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Advisor: Mike Albrow

August 10, 2010

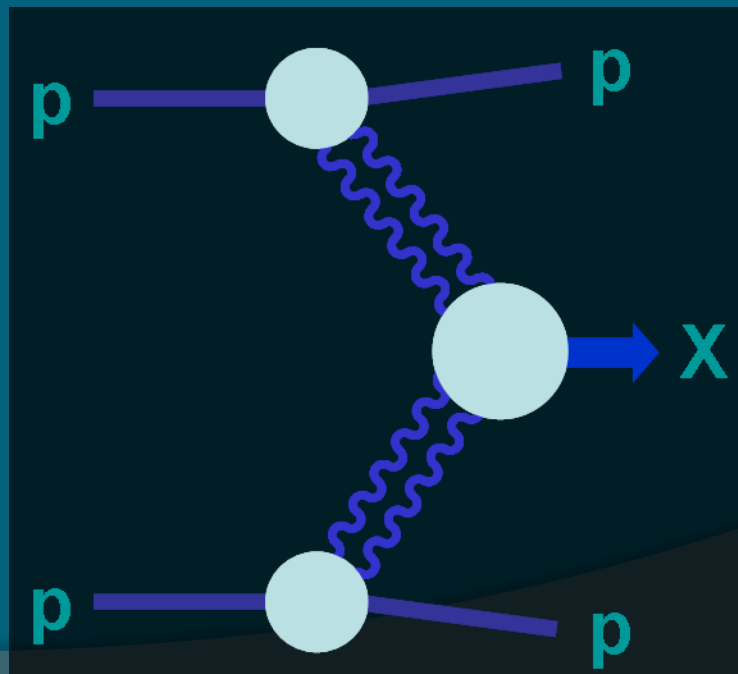
# Modeling Quartz Cherenkov Detector

# Outline

- ⦿ Why do we need fast timing?
- ⦿ Why Cherenkov?
- ⦿ Simulation Setup
- ⦿ Photo-Detectors
- ⦿ Simulation Data
- ⦿ Timing Resolutions
- ⦿ Further Studies

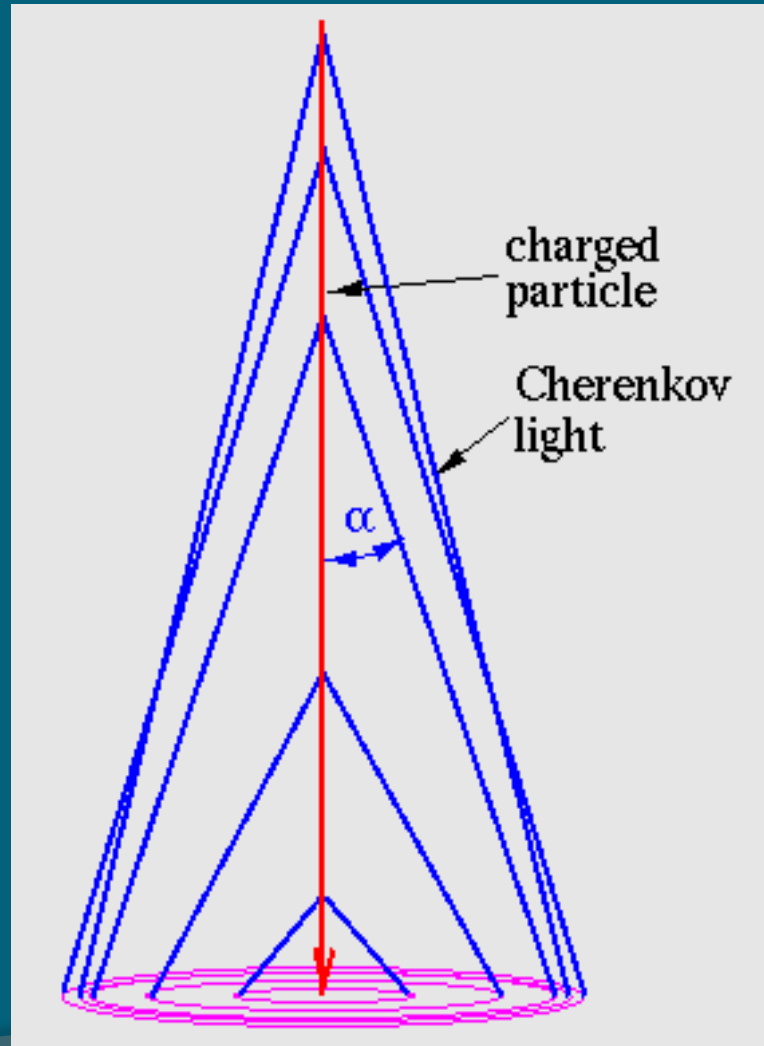
# Why Fast Timing?

- CEP
- High Precision Spectrometer
- Vertex Measurements



# Why Cherenkov?

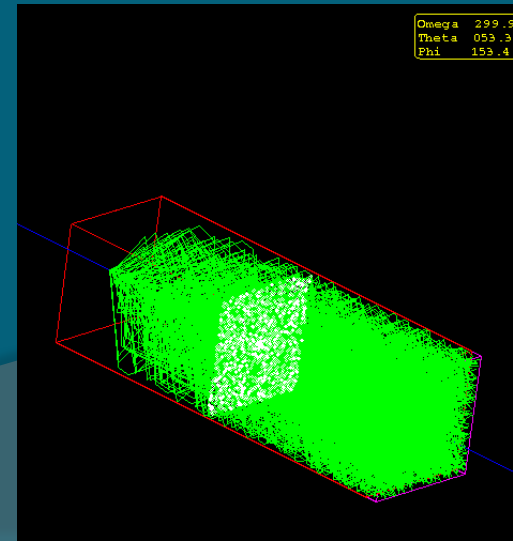
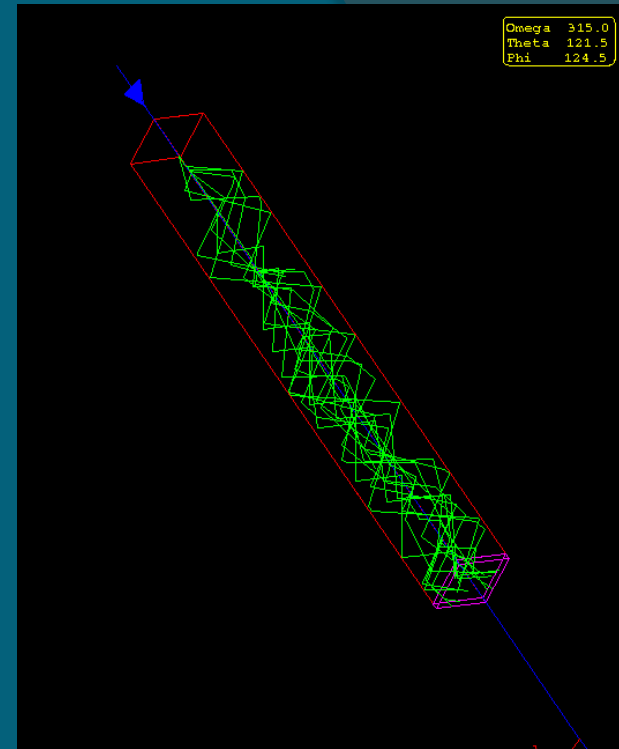
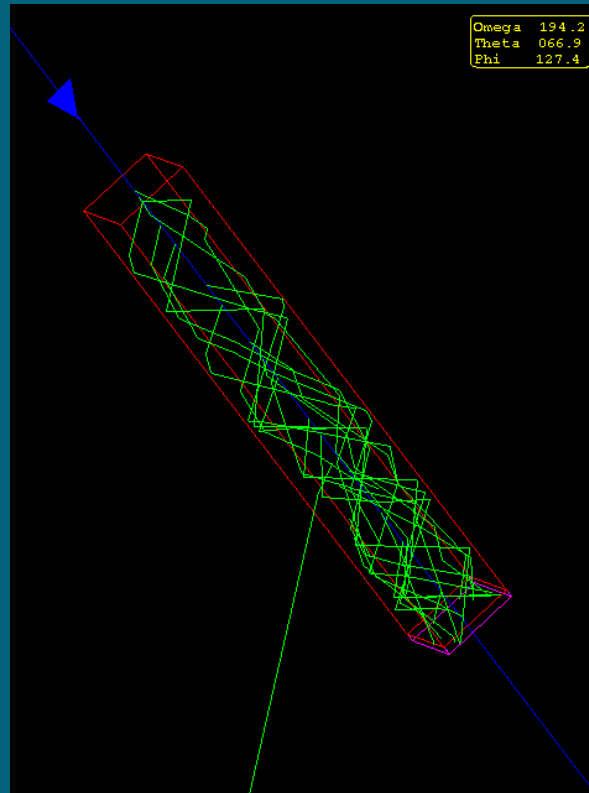
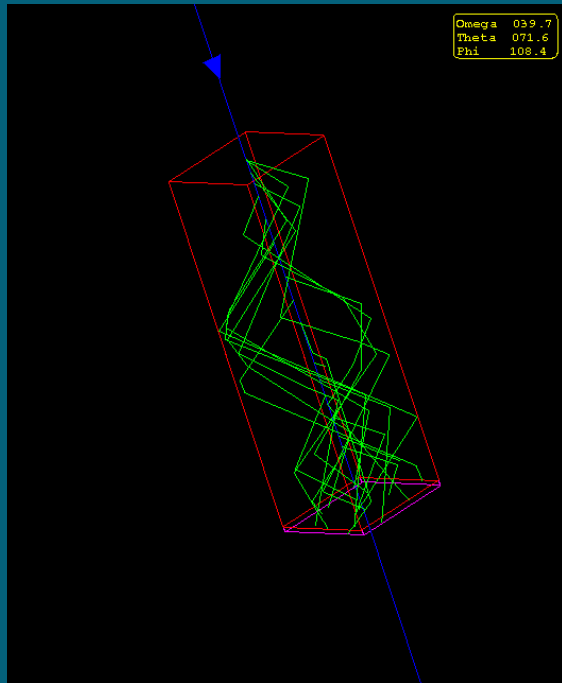
- Prompt



