

# Calibrating LArPix for TinyTPC

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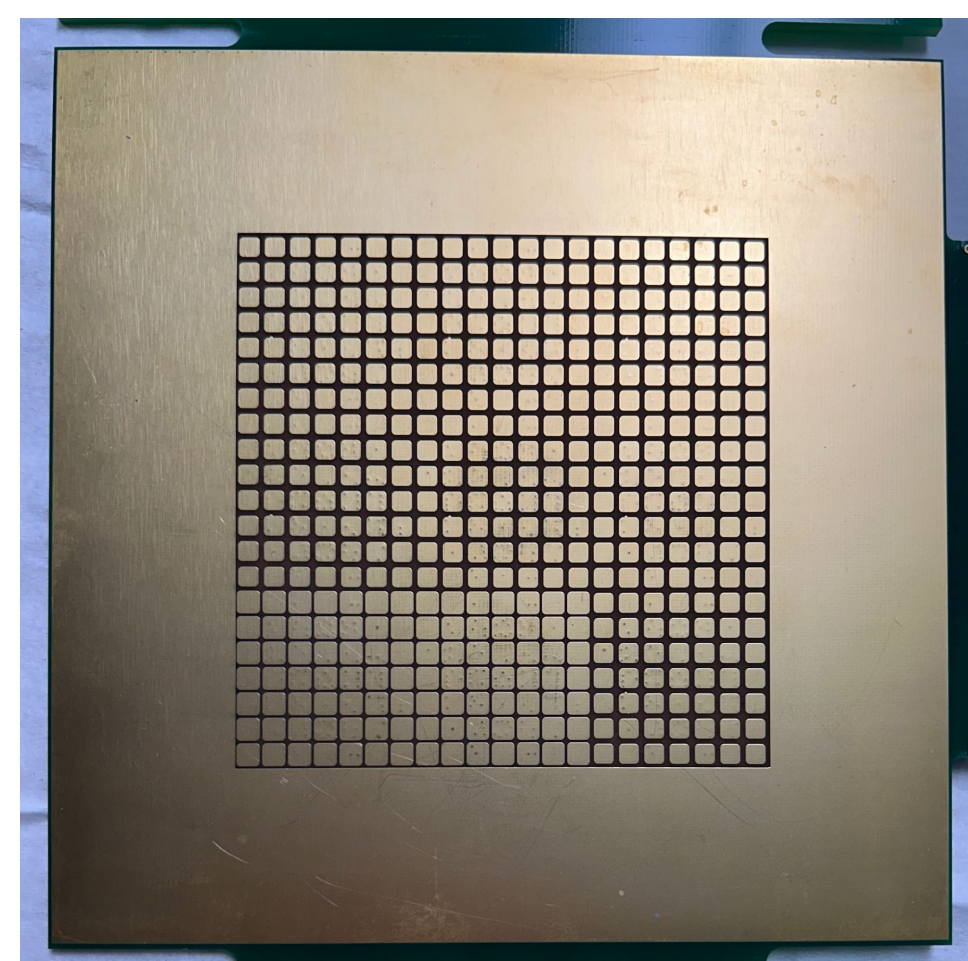
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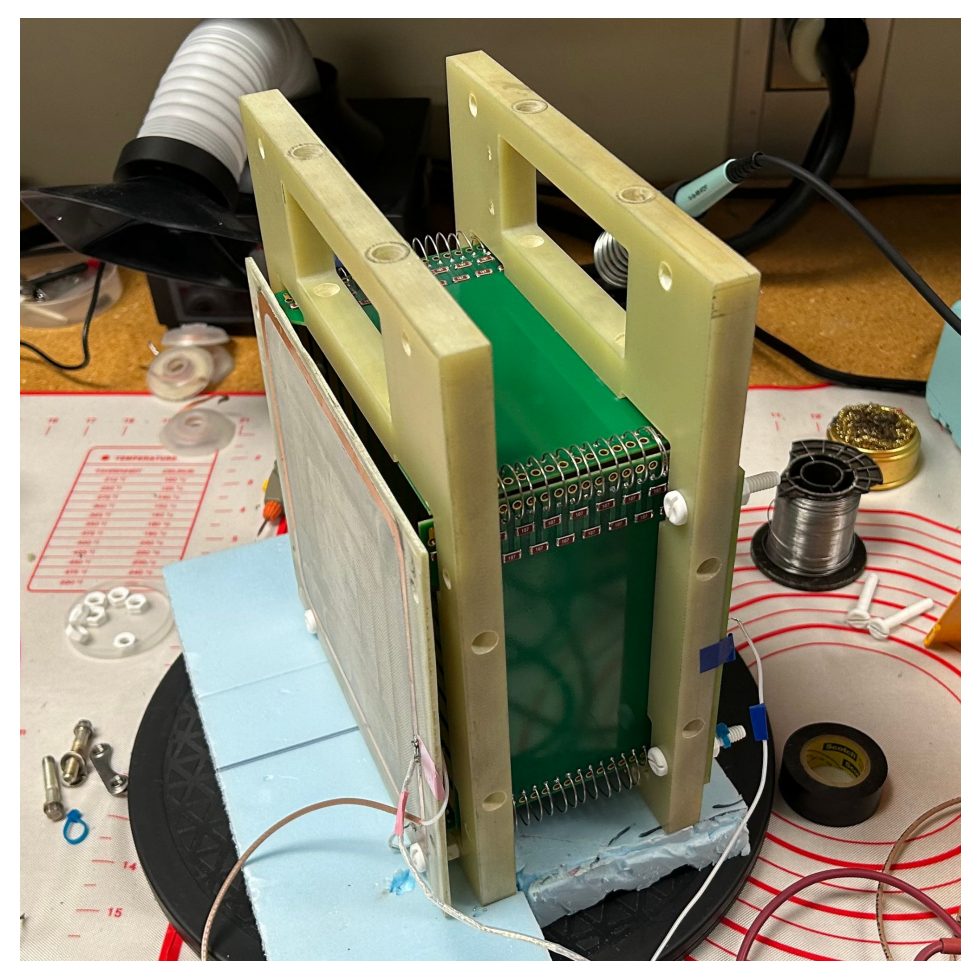
## Introduction

This setup will be used to demonstrate and characterize the effects of photosensitive dopants in low energy ( $<5$  MeV) signals. Refer to posters #84 Doped LAr as a Platform for Low-Energy Physics and #83 TinyTPC: A Test Stand for LAr Doping for more information for the physical setup.

