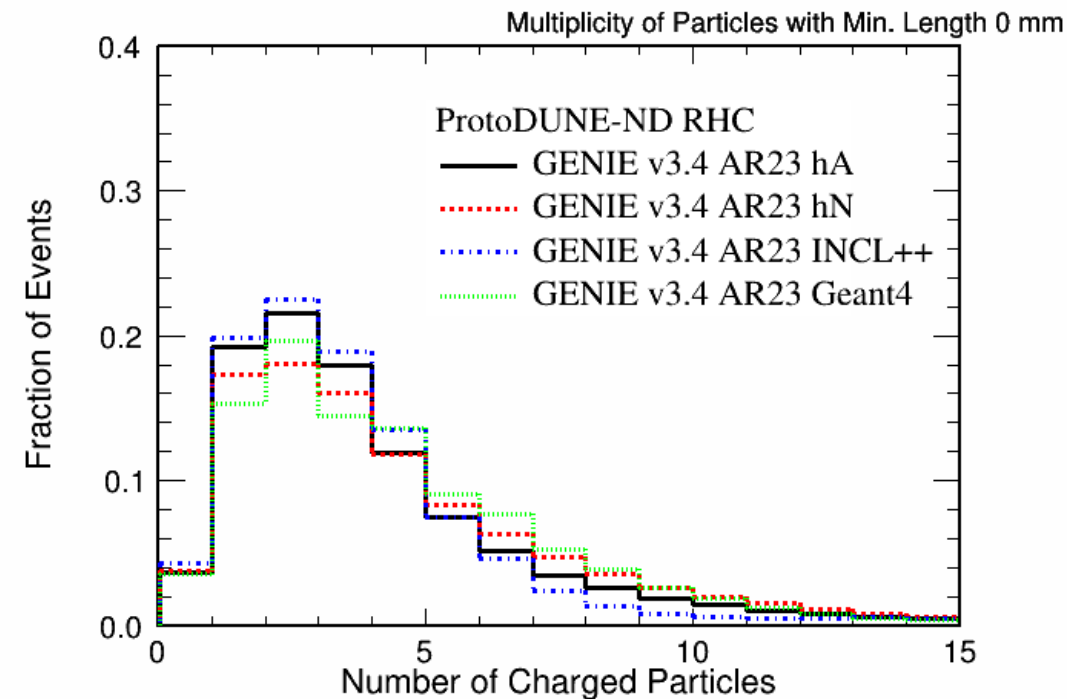# Cheated Track Multiplicity with PicoRun 4.1 CAFs

