NectarCam : MC - Data Comparison

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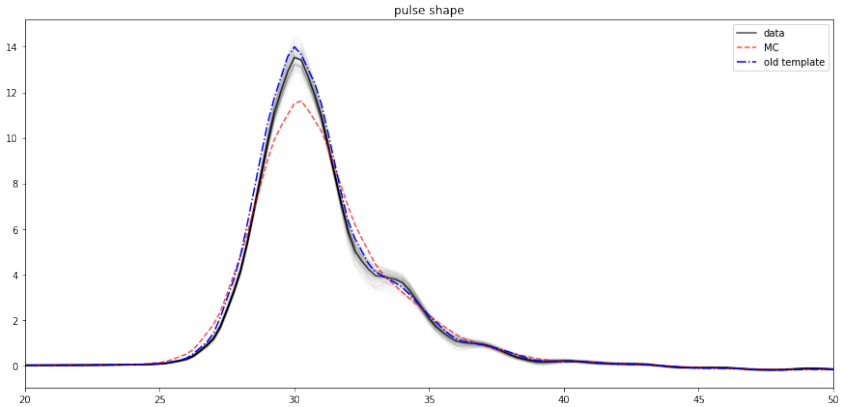
Overview

1. Flat field
2. single/multi photoelectron spectrum
3. NSB runs
4. Camera Layout

New pulse shape in the MC

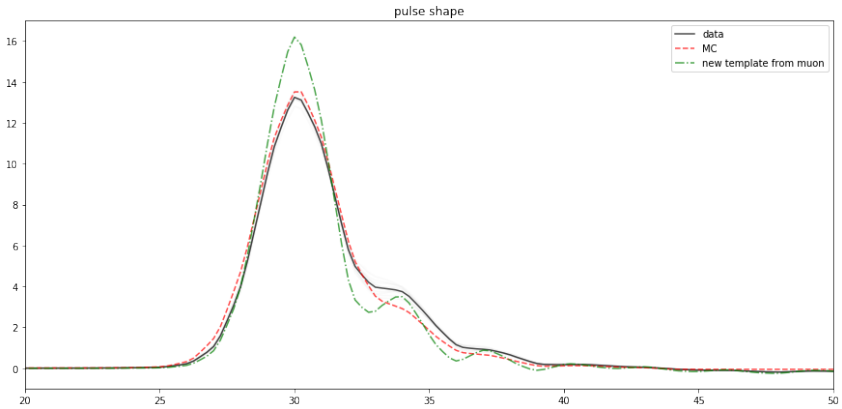
old pulse shape

- from Flat field run at $\sim$ 30 p.e.
- fadc_amplitude=14.0
- reconstructed pulse from MC is smaller and wider than from the data



new pulse shape

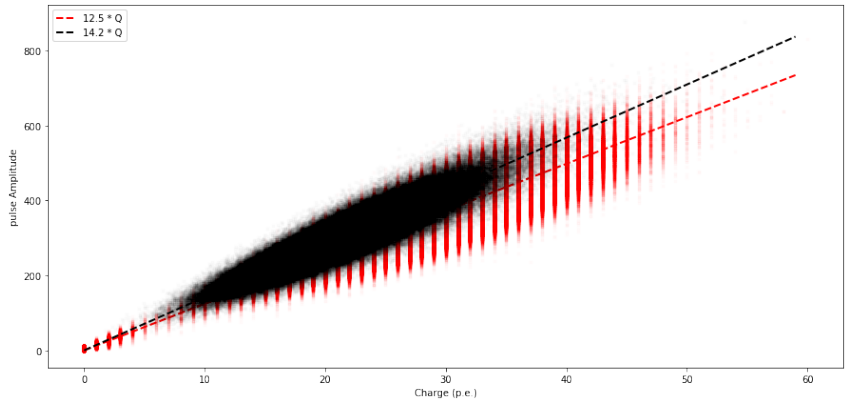
- from internal trigger run in the dark
- fadc_amplitude=16.2
- keeping events $>$ 30 p.e.
- mostly muons and some afterpulses
- good agreement with the data !



New pulse shape in the MC

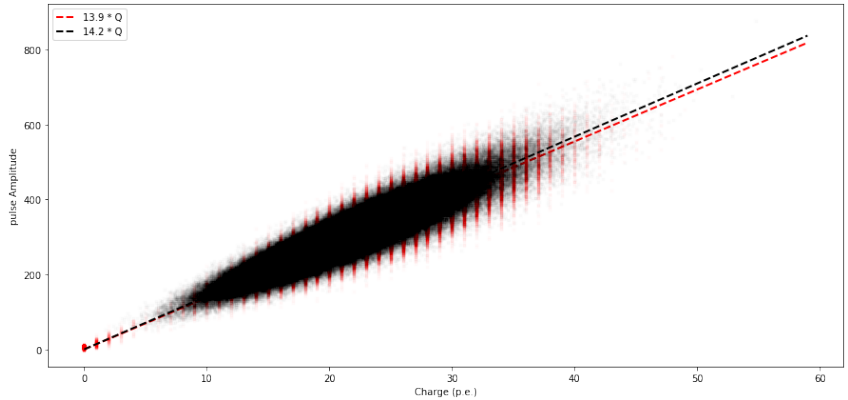
old pulse Amplitude / p.e.

