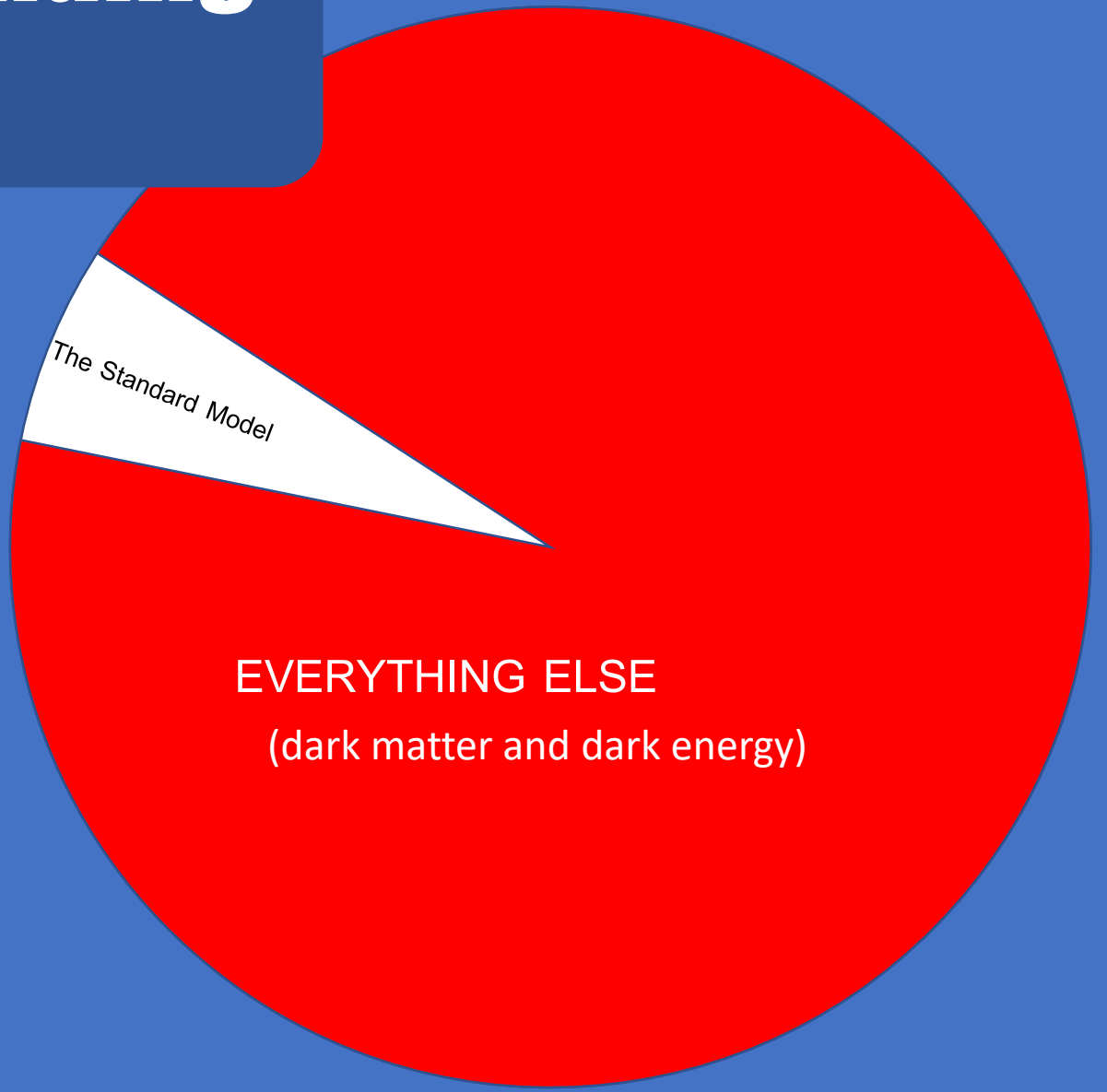
The Current Understanding of Particle Physics:

(Some) Experiments are looking to:

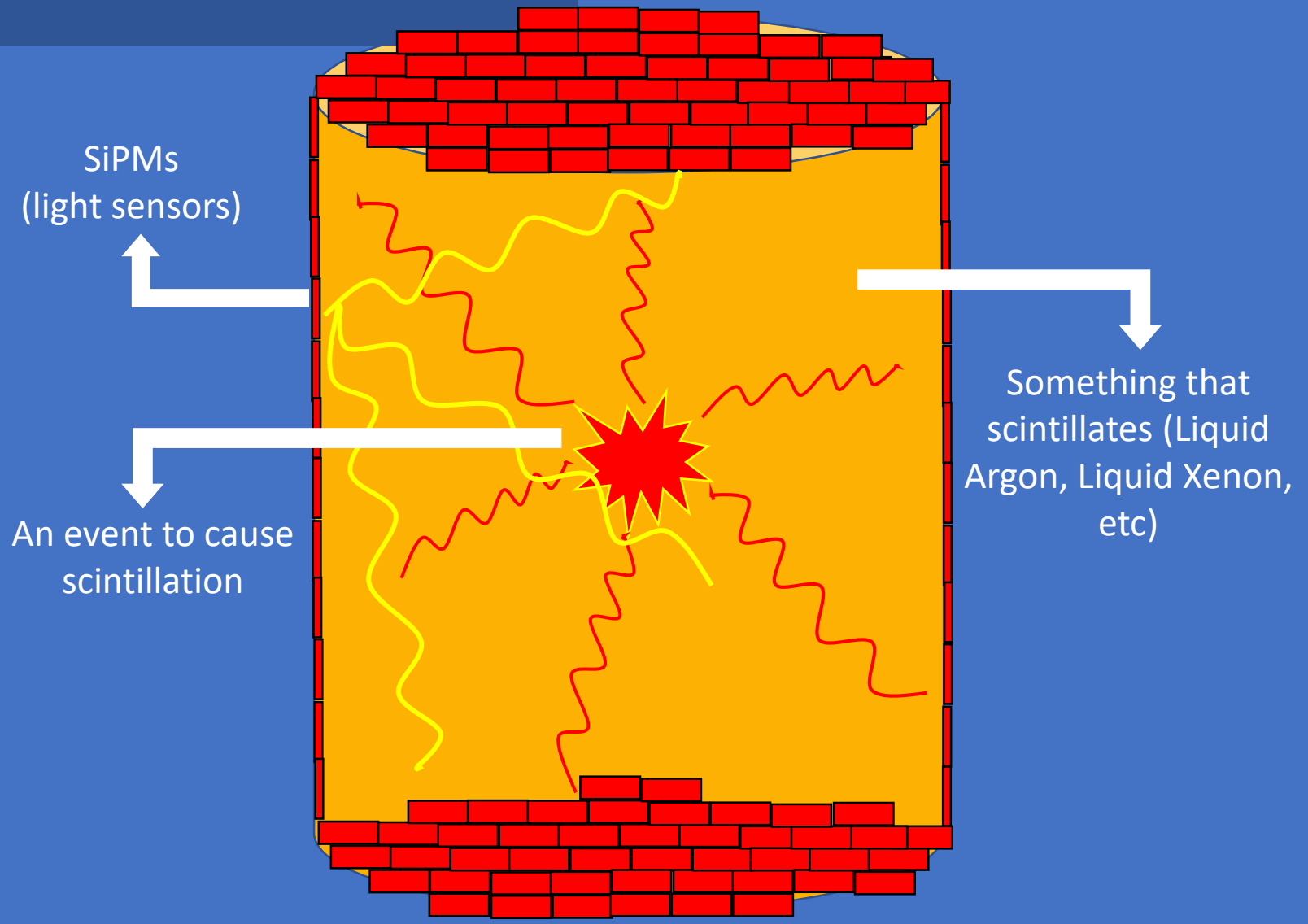
a) Probe the Standard Model

b) Detect Dark Matter



A Generic Search Experiment:

How can we measure the light emitted from SiPMs?

