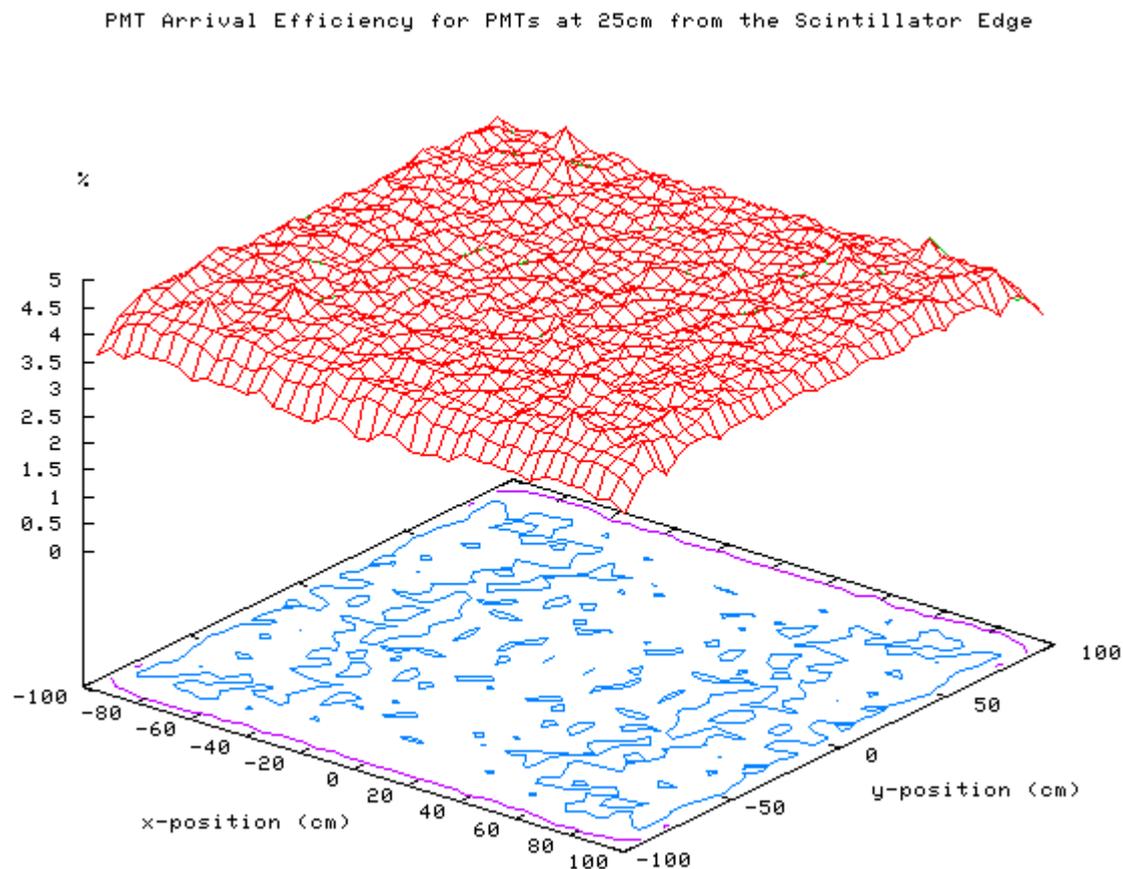


Preradiator Simulation with Geant4

December 1, 2004

- Simulation of the entire 2m by 2m scintillator slab using 125MeV e-.
- Due to the size of the scintillator and the number of objects (fibers, claddings, et cetera) being simulated the run time per event is large.
- This report represents the simulation of 4000 e-.
- Due to symmetry relationships, only one quarter of the scintillator was illuminated with Geant4 and then the other three quarters were “mirrored” during post-processing. The graphs in this report were generated using the post-processed 16,000 e-.



