Muon Removal And Event Merging

Caius
NuE Working Group, 13/12/2005



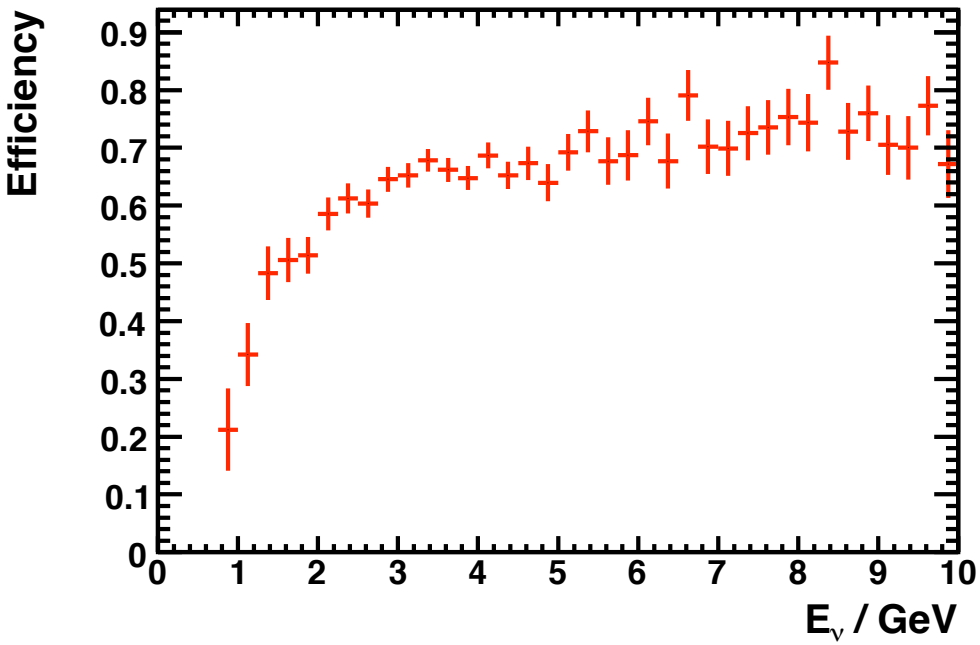


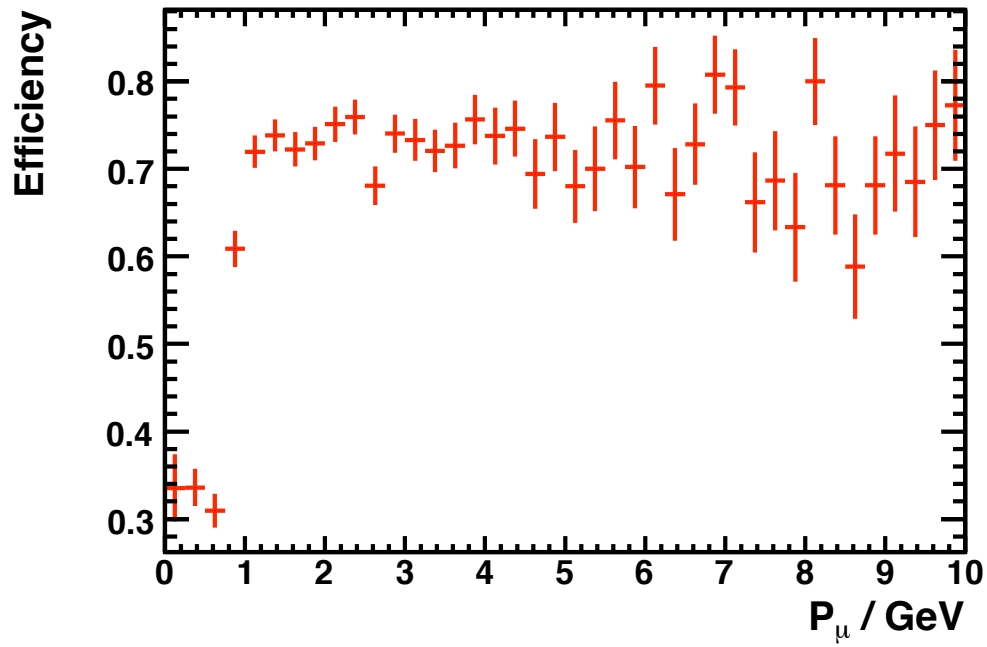
Input Events Selection

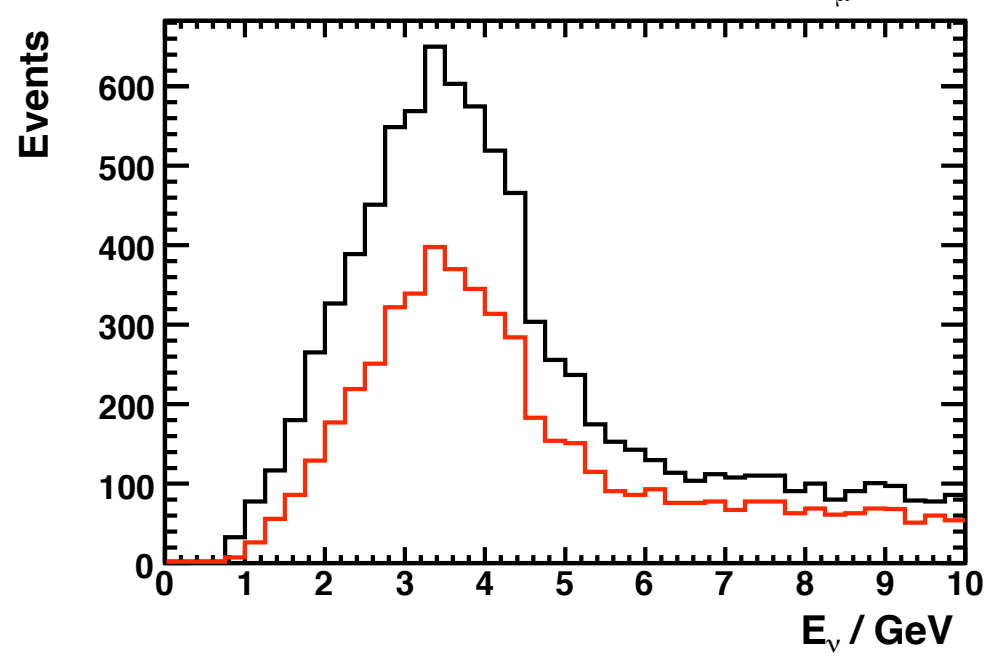
- Want a sample of "golden" NuMu CC events
- Require:
  - 1 or more track reco'ed, with ≥15 planes
  - Vertex contained
  - Tagged as a real spill (Data)
  - Not a cosmic (dcosZ<0.5)
  - LI stripping.
- Input data:
  - Spill stripped raw data Sept/Oct, LI stripped, 1,422,741 spills
  - Carrot 'beam' fardet MC (1002-1009)

Selection Efficiency

- Fraction of tracked nu mu CC events selected.



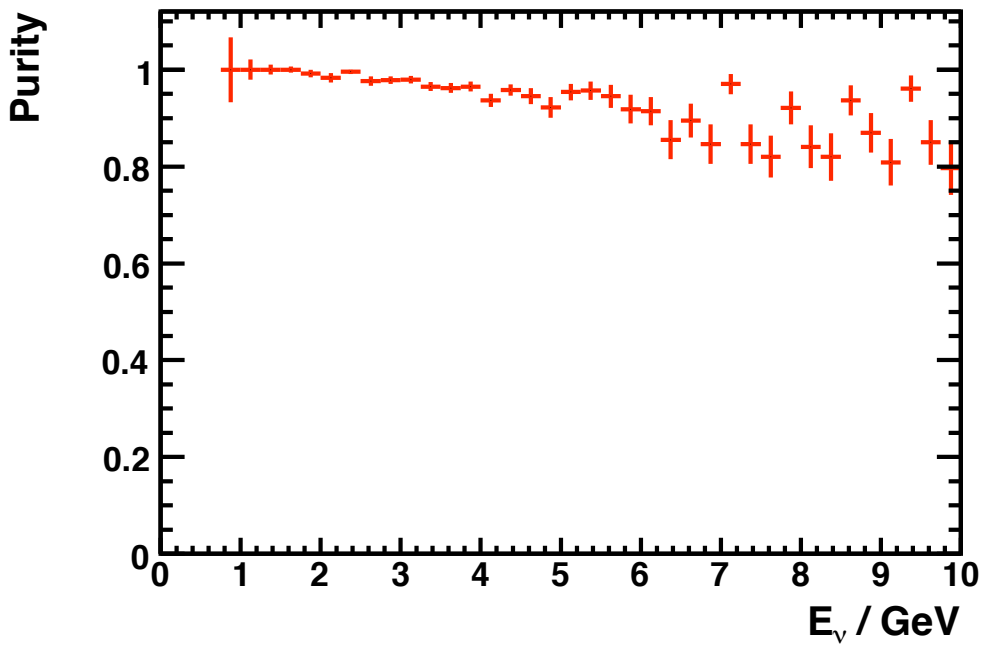




Selection Purity

- Fraction of retained events that are numu cc

	Fraction of selected
NuMu CC	**91.3±0.3 %**
NuE CC	**0.7±0.1 %**
NC	**8.0±0.3 %**