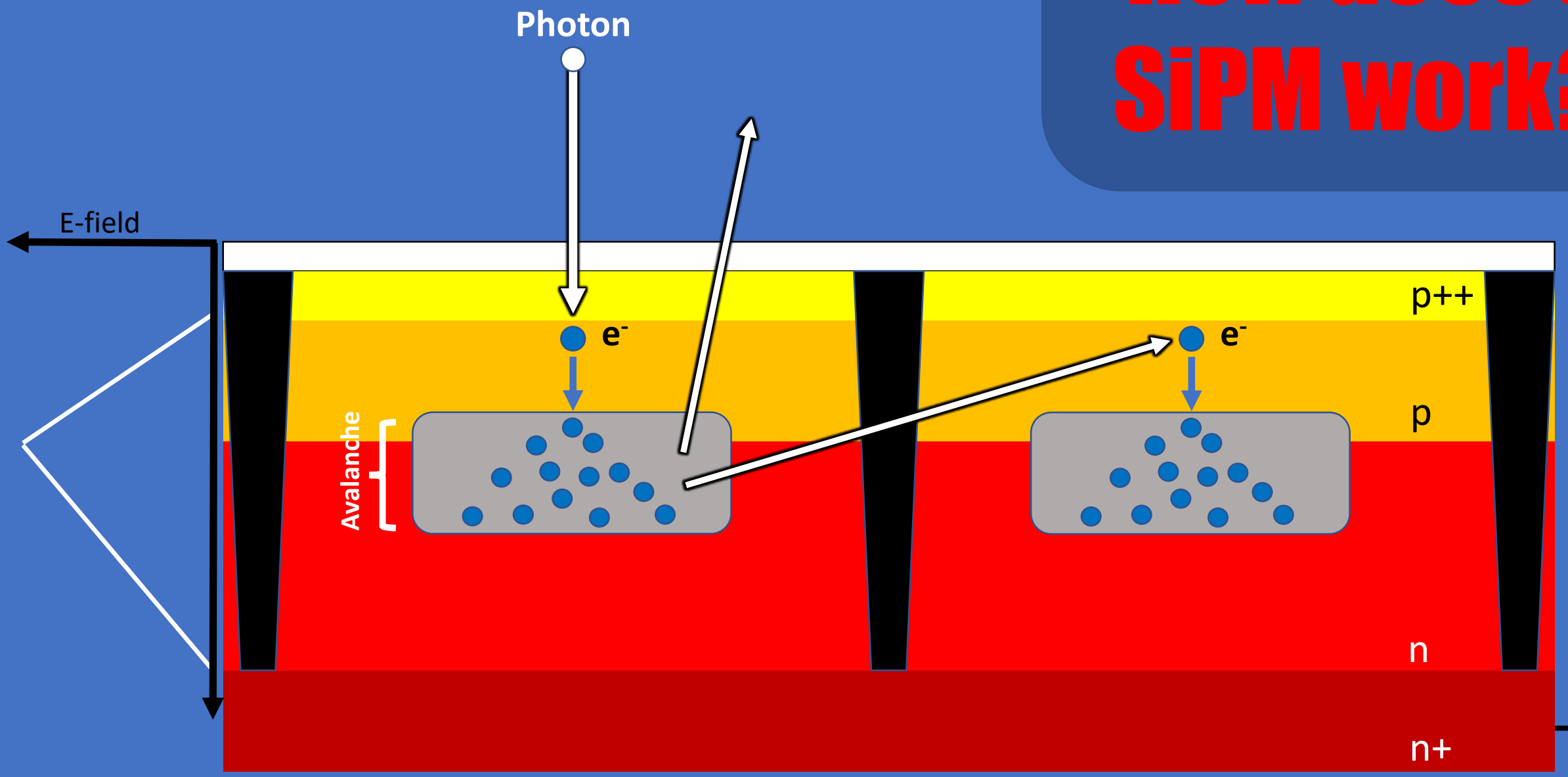


Laser-Driven Photon Emission in SiPMs with MIEL

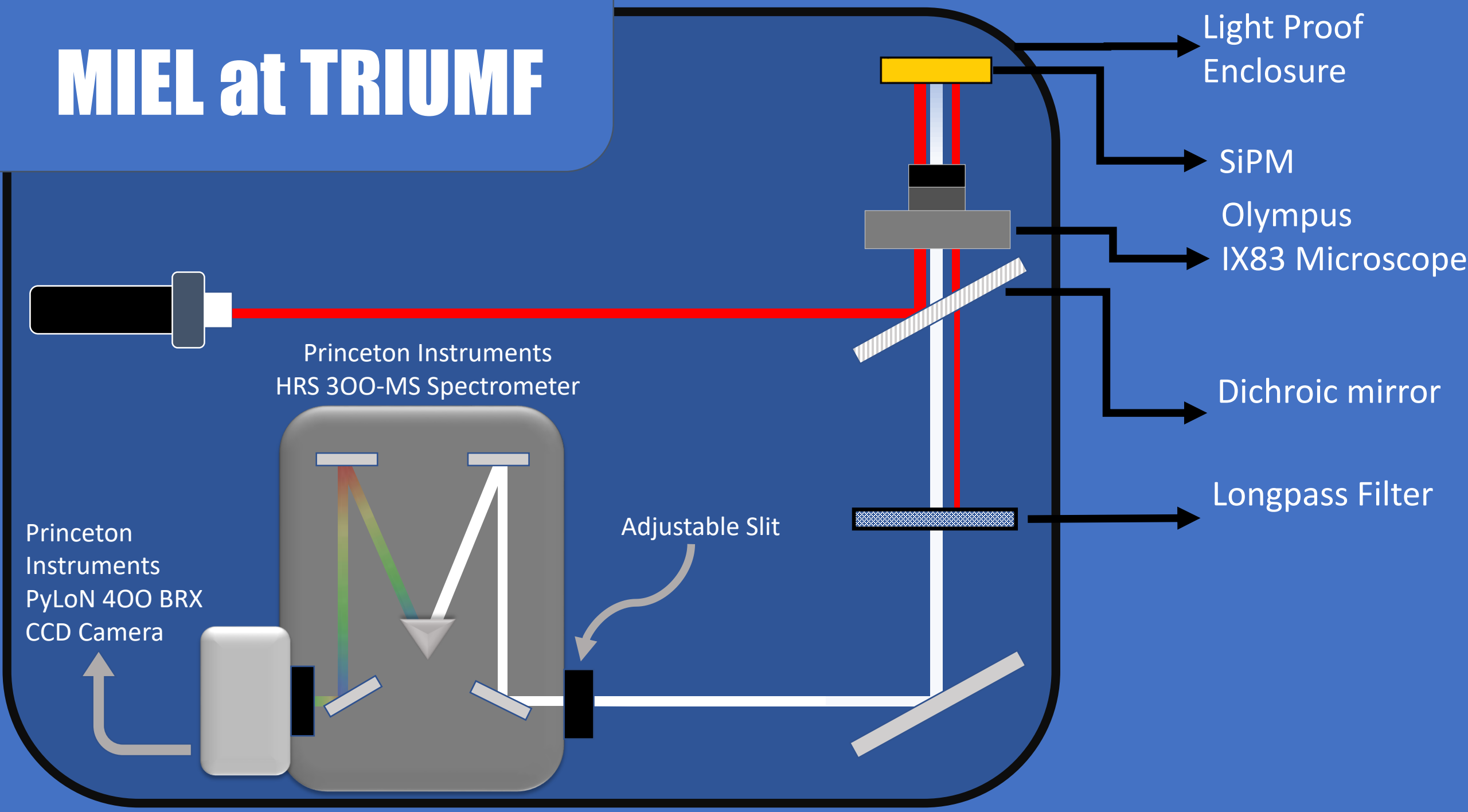
CASST Student Talk Competition
Zach Charlesworth
August 2022

