

Light analysis of 311 PMTs - preliminary results -

Light Detection System meeting

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Overview

Analysis of first light data.

- Raw data.
- Single PhotoElectron.
- Noise characterization.

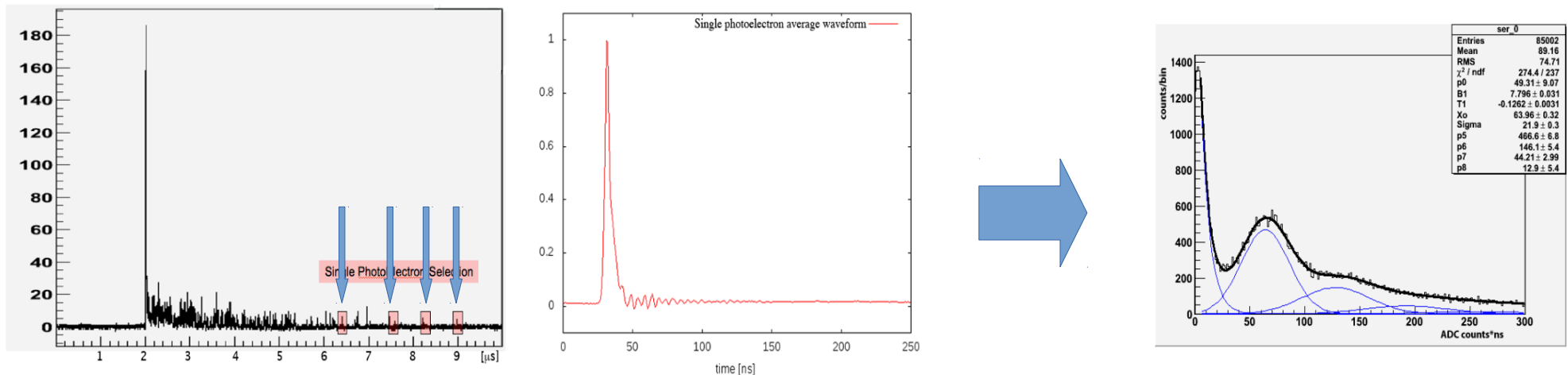
Raw data

- 3h run, march 6th 2017.
- File: output00000211.root, available [here](#).
- Data taken in coincidence with the CRT, but no CRT data available in the root file.
- Almost 4000 events.
- Window of 4 μ s x 4096ADC (12 bits – 2V).
- Sampling of 4ns.

Thank you to Alberto and Silvestro

SPE Spectrum

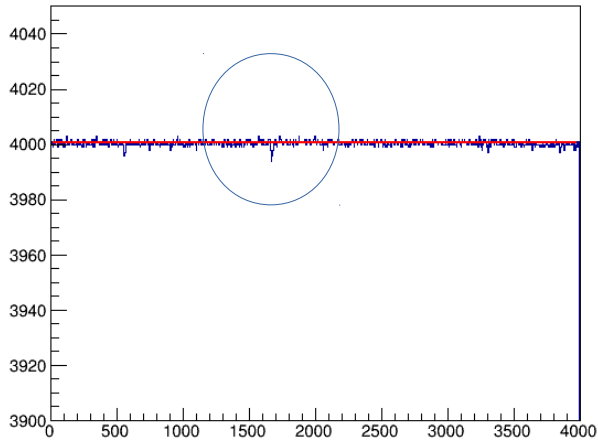
- The goal is to calculate Gain through SPE events identified in the waveform tail, as it is done in the literature [1].



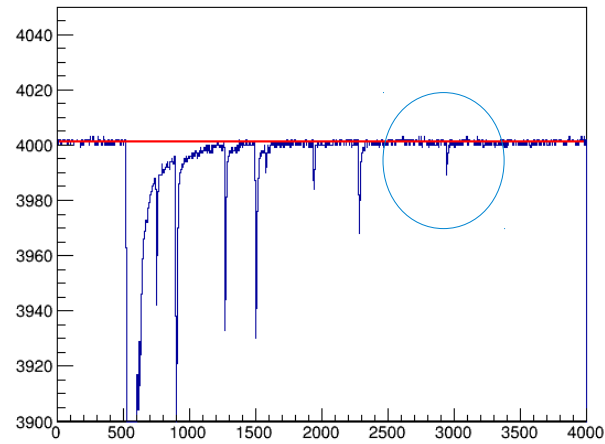
[1] ACIARRI et al. (2011) "Demonstration and Comparison of Operation of Photomultiplier Tubes at Liquid Argon Temperature", arXiv:1108.5584v2.

