FLAME – PRELIMINARY ANALYSIS

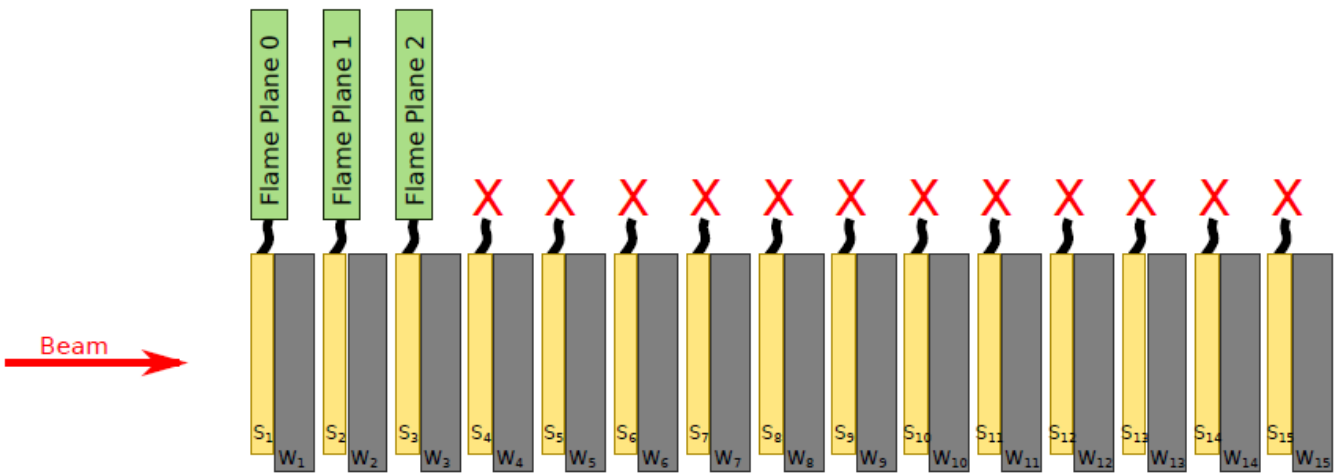
November 25, 2020

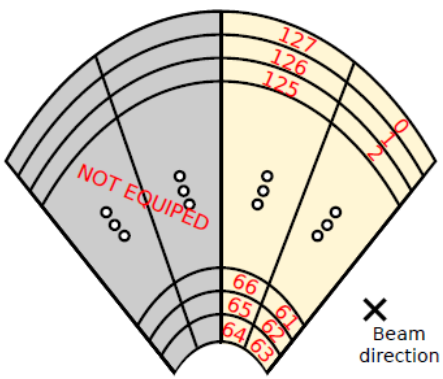
Intro – goal

Purpose

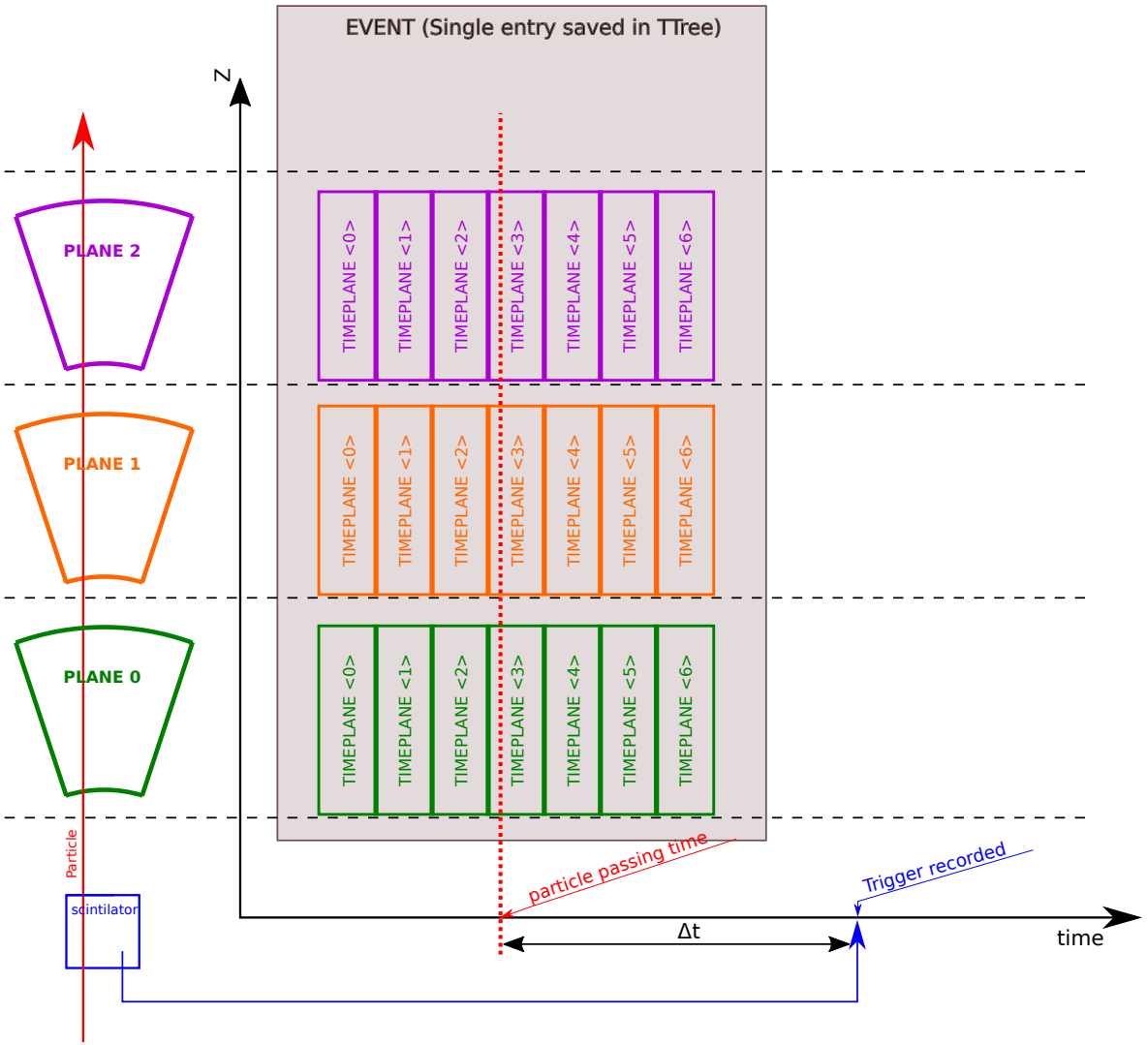
Calibrate channels, investigate channel to channel gain variations

- Calibration can be easily obtained from MIP peak position → data without tungsten plate chosen
- Main focus on Plane 0 → clear data sample
- Configuration (A-) – logbook





Stored data structure



- There is a delay (Δt) between the time when the particle is passing through the setup and time when trigger information is recorded by readout
- It needs to be taken to account and proper offset has to be applied during data-taking to save valuable frames (timeplanes)
- To have save margin for each trigger received, 7 consecutive frames (timeplanes) are stored (expected == timeplane[3] +/- 3)

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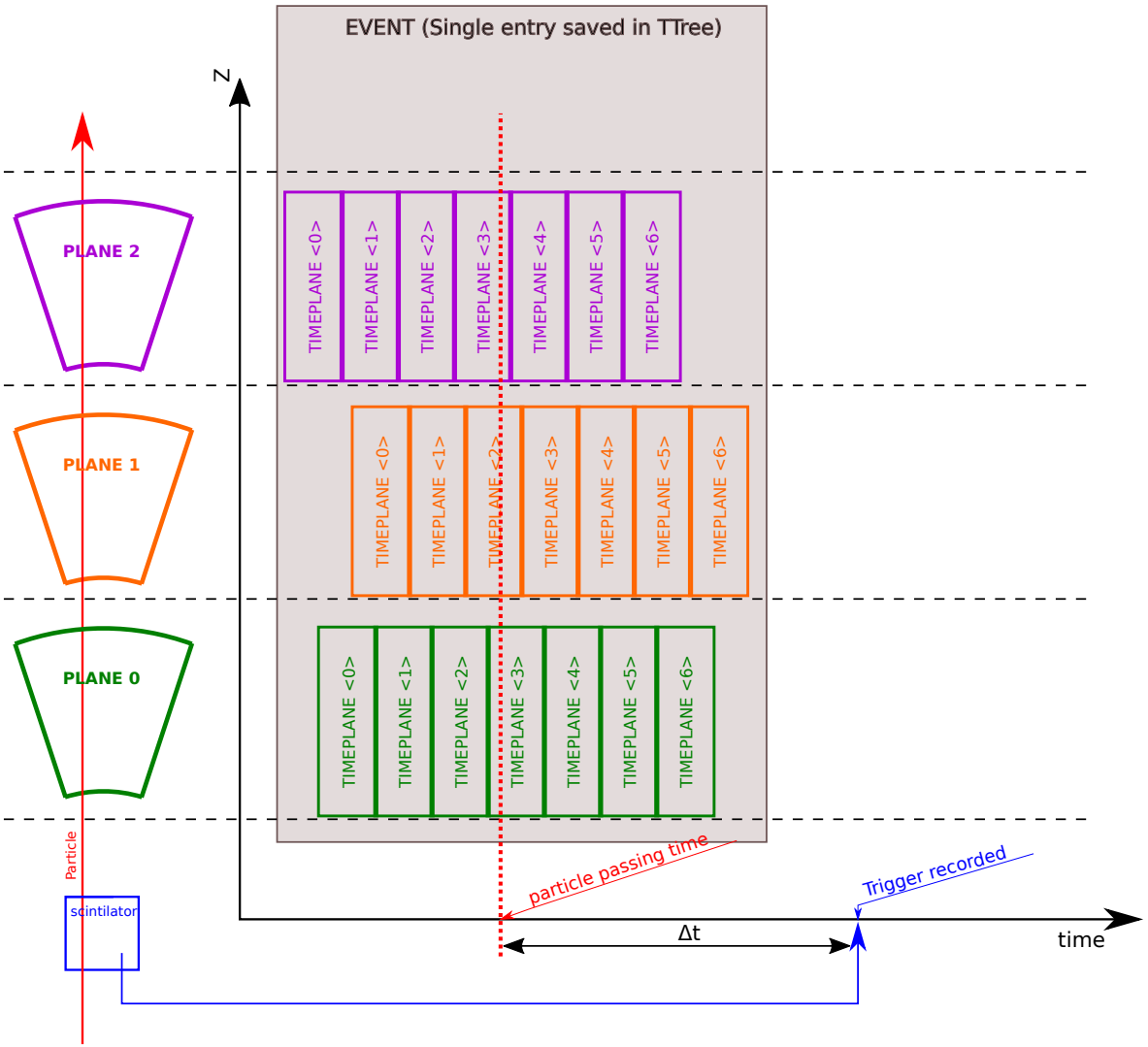

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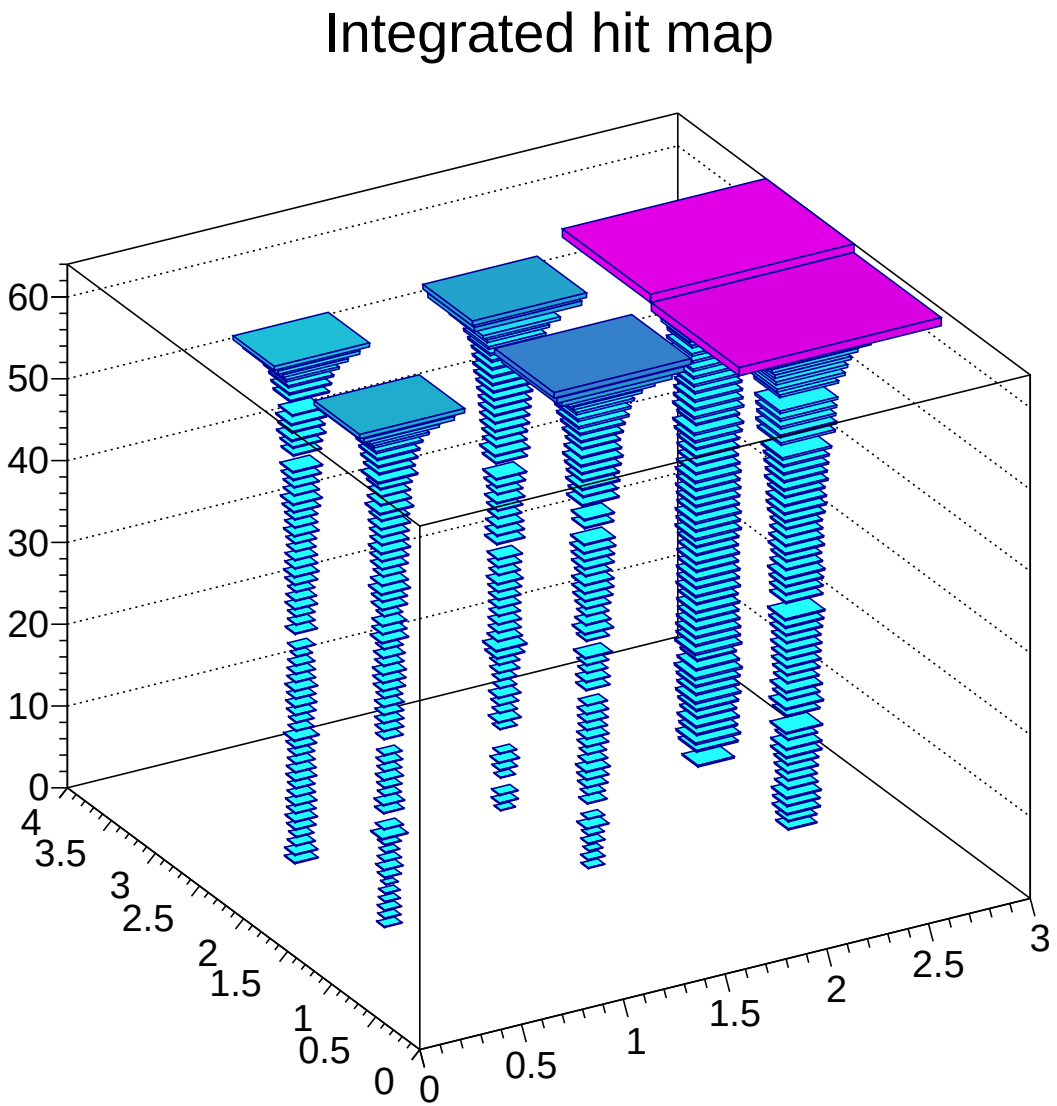
- To have save margin for each trigger received, 7 consecutive frames (timeplanes) are stored (expected == timeplane[3] +/- 3)
- Moreover in the current setup each plane was running with independent FPGA clk → thus the asynchronizations between planes may occure
- theoretically we expected each hit to be in timeplane = 3, but it might happen that signal will be in other timeplane
- thus 3 frames back and front in reference to the trigger are saved in the event

Event selection – chain of runs



- we want to make channel calibration → need to have signal in each channel
- single run → beam covers only the part of the FLAME plane
- concatenation of runs 833-868
- signal in each channel

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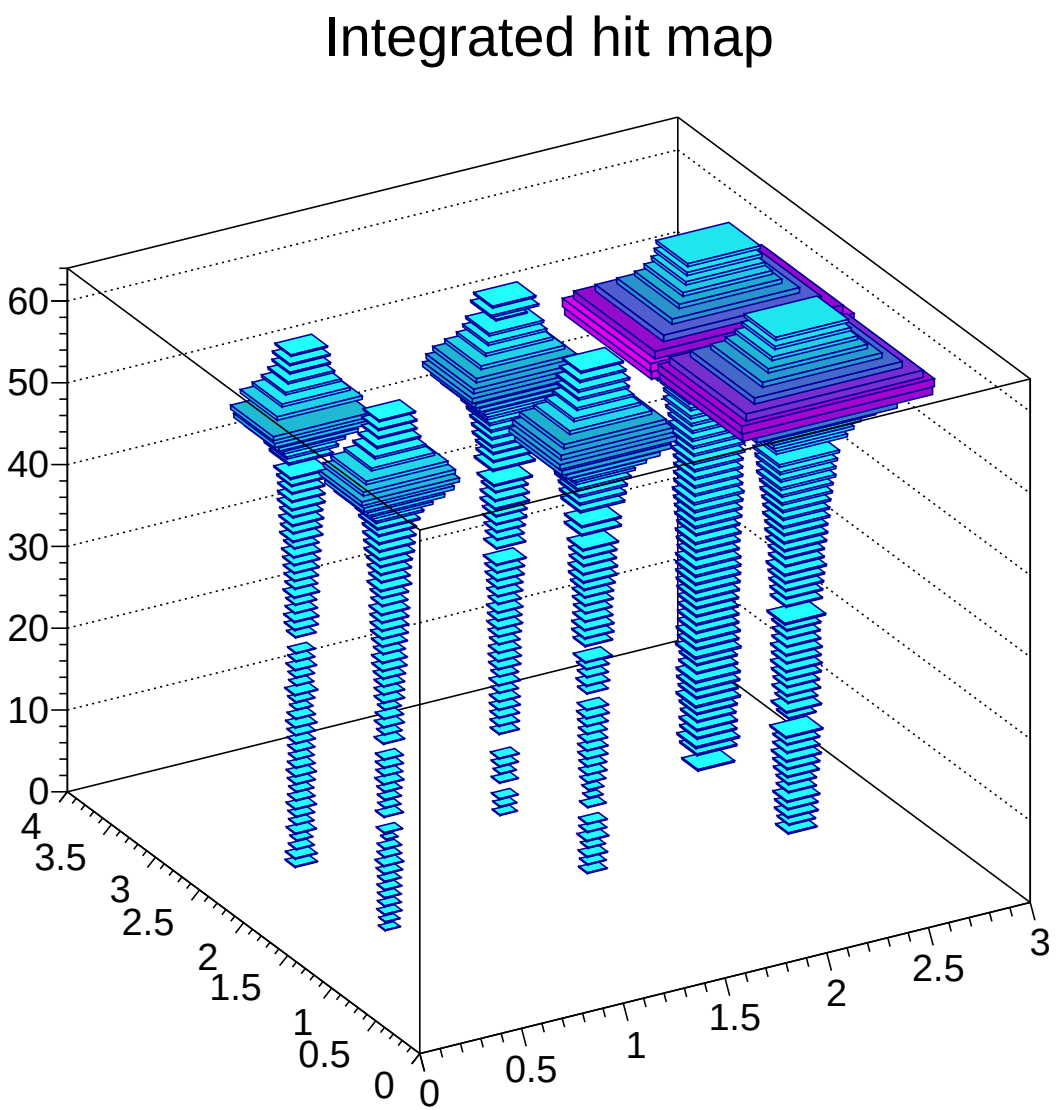

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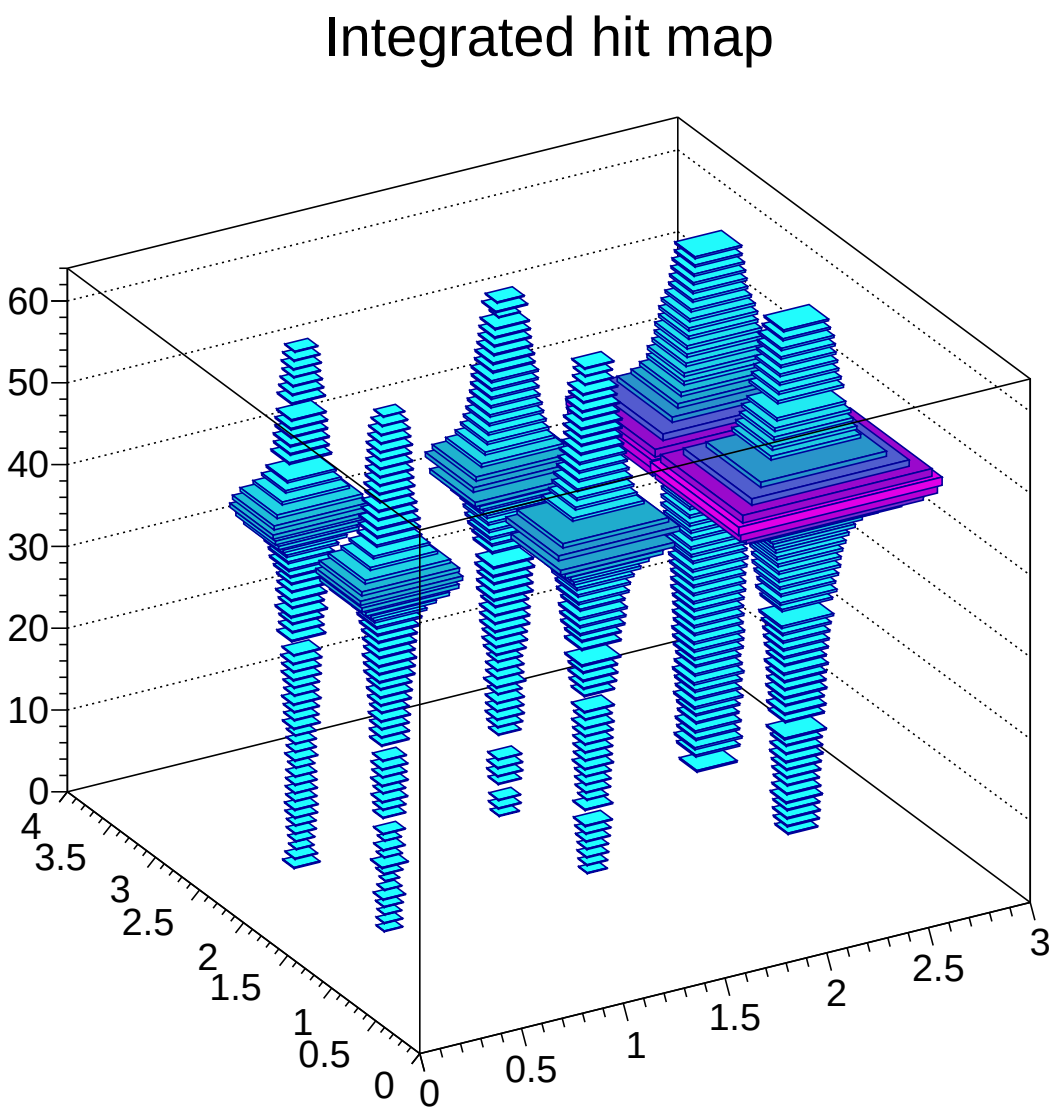

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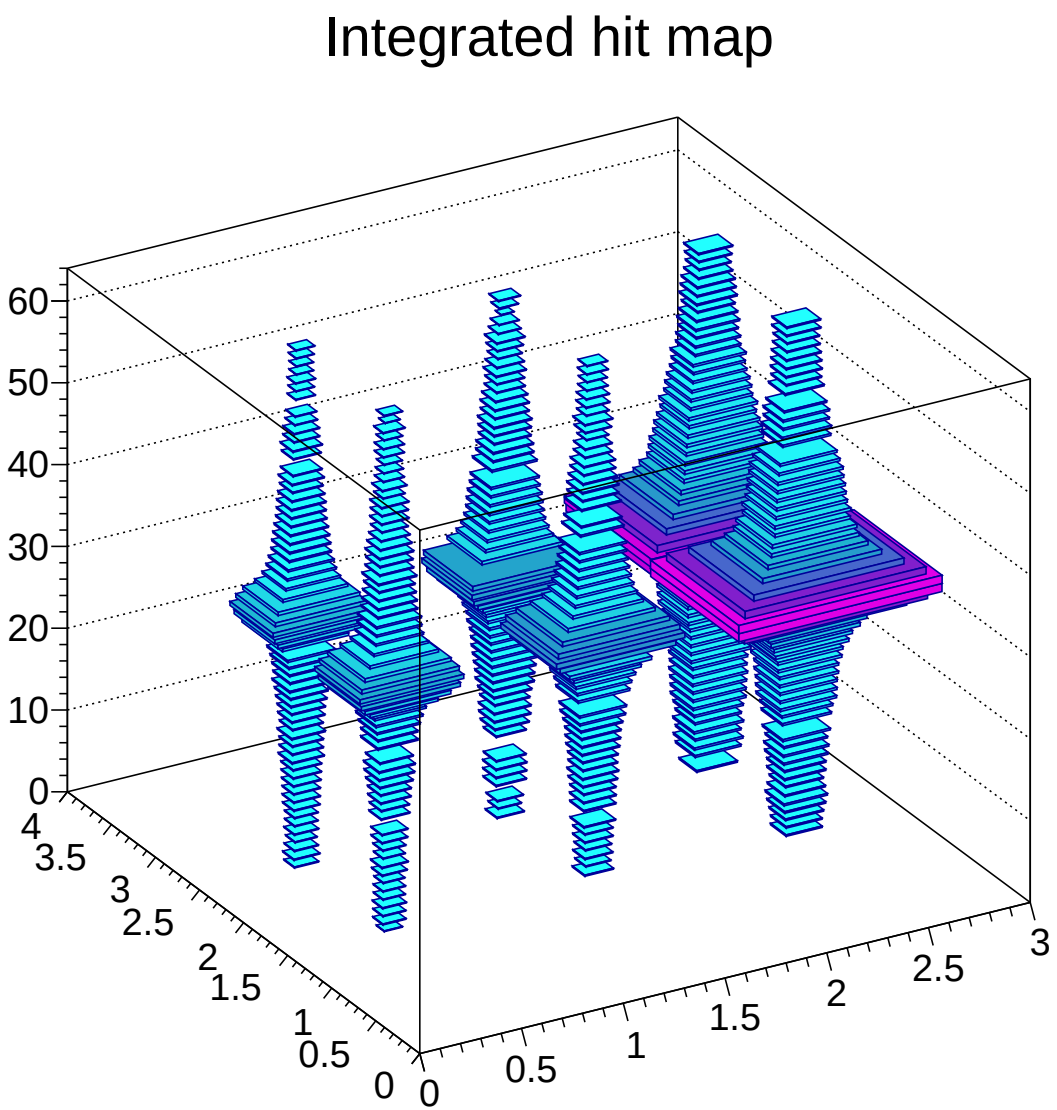

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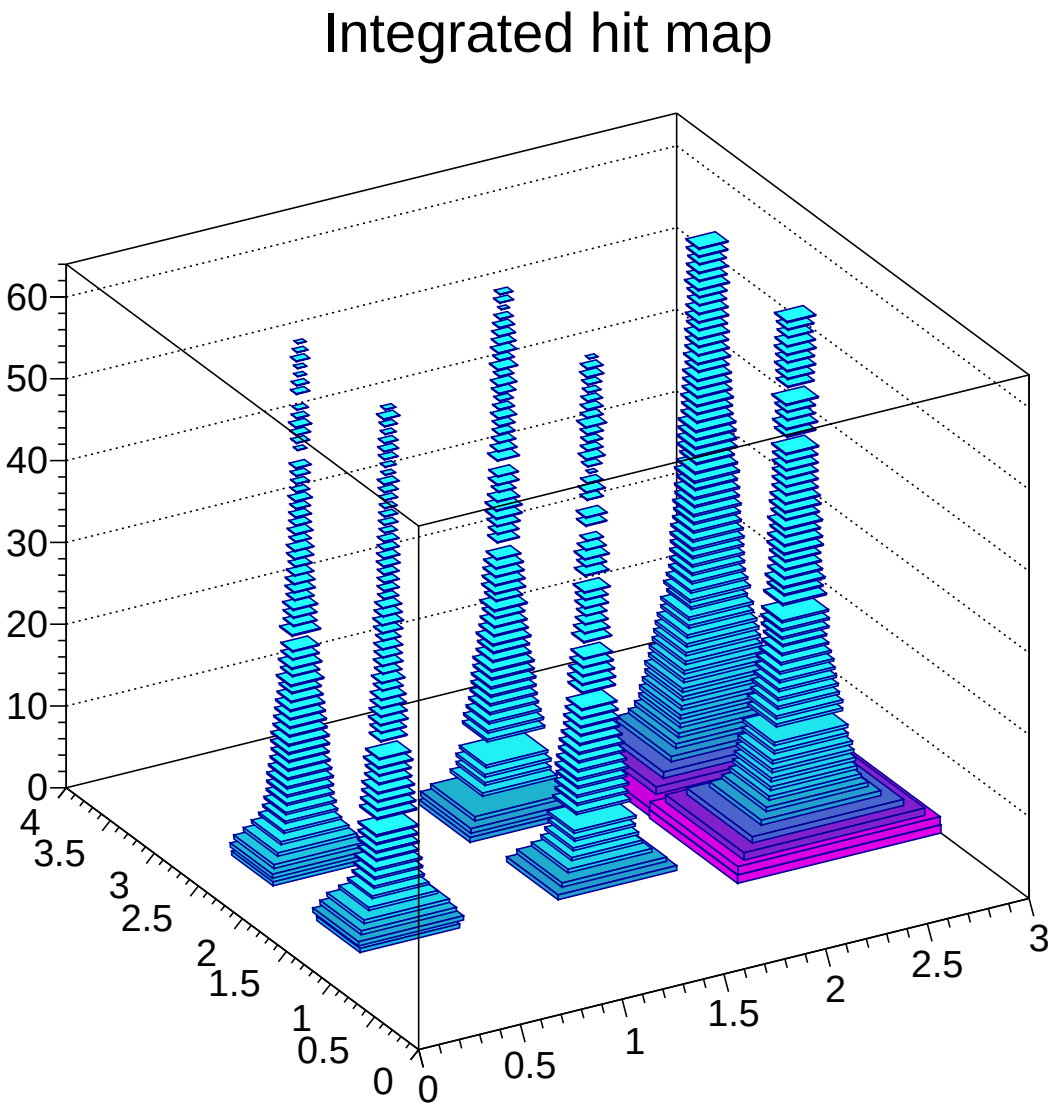

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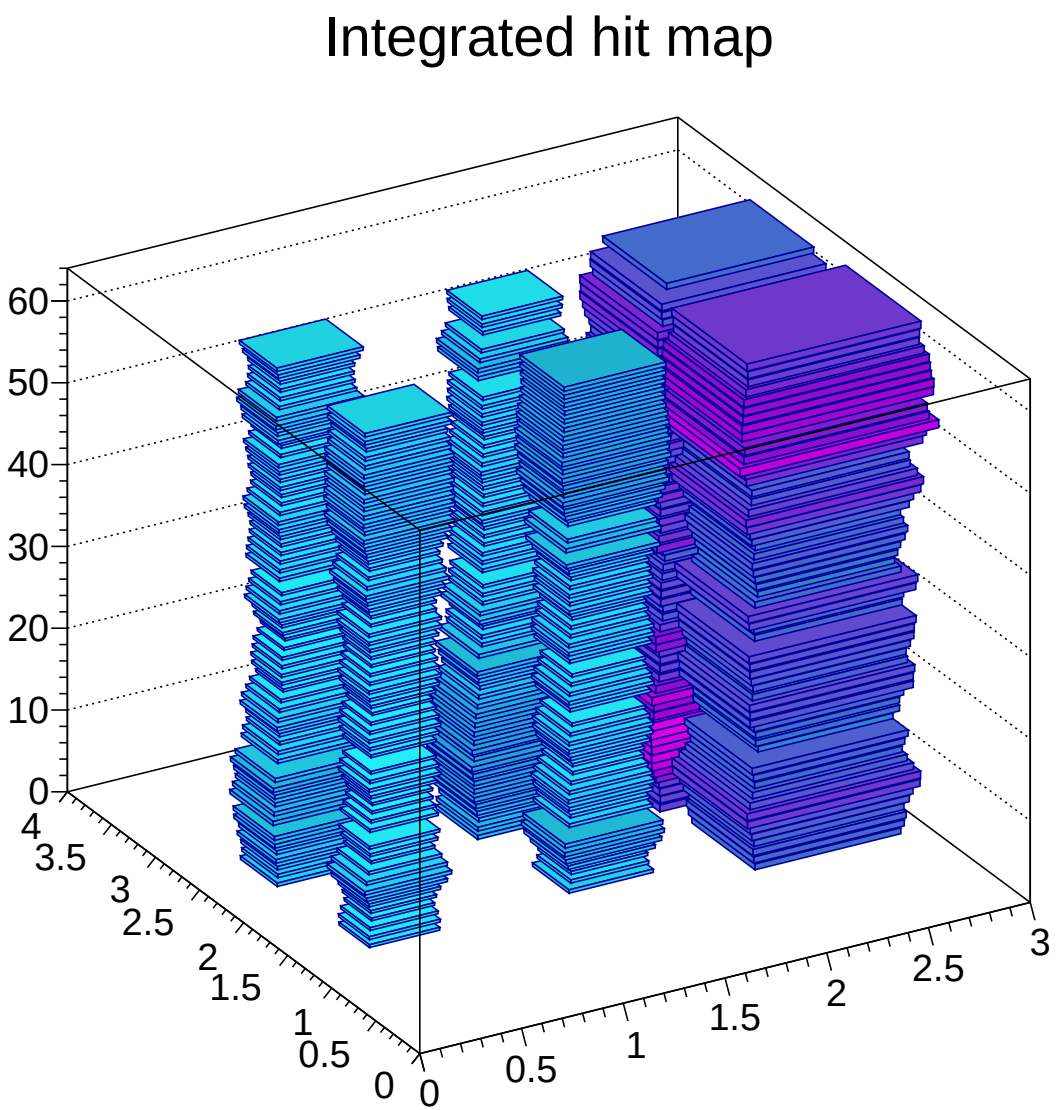