TRIUMF

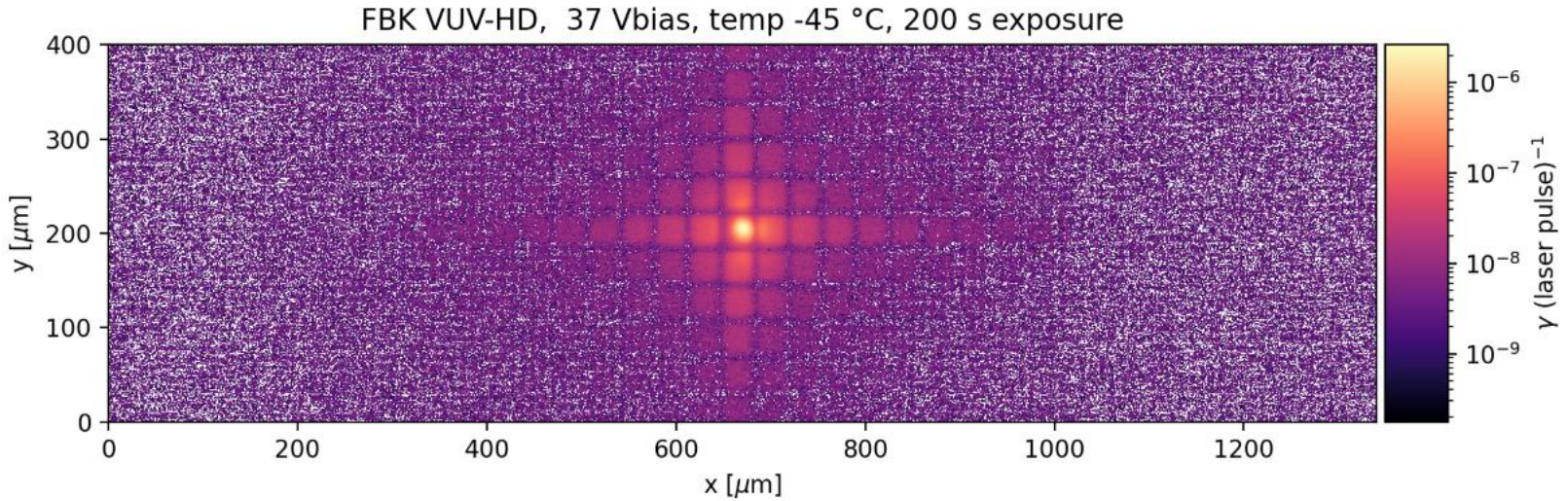
How does a SiPM work?



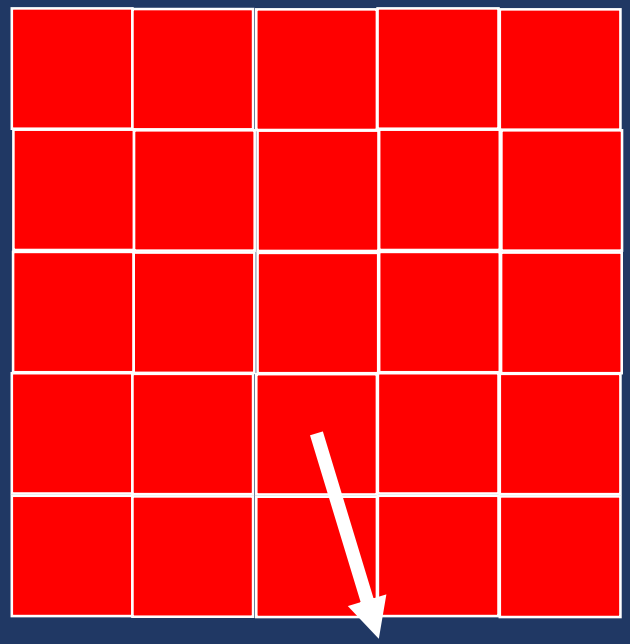
MIEL at TRIUMF



Light Emission Visualized:



SiPM layout:

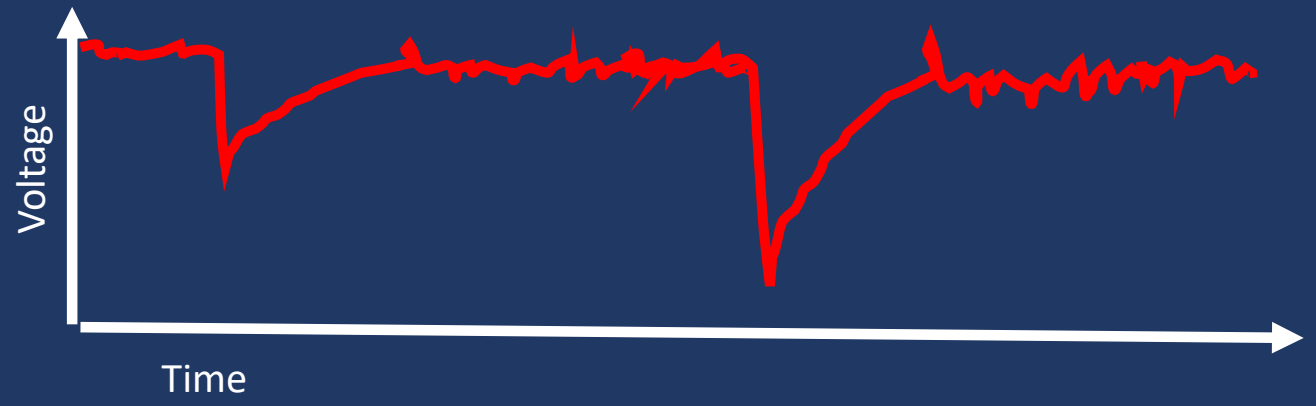


SPAD
(Single Photon Avalanche Diode)