Looking for SPE candidates

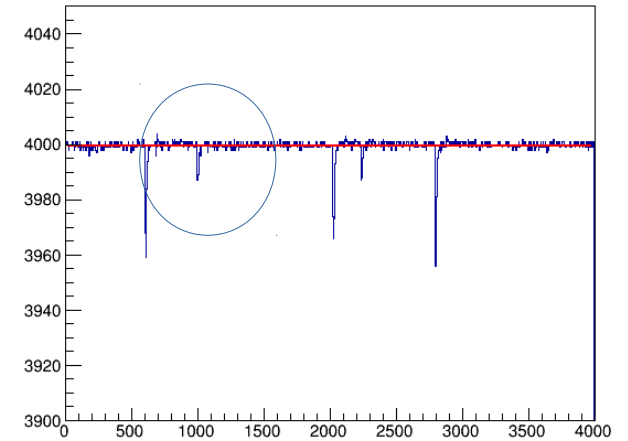
waveform_0_29



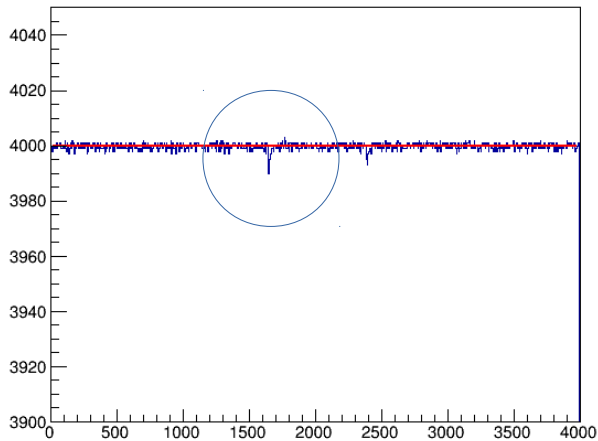
waveform_1_98



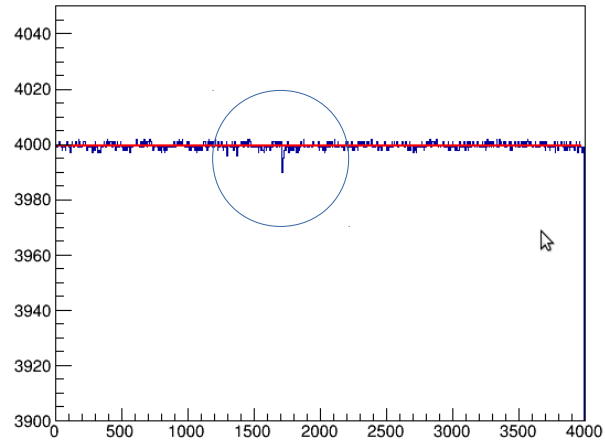
waveform_2_29



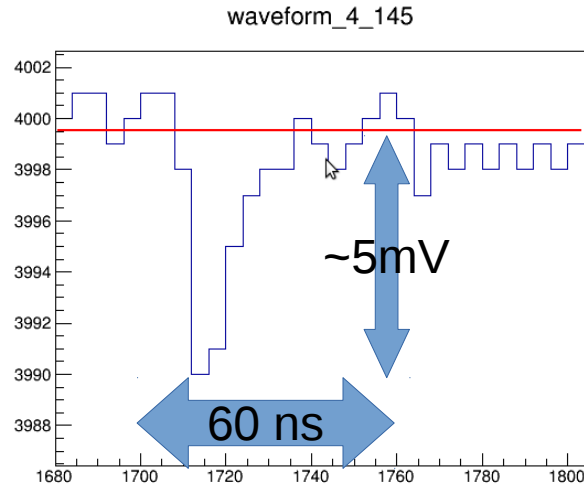
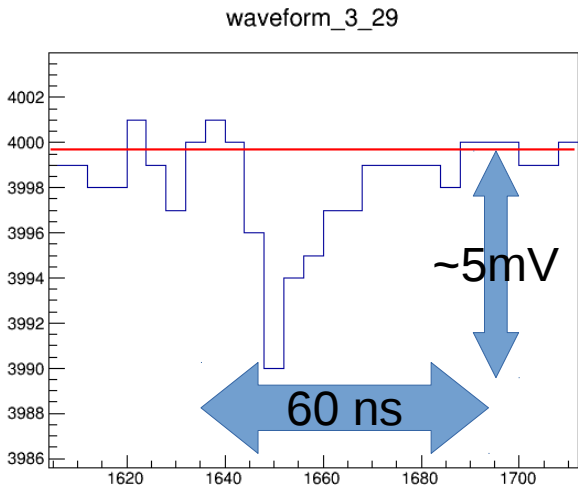
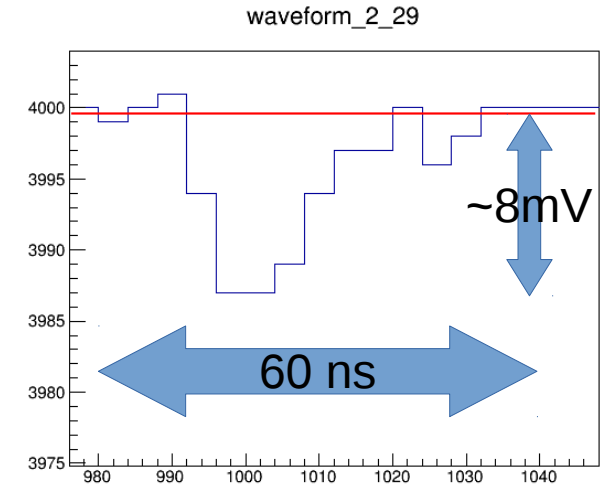
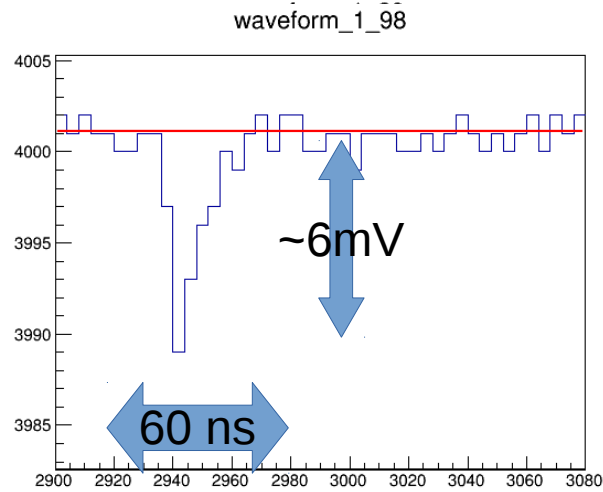
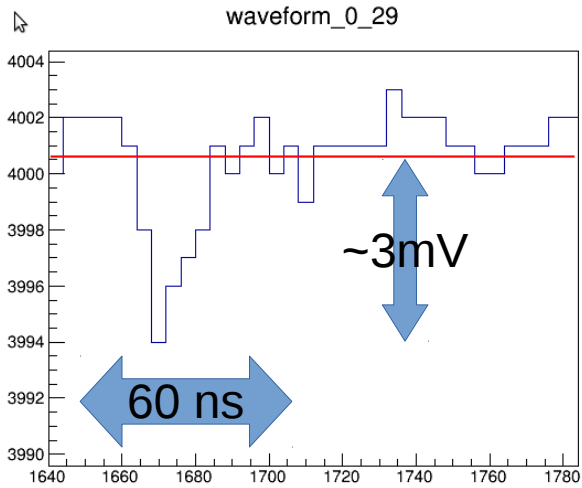
waveform_3_29



