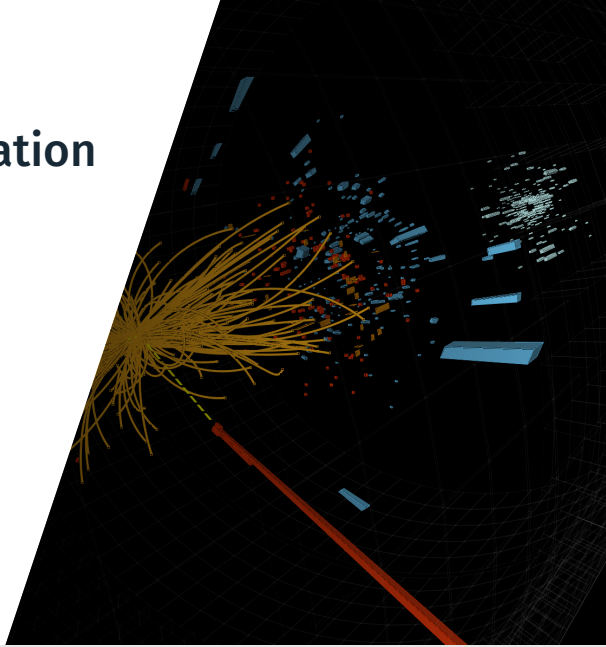
Shared Hit Truth Investigation

Veome Kapil

Princeton University
July 31, 2020

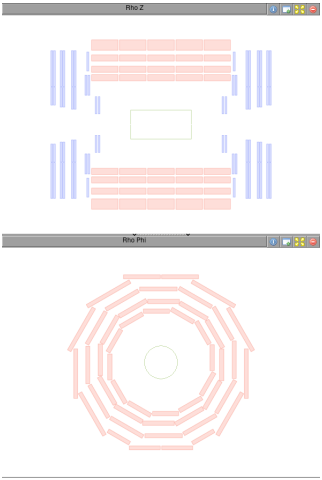


Event Displays

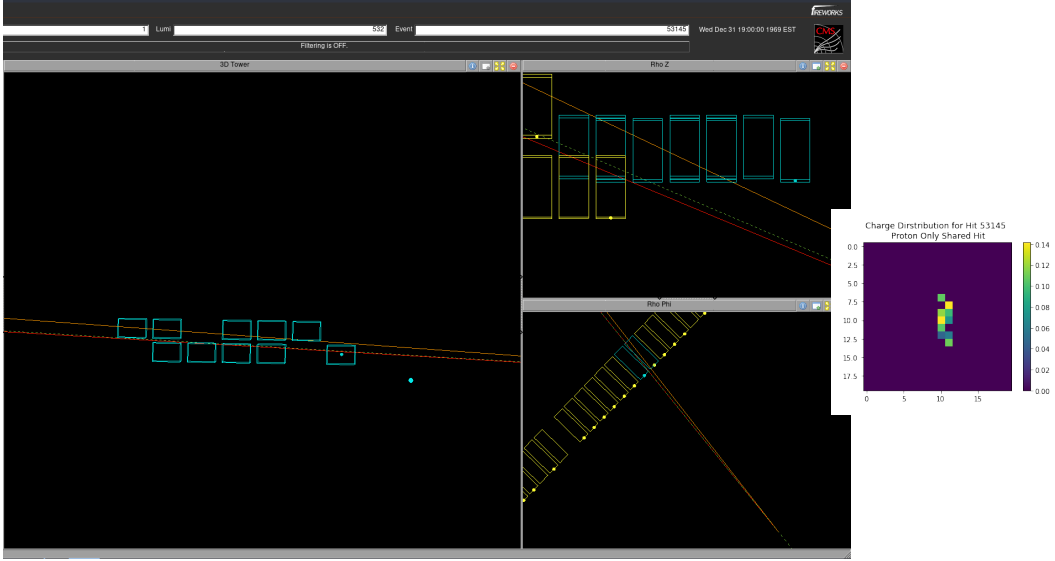
Looked at RAW and RECO event displays for:

- Shared Hit containing 1 Sim Proton.
- Shared Hit containing 1 Sim Pion.
- Shared Hit containing a Sim Proton AND a Sim Pion.

