

# Interim Report

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# Goal

To assist with implementing light concentrators with the RICH detector (which is a part of the MARQ spectrometer).

Both by testing and simulating the behavior of the concentrators when interacting with particles.



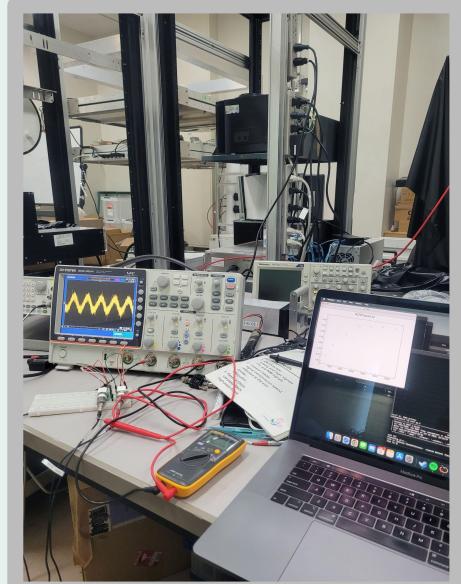
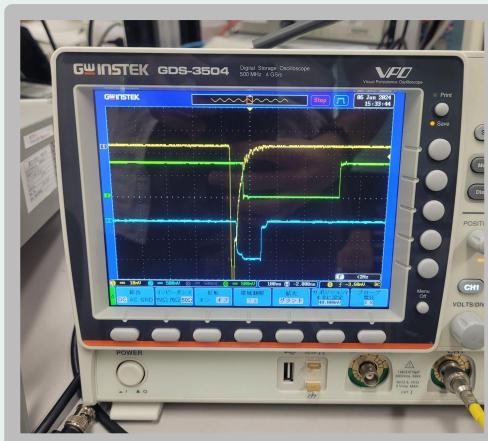
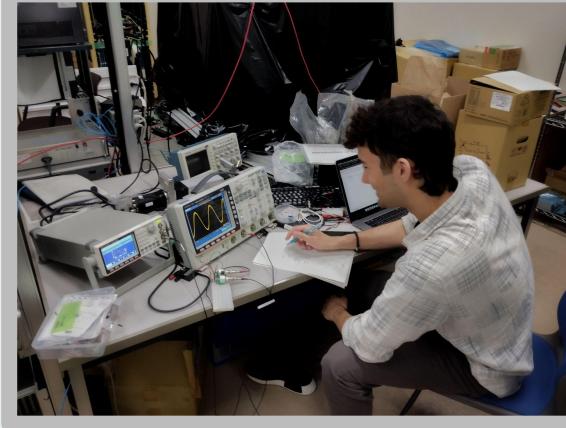


# Why Does it Matter?

- ❑ As particles travel through a medium at a speed faster than light they emit Cherenkov radiation(also called Cherenkov light).
- ❑ Using the light concentrator we can focus the light onto a PMT which enhances the amount of light detected = better performance of the detector.