waveform_4_145



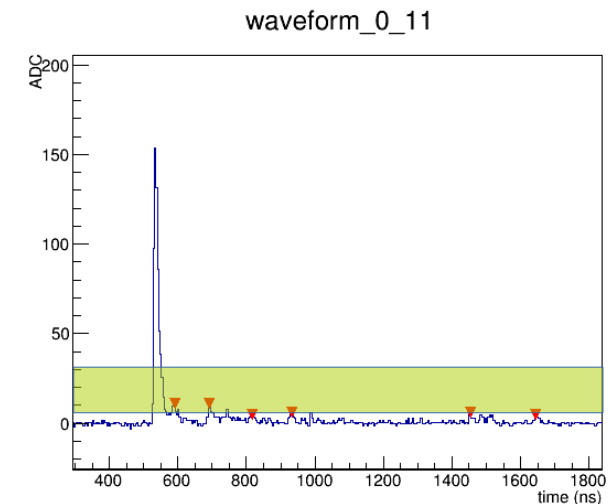
Looking for SPE candidates



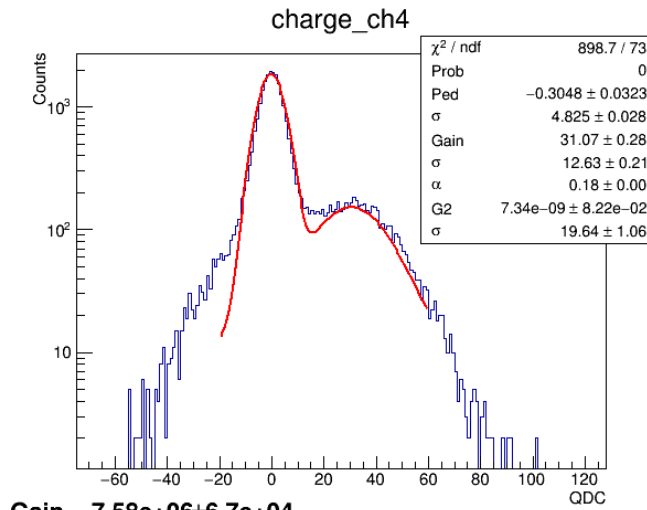
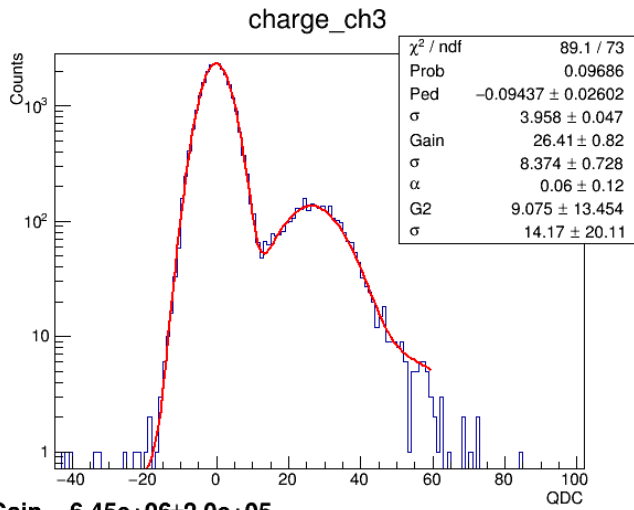
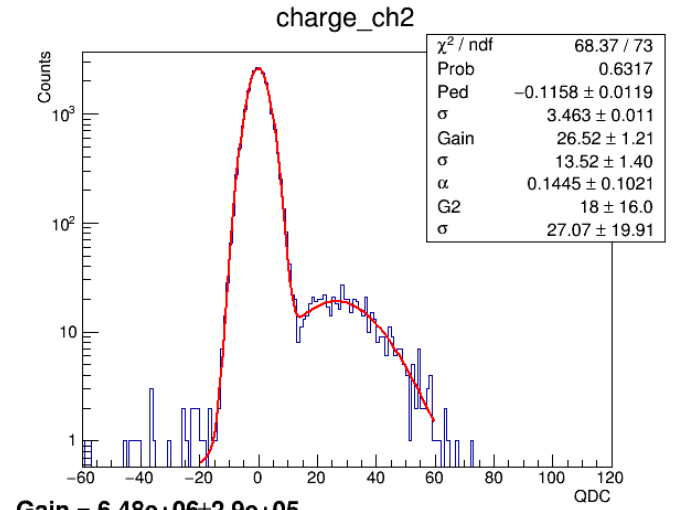
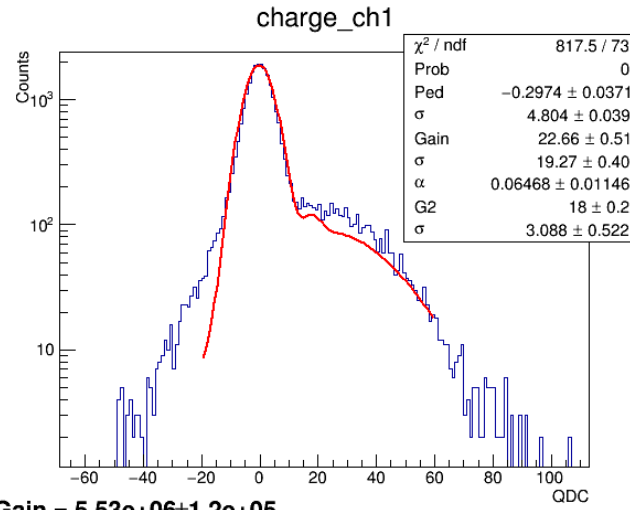
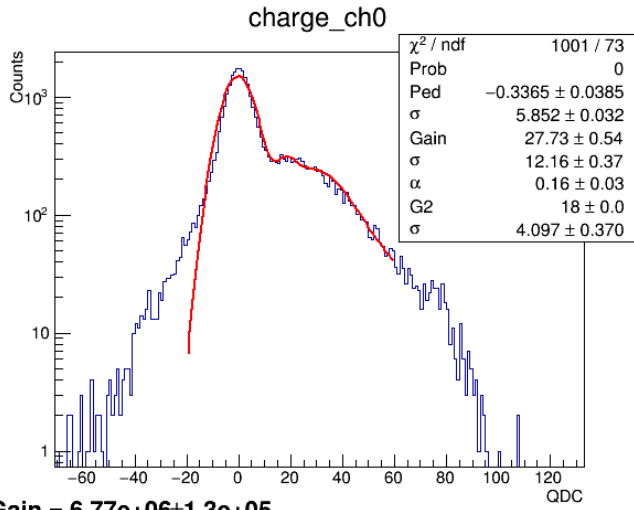
Selecting SPE events:

- Filter SPE events in the tail of muon events.
- Defined a minimum and maximum trigger and within an integration window.
- Window = 60ns (15bins).
- Pedestal only calculated in the first 500ns, if StdDev is lower than 3ADC (~1.5mV) to delete noise.