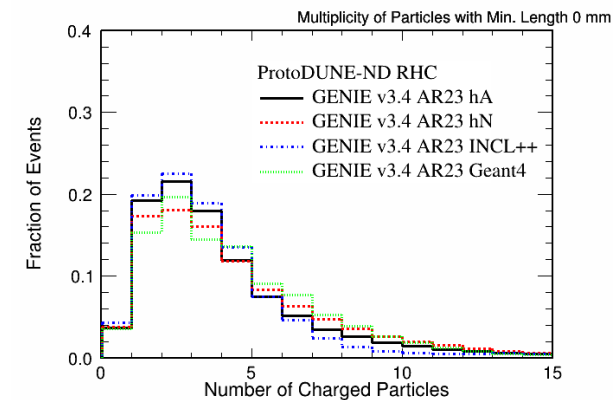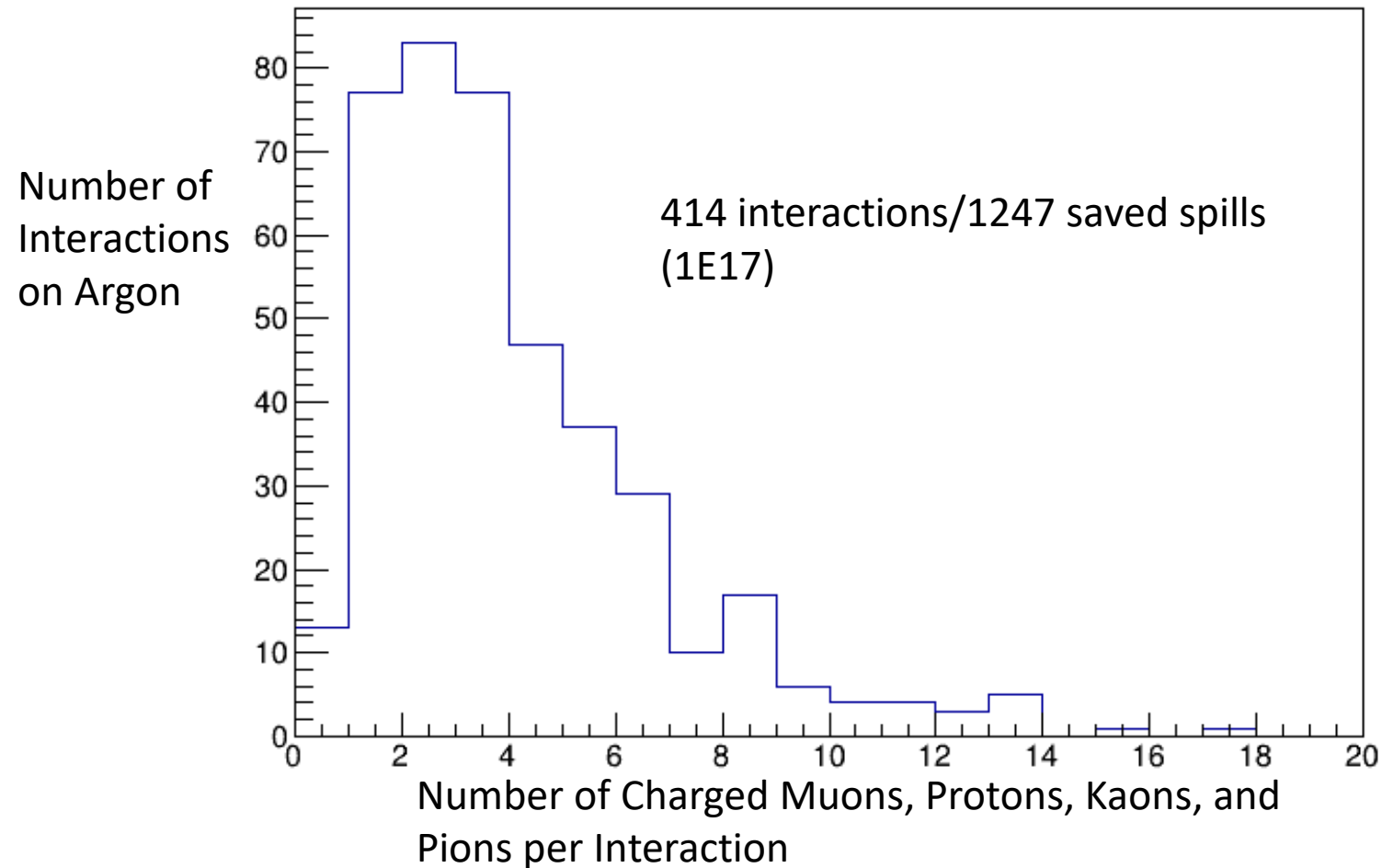Richie Diurba for the Track Mult. Group

Goals for Presentation

- Show distributions for PicoRun 4.1 with a cheated event selection using GENIE info.

    - Thank you to the CAF team for producing these files!

- Purity using GENIE info still to be explored, previously used G4 interaction info stored in MLReco h5 files which may be different.