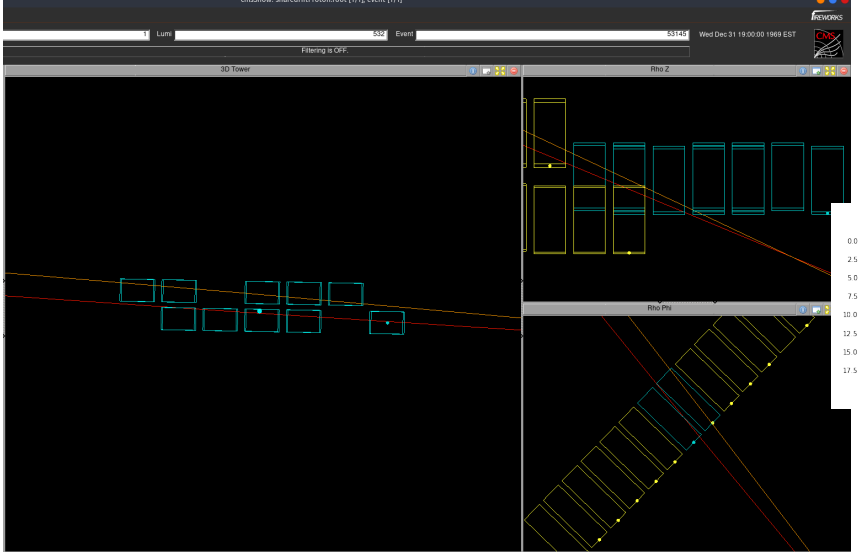
Coordinate Reference

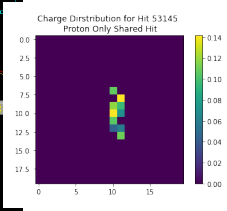


Shared Hit with 1 Sim Track (Proton)



