ProtoDUNE Beam Simulation Interface Update

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ProtoDUNE Measurments Meeting

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Introduction

- Before the break, we had an initial version of the beam simulation interface working.
- Produced a single particle per event (or beam spill interaction on the target).
  - This is the simplest approach we could take, but it was the initial starting point.
- This talk details the updates made since then.

Multiple Particles

- A more realistic approach requires us to consider all particles that are produced in the beam.

- In reality we will trigger on a given particle, but there could well be other particles associated with this one.
  - Beam halo muons, particles arising from scattering, interactions etc.

- The input files contain both a list of those “good particles” that we would trigger on, plus a list of all the other particles.

Retrieving Beam Information

- I have added a section to the AnalysisTree to access the information from the protoDUNE beam generator.

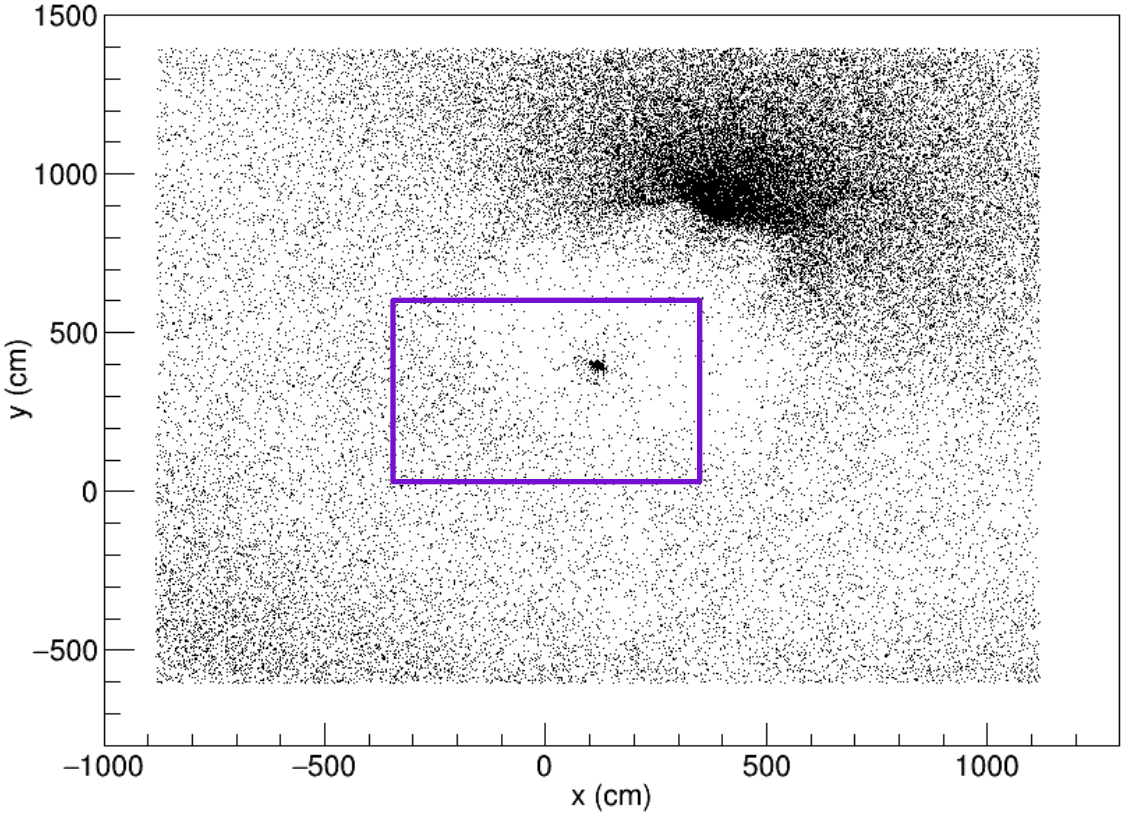
- For each beam event there is a list of all the beam particles:
  - Vertex position and time at the front face of the detector.
  - Momentum and energy on the front face of the detector.
  - PDG code.
  - Whether this is a “good particle”.

- The following plots have been made using the information from the tree.
  - 4303 beam events (a total of 4316 good particles) at +7.0 GeV.

Particle Positions

- Position of all beam particles in events with a “good particle” (looking back towards the beam).

