Progress on Wavelength Shifting Light Collector Plates

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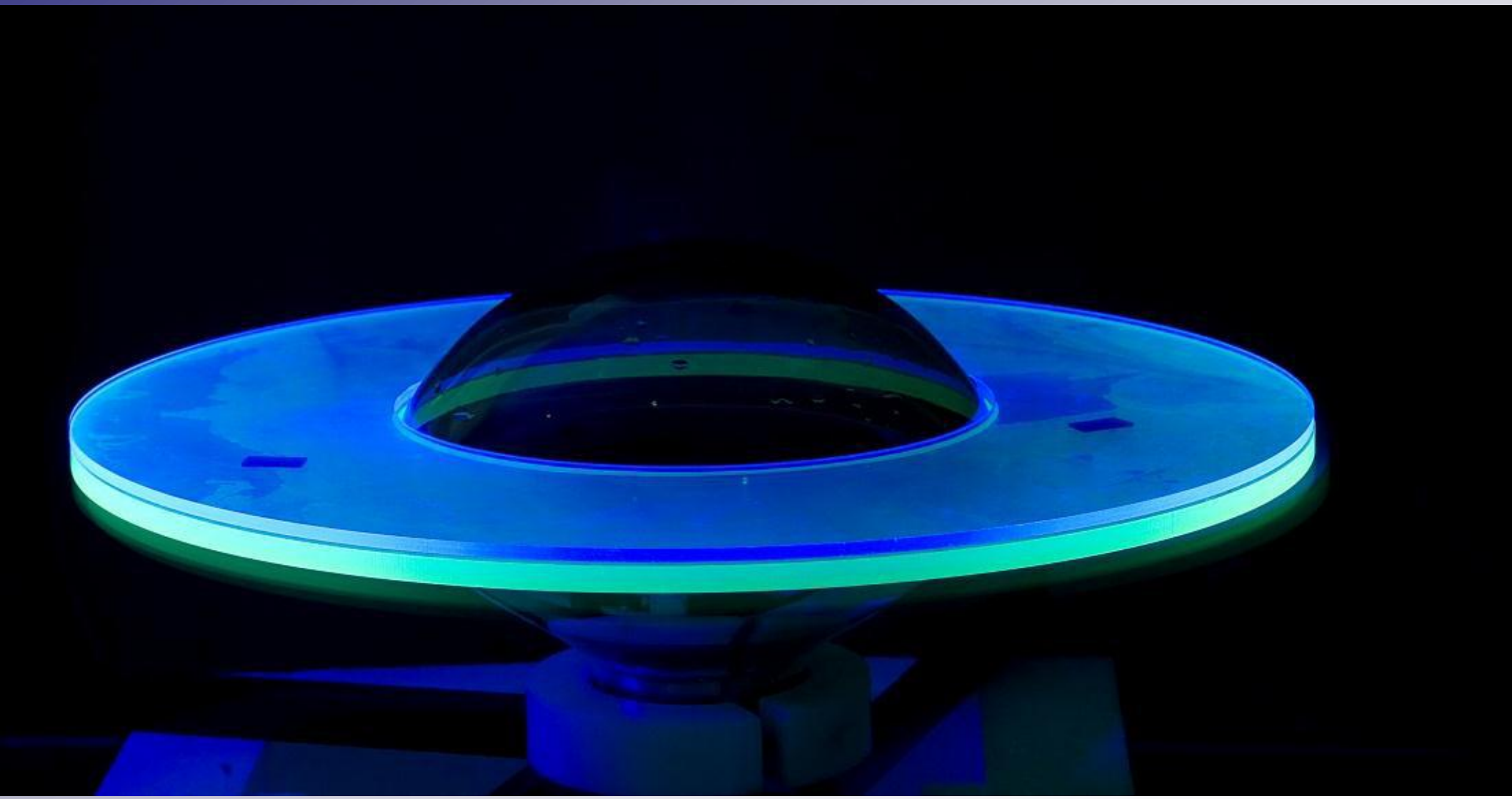


Prototypes

Prototype 1 (BC-499-76)

UV → blue

ID: 10″, OD 20″, 5 mm thick

Polyvinyl toluene (PVT) base

Fluor: POPOP + ??

Index of refraction = 1.58

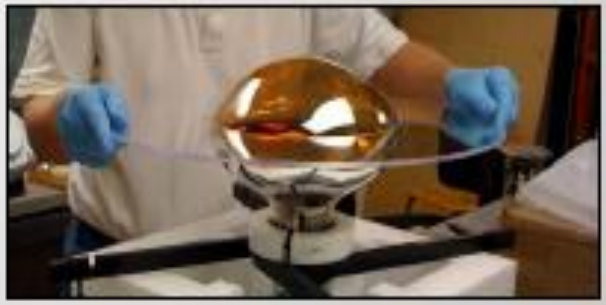
Density = 1.04 g/cm^3

Decay time = 2.1 ns

Vendor: Saint-Gobain

PMT area: 78.5 in^2

Plate area: 235.6 in^2



Prototype 2 (BC-482A)

blue → green

ID: 10″, OD 20″, 10 mm thick

Polyvinyl toluene (PVT) base

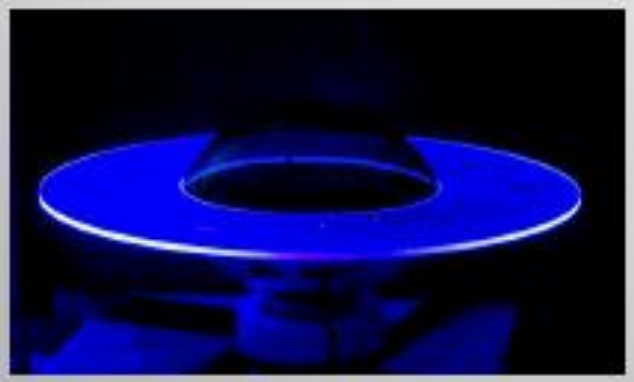
Fluor: BBQ?

