

GE Silicone Sealants ^{222}Rn Emanation Measurement

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Overview of Emanation

Two samples were emanated throughout the latter half of 2023

- GE All-Purpose Silicone Sealant was emanated four times with a total of 465 hours of usable assay data.
- GE Advanced Silicone Sealant was emanated three times with a total of N hours of usable assay data.



Overview of GE All-Purpose Silicone Sealant Emanation

A sample of GE All-Purpose Silicone Sealant was emanated six times throughout Summer 2023.

- However, only four of those runs contained useful assay data, resulting in 465 hours of data available to analyze.
- The sample emanated had a surface area of approximately 200 cm^2
- Overall, the sample was determined to emanate at a rate of $0.00^{+0.02}_{-0.00} \text{ mBq}$
 - The uncertainties in this figure were calculated separately for top and bottom errors in order to provide a more conservative estimate.

Overall, this sample has an emanation rate sufficiently low for use in SuperCDMS



GE All-Purpose Silicone Sealant

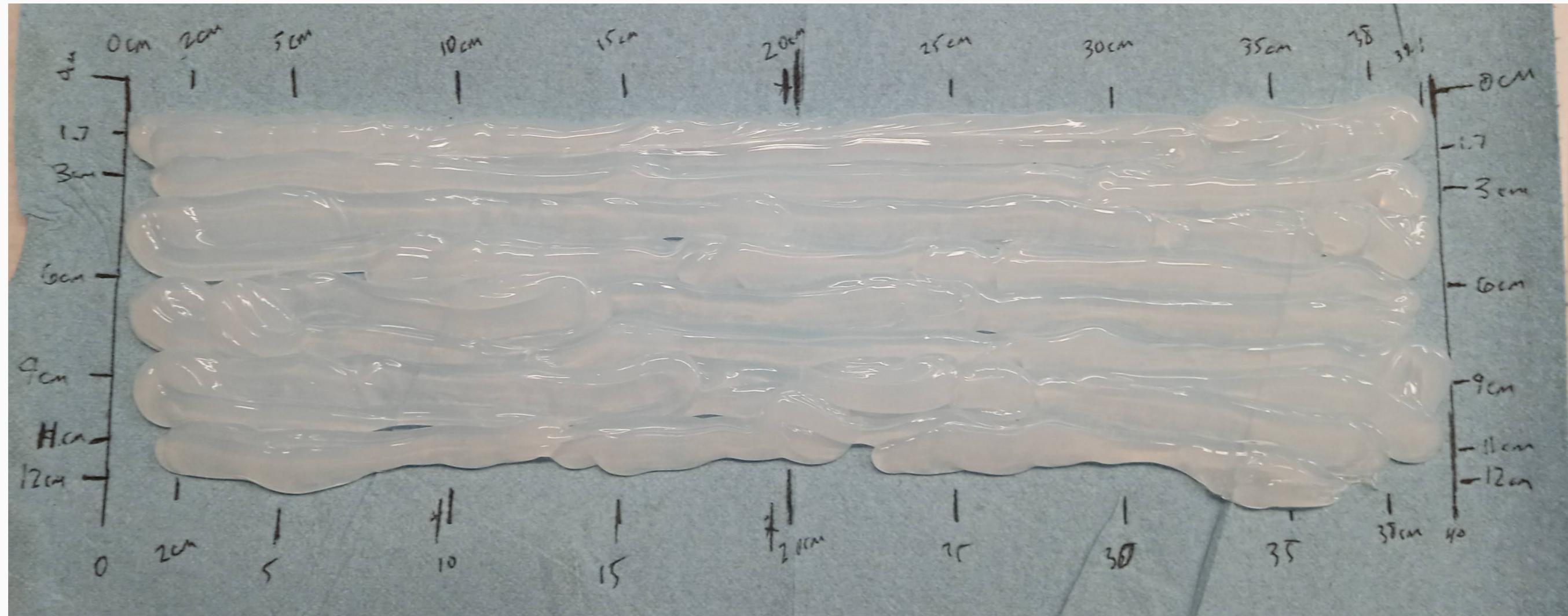


Figure 1: GE All-Purpose Silicone Sealant



Run 717 Analysis

Run 717 occurred in June 2023.

- Emanation Rate was determined to be $0.00^{+0.03}_{-0.00}$ mBq.
- This determination was based on the observed emanation rate of ^{214}Po .
- The ^{218}Po rate wasn't used as poor resolution between the peaks of ^{218}Po and ^{210}Po likely caused ^{210}Po events to spill over into the ^{218}Po ROI

The Rate vs. Time plot for Run 717 follows.

See backup slides for Run 717



Rate vs. Time, Run 717

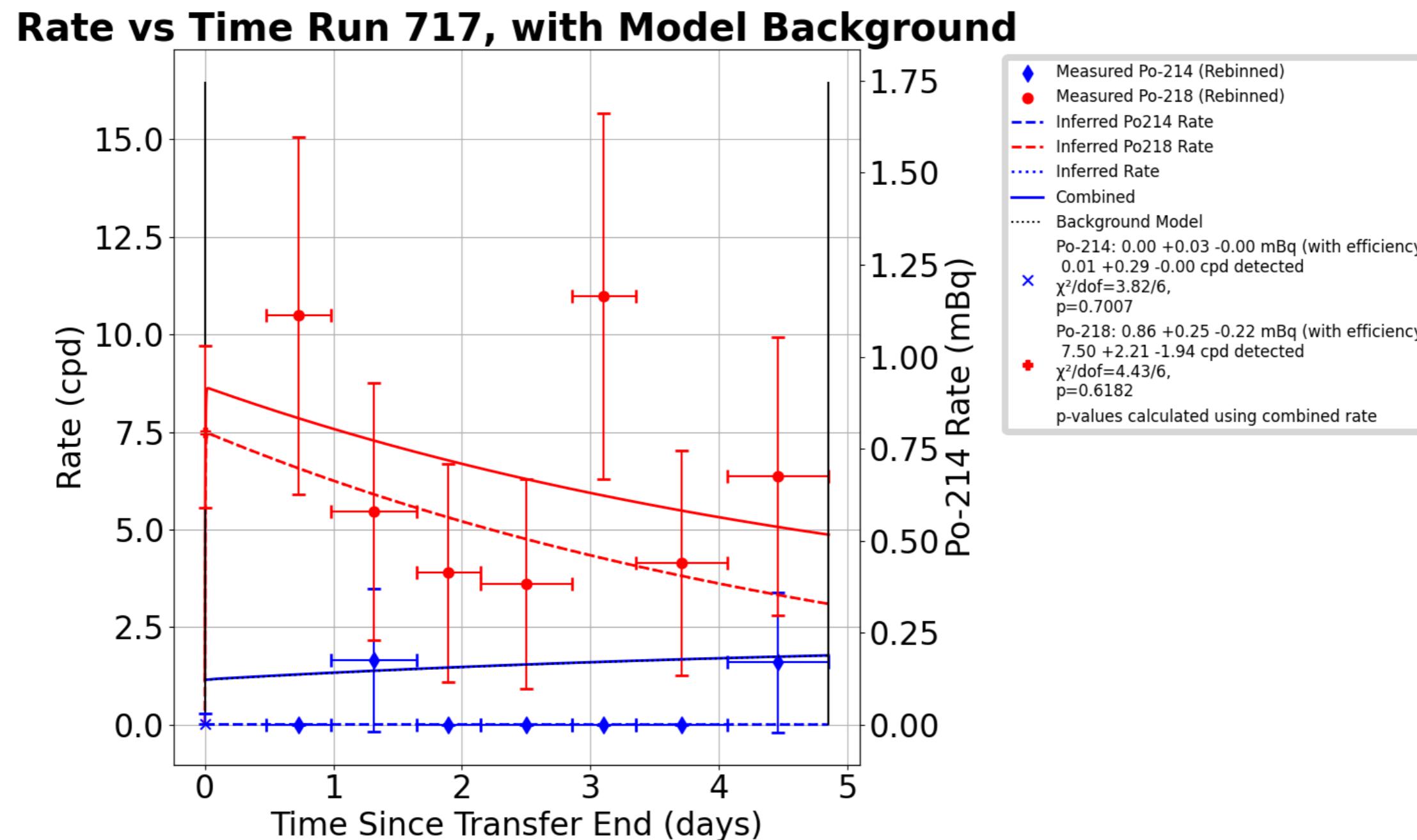


Figure 2: ^{222}Rn Emanation Rate: $0.00^{+0.03}_{-0.00}$ mBq (from ^{214}Po Rate)



Run 720 Analysis

Run 720 occurred in June and July 2023.

- Emanation Rate was determined to be $0.00^{+0.54}_{-0.00}$ mBq.
- This determination was based on the observed emanation rate of ^{214}Po .
- The ^{218}Po rate wasn't used as poor resolution between the peaks of ^{218}Po and ^{210}Po likely caused ^{210}Po events to spill over into the ^{218}Po ROI

See Backup Slides for Run 720



Rate vs. Time, Run 720

Rate vs Time Run 721, with Model Background

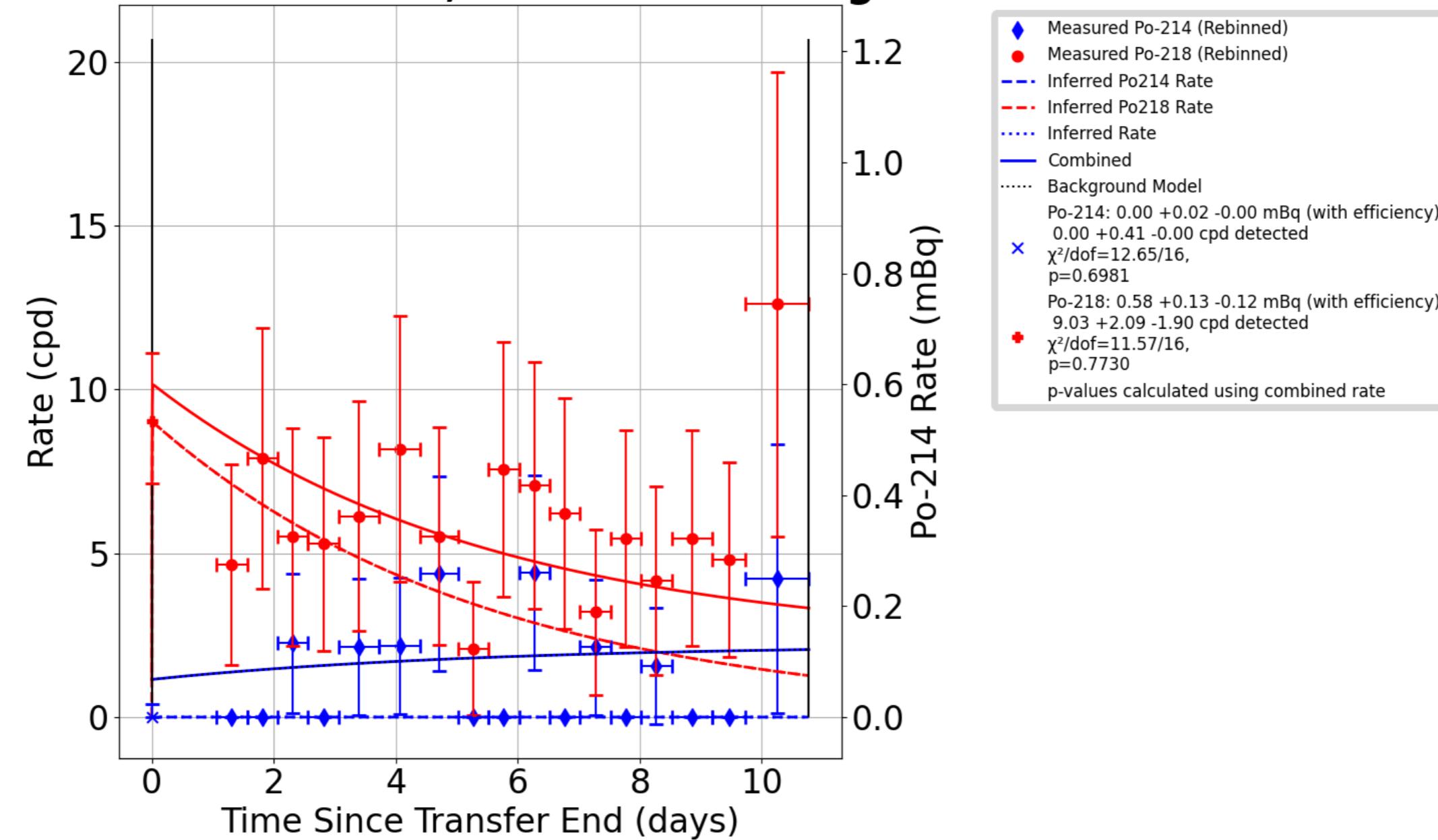


Figure 3: ^{222}Rn Emanation Rate: $0.00^{+0.54}_{-0.00}$ mBq (from ^{214}Po rate)



Run 721 Analysis

- Emanation Rate was determined to be **0.00 $^{+0.02}_{-0.00}$ mBq**.
- This determination was based on the observed emanation rate of ^{214}Po .
- The ^{218}Po rate wasn't used as poor resolution between the peaks of ^{218}Po and ^{210}Po likely caused ^{210}Po events to spill over into the ^{218}Po ROI

See Backup Slides for Run 721



Rate vs. Time, Run 721

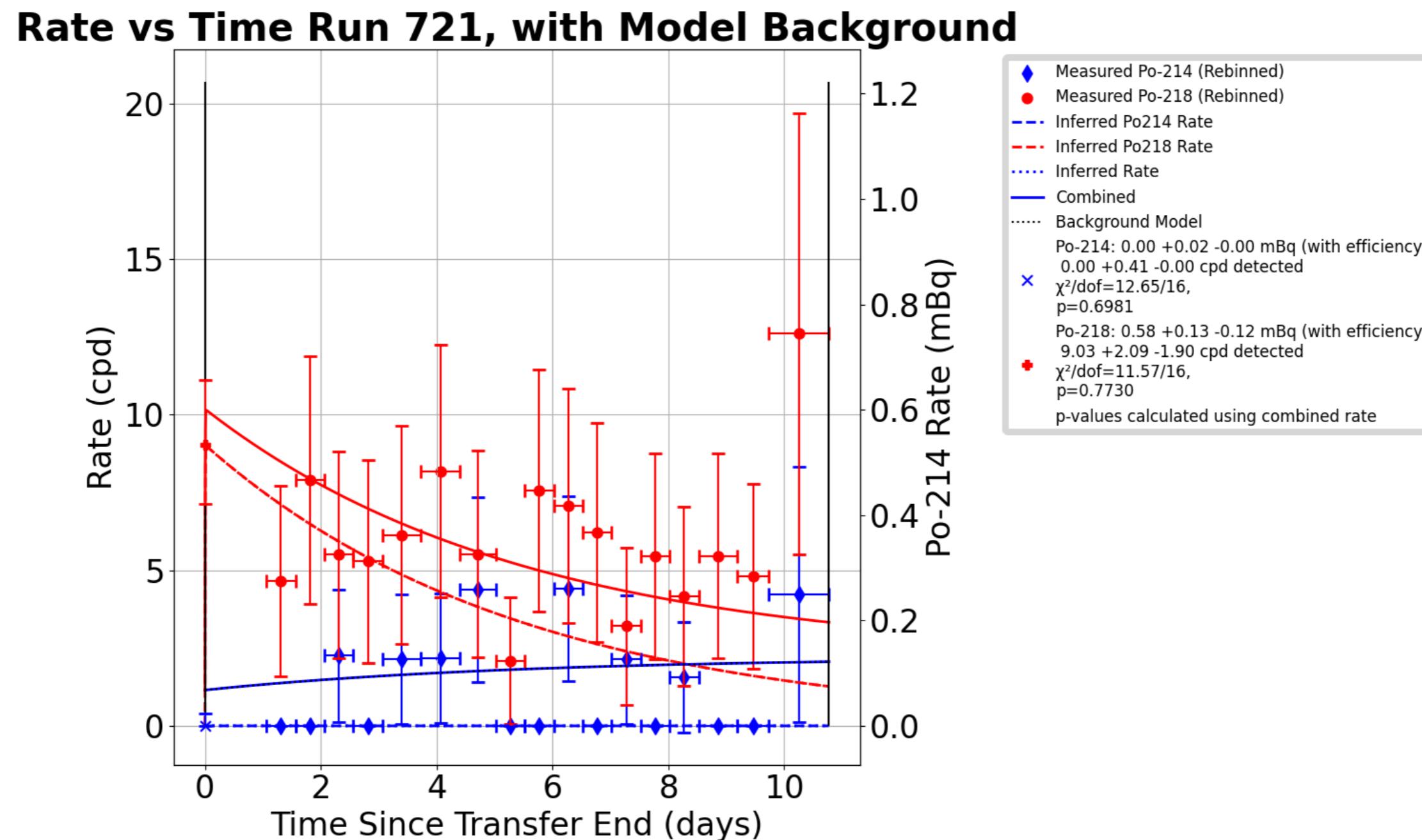


Figure 4: ^{222}Rn Emanation Rate: $0.00^{+0.02}_{-0.00}$ mBq (from ^{214}Po rate)



Run 722 Analysis

- Emanation Rate was determined to be **0.177 $\begin{smallmatrix} +0.096 \\ -0.081 \end{smallmatrix}$ mBq.**
- This determination was based on the combined rates ^{214}Po and ^{218}Po .