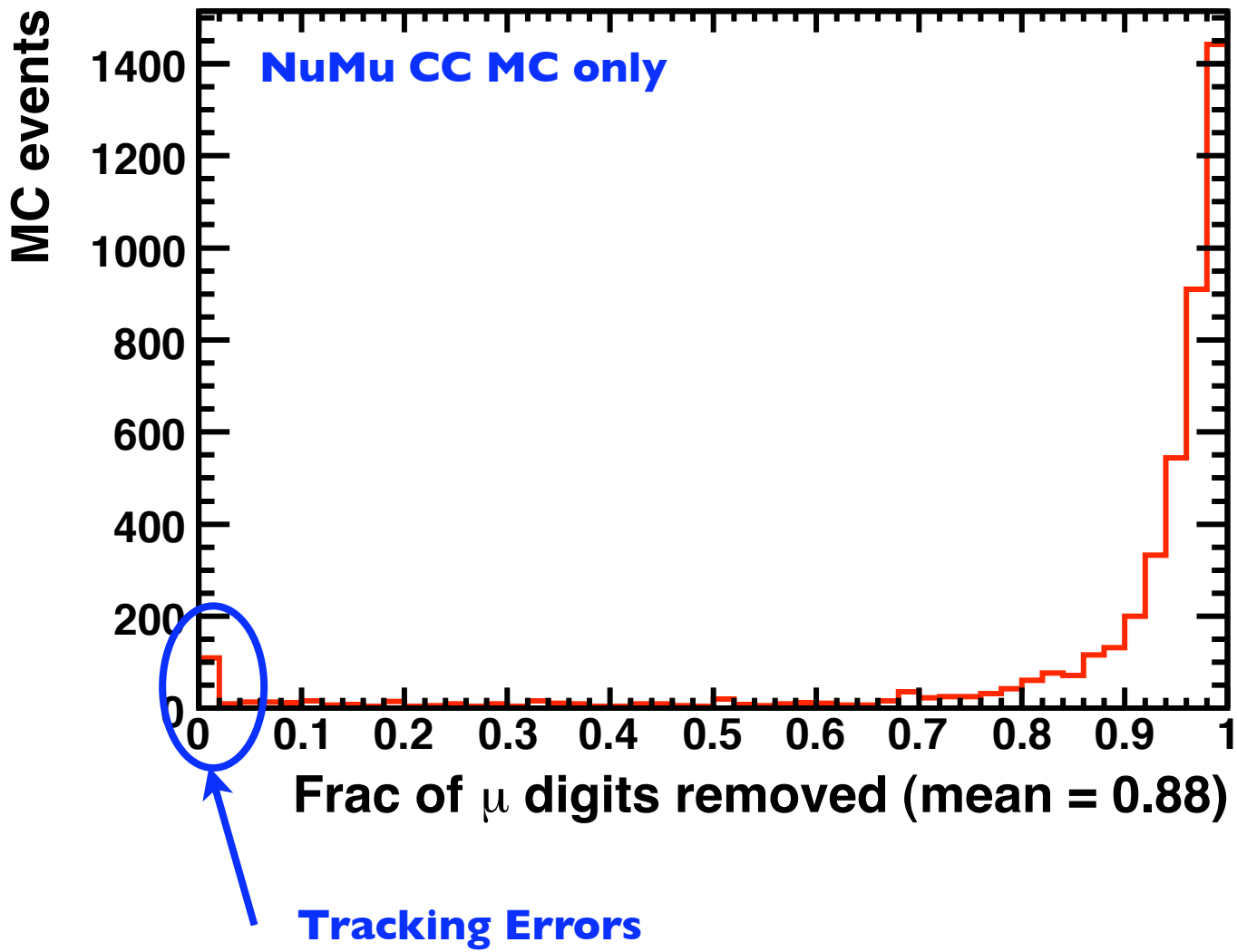


Method Muon Removal Method

- Use Cand files from farm.
- Take reco'ed track and look for the Max Shower Plane:
  - work from vertex count 5 'track like planes', the 6th is the 'max shower plane'
    - 'trk like plane', >80% PE's in track and total PE's in plane >3
  - Kill all digits after 'max shower plane'
- Follow back into shower, and remove all track hits <2MIPS
- For track hits >2MIPs look in adjacent strips, if >3PE keep, else remove.
- Write out new CandDigitList without the muon hits.
- Kill all other Candidates.

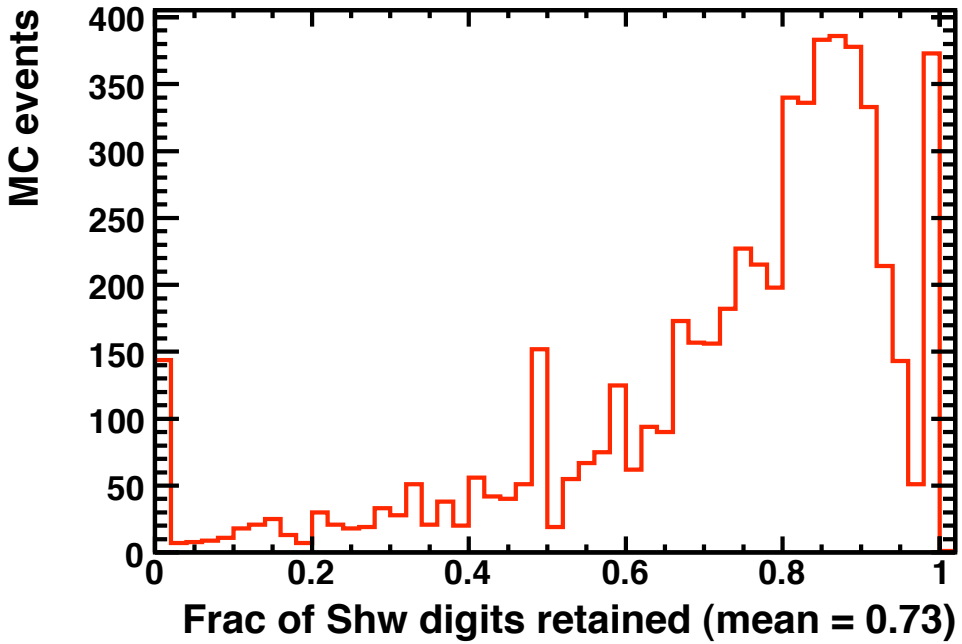
Muon Removal Efficiency

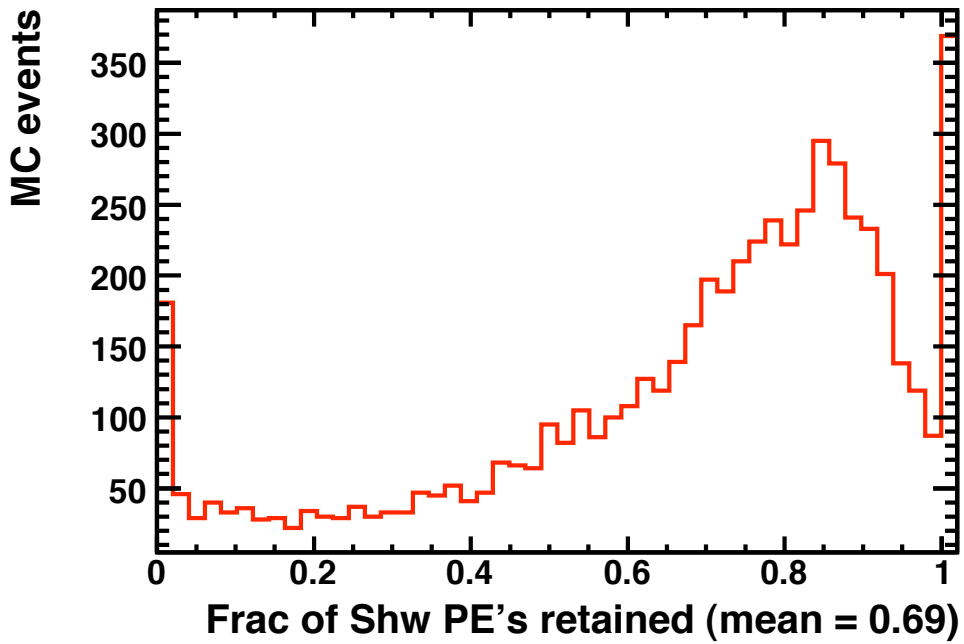
- Fraction of digits that are truly muons (have a muon component) that are removed.



