# Results from Run 13 W-test production analysis

Apple - to - Apple comparisons

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# W Test Production Details

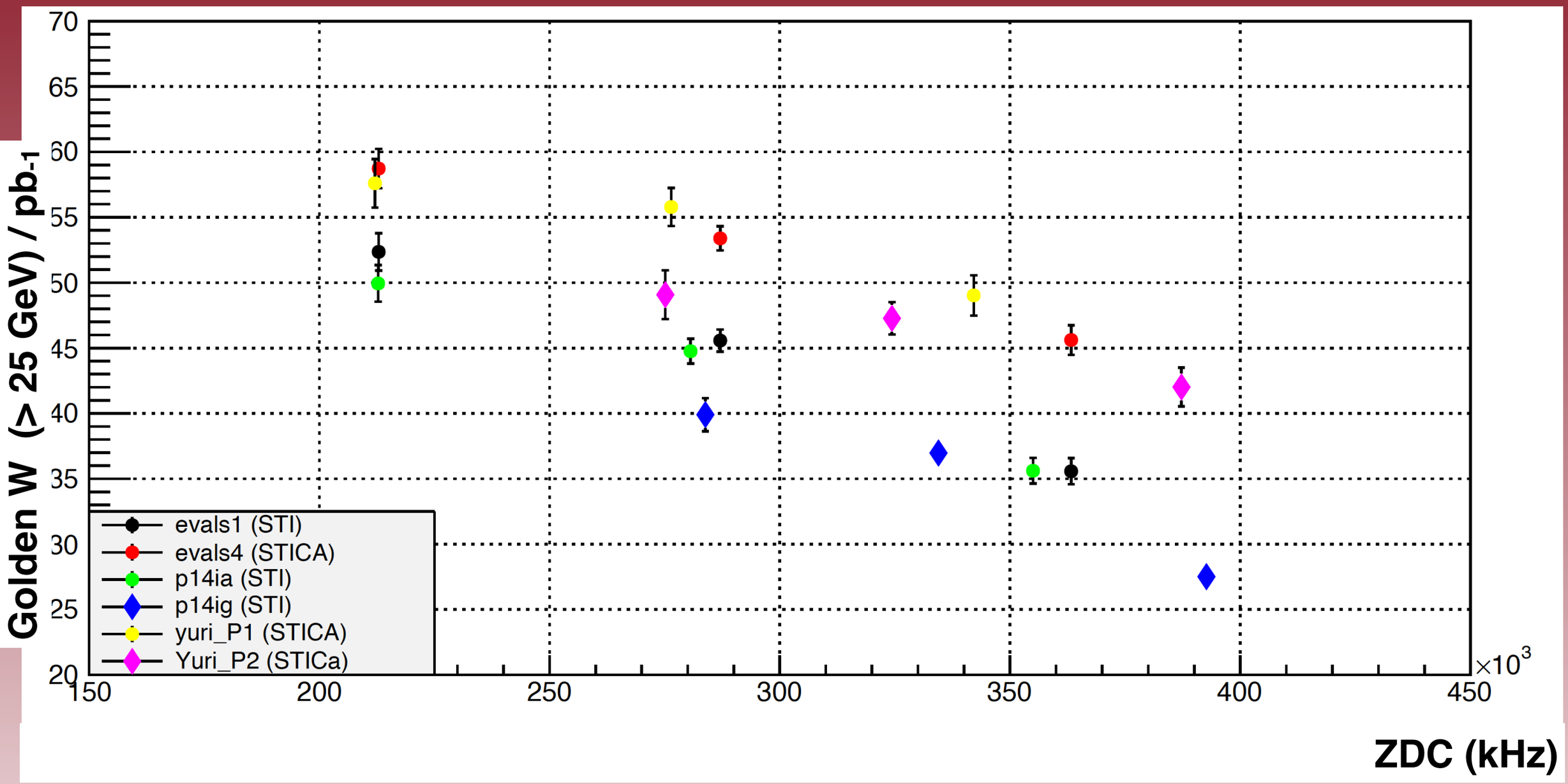
| Production | Library | Vertex-Finding algo | Tracking algo | nEvents (M) |
|---|---|---|---|---|
| Evals 1 | SL16b | PPV_W | STI | ~12 [only period 1] |
| Evals 2 | EVAL | PPV_W | STI_updated* | ~12 [only period 1] |
| Evals 4 | EVAL | PPV_W | STICA | ~12 [only period 1] |
| P14ia [run 13 official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

- * : STI_updated - a hit can be used by few tracks instead by only one / a hit can reuse for different tracks fitting.
- ** - Yuri's code

# W Test Production analysis- Comparisons

| Comparisons | purpose ? | Result |
|---|---|---|
| EVALS 1 vs EVALS 2 | difference between STI vs STI_updated | No difference |
| EVALS 1 vs EVALS 4 | difference between STI vs STICA | 18 % enhancement in Final W |
| EVALS 1 vs p14ia | difference between with and without new HFT material in STAR library | 4 % enhancement in Final W |
| Yuri's - P1 vs p14ia | difference between STI vs STICA | 20 % enhancement in Final W |
| Yuri's - P2 vs p14ig | difference between STI vs STICA | 29 % enhancement in Final W |

# 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 .

# Evals 1 vs Evals 2

Apple- to -Apple comparison

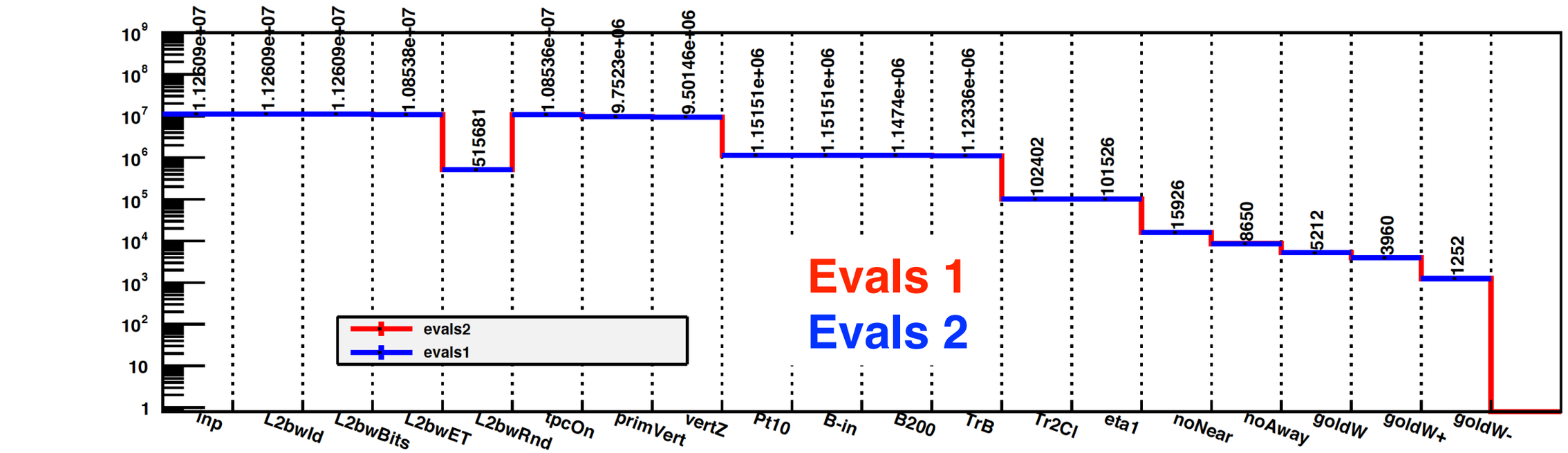
# Details / Notes

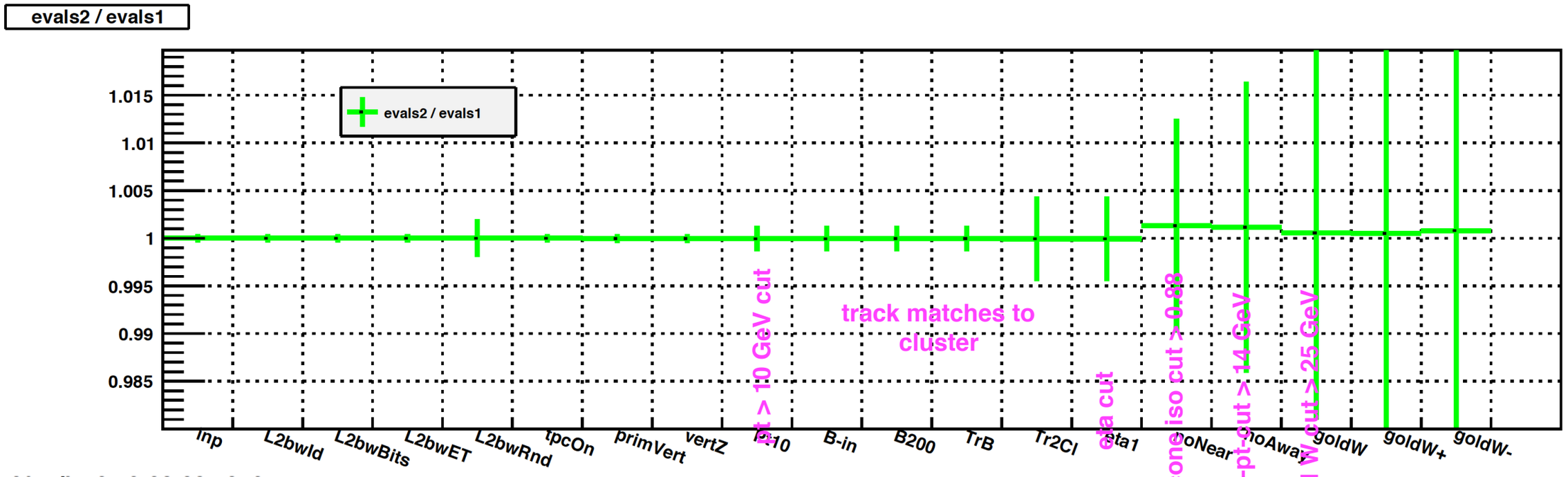
| Production | Production Library [also W-code compiled | Tracking | vertex finding | BEMC-gains | # of runs used in the comparison | # of events |
|---|---|---|---|---|---|---|
| “evals2” | EVAL | Sti [updated] | PPV_W | run 12 - 200 GeV | 896 | 11.26 M |
| “evals1” | SL16b | Sti | PPV_W | run 12 200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

