

S. BORDONI, L. WHITEHEAD

PRIMARY PIONS :

P. GUNS AND BEAM @2 GEV

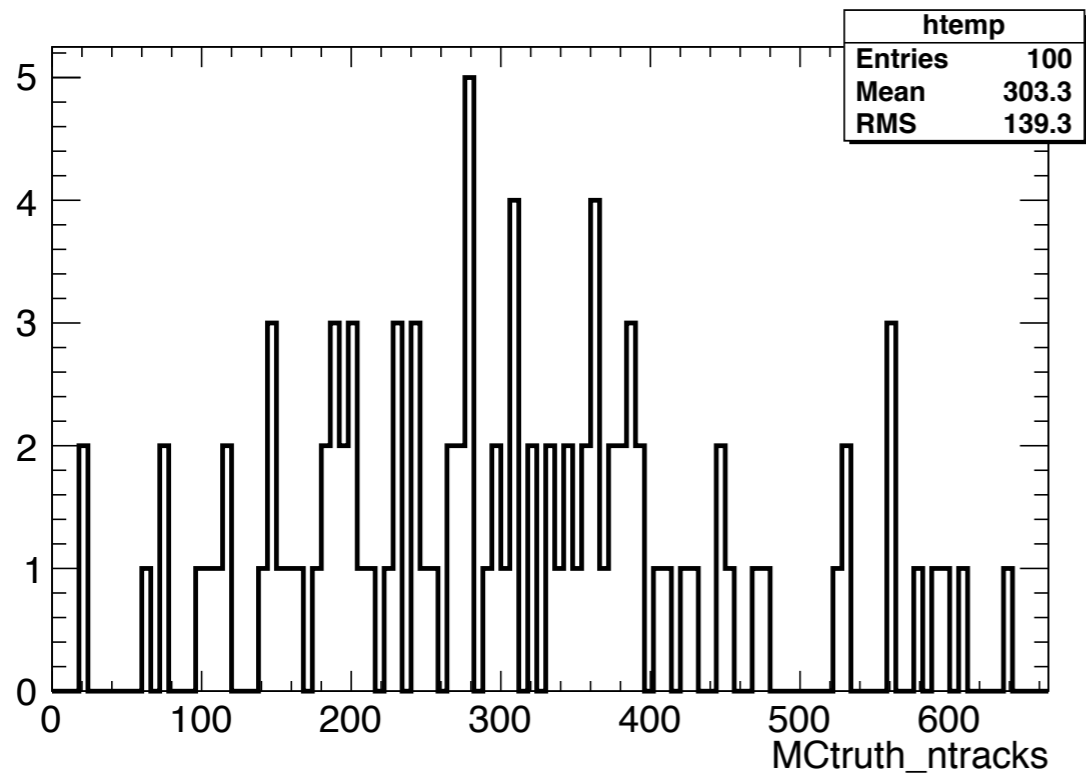
INTRO:

- ▶ First look to primary pions informations using the bare MCtruth and reconstruction informations
- ▶ PFParticle approach not abandoned but before looking at "elaborated" objects a close look to the reconstruction performances is needed
- ▶ In the next slides:
 - ▶ some plots from PGuns @ 2GeV (arbitrary choice) to have a clear view of the reconstruction performances
 - ▶ First look to beam events (thanks Leigh!) to start adding some complexity

