

OSU Light Collection

7/6/26

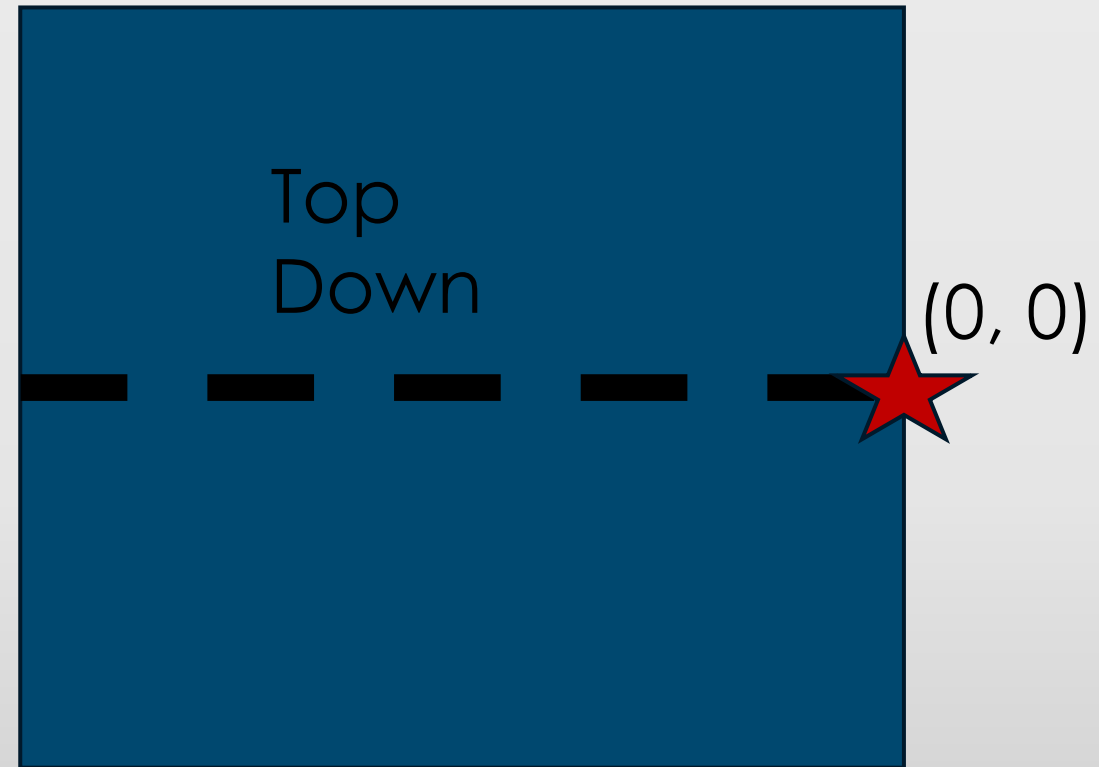
Sam Corey



THE OHIO STATE UNIVERSITY

SiPM on Edge Setup

- SiPM positioned at $(0, 0)$
- Move Sr90 source to positions along dashed line.
- 120 second exposures, check noise before and after collecting.
- Subtract noise from each ADC spectrum, integrate for yield.



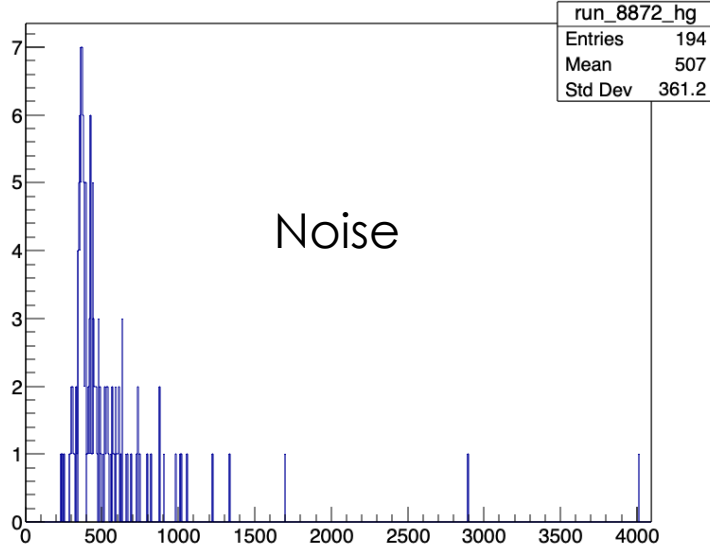
Edge On



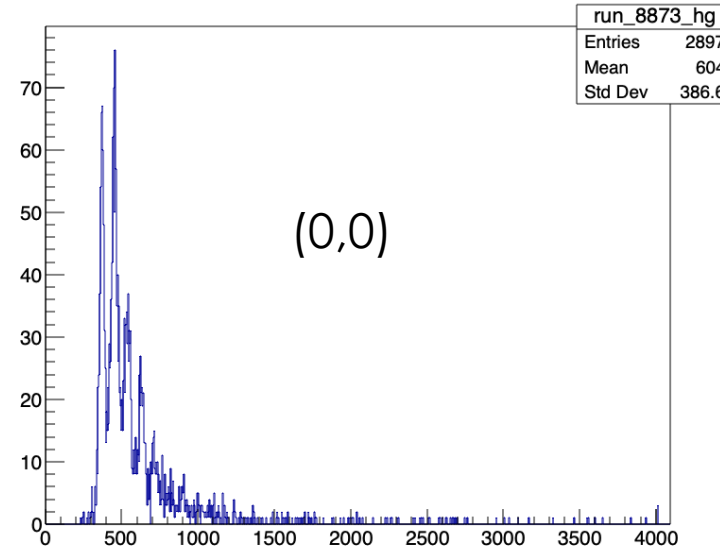
SiPM facing into the edge

Example ADC

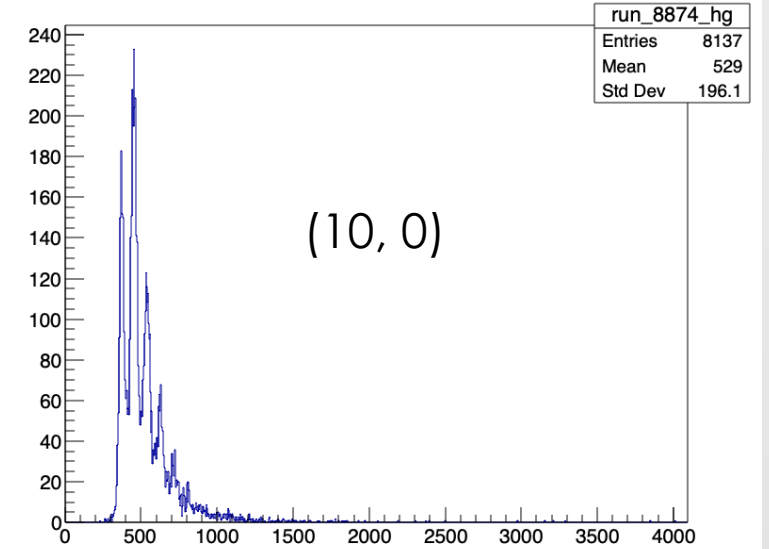
High Gain



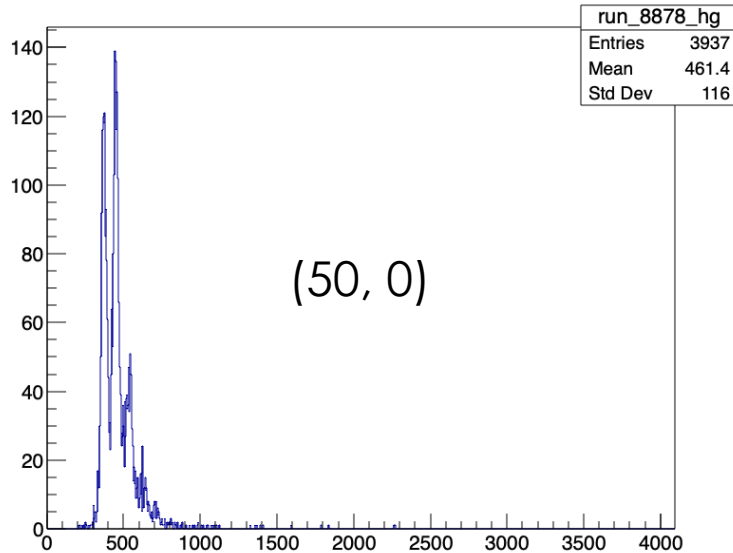
High Gain



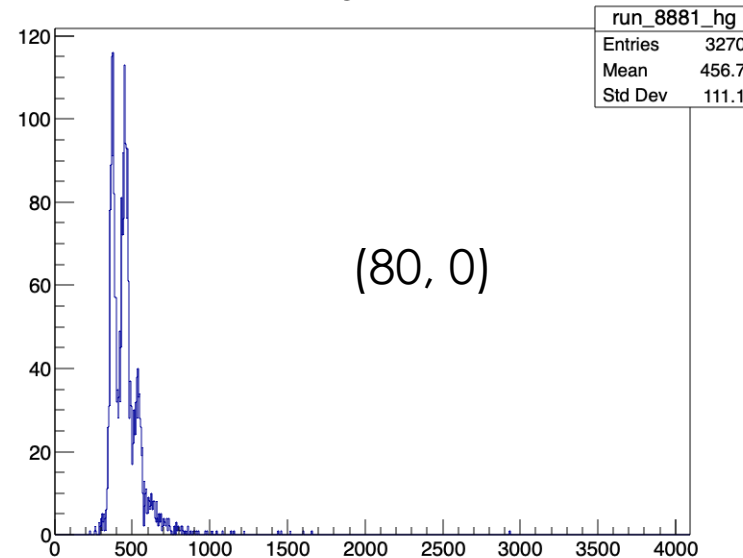
High Gain



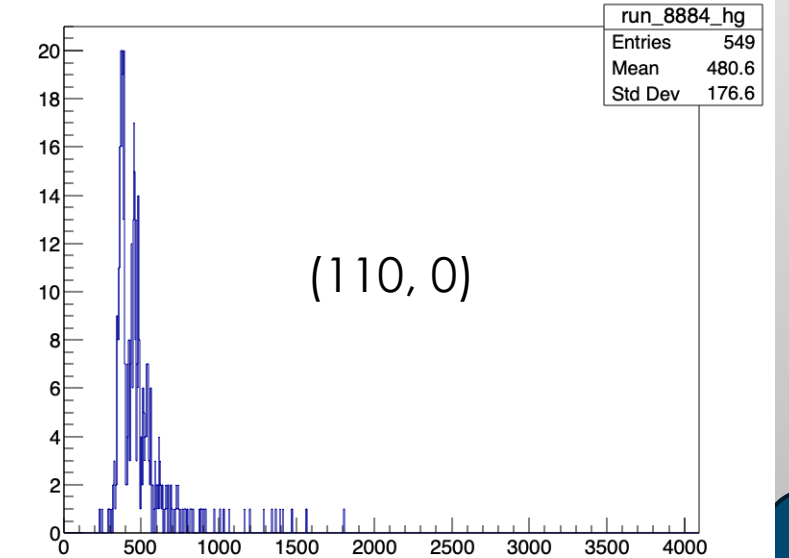
High Gain



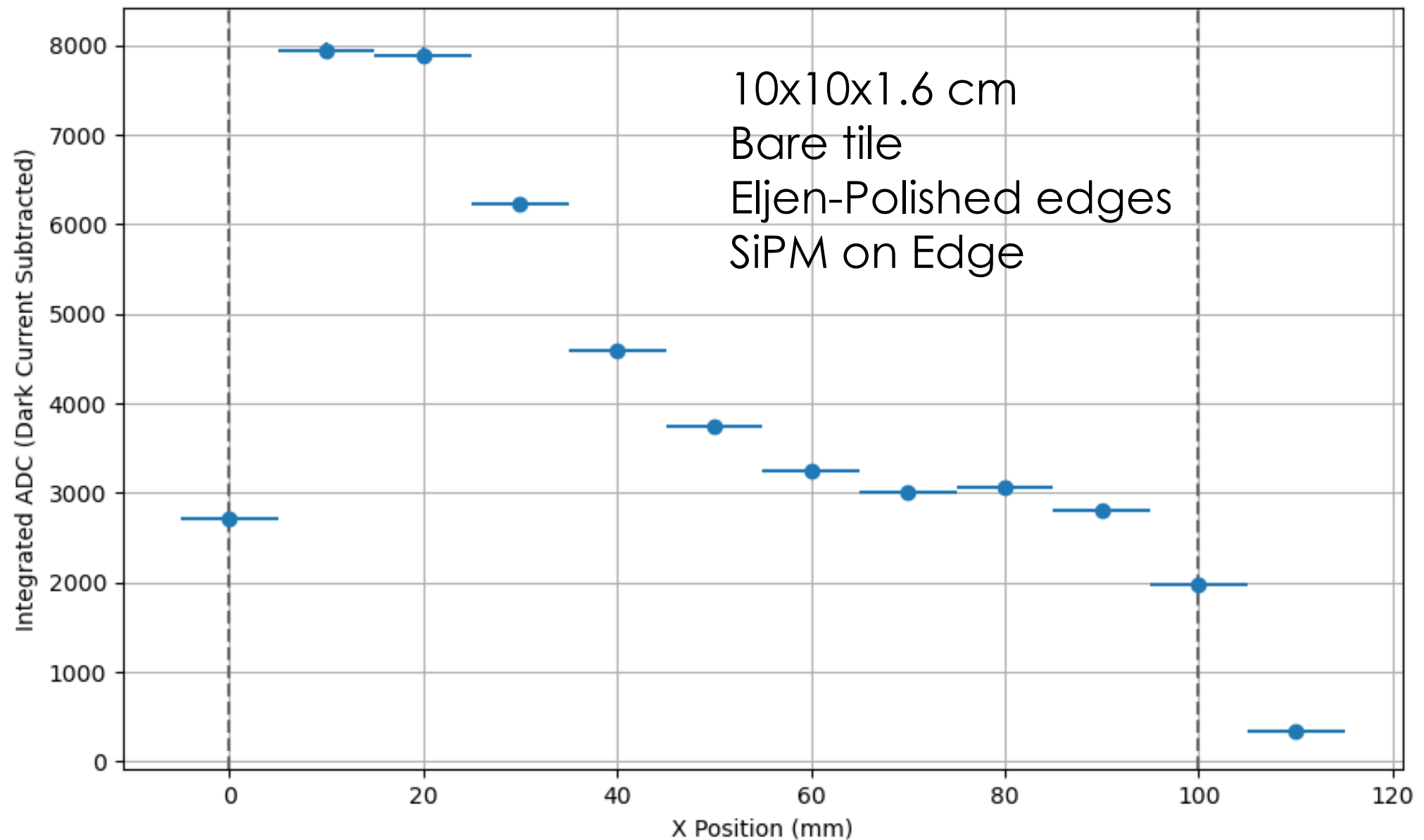
High Gain



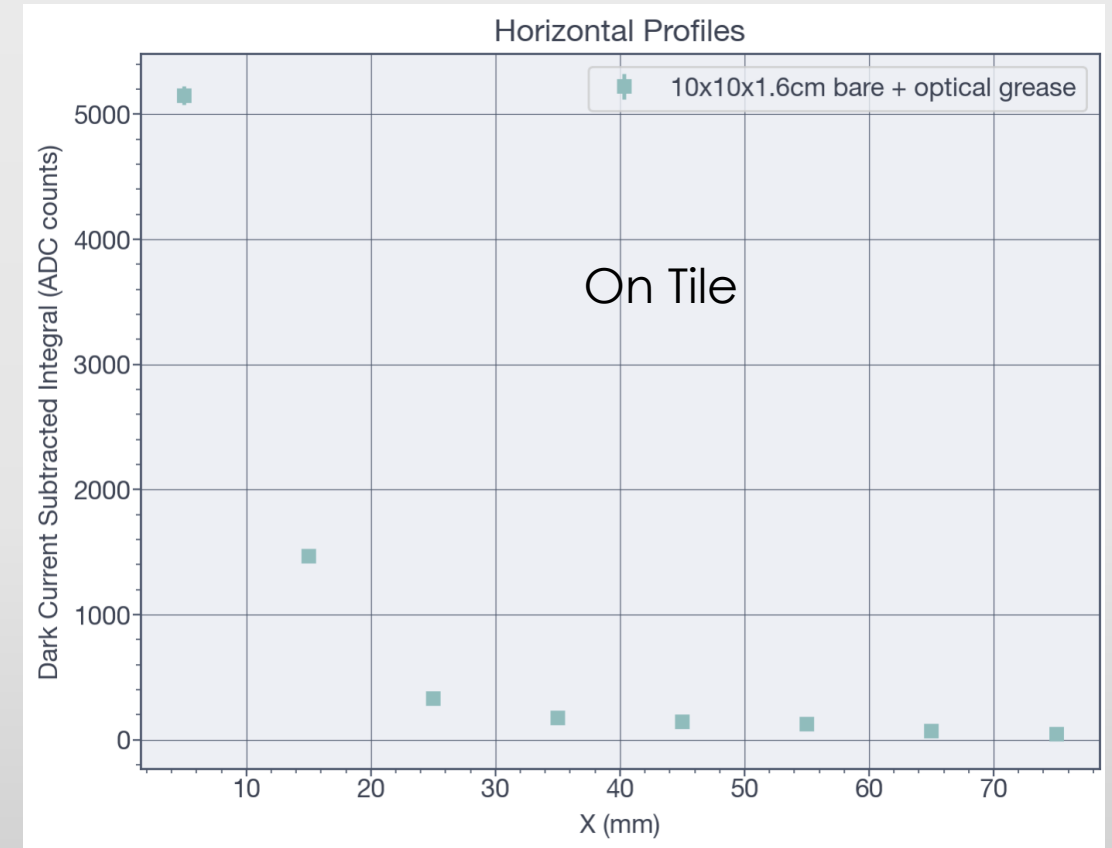
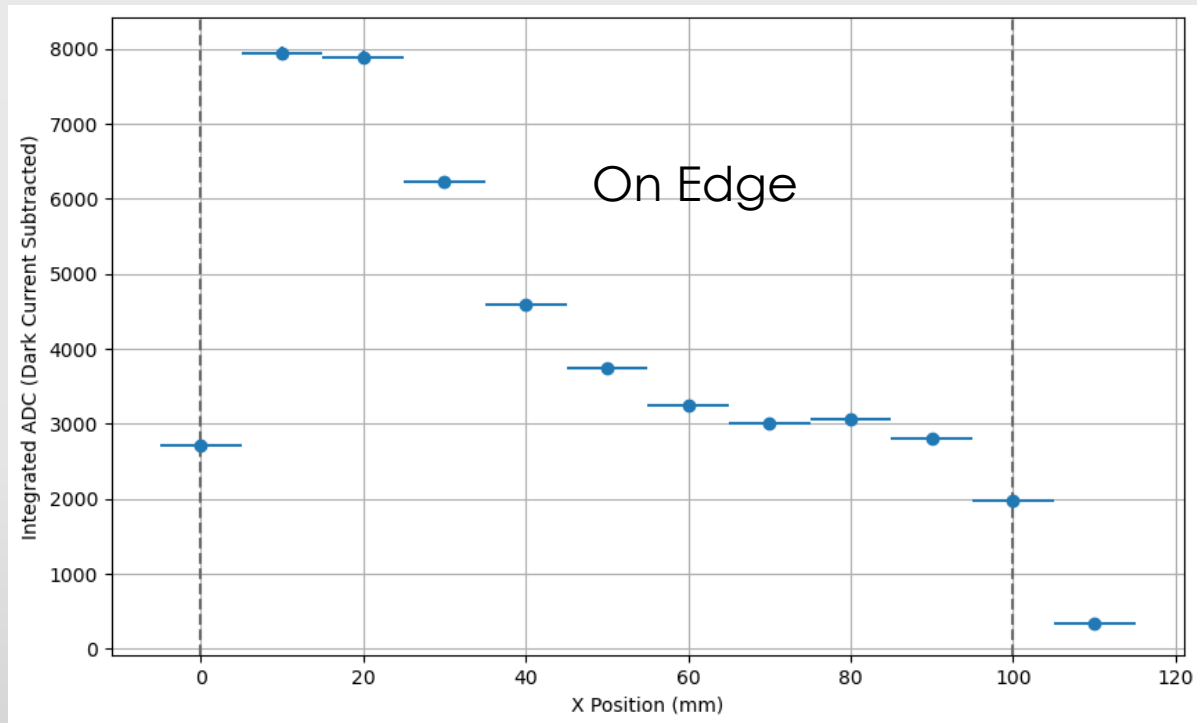
High Gain



Yield vs. position



Comparison to SiPM on Tile



- Same tile, with SiPM in different positions
- Next steps: 5x5x1.6 bare tile, get wrapping and polishing materials for wrapped, painted comparisons.

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.