- Purple box shows the rough extent of the active volume in (x,y)

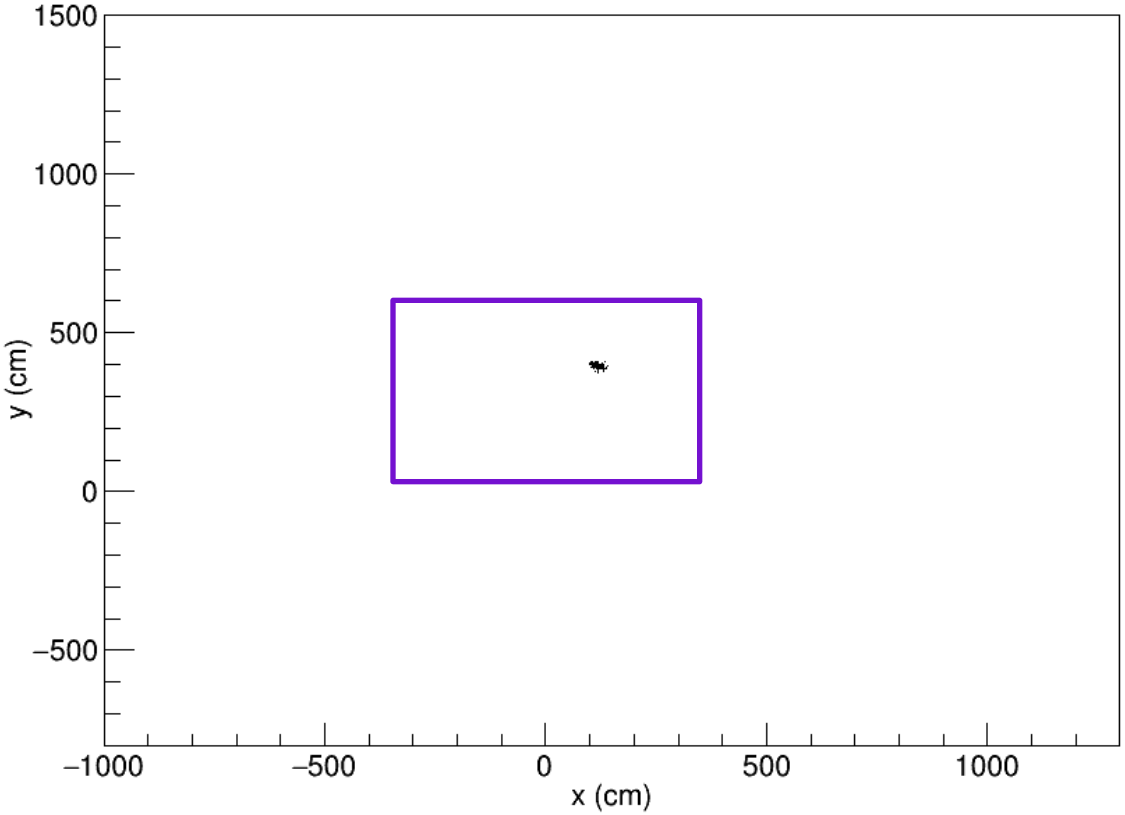


Particle Positions

- Position of all beam particles in events with a “good particle” (looking back towards the beam).

- Purple box shows the rough extent of the active volume in (x,y).

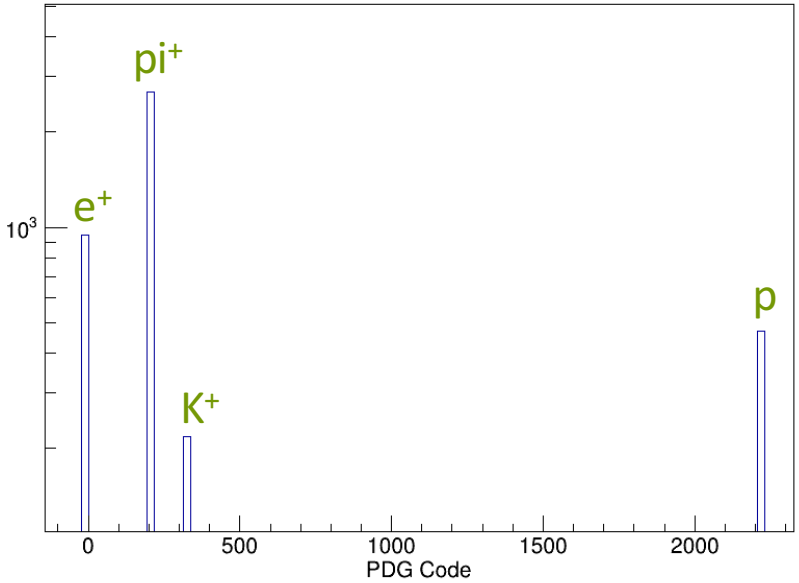
- As expected, the good particles are only in the beam spot.