- LArPix anode plane pixel readout
- 9 chips of 49 channels each



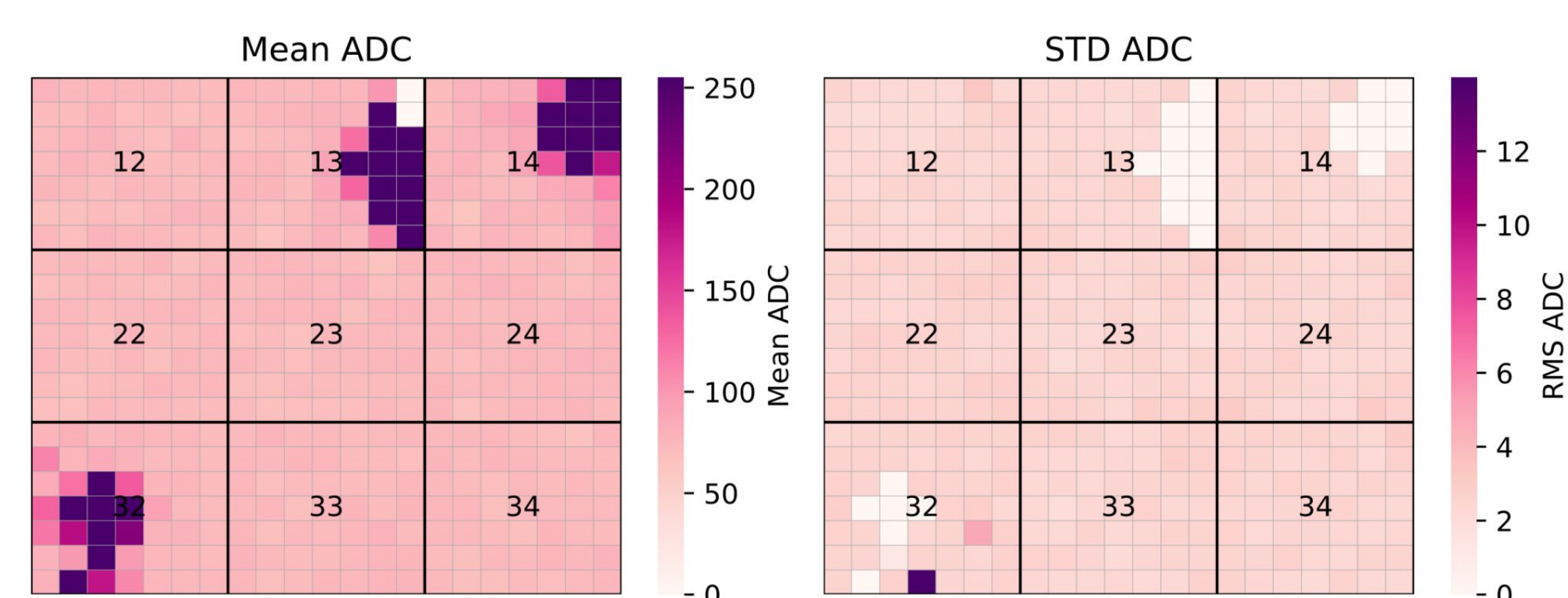
LArPix pixelated anode plane



TinyTPC on the bench

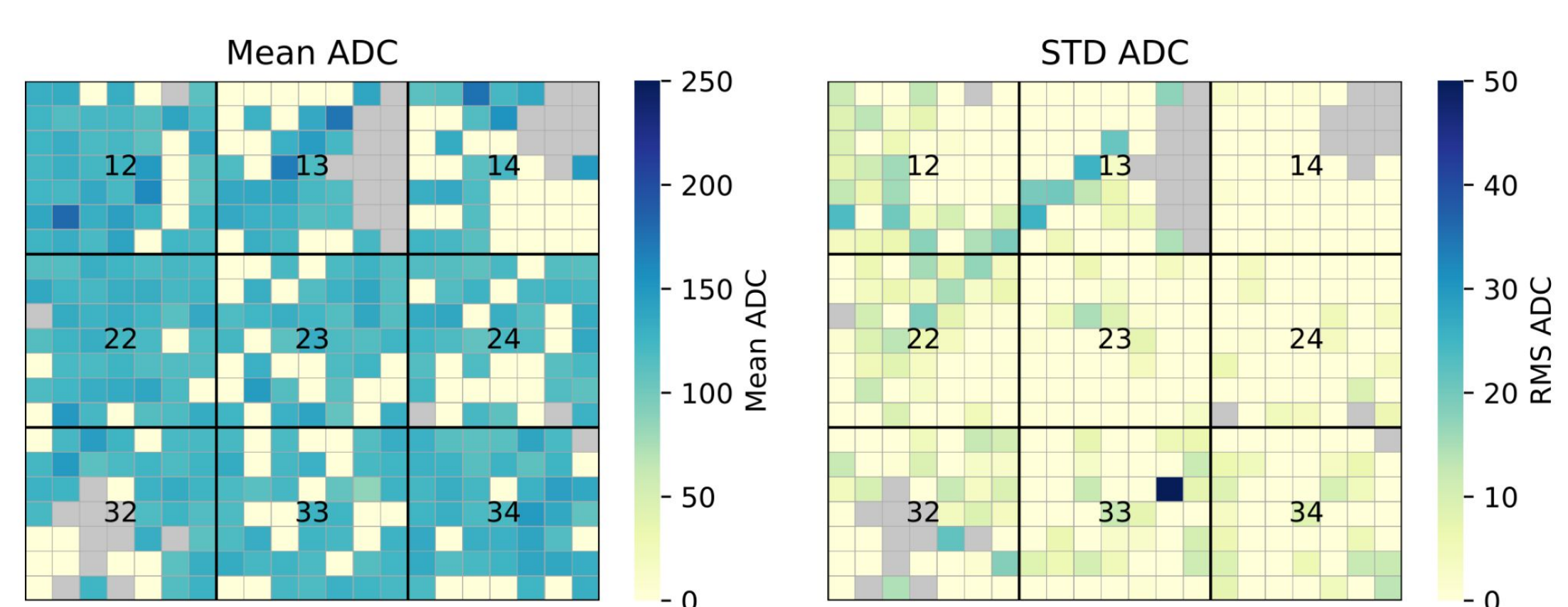
- Calibration involves finding muon tracks in the data, reconstructing their tracks, calculating the track dx corresponding to each pixel, and using the resulting dADC/dx landau distribution to make an ADC to energy conversion
- Cosmic muon tracks are used to calibrate because their dE/dx distribution is well known

