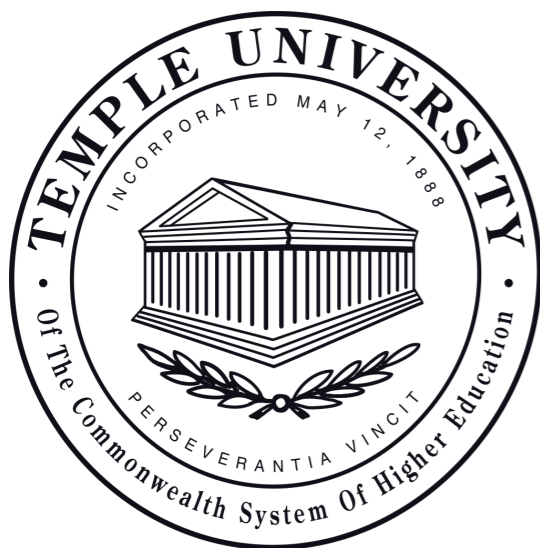


STAR 2013 W AL Preliminary : PWG Presentation I

Devika Gunarathne & Jinlong Zhang

(on behalf of)

Run 13 W A_L analysis group



Outline

- Executive Summary
- Data Set
- Data / Embedding Production Details
- W cuts
- BG Estimation
- AL Plots / Spin sorted W yields
- Money Plots
- Summary

Executive Summary - I

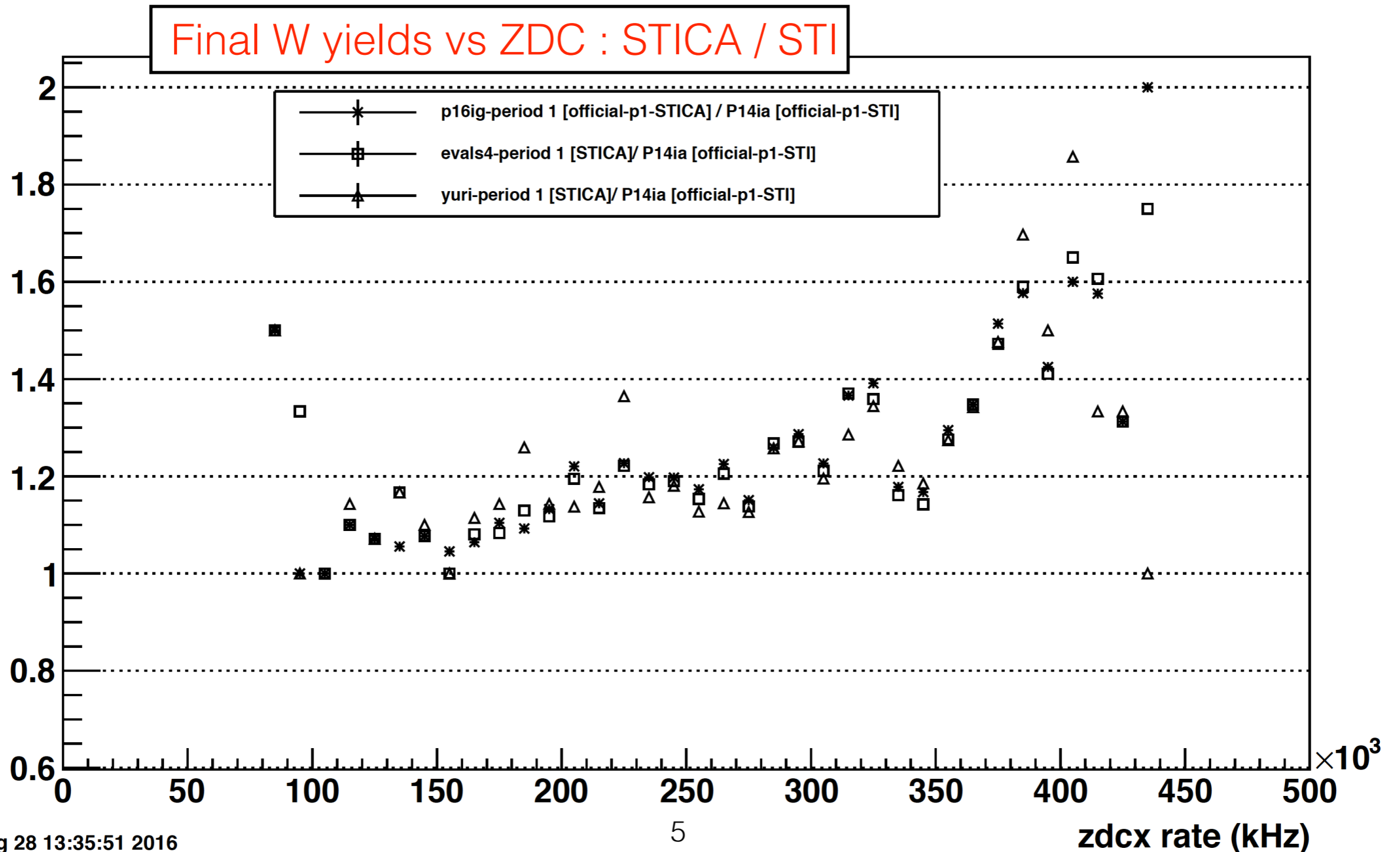
- For the purpose of releasing STAR 2013 W AL preliminary results, we will use Run 13 period 1 data from official [P16ig / STICA] production and Run 13 period 2 data from Yuri's [TFG16a / STICA] production.
- The reasons for this selection: namely “ 1 . Why not use official [P16ig] data production for both period 1 and period 2 ?” , 2 . “Why not use Yuri's [TFG16a] production for both period 1 and period 2 ?” are the followings.
 - We found inconsistency in the track reconstruction efficiency [low] for the official [P16ig] period 2 data production, in comparison to official [P16ig] period 1 data production, evals4 [STICA] production and Yuri's [STICA] production for the data of the same luminosity.
 - For official [P16ig / STICA] period 2 production, the improvement of reconstructed W tracks at mid - rapidity region are either low / same level with period 1, in contrast to what one expected to be: systematically larger track reconstruction than period 1 due to high luminosity data in average than period 1.
 - In contrast to official period 2 production, Yuri's production shows good improvement of reconstructed W tracks at mid - rapidity region as expected. Also consistency with track reconstruction efficiency with period 1 and other STICA data production as mentioned in the previous point for that data in the same luminosities.
 - As a result of the lower improvement in track reconstruction explained above than expected, period 2 official data production exhibit poor data - MC comparison in W analysis in contrast to what one expected to see: A significantly improved data - MC comparison in comparison to STI production.

Executive Summary - II

- Then why not use Yuri's production for both period 1 and period 2?
 - While selecting run lists for the analysis, we check each runs to see whether # of W trigger events that have produced in the MuDst matches with what recorded in the DB. If the produced events are smaller than DB records, then most likely some daq files were not used / Jobs crashed ..etc. But if the produced events are larger than what recorded in DB this is a problem. It could be that due to use of some duplicates daq files.
 - We found 25 % runs [about the same statistics] in Yuri's period 1 production with more events processed than what recorded in the DB.
 - Because of this reason we cannot use Yuri's period 1 production. Yuri's period 2 production has no such issue.
- Run 13 preliminary calibration gain constants are used after scaling based on Z invariant mass within the 3% systematic uncertainty.
- An additional W cut , awayET cut is used in comparison to run 12 analysis [to obtain better data MC comparison] , but studies to optimize this cuts are ongoing.
- Preliminary AL plots / money plots will be shown today while final version to be release during next PWG presentation.

Why We don't Use Official Period 2 Production ?

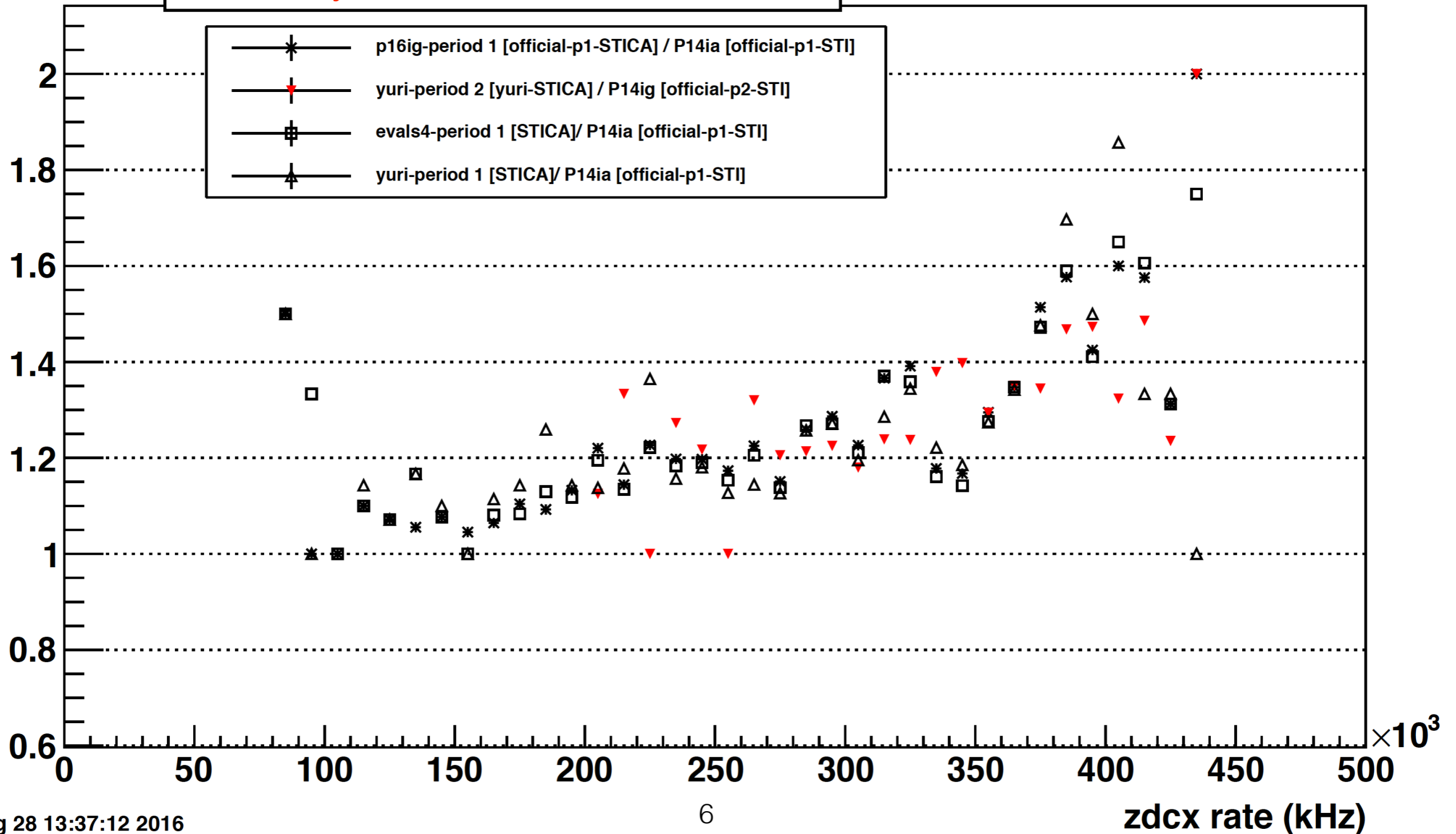
- STICA track reconstruction efficiency improve with increasing luminosity.
- This plot compare ratios of STICA to STI of several STICA production. [All Run 13 - period 1]
- All 3 production consistent with each other.



Why We don't Use Official Period 2 Production ?

- Now lets's add Yuri's - period 2 [STICA]production.
- Yuri's period 2 [STICA] enhancement in track reconstruction is consistent with other productions

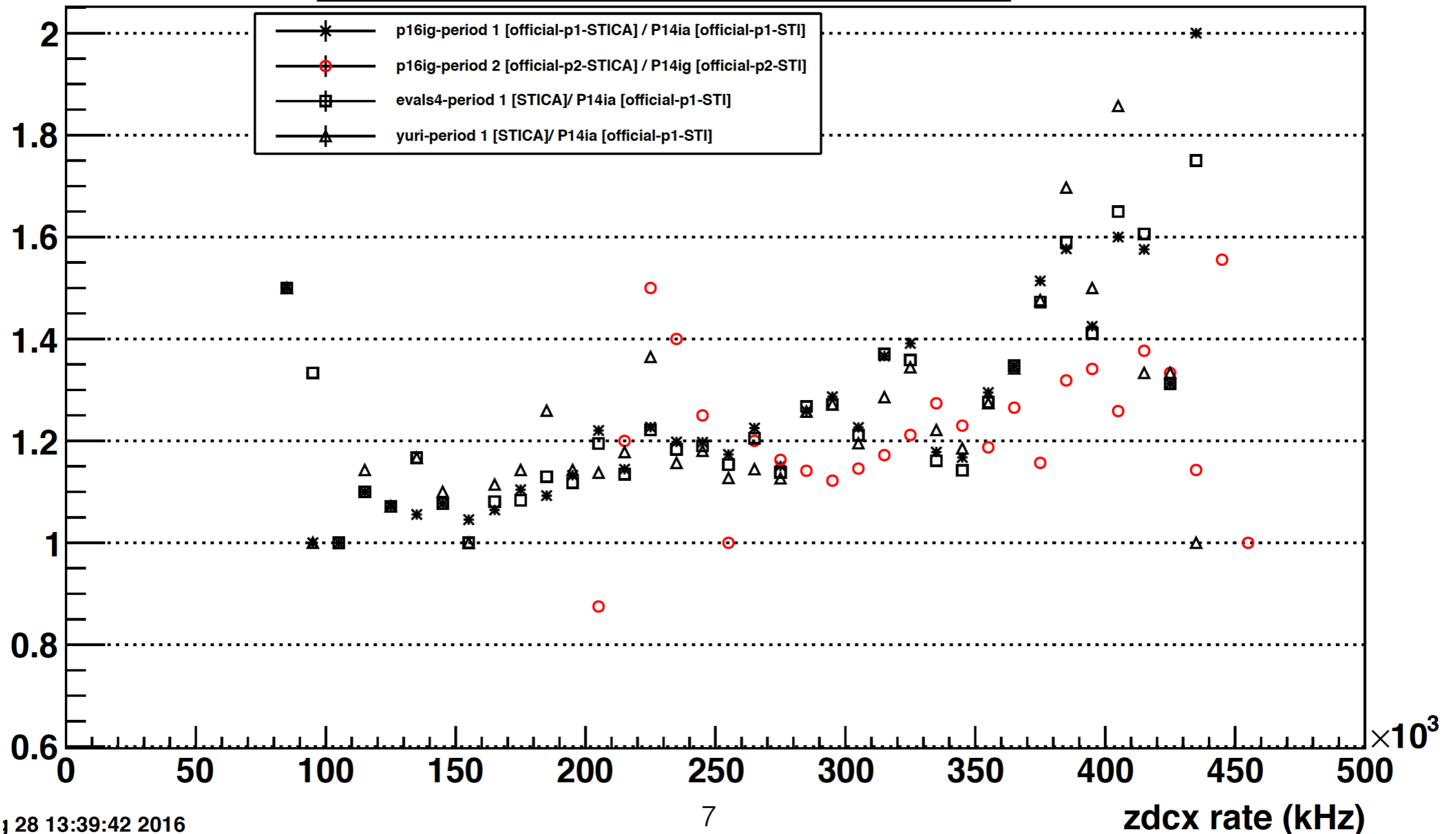
Final W yields vs ZDC : STICA / STI



Why We don't Use Official Period 2 Production ?

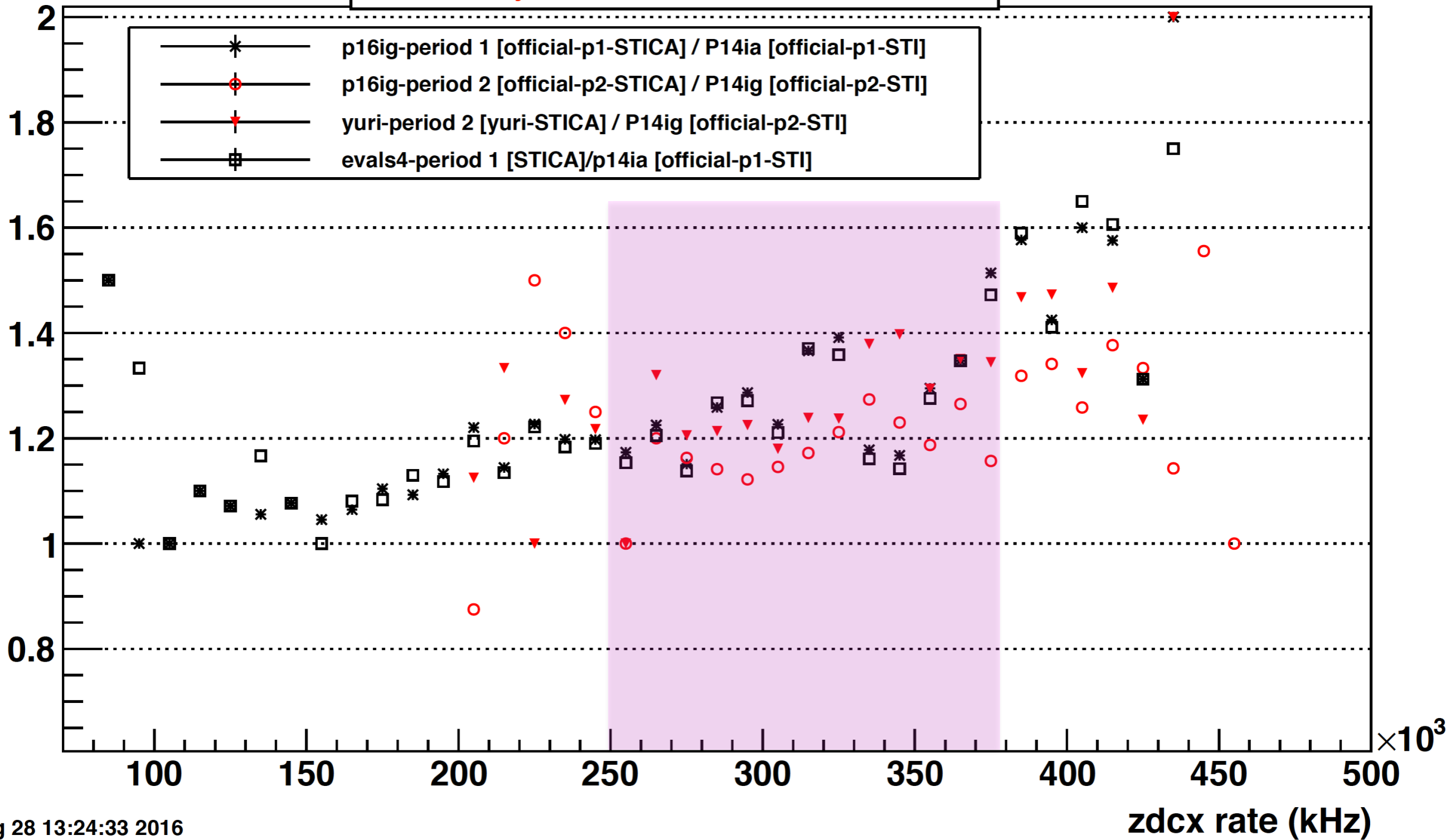
- Here we add official [P16ig] - period 2 production.
- Official period 2 production has low STICA / STI ratio in comparison to other productions, does not consist with other STICA production

Final W yields vs ZDC: STICA / STI



Why We don't Use Official Period 2 Production ?

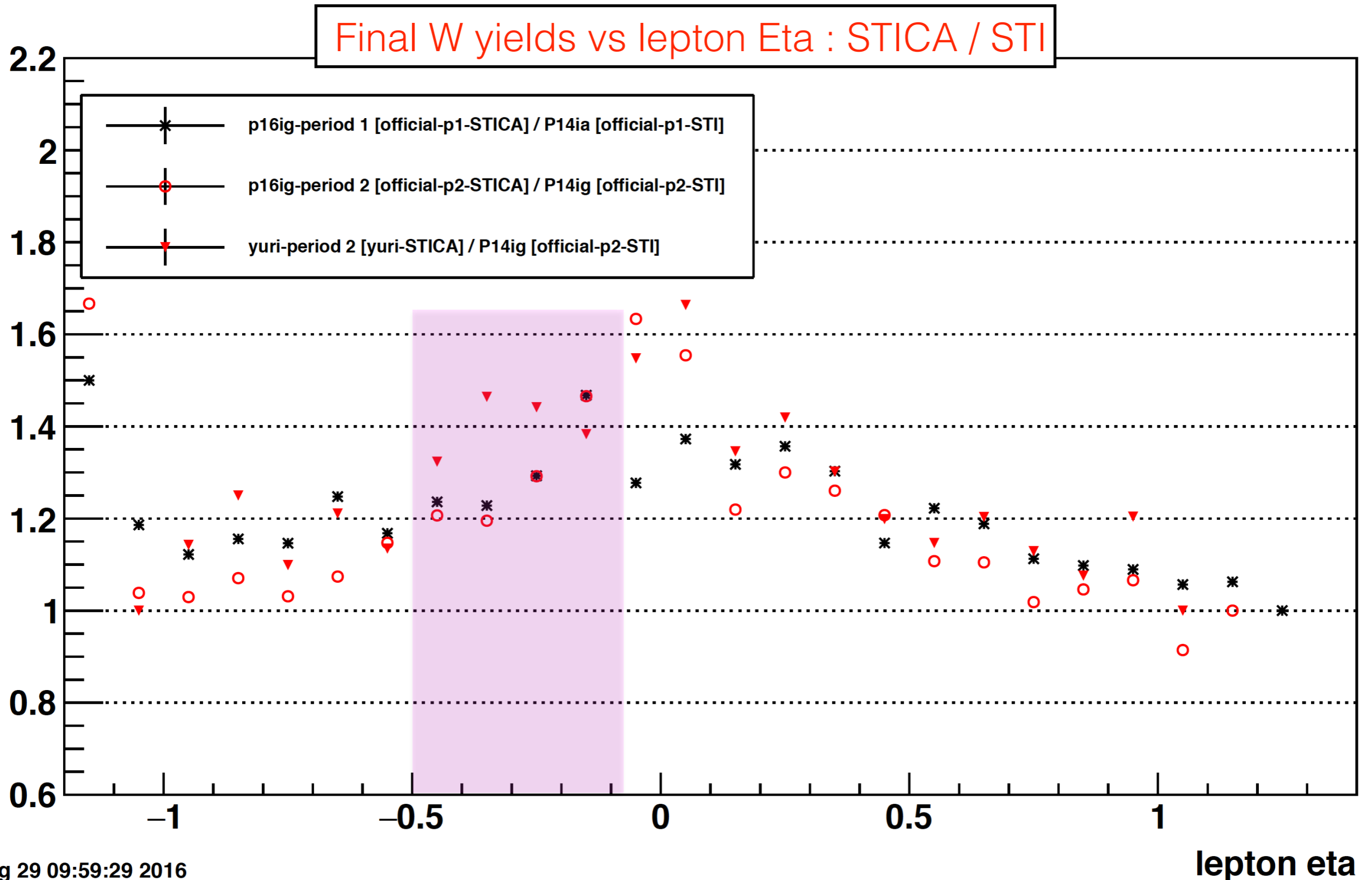
Final W yields vs ZDC: STICA / STI



Aug 28 13:24:33 2016

Why We don't Use Official Period 2 Production ?

- Period 2 mid-rapidity track reconstruction expects to be higher than period 1 due to high luminosity in Period 1



Data Set

- Official P16ig production - Period 1
 - # of Runs = 908
 - Total Integrated Luminosity = 123.8 pb^{-1}
- Yuri TFG16a production - Period 2
 - # of Runs = ~ 700
 - Total Integrated Luminosity = $\sim 120^{-1}$

Data / Embedding Production Details

	Tracking	Vertex	Geometry
DATA	STICA	PPV_W	P1 : y2013_2c P2 : y2013_1c
EMBEDDING	STICA	PPV_W	P1 : y2013_2c P2 : y2013_1c

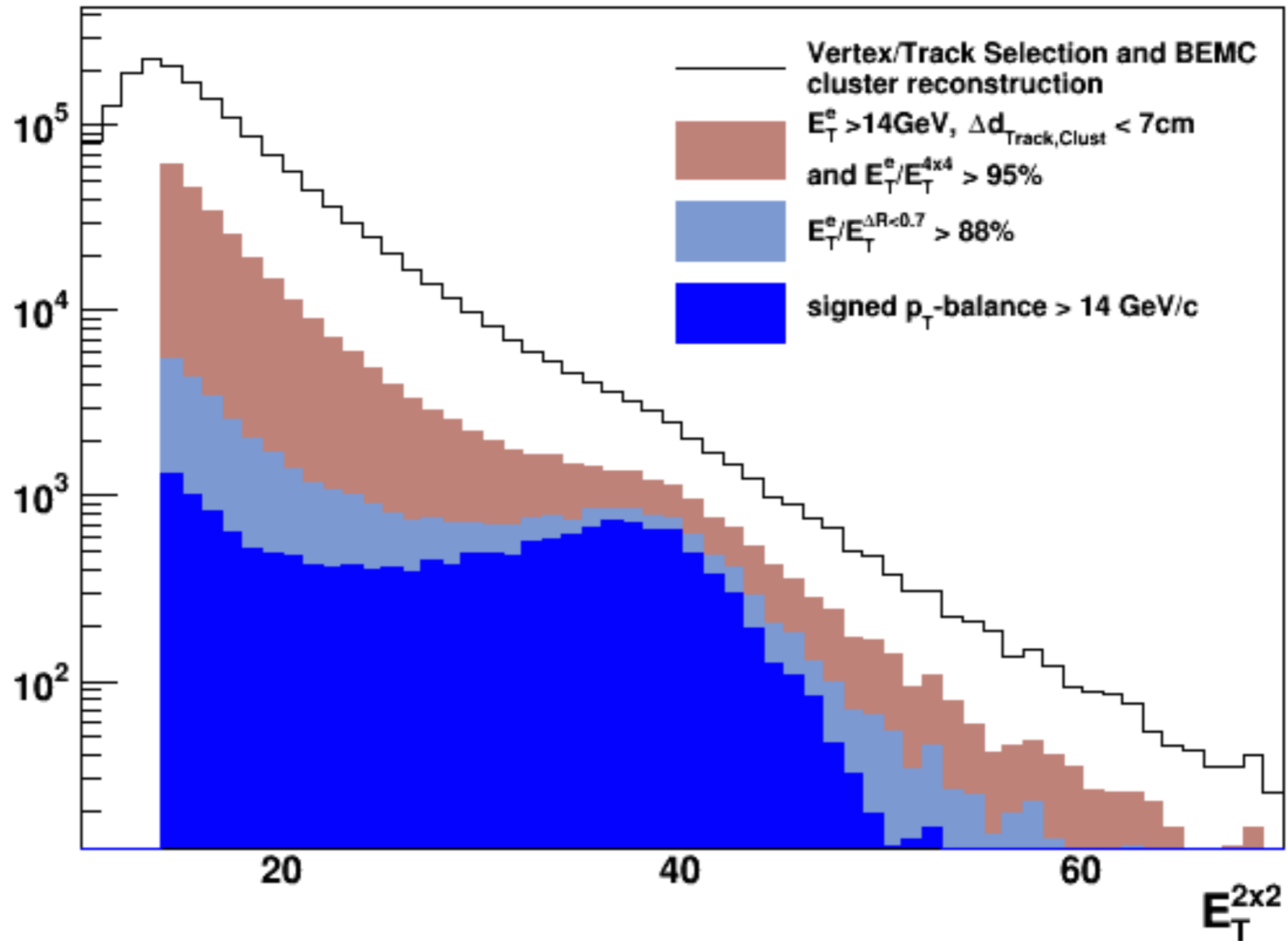
PYTHIA INFORMATION	LIBRARY : 6_4_22 TUNE : Perugia 0 PT min : 10 GeV
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W Cuts

Vertex	$ V_z < 100, \text{rank} > 0$
Tracking	$n\text{FitPoints} > 15, n\text{HitFit}/n\text{HitPoss} > 0.51, R_{xy\text{In}} < 90, R_{xy\text{Out}} > 160, \text{track-cluster-distance} < 7$
W Selection	$ET/E(4 \times 4) > 0.95, ET/E(\text{nearCone } \Delta R < 0.7) > 0.88, \text{signed } p\text{Tbalance} > 14\text{GeV}, \text{awayET} < 10\text{GeV}$
Z Selection	$ET/E(4 \times 4) > 0.9, ET/E(\text{nearCone } \Delta R < 0.7) > 0.88, \text{back-to-back } e^+ e^-, 70 < M_{ee} < 110$
EndCap Cuts	$R_{\text{ESMD}} > 0.6$

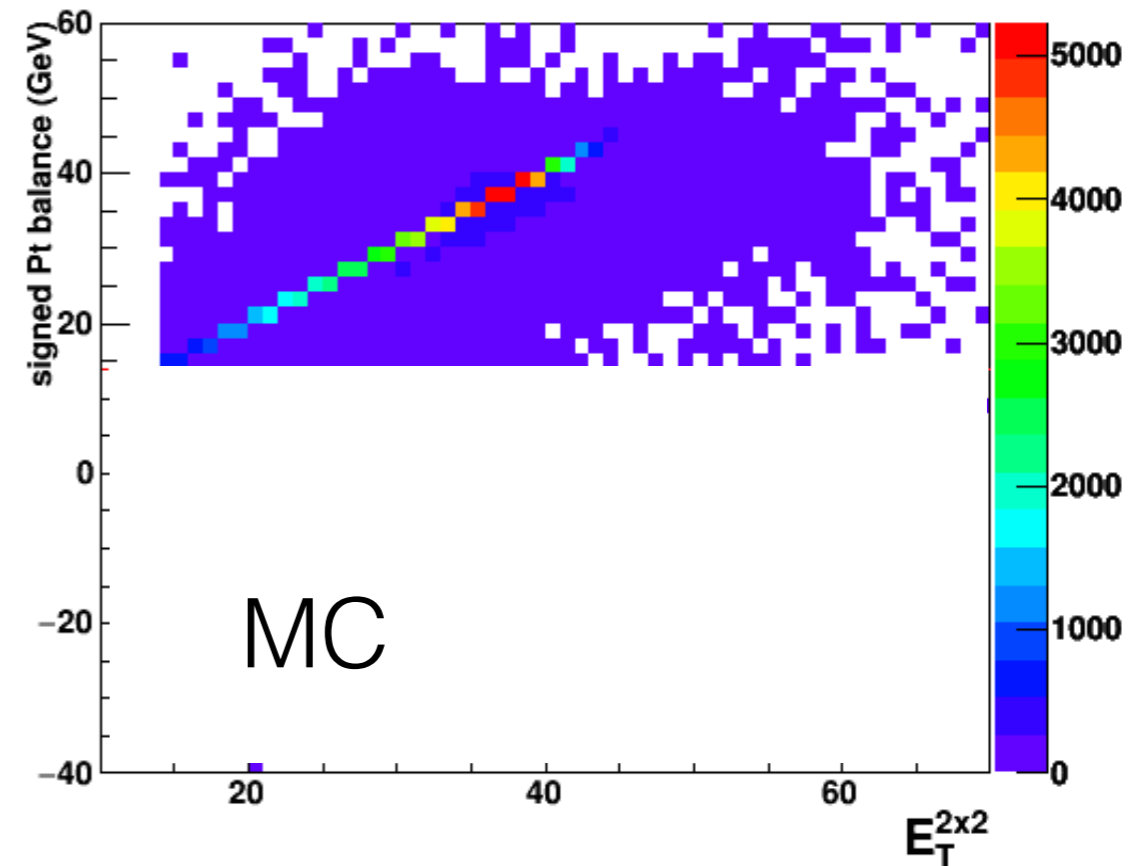
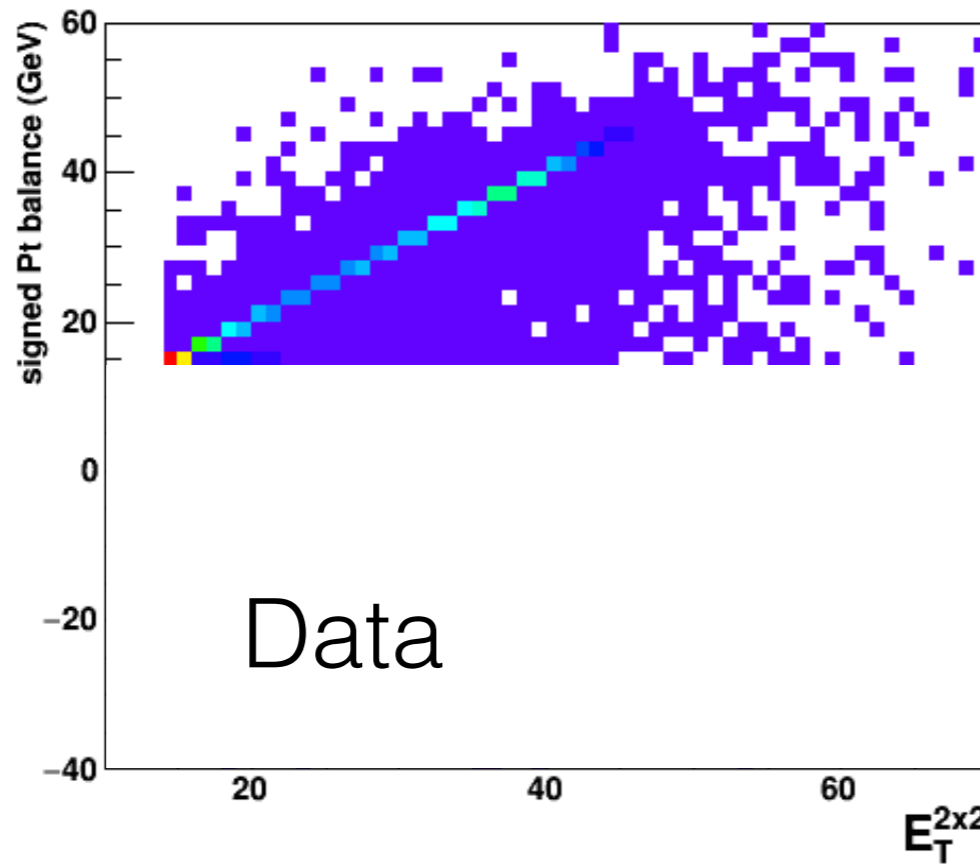
W Selection Histograms : Period 1 + Period 2

ET Distribution as a function of W selection cuts

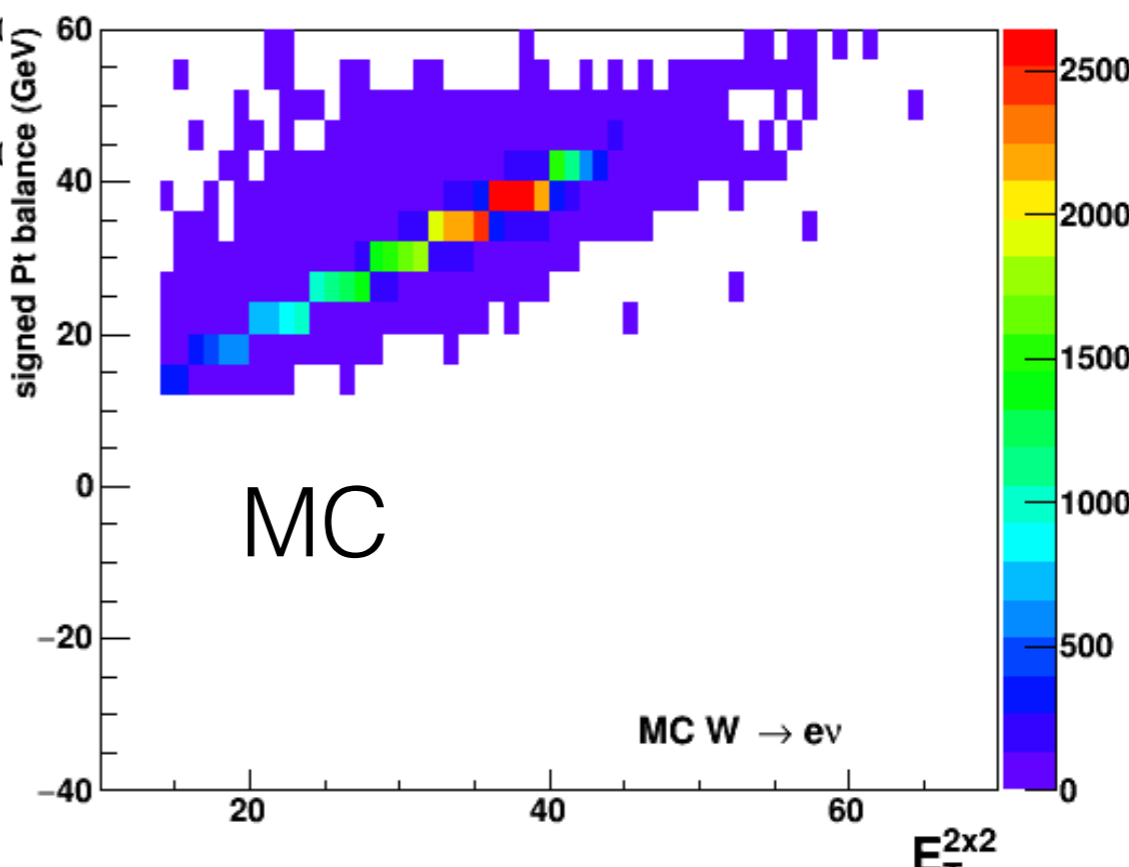
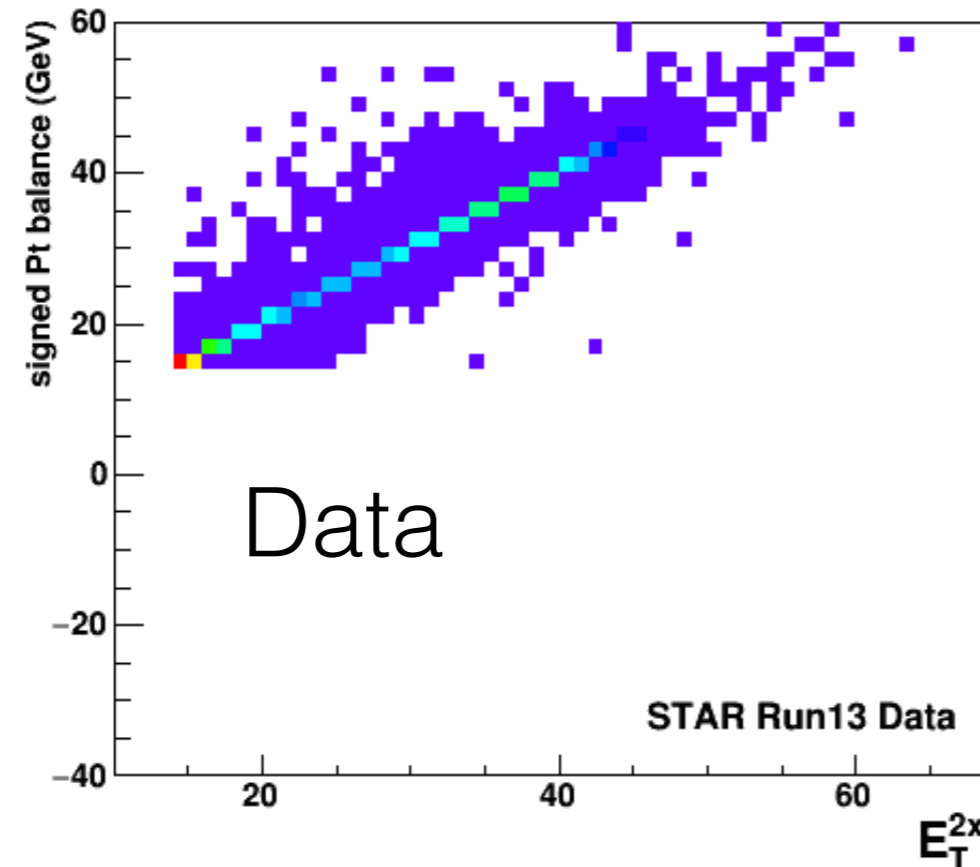


