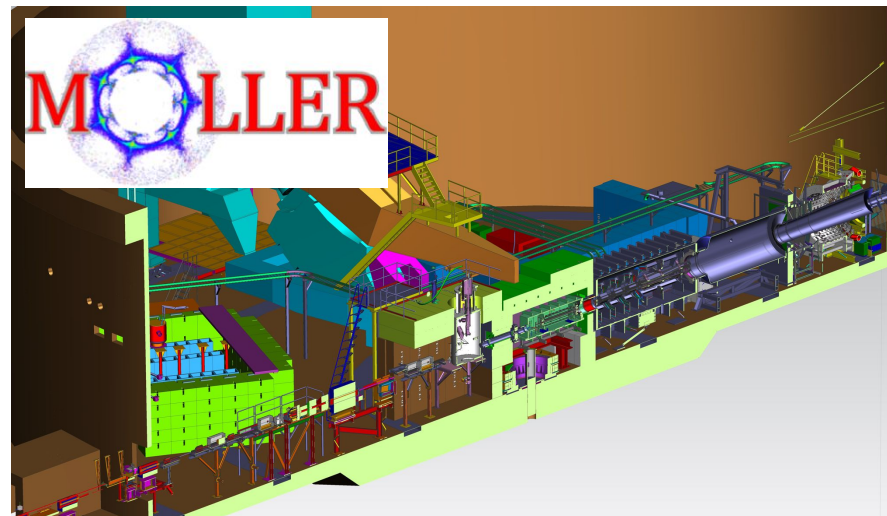
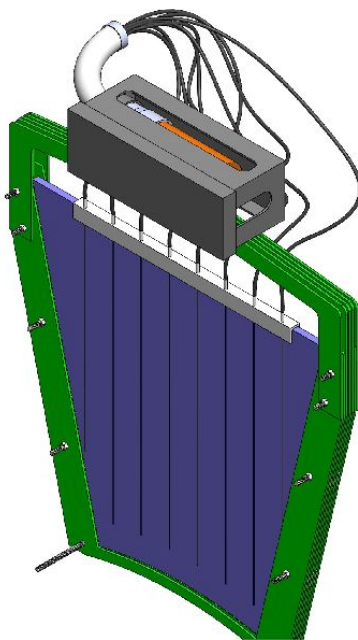


Trigger Scintillator Update

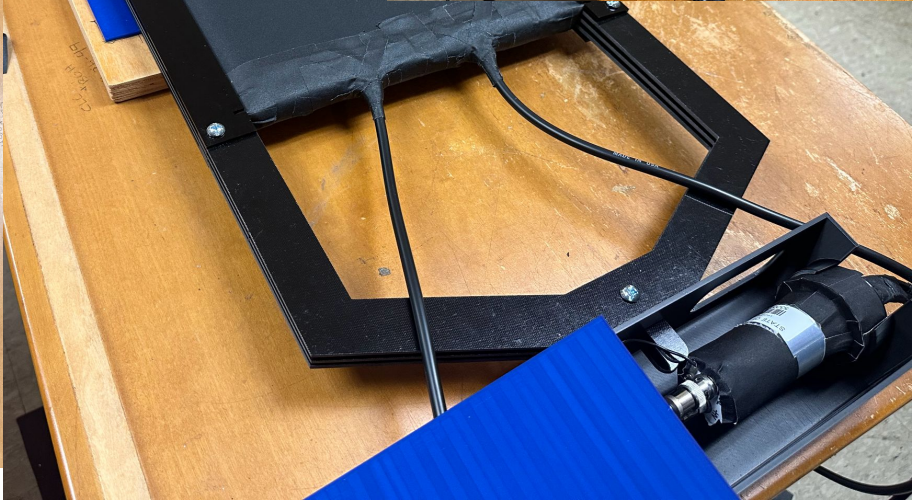
MOLLER Collaboration Meeting 5-2024

Rakitha S. Beminiwattha
Louisiana Tech University



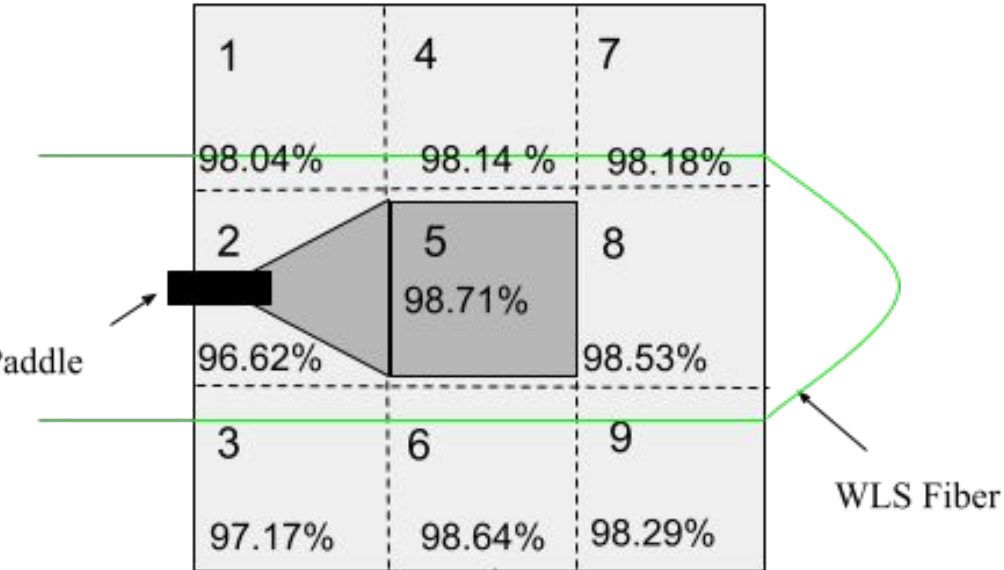
Graduate Students: Lasitha Weliyanga and Shashini Chandrasena
Undergraduates: Kamden Perkins, Elizabeth Dieguez