Geometry

- 2m by 2m by 8mm scintillator
- Scintillator is coated with a reflective paint on all sides
- 192 round fibers, each with a diameter of 1.0mm, are spaced 1.05cm apart
- The fibers extend 100cm past the ends of the scintillator
- At the end of each fiber is a “PMT”
- A second set of “pseudo-PMTs” were placed at 25cm past the ends of the scintillator to simulate the effect of having the PMTs at that location.
- The best available data on the titanium dioxide paint, BC404 scintillator, BCF-99 wavelength shifting fibers, and FEU-115M fibers was used

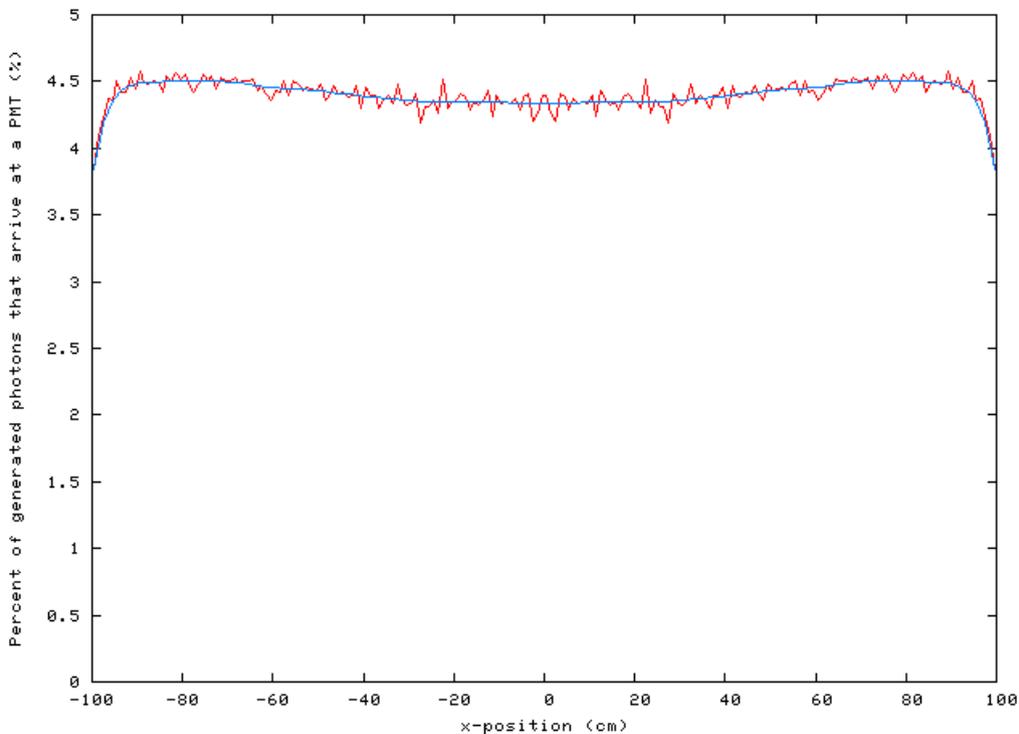
PMTs at 25cm from the Scintillator Edge

Photon Arrival Efficiency

