UNIVERSITY OF TORONTO

ν_e CCQE/CC1π^+ Selection Studies

Trevor Towstego

ν_e CCQE/CC1π^+ Meeting

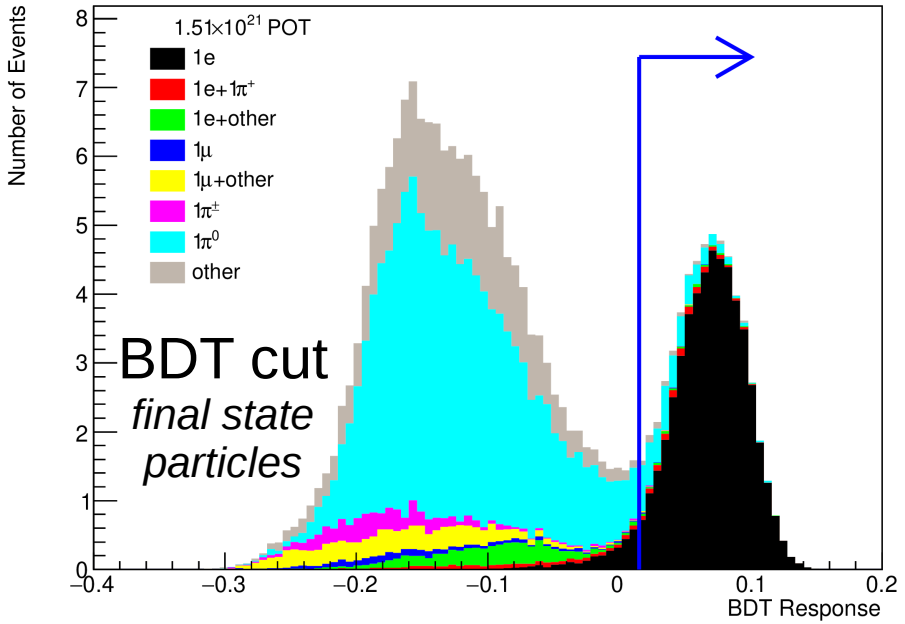
November 28, 2019

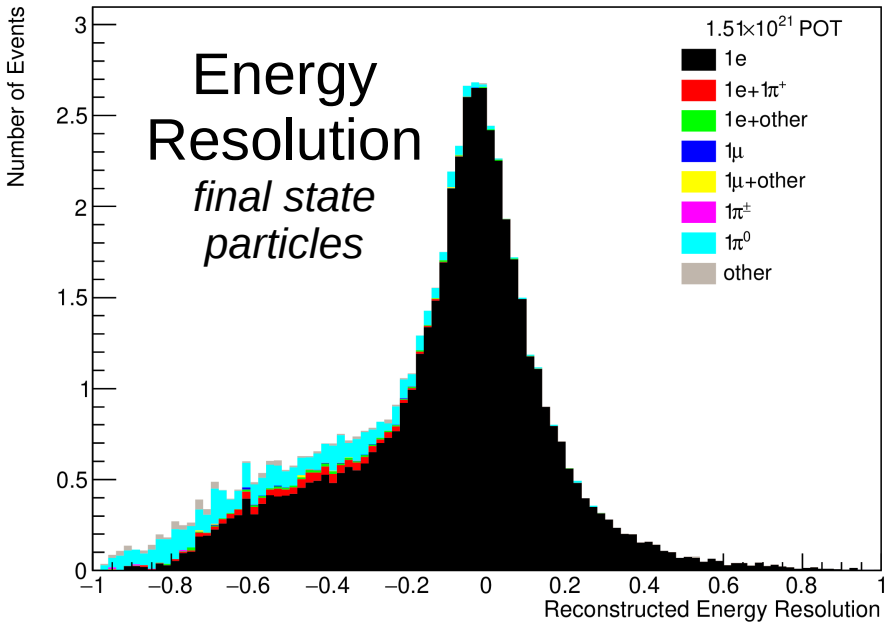
New ν_e CCQE Sample

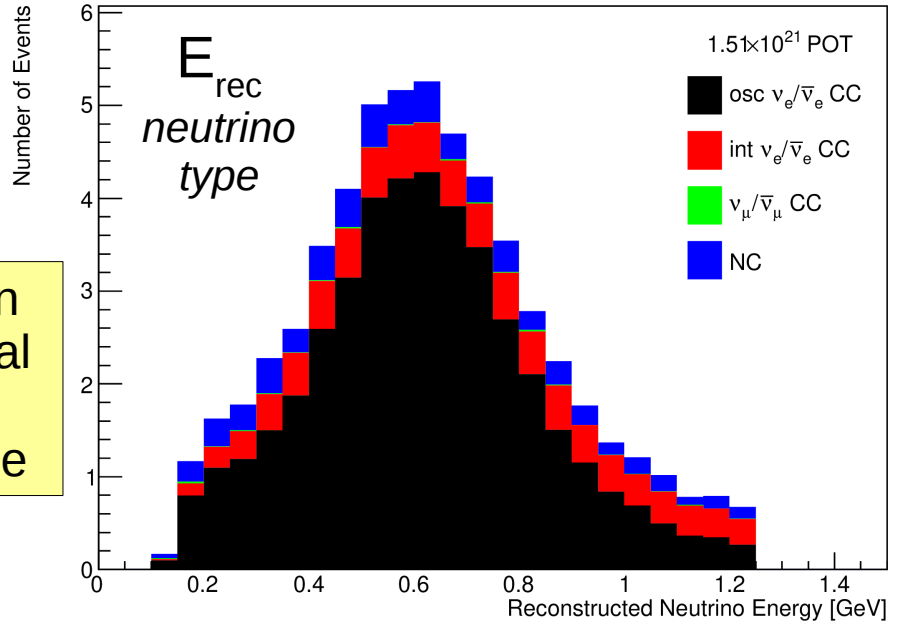
- Updated E_{vis} cut in new ν_e CCQE sample
  - Had forgotten that existing sample has an additional E_{vis} cut at 100 MeV

ν_e CCQE Sample Cuts
Fully Contained (evclass==1 && nhitac<16)
E_{vis} > 100 MeV
Fiducial Volume (Wall > 80 cm && ToWall > 170 cm)
Not 1-ring μ-like
0 decay e
E_{rec} < 1.25 GeV
BDT cut

New ν_e CCQE *Sample Summary*







1.51×10²¹ POT	
osc. $\nu_e/\bar{\nu}_e$ CC	**other**
42.64	15.11
1e	**not 1e**
50.92	6.82