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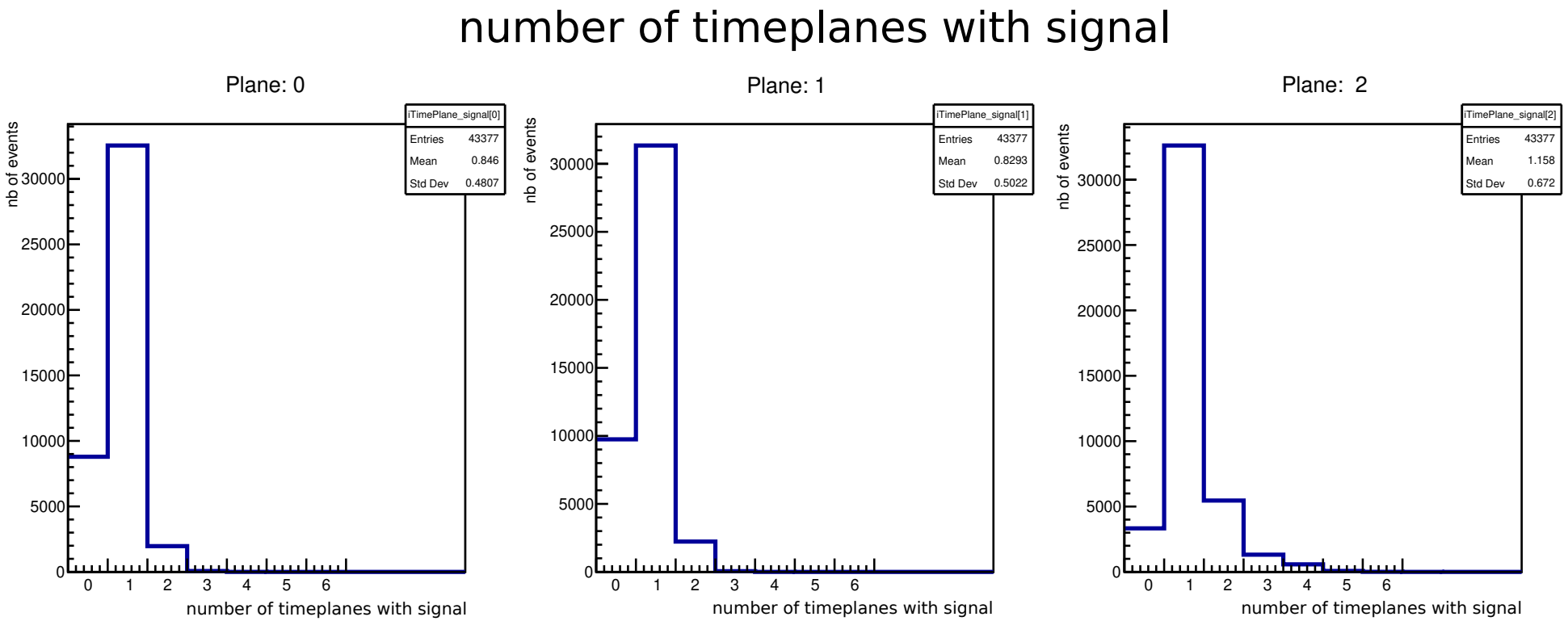
EVENT SELECTION

- one needs to develop a proper procedure for data selection
- mainly selection on timeplanes
- cut on noisy entries

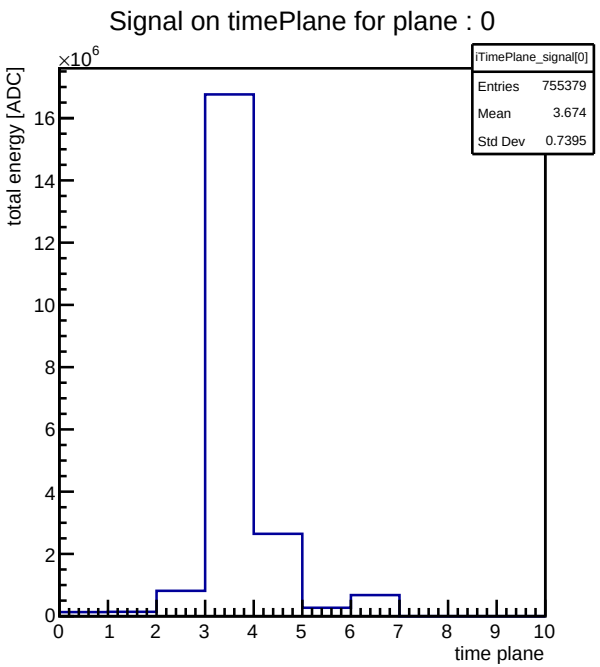
Event selection – timeplane analysis

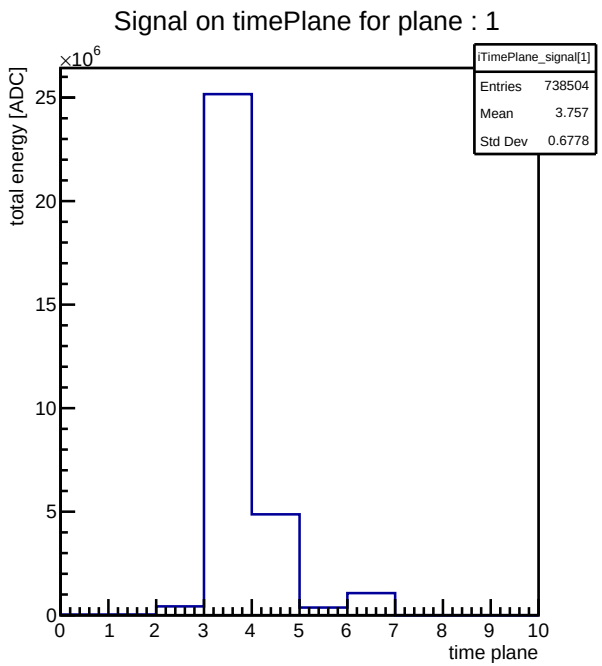


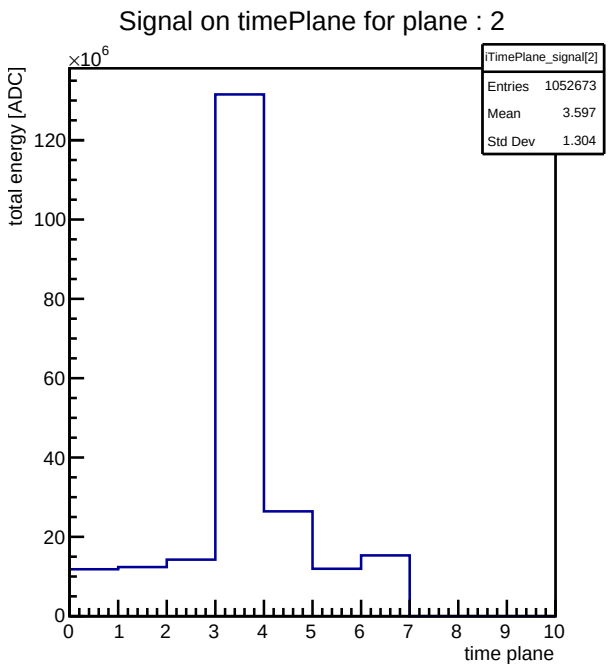
- There are events with the signal on more than one timeplane.
- Several percent, but still, needs to verify why it is like that (since not expected)

Event selection – timeplane analysis

Signal integrated over each timeplane



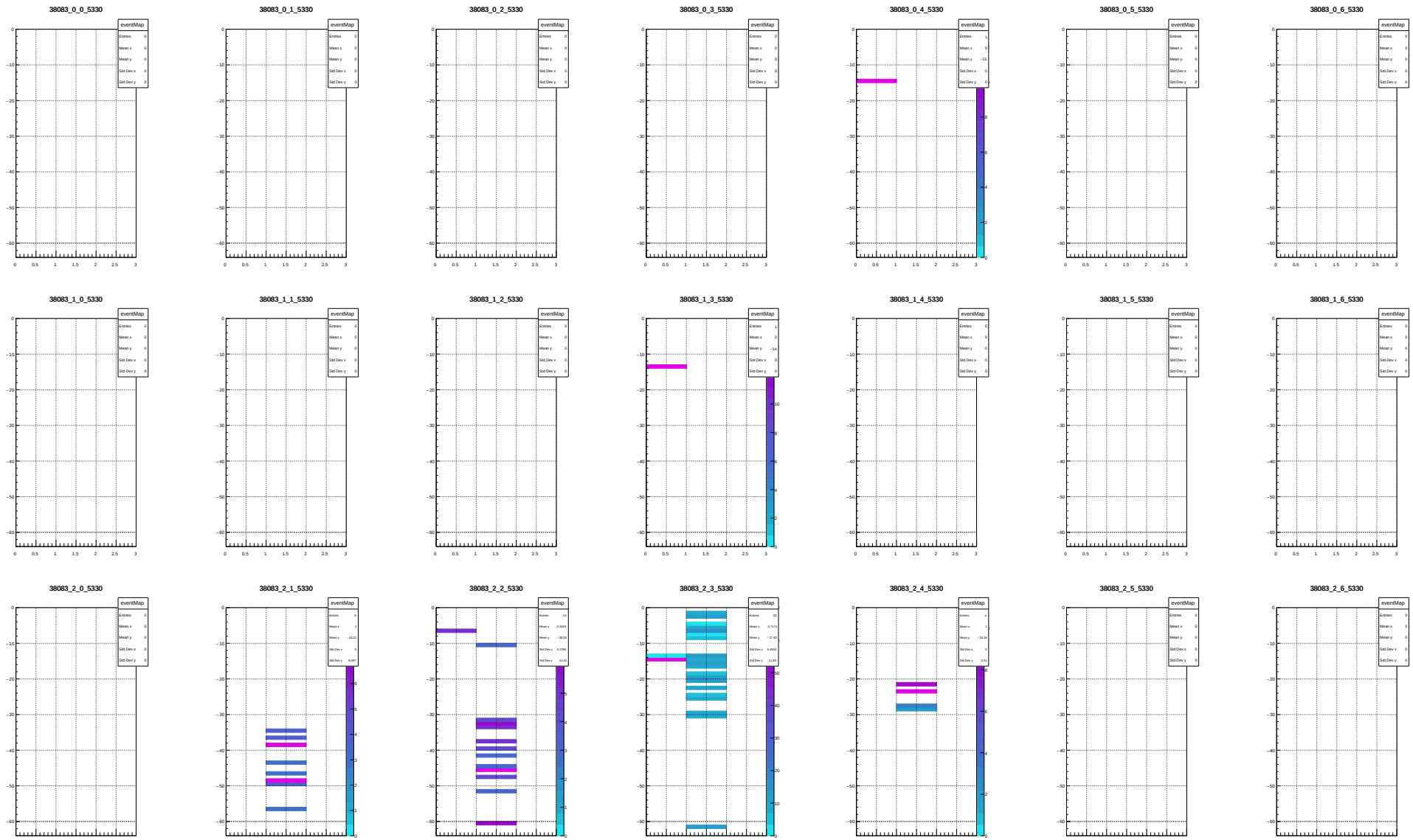




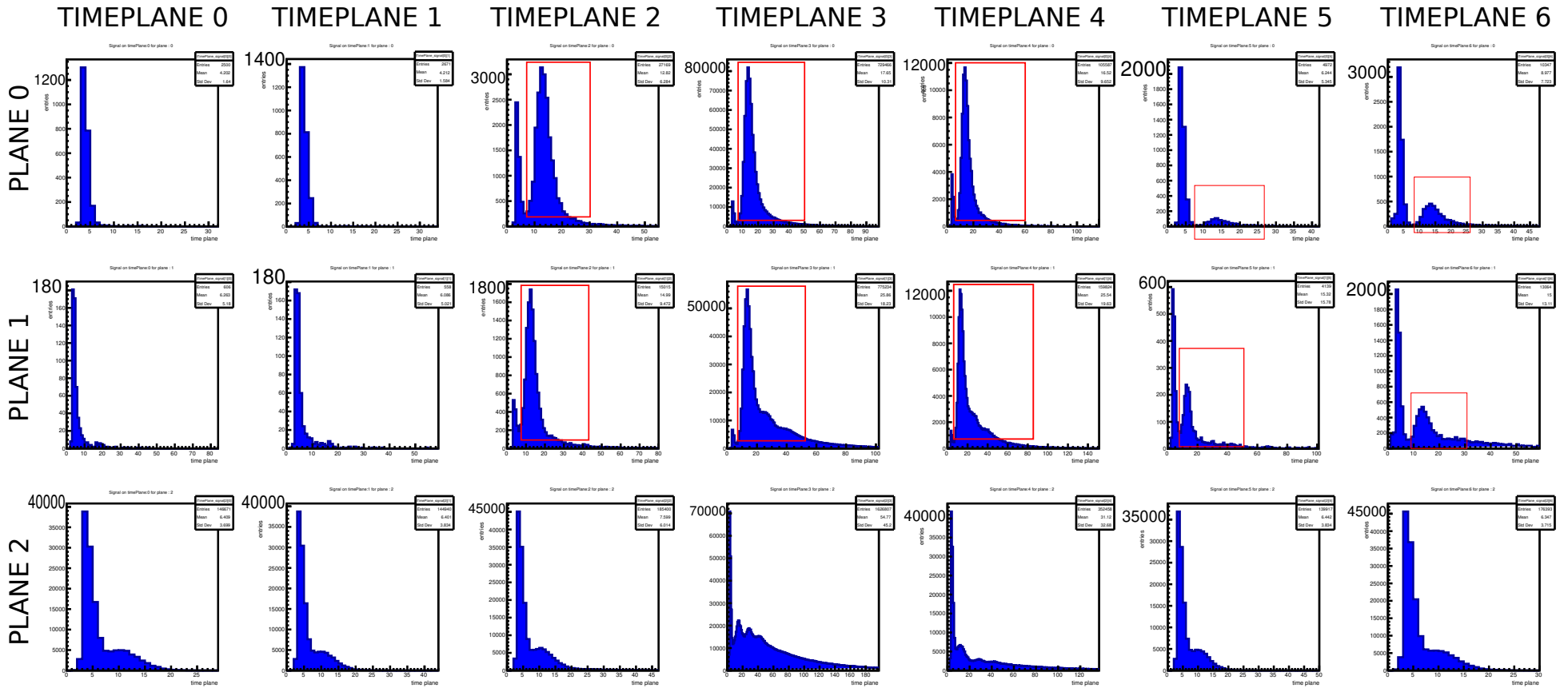
- integrated signal over timeplane separately for each FLAME plane
- most signal in timeplane[3] - as expected
- entries from neighbouring timeplanes[2/4] are also understood - (FPGA clk shifts)
- entries in timeplanes[0,1,5,6] not really expected
- they might be evidence of pileup or noise entries
- not negligable → see how looks single event, verify how spectra on each timeplane look like.

Selected single event – on each plane, per timeplane

TIMEPLANE_0 TIMEPLANE_1 TIMEPLANE_2 TIMEPLANE_3 TIMEPLANE_4 TIMEPLANE_5 TIMEPLANE_6



Event selection – integrated signal per plane per timeplane



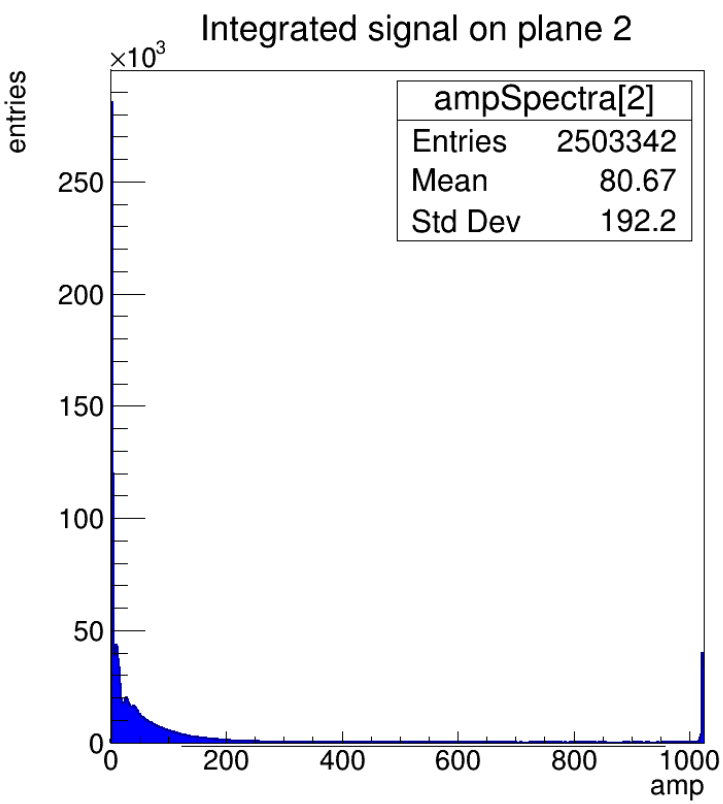
- peak at 6 ADC $\rightarrow$ noise
- MIP signal visible not only on timeplane $= 3 \rightarrow$ clk shift or pile-up
- no signal on timeplanes[1,2]
- but some procedure needs to be introduced for extracting signal for other timeplanes

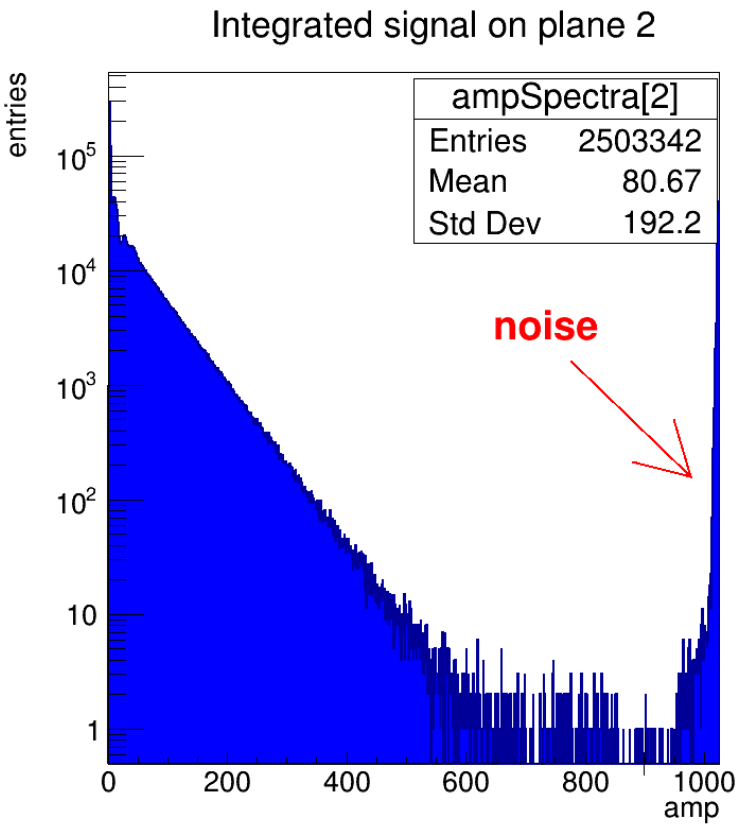
Event selection – timeplanes selection

What we decided in terms of timeplanes?

- make a cut for noise $\rightarrow$ threshold tuned for each plane
- we "take" signals from timeplanes 2-3-4
- remark: we cannot have signal in the same channel in two consecutive timeplanes (for example channel 10 cannot have a signal on timeplane 2 and 3 $\rightarrow$ because of readout)
- **proposition of data selection:** merge timeplanes 2-3-4 BUT exclude all events for which the same pad responded twice (means: on timeplane 2 and 4 simply)

Event selection – cut on noise



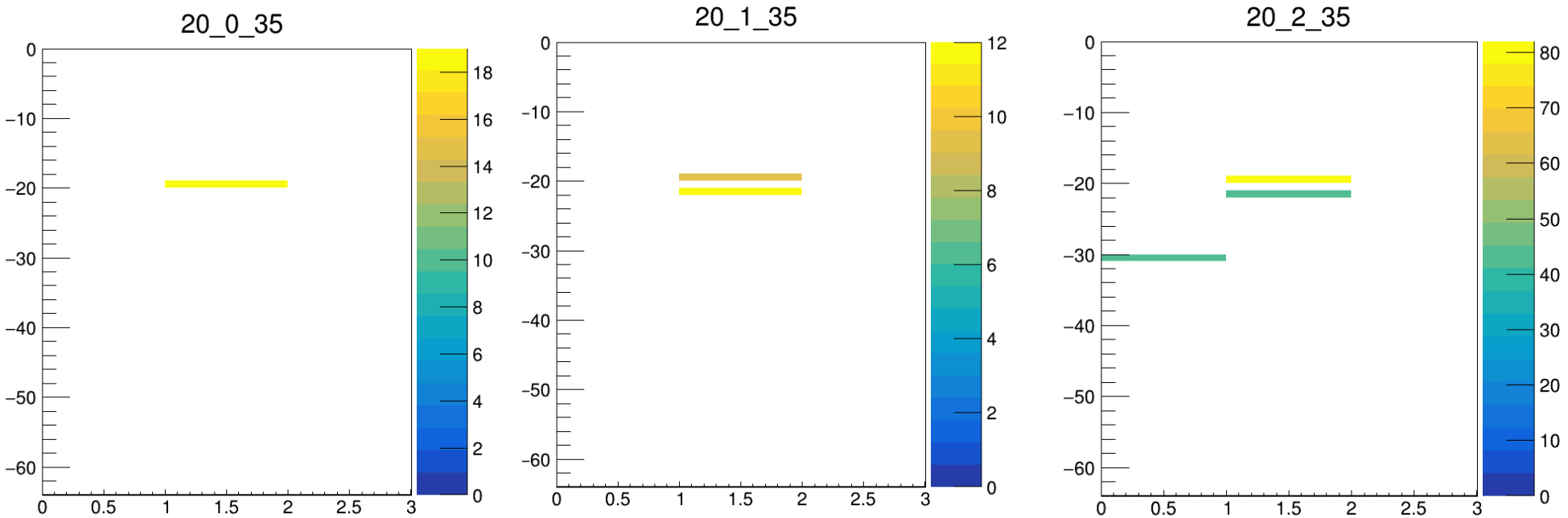


- integrated signal over all events, shown for plane 2
- artificial high energy has to be cut out (amp $<$ 900)
- these are negative noise passing through signal reconstruction

CLUSTERIZATION

- how to form clusters
- to be discussed

Exemplary event – run 864, event: 20, TLU number: 35

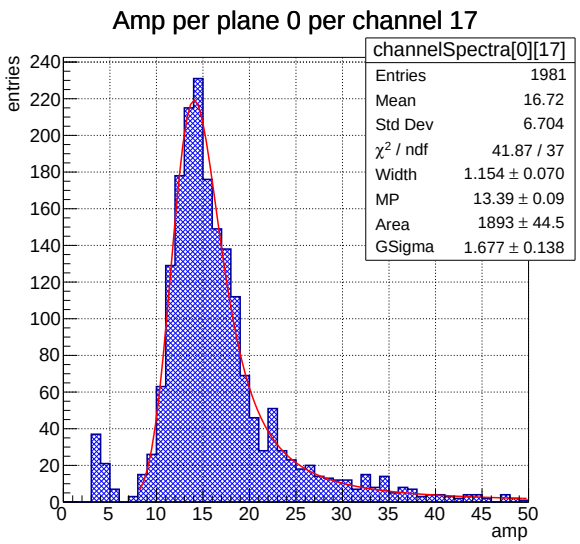


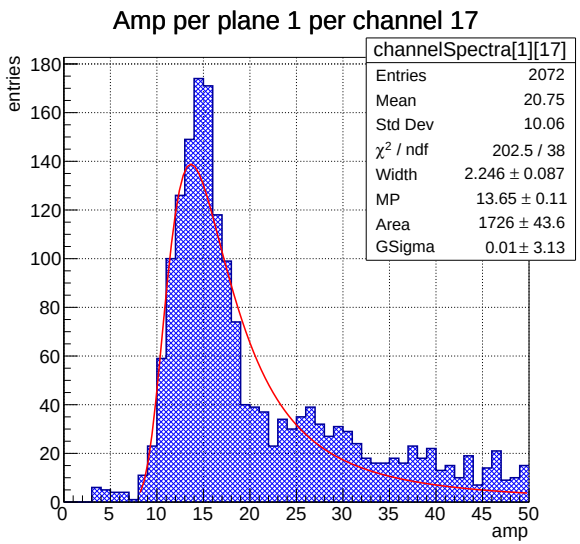
- timeplane = 3
- initial procedure implemented → algorithm searches for pad with the highest signal and adds all pads with signal in X distance from the seed
- question: what X should be? or maybe we have to integrate over whole frame?

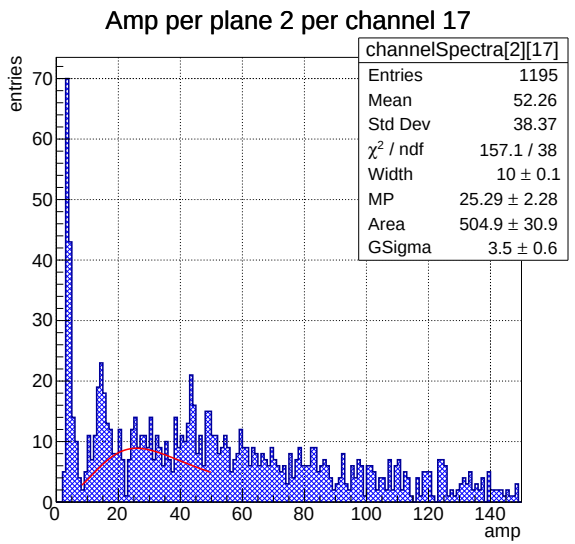
CHANNEL CALIBRATION

Event selection for calibration

- Select only timeplane = 3
- Cut on amplitude < 900
- Select events only with single pad responded (= one-pad cluster, single particle per plane) → cuts statistics only, does not introduce "physics" limitation
- dead channels masked
- langaus fitted in range [8-50] ADC

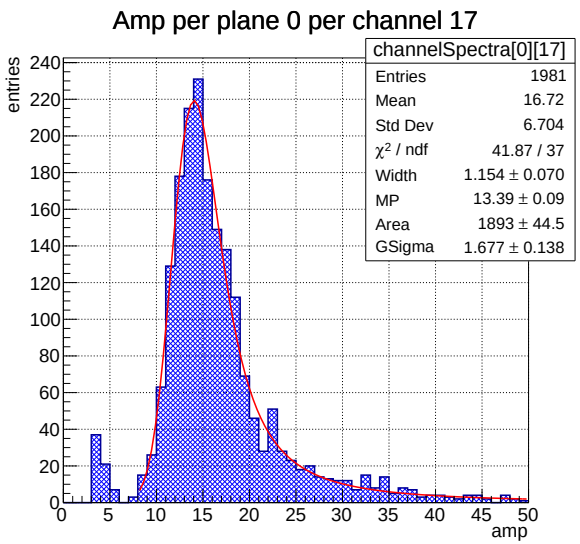


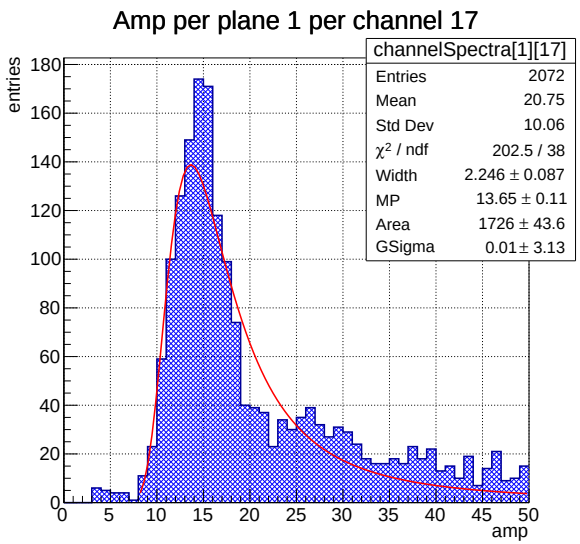


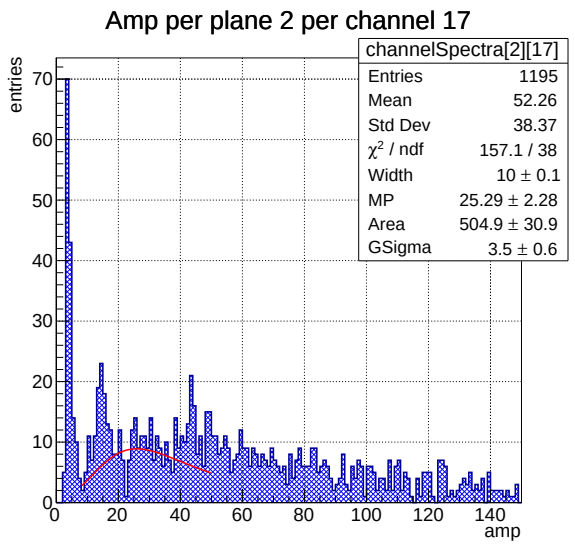


Event selection for calibration

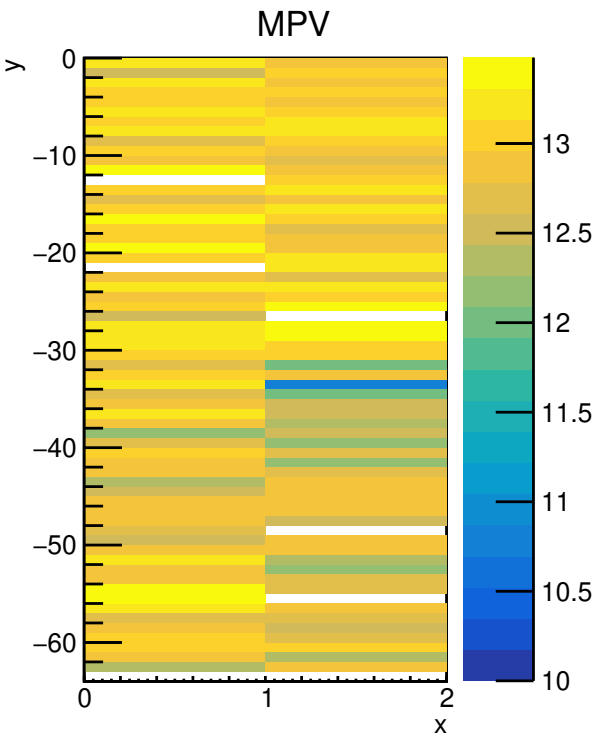
- straightforward calibration only for plane 0
- one may think of some procedure allowing for the calibration of plane 1 since the MIP contribution is still visible → but not so obvious
- but no idea how to calibrate plane 2
- in backup → one can find such a plot for each channel and each plane

