OPTIMIZING LIGHT COLLECTION FOR LOW INDEX AEROGELS USED IN CHERENKOV DETECTORS

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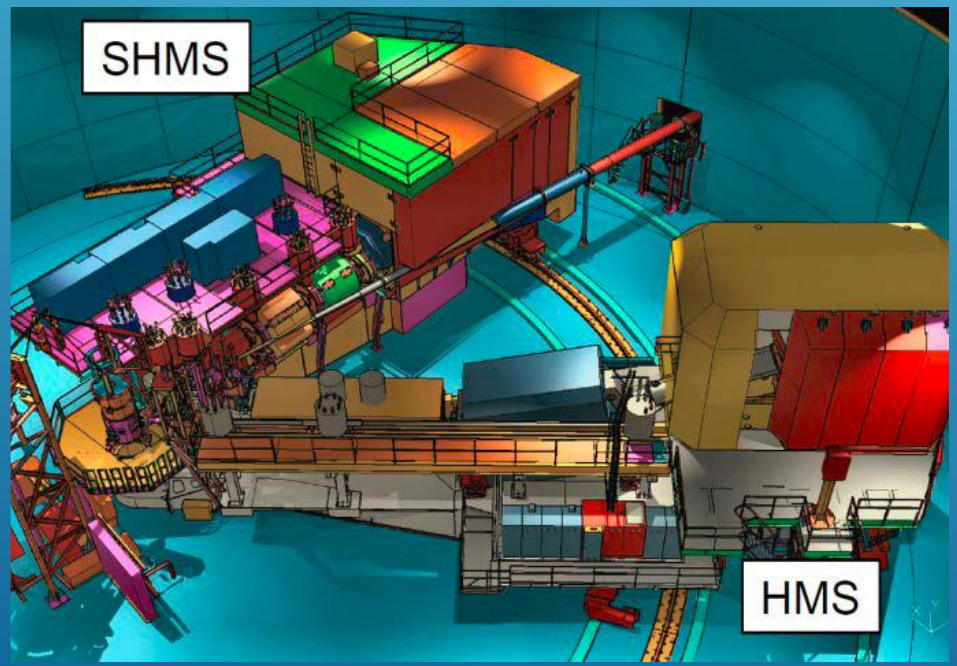
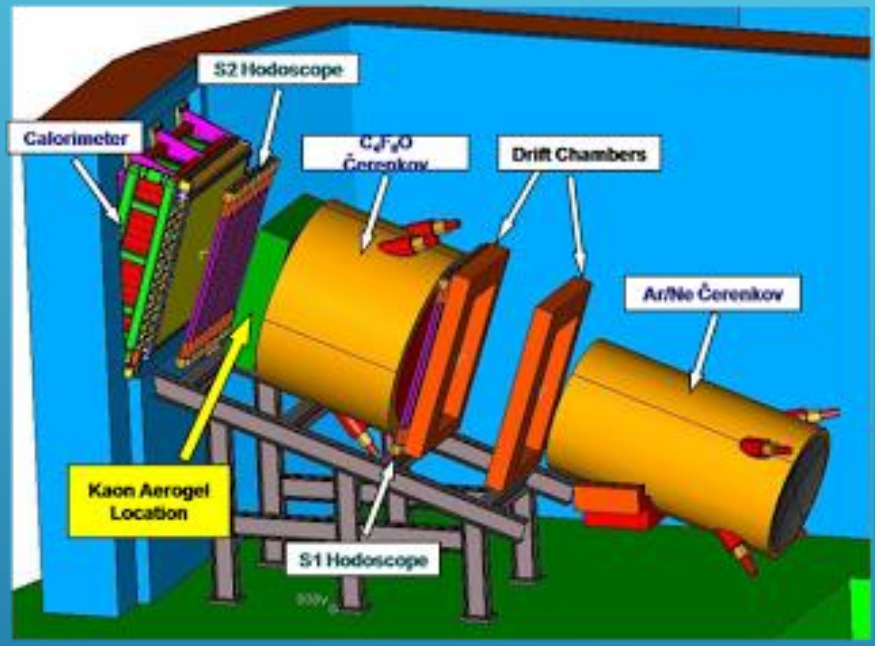
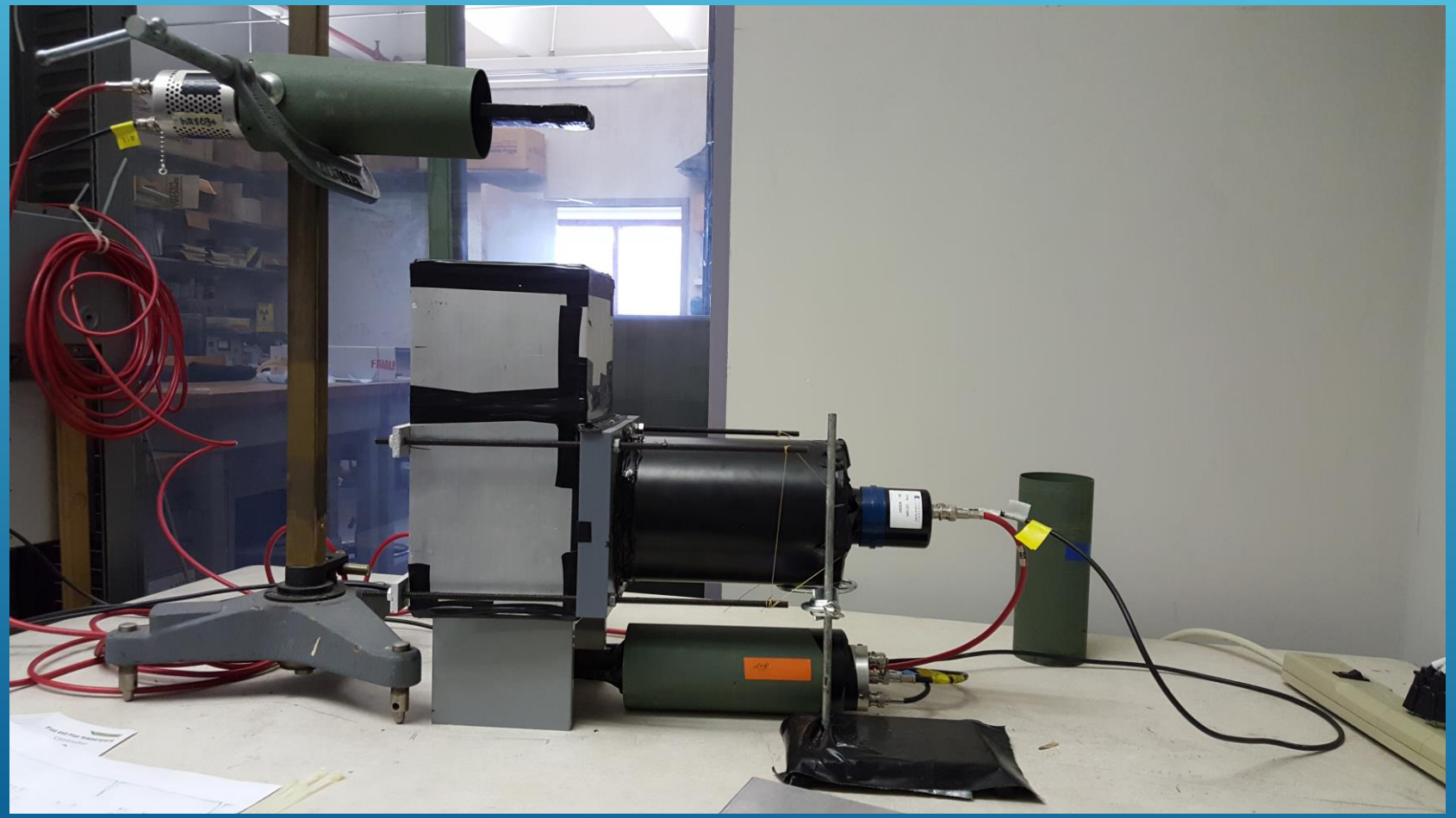
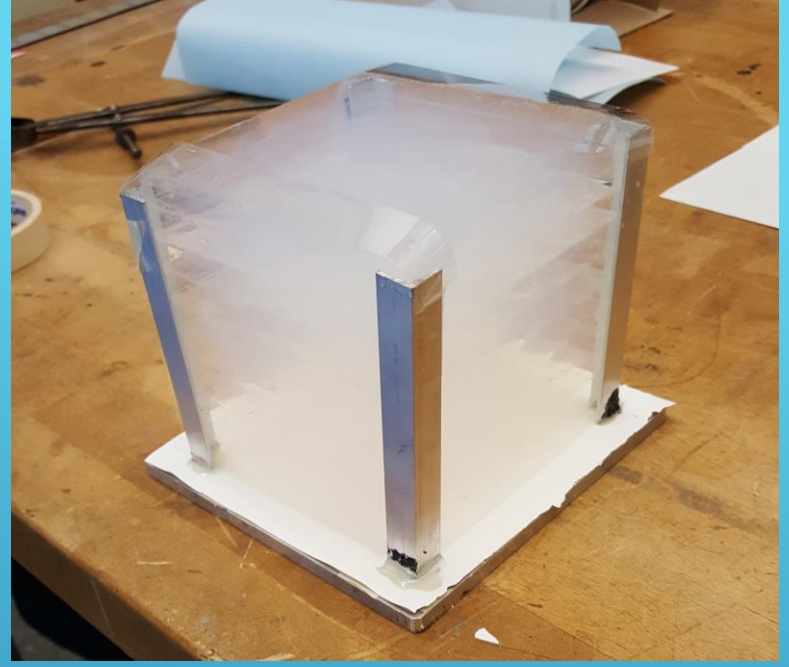
WHY AM I DOING THIS?