6% increase in oscillated signal compared to existing sample

ν_e CCQE: Old vs. New

Final State

1.51×10²¹ POT	1e	1e+1π⁺	1e+other	1μ	1μ+other	1π±	1π⁰	other
old sample	47.65	0.95	0.26	0.15	0.02	0.15	3.18	0.48
new sample	50.92	0.99	0.34	0.06	0.04	0.03	4.70	0.66

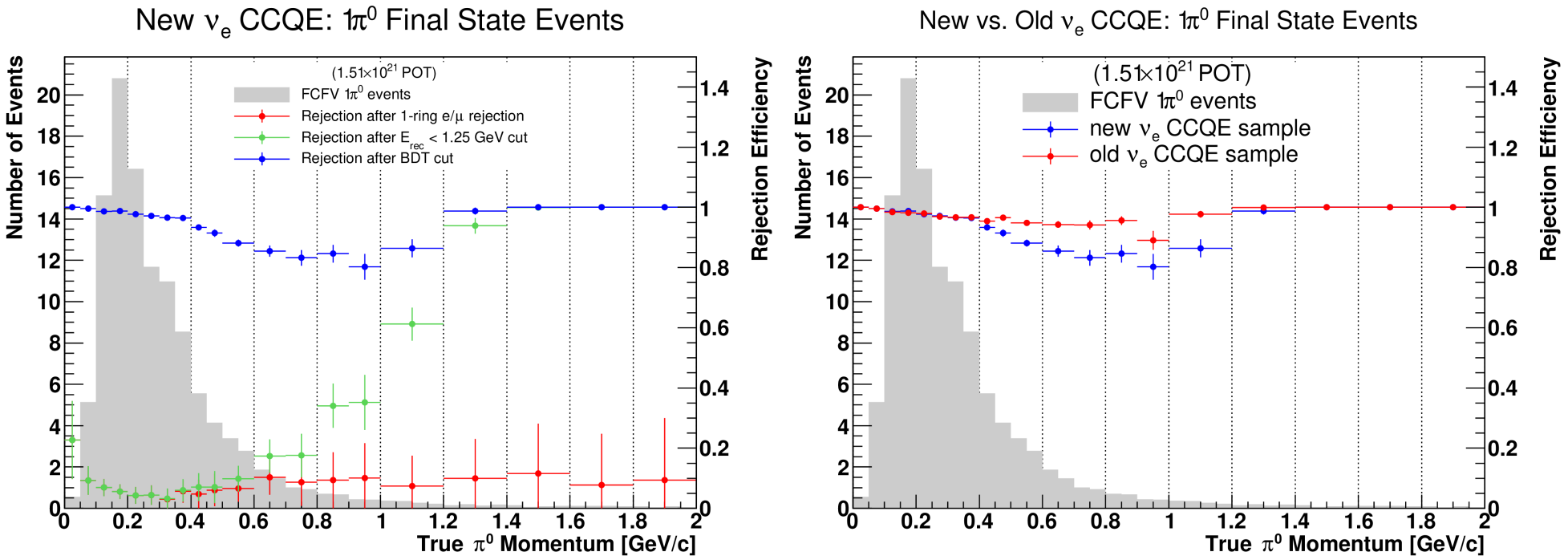
NEUT Mode

1.51×10²¹ POT	$\nu_e/\bar{\nu}_e$ CC QE	$\nu_e/\bar{\nu}_e$ CC 1π±	$\nu_e/\bar{\nu}_e$ CC other	$\nu_\mu/\bar{\nu}_\mu$ CC QE	$\nu_\mu/\bar{\nu}_\mu$ CC other	NC
old sample	42.24	4.71	1.37	0.19	0.08	4.26
new sample	45.39	4.81	1.44	0.11	0.08	5.92

Neutrino Type

1.51×10²¹ POT	osc $\nu_e/\bar{\nu}_e$ CC	int $\nu_e/\bar{\nu}_e$ CC	$\nu_\mu/\bar{\nu}_\mu$ CC	NC
old sample	40.17	8.14	0.27	4.26
new sample	42.64	9.00	0.19	5.92

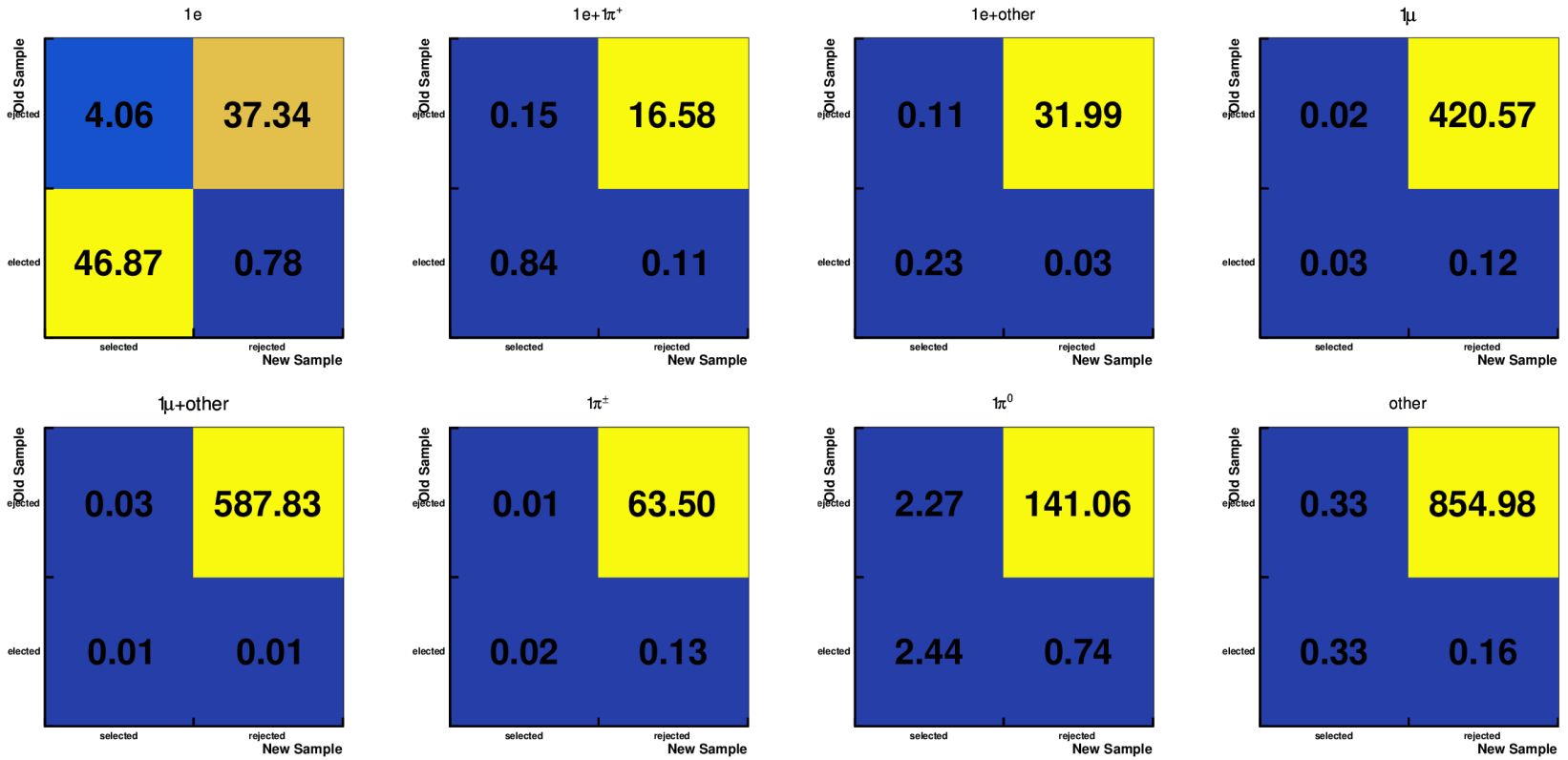
Systematics Check: $p_{\pi 0}$ Dependence