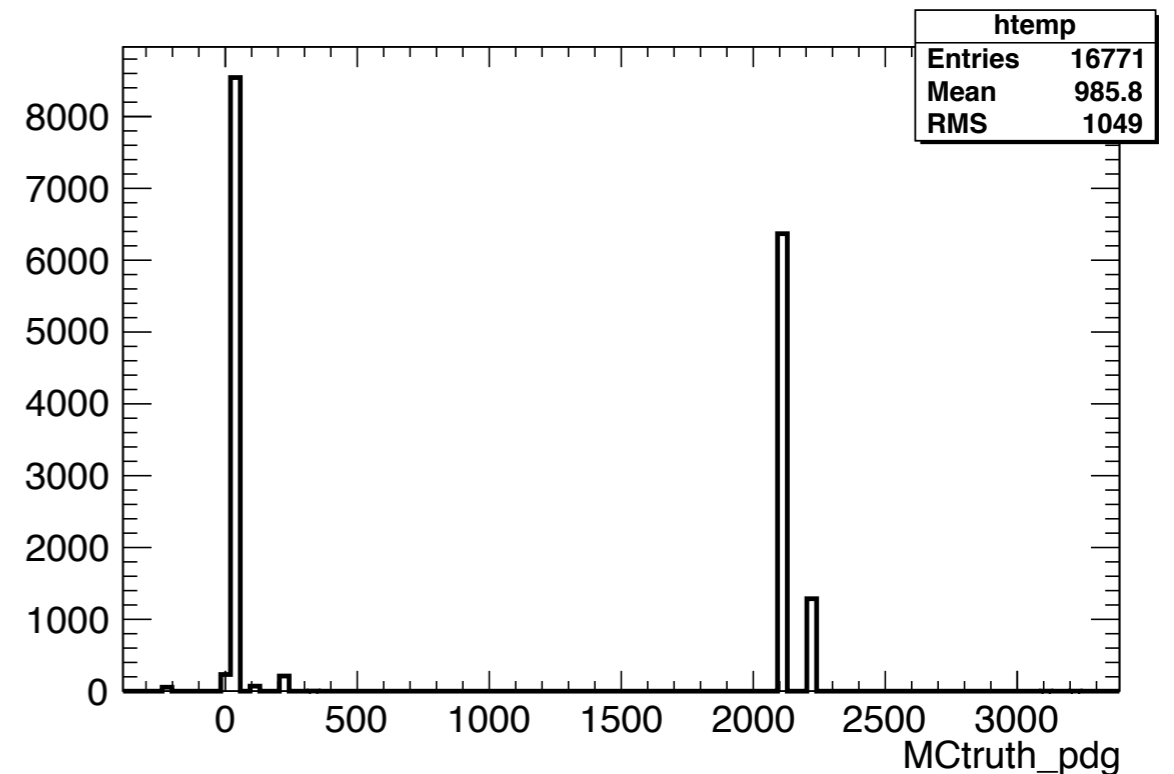
PION P. GUNS @ 26EV

MC TRUTH INFORMATIONS

N tracks per event



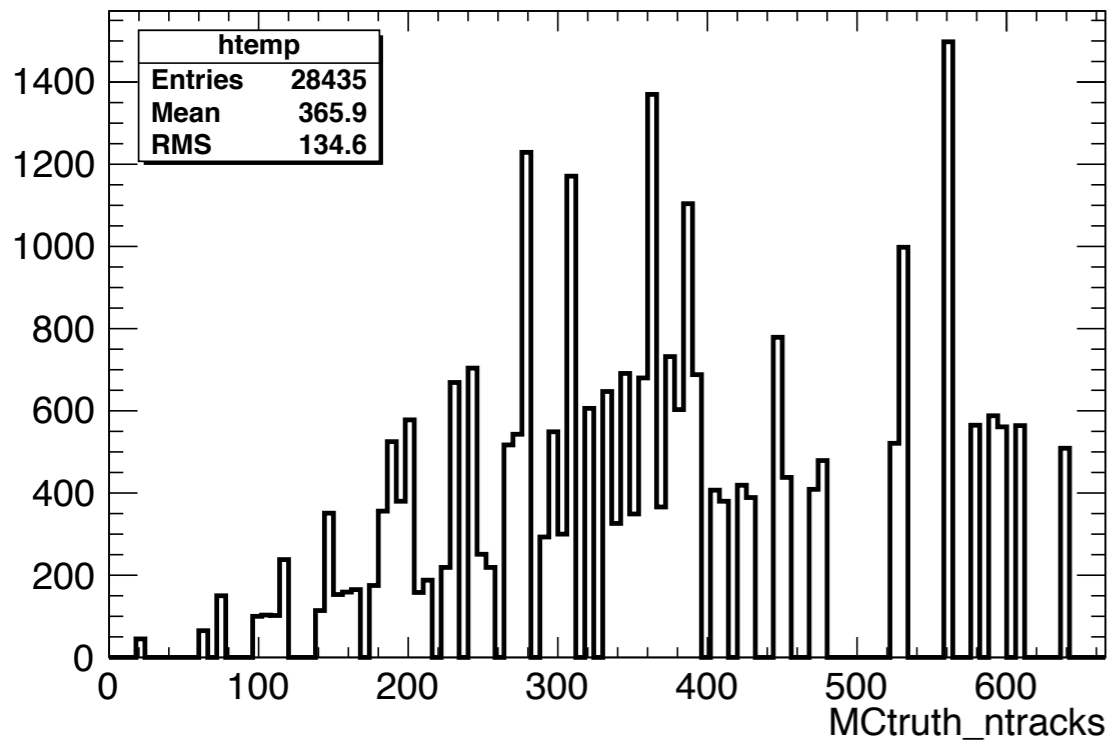
tracks PDG



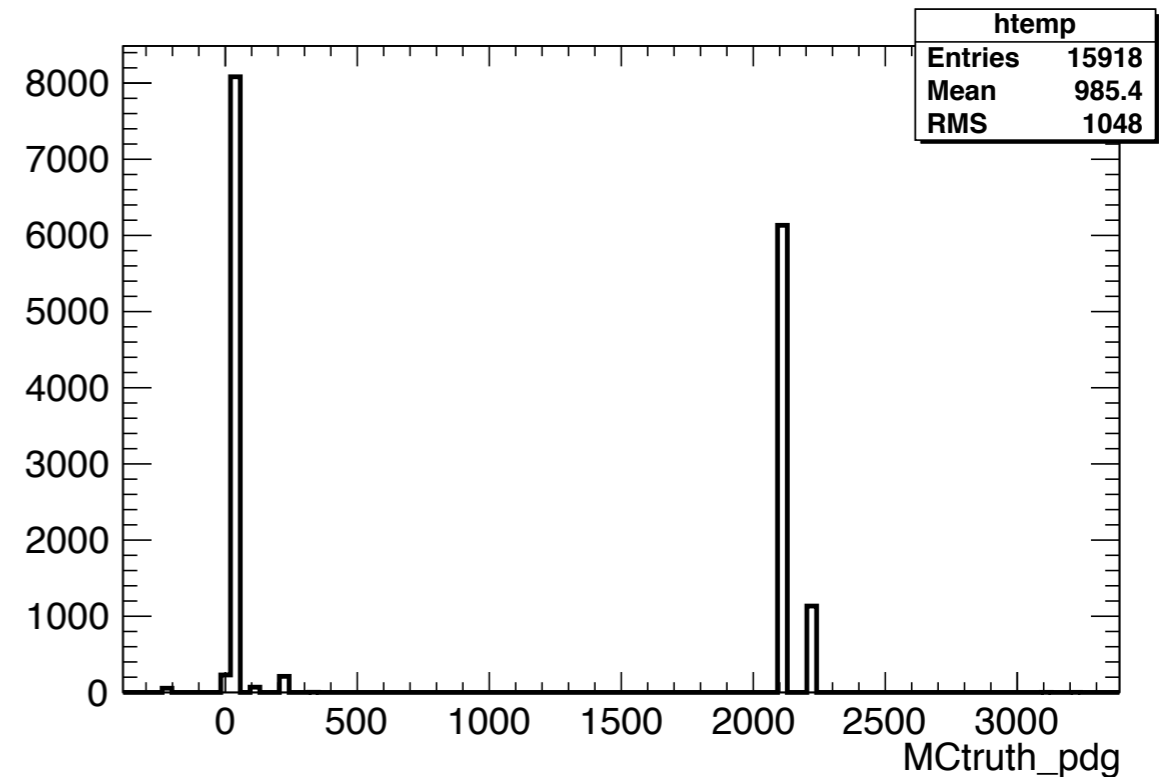
| | all tracks | in TPC active |
|-----------|---------------|---------------|
| n Tracks | 30330 | 28435 (93.8%) |
| dummy PDG | 13559 (44.7%) | 12517 (44.0%) |

MC TRUTH INFORMATIONS

N tracks per event



tracks PDG



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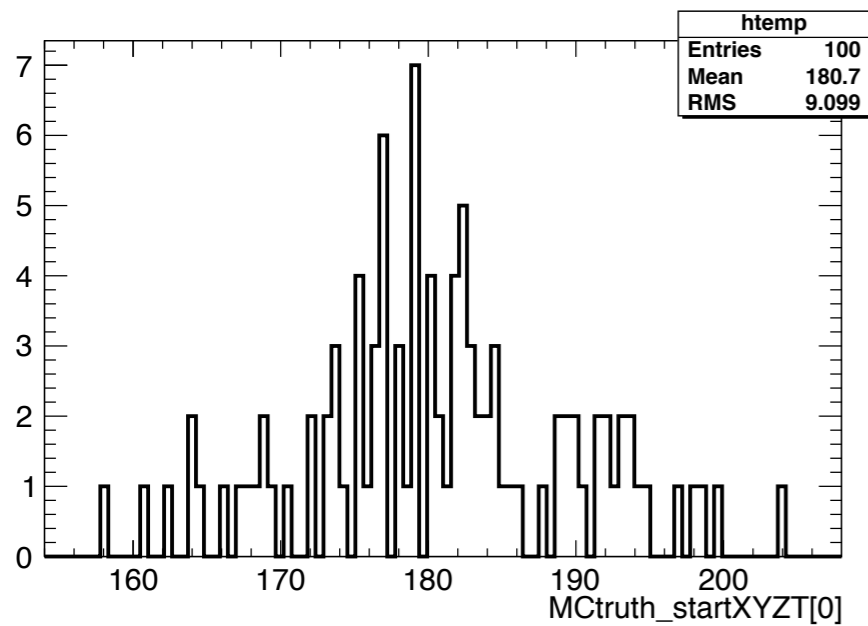
MC TRUTH INFORMATIONS

- ▶ By asking for primary particles (mother =0) we get 100 tracks as expected
 - ▶ all are pions
 - ▶ all enters the TPC active volume