- fadc_amplitude=14.0
- reconstructed Amplitude/p.e. : 12.5



new pulse Amplitude / p.e.

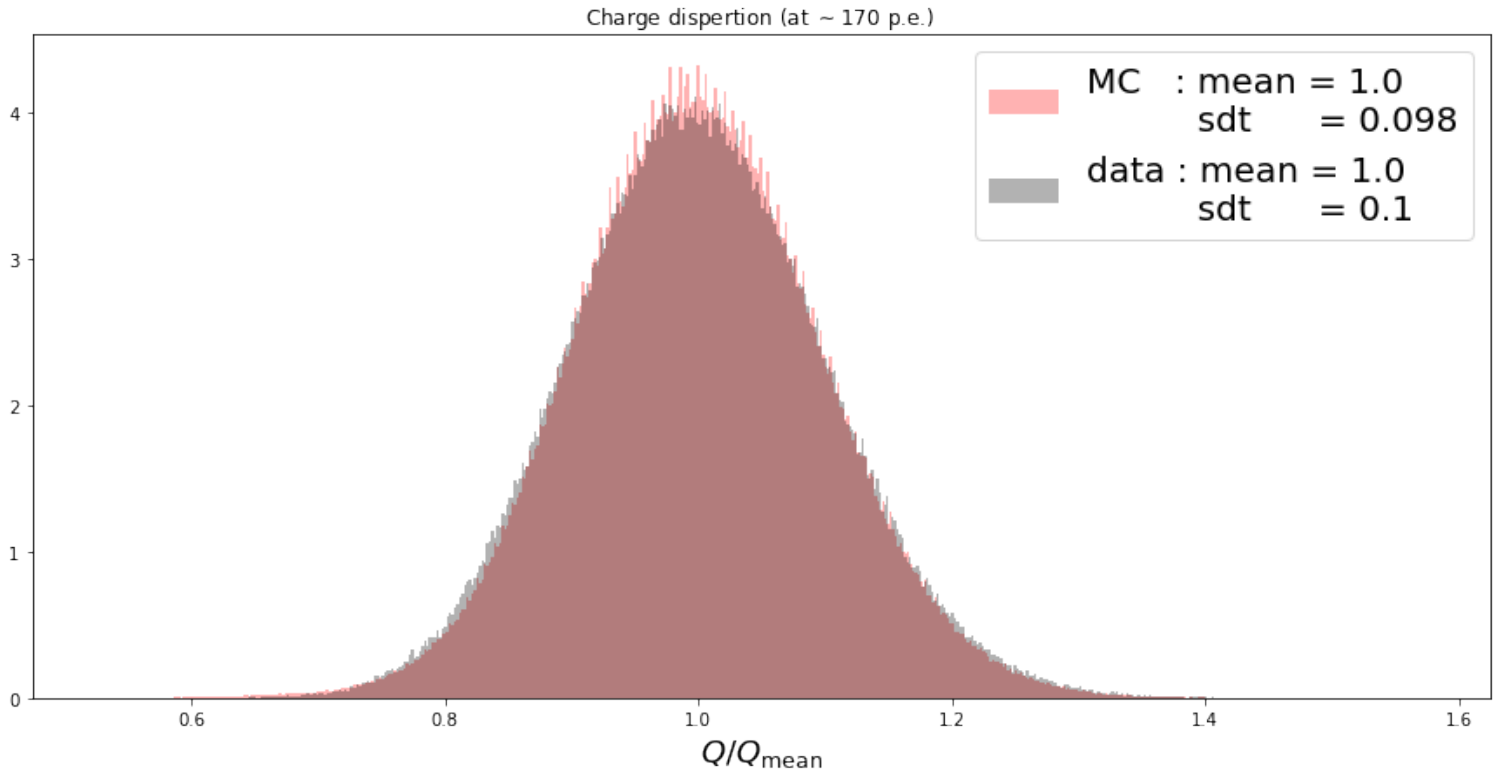
- fadc_amplitude=16.2
- reconstructed Amplitude/p.e. : 13.9



