Cherenkov Prototype Test Waveform Data Analysis

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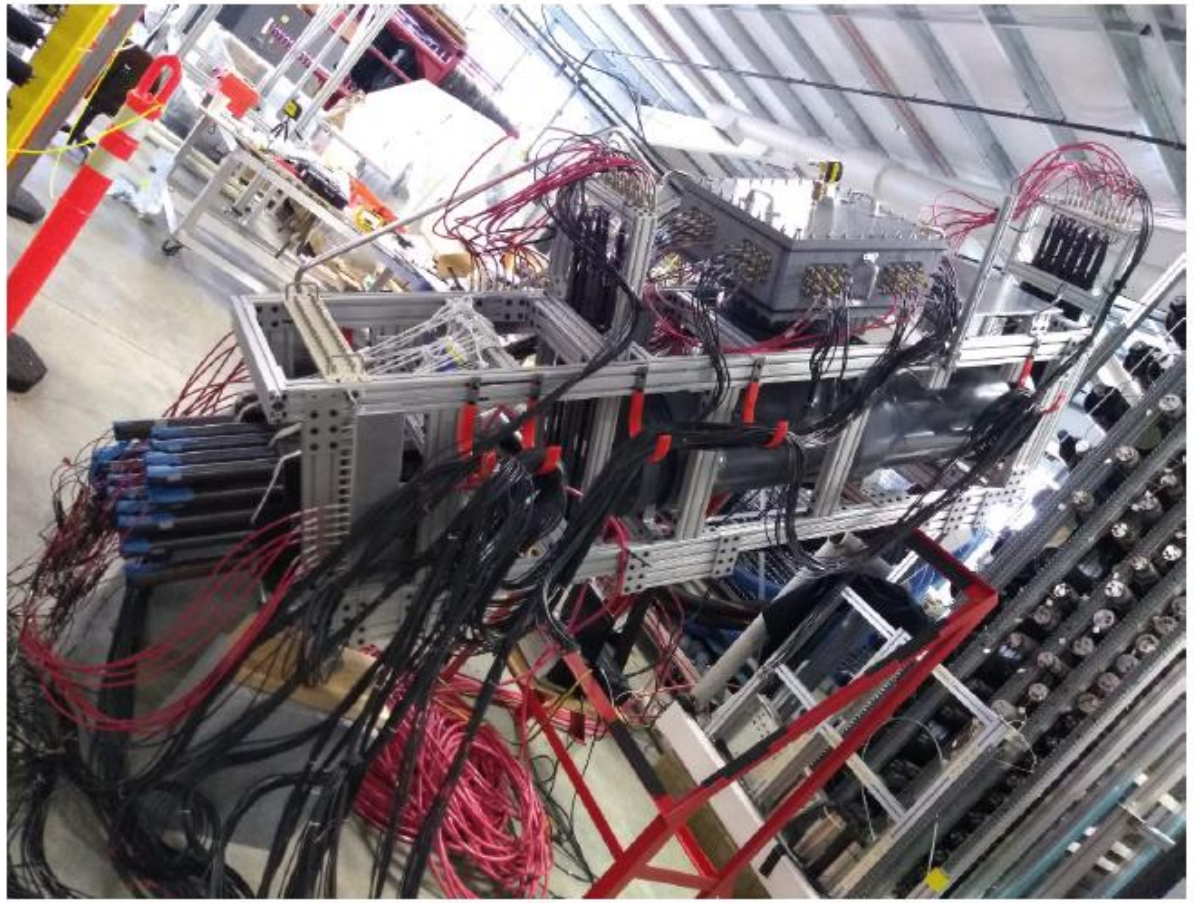
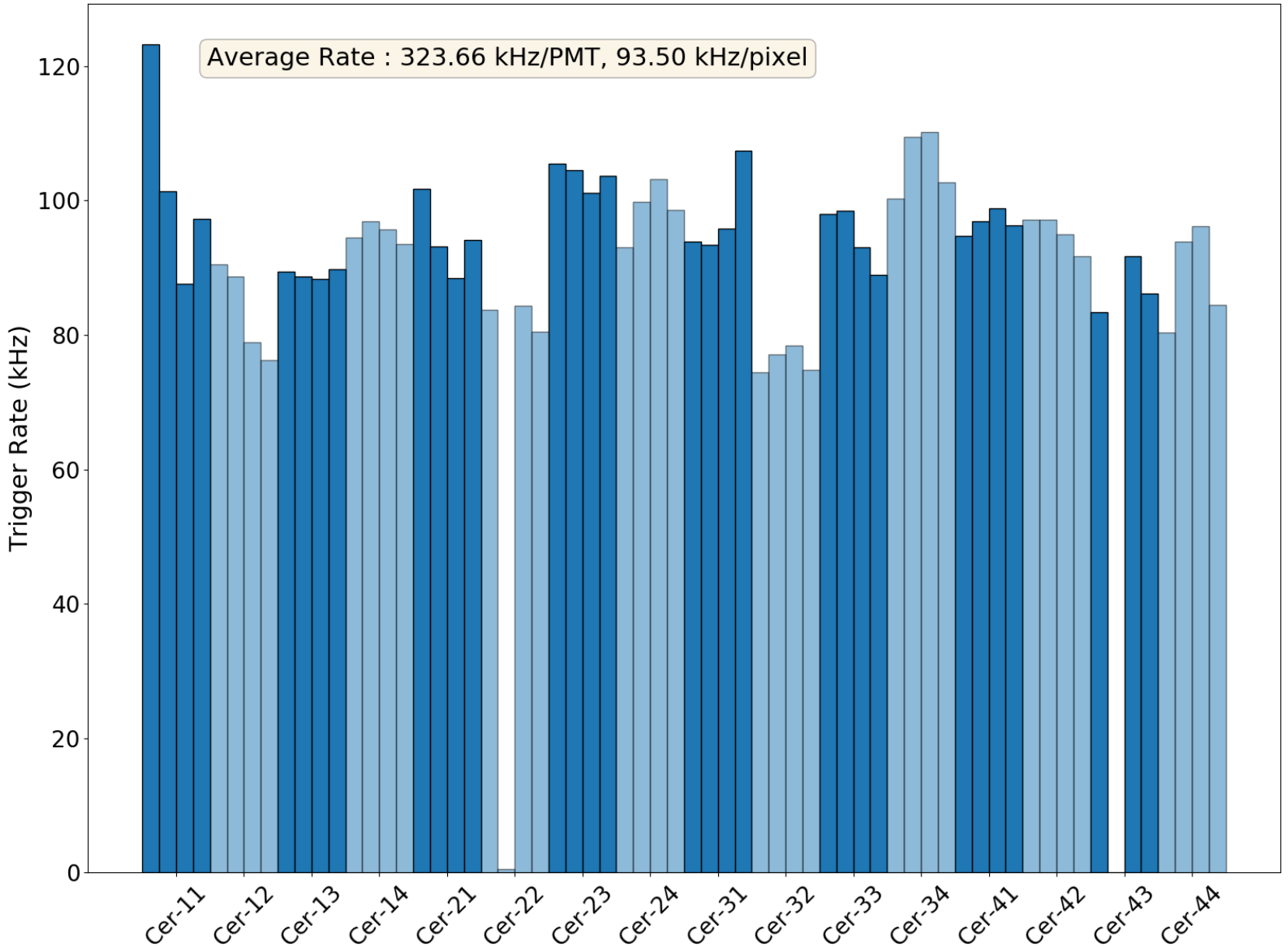
Cherenkov Prototype Detector

- Detector package includes
  - Cherenkov tank (CO_2 at 0.3 psi)
  - 2 scintillator planes
  - 9 calorimeter blocks
  - 16 maPMTs (4 pixels and 1 sum for each)
- Readouts: JLab FADC250
- Waveform Data Analysis
  - Run 160: 1 hour 30 μA on Pol. ^{3}He target
  - ~105 degree w.r.t the beamline
  - ~17 feet away from the target

