Progress Update

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UofT Neutrino/DM Meeting
March 7, 2018

non-TMVA related

- Roger replied to my email regarding OD MC files
  - Never used in official analysis, so not copied to any standard location
  - Try looking at Taritee Wongjirad's directory on sukap (former Duke student)
  - If unsuccessful, could try contacting Taritree's advisor (Kate Scholberg)
- Discussed some fiTQun related things with Mike yesterday at T2K-SK meeting
  - 2R electron-proton fits not yet done
    - proton fit performs poorly
  - No technote detailing multi-ring fits
    - I would like to have a better understanding of the difference between 2Repi vs 2Rpie fits, since results of each seem to be quite different
- Mike also commented on superscan issues
  - superscan should have been updated to be compatible with fiTQun
    - didn't quite know which version
  - Will send out another email, including Roger and Cris, detailing the issue

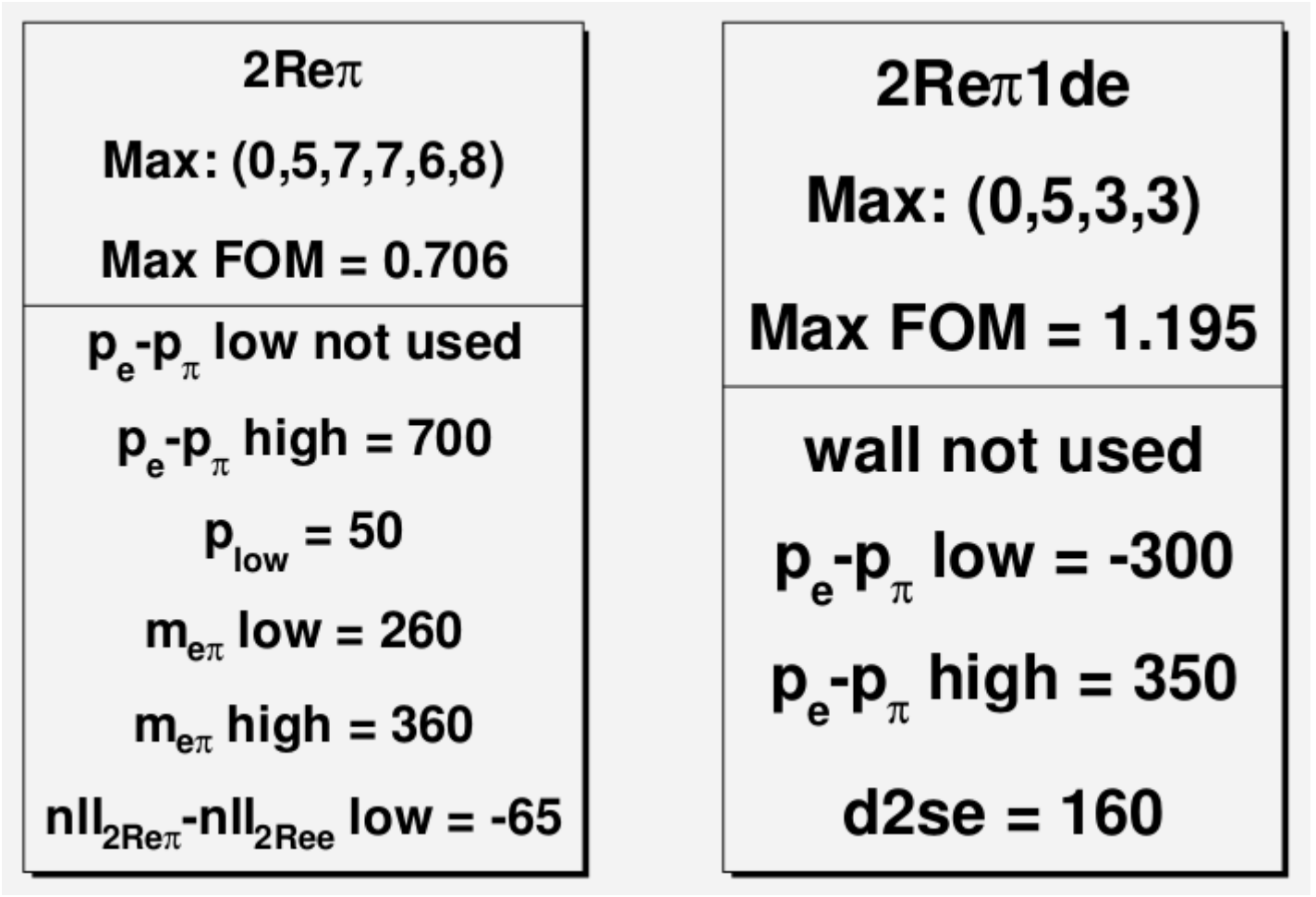
Modified Baseline Cutflow

- Using slightly modified baseline:
  - FCFV: evclass==1 && evis>30. && nhitac<16 && fqwall_2r>50.
  - 2 rings: fqmrnring[0]==2
  - 2Repi-like: ((fqmrpid[0][0]==ie && fqmrpid[0][1]==ipip) || (fqmrpid[0][0]==ipip && fqmrpid[0][1]==ie))
  - 0 or 1 decay electron: fqnse==1 or 2
  - Erec<1.5 GeV

Sample	cut	$\nu_\mu/\bar{\nu}_\mu$ CC	intrinsic $\nu_e/\bar{\nu}_e$ CC	osc $\nu_e/\bar{\nu}_e$ CC	$\nu_\mu/\bar{\nu}_\mu$ NC	$\nu_e/\bar{\nu}_e$ NC	Signal	Background	Purity	FOM