- **All the runs which were used for the comparison compared for # events processed. Runs which have processed exactly the same # of events were chosen.**

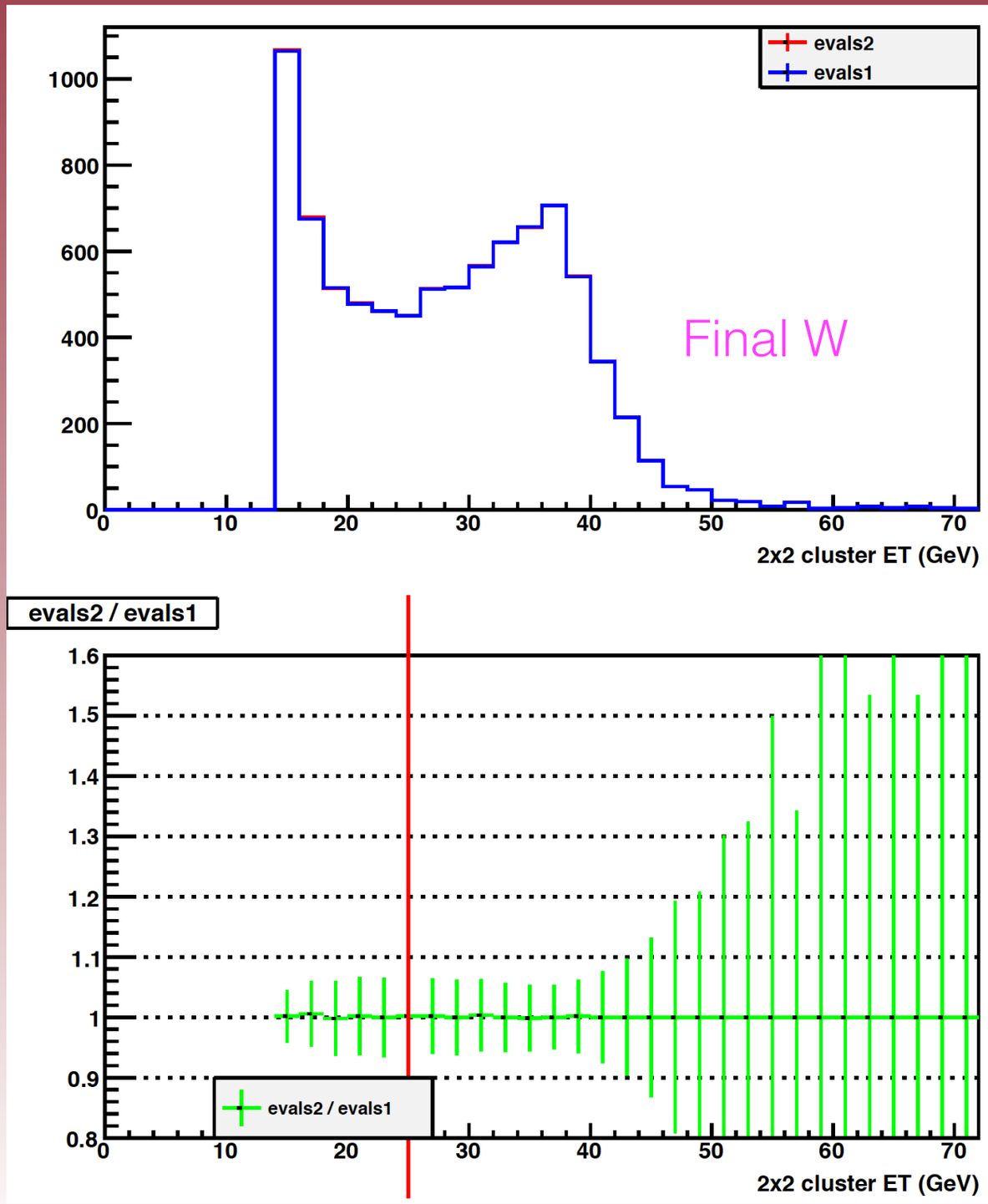
- **SL16b - https://drupal.star.bnl.gov/STAR/comp/sofi/soft-n-libs/library-release-history/2016-0#SL16b**
- **STi_Updated : A hit can be used by a few tracks instead only one**

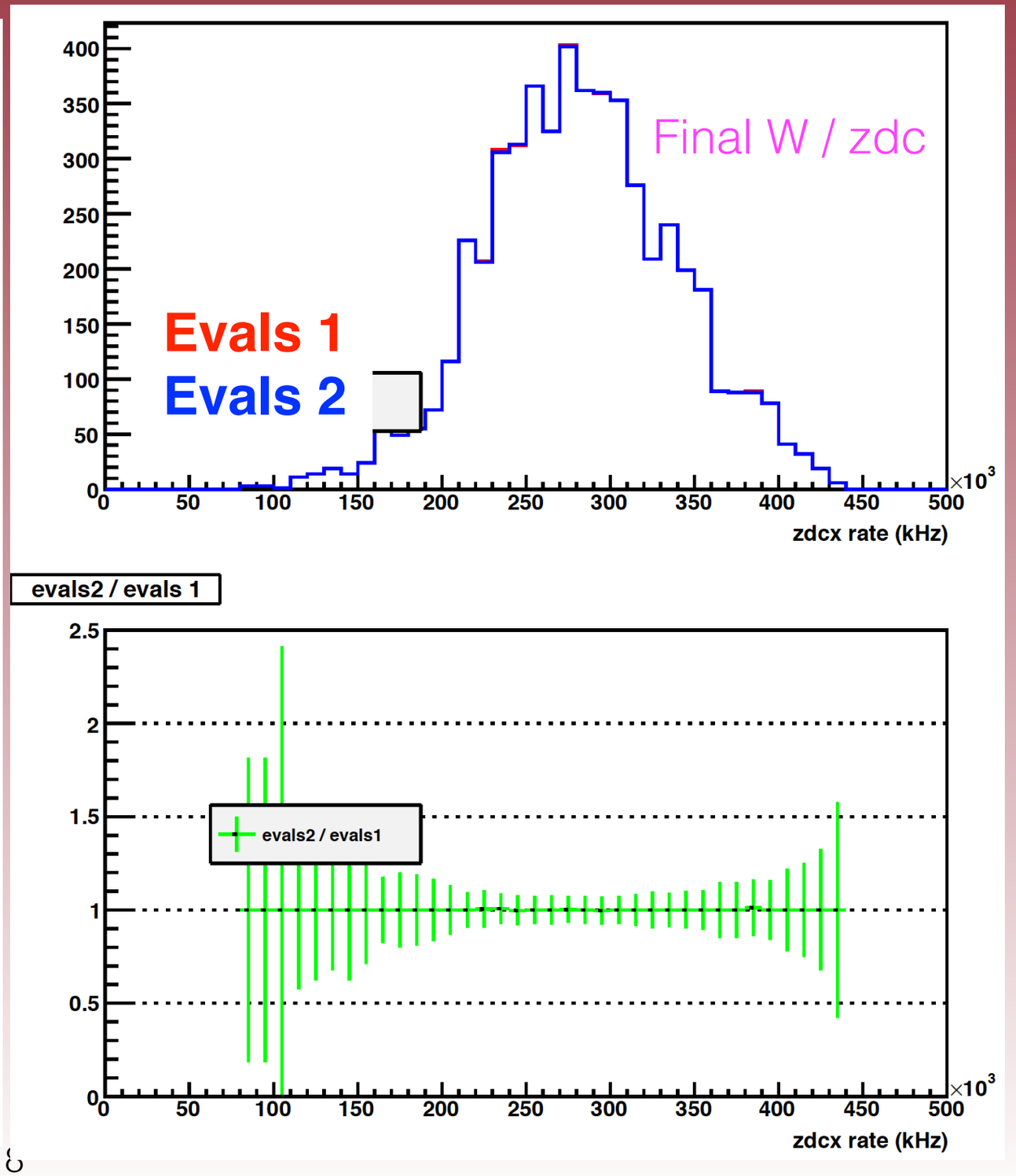
# Events Counts



# Final W, Final W ZDC



# Summary

- No observable / considerable difference between Evals 1 vs Evals 2. Meaning **no difference** between **STI vs STI_updated** [sti_updated :hit reuse for different tracks fitting].