Proof of Concept Prototype Module

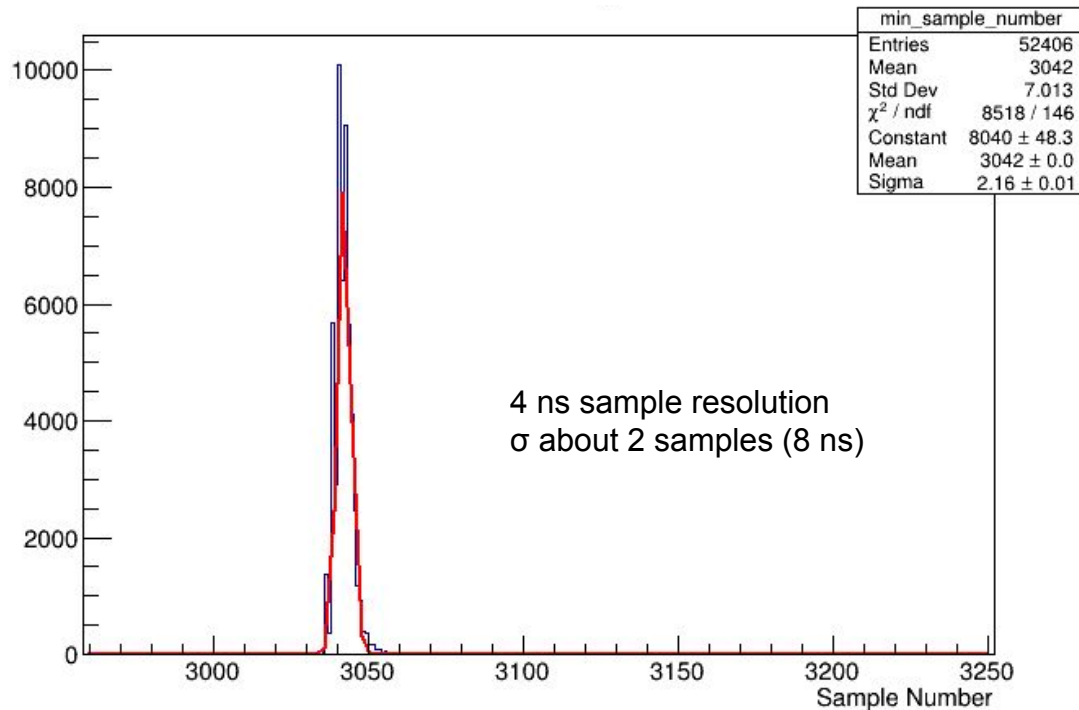


Cosmic-Ray Efficiency from Proof-of-concept Prototype

Trigger using coincidence with two scintillator paddles



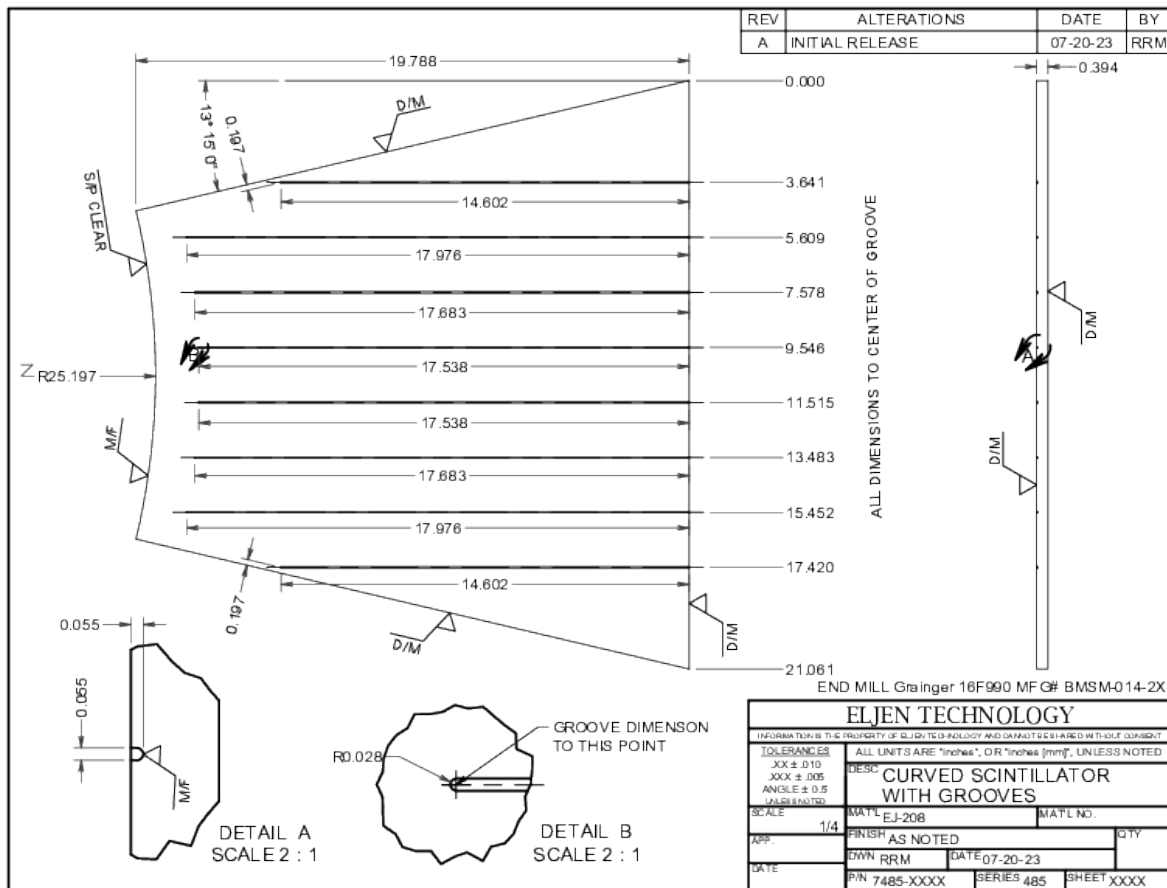
Timing Resolution from Proof-of-concept Prototype



Distribution of sample number at which cosmic ray signal drops below a threshold

Final Scintillator Design Summary

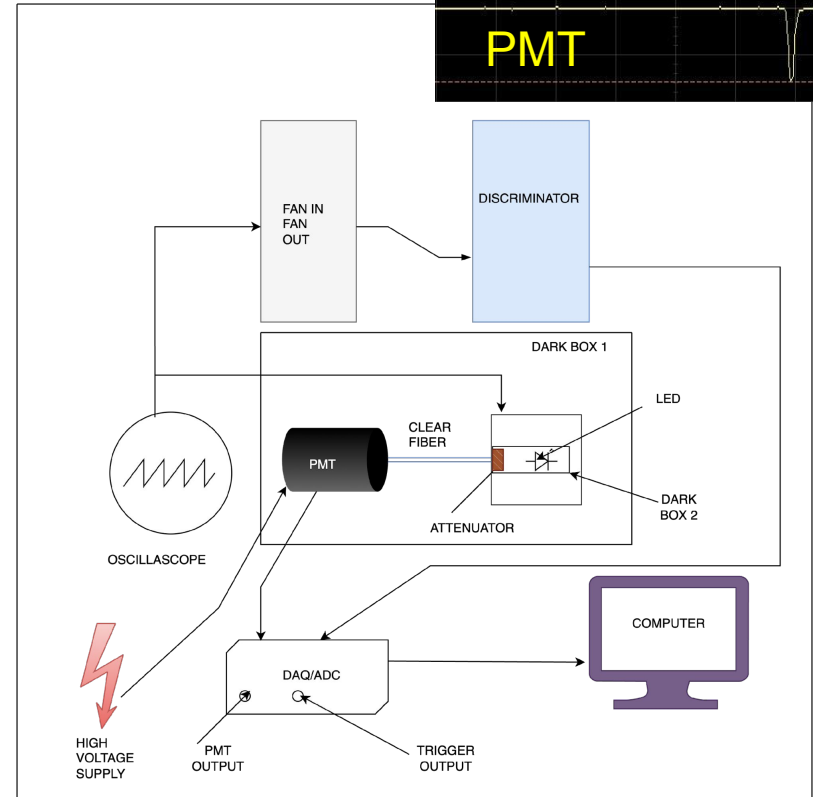
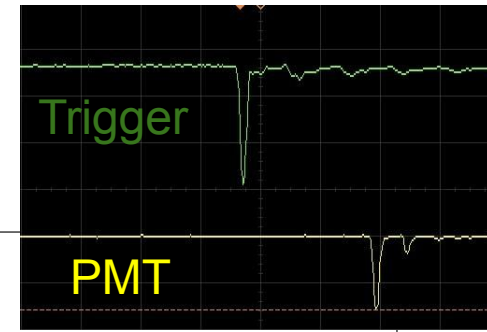
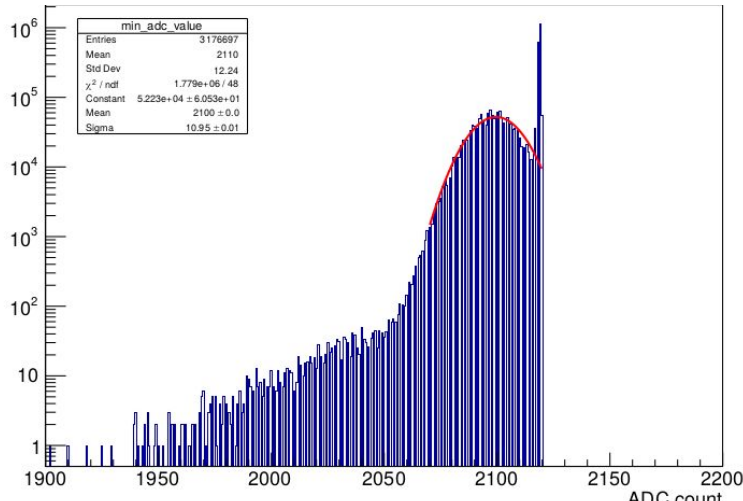
- Surface is diamond-milled
- The grooves are circular and machine finished
 - This gives a light diffusing surface quality
 - Our simulation has shown this increased light collection by the fiber
 - Also discussed in paper¹
- The bottom is sanded and polished
 - Helps diffuse light and comes out of the scintillator
- Fibers will be glued to the scintillator grooves using optical glue EJ-500
 - Improves light collection¹
- Scintillator to be wrapped in 3M DF2000MA (over 99% reflective wrap for wavelengths relevant)



