Results from Run 13 W-test production analysis

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S&C meeting 04-13-2016

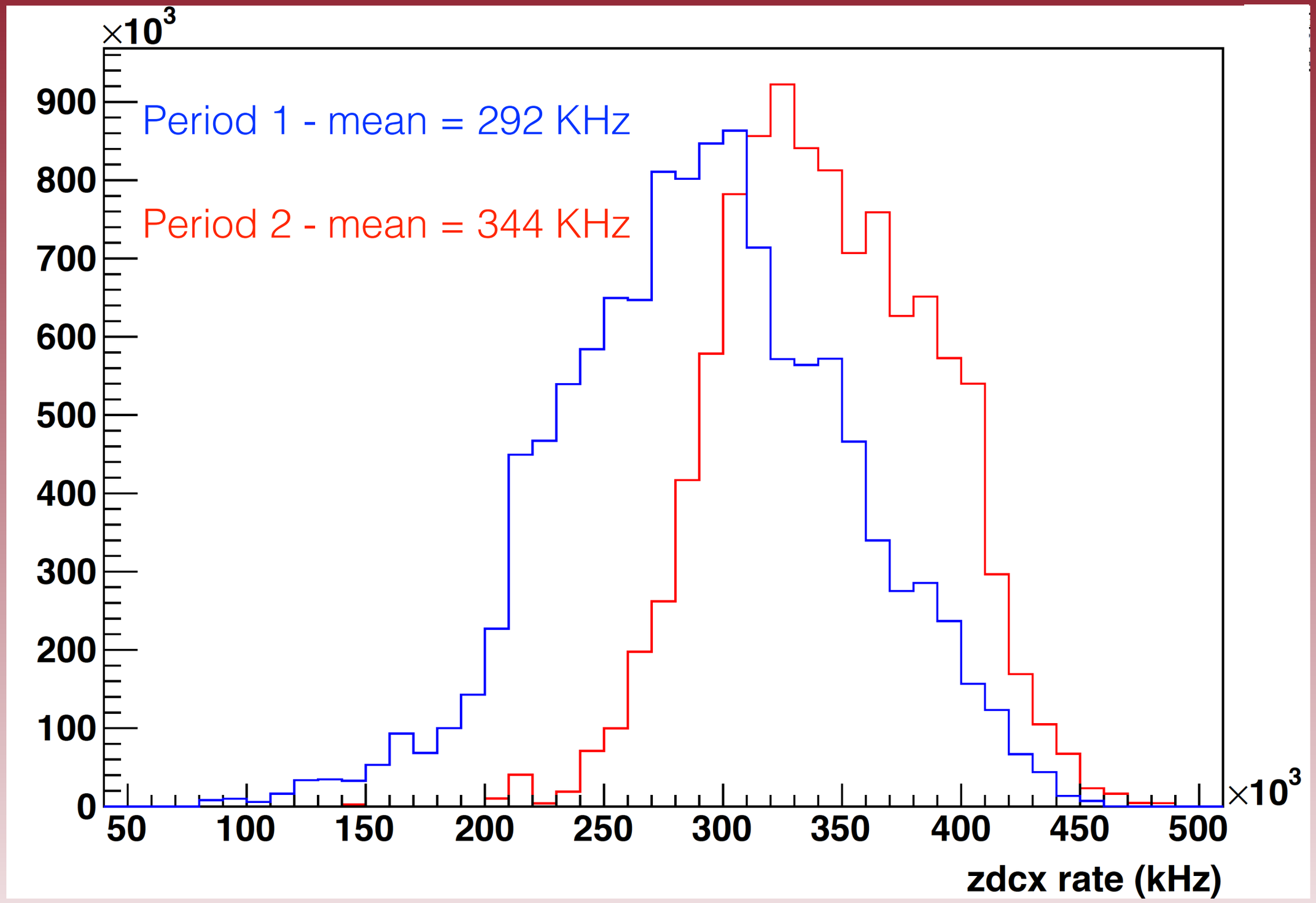
W Test Production Details

Production	Library	Vertex-Finding algo	Tracking algo	nEvents (M)
Evals 1	SL16b	PPV_W	STI	~12 [only period 1]
Evals 2	EVAL	PPV_W	STI*	~12 [only period 1]
Evals 4	EVAL	PPV_W	STICA	~12 [only period 1]
Yuri - period 1	DEV2/TFG16a	PPV_W	STICA**	~12 [only period 1]
Yuri - period 2	DEV2/TFG16a	PPV_W	STICA**	~10 [only period 2]
P14ia [run 13 official period 1]	SL14a	PPV_W	STI	~12 [only period 1]
P14ig [run 13 official period 2]	SL14g	PPV_W	STI	~10 [only period 2]

** - Yuri's STI in Eval*
*** - Yuri's STICA*

- Yuri's local production was used in the analysis :
  - to evaluate the performance of STICA in full luminosity range of run 13.
  - to understand if there is any negative interference effect between STICA and the additional HFT material.

Run 13 Luminosity



- ~90% of Period 2 statistics is above 300 KHz.
- ~50 % of Period 1 statistics is above 300 KHz.

W Test Production analysis-Comparisons

Comparisons	Purpose	Result
EVALS 1 vs EVALS 2	difference between STI in official library vs STI* in EVAL	No difference
EVALS 1 vs EVALS 4	difference between official STI vs STICA in EVAL	18 % enhancement in Final W
Yuri - P1 vs EVALS 4	difference between Yuri's STICA vs STICA in EVAL	No difference
EVALS 1 vs p14ia	difference between STI with and without new HFT materials	~4 % enhancement in Final W
Yuri's - P1 vs p14ia	difference between STI with no new HFT materials vs Yuri's STICA **	22 % enhancement in Final W
Yuri's - P2 vs p14ig	difference between STI with no new HFT materials vs Yuri's STICA **	29 % enhancement in Final W

** - Yuri's STI in Eval*

*** - Yuri's STICA*

Analysis Details / Notes

- All the “evals” productions are from run 13 period 1 (day 76-126)
- 98 runs (0.18 M) have removed from this analysis from each productions [12.2 M] since those runs have failed run QA done for run 13 W AL analysis. 937 runs [12.02 M] were used.
- For period 2 analysis, 716 [~10 M] runs were used. They were also chosen from QA’d run list of run 13 period 2 W AL analysis.
- Official W -AL code were used and run 12 200 GeV BEMC tower calibration gains were used.
- For Each production W code also was compiled with the same production library.
- All the comparisons are apple-to-apple [Exactly same # of runs with same # of events that have processed were compared]

Evals 1 vs Evals 2

Apple- to -Apple comparison

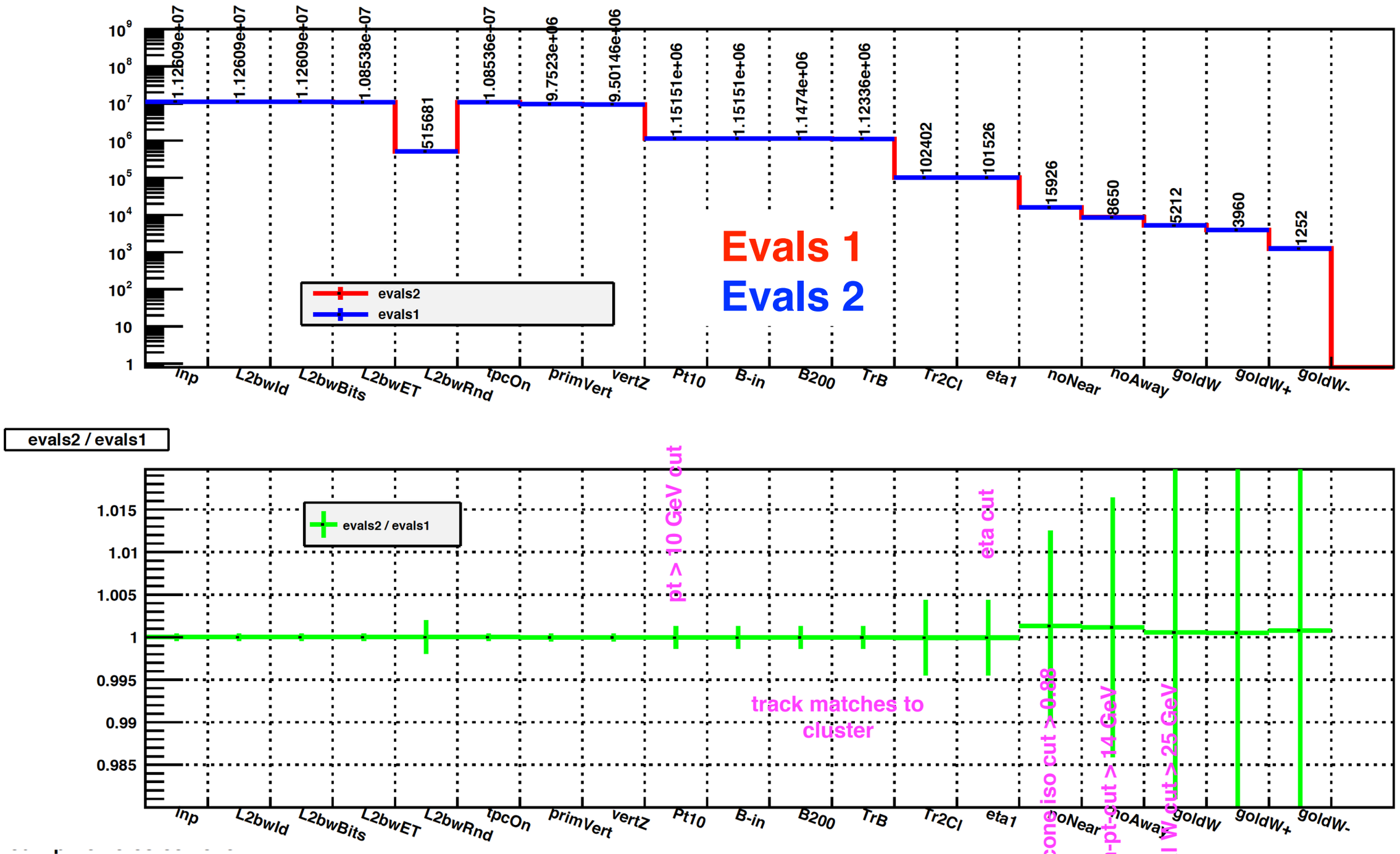
To investigate the difference between STI [in official STAR SL16b library] vs STI* [Yuri's STI in EVAL]

Details / Notes

Production	Production Library [also W-code compiled library]	Tracking	vertex finding	BEMC-gains	# of runs used in the comparison	# of events
"evals2"	EVAL	Sti*	PPV_W	run 12 - 200 GeV	896	11.26 M
"evals1"	SL16b	Sti	PPV_W	run 12 200 GeV	896	11.26 M

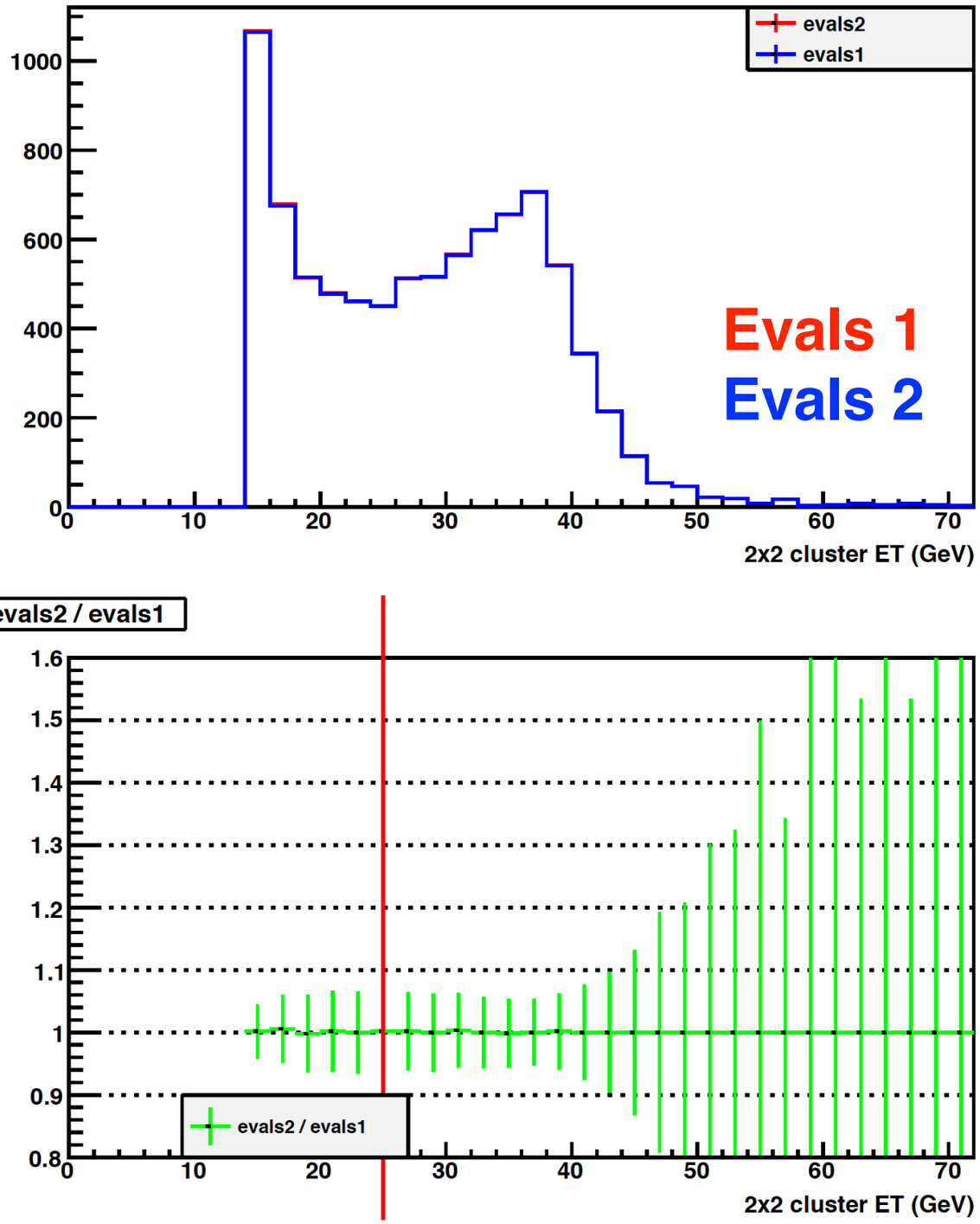
** - Yuri's STI in Eval*

Events Counts as a function of W cuts

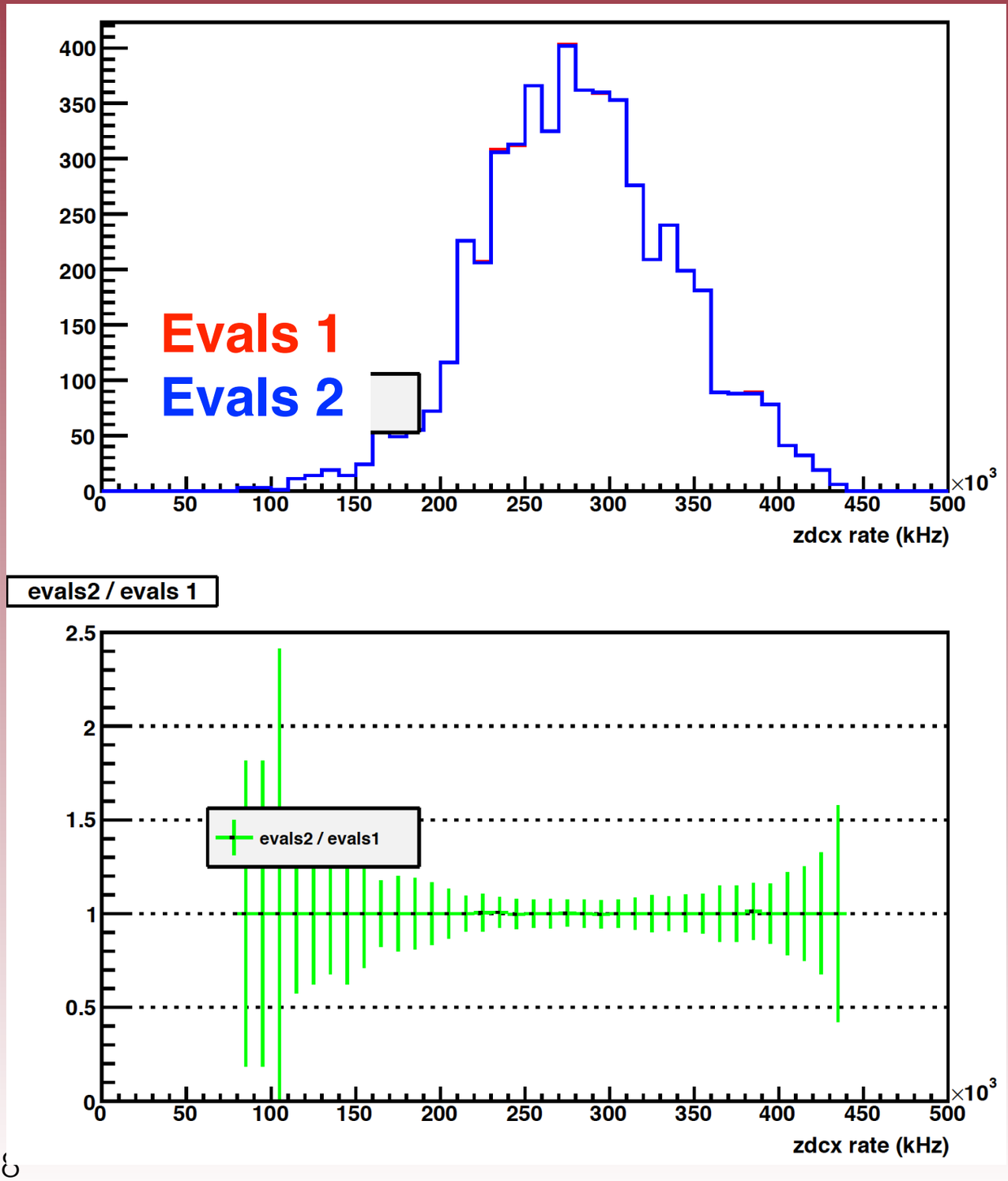


Final W : Et , ZDC

Final W - Et



Final W - ZDC



Summary

- No observable considerable difference between Evals 1 vs Evals 2. Meaning **no difference** between **official STI in SL16b** vs **Yuri's STI in EVAL**

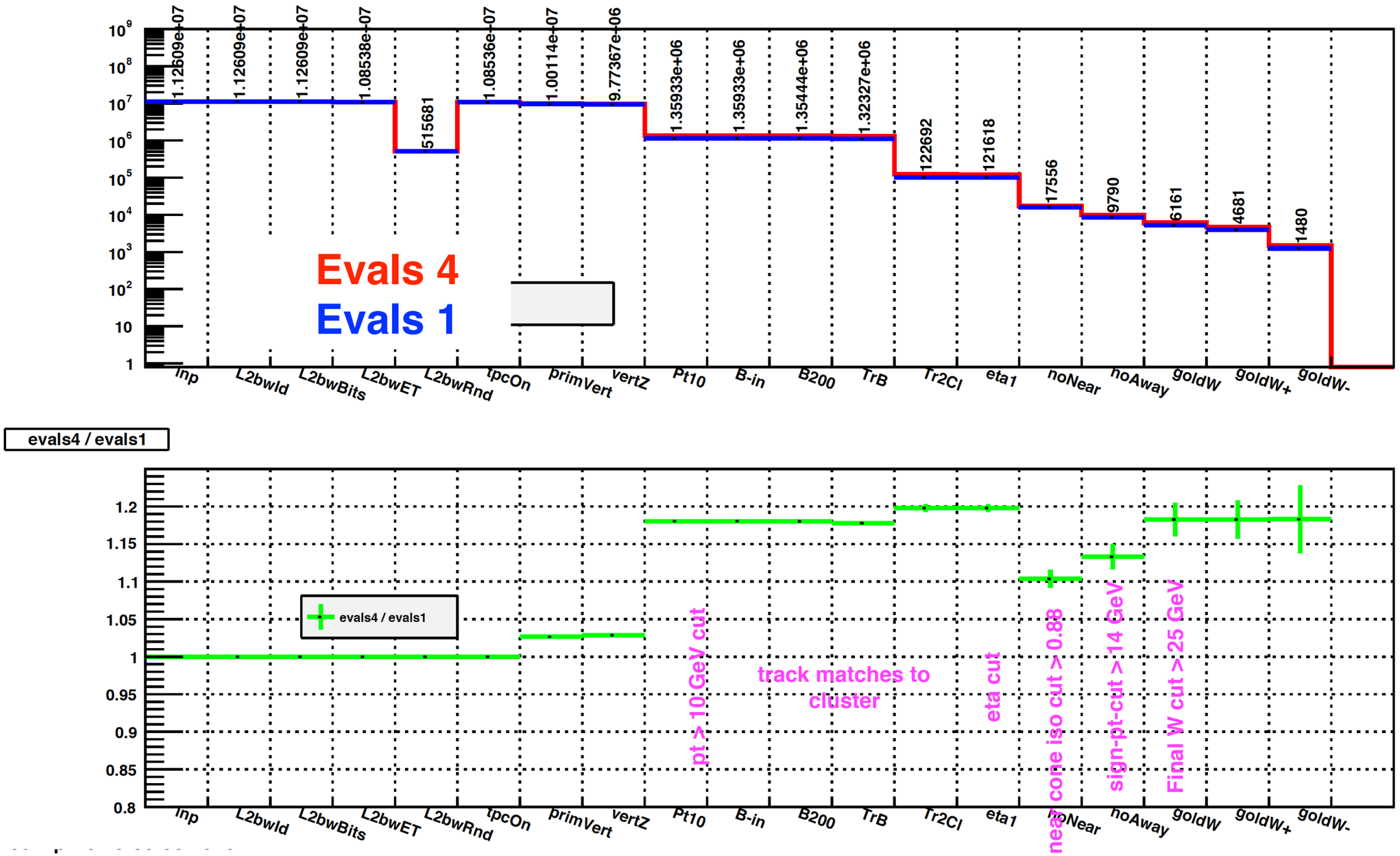
Evals 1 vs Evals 4

Apple- to -Apple comparison

To investigate the difference between official STI vs STICA in EVAL

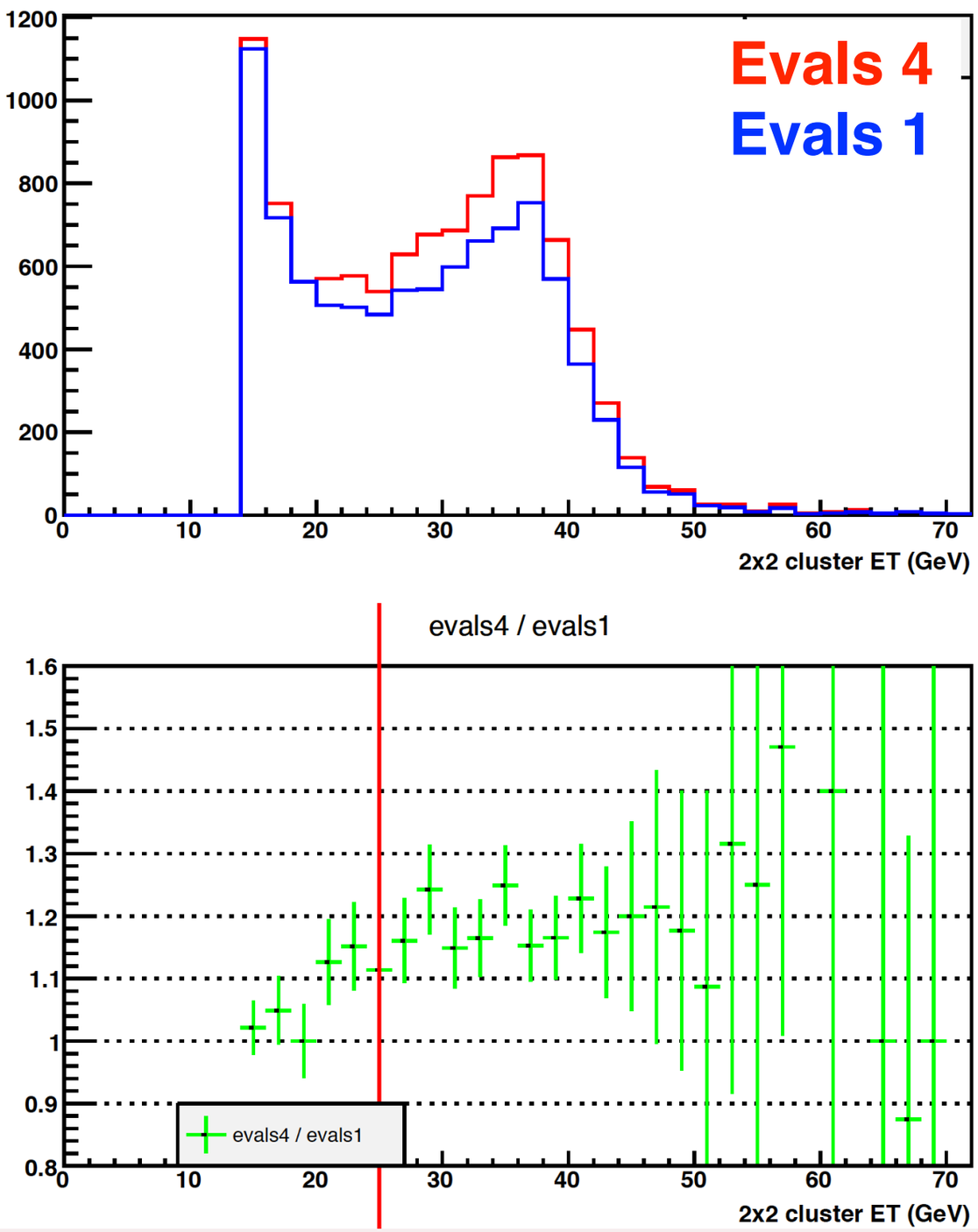
Production	Production Library [also W-code compiled library]	Tracking	vertex finding	BEMC-gains	# of runs used in the comparison	# of events
“evals4”	EVAL	StiCA	PPV_W	run 12 - 200 GeV	896	11.26 M
“evals1”	SL16b	Sti	PPV_W	run 12 200 GeV	896	11.26 M