Shared Hit with Proton Only, RAW



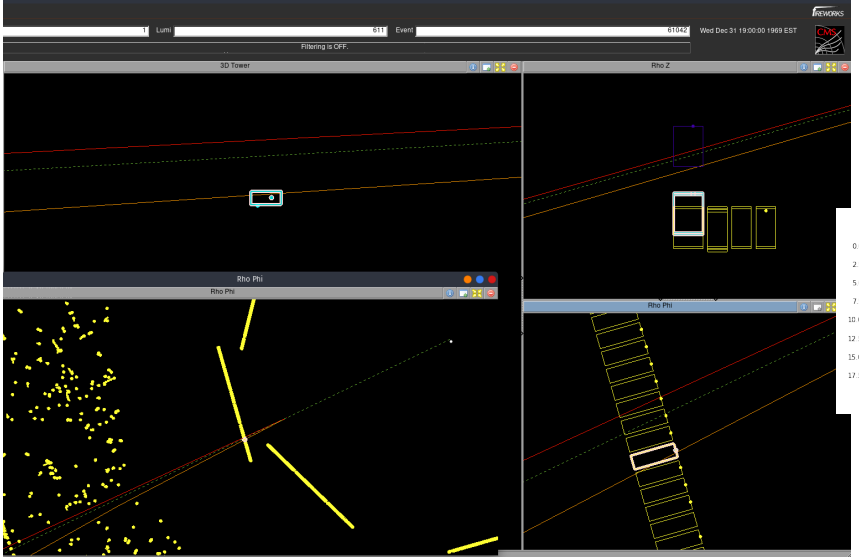


Shared Hit with Proton Only, RECO

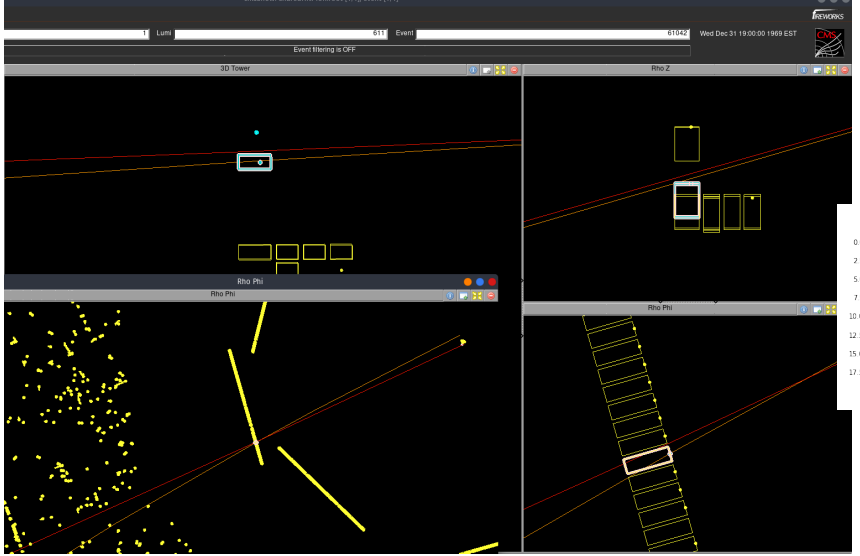
Shared Hit with 1 Sim Track (Proton)

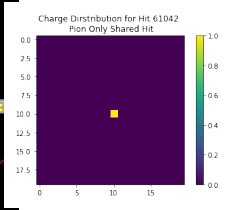
- Proton and Pion both go through cluster.
- Reco and Gen Protons are closer than Reco and Gen Pions.

Shared Hit with 1 Sim Track (Pion)

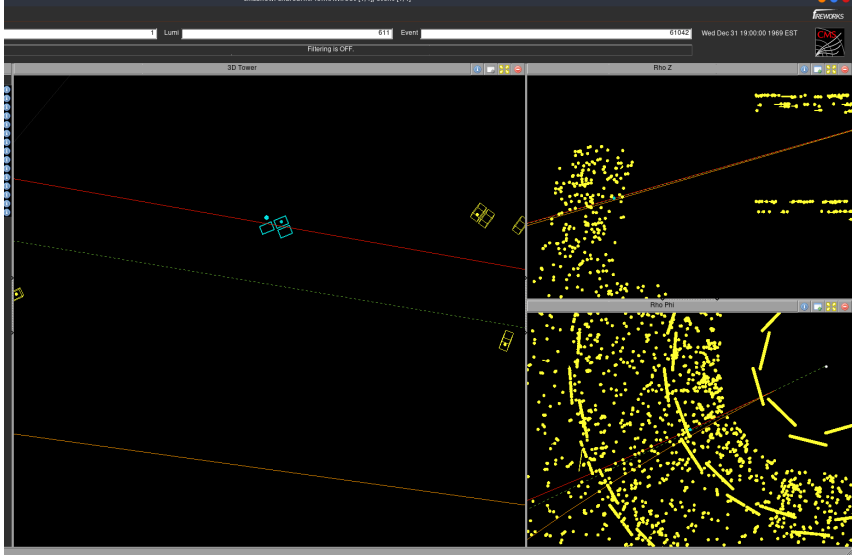


Shared Hit with Pion Only, RAW





Shared Hit with Pion Only, RECO

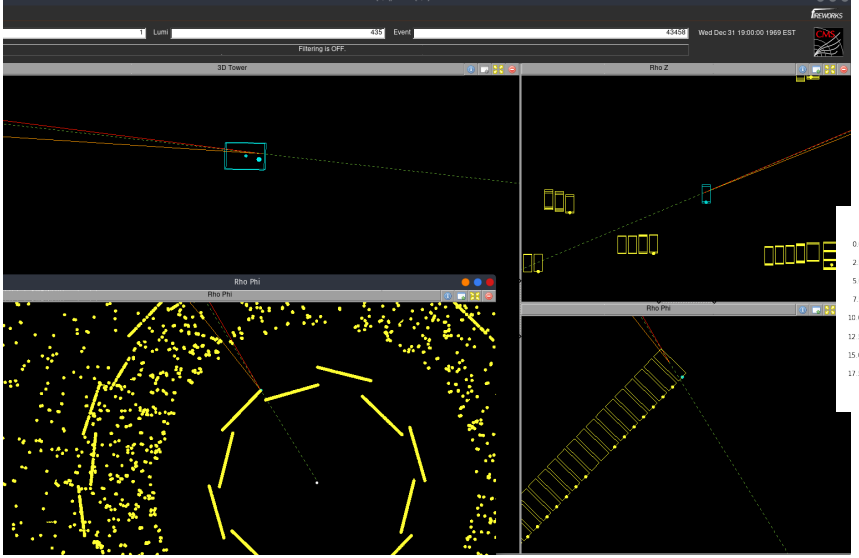


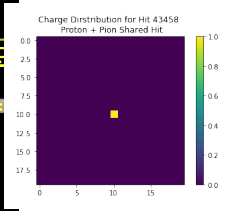
Shared Hit with Pion Only, RECO, Proton Pixel Hit

Shared Hit with 1 Sim Track (Pion)

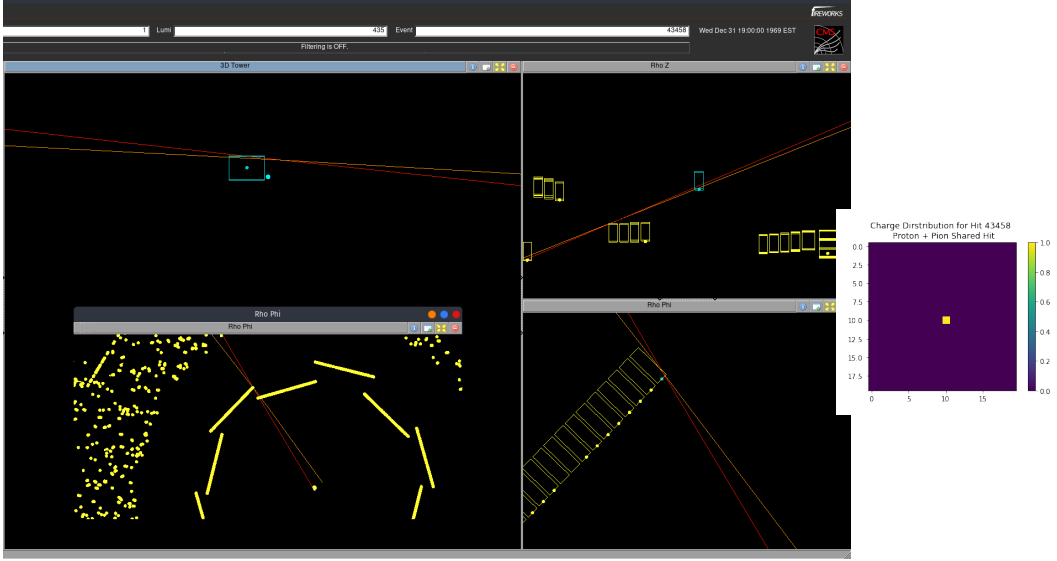
- Neither Gen Pion nor Gen Proton go through cluster, but the Pion is nearby.

Shared Hit with 2 Sim Tracks (Proton and Pion)





Shared Hit with Proton and Pion, RAW



Shared Hit with Proton and Pion, RECO

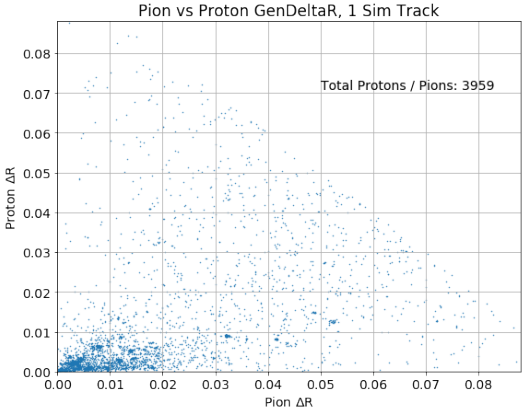
Shared Hit with 1 Sim Track (Pion)

- Lambda decays inside the pixel layer.

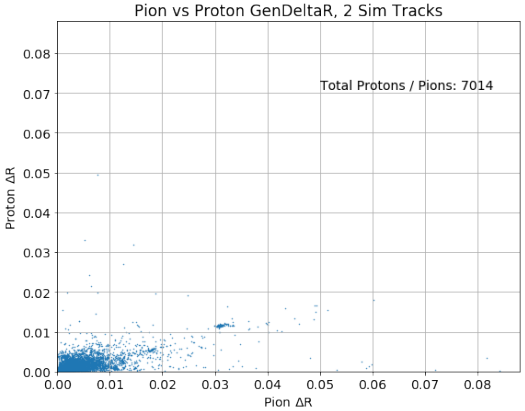
GenDeltaR Plots

- Pion Delta R vs Proton Delta R.
- Delta R is calculated between Gen and Reco Particles.
- Data: First 400 data sets from bouchamaouihichem/G_dataset_script/MClist_CMSSW_10_0_untaped.txt.

GenDeltaR Plots

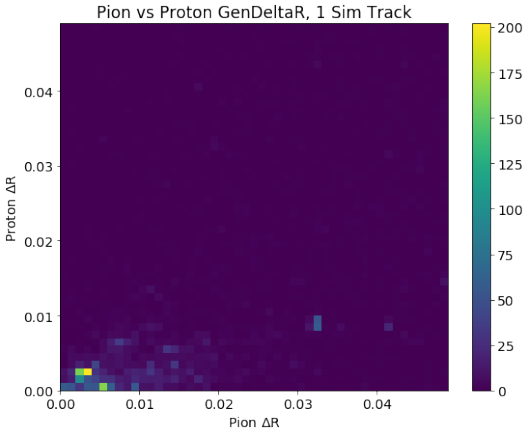


(a) 1 Sim Track

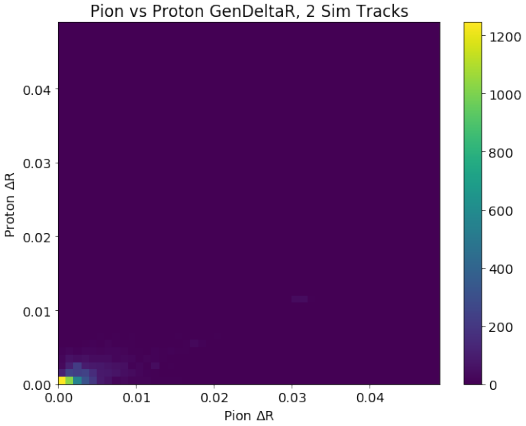


(b) 2 Sim Tracks

GenDeltaR Plots



(c) 1 Sim Track

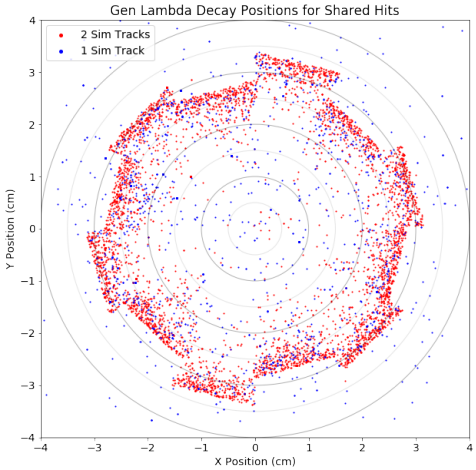


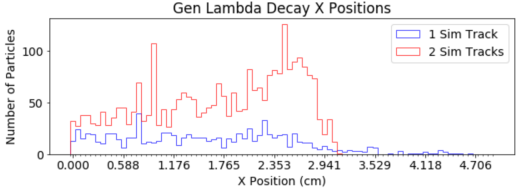
(d) 2 Sim Tracks

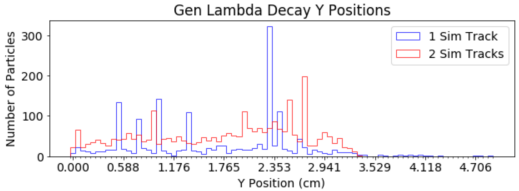
GenDeltaR Plots

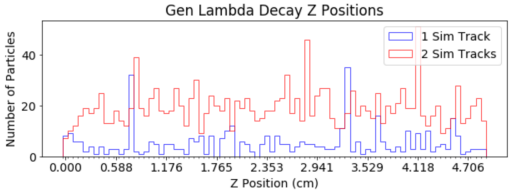
- Larger spread in Pion ΔR than Proton ΔR.
- 2 Sim Track ΔRs are better than 1 Sim Track ΔRs for both Protons and Pions.

Lambda Decay Positions




Gen Lambda Decay X Positions
1 Sim Track
2 Sim Tracks
Number of Particles
0
50
100
0.000
0.588
1.176
1.765
2.353
2.941
3.529
4.118
4.706
X Position (cm)


Gen Lambda Decay Y Positions
1 Sim Track
2 Sim Tracks
Number of Particles
0
100
200
300
0.000
0.588
1.176
1.765
2.353
2.941
3.529
4.118
4.706
Y Position (cm)


Gen Lambda Decay Z Positions
1 Sim Track
2 Sim Tracks
Number of Particles
0
20
40
0.000
0.588
1.176
1.765
2.353
2.941
3.529
4.118
4.706
Z Position (cm)

Lambda Decay Positions

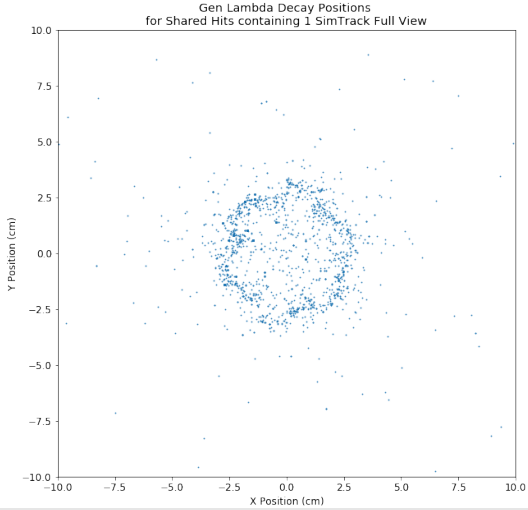
- Expected peak near 2.5cm.
- Non-physical spikes near 0.8cm, 1.3cm.
- 1 Sim Track decays: happen inside and outside the pixel layers.
- 2 Sim Track decays: almost always within the pixel layers.

