Karlsruher Institut für Technologie

Current status of the MMC data analysis

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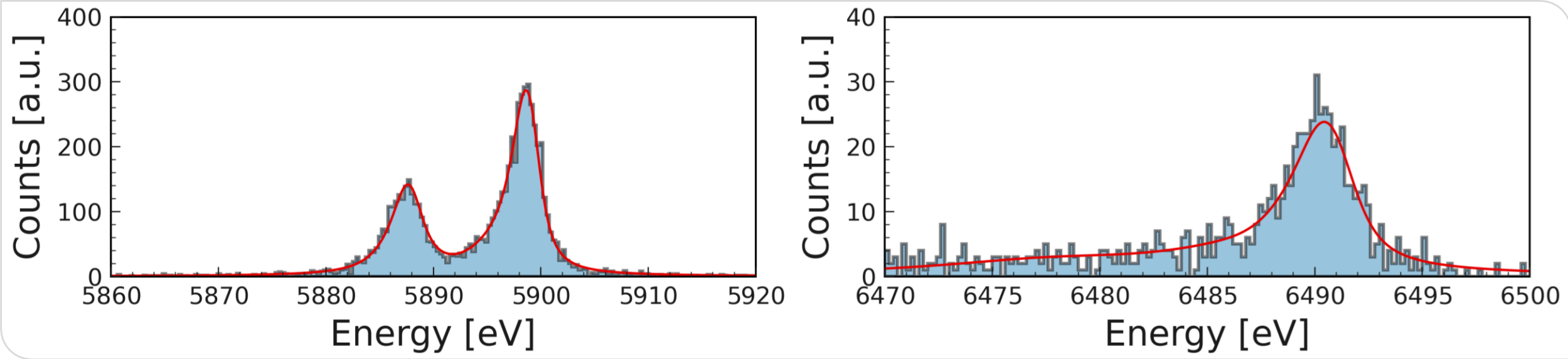
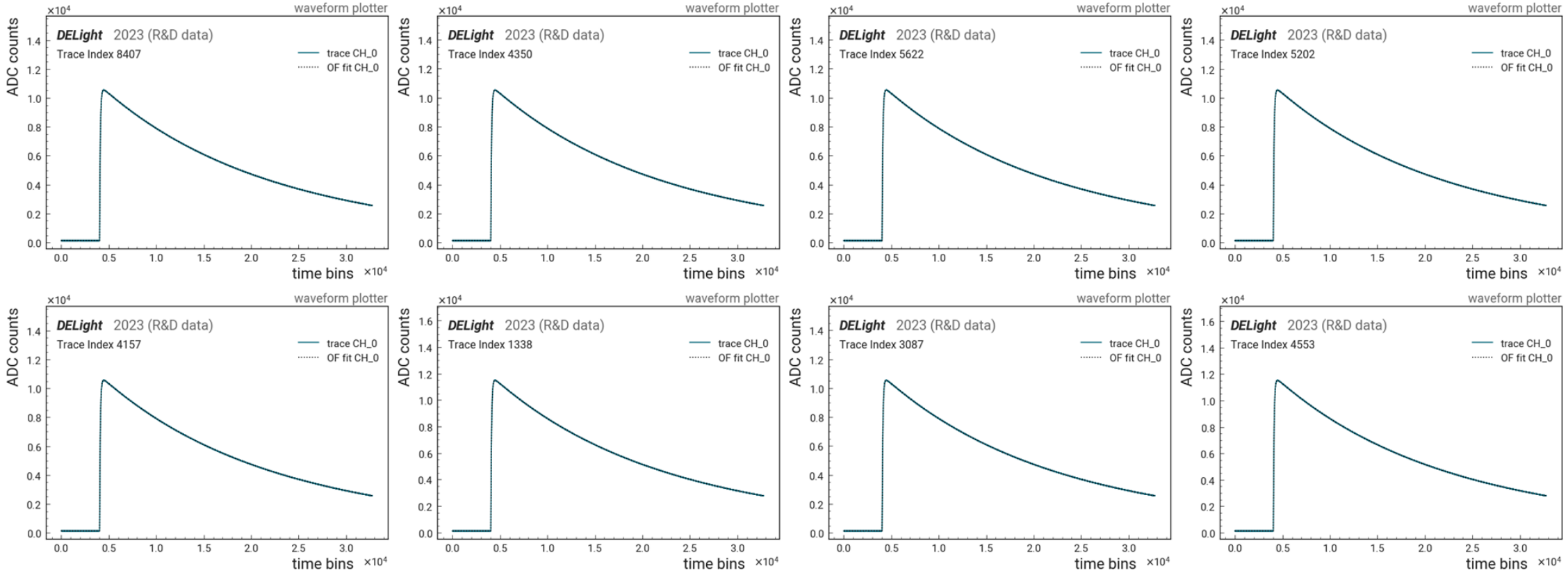


Data

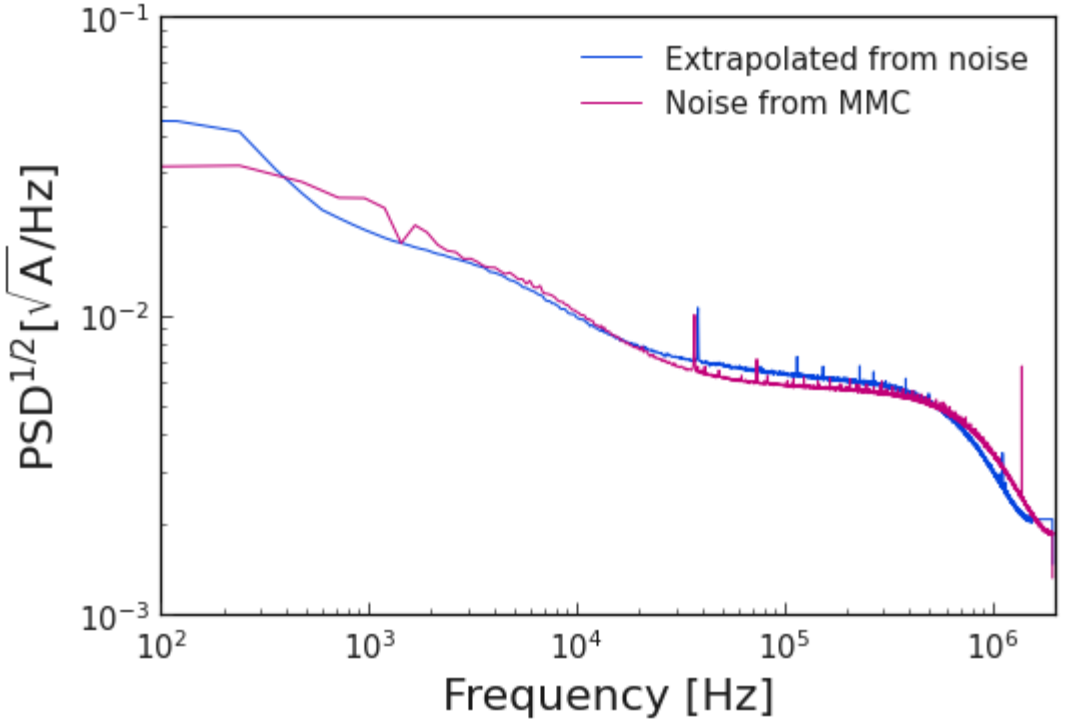
We have a total of 8654 traces.