Charge resolution

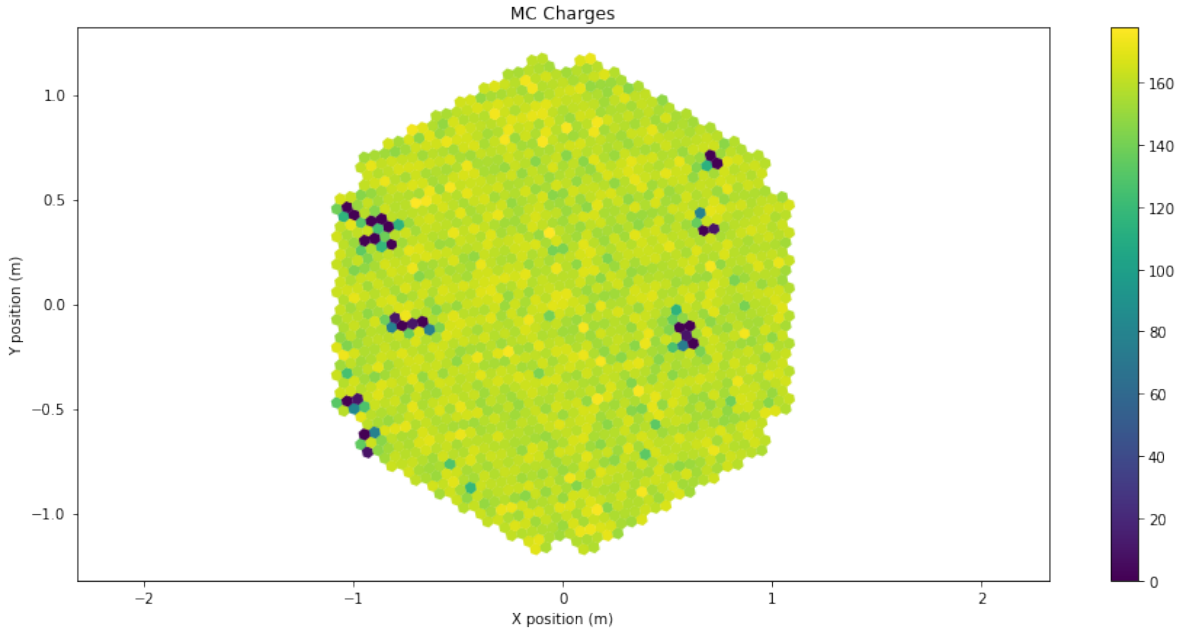
- MC distribution of $\frac{Q_{\text{reco}}}{<Q_{\text{sim}}>_{\text{mean}}}$
- Data distribution of $\frac{Q_{\text{reco}}}{<Q_{\text{reco}}>_{\text{mean}}}$

$$Q_{\text{reco}} = \sum_{t_{\text{max}}-6}^{t_{\text{max}}+10} \text{smpl} - \text{pedestal}$$



MC Flat Field

photo_electron_image :

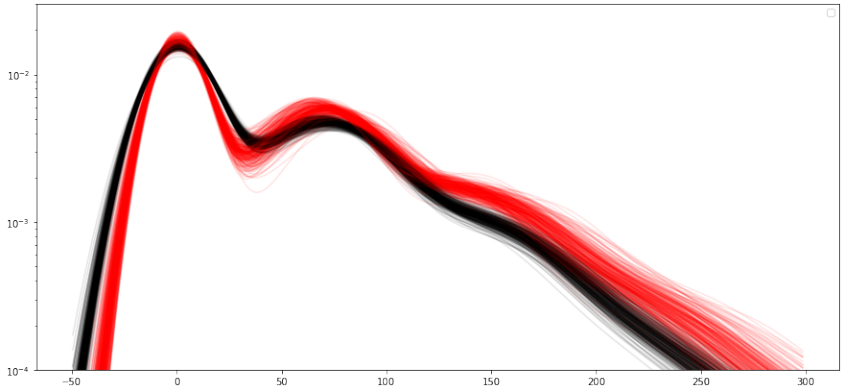


Broken or non illuminated pixels in the MC ?

multi electron spectrum

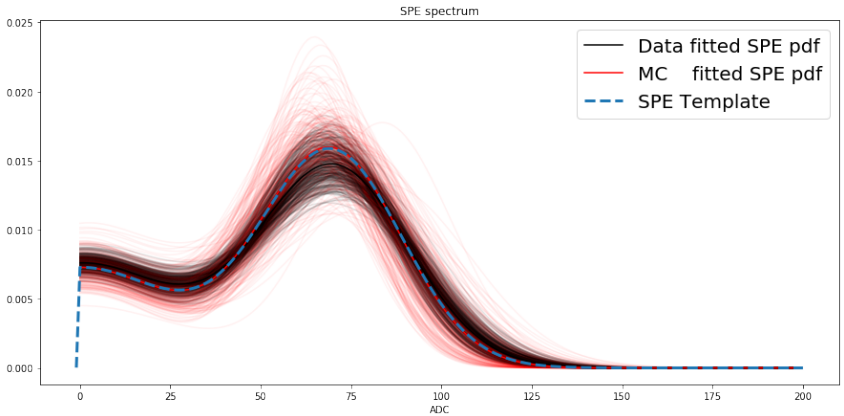
mes spectrum

- Wider pedestals in the Data
  - electronic noise isn't Gaussian and uncorrelated
- Illumination is not the same