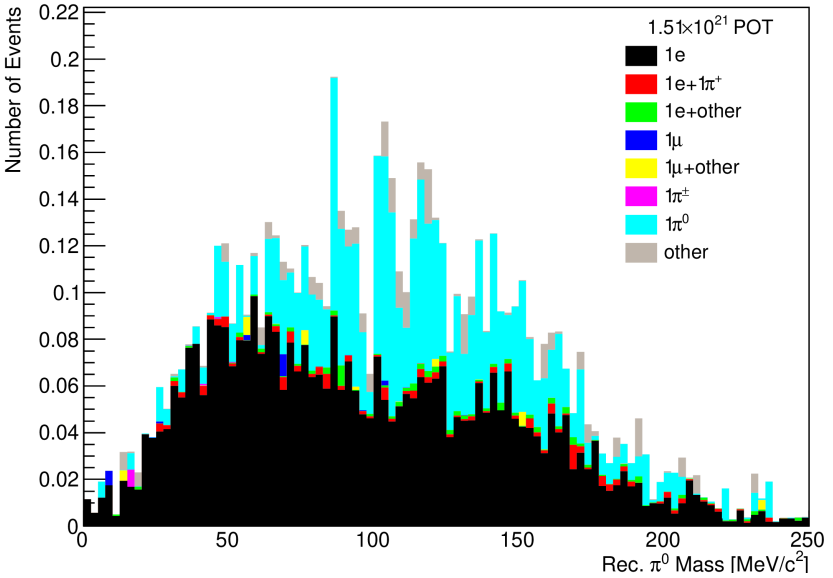
- Check $1\pi^0$ rejection efficiency dependence on π^0 momentum
- Left plot shows rejection efficiency at three points in cut flow
- Right plot shows a comparison of the $1\pi^0$ rejection for the new vs. old ν_e CCQE samples

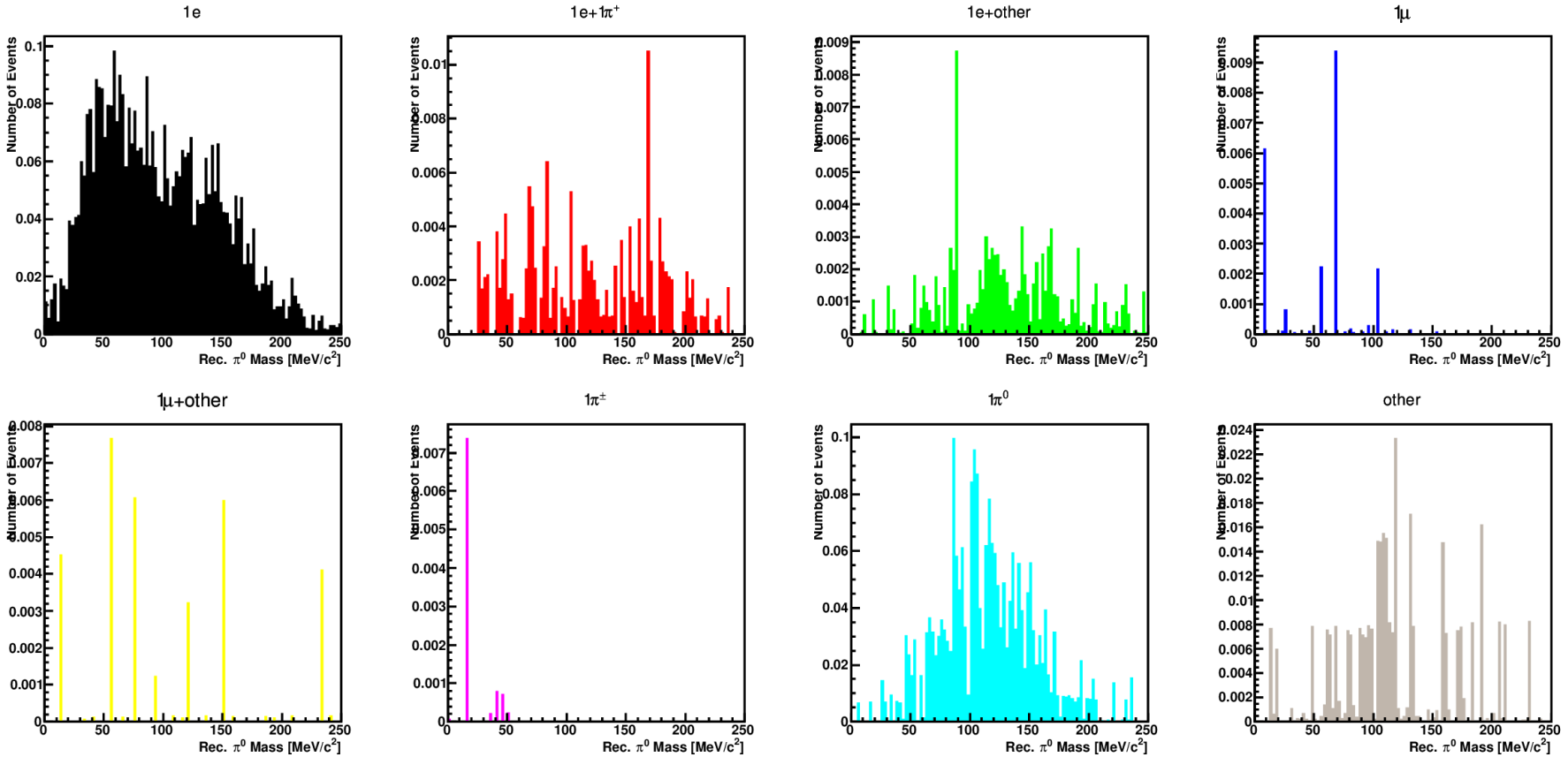
Old vs. New: Intersections

- Top left: rejected by old, selected by new
- Top right: rejected by both samples
- Bottom left: selected by both samples
- Bottom right: selected by old, rejected by new