2Repi	FCFV	450.64	59.81	92.29	175.06	9.37	92.29	694.89	0.12	3.289
	2 rings	75.56	11.68	11.06	85.38	4.10	11.06	176.72	0.06	0.807
	epi-like	7.61	4.95	5.07	5.63	0.37	5.07	18.58	0.21	1.042
	0 decay e	1.87	2.23	1.95	3.47	0.22	1.95	7.79	0.20	0.626
	Erec<1.5GeV	0.47	0.63	1.44	2.24	0.13	**1.44**	**3.47**	**0.29**	**0.652**
2Repi1de	FCFV	450.64	59.81	92.29	175.06	9.37	92.29	694.89	0.12	3.289
	2 rings	75.56	11.68	11.06	85.38	4.10	11.06	176.72	0.06	0.807
	epi-like	7.61	4.95	5.07	5.63	0.37	5.07	18.58	0.21	1.042
	1 decay e	3.69	2.41	3.04	1.75	0.13	3.04	7.98	0.28	0.916
	Erec<1.5GeV	0.91	0.92	2.75	1.11	0.09	**2.75**	**3.03**	**0.48**	**1.145**

Grid Search Result

baseline: 0.652



baseline: 1.145

Grid Search Cutflow

Sample	cut	$\nu_\mu/\bar{\nu}_\mu$ CC	intrinsic $\nu_e/\bar{\nu}_e$ CC	osc $\nu_e/\bar{\nu}_e$ CC	$\nu_\mu/\bar{\nu}_\mu$ NC	$\nu_e/\bar{\nu}_e$ NC	Signal	Background	Purity	FOM
2Reπ	baseline	0.47	0.63	1.44	2.24	0.13	1.44	3.47	0.29	0.652
	p_e-p_π<700MeV	0.46	0.62	1.44	2.23	0.13	1.44	3.45	0.30	0.653
	p_{low}>50MeV	0.38	0.61	1.41	1.73	0.09	1.41	2.81	0.34	0.688
	$m_{e\pi}$<260MeV >360MeV || $nl_{2Re\pi}$-nll_{2Ree}<-65	**0.34**	**0.60**	**1.37**	**1.38**	**0.07**	**1.37**	**2.39**	**0.36**	**0.706**
2Reπ1de	baseline	0.91	0.92	2.75	1.11	0.09	2.75	3.03	0.48	1.145
	-300<p_e-p_π<350	0.69	0.73	2.47	0.48	0.04	2.47	1.94	0.56	1.176
	d2se<160	**0.52**	**0.68**	**2.40**	**0.39**	**0.04**	**2.40**	**1.63**	**0.60**	**1.195**