Optimum filter: noise PSD

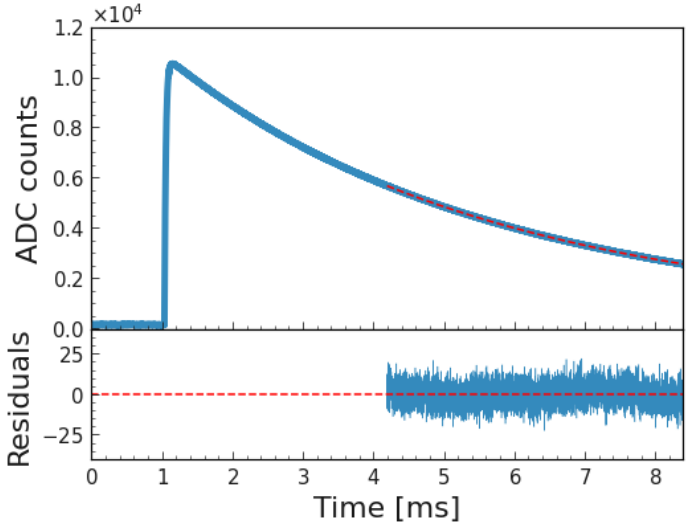
Noise PSD could be retrieved in two ways:

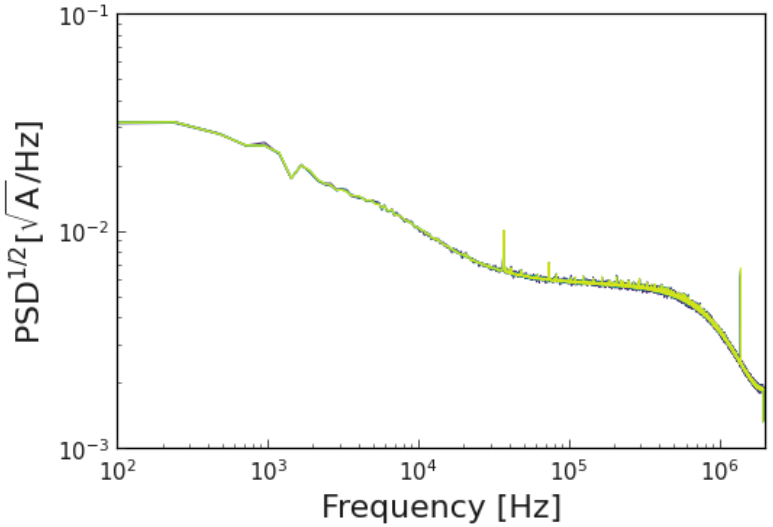
- Noise background data (not clear time and condition of data taking);
- **Noise extracted from data**.



Optimum filter: noise PSD

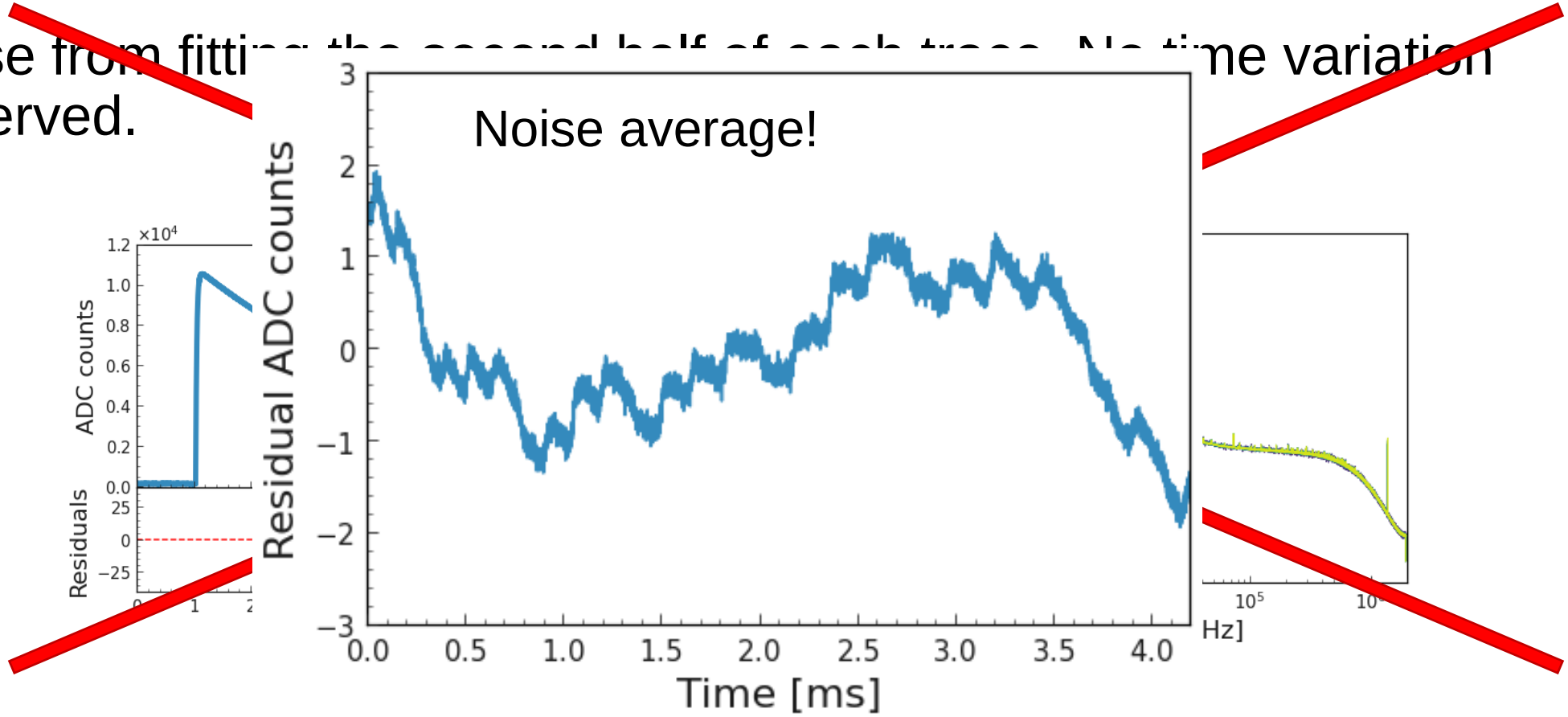
- Noise from fitting the second half of each trace. No time variation observed.





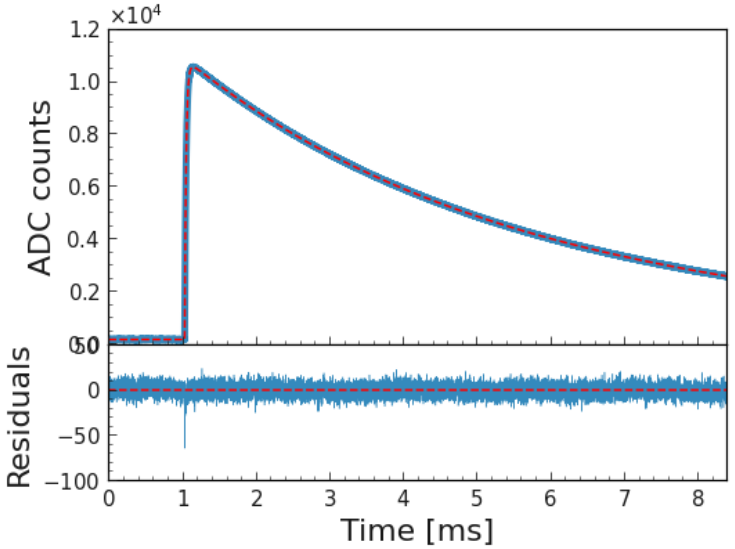
Optimum filter: noise PSD

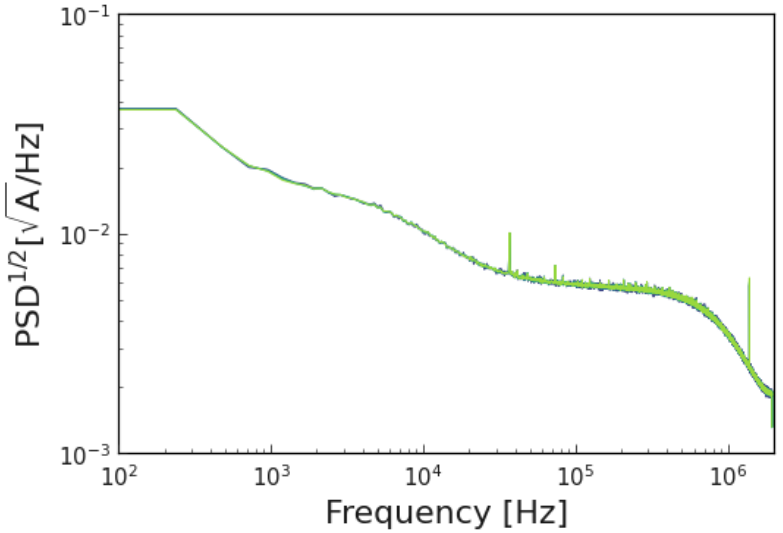
- Noise from fitting the second half of each trace. No time variation observed.

