Coldbox analisys: HD-VD insights

Federico Galizzi - CERN

Major suspected

t

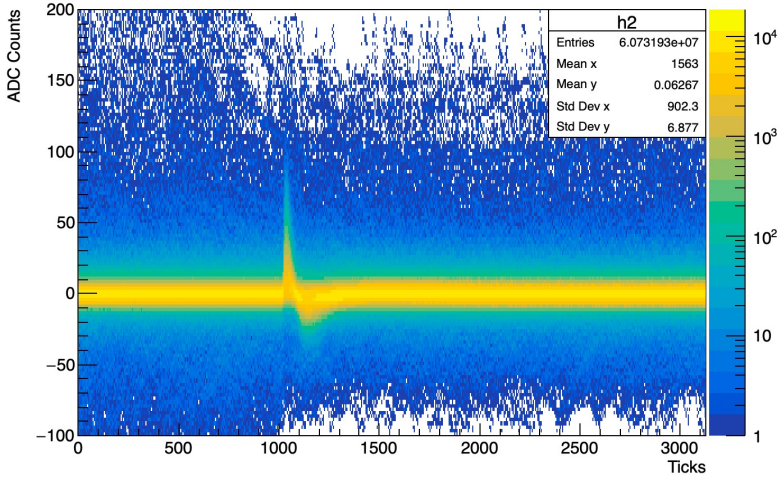
- Waveform selection (cuts) and difference in statistics
- Fit function
  - Dante & Ajib: $Gaus(\mu_0, N_0, \sigma_0) + Gaus(\mu_1, N_1, \sigma_1) + Gaus(\mu_2, N_2, \sigma_2)$
    - 9 parameters, 3 peaks
    - Let's call it 3Gaus
  - Federico: $Gaus(\mu_0, N_0, \sigma_0) + Gaus\left(\mu_0 + G, N_1, \sqrt{\sigma_0^2 + \sigma_{cel}^2}\right) + Gaus\left(\mu_0 + 2G, N_1, \sqrt{\sigma_0^2 + 2\sigma_{cel}^2}\right) \ldots$
    - 10 parameters, 6 peaks
    - Let's call it 6Gaus
- Fit range

Cuts & statistics

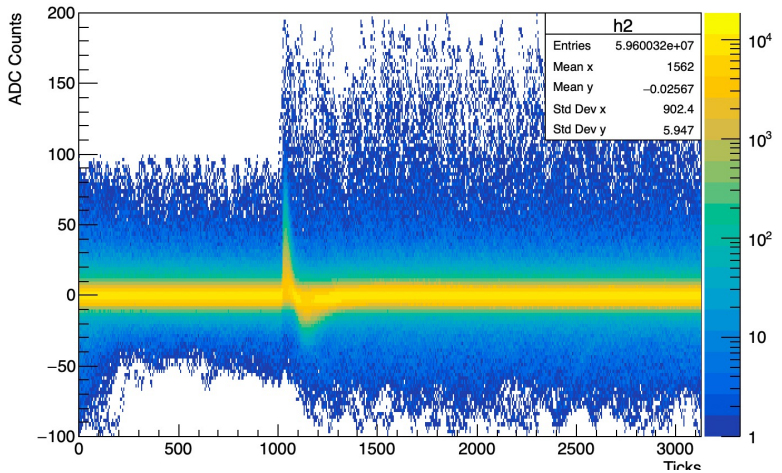
The cuts are a requirement on the baseline

- Signals in the baseline affect its estimation
  - We have to assess the SNR of the electronic, so reducing ”environmental effects” and biases in the analysis is desiderable
- BSL = the threshold (in ADC) on the pre-trigger