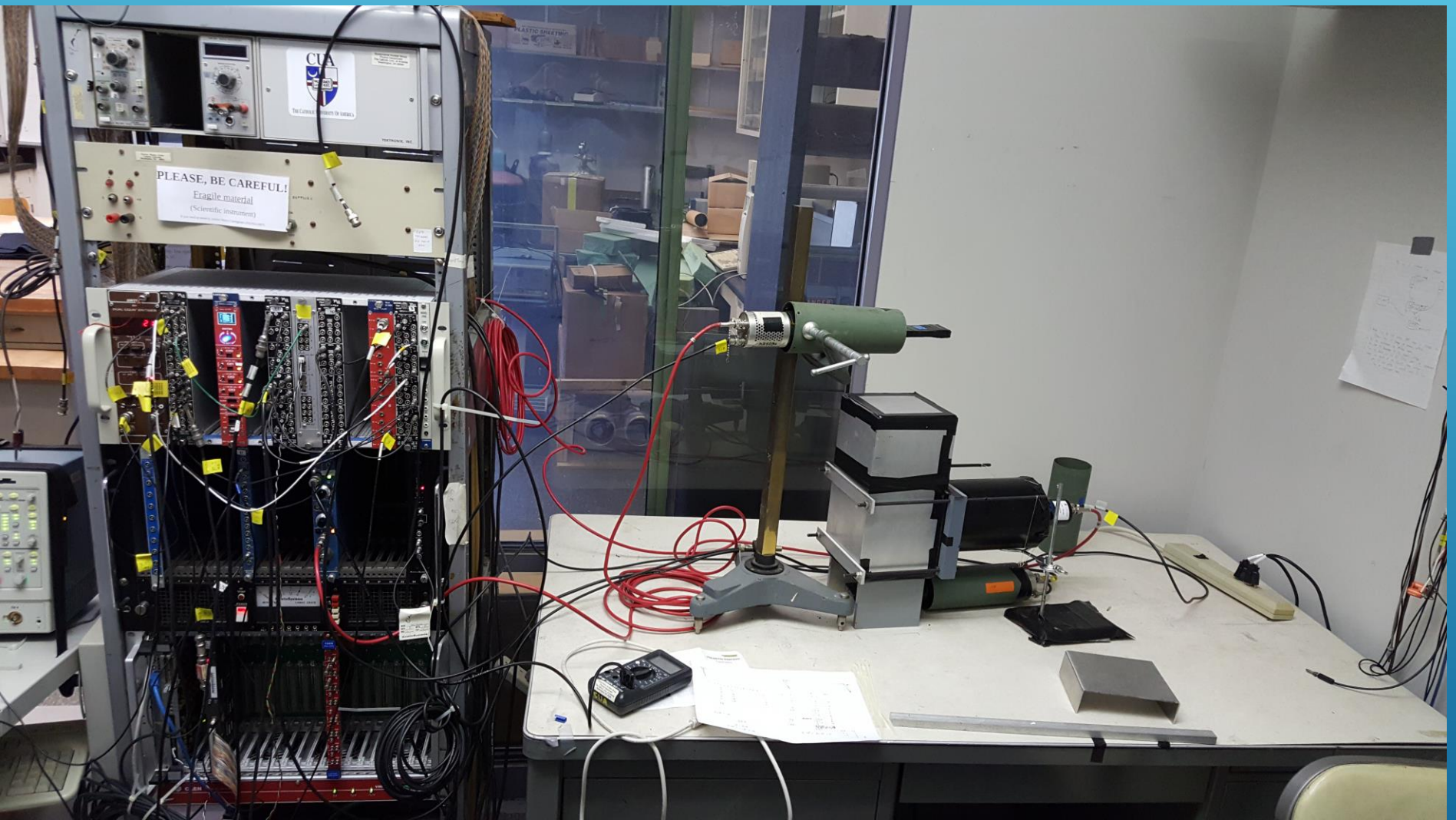


PROTOTYPE





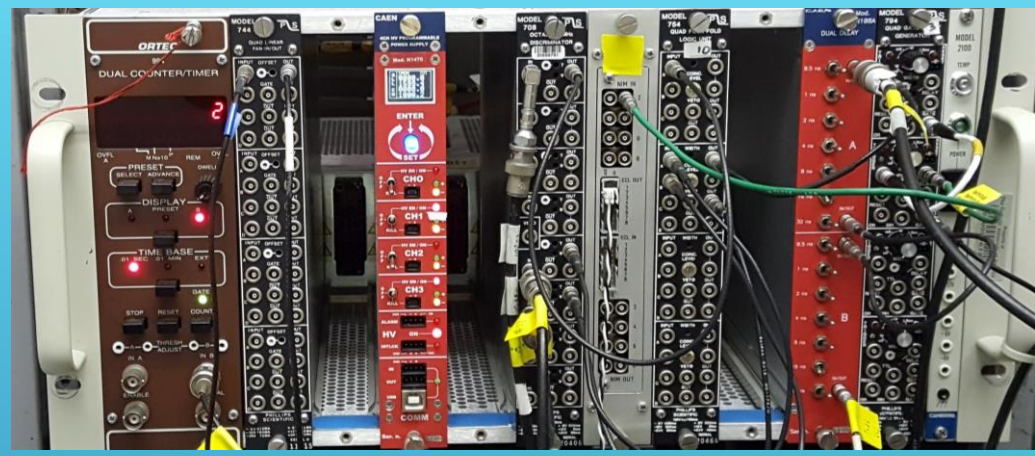
SETUP


PLEASE, BE CAREFUL!
Fragile material
(Scientific instrument)

CONSTANTS

- 10 Tiles of Aerogel
- 1800 Volts to the Prototype PMT
- 1600 Volts to the Scintillator PMTs
- Logic board setup

SCINTILLATOR SIGNALS



1

Discriminator

The discriminator alters the small signal received by the scintillator PMTs into constant pulses to be better recorded by the logic board

2

Logic Board

The coincidence module receives the two signals from the discriminator and creates a signal if and only if the two signals overlap (coincide)

3

Gate Generator

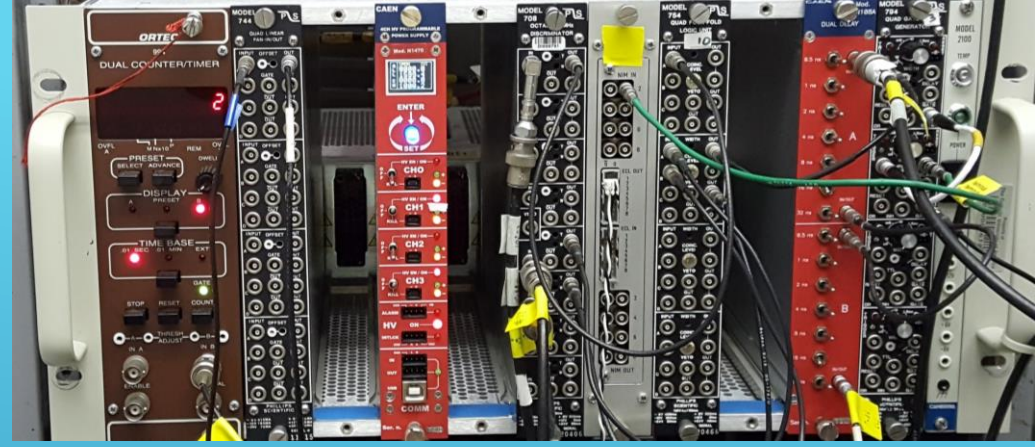
This module receives the coincidence signal, and creates a gate to tell the computer when to record the signal of the prototype

4

Fan IN / OUT

This module copies the input it receives and outputs four copies. This allows us to run multiple setups at a time as either gate that creates a signal is copied and sent to the computer

PMT SIGNAL



Prototype

The PMT from the prototype receives a signal from the Aerogel, and amplifies this signal

Delay Module

To ensure that the signal from the prototype and the gate set to measure it are in sync, the signal from the PMT is delayed

ANALOGUE TO DIGITAL CONVERTER (ADC)

The ADC converts the signals received by the gate generator and the delay module into signals recognizable by the computer. This signal is then sent to the computer for recording, and later processing by us.