See Backup Slides for Run 722



Rate vs. Time, Run 722

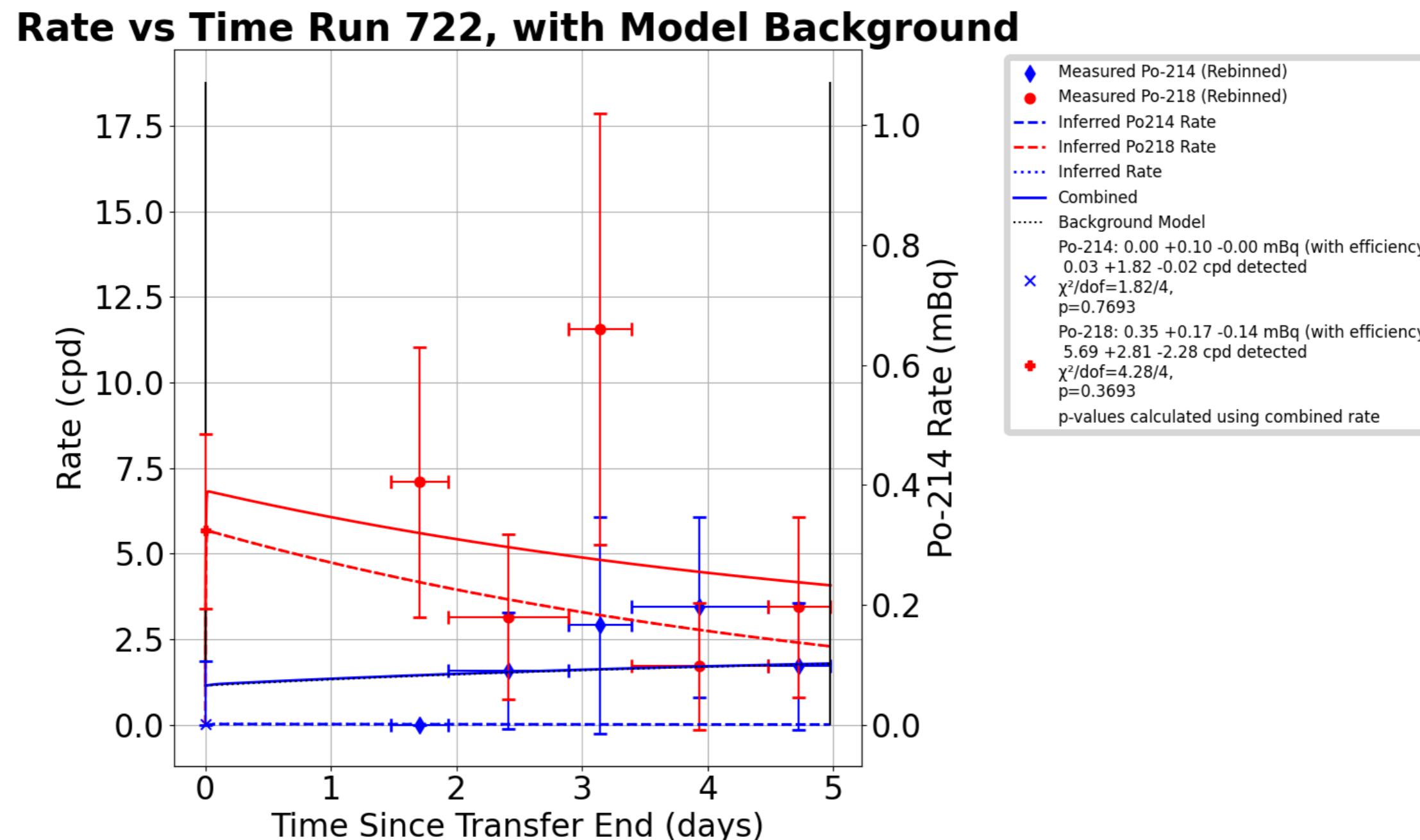


Figure 5: ^{222}Rn Emanation Rate: $0.177^{+0.096}_{-0.081} \text{ mBq}$ (from combined rate)



Overview of GE Advanced Silicone Sealant Emanation

A sample of GE Advanced Silicone Sealant was emanated four times throughout late 2023.



Rate vs. Time, Run 722

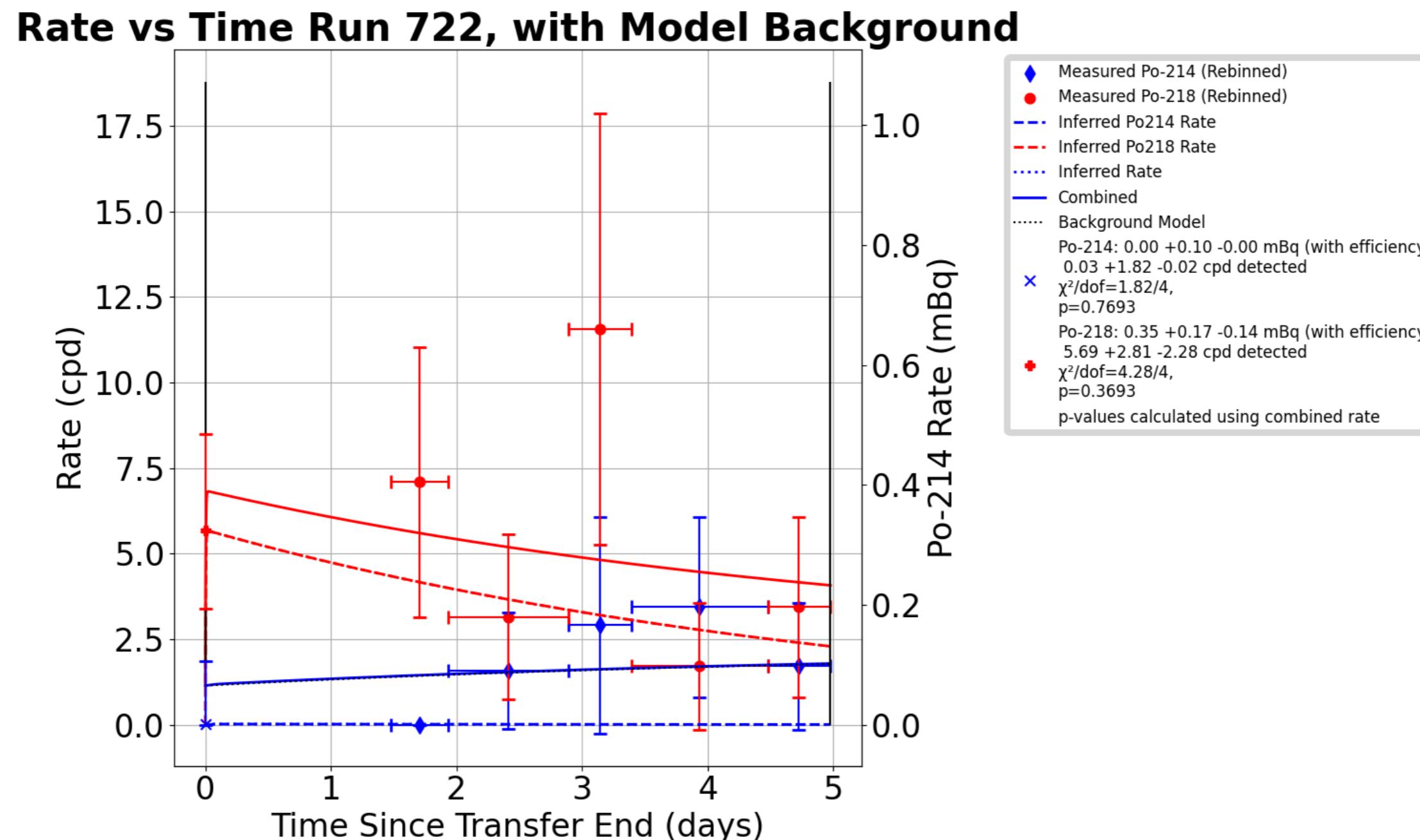


Figure 6: ^{222}Rn Emanation Rate: $0.177^{+0.096}_{-0.081} \text{ mBq}$ (from combined rate)



Backup Slides

Backup Slides contain additional data and information that may be helpful to provide context if questions come up.



Run 717 Backup Slides

The following slides contain additional data and information regarding Run 717.



Raw Data, Run 717

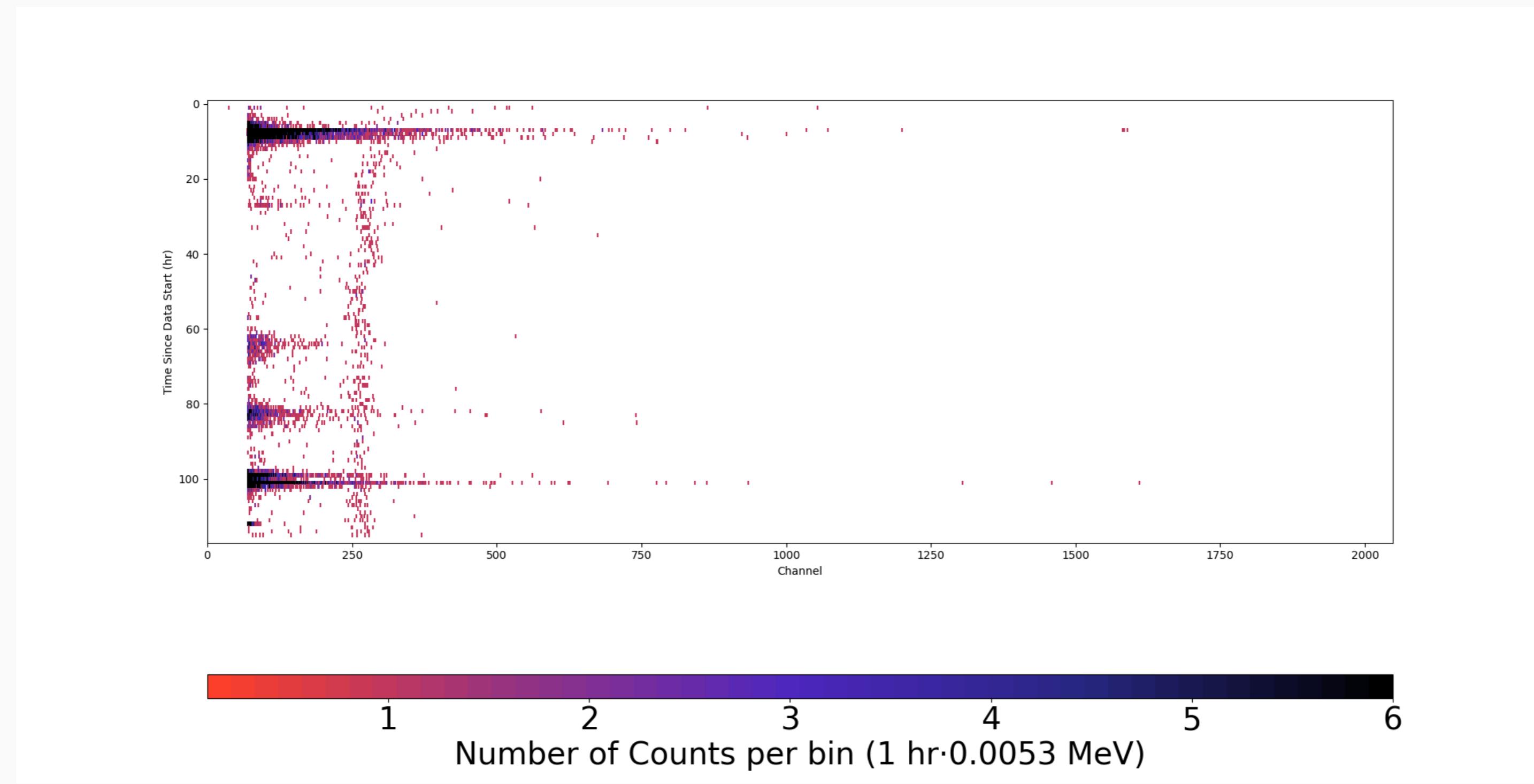


Figure 7: Large regions of noisy data had to be removed



Raw Data after Removing Bad Intervals, Run 717

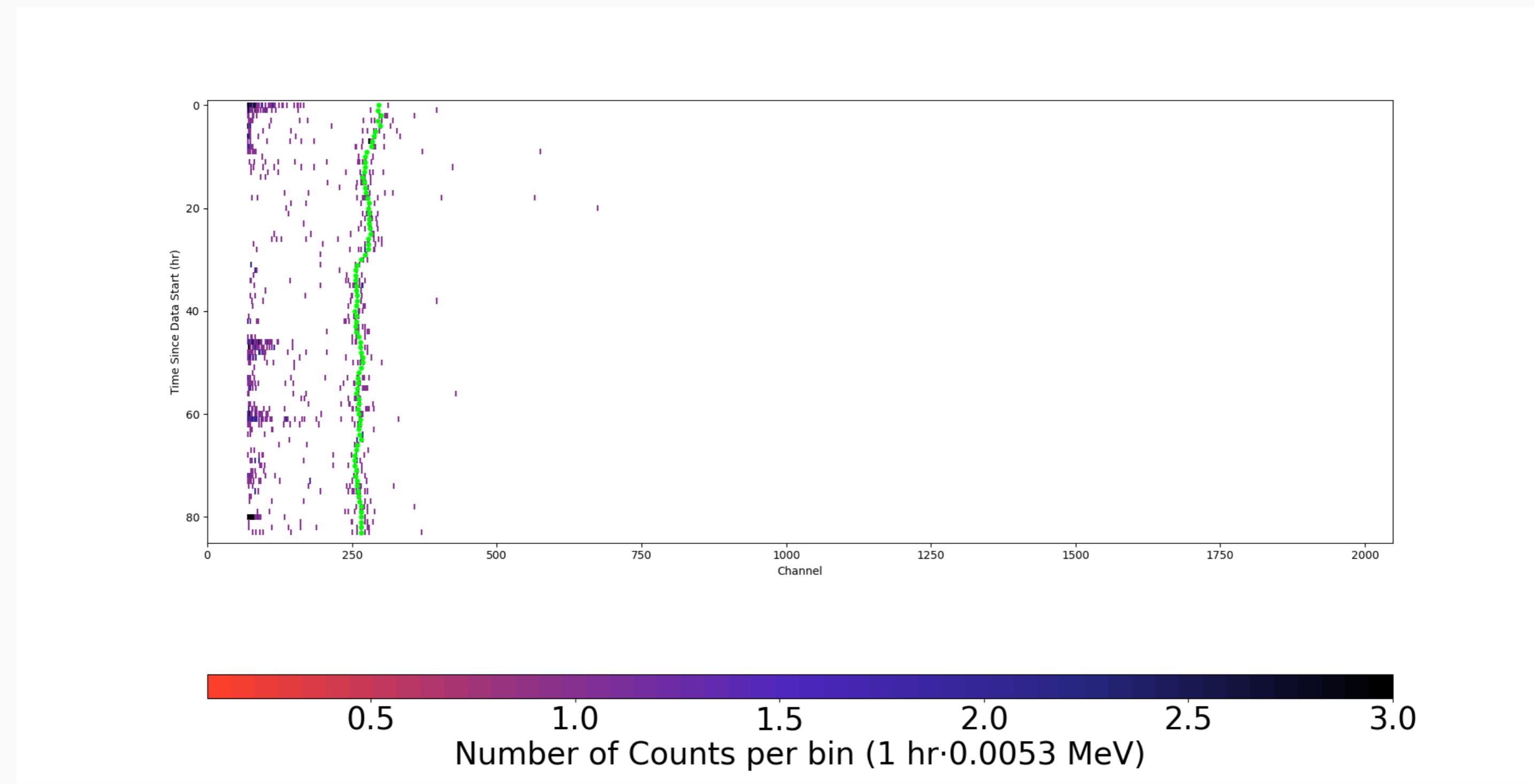


Figure 8: Gain is extremely low, resulting in poor data resolution



Gain-Corrected Data, Run 717

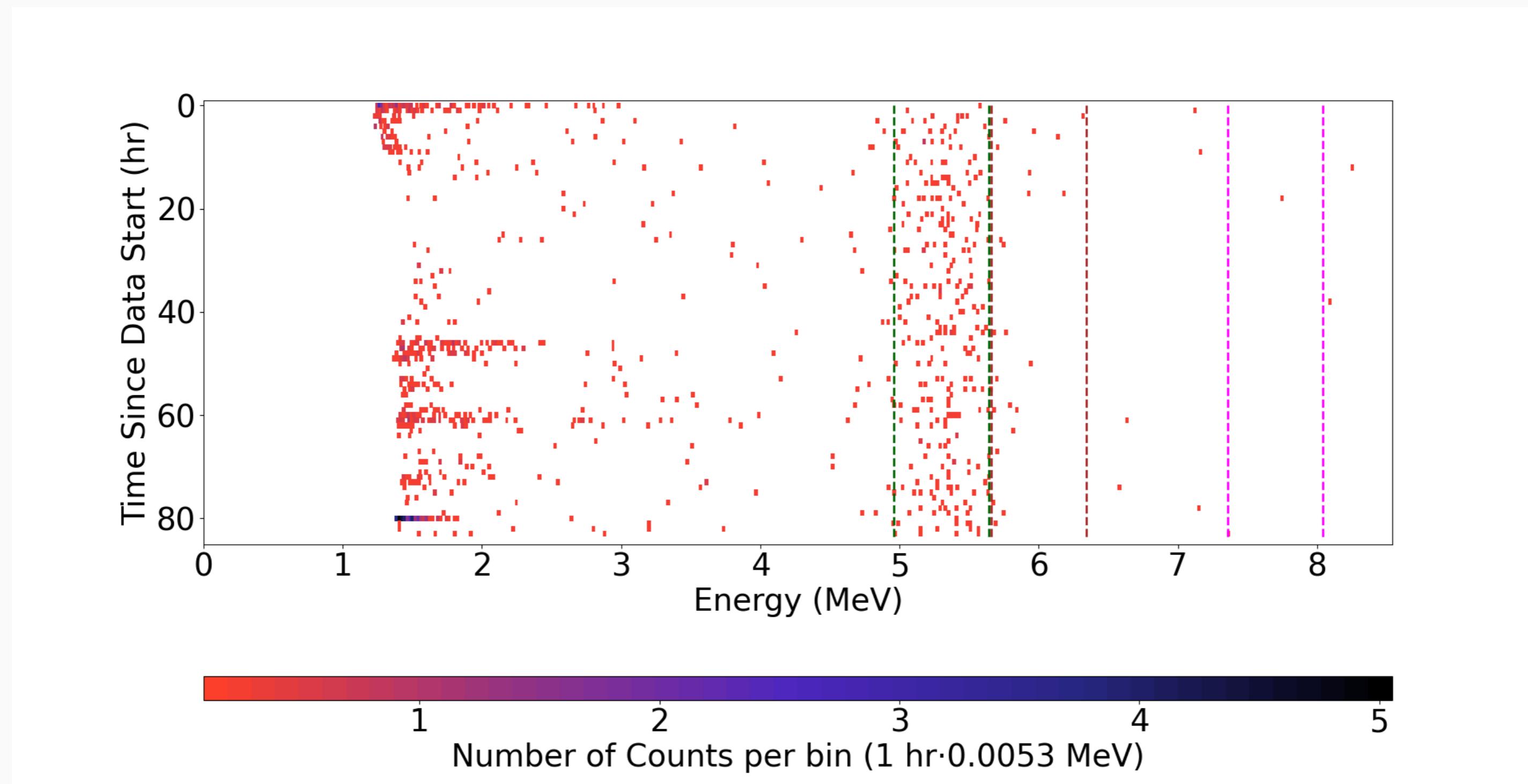


Figure 9: Data has been corrected to center the 5.3 MeV ^{210}Po peak at MCA channel 1000