Channel	Trigger (ADC)	Max (ADC)
0	3	9
1	3	9
2	4	12
3	3	9
4	3	9

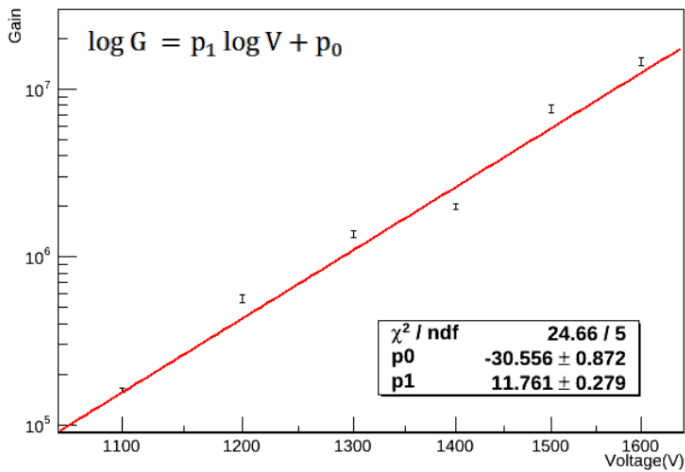


SPE spectrum

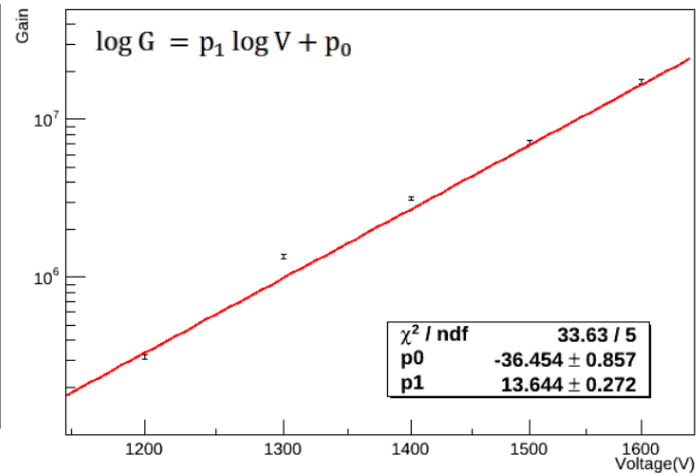


Expected gain

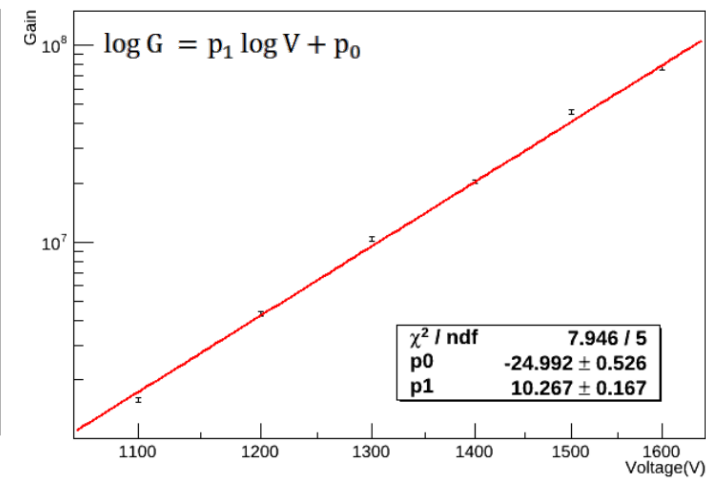
FA093 coated + KEK base



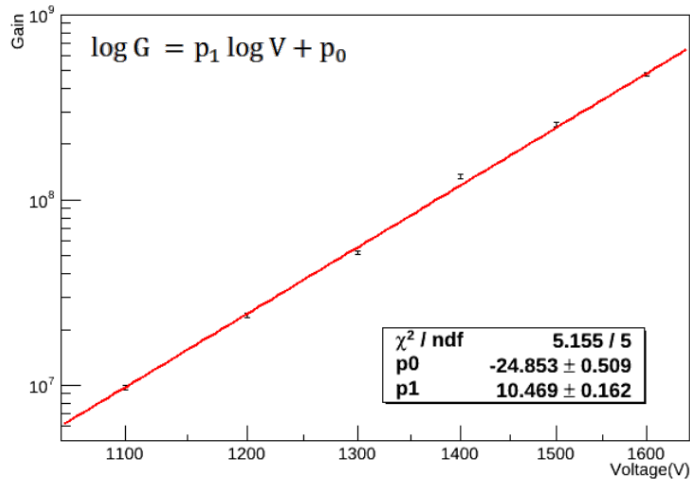
FA092 + Coated plate + KEK base



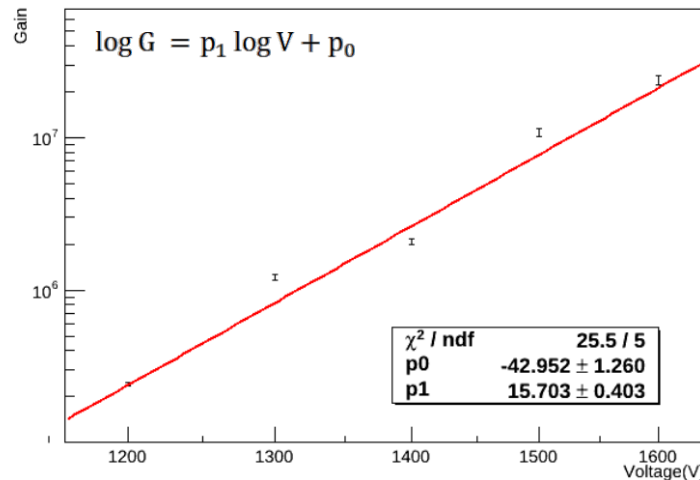
FA090 coated + CIEMAT base



FA094 + Coated plate + CIEMAT base



FA091 coated + KEK base



From the calibration done by Diana Navas and Laura Zambelli on may 2015.

