

# OSU Light Collection

## 4/21/25

Sam Corey



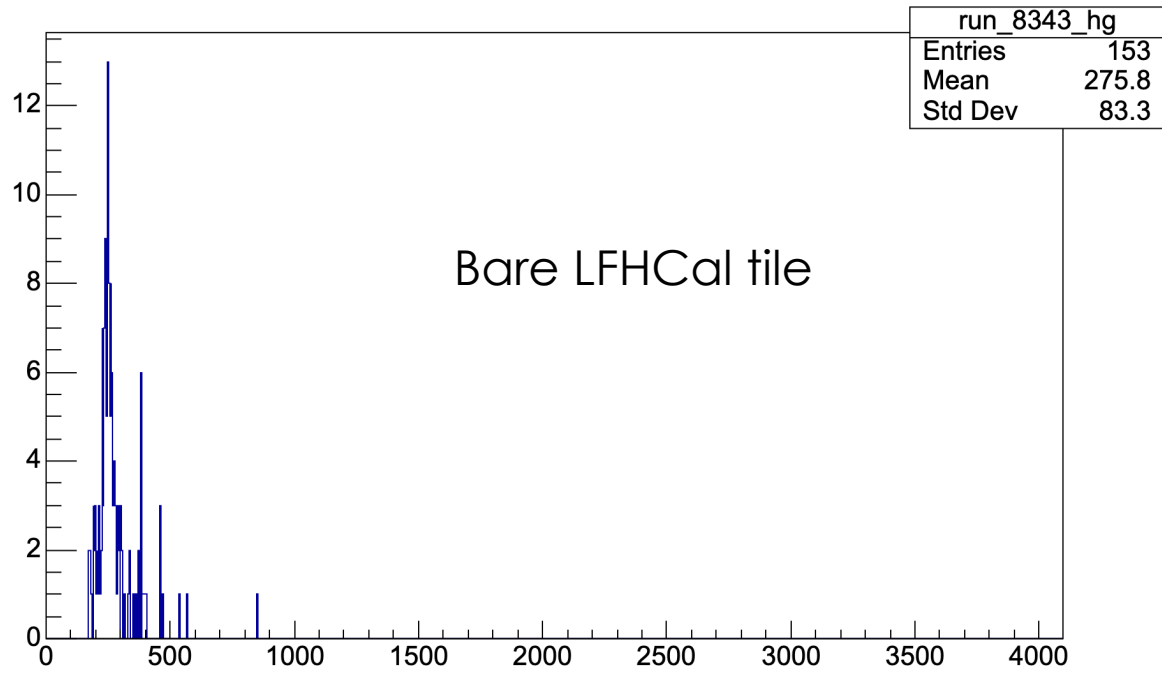
THE OHIO STATE UNIVERSITY

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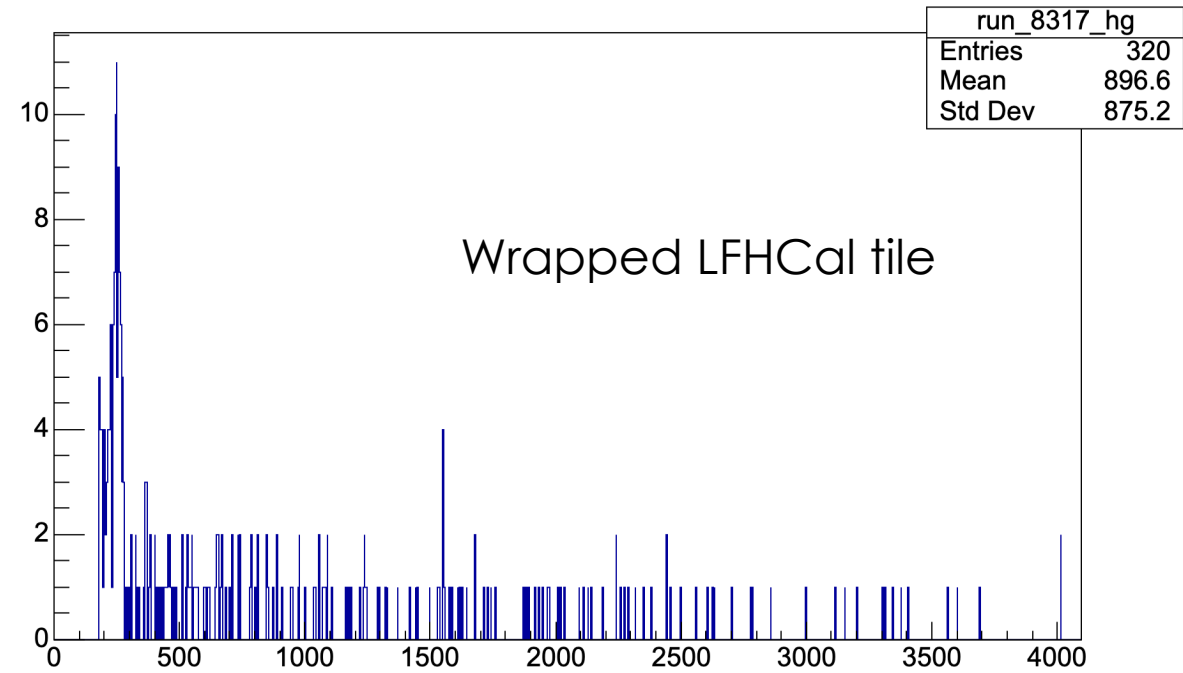
# Noise from different tiles