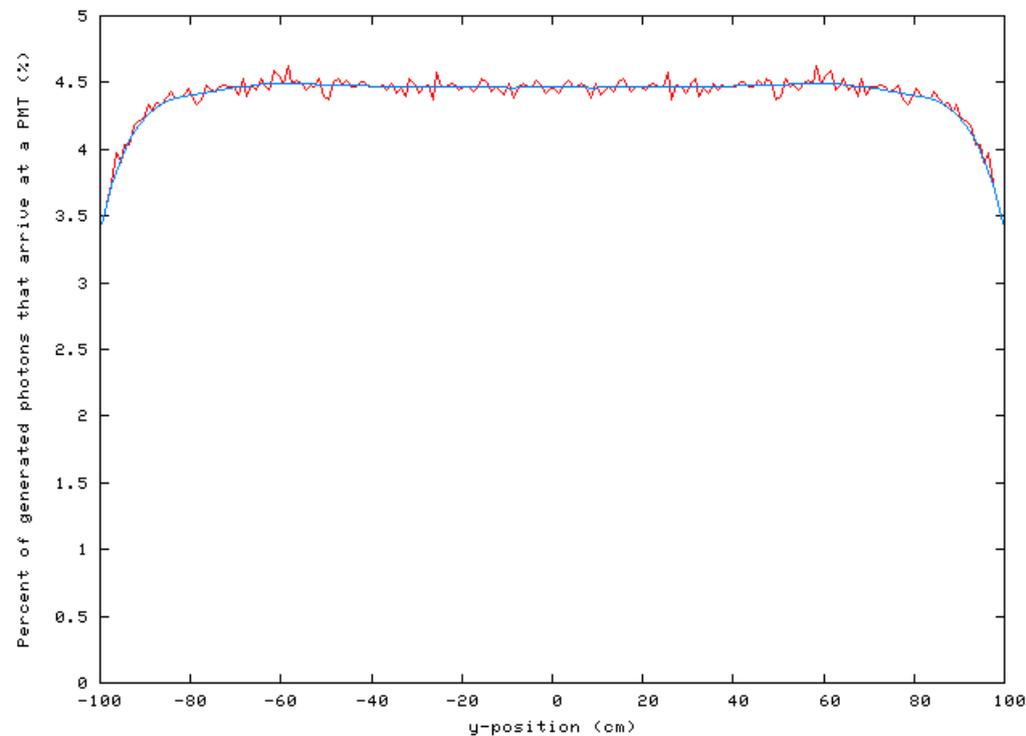
Average Efficiency: 4.24%

Average Number of Detected Photons: 421/event

PMT Arrival Efficiency for PMTs at 25cm from the Scintillator Edge



PMT Arrival Efficiency for PMTs at 25cm from the Scintillator Edge



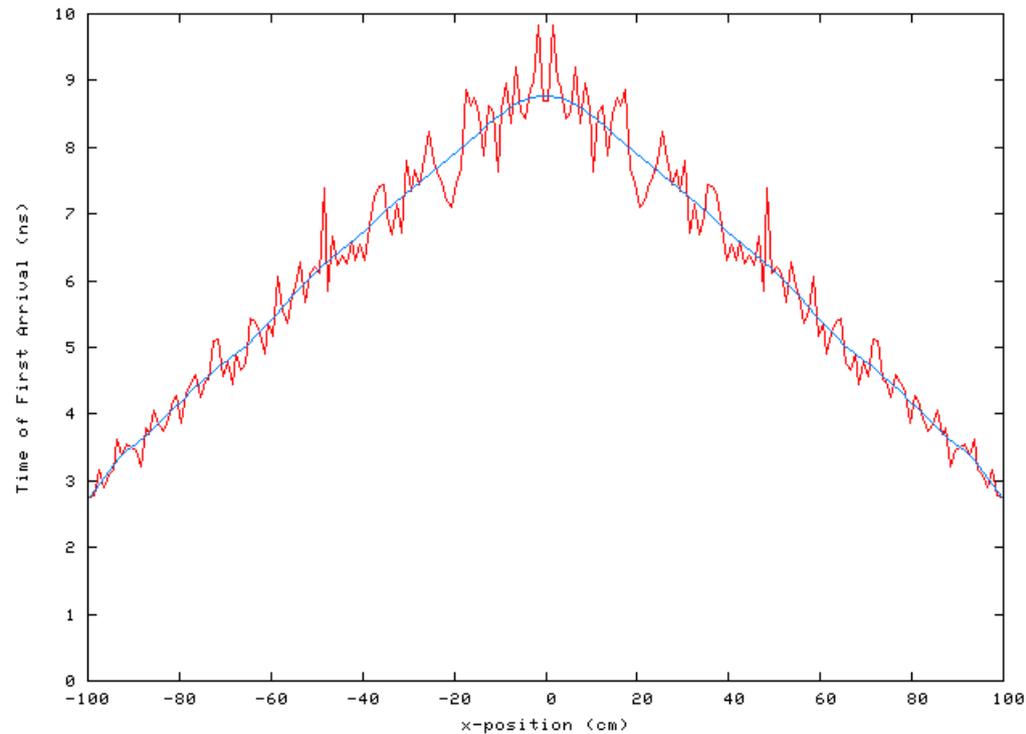
PMTs at 25cm from the Scintillator Edge

Timing Information