spe pdf

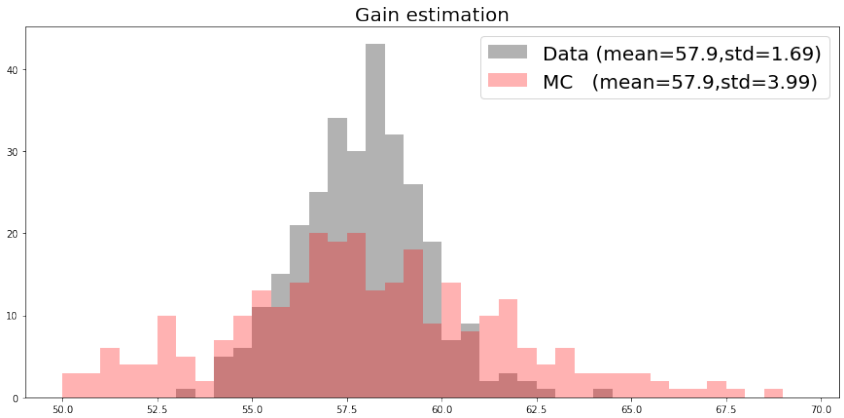
- good agreement
- dispersion is higher in the MC



Gain reconstruction

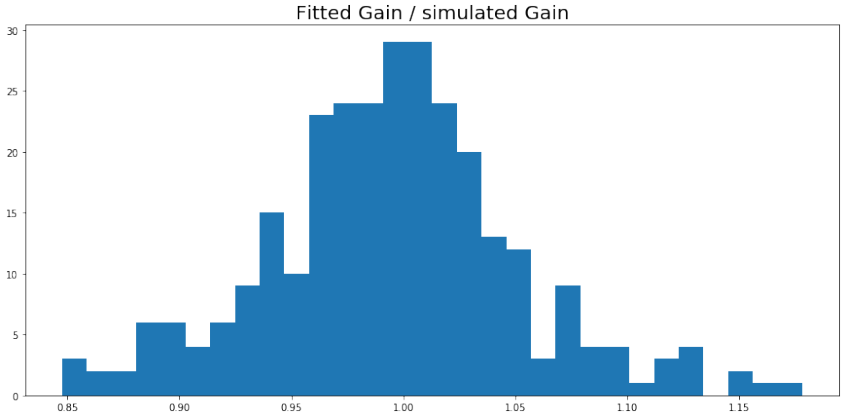
Gain estimation

- Wider distribution in the MC
- Very good agreement for the mean value



Gain estimation resolution

- precision of $\sim 5.7\%$
  - assuming I understand well the dc_to_pe parameter in the MC files.
  - only 10k events

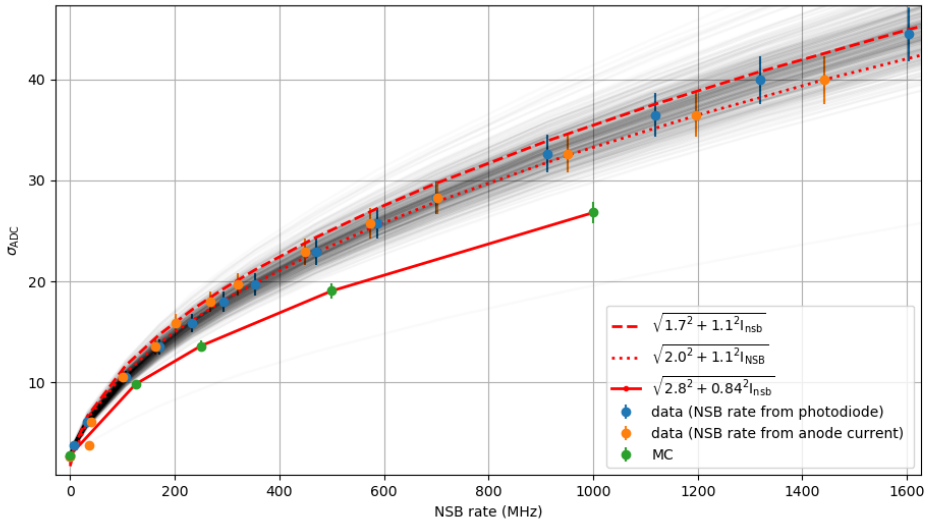


NSB noise

- Non negligible mismatch between the MC and the data.
- Updated pulse shape & pulse amplitude did not solve the issue