Events Counts as a function of W cuts

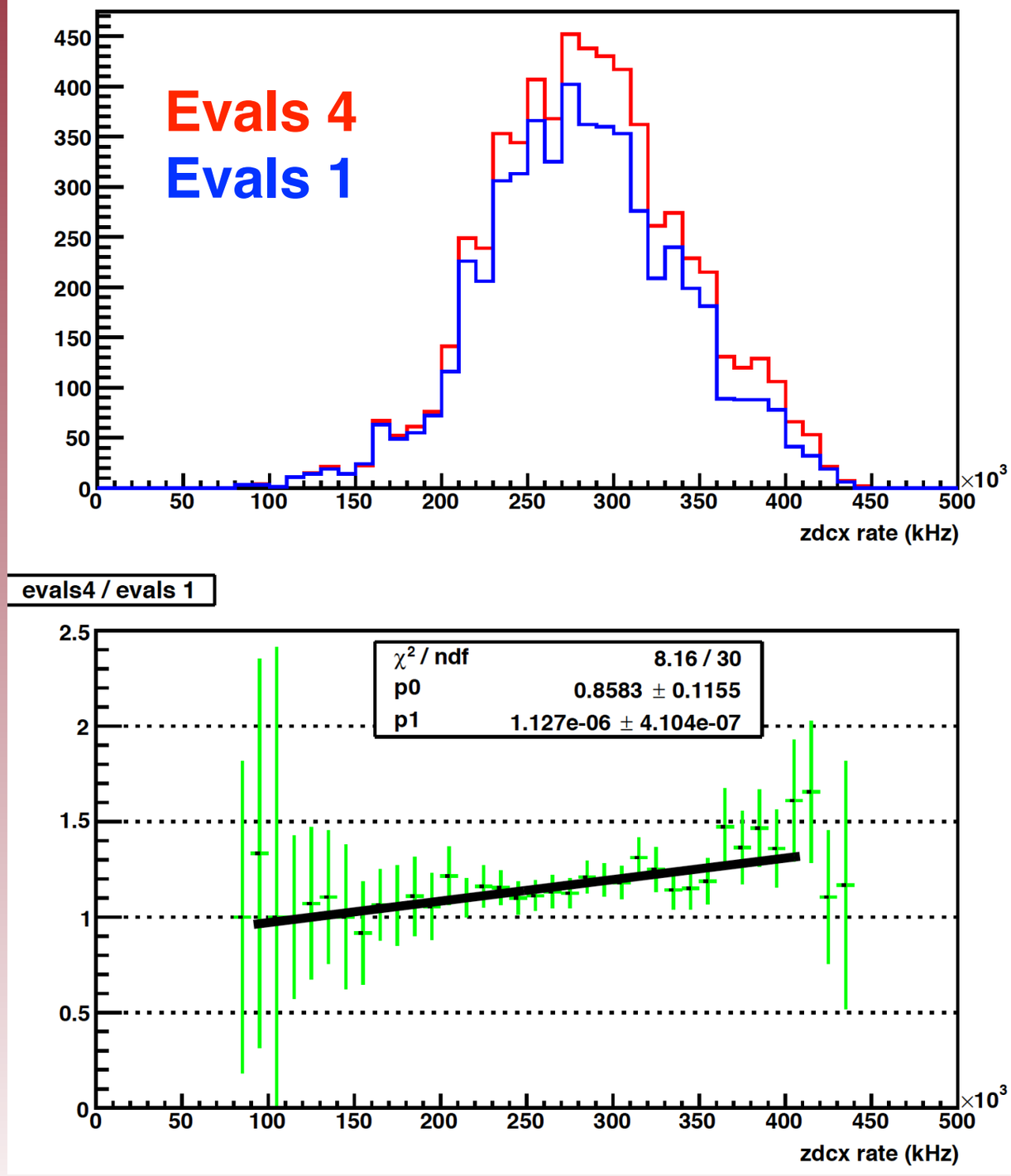


Final W : Et , ZDC

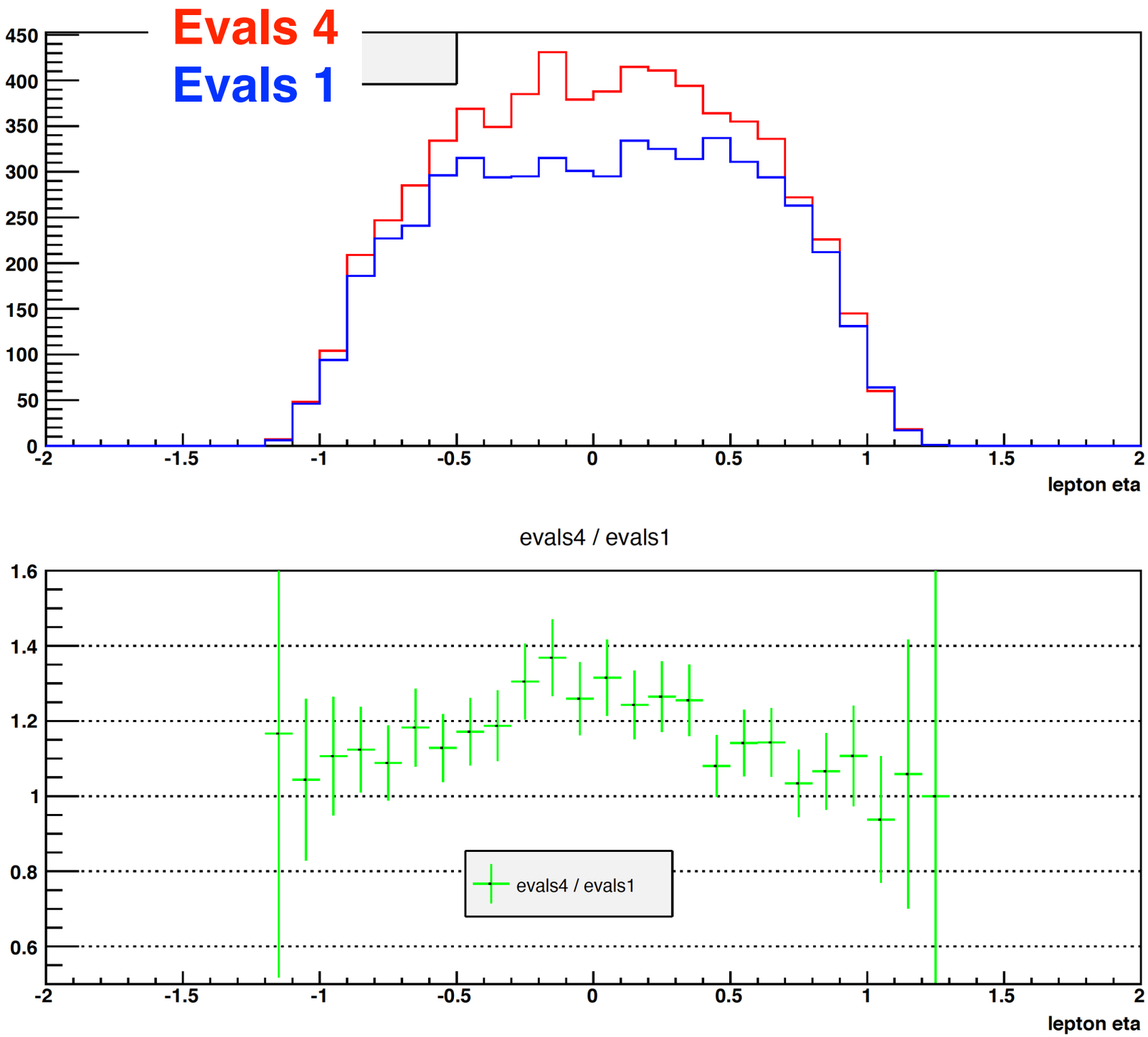
Final W - Et



Final W - ZDC



Final W Eta


Evals 4
Evals 1
450
400
350
300
250
200
150
100
50
0
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
lepton eta
evals4 / evals1
1.6
1.4
1.2
1
0.8
0.6
evals4 / evals1
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
lepton eta

Summary

- We see ~18 % enhancement in tracks above Pt = 10 GeV and similar enhancement in final W [> 25 GeV] tracks using STICA tracking.
- Significant enhancement of **final W Eta in mid rapidity** region where a “dip” [data-MC discrepancy] was observed previously.

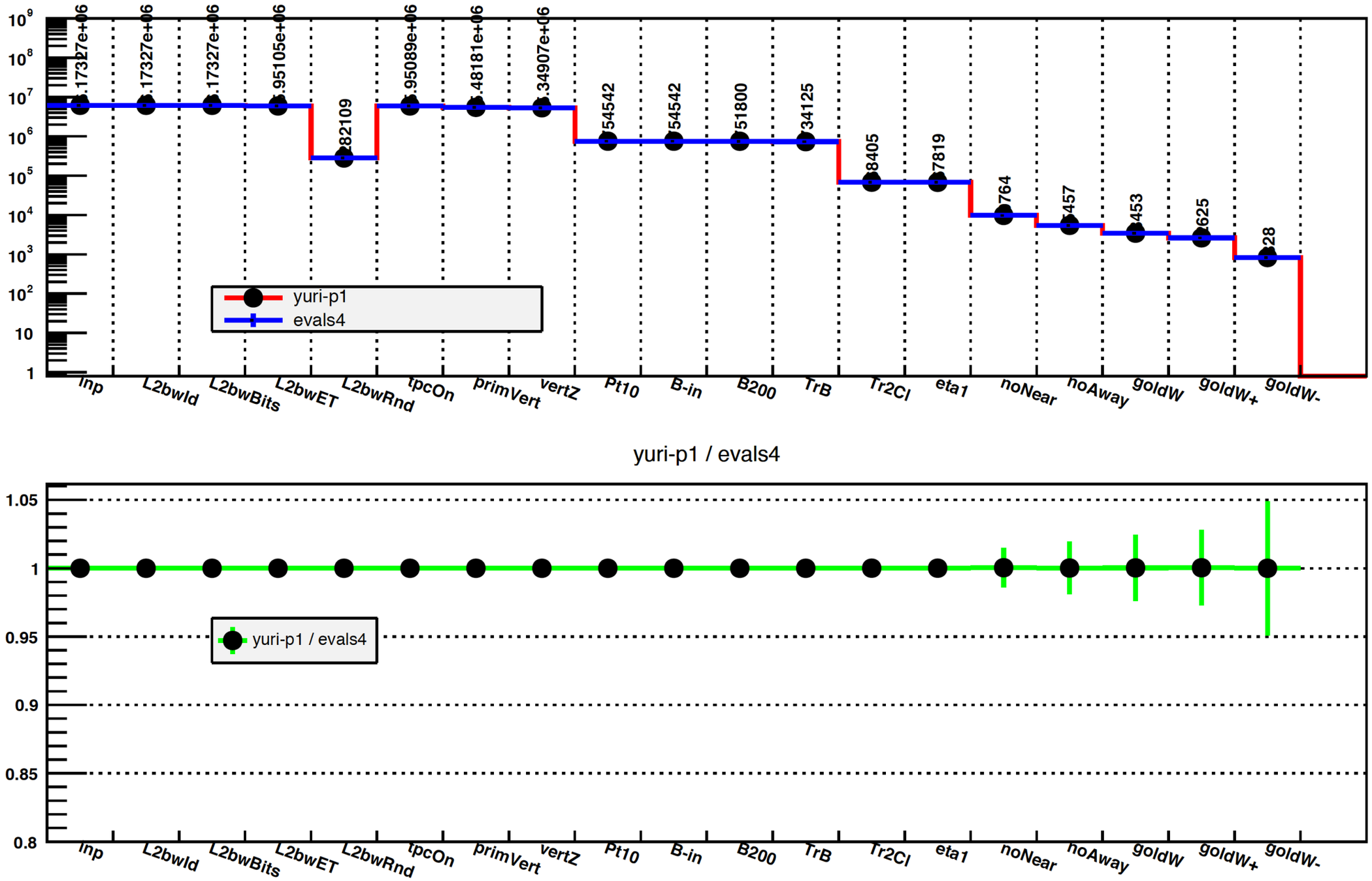
Evals 4 vs Yuri's-P1

apple- to -apple comparison

To investigate the difference between STICA in EVAL vs Yuri's STICA

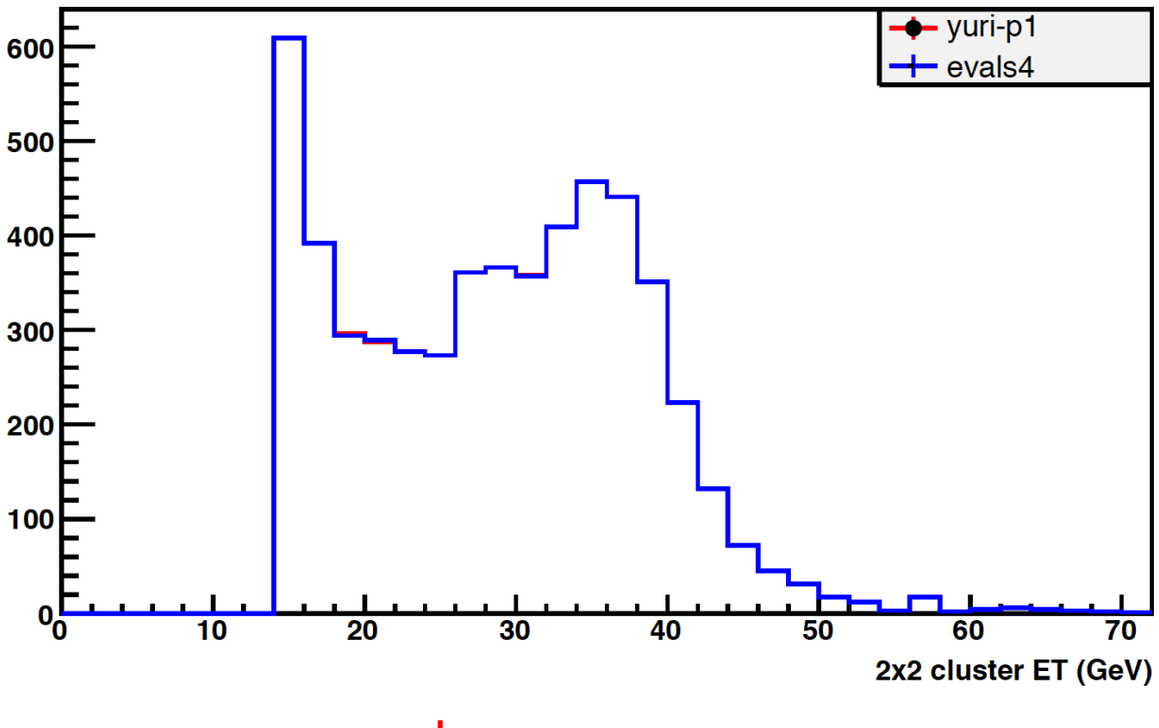
Production	Production Library [also W-code compiled library]	Tracking	vertex finding	BEMC-gains	# of runs used in the comparison	# of events
"evals4"	EVAL	StiCA	PPV_W	run 12 - 200 GeV	585	6172606
Yuri's - P1 (day 129-161)	DEV2/ TFG16a	StiCA [Yuri's code]	PPV_W	run 12 200 GeV	585	6172606

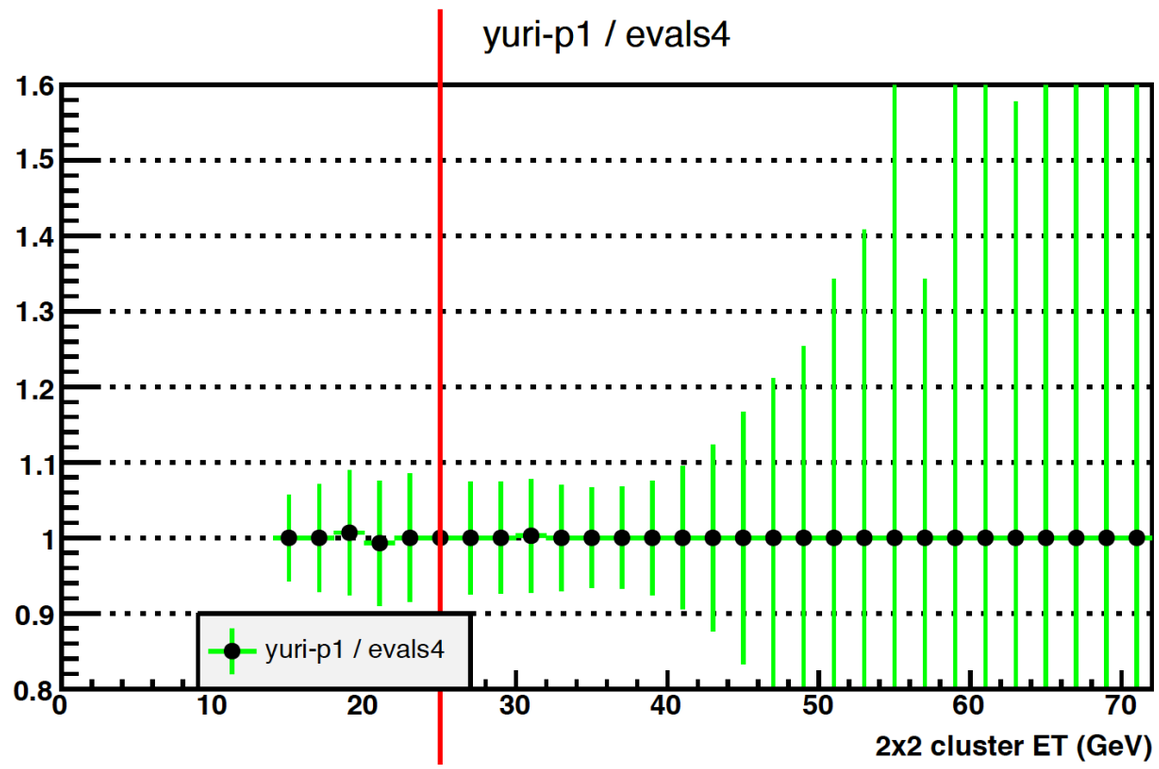
Events Counts as a function of W cuts



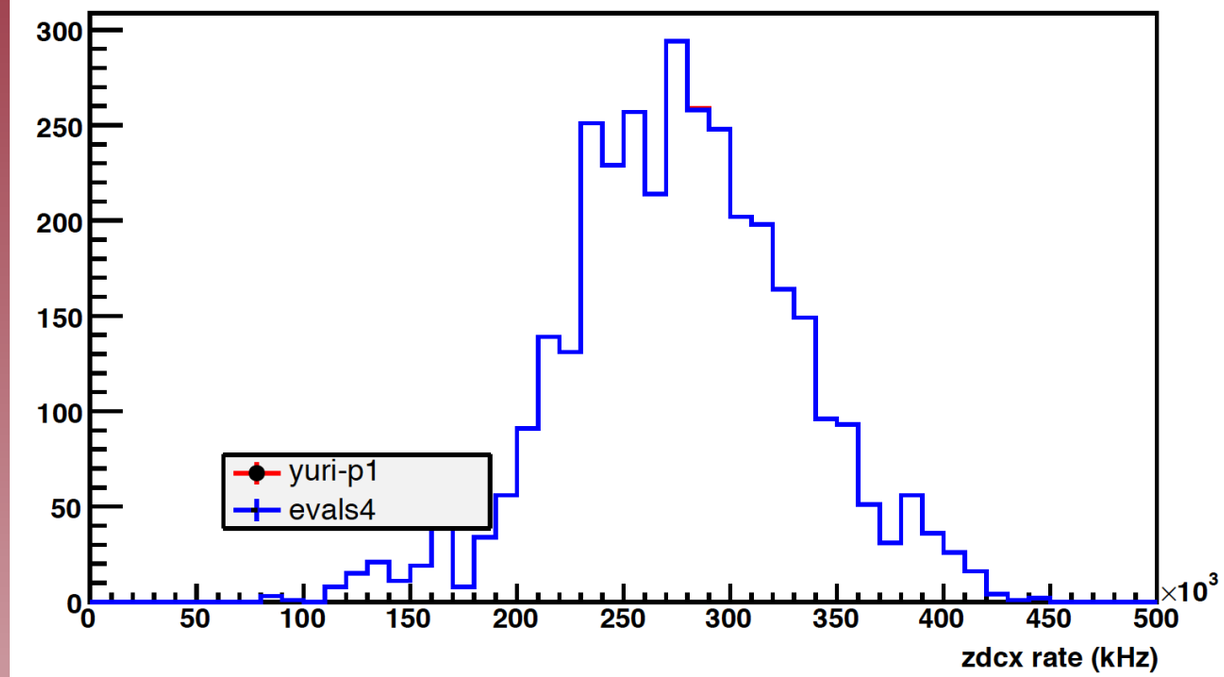
Final W : Et , ZDC

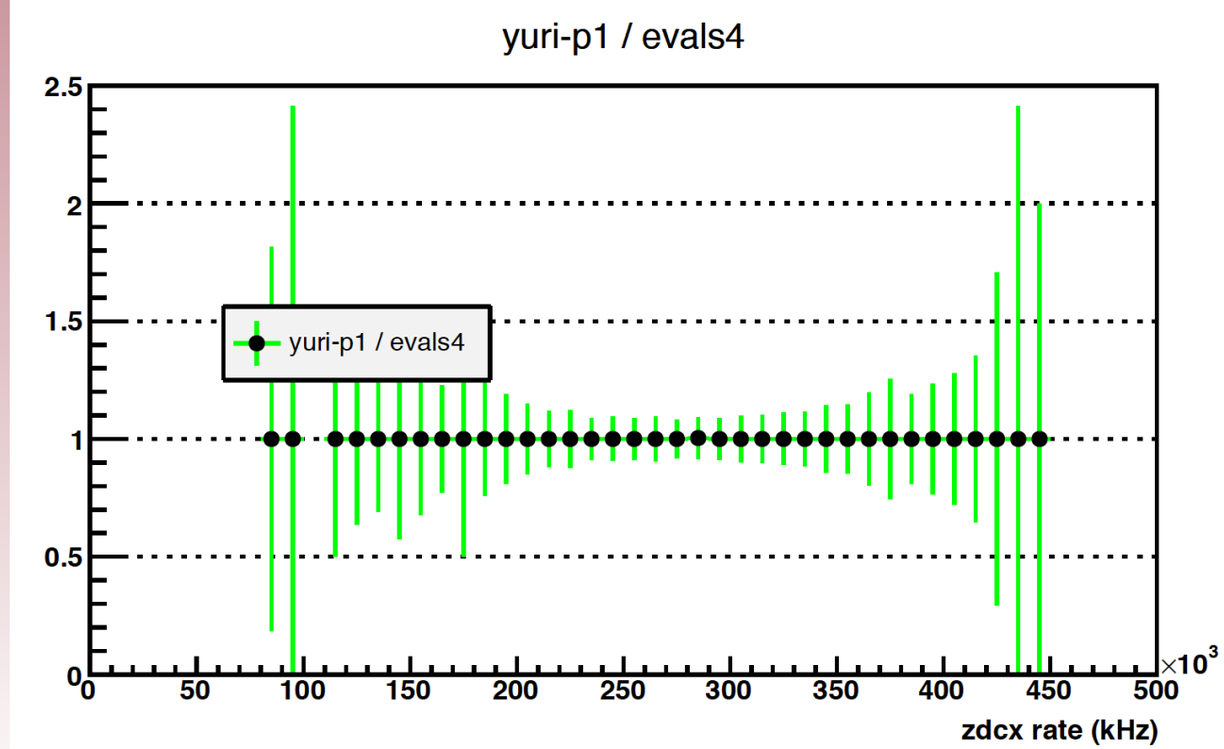
Final W - Et





Final W - ZDC





Summary

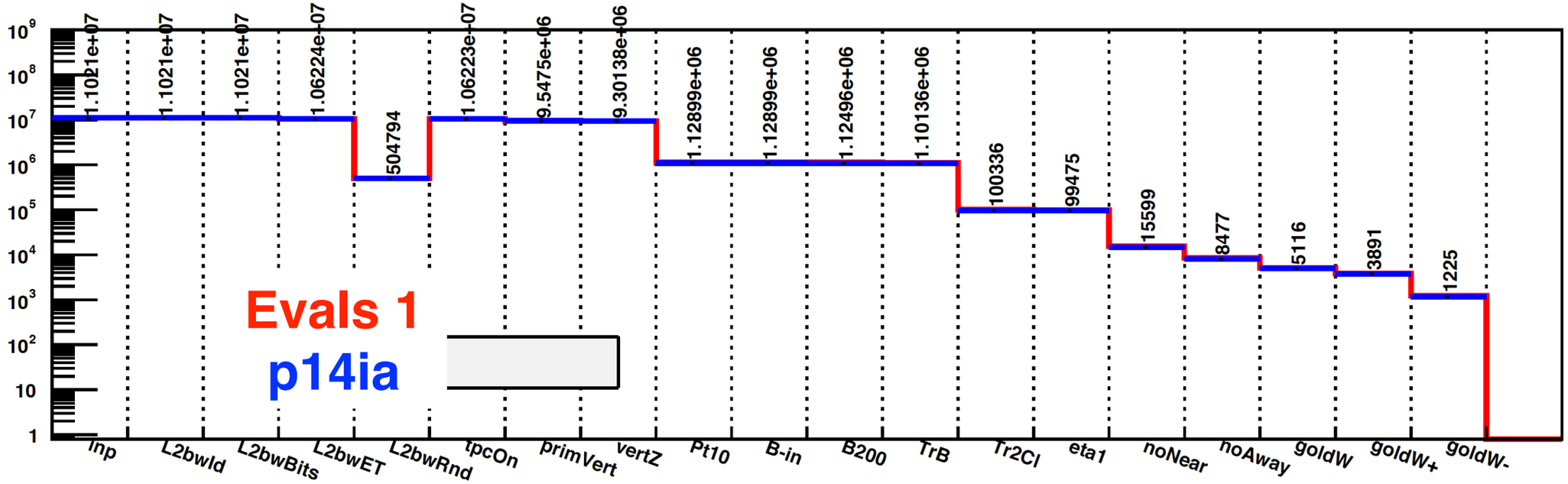
- Absolutely **NO** difference between Evals 4 vs Yuri-p1. Meaning **no difference** between **STICA in EVAL vs STICA in Yuri's code.**