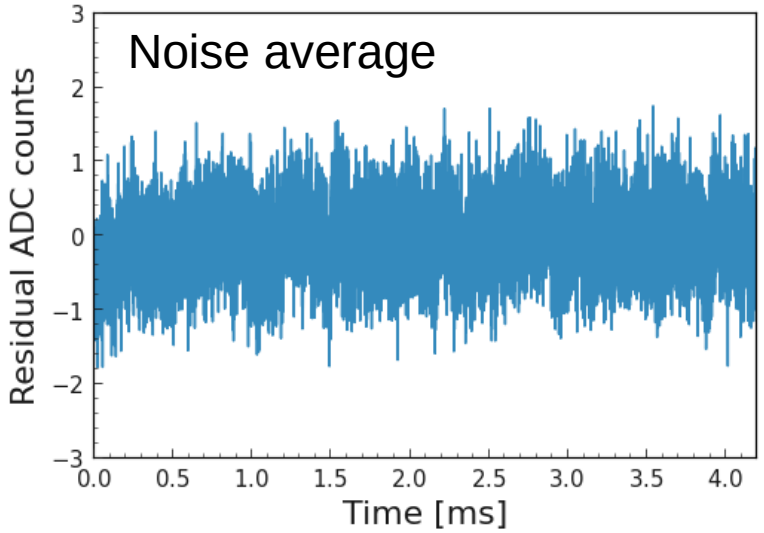


Optimum filter: noise PSD

- Using a previous noise template, we use the difference between the OF fit template and the trace. We consider only the second half of the trace (exlclude peak region).

