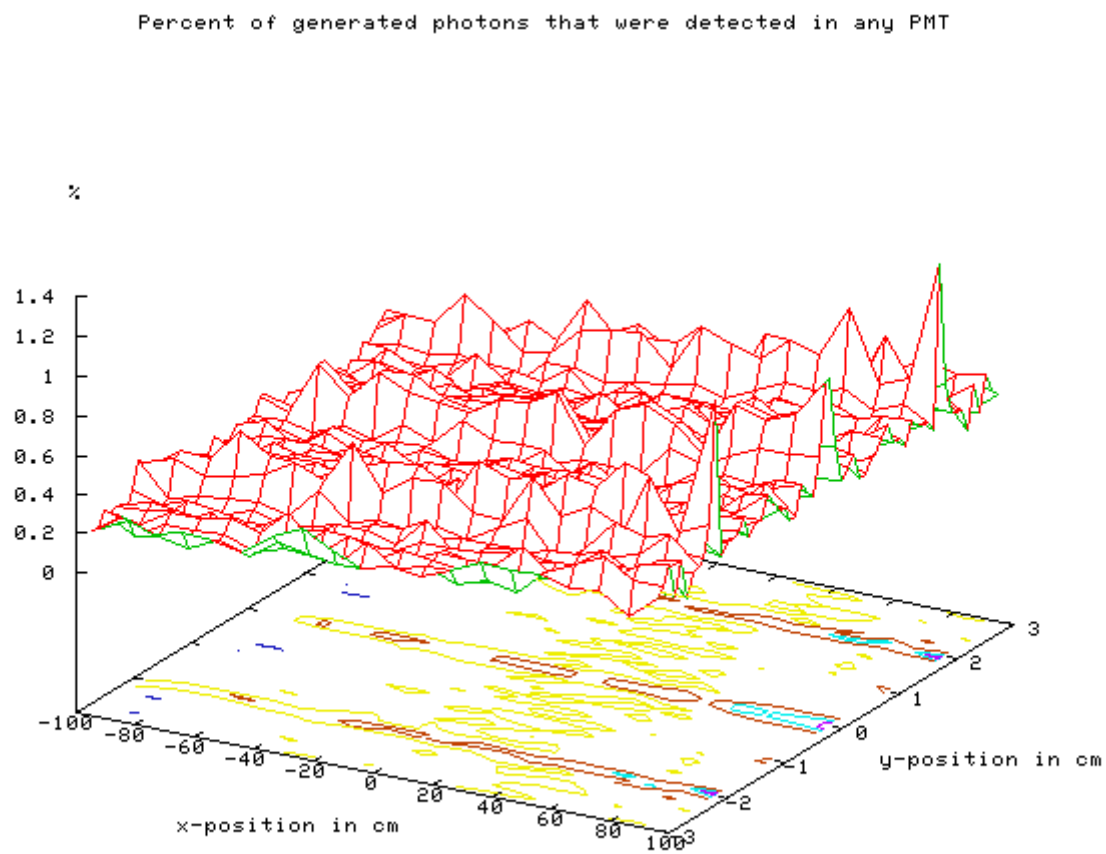
KOPIO Preradiator Simulation with Geant4