# Evals 1 vs Evals 4

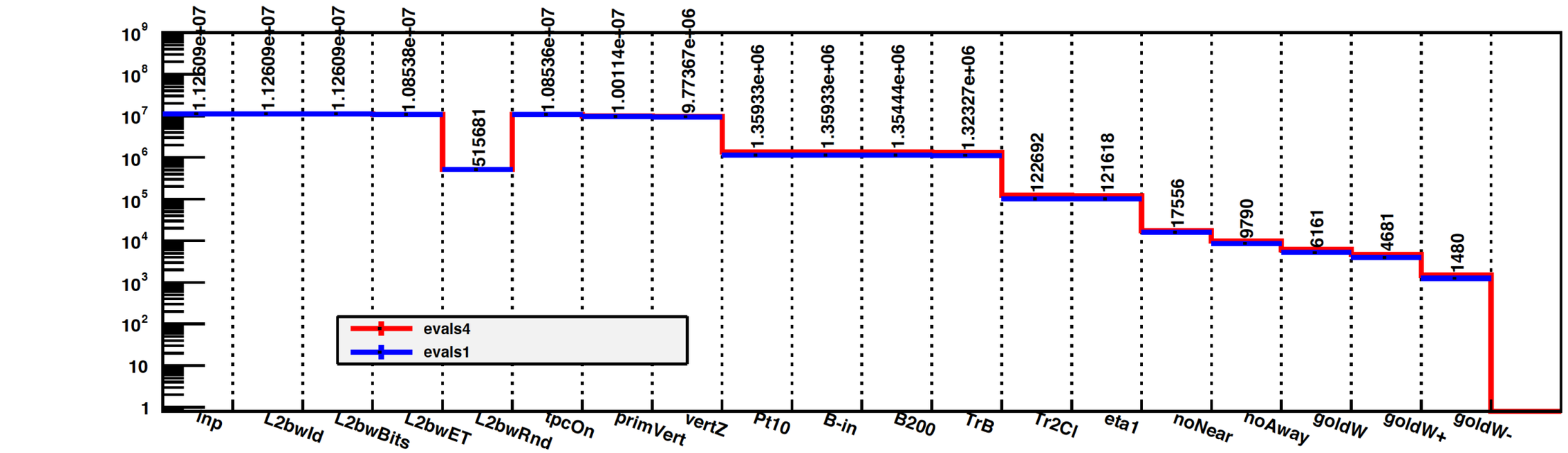
Apple- to -Apple comparison

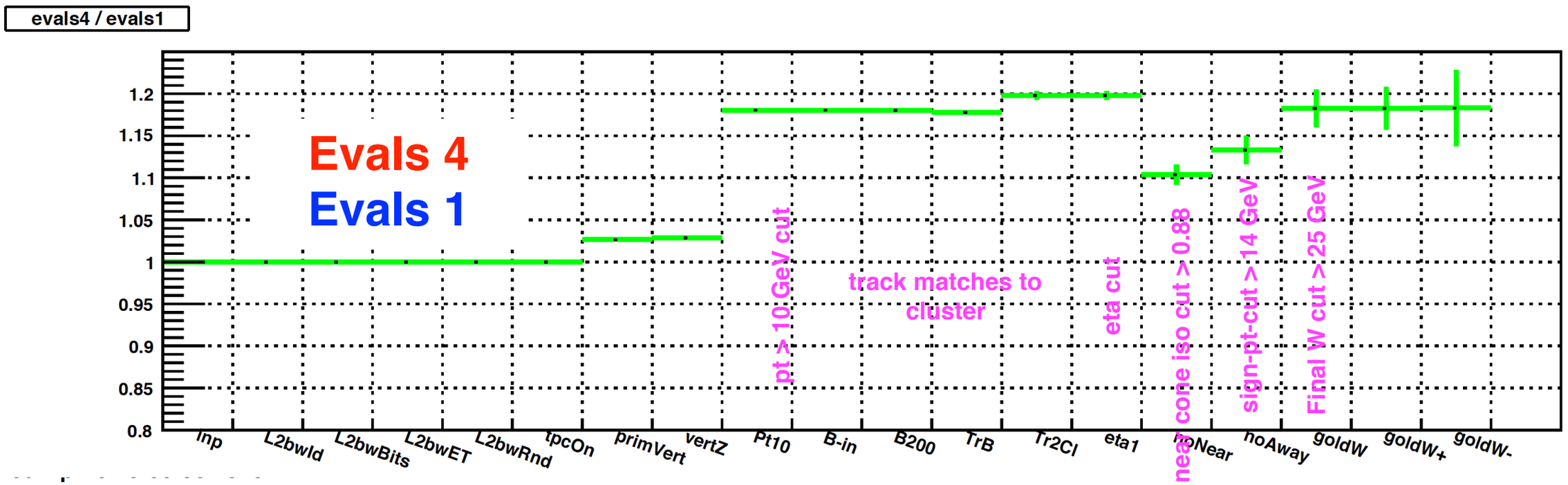
# Details / Notes

| Production | Production Library [also W-code compiled | 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 |

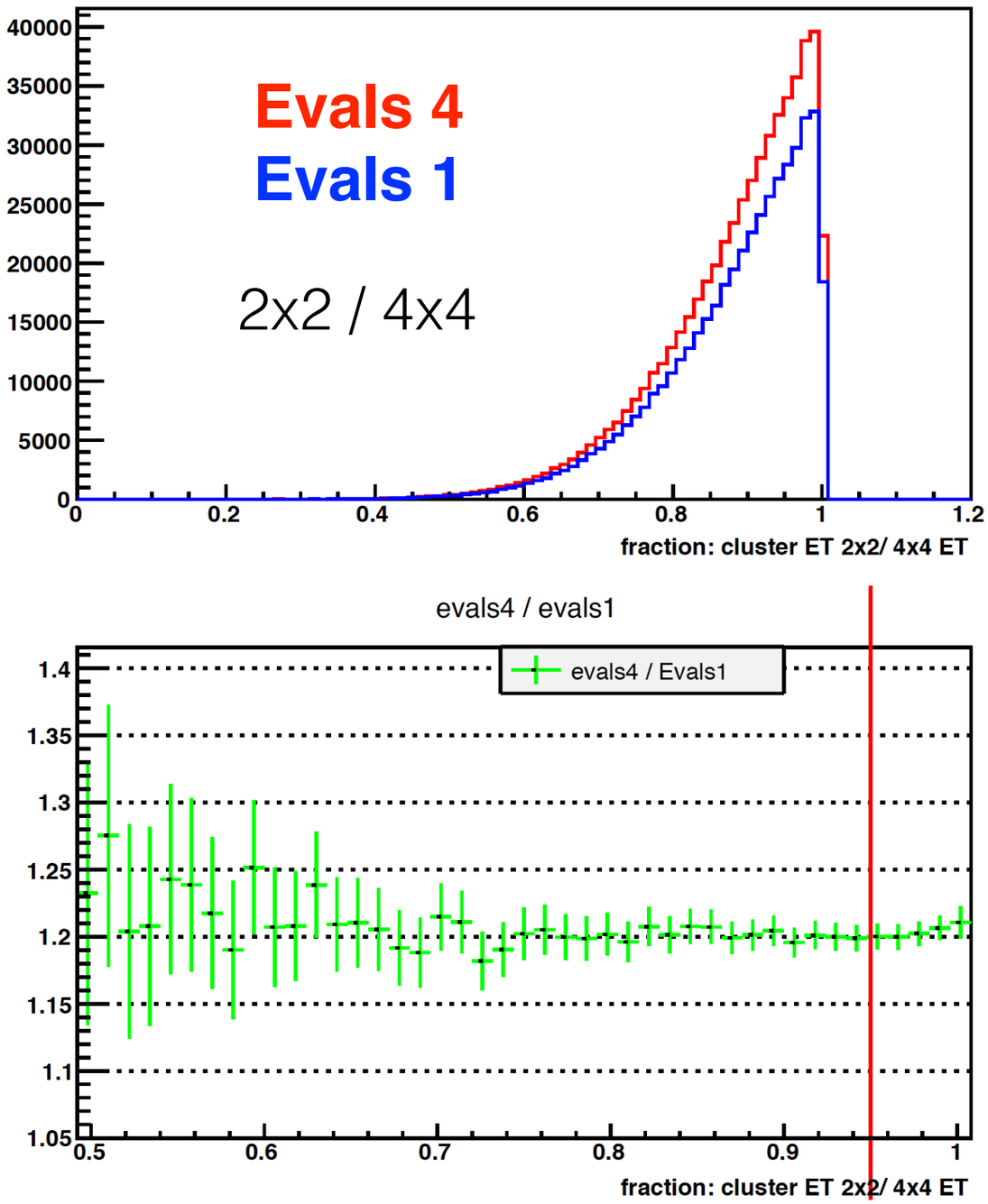
- **Runs which have processed exactly the same # of events in both sets were chosen.**
- **SL16b - https://drupal.star.bnl.gov/STAR/comp/sofi/soft-n-libs/library-release-history/2016-0#SL16b**