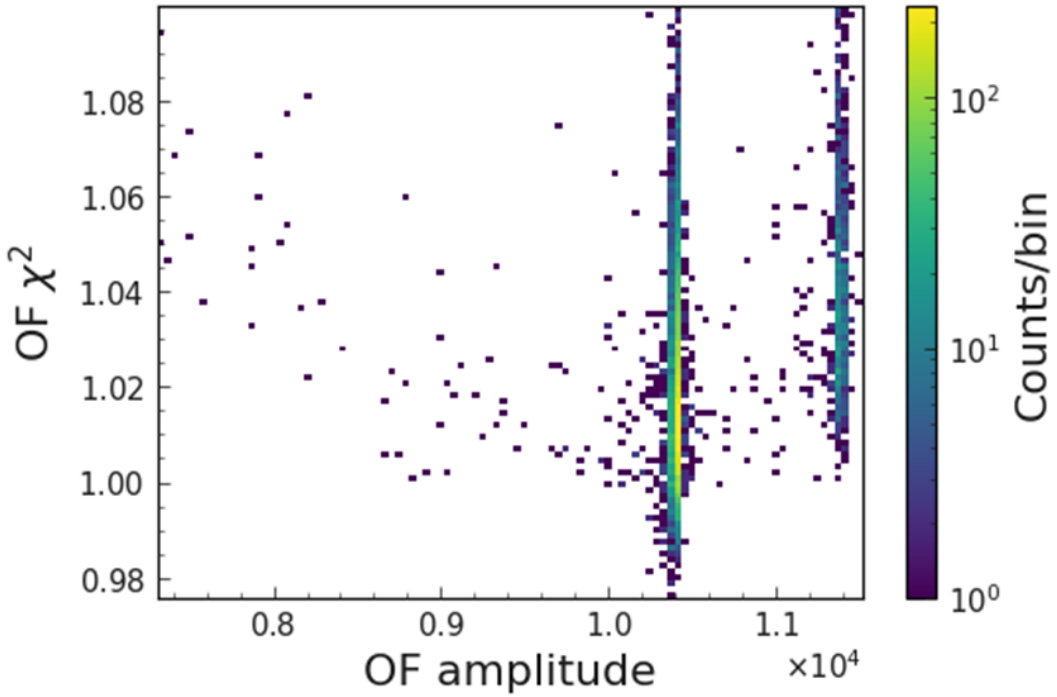






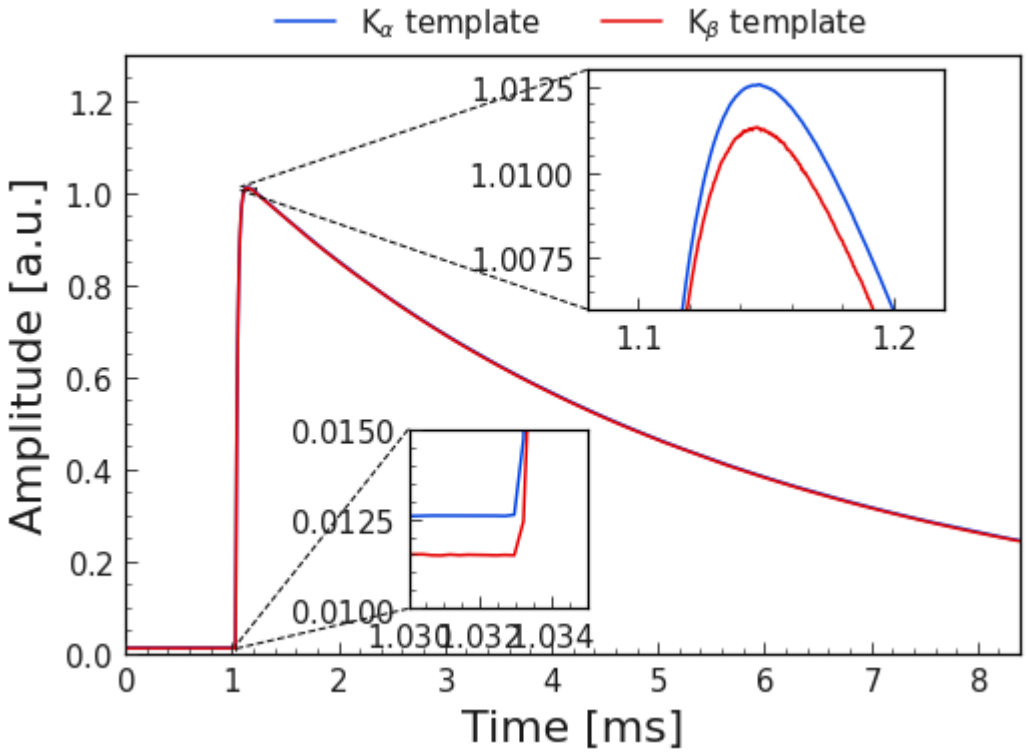
Optimum filter: the template

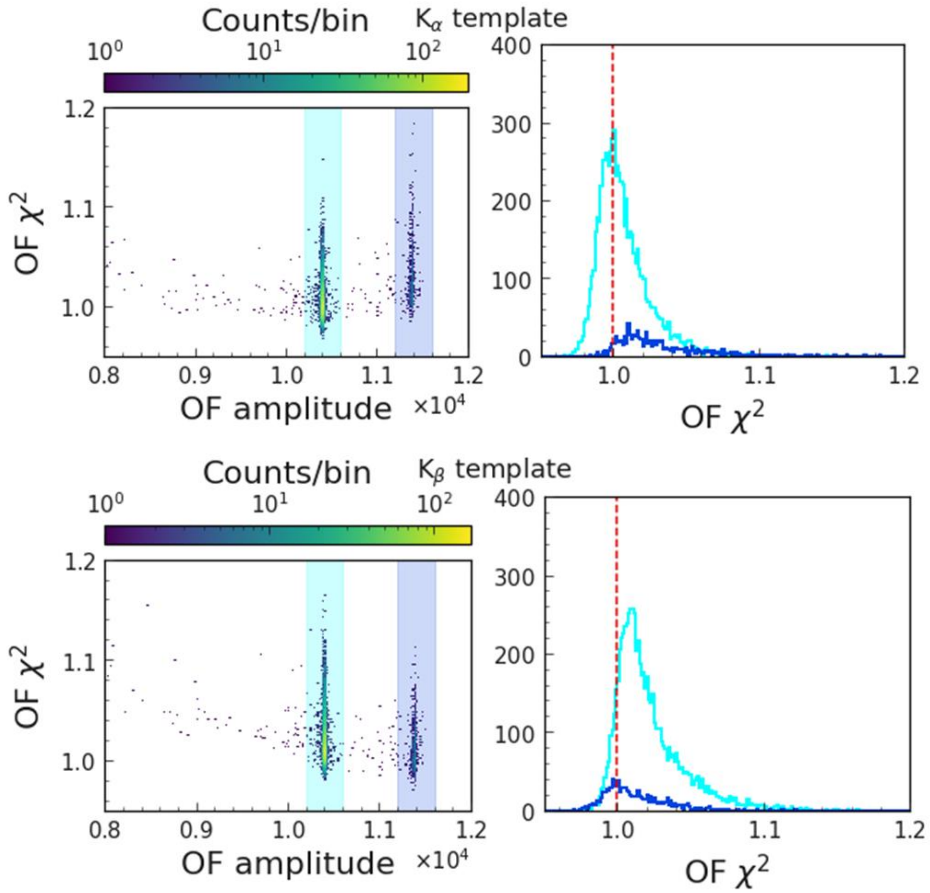
- Using previous template (thanks Greta!) there is a small dependence of the OF χ^2 on the trace amplitude (i.e., energy).



Optimum filter: the templates

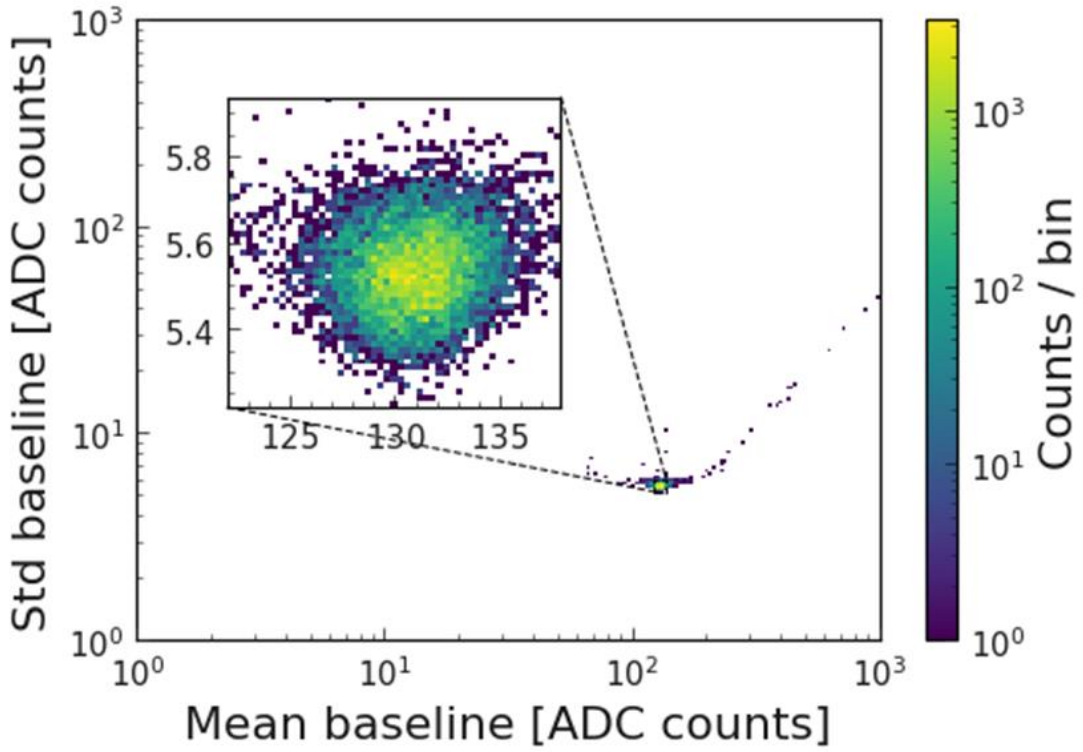
- Two templates (one for K_α and one for K_β) were produced.



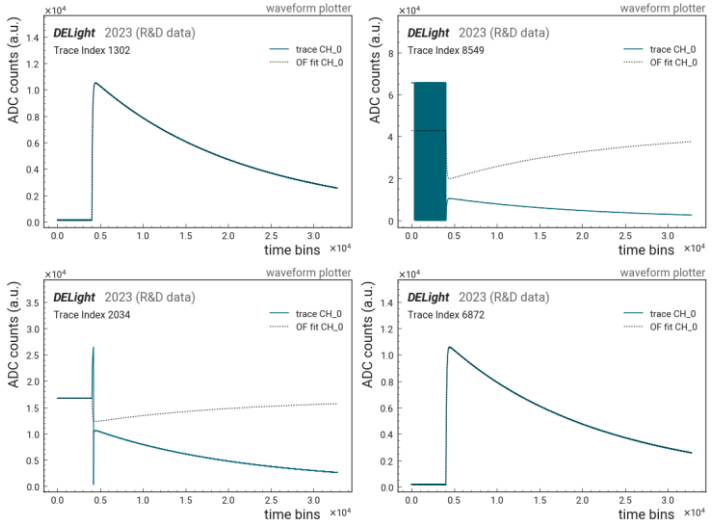


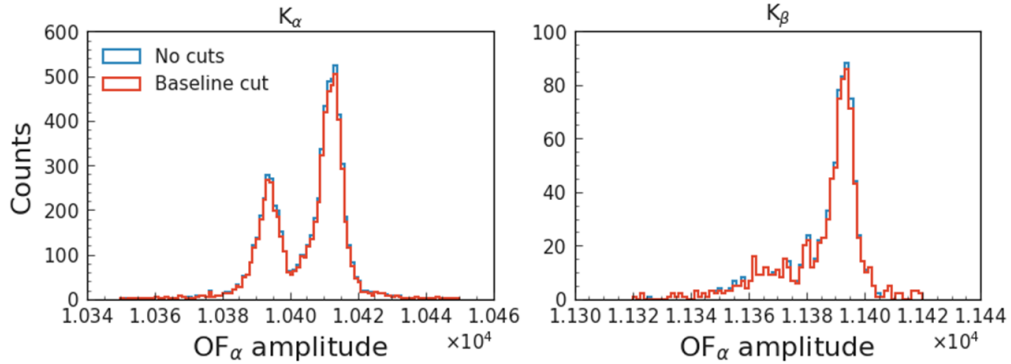
Baseline quality cut

- time
- channel
- trace_index
- temperature
- **mean_baseline**
- **std_baseline**
- mean
- std
- A
- rise_time
- TF_ampl
- TF_chi2
- TF_baseline
- baseline_slope
- time_shift
- OF_ampl_0
- OF_chi2_0
- OF_time_0
- OF_ampl_1
- OF_chi2_1
- OF_time_1



