ND LE, pME pHE data : Data/MC comparisons

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Outline

- Data/MC comparisons using a clean CC sample
  - LE March data (whole data set)
  - PME May data (fraction of total data set)
  - PHE May data (fraction of total data set)
- Observations
- Summary/ Plans

Events, releases,POTs e.t.c

- March LE data
  - -POT : 5.470 E17(after imposing beam quality cuts)
  - -Release Data & MC : R1.15
- March pME data
  - -POT : 5.318 E17(after imposing beam quality cuts)
  - -Release Data & MC : R1.16
- March pHE data
  - -POT : 1.787 E17(after imposing beam quality cuts)
  - -Release Data & MC : R1.16
- Known features of DATA & MC :
  - -ND Not calibrated
  - -DATA & MC have different Field Maps

Total Events & Track Rates DATA/MC (pot normalization)

LE	EVENTS	TRACKS
DATA	20951	16713 % of "good" tracks : 80%
MC	20201	16971 %of "good" tracks : 84%
diff	+4%	-1.5%
pME	EVENTS	TRACKS
DATA	36579	28773 % of "good" tracks : 79%
MC	41080	33327 % of "good" tracks : 81%
diff	-11%	-14%
pHE	EVENTS	TRACKS
DATA	18818	14982 % of "good" tracks : 80%
MC	20617	16800 % of "good" tracks : 81%
diff	-9 %	-11%

Total Events & Track Rates DATA/MC con't

• From previous number I can conclude that:

1) March LE event rates seem to agree within 5% between data and MC

2) May pME and pHE event data rates less by ~10% than expectations.

Sam C. told me that ACNET devices that measure protons on target show different behavior with increase in beam intensity.

- March data <intensity> : 8E12
- May pME & pHE data <intensity> : 10E12

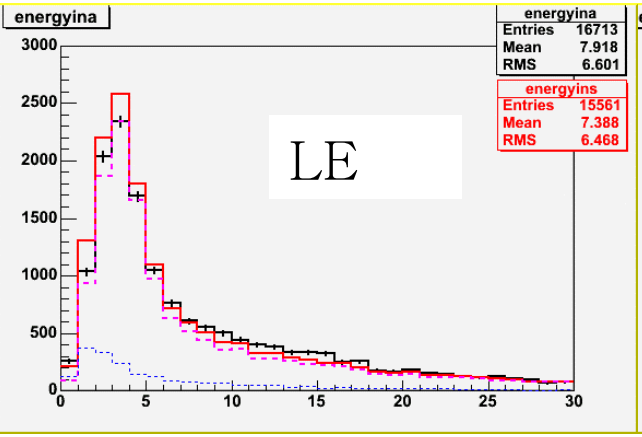
(Is that a significant difference? I don't know, need to find out more about this)

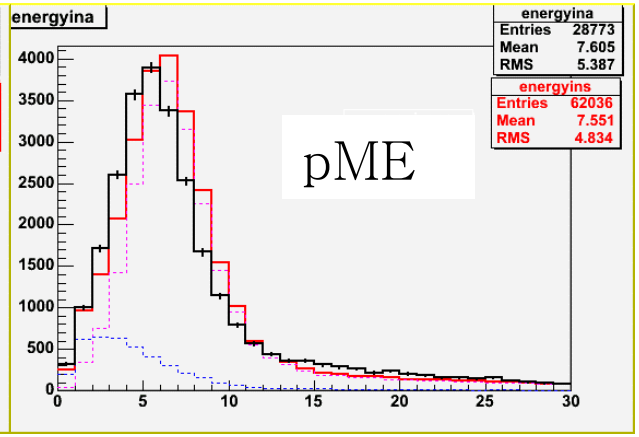
• May running so far shows a quite large beam sigma, which is again dependent on intensity. That could account for small percentage of "lost" POTs (again I want to test this with May data of smaller beam size)

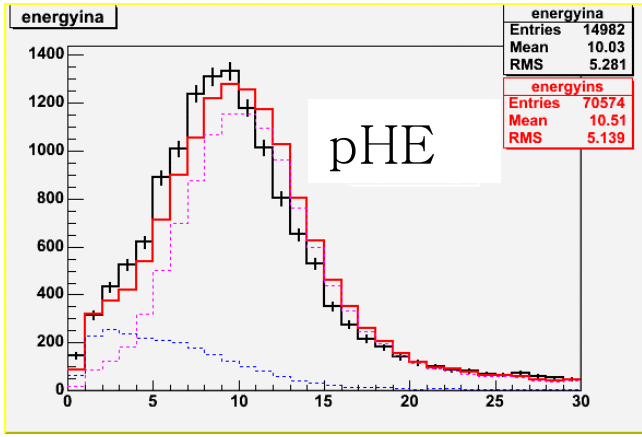
All distributions shown are normalized on unit area (to better compare shapes), unless otherwise stated.