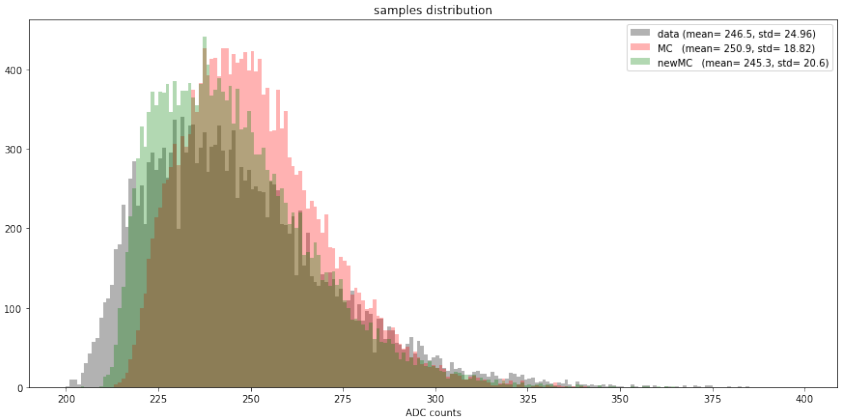
- this is not understand yet

Samples st.d. evolution with the NSB level :

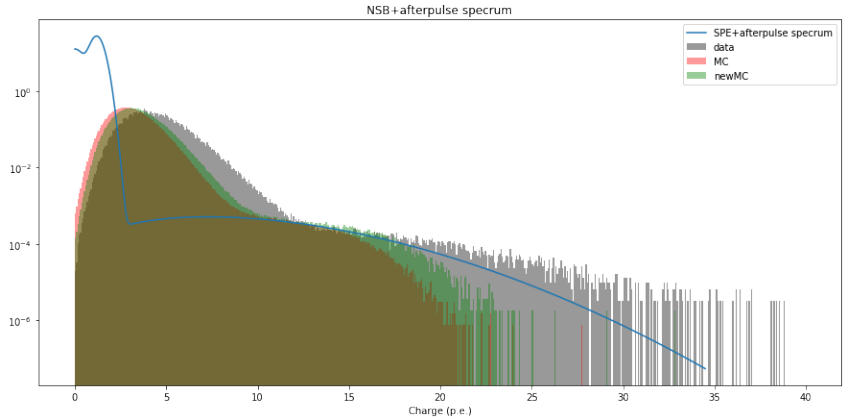


NSB noise

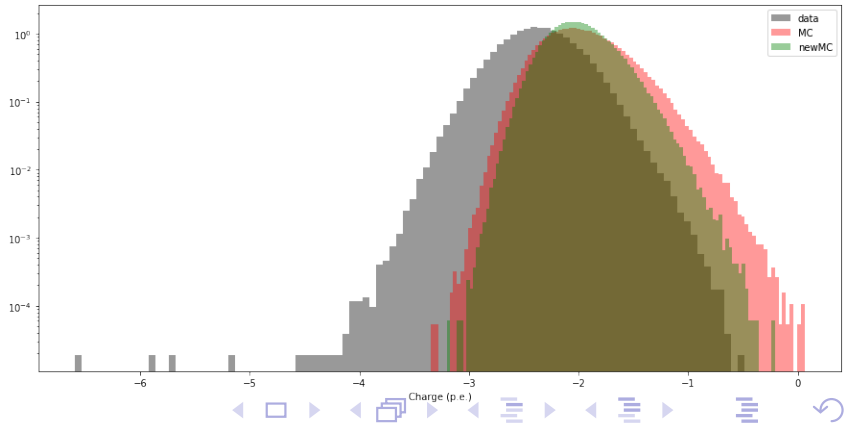
Samples distribution



max sample in wf



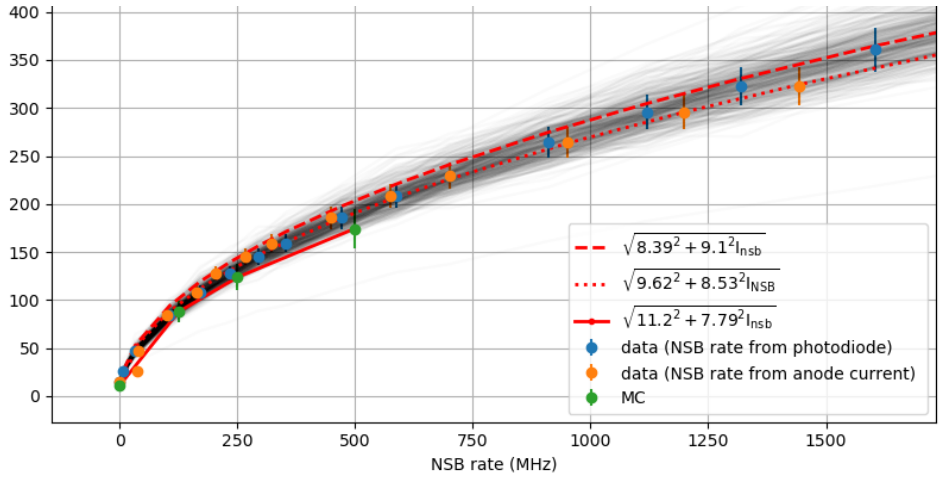