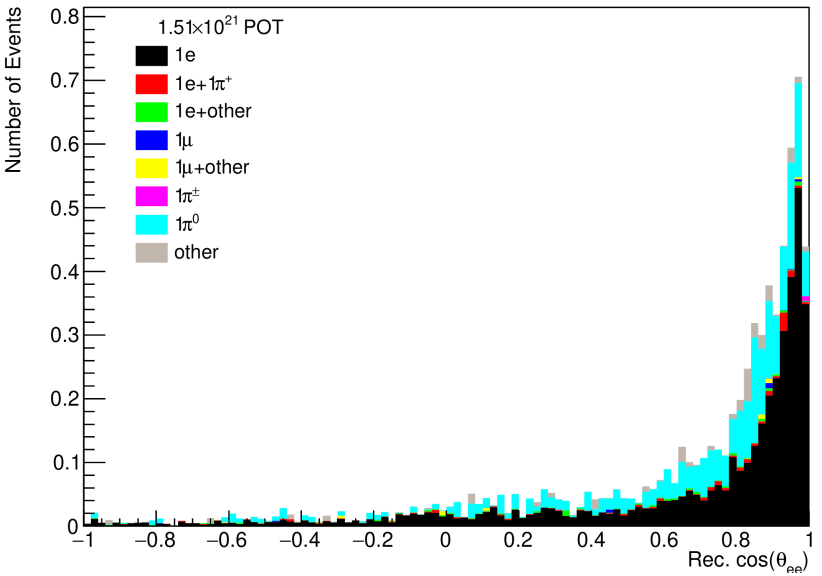


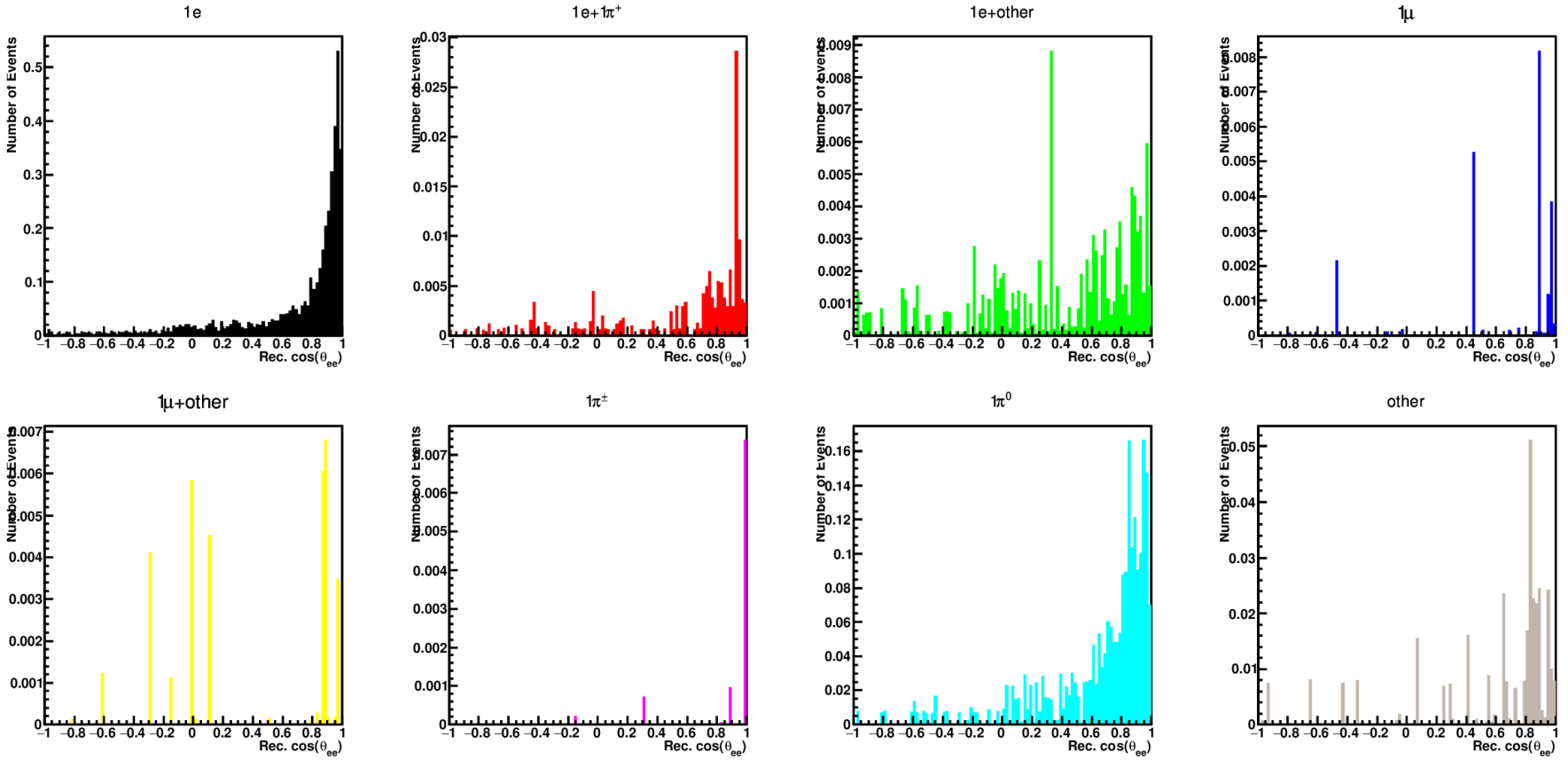
Reconstructed π^0 Mass



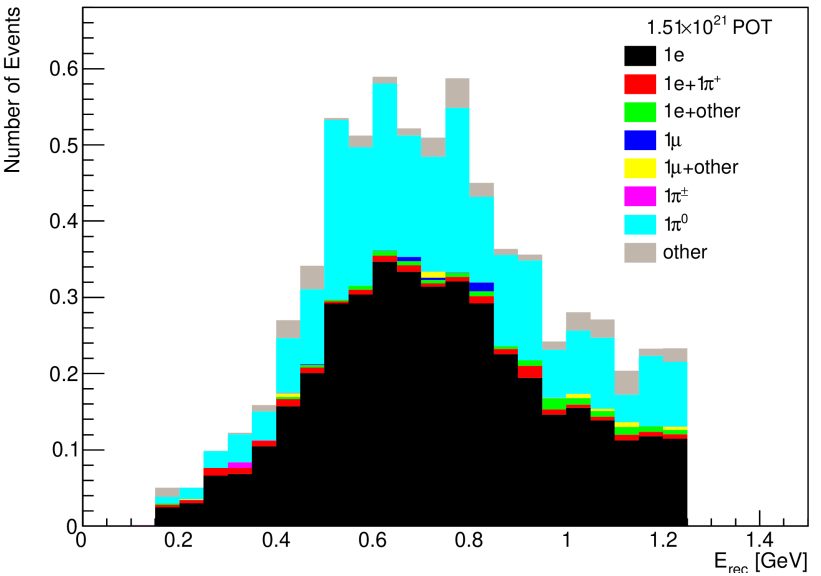


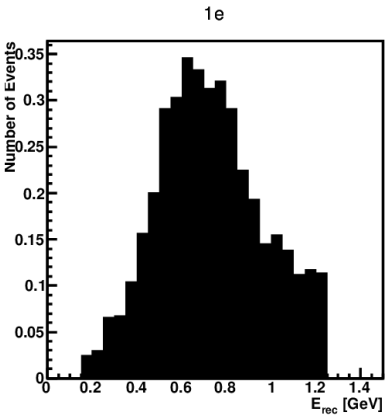
Reconstructed $\cos(\theta_{ee})$

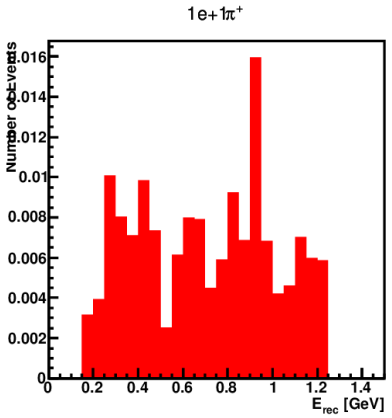


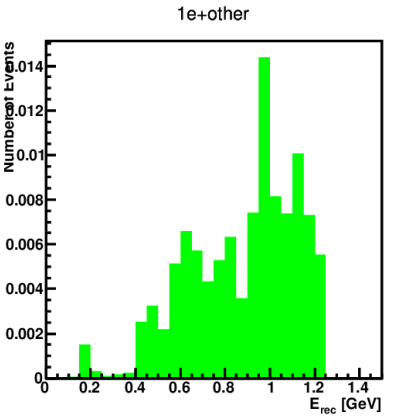


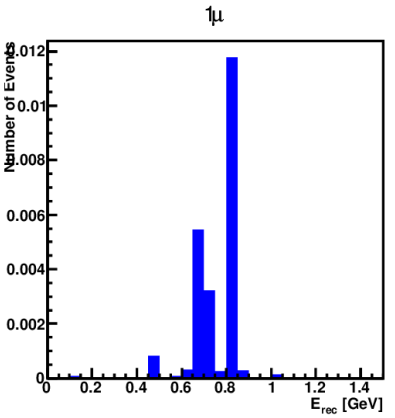
Reconstructed ν Energy

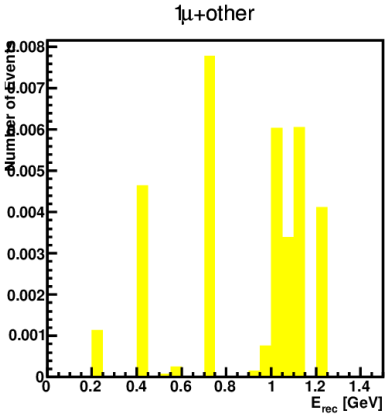


