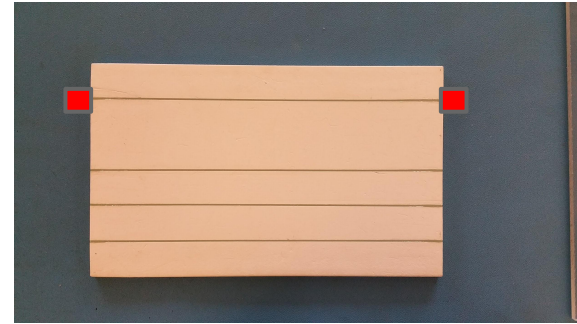
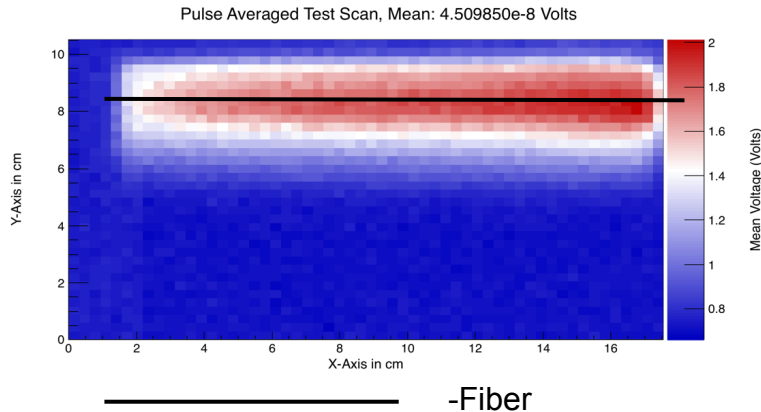


Control Panel Light Map Asymmetry Investigation Week of May 25

Sebastian Seeds - Sebastian Vazquez

Light Map Asymmetry

Early light map results display an increasing gradient of light intensity from left to right in a control panel. We seek to explain and mitigate this effect to establish a consistent control for further tests on laser-etched panels.



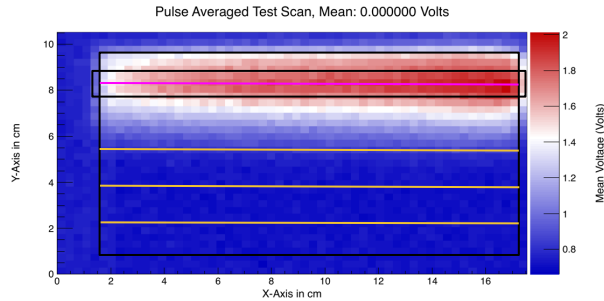
A1 - Panel with Diffusive coating

■ - SiPM

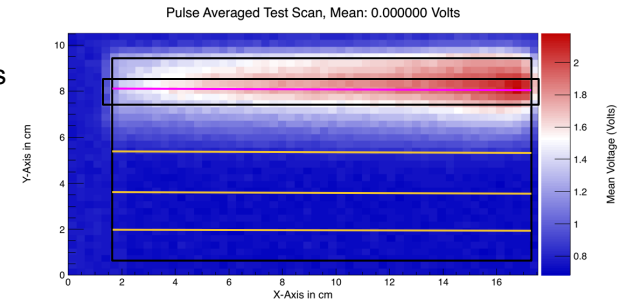
Example histogram from data taken with an air coupled SiPM to the left side of panel A1. Each bin represents an average of 1000 integrated pulses from the SiPM triggering on double coincidence from both SiPMs. Roughly a 20% variance in light yield from left to right across the fiber.

