

Silicone Gasket Emanation Report

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SD Mines

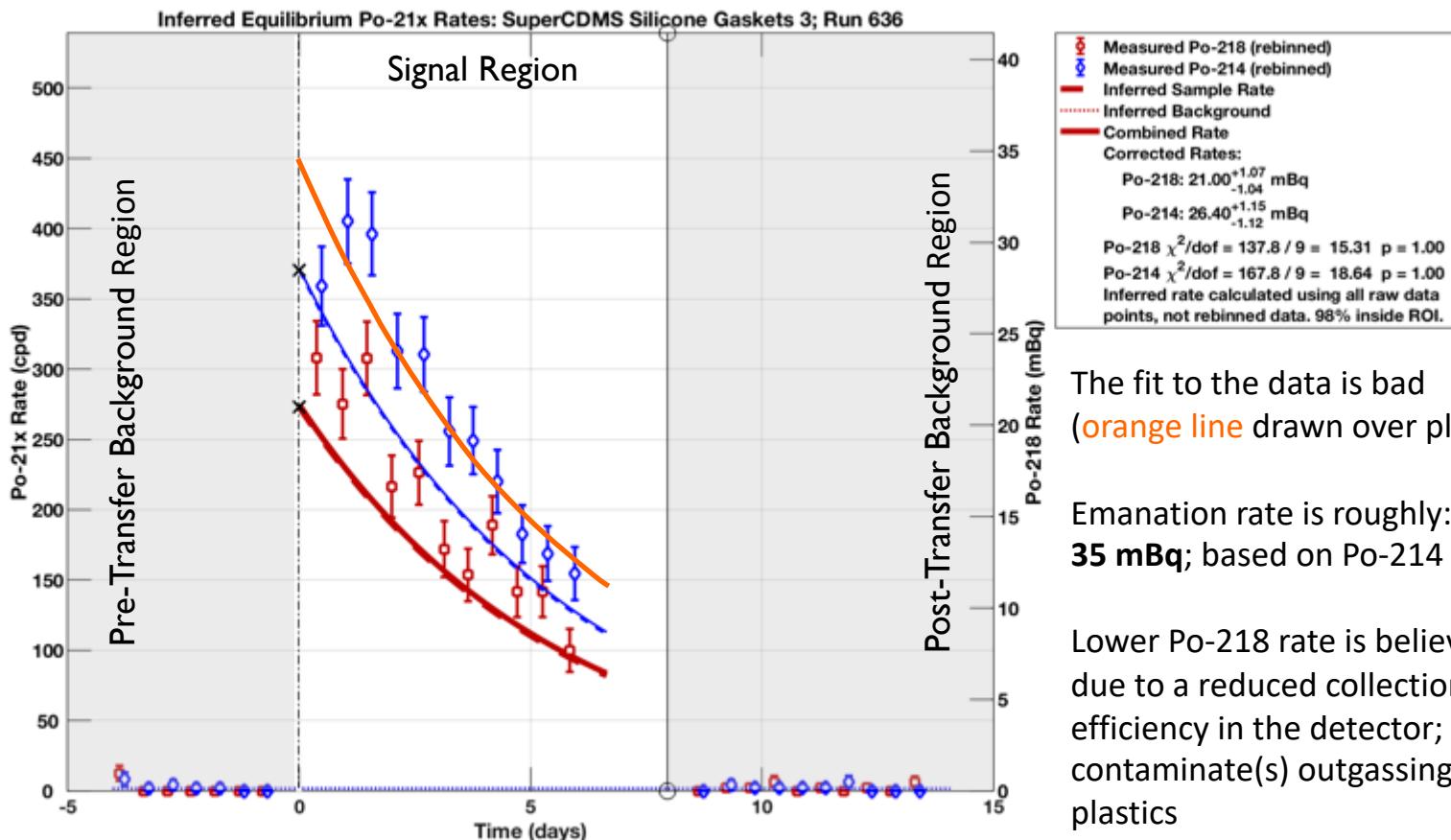


Ten 8-inch silicone tri-clamp gaskets inside the small emanation chamber at SD Mines

Summary from Last Time

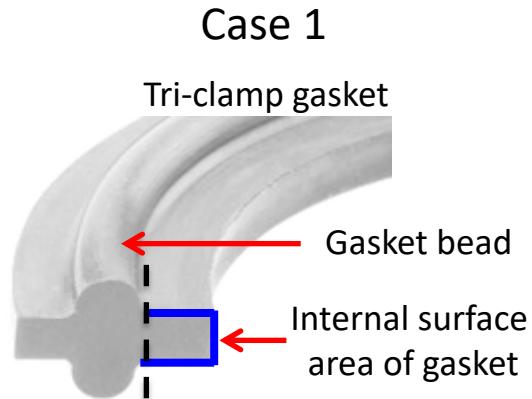
- The potential gasket material for tower storage/shipping containers
 - 8" tri-clamp silicone gaskets (link below)
<https://shop.distillery-equipment.com/products/silicone-tri-clamp-gasket-8>
- September to October 2020
Ten gaskets emanated three times inside small emanation chamber at SD Mines
 - Emanation rate of 35 mBq for all ten gaskets --> 3.5 mBq/gasket
 - On the high end, but within expected range for silicone and PTFE gaskets
- This result implies Pb-210 plate-out onto detectors (model dependent):
 - Conservative estimate: **6.0 nBq/cm² per year**
 - More realistic estimate: **0.8 nBq/cm² per year**

Run 636, Ten Silicone Gaskets #3: 10/2/2020– 10/13/2020

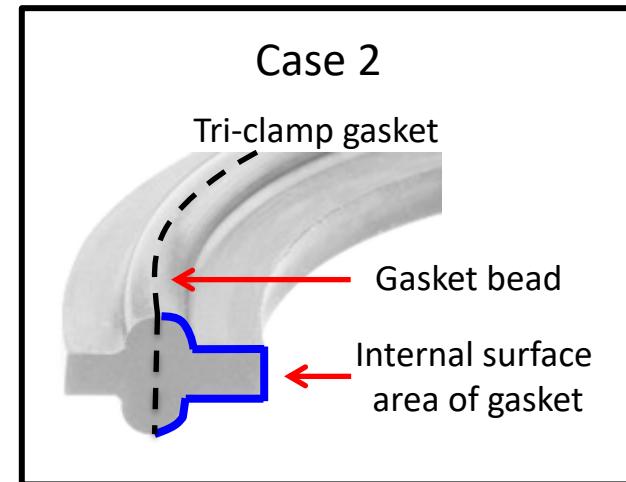


Gasket dimensions and surface area exposed to container inner volume

- Measured (w/ calipers) the dimensions of a single silicone gasket
- **The surface area of a single gasket is approximately 180 cm²**
 - Width of gasket measured to be 0.400" and agrees with the difference of inner and outer diameter specs given by vendor (7.78" and 8.57" respectively)
- Unclear on how to define “the surface area internal to the bead is exposed to the container inner volume”

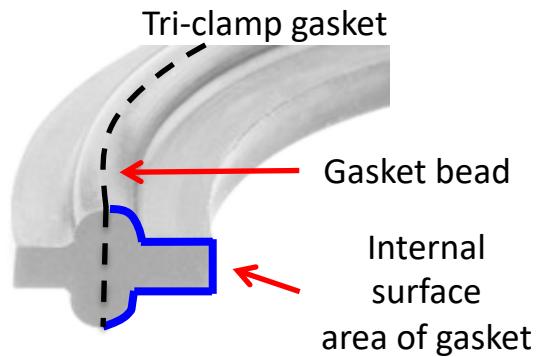


or



Summary of ten gasket emanation

- Emanation rate (conservative): **3.5 mBq per gasket**
- Surface area of a single gasket is measured to be 181.3 cm²
- Emanation of each gasket: **193.1 mBq/m²**
- Each gasket has (conservative estimate) 86.0 cm² exposed to the inner volume of the tower shipping/storage container
 - Assumes that all the surface area internal to the bead is exposed to the container inner volume
 - See note by Ray:
<https://confluence.slac.stanford.edu/display/CDMS/Tower+Storage+Container+-+Radon+Emanation+Note>
- Expected equilibrium levels of radon inside container: **1.7 mBq**



Summary from Last Time

- December 2020:
 - Four gaskets, at random, sent to SLAC
 - Confirm the gaskets fit the tower storage container --> They do!!
 - One gasket used for Tower 1 shipping container
- Additional assays performed at SD Mines on the six remaining gaskets
 - Check if the 35 mBq emanation rate is dominated by one or more "hot" gaskets
 - Important to have gaskets with low emanation rate for tower containers 2, 3, & 4
- General plan:
 1. Screen single gasket to check for emanation rate variability
 - If rate is low, send to SLAC for Tower 2 storage container
 2. Screen two more of the gaskets at SD Mines
 - Pre-screen for use with Towers 3 & 4 storage containers
 - Ship to SLAC if emanation rate is acceptably low
 3. Assay three remaining gaskets

Current Emanation Summary

- February to April 2021:

Single gasket emanated four times inside small emanation chamber at SD Mines

Po-218	Po-214	Po-218 & Po-214	Rate/gasket
$5.9^{+0.3}_{-0.3}$ mBq	$5.4^{+0.3}_{-0.3}$ mBq	$5.7^{+0.2}_{-0.2}$ mBq	5.7 mBq

- May to June 2021:

Two gaskets emanated twice inside the small emanation chamber at SD Mines

Po-218	Po-214	Po-218 & Po-214	Rate/gasket
$8.0^{+0.5}_{-0.5}$ mBq	$8.0^{+0.5}_{-0.4}$ mBq	$8.0^{+0.3}_{-0.3}$ mBq	4.0 mBq

- July to September 2021:

Three gaskets emanated four times inside the small emanation chamber at SD Mines

Po-218	Po-214	Po-218 & Po-214	Rate/gasket
$8.0^{+0.4}_{-0.4}$ mBq	$10.0^{+0.4}_{-0.4}$ mBq	$9.1^{+0.3}_{-0.3}$ mBq	3.0 mBq

Current Emanation Summary

- The measurements of the batch of three are somewhat inconsistent
 - Currently emanating this batch of gaskets again
- If we take these emanation rates as is:
 - Four gaskets sent to SLAC account for approx. 12.2 mBq of the total 35 mBq
 - Average rate of each gasket: 3.1 mBq/gasket

Batch	Measured rate	Rate/gasket	Rate/m ²
Ten gaskets	35 mBq	3.5 mBq	193. 1 mBq/m²
Single gasket	$5.7^{+0.2}_{-0.2}$ mBq	5.7 mBq	314. 4 mBq/m²
Two gaskets	$8.0^{+0.3}_{-0.3}$ mBq	4.0 mBq	220. 6 mBq/m²
Three gaskets	$9.1^{+0.3}_{-0.3}$ mBq	3.0 mBq	165. 5 mBq/m²
Four gaskets (SLAC)	12.2 mBq	3.1 mBq	171. 1 mBq/m²

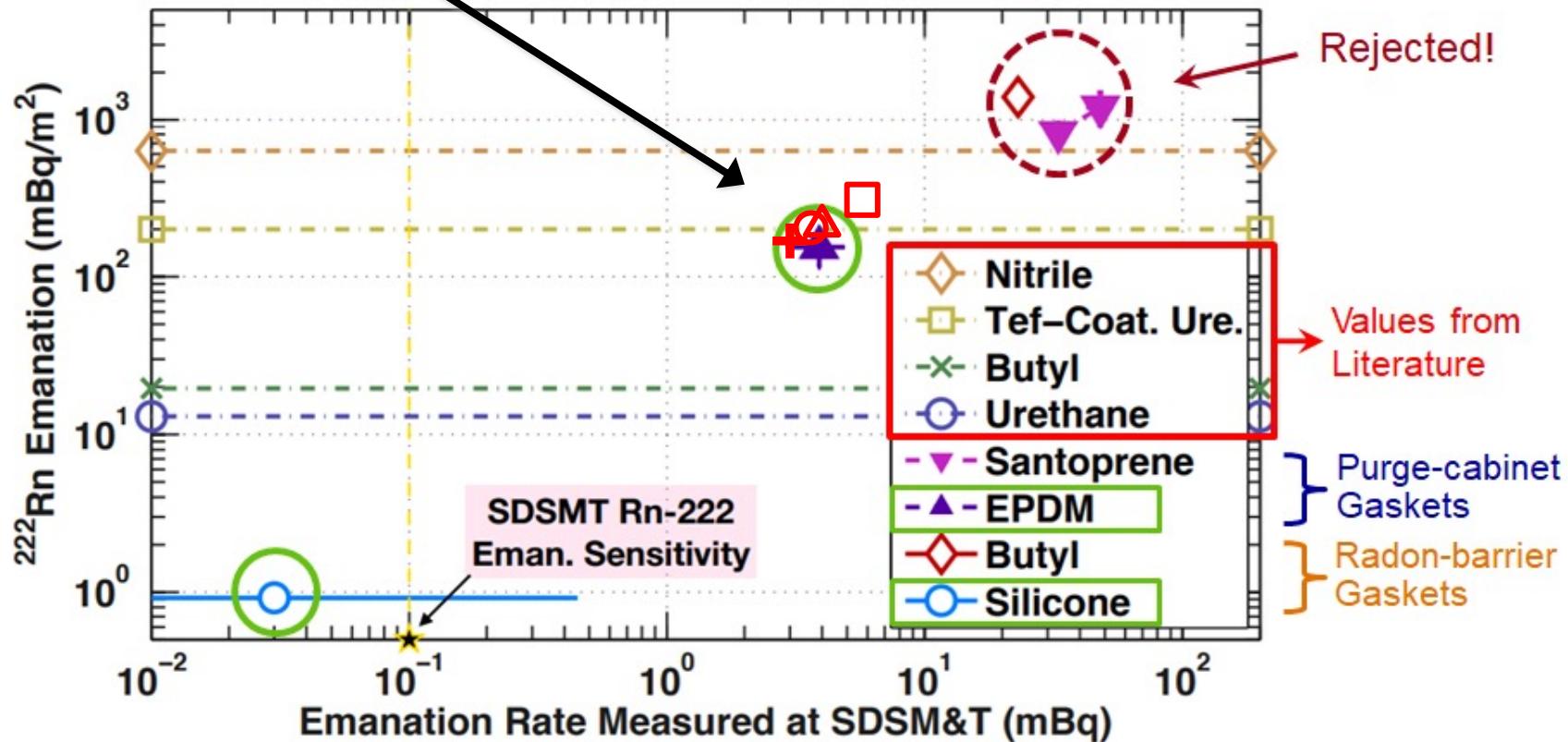
8" Silicone Tri-clamp gasket

Red circle: Ten gasket emanation (average)

Red square: Single gasket emanation

Red triangle: Two gasket emanation (average)

Red cross: Three gasket emanation (average)



Estimated Background from Pb-210

Model 1 - Plate-out height

- Approximate radon concentration inside storage container based on internal volume and radon level
- Estimate the amount of Pb-210 plate-out an effective plate-out height
 - Estimated internal volume: ~0.017 m³
 - Assume 1 cm plate-out height (conservative overestimate)

Pb-210 plate-out = Concentration x (ratio of exposed gasket) / (0.017 m³) x (0.01 m) x (1 year/32 years) x (1 m²/10⁴ cm²) x (10⁶ nBq/1 mBq)

- 3.5 mBq/gasket = 3.1 nBq/cm² per year of storage
- 5.7 mBq/gasket = 5.0 nBq/cm² per year of storage
- 4.0 mBq/gasket = 3.5 nBq/cm² per year of storage
- 3.0 mBq/gasket = 2.6 nBq/cm² per year of storage

Estimated Background from Pb-210

Model 2 - Plate-out fraction

- Estimate fractional surface area represented by the detector surfaces
- Estimate Pb-210 plate-out assuming all the radon decays plate-out equally across available surfaces.
- See Ray's note for the table of estimated surface areas
 - Total surface area: 0.89 m²
 - Detector surface area: 0.026 m²
 - Each detector represents a fractional area of ~3%

Pb-210 plate-out = Concentration x (ratio of exposed gasket) / (260 cm²) x (0.03) x (1 year/32 years) x (10⁶ nBq/1 mBq)

- 3.5 mBq/gasket = 6.0 nBq/cm² per year of storage
- 5.7 mBq/gasket = 9.7 nBq/cm² per year of storage
- 4.0 mBq/gasket = 6.8 nBq/cm² per year of storage
- 3.0 mBq/gasket = 5.1 nBq/cm² per year of storage

Estimated Background from Pb-210

Model 3 - Plate out Fraction (better)

- Combine the approaches of model 1 and model 2
- See Ray's note for the details

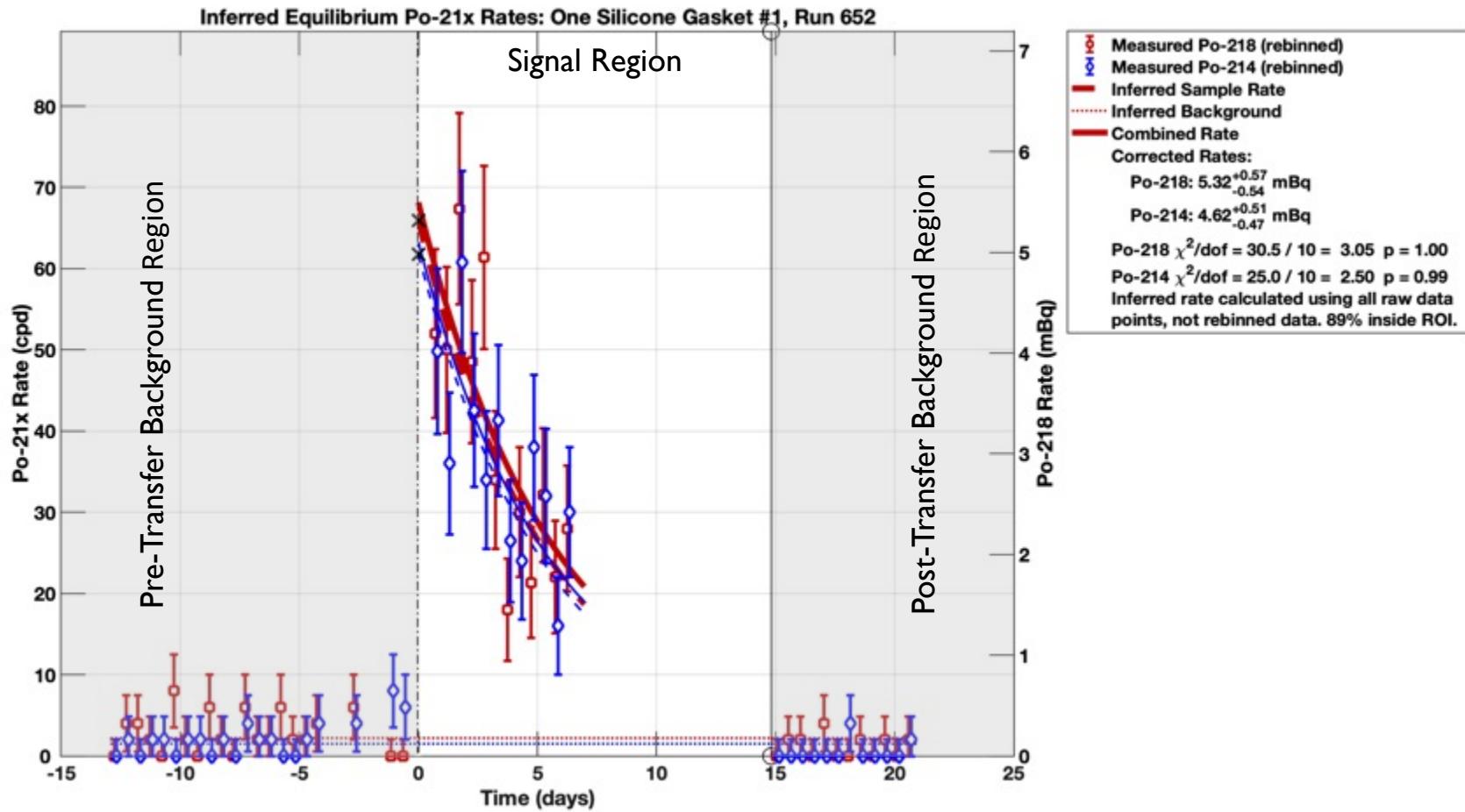
Pb-210 plate-out = Concentration x (ratio of exposed gasket) / (260 cm²) x (0.039) x (0.10) x (1 year/32 years) x (10⁶ nBq/1 mBq)

- 3.5 mBq = 0.8 nBq/cm² per year of storage
- 5.7 mBq = 1.3 nBq/cm² per year of storage
- 4.0 mBq = 0.9 nBq/cm² per year of storage
- 3.0 mBq = 0.7 nBq/cm² per year of storage

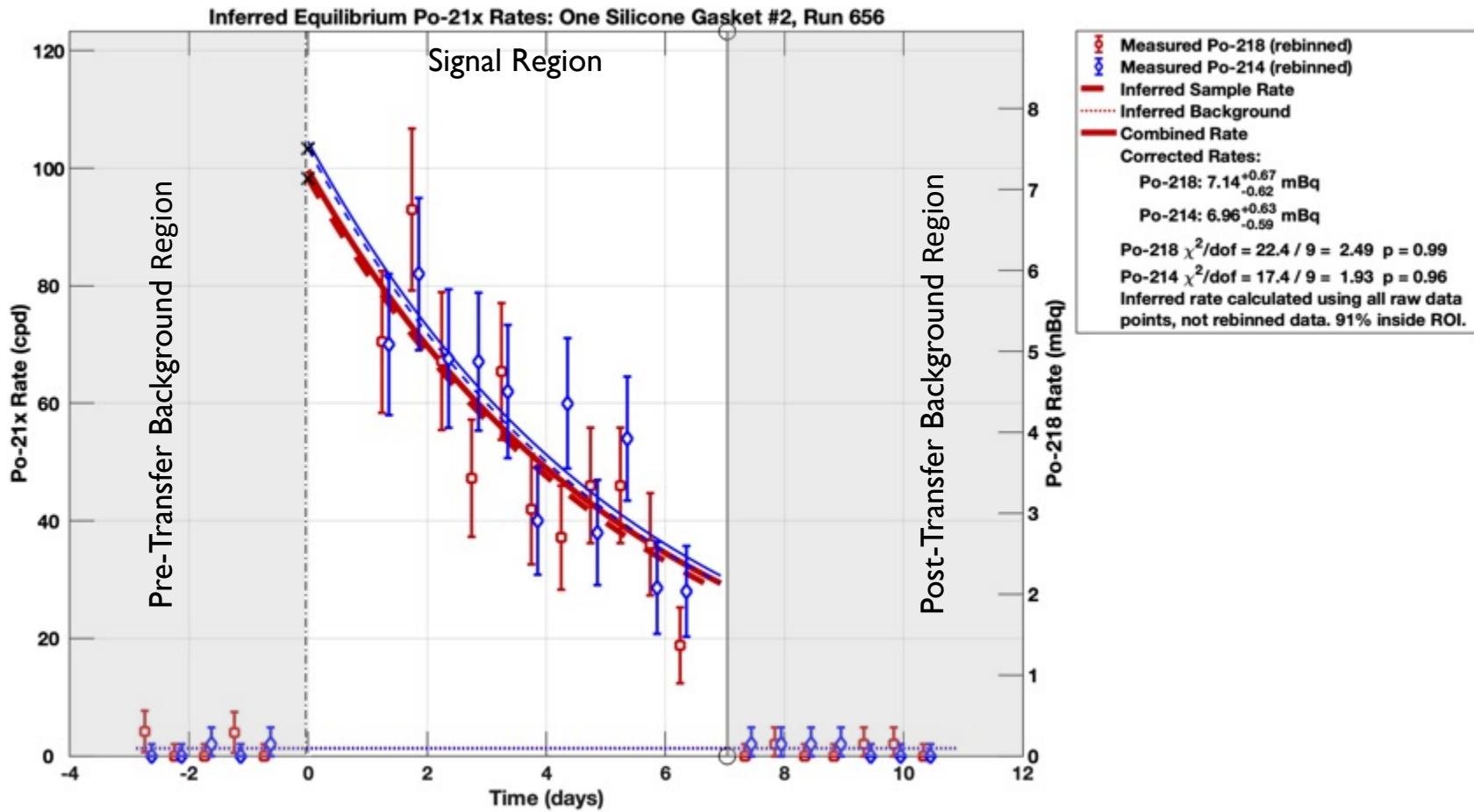
Estimated Background from Pb-210

Pb-210 plate-out	Model 1	Model 2	Model 3
3.5 mBq/gasket	3.1 nBq/cm ²	6.0 nBq/cm ²	0.8 nBq/cm ²
5.7 mBq/gasket	5.0 nBq/cm ²	9.7 nBq/cm ²	1.3 nBq/cm ²
4.0 mBq/gasket	3.5 nBq/cm ²	6.8 nBq/cm ²	0.9 nBq/cm ²
3.0 mBq/gasket	2.6 nBq/cm ²	5.1 nBq/cm ²	0.7 nBq/cm ²

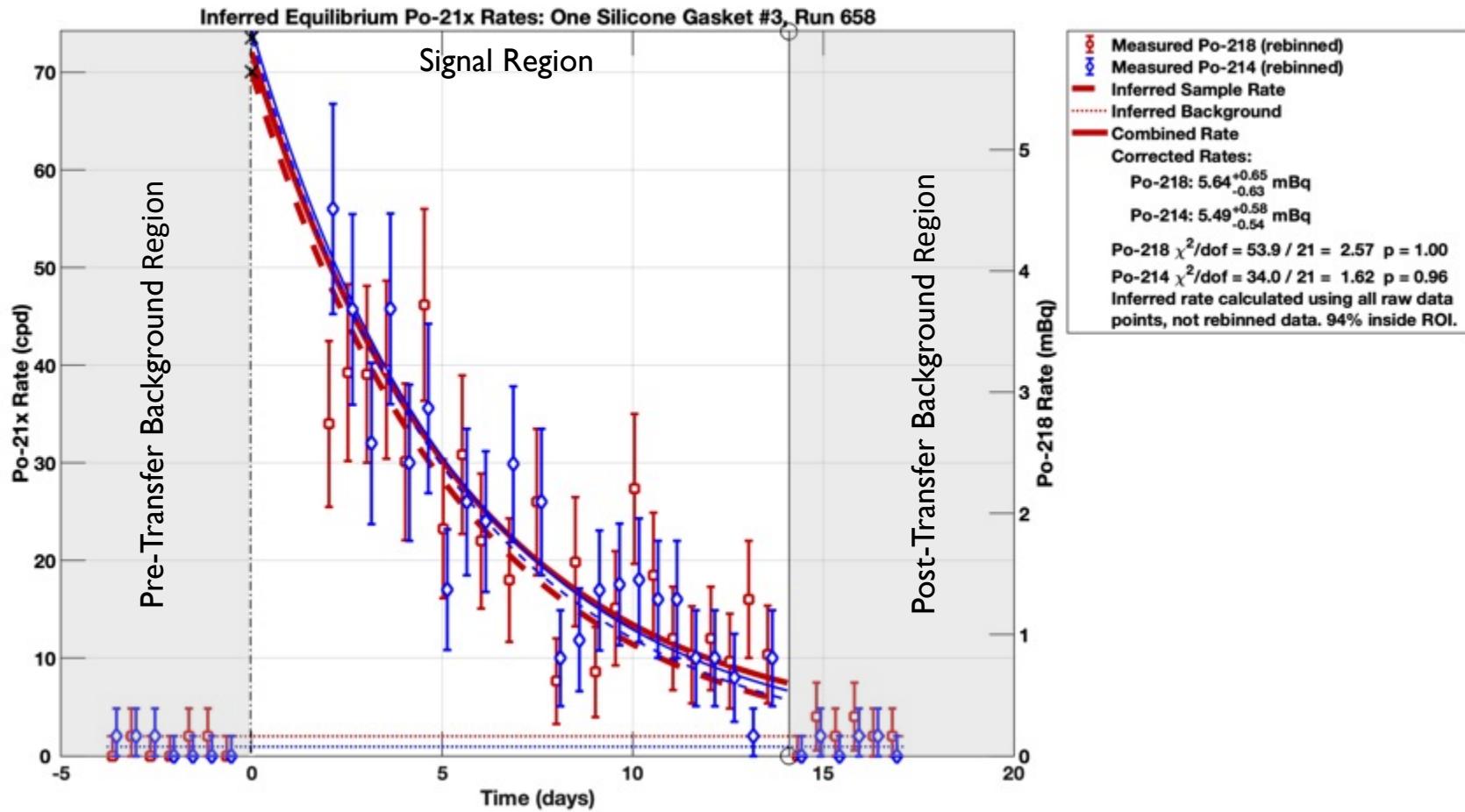
Run 652, Single Silicone Gasket #1: 2/10/2021 – 2/23/2021



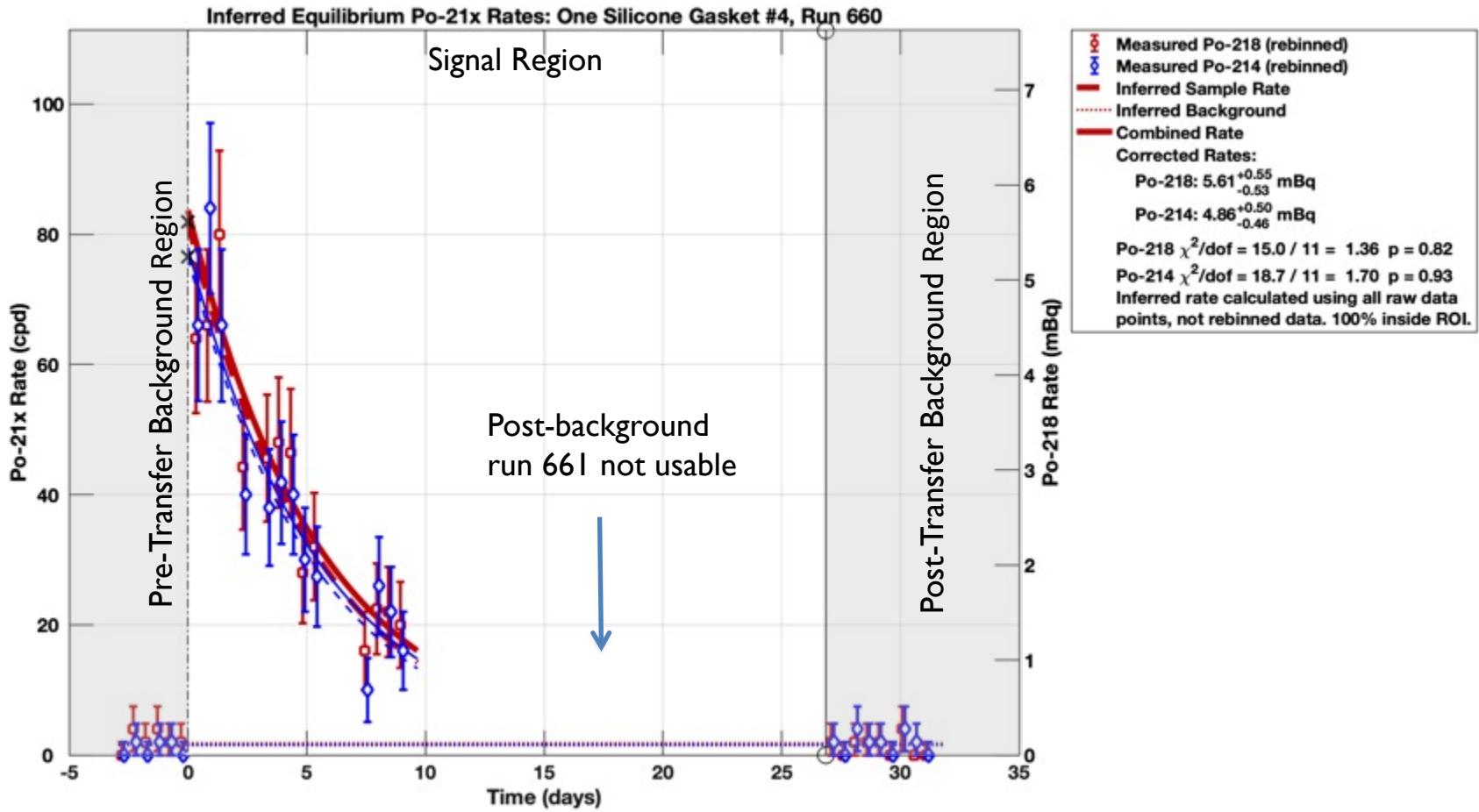
Run 656, Single Silicone Gasket #2: 2/23/2021 – 3/19/2021



Run 658, Single Silicone Gasket #3: 3/19/2021 – 3/30/2021



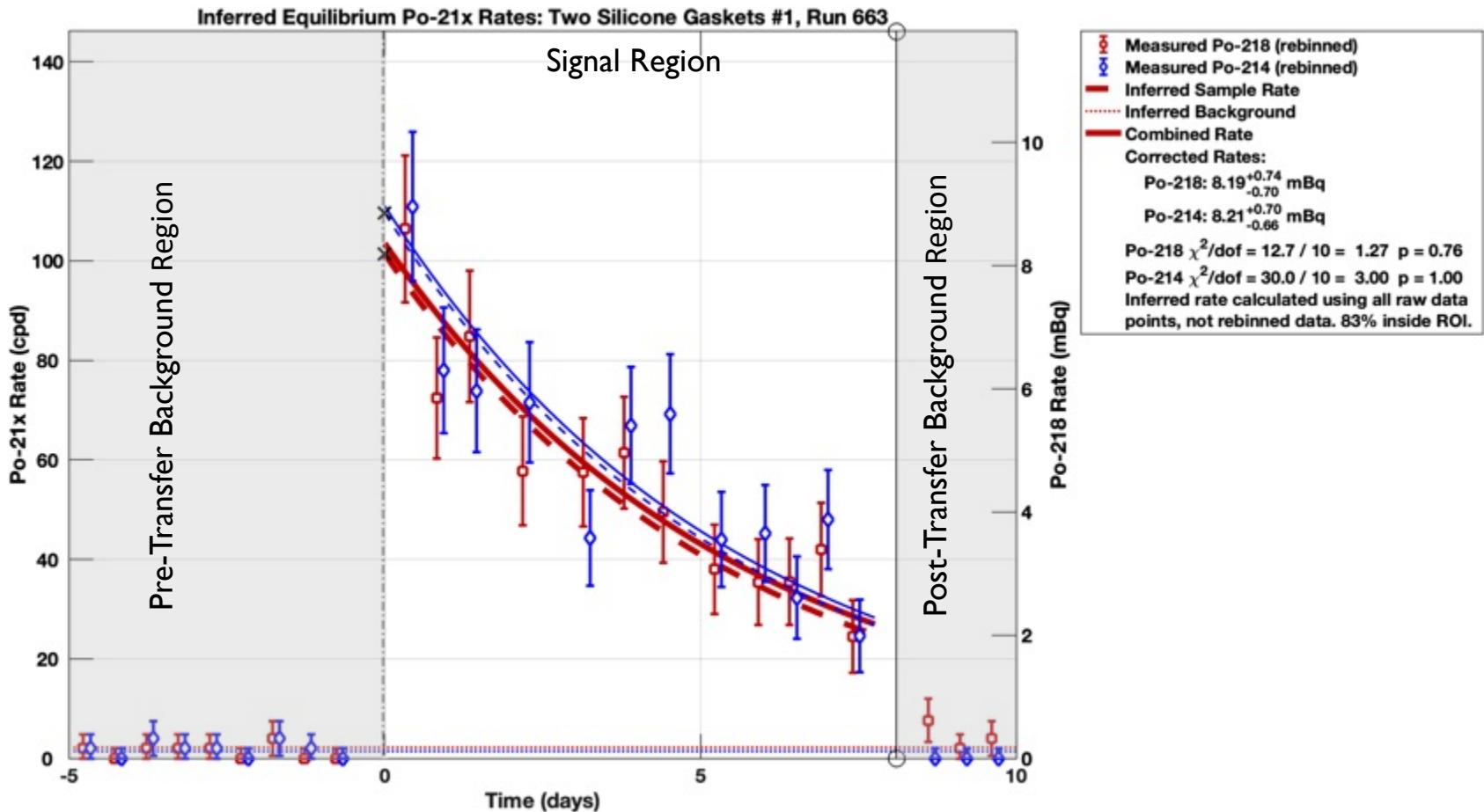
Run 660, Single Silicone Gasket #4: 3/30/2021 – 4/16/2021



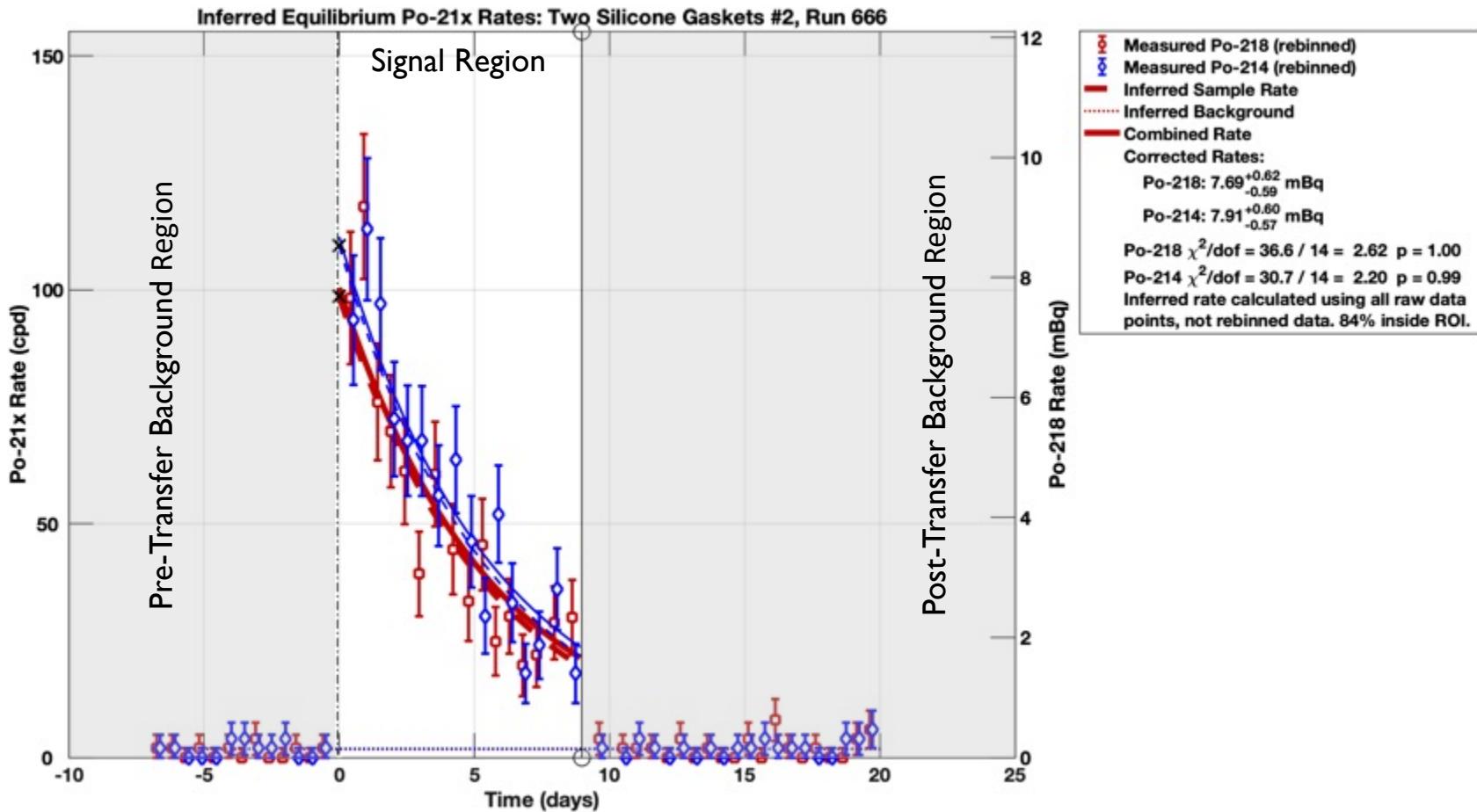
Single Silicone Gasket: Summary of Results

Sample	Po-218	Po-214	Po-218 & Po-214
Run 653	$5.3^{+0.6}_{-0.5}$ mBq	$4.6^{+0.5}_{-0.5}$ mBq	$5.0^{+0.4}_{-0.4}$ mBq
Run 656	$7.1^{+0.7}_{-0.6}$ mBq	$7.0^{+0.6}_{-0.6}$ mBq	$7.1^{+0.5}_{-0.4}$ mBq
Run 658	$5.6^{+0.7}_{-0.6}$ mBq	$5.5^{+0.6}_{-0.5}$ mBq	$5.6^{+0.4}_{-0.4}$ mBq
Run 660	$5.6^{+0.6}_{-0.5}$ mBq	$4.9^{+0.5}_{-0.5}$ mBq	$5.2^{+0.4}_{-0.4}$ mBq
Combined	$5.9^{+0.3}_{-0.3}$ mBq	$5.4^{+0.3}_{-0.3}$ mBq	$5.7^{+0.2}_{-0.2}$ mBq

Run 663, Two Silicone Gaskets #1: 4/29/2021 – 5/18/2021



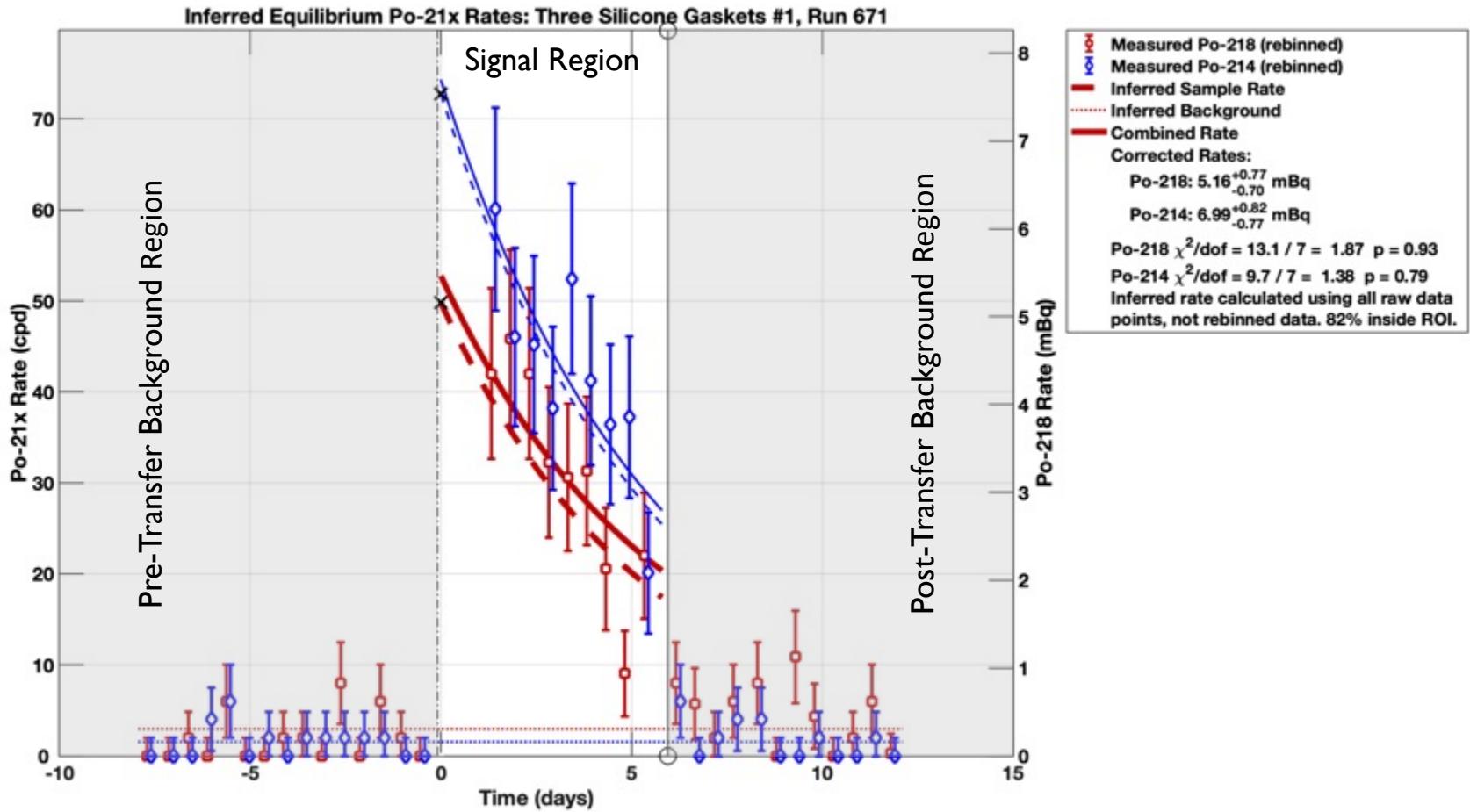
Run 666, Two Silicone Gaskets #2: 5/18/2021 – 6/15/2021



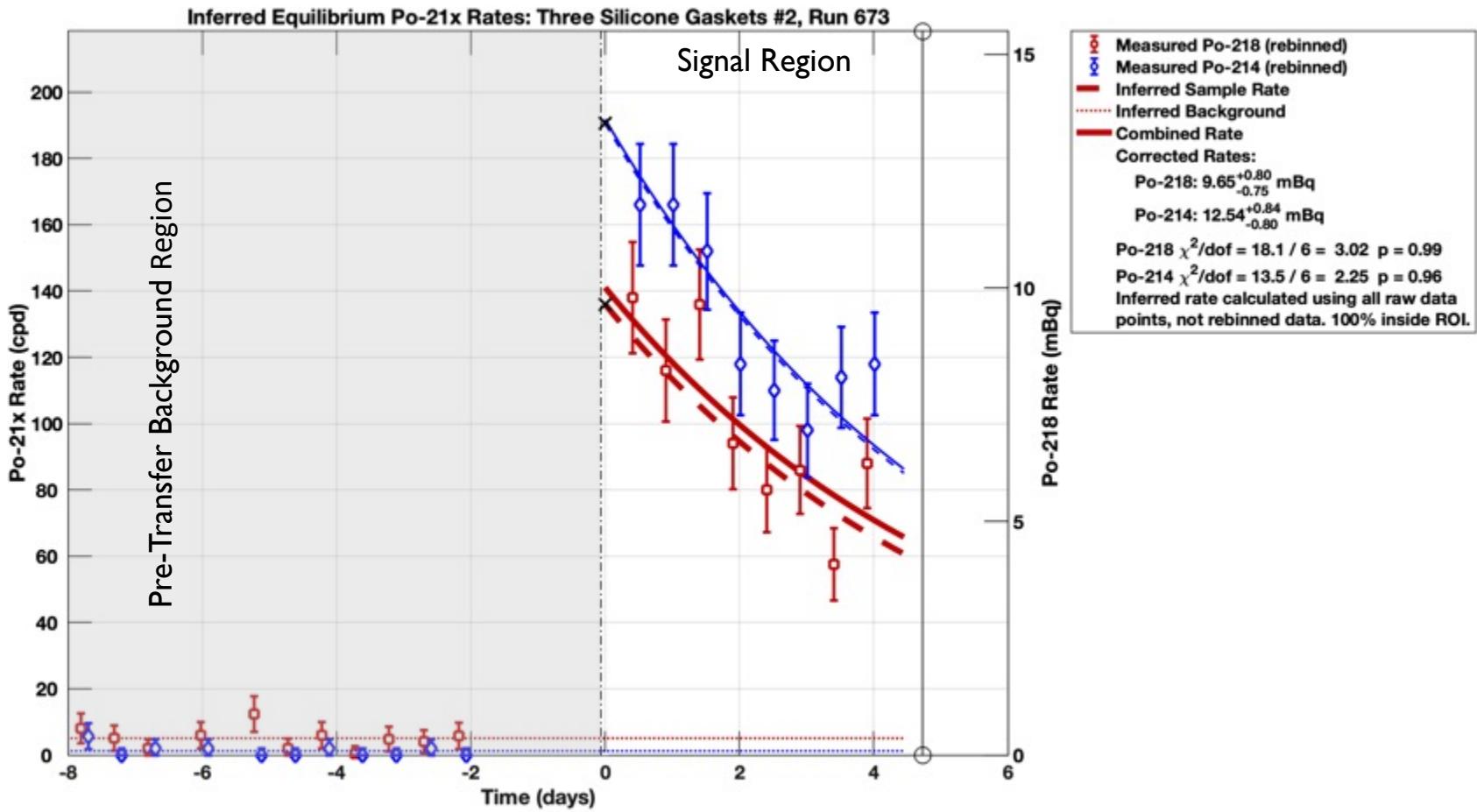
Two Silicone Gaskets: Summary of Results

Sample	Po-218	Po-214	Po-218 & Po-214
Run 663	$8.2^{+0.7}_{-0.7}$ mBq	$8.2^{+0.7}_{-0.7}$ mBq	$8.2^{+0.5}_{-0.5}$ mBq
Run 666	$7.7^{+0.6}_{-0.6}$ mBq	$7.9^{+0.6}_{-0.6}$ mBq	$7.8^{+0.4}_{-0.4}$ mBq
Combined	$8.0^{+0.5}_{-0.5}$ mBq	$8.0^{+0.5}_{-0.4}$ mBq	$8.0^{+0.3}_{-0.3}$ mBq

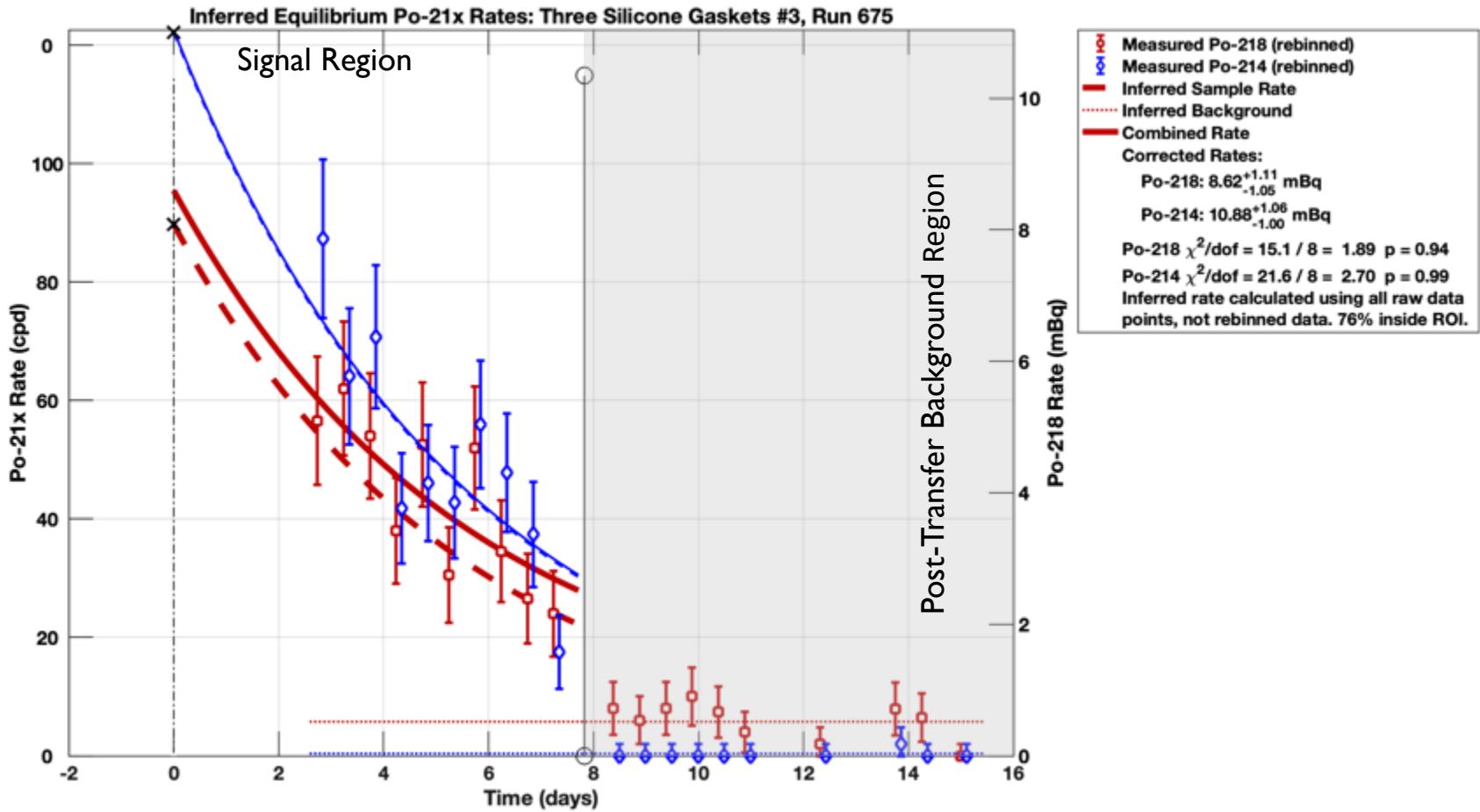
Run 671, Three Silicone Gaskets #1: 7/29/2021 – 8/06/2021



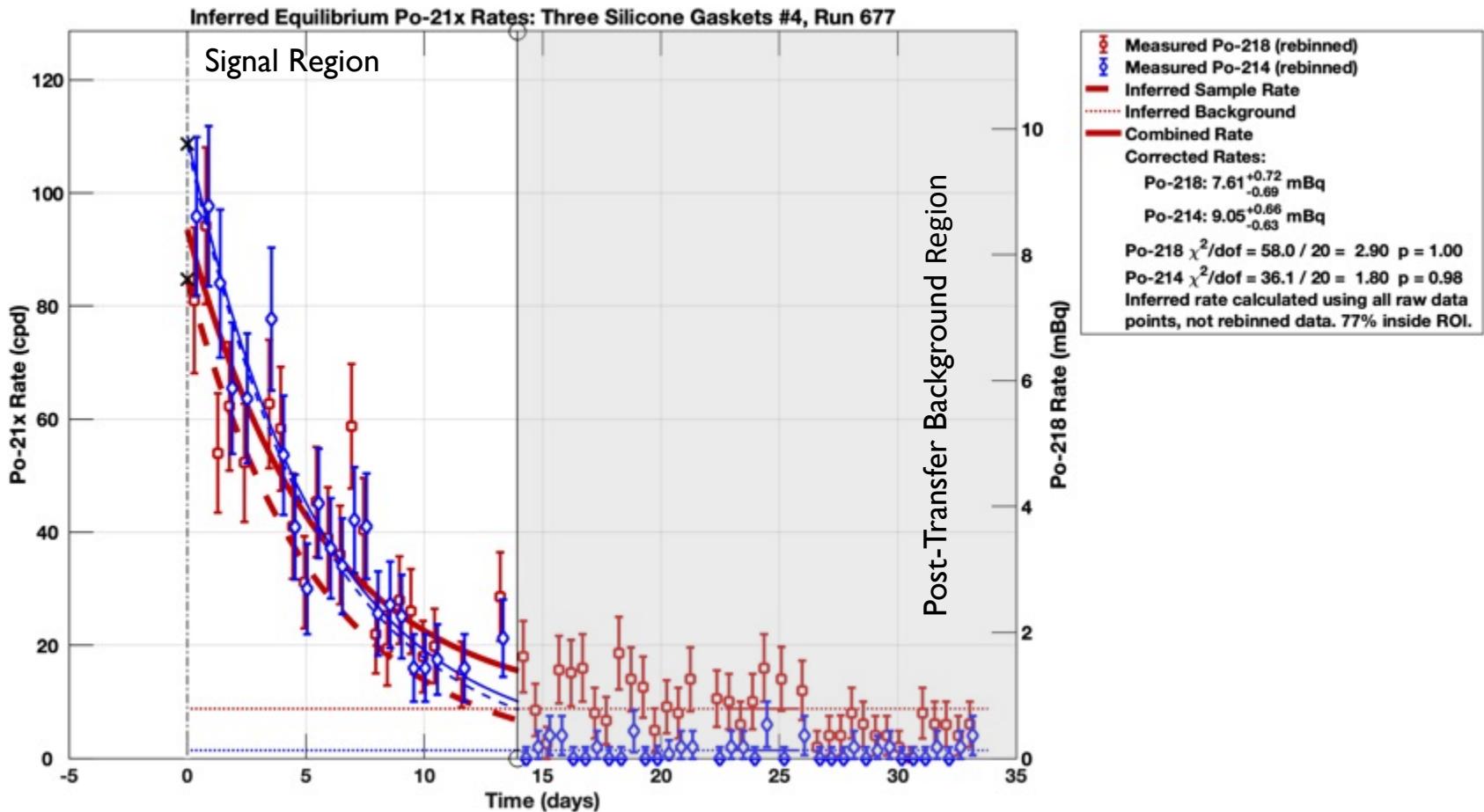
Run 673, Three Silicone Gaskets #2: 8/06/2021 – 8/20/2021



Run 675, Three Silicone Gaskets #3: 8/20/2021 – 9/01/2021



Run 677, Three Silicone Gaskets #4: 9/01/2021 – 9/17/2021



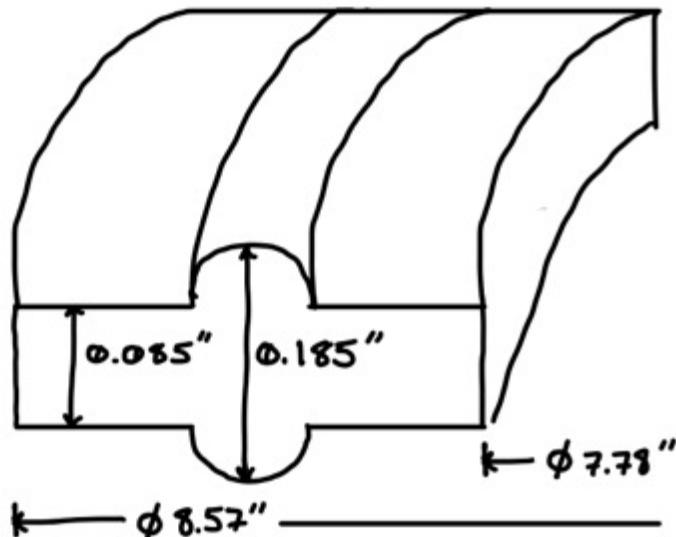
Three Silicone Gaskets: Summary of Results

Sample Rate	Po-218	Po-214	Po-218 & Po-214
Run 671	$5.1^{+0.8}_{-0.7}$ mBq	$7.0^{+0.8}_{-0.8}$ mBq	$6.1^{+0.6}_{-0.5}$ mBq
Run 673	$9.7^{+0.8}_{-0.8}$ mBq	$12.5^{+0.8}_{-0.8}$ mBq	$11.2^{+0.6}_{-0.6}$ mBq
Run 675	$8.6^{+1.1}_{-1.1}$ mBq	$10.9^{+1.1}_{-1.0}$ mBq	$9.8^{+0.8}_{-0.7}$ mBq
Run 677	$7.6^{+0.7}_{-0.7}$ mBq	$9.1^{+0.7}_{-0.6}$ mBq	$8.4^{+0.5}_{-0.5}$ mBq
Combined	$8.0^{+0.4}_{-0.4}$ mBq	$10.0^{+0.4}_{-0.4}$ mBq	$9.1^{+0.3}_{-0.3}$ mBq

Gasket Surface Area

SuperCDMS Silicone Gasket

8" Silicone tri-clamp gasket, for SuperCDMS shipping/storage container



Gasket width (specs)

$$\frac{8.57" - 7.78"}{2} = \frac{0.79"}{2} \approx \frac{0.8"}{2}$$

Measured width = 0.400"

Height, gland to gland: 0.185"

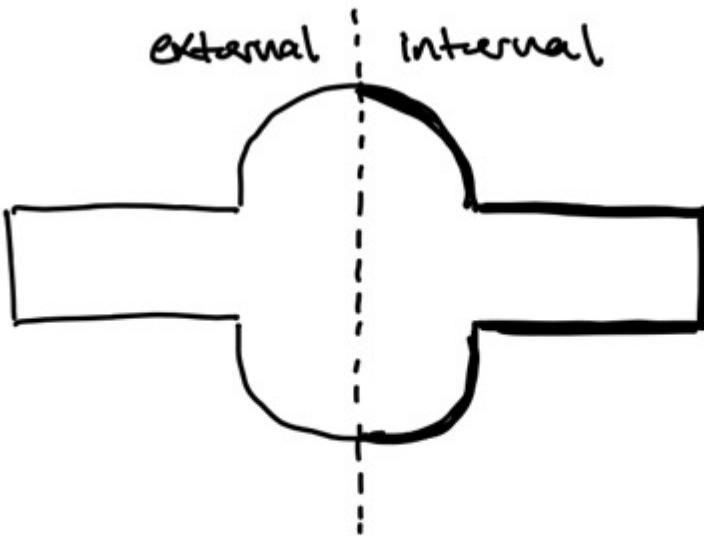
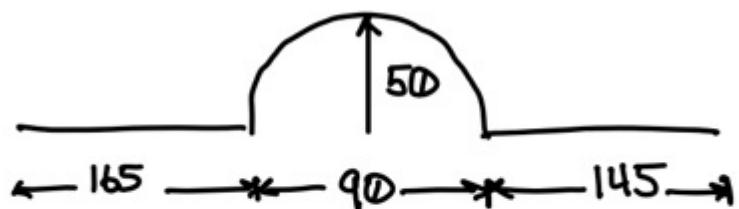
Height, w/o glands: 0.085"

top/bottom look symmetric

Gland height: 0.050"

Assume that all of the surface area internal to the bead center is exposed to the shipping container inner volume.