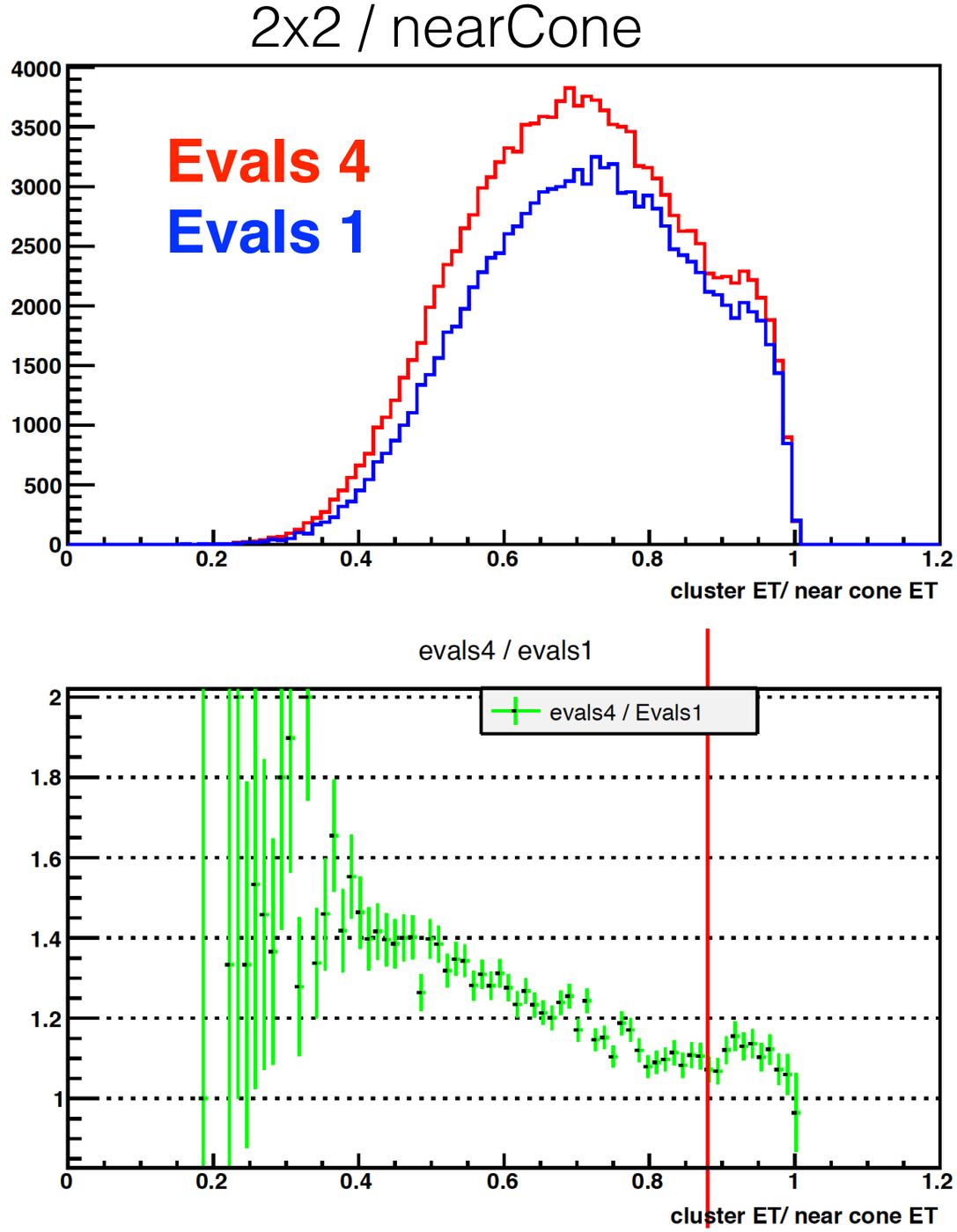
# Events Counts



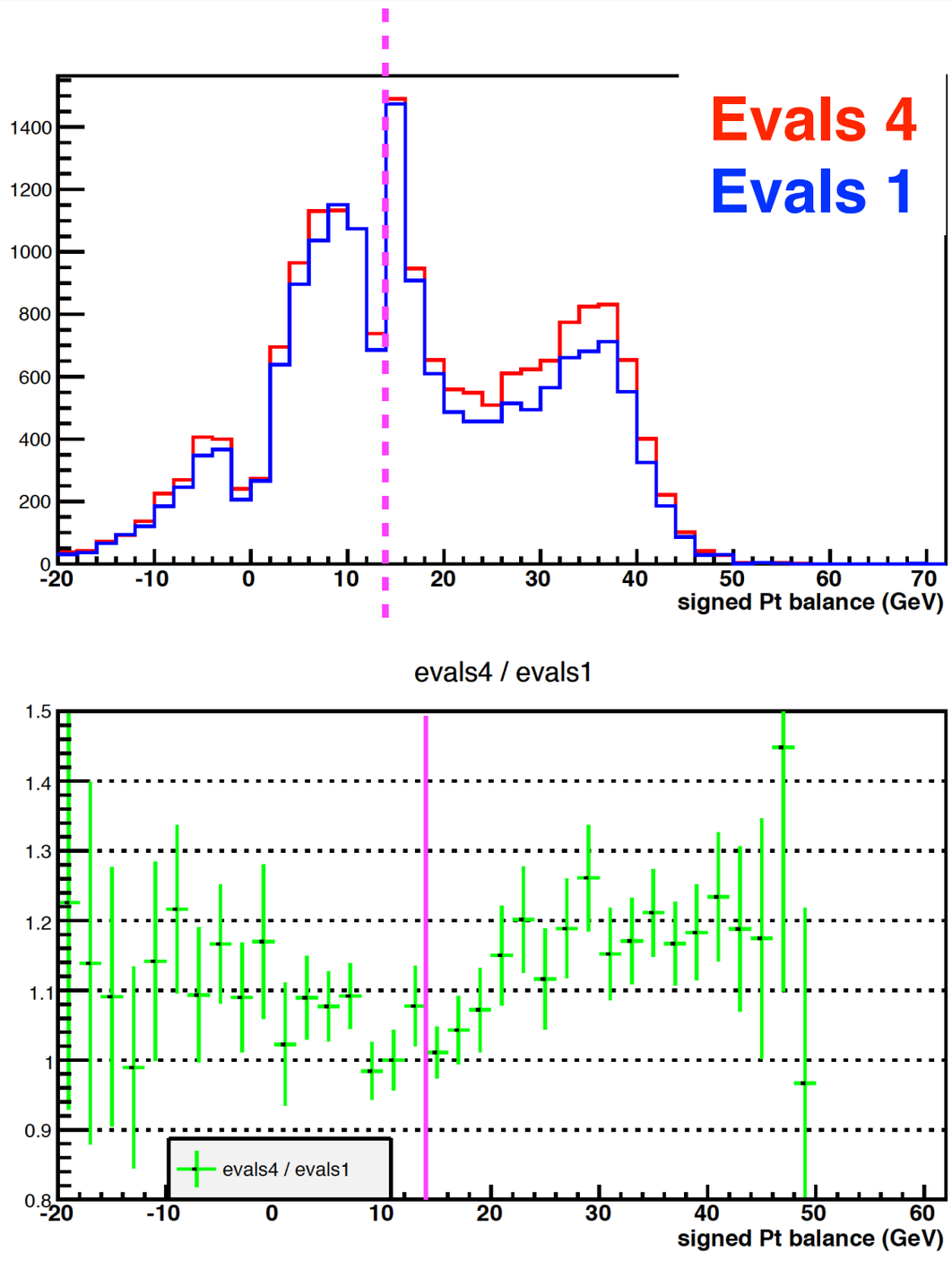



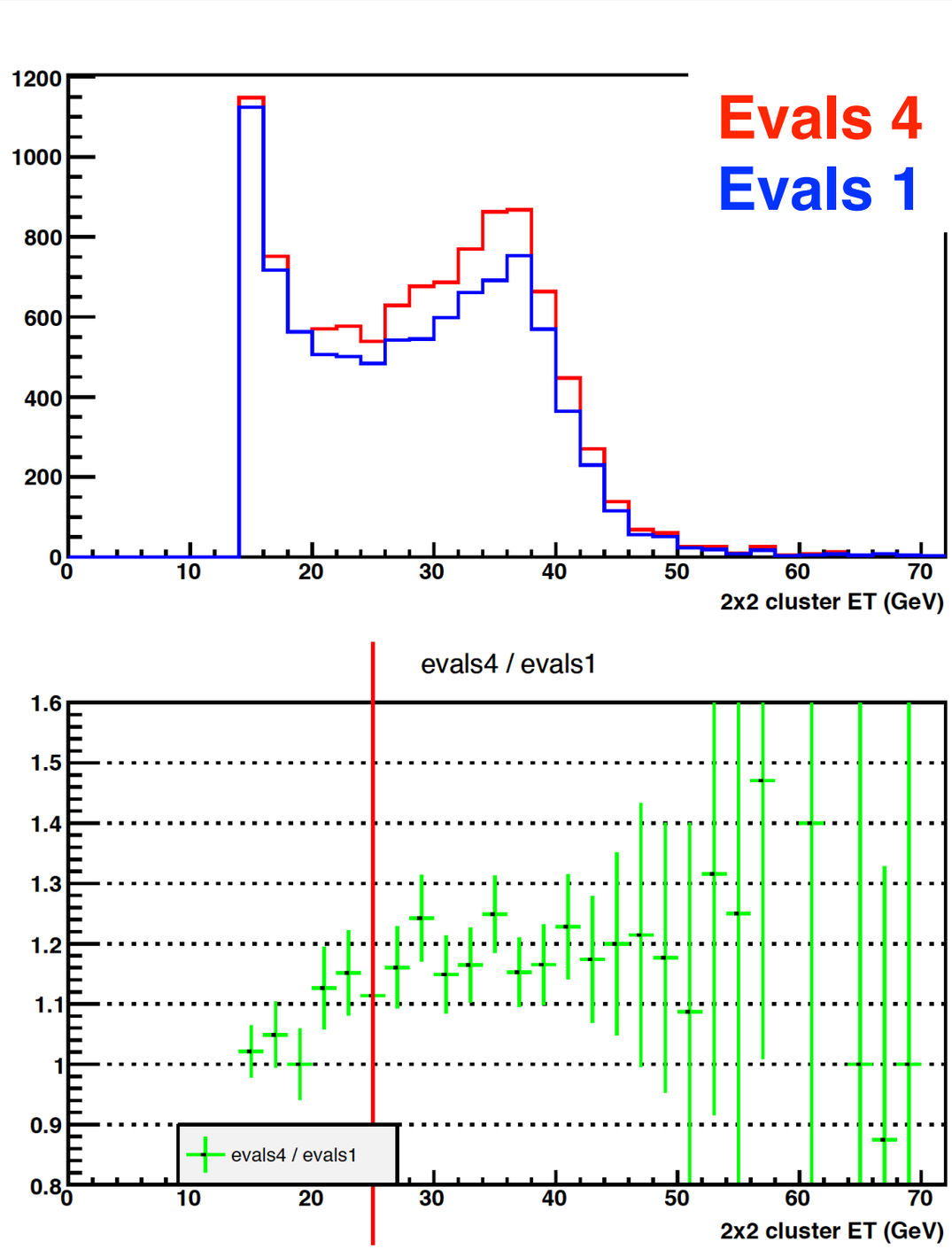
# Isolation cuts



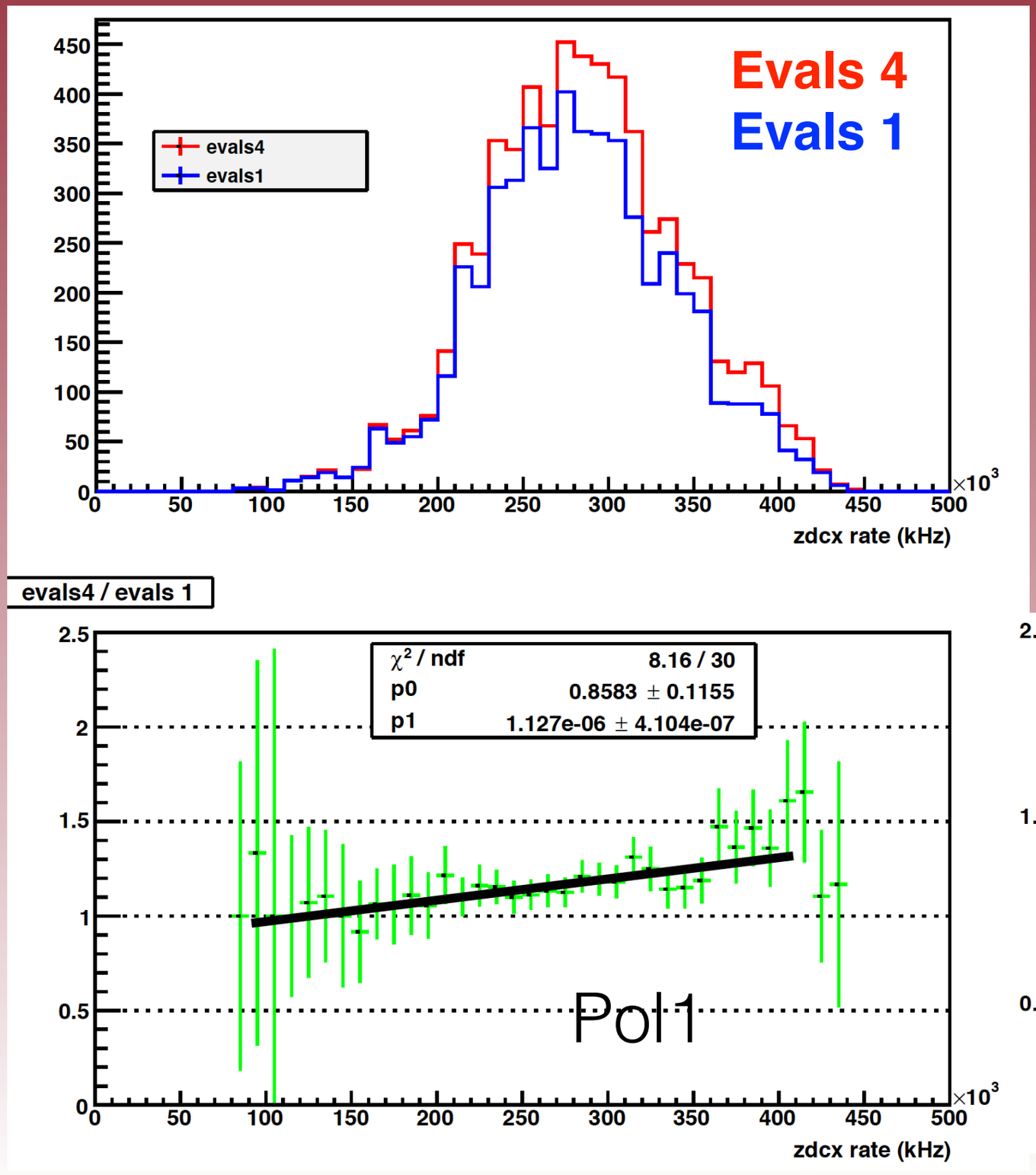