Noise taken with source ~50 cm from tile, placed over SiPM

High Gain



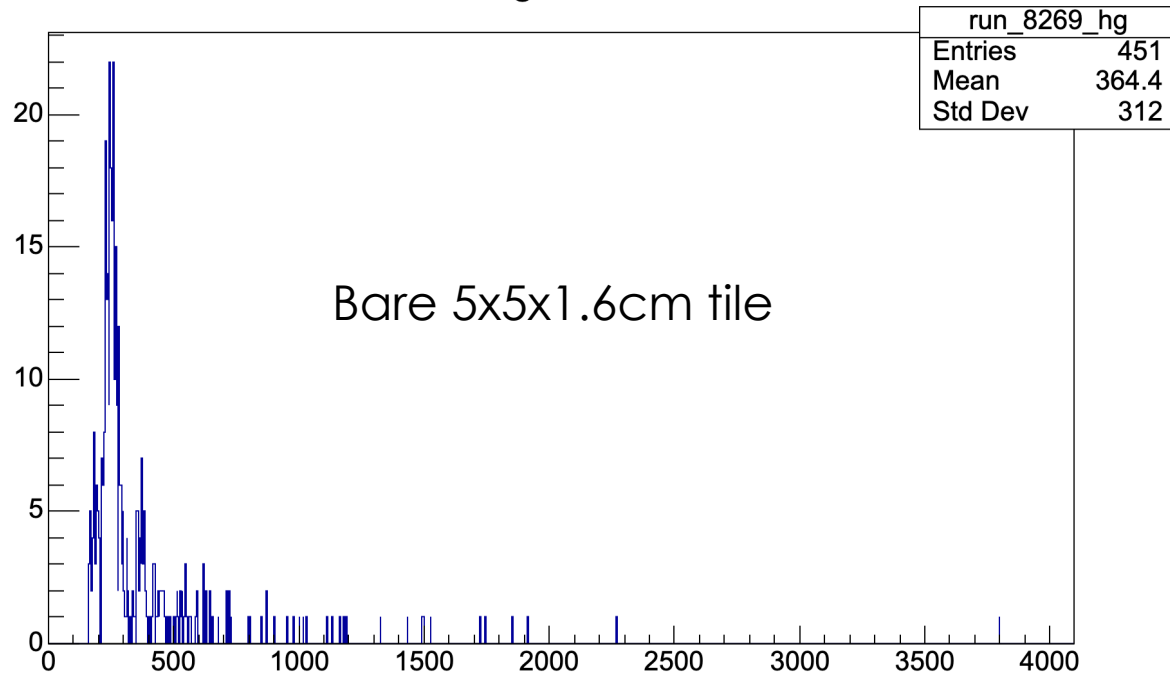
High Gain



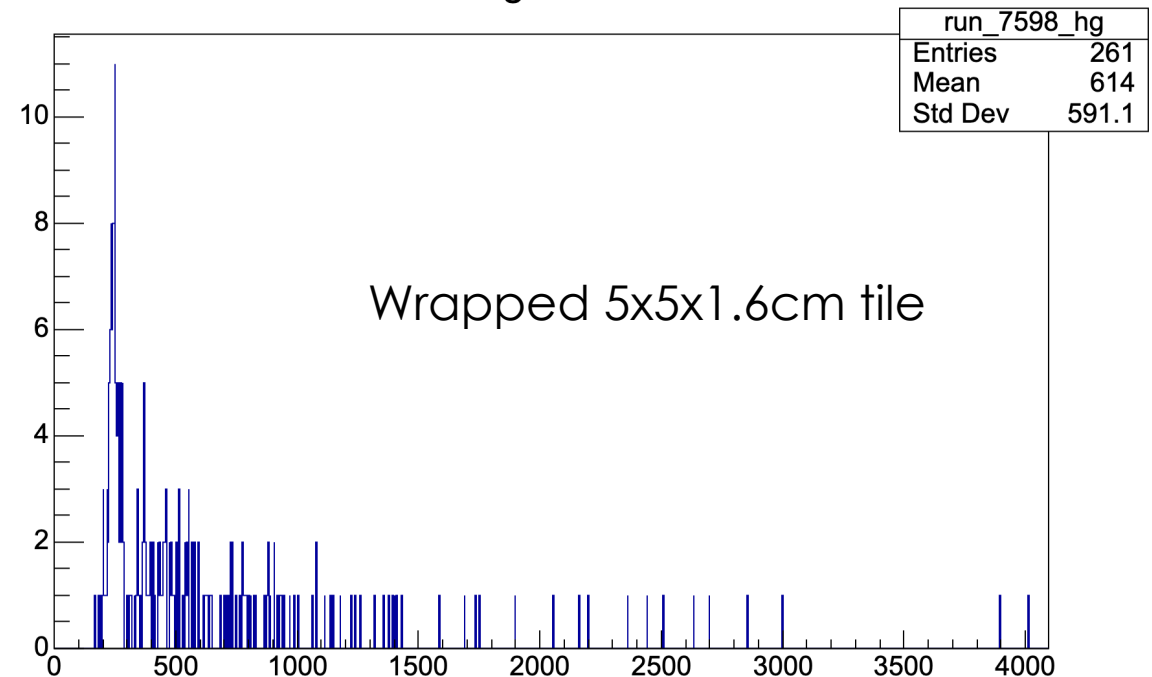
# Noise from different tiles

Noise taken with source ~50 cm from tile, placed over SiPM

High Gain



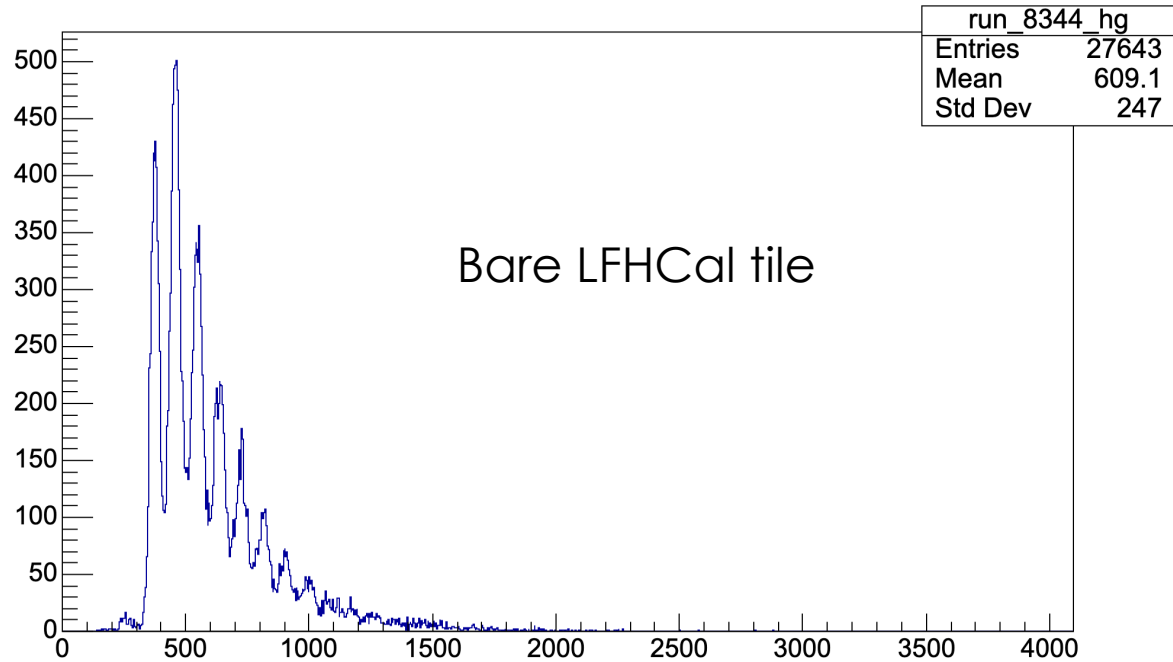
High Gain



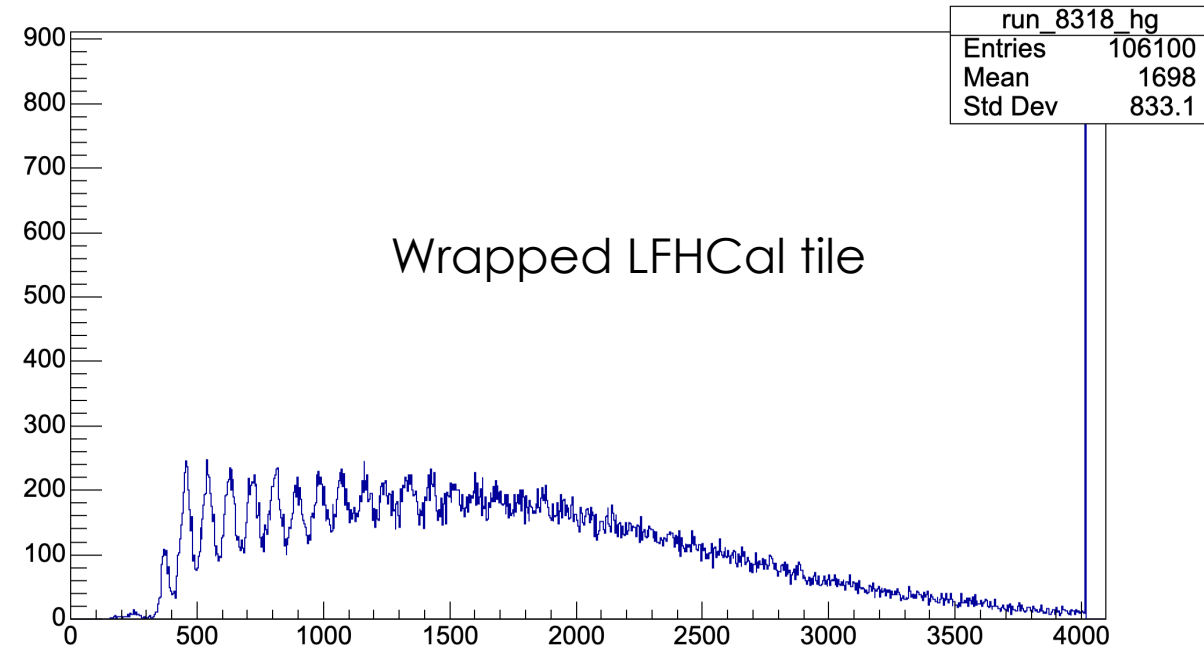
# ADC spectra for wrapped vs. unwrapped

Data taken with source at (0,0), directly over SiPM

High Gain



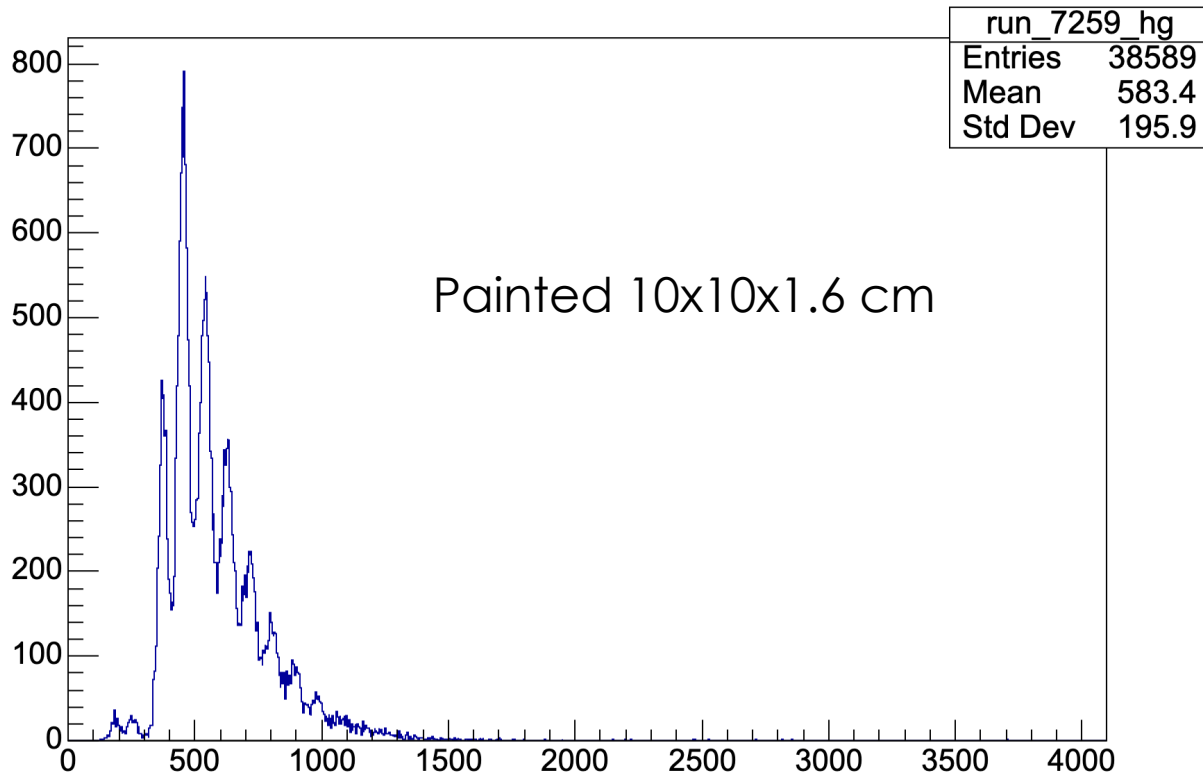
High Gain



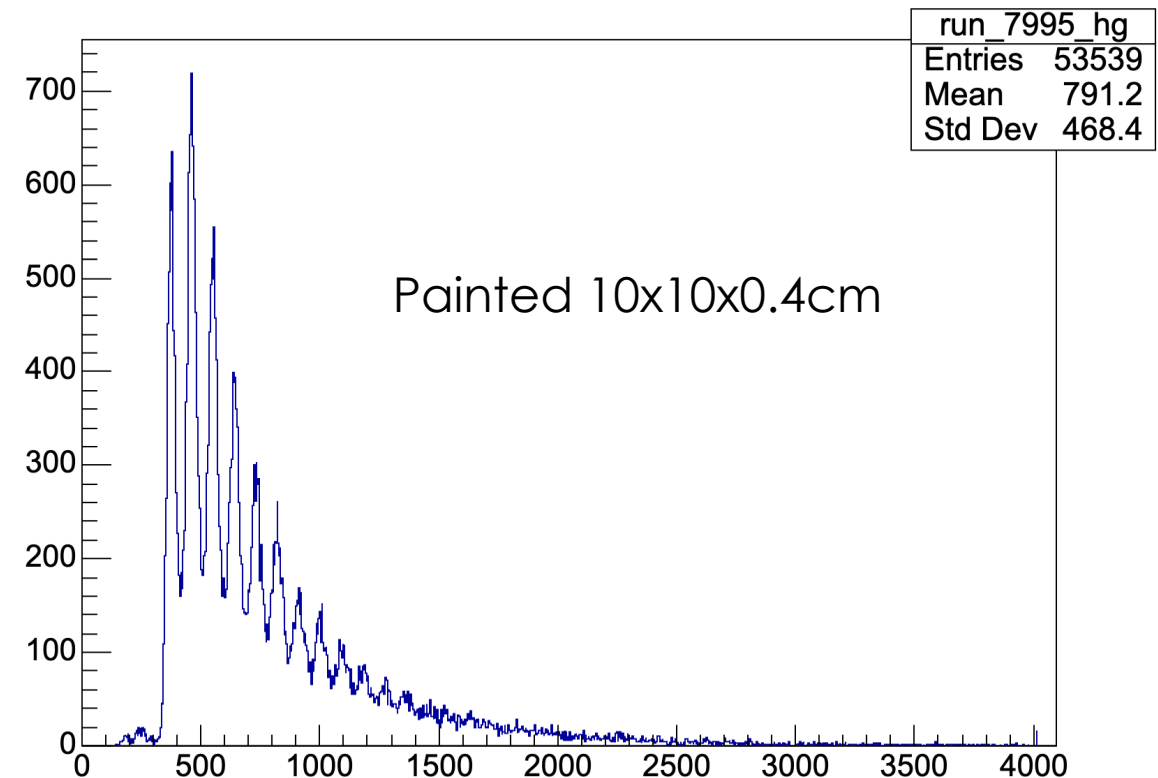
# ADC spectra for thick vs. thin tiles

Data taken with source at (5mm,5mm), slightly away from SiPM

High Gain



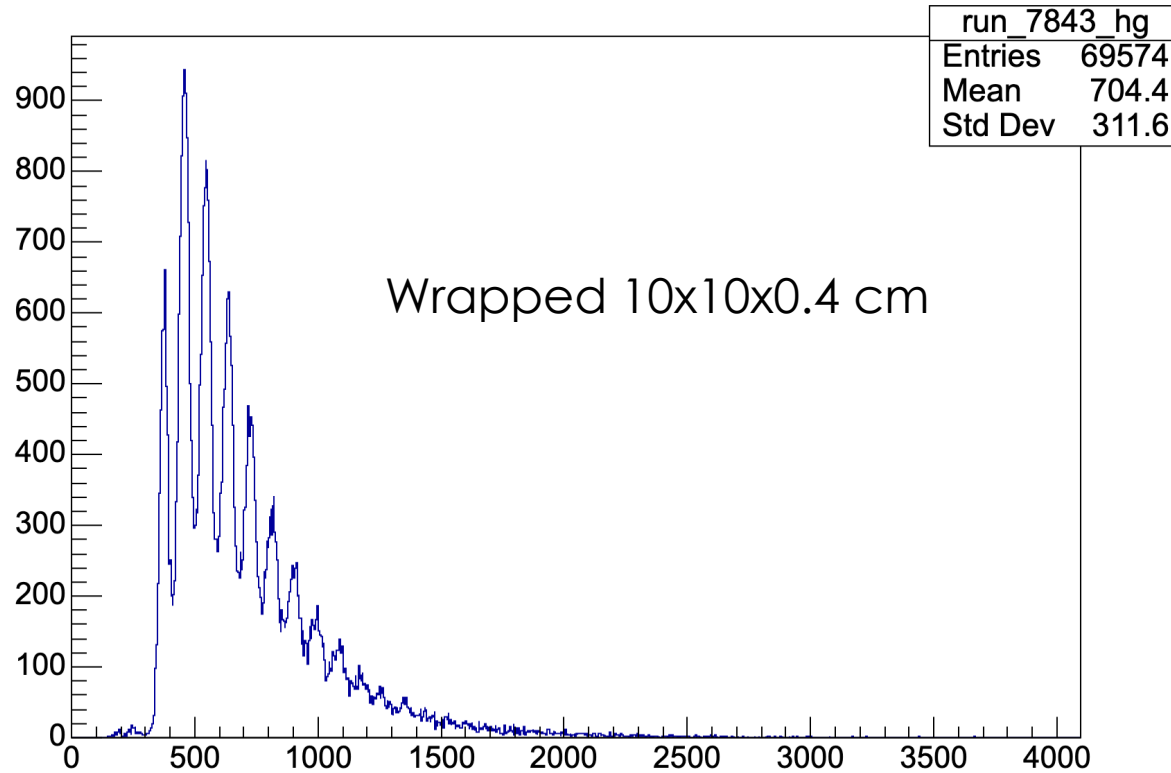
High Gain



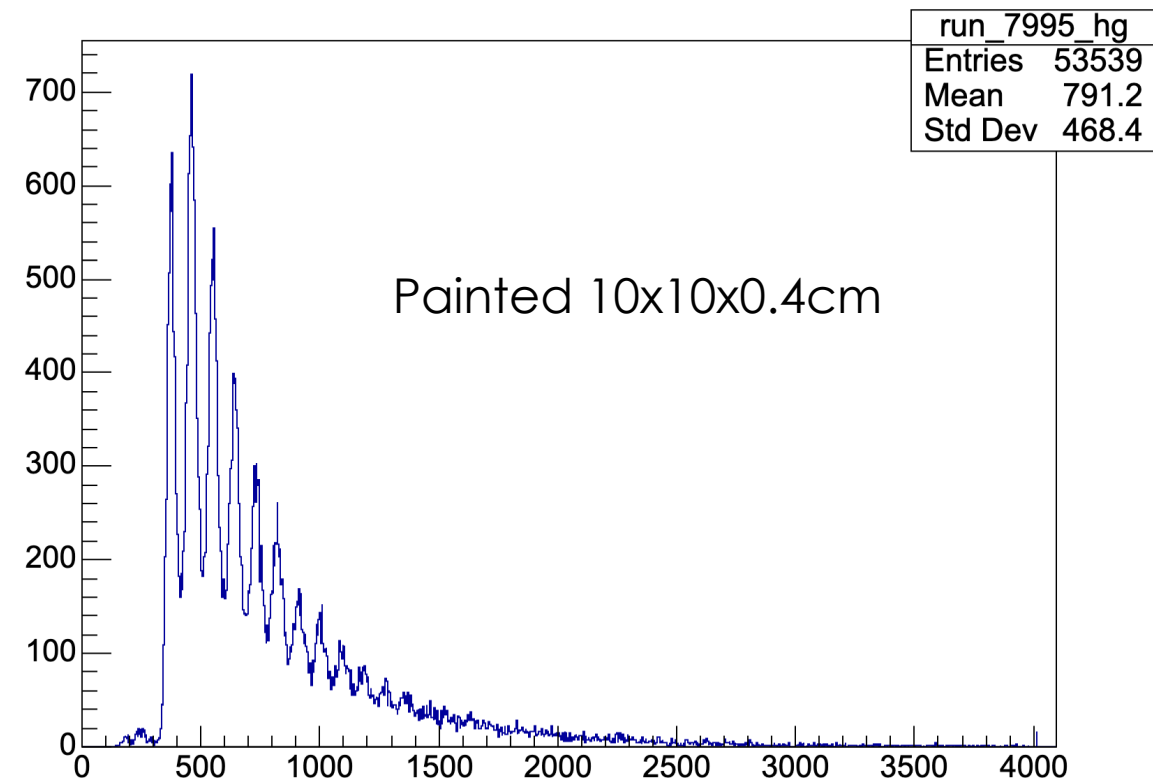
# ADC spectra for wrapped vs painted tiles

Data taken with source at (5mm,5mm), slightly away from SiPM

High Gain

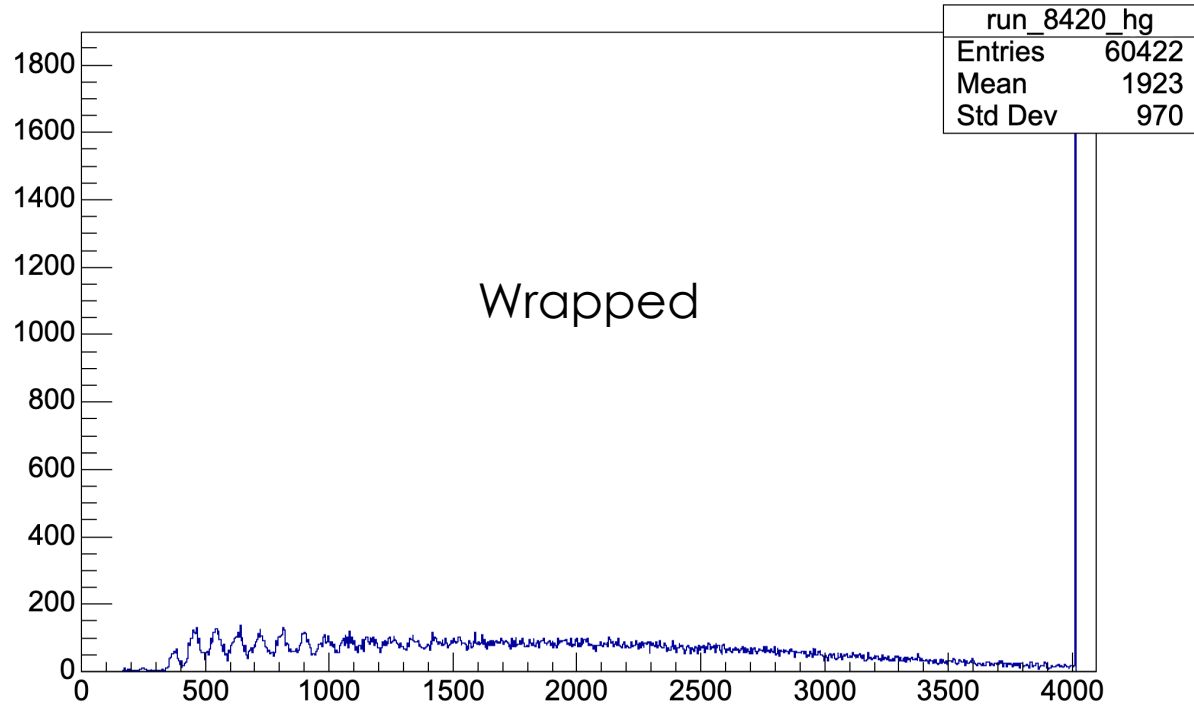


High Gain

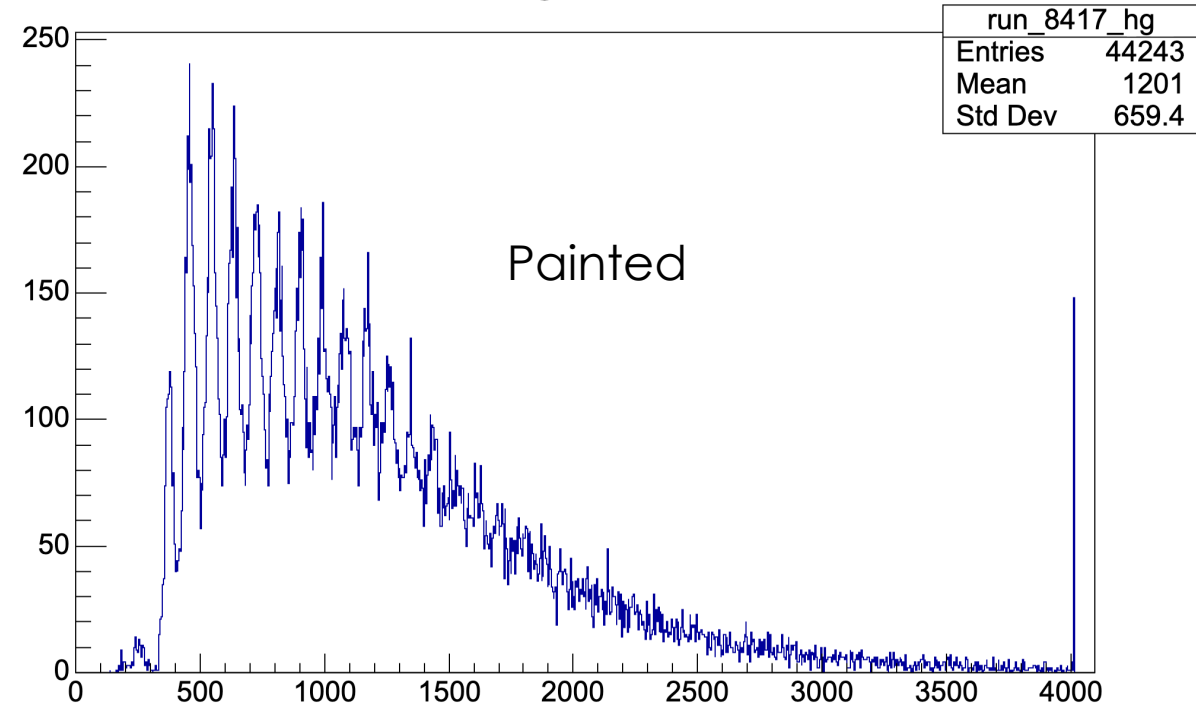


# Wrapped vs Painted LFHcal Tile

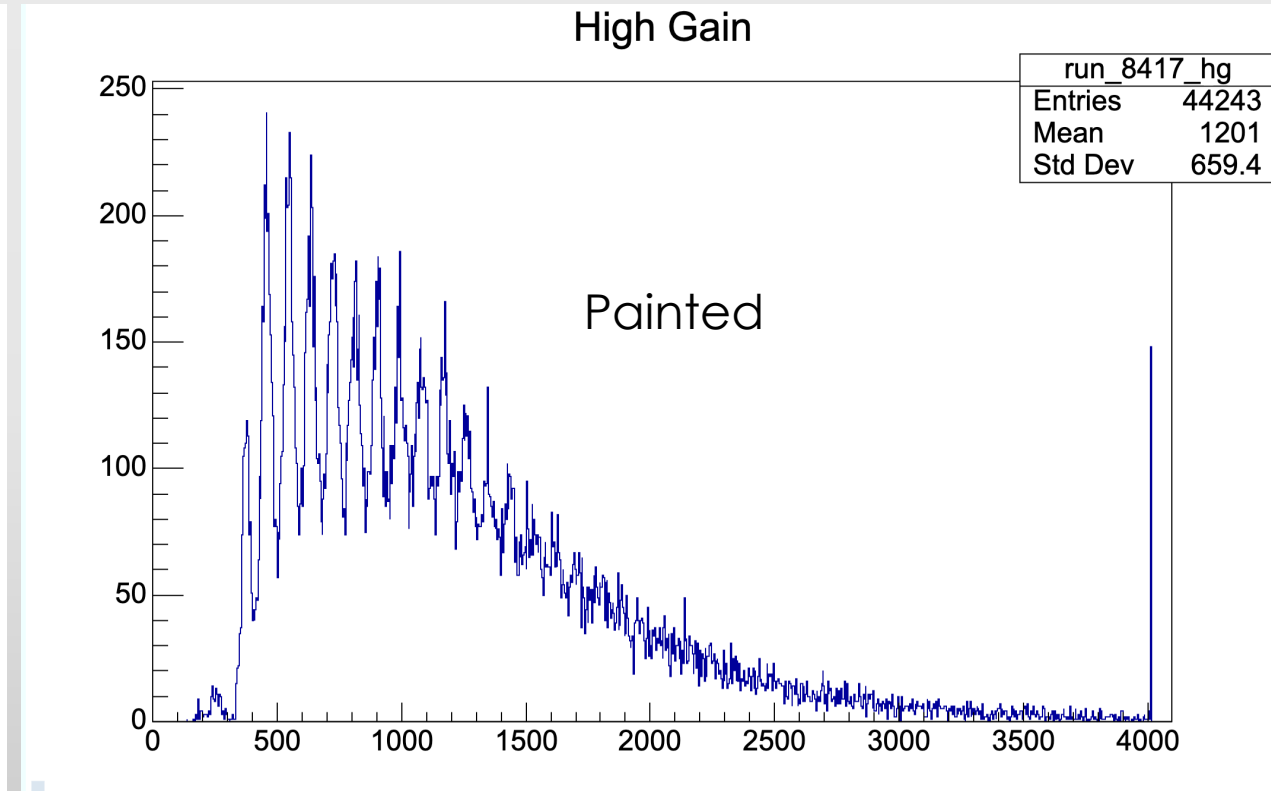
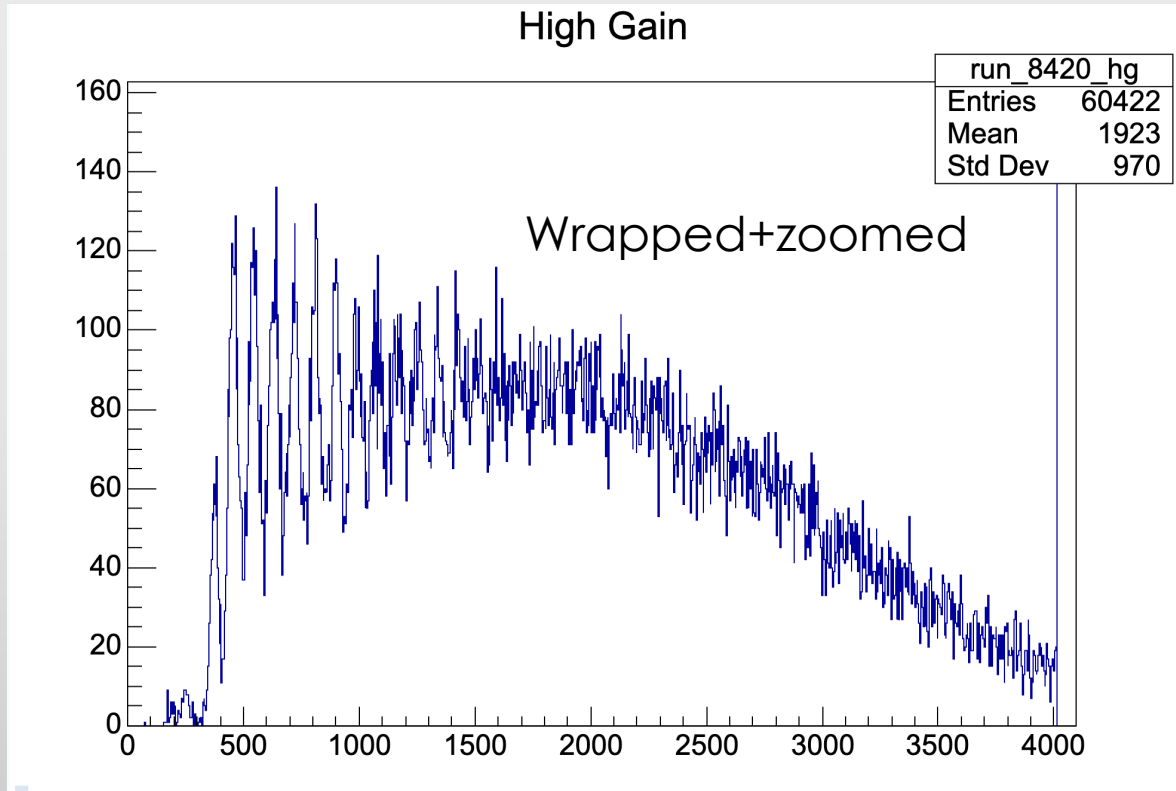
High Gain



High Gain



# Wrapped vs Painted LFHcal Tile



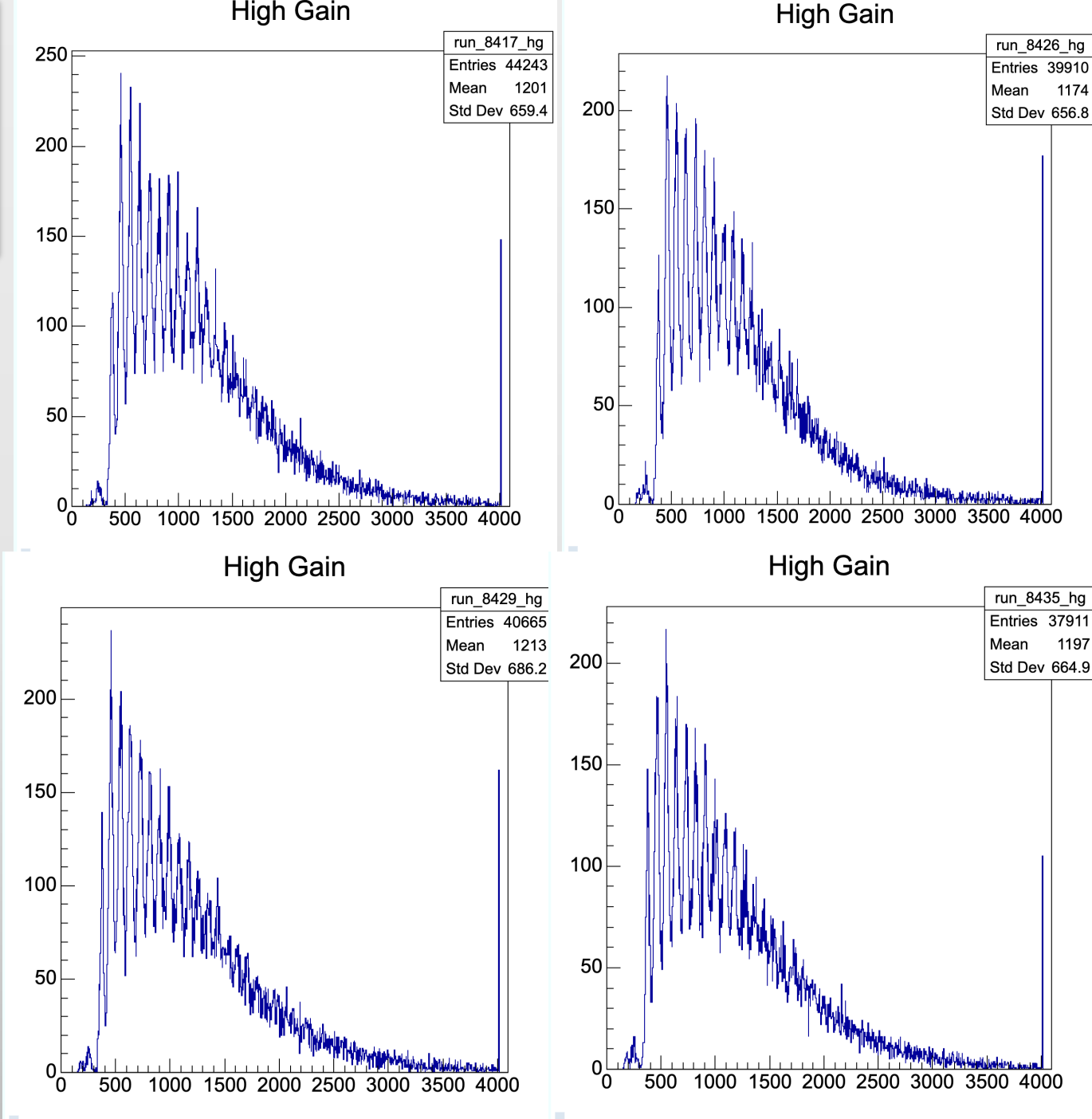
Overall less yield on painted for these tiles, which doesn't match what we saw for other wrapped tiles.