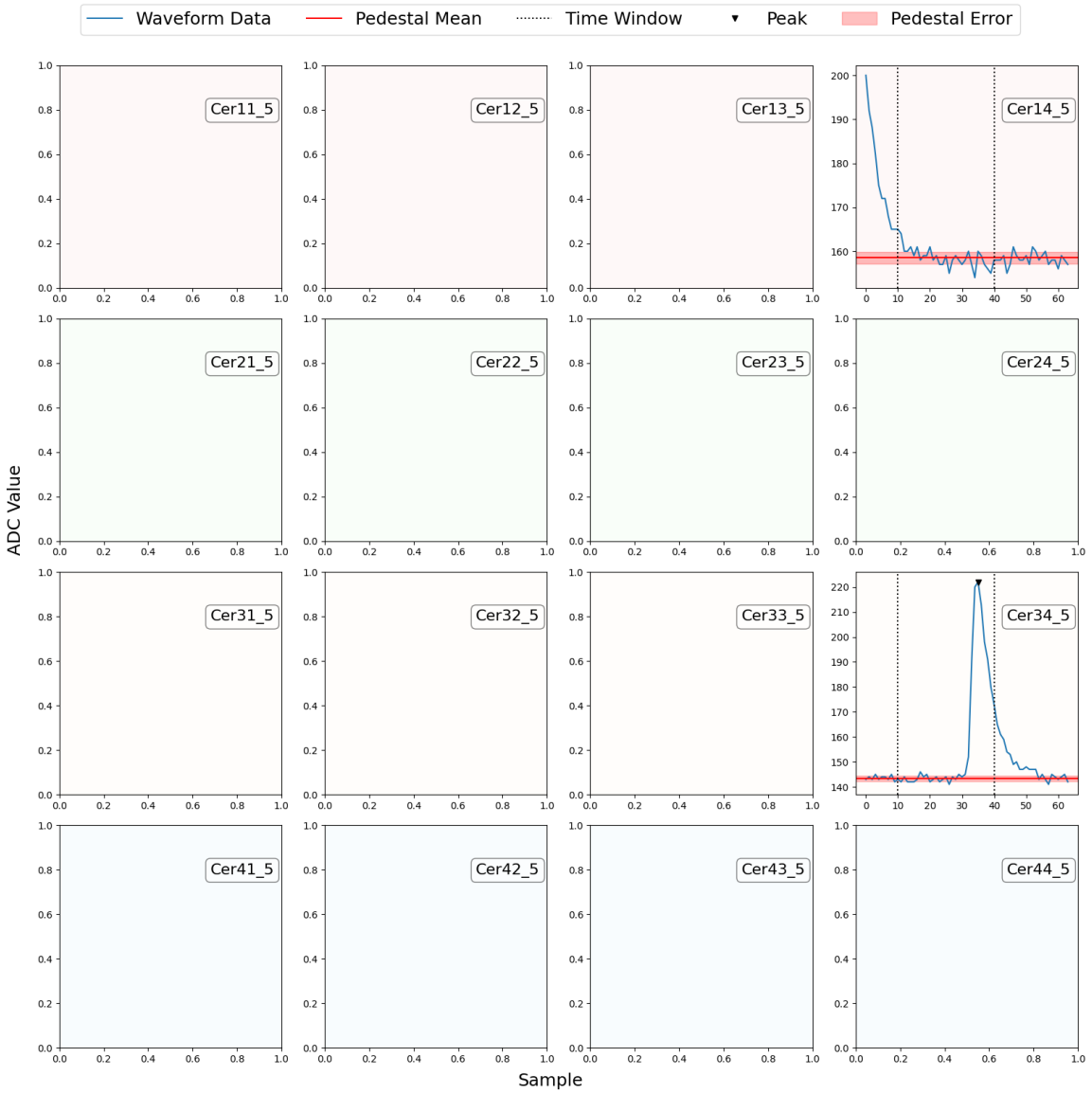


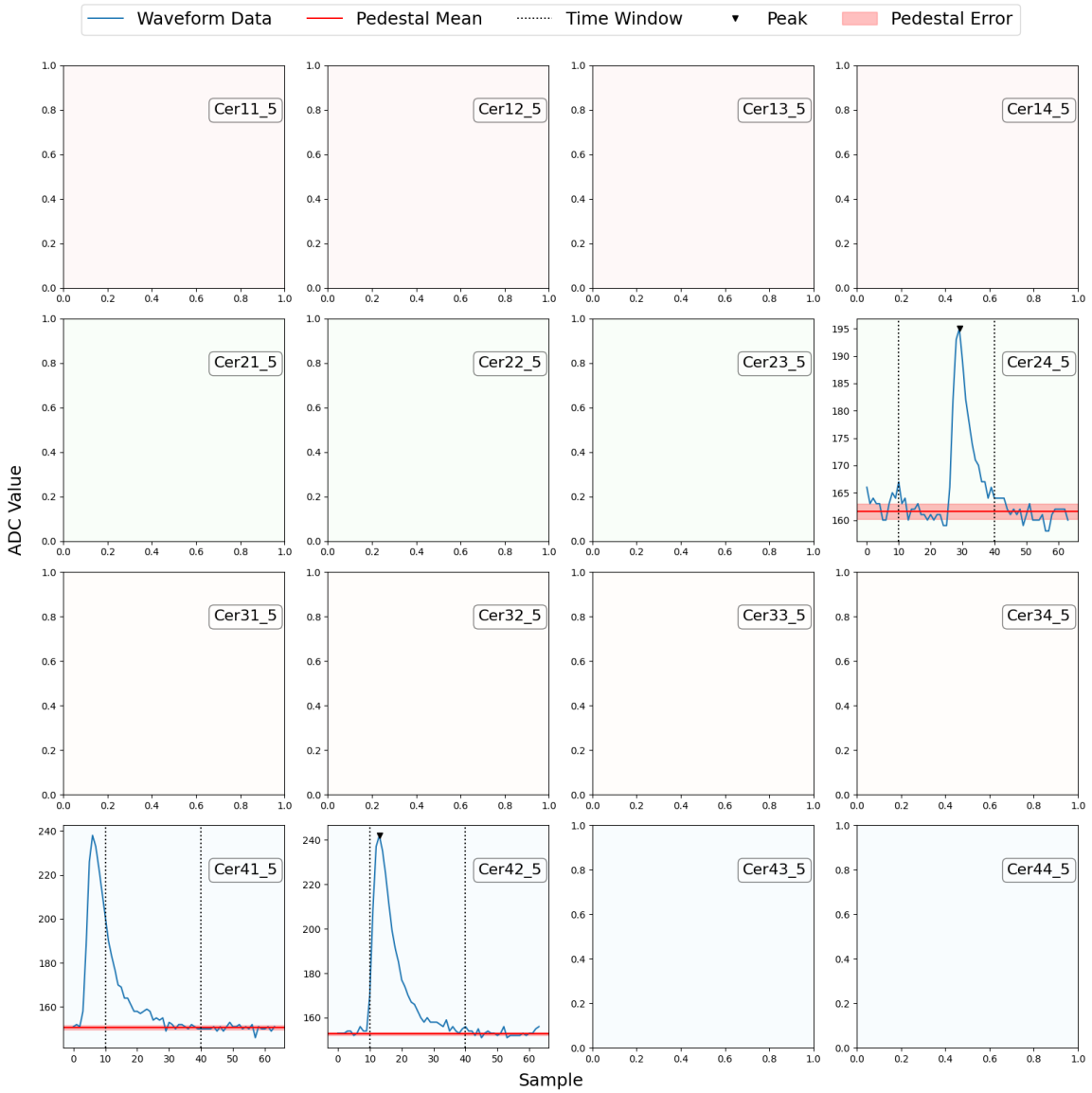
Plots from the quarterly progress report 1