Reco Energy Distributions : Events with "good" track

Red MC , Magenta : true CC , Blue true NC, Black Data







LE : Peak of energy distribution the same, higher energy tail in data

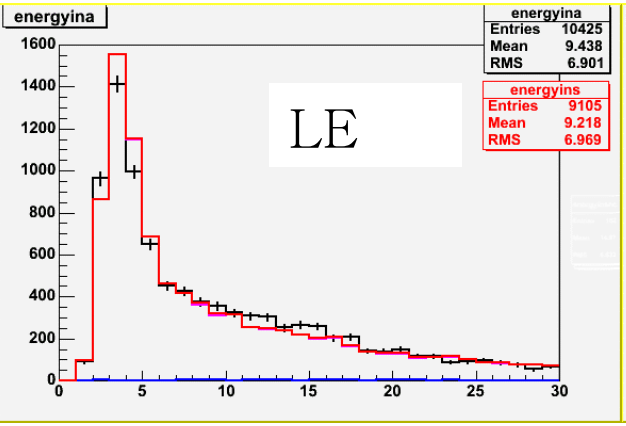
PME : Peak of energy distribution lower in data by ~ 1 a GeV

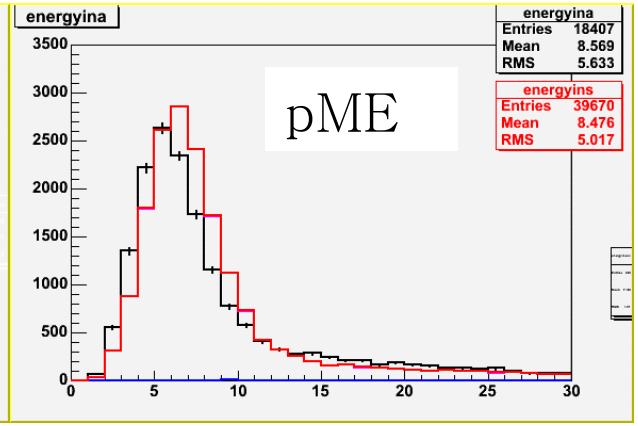
PHE : Peak of energy distribution lower in data by ~ 1 a GeV

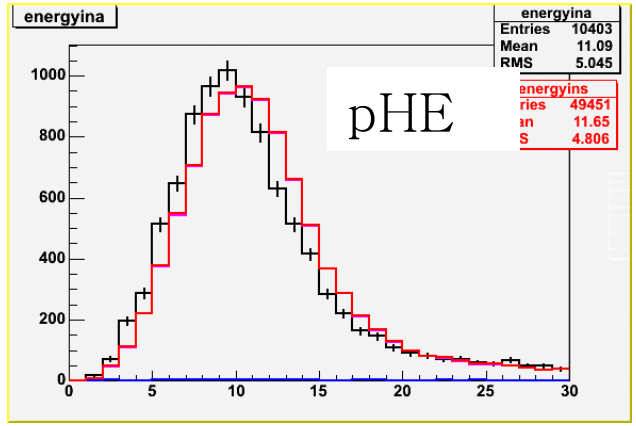
- This time I started a bit backwards, from higher level plots to lower ones.
- The "good track" samples are enhanced in CC events BUT have large contamination in NC.
- For these initial studies I decide to impose a plane cut (40 planes) that rejects the vast majority of NC events, and I can use a clean CC sample.
- Of course later (in order not to bias myself) I would like to use "CC-like" events using the existing PIDs i.e David PDFs and my ANNs

Reco Energy Distributions : Events with "good" Long Track : Clean Sample of CC events

