PLUME Detector:

Geant4 Exploration 6

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Simulation Description

The beam is placed 5.0 cm from the quartz tablet at a random position and it is released at $90°$ from the detector. For this study, one hundred thousand events are displayed in order to perform an analysis of the detected photons and its positions at the detector window.

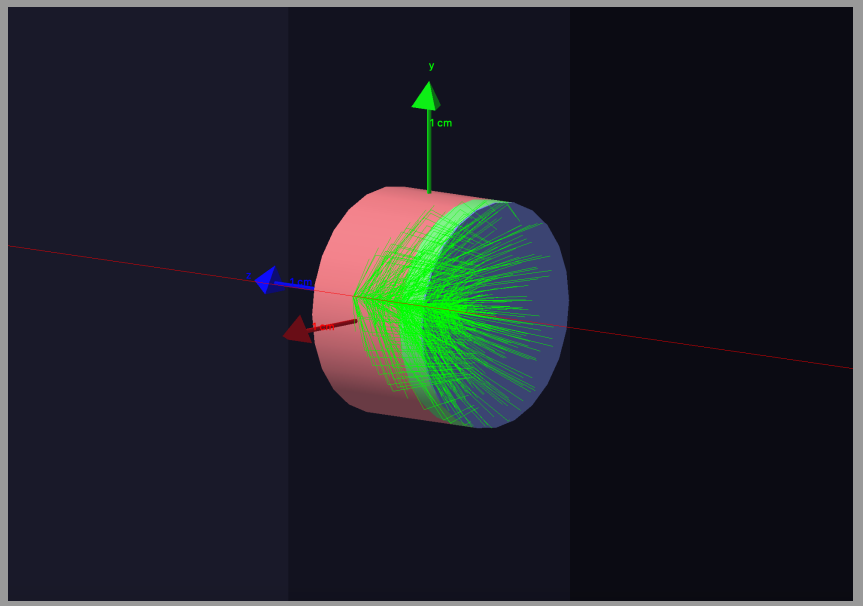

Figure 1: Perpendicular Beam in Single Module Simulation.

Detected Position Normalization

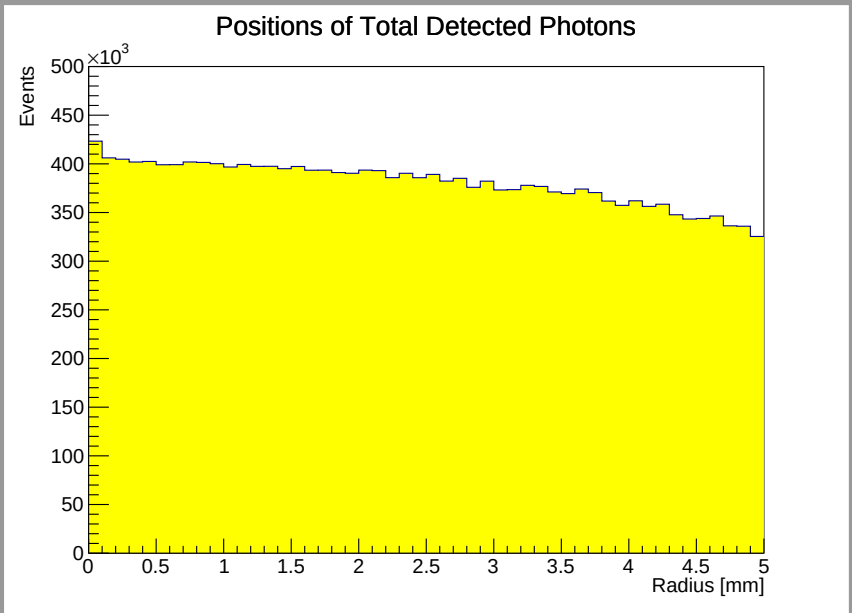

Figure 2: Normalized distribution of detected photons in dependence of entrance position.

Figure 2 illustrates the number of photons which hit a certain radius of the detector tablet. The histogram is normalized by a factor of $\frac{1}{R_b}$, where R_b corresponds to the magnitude of the center for each bin.

