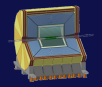
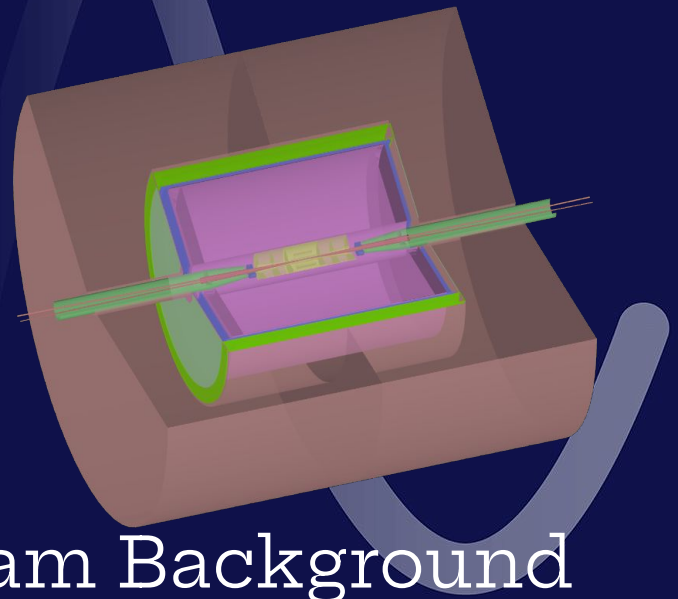


FCC-ee IDEA detector concept

FCC IDEA



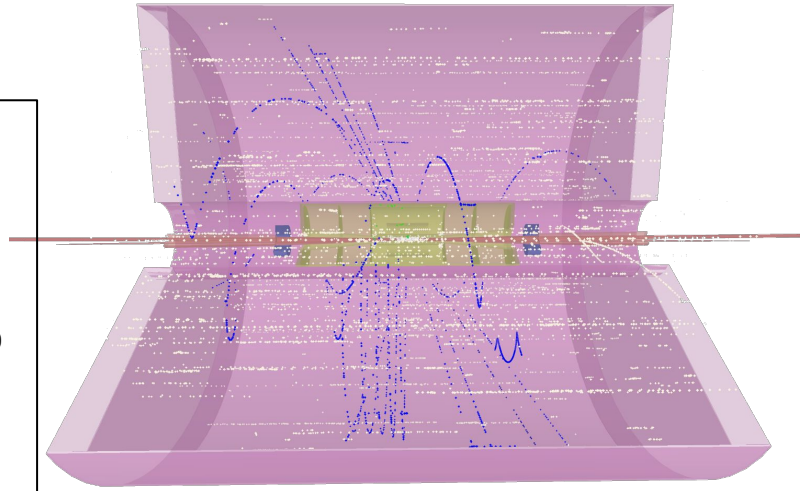
Beam Background

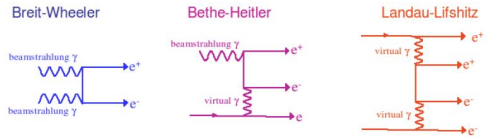
Drift Chamber

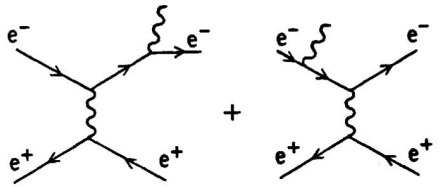
Alexander Poulin, Charles Schwarze, Dolores Garcia, Brieuc, Francois, Christoph Paus, Jan Eysermans, Luca Lavezzo, Eluned Smith

Beam Background Study

- Beam Induced Background on the IDEA Detector (Wire Drift Chamber) version **o1_v03** with **CAD beam pipe**
  - Generated with GuineaPig samples where the particle origin is set to 000
- Focused on luminosity background signals caused by two counter-rotating beams
  - Incoherent Pair Creation (IPC) (Guinea Pig Simulation)
- Signal $Z \rightarrow qq$ (q=u,d) at E_{CM} 91 GeV generated with Pythia







Our goal is to better understand and characterize the IPC background

Beam Background Study

All presented results use the **IDEA_o1_v03 with the CAD beampipe**

The data is generated using Guinea Pig files (generated by Andrea Ciarma):