W Selection Histograms

Sign Pt Balance distribution as a function E_T : Before away ET cut

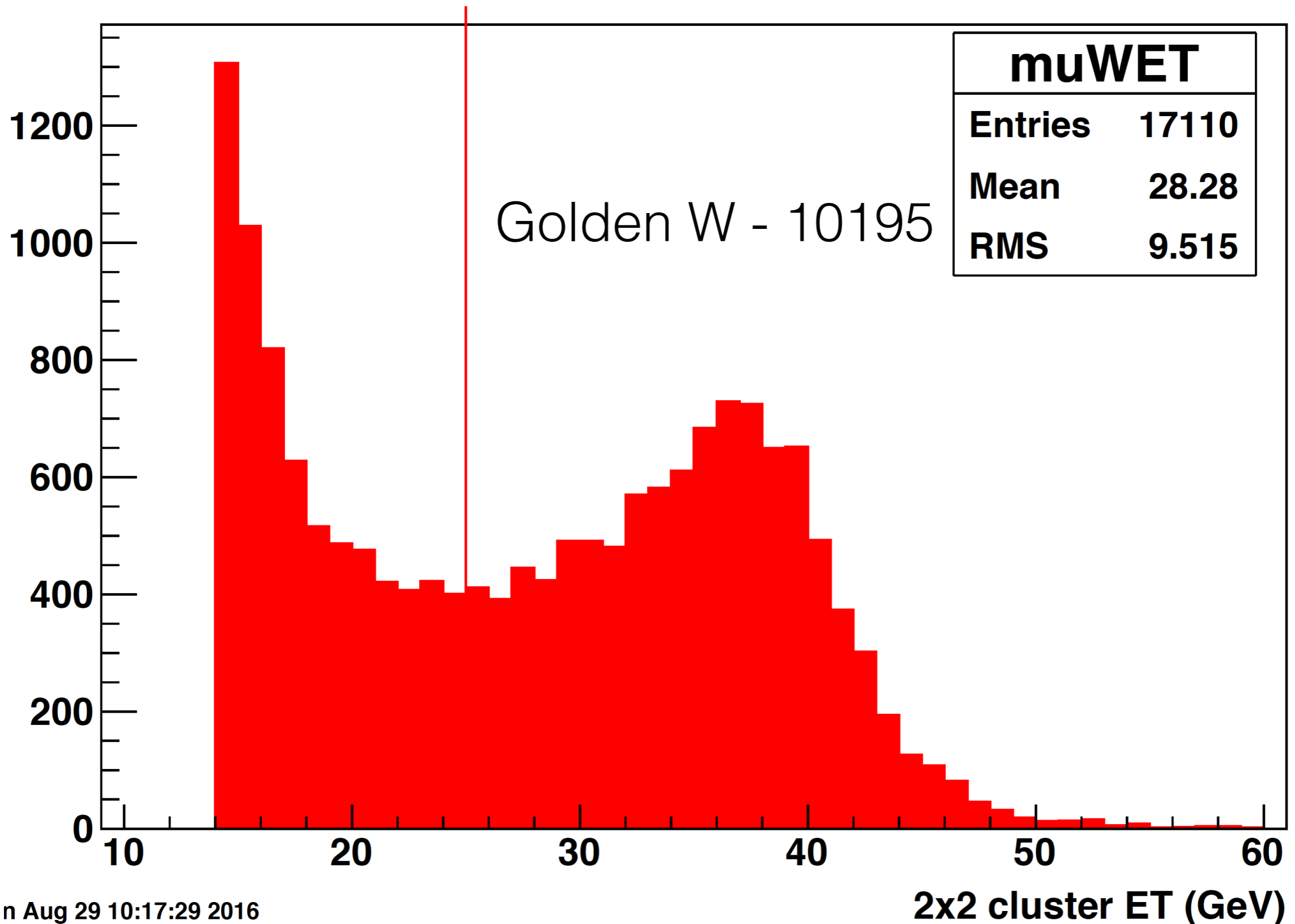


Sign Pt Balance distribution as a function E_T : After away ET cut



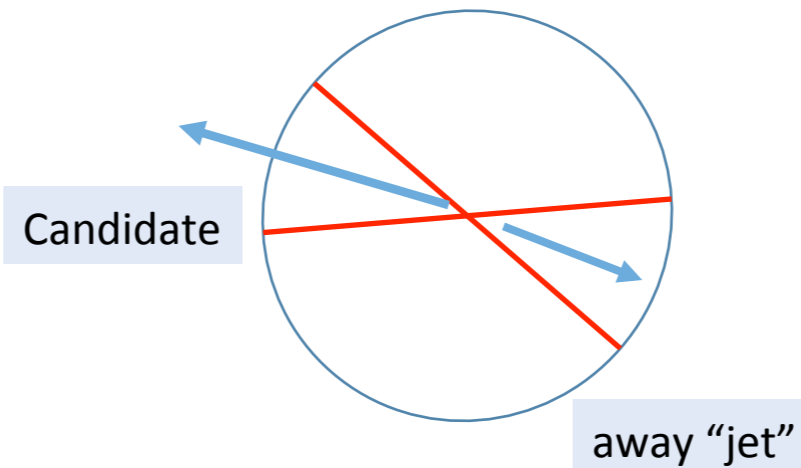
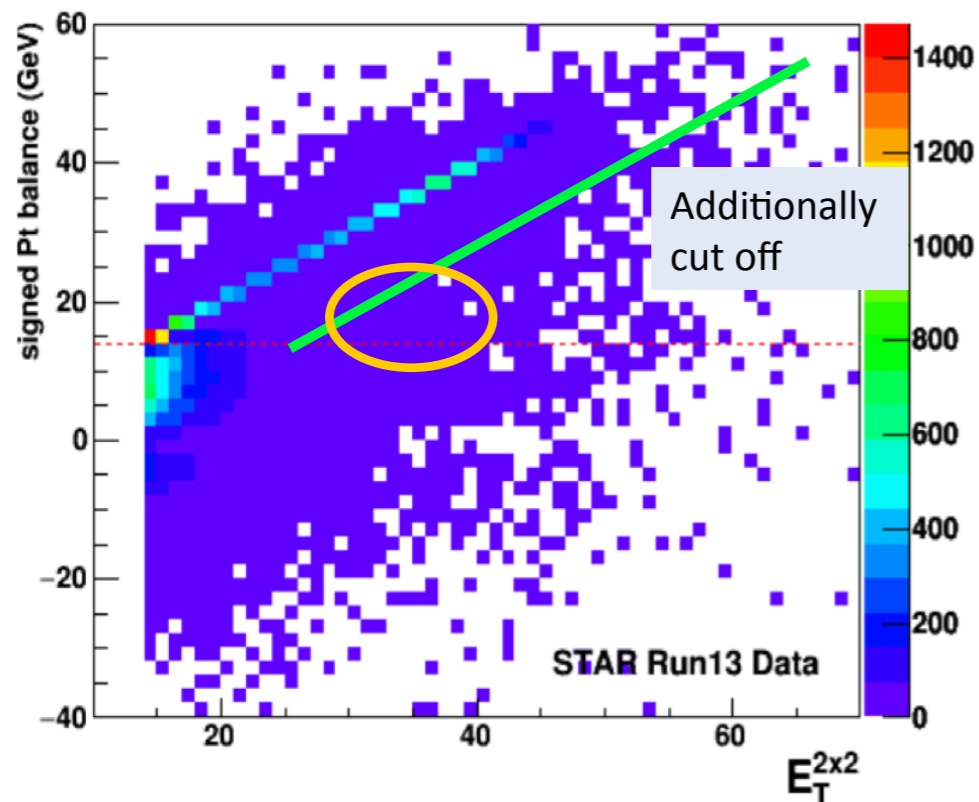
W Selection Histograms

ET Distributions of Final W yields : Period 1 + Period 2



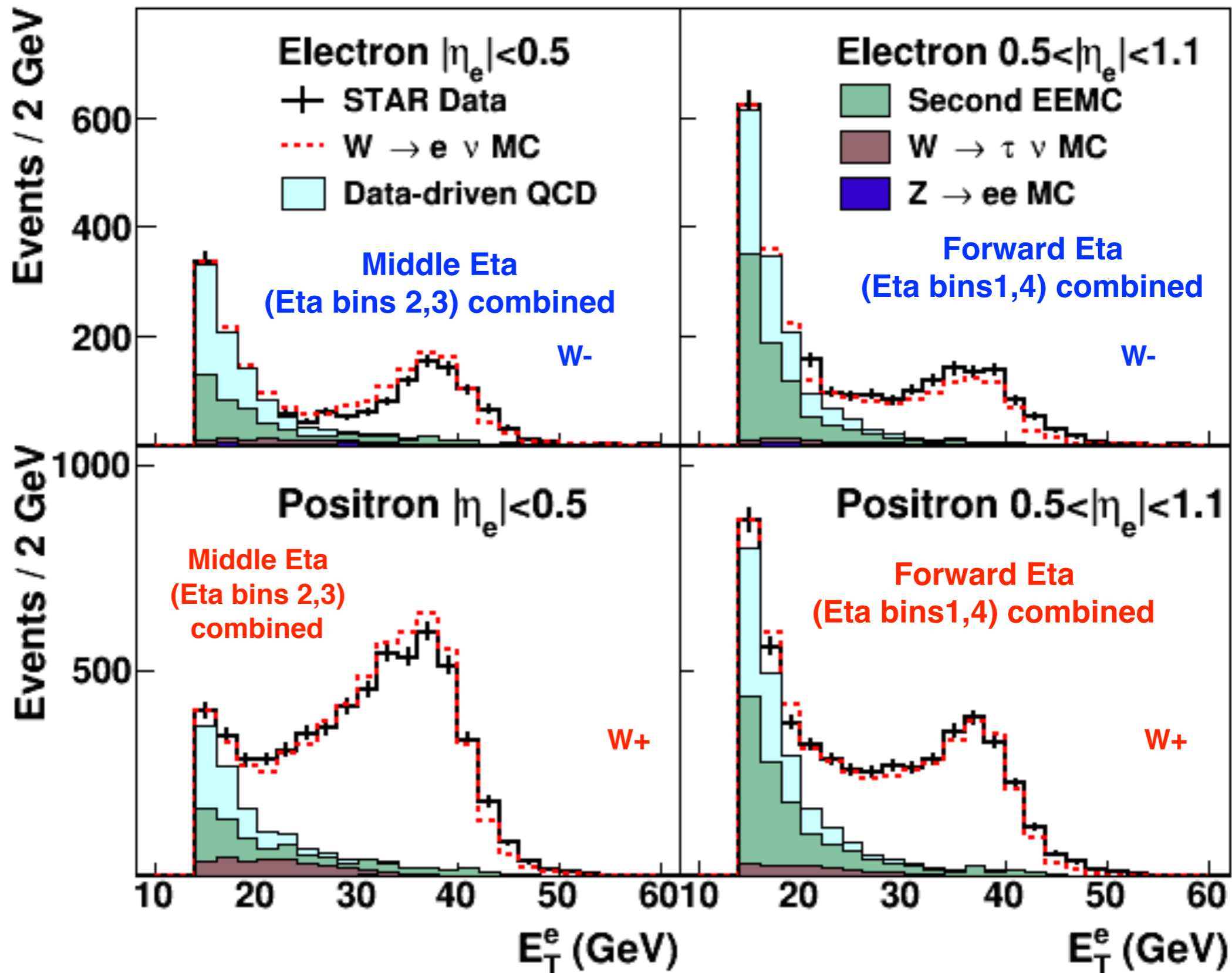
W Selection : Away ET cut

Away ET cut



- signPt balance : Based on the ET difference between candidate and away jet
 - awayET : Based on ET of away jet.
-
- We have used a fairly tight away ET cut for now [10 GeV] , but we noticed that the impact of the cut has various differences between eta bins and between charge and also between different ET regions. Therefore studies to optimize this cut is ongoing.

BG Estimation : Middle Eta , Forward Eta combined - Period 1 + Period 2



BG Estimation Yields Summary : Period 1

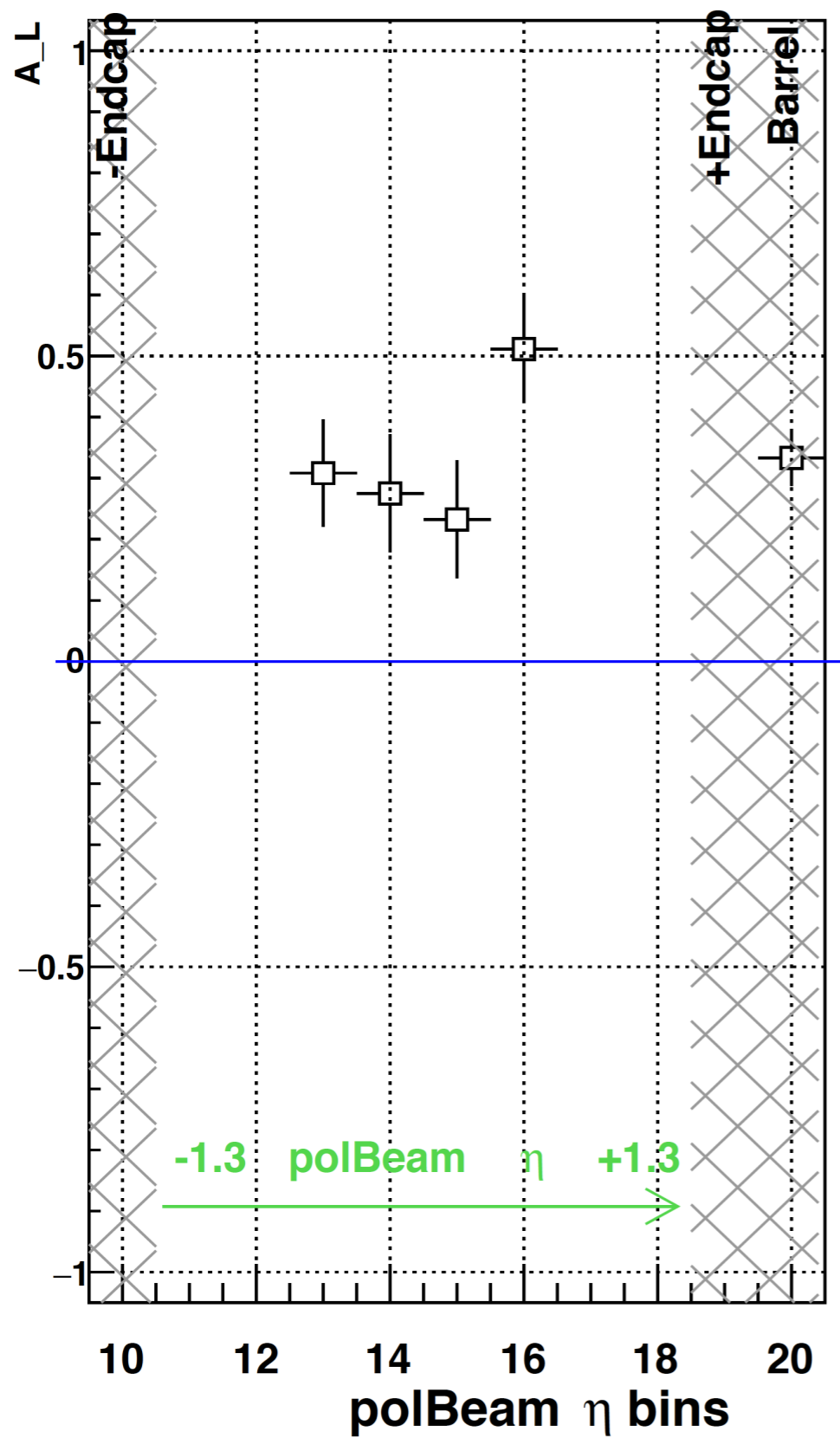
WN background summary: yields 25<ET<50 GeV										
starPhysEta Bin	rawYield	qcdBkgd	secondEEM	zeeBkgd	wTauYield	totalBkgd	wYield	beta +/- err	+syst	-syst
1	252	7.05	26	4.73	5.78	37.78	214.22	0.850 +/- 0.022	0.013	0.012
2	267	11.92	30	6.62	6.22	48.53	218.47	0.818 +/- 0.022	0.026	0.022
3	254	14.58	21	6.05	7.2	41.63	212.37	0.836 +/- 0.020	0.027	0.042
4	311	8.61	17	4.63	4.98	30.24	280.76	0.903 +/- 0.014	0.009	0.017
8	1095	36.48	91	21.18	24.27	148.66	946.34	0.864 +/- 0.009	0.011	0.011
WP background summary: yields 25<ET<50 GeV										
starPhysEta Bin	rawYield	qcdBkgd	secondEEM	zeeBkgd	wTauYield	totalBkgd	wYield	beta +/- err	+syst	-syst
1	763	7.82	65	3.4	13.53	76.23	686.77	0.900 +/- 0.011	0.005	0.004
2	1226	9.03	55	9.08	26.42	73.1	1152.9	0.940 +/- 0.006	0.004	0.005
3	1255	11.16	50	4.82	25.26	65.98	1189.02	0.947 +/- 0.006	0.003	0.009
4	764	20.73	27	3.12	14.69	50.85	713.15	0.933 +/- 0.007	0.013	0.014
8	4018	44.88	194	20.61	80.26	259.49	3758.51	0.935 +/- 0.004	0.004	0.004

BG Estimation Yields Summary : Period 2

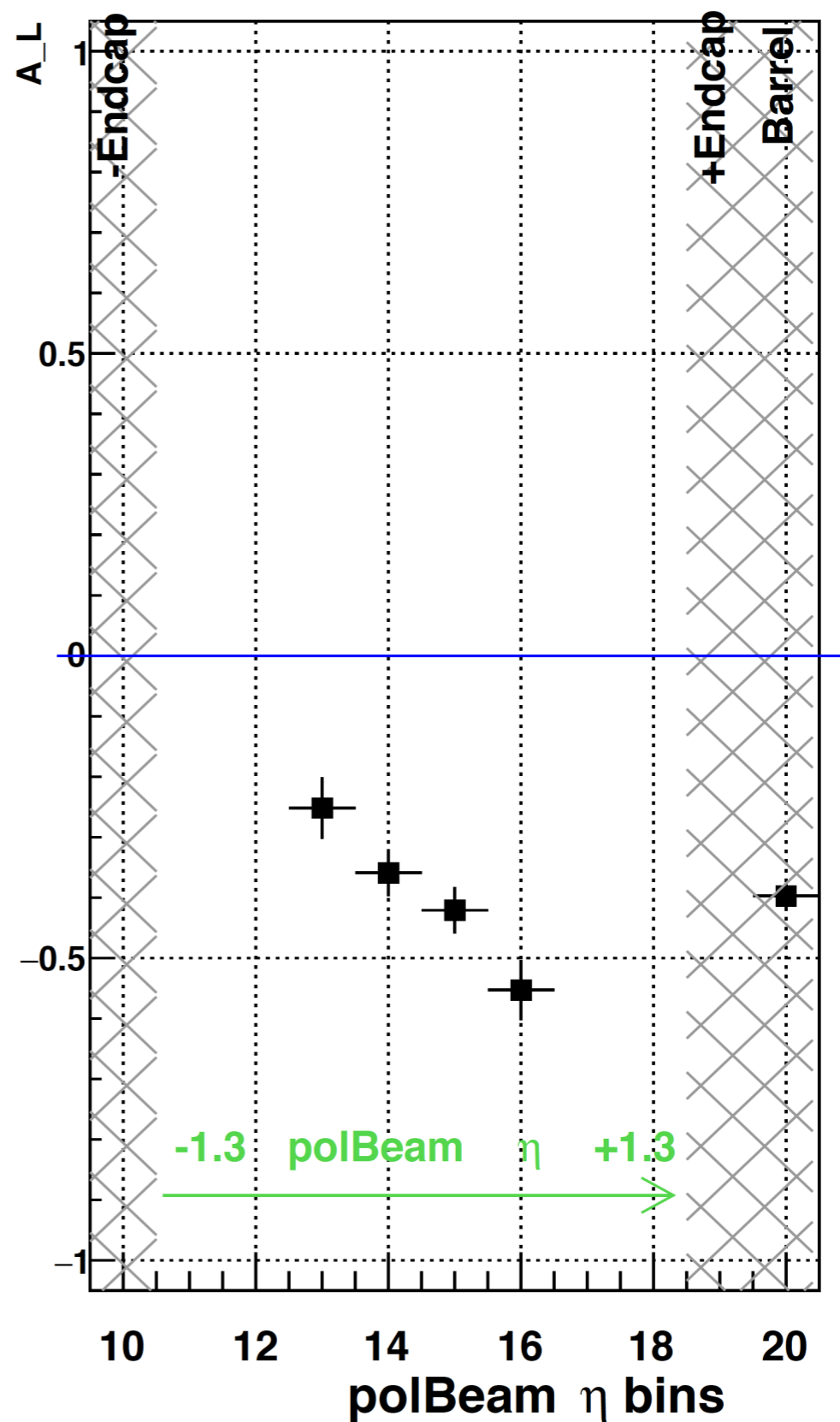
WN background summary: yields 25<ET<50 GeV										
starPhysEta Bin	rawYield	qcdBkgd	secondEEM	zeeBkgd	wTauYield	totalBkgd	wYield	beta +/- err	+syst	-syst
1	229	10.36	19	3.18	4.21	32.53	196.47	0.858 +/- 0.020	0.029	0.021
2	180	5.14	20	5.78	5.9	30.93	149.07	0.828 +/- 0.027	0.015	0.023
3	193	8.86	22	7.98	4.37	38.84	154.16	0.799 +/- 0.027	0.022	0.042
4	242	7.81	9	3.42	4.06	20.23	221.77	0.916 +/- 0.016	0.021	0.017
8	848	30.96	72	19.79	18.54	122.75	725.25	0.855 +/- 0.011	0.018	0.016
WP background summary: yields 25<ET<50 GeV										
starPhysEta Bin	rawYield	qcdBkgd	secondEEM	zeeBkgd	wTauYield	totalBkgd	wYield	beta +/- err	+syst	-syst
1	569	12.38	49	3.99	11.61	65.37	503.63	0.885 +/- 0.013	0.012	0.012
2	805	10.95	38	4.32	18.88	53.27	751.73	0.934 +/- 0.008	0.007	0.014
3	956	8.35	32	5.62	22.05	45.97	910.03	0.952 +/- 0.006	0.004	0.008
4	631	8.13	35	3.5	12.92	46.63	584.37	0.926 +/- 0.010	0.006	0.008
8	2964	37.61	150	16.29	65.69	203.9	2760.1	0.931 +/- 0.004	0.005	0.006

AL Plots : Period 1

AL (polBeamEta) , Q=N

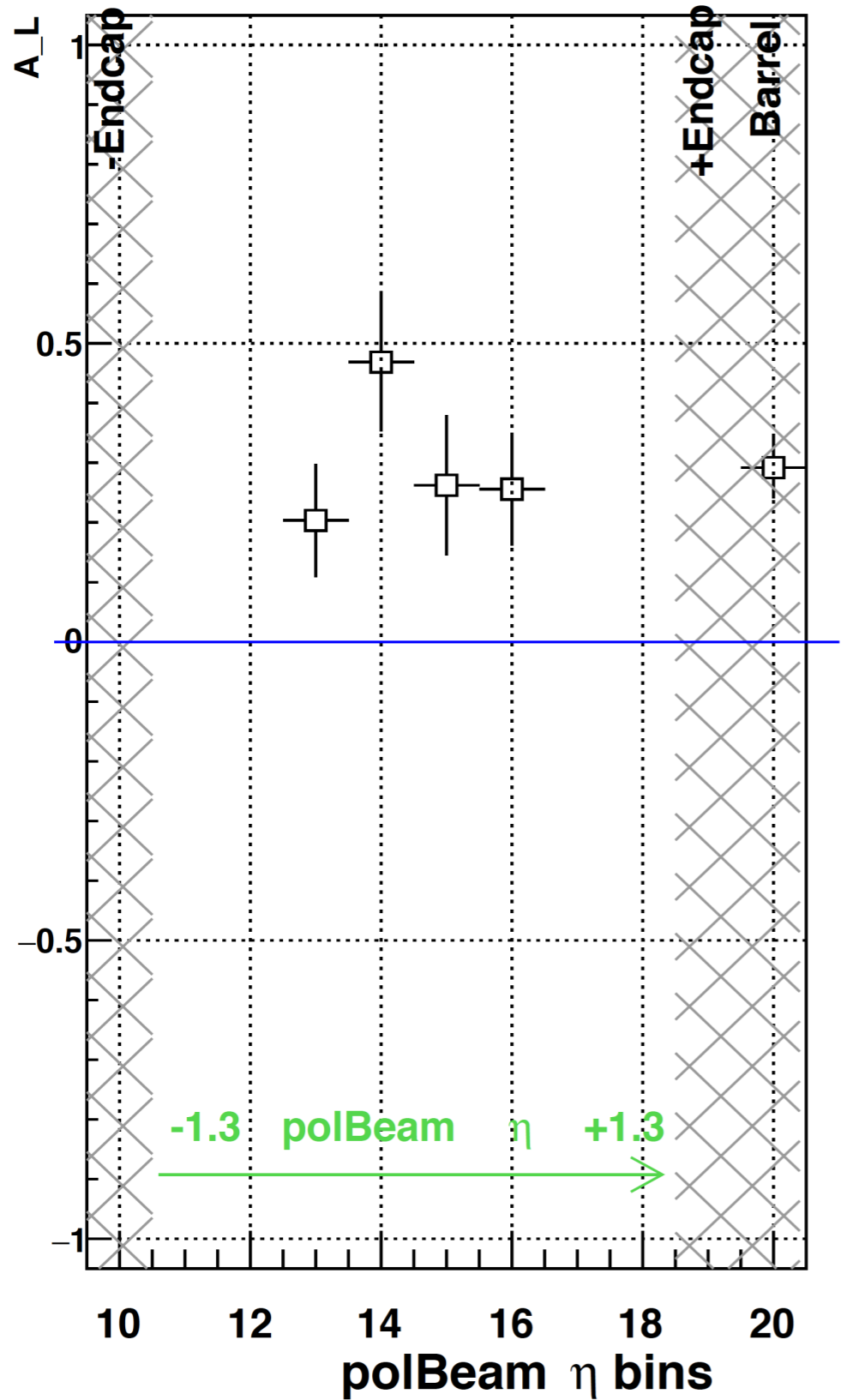


AL (polBeamEta) , Q=P

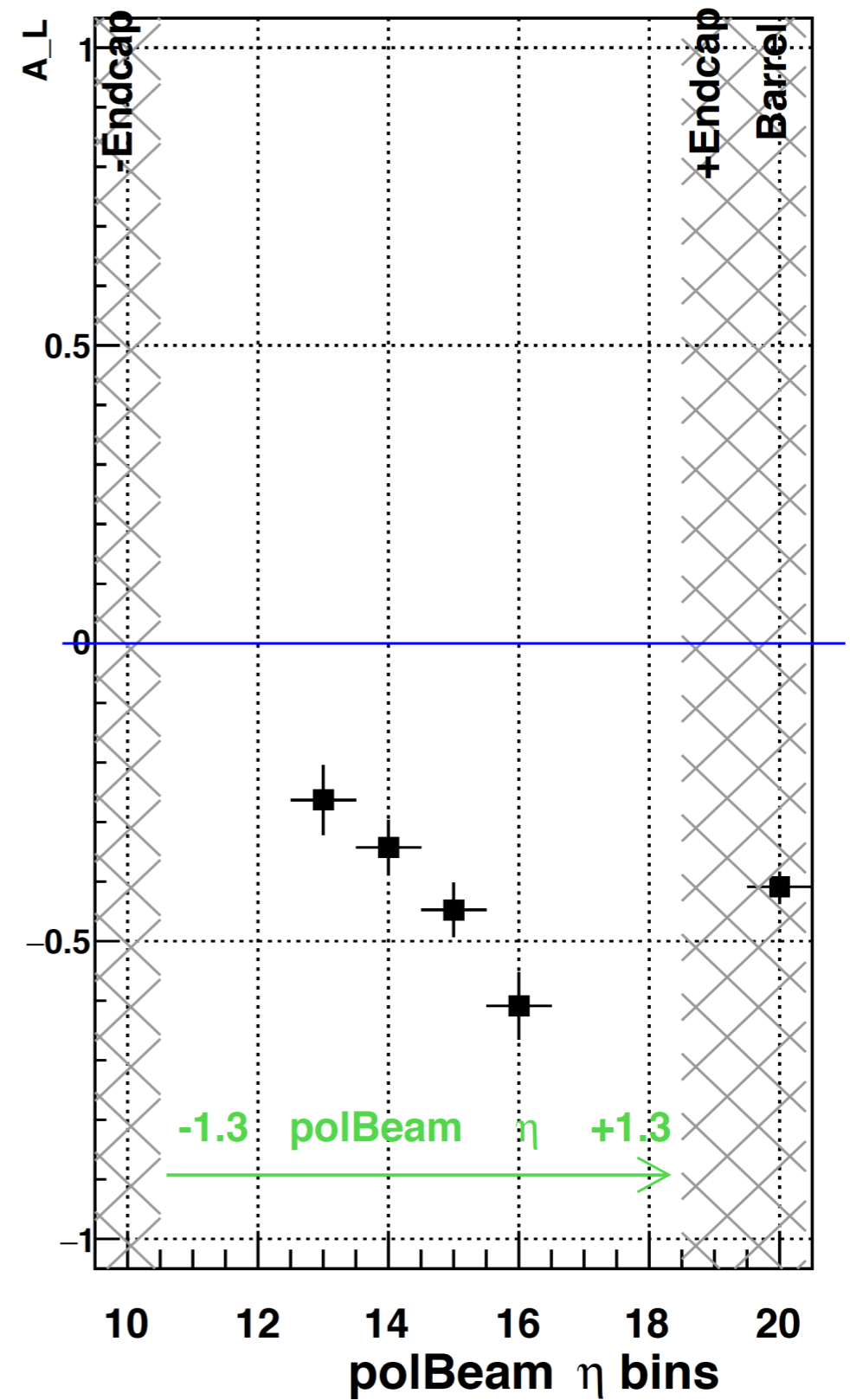


AL Plots : Period 2

AL (polBeamEta) , Q=N



AL (polBeamEta) , Q=P



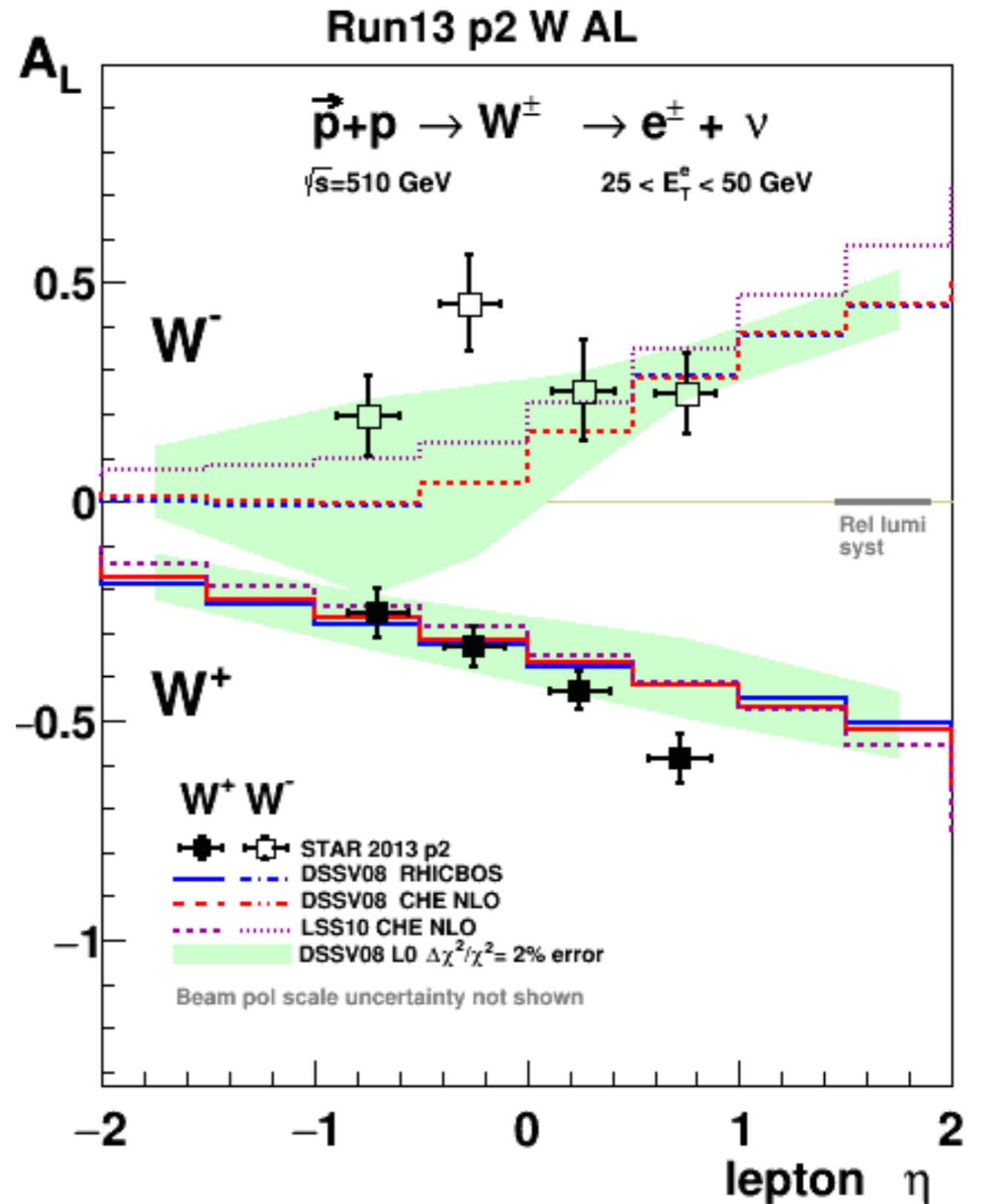
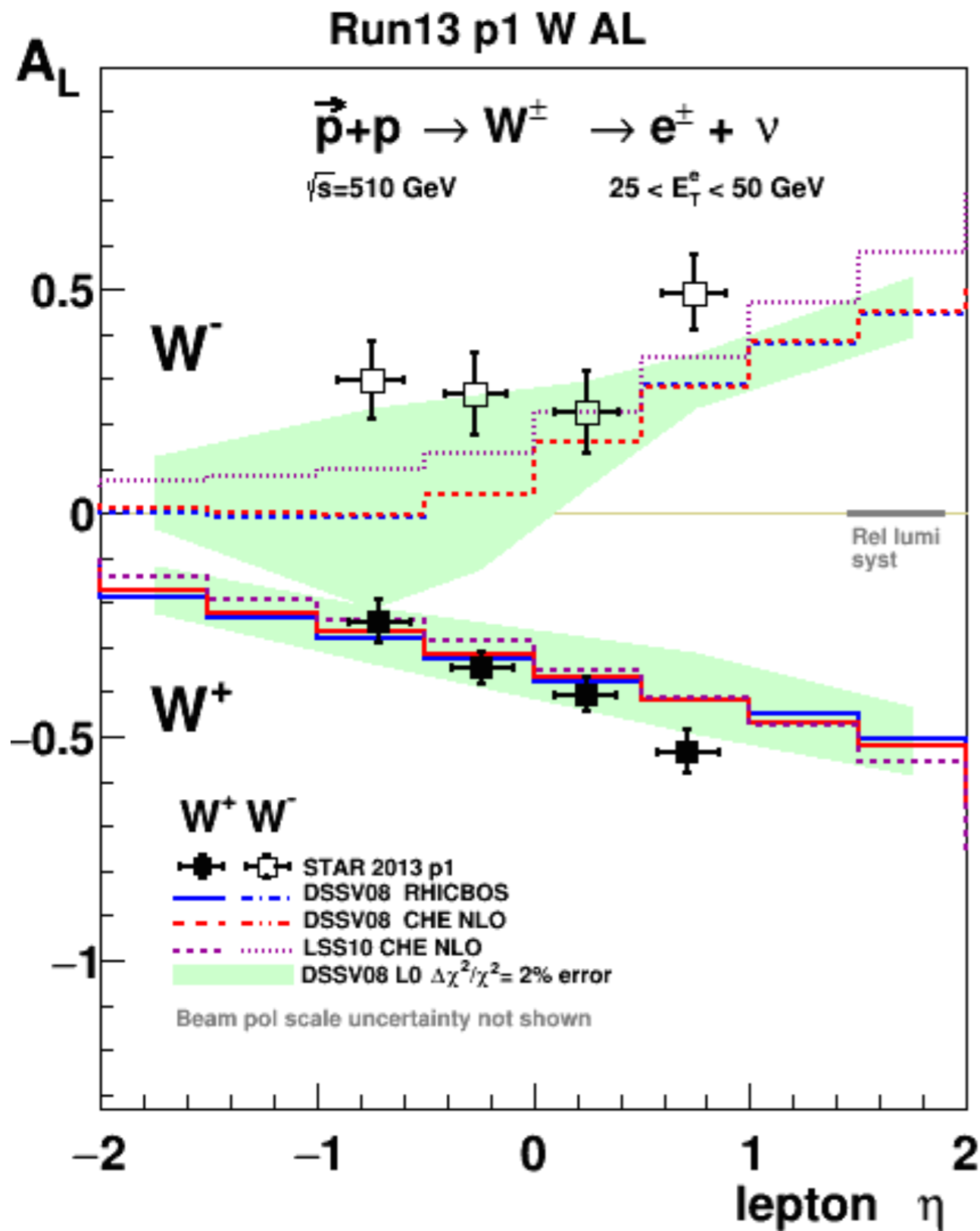
W Spin Sorted Yields Summary - Star Eta Bins

run13 period 1	star-bin	sum yields	++	+-	-+	--	beta
W+	1	763	111	225	159	267	0.9
	2	1226	189	298	302	436	0.94
	3	1255	193	290	333	438	0.95
	4	764	113	171	219	261	0.94
	lumi-corr:		0.995	0.997	0.998	1.009	
W-	1	251	95	52	64	40	0.85
	2	267	89	66	66	46	0.83
	3	254	73	59	64	57	0.84
	4	310	100	89	74	47	0.9
	lumi-corr:		0.995	0.997	0.998	1.009	
run13 period 2	star-bin	sum yields	++	+-	-+	--	beta
W+	1	567	83	167	105	213	0.89
	2	805	113	198	198	295	0.93
	3	956	159	209	257	331	0.95
	4	631	102	131	170	228	0.93
	lumi-corr:		1.006	0.995	0.994	1.005	
W-	1	227	70	58	64	35	0.87
	2	180	66	44	39	31	0.83
	3	193	60	43	55	35	0.8
	4	242	65	65	65	47	0.92
	lumi-corr:		1.006	0.995	0.994	1.005	

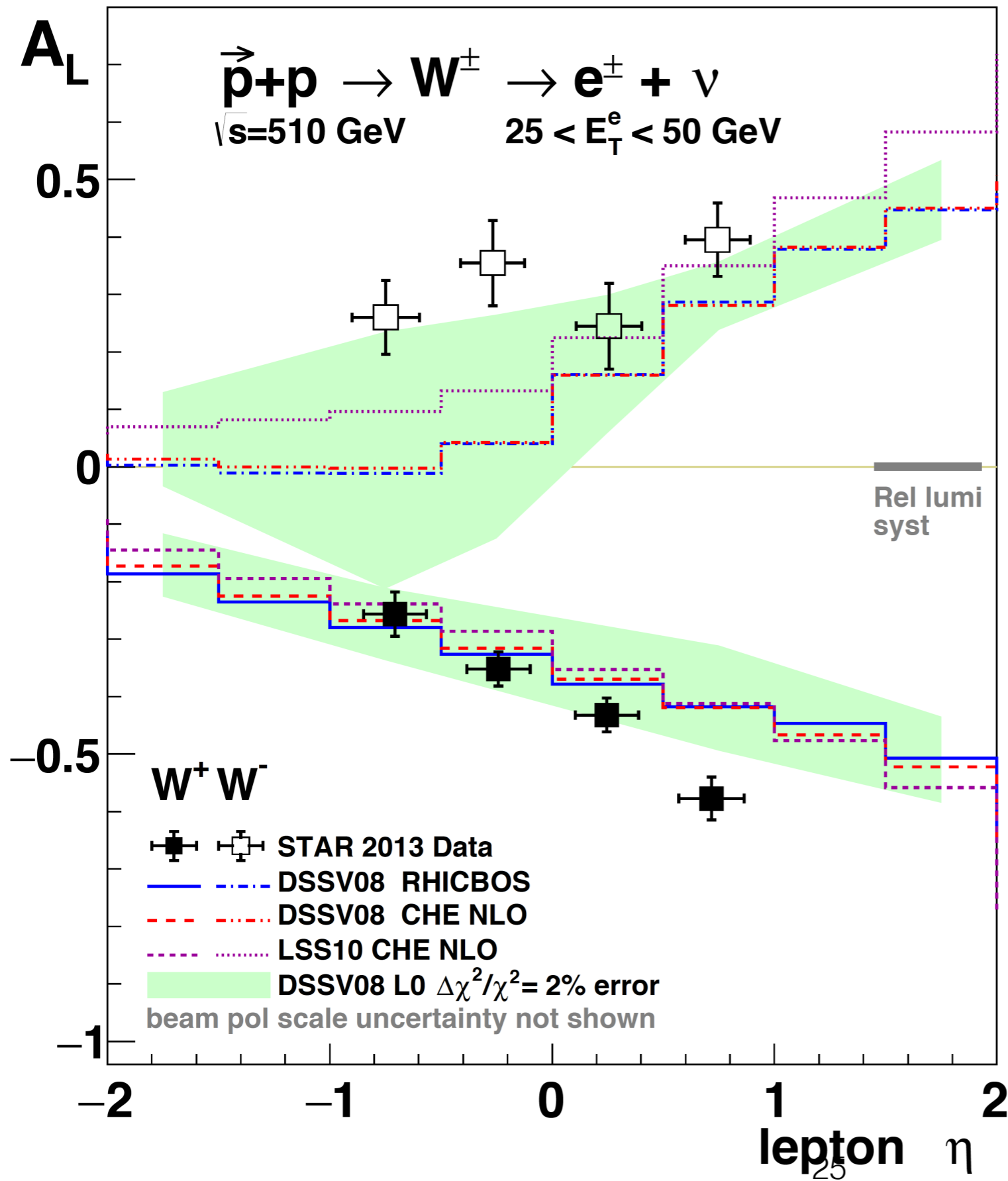
W AL Summary - Pol. beam Eta bins

period1	pol-etabin	Nevent	AL		Err
W+	13	1527	-0.252	+/-	0.051
	14	2481	-0.359	+/-	0.039
	15	2481	-0.421	+/-	0.039
	16	1527	-0.553	+/-	0.05
W-	13	561	0.308	+/-	0.088
	14	521	0.275	+/-	0.096
	15	521	0.233	+/-	0.097
	16	561	0.512	+/-	0.086
period2	pol-etabin	Nevent	AL		Err
W+	13	1198	-0.263	+/-	0.059
	14	1761	-0.343	+/-	0.046
	15	1761	-0.448	+/-	0.046
	16	1198	-0.609	+/-	0.057
W-	13	469	0.204	+/-	0.095
	14	373	0.469	+/-	0.116
	15	373	0.263	+/-	0.117
	16	469	0.256	+/-	0.095