## Running Process



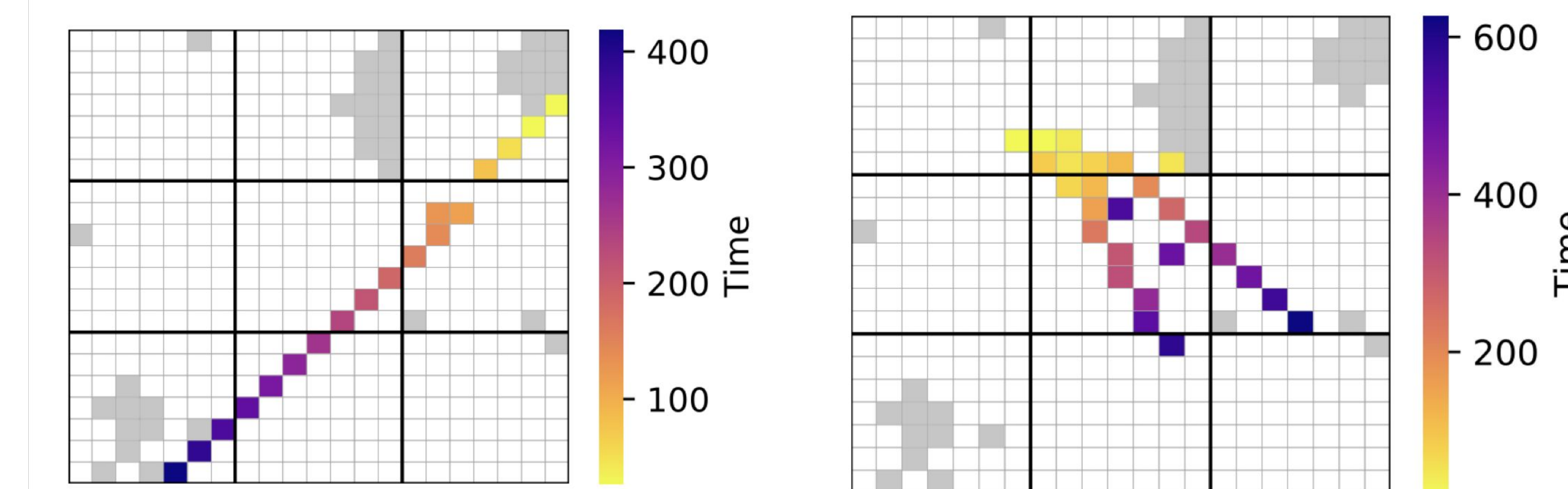
Mean ADC and RMS ADC for a pedestal run

- Pedestal runs are used to set thresholds before data runs
- Pedestal information is collected every second
- Mean sets threshold, RMS gets rid of noise
- Pedestal values are subtracted from data values



Mean ADC and RMS ADC for a data run

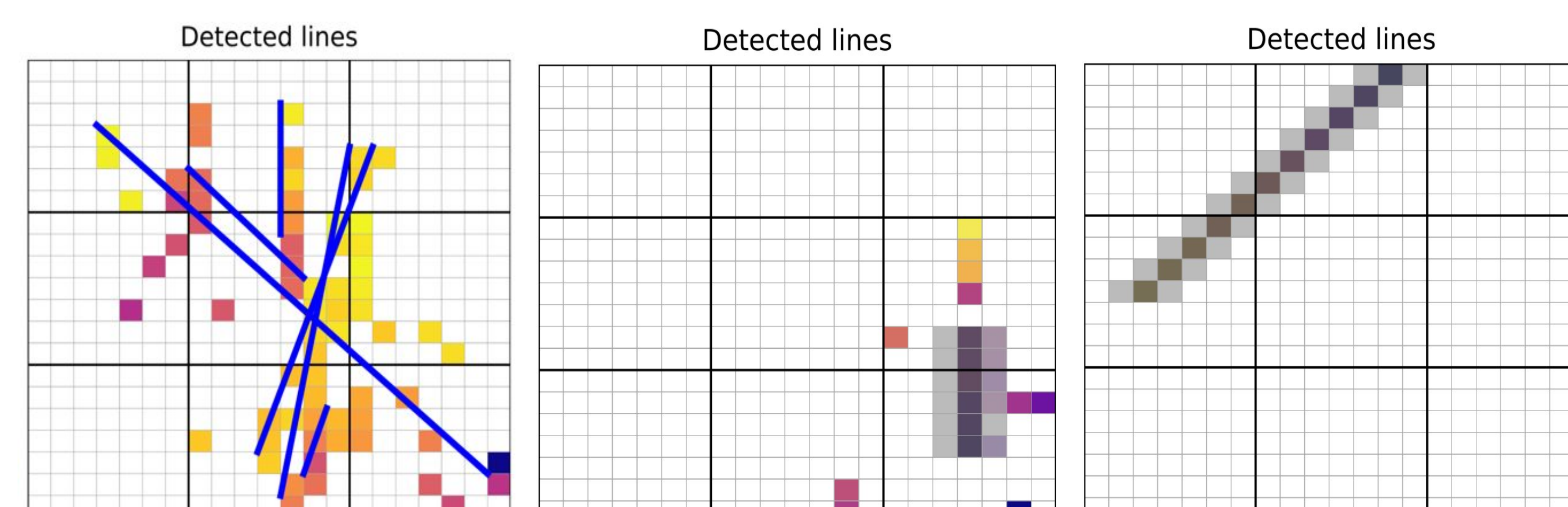
## Track Selection



Track from anode to cathode

Shower topology

- Runs are broken into slices and select slices where there are more than 10 hits
- 2D Hough lines are used to find straight tracks
- If a slice has more than 1 hough line or falls below an accuracy cutoff
- Purity = 72.7%
- Efficiency = 77.4%