Counts vs. Energy, Run 717

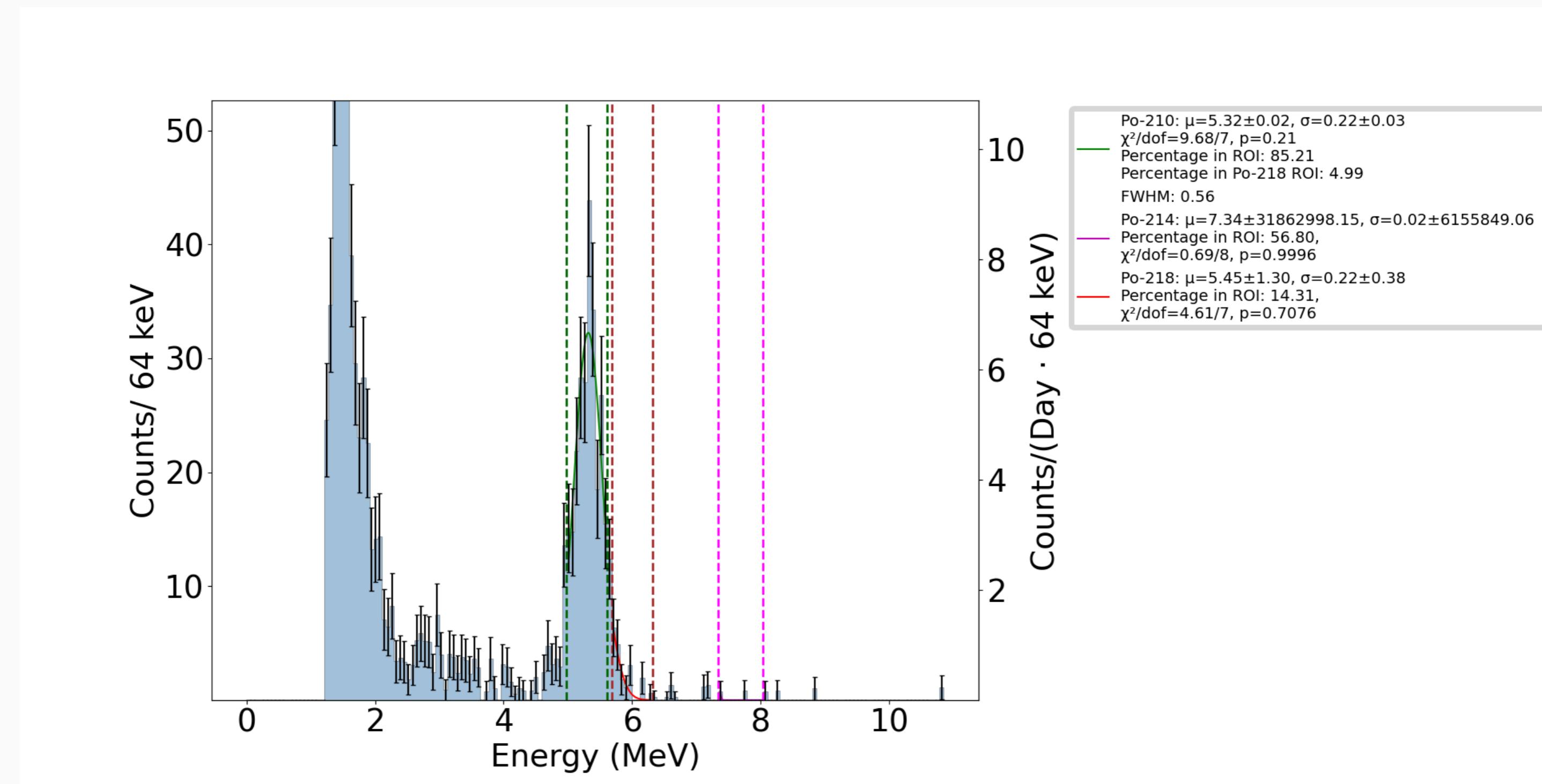


Figure 10: ^{210}Po peak has poor resolution and bleeds into ^{218}Po ROI

Combined NLL, Run 717

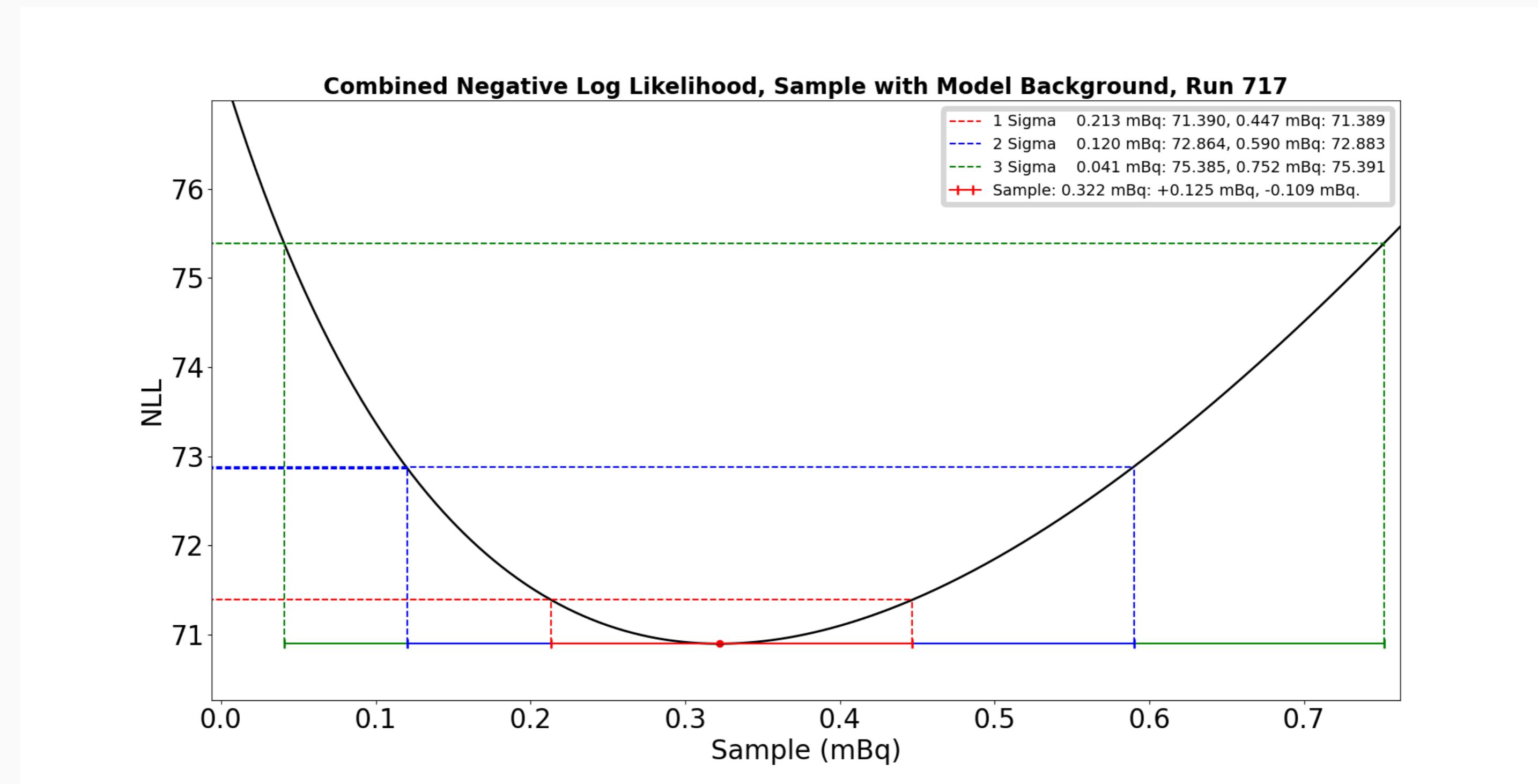


Figure 11: This rate is not used because of the resolution problems discussed earlier

^{218}Po NLL, Run 717

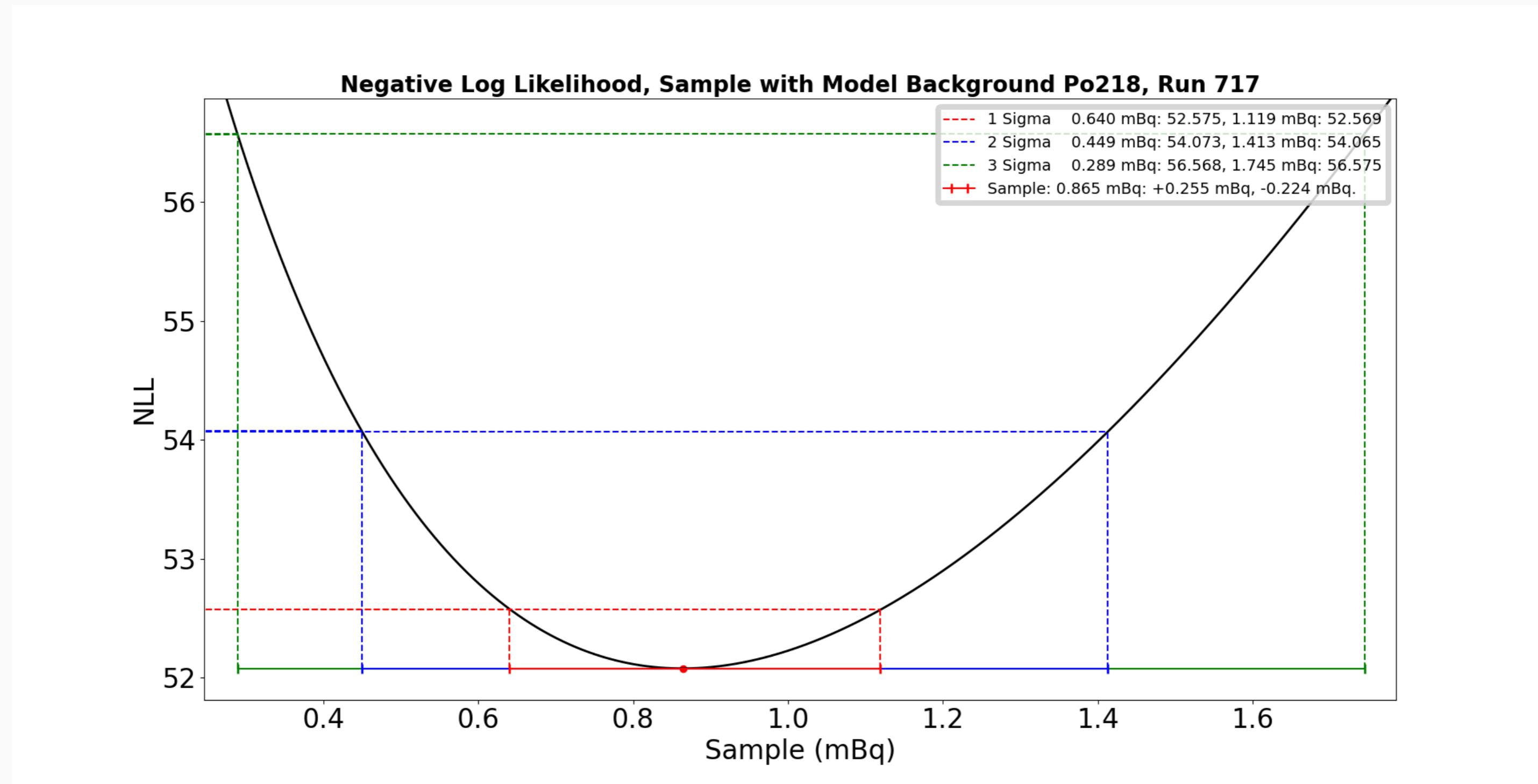


Figure 12: This rate is artificially high because of spillage from the ^{210}Po ROI



^{214}Po NLL, Run 717

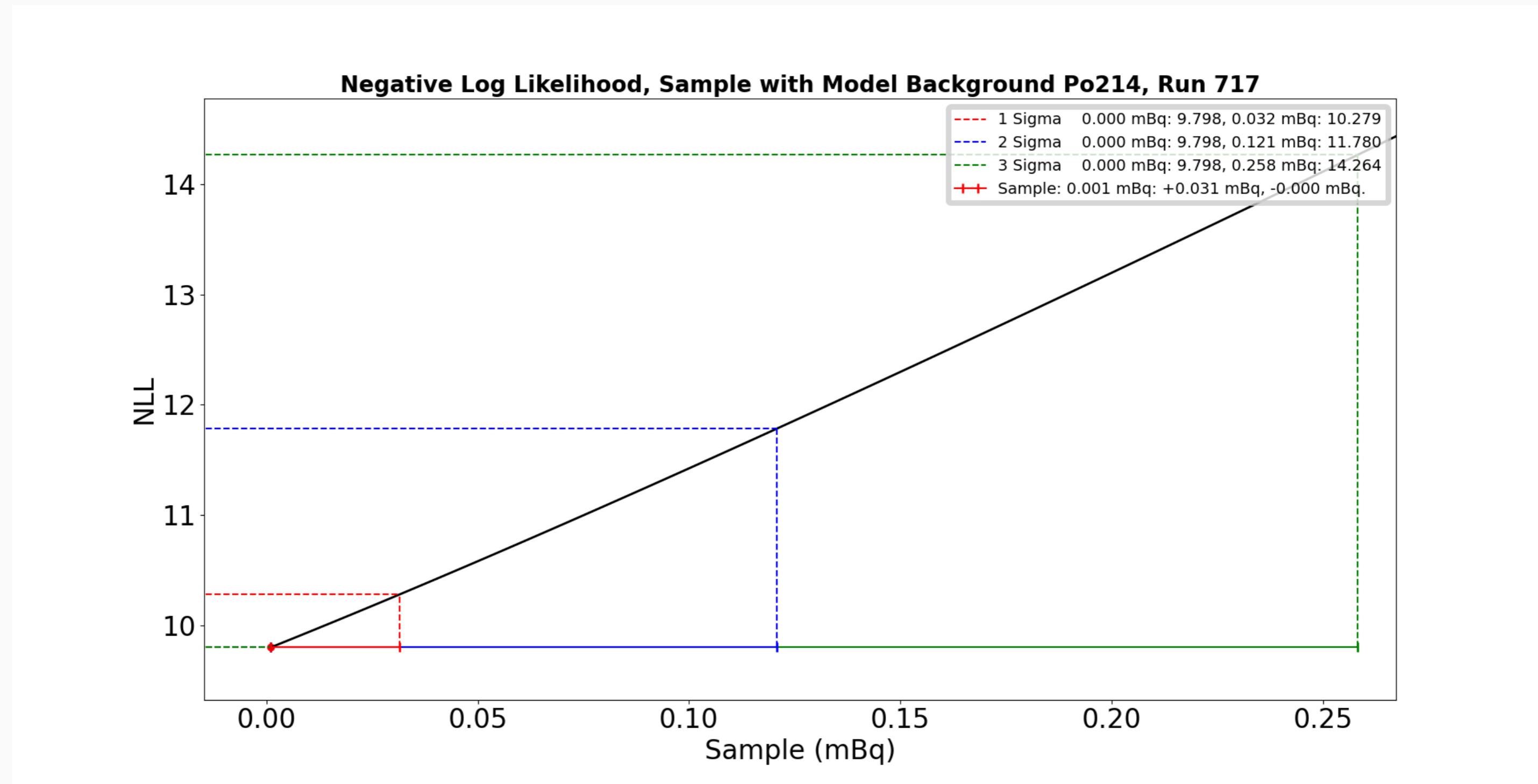


Figure 13: This is the rate that was used to determine the emanation rate of Run 717

Live Time Efficiency

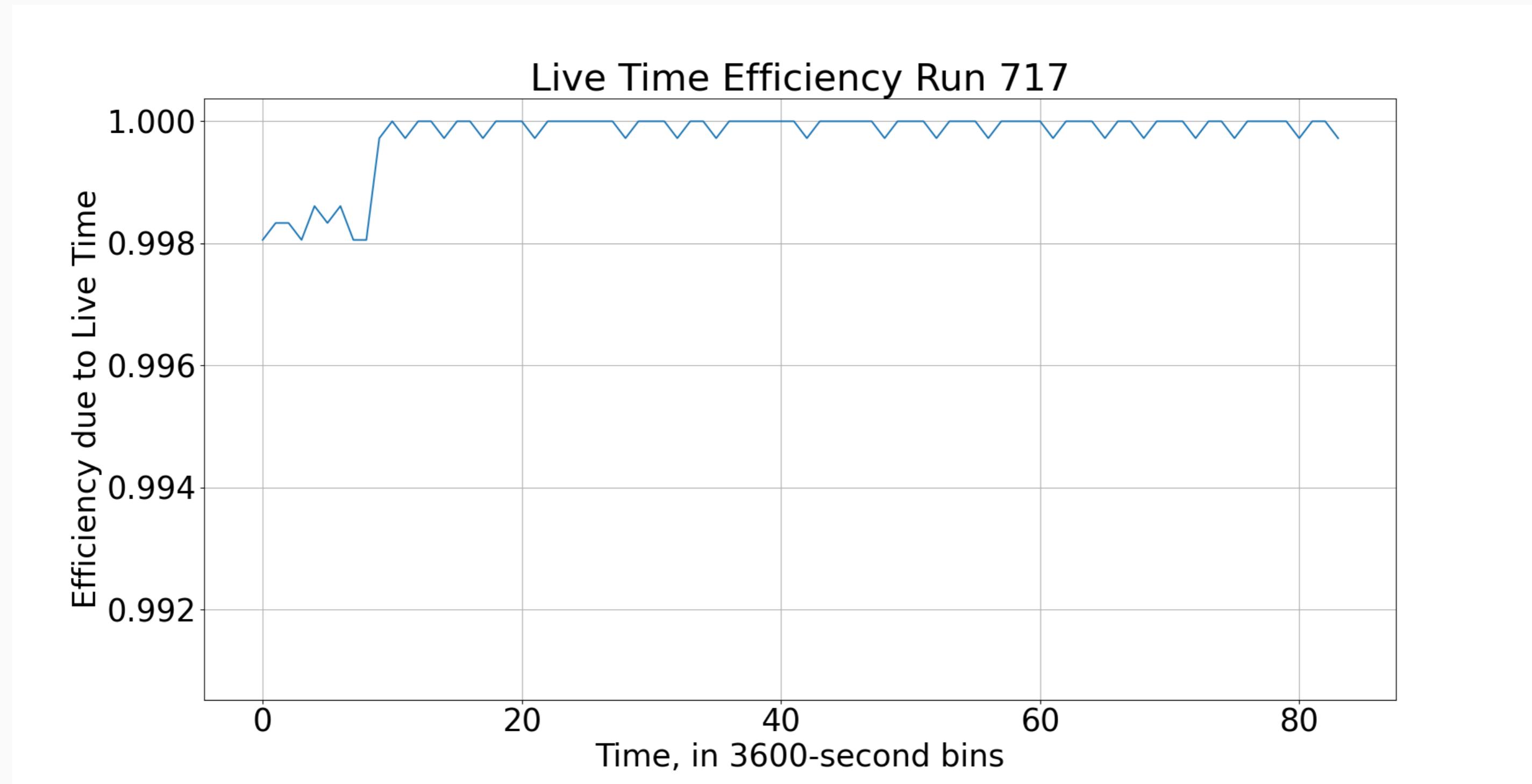


Figure 14: Detector had relatively little dead time



Notes on Run 717 Analysis

A large portion of the data had to be discarded due to high levels of noise that interfered with gain correction and rate finding. The run also exhibited low gain, with the ^{210}Po peak resting somewhere around MCA channel 250, rather than the standard 1000. The low gain caused further issues with data resolution, which caused the ^{218}Po rate calculated to include spill-over from ^{210}Po events. Because of this, the ^{214}Po rate was exclusively used to determine the emanation rate for this run.