Conclusions

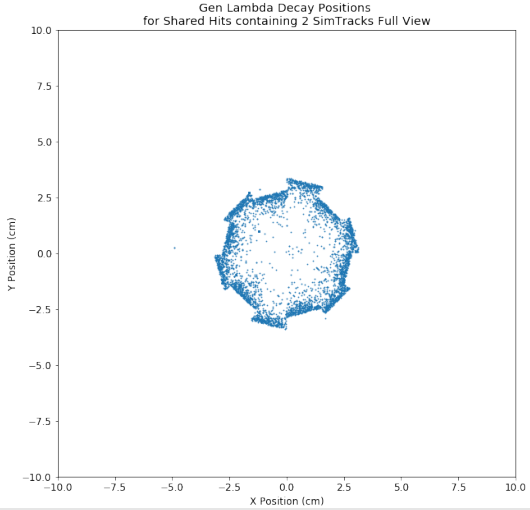
- Shared Hits with 1 sim track show unexpected behavior:
  - Inconsistencies between Gen and Reco tracks.
  - Wide range of decay positions.
- Reco tracks are better correlated to Gen tracks for 2 sim track shared hits than 1 sim track shared hits.
- Reco Protons are better correlated to Gen than Pions. Could be a gen-level cut issue.

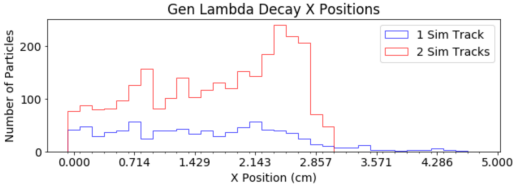
Backup

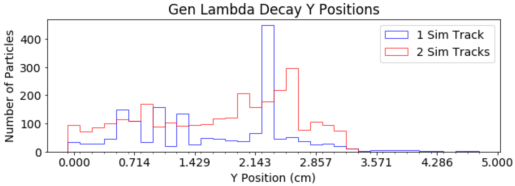
Lambda Decay Positions

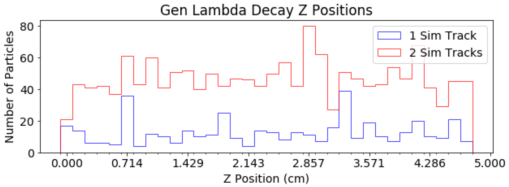


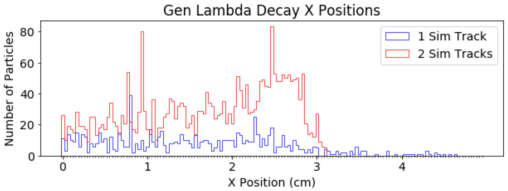
Lambda Decay Positions

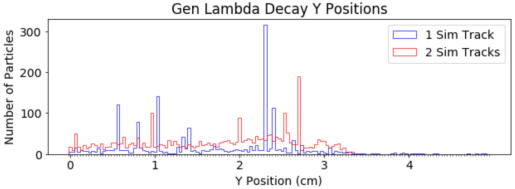


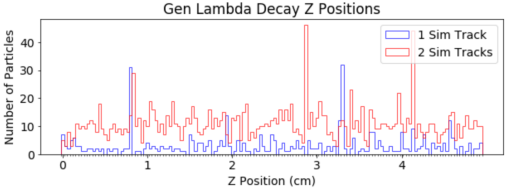

Gen Lambda Decay X Positions
1 Sim Track
2 Sim Tracks
Number of Particles
0
100
200
0.000
0.714
1.429
2.143
2.857
3.571
4.286
5.000
X Position (cm)


Gen Lambda Decay Y Positions
1 Sim Track
2 Sim Tracks
Number of Particles
0
100
200
300
400
0.000
0.714
1.429
2.143
2.857
3.571
4.286
5.000
Y Position (cm)


Gen Lambda Decay Z Positions
1 Sim Track
2 Sim Tracks
Number of Particles
0
20
40
60
80
0.000
0.714
1.429
2.143
2.857
3.571
4.286
5.000
Z Position (cm)


Gen Lambda Decay X Positions
1 Sim Track
2 Sim Tracks
Number of Particles
X Position (cm)


Gen Lambda Decay Y Positions
1 Sim Track
2 Sim Tracks
Number of Particles
Y Position (cm)


Gen Lambda Decay Z Positions
1 Sim Track
2 Sim Tracks
Number of Particles
Z Position (cm)