Money Plot : Period 1, Period 2

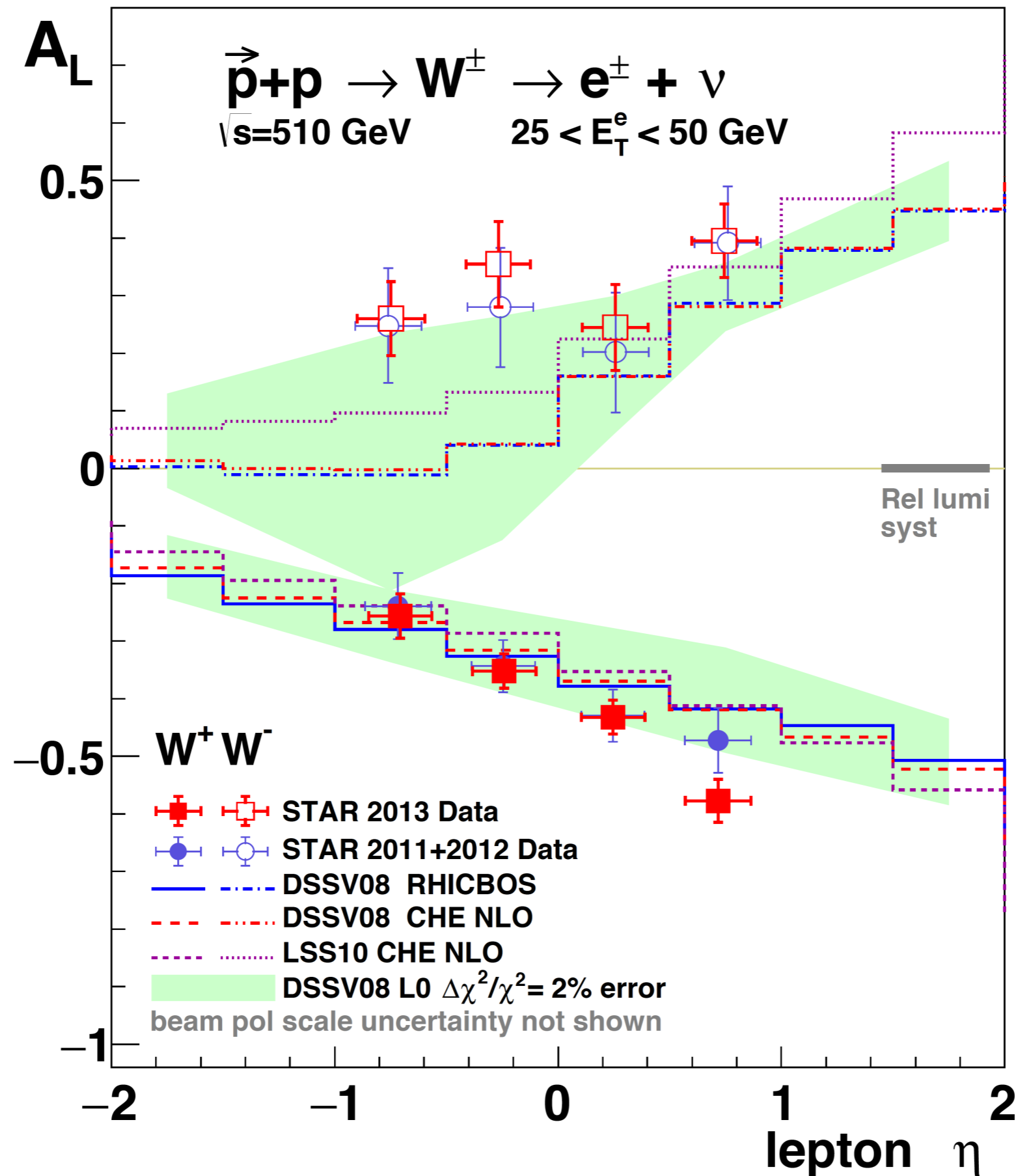


Money Plot : Period 1 + Period 2 combined



W ⁺	1	AL+/-Err:	-0.257+/-0.039
	2	AL+/-Err:	-0.352+/-0.030
	3	AL+/-Err:	-0.432+/-0.029
	4	AL+/-Err:	-0.577+/-0.037
W ⁻	1	AL+/-Err:	0.260+/-0.064
	2	AL+/-Err:	0.354+/-0.074
	3	AL+/-Err:	0.245+/-0.074
	4	AL+/-Err:	0.395+/-0.064

Money Plot Run 13 in comparison to Run 12



Summary / To do

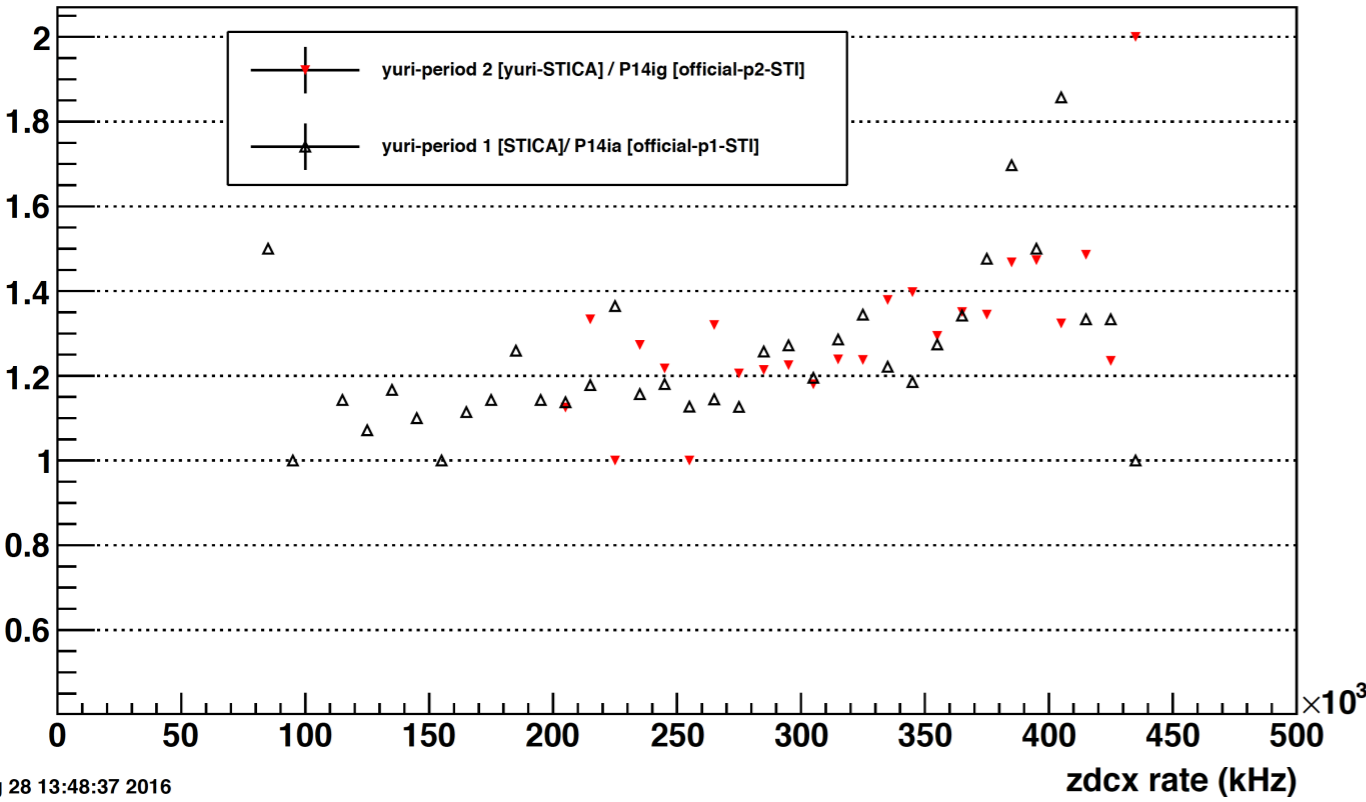
- First Preliminary W AL is calculated for STAR 2013 data using period 1 official data production and period 2 Yuri's data production.
- Study to optimize away ET cut is ongoing.
- Obtain Final Preliminary AL plot for the next PWG presentation.

Date	Task
Aug 29	PWG Presentation 1
Week of Sep 5th-11th	PWG Presentation 2
Sep 11 - 16	INPC 2016
Sep 24 - 30	SPIN 2016

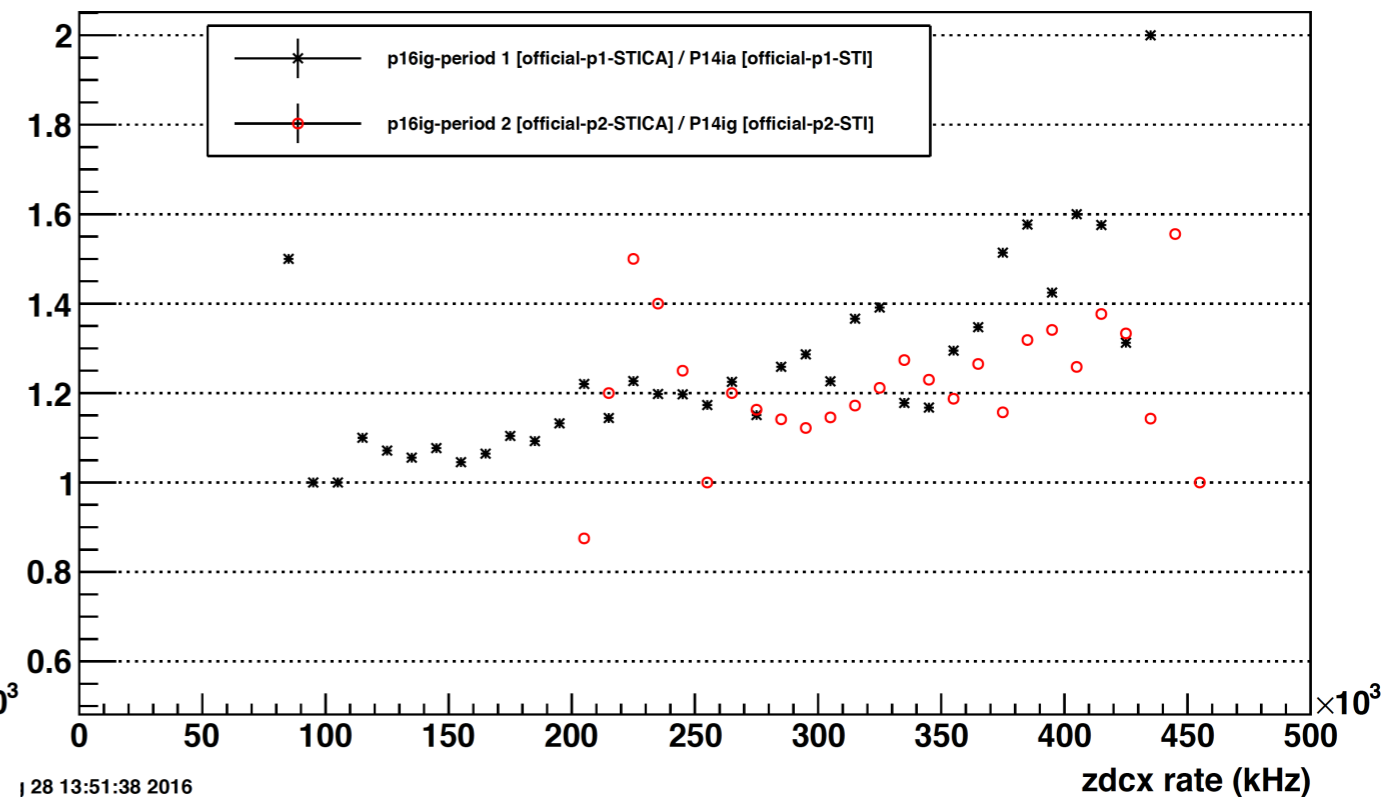
Backup

Why We don't Use Official Period 2 Production ?

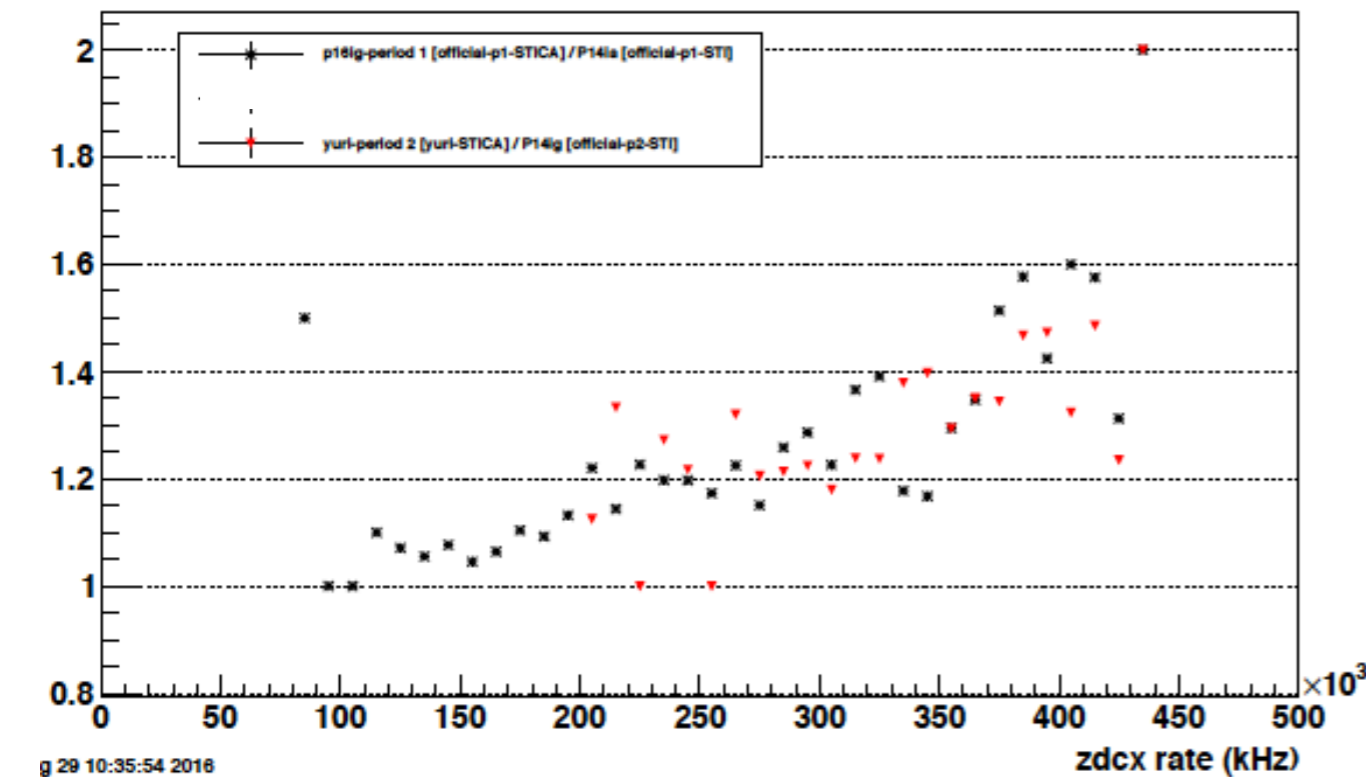
Yuri P1 vs Yuri P2



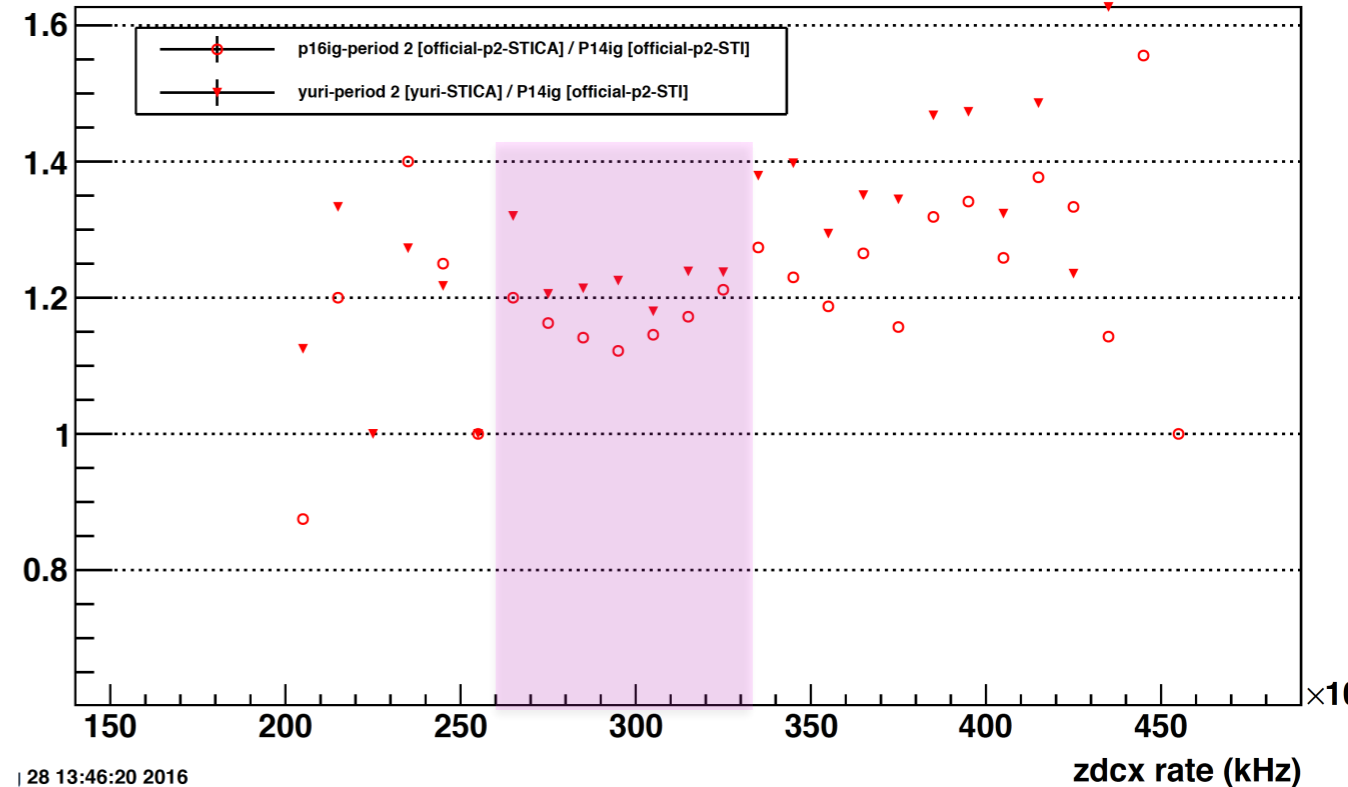
Official P1 vs Official P2



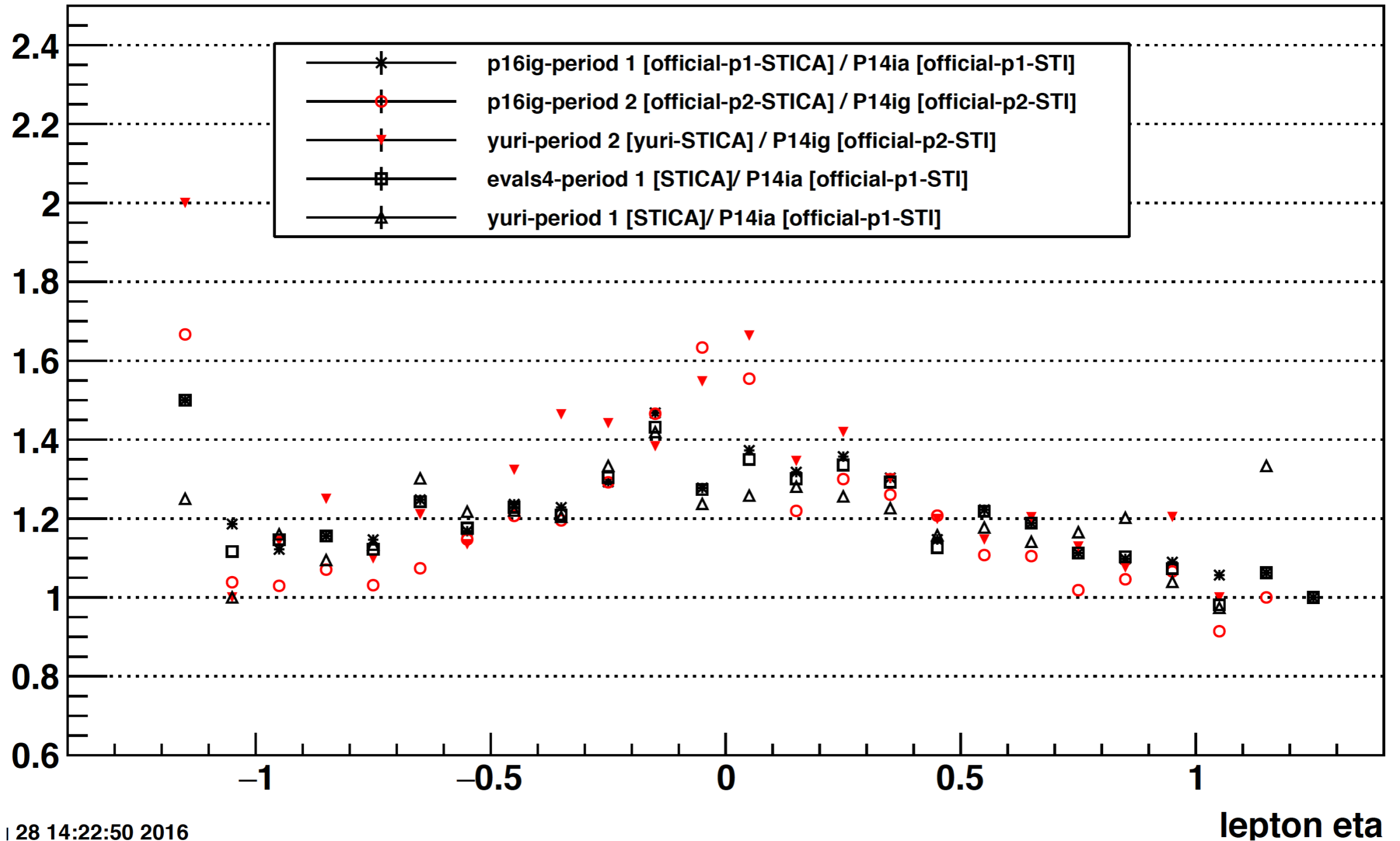
Official P1 vs Yuri P2



Yuri P2 vs Official P2

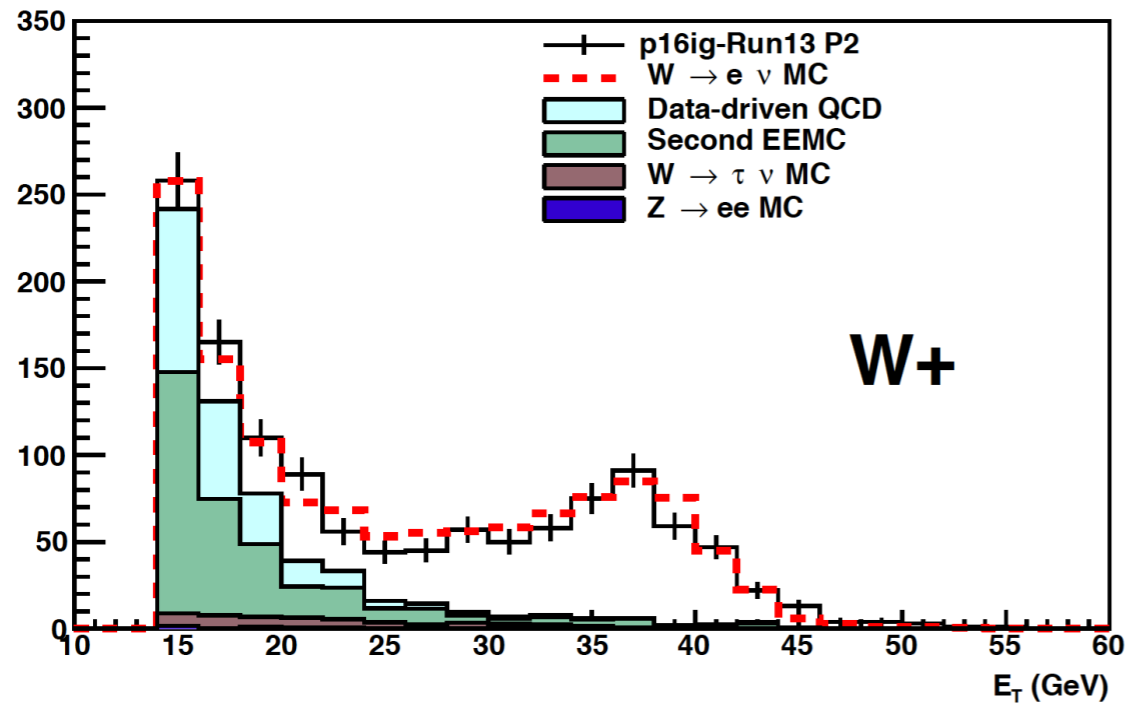


Why We don't Use Official Period 2 Production ?