# Simulation Tools

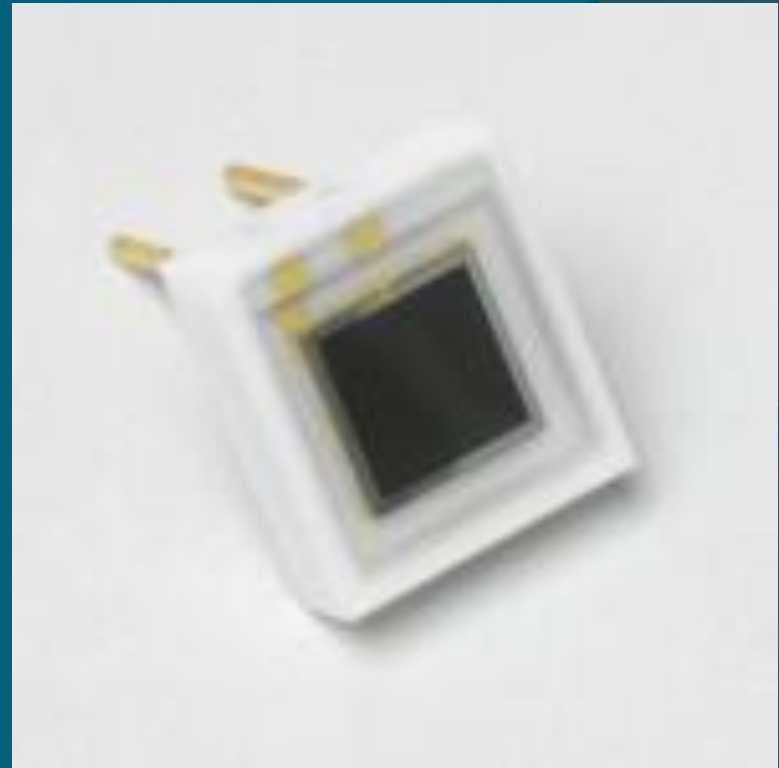
- Geant4
- ROOT

# SiPM Setup

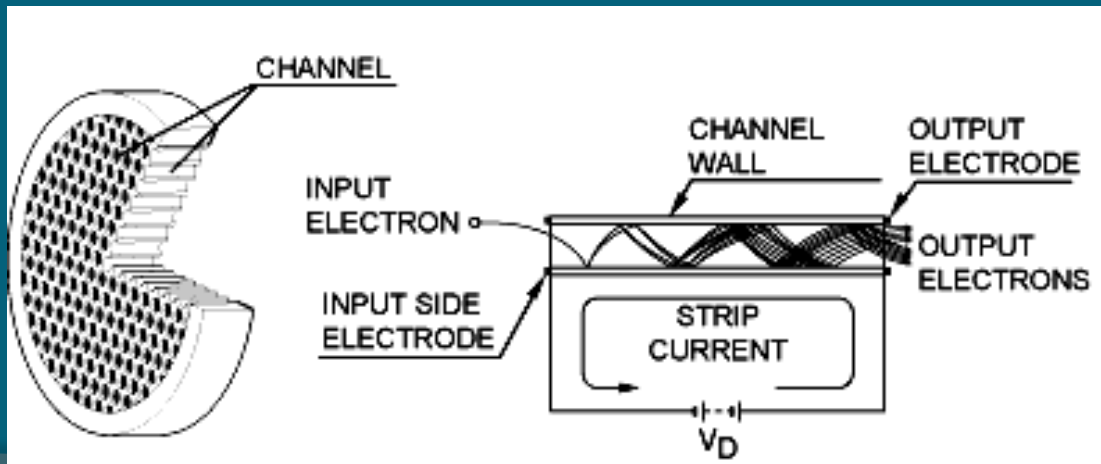


# Photodetectors

- SiPM
- MCP



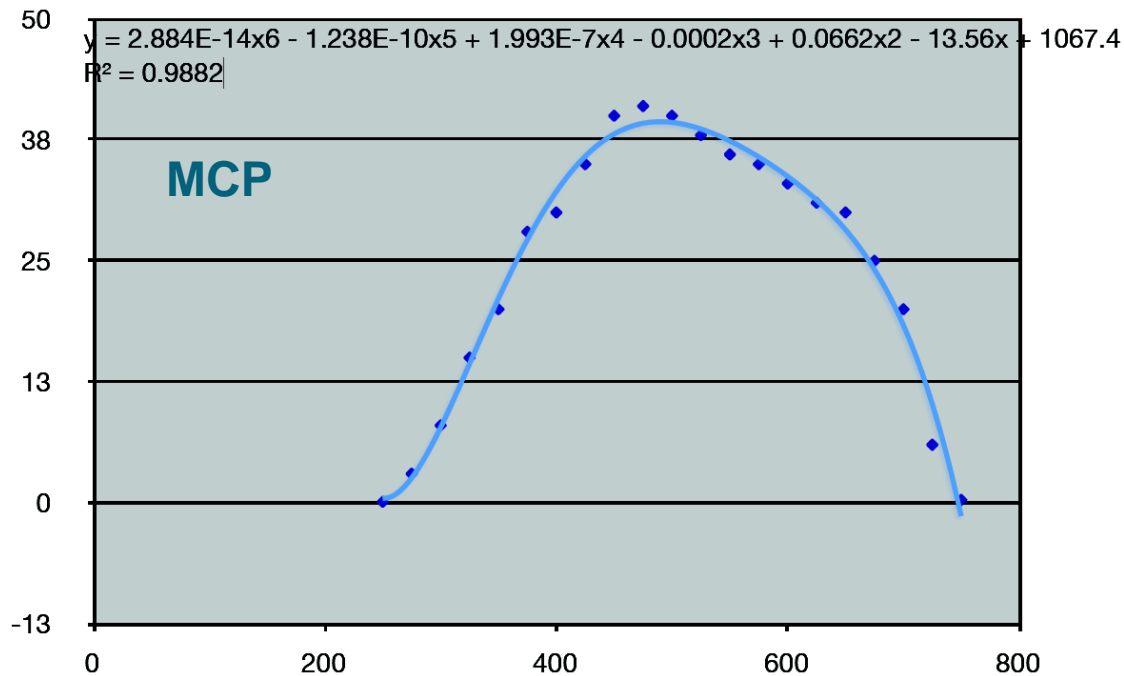
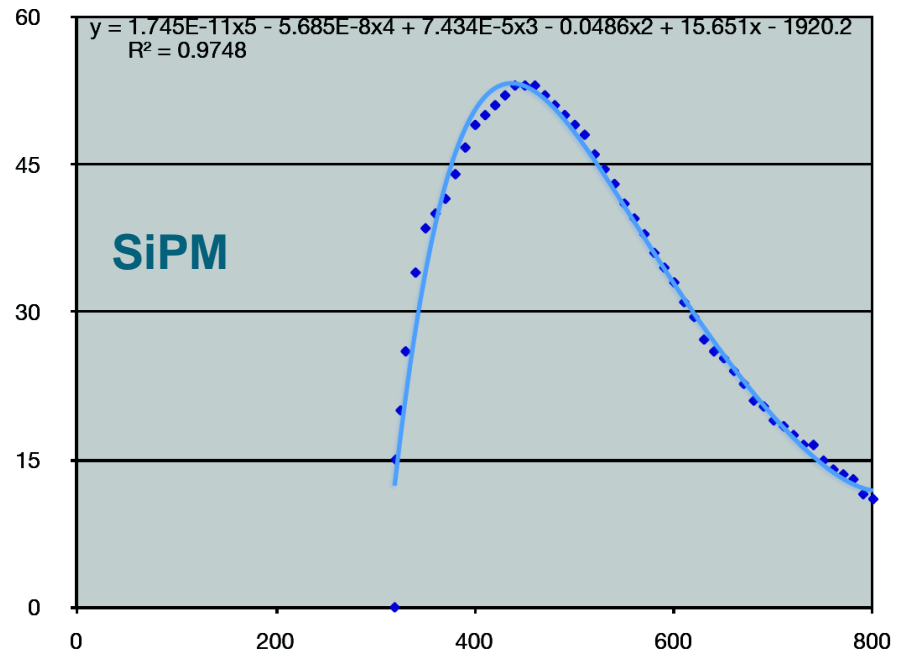
[http://jp.hamamatsu.com/products/sensor-ssd/4010/4025/S10362-33-050C/index\\_en.html](http://jp.hamamatsu.com/products/sensor-ssd/4010/4025/S10362-33-050C/index_en.html)



[http://www.dmp Photonics.com/MCP\\_MCPIImageIntensifiers/microchannel\\_plates.htm](http://www.dmp Photonics.com/MCP_MCPIImageIntensifiers/microchannel_plates.htm)