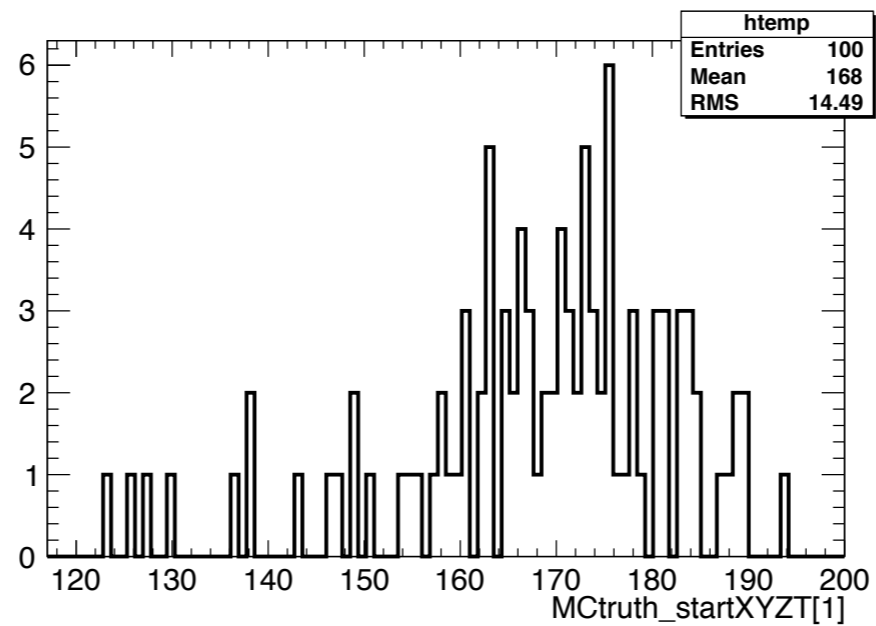
MC TRUTH INFORMATIONS

True vertex position for primary particle inside the active TPC volume

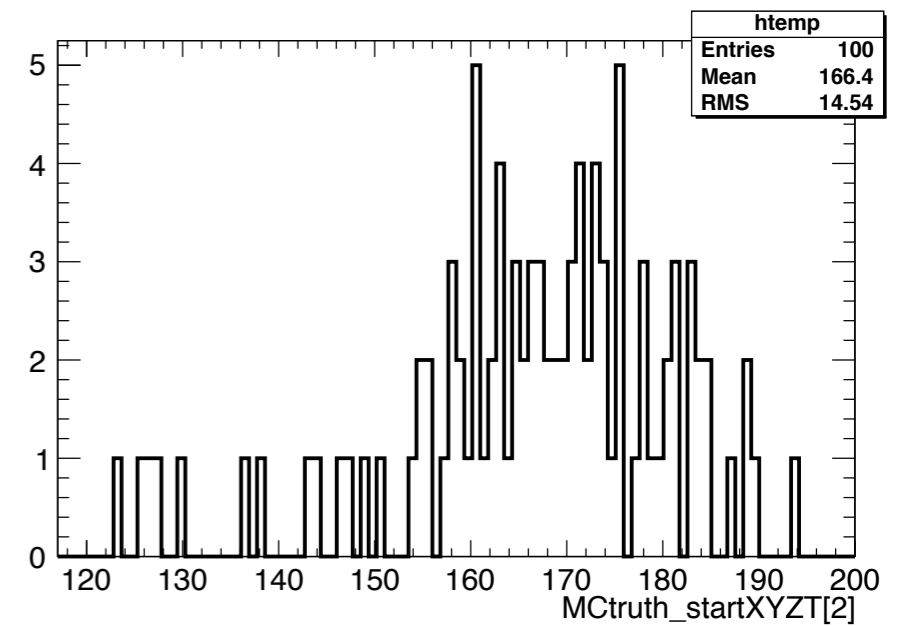
V_x



V_y



V_z



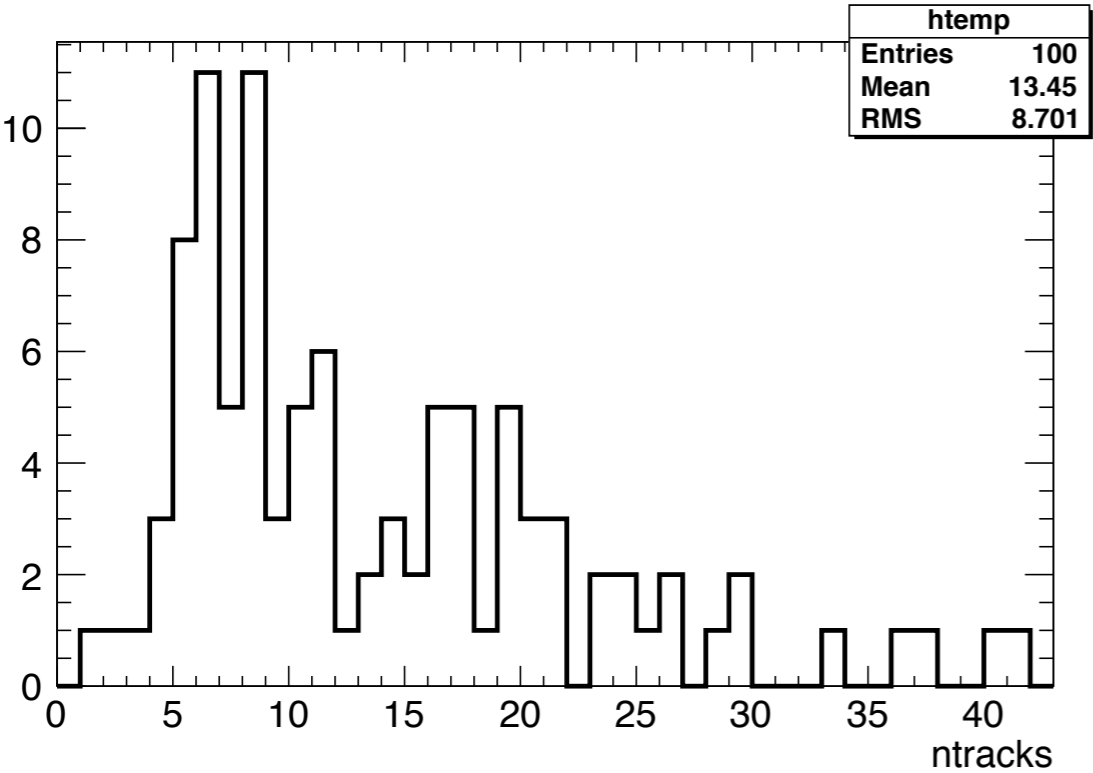
RECO TRACKS : RECO & MC INFORMATIONS

Strategy :

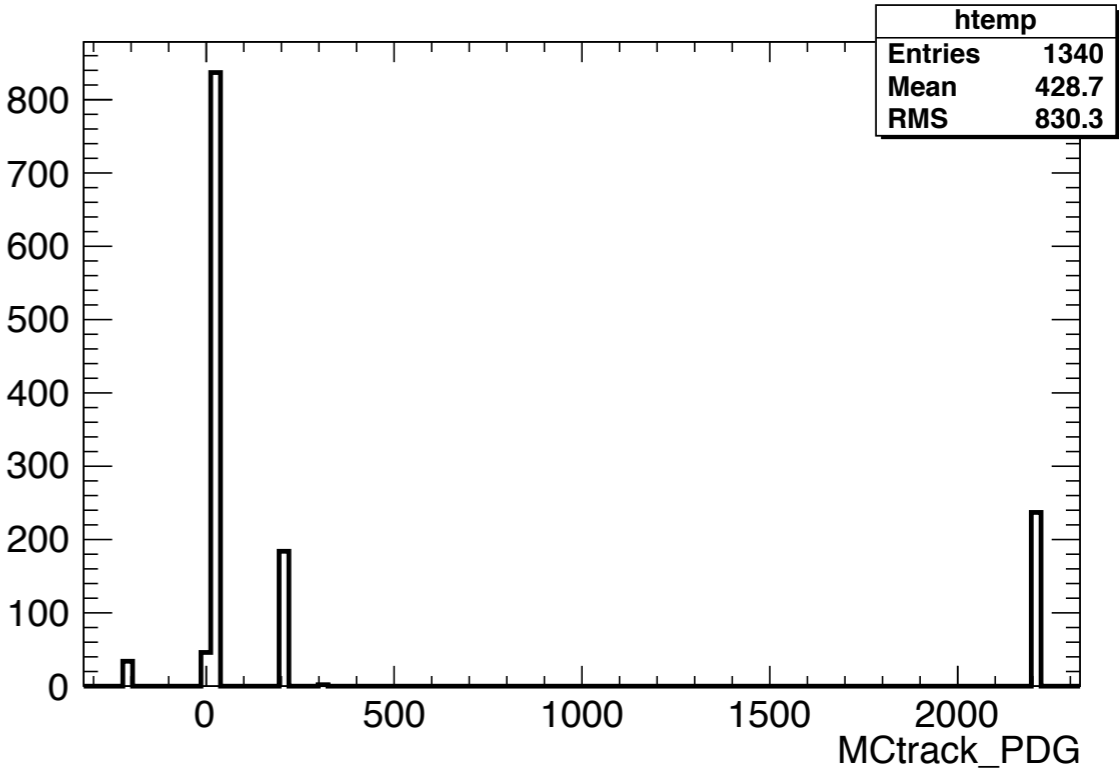
- ▶ Looking at the reconstructed tracks,
- ▶ Derive the informations about the associated tracks
 - ▶ get PDG, mother, active volume..
- ▶ Find a candidate primary particle looking at its proximity with the beam window
 - ▶ get reco infos
 - ▶ get MC infos

RECO TRACKS : RECO & MC INFORMATIONS

N tracks per event



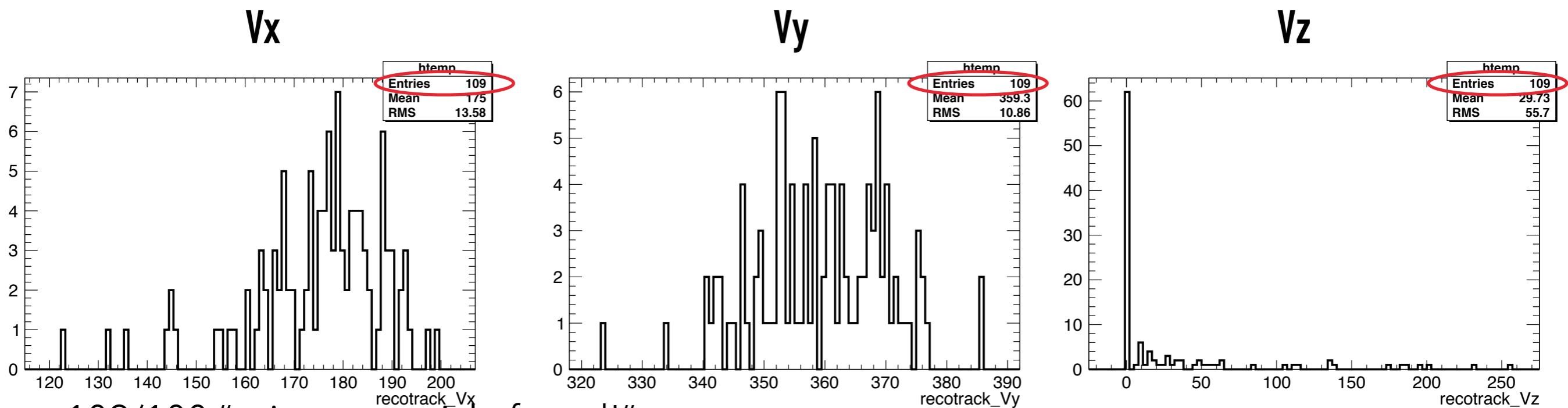
tracks PDG



99.6% of tracks with not dummy PDG (<9999)