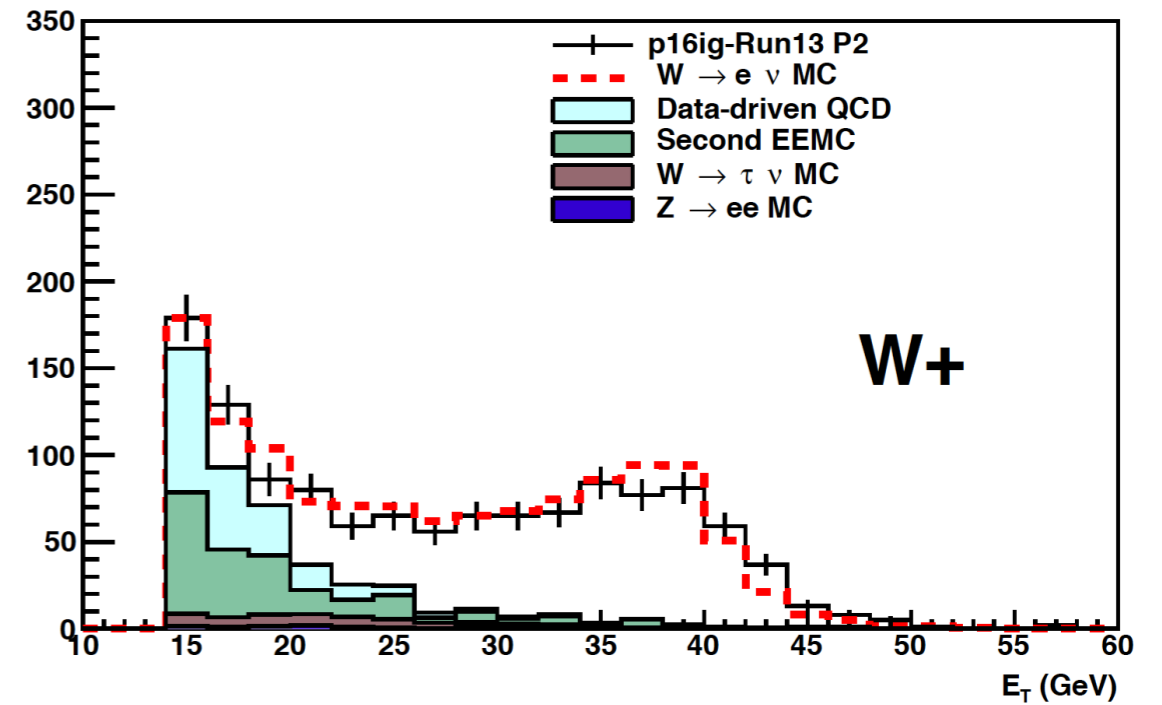


Period 2 Official BG estimation : W^+

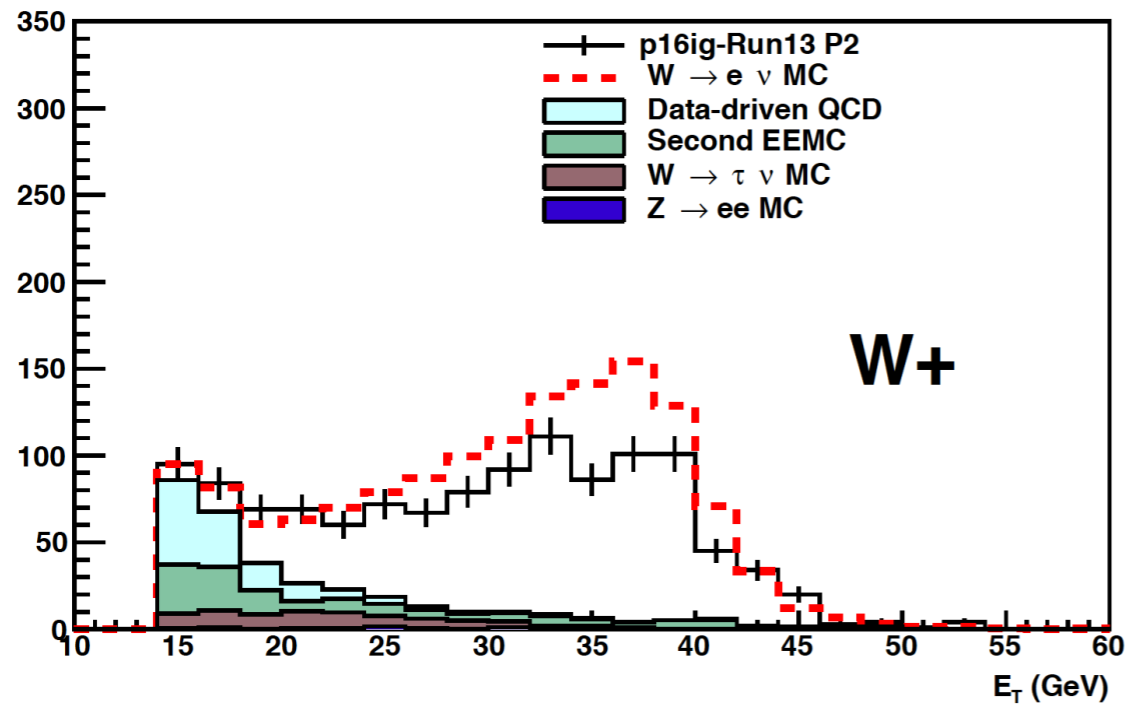
Barrel: pos_muclustpTbal_wE: Eta1



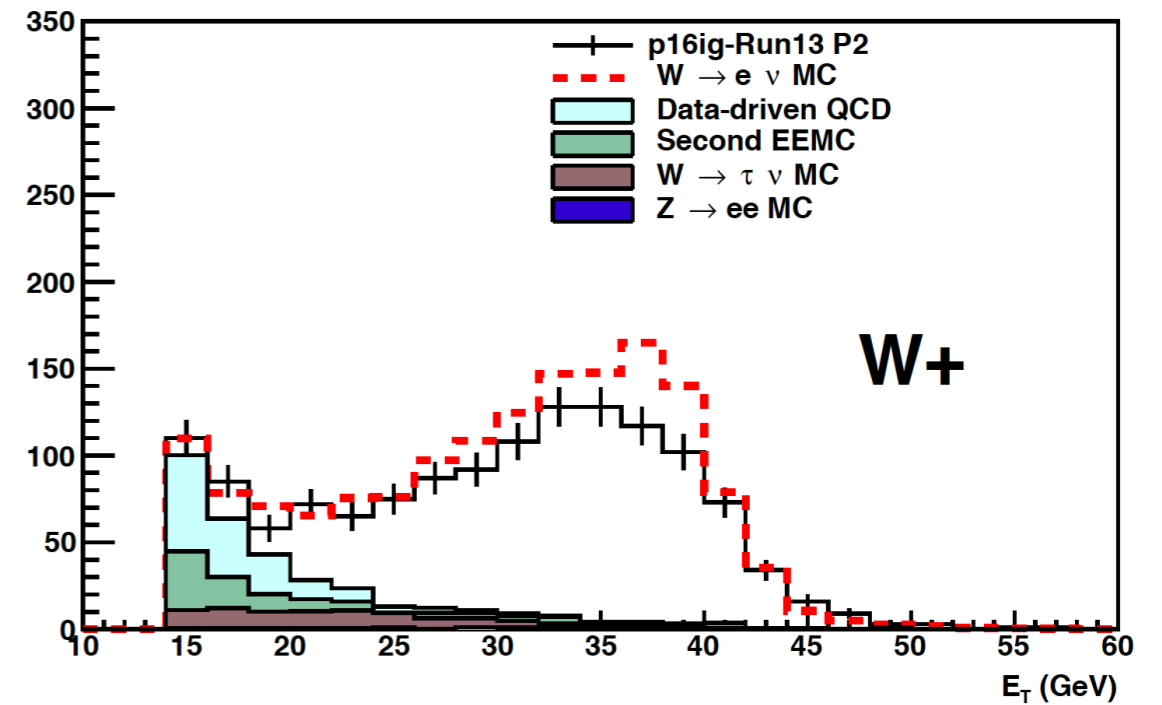
Barrel: pos_muclustpTbal_wE: Eta4



Barrel: pos_muclustpTbal_wE: Eta2

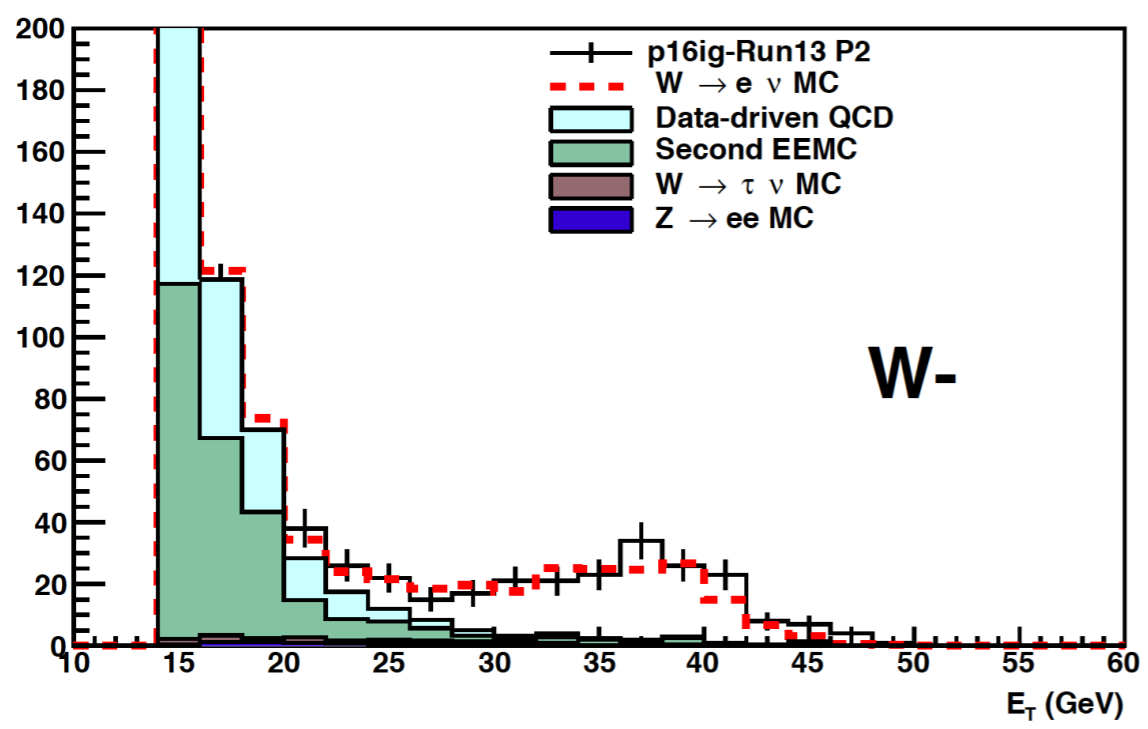


Barrel: pos_muclustpTbal_wE: Eta3

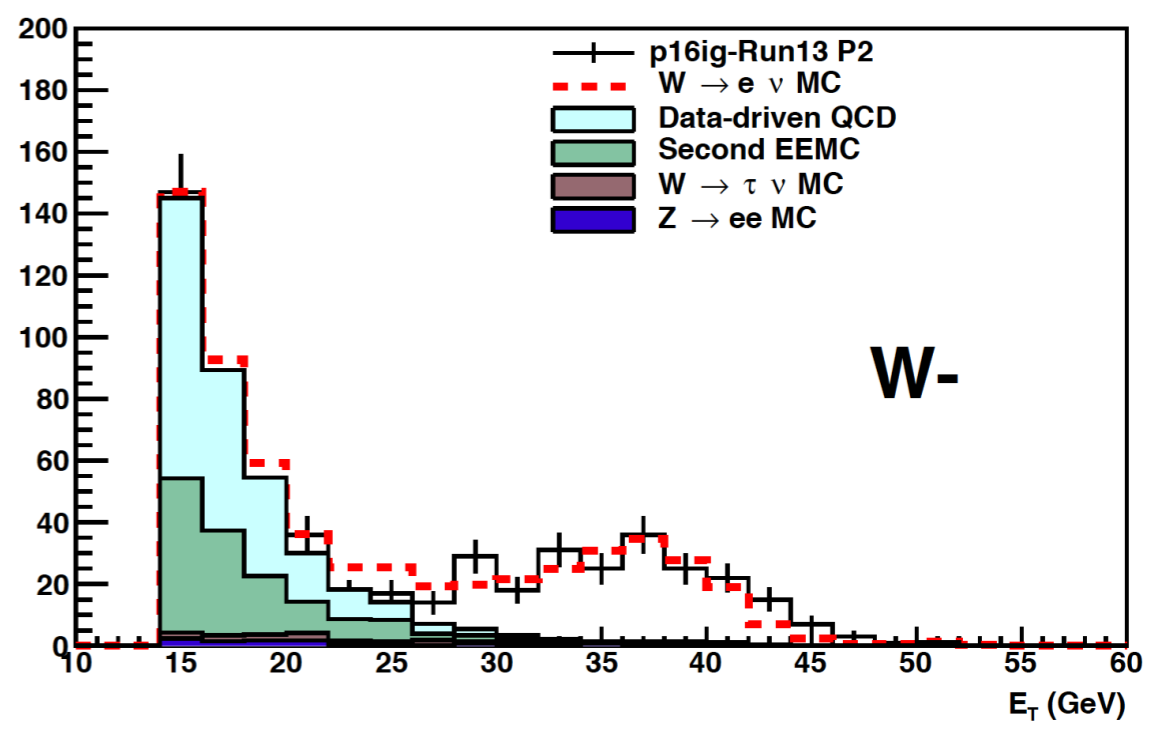


Period 2 Official BG estimation : W -

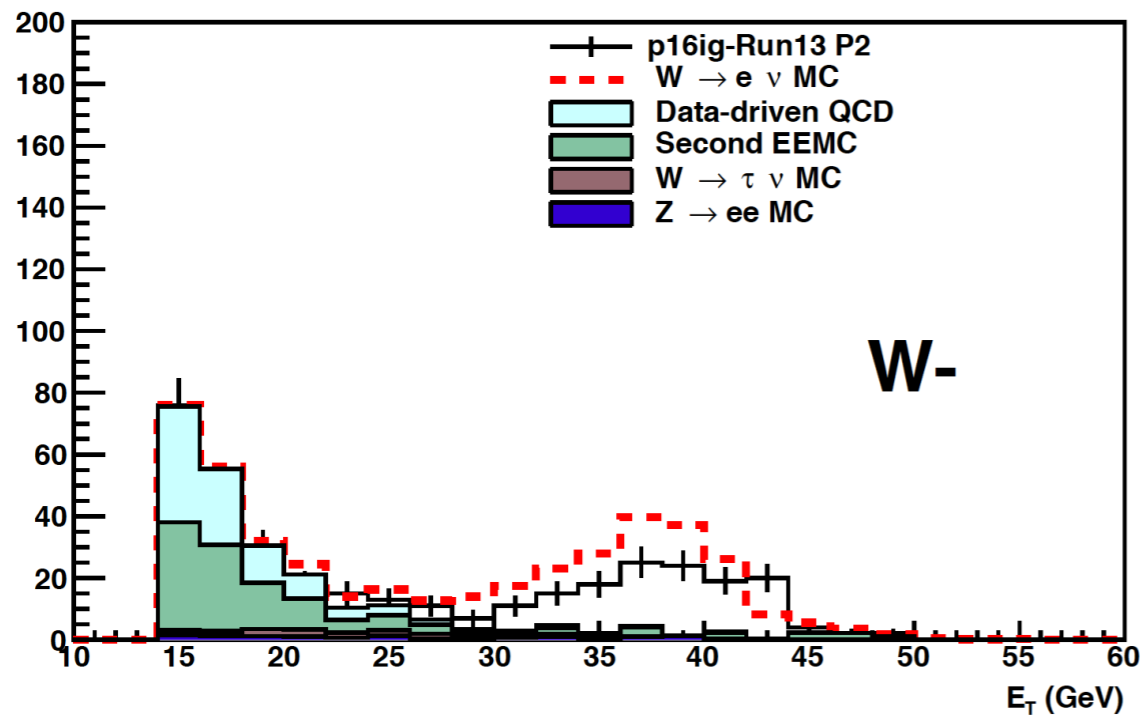
Barrel: neg_muclustpTbal_wE: Eta1



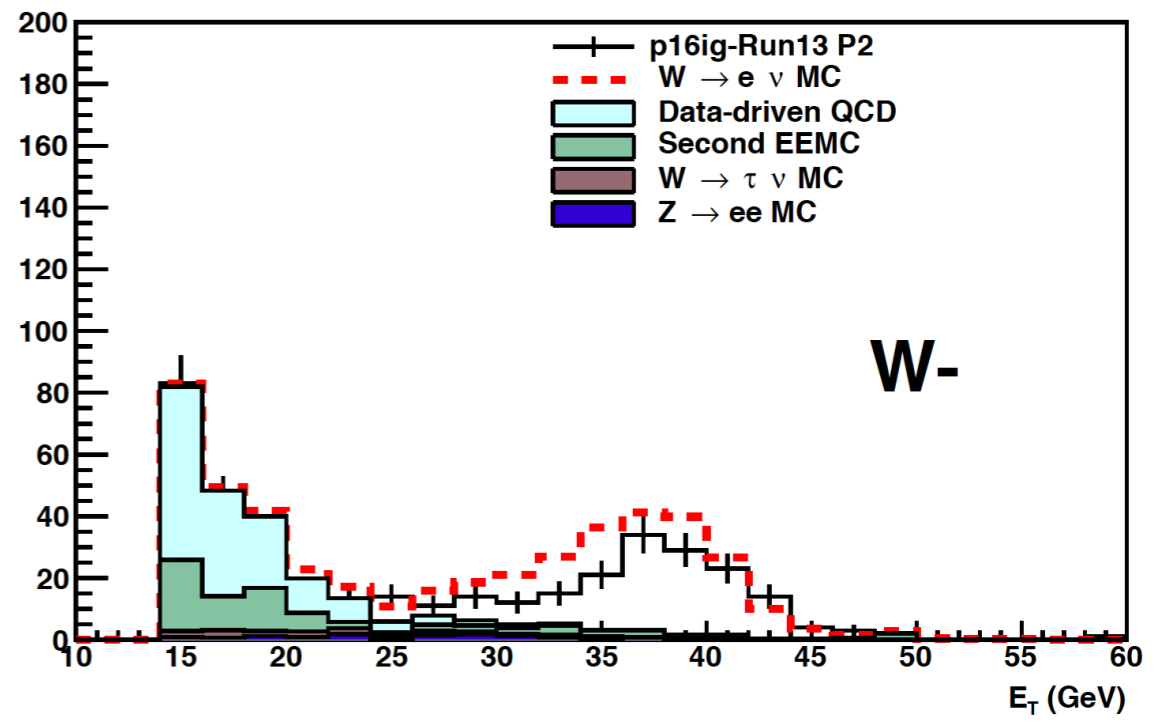
Barrel: neg_muclustpTbal_wE: Eta4



Barrel: neg_muclustpTbal_wE: Eta2



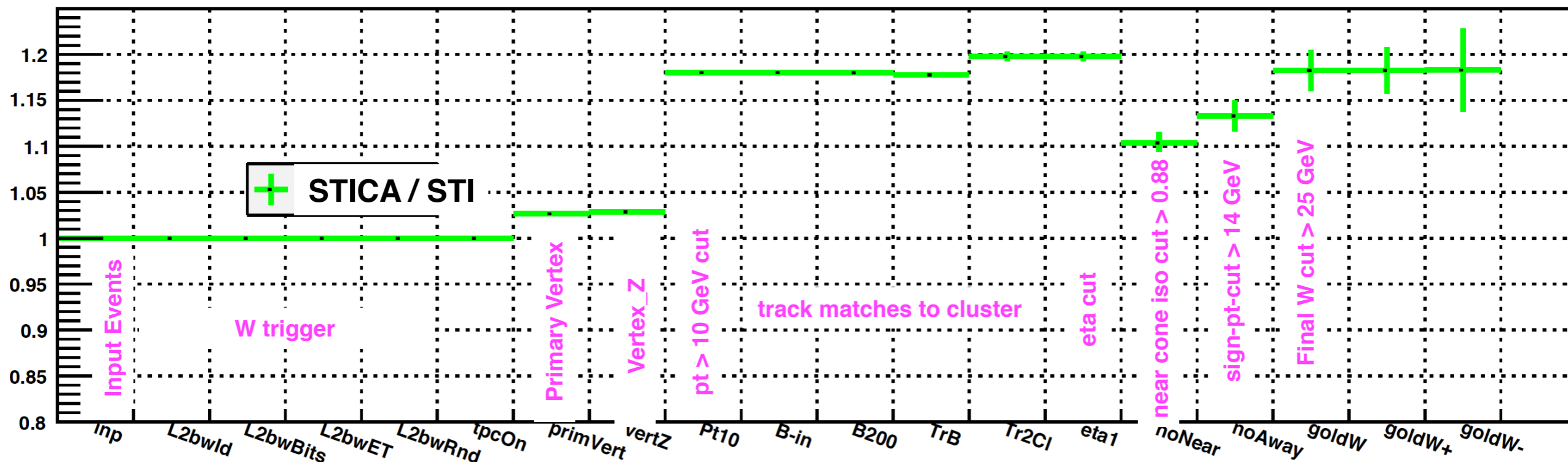
Barrel: neg_muclustpTbal_wE: Eta3



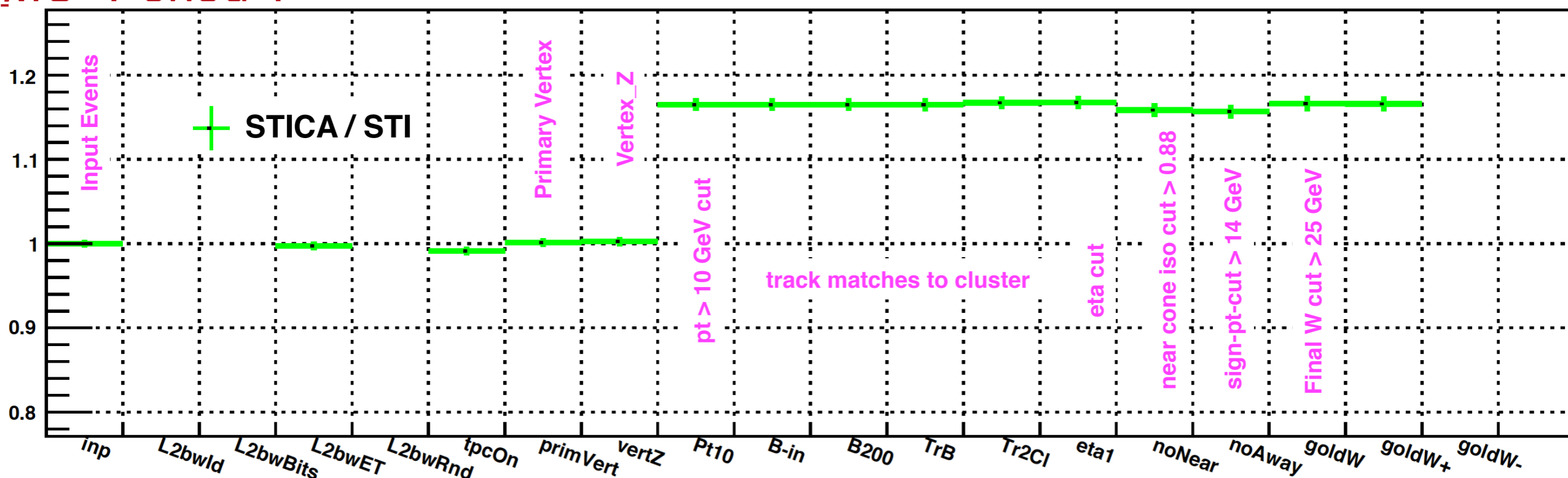
STICA Evaluation Summary -1

Data - Period 1

of events as a function of W cuts



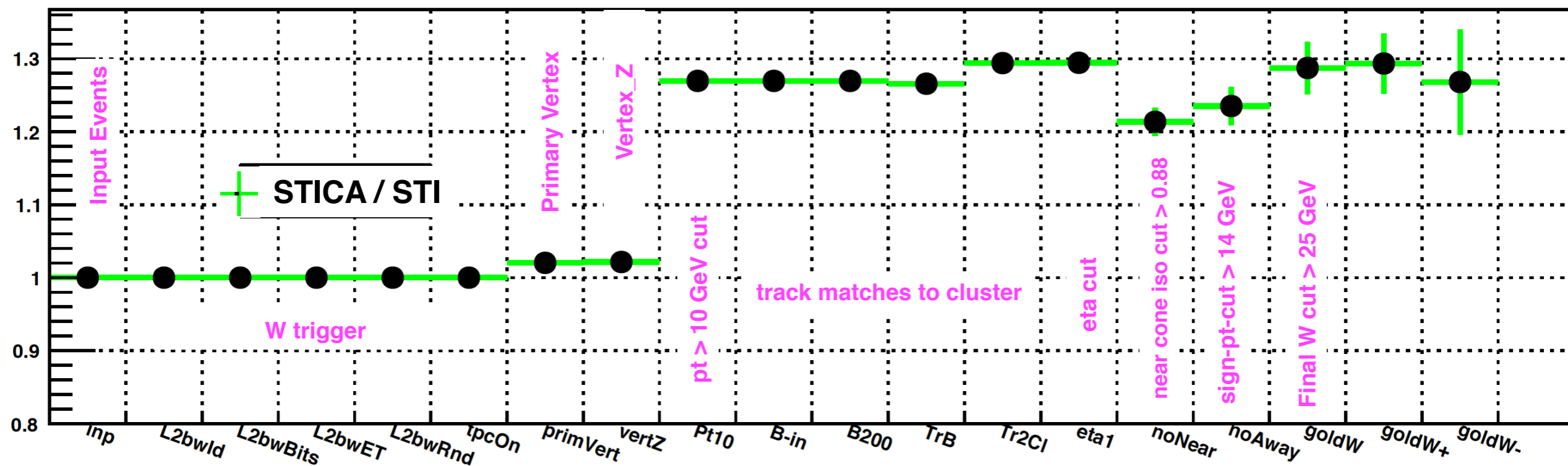
MC- Period 1



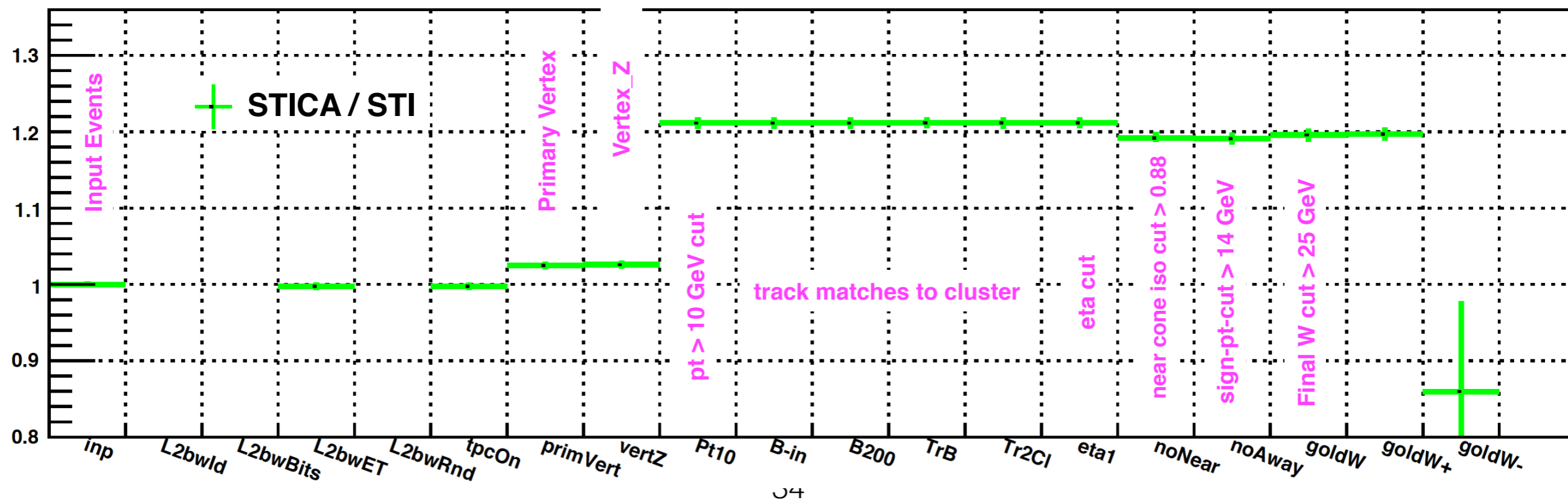
STICA Evaluation Summary -2

Data - Period 2

of events as a function of W cuts



MC- Period 2

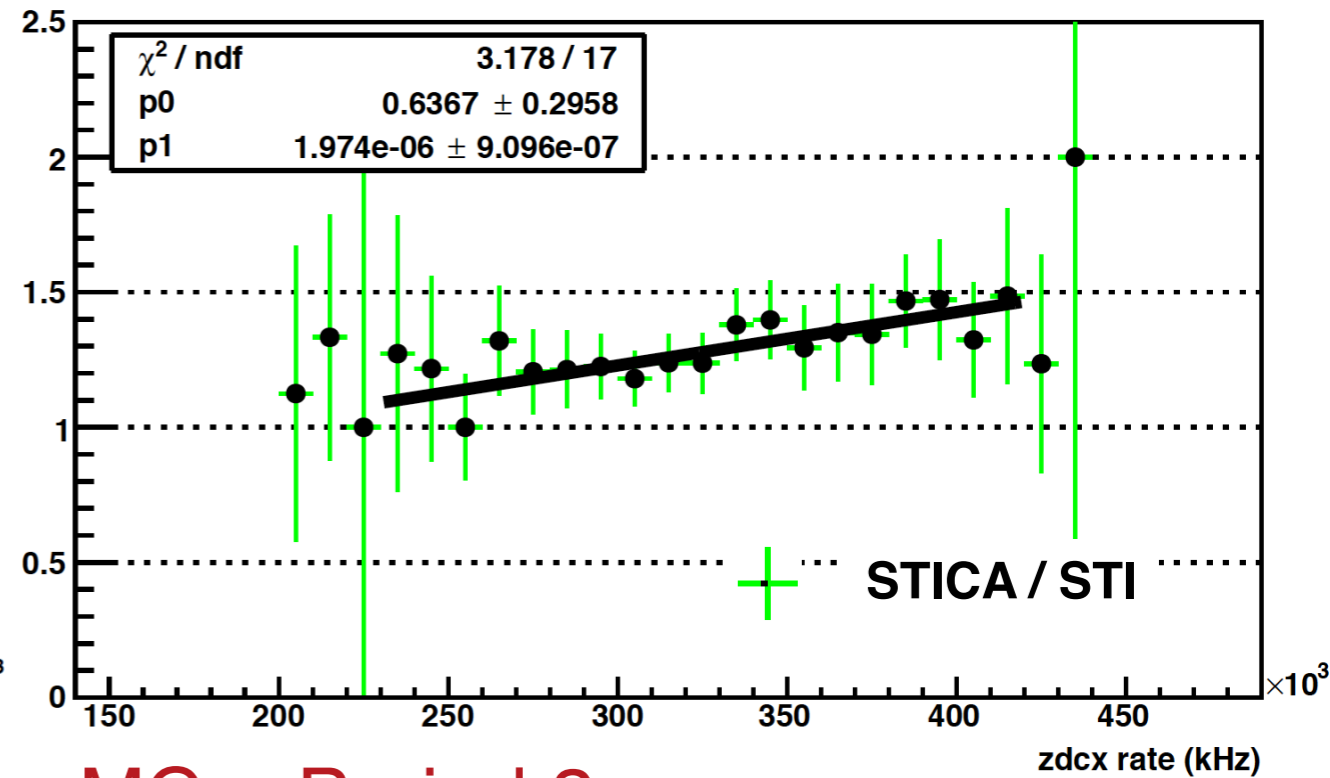
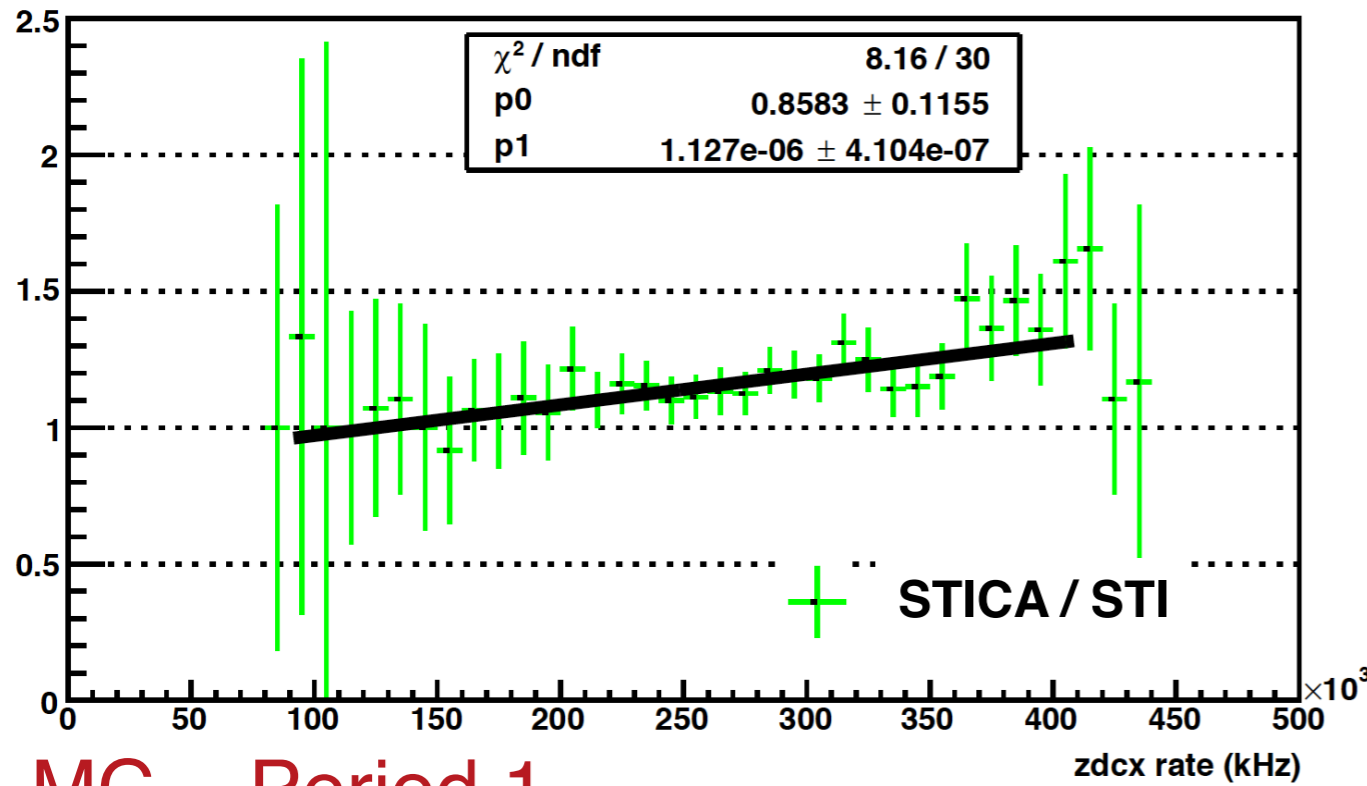


STICA Evaluation Summary -5

W ZDC_X Distributions

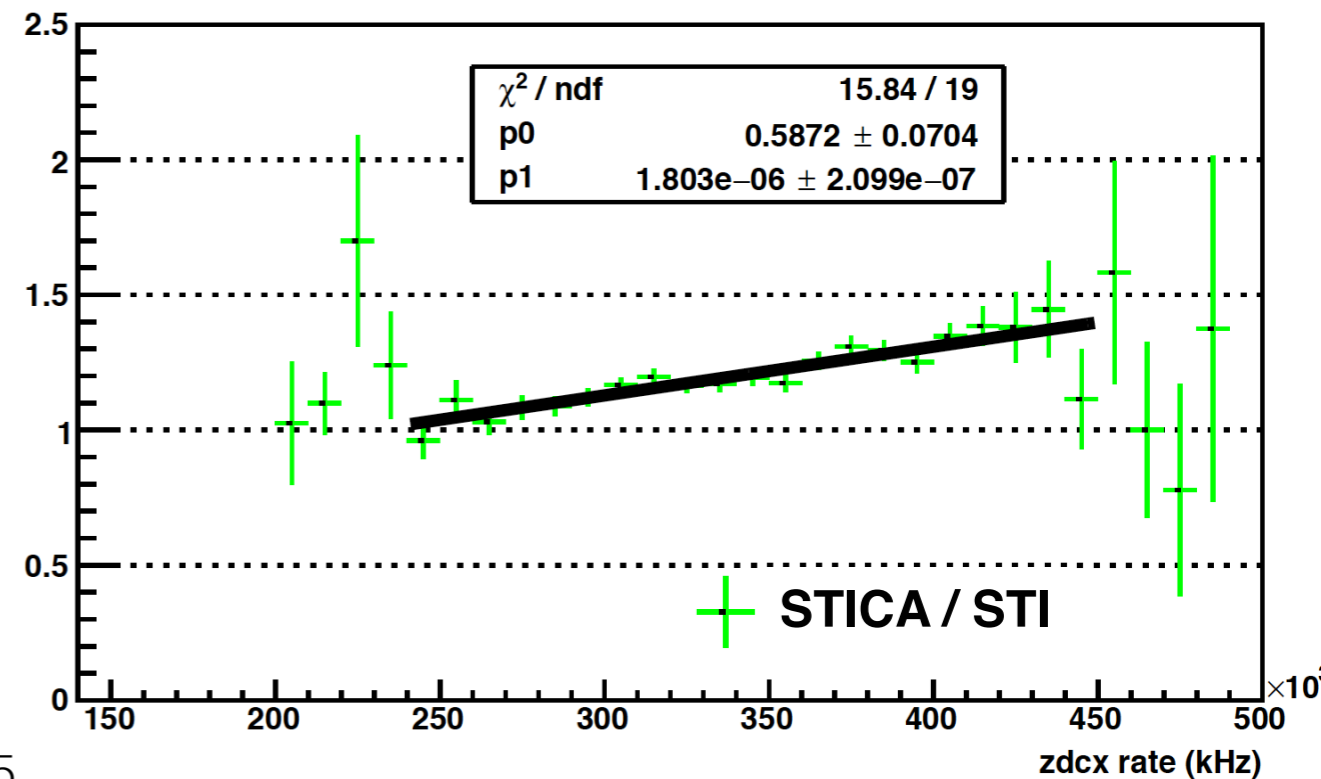
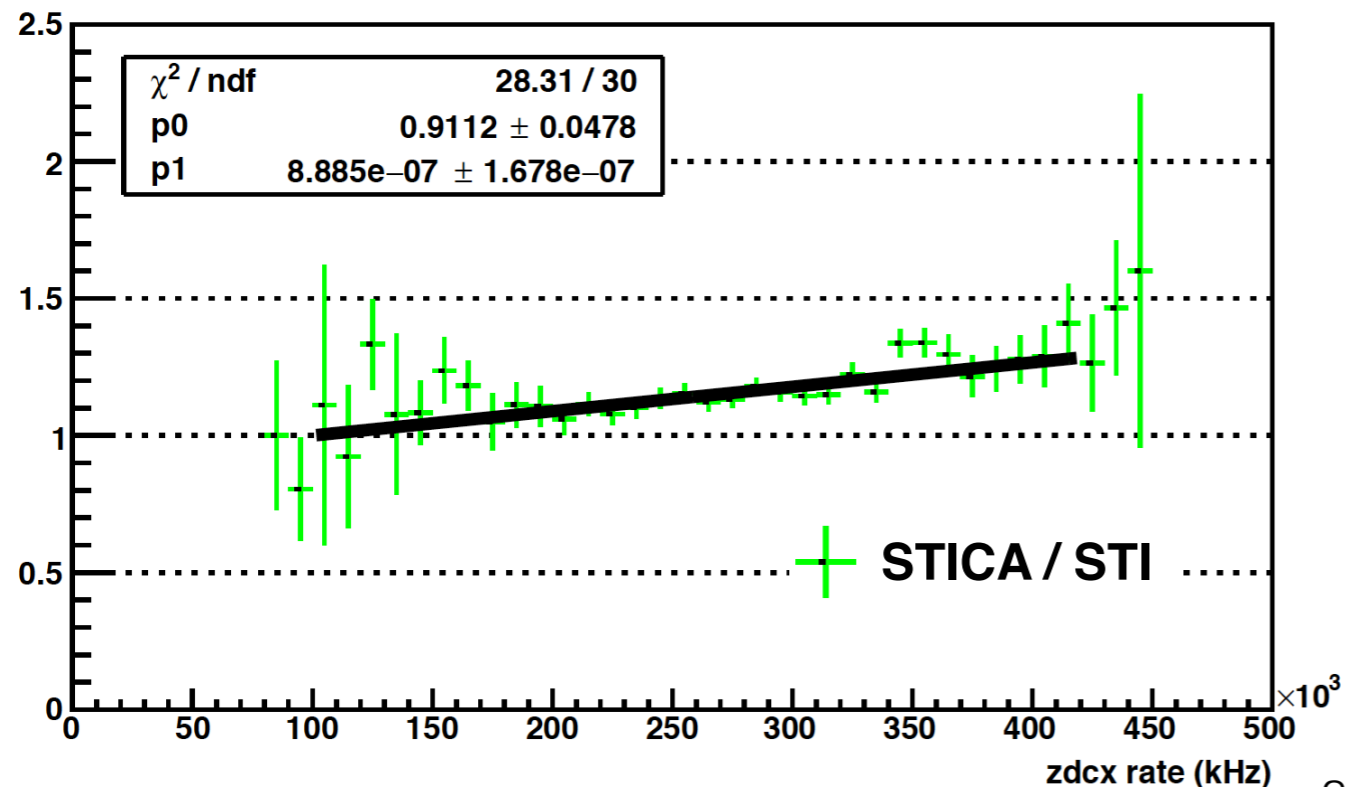
Data - Period 1

Data - Period 2



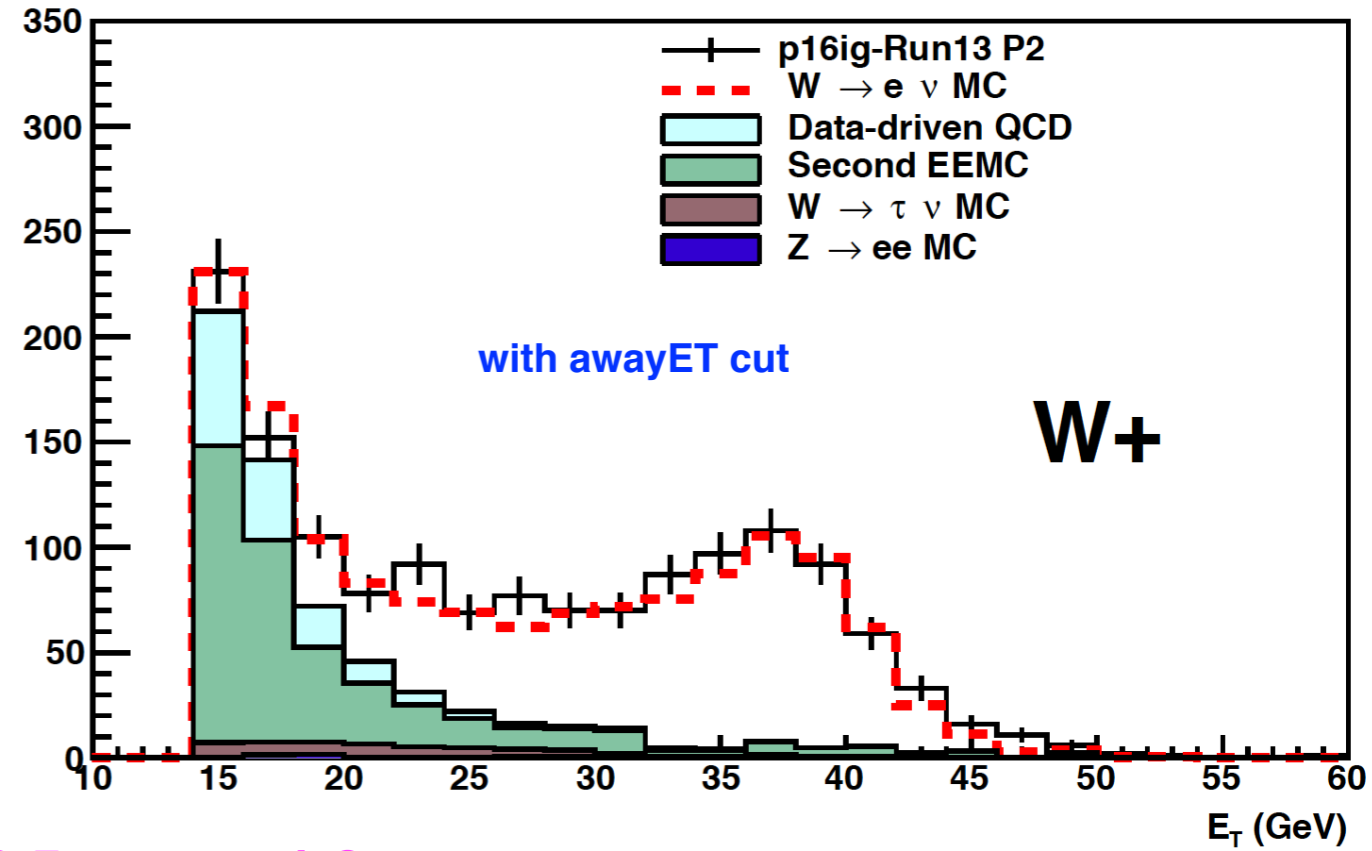
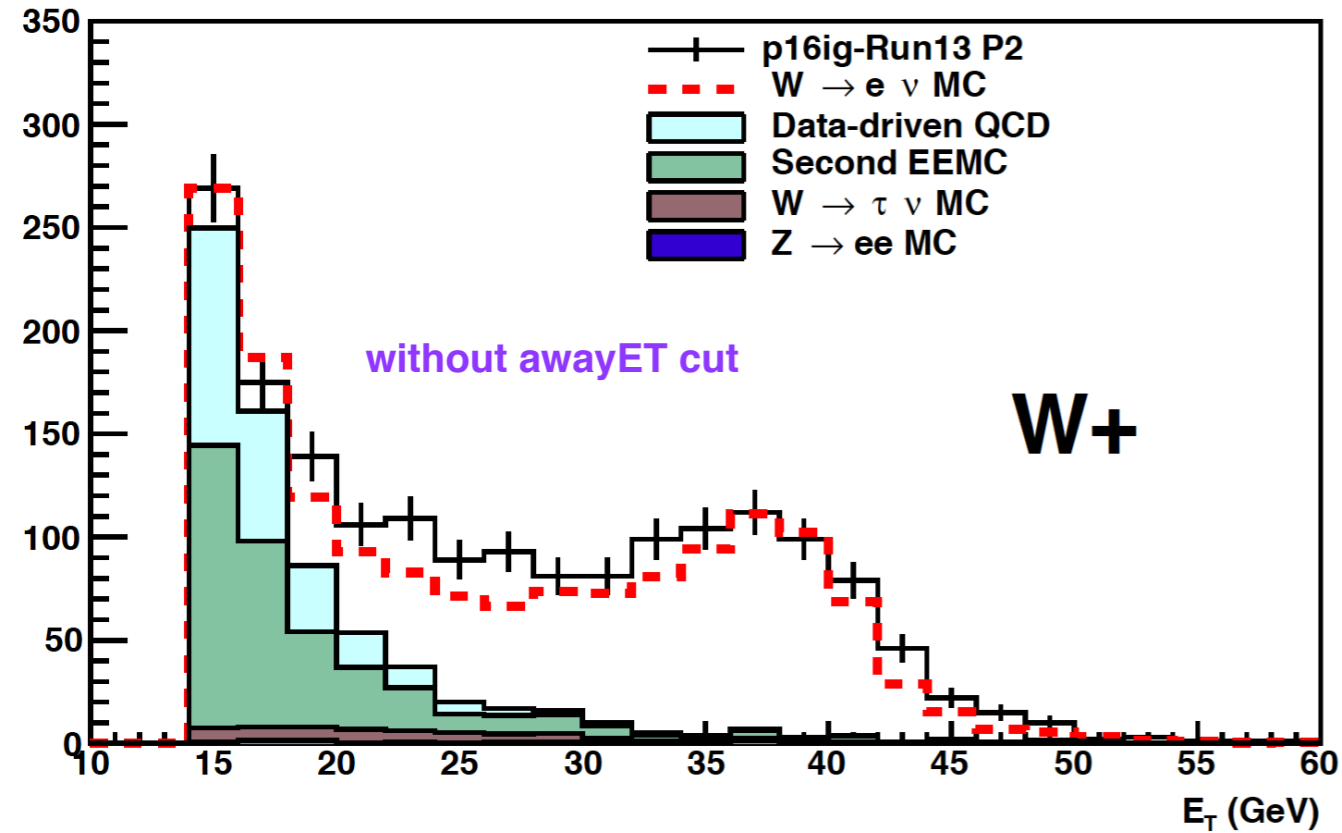
MC - Period 1

MC - Period 2

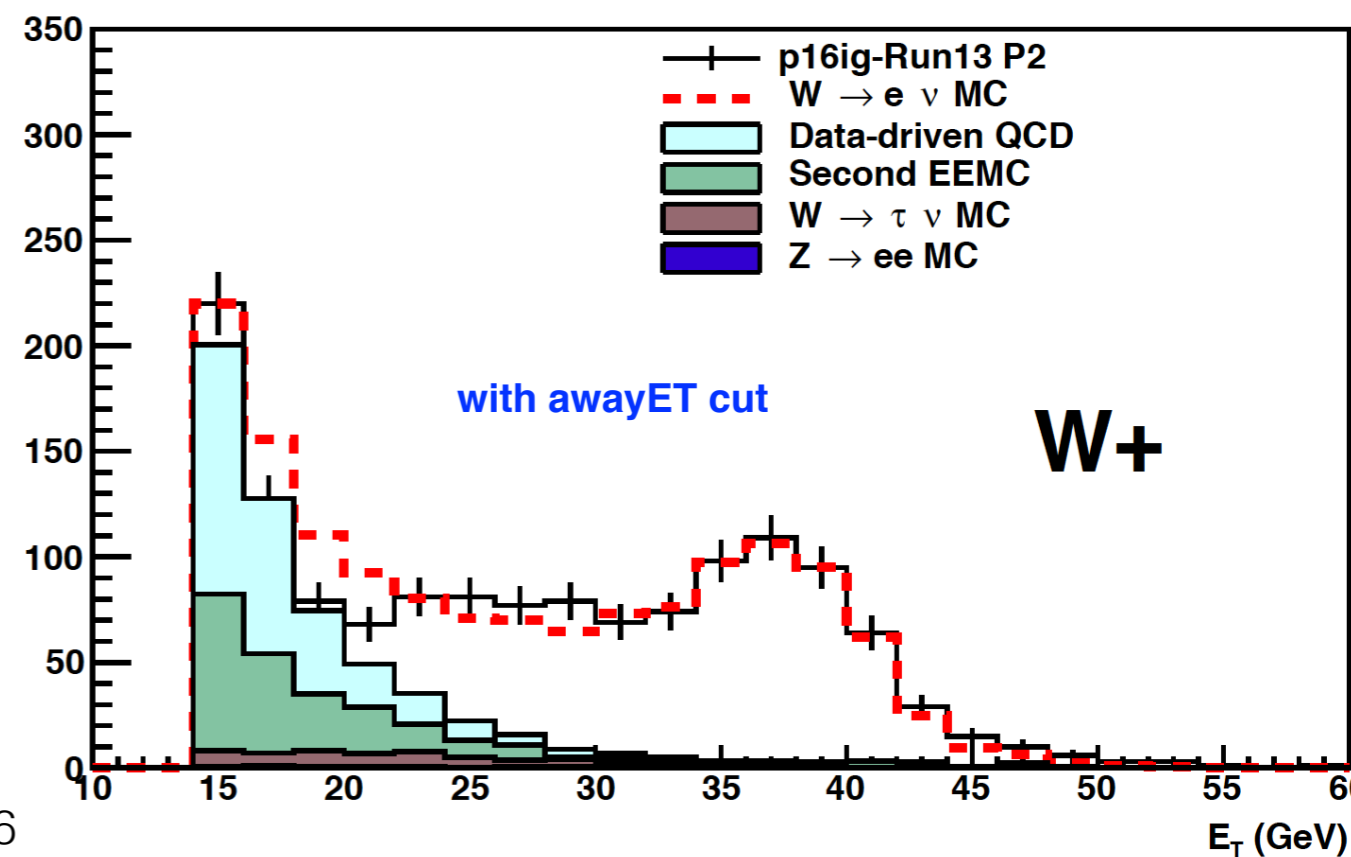
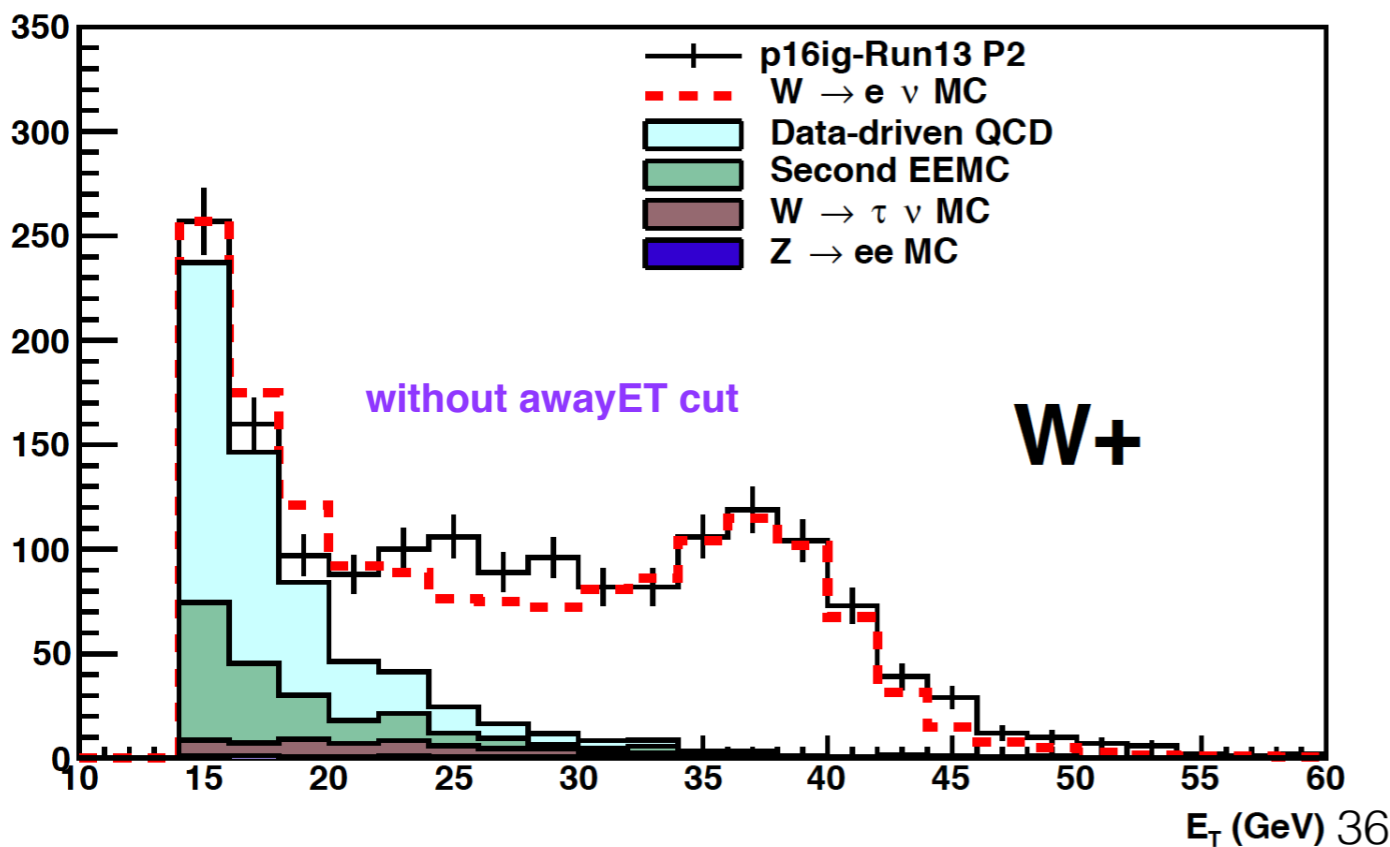