# Sign Pt, Final W

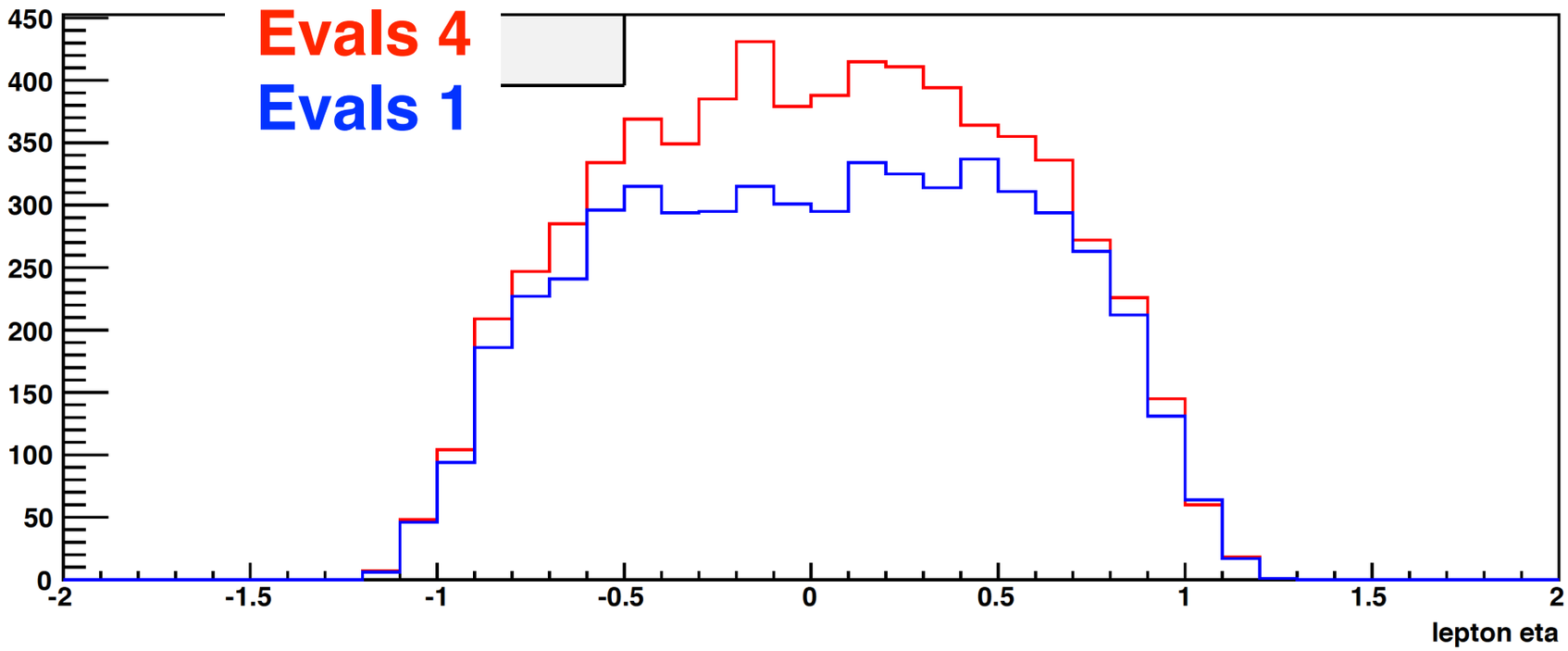


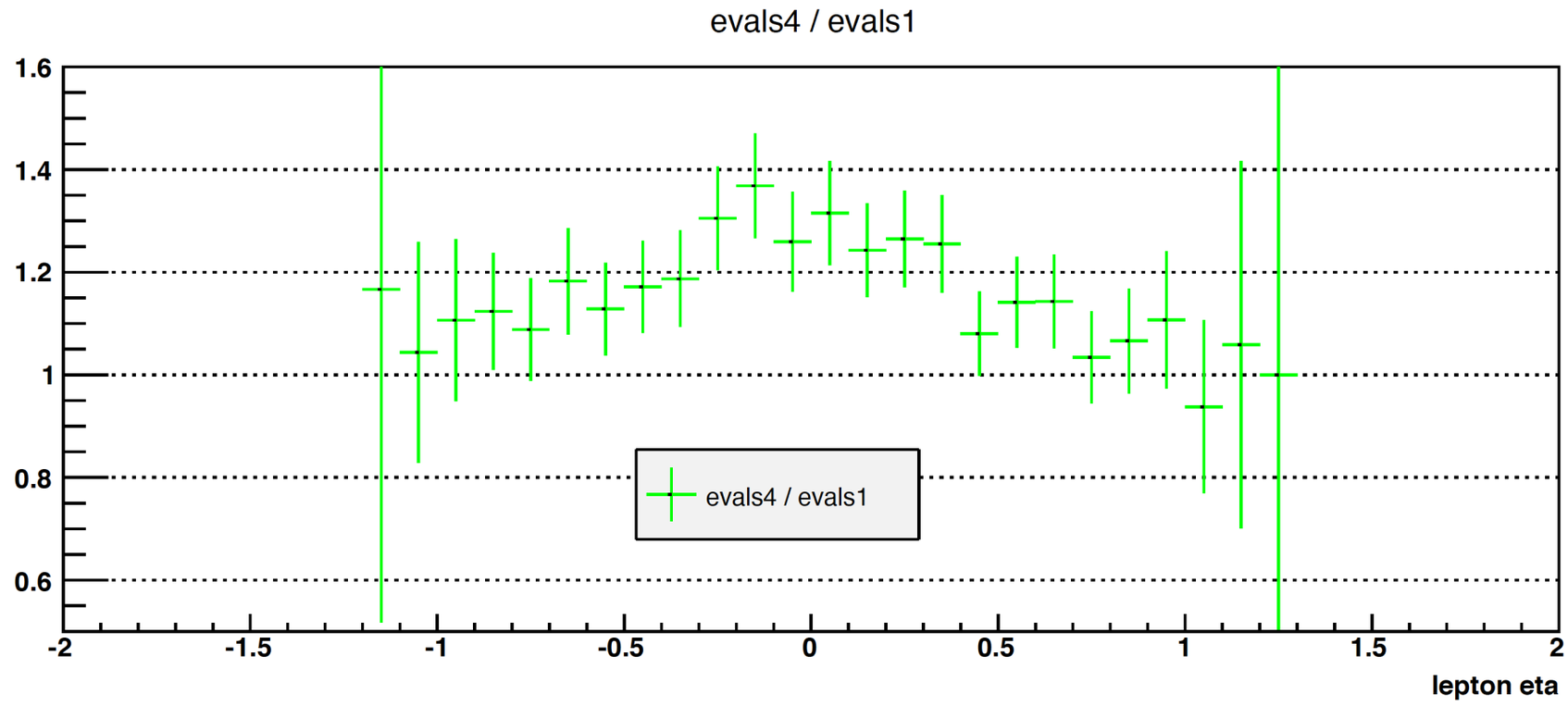



# Final W ZDC

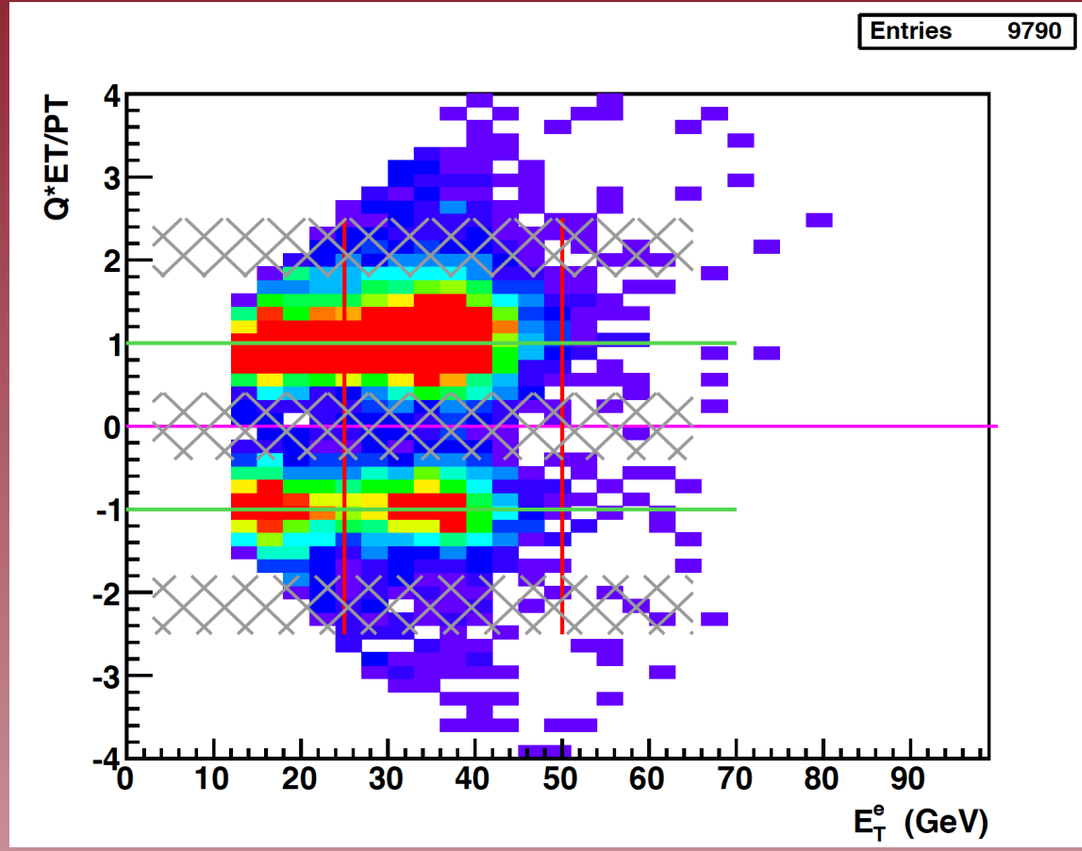

evals4
evals1
Evals 4
Evals 1
zdcx rate (kHz)
evals4 / evals 1
χ² / ndf 8.16 / 30
p0 0.8583 ± 0.1155
p1 1.127e-06 ± 4.104e-07
Pol1
zdcx rate (kHz)
χ² / ndf 17.49 / 34
p0 1.171 ± 0.022
Pol0
zdcx rate (kHz)