Scalers for MAPMT

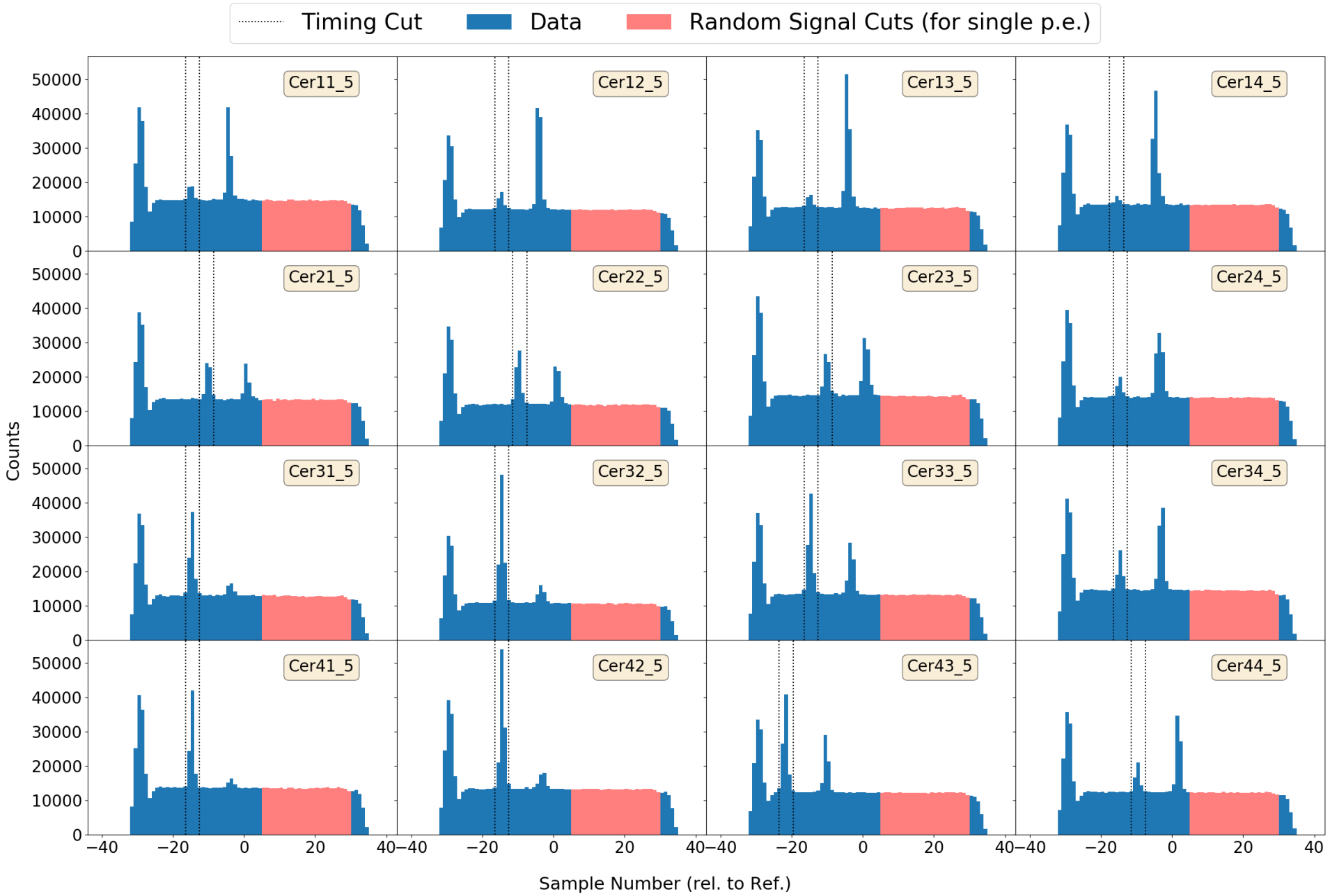


Waveform Analysis – Examples

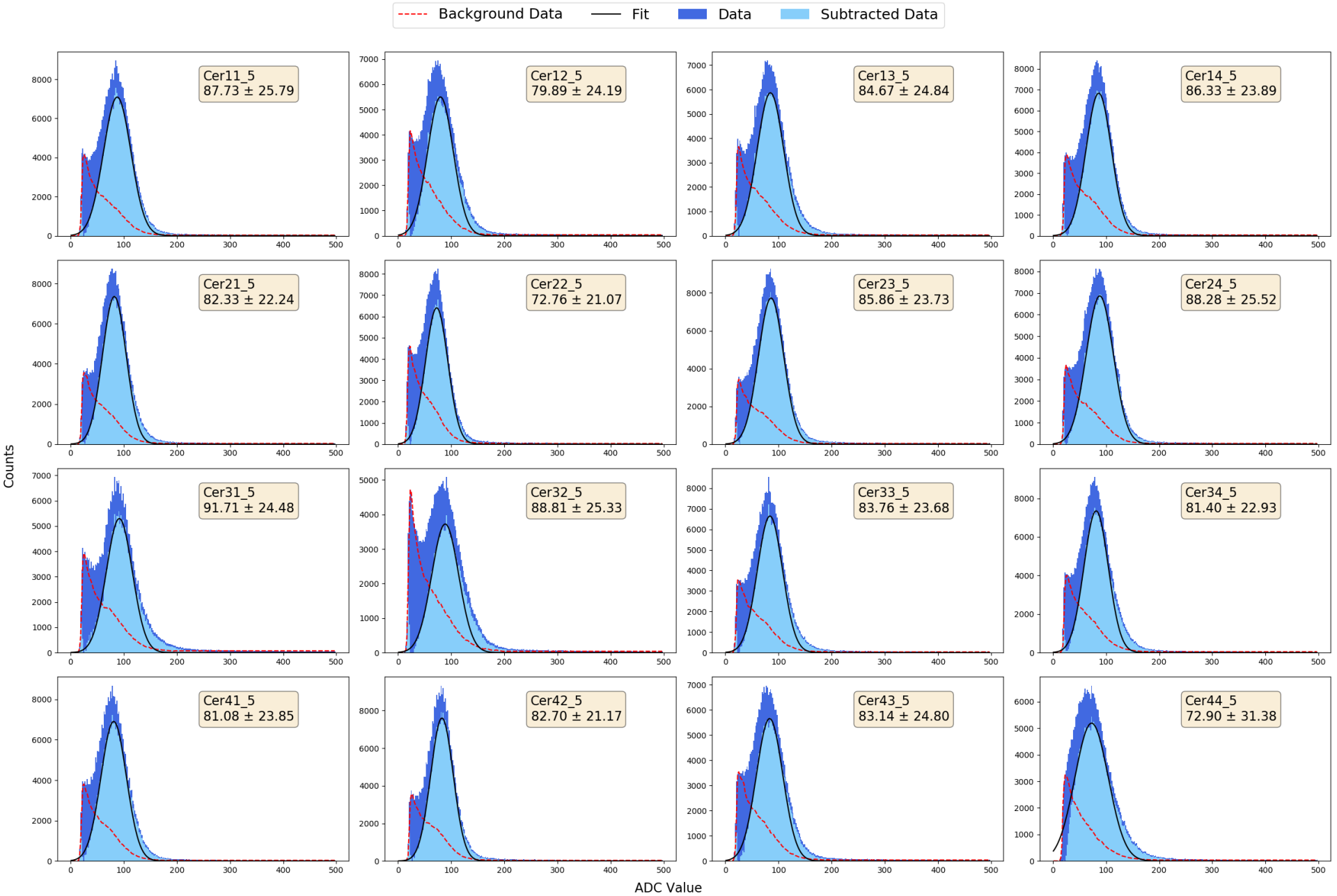




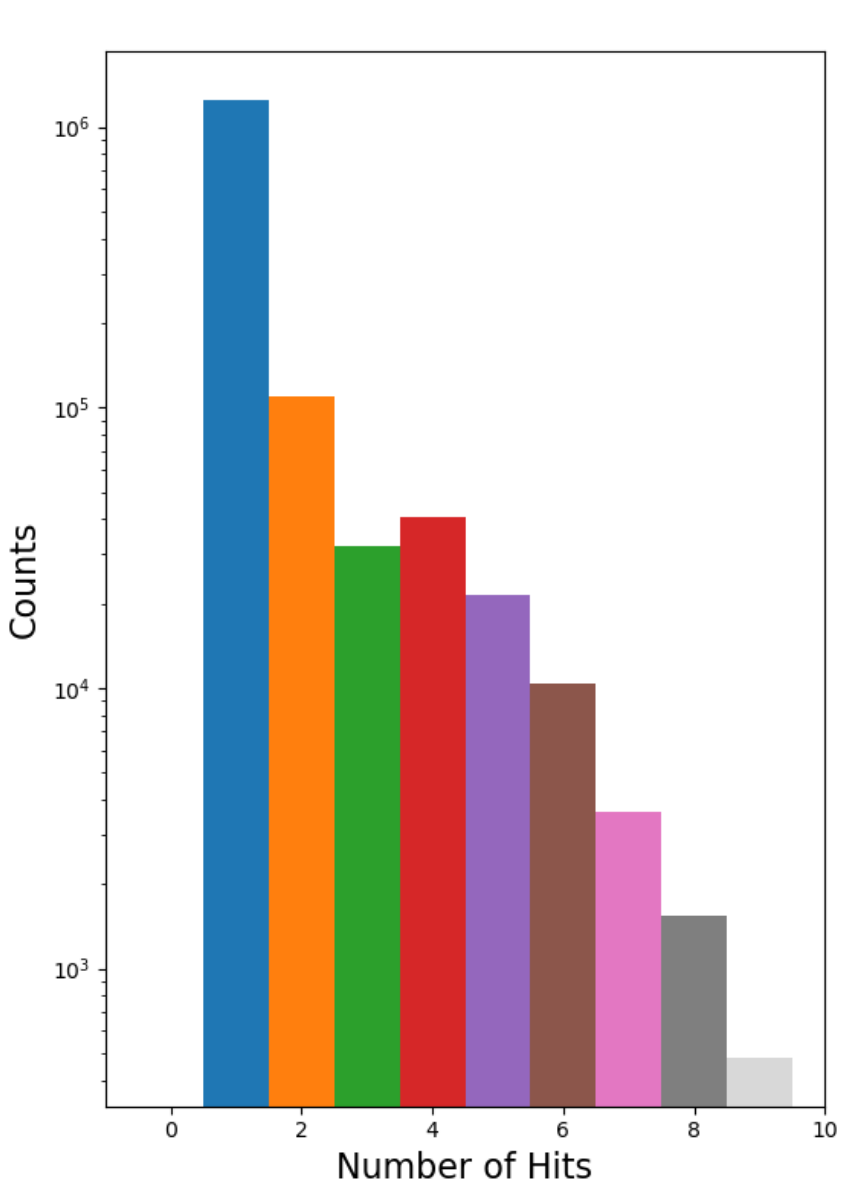
Cherenkov Channels – Timing relative to Cal.