I didn't do this wrapping myself- maybe those can be improved?

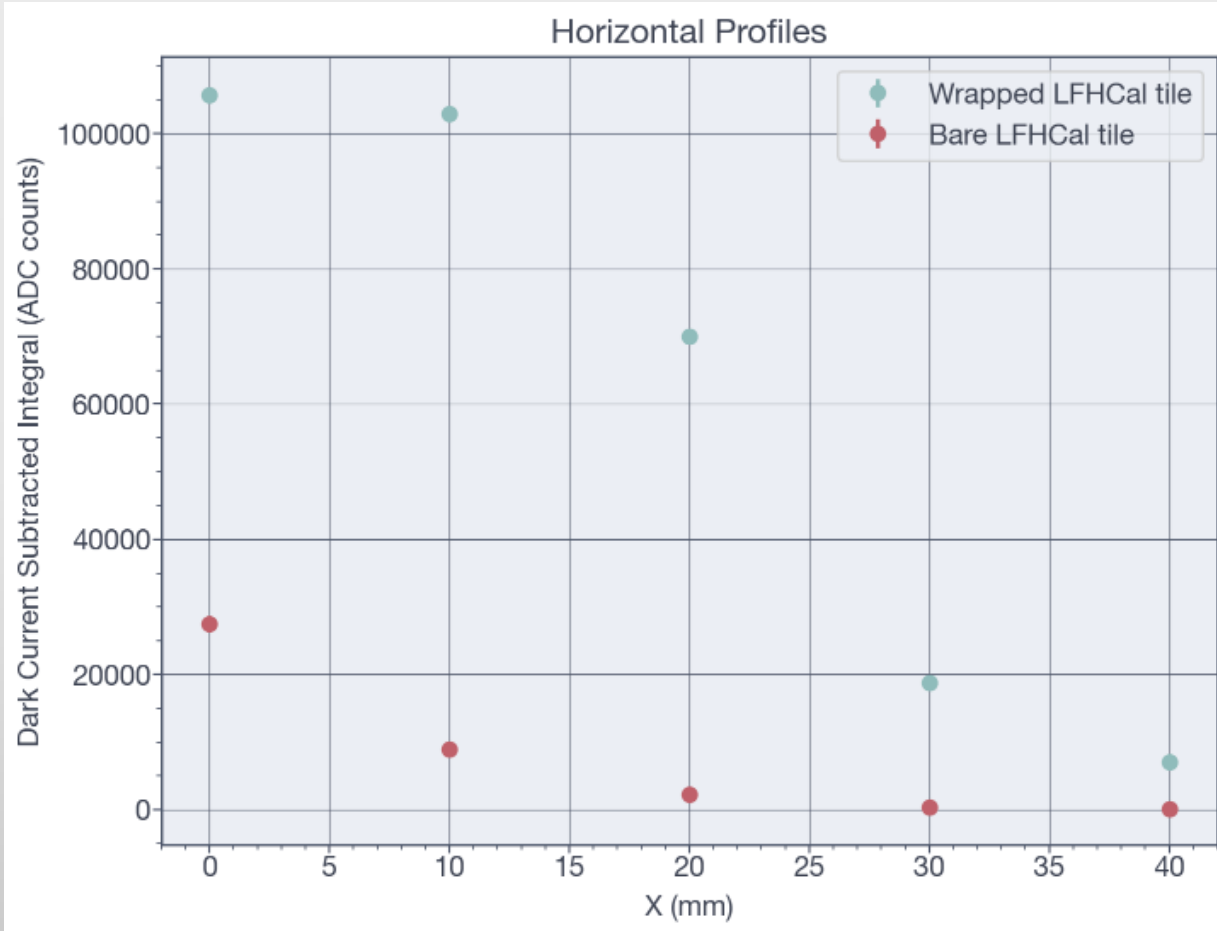
Or, the difference is more stark for thinner, smaller tiles.

# Consistency after placing and replacing tile

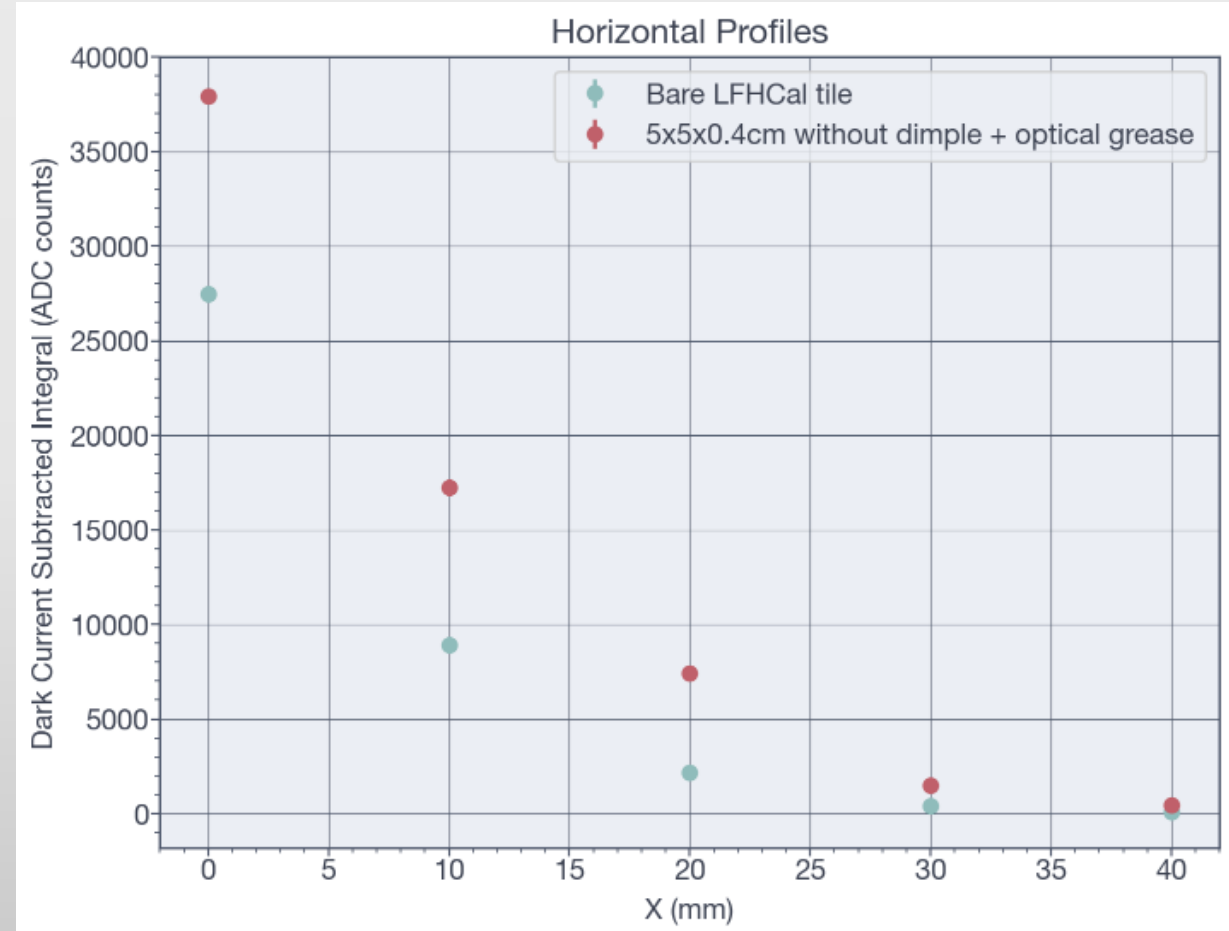
- Wanted to check how sensitive our setup is to small changes when swapping, replacing tiles etc.
- Took a few measurements with minor shift of tile, picking up and replacing, LFHCal painted tile to see.



# LFHCal tile scans

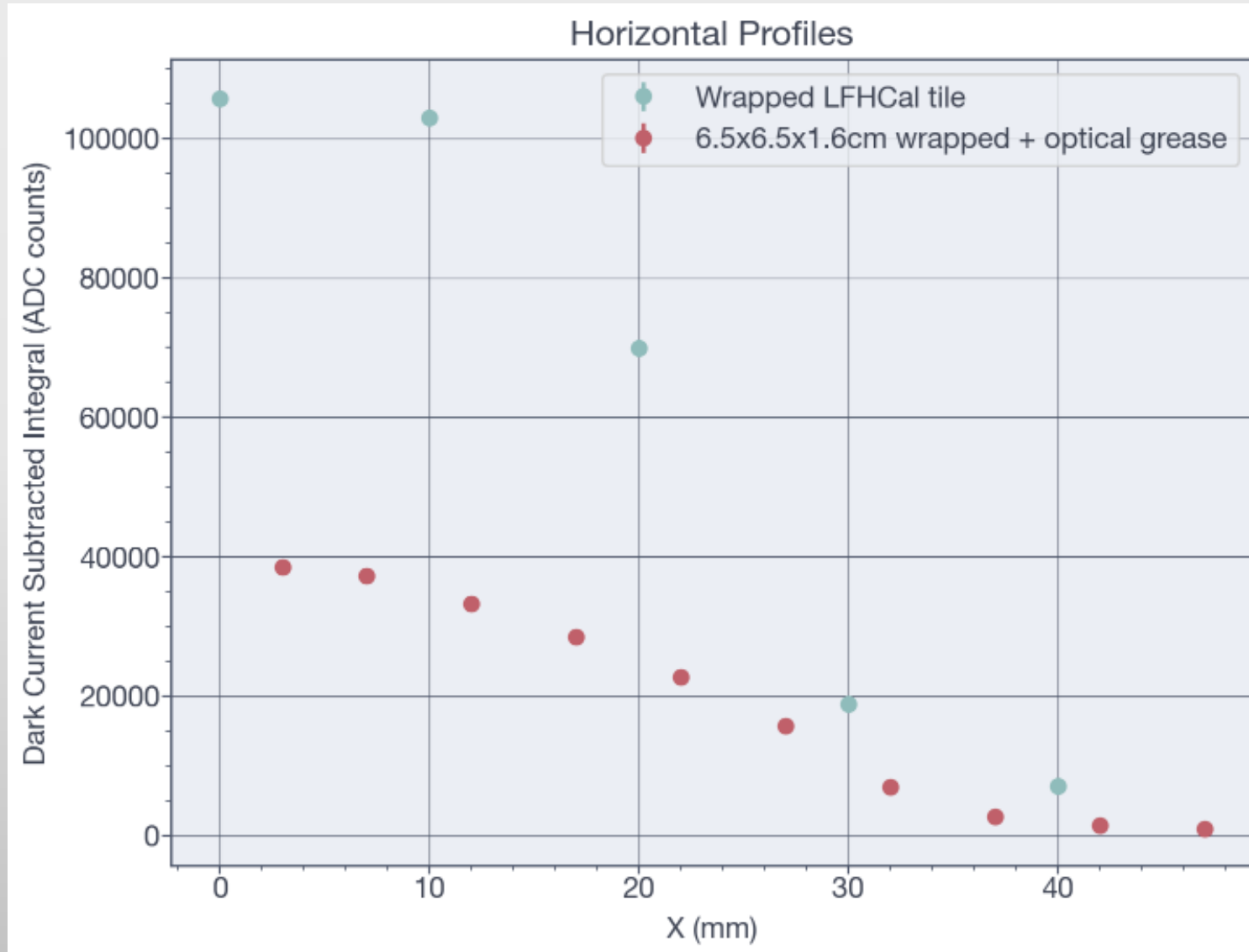


Wrapped vs unwrapped



Bare LFHCal tile vs our bare 5x5

# LFHCaI vs Thick tile



# Backup

# List of available sample tiles

## Polished+milled to correct size

- ~20 2.4x2.4x0.4 with dimple
- 1 2.4x2.4x0.4 painted with dimple
- 3 4.7x4.7x0.4 with dimple
- 1 4.7x4.7x0.4 painted with dimple
- 1 4.7x4.7x0.4 wrapped with dimple
- 2 5x5x0.4
- 1 5x5x1.6
- 1 10x10x1.6

## Unpolished+not milled to stated size.

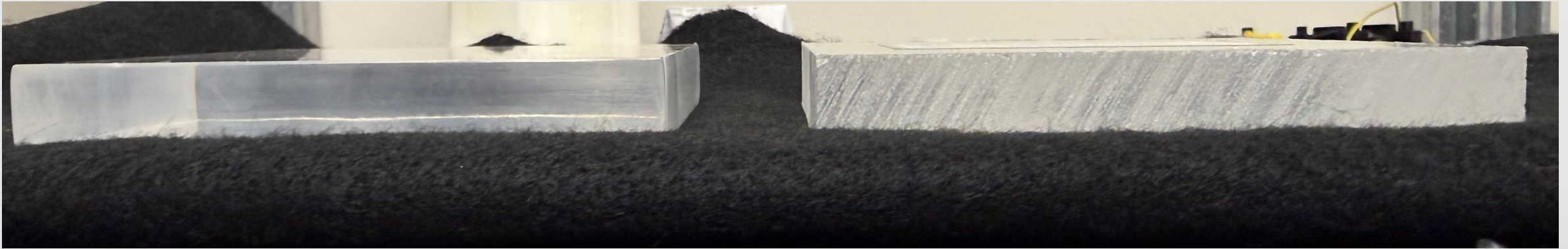
- 3 5x5x0.4
- 2 5x5x0.8
- 1 5x5x0.8 with dimple
- 3 5x5x1.6
- 1 10x10x0.4
- 1 10x10x0.4 with dimple
- 3 10x10x0.8
- 3 10x10x1.6

About ~2cm  
extra material  
in x,y

Will show results from this one today

# Polishing the unpolished tiles

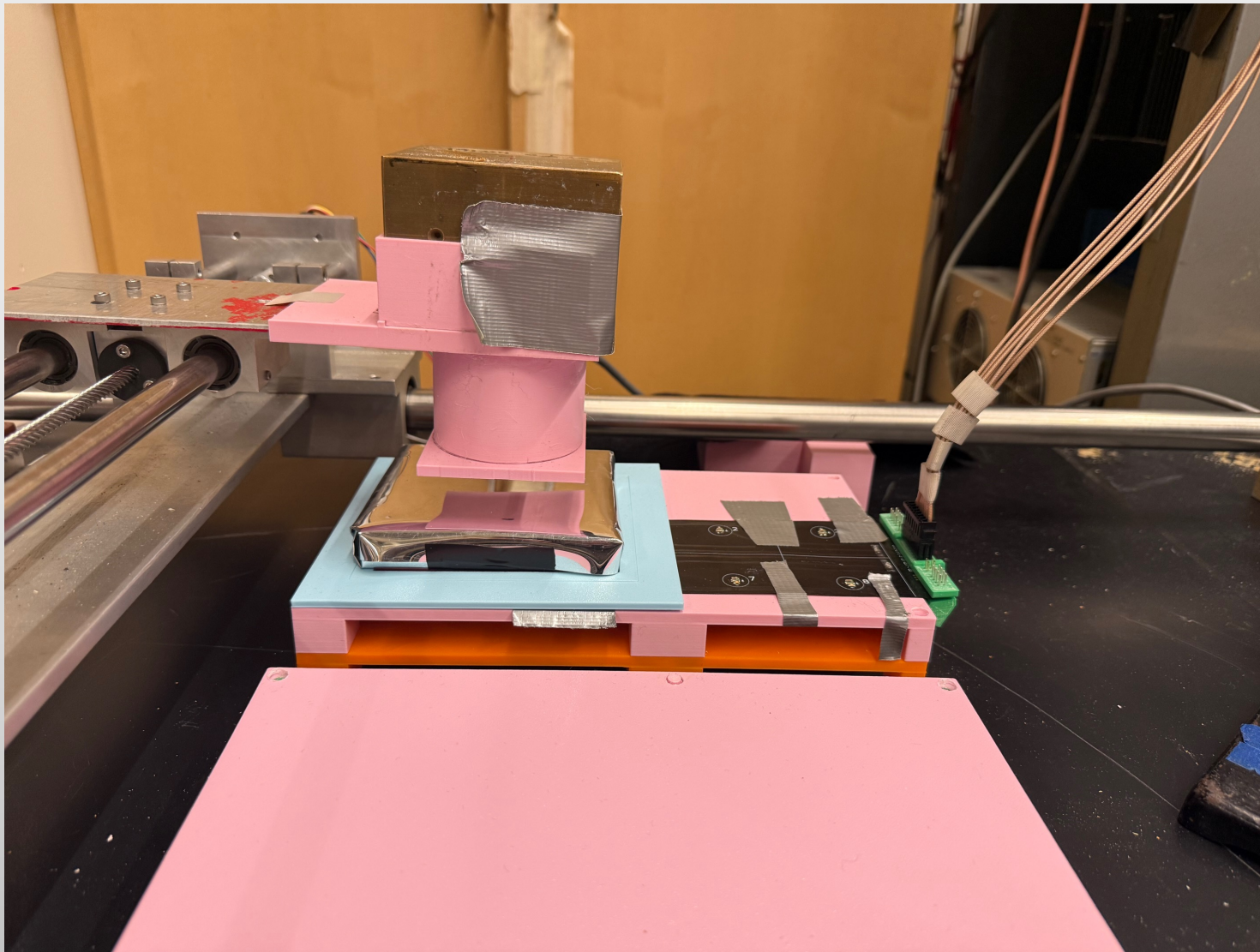
- Recently started polishing some of the un-milled tiles by hand.
- Here's an example



