

Single-photo electron amplitudes and baseline RMS in ProtoDUNE-HD

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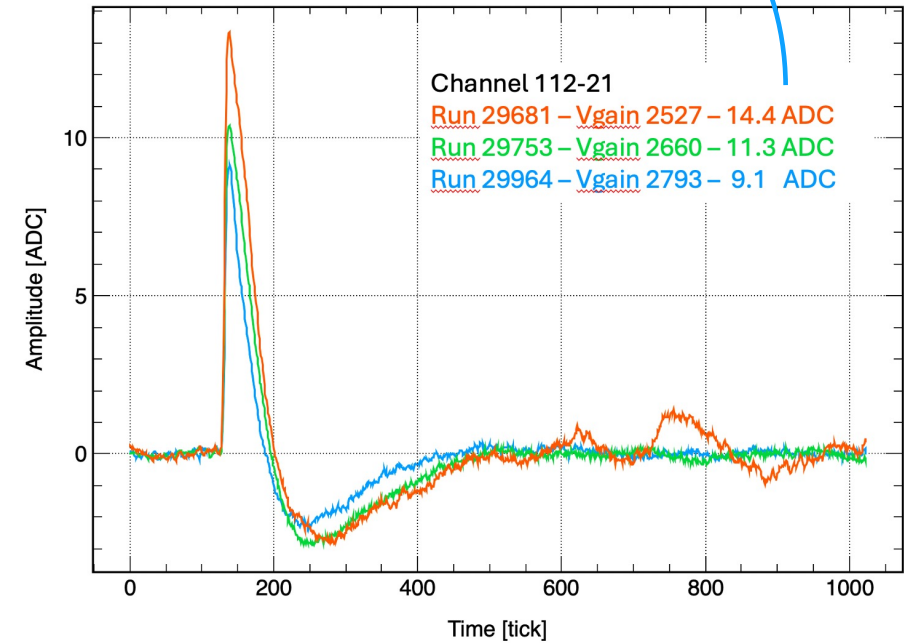


In this presentation

Outline

- An input for Jose's simulation based on data
- Spe amplitude estimates
 - 9th July calibration: APA1 – runs: 27901, 27902, 27903, 27904
 - 30th July calibration: APA 2,3,4 – runs: 28368, 28369, 28370, 28371, 28489, 28491, 28492, 28493, 28494, 28495
 - **Remember:** signal amplitude changes with the overvoltage and the electronic chain gain (we can play with DAPHNE's gain)
- Baseline noise (RMS)
 - 8th July runs: APA 1,2 (run 27877) APA 3,4 (run 27877)
 - **Remember:** Noise level can vary **only** for DAPHNE's gain (if we exclude environmental interferences)
- Choice of the runs: they are the ones used to tune DAPHNE's gain at the beginning of August (see my [CM talk](#)) and they reflect the configuration used for many cosmic ray runs