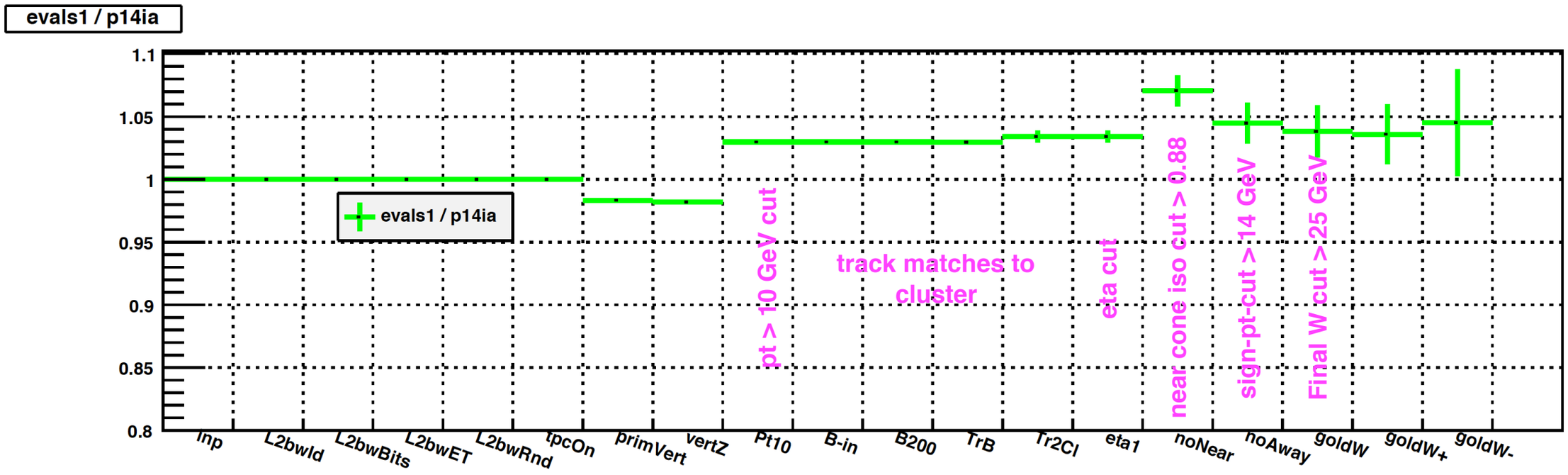
Evals 1 vs p14ia

To investigate the difference between STI in newer STAR library (SL16b) with HFT material vs STI in old STAR library (SL14a) without HFT materials

Production	Production Library [also W-code compiled	Tracking	vertex finding	BEMC-gains	# of runs used in the comparison	# of events
P14ia [official run 13 - P1 (day 76-128)	SL14a	Sti	PPV_W	run 12 - 200 GeV	885	11.021 M
“evals1”	SL16b	Sti	PPV_W	run 12 200 GeV	885	11.021 M

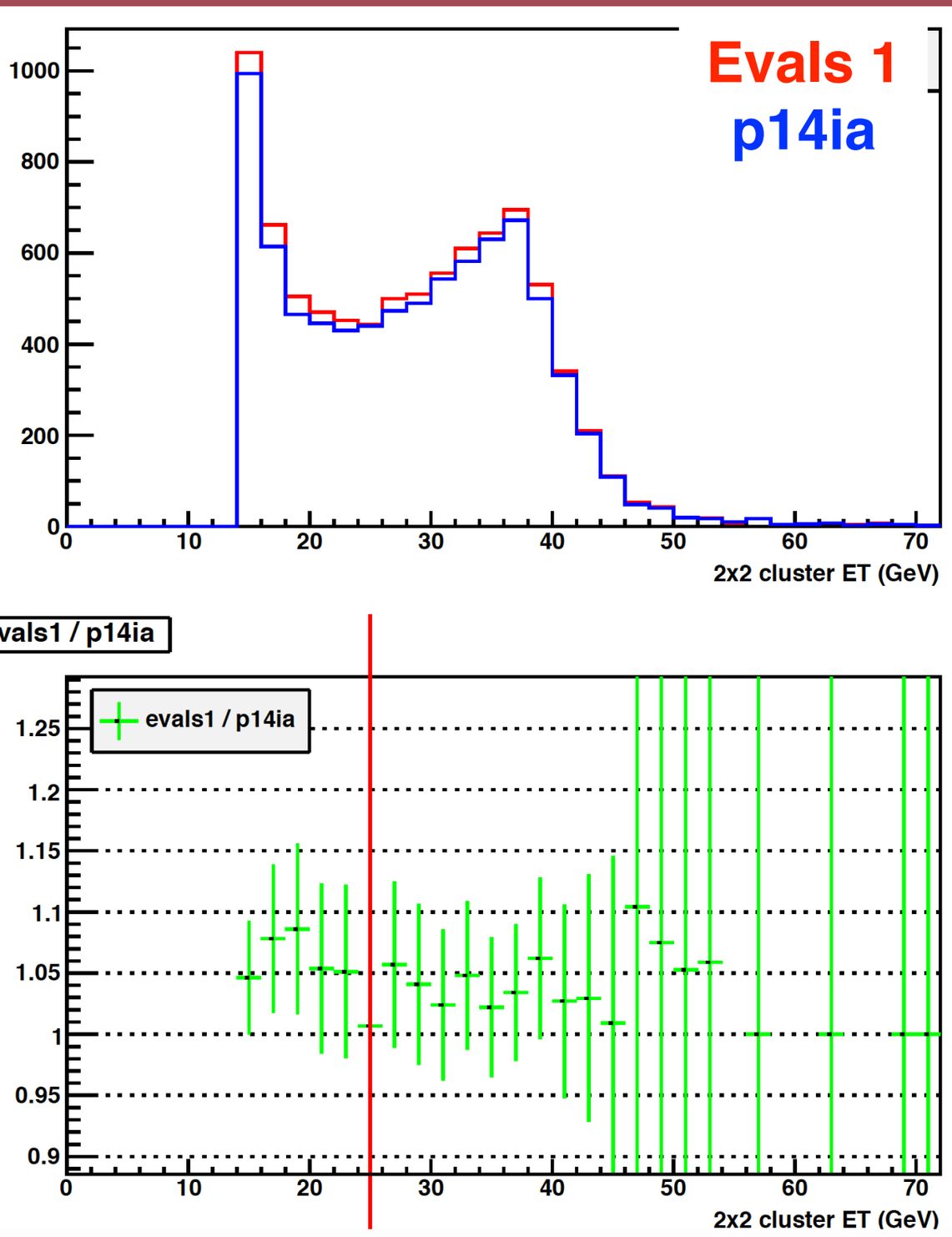
Events Counts as a function of W cuts



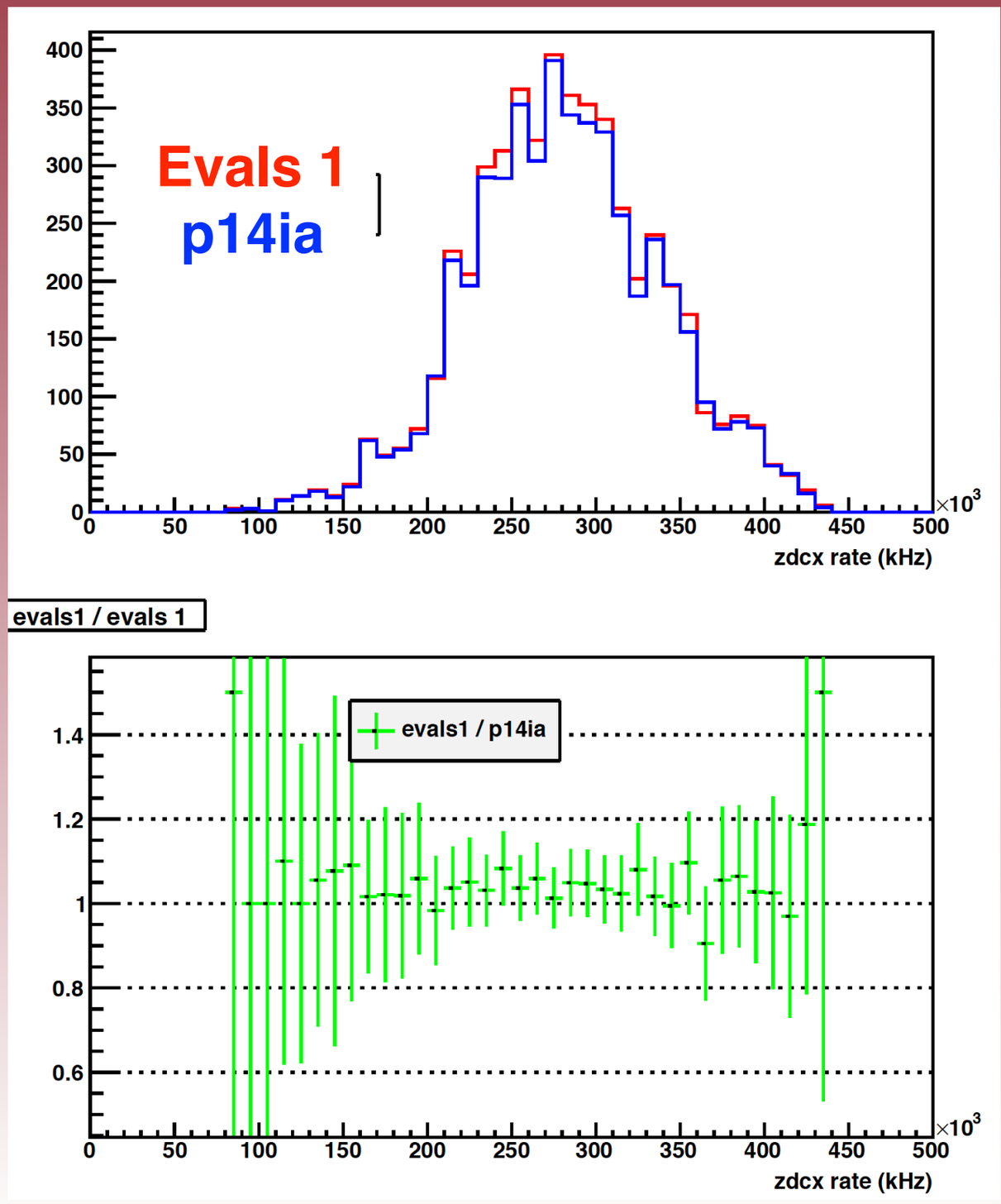


Final W : Et , ZDC

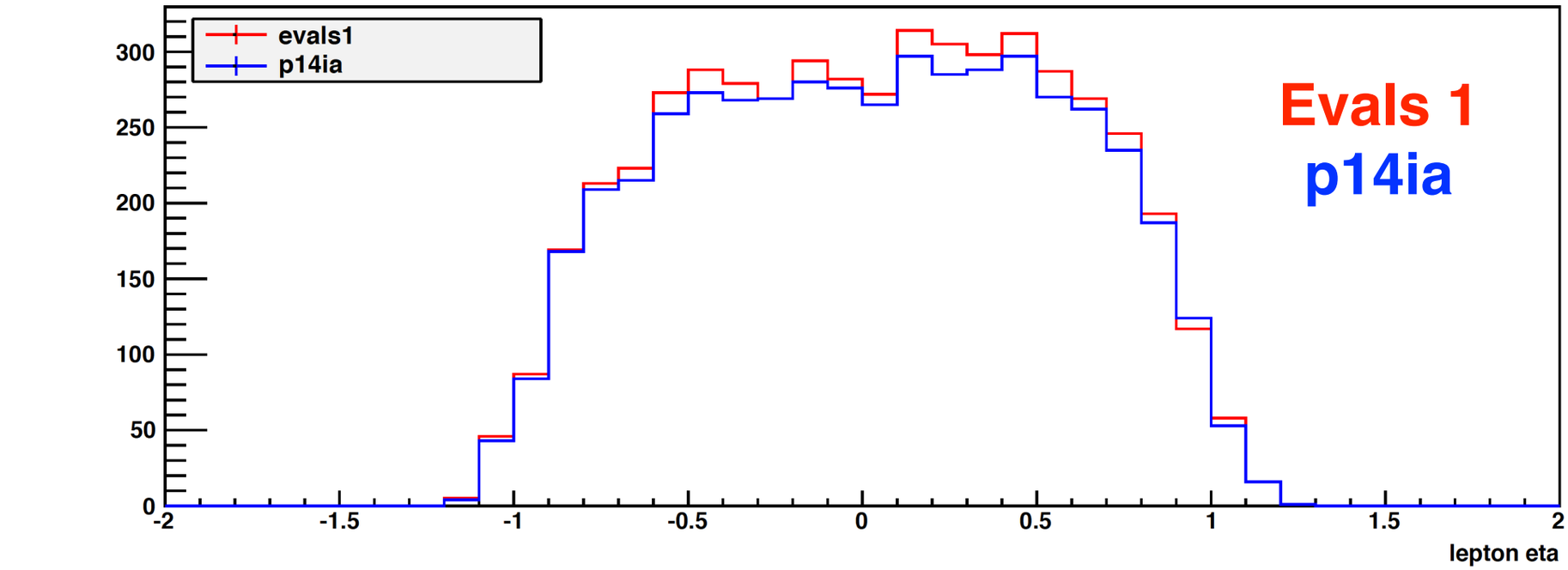
Final W - Et

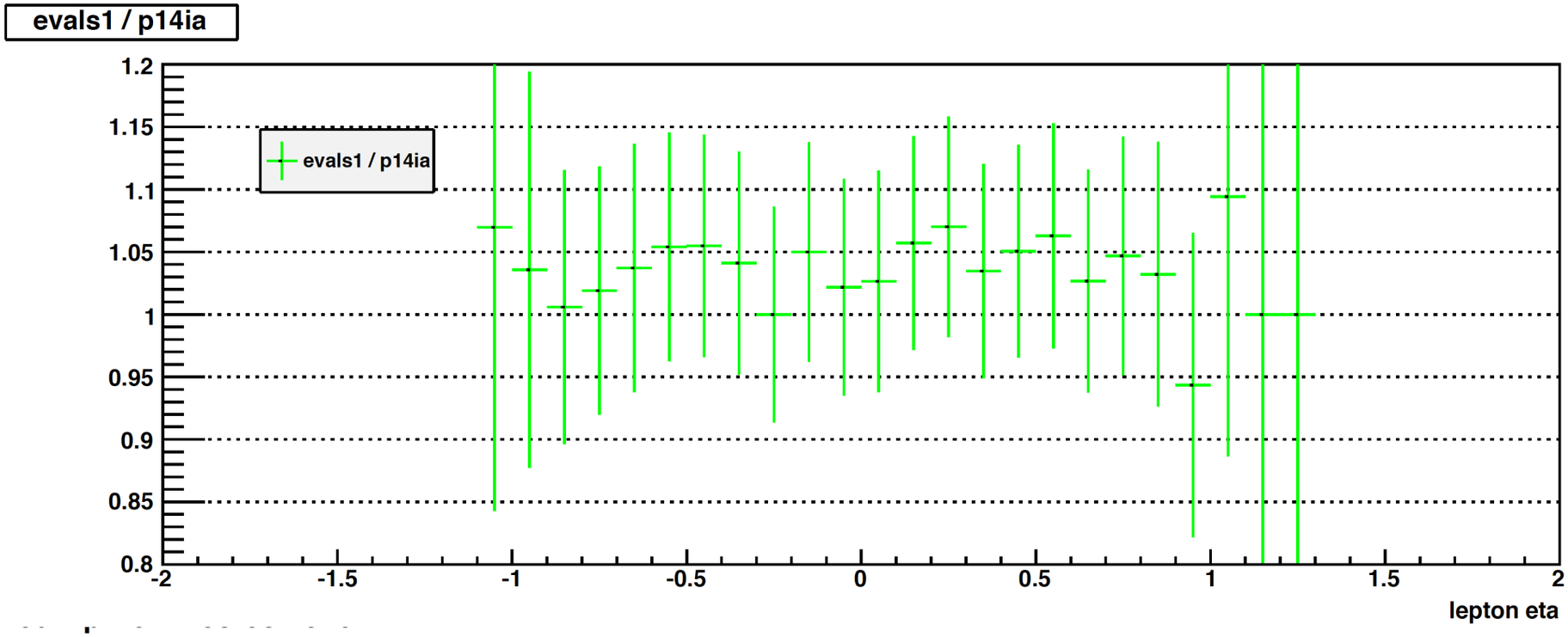


Final W - ZDC



Final W Eta


evals1
p14ia
Evals 1
p14ia
300
250
200
150
100
50
0
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
lepton eta


evals1 / p14ia
evals1 / p14ia
1.2
1.15
1.1
1.05
1
0.95
0.9
0.85
0.8
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
lepton eta

Summary

- ~ 4% enhancement in tracks and final Ws.
- This could be caused by new HFT material / tracking definitions in new SL16b library.
- Nothing will change in the physics due to this.

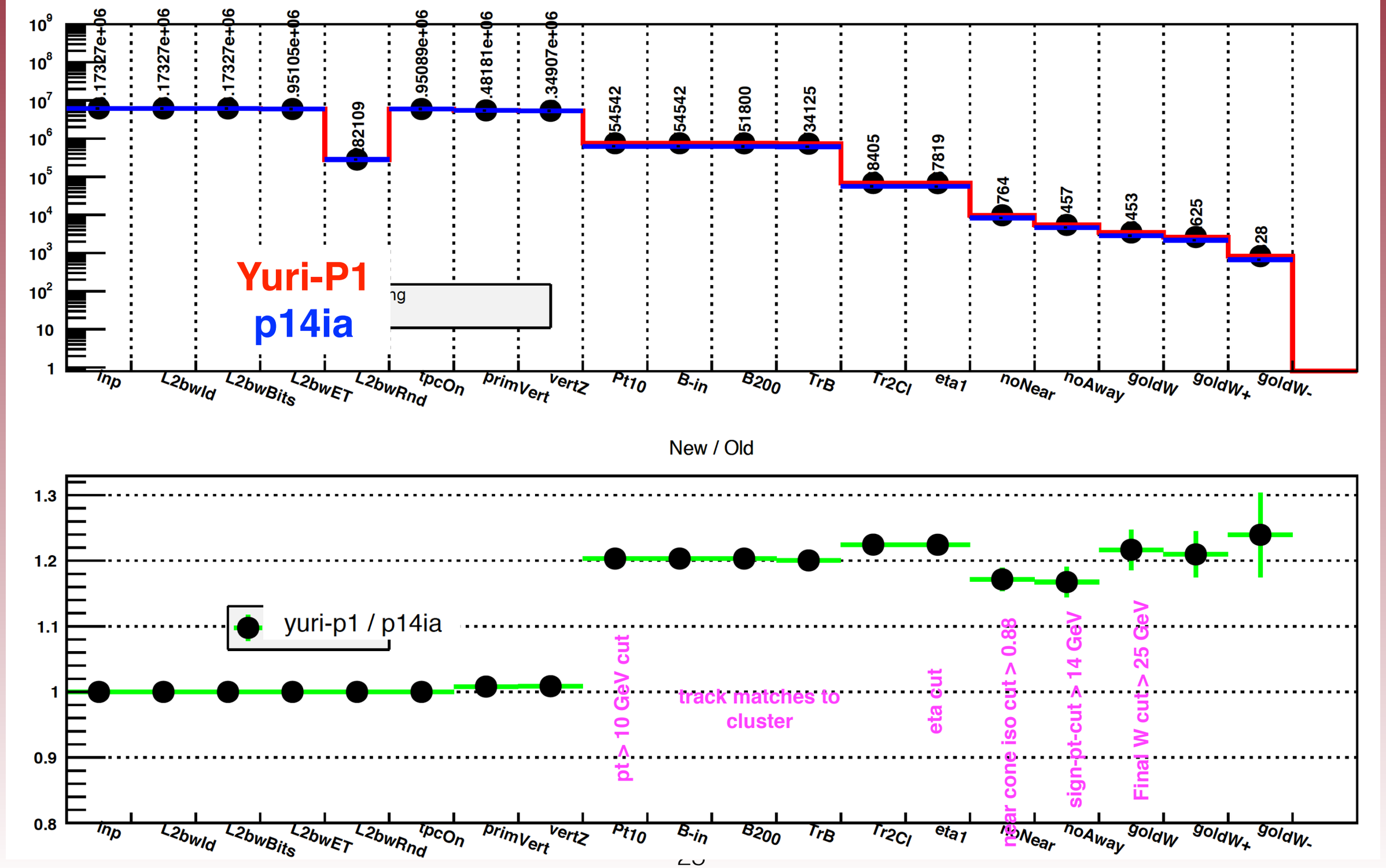
Yuri's-P1 vs P14ia [run 13 - official -P1]

apple- to -apple comparison

To investigate the difference between STI with no HFT material vs Yuri's STICA in run 13 period 1 [<ZDC> ~ 290 kHZ and 50% statistics is below 300 kHz]

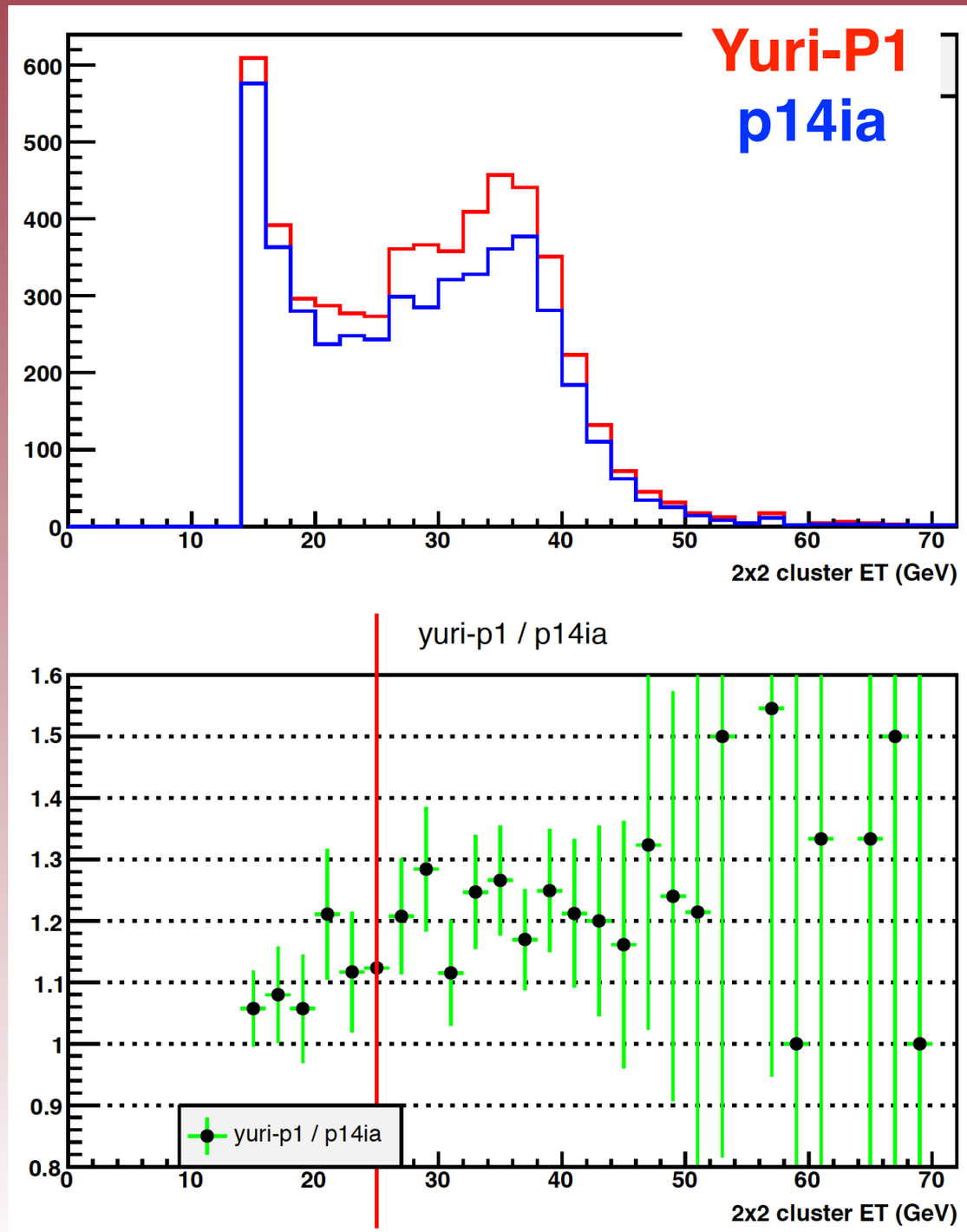
Production	Production Library [also W-code compiled library]	Tracking	vertex finding	BEMC-gains	# of runs used in the comparison	# of events
P14ia [official run 13 - P2 (day 76-126)	SL14a	Sti	PPV_W	run 12 - 200 GeV	585	6172606
Yuri's - P2 (day 76-126)	DEV2/TFG16a	StiCA [Yuri's code]	PPV_W	run 12 200 GeV	585	6172606