min sample in wf

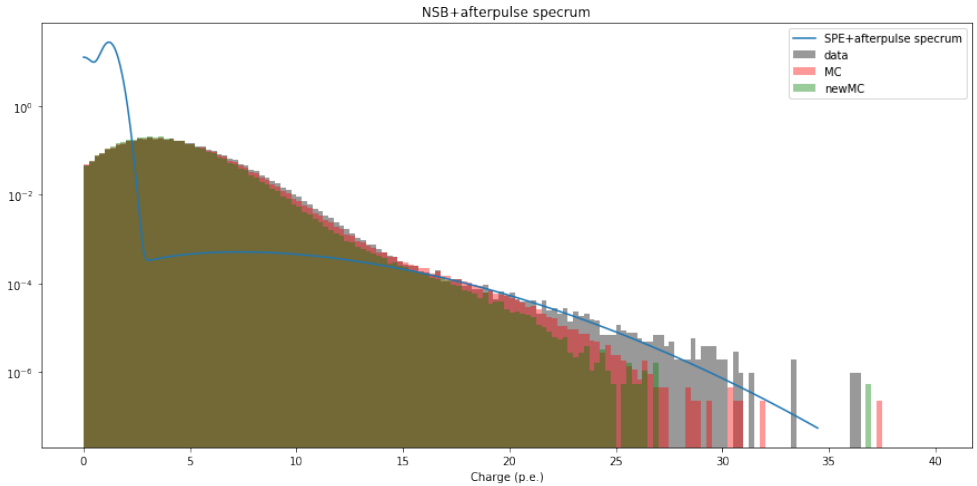


NSB noise (integrated distribution)

- Things goes better looking at the integrated distribution.

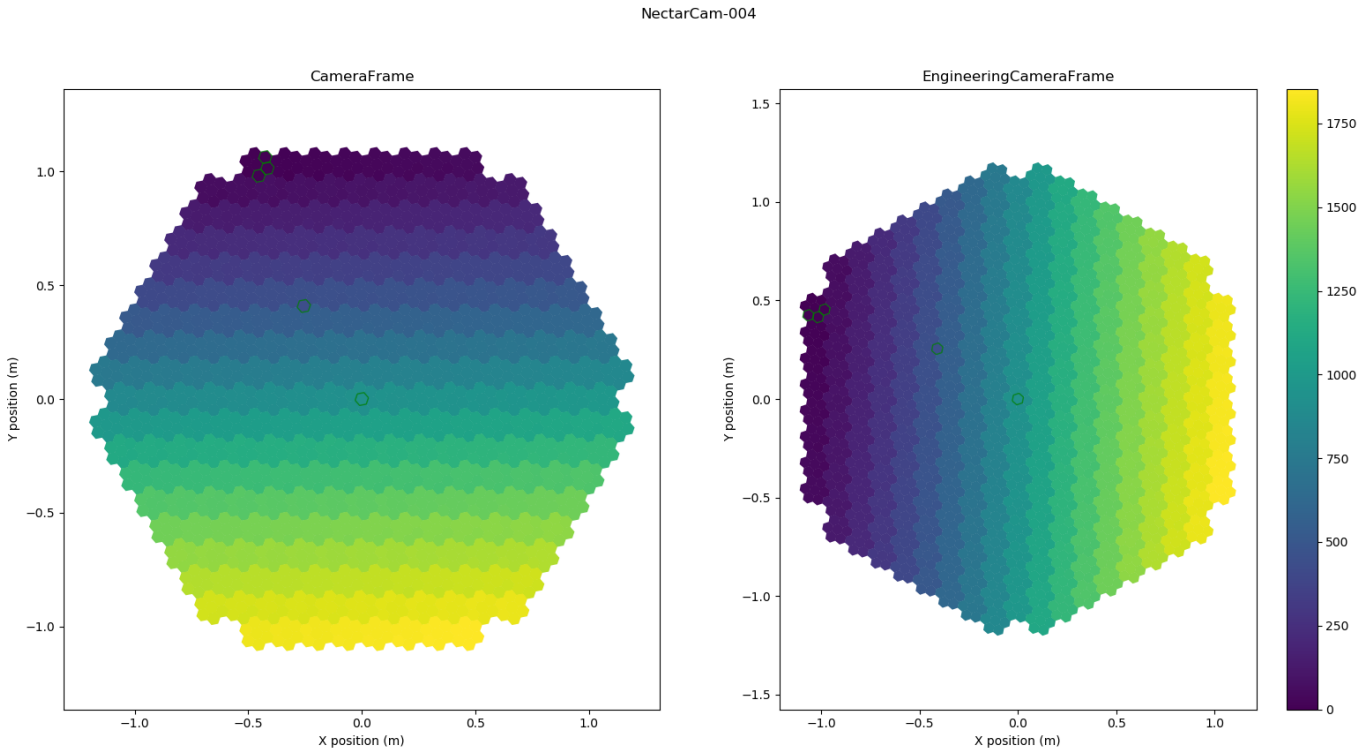
Integrated pedestal st.d. evolution with the NSB level :





