

Study of the Performance of LumiCal in Combination with a Tracking Detector

Oleksandr Borysov, Tel Aviv University

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Outline

- Introduction and motivation for the study
- Geometry implementation in LuCaS
- Hits multiplicity generated by electrons
- LumiCal with and without tracking detector
- Summary and plans

LumiCal Clustering Algorithm

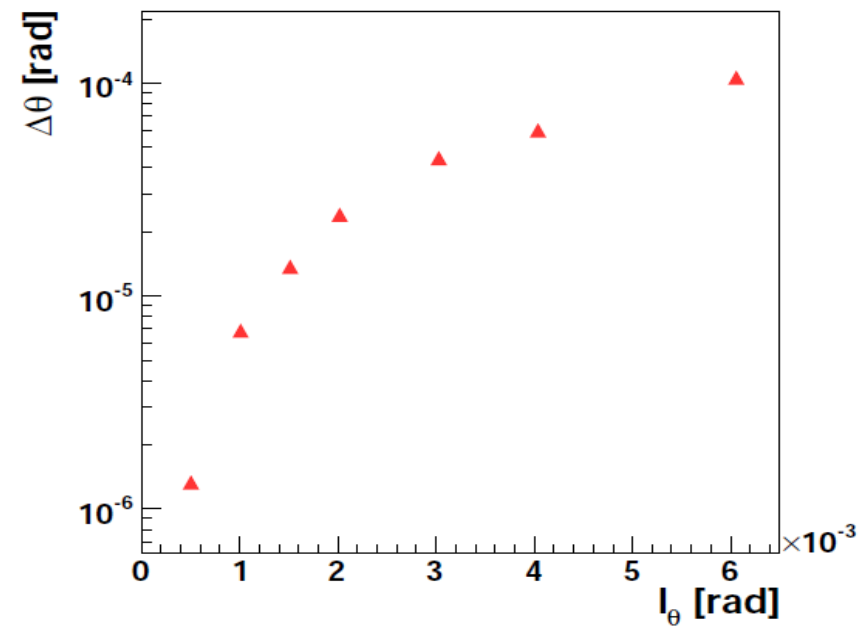
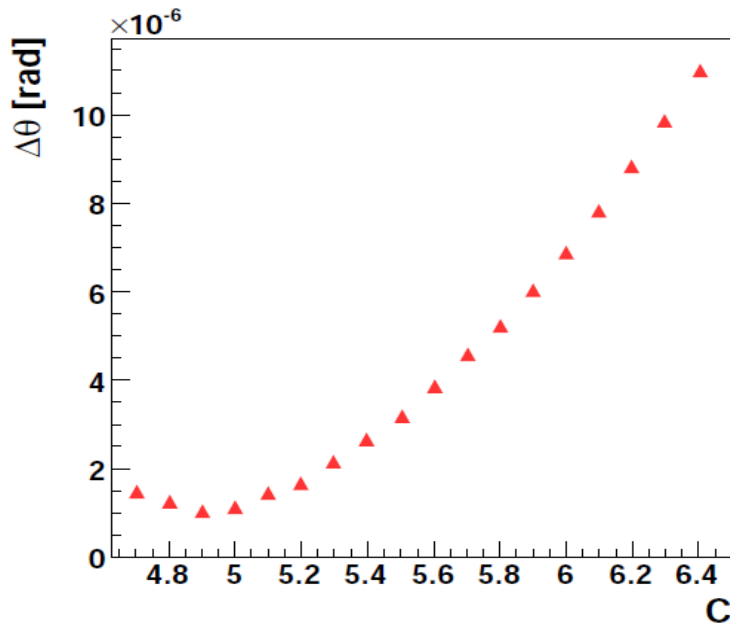
- Polar and azimuthal angles measured based on reconstruction in LumiCal;
- Studied earlier by Iftach Sadeh at TAU;
- Clustering Algorithm:
 - Selection of shower peak layer (z direction) and perform the 2D clustering within the layer;
 - Composing 3D clusters and finally assigning all hits to these clusters;
 - Correcting the parameters of the cluster based on their energy density distribution.
- It was shown that the reconstruction algorithm gives a bias in polar angle measurement, while the precise θ is crucial for luminosity measurement.