Events Counts as a function of W cuts

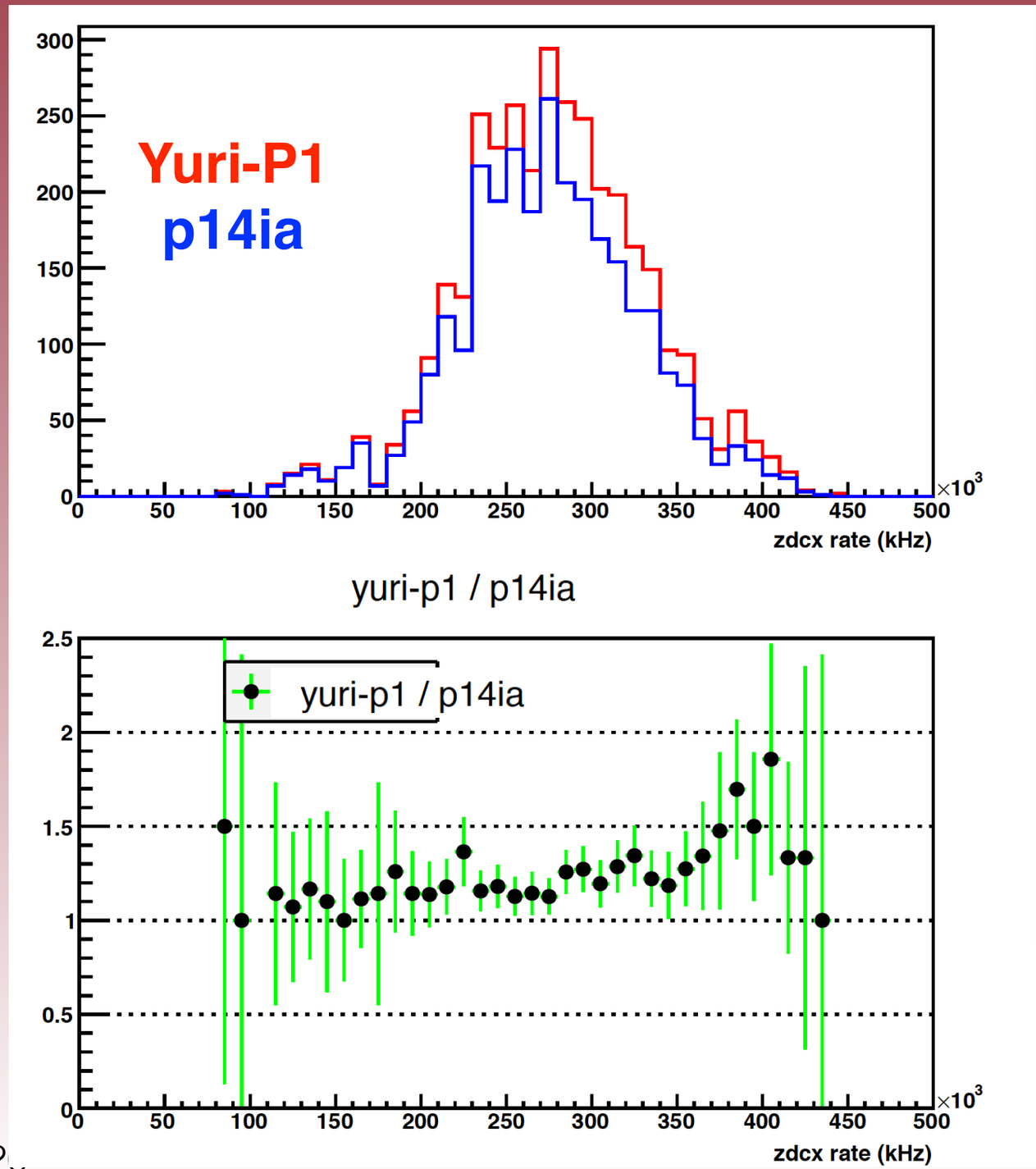


Final W : Et , ZDC

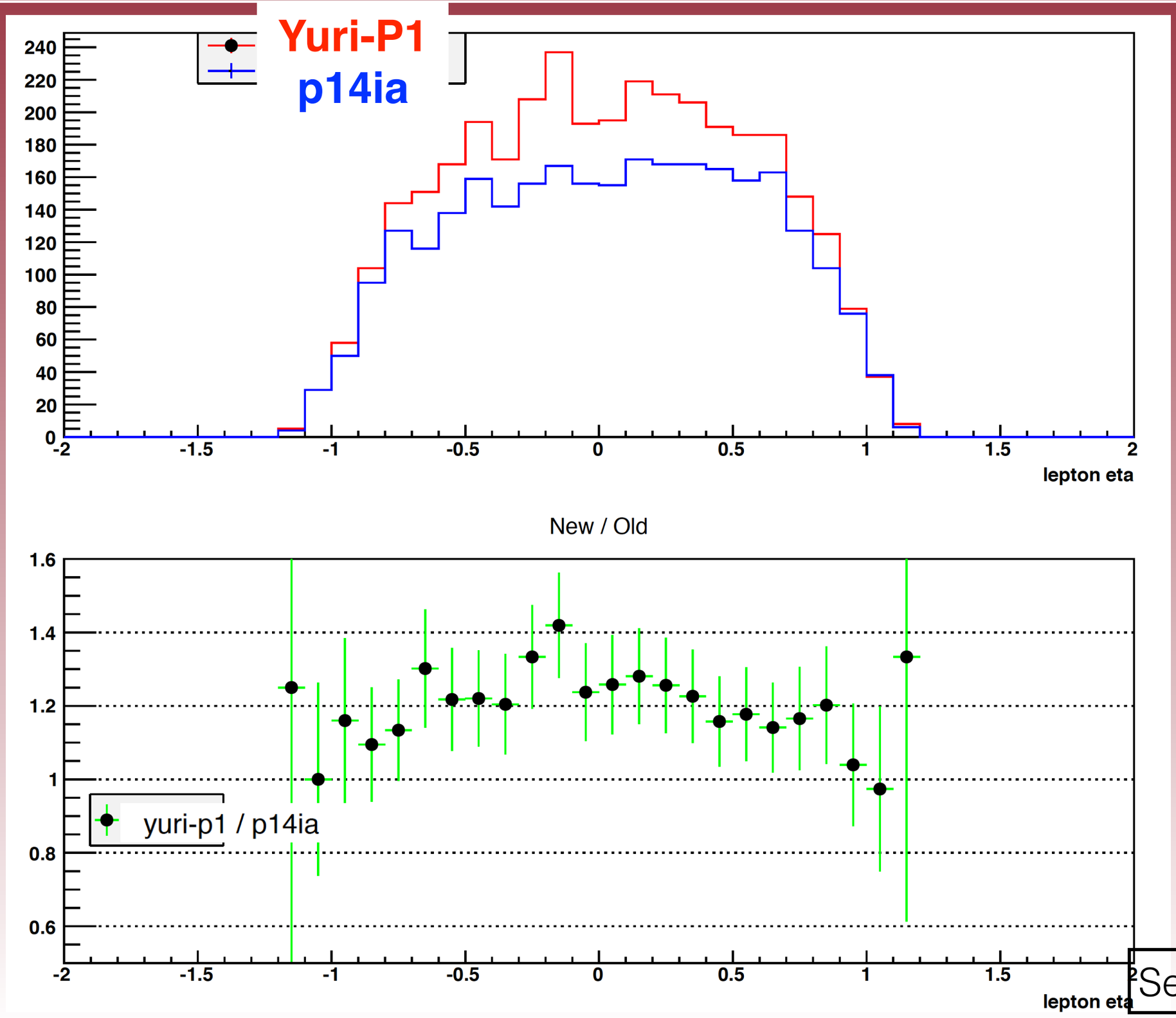
Final W - Et



Final W - ZDC



Final W eta



See Back -up 1

Summary

- ~22 % enhancement in tracks above Pt = 10 GeV and similar enhancement in final W [> 25 GeV] tracks.

- Yuri's production period 1 shows similar results to that of "evals4" which also use "STICA" code on period 1.

- ~18 % change in [evals 1 vs evals 4] + ~ 4% change in [evals 1 vs p14ia] added up to **22% change in Yuri -P1 vs p14ia**. So I would say actual changes to W enhancement in run 13 period 1 from tracking improvement [which include HFT material and STICA] , since official Run 13 production to now is ~ 22% .

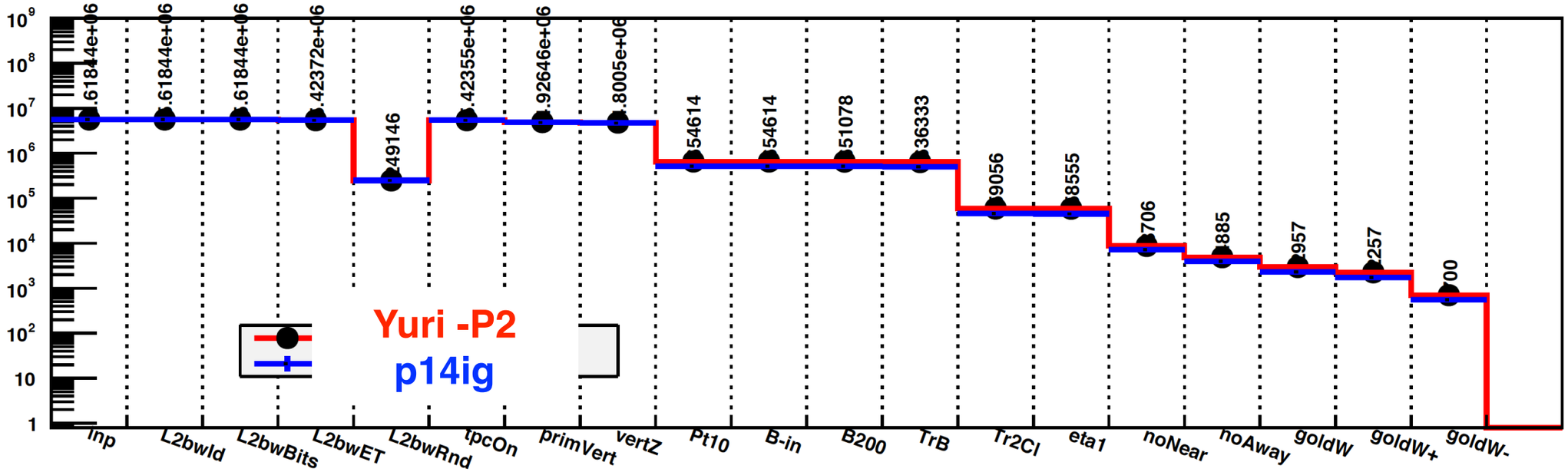
Yuri's-P2 vs P14ig [run 13 - official -P2]

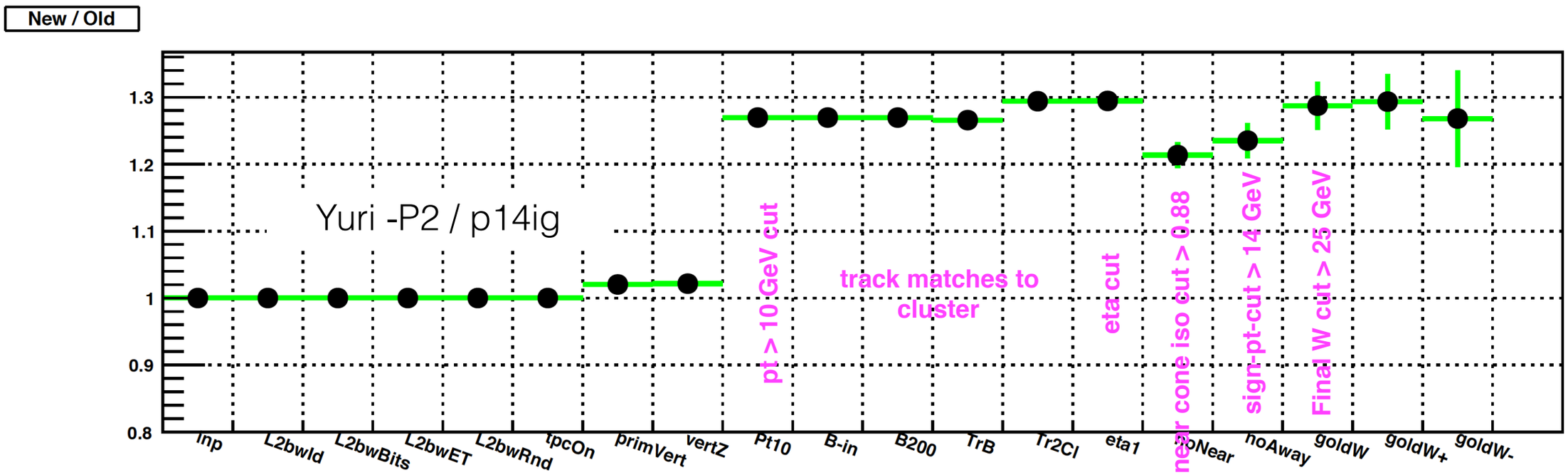
apple- to -apple comparison

To investigate the difference between STI vs STICA [STICA is in Yuri's code] in run 13 period 2 [<ZDC> ~ 350 kHZ and 90% statistics is above 300 kHz] and to test how StiCA deals with the addition HFT materials.

Production	Production Library [also W-code compiled library]	Tracking	vertex finding	BEMC-gains	# of runs used in the comparison	# of events
P14ig [official run 13 - P2 (day 129-161)	SL14g	Sti	PPV_W	run 12 - 200 GeV	436	5618340
Yuri's - P2 (day 129-161)	DEV2/TFG16a	StiCA [Yuri's code]	PPV_W	run 12 200 GeV	436	5618485