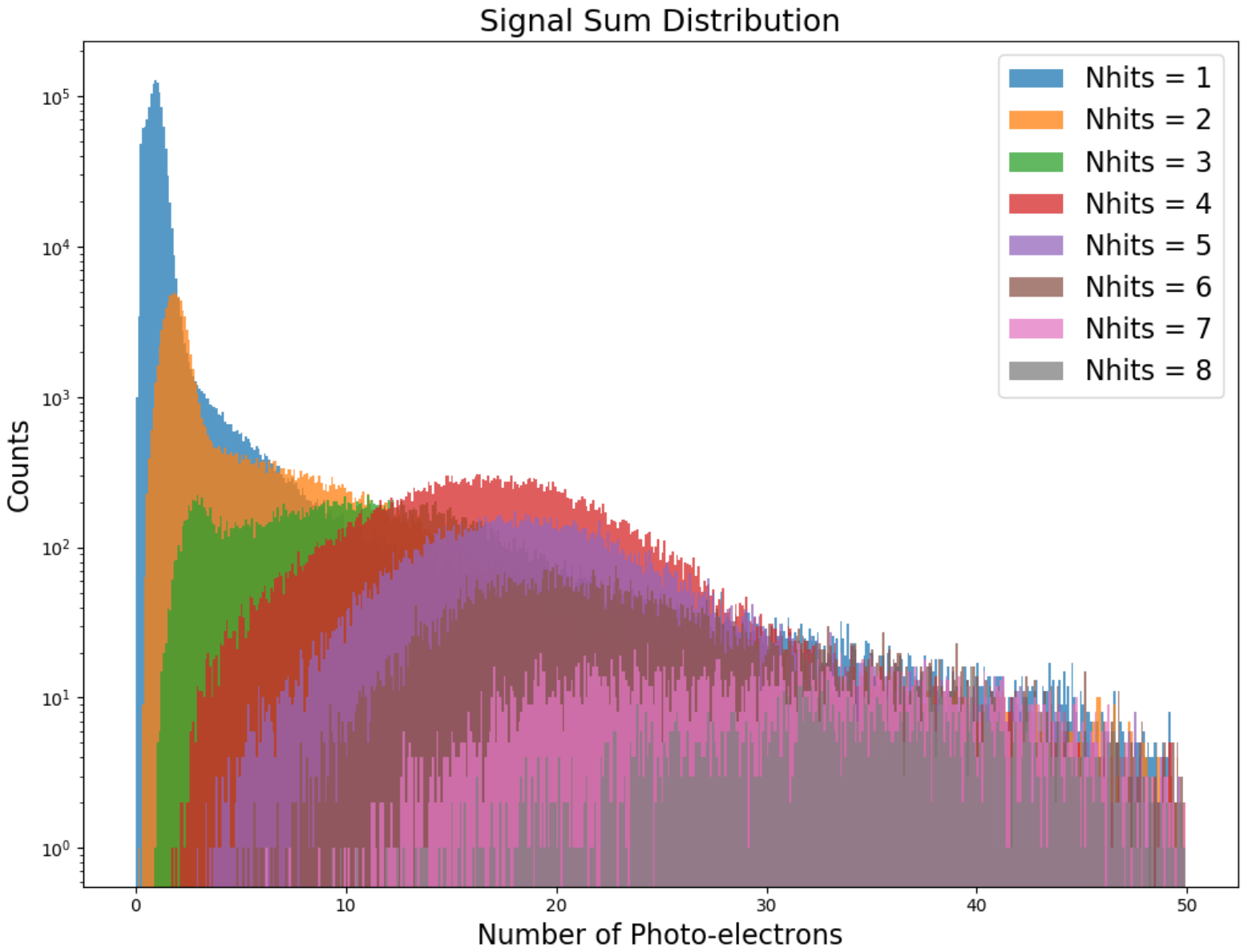


Random Signals – Single p.e. Peak Fit

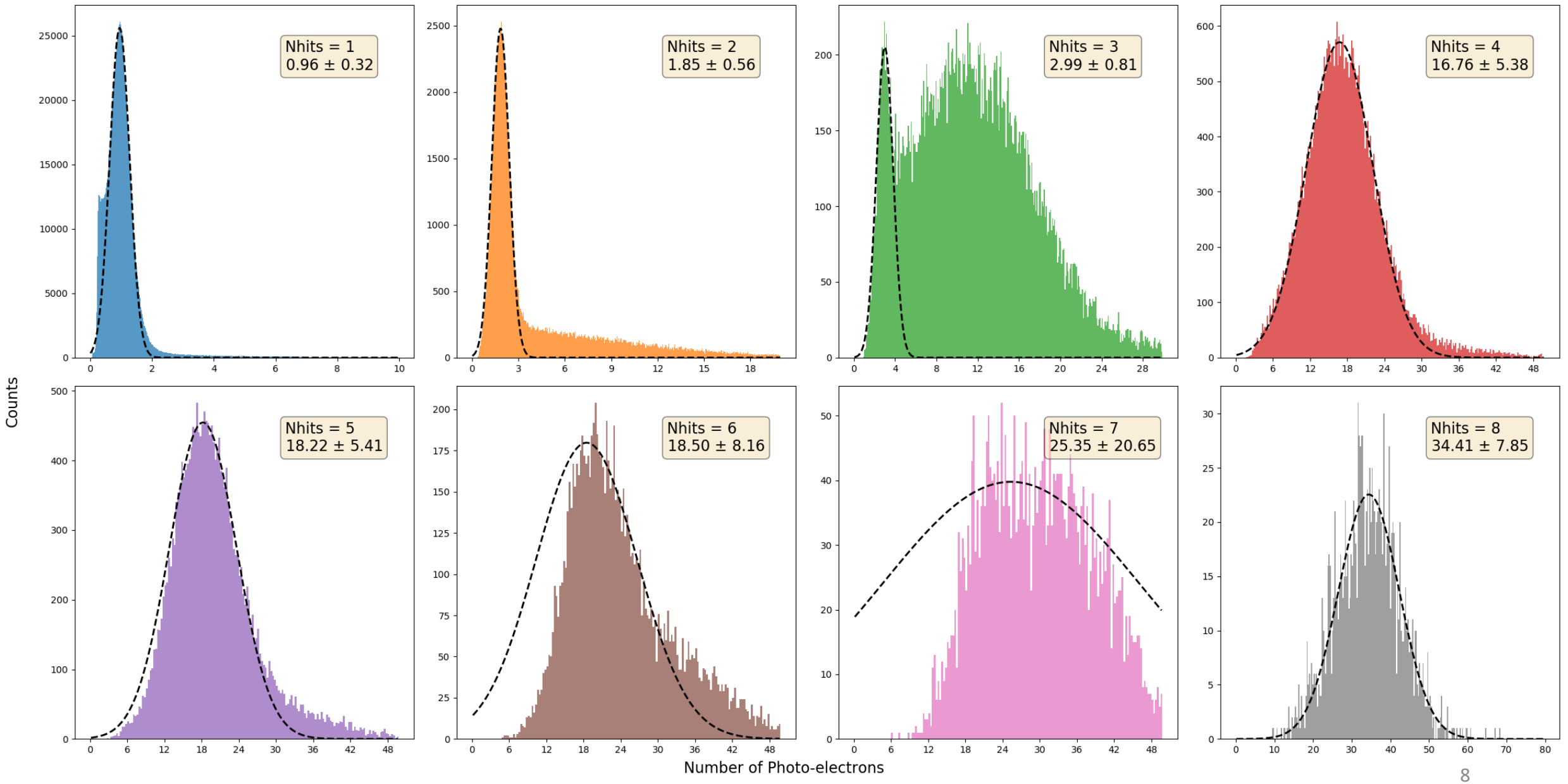


Signal Sums by Number of Fired PMTs

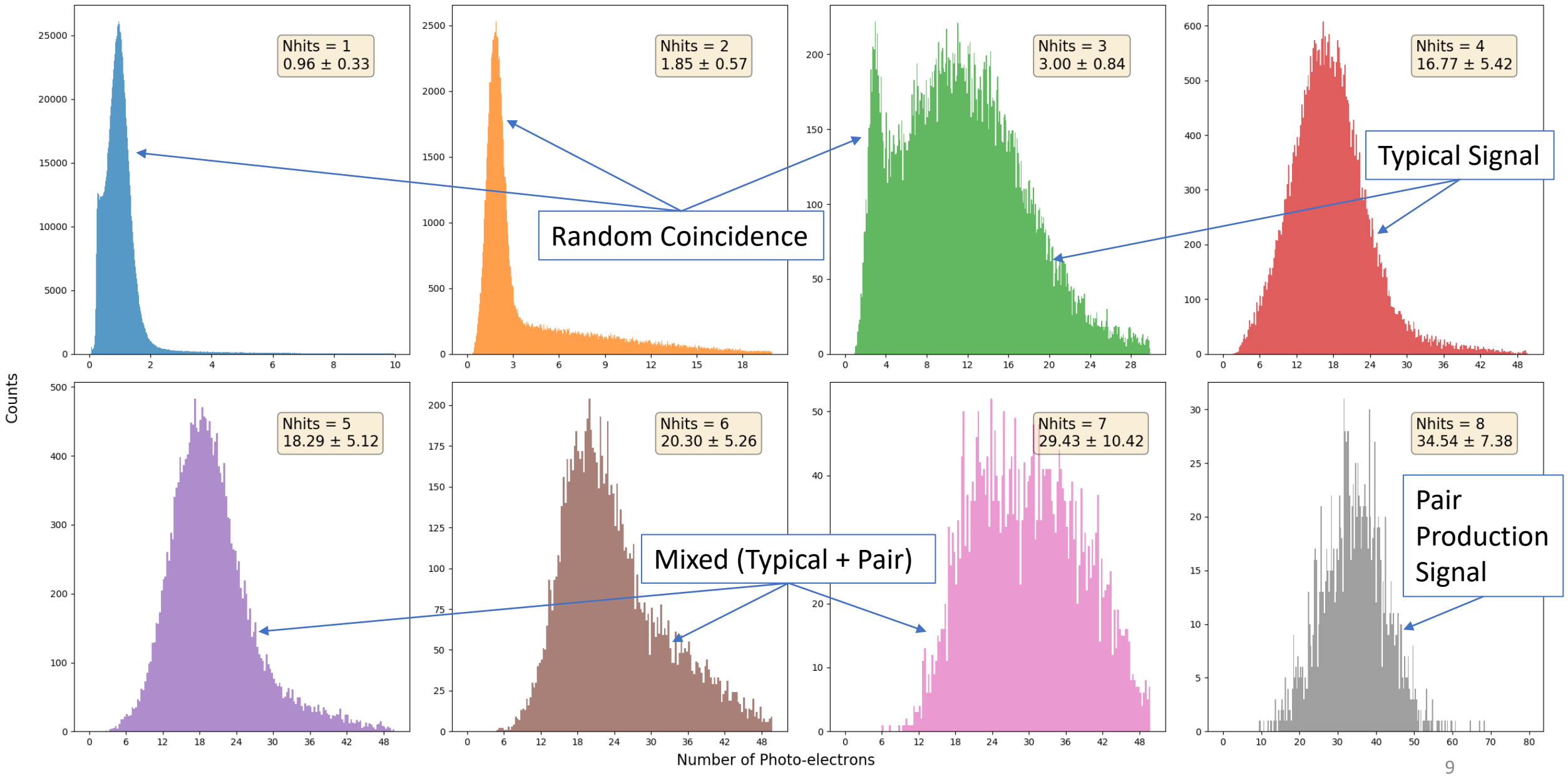


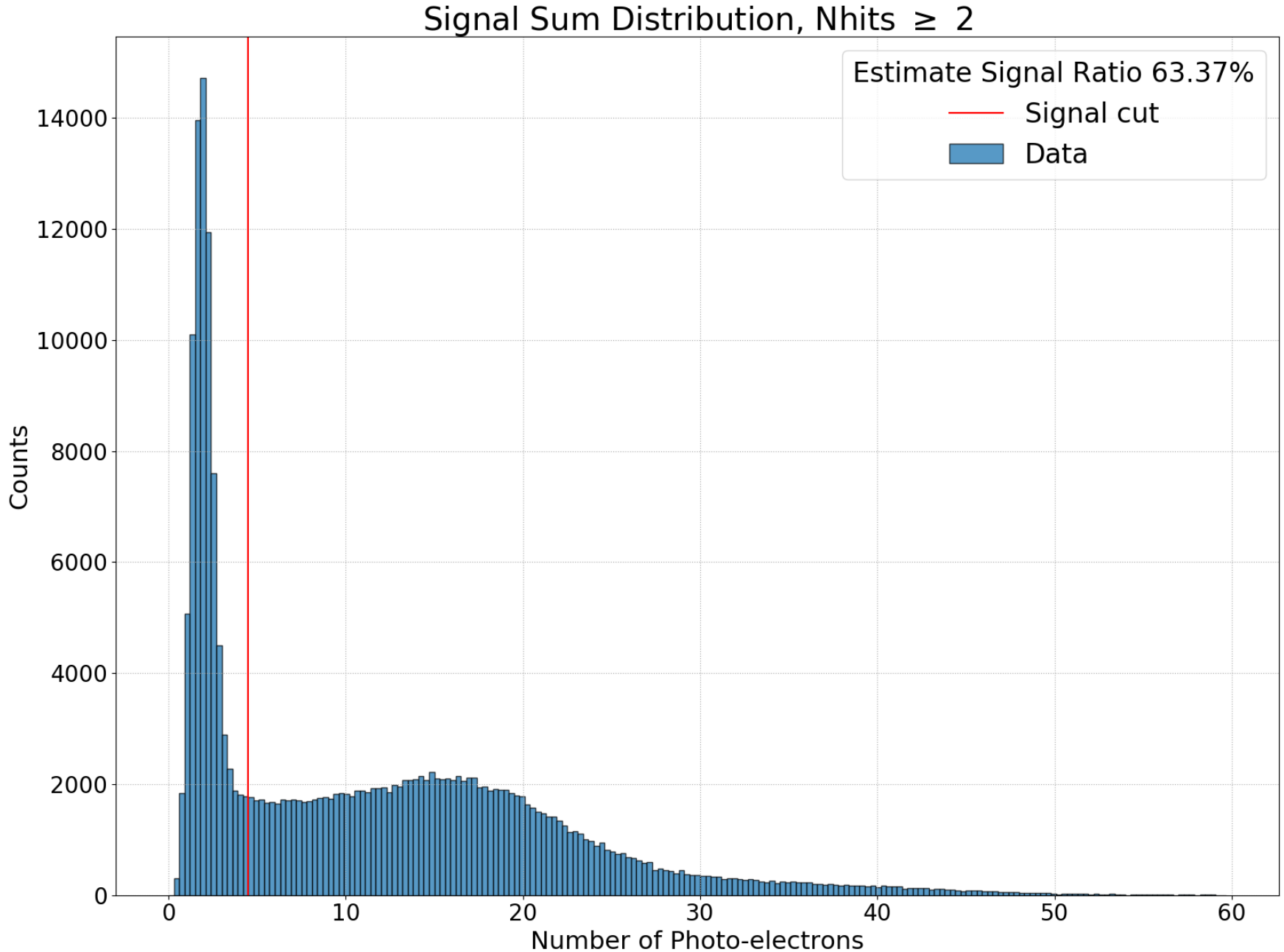