Polar Angle Bias

Polar angle reconstruction in LumiCal:

$$\langle \theta \rangle = \frac{\sum_i \theta_i \cdot \mathcal{W}_i}{\sum_i \mathcal{W}_i}.$$

$$\mathcal{W}_i = \max\left\{ 0, \mathcal{C} + \ln \frac{E_i}{E_{tot}} \right\},$$



Polar angle bias depending on weight constant and angular cell size at optimal (weight constant)

Tracking Detector

- Improve polar angle measurement accuracy;
- Provide more information to enable e/ γ identification, important for various physics study.

As a possible candidate could be Mimosa sensor

- Mimosa – MOS Active Pixel, developed in Strasbourg.
- Mimosa-26 is used in STAR inner tracker at RHIC, possibly also for ALICE ITS upgrade;
- We are developing the facilities for Mimosa test at TAU;
- Important to evaluate the radiation dose and radiation hardness of the Mimosa sensor;

Tracking Detector in LuCaS

Lucas

viewer-0 (OpenGLStoredQt) x

Scene tree Help History

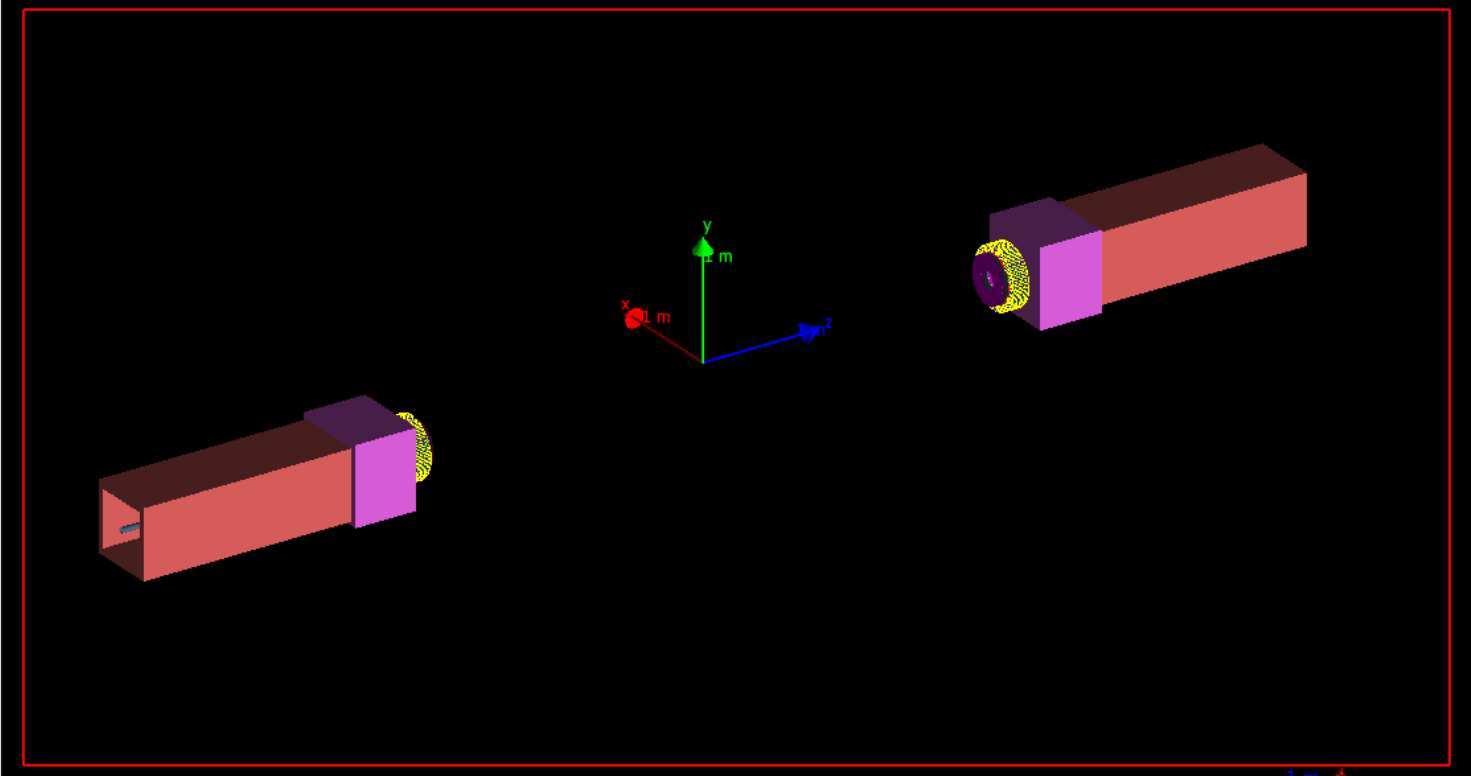
viewer-0 (OpenGLStoredQt)

