2x2 Multiplicity Study: Current Status

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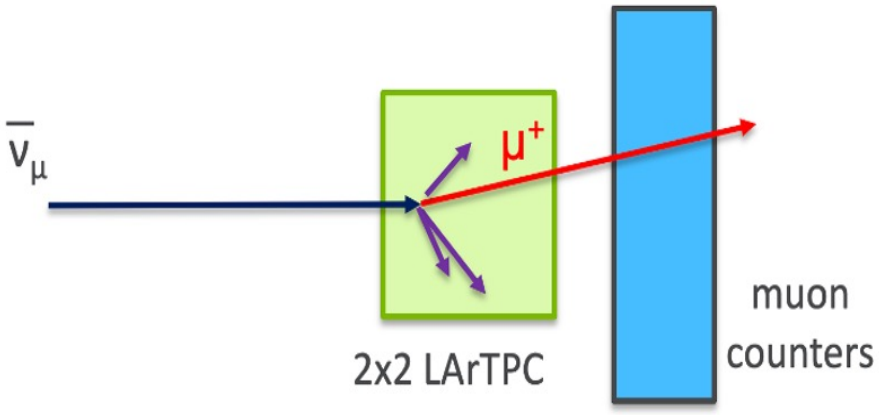
Charged Particle Multiplicity Study Status

(Zelimir, Bilal)

- Current Effort is focused on
  - -Understanding of Final State charged particles distribution
  - -Optimizing the selection of the charged particles
- Use MiniRun4 Simulation and corresponding ML-reco files
  - -In contact with ML-reconstruction group
  - -Presenting/discussing intermediate results at ML-reco meetings
- Updates since previous “First Analysis” report
  - -Using nearly the full ML-reco file statistics in h5 format
  - -Comparison of ML-reco “observed” to ML-reco “truth”



Charged Particle Multiplicity Study Status

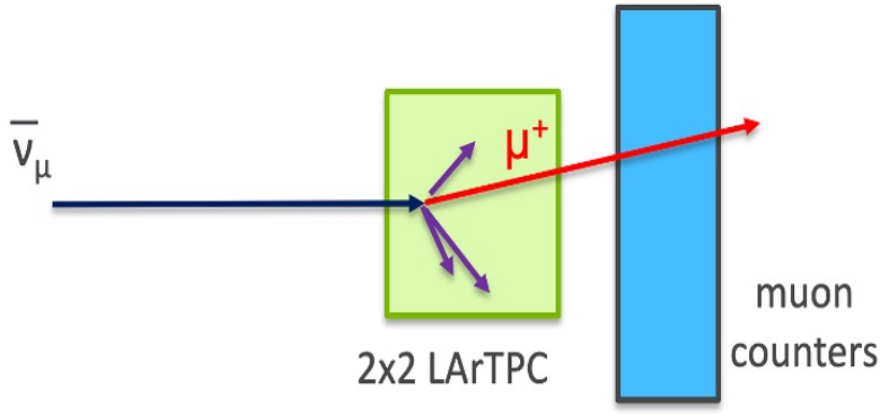
(Zelimir, Bilal)

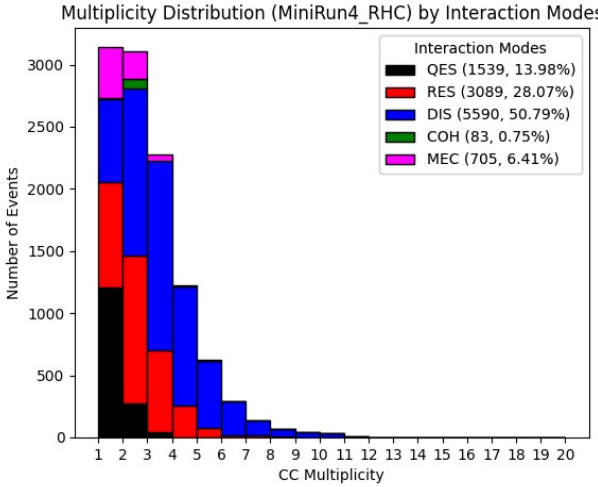
What do we expect to see?

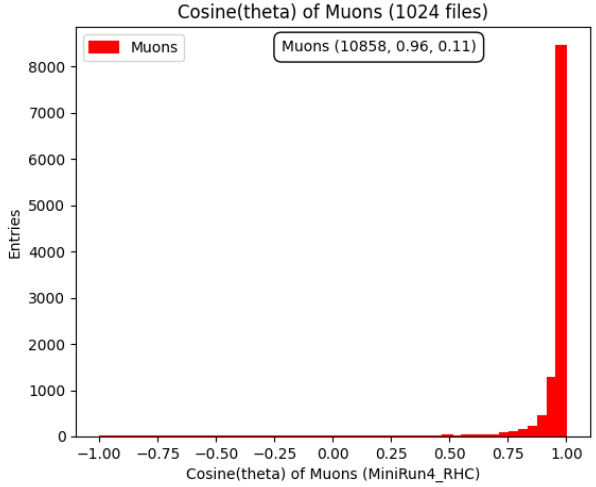
-Based on MiniRun4 Geant4 truth

-With the following conditions:

CC interactions within LArFV
track length > 5cm,
10 cm from outer boundaries along x, y, z
10 cm from inner boundaries along x, z.