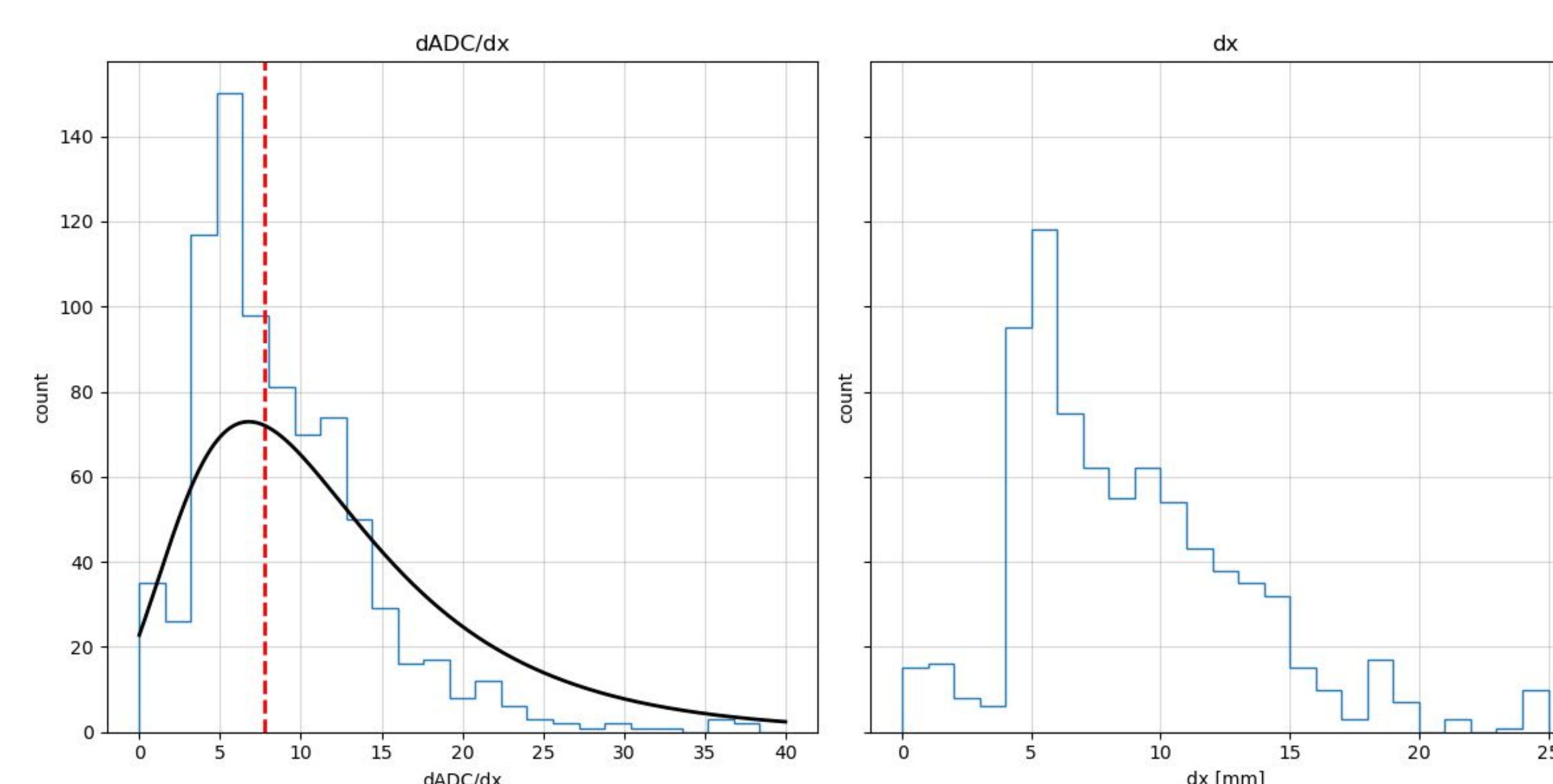


Failed slice (too many lines)

Failed slice (not accurate)

Accepted slice

## dE/dx calculations



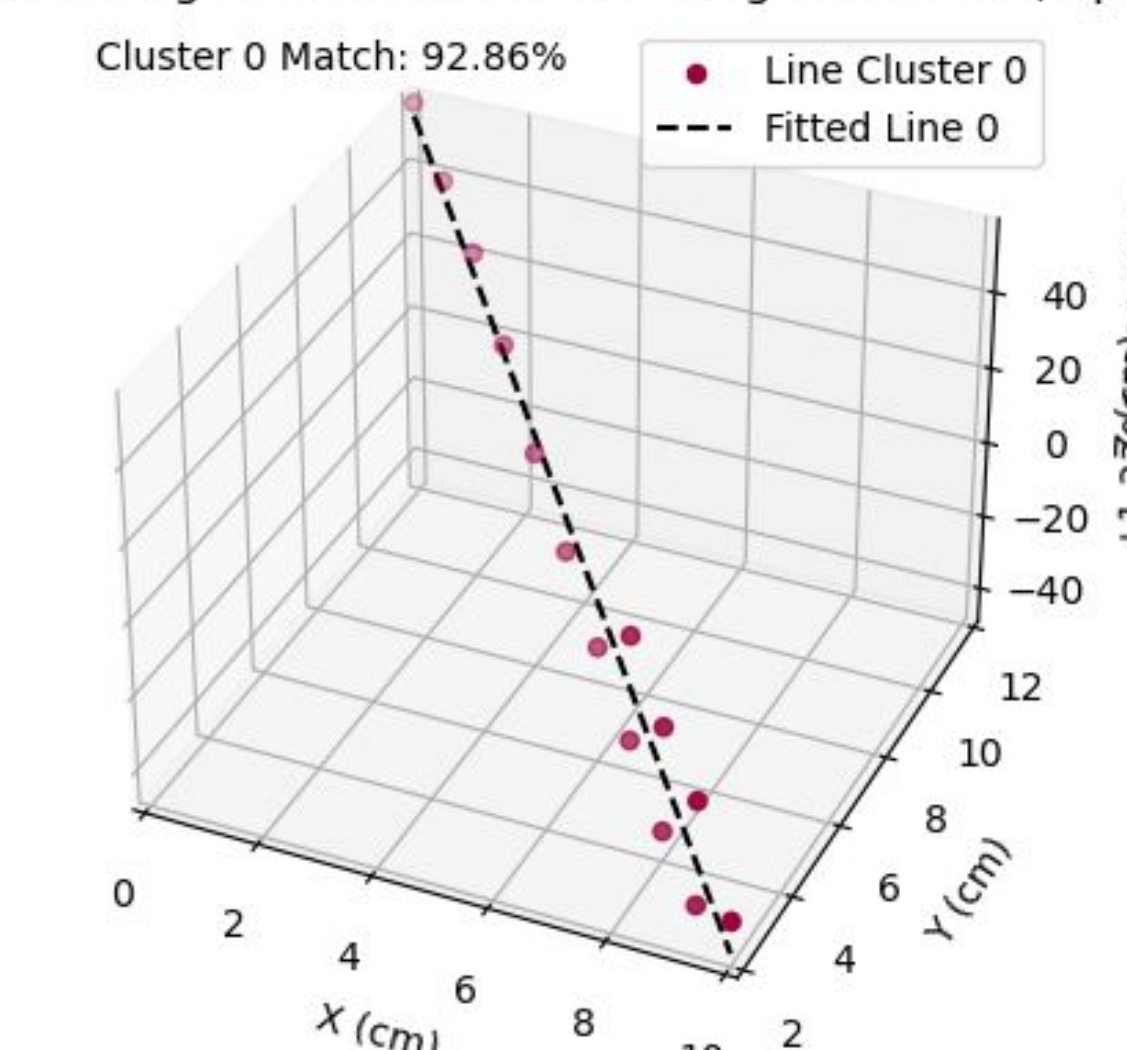
dADC/dx landau distribution and dx values

- Calculated the distance a track travelled through a channel
- Divided the ADC by this distance
- ADC is analogous to charge