[Back to Rate vs Time Run 717](#)



Run 720 Backup Slides

The following slides contain additional data and information regarding Run 720.



Raw Data, Run 720

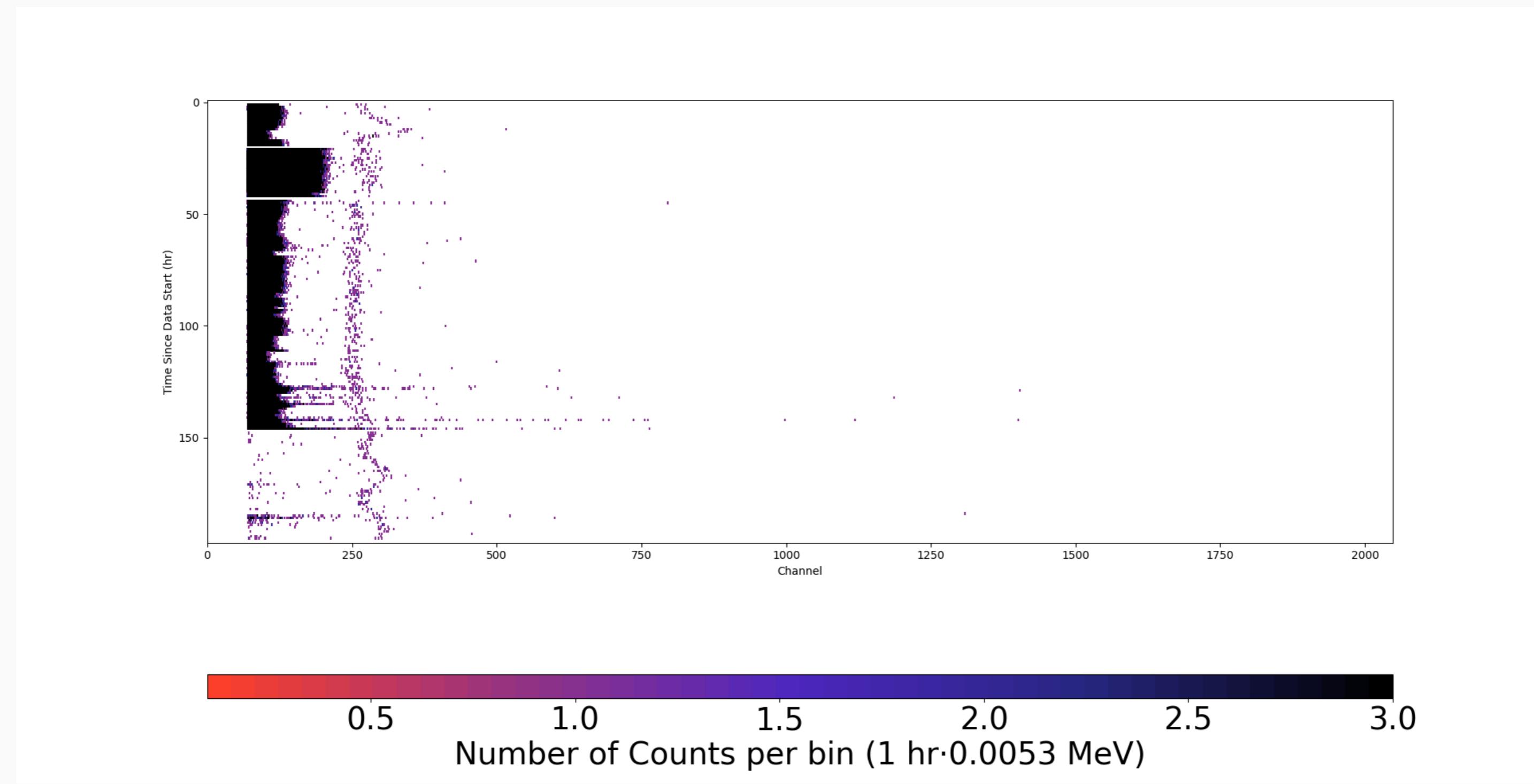


Figure 15: Run 720 exhibited both gain shift and areas of problematic noise



Raw Data after Removing Bad Intervals, Run 720

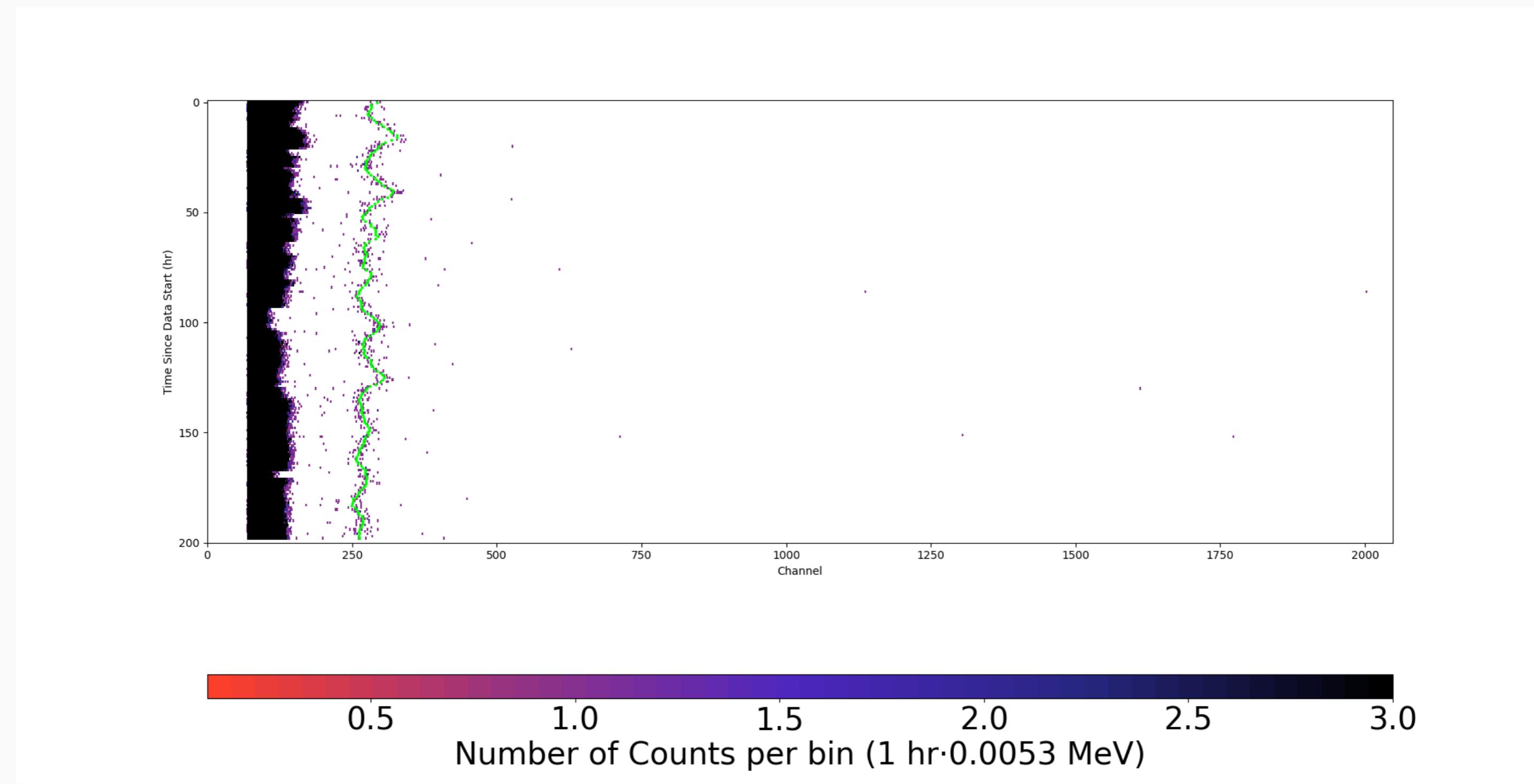


Figure 16: Gain is extremely low, resulting in poor data resolution



Gain-Corrected Data, Run 720

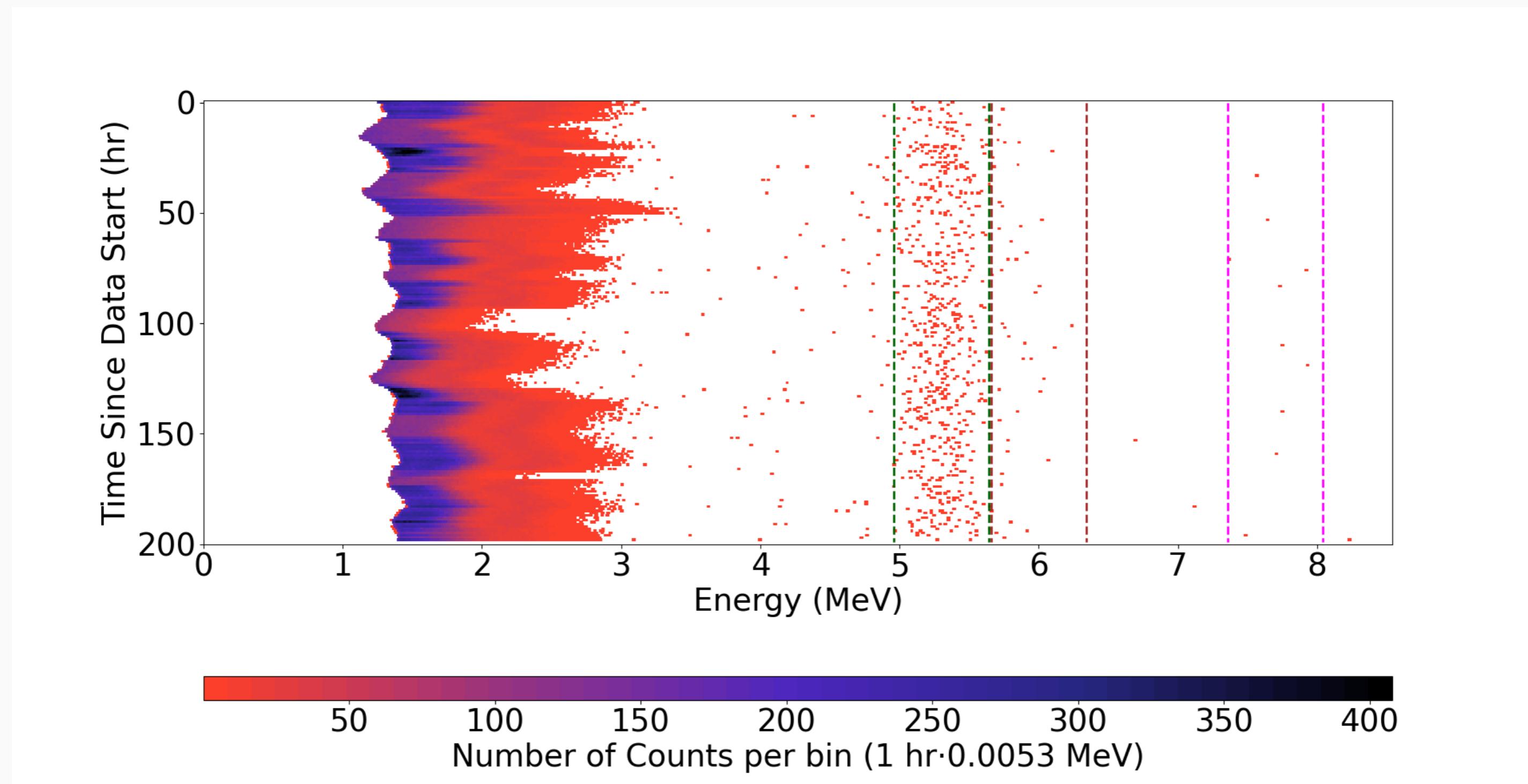


Figure 17: Data has been corrected to center the 5.3 MeV ^{210}Po peak at MCA channel 1000



Counts vs. Energy, Run 720

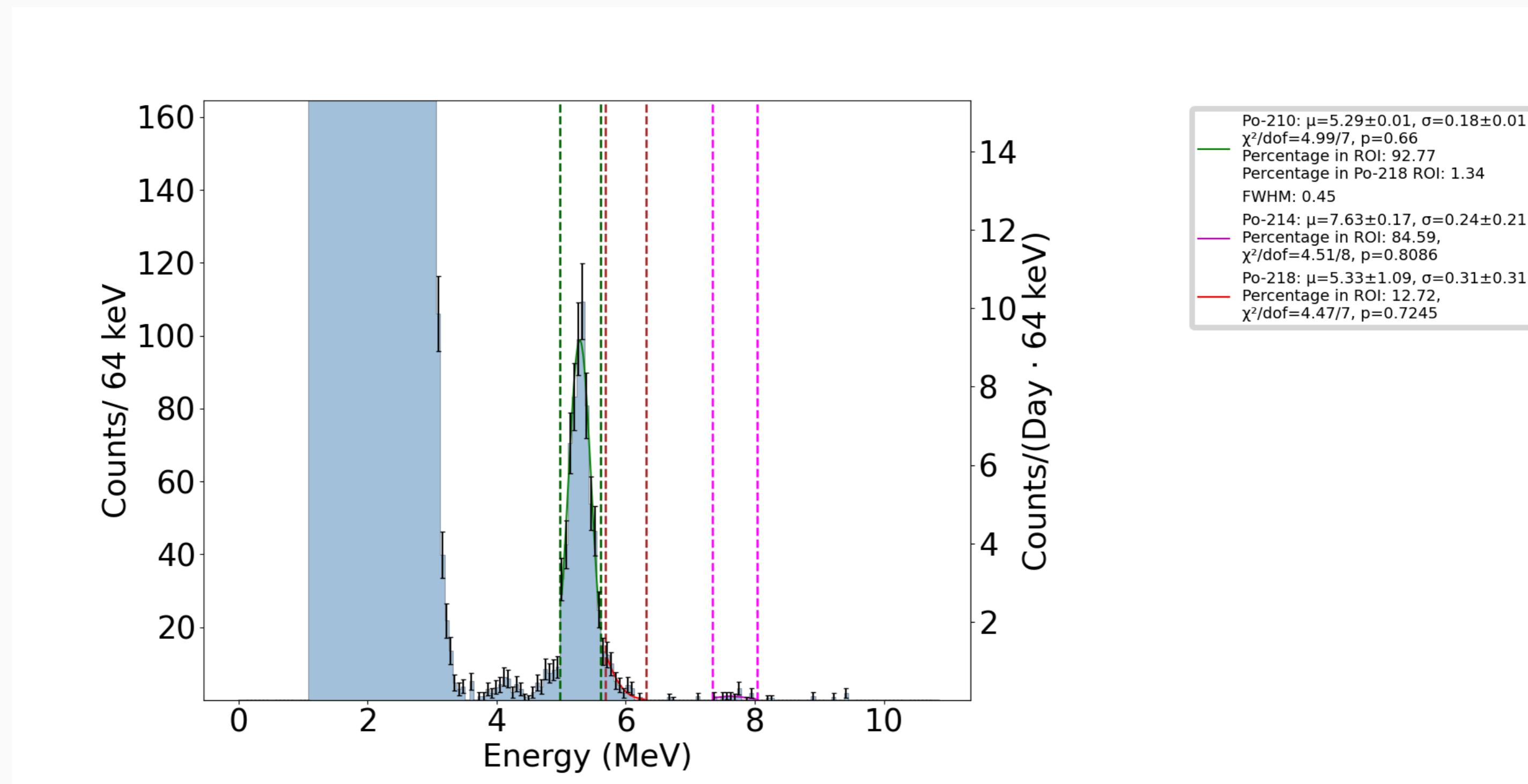


Figure 18: ^{210}Po peak has poor resolution and bleeds into ^{218}Po ROI



Combined NLL, Run 720

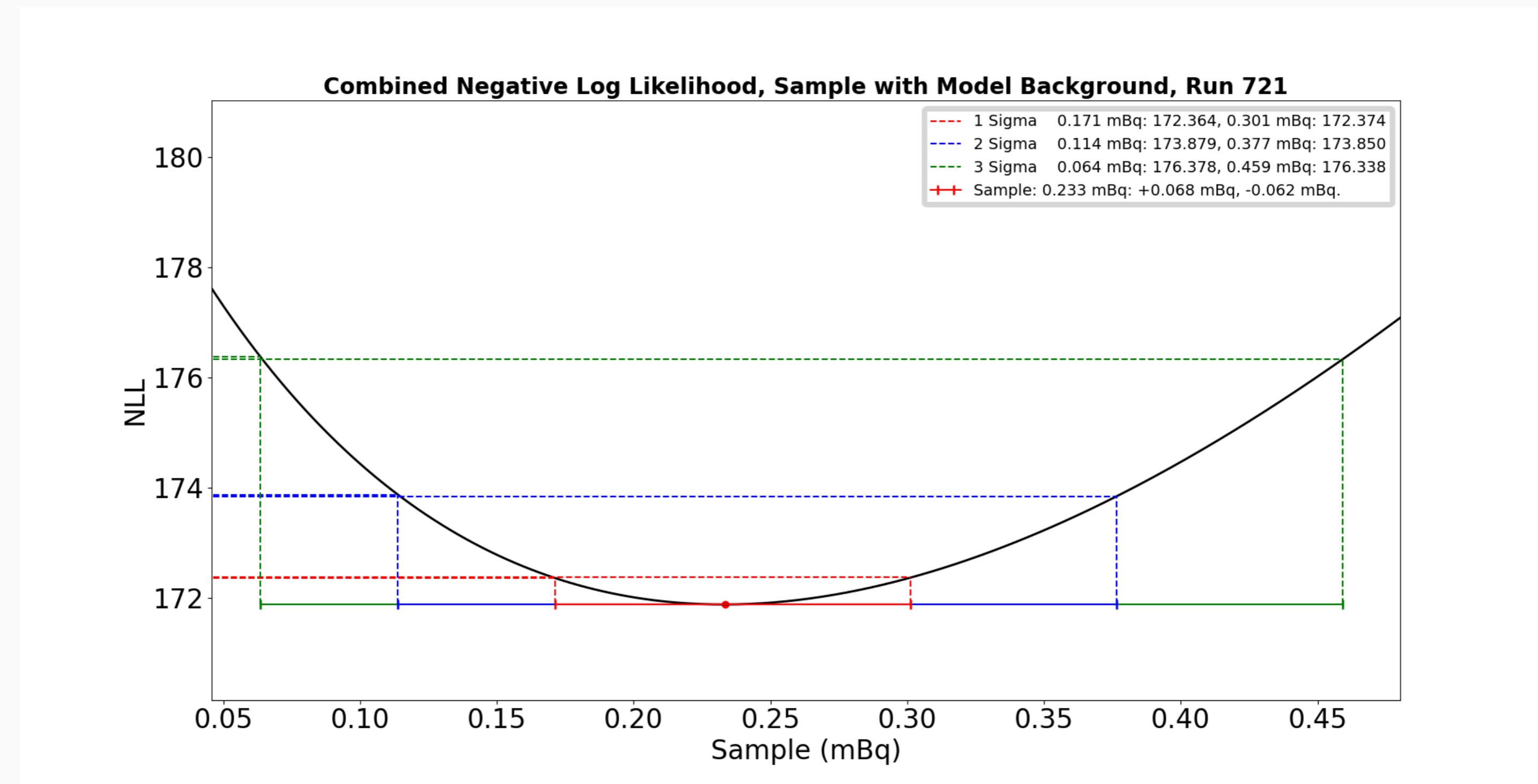


Figure 19: This rate is not used because of the resolution problems discussed earlier