RECO TRACKS : RECO & MC INFORMATIONS

- ▶ Vertex position for Reco tracks associated to MC tracks with mother =0

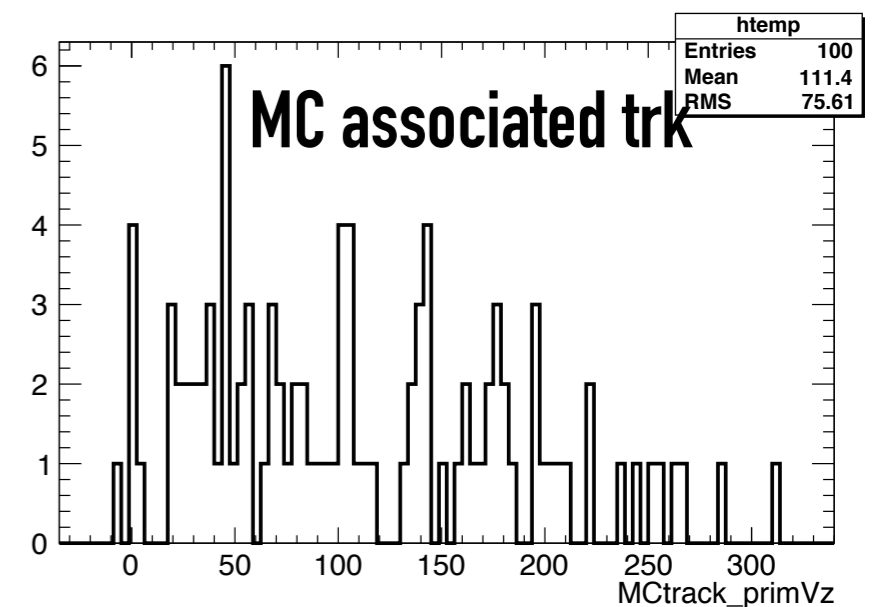
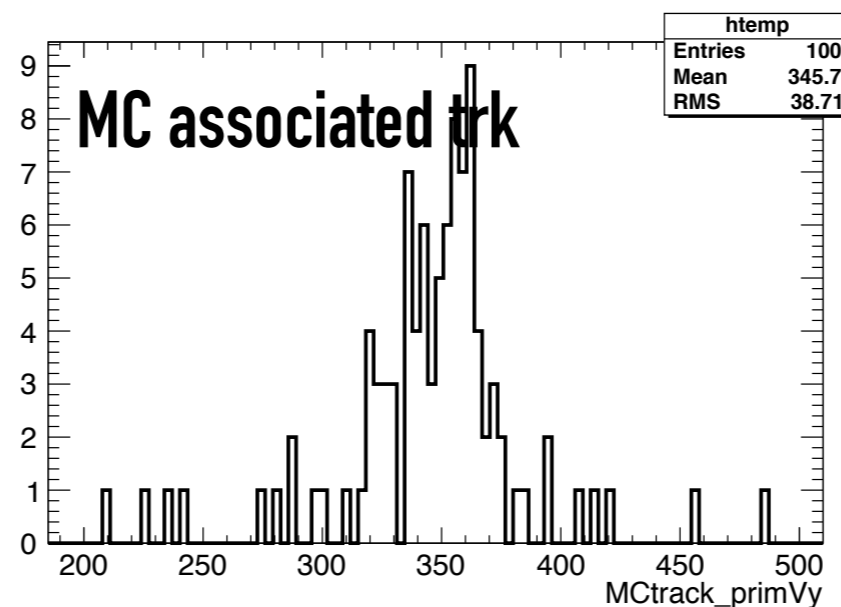
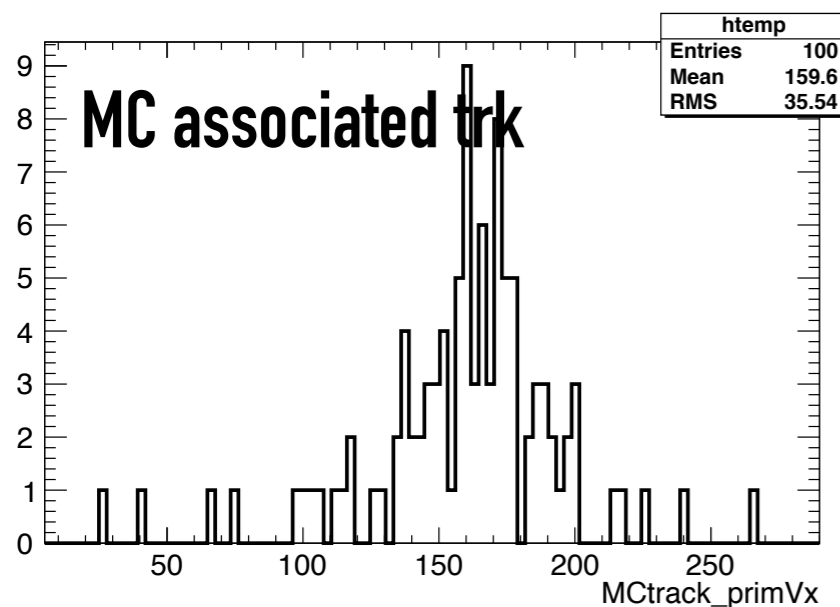
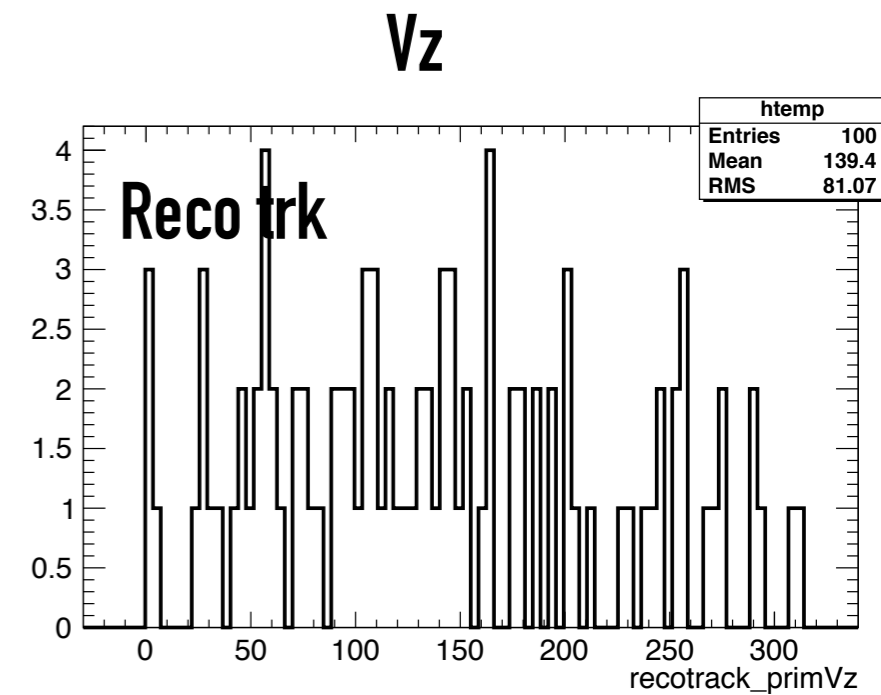
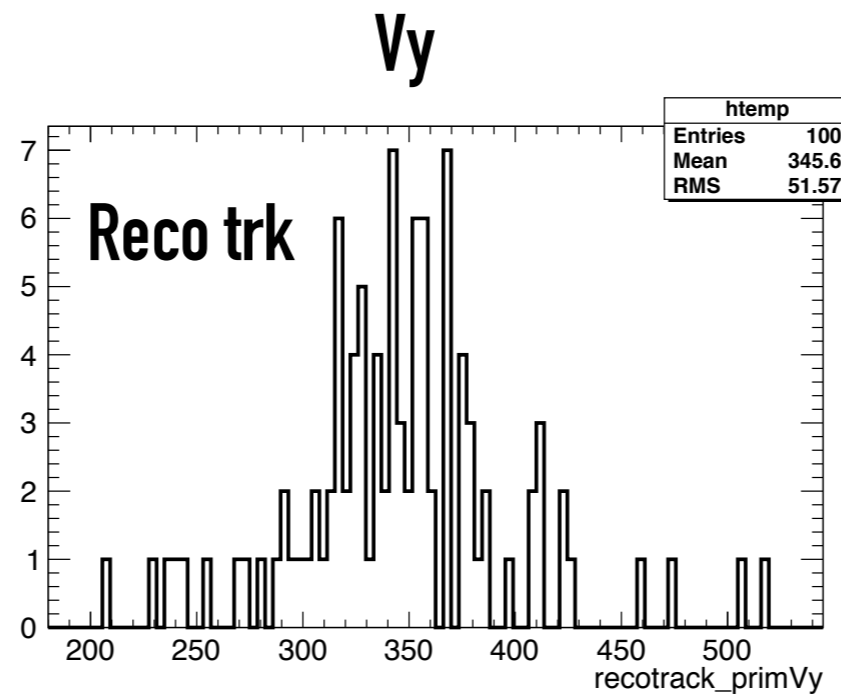
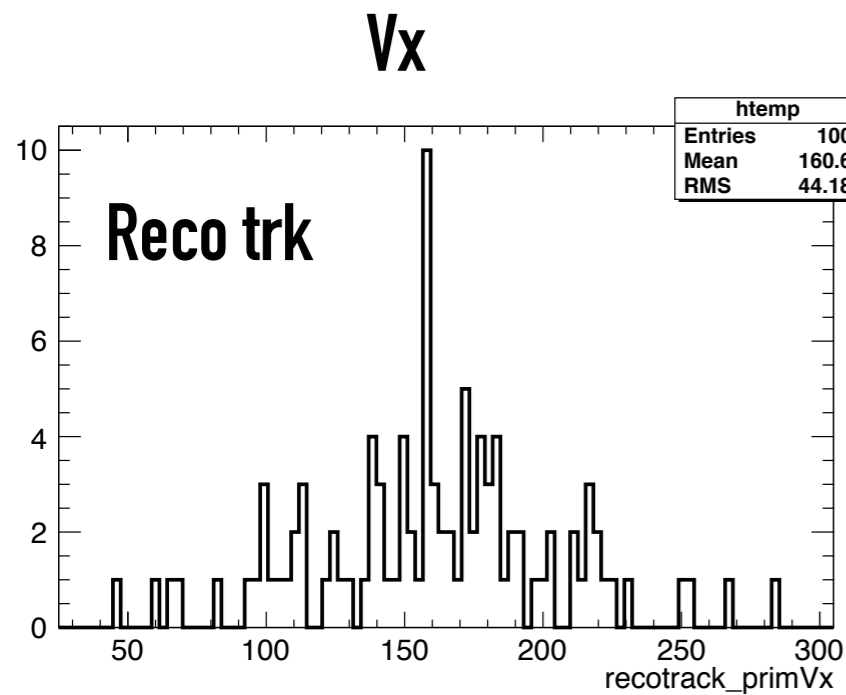


