

KAHVELab

02.08.25 Data Analysis

Barbaros Uğurkan

# Introduction

Our ADC counts have consistently been higher than anticipated. Previous scanning operations revealed a significant discrepancy: counts were notably higher during vertical scans compared to horizontal scans. We hypothesize two potential causes for this observation:

1. **System Stabilization:** The system may require a certain period to stabilize, causing initial high counts that subsequently decrease.
2. **Vertical Scan Anomaly:** A specific issue or inherent difference within the vertical scanning mechanism or setup could be causing the elevated counts.

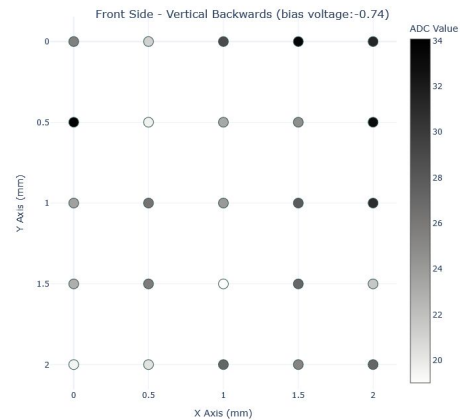
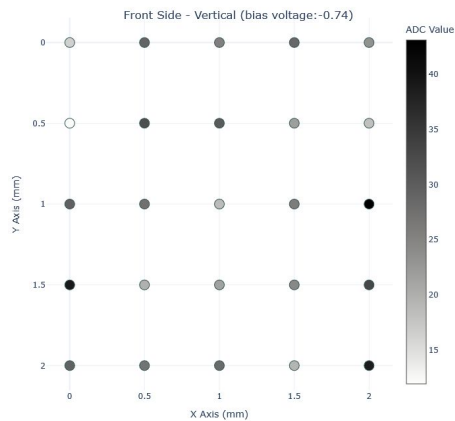
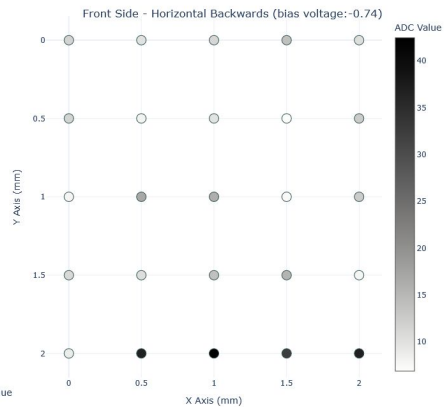
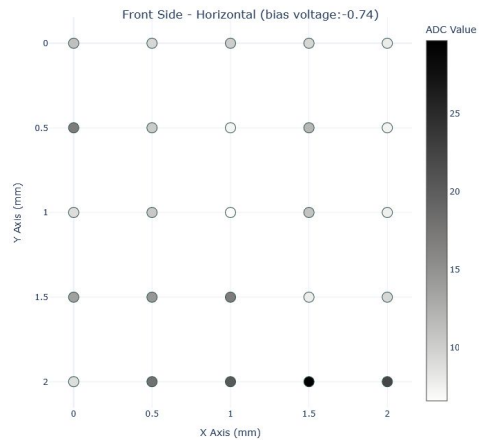
To investigate these hypotheses, a new data set was acquired and analyzed.