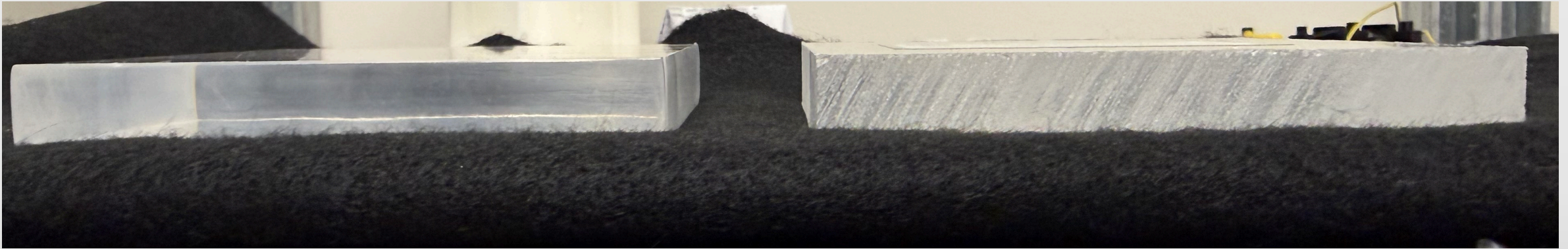
- 3 5x5x0.4
- 2 5x5x0.8
- 1 5x5x0.8 with dimple
- 3 5x5x1.6
- 1 10x10x0.4
- 1 10x10x0.4 with dimple
- 3 10x10x0.8
- 3 10x10x1.6

About ~2cm
extra material
in x,y

Will show results from this one today

Polishing the unpolished tiles

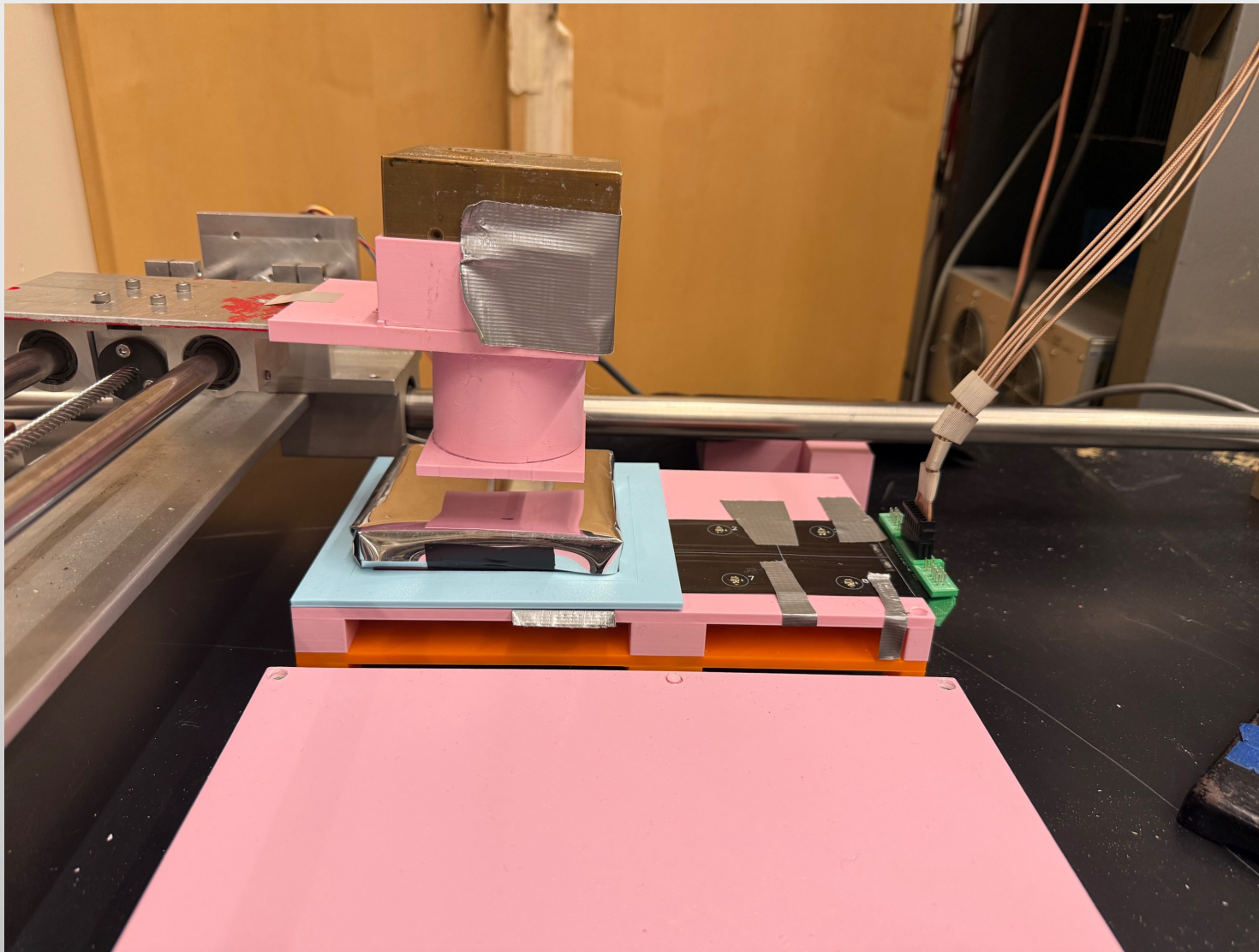
- Recently started polishing some of the un-milled tiles by hand.
- Here's an example



Polished

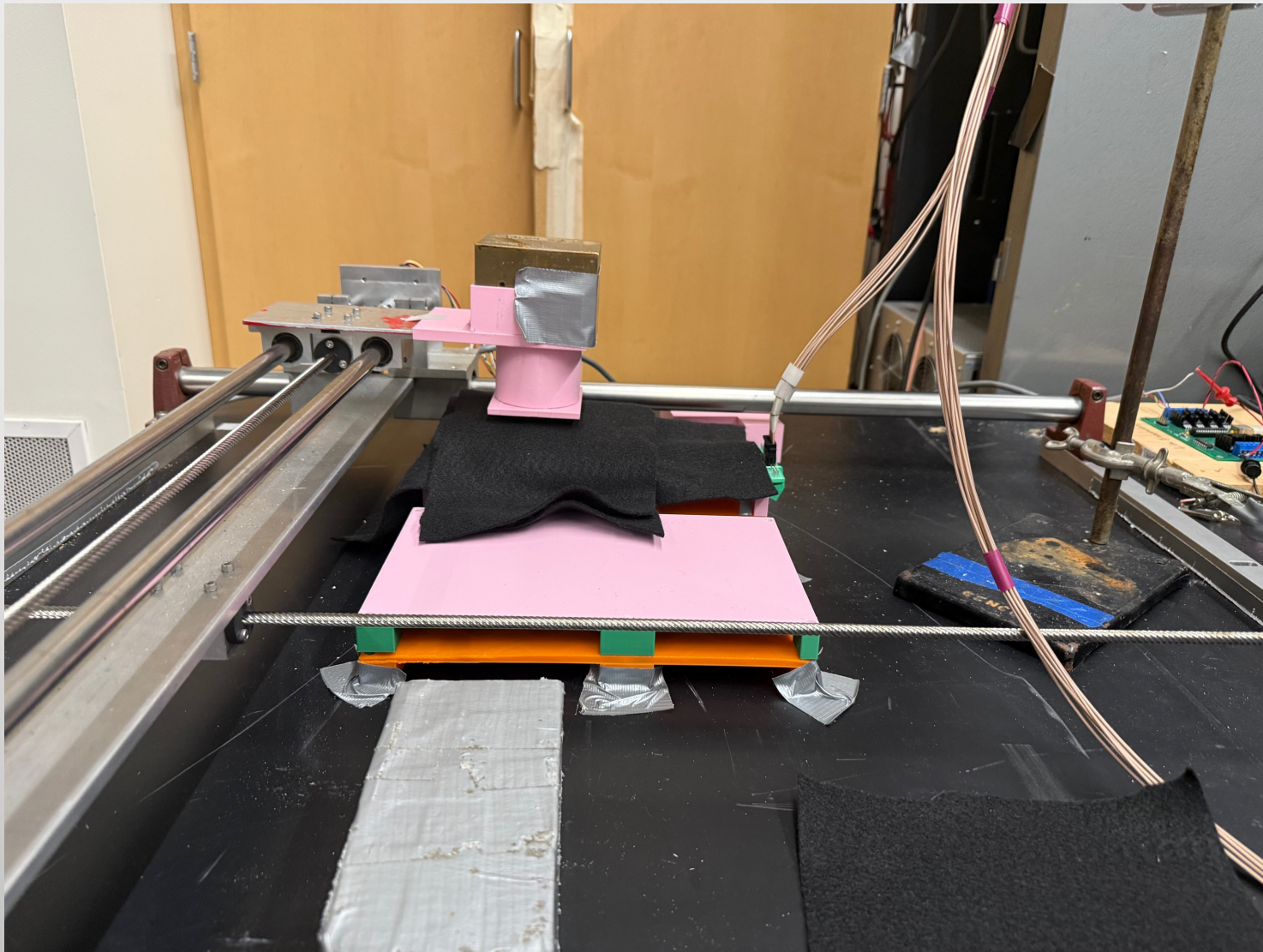
Original

Lab setup



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

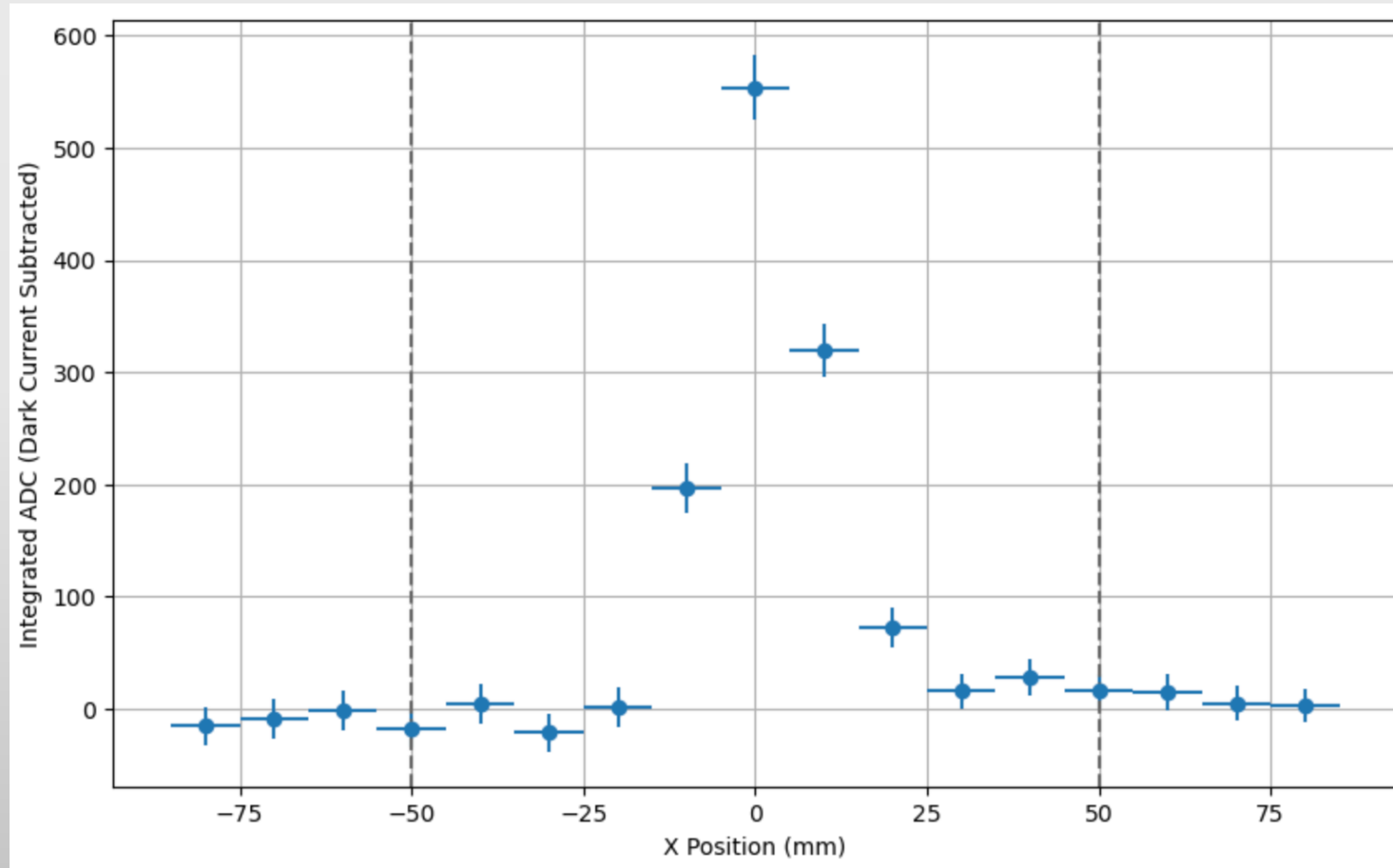
Lab setup (pt 2)



- 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:



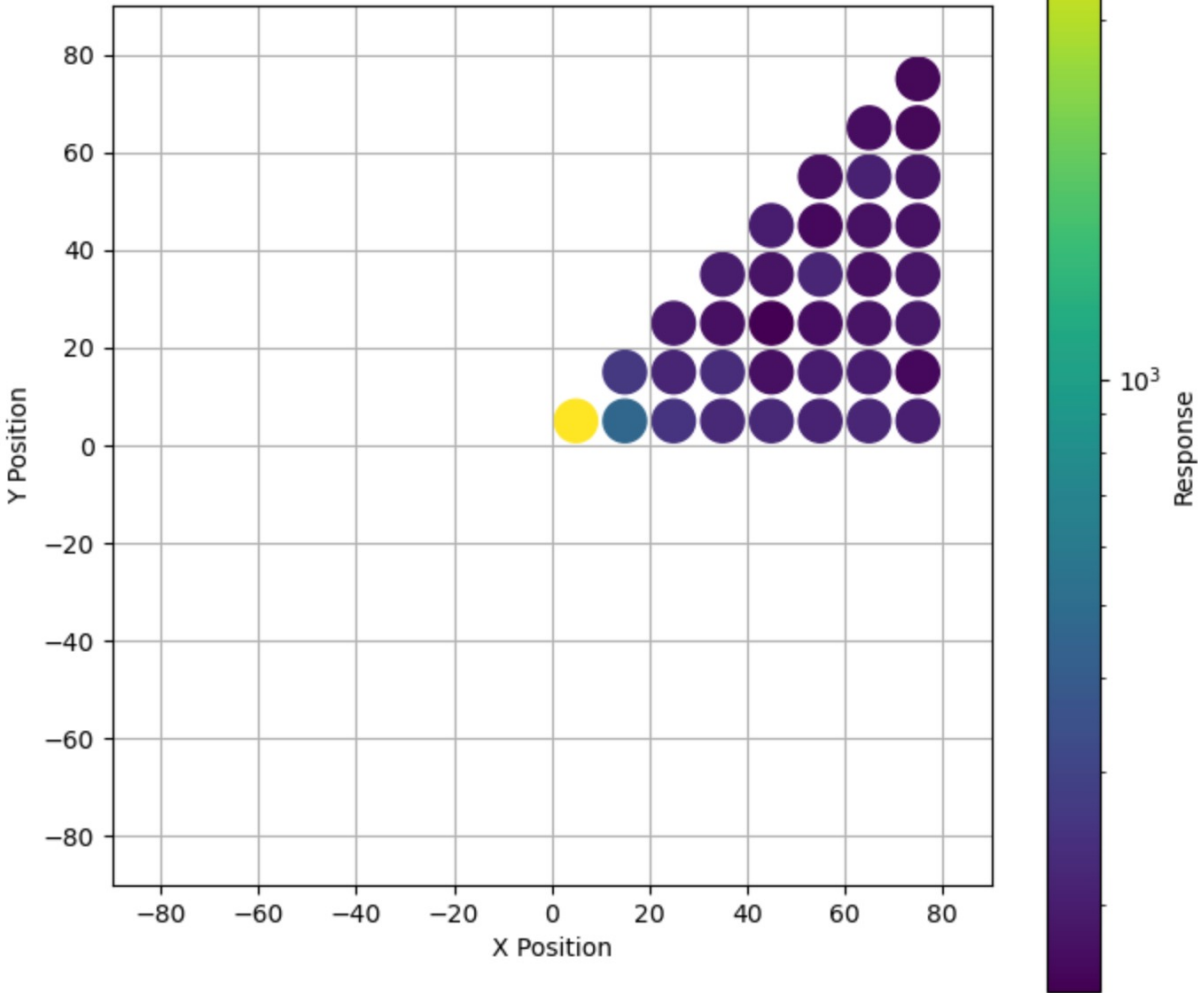
Vertical lines=edge of the tile

Results from unwrapped, polished 10x10 tile

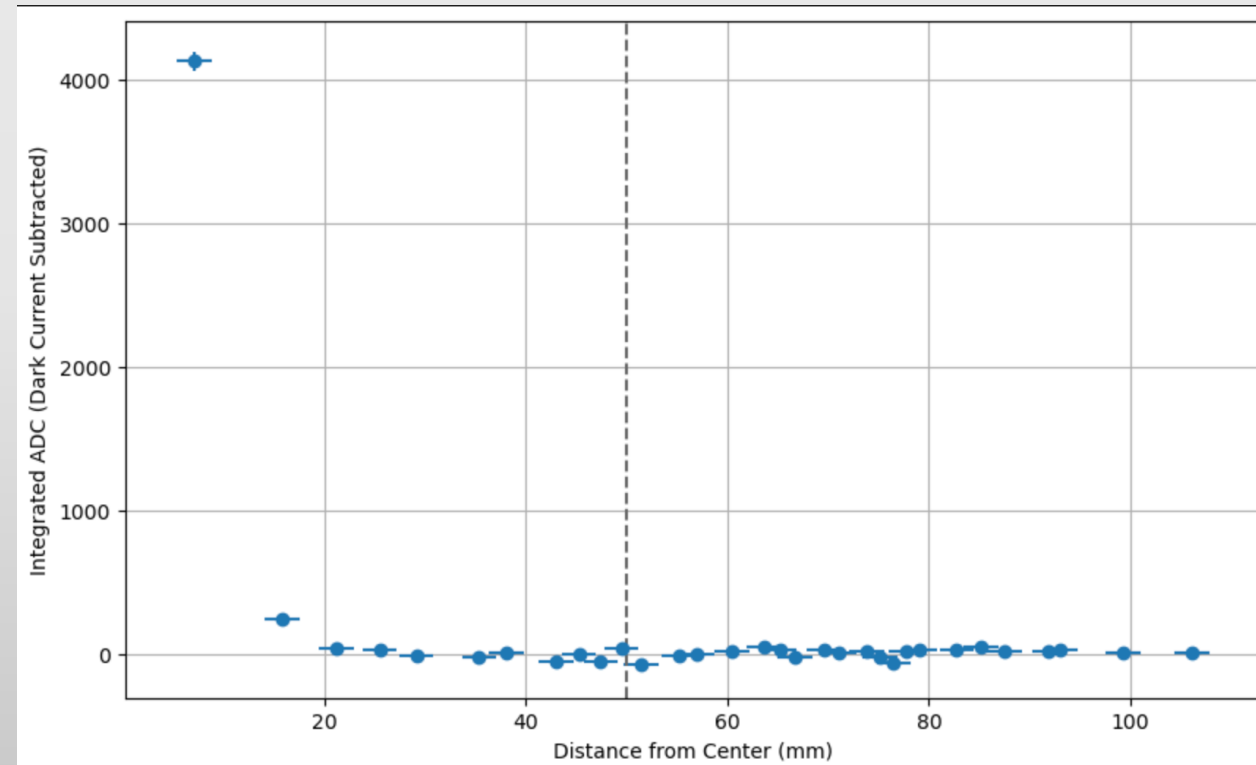
- 1/8th grid scan

X vs. y vs. yield

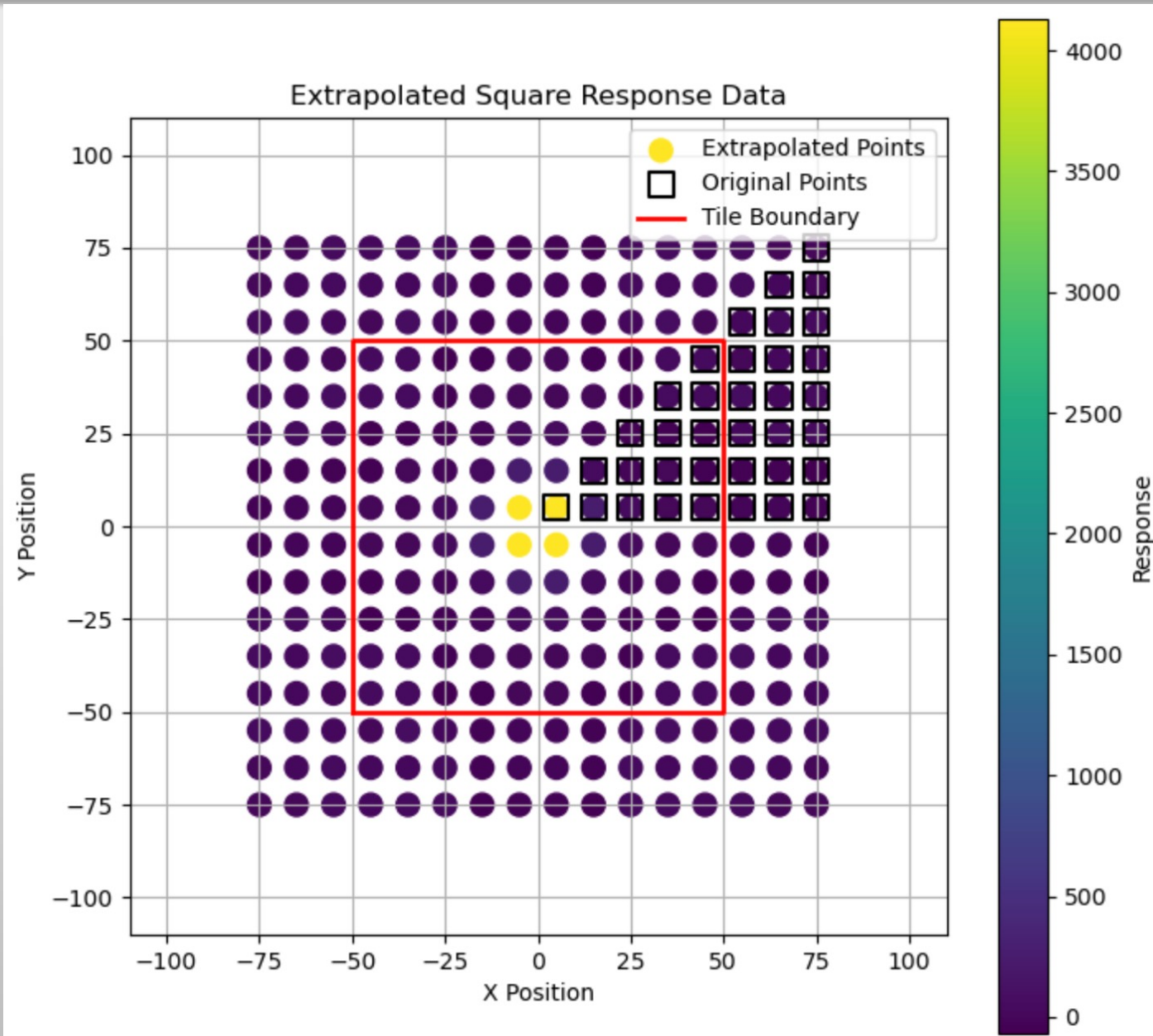
Original Square Response Data



$\sqrt{x^2 + y^2}$ vs yield

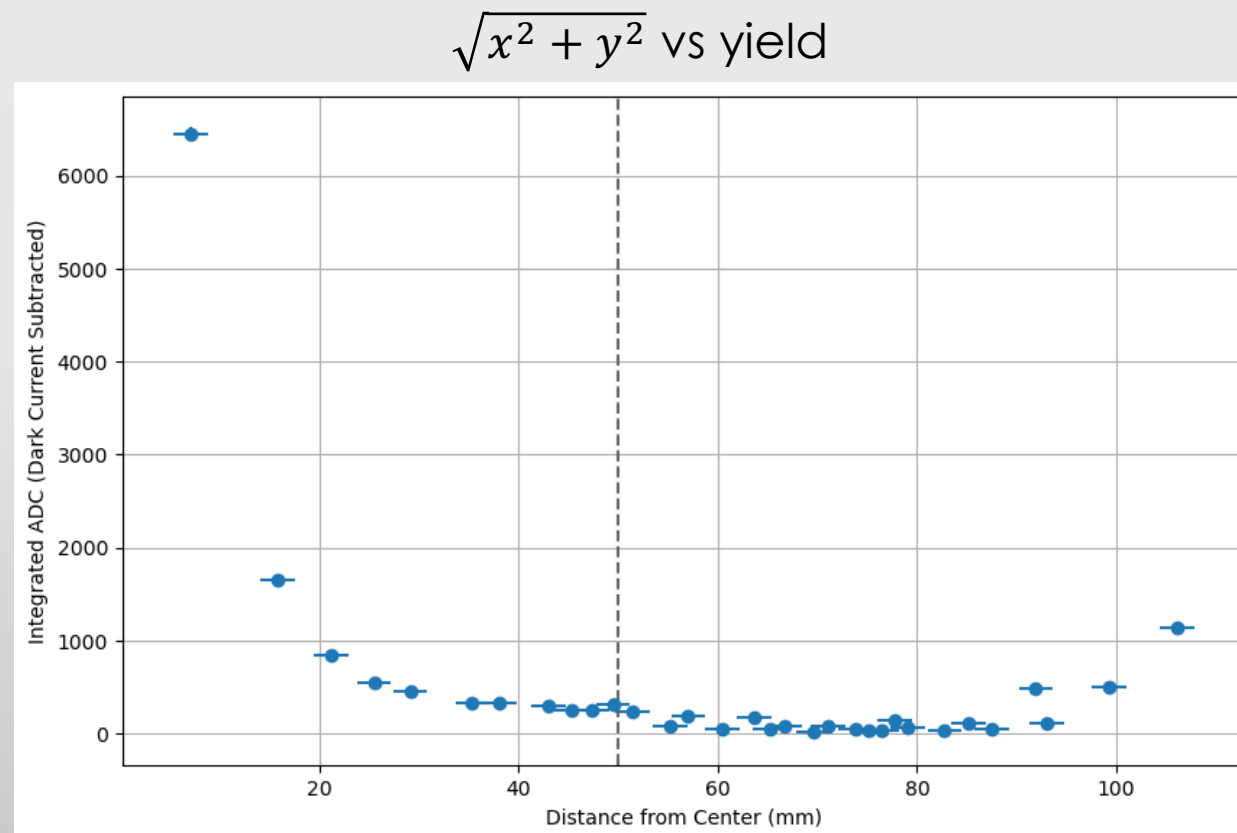
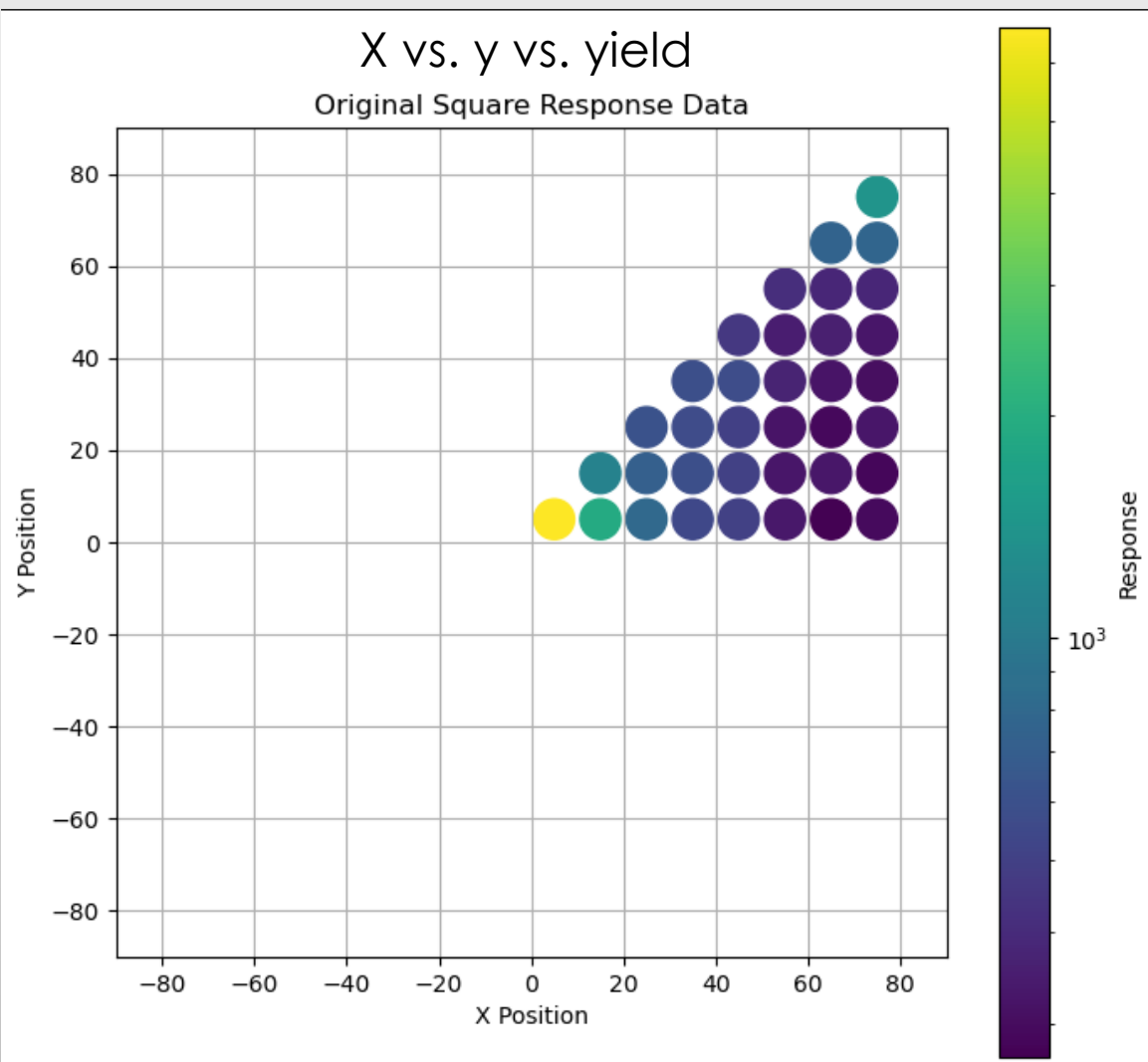


Heatmap from exploiting square symmetry



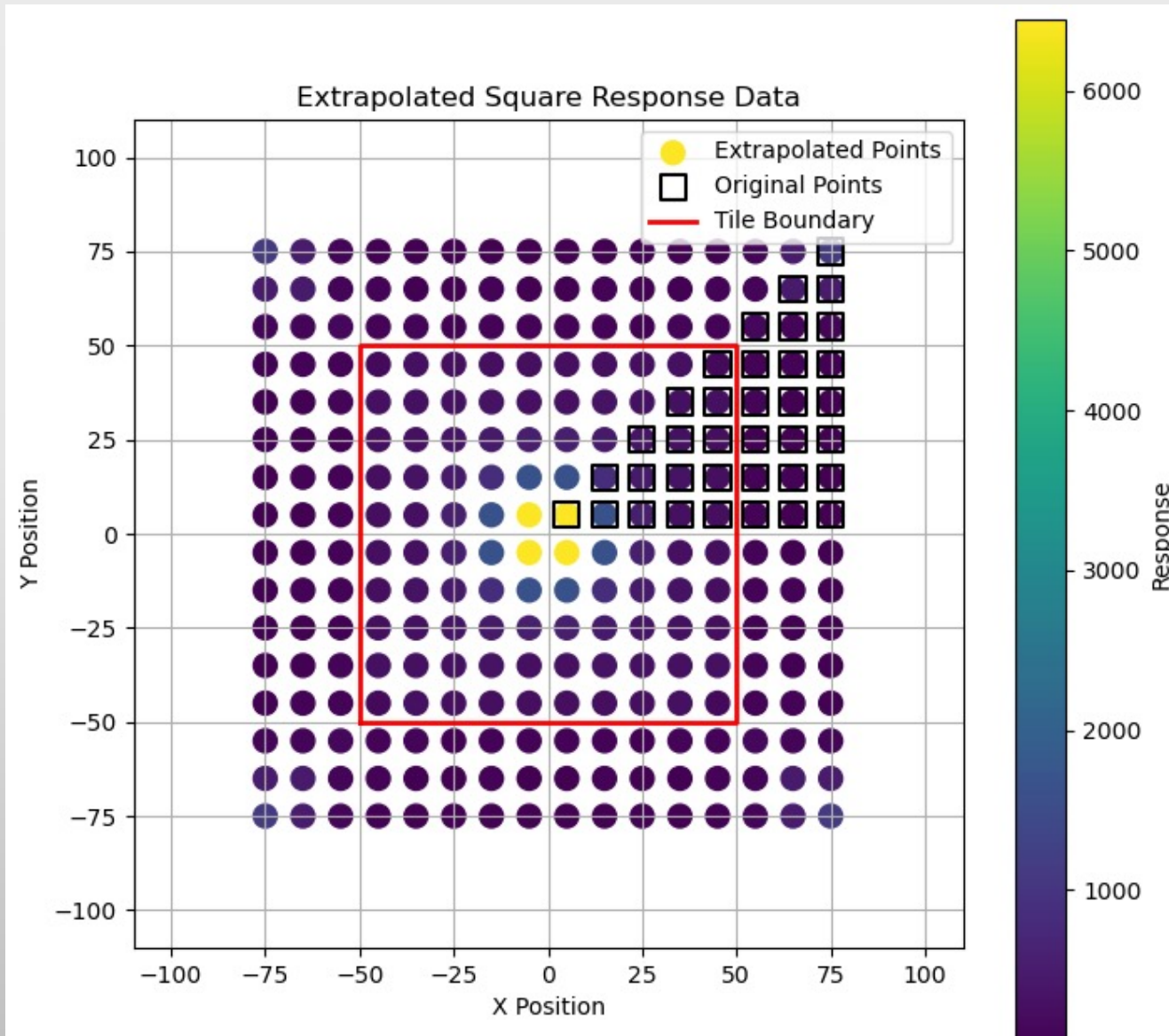
Results from wrapped, polished 10x10 tile

- 1/8th 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



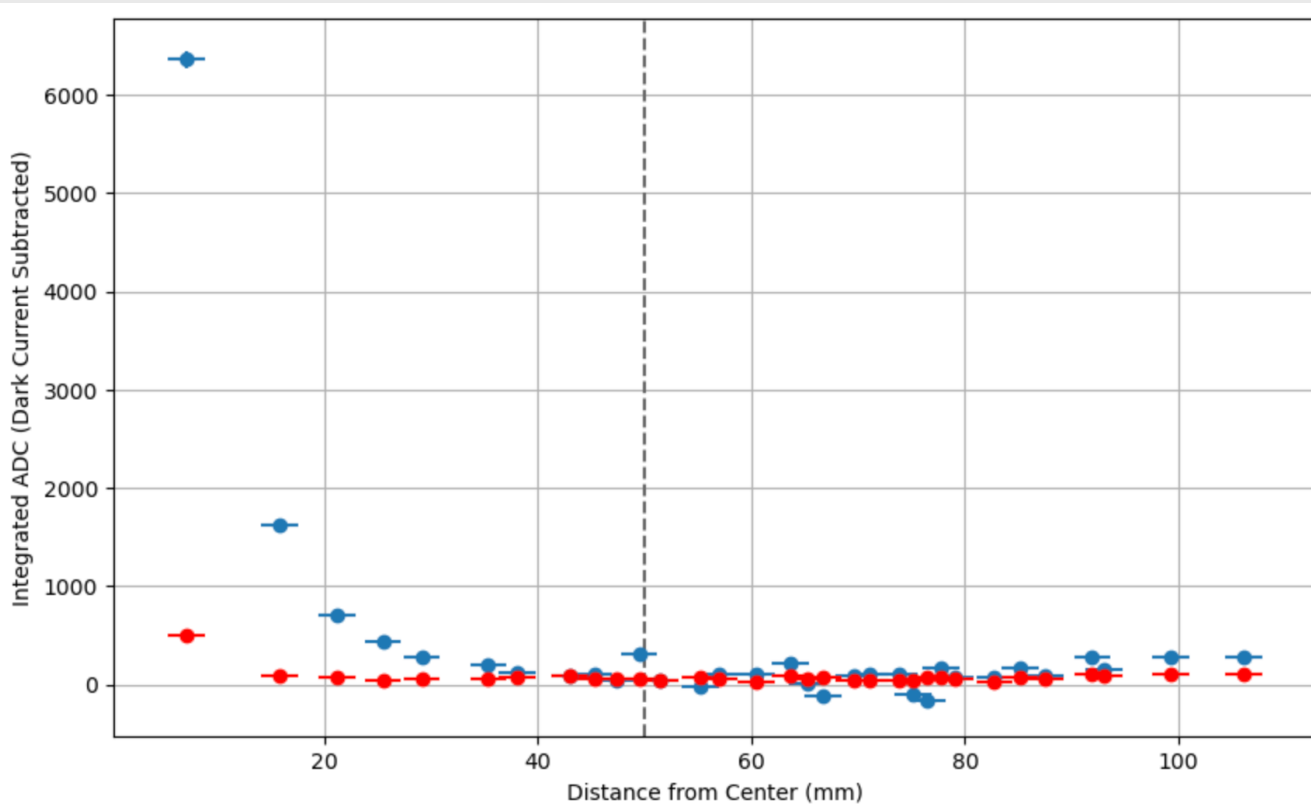
Clear improvement from unwrapped case, but very far from ideal.

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.

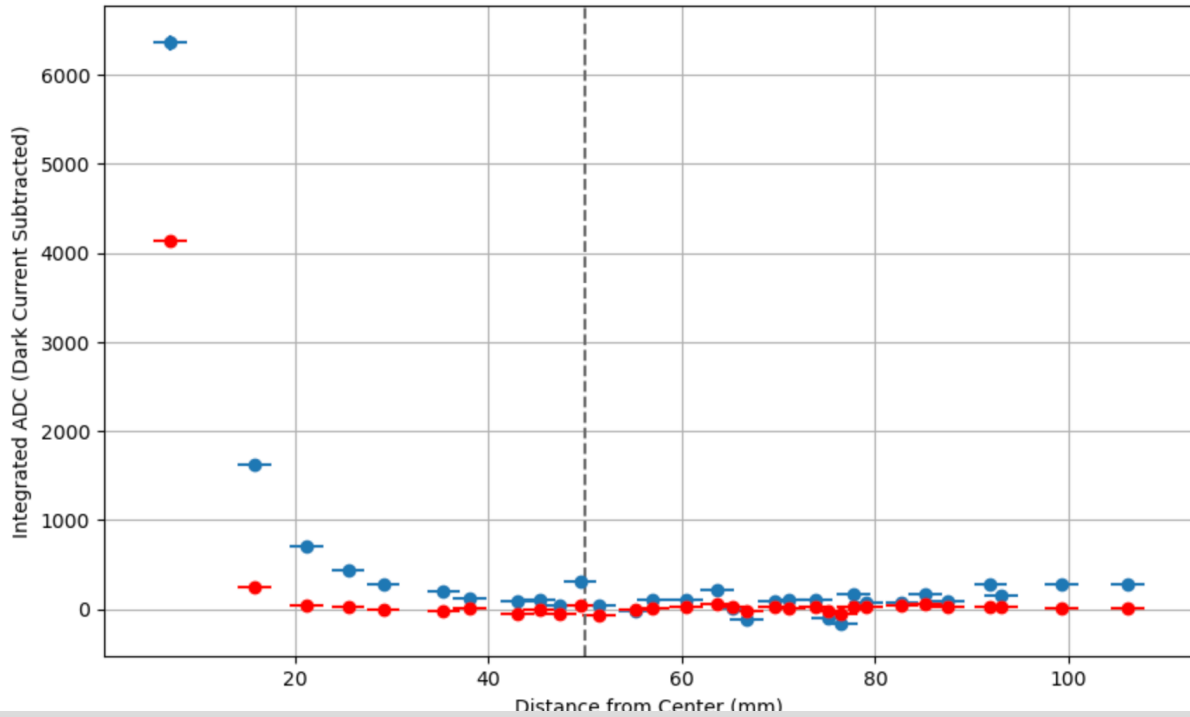
Scan with no tile

- 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.

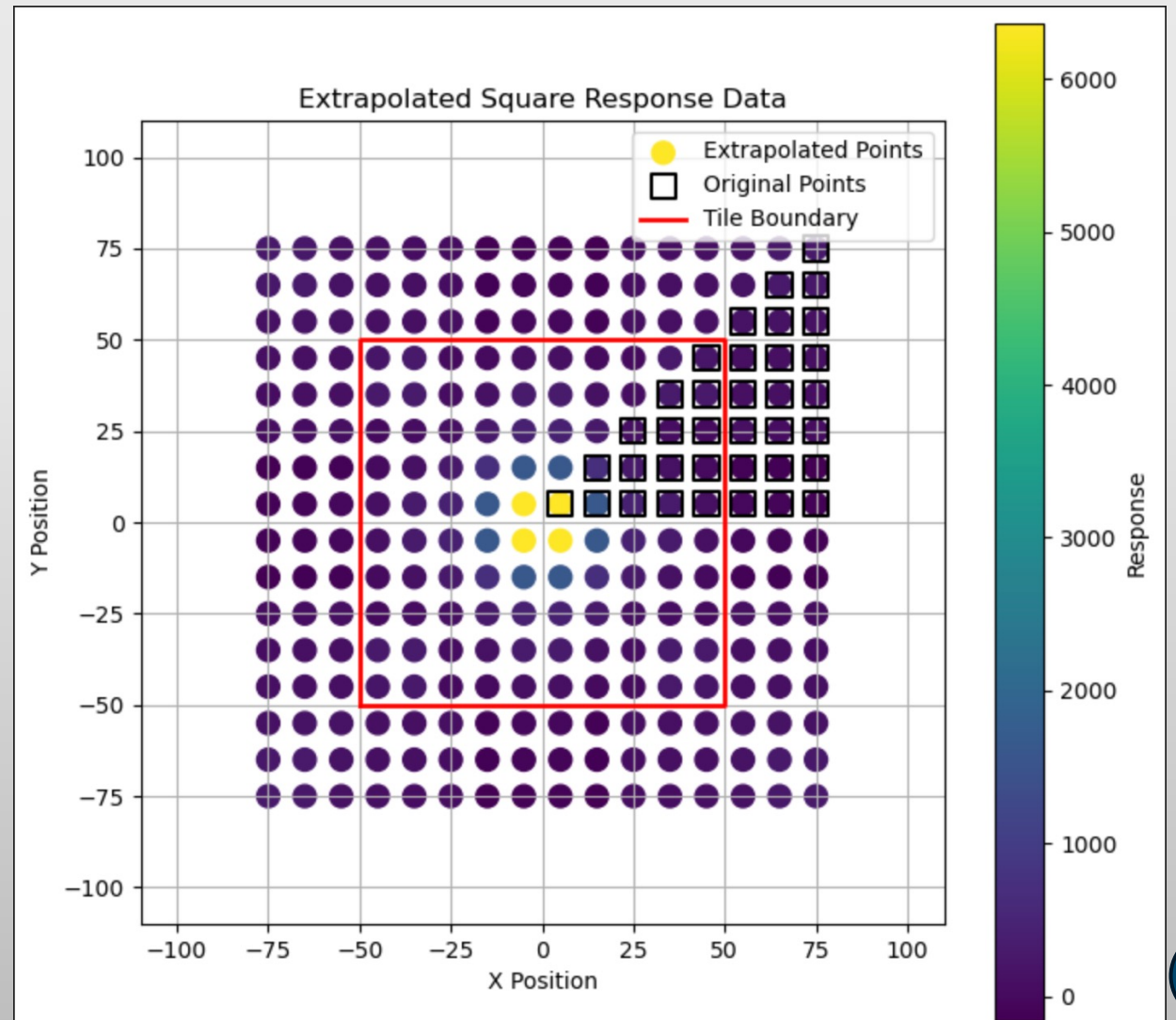


On the list: painted 10x10 tile, extra mechanical pressure, optical grease
Also, will try move SiPM to edge of tile, but this will take longer to set up.