Background Estimation : W^+ : - Period 1

Eta 1 = $-1.0 < \eta < -0.5$

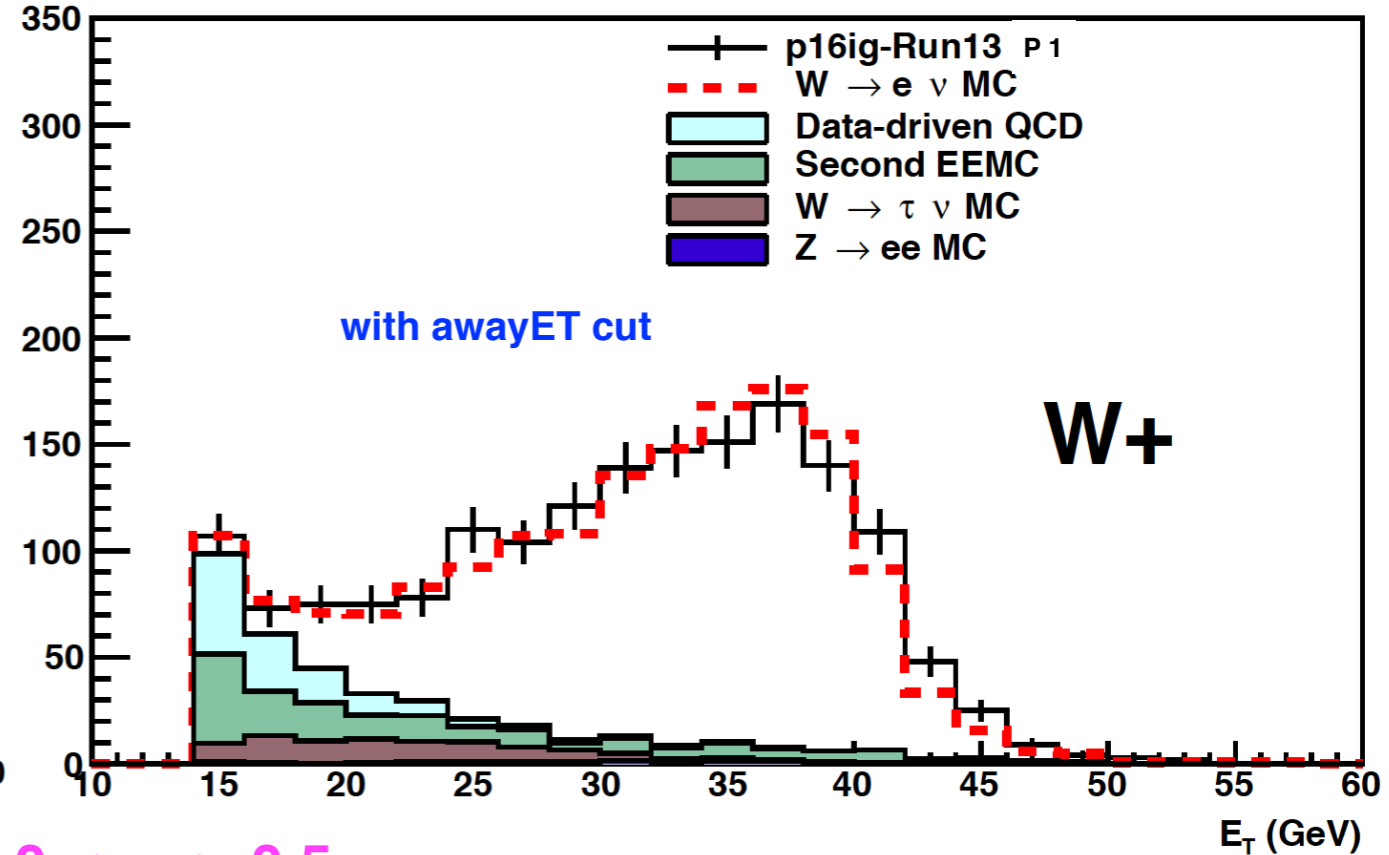
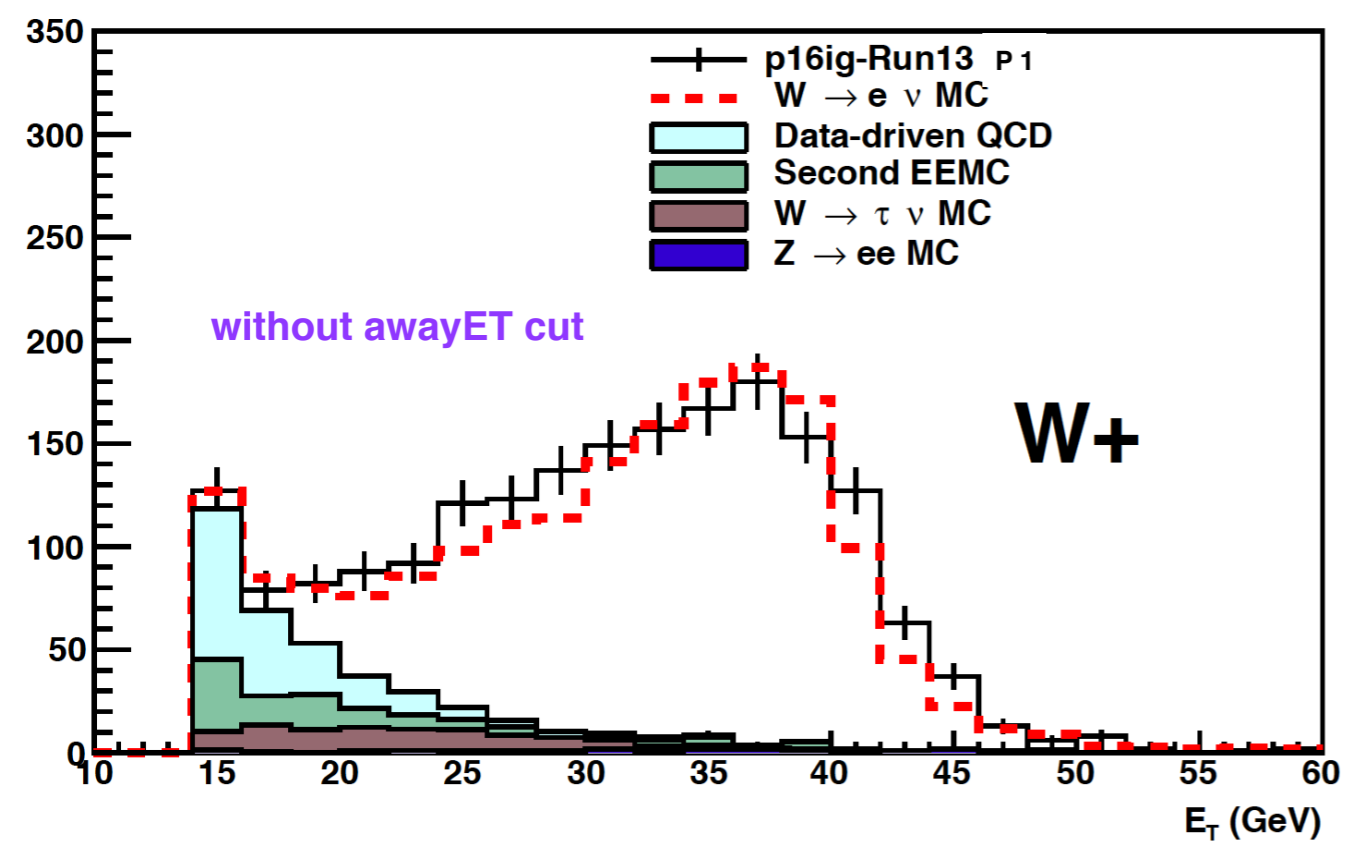


Eta 4 = $+0.5 < \eta < +1.0$

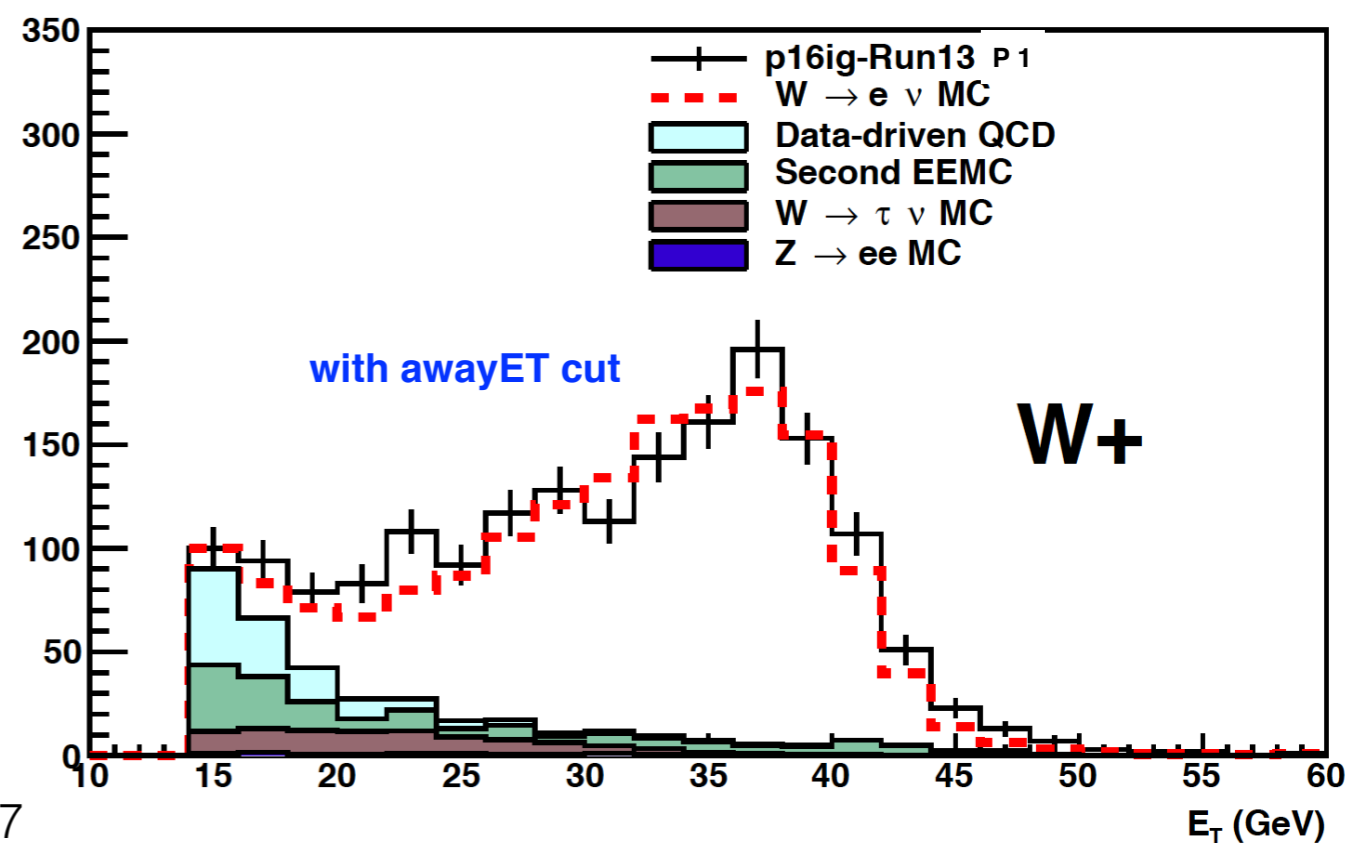
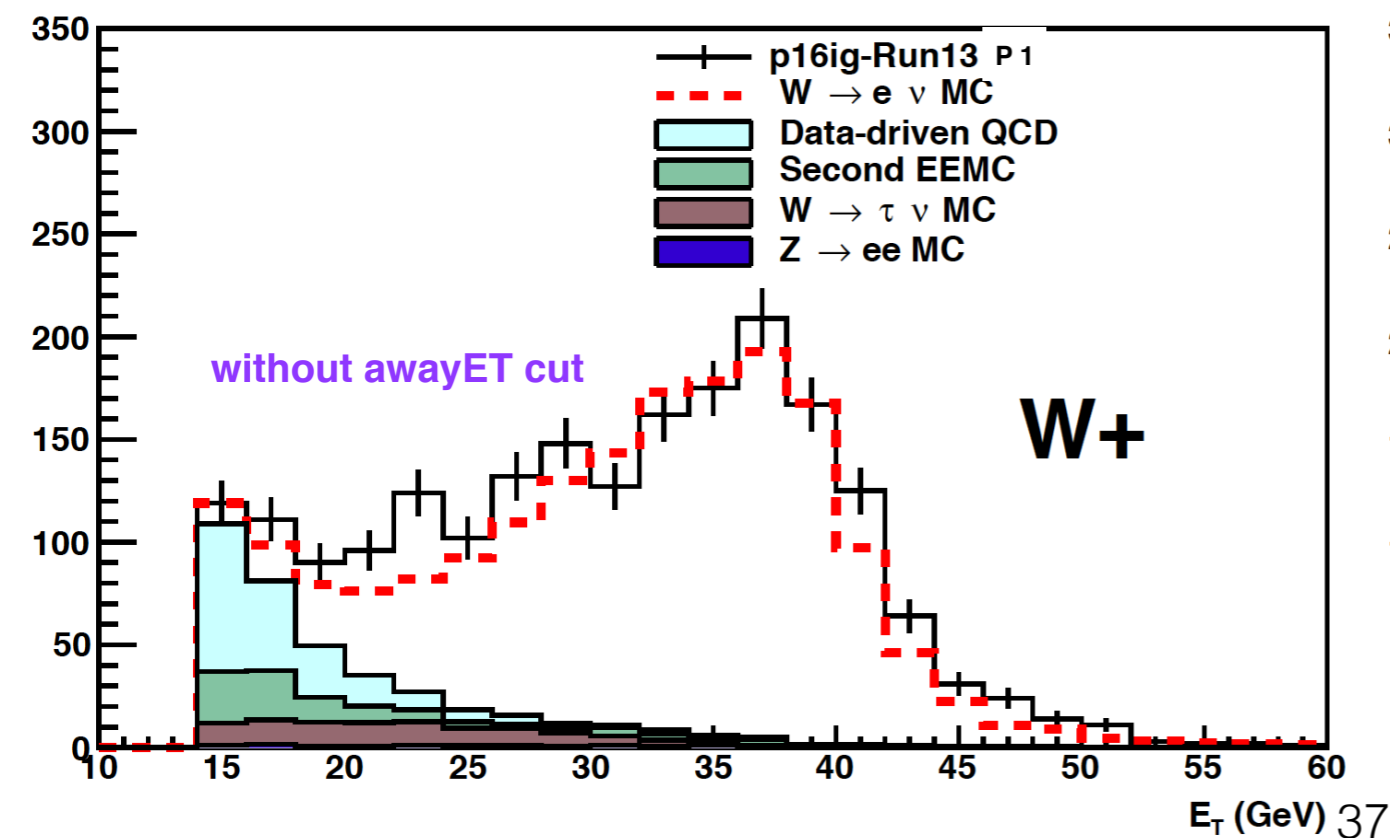


Background Estimation : W^+ : - Period 1

Eta 2 = $-0.5 < \eta < 0$

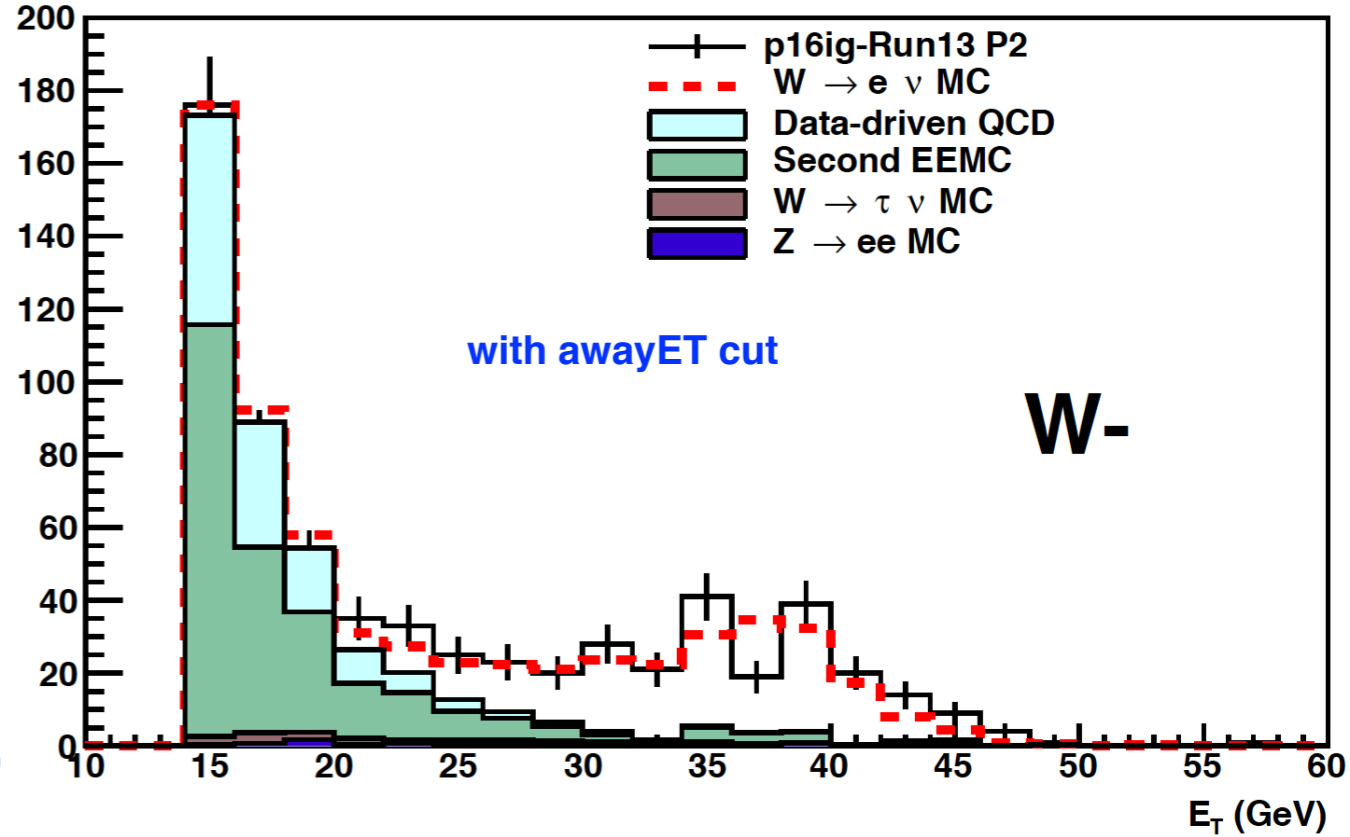
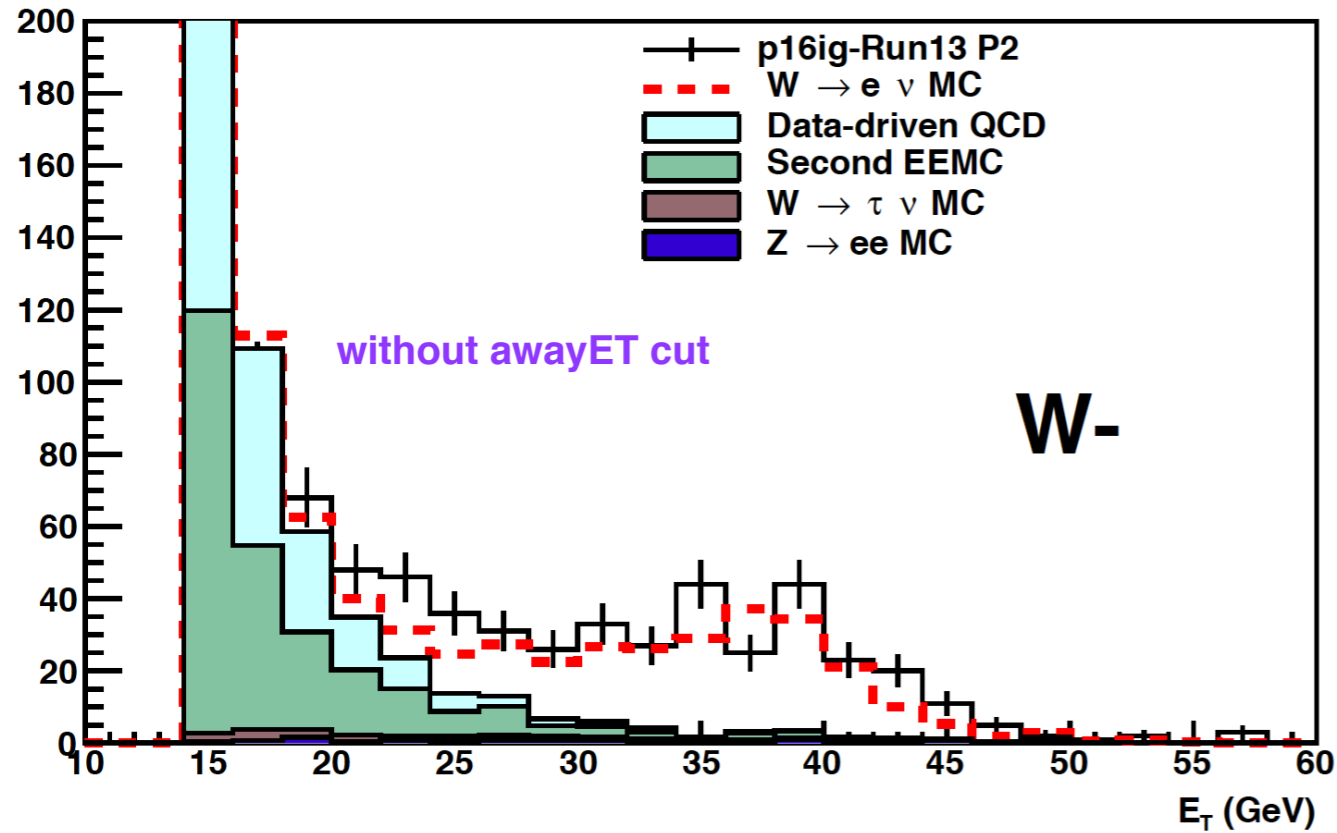


Eta 3 = $0 < \eta < +0.5$

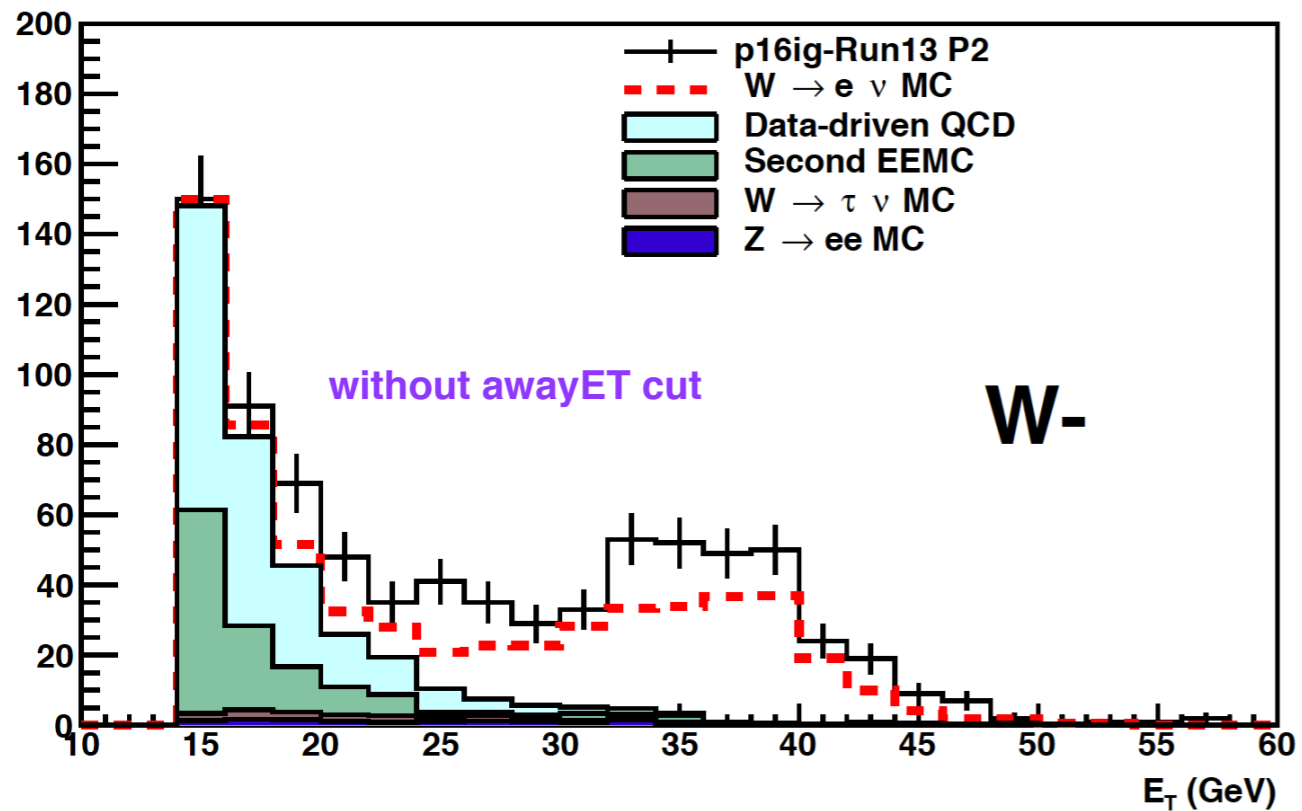


Background Estimation : W^- : - Period 1

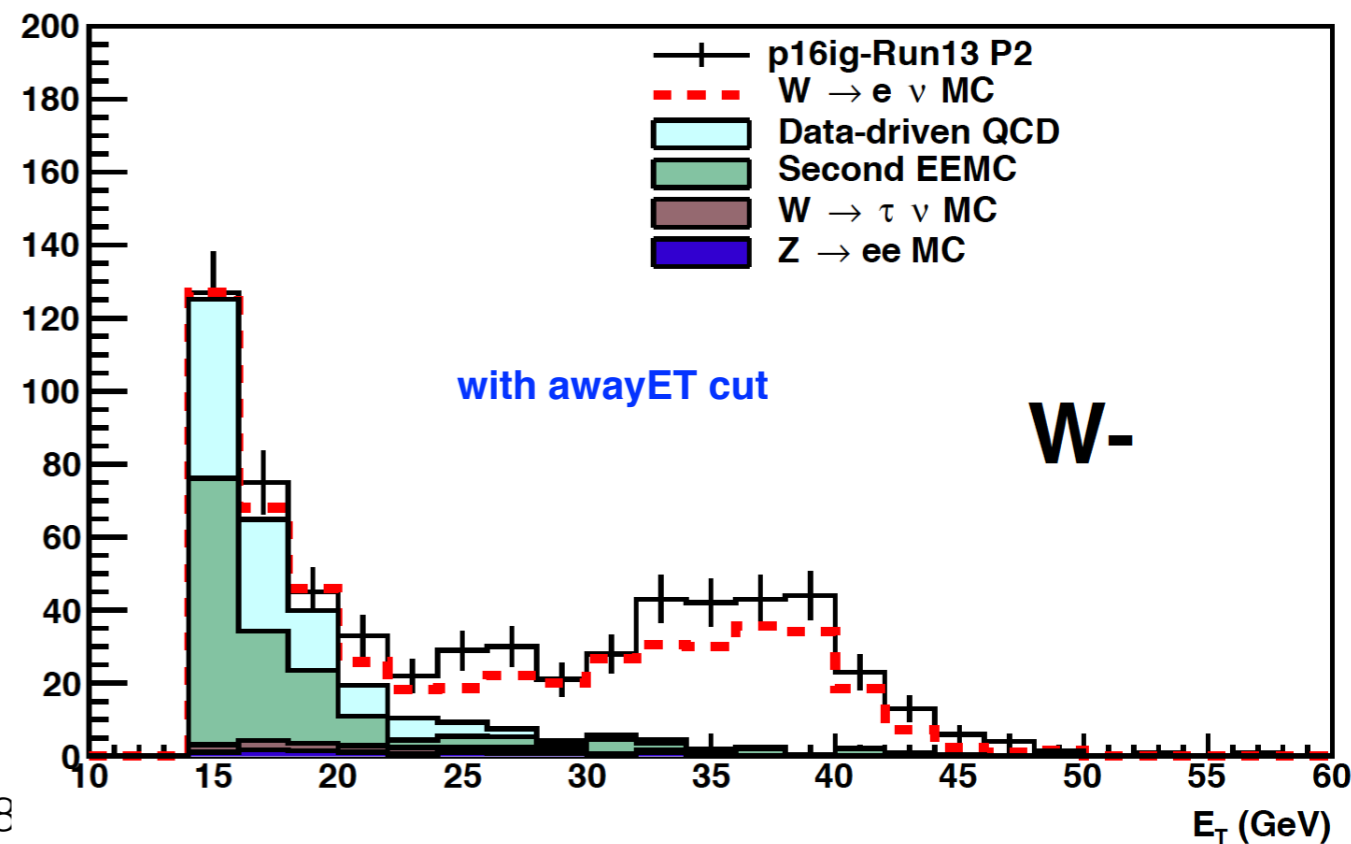
Eta 1 = $-1.0 < \eta < -0.5$



Eta 4 = $+0.5 < \eta < +1.0$

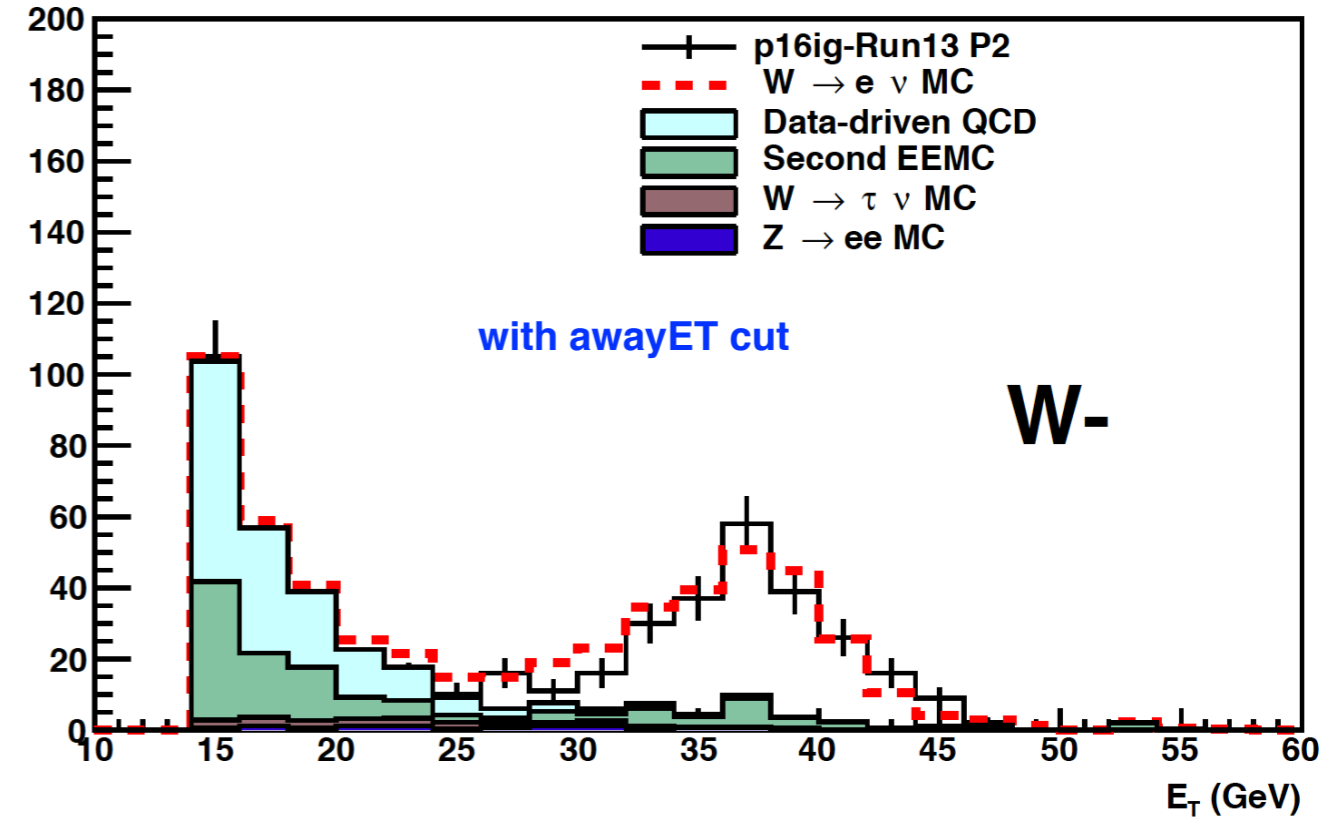
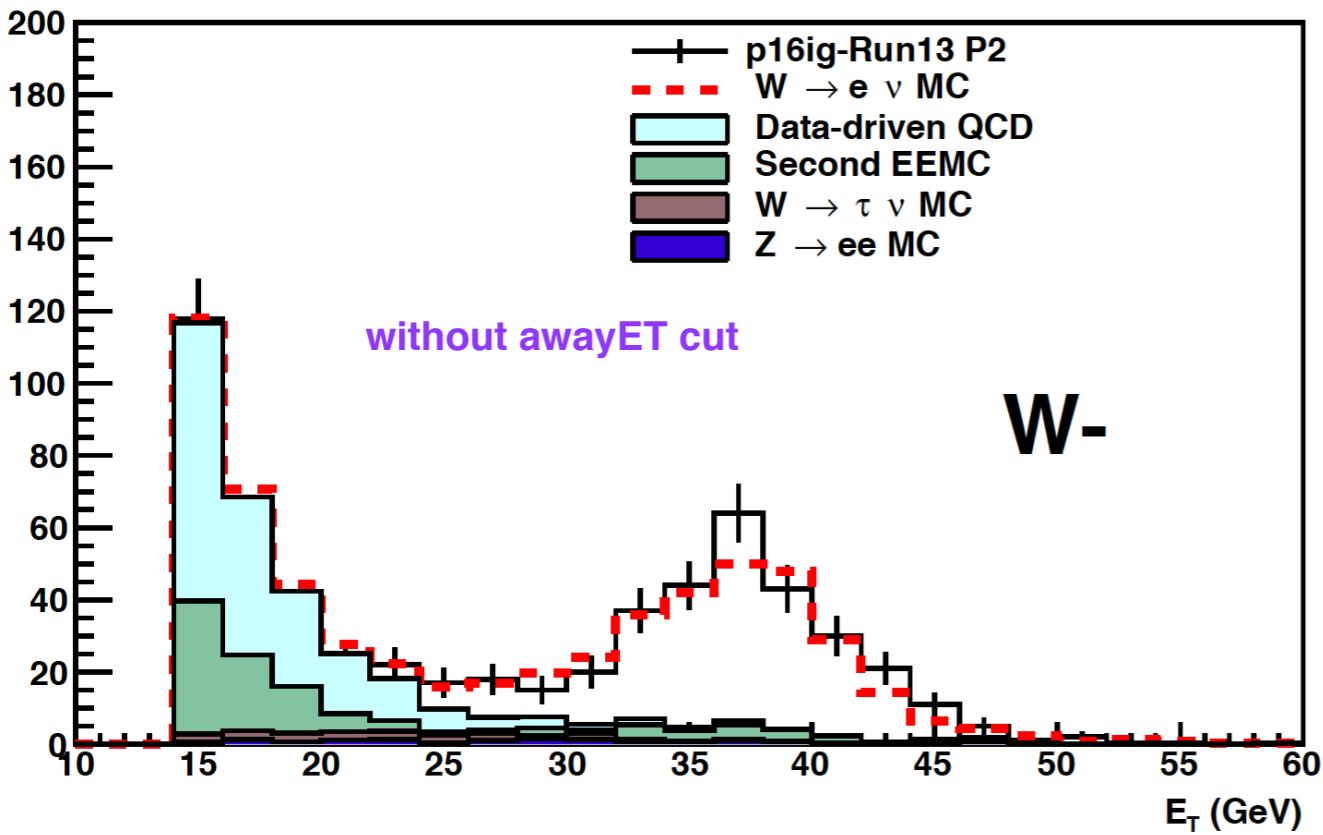


38

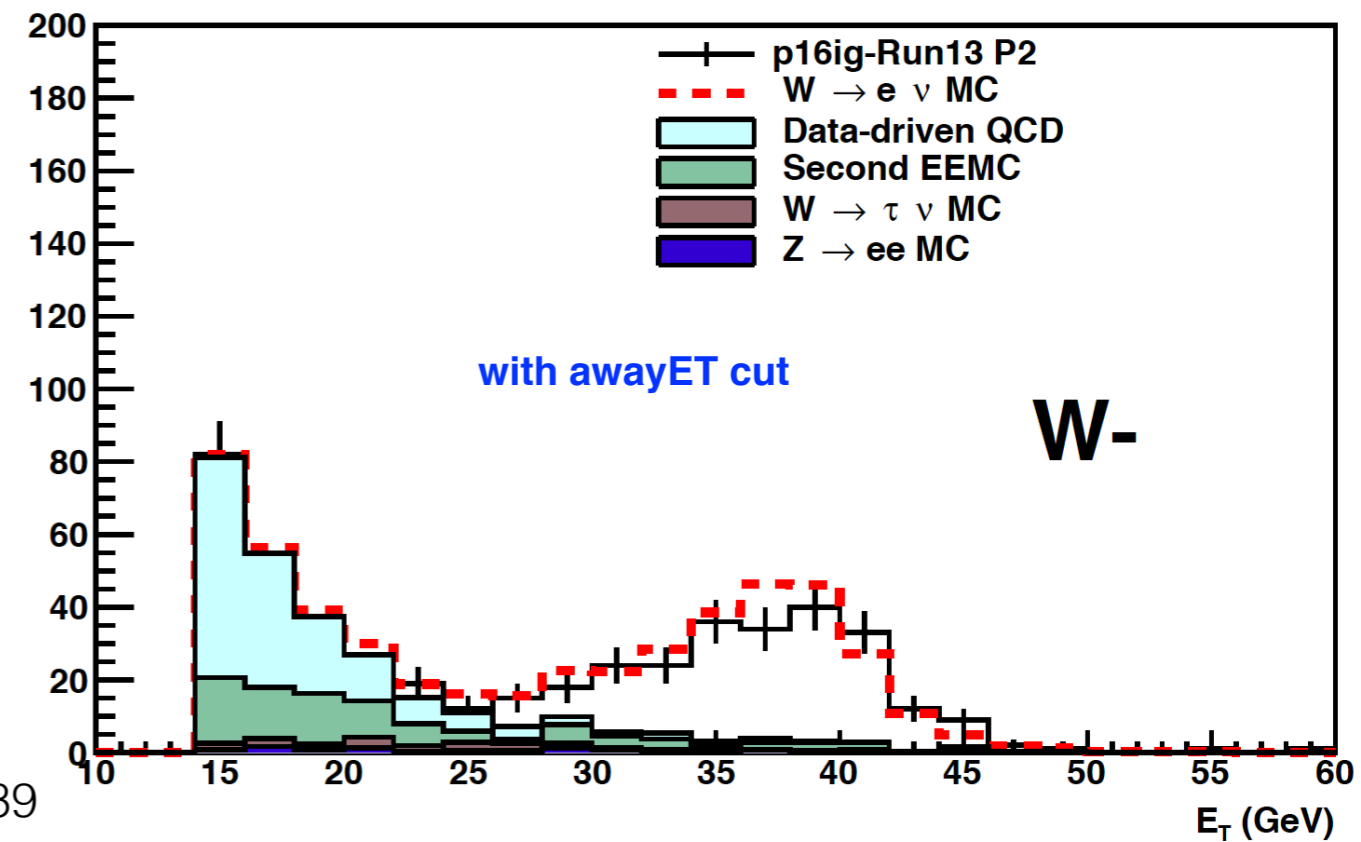
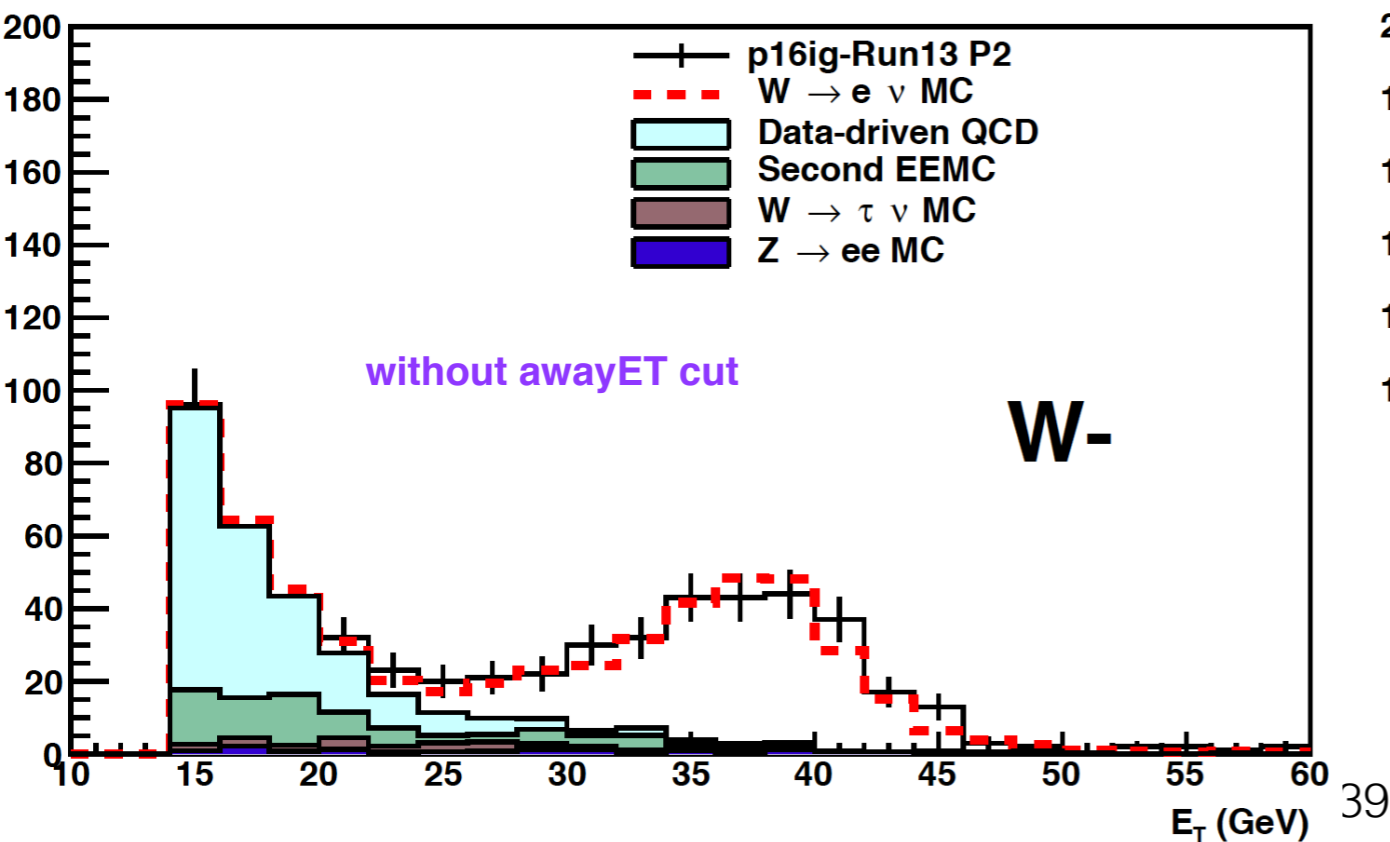