109/100 "primary particle found!"

- ▶ Broken tracks? other reconstruction issues?
- ▶ Are there variables we can use to point out reconstruction issues?
 - ▶ currently checking track length or the Trk number of measurements points . More details to be studied

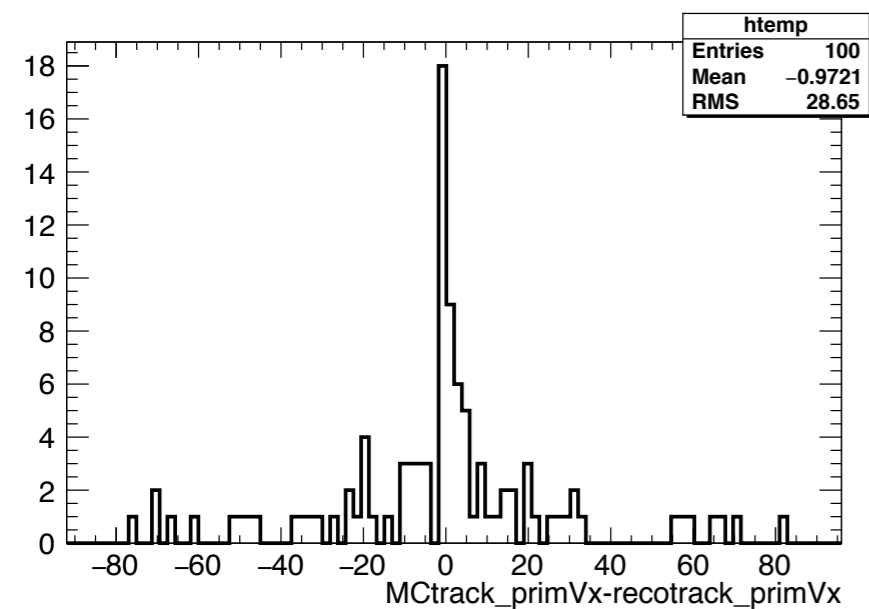
RECO TRACKS : RECO & MC INFORMATIONS

- ▶ Vertex position for closest Reco track to the beam window

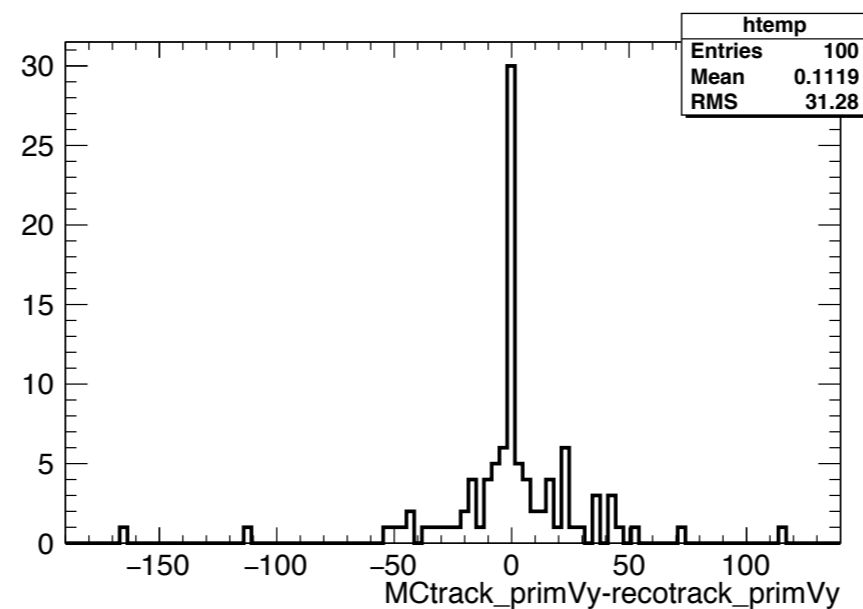


RECO TRACKS : RECO & MC INFORMATIONS

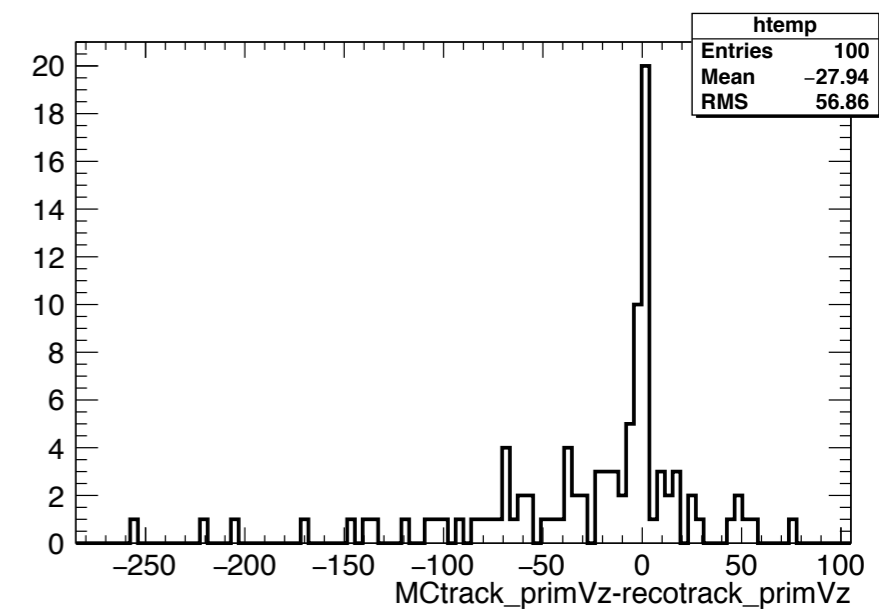
$$\Delta V_x = \text{MC} - \text{Reco}$$