In the analysis $V_{\text{gain}} = 2318$,
so we had larger signals

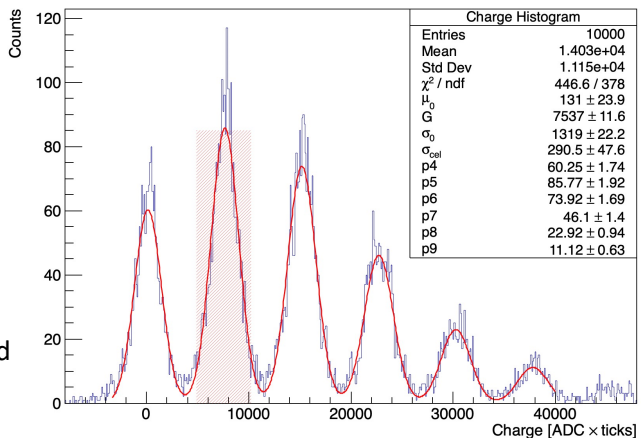


Example from last week data

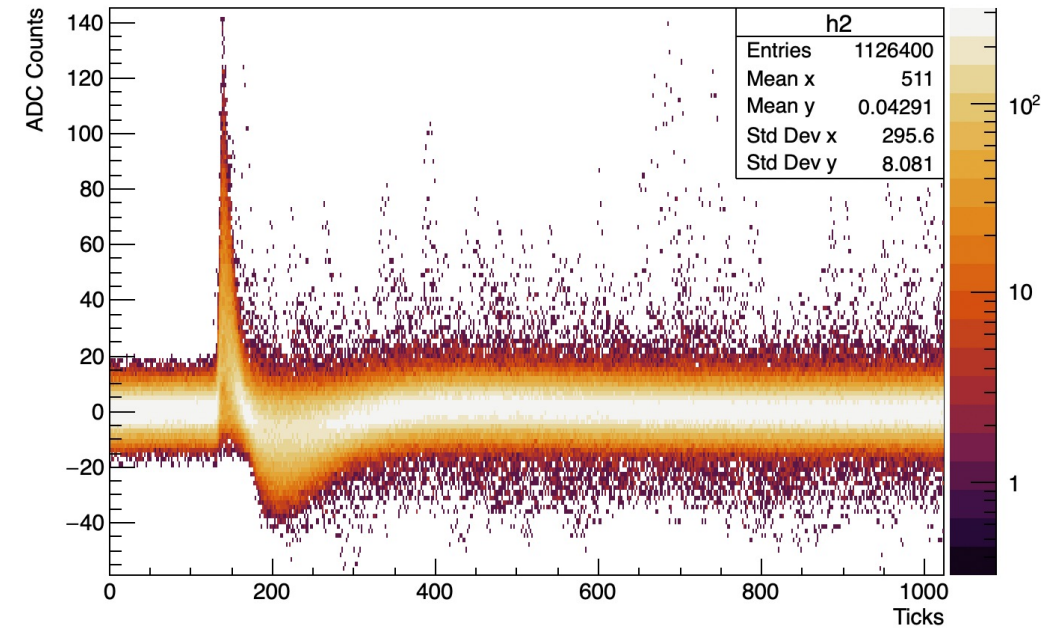
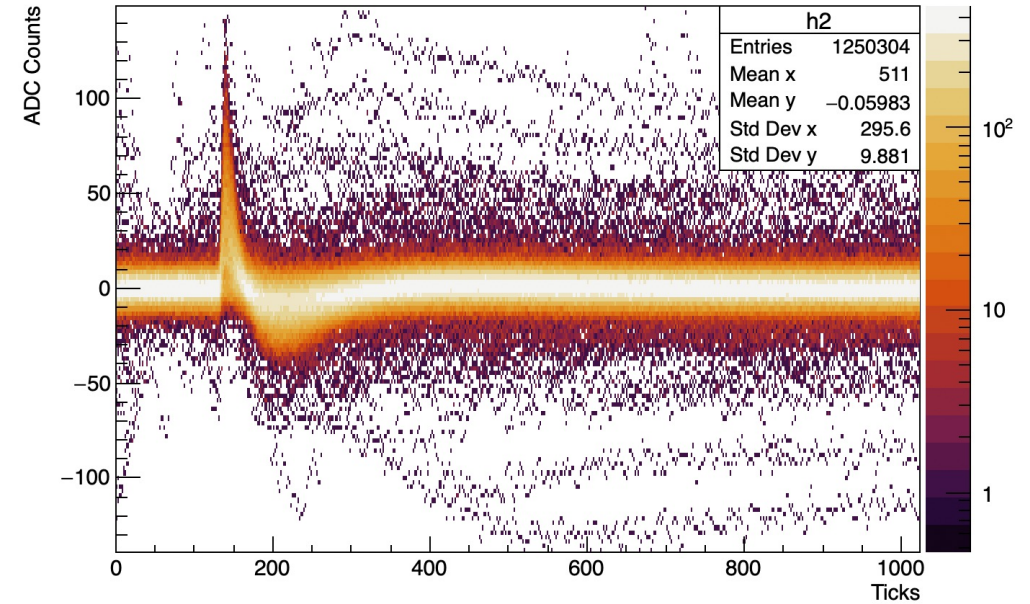
SPE amplitudes