Shower Efficiency

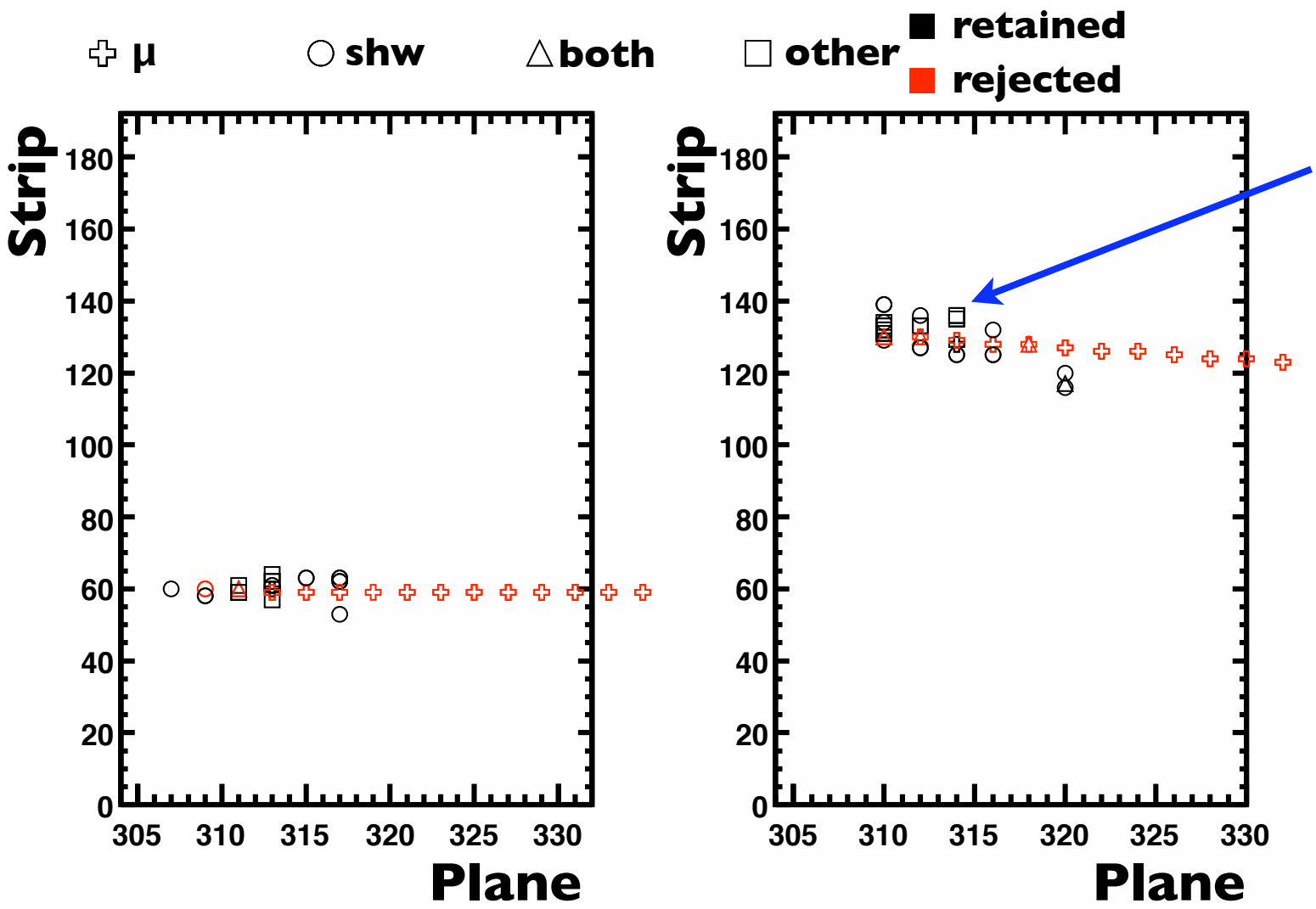
- The efficiency for keep digits that have some shower component. Shower hits defined in ShowerCompleteness()





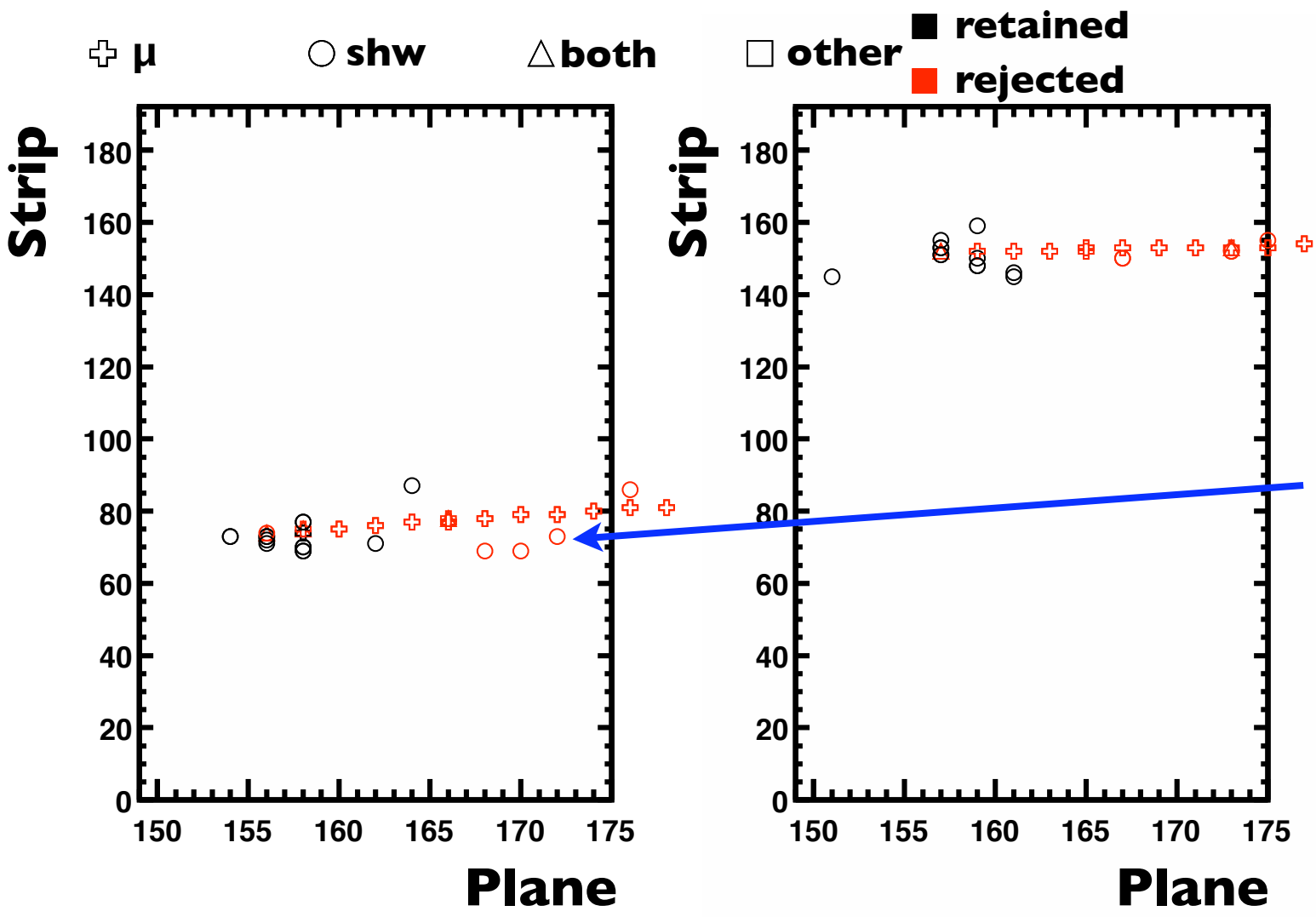
	Fraction of Rejected Shw Digits
Out of Vertex Area	75 %
Tracked && !Muon	43 %
Mixed Muon and Shw	25 %
Reco'ed XTalk	7 %

But...



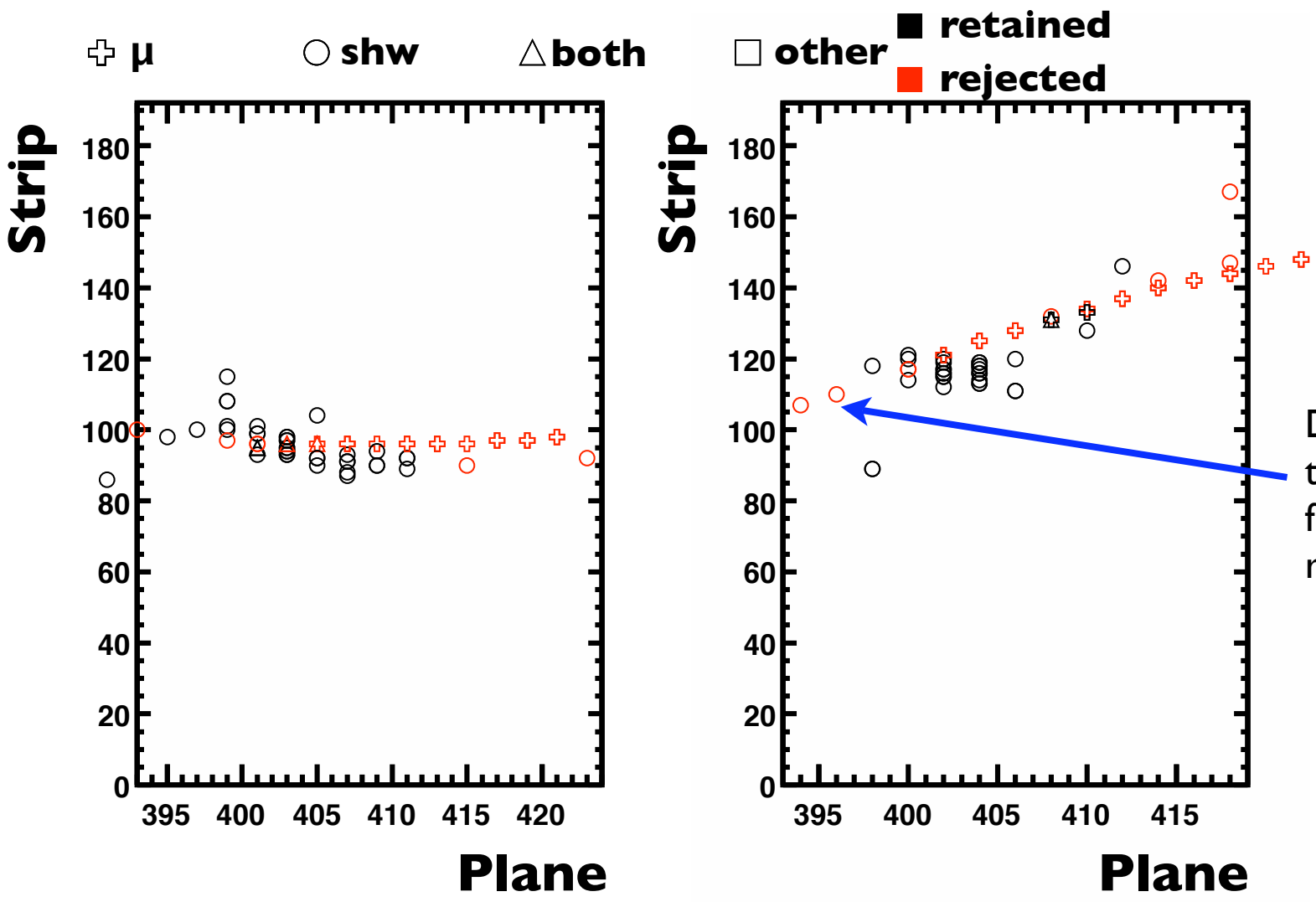
Have PDG code=22, i.e. a γ .These do no get tagged as true shower digits. Maybe a bug in Jim's code, maybe a problem with MC i/o.