Polished

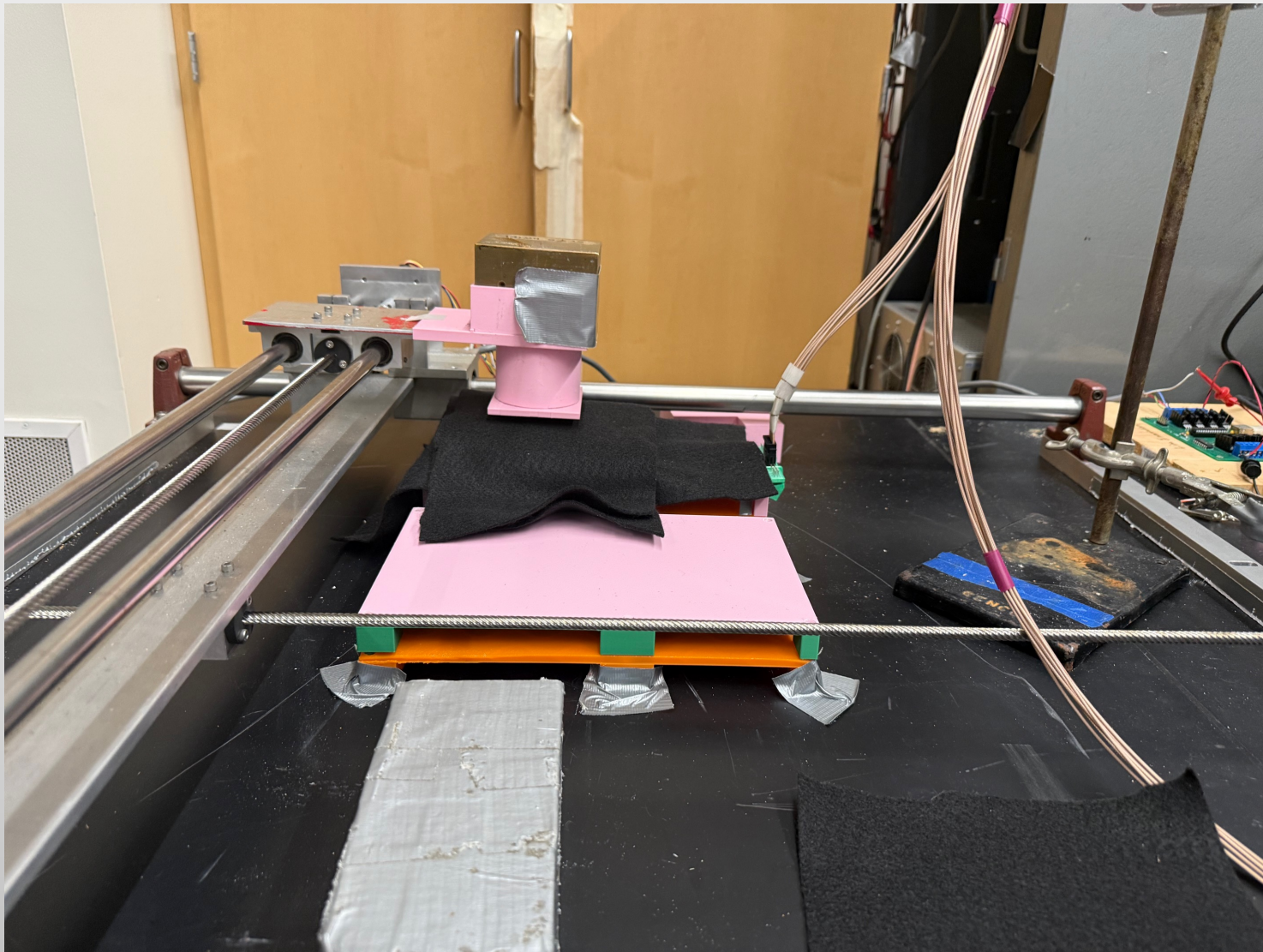
Original

# Lab setup



- Sr90 beta source
- Source moved through a list of positions via x-y table
- Tile centered over SiPM
- Readout through CAEN module

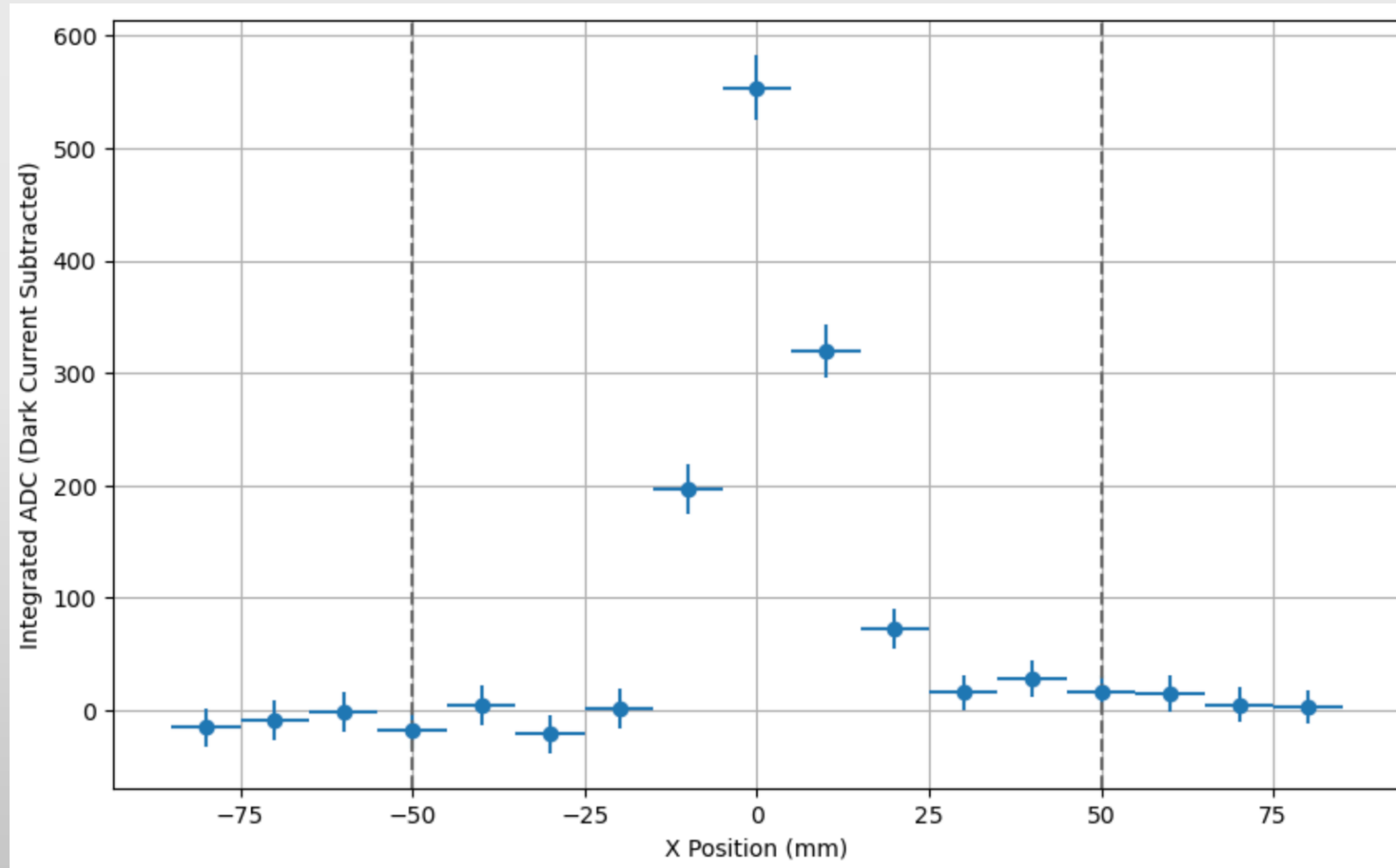
# Lab setup (pt 2)



- For data taking, cover tile with felt and turn off the lights

# Results from unwrapped, polished 10x10 tile

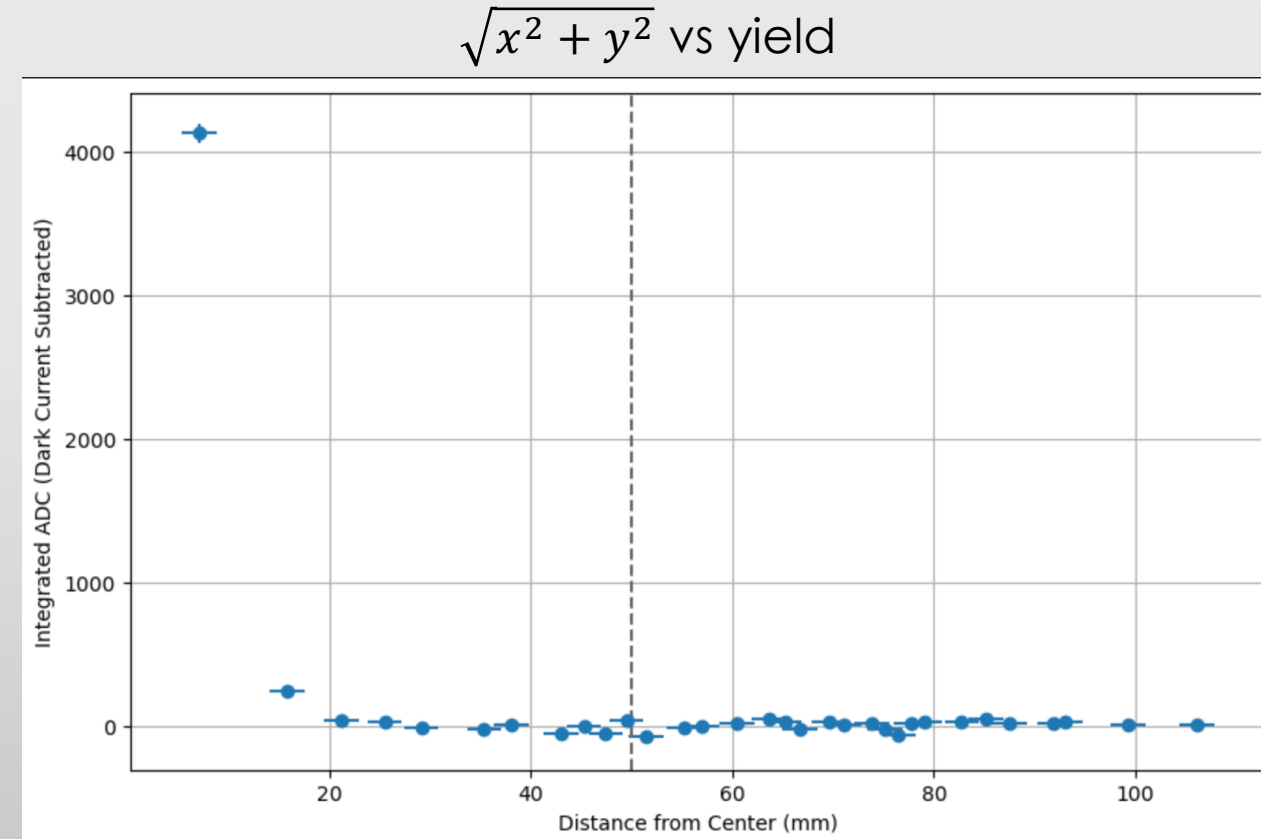
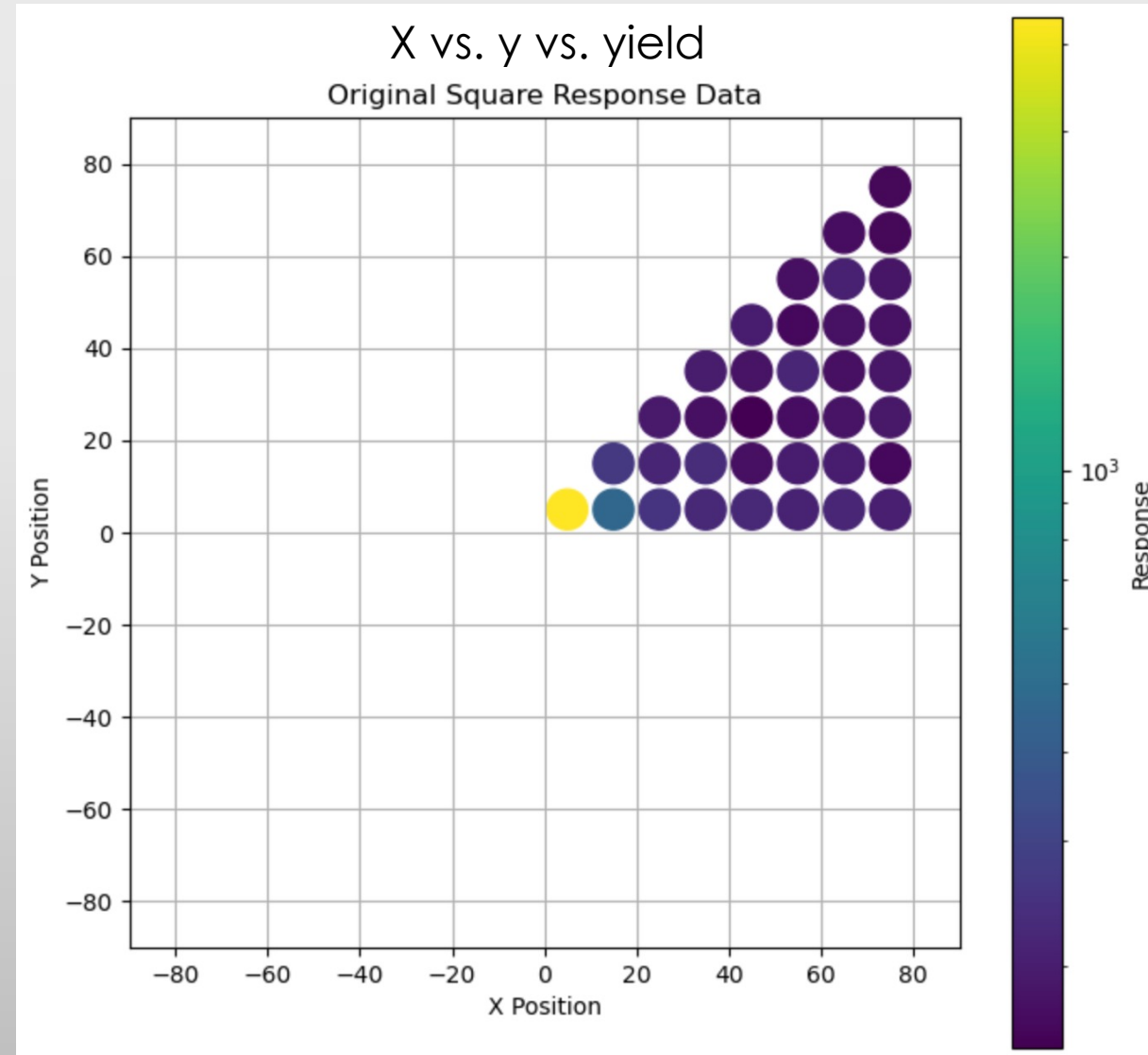
- Horizontal scan across the center of the tile:



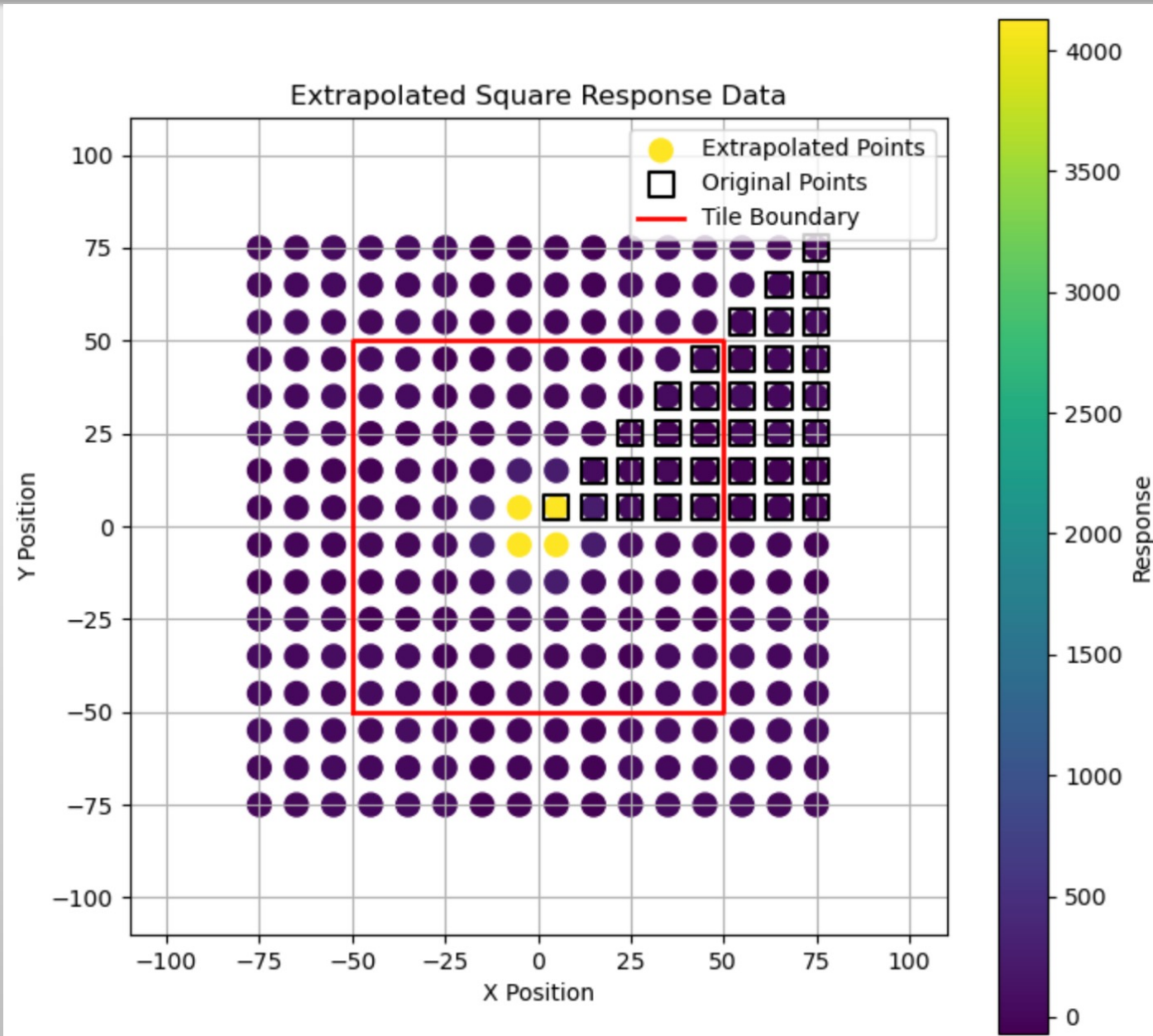
Vertical lines=edge of the tile

# Results from unwrapped, polished 10x10 tile

- 1/8<sup>th</sup> grid scan

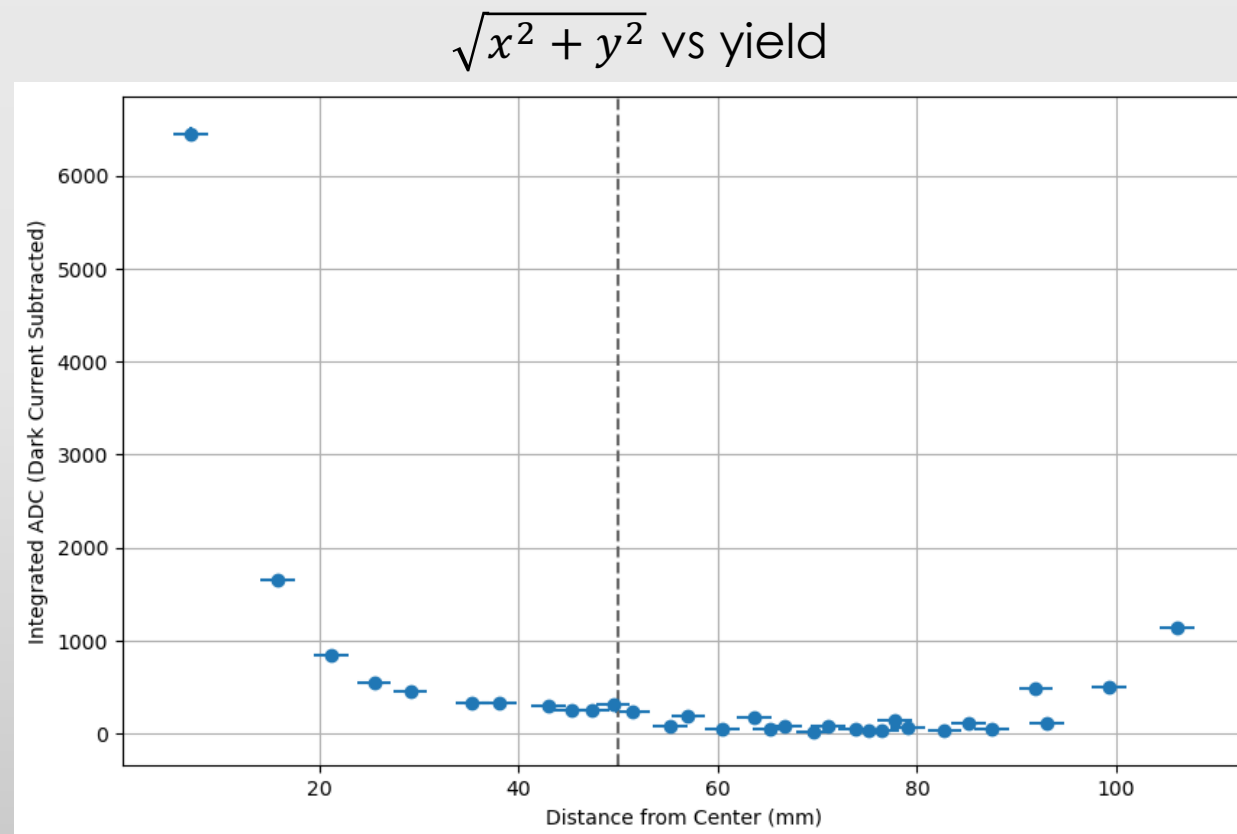
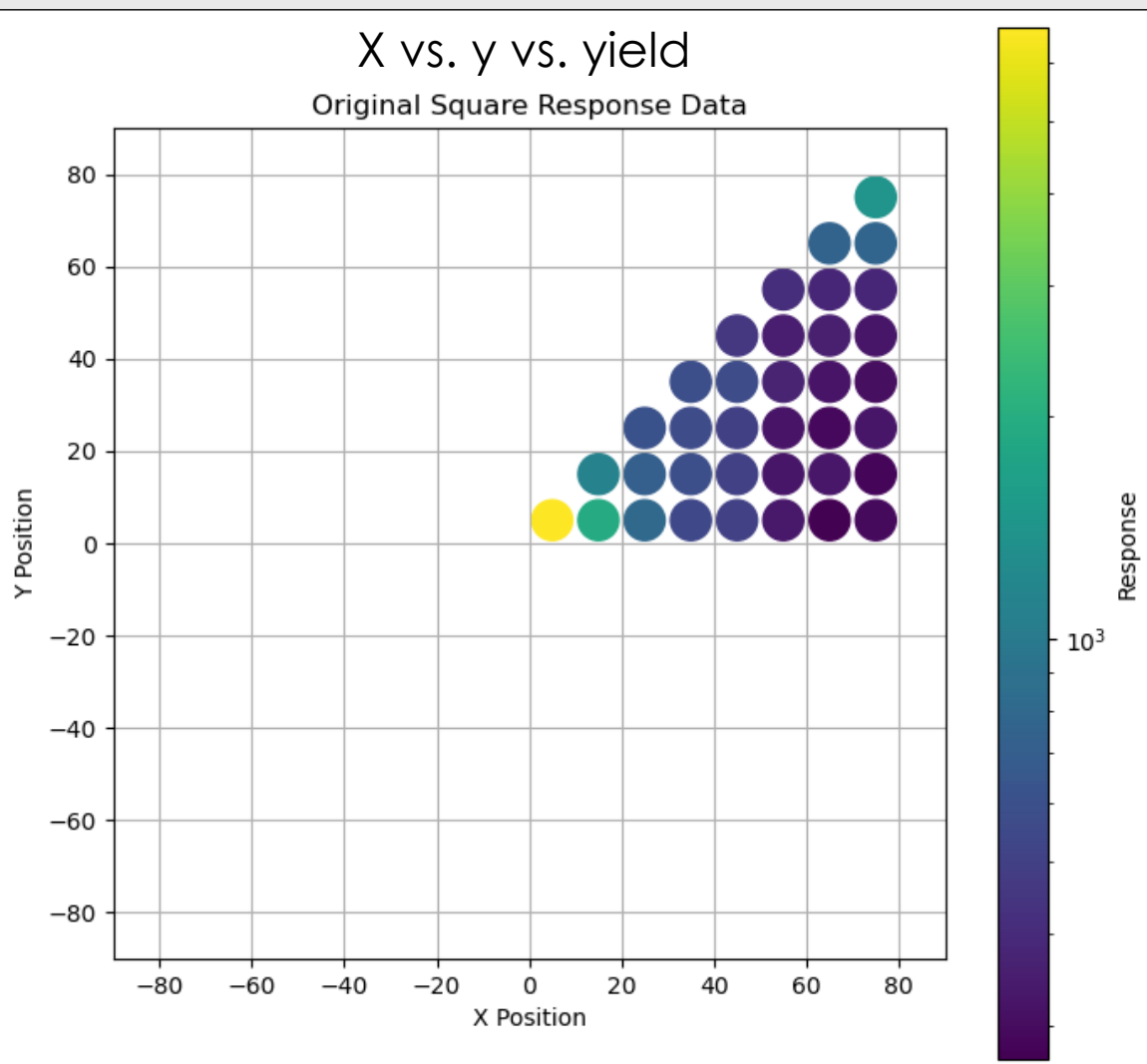


# Heatmap from exploiting square symmetry



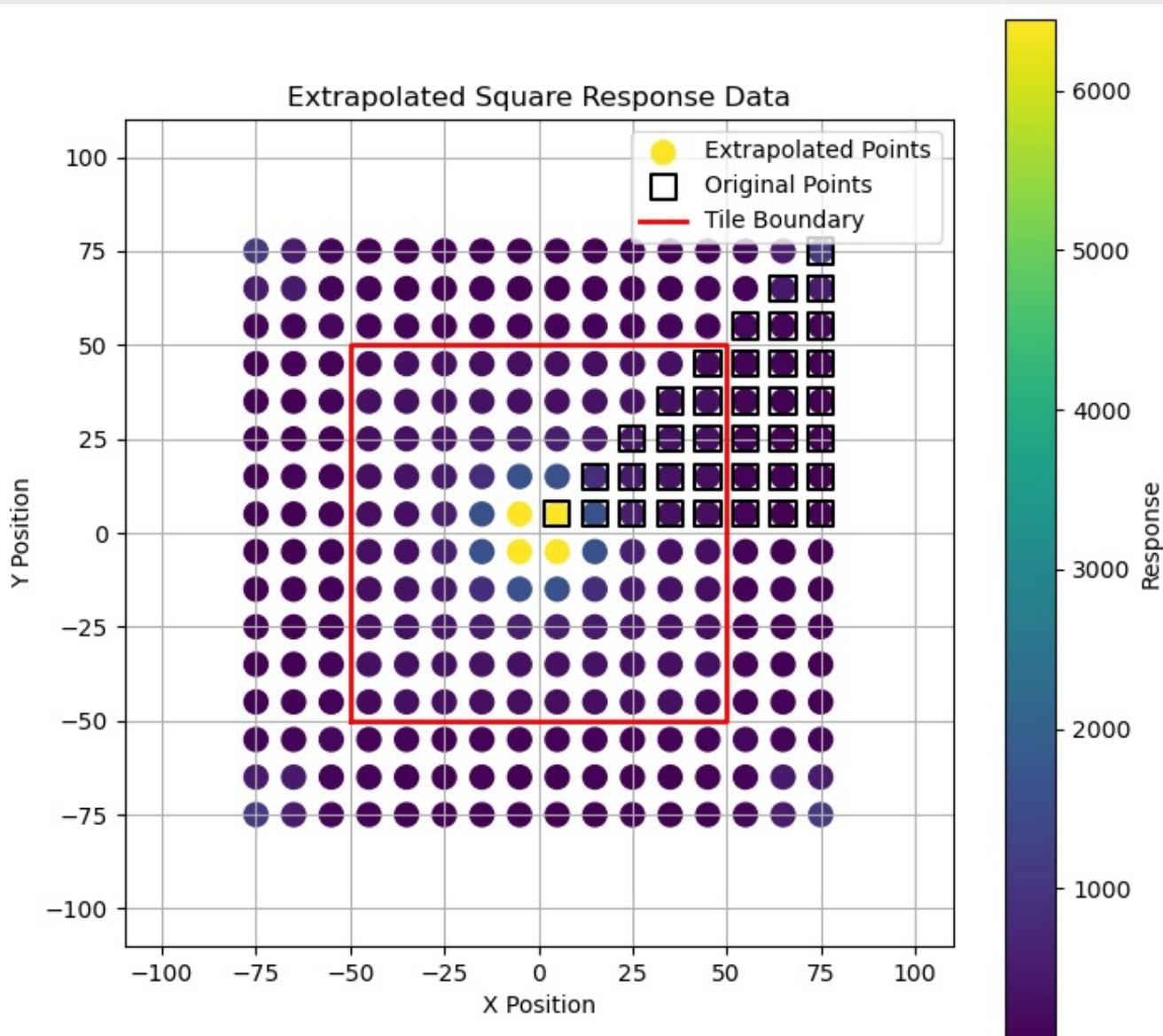
# Results from wrapped, polished 10x10 tile

- 1/8<sup>th</sup> grid scan



Note: ignore these high yield points at 75, 75  
I suspect due to my phone flashlight checking if it  
was done

# Heatmap from exploiting square symmetry



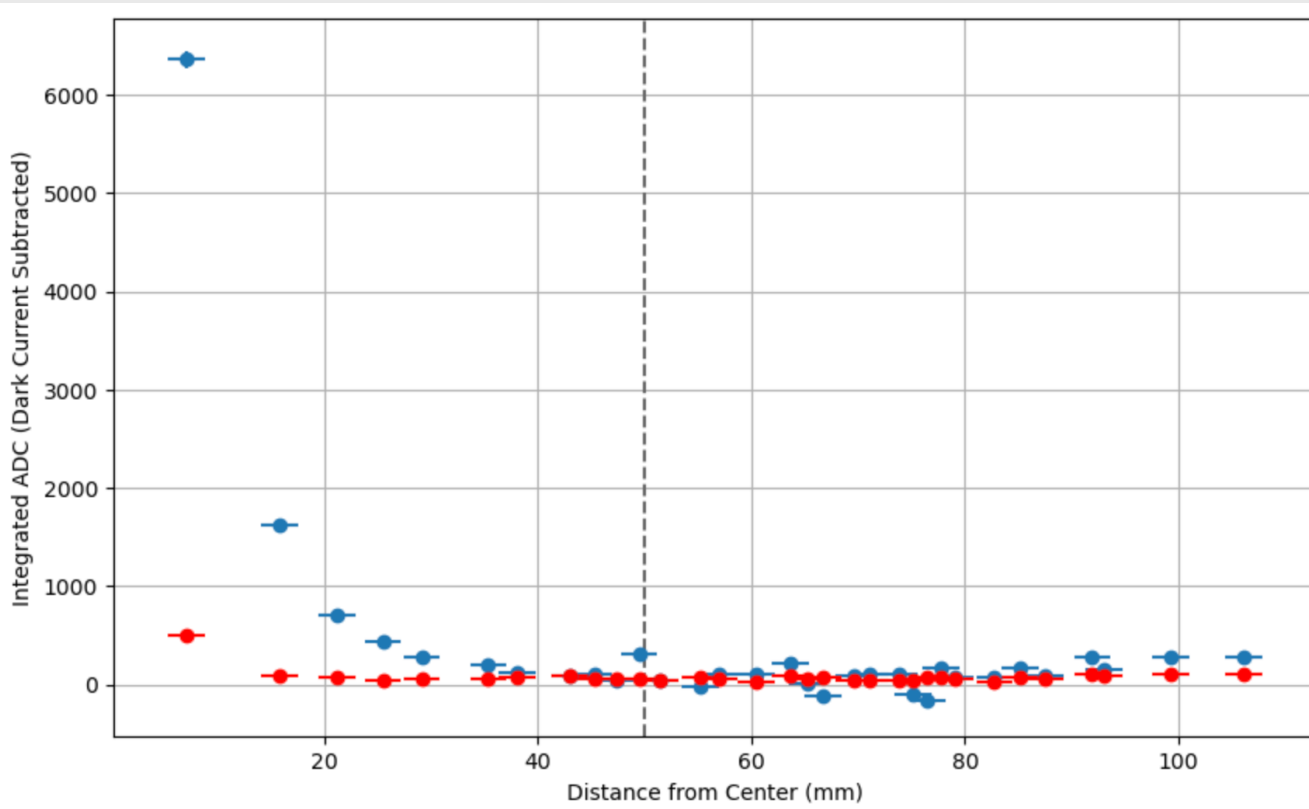
Clear improvement from unwrapped case, but very far from ideal.

Maybe wrapping can be improved (better technique/methodology)

Possible improvement by adding layer of reflective material over the PCB with only a very small hole for the SiPM. Could be that the whole cut into the tile's wrapping is too large.

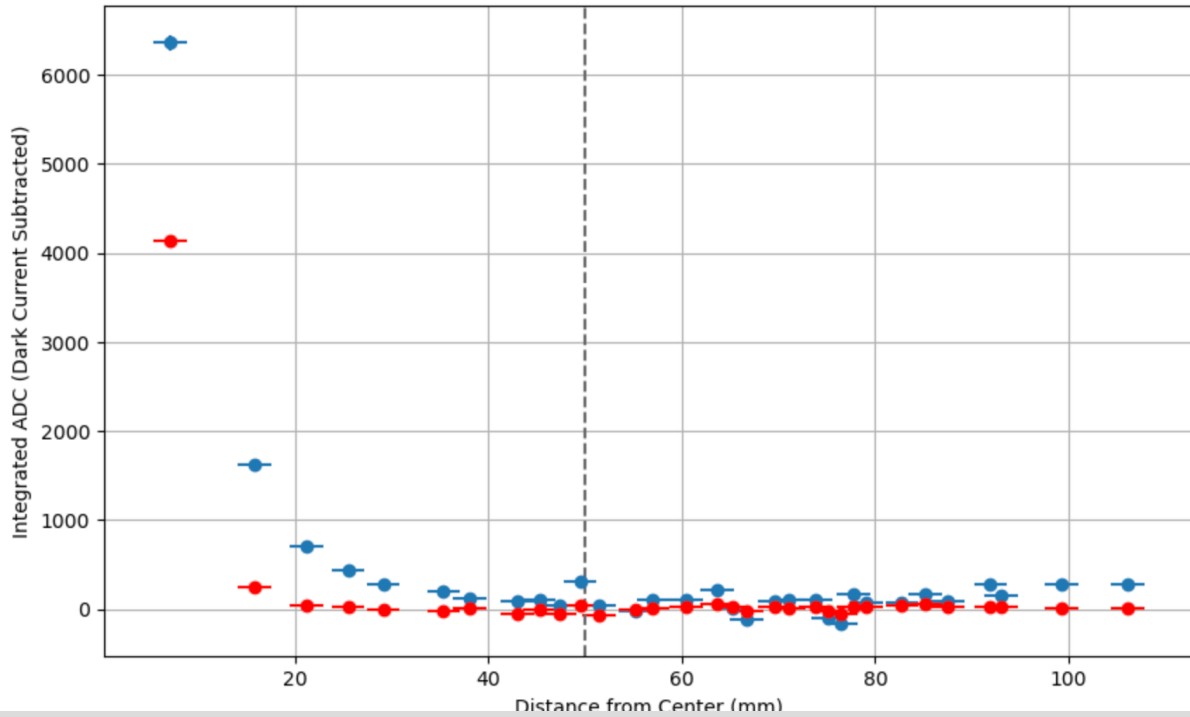
# Scan with no tile

- Repeat the same scan as before but with no tile at all
- This contributes some to the non-uniformity.  $\sim 7.5\%$  overestimating most central region of tile.
- Great to know, but doesn't solve issues.

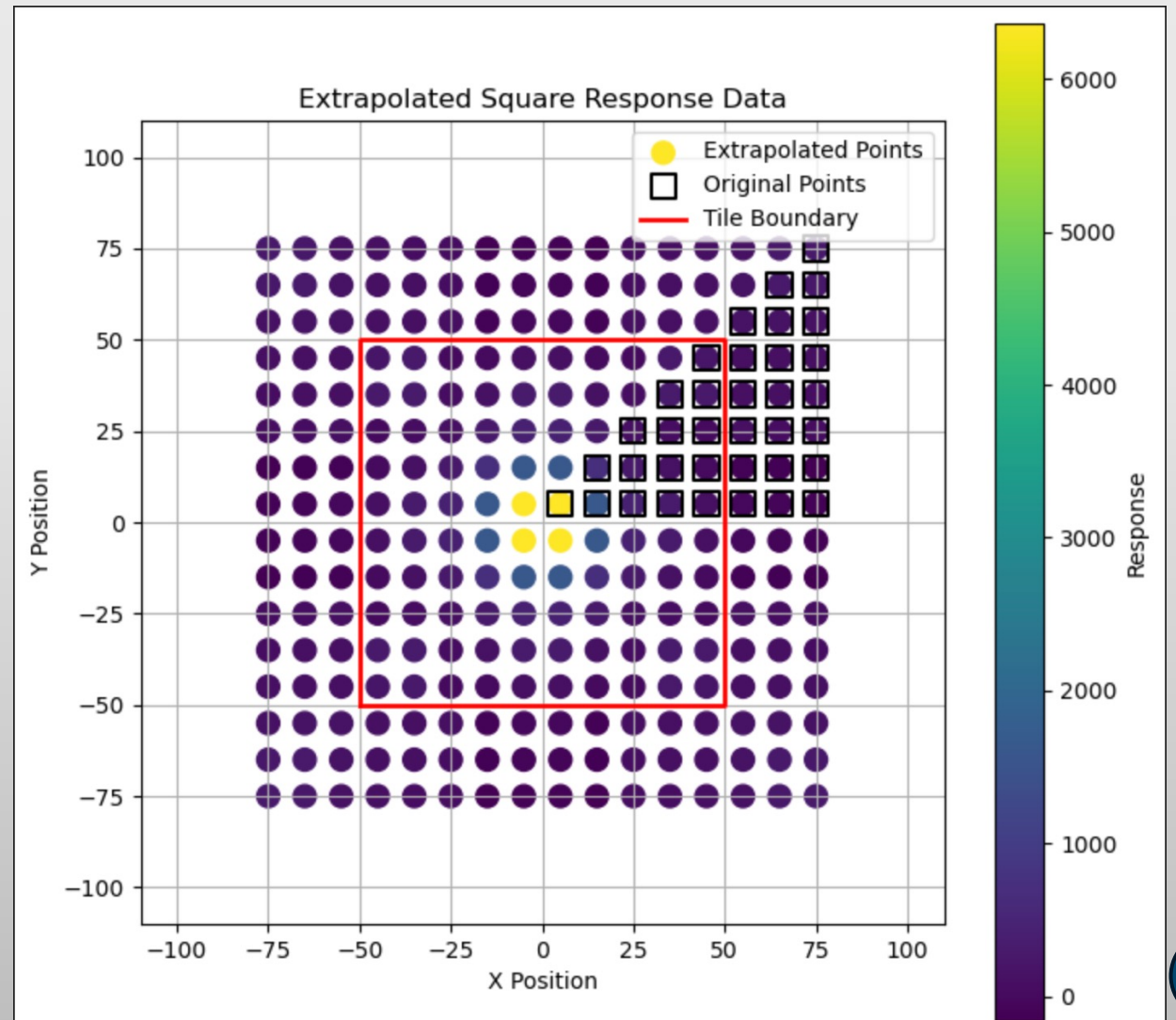


On the list: painted 10x10 tile, extra mechanical pressure, optical grease  
Also, will try move SiPM to edge of tile, but this will take longer to set up.