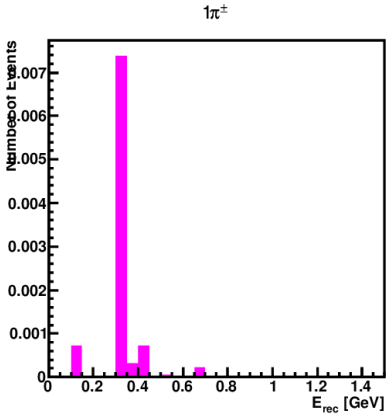


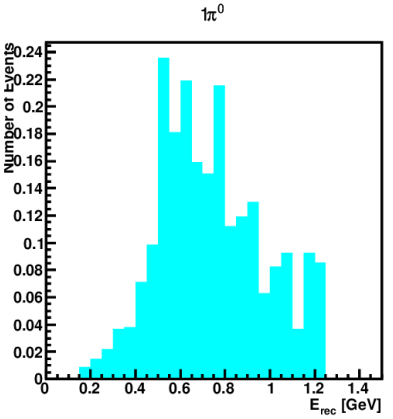


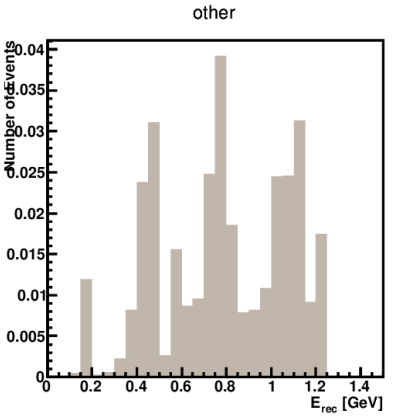




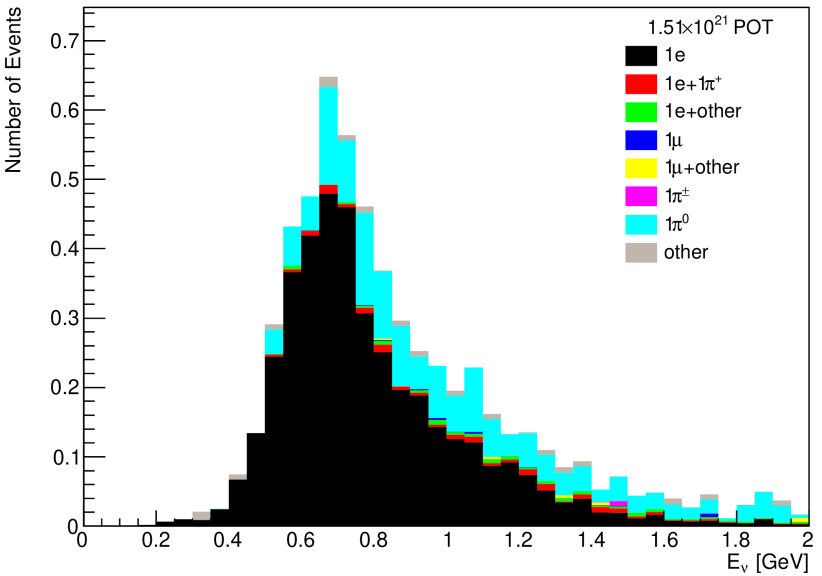


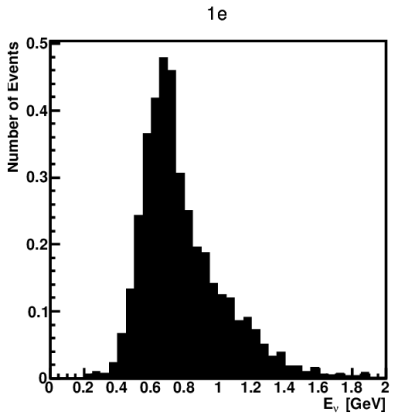


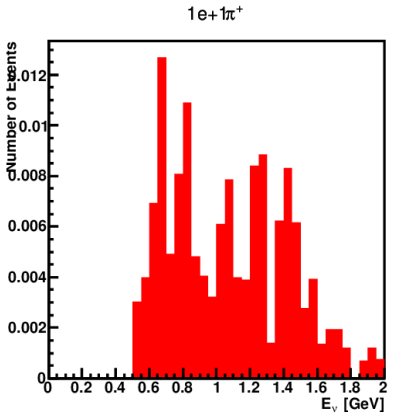


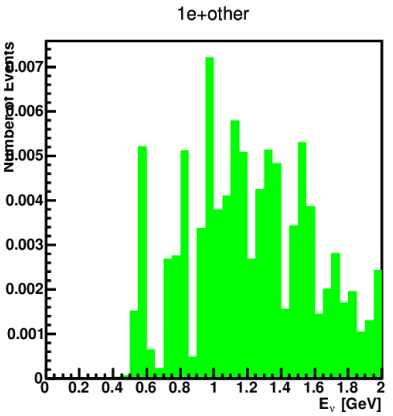


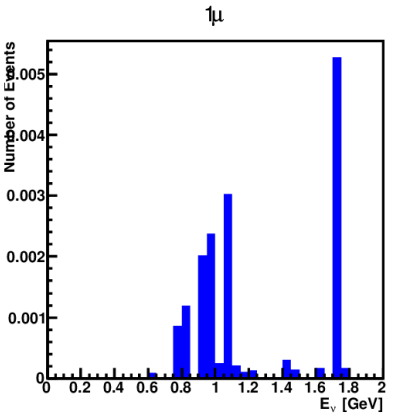
True ν Energy

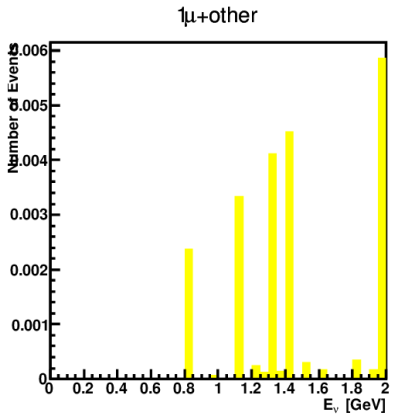


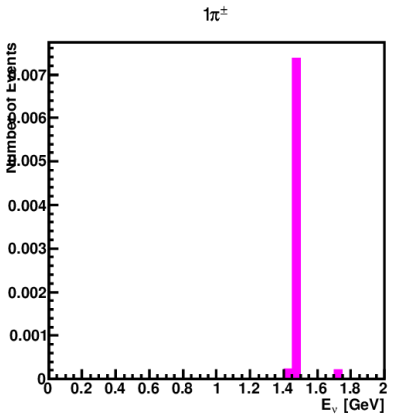