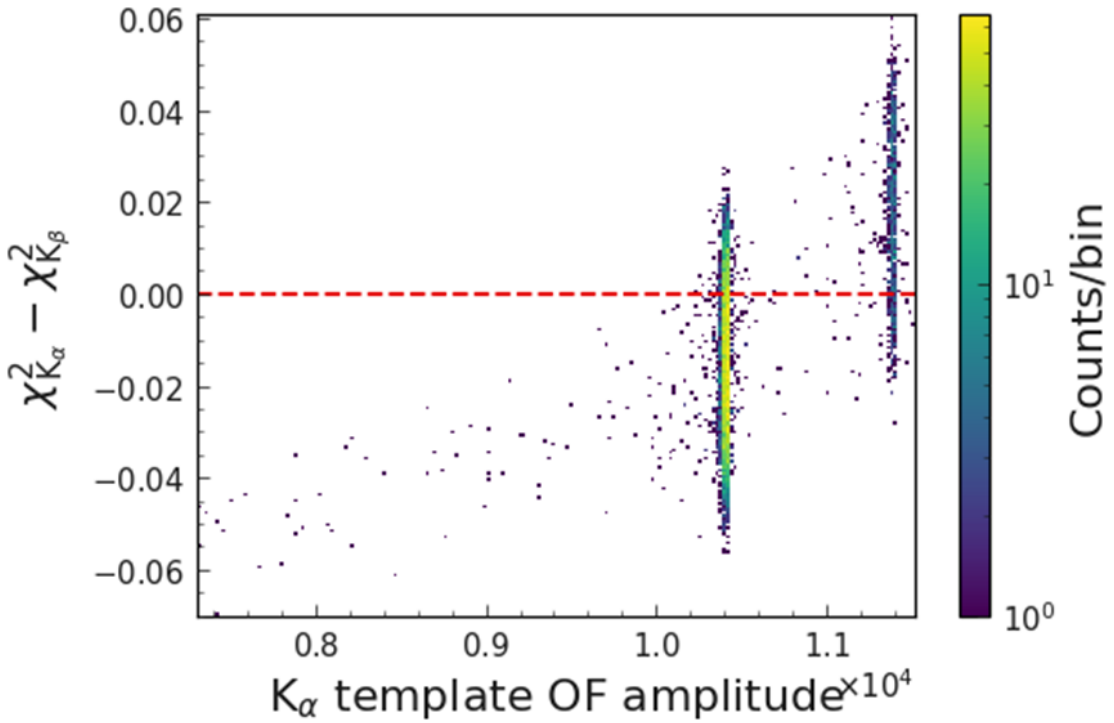
Rejected traces

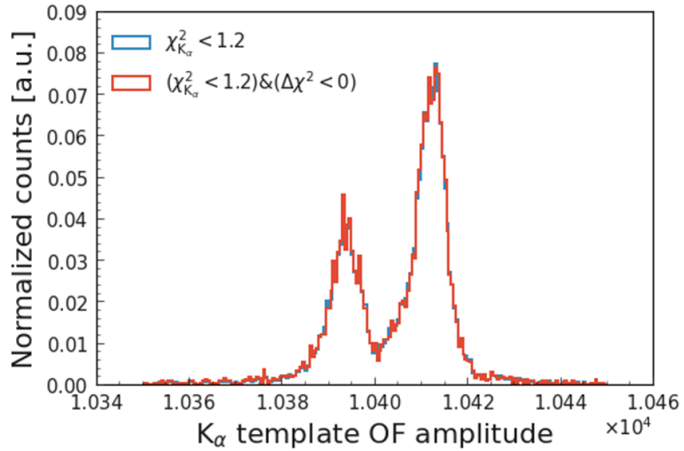


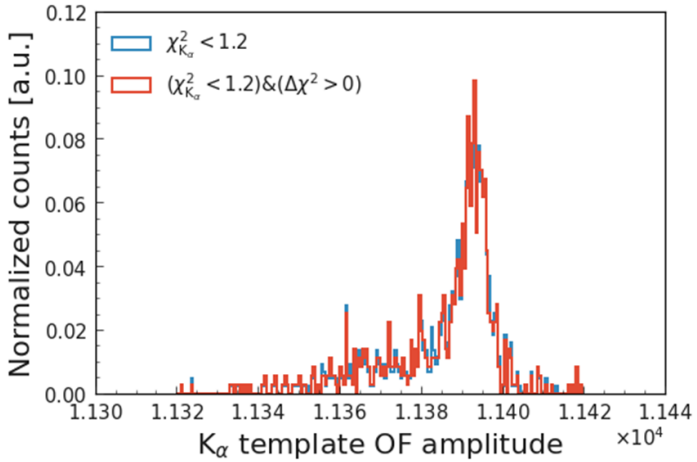


$\Delta\chi^2$ quality cut

- time
- channel
- trace_index
- temperature
- mean_baseline
- std_baseline
- mean
- std
- A
- rise_time
- TF_ampl
- TF_chi2
- TF_baseline
- baseline_slope
- time_shift
- OF_ampl_0
- **OF_chi2_0**
- OF_time_0
- OF_ampl_1
- **OF_chi2_1**
- OF_time_1