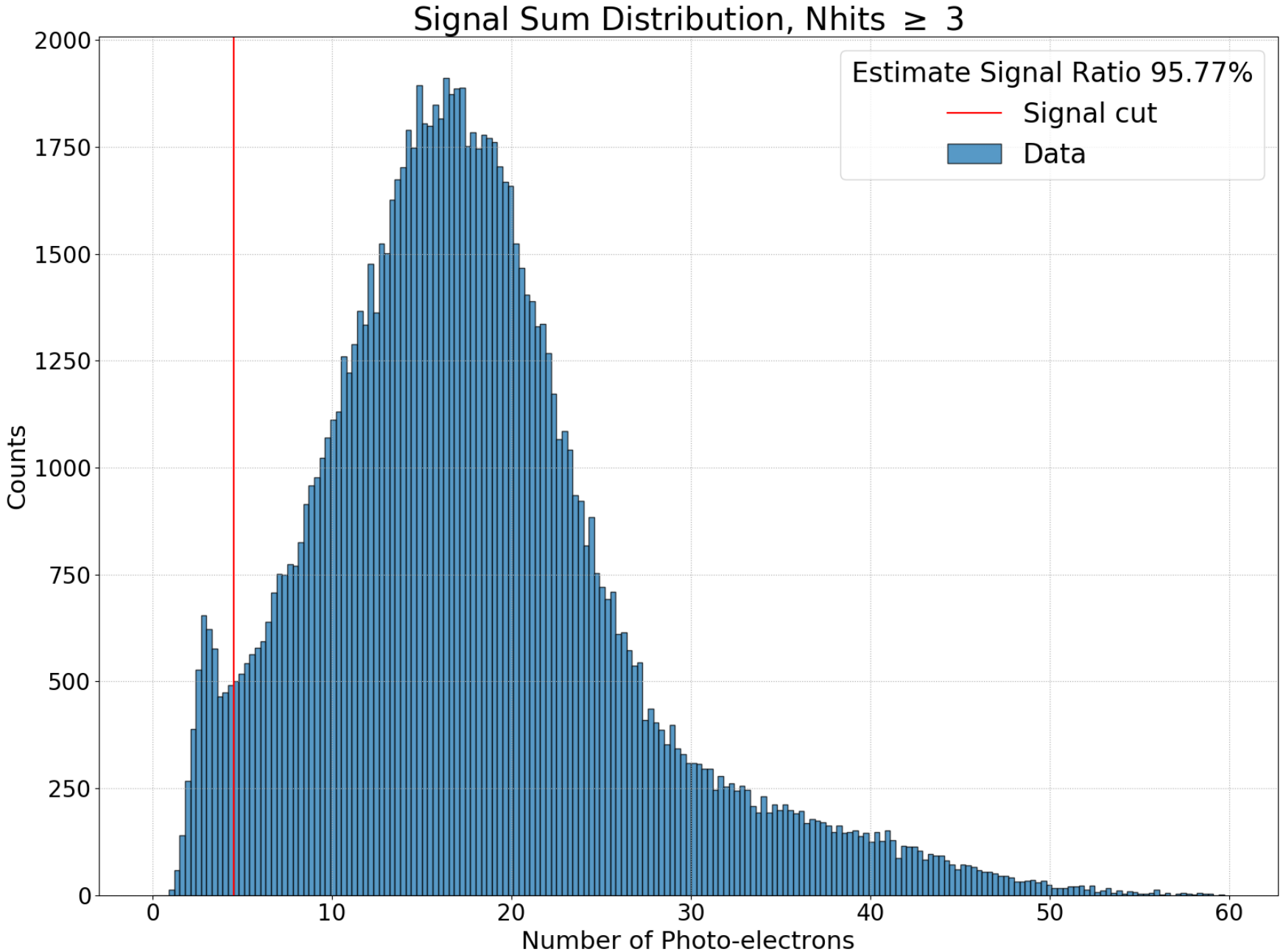
Signal Sums - Fits



Signal Sums - Fits

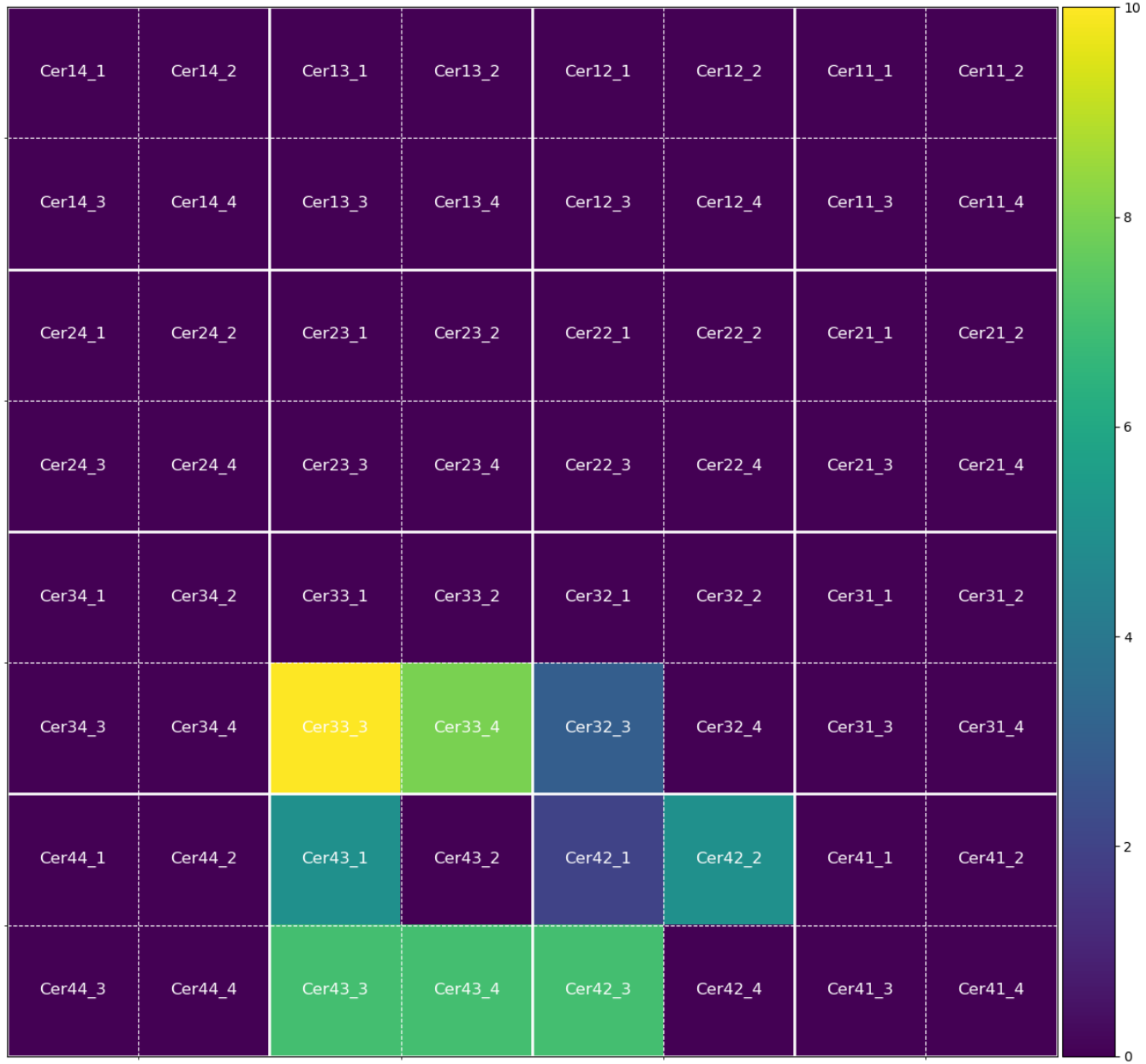



Signal Sum Distribution, Nhits ≥ 2
Estimate Signal Ratio 63.37%
Signal cut
Data
Counts
0
2000
4000
6000
8000
10000
12000
14000
0
10
20
30
40
50
60
Number of Photo-electrons


Signal Sum Distribution, Nhits ≥ 3
Estimate Signal Ratio 95.77%
Signal cut
Data
Counts
Number of Photo-electrons
0
250
500
750
1000
1250
1500
1750
2000
0
10
20
30
40
50
60