# “Improved” wrapping results

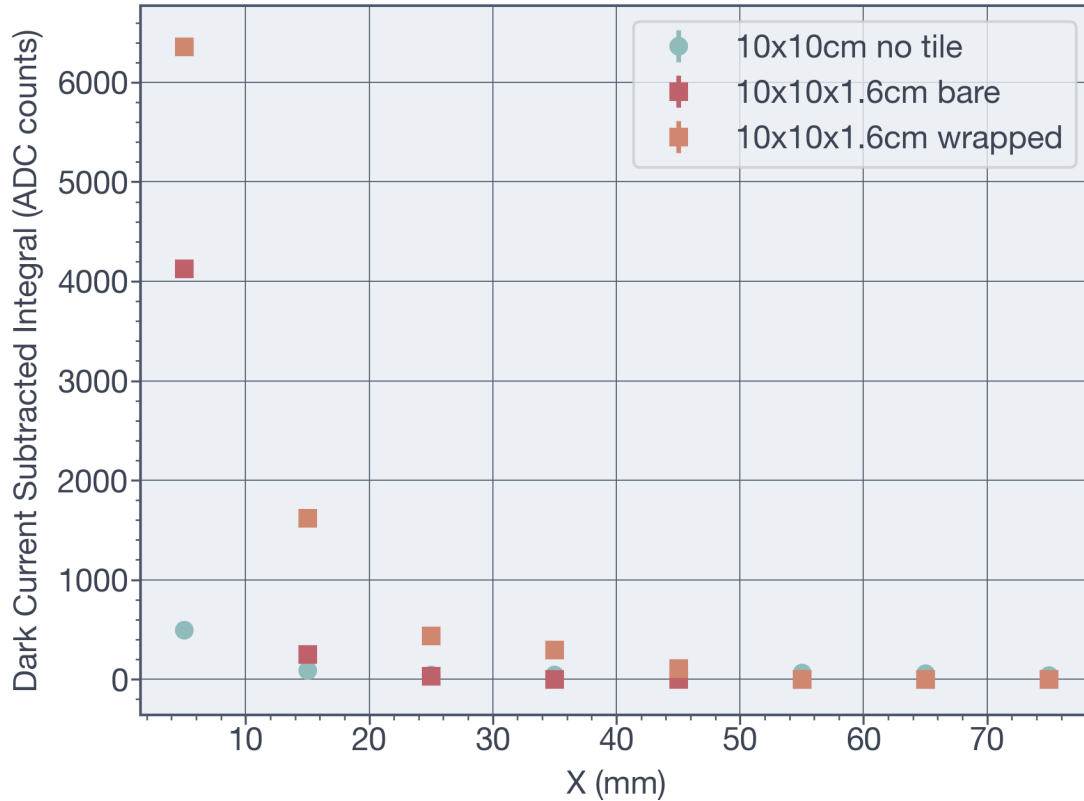


One (of many) questions: is it possible that we are uniform above ~25 cm and we're seeing our source directly at the 0cm peak?

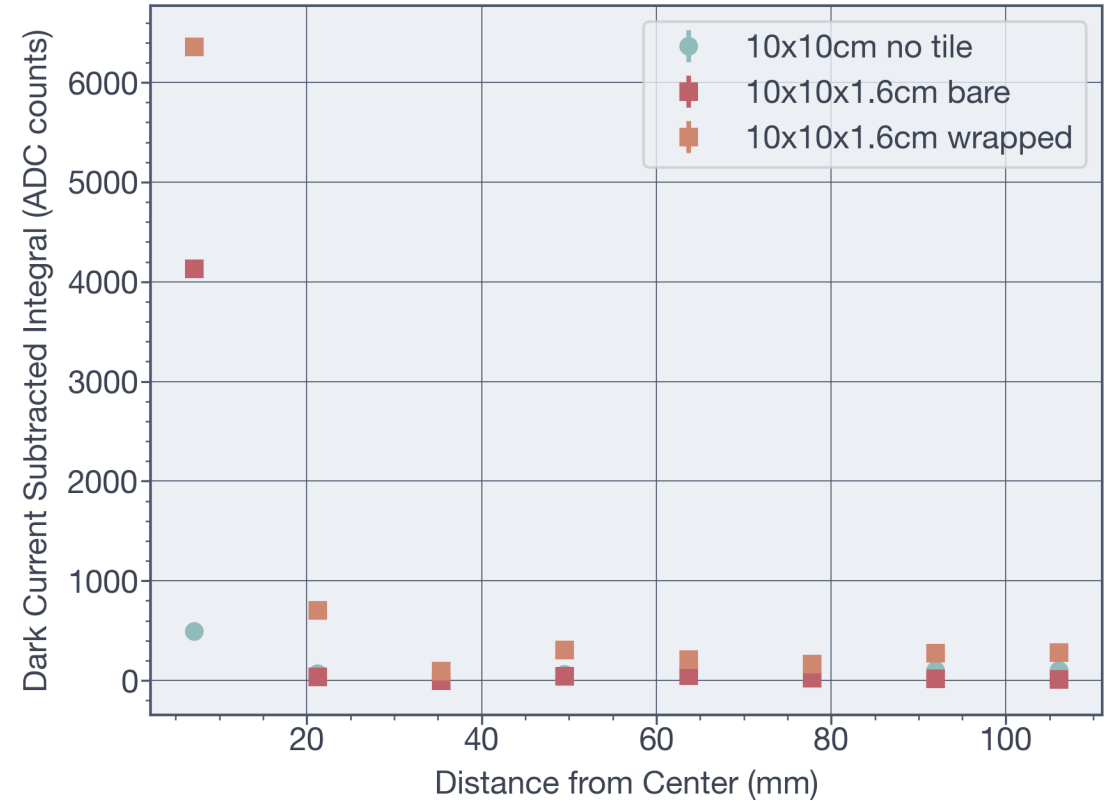


# So far: 10x10x1.6 with and without wrapping

Horizontal Profiles



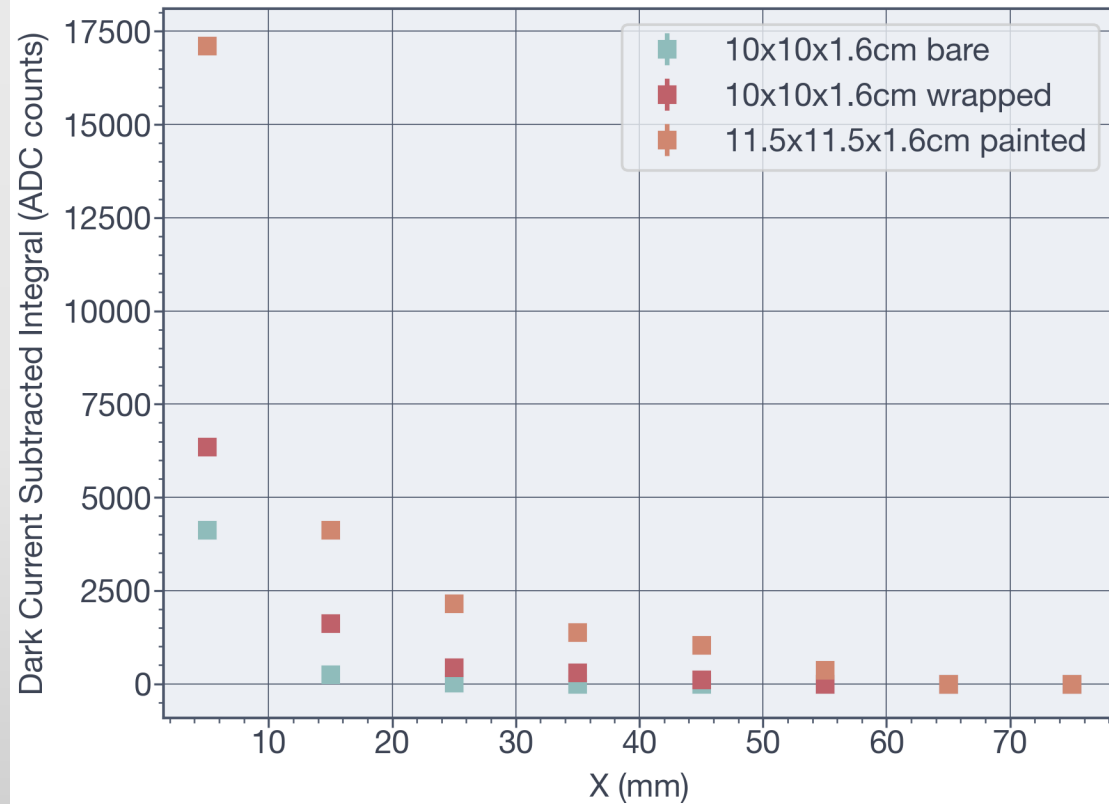
Diagonal Profiles



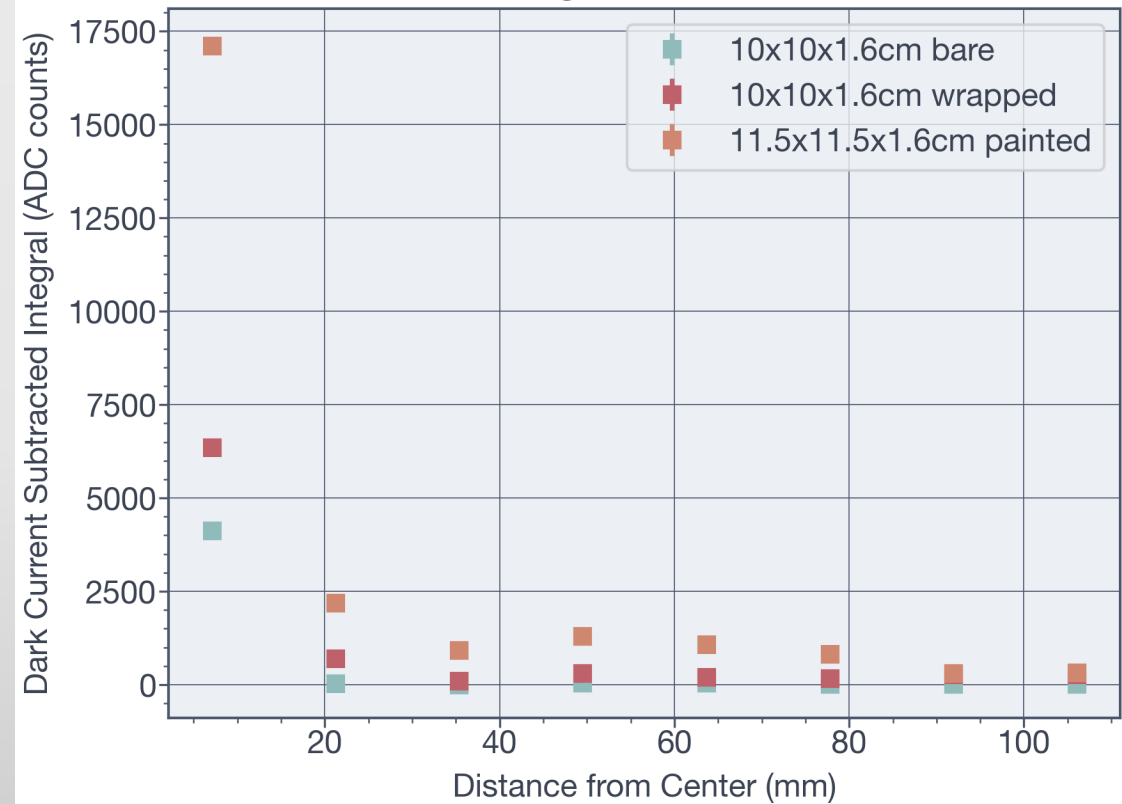
- As of last week, we have scans of this tile with no dimple or optical grease
- Tried wrapped vs. unwrapped. Also checked response of bare SiPM

# Swap to another tile: 11.5x11.5 painted

Horizontal Profiles



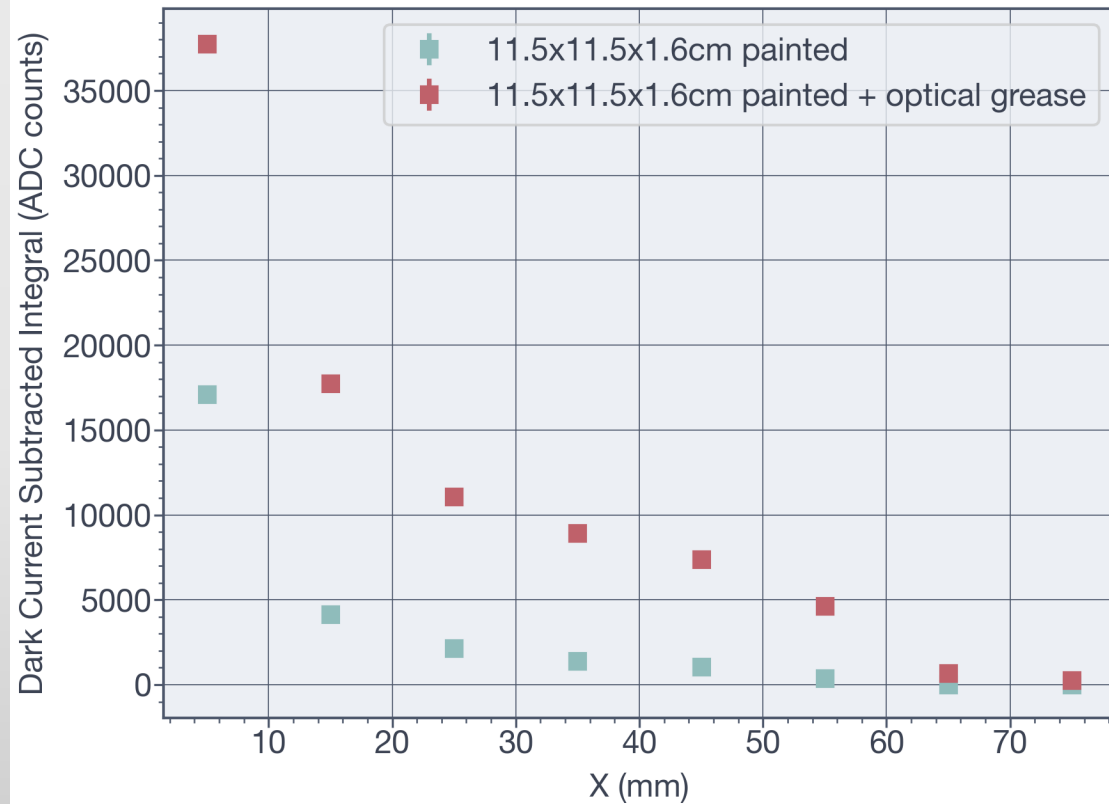
Diagonal Profiles



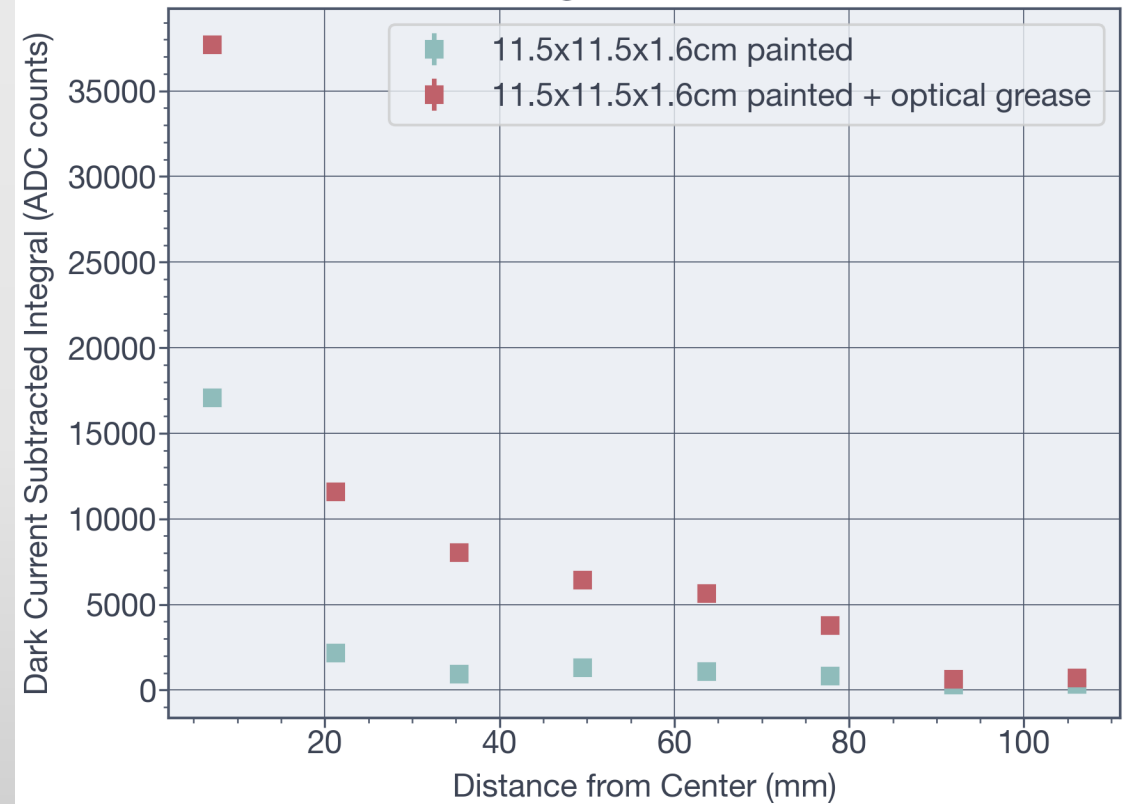
- ~3x higher yield than wrapped at center of the tile
  - ~10x higher yield at the edge
- Now add optical grease