INDEPENDENT VARIABLE

For Comparison

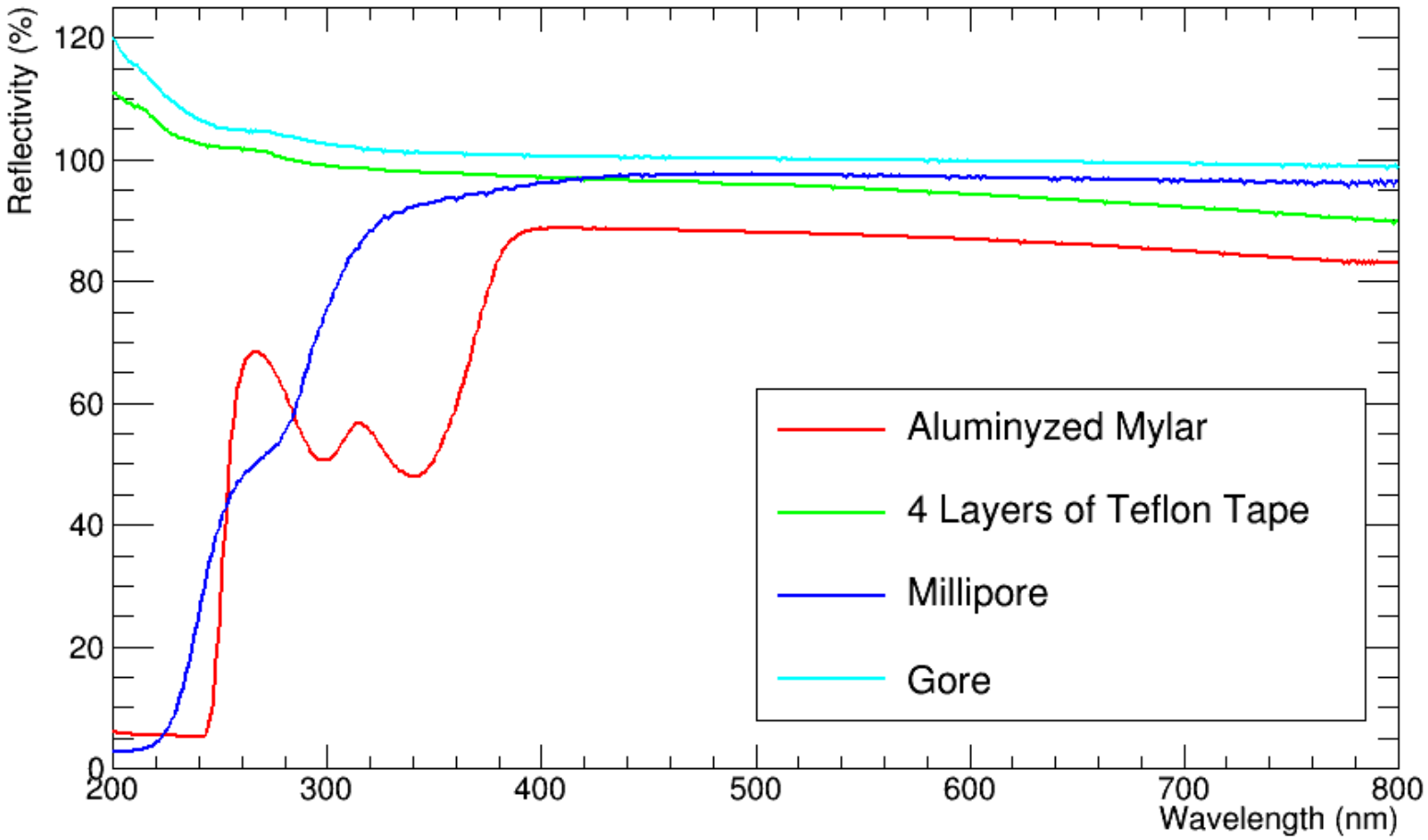
Approximate number of photons inside the detector: 15

Approximate number of photons emitted by a 100 watt light bulb: 2.4×10^{19}

I changed the reflective material inside of the prototype to ensure that the most effective reflector was being used in the main Aerogel Cherenkov Detector. The reflector is important as we are dealing with really low amounts of light, and it is important that as much light is reflected into the PMTs as possible.