# Methodology

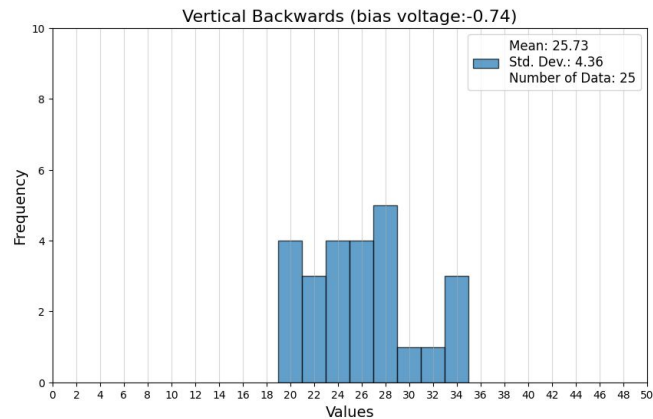
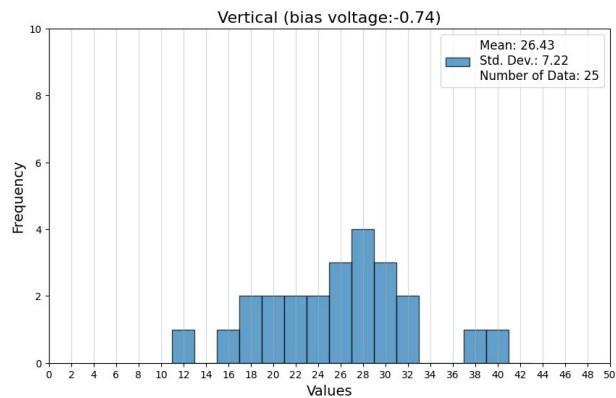
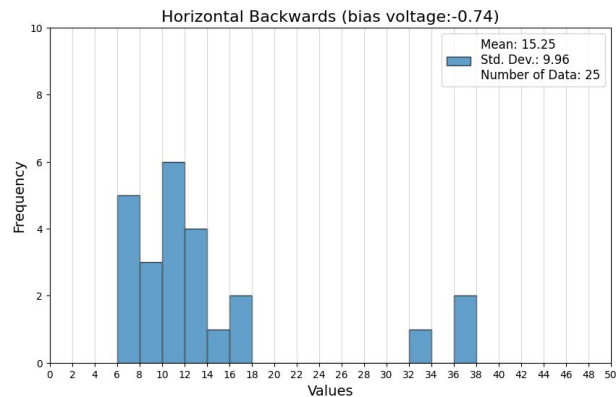
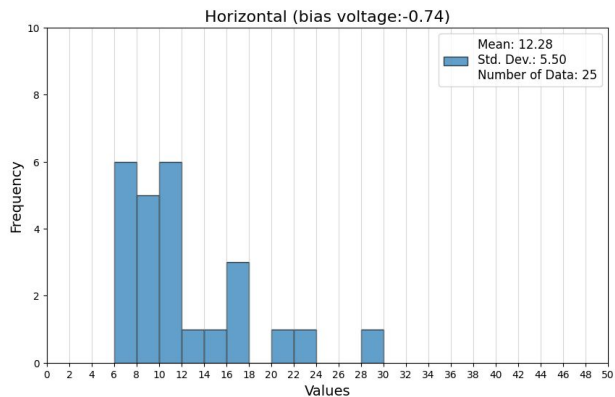
The new data acquisition was designed to test our hypotheses by implementing several changes:

- **Modified Scan Order:** The scan order was changed to Horizontal, Horizontal-Backwards, Vertical, and Vertical-Backwards (labeled as `metal1`, `metal2`, `metal3`, `metal4`). This was done to observe if starting with horizontal scans would affect the subsequent vertical counts.
- **System Stabilization Check:** After the initial scan sequence, the system was allowed to stabilize for a period. A new vertical scan (labeled `vertical.wait`) was then performed to specifically evaluate the effect of stabilization.
- **Background Radiation Measurement:** "No beam" data was collected with the bias voltage adjusted from -0.74V to -1.00V. This suppressed the electron beam, allowing for the measurement of background radiation using only the gun's light. This was done in a Vertical, Vertical-Backwards, Horizontal, Horizontal-Backwards sequence for ease of comparison.
- **Data Structure:** The new dataset consists of 25 measurements within a single folder, unlike the previous method which used an average of 2 measurements from 10 data points across 5 folders.