Scene tree : viewer-0 (OpenGLStoredQt)

- Axes
- Frame
- Scale
- Touchables
- World [0]
 - BCal1 [1]
 - BCal2 [2]
 - BCalFrontWall-1 [1]
 - BCalFrontWall-2 [2]
 - CentralPipe [1]
 - LCalFront1 [1]
 - LCalFront2 [2]
 - LcalInnerTube1 [1]
 - LcalInnerTube2 [2]
 - LHcal1 [1]
 - LHcal2 [2]
 - LumiCalDetector1 [1]
 - LumiCalDetector2 [2]
 - LumiCalTracker1 [1]
 - TrackingSensor1 [0]
 - TrackingSensor2 [0]
 - LumiCalTracker2 [2]
 - TrackingSensor1 [0]
 - TrackingSensor2 [0]
 - Mask1 [1]
 - Mask2 [2]
 - OutBeamTube1 [1]
 - OutBeamTube2 [1]

Touchable slider
Show all Hide all

select item(s)



viewer-0 (OpenGLStoredQt) x

Output

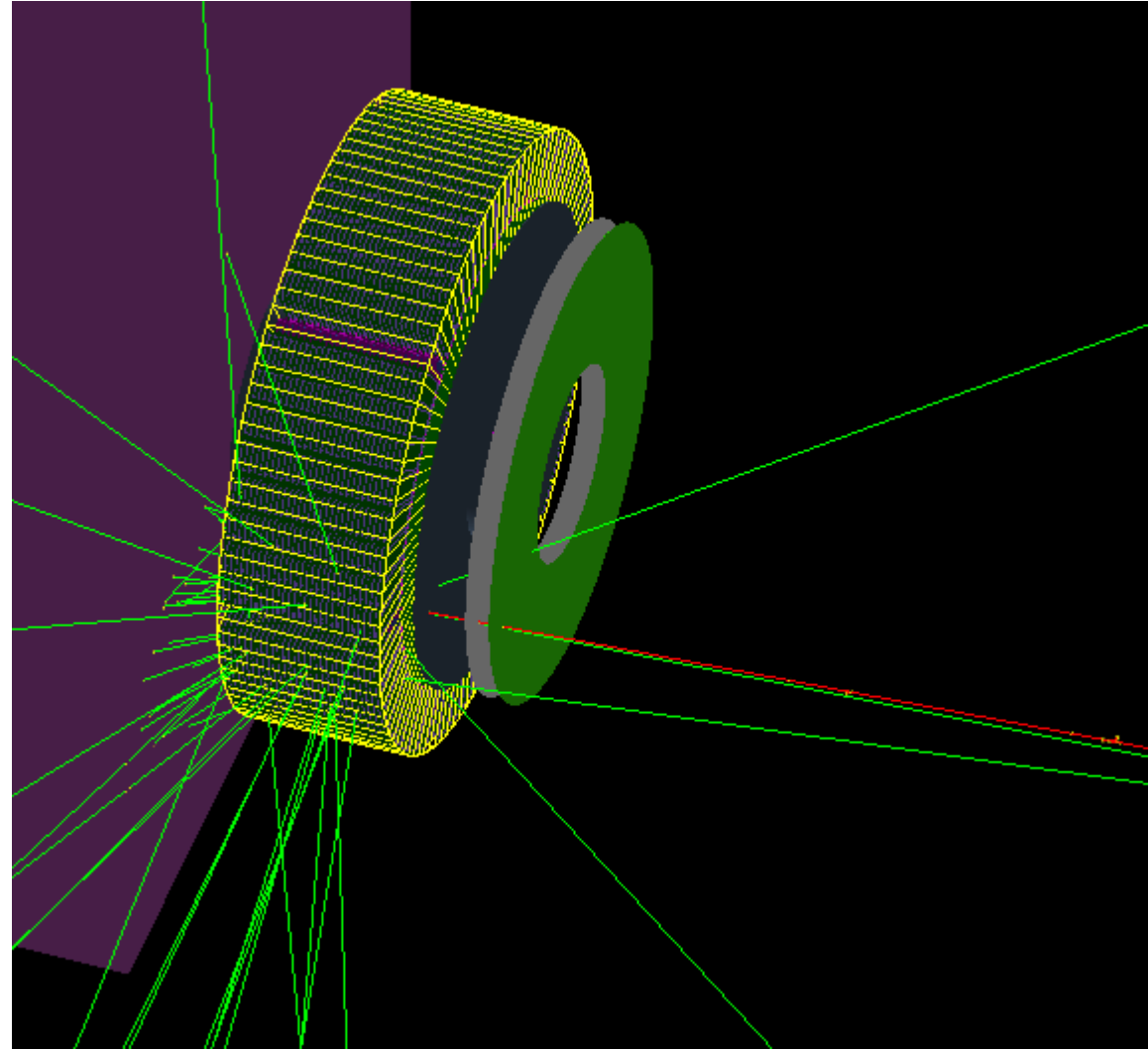
```
Initial momentum (IMom): G4BestUnit (G4ThreeVector)
No. of points (NTP): G4int
PDG Encoding (PDG): G4int
Parent ID (PID): G4int
Particle Name (PN): G4String
G4SmoothTrajectoryPoint:
  Auxiliary Point Position (Aux): G4BestUnit (G4ThreeVector)
  Step Position (Pos): G4BestUnit (G4ThreeVector)
ERROR: Logical volume "Envelope" not found in logical volume store.
Visualization verbosity changed to warnings (3)
```

