

# KOPIO Preradiator Simulation with KOptics

# Geometry Used

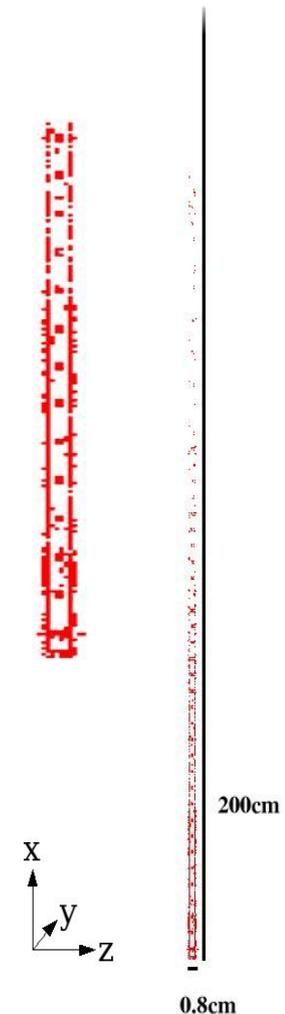
- Scintillator:  $x=200\text{cm}$ ,  $y=200\text{cm}$ ,  $z=0.8\text{cm}$
- Scintillator wrapped with Tyvek
- Wave-shifting fibers: 1mm diameter, spaced 1cm center-to-center, parallel to the y-axis, extending from one end of the scintillator to 50cm past the other.
- Fiber cladding: 0.1mm thick
- PMT placed at the end of the fiber that extends from the scintillator.

# Materials

- Bicron optical fibers and Bicron fiber cladding
- Plastic Scintillator (PilotB)
- Quartz PMT window

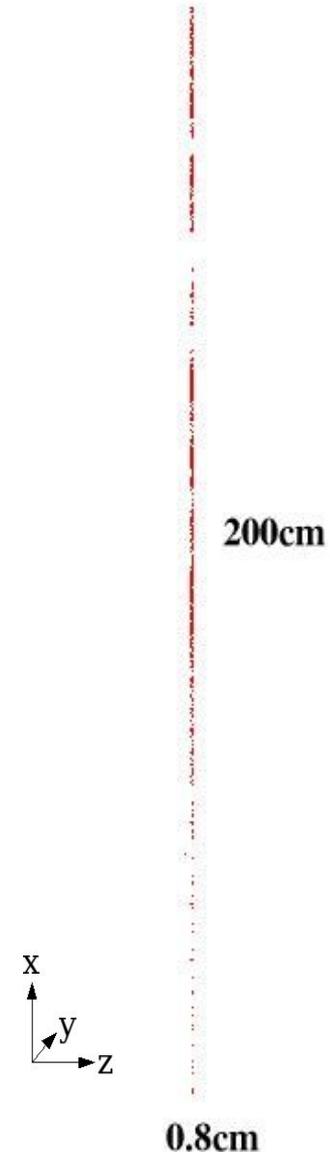
# Fixed starting position, 200 fibers

- Photons emitted from ( $x=2\text{cm}$ ,  $y=20\text{cm}$ ,  $z=.2\text{cm}$ ).
- All 200 fibers were in place and 100 photons were simulated.
- This view shows points where intersections occurred (not necessarily start/stop points).
- Fibers (oriented along the  $y$ -axis) are seen edge on and appear as clusters inside of the box formed by the edge of the scintillator.
- Left image is a magnification of the bottom of the right image.



# Random Starting Positions, 200 fibers

- Uniformly random starting positions over the full volume of the scintillator.
- All 200 fibers were in place and 100 photons were simulated.
- This view shows points where photons traveled through.
- The points are now more evenly distributed throughout the scintillator. Variations in point density are likely due to the small number of events run.

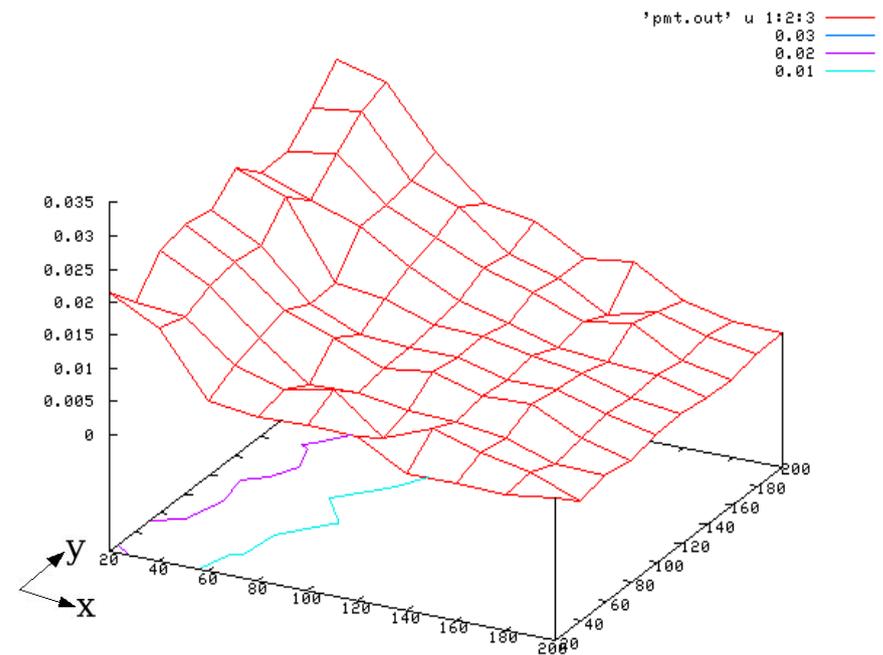


# Random Starting Positions, Single Fiber

- Random starting positions over the full volume of the scintillator.
- All fibers, except one at 25cm from the left edge of the scintillator, were removed to improve processing time.
- Several thousand photons were simulated.
- Since KOptics handles the photons from energy deposit to arrival at the PMT, a post-processor was used to simulate the effects of the quantum efficiency of the PMT ( $\sim 20\%$ ) and to apply a Poisson distribution.