Low Eff. Example 1



Digits outside the vertex region, removed as it is assumed that they are from the muon

Low Eff. Example 2



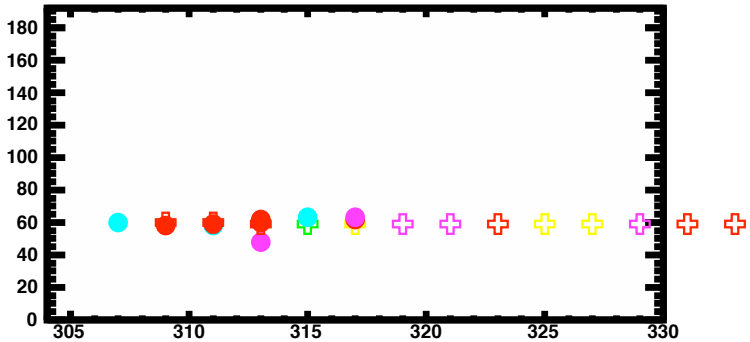
Digits are on reco'ed track, assumed to be from the muon and removed.

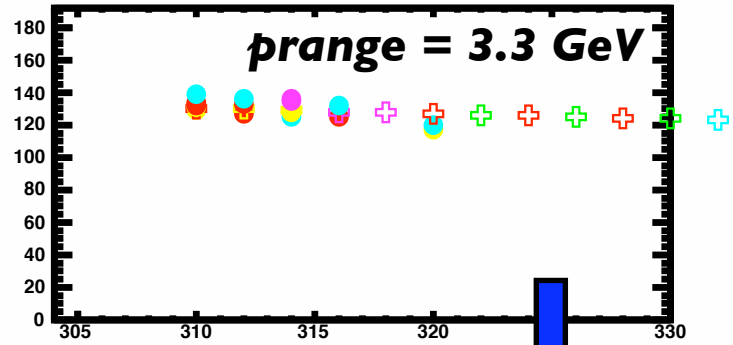
Event Merging

- Take muon parameters, dcosx,dcosy,dcosz and P (from fit or range depending on end containment)
- Give parameters to Chris to generate electrons with same input true parameters.
- Write out digits in text files.
- Read back into framework and combine stripped digit list with the digits from the electrons
  - Read in digits
  - Combine with current data digits:
    - build pixel maps
    - align digits in time (TDCs) using muon TDC's
    - recalculate timewalk
    - recalculate the trigger times
    - remultiplex event
- Write out a 'merged' cand digit list
- Run this digit list through regular reconstruction.

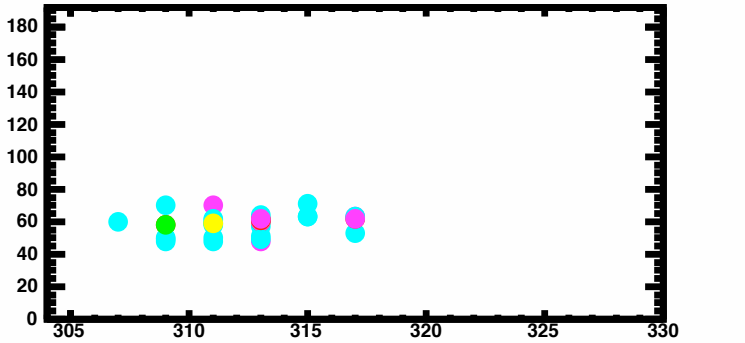
MC Example 1

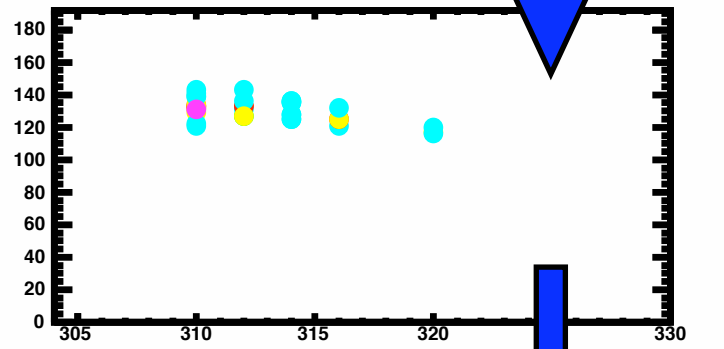
Original Event



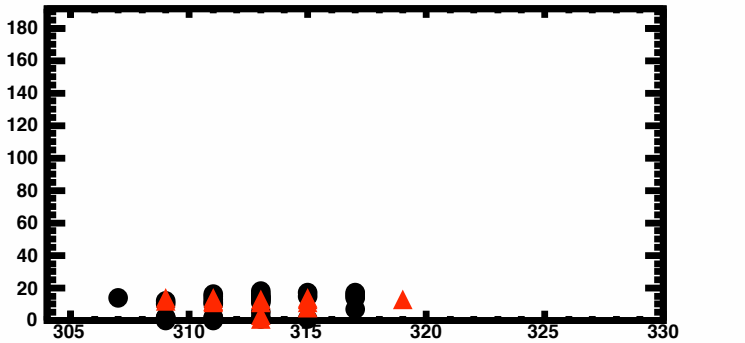


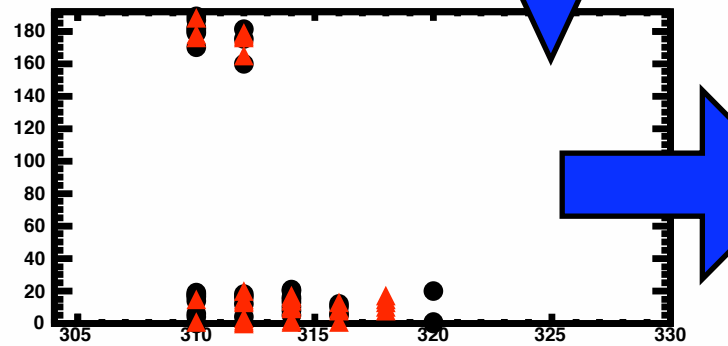
Muon removed





Electron Added + remultiplexed





Std. Reco.

Example 1 (b)

Run: 21001002, Snarl: 0, Slice: 1(/1), Event 1(/1)