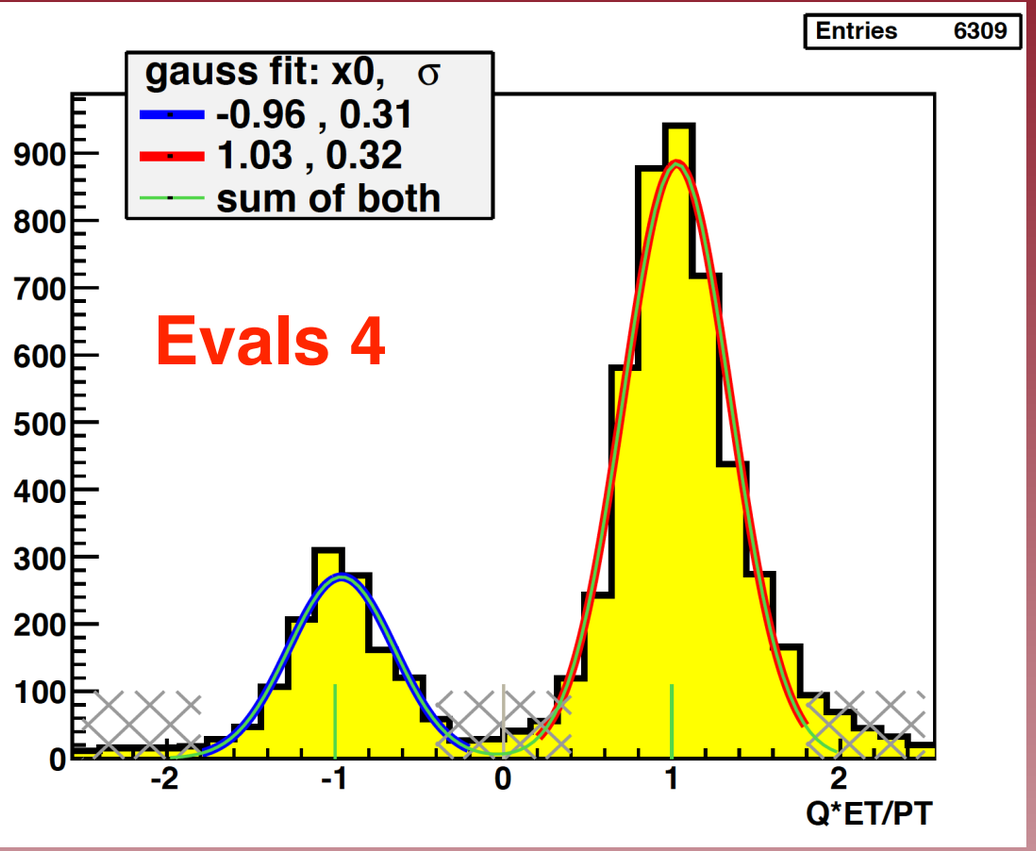
# Final W Eta

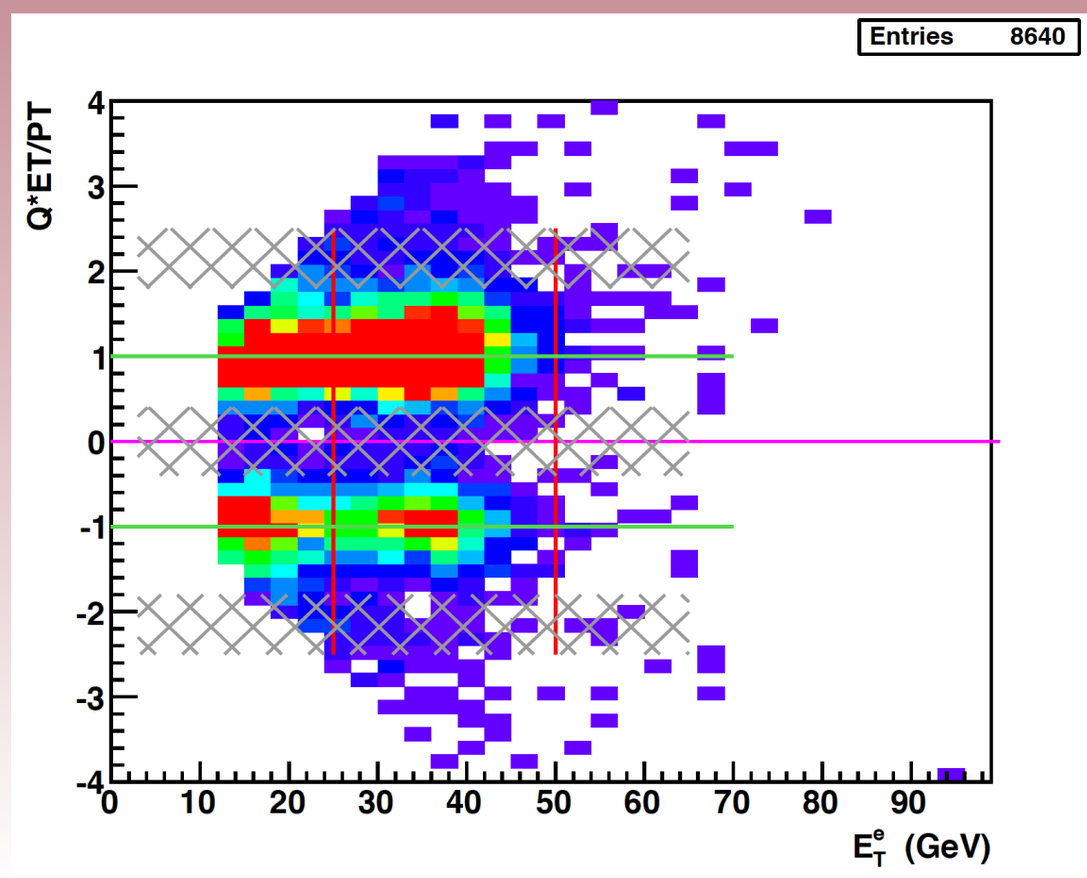

Evals 4
Evals 1
450
400
350
300
250
200
150
100
50
0
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
lepton eta

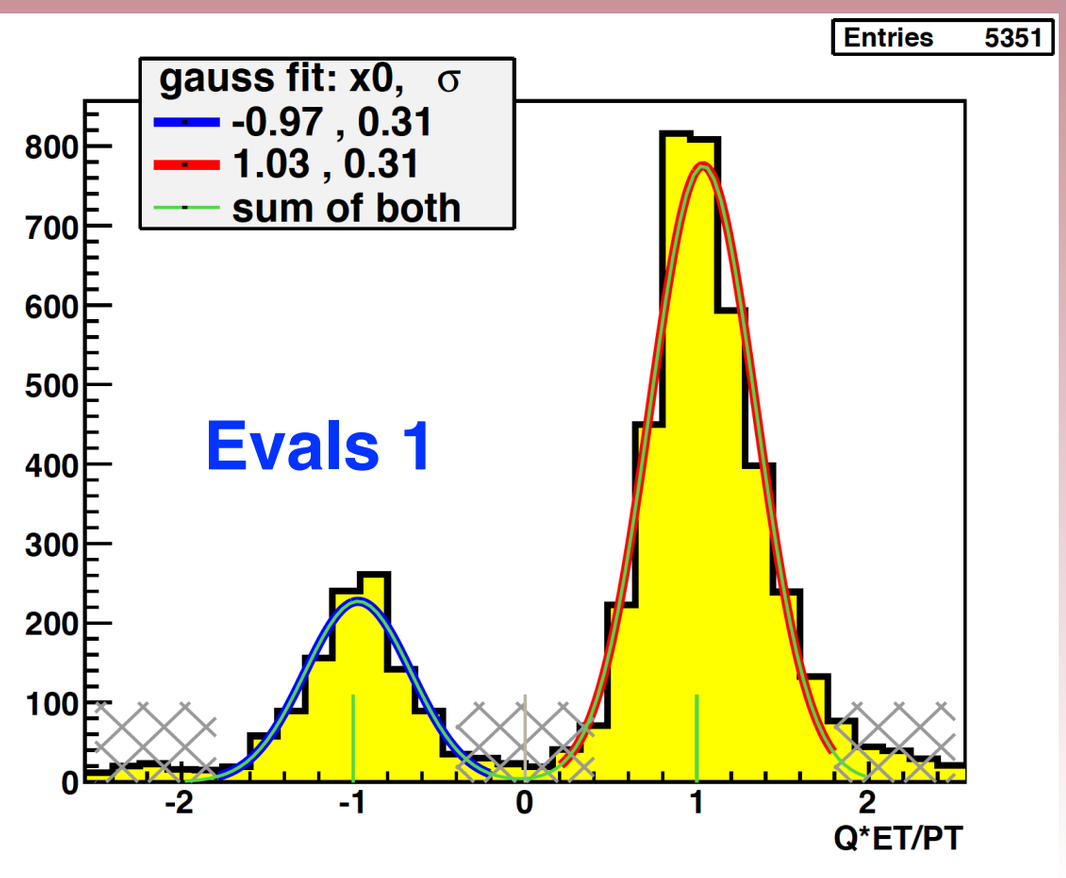

evals4 / evals1
1.6
1.4
1.2
1
0.8
0.6
evals4 / evals1
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
lepton eta