# Kickoff Week

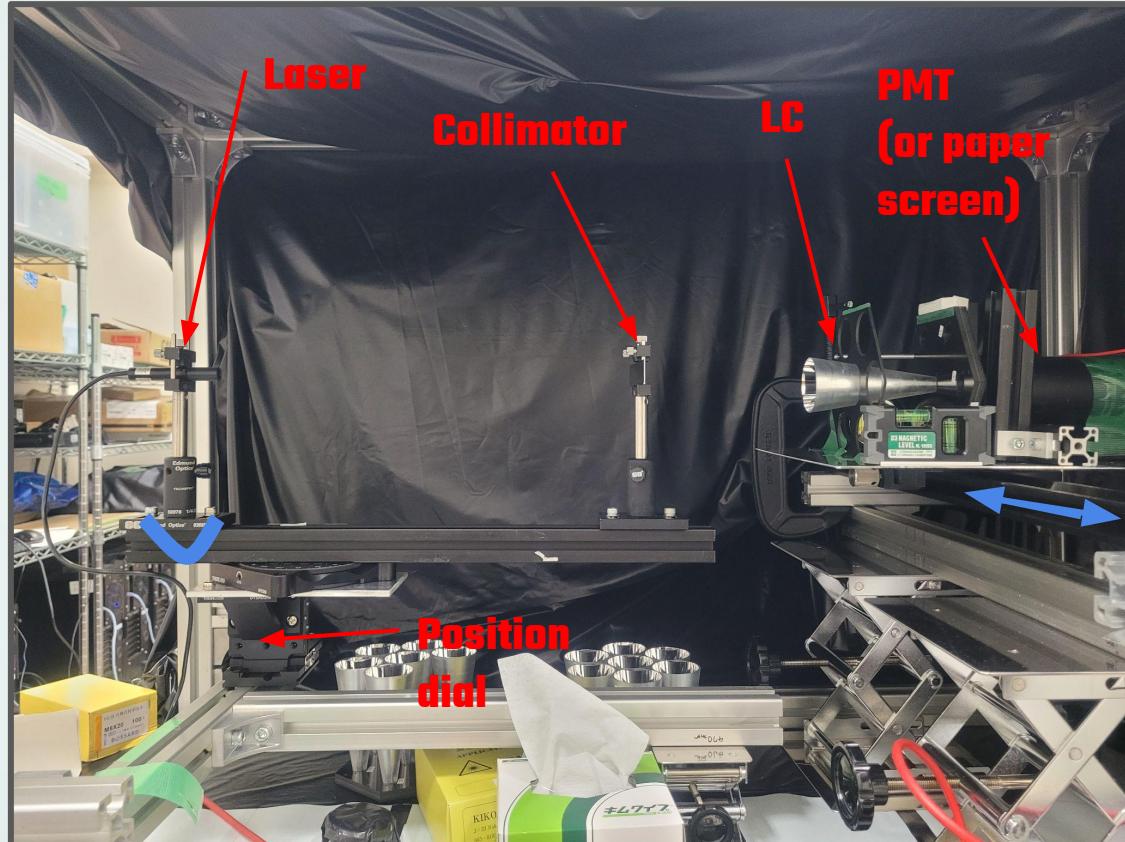
- Go over digitization of analogue signal produced using the Arbitrary Function Generator
- Recorded sample data from the AFG and VPO on root as well as plotting graphs
- Intro of using the Oscilloscope



# Physical Testing

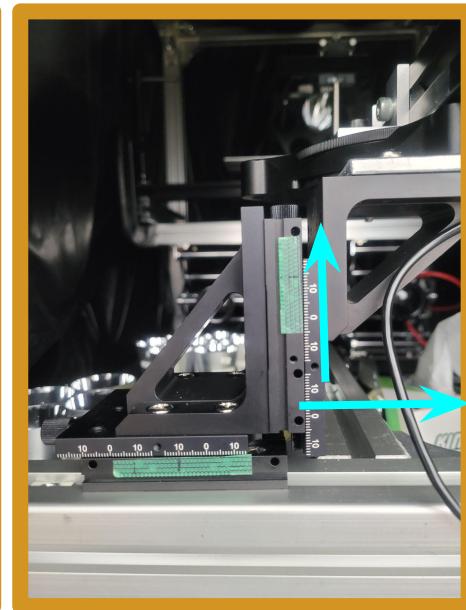
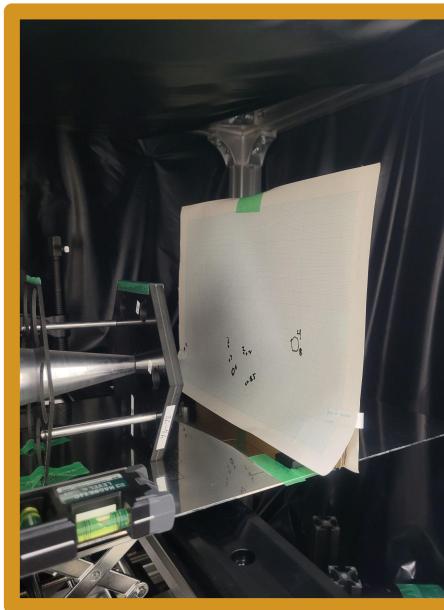
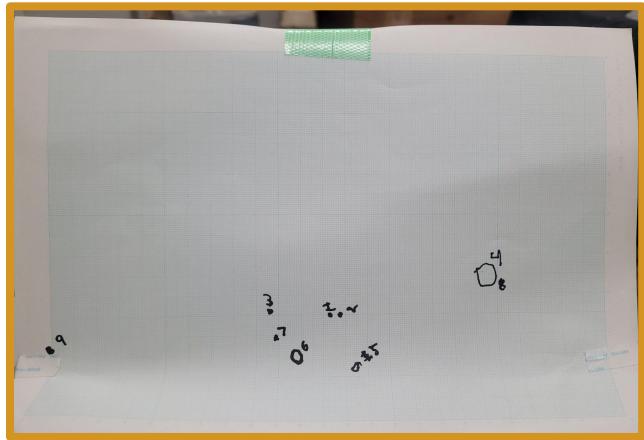
(without PMT)