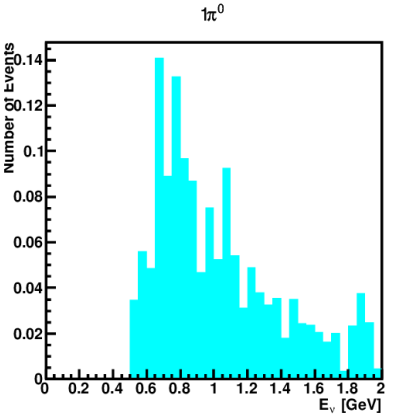


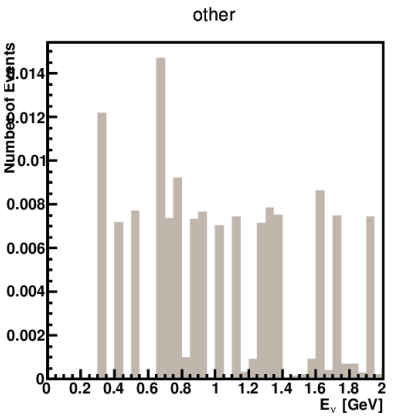




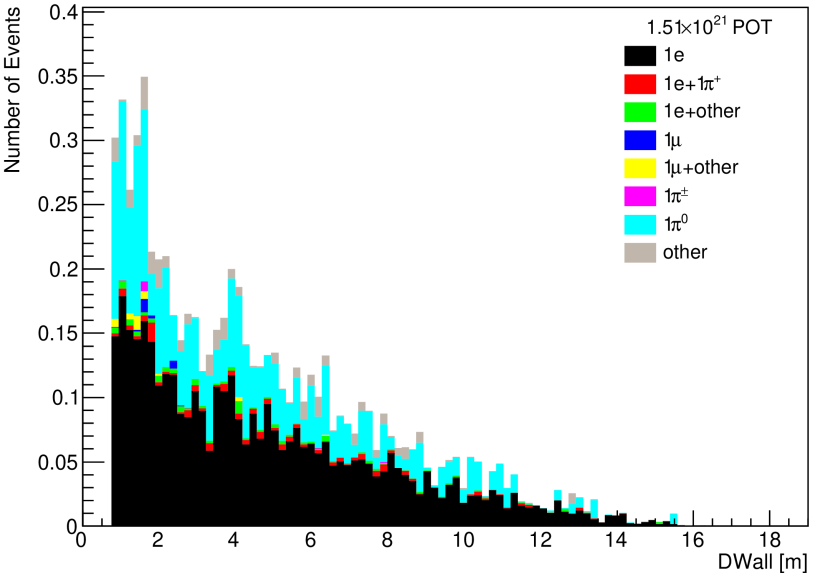


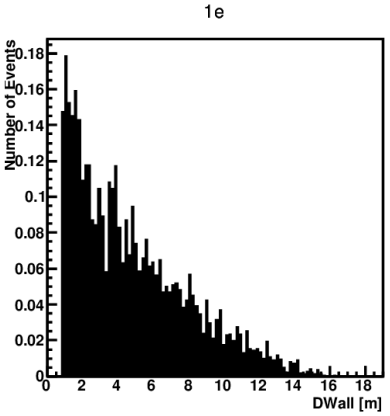


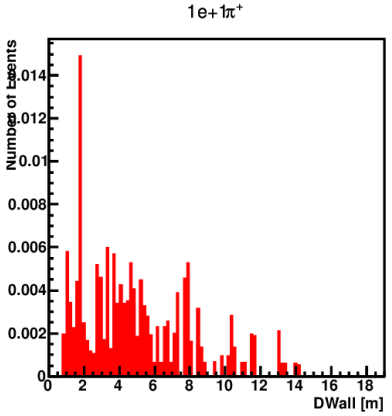


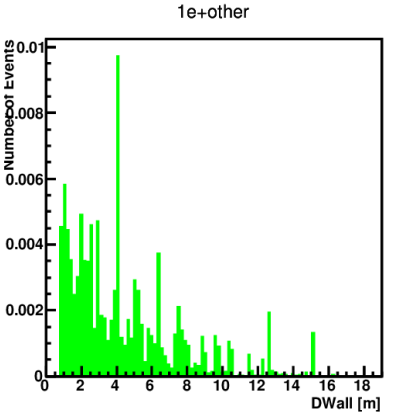


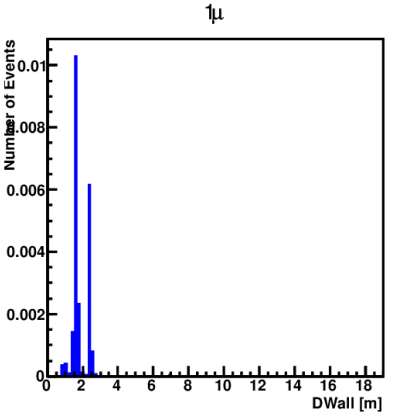
DWall

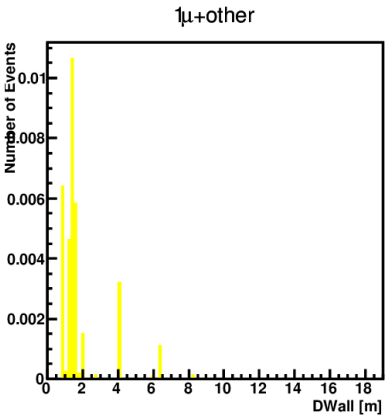

1.51×10^21 POT
1e
1e+1π+
1e+other
1μ
1μ+other
1π±
1π0
other
Number of Events