- In this files the vertex of the particles has been corrected to 0,0,0
- path: `/eos/experiment/fcc/users/b/brfranco/background_files/guineaPig_andrea_June2024_v23_vtx000/`

Then we use the following ddsim command:

- ```
  ddsim  --compactFile $PATH_TO_K4GEO/FCCee/IDEA/compact/$GEOMETRY_VERSION/$GEOMETRY_VERSION.xml  \
      --outputFile out_sim_edm4hep_background_${SEED}.root \
      --inputFiles pairs.pairs \
      --numberOfEvents ${NEV} --random.seed ${SEED} \
      --part.keepAllParticles True \
      --crossingAngleBoost 0.015
  ```
  ```

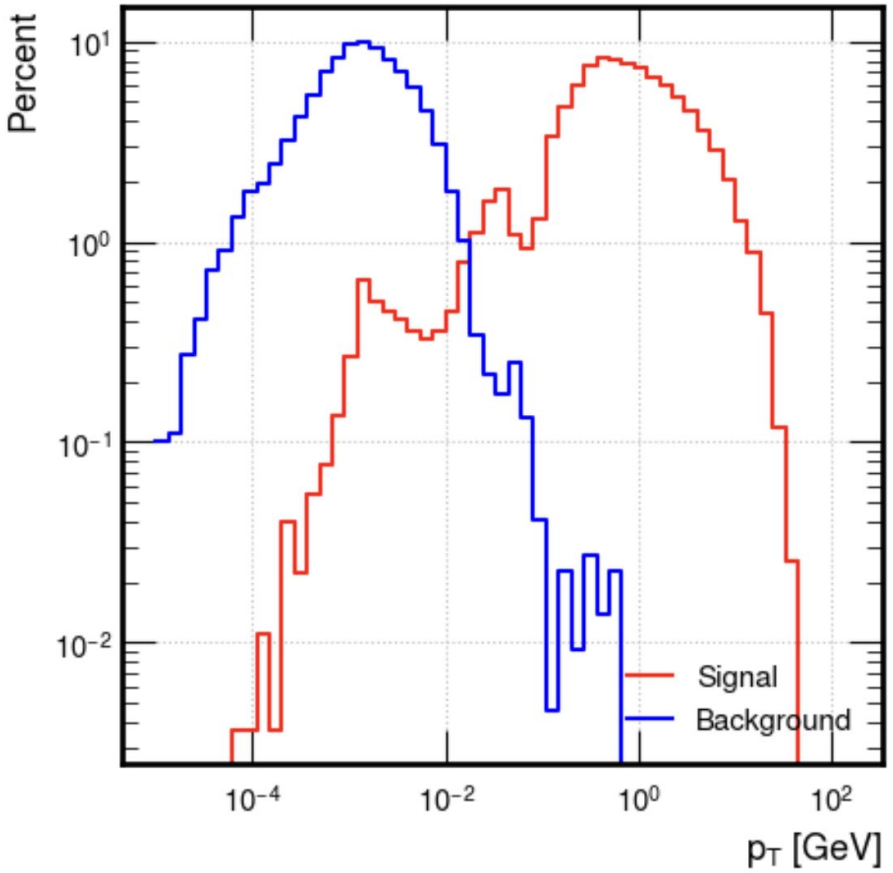
Momentum of MC particles that left hits in the drift chamber

Investigated the momentum of an MC particle given it left hits in the drift chamber