$$\Delta V_y = \text{MC} - \text{Reco}$$



$$\Delta V_z = \text{MC} - \text{Reco}$$



Clearly better definition wrt to what shown using PFParticle

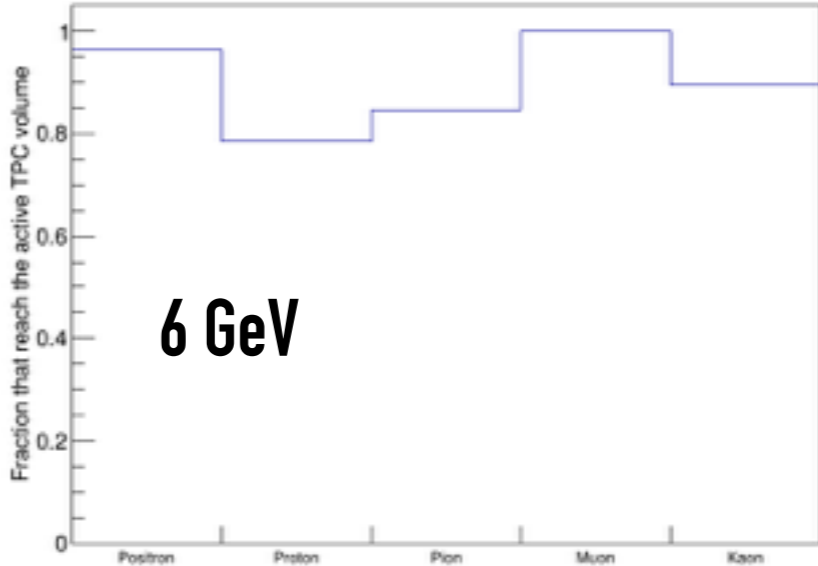
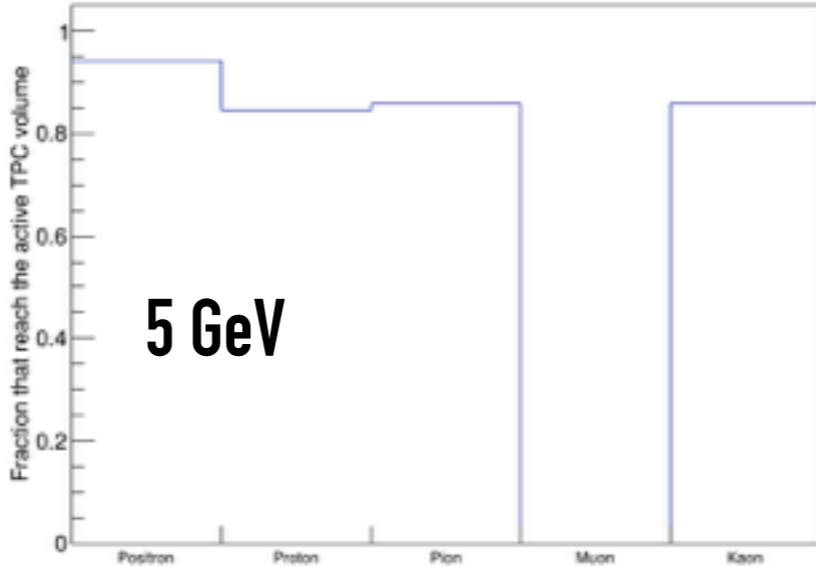
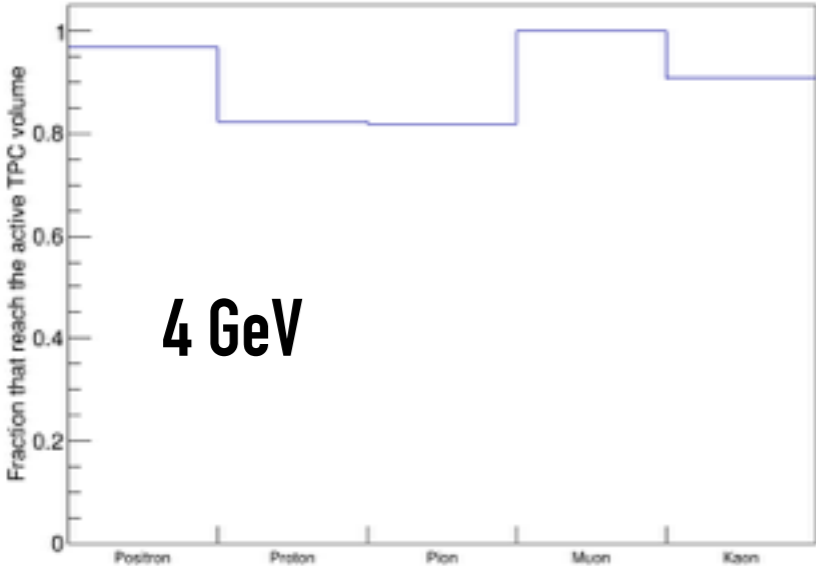
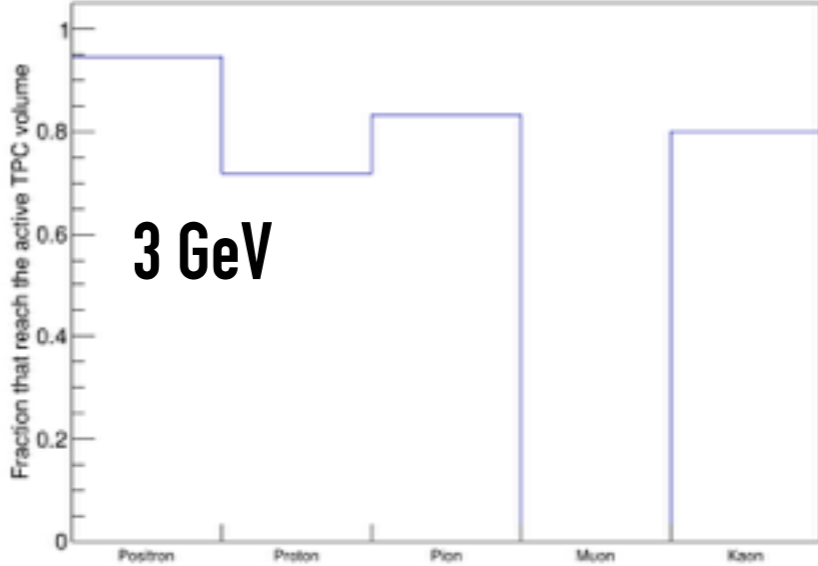
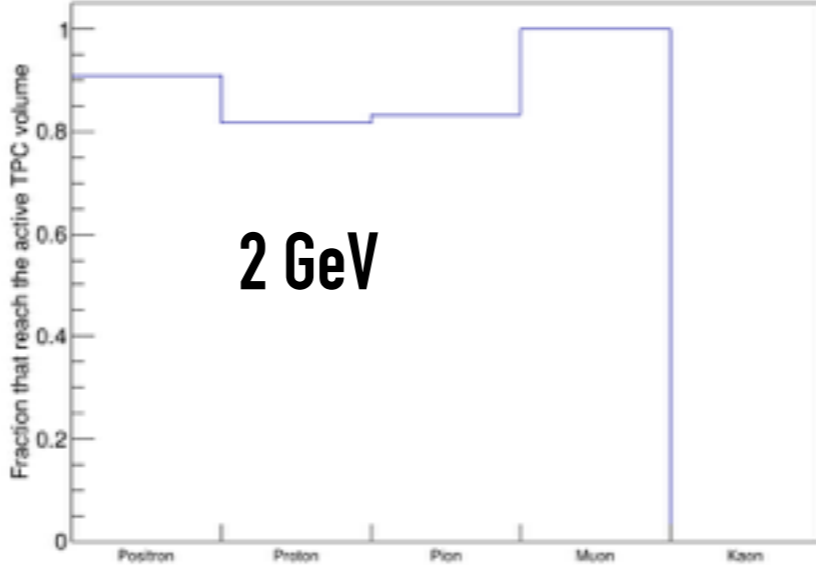
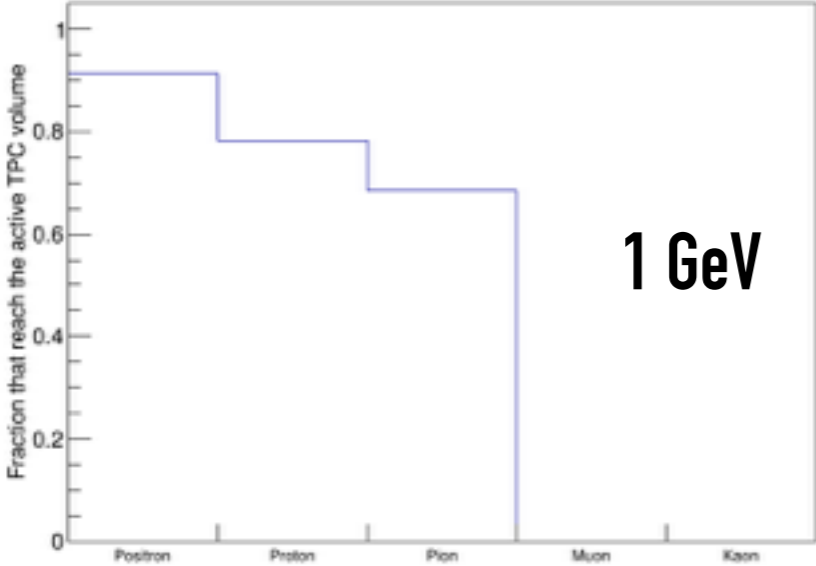
P.GUNS STUDIES SUMMARY

- ▶ First look at "raw" MCtruth and Reco informations (i.e. not using PFParticle objects)
- ▶ Understand reconstruction possible issues (broken tracks, crazy associations) by determining some key distributions
- ▶ Add info "inActiveVolume" also for Reco Tracks
- ▶ Check the quality of primary particle criteria (proximity to the beam window) by retrieving the infos of the G4 physical process
- ▶ Vertex reconstruction seems to work pretty fine

