Calib Update 2023-07-20

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Been working on the SHMS HGC calibration for some time.

Got the calibration working but there is a puzzling trend in the calibration parameters.

I'll quickly go over how the calibration is done and what I've done to parameterize the calibration parameters.
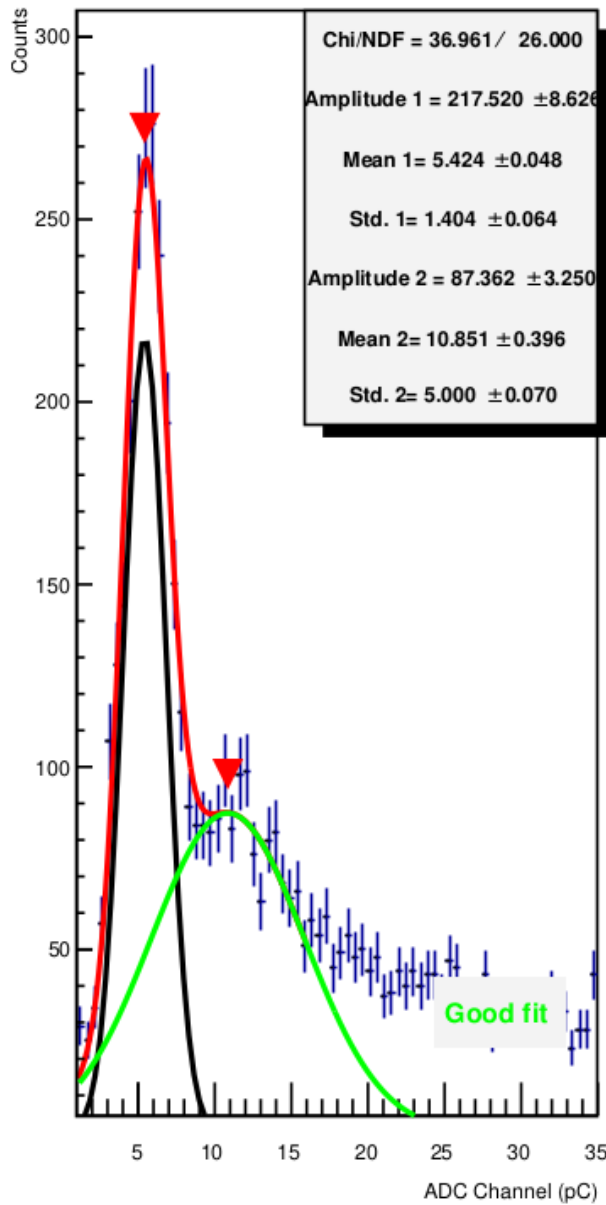
HGC Calibration Overview