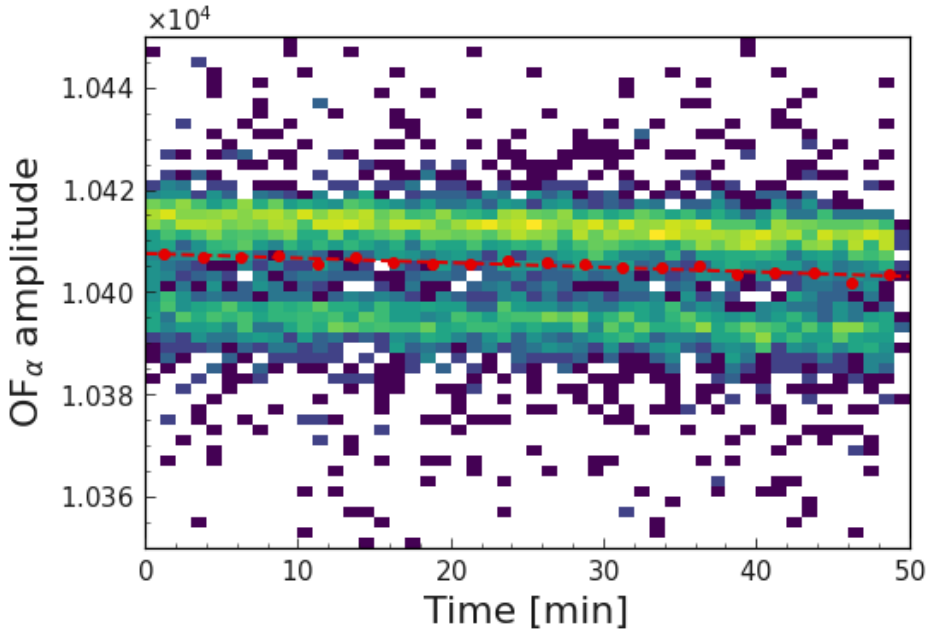


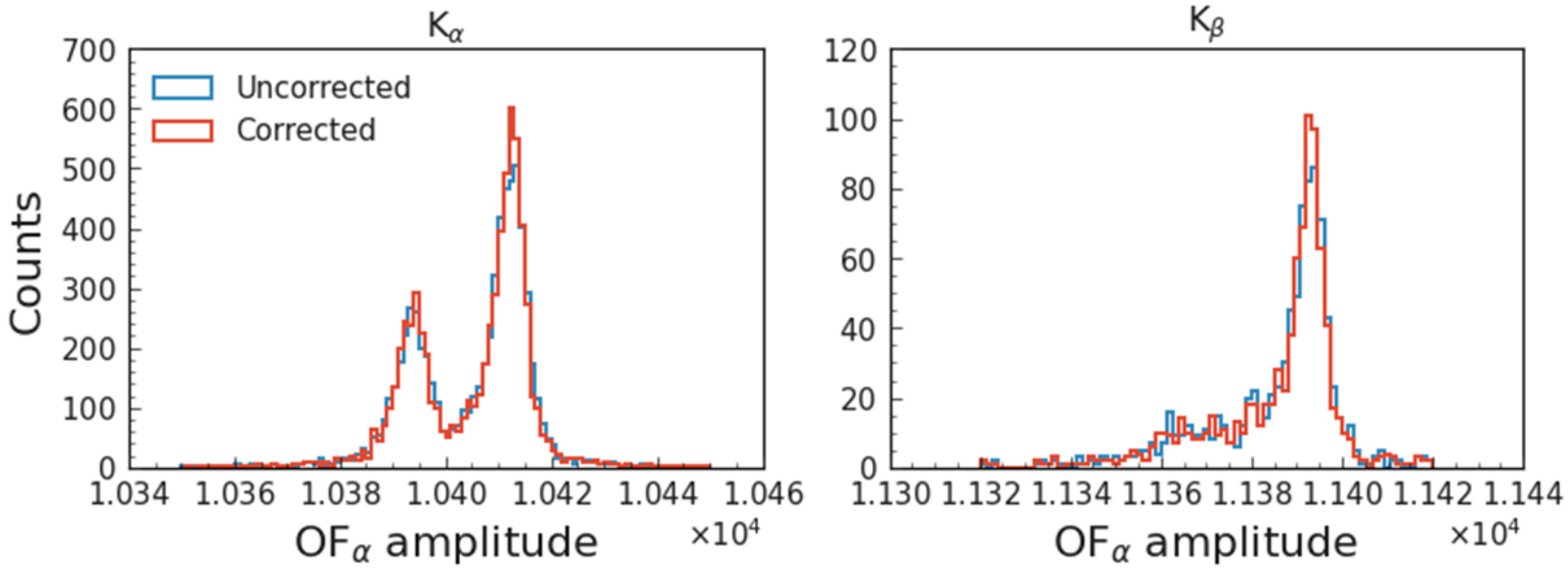


Time correction

- time
- channel
- trace_index
- temperature
- mean_baseline
- std_baseline
- mean
- std
- A
- rise_time
- TF_ampl
- TF_chi2
- TF_baseline
- baseline_slope
- time_shift
- OF_ampl_0
- OF_chi2_0
- OF_time_0
- OF_ampl_1
- OF_chi2_1
- OF_time_1

Averaged over time and corrected for linear interpolation

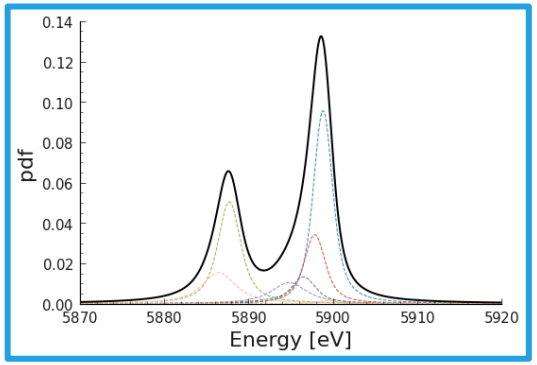


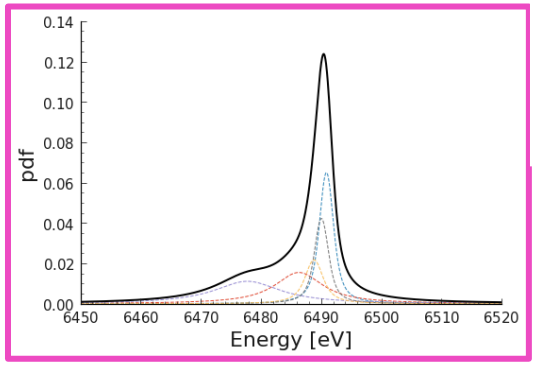


Fitting procedure

- After all the cuts we are left with 8014 traces (92.6% acceptance):
  - Statistic allows for **unbinned likelihood**.

$$\mathcal{L} = \prod_i^N \left(k_\alpha \cdot f_{\mathrm{K}_\alpha}(E, \sigma_E) + (1 - k_\alpha) \cdot f_{\mathrm{K}_\beta}(E, \sigma_E) \right) \qquad E = \mathrm{p}_2 \cdot A_{\mathrm{OF}}^2 + \mathrm{p}_1 \cdot A_{\mathrm{OF}}$$



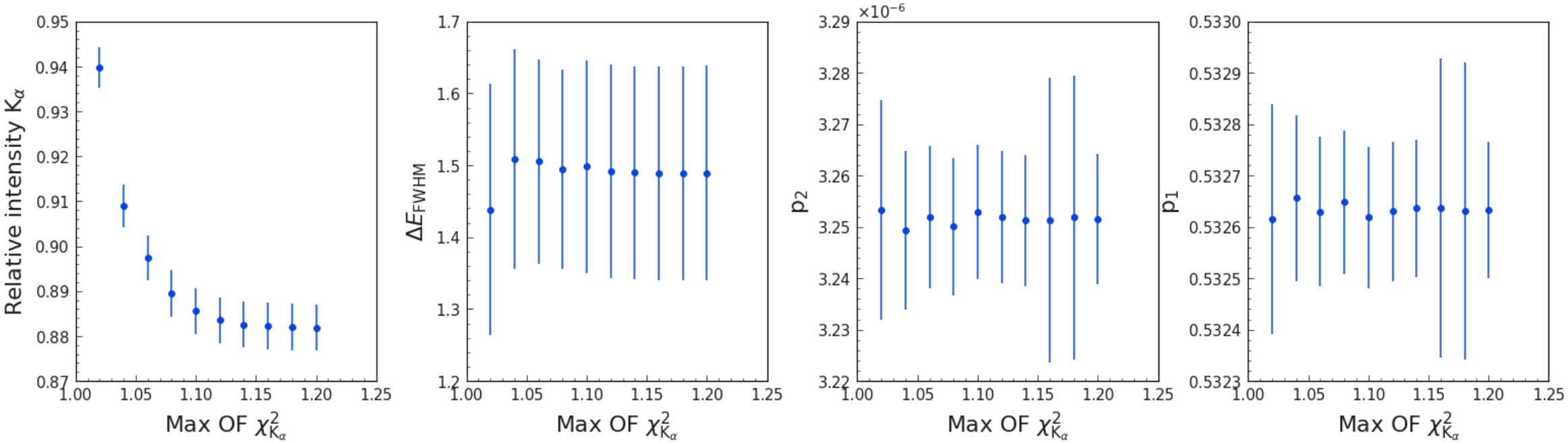


Four variables:

- Signal intensity κ_α
- Energy calibration $\mathbf{p_1}$ and $\mathbf{p_2}$
- Energy resolution σ_E

Fit results

- Minimization is done using *iminuit*, initial conditions were selected after random selections.



X^2 upper cut has no impact on the fit convergence. Uncertainties correlated!