1 Embedded wavelength shifting fiber readout of long scintillators by Wojcik, R. et al
<https://inis.iaea.org/search/searchsinglerecord.aspx?recordsFor=SingleRecord&RN=25052789>

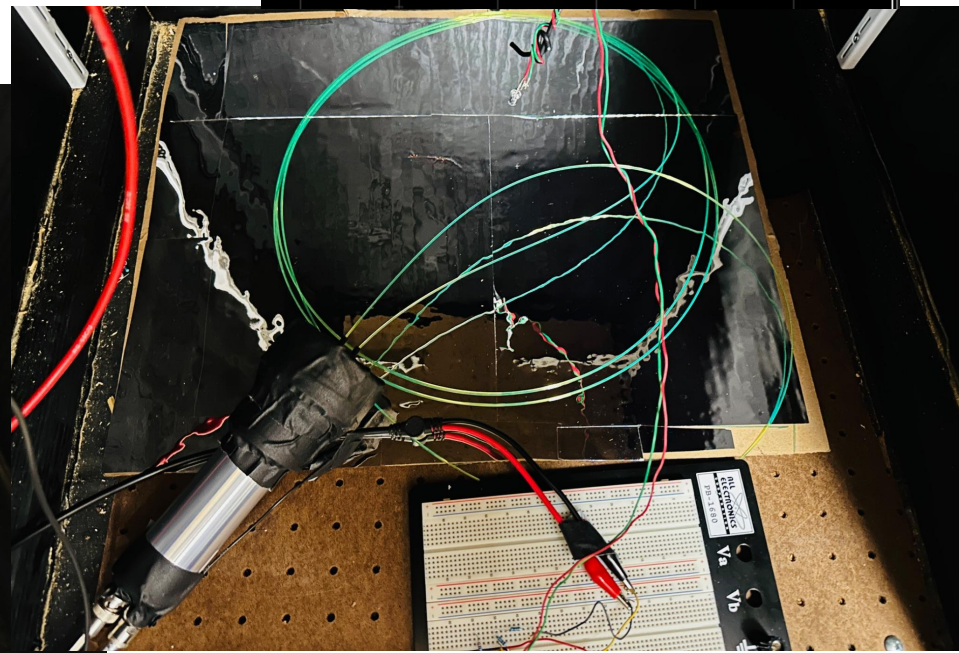
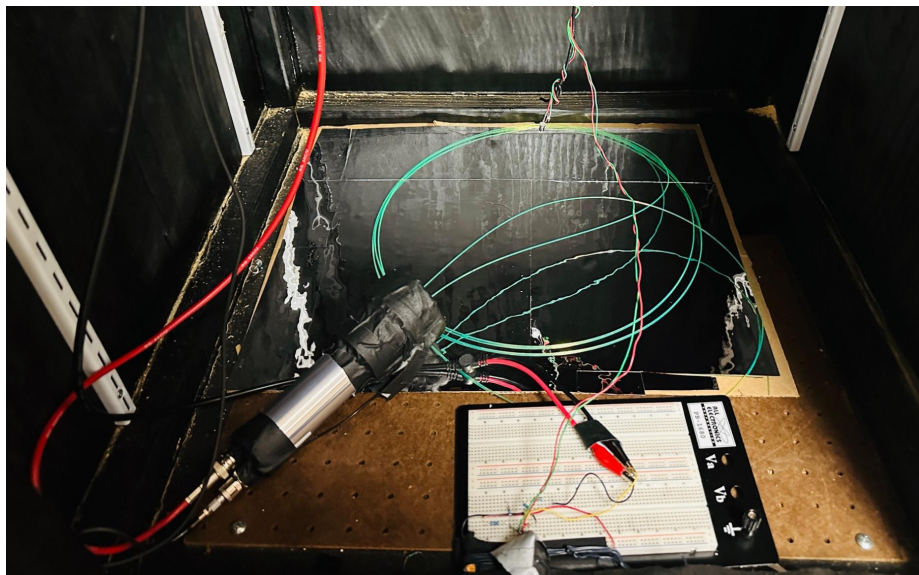
LED Test Stand: PMT Calibration

