrote the PlaneCEDAR files for COOOL:

- Now hits and timings are also written to the ROOT tree
- Changed naming of histograms to be in the normal detector scheme
- Added Plots for every PMT (sum of all 4 photo cathodes)
- Added Plots for each photo cathode

Not yet integrated in the normal COOOL version working version can be found under:

```
/online/daq/moritz/coral_trunk/src/cool/src/cool
```

```
/online/daq/shift/shift_plots/[cedar_new.cfg,cedar1_timing.cfg,cedar2_timing.cfg]
```

Finding the right working point I

We checked channel by channel and observed crosstalk between a few channel

During access we found some loose connector and some bad crimpings
→ we exchange them and this issue seemed to be solved.

Problems during finding working point (read out):

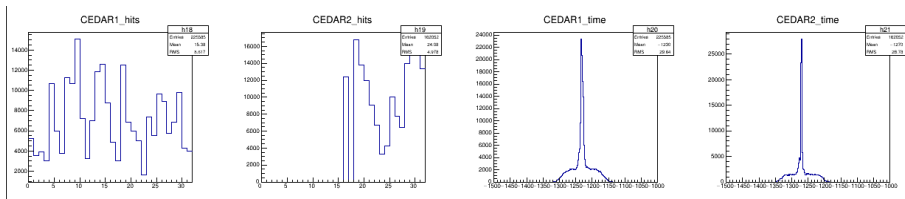
- No Data from one or more TDC → one channel has to high rate → event size exceeding
(affects one TDC or all TDCs on multiplexer)
- Wrong hit timing → mostly solved by reloading FW
Some channel show this behavior more often (TDC4:9,24,29) also rate depended ?
- Two hits with the same timing → Error in timing encoding

Still waiting on new firmware with higher rate capability !
should solve most of the problems !

Finding the right working point II

We started from the values which indicated the border between the noise region (100MHz) and the dark count region (100-200Hz) which we determine with the scope and added some margin to prevent retriggering on the ringing.

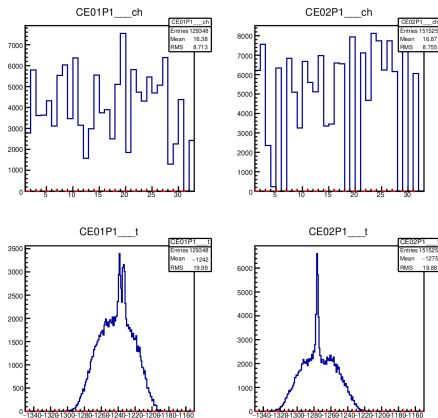
Results for low intensity beam (40mm Target Col1-4@6mm):



But with normal beam conditions we got almost 100% readout error!
First half of CEDAR 2 was fixed by exchanging cable.

Working Points for High intensity

So we reviewed the results from Low Intensity channel by channel for the normal beam conditions (For CEDAR2 we have to make them much higher):

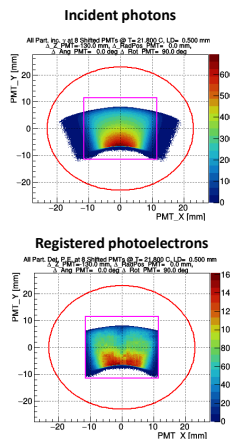


The readout was more stable after closing the diaphragm to 0.35mm and shorten the readout window to 64ns

Monte Carlo Predictions

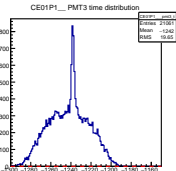
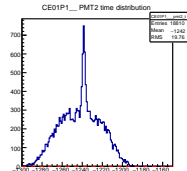
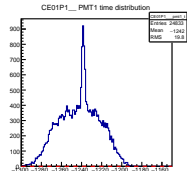
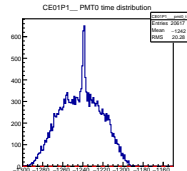
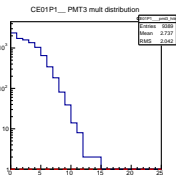
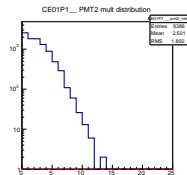
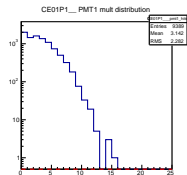
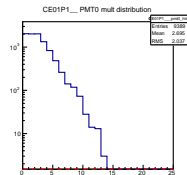
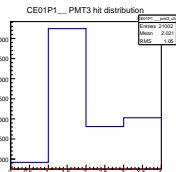
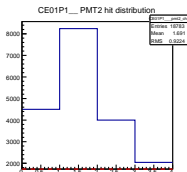
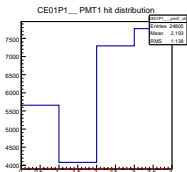
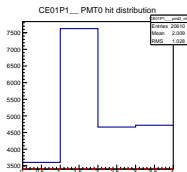
Monte Carlo Predictions

- New results from Monte-Carlo by Flavio
- If the PMT is hit during an event, then average number of PMT pads that get the hit is two
- Average number of photons that hit photocathode (pressure set to kaon) is approx. 6, which gives on average two photoelectrons
 - Recommended threshold is 0.8 p.e.