- Using the HGC calib code that Vijay wrote
  - For full details see his talk:
    https://hallcweb.jlab.org/DocDB/0011/001100/001/Updated_HGC_calib_code_2020.pdf
  - And Report:
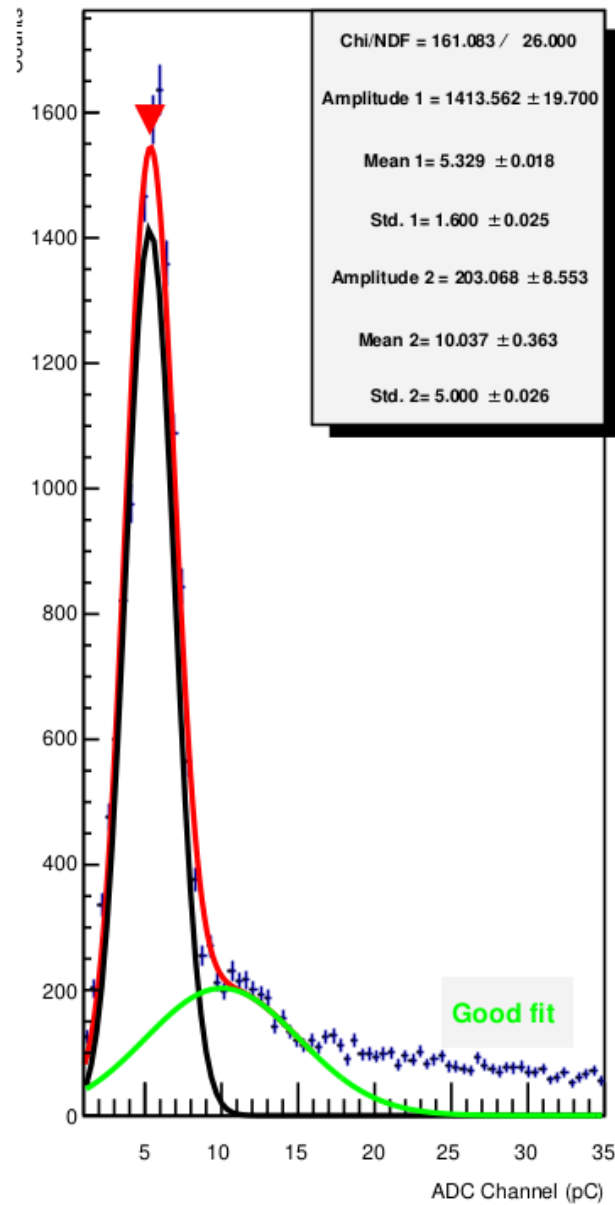   https://hallcweb.jlab.org/DocDB/0010/001098/001/calib_shms_hgc_report_20oct27.pdf