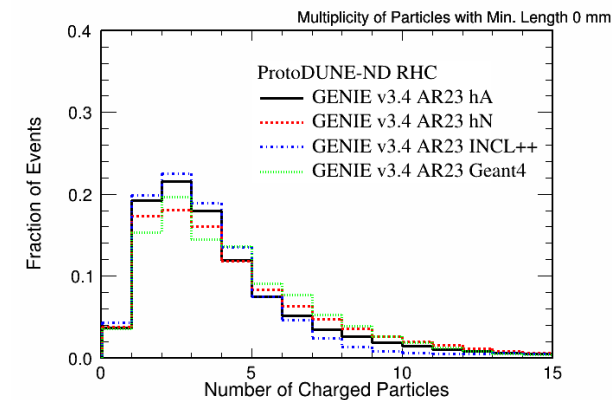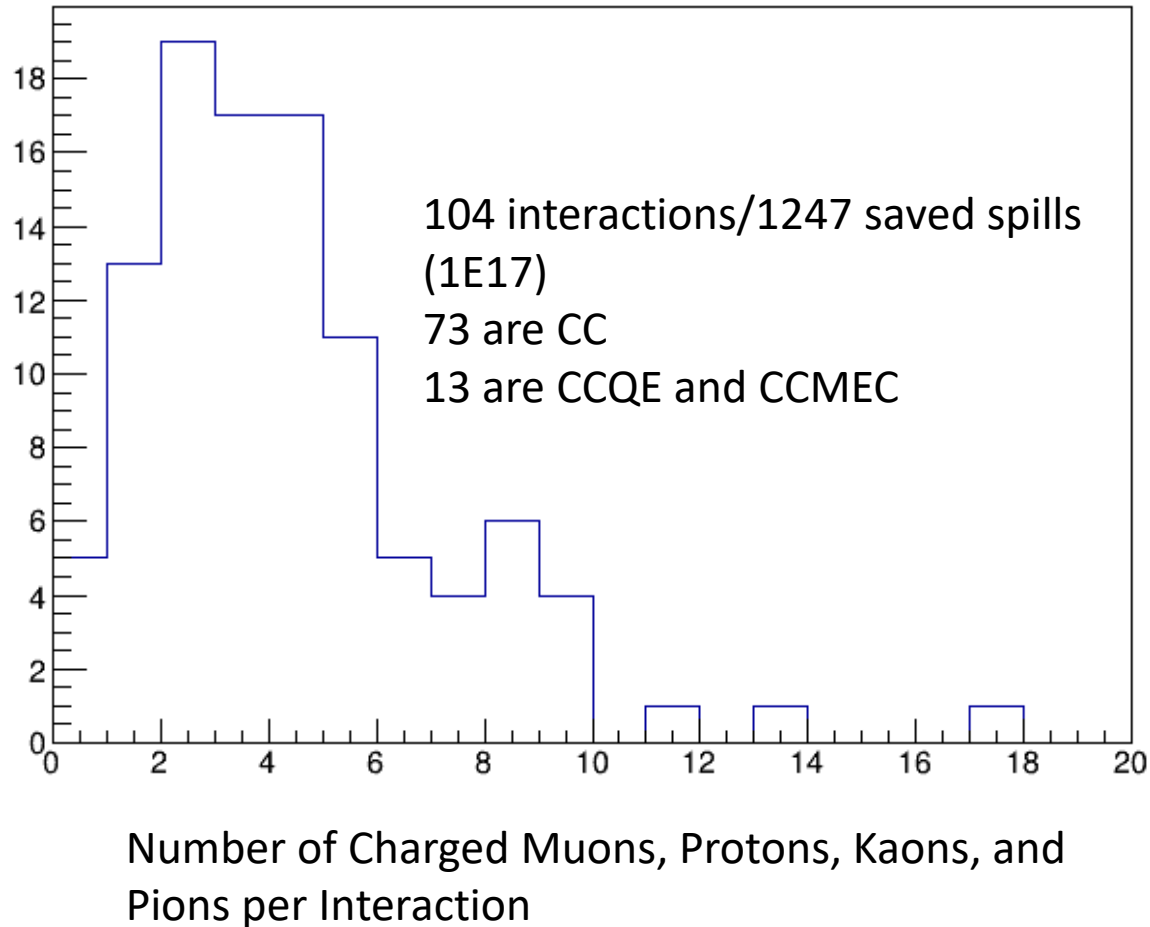Nominal Distribution using GENIE out-of-the-box:

Nominal GENIE Truth Distribution with CAFs

Number of Interactions on Argon

414 interactions/1247 saved spills (1E17)

Number of Charged Muons, Protons, Kaons, and Pions per Interaction

Multiplicity of Particles with Min. Length 0 mm

ProtoDUNE-ND RHC
GENIE v3.4 AR23 hA
GENIE v3.4 AR23 hN
GENIE v3.4 AR23 INCL++
GENIE v3.4 AR23 Geant4

Fraction of Events

Number of Charged Particles

Nominal GENIE Truth Distribution with CAFs

Let's add the fiducial volume to avoid dead space: 10<abs(z-1300)<50 and 10<x<50 cm