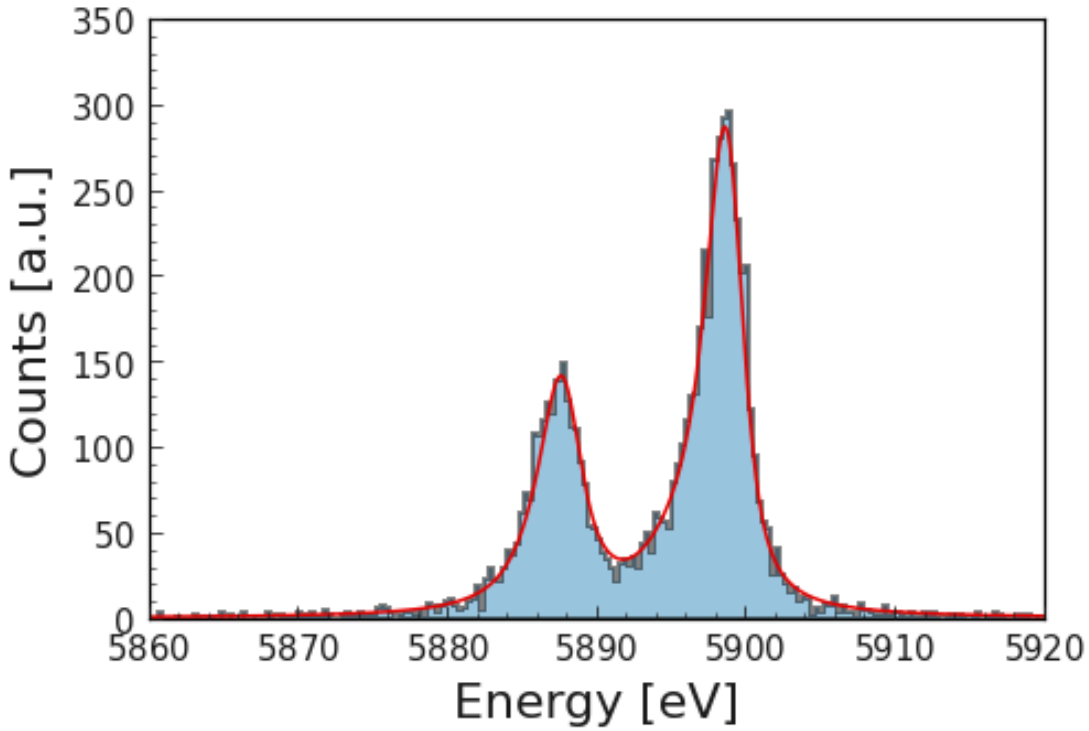
Fit results

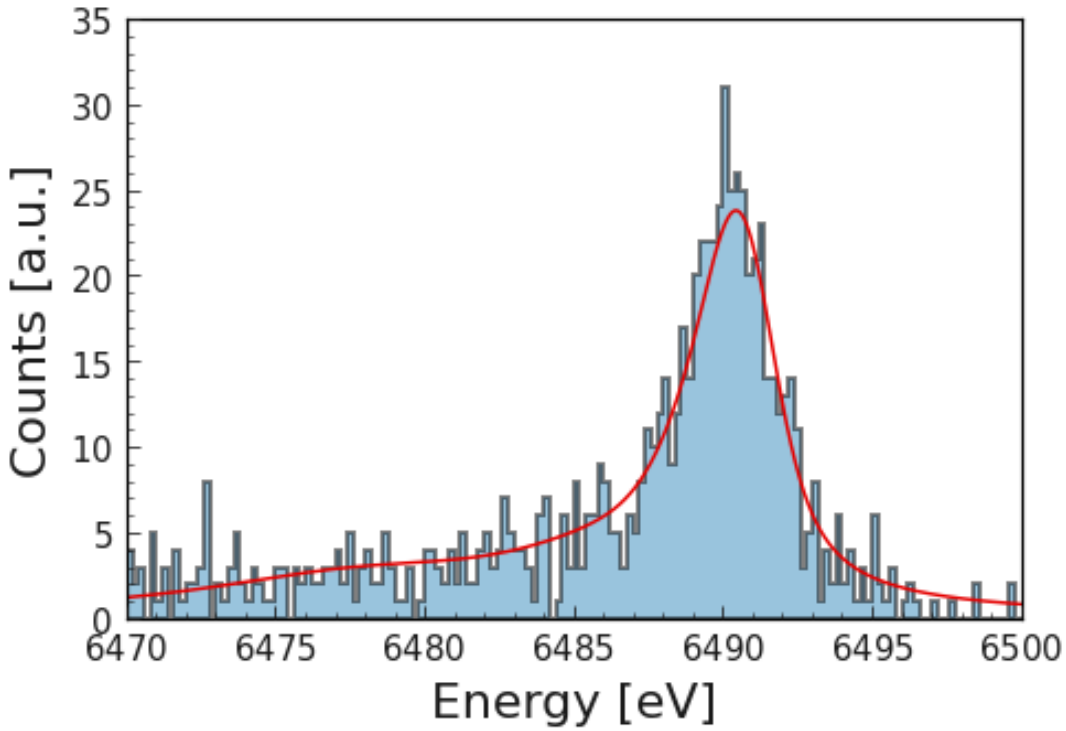
- Covariance suggests degeneracy between p_1 and p_2.

	ka	E_2	E_1	E_0	sigma_0
ka	2.65e-05	-1.09e-13	1.15e-09	0	5.59e-09
E_2	-1.09e-13	7.76e-16	-8.14e-12 **(-1.000)**	0	-1.09e-10 **(-0.062)**
E_1	1.15e-09	-8.14e-12 **(-1.000)**	8.55e-08	0	1.18e-06 **(0.064)**
E_0	0	0	0	0	0
sigma_0	5.59e-09	-1.09e-10 **(-0.062)**	1.18e-06 **(0.064)**	0	0.00398