Background Estimation : W^- : - Period 1

$\text{Eta 2} = -0.5 < \eta < 0$

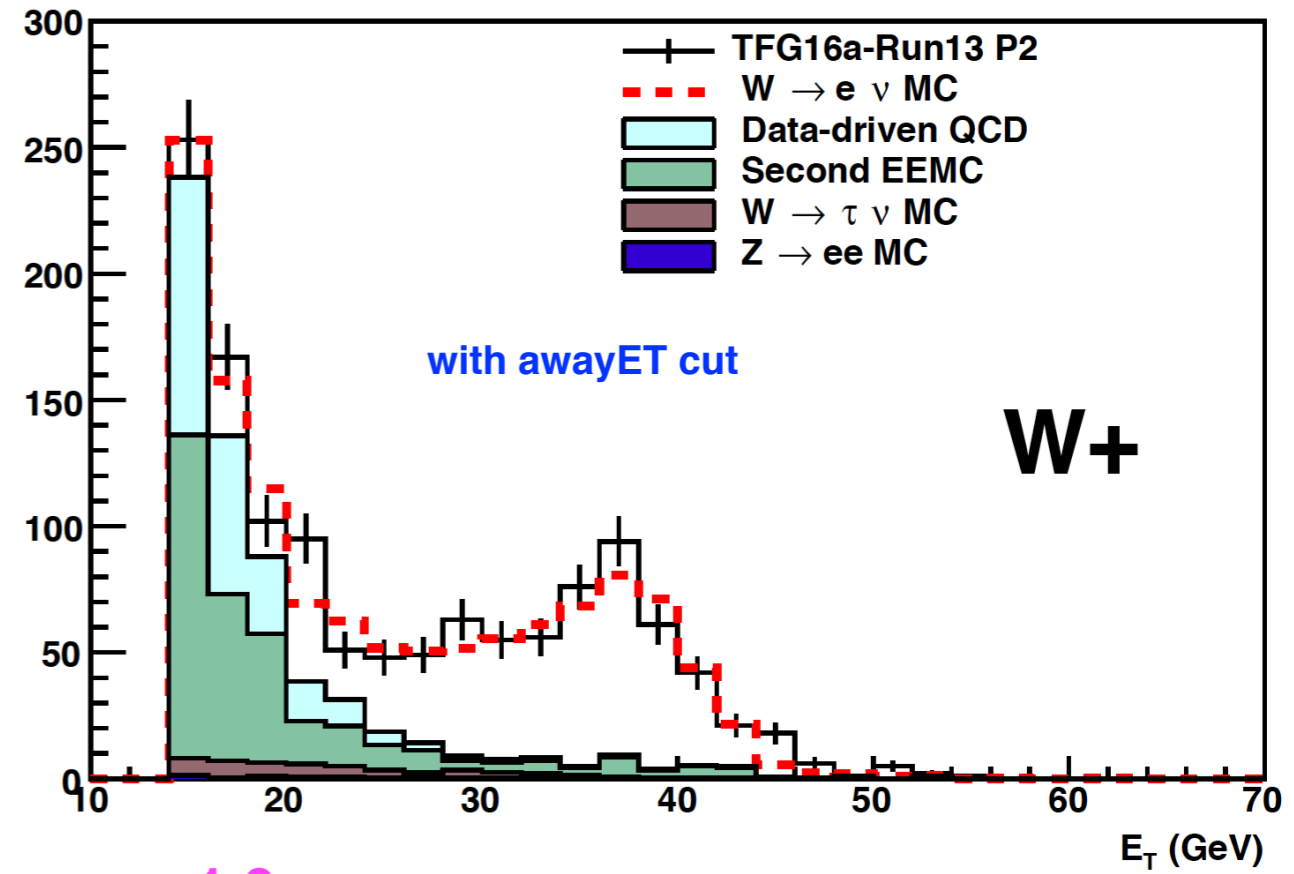
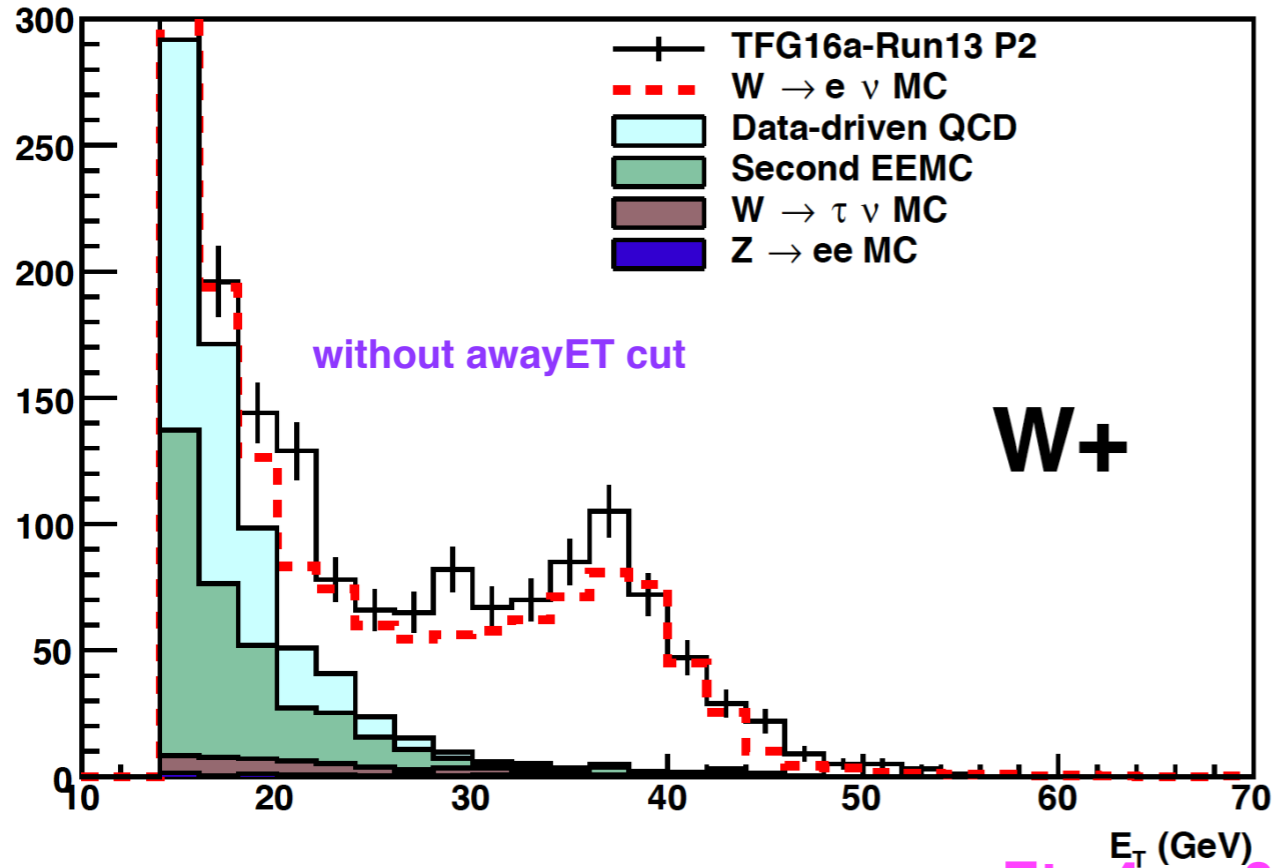


$\text{Eta 3} = 0 < \eta < +0.5$

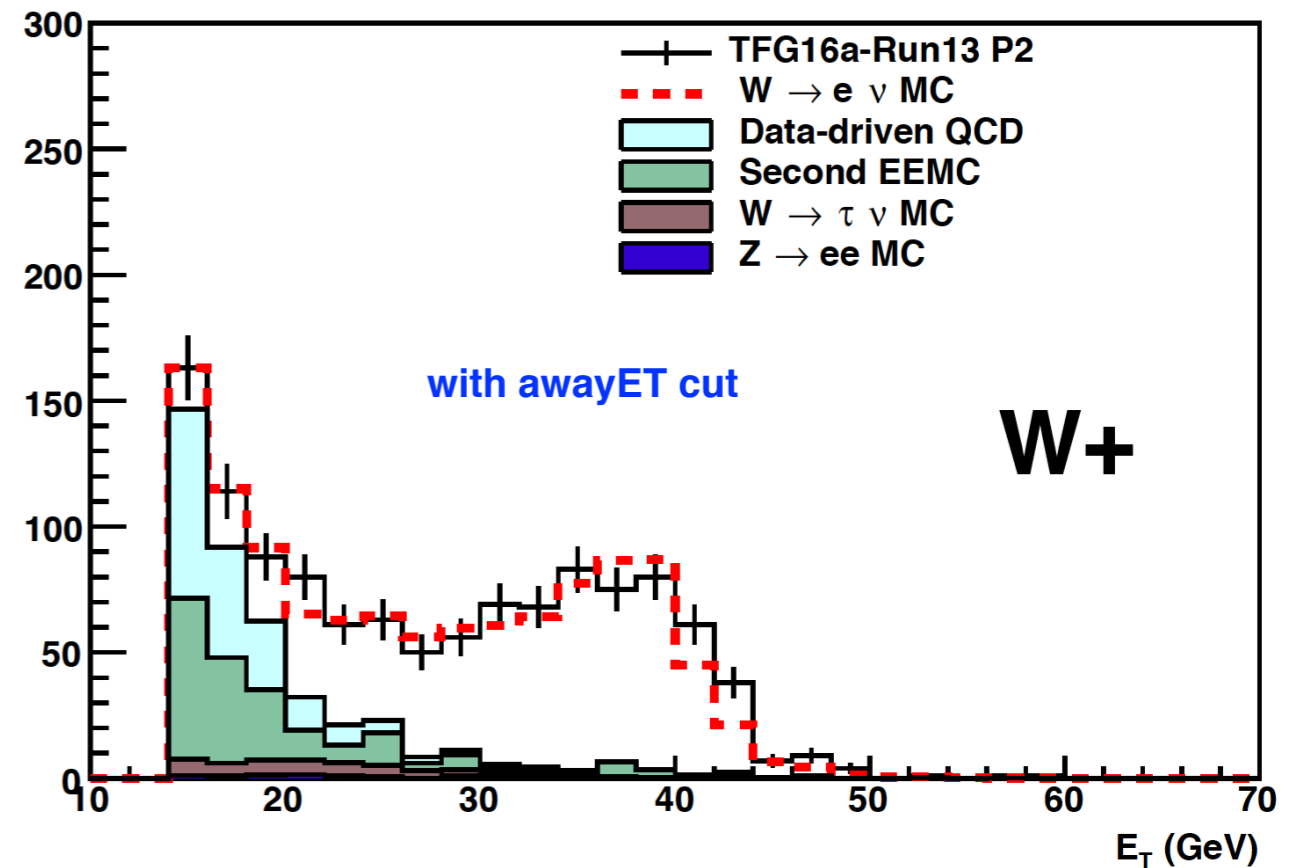
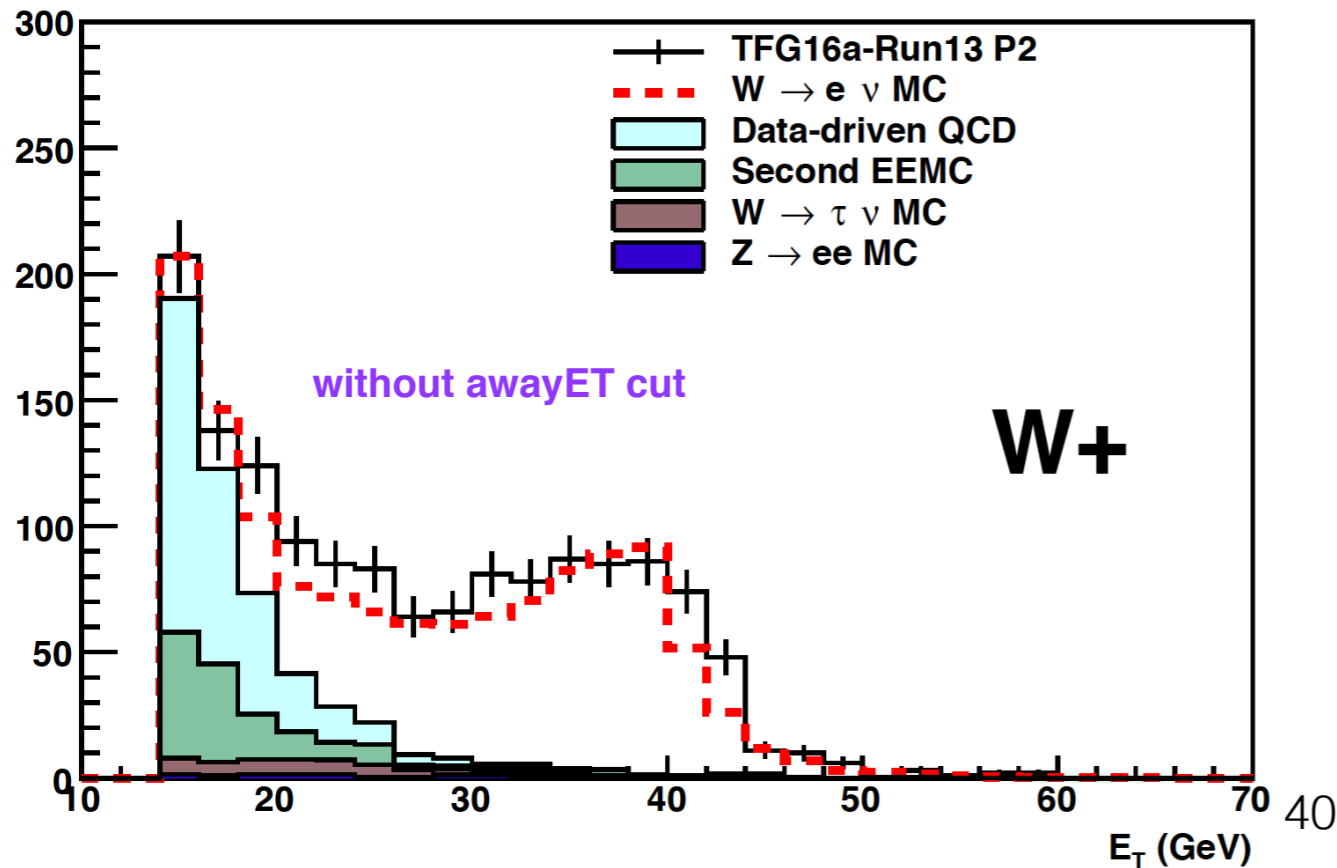


Background Estimation : W^+ : - Period 2

Eta 1 = $-1.0 < \eta < -0.5$

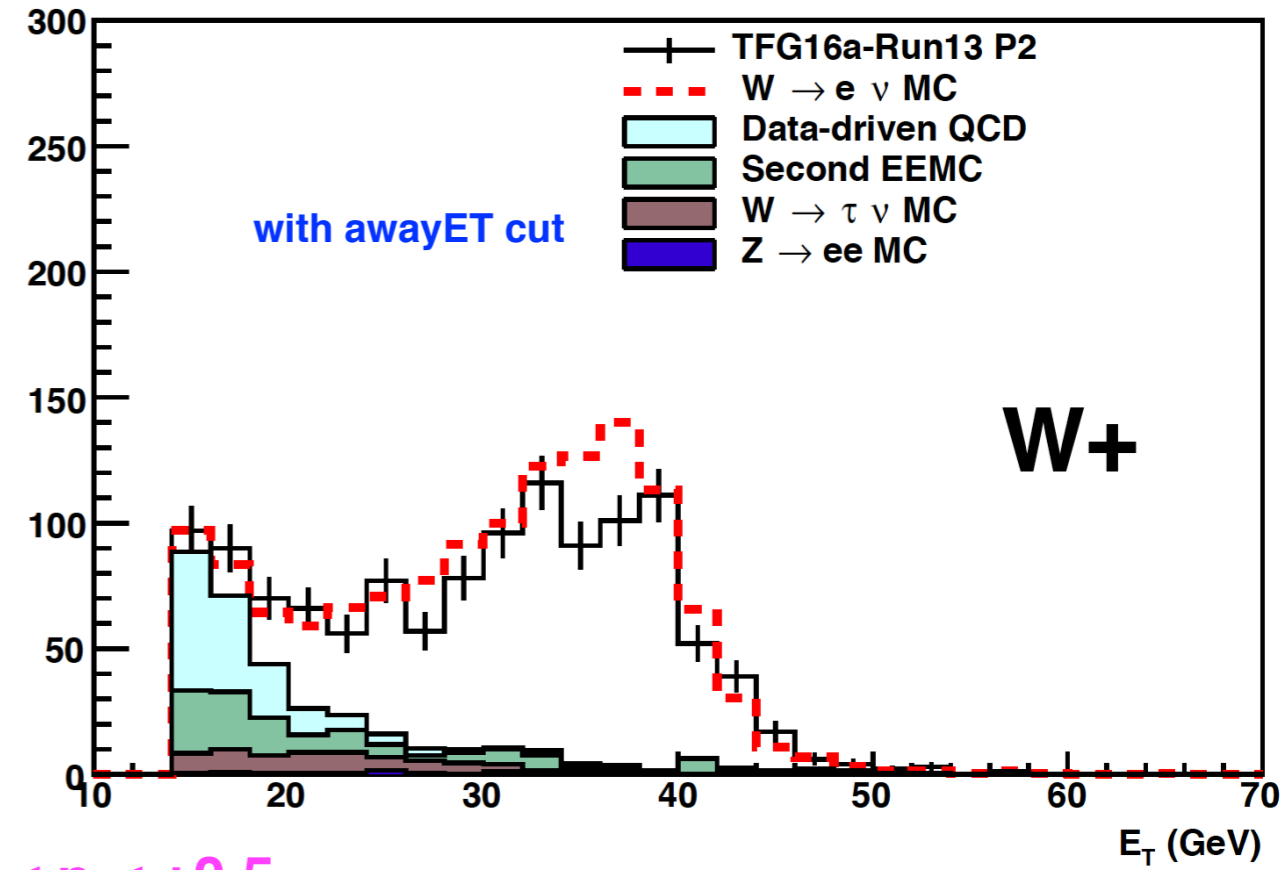
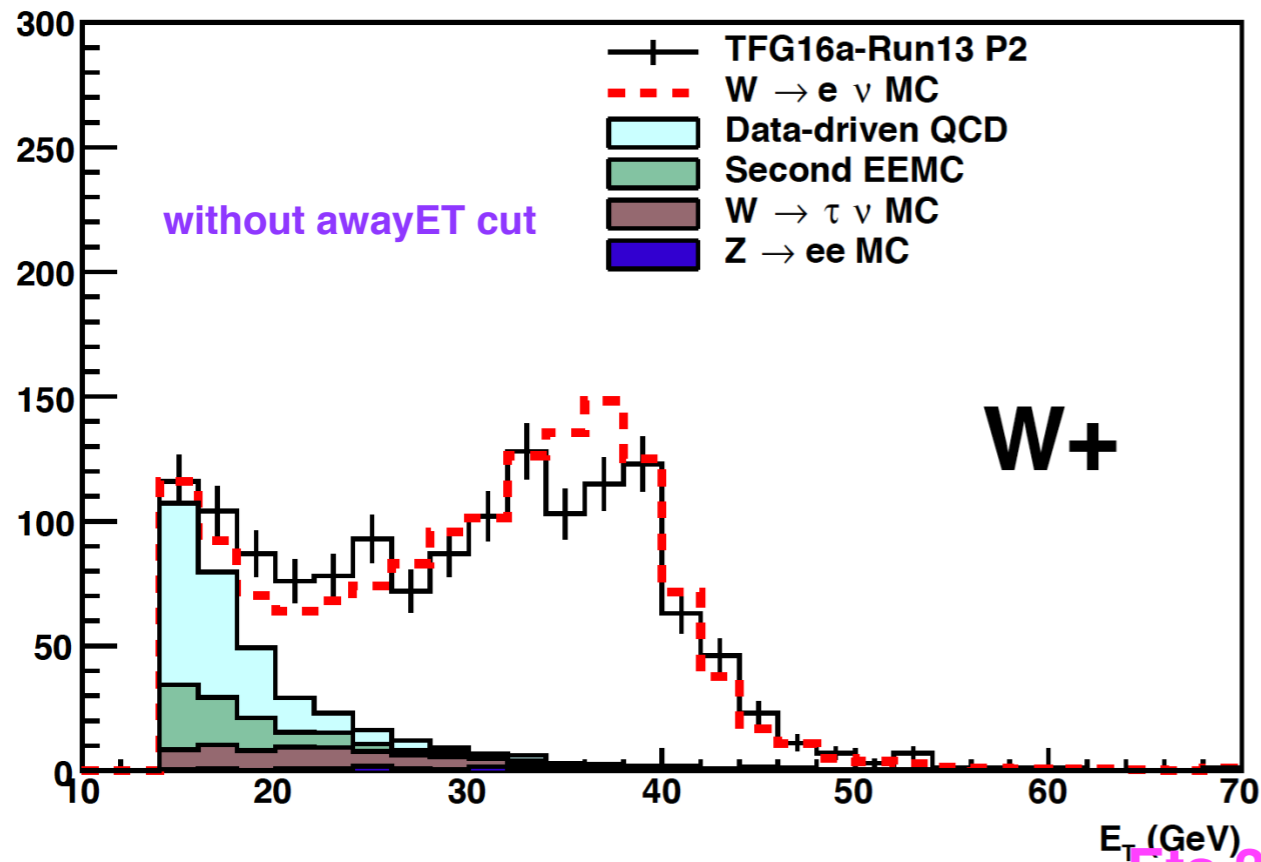


Eta 4 = $+0.5 < \eta < +1.0$

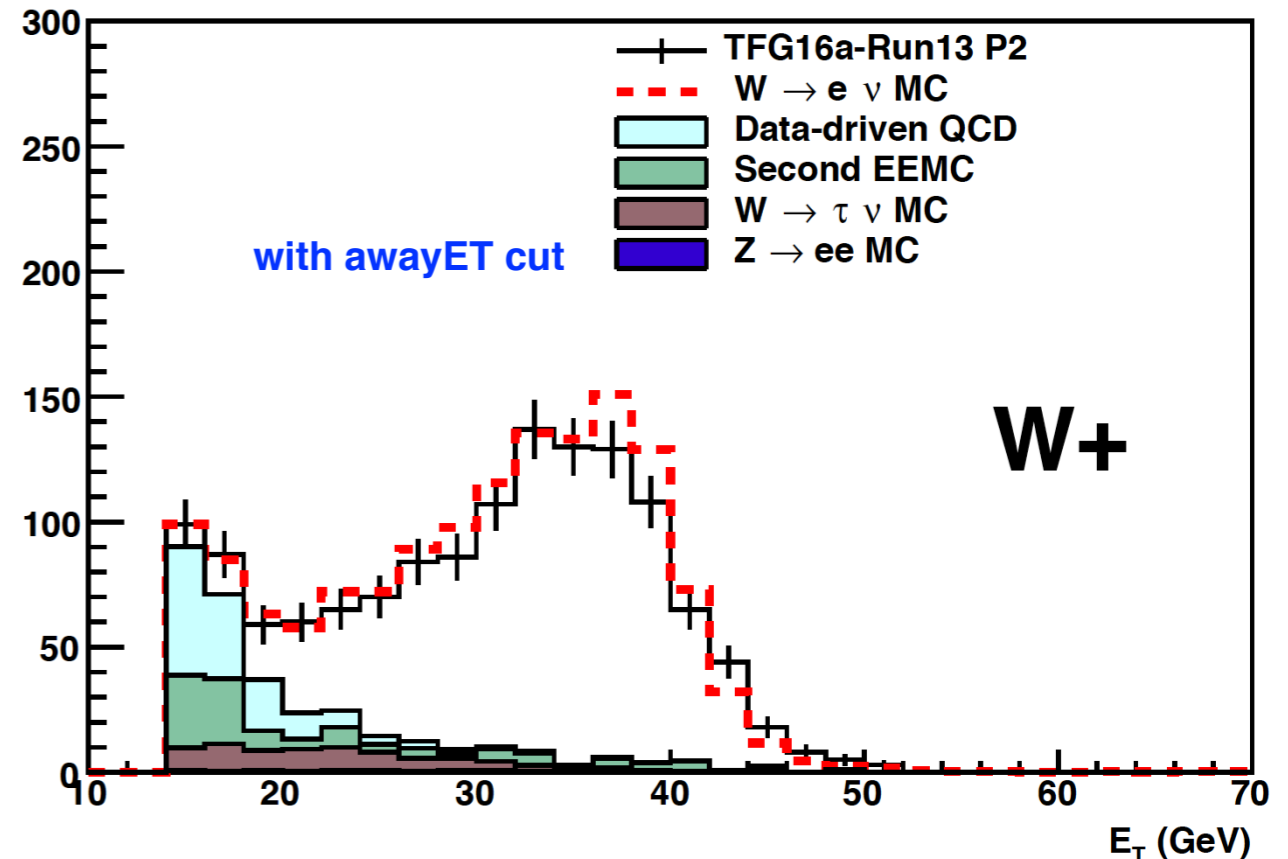
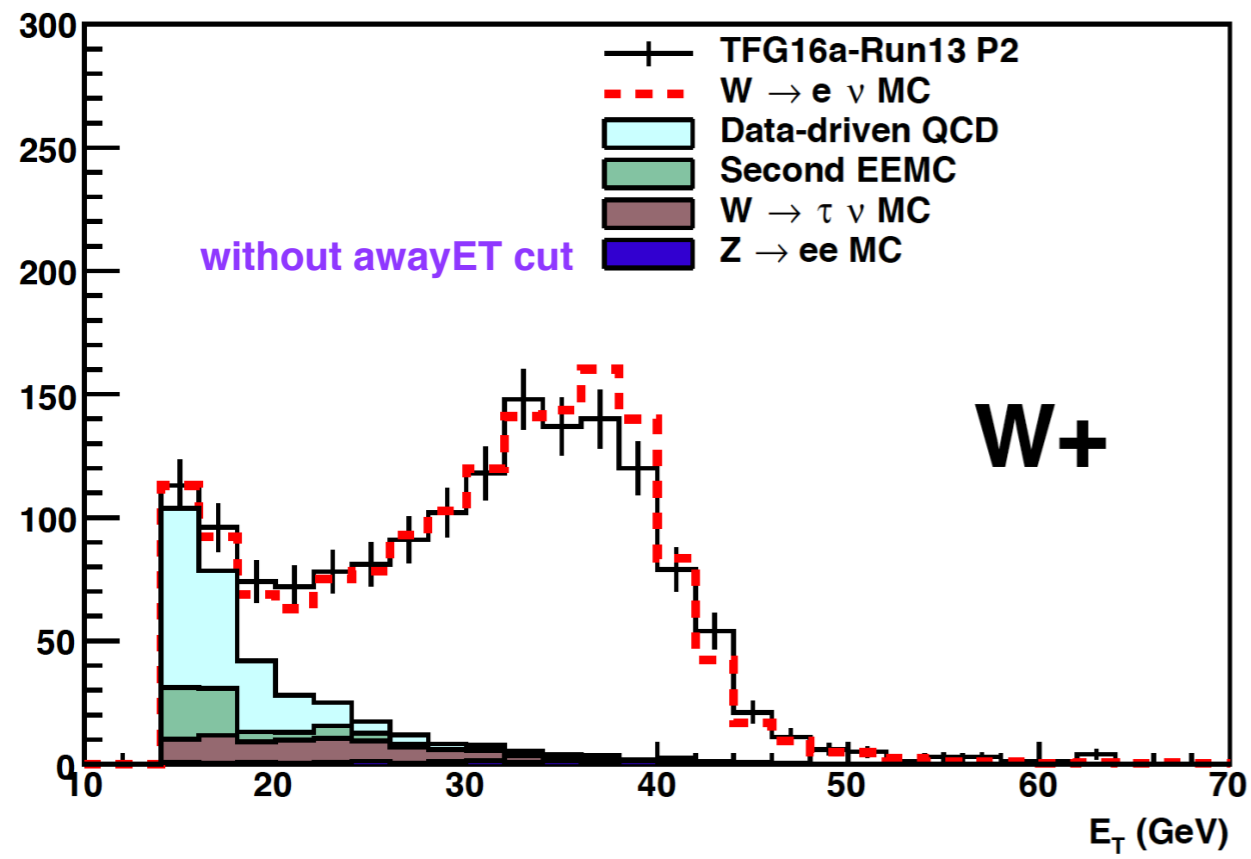


Background Estimation : W^+ : - Period 2

Eta 2 = $-0.5 < \eta < 0$

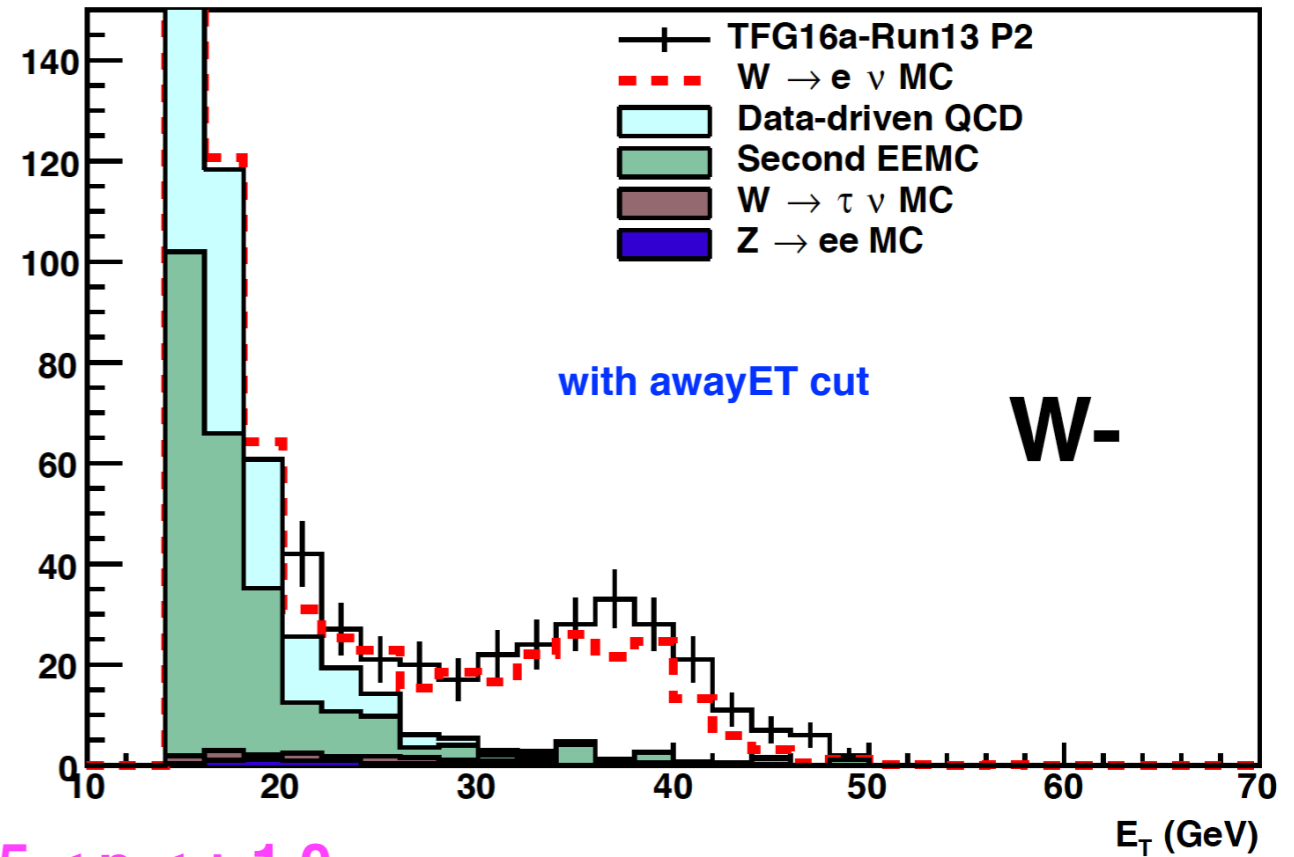
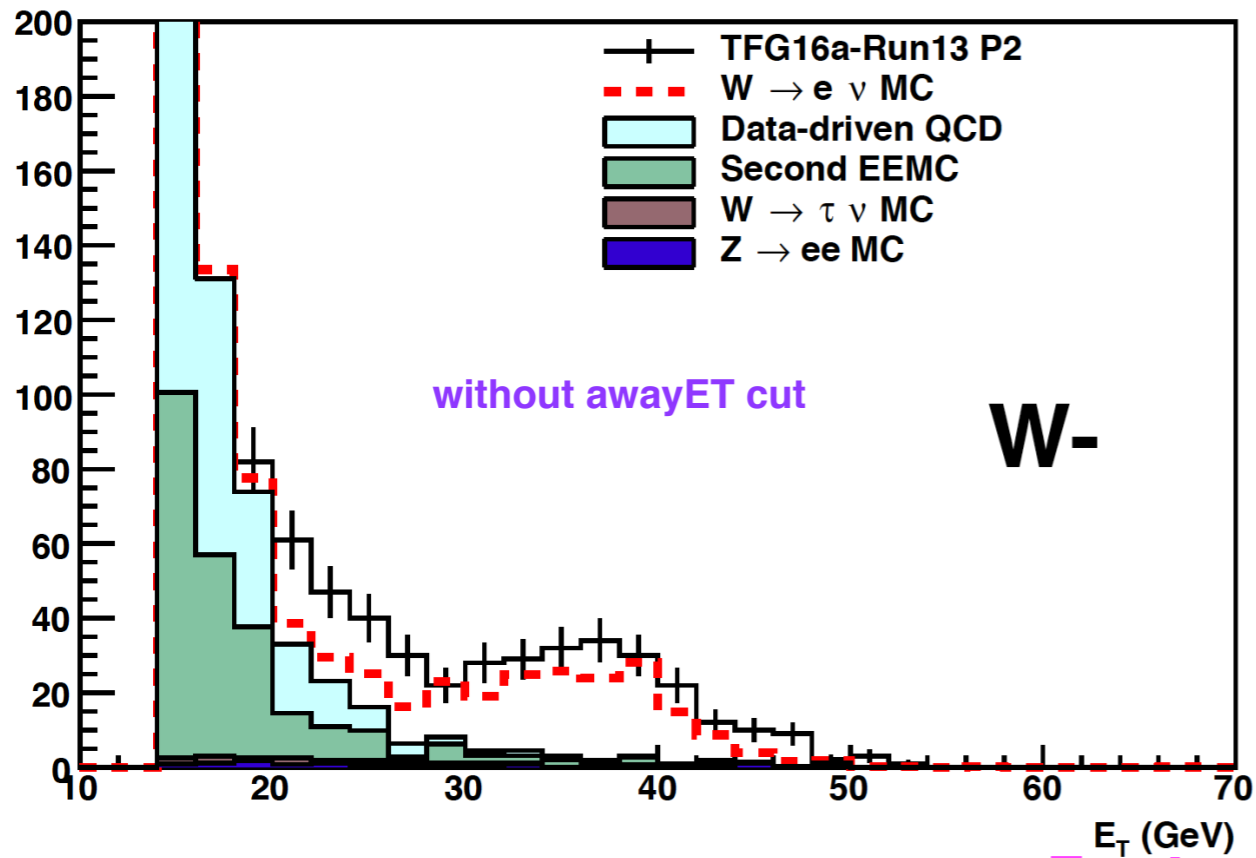


Eta 3 = $0 < \eta < +0.5$

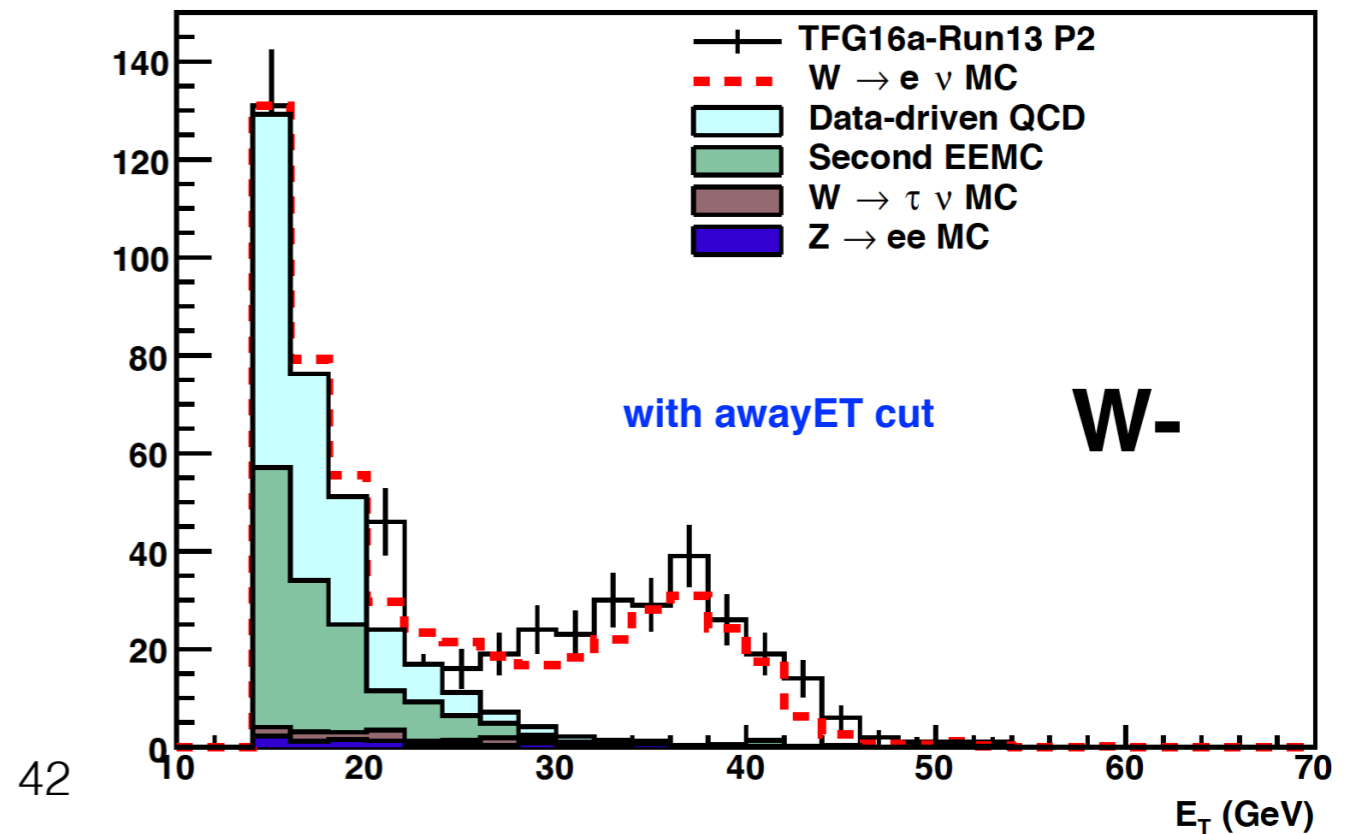
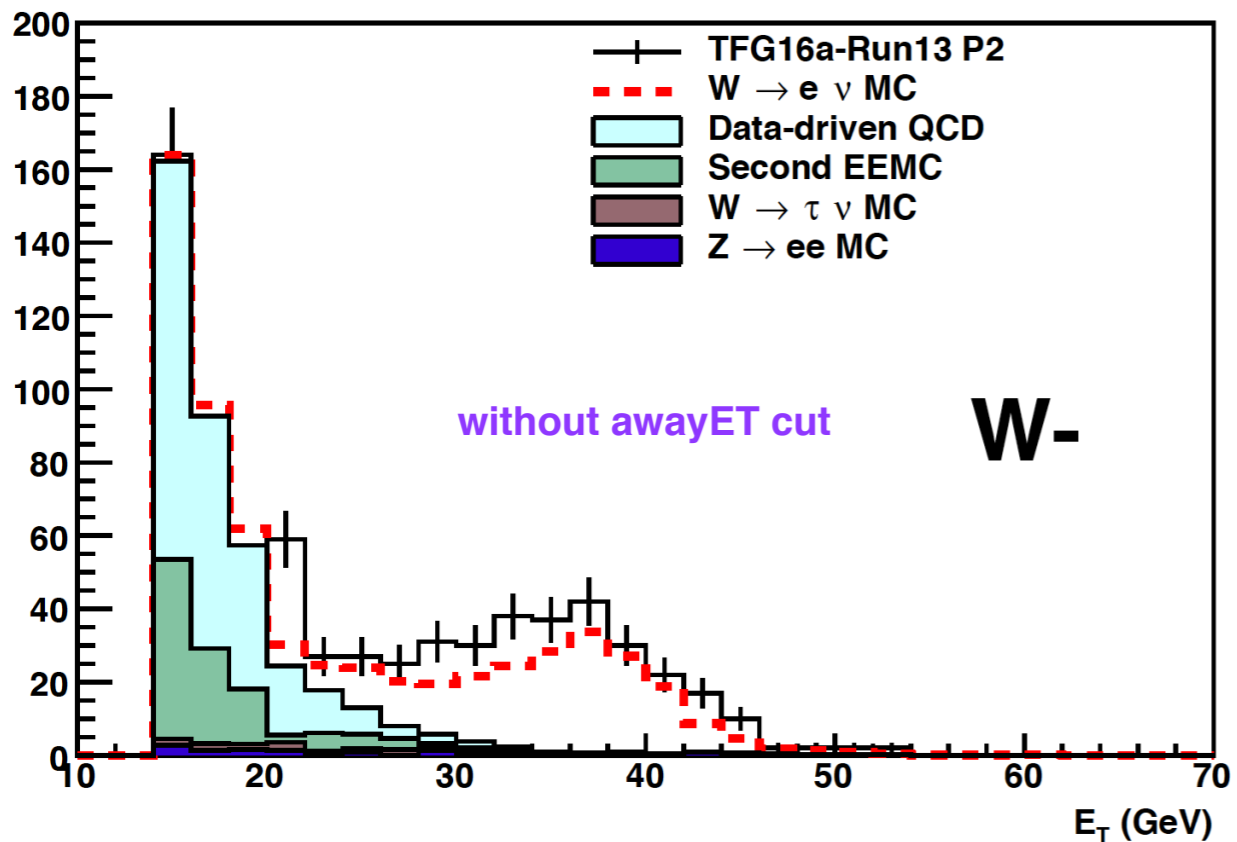