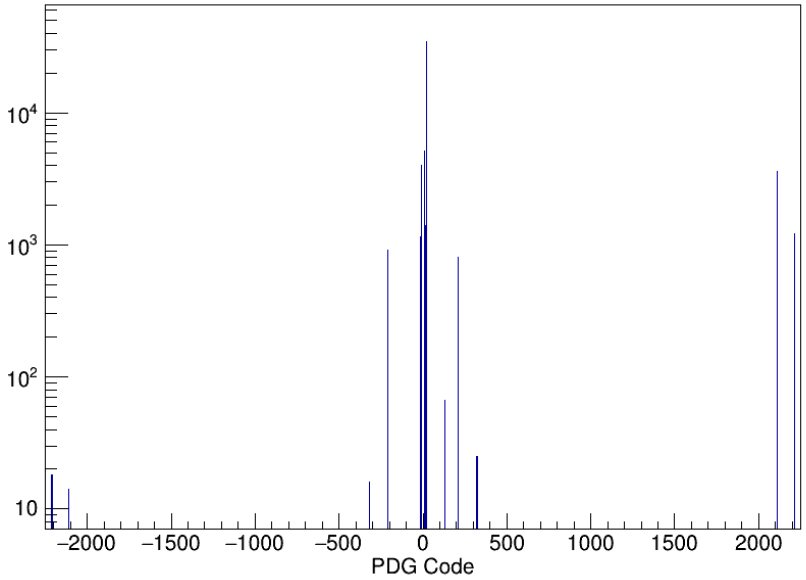
Particle Species

- The PDG code of the different particles.

Good Particles



Beam Background Particles

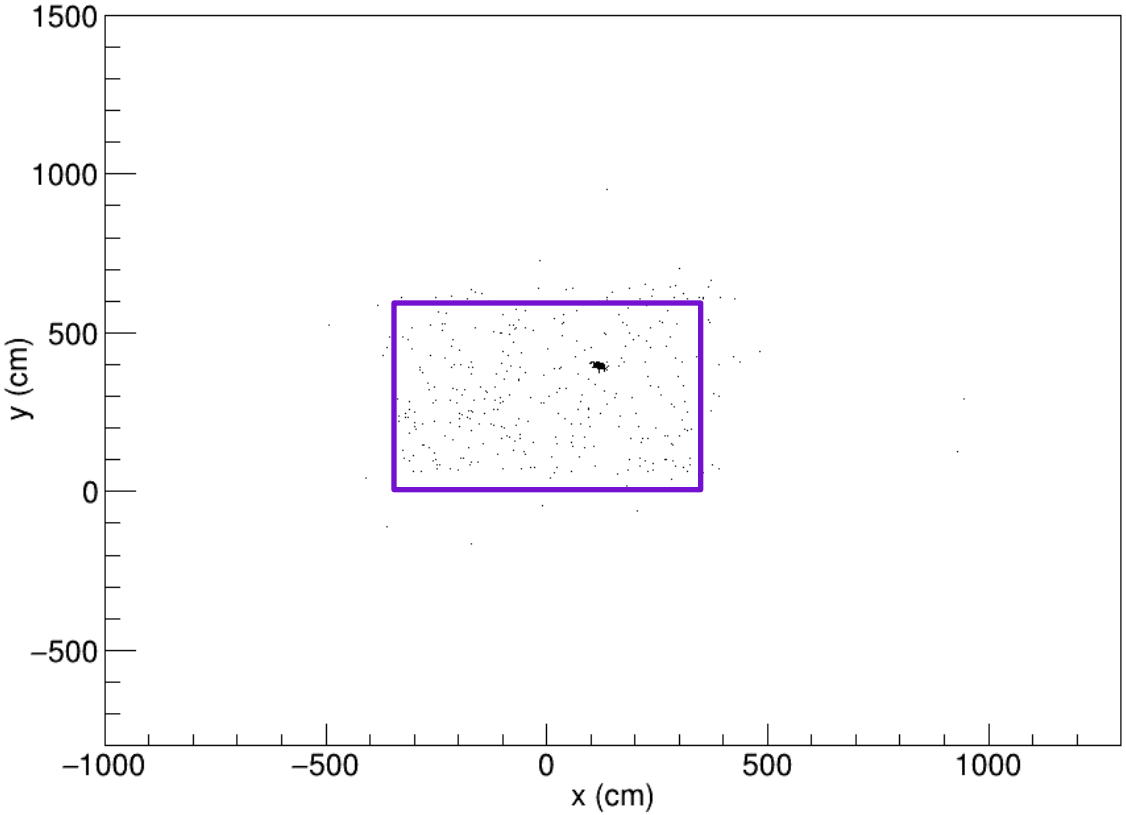


Background Particles

- Look at those beam background particles that make it into the active volume after propagation by GEANT4.

- Ignore the small region around the beam spot for now.

- Will write some code to properly identify the good particles.



Summary

- I have updated the protoDUNE beam generator module to include beam background particles as well as the main particle.
- I also added the ability to extract the beam generator information from the AnalysisTree.
- Next steps:
  - Write a macro to properly study the background particles that reach the active volume.
  - Tomorrow I will meet with Paola Sala at CERN to discuss having this interface work with her FLUKA simulation of the beam line.
  - Start working on the matching of the beam / TPC.