- This can be used to compare with TMVA results

Some results using TMVA

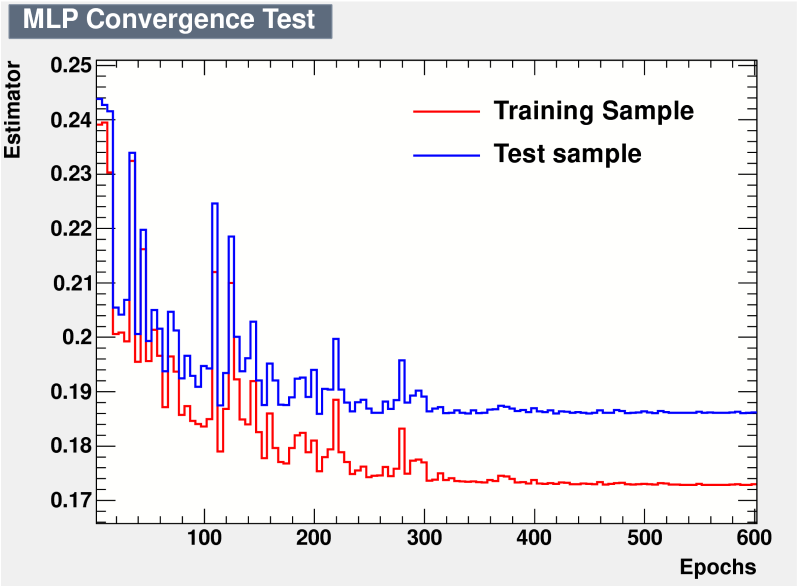
2Repi	MLP		BDT	
Cuts	**Notes**	**FOM**	**Notes**	**FOM**
p_low p_e-p_pi 2Repi-like vs 2Ree nll m_epi	HiddenLayers=N+5	0.700	MaxDepth=3	0.735
p_low p_e-p_pi 2Repi vs 2Rpie nll m_epi	HiddenLayers=N+5	0.715	MaxDepth=3	0.745
p_low p_e-p_pi 2Rpie vs 2Ree nll m_epi	HiddenLayers=N+5	0.701	MaxDepth=3	0.748
p_low p_e-p_pi 2Repi vs 2Rpie nll 2Rpie vs 2Ree nll m_epi	HiddenLayers=N+5	0.713	MaxDepth=3	0.756
p_low p_e-p_pi 2Repi vs 2Rpie nll 2Rpie vs 2Ree nll m_epi cos(theta)	HiddenLayers=N+5	0.716	MaxDepth=3	0.762
p_low p_e-p_pi 2Repi vs 2Rpie nll 2Rpie vs 2Ree nll m_epi cos(theta)	HiddenLayers=N+5,N	0.739	MaxDepth=4	0.777