Gasket dimensions in $\frac{1}{1000}$ "



Gasket Sections

① Toroid of $R = \textcircled{1.050}$ "

$$\text{Centered @ } R = 7.78"/2 + 0.145" + 0.045" = 4.08"$$

② Ring of height $h = 0.085"$

$$\text{Centered @ } R = 7.78"/2 = 3.89"$$

③ Ring of height $h = 0.085"$

$$\text{Centered @ } R = 8.57"/2 = 4.285"$$

④ Ring of inner radius $R_1 = 3.89"$

$$\text{Ring of outer radius } R_2 = 3.89" + 0.145" = 4.035"$$

⑤ Ring of inner radius $R_1 = 3.89" + 0.145 + 0.09 = 4.125"$

$$\text{Ring of outer radius } R_2 = 4.285"$$

Gasket Surface Area

$$A_1 = 4\pi^2 R r = 4\pi^2 (4.08") (0.050") (2.54 \text{ cm/in})^2 = 51.959 \text{ cm}^2$$

$$A_2 = 2\pi R h = 2\pi (3.89") (0.085") (2.54 \text{ cm/in})^2 = 13.403 \text{ cm}^2$$

$$A_3 = 2\pi R h = 2\pi (4.285") (0.085") (2.54 \text{ cm/in})^2 = 14.764 \text{ cm}^2$$

$$A_4 = \pi(R_2^2 - R_1^2) = \pi[(4.035")^2 - (3.89")^2] (2.54 \text{ cm/in})^2 = 23.291 \text{ cm}^2$$

$$A_5 = \pi(R_2^2 - R_1^2) = \pi[(4.285")^2 - (4.125")^2] (2.54 \text{ cm/in})^2 = 27.273 \text{ cm}^2$$

Internal Surface Area:

$$\frac{1}{2} A_1 + A_2 + 2A_4 = 86.0 \text{ cm}^2$$

Fraction of gasket exposed
to inner volume: 0.474

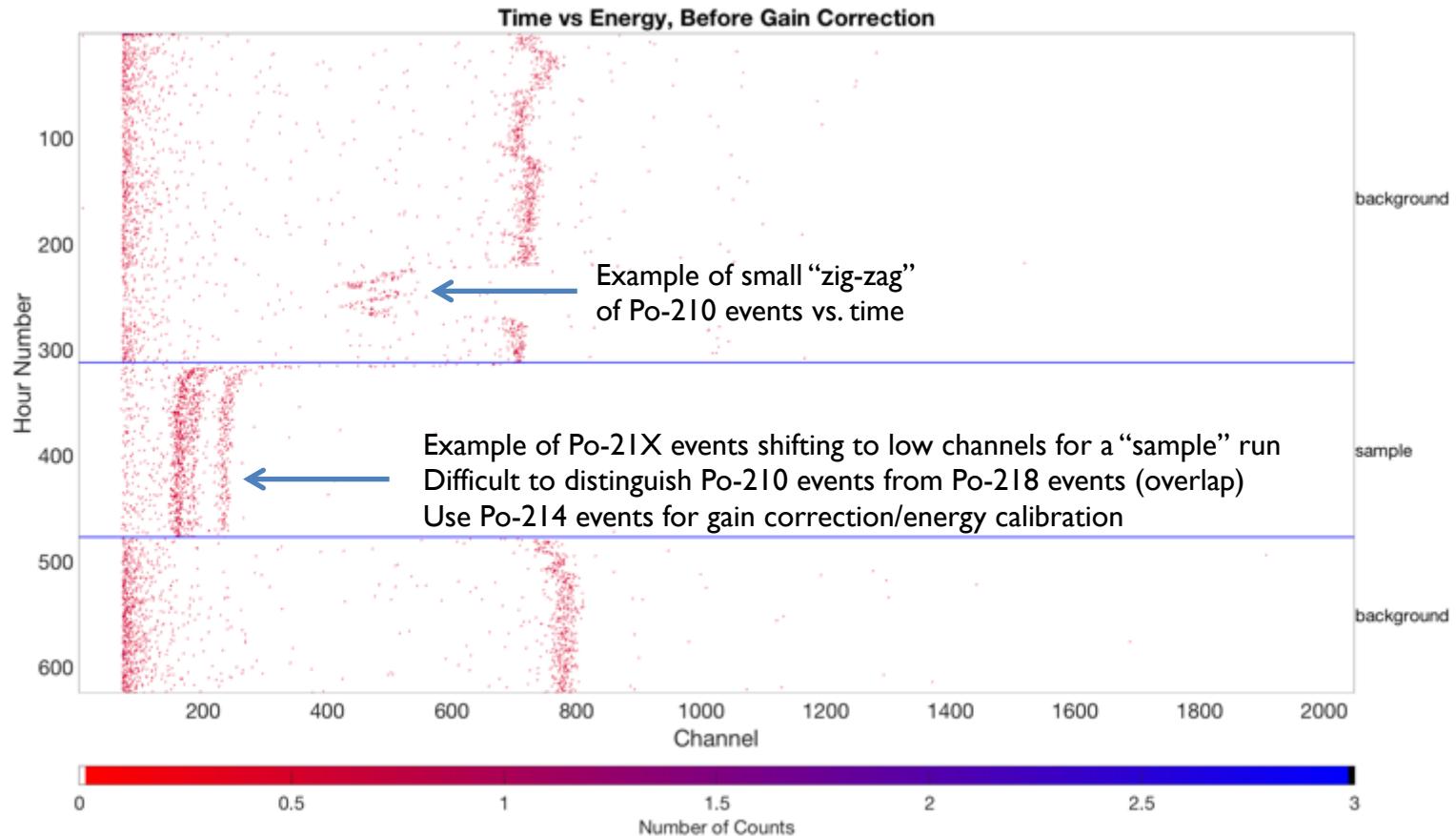
Total Surface Area:

$$A_1 + A_2 + A_3 + 2A_4 + 2A_5 = 181.3 \text{ cm}^2$$

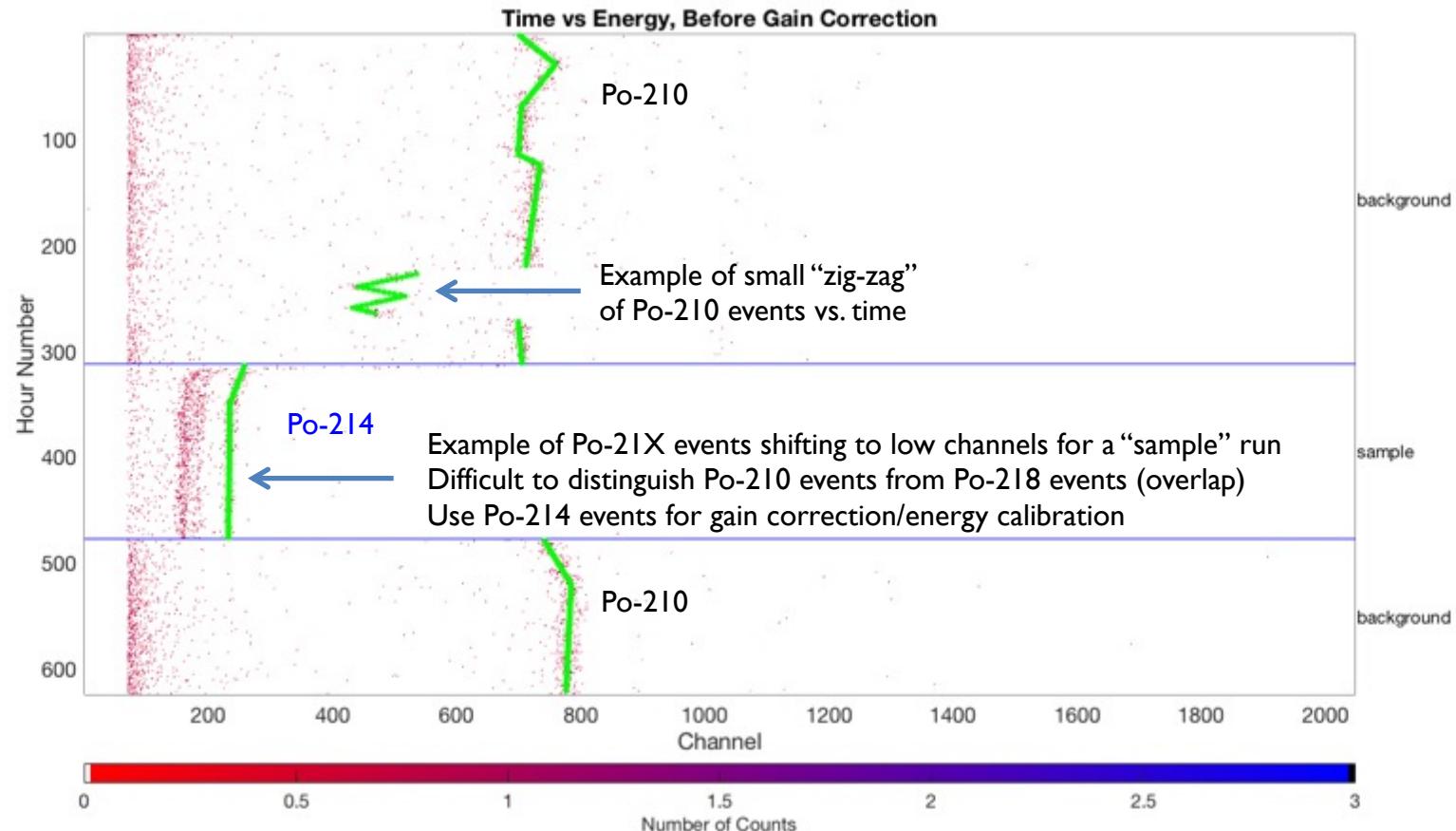
Note on Detector Behavior

- Note: since initial assay of all 10 silicone gaskets (late 2020):
 - The HV detector has started shifting (e.g., Po-210, Po-214 and Po-218) events to lower channels than previously observed; decreases energy resolution
 - Initially, this occurred only for the sample runs, but now it is now common for almost every run (both sample and background runs)
 - Occasionally, (e.g., Po-210) events drift back and forth between high and low channels over time (“zig- zagging”) making some, or all, of the run unusable
 - Still possible to get a decent emanation rate for samples with a decreased energy resolution; some overlap between Po-210 and Po-218 events

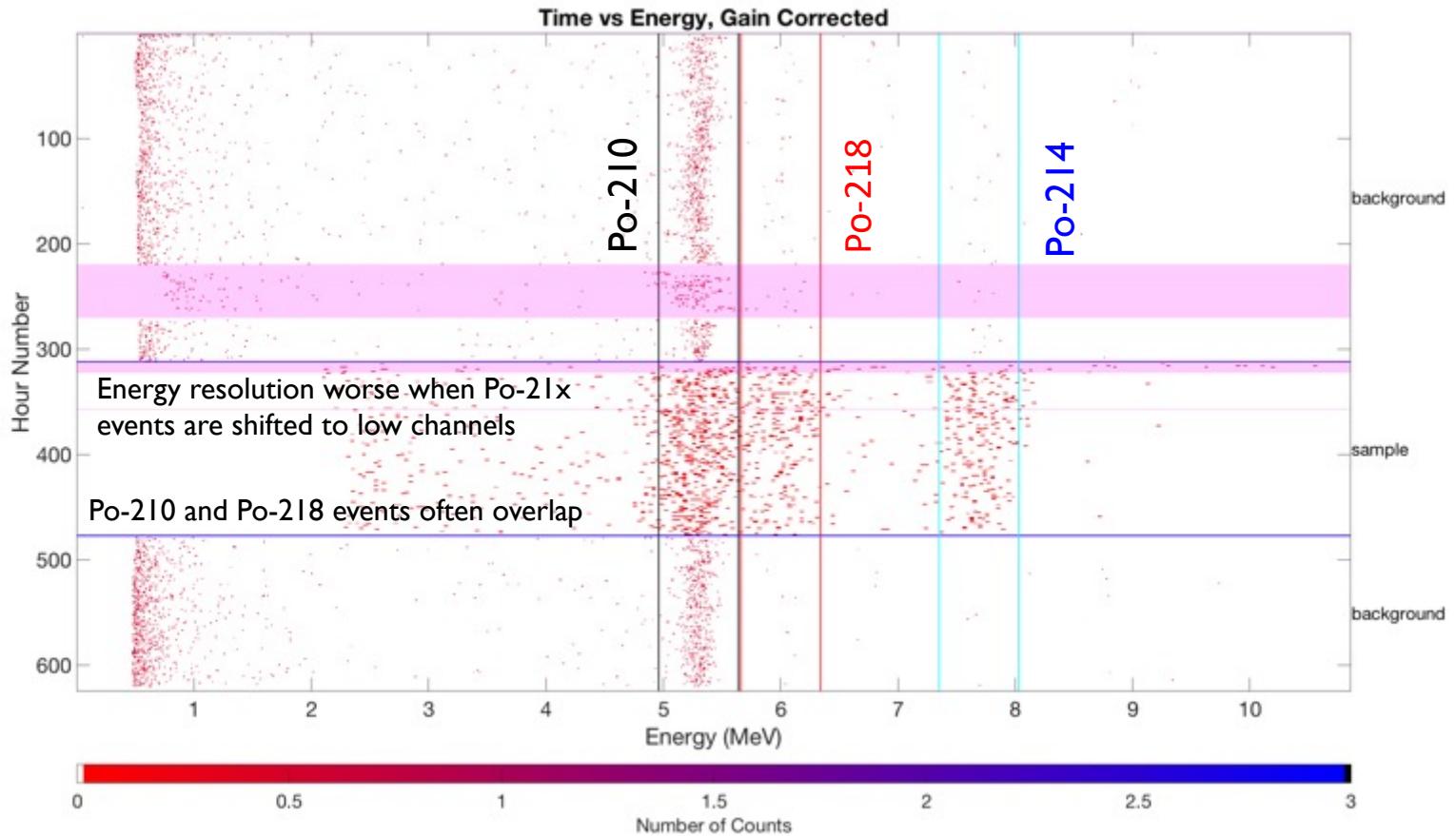
Run 652, One Silicone Gasket #1: Raw data



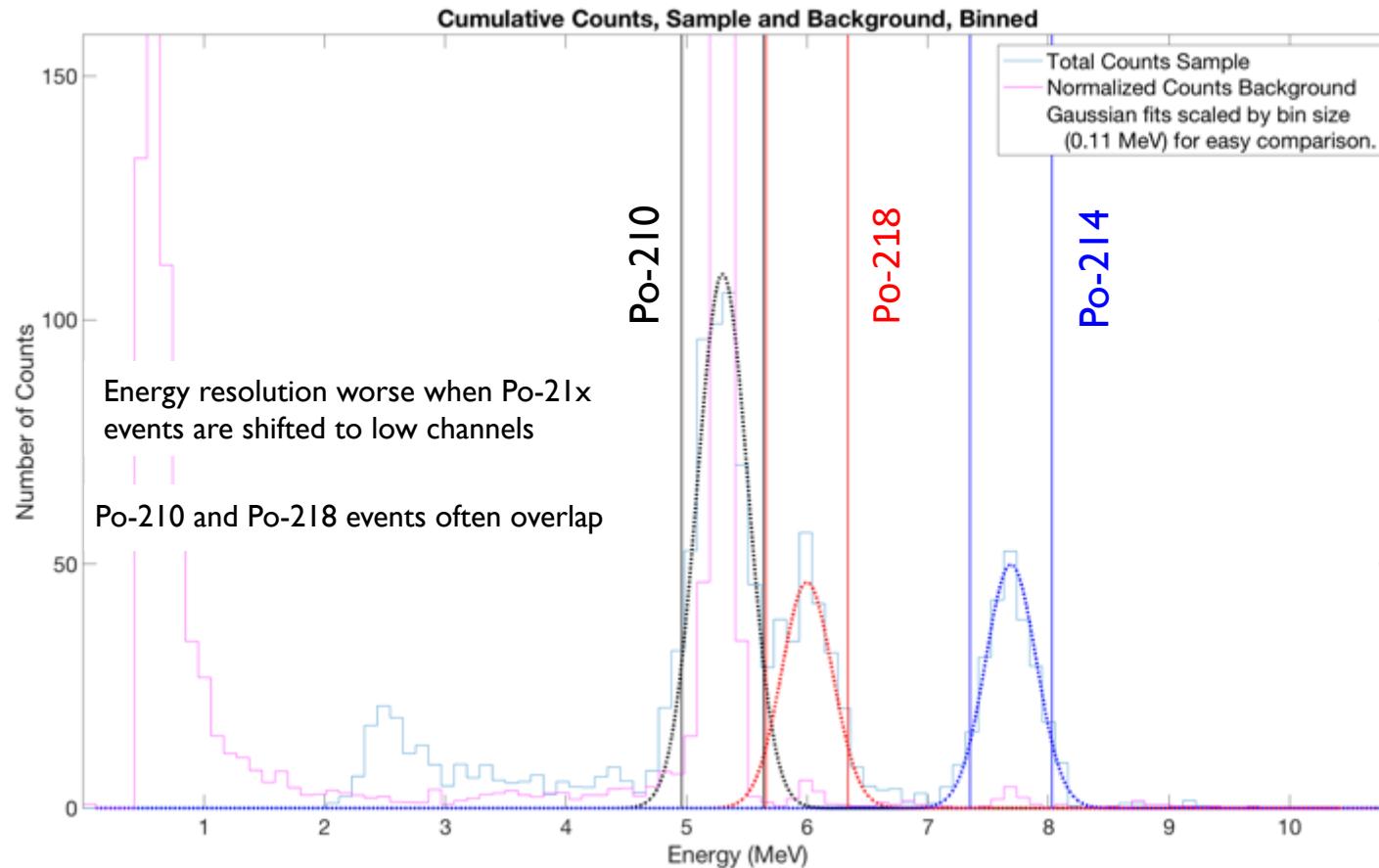
Run 652, One Silicone Gasket #1: Fit of Po-21x events



Run 652, One Silicone Gasket #1: Gain correction w/ bad intervals

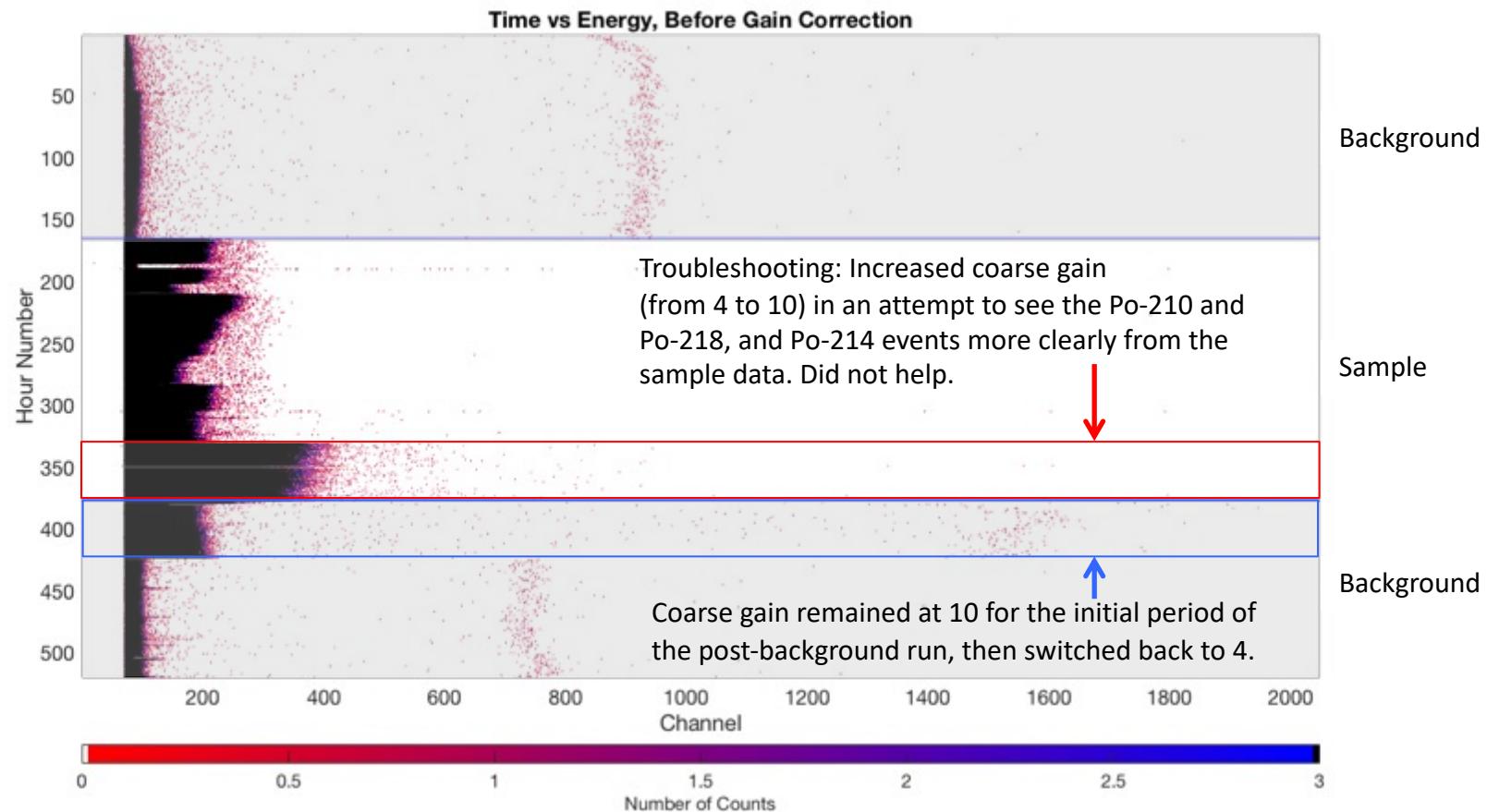


Run 652, One Silicone Gasket #1: Cumulative counts

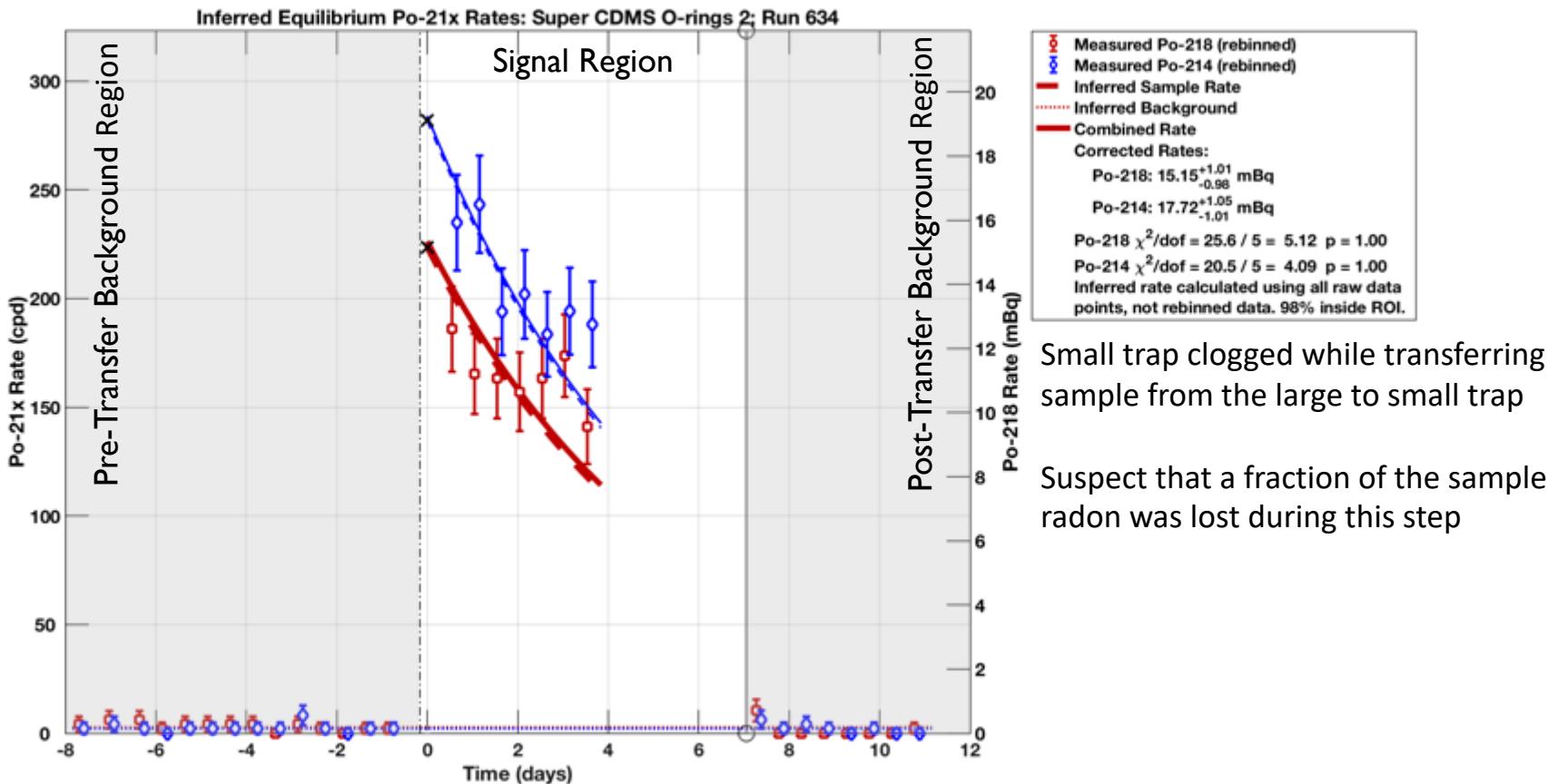


Backup slides

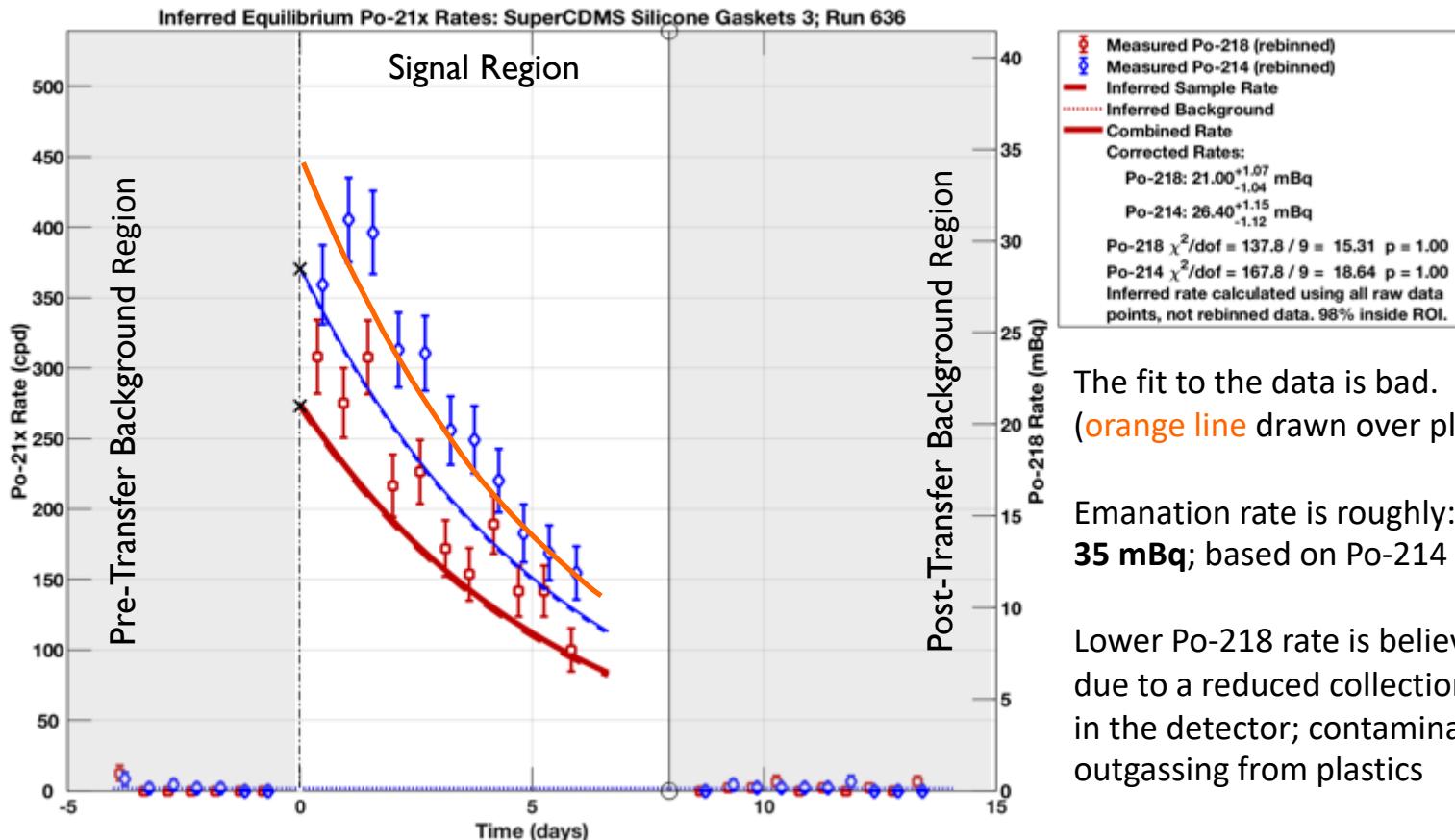
First emanation (8/27/20 – 9/9/20)



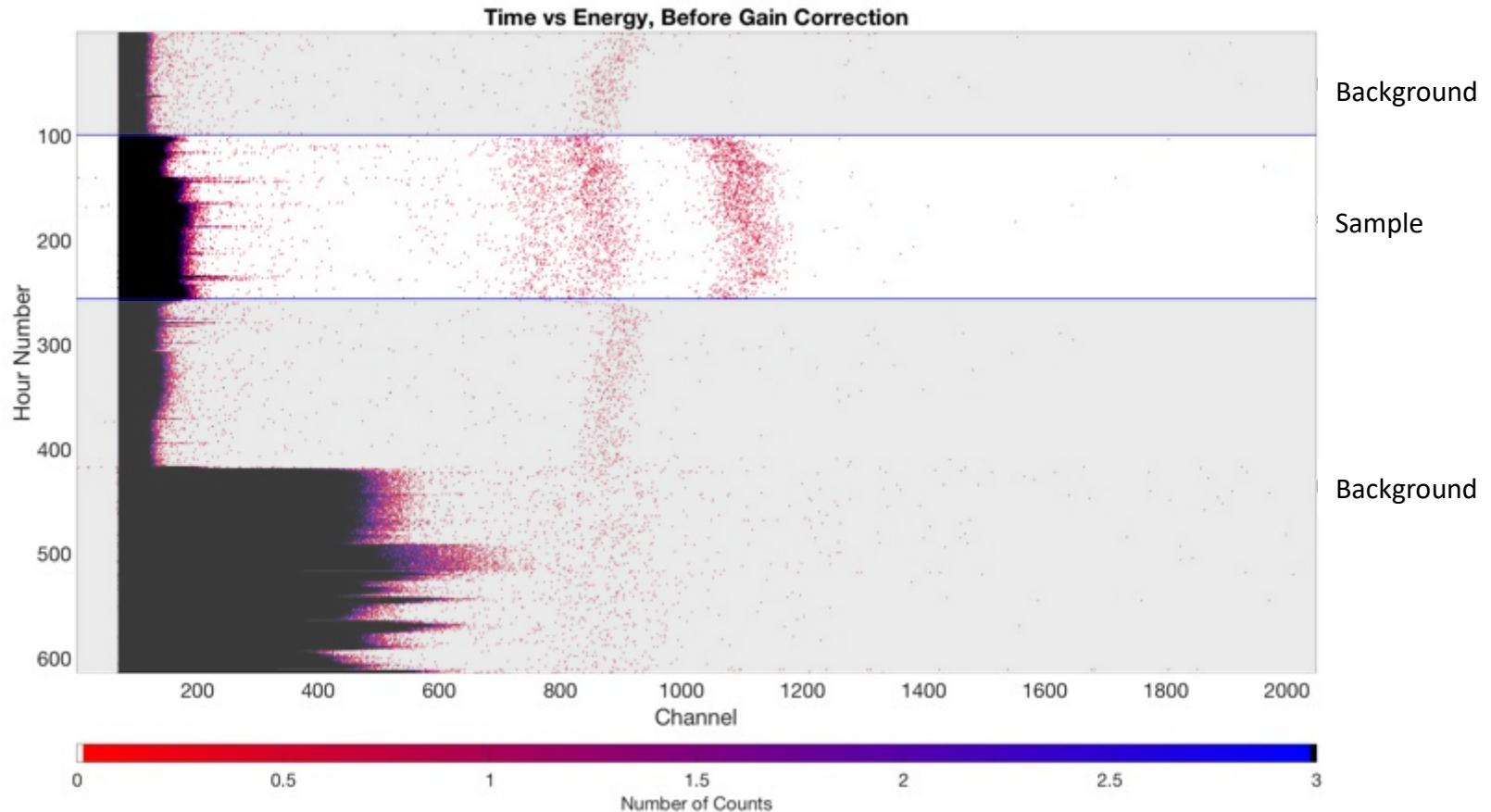
Second emanation (9/9/20 – 10/2/20)



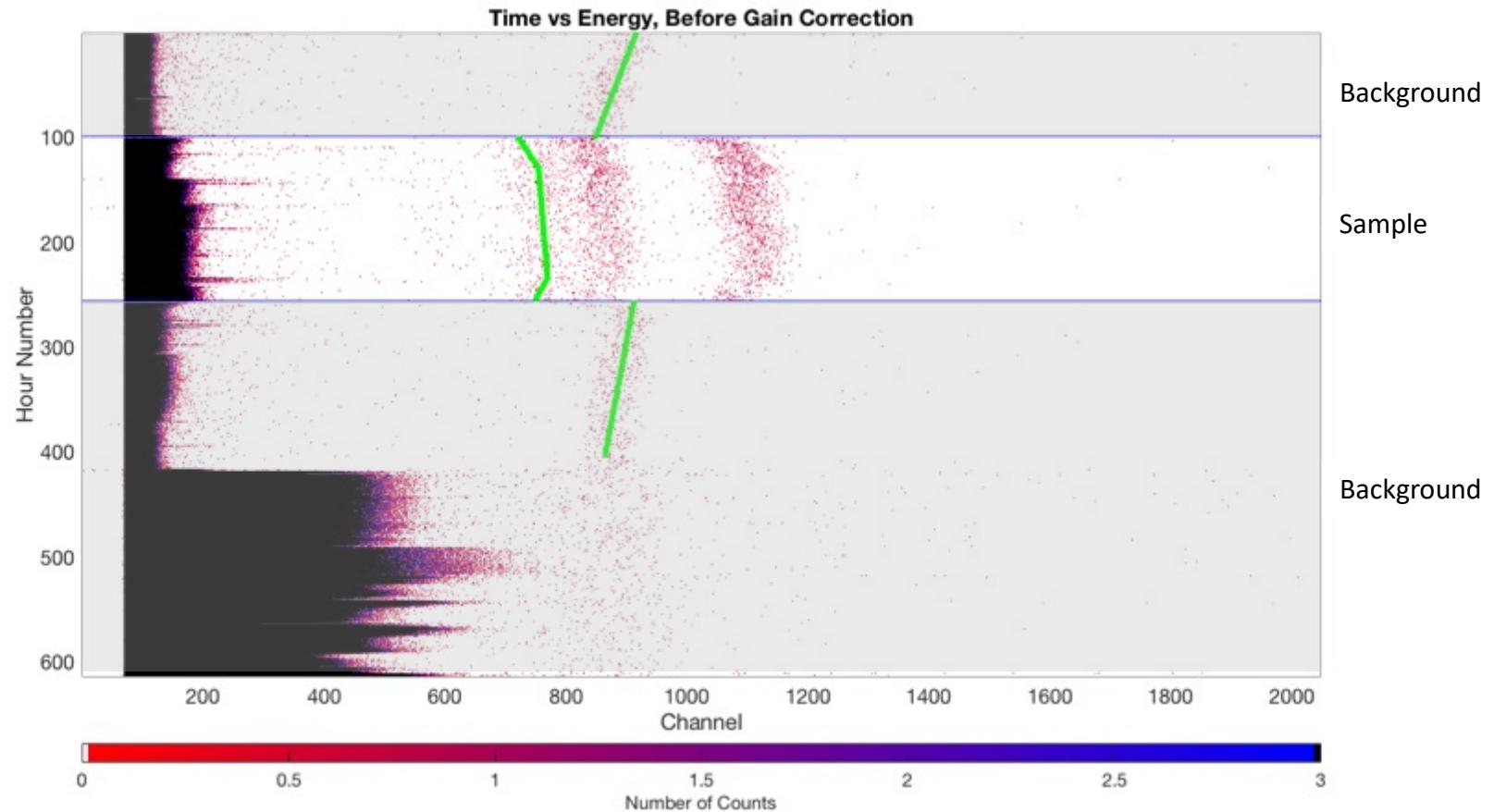
Third emanation (10/2/20– 10/13/20)



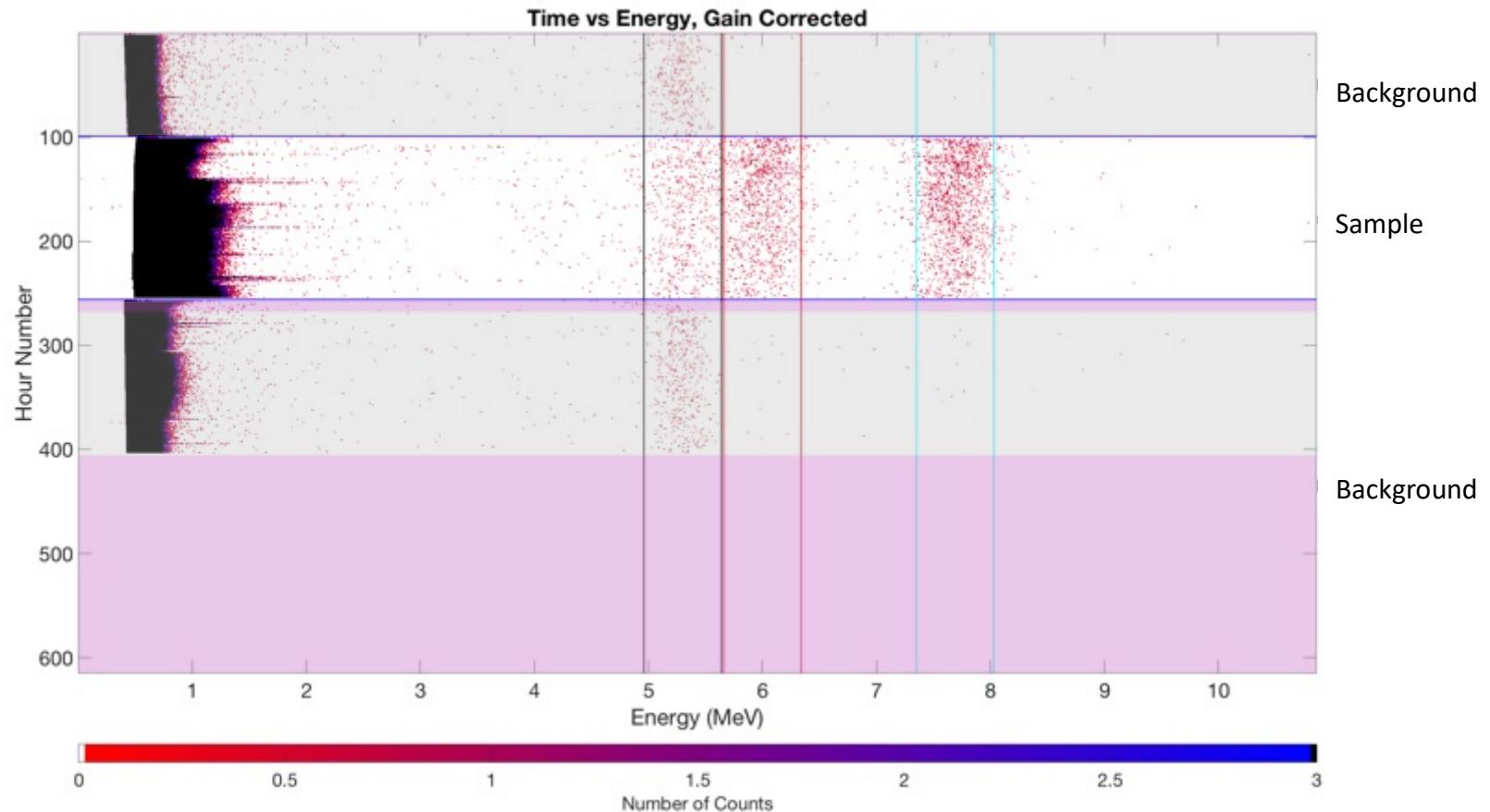
Raw data



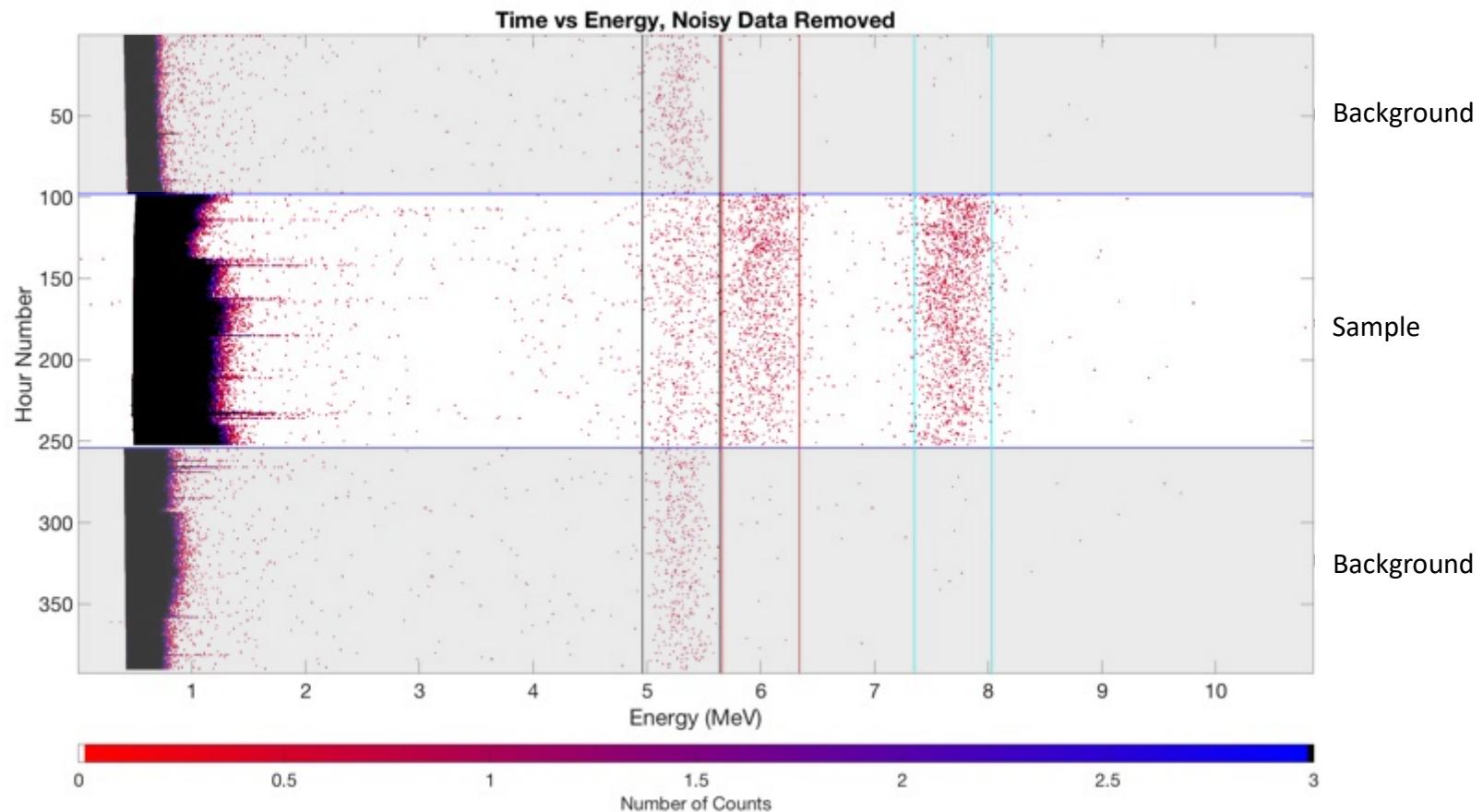
Fit of Po-210 Events



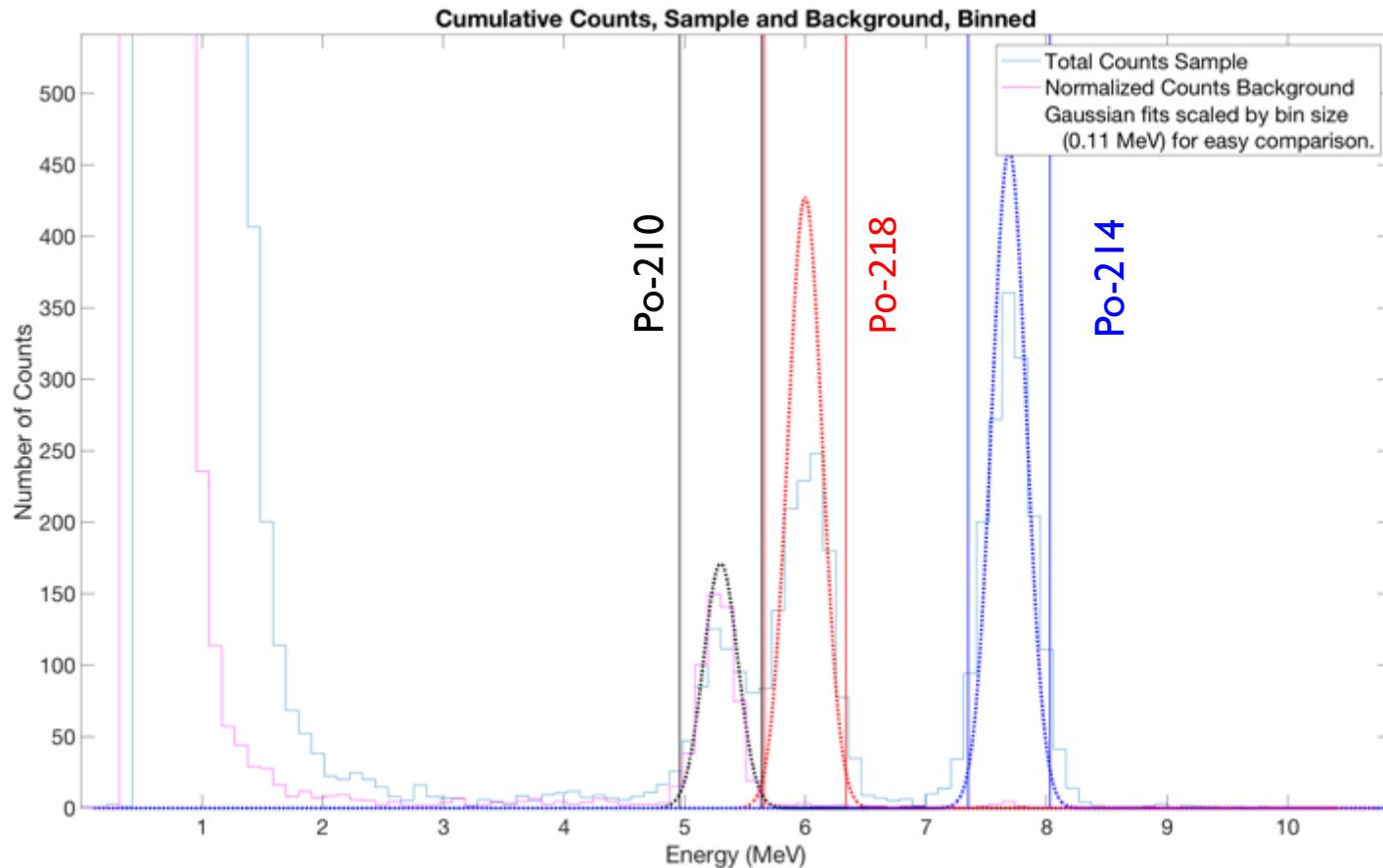
Gain Correction w/ Bad Intervals



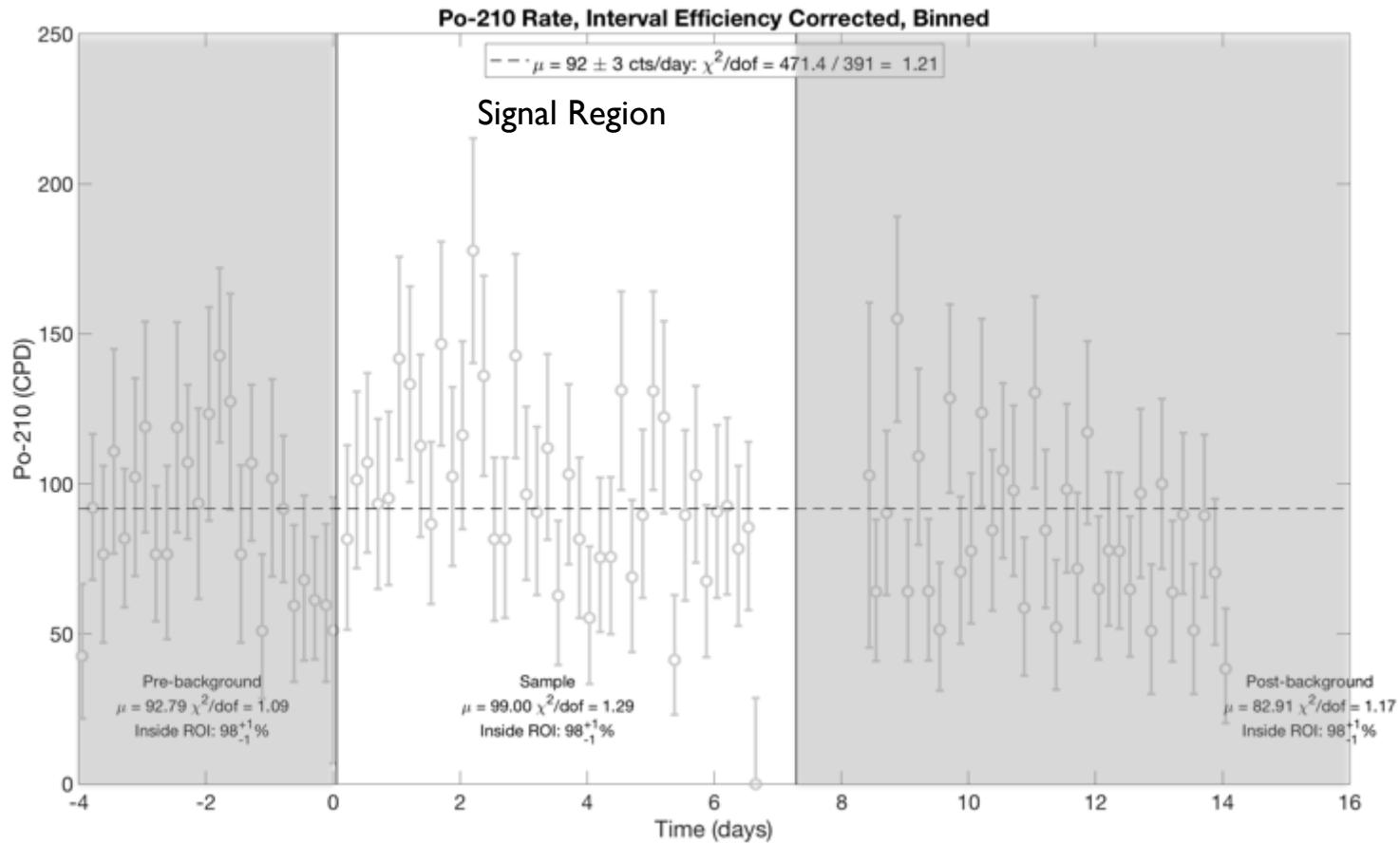
Gain Correction w/o Bad Intervals



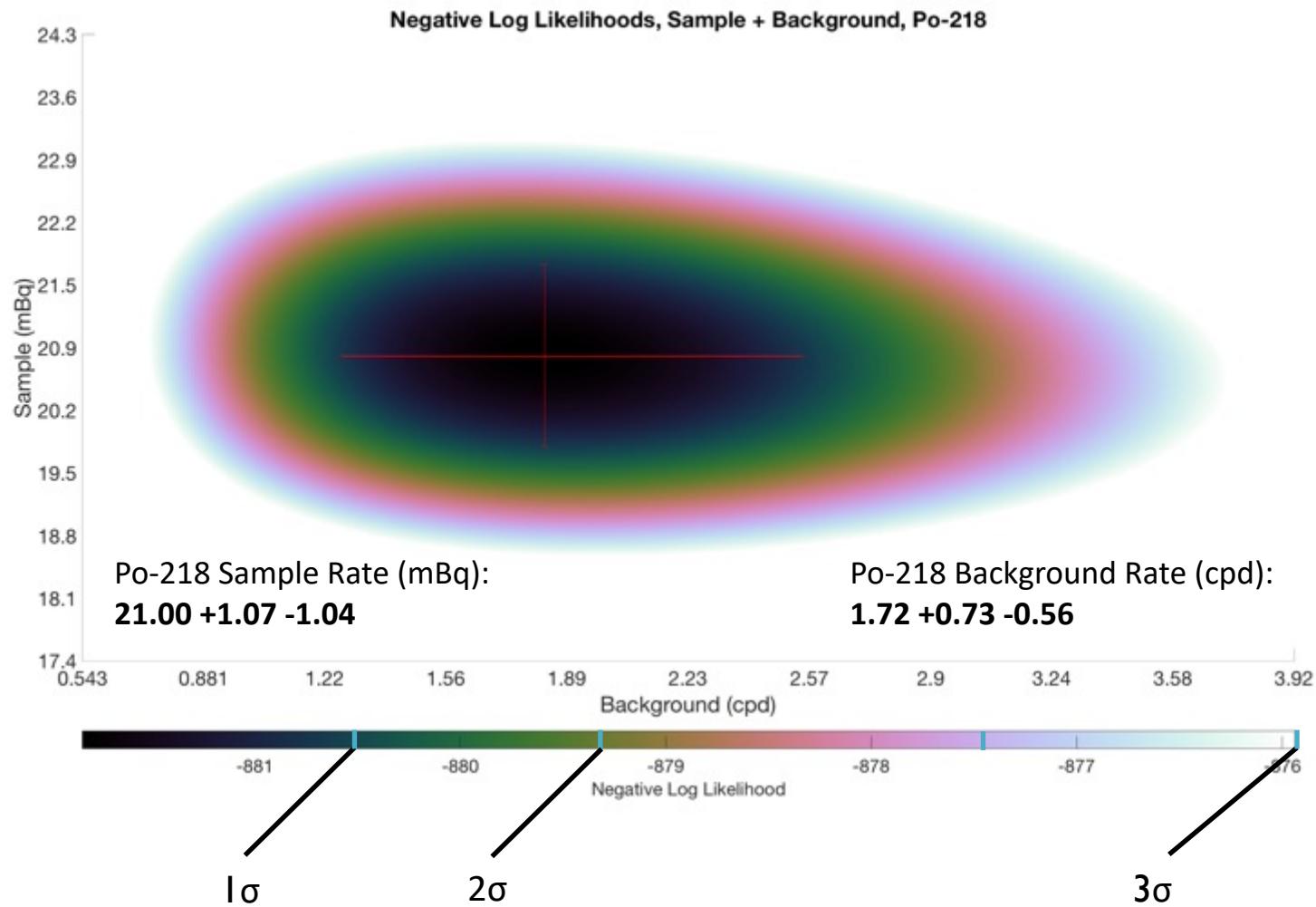
Cumulative Counts



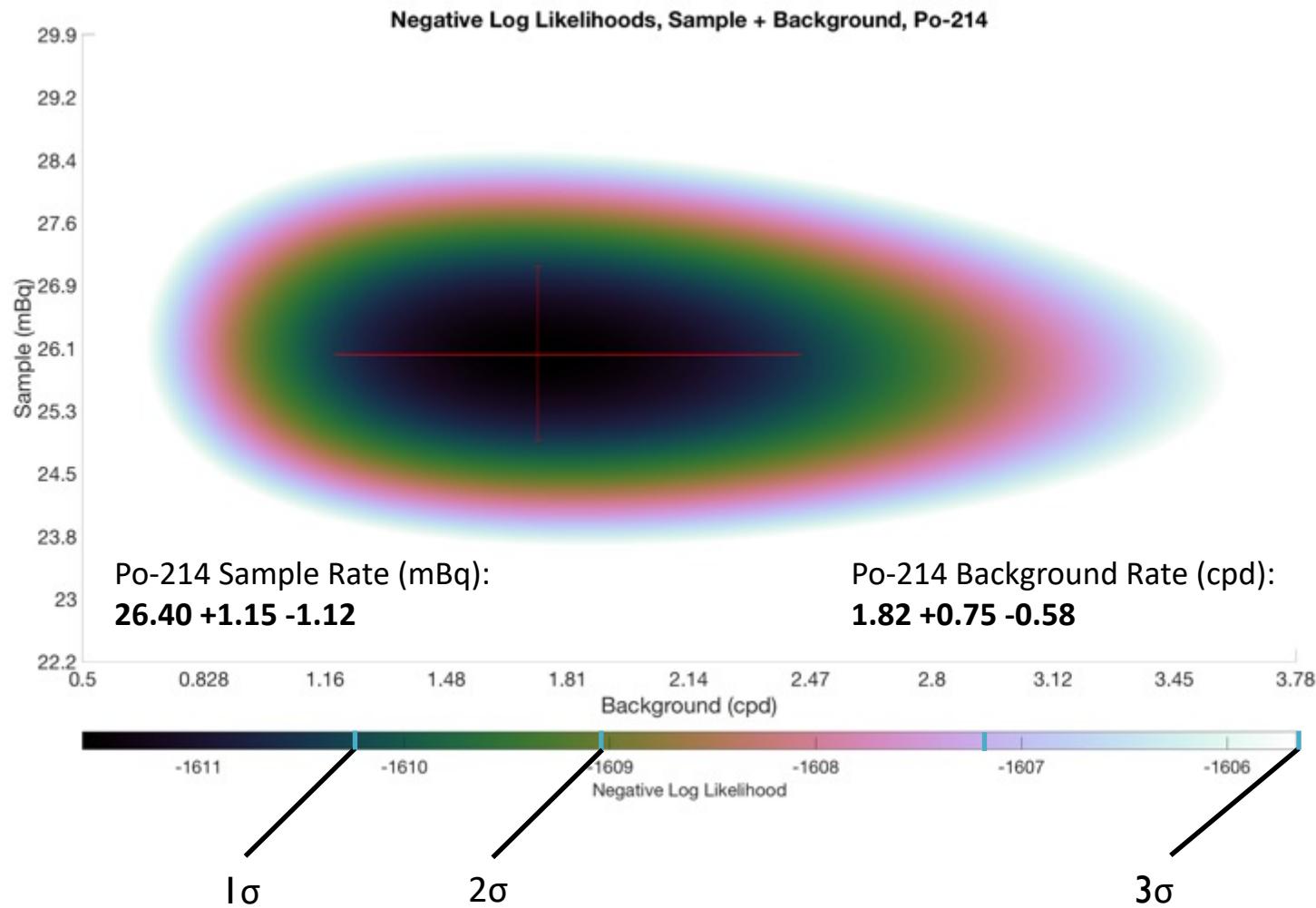
Po-210 Rate



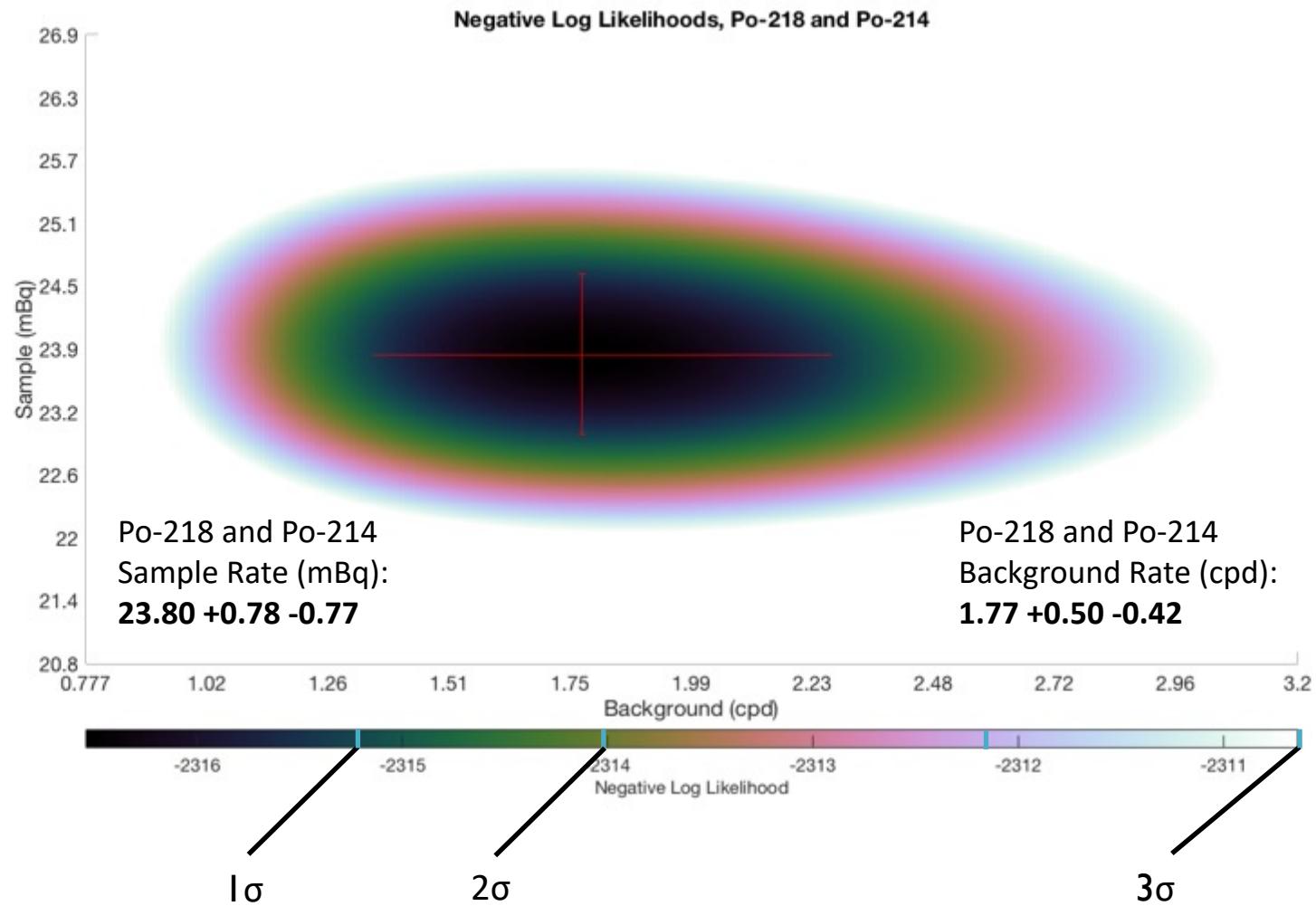
Po-218 Negative Log Likelihoods



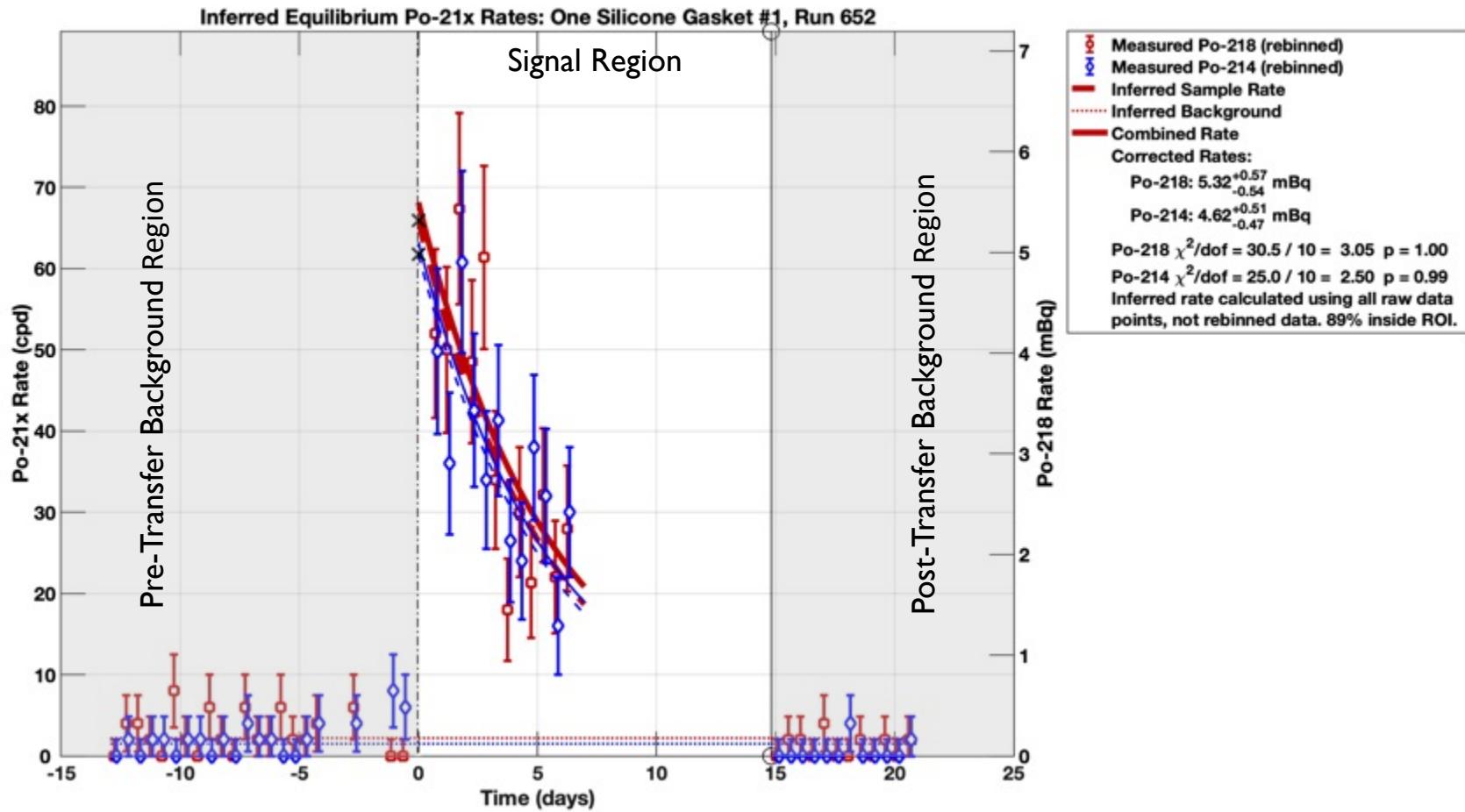
Po-214 Negative Log Likelihoods



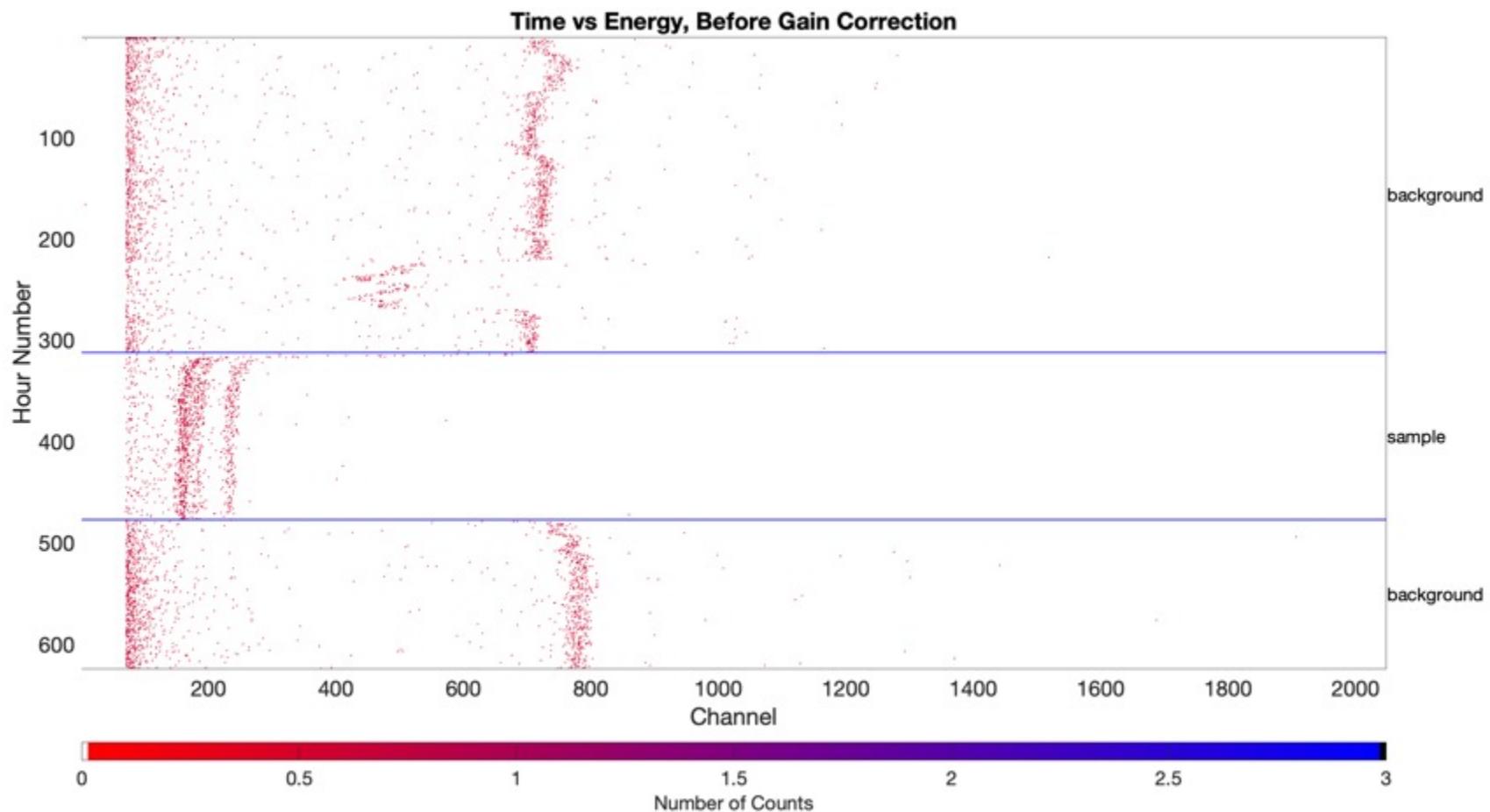
Combined Negative Log Likelihoods



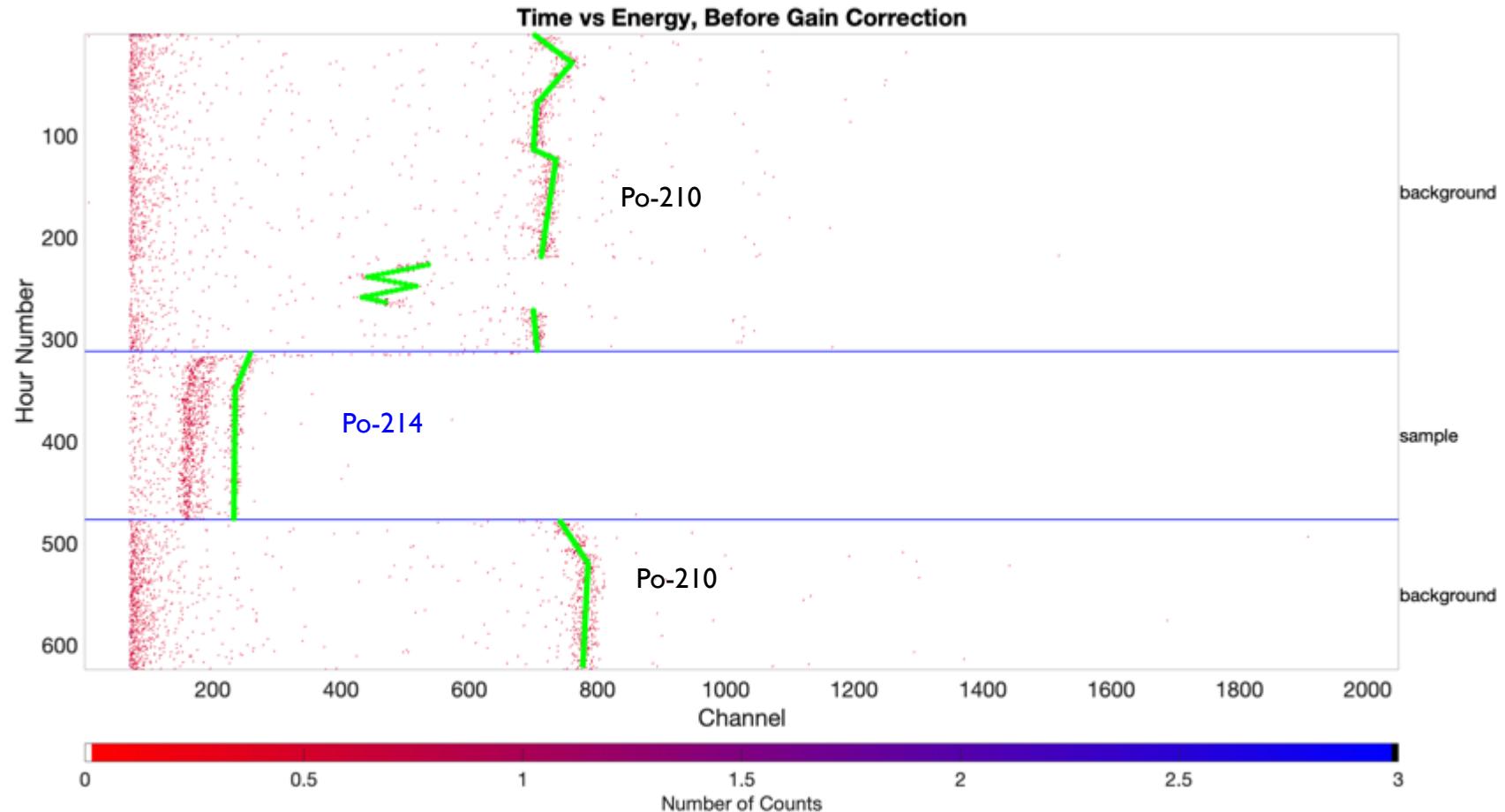
Run 652, Single Silicone Gasket #1: 2/10/2021 – 2/23/2021