# QE and PDE

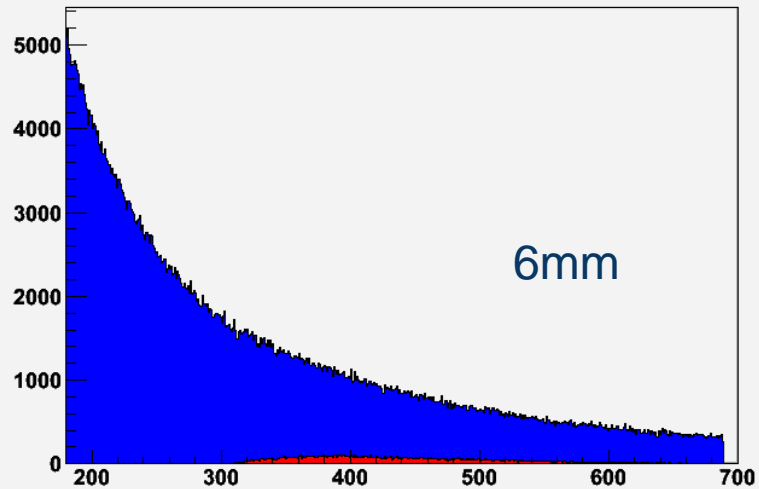
- SiPM
- MCP



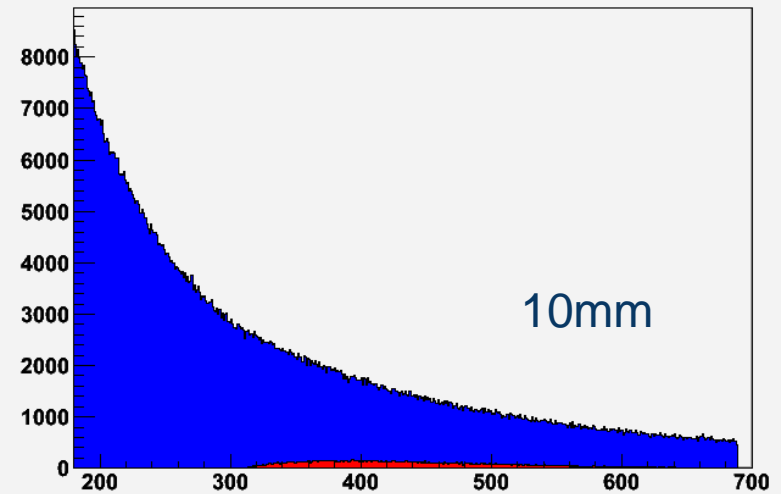


# Photons At Detector vs. $\lambda$

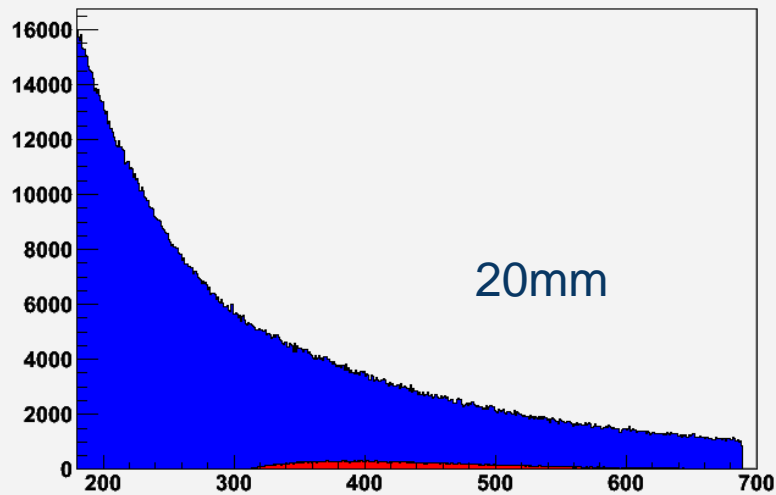
Photons Lost Due to Quantum Efficiency of Detector



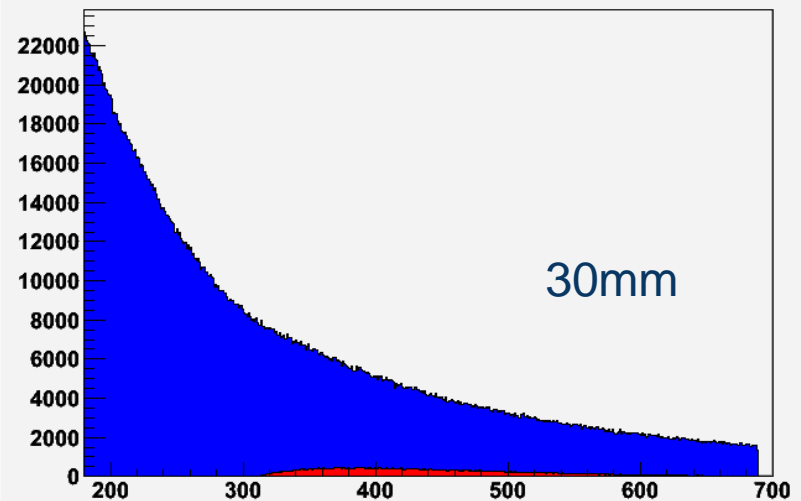
Photons Lost Due to Quantum Efficiency of Detector



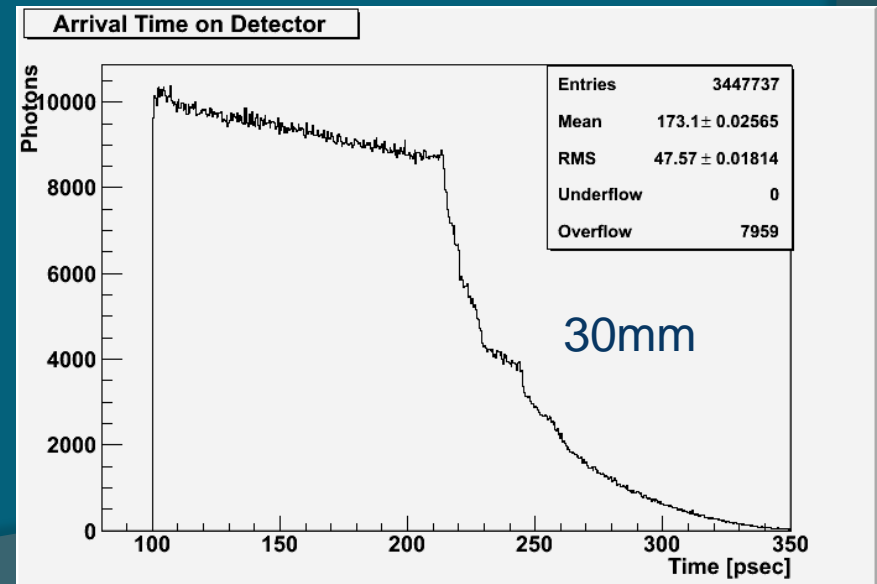
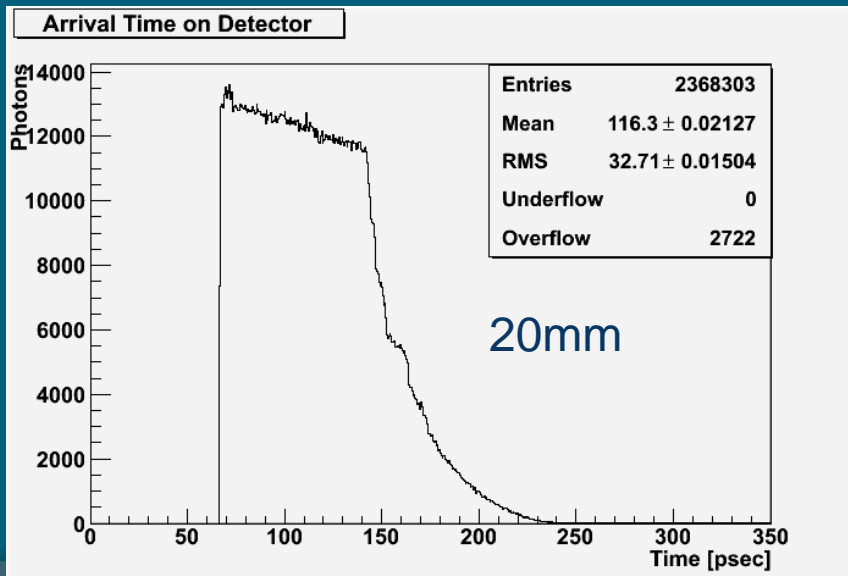
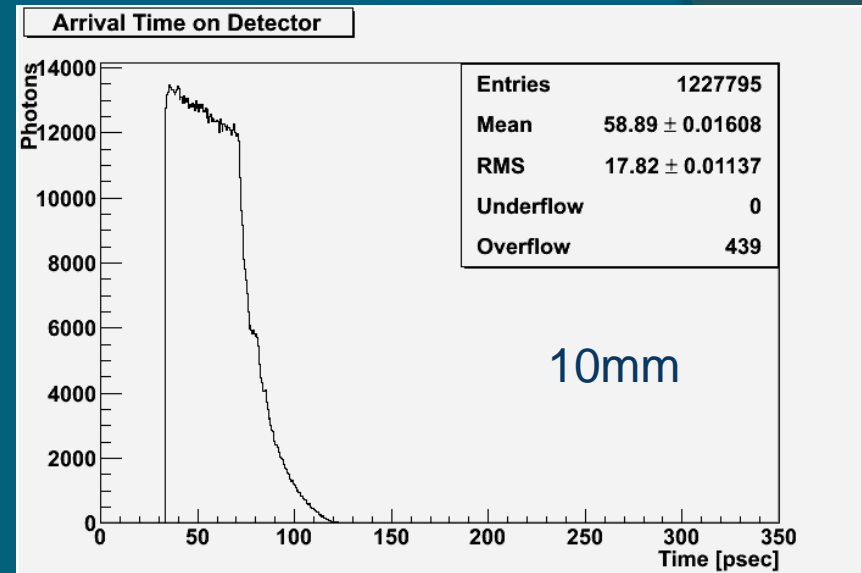
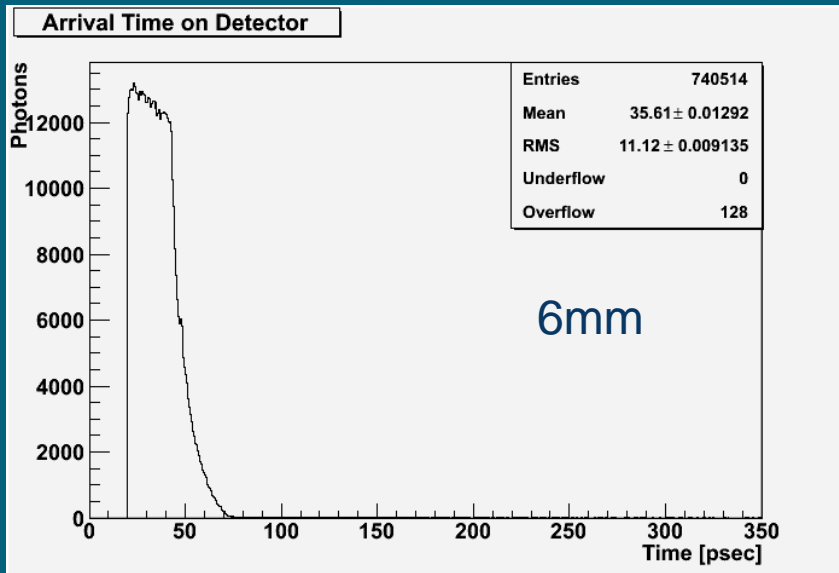
Photons Lost Due to Quantum Efficiency of Detector