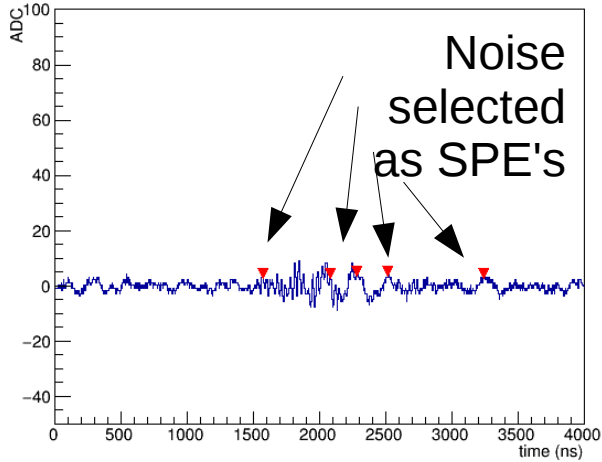
Preliminary results:

- Still on progress.
- Several filters are being developed to delete noise, and increase the efficiency of collecting SPE events.

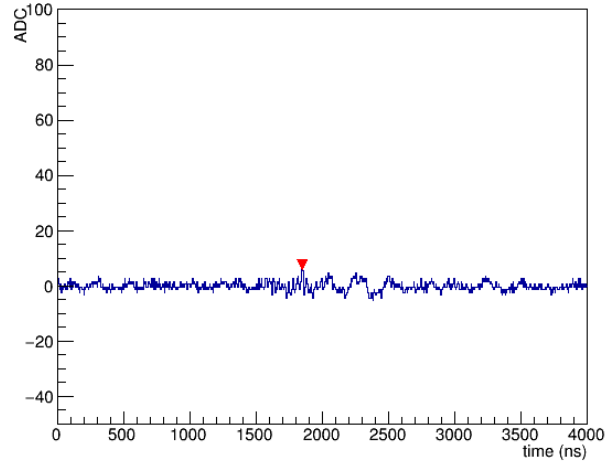
Channel	0	1	2	3	4
PMT	FA0093	FA0092	FA0090	FA0094	FA0091
Gain (2015)	6.3e6	7.6e6	9.5e6	9.7e6	8.4e6
New Gain:	-	-	~6.5e6	~6.5e6	~7.5e6
Voltage	-1500	-1500	1300v	1100v	-1500
PTB	Coated	Coated plate	Coated	Coated plate	Coated