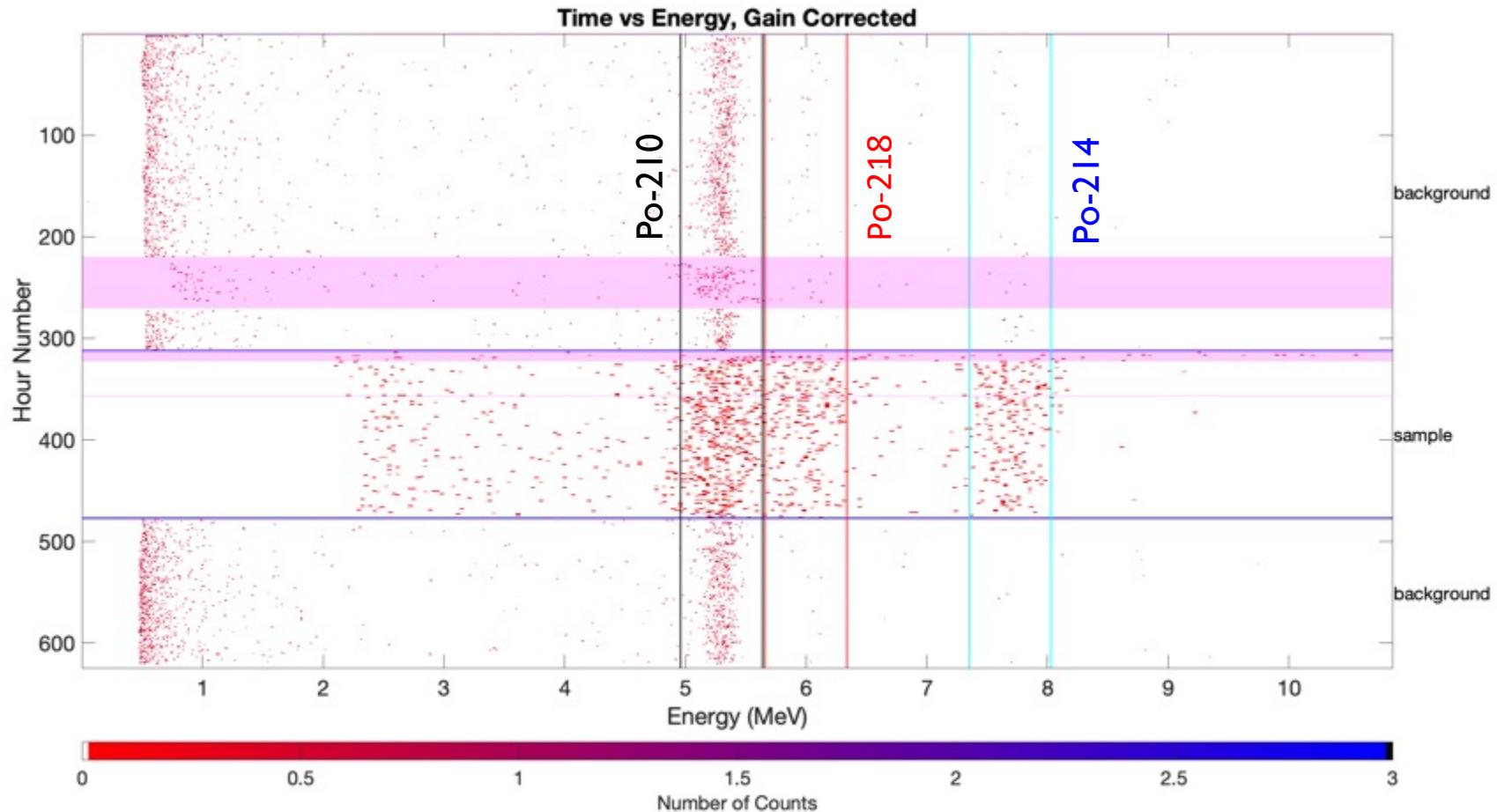
Run 652, Single Silicone Gasket #1: Raw data



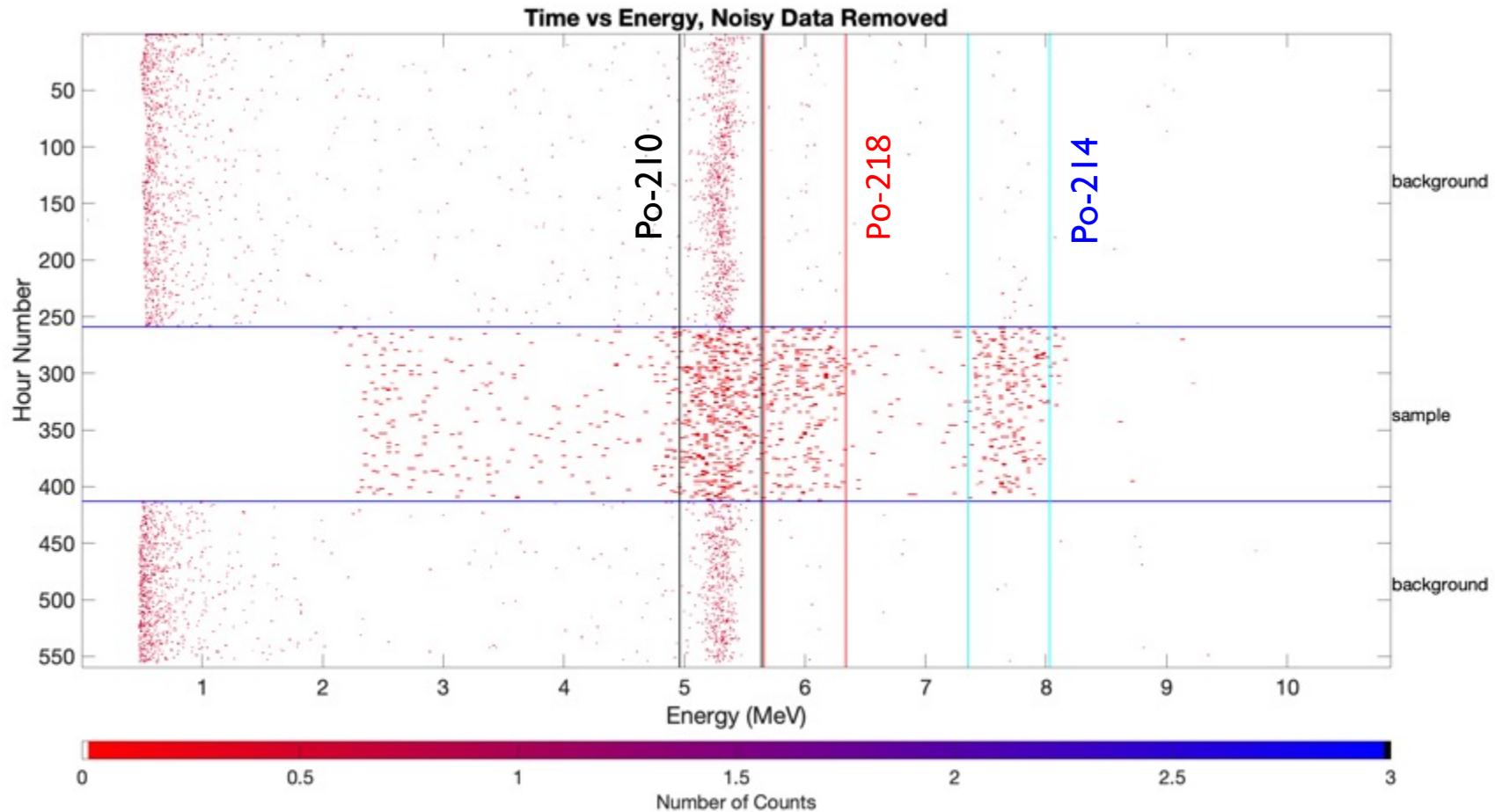
Run 652, Single Silicone Gasket #1: Fit of Po-21x events



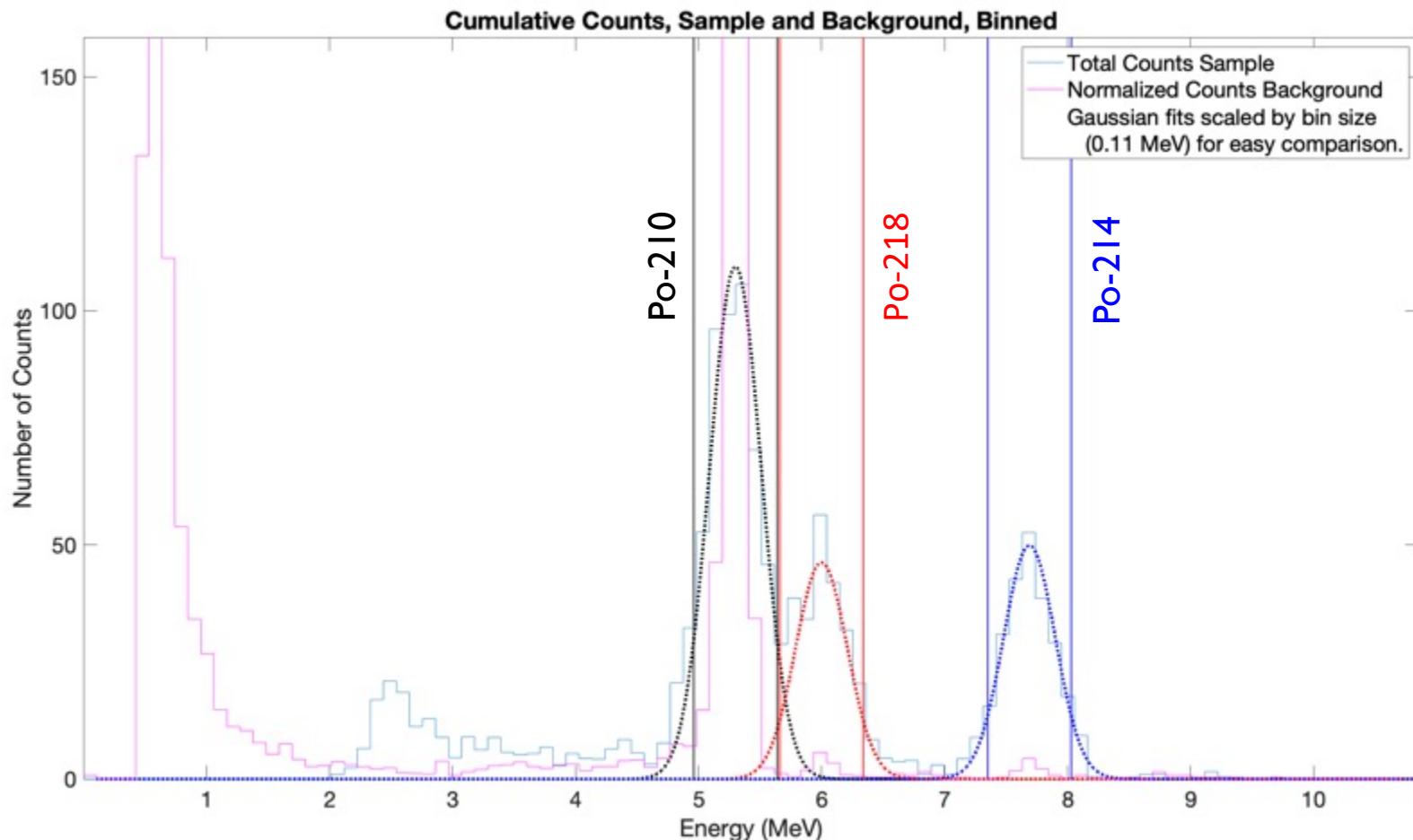
Run 652, Single Silicone Gasket #1: Gain correction w/ bad intervals



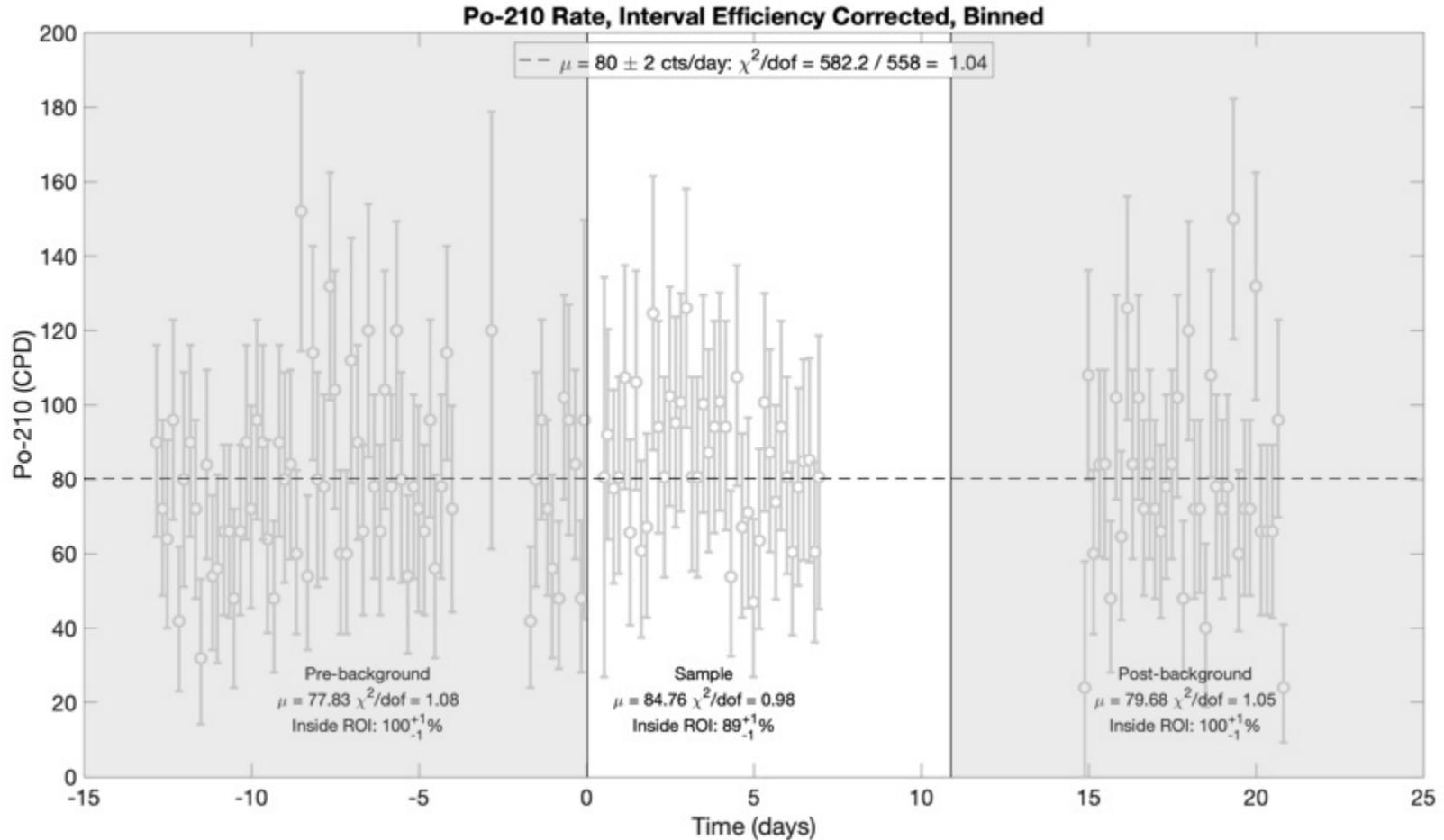
Run 652, Single Silicone Gasket #1: Gain correction w/o bad intervals



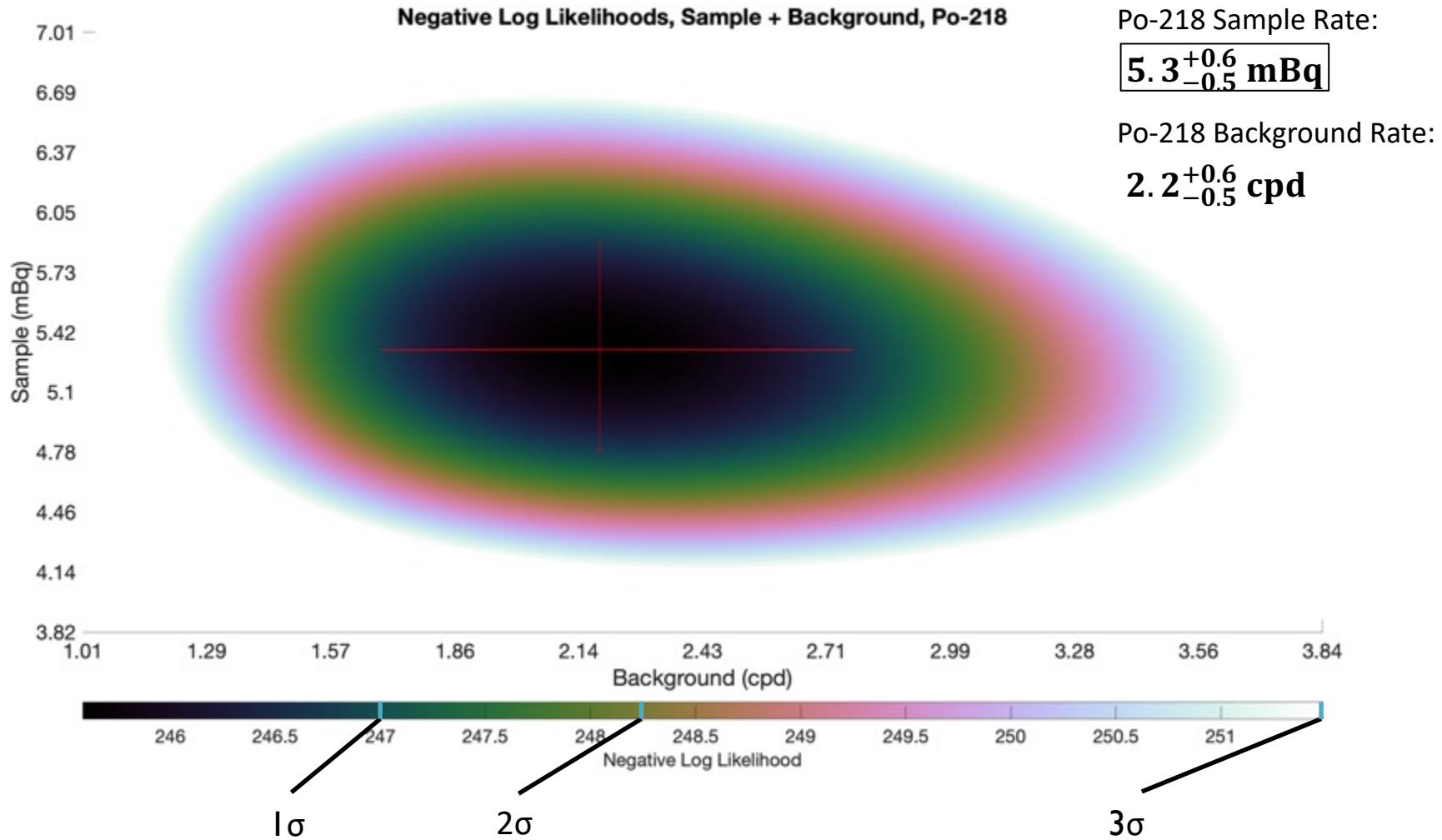
Run 652, Single Silicone Gasket #1: Cumulative counts



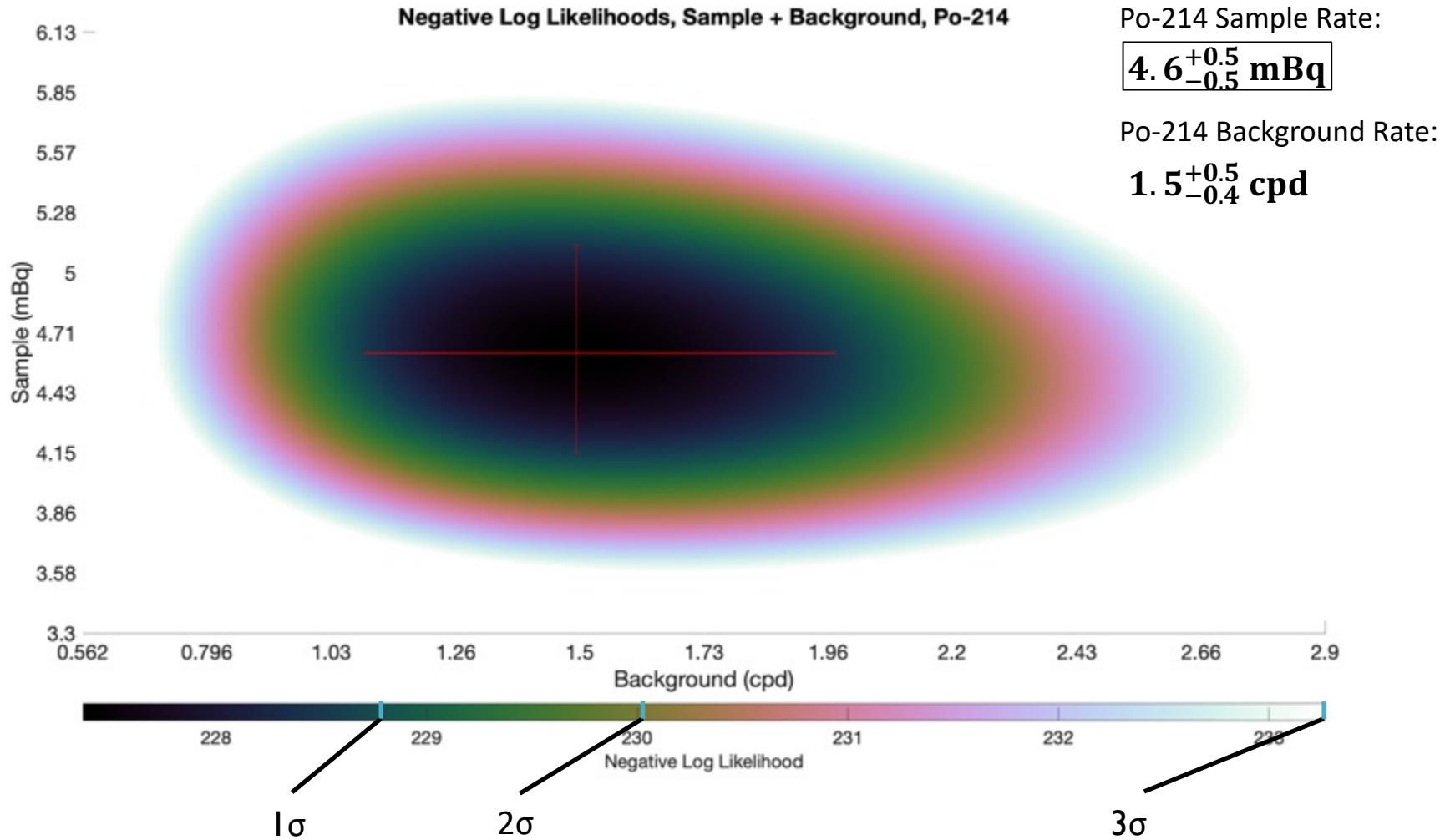
Run 652, Single Silicone Gasket #1: Po-210 rate



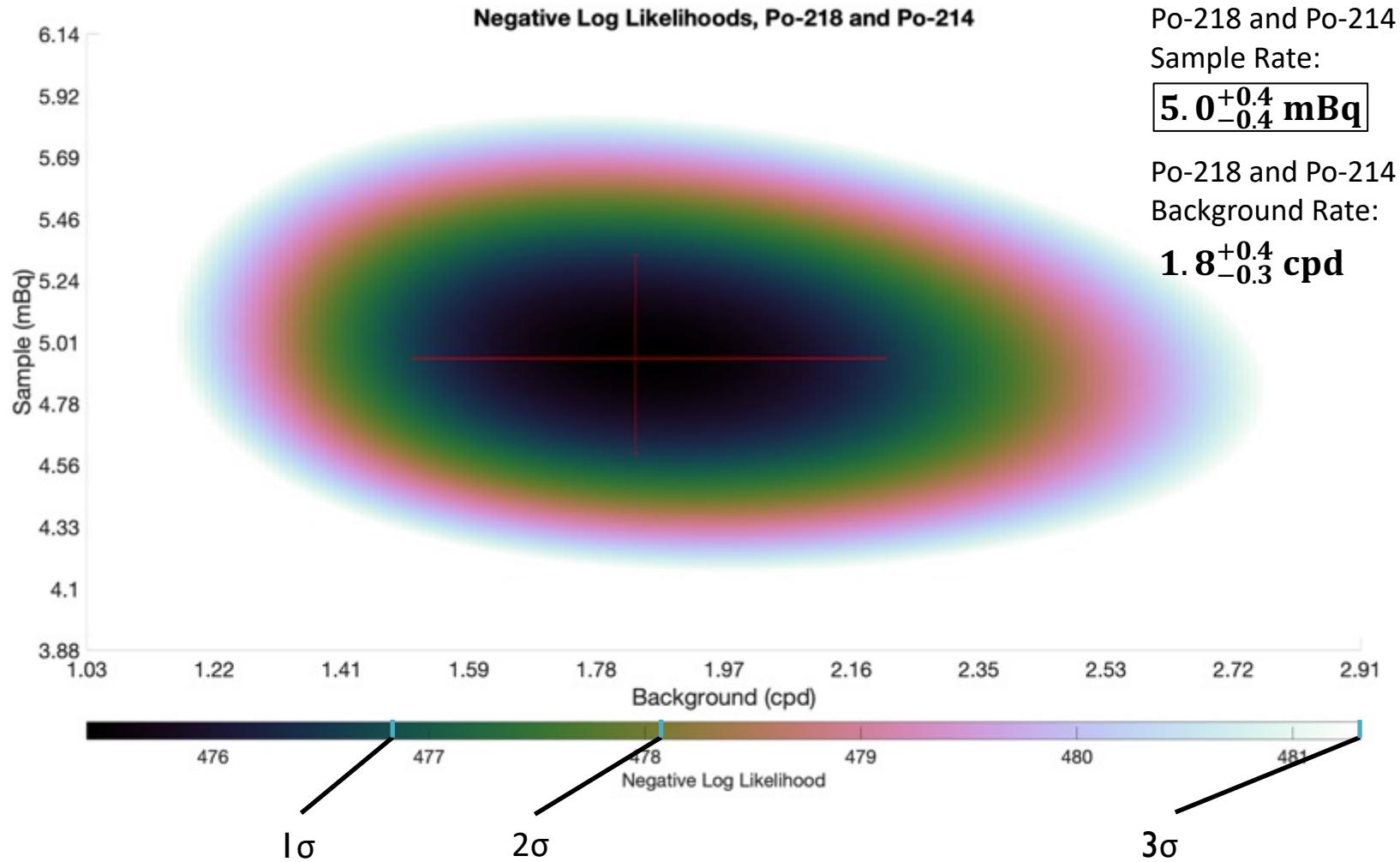
Run 652, Single Silicone Gasket #1: Po-218 Neg. Log Likelihoods



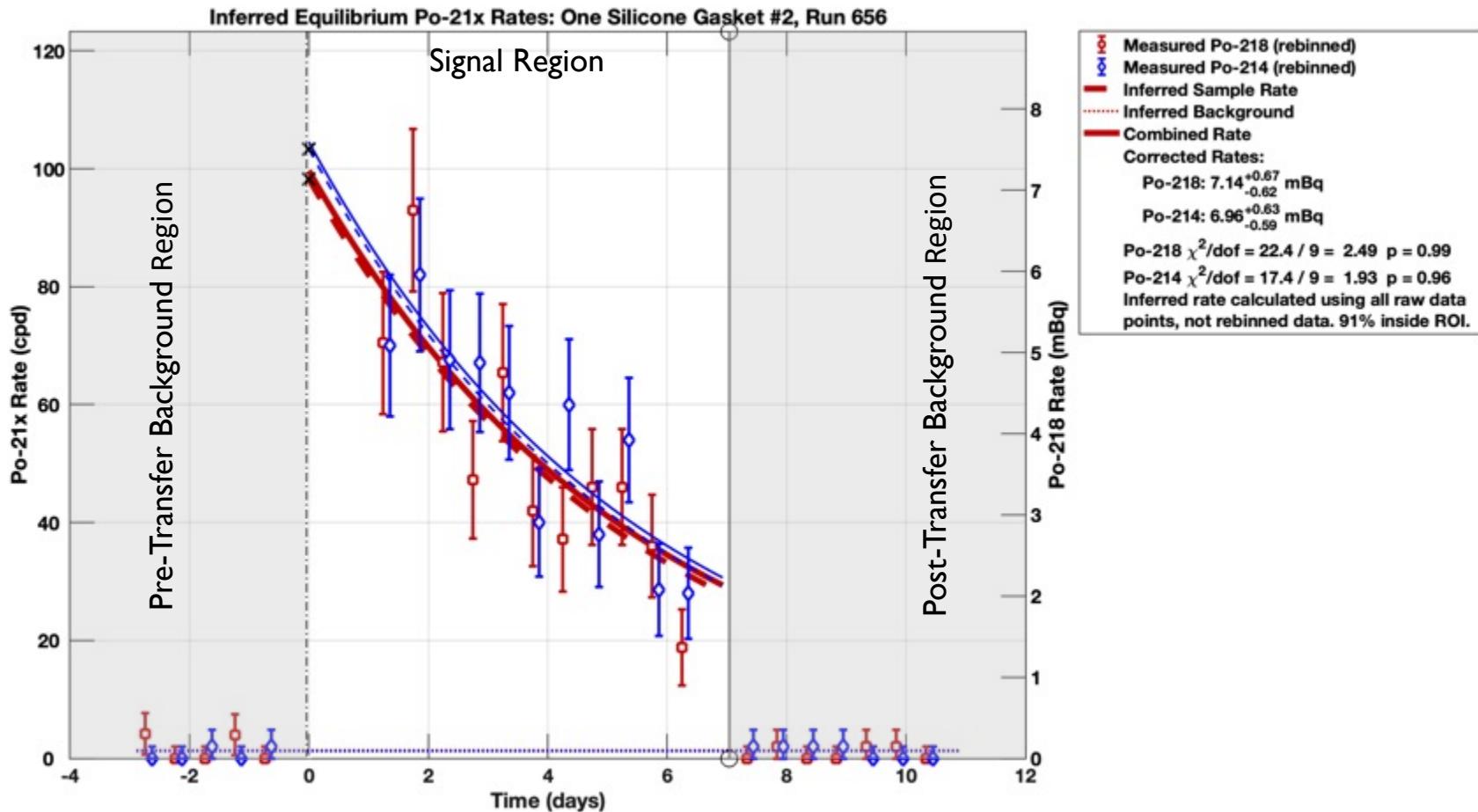
Run 652, Single Silicone Gasket #1: Po-214 Neg. Log Likelihoods



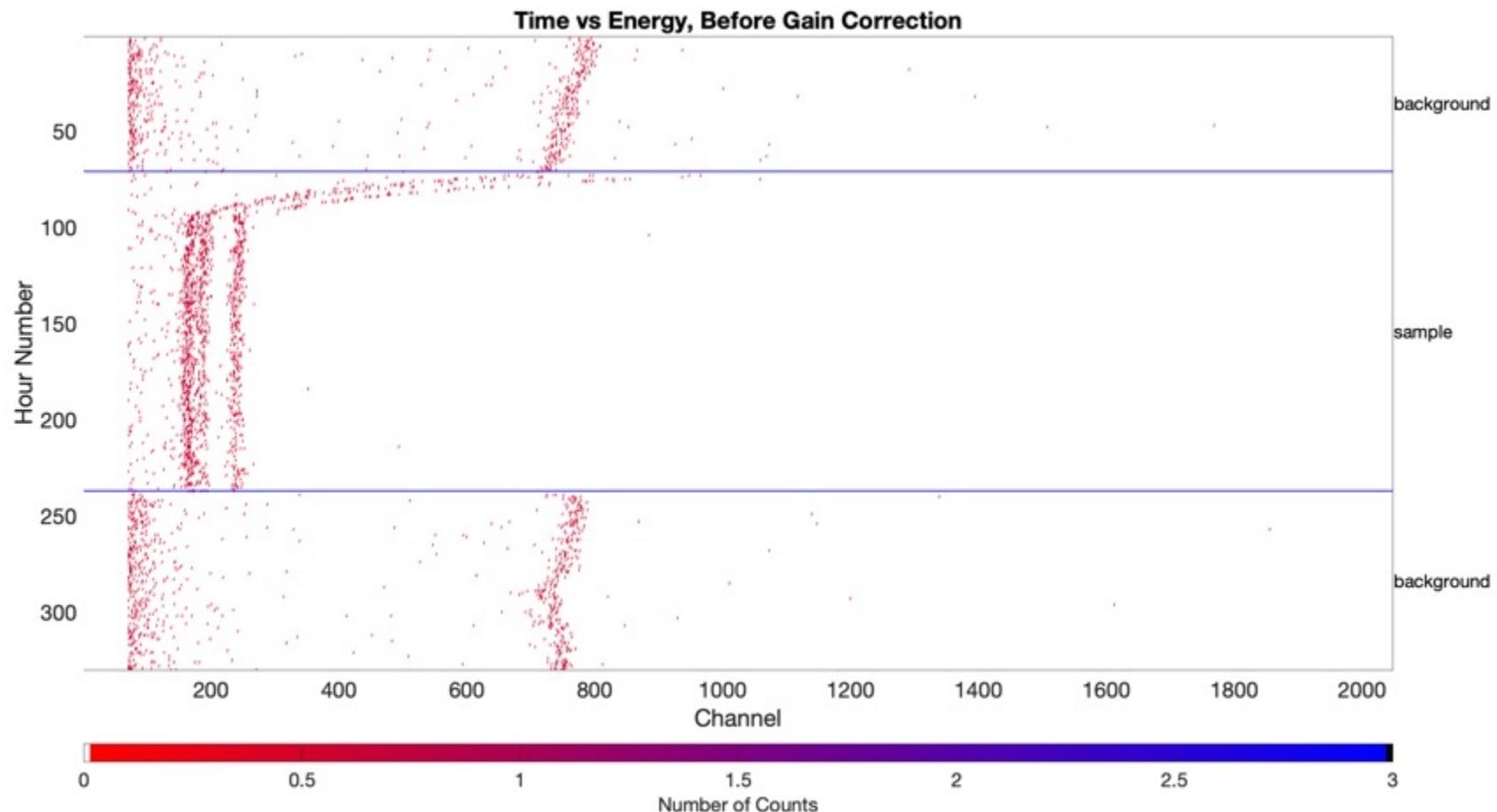
Run 652, Single Silicone Gasket #1: Po-218 & Po-214 Neg. Log Likelihoods



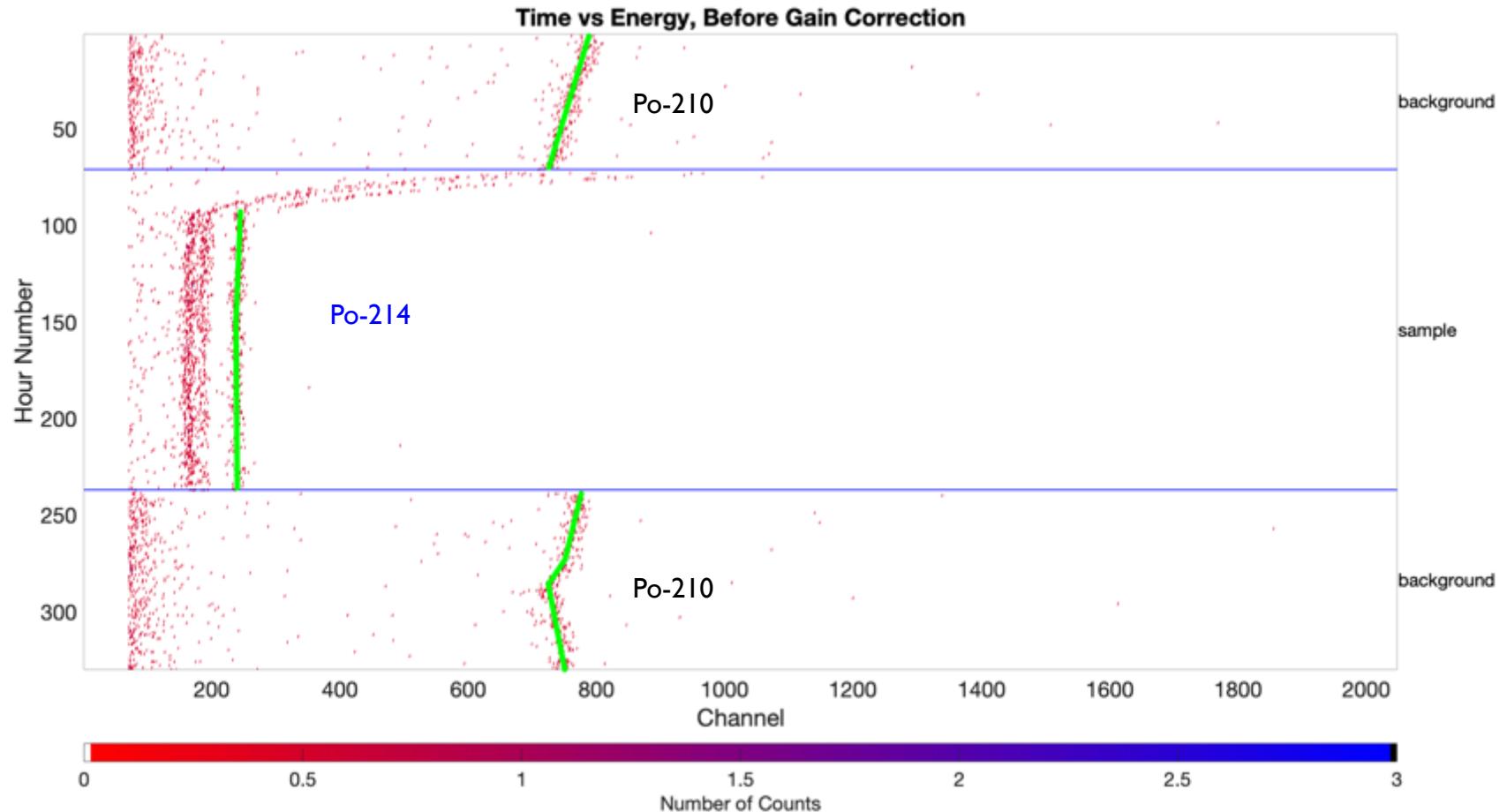
Run 656, Single Silicone Gasket #2: 2/23/2021 – 3/19/2021



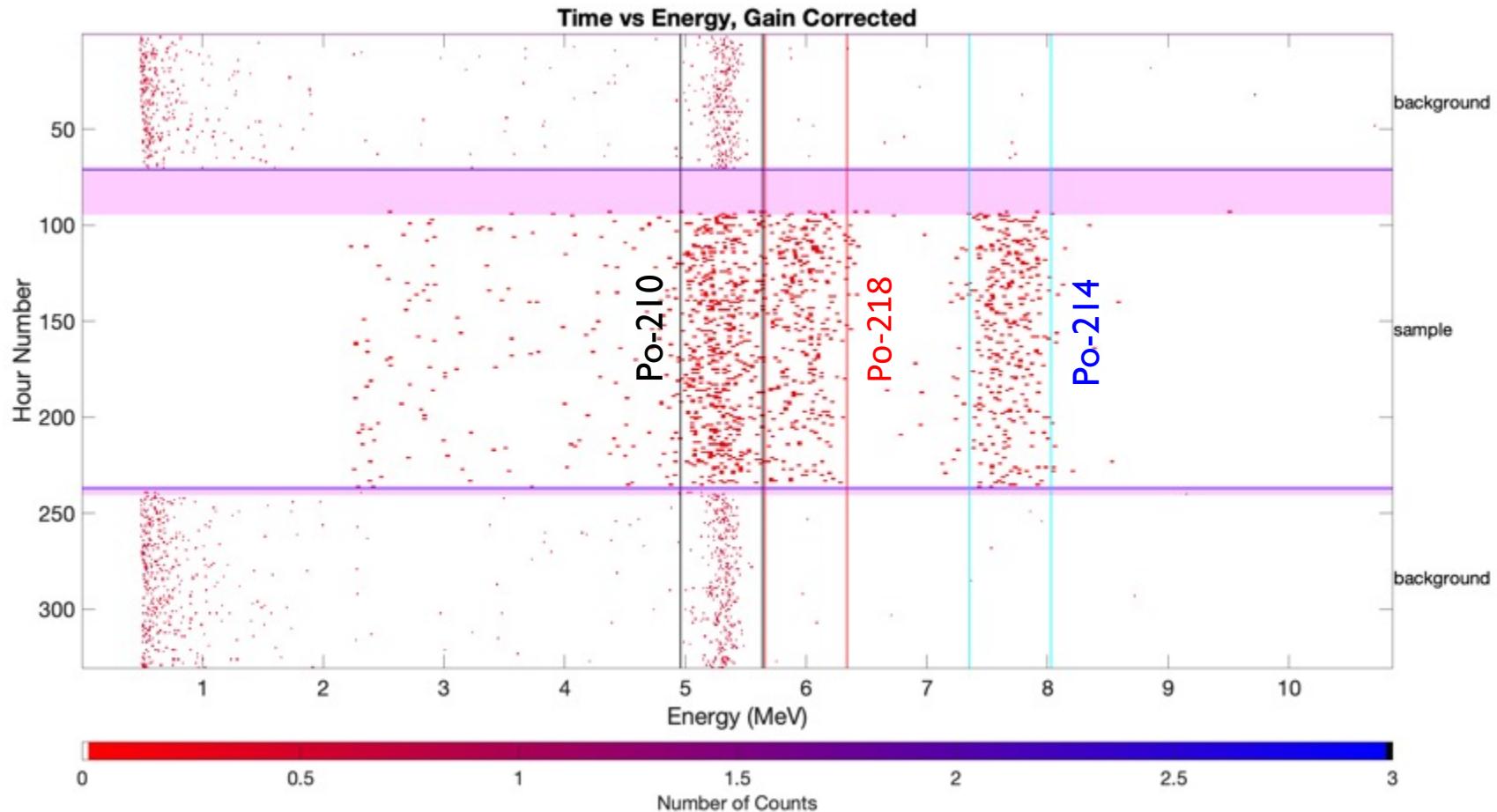
Run 656, Single Silicone Gasket #2: Raw data



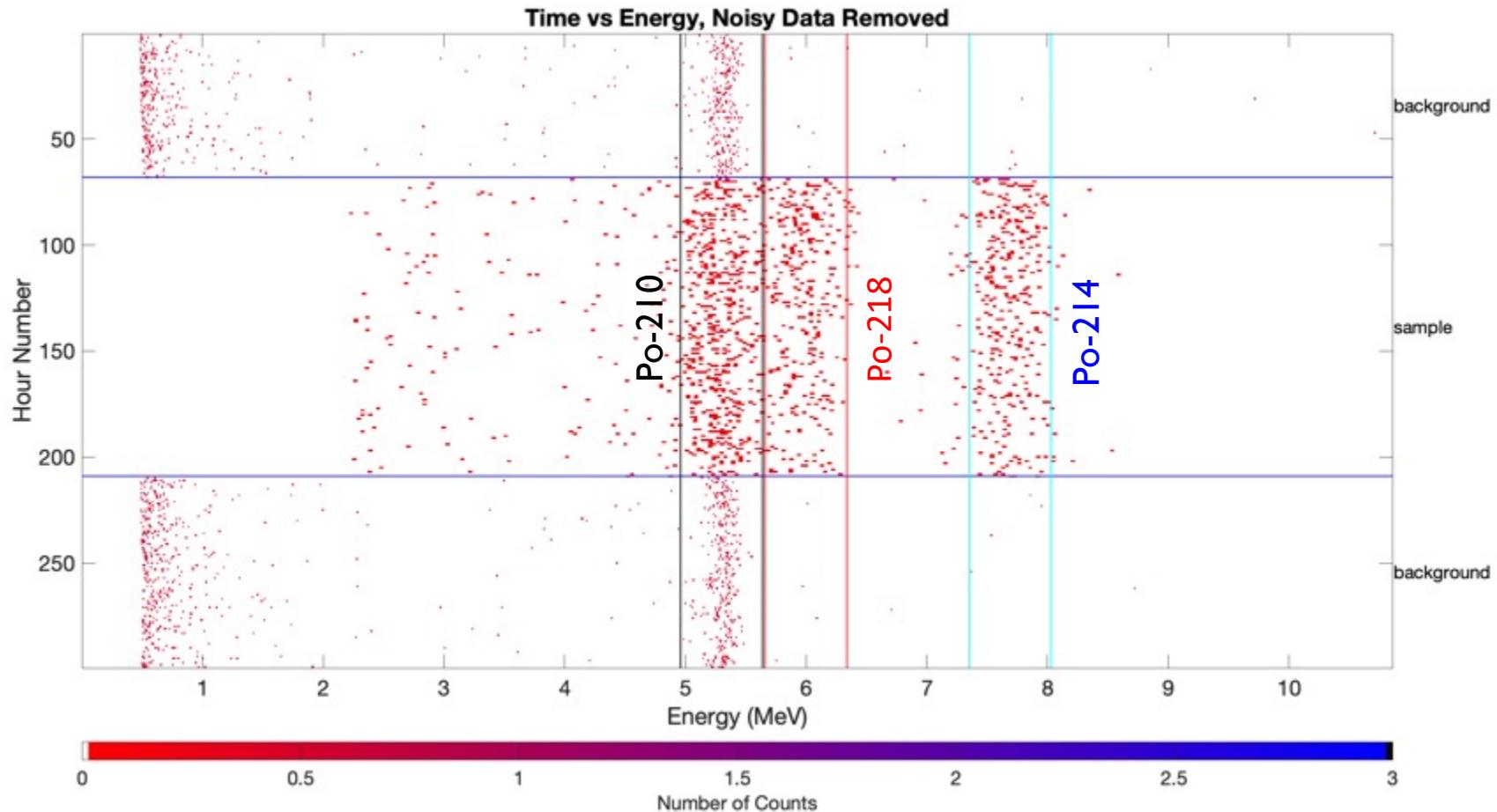
Run 656, Single Silicone Gasket #2: Fit of Po-21x events



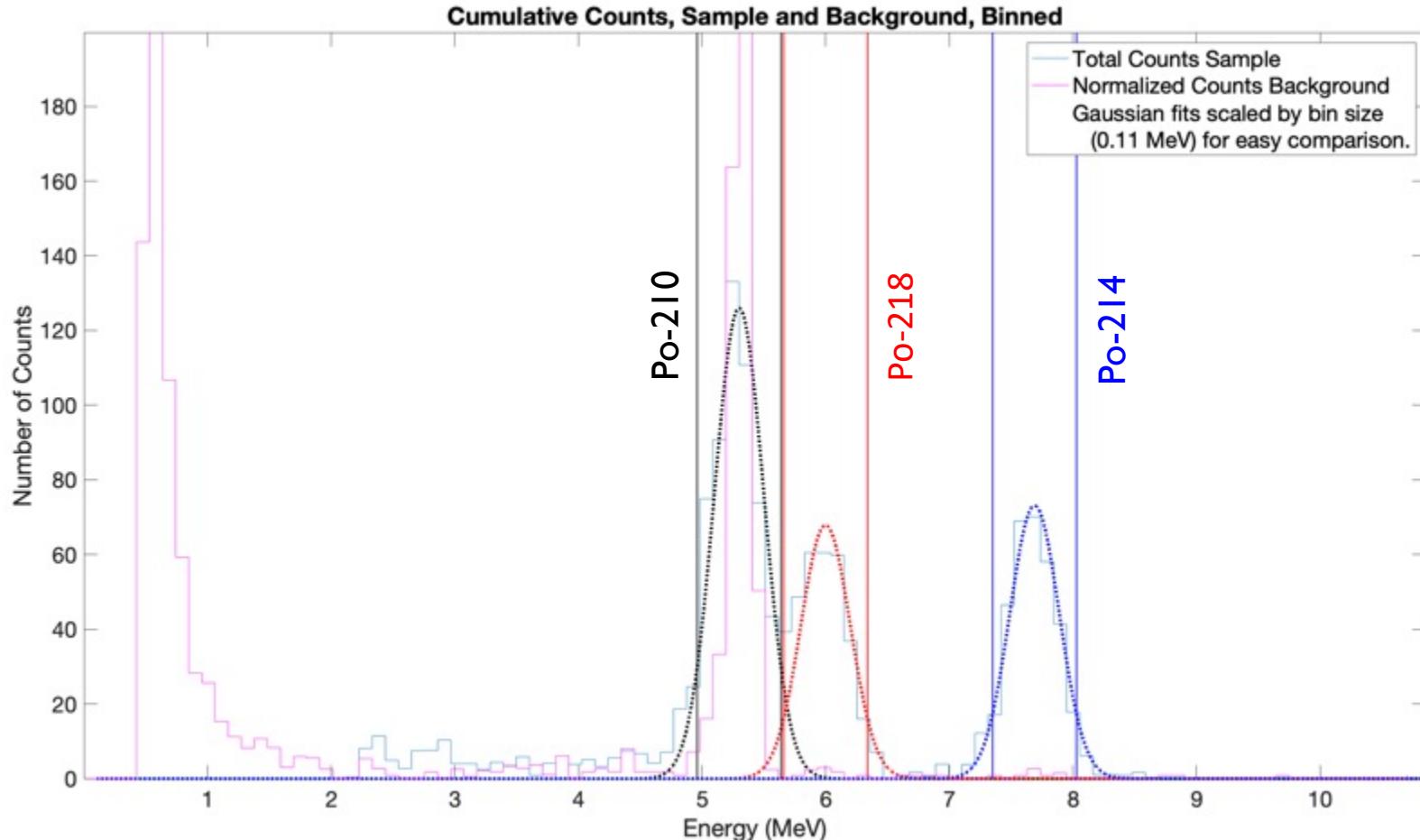
Run 656, Single Silicone Gasket #2: Gain correction w/ bad intervals



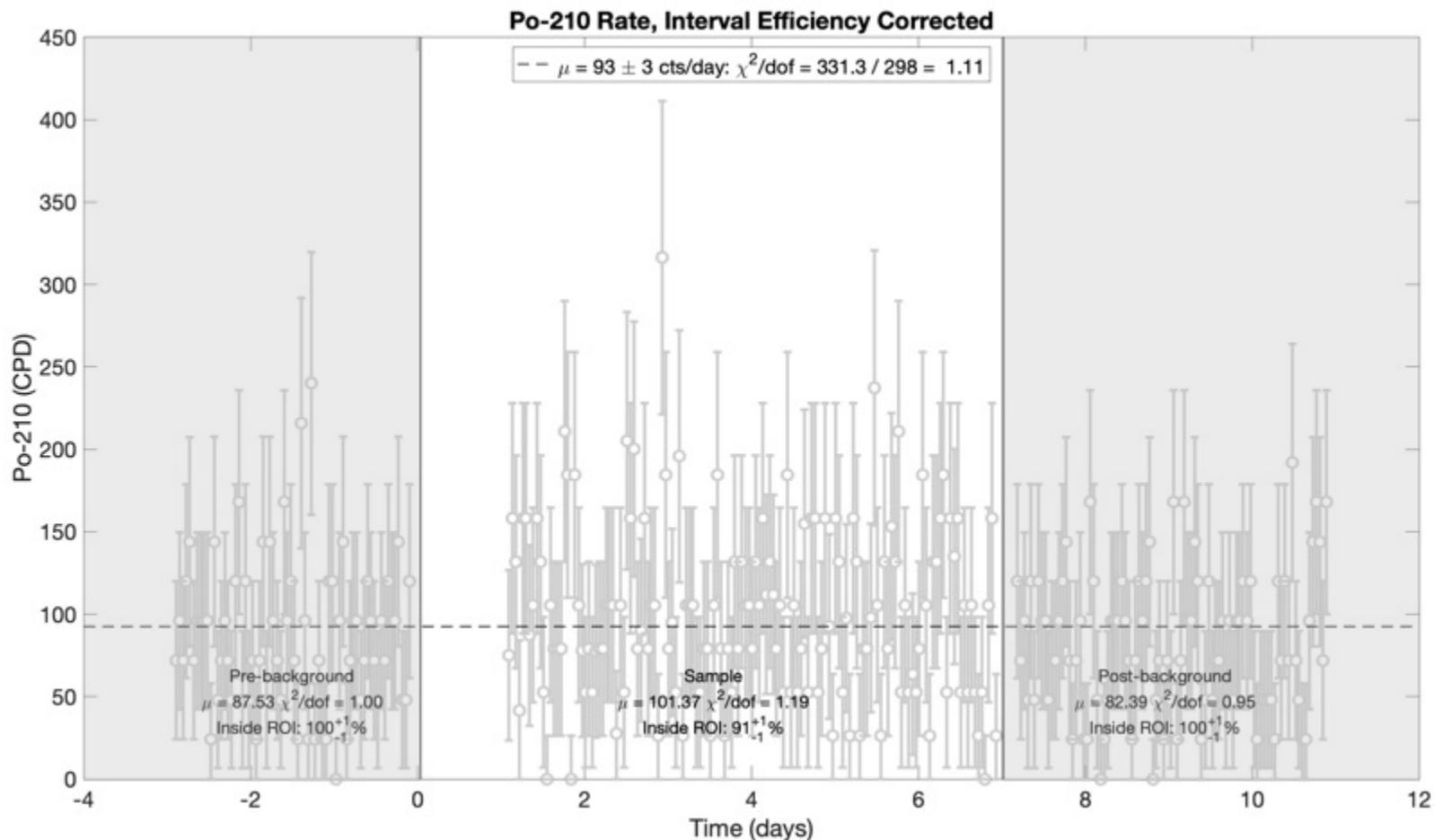
Run 656, Single Silicone Gasket #2: Gain correction w/o bad intervals



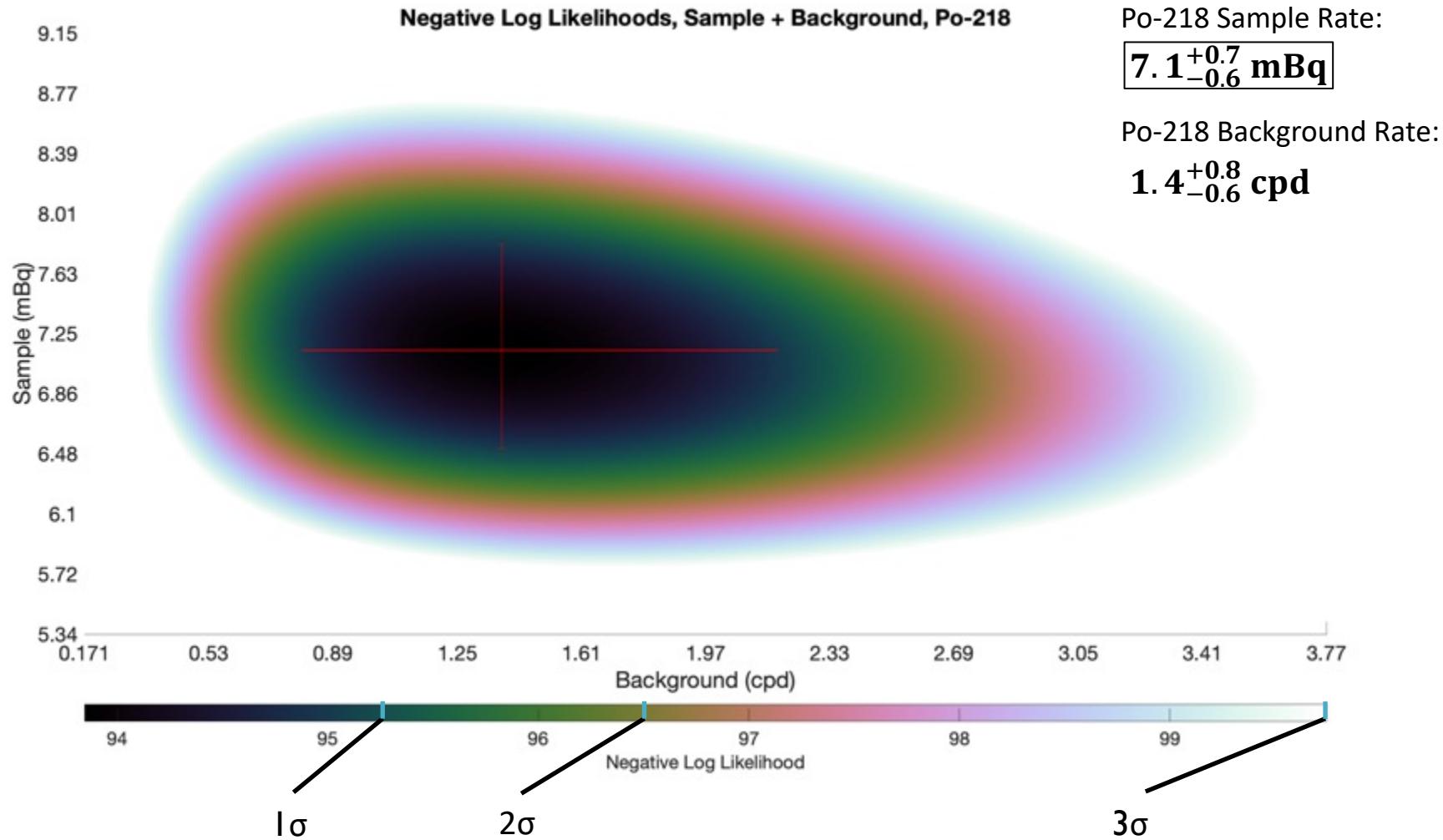
Run 656, Single Silicone Gasket #2: Cumulative counts



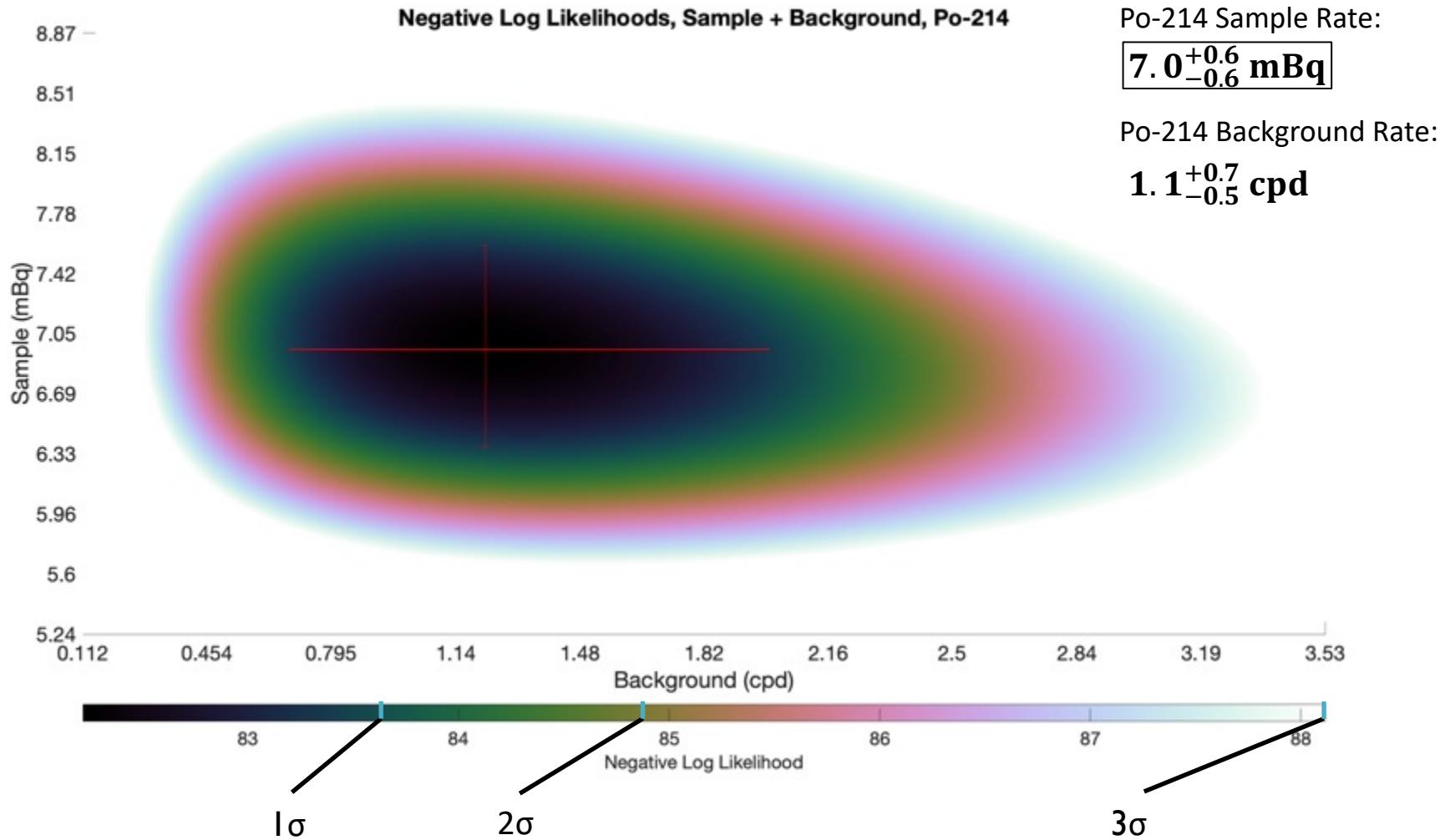
Run 656, Single Silicone Gasket #2: Po-210 rate



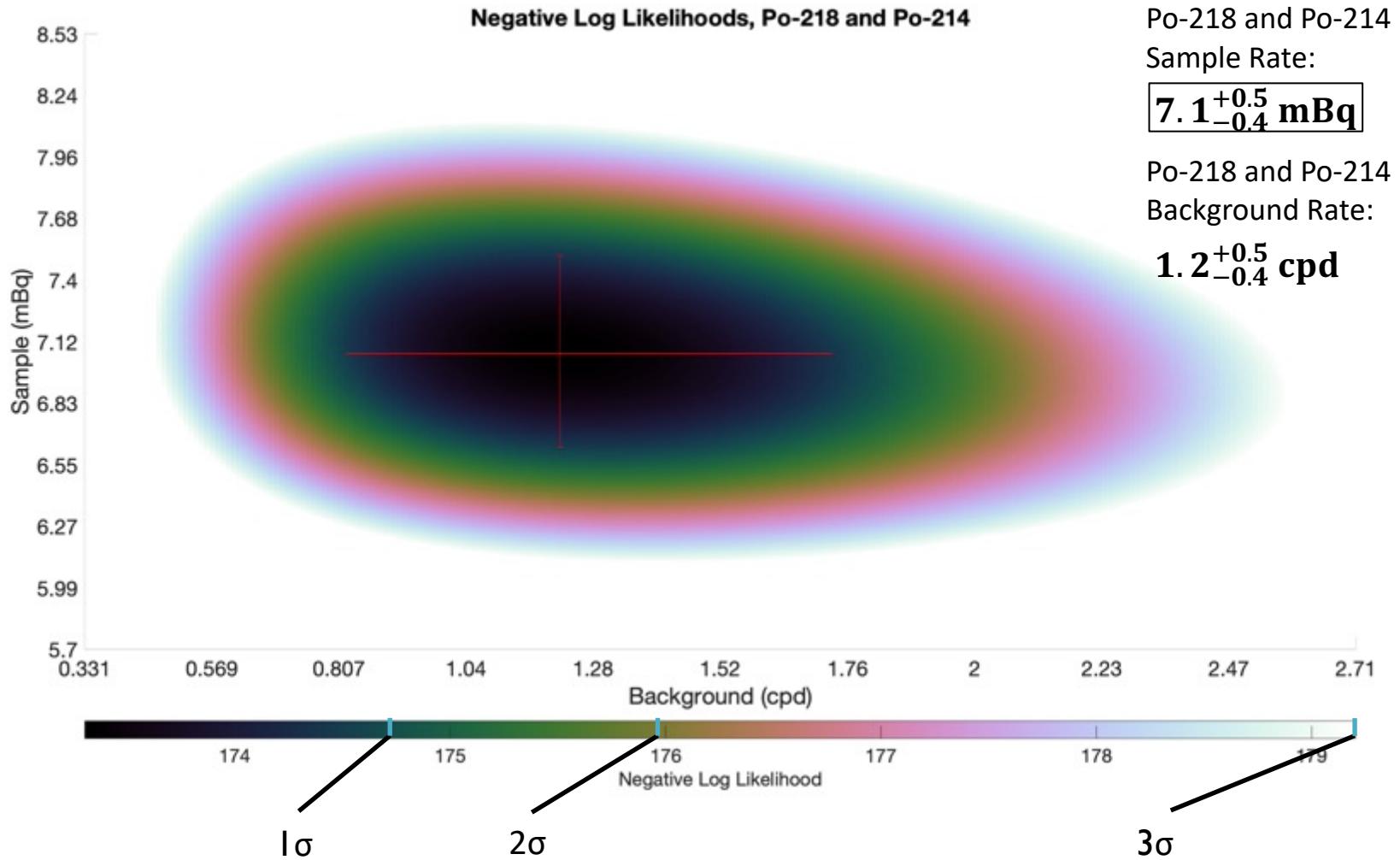
Run 656, Single Silicone Gasket #2: Po-218 Neg. Log Likelihoods



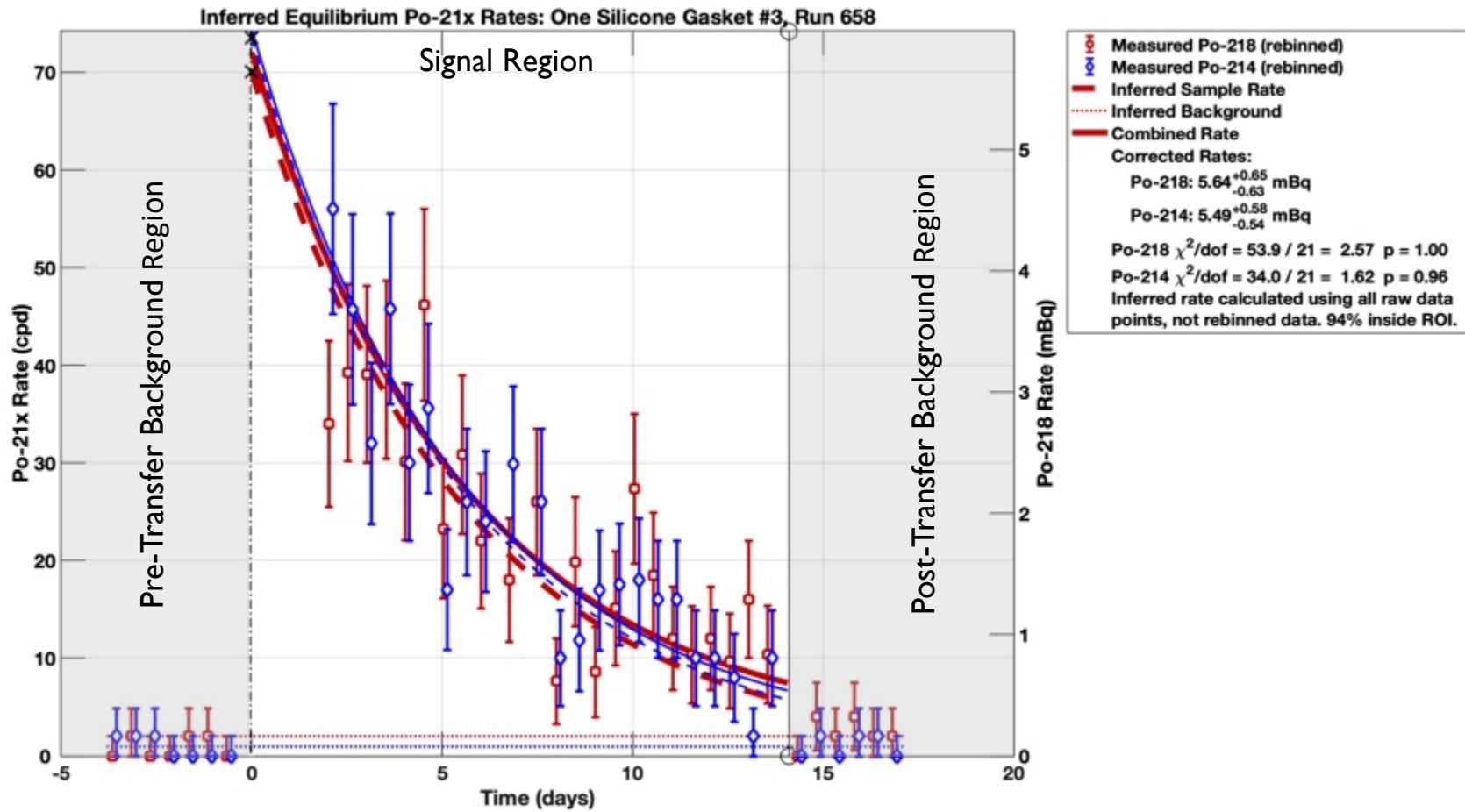
Run 656, Single Silicone Gasket #2: Po-214 Neg. Log Likelihoods