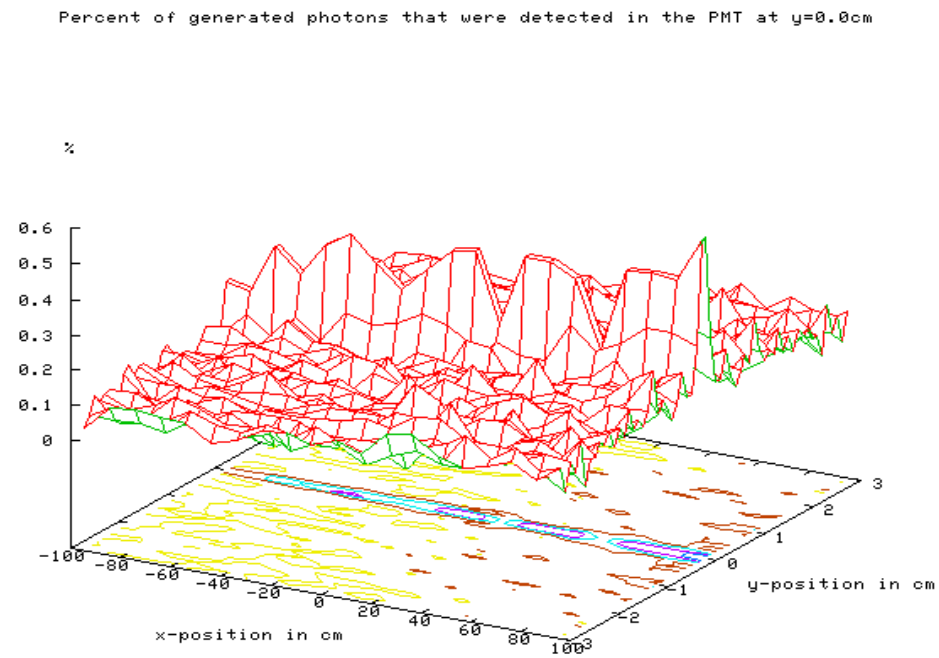
- The original motivation was the Geant4 "project05" code by JP Archambault and the Geant4 example "N06".
- Our code produced optical photons from e^- energy loss (approx. 1 photon per 100eV), each of which were tracked.
- Our Geant4 code dumps tracking information to an output file where it is post-processed.
- The plots in this report are the result of the simulation of 20,000 125MeV e^-.
- Scintillator strip, with no reflective coating, x=2.0m,y=6.0cm,z=0.8cm, with the origin at the center.
- Three square air grooves of 1mm by 1mm run the full length of the scintillator. They are placed at y=-2.0cm, y=0.0cm, and y=-2.0cm.
- In each groove is a WLS fiber, 1mm in diameter, with two cladding layers to improve efficiency.
- Fibers extend 25cm past the end of the scintillator where they are connected to three PMTs.

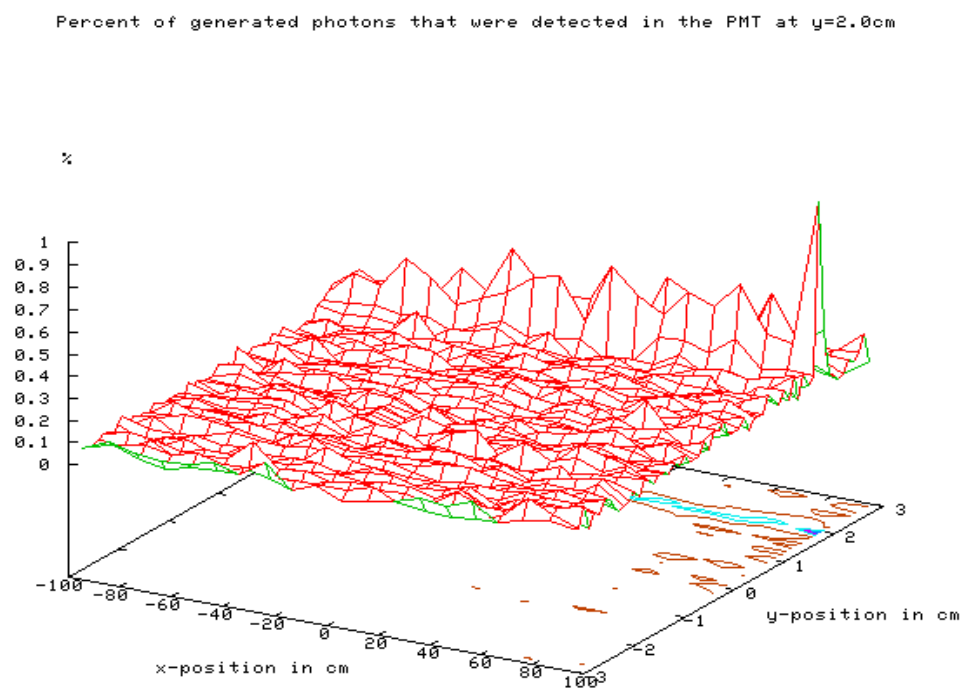
Percent of generated photons that are detected

- The following graphs show, for a given position, the percentage of generated photons that make it to the specified PMT.
- For all three PMTs (shown at the right), the fibers are visible as regions of increased detection.
- The average number of photons generated per event is 16022.
- For all three PMTs, the minimum number of photons detected per event is 18, the maximum is 315, and the average is 65.



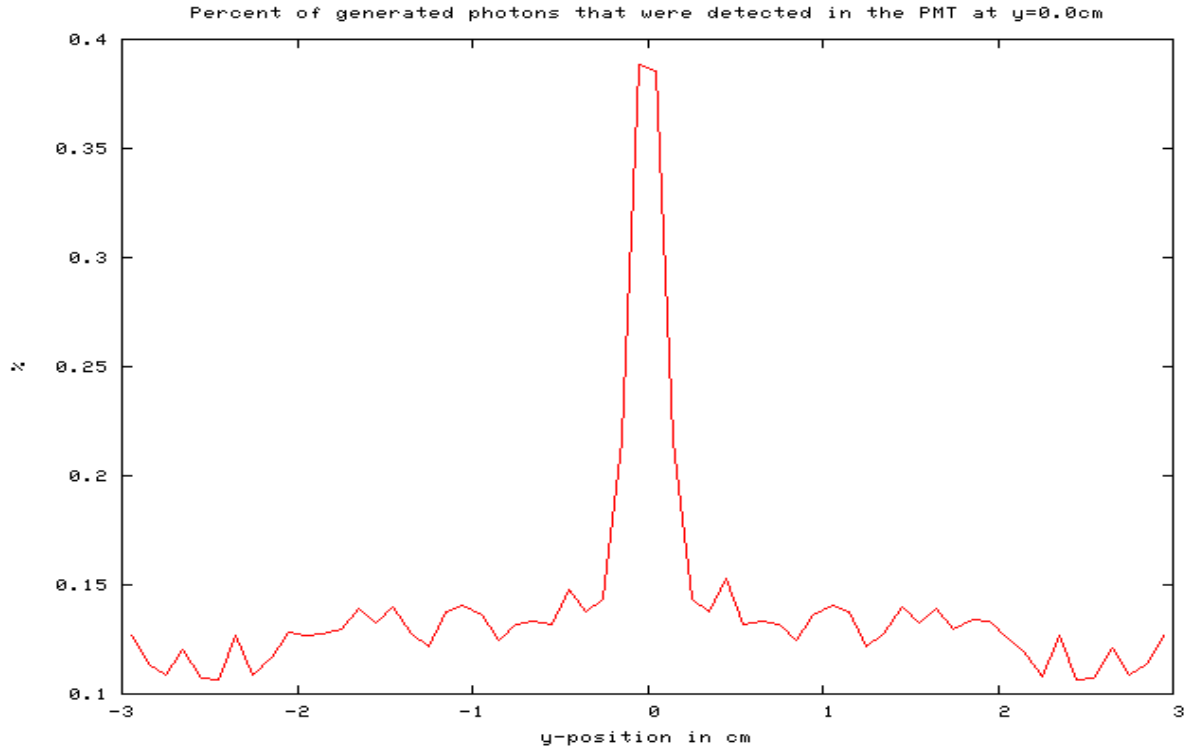
- For the centered PMT (top graph) and an off-center PMT (bottom graph) the fibers connected to the other PMTs are not detectable.
- The average number of photons generated per event is 16022.
- For the centered PMT (top graph), the minimum number of photons detected per event is 3, the maximum is 166, and the average is 22.
- For the off-center PMT (bottom graph), the minimum number of photons detected per event is 3, the maximum is 184, and the average is 21.