Characteristic Light Gradient: Panel A1

SiPM 1 - Attached Left Side

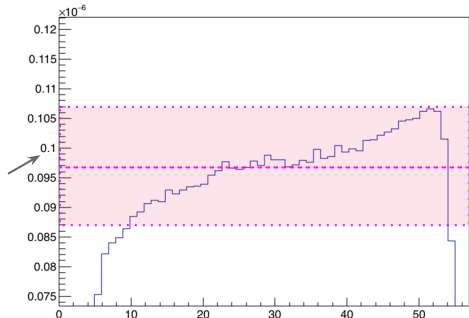


SiPM 2 - Attached Right Side



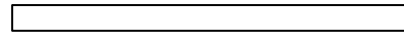
— - Fiber with attached SiPMs

X Projection, Averaged over 3 Rows at Y = 9, With 25.0 % Window About the Middle



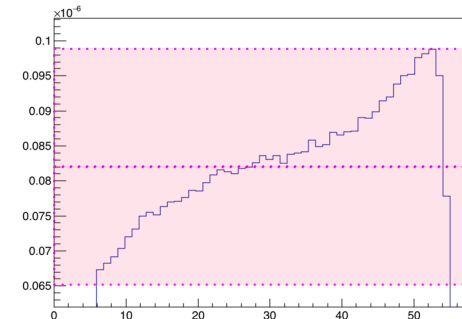
+8% increase from mean to peak

± 25% window from mean at the middle of the panel



Projections from boxed region
- 3 rows across the panel

X Projection, Averaged over 3 Rows at Y = 9, With 25.0 % Window About the Middle



+20% increase from mean to peak

± 25% window from mean at the middle of the panel

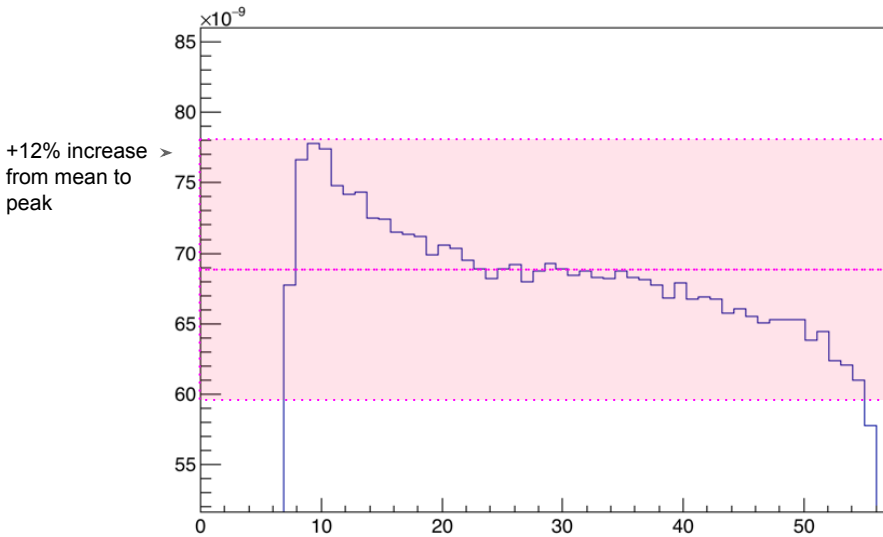
Light Gradient: Panel A1 Rotated



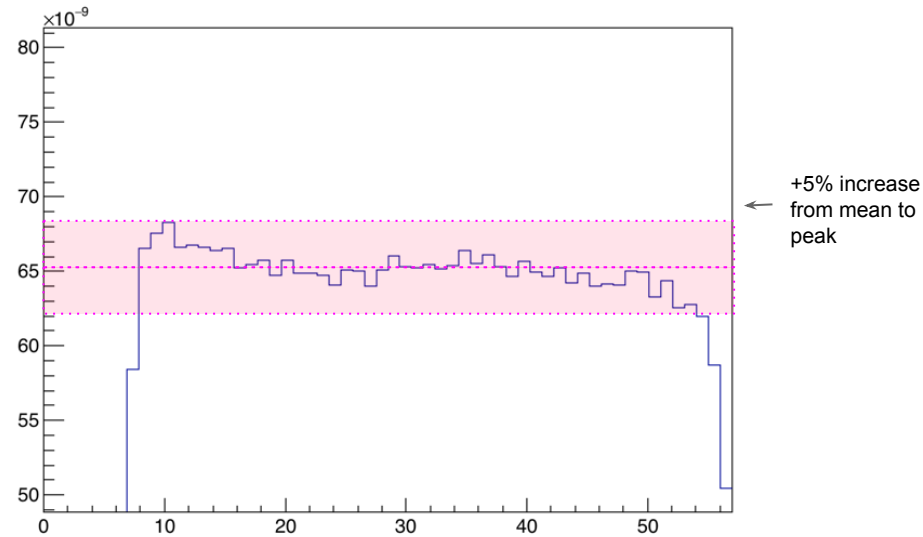
Panel A1 after a rotation of π rads

Note that the general trend in light yield reversed as the panel was rotated. In addition, the SiPM with the higher light yield reversed as well.