Camera Layout

One want to be sure we use the same layout for MC production and data analysis in ctapipe.

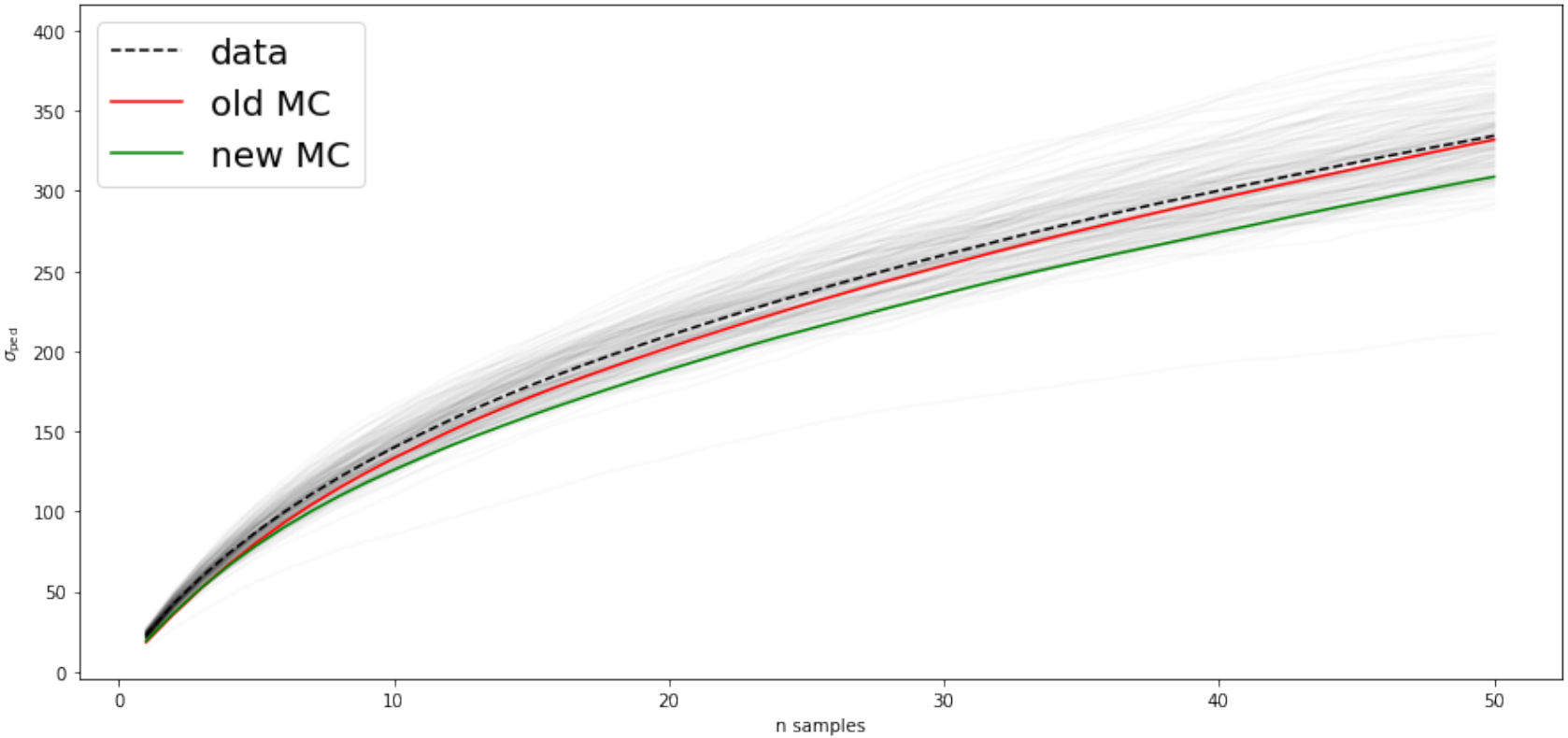


Summary

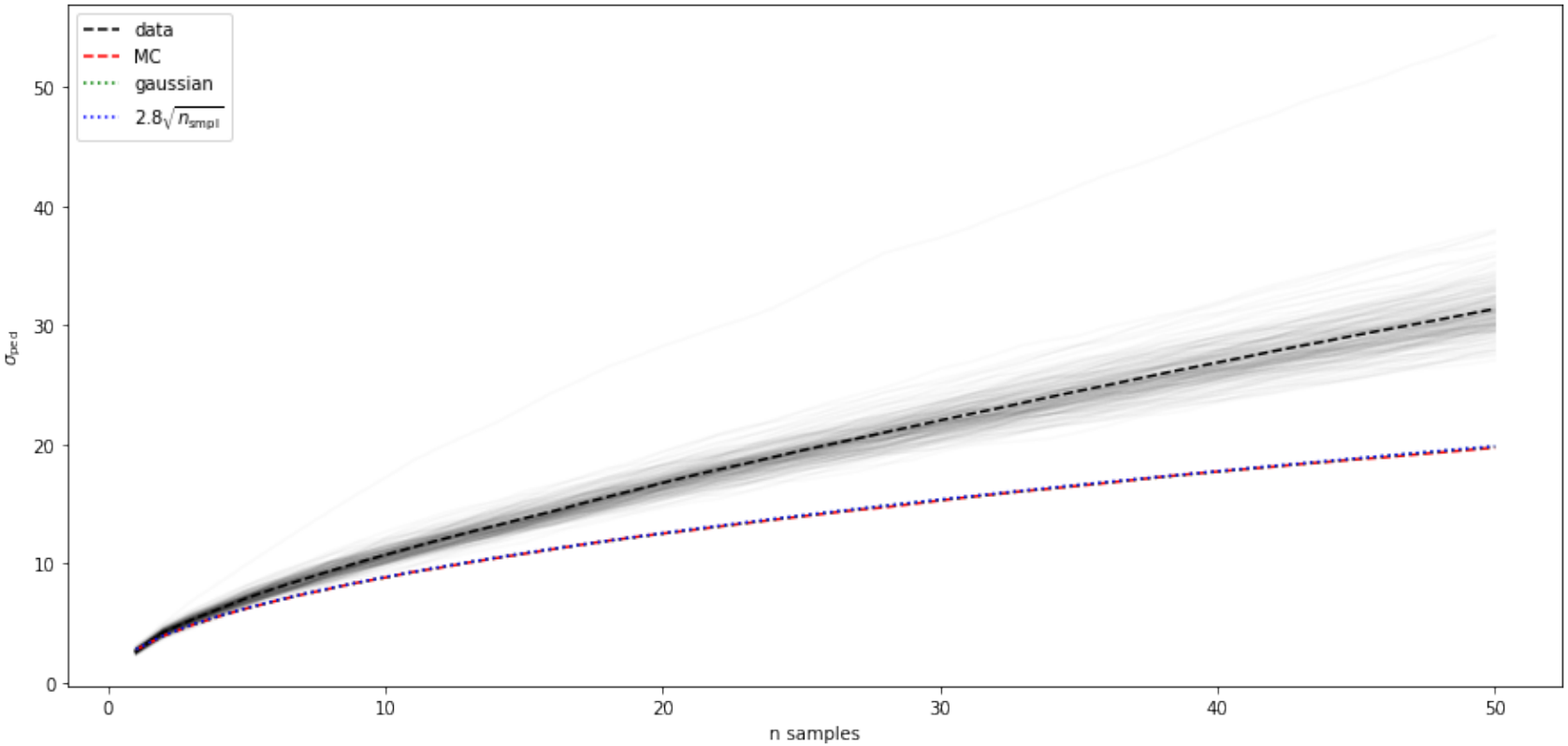
- Model have been updated :
  - New pulse shape.
  - New value for parameters fadc_amplitude & fadc_lg_amplitude
- The agreement is much better since the update.
- Disagreements remain with the samples distribution in the waveform with NSB
- Also :
  - Afterpulse spectrum cutoff in MC (max sample distribution)
  - 64 samples in the MC vs 60 in the data
  - Pixel with no charge in the MC ?

Bonus plots

pedestal sd.d. Vs number of integrated pixels (NSB $\sim$ 500 MHz)



pedestal sd.d. Vs number of integrated pixels (NSB = 0 MHz)



NSB $\sim$ 500 MHz