BEAM @ 2GEV

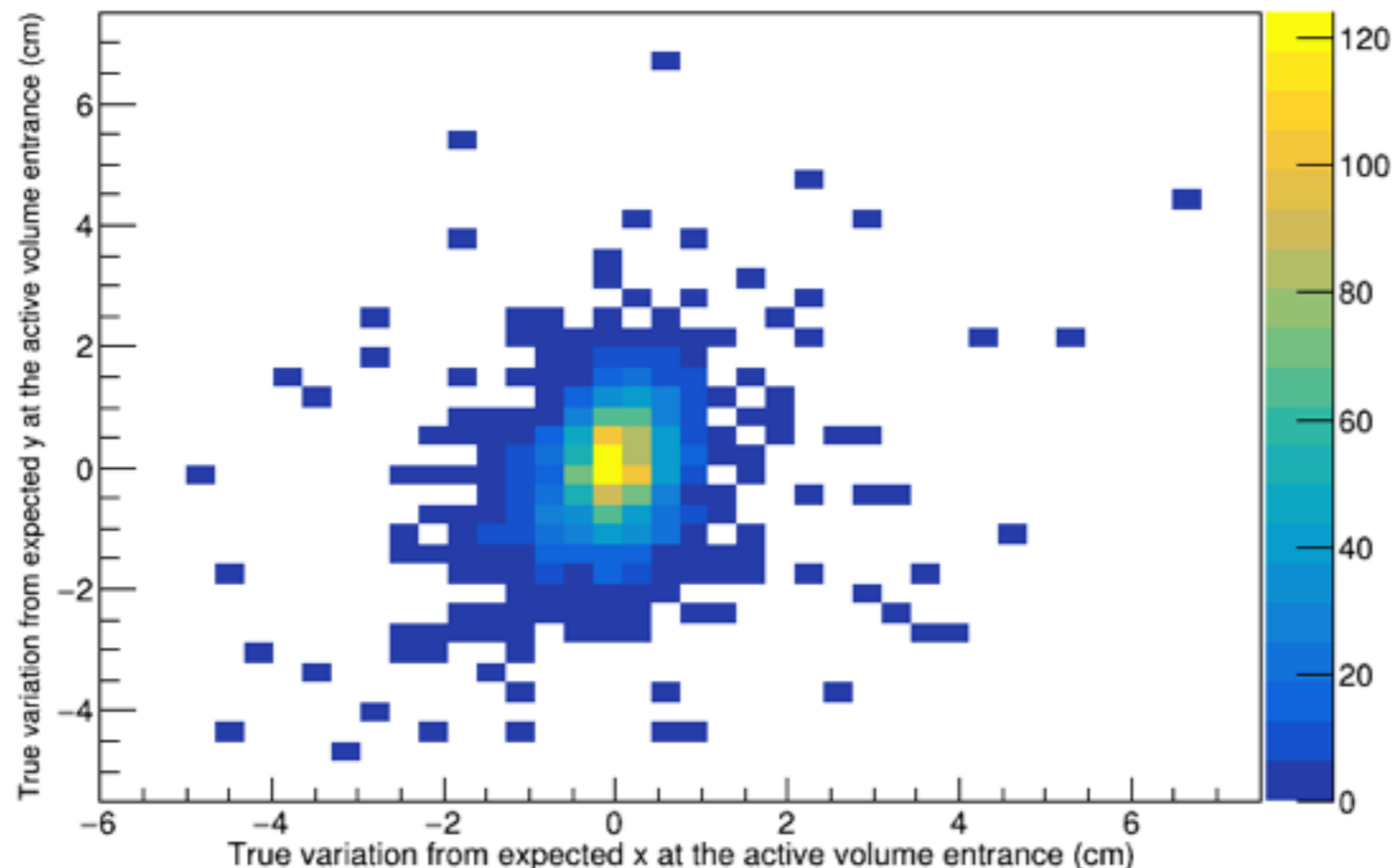
G4 INFORMATIONS : SURVIVAL FRACTION

Leigh's plots



G4 INFORMATIONS : PREDICTED POSITION IN THE ACTIVE VOLUME

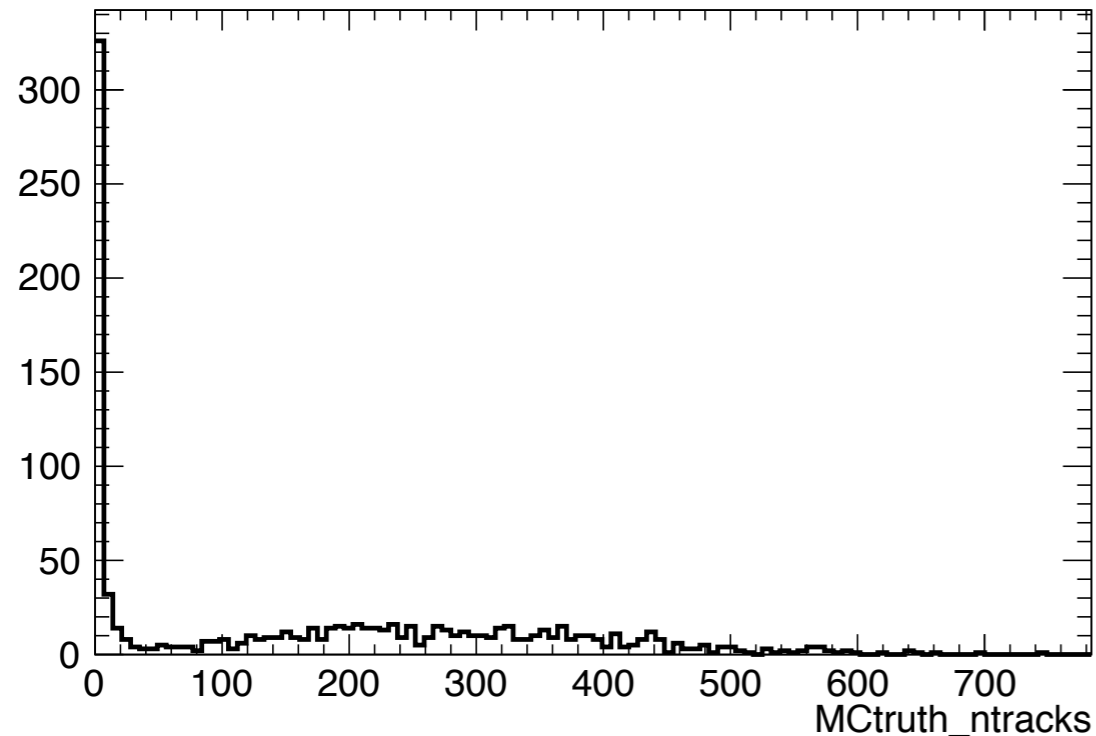
- ▶ Linear extrapolation from the last known position of the particle in the beam to the TPC active volume
 - ▶ Only Pions considered, all energies
 - ▶ Width due to particle scattering etc
 - ▶ No reco effects taken into account so far



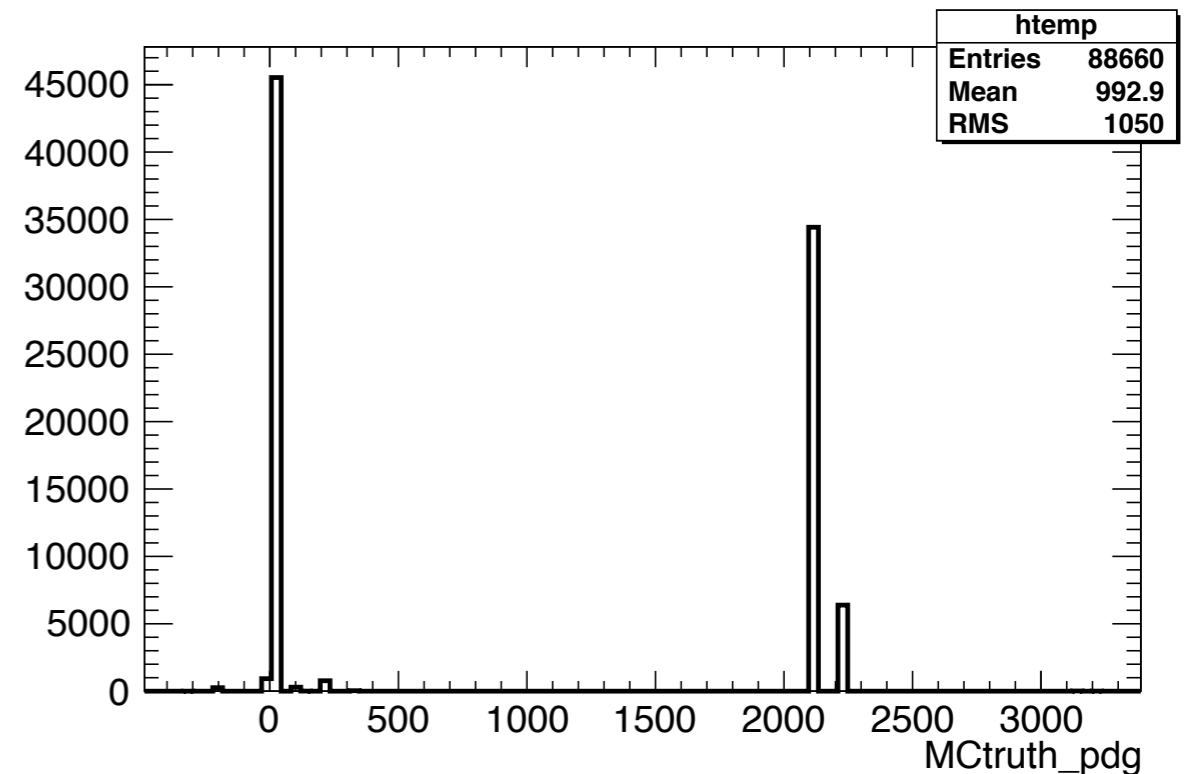
Leigh's plot

AFTER DETSIM AND RECO: TRUTH INFOS (2GEV BEAM)