- The testing starts with adjusting the laser to shoot straight into the center of the light concentrator through a Collimator.
- First a paper screen will be put behind the LC, instead of the PMT to observe the behavior.



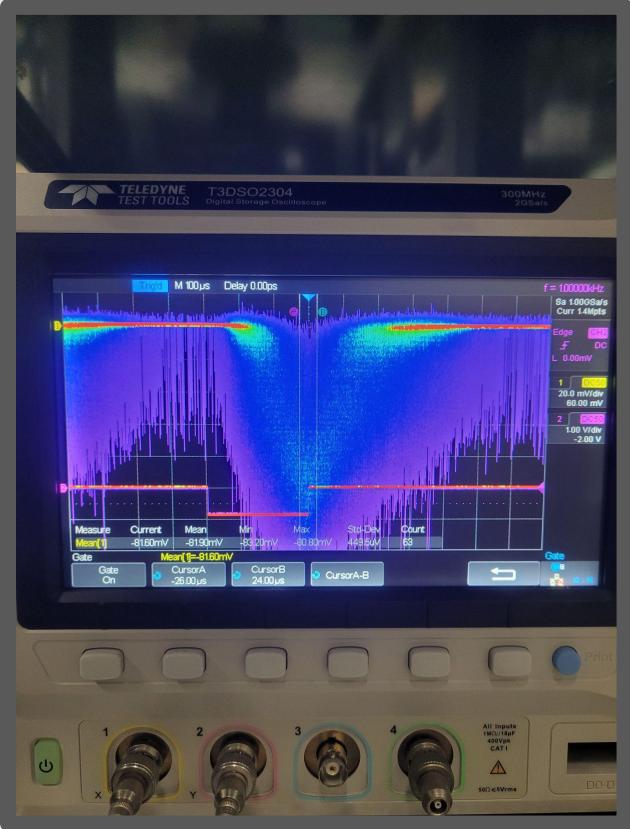
# Physical Results

- Marking the screen helps to estimate behavior of results with pmt installed as well as check the positions of the laser before gathering data
  
- From the center, the laser can be moved around 23mm to the right
  
- Marking every point at which the light fully transitions to another part of the paper.  
(Every 5mm moved, a transition would occur)
  
- Testing also involved lifting the Y position (5mm,10mm,15mm) before moving the x again
  
- Using the screen we, calculate the distance and angle of all transition points (*4 tests in total*)



# PMT Testing

- Now with the PMT installed and supplied 1800v we can read the pulse height
- Recorded results done by screen test. Any shift in x/y will be taken with a measurement every 1mm or 5mm
- The Pulse shape would not change except for when x is approaching the edge of the LC



# Driving Laser with TTL Pulse

PMT Out

TTL(NIM)