clear output Filter:

Session:

Tracker effect on LumiCal

- Two layers of 50 μm silicon, 50 mm away from the LumiCal with 20 mm between them
- Multiple scattering on big angles in tracking detector;
- Secondary particles production;

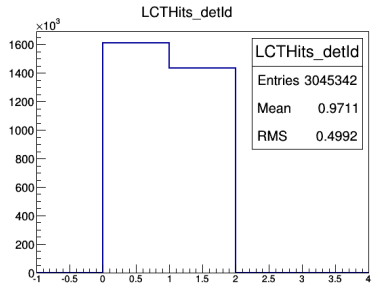


Simulation

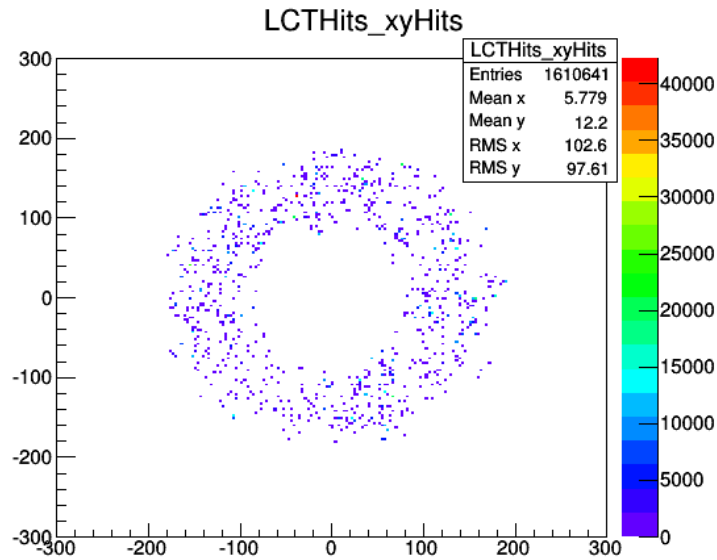
- 250 GeV electrons;
- Uniformly distributed over azimuthal angle 2π ;
- Uniformly distributed over polar angle in the range 41 - 69 mrad;
- 2.5k primary tracks were processed.