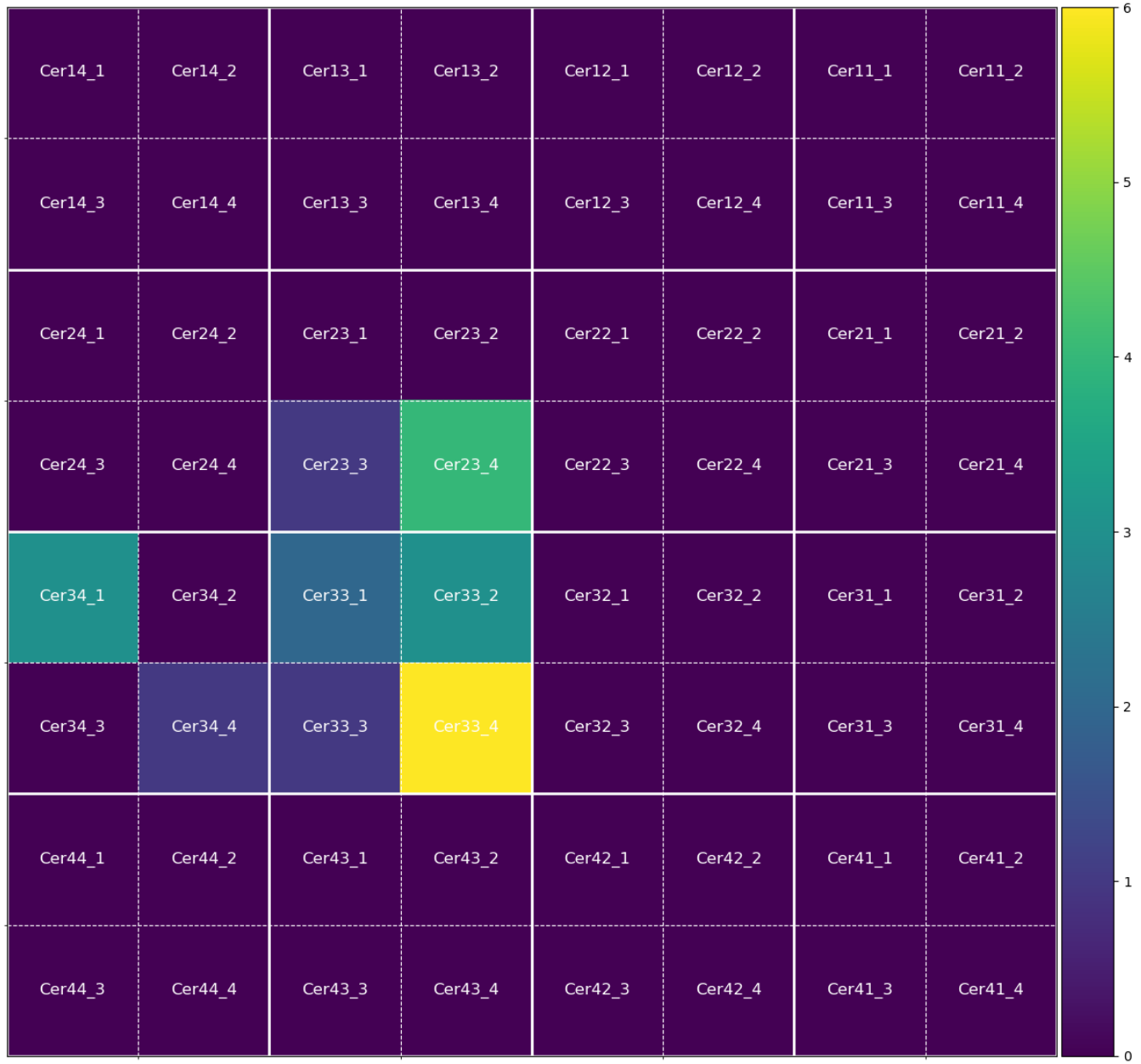
Ongoing pixel Analysis – Event Samples

Regular Signal



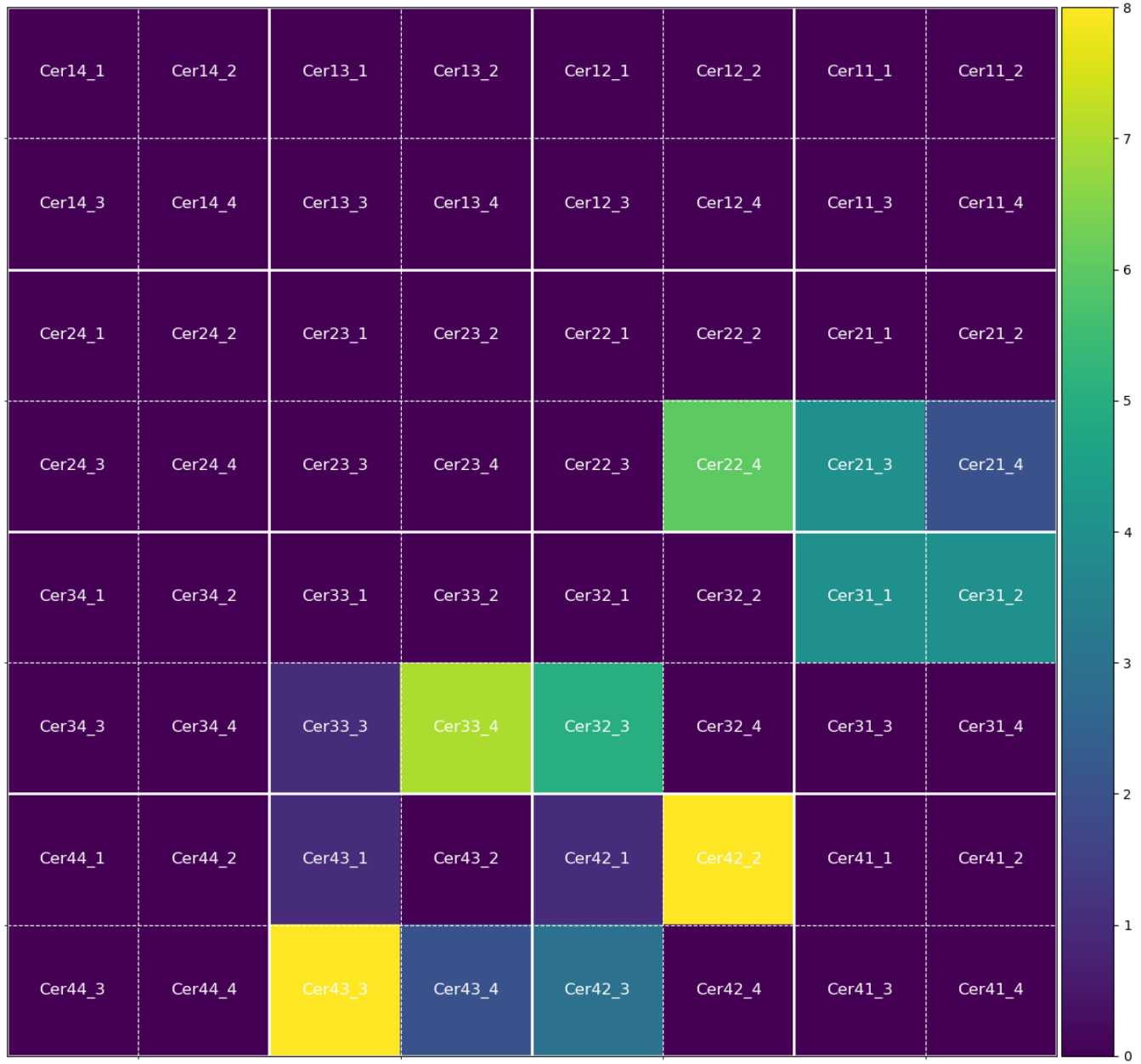
Ongoing pixel Analysis – Event Samples

Regular Signal Incomplete Ring



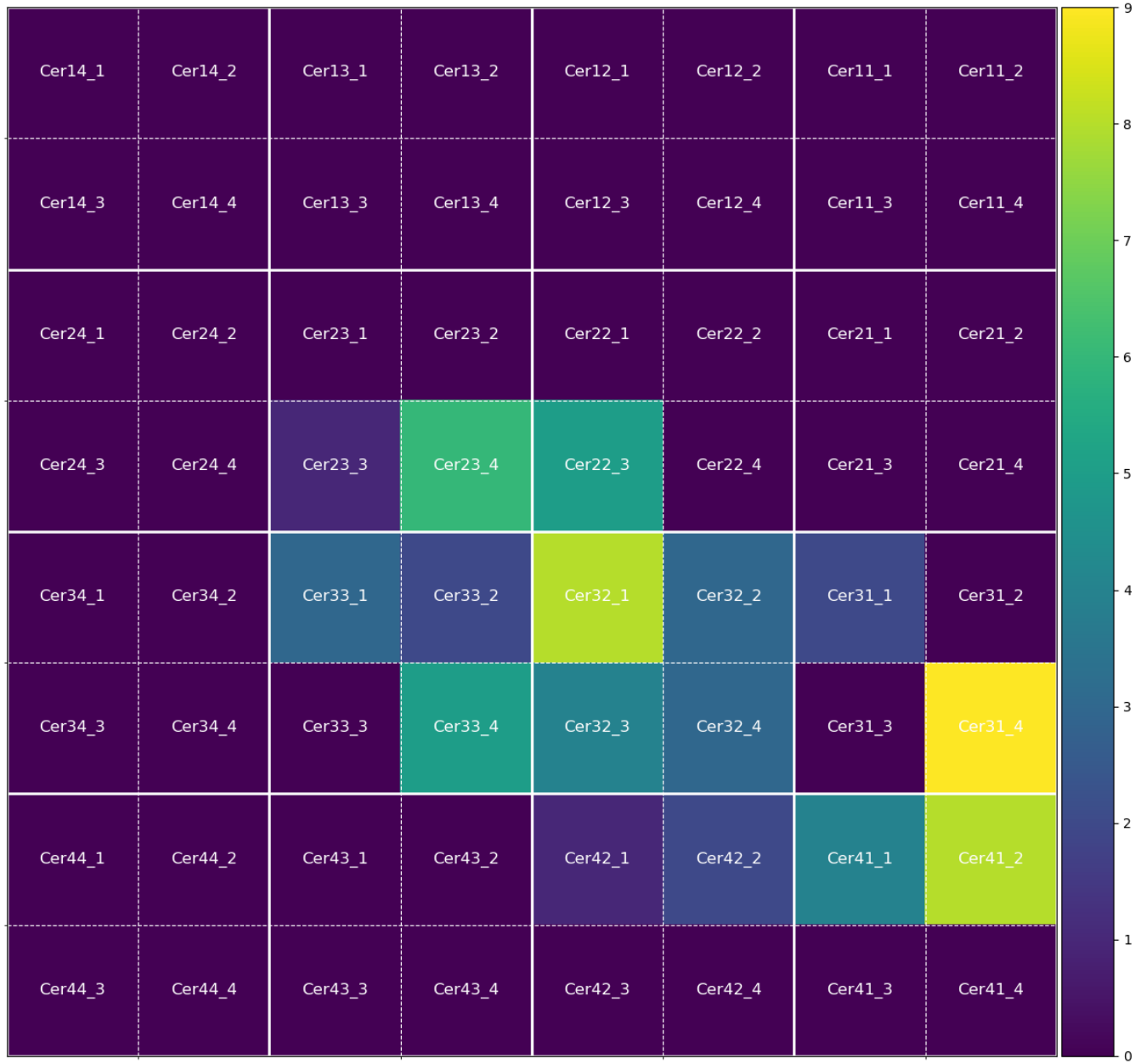
Ongoing pixel Analysis – Event Samples

Pair Production Signal



Ongoing pixel Analysis – Event Samples

Pair Production Signal

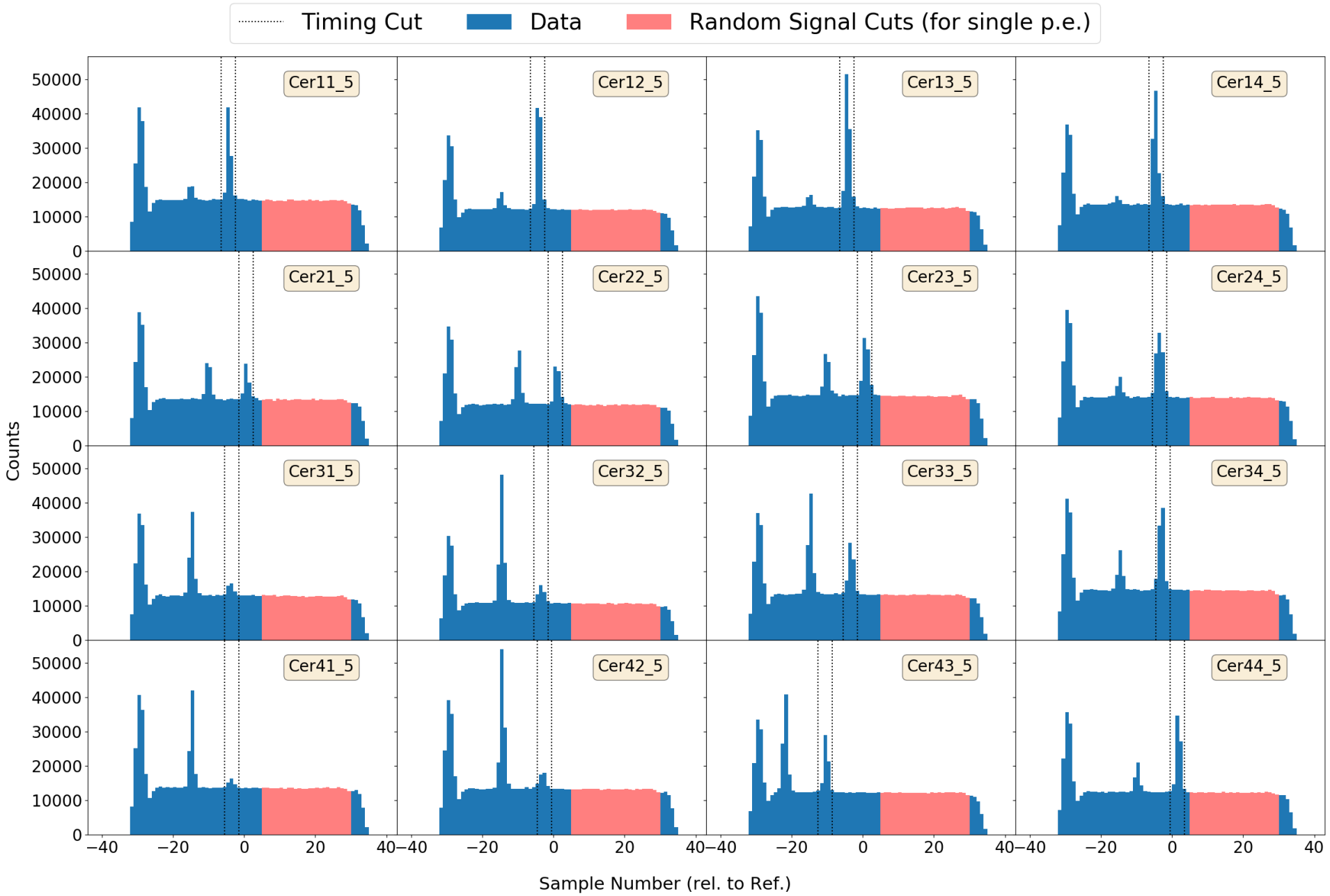


Summary

- Great data obtained from the test