- Shown in percentage to compare signal and background one to one

Key Properties:

- Signal retains a larger number of particles as the momentum increases, bkg falls off around 0.1 GeV
  - Signal has higher energy due to Z→qq



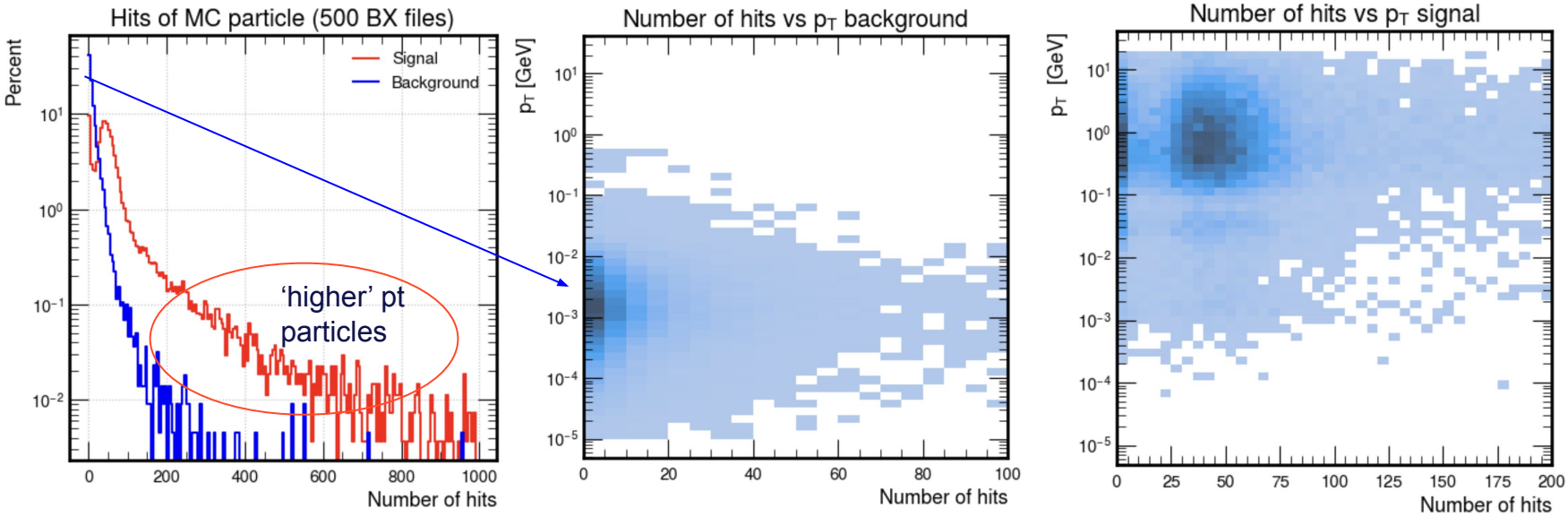
Hits of MC particles that left hits in the drift chamber

Explored how many hits an MC particle left in the drift chamber

- Shown in percentage to compare signal and background one to one

Key Properties:

- Background has higher percentage in the <5 hits bins

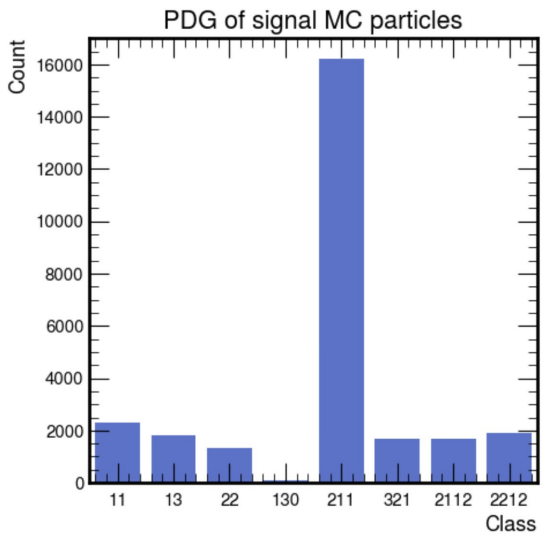


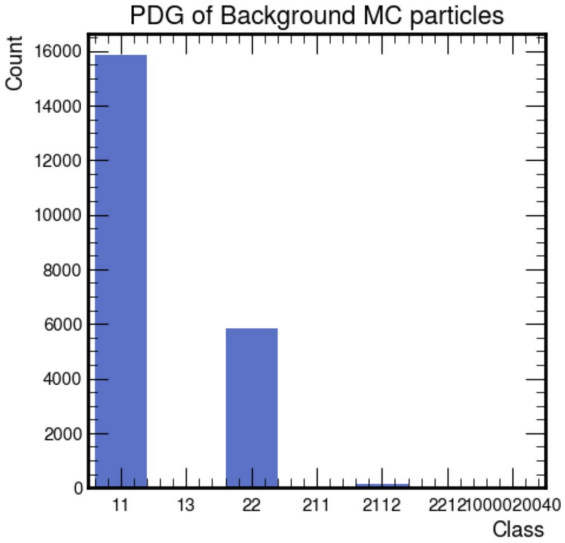
PDG of MC particles that left hits in the drift chamber