DWall [m]

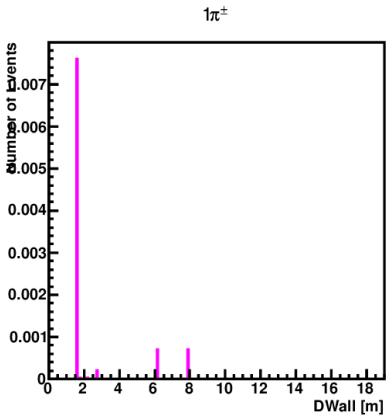

1e
Number of Events
DWall [m]

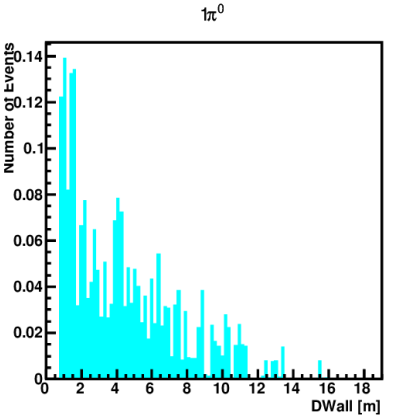

1e+1π+
Number of Events
DWall [m]

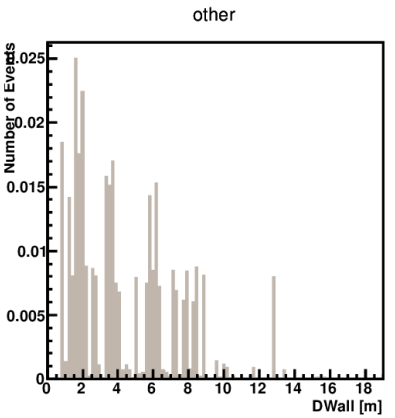

1e+other
Number of Events
DWall [m]


1μ
Number of Events
DWall [m]

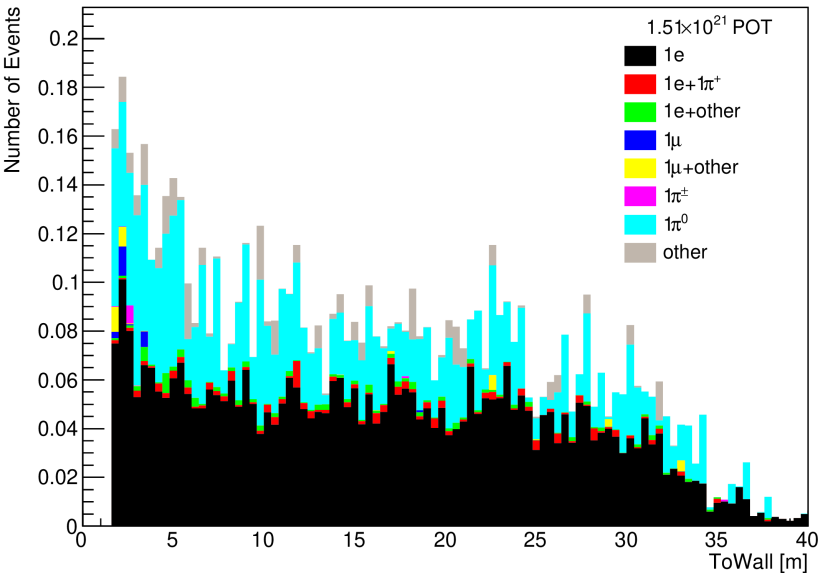

1μ+other
Number of Events
DWall [m]

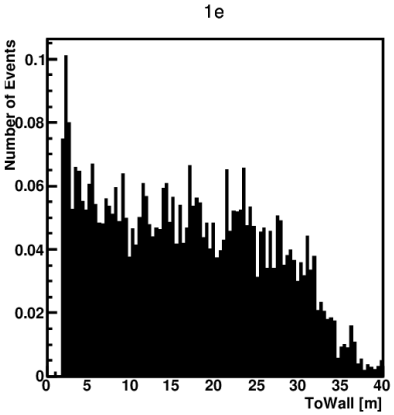

1π±
Number of Events
DWall [m]

