Progress Update

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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**

```
efficiency   = gs_sig / bl_sig
bg_rejection = (bl_bkg - gs_bkg) / bl_bkg
```

2Repi

```
efficiency   = 0.951
bg_rejection = 0.311
```

2Repi1de

```
efficiency   = 0.873
bg_rejection = 0.462
```

Some results using TMVA

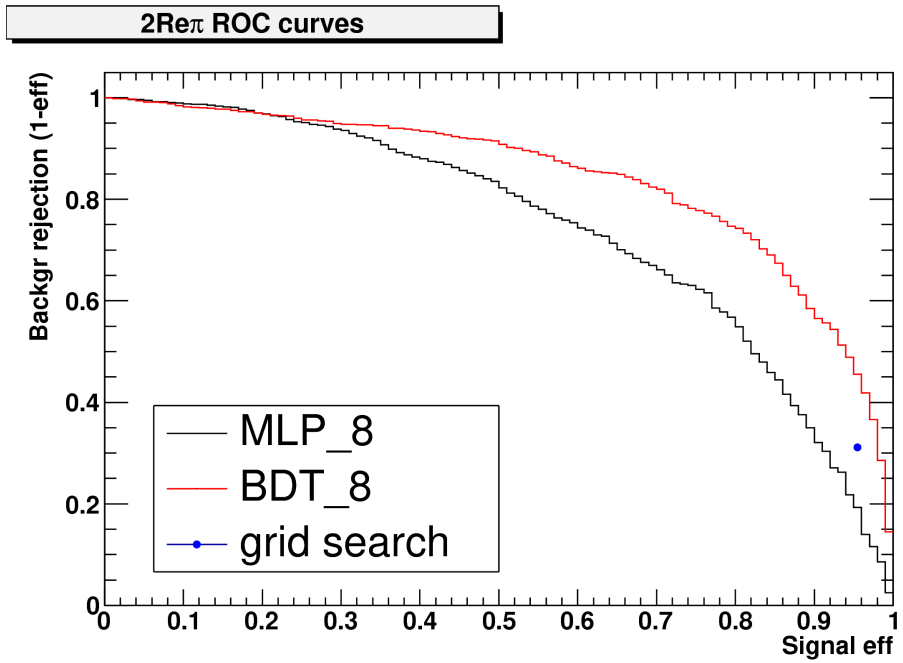
2Repi	MLP		BDT	
Cuts	**Notes**	**FOM**	**Notes**	**FOM**
p_low p_e-p_pi 2Repi vs 2Rpie nll 2Rpie vs 2Ree nll m_epi cos(theta)	HiddenLayers=N+5	0.716	MaxDepth=3	0.762
p_low p_e-p_pi 2Repi vs 2Rpie nll 2Rpie vs 2Ree nll m_epi cos(theta)	HiddenLayers=N+5,N	0.739	MaxDepth=4	0.777
p_low p_e p_pi 2Repi vs 2Rpie nll 2Rpie vs 2Ree nll m_epi cos(theta)	HiddenLayers=N+5,N	0.733	MaxDepth=4	0.784
p_low p_e p_pi 2Repi vs 2Rpie nll 2Rpie vs 2Ree nll m_epi cos(theta)	HiddenLayers=N+5,N,N	0.730	MaxDepth=5	0.802

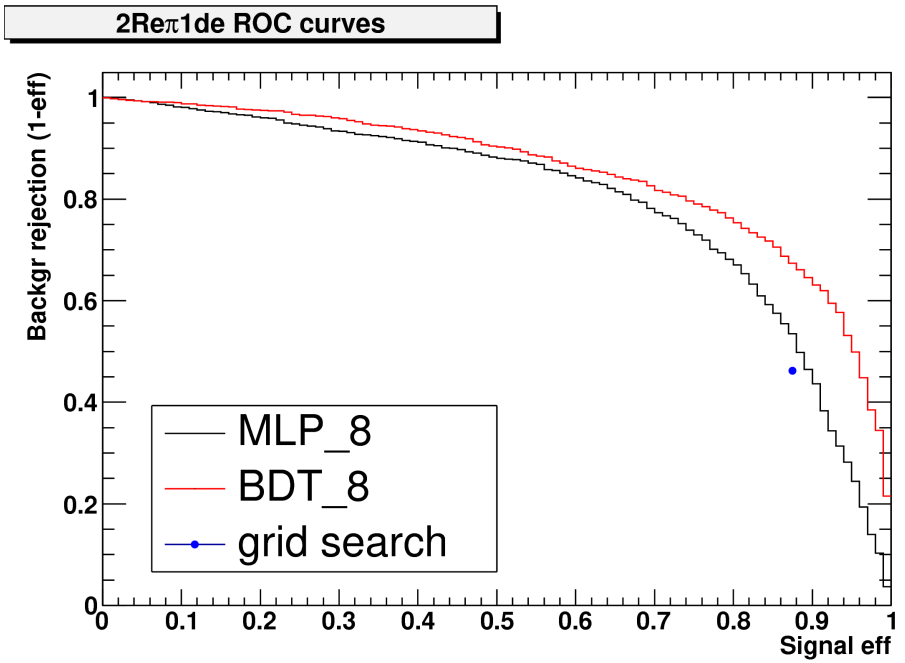
baseline: 0.652
grid: 0.706

2Repi1de	MLP		BDT	
Cuts	**Notes**	**FOM**	**Notes**	**FOM**
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
p_e p_pi d2se 2Repi vs 2Rpie nll 2Rpie vs 2Ree nll cos(theta)	HiddenLayers=N+5,N	1.278	MaxDepth=4	1.300
p_e p_pi d2se 2Repi vs 2Rpie nll 2Rpie vs 2Ree nll cos(theta)	HiddenLayers=N+5,N,N	1.277	MaxDepth=5	1.311

baseline: 1.145
grid: 1.195

ROC Curves





- These curves correspond to the last row on previous slide
- Code is meant to handle multiple tmva output files (couldn't get them to show today – neut cluster issues)

TMVA vs fiTQun

- Want to compare performance of TMVA vs fiTQun regarding initial 2Repi-like selection
- Initial method:
  - Rather than pre-selecting baseline events, pre-select events using:
    - FCFV: evclass==1 && evis>30. && fqwall_2R>50. && nhitac<16
    - 2-ring: fqmrnring[0]==2
    - 1 or 2 sub-events: fqnse==1 or fqnse==2
  - Store 2Repi, 2Rpie, and 2Ree likelihoods in ntuple
  - Using likelihoods, see if TMVA can out-perform fiTQun's baseline
- Currently have code that generates ntuple files working
  - need to store as multiple files since there are so many events

Other things on the to-do list

- Resolve superscan issues to look at NC1pi0 events
- Find OD MC
- Generalize towards using BDTs in MR algorithm?
- Study more into optimization/advanced techniques for BDTs and ANNs
  - Didn’t get around to this over the past week