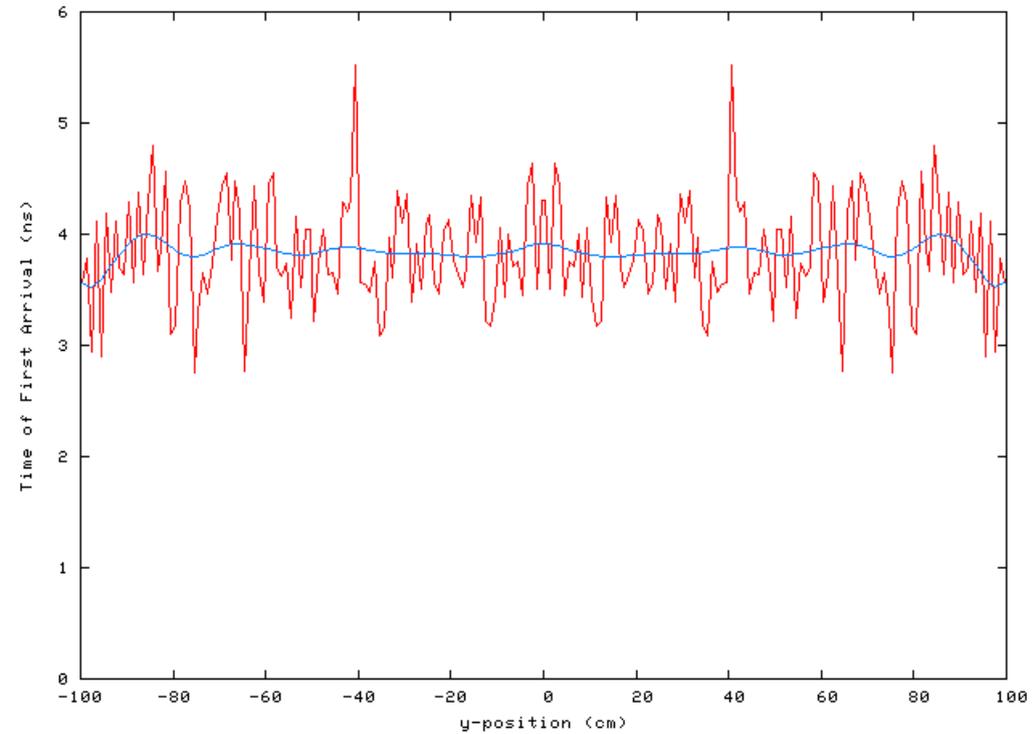
Average Arrival Time: 19.9ns

Percent of Photons Arriving After 40ns: 3.45%

Time of First Arrival for PMTs at 25cm from the Scintillator Edge



Time of First Arrival for PMTs at 25cm from the Scintillator Edge



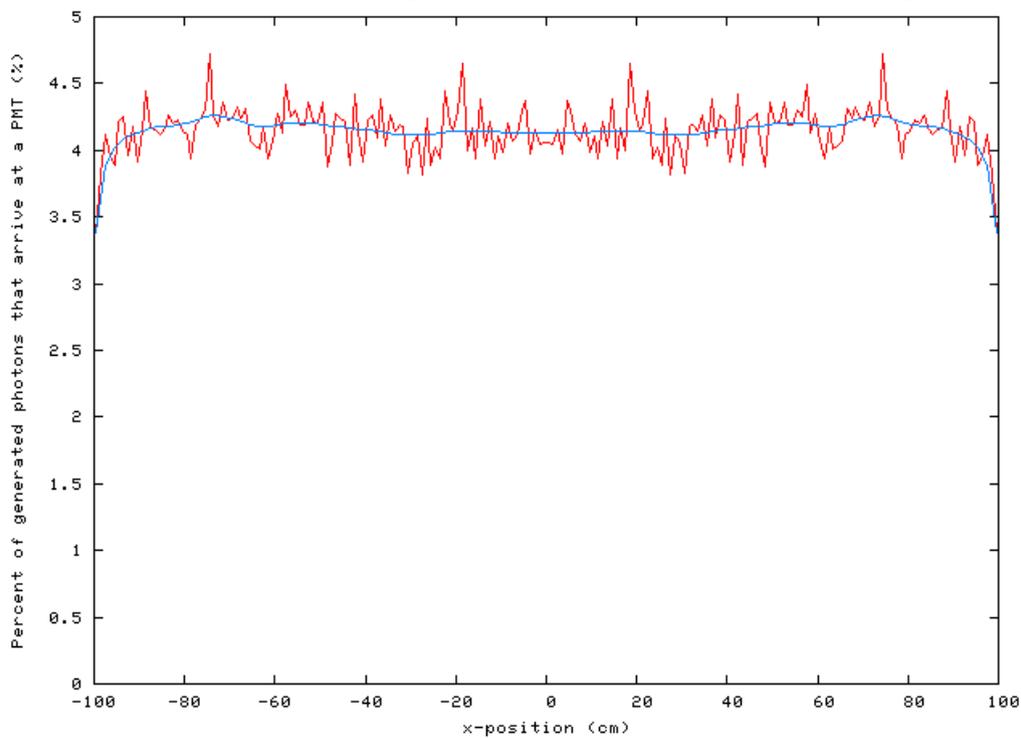
PMTs at 100cm from the Scintillator Edge

Photon Arrival Efficiency

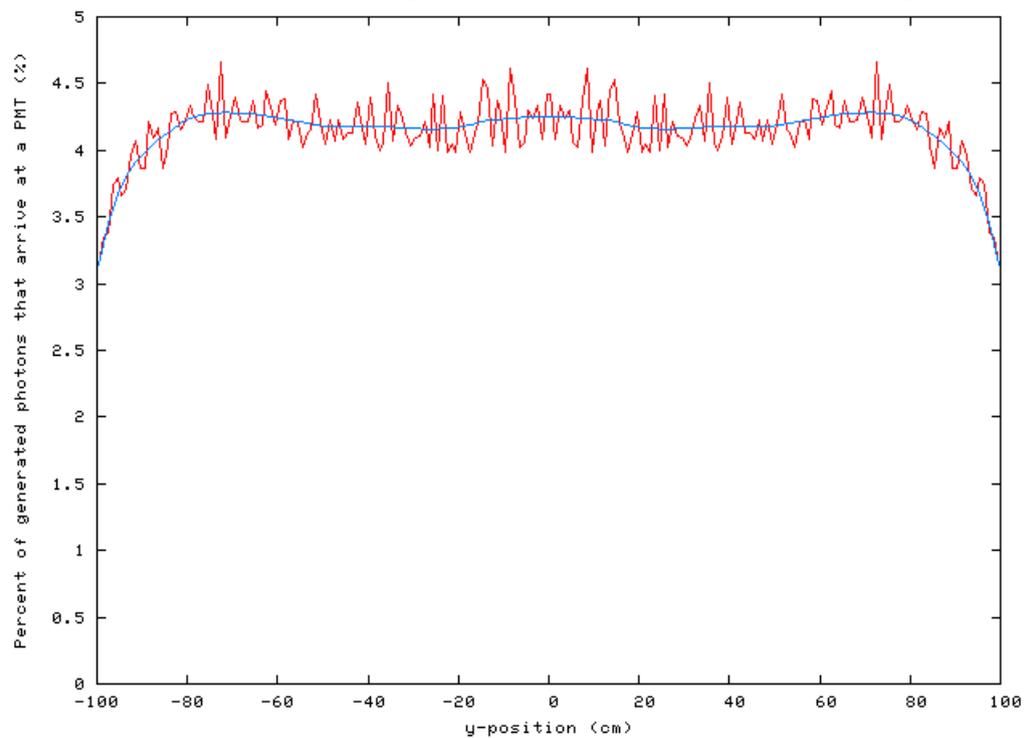
Average Efficiency: 3.99%

Average Number of Detected Photons: 397/event

PMT Arrival Efficiency for PMTs at 100cm from the Scintillator Edge



PMT Arrival Efficiency for PMTs at 100cm from the Scintillator Edge



PMTs at 100cm from the Scintillator Edge

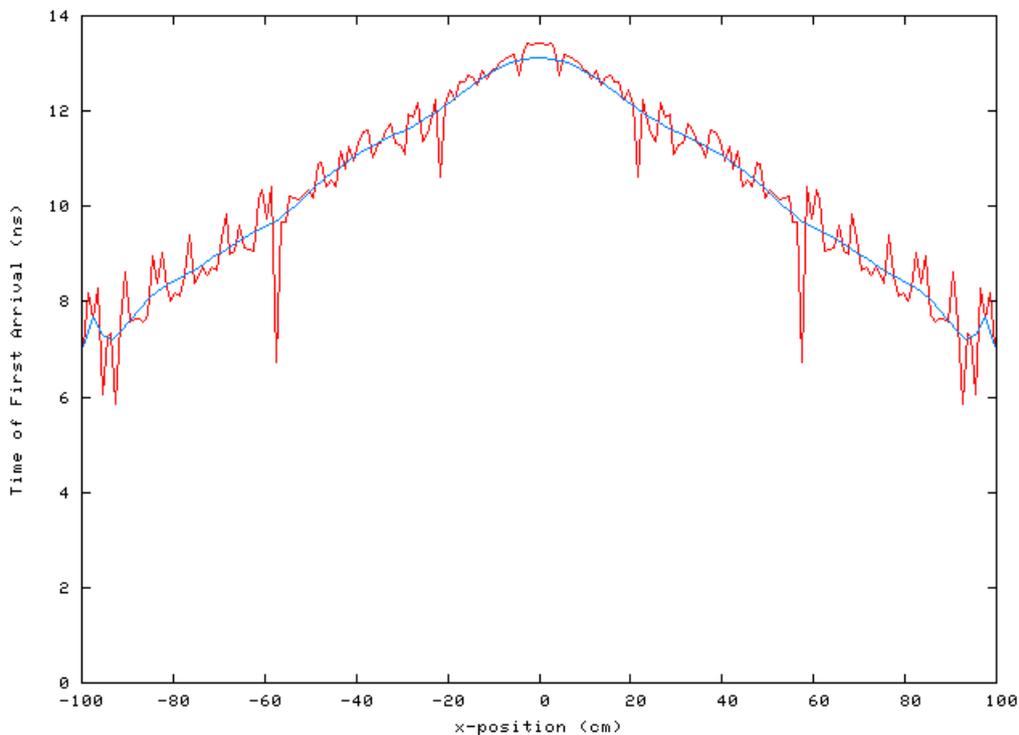
Timing Information

Average Arrival Time: 22.0ns

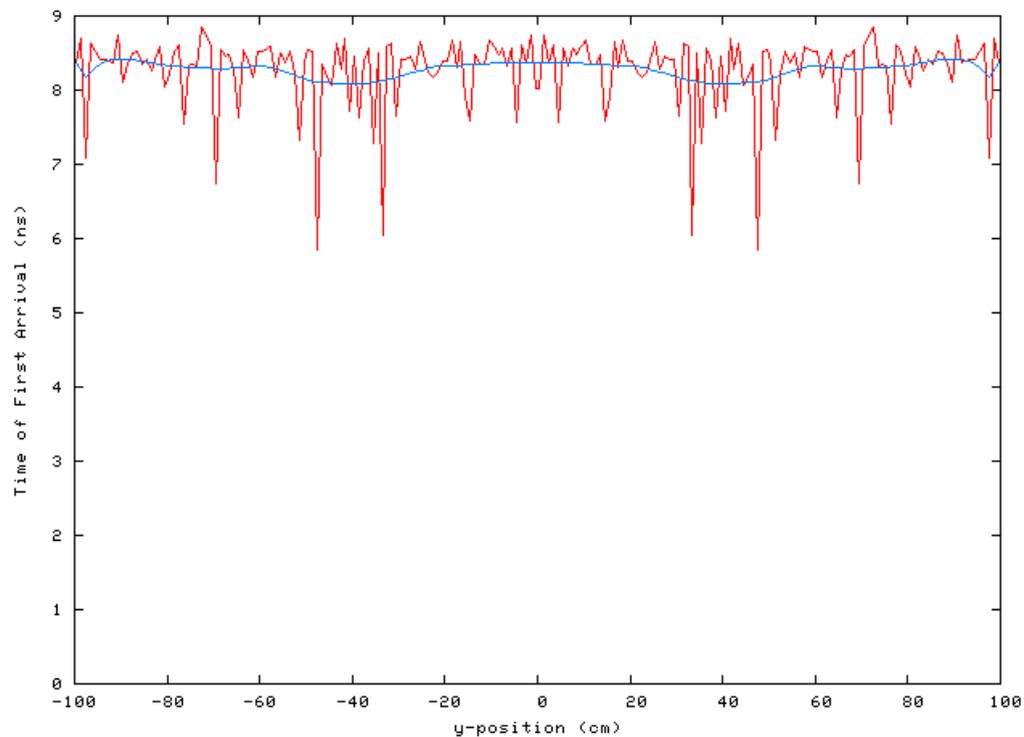
Percent of Photons Arriving After 40ns: 4.88%

Percent of Photons Arriving After 44ns: 3.30%

Time of First Arrival for PMTs at 100cm from the Scintillator Edge



Time of First Arrival for PMTs at 100cm from the Scintillator Edge



Square versus Round Fibers

- e- entered the scintillator at x=50.0cm y=50.0cm
- multiple events
- square fibers were 1mm on a side
- round fibers had a diameter of 1mm
- airspace holes had a diameter of 2mm and were round for both fiber shapes
- only data from the front set x=125.0cm of PMTs is shown