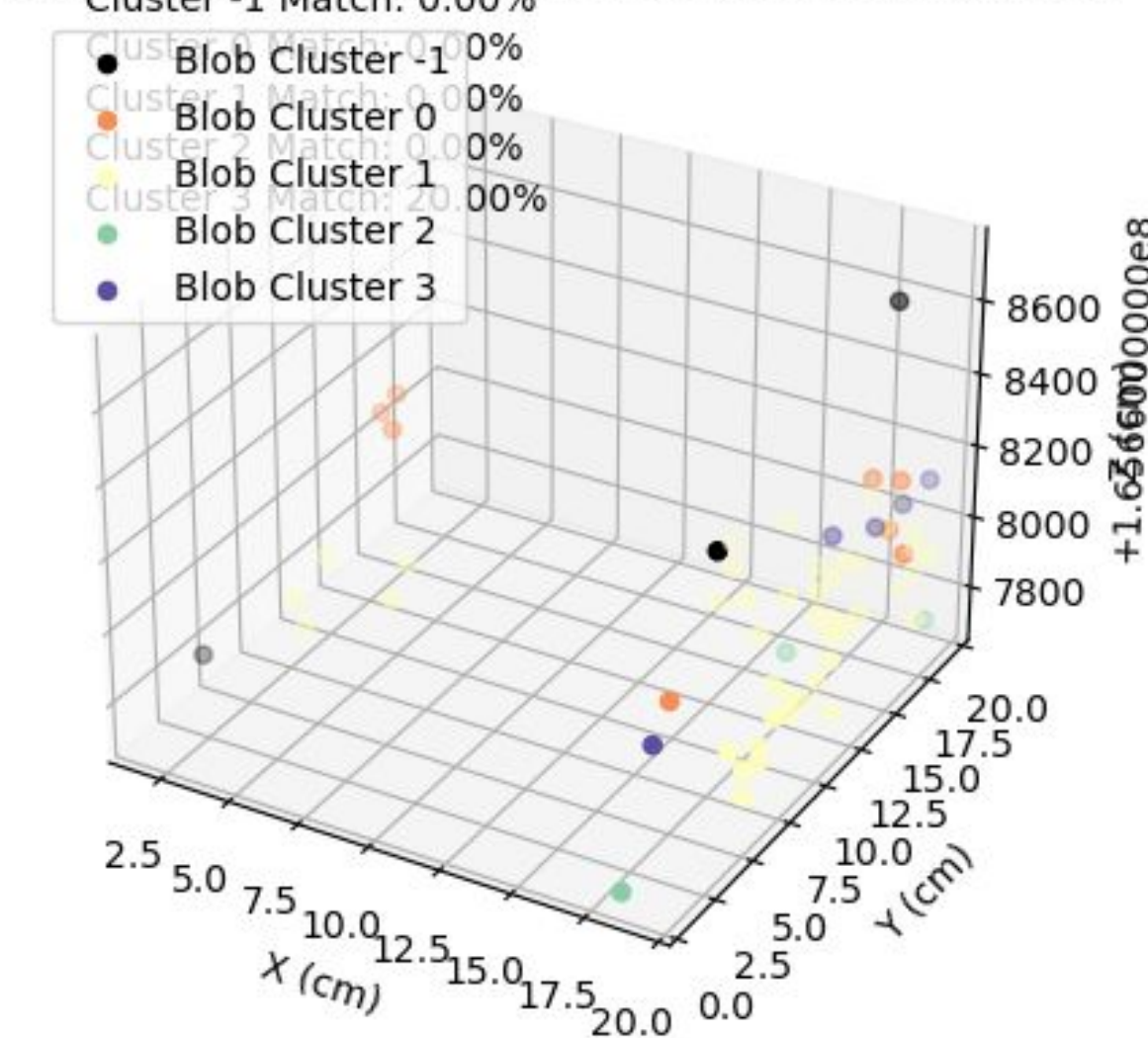
## Clustering Algorithm

- Exploring improvements to the 2D tracking with a 3D clustering algorithm
- Density based clustering algorithm using DBSCAN
- Groups hits that likely come from muon tracks and makes a best fit line

DBSCAN Clustering and RANSAC Line Fitting of 3D Data, eps = 20.00 DBSCAN Clustering and RANSAC Line Fitting of 3D Data, eps = 20.00



Successful line clustering



Unsuccessful line clustering

## Next Steps

- We are currently taking data to get enough to calibrate
  - TinyTPC is currently deployed in the Blanche cryostat in the Proton Assembly Building at Fermilab
- Compare the purity, efficiency, and running time of the two clustering methods
- Turning the Landau dADC/dx distributions into a charge calibration pixel by pixel