Noise damage the SPE spectrum

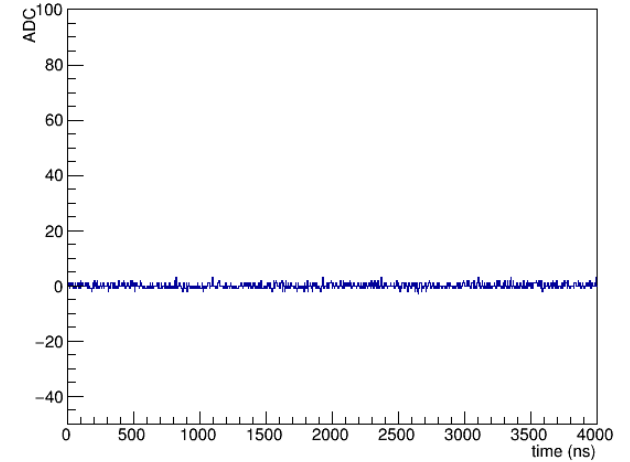
waveform_0_119



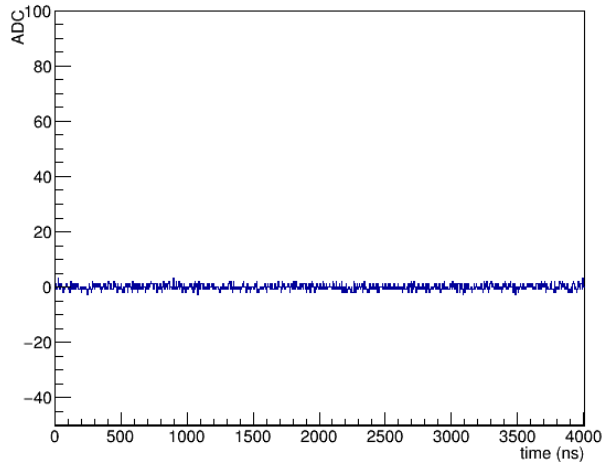
waveform_1_119



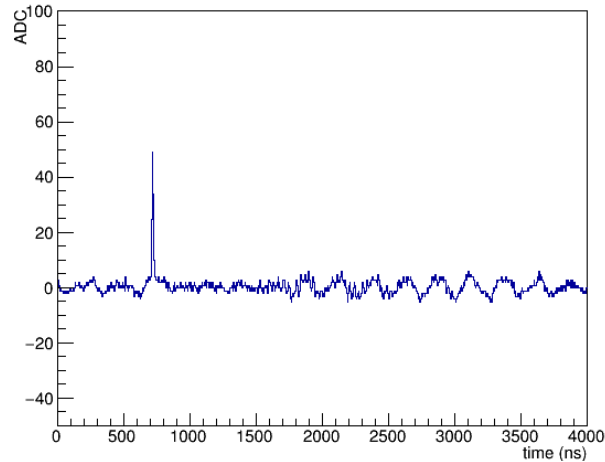
waveform_2_119



waveform_3_119



waveform_4_119

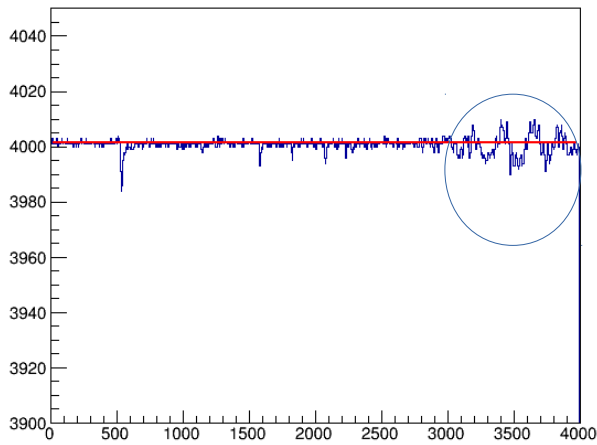


Noise analysis

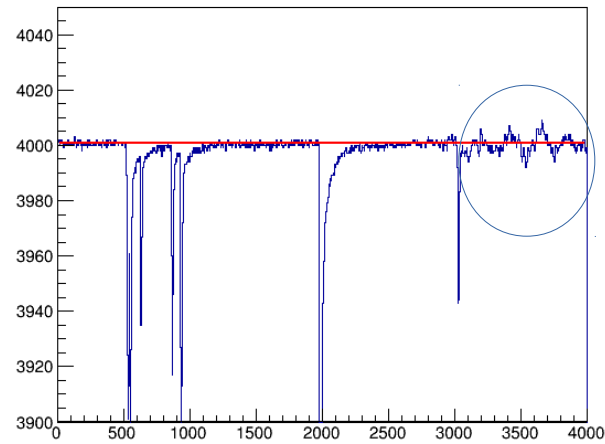
- We see some missing stability in the signal of some channels.
- Ch0, ch1 and ch3 with positive base, and two cables - > more noise expected.
- Oscillations larger than SPE signal → They can mask each other.
- Should we consider a filter to delete the noisy data?
- Are the different channels noise correlated?

Noise in ch0, ch1 & ch4?

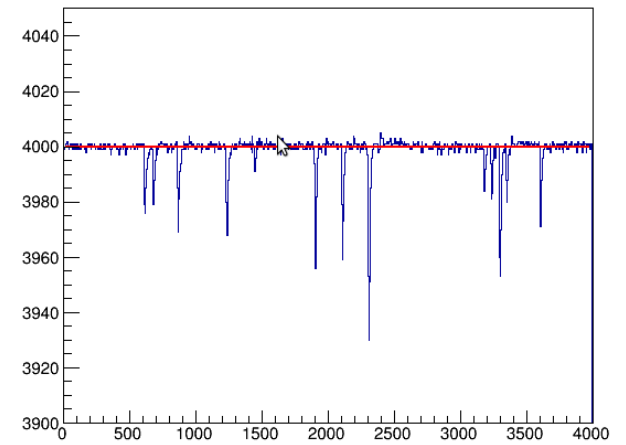
waveform_0_153



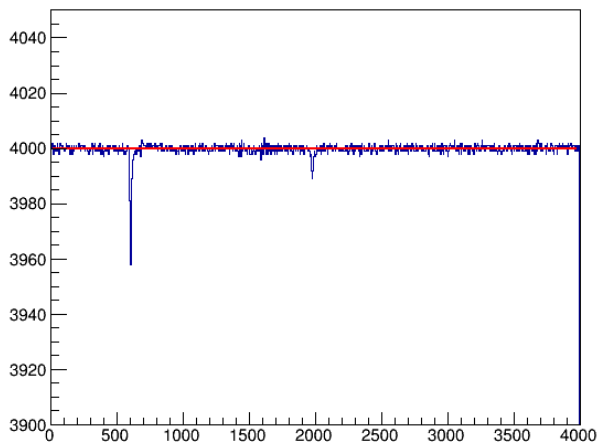
waveform_1_153



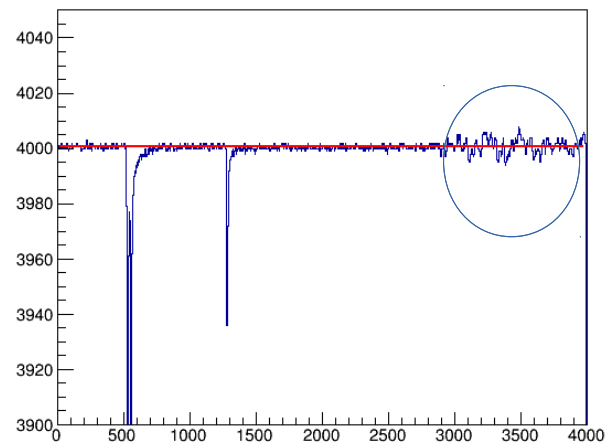
waveform_2_153



waveform_3_153

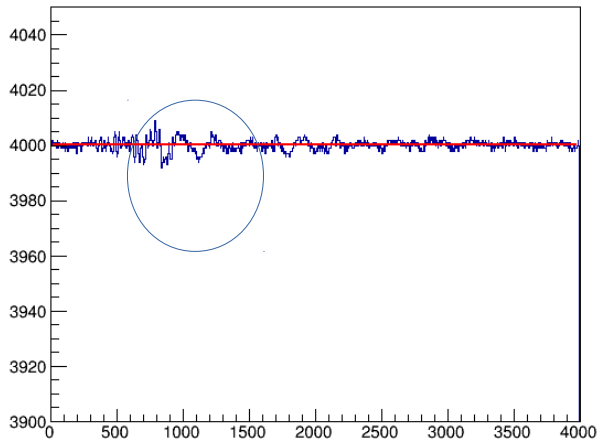


waveform_4_153

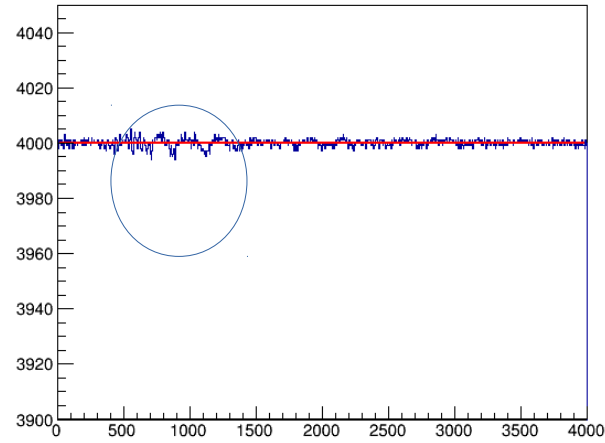


Noise in ch0, ch1 & ch4?