Clock Generator

rate  
100/1k/10k/100k

NIM out

Gate Generator

width  
40ns-40 $\mu$ s

TTL out

DC 5V

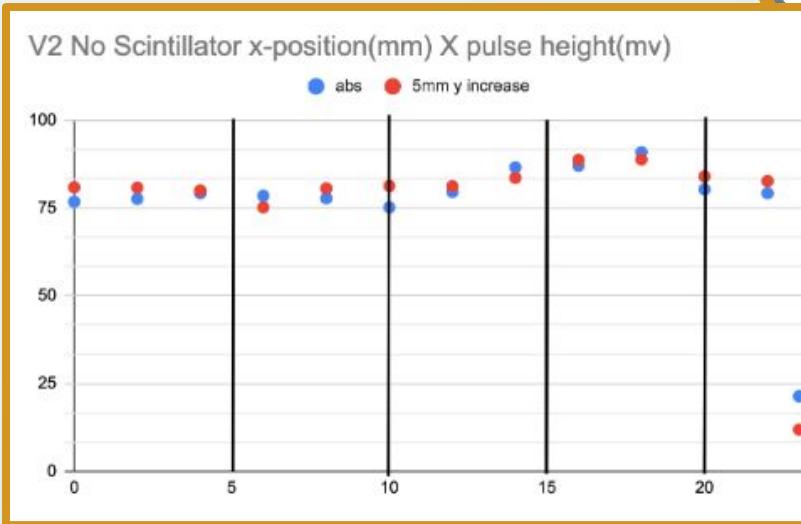
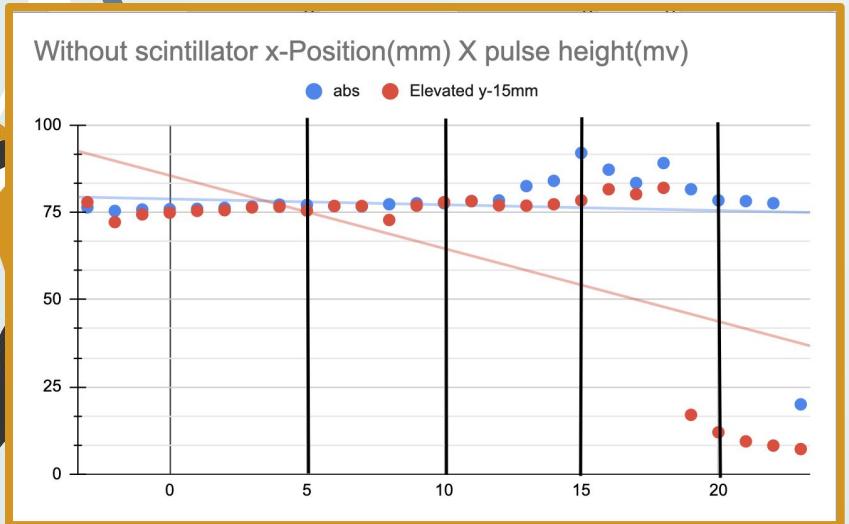


Laser



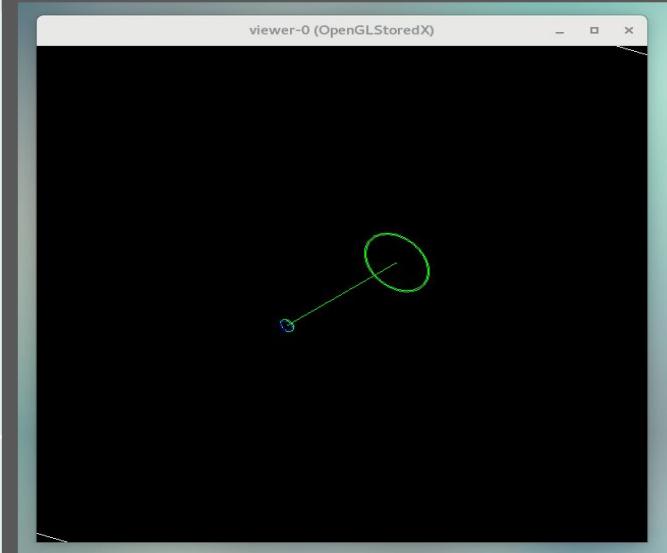
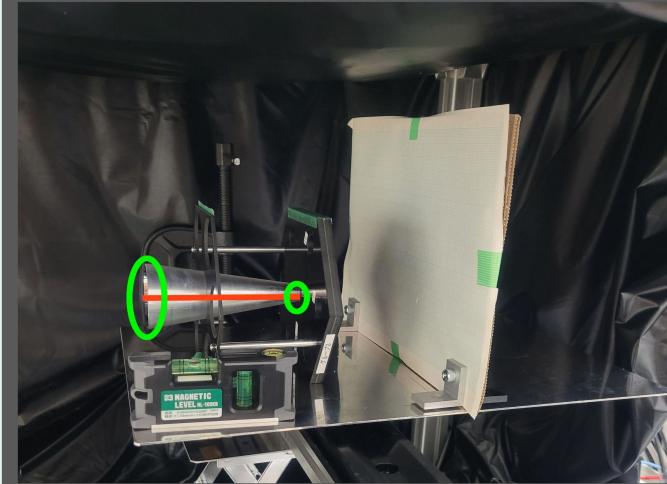
# PMT Results