- 405 nm LED light source
 - Attenuators: Neutral density filters of 2.0, 1.3, and 1.0 can be inserted to control intensity
- 100 μm aperture clear fiber transmit light from LED to PMT
- Tuned the setup to see single photoelectron (SPE) peak



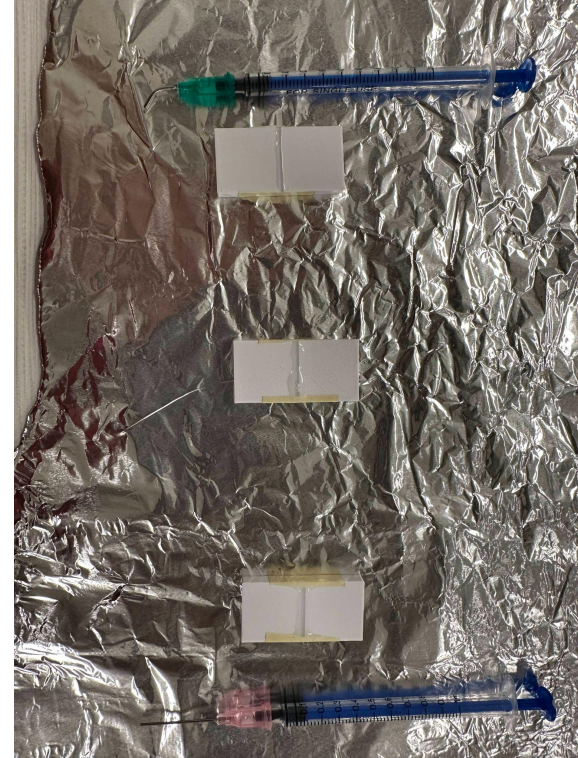
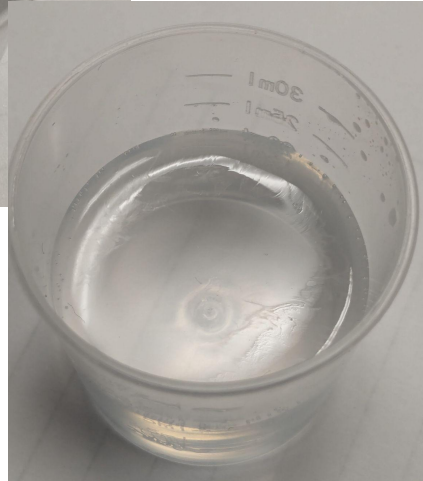
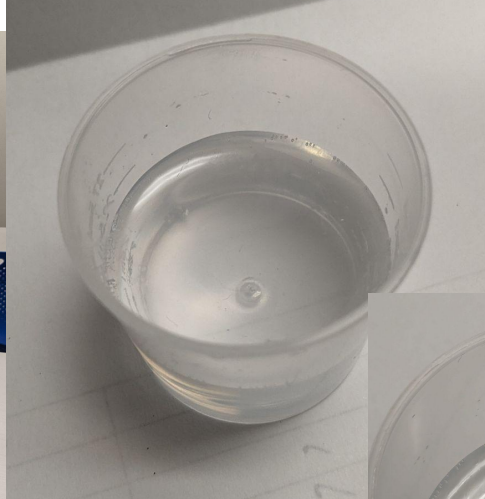
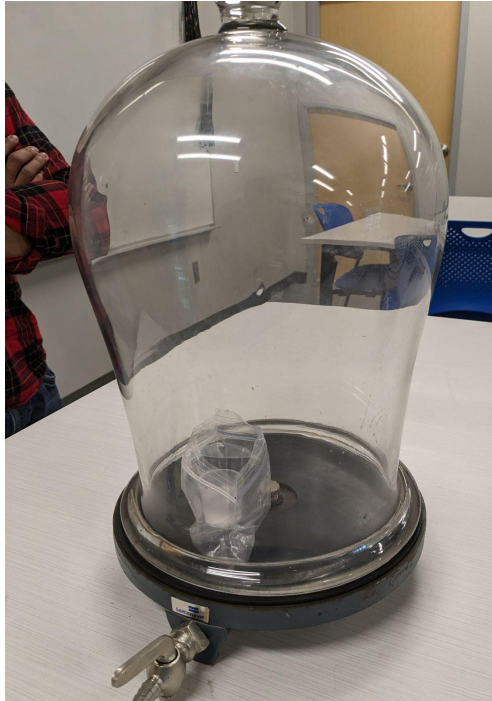
LED Test Stand: Fiber Light Yield

- 405 nm LED light source
- WLS fiber transmit light from LED to PMT
- Count/Integrate single photoelectron (SPE) peaks
- Compare between fibers