Reco

#Trks: 0

#Shws: 1

q/p: 0.000 +/- 0.000, p/q: 0.000

TrkRangeEnergy: 0.000 RecoShwEnergy: 6.013

Vtx: 0.00, 0.00, 0.00

Truth

N/A

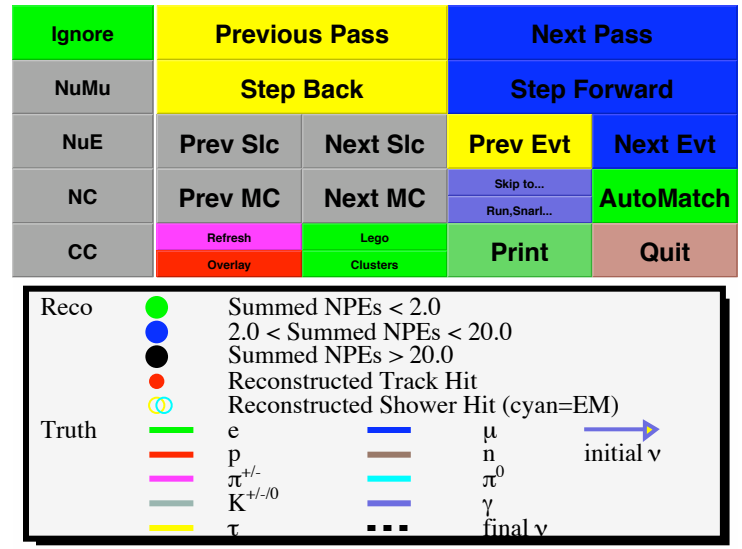
N/A

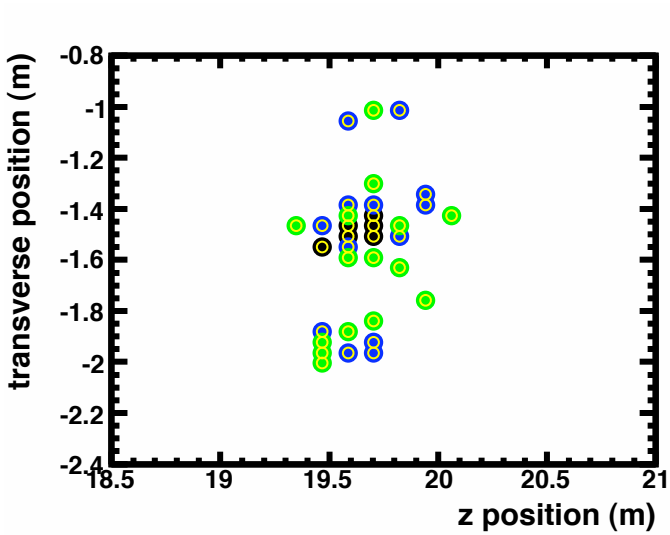
N/A

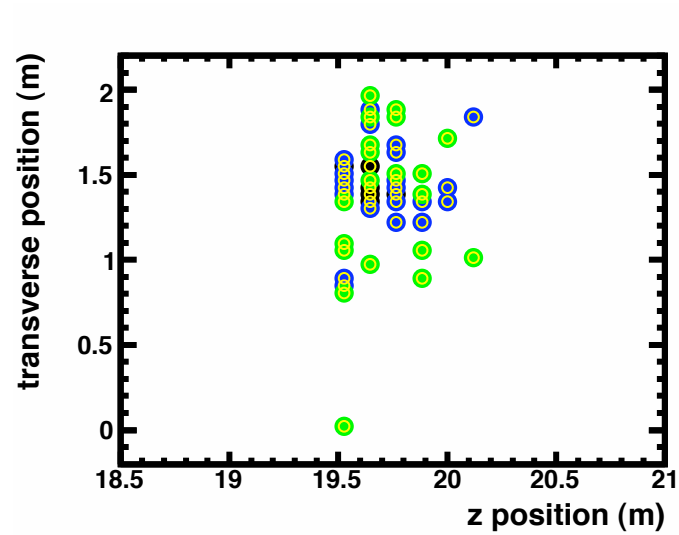
N/A

N/A

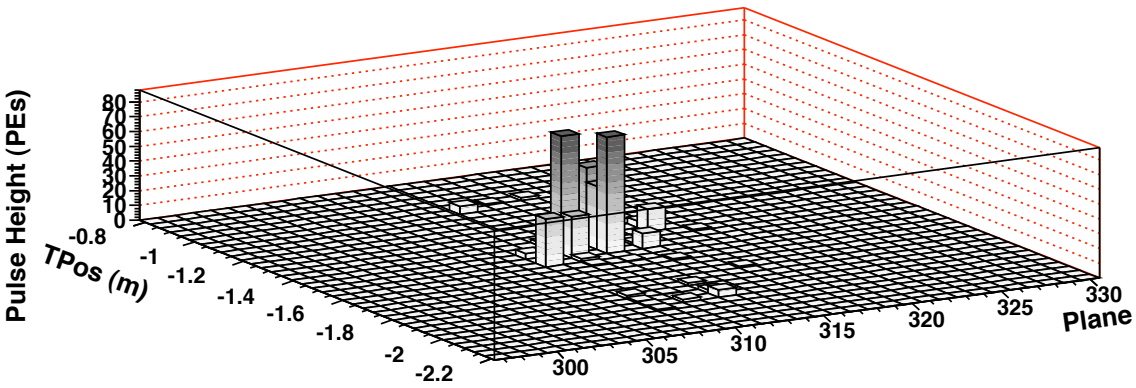
N/A

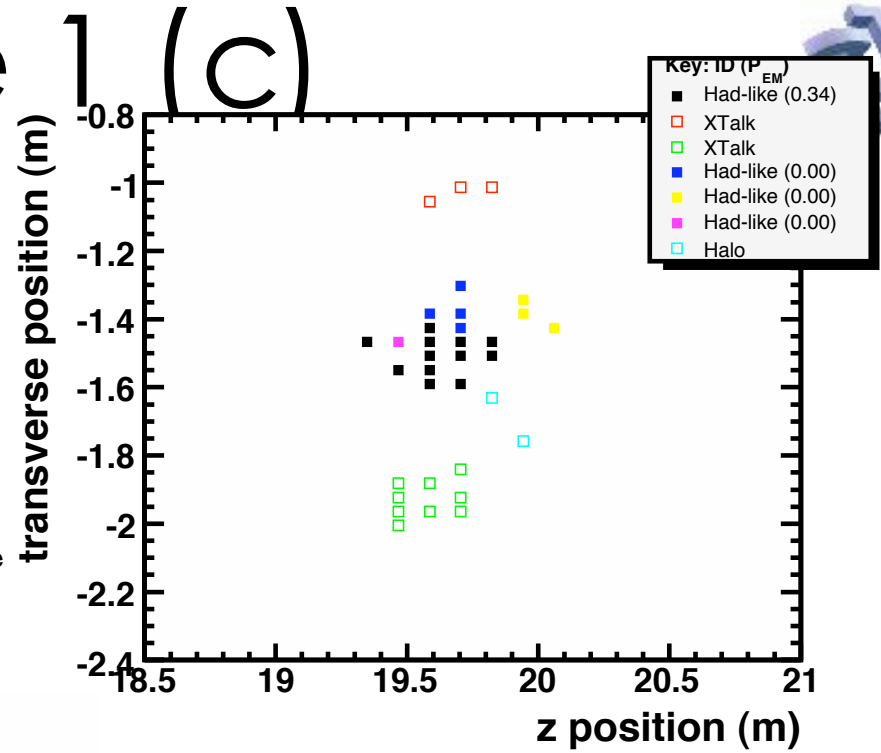


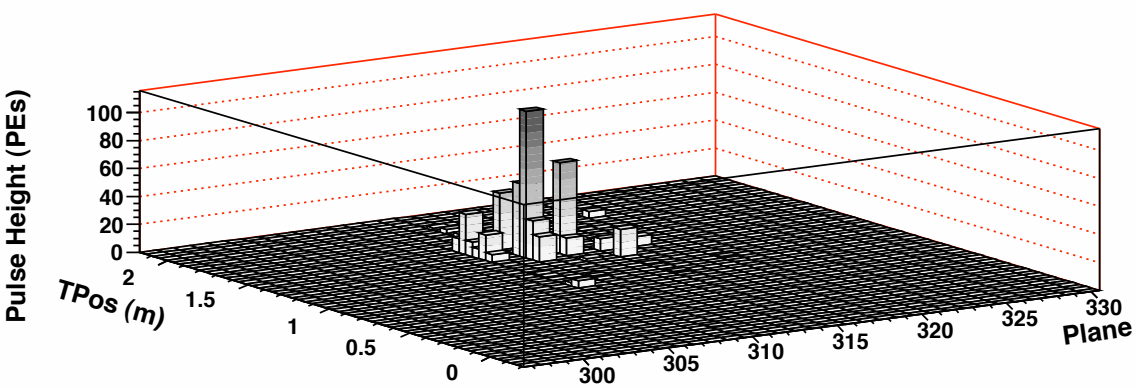


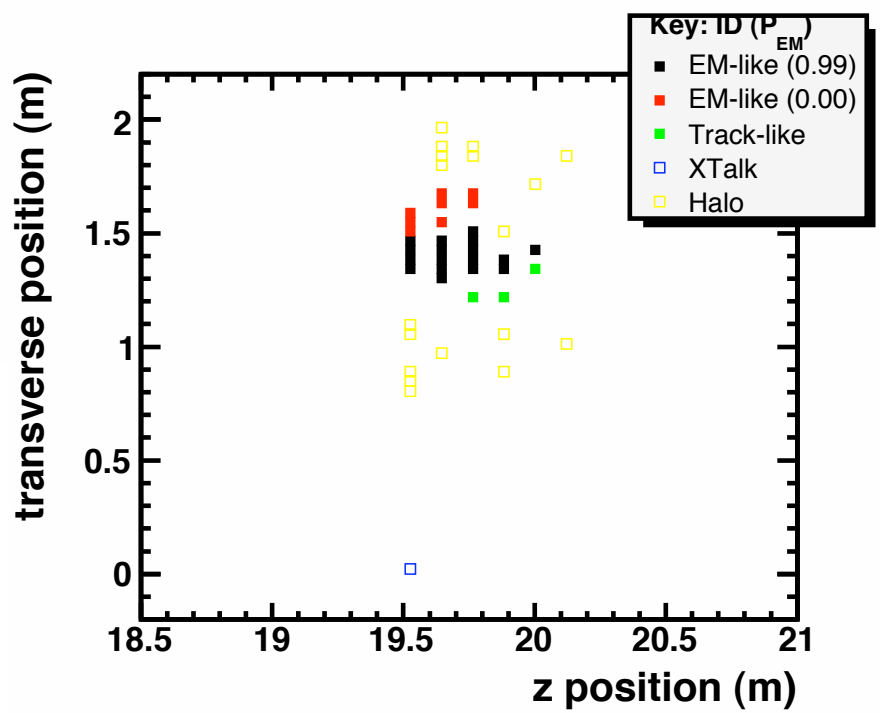


Example 1 (c)


Pulse Height (PEs)
TPos (m)
Plane

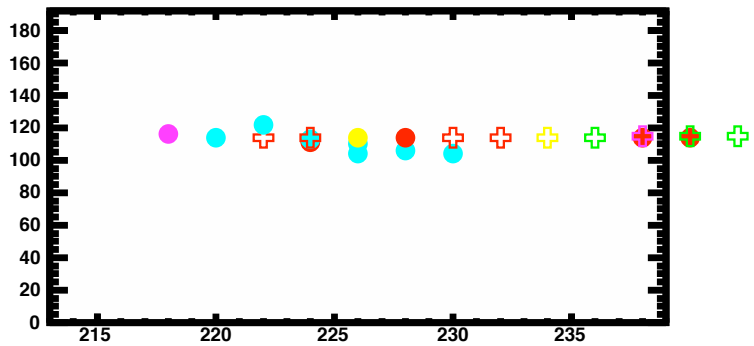

Key: ID (P_EM)
Had-like (0.34)
XTalk
XTalk
Had-like (0.00)
Had-like (0.00)
Had-like (0.00)
Halo
transverse position (m)
z position (m)