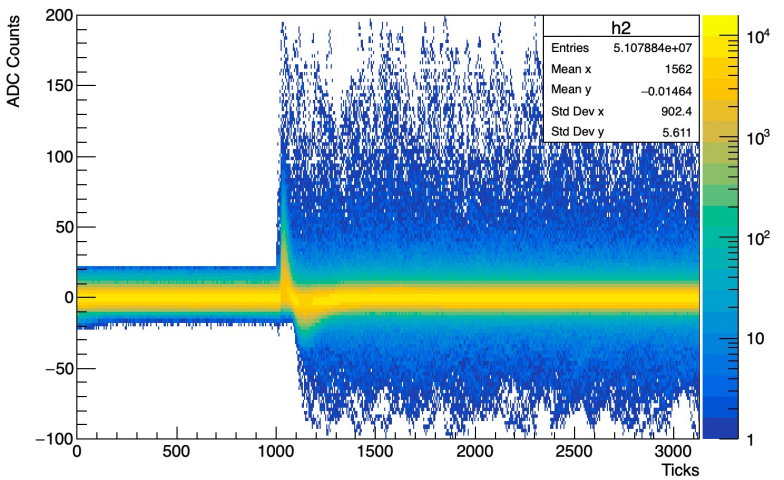
No cuts



BSL = 100



BSL = 22



Cuts & statistics

Results

Negligible difference between 8’000 and 40’000. Once you have thousands of events in the 0 pe and 1 pe peak, the fit is stable.

The positioning of the integration window has an impact.

The cuts are useful to discard events with a dirty baseline

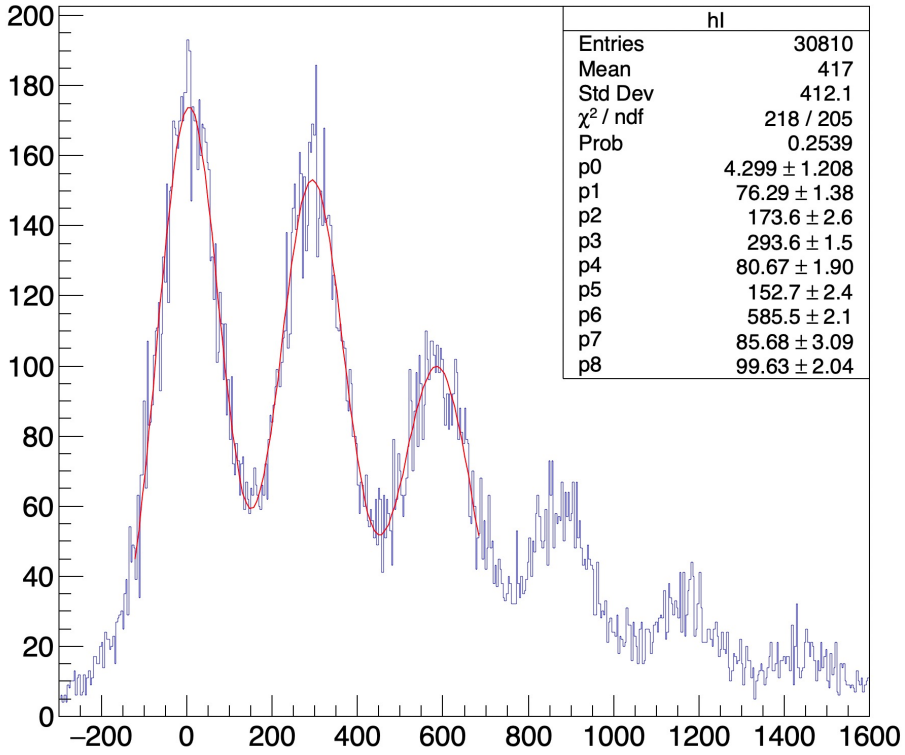
	Int win	erase	V Bias	Attenuation	mu0	emu0	Gain	eGain	s0	es0	SNR	Comments
HD 24062	1020-1070	1500	32.5	1925	4.3	2	290.4	1.2	77	1.5	3.77	No cuts - Enries: 8000 - WF 500
	1020-1070	1500	32.5	1925	5.5	1.5	289.4	0.96	78.2	0.67	3.70	No cuts - Enries: 16000 - WF 1000
	1020-1070	1500	32.5	1925	4.2	1.2	289.7	0.81	77.7	0.98	3.73	No cuts - Enries: 24000 - WF 1500
	1020-1070	1500	32.5	1925	4.7	0.94	289.1	0.64	77.8	0.75	3.72	No cuts - Enries: 40000 - WF 2500
	1016-1066	1500	32.5	1925	4.7	0.94	279.1	0.63	77	0.74	3.62	"" Same integration window as Dante
	1016-1066	1500	32.5	1925	0.81	1.2	279.3	0.82	82.3	0.94	3.39	"" Baseline computed only on 500 ticks
	516-566	2000	32.5	1925	3.5	1	279.6	0.71	79	1.8	3.54	"" Baseline computed only on 500 ticks immediately before the pulse
	1020-1070	1500	32.5	1925	4.5	0.97	289.2	0.65	77.5	0.78	3.73	Bsl 100 - Entries: 38130 - WF 2500
	1020-1070	1500	32.5	1925	4.5	0.94	289	0.62	77	0.75	3.75	Bsl 60 - Entries 37700 - WF 2500
	1020-1070	1500	32.5	1925	3.7	1	289.4	0.65	76.9	0.79	3.76	Bsl 40 - Entries 36900 - WH 2500
	1020-1070	1500	32.5	1925	2	1.1	289.8	0.68	75.8	0.82	3.82	Bsl 22 - Entries 32600 - WF 2500
	1020-1070	1500	32.5	1925	2.4	1.3	288.5	0.76	72.4	1	3.98	Bsl 13 - Entries 16520 - WF 2500
	Int win	erase	V Bias	Attenuation	mu0	emu0	Gain	eGain	s0	es0	SNR	Comments
VD 24062	1015-1065	1500	32.5	1925	-1.2	2	248.8	1.6	68.1	1.7	3.65	No cuts - Enries: 8000 - WF 500
	1015-1065	1500	32.5	1925	-0.75	1.6	248.7	1.2	68.8	1.3	3.61	No cuts - Enries: 16000 - WF 1000
	1015-1065	1500	32.5	1925	-1.3	1.3	249.6	1	70	1	3.57	No cuts - Enries: 24000 - WF 1500
	1015-1065	1500	32.5	1925	-0.66	0.96	250.1	0.74	69.7	0.79	3.59	No cuts - Enries: 40000 - WF 2500
	1015-1065	1500	32.5	1925	-0.9	0.96	250.5	0.71	69.8	0.79	3.59	Bsl 100 - Entries: 38150 - WF 2500
	1015-1065	1500	32.5	1925	-0.93	0.97	250.4	0.72	69.6	0.79	3.60	Bsl 60 - entries: 37670 - WF 2500
	1015-1065	1500	32.5	1925	-1.1	1	250.4	0.73	69.3	0.81	3.61	Bsl 40 - Entries: 37070 - WF 2500
	1015-1065	1500	32.5	1925	-1.7	0.97	250.6	0.72	68.9	0.98	3.64	Bsl 22 - entries: 35080 - WF 2500
	1015-1065	1500	32.5	1925	-2.5	0.99	250.6	0.75	68.2	0.8	3.67	Bsl 16 - Entries: 33134 - WF 2500
	1015-1065	1500	32.5	1925	-5.3	1.3	250.4	1	64.8	1.1	3.86	Bsl 8 - Entries: 14670 - WF 2500

Fit function

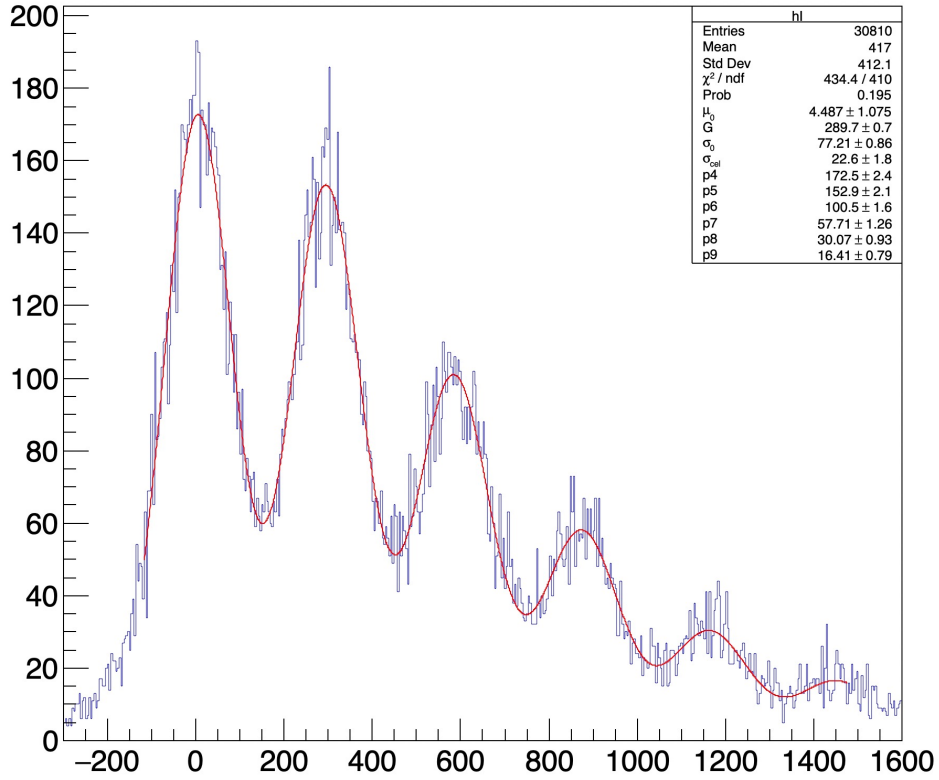
Correlation of the parameters

- In certain condition, they give similar mean values
- 3Gaus-fit returns larger uncertainity due to more degrees of freedom

3Gaus: Gain = p3-p0 = 289.4
SNR = Gain/p1 = 3.79



6Gaus: Gain = G = 289.7
SNR = G/σ_0 = 3.75

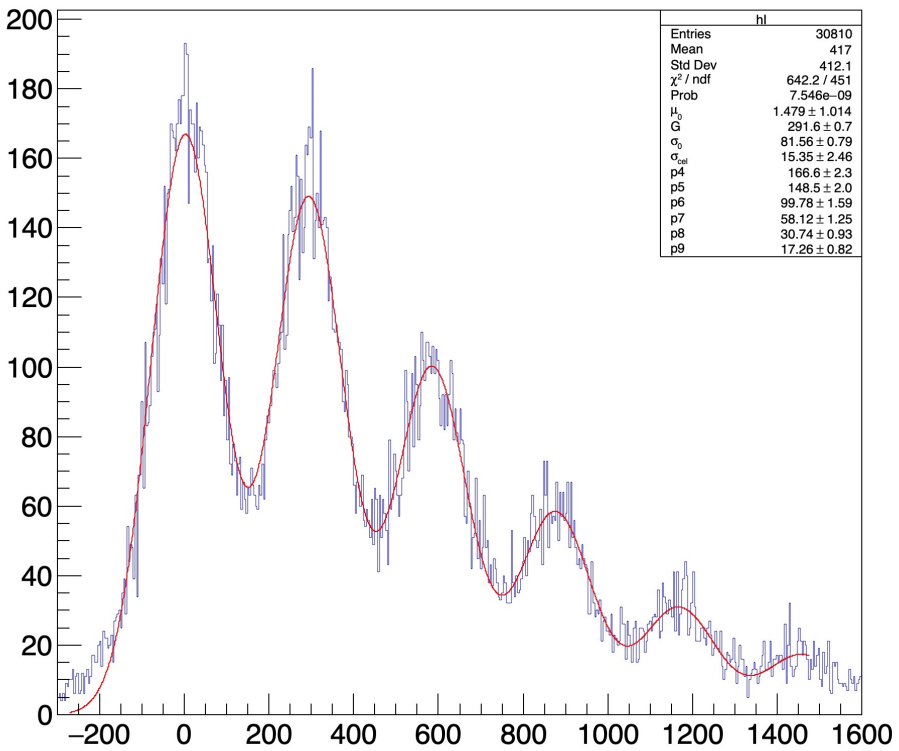


Fit range

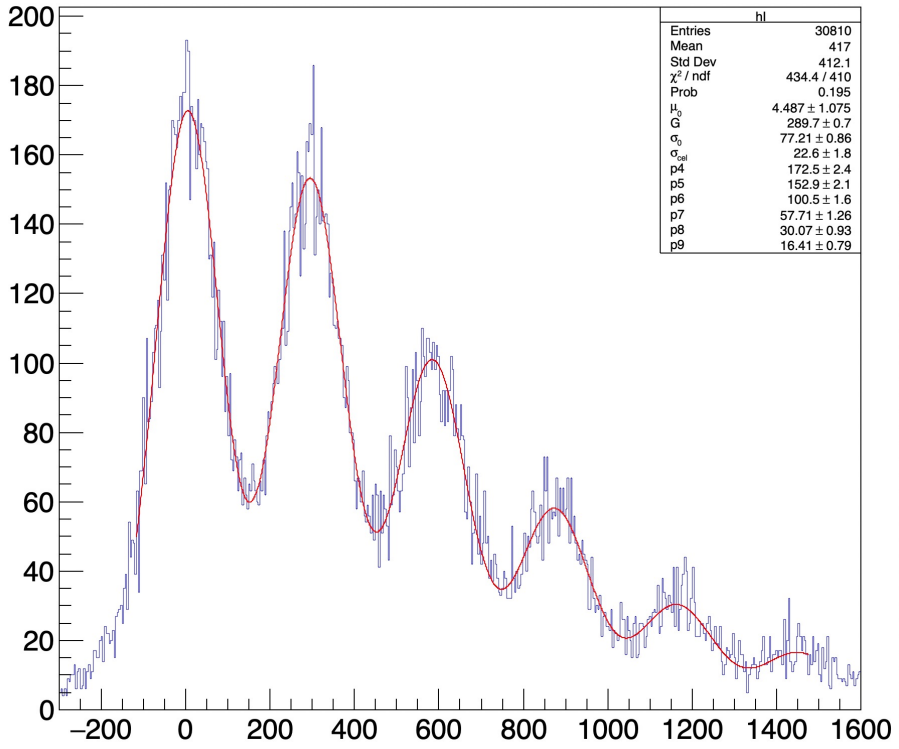
Critical point?

- The 0 p.e. peak has non-gaussian left tail (especially without cuts!) -> bias on σ_0
- The χ^2 suggests to limit the fit range, excluding the tail (see also next slides)