➤ Graphing the PMT results compared to the screen results show that the transitions every 5mm do not significantly change the pulse height meaning the LC is very efficient at reflecting the light until it reaches the very end



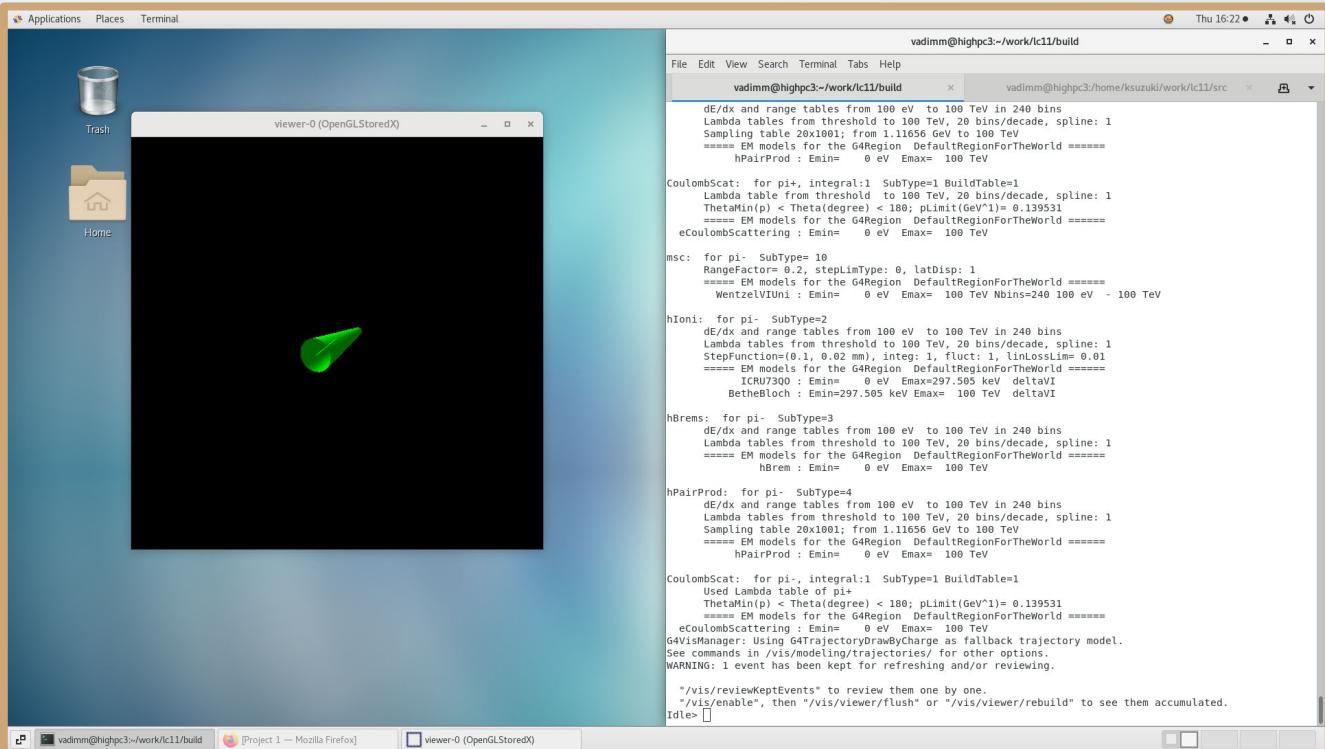
# Creating Visual Sim

- Using Geant4 to simulate this process
- First big project halt as it involved having to learn and understand Geant4 as well as other programs to get the sim to function
- Multiple different versions of the simulation were made before settling on the current