Optical Glue Application

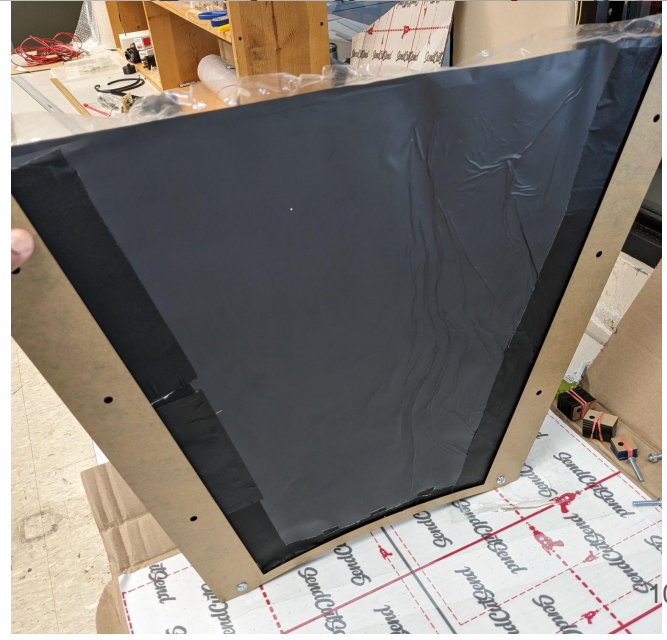
- Glue application is the most important aspect as there is no room for error
- Tested de-bubbling step
- Applied de-bubbled glue to 3D printed grooves



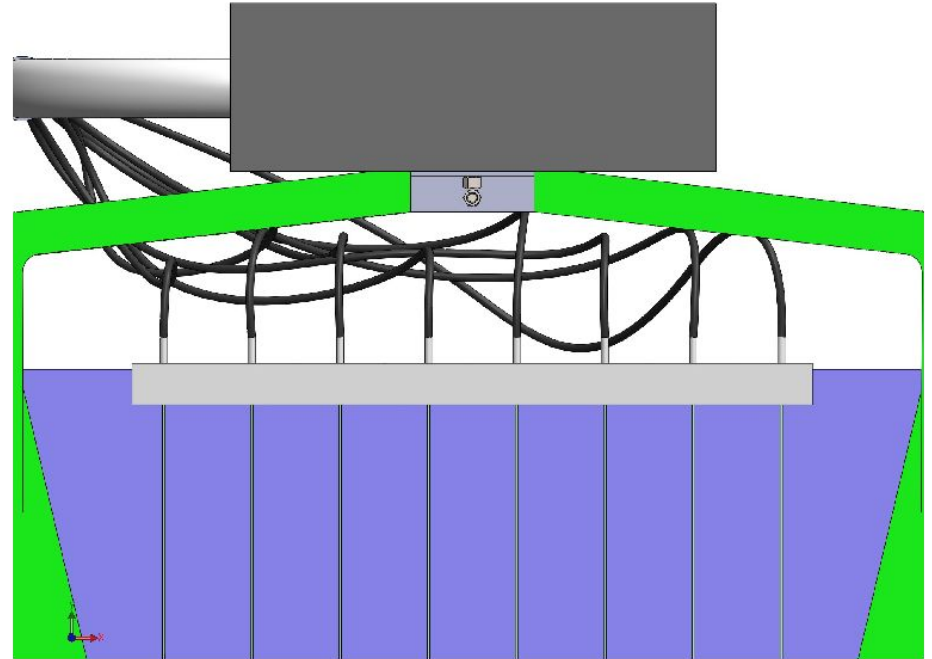
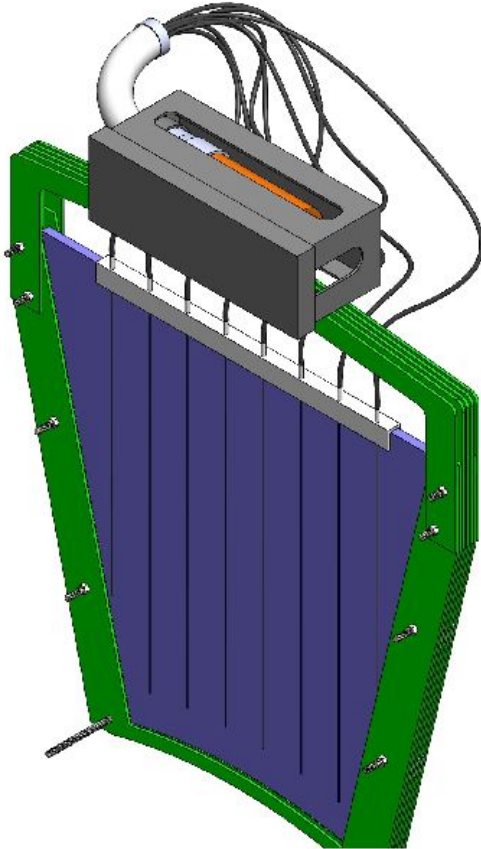
Prototype Frame Construction