The gist is that we fit 2 Gaussians to the 1 and 2 Photo-electron peaks and then use these as the starting point for fitting 4 Gauss and 2 Poisson distributions.
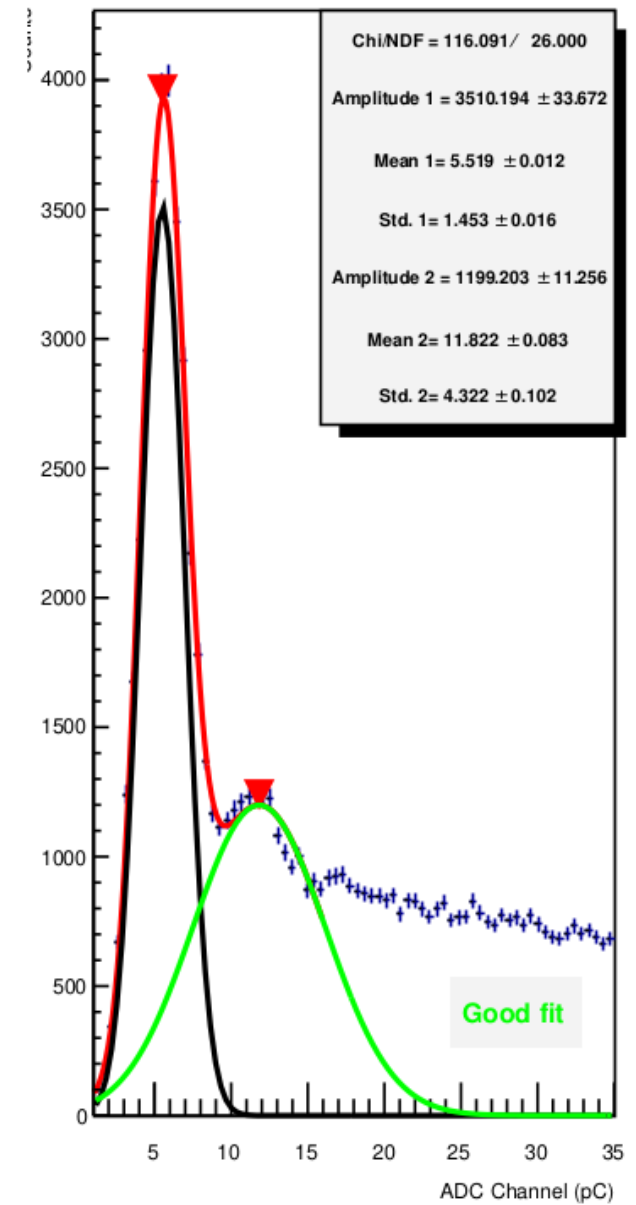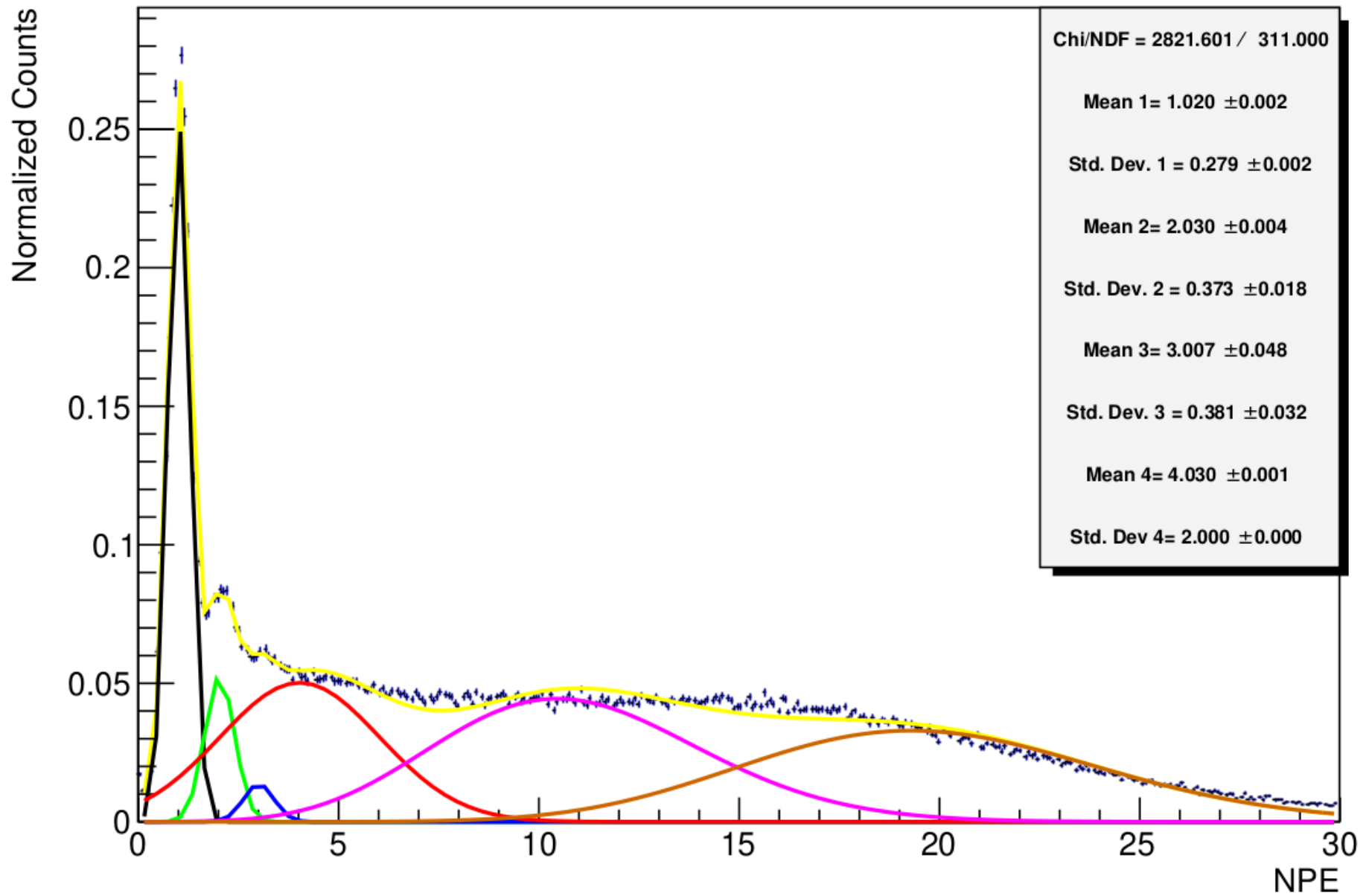
Example 2 Gauss