# W charge Separation

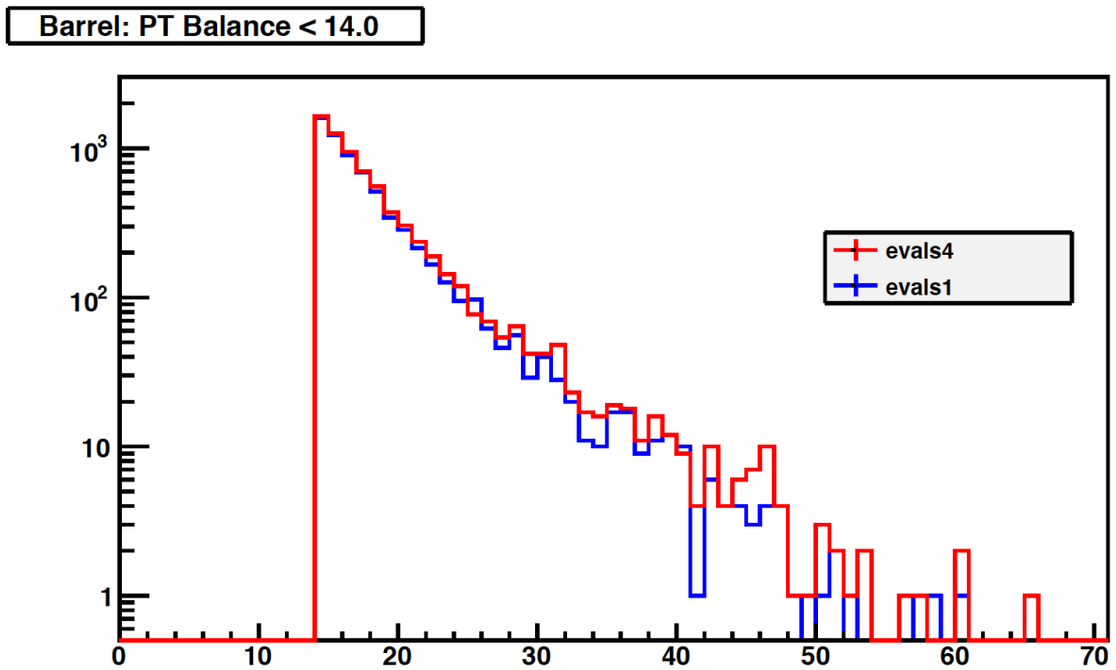


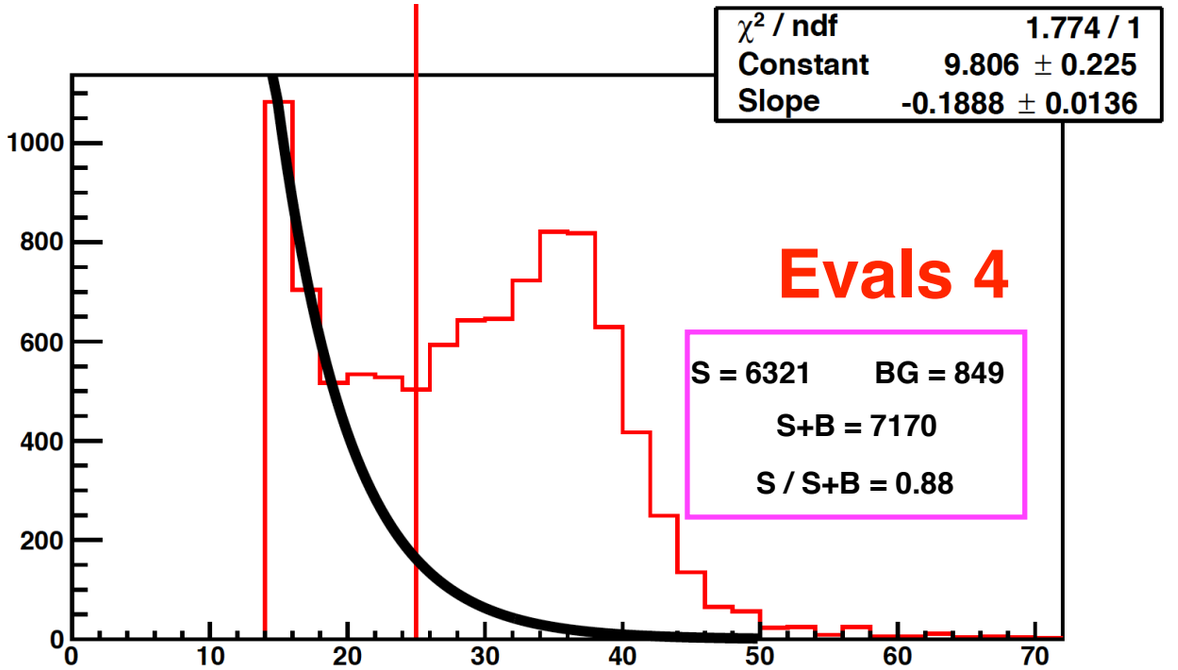



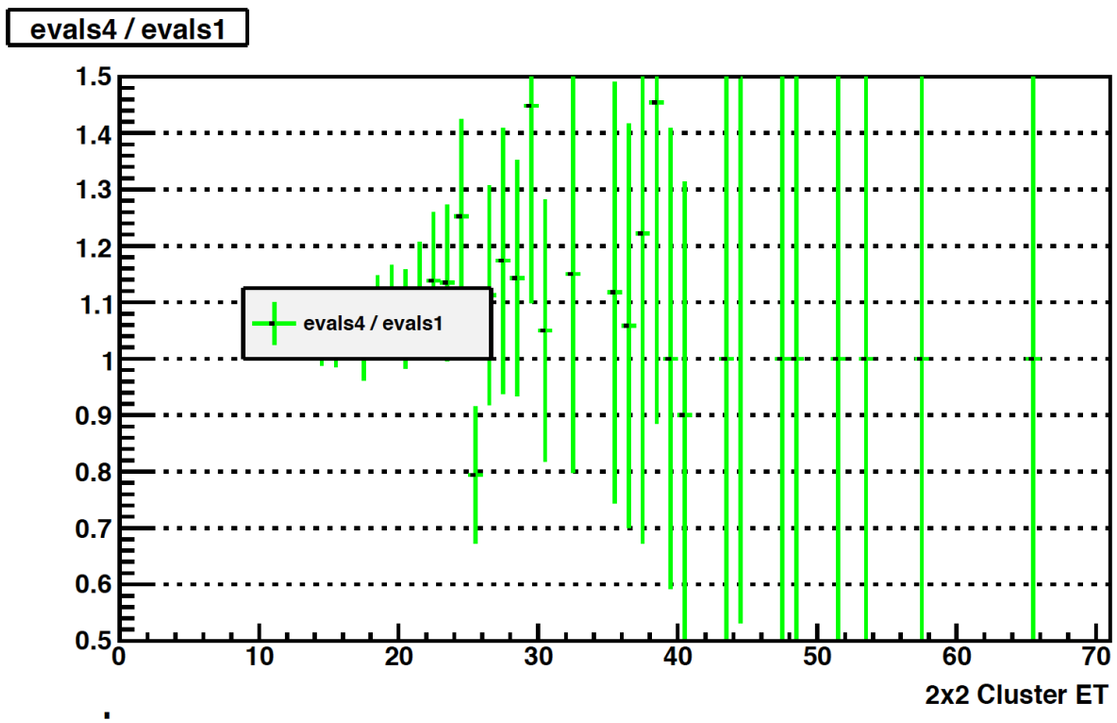



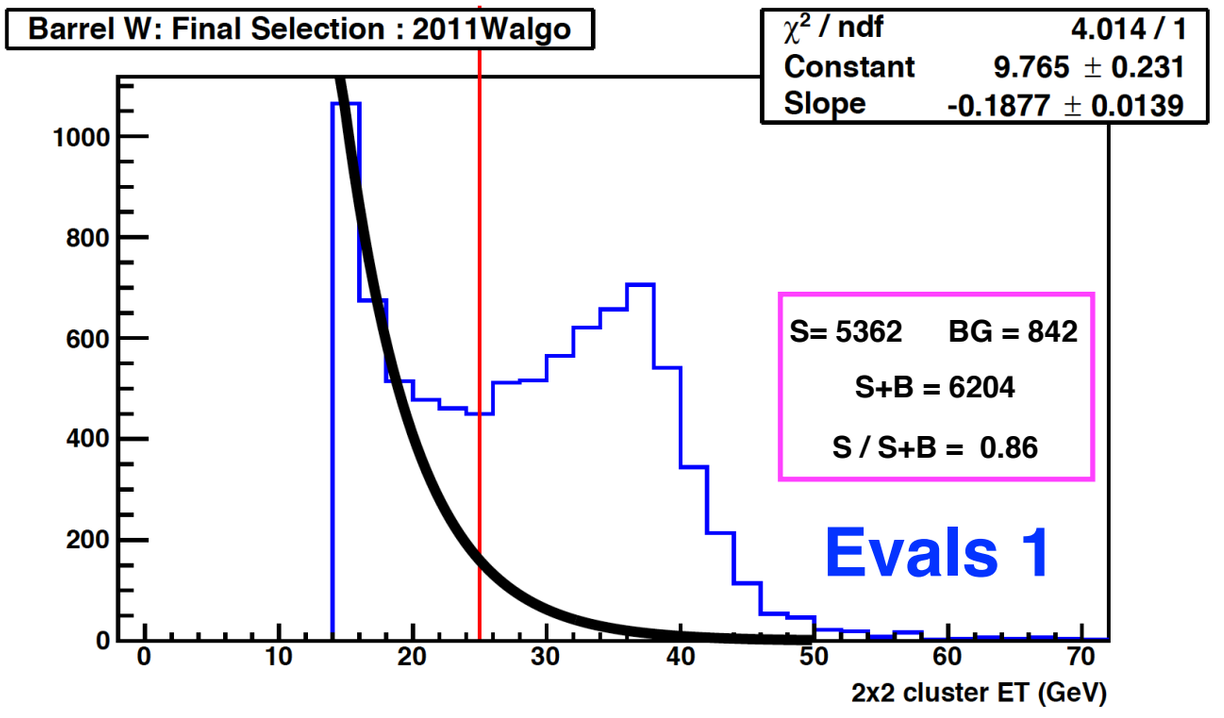



# QCD BG


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)

# Summary

- ~20 % enhancement in tracks above Pt = 10 GeV and similar enhancement in final W [> 25 GeV] tracks.

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

- improvement in signal to background ratio.

# Evals 1 vs p14ia

Apple- to -Apple comparison

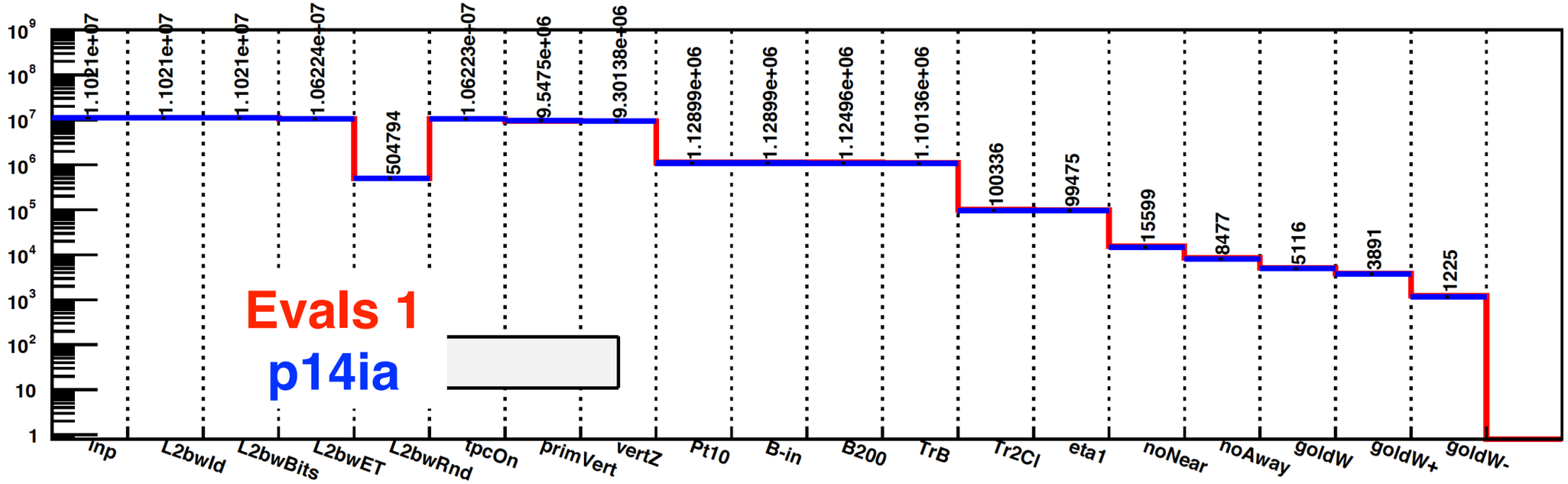
# Details / Notes