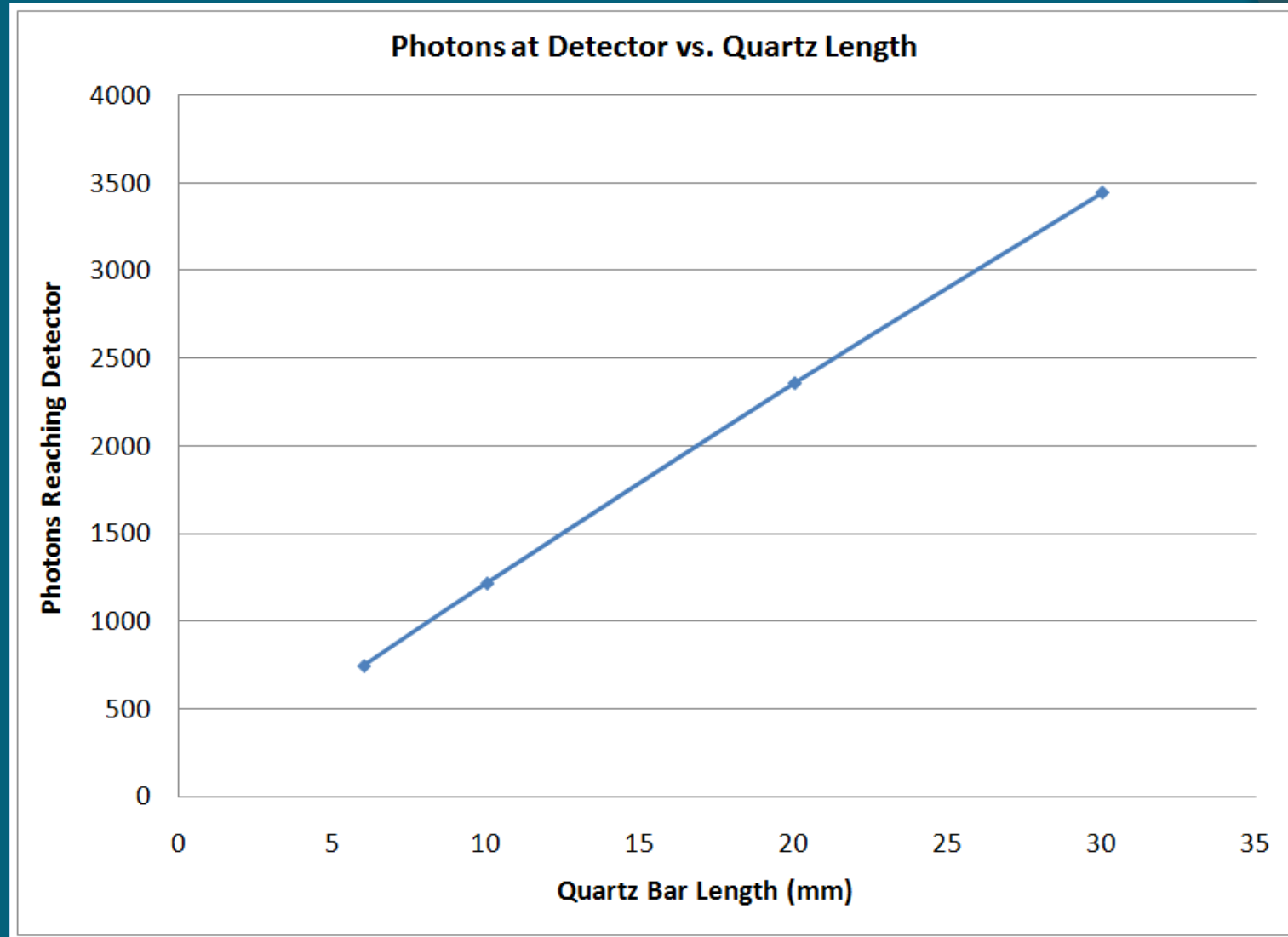
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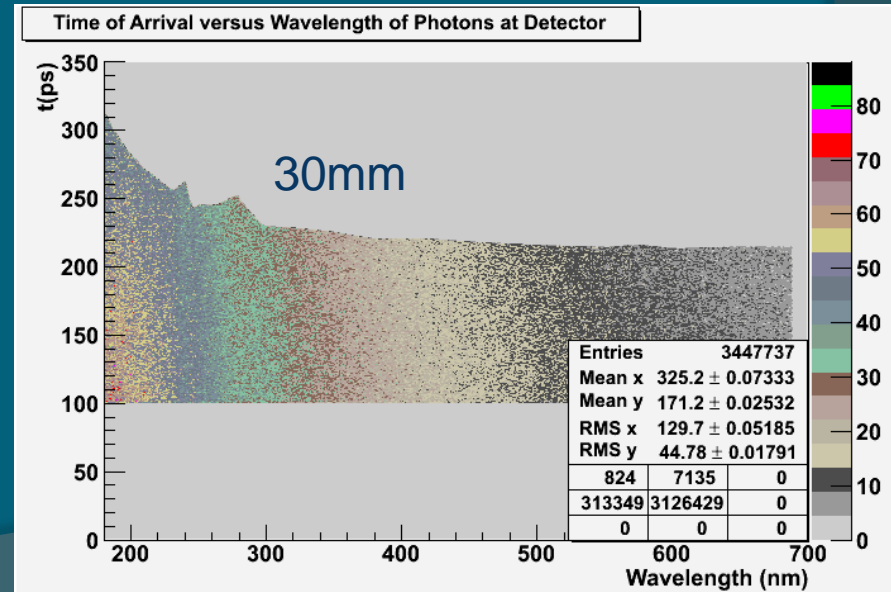
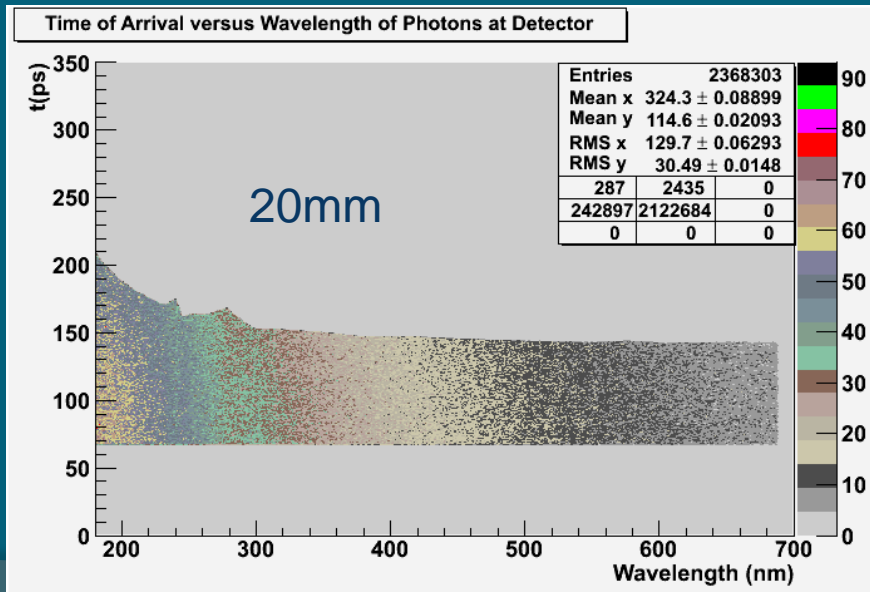
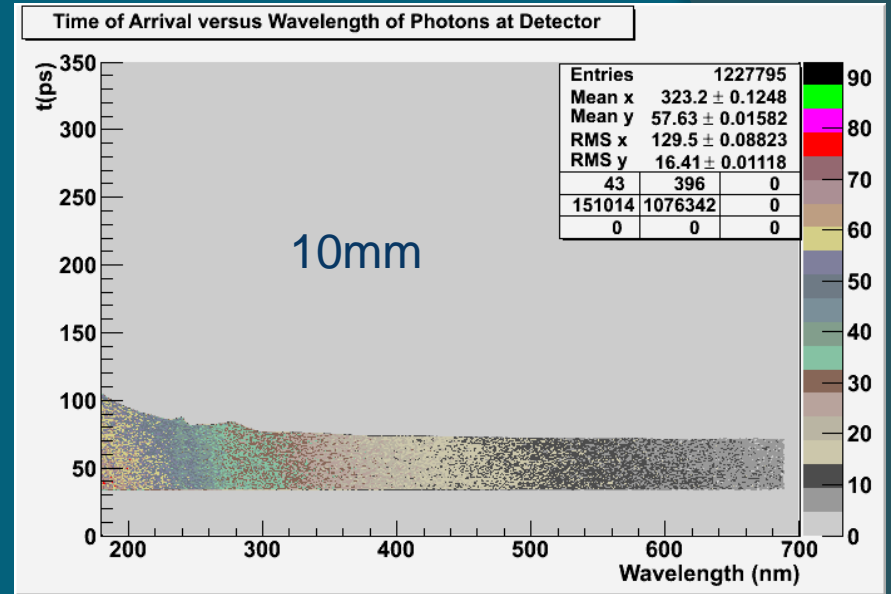
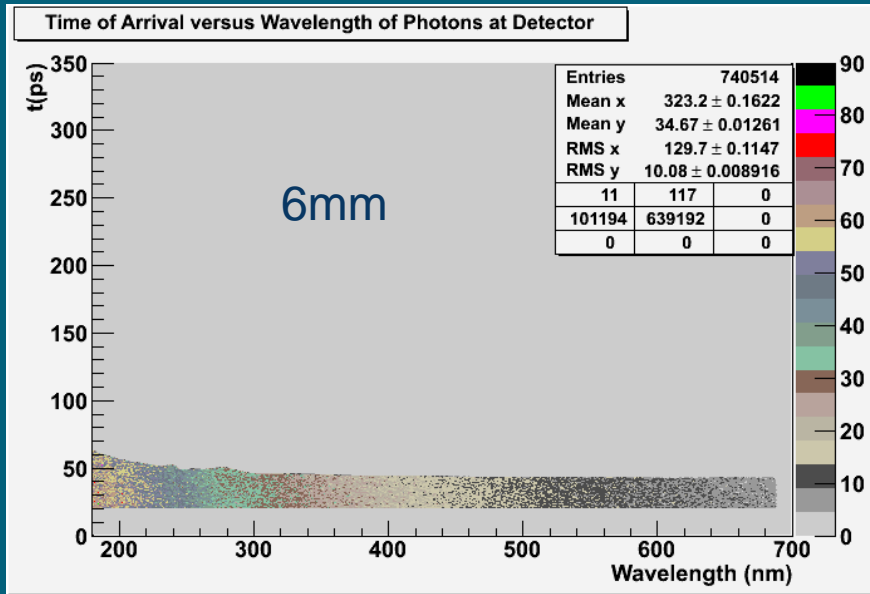
# Photons At Detector vs. Time