“Improved” wrapping results

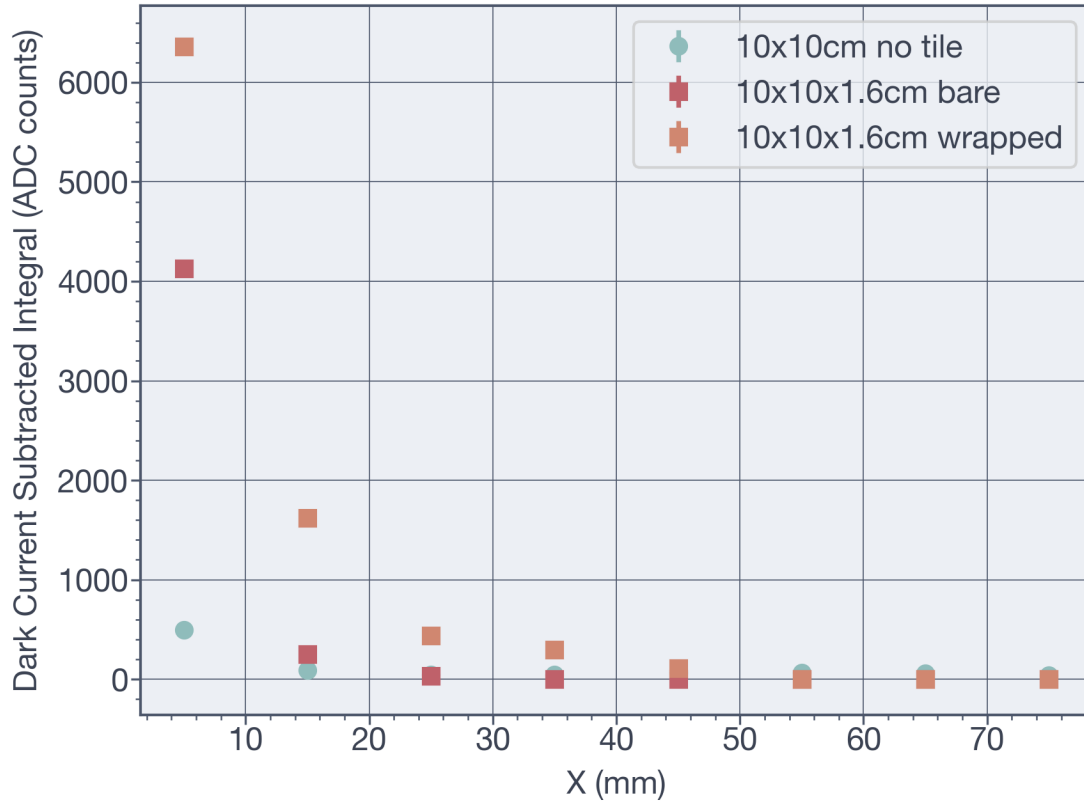


One (of many) questions: is it possible that we are uniform above ~25 cm and we're seeing our source directly at the 0cm peak?

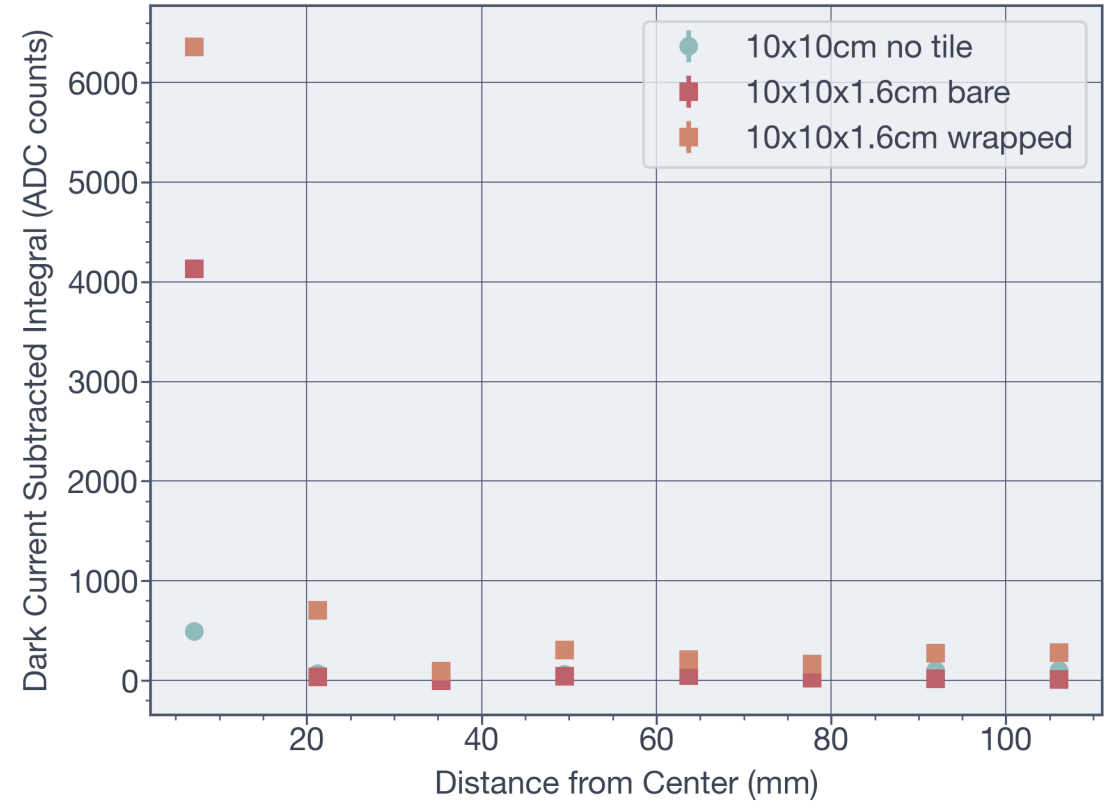


So far: 10x10x1.6 with and without wrapping

Horizontal Profiles



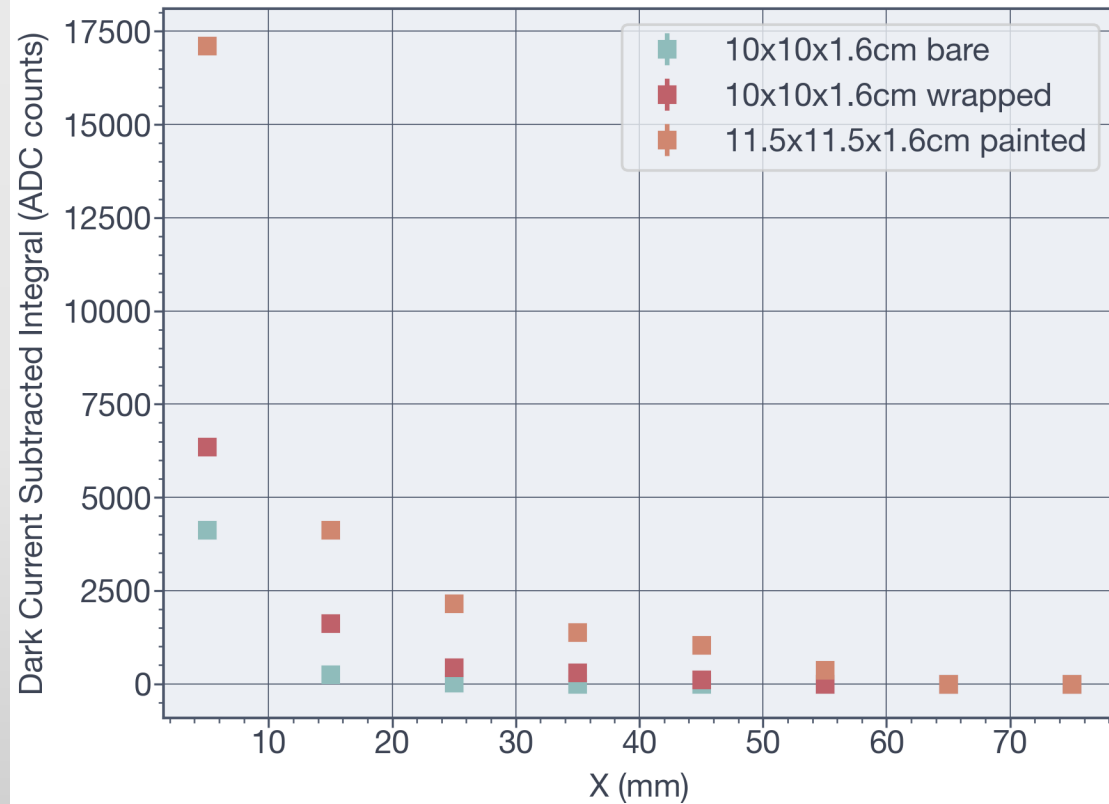
Diagonal Profiles



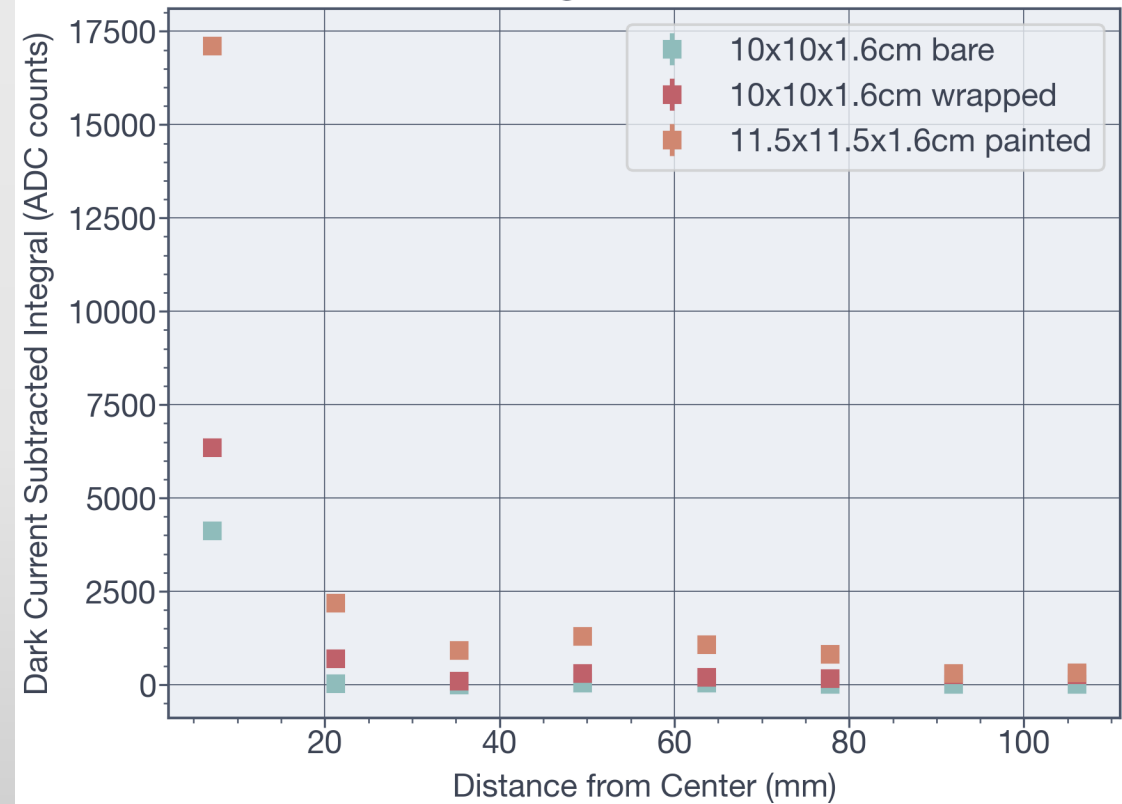
- As of last week, we have scans of this tile with no dimple or optical grease
- Tried wrapped vs. unwrapped. Also checked response of bare SiPM

Swap to another tile: 11.5x11.5 painted

Horizontal Profiles



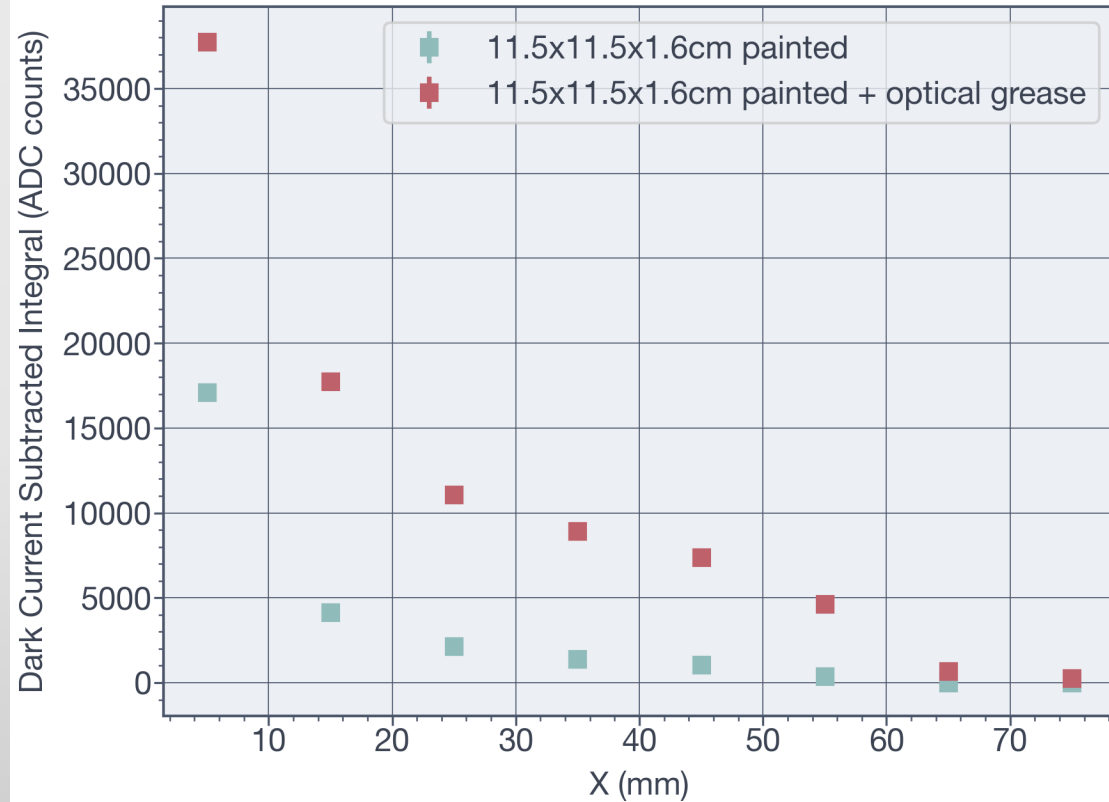
Diagonal Profiles



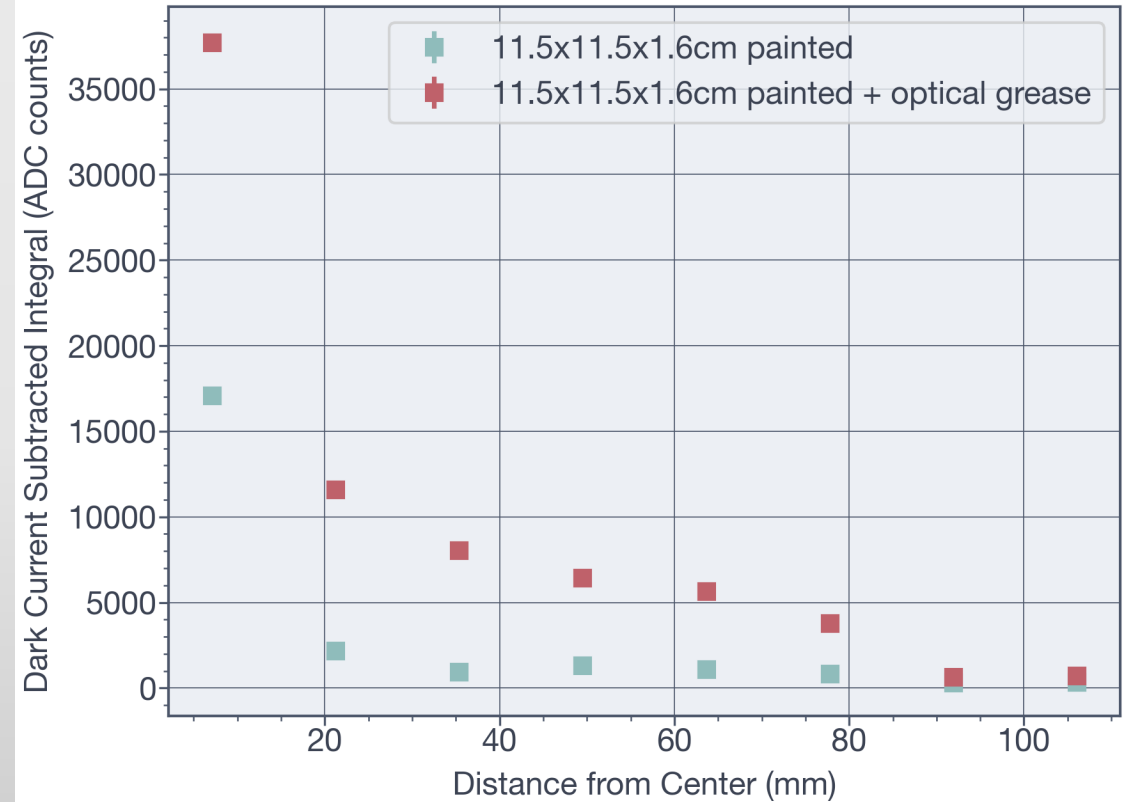
- ~3x higher yield than wrapped at center of the tile
 - ~10x higher yield at the edge
- Now add optical grease

11.5x11.5 painted w/ optical grease

Horizontal Profiles



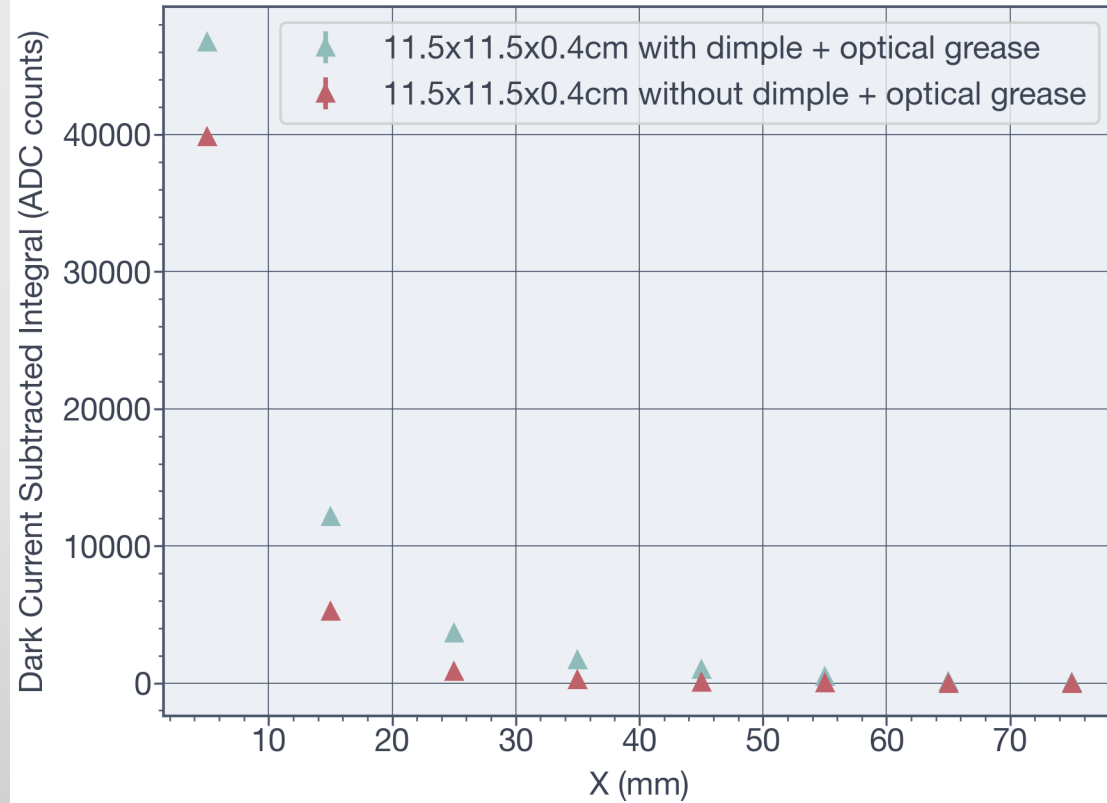
Diagonal Profiles



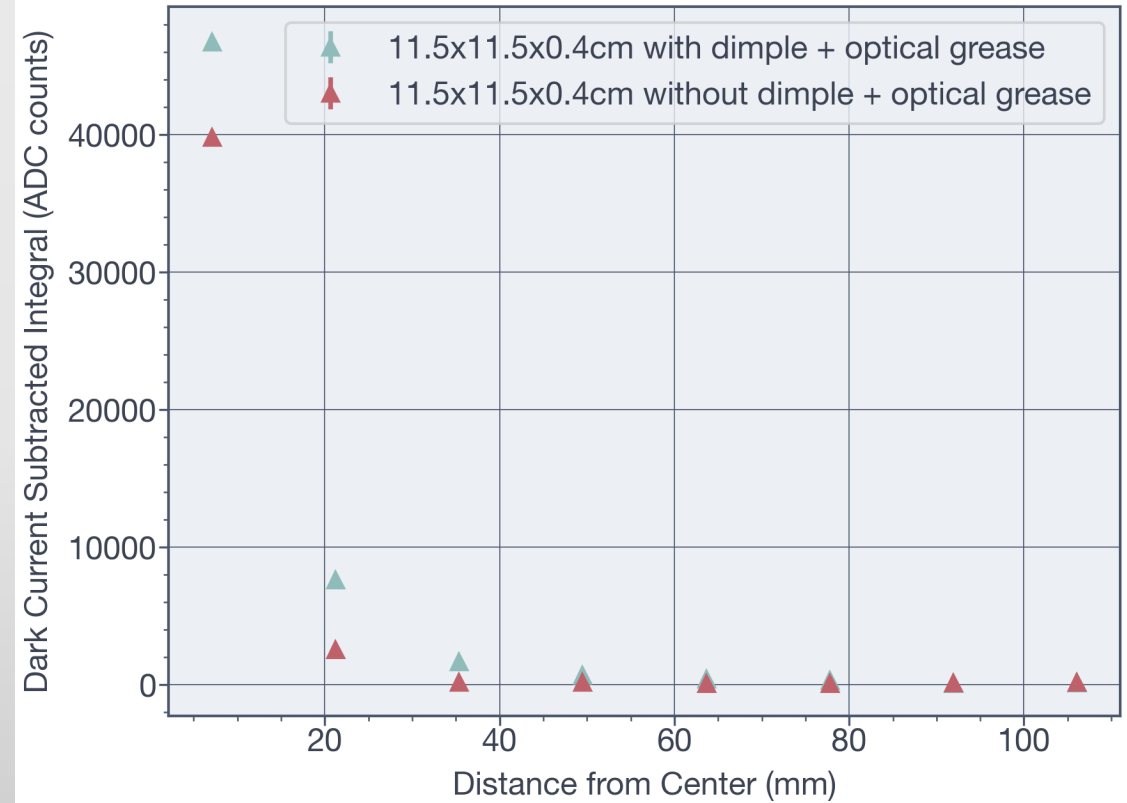
- Another >3x improvement!
- Painted tiles+optical grease seems very good!
- But still not very uniform->check out tiles with a dimple.