(example of distributions we expect to see)

Charged Particle Multiplicity Study Status

(Zelimir, Bilal)

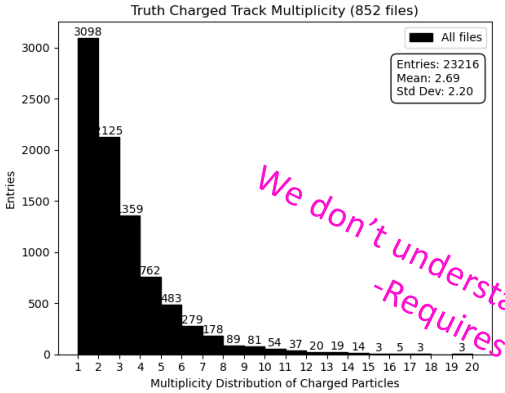
What do we have observed:

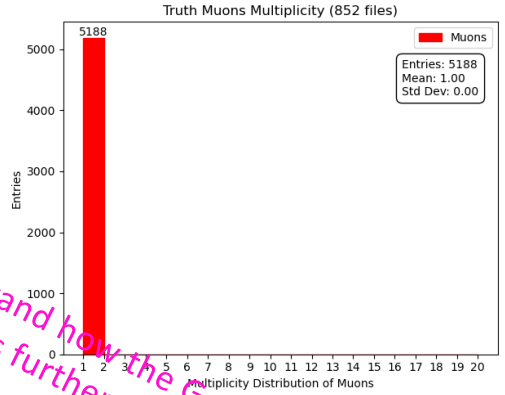
-Based on MiniRun4 ML-reco h5 files

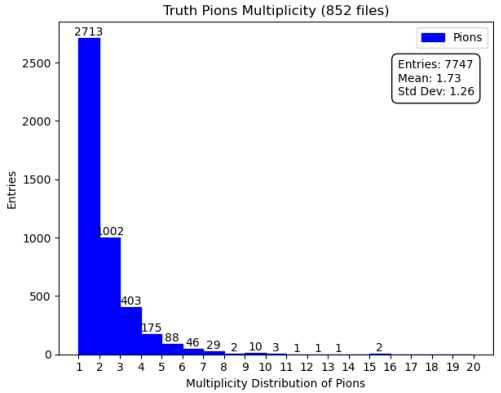
-With the following conditions:

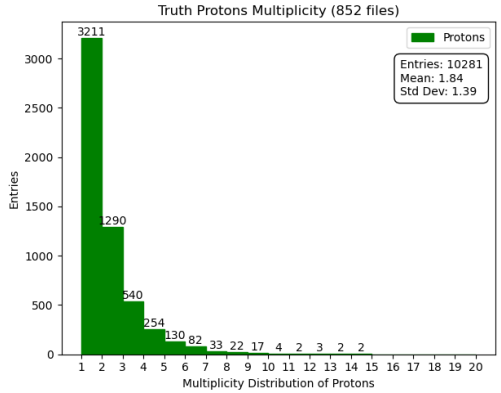
CC interactions with single muon
within LArFV
track length > 5cm,
10 cm from outer boundaries along x, y, z
10 cm from inner boundaries along x, z.

ML-reco "Truth"



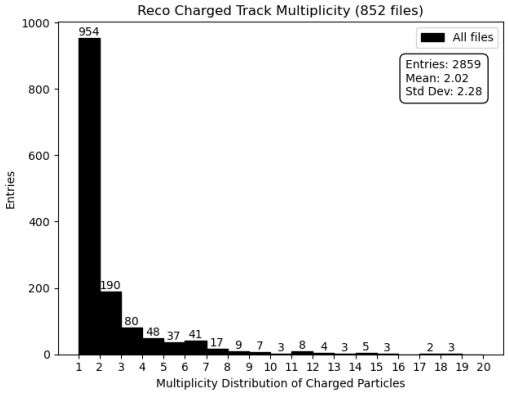


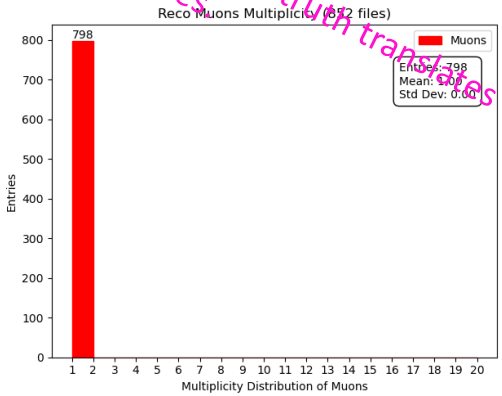


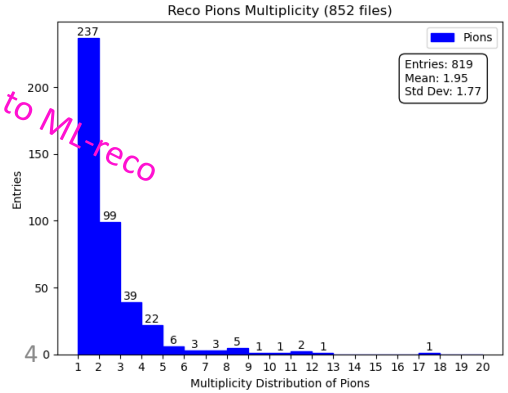


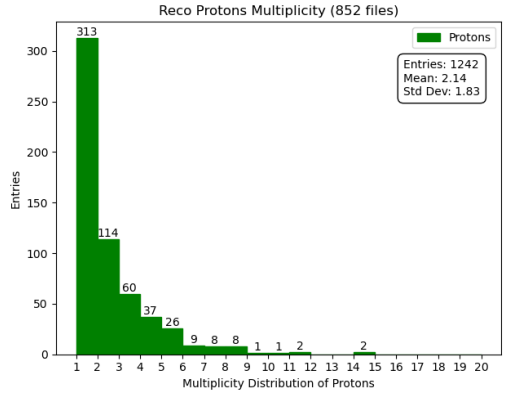
We don't understand how the Geant4 truth translates to ML-reco
-Requires further studies