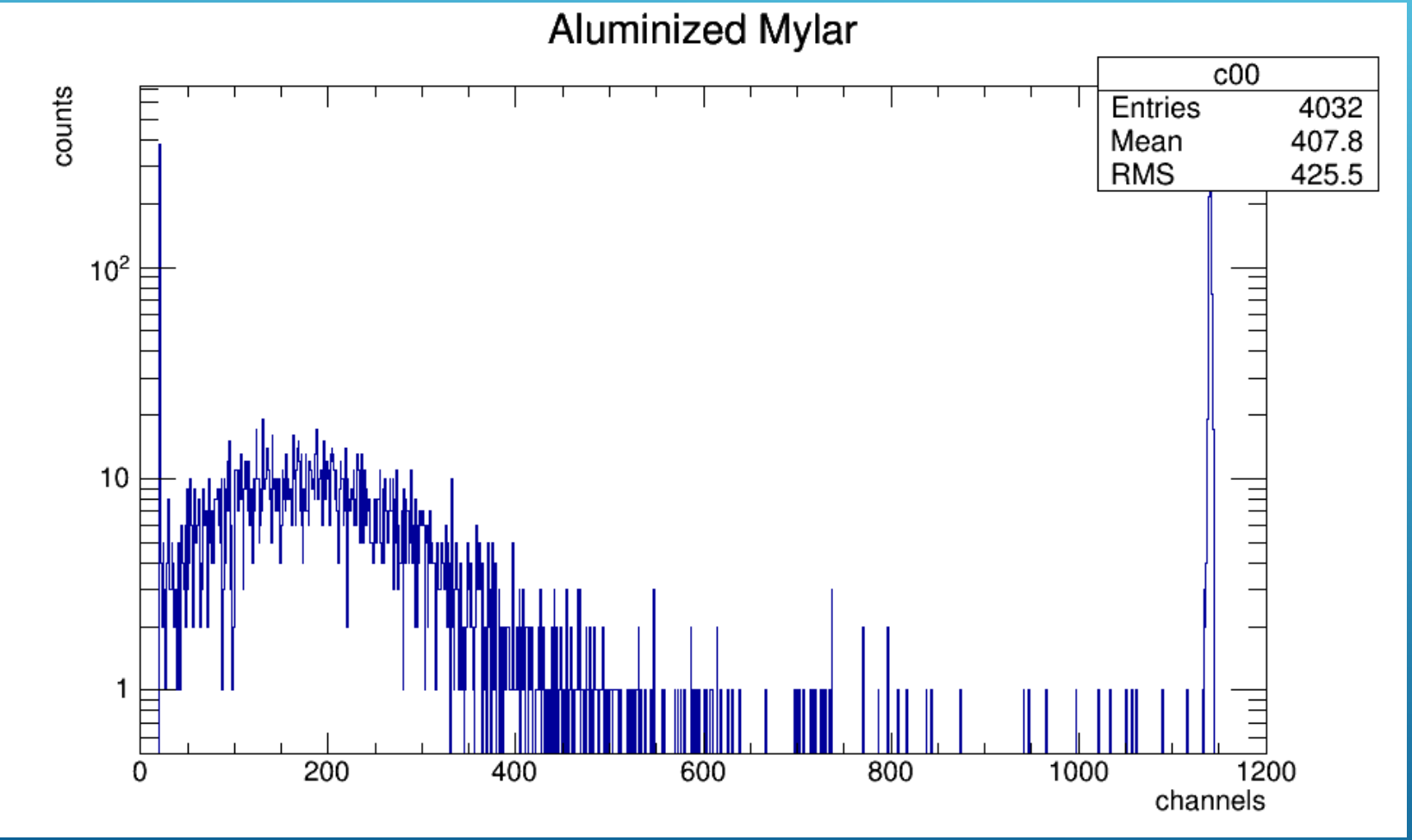
24,000,000,000,000,000,000 (2.4 quintillion)