Pulse Integral PMT2 quad1

Chi/NDF = 36.961 / 26.000

Amplitude 1 = 217.520 ±8.626

Mean 1= 5.424 ±0.048

Std. 1= 1.404 ±0.064

Amplitude 2 = 87.362 ±3.250

Mean 2= 10.851 ±0.396

Std. 2= 5.000 ±0.070

Good fit

Pulse Integral PMT2 quad3

Chi/NDF = 161.083 / 26.000

Amplitude 1 = 1413.562 ±19.700

Mean 1= 5.329 ±0.018

Std. 1= 1.600 ±0.025

Amplitude 2 = 203.068 ±8.553

Mean 2= 10.037 ±0.363

Std. 2= 5.000 ±0.026

Good fit

Pulse Integral PMT2 quad4

Chi/NDF = 116.091 / 26.000

Amplitude 1 = 3510.194 ±33.672

Mean 1= 5.519 ±0.012

Std. 1= 1.453 ±0.016

Amplitude 2 = 1199.203 ±11.256

Mean 2= 11.822 ±0.083

Std. 2= 4.322 ±0.102

Good fit

ADC Channel (pC)

Example Full Fit
Scaled ADC spectra for PMT2

Chi/NDF = 2821.601 / 311.000

Mean 1= 1.020 ±0.002

Std. Dev. 1 = 0.279 ±0.002

Mean 2= 2.030 ±0.004

Std. Dev. 2 = 0.373 ±0.018

Mean 3= 3.007 ±0.048

Std. Dev. 3 = 0.381 ±0.032

Mean 4= 4.030 ±0.001

Std. Dev 4= 2.000 ±0.000

Full Fit Zoomed In
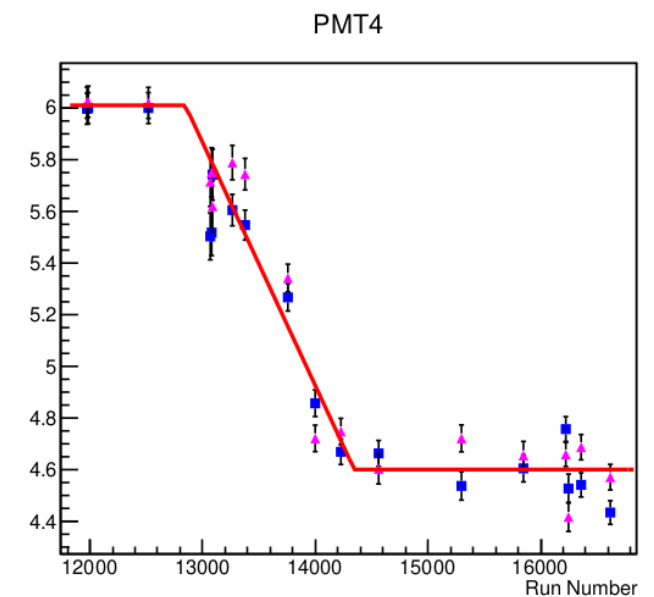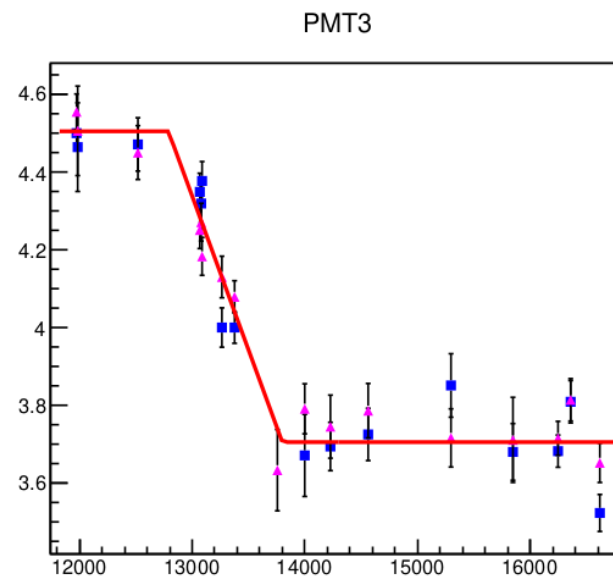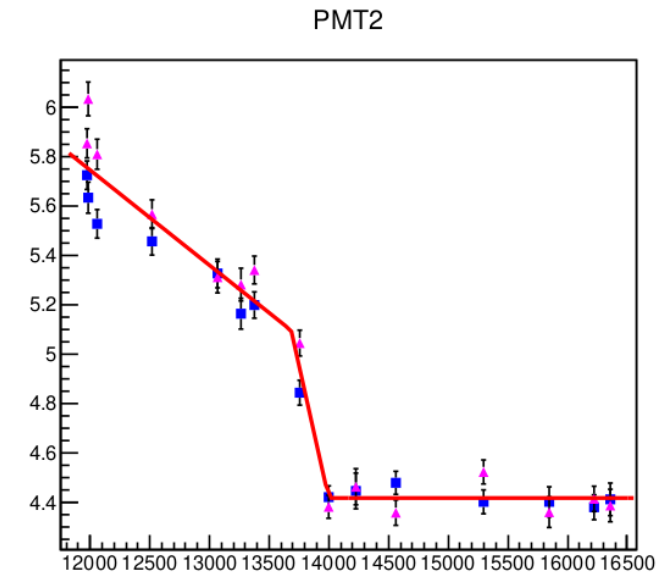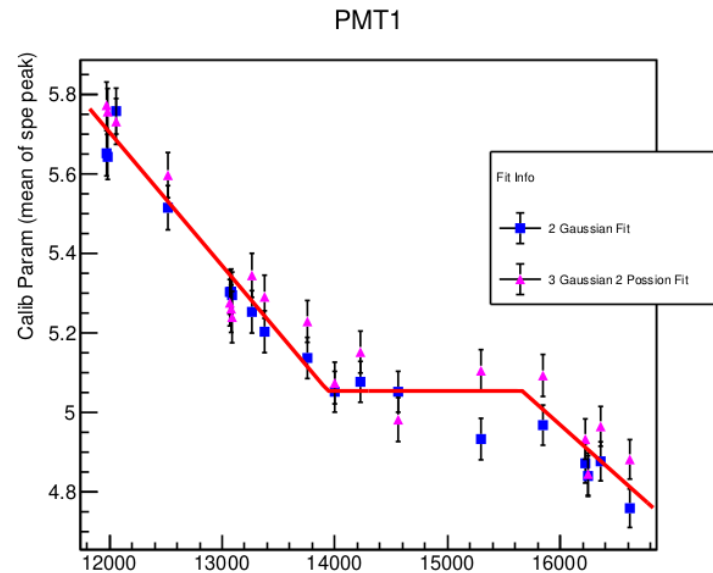## Scaled ADC spectra for PMT2
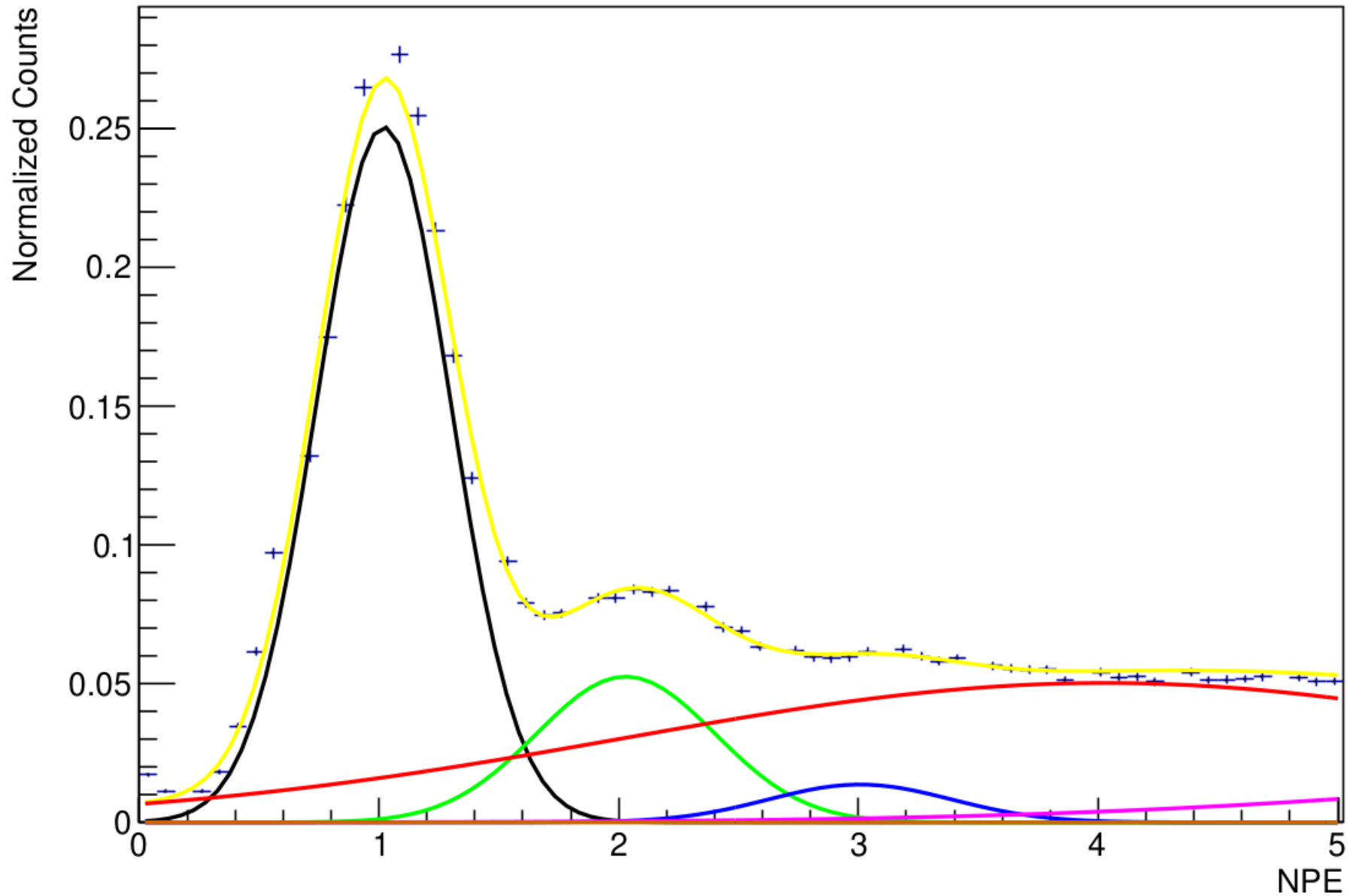
Calibration Parameters