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

Horizontal Profiles

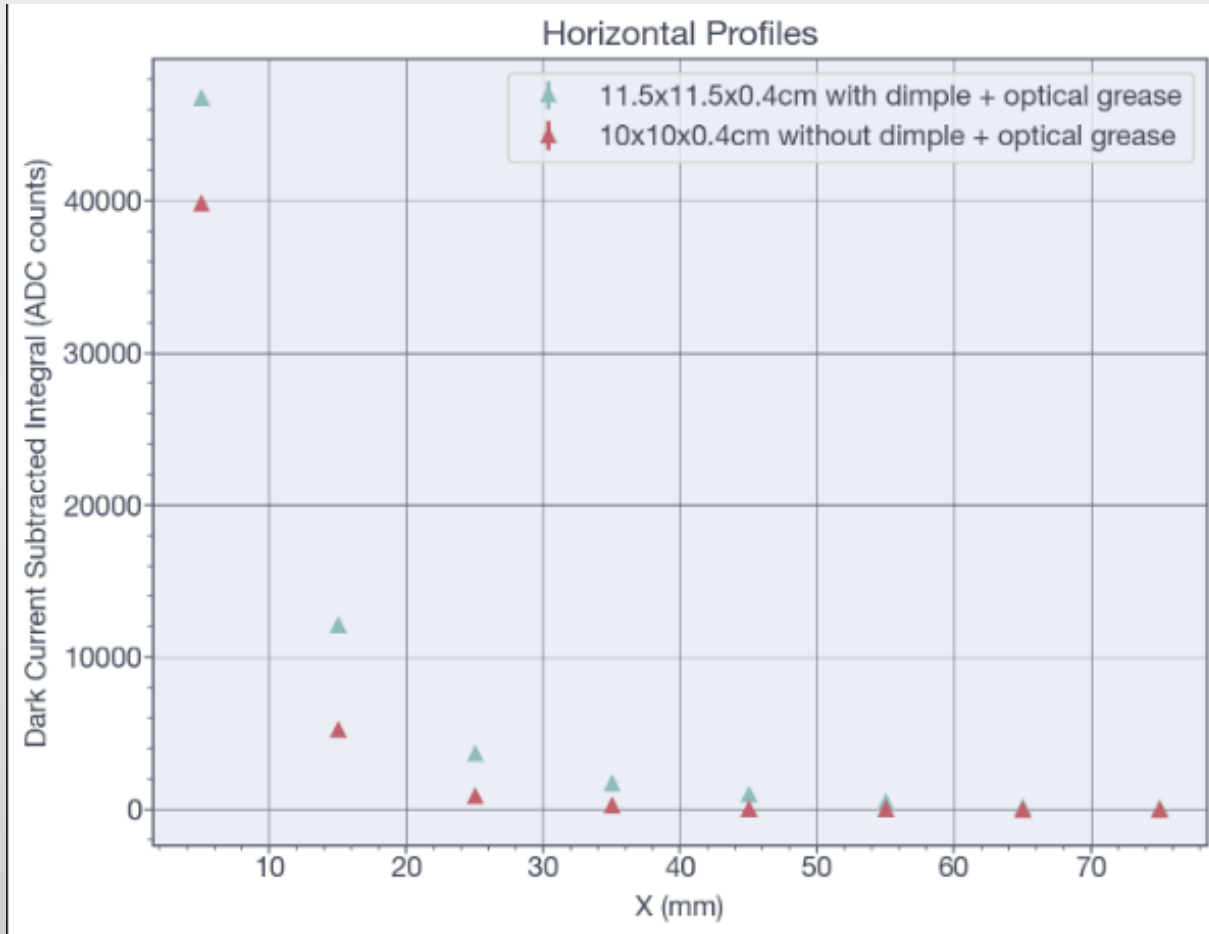


Diagonal Profiles

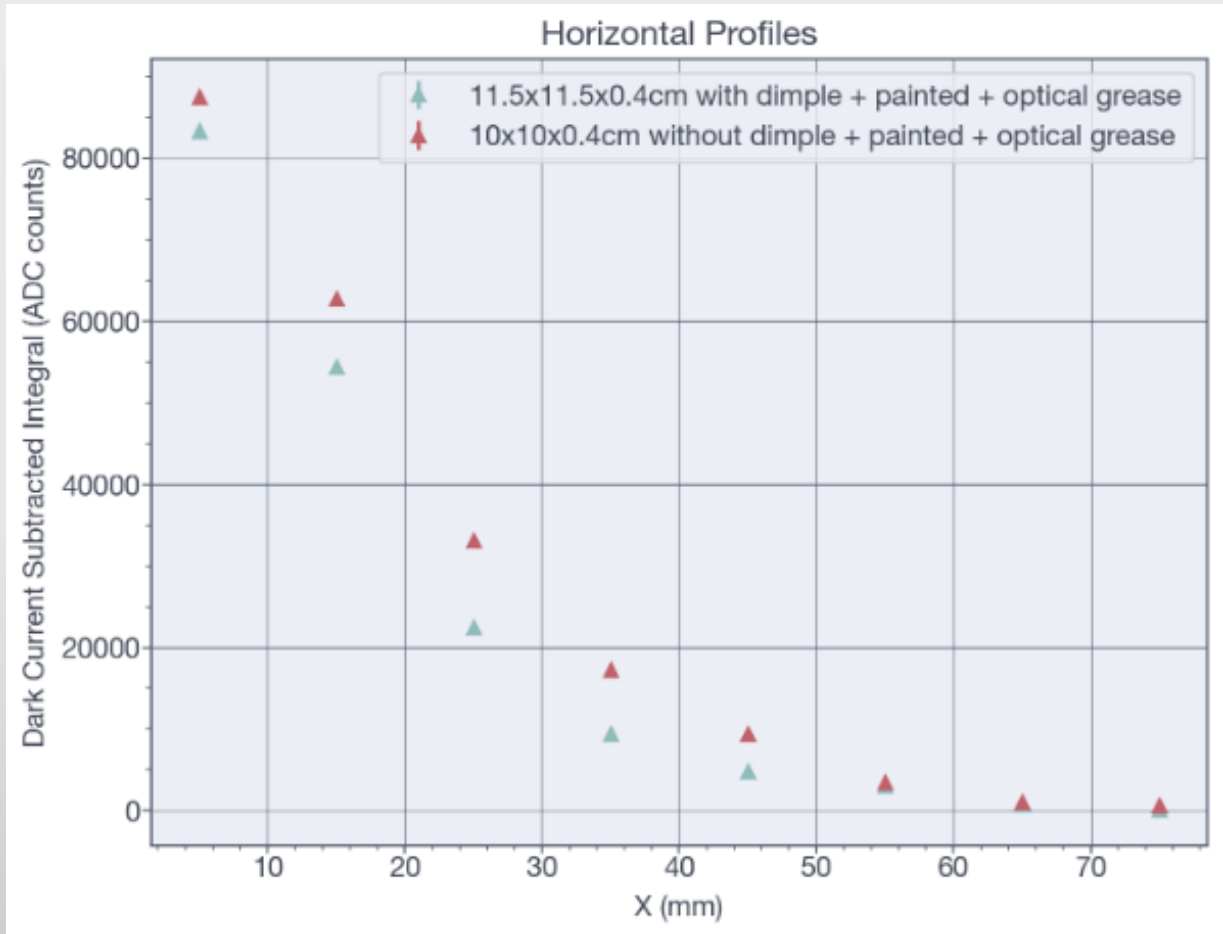


- Forthcoming: Wrap these, test again, then paint them. Also, various 5x5 tiles.

Thin tiles with/without dimple

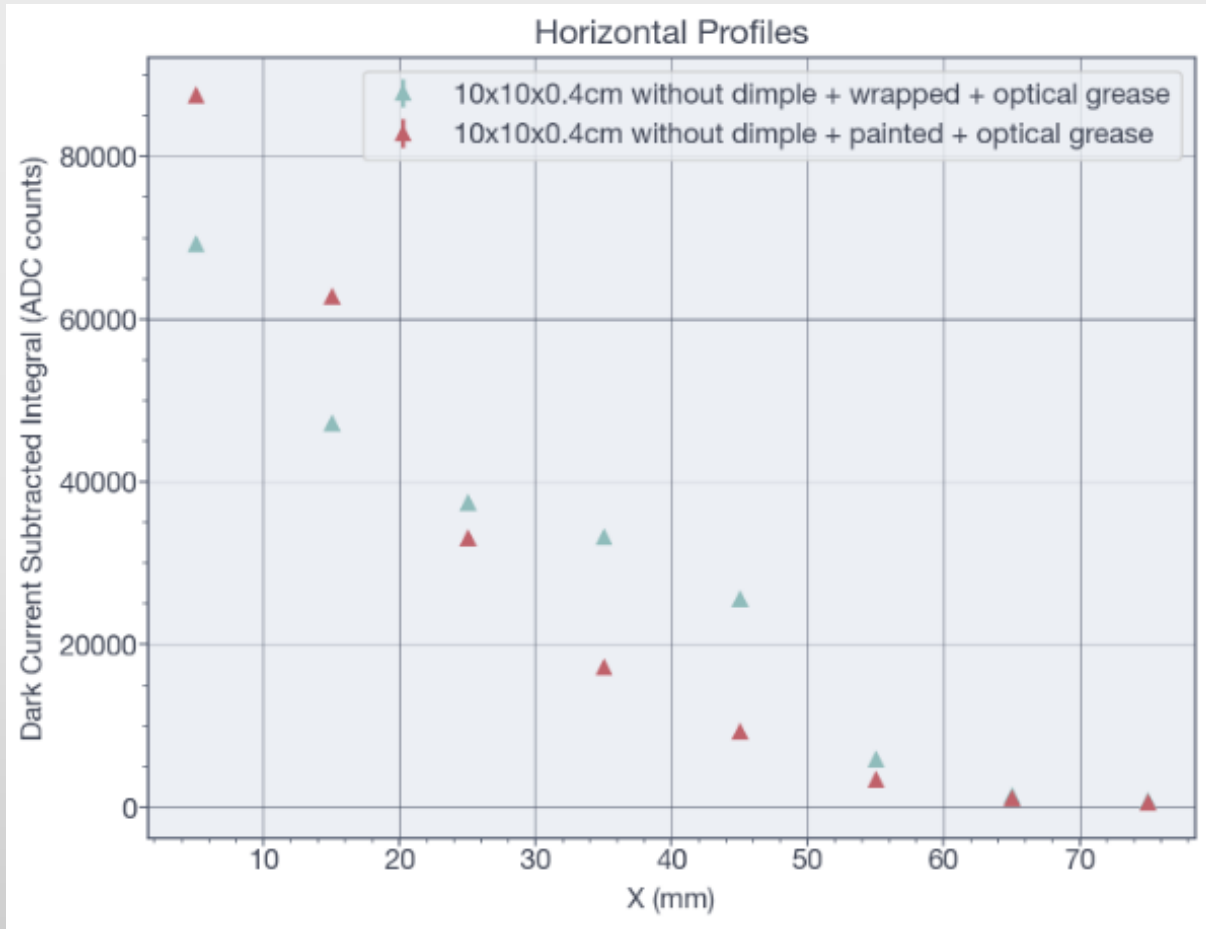


Bare files

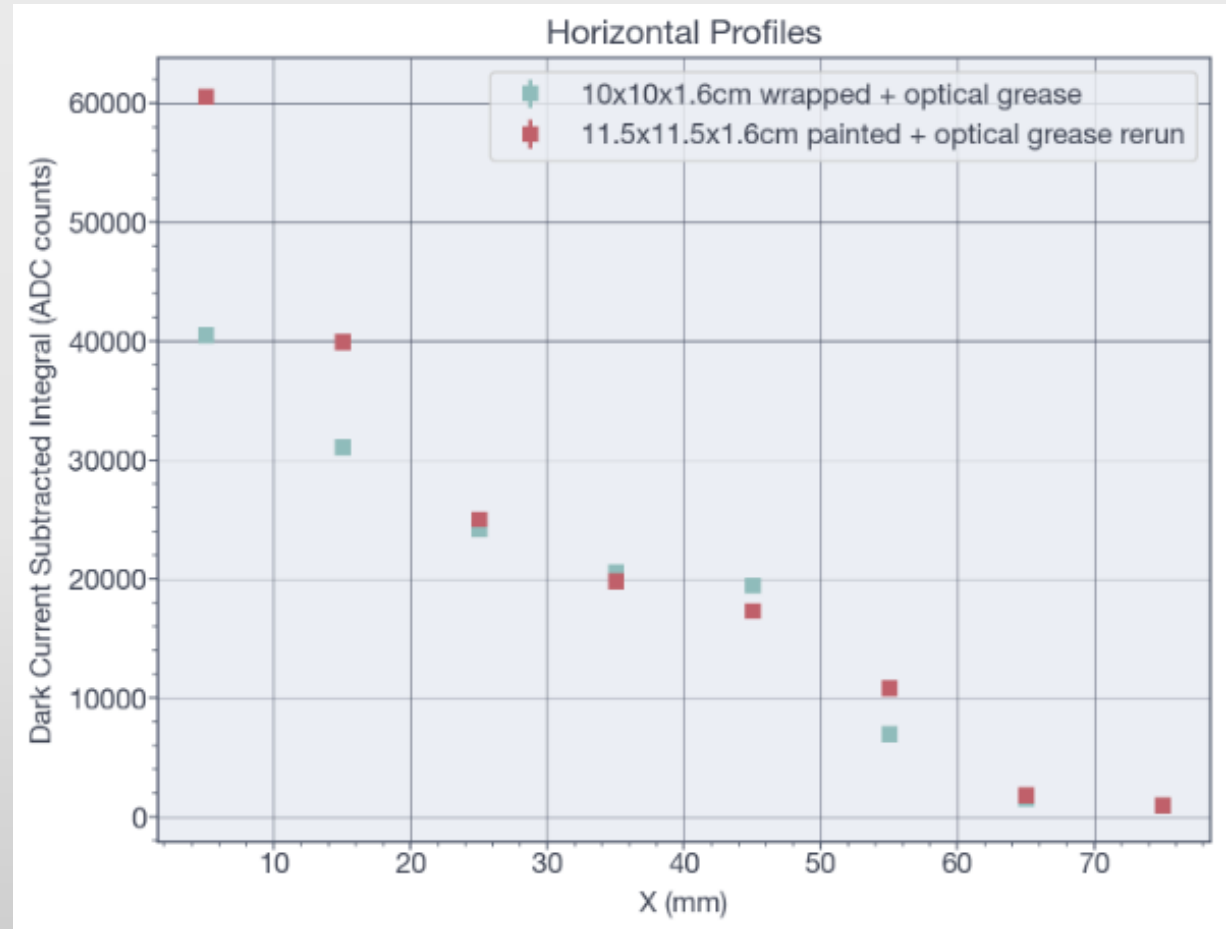


Painted tiles

wrapped vs. painted w/ optical grease

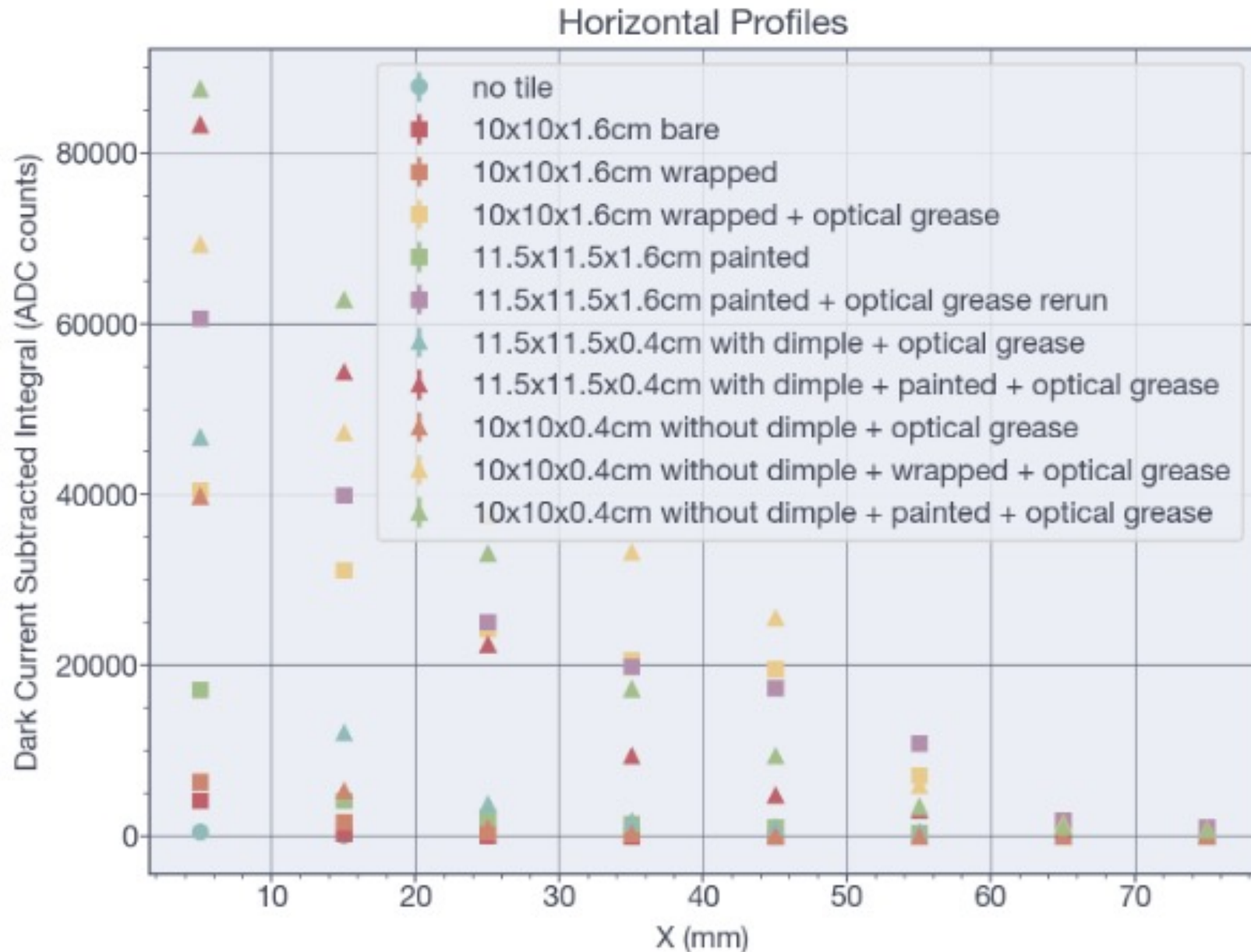


4mm tiles



16mm tiles

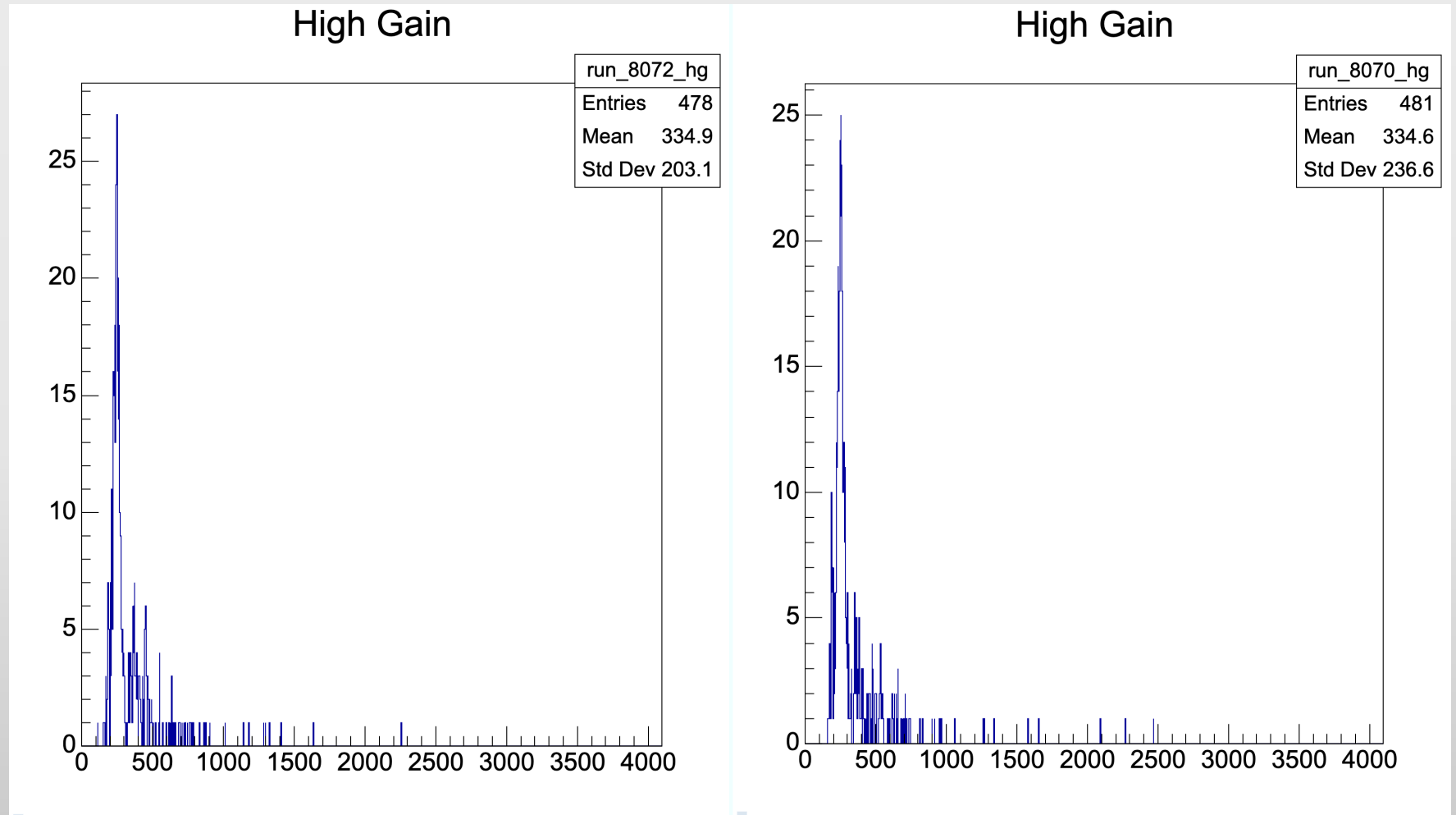
Everything so far



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

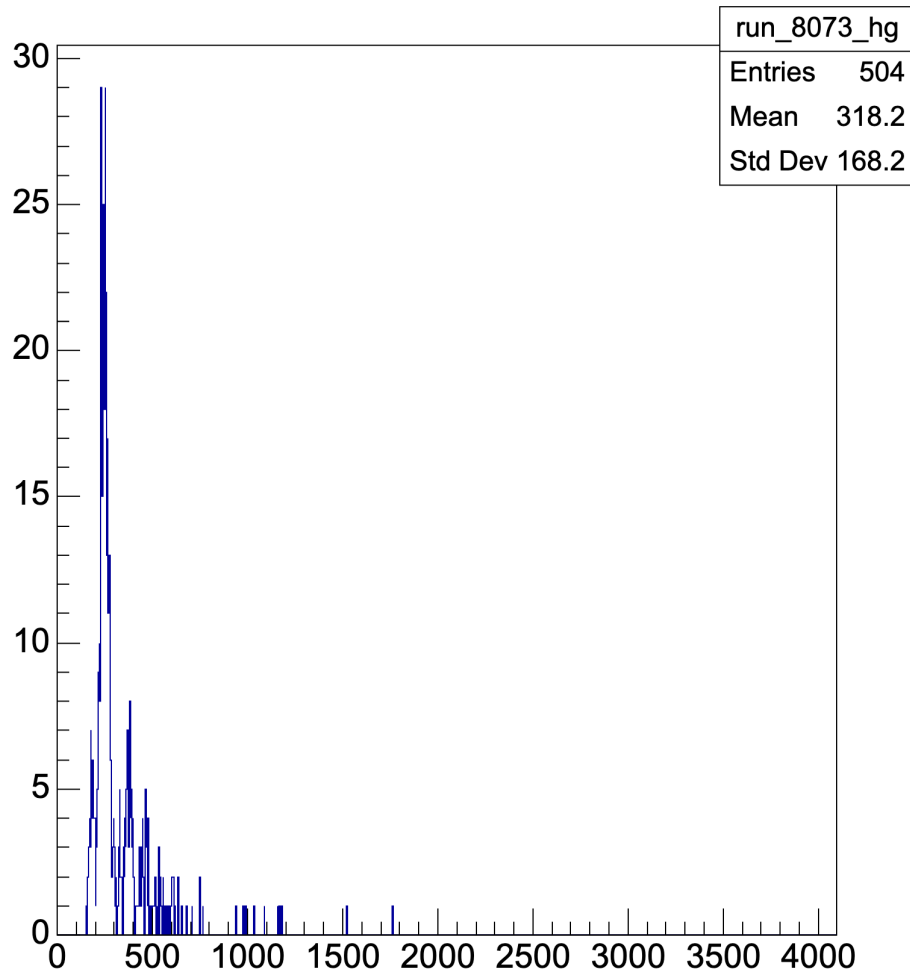
- 2 noise measurements, 5min exposure.
- Repeat with different sources of extra light leaking in to see size of effect