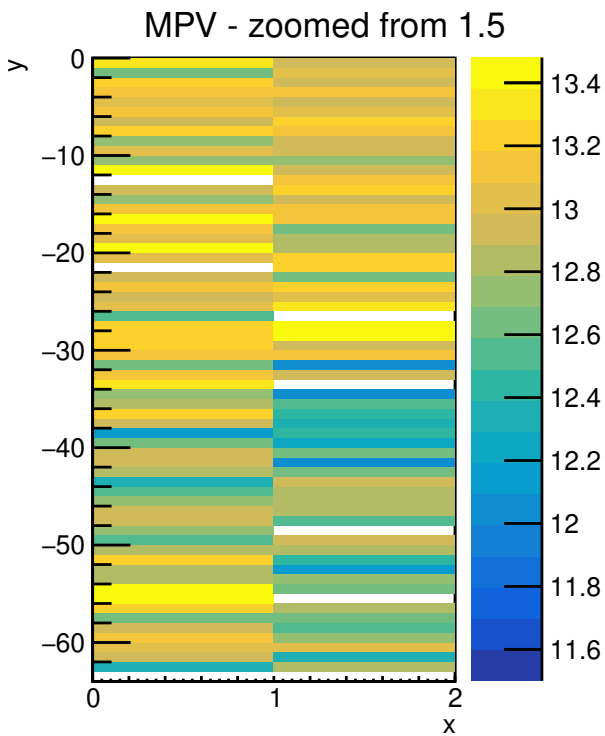


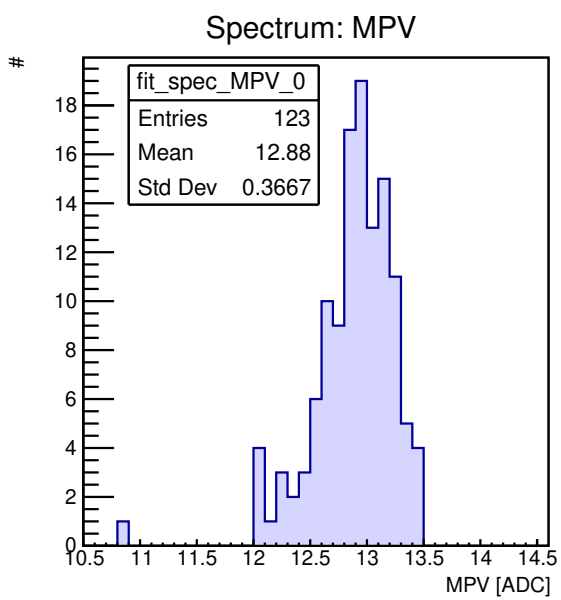


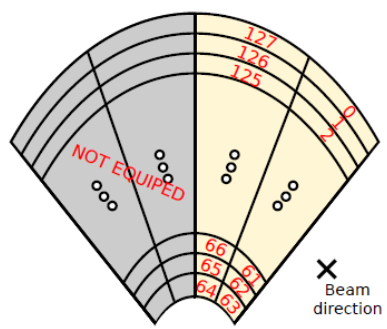


Calibration - MPV – plane 0



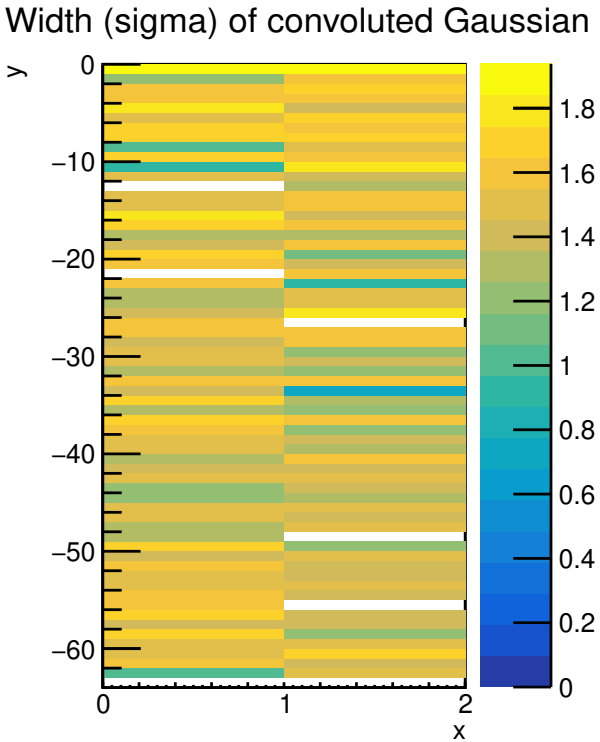


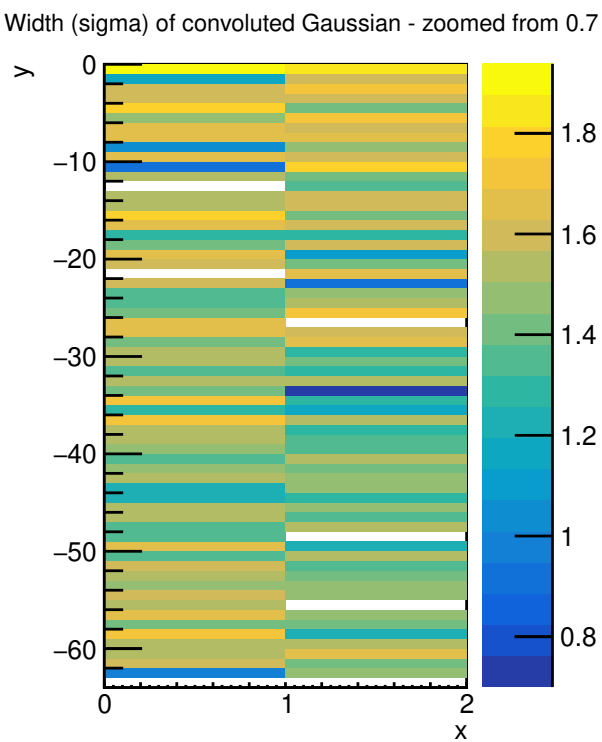


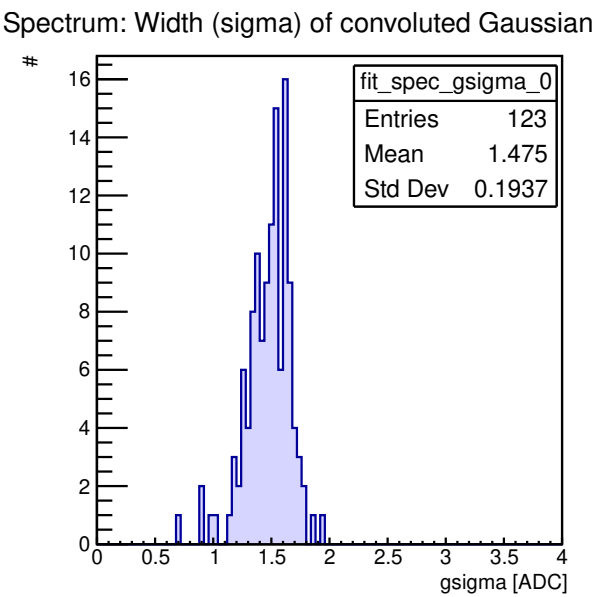


- homogeneous MPV (gain) distribution
- average MPV for plane 0: 12.88 $\pm$ 0.37 [ADC]
- so for the moment we propose to use a common calibration factor 12.88 ADC/MIP for each pad on each plane

Calibration - gsigma Gauss – plane 0

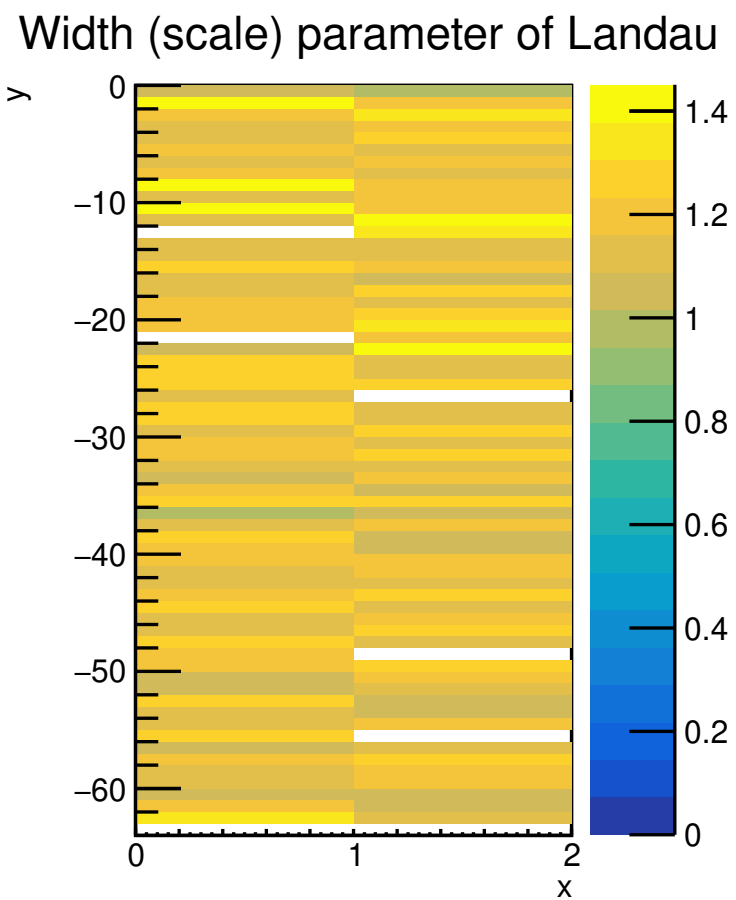


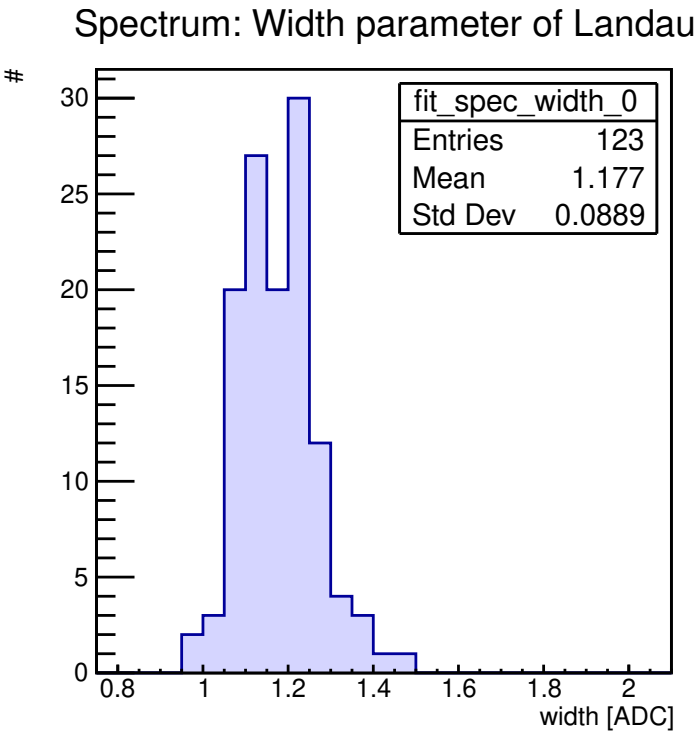




- width of the Gauss: 1.48 ± 0.19 [ADC]
- one pad shows deviation from the average value

Calibration - width Landau – plane 0





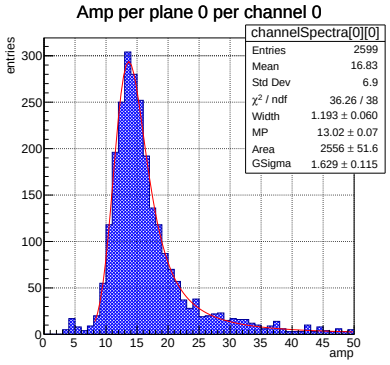
- width of the Landau: 1.18 ± 0.09 [ADC]

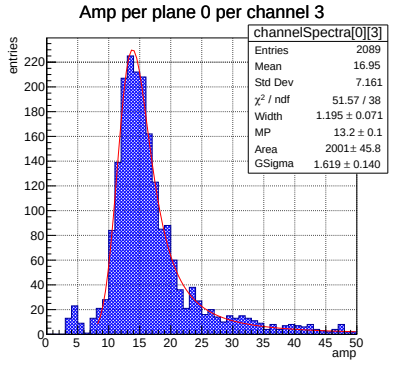
BACKUP

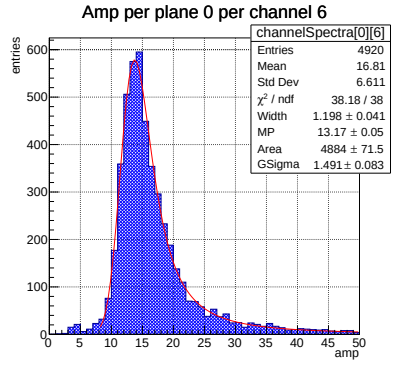
- Signal in channel for all planes + langauss fit

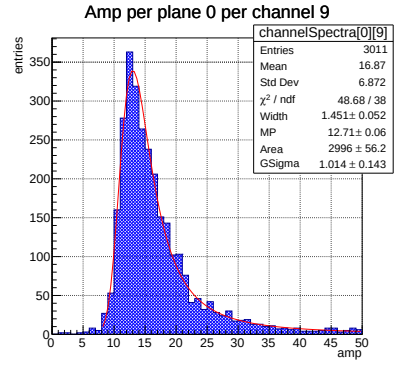
PLANE 0 – fits

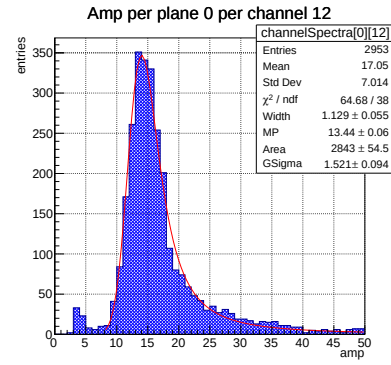
Signal in channel – plane 0 – channels 0-14

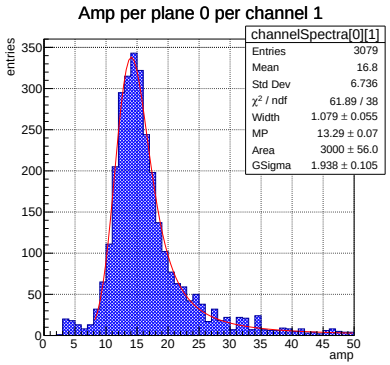


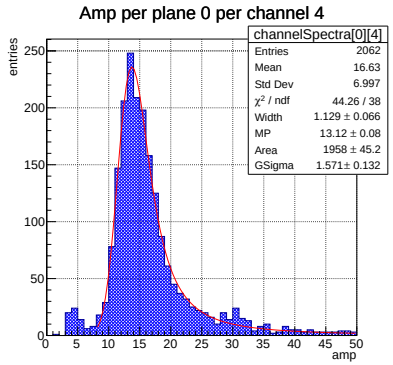


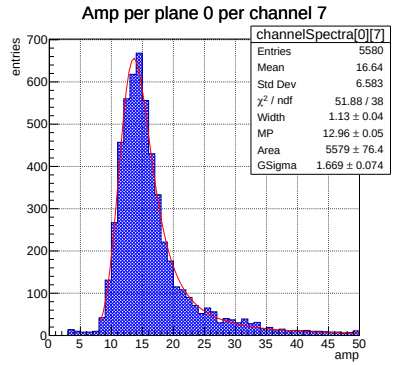


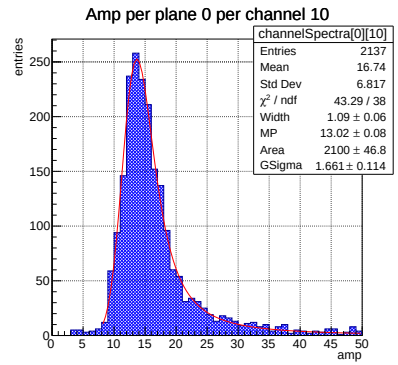


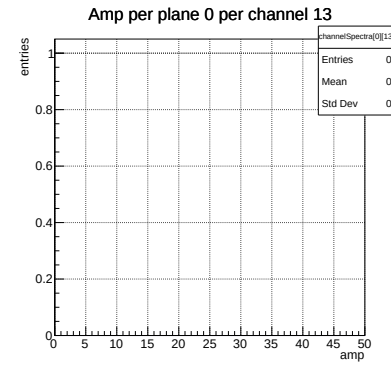


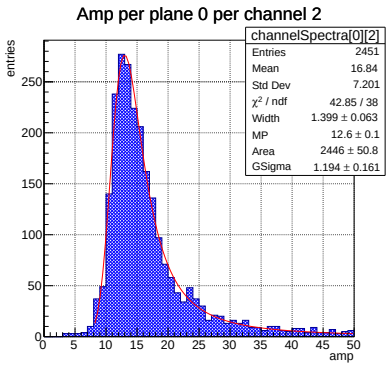


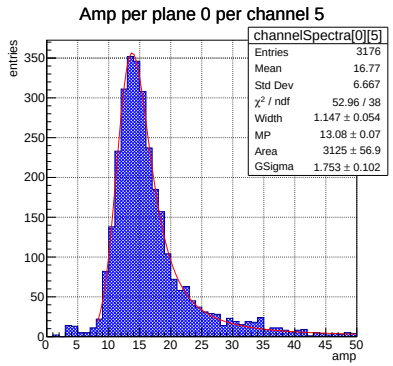


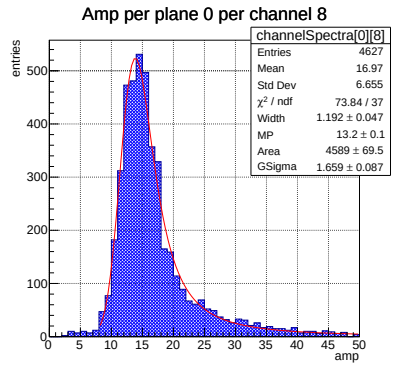


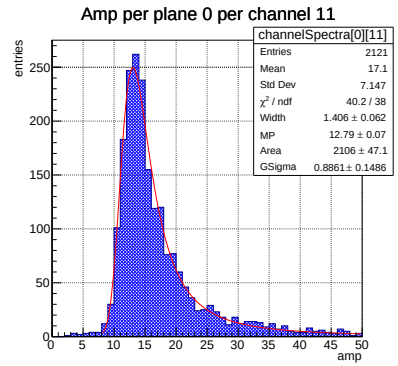


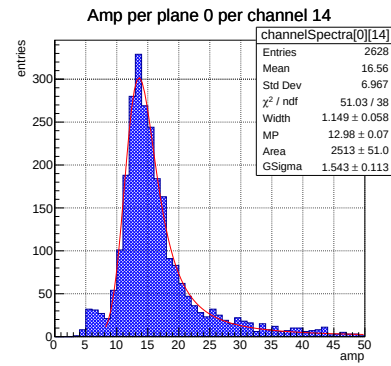




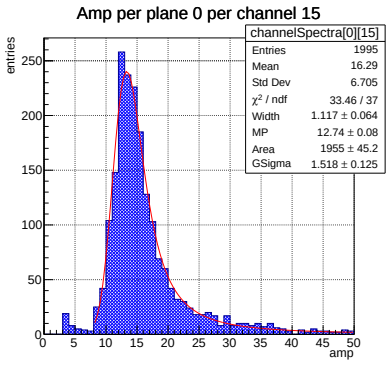


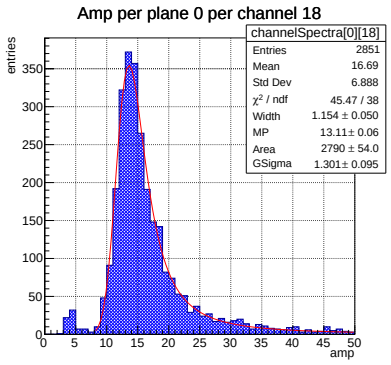


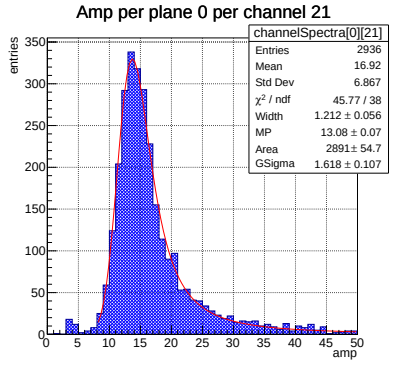


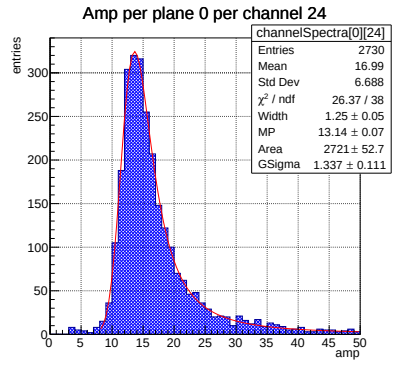


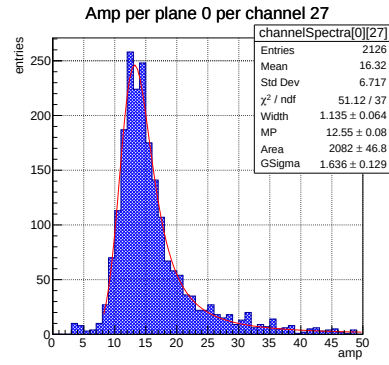
Signal in channel – plane 0 – channels 15-29

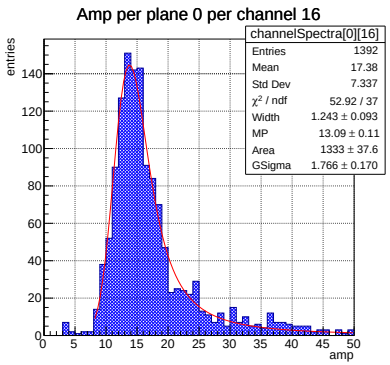


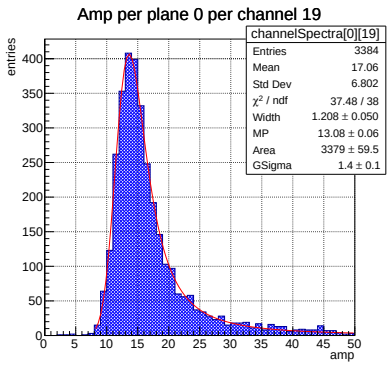


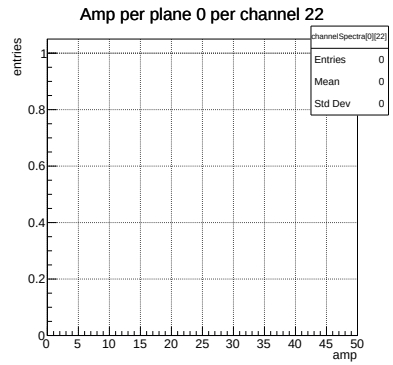


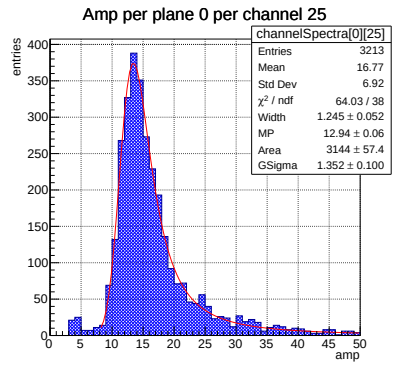


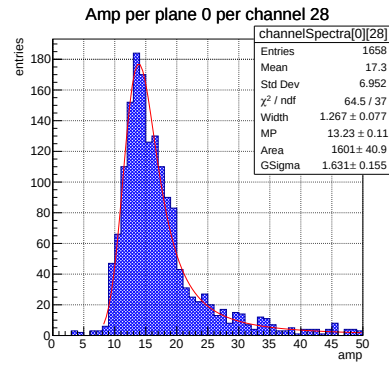


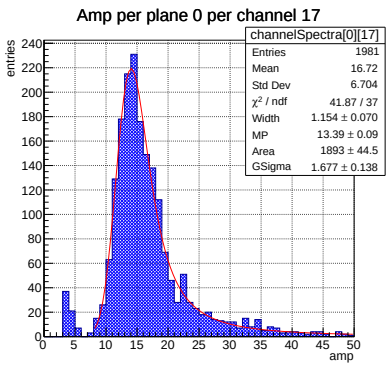


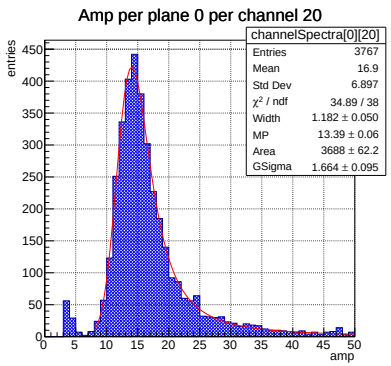


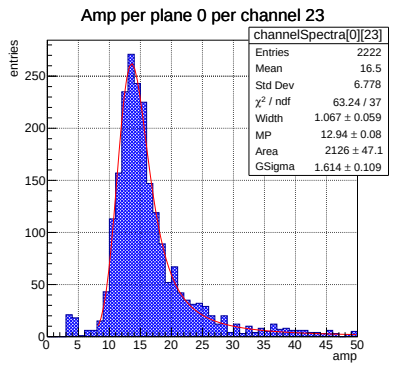


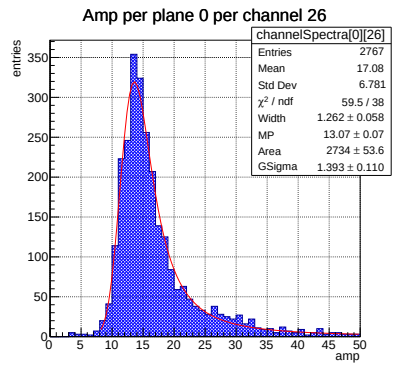


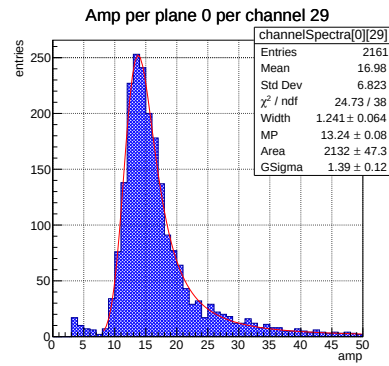




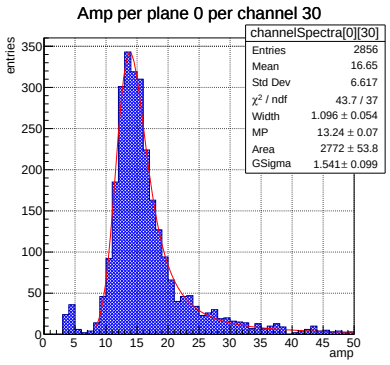


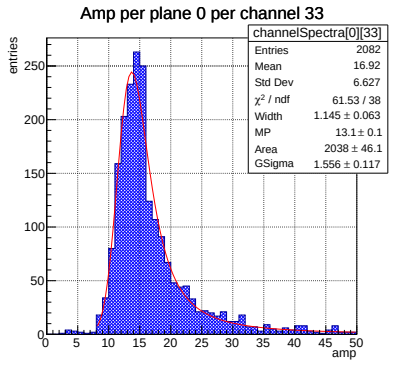


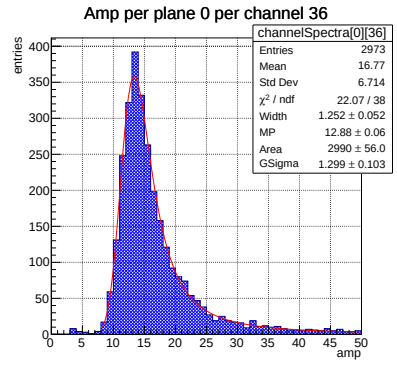


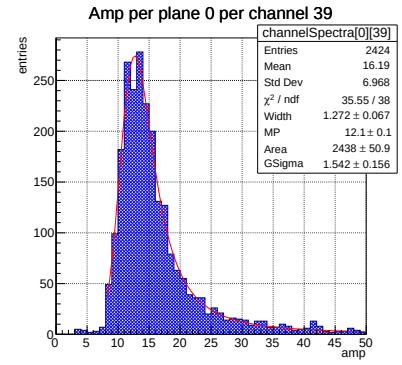


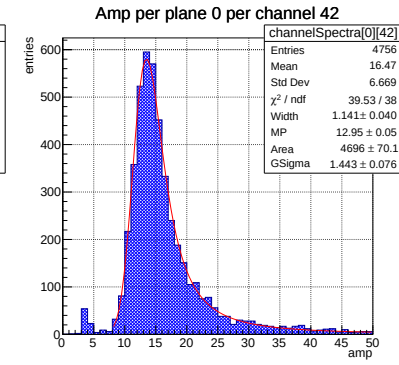
Signal in channel – plane 0 – channels 30-44