Waveform selection

- Cut waveforms with a signal in the pre-LED baseline
 - To void baseline mis-evaluation
 - Acceptance range ± 20 ADCs
- Cut waveforms with large pulses in coincidence
 - To ensure I'm integrating only the LED signal
- About 10% loss of statistics
 - Ok, since I believe the results uncertainty is not statistically dominated



This histogram comes from an old presentation



SPE candidate

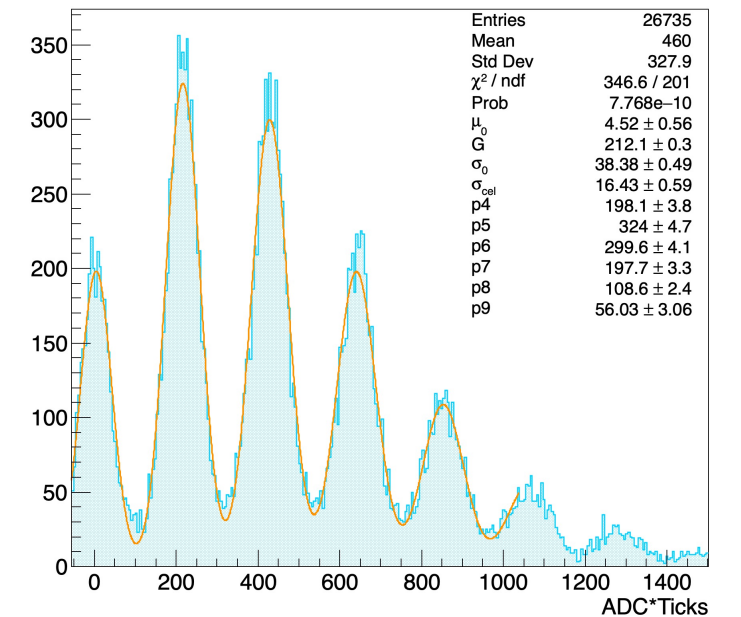
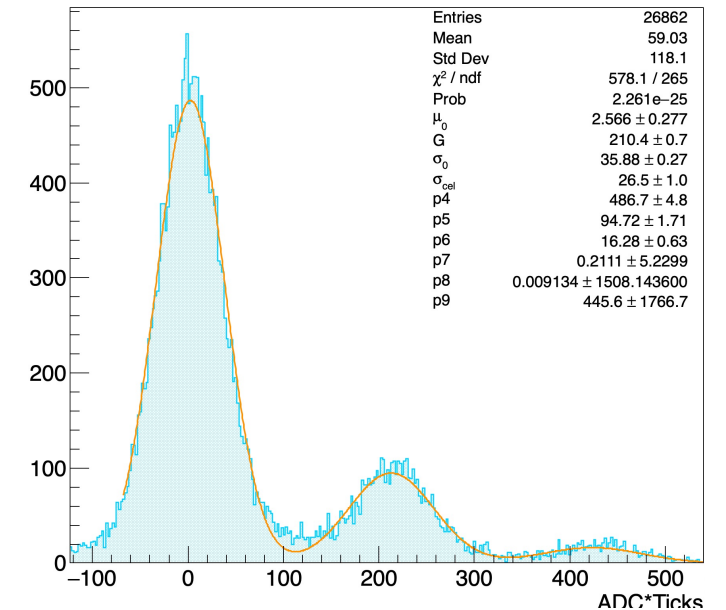
Selection

- After fitting the calibration histogram with a multi gaussian function*, we select the waveforms whose histogram is within $\pm 1\sigma$ from the corresponding peak
- We observed certain correlation between the average number of detected photons and the estimated amplitude
 - Considering the possible 0 pe and 2 pe waveforms gives very little correction
 - There could be a subtle correlation in the fit parameters that bias the selection (?)