Square Fibers

Average Arrival Time: 15.1ns

Percent of Photons Arriving After 40ns: 2.10%

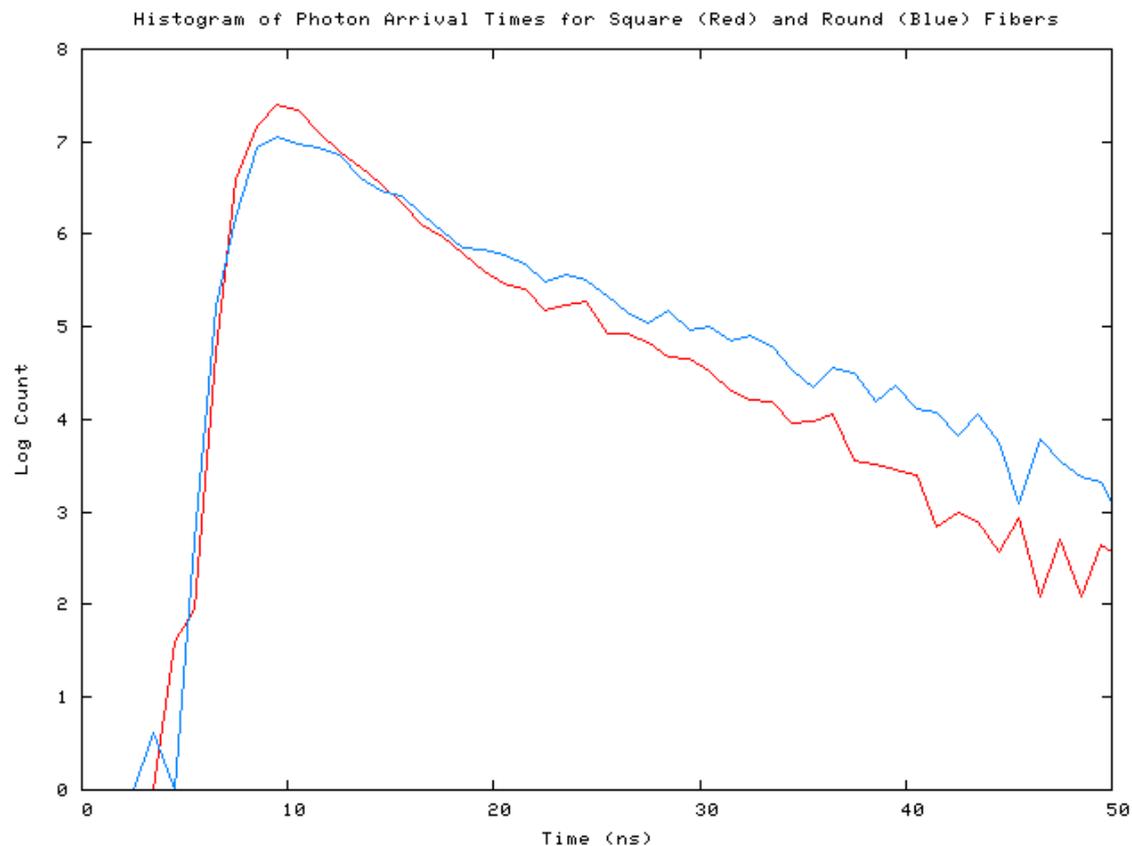
Average Number of Detected Photons: 295

Round Fibers

Average Arrival Time: 18.2ns

Percent of Photons Arriving After 40ns: 5.55%

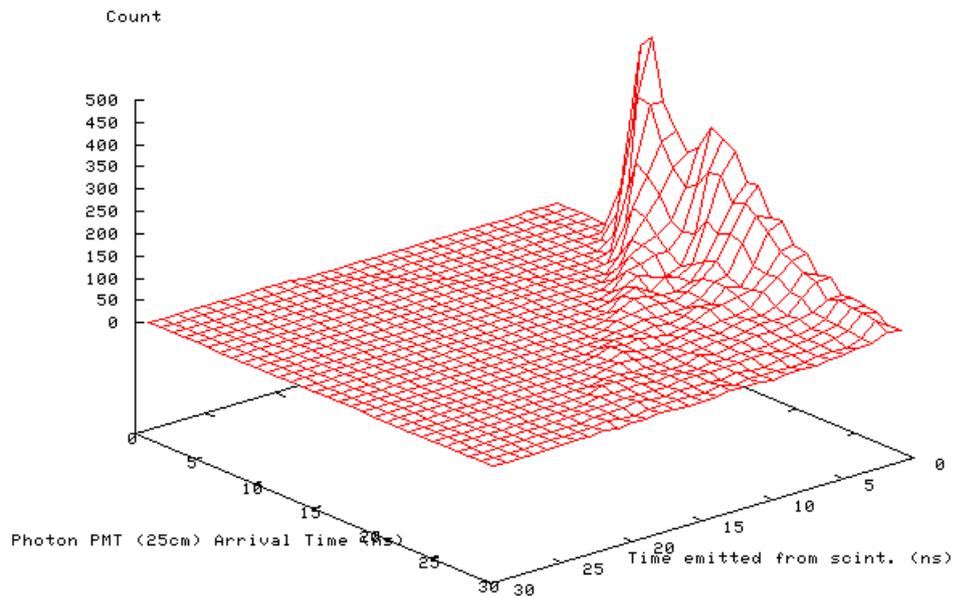
Average Number of Detected Photons: 641



Emission Time versus Arrival Time

- e- entered the scintillator at x=50.0cm y=50.0cm
- multiple events
- data from both the front set x=125.0cm and the back set x=-125.0cm of PMTs is shown, which gives rise to the two peaks that can be seen in the plots

Histogram of Photon Times with Round Fibers (1mm diameter)



Histogram of Photon Times with Square Fibers (1mm on a side)