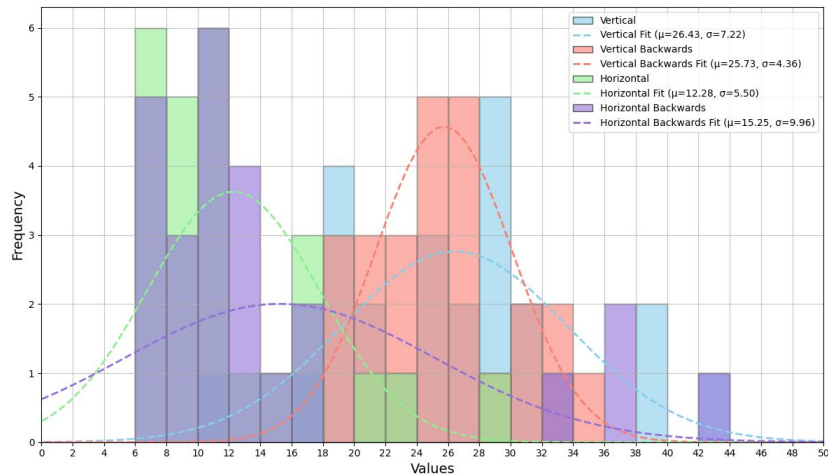
# Plots of first data set (folder names: metal1,metal2,metal3,metal4)



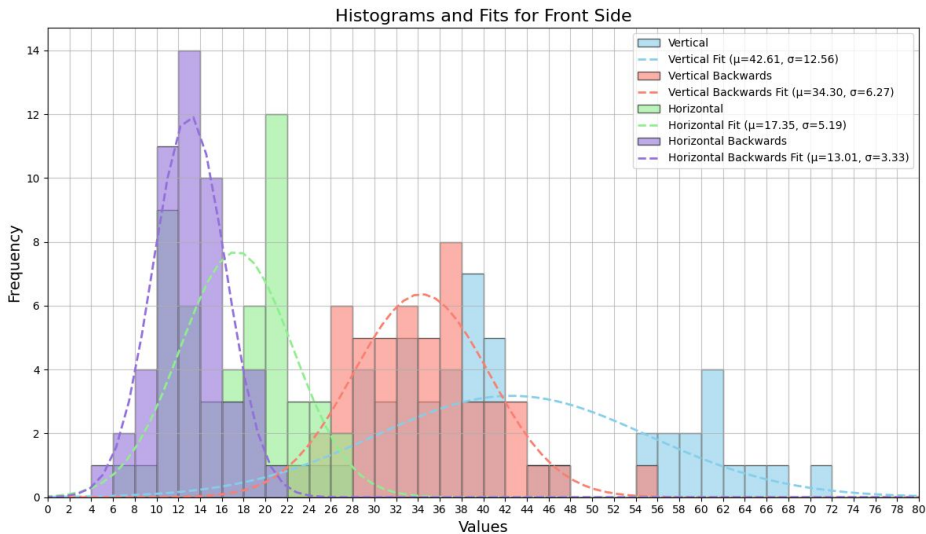
# Histograms of first data set (folder names: metal1,metal2,metal3,metal4)



(the order is first horizontal, then vertical)