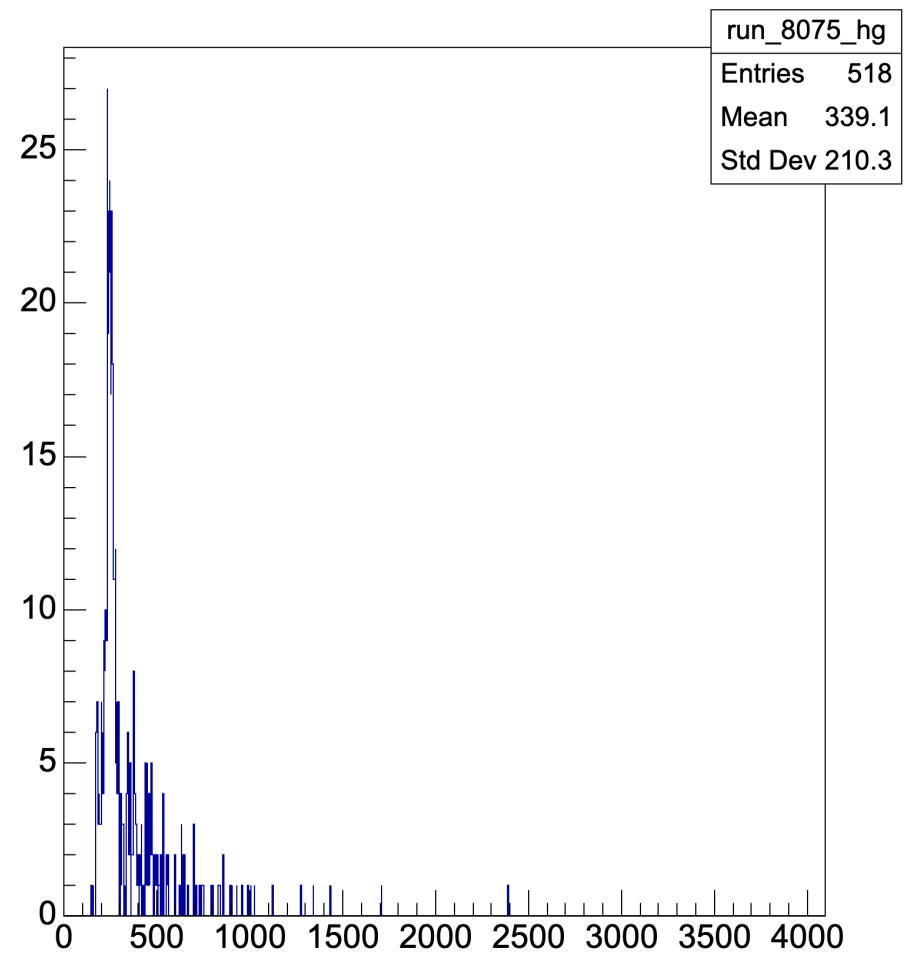
This run: as little light as we can with current setup

Noise Measurements

High Gain

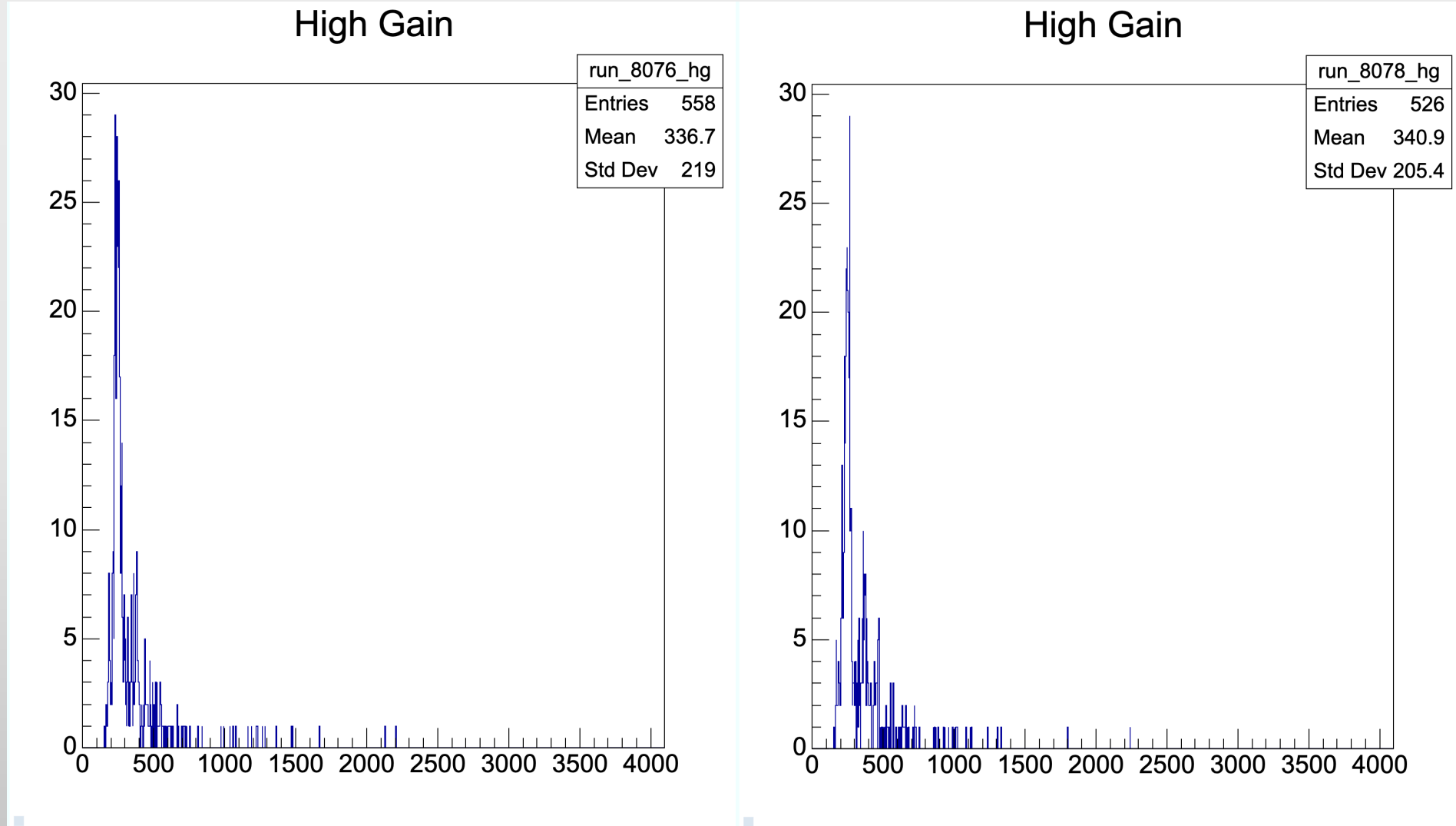


High Gain



Nearby computer monitor left on

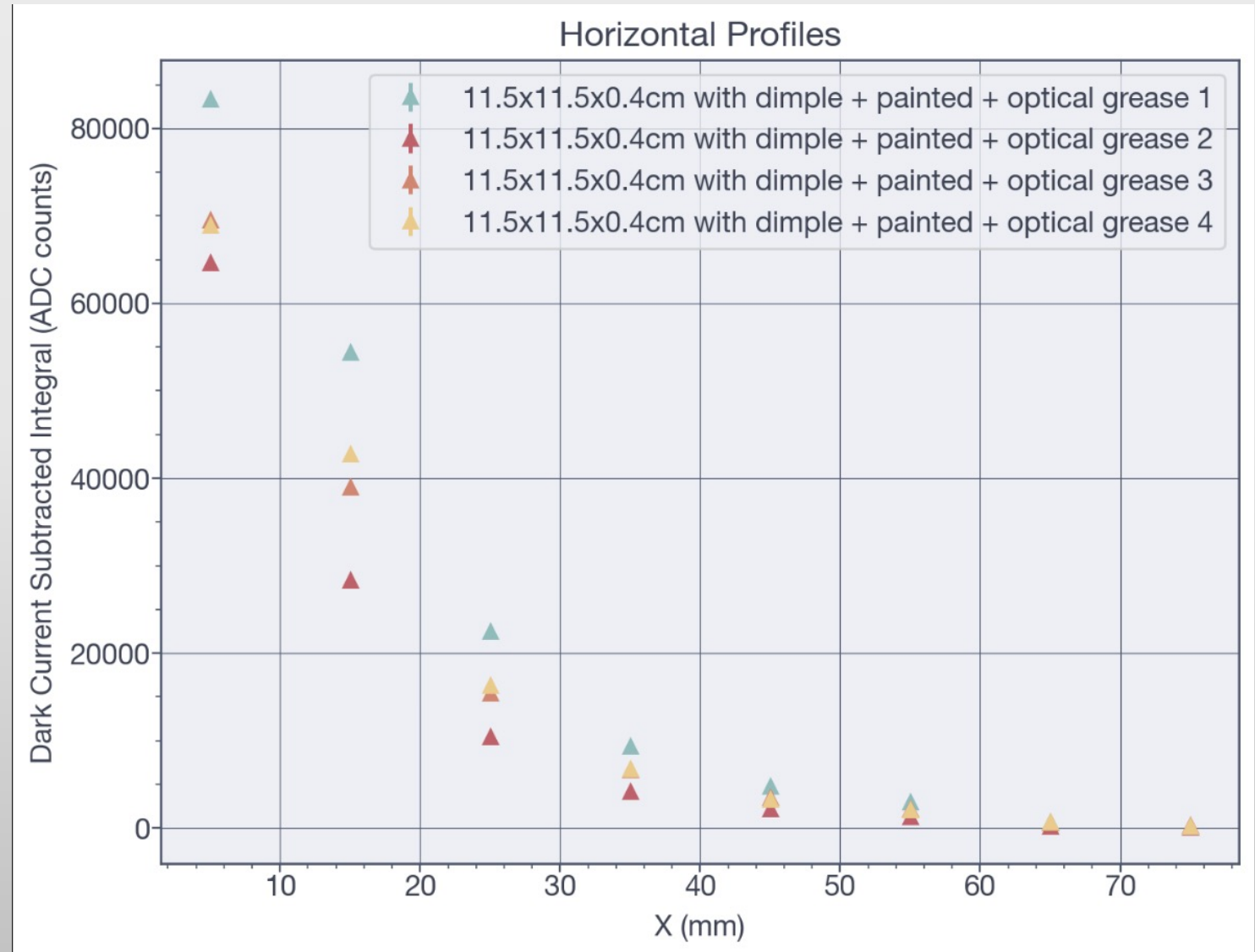
Noise Measurements



Flashlight left on ~20 ft from test setup

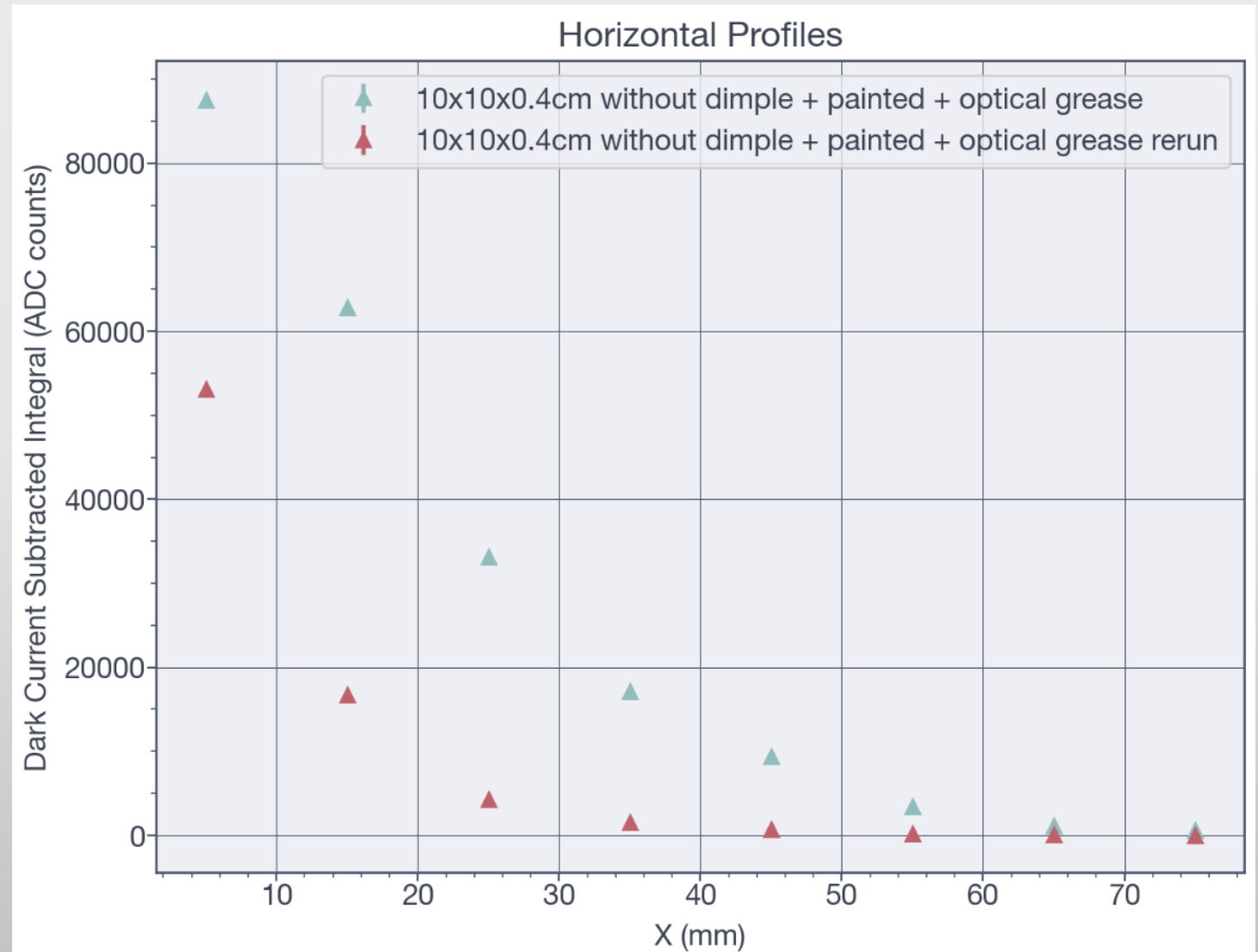
Reproducibility

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



Reproducibility

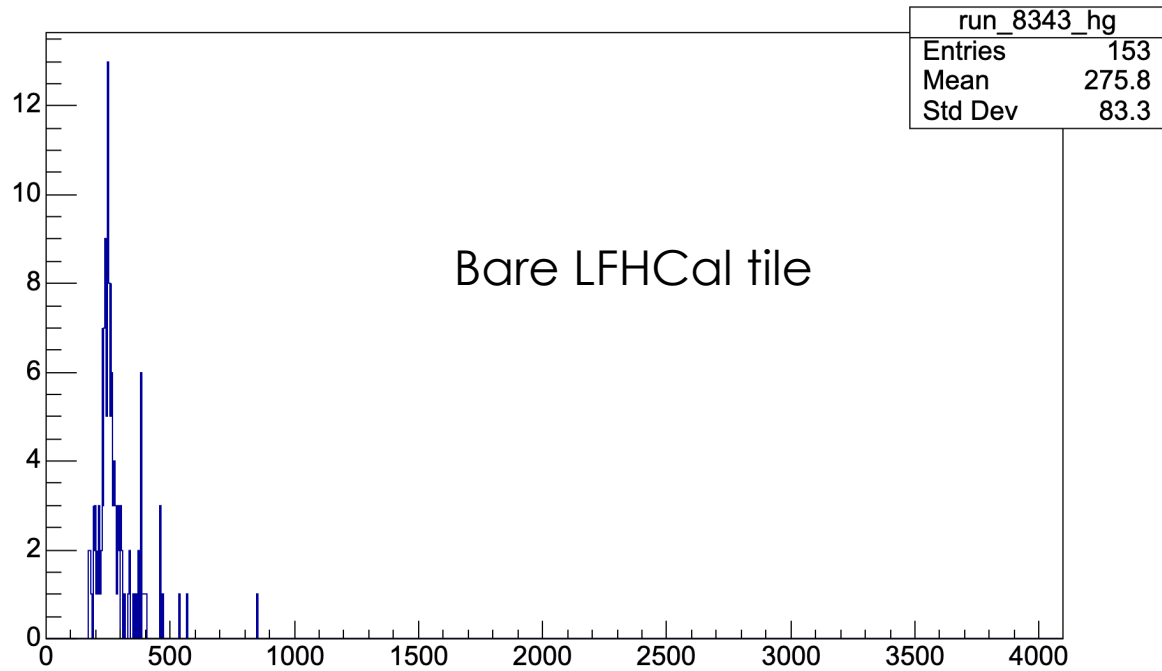
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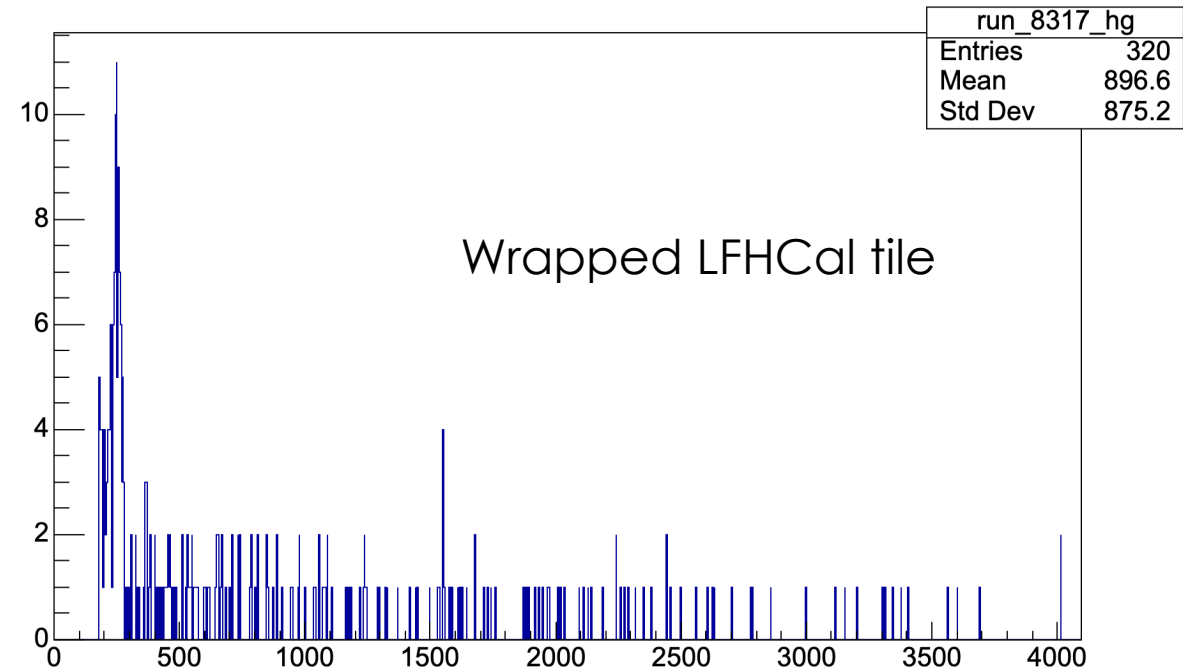
Noise from different tiles