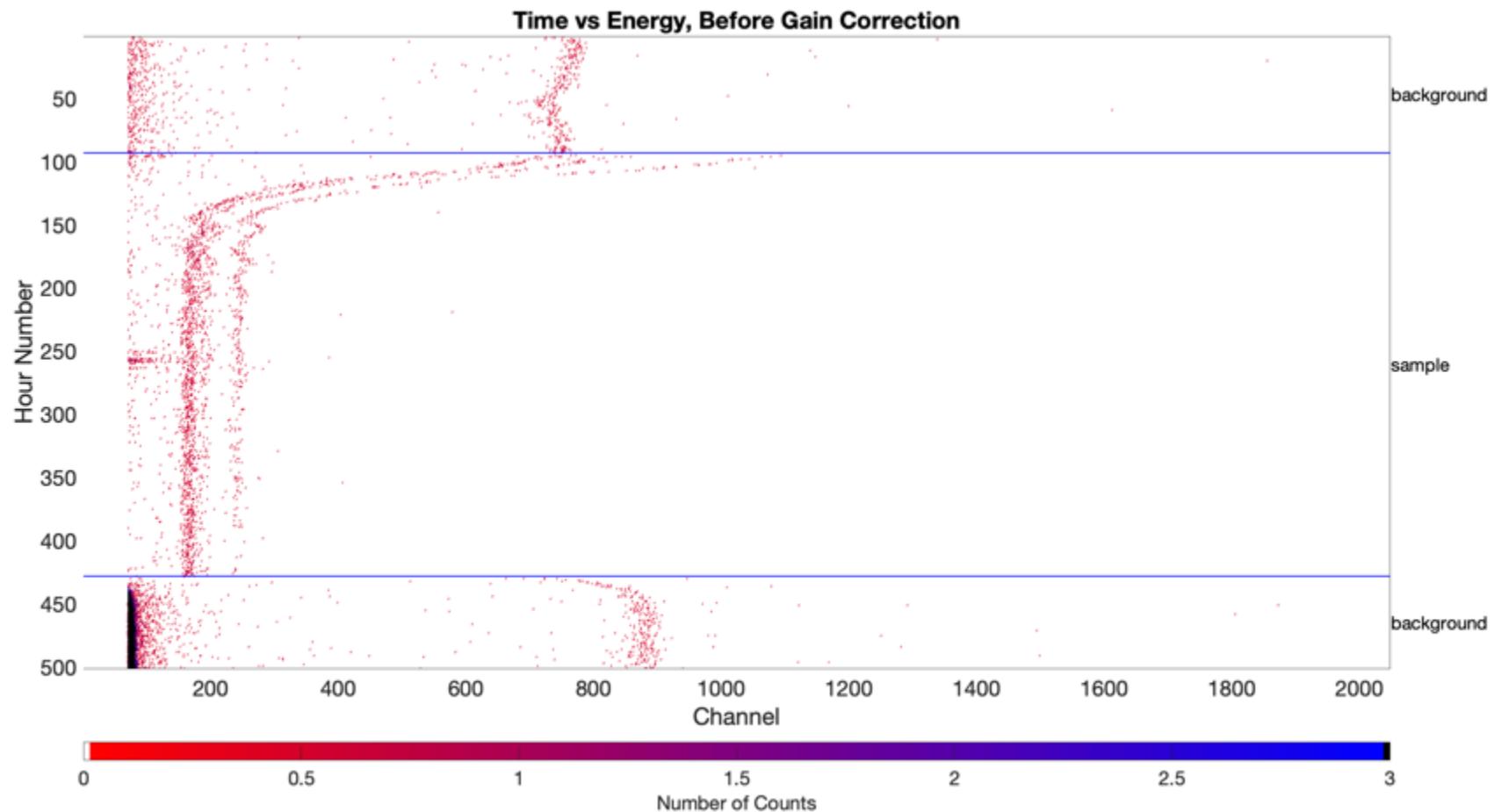
Run 656, Single Silicone Gasket #2: Po-218 & Po-214 Neg. Log Likelihoods



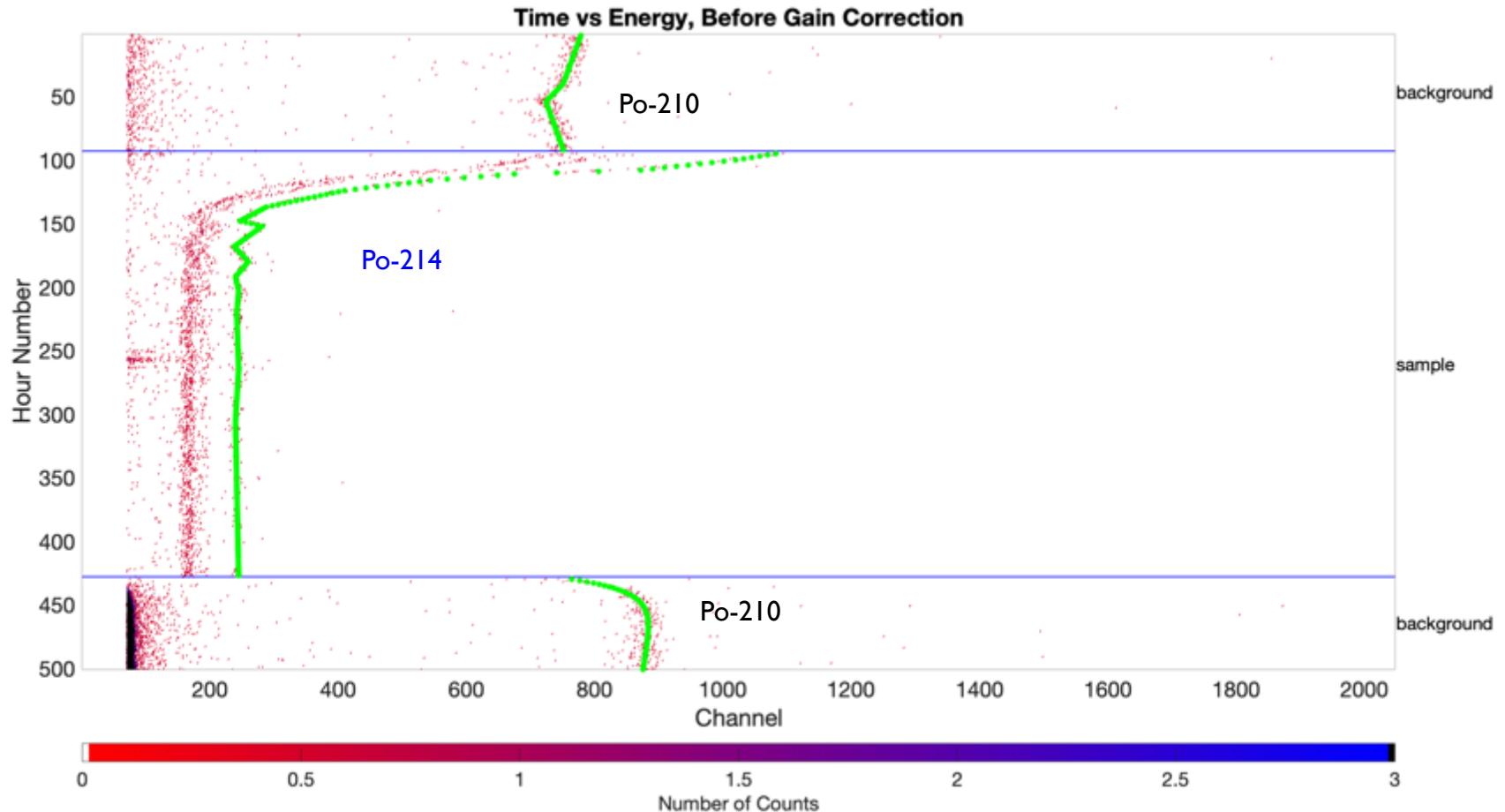
Run 658, Single Silicone Gasket #3: 3/19/2021 – 3/30/2021



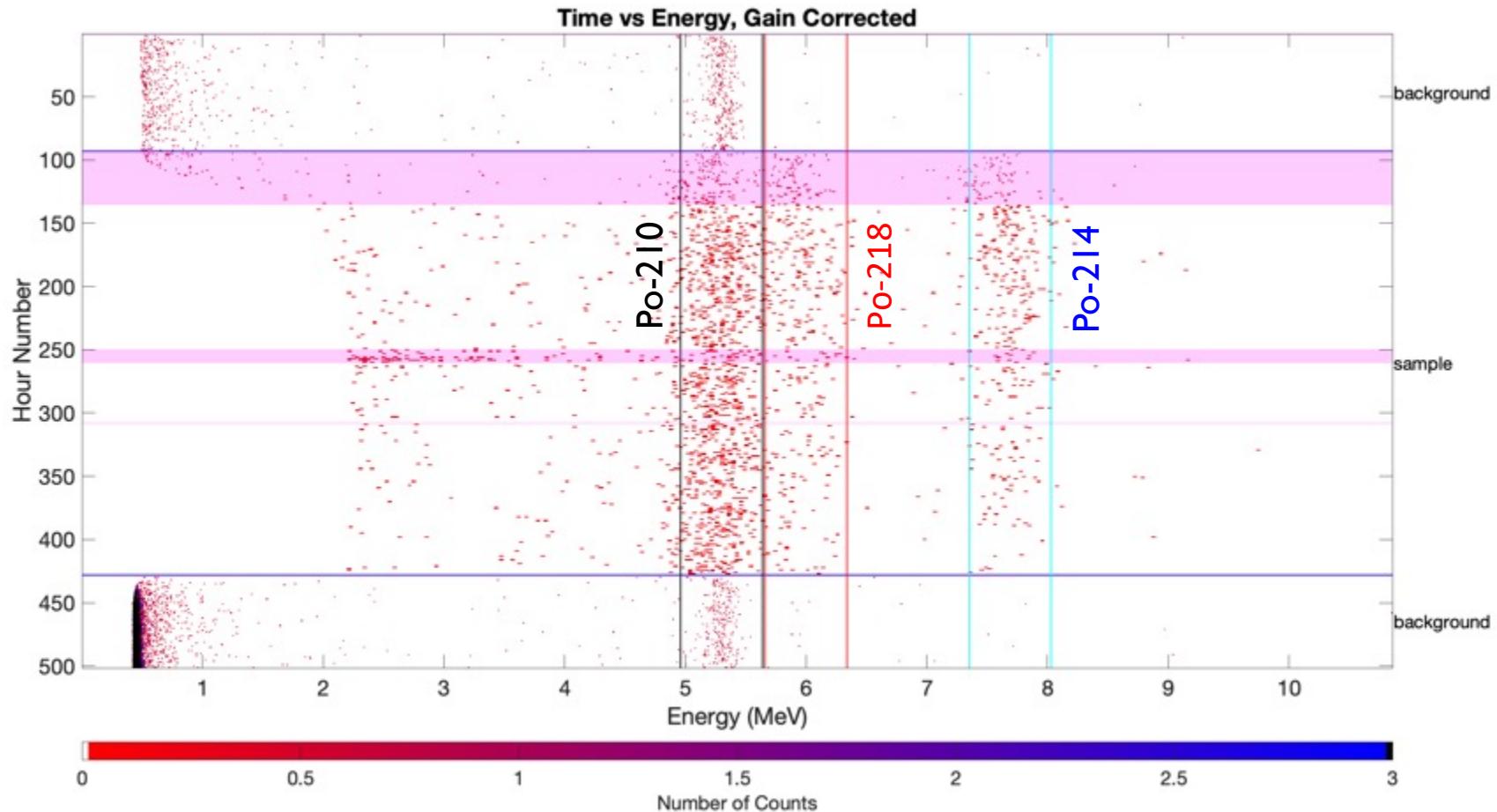
Run 658, Single Silicone Gasket #3: Raw data



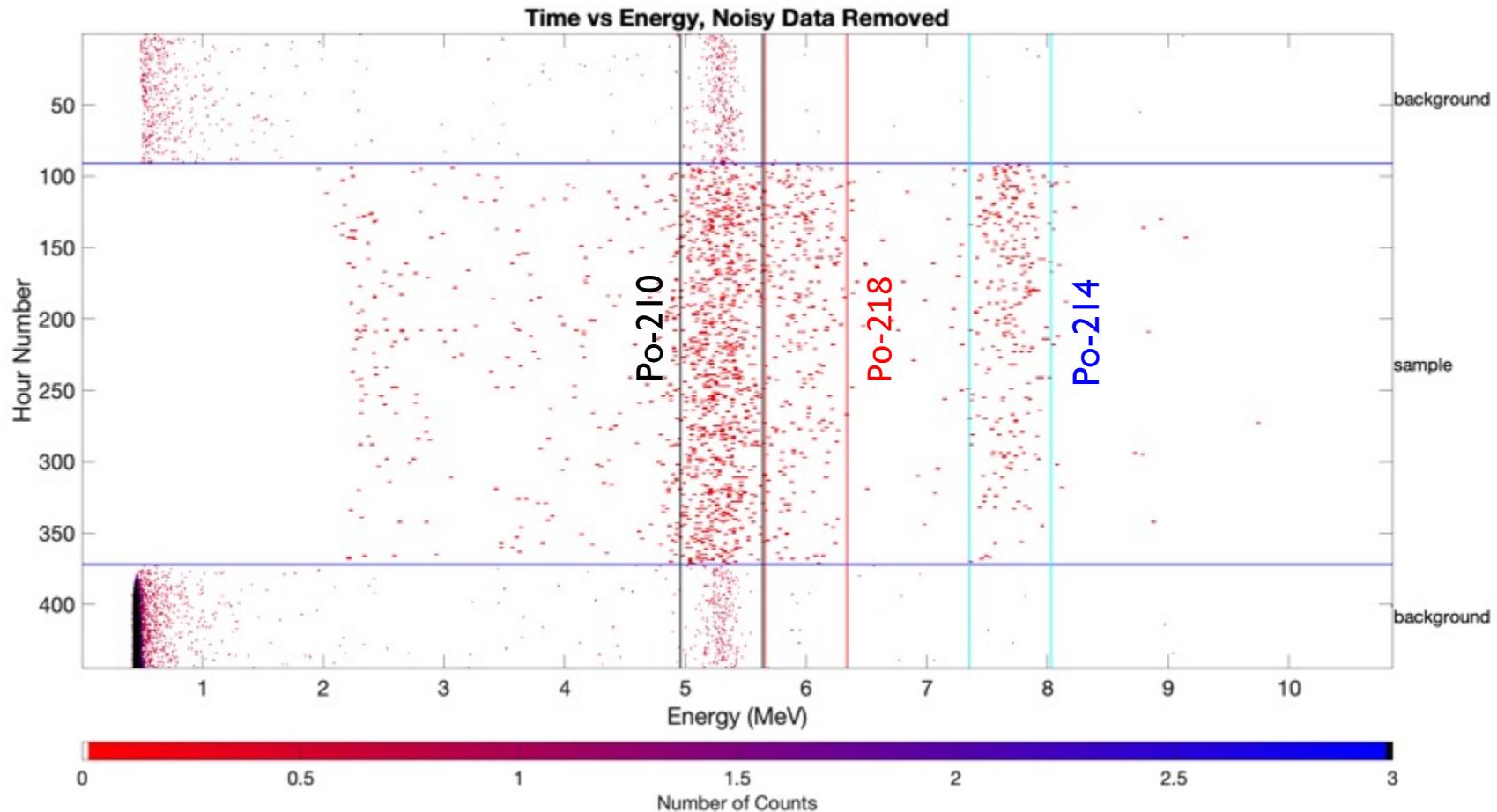
Run 658, Single Silicone Gasket #3: Fit of Po-21x events



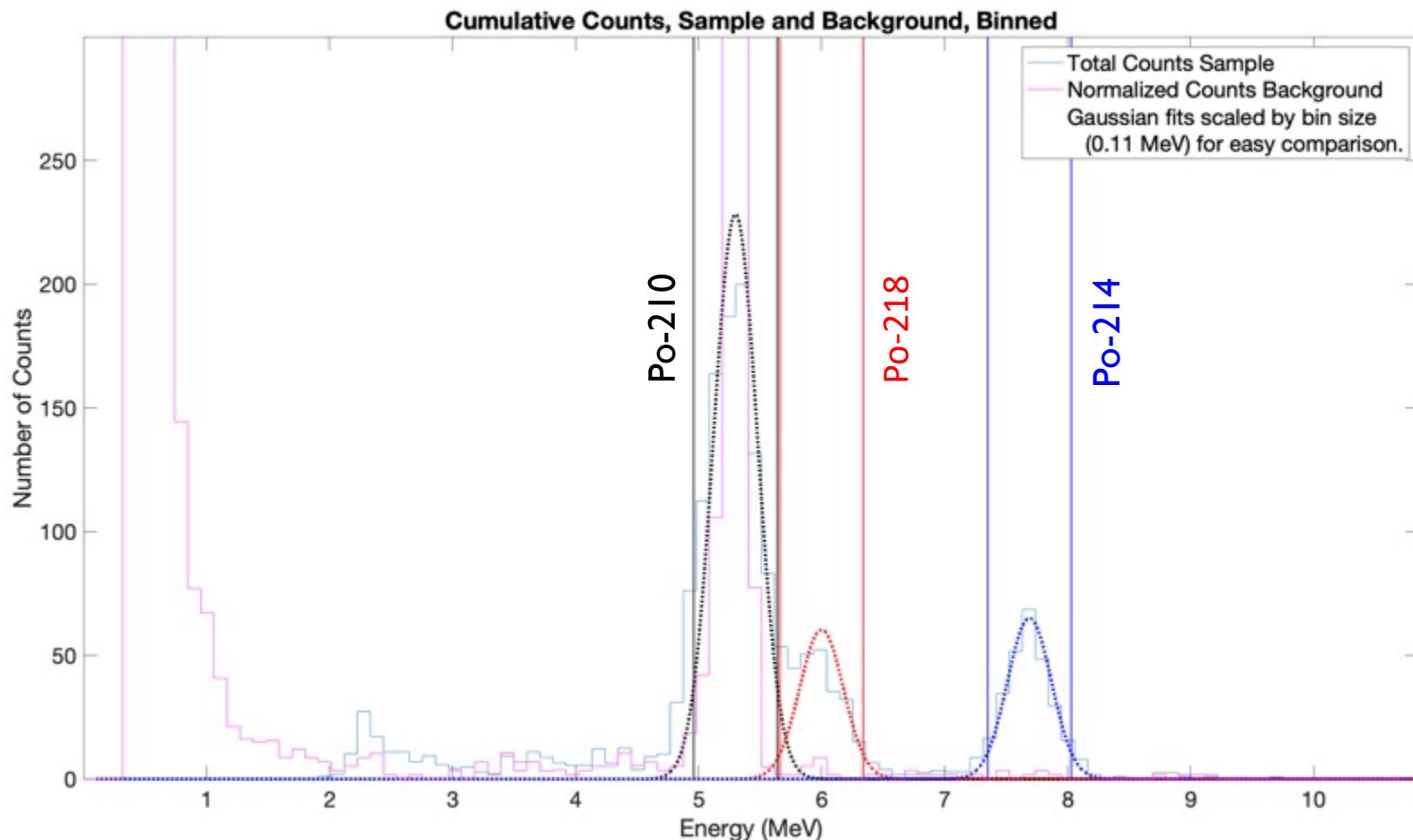
Run 658, Single Silicone Gasket #3: Gain correction w/ bad intervals



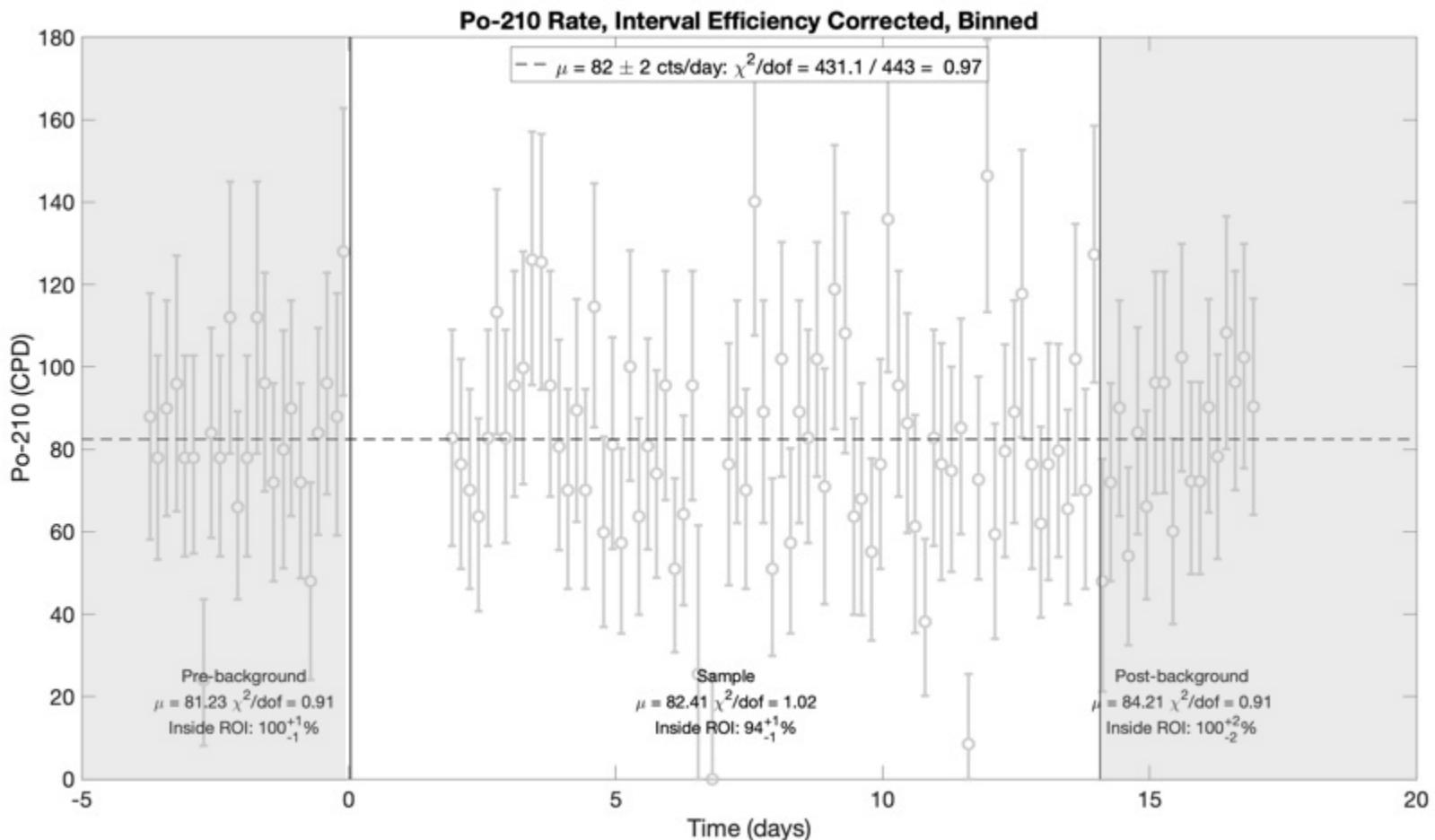
Run 658, Single Silicone Gasket #3: Gain correction w/o bad intervals



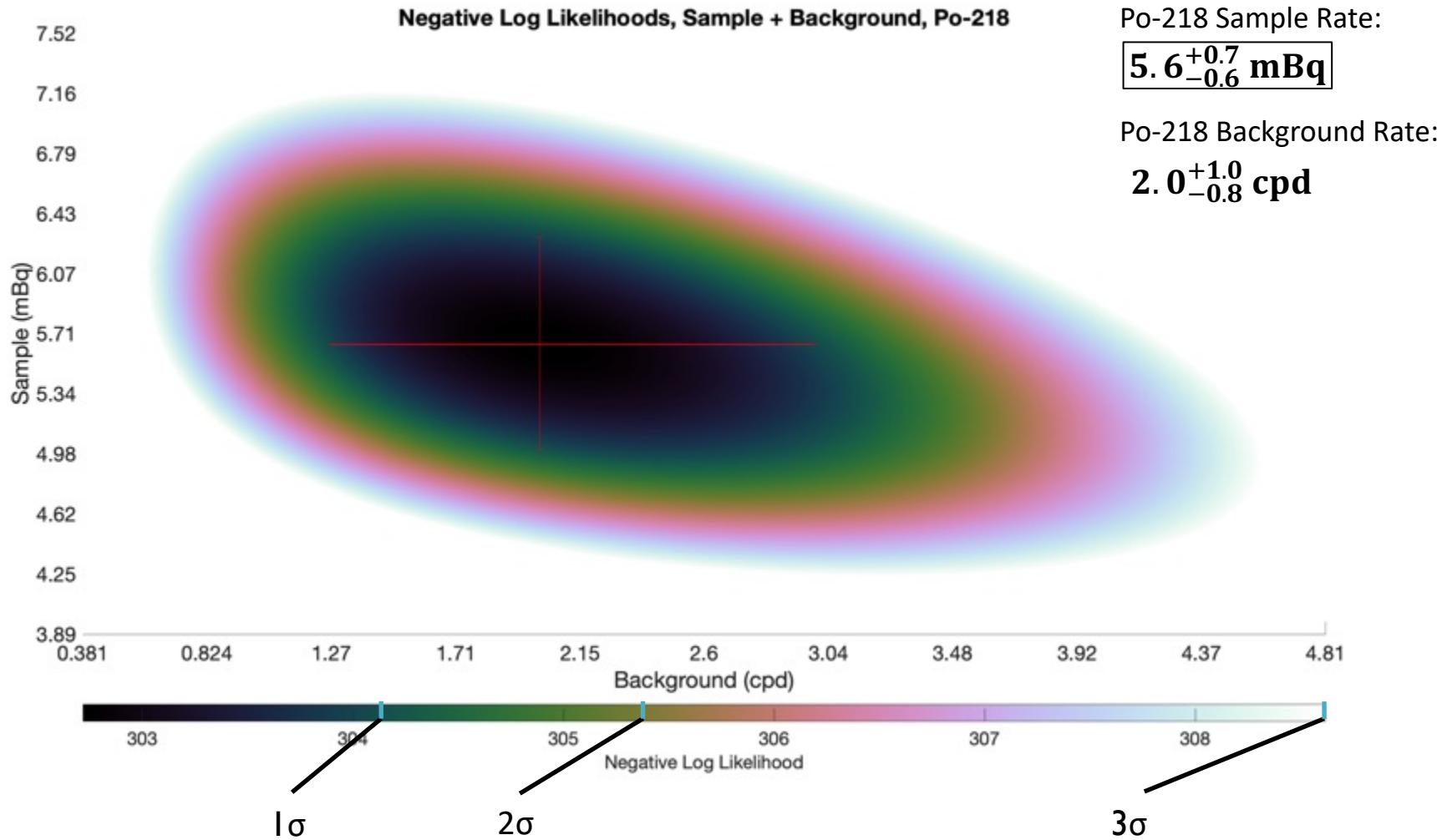
Run 658, Single Silicone Gasket #3: Cumulative counts



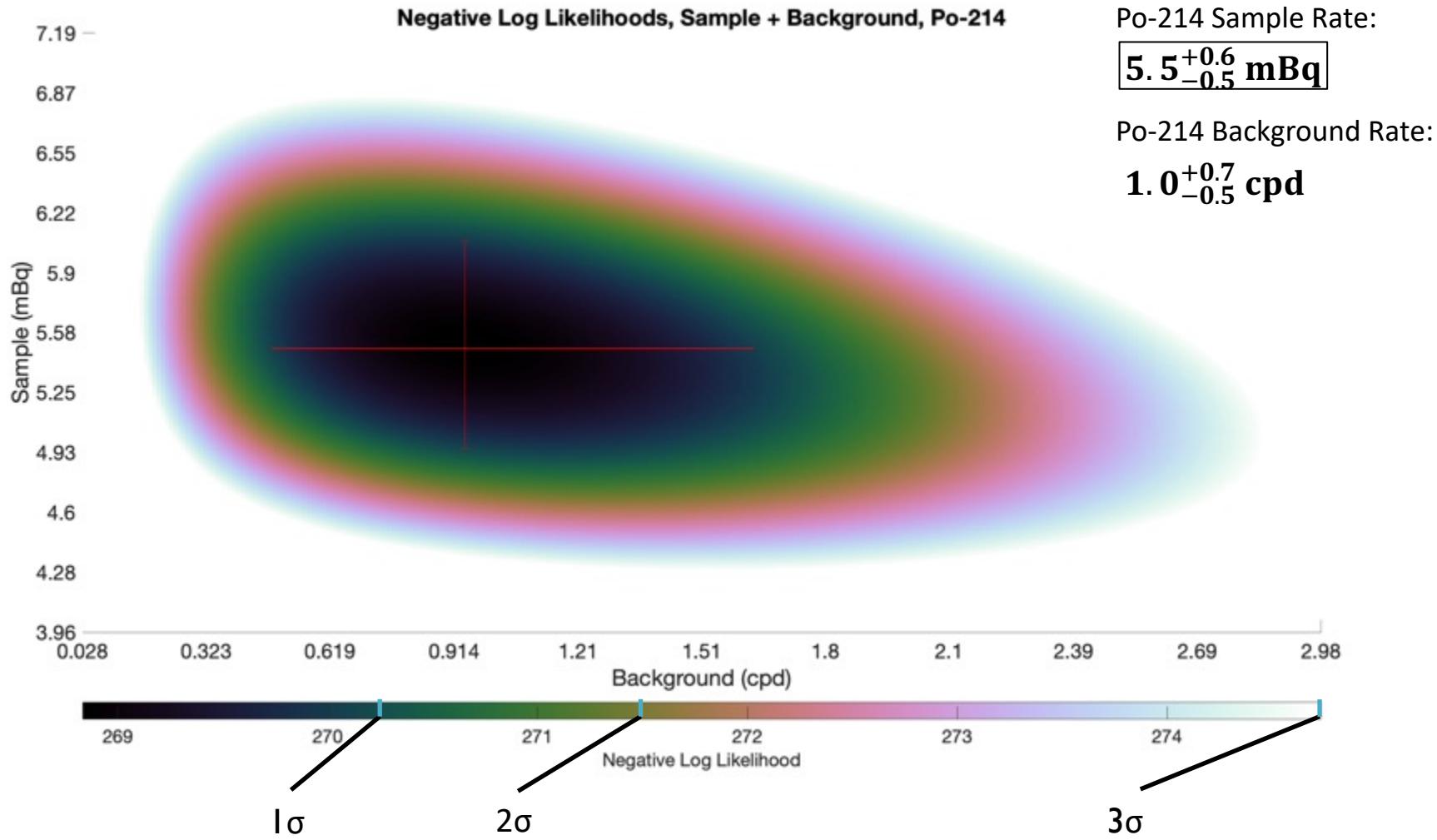
Run 658, Single Silicone Gasket #3: Po-210 rate



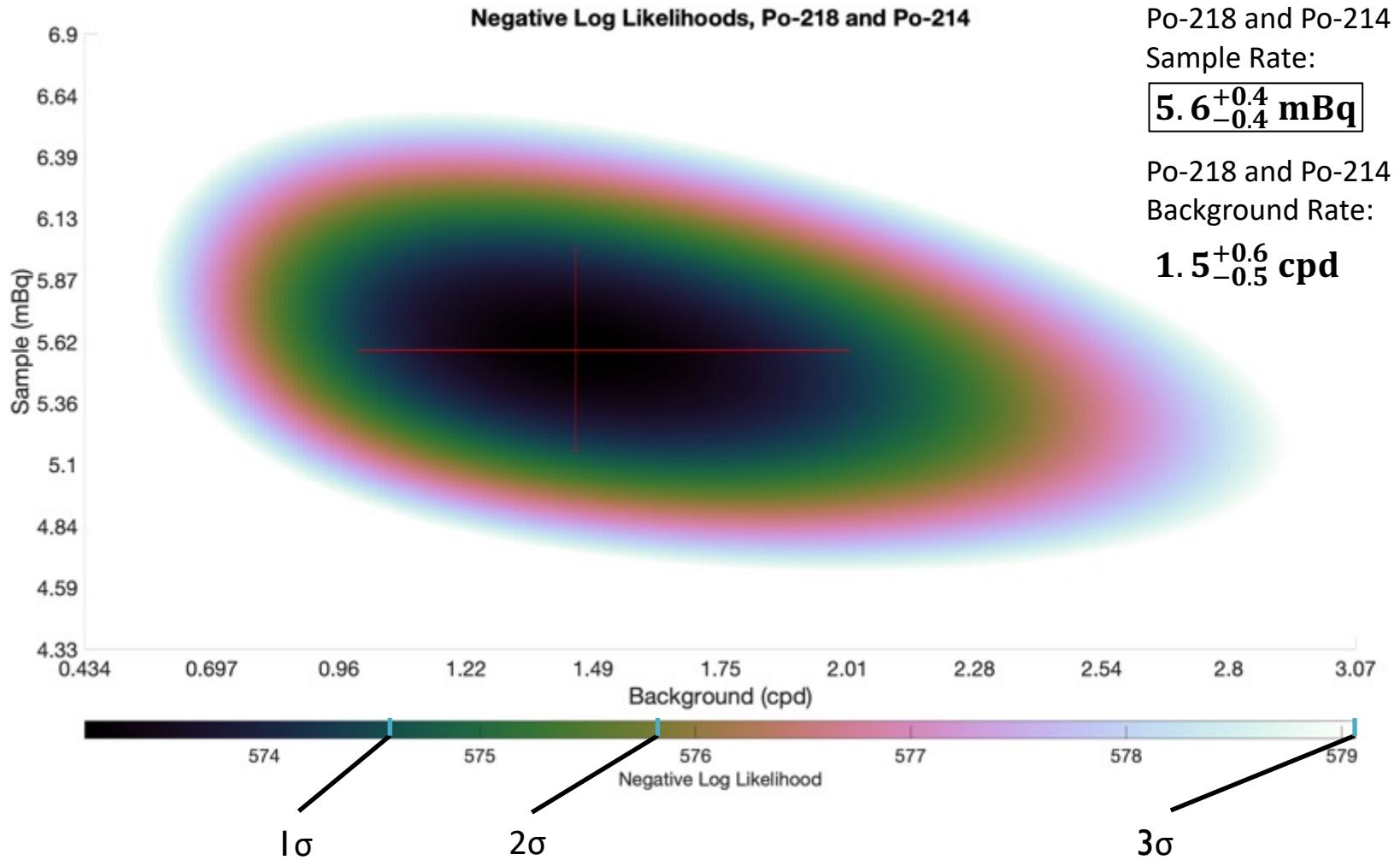
Run 658, Single Silicone Gasket #3: Po-218 Neg. Log Likelihoods



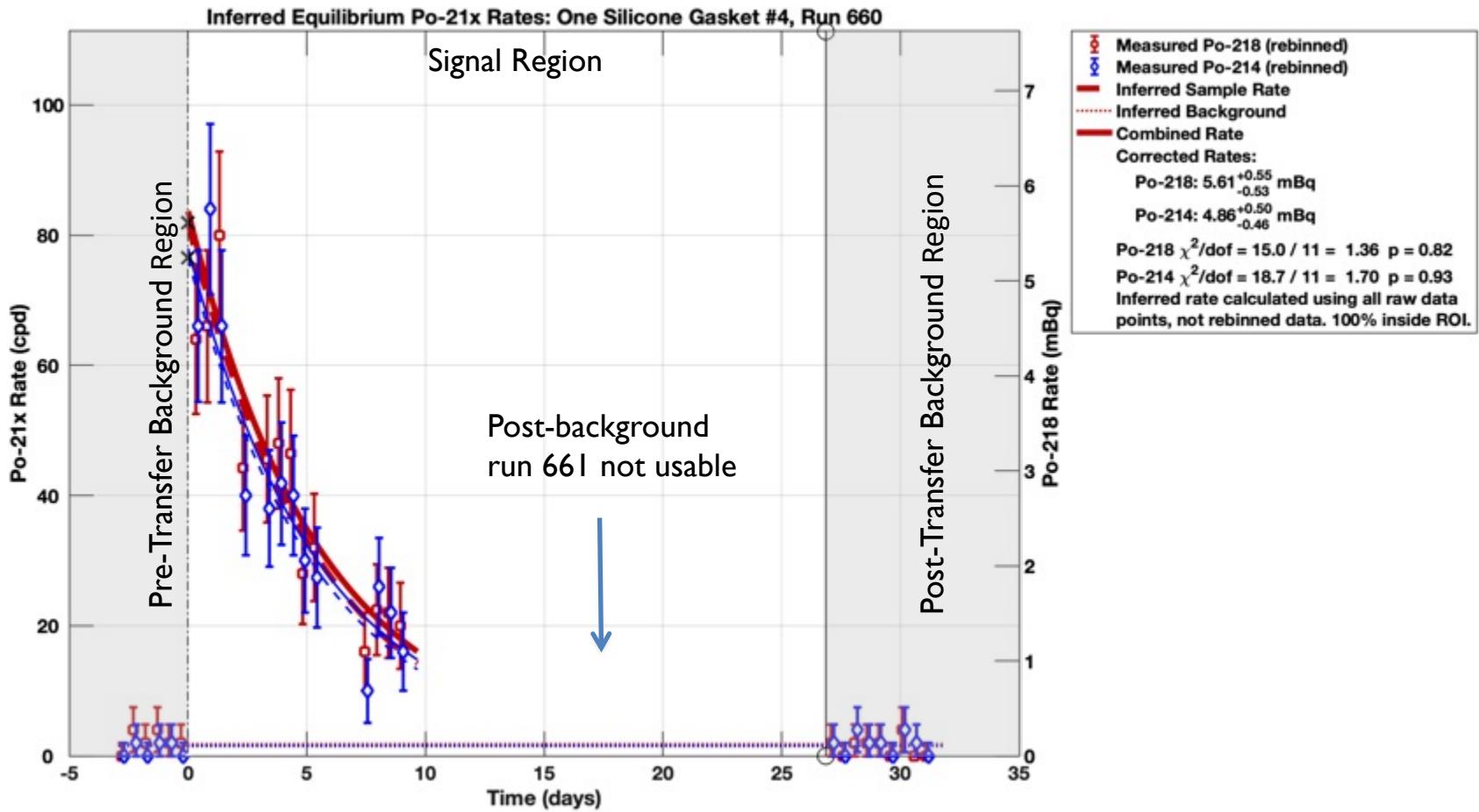
Run 658, Single Silicone Gasket #3: Po-214 Neg. Log Likelihoods



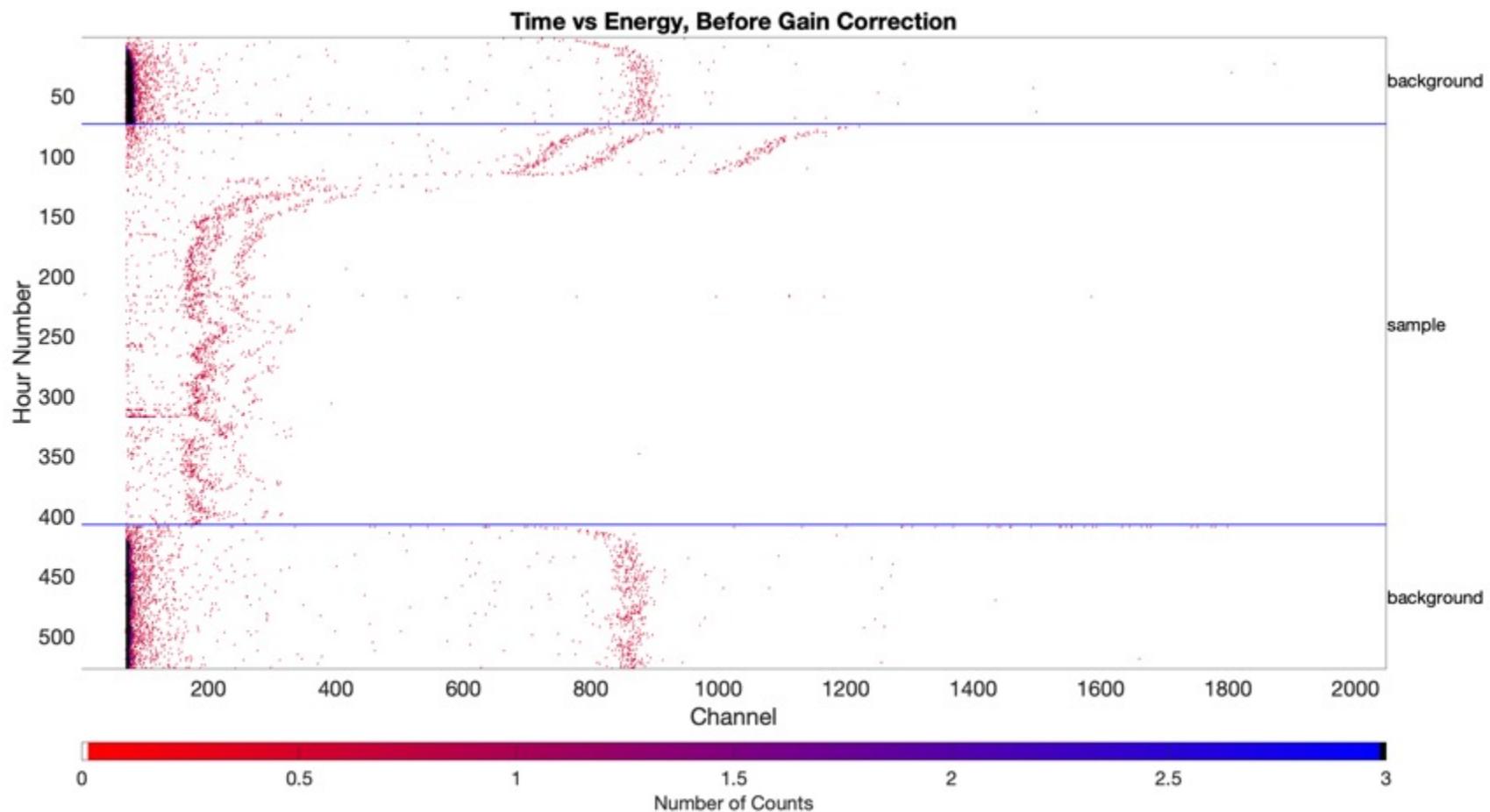
Run 658, Single Silicone Gasket #3: Po-218 & Po-214 Neg. Log Likelihoods



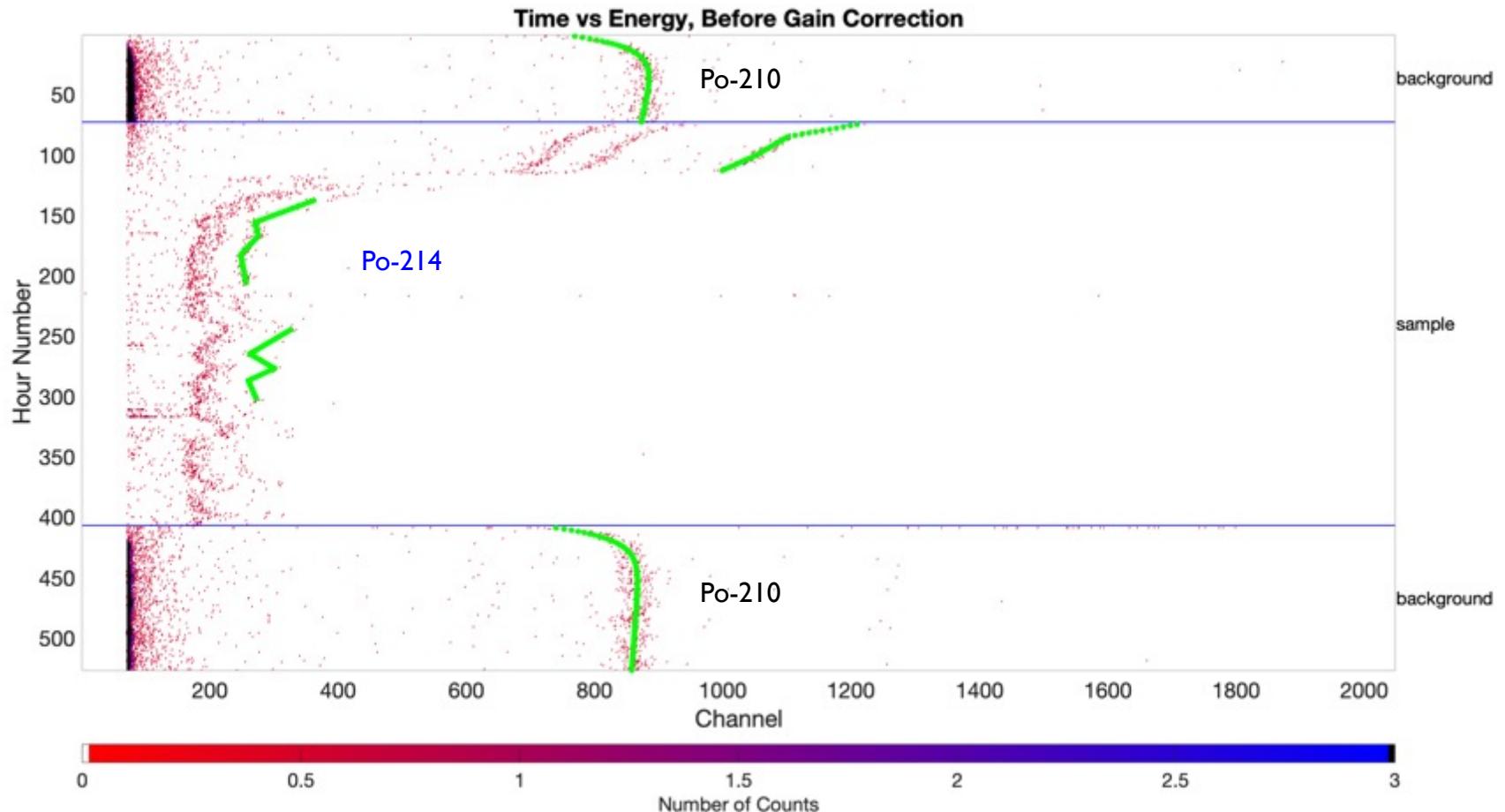
Run 660, Single Silicone Gasket #4: 3/30/2021 – 4/16/2021



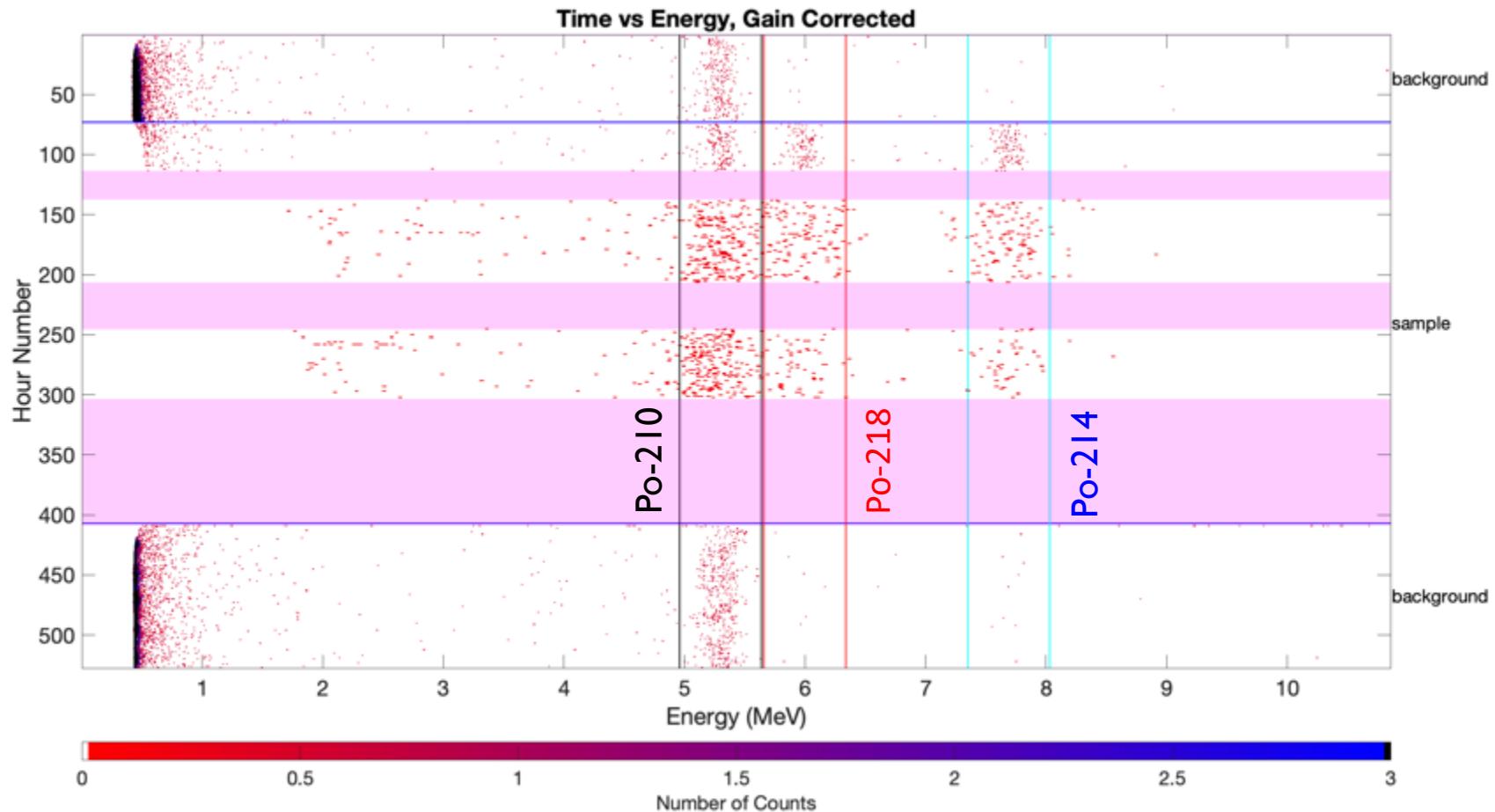
Run 660, Single Silicone Gasket #4: Raw data



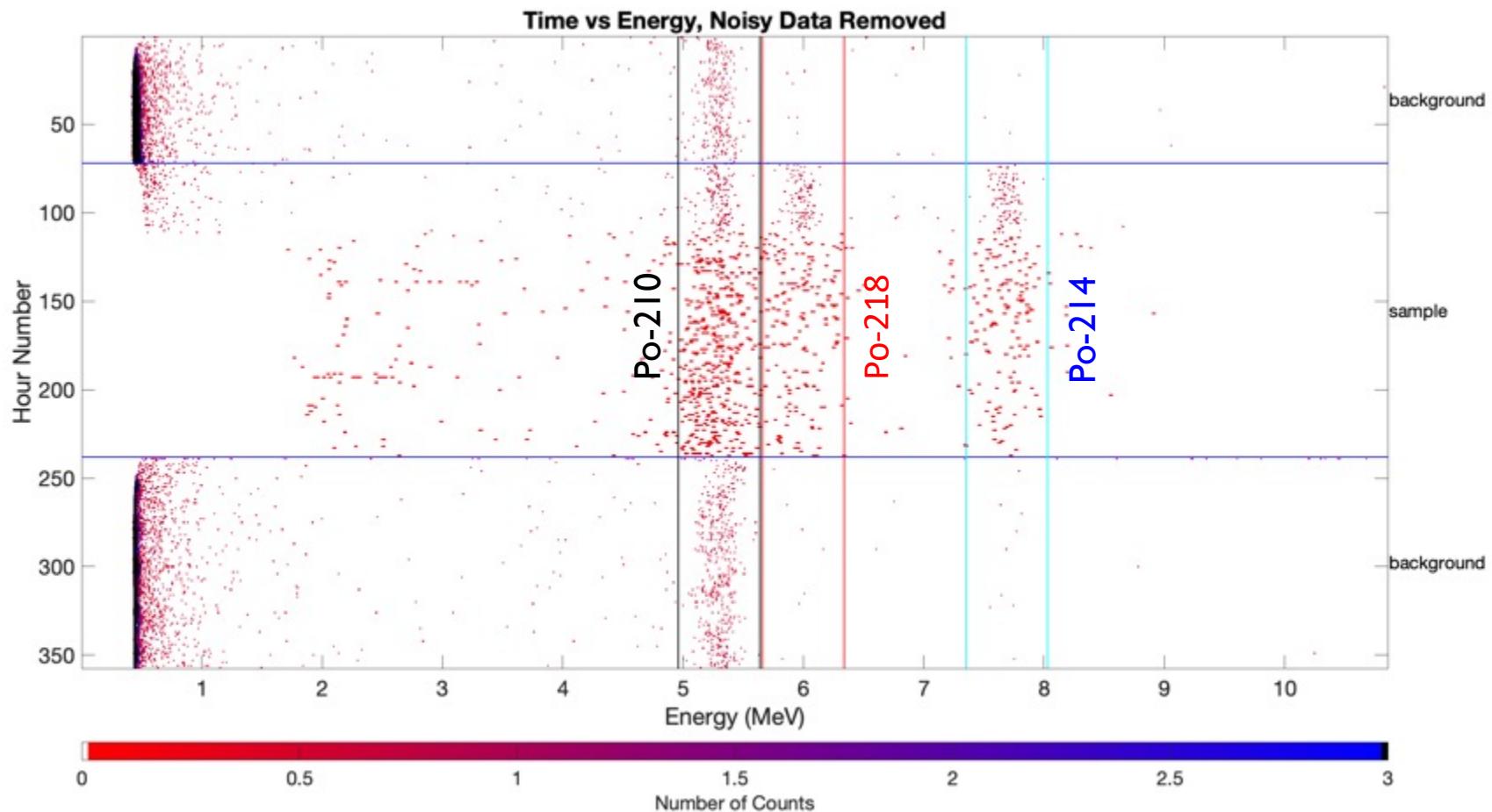
Run 660, Single Silicone Gasket #4: Fit of Po-21x events



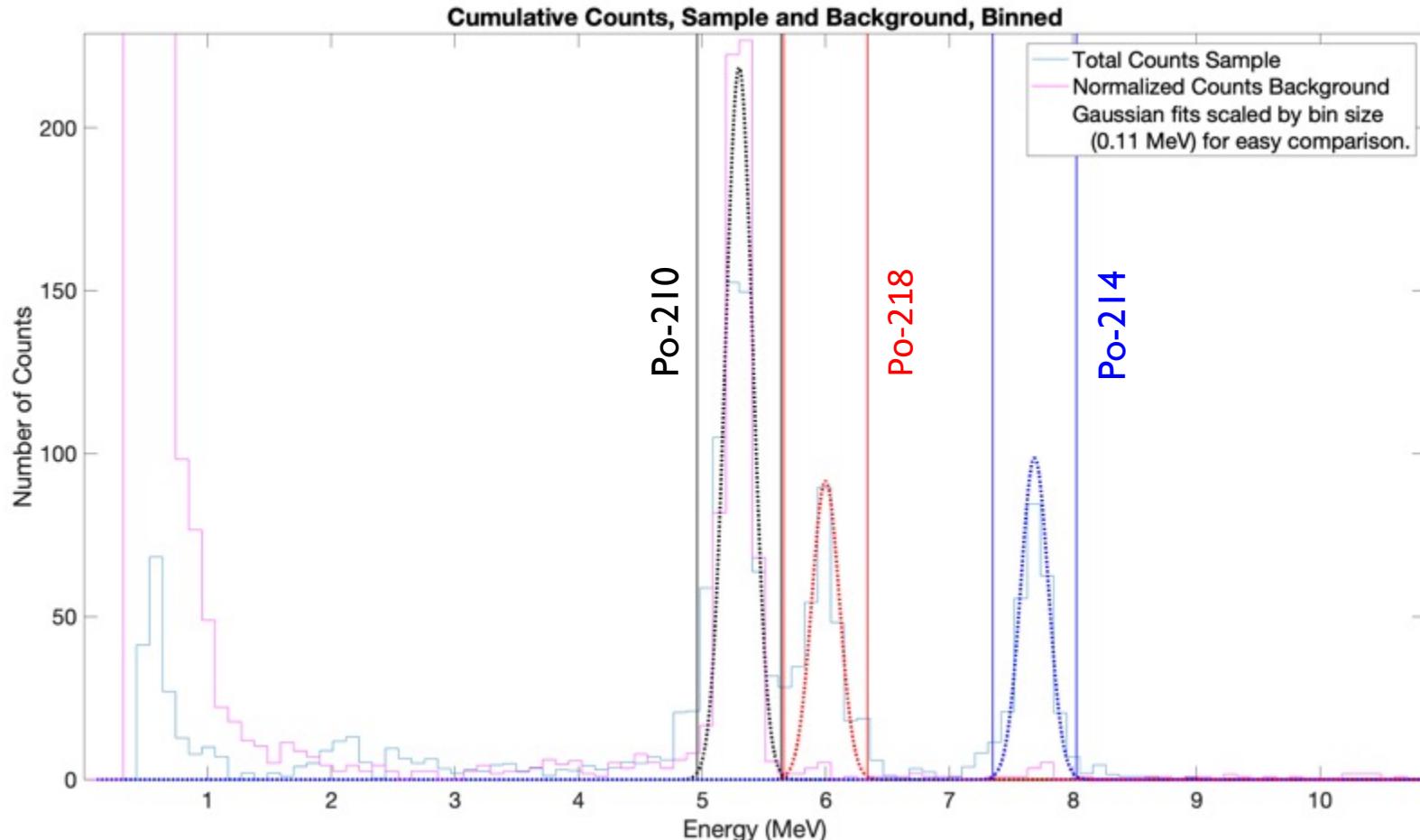
Run 660, One Silicone Gasket #4: Gain correction w/ bad intervals



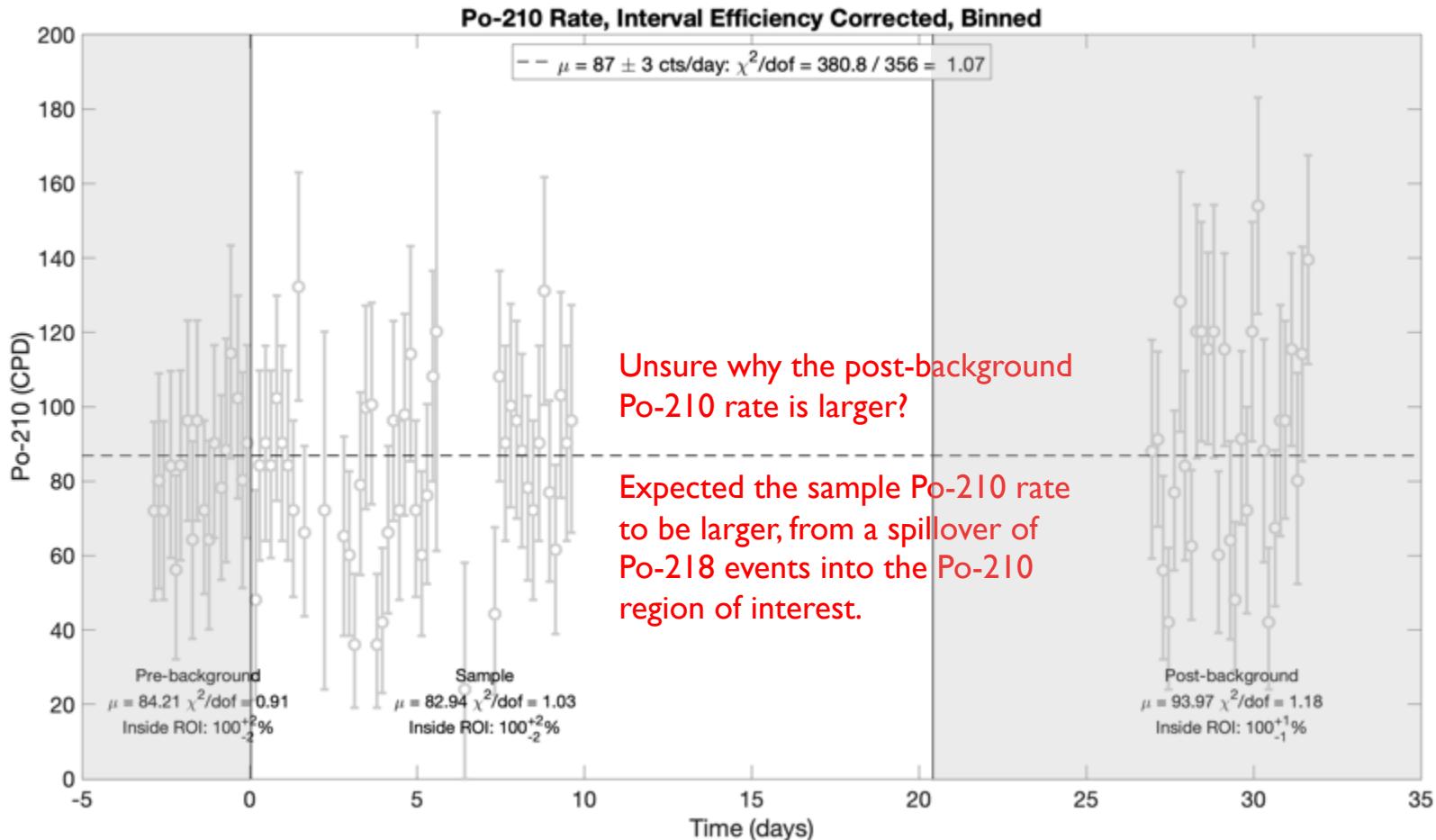
Run 660, One Silicone Gasket #4: Gain correction w/o bad intervals



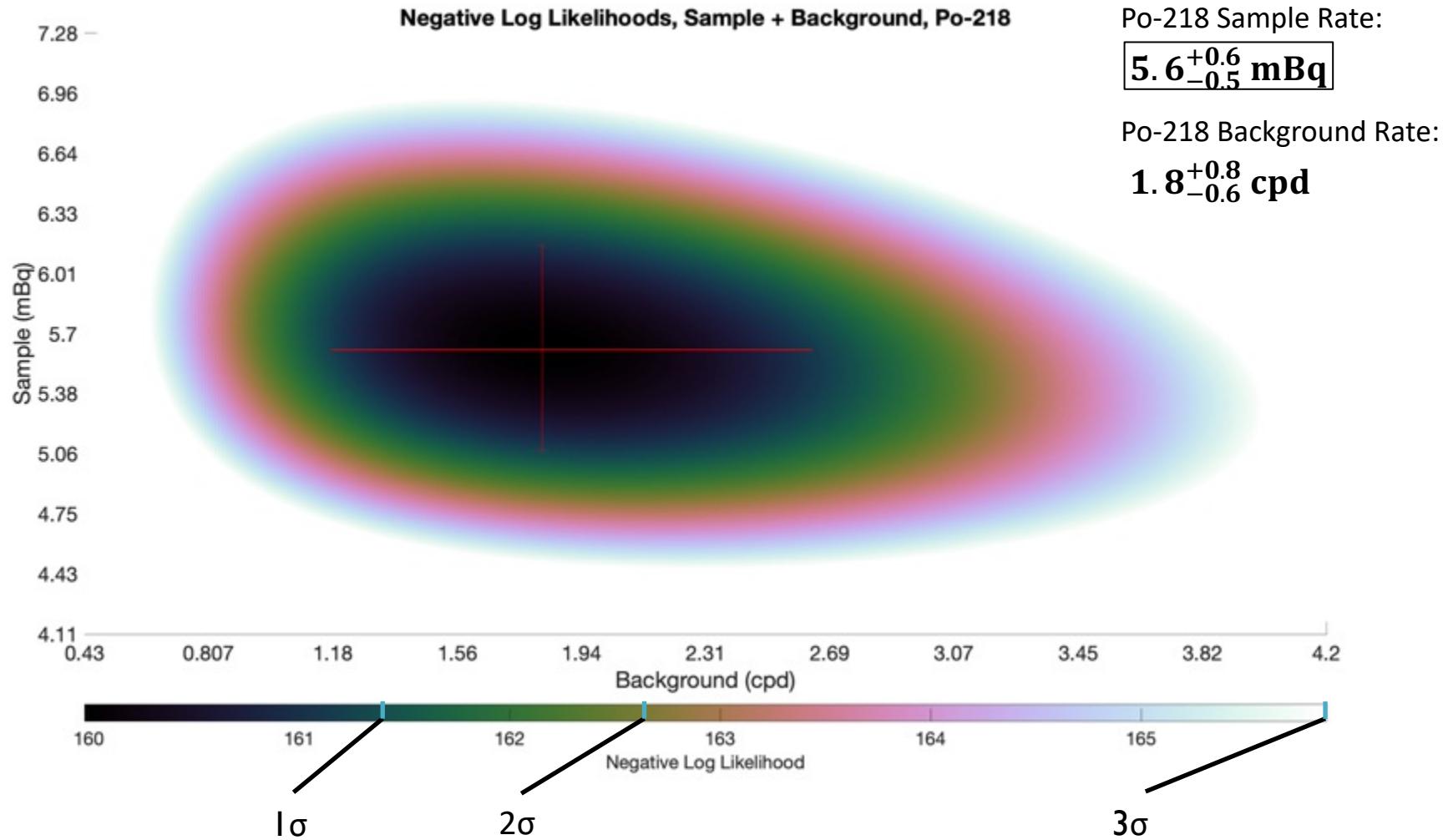
Run 660, Single Silicone Gasket #4: Cumulative counts



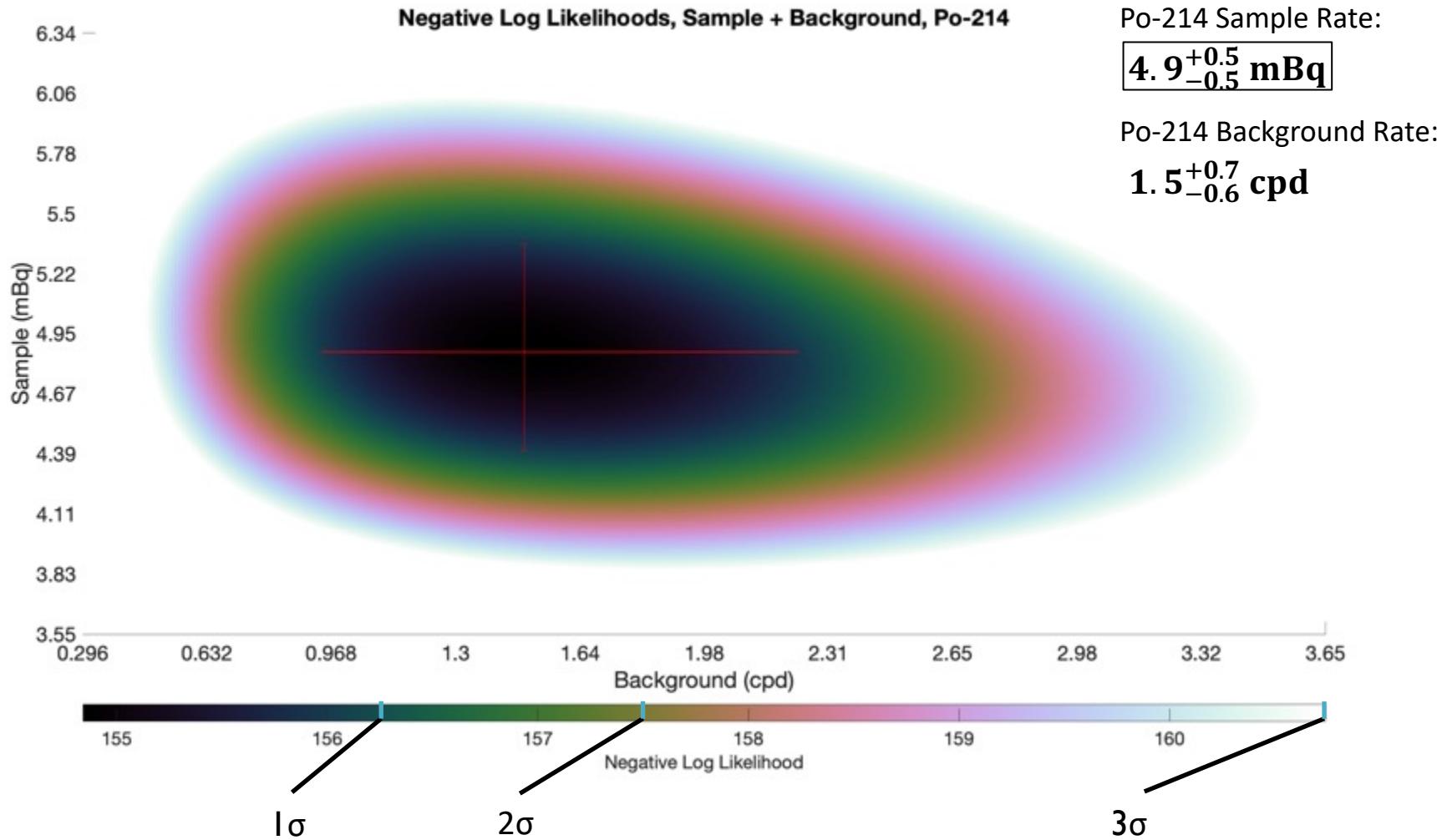
Run 660, Single Silicone Gasket #4: Po-210 rate