Red MC , Magenta : true CC , Blue true NC, Black Data







LE : Peak of energy distribution the same, higher energy tail in data

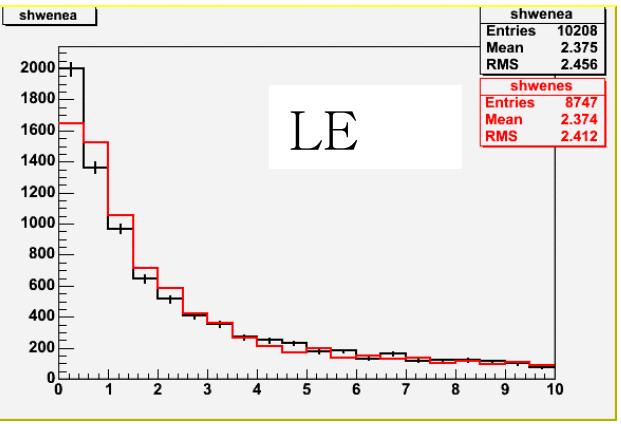
PME : Peak of energy distribution lower in data by ~ 1 a GeV higher energy tail in data

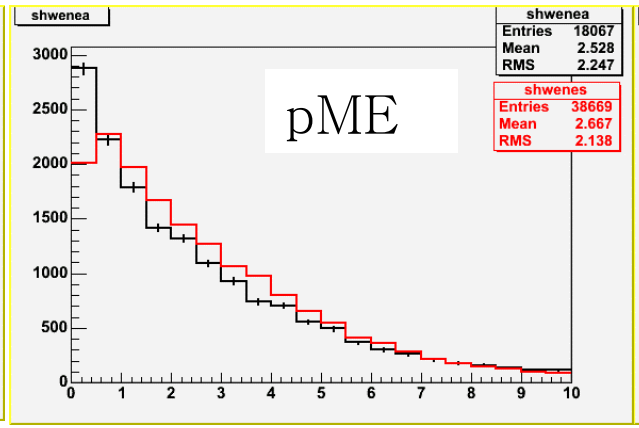
PHE : Peak of energy distribution lower in data by ~ 1 a GeV

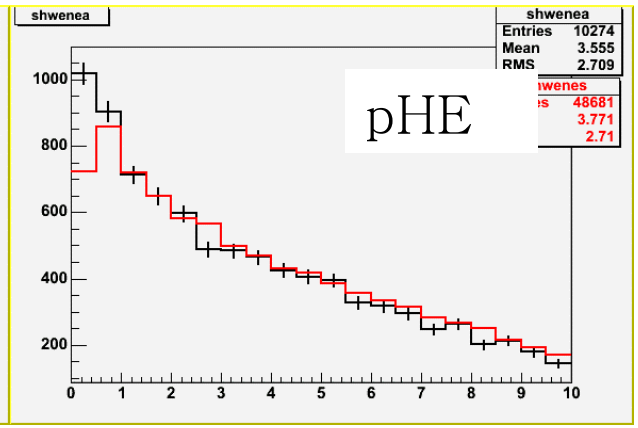
- Differences are quite significant. Want to check muon momenta and shower energies for these events

Reco Shower Distributions : Events with "good" Long Track : Clean Sample of CC events

Red MC , Magenta : true CC , Blue true NC, Black Data







LE : Lower shower energy in data, clear excess on lowest bin

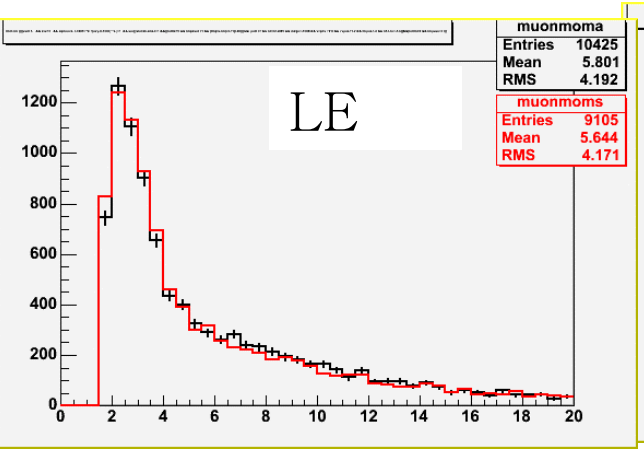
PME : Lower shower energy in data, clear excess on lowest bin