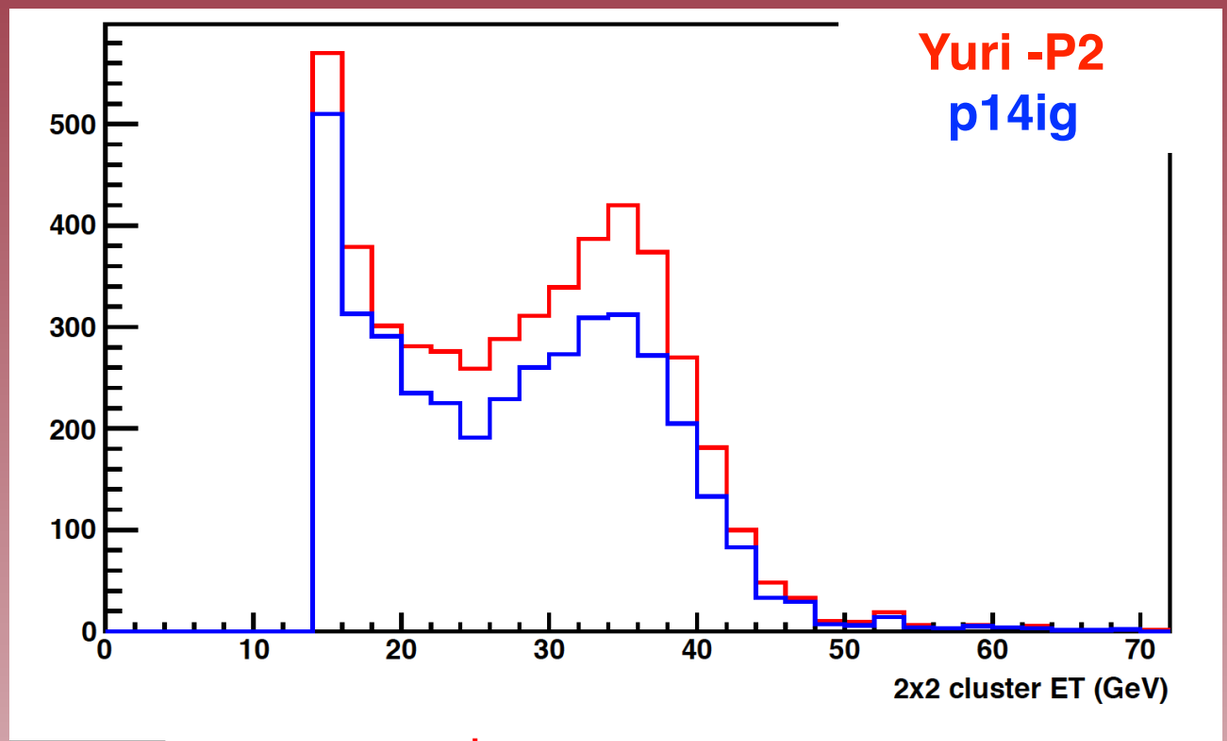
Events Counts as a function of W cuts

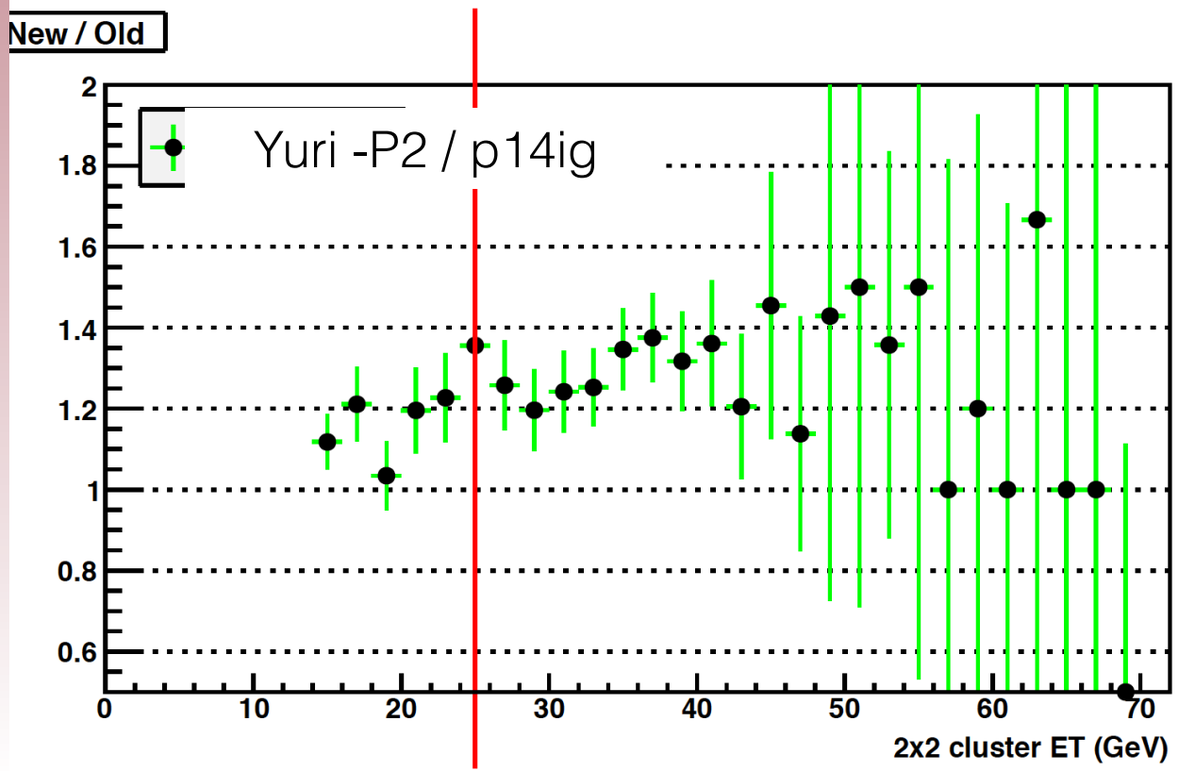




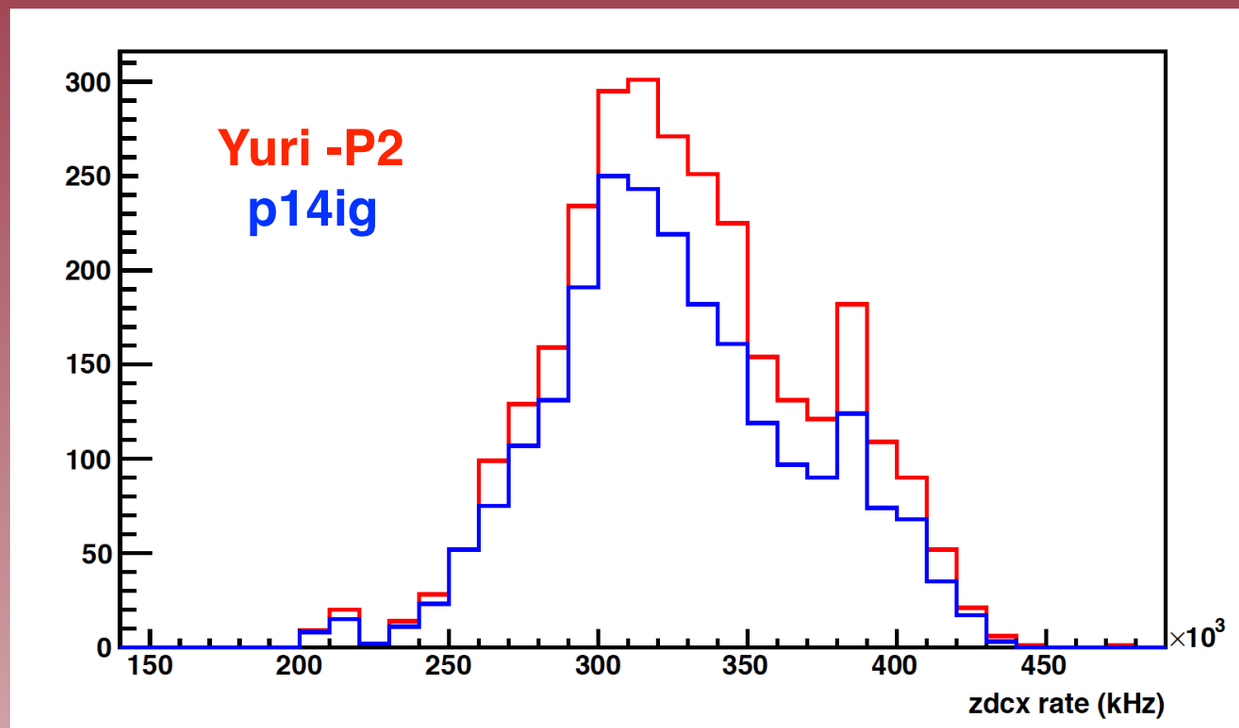
Final W : Et , ZDC

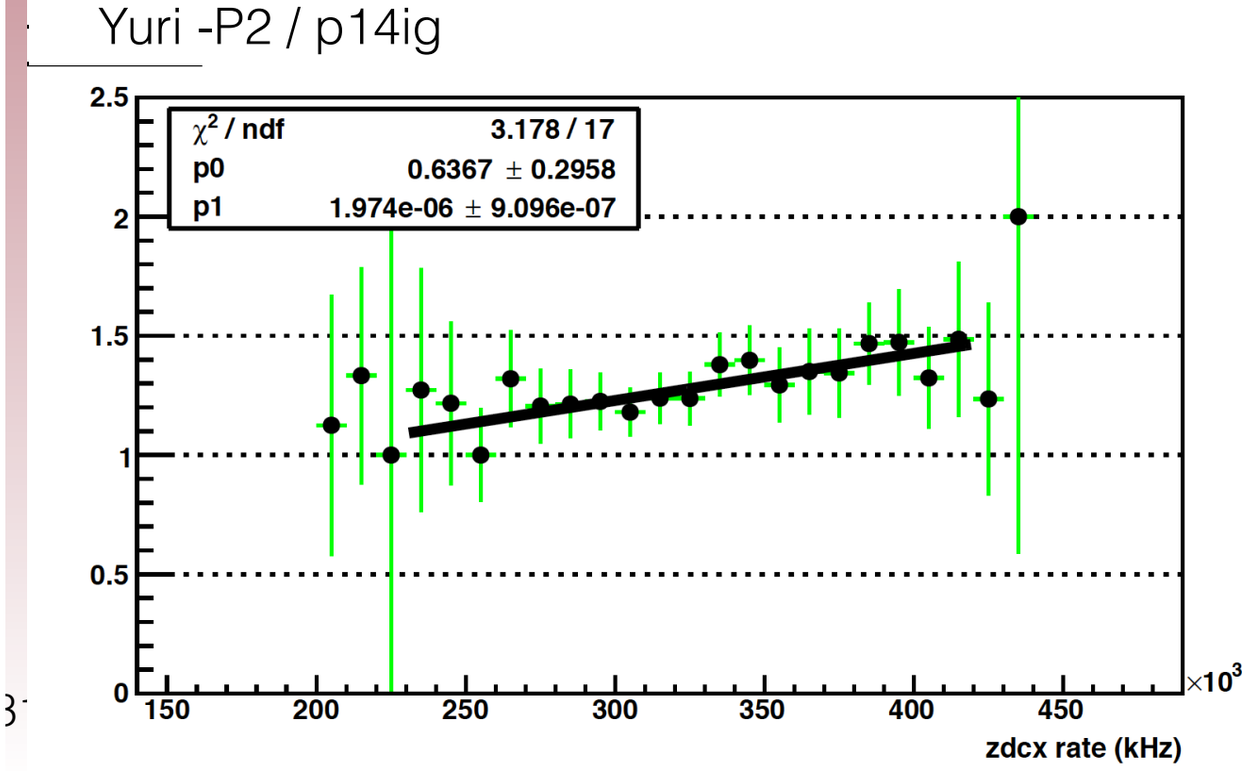
Final W - Et



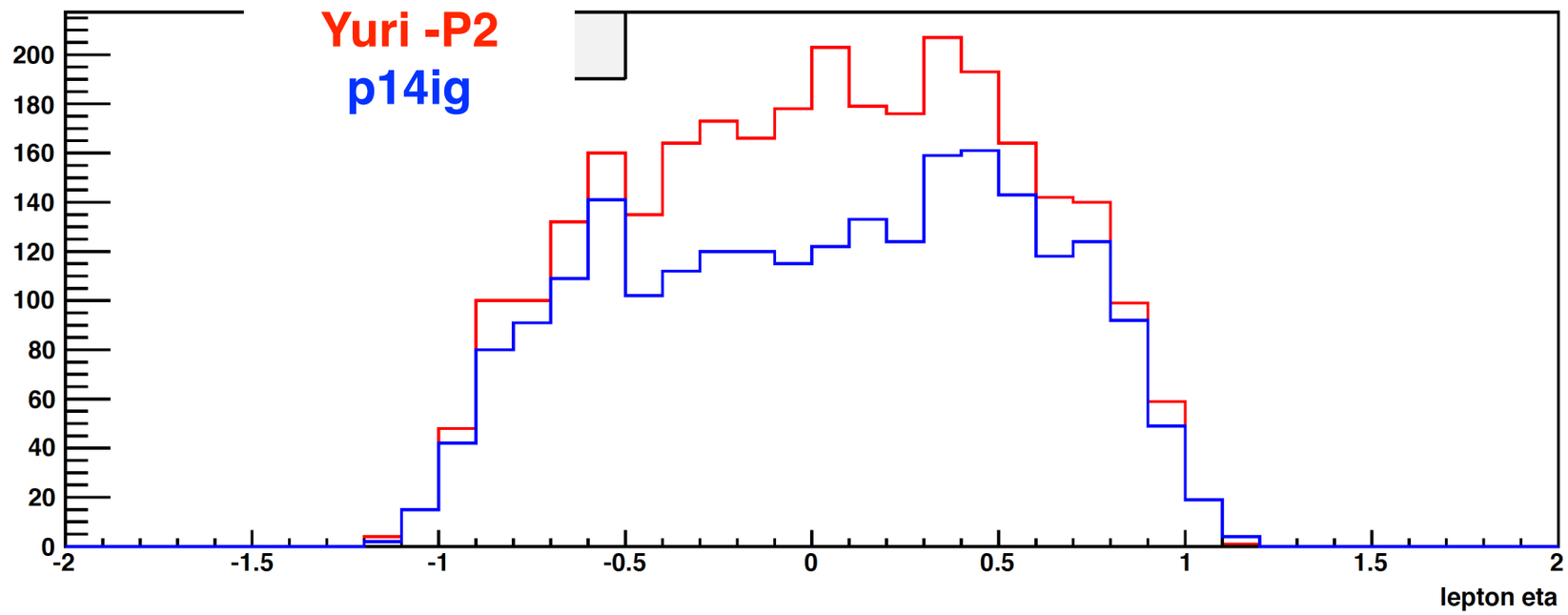


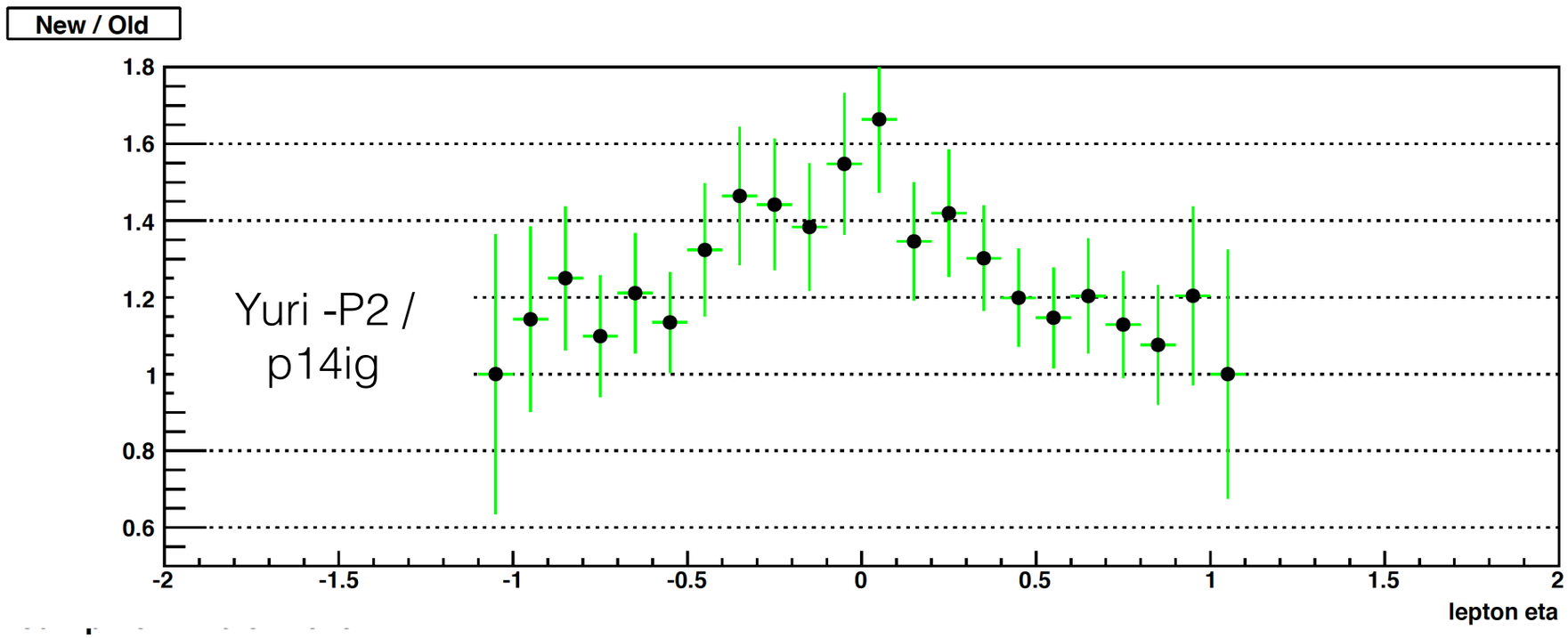
Final W - ZDC





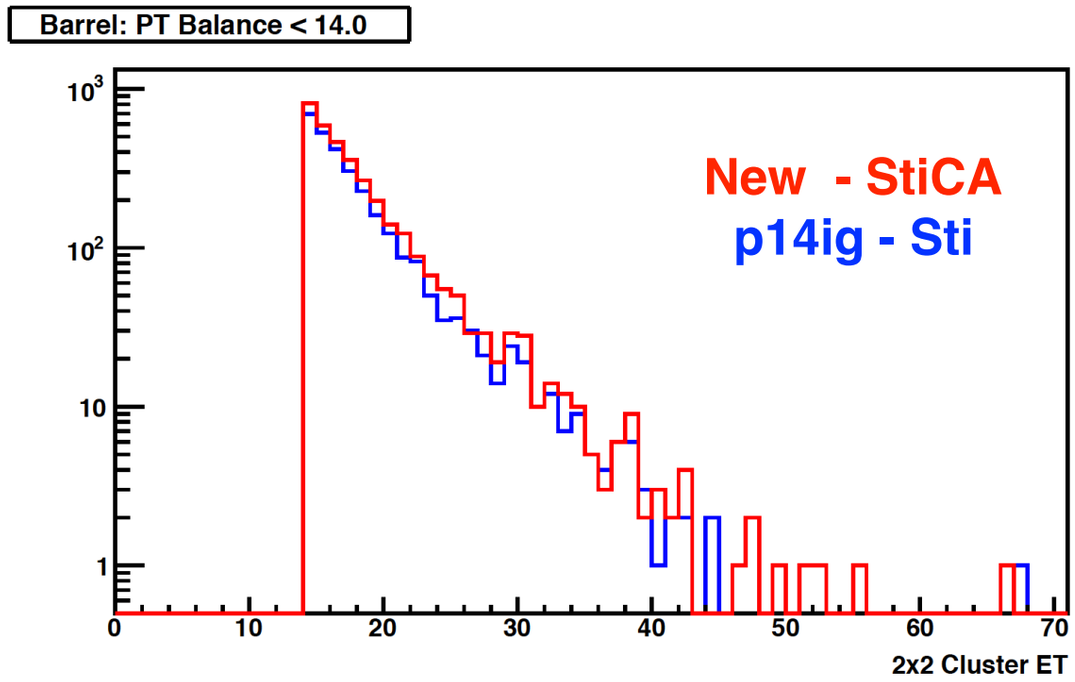
Final W Eta

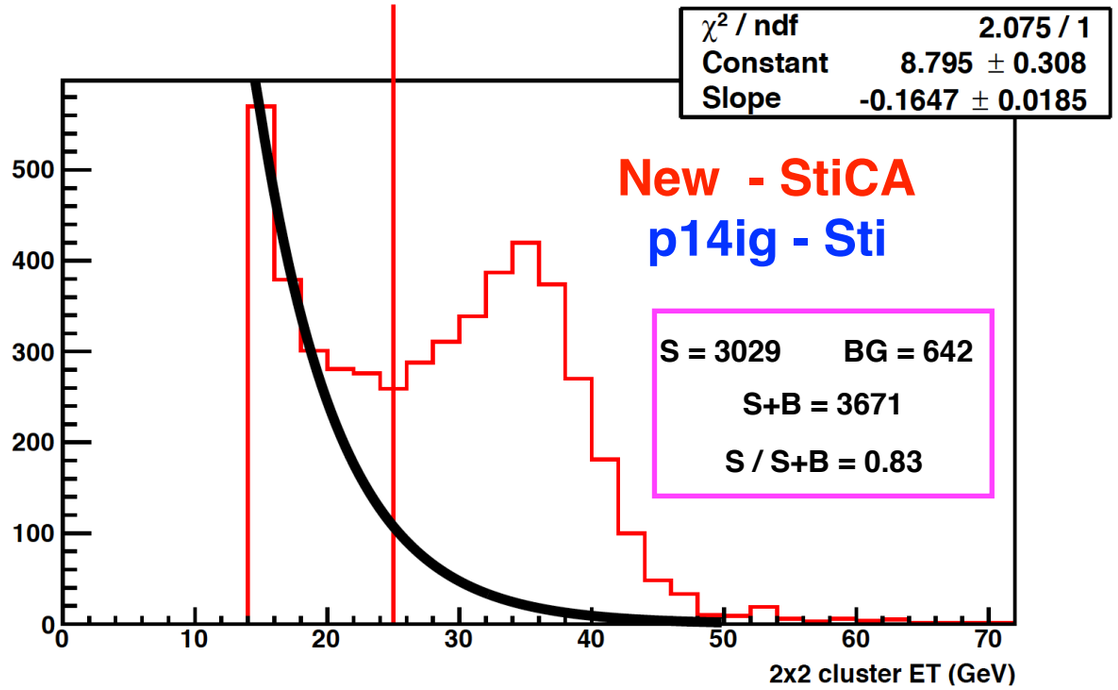


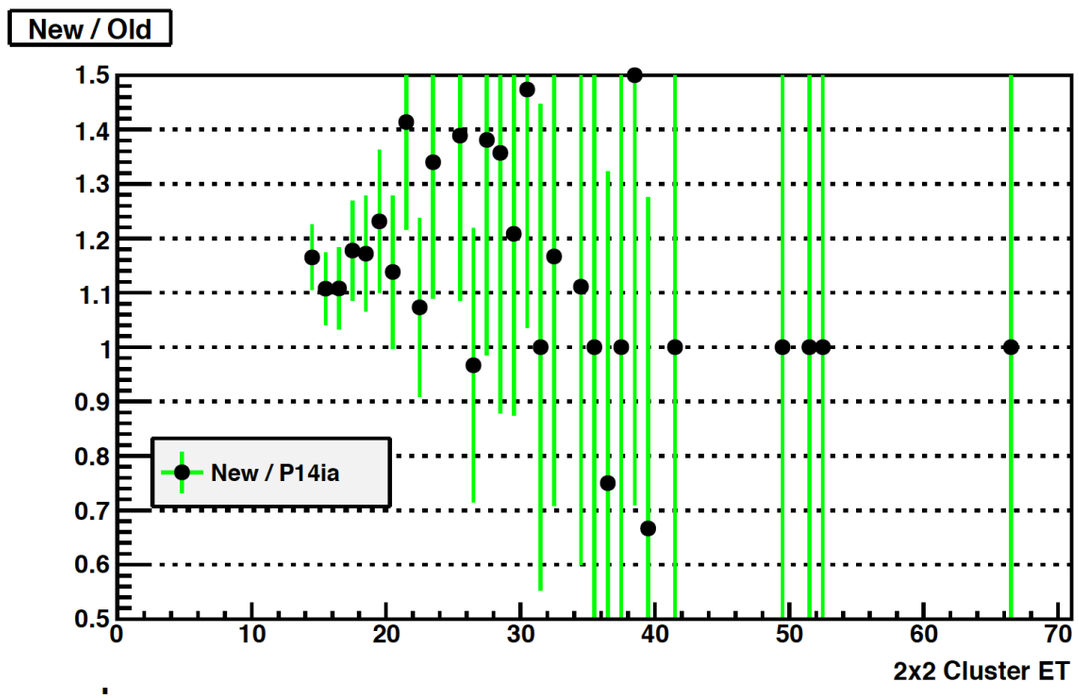


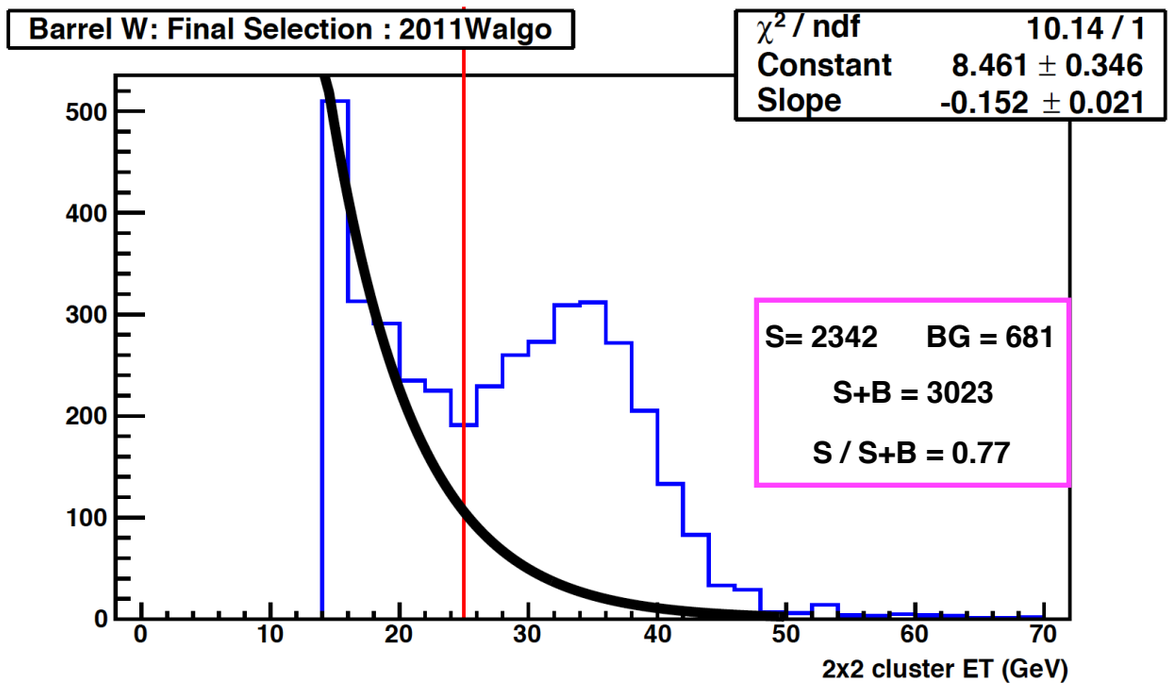
See Back -up 2

QCD BG


Barrel: PT Balance < 14.0
New - StiCA
p14ig - Sti
2x2 Cluster ET


χ² / ndf 2.075 / 1
Constant 8.795 ± 0.308
Slope -0.1647 ± 0.0185
New - StiCA
p14ig - Sti
S = 3029 BG = 642
S+B = 3671
S / S+B = 0.83
2x2 cluster ET (GeV)


New / Old
New / P14ia
2x2 Cluster ET


Barrel W: Final Selection : 2011Walgo
χ² / ndf 10.14 / 1
Constant 8.461 ± 0.346
Slope -0.152 ± 0.021
S= 2342 BG = 681
S+B = 3023
S / S+B = 0.77
2x2 cluster ET (GeV)

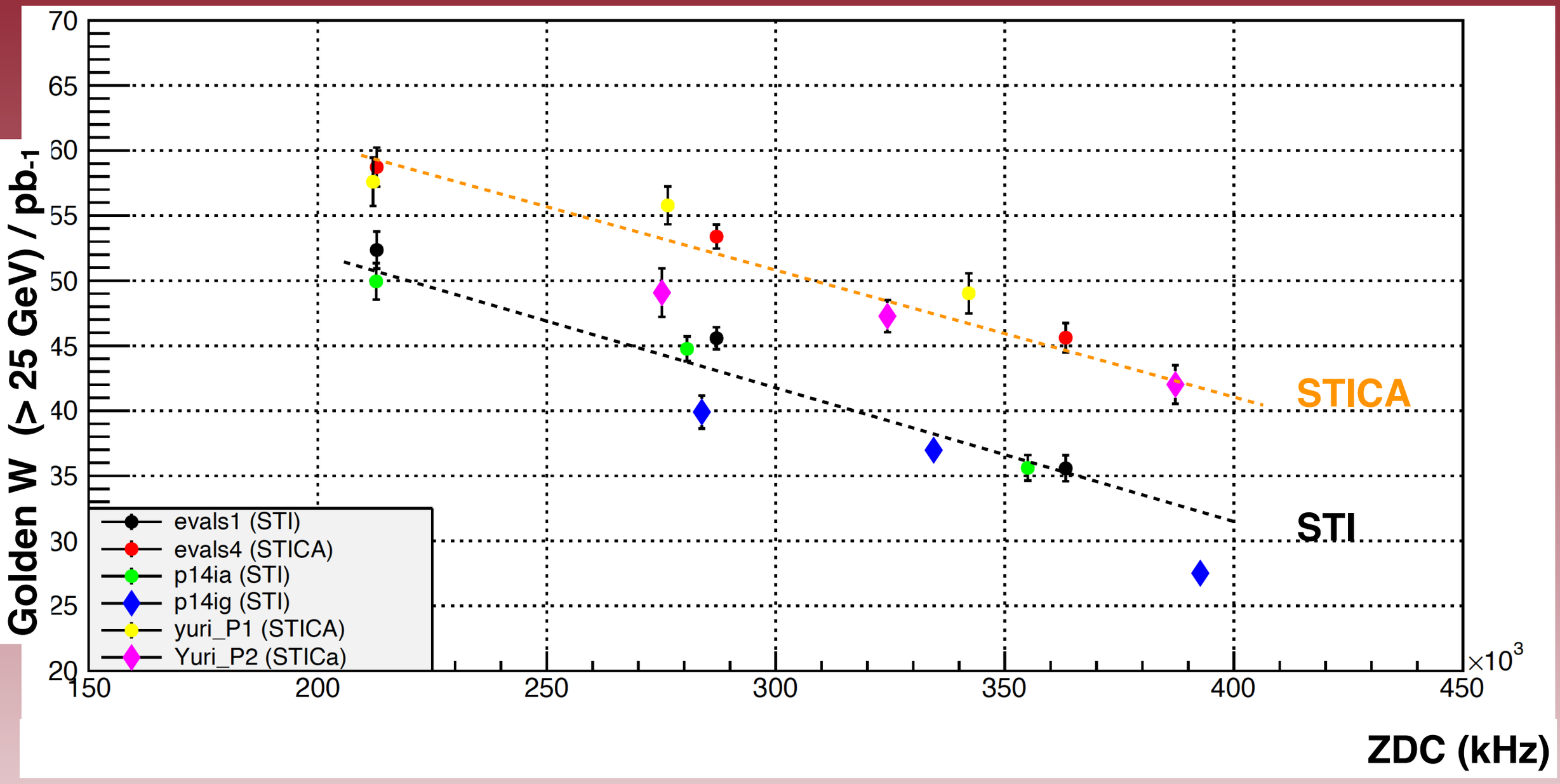
Summary

- ~29 % enhancement in tracks above Pt = 10 GeV and similar enhancement in final W [> 25 GeV] tracks. So this enhancement is since the official run 13 - period 2 production. If a new test production were to made using EVAL for period 2 I would except enhancement of [29% - ~4%] ~ 25 %.

- Significant enhancement of final W Eta in mid rapidity region where a “dip” was observed previously.

- Significant improvement in signal to background ratio .

W efficiency as a function of ZDC



- Black(P1) , Green (P1) and Blue (P2) used STI tracking
- Red(P1) , Yellow (P1), Magenta (P2) used STICA tracking
- Enhancement in efficiency increases with increasing ZDC .

Summary / Conclusions

- No difference between STI vs STI* [official STI vs Yuri's STI in EVAL] codes.
- ~18% enhancement in run 13 period 1 W, from STI to STICA codes which also include HFT materials.
- No difference between STICA in EVAL library vs STICA in Yuri's code.
- ~ 4 % enhancement from STI code with and without HFT materials.
- Yuri's production allows to investigate the STICA tracking performance for whole luminosity range of run 13 where <ZDC> increased from Period 1 to Period 2 by 15 % and 90 % statistics in period 2 lies above the <ZDC> of period 1, and also to test how StiCA deals with the additional material of the HFT material in period 2.
- Enhancement in W from Yuri's period 1 production is in agreement with the enhancement in EVALS 4.
- Enhancement in W in period 2 is about ~ 29 % from STI to STICA with No HFT in STI. It would be ~ 25 % from STI to STICA with HFT included in STI.
- **Enhancement in W efficiency is significant from STI to STICA. Improvement increases with increasing luminosity.**

Reproduction of Run 13 data with STICA+PPV_W settings is urgently requested follow up by MC Embedding production for W AL analysis and cross section analyses.

Outlook

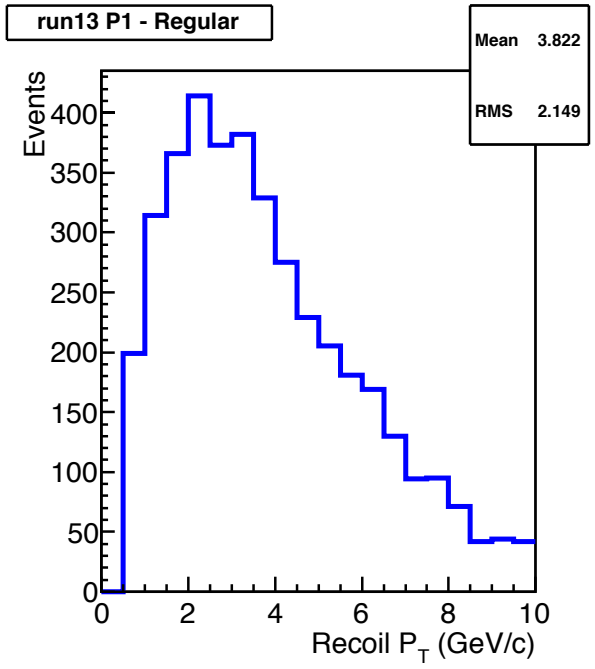
- First results for Evals 6 is obtained in comparison to Evals 1, to see the difference between with and without “hits reuse for tracks in STI”, but need to be wetted in more detail to make sure all is correct and it is a true apple-to-apple comparison

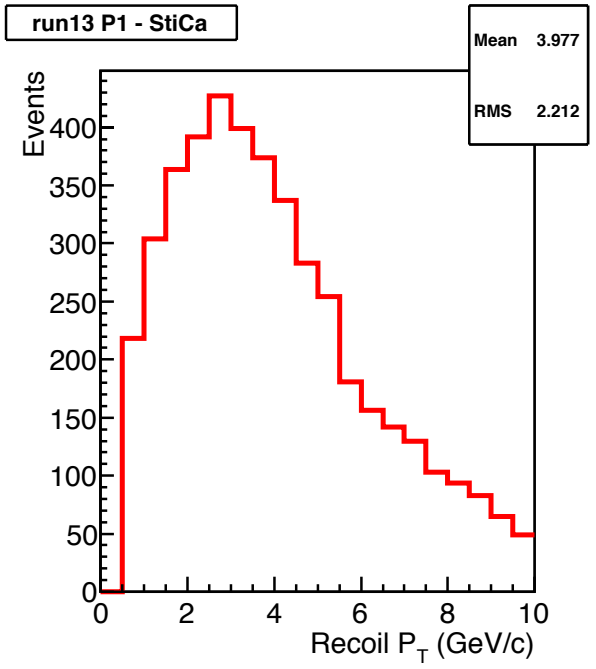
- Once the proper evaluation done this results also can be present to S&C soon.

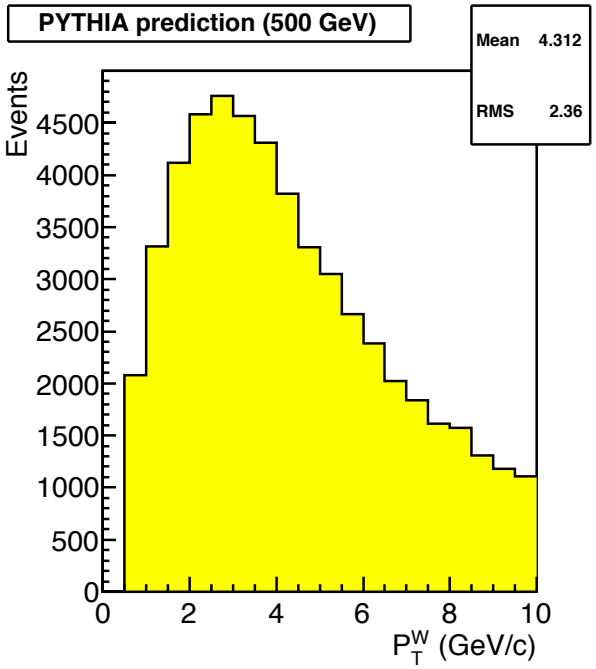
Analysis from Salvatore

reconstruction of the W-recoil

Production comparison







Regular: Sti official production (SL14a)

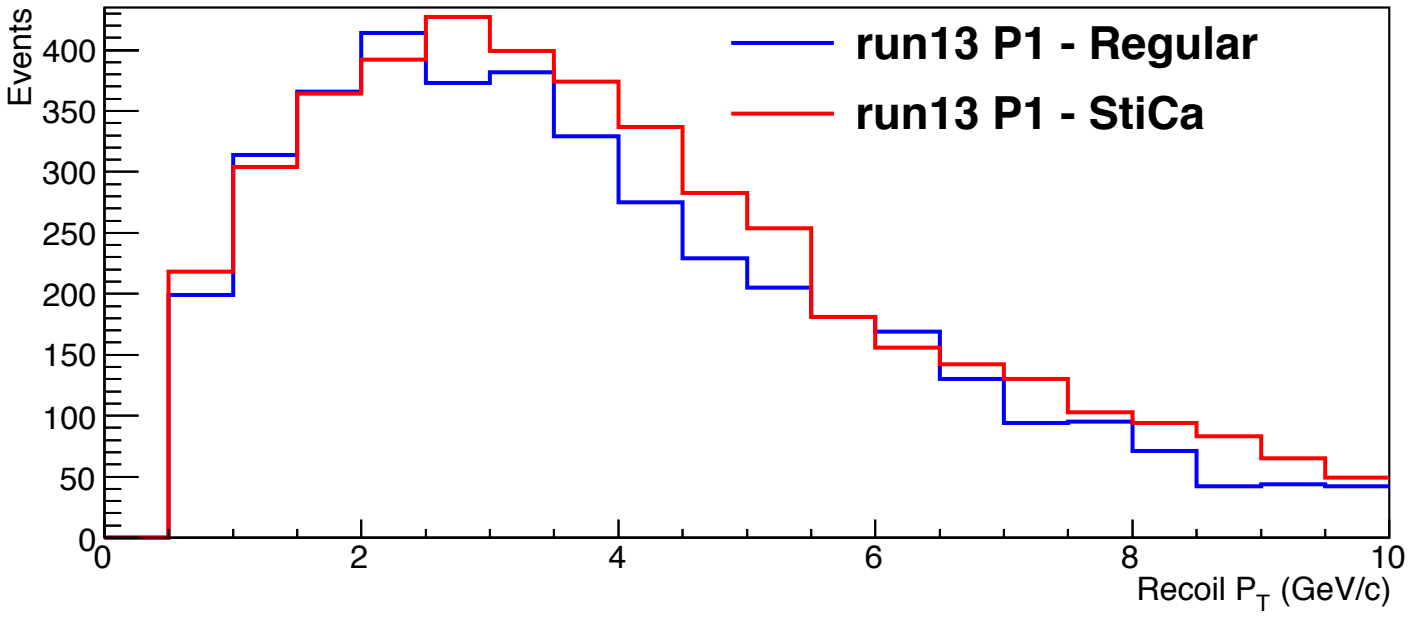
StiCa: Yuri's StiCa private production (dev2)

All W reconstruction cuts applied

No MC correction to get full recoil Pt done**!**

Sti Mean = 3.82 GeV **StiCa Mean= 3.98 GeV** **PYTHIA prediction = 4.31**

Production comparison



Regular: Sti official production (SL14a)

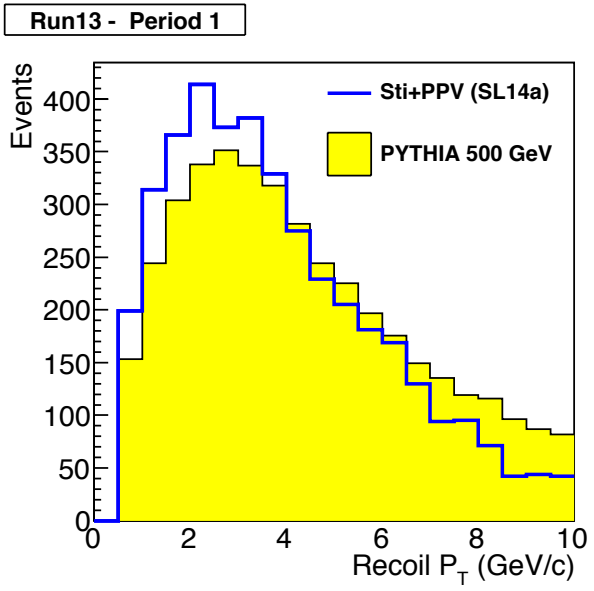
StiCa: Yuri's StiCa private production (dev2)

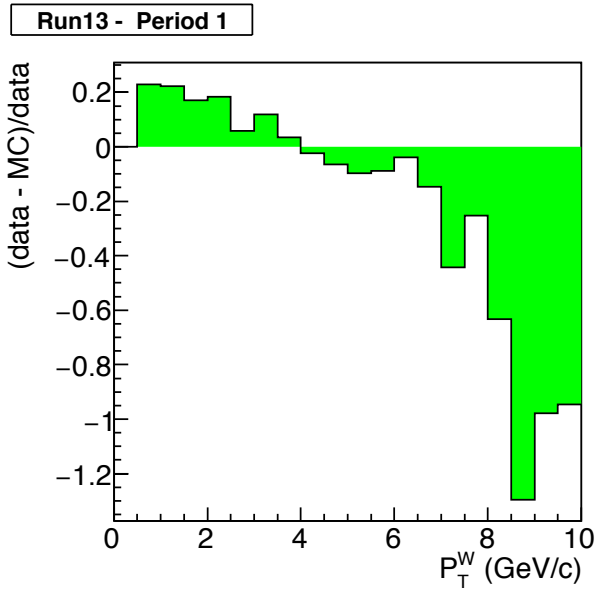
All W reconstruction cuts applied

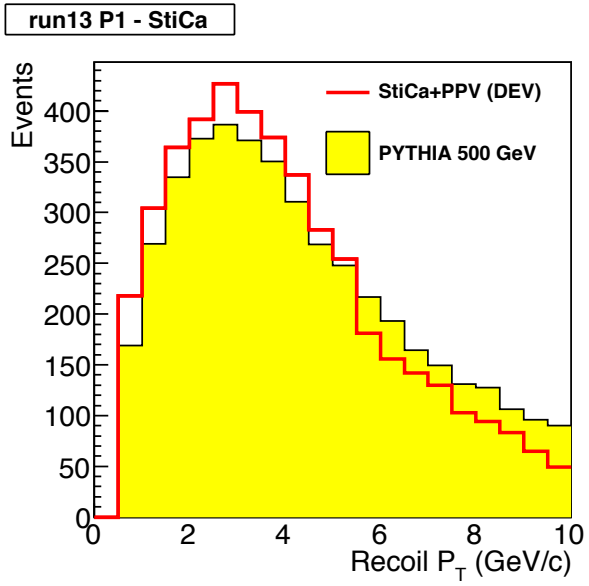
No Pt correction done!