# 11.5x11.5 painted w/ optical grease

Horizontal Profiles



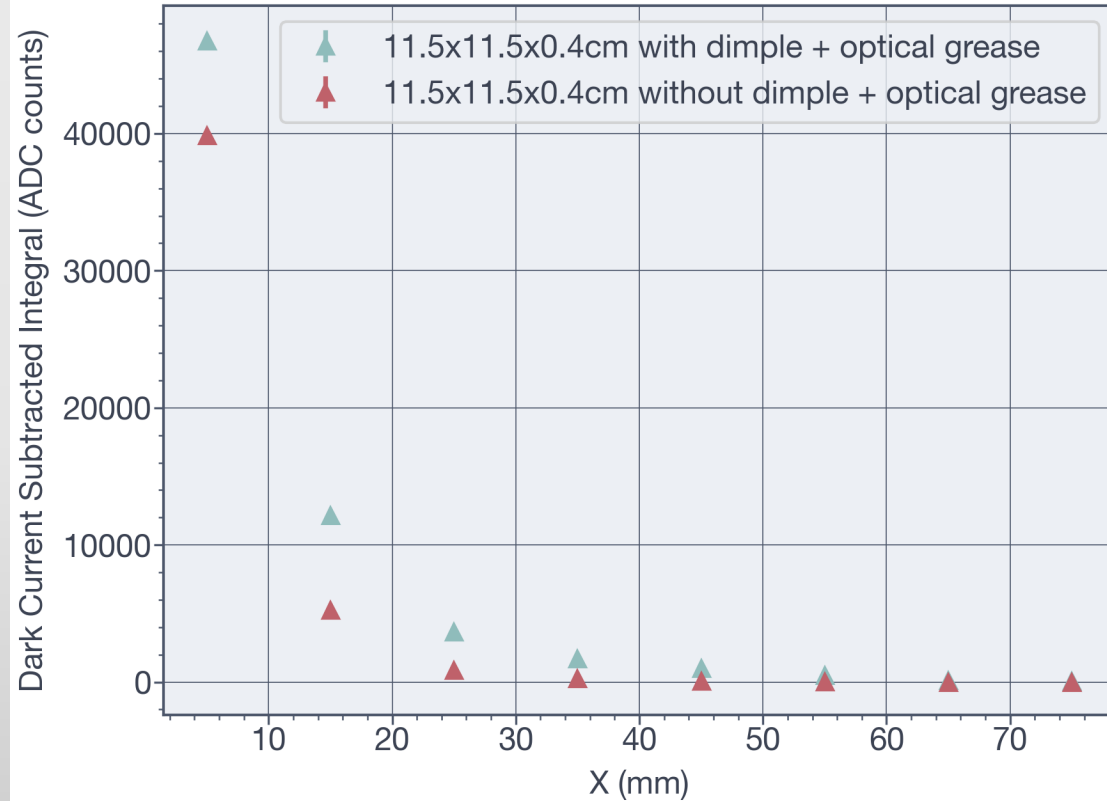
Diagonal Profiles



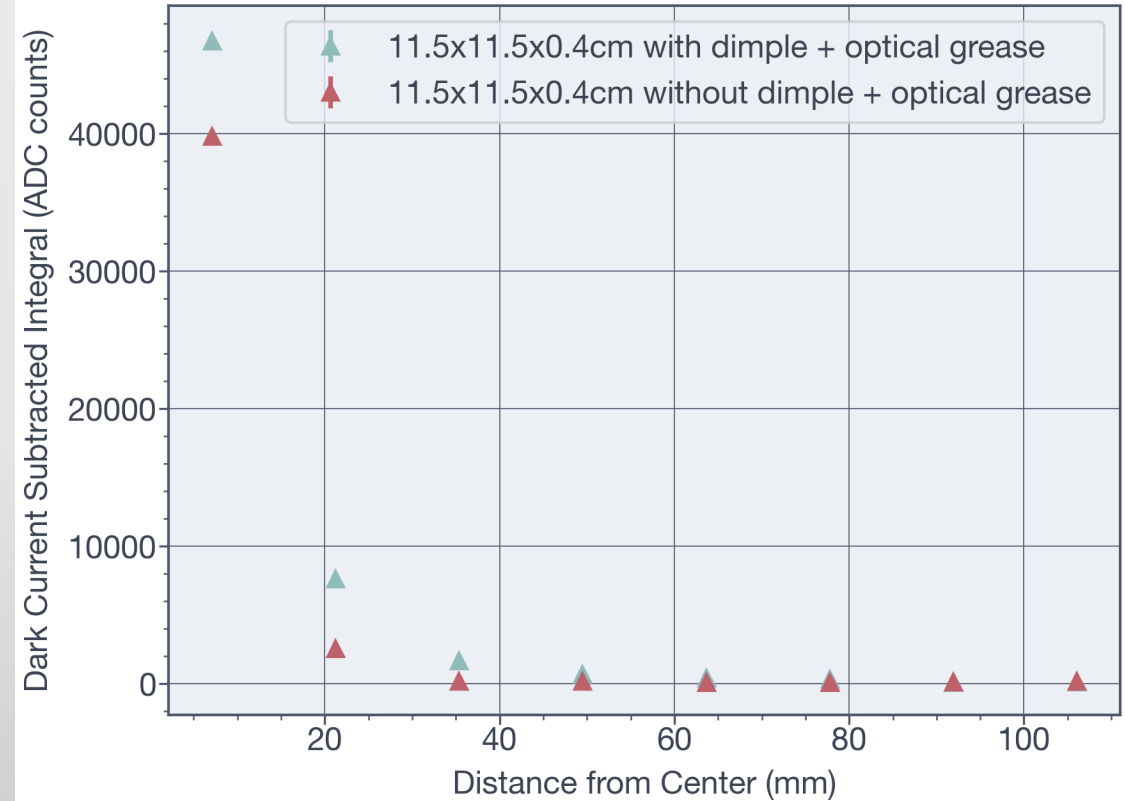
- Another >3x improvement!
- Painted tiles+optical grease seems very good!
- But still not very uniform->check out tiles with a dimple.

# 11.5x11.5x0.4 bare tile w/ optical grease

Horizontal Profiles

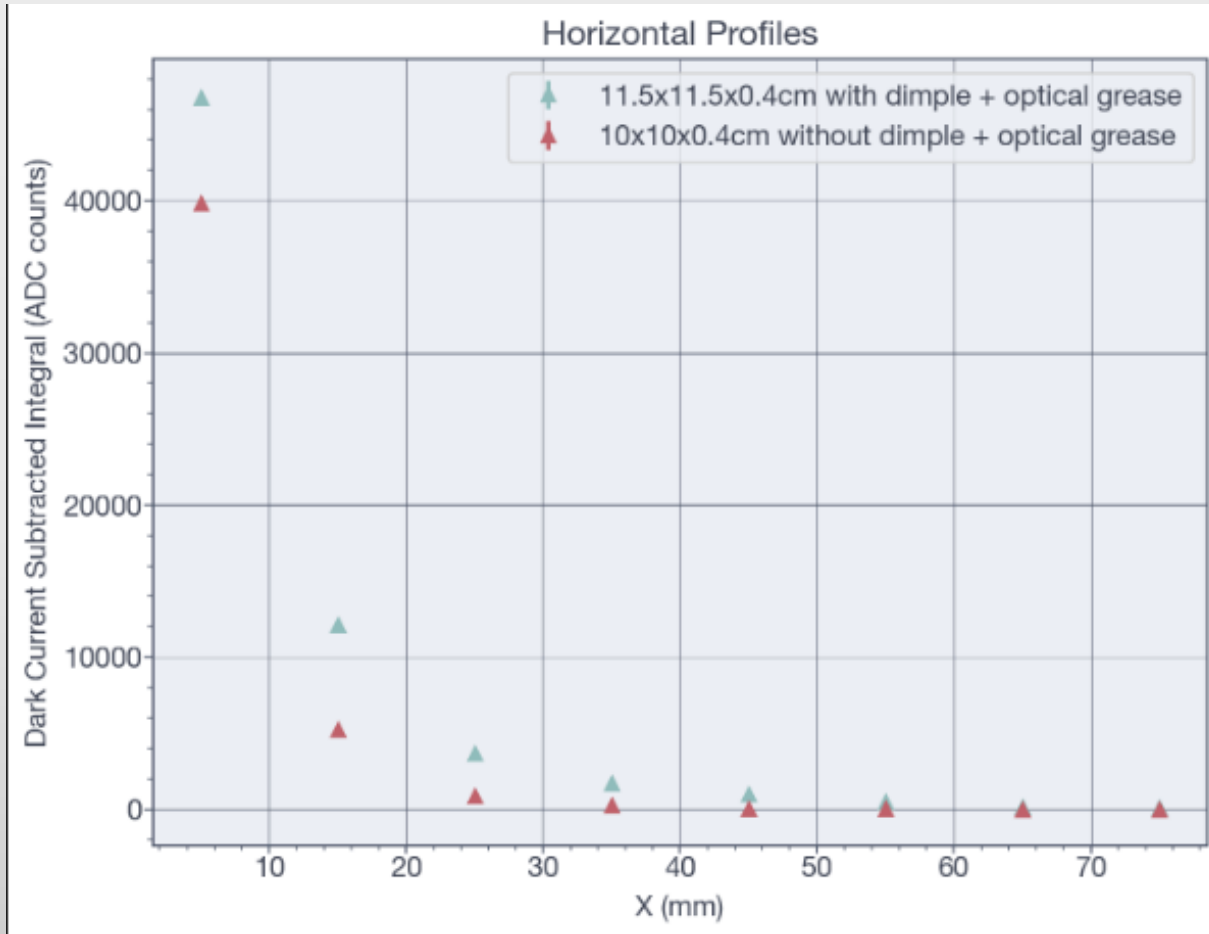


Diagonal Profiles

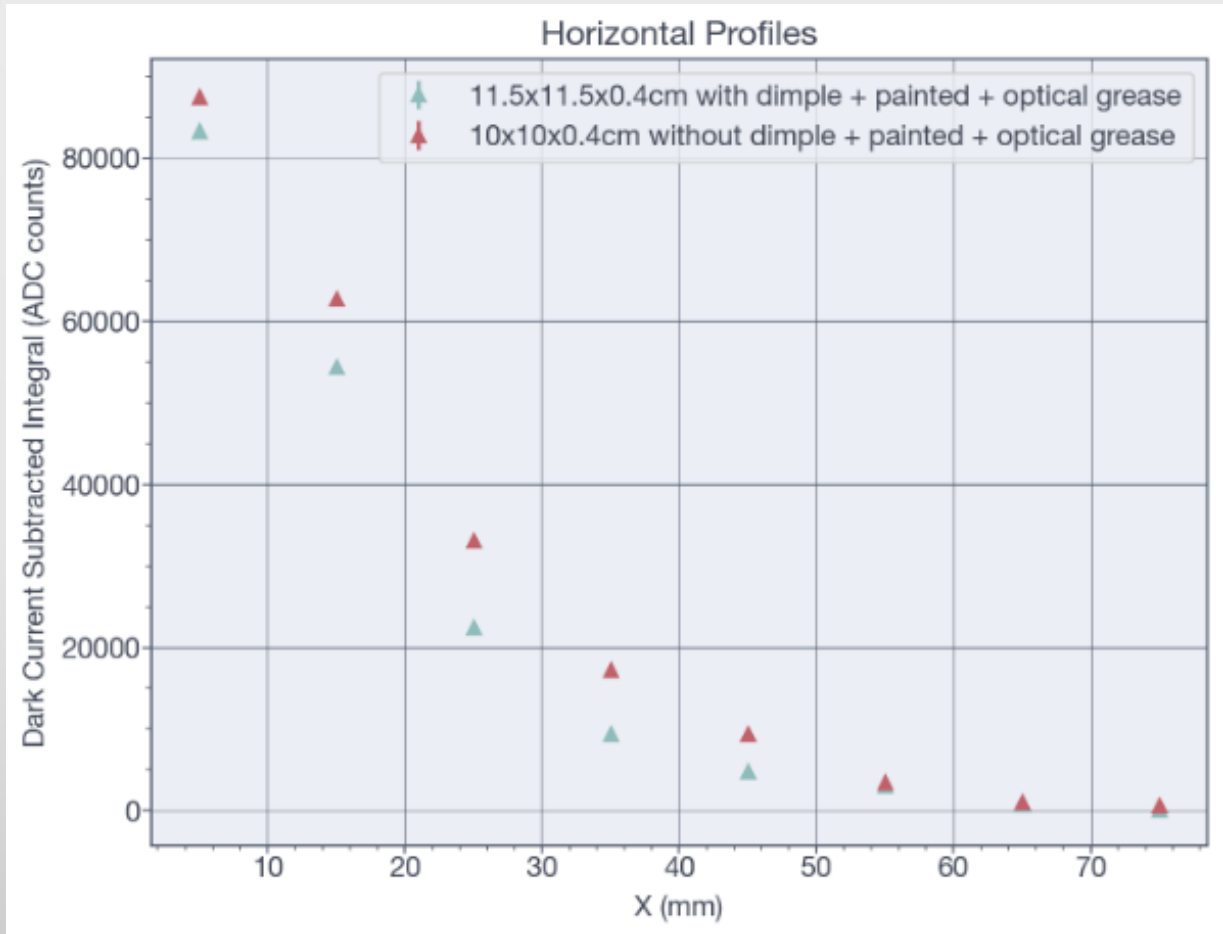


- Forthcoming: Wrap these, test again, then paint them. Also, various 5x5 tiles.