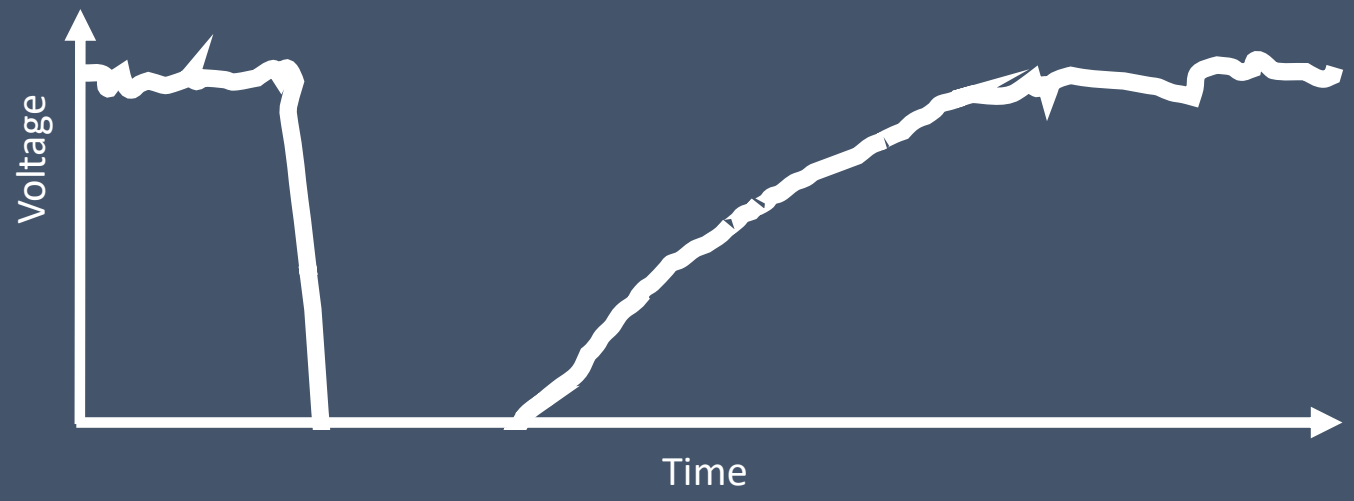
Charge Readout of a SiPM

1 SPAD fires:

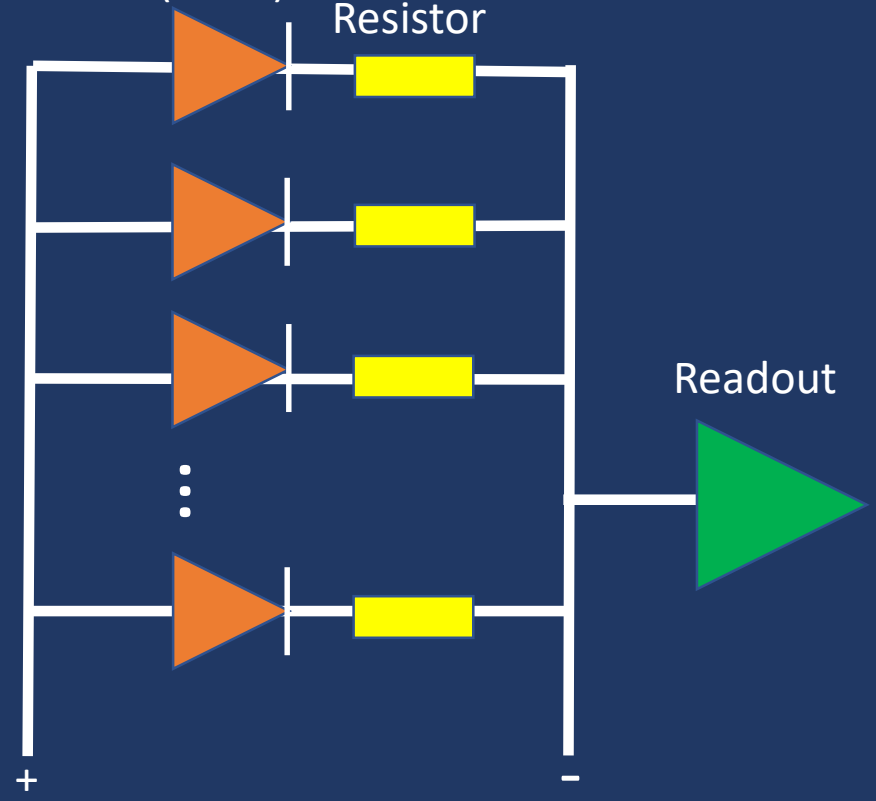
2 SPADs fire:



10 SPADs fire:



Single Photon Avalanche Diode (SPAD)



“Finger Plots”