  - Number of photo-electrons is about 17 for typical signals
  - Single photon rates is about 324 kHz/PMT
  - Expect MHz/PMT level from the upcoming test

- Form the triggers
  - Signal ratio is about 63% for Nhits ≥ 2
  - Ongoing study for pattern recognition with pixel signals
    - — Traditional algorithm or deep learning algorithm

Backup – the Other Peak



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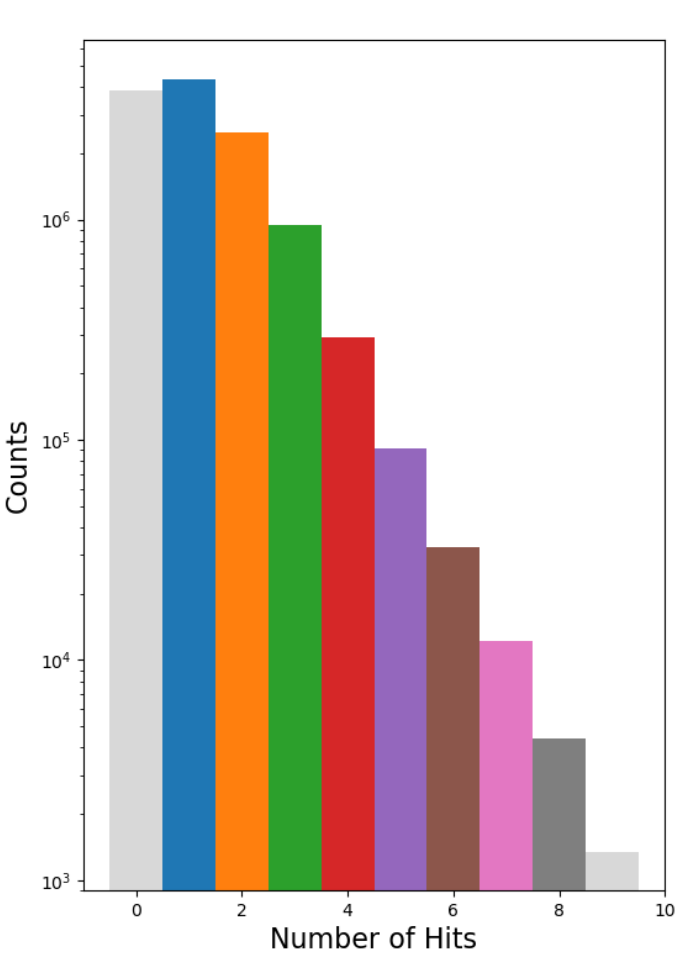

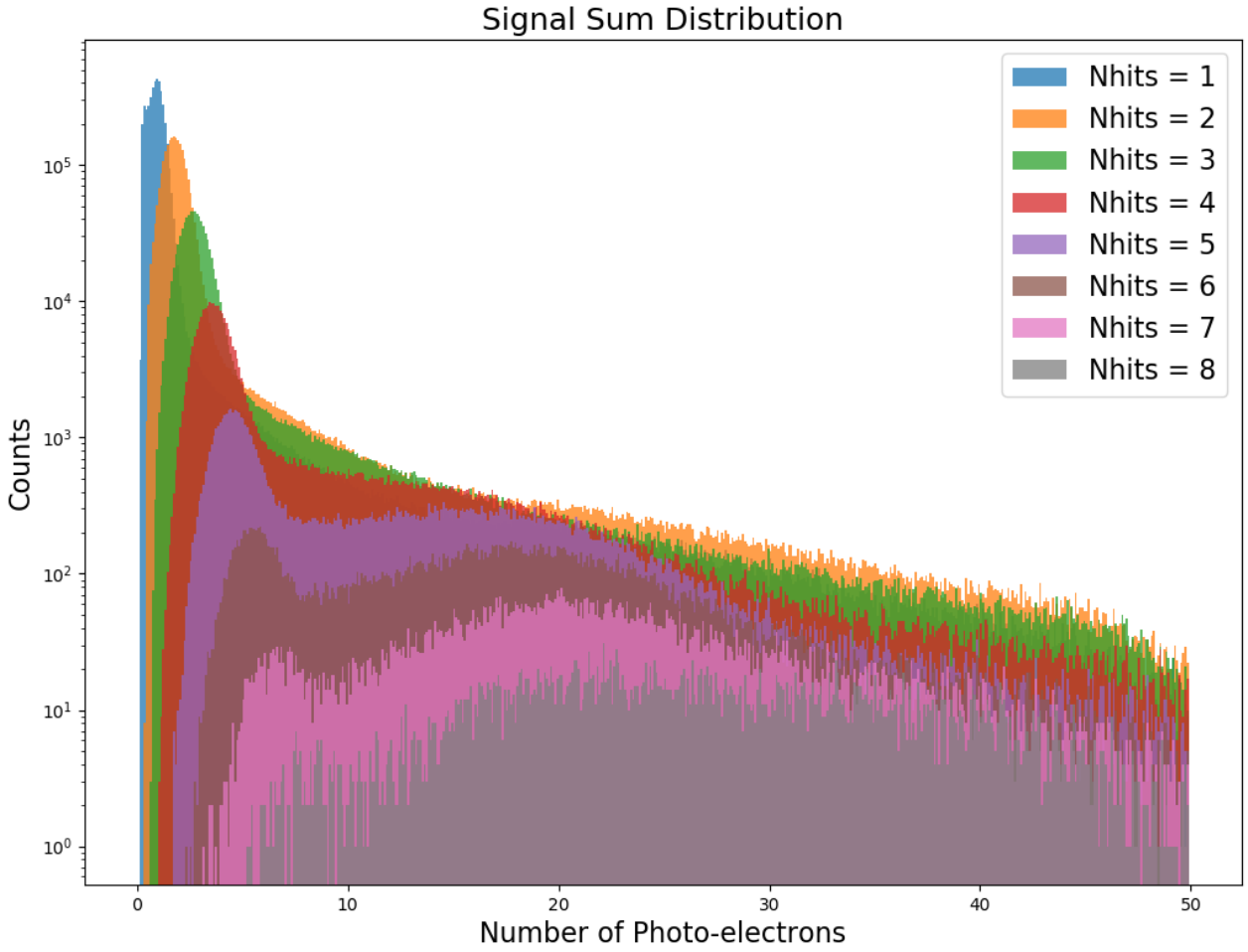

Backup – the Other Peak