Hits Occupancy for Tracking Sensors

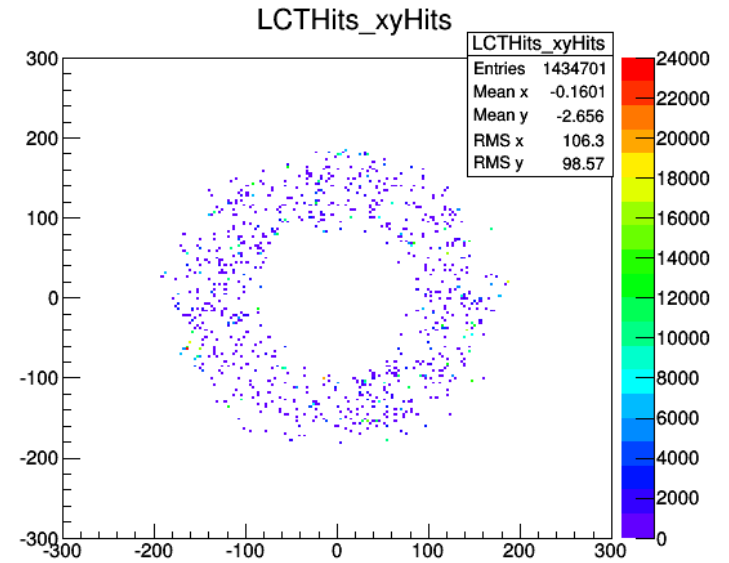
Close/Far



Sensor close to LumiCal

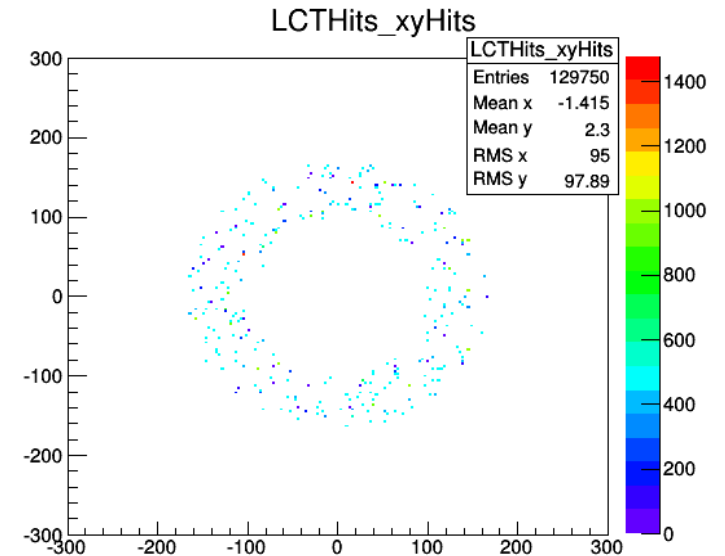
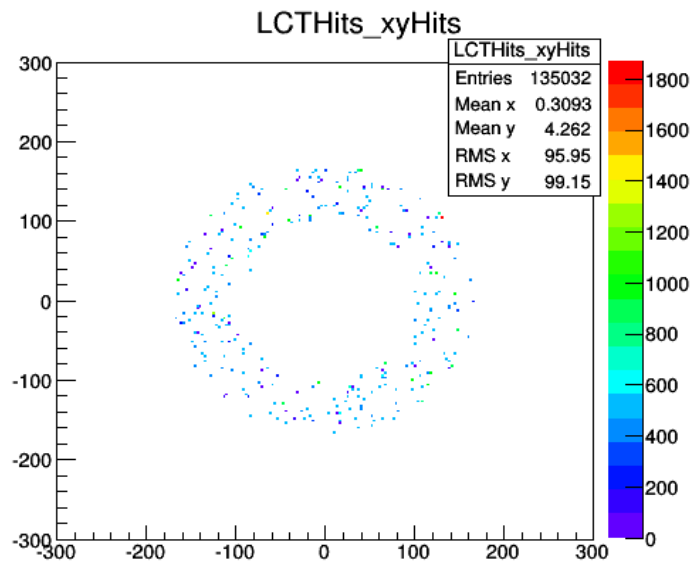