Number of Interactions on Argon

104 interactions/1247 saved spills (1E17)
73 are CC
13 are CCQE and CCMEC

Number of Charged Muons, Protons, Kaons, and Pions per Interaction

Multiplicity of Particles with Min. Length 0 mm

ProtoDUNE-ND RHC
GENIE v3.4 AR23 hA
GENIE v3.4 AR23 hN
GENIE v3.4 AR23 INCL++
GENIE v3.4 AR23 Geant4

Fraction of Events
Number of Charged Particles

Cheated Event Selection

Check for DLP MLReco interaction vertex within 5 cm of the GENIE vertex in all Cartesian directions:

- 41 interactions found with a track>0 cm (efficiency of around 40% for all interactions)

All Interactions Regardless of Minimum Track
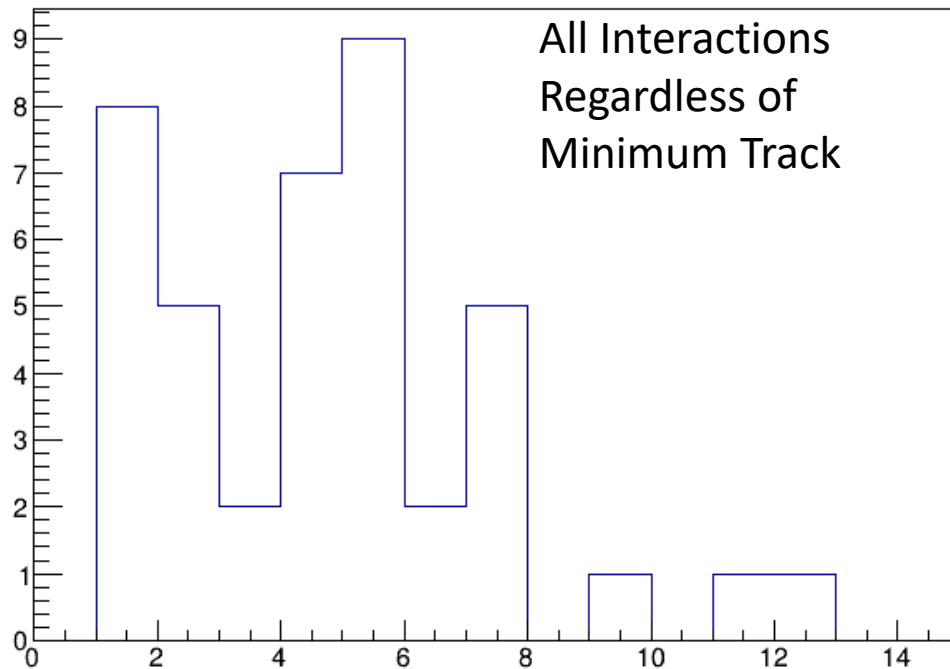
Number of Total Tracks in the Interaction (Are they all primary? That variable is not available for dlp.tracks, could it be added?)