X Projection, Averaged over 3 Rows at Y = 0, With 25.0 % Window About the Middle



X Projection, Averaged over 3 Rows at Y = 0, With 25.0 % Window About the Middle



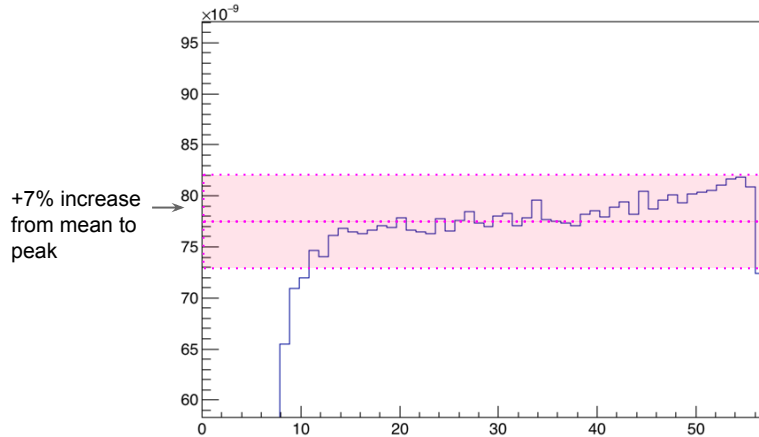
$\pm 25\%$ window from mean at the middle of the panel

Light Gradient: A1 Fiber 3

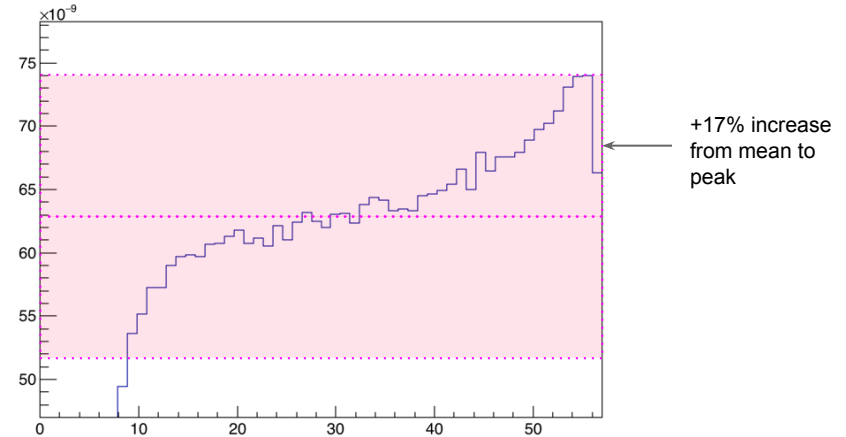


Identical light yield trend present on all fibers across the panel.

X Projection, Averaged over 3 Rows at Y = 0, With 25.0 % Window About the Middle



X Projection, Averaged over 3 Rows at Y = 0, With 25.0 % Window About the Middle



± 25% window from mean at the middle of the panel

Several Conclusions Drawn from A1

- There is a clear and measurable light yield gradient across the panel.
- Gradient might be due in part to manufacturing inconsistencies in the coating and doping of the panel or installation of the fiber.
- Results have shown large variance within the magnitude of the gradient effect but have all confirmed its existence.

New Test Panel

We've tested panel A4 (no coating) to compare light maps and associated projections over single parameter changes. If the light gradient reported is due to inconsistencies within the coating, then the light yield associated with A4 should create an even light gradient around the fiber.