Total Photons Detected Position

For the following analysis, the module was divided in five different zones, all of which have the same area. In figure 3 is displayed the contour of each zone in a plot of the number of electrons which pass through the quartz tablet.
Each zone has the following radius range:

- $[0, 2.24)$
- $[2.24, 3.16)$
- $[3.16, 3.87)$
- $[3.87, 4.47)$
- $[4.47, 5]$

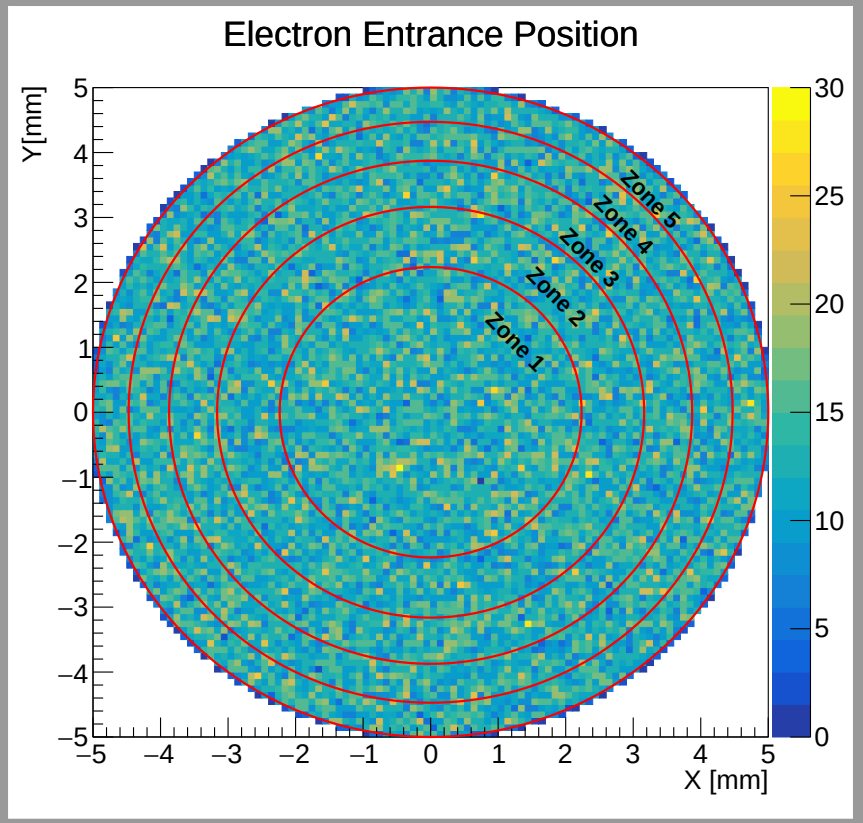

Figure 3: Position of electrons at the quartz tablet surface. The distinction of the zones is provided for the following analysis.

Total Photons Detected Position by Zones

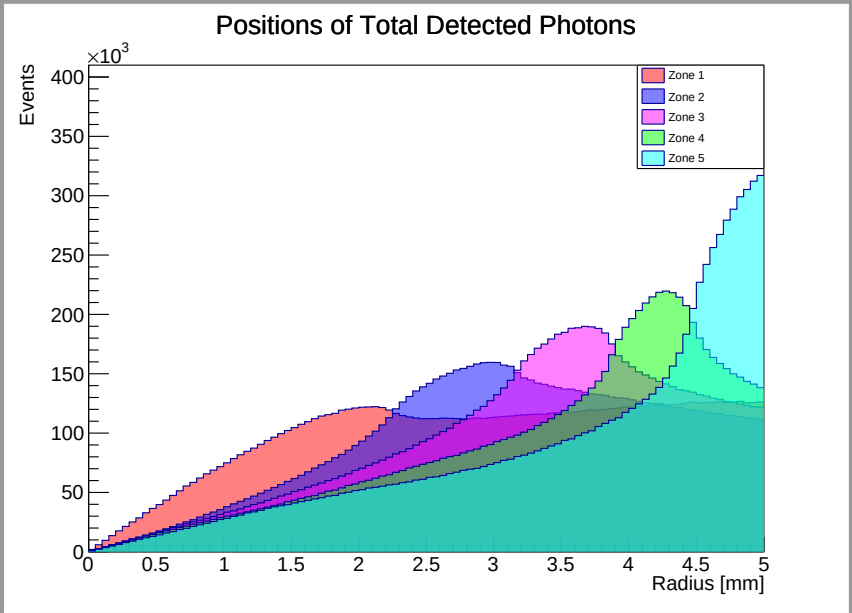

Figure 4: Distribution of positions of detected photons in dependence of the zone in which the electron hit the quartz tablet.

Figure 3 illustrates the number of photons which hit a certain radius of the detector tablet taking into account the entrance position of the electron at the quartz tablet. For each case, the peak is highly related to the border of the zone from the primary electron.