Errors:

$$\sigma^2 = \sigma_{Bsl_rnd}^2 + \sigma_{Bsl_Eval}^2 + \sigma_{Fit_sel}^2$$

- $\sigma_{Bsl_rnd} = \frac{\text{Noise RMS}}{(\#Spe\ candidates)^{0.5}}$ [typically $\frac{\sim 4\ ADC}{10^3\ candidates}$]
- $\sigma_{Bsl_eval} =$ Evaluation of the baseline (could be a bias?)
- $\sigma_{Fit_sel} =$ selection not perfectly centered in the 1pe peak



Insight

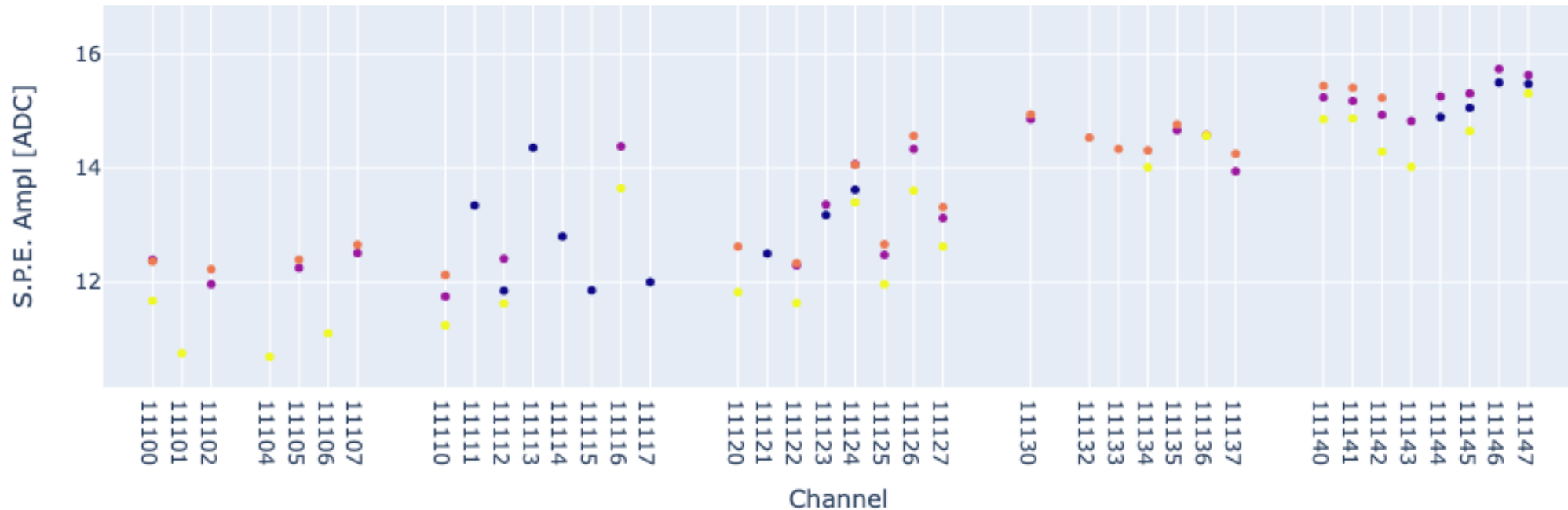
The LED intensity – Spe amplitude correlation