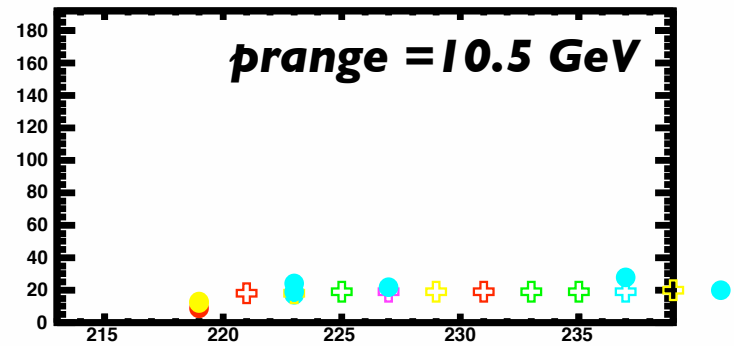

Pulse Height (PEs)
TPos (m)
Plane


Key: ID (P_EM)
EM-like (0.99)
EM-like (0.00)
Track-like
XTalk
Halo
transverse position (m)
z position (m)

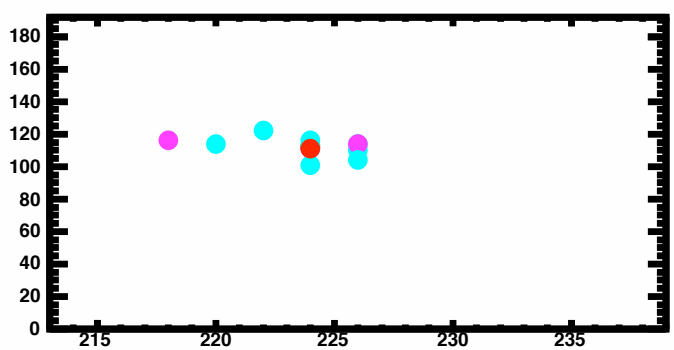
MC Example (a)

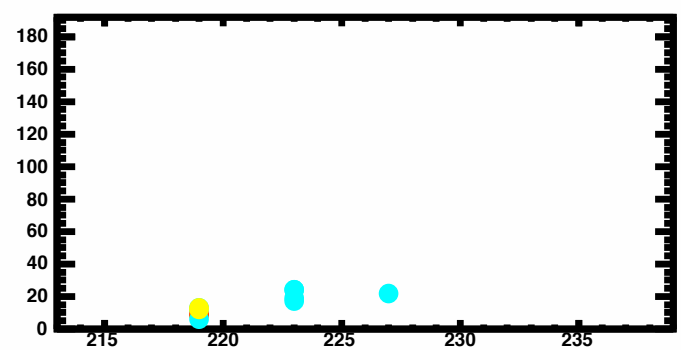
Original Event



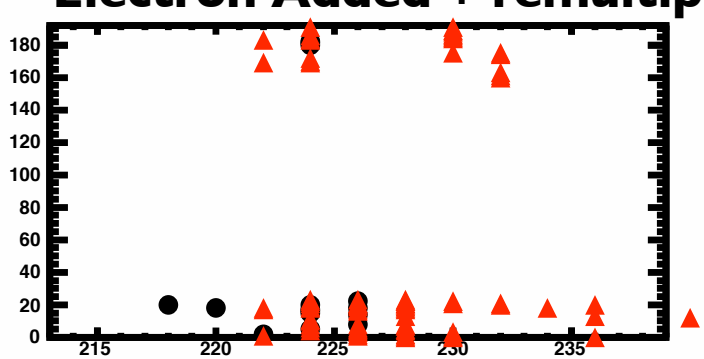


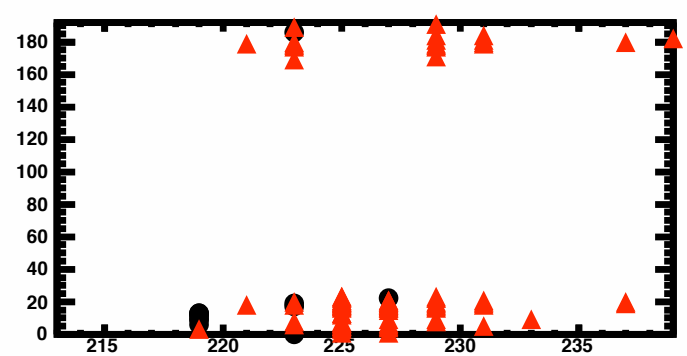
Muon removed





Electron Added + remultiplexed





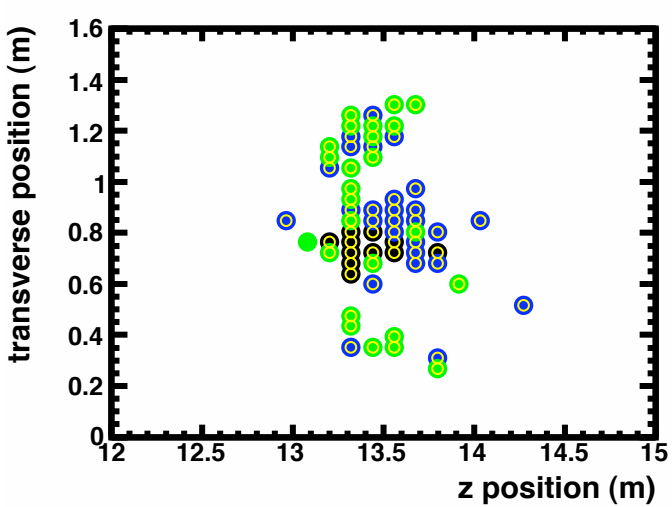
MC Example 2 (b)

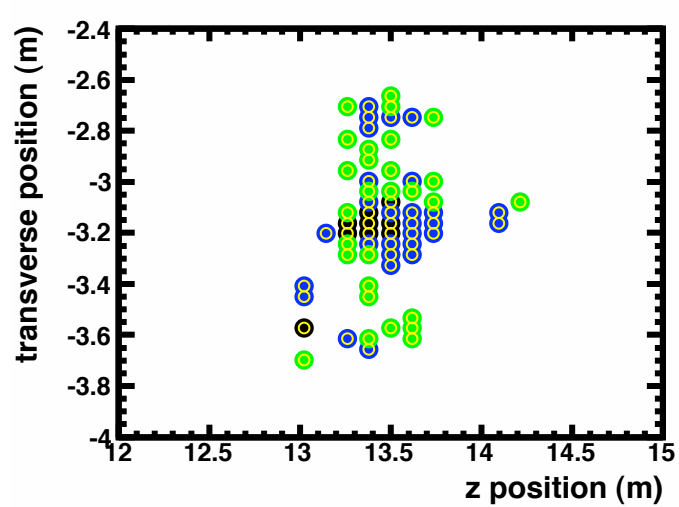
Run: 21001002, Snarl: 3, Slice: 1(/1), Event 1(/1)
Reco
#Trks: 0
#Shws: 1
q/p: 0.000 +/- 0.000, p/q: 0.000
TrkRangeEnergy: 0.000 RecoShwEnergy: 12.317
Vtx: 0.00, 0.00, 0.00
Truth
N/A
N/A
N/A
N/A
N/A
N/A

Ignore	Previous Pass		Next Pass	
NuMu	Step Back		Step Forward	
NuE	Prev Slc	Next Slc	Prev Evt	Next Evt
NC	Prev MC	Next MC	Skip to... / Run,Snarl...	AutoMatch
CC	Refresh / Overlay	Lego / Clusters	Print	Quit

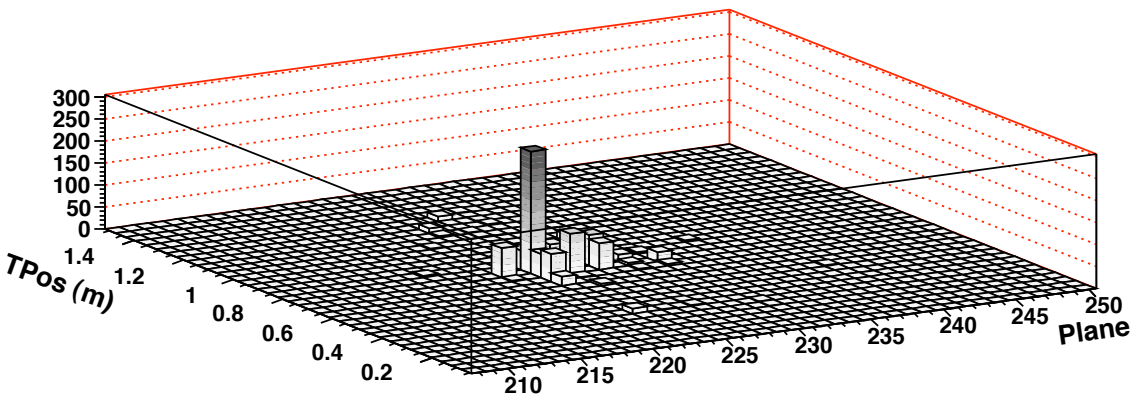
Reco
Summed NPEs < 2.0
2.0 < Summed NPEs < 20.0
Summed NPEs > 20.0
Reconstructed Track Hit
Reconstructed Shower Hit (cyan=EM)