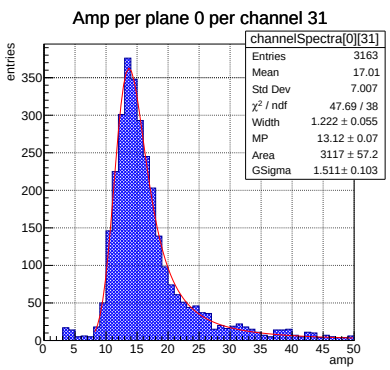


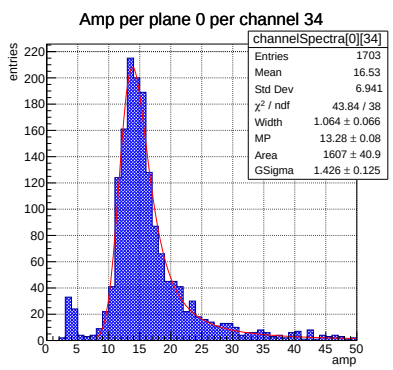


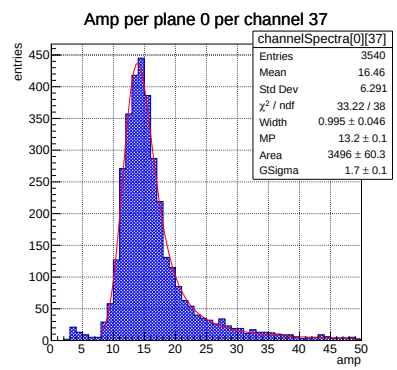


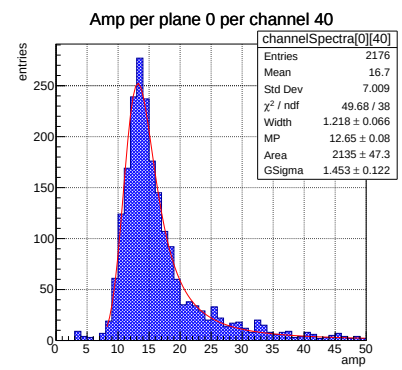


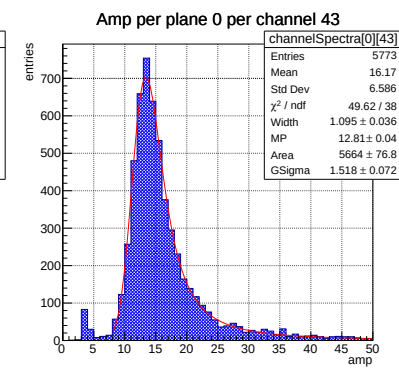


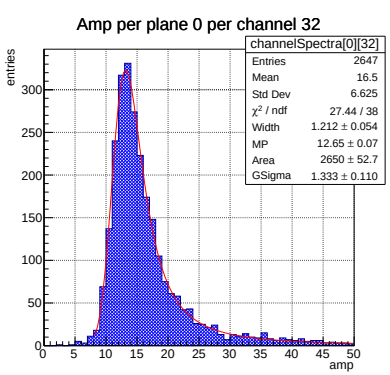


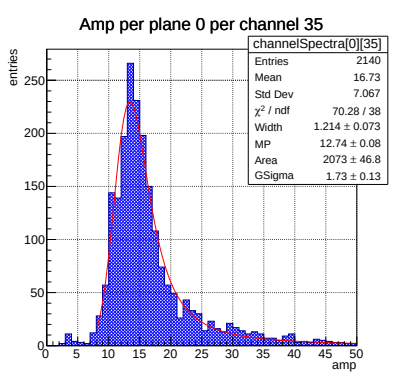


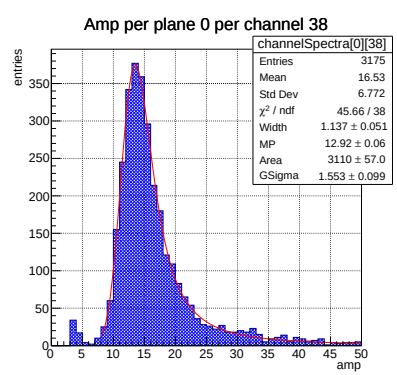


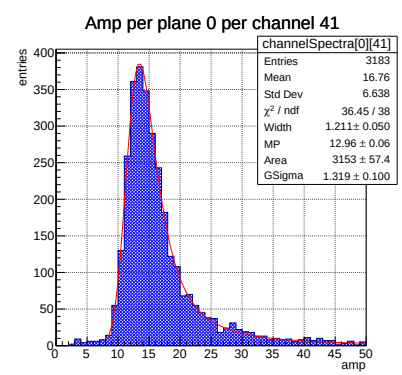


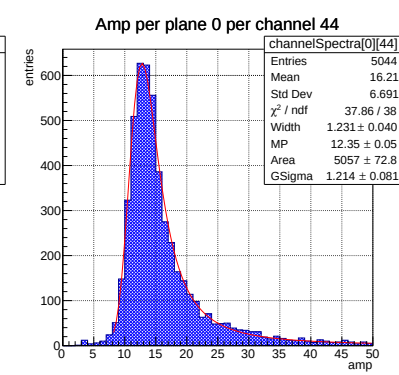




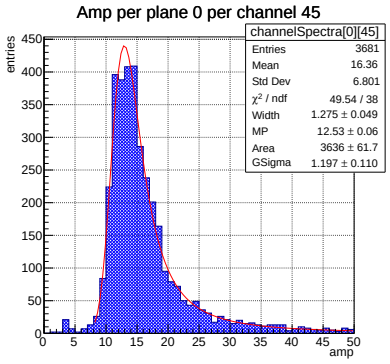


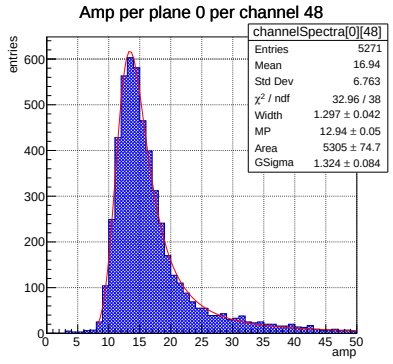


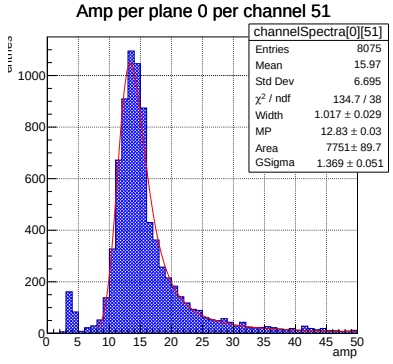


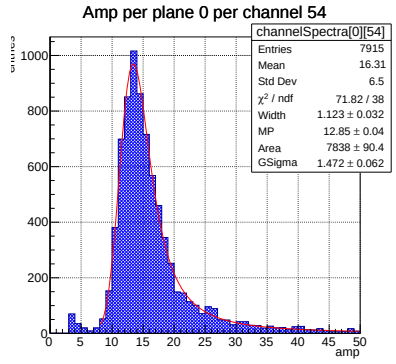


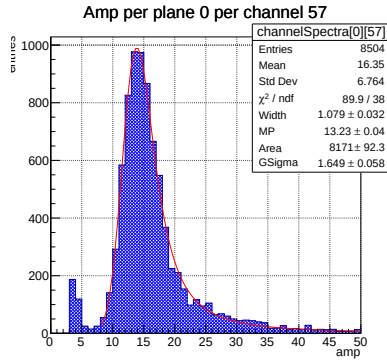
Signal in channel – plane 0 – channels 45-59

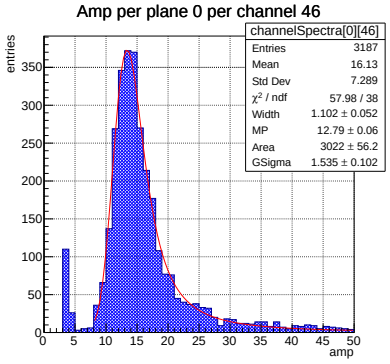


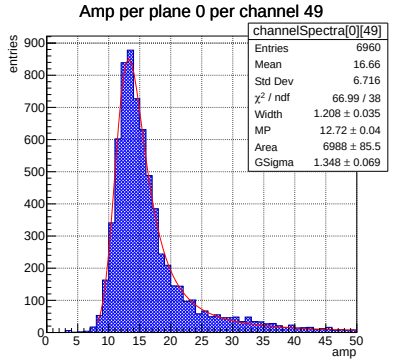


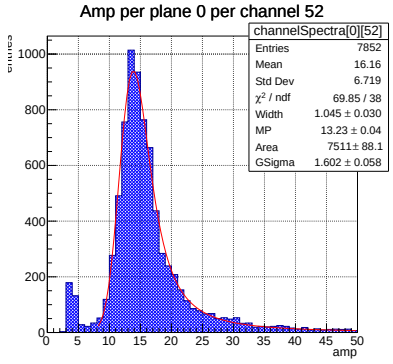


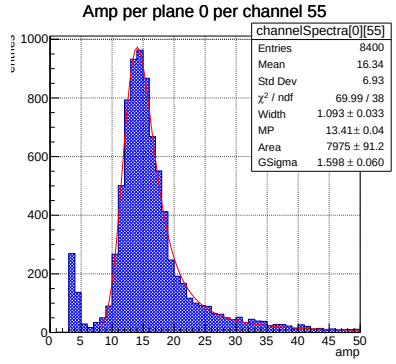


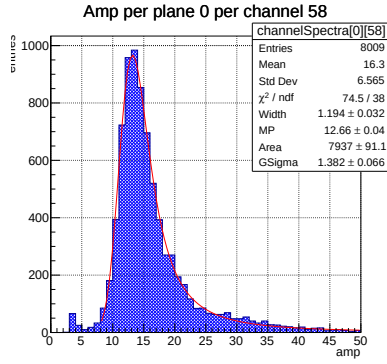


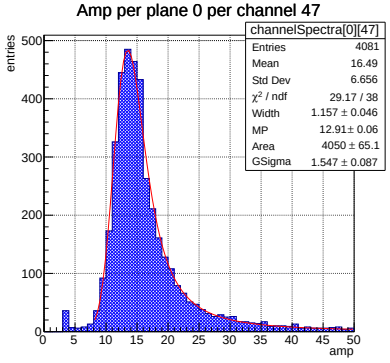


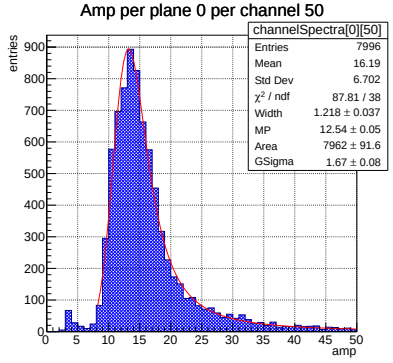


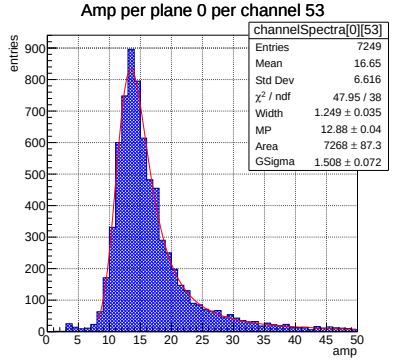


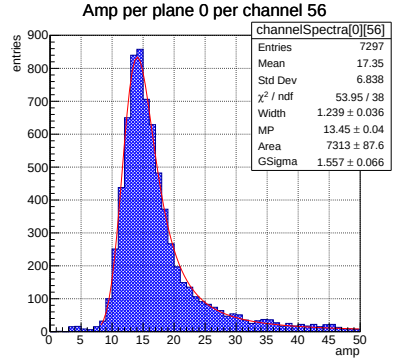


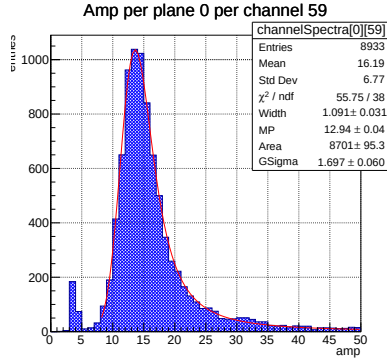




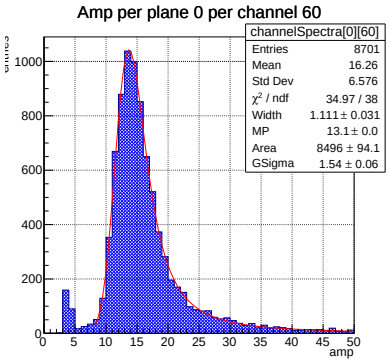


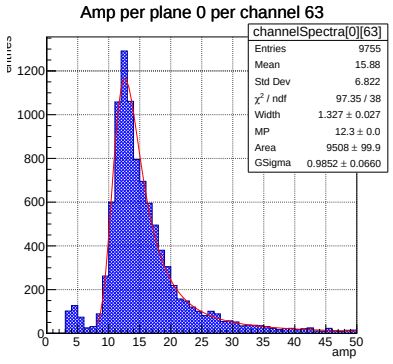


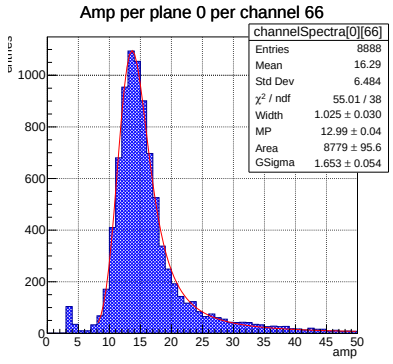


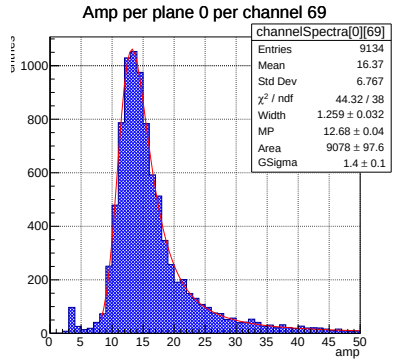


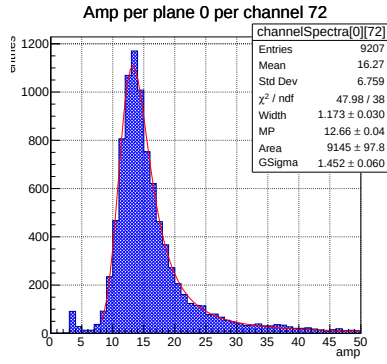
Signal in channel – plane 0 – channels 60-74

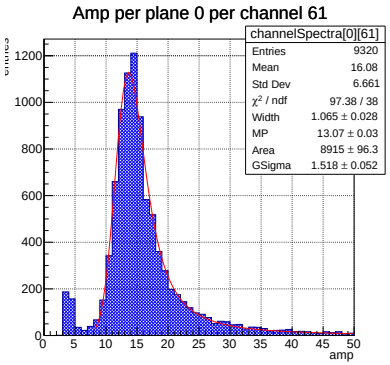


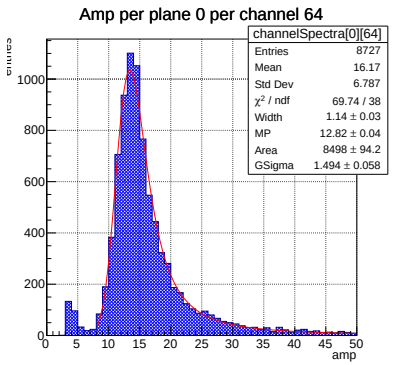


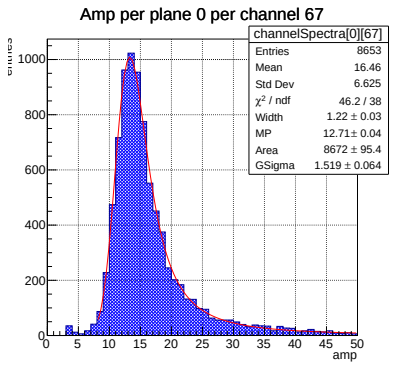


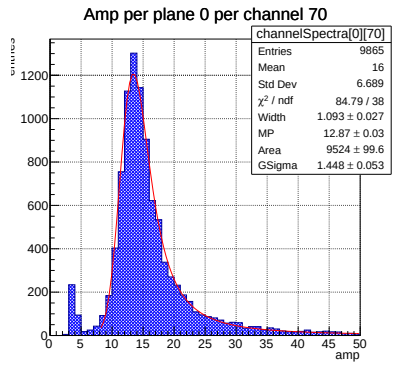


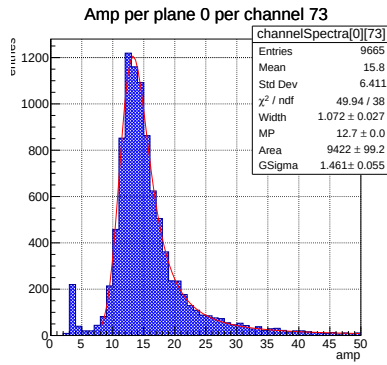


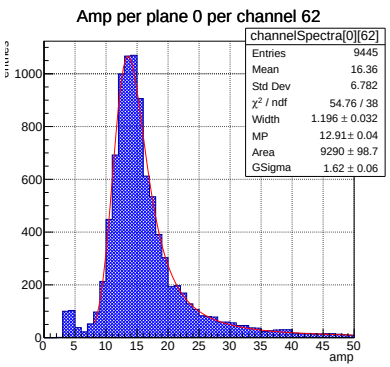


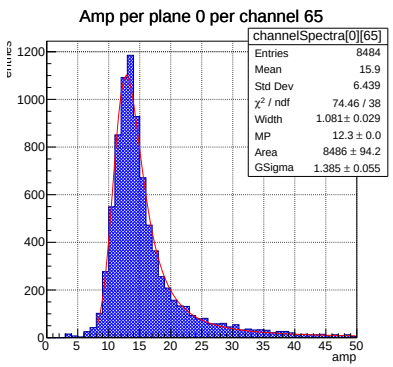


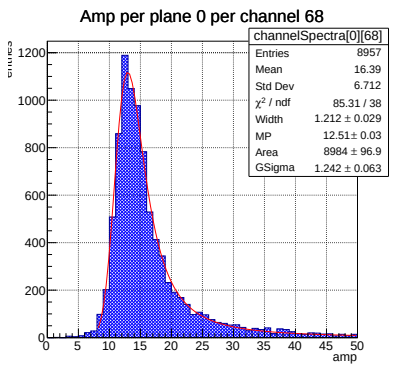


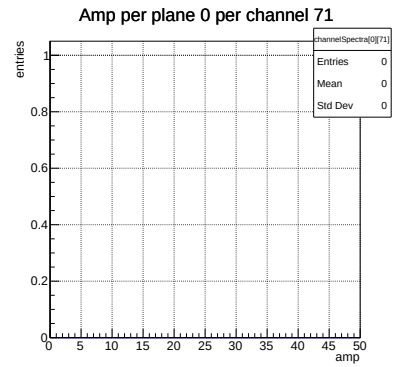


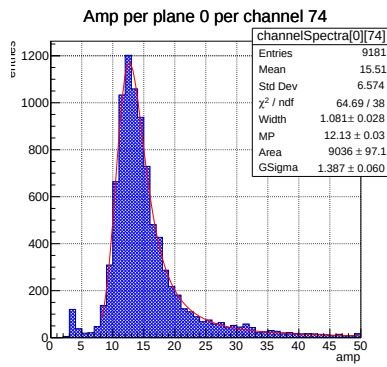




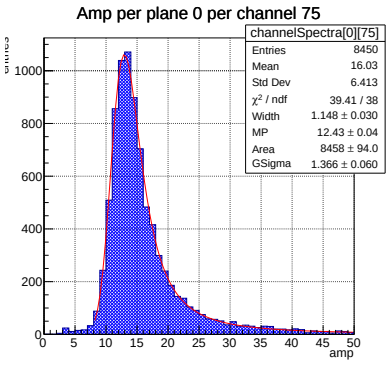


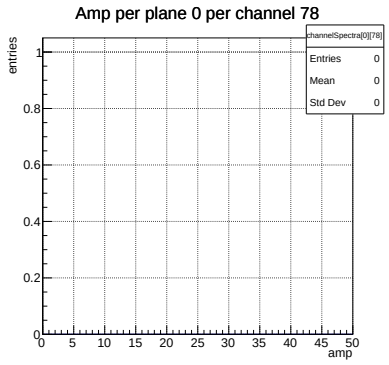


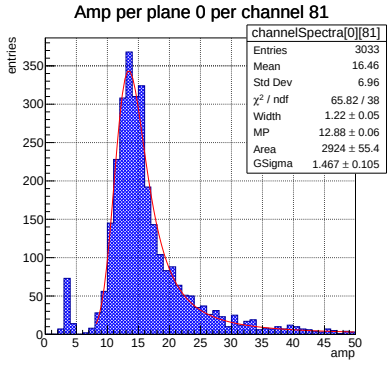


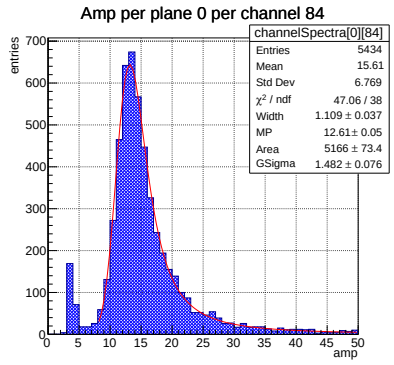


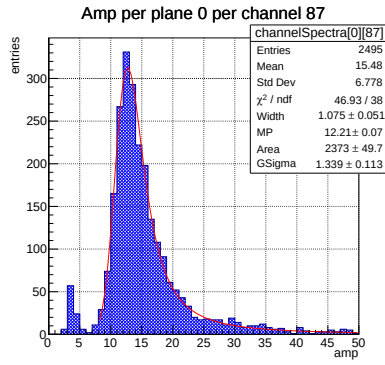
Signal in channel – plane 0 – channels 75-89

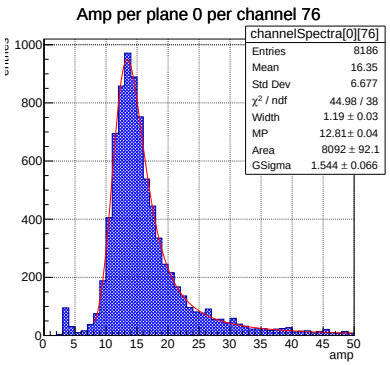


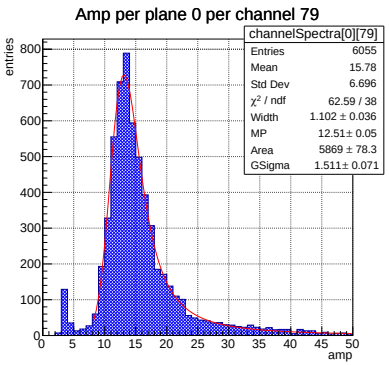


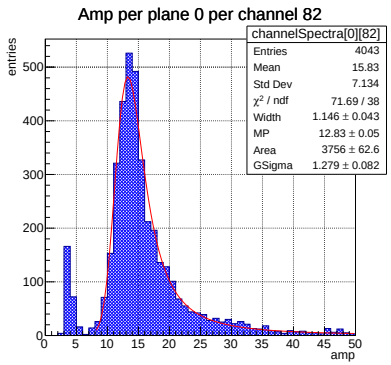


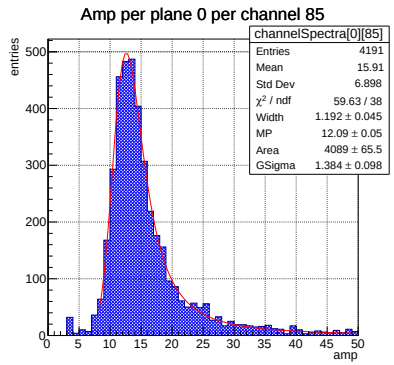


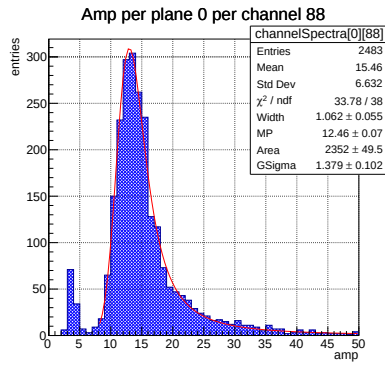


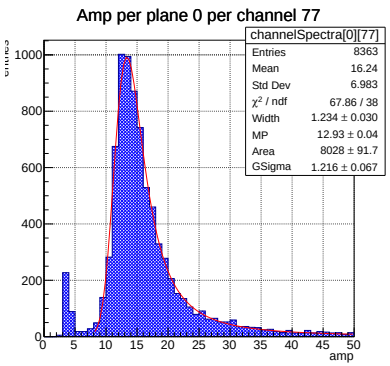


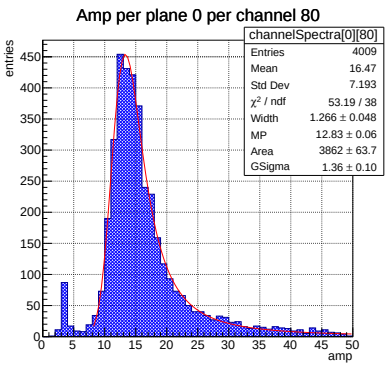


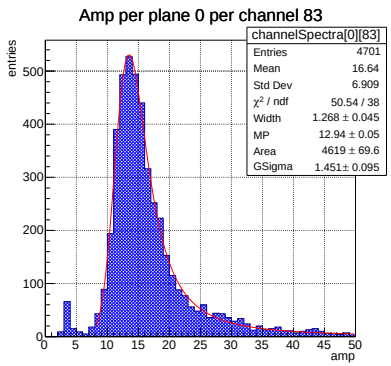


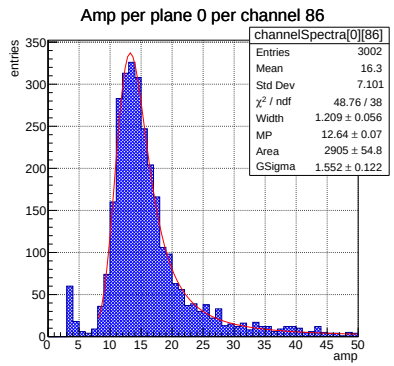


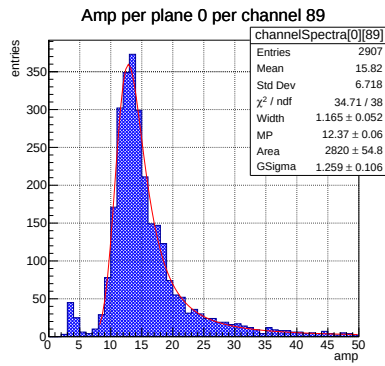




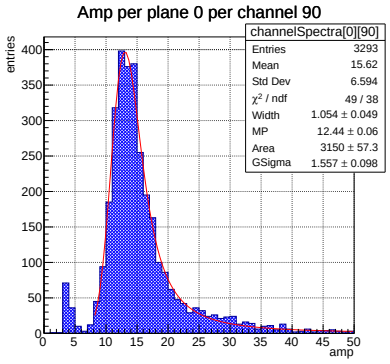


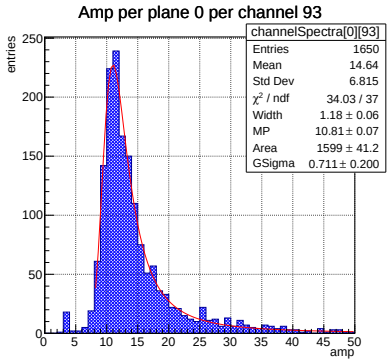


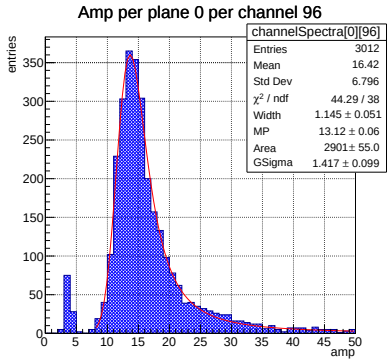


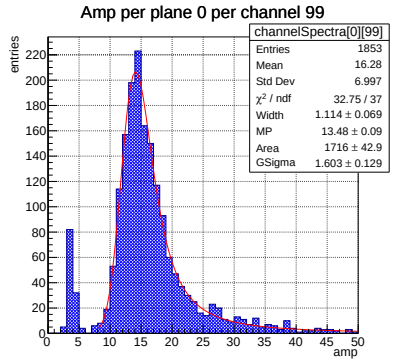


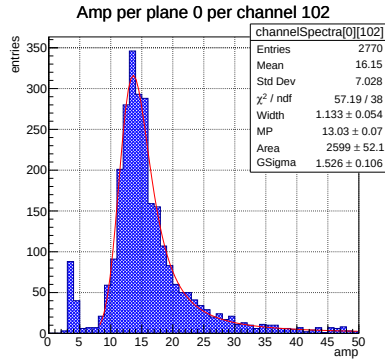
Signal in channel – plane 0 – channels 90-104

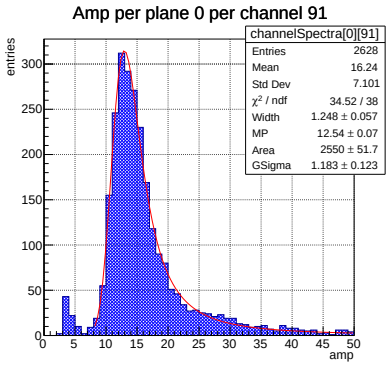


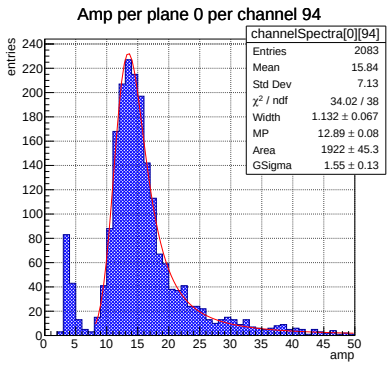


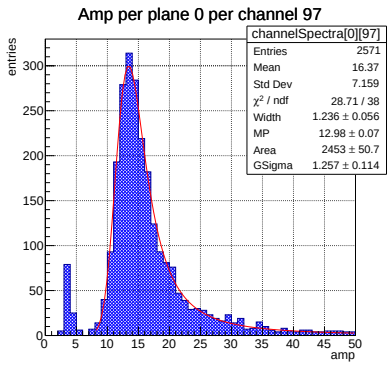


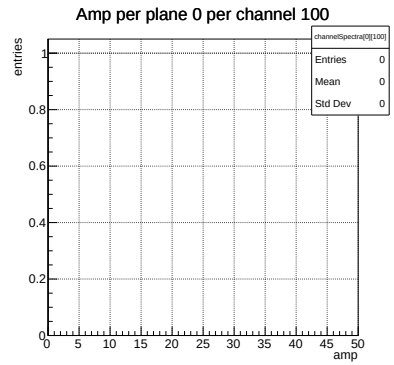


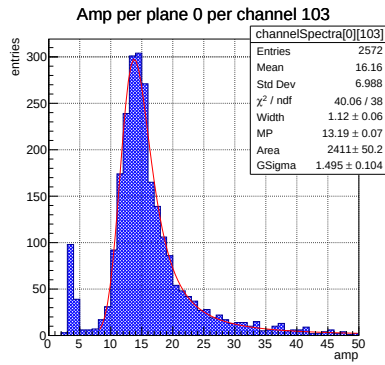


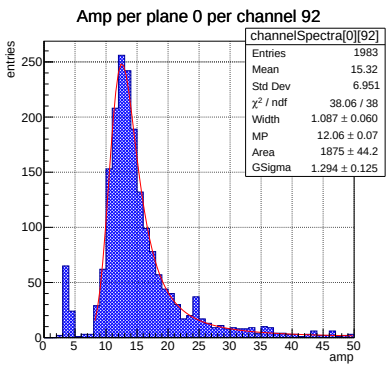


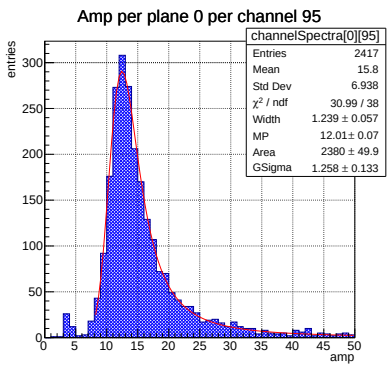


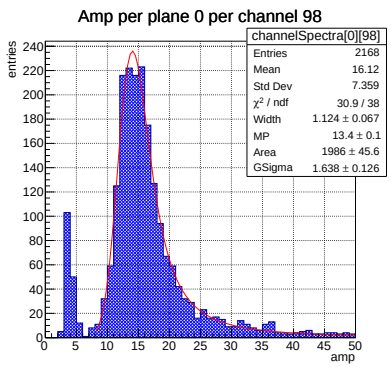


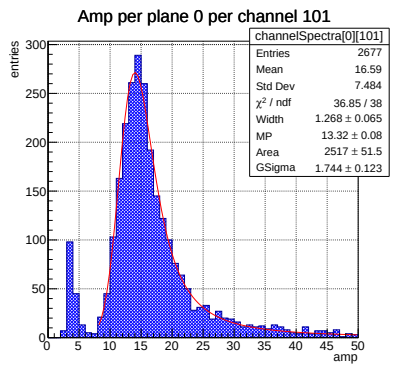


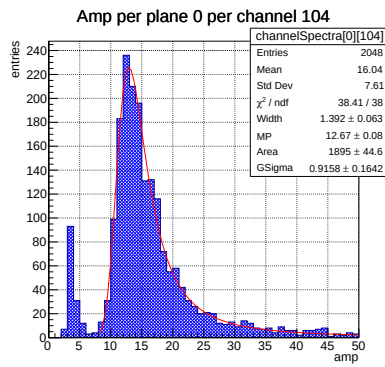




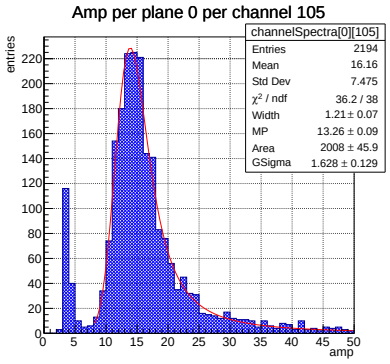


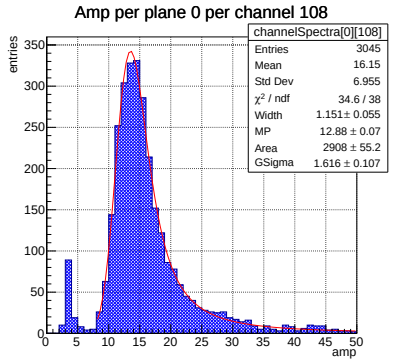


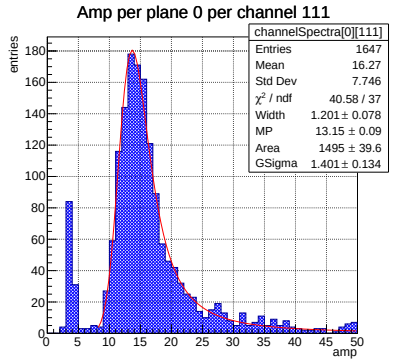


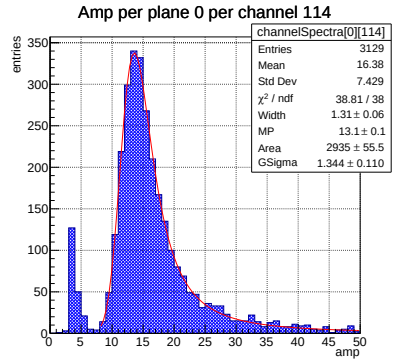


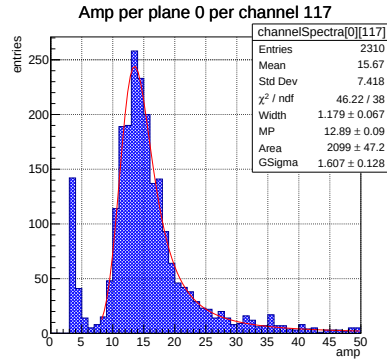
Signal in channel – plane 0 – channels 105-119