ML-reco "Observed"





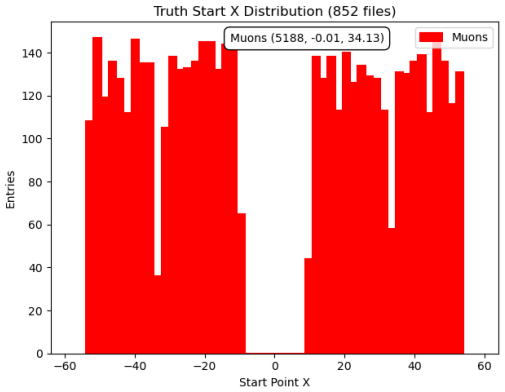


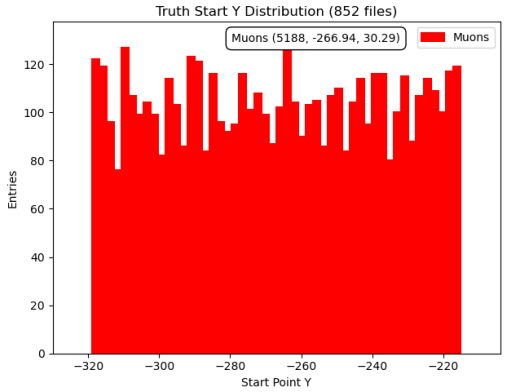


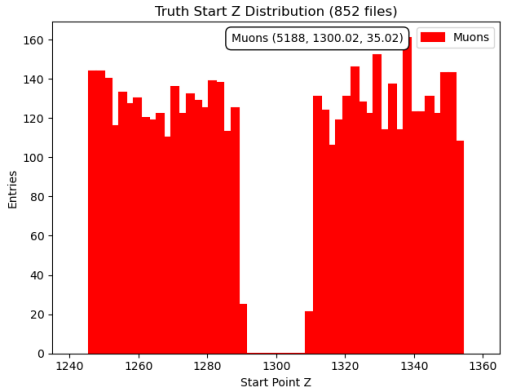
Charged Particle Multiplicity Study Status

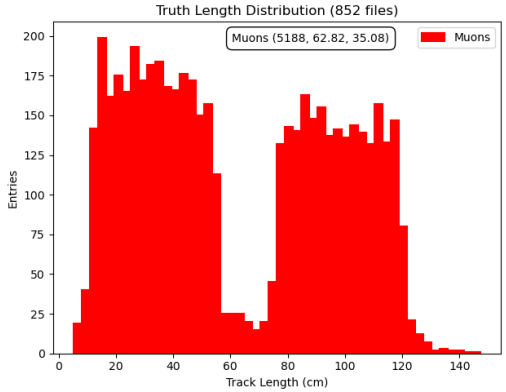
(Zelimir, Bilal)

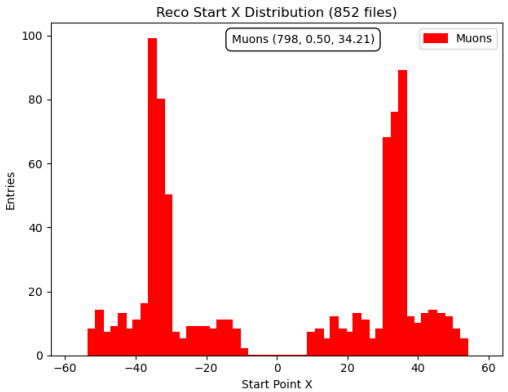
- Truth and Reco muons' starting vertices are shown here.
- Two distinct peaks on Start X for Reco Muons, around 35 cm, likely because of cathodes "discontinuity"
  -Requires further studies.