Explored the types of particles which left hits in the drift chamber

Key Properties:

- Bkg signals is mostly electrons especially at lower energies
- Some 'unexpected' particles in bkg signals due to minimum E threshold in ddsim (22, 2112, which are assigned to the parent)
- Signals has more diverse particles due to generation from physics event



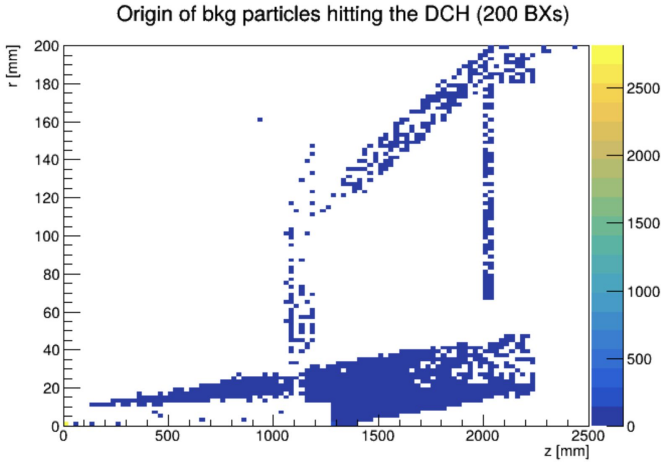


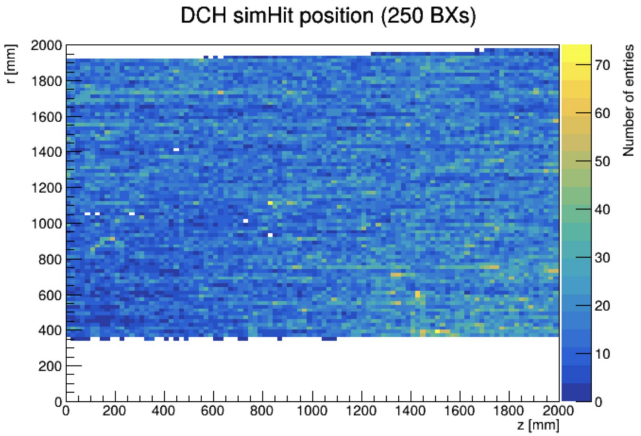
Location of Hits and Monte Carlo Particles over phi and Z

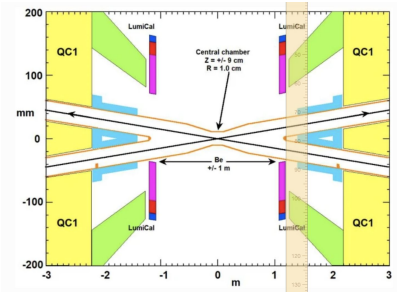
Looked at location of particles and hits based on Z axis and radius

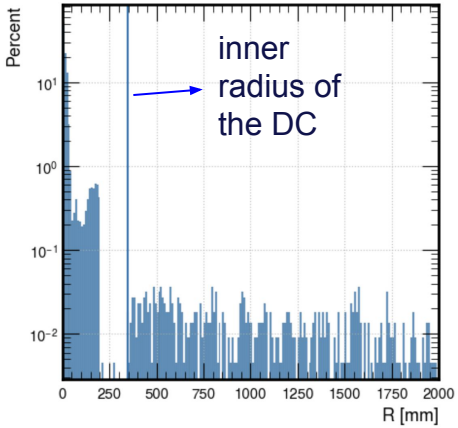
Key Properties

- MCParticles are generated at a higher concentration near the beam pipe, there is a lower percentage in the drift chamber