## Acknowledgements

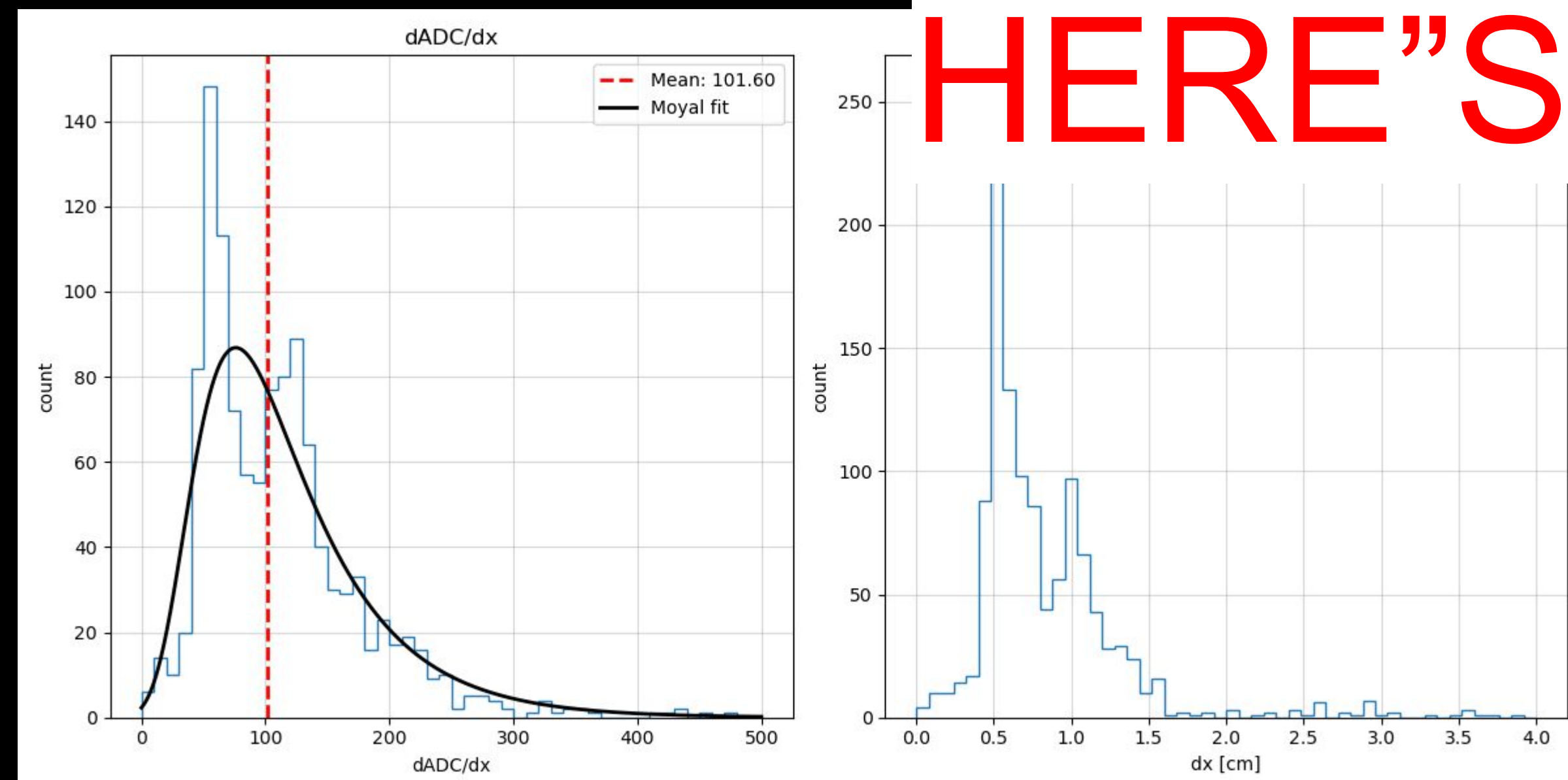
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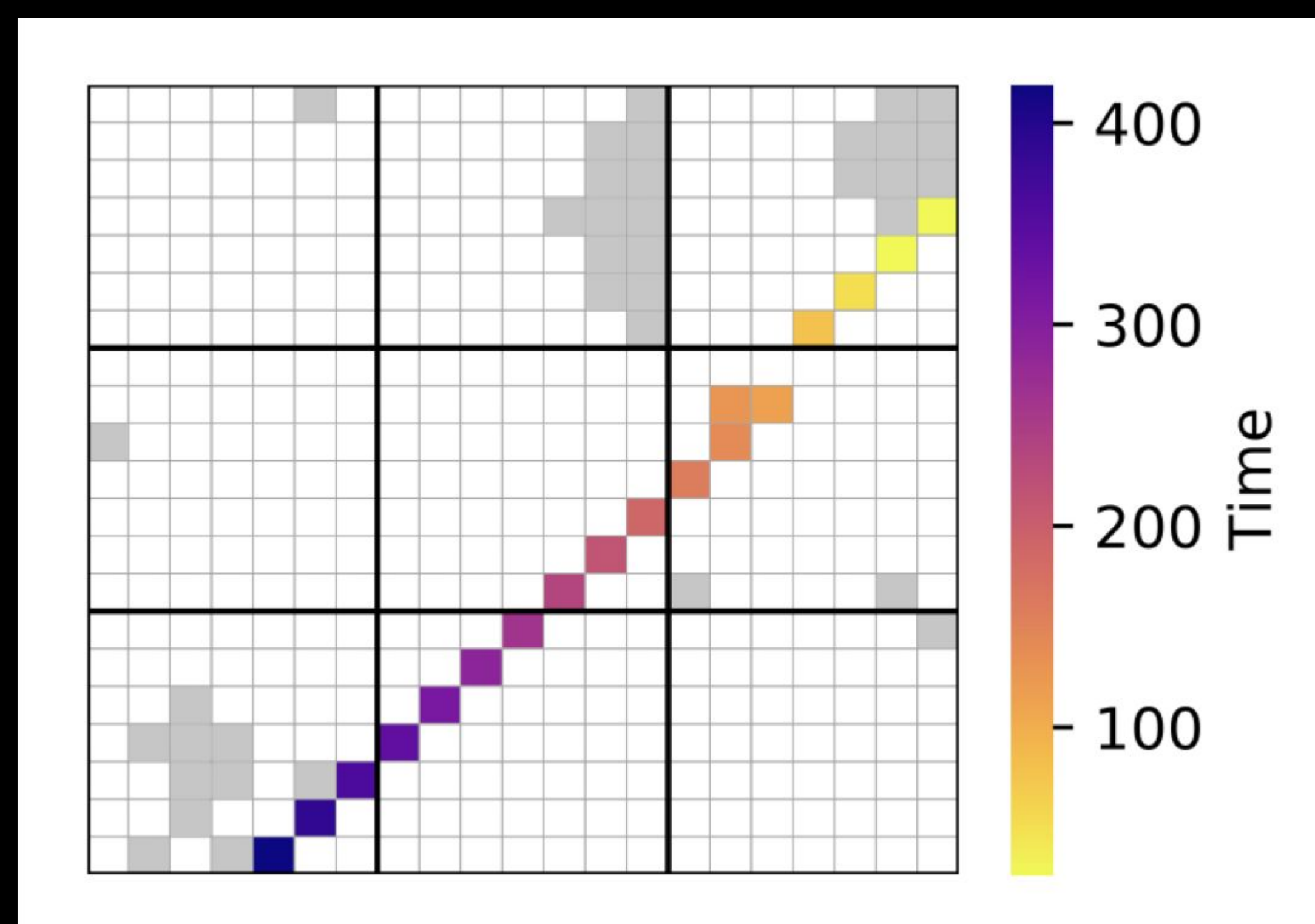
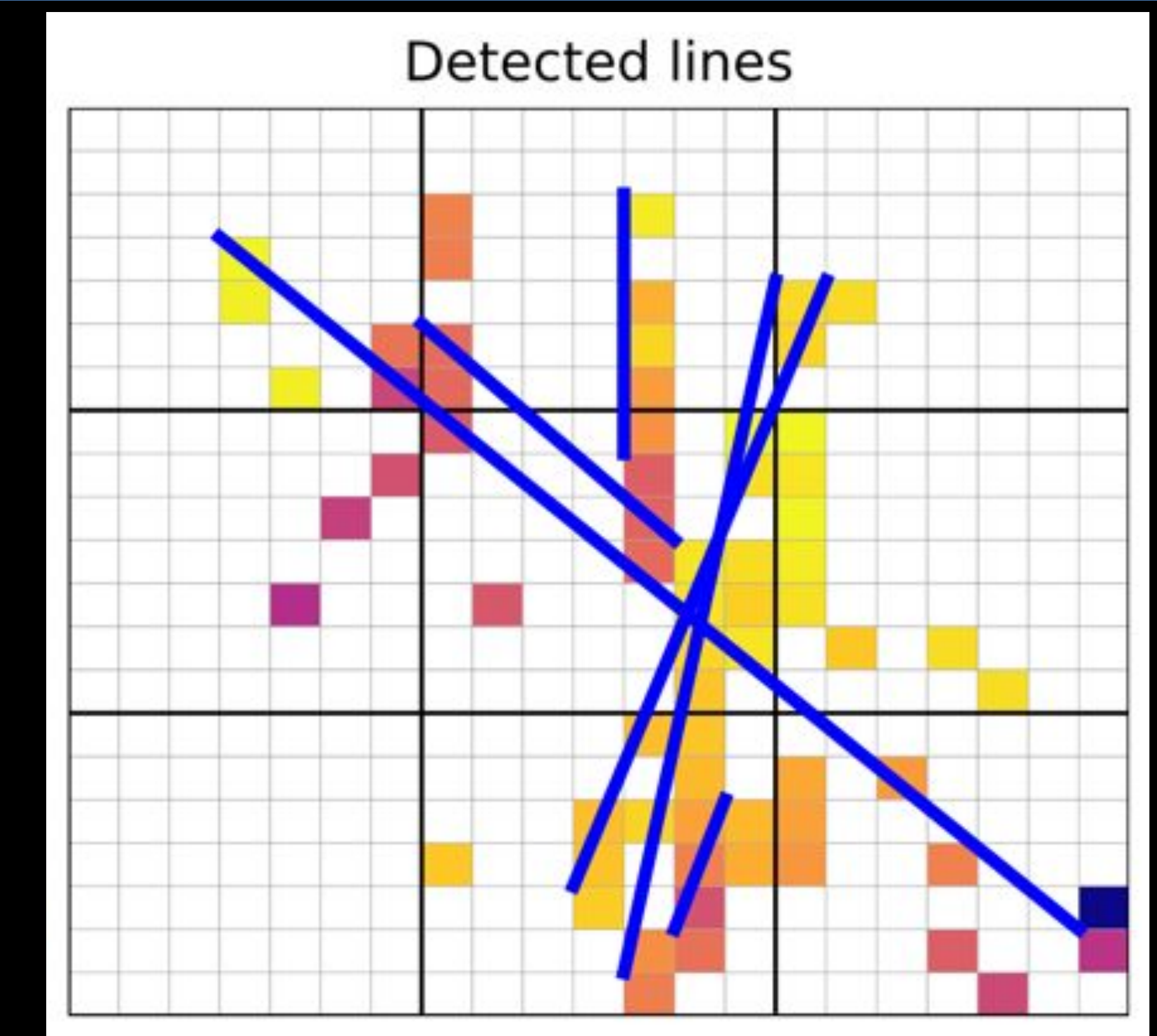