A4 - Clear Panel (new)

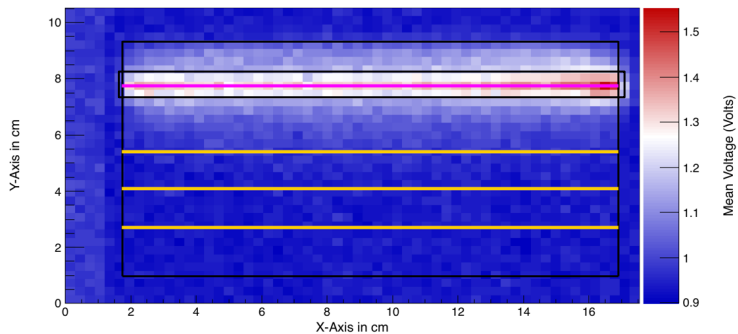


A1 - Panel with diffusive coating (old)

A4 Clear Panel

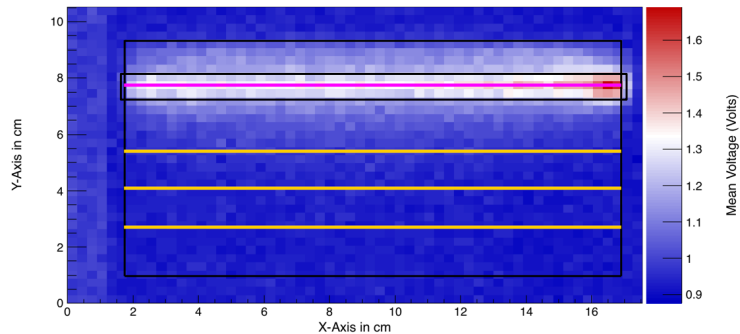
SiPM 1 - Attached Left Side

Pulse Averaged Test Scan, Mean: 2.623962e-8 Volts

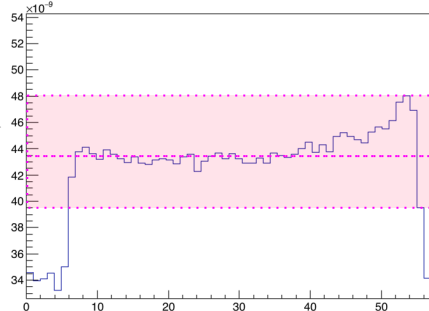


SiPM 2 - Attached Right Side

Pulse Averaged Test Scan, Mean: 2.178194e-8 Volts



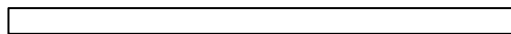
X Projection, Averaged over 3 Rows at Y = 9, With 25.0 % Window About the Middle