Background Estimation : W^- : - Period 2

$\text{Eta 1} = -1.0 < \eta < -0.5$

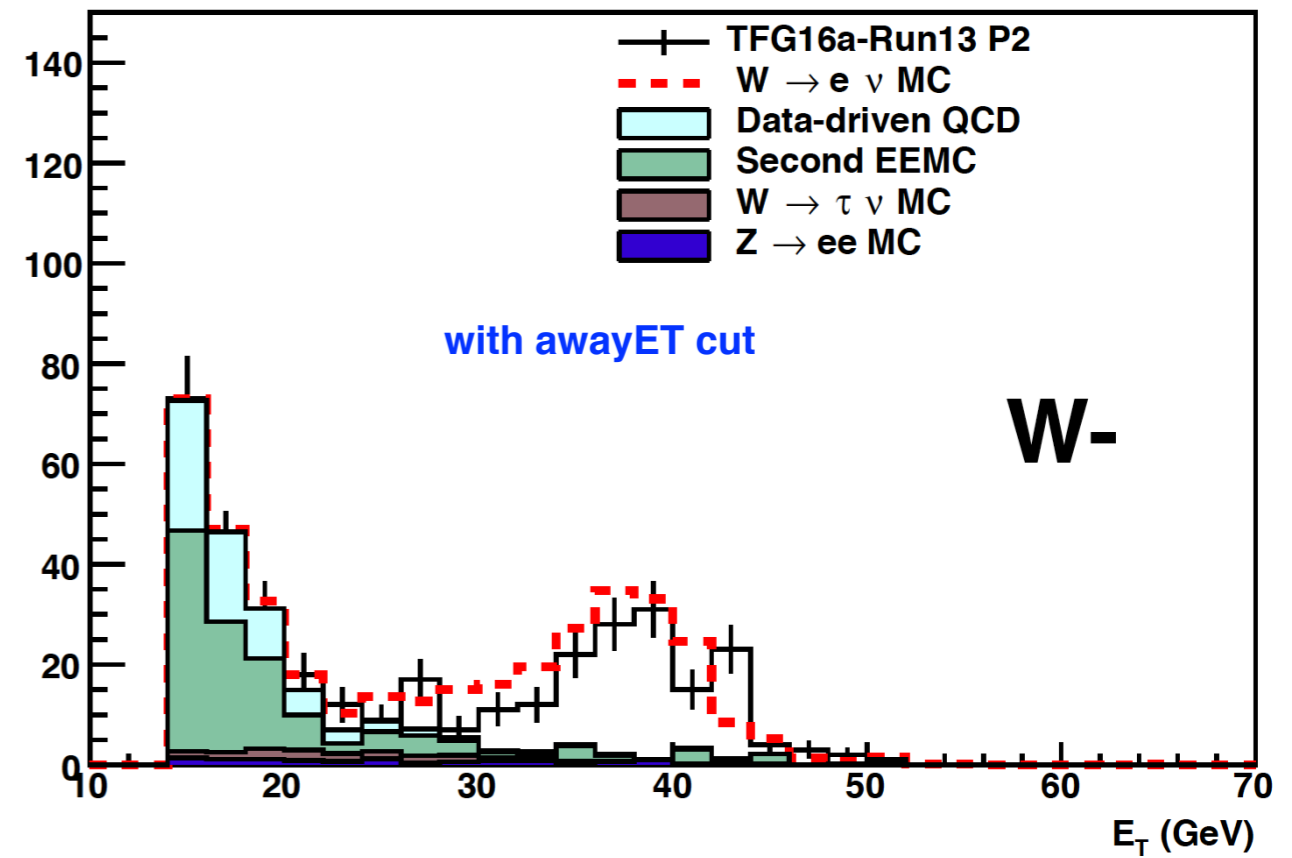
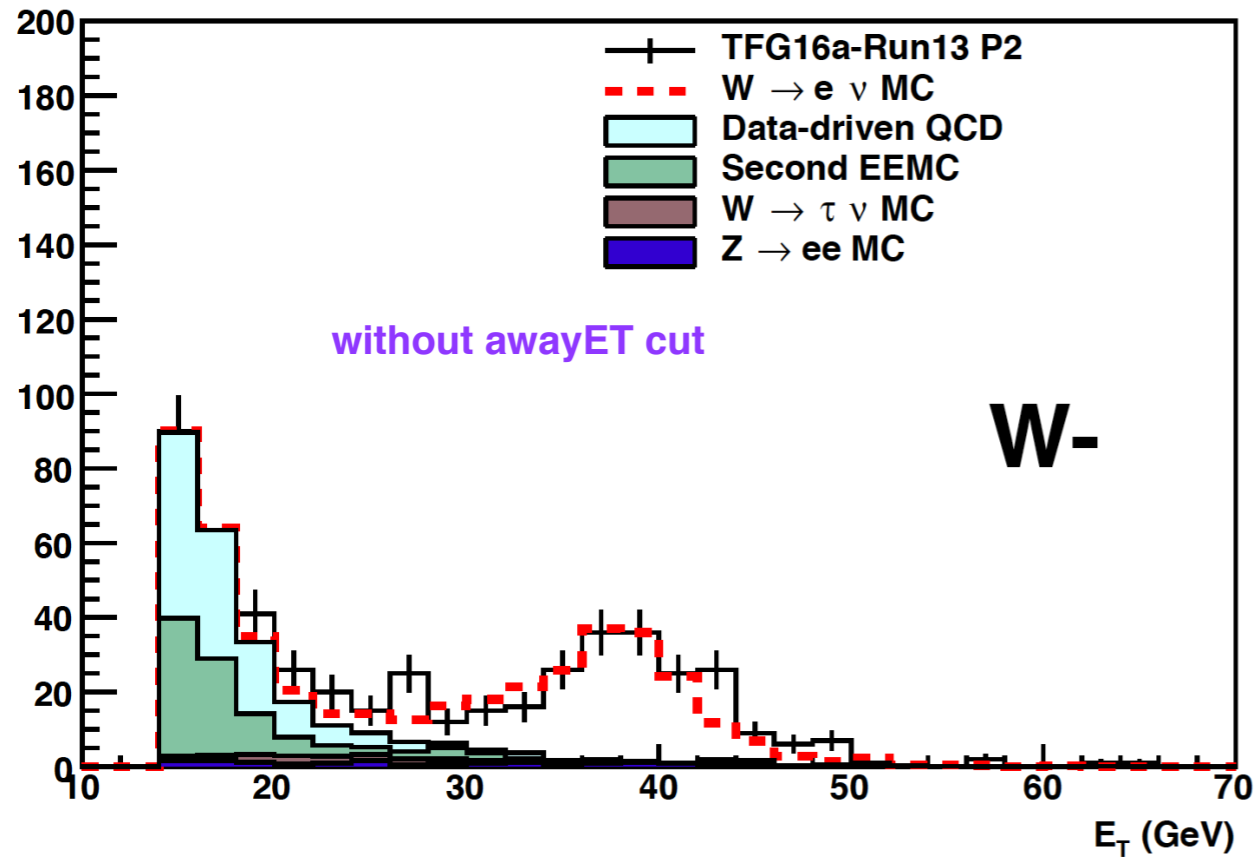


$\text{Eta 4} = +0.5 < \eta < +1.0$

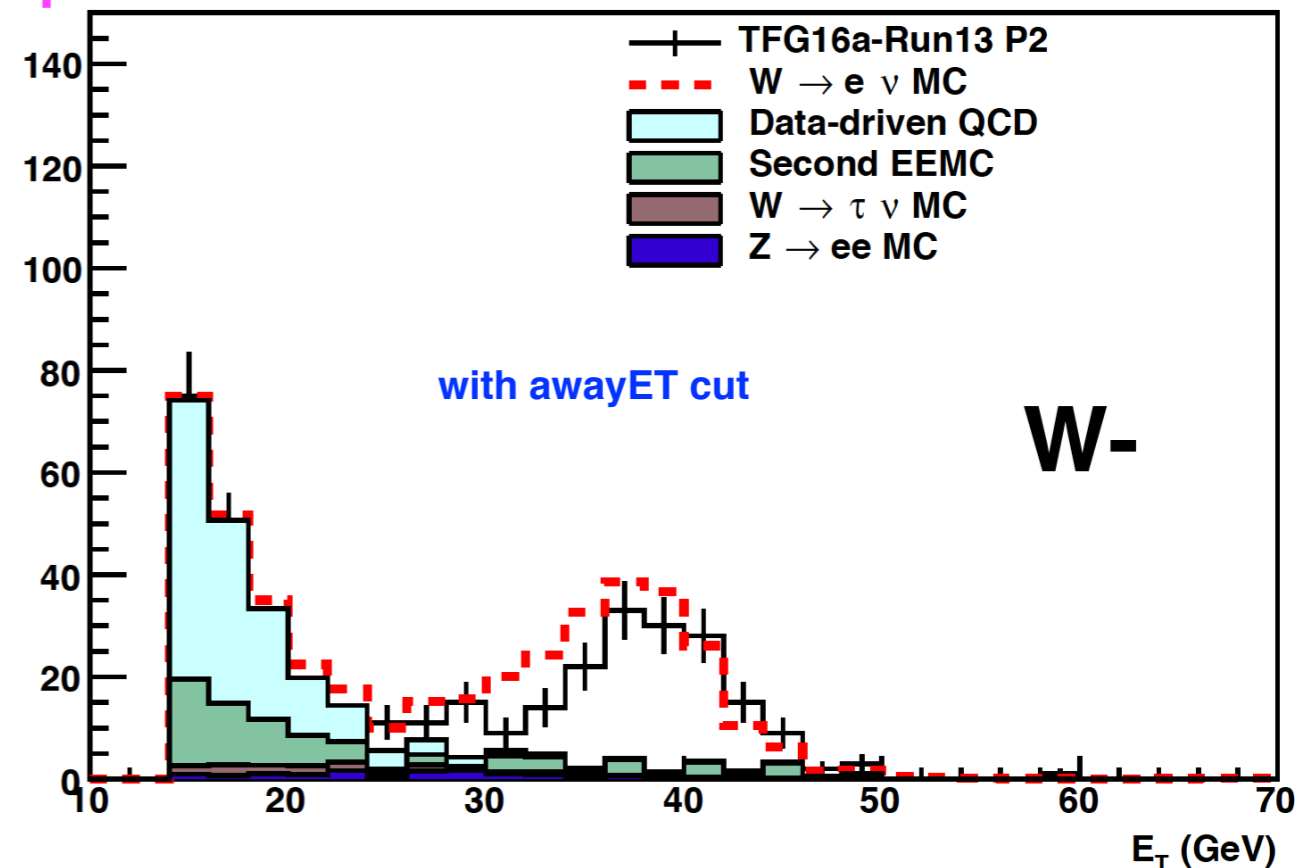
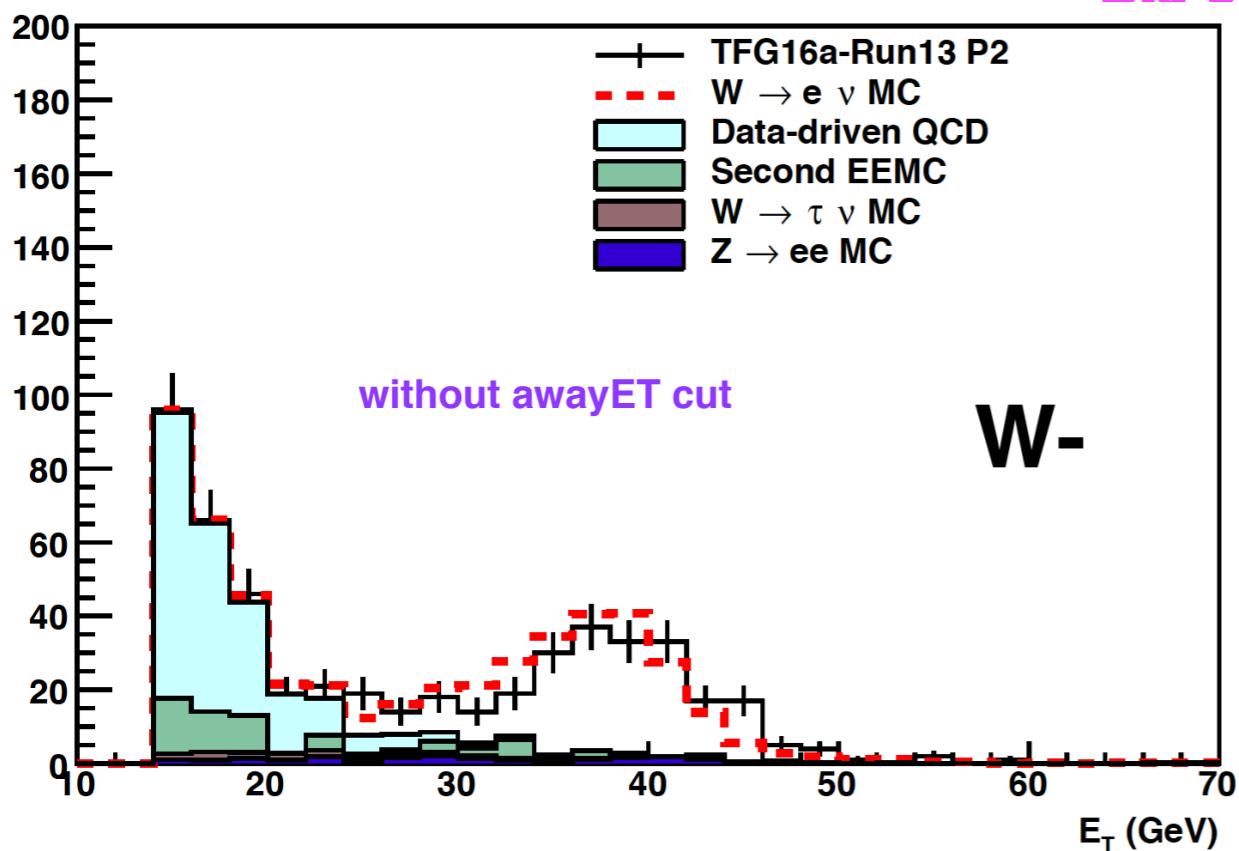


Background Estimation : W^- : - Period 2

Eta 2 = $-0.5 < \eta < 0$



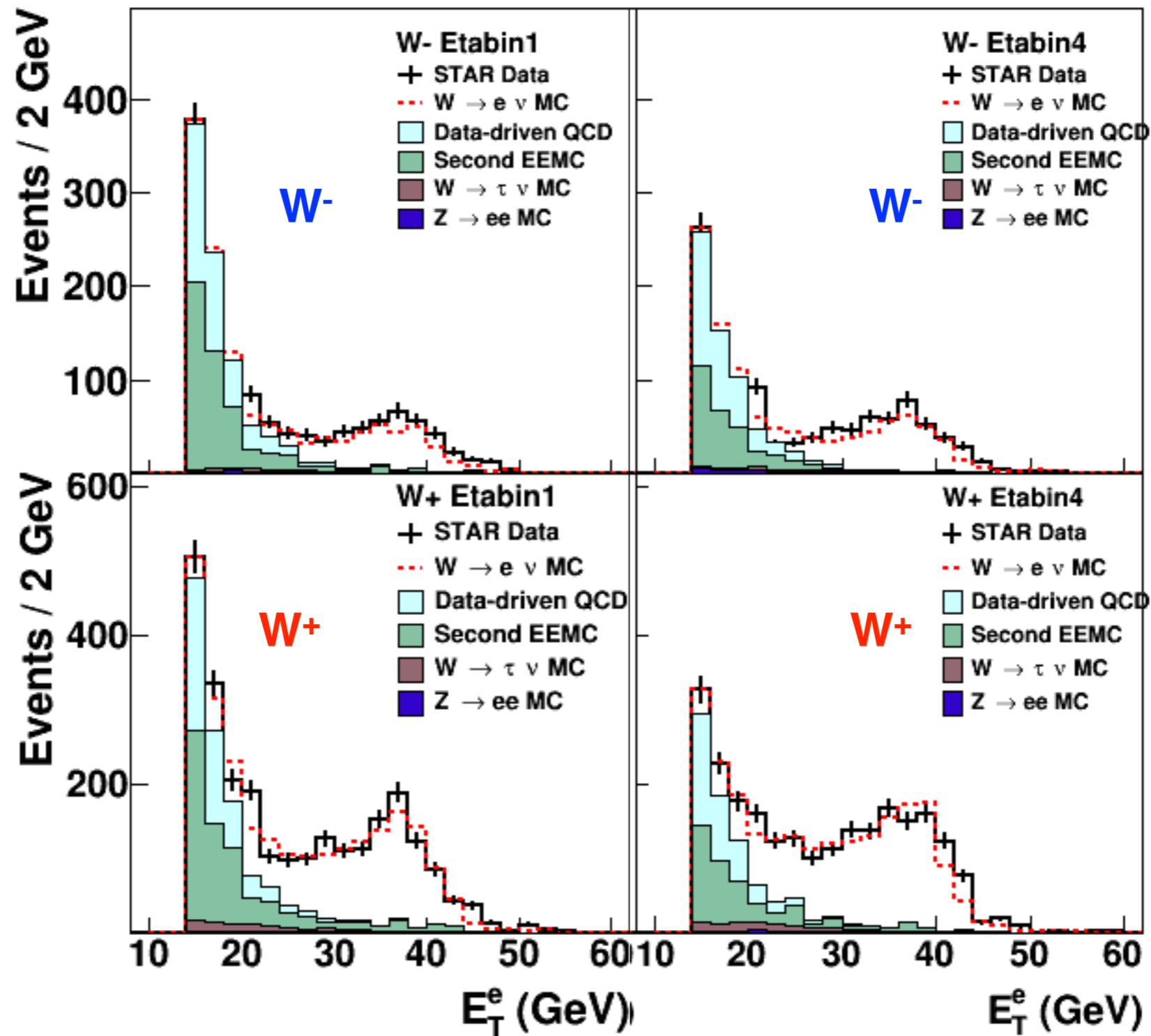
Eta 3 = $0 < \eta < +0.5$



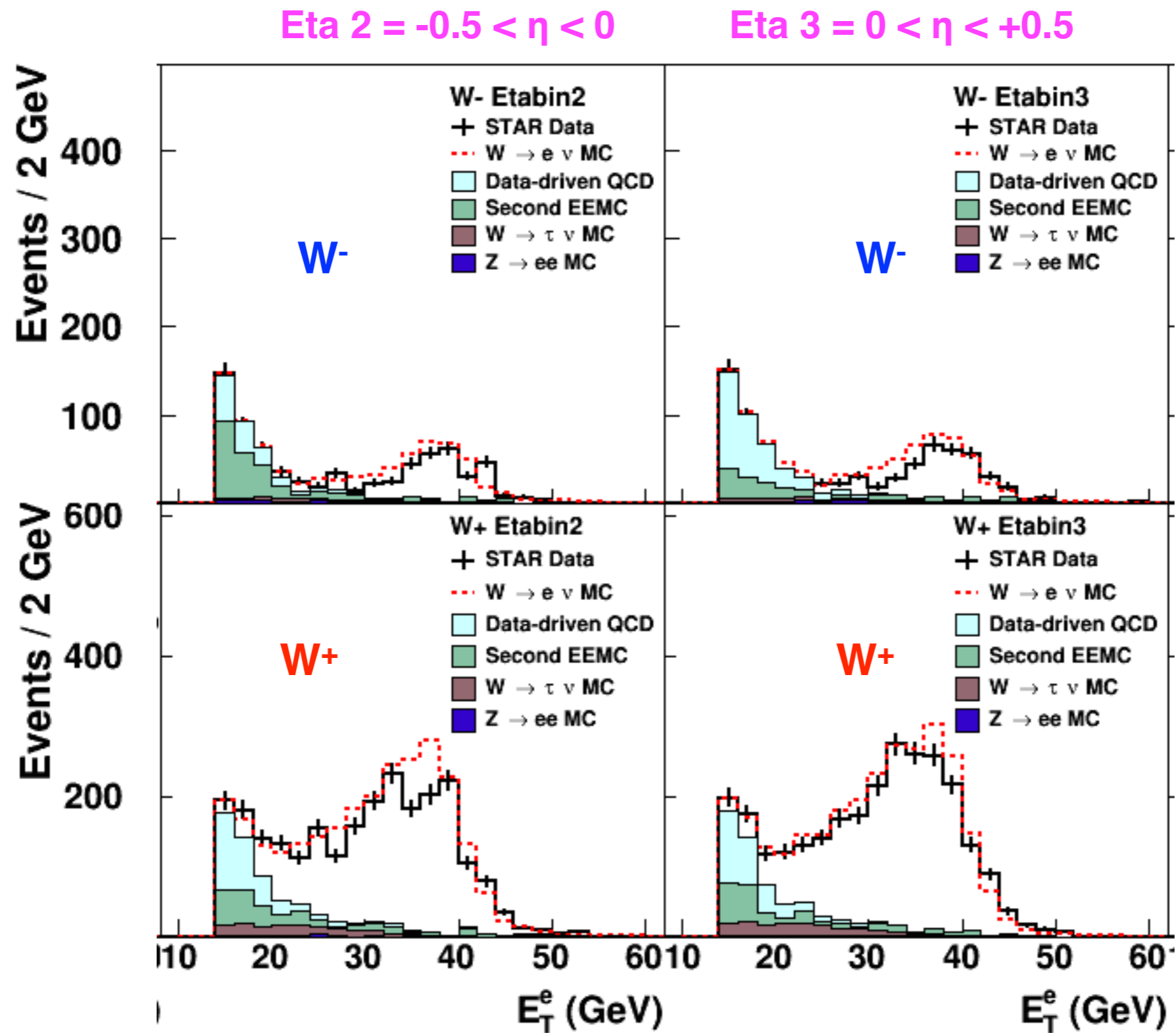
BG Estimation : 4 Eta bins: Period 1 + Period 2

Eta 1 = $-1.0 < \eta < -0.5$

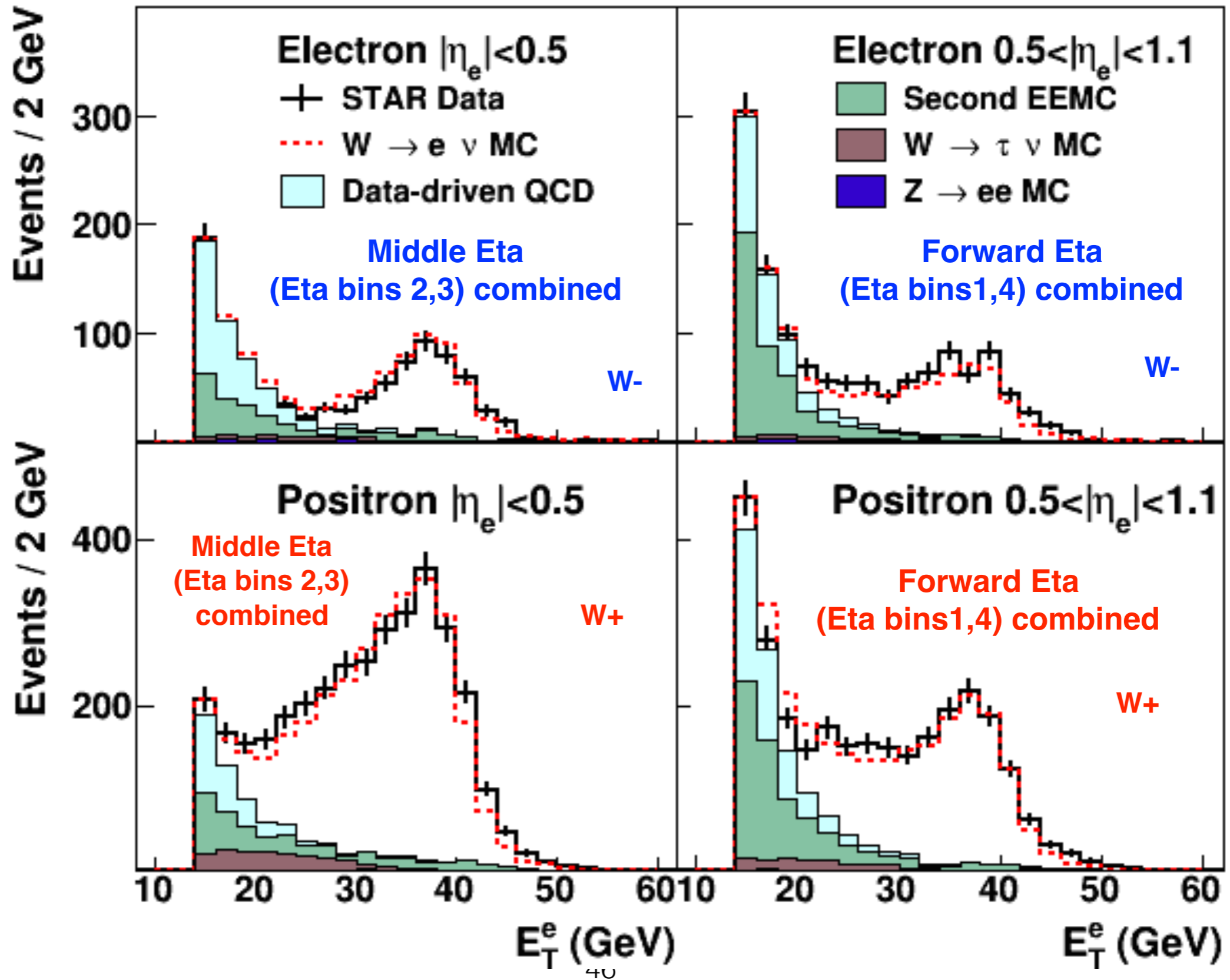
Eta 4 = $+0.5 < \eta < +1.0$



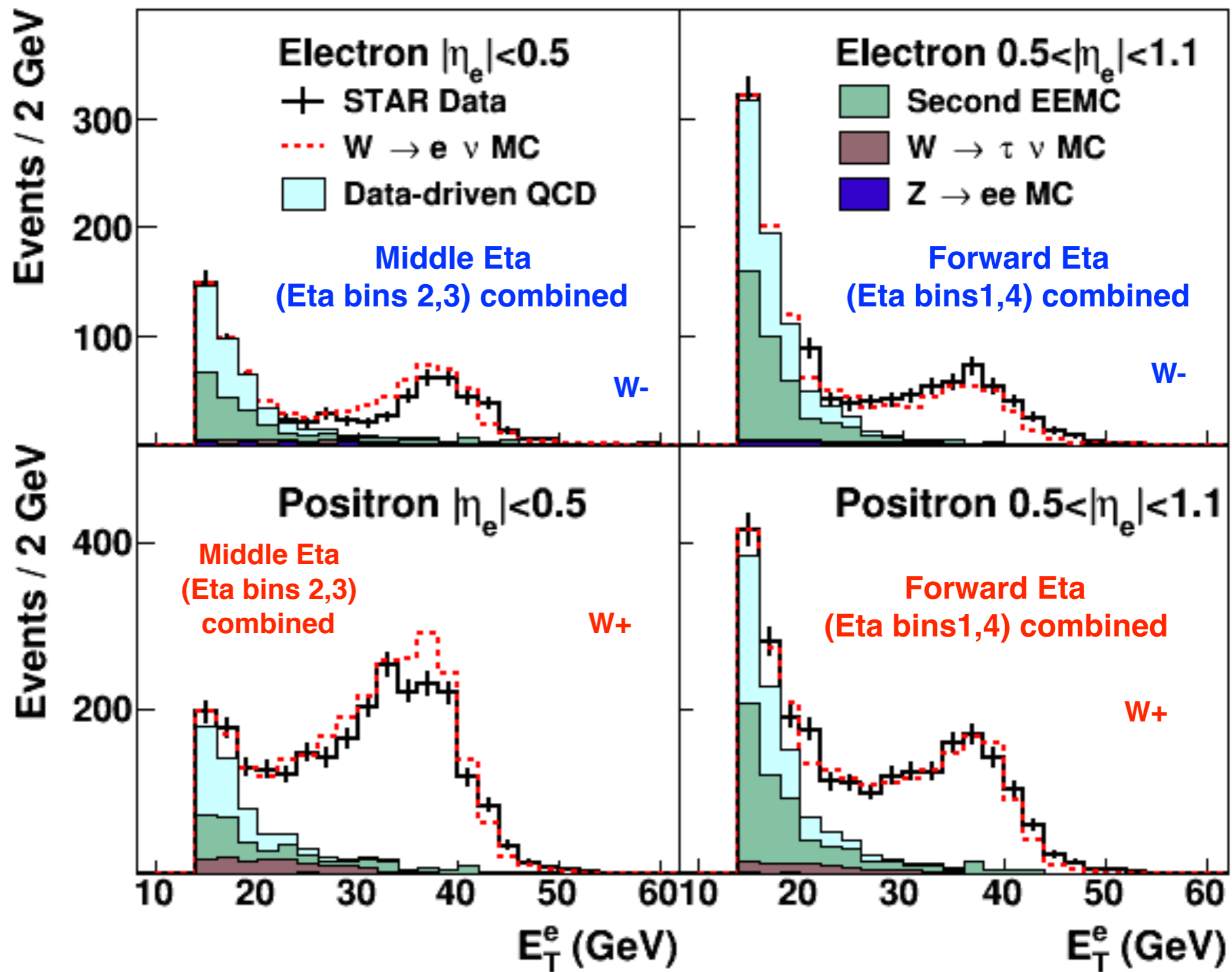
BG Estimation : 4 Eta bins: Period 1 + Period 2



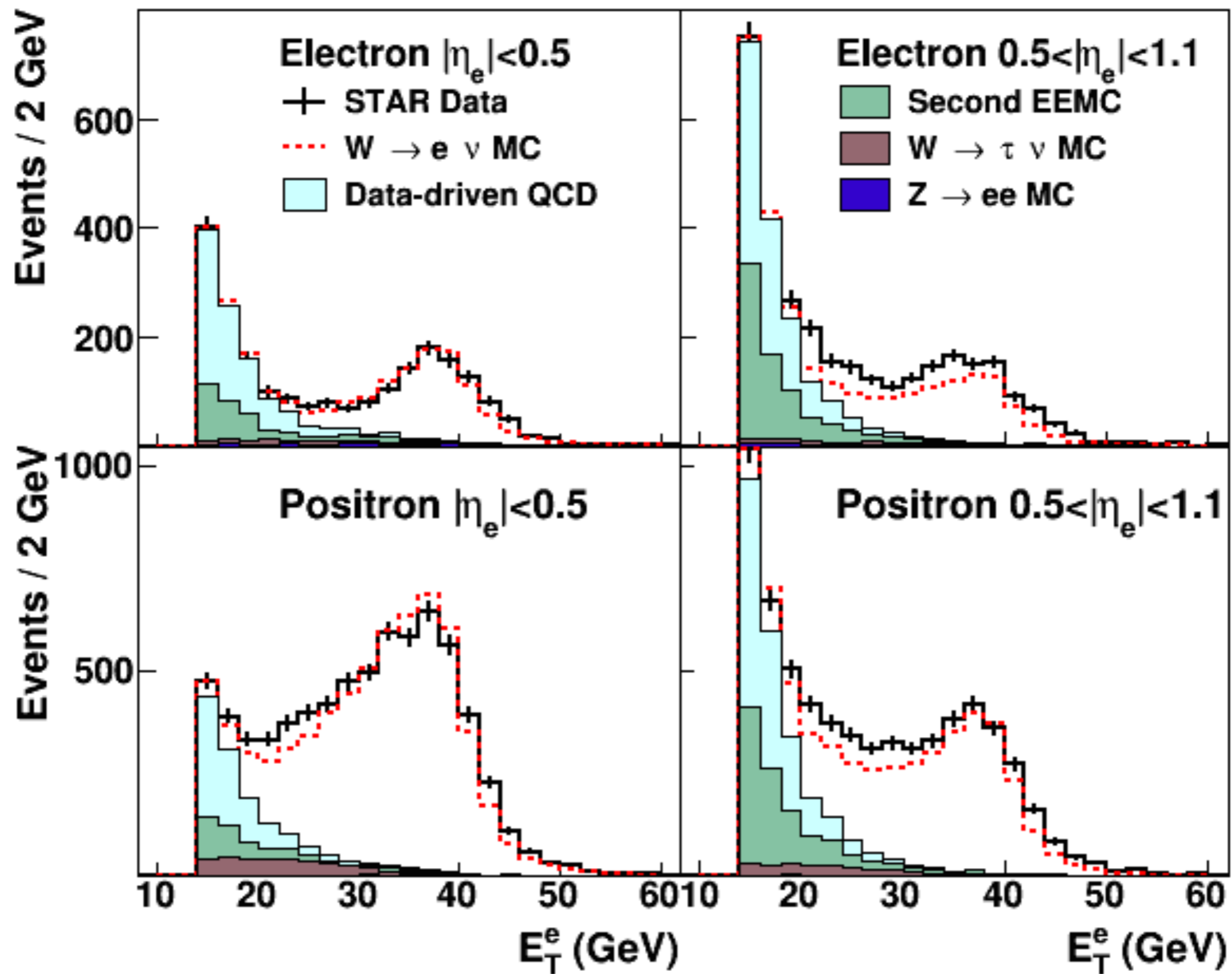
BG Estimation : Middle Eta , Forward Eta combined - Period 1



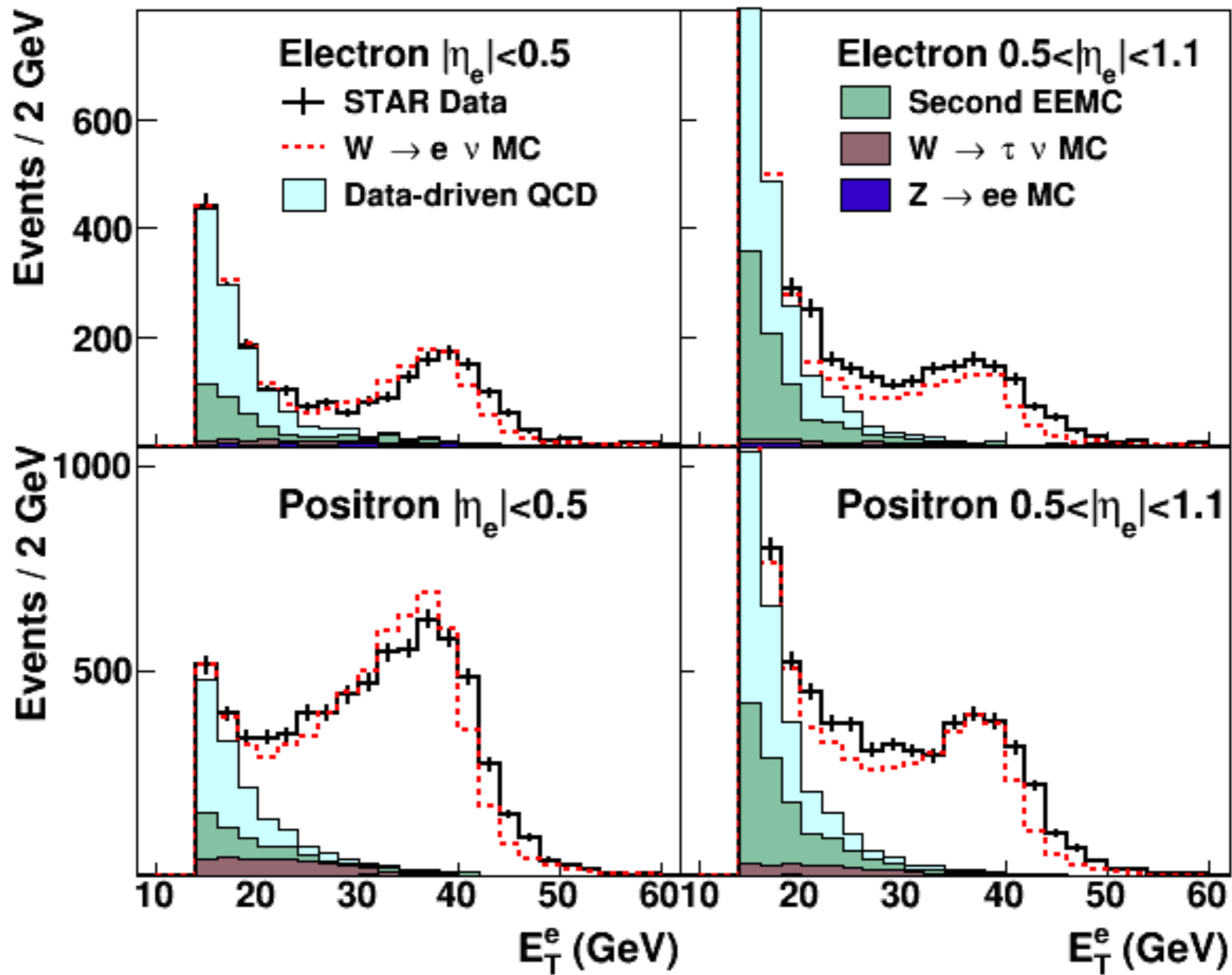
BG Estimation : Middle Eta , Forward Eta combined : Period 2