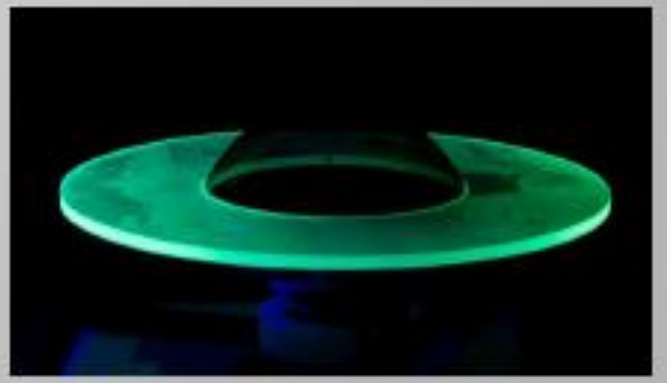
Index of refraction = 1.58

Density = 1.04 g/cm^3

Decay time = 12 ns

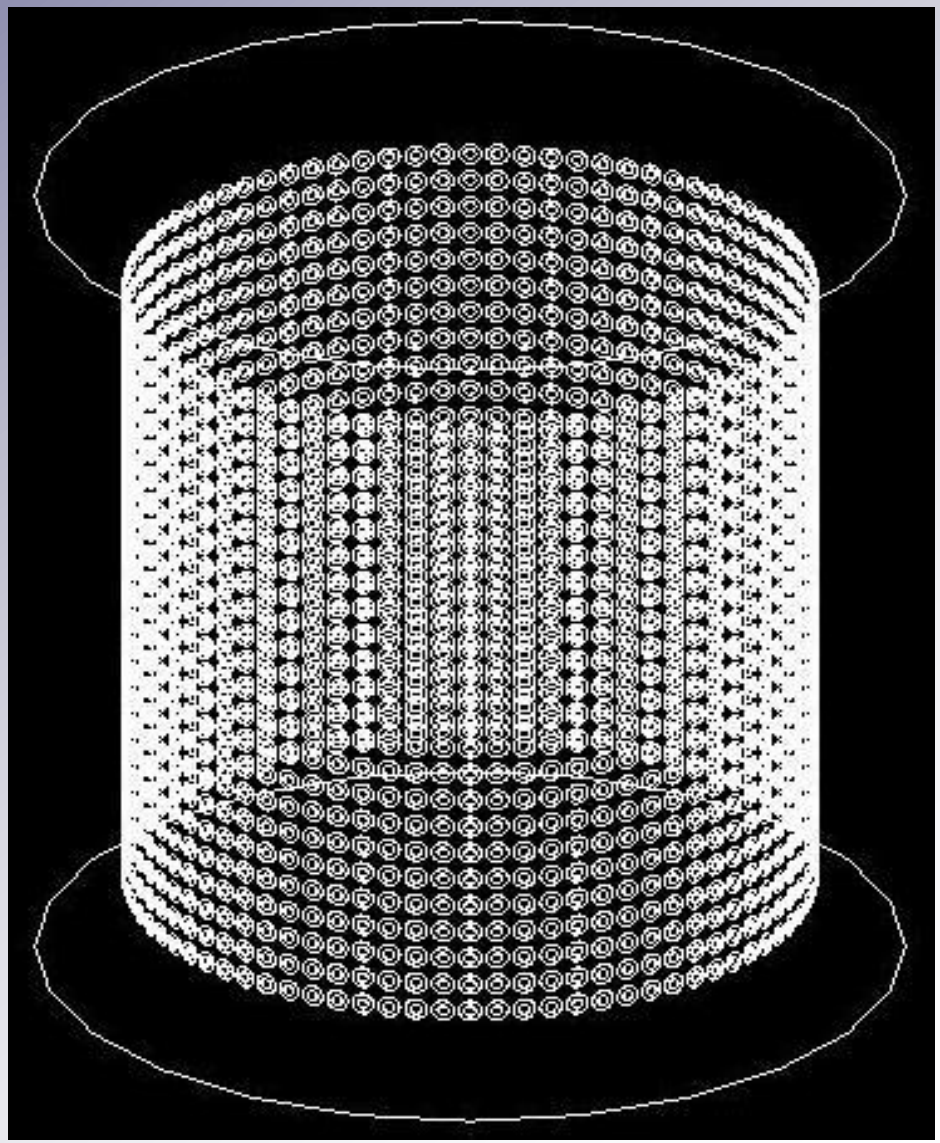
Vendor: Saint-Gobain





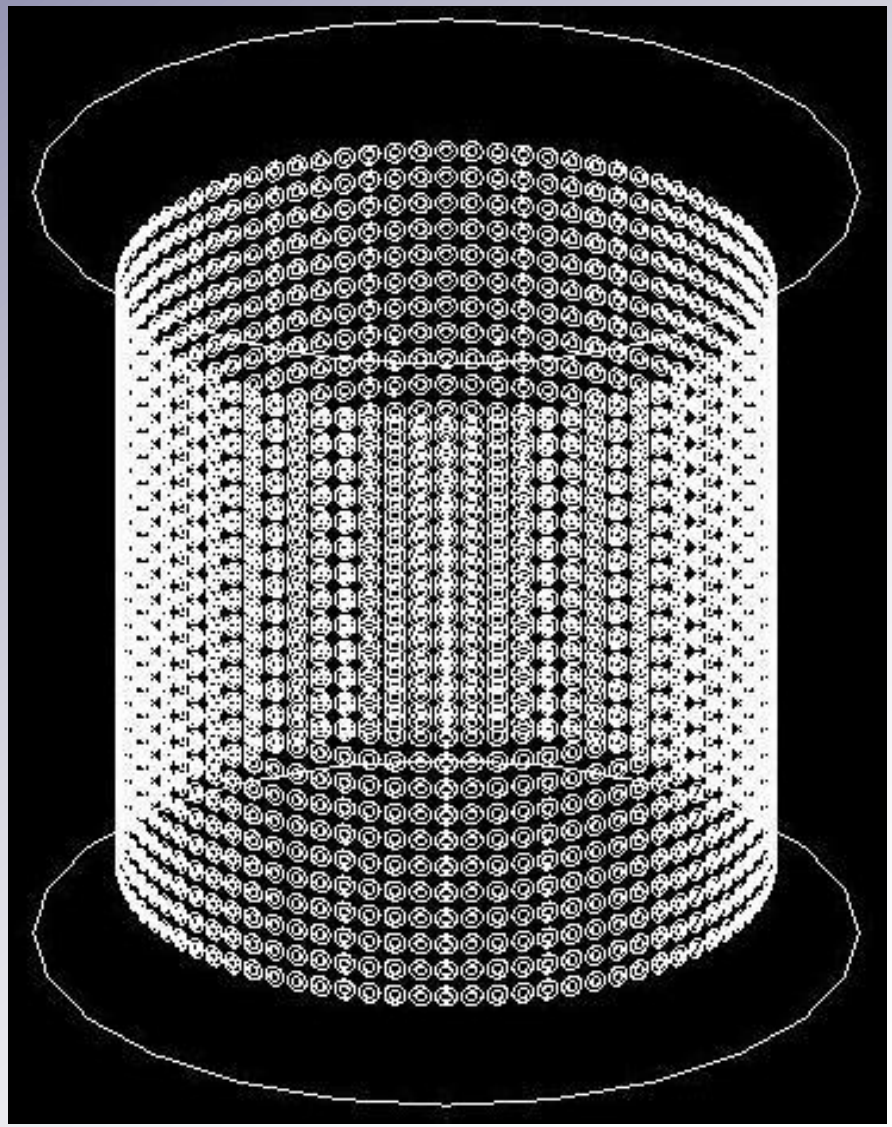
New Modifications to the Simulations

- Ran into a few issues running the collaboration's simulation
- Already had a simulation of one light collector on one PMT
  - Loop over it 1000s of times and put them on a cylinder
- Endcaps ignored for now, for simplicity
  - Code for them in simulation but not analysis