REFLECTIVITY

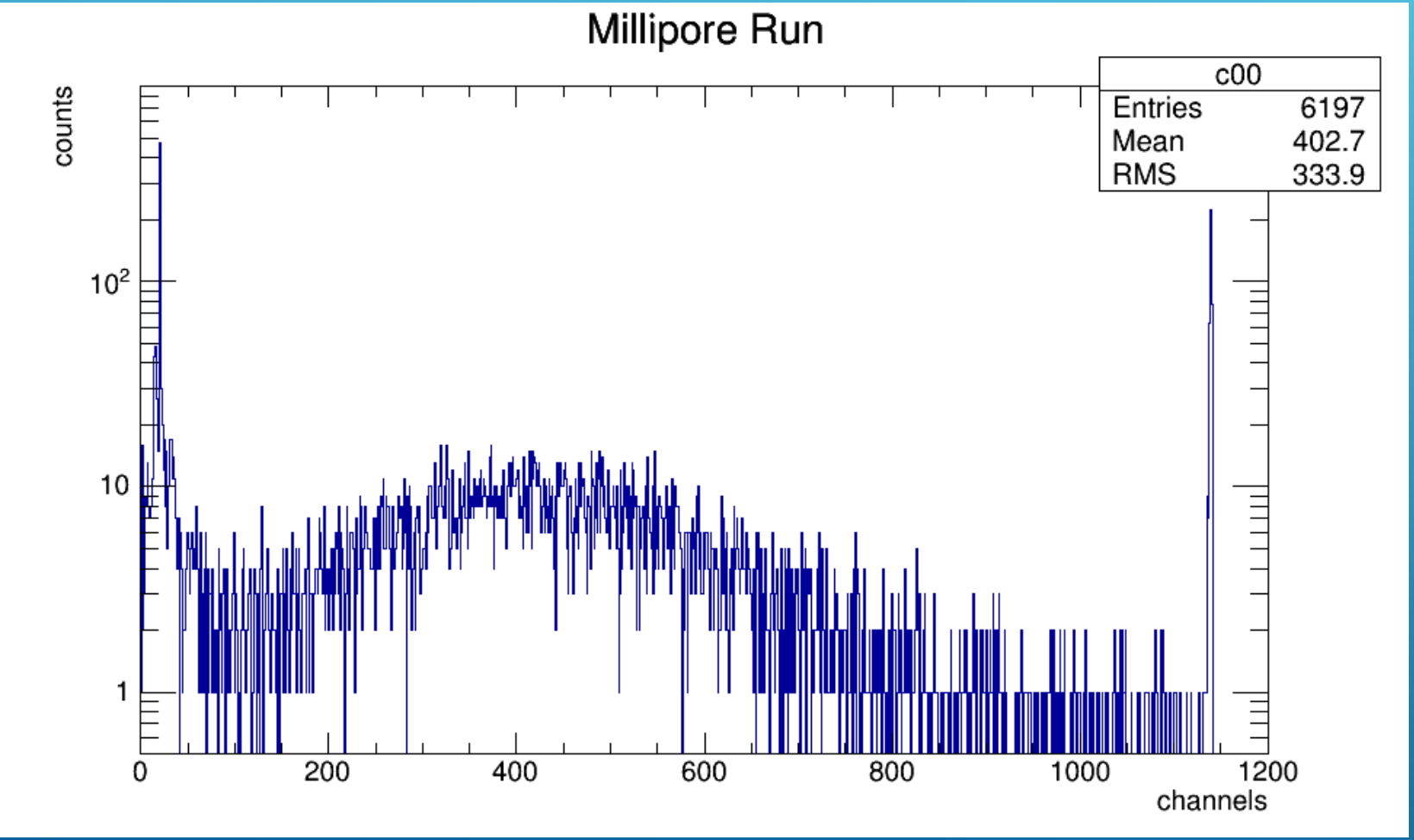


Values greater than 100% signify a reflectivity greater than that of the normalization sample