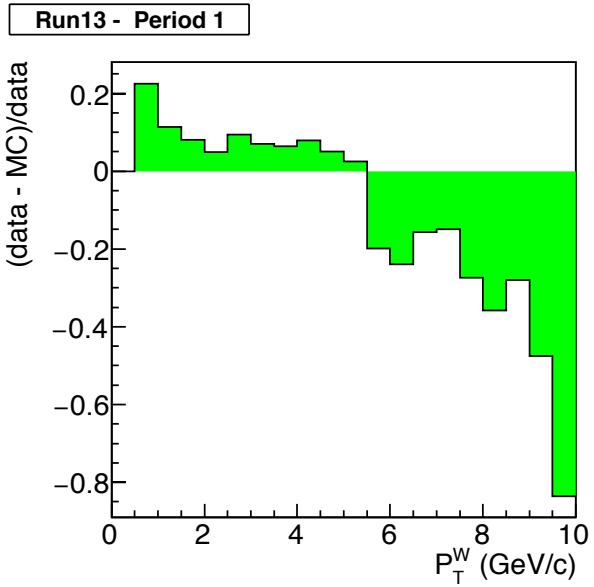
- Overall ratio StiCa(Yuri's)/Sti(regular) = 1.11 after W reco. cuts for run 13 period 1
- StiCa W-Pt peak and distribution shifted to the right... lets compare to expectation

Production comparison







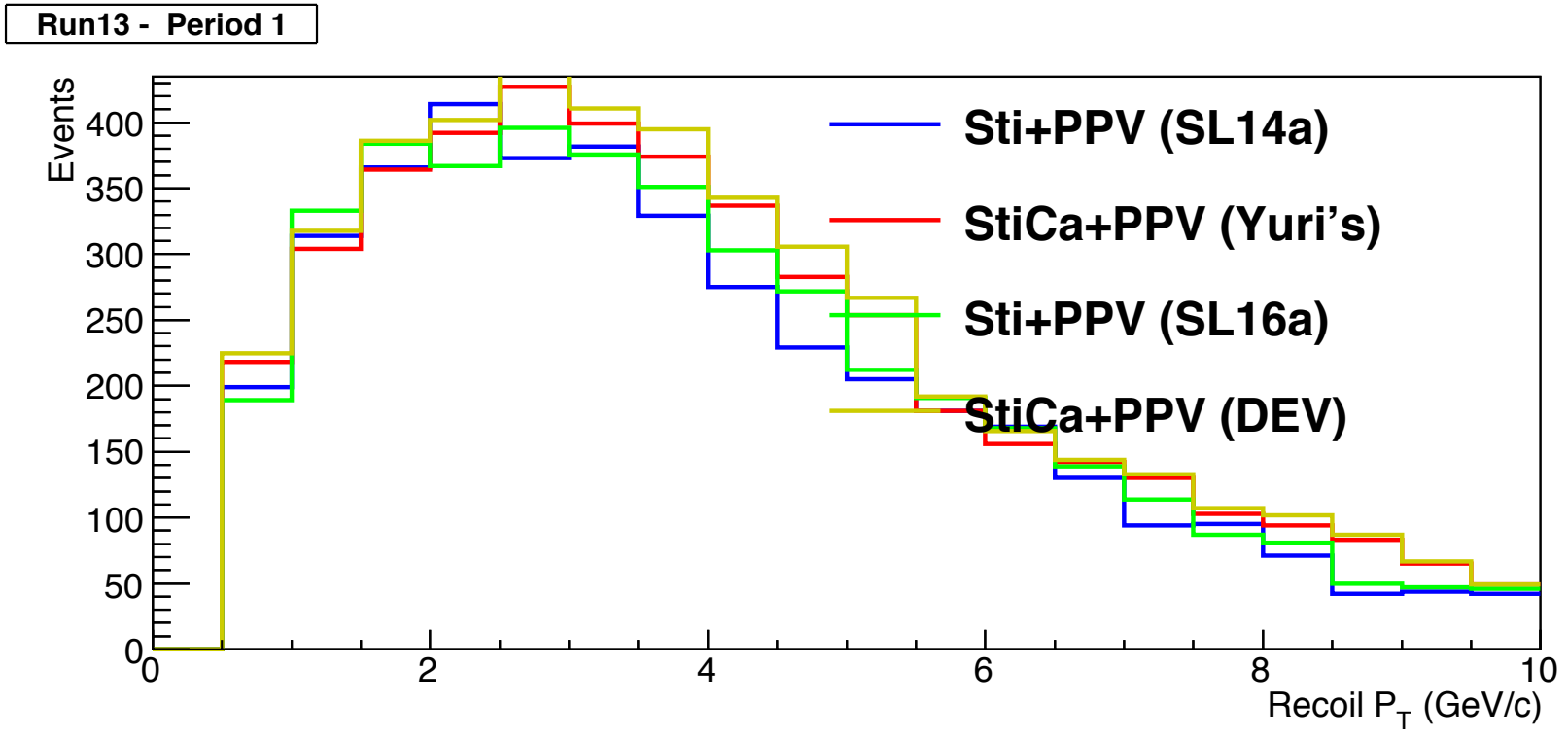


StiCa peak on top of the prediction peak

→ less correction needed!

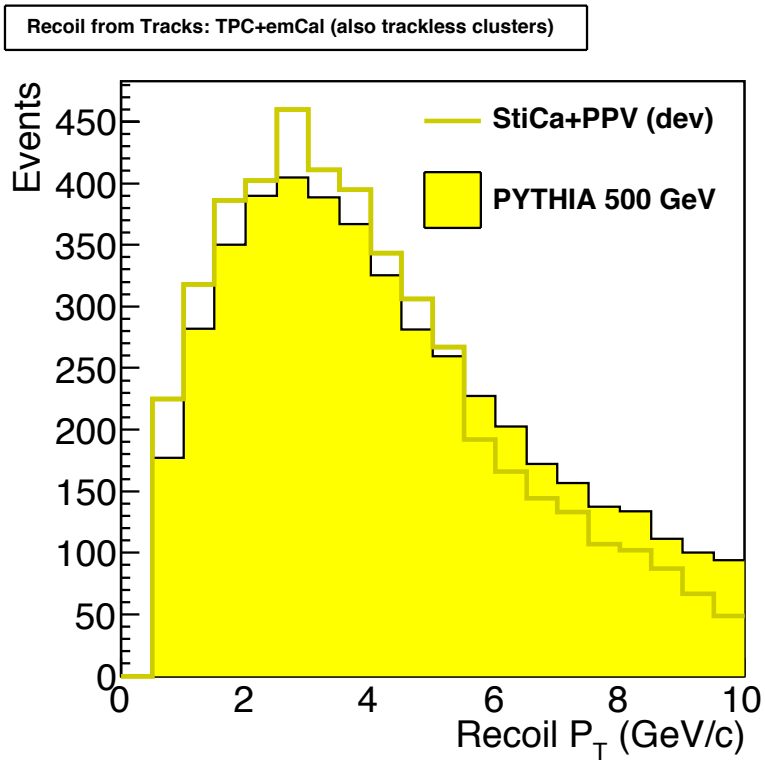
Lets look at all the TEST productions

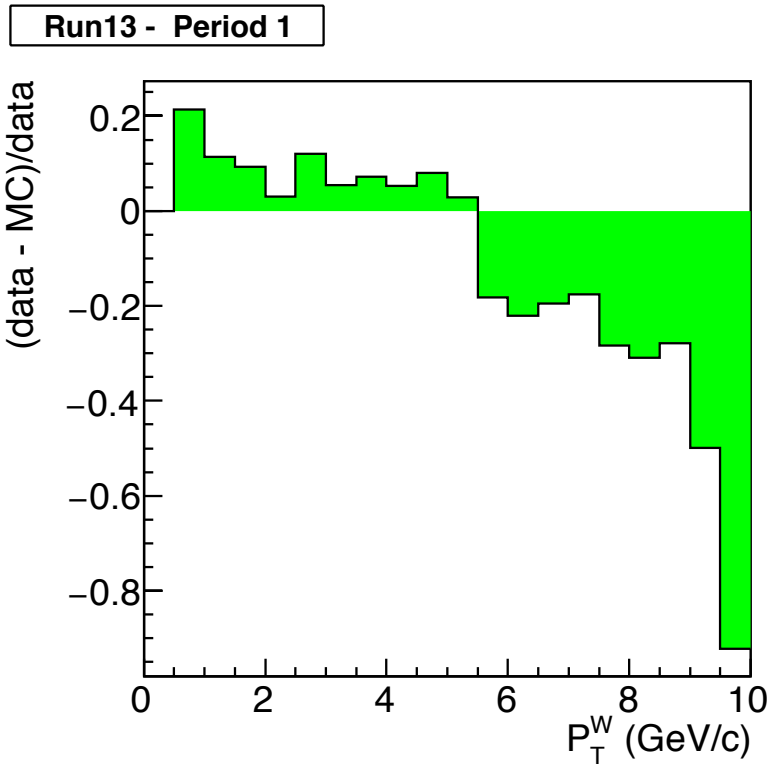
Production comparison



Regular: Sti official production (SL14a)
StiCa: Yuri's StiCa private production (dev2)
TEST Evals1: Sti+PPV test production (SL16a)
TEST Evals2: Sti+PPV test production (dev)
TEST Evals4: StiCa+PPV test production (dev)

StiCa+PPv: evals4

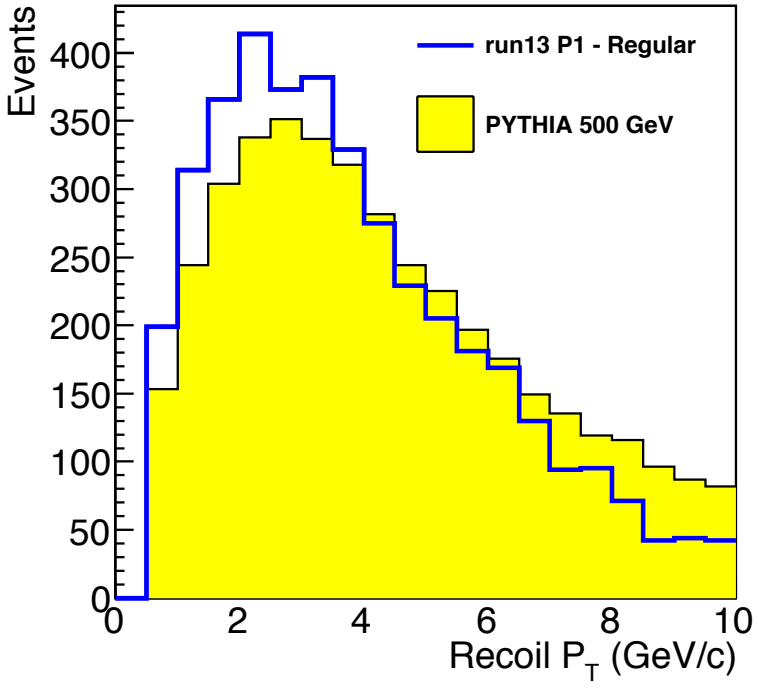


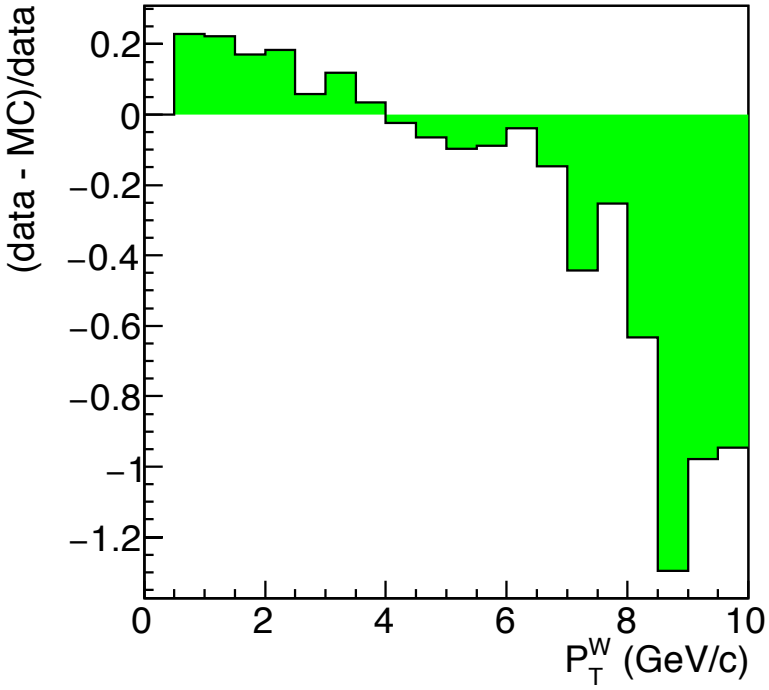


StiCa+PPV: test production evals4

Yellow filled histo is PYTHIA prediction at generated level (no experimental effects)

Sti+PPv: official current production (SL14a)

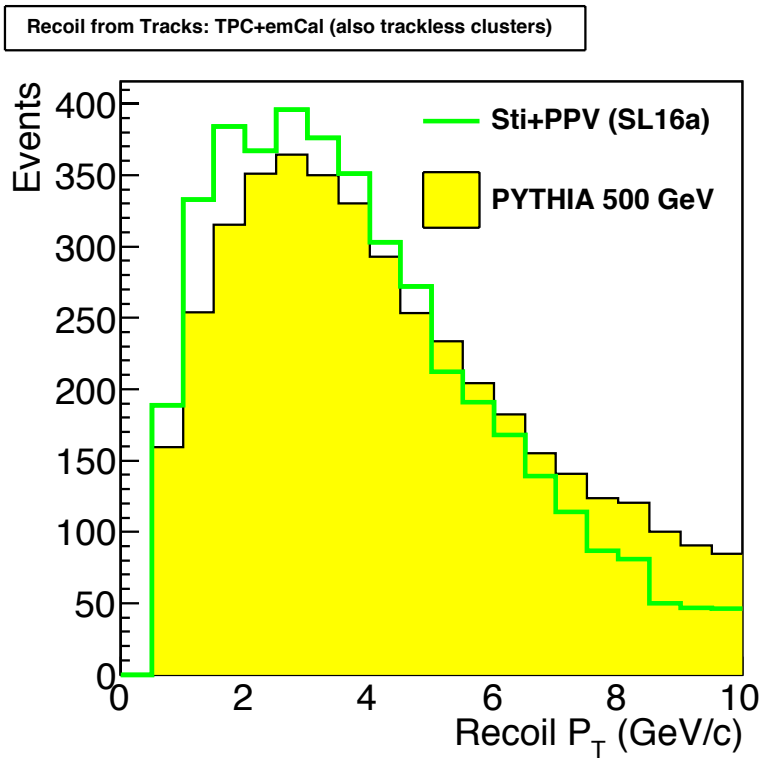


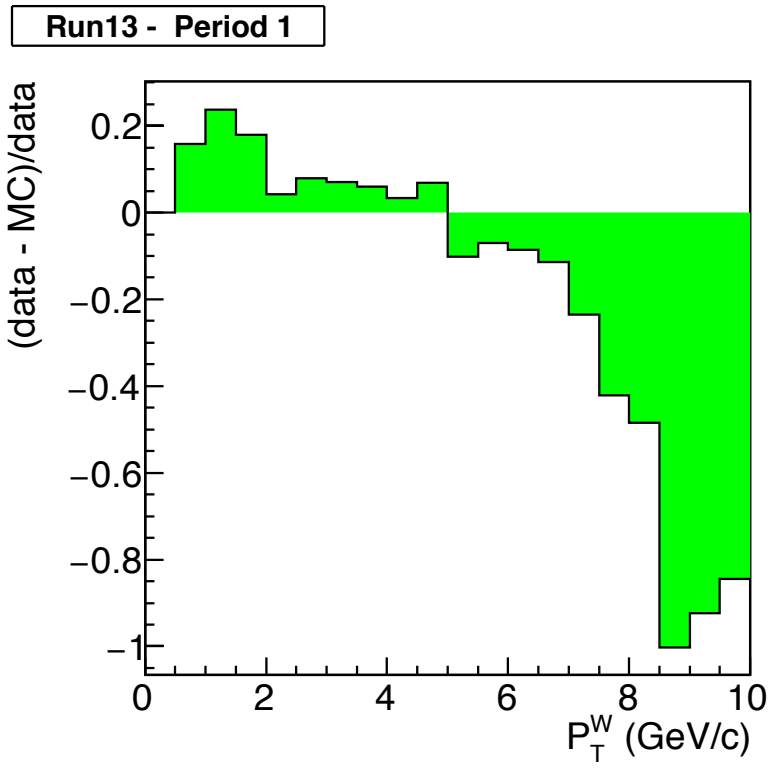


Regular: Sti official production (SL14a)

Yellow is PYTHIA prediction at generated level (no experimental effects)

Sti+PPv: evals1

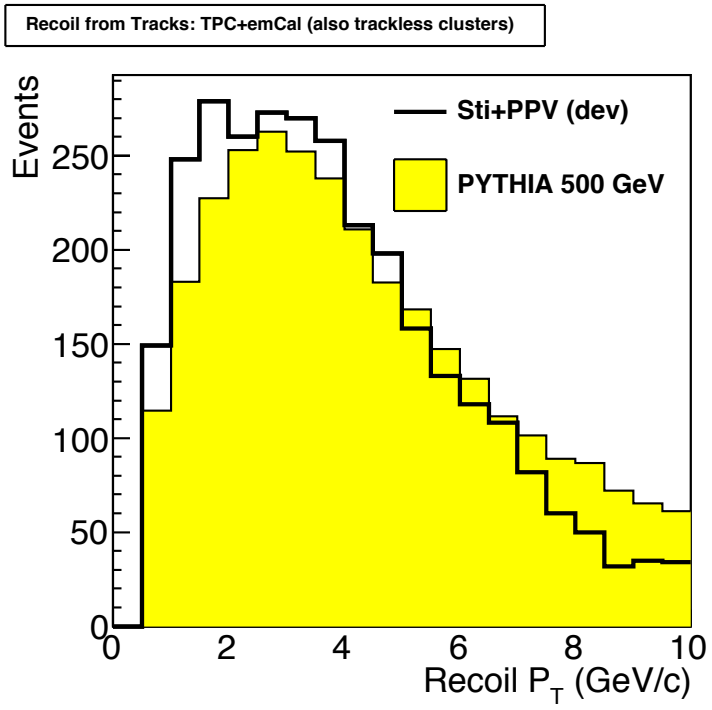


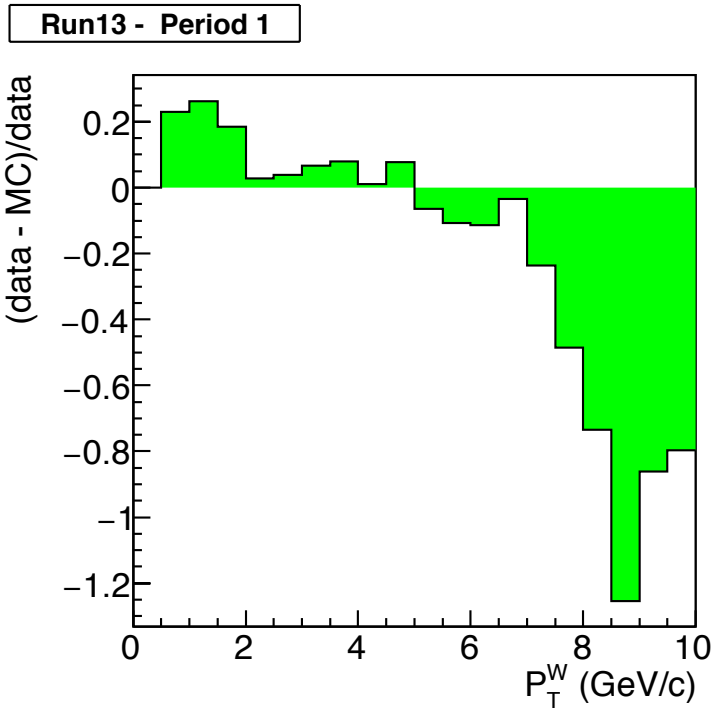


TEST Evals1: Sti+PPV test production (SL16a)

Yellow is PYTHIA prediction at generated level (no experimental effects)

Sti+PPv: evals2





TEST Evals2: Sti+PPV test production (dev)

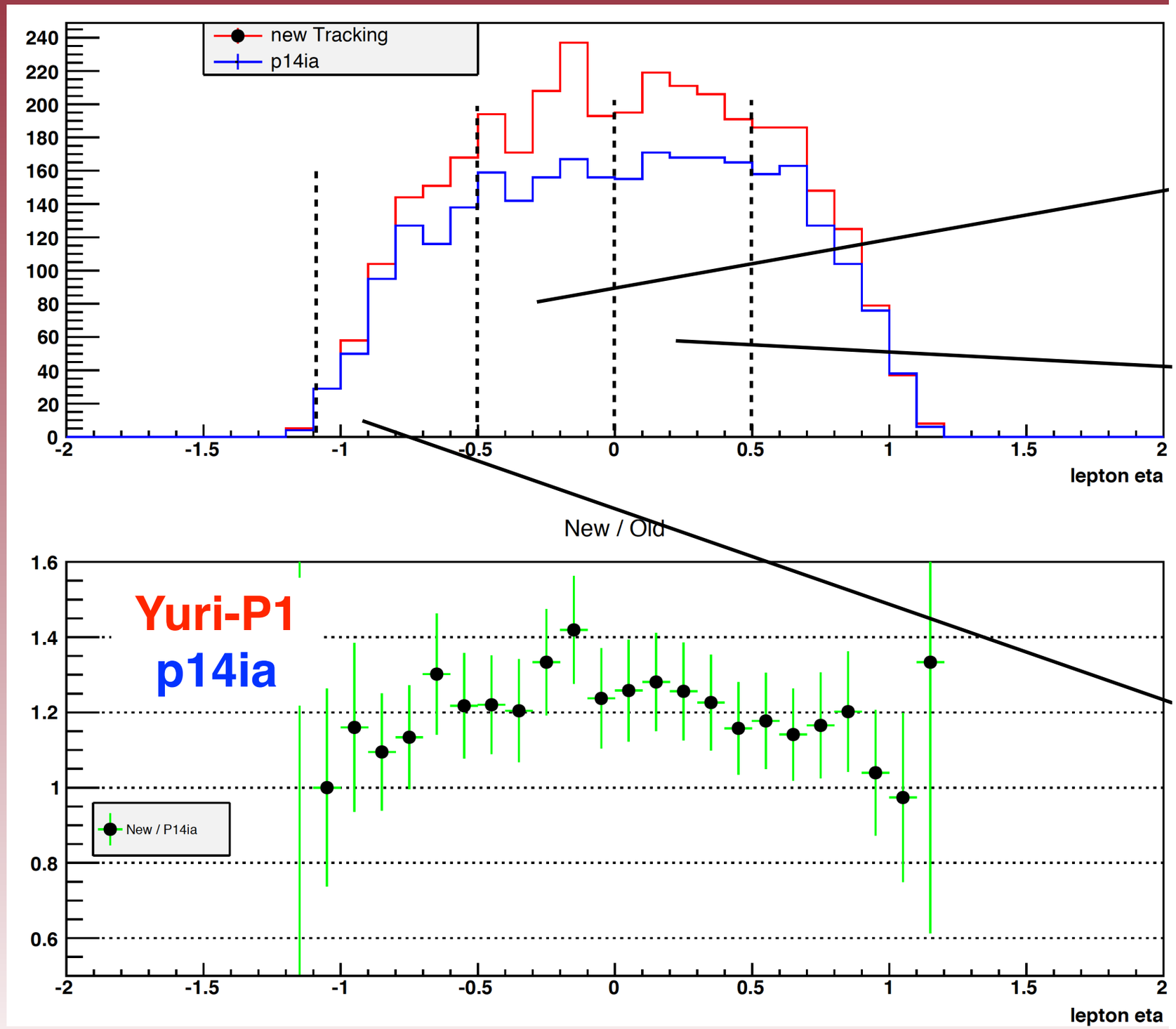
Yellow is PYTHIA prediction at generated level (no experimental effects)