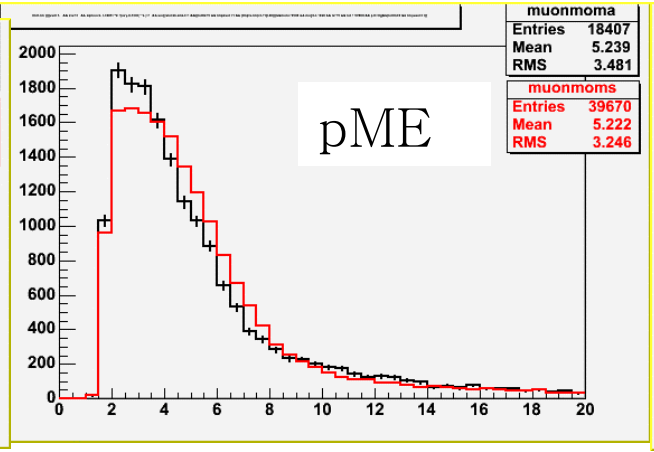
PHE : Lower shower energy in data, clear excess on lowest

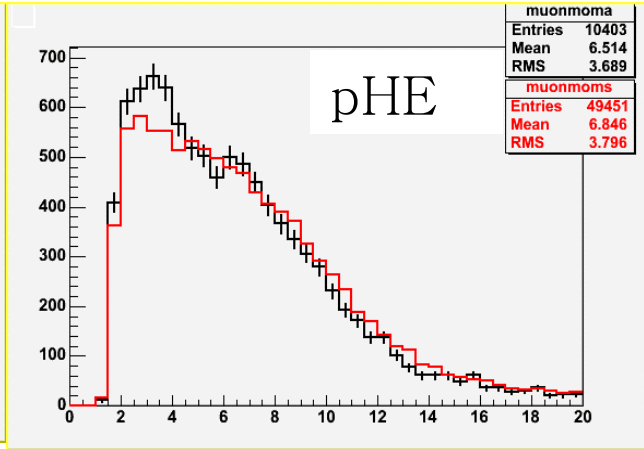
- Differences are quite significant and in all three energy scales towards the same direction. Physics or detector/reco effect. I want to study that.

Reco Emu Distributions : Events with "good" Long Track : Clean Sample of CC events

Red MC , Magenta : true CC , Blue true NC, Black Data







LE : Slightly higher momenta in data.

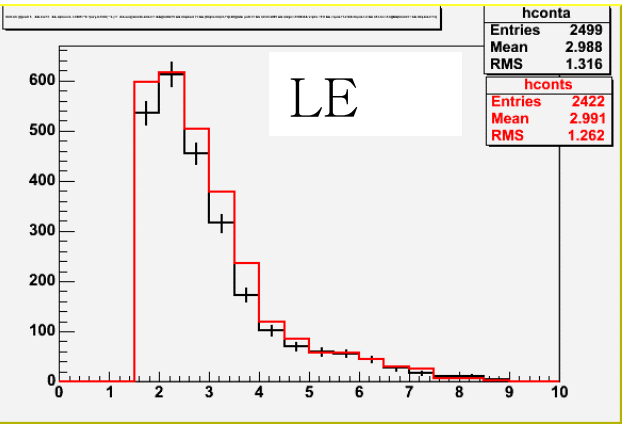
PME : Different shapes : excess of lower momenta in data, while high energy tail data slightly higher than MC.

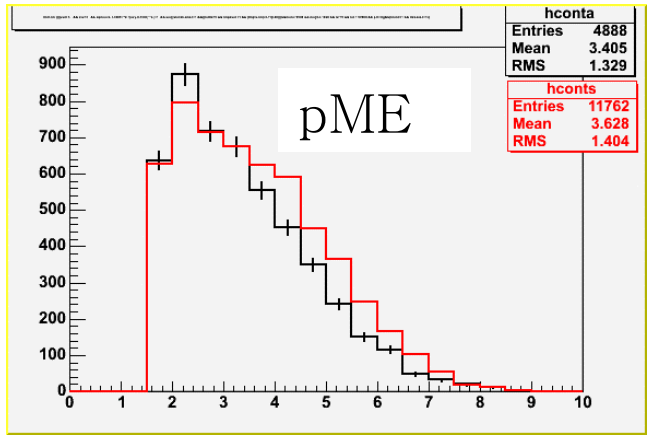
PHE : Different shapes : excess of lower momenta in data and slightly higher momentum in MC.