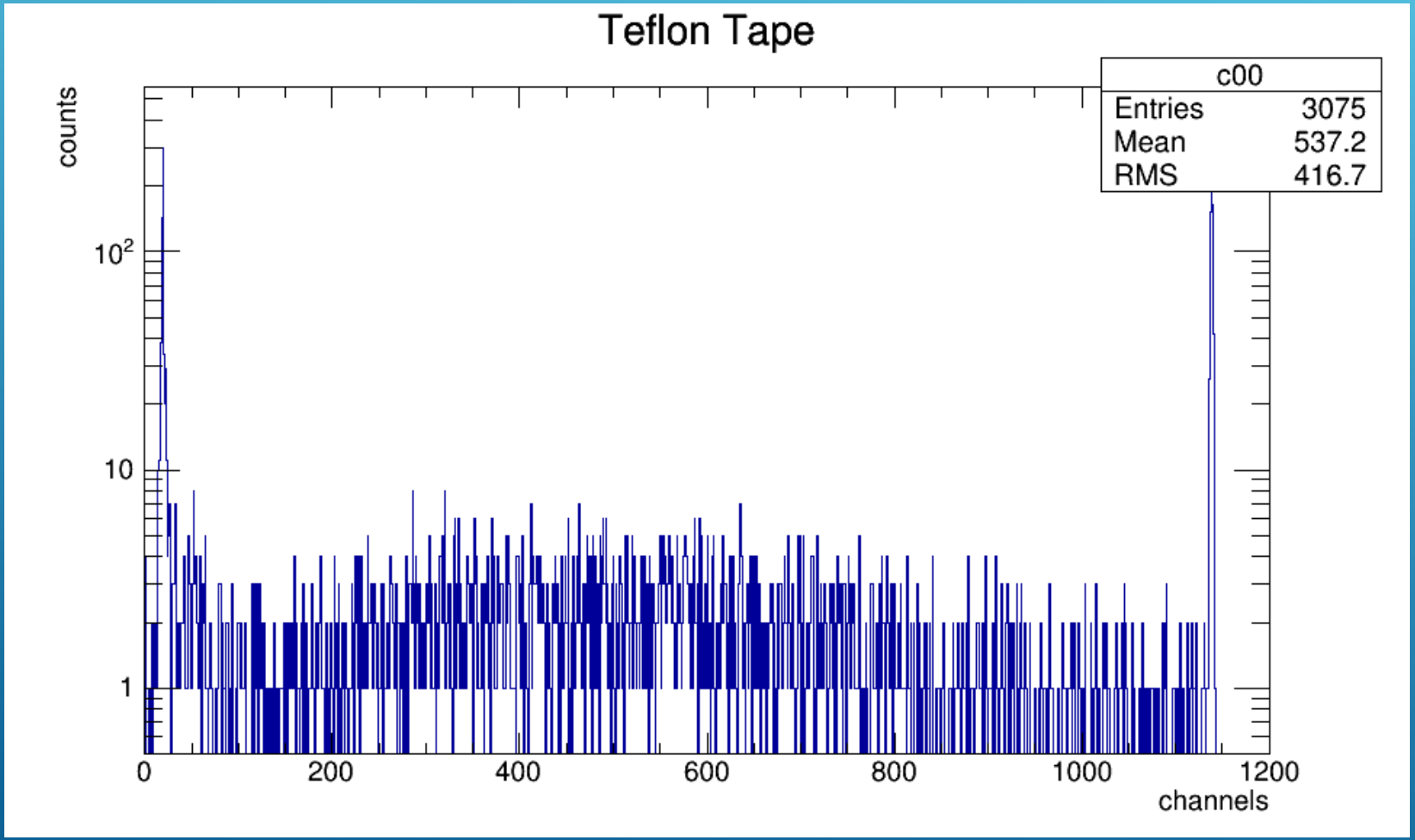
RESULTS – ALUMINIZED MYLAR



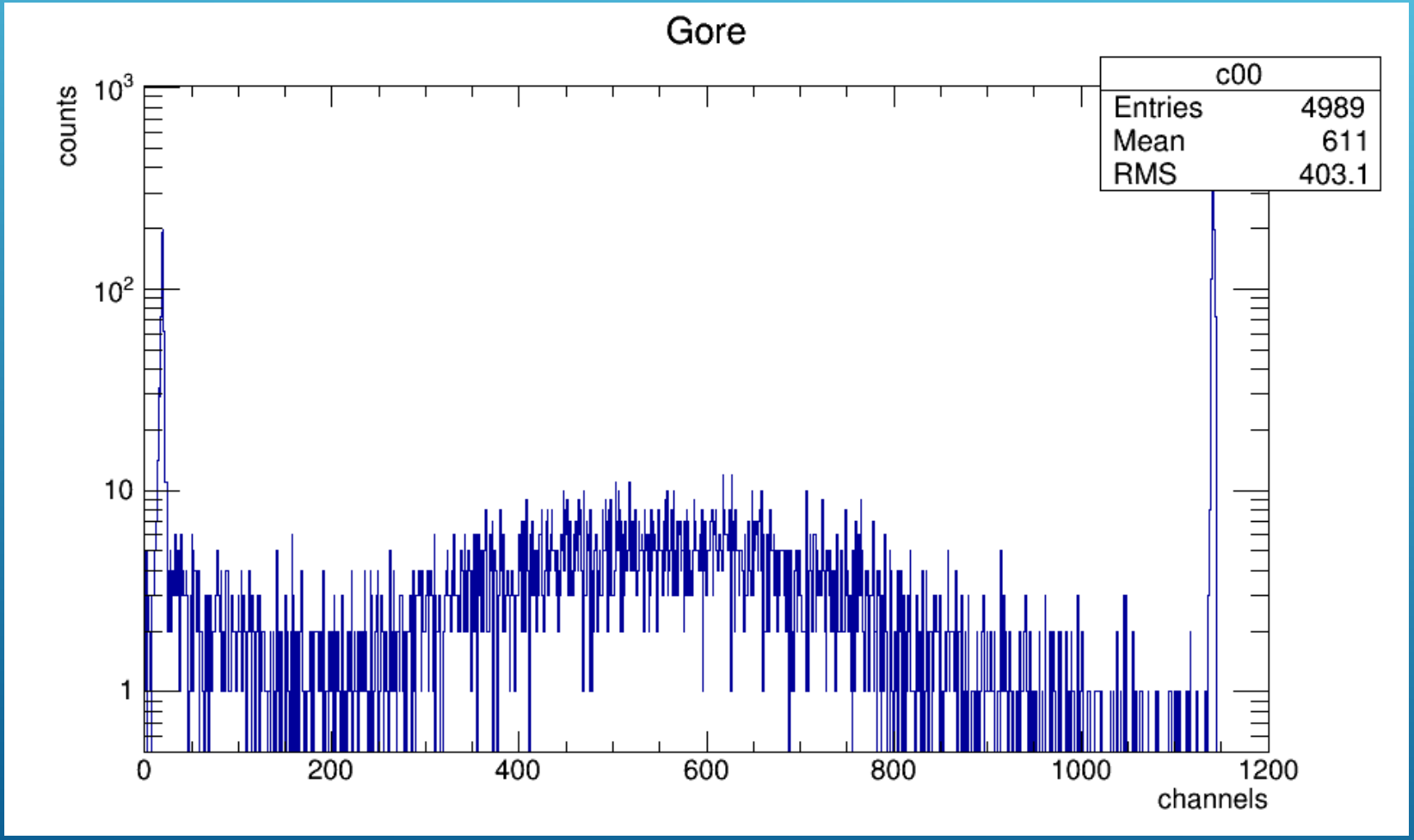
RESULTS – MILLIPORE



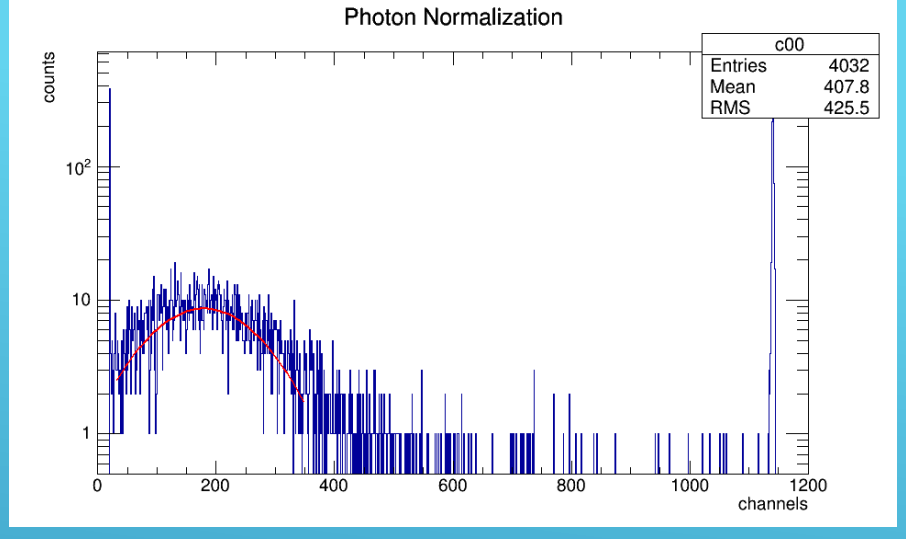
RESULTS – TEFLON TAPE

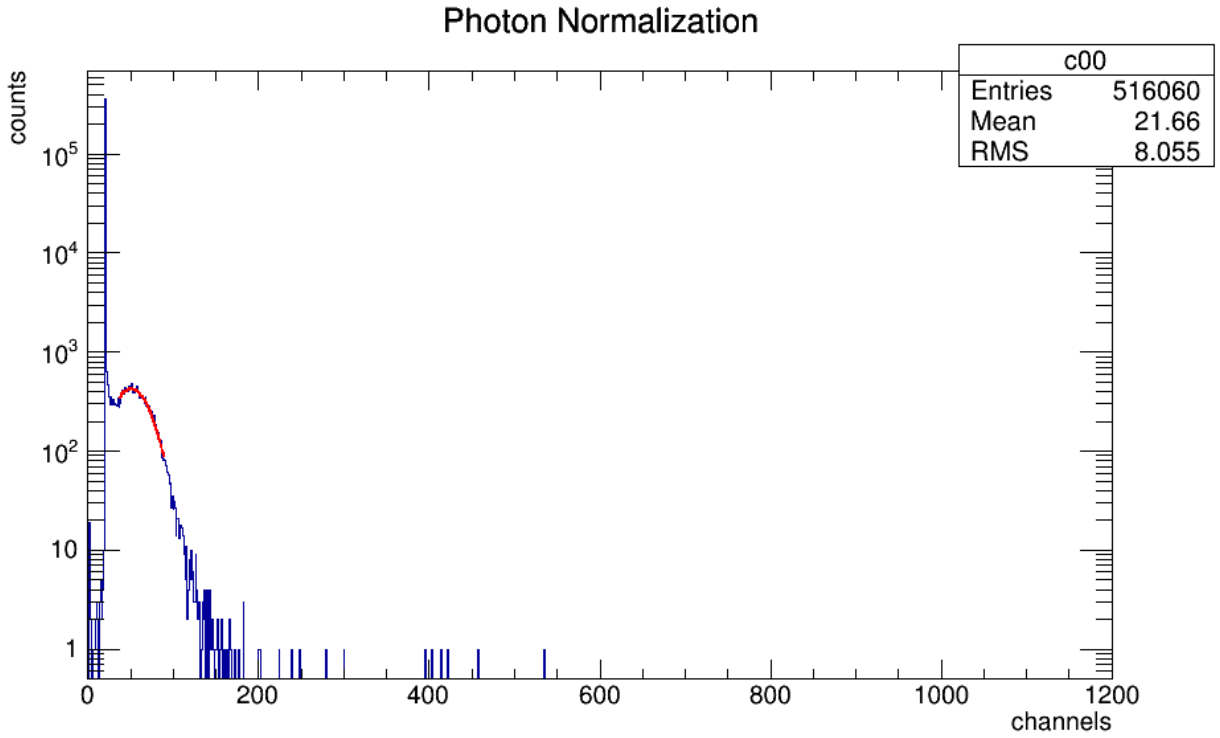


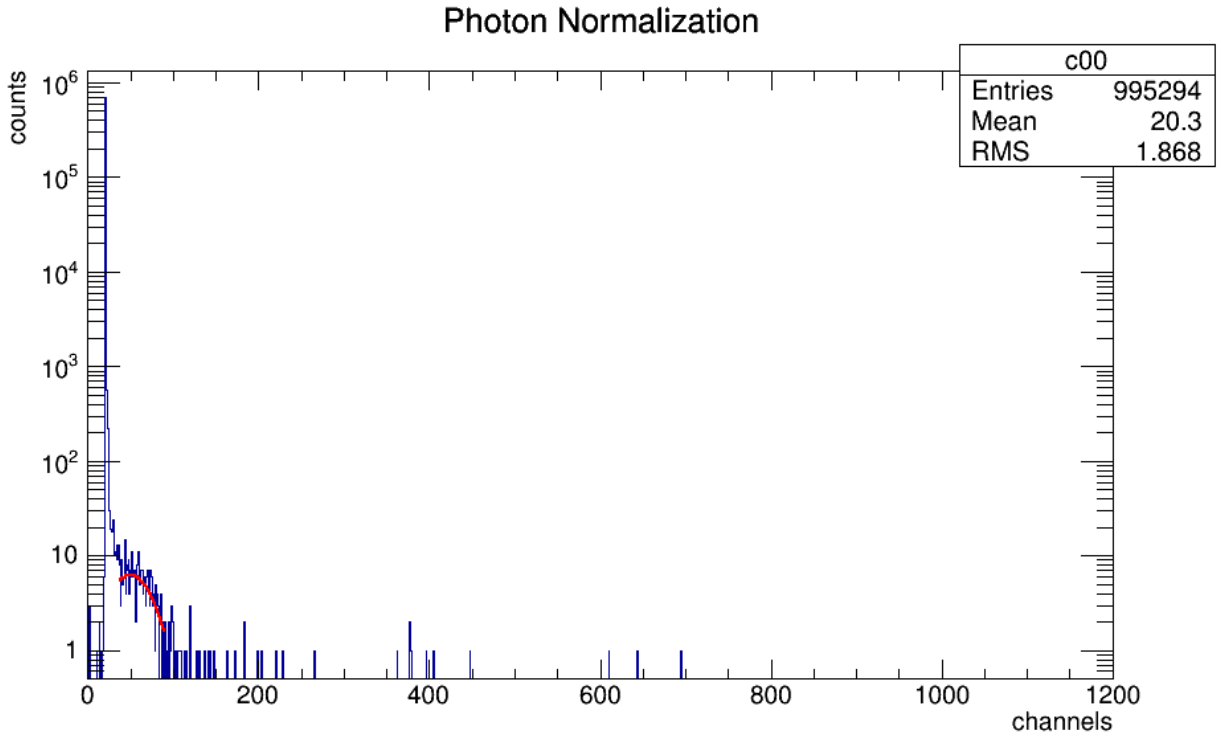
RESULTS – GORE



NORMALIZATION







NORMALIZED RESULTS

- Aluminized Mylar - 5.39 ± 0.08
- Millipore - 14.0 ± 0.1
- Teflon Tape (4 layers) - 15.0 ± 0.8
- Gore (1 mm) - 16.4 ± 0.2

WHAT DOES THAT MEAN?

This means that the most reflective material is Gore. Followed by Teflon, then Millipore, then Aluminized Mylar.

Ok so now what?

This would suggest that the best reflective material is Gore. But as Gore is expensive, it supplies an alternative: Teflon Tape. Currently the detector is 60% / 40% - Gore / Millipore. This experiment recommends that the Millipore in the detector be replaced with Teflon Tape.