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

High Gain



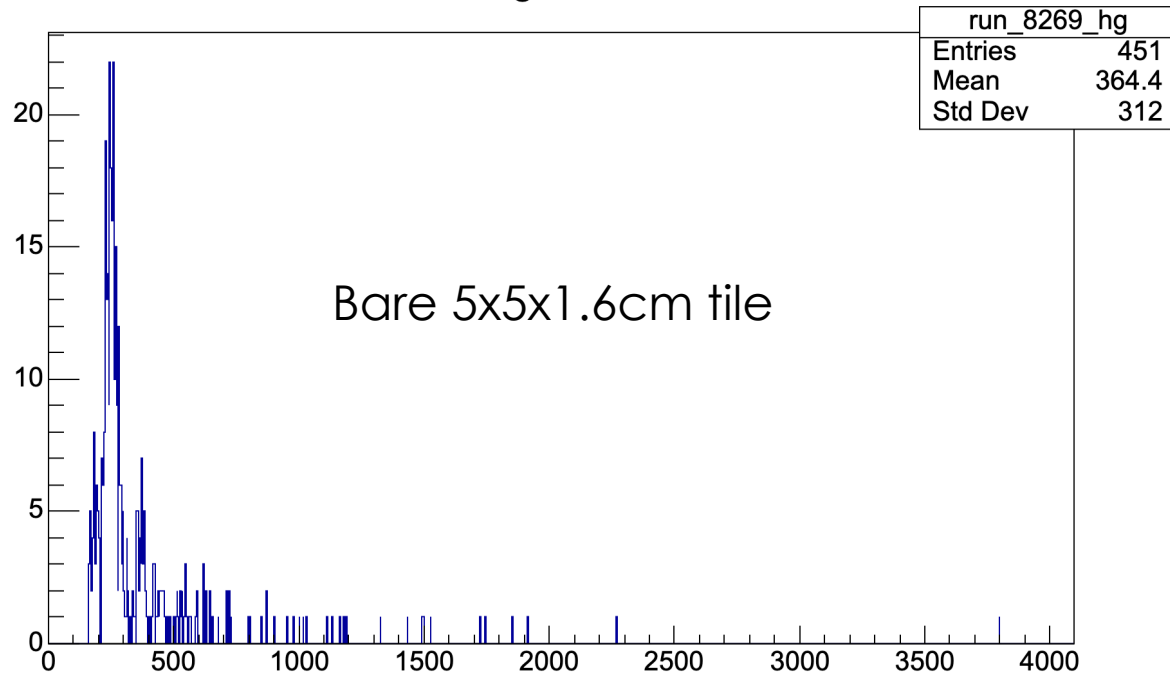
High Gain



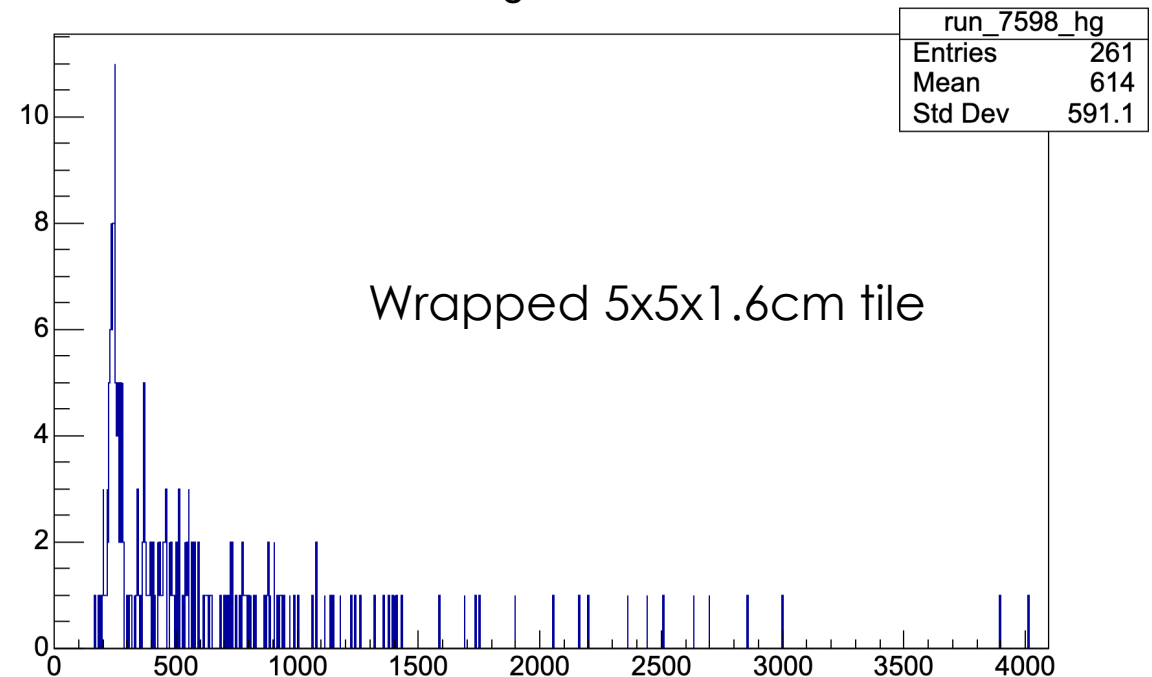
Noise from different tiles

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

High Gain



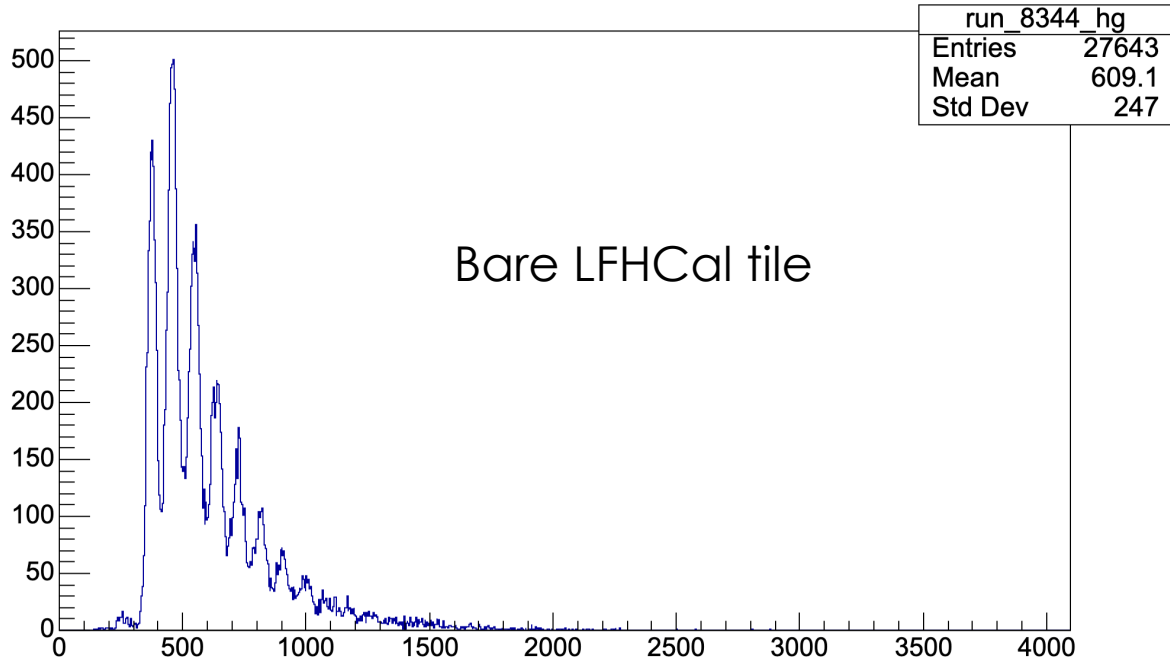
High Gain



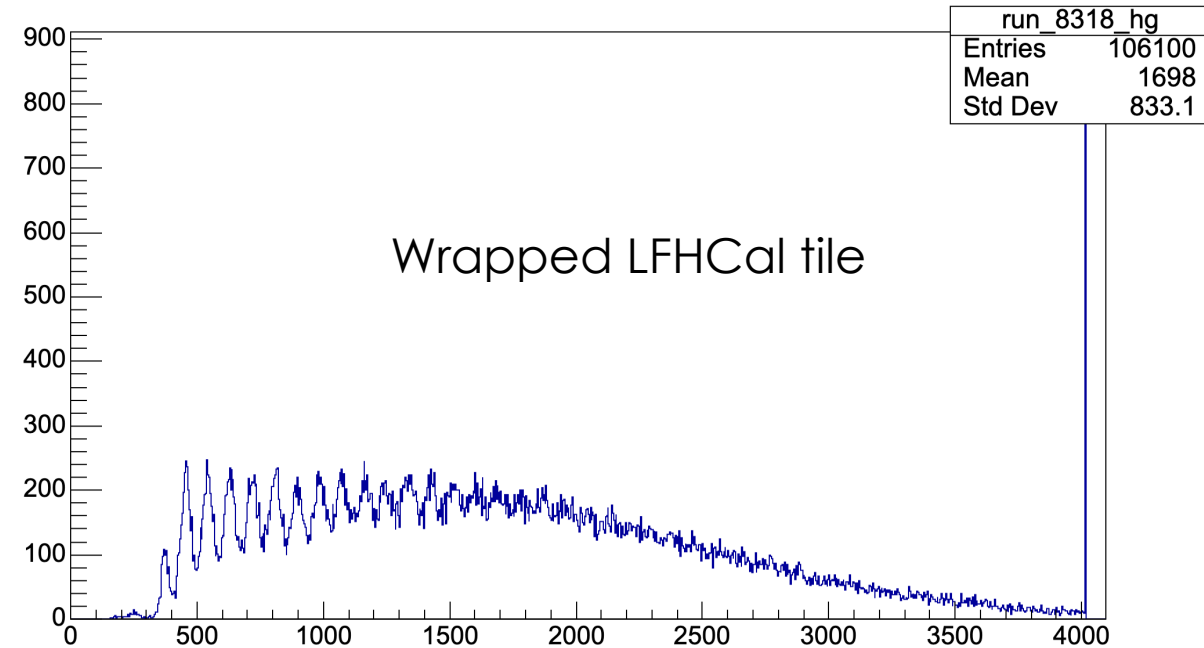
ADC spectra for wrapped vs. unwrapped

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

High Gain



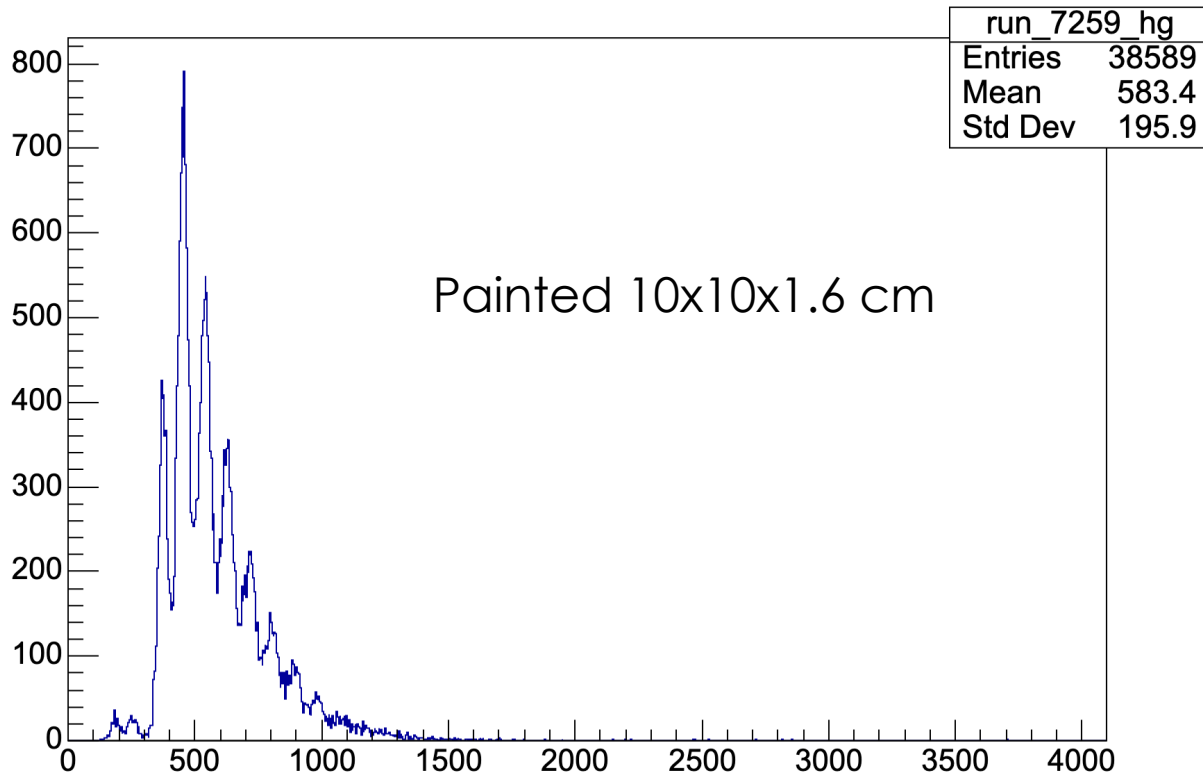
High Gain



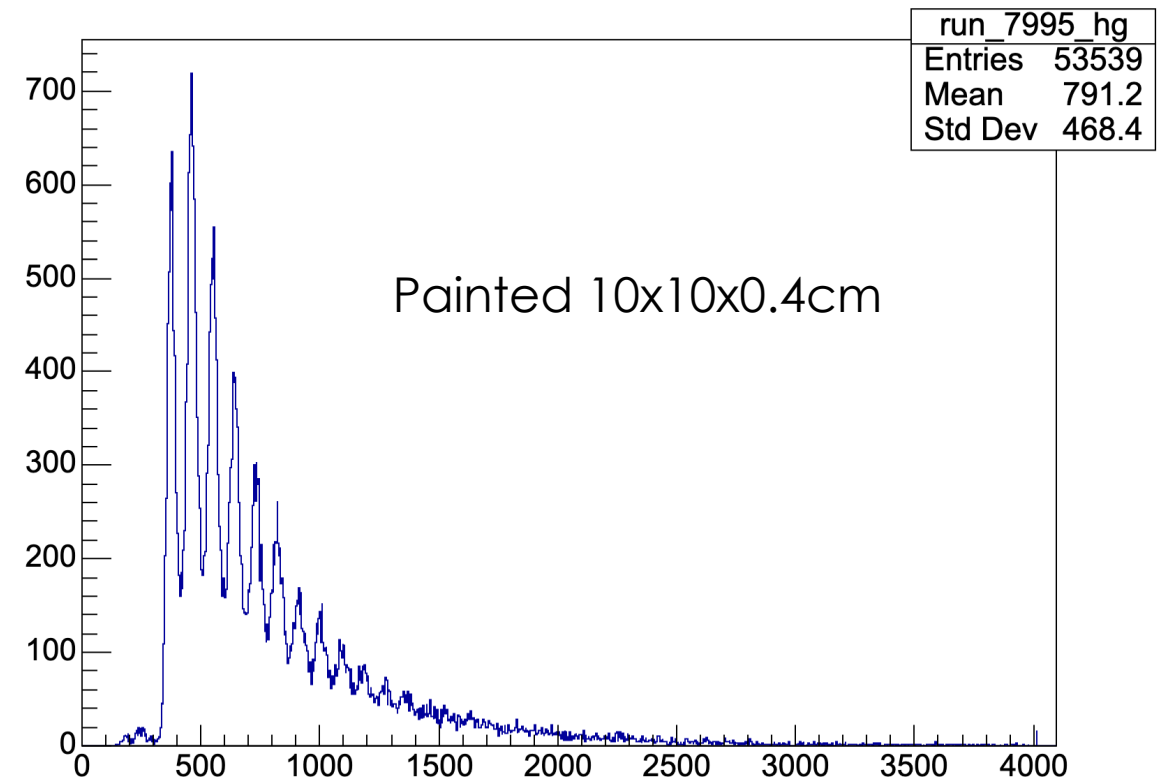
ADC spectra for thick vs. thin tiles

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

High Gain



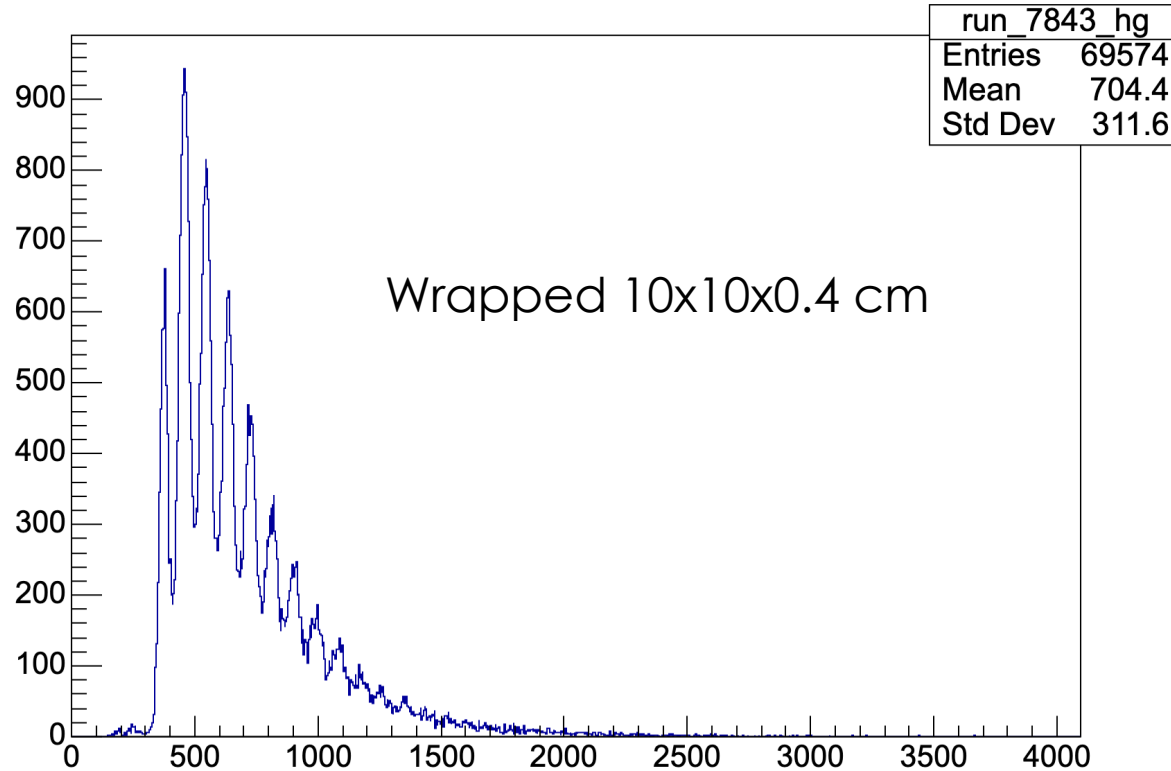
High Gain



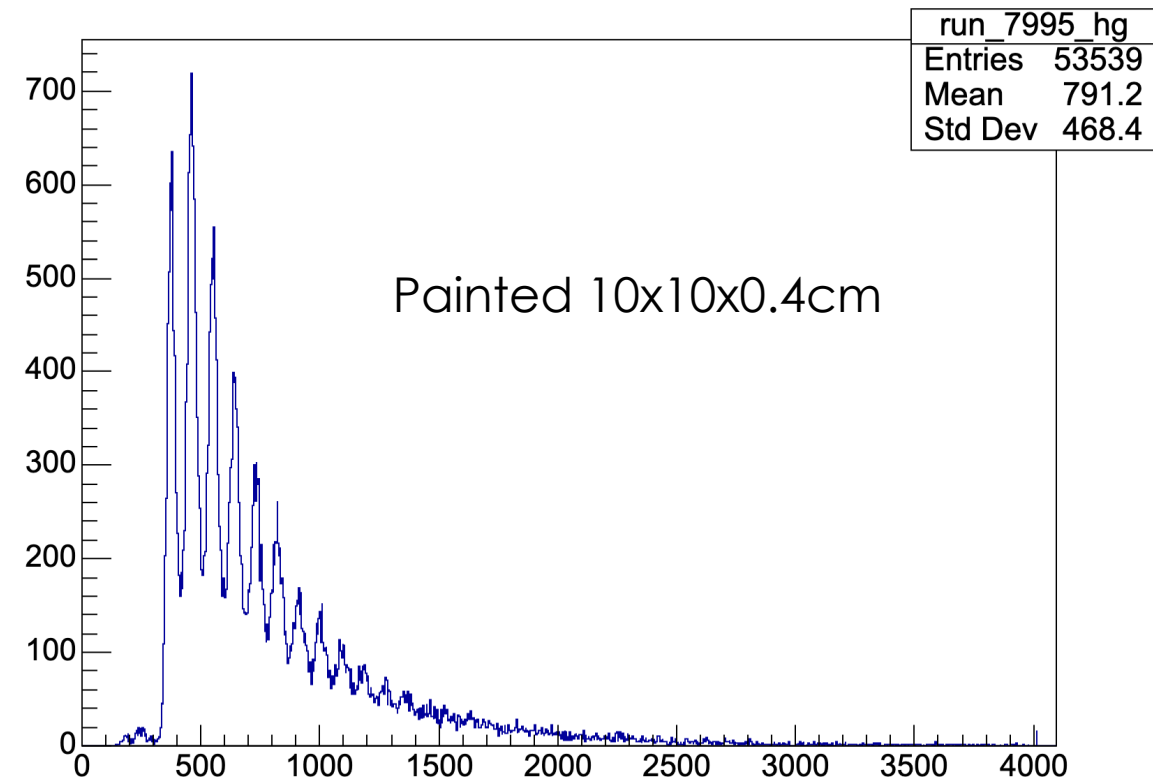
ADC spectra for wrapped vs painted tiles