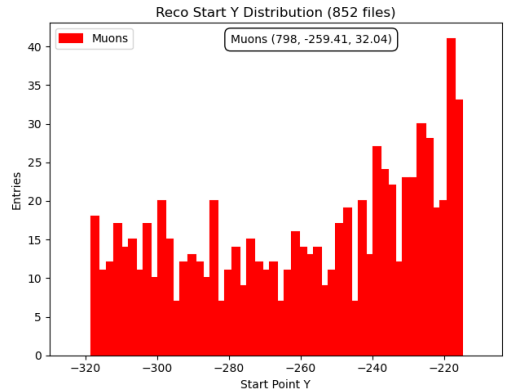


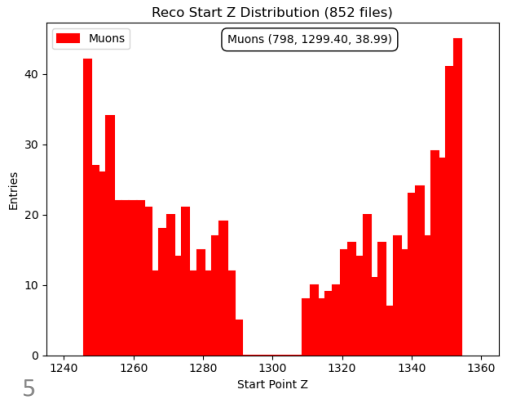


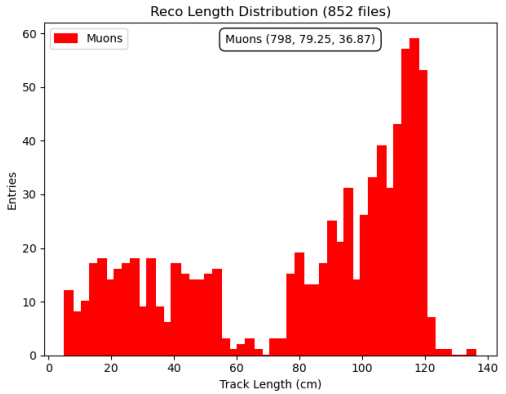








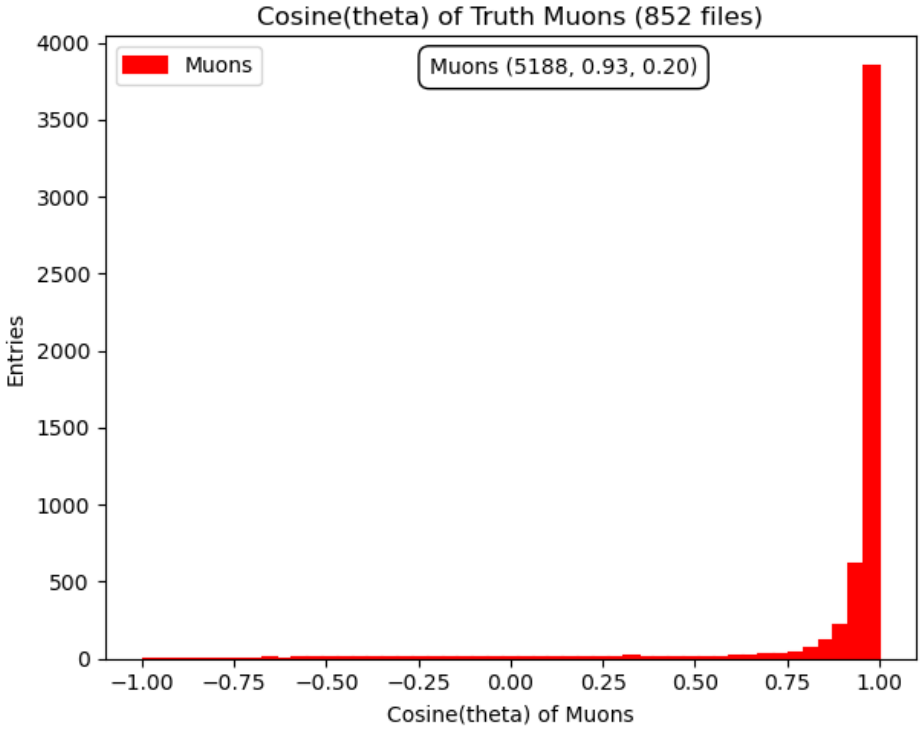


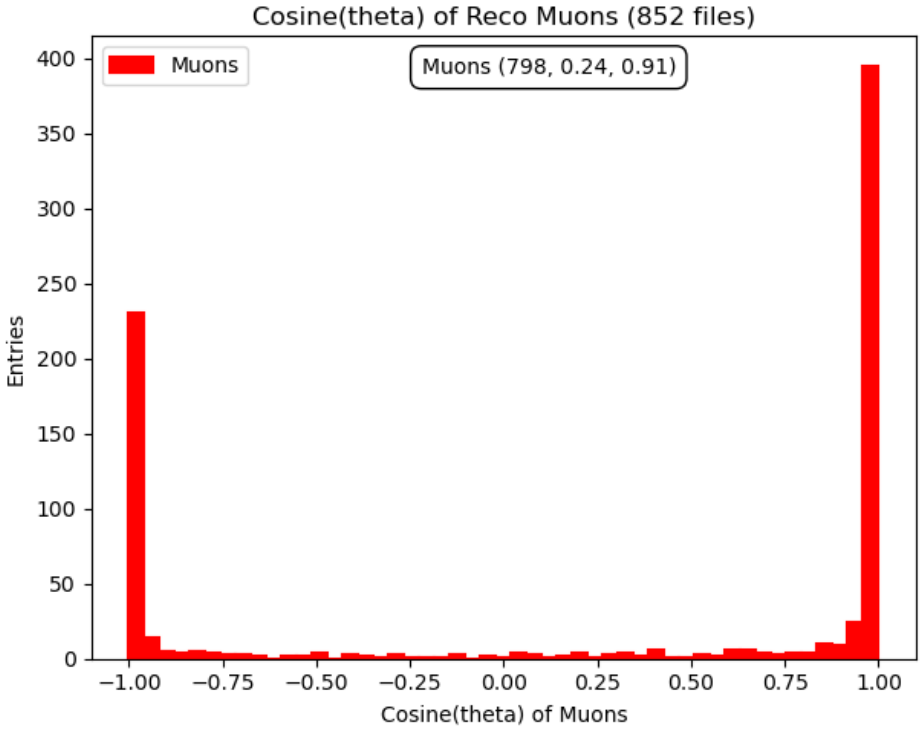


Charged Particle Multiplicity Study Status

(Zelimir, Bilal)

- Truth and Reco muons' cosine distributions presented.
- Almost all the truth muons are forward-going.
- In reco muons distributions there are "backward" oriented muons; ML-reco does not necessarily know the muon direction
  -Requires further study.

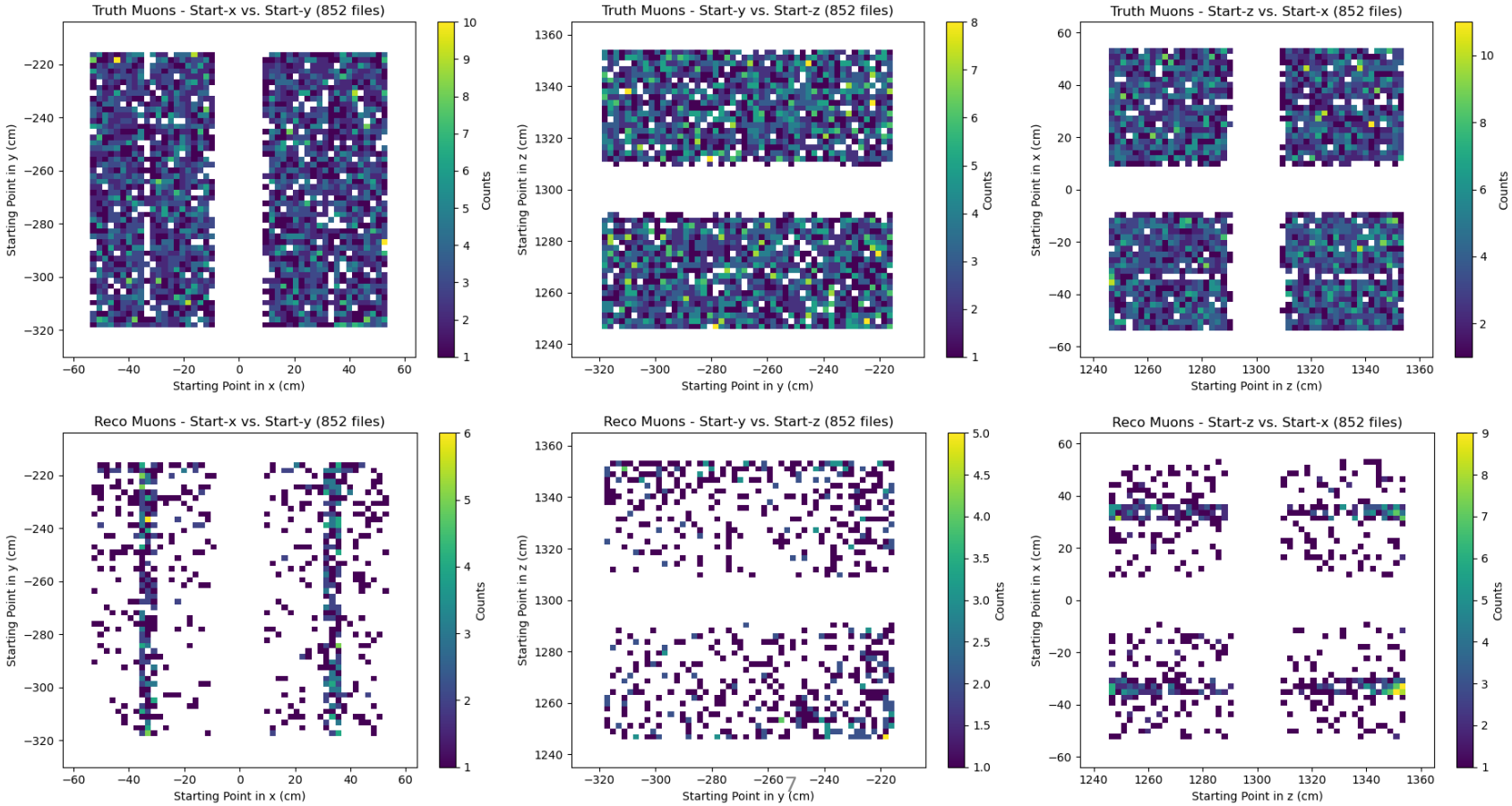




Charged Particle Multiplicity Study Status

(Zelimir, Bilal)

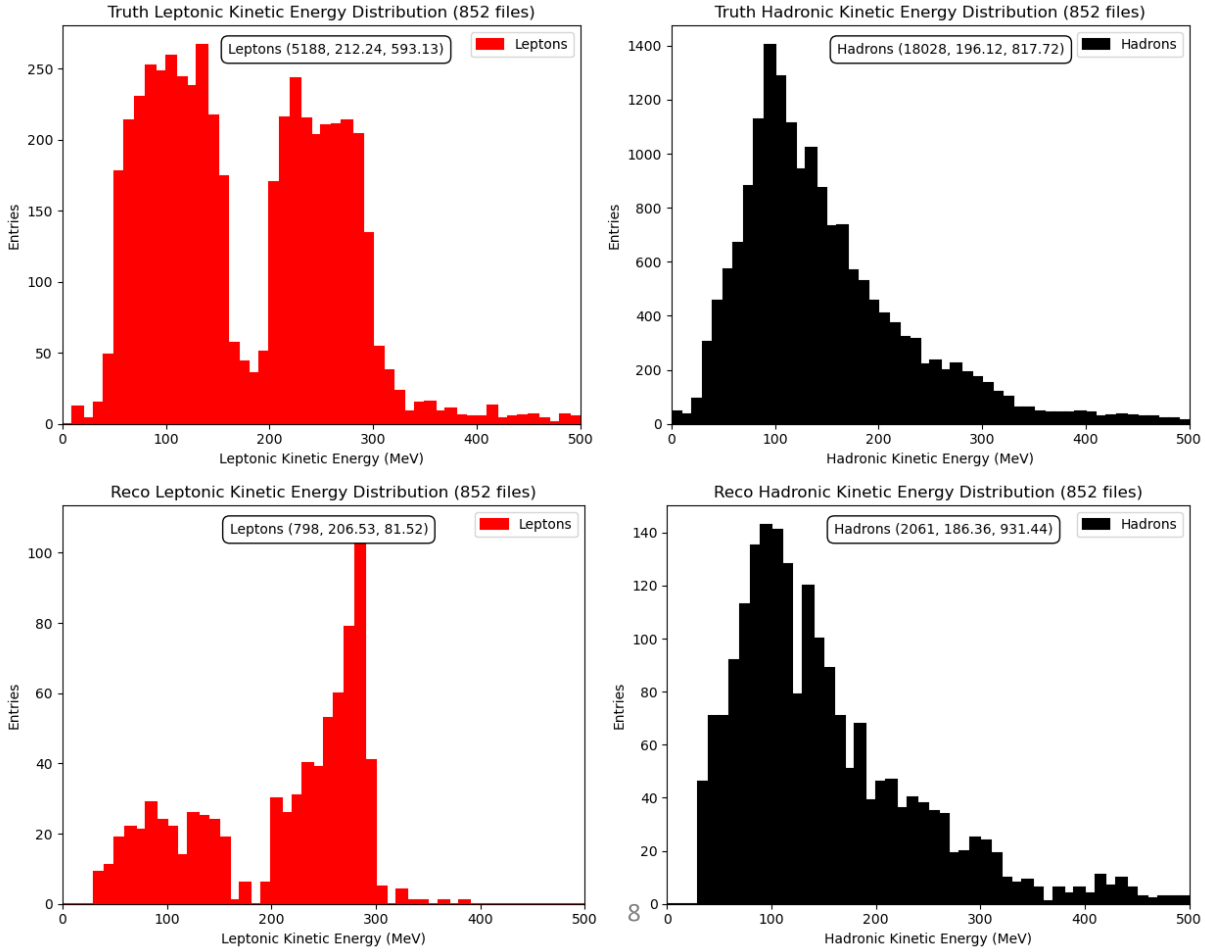
- 2D histograms of muon starting points of Truth and Reco muons are shown (x, y, z).
  - -Truth muons vertex uniformly distributed within the FV.
  - -Reco muons vertex around cathodes (*x* directions); requires further studies.



Charged Particle Multiplicity Study Status

(Zelimir, Bilal)

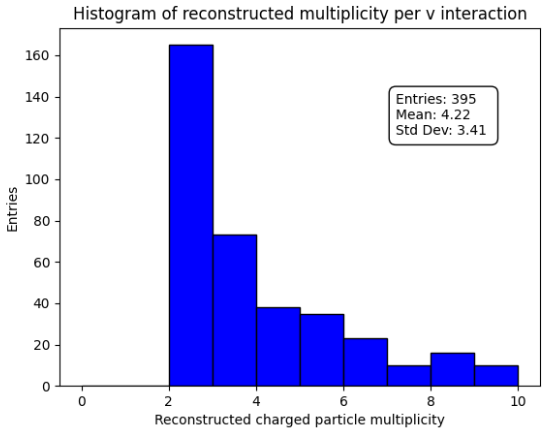
- Studied Truth and Reco leptonic and hadronic kinetic energy distributions
  -No surprises so far.

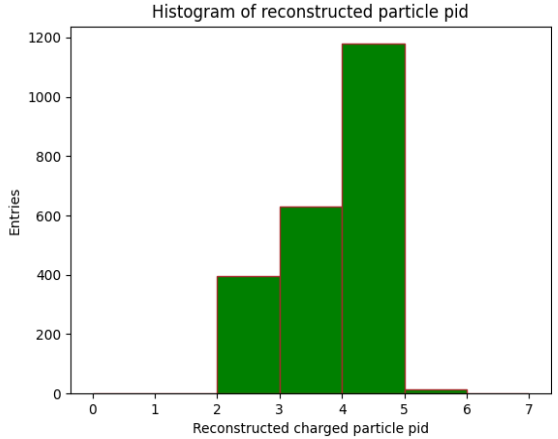


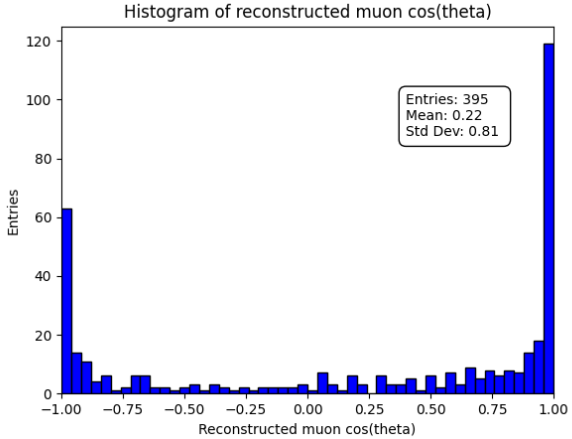
Charged Particle Multiplicity Study Status

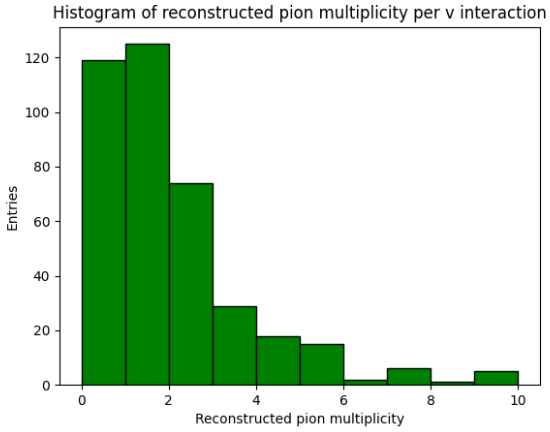
(Zelimir, Bilal)

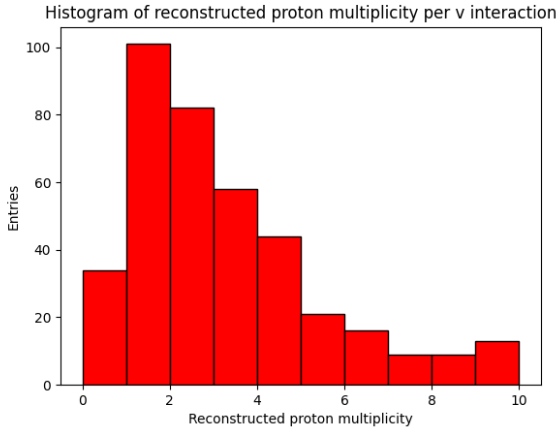
- Cross Checks with “5 cm” cuts, used Polaris HPC (node: 1CPU + 4GPU) to run the analysis on mlreco/larcv2 container.











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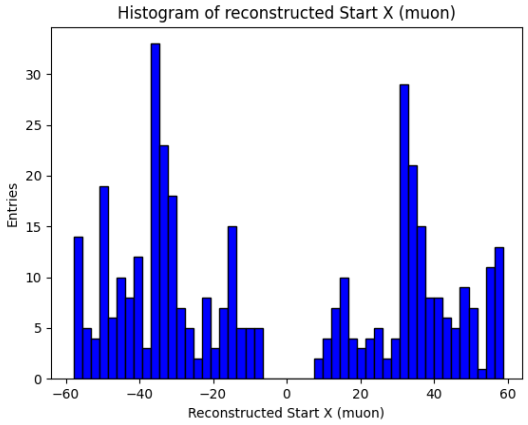
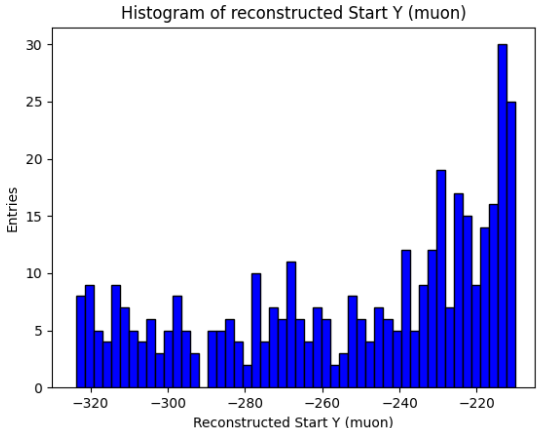
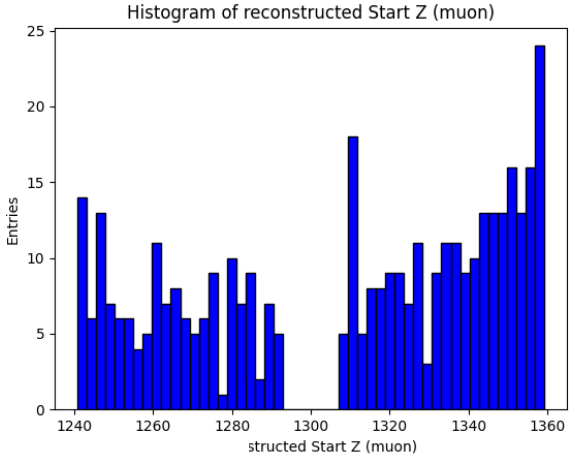
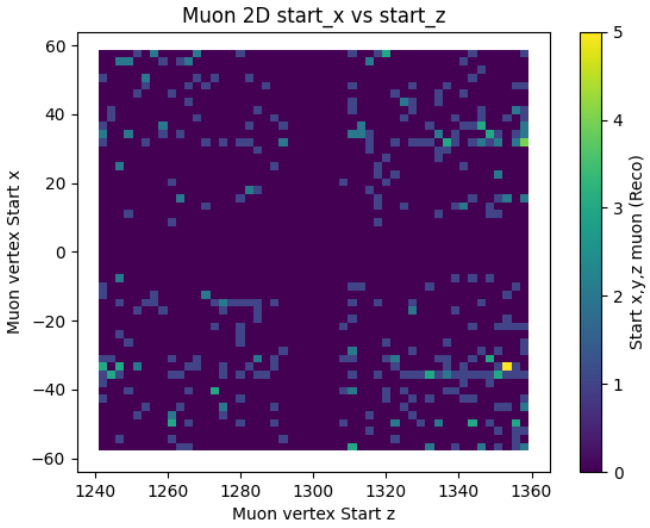
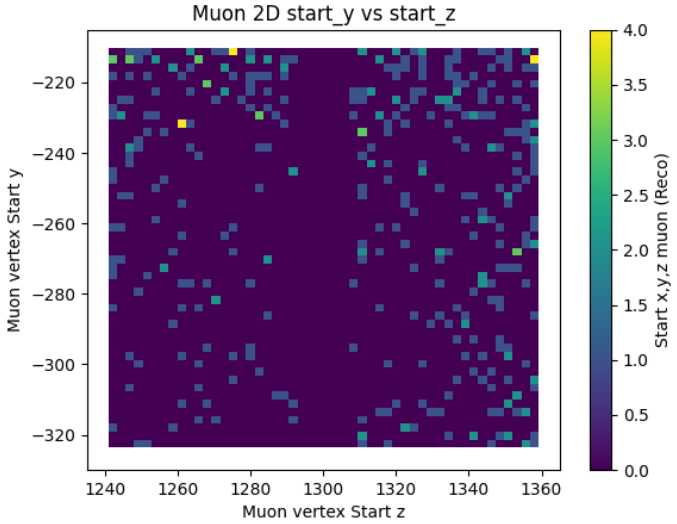






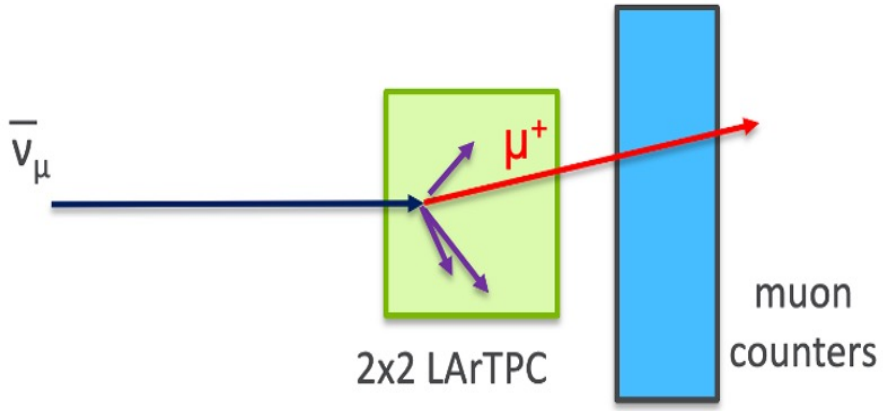




Summary

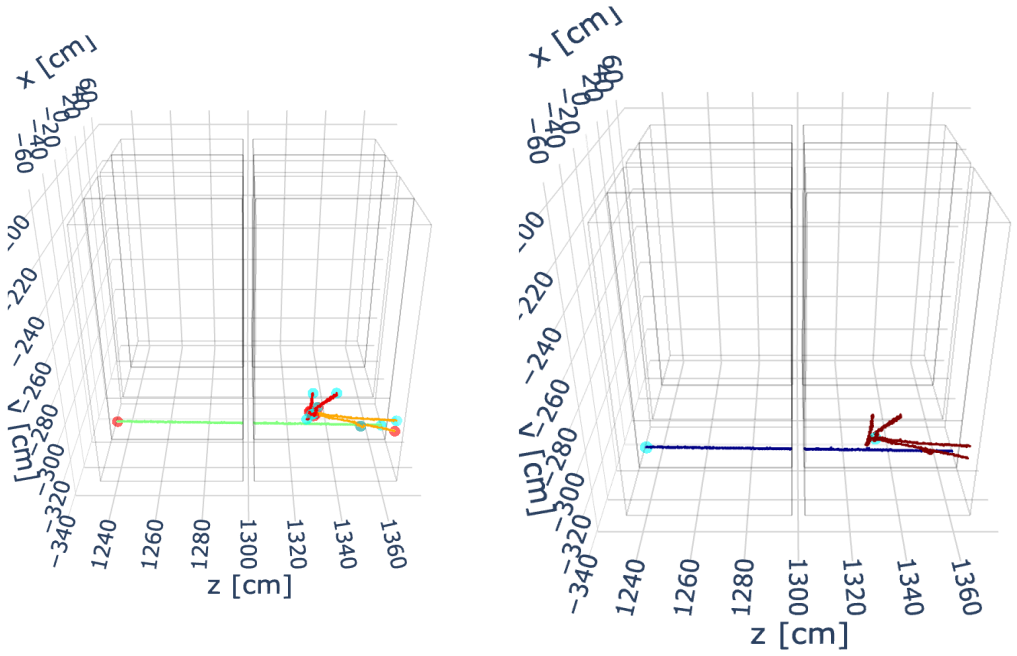
(Zelimir, Bilal)

- Current Effort to Understanding of Final State charged particles distribution
  -Observed features that we understand and those that we don't understand well.
- Leads optimizing the selection of the charged particles
  -Additional studies will be needed.
- Starting to look at CAF files.
- New MiniRun5 will additional information will help.
- Comparison to PANDORA will help.



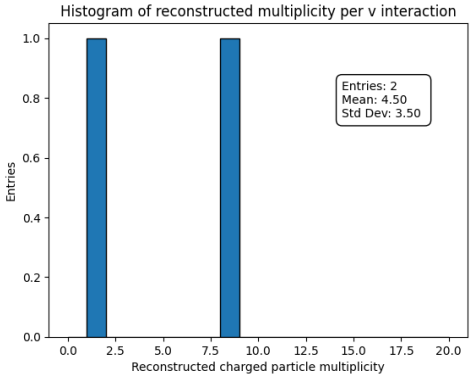
Backup Slides

➢ Event Example



➢ Raw multiplicity

No cuts:



After Cuts *: