



UNIVERSITY OF
TORONTO

ν_e CCQE/CC1 π^+ Selection Studies

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 ν_e CCQE/CC1 π^+ Meeting
May 10, 2019

Overview

- Summary of 1Re0de (ν_e CCQE) selection
 - Added wall to BDT variables
 - Comparison to previous 2Re π 0de (ν_e CC1 π^+) sample
 - Variable importance
- Hybrid sample progress
- Travel plans

pre-BDT Cuts and BDT Training Variables

pre-BDT cuts		
Cut	0 decay e	1 decay e
FCFV	Wall > 50 cm	
not 1Re	not 1Re-like (TN319, no FCFV requirement)	
0 decay e	1 sub-event	2 sub-events
E_{rec}	$E_{\text{rec}} < 1.5 \text{ GeV}$	

BDT Training Variables	
OLD: 2Re π 0de / ν_e CC 0de	NEW: 1Re 0de
up to 3-ring $-\ln(L)$ ratios	up to 3-ring $-\ln(L)$ ratios
m_{π^0}	m_{π^0}
1R+2R fit momenta	1R+2R fit momenta
E_{rec} (CC1 π^+)	E_{rec} (CCQE)
	Wall
ToWall e and π (2Re π)	ToWall e (1Re)
p_{low} (2Re π)	ToWall e_1 and e_2 (2Ree)
	p_{low} (2Ree)
	$\cos(\theta_{ee})$ (2Ree)

2Re π 0de Exclusive Selection

BDT training signal = $1e^{+/-}1\pi^{+/-}$

visible FSP:	1e1 $\pi^{+/-}$	1e	1e other	1 μ 1 $\pi^{+/-}$	1 μ	1 μ other	0l1 π^+	0l1 π^-	0l1 π^0	0lN π	0l other		1e $^{+/-}$ 1 $\pi^{+/-}$	other	FOM
	0.42	0.00	0.02	0.01	0.01	0.02	0.03	0.03	0.02	0.03	0.00		0.42	0.17	0.55
NEUT mode:	ν_e CC1 π^+	ν_e CCQE	ν_e CCN π	ν_e CCDIS	ν_e CCother	$\bar{\nu}_e$ CC	ν_μ CC	NC					$\nu_e/\bar{\nu}_e$ CC1 π^+	other	FOM
	0.38	0.01	0.02	0.00	0.01	0.02	0.04	0.10					0.38	0.21	0.50
ν type:	osc ν_e CC	int ν_e CC	ν_μ CC	NC									osc $\nu_e/\bar{\nu}_e$ CC	other	FOM
	0.31	0.14	0.04	0.10									0.31	0.28	0.41

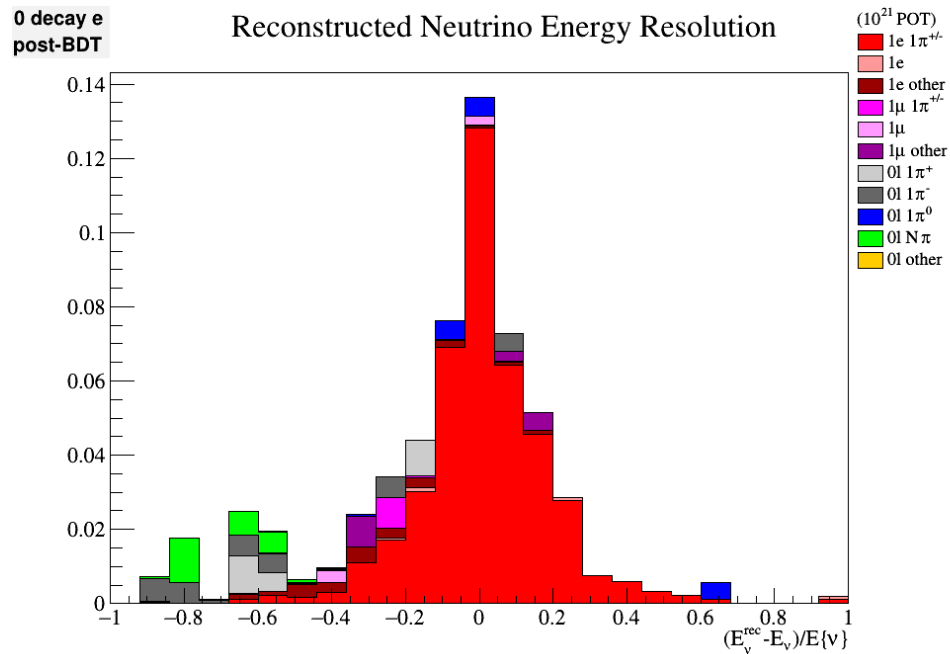
ν_e CC 0de Inclusive Selection

BDT training signal = $\nu_e/\bar{\nu}_e$ CC

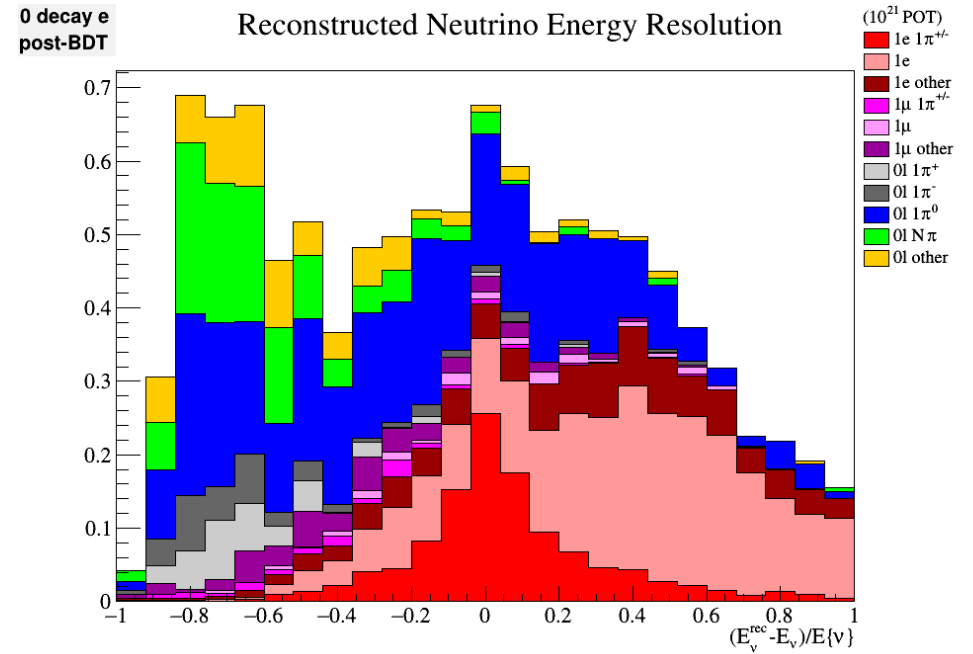
visible FSP:	1e1 $\pi^{+/-}$	1e	1e other	1 μ 1 $\pi^{+/-}$	1 μ	1 μ other	0l1 π^+	0l1 π^-	0l1 π^0	0lN π	0l other		1e $^{+/-}$ 1 $\pi^{+/-}$	other	FOM
	1.25	3.50	1.54	0.15	0.16	0.72	0.41	0.44	3.51	1.63	0.86		1.25	12.93	0.33
NEUT mode:	ν_e CC1 π^+	ν_e CCQE	ν_e CCN π	ν_e CCDIS	ν_e CCother	$\bar{\nu}_e$ CC	ν_μ CC	NC					$\nu_e/\bar{\nu}_e$ CC1 π^+	other	FOM
	1.85	3.10	0.27	0.06	0.80	0.21	1.03	6.86					1.85	12.33	0.49
ν type:	osc ν_e CC	int ν_e CC	ν_μ CC	NC									osc $\nu_e/\bar{\nu}_e$ CC	other	FOM
	4.58	1.71	1.03	6.86									4.58	9.60	1.22

E_{rec} Resolution

2Re π^0 de Exclusive Selection



2Re π^0 de Inclusive Selection



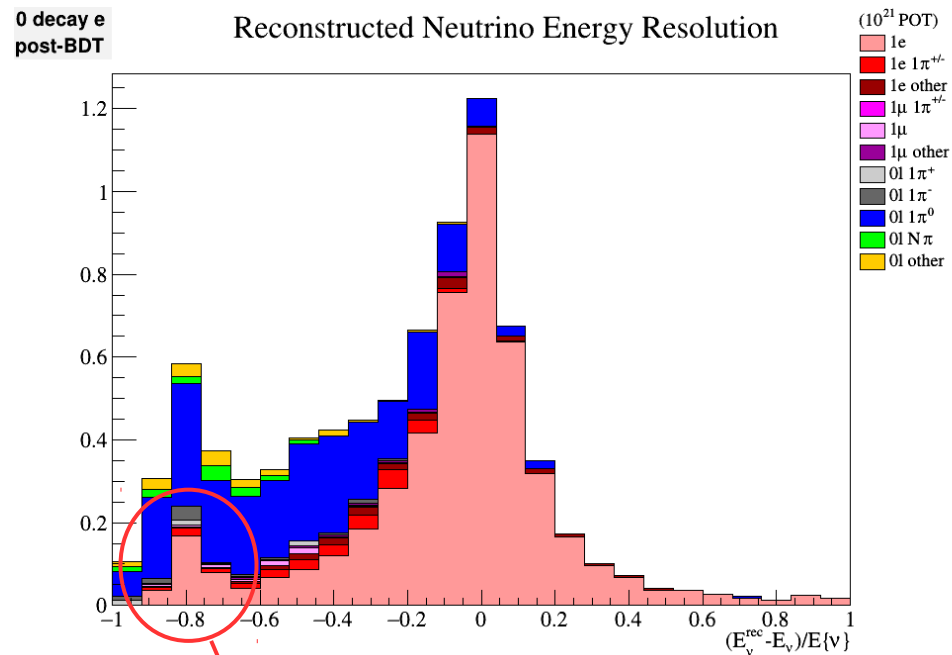
1Re 0de Selection

BDT training signal = $1e^{+/-}$

visible FSP:	$1e1\pi^{+/-}$	1e	1e other	$1\mu1\pi^{+/-}$	1μ	1μ other	$0l1\pi^+$	$0l1\pi^-$	$0l1\pi^0$	$0lN\pi$	$0l$ other		$1e^{+/-}$	other	FOM
	0.24	4.88	0.19	0.01	0.06	0.05	0.04	0.08	2.34	0.13	0.17		4.88	3.30	1.70
NEUT mode:	ν_e CC $1\pi^+$	ν_e CCQE	ν_e CCN π	ν_e CCDIS	ν_e CCother	$\bar{\nu}_e$ CC	ν_μ CC	NC					$\nu_e/\bar{\nu}_e$ CCQE	other	FOM
	0.61	4.20	0.05	0.01	0.16	0.27	0.12	2.76					4.40	3.77	1.54
ν type:	osc ν_e CC	int ν_e CC	ν_μ CC	NC									osc $\nu_e/\bar{\nu}_e$ CC	other	FOM
	3.58	1.72	0.12	2.76									3.58	4.60	1.25

E_{rec} Resolution

1Re Selection



Primarily ν_e CC $1\pi^+$ events with π^+ below visible threshold

2Re π 0de vs. 1Re 0de: Summary

		2Re π 0de Exclusive	ν_e CC 0de Inclusive		1Re 0de
Final State Particles	1e ^{+/-} 1 π ^{+/-}	0.42	1.25	1e ^{+/-}	4.88
	other	0.17	12.93	other	3.30
	FOM	0.55	0.33	FOM	1.70
NEUT Mode	$\nu_e/\bar{\nu}_e$ CC1 π^+	0.38	1.85	$\nu_e/\bar{\nu}_e$ CCQE	4.40
	other	0.21	12.33	other	3.77
	FOM	0.50	0.49	FOM	1.54
Neutrino Type	osc $\nu_e/\bar{\nu}_e$ CC	0.31	4.58	osc $\nu_e/\bar{\nu}_e$ CC	3.58
	other	0.28	9.60	other	4.60
	FOM	0.41	1.22	FOM	1.25

Existing 1Re selections (TN319)

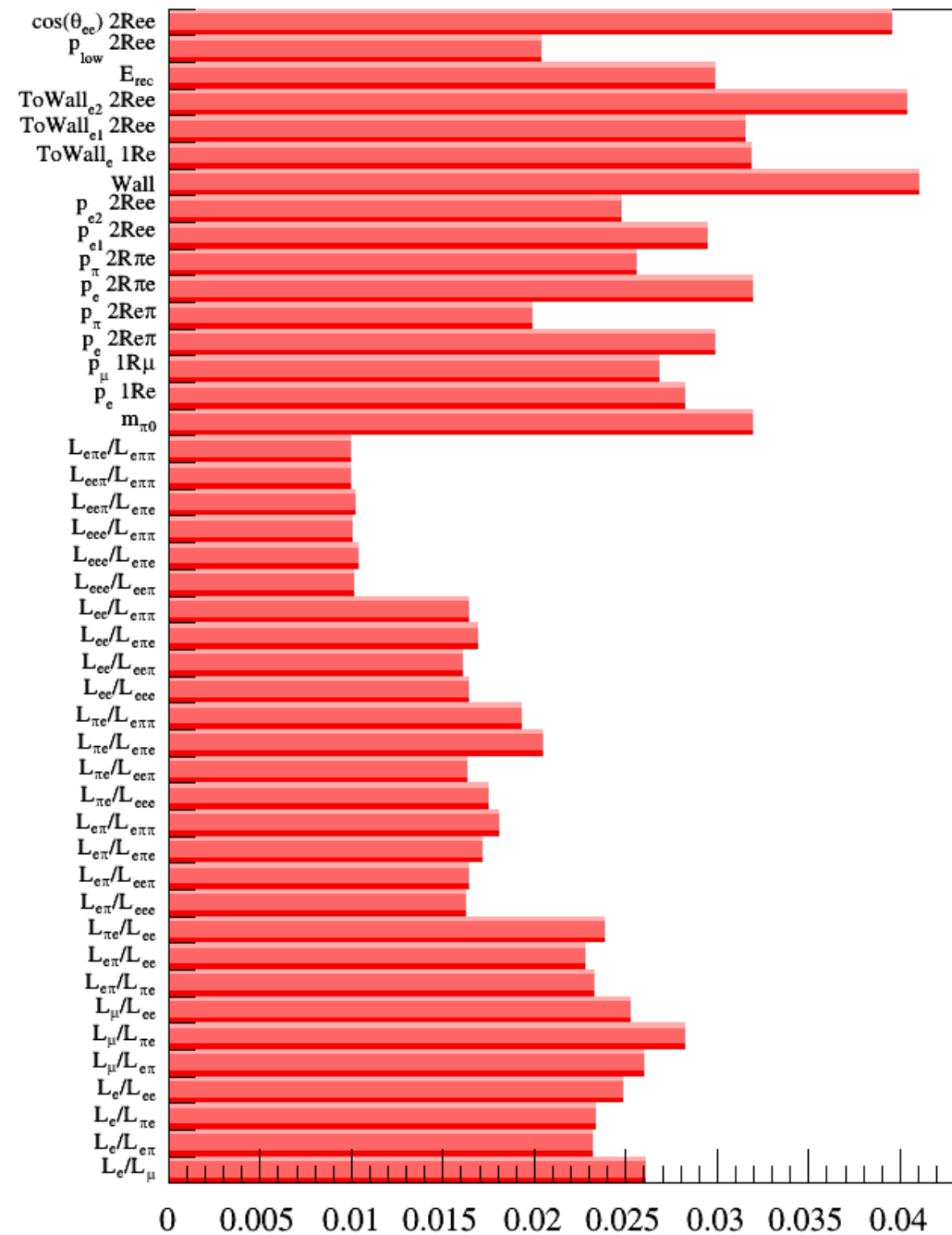
TN319 1-Ring Samples (10 ²¹ POT)				
Sample	osc ν_e CC	int ν_e CC	ν_μ CC	NC
ν_e CCQE	34.84	5.40	0.17	2.77
ν_e CC1 π^+	4.61	0.76	0.11	0.25

Proposed Samples Summary

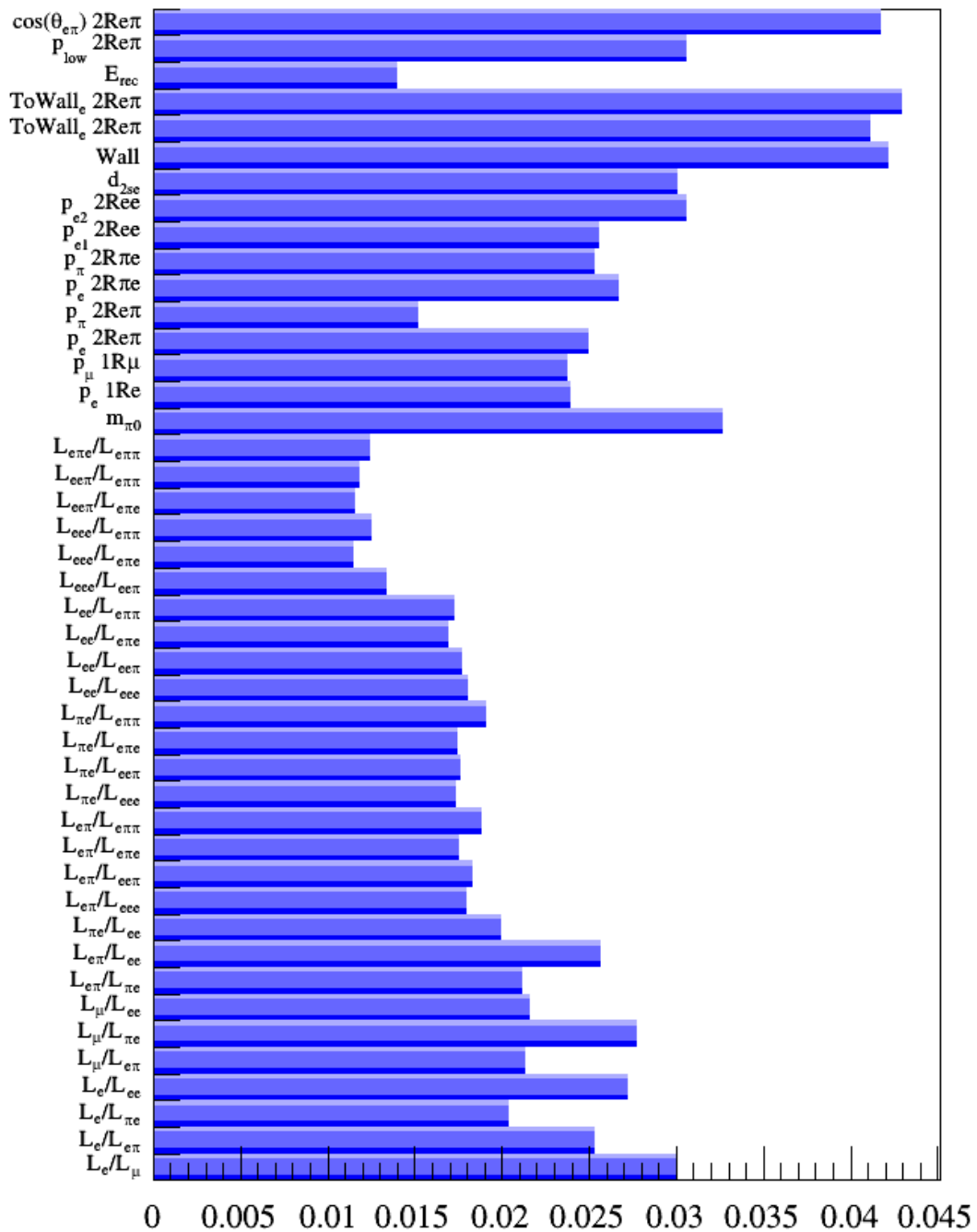
pre-BDT cuts		
Cut	0 decay e	1 decay e
FCFV	Wall > 50 cm	
not 1Re	not 1Re-like (TN319, no FCFV requirement)	
0 decay e	1 sub-event	2 sub-events
E_{rec}	$E_{\text{rec}} < 1.5 \text{ GeV}$	

BDT Training Variables	
1Re 0de	2Re π 1de
up to 3-ring -ln(L) ratios	up to 3-ring -ln(L) ratios
m_{π^0}	m_{π^0}
1R+2R fit momenta	1R+2R fit momenta
E_{rec} (CCQE)	E_{rec} (CC1 π^+)
Wall	Wall
ToWall e (1Re)	ToWall e and π (2Re π)
ToWall e_1 and e_2 (2Ree)	$d_{2\text{se}}$
p_{low} (2Ree)	p_{low} (2Re π)
$\cos(\theta_{ee})$ (2Ree)	$\cos(\theta_{e\pi})$ (2Re π)

	1Re 0de		2Re π 1de	
Final State Particles	1e $^{+/-}$	4.88	1e $^{+/-}$ 1 $\pi^{+/-}$	1.95
	other	3.30	other	1.02
	FOM	1.70	FOM	1.13
NEUT Mode	$\nu_e/\bar{\nu}_e$ CCQE	4.40	$\nu_e/\bar{\nu}_e$ CC1 π^+	2.02
	other	3.77	other	0.95
	FOM	1.54	FOM	1.17
Neutrino Type	osc $\nu_e/\bar{\nu}_e$ CC	3.58	osc $\nu_e/\bar{\nu}_e$ CC	1.63
	other	4.60	other	1.34
	FOM	1.25	FOM	0.95



Variable
Importance
From 1Re 0de Training



Variable
Importance
From 2Re π 1de Training

Thoughts on Presentation

- T2K-SK meeting is on the coming Monday, May 13 at 09:00 EDT
- Put more detailed tables in backup
 - with FCFV, pre-BDT, and post-BDT rows
- Put more plots of new 1Re 0de selection in backup as well

Hybrid Sample

- Started working on adapting Yoshida-san's hybrid $\mu\pi^+$ sample code towards an $e\pi^+$ sample
- First few steps went relatively smoothly
 - Generate list of 1-ring e-like events from atm data and from MC
 - Equalize MC to data
 - Extract e-like events from zbs files (data and MC)
- Now modifying code for next step
 - Extract all $e\pi^+$ events containing from T2K MC

Travel

- John said the NSERC account is now working
- Should be reimbursed for previous trips (T2K meeting and HK MLW) soon
- Will not be attending SK meeting this month
- Will be attending T2K meeting in August (in Paris)
 - Approved for affordable accommodations on campus