# Thin tiles with/without dimple

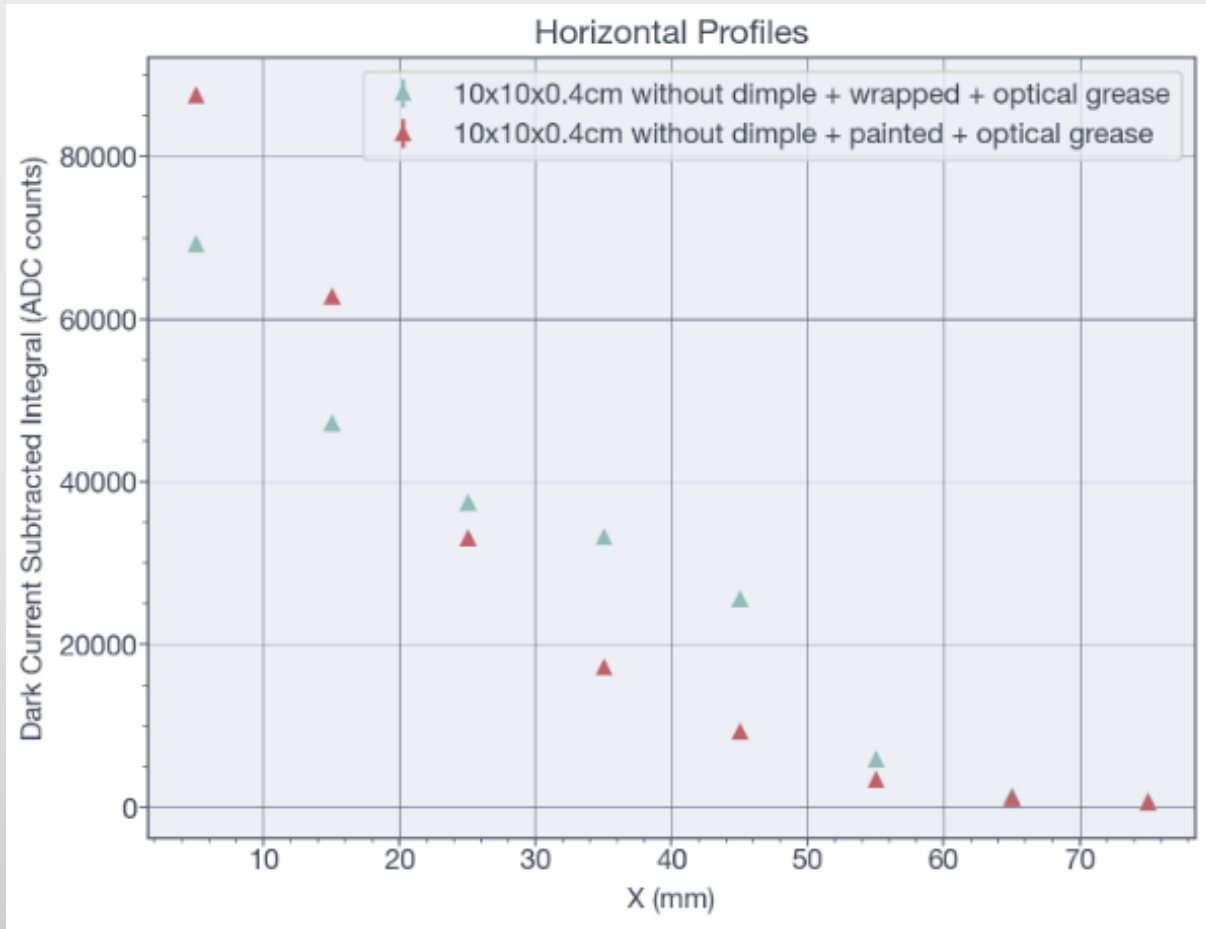


Bare tiles

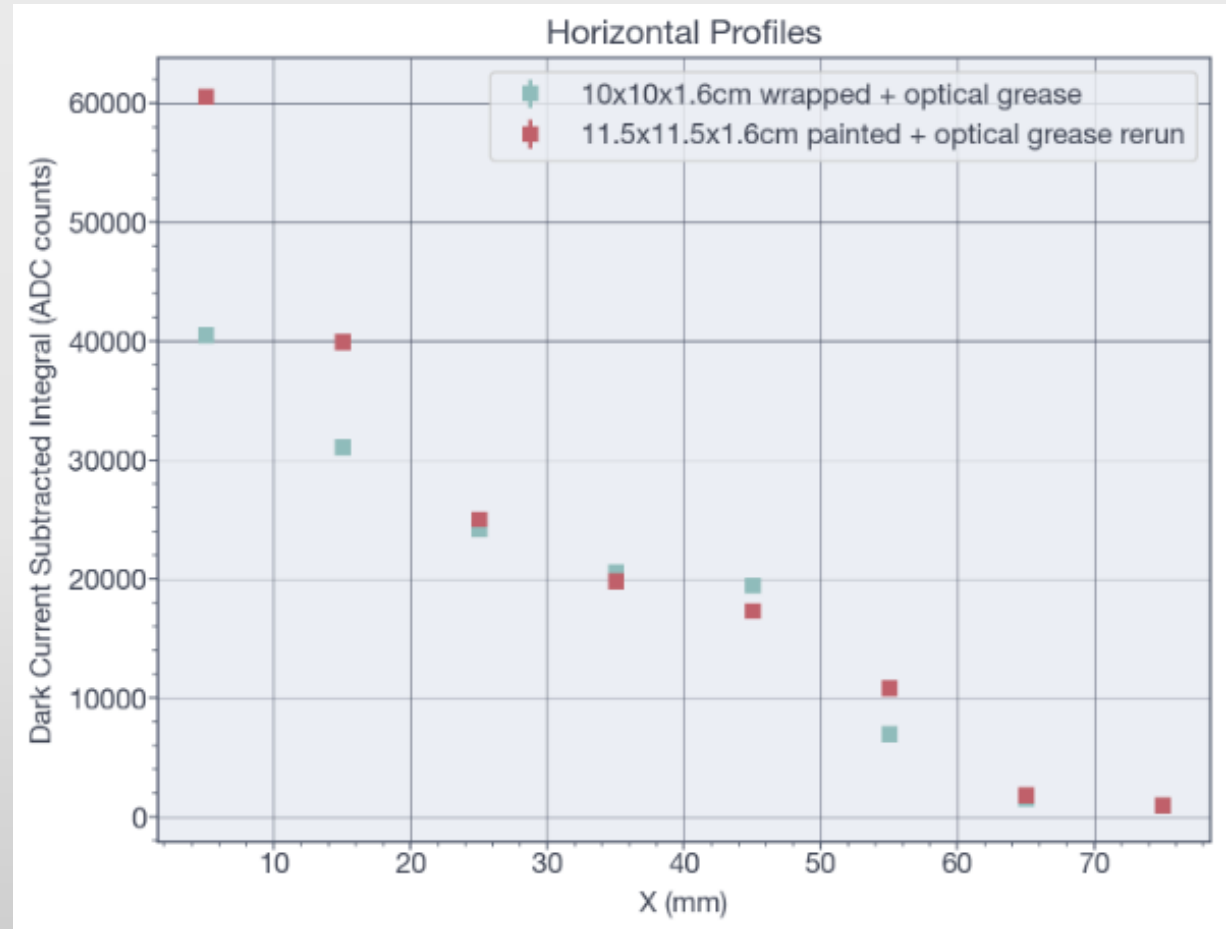


Painted tiles

# wrapped vs. painted w/ optical grease

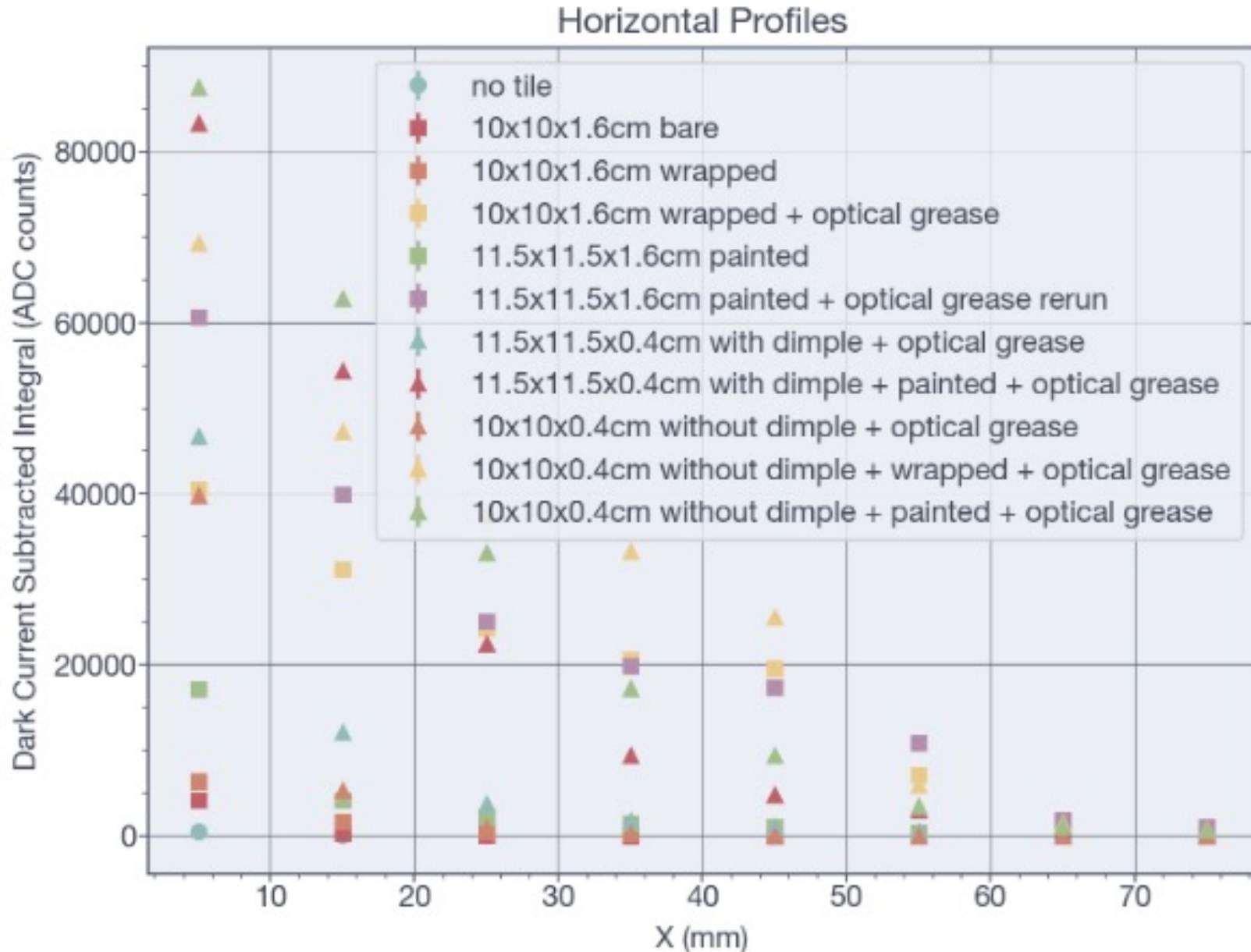


4mm tiles



16mm tiles

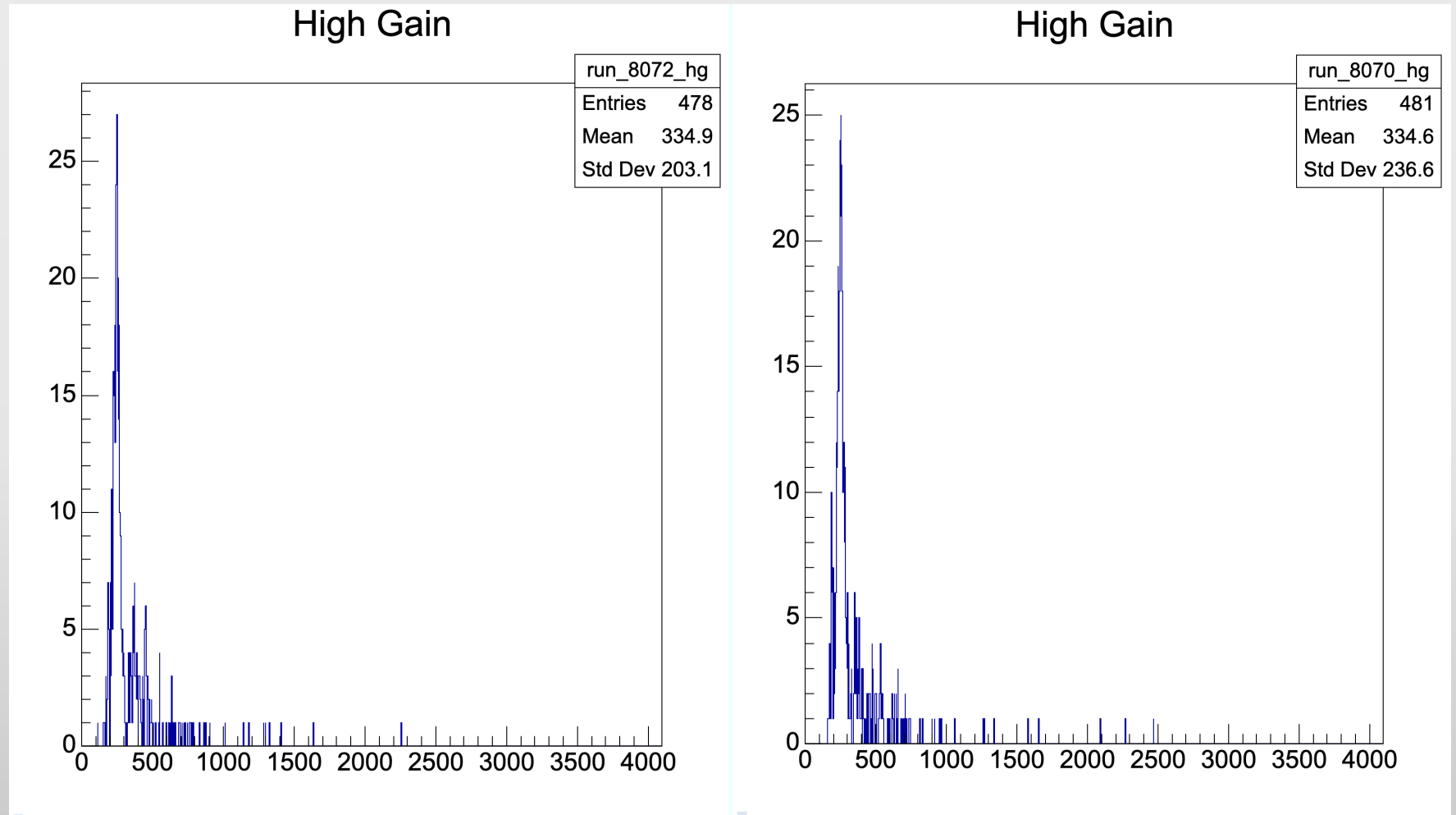
# Everything so far



Obviously hard to read like this; please request whatever subset you'd like to see, and I will pull up my plotting notebook

# Noise measurements

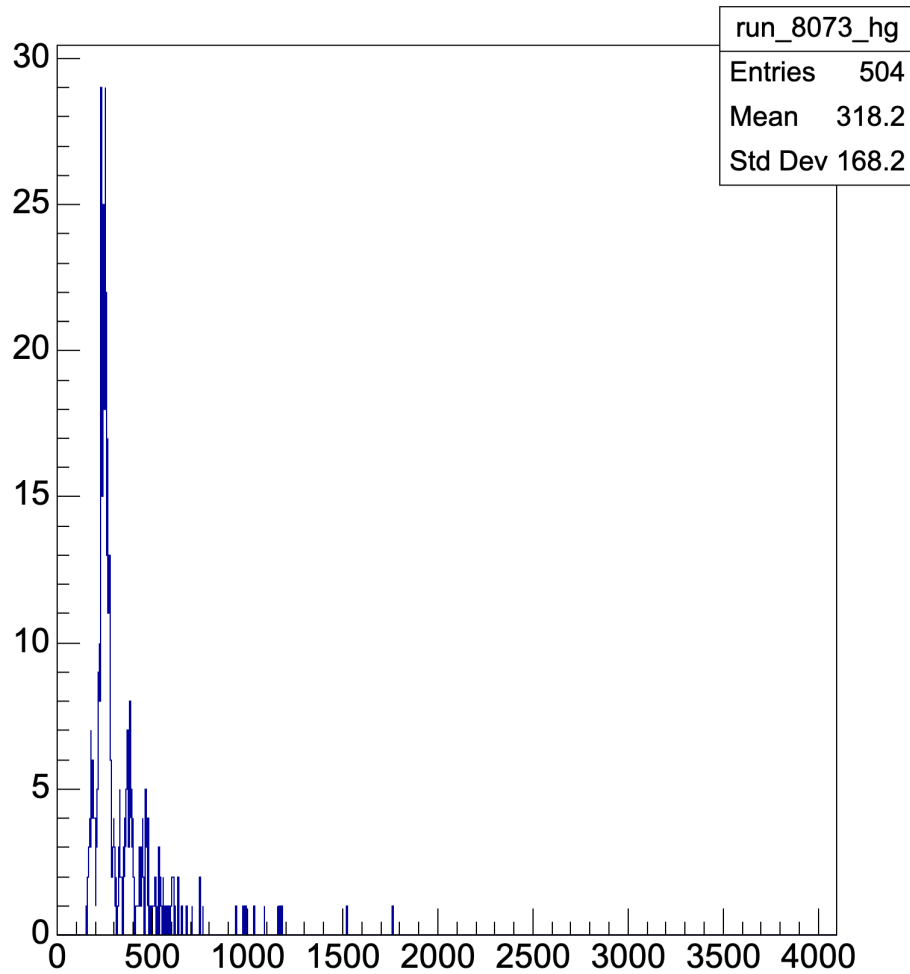
- 2 noise measurements, 5min exposure.
- Repeat with different sources of extra light leaking in to see size of effect



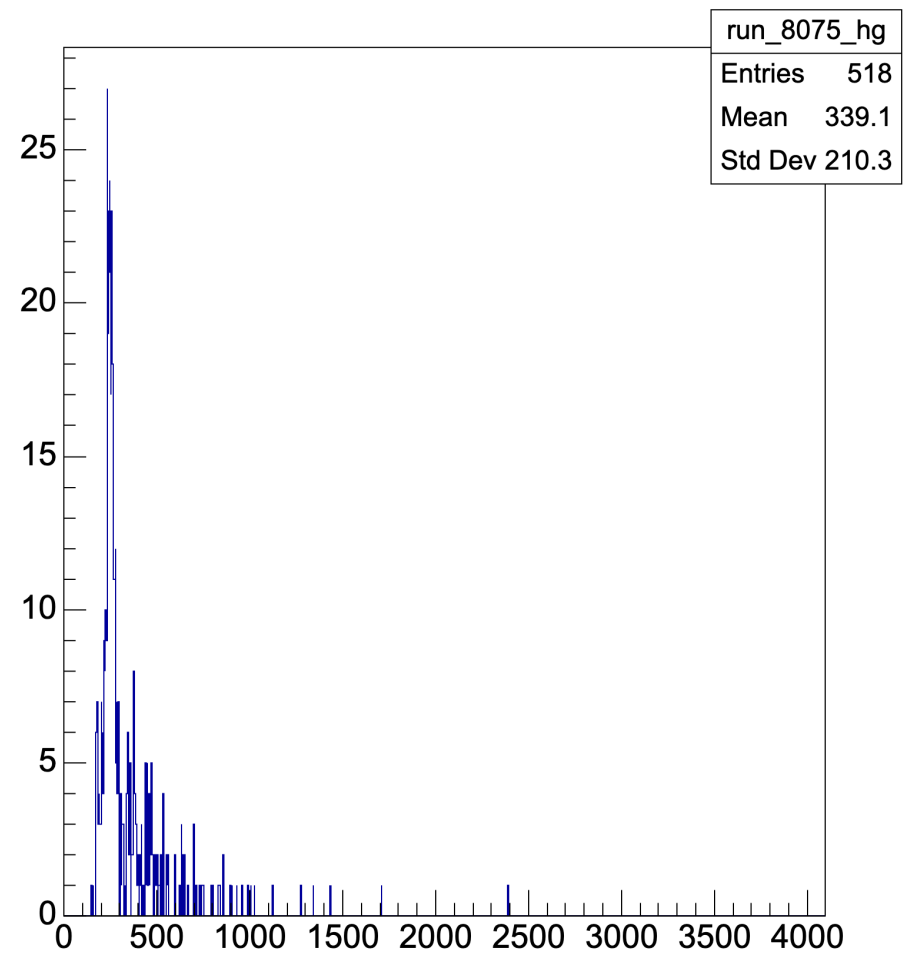
This run: as little light as we can with current setup

# Noise Measurements

High Gain

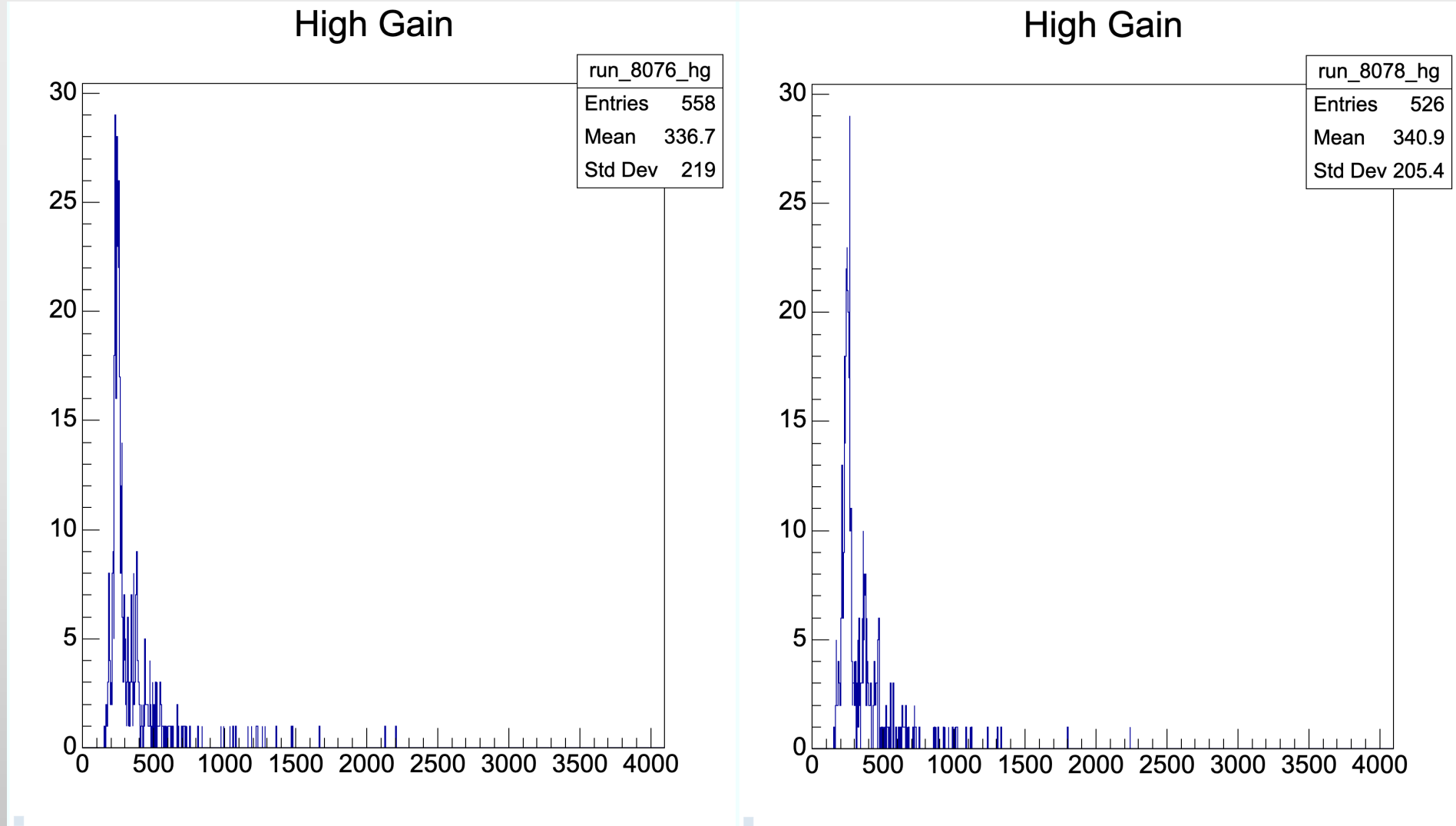


High Gain



Nearby computer monitor left on

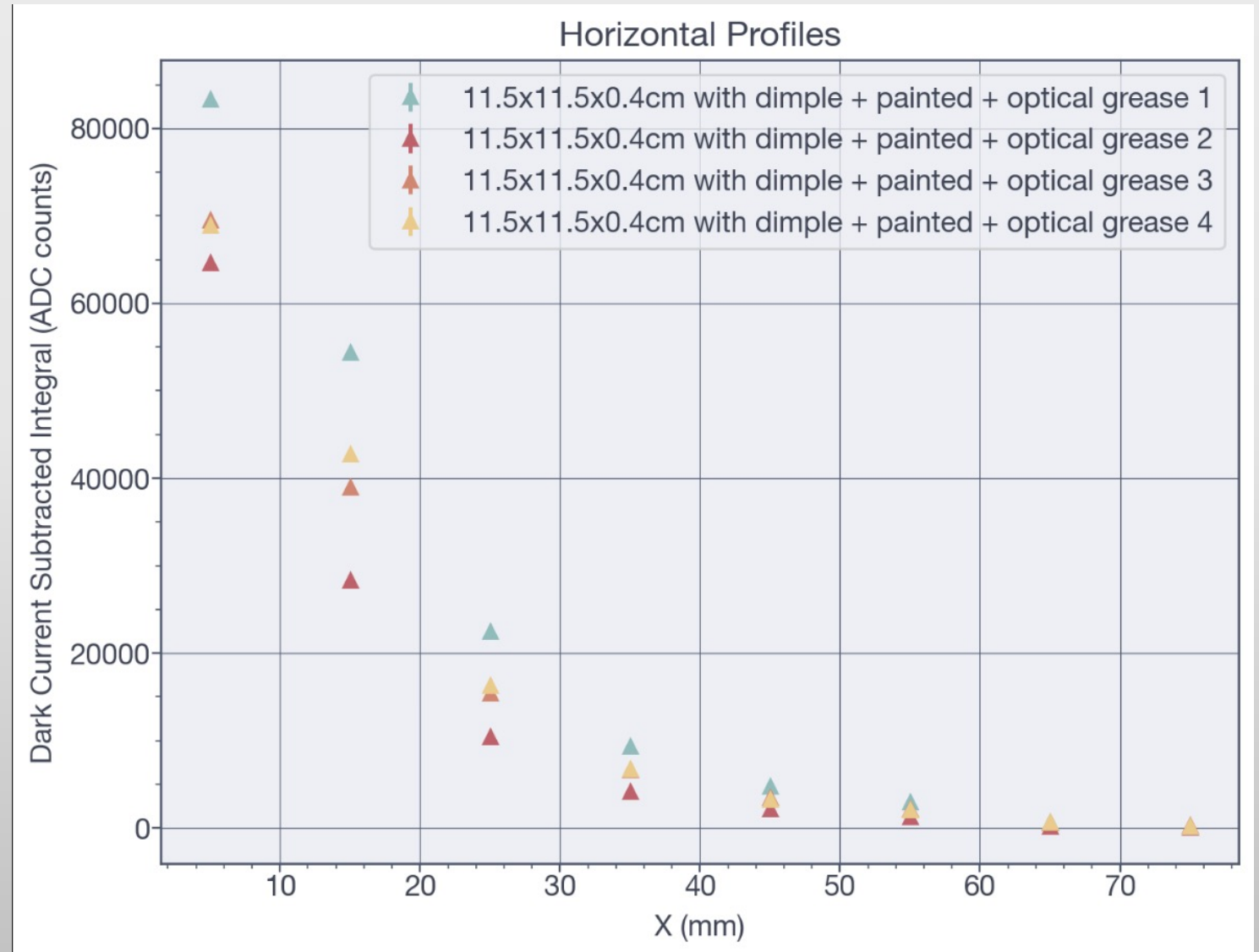
# Noise Measurements



Flashlight left on ~20 ft from test setup

# Reproducibility

- We have some inconsistency occurring when we retake data.
- Currently investigating. Here are my examples.



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