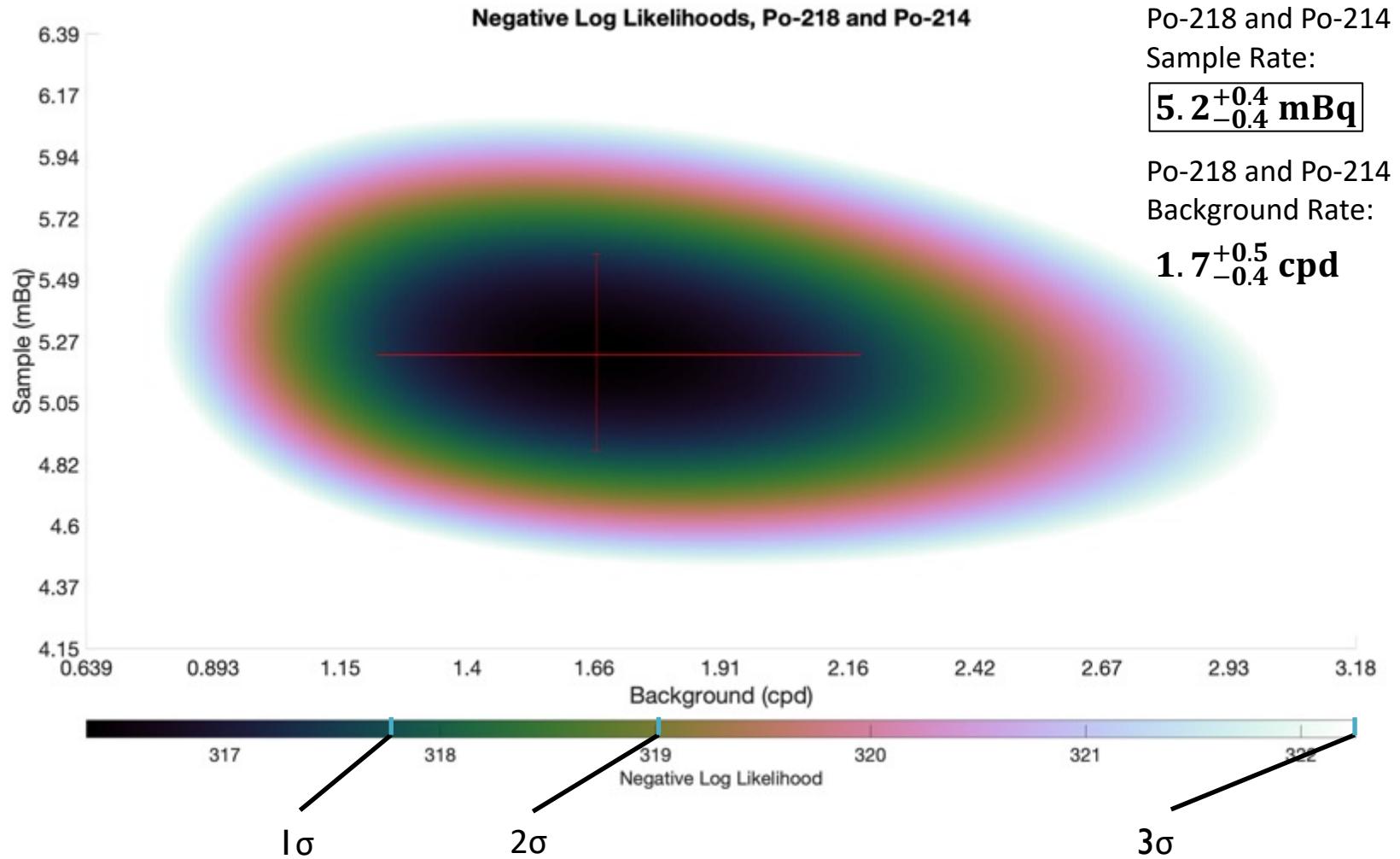
Run 660, Single Silicone Gasket #4: Po-218 Neg. Log Likelihoods



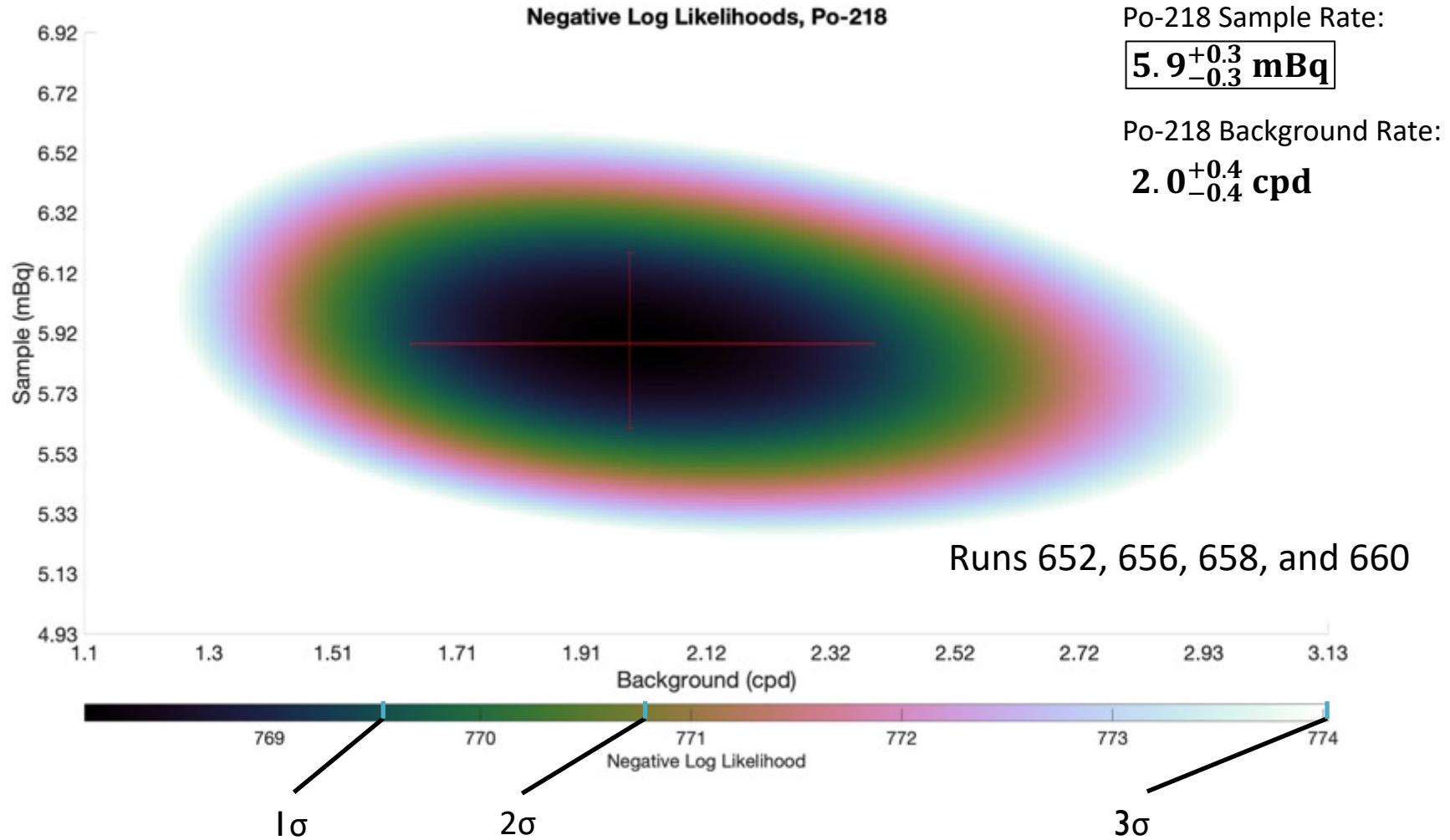
Run 660, Single Silicone Gasket #4: Po-214 Neg. Log Likelihoods



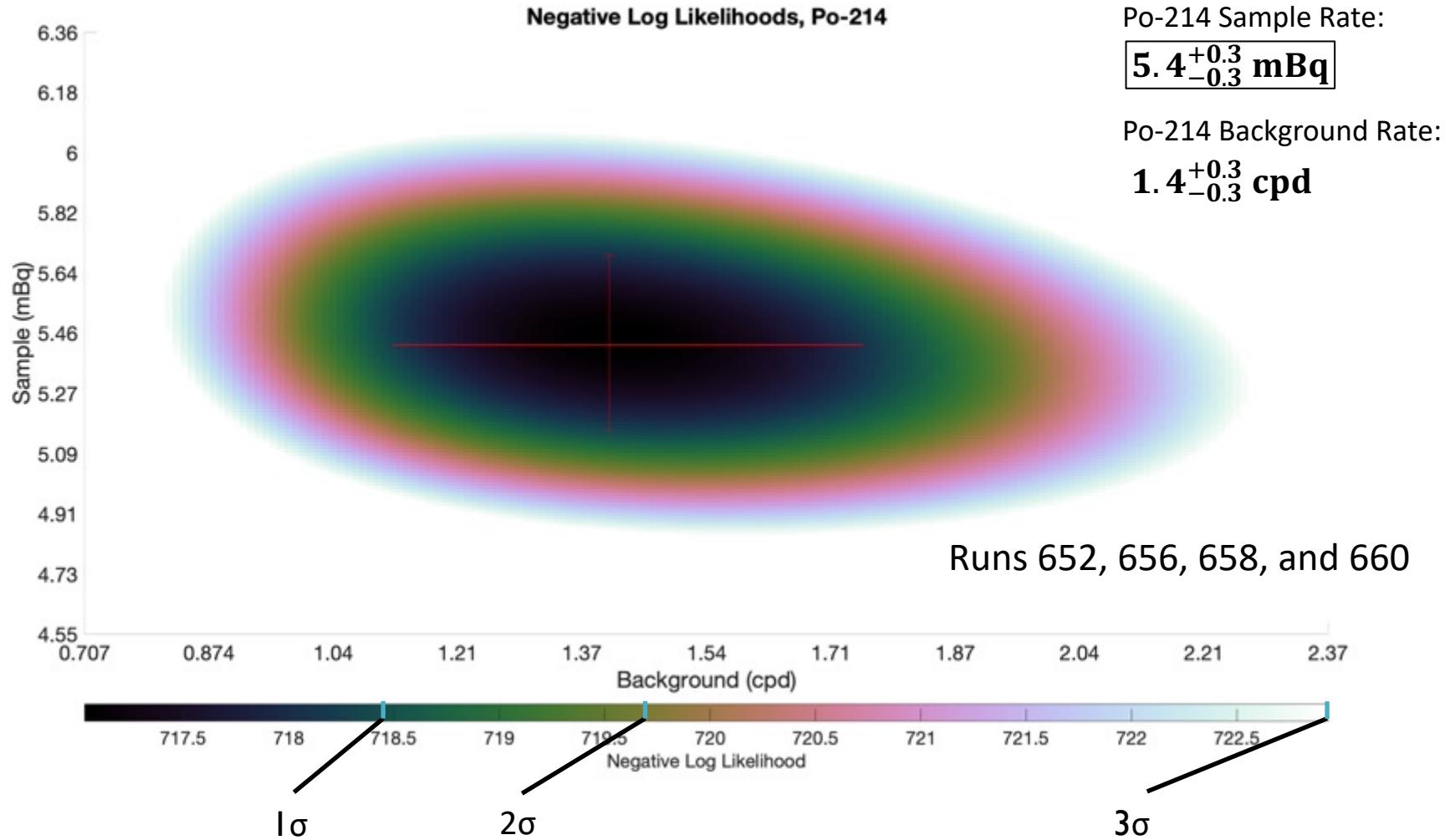
Run 660, Single Silicone Gasket #4: Po-218 & Po-214 Neg. Log Likelihoods



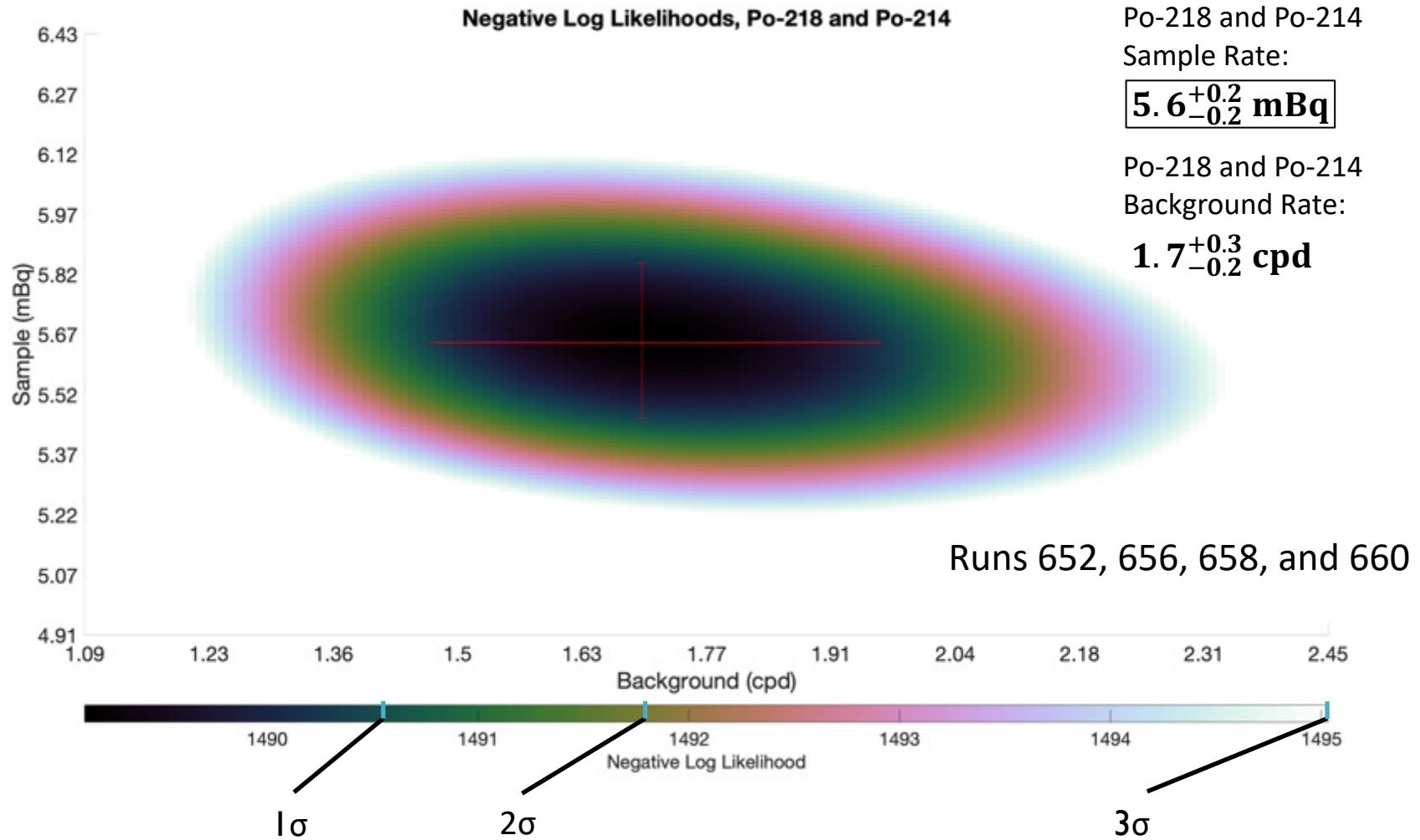
Single Silicone Gasket: Po-218 Neg. Log Likelihoods



Single Silicone Gasket: Po-214 Neg. Log Likelihoods



Single Silicone Gasket: Po-218 & Po-214 Neg. Log Likelihoods

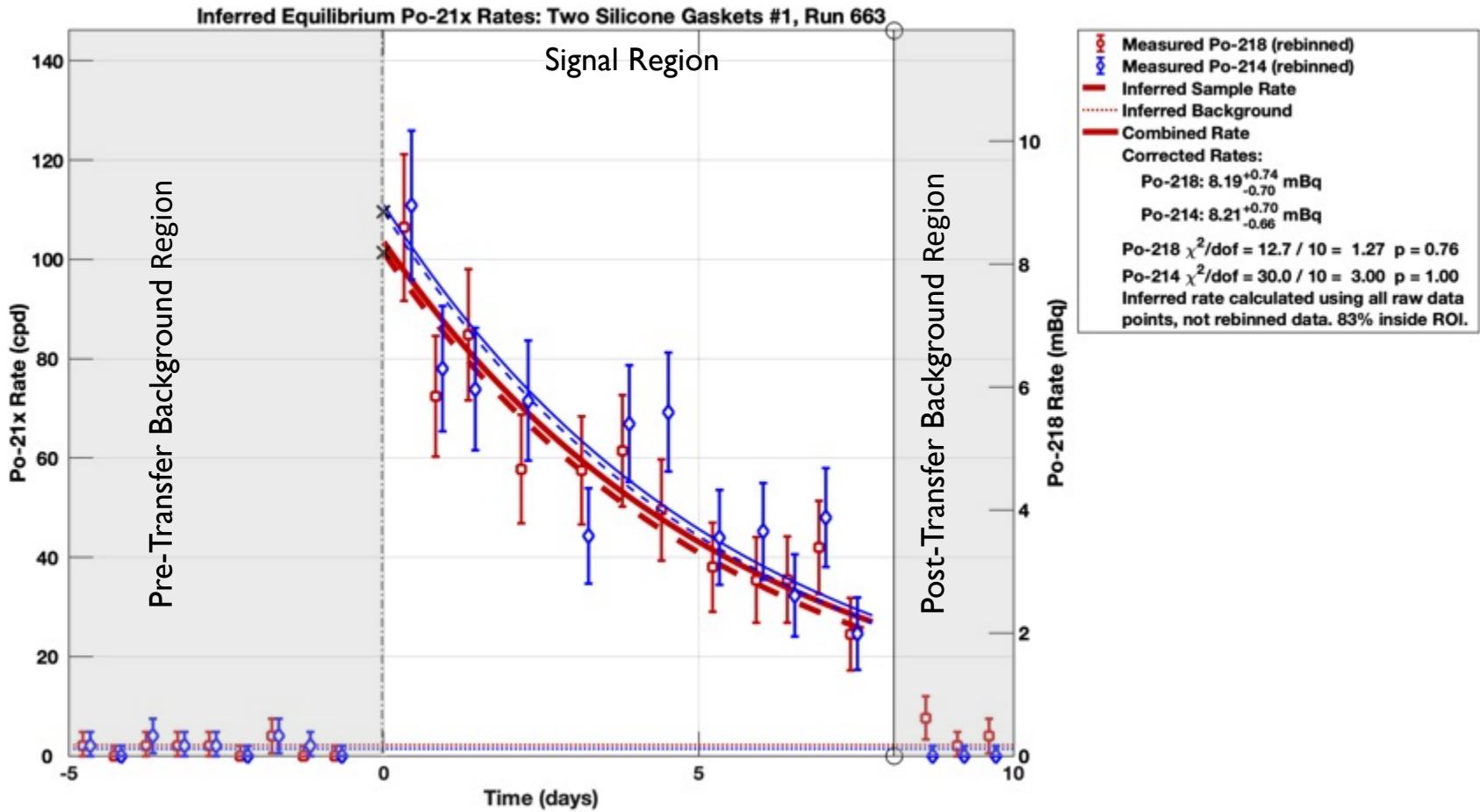


Single Silicone Gasket: Summary of Results

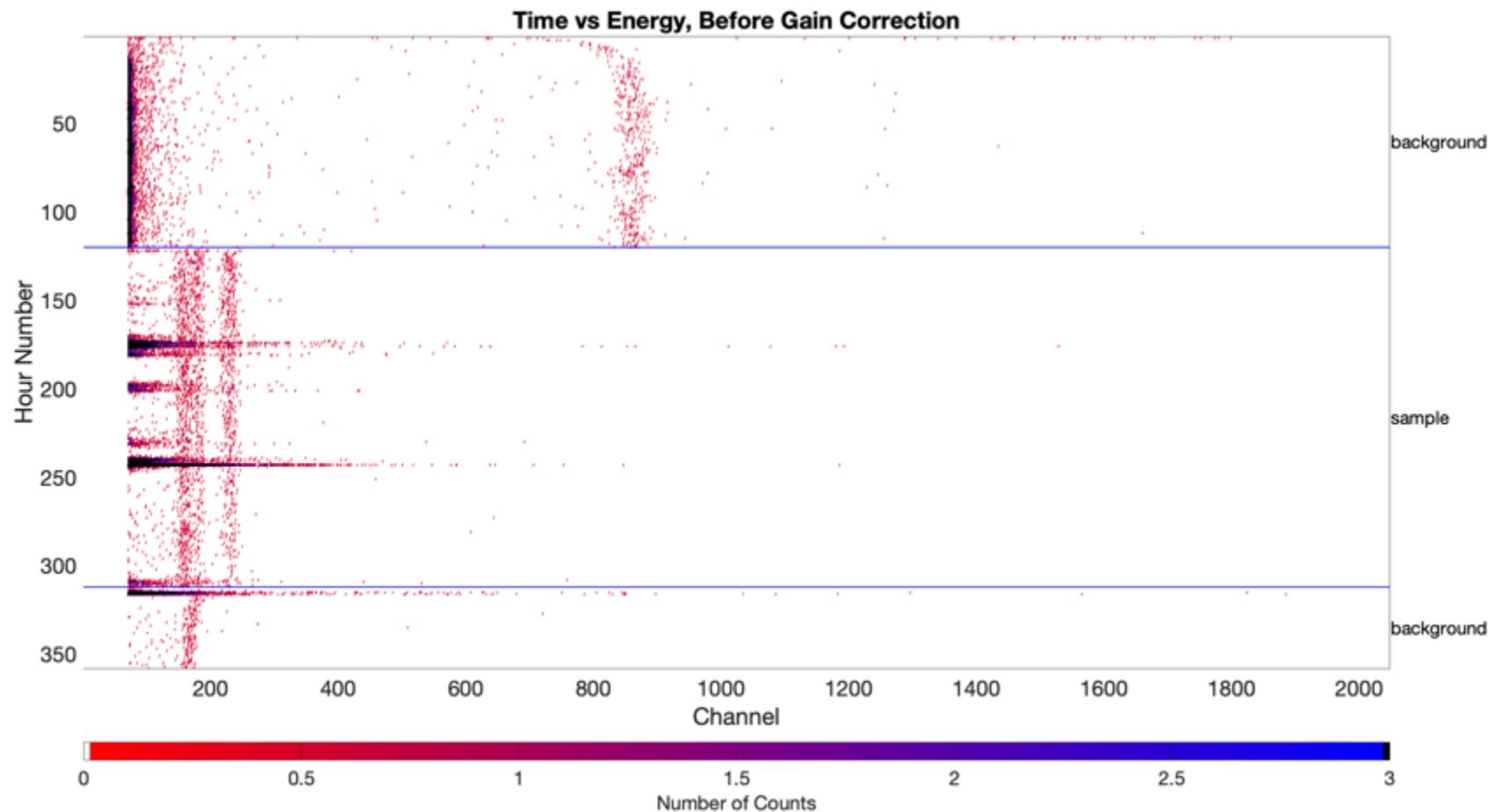
Sample	Po-218	Po-214	Po-218 & Po-214
Run 653	$5.3^{+0.6}_{-0.5}$ mBq	$4.6^{+0.5}_{-0.5}$ mBq	$5.0^{+0.4}_{-0.4}$ mBq
Run 656	$7.1^{+0.7}_{-0.6}$ mBq	$7.0^{+0.6}_{-0.6}$ mBq	$7.1^{+0.5}_{-0.4}$ mBq
Run 658	$5.6^{+0.7}_{-0.6}$ mBq	$5.5^{+0.6}_{-0.5}$ mBq	$5.6^{+0.4}_{-0.4}$ mBq
Run 660	$5.6^{+0.6}_{-0.5}$ mBq	$4.9^{+0.5}_{-0.5}$ mBq	$5.2^{+0.4}_{-0.4}$ mBq
Combined	$5.9^{+0.3}_{-0.3}$ mBq	$5.4^{+0.3}_{-0.3}$ mBq	$5.7^{+0.2}_{-0.2}$ mBq

Run 663, Two Silicone Gaskets #1:

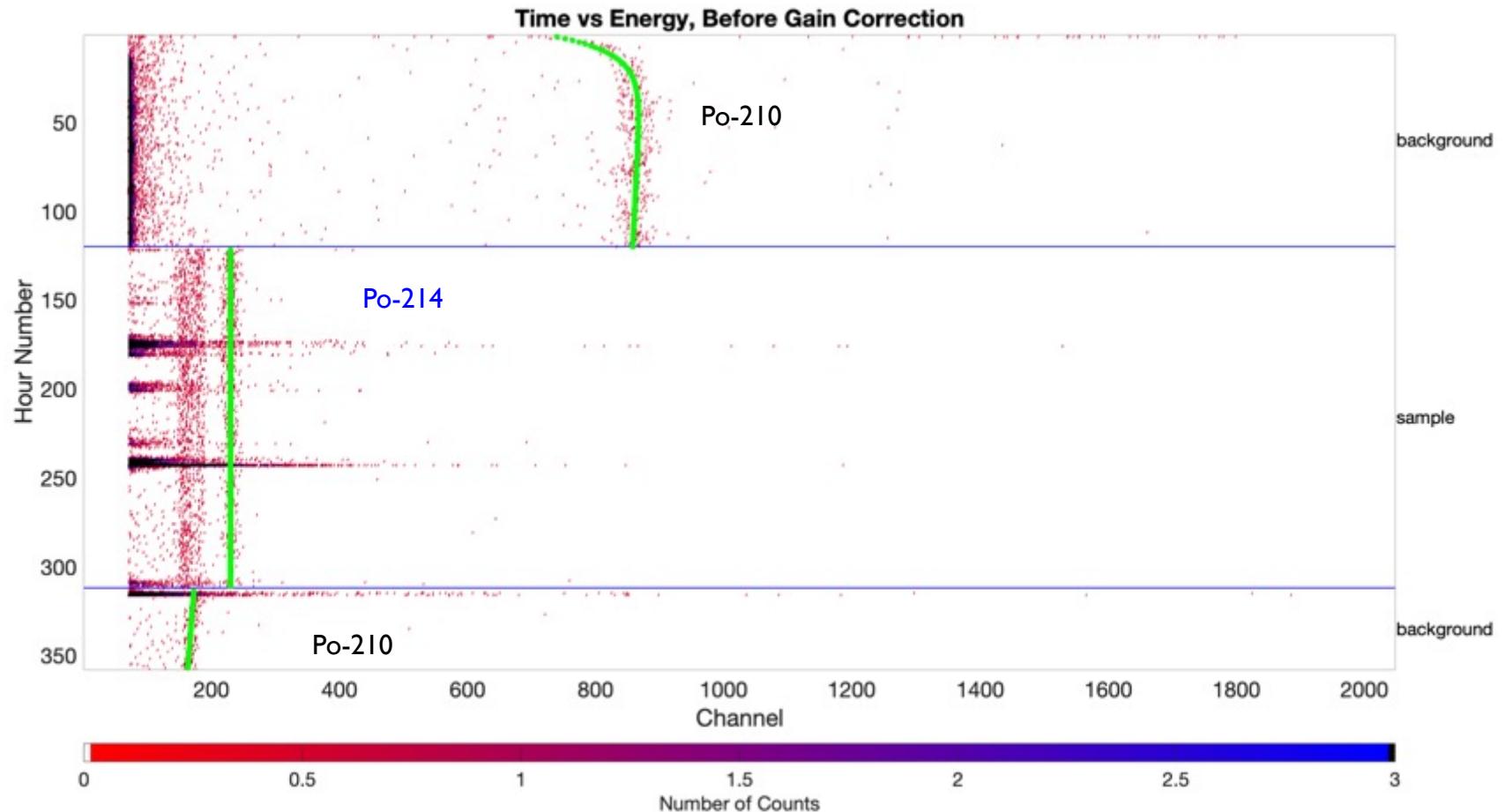
4/29/2021 – 5/18/2021



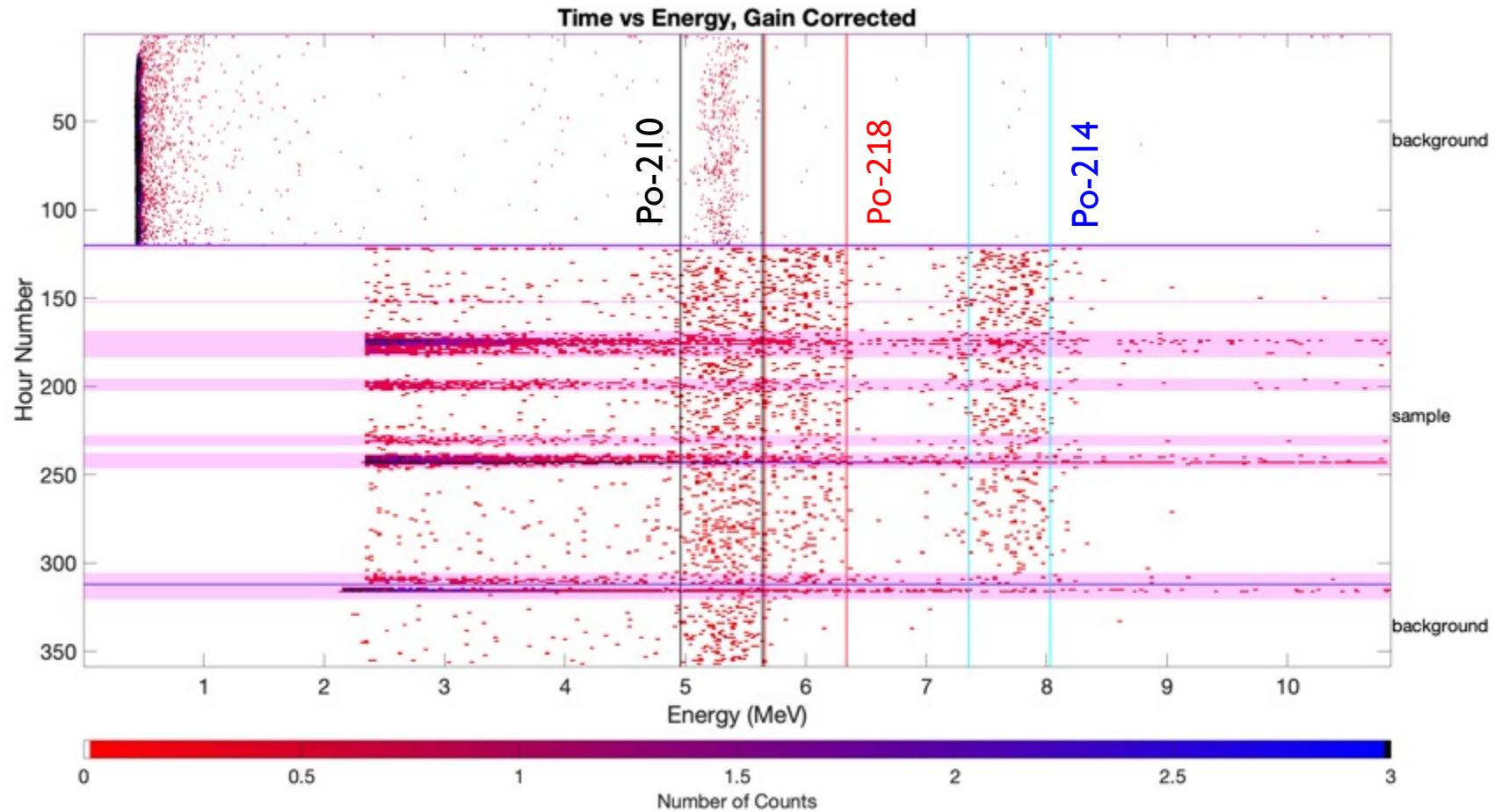
Run 663, Two Silicone Gaskets #1: Raw data



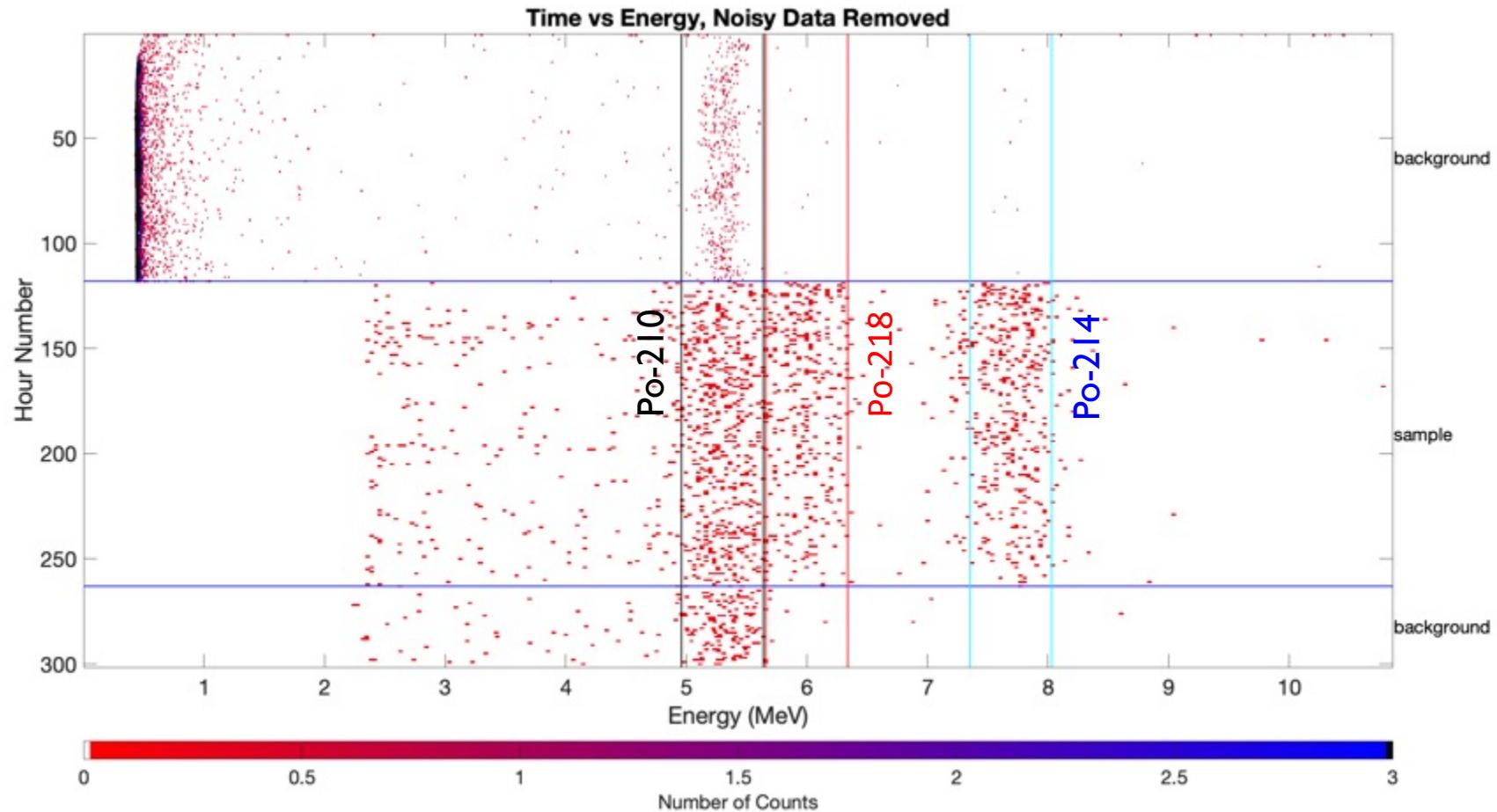
Run 663, Two Silicone Gaskets #1: Fit of Po-21x events



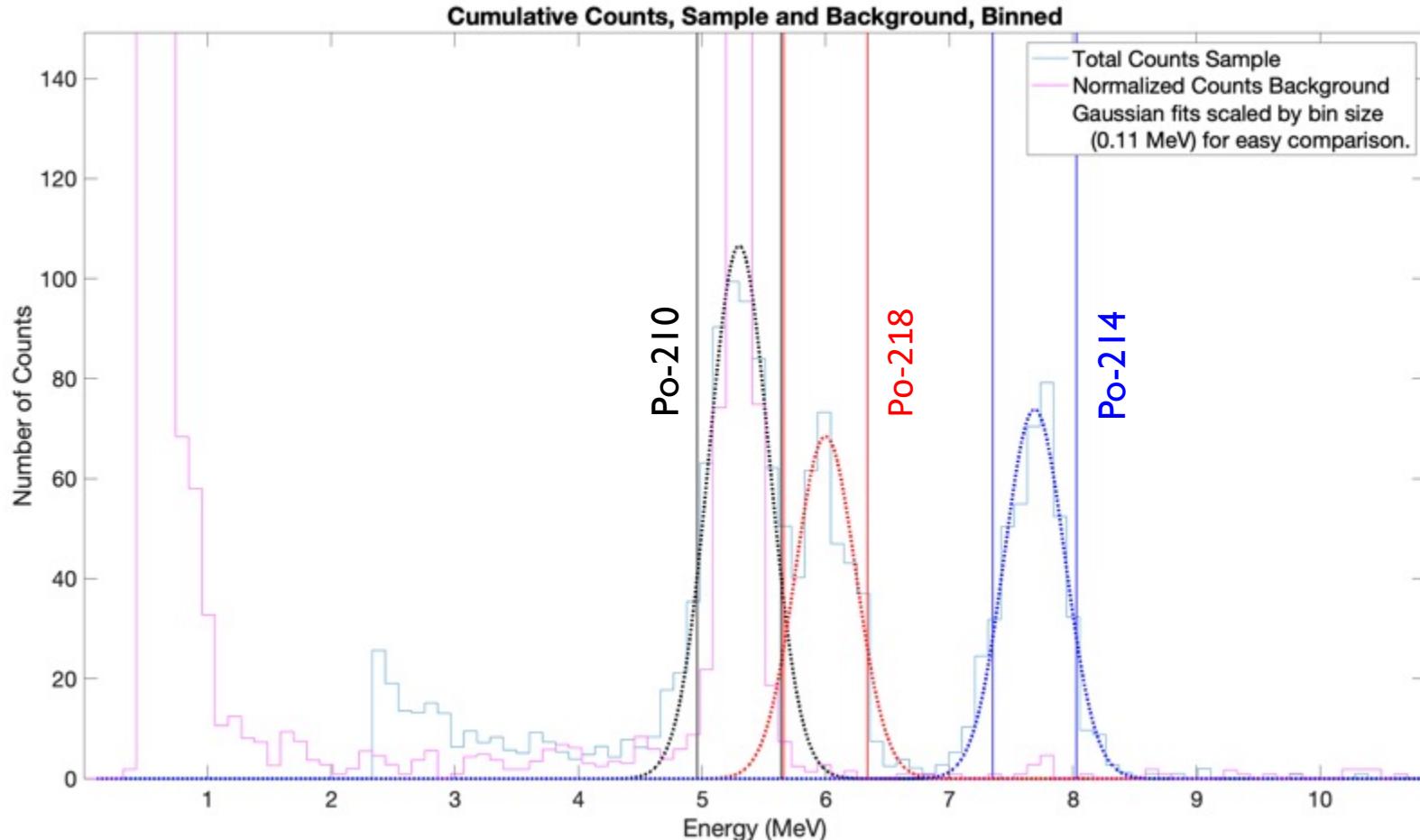
Run 663, Two Silicone Gaskets #1: Gain correction w/ bad intervals



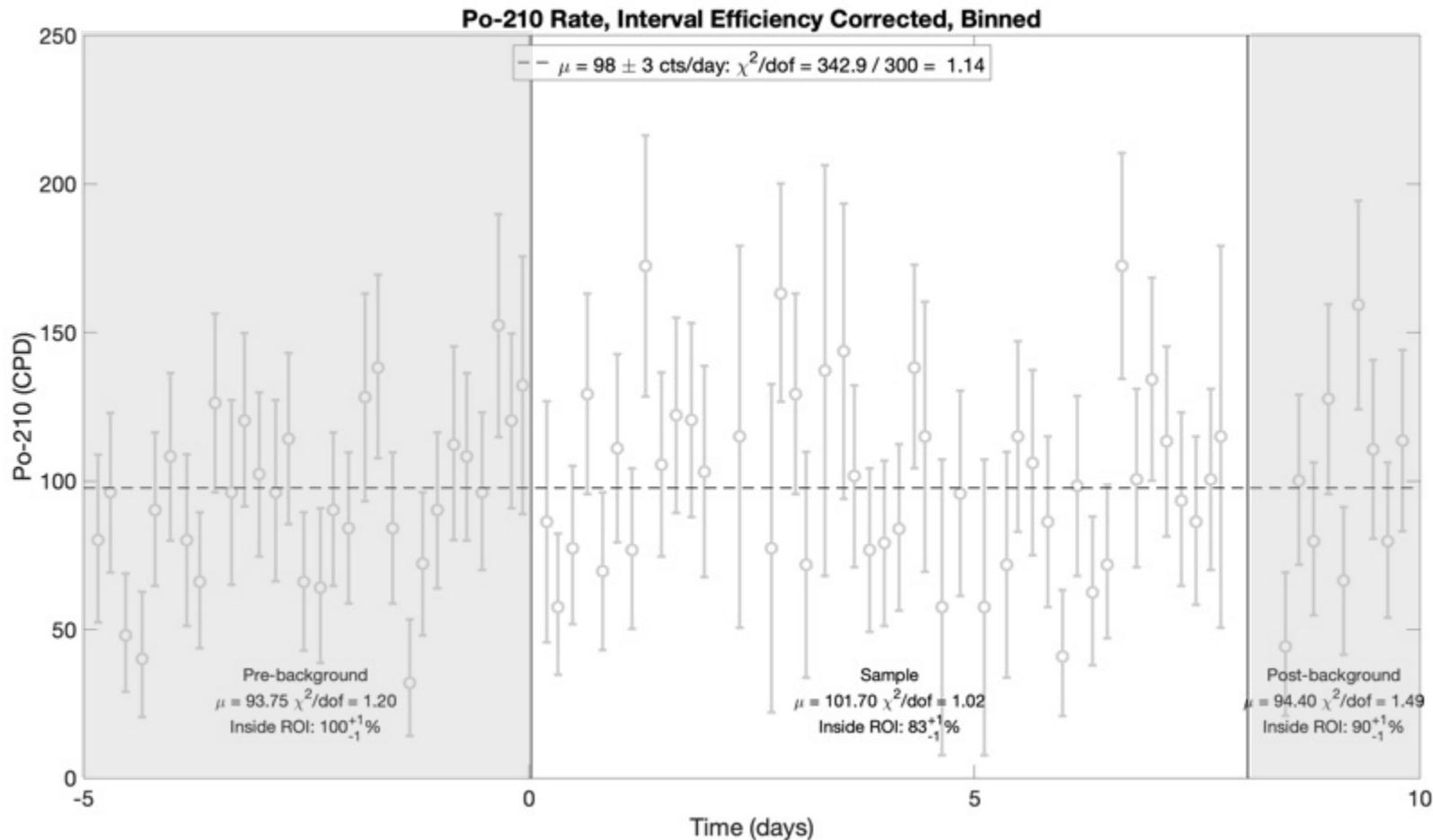
Run 663, Two Silicone Gaskets #1: Gain Correction w/o Bad Intervals



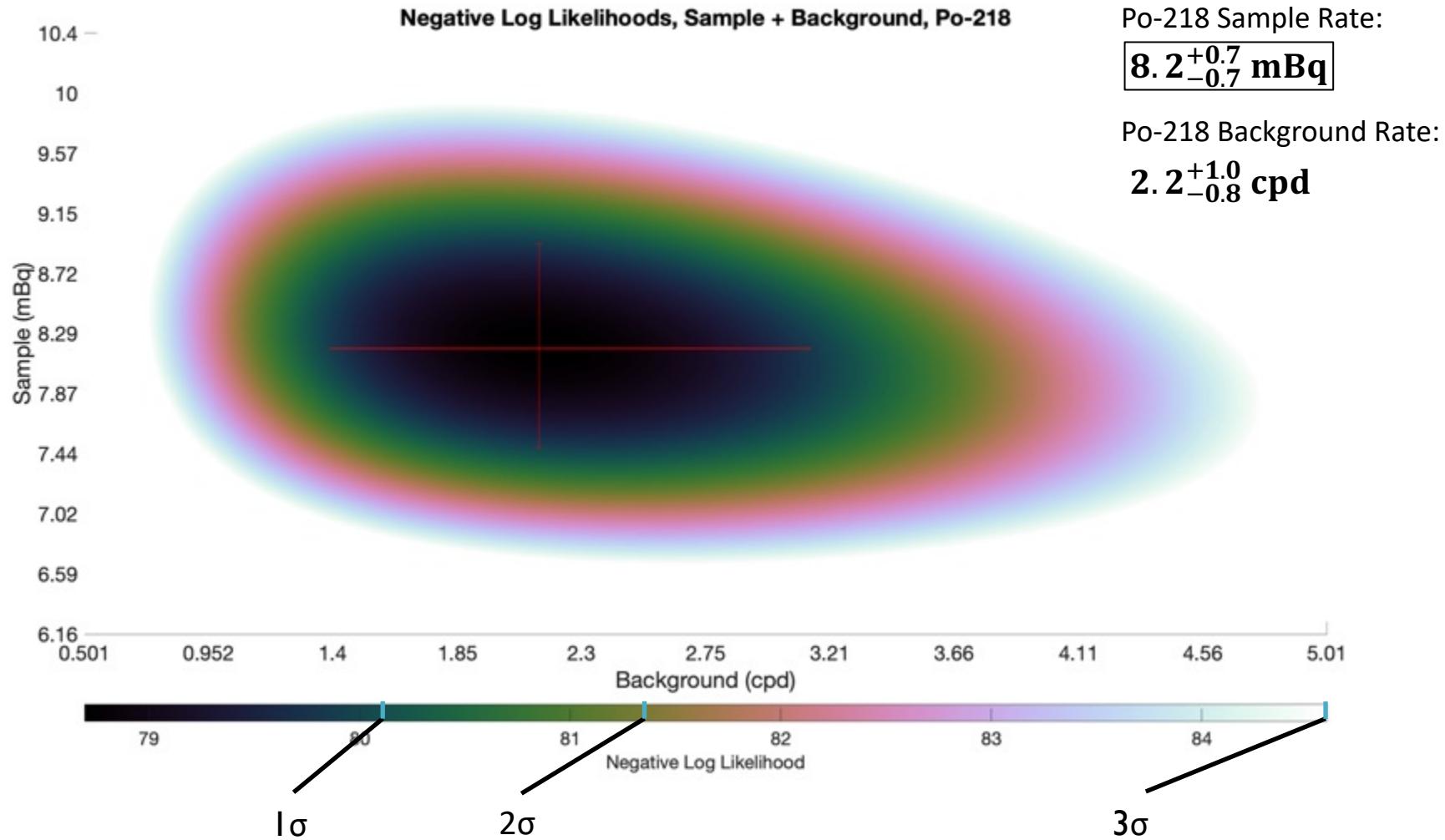
Run 663, Two Silicone Gaskets #1: Cumulative counts



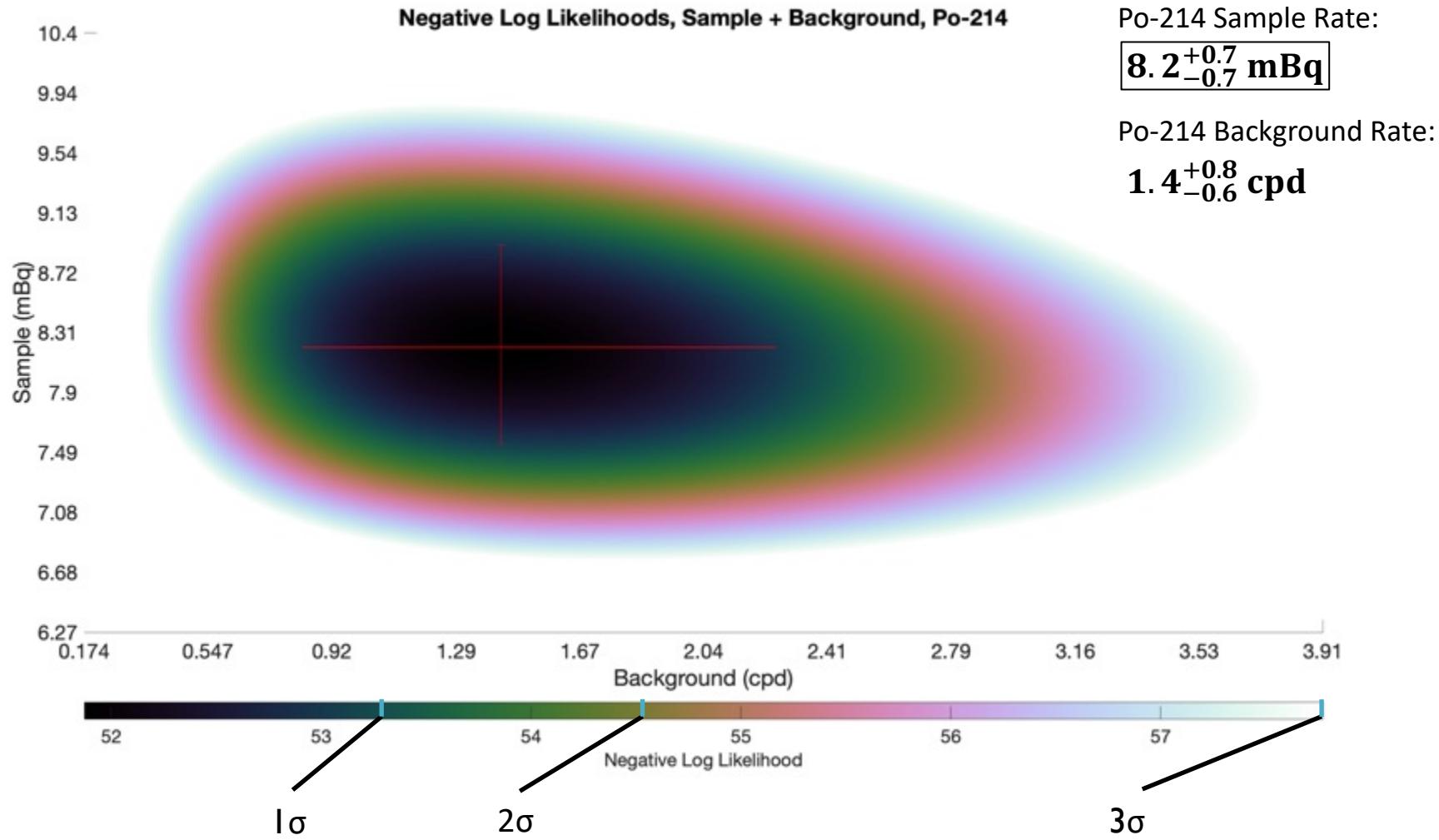
Run 663, Two Silicone Gaskets #1: Po-210 rate



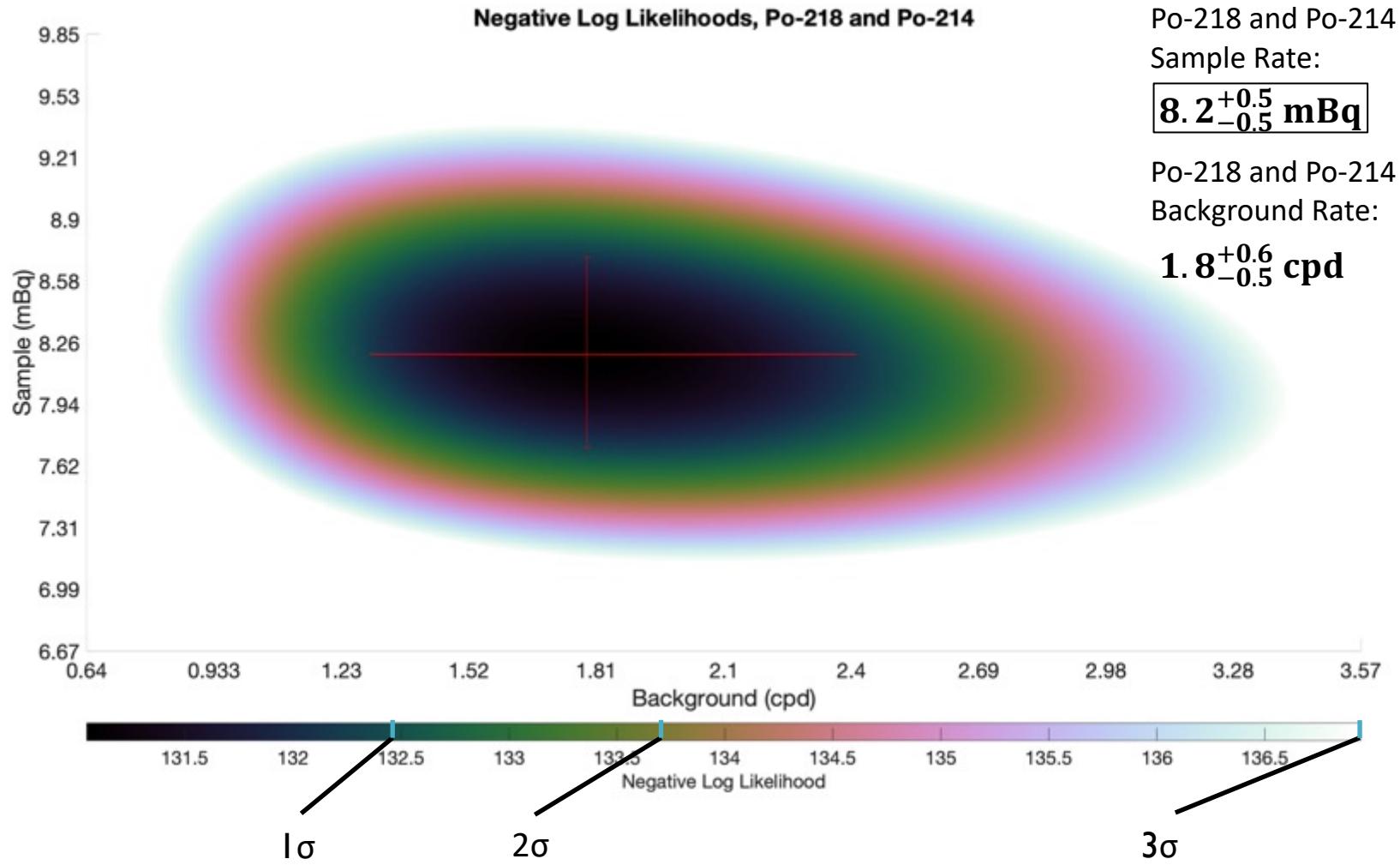
Run 663, Two Silicone Gaskets #1: Po-218 Neg. Log Likelihood



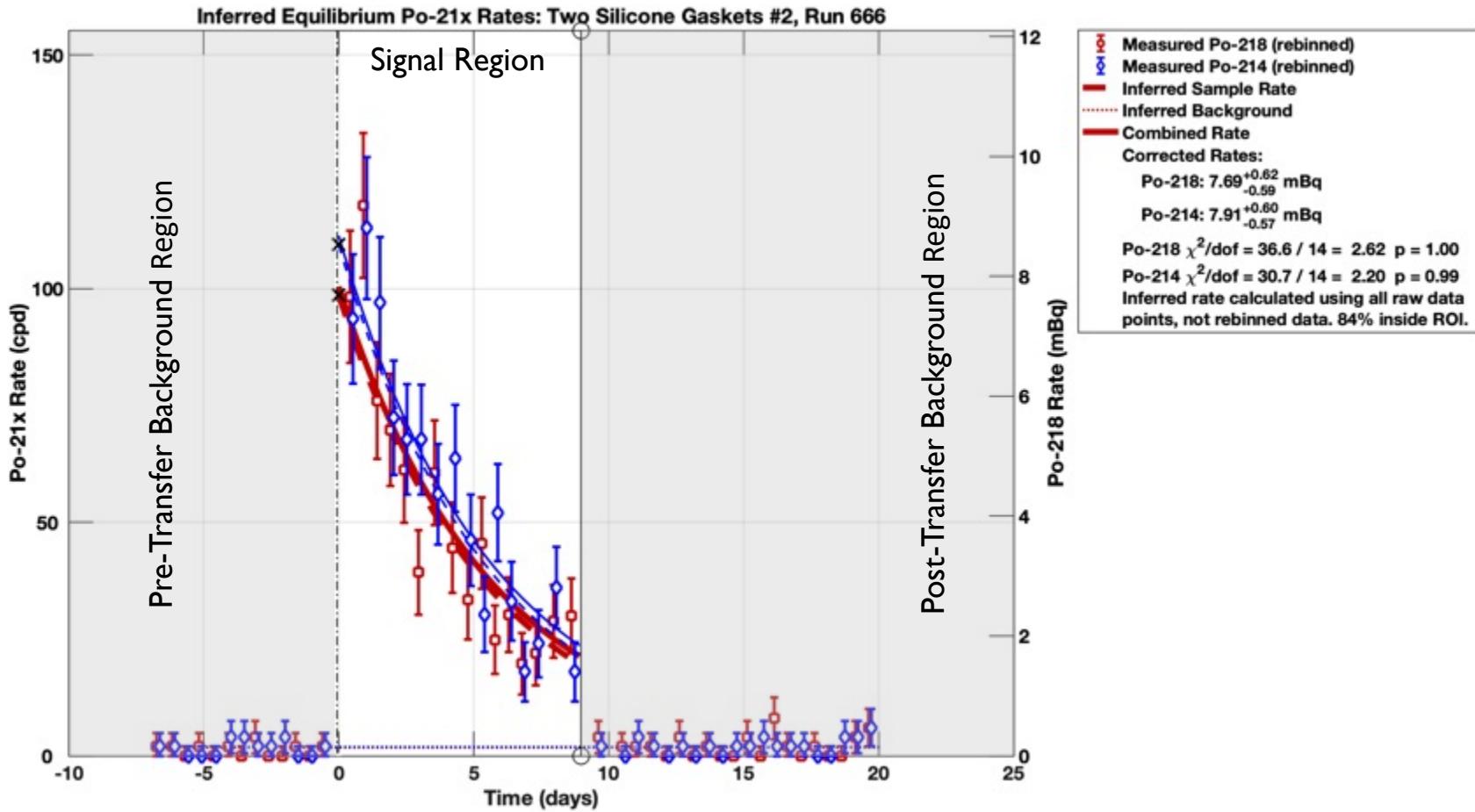
Run 663, Two Silicone Gaskets #1: Po-214 Neg. Log Likelihood



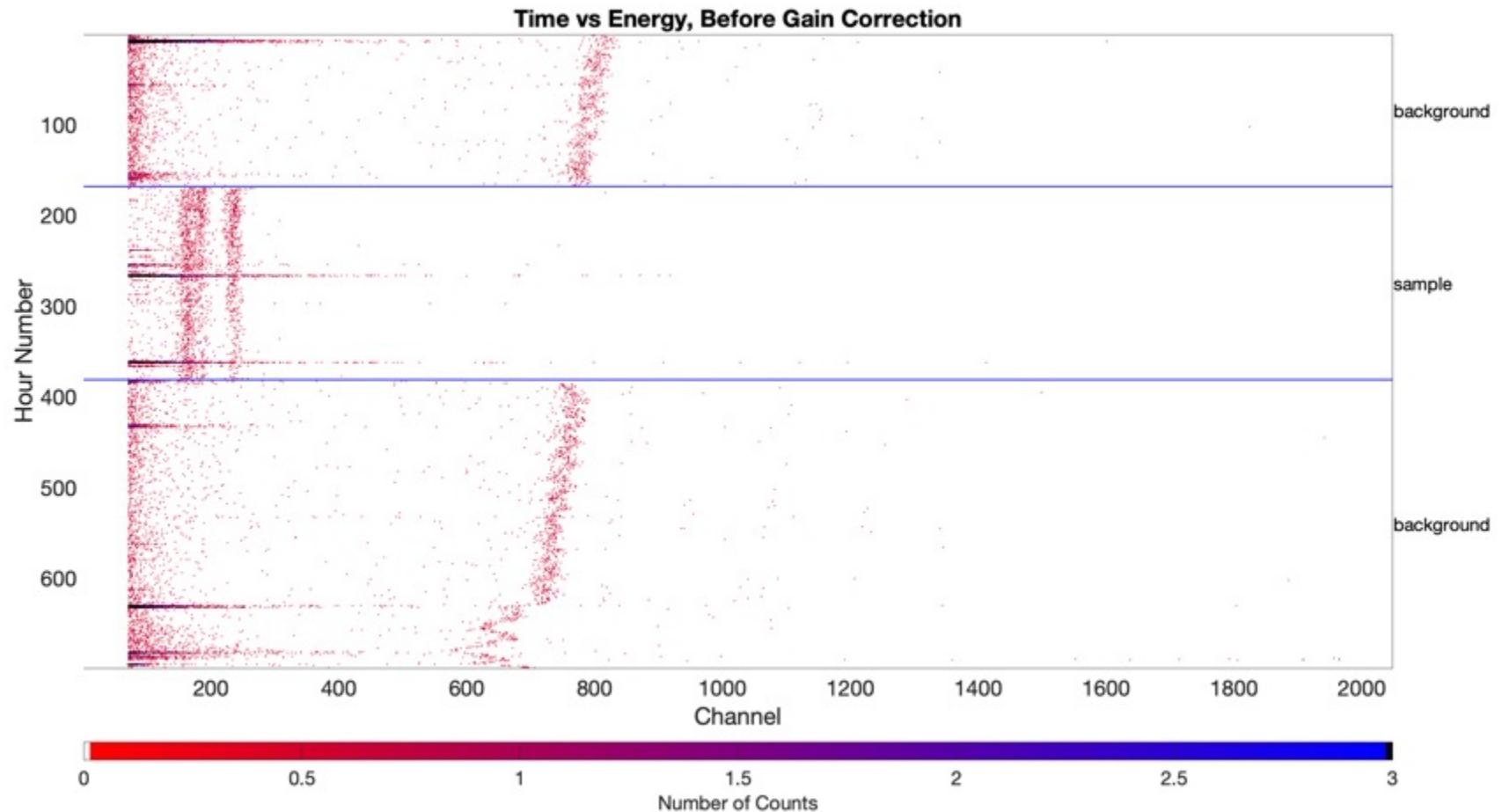
Run 663, Two Silicone Gaskets #1: Po-218 & Po-214 Neg. Log Likelihoods



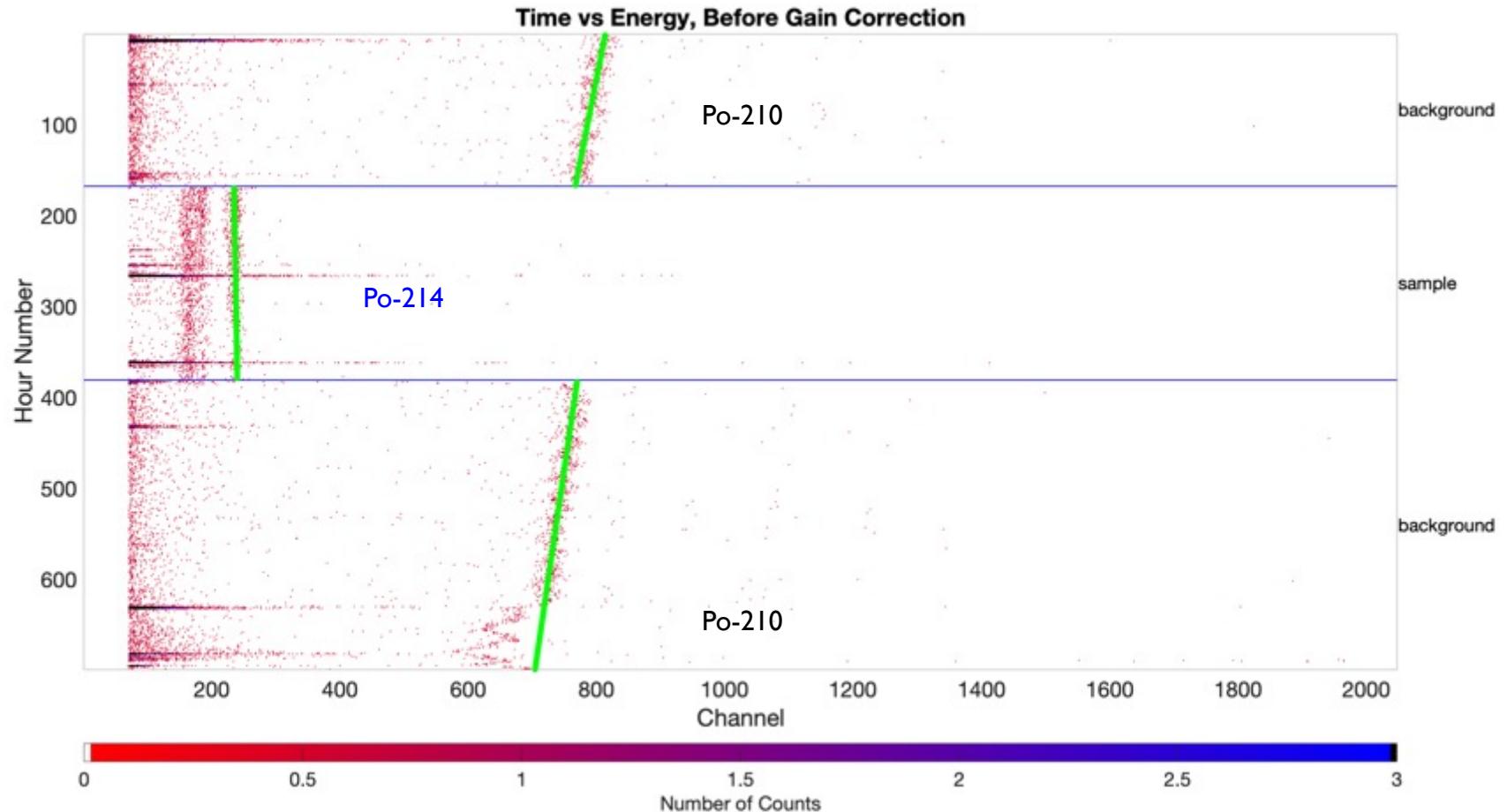
Run 666, Two Silicone Gaskets #2: 5/18/2021 – 6/15/2021