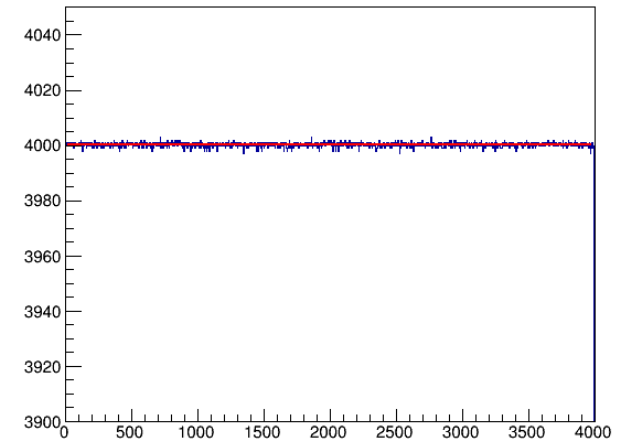
waveform_0_160



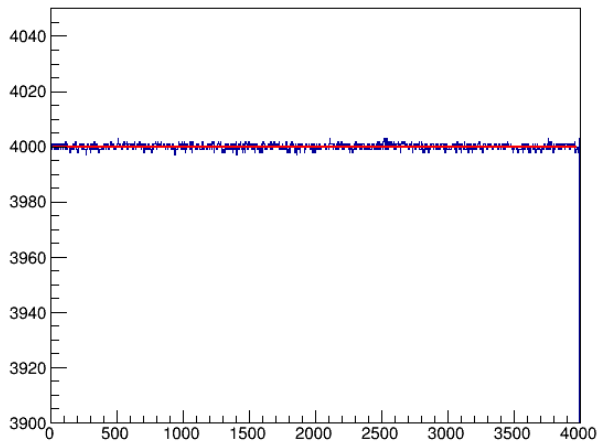
waveform_1_160



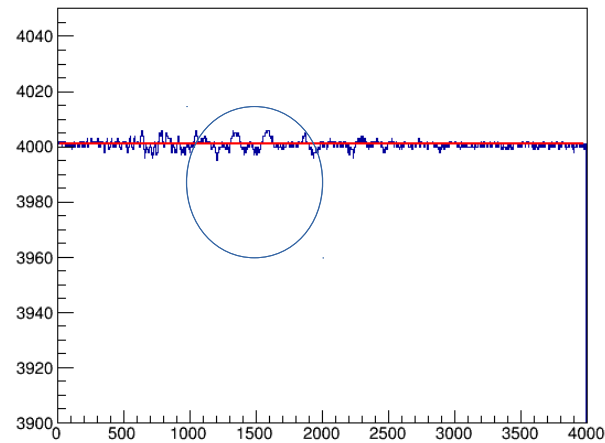
waveform_2_160



waveform_3_160

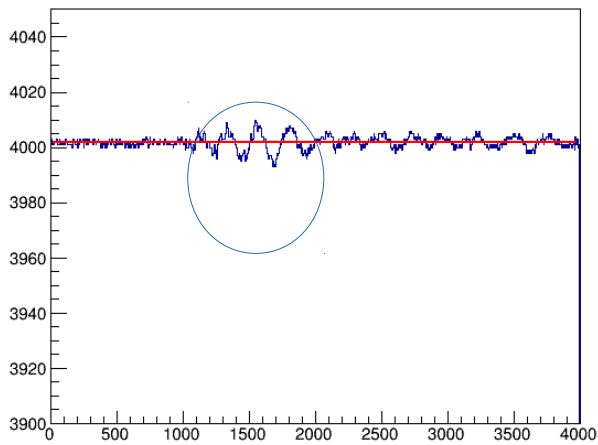


waveform_4_160

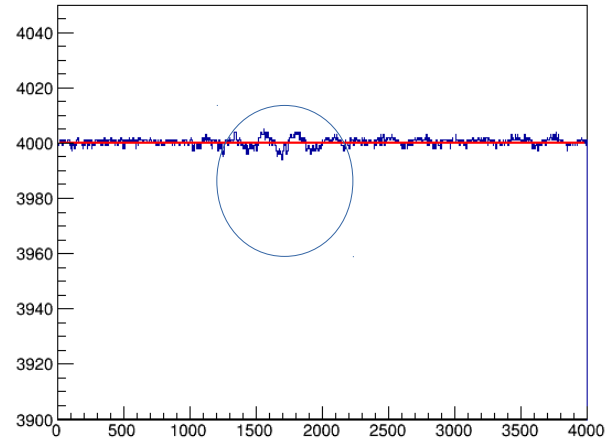


Noise in ch0, ch1 & ch4?