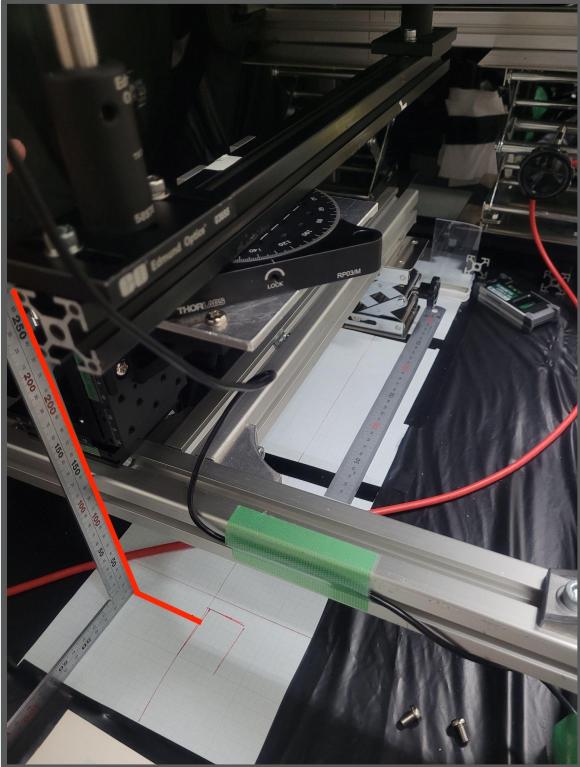
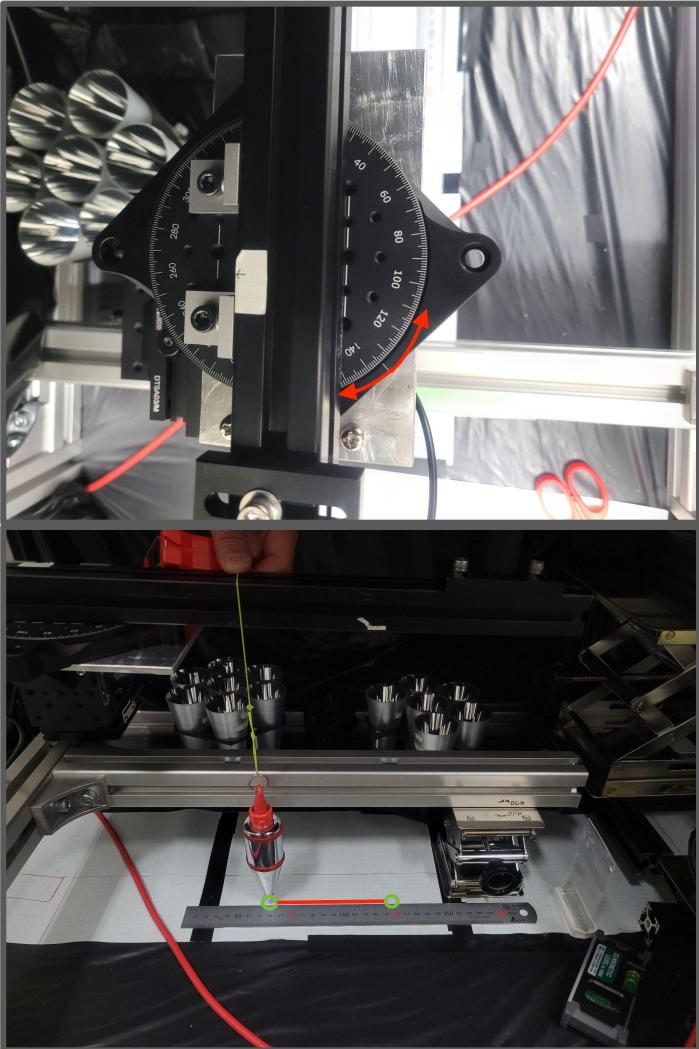
# Progress so Far

- Defined cone shape
- Beam direction
- Changing angle
- Next, getting viable data results



# Finite Angles Measurements

- Needing to test the reflectivity of these concentrators, more angled laser tests are required.
- To understand if the LC is still efficient at reflecting the same strand of light multiple times
- Precision and reproducibility is key



# Conclusion

## Screen Testing

Continue screen tests and measuring angles and transitions for the finite angles

## PMT Testing

Using PMT determine how much the loss in efficiency is of the LC if multiple reflections happen before entering the PMT

## Sim Program

Continue to work towards a complete sim that will be able to realistically depict this experiment

The background features a light blue-grey gradient with various organic, rounded shapes in shades of teal, orange, and dark grey scattered across the surface.

Questions?