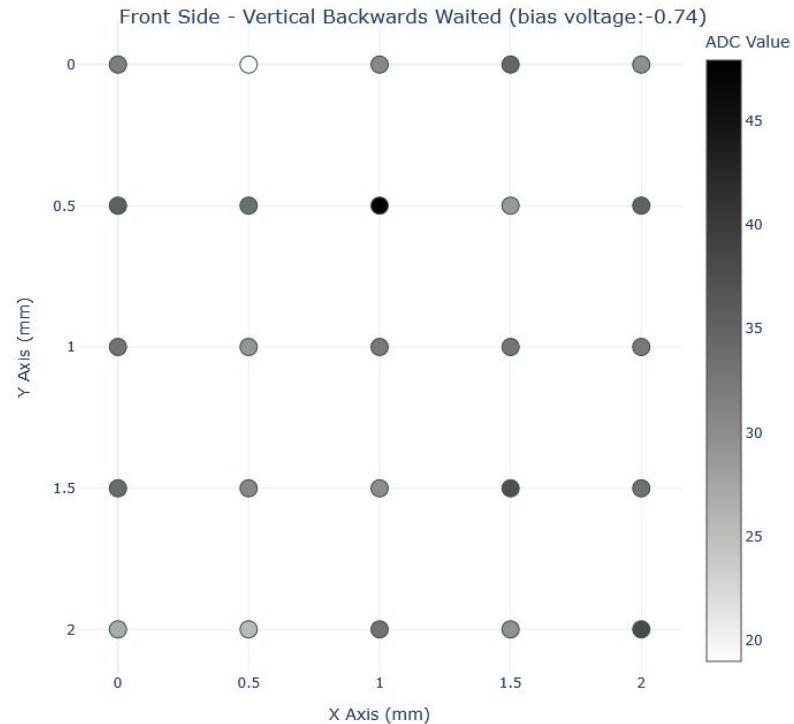
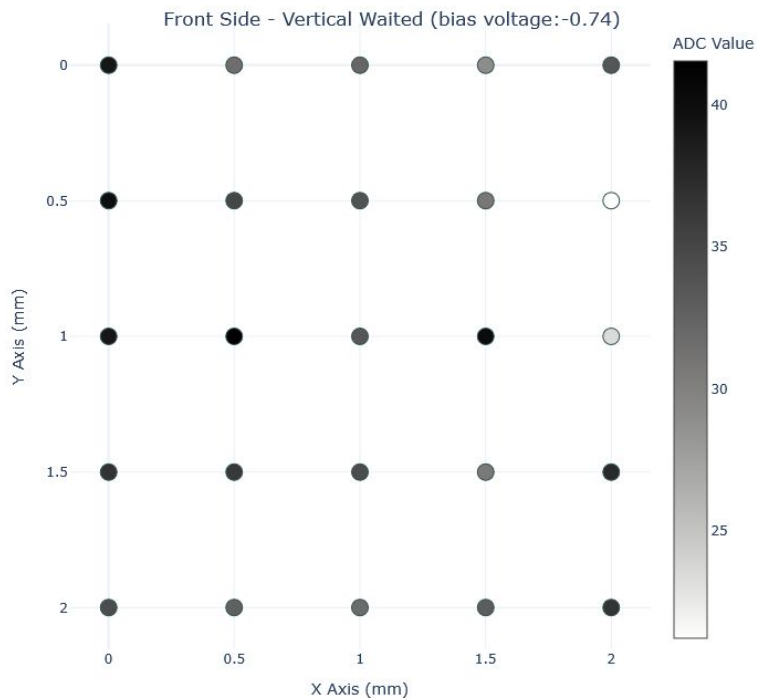
# Histograms and fits of previous data set (the order is first vertical, then horizontal)