Calibration parameters appear to have trends in them.

To deal with this behavior I fit piece-wise functions to them.

Cause of these trends is unknown, but it seems like the shut down in Dec 2022 caused them to stop drifting

Parameterization Equations

PMT 1:
$$y = \begin{cases} 9.73489 - 0.000335835x & x < 13938 \\ 5.054 & 13938 < x < 15662 \\ 5.054 - 0.000252903(x - 15662) & x > 15662 \end{cases}$$

PMT 2:
$$y = \begin{cases} 10.3698 - 0.000385347x & x < 13684 \\ 5.09647 - 0.00216313(x - 13684) & 13684 < x < 13998 \\ 4.41735 & x > 13998 \end{cases}$$

PMT 3:
$$y = \begin{cases} 4.50479 & x < 12789 \\ 4.50479 - 0.000791034(x - 12789) & 12789 < x < 13800 \\ 3.70524 & x > 13800 \end{cases}$$

PMT 4:
$$y = \begin{cases} 6.01045 & x < 12846 \\ 6.01045 - 0.000940862(x - 12846.5) & 12846 < x < 14345 \\ 4.60056 & x > 14345 \end{cases}$$

Conclusion

I have not yet Implemented the calibrations into hcana, that is the next step

Dave Gaskell has informed me that it is possible to include functions into the param files used by hcana, so that is the plan.

I have also been working on verifying the standard.kinamatics file for 2021 data.