- This is likely explained by the 'crotch' where the interaction region separate again in two pipes









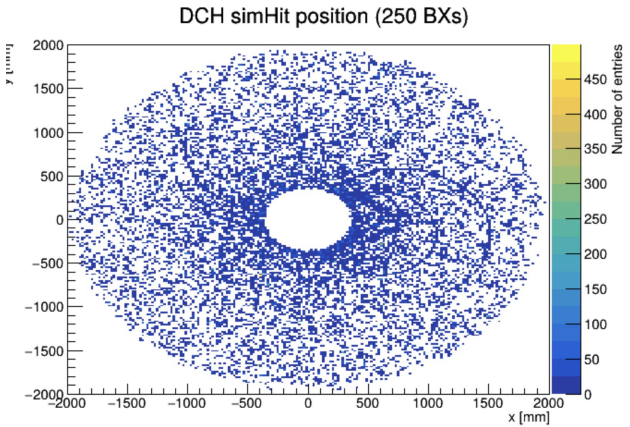
Location of Hits and Monte Carlo Particles on XY-Plane

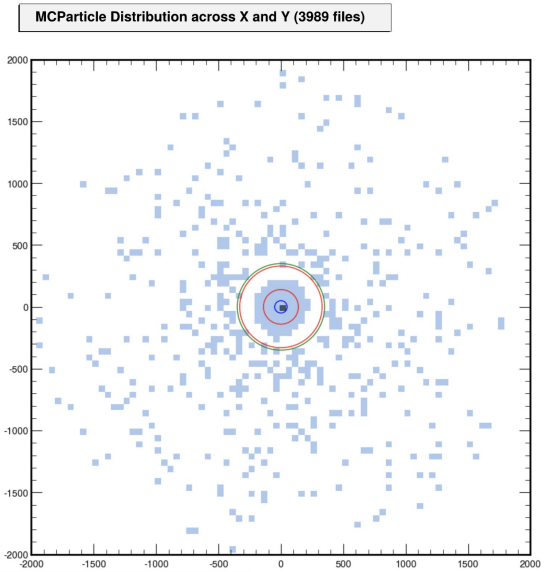
Explored how hits and MCParticles (vertex) are distributed over XY-Plane

Red circles indicates layers of the outer Vertex Detector

Key Properties

- MCParticles are generated throughout the detector
- Most generated in the vertex detector as shown in previous slide

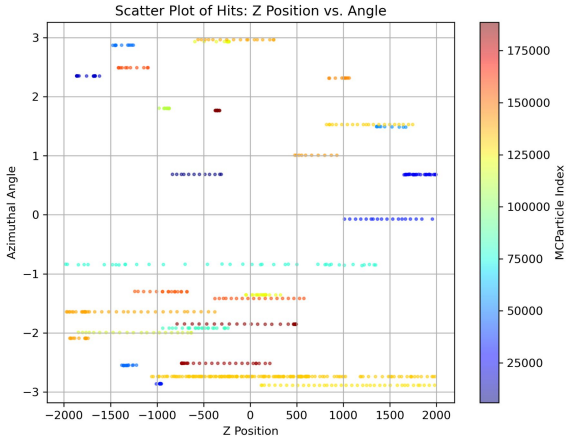


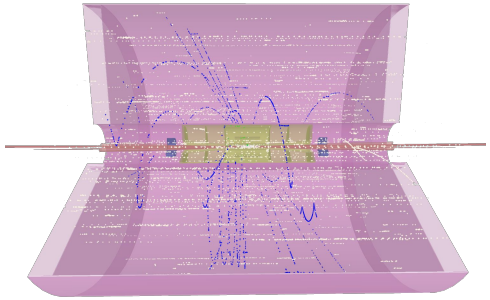


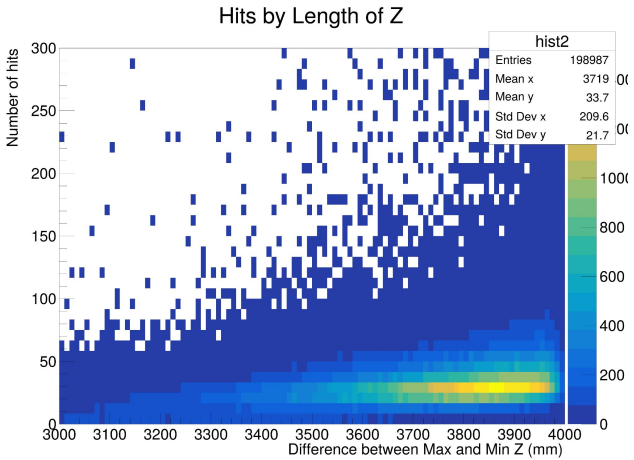
Visualization of Hit Trajectories

Aimed to characterize behavior of horizontal groups of hits
- Color-Indexed by MC Particle ID

Key Properties
- Top graph only uses one event file
- Hit tracks come in different lengths
- Most tracks consist of 20-40 hits
- Length of track scales with # of hits



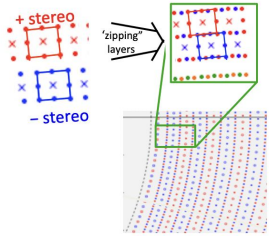


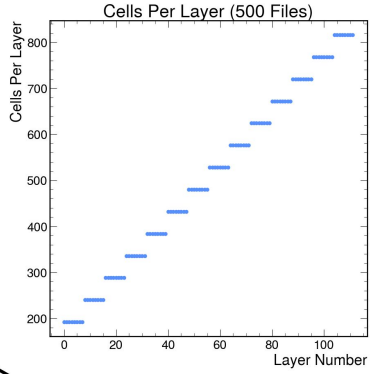


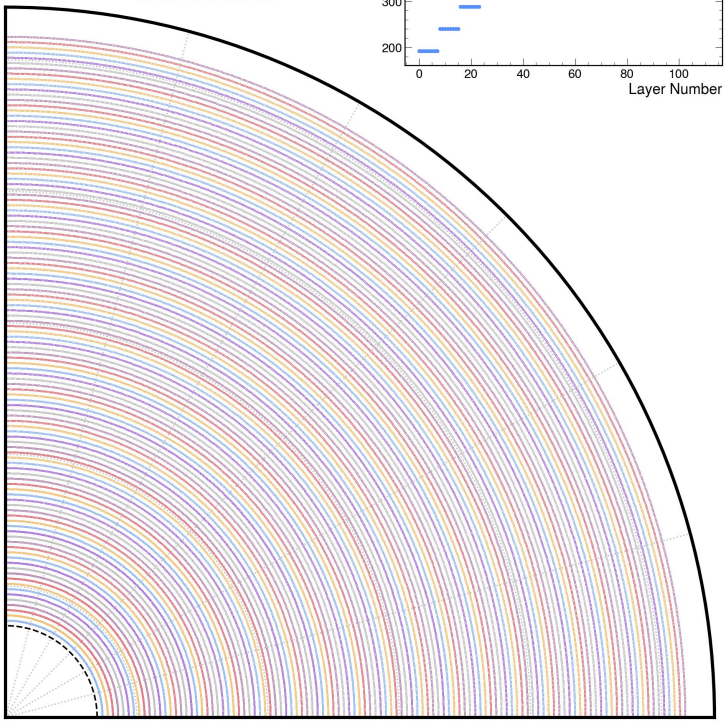
Occupancy

- Detector is composed of many wires, these are split as:
  - 14 Superlayers
    - Each superlayer has layers, total layers for entire detector is 112
      - Each layer has cells which increase with radius

- Occupancy is the percentage of cells that has been fired
  - Calculated where for each layer, get the percent of the number of cells that has been fired by the total number of cells for that layer





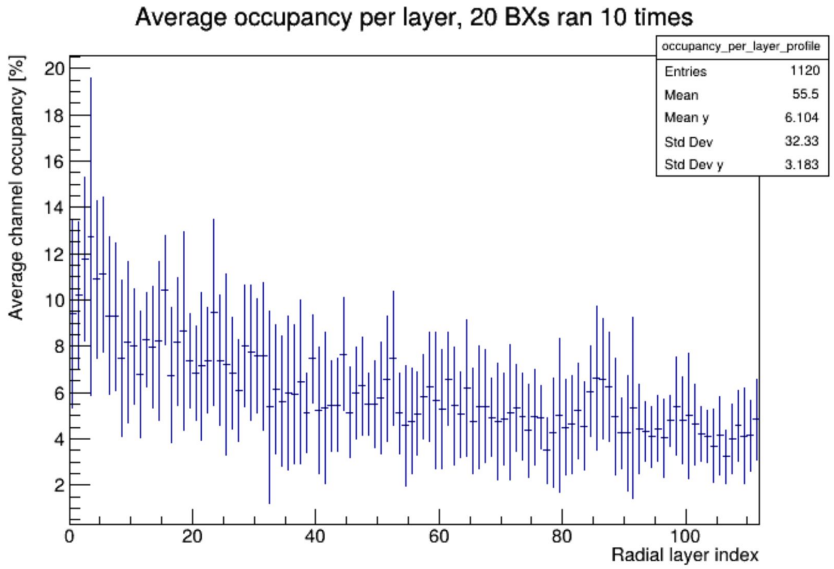


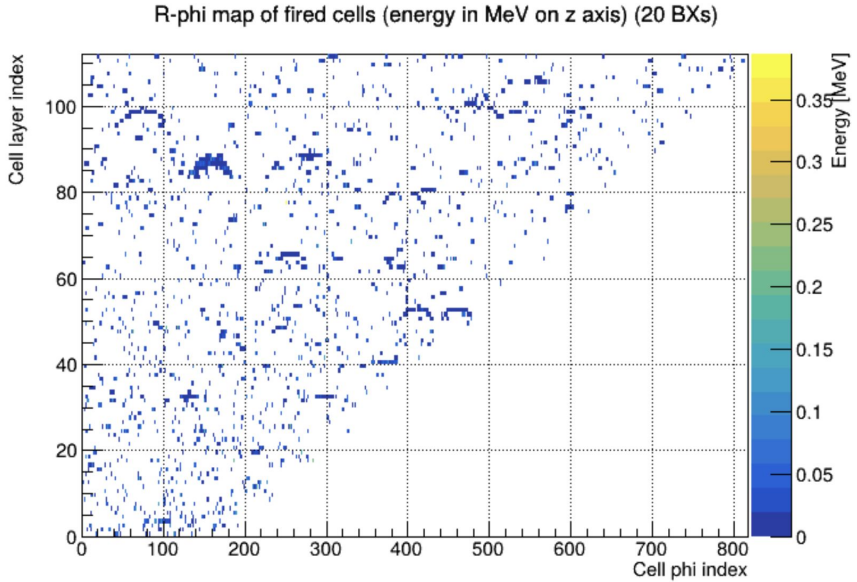
Occupancy of MC particles

Bunch (20 Bkg-Green, 1 Signal-Red)

Investigated the average occupancy for a given batch, Bkg batch was 20 event, Signal batch was 1 event

- Batched since an overlaid file has 1 signal event with 20 bkg events

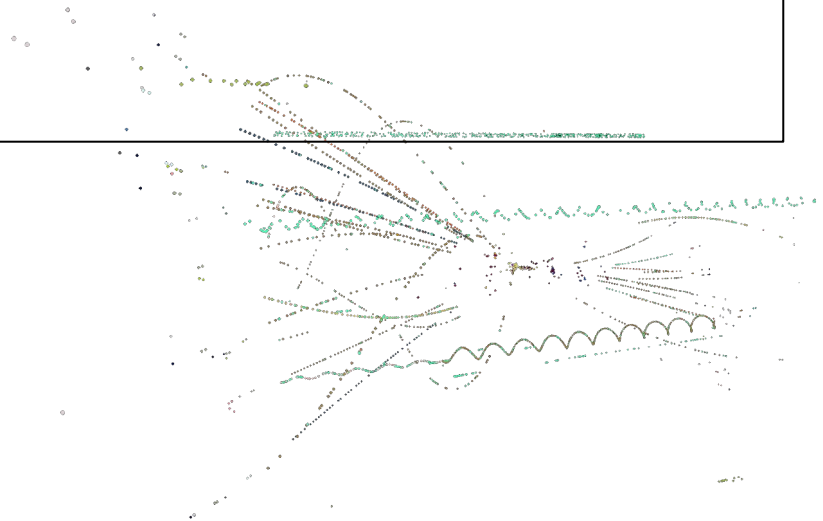




The Future

Whats next:

- Explore differences in overlaid signal and background files (using the OverlayTiming Gaudi Alg)
- Background mitigation studies using the properties of the background



Any Questions?

Thank you

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