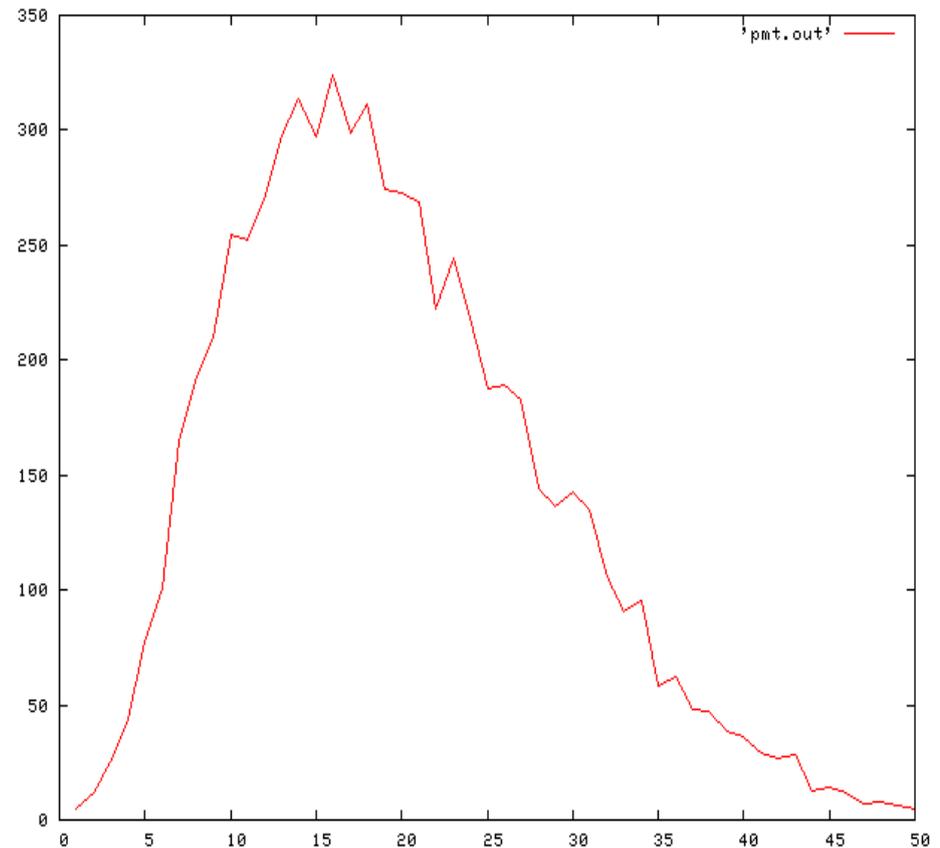
# Efficiencies

- Of the photons that make it to the PMT, the graph represents the percent of those generated at each location.
- The fiber is at  $x=25\text{cm}$  and the PMT is at  $y=250\text{cm}$  (past the back edge of the scintillator).



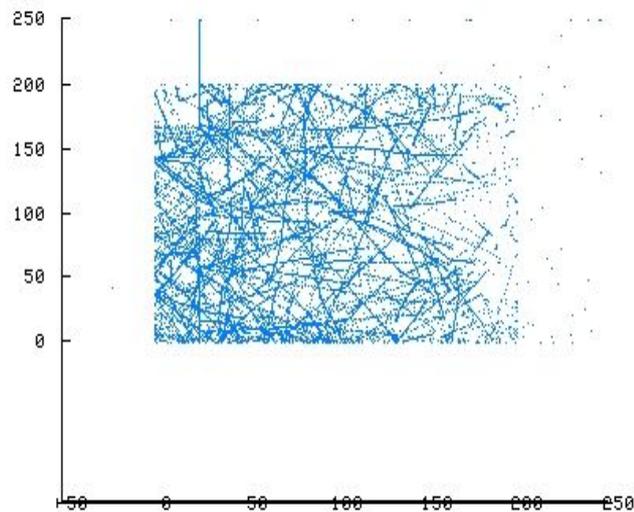
# Photons entering the PMT

- The number of photons entering the PMT each ns with 0ns being the time of energy deposit. A Poisson distribution was applied to “smear” the output resulting in a non-zero number at times close to zero.

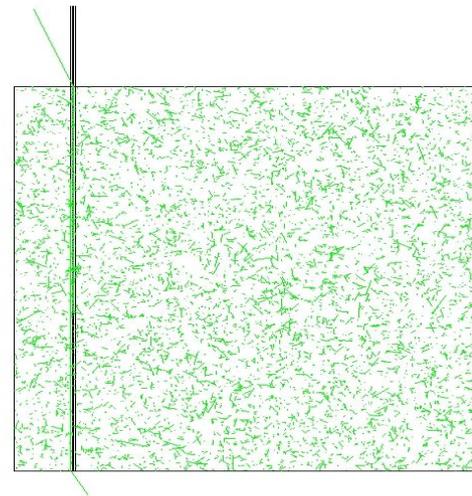


# KOptics versus Geant 4 (Archambault)

This comparison is only to show the visualization differences between KOptics and the Geant4 version. The geometries used are slightly different, however, note the points outside of the scintillator in KOptics, which indicate photons that were allowed to travel through the reflective wrapping.



• KOptics



• Geant4