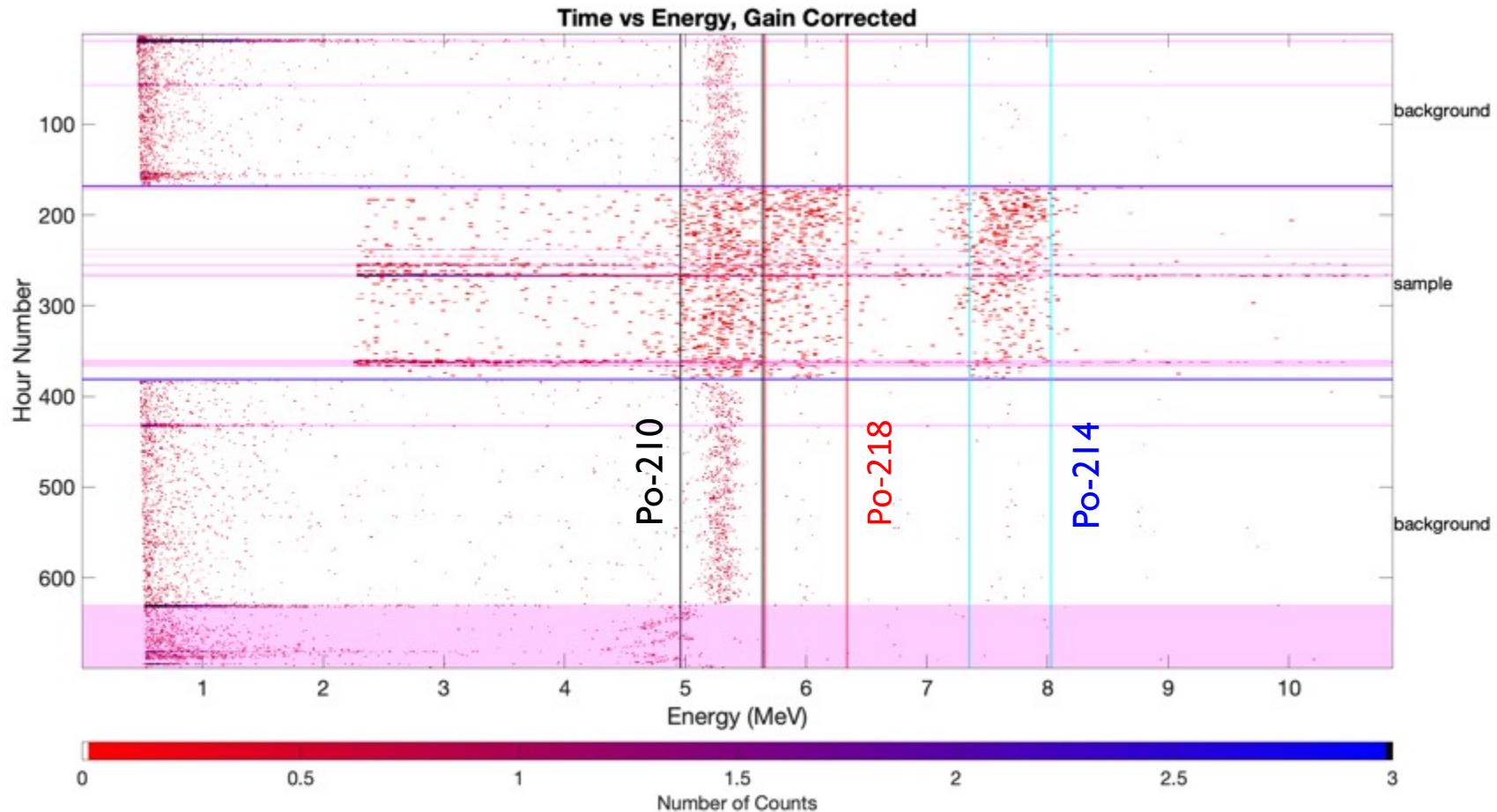
Run 666, Two Silicone Gaskets #2: Raw data



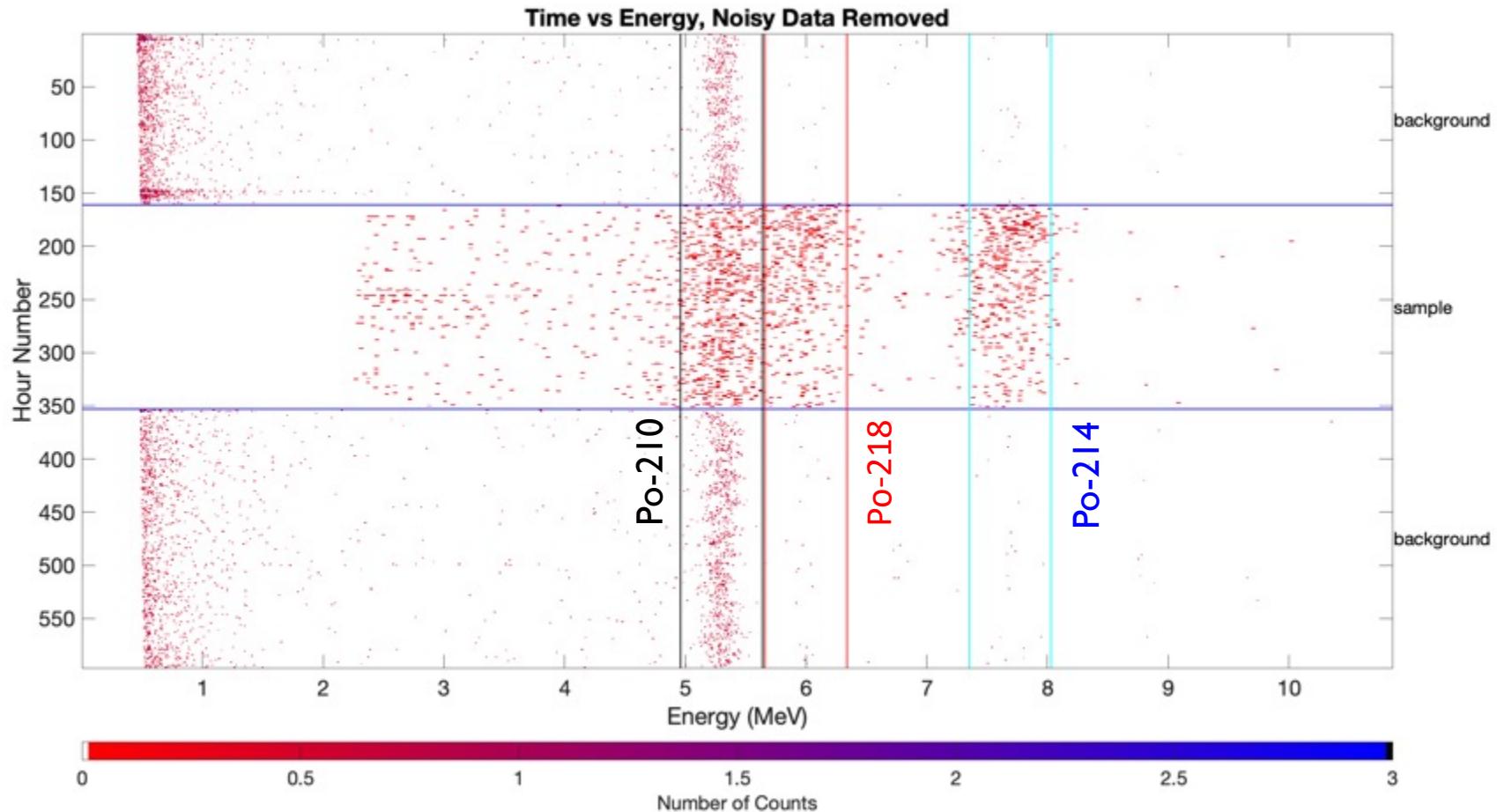
Run 666, Two Silicone Gaskets #2: Fit of Po-21x events



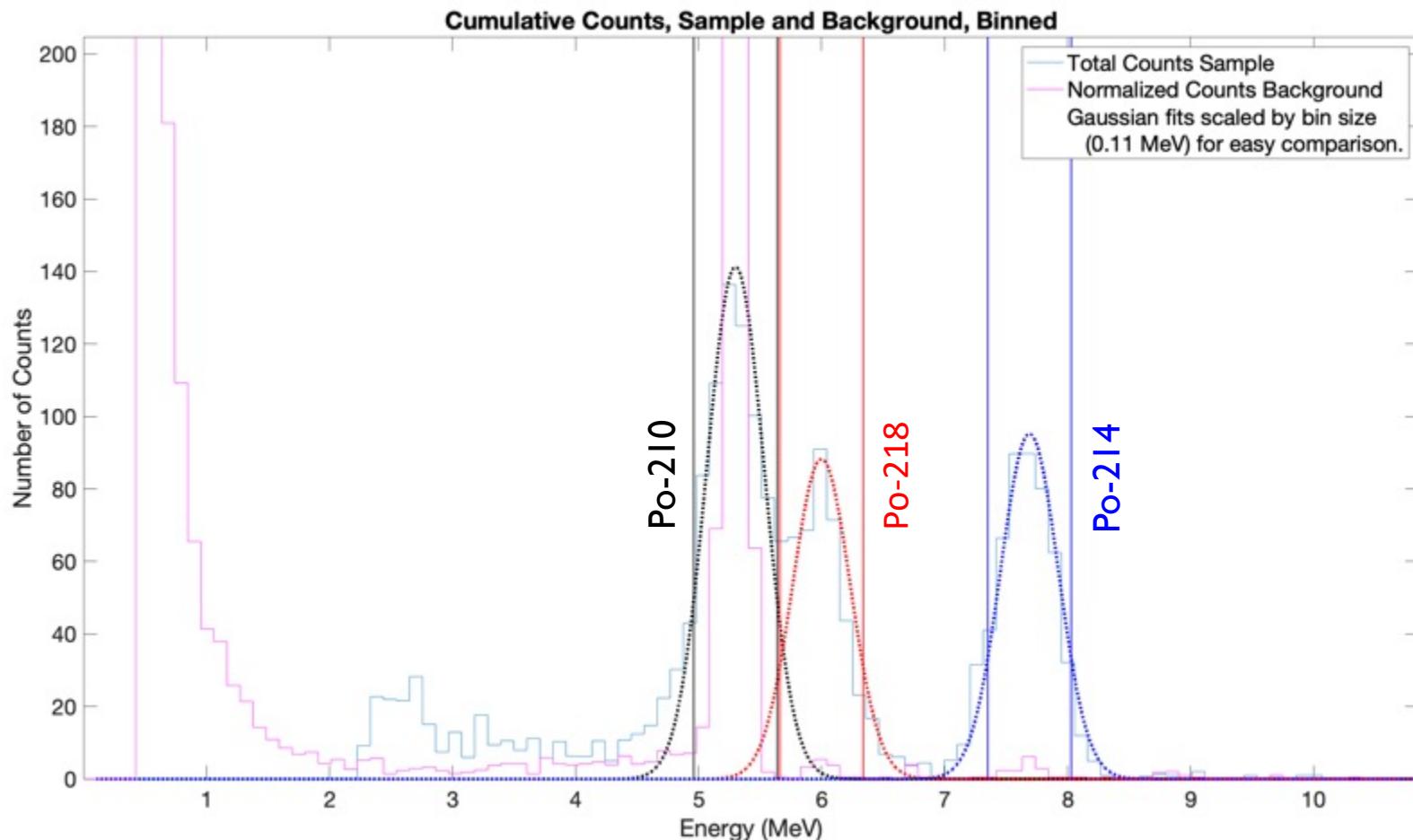
Run 666, Two Silicone Gaskets #2: Gain correction w/ bad intervals



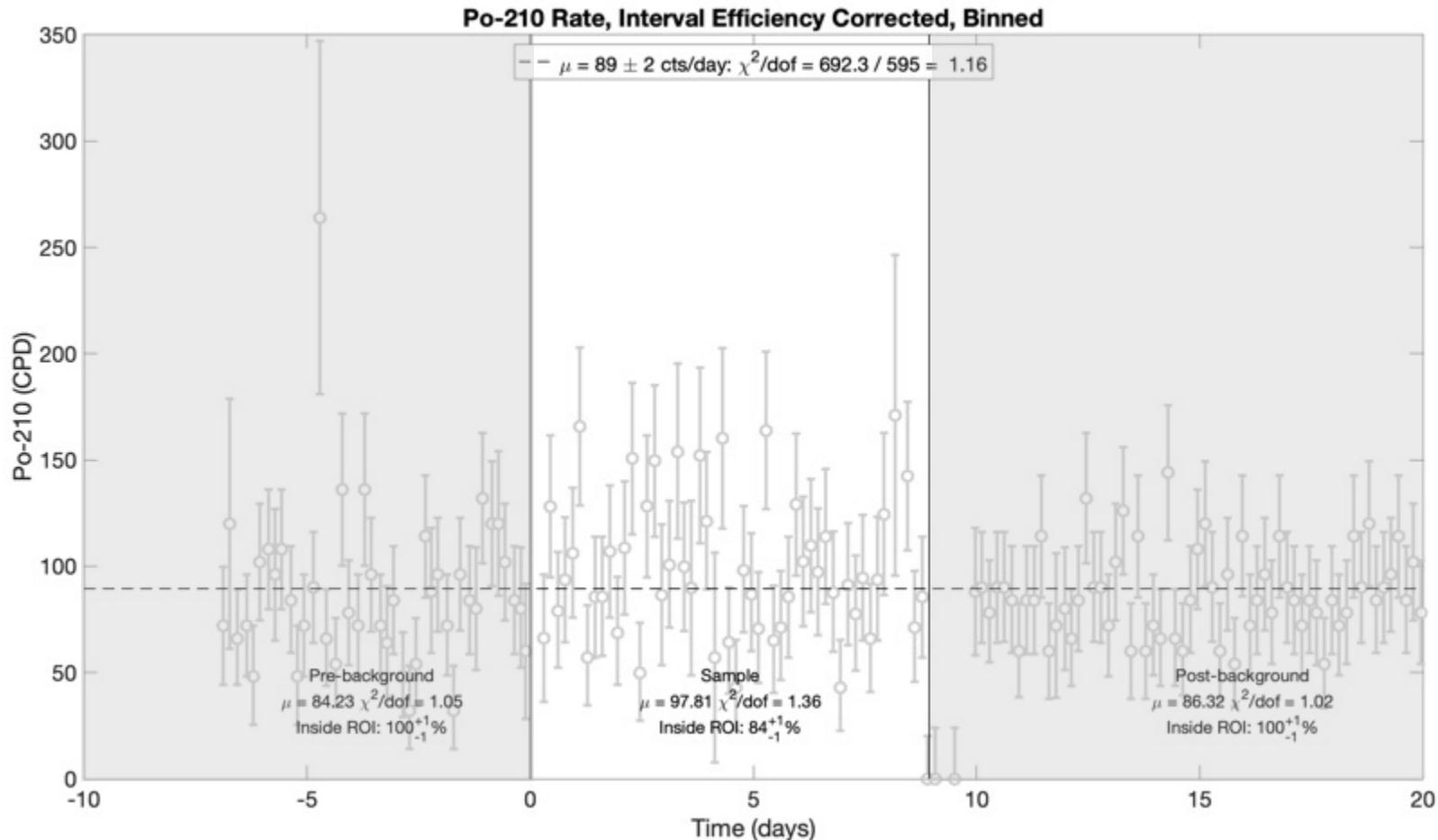
Run 666, Two Silicone Gaskets #2: Gain correction w/o bad intervals



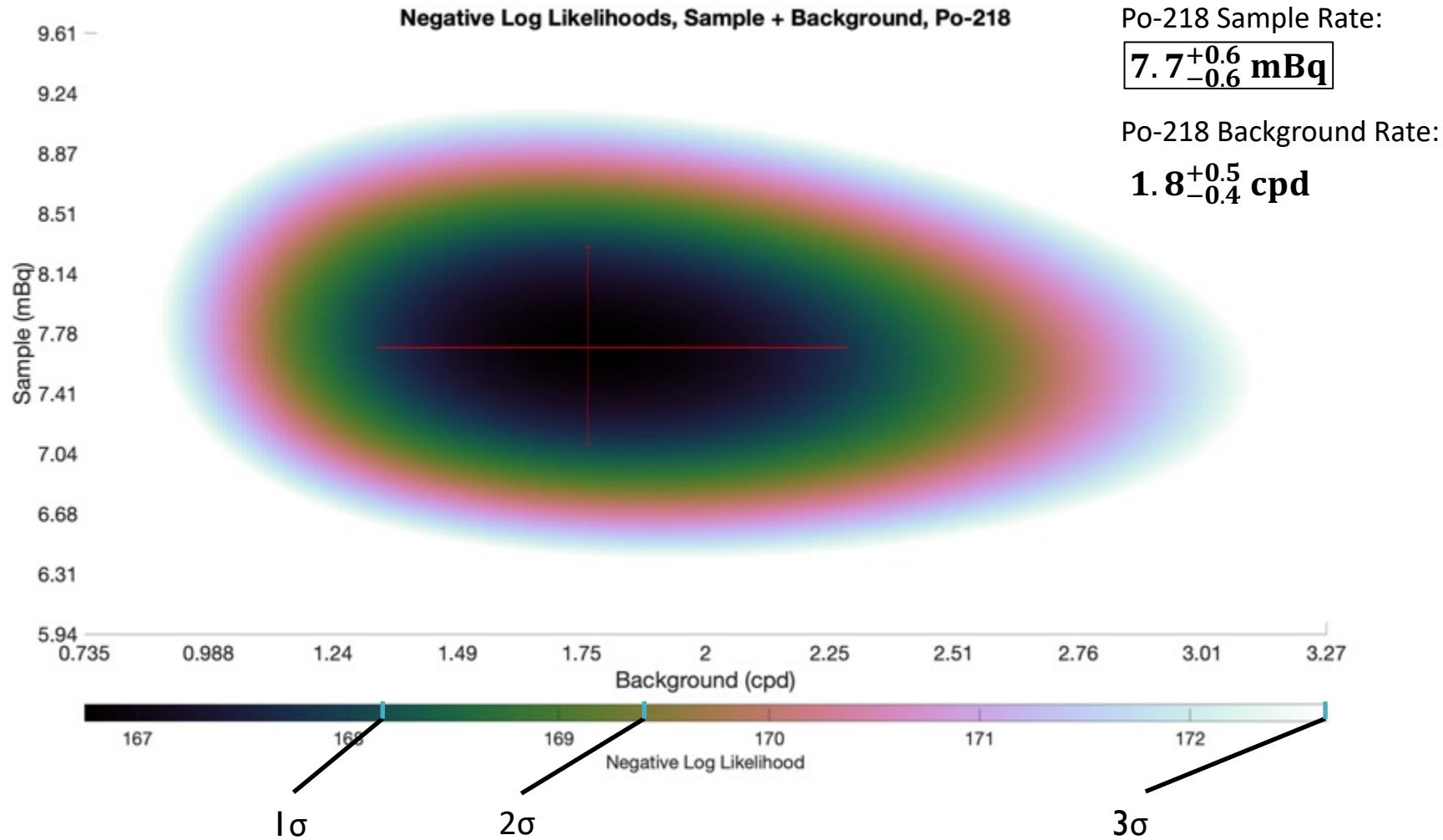
Run 666, Two Silicone Gaskets #2: Cumulative counts



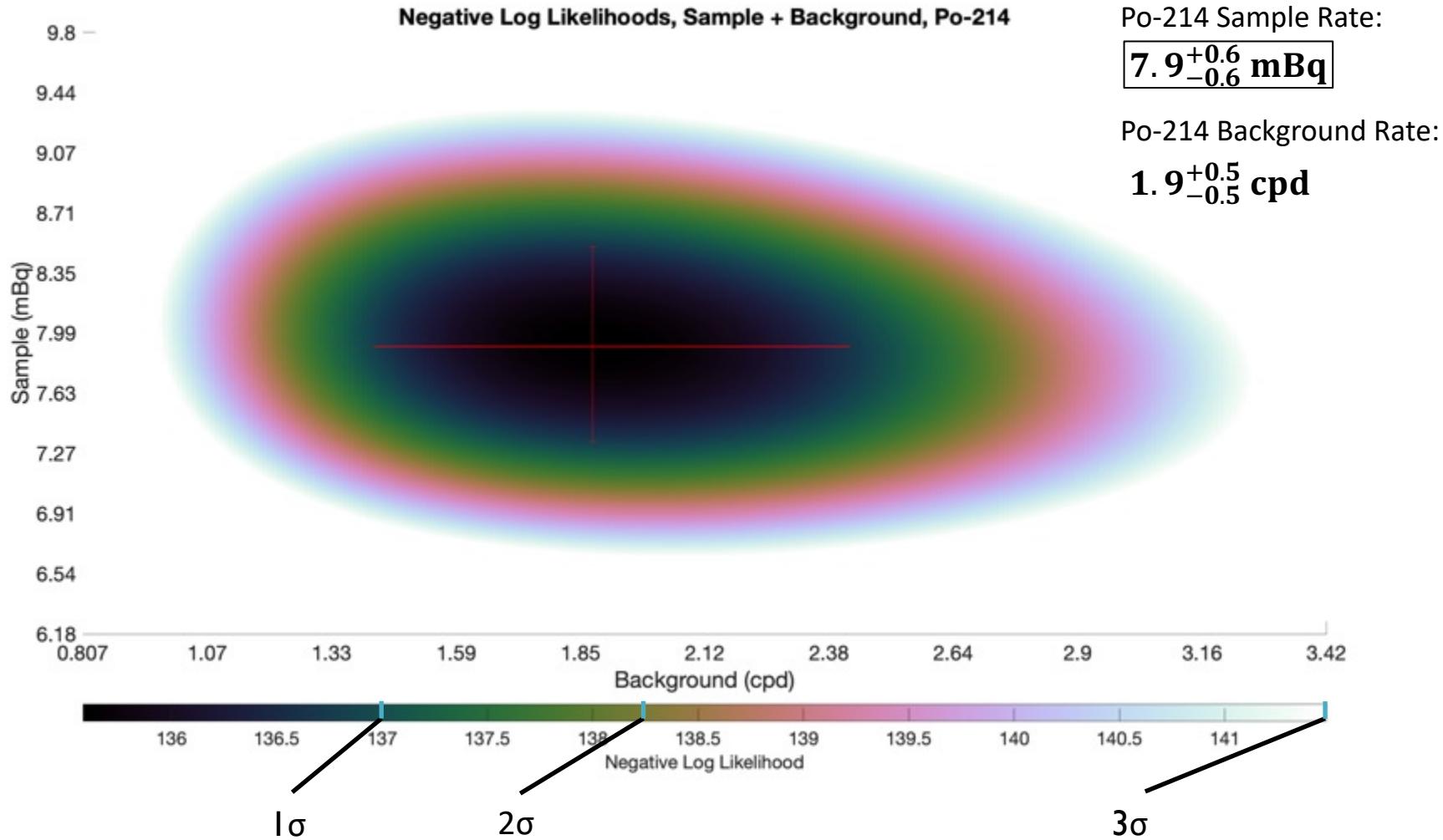
Run 666, Two Silicone Gaskets #2: Po-210 rate



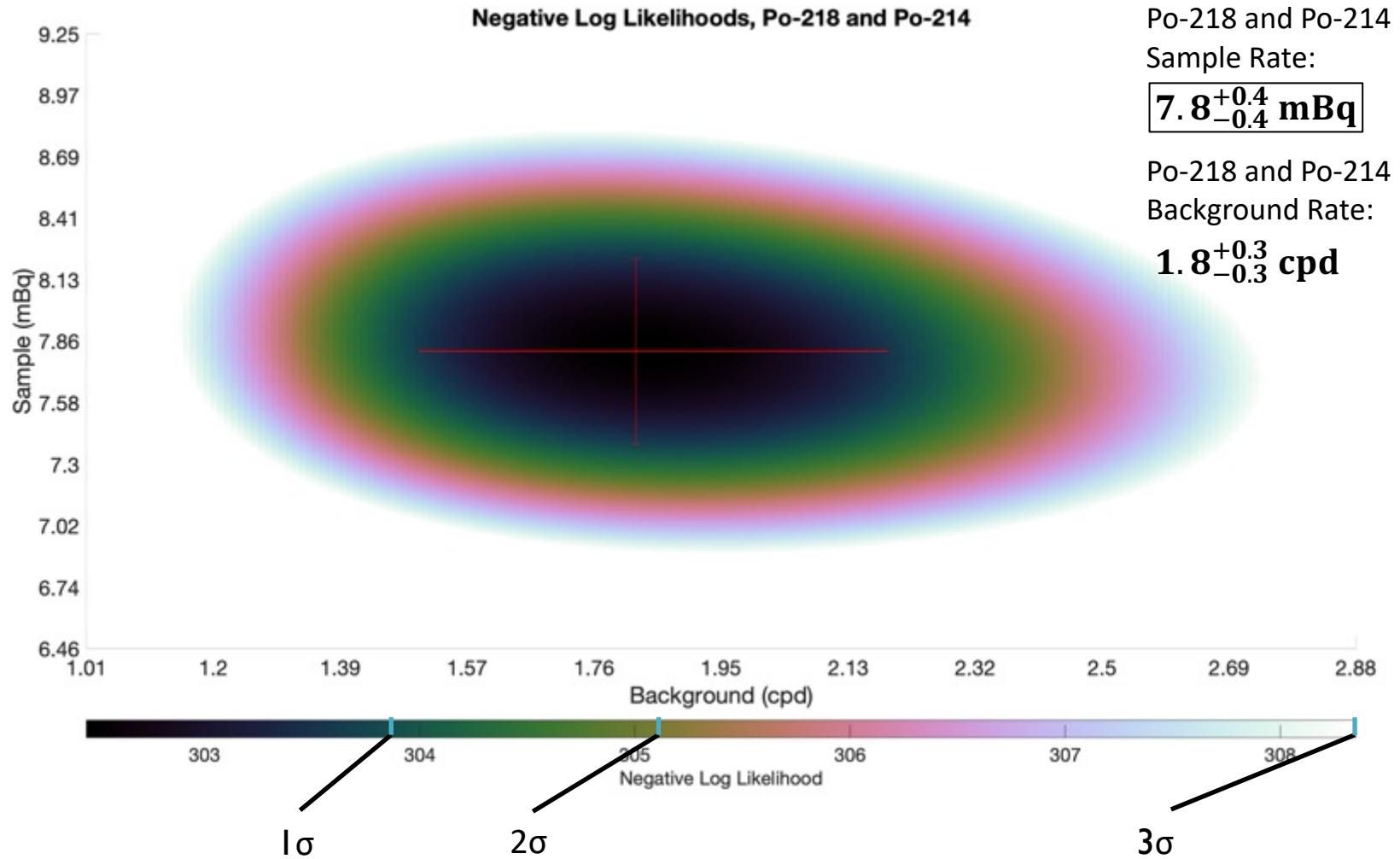
Run 666, Two Silicone Gaskets #2: Po-218 Neg. Log Likelihood



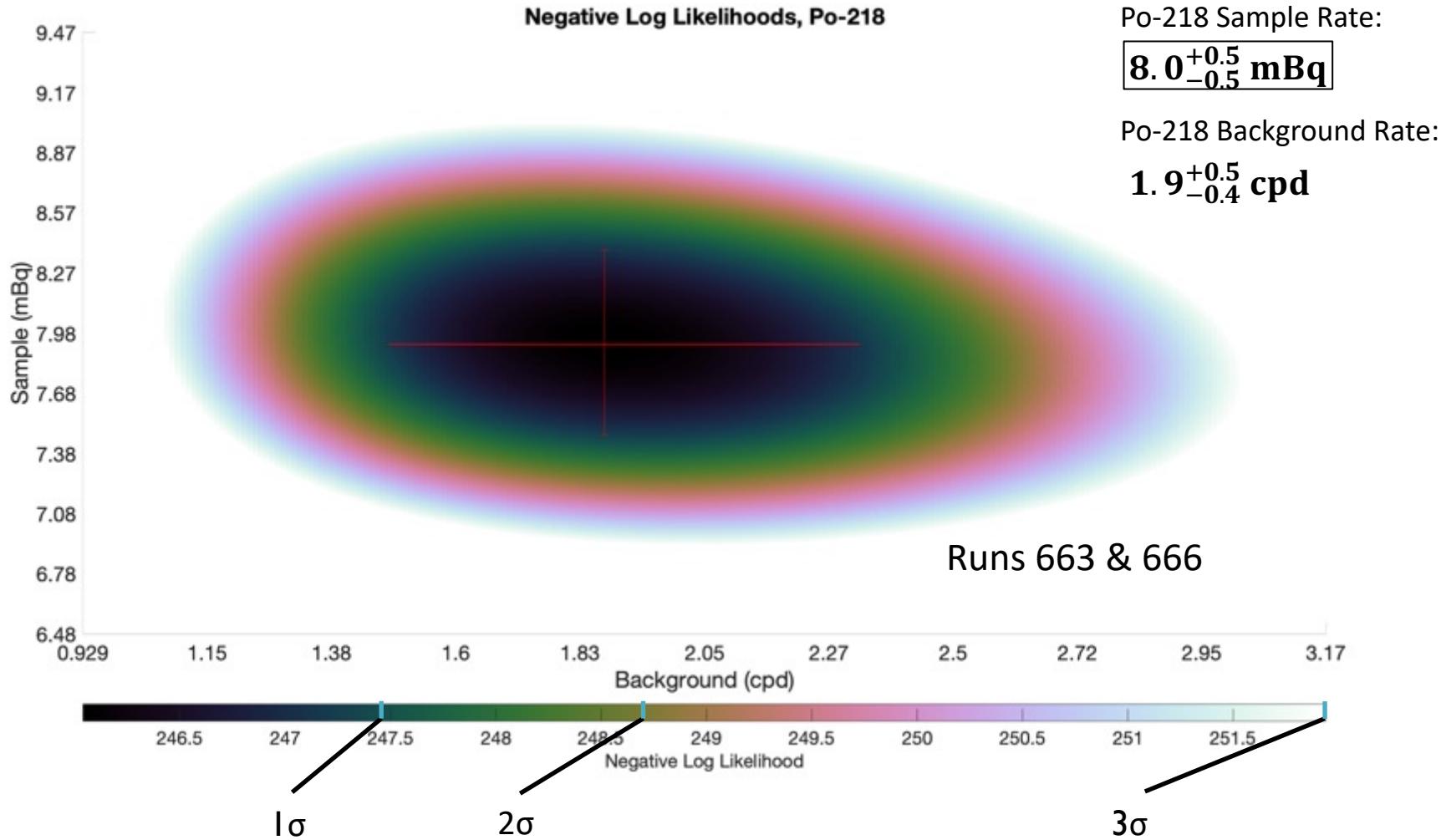
Run 666, Two Silicone Gaskets #2: Po-214 Neg. Log Likelihood



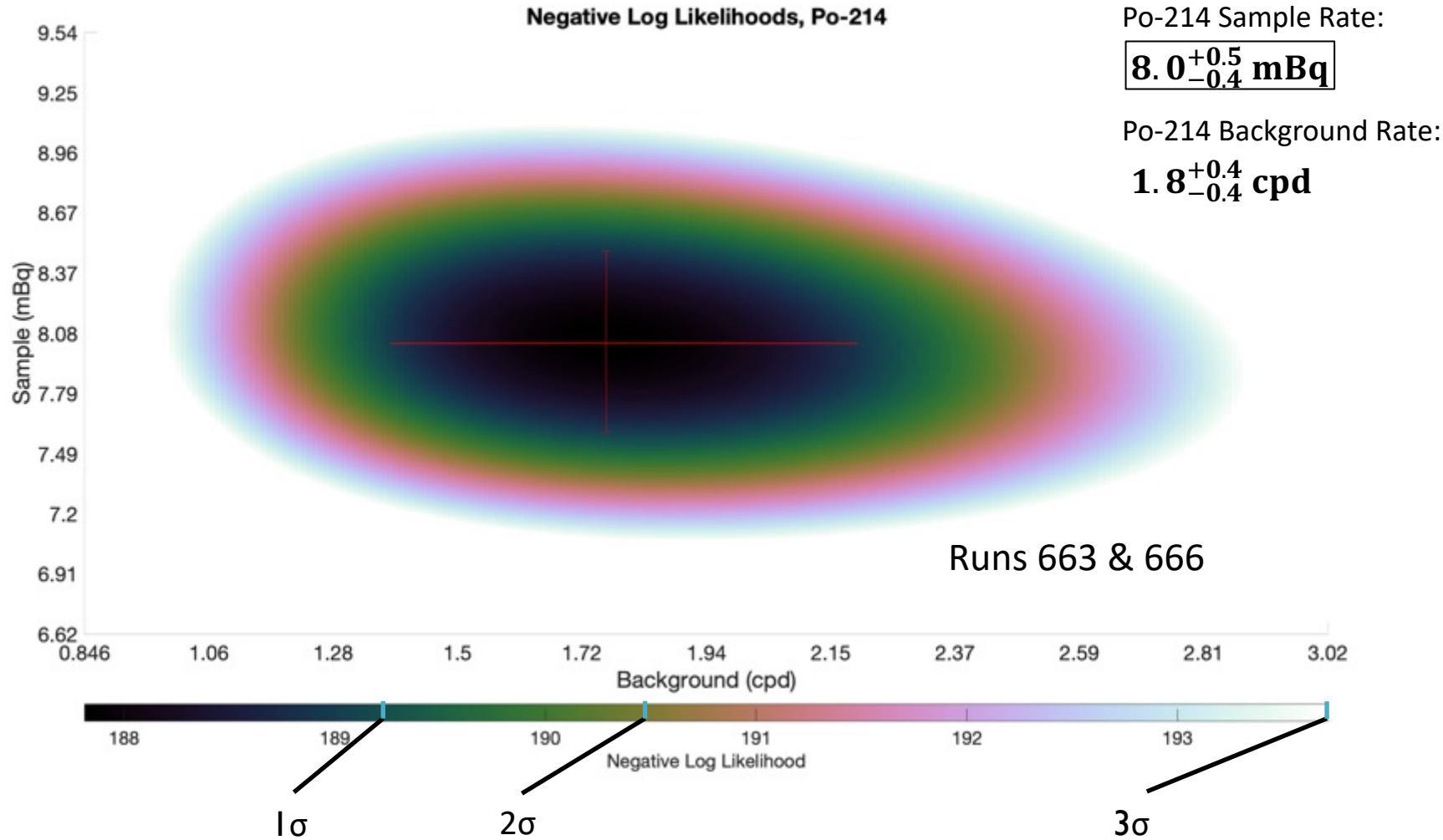
Run 666, Two Silicone Gaskets #2: Po-218 & Po-214 Neg. Log Likelihoods



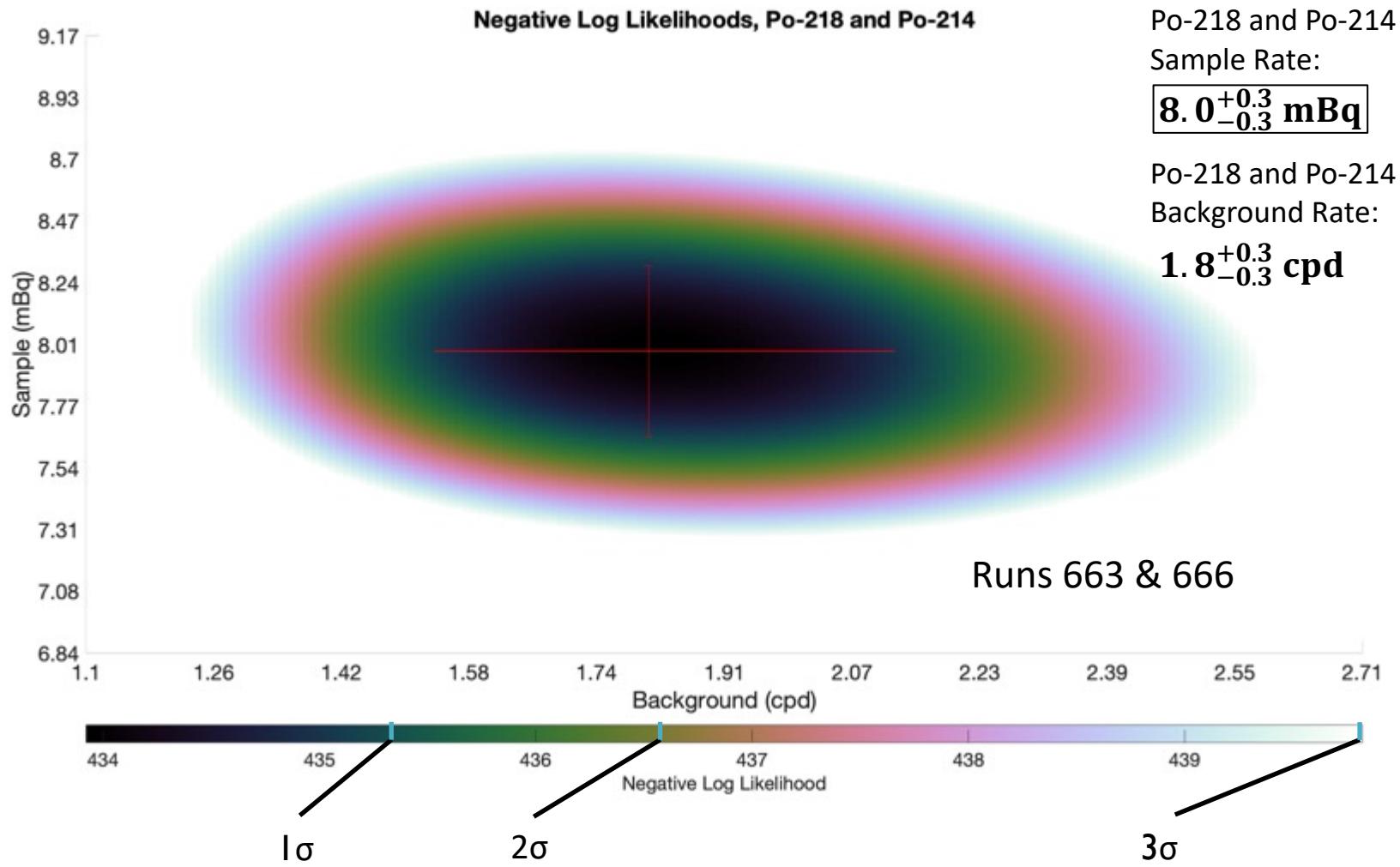
Two Silicone Gaskets: Po-218 Neg. Log Likelihoods



Two Silicone Gaskets: Po-214 Neg. Log Likelihoods



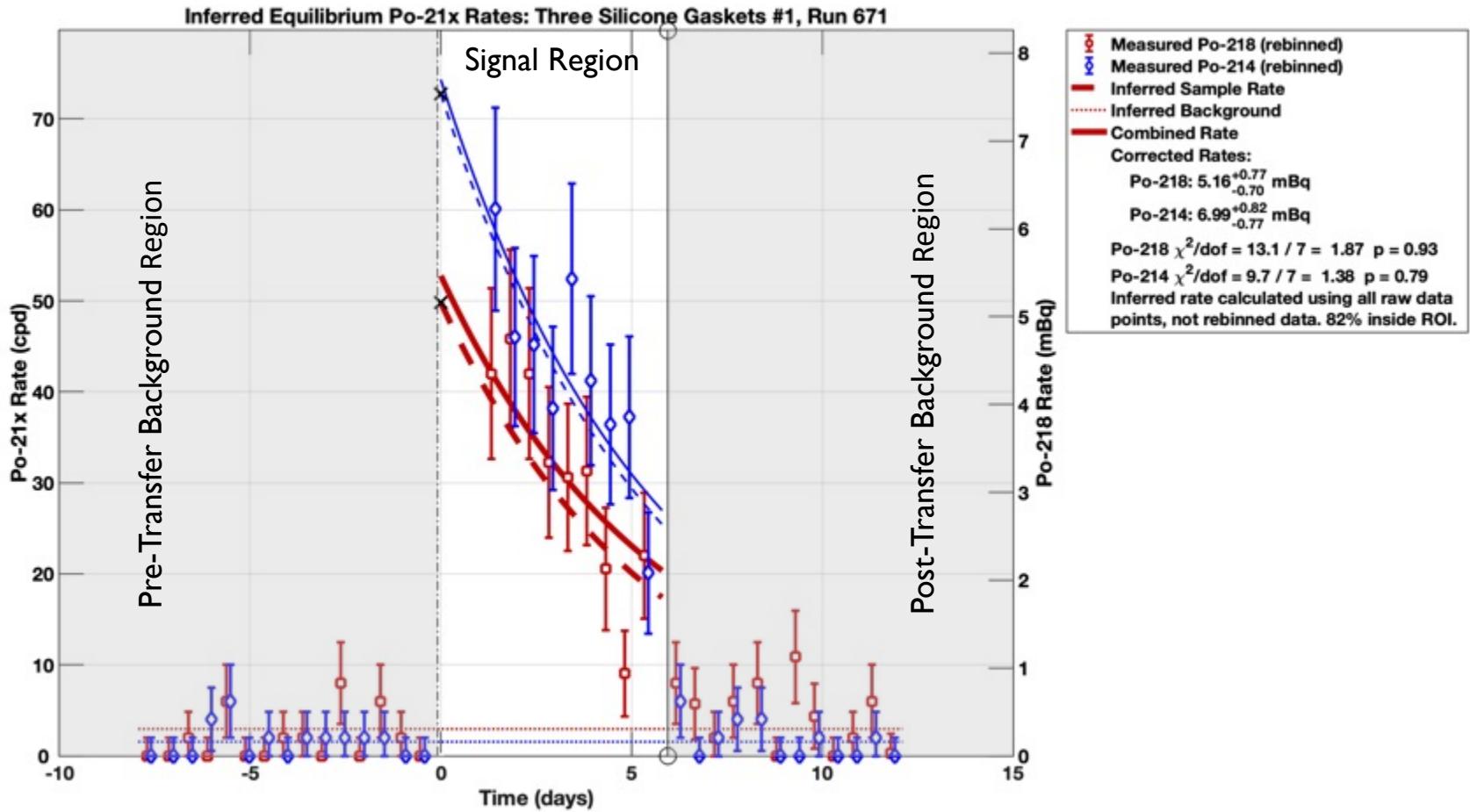
Two Silicone Gaskets: Po-218 & Po-214 Neg. Log Likelihoods



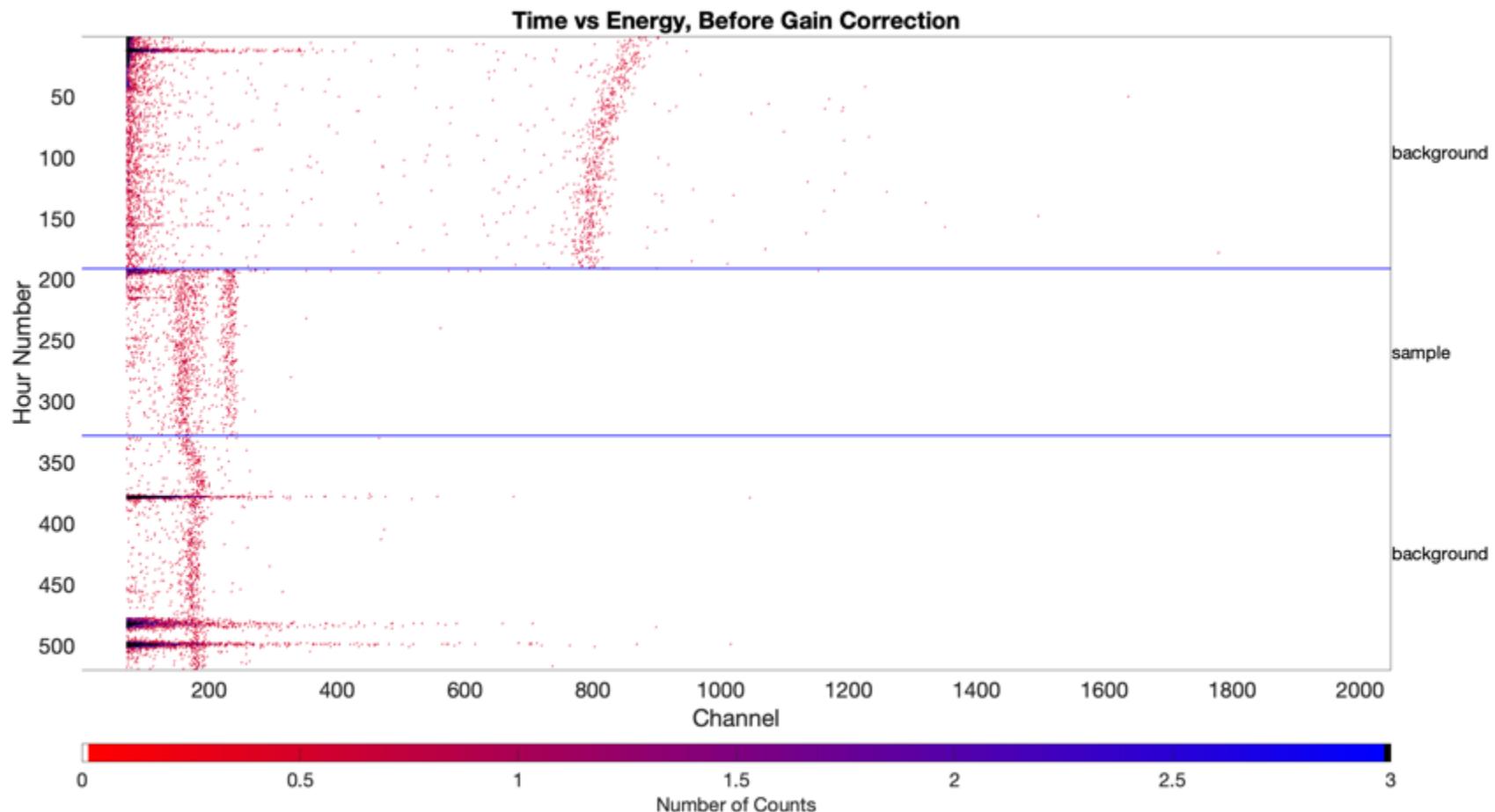
Two Silicone Gaskets: Summary of Results

Sample	Po-218	Po-214	Po-218 & Po-214
Run 663	$8.2^{+0.7}_{-0.7}$ mBq	$8.2^{+0.7}_{-0.7}$ mBq	$8.2^{+0.5}_{-0.5}$ mBq
Run 666	$7.7^{+0.6}_{-0.6}$ mBq	$7.9^{+0.6}_{-0.6}$ mBq	$7.8^{+0.4}_{-0.4}$ mBq
Combined	$8.0^{+0.5}_{-0.5}$ mBq	$8.0^{+0.5}_{-0.4}$ mBq	$8.0^{+0.3}_{-0.3}$ mBq

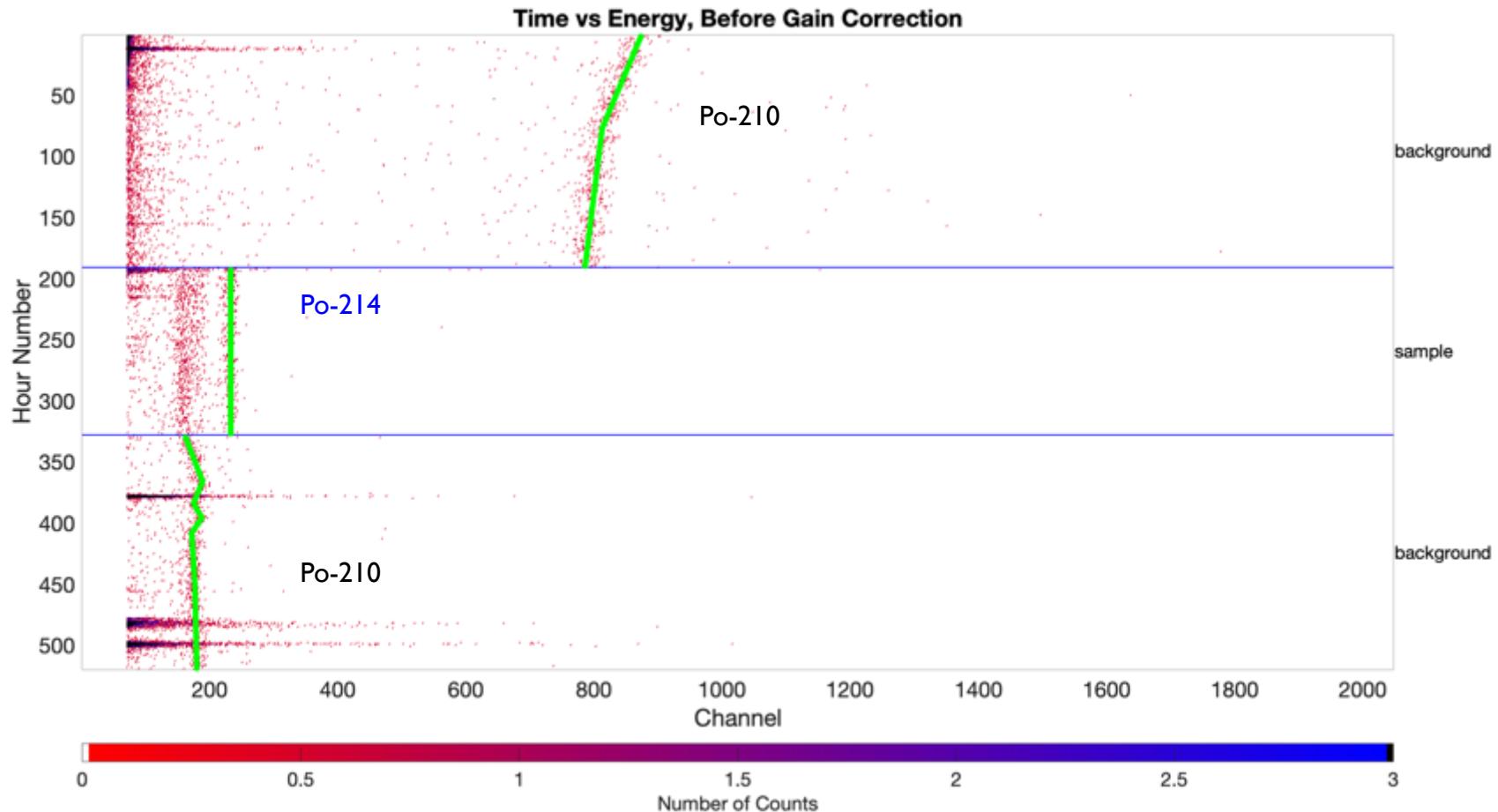
Run 671, Three Silicone Gaskets #1: 7/29/2021 – 8/06/2021



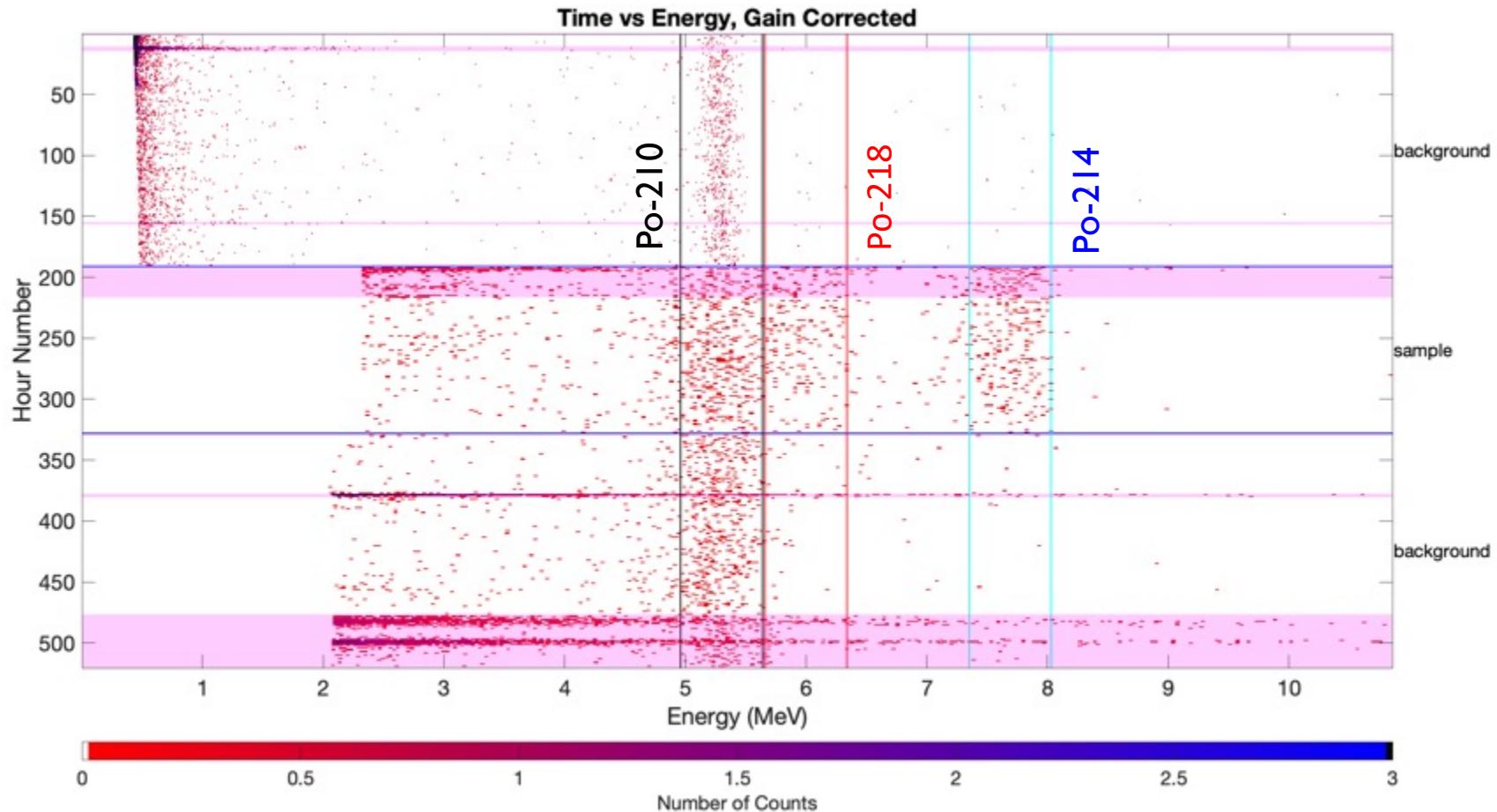
Run 671, Three Silicone Gaskets #1: Raw data



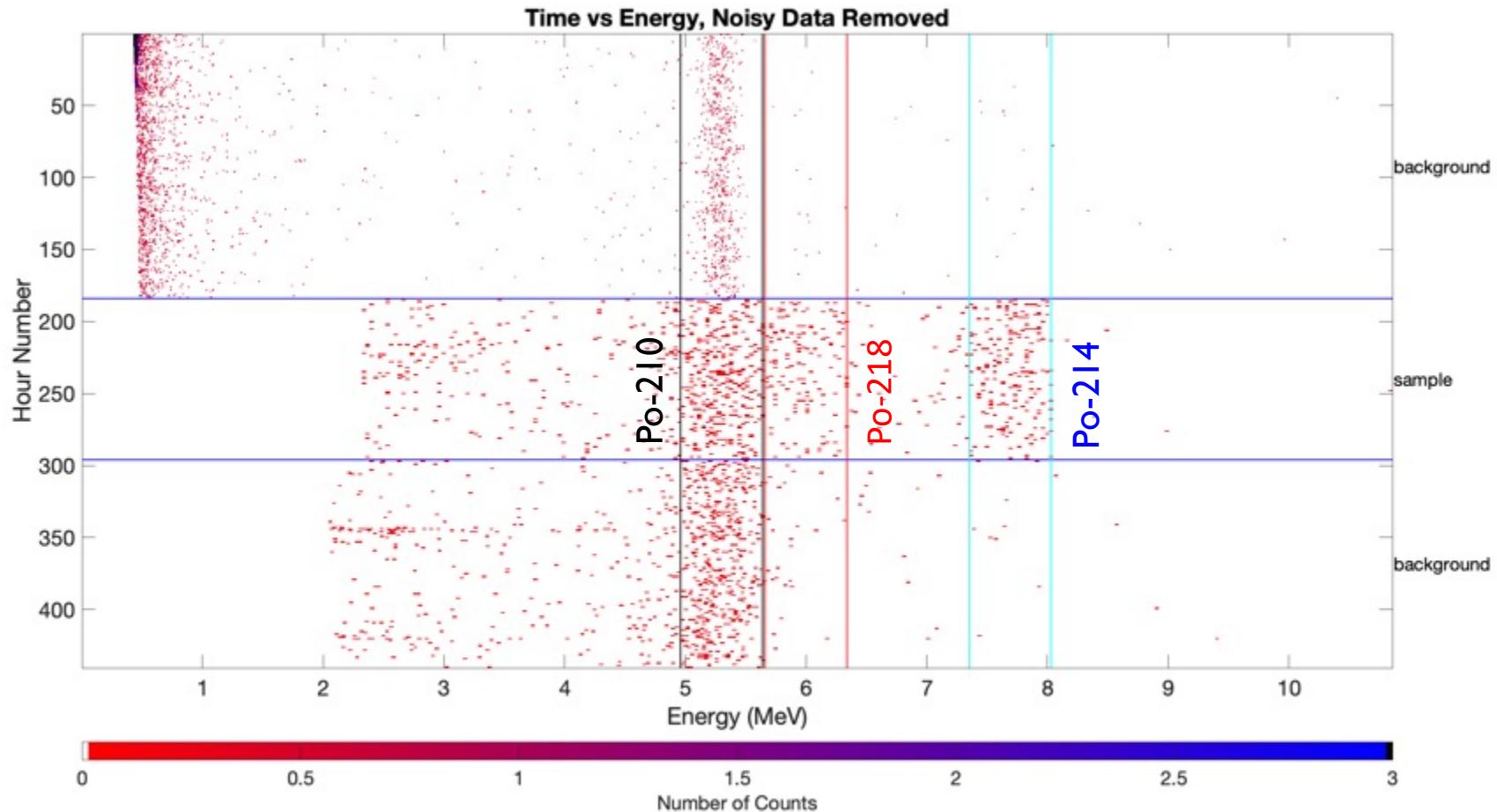
Run 671, Three Silicone Gaskets #1: Fit of Po-21x events



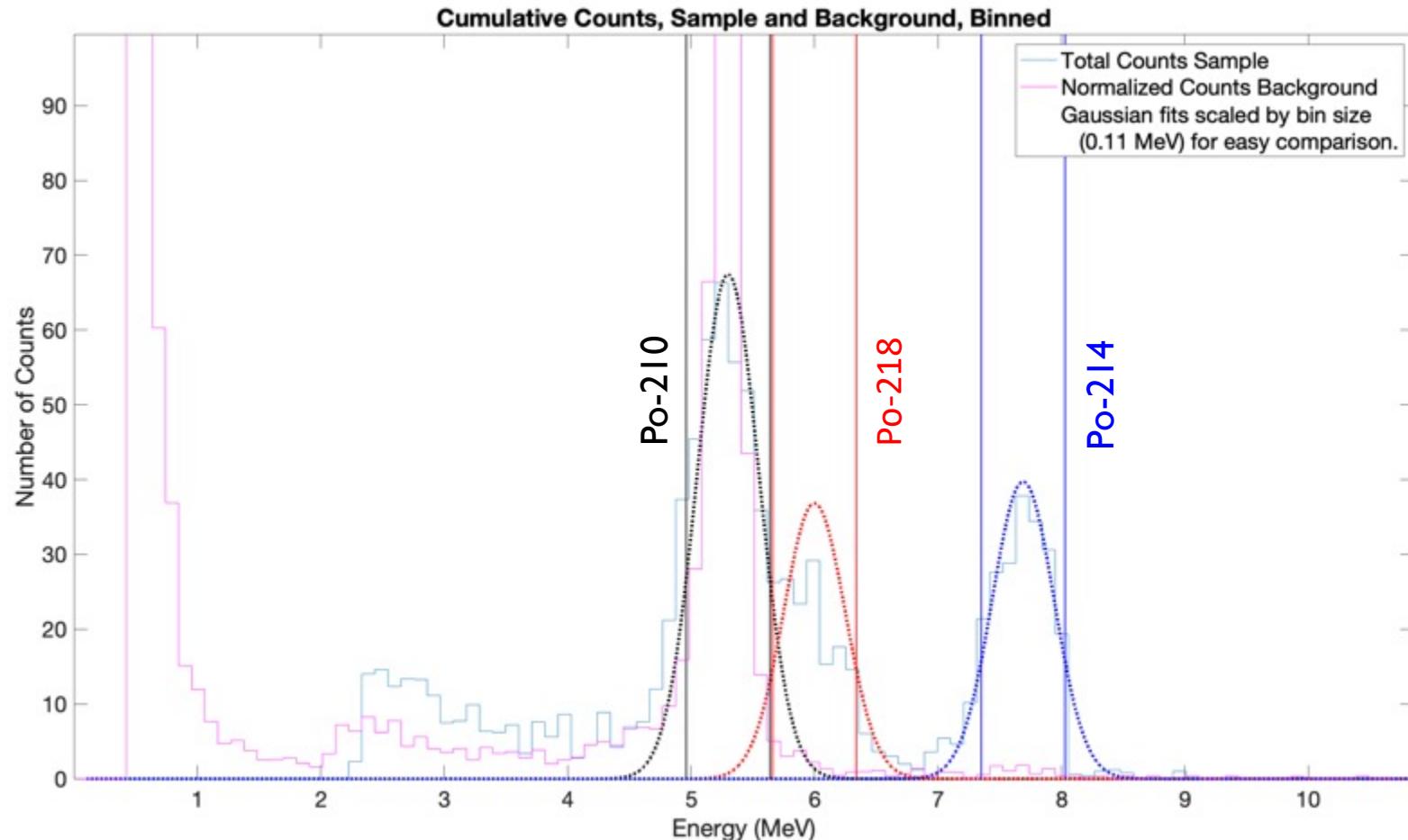
Run 671, Three Silicone Gaskets #1: Gain correction w/ bad intervals



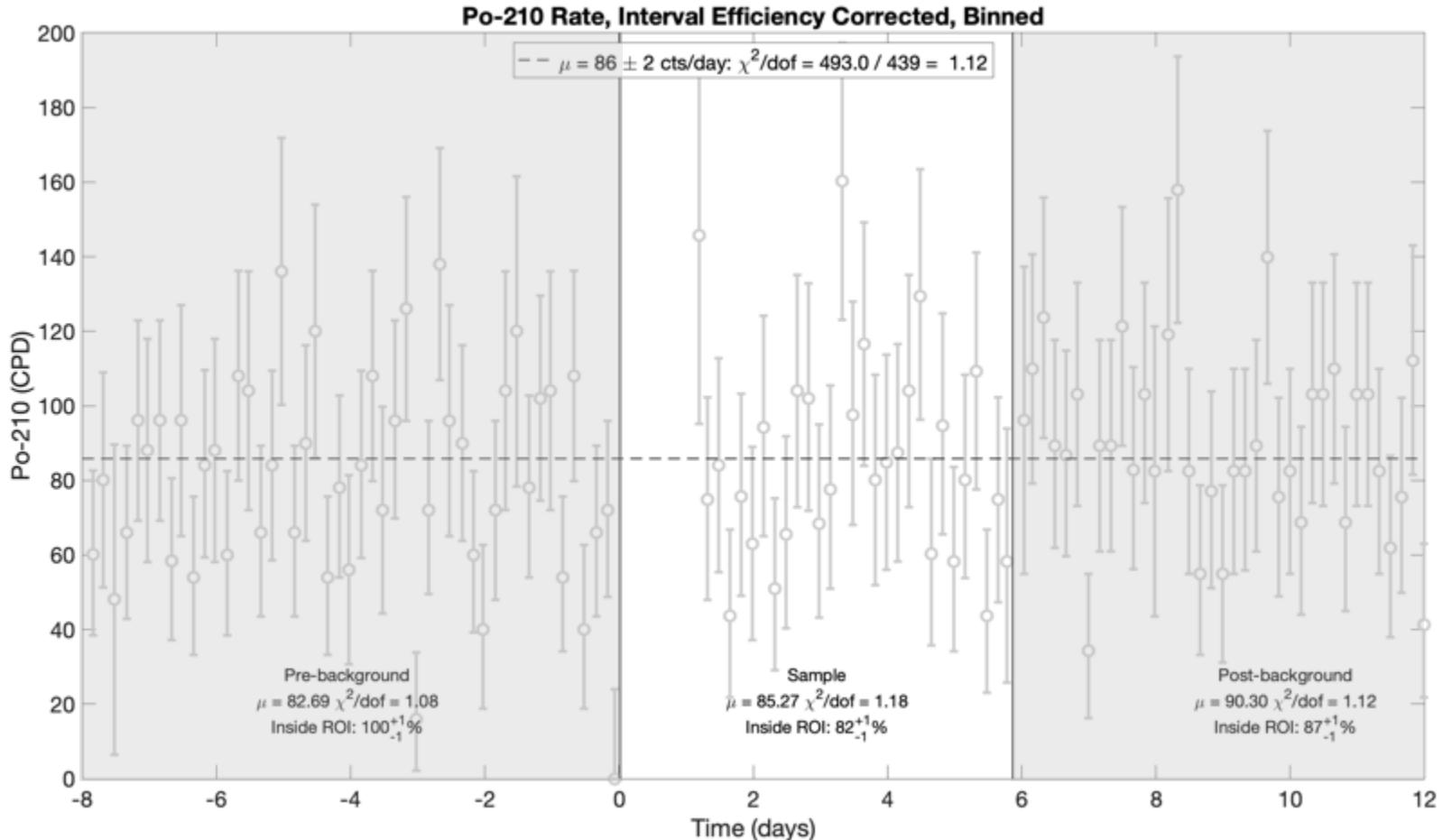
Run 671, Three Silicone Gaskets #1: Gain Correction w/o Bad Intervals



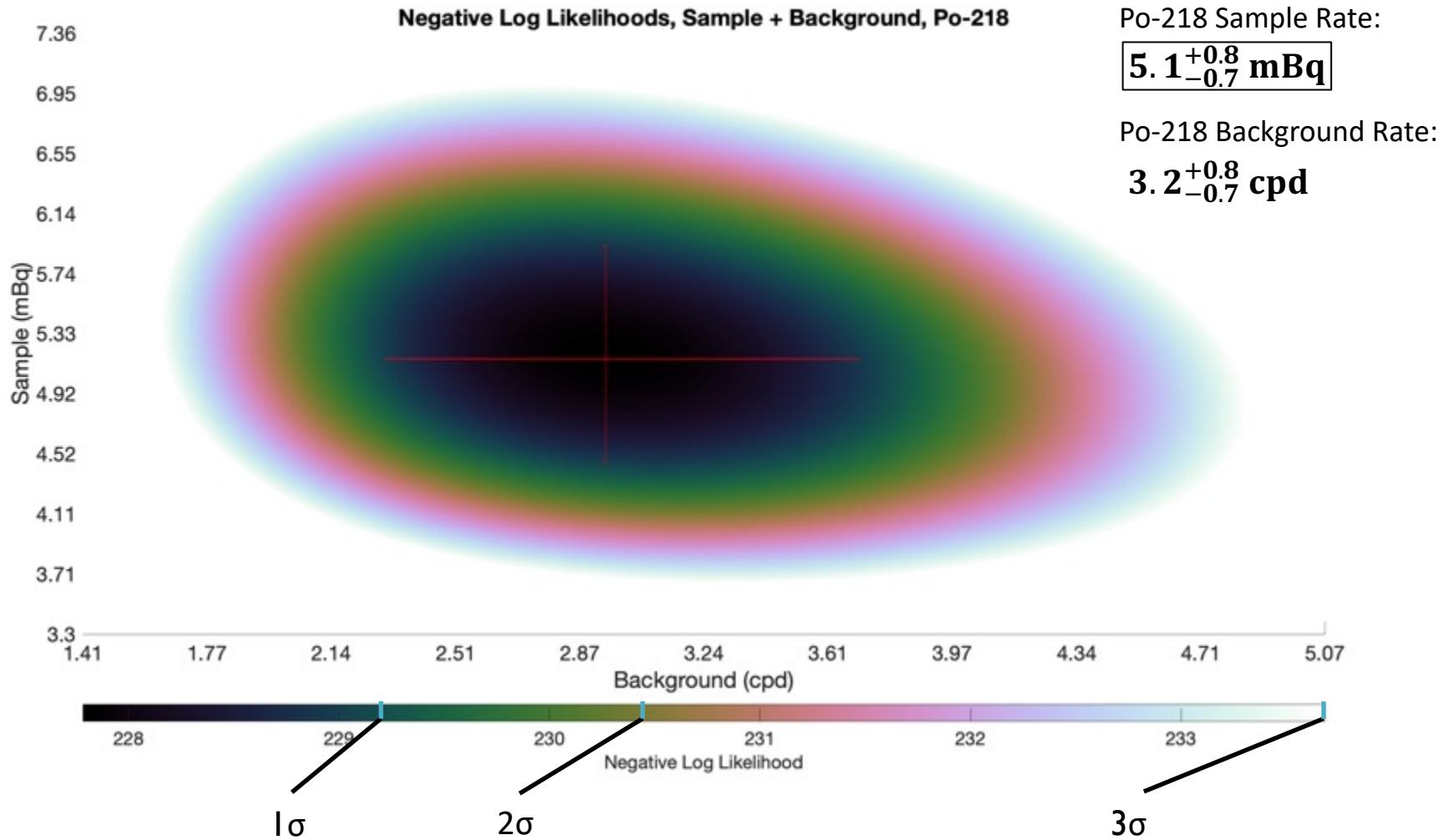
Run 671, Three Silicone Gaskets #1: Cumulative counts