Total Photons Detection Position by Zones

As it was previously performed, figure 4 was normalized by a factor of $\frac{1}{R_b}$, where R_b corresponds to the magnitude of the center for each bin.

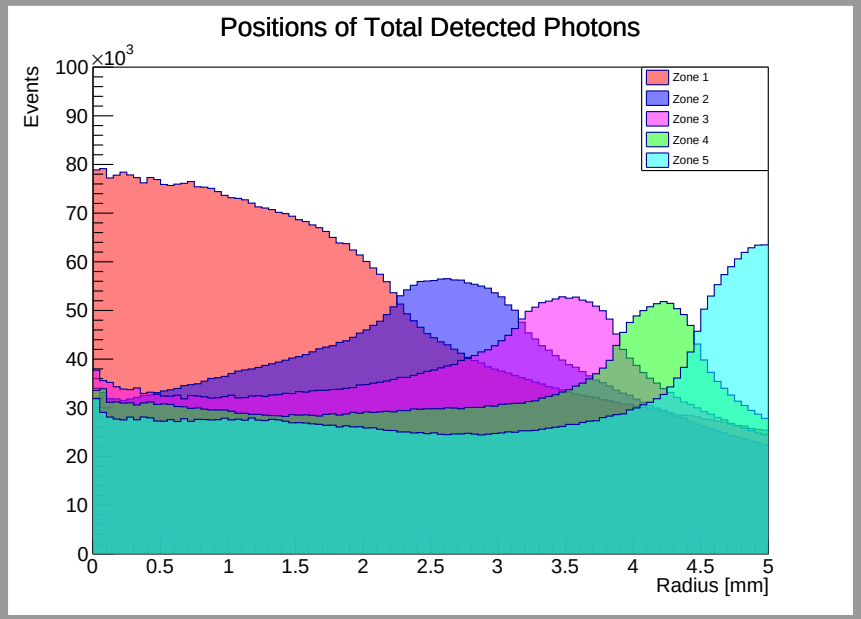

Figure 5: Normalized distribution of positions of detected photons in dependence of the zone in which the electron hit the quartz tablet.

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Random Angle Beam

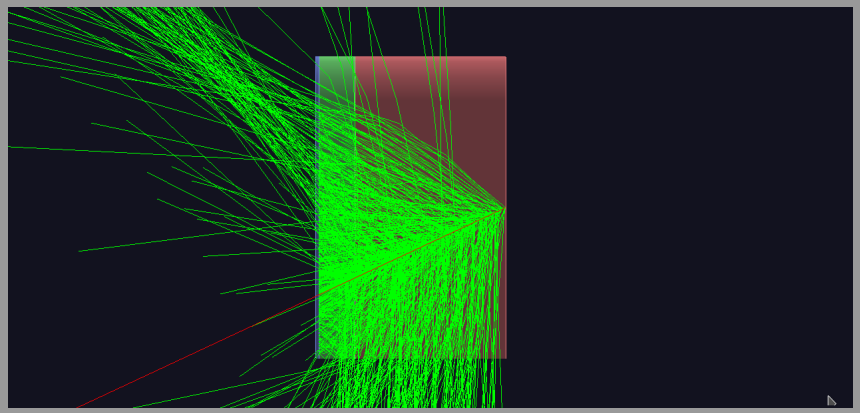

Figure 6: Beam starting at the beginning of the detector.

The primary particle is set at the beginning of the detector, and the momentum direction is configured so that the azimuthal angle varies from 0 to 60 degrees.

Normalization

For the normalization, we count the radius of the detector tablet in which the photon was detected. The bin increase in a factor of $\frac{1}{R_b}$, where R_b is the radius at the center of the bin.