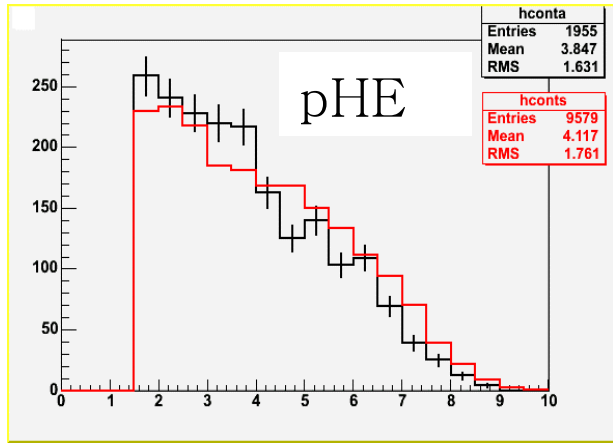
- Differences are quite significant. In data, regardless of the momentum estimation, there is a significant excess of exiting tracks for the pME and pHE (not for low) (difference in magnetic field? Need to check with same field maps)

Reco Emu (range) Distributions : Events with "good" Long Track : Clean Sample of CC events

Red MC , Magenta : true CC , Blue true NC, Black Data







LE : Less stoping tracks in data, contained tracks with slightly lower momenta

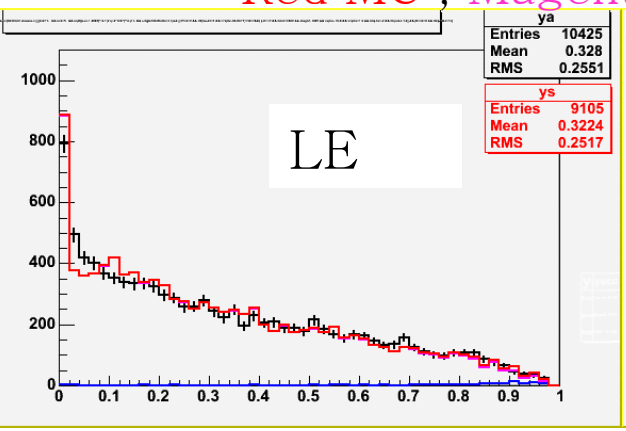
PME : Less stoping tracks in data , contained tracks with slightly lower momenta

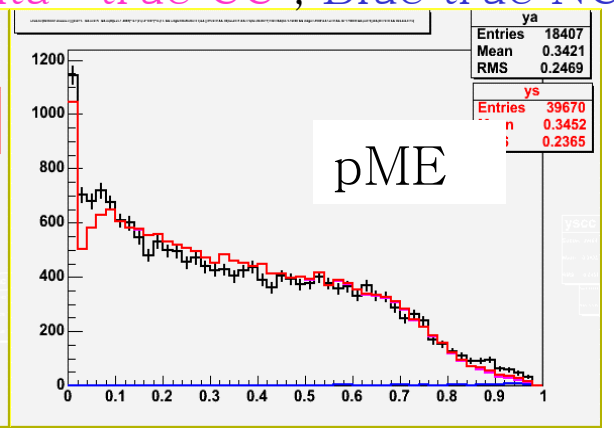
PHE : Less stoping tracks in data , contained tracks with slightly lower momenta

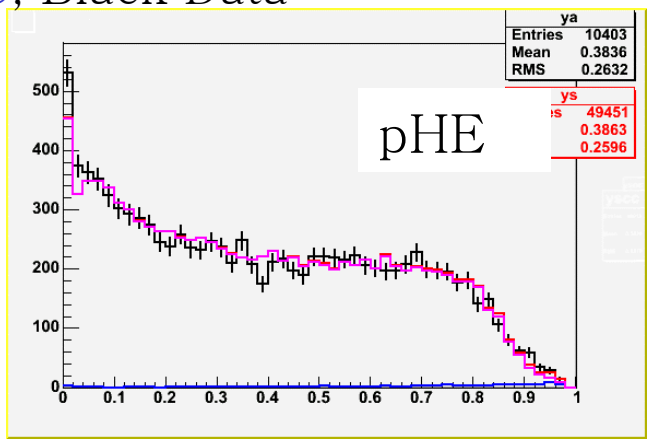
- Differences are quite significant and in all three energy scales towards the same direction.

Y Distributions : Events with "good" Long Track : Clean Sample of CC events

Red MC , Magenta : true CC , Blue true NC, Black Data







LE : Excess of QE-like events in MC. Different shape at QE-RES region.

PME : Excess of QE-like events in Data. Different shape at QE-RES region.

PHE : Excess of QE-like events in Data. Different shape at QE-RES region.

Conclusions - Plans

- pME and pHE Data show quite significant differences from MC.
- These differences I believe are quite big to be accommodated by detector/reco effects. (under investigation)
- I am going to focus on initially selecting "easy/clean" populations of CC –DIS events (and possibly QE), in order to factorize and quantify differences.
- Suggestions are welcome.