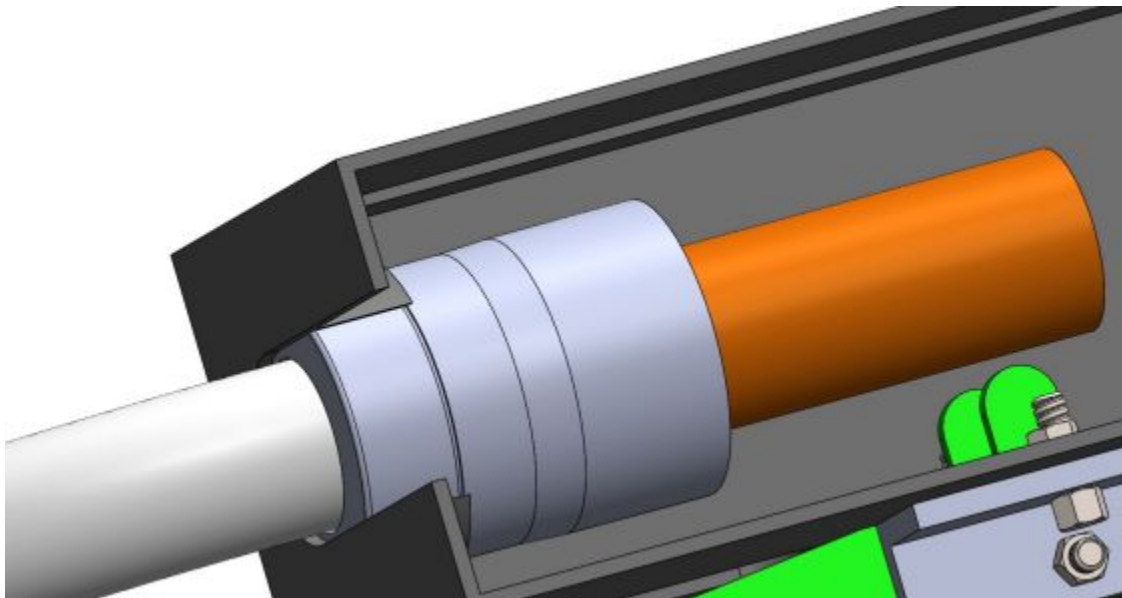
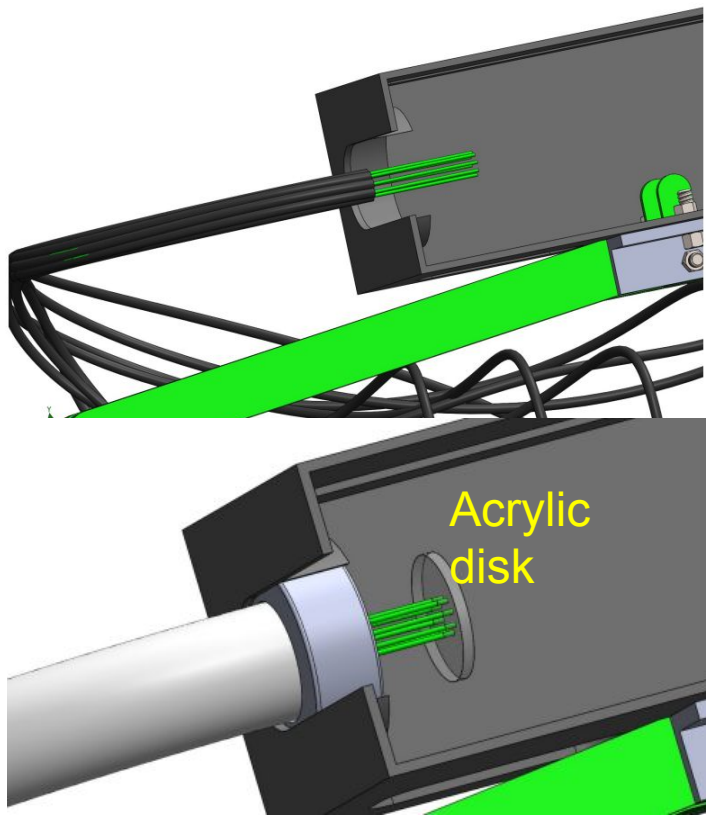
Prototype Assembly



Prototype Frame Construction CAD Final



PMT to Fiber Bundle Coupling



On-going Task List

- Quality Control: Test quality of wavelength shifting (WLS) fibers
 - Light transmission to both ends
 - Light yield from a pulsed LED
 - Compare yield between fibers
- Test different techniques for optical glue application (WLS fiber gluing into grooves)
- Improve PMT window to fiber coupling frame structure