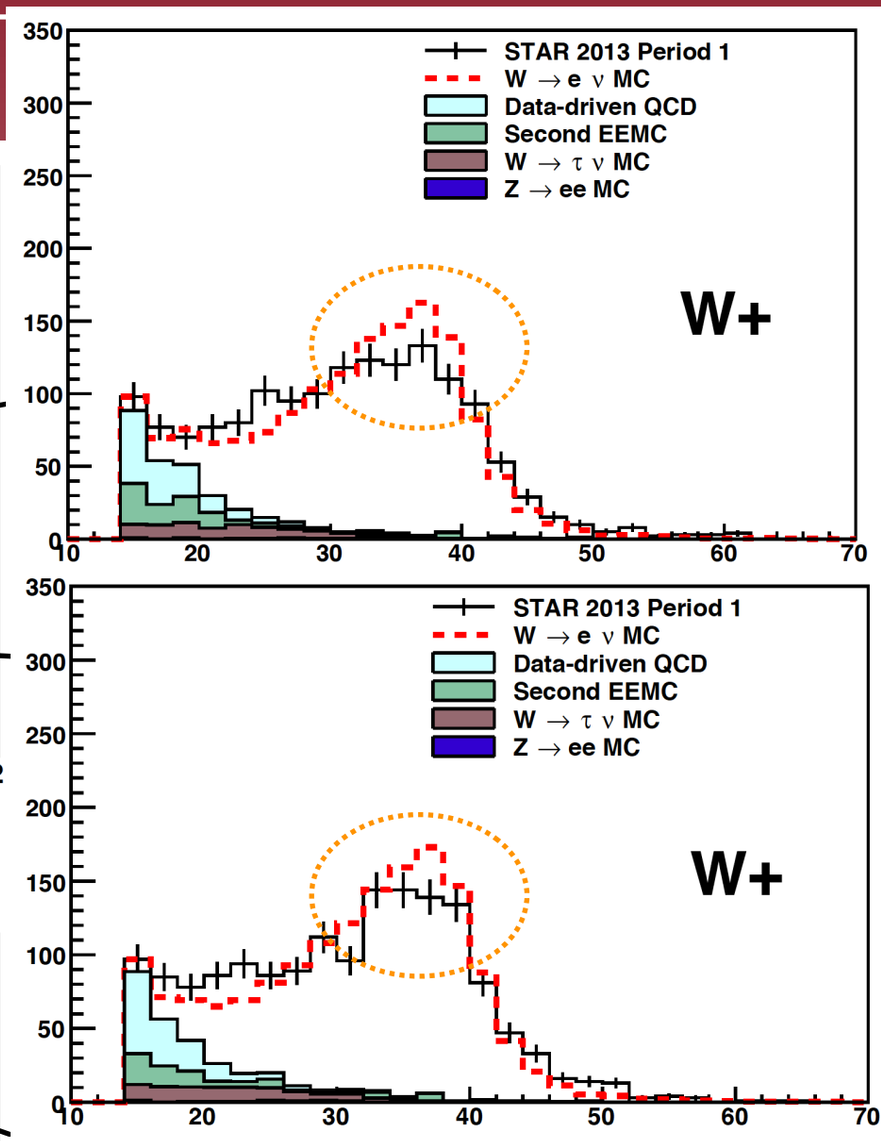
Conclusions

- StiCa shows a better W-selection efficiency also after the reconstruction cuts
- StiCa reconstructs more hadronic recoil → the reconstruction of the boson Pt before any MC correction is better → correction required will be smaller