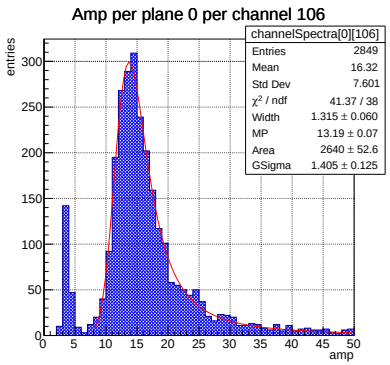


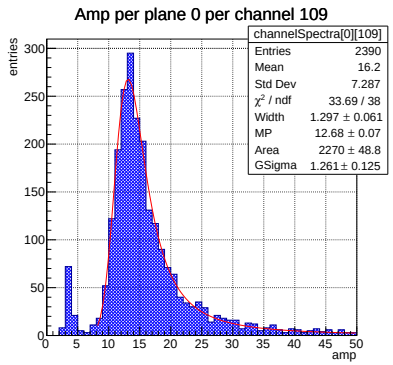


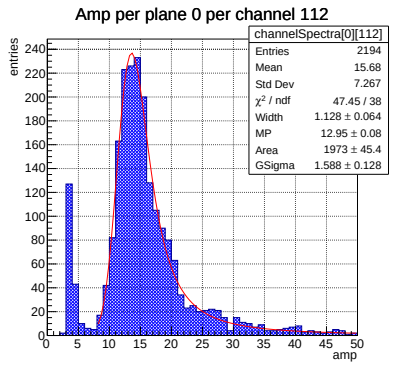


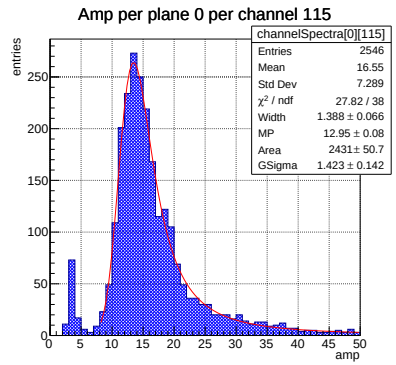


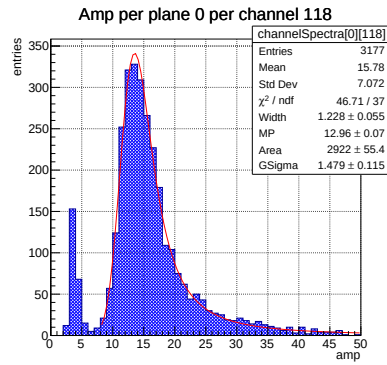


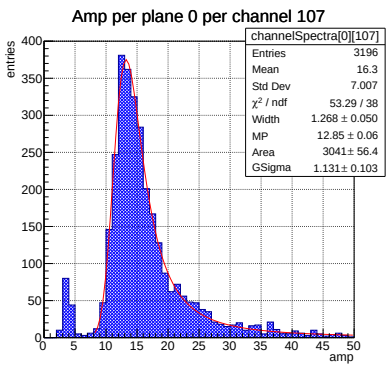


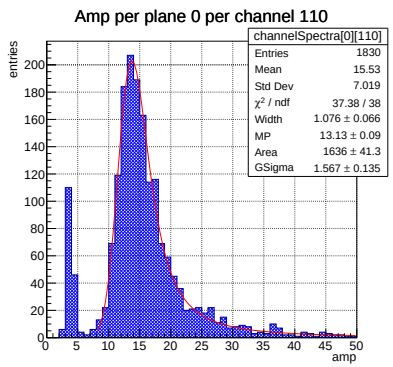


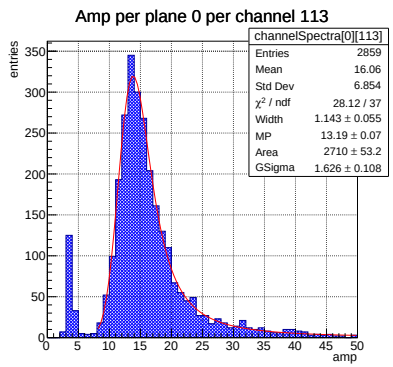


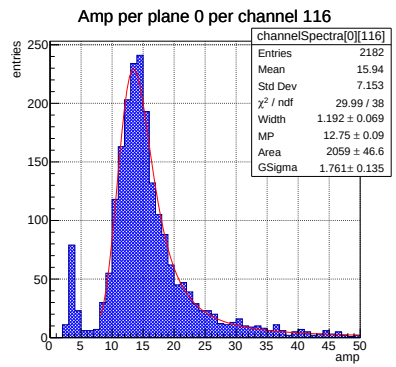


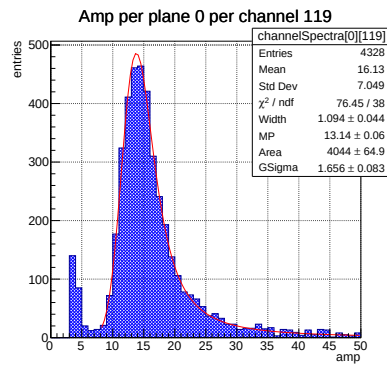




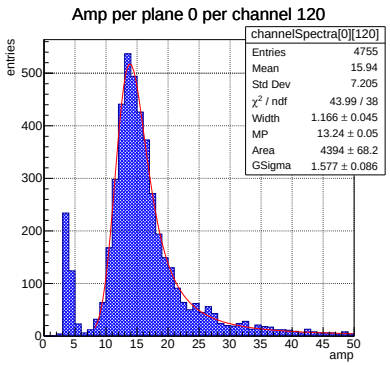


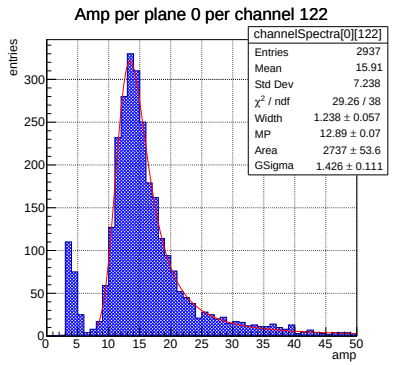


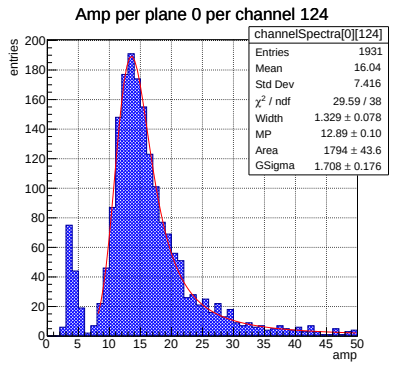


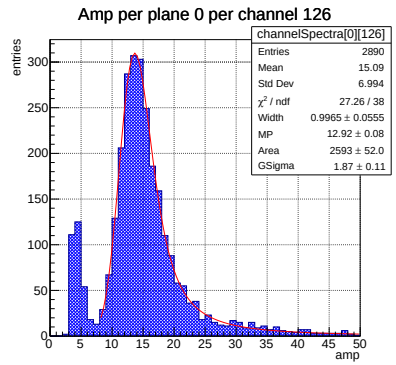


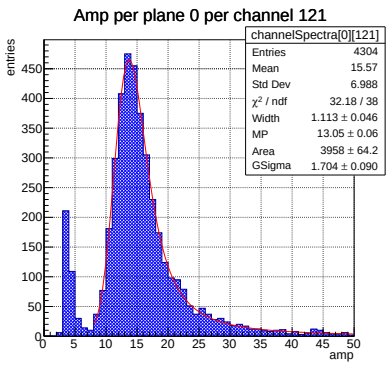
Signal in channel – plane 0 – channels 120-127

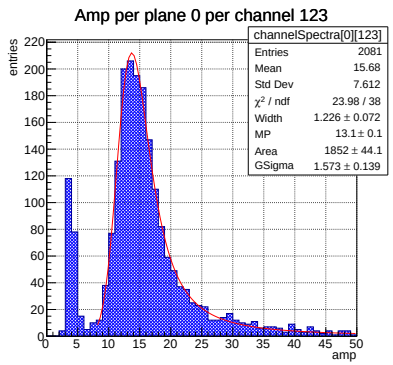


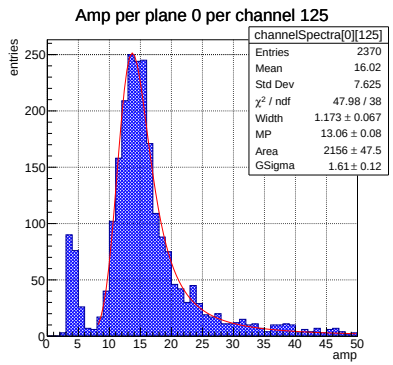


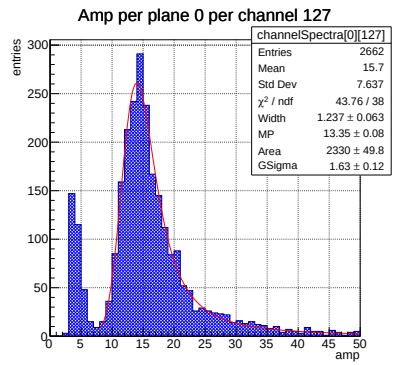






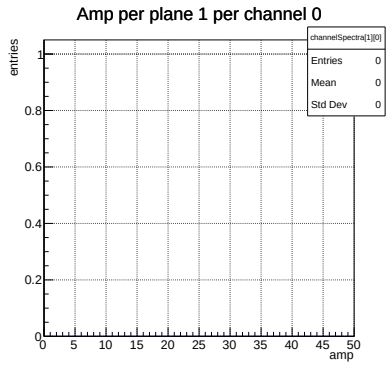


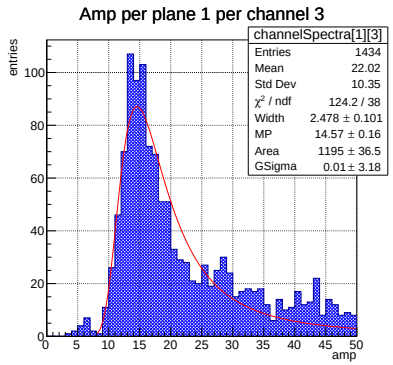


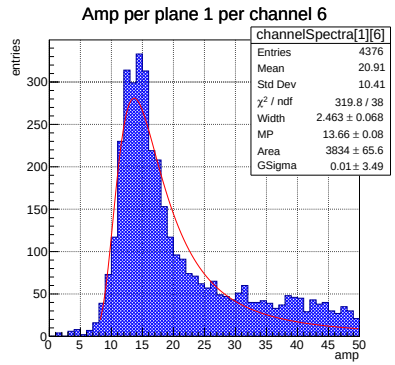


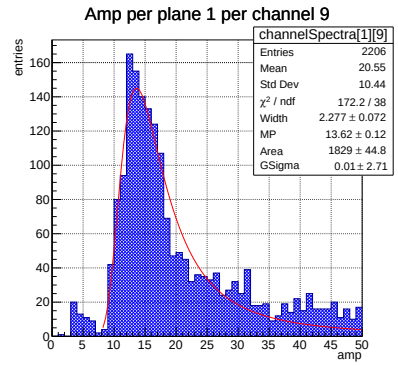
PLANE 1

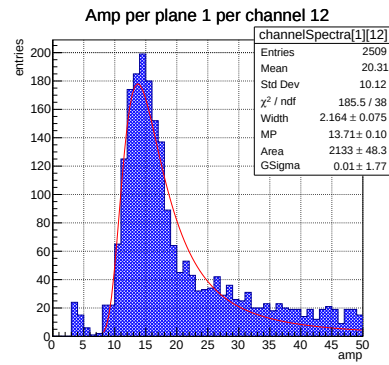
Signal in channel – plane – channels 0-14

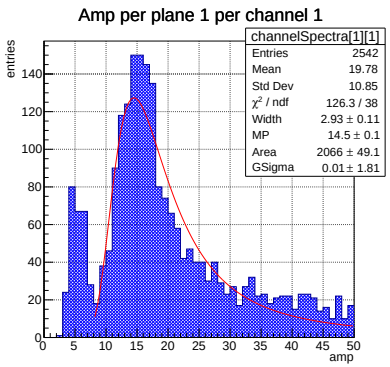


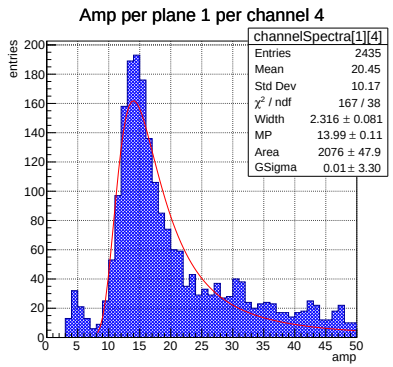


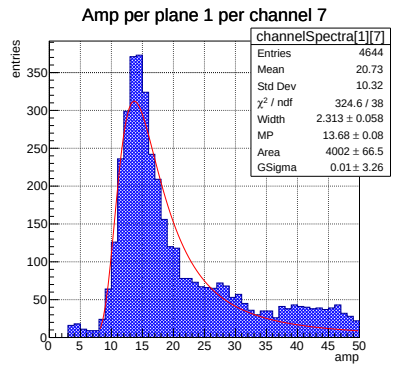


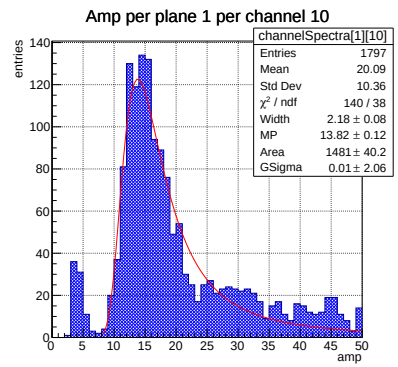


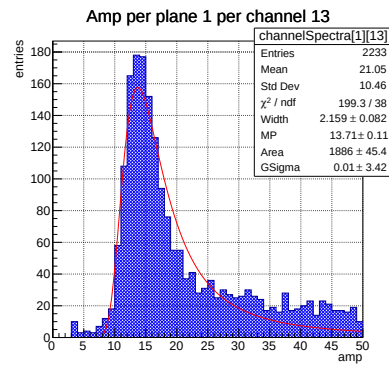


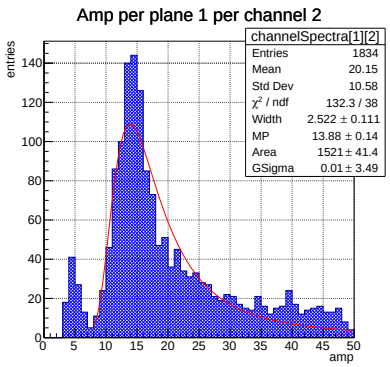


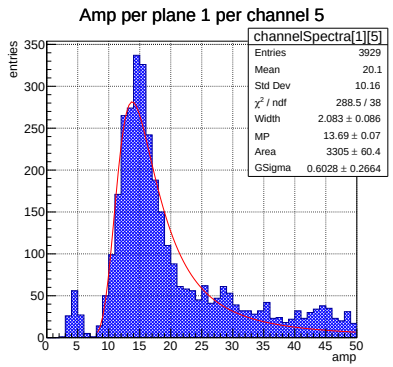


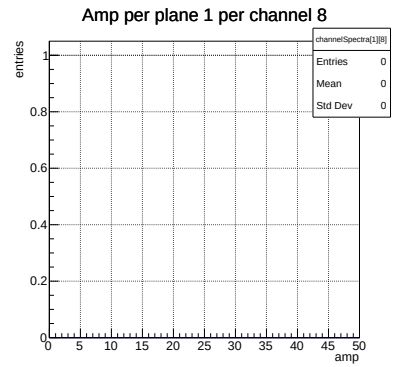


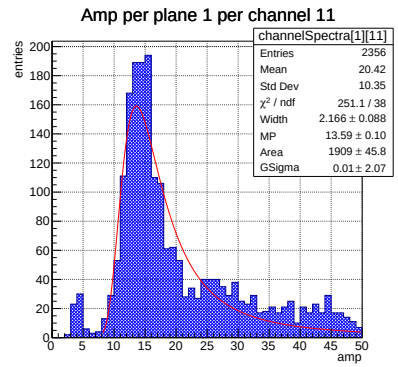


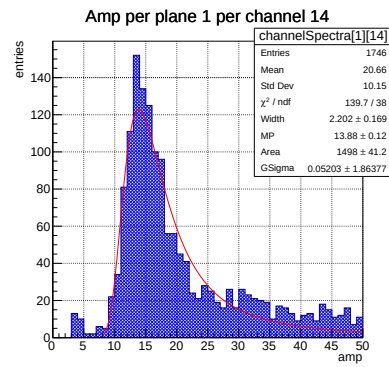




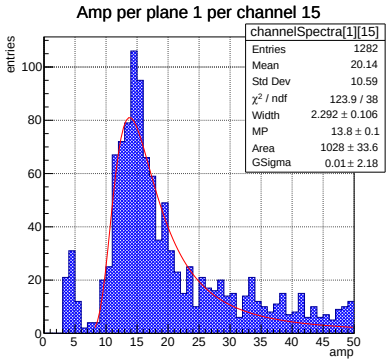


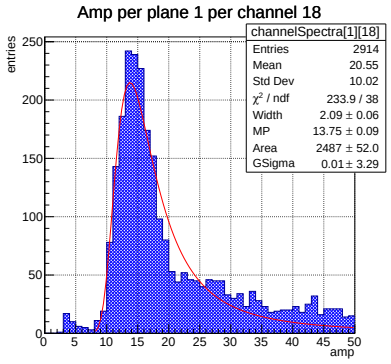


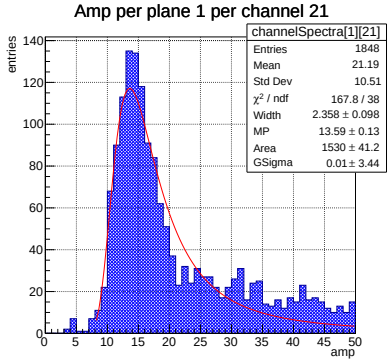


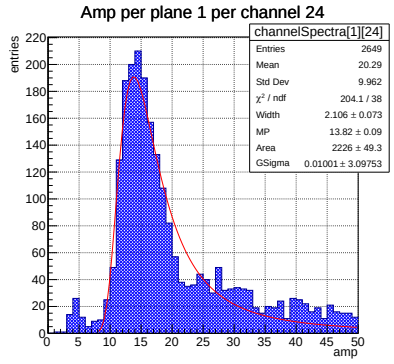


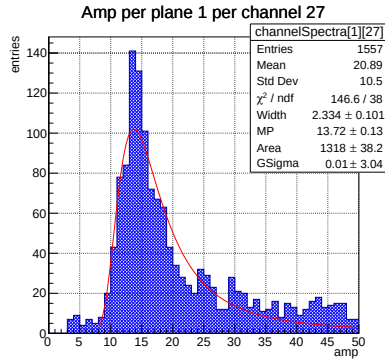
Signal in channel – plane 1 – channels 15-29

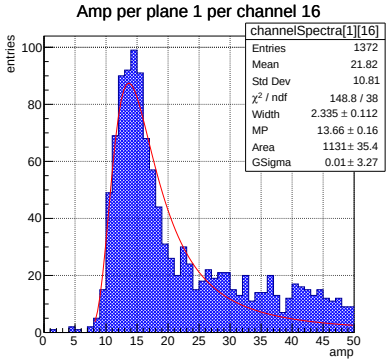


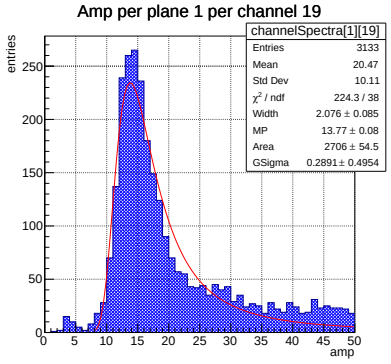


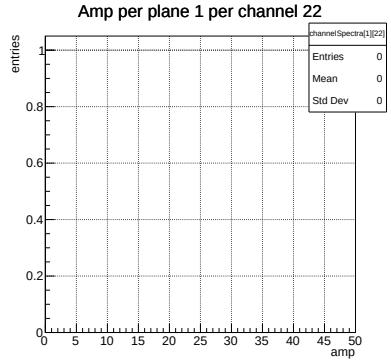


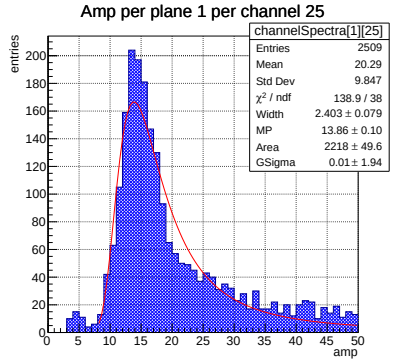


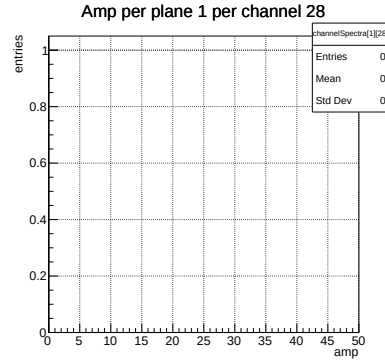


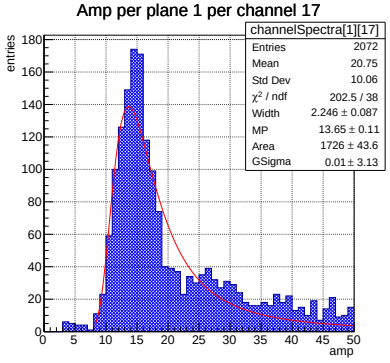


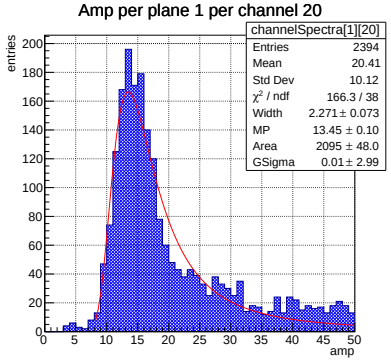


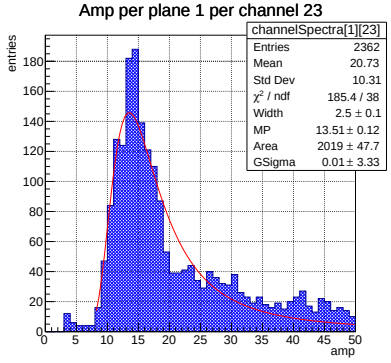


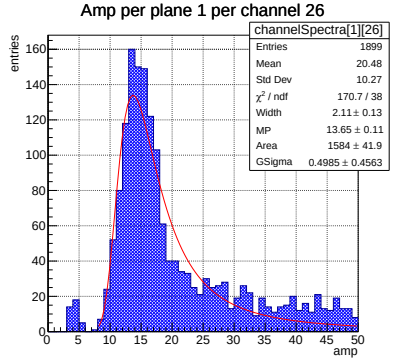


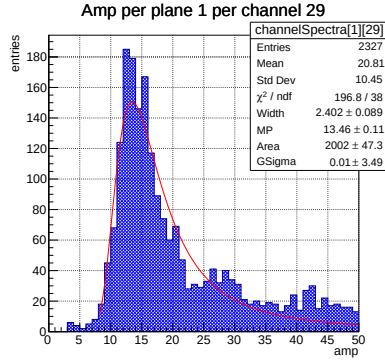




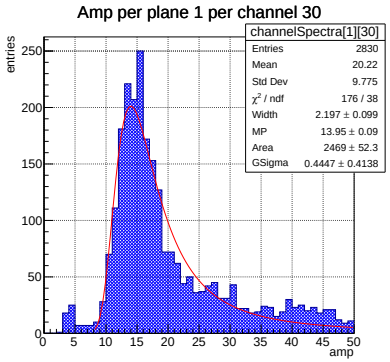


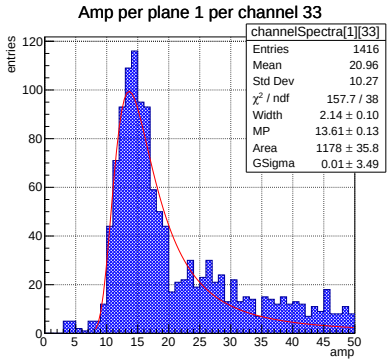


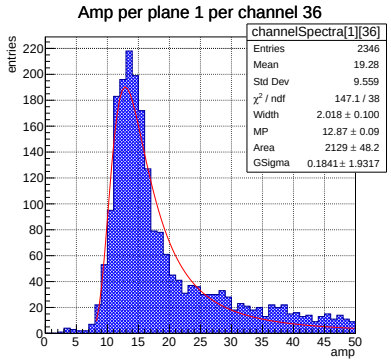


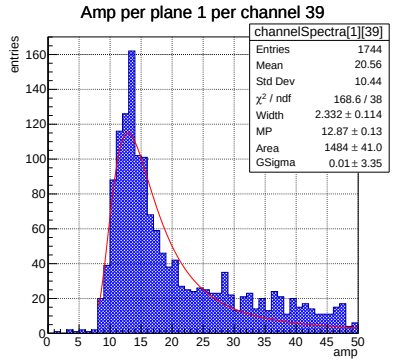


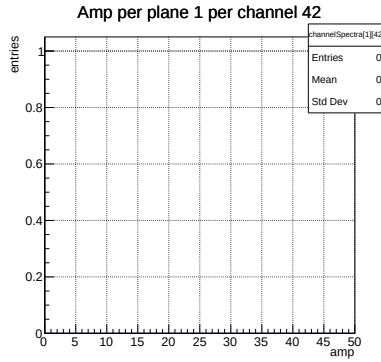
Signal in channel – plane 1 – channels 30-44

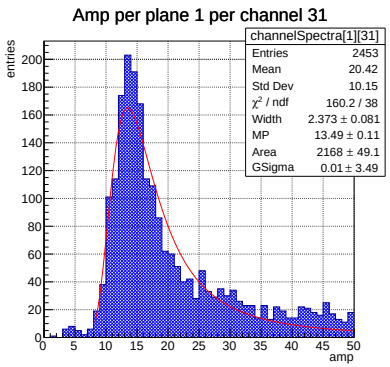


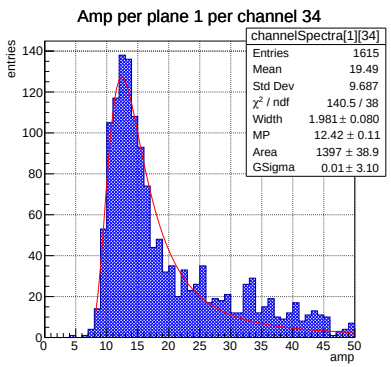


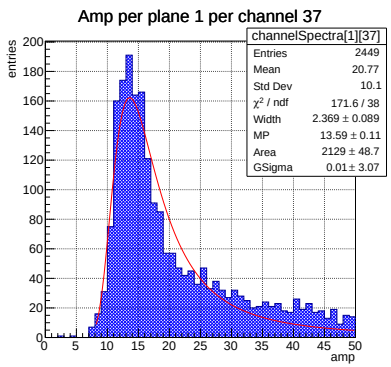


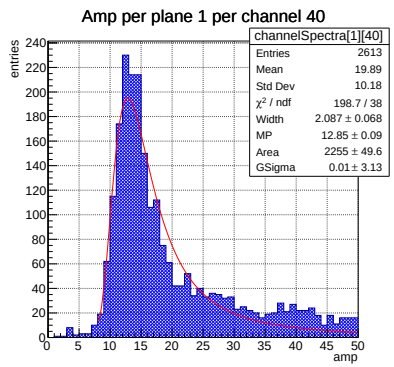


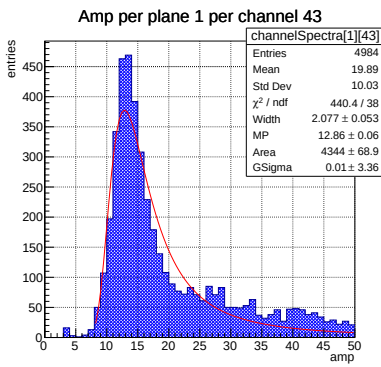


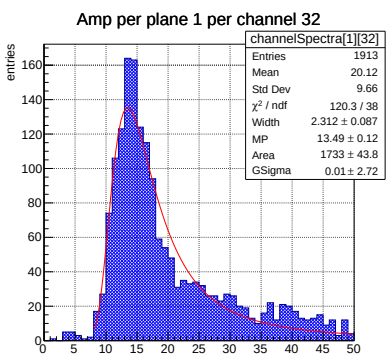


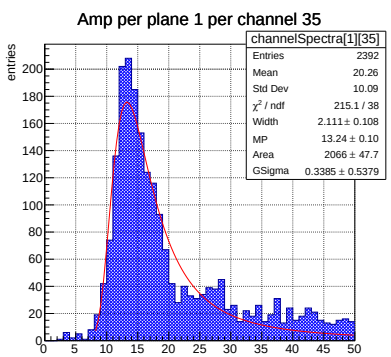


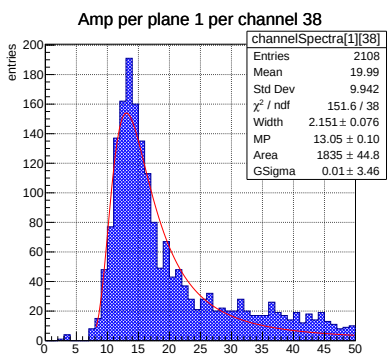


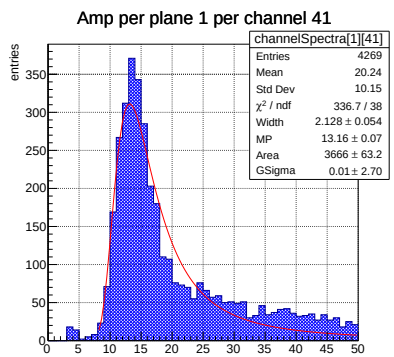


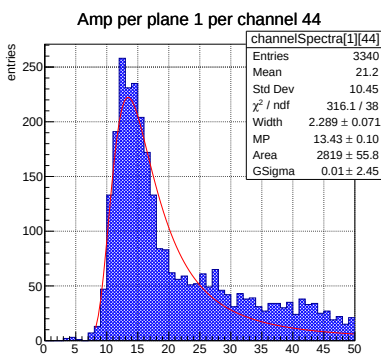




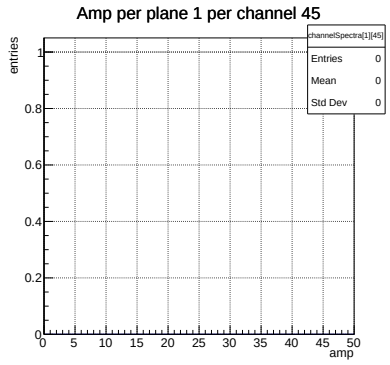


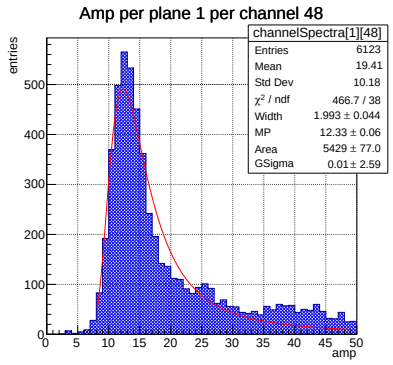


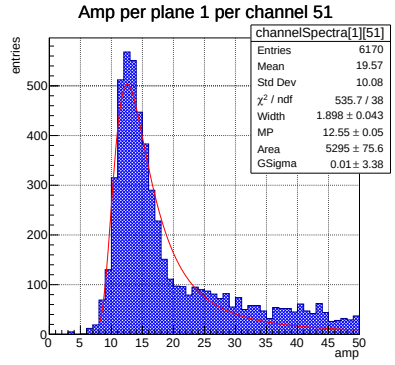


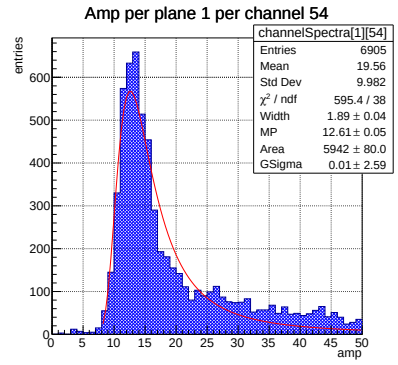


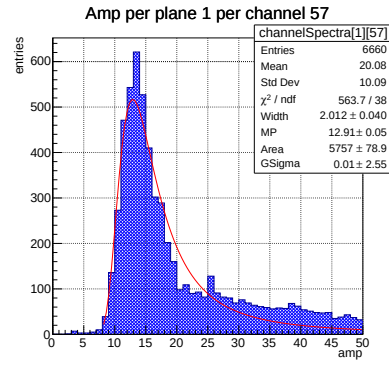
Signal in channel – plane 1 – channels 45-59

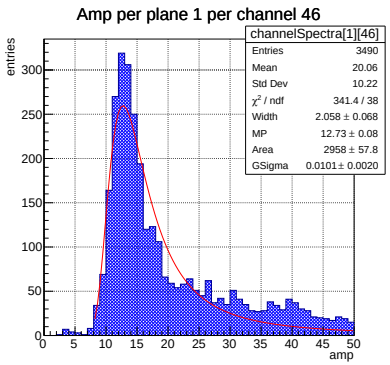


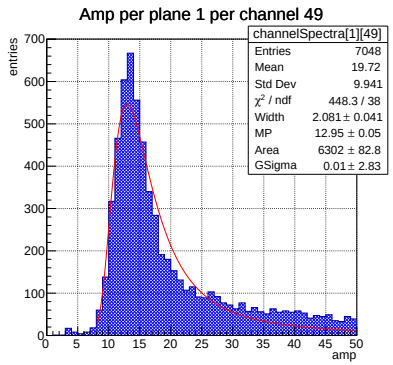


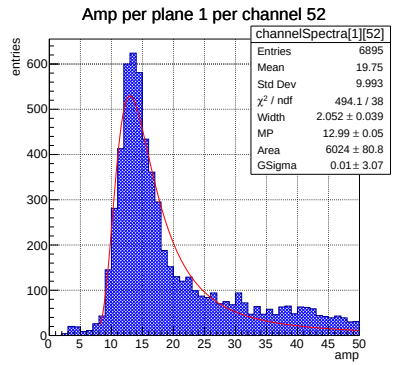


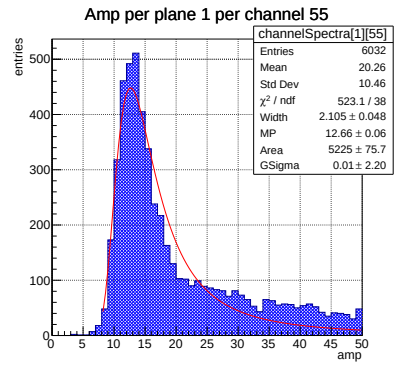


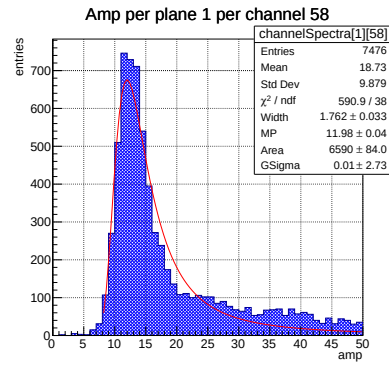


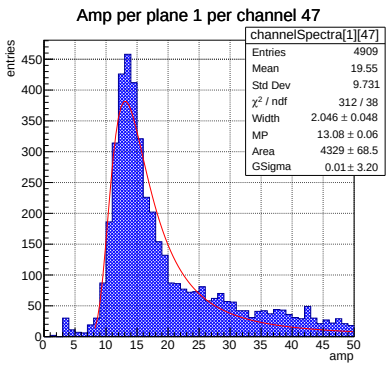


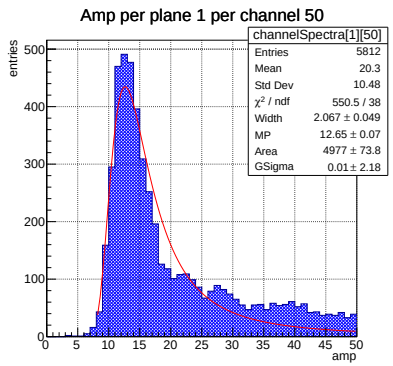


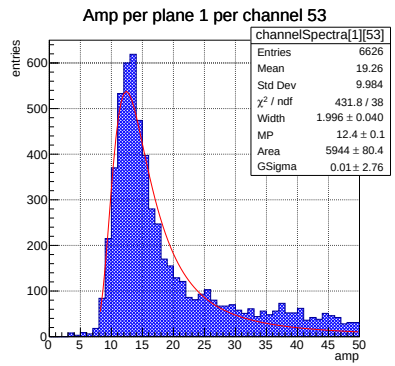


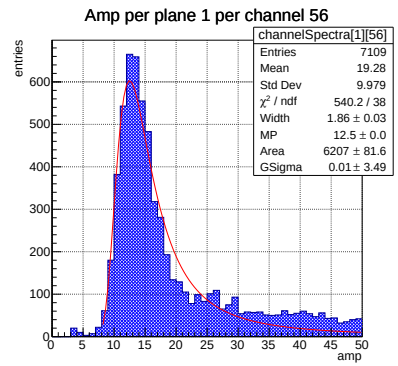


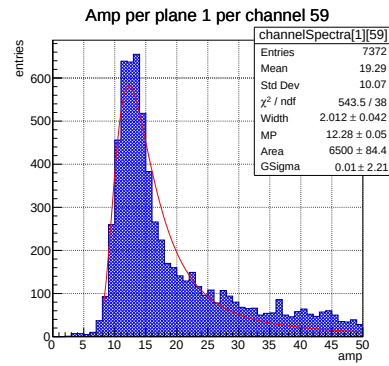




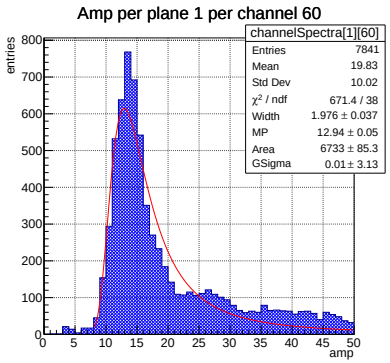


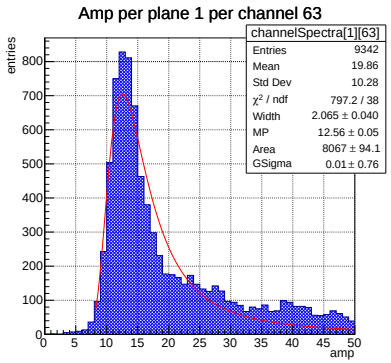


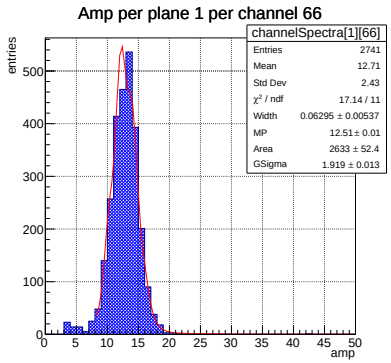


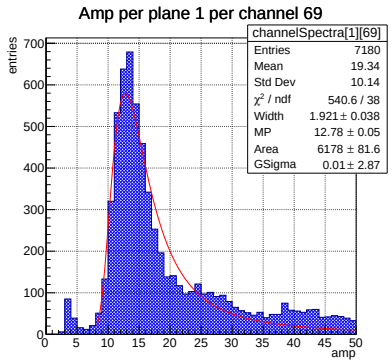


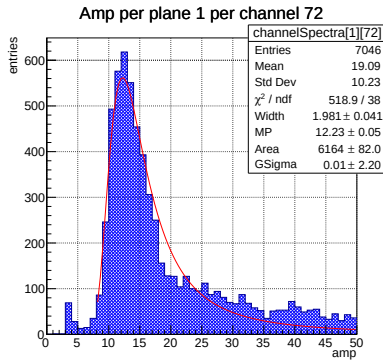
Signal in channel – plane 1 – channels 60-74

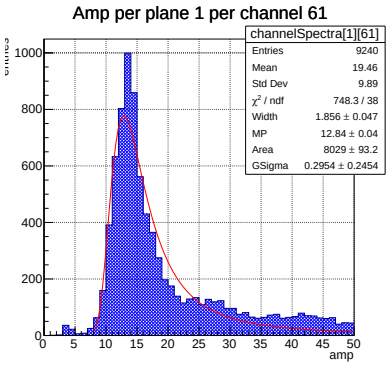


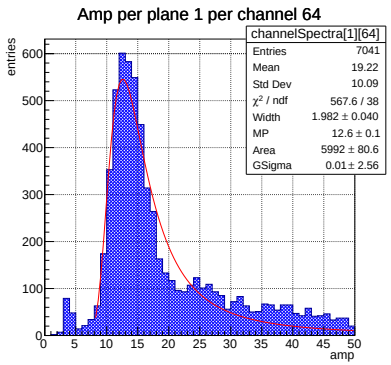


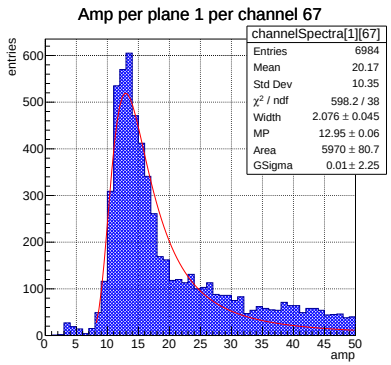


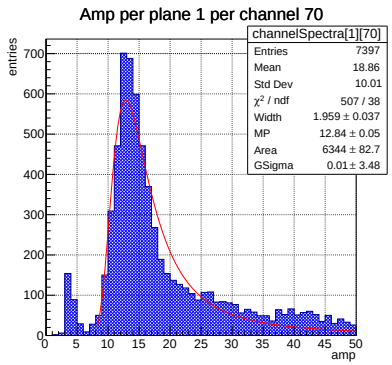


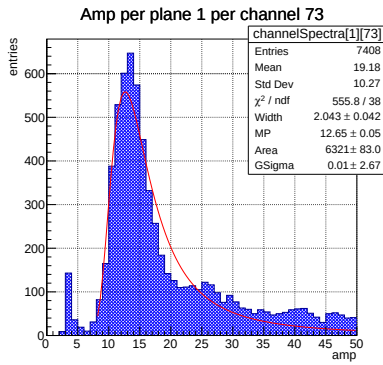


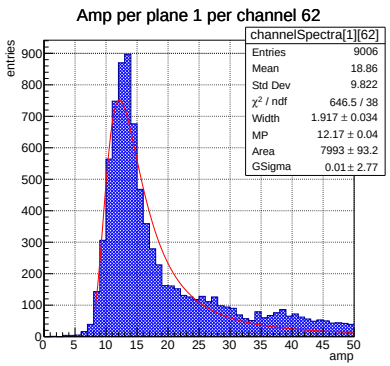


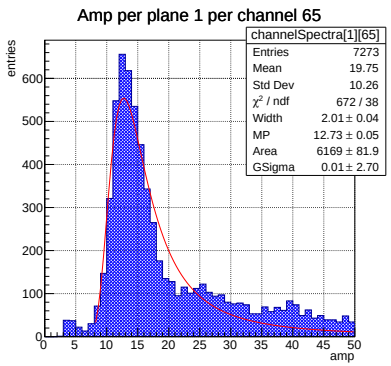


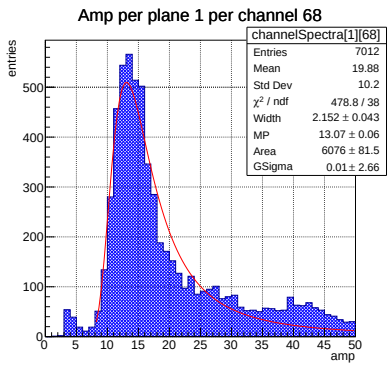


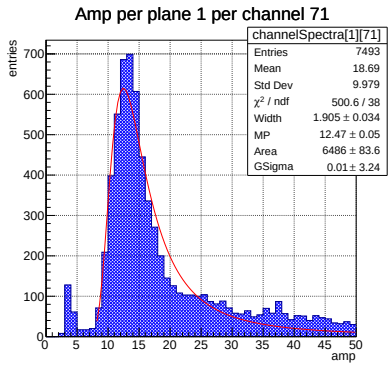


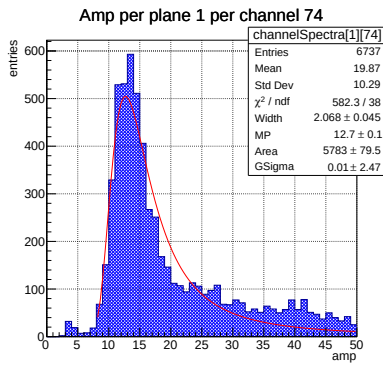




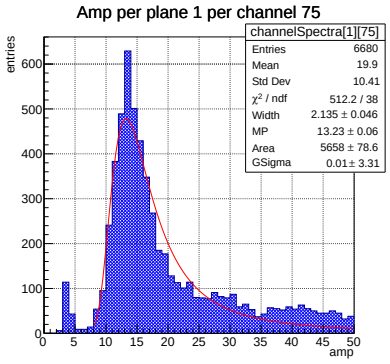


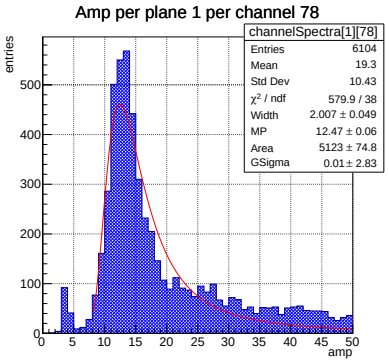


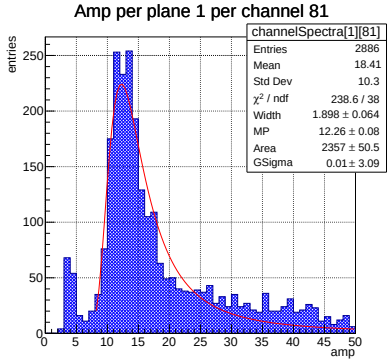


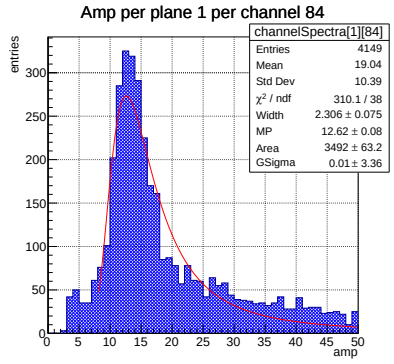


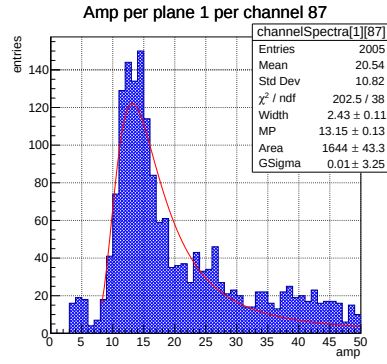
Signal in channel – plane 1 – channels 75-89

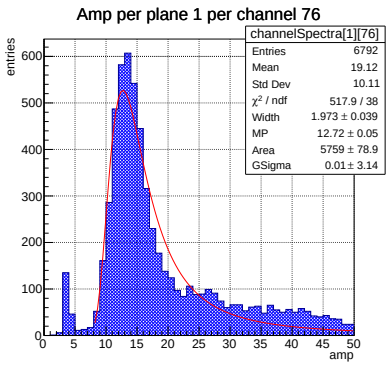


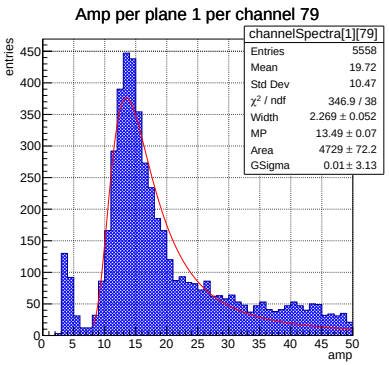


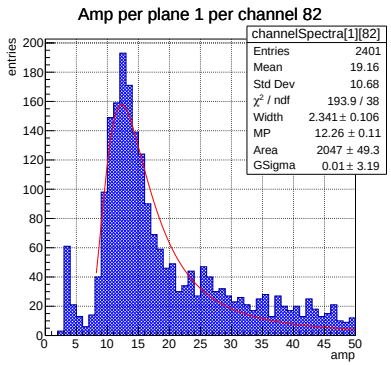


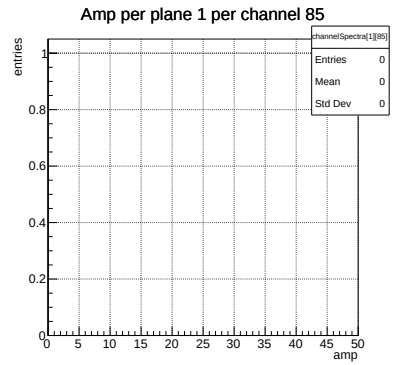


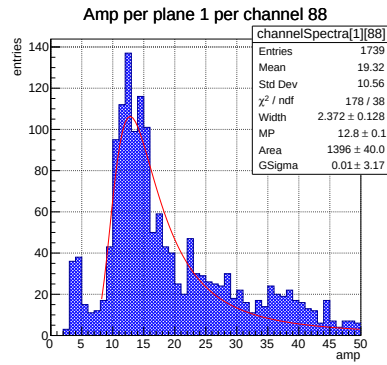


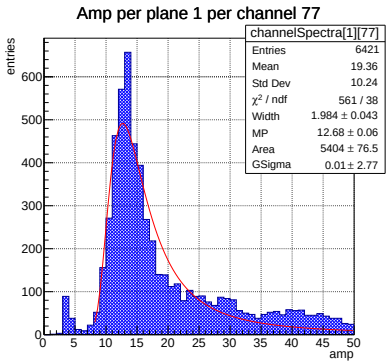


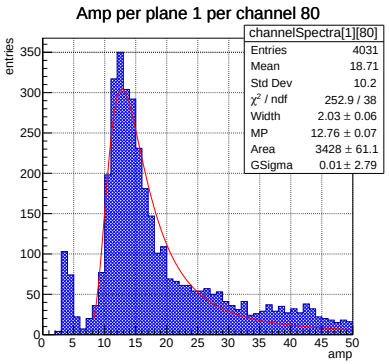


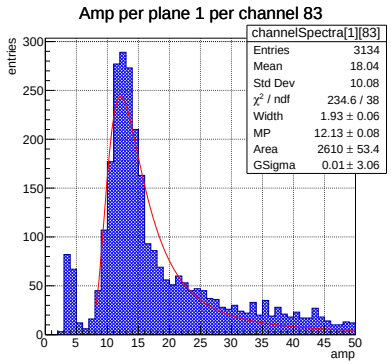


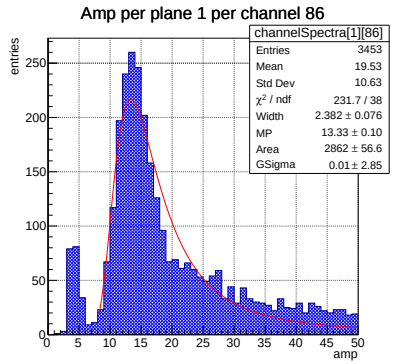


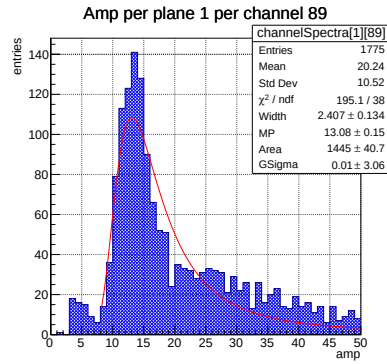




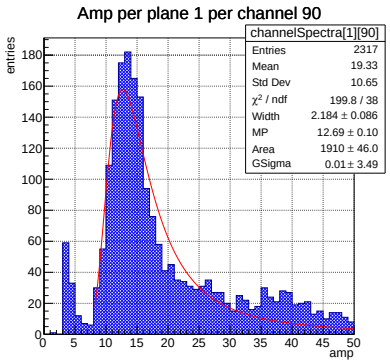


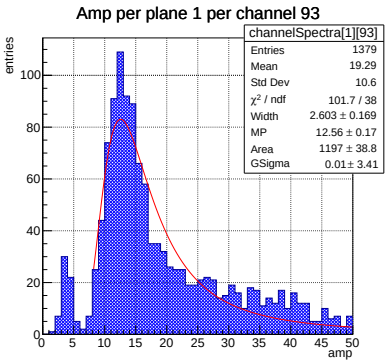


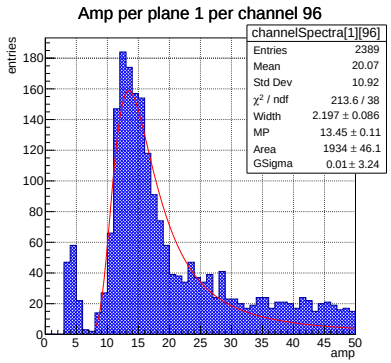


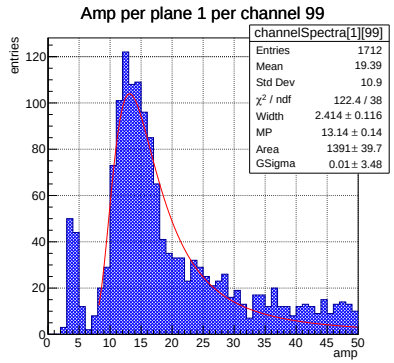


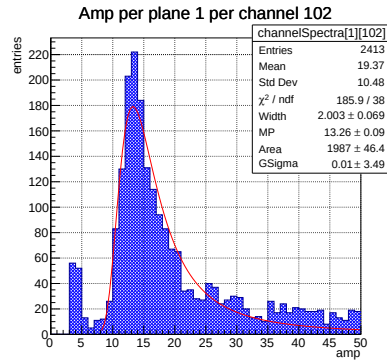
Signal in channel – plane 1 – channels 90-104

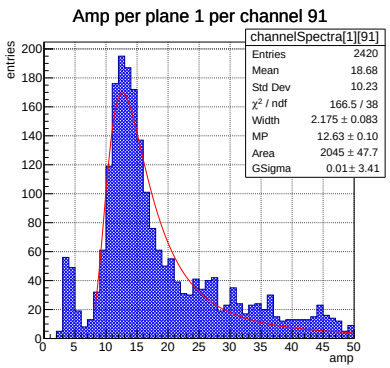


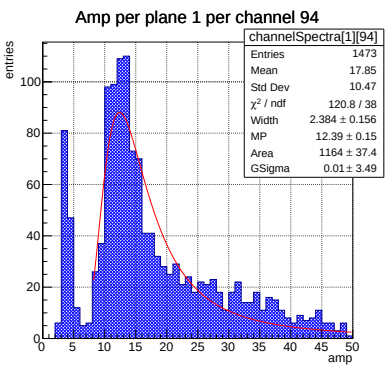


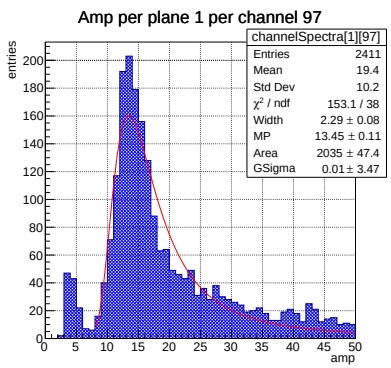


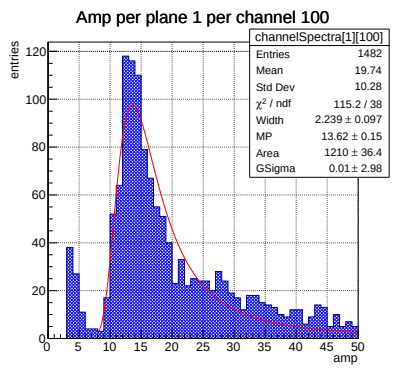


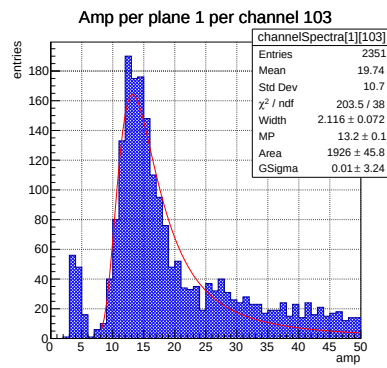


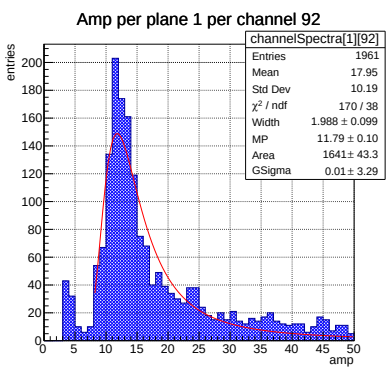


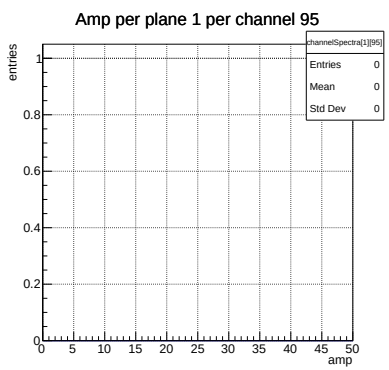


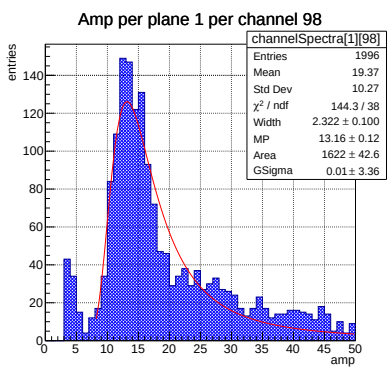


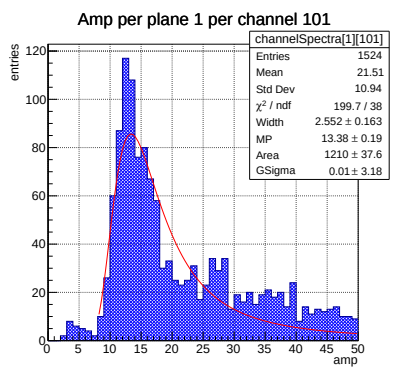


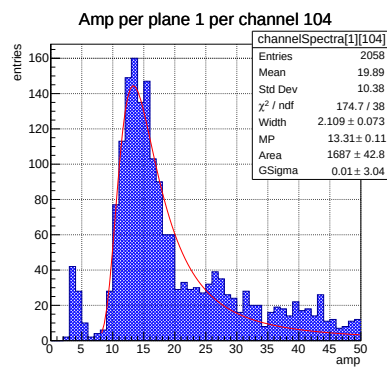




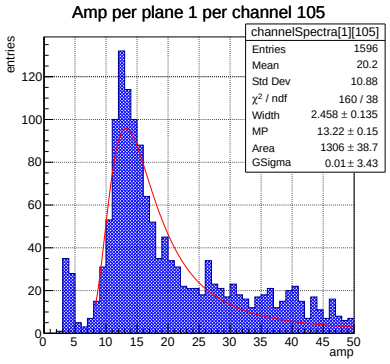


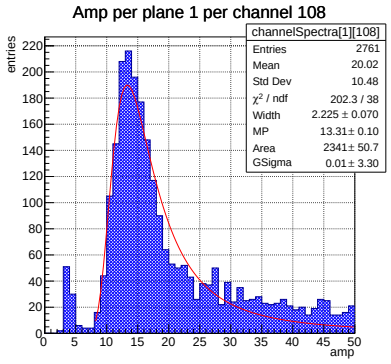


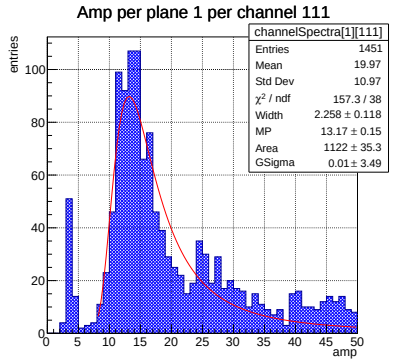


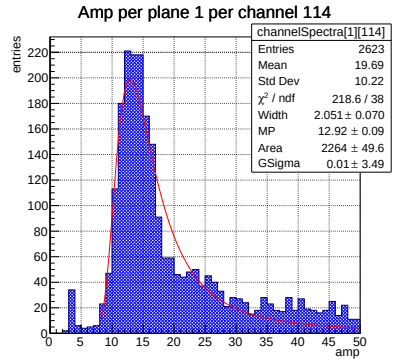


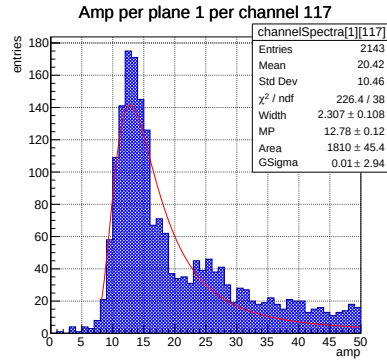
Signal in channel – plane 1 – channels 105-119