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

High Gain

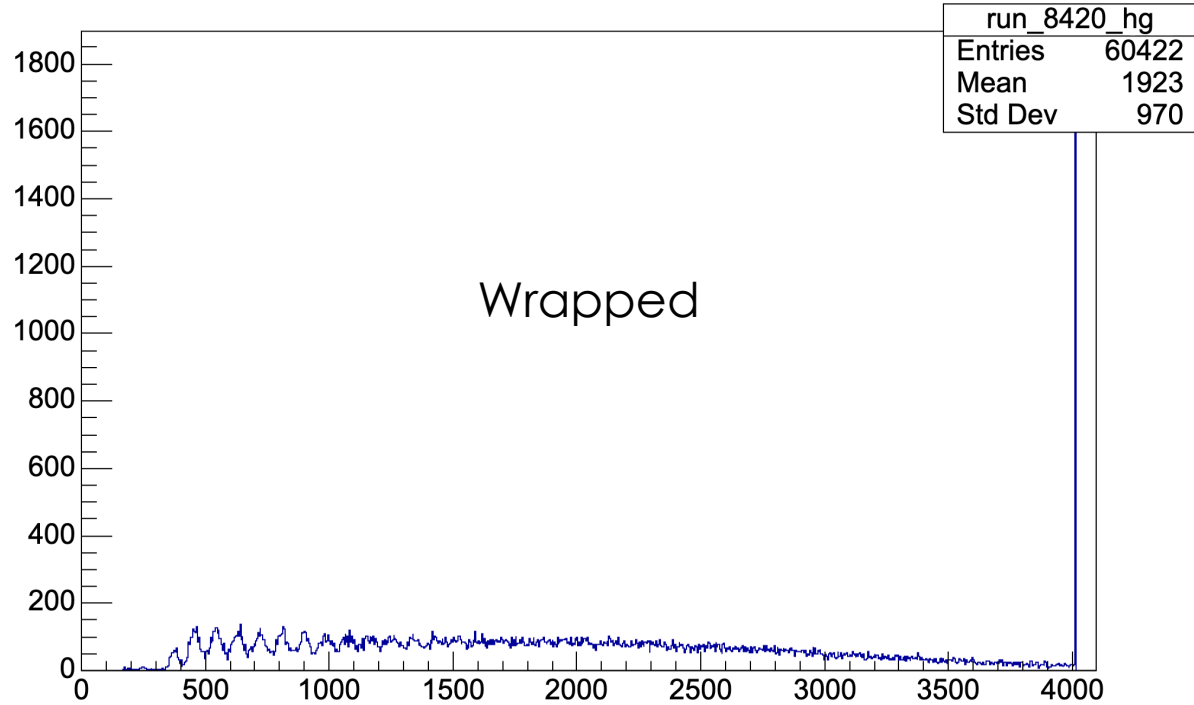


High Gain

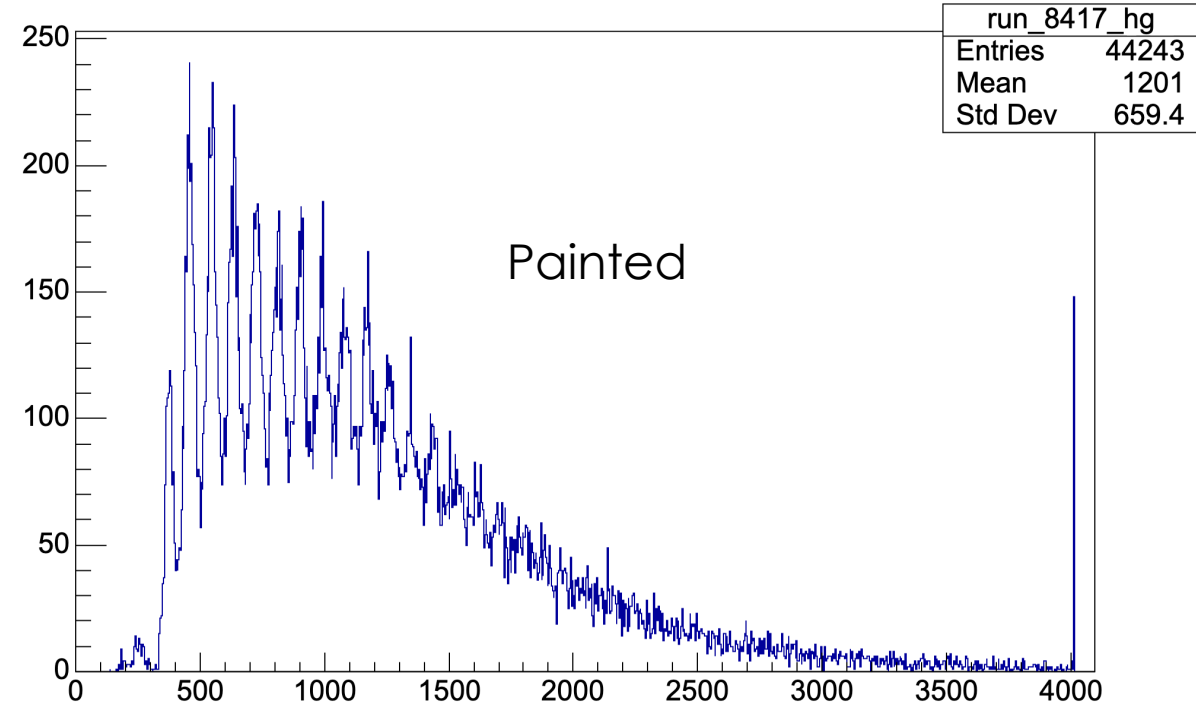


Wrapped vs Painted LFHcal Tile

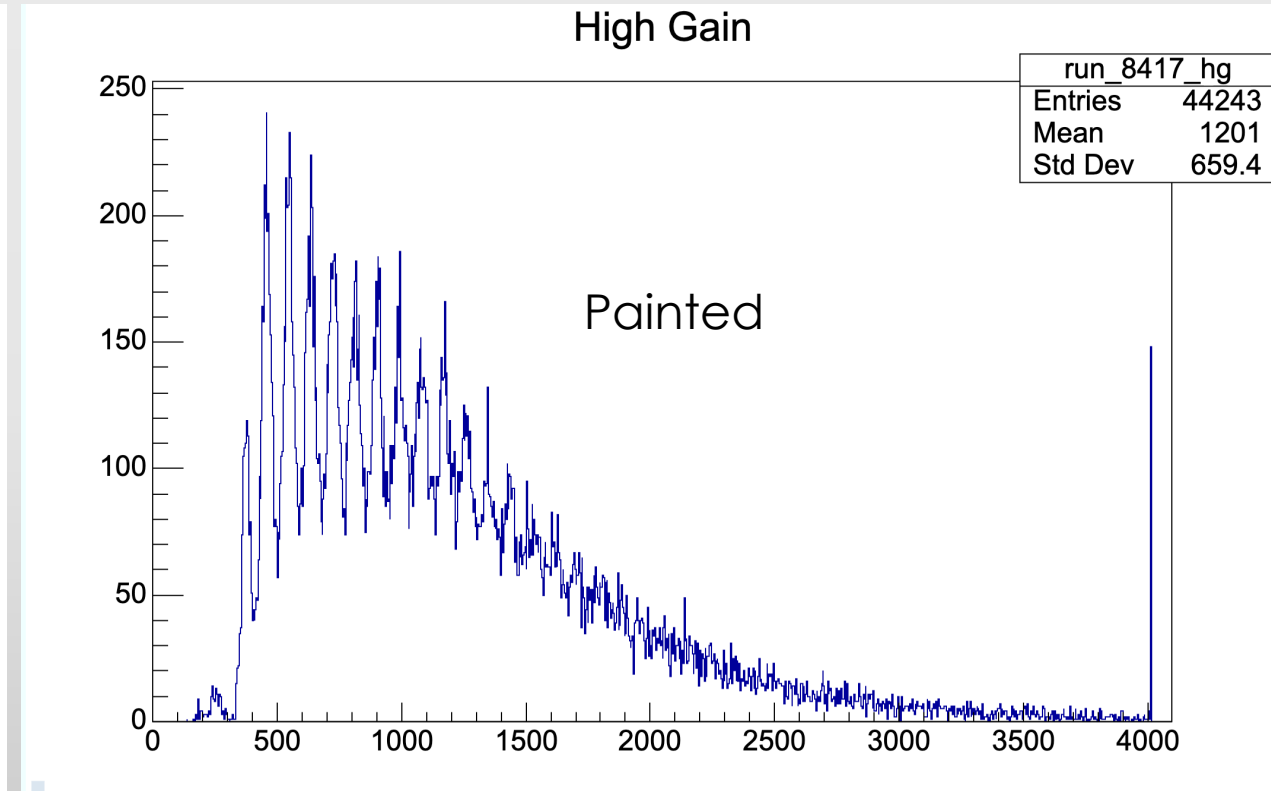
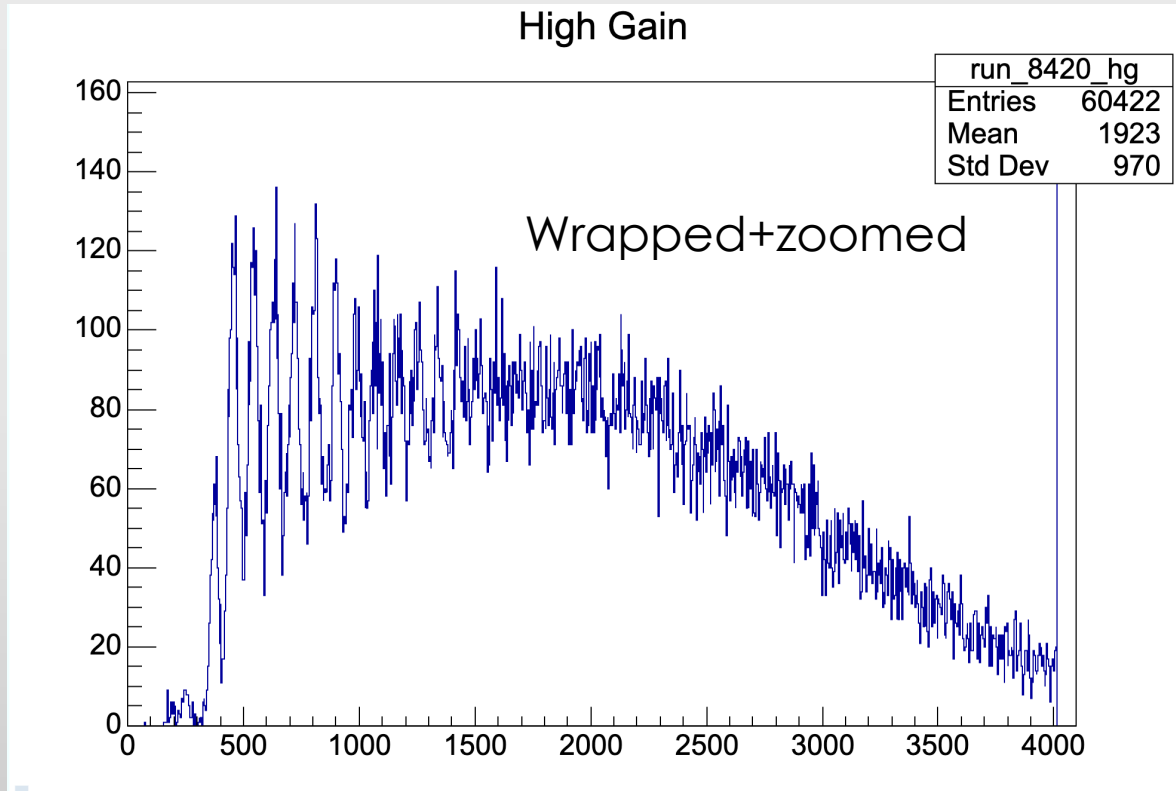
High Gain



High Gain



Wrapped vs Painted LFHcal Tile



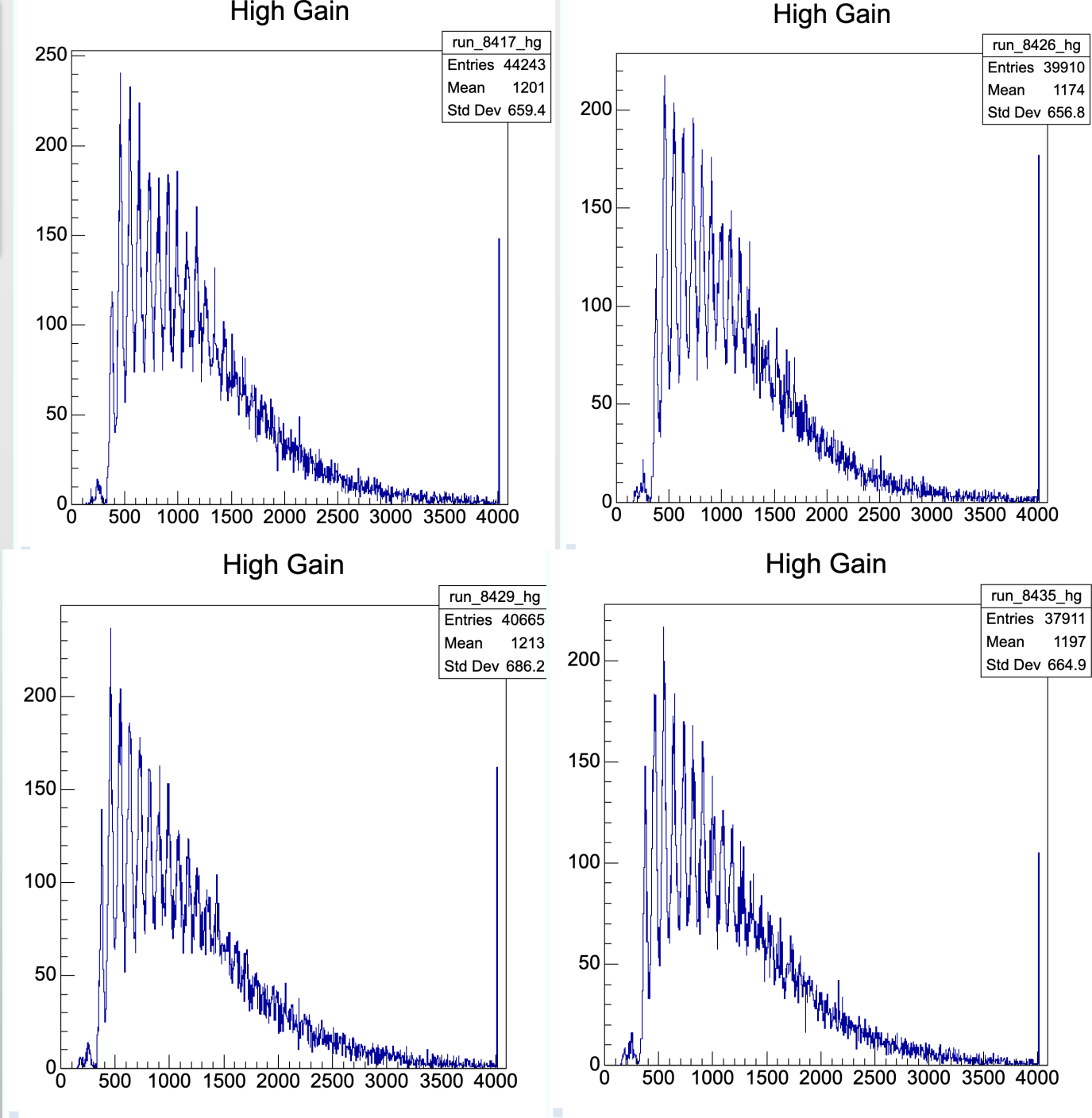
Overall less yield on painted for these tiles, which doesn't match what we saw for other wrapped tiles.

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

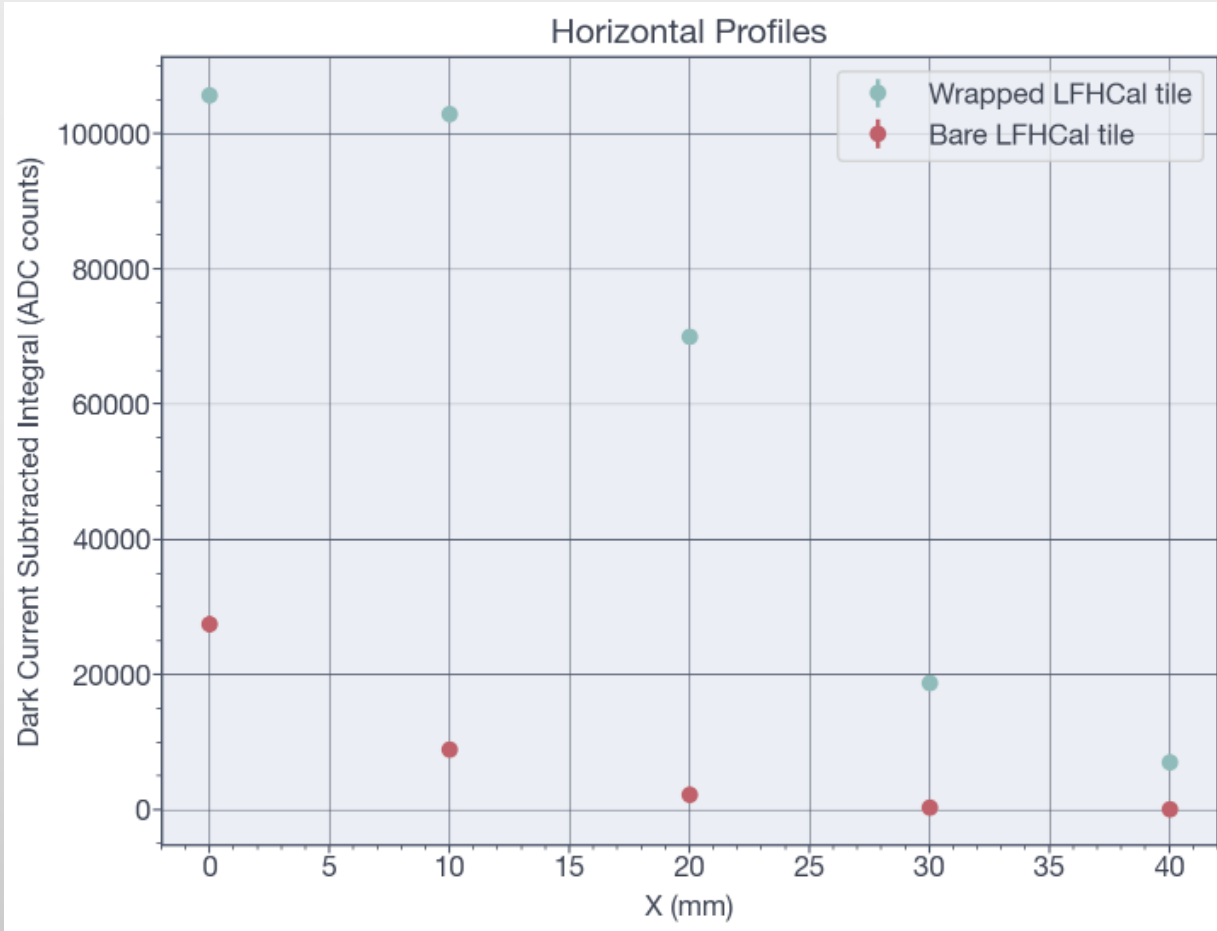
Or, the difference is more stark for thinner, smaller tiles.

Consistency after placing and replacing tile

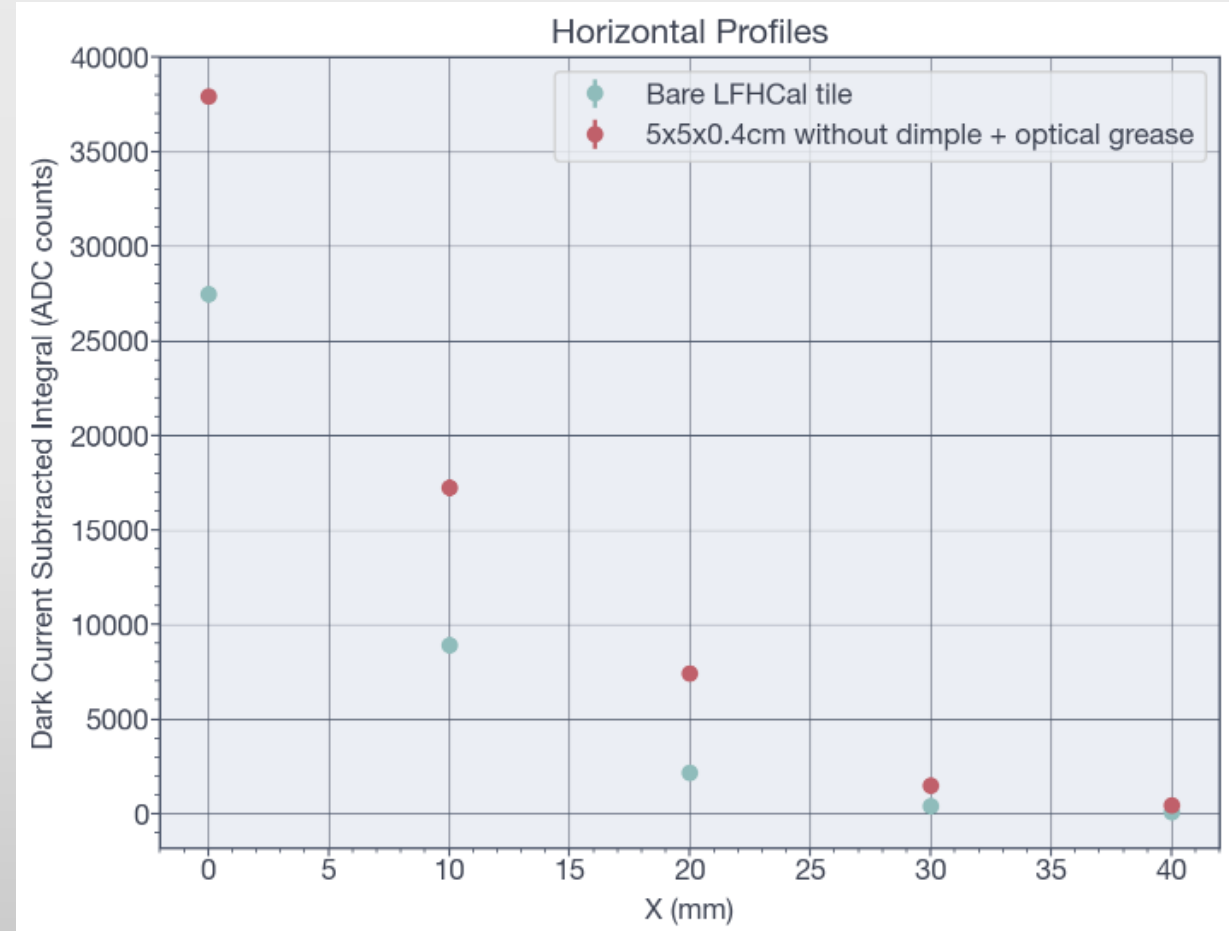
- Wanted to check how sensitive our setup is to small changes when swapping, replacing tiles etc.
- Took a few measurements with minor shift of tile, picking up and replacing, LFHCal painted tile to see.



LFHCal tile scans



Wrapped vs unwrapped



Bare LFHCal tile vs our bare 5x5

LFHCaI vs Thick tile