Sensor far from Lumical



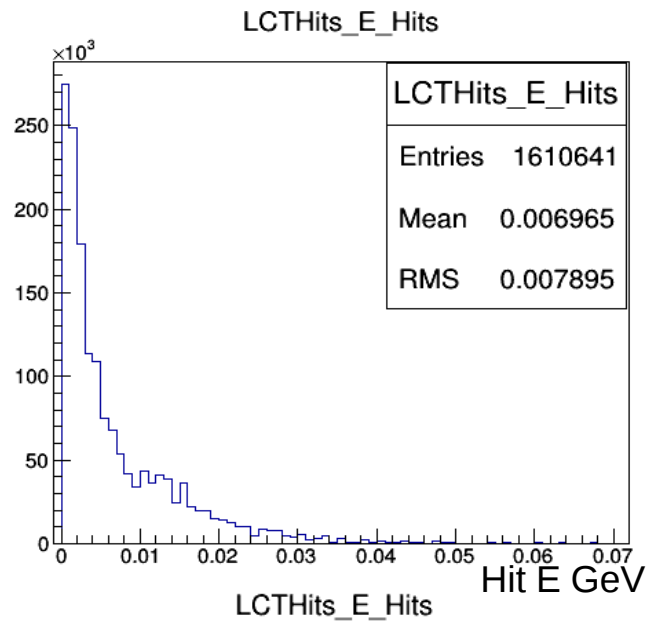
All tracks

Only primary tracks



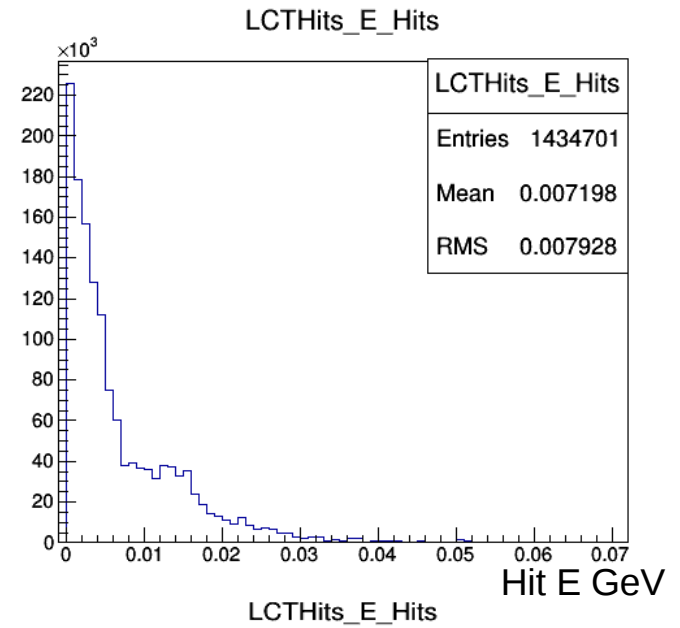
Hit Energy Distribution

Sensor close to LumiCal

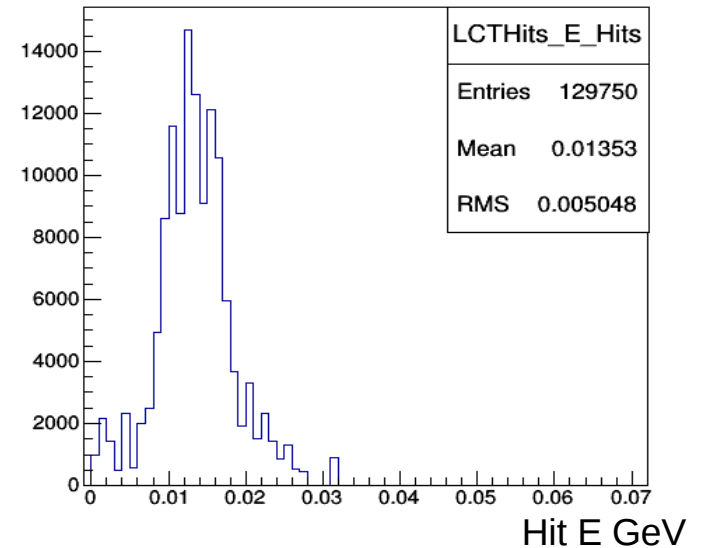
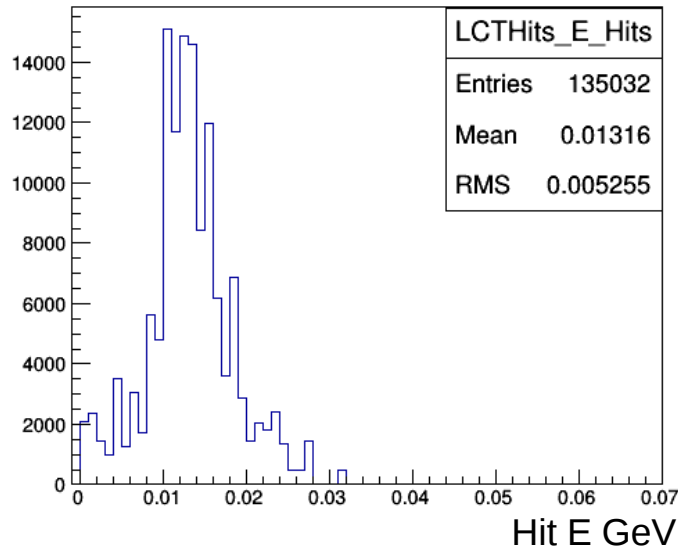