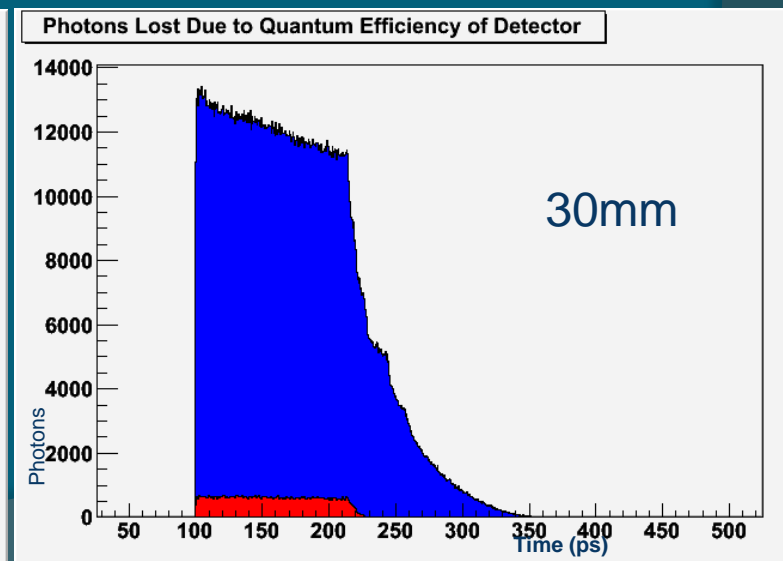
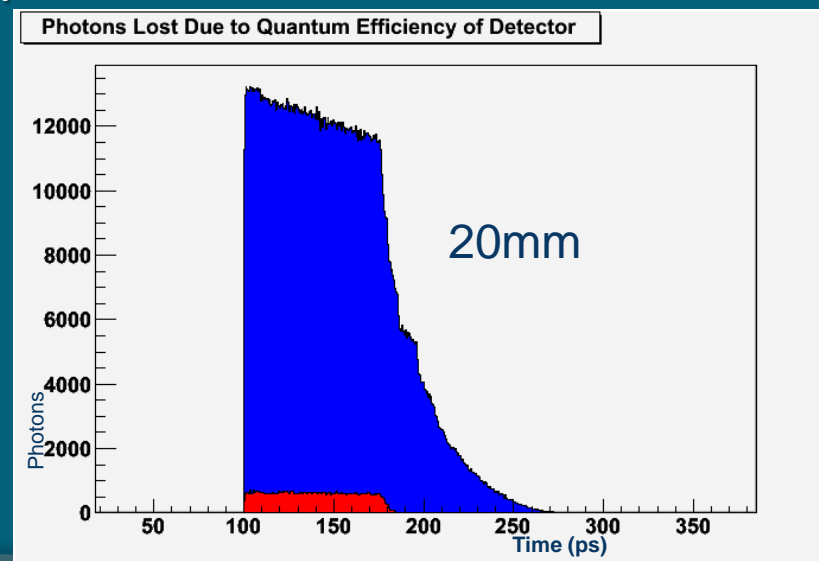
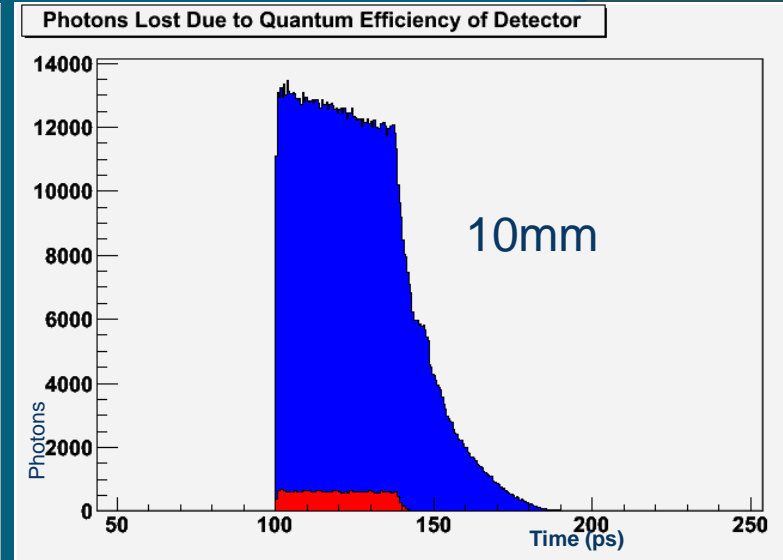
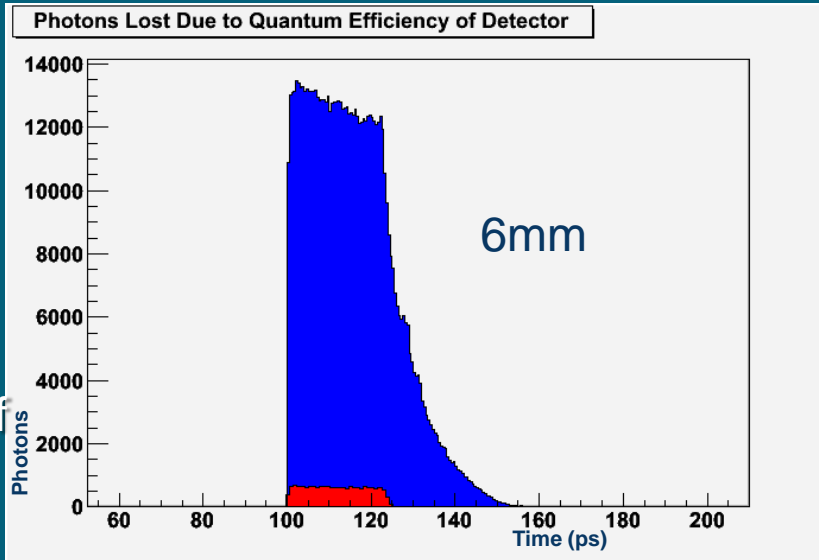
# No. of Photons At Detector



# Time of Arrival vs. $\lambda$ at Det.



# Photons At Detector & Detected

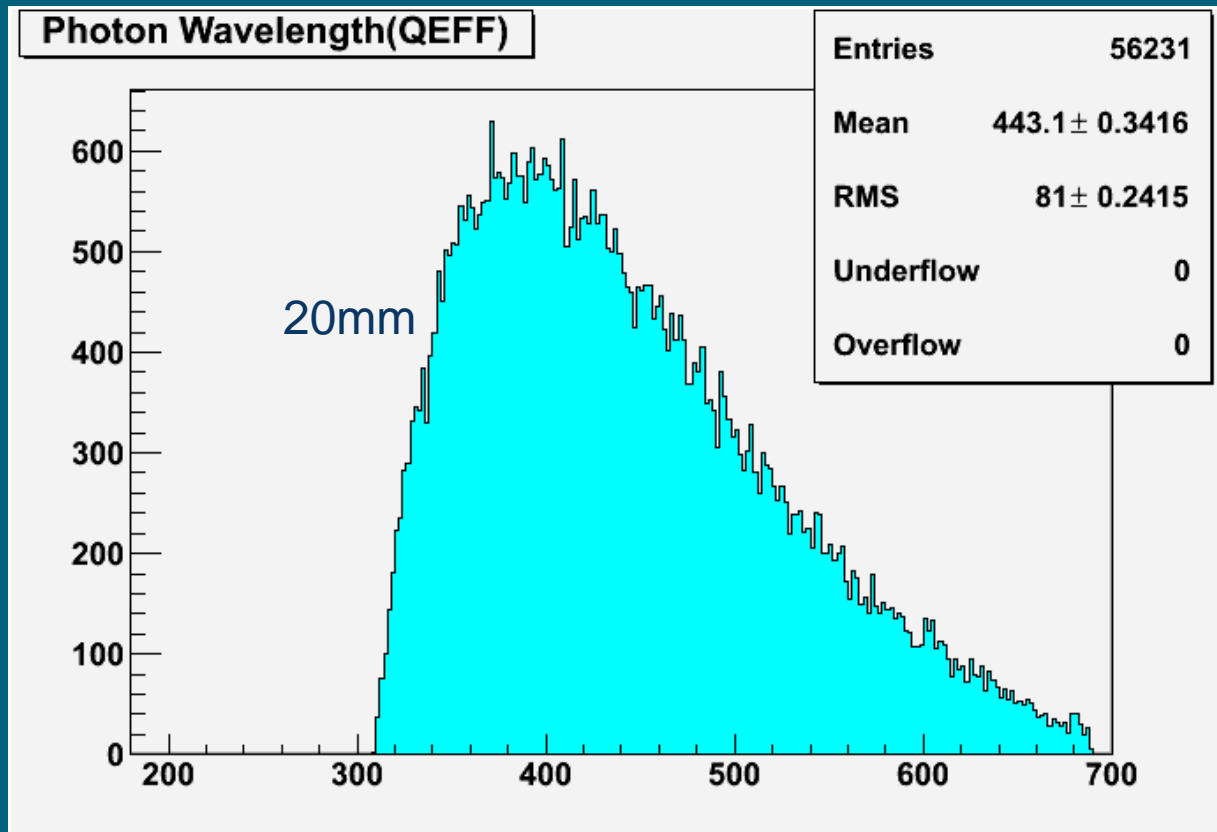


No.  
Photons  
vs. Time of  
Arrival

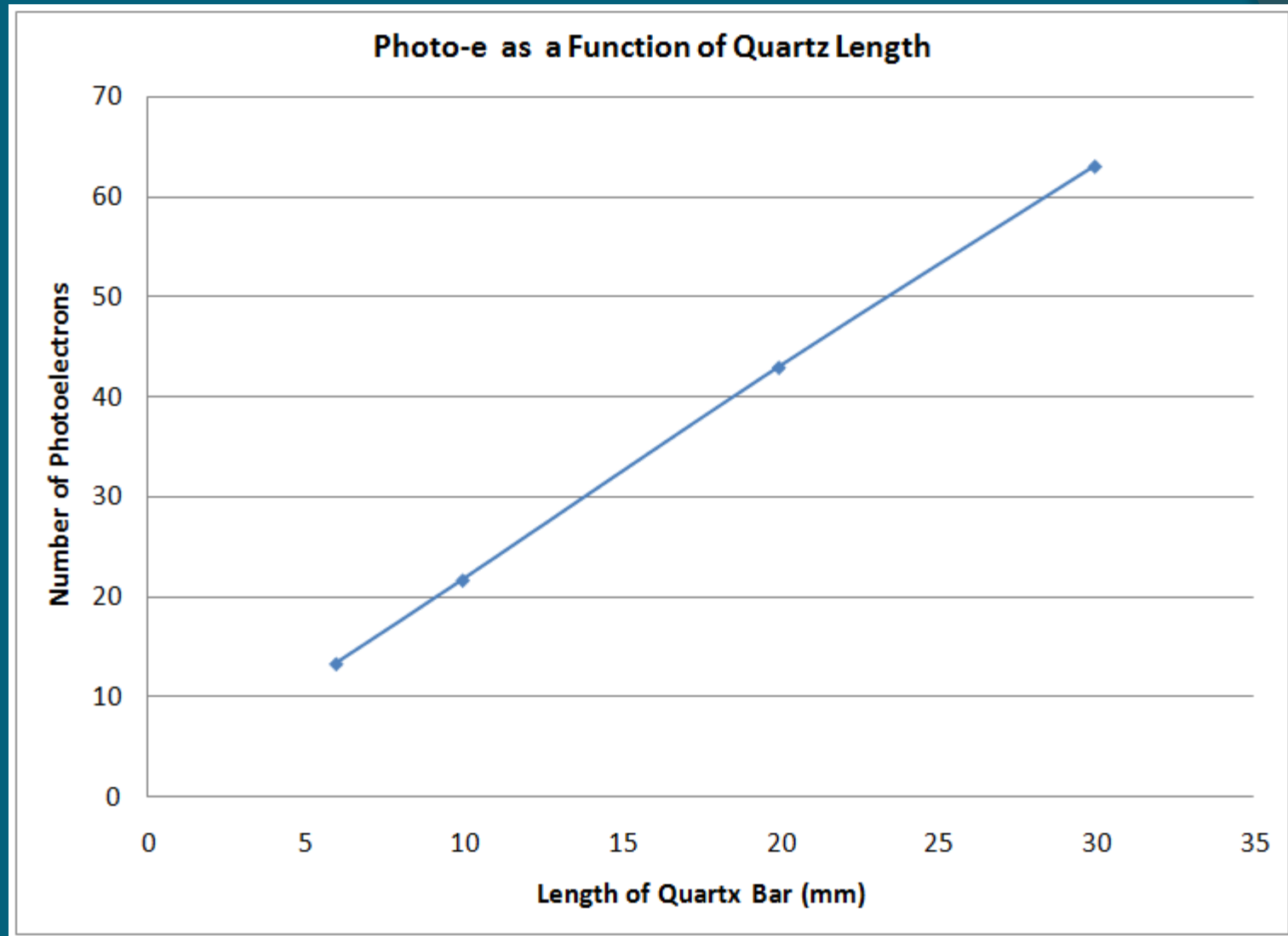
At Detector  
(Blue)

Detected  
(Red)

# Photons At Detector & Detected

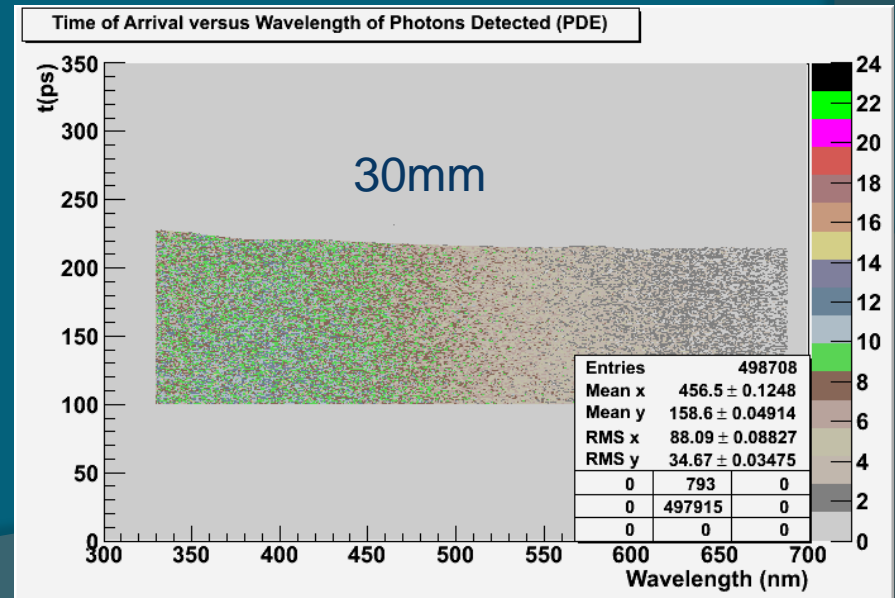
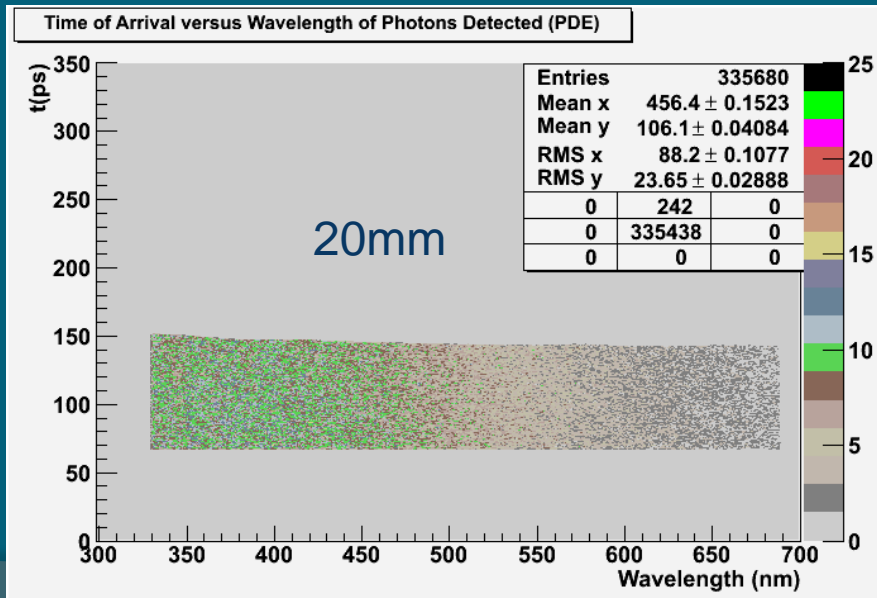
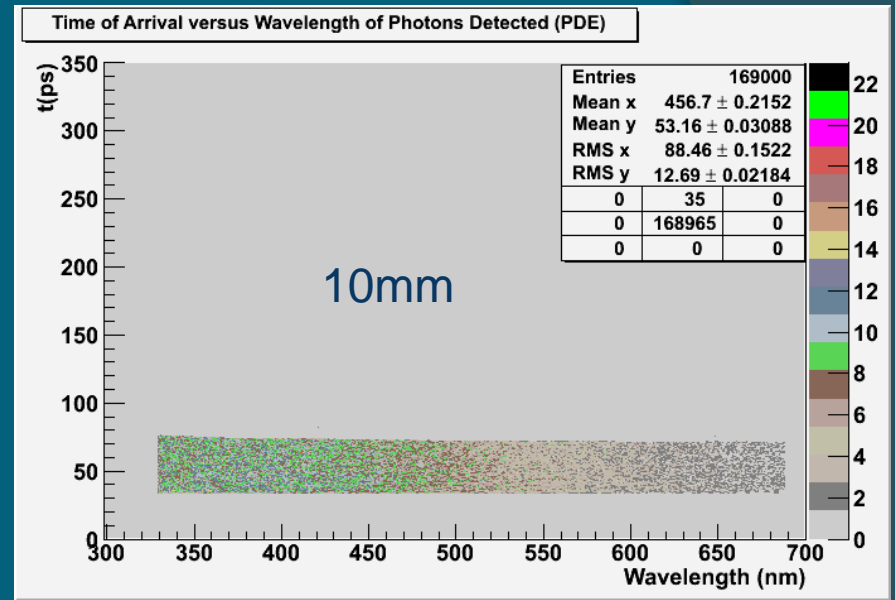
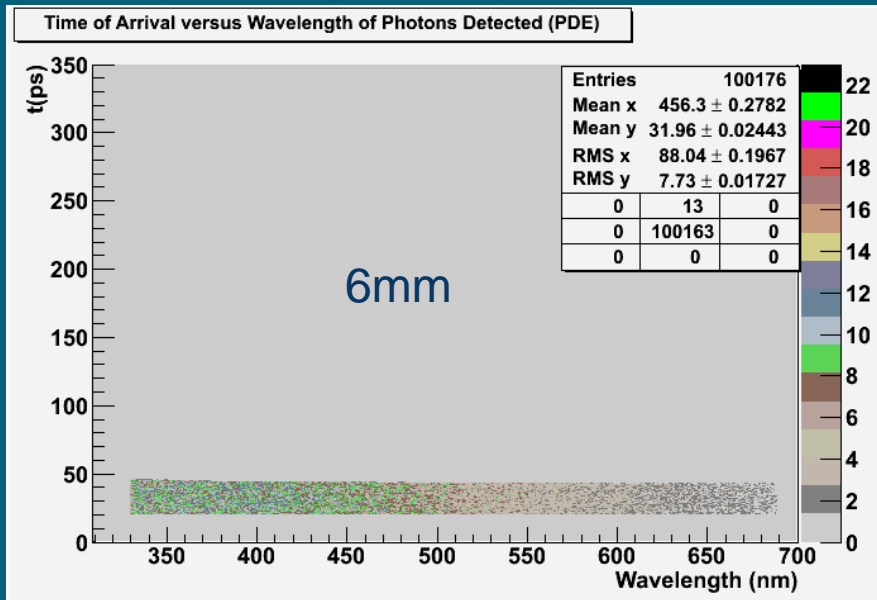


# No. of Photo-e At Detector





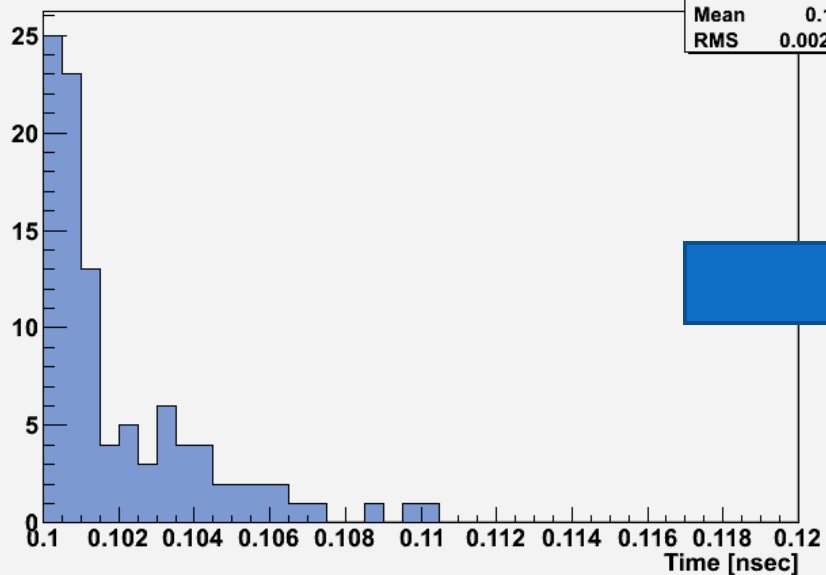
# Time of Arrival vs. $\lambda$ Photo-e



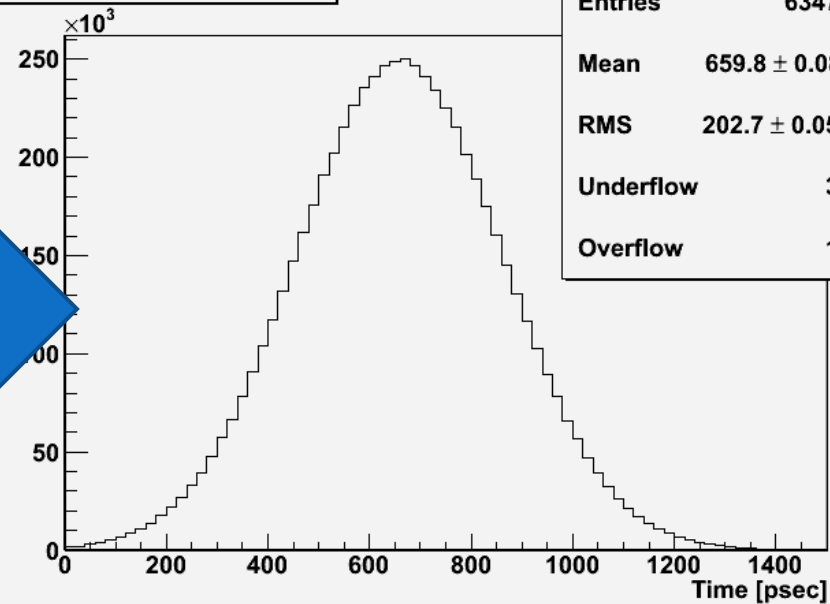


# Jitter

Arrival Time of First Photon on Detector (QEFF)

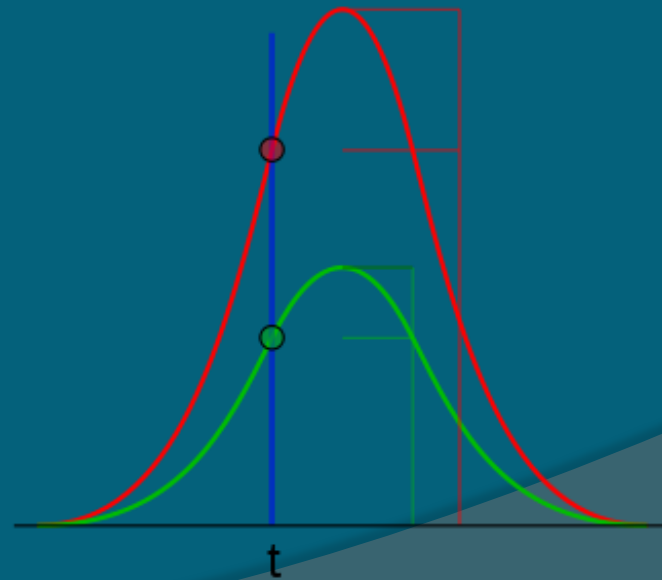
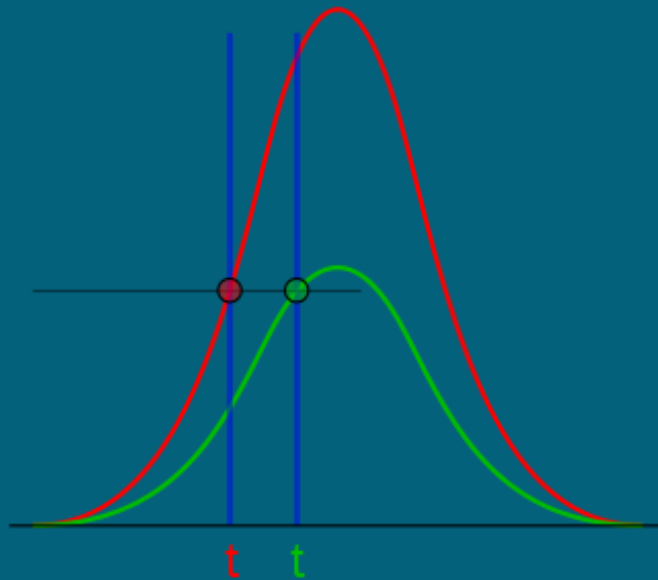
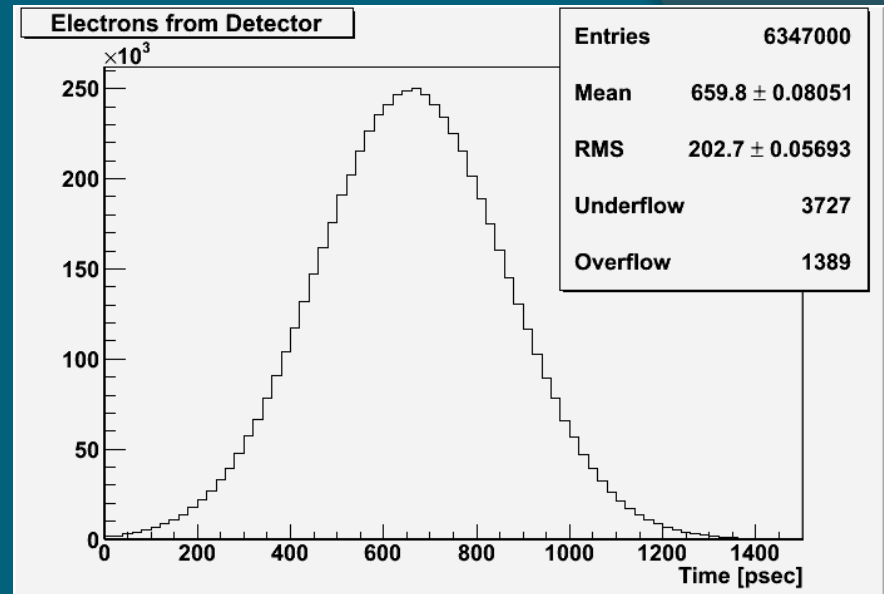