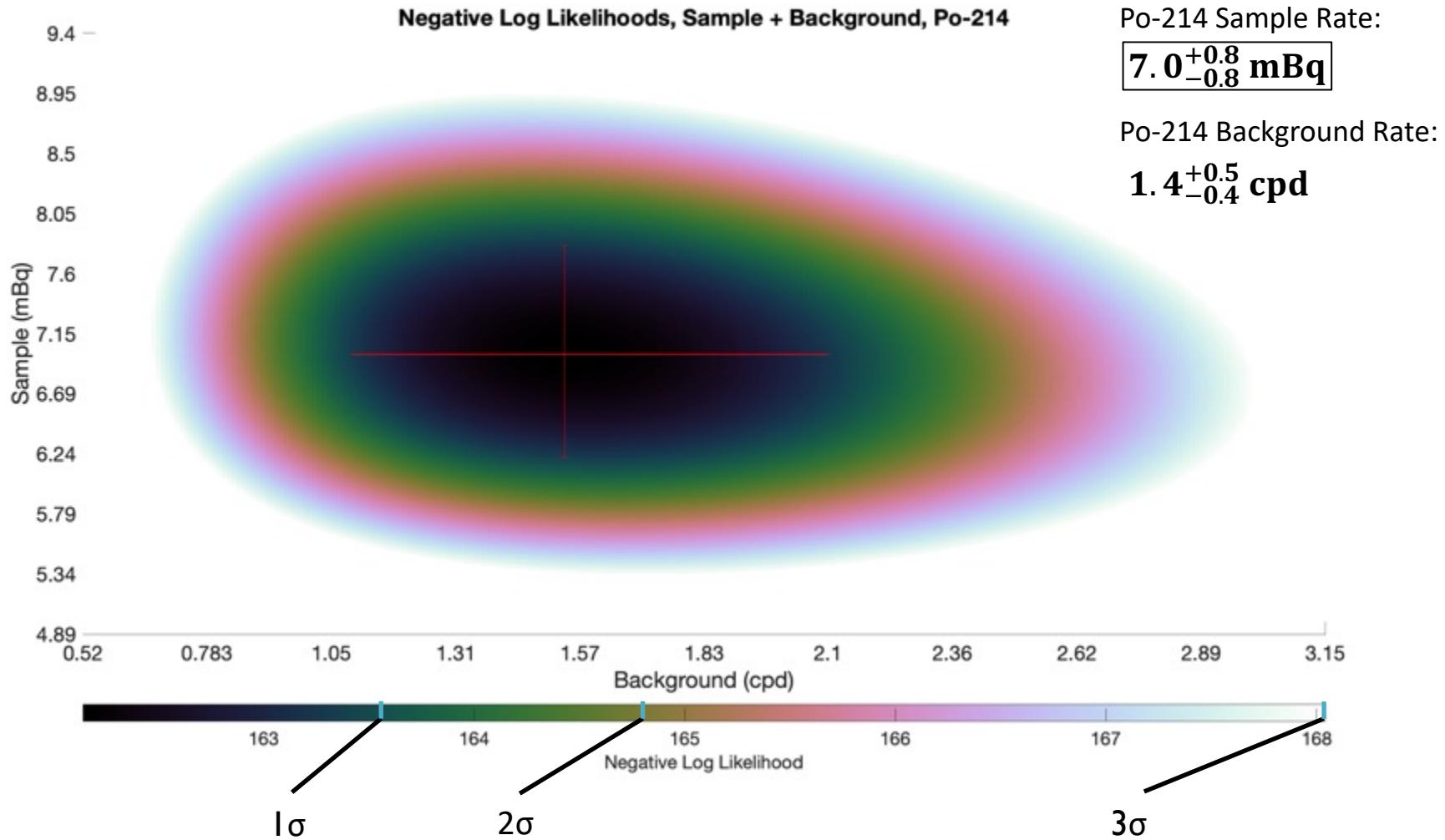
Run 671, Three Silicone Gaskets #1: Po-210 rate



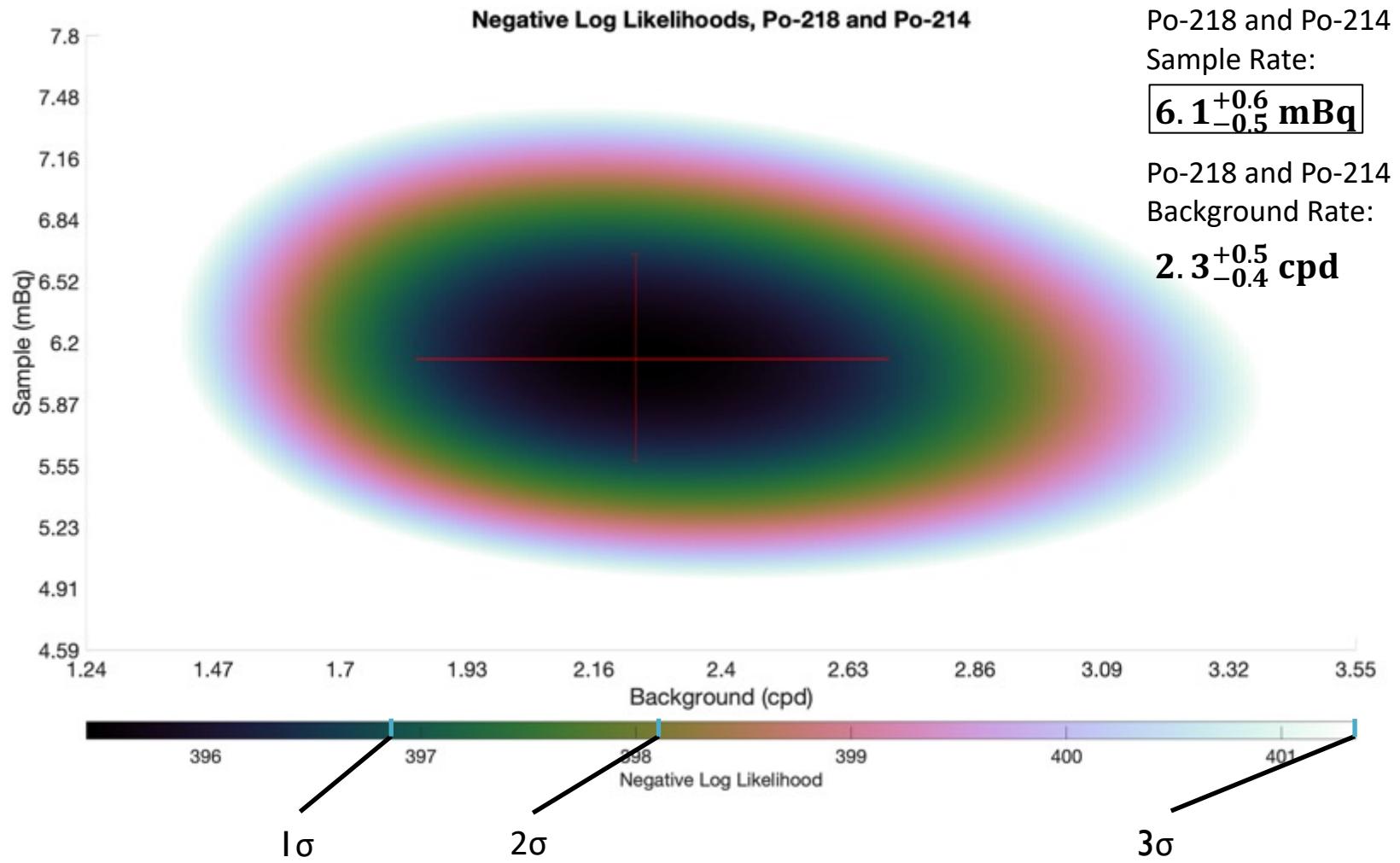
Run 671, Three Silicone Gaskets #1: Po-218 Neg. Log Likelihood



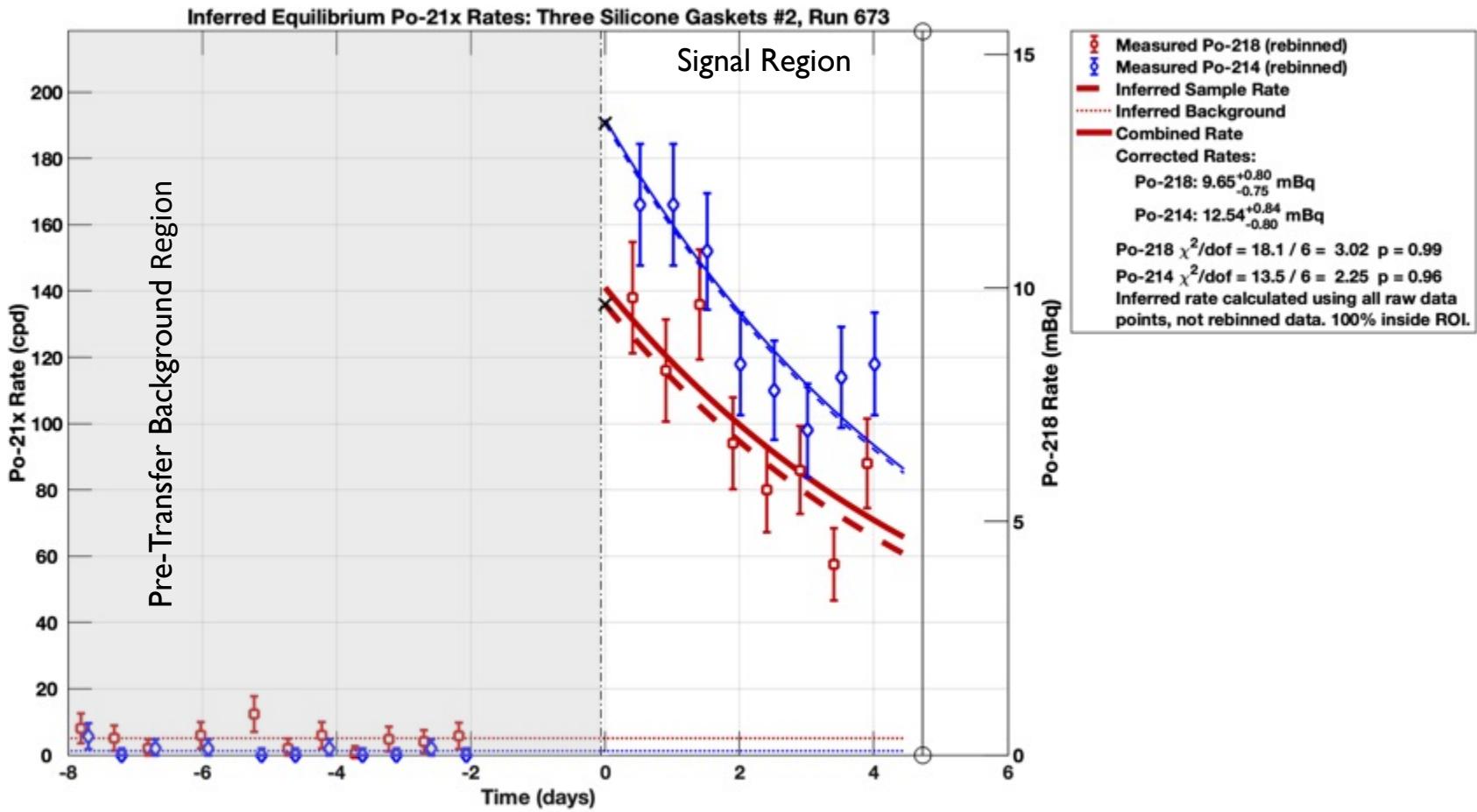
Run 671, Three Silicone Gaskets #1: Po-214 Neg. Log Likelihood



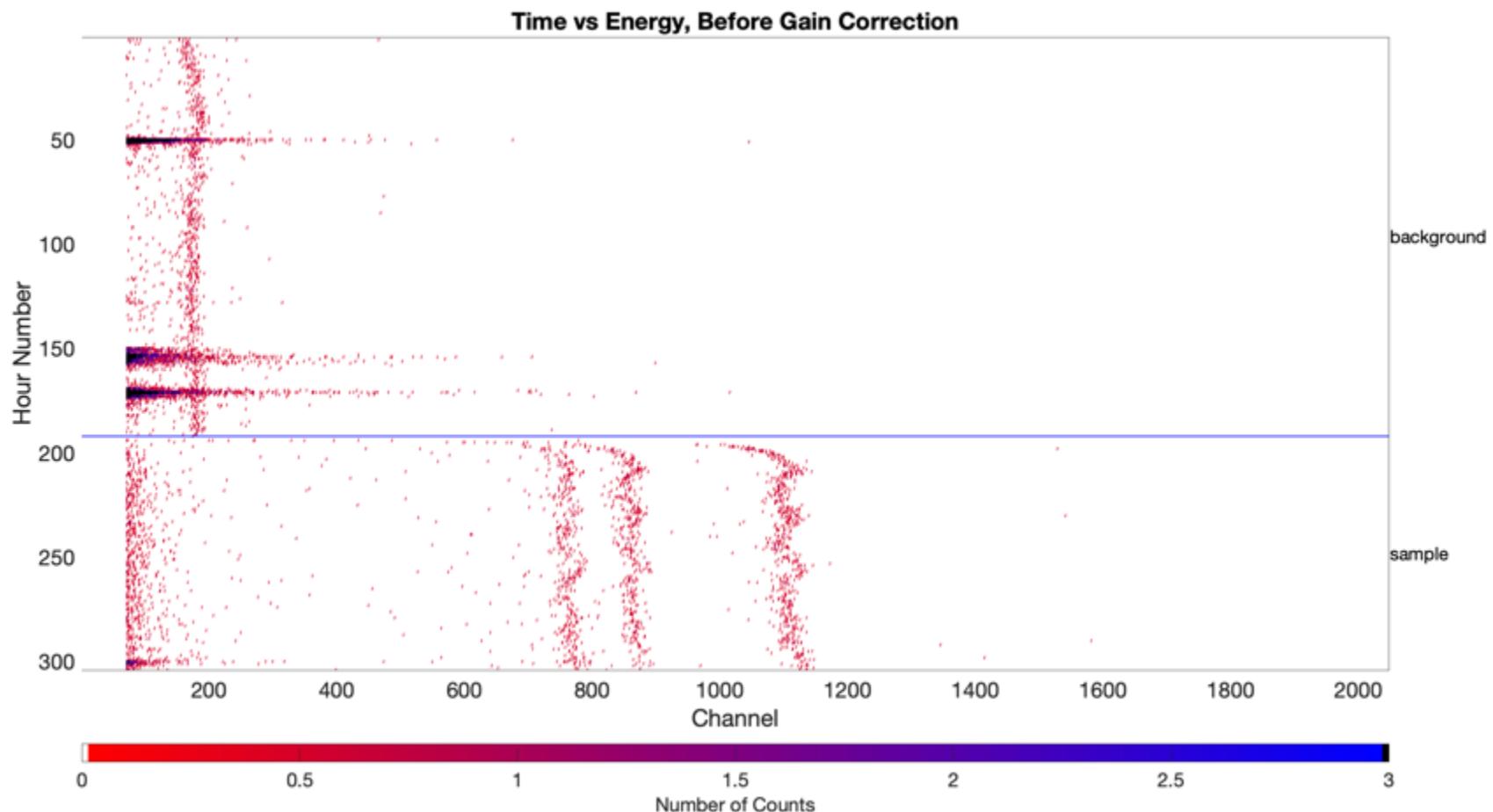
Run 671, Three Silicone Gaskets #1: Po-218 & Po-214 Neg. Log Likelihoods



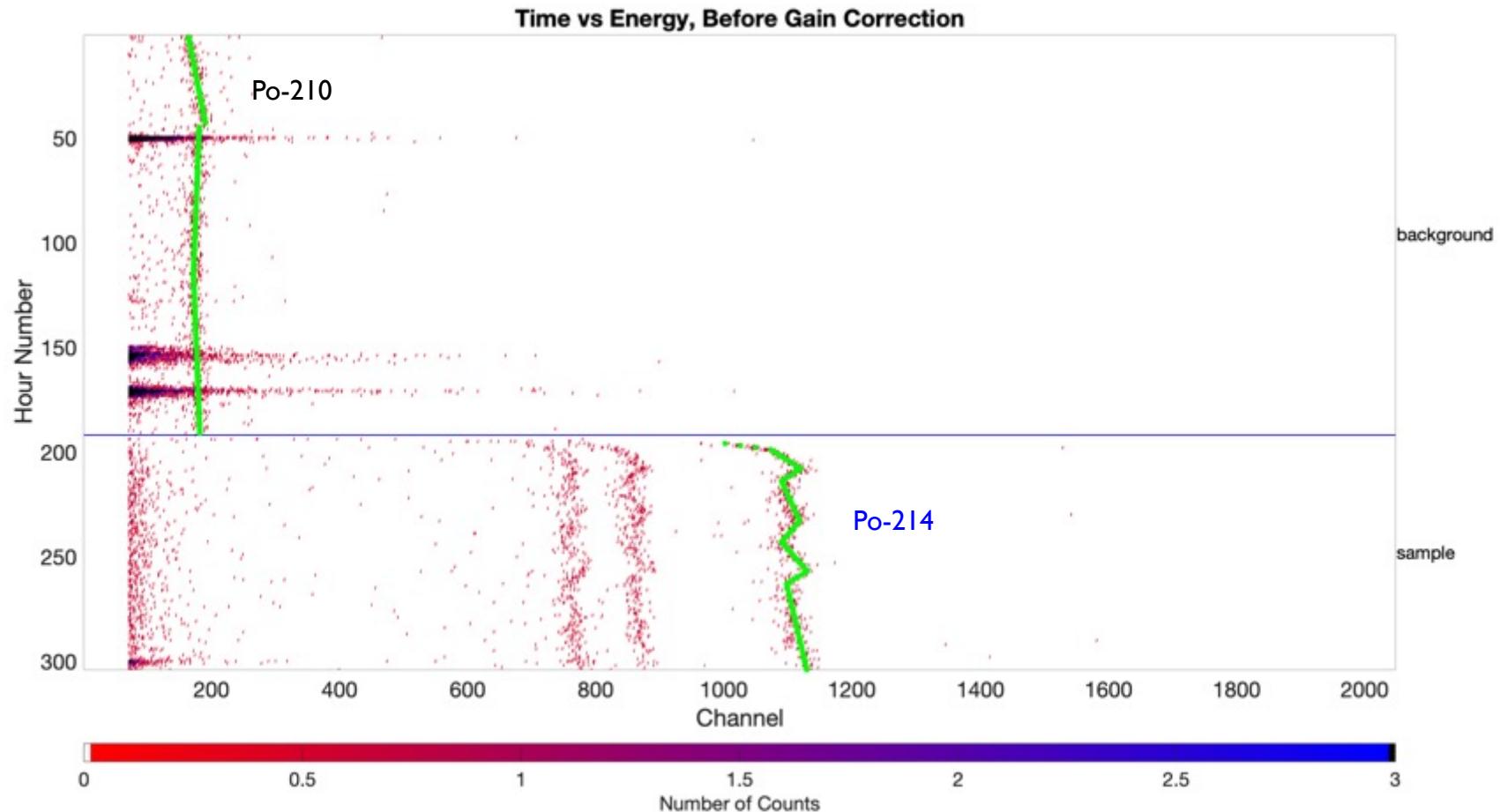
Run 673, Three Silicone Gaskets #2: 8/06/2021 – 8/20/2021



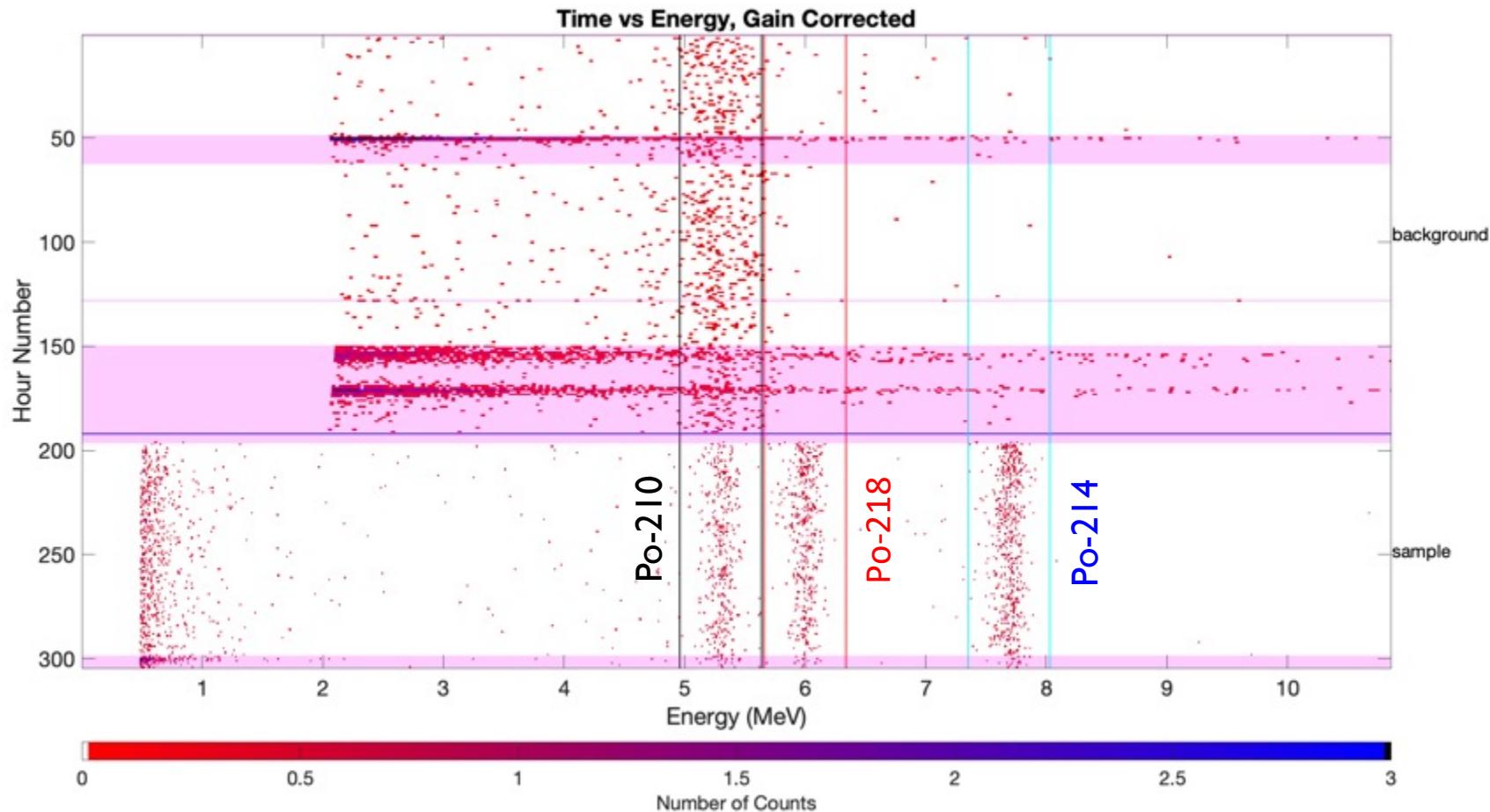
Run 673, Three Silicone Gaskets #2: Raw data



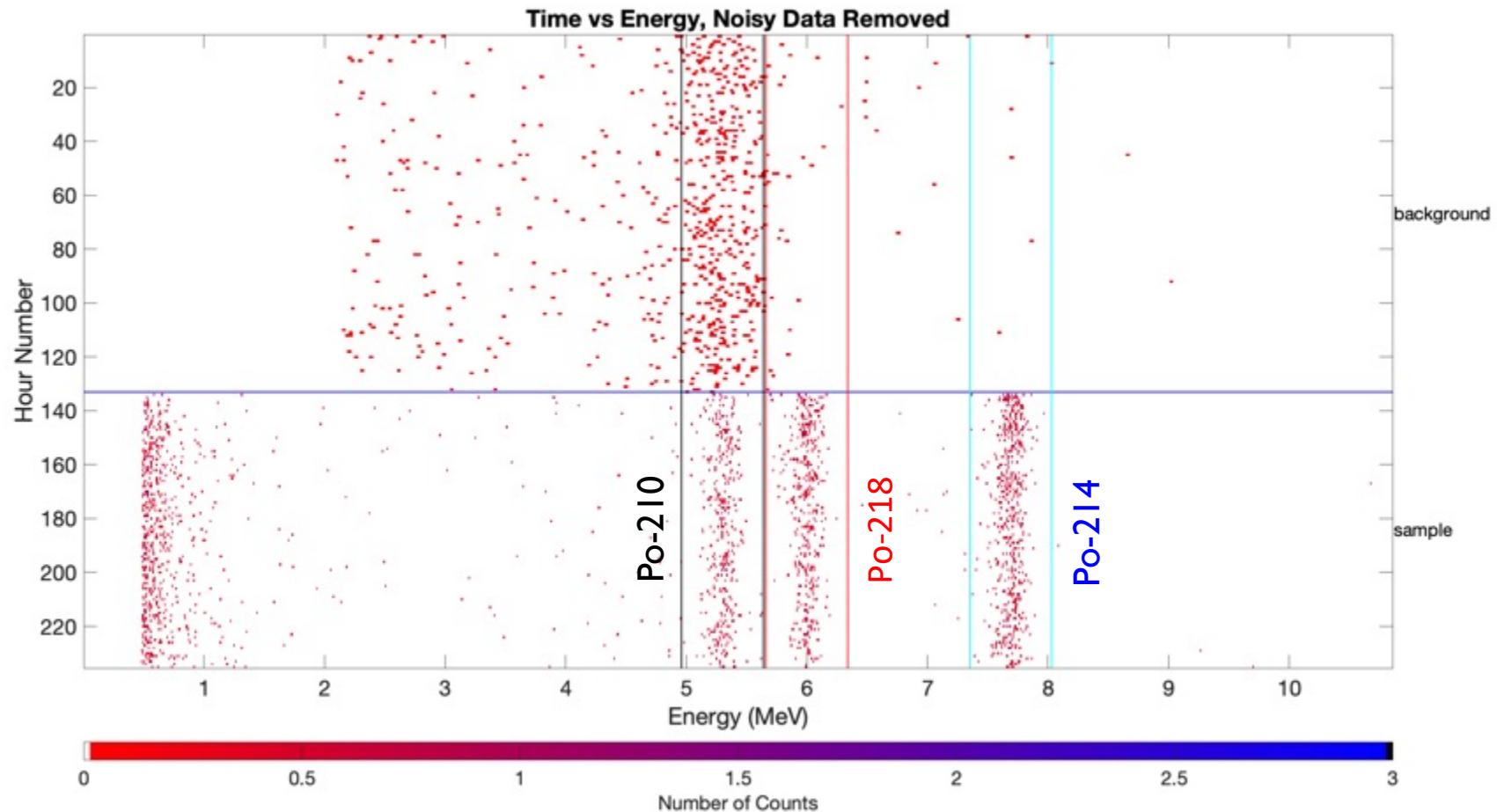
Run 673, Three Silicone Gaskets #2: Fit of Po-21x events



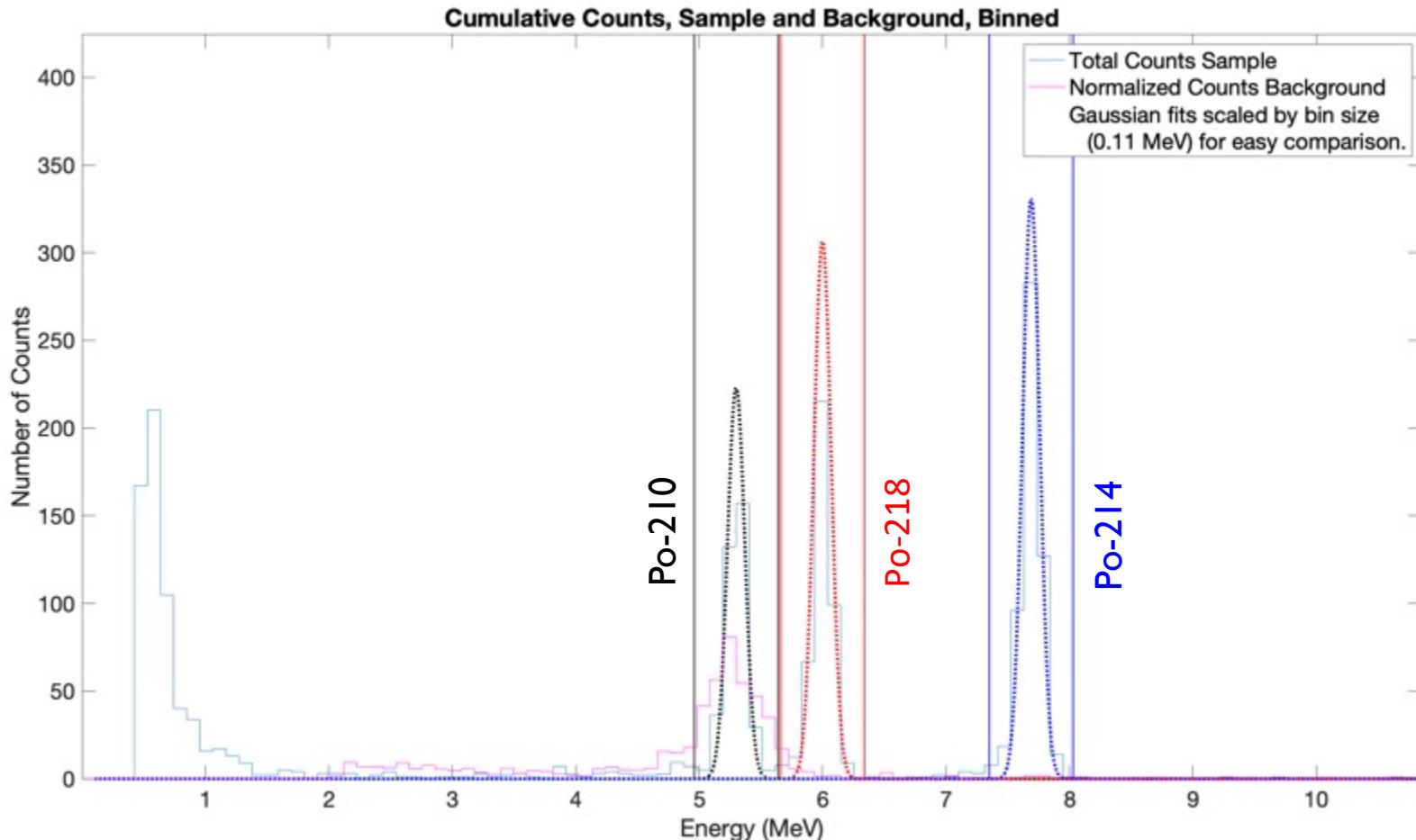
Run 673, Three Silicone Gaskets #2: Gain correction w/ bad intervals



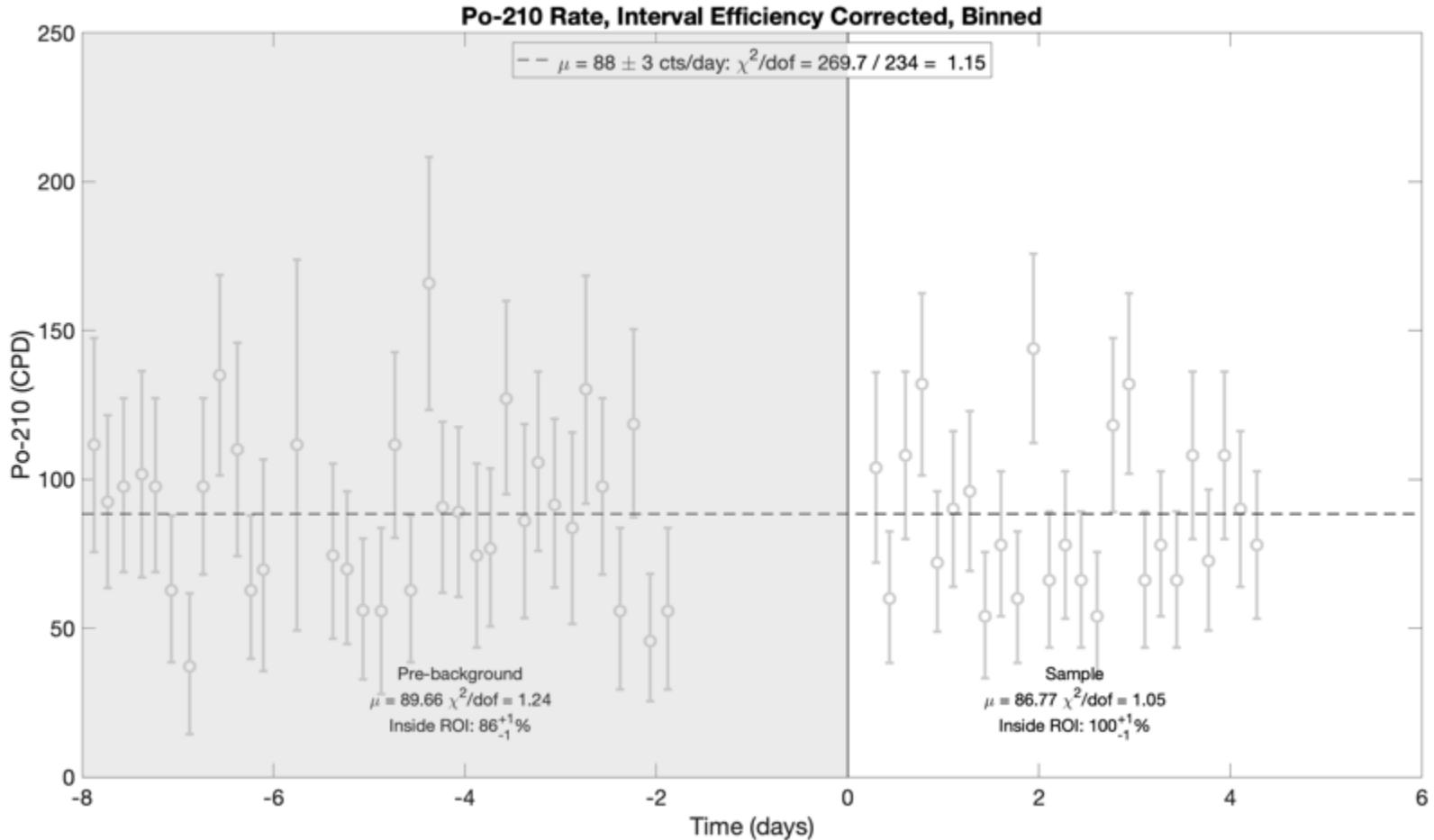
Run 673, Three Silicone Gaskets #2: Gain Correction w/o Bad Intervals



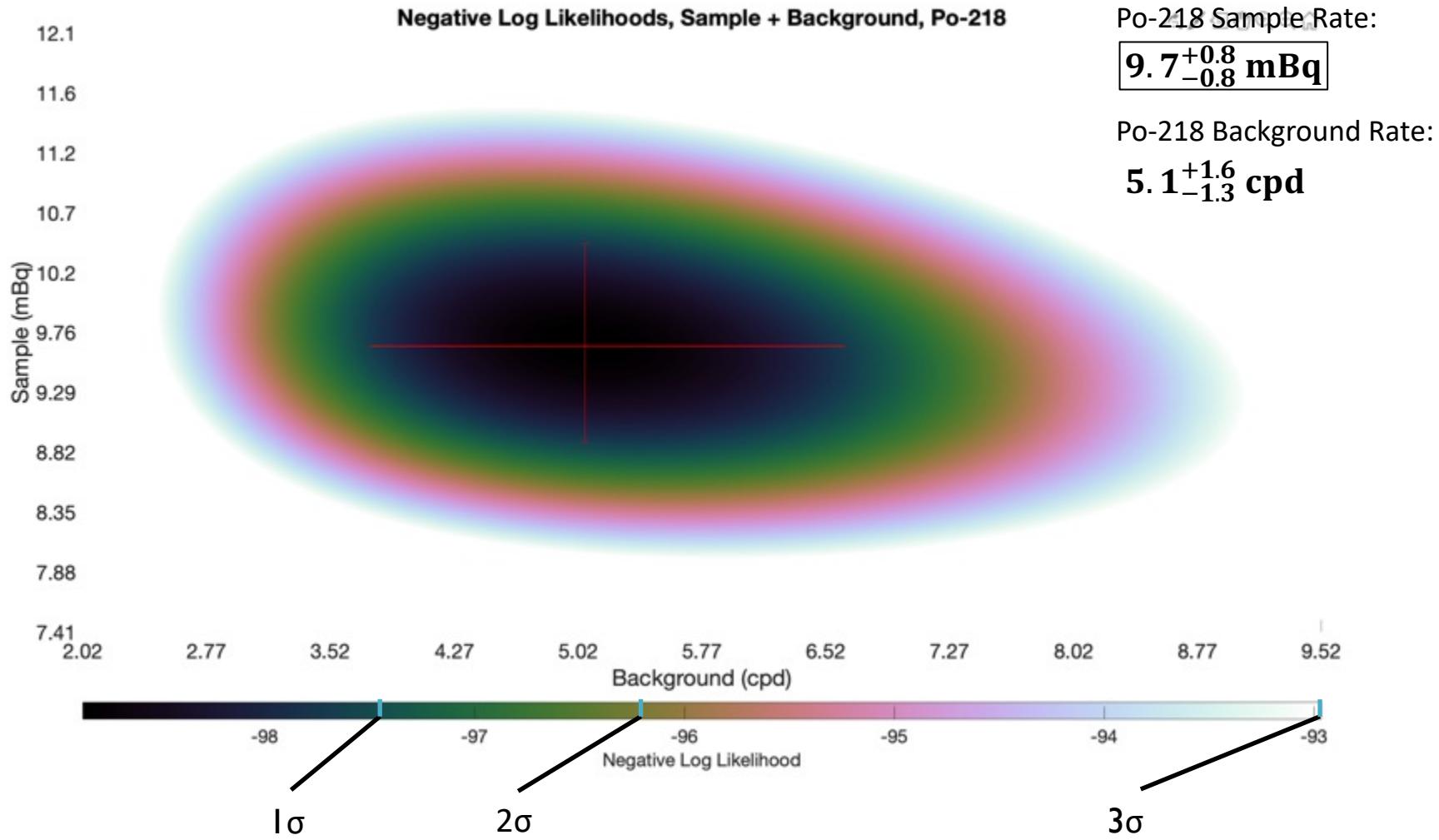
Run 673, Three Silicone Gaskets #2: Cumulative counts



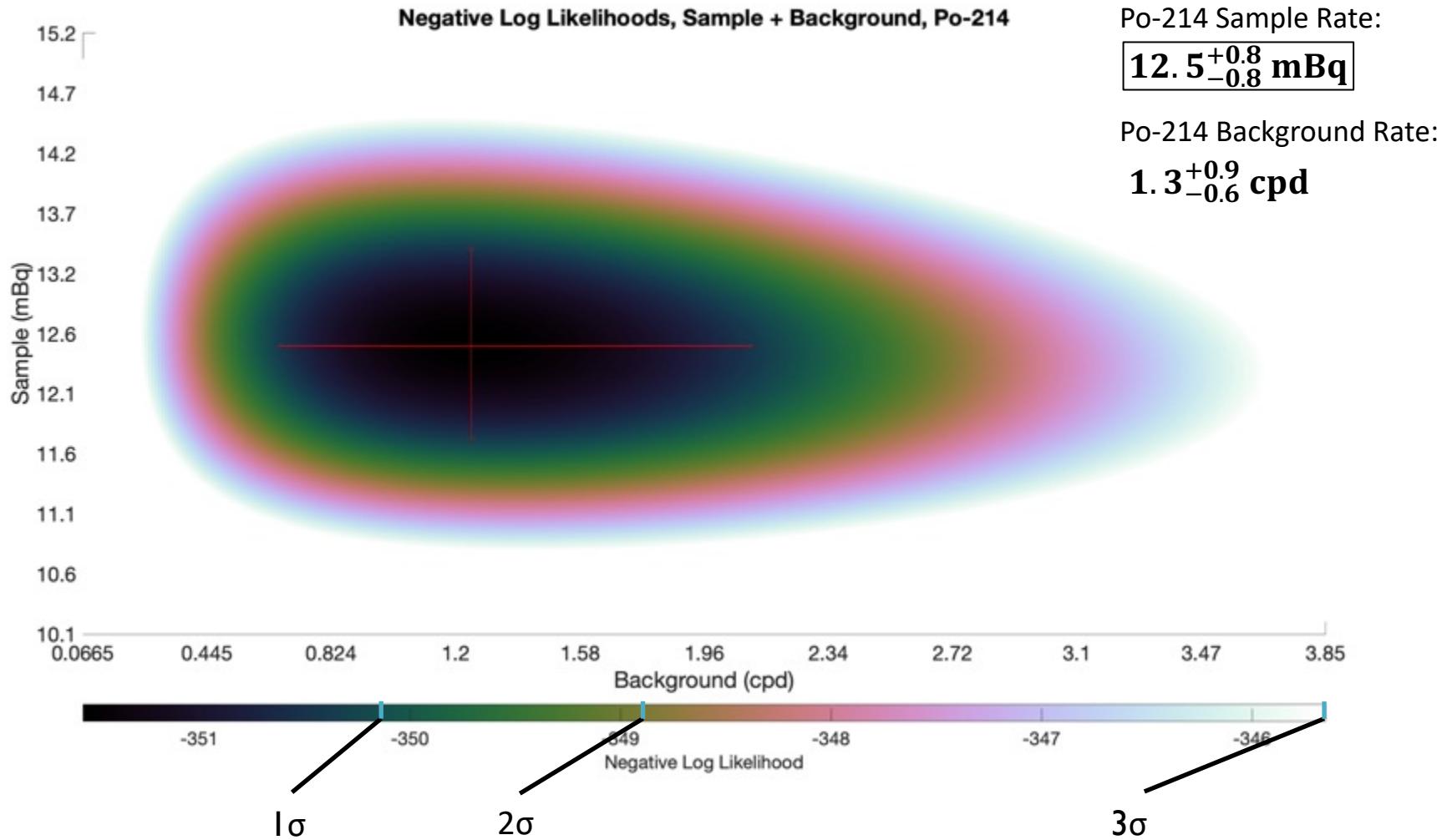
Run 673, Three Silicone Gaskets #2: Po-210 rate



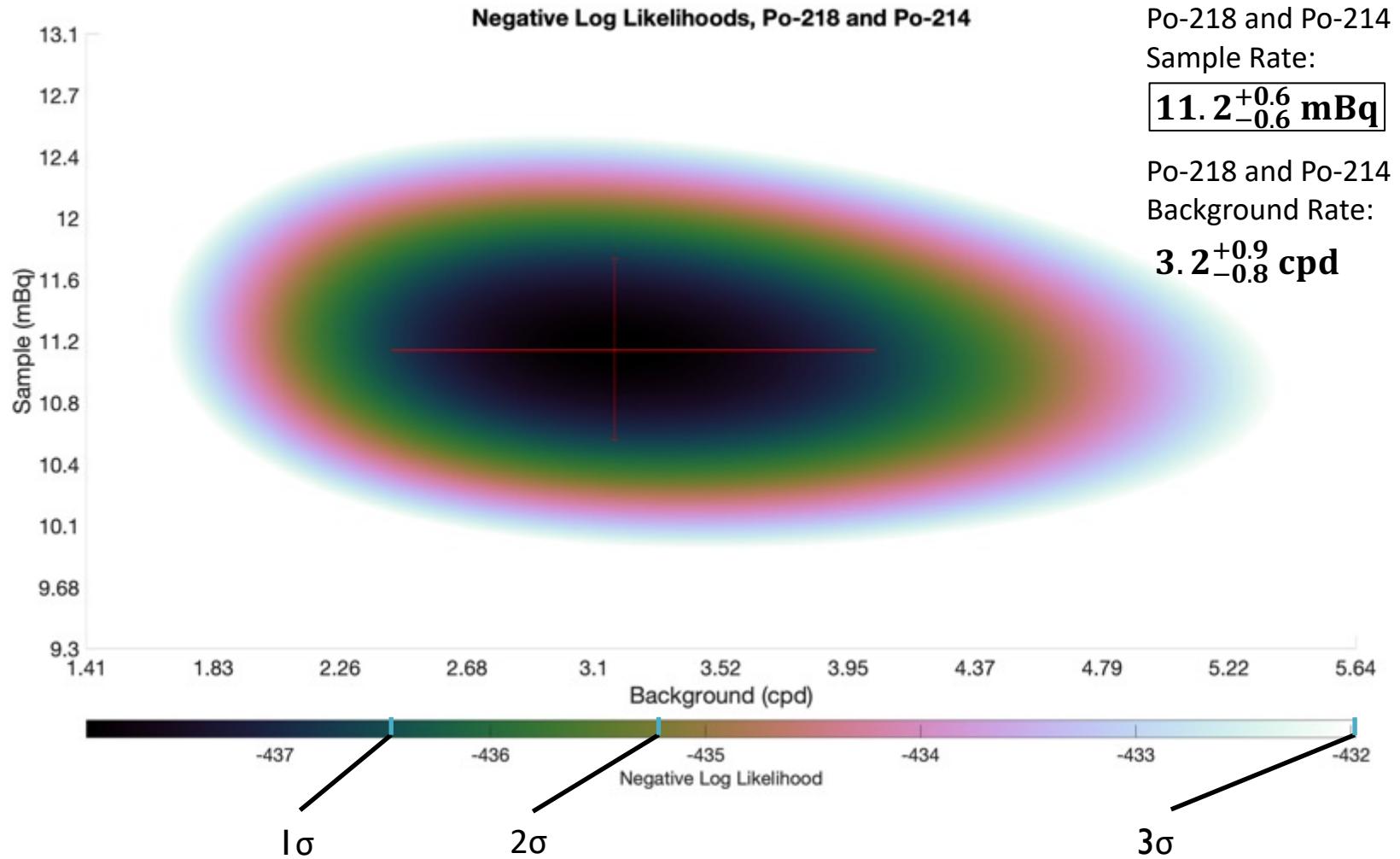
Run 673, Three Silicone Gaskets #2: Po-218 Neg. Log Likelihood



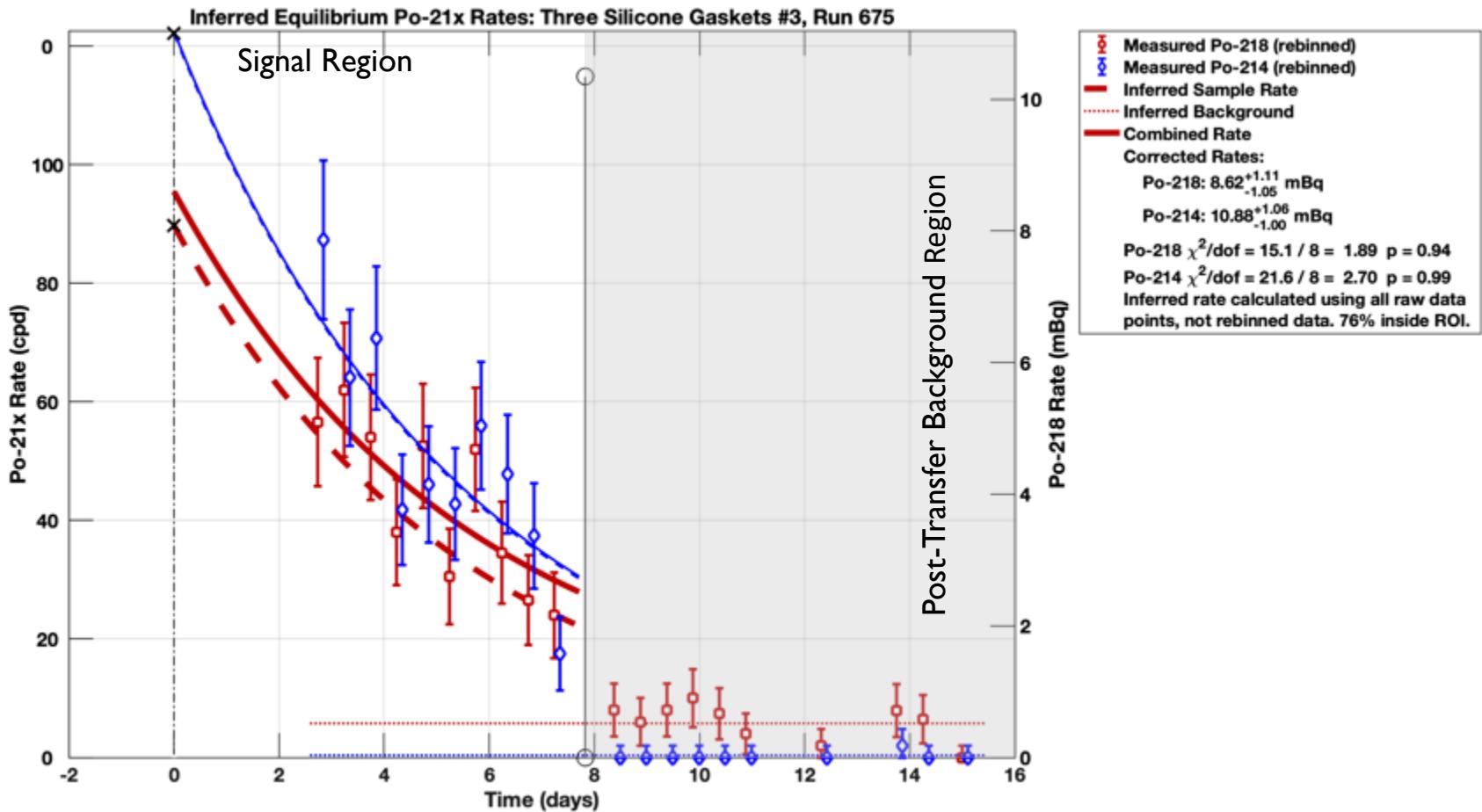
Run 673, Three Silicone Gaskets #2: Po-214 Neg. Log Likelihood



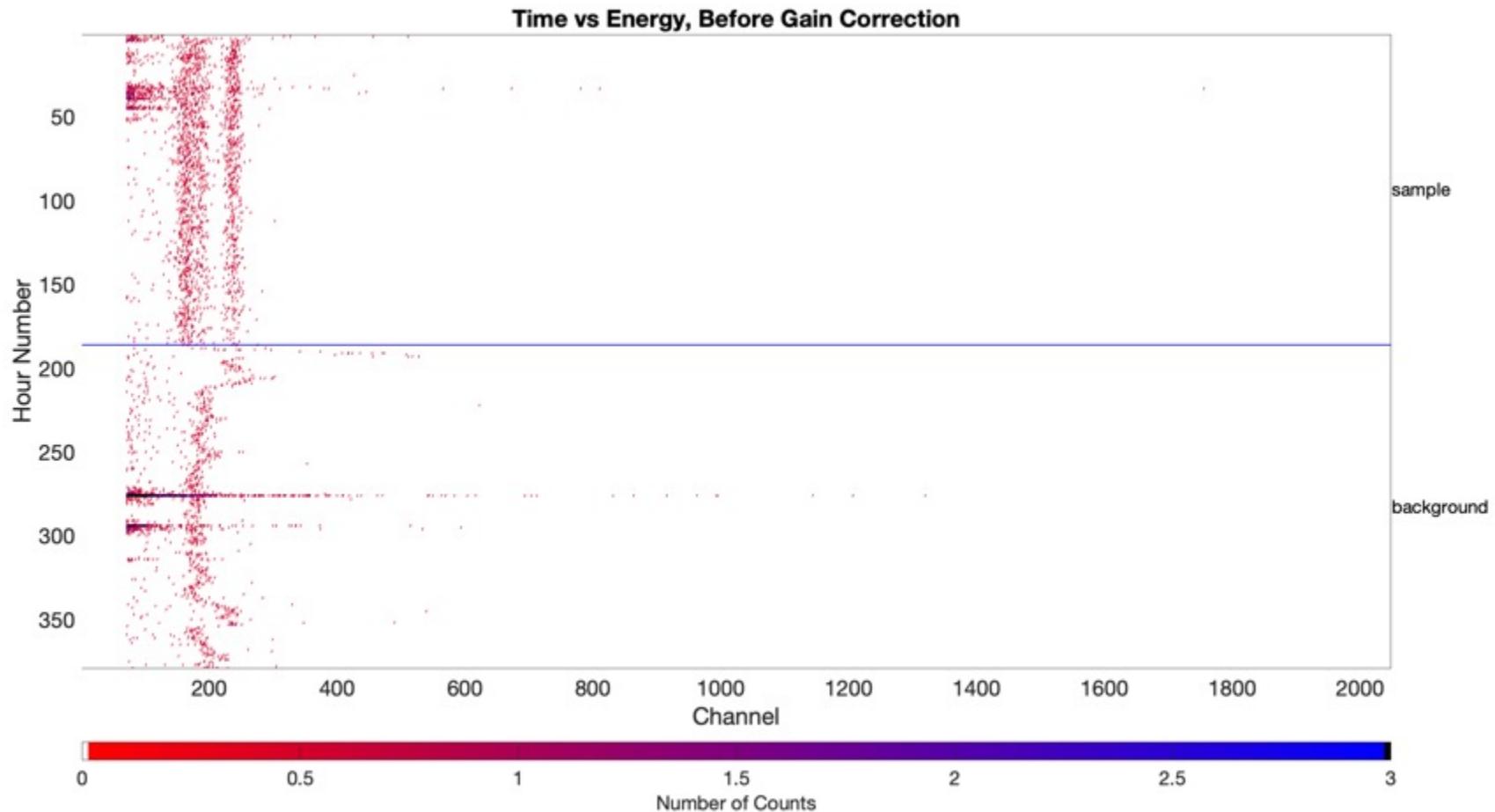
Run 673, Three Silicone Gaskets #2: Po-218 & Po-214 Neg. Log Likelihoods



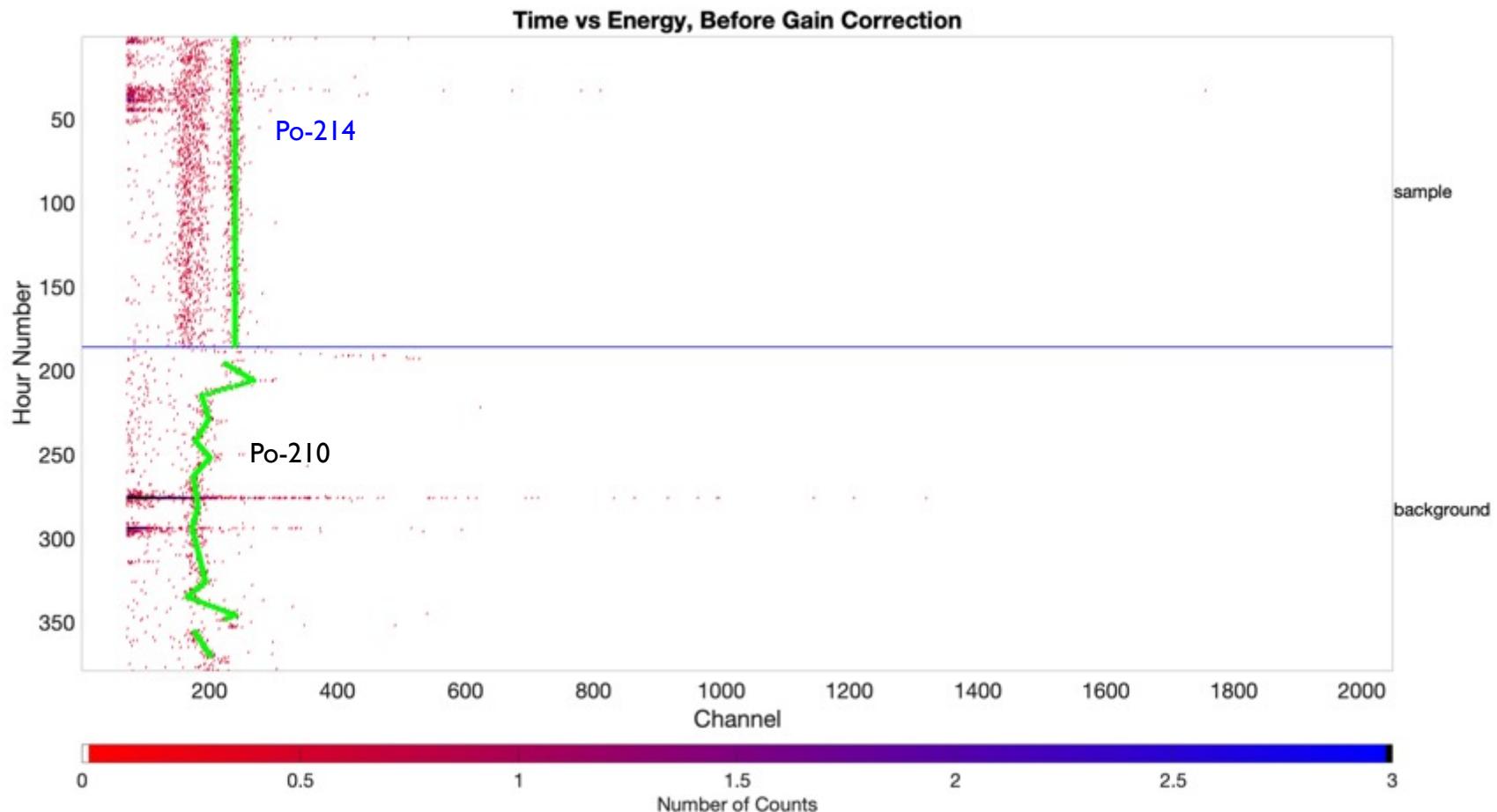
Run 675, Three Silicone Gaskets #3: 8/20/2021 – 9/01/2021



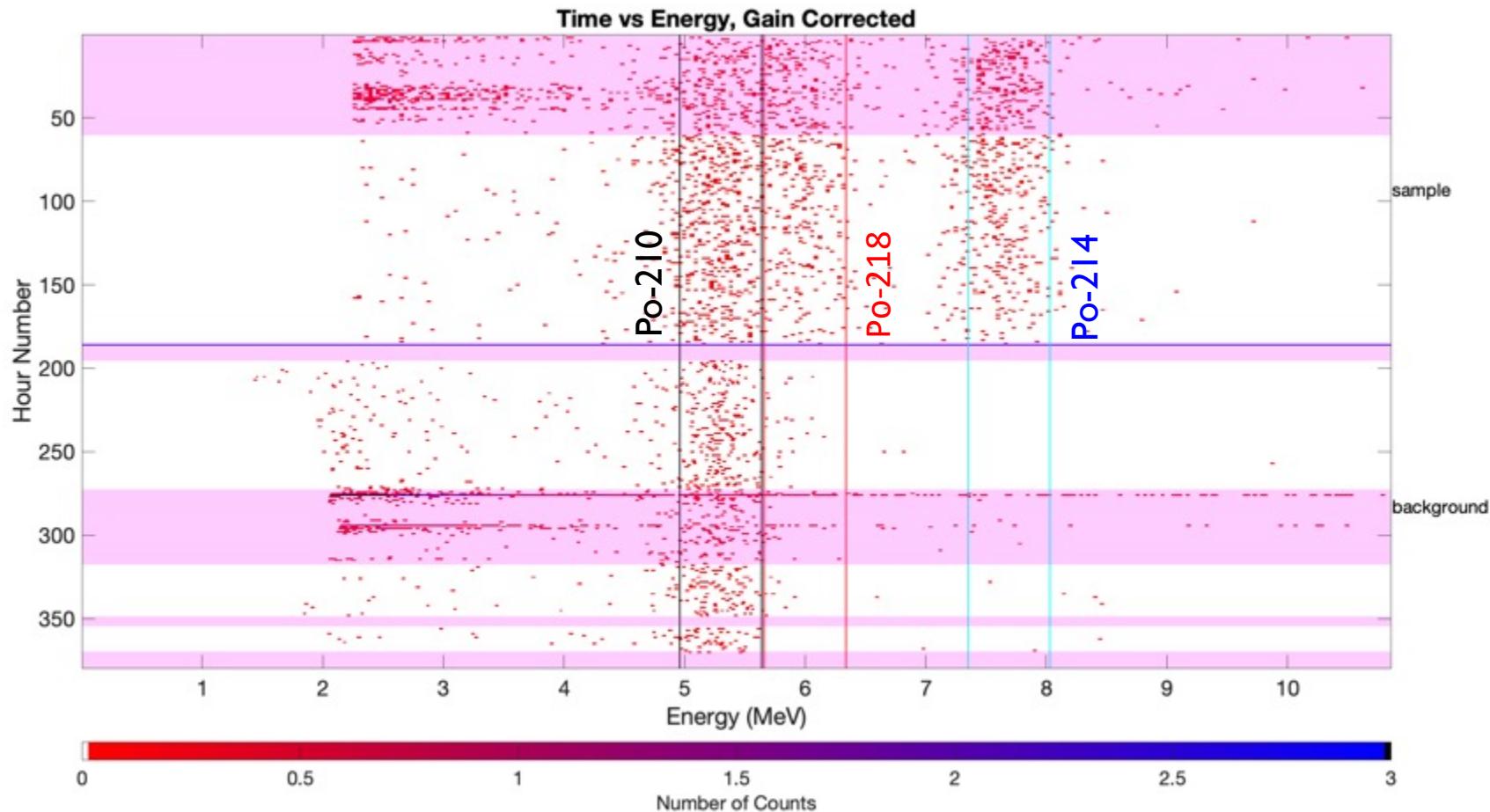
Run 675, Three Silicone Gaskets #3: Raw data



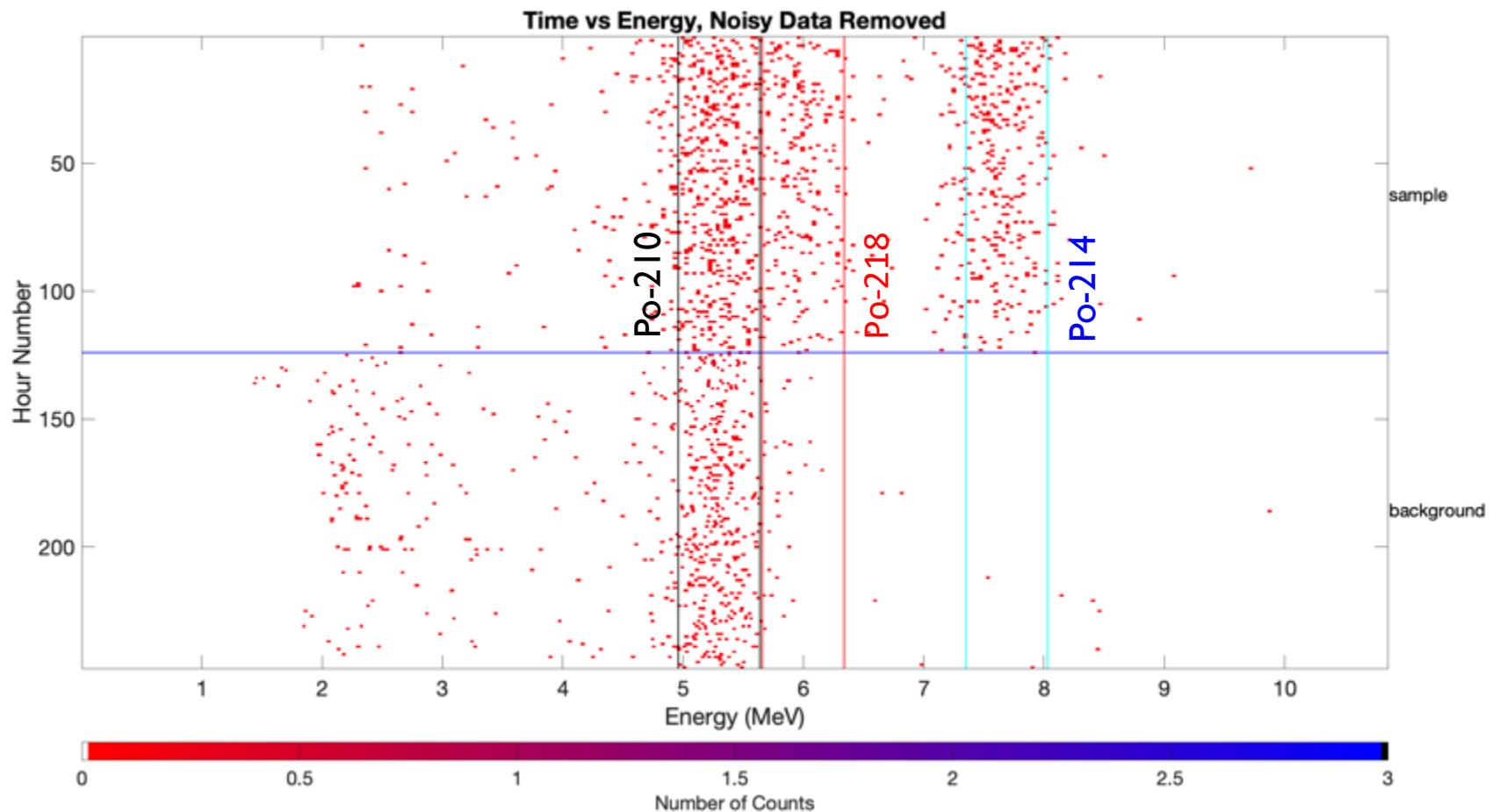
Run 675, Three Silicone Gaskets #3: Fit of Po-21x events



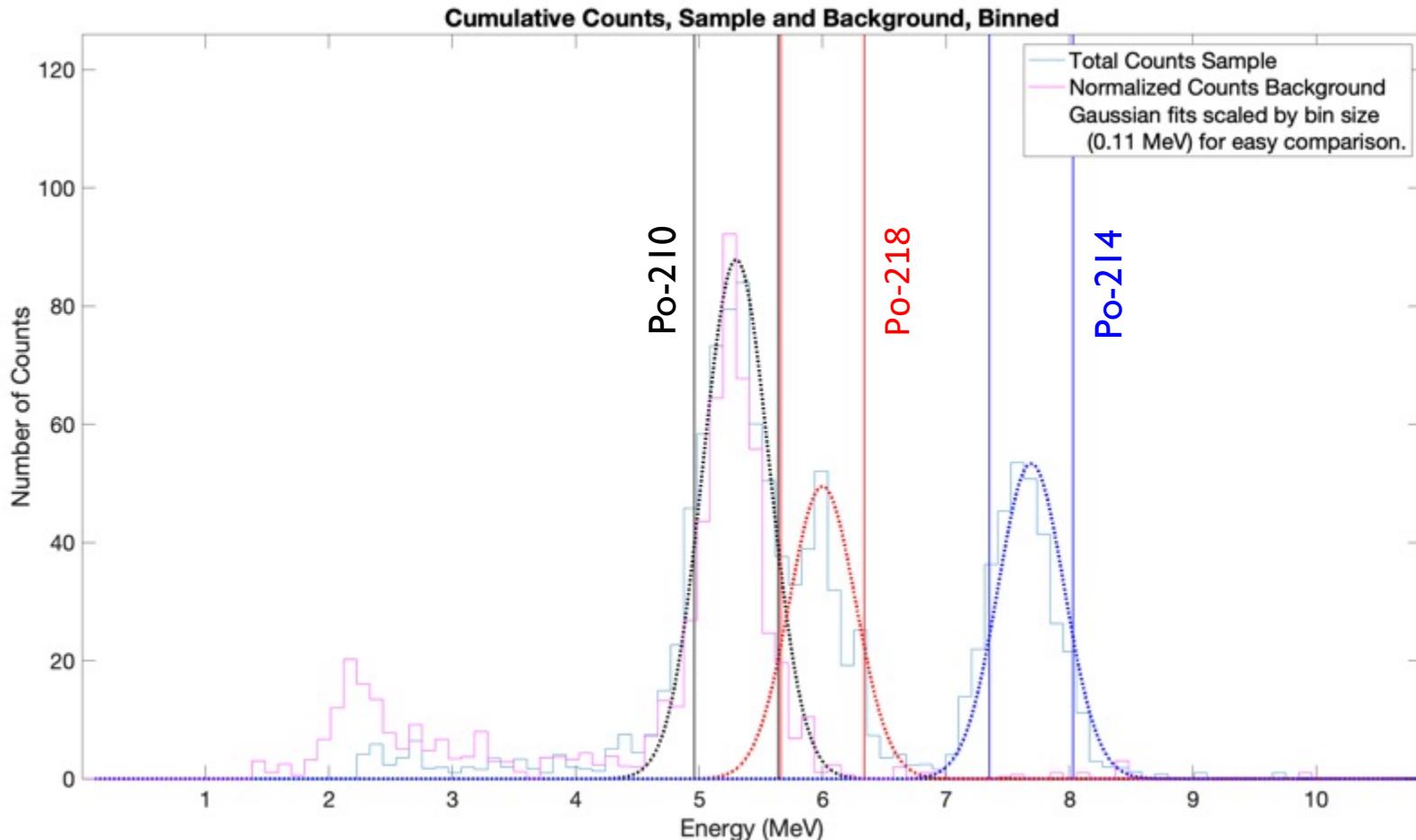
Run 675, Three Silicone Gaskets #3: Gain correction w/ bad intervals