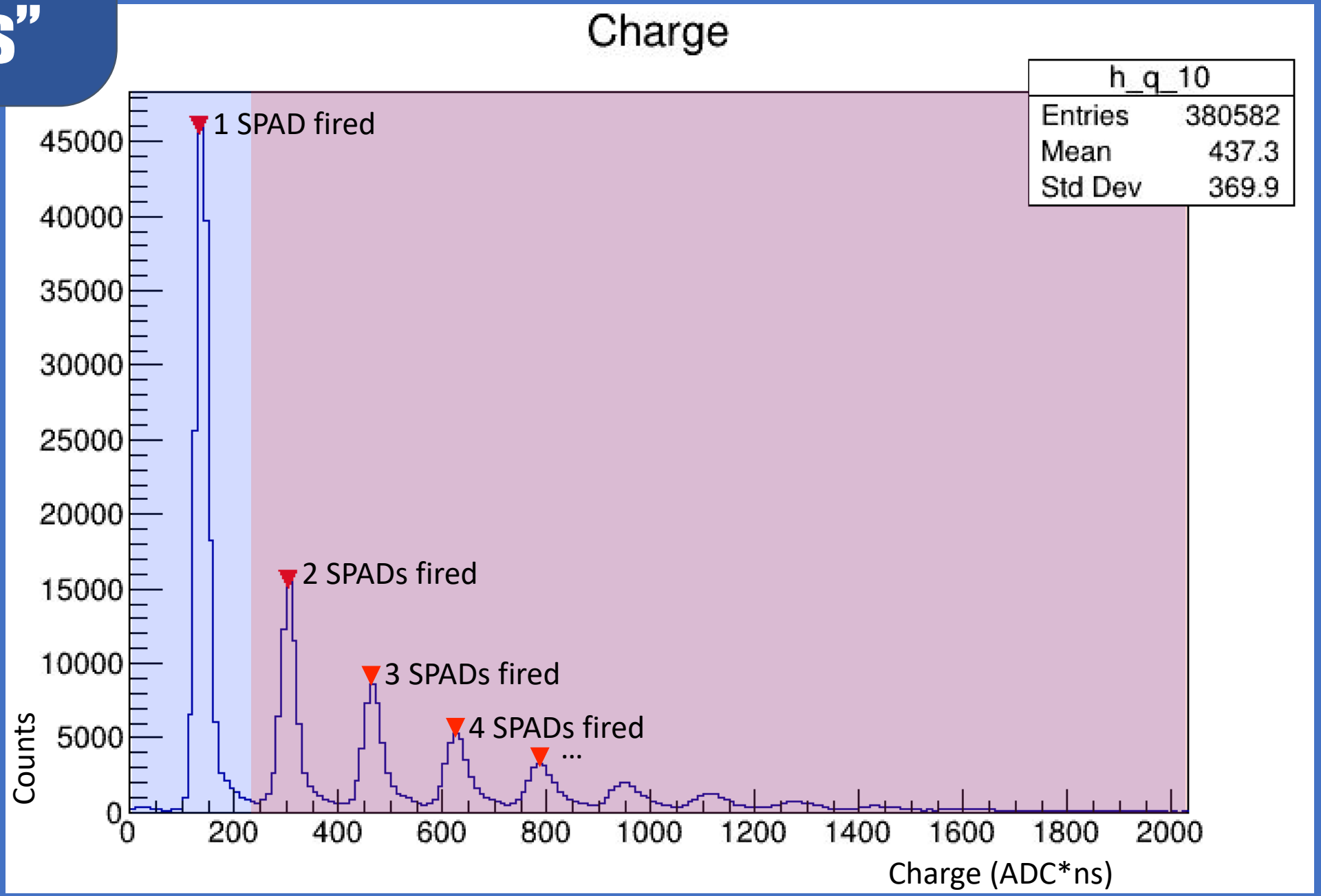
Number of times there’s cross-talk

÷

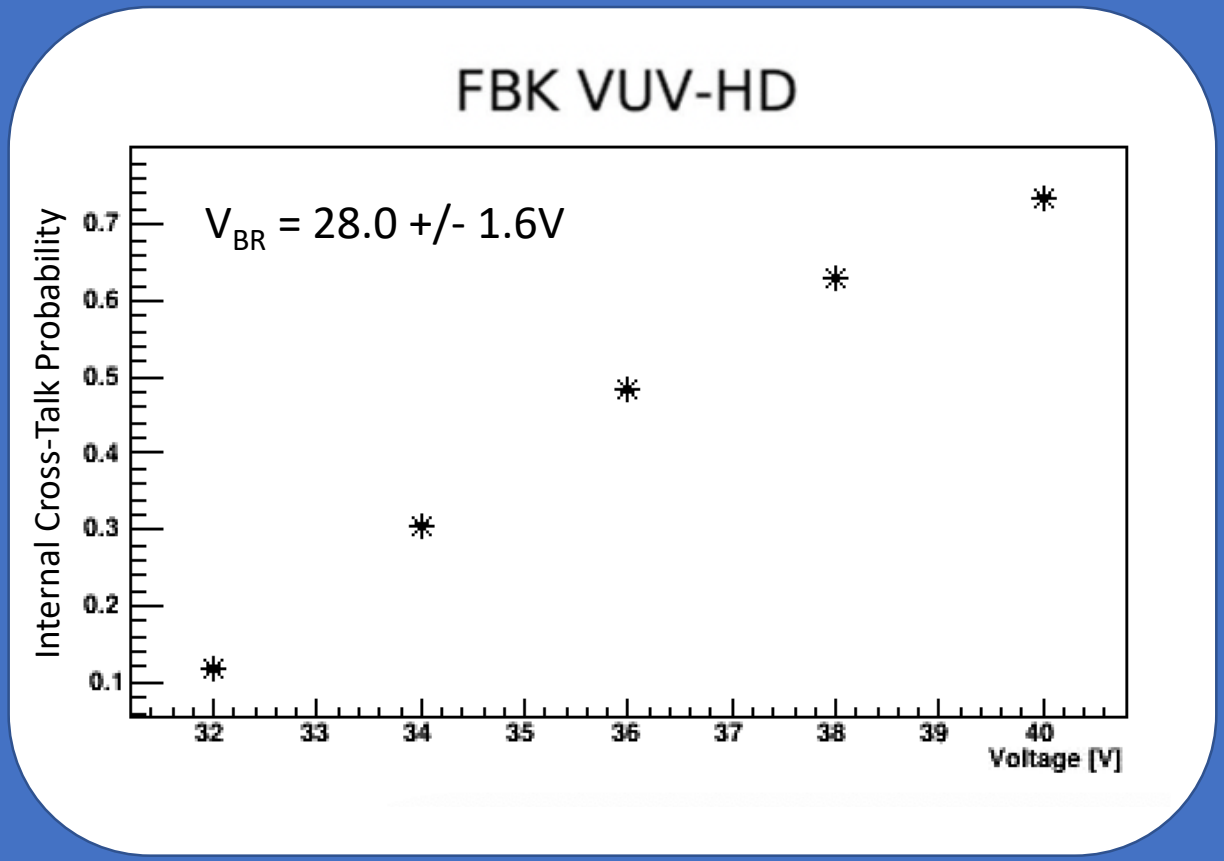
Number of times the SiPM fires

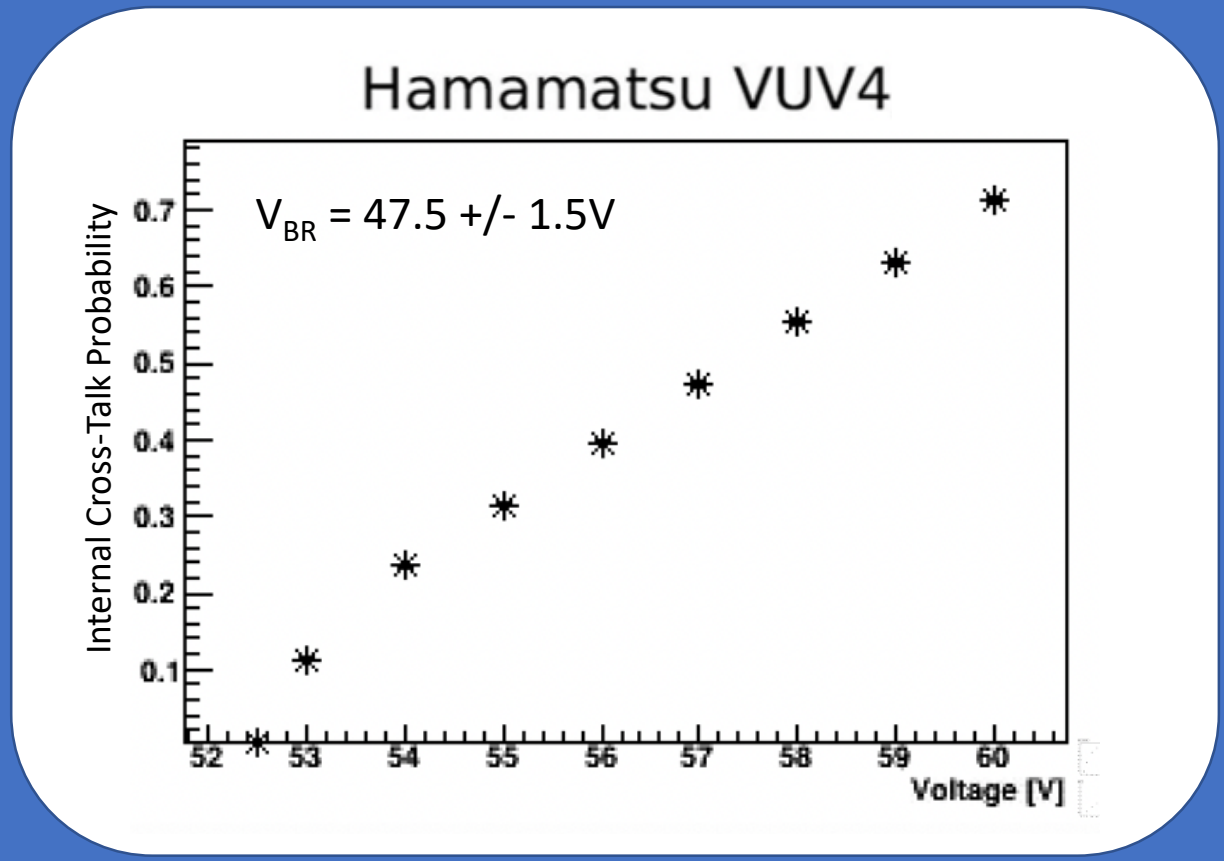
=

The probability of cross-talk



Quantifying Internal Cross-Talk:





Recap:

Quantifying and Measuring Internal and External Cross Talk

Better energy resolution and more precise detectors

Advances particle physics through rare event searches and dark matter searches

Acknowledgments:

TRIUMF PHAAR Group:

Fabrice Retière (Head)
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Noah Albano
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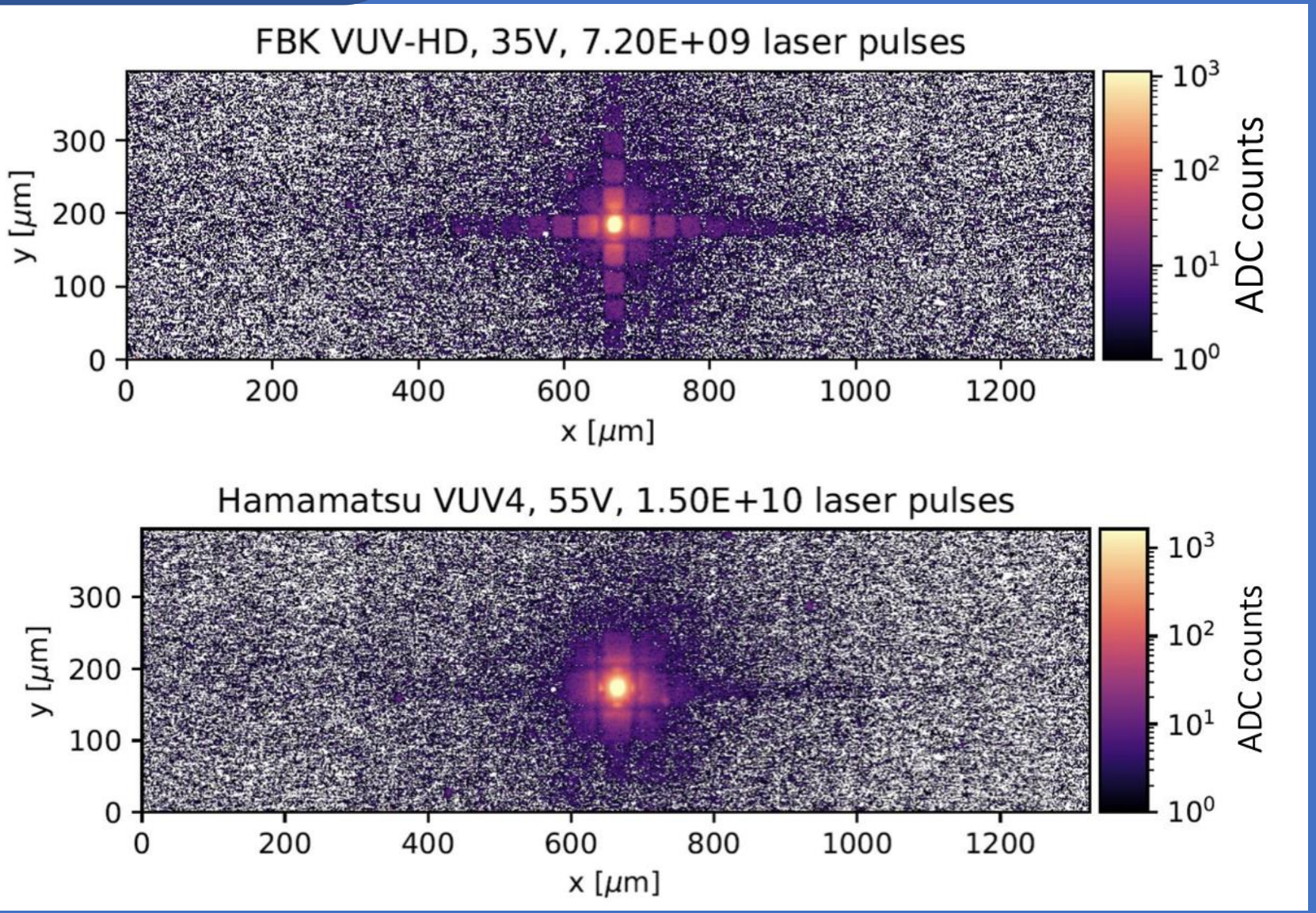
Byeongguk Min
Seraphim Koulosousas
Maia Henriksson-Ward
Mayur Patel
Nicolas Massacret

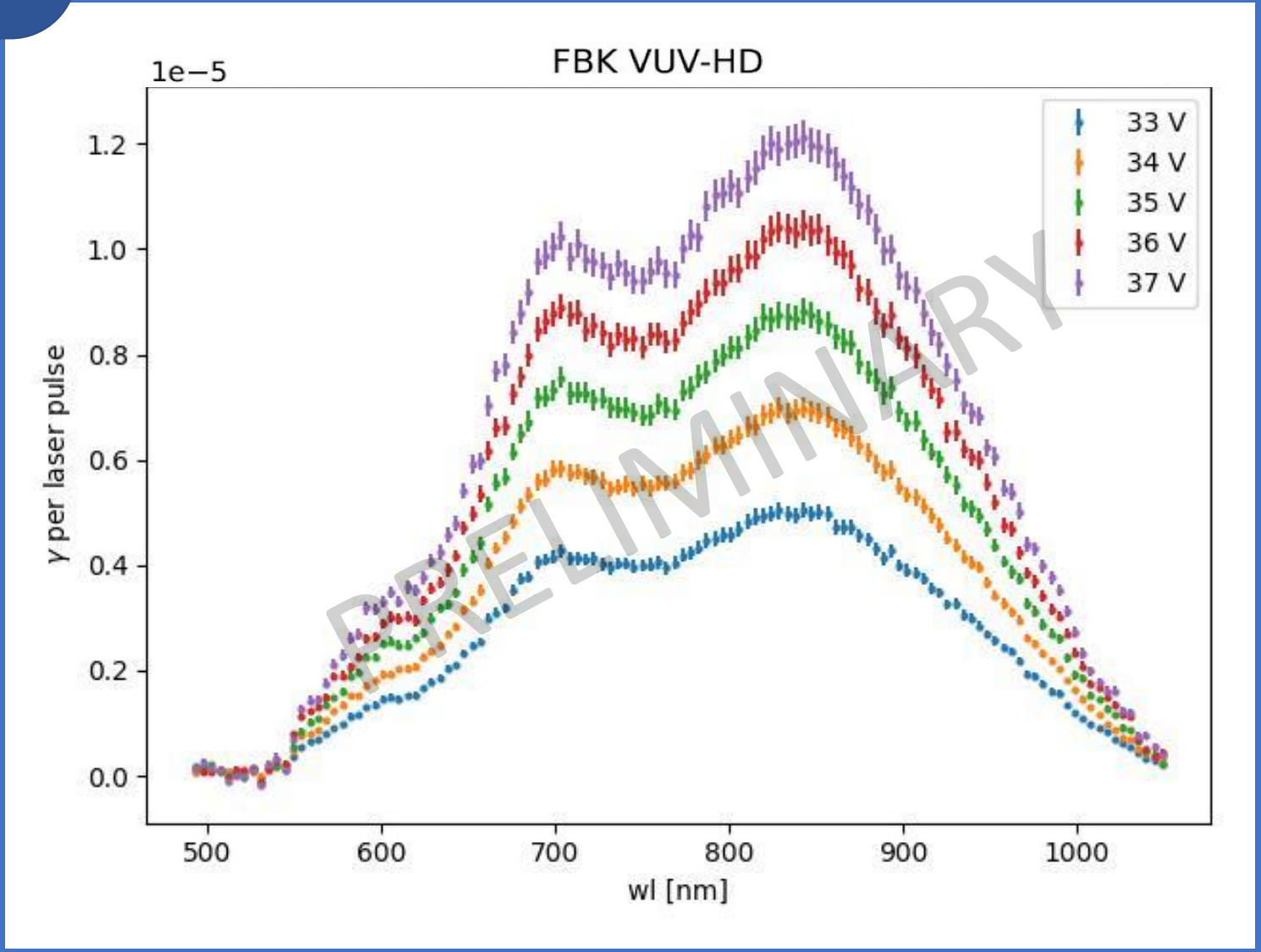
BACKUP:



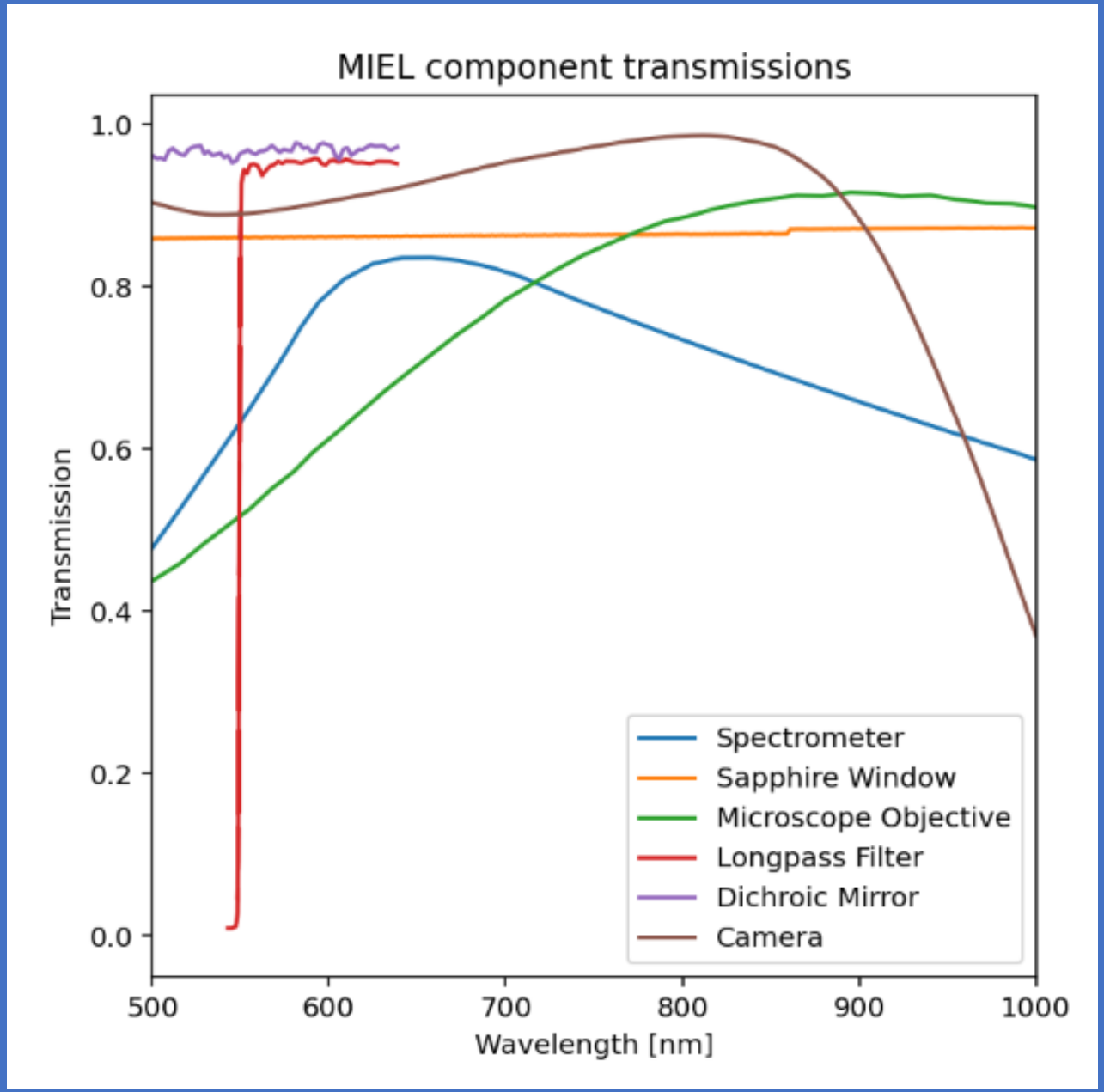
Polysilicon Trenches

Tungsten Trenches

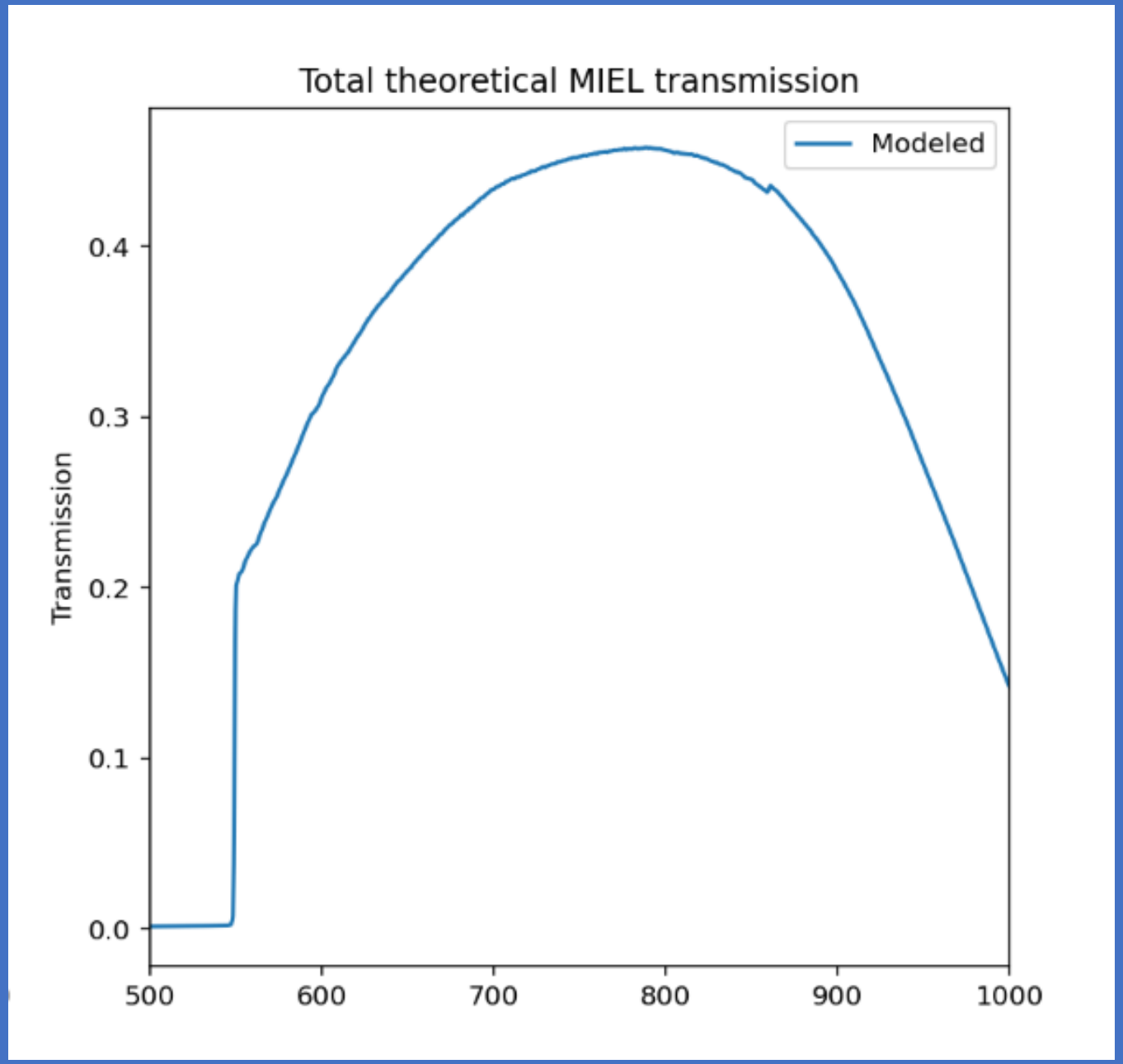
BACKUP:


FBK VUV-HD
1e−5
1.2
1.0
0.8
0.6
0.4
0.2
0.0
γ per laser pulse
500
600
700
800
900
1000
wl [nm]
33 V
34 V
35 V
36 V
37 V
PRELIMINARY

BACKUP:

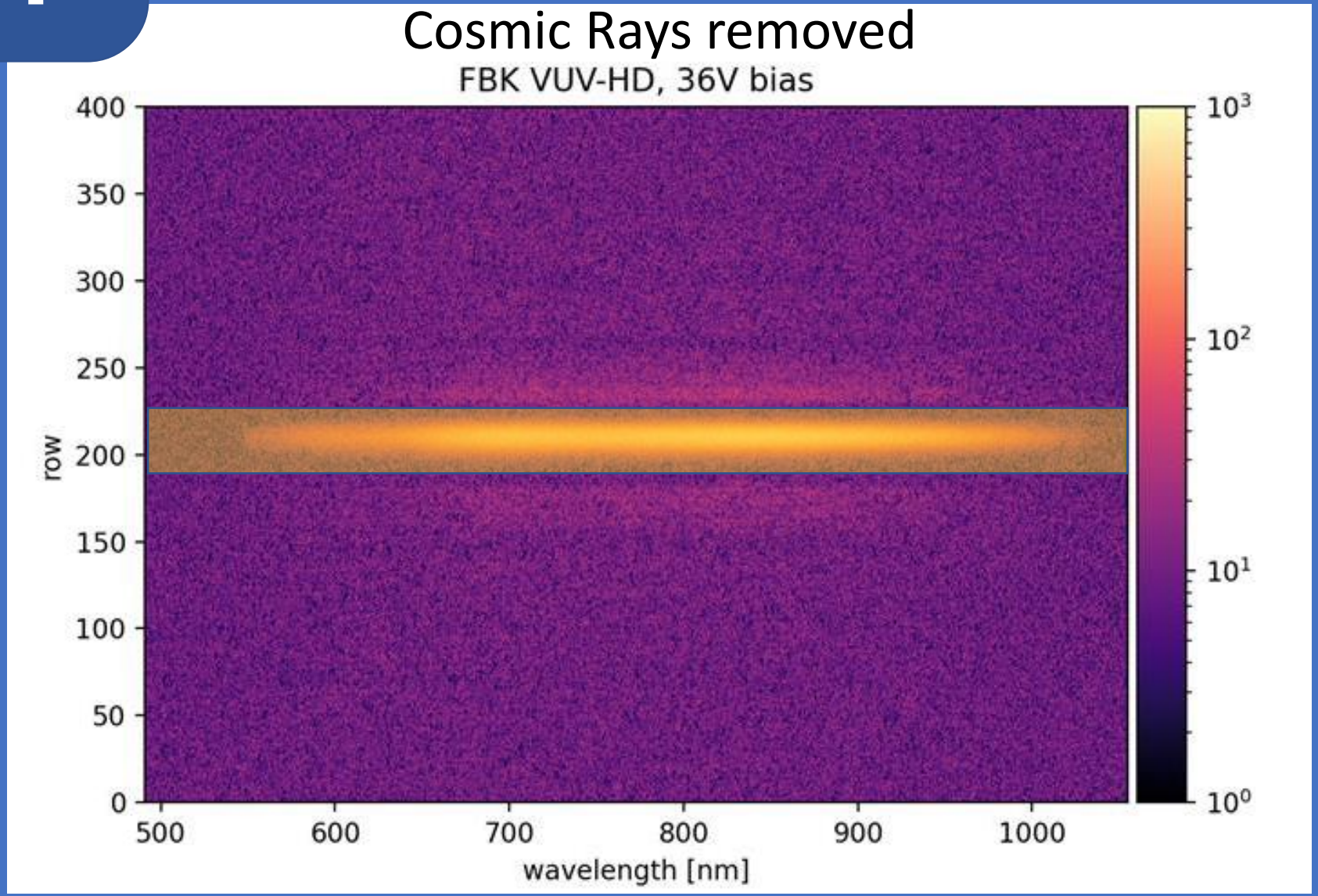

MIEL component transmissions
Transmission
1.0
0.8
0.6
0.4
0.2
0.0
500
600
700
800
900
1000
Wavelength [nm]
Spectrometer
Sapphire Window
Microscope Objective
Longpass Filter
Dichroic Mirror
Camera

BACKUP:

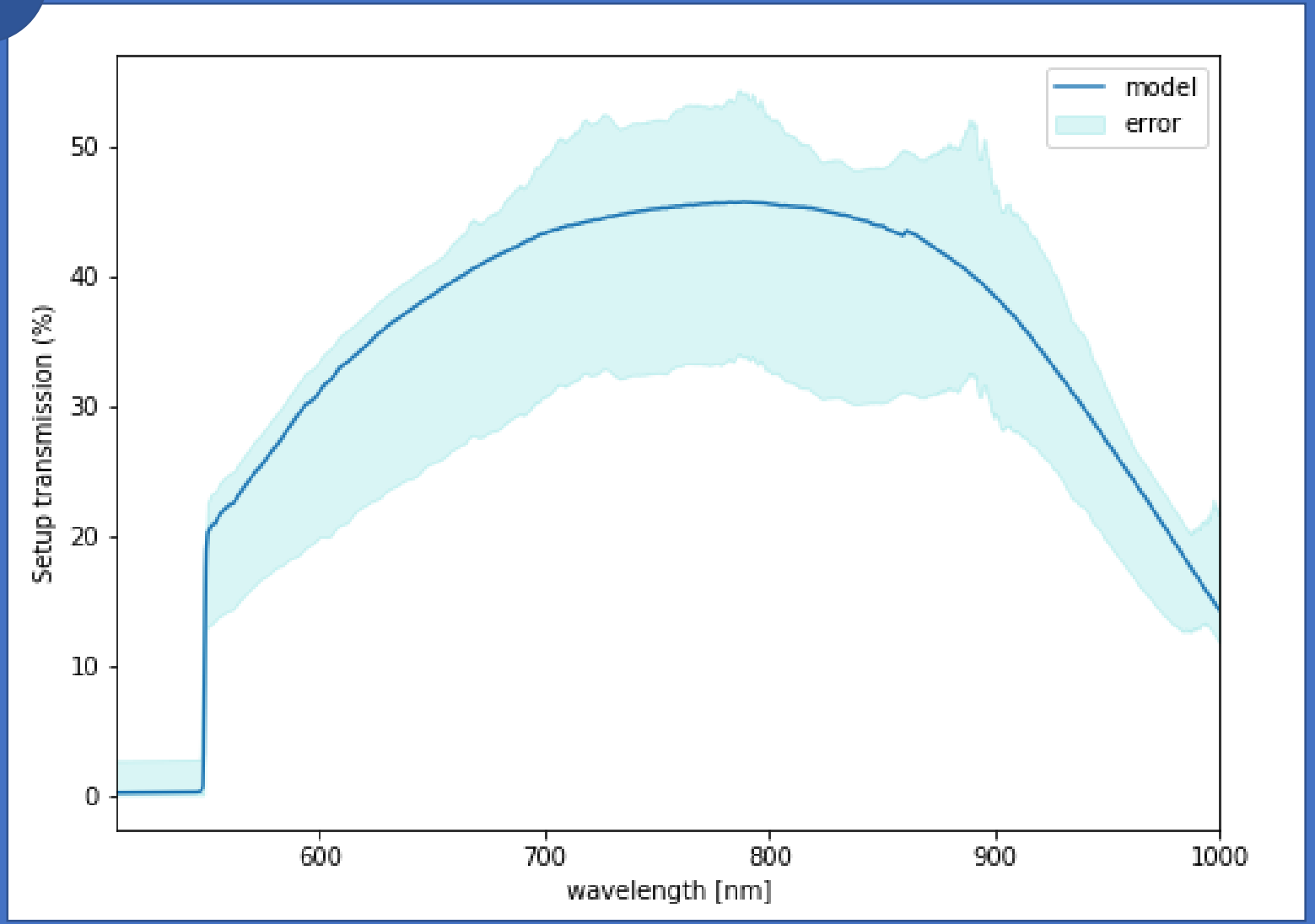

Total theoretical MIEL transmission
Modeled
Transmission
0.0
0.1
0.2
0.3
0.4
500
600
700
800
900
1000

BACKUP:

Cosmic Rays removed



BACKUP:


model
error
Setup transmission (%)
0
10
20
30
40
50
600
700
800
900
1000
wavelength [nm]