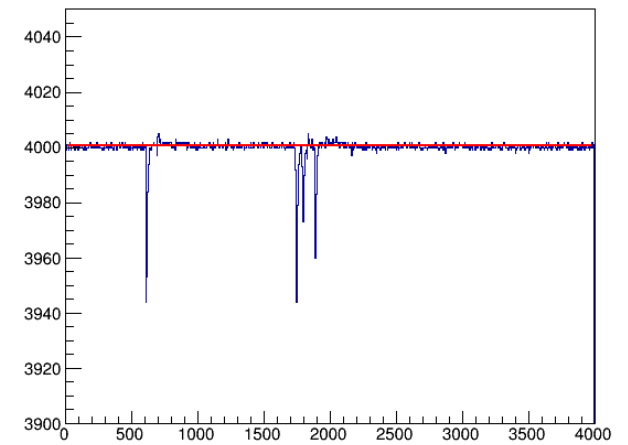
waveform_0_167



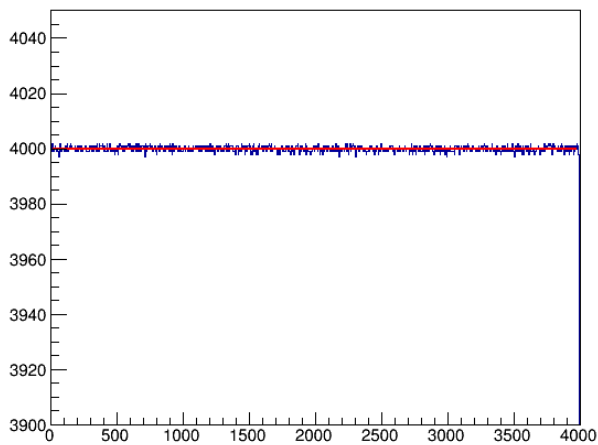
waveform_1_167



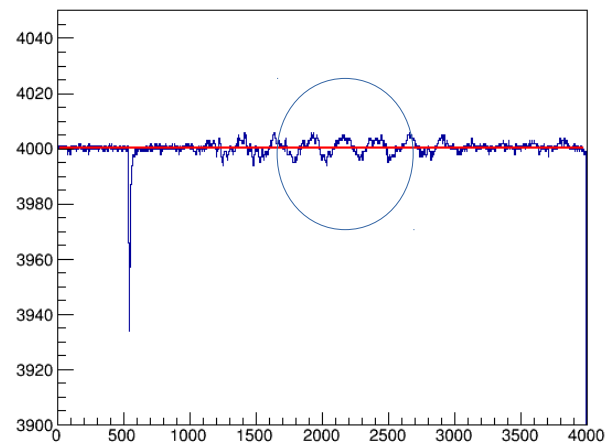
waveform_2_167



waveform_3_167



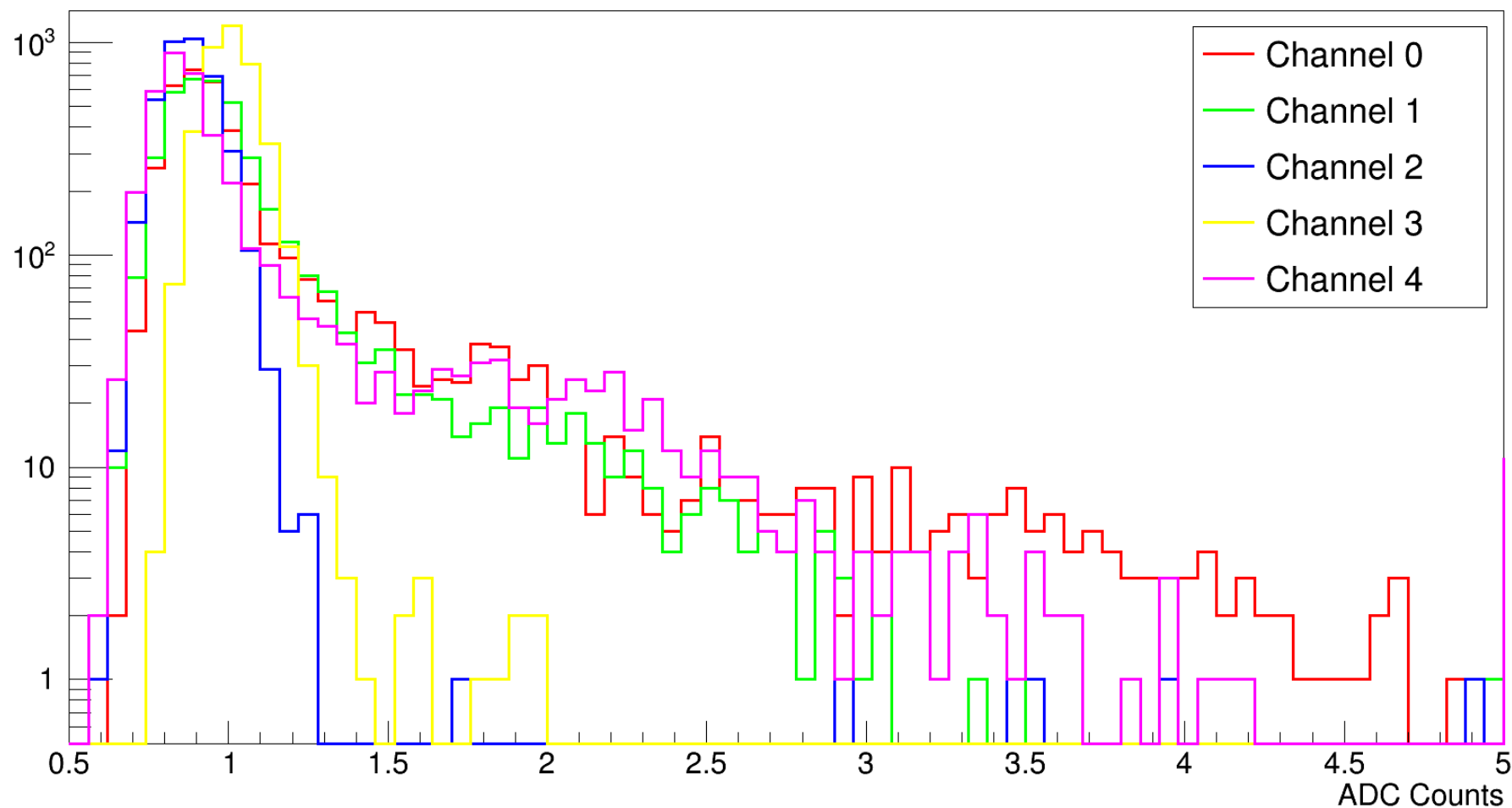
waveform_4_167



4

Noise in ch0, ch1 & ch4

Pedestal standard deviation distribution



Noise analysis

- Next steps:
 - To be able to detect noisy events, and further study the correlation of noise between channels.
 - To find if this noise have a defined frequency - > Some external signal is coupling?

Thank you.