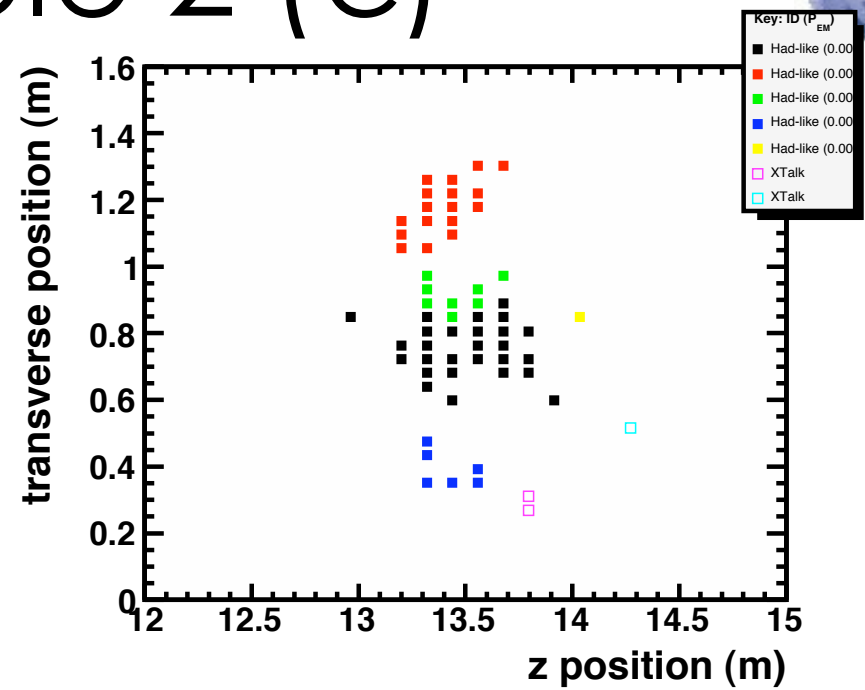
Truth
e, μ, initial ν
p, n
$\pi^{+/-}$, π^0
$K^{+/-/0}$, γ
τ, final ν

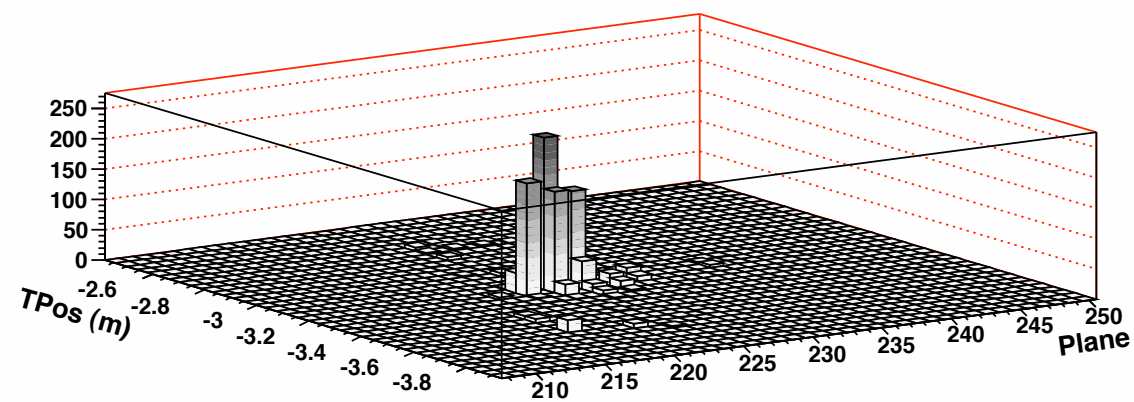


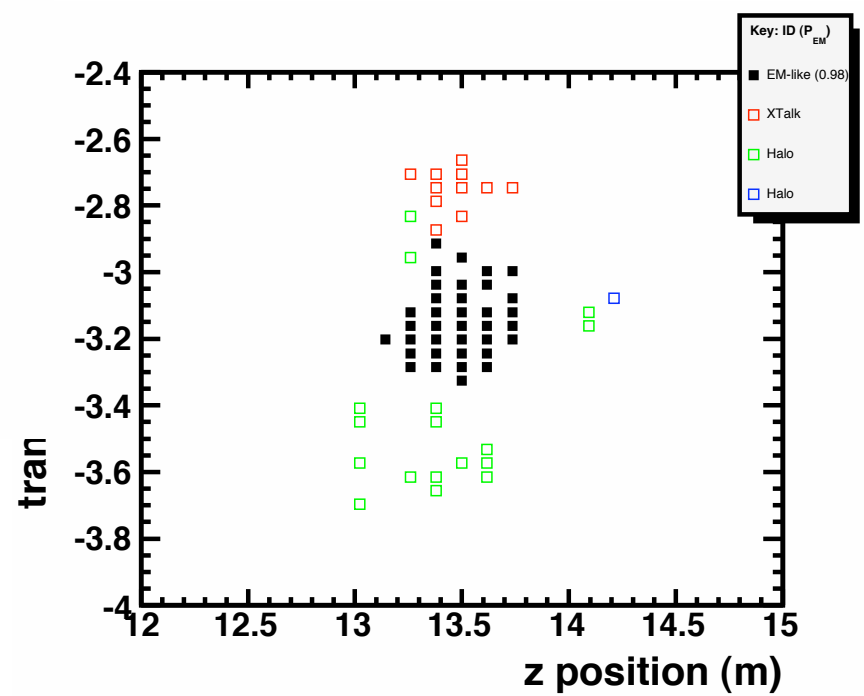


MC Example 2 (c)



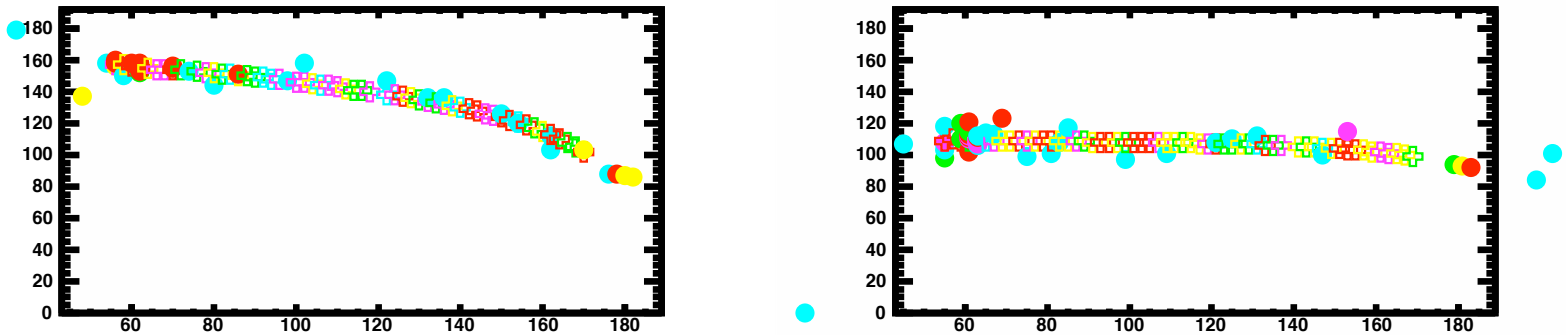




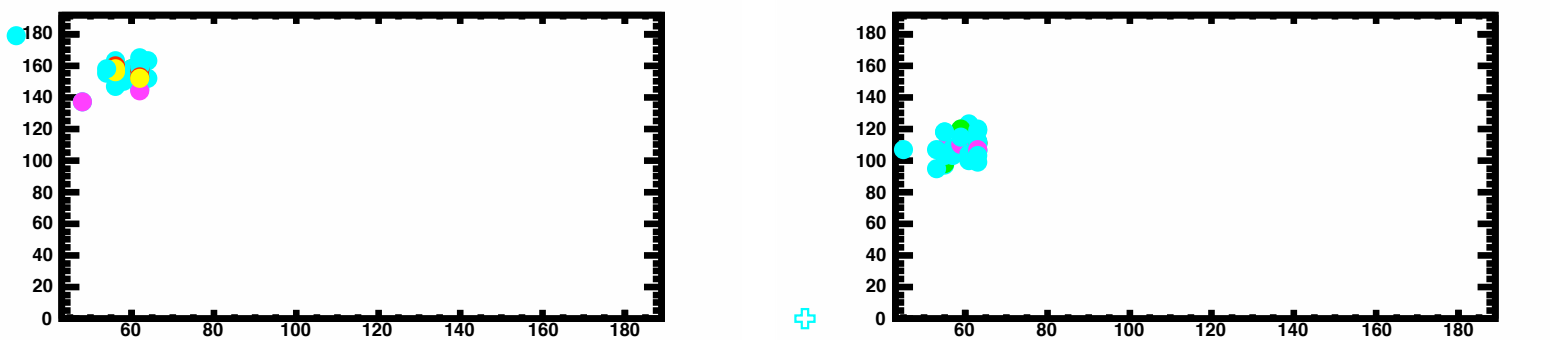


Example Data Events

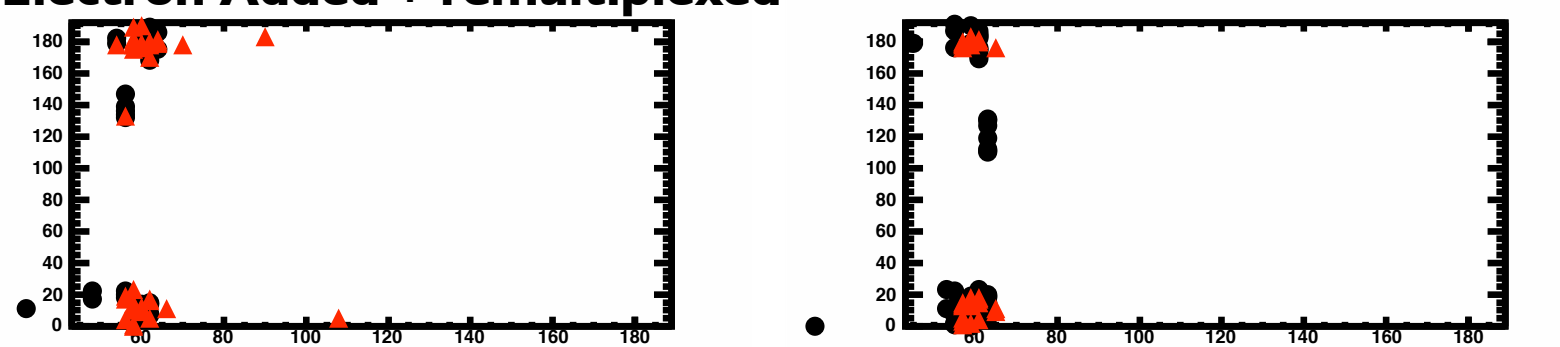
Original Event



Muon removed



Electron Added + remultiplexed



Data 1 (b)