# Analysis

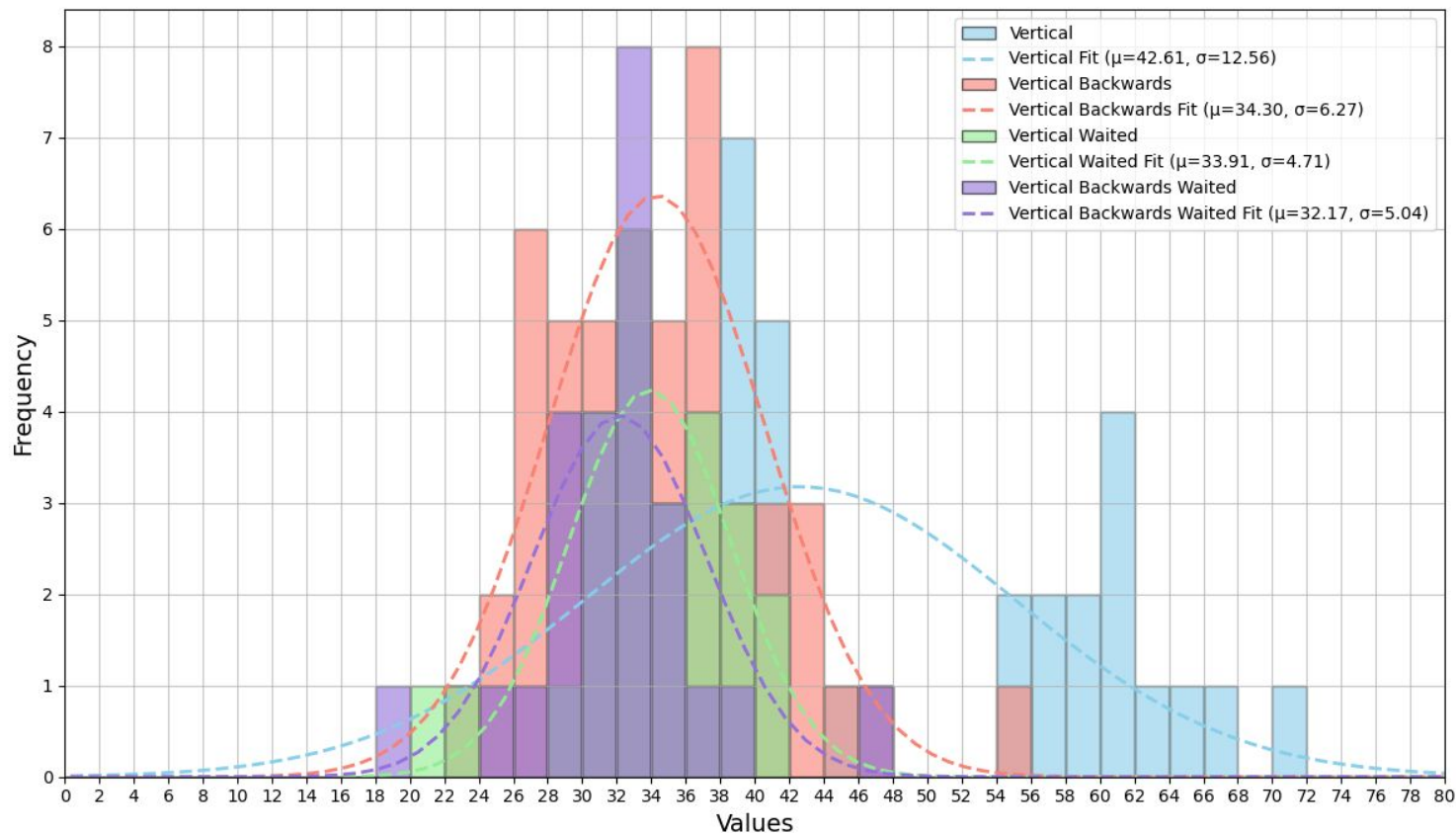
The initial graphs confirm that both hypotheses hold merit. The average counts for vertical scans have decreased and are now closer to the horizontal counts. Furthermore, their standard deviations have also been reduced. This provides strong evidence that the order of scanning and allowing the system to stabilize significantly impacts the ADC counts. However, a residual difference between vertical and horizontal scans remains, suggesting that a specific anomaly in the vertical scan setup is also a contributing factor.

# Plots of waited verticals





# Histograms of waited verticals and previous verticals

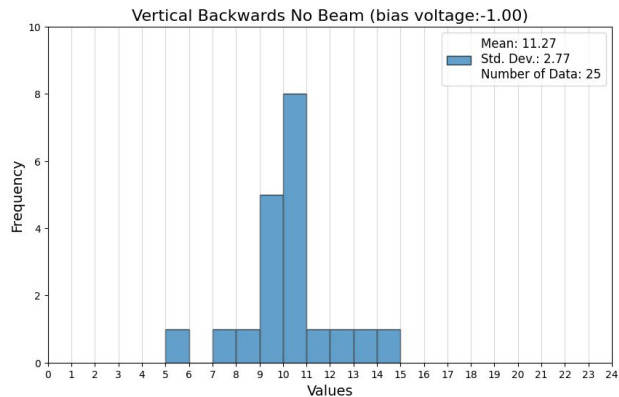
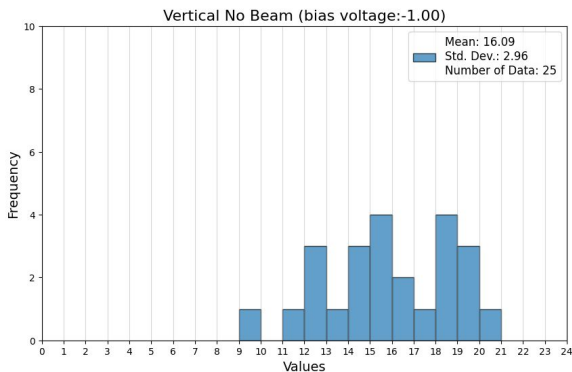
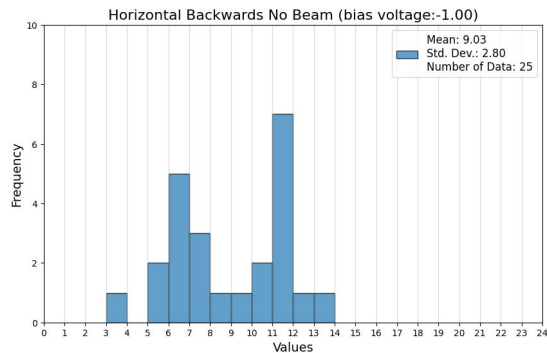
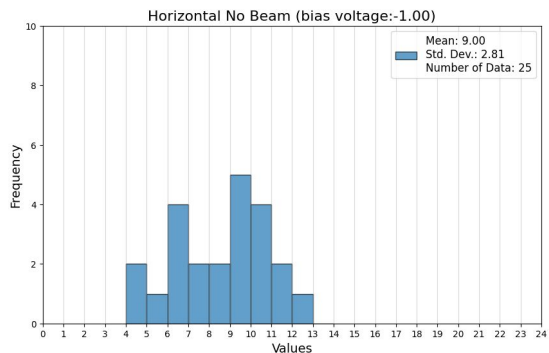


# Analysis

A comparative histogram analysis between the previous data and the new, stabilized vertical data (specifically `vertical.wait`) clearly demonstrates the effectiveness of the stabilization period. The distributions show that waiting for the system to reach equilibrium successfully reduces the average ADC counts and improves data consistency.