IMAGES WE CAN USE. I HATE GOOGLE SLIDES. WORST UI IN THE GAME

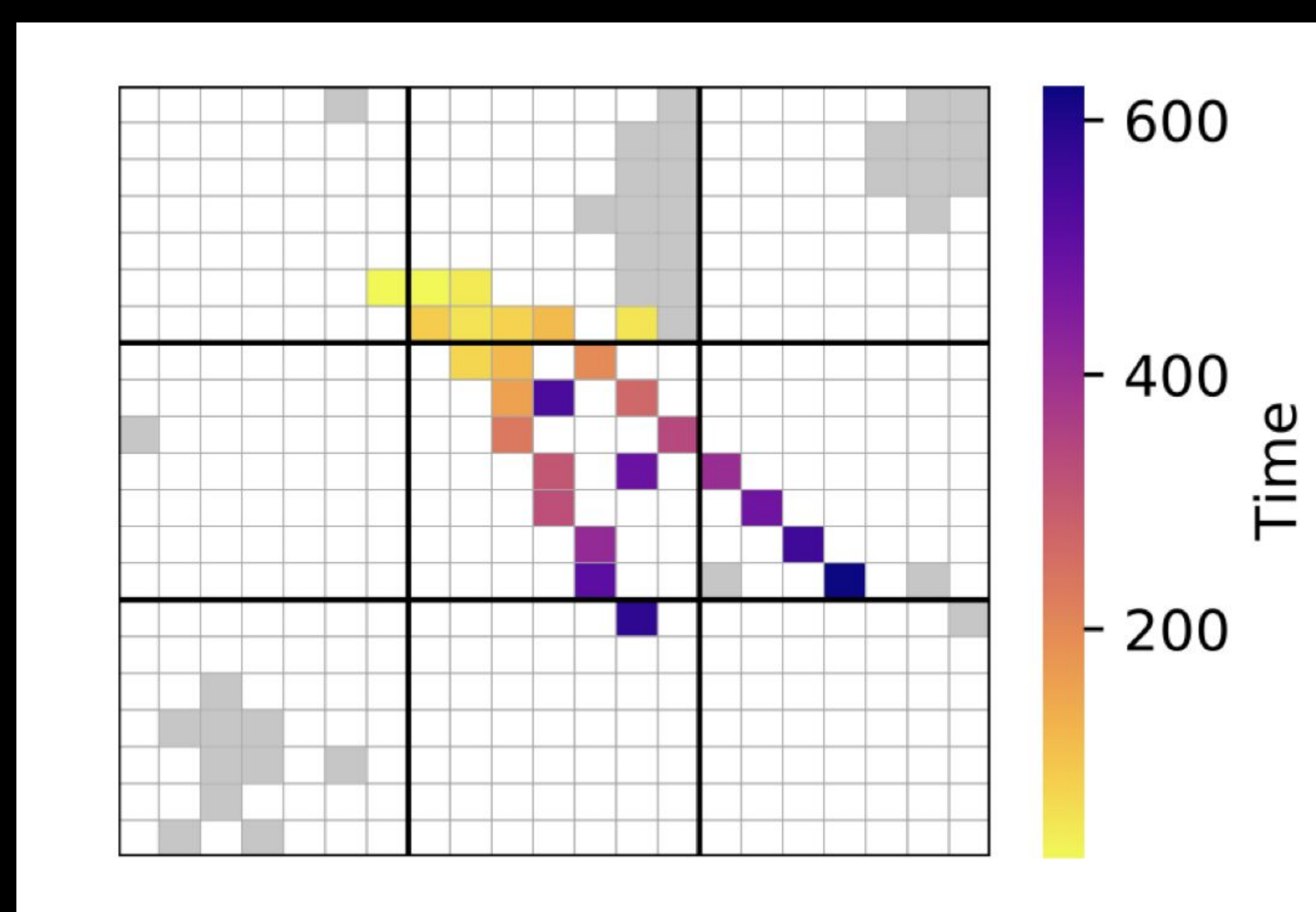
THE LANDAU DISTRIBUTION SEEMS TO BE ACTING WEIRD AND IDK HOW TO FIX IT. HERE'S A PLOT WITHOUT THE FIT