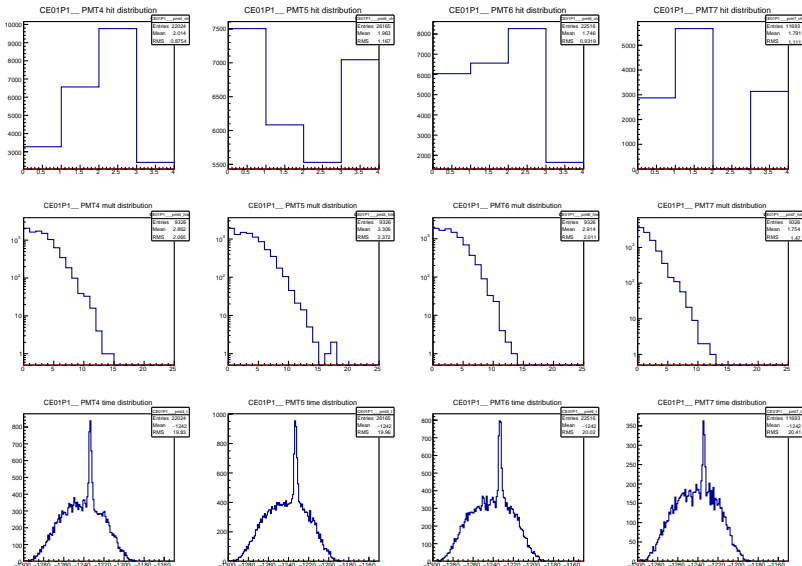


Simulations by Flavio from Marcins TB talk on 03.08.2018

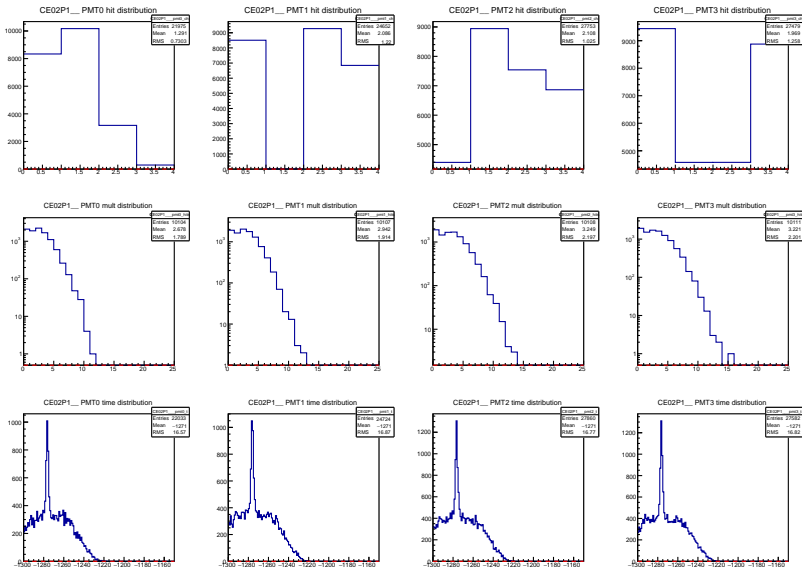
CEDAR1 PMT overview I



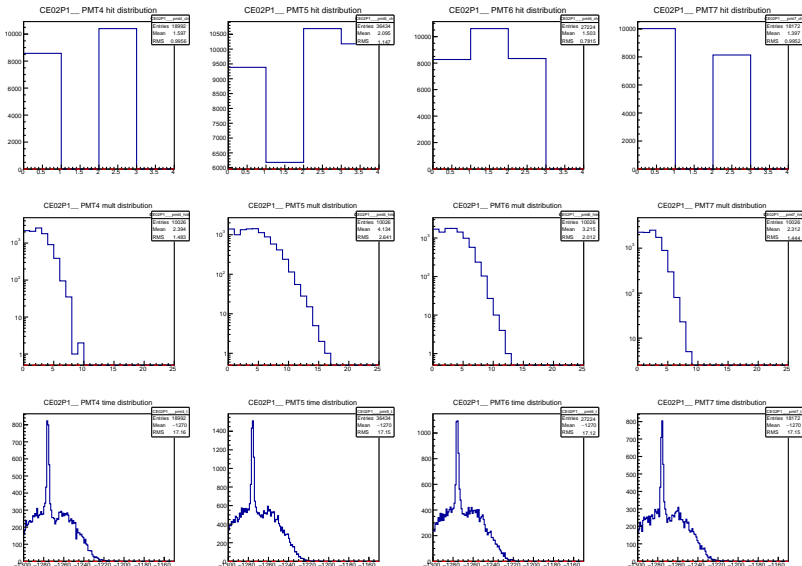
CEDAR1 PMT overview II



CEDAR2 PMT overview I



CEDAR2 PMT overview II



Conclusion

- It seems that the Discriminators and PMT amplifier working fine
Still some problems with ringing but we can deal with it with the right TH
- With high rate we got readout problems and missing some channels
At the moment we solved it by closing the diaphragm to 0.35mm and set the time window to 64ns
- We still need fine tuning of the TH to obtain 0.8pe efficiency
- The automatic threshold scan does not work with the current ifTDC FW
- We still missing some channels due to high rate ?
- We have to make some offline analysis to determine the right working point for high efficiency

We need the new ifTDC firmware with higher rate capability