N tracks per event



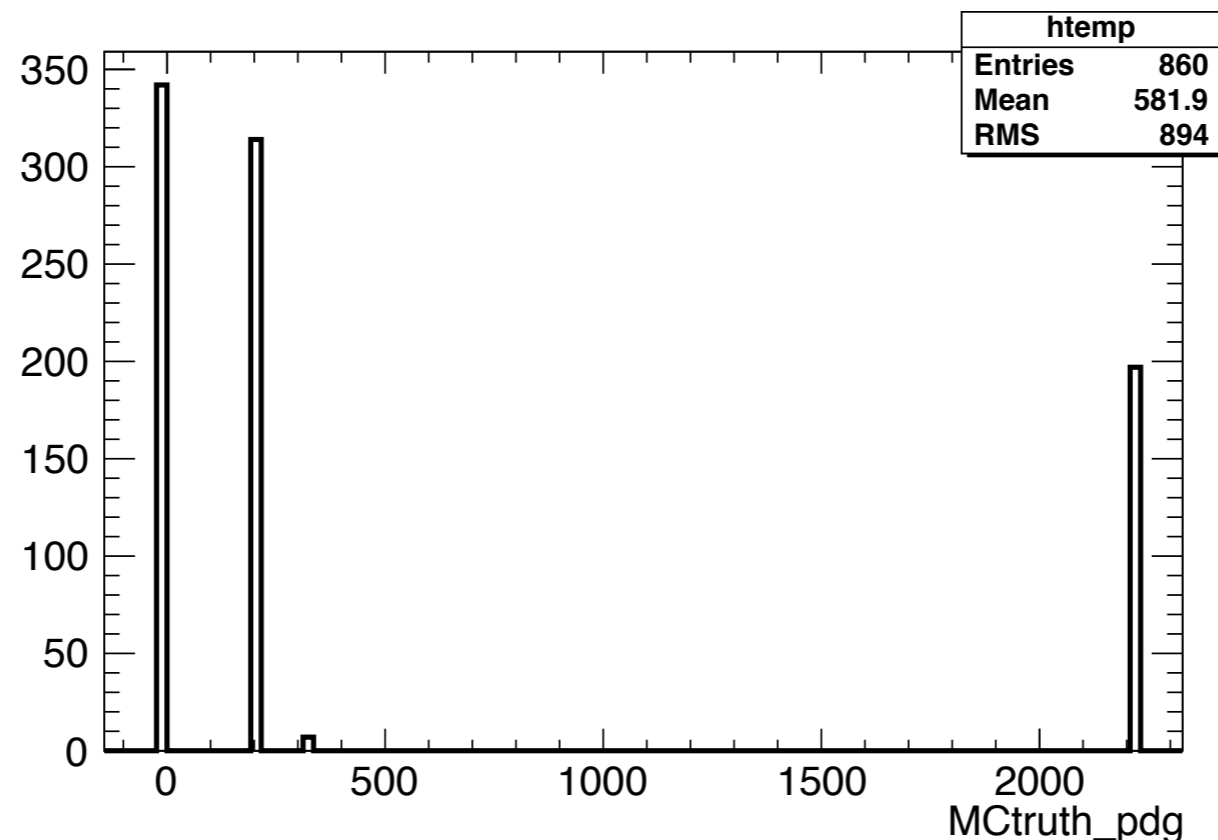
tracks PDG



- ▶ ~56% of tracks with not dummy PDG (<9999)
- ▶ ~91% not dummy PDG, in the Active TPC

AFTER DETSIM AND RECO: TRUTH INFOS (2GEV BEAM)

- ▶ 88660 true tracks in active TPC for 994 events
- ▶ 860 primary particles (86.5%) in the active TPC volume
- ▶ only 314 (36.5%) are primary pions! *in TDR at the cryostat entrance $\pi \sim 39\%$*



π^+ : 36.5%

e^- : 38%

p : 22.9%

K^+ : 0.8%

μ^- : 1.7%

BEAM SIMULATION SHORT SUMMARY

- ▶ First look at the beam simulation interfaced with LArSoft.
 - ▶ Understanding of the beam composition at the G4step (Leigh) and after detsim and reconstruction step (me)
 - ▶ First look at the infos from reconstruction on-going. Unfortunately not in time for the meeting
 - need to understand how to improve the criteria for the candidate primary particle
 - need to implement the “inside Active TPC volume” criteria

more soon..

MC TRUTH INFORMATION

P. gun position:

$$x = 118.106 \text{ cm}$$

$$y = 395.649$$

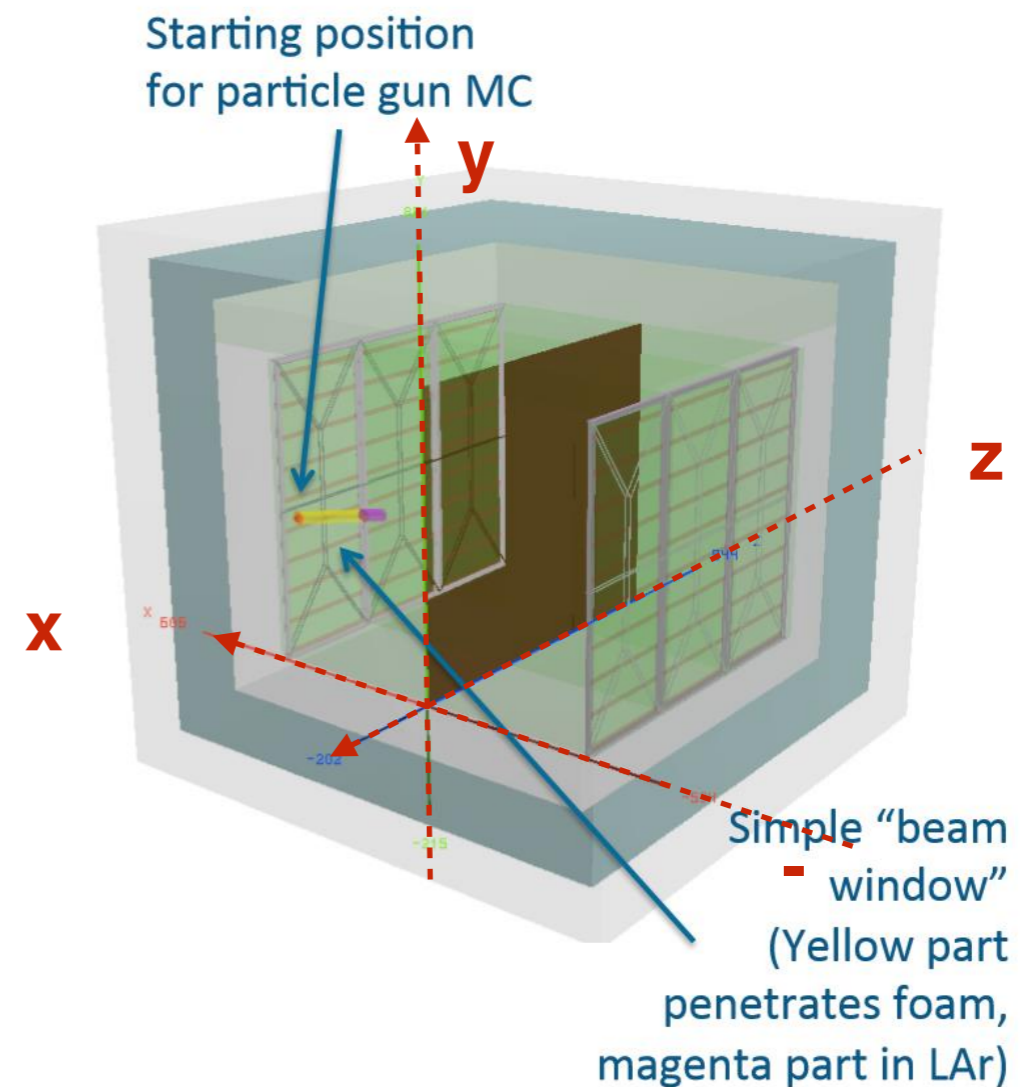
$$z = -196.113$$

TPC Active Boundaries:

$$x: -380.434 \text{ to } 380.434$$

$$y: 0 \text{ to } 607.499$$

$$z: -0.49375 \text{ to } 695.286$$



G4 protoDUNE simulation