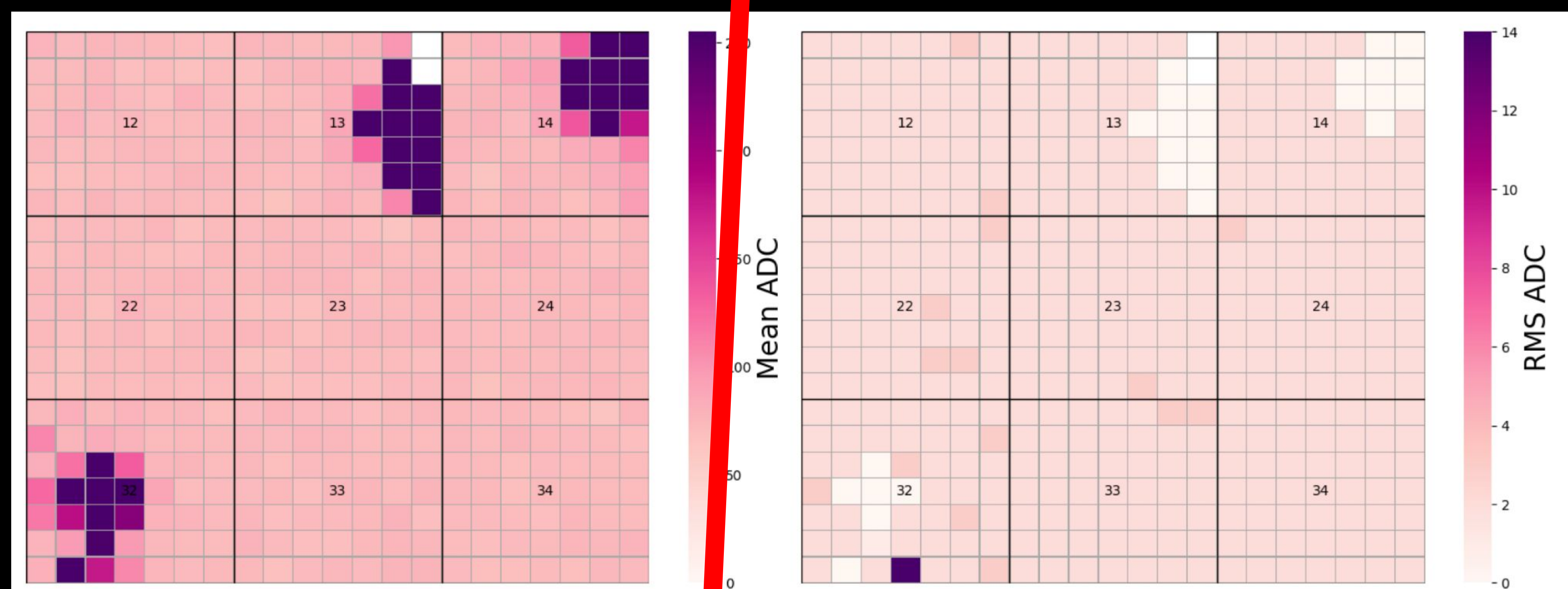
MAYBE USE THE DEDX CALC. IDK. IT MIGHT BE WRONG. I GOTTA CHECK



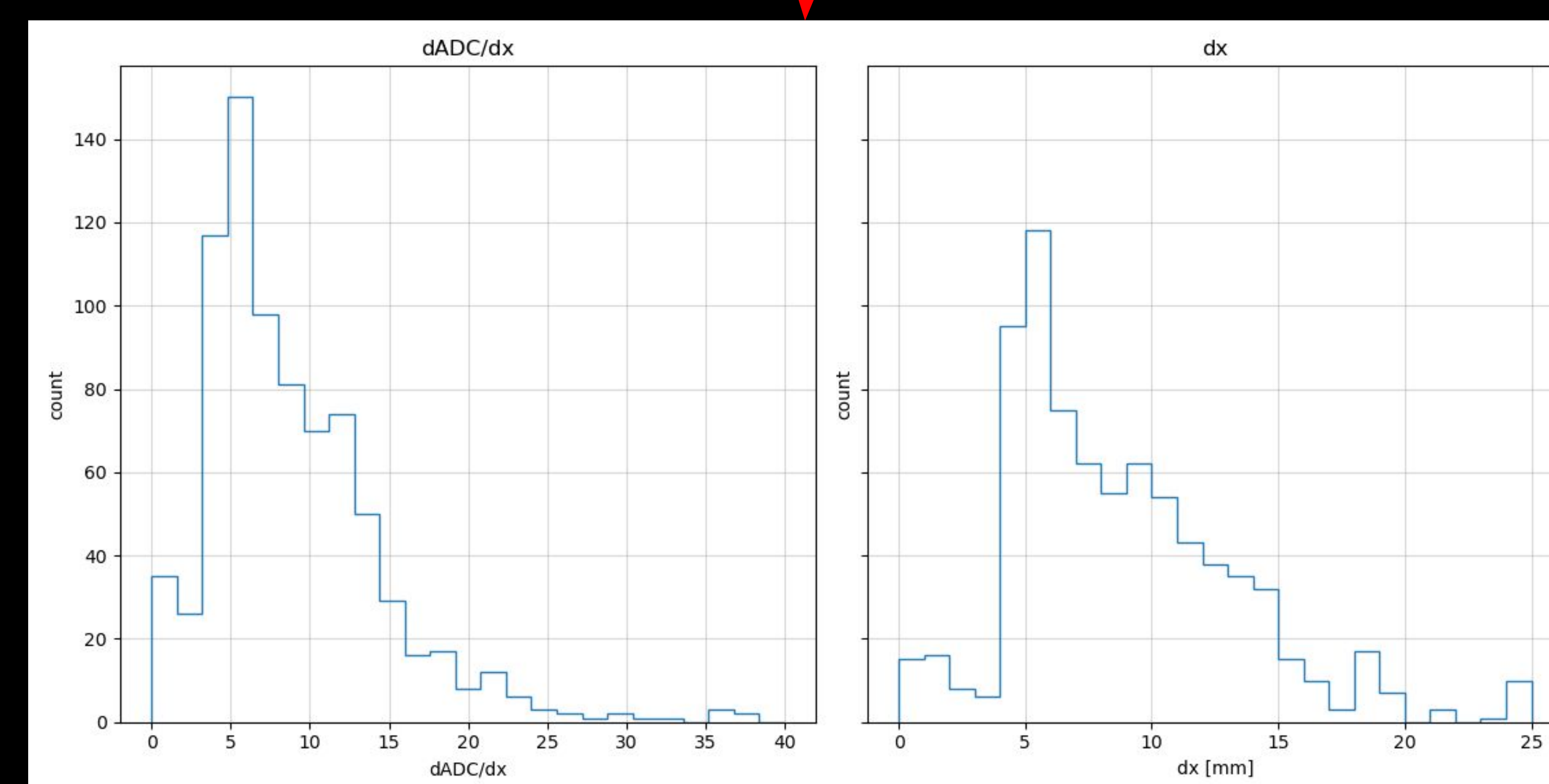
TRACK FROM ANODE TO CATHODE



SHOWER TOPOLOGY. LOOKS COOL. REMEMBER WHEN ALL THE CHIPS WORKED



PEDESTAL VALUES. WE SUBTRACT THESE TO GET ADC VALUES WHICH ARE ANALAGOUS TO CHARGE. Mean sets threshold, RMS gets rid of noise. Channels that are not responding or that have a mean ADC above a set max are turned off



THIS ONE FAILED THE HOUGH LINES TEST BC THERES TOO MANY HOUGH LINES! WE PROB ONLY NEED THE DETECTED LINES PART

HOUGH LINES. USED TO SELECT STRIGHT LINES THAT COULD BE MUON TRACKS. IT DETECTS THE TRACK AND THEN GIVES IT AN ACCURACY SCORE. IF THE ACCURACY SCORE IS LESS THAN 80%, IT FAILS. IF THERE'S MORE THAN ONE HOUGH LINE IT FAILS.