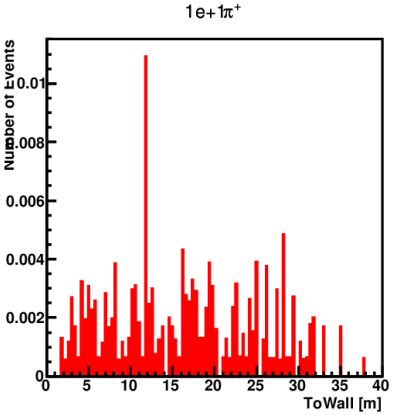

1π0
Number of Events
DWall [m]

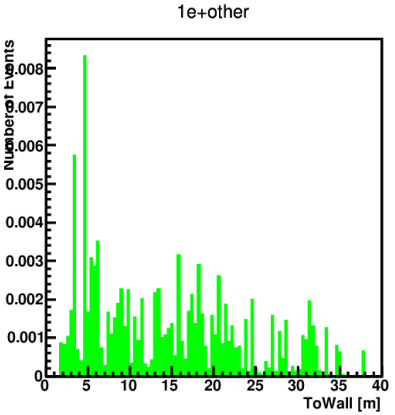

other
Number of Events
DWall [m]

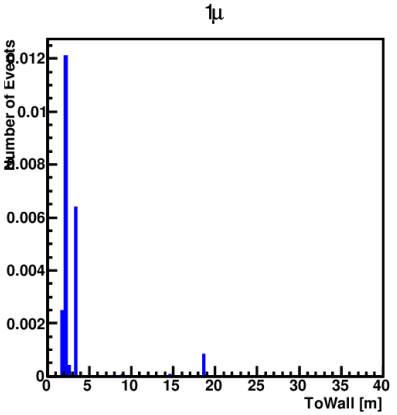
ToWall

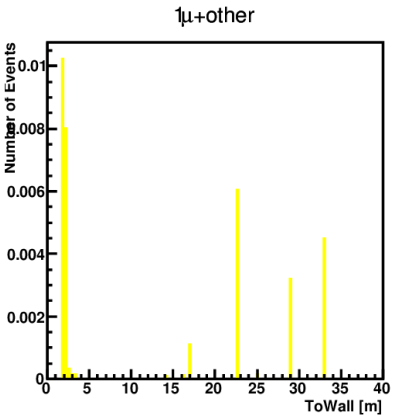

1.51×10^21 POT
1e
1e+1π+
1e+other
1μ
1μ+other
1π±
1π0
other
Number of Events
ToWall [m]

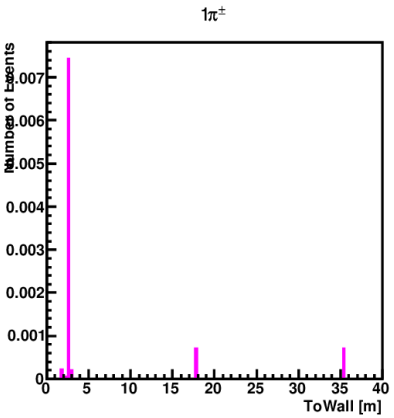

1e
Number of Events
ToWall [m]

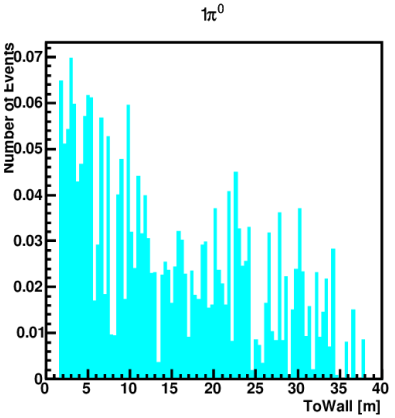

1e+1π+
Number of Events
ToWall [m]

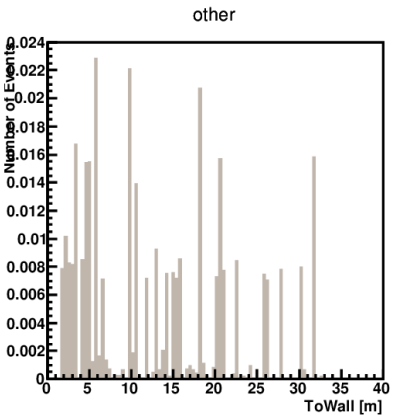

1e+other
Number of Events
ToWall [m]


1μ
Number of Events
ToWall [m]


1μ+other
Number of Events
ToWall [m]


1π±
Number of Events
ToWall [m]


1π0
Number of Events
ToWall [m]


other
Number of Events
ToWall [m]

Committee Meeting

- Friday, December 6th at 10 AM EST
- Will prepare report and send it out by end of the day tomorrow

Backup

Detailed Cutflow: New ν_e CCQE

Final State

1.51×10²¹ POT	1e	1e+1π⁺	1e+other	1μ	1μ+other	1π±	1π⁰	other
All	89.05	17.68	32.36	420.74	587.88	63.65	146.50	855.79
FCFV	69.08	13.67	24.58	252.33	358.87	19.27	115.82	140.37
Not 1Rμ	69.03	13.66	24.58	34.84	341.03	13.82	115.78	138.99
0 decay e	63.68	3.77	15.52	6.71	55.82	6.20	110.67	60.91
E_{rec} < 1.25 GeV	53.81	2.67	6.24	2.57	9.40	6.14	105.27	37.47
BDT cut	50.92	0.99	0.34	0.06	0.04	0.03	4.70	0.66

NEUT Mode

1.51×10²¹ POT	$\nu_e/\bar{\nu}_e$ CC QE	$\nu_e/\bar{\nu}_e$ CC 1π±	$\nu_e/\bar{\nu}_e$ CC other	$\nu_\mu/\bar{\nu}_\mu$ CC QE	$\nu_\mu/\bar{\nu}_\mu$ CC other	NC
All	74.53	36.95	27.36	377.57	706.00	991.26
FCFV	58.31	27.37	20.25	221.33	423.43	243.28
Not 1Rμ	58.27	27.34	20.25	33.60	375.83	236.42
0 decay e	57.44	12.36	12.28	9.73	58.39	173.06
E_{rec} < 1.25 GeV	48.00	8.96	4.92	3.64	9.72	148.33
BDT cut	45.39	4.81	1.44	0.11	0.08	5.92

Neutrino Type

1.51×10²¹ POT	osc $\nu_e/\bar{\nu}_e$ CC	int $\nu_e/\bar{\nu}_e$ CC	$\nu_\mu/\bar{\nu}_\mu$ CC	NC
All	83.57	55.26	1083.57	991.26
FCFV	64.00	41.93	644.76	243.28
Not 1Rμ	63.94	41.92	409.43	236.42
0 decay e	52.97	29.12	68.12	173.06
E_{rec} < 1.25 GeV	49.78	12.11	13.36	148.33
BDT cut	42.64	9.00	0.19	5.92