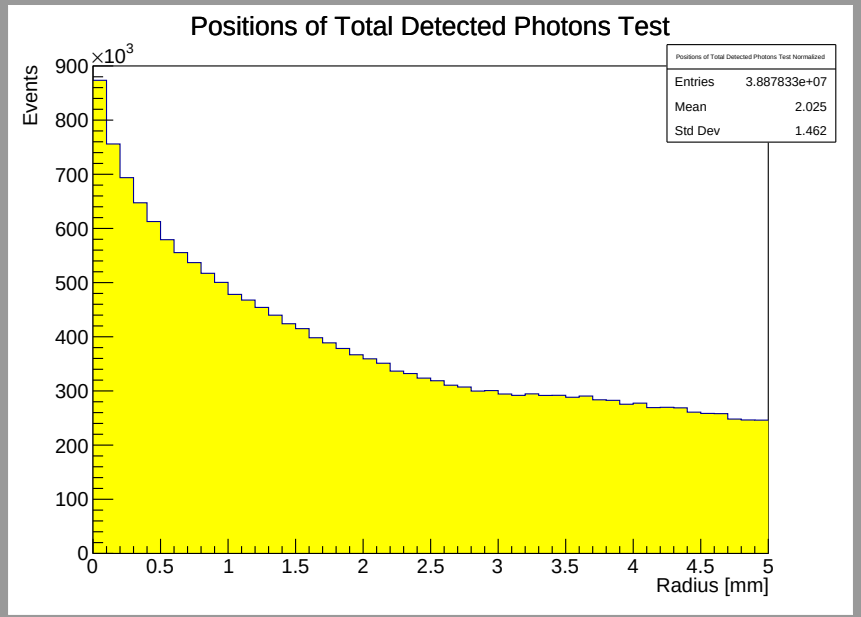

Figure 7: Number of detected photons vs radius, normalized.

Base Line Analysis

We considered a baseline in which the primary particle is set at the beginning of the detector, hitting the detector perpendicularly. The we get 5 groups of data according the following azimuthal angle configuration.

1. $[0, 12)$
2. $[12, 24)$
3. $[24, 36)$
4. $[36, 48)$
5. $[48, 60)$

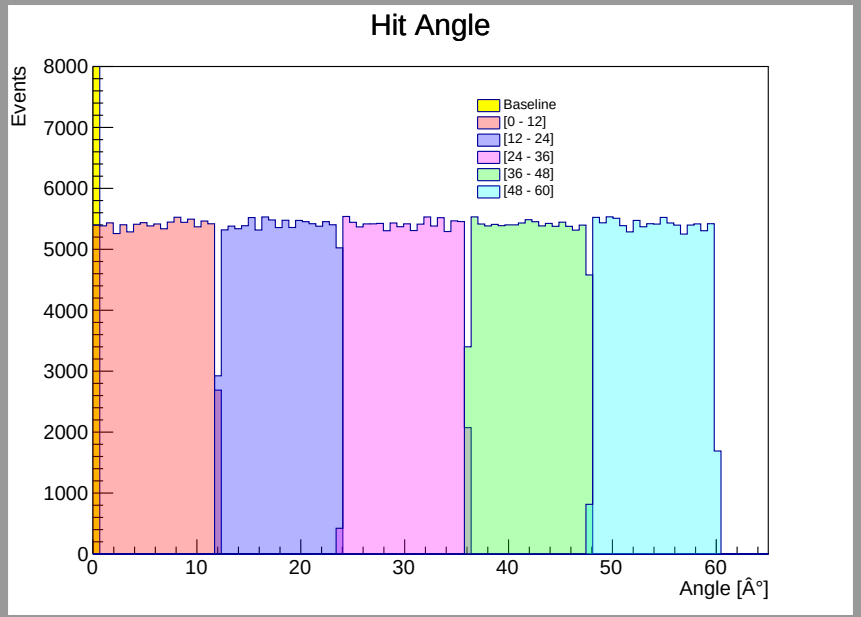

Figure 8: Number of detected photons vs radius, normalized.

Photons detection

This is the count of all the photons that reach the detector tablet (the last cylinder). When the hit angle increase, the peak move to the left.