^{218}Po NLL, Run 720

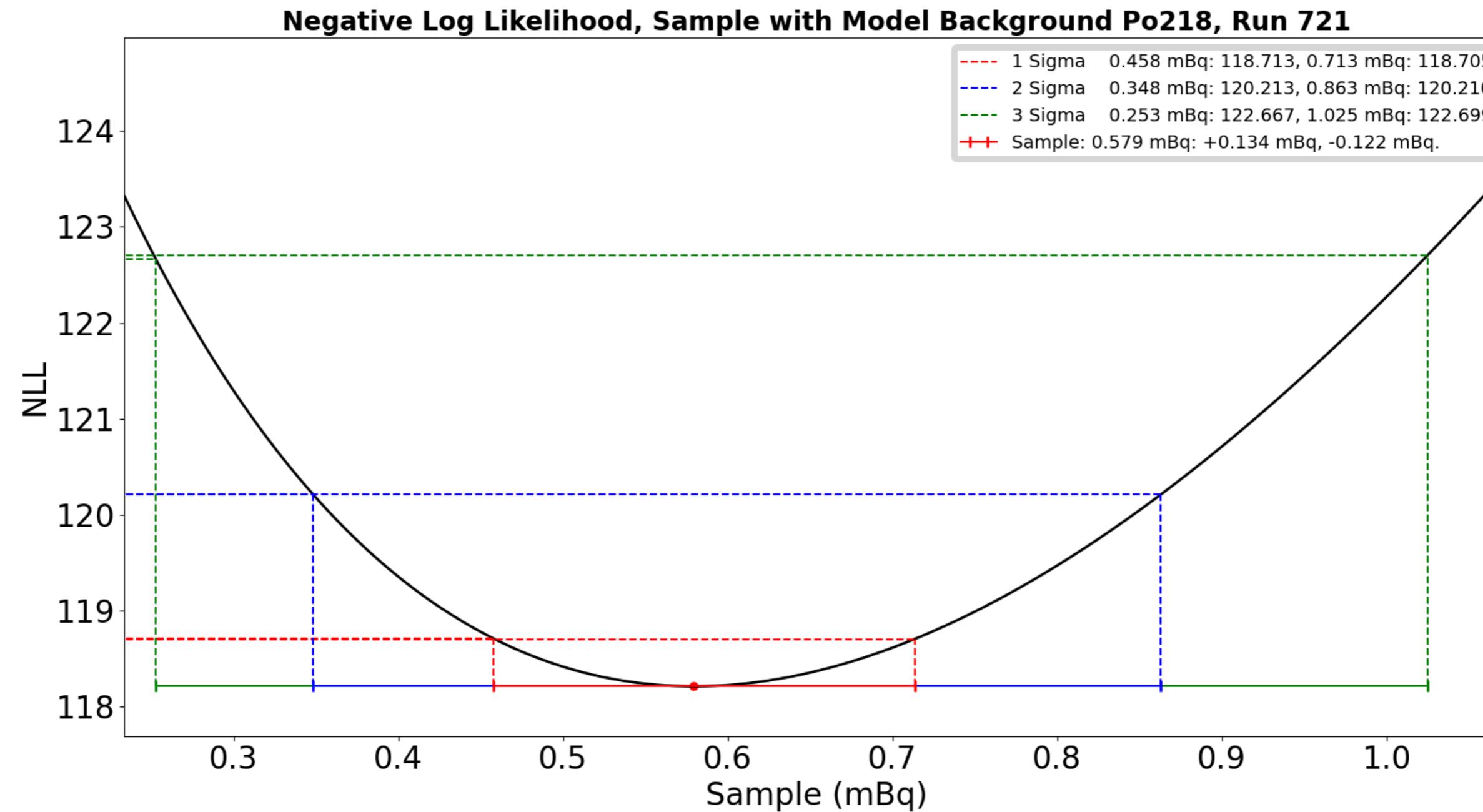


Figure 20: This rate is artificially high because of spillage from the ^{210}Po ROI

^{214}Po NLL, Run 720

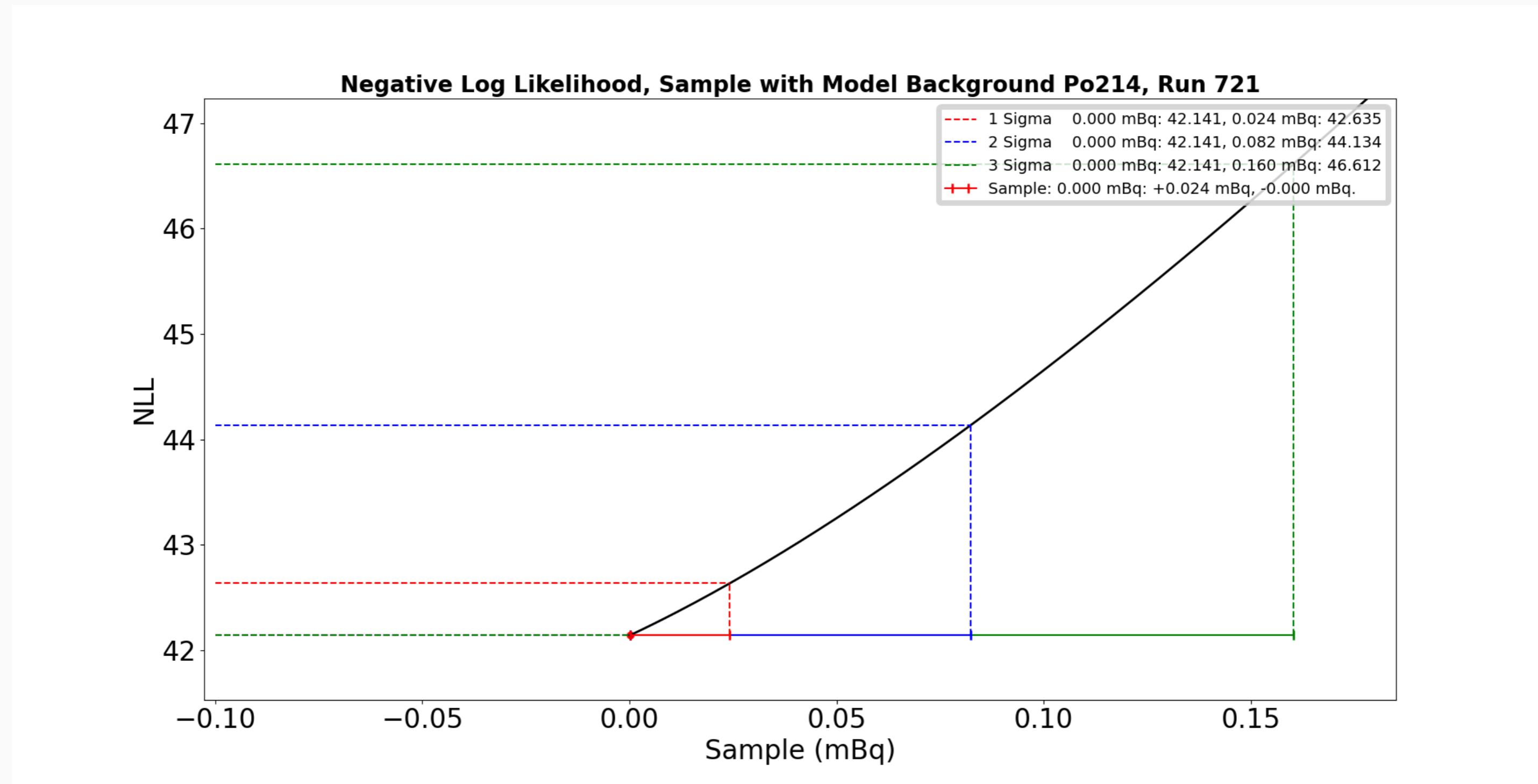


Figure 21: This is the rate that was used to determine the emanation rate of Run 720



Live Time Efficiency

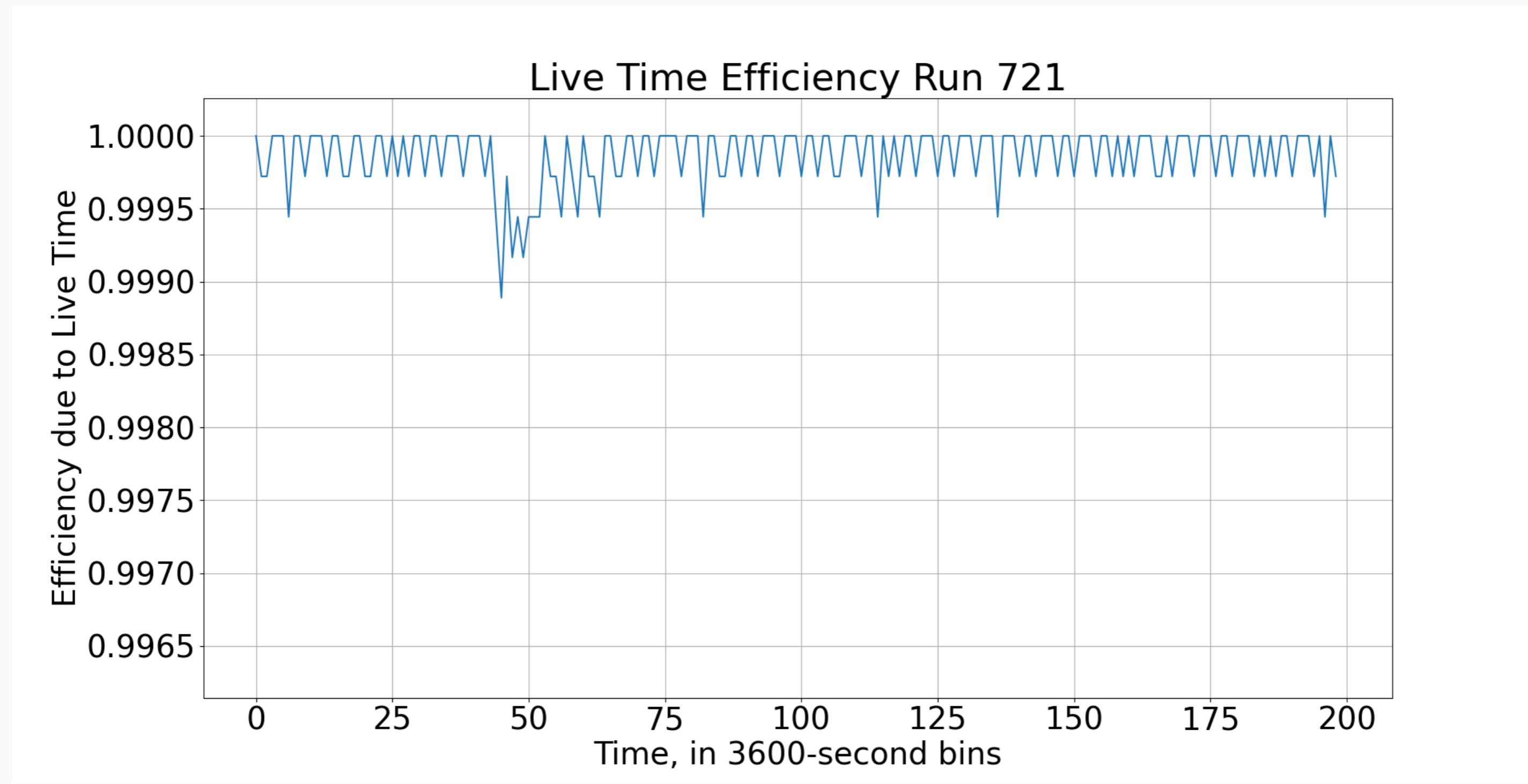


Figure 22: Detector had relatively little dead time



Notes on Run 721 Analysis

Run 721 exhibits low gain that appears to vary periodically. Unfortunately, there is no environmental data to compare the shifts to. Several bins had to be cut due to high noise. The low resolution exhibited by Run 721 gives way to ^{210}Po events spilling over into the ^{218}Po ROI. Because of this, the ^{214}Po rate alone was used to determine the emanation rate for run 721. Overall, Run 721 appears to be consistent with our backgrounds.

[Back to Rate vs Time Run 721](#)



Run 721 Backup Slides

The following slides contain additional data and information regarding Run 721.



Raw Data, Run 721

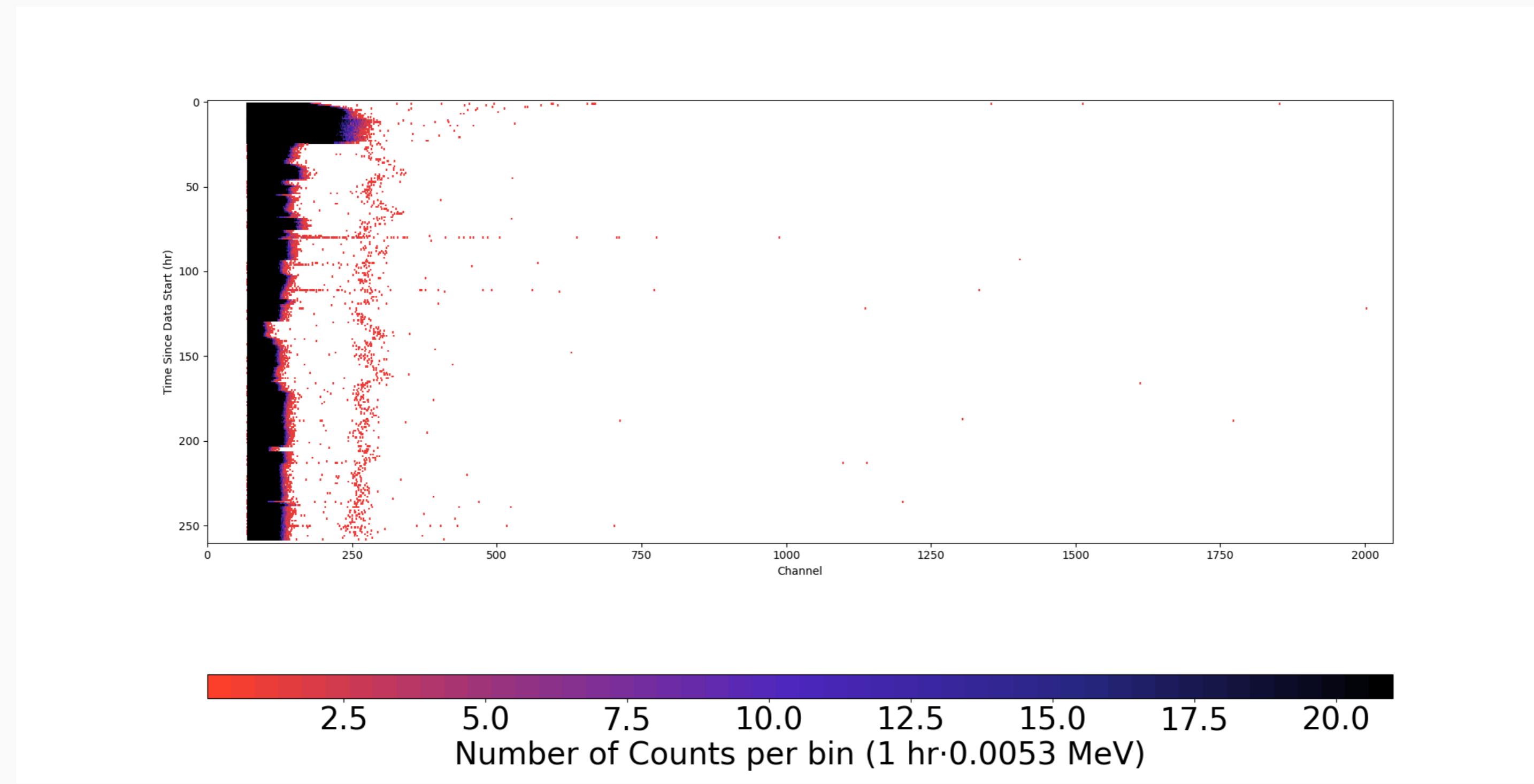


Figure 23: Run 721 exhibited both gain shift and areas of problematic noise



Raw Data after Removing Bad Intervals, Run 721

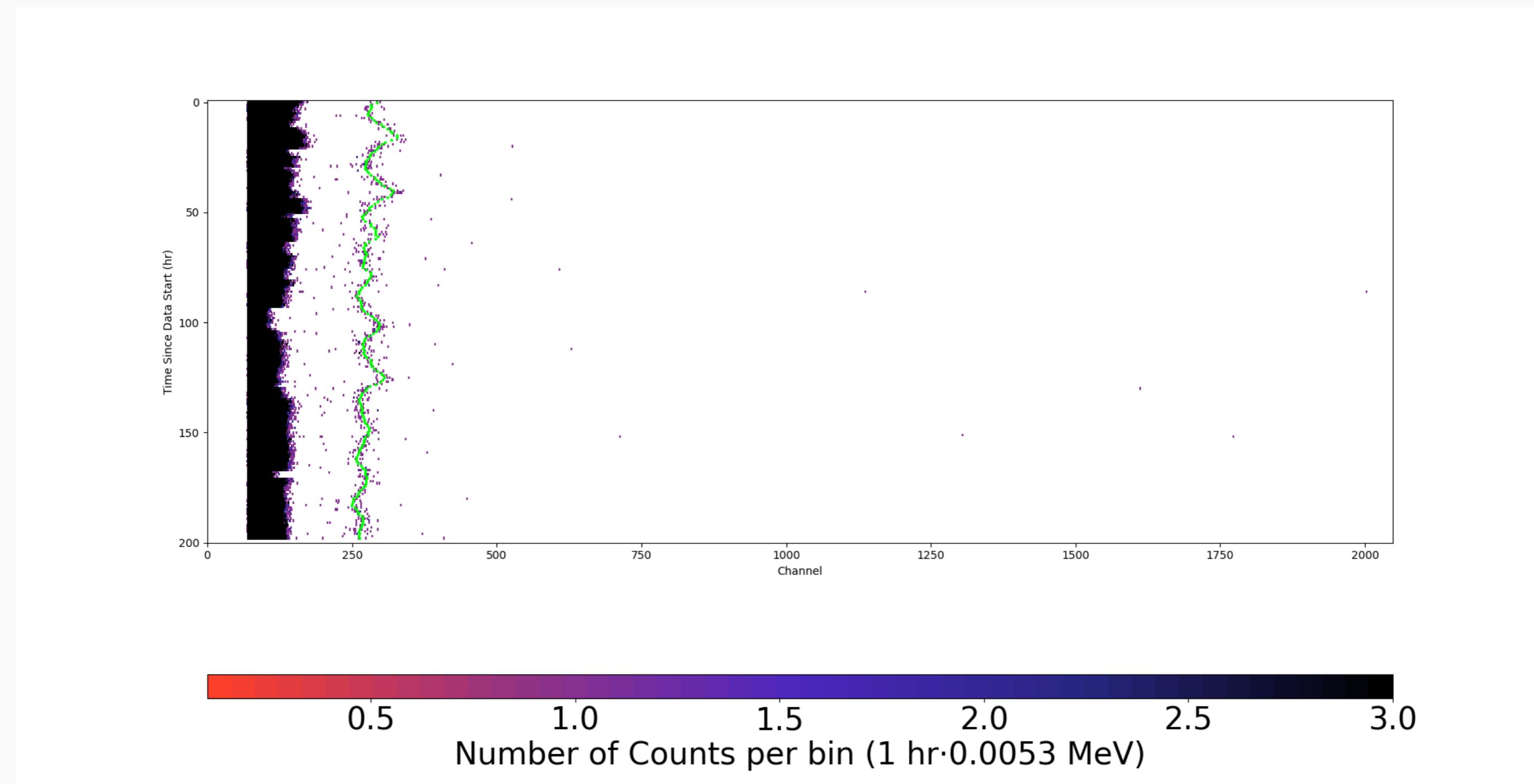


Figure 24: Gain is extremely low, resulting in poor data resolution



Gain-Corrected Data, Run 721

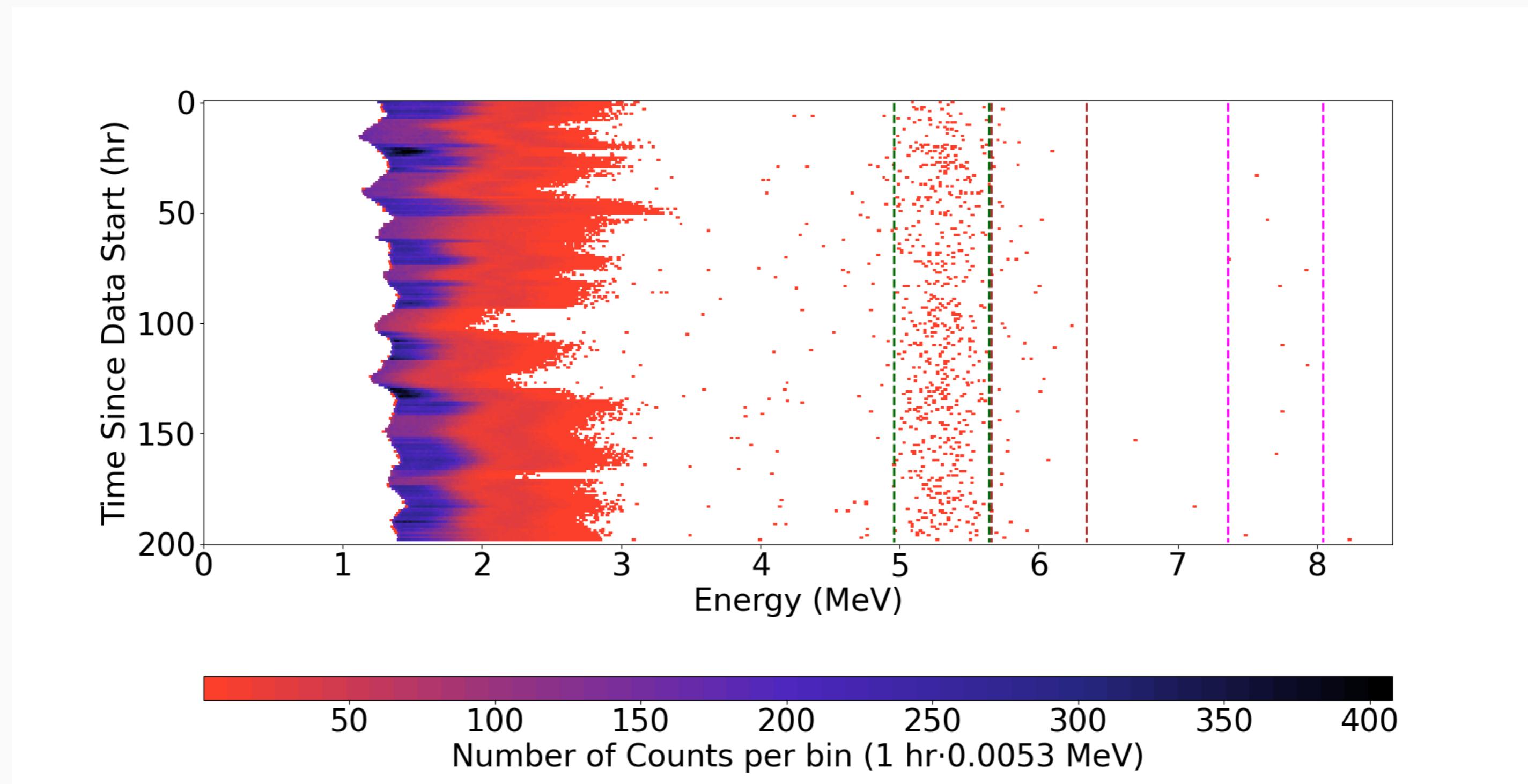


Figure 25: Data has been corrected to center the 5.3 MeV ^{210}Po peak at MCA channel 1000



Counts vs. Energy, Run 721

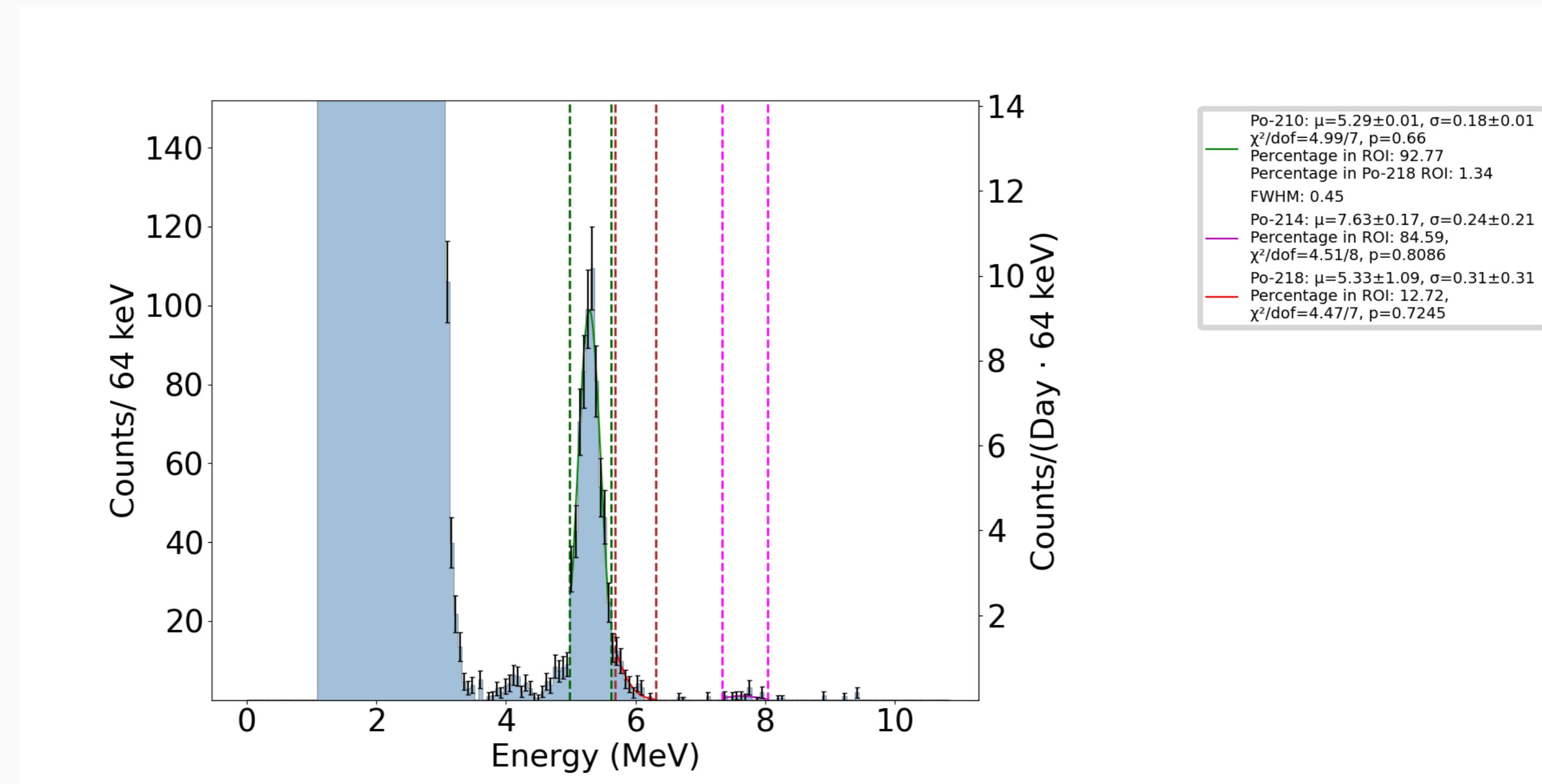


Figure 26: ^{210}Po peak has poor resolution and bleeds into ^{218}Po ROI



Combined NLL, Run 721

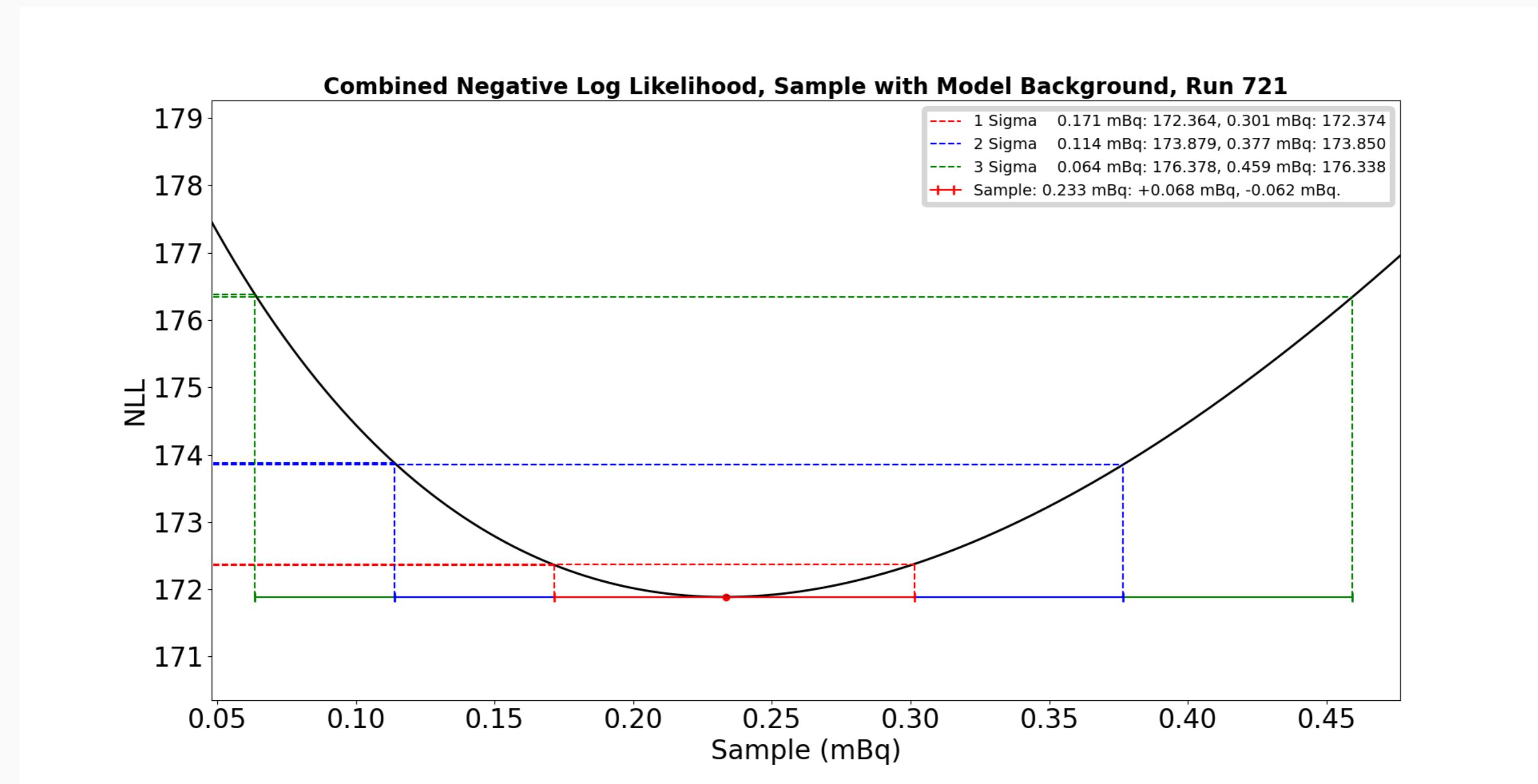


Figure 27: This rate is not used because of the resolution problems discussed earlier



^{218}Po NLL, Run 721

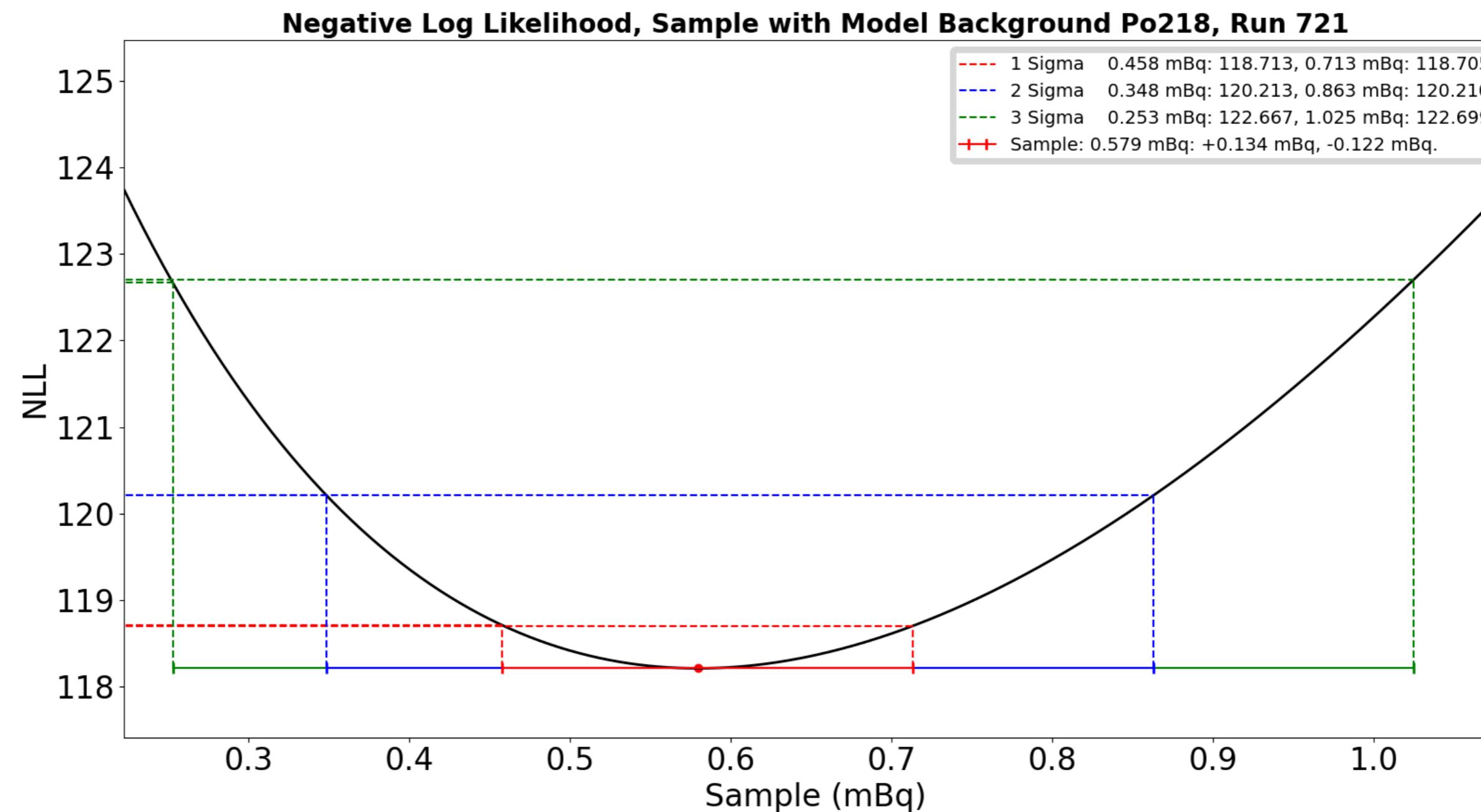


Figure 28: This rate is artificially high because of spillage from the ^{210}Po ROI



^{214}Po NLL, Run 721

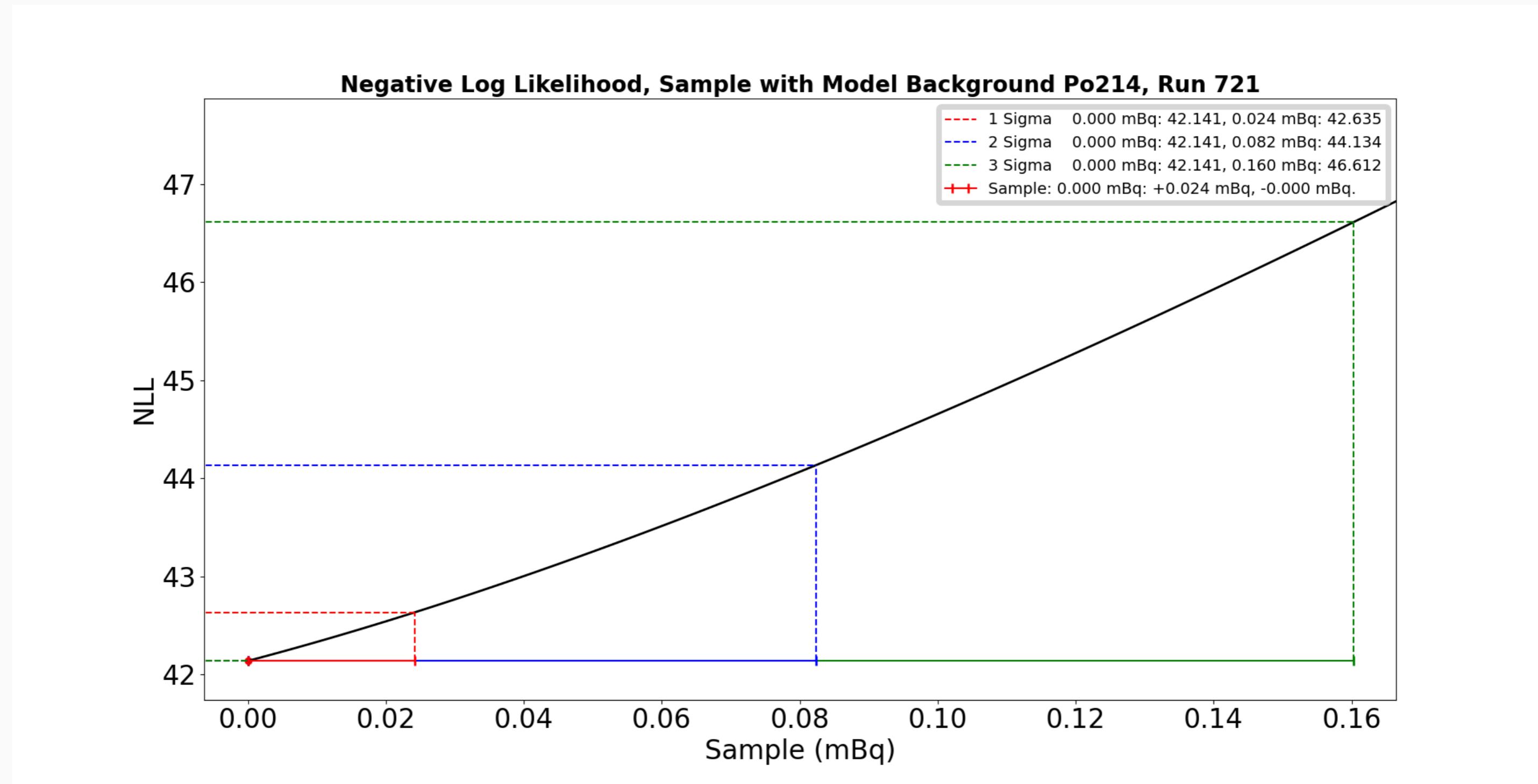


Figure 29: This is the rate that was used to determine the emanation rate of Run 721

Live Time Efficiency



Figure 30: Detector had relatively little dead time



Notes on Run 721 Analysis

Run 721 exhibits low gain that appears to vary periodically. Unfortunately, there is no environmental data to compare the shifts to. Several bins had to be cut due to high noise. The low resolution exhibited by Run 721 gives way to ^{210}Po events spilling over into the ^{218}Po ROI. Because of this, the ^{214}Po rate alone was used to determine the emanation rate for run 721. Overall, Run 721 appears to be consistent with our backgrounds.

[Back to Rate vs Time Run 721](#)



Run 722 Backup Slides

The following slides contain additional data and information regarding Run 722.



Raw Data, Run 722

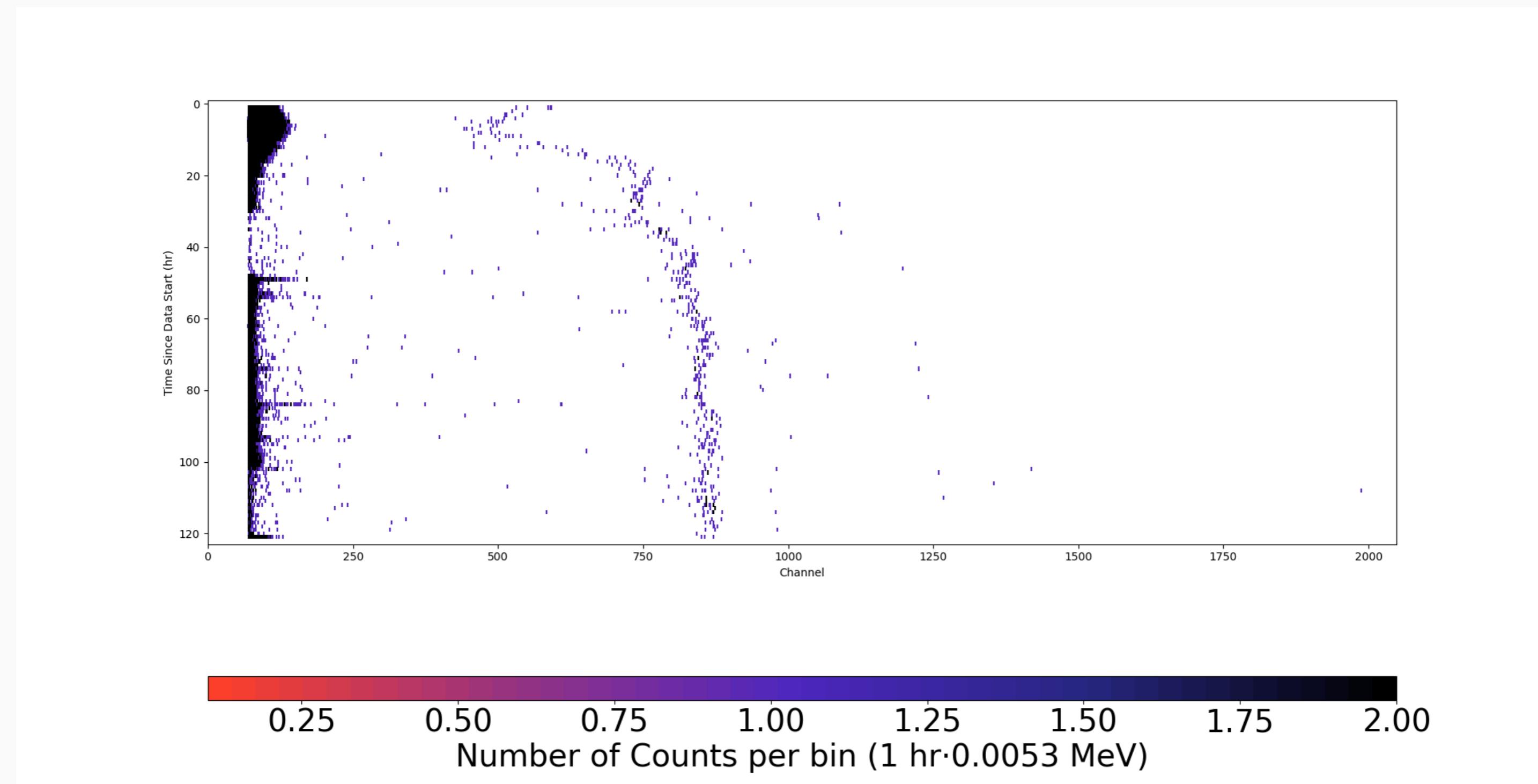


Figure 31: Run 722 exhibited such extreme gain shift that hours had to be removed to enable gain correction



Raw Data after Removing Bad Intervals, Run 722

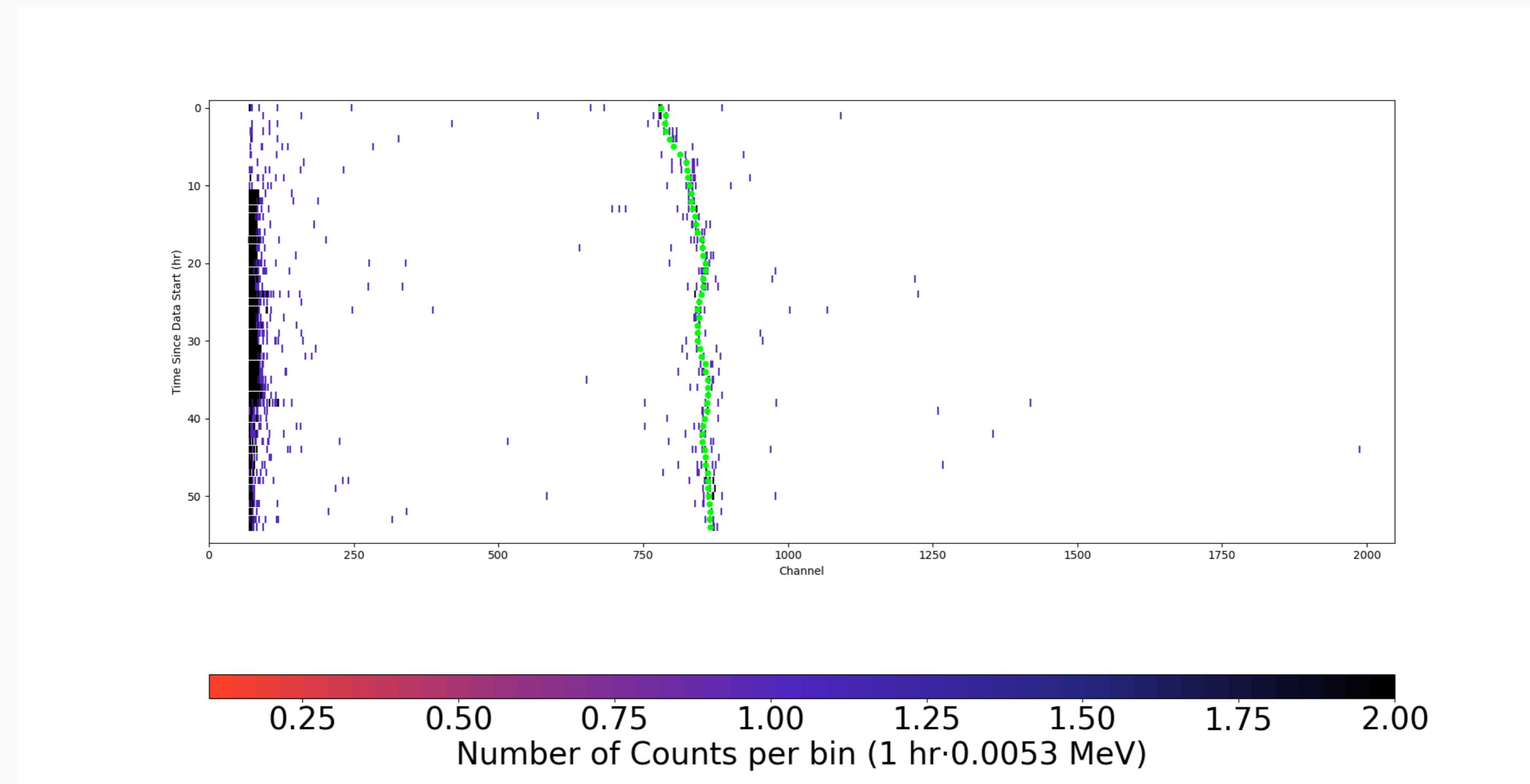


Figure 32: Data exhibits less extreme gain shifts and is able to be gain corrected