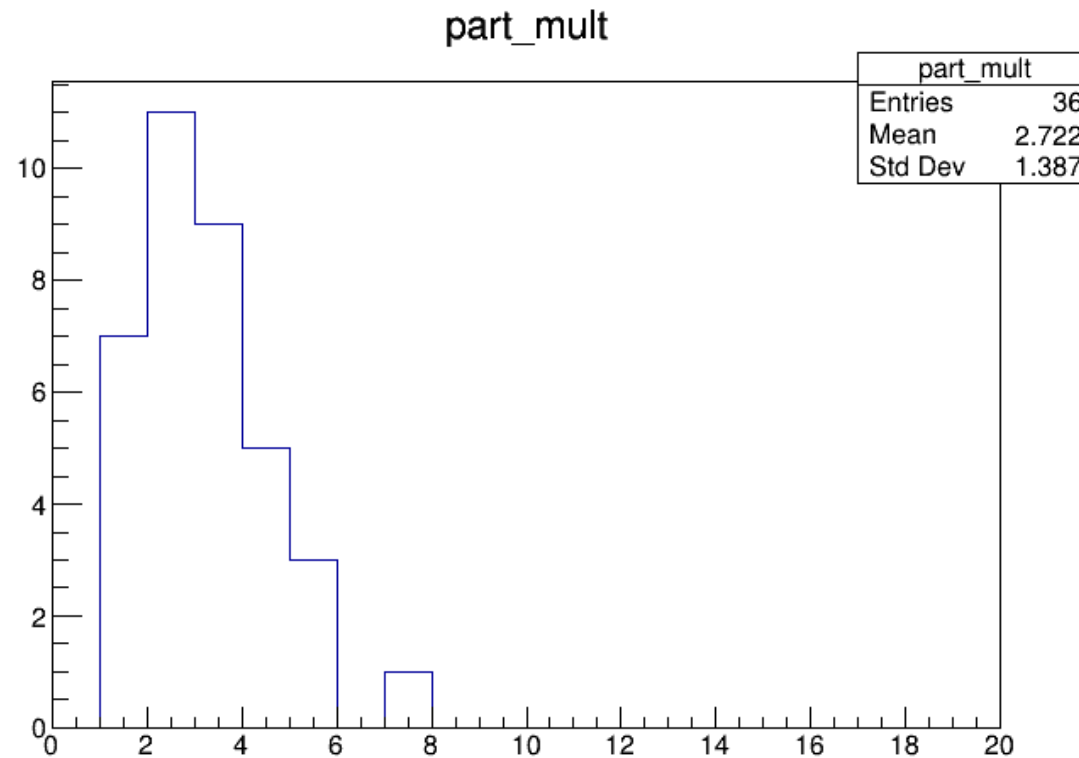Minimum 1 Track with 10 cm Length
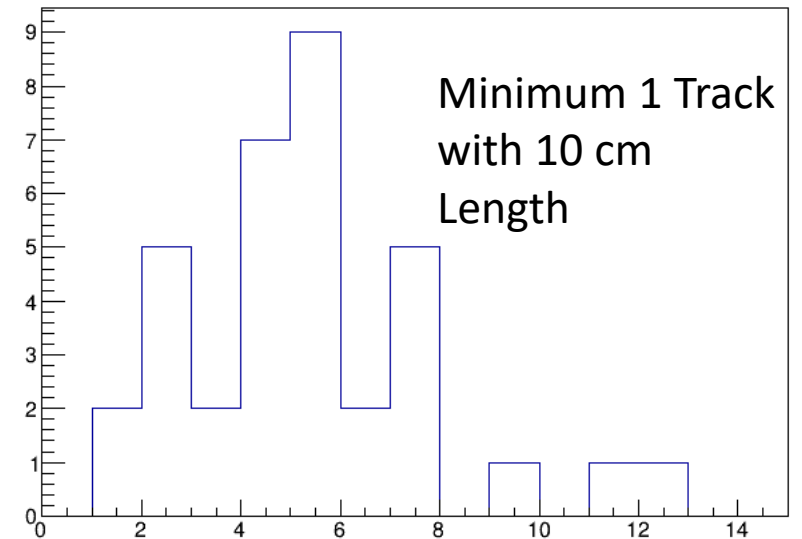
Cheated Event Selection using Particle Product

DLP Particles do have the "Primary" flag so we can investigate there:

- 36 interactions found with 1 primary track (efficiency of around 40% for all interactions)
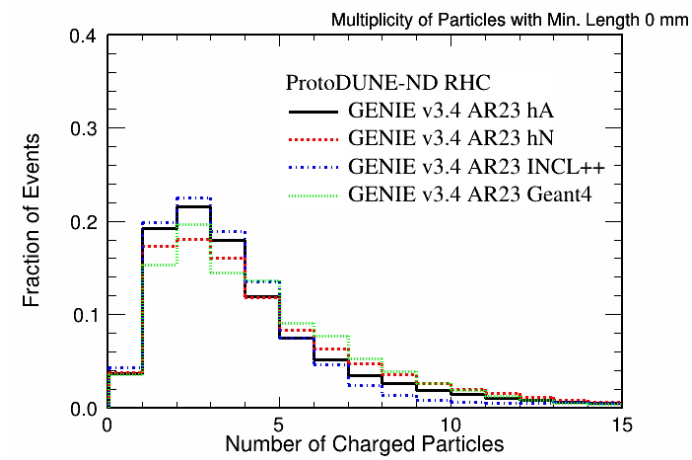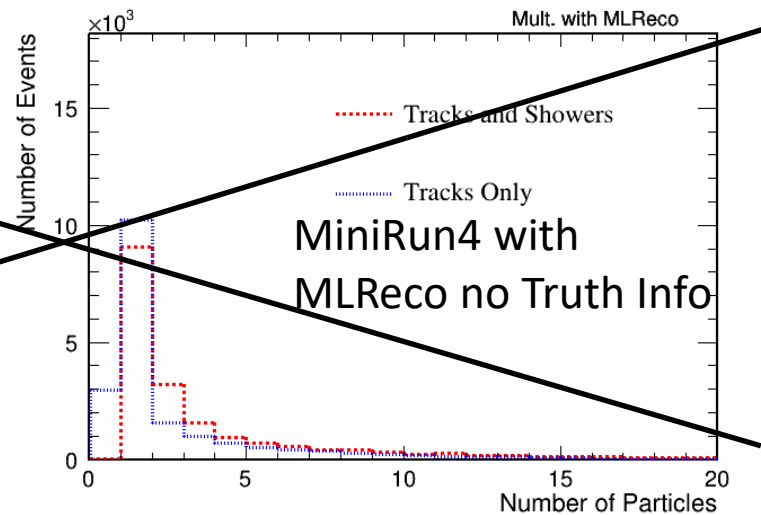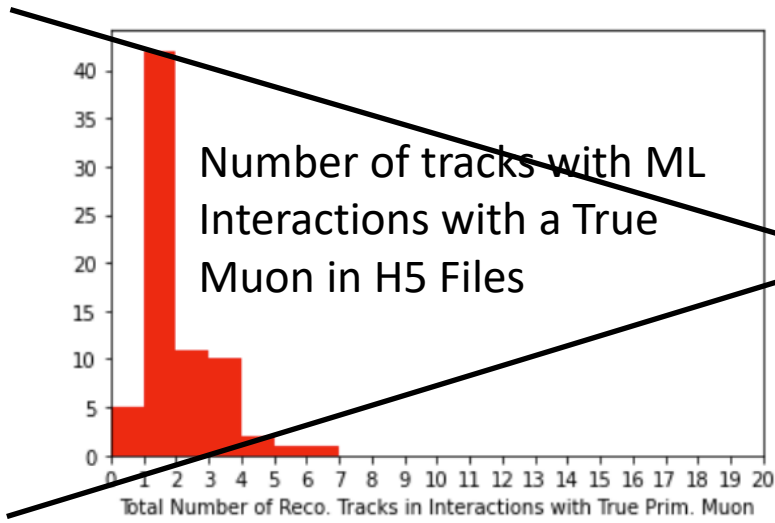
All Interactions with a Primary
Track (pi+/-, p, mu, K+/-)

part_mult

part_mult	
Entries	36
Mean	2.722
Std Dev	1.387

Number of Total Primary Tracks in the Interaction

Conclusion

A long-standing issue in the H5 files has been defeated:

Number of tracks with ML Interactions with a True Muon in H5 Files

MiniRun4 with MLReco no Truth Info

Conclusion

A long-standing issue in the H5 files has been defeated:
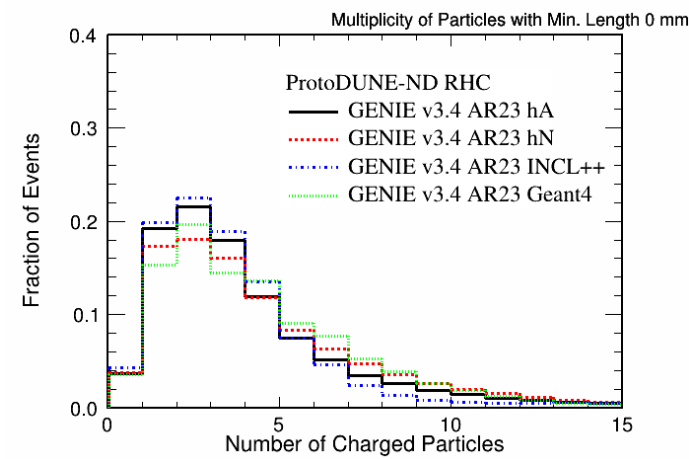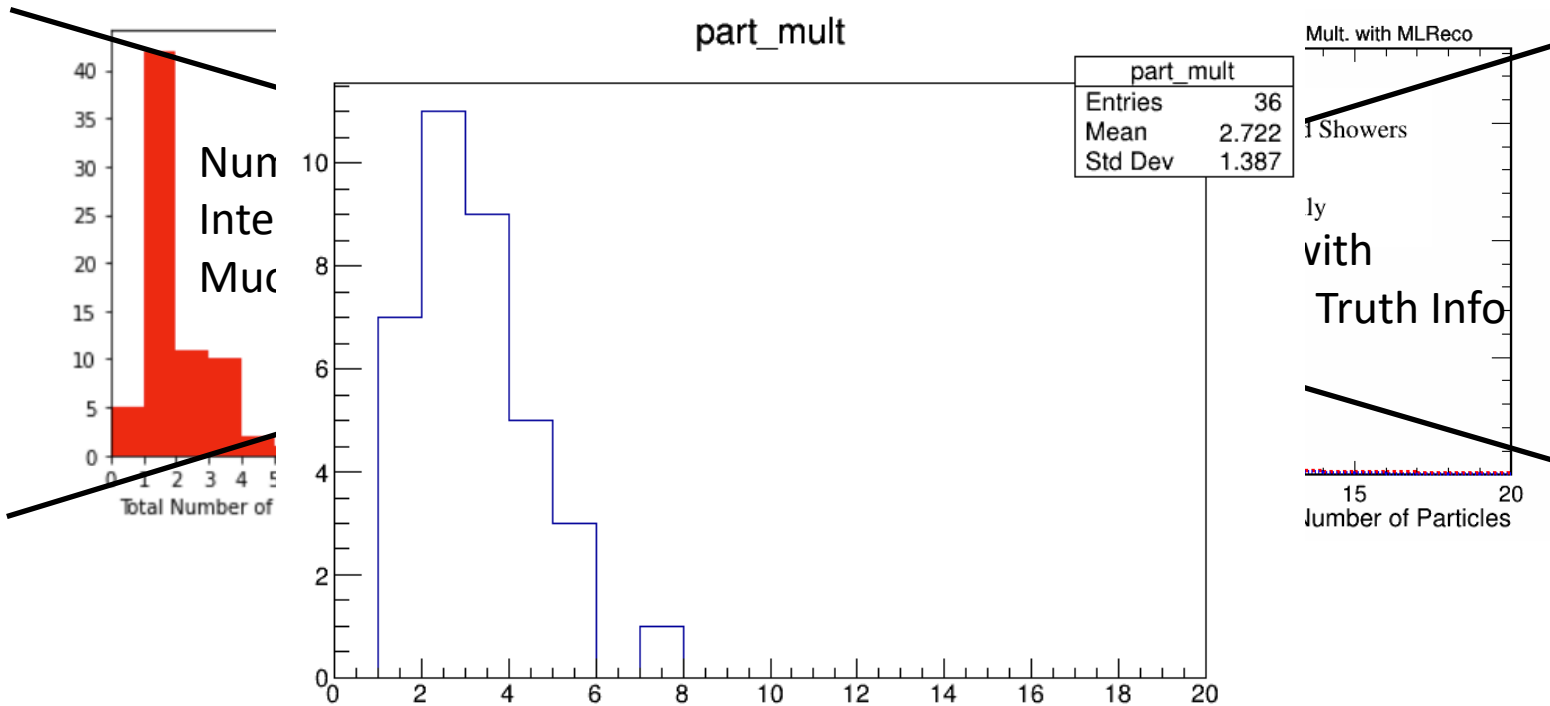
Cheated events show that MLReco matches expectation from GENIE.

Next step is optimizing the purity and figuring out the corrects cuts.

Instructions:

Used the hard work of Sindhu and Jeremy, specifically uses Sindhu's tutorial and code:

Files live here: /dune/app/users/rdiurba/cafCheatedTutorial

source setup.sh

source compile_cheated.sh

./cheated_plotter PicoRun41CAF.txt test.root

That's it!