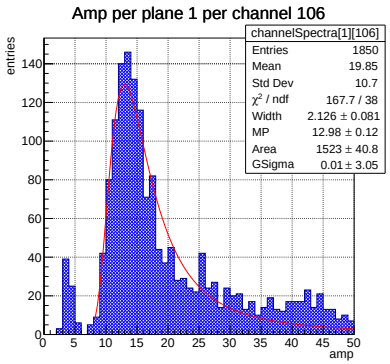


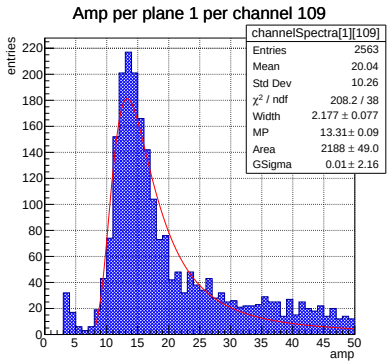


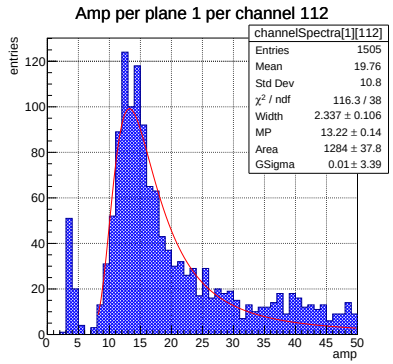


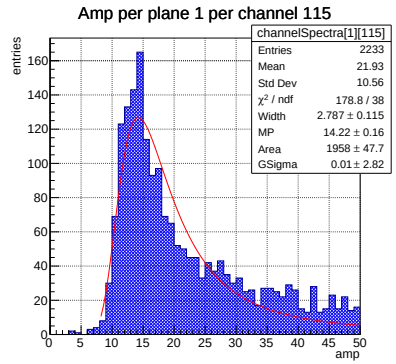


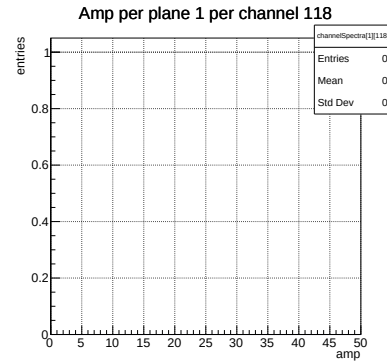


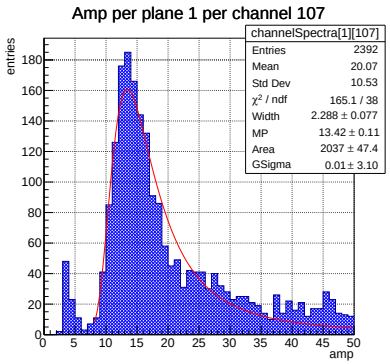


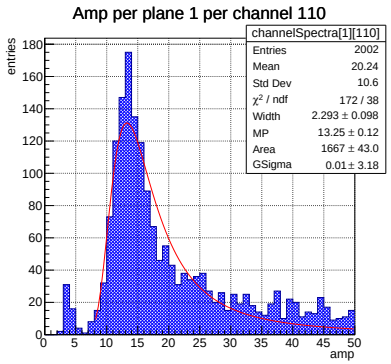


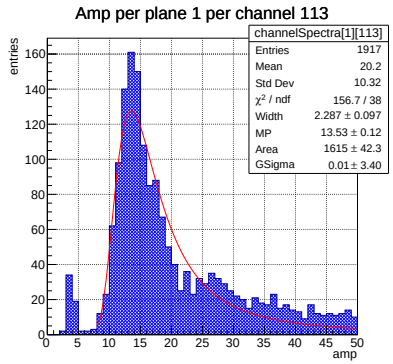


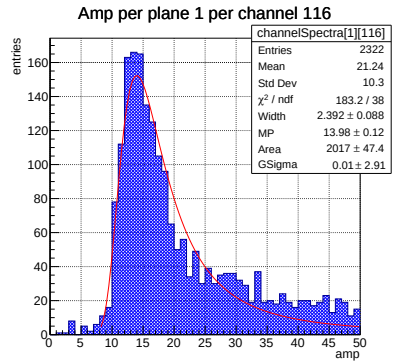


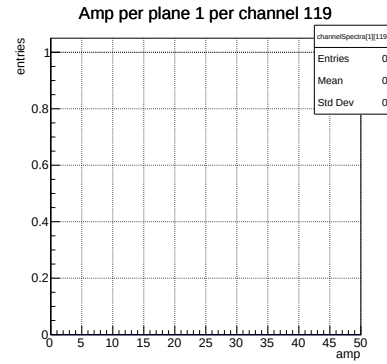




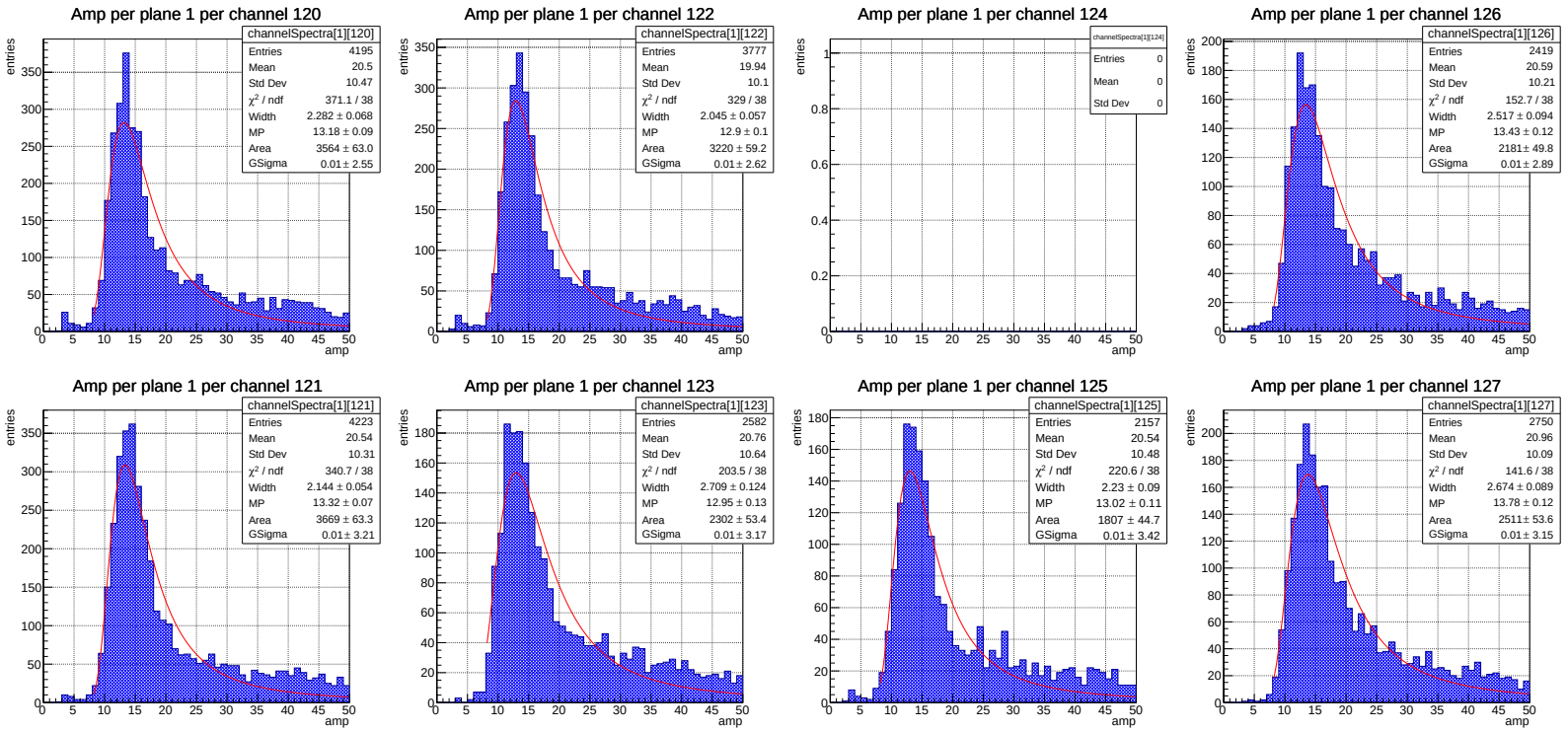






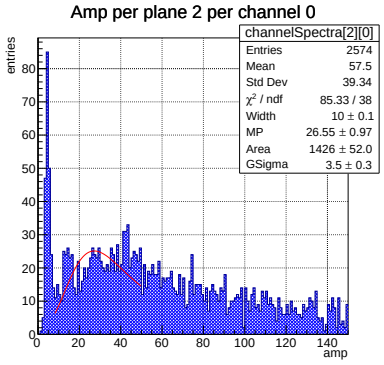


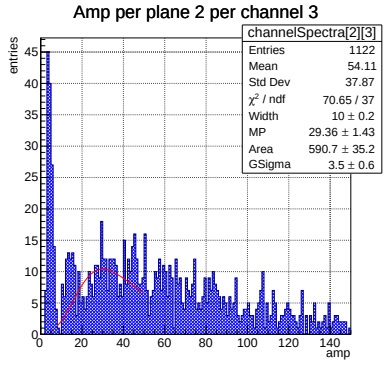
Signal in channel – plane 1 – channels 120-127

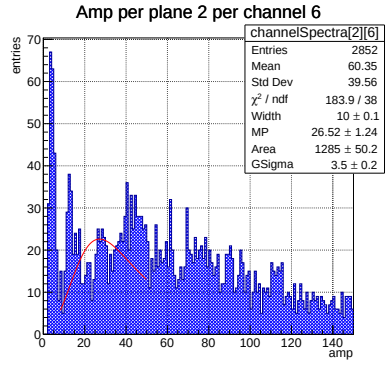


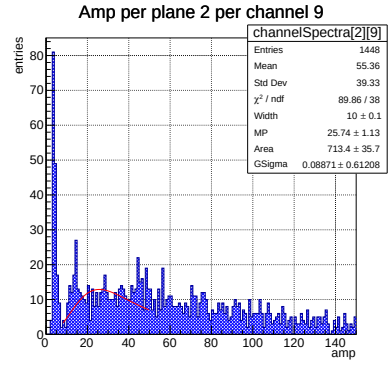
PLANE 2

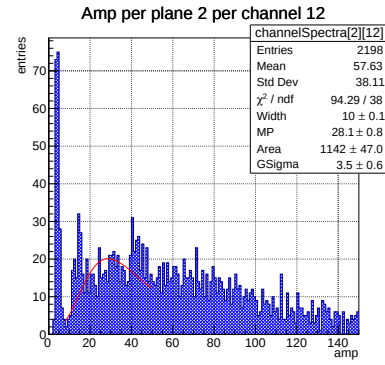
Signal in channel – plane 2 – channels 0-14

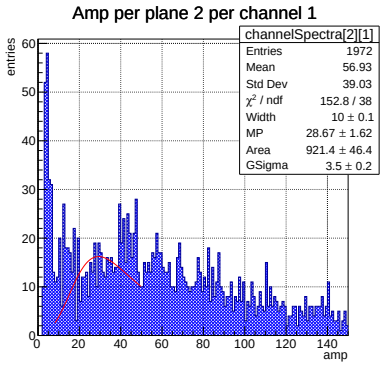


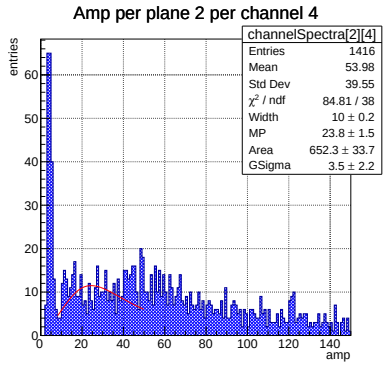


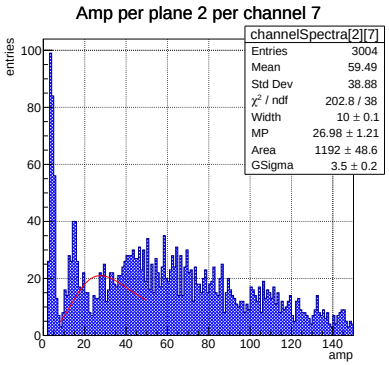


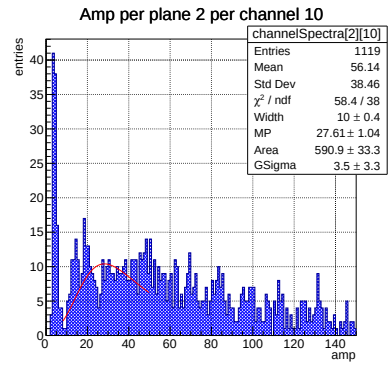


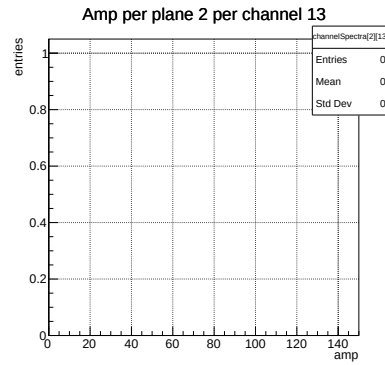


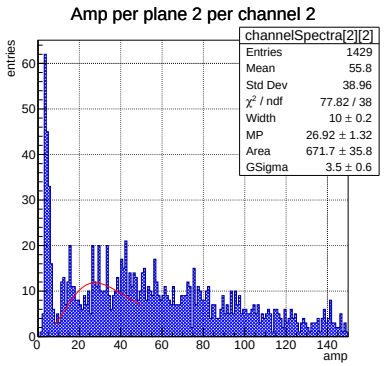


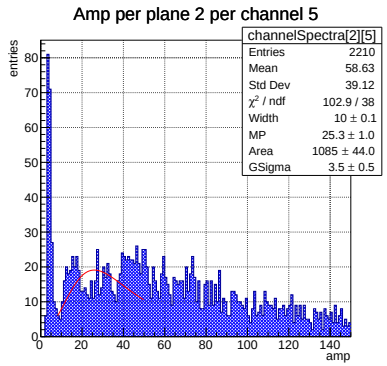


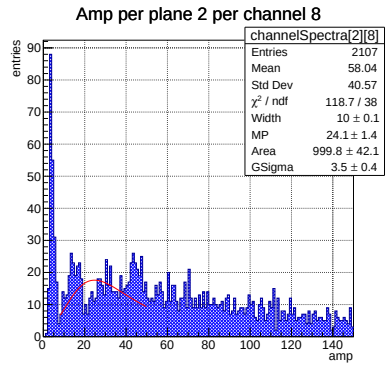


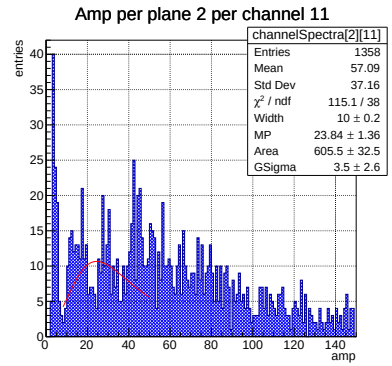


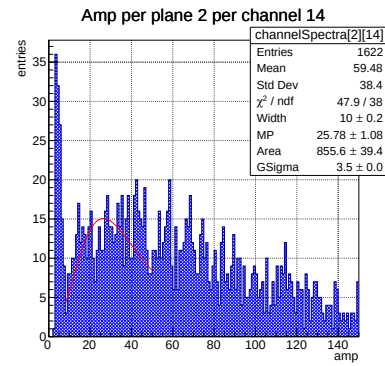




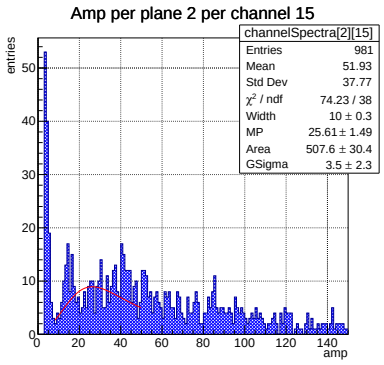


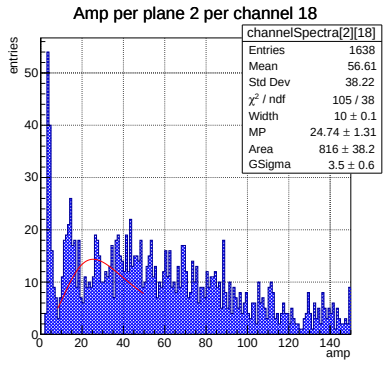


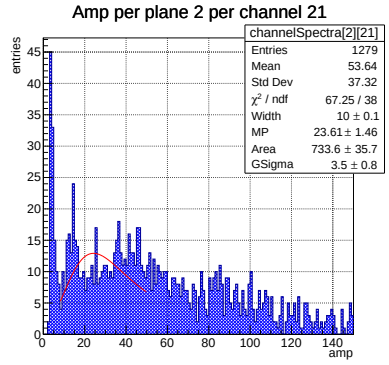


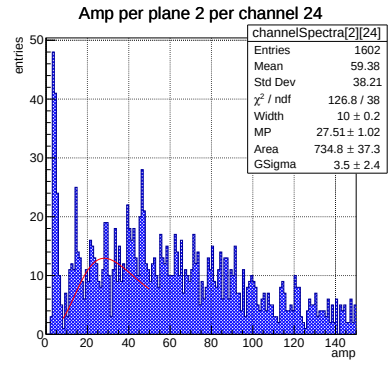


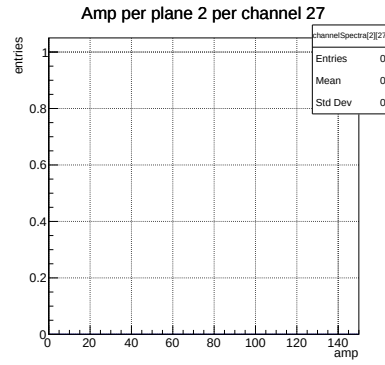
Signal in channel – plane 2 – channels 15-29

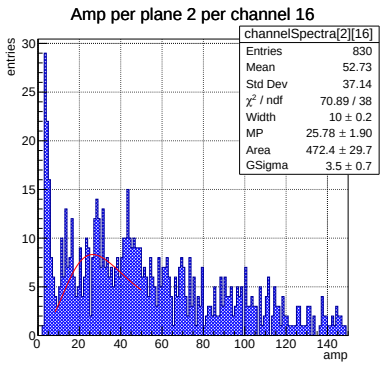


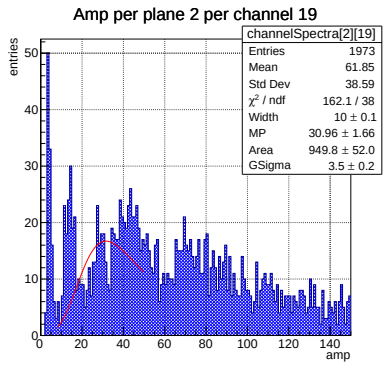


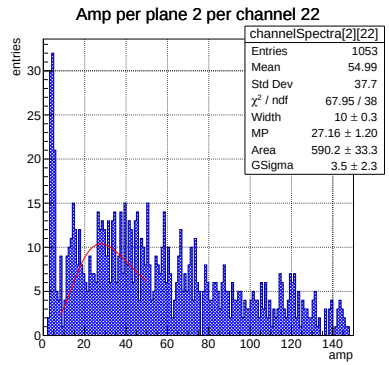


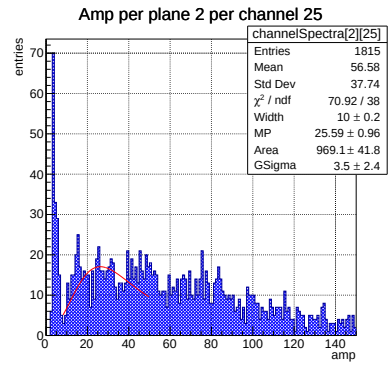


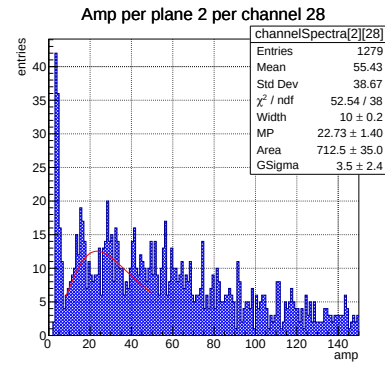


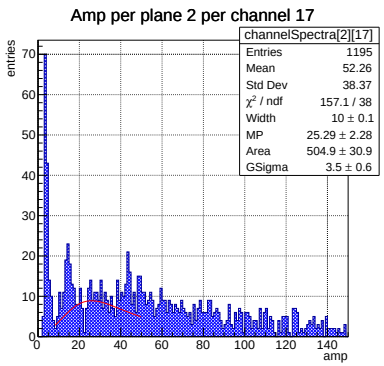


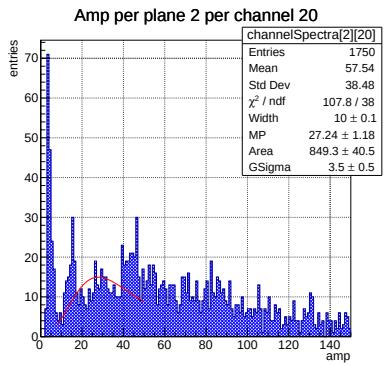


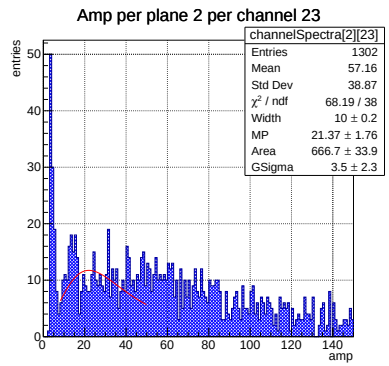


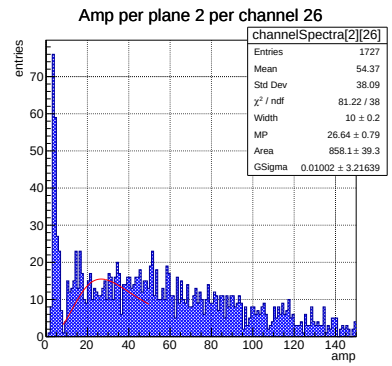


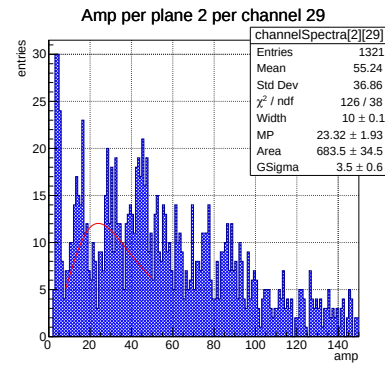




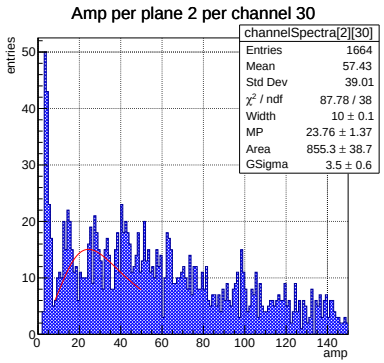


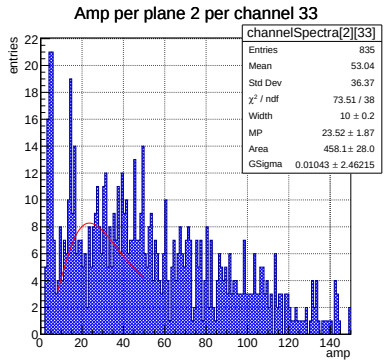


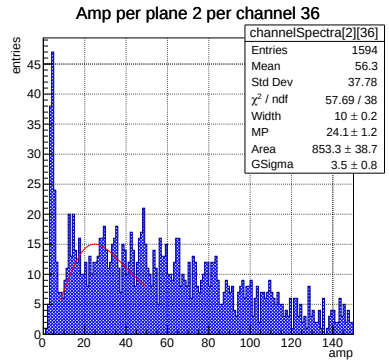


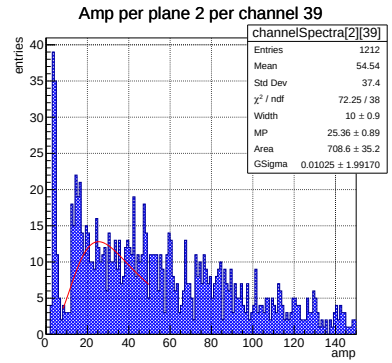


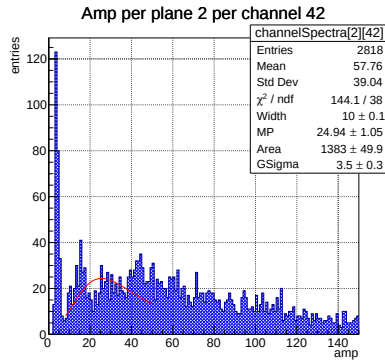
Signal in channel – plane 2 – channels 30-44

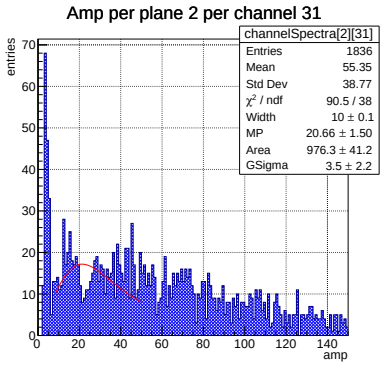


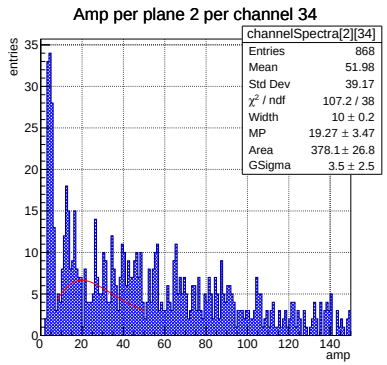


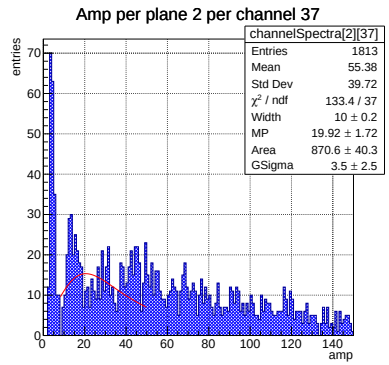


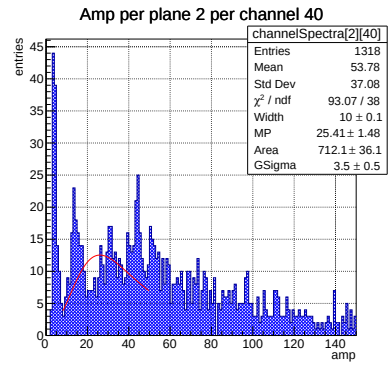


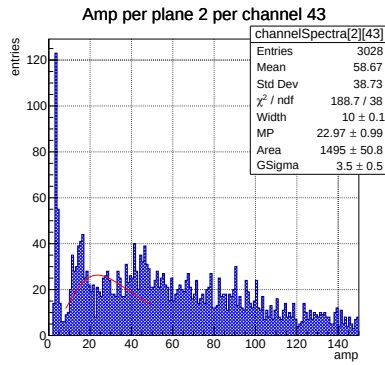


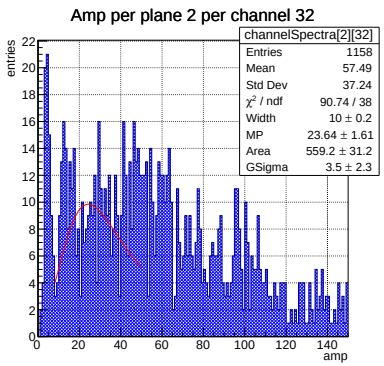


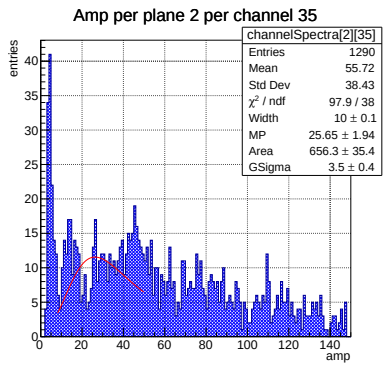


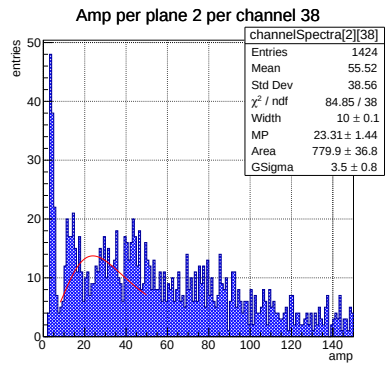


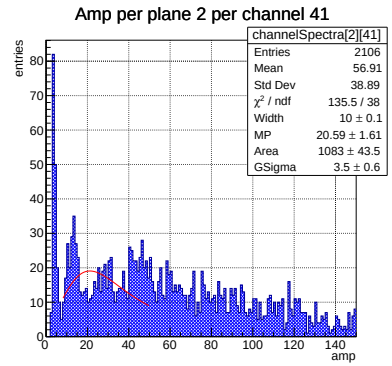


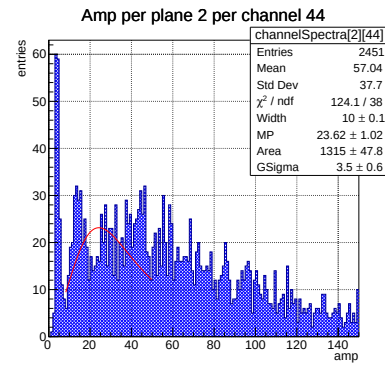




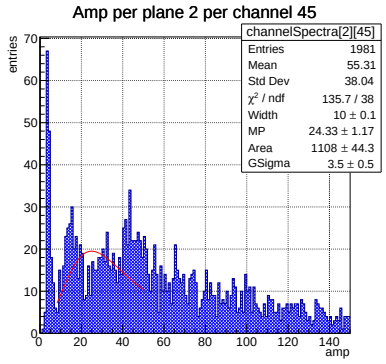


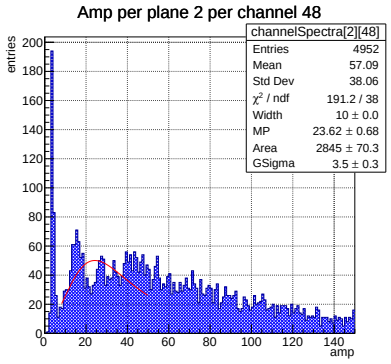


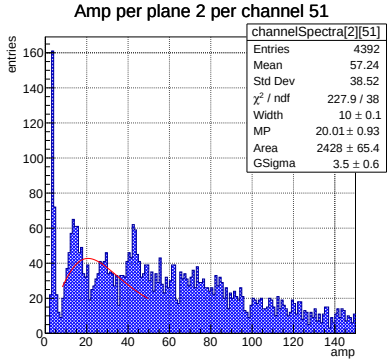


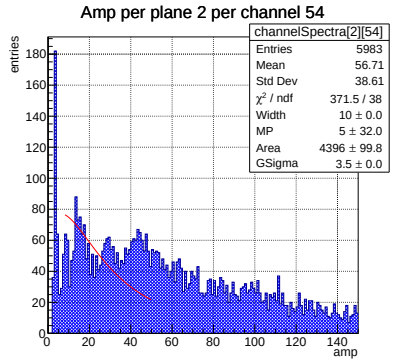


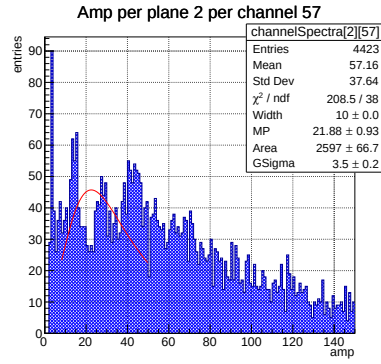
Signal in channel – plane 2 – channels 45-59

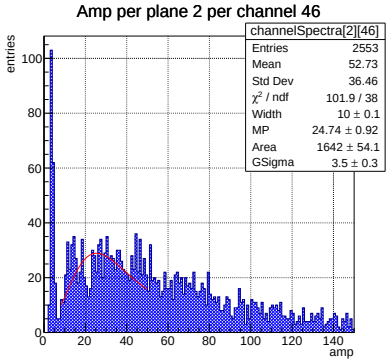


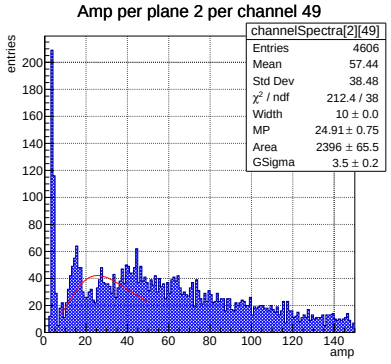


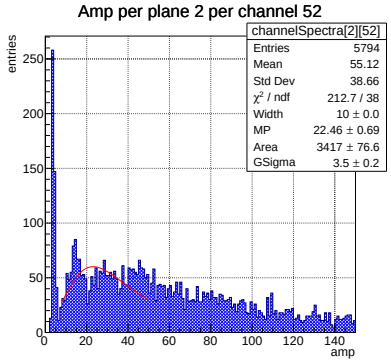


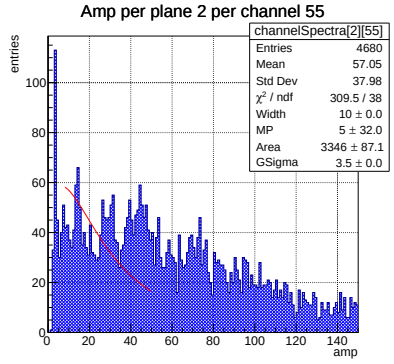


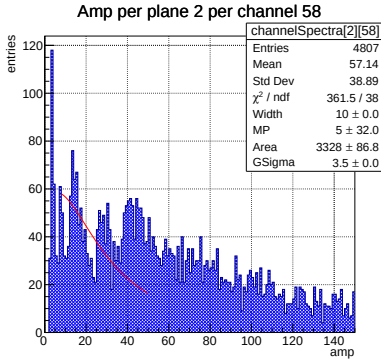


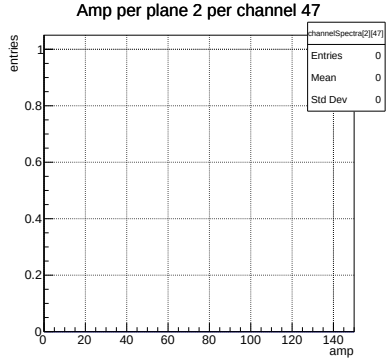


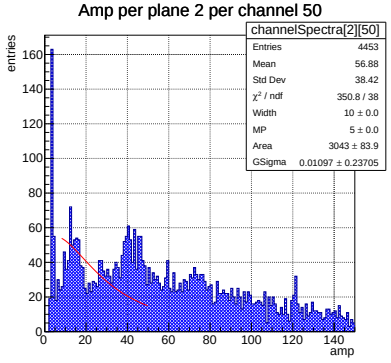


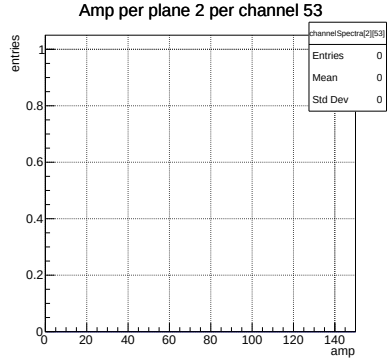


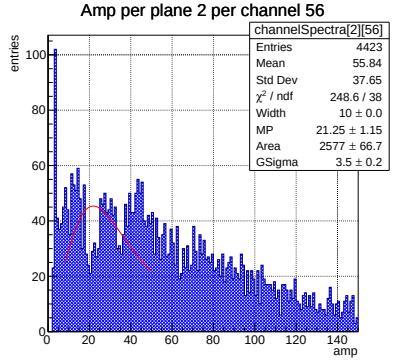


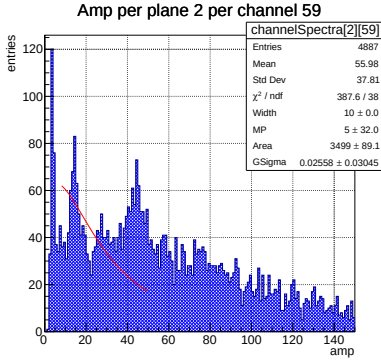




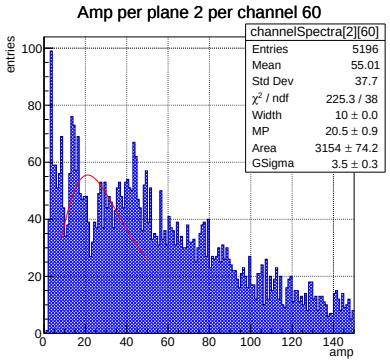


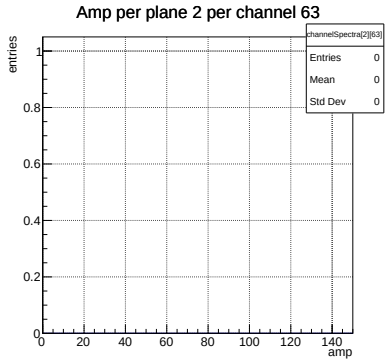


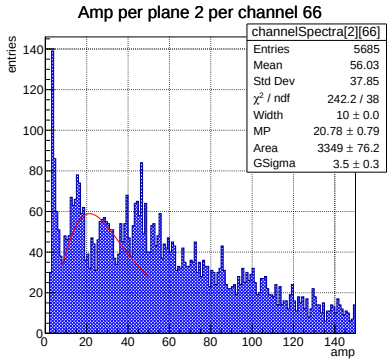


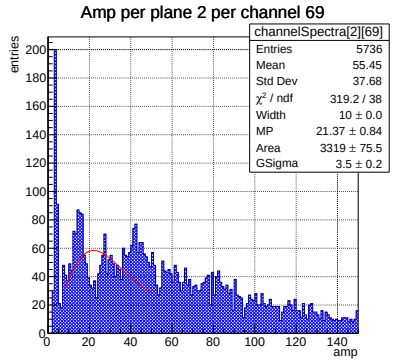


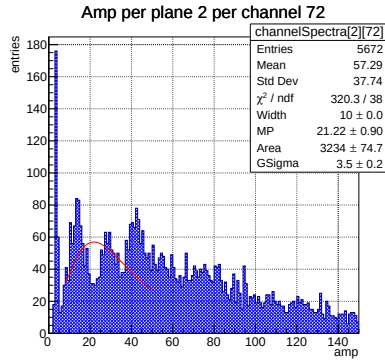
Signal in channel – plane 2 – channels 60-74

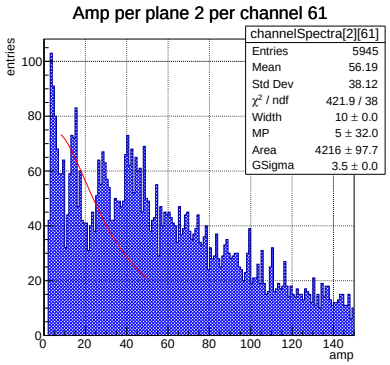


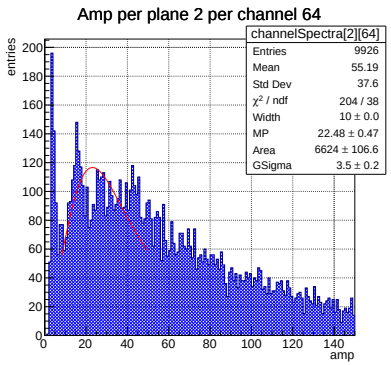


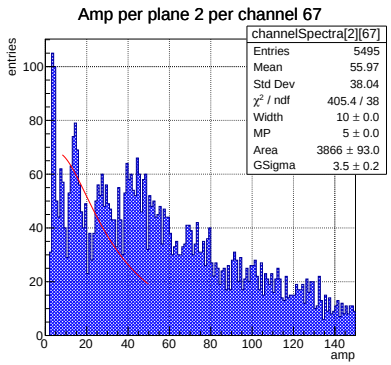


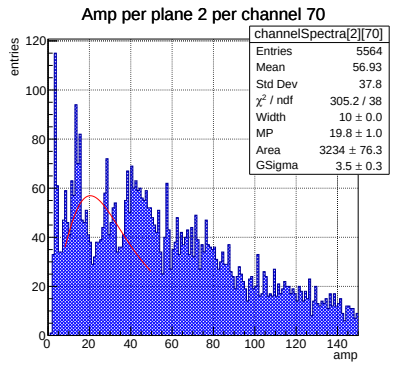


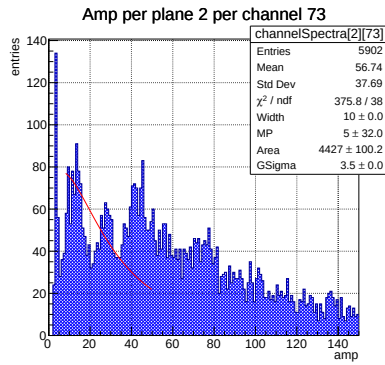


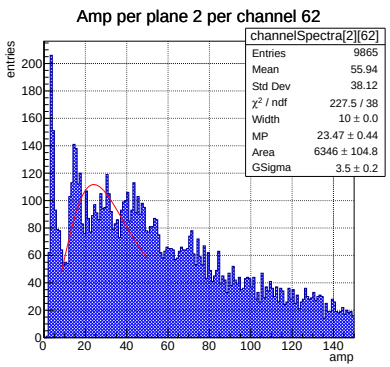


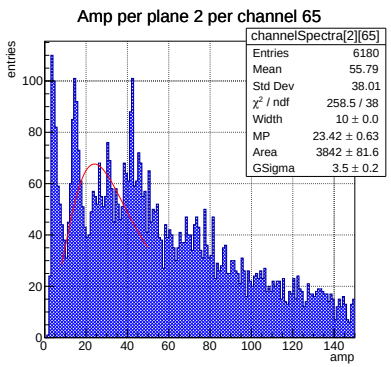


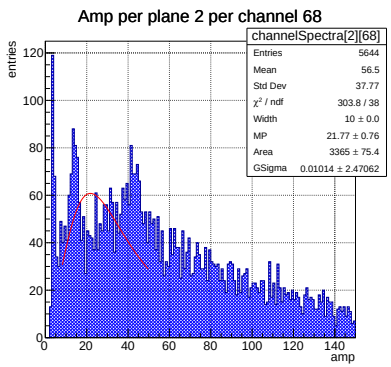


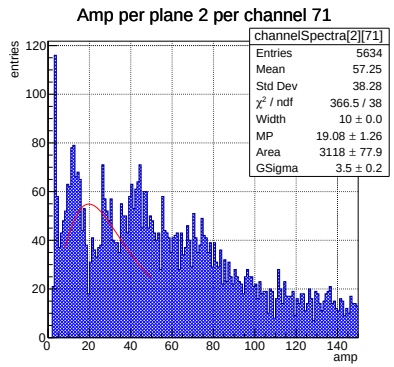


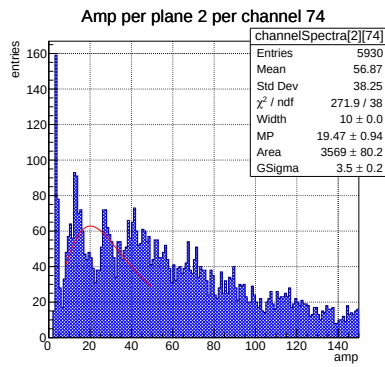




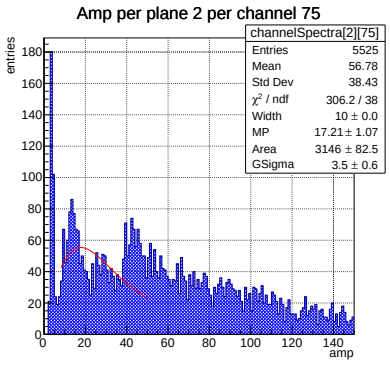


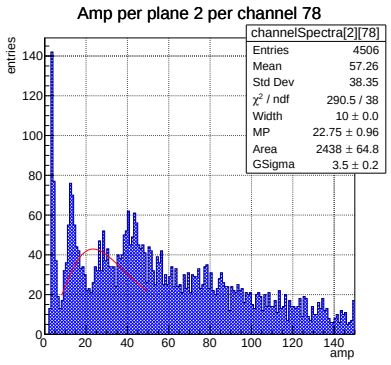


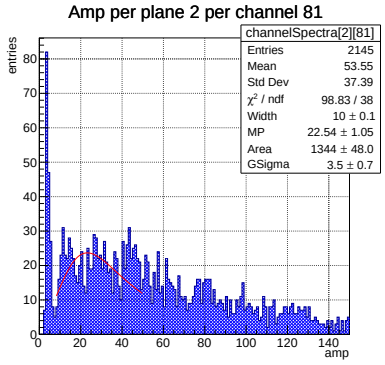


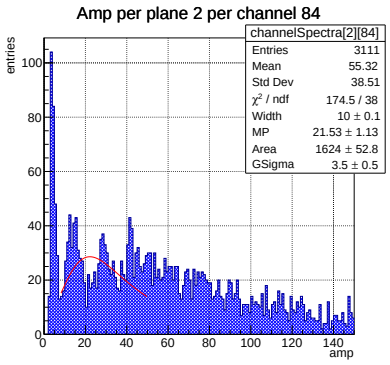


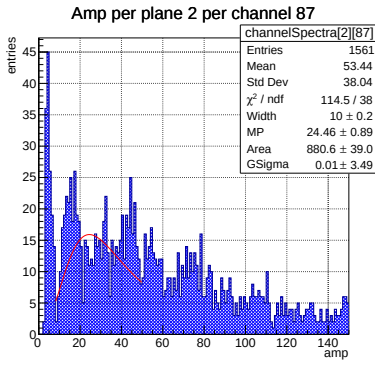
Signal in channel – plane 2 – channels 75-89

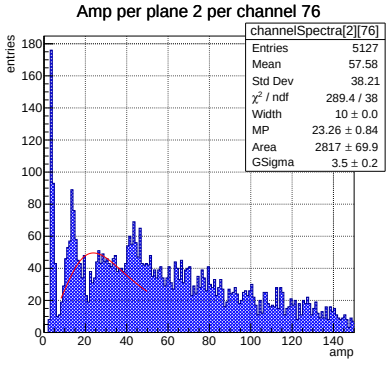


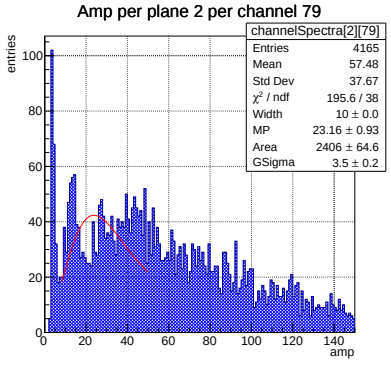


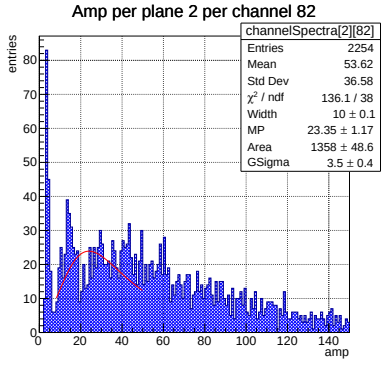


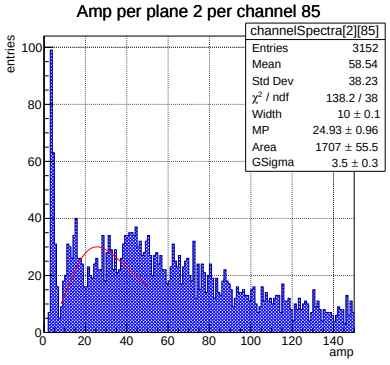


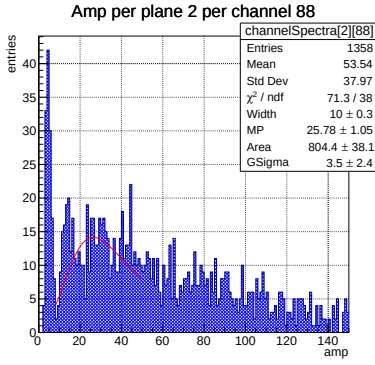


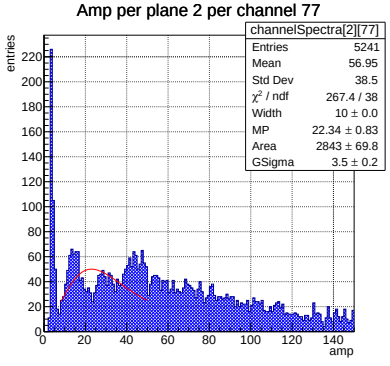


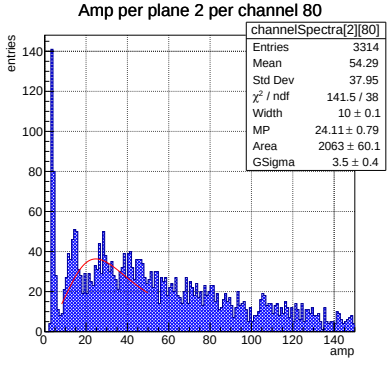


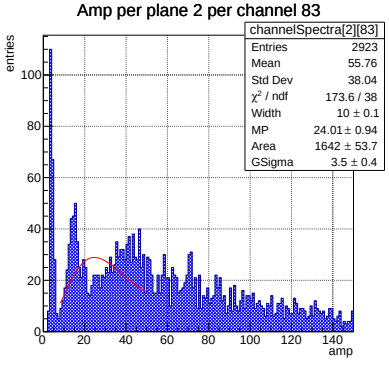


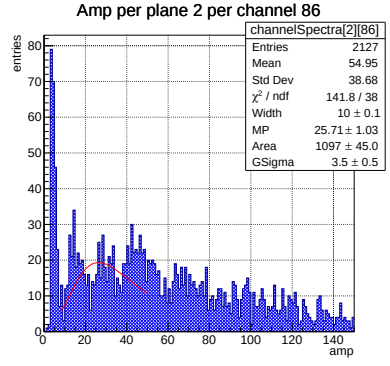


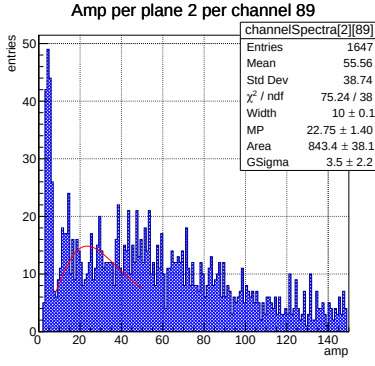




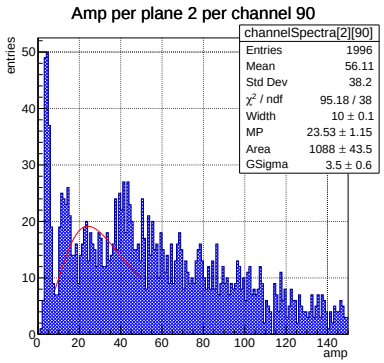


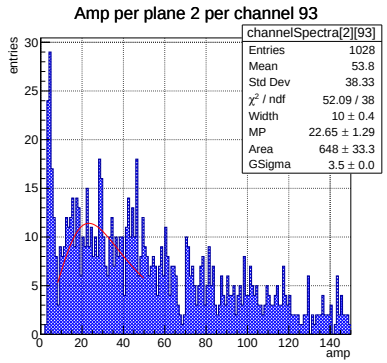


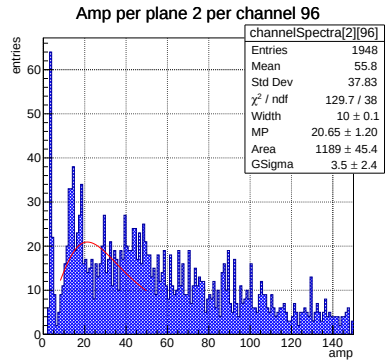


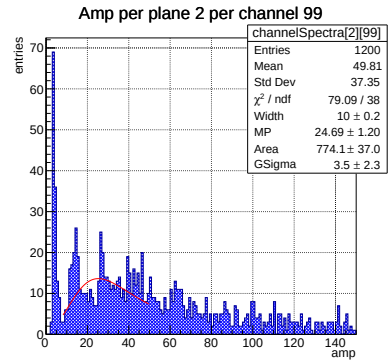


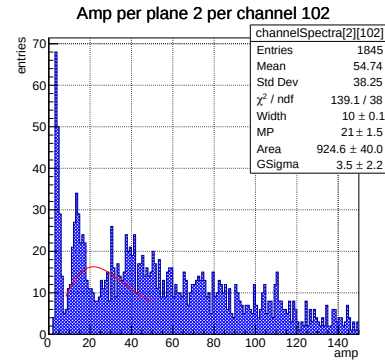
Signal in channel – plane 2 – channels 90-104

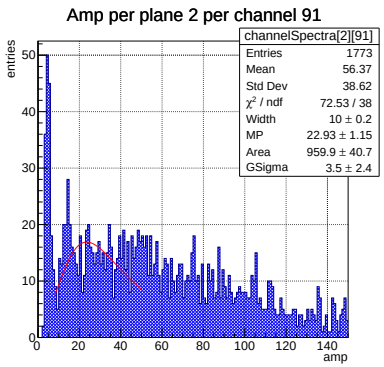


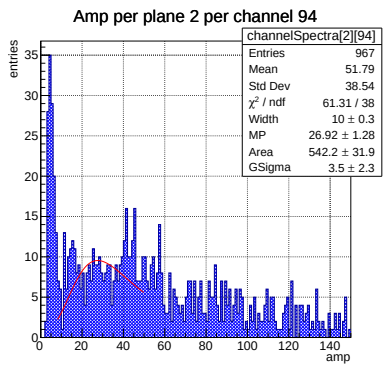


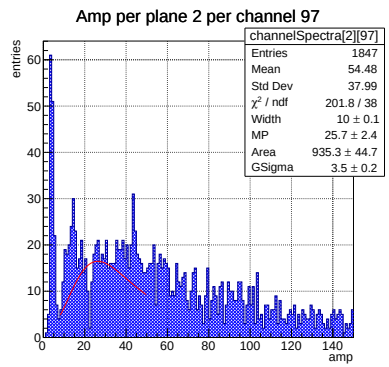


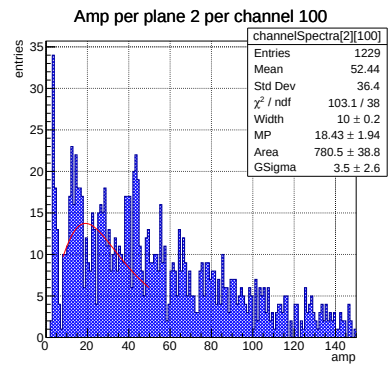


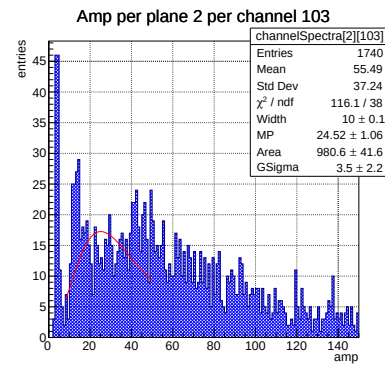


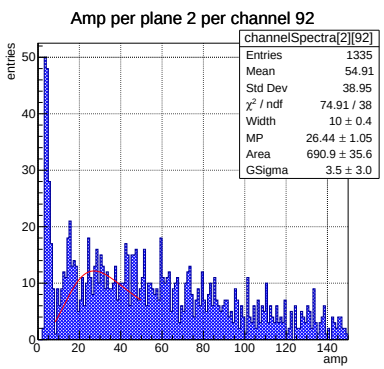


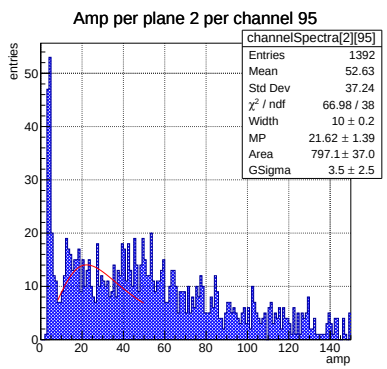


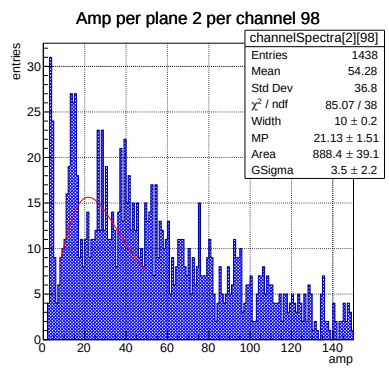


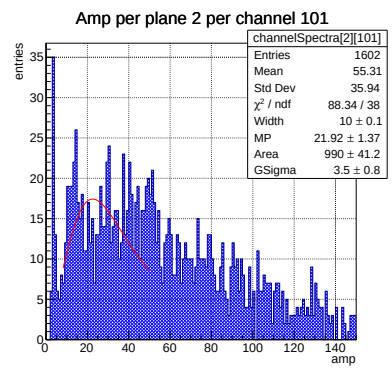


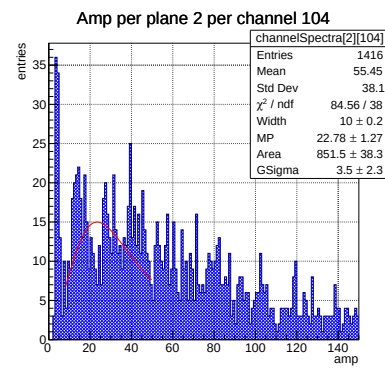






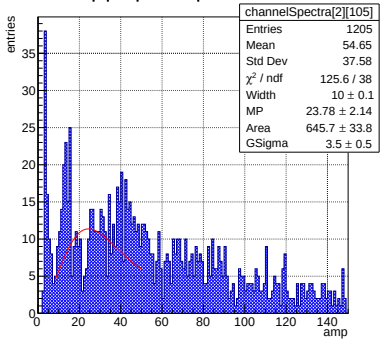




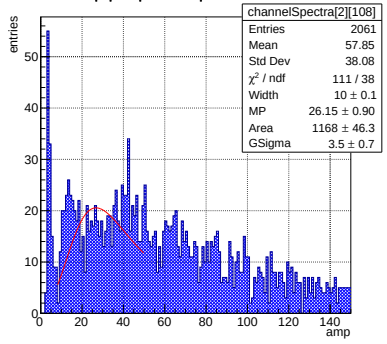


Signal in channel – plane 2 – channels 105-119

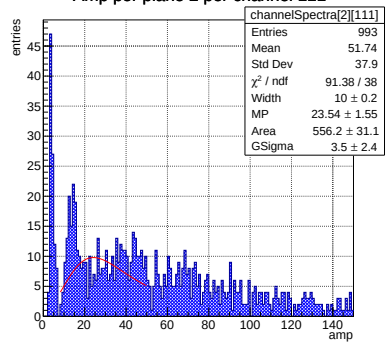
Amp per plane 2 per channel 105



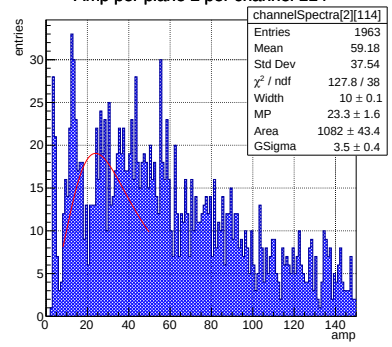
Amp per plane 2 per channel 108



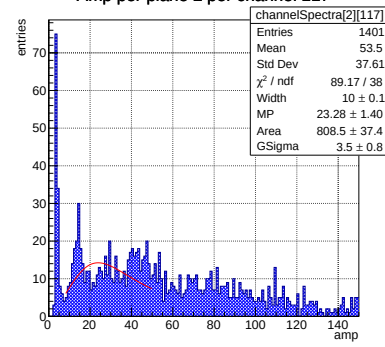
Amp per plane 2 per channel 111



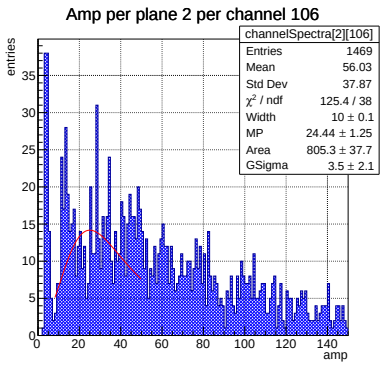
Amp per plane 2 per channel 114



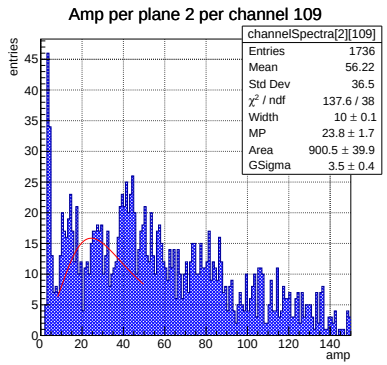
Amp per plane 2 per channel 117



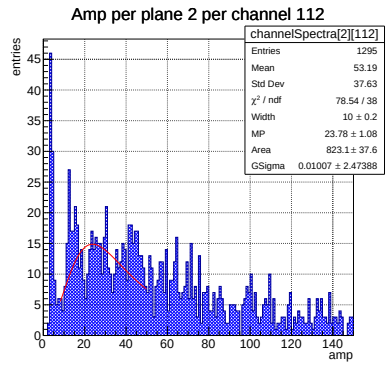
Amp per plane 2 per channel 106



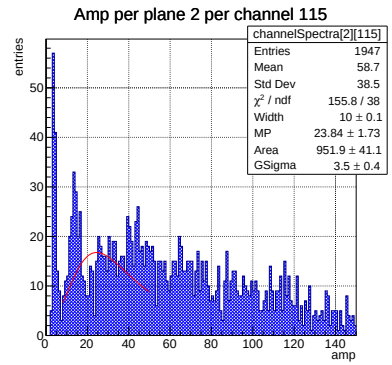
Amp per plane 2 per channel 109



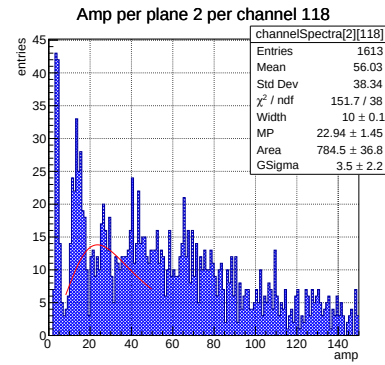
Amp per plane 2 per channel 112



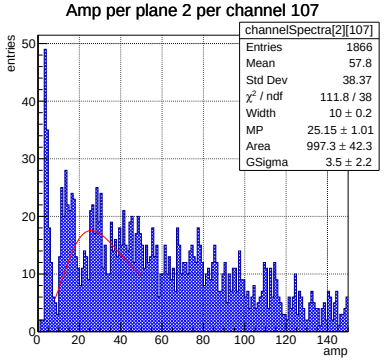
Amp per plane 2 per channel 115



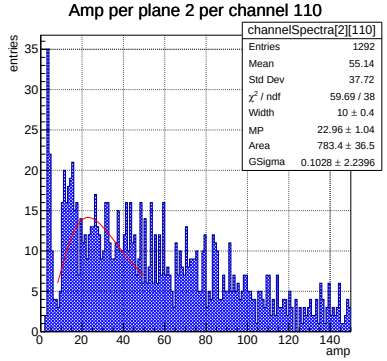
Amp per plane 2 per channel 118



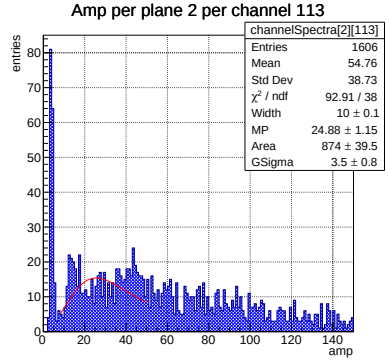
Amp per plane 2 per channel 107



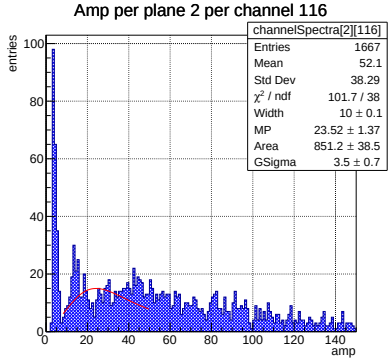
Amp per plane 2 per channel 110



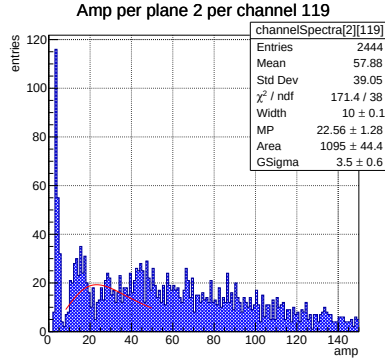
Amp per plane 2 per channel 113



Amp per plane 2 per channel 116



Amp per plane 2 per channel 119



Signal in channel – plane 2 – channels 120-127