+12% sudden increase from mean to peak on right side

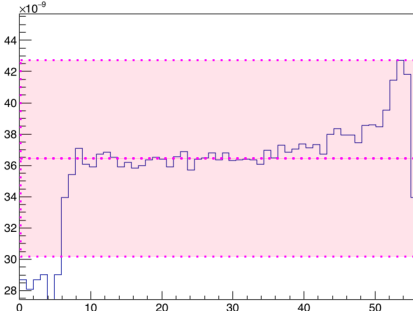
— - Fiber with attached SiPMs

Projections from boxed region
- 3 rows across the panel



± 25% window from mean at the middle of the panel

X Projection, Averaged over 3 Rows at Y = 9, With 25.0 % Window About the Middle

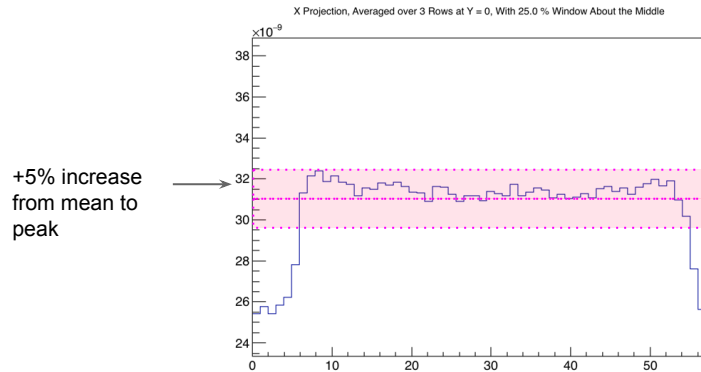


+16% sudden increase from mean to peak on right side

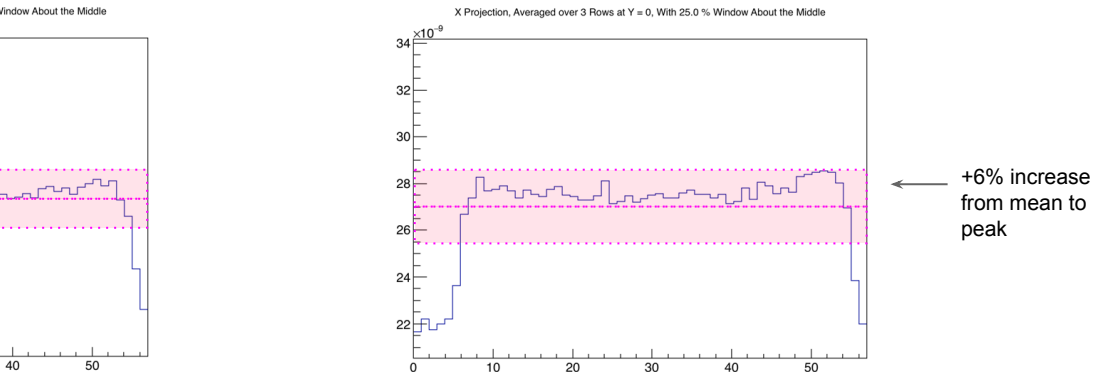
A4 Clear Panel - Panel Rotated π Radians Recoupled - Projections

- 3 row projections from the same section of the panel depicted on previous slide, with a π rad rotation of the panel.

SiPM 1 - Attached Left Side



SiPM 2 - Attached Right Side

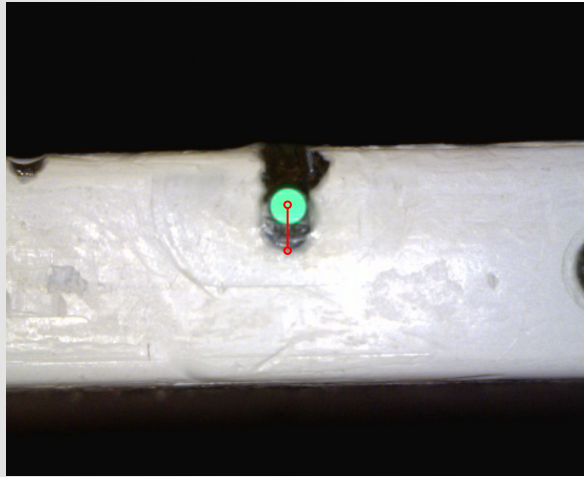


$\pm 25\%$ window from mean at the middle of the panel

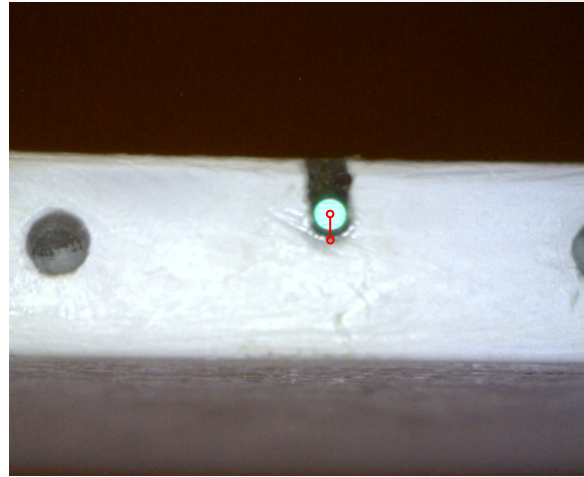
A4 Clear Panel - Features

- Consistent trend of increasing light yield across unrotated panel from left to right is less noticeable.
- Sudden drop of light yield immediately before the panel on the left side.
- Consistent trend not apparent after rotation.

Variation in fiber depth among fibers



fixed 1.7 mm
from bottom of
milled groove



fixed 0.76 mm
from bottom of
milled groove

- Variation in fiber depth appears to correlate with the light yield across the panel, where the further from the bottom the fiber sits, the less light is collected.
- Panel A1 has a much greater variation in fiber depth for all fibers than A4.

Investigating effect of slight panel to scan misalignment on gradient.

Scan Region 



Misalignment exaggerated slightly