All tracks

Sensor far from Lumical

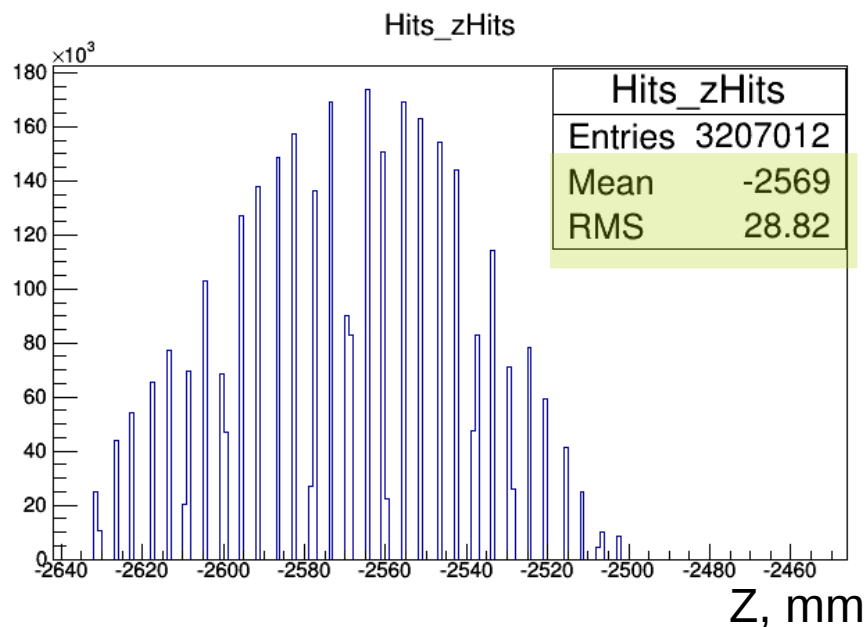


Only primary tracks

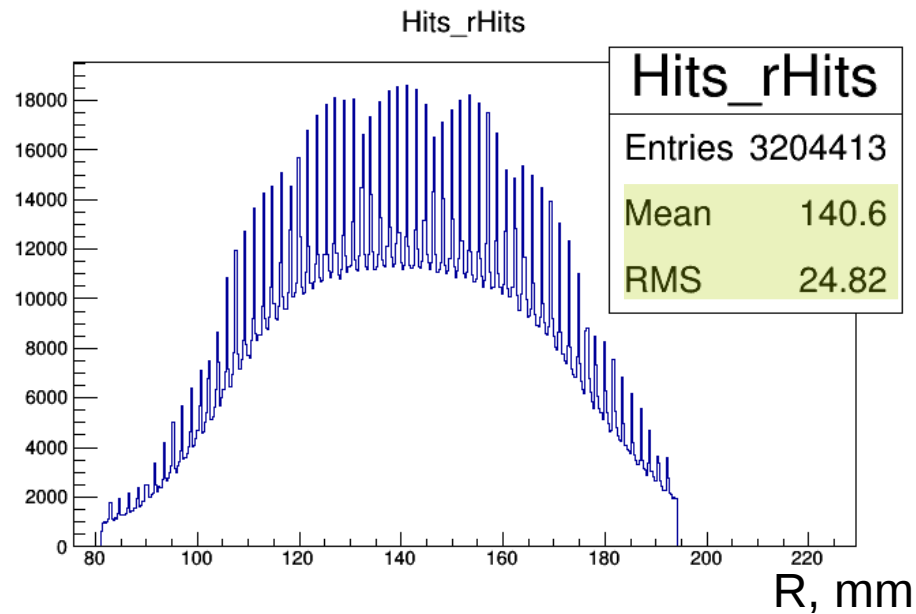
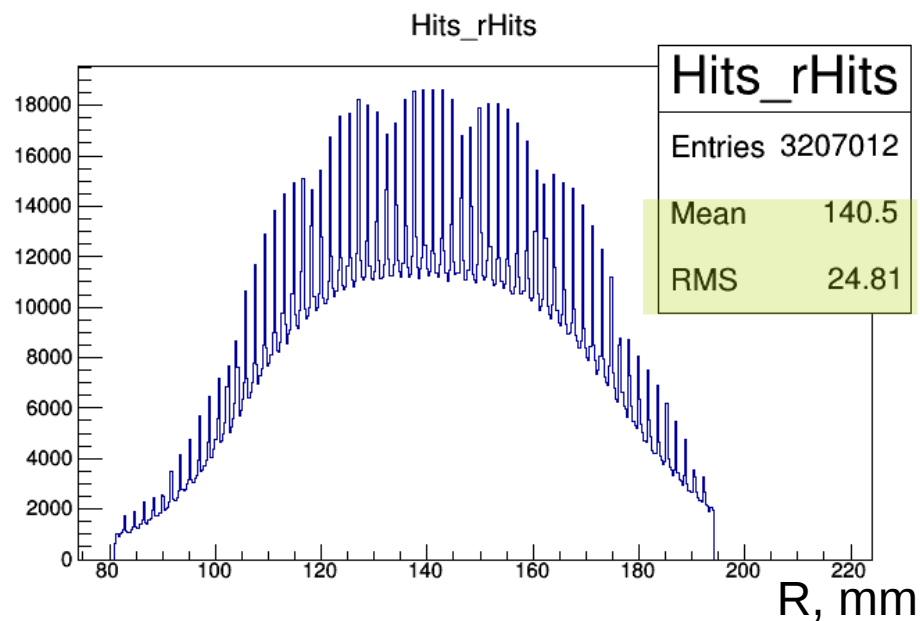
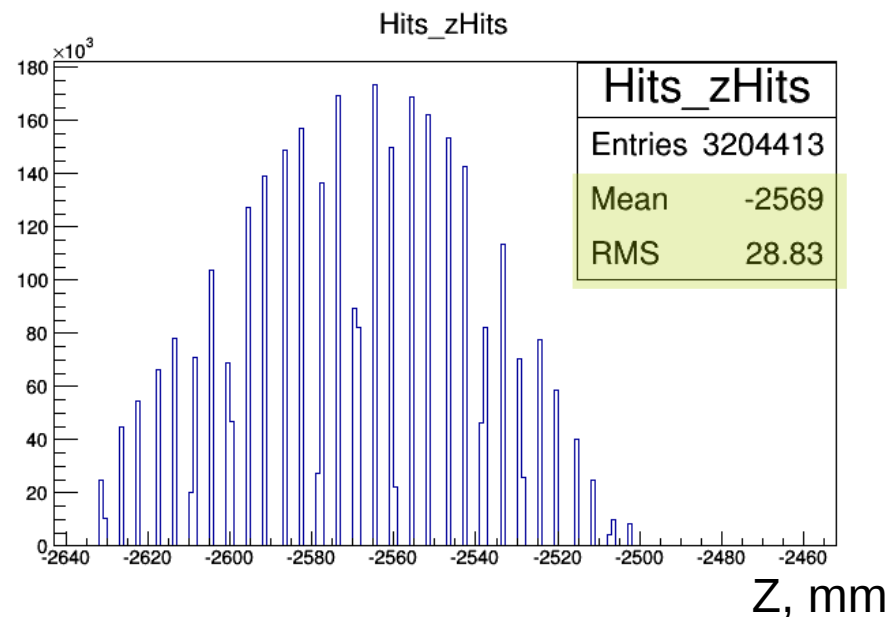


LumiCal w/, w/o Tracking Detector

With tracking detector



W/o tracking detector



Summary and Plans

- There is significant occupancy of tracking detector caused by the scattered particles from LumiCal.
- There does not seem to be a strong influence of tracking detector on LumiCal performance.
- Check the performance with track reconstruction.
- Study different configurations of tracking detector.
- Approach e/ γ identification.