Gain-Corrected Data, Run 722

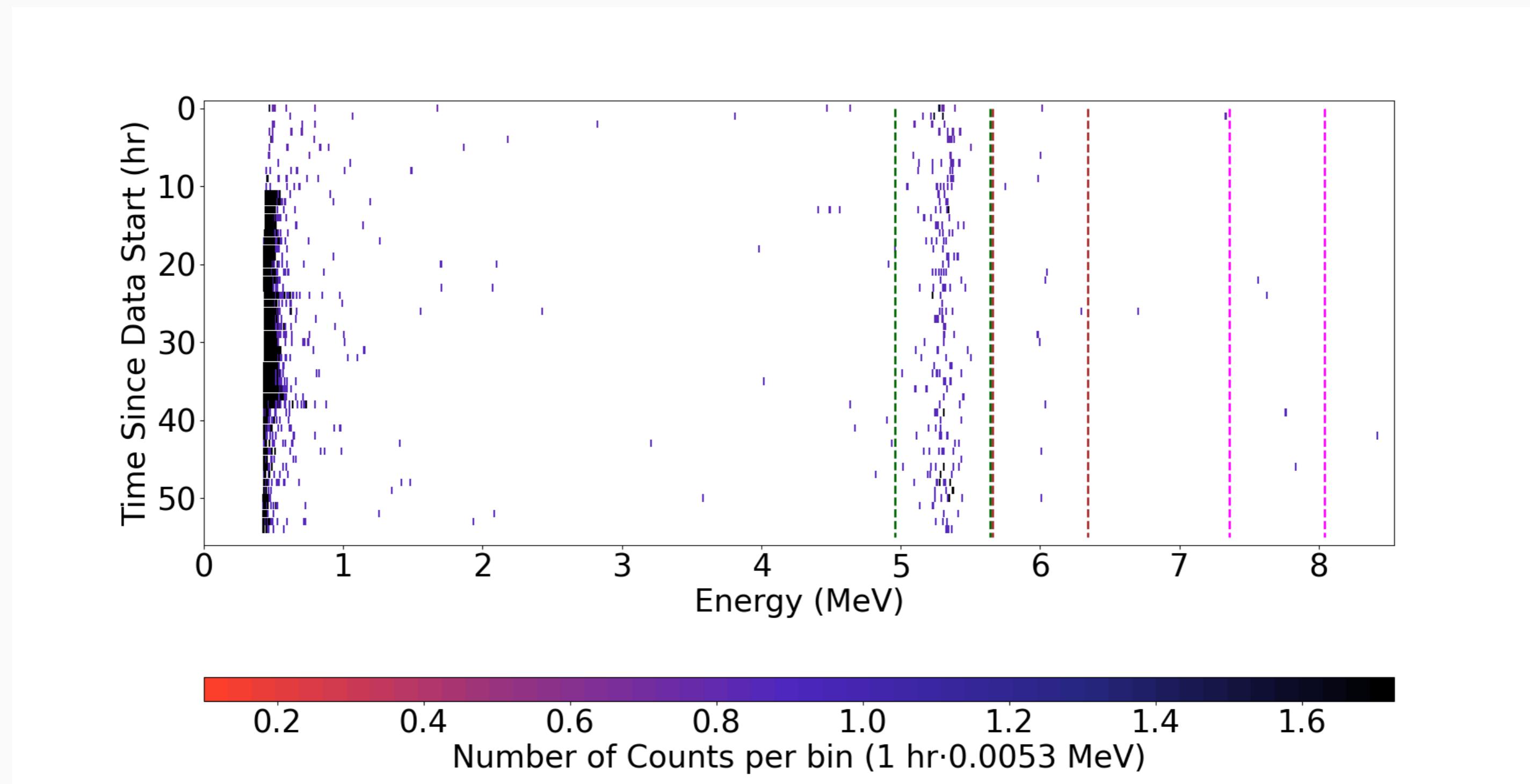


Figure 33: Data exhibits relatively good resolution and no spillage is apparent



Counts vs. Energy, Run 722

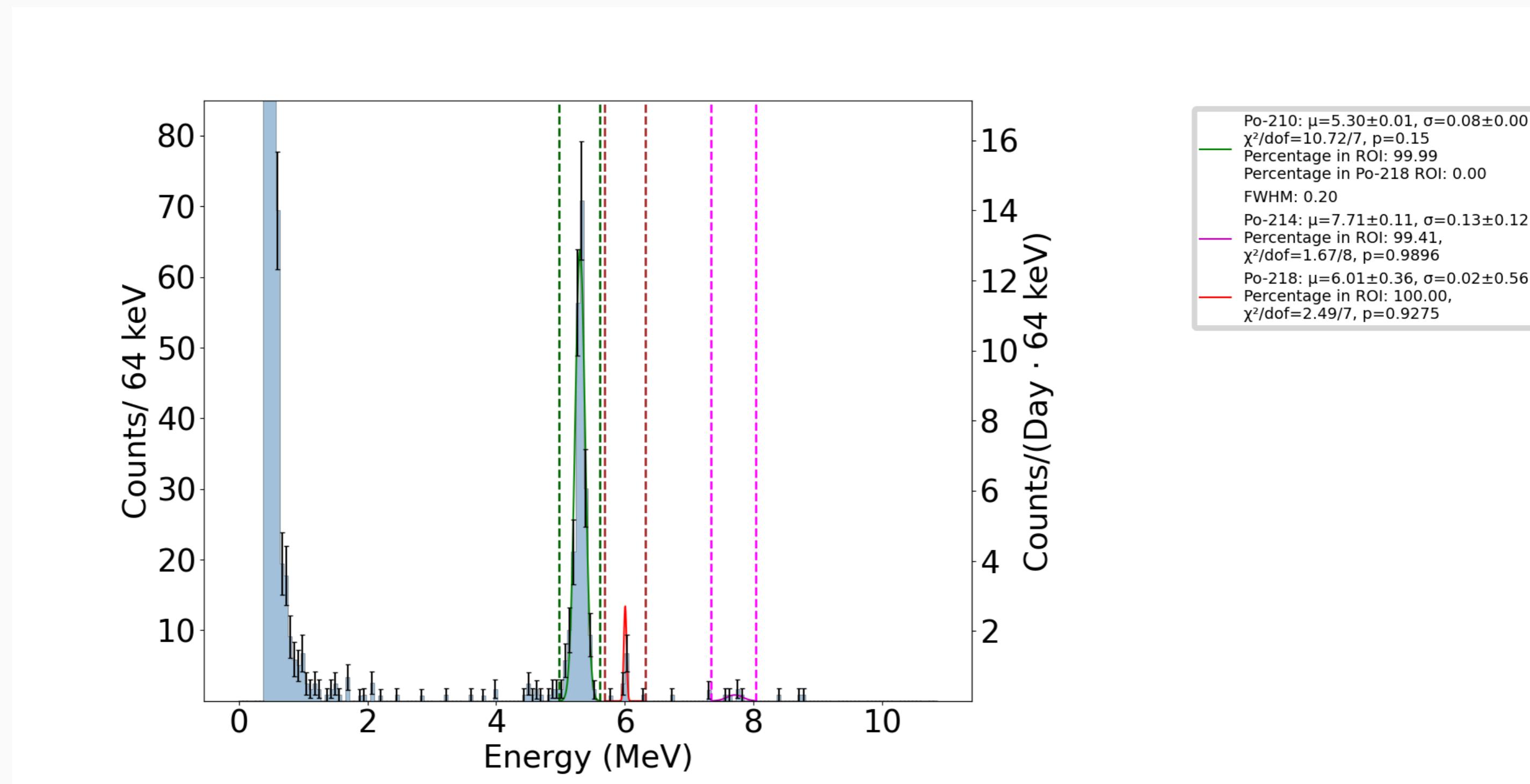


Figure 34: Each peak exhibits good resolution



Combined NLL, Run 722

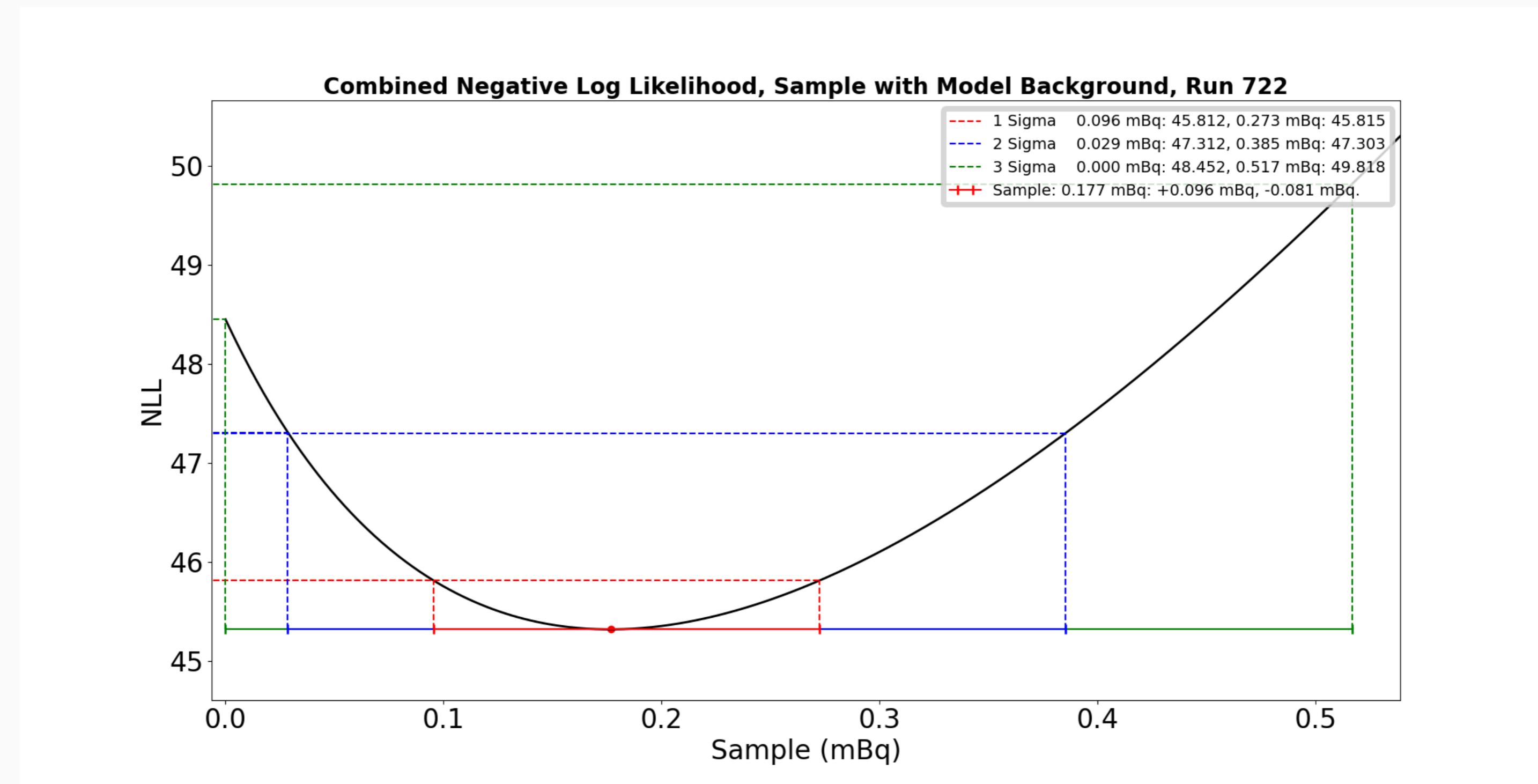


Figure 35: This rate is used for the emanation rate for Run 722



^{218}Po NLL, Run 722

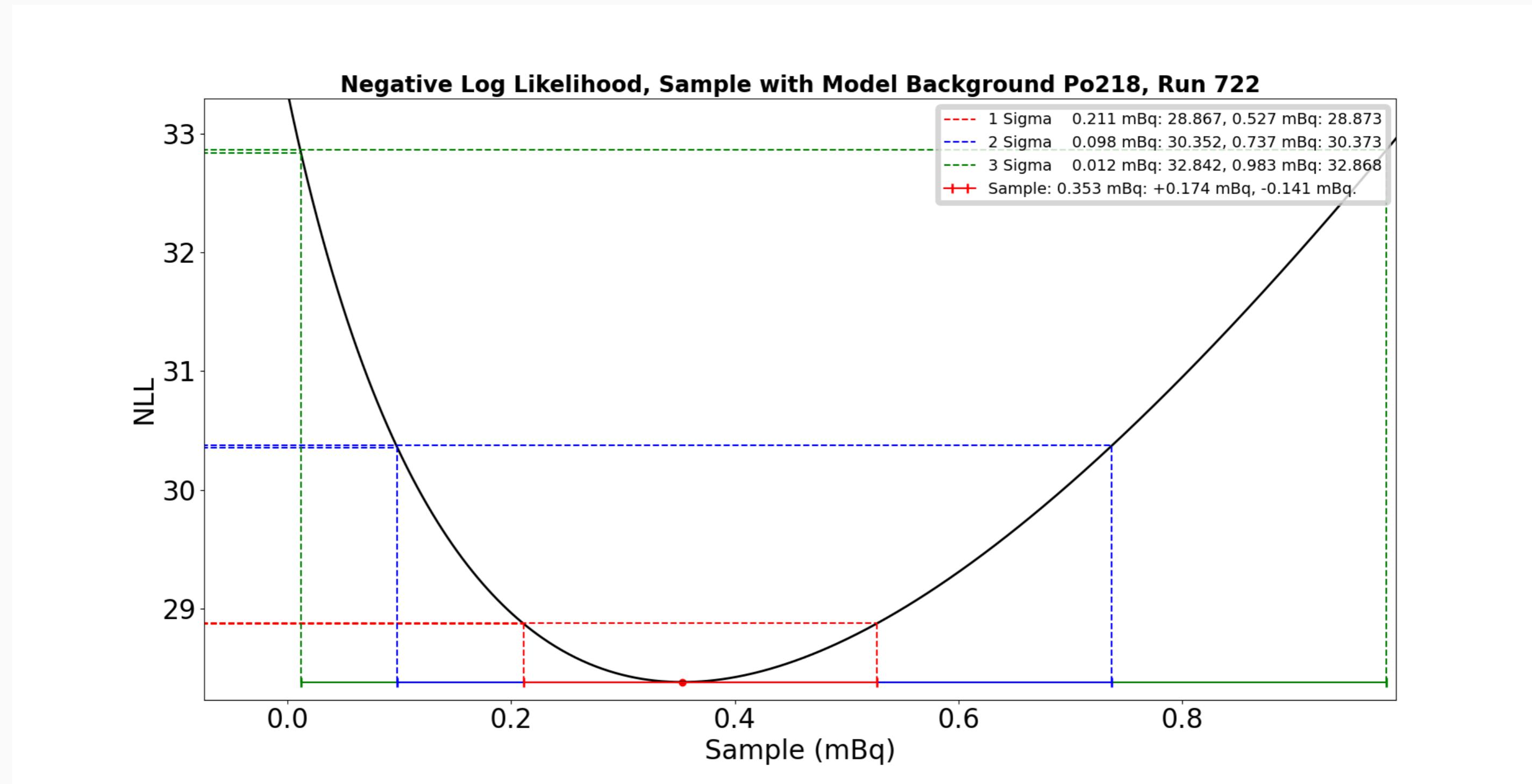


Figure 36: This rate is used to determine the combined rate



^{214}Po NLL, Run 722

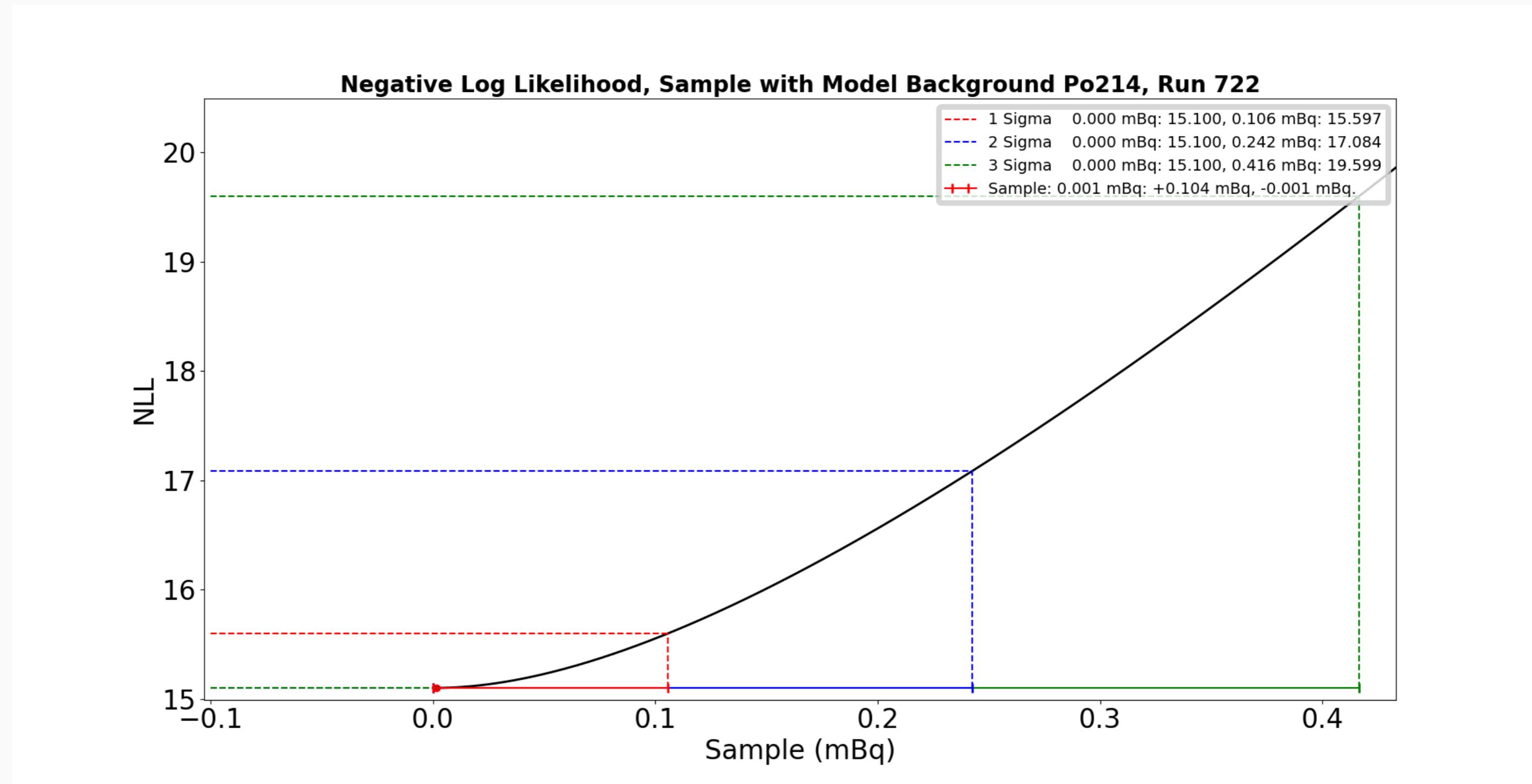


Figure 37: This rate is used to determine the combined rate



Live Time Efficiency

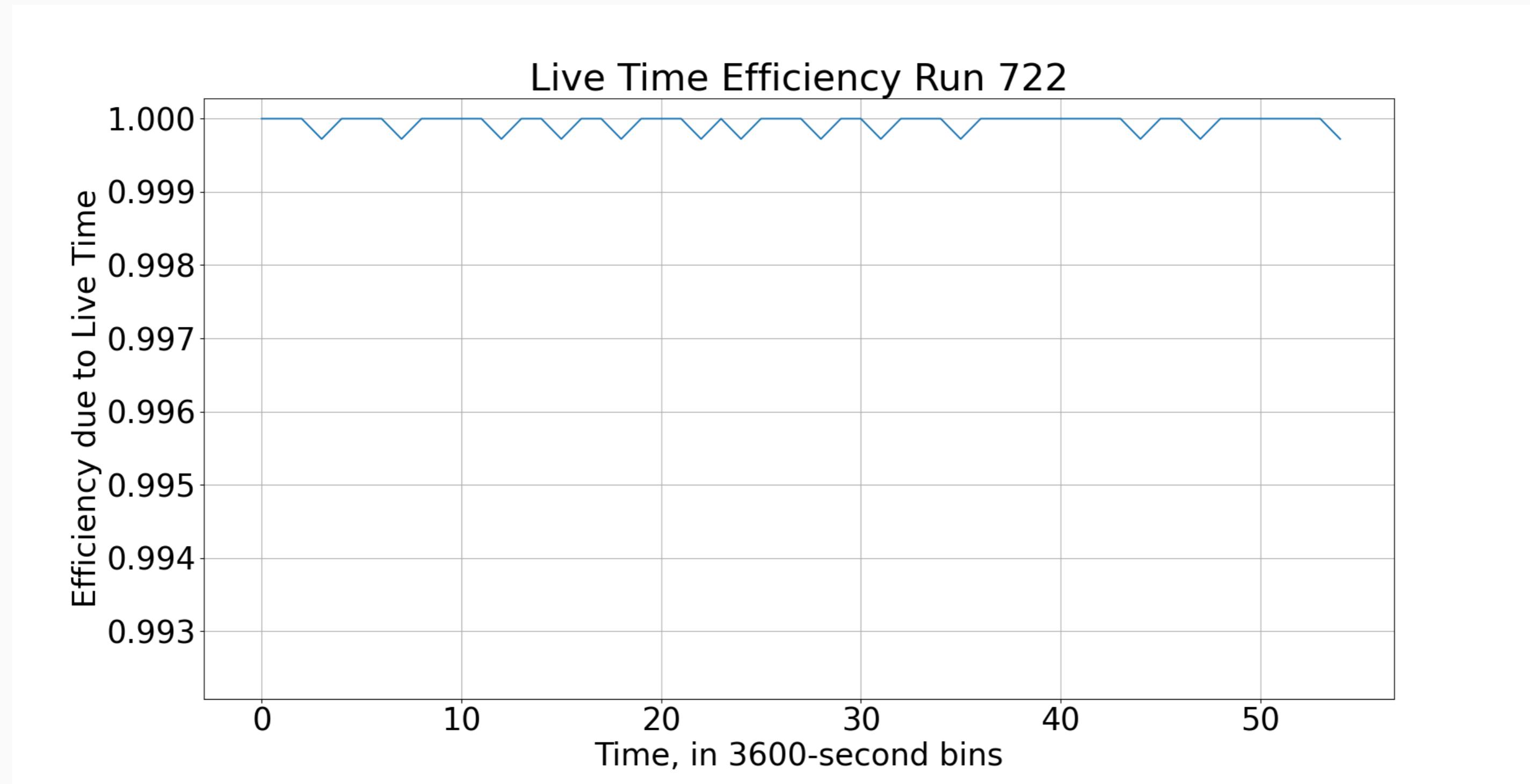


Figure 38: Detector had relatively little dead time



Notes on Run 722 Analysis

Run 722 exhibits such extreme shifts in gain that peak finding was impossible without removing several hours of data. However, there is better resolution and the combined rate was able to be utilized for this run.

[Back to Rate vs Time Run 722](#)