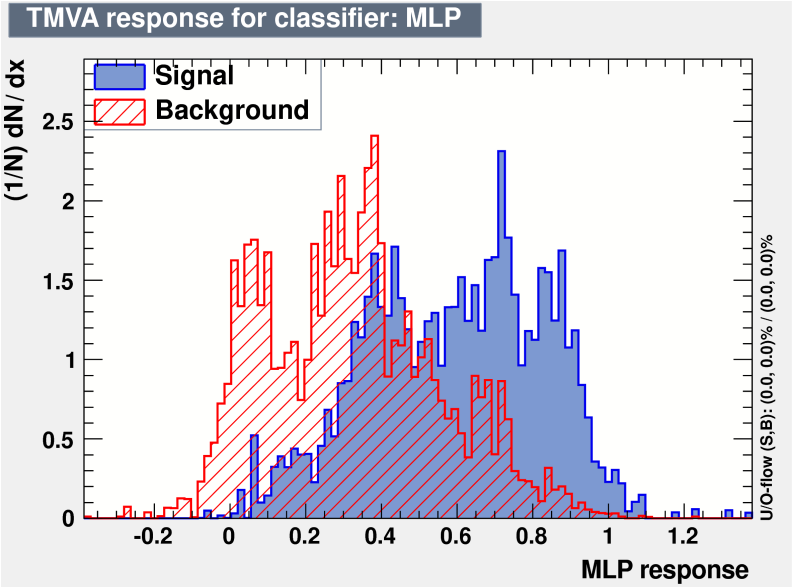
baseline: 0.652
grid: 0.706

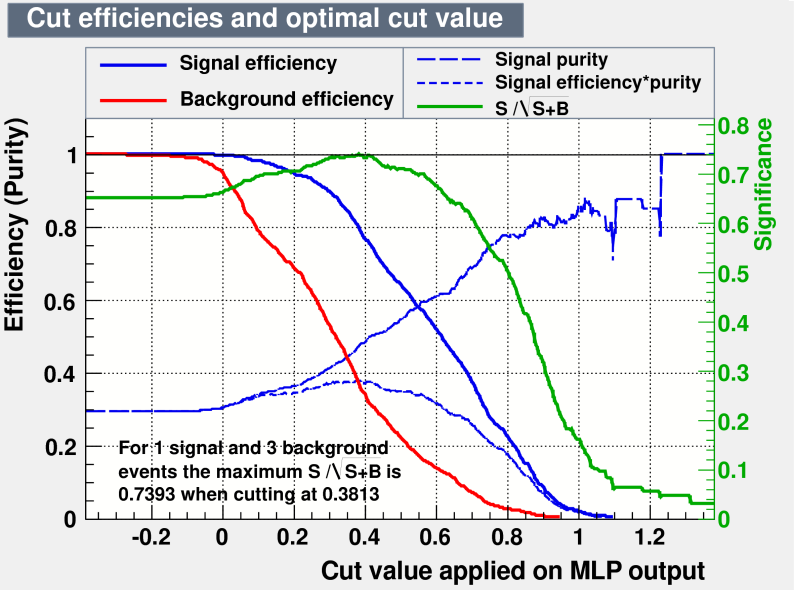
2Repi1de	MLP		BDT	
Cuts	**Notes**	**FOM**	**Notes**	**FOM**
p_e-p_pi d2se	HiddenLayers=N+5	1.160	MaxDepth=3	1.180
p_e-p_pi d2se 2Repi vs 2Rpie nll	HiddenLayers=N+5	1.207	MaxDepth=3	1.228
p_e-p_pi d2se 2Rpie vs 2Ree nll	HiddenLayers=N+5	1.195	MaxDepth=3	1.234
p_e-p_pi d2se 2Repi vs 2Rpie nll 2Rpie vs 2Ree nll	HiddenLayers=N+5	1.202	MaxDepth=3	1.239
p_e-p_pi d2se 2Repi vs 2Rpie nll 2Rpie vs 2Ree nll cos(theta)	HiddenLayers=N+5	1.216	MaxDepth=3	1.248
p_e-p_pi d2se 2Repi vs 2Rpie nll 2Rpie vs 2Ree nll cos(theta)	HiddenLayers=N+5,N	1.238	MaxDepth=4	1.257