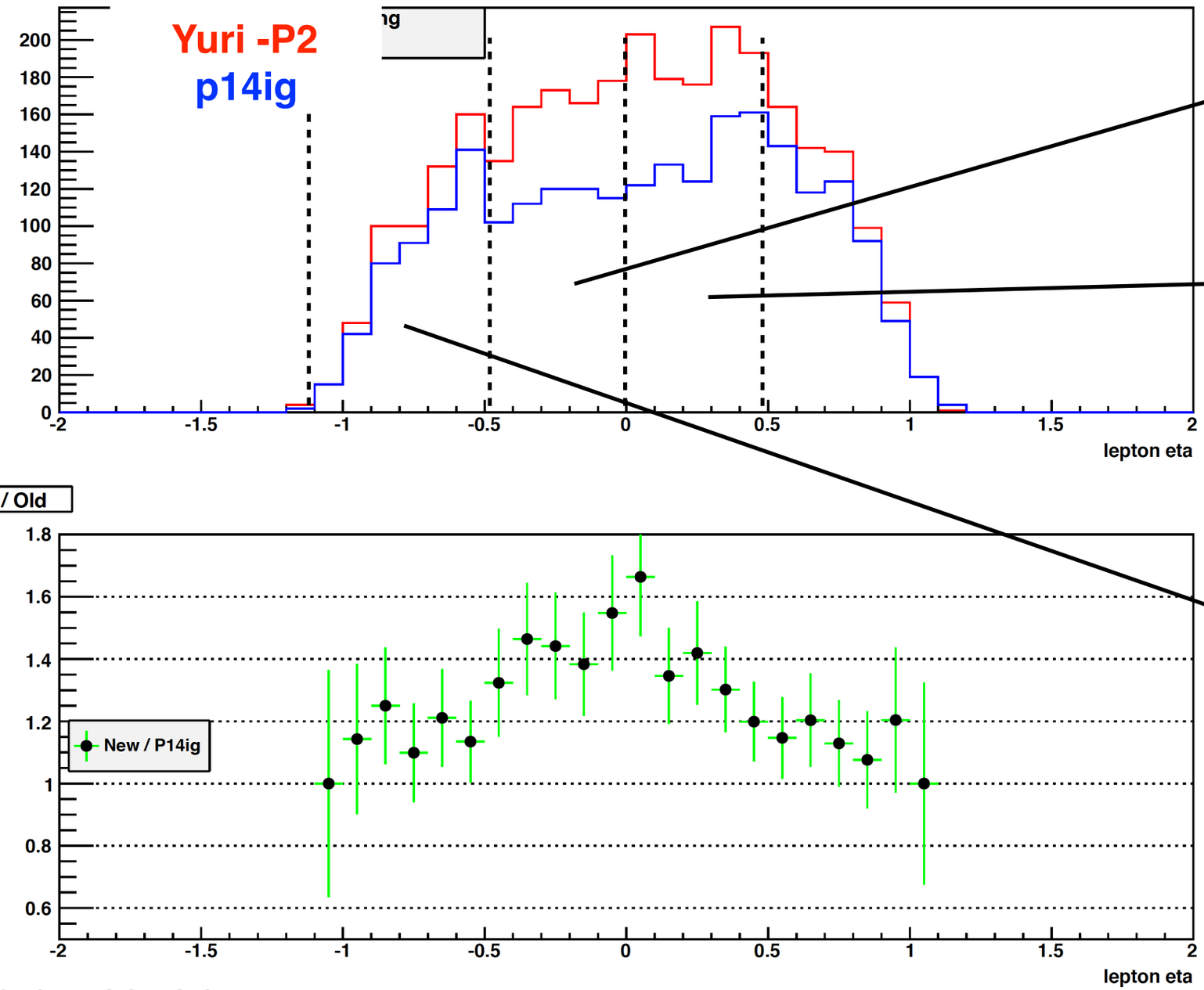
Back up

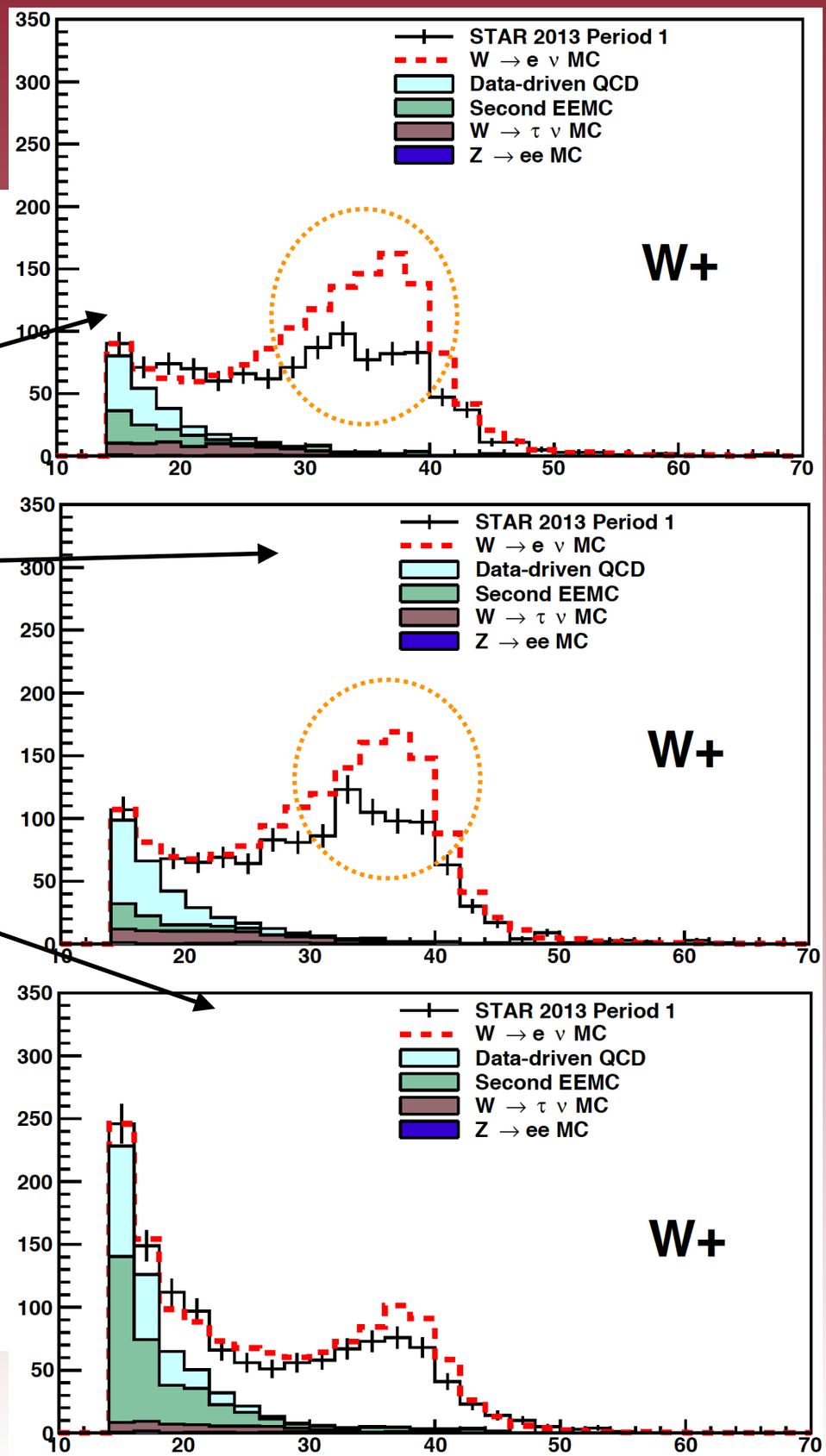
Back up 1 : Final W Eta - P1



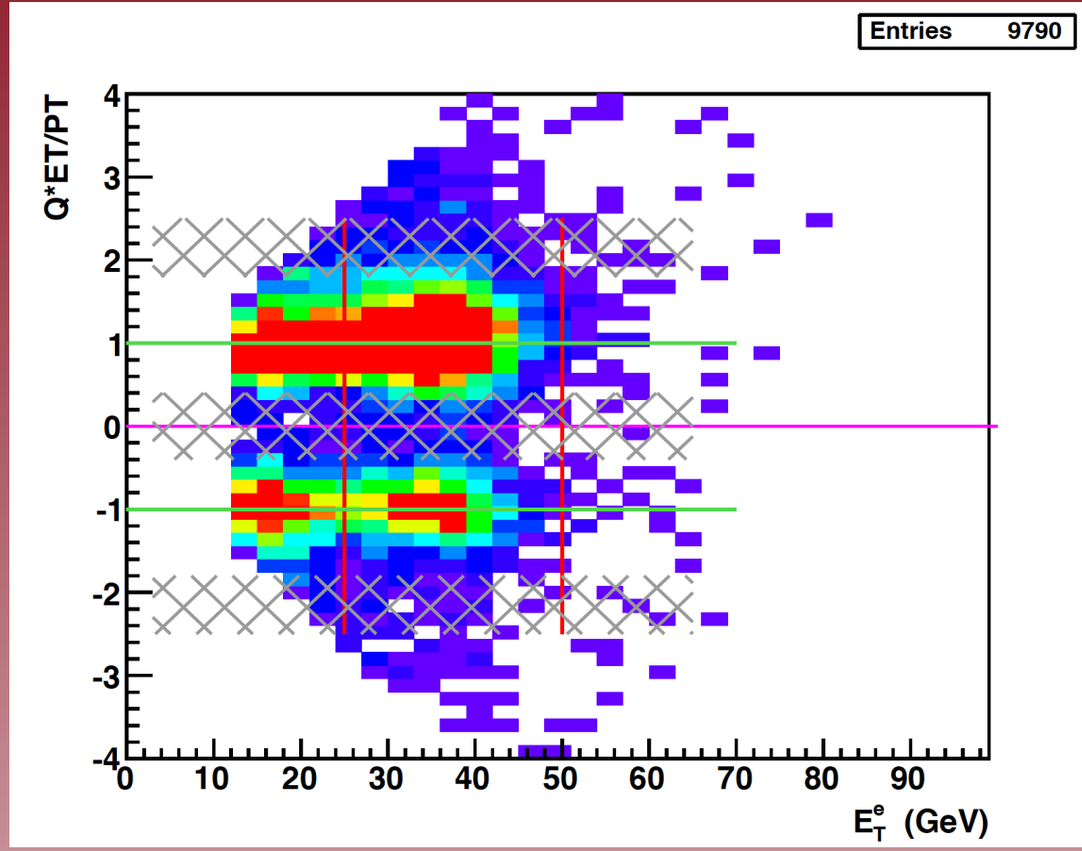


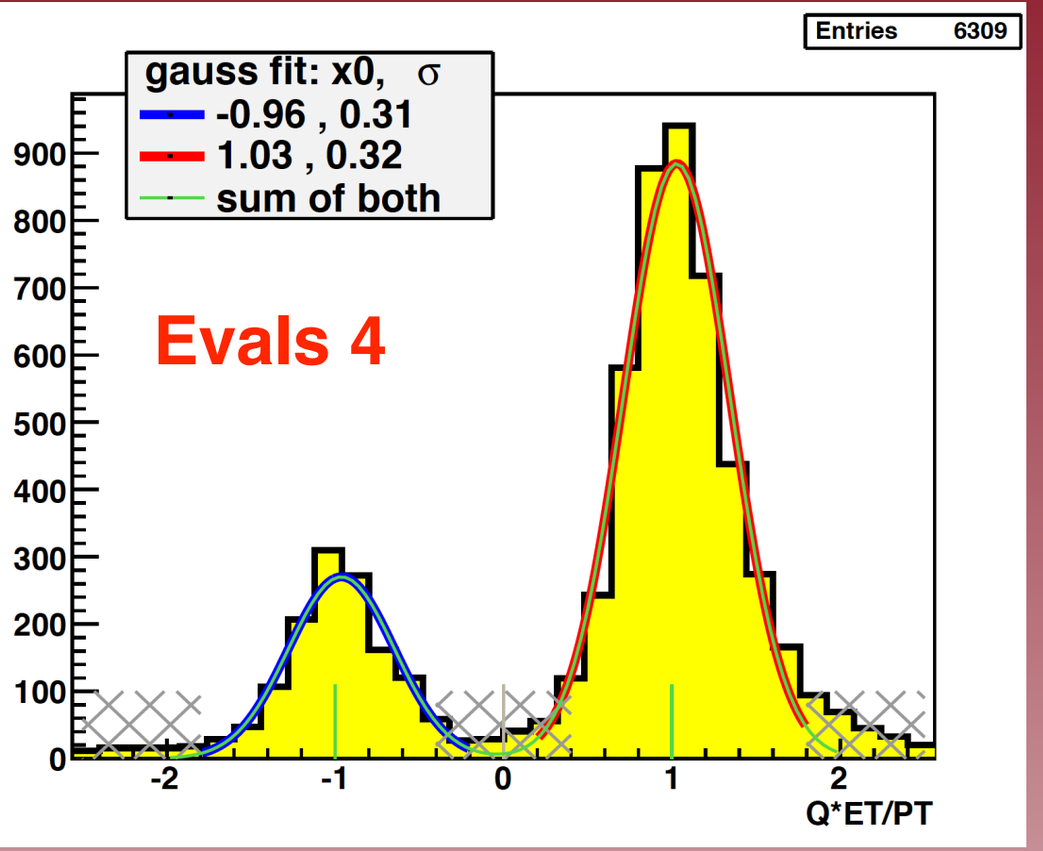
Back up 2 : Final W Eta - P2

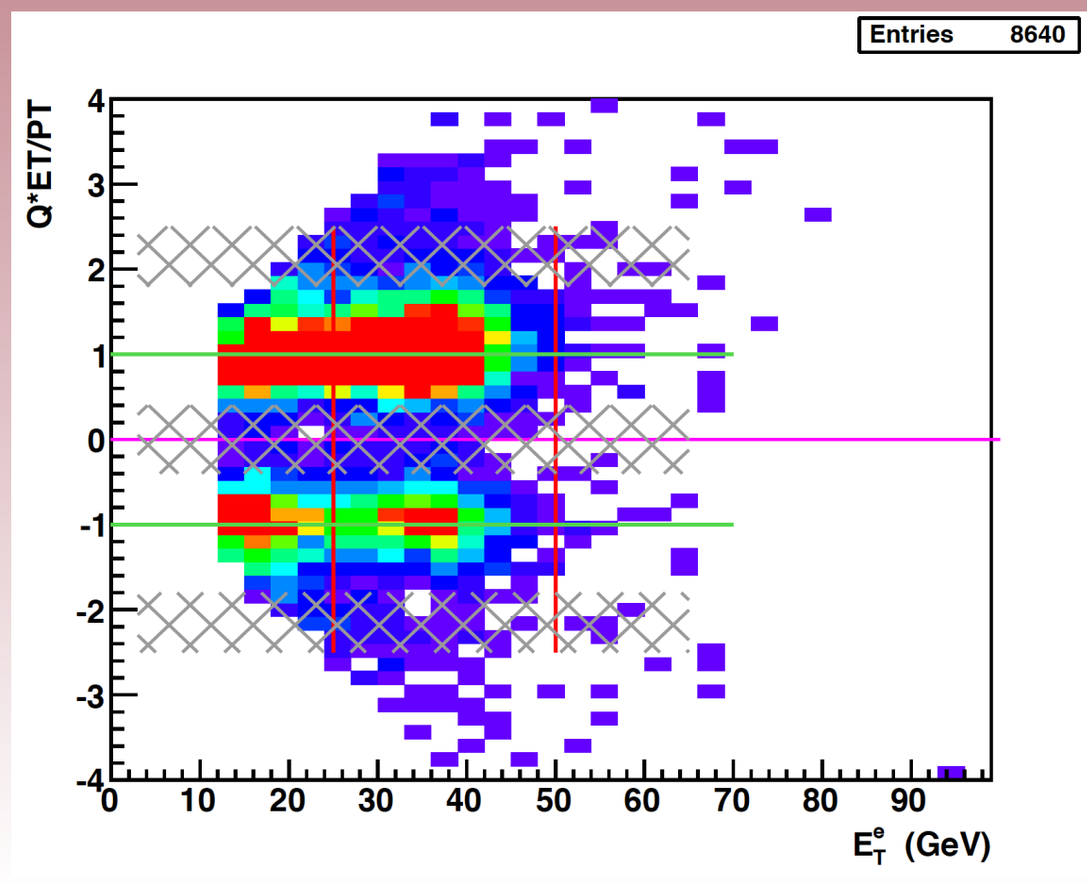


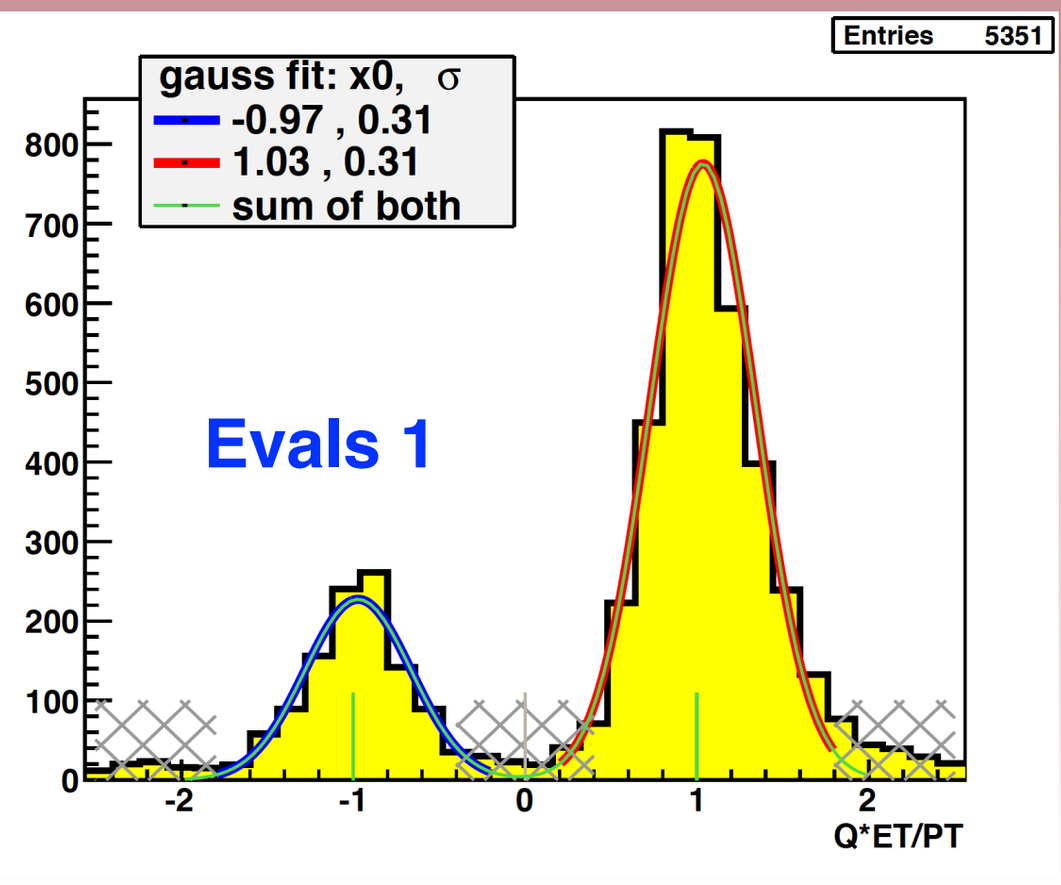


W charge Separation

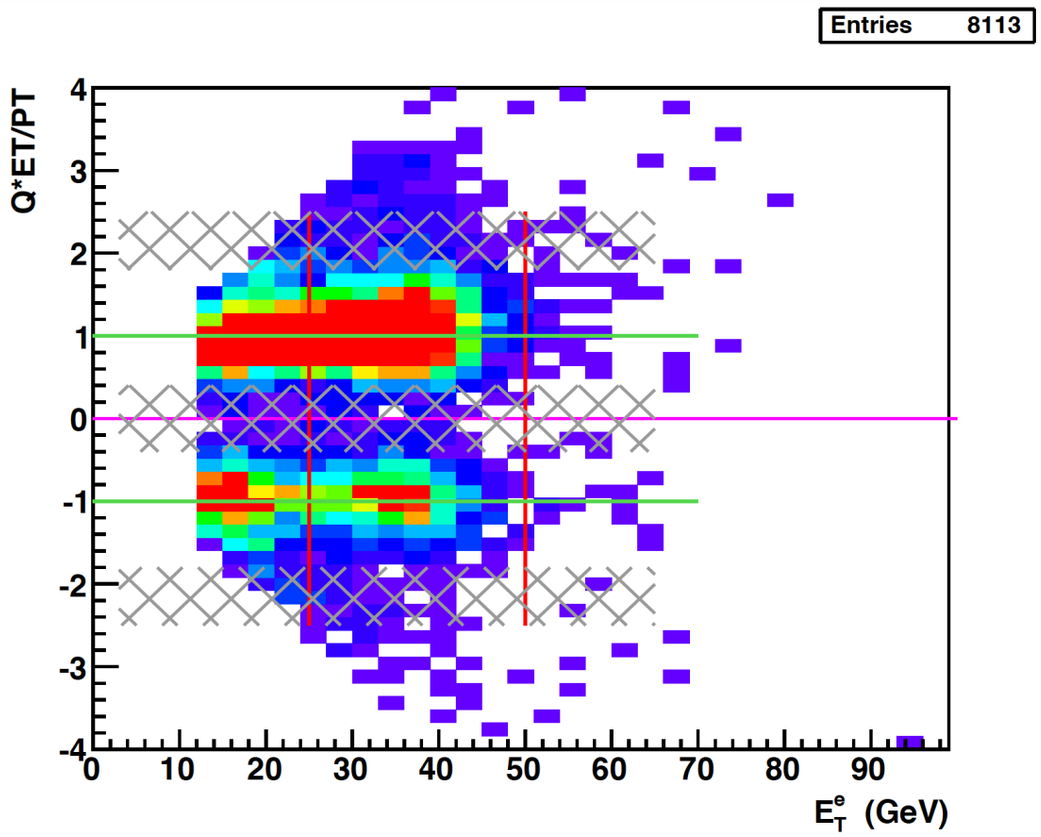


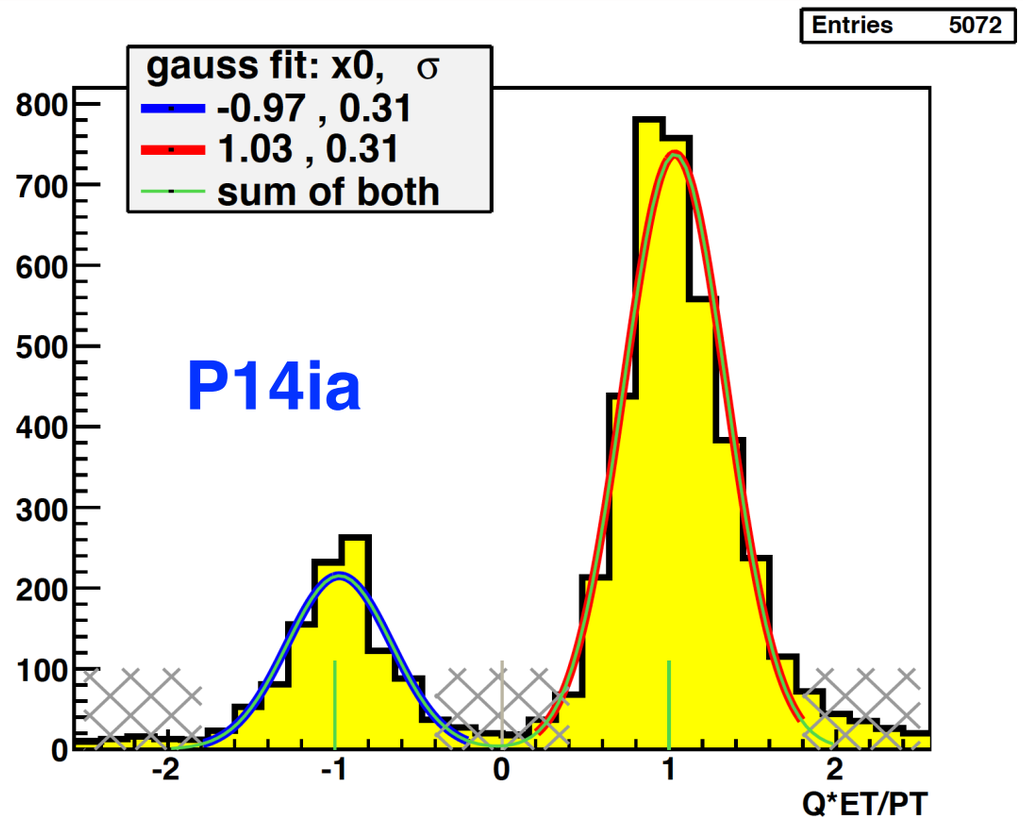


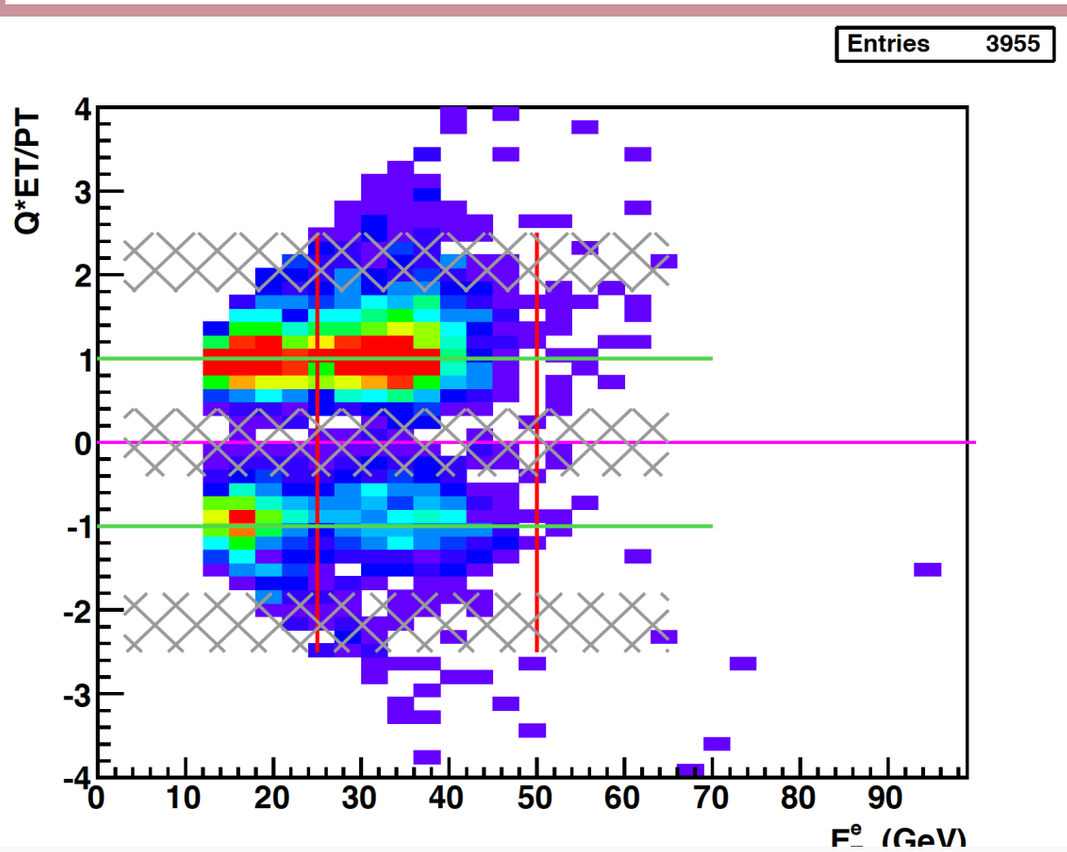


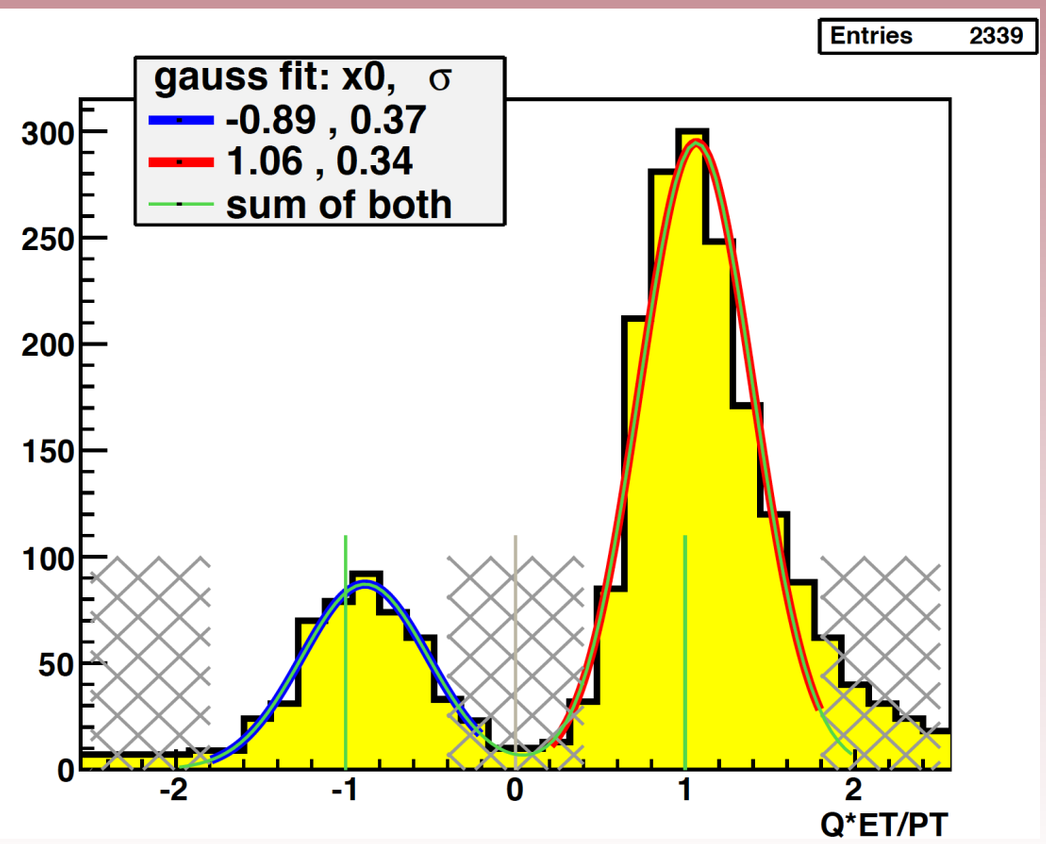


W Charge Separation

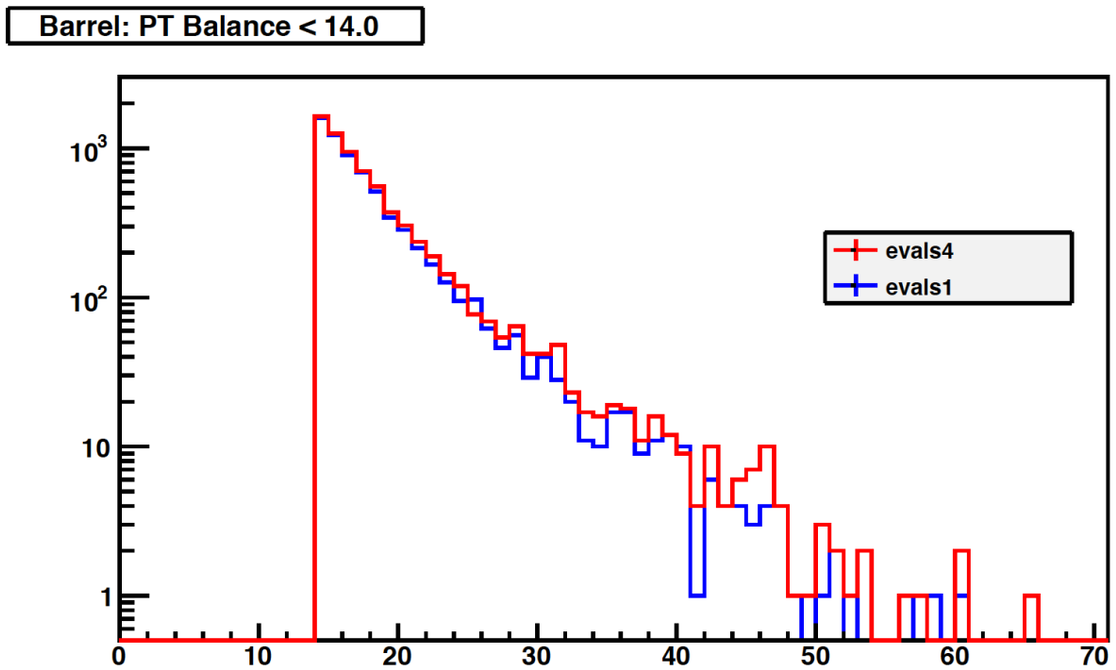


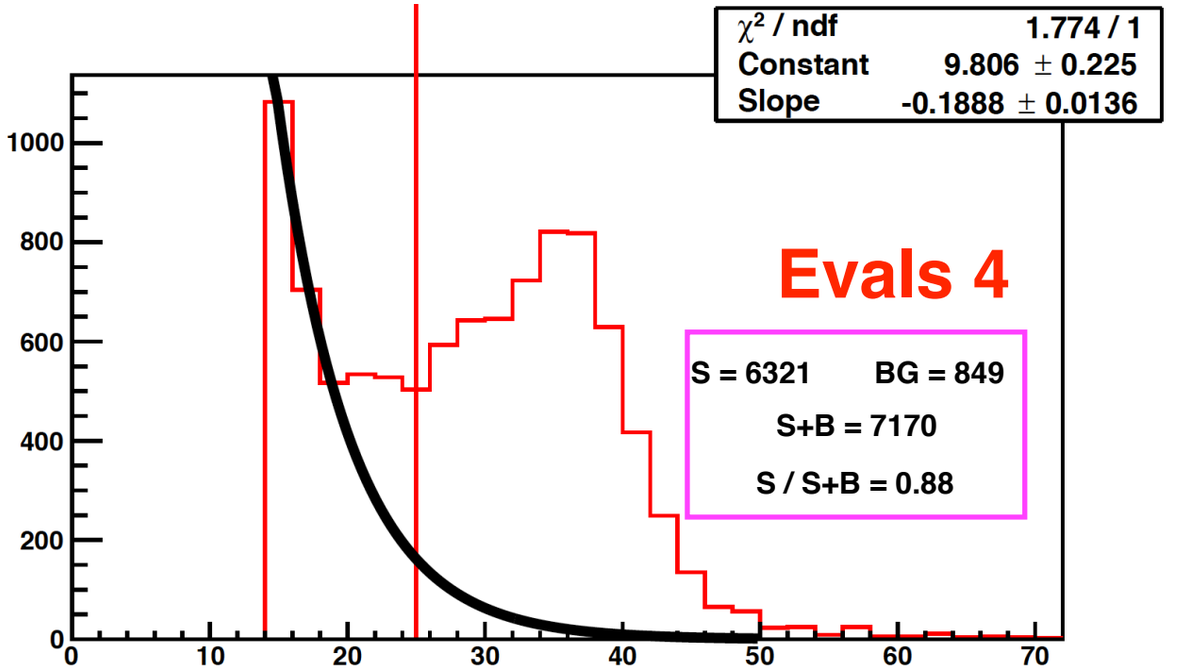


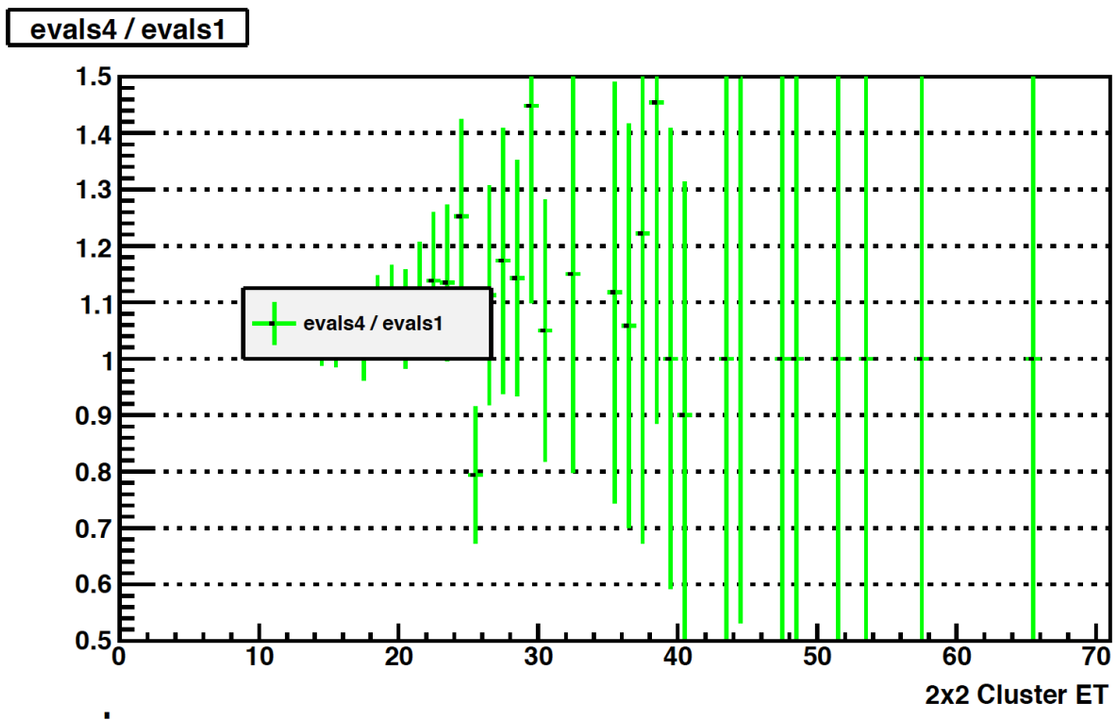


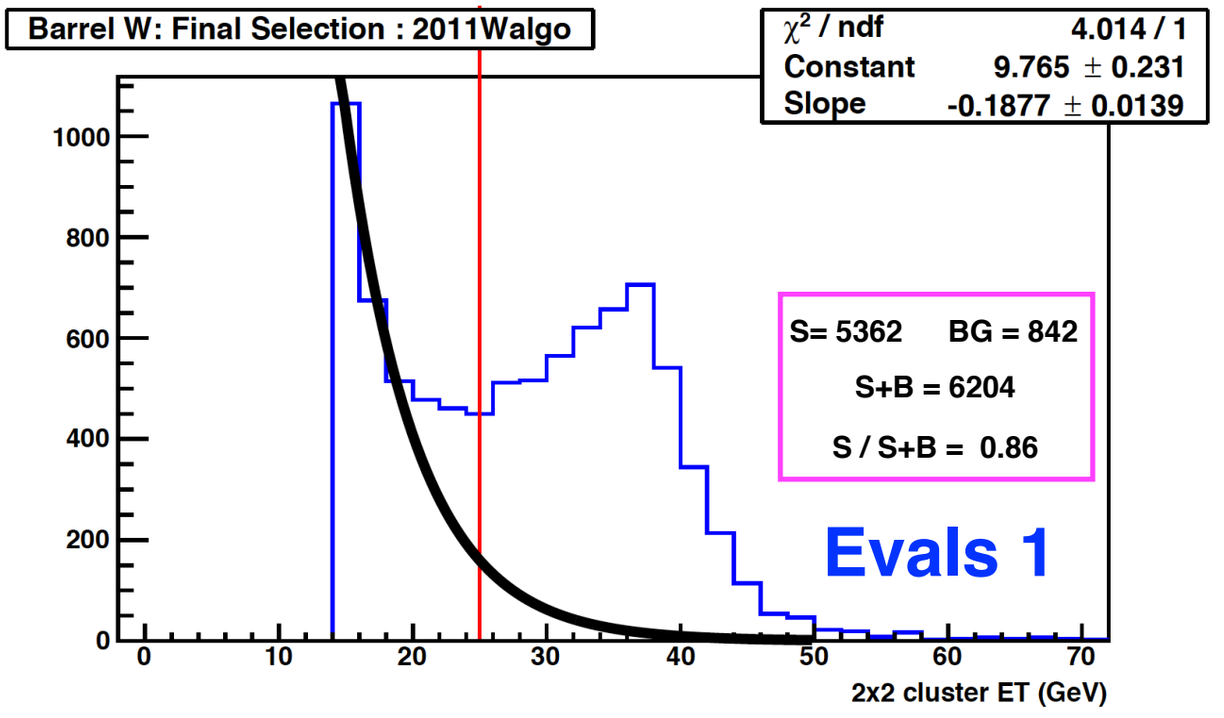


QCD BG

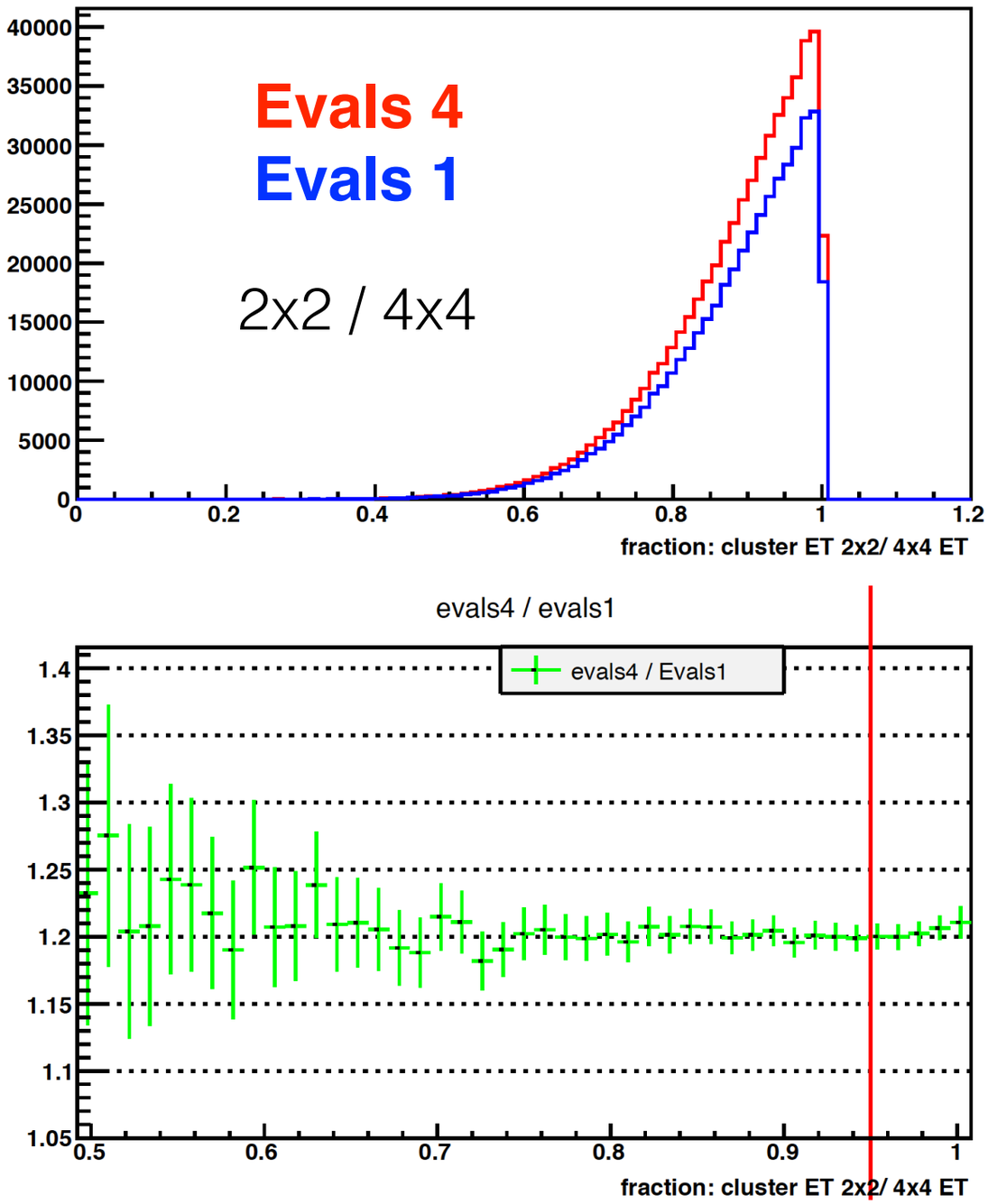

Barrel: PT Balance < 14.0
evals4
evals1
2x2 Cluster ET

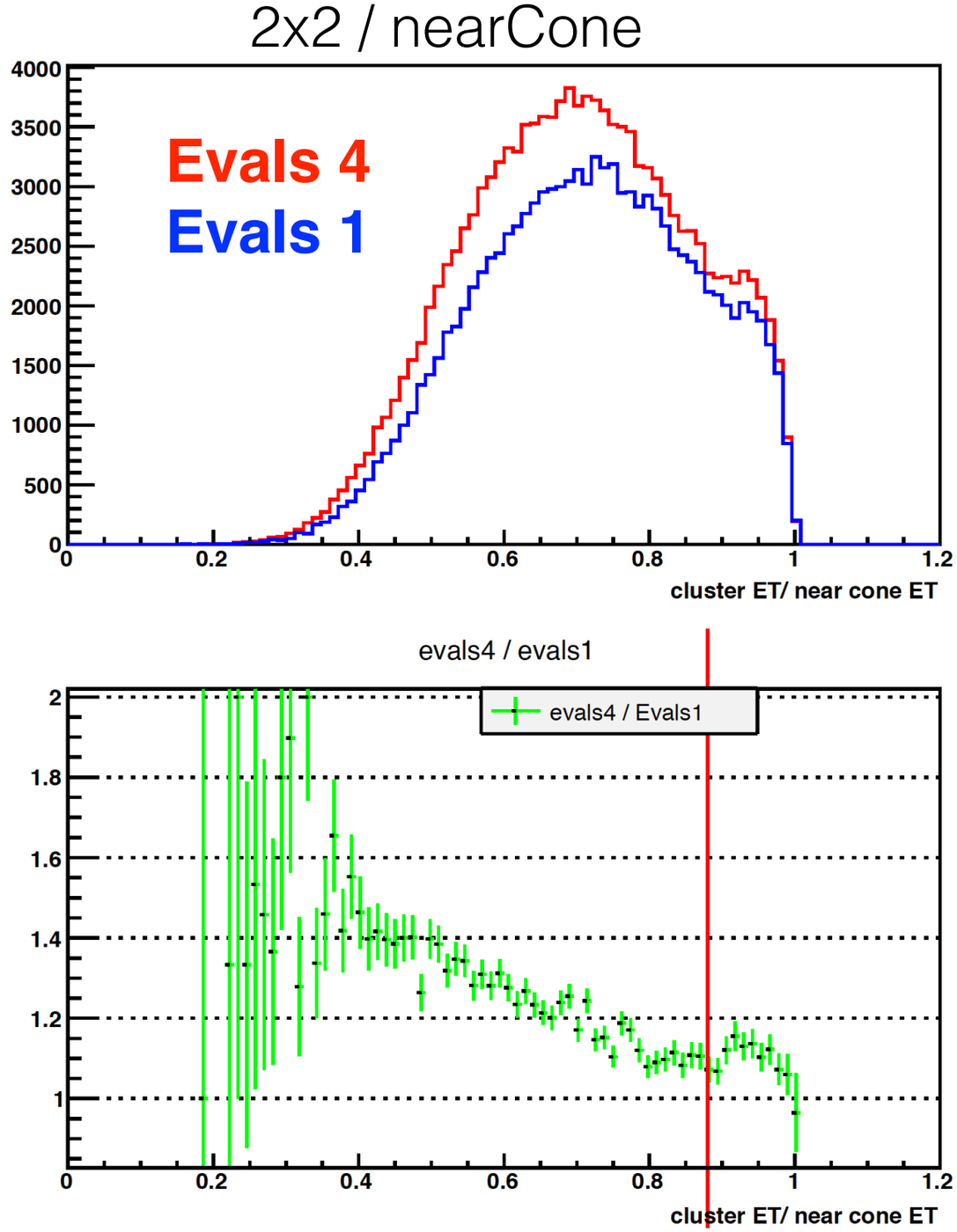

χ² / ndf 1.774 / 1
Constant 9.806 ± 0.225
Slope -0.1888 ± 0.0136
Evals 4
S = 6321 BG = 849
S+B = 7170
S / S+B = 0.88
2x2 cluster ET (GeV)


evals4 / evals1
evals4 / evals1
2x2 Cluster ET


Barrel W: Final Selection : 2011Walgo
χ² / ndf 4.014 / 1
Constant 9.765 ± 0.231
Slope -0.1877 ± 0.0139
S= 5362 BG = 842
S+B = 6204
S / S+B = 0.86
Evals 1
2x2 cluster ET (GeV)

Isolation cuts





Isolation cuts