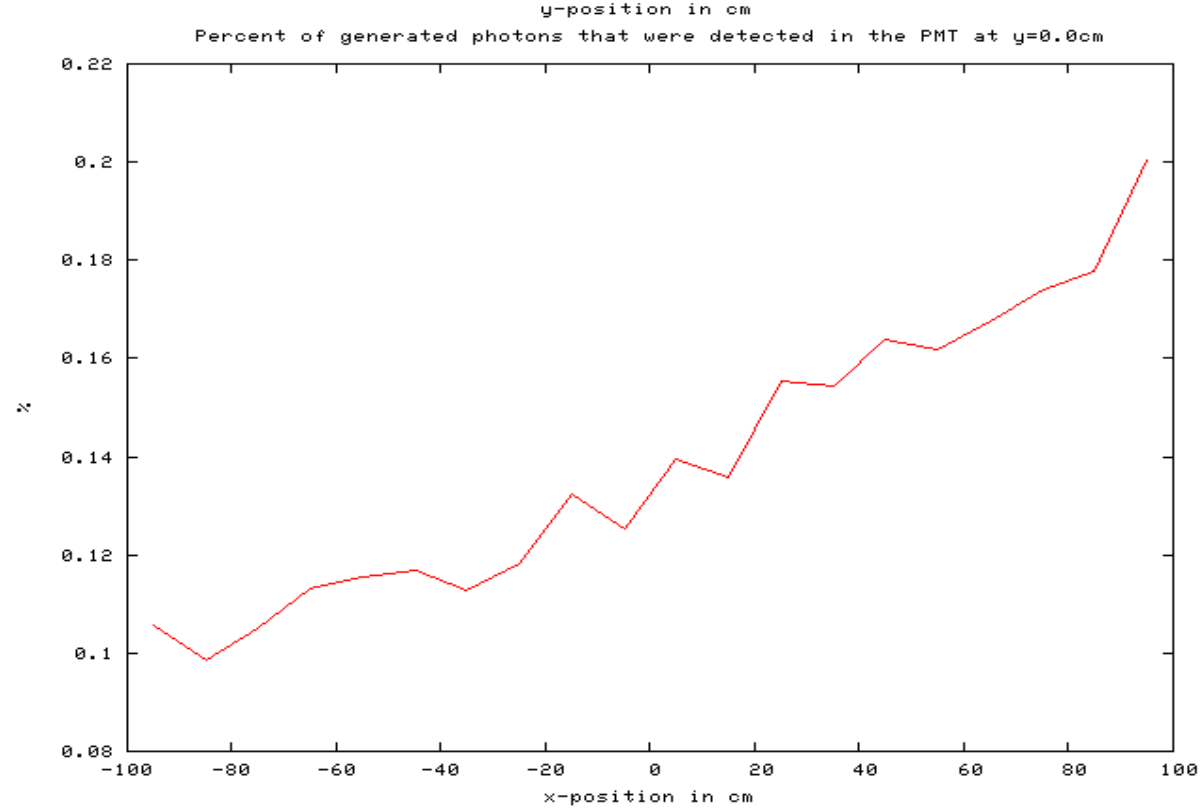




- For the centered PMT, looking across the y-direction, the percent of detected photons spikes sharply near the fiber and falls off gradually with distance from the fiber.

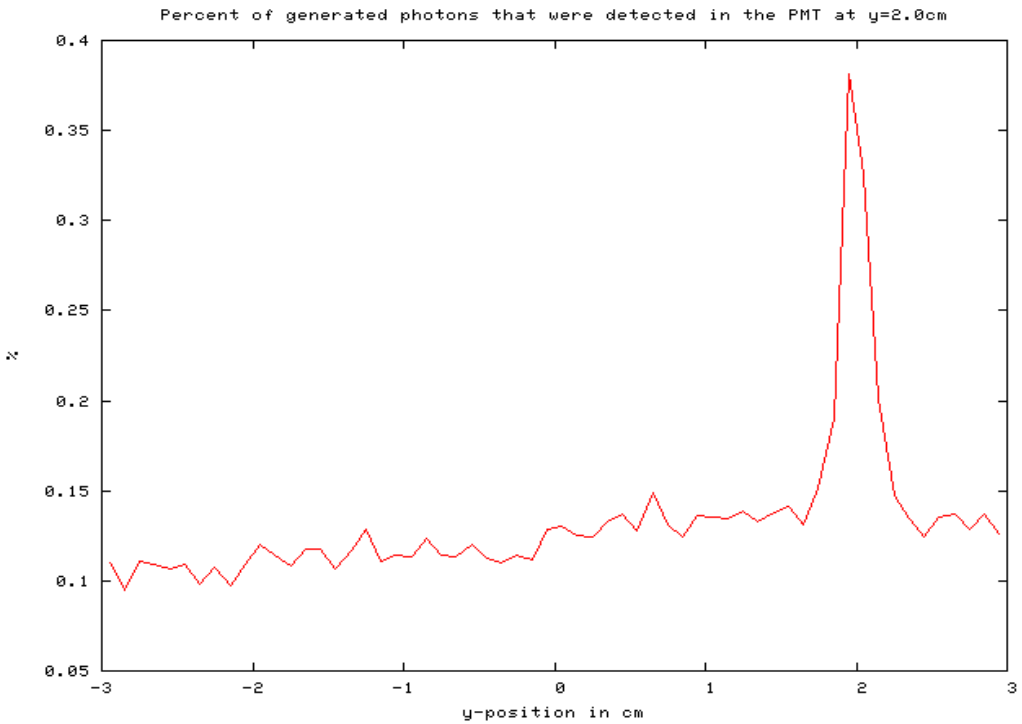
- Looking across the x-direction, the percent decreases gradually with distance from the PMT.