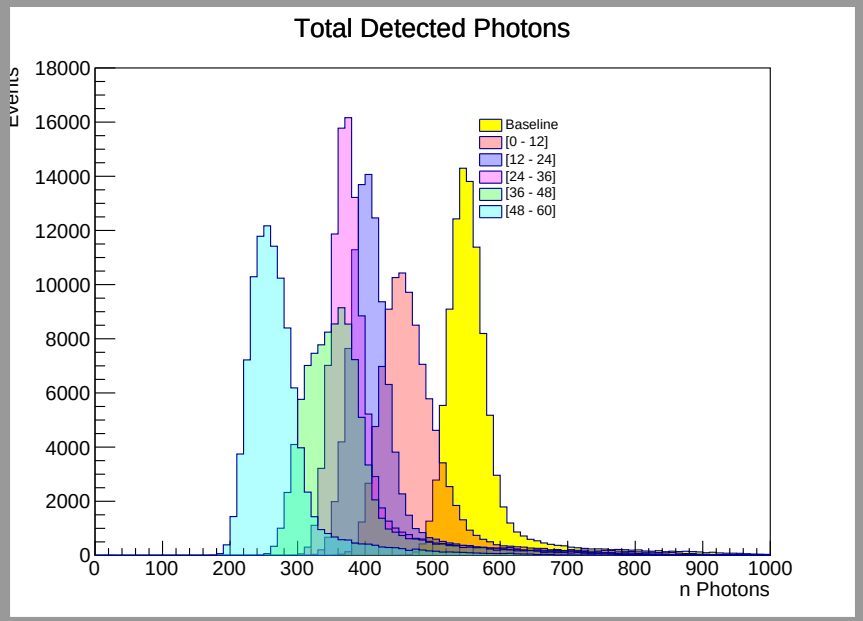

Figure 9: Number of detected photons vs radius, normalized.

Photons detection position

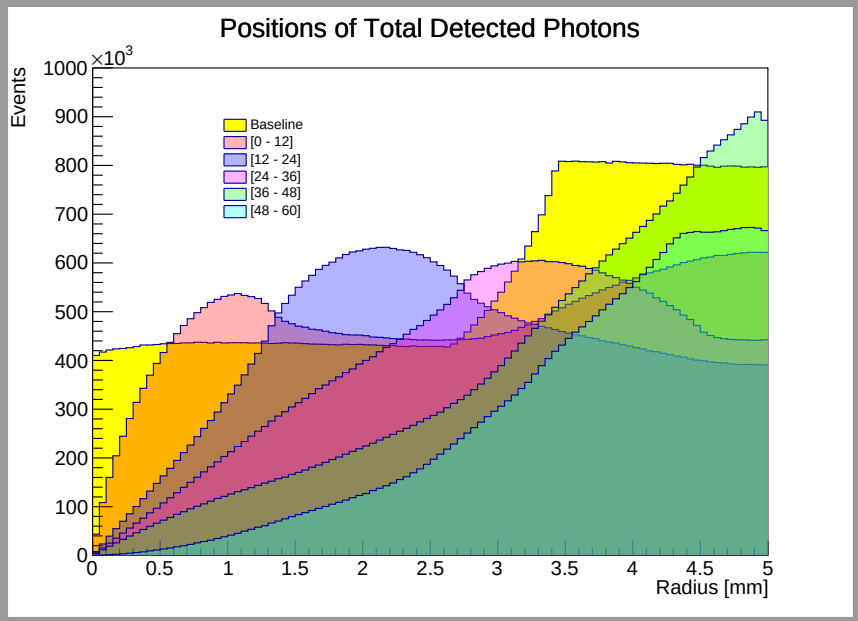

Figure 10: Number of detected photons vs radius, normalized.

For all the photons that we count in the previous histogram, we get the radius in which the photons hit the detector tablet.

Photons detection position

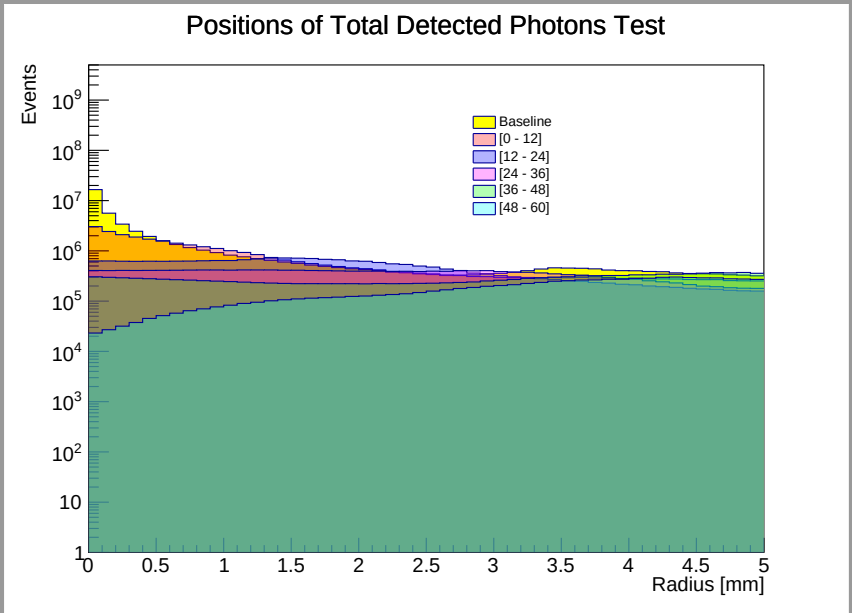

Figure 11: Number of detected photons vs radius, normalized.

We normalized the previous histogram with the bin radius as explained before.