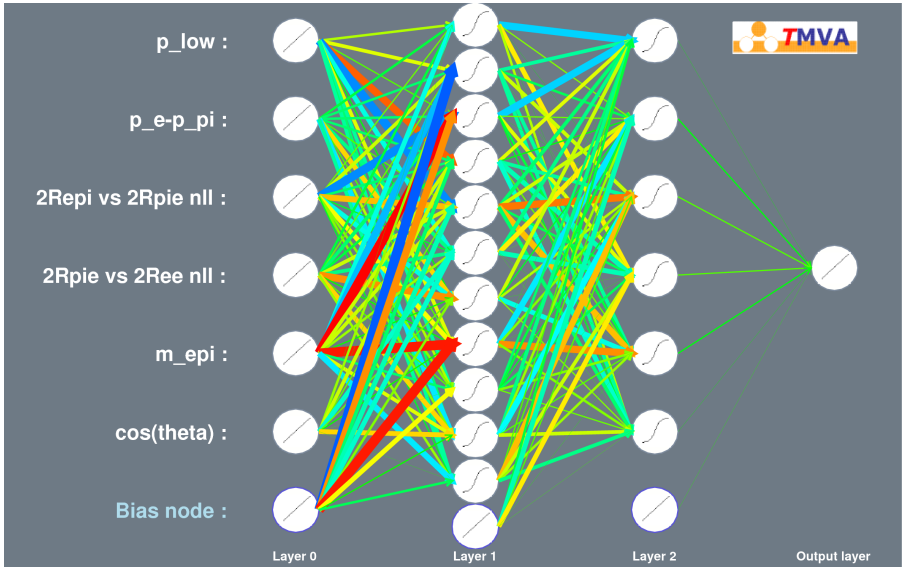
baseline: 1.145
grid: 1.195

Best MLP Plots

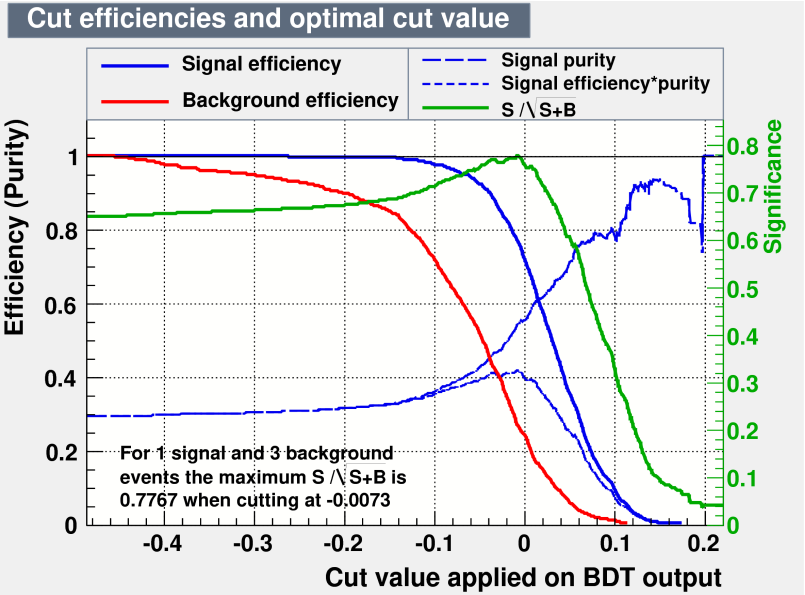


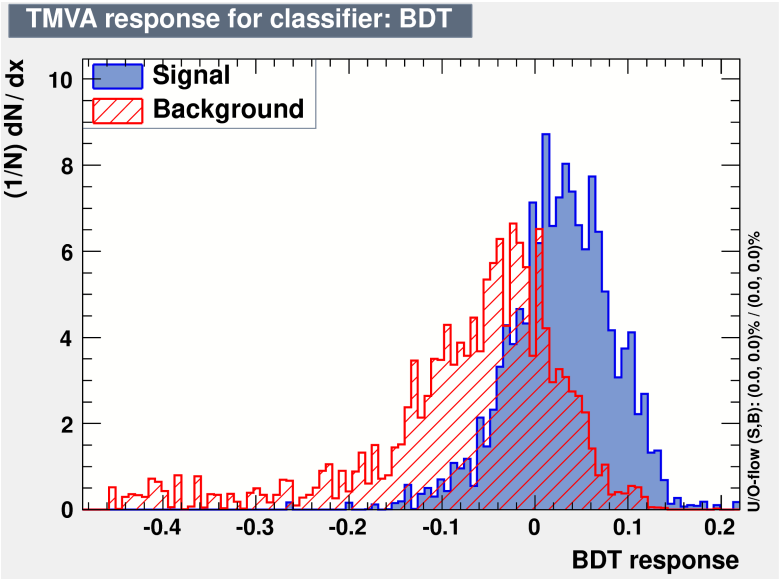


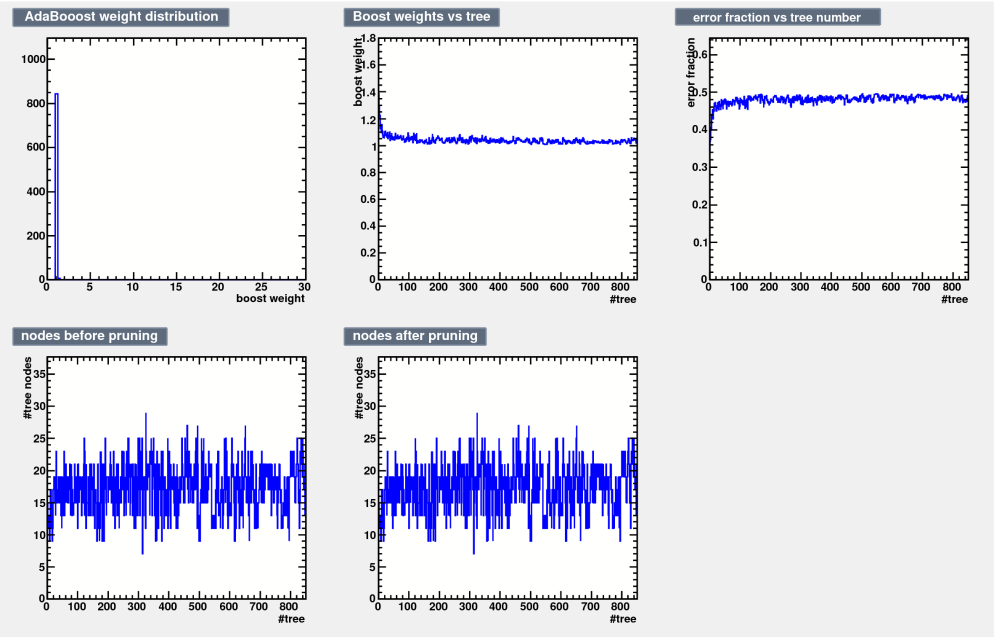




Best BDT Plots







Other things on the to-do list

- Would like to develop pre-baseline cut n-tuples to feed into TMVA
  - See if it does better that fiTQun using likelihood information
- Study more into optimization/advanced techniques for BDTs and ANNs
  - Lots of parameters to play around with – would help to have some better intuition here