SNR = 3.58



SNR = 3.75

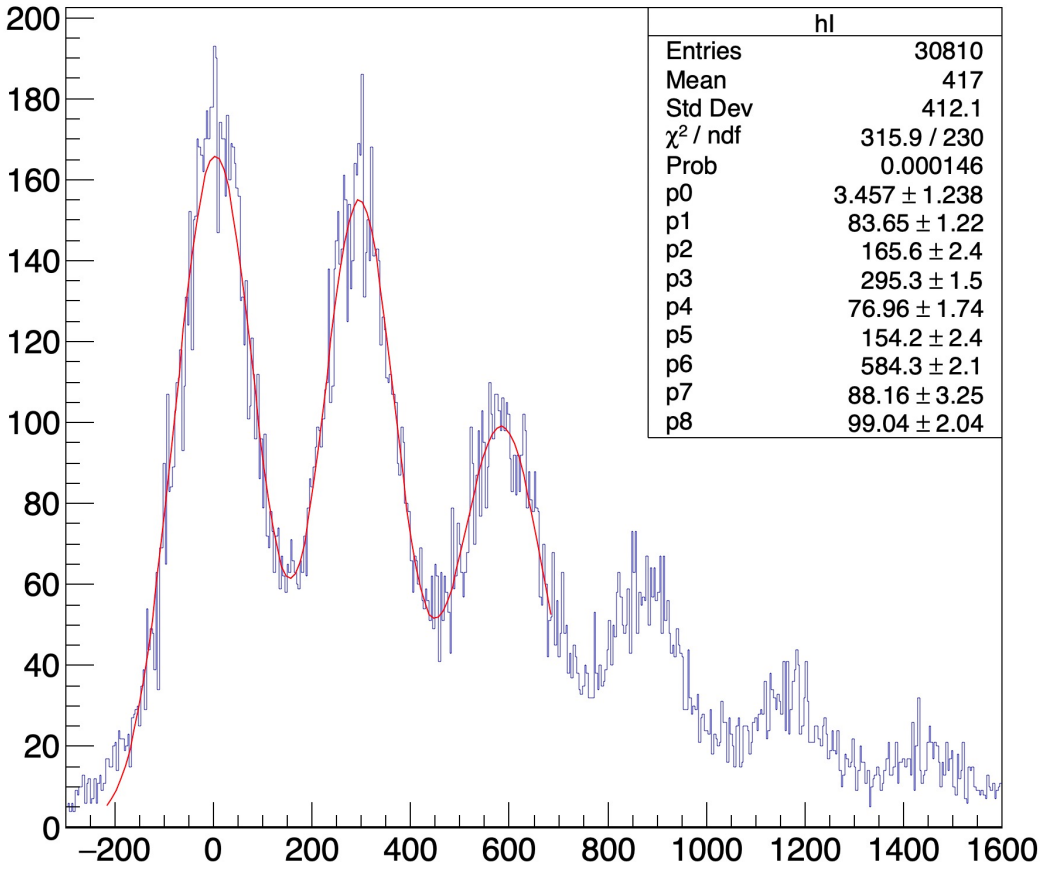


Fit range

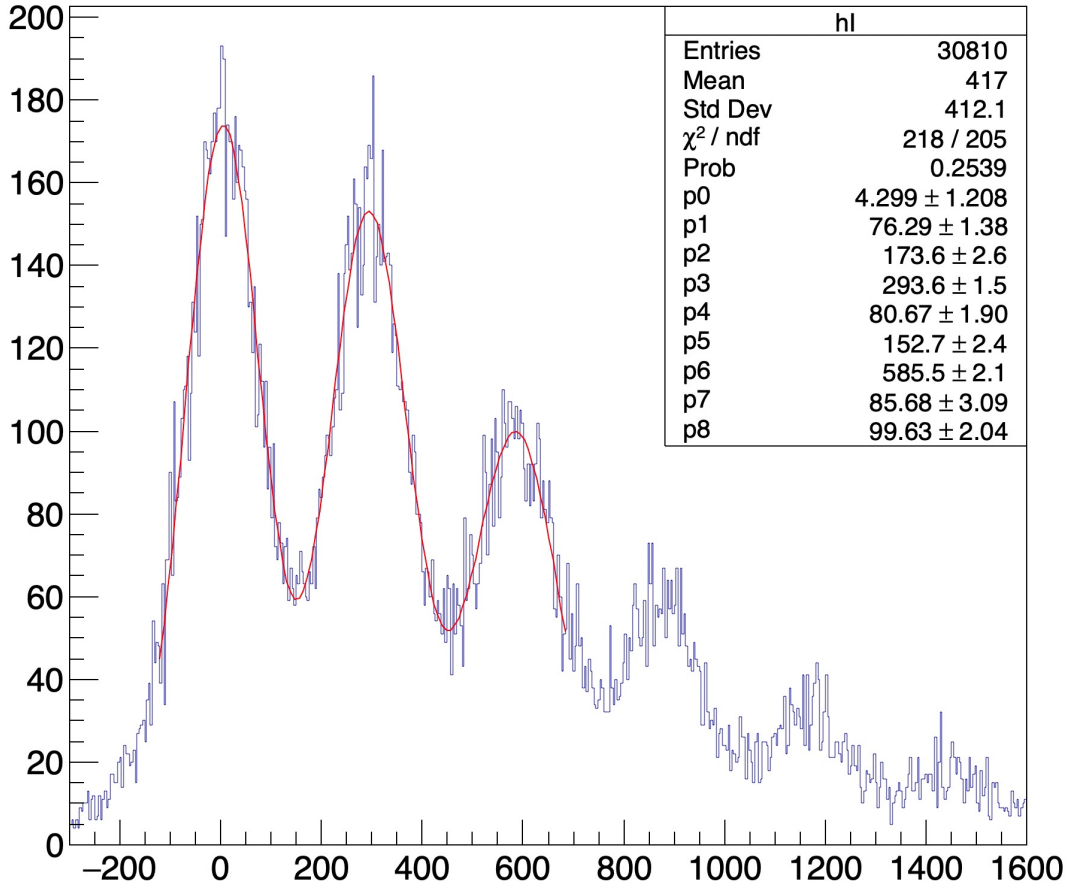
Pt.2

- The same happens with 3Gaus

SNR = 3.49



SNR = 3.79



Fit range

Pt.3

- Here I am integrating a region where no signal are expected, a way to estimate σ_0 independently and with more statistics.
- Same behaviour of χ^2 and σ_0