Without away ET cut

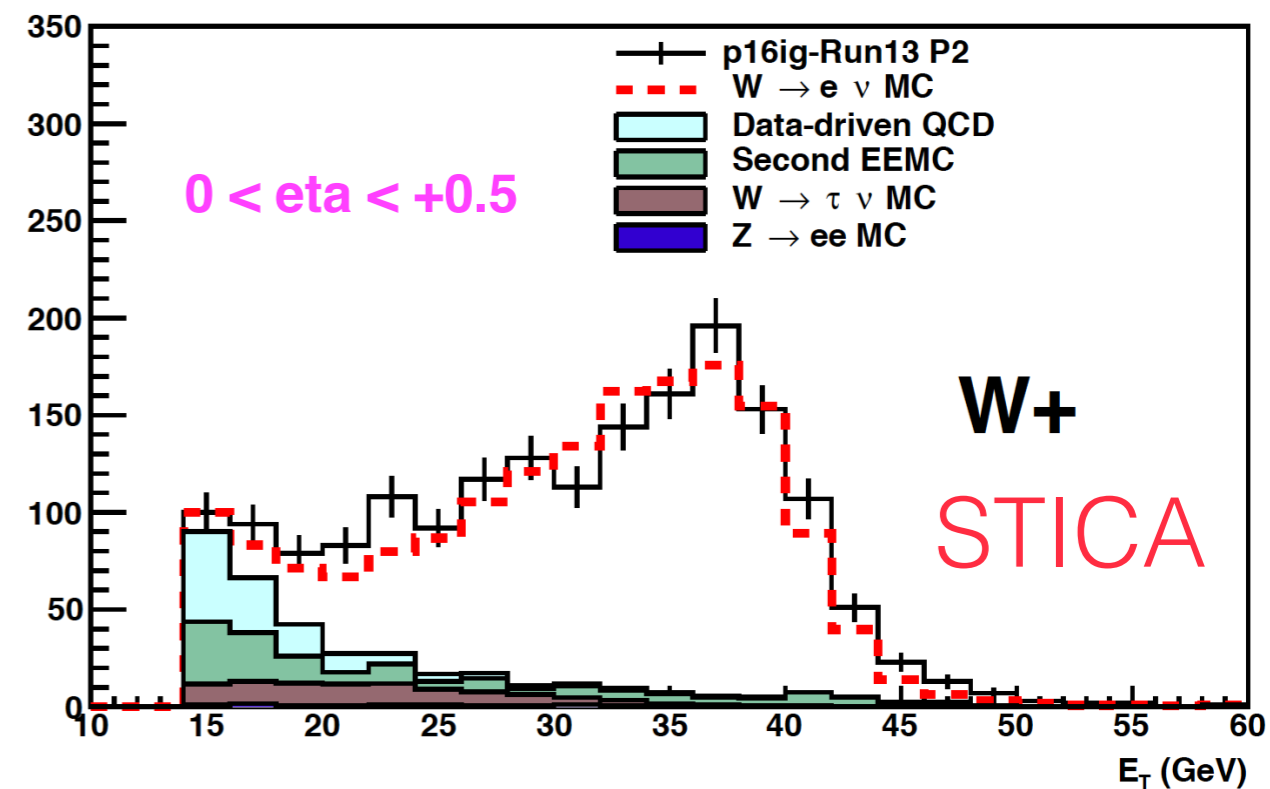
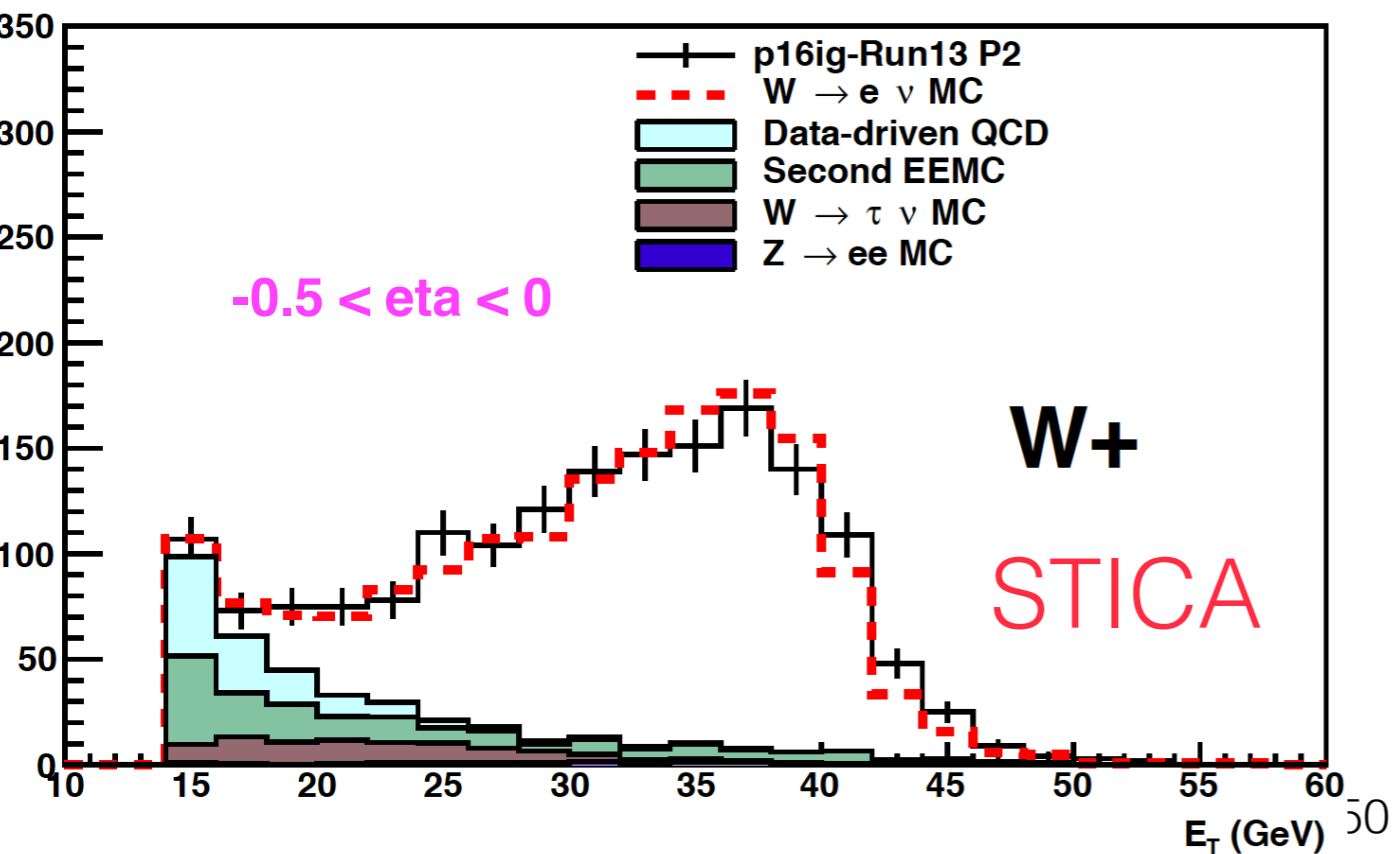
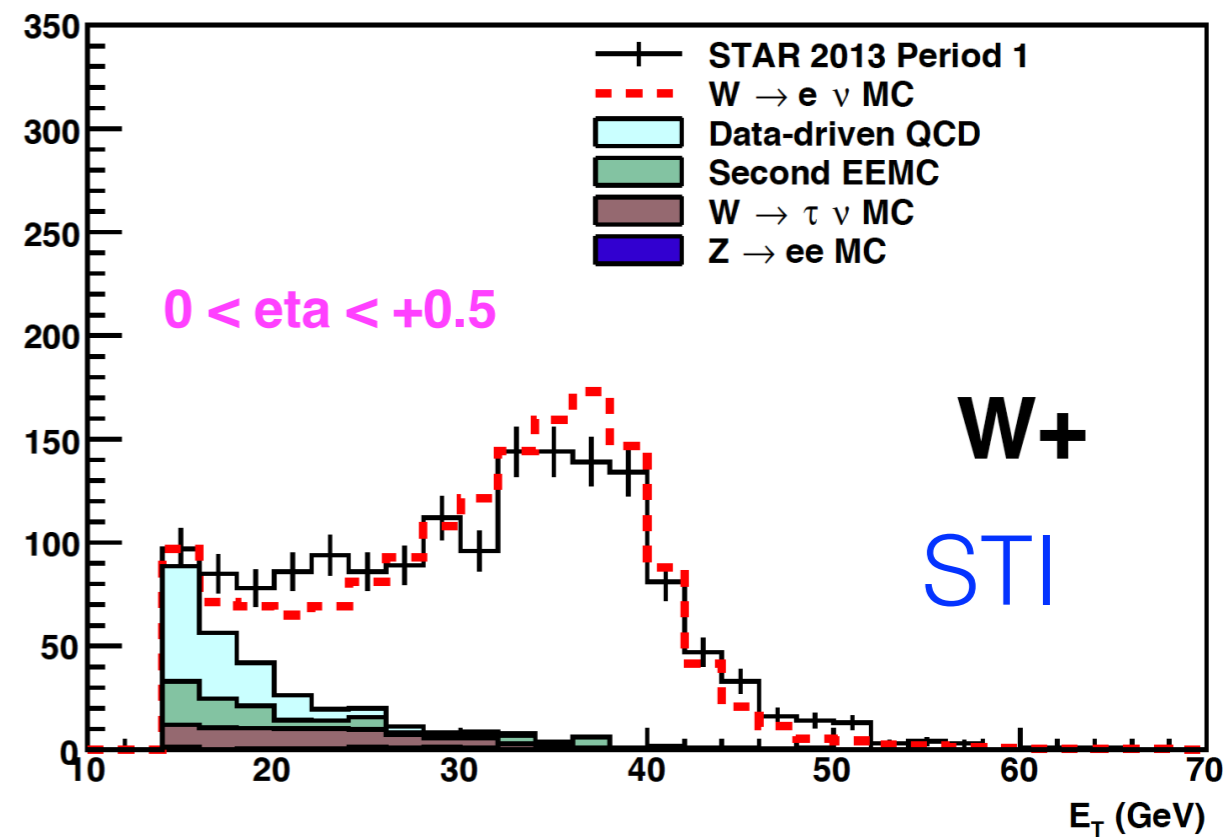
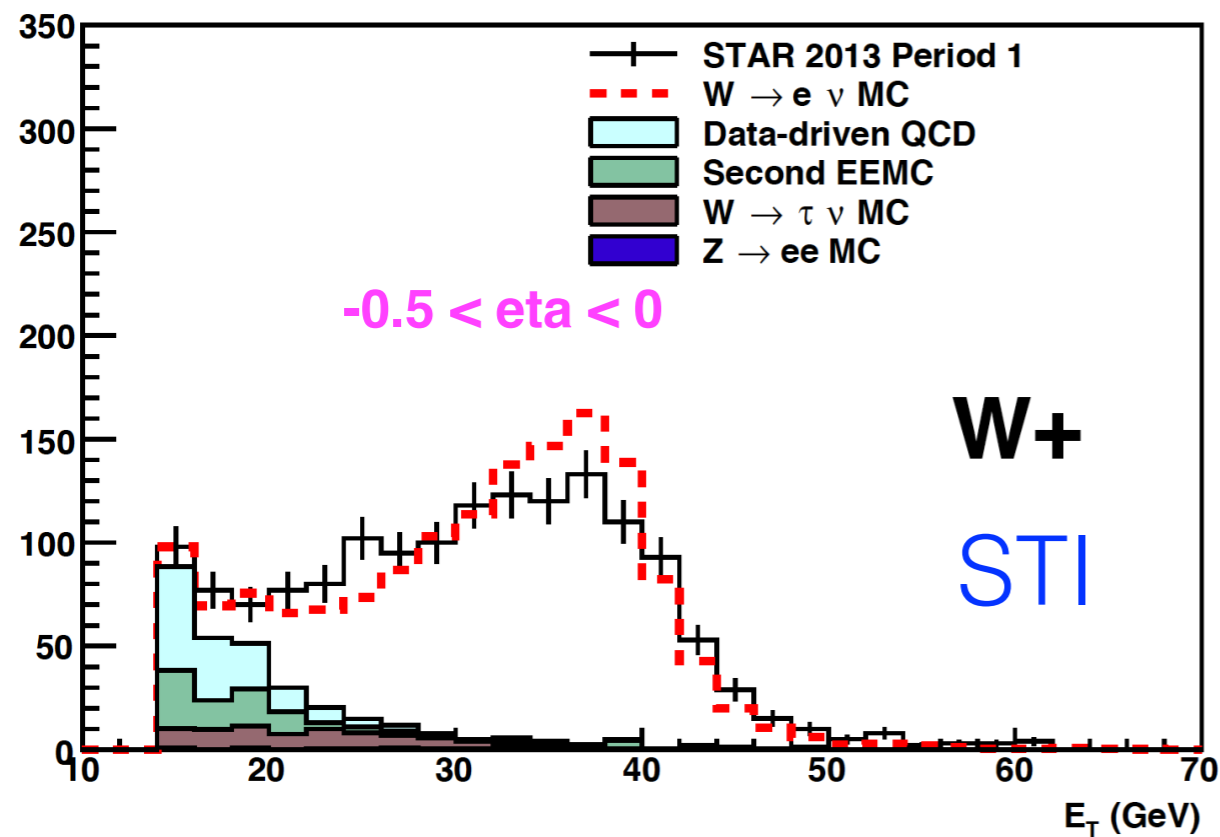


Without away ET cut and without scaling gains



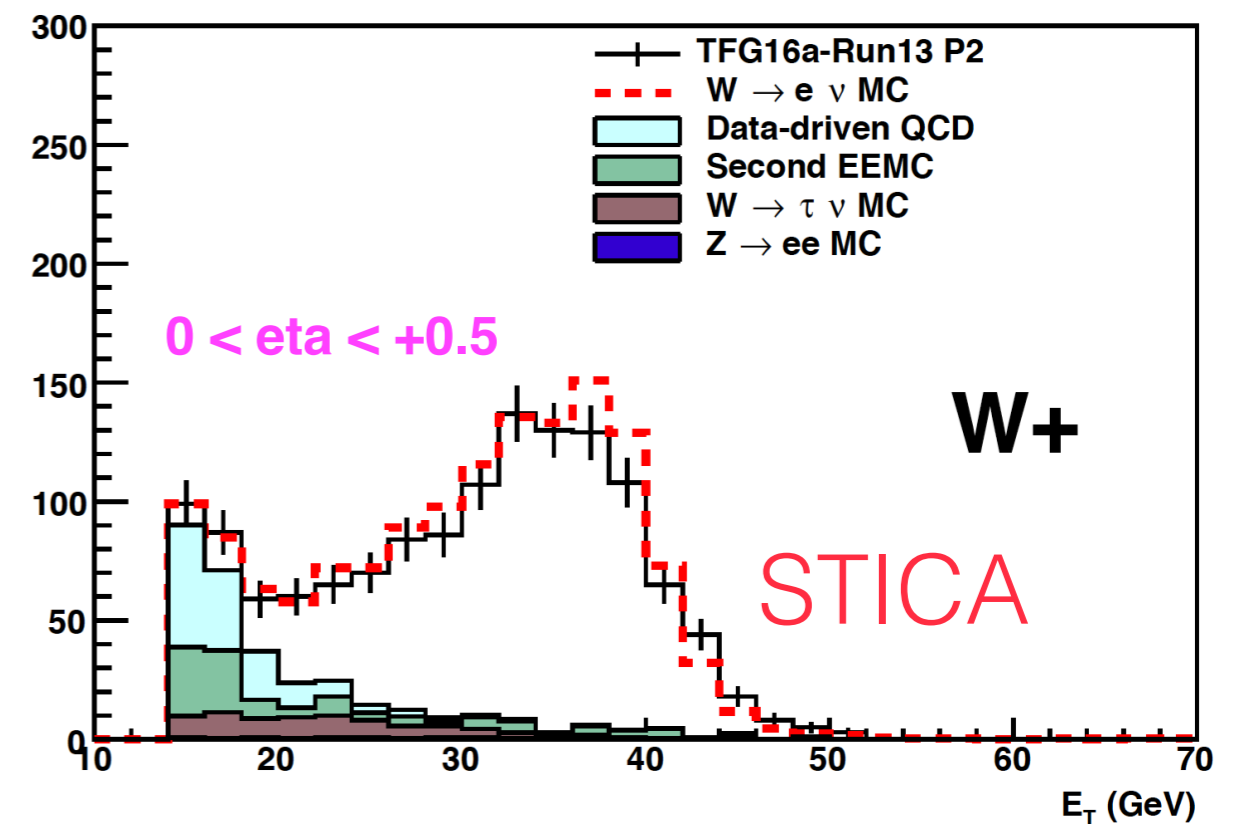
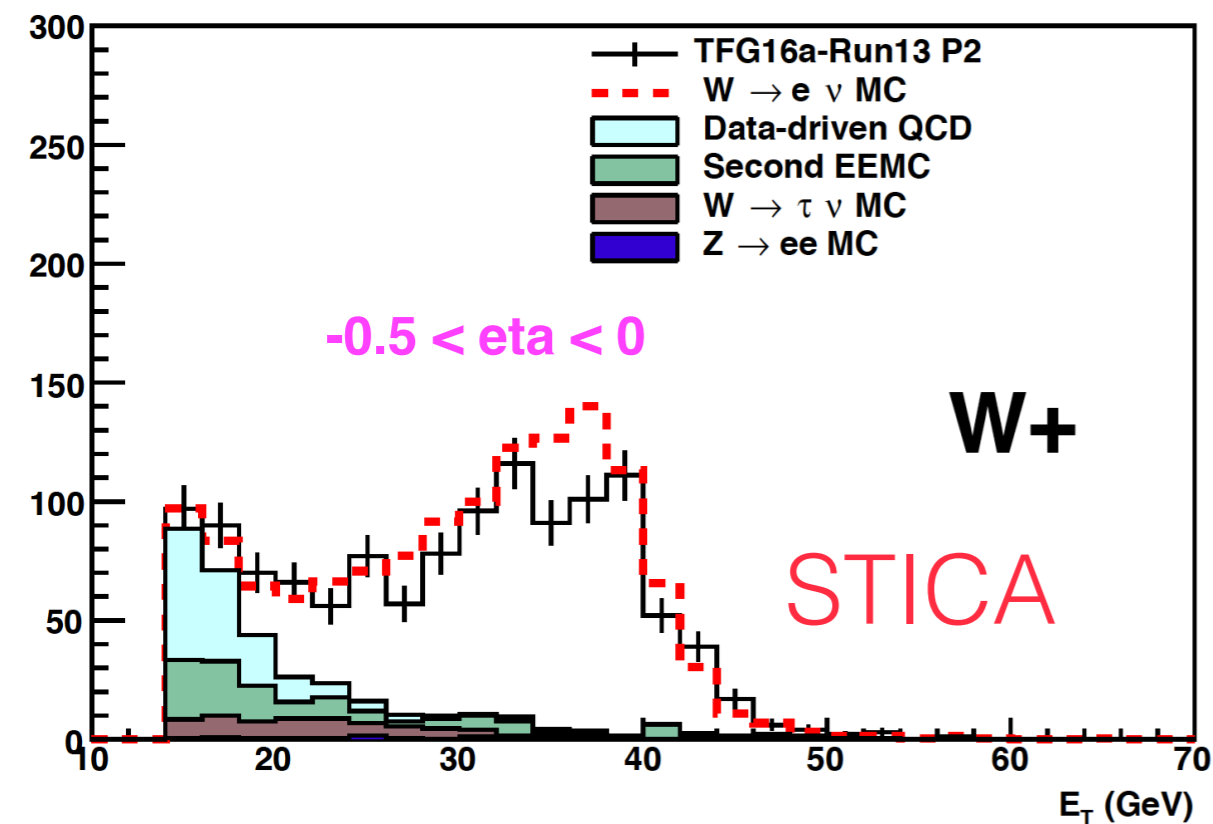
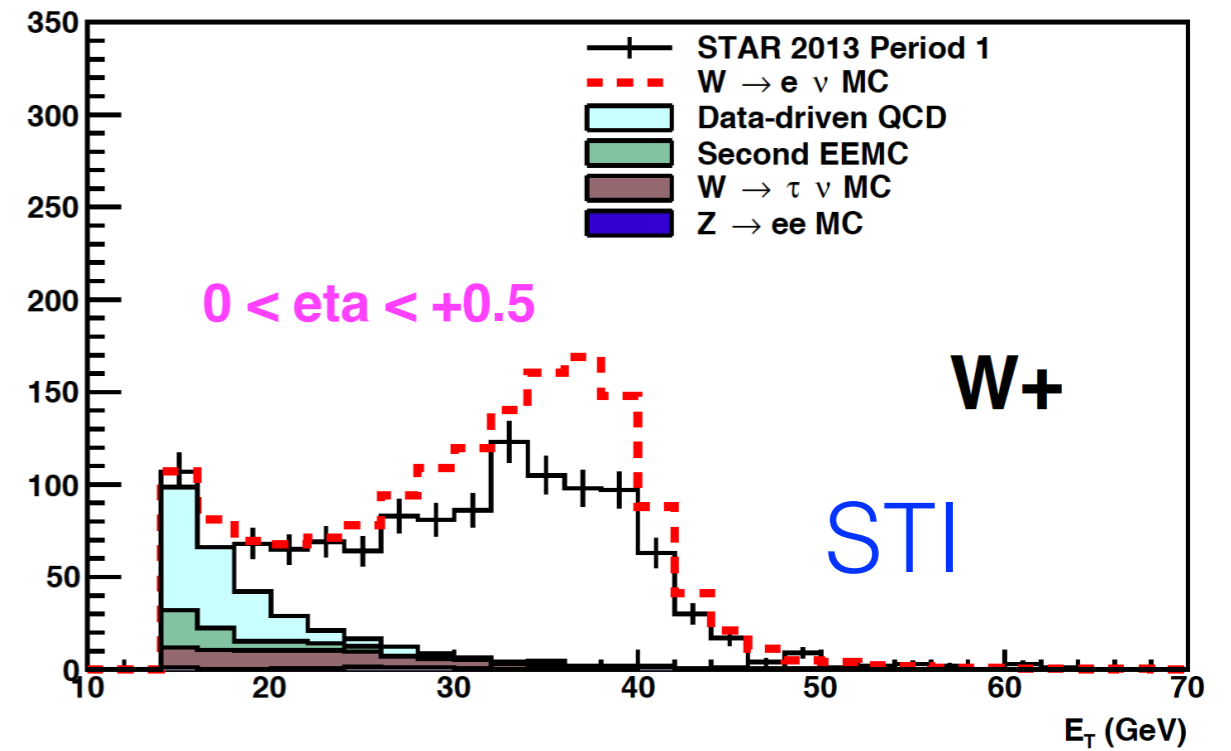
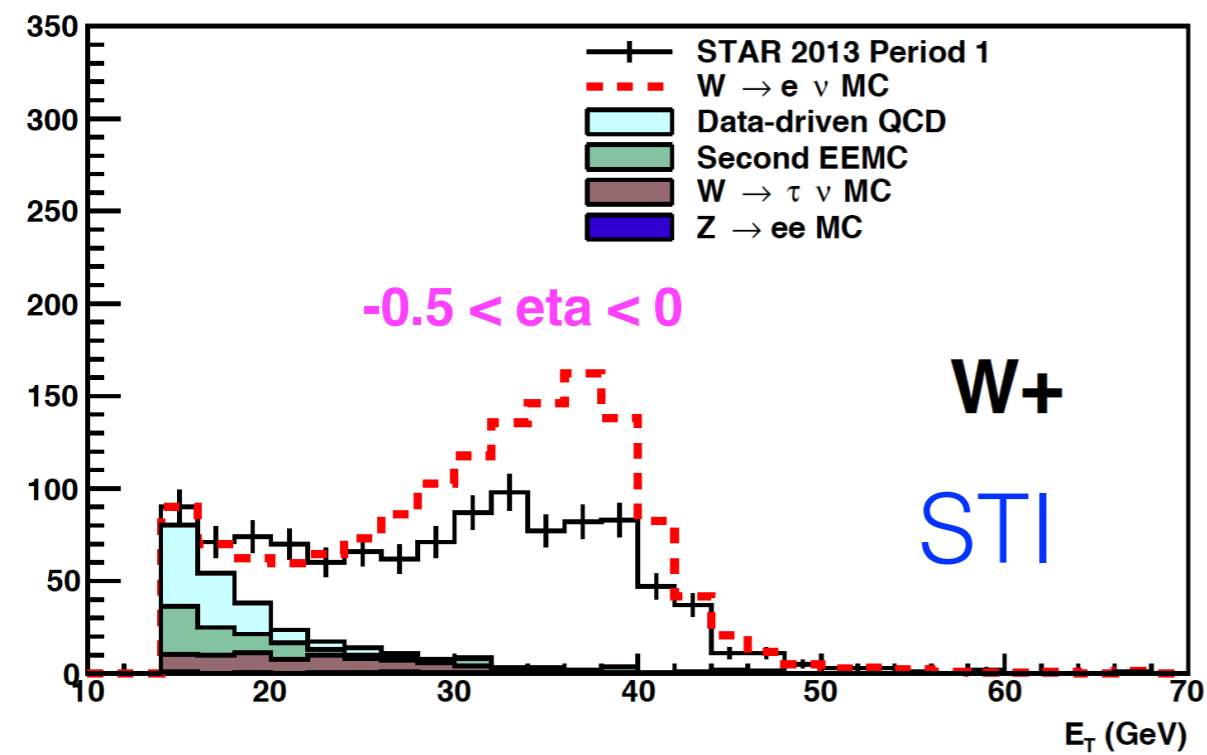
Period 1 : BG Estimation Before and Now

STI vs STICA - mid rapidity Eta bins

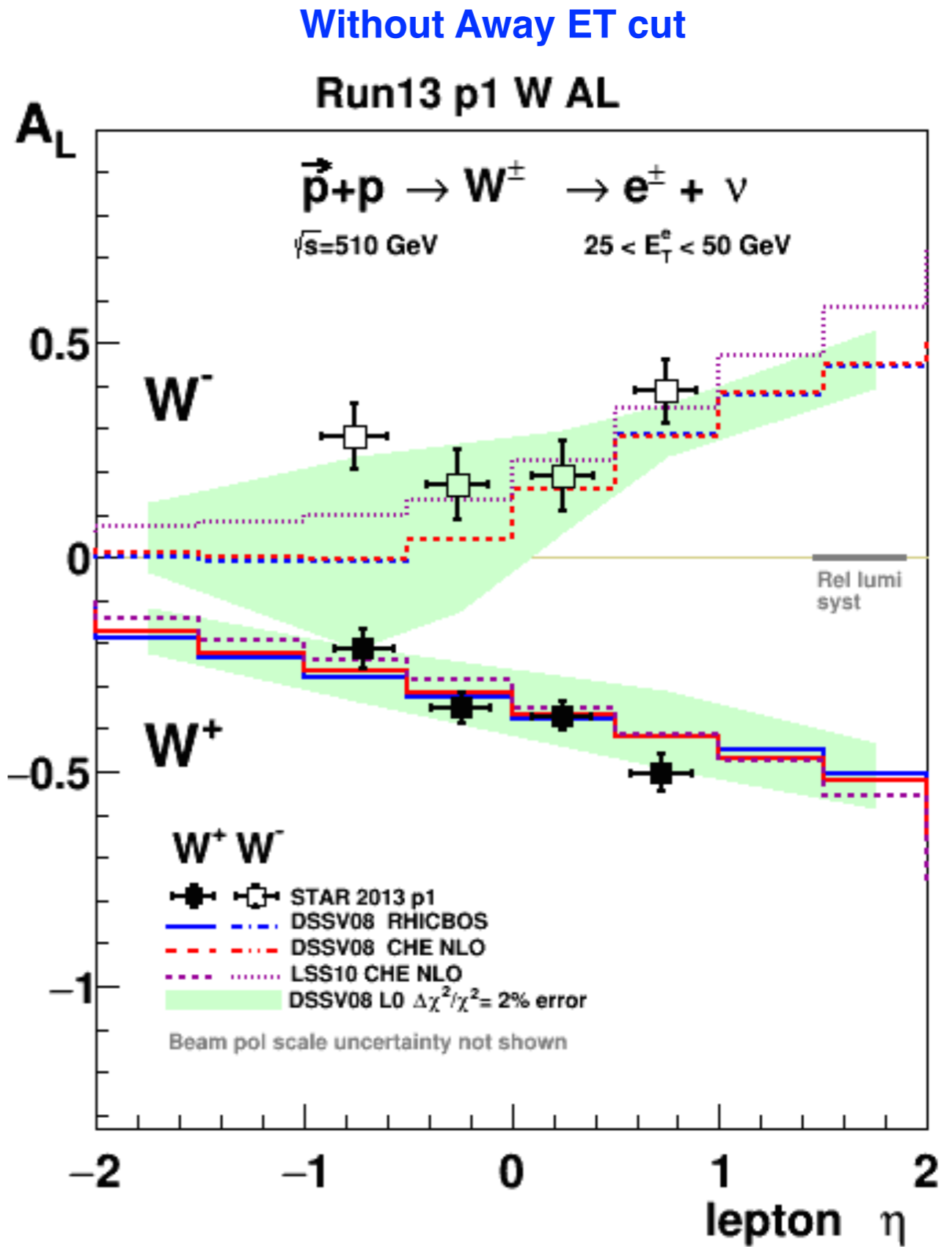
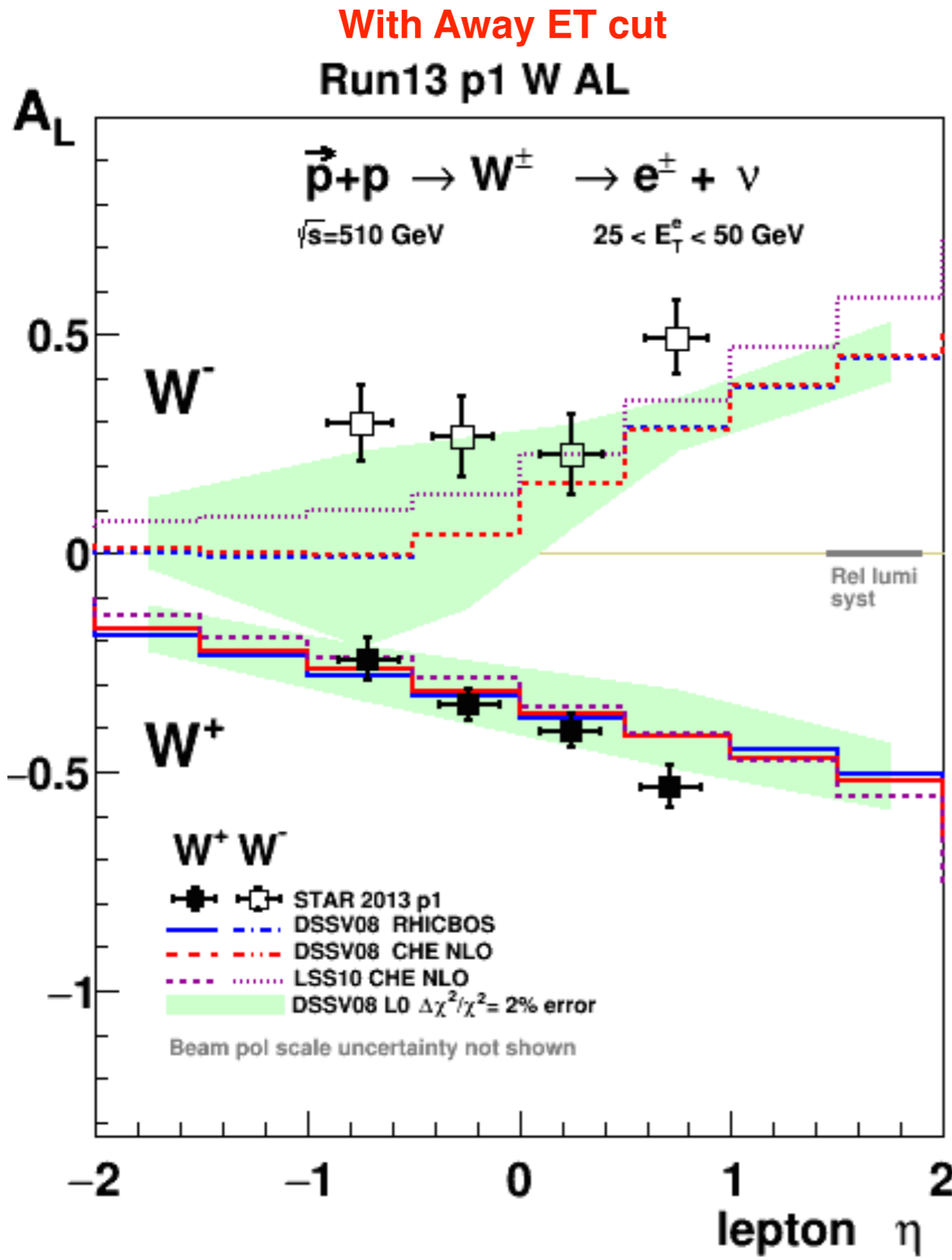


Period 2 : BG Estimation Before and Now

STI vs STICA - mid rapidity Eta bins



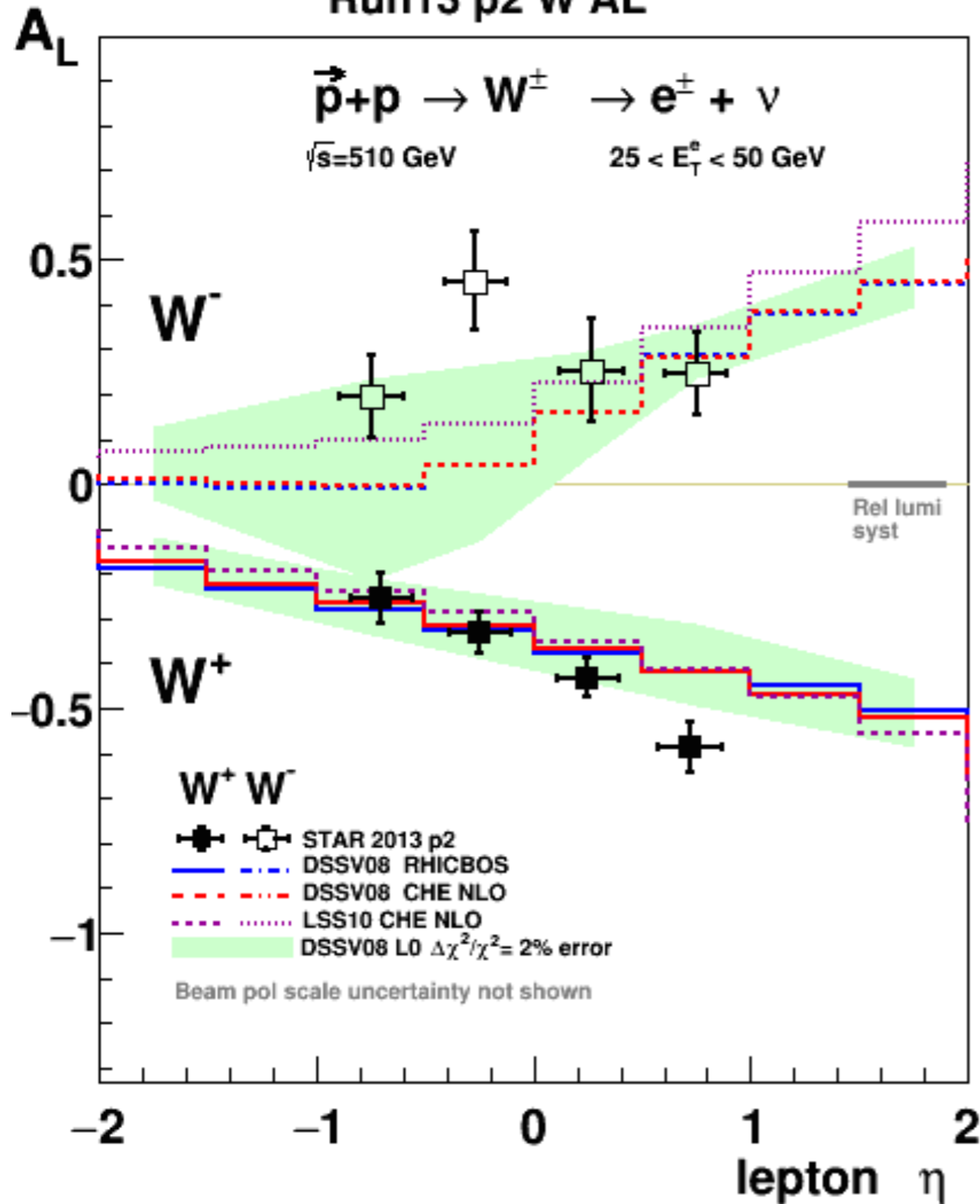
Money Plot : Period 1, with and without out away ET cut



Money Plot : Period 2, with and without out away ET cut

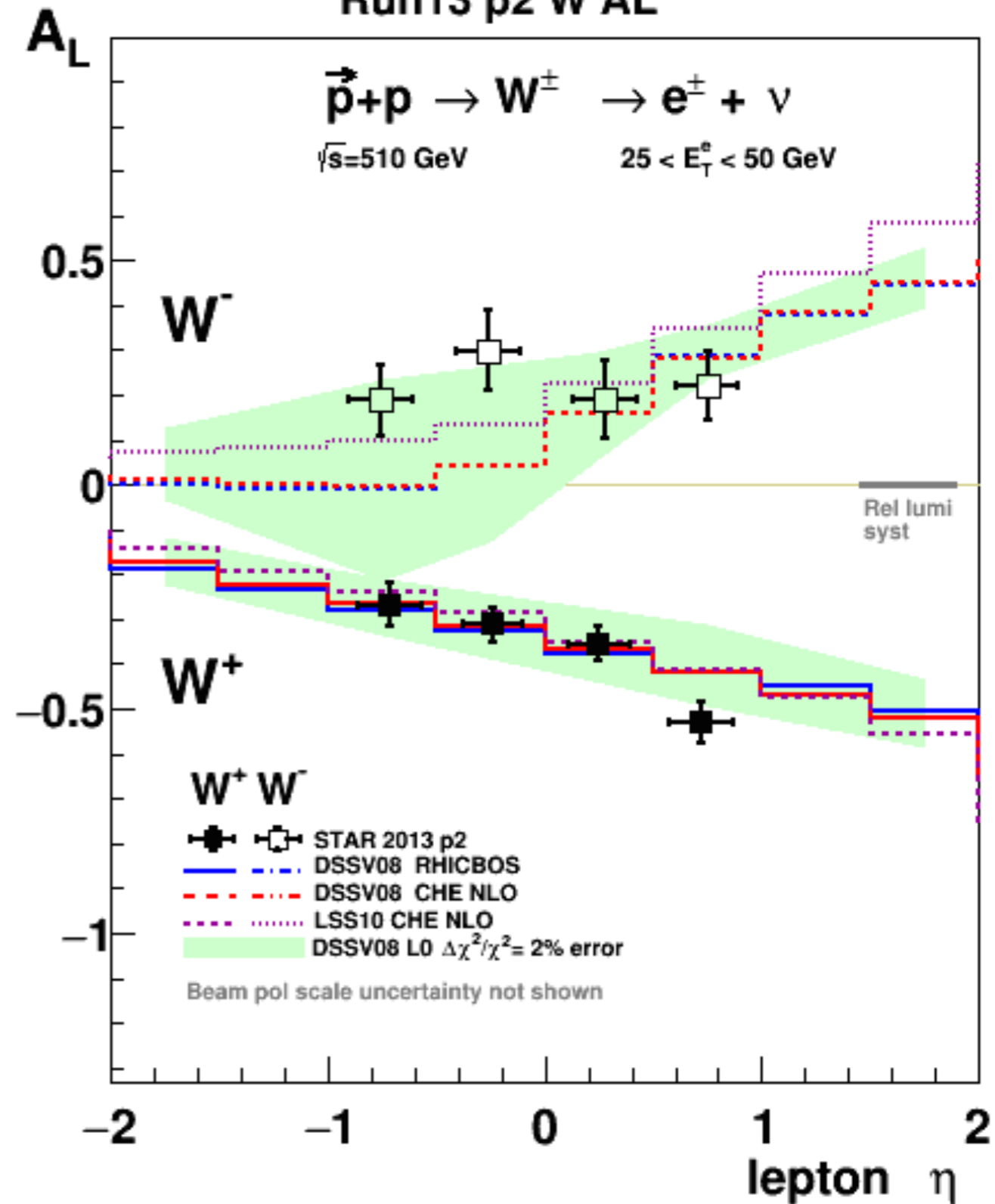
With Away ET cut

Run13 p2 W AL



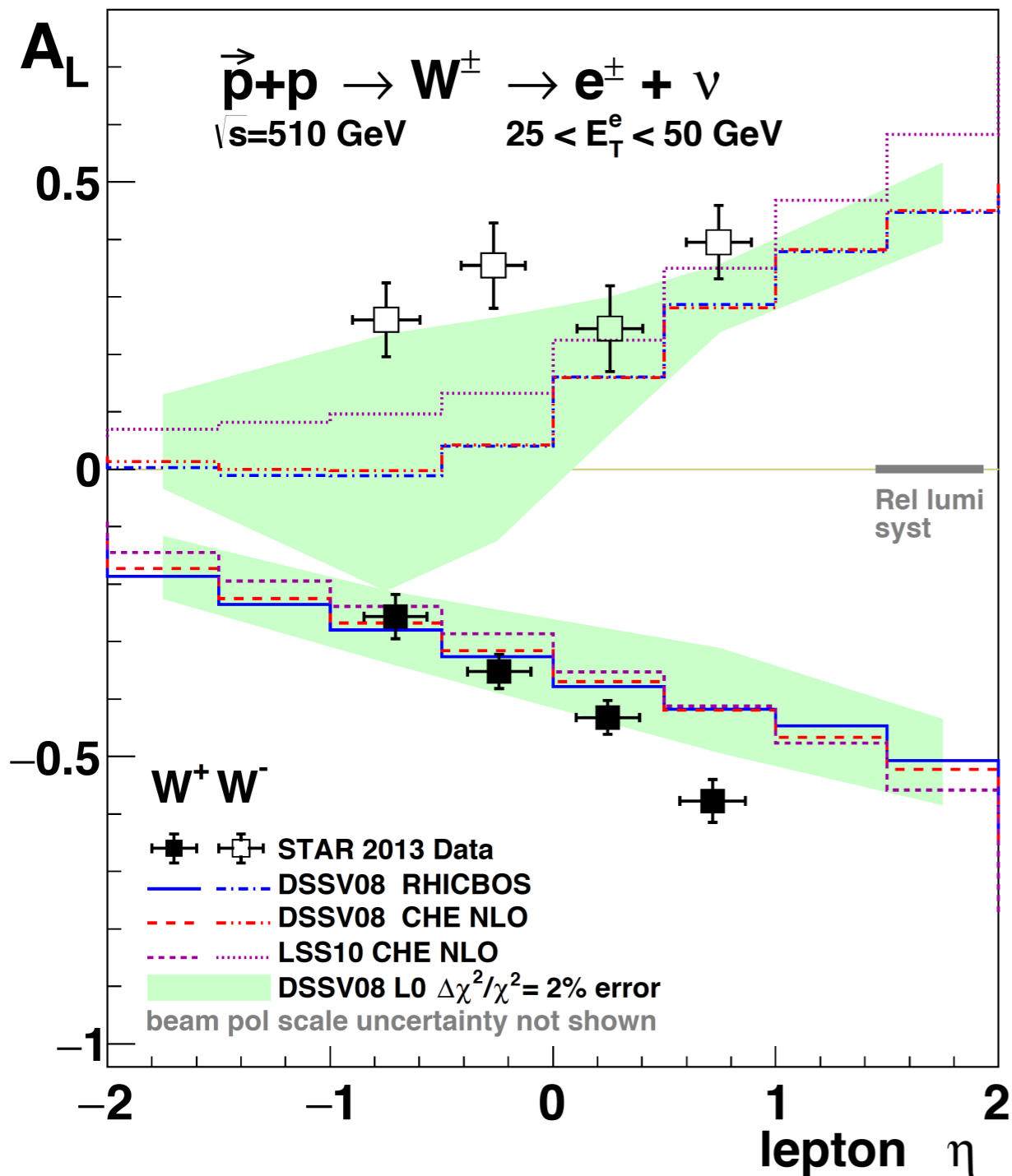
Without Away ET cut

Run13 p2 W AL

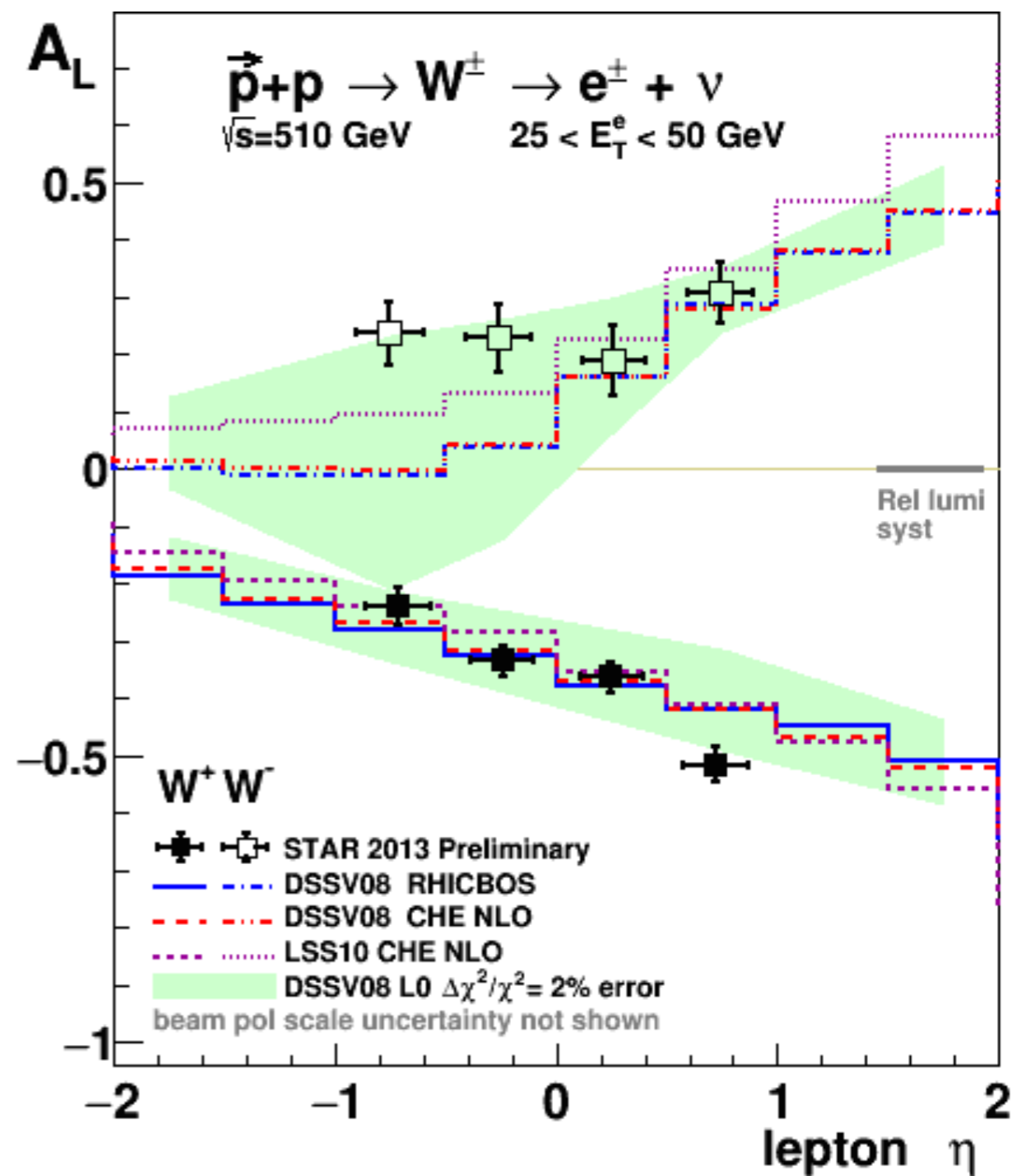


Money Plot : Combined, with and without out away ET cut

With Away ET cut



Without Away ET cut



AL Comparison