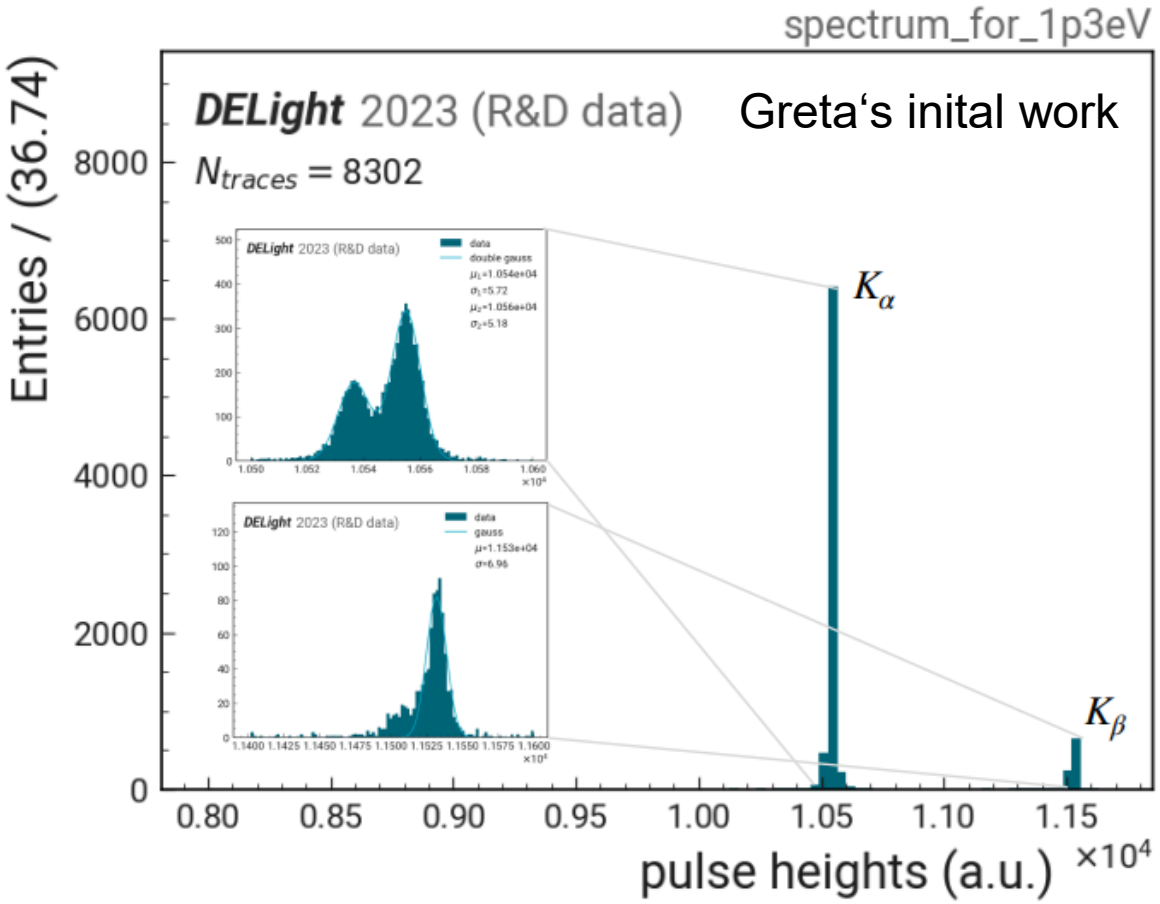
Fit results

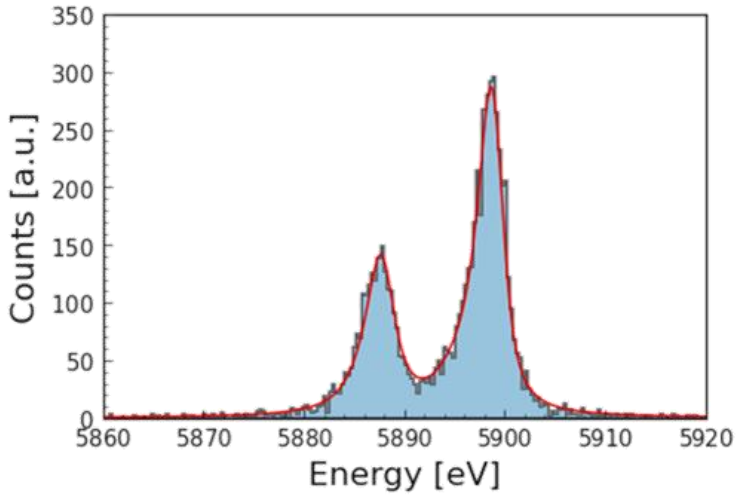
- Energy resolution $\sigma_E = (0.63 \pm 0.06)$ eV $\rightarrow$ $\Delta E_{FWHM} = (1.49 \pm 0.15)$ eV

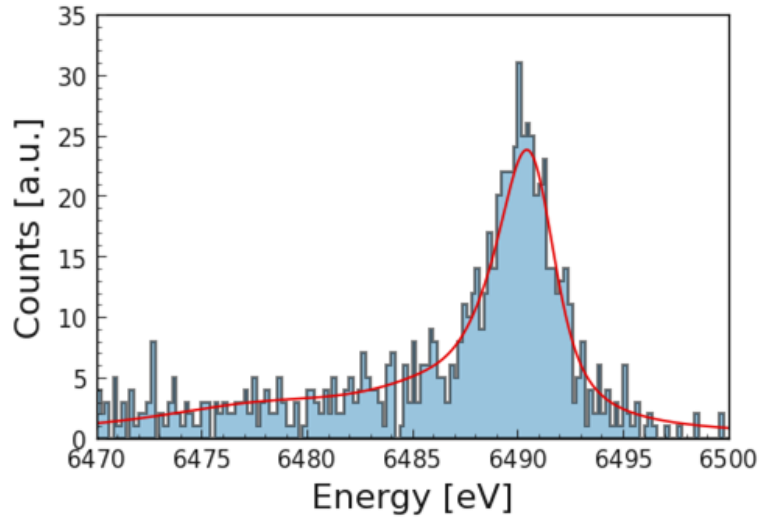




Comparison to previous works







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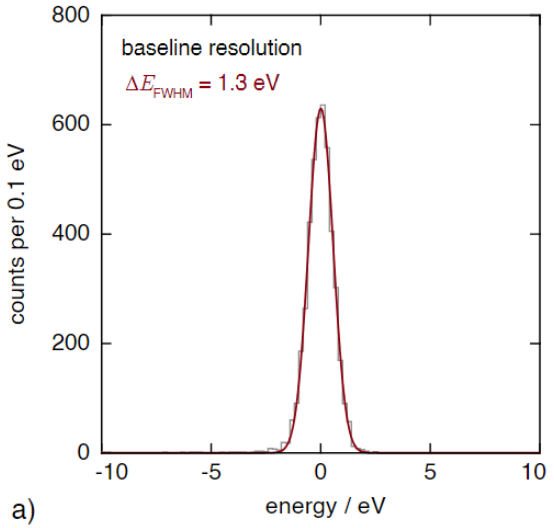
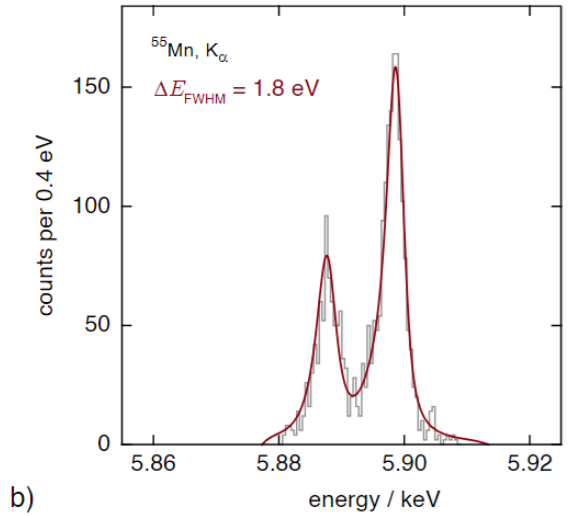
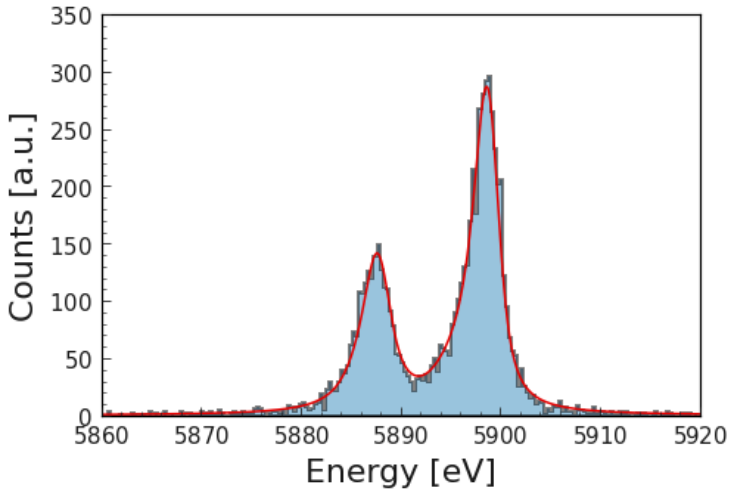




Krantz thesis



What next? Fitting

- Cross-check results using χ^2 minimization (binned fit);
- Improve noise selection;
- Better understanding of the degeneracy of p_1 and p_2, maybe different parameterization?
- Increase statistics with multichannel data.