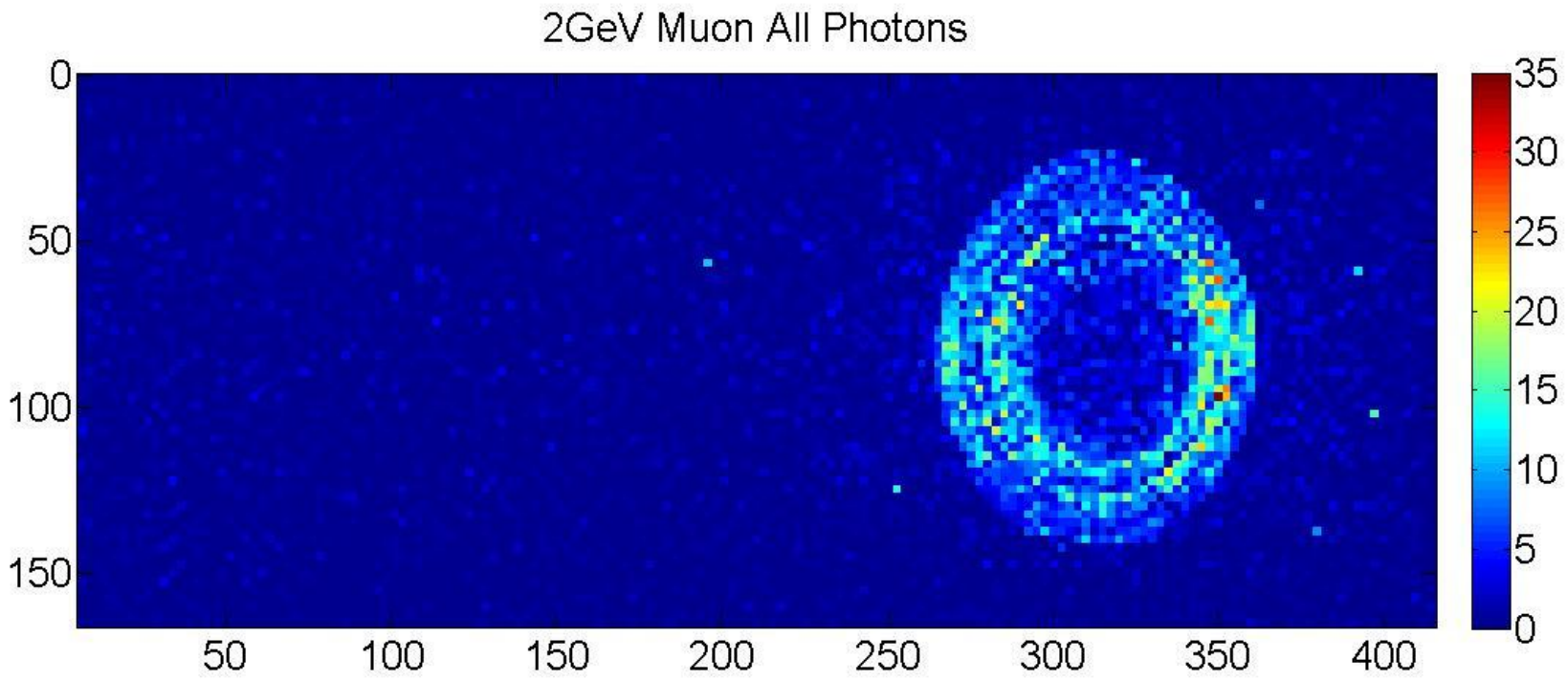


Simulation Geometry

- 40m diameter
- 50m tall
- 10” HQE PMTs
  - QE being accounted for
- 29” diameter light collectors, UV -> blue, 10X dye
- 30” center to center PMT spacing
- Much bigger than one pictured at right

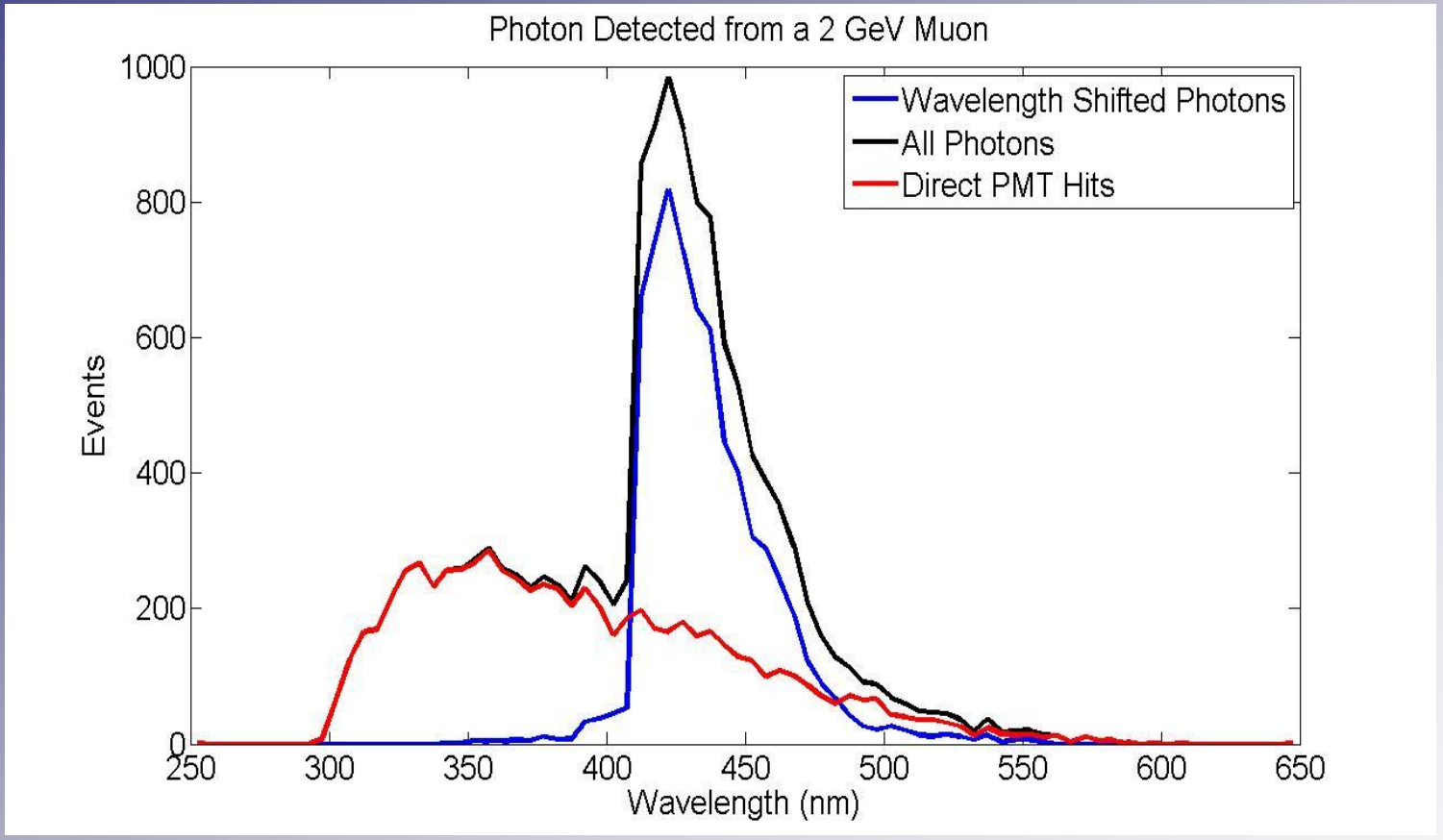


Ring Produced by a 2 GeV Muon



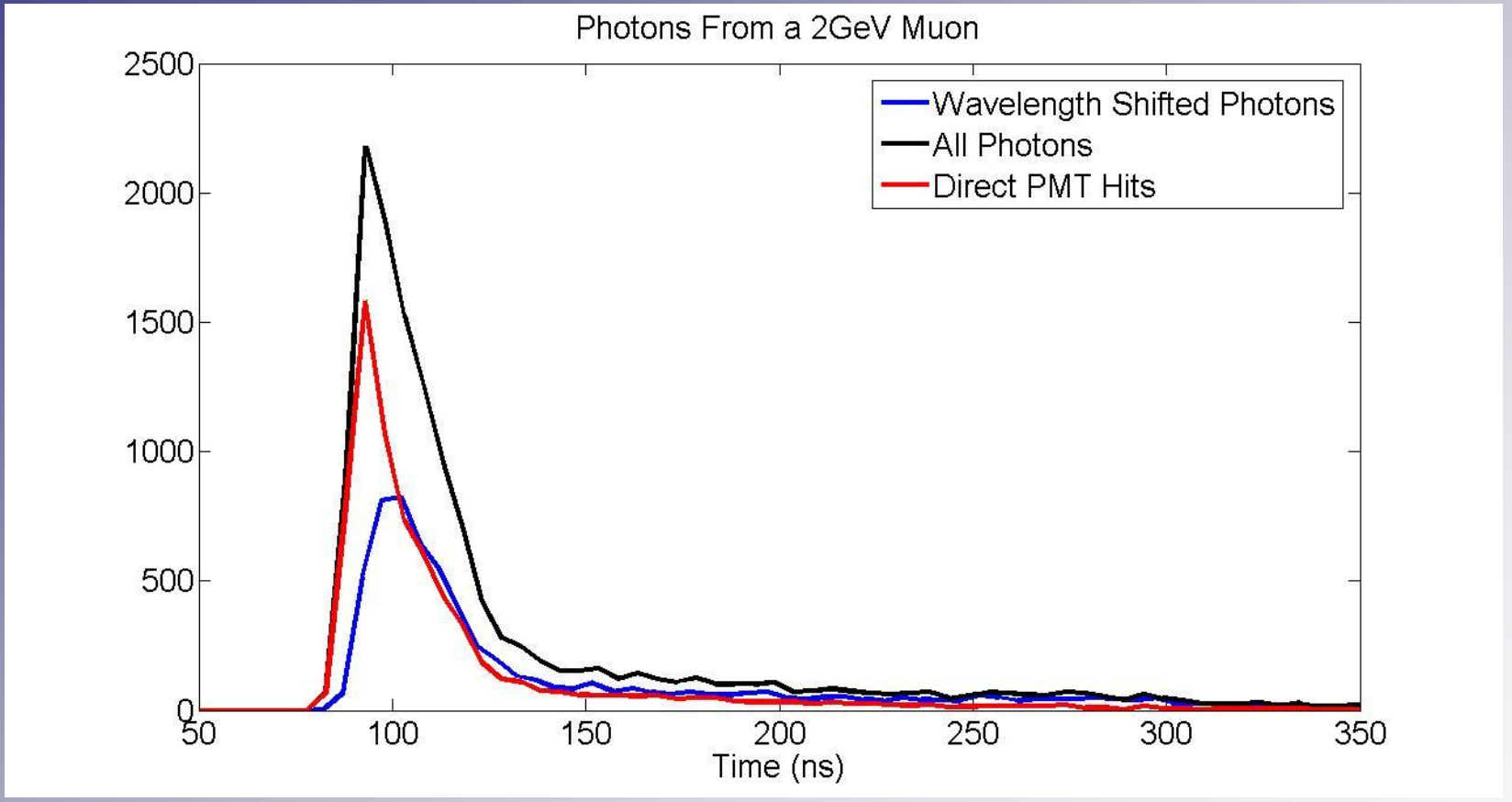
- Muon shot from the center of tank towards the wall

Photons Produced by a 2 GeV Muon



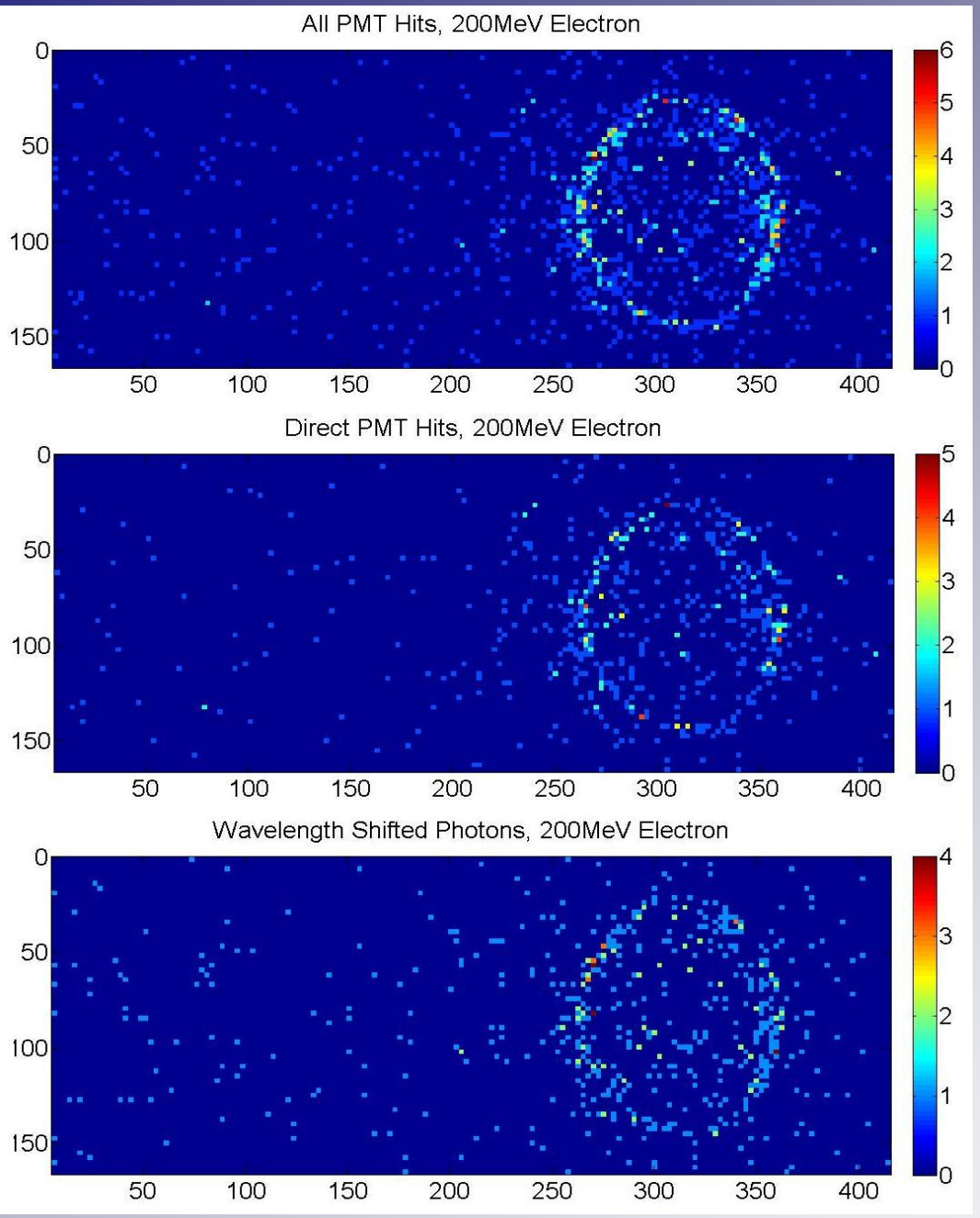
- Light collector increased light reaching PMT by 93%

Photon Arrival Times for 2 GeV Muon



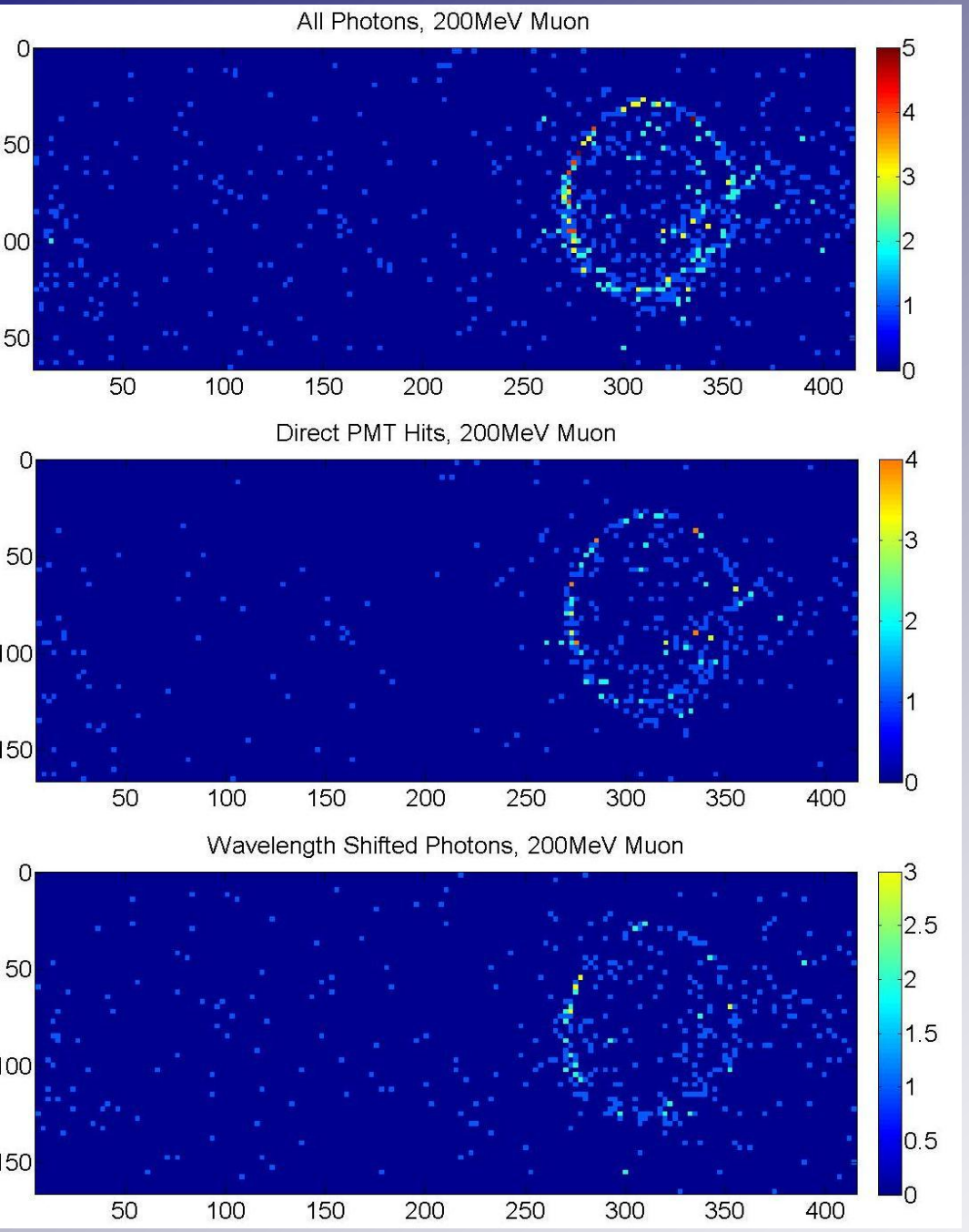
- Raw hit times, not time of flight subtracted
- LC photon leading edge delayed ~5ns

200MeV Electron Event



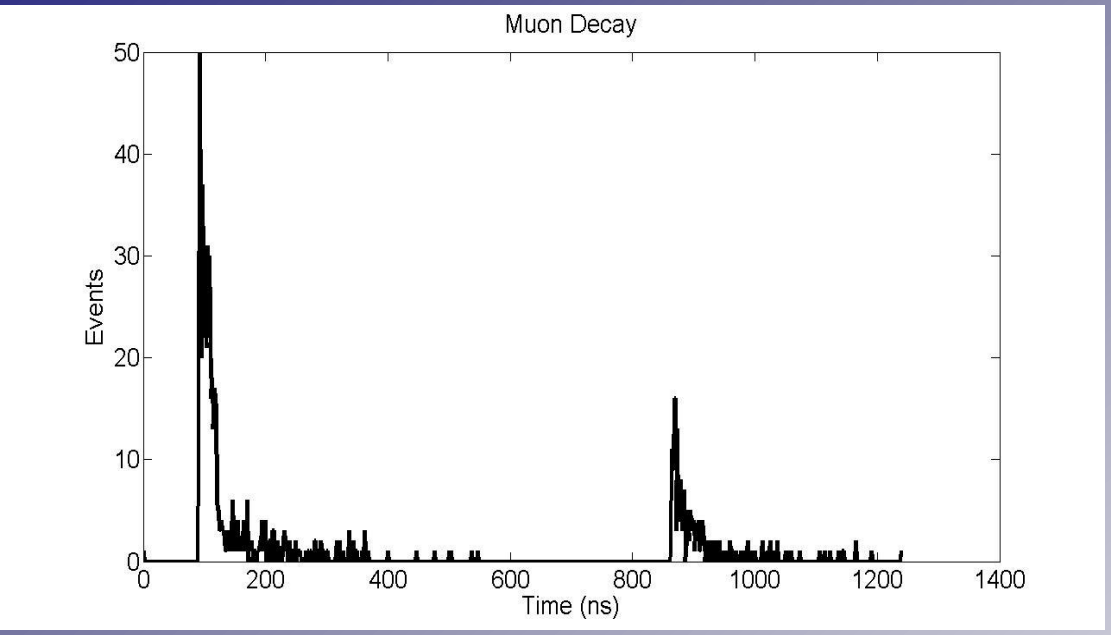
- Light collector produces more scattered light than Rayleigh scattering

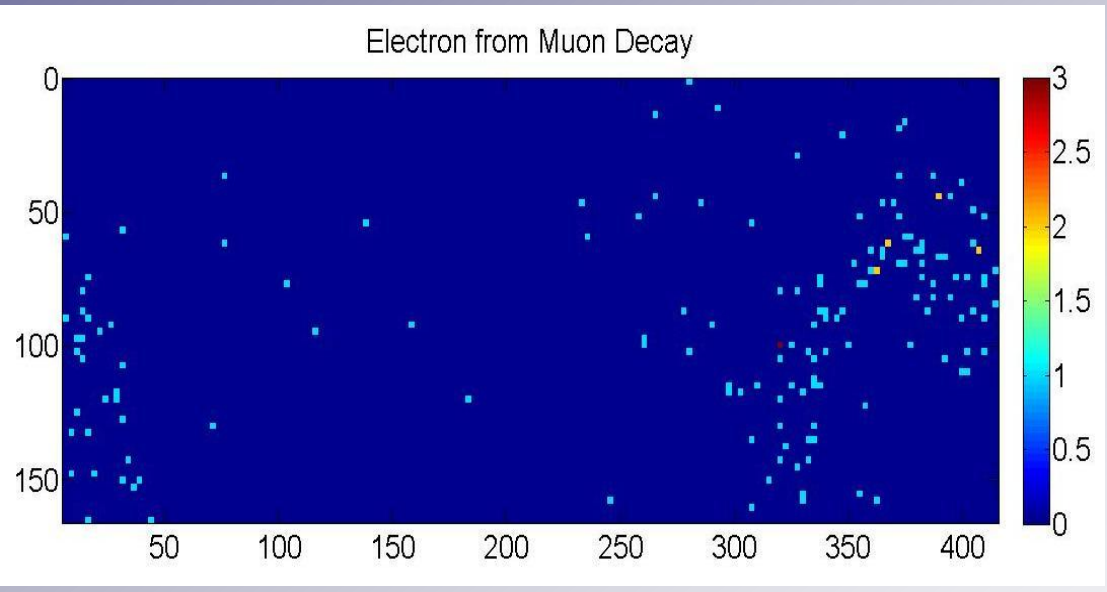
200MeV Muon Event



- Not as much diffuse light as first appears
  - Timing information shows that the muon decayed
  - Downward going electron ring present but less obvious due to lack of endcaps

200 MeV Muon, Timing

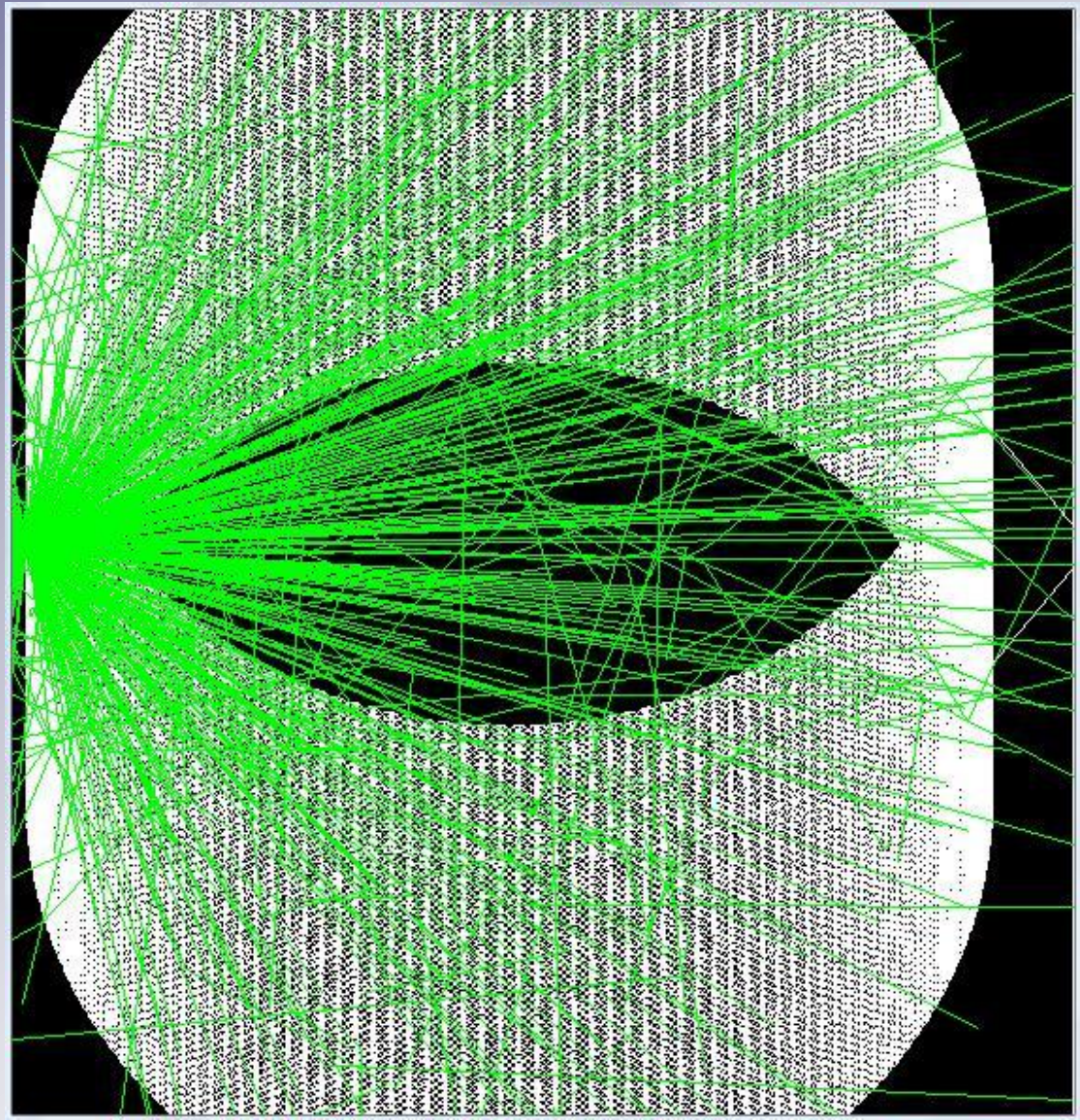




- Muon decayed after 0.8 microsecond
  - Clear signal seen
  - Not obscured due to light scattered by light collectors
- The events from the electron signal plotted based on timing information

Crosstalk

- Light emitted from the front face of a light collector can propagate to other PMTs
- Shot 100000 UV photons into a light collector and looked for PMT hits
  - Crosstalk probability for this case was ~1%
  - Probability of light reaching correct PMT ~5%



Immediate Plans

- Get a simulated light collector plate into the LBNE collaboration simulation
  - Get others working on reconstruction with light collectors
- Continue working on in-house simulation
  - PMT size, LC size, materials, photocathode coverage all easily played with
  - Try to determine optimal light collector design, minimize crosstalk, avoid weird position dependent effects
- Prepare for experimental timing measurements
- Make experimental measurements of light collectors illuminated by Cerenkov light, loaned Auger tank