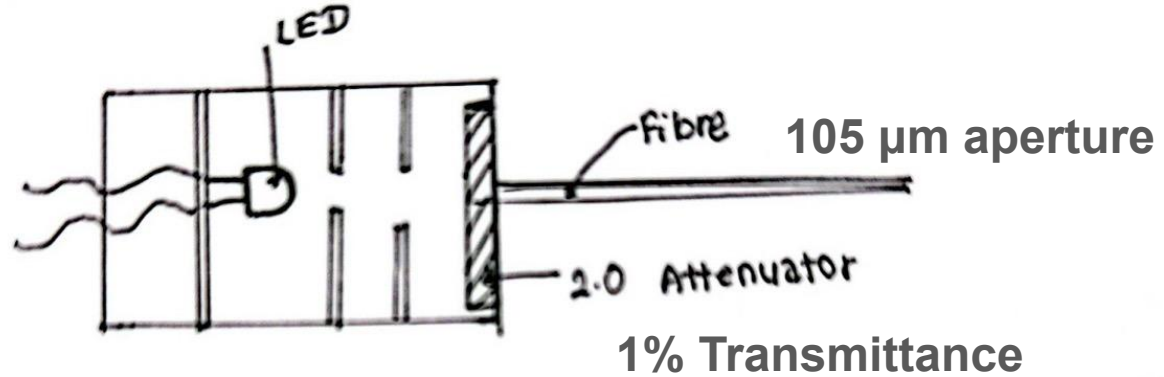
Next Steps

- Glue fibers to scintillator
- Wrap the scintillator
- Assemble the frame and PMT mount
- Couple fibers to the PMT
- Initial tests for light leaks
- Test the final prototype using cosmics
 - Efficiency
 - Timing resolution

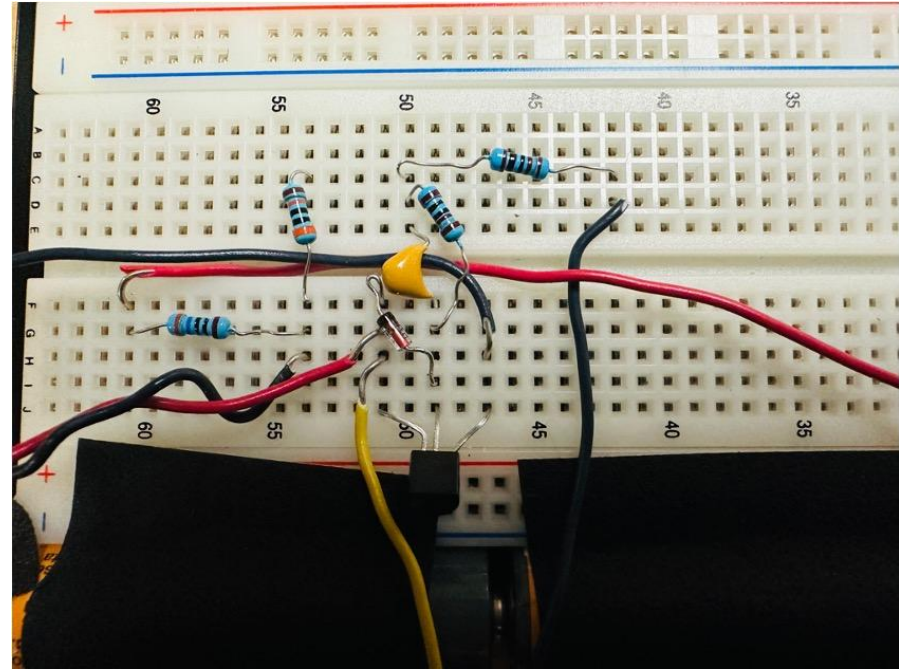
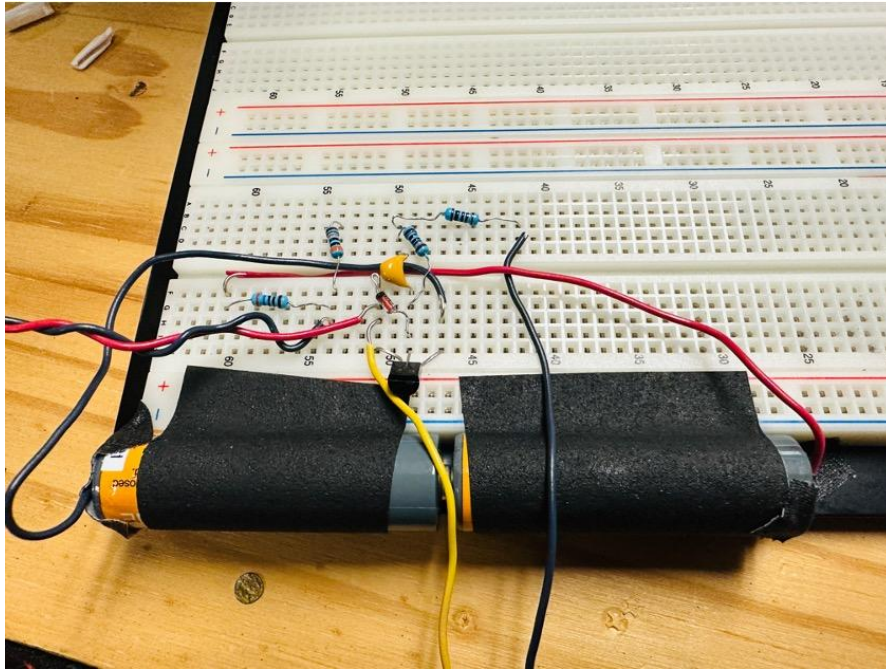
Supplementary

Light box

407 nm Blue LED



The Driver circuit



ADC Spectrum from Proof-of-concept Prototype