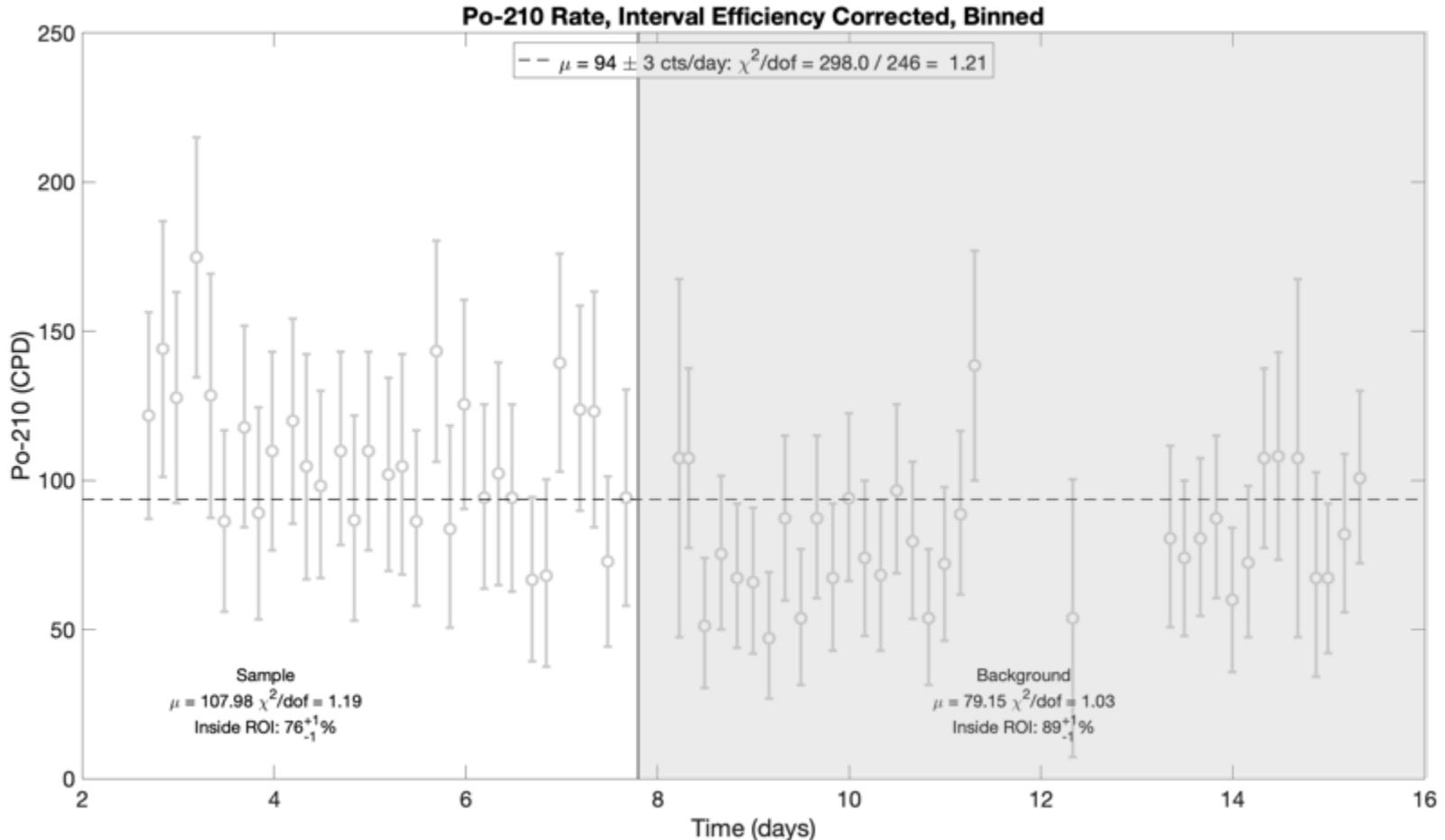
Run 675, Three Silicone Gaskets #3: Gain Correction w/o Bad Intervals



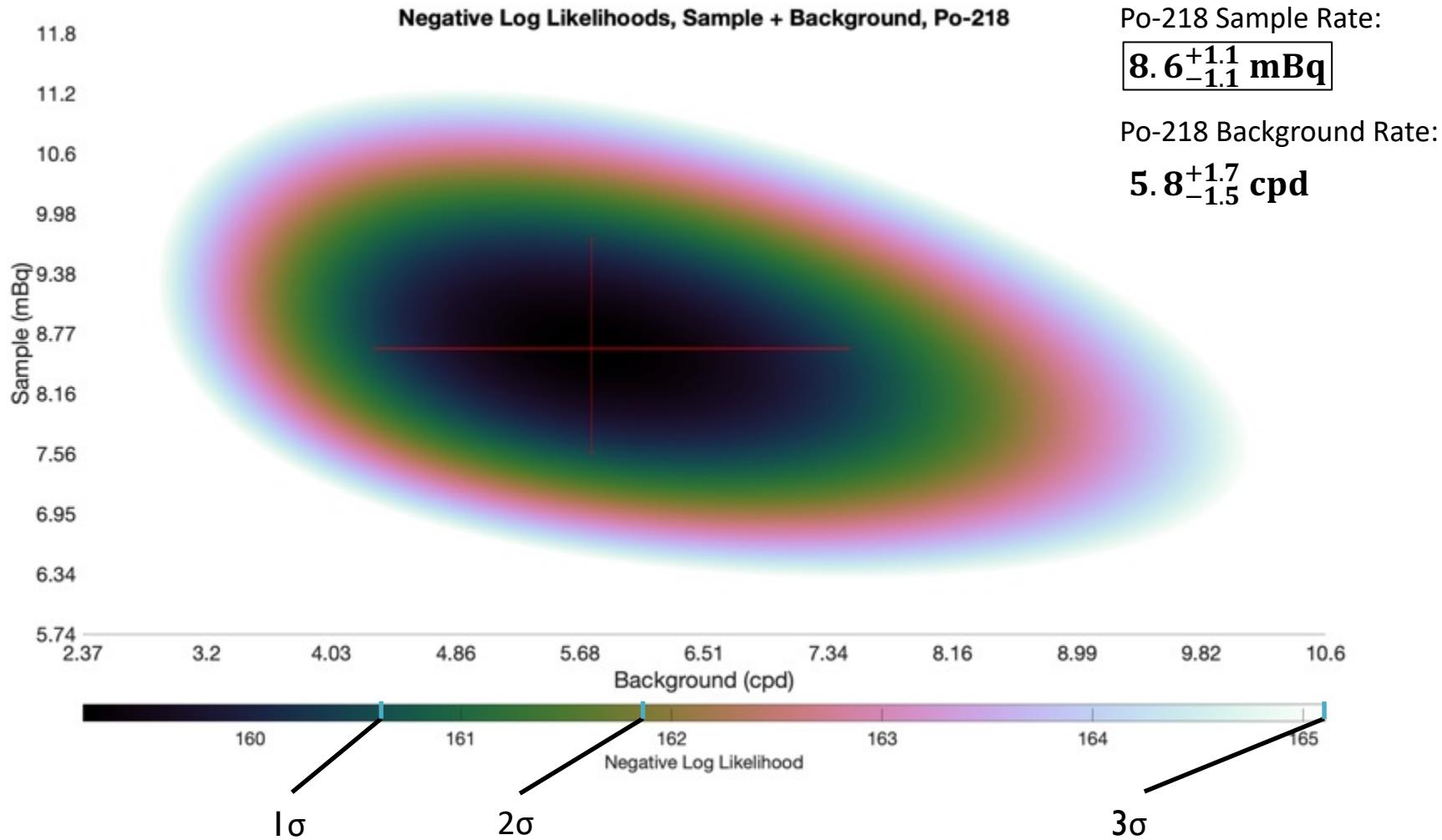
Run 675, Three Silicone Gaskets #3: Cumulative counts



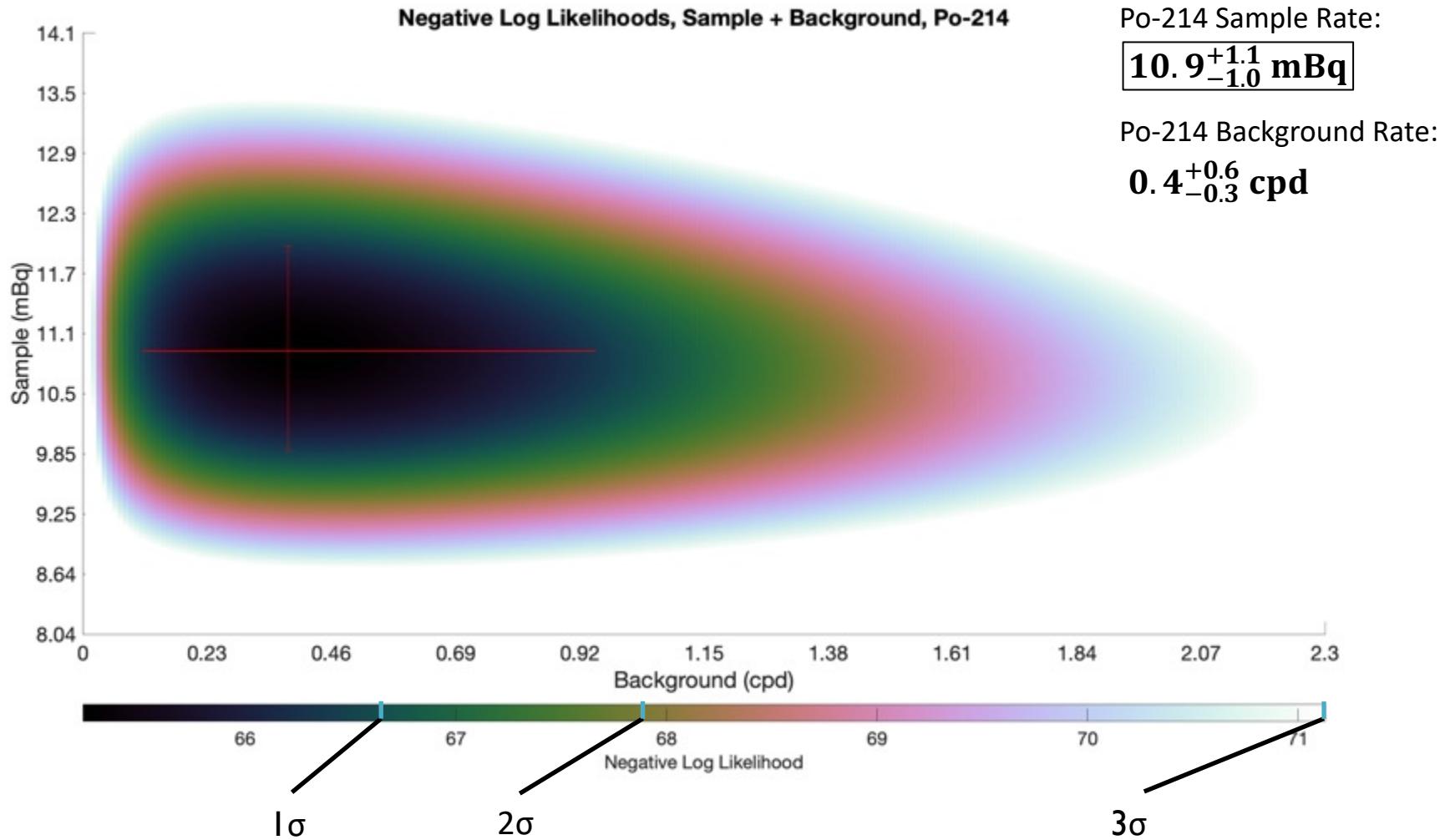
Run 675, Three Silicone Gaskets #3: Po-210 rate



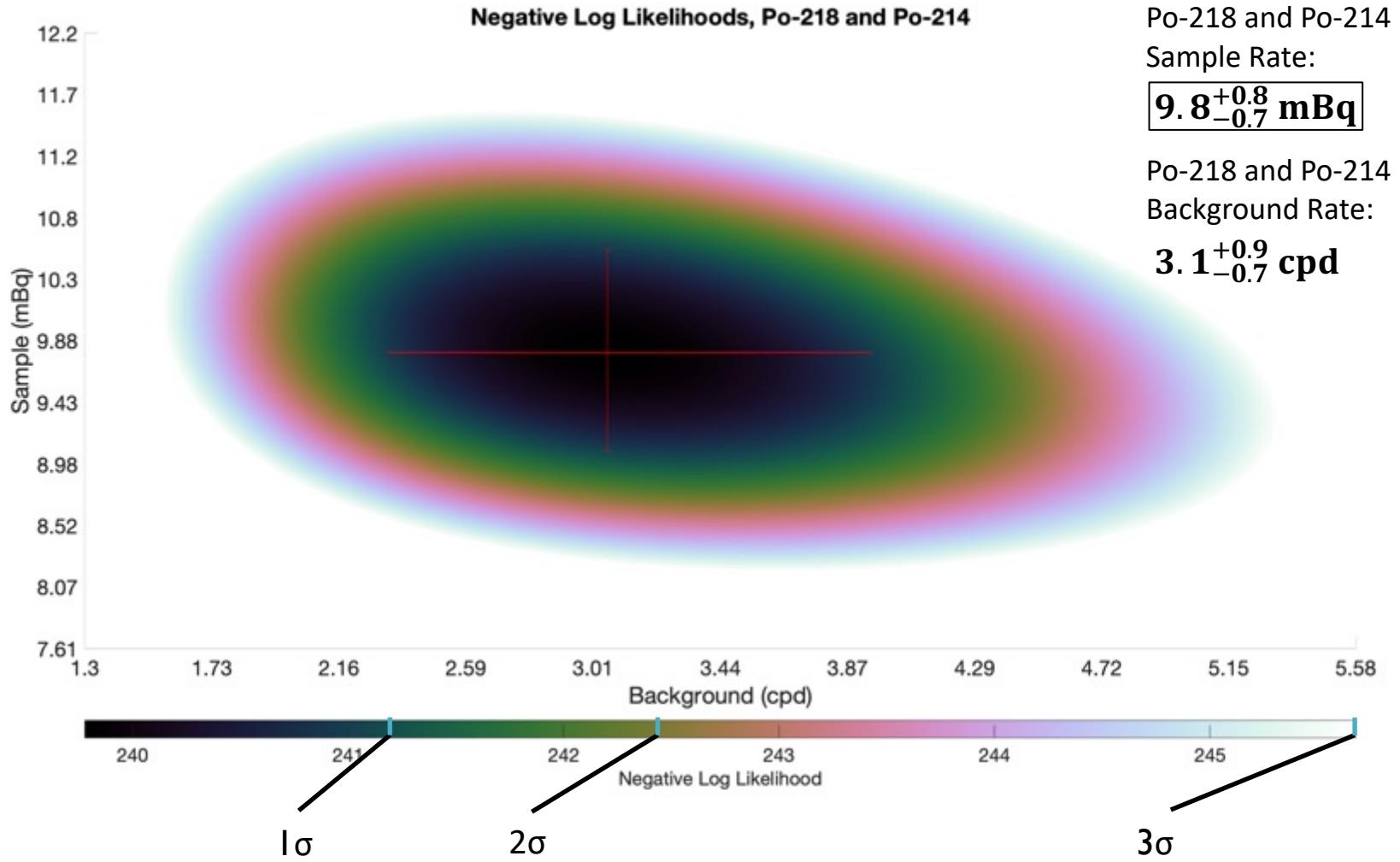
Run 675, Three Silicone Gaskets #3: Po-218 Neg. Log Likelihood



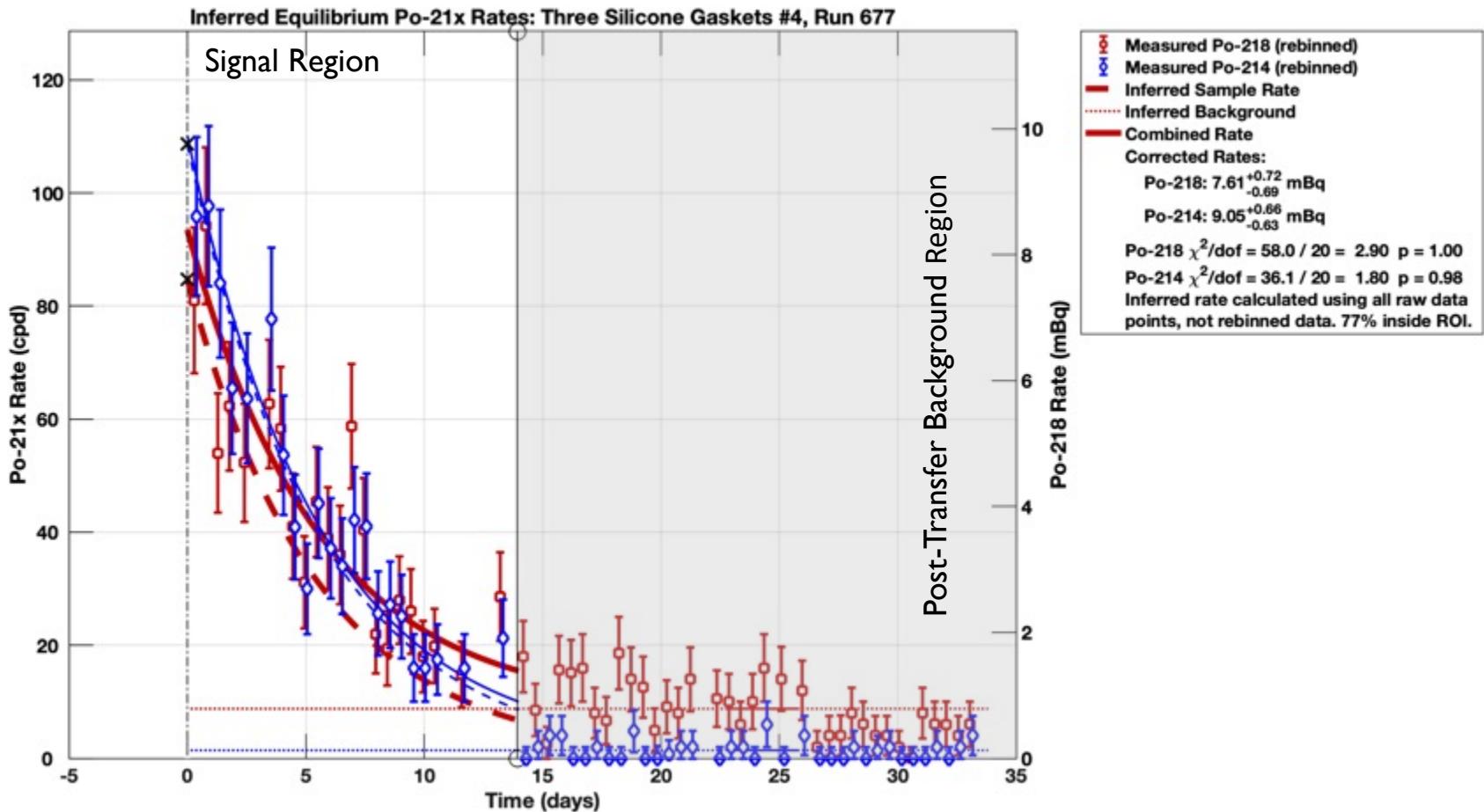
Run 675, Three Silicone Gaskets #3: Po-214 Neg. Log Likelihood



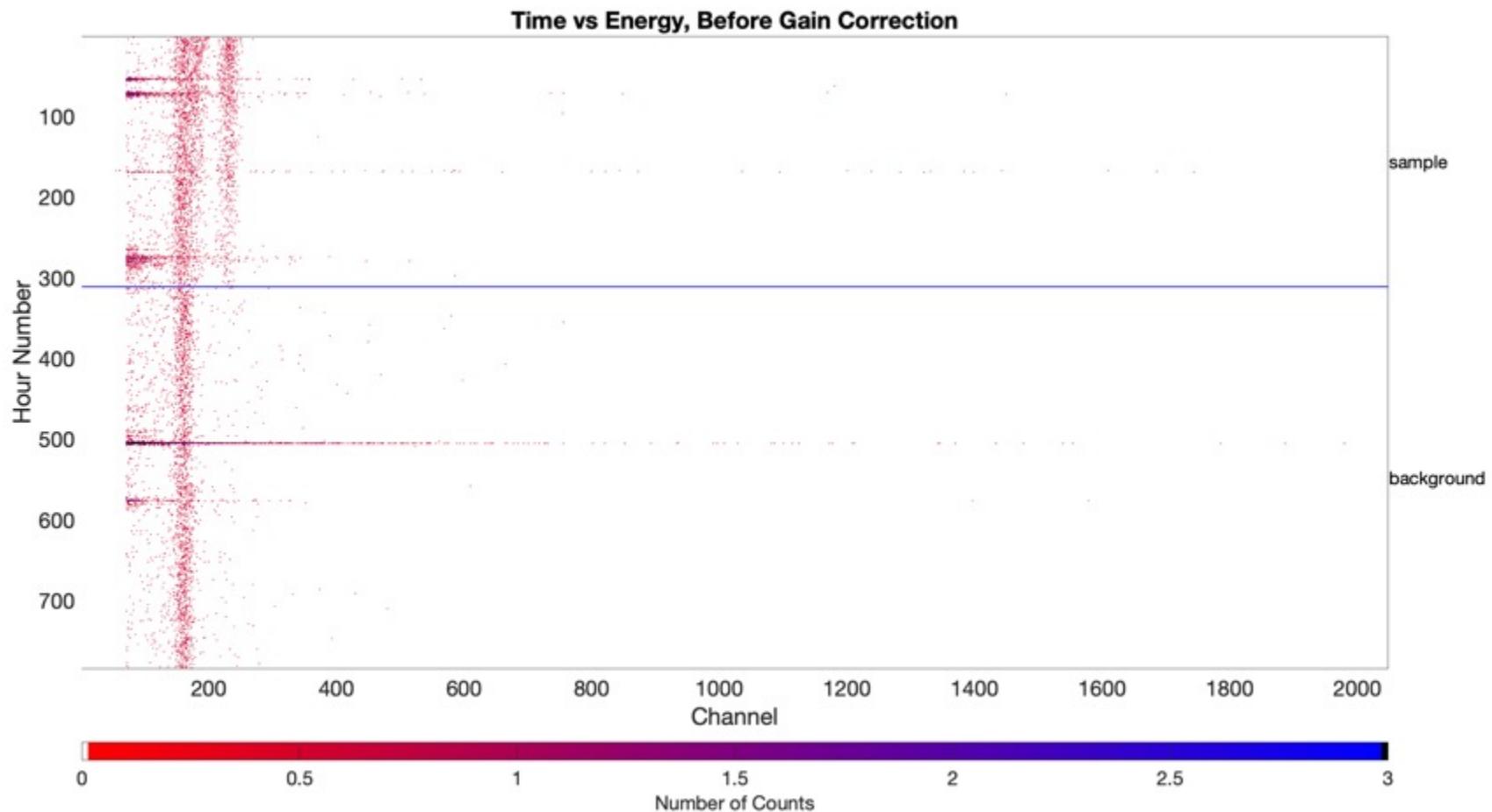
Run 675, Three Silicone Gaskets #3: Po-218 & Po-214 Neg. Log Likelihoods



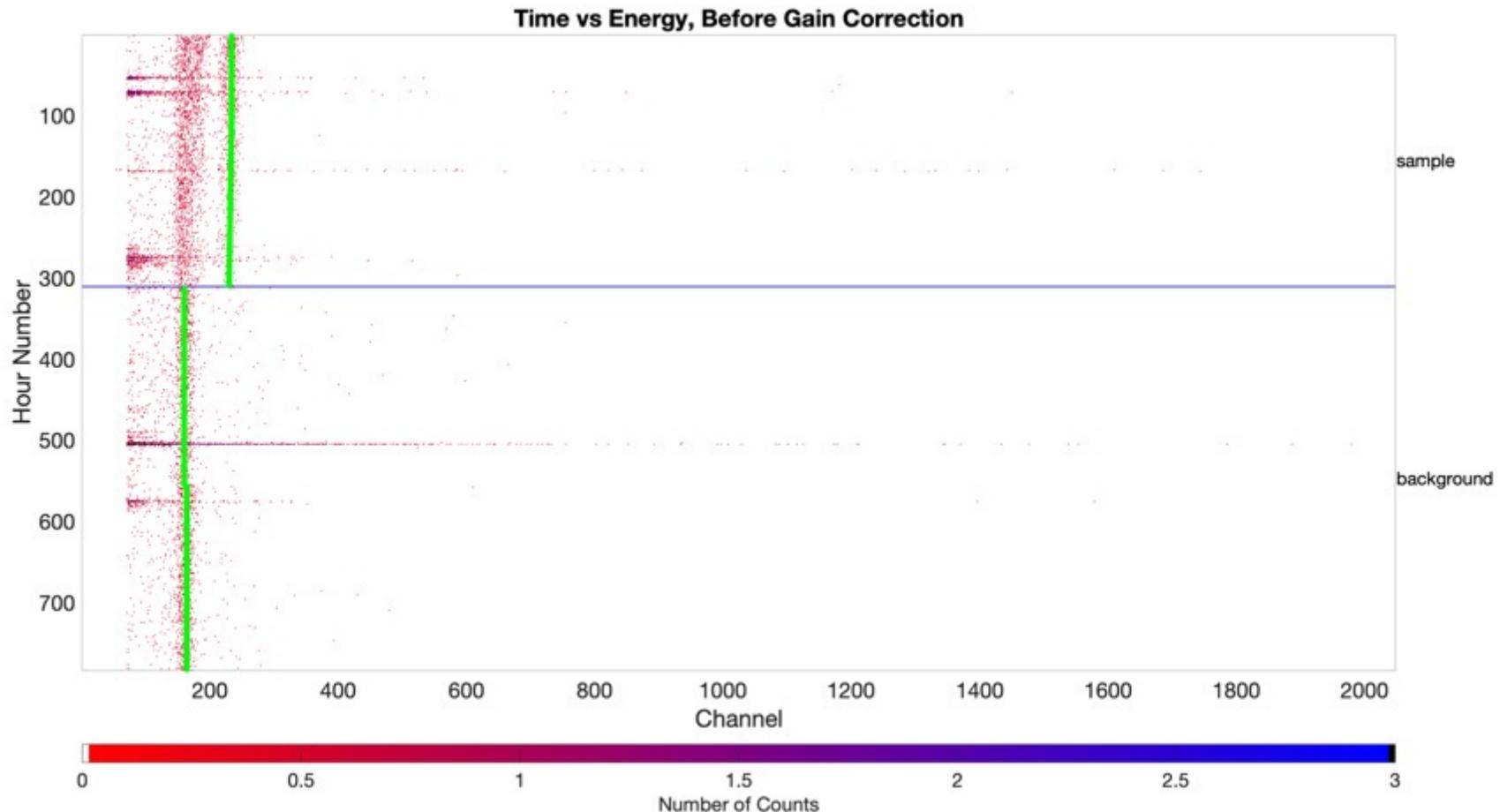
Run 677, Three Silicone Gaskets #4: 9/01/2021 – 9/17/2021



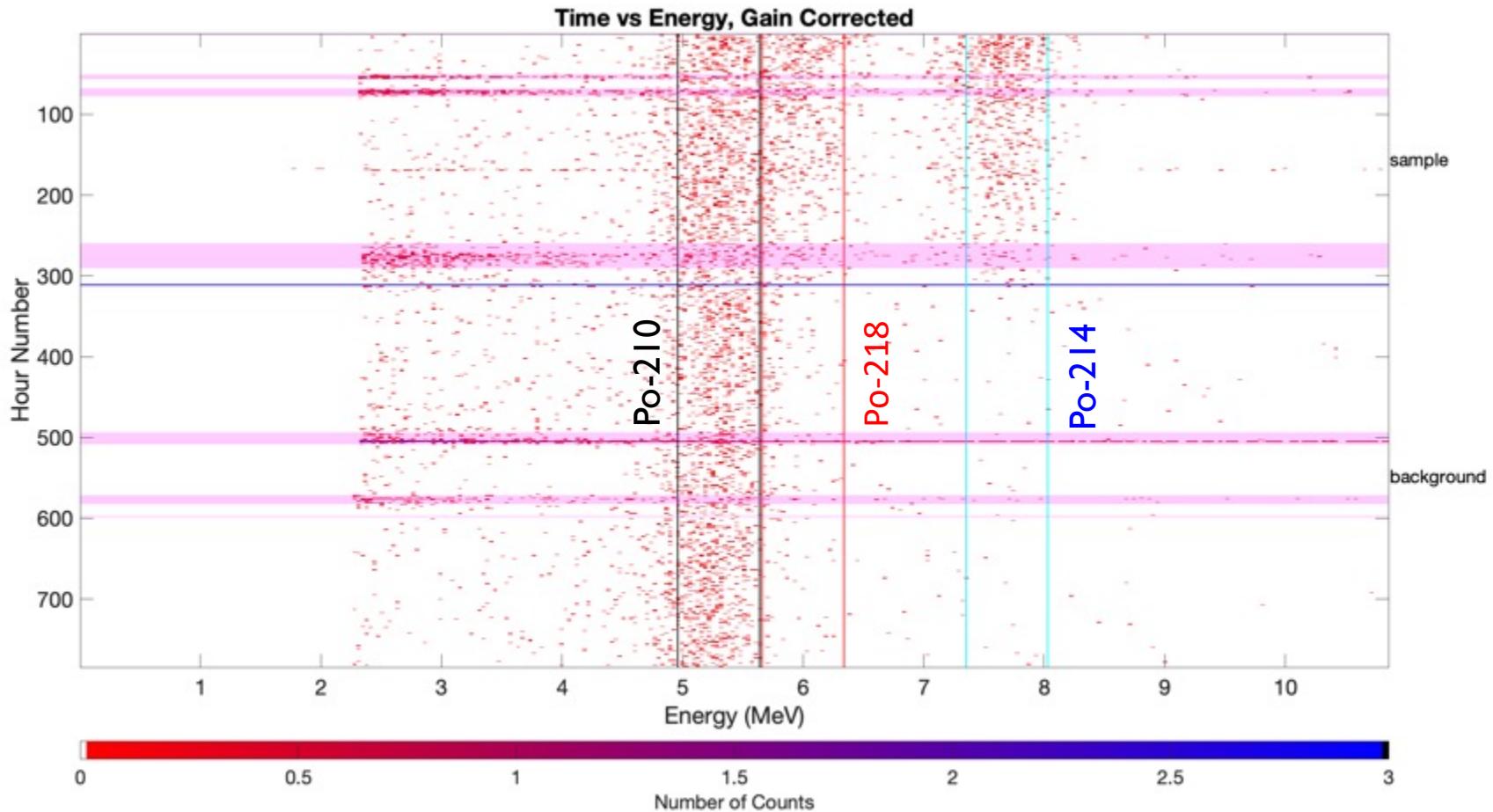
Run 677, Three Silicone Gaskets #4: Raw data



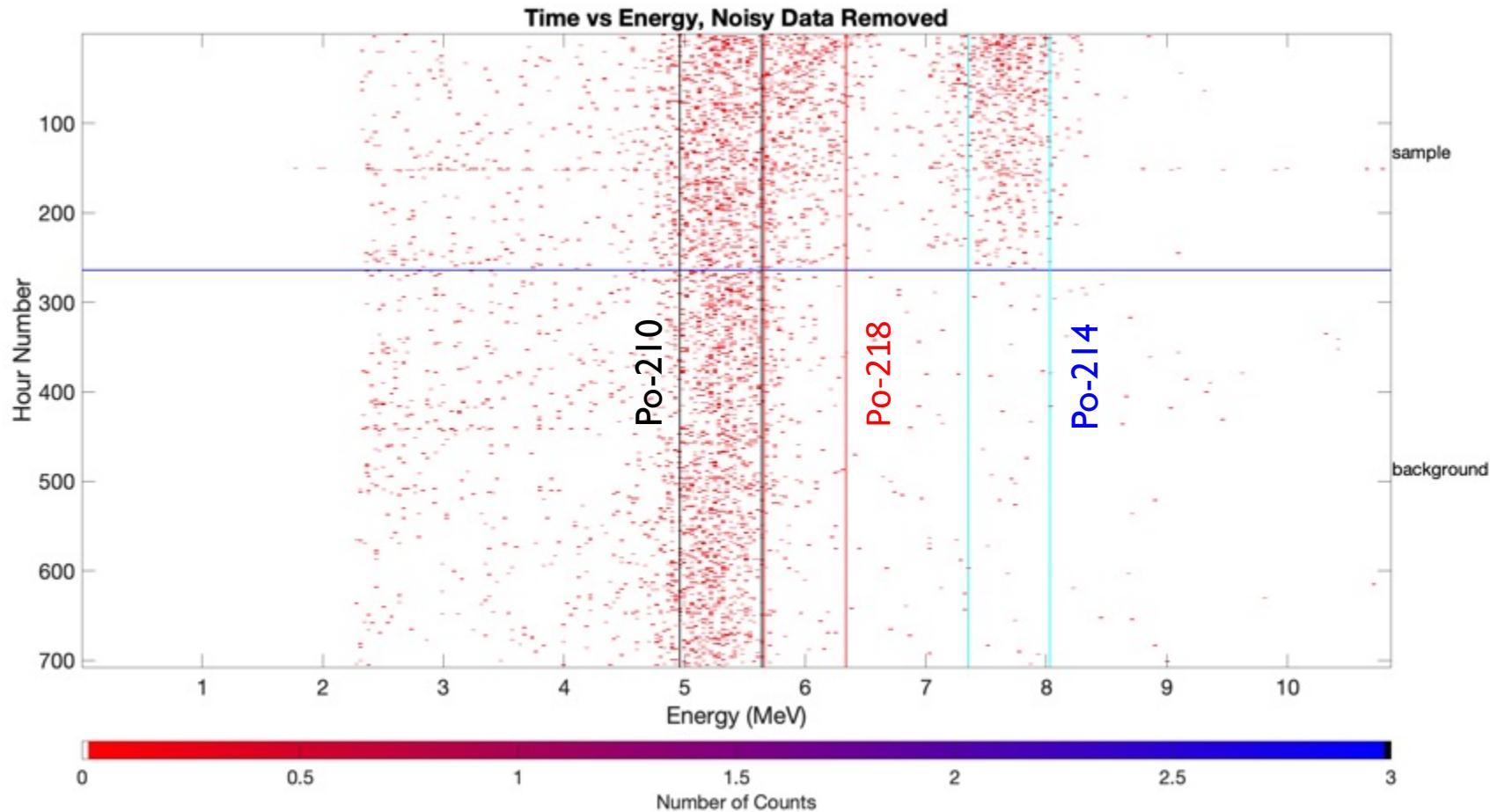
Run 677, Three Silicone Gaskets #4: Fit of Po-21x events



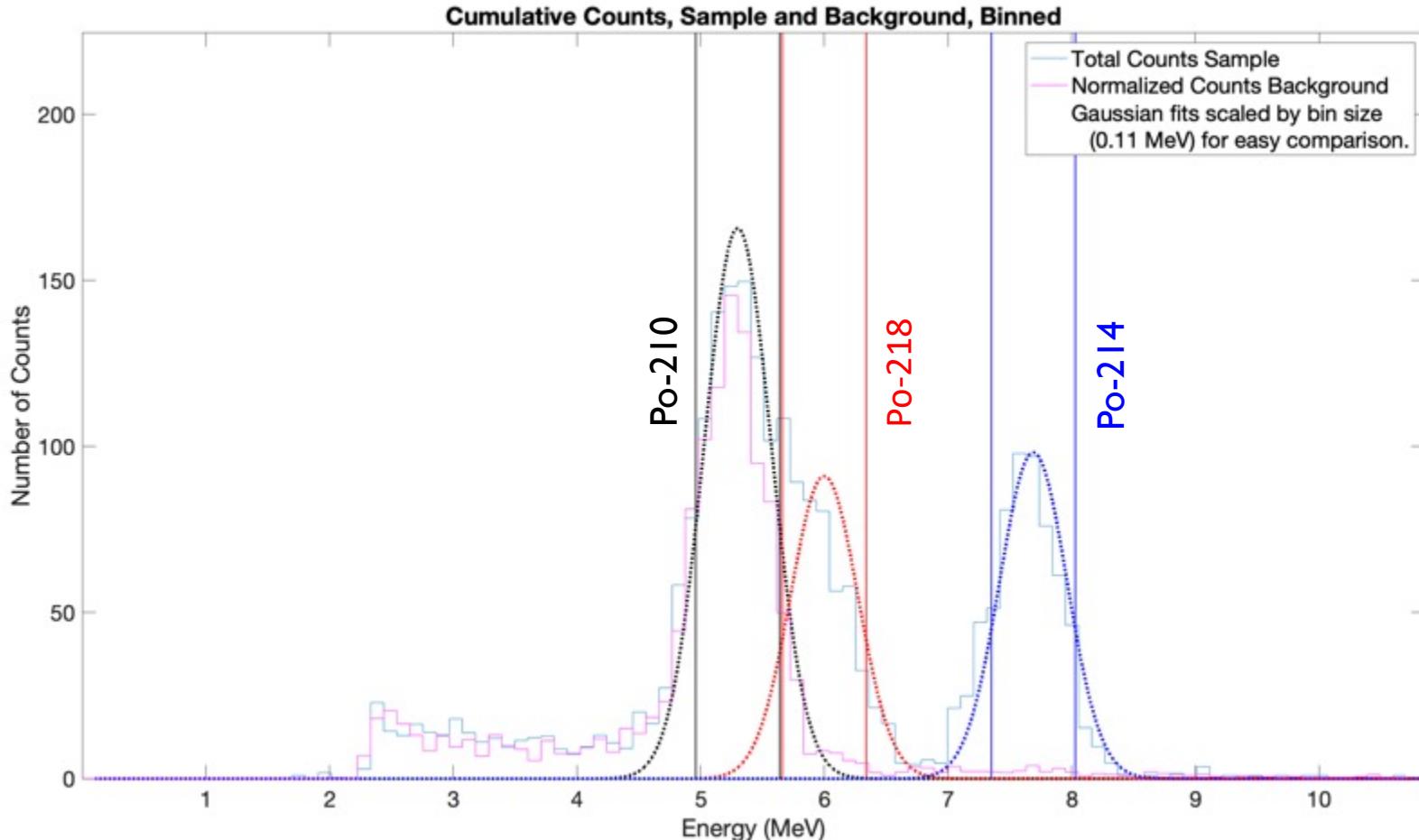
Run 677, Three Silicone Gaskets #4: Gain correction w/ bad intervals



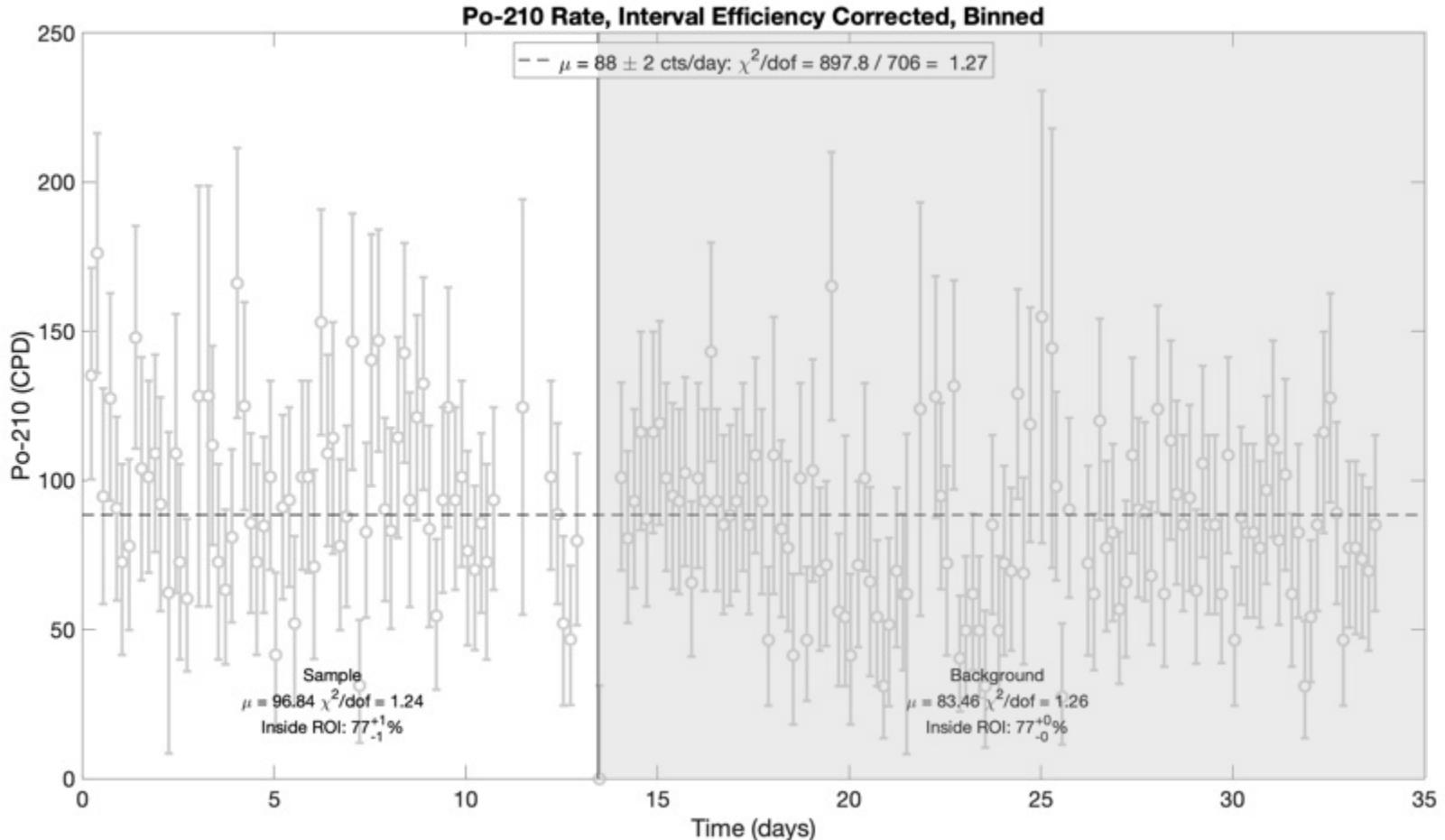
Run 677, Three Silicone Gaskets #4: Gain Correction w/o Bad Intervals



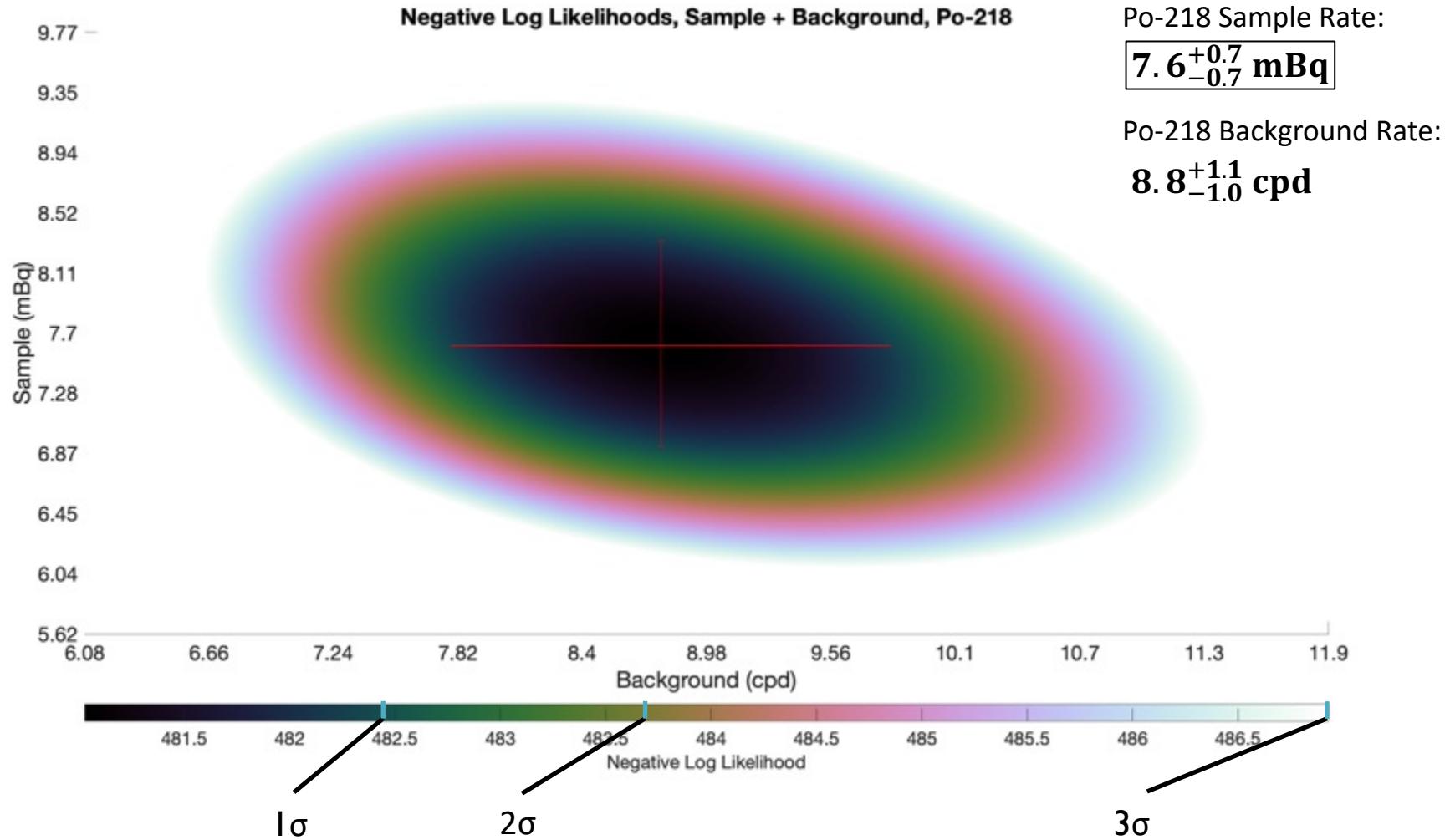
Run 677, Three Silicone Gaskets #4: Cumulative counts



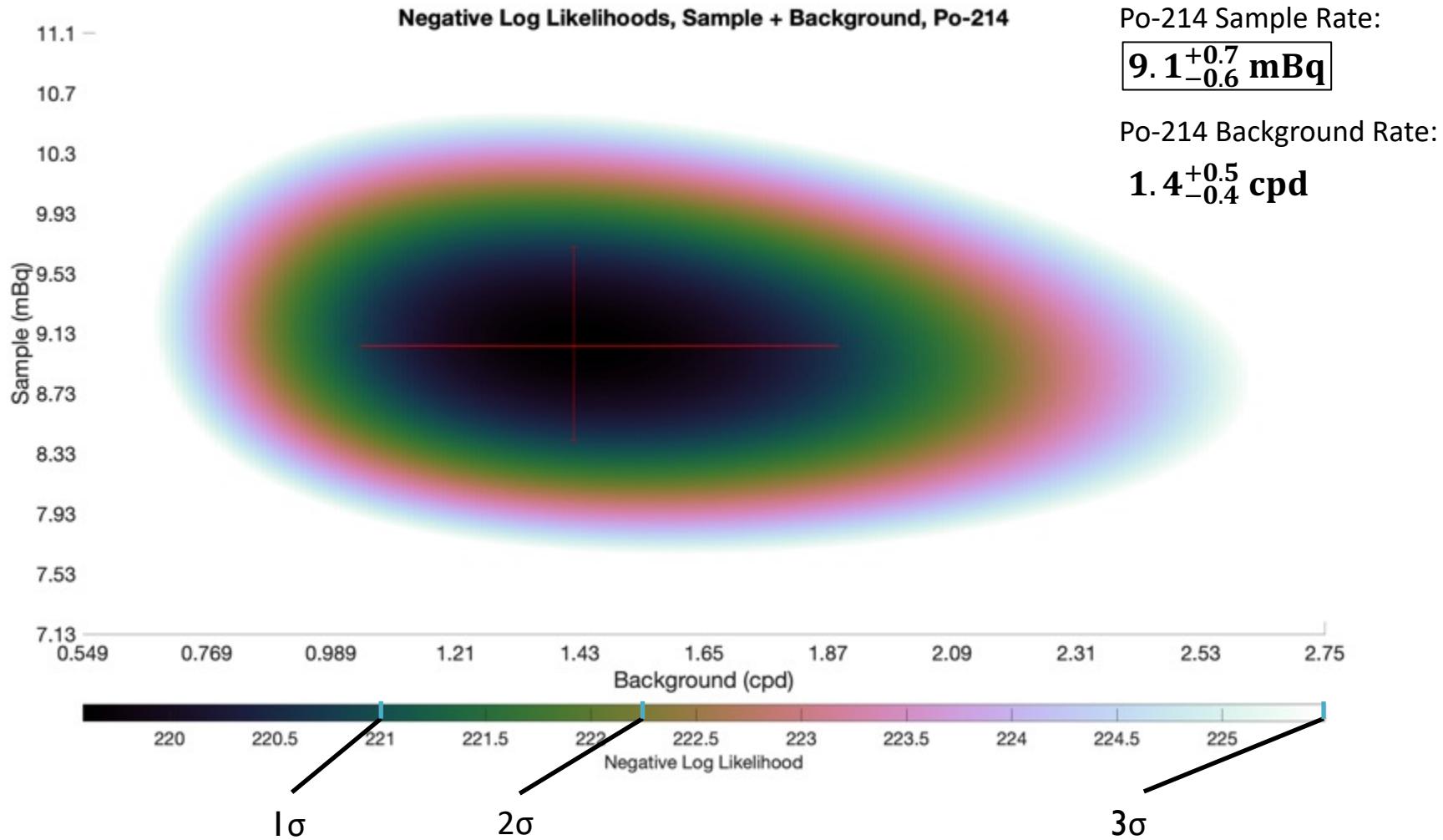
Run 677, Three Silicone Gaskets #4: Po-210 rate



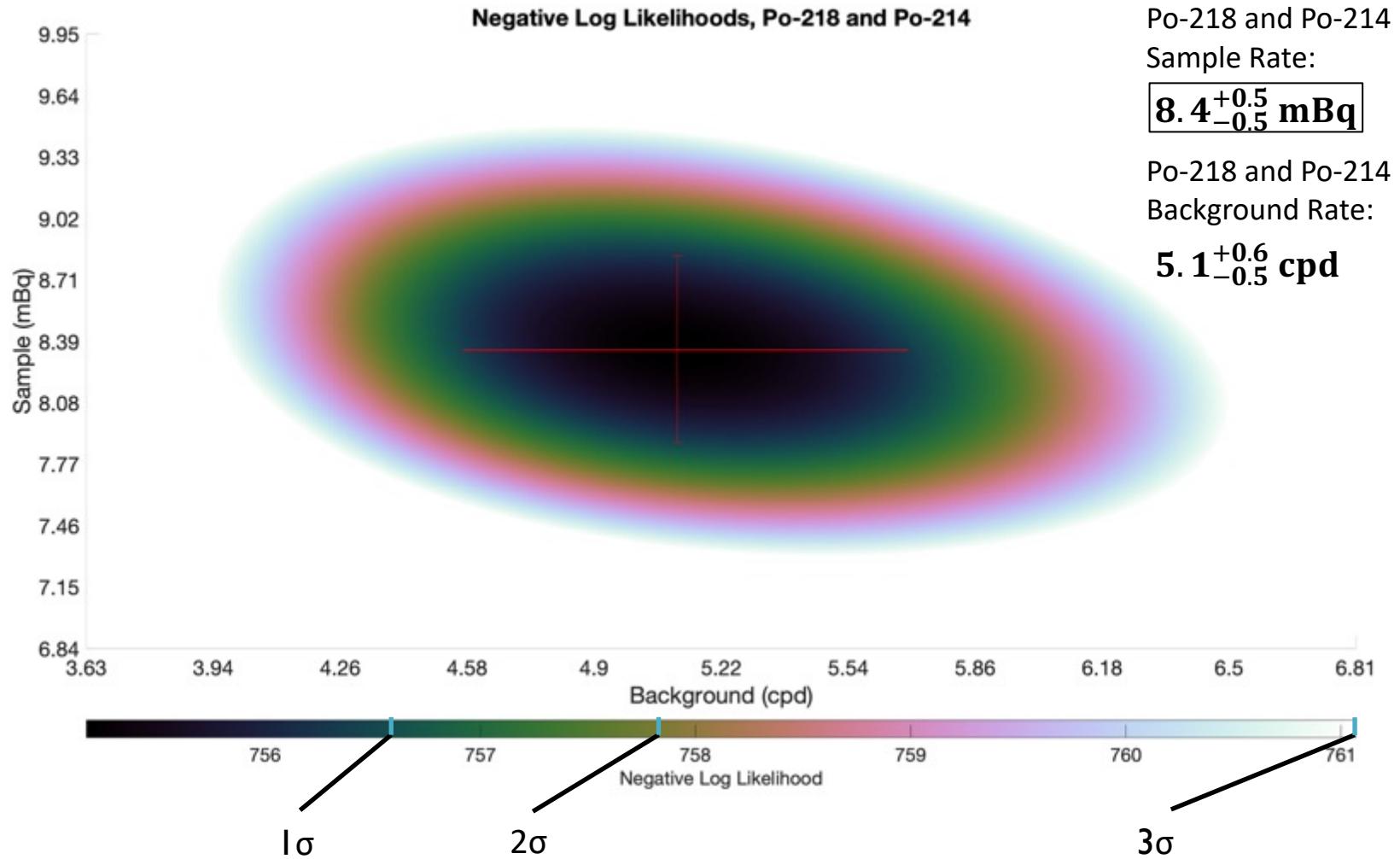
Run 677, Three Silicone Gaskets #4: Po-218 Neg. Log Likelihood



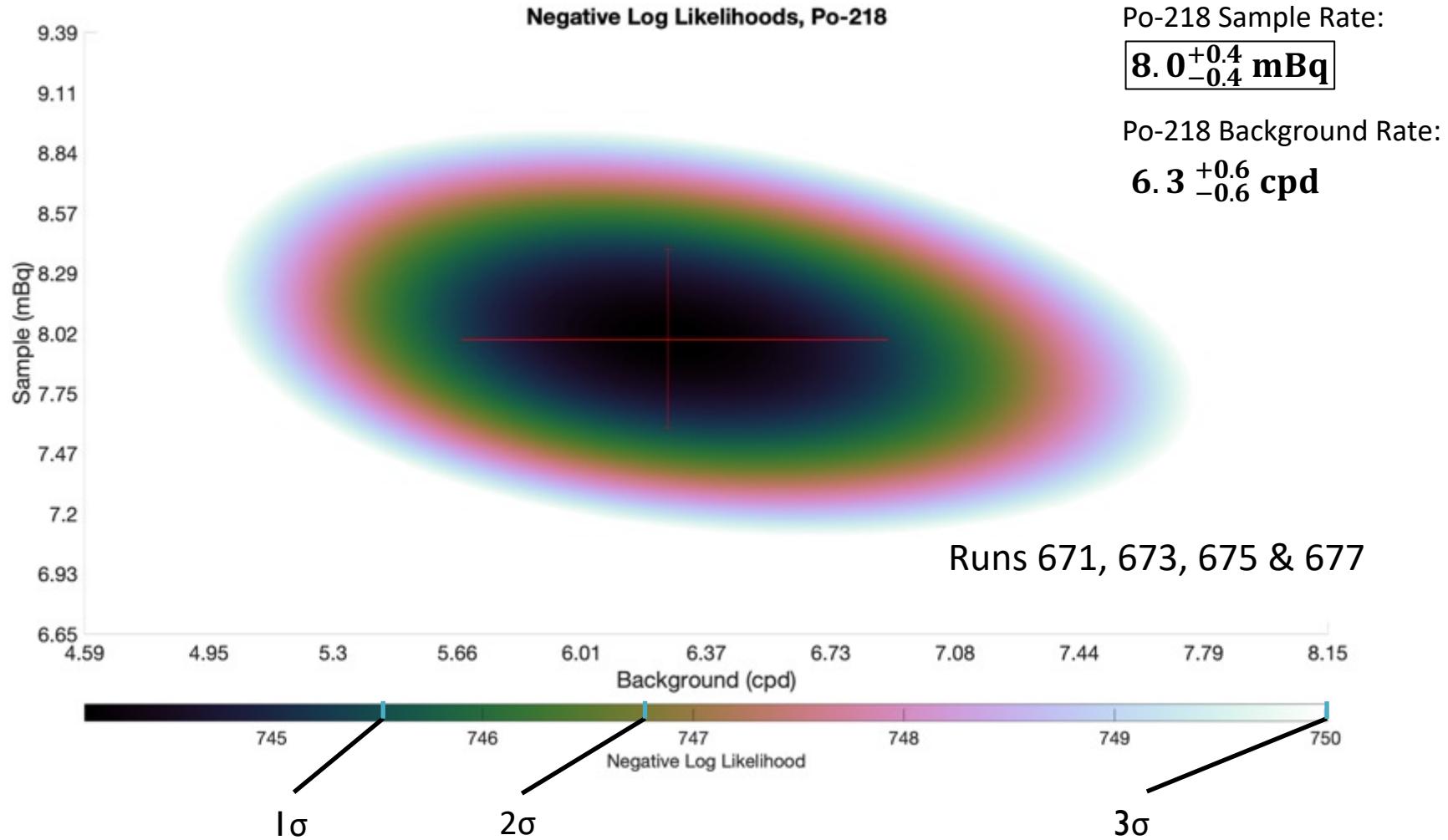
Run 677, Three Silicone Gaskets #4: Po-214 Neg. Log Likelihood



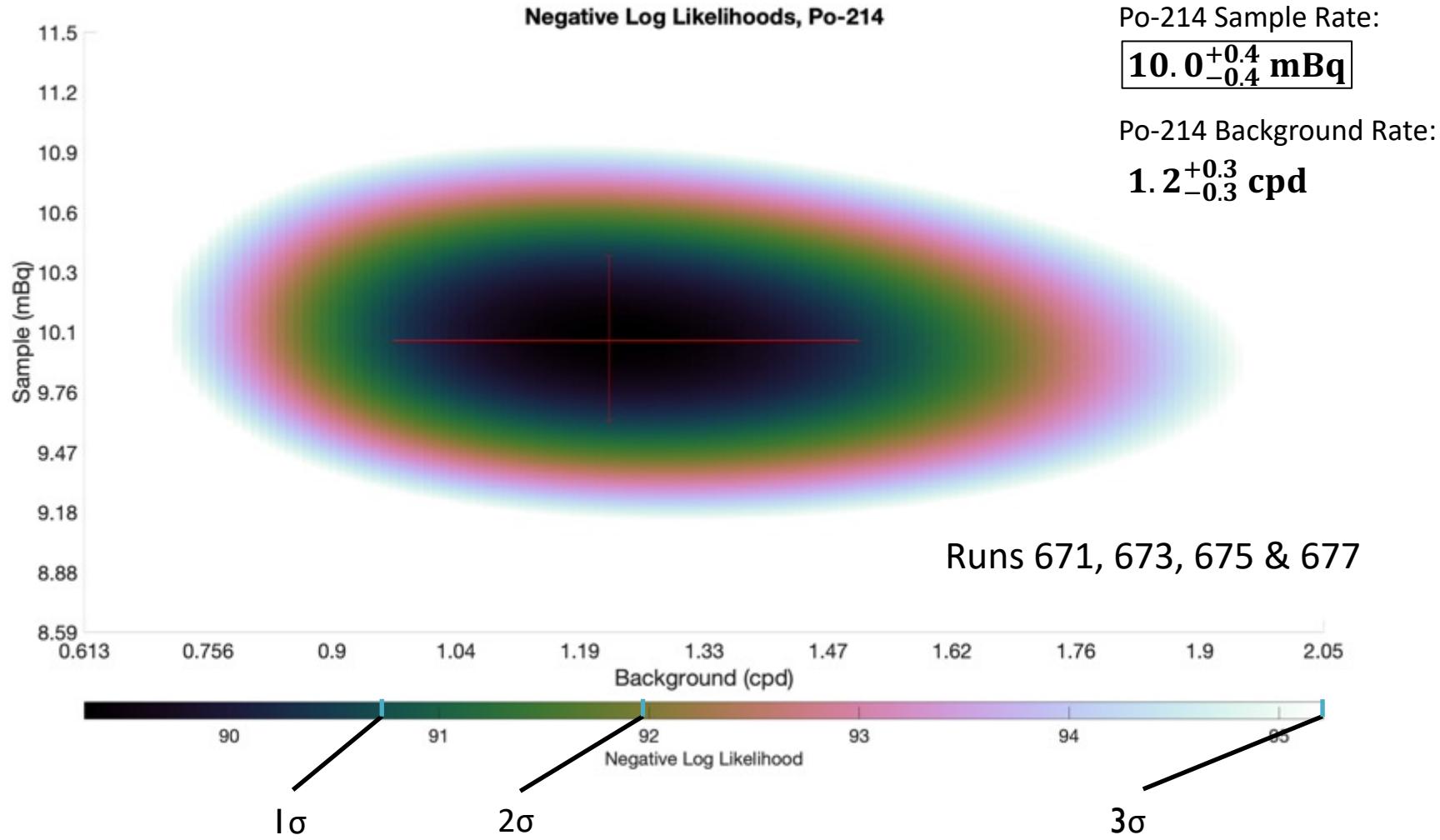
Run 677, Three Silicone Gaskets #4: Po-218 & Po-214 Neg. Log Likelihoods



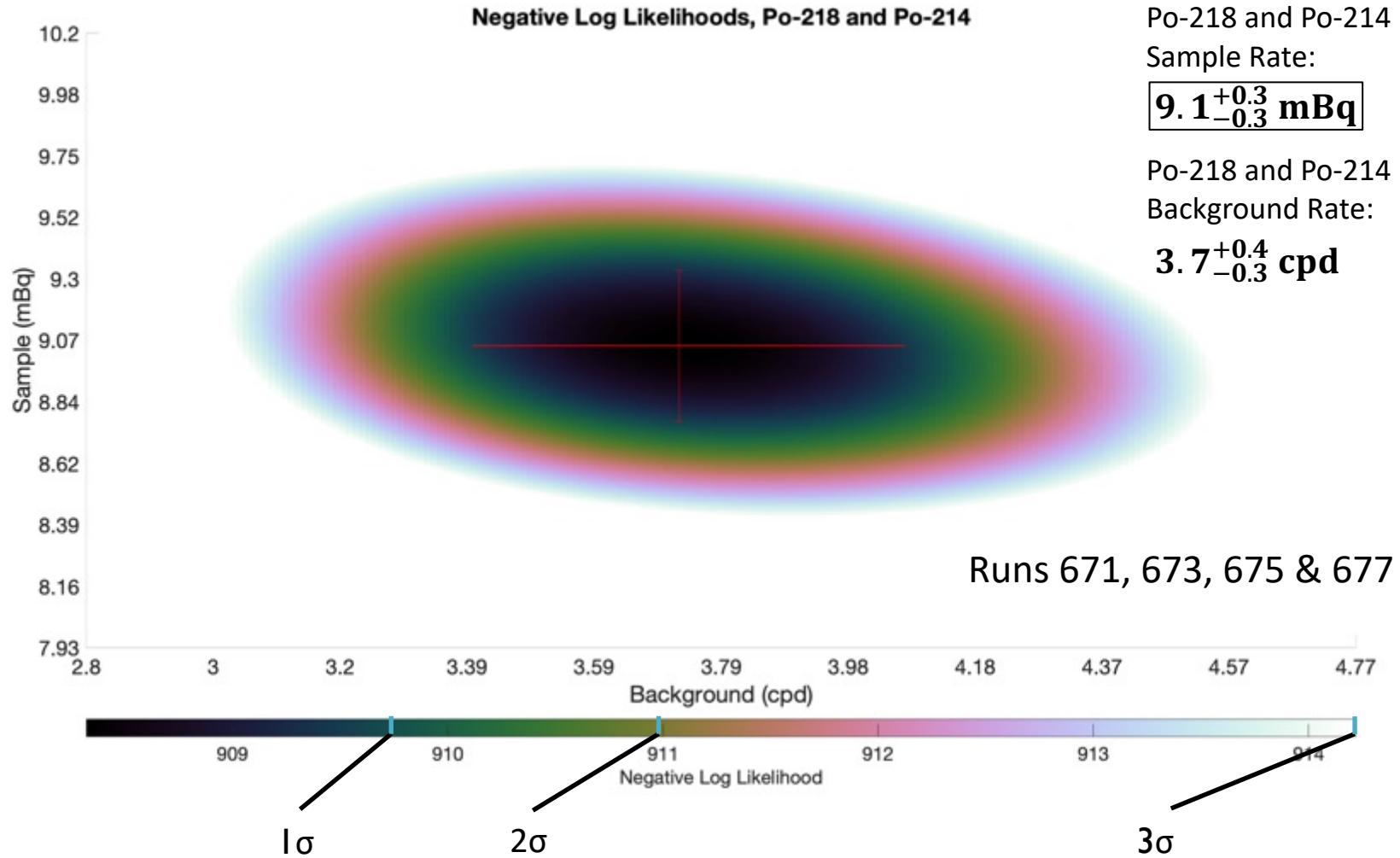
Three Silicone Gaskets: Po-218 Neg. Log Likelihoods



Three Silicone Gaskets: Po-214 Neg. Log Likelihoods



Three Silicone Gaskets: Po-218 & Po-214 Neg. Log Likelihoods



Three Silicone Gaskets: Summary of Results

Sample Rate	Po-218	Po-214	Po-218 & Po-214
Run 671	$5.1^{+0.8}_{-0.7}$ mBq	$7.0^{+0.8}_{-0.8}$ mBq	$6.1^{+0.6}_{-0.5}$ mBq
Run 673	$9.7^{+0.8}_{-0.8}$ mBq	$12.5^{+0.8}_{-0.8}$ mBq	$11.2^{+0.6}_{-0.6}$ mBq
Run 675	$8.6^{+1.1}_{-1.1}$ mBq	$10.9^{+1.1}_{-1.0}$ mBq	$9.8^{+0.8}_{-0.7}$ mBq
Run 677	$7.6^{+0.7}_{-0.7}$ mBq	$9.1^{+0.7}_{-0.6}$ mBq	$8.4^{+0.5}_{-0.5}$ mBq
Combined	$8.0^{+0.4}_{-0.4}$ mBq	$10.0^{+0.4}_{-0.4}$ mBq	$9.1^{+0.3}_{-0.3}$ mBq