Note: it's a correlation in the results, it's not physical

EP 111 - Before VGain tuning

Runs 28368-69-70-71

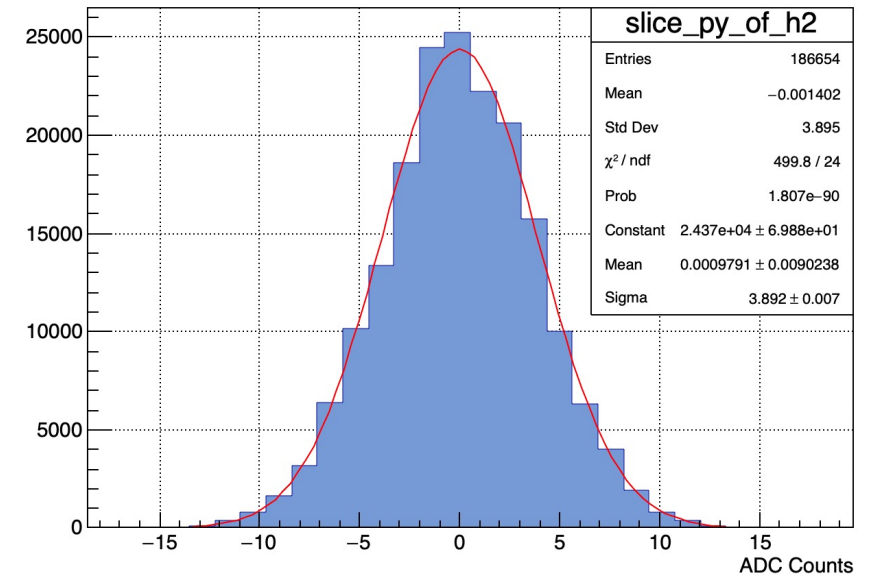
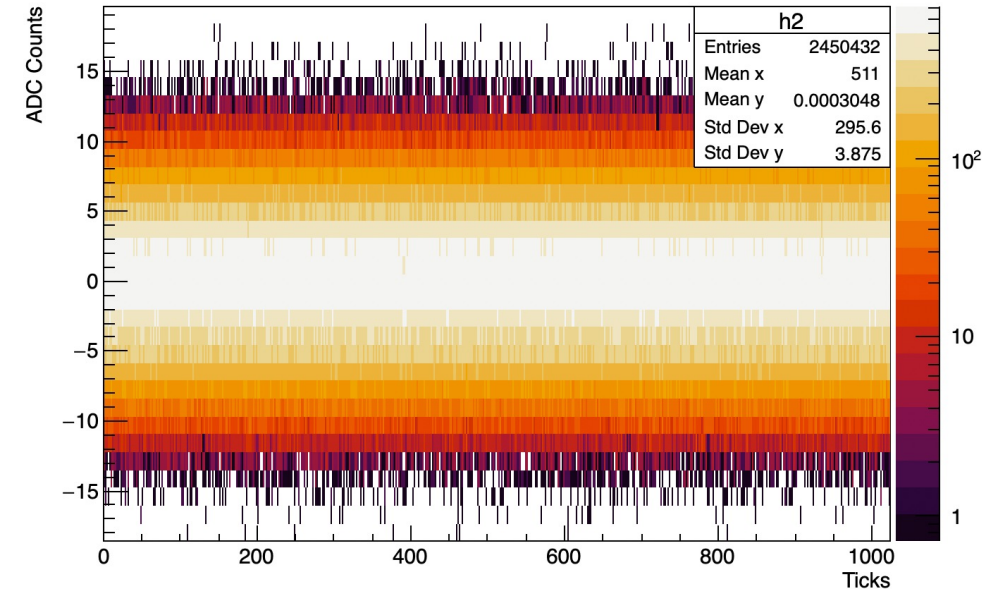
Yellow points are from run 28371 – mask 12



RMS of the baseline

A noise-level indication

- Dedicated runs with SiPM biased below their breakdown
- Full-baseline subtraction
- Projection and RMS evaluation
- Looks pretty gaussian



Conclusions

... and “to dos”

- We have the data to characterize the signal response and the noise level
 - For the SPE shape (spe template) look at [Henrique's](#) tau slow studies or [Maritza's](#) template.
 - We also have noise FFTs
- Improve the analysis
- Analyses for other calibrations

[... It's a long way](#) (youtube)