Run: 32898, Snarl: 69211, Slice: 1(/2), Event 1(/2)

Reco

#Trks: 1

#Shws: 1

q/p: 1.177 +/- 0.227, p/q: 0.849

TrkRangeEnergy: 0.635 RecoShwEnergy: 4.345

Vtx: 1.36, 2.03, 3.16

Truth

N/A

N/A

N/A

N/A

N/A

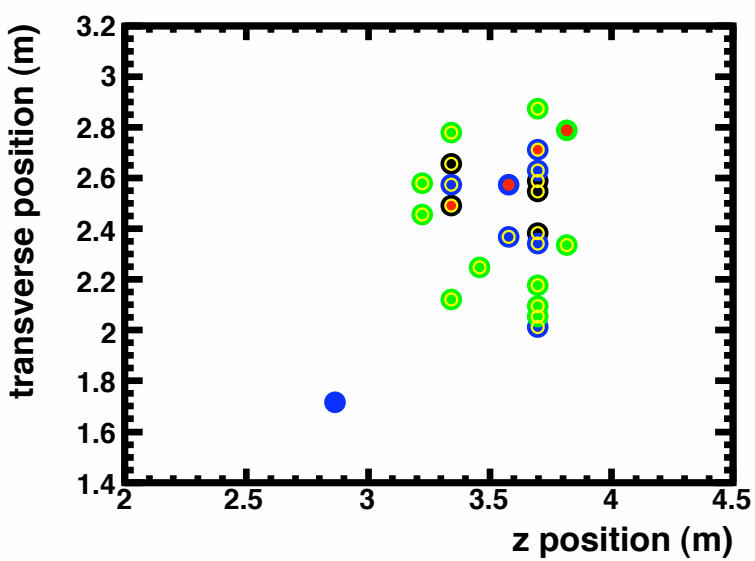
N/A

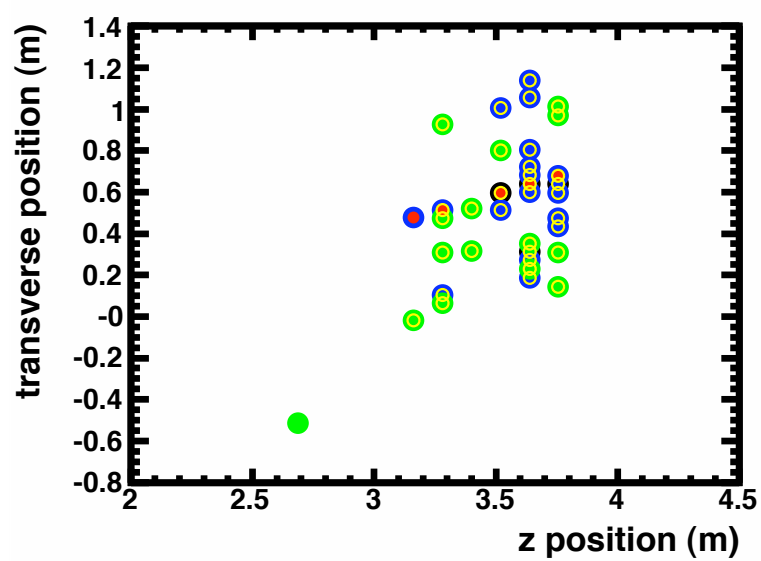
Ignore	Previous Pass		Next Pass	
NuMu	Step Back		Step Forward	
NuE	Prev Slc	Next Slc	Prev Evt	Next Evt
NC	Prev MC	Next MC	Skip to... / Run,Snarl...	AutoMatch
CC	Refresh / Overlay	Lego / Clusters	Print	Quit

Reco
- Summed NPEs < 2.0
- 2.0 < Summed NPEs < 20.0
- Summed NPEs > 20.0
- Reconstructed Track Hit
- Reconstructed Shower Hit (cyan=EM)

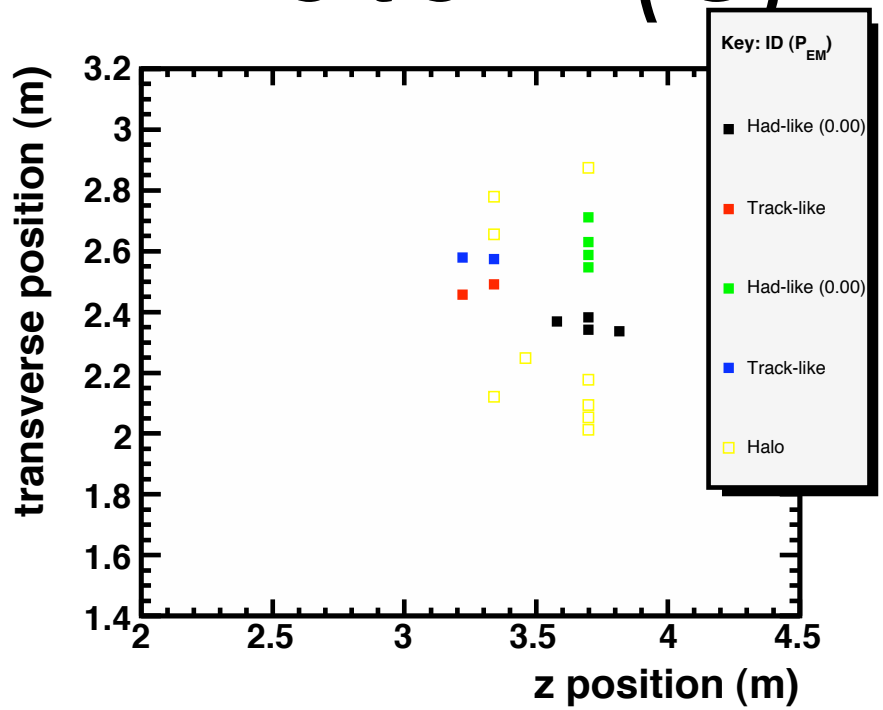
Truth
- e, μ
- p, n
- $\pi^{+/-}$, π^0
- $K^{+/-/0}$, γ
- τ, final ν

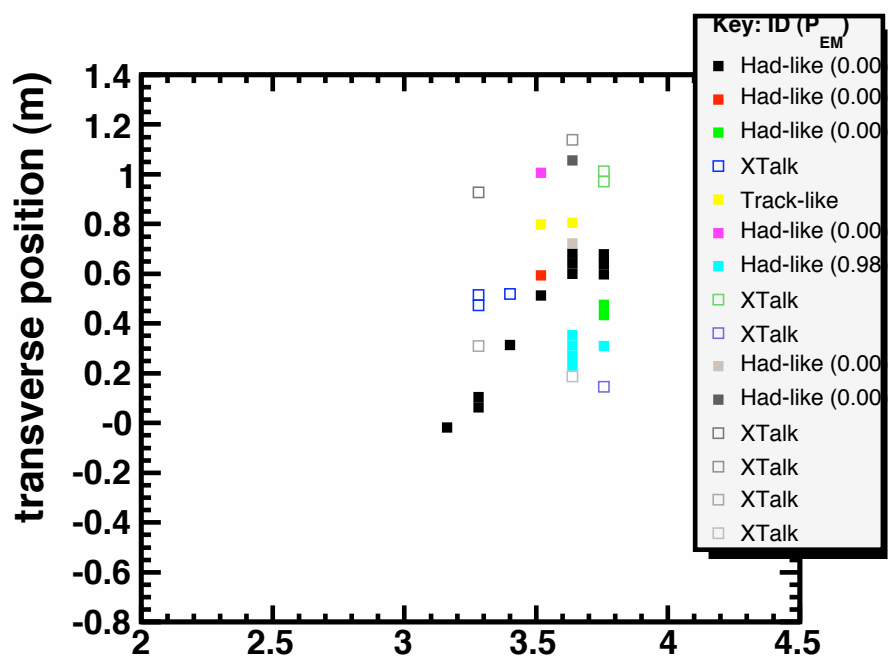
initial ν





Data 1 (c)


Key: ID (P_{EM})
Had-like (0.00)
Track-like
Had-like (0.00)
Track-like
Halo
transverse position (m)
z position (m)
3.2
3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
2
2.5
3
3.5
4
4.5


Key: ID (P_{EM})
Had-like (0.00
Had-like (0.00
Had-like (0.00
XTalk
Track-like
Had-like (0.00
Had-like (0.98
XTalk
XTalk
Had-like (0.00
Had-like (0.00
XTalk
XTalk
XTalk
XTalk
transverse position (m)
1.4
1.2
1
0.8
0.6
0.4
0.2
-0
-0.2
-0.4
-0.6
-0.8
2
2.5
3
3.5
4
4.5

Current limitations (TO DO)

- XTalk from track digits on planes with shower energy no removed.
- 2/36 is not correctly applied (and never can be with this method)
- No attempt made to evaluate how good input parameters are.
- Event timing still needs some work
- Combined shw+trk digits still not correctly handled.
- Mixed calibration for data and MC not correctly handled.



Summary



- Code is written and it works, needs to go in CVS
- There are currently many limitations
- Its a royal pain to run, multiple steps, input/output files
- Has to run on cand files (a real headache), and possible bugs.
- 1st order events look okay, but I'm not experienced nue person, hand scan?
- Question: Continue with Fardet , 55 events in sept/oct?