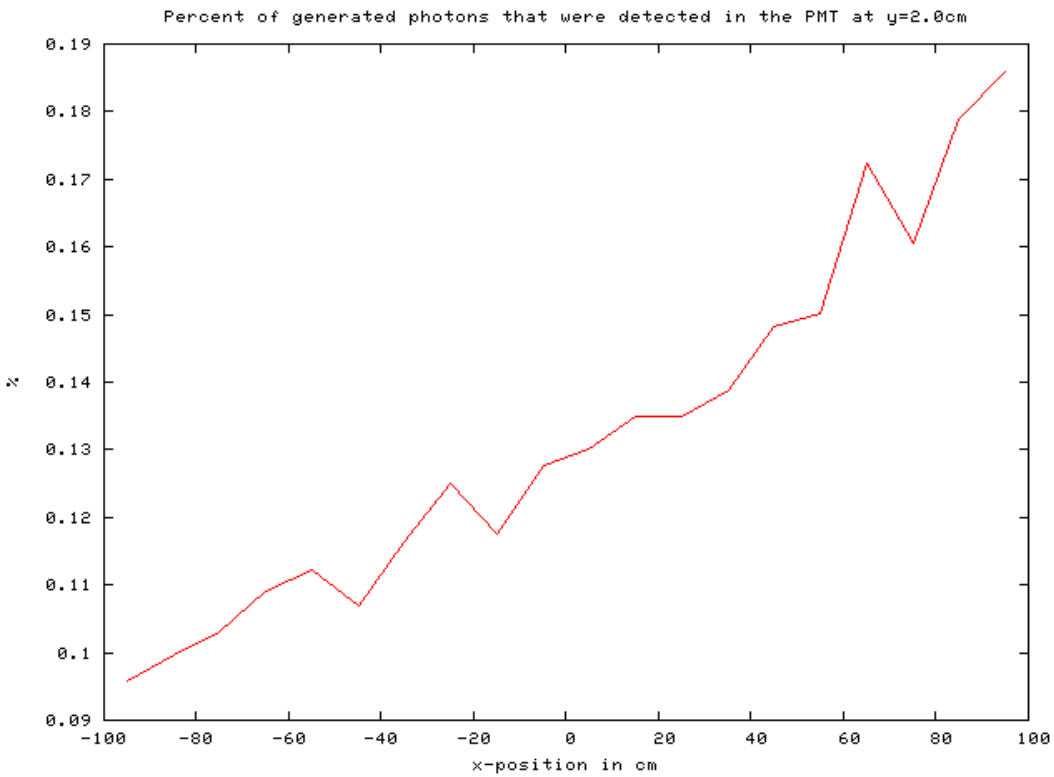




- For the off-center PMT, looking across the y-direction, the percent of detected photons spikes sharply near the fiber and falls off gradually with distance from the fiber.

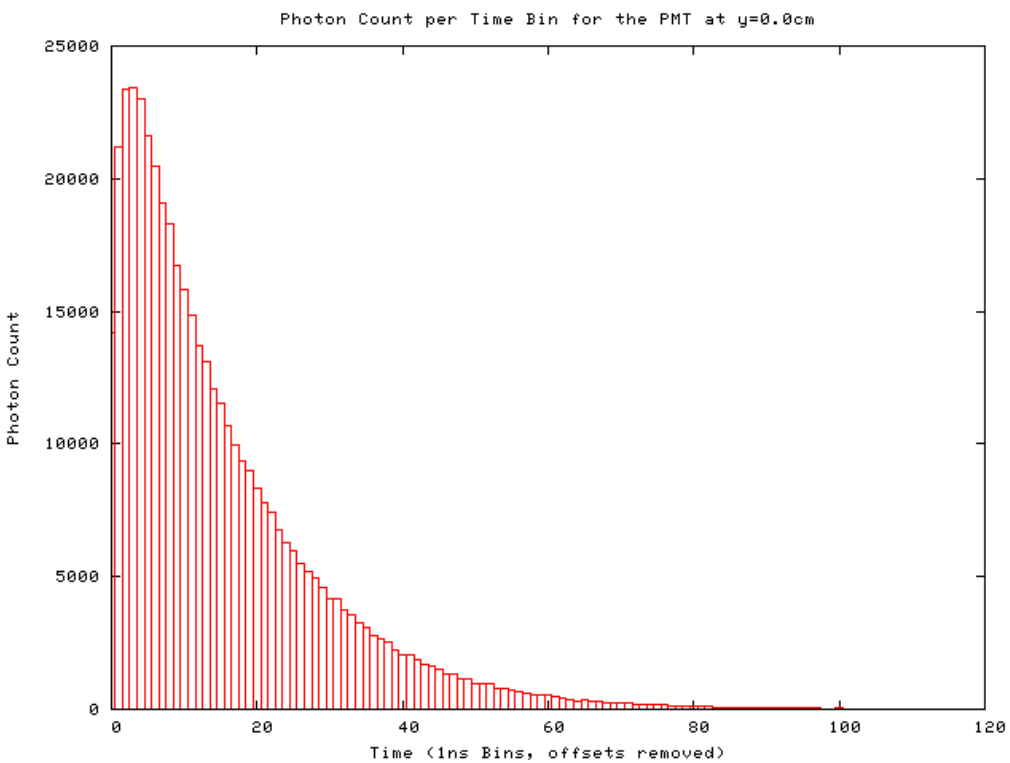
- Looking across the x-direction, the percent decreases gradually with distance from the PMT.

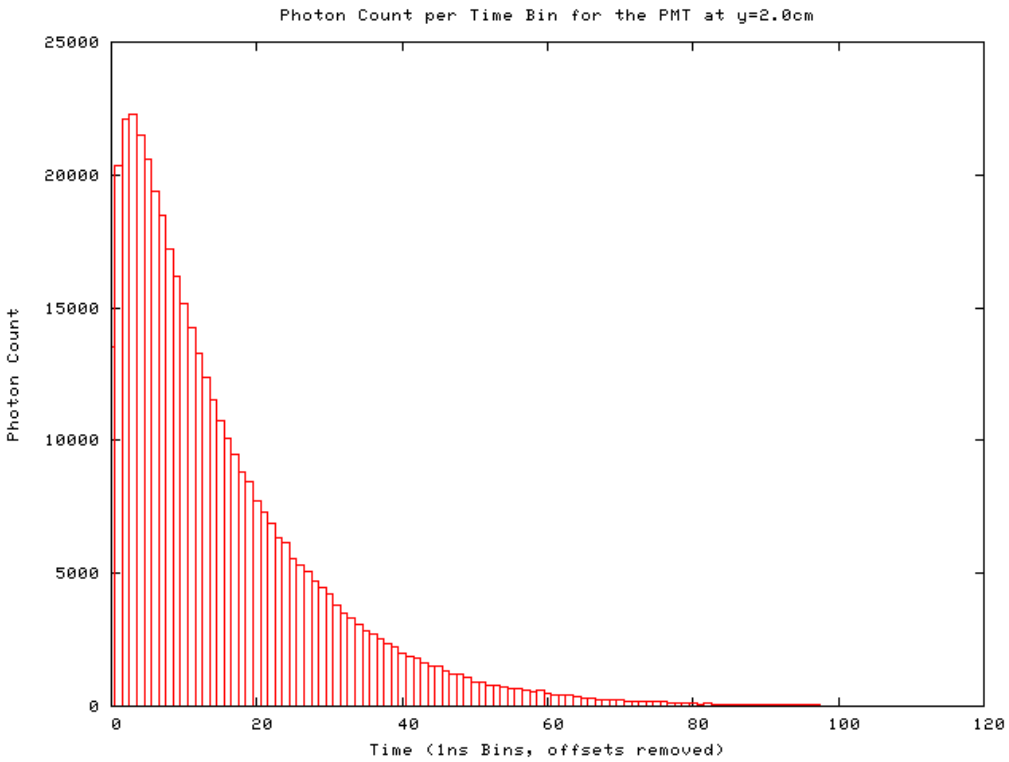




Histograms of Arrival Times at the PMTs

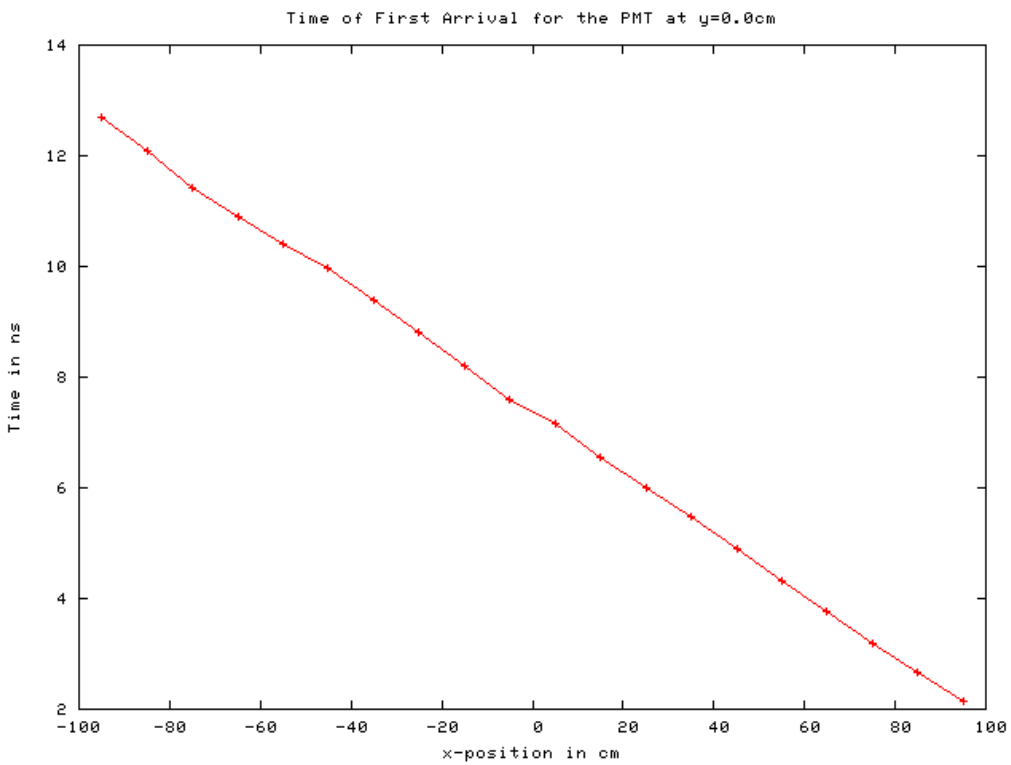
- For each event, the histogram was generated. Then the time from the beginning of the event to the time the first photon arrived was removed such that the first photon in all of the histograms arrived at time=0. The counts for each bin were summed over all of the histograms.
- The histogram for the centered PMT is virtually indistinguishable in shape from that for the off-center PMT.

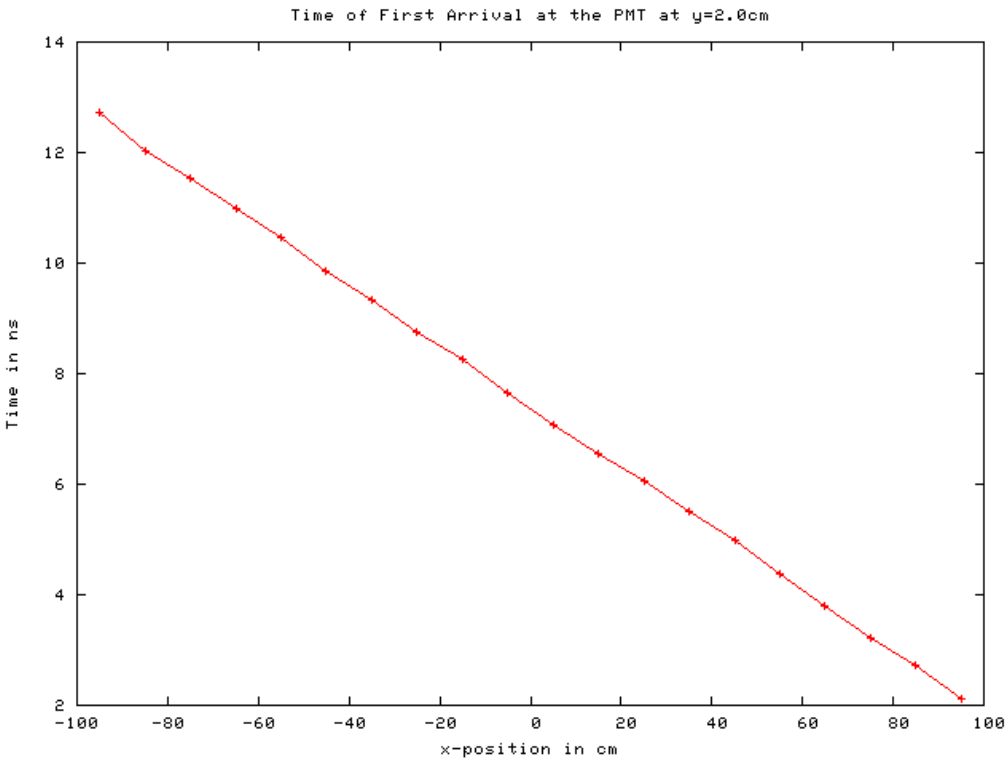


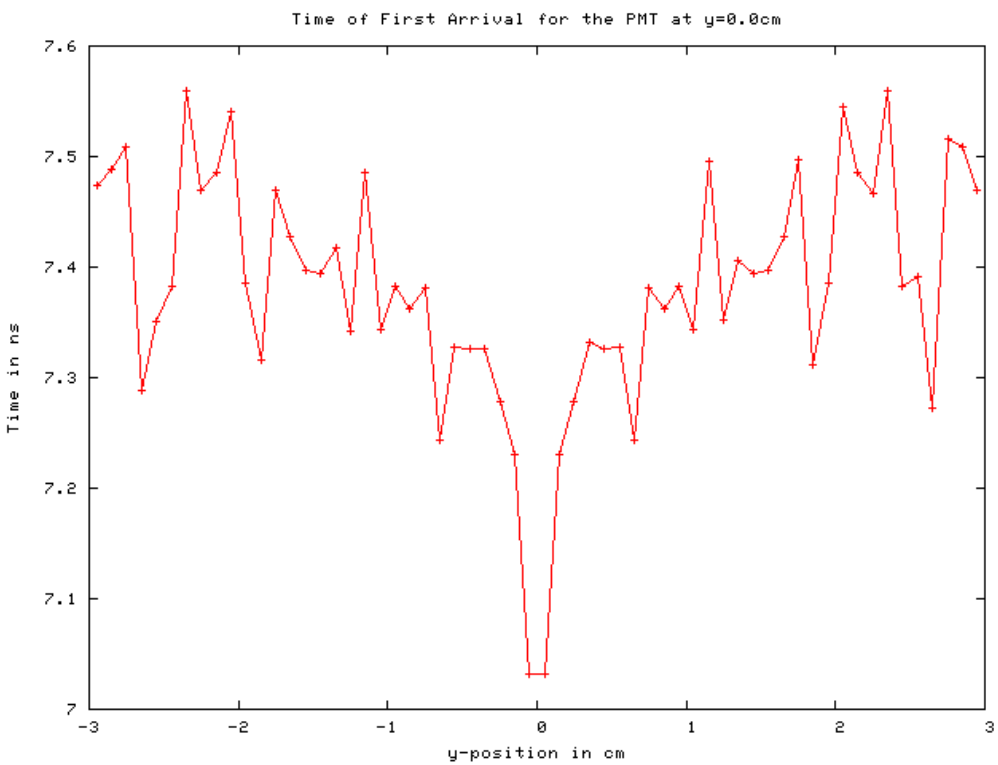
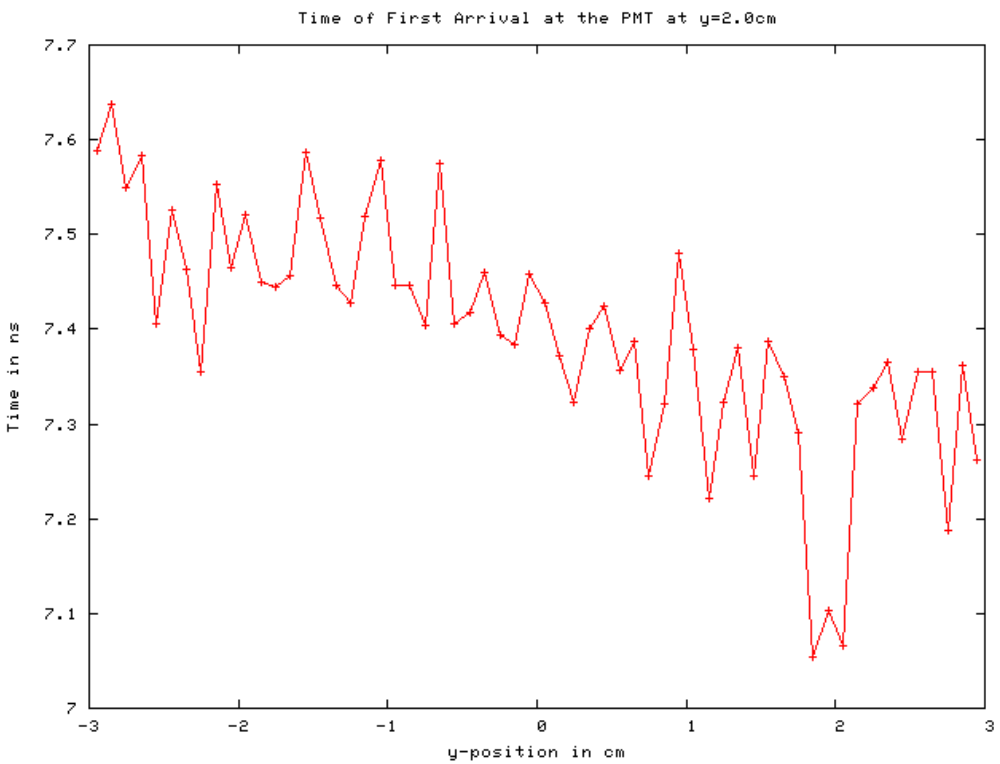


Time of First Arrival in the x-direction

- These graphs give the time of the first arrival of a photon at the PMT with respect to the x-position of the energy deposit, averaged over all y-positions.
- The time of first arrival is linearly dependent on distance from the PMT.





Time of First Arrival in the y-direction

- These graphs give the time of the first arrival of a photon at the PMT with respect to the y-position of the energy deposit, averaged over all x-positions.
- The time of the first arrival is weakly dependent on distance from the fiber.