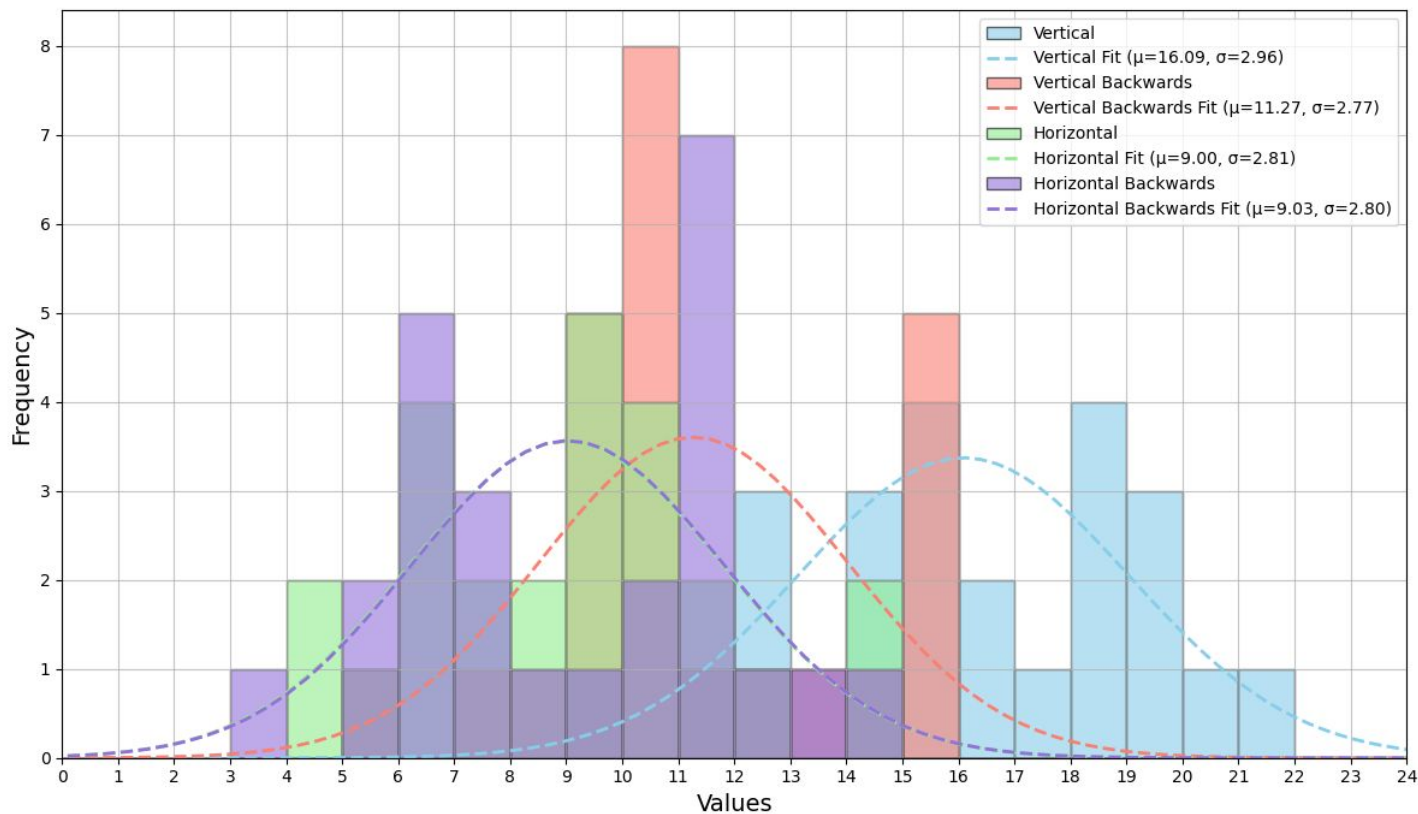
# Histograms of second data set

(folder names: no.beam.hor,no.beam.hor2,  
no.beam.ver, no.beam.ver2)



# Histograms and fits of second data set

(folder names: no.beam.hor,no.beam.hor2, no.beam.ver, no.beam.ver2) (Note: horizontal and horizontal backwards fits are overlapping )



# Analysis

Histograms of the "no beam" data revealed that even without the electron beam, vertical counts are still higher than horizontal counts. This result, while not yet fully understood, indicates a potential asymmetry in the background radiation or detector response. The analysis also showed that the average background radiation has increased to approximately 11 counts, up from the previous value of 7 counts.

# Further Improvements

Based on these findings, we have decided on two key actions:

1. **Wait for Stabilization:** All future data acquisition will include a mandatory waiting period to allow the system to stabilize before starting the scanning process.
2. **Vertical Scan Correction:** Given the persistent discrepancy, a correction mechanism will be developed and implemented for the vertical scanning procedure to account for the identified anomaly.