

# Study of Nearby Effects at the Interaction Point of the PLUME detector at the LHCb

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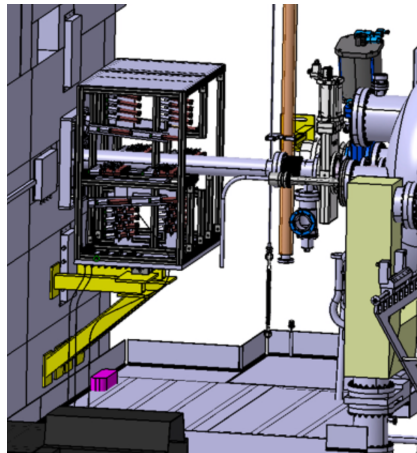
# PLUME Detector at LHCb

During Run 3 is expected an increase of:

- Luminosity.
- Number of visible interactions per bunch  $\mu$ .

PLUME detector is designed to:

- Measure online luminosity and  $\mu$  in real time.
- Provide measurements of background radiation.
- Examine the LHC filling scheme.
- Deliver offline luminosity.



[1] LHCb PLUME: Probe for LUminosity MEasurement.

Figure: Schematic view of the PLUME detector set up at the LHCb [1].

# Simulation of the Elementary Module for Detection

The simulation corresponds to a section of the detection unit. The geometry consists of three cylinders that represent:

- The quartz tablet.
- The PMT window.
- The PMT detector.

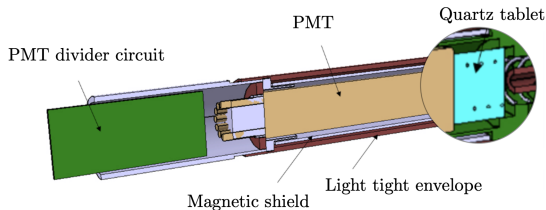


Figure: Sketch of the PLUME elementary detection module [1].

[1] LHCb PLUME: Probe for LUminosity MEasurement.

# Photons Created in the Quartz Tablet

For the first part of the analysis, an electron of 6 GeV was shot perpendicularly to the center of the detector.

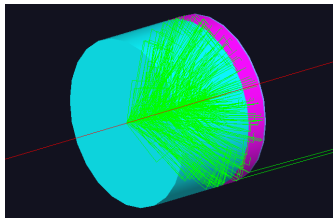


Figure: Sketch of the portion simulated with Geant4.

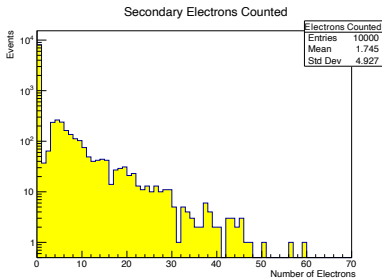


Figure: Secondary electrons produced in the quartz tablet.

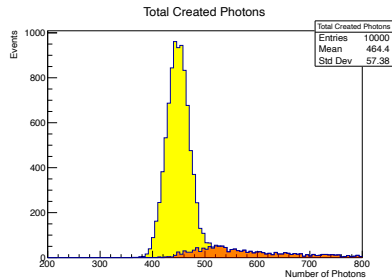


Figure: Histogram of the total created photons in the quartz tablet.

# Random Perpendicular Beam

For this analysis the primary electron was configured such that the particle hits perpendicularly the detector and the entrance point is random with an uniform distribution in the effective area.

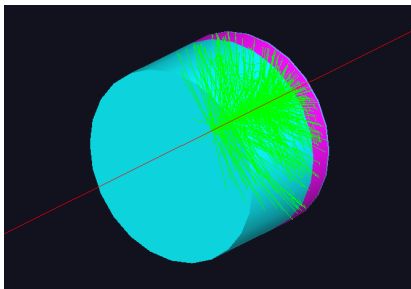


Figure: Sketch of the configuration for random perpendicular analysis.

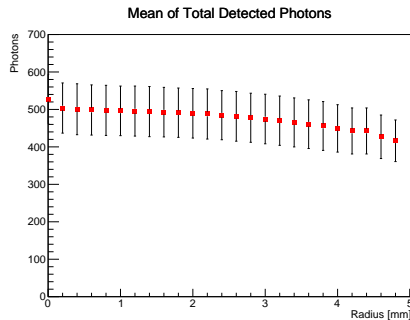


Figure: Mean of total detected photons depending on the entrance position.

# Random Angle Beam

In this configuration the primary particle starts at the beginning of the detector and the azimuth angle varies in an uniform distribution from 0 to 60 degrees.

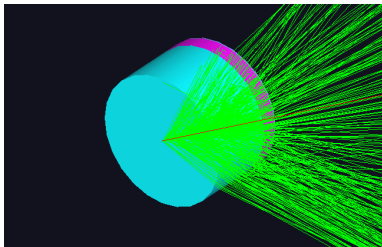


Figure: Sketch of the configuration for random angle analysis.

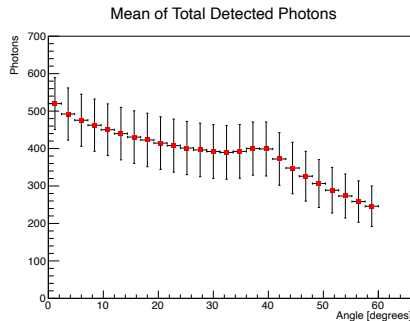


Figure: Mean of total detected photons for a given hit angle.

# Conclusions

1. The number of photons produced by the primary electron has a normal distribution, the secondary photons add a tail at the end of the distribution.
2. If the particle hits perpendicularly the detector randomly in the effective area, the results are similar that the beam hitting the center of the quartz.
3. When the azimuthal angle varies, the distribution of detected photons change. It is due to geometrical reasons, and considering that some photons do not reflect inside the quartz, escaping from the detector.

The End



# Zones Division for Random Perpendicular Study

For the random perpendicular analysis we divided the effective area in 5 regions of the same area. With this division, each zone has nearly the same amount of events.

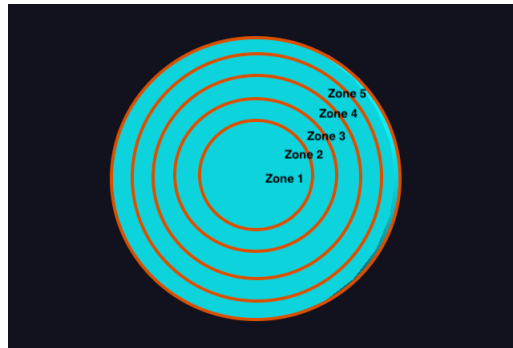
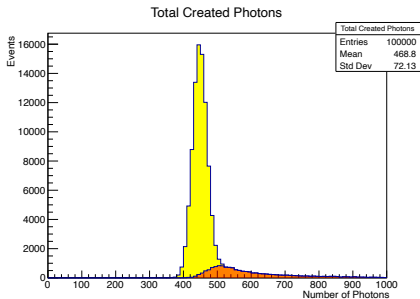


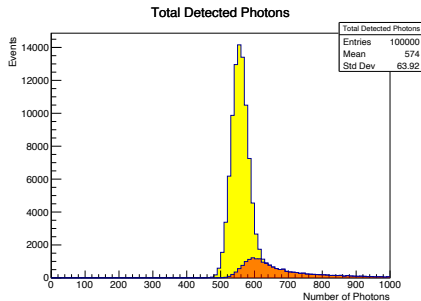
Figure: Division for the effective area in the quartz tablet.

# Photons Created and Detected for the Random Perpendicular Analysis

For this configuration, integrating over all the zones.



**Figure:** Histogram of (yellow) the total created photons in the quartz tablet, (red) the total created photons in the quartz tablet where the event has secondary photons.



**Figure:** Histogram of (yellow) the total detected photons in the quartz tablet, (red) the total created photons in the quartz tablet where the event has secondary photons.

# Reflections Analysis for the Random Perpendicular Study

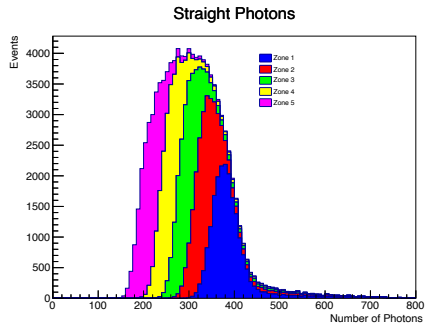


Figure: Photons with no reflections produced in the quartz tablet.

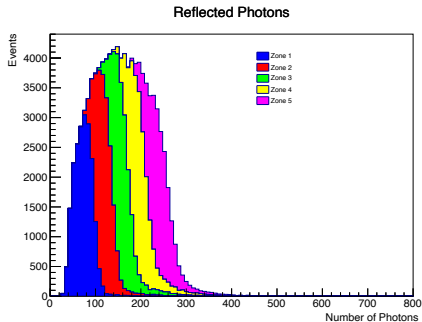
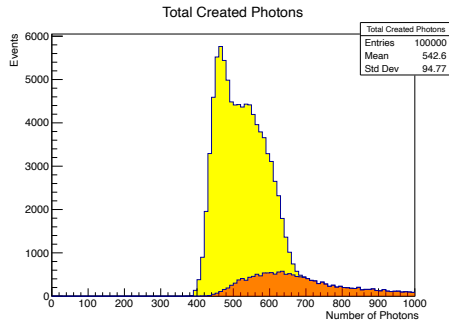


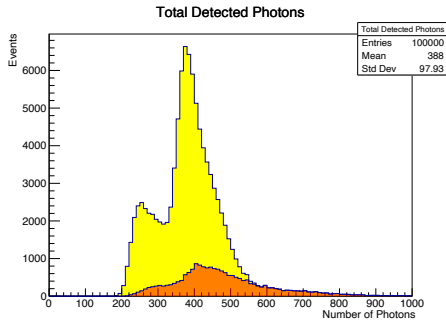
Figure: Photons with at least one reflection produced in the quartz tablet.

# Photons Created and Detected for the Random Angle Analysis

For the total photons created in the quartz, we got similar results as in the analysis performed by shooting the particle perpendicularly to the center of the cylinder.



**Figure:** Histogram of (yellow) the total created photons in the quartz tablet, (red) the total created photons in the quartz tablet where the event has secondary photons.



**Figure:** Histogram of (yellow) the total detected photons in the quartz tablet, (red) the total created photons in the quartz tablet where the event has secondary photons.

# Reflections Analysis for the Random Angle Study

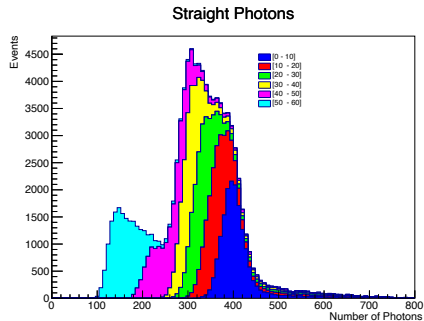


Figure: Photons with no reflections produced in the quartz tablet.

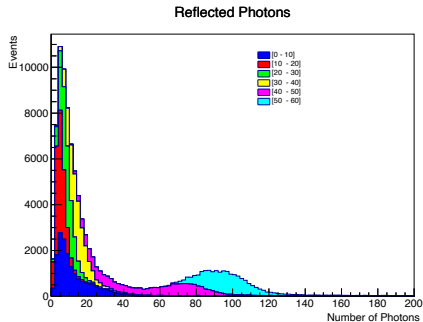


Figure: Photons with at least one reflection produced in the quartz tablet.