Electrons from Detector

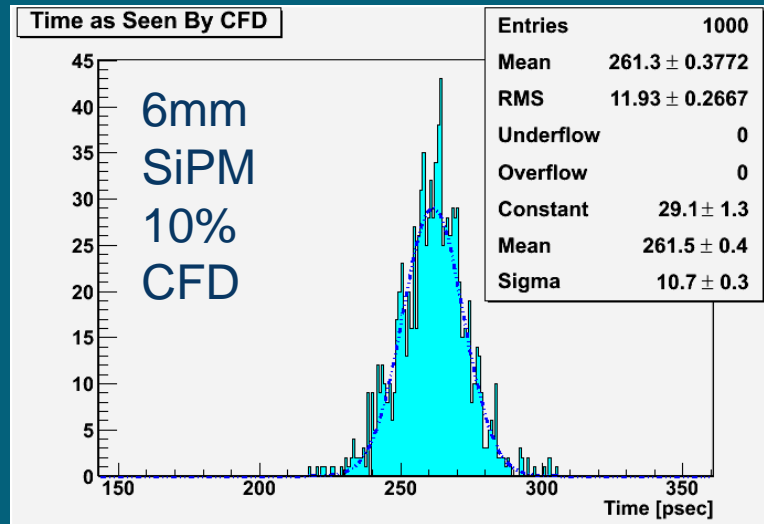


# CFD Timing

## ⦿ Jittered Pulse



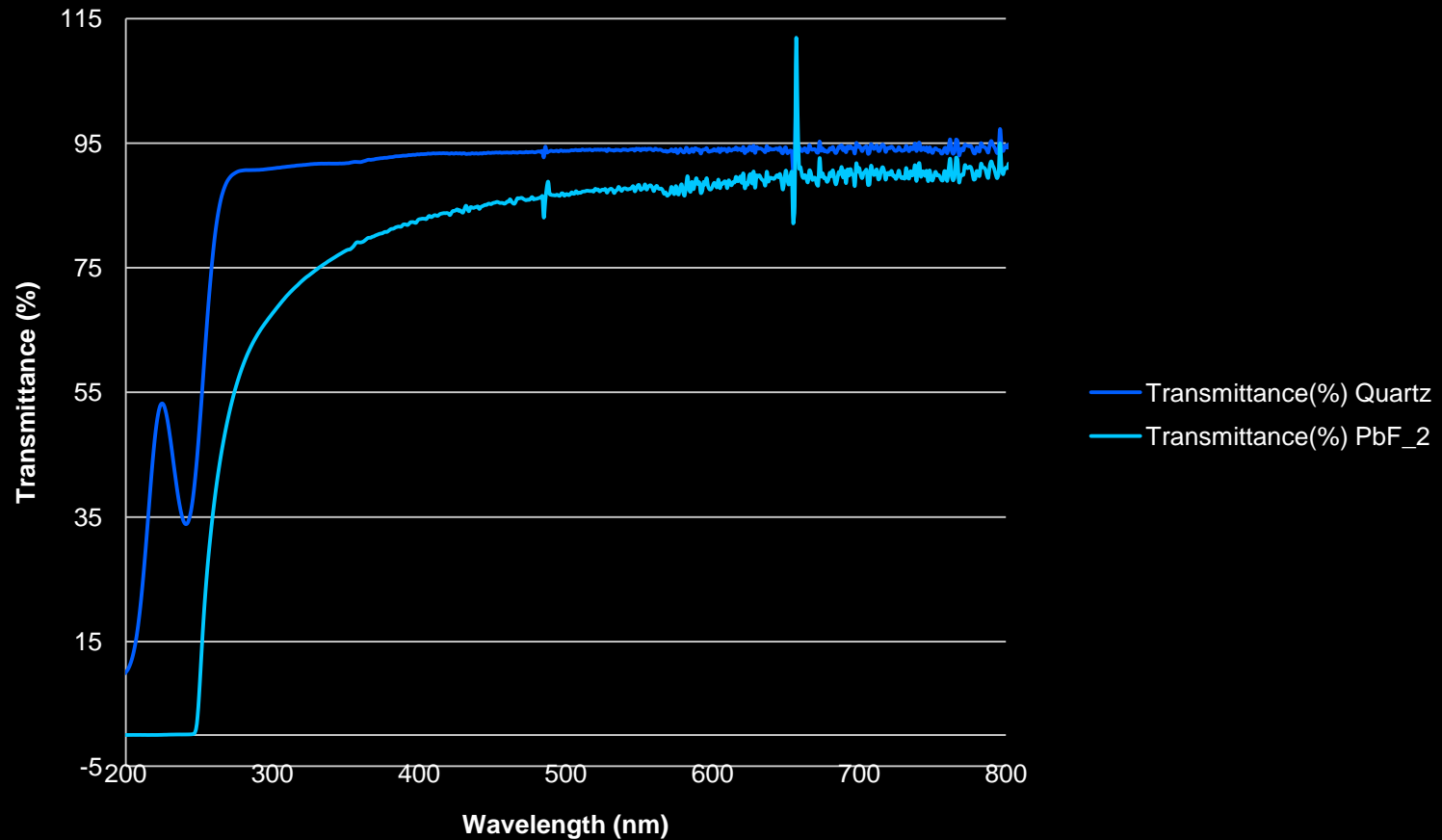
# Timing for Differing L, Fractions



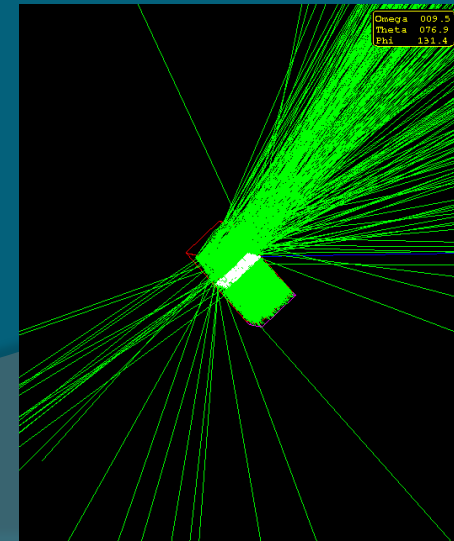
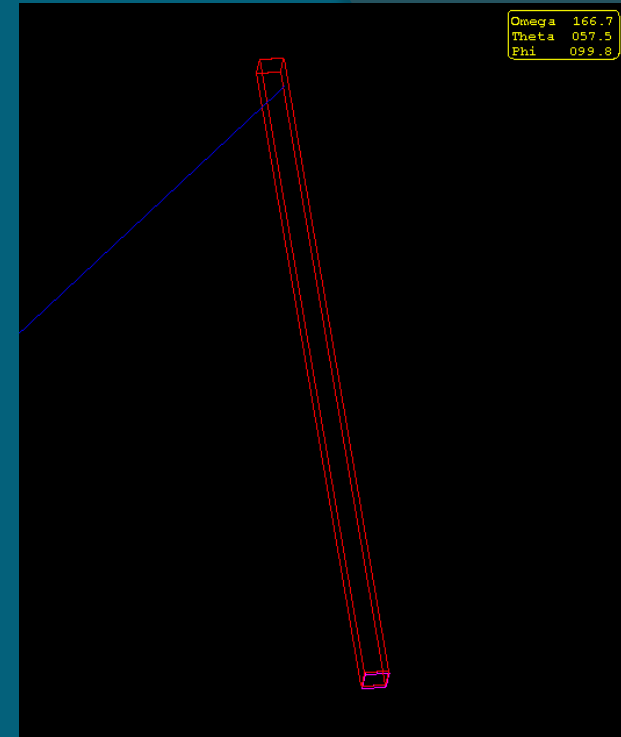
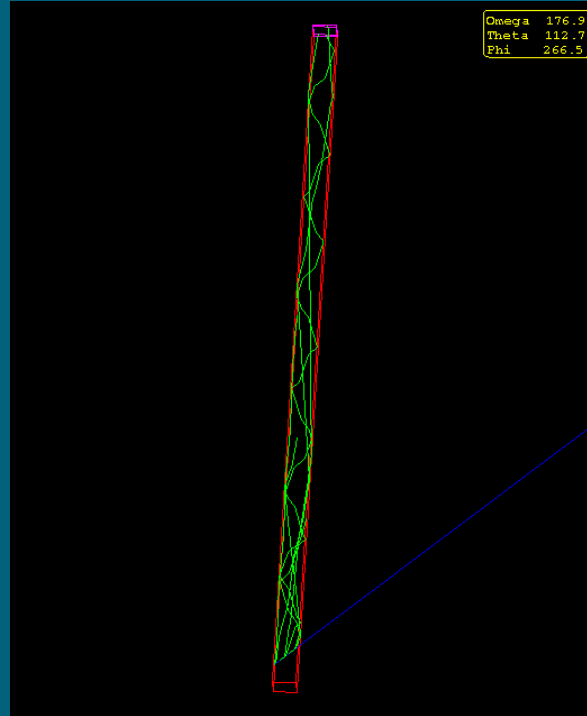
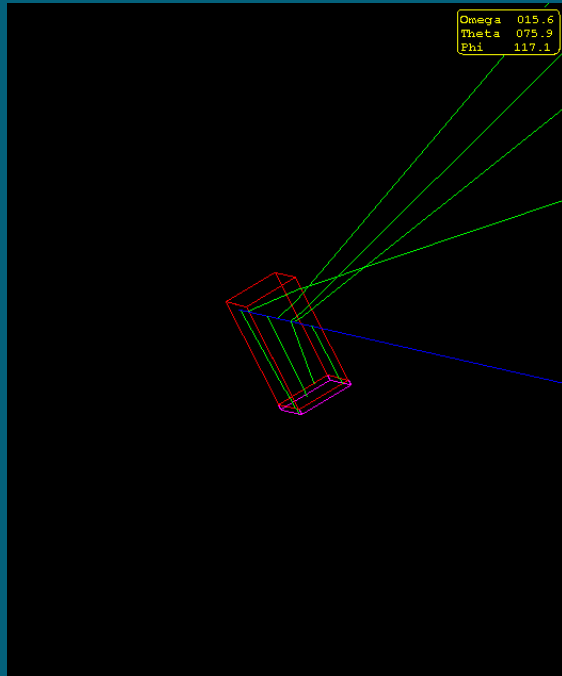
Fraction	0.1	0.2	0.4
Protons	1000	1000	1000
Timing ( $\pm 2.5$ psec) 6mm	12.3	10.7	9.4
Timing ( $\pm 2.0$ psec) 10mm	10.2	9.2	7.7
Timing ( $\pm 1.5$ psec) 20mm	7.6	6.9	6.1
Timing ( $\pm 1.9$ psec) 30mm	6.7	6.3	6.0

# Quartz and PbF2

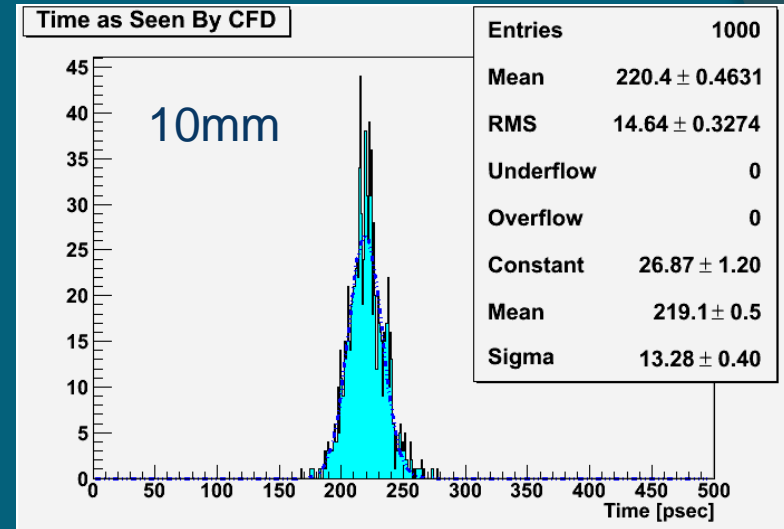
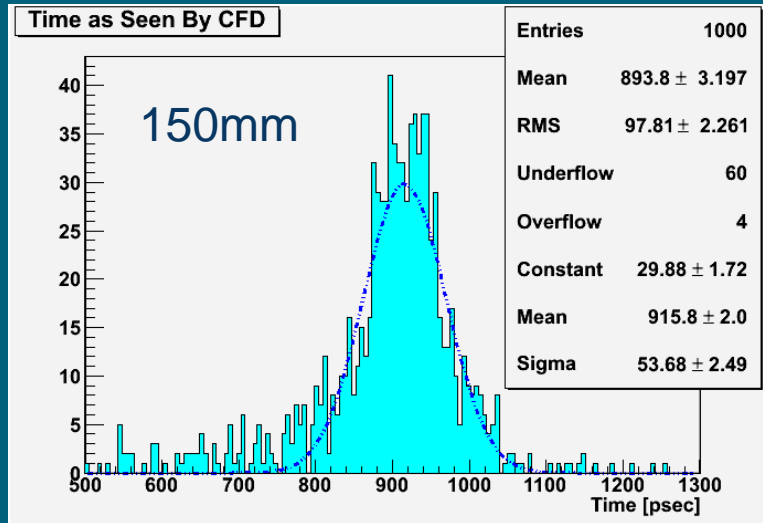
Transmittance vs. Wavelength for Quartz and PbF2



# QUARTIC Setup



# Timing for Differing L, Fractions QUARTIC



Fraction	0.2	0.4
Protons	1000	1000
Timing ( $\pm 0.4$ psec) 10mm	13.3	12.2
Timing ( $\pm 2.5$ psec) 150mm	53.7	55.3

# Further Studies

- Look at Lead Fluoride as a Possible Radiator.
- Simulate Blue & Red Filters
- Do more QUARTIC setups
- Find the factor of 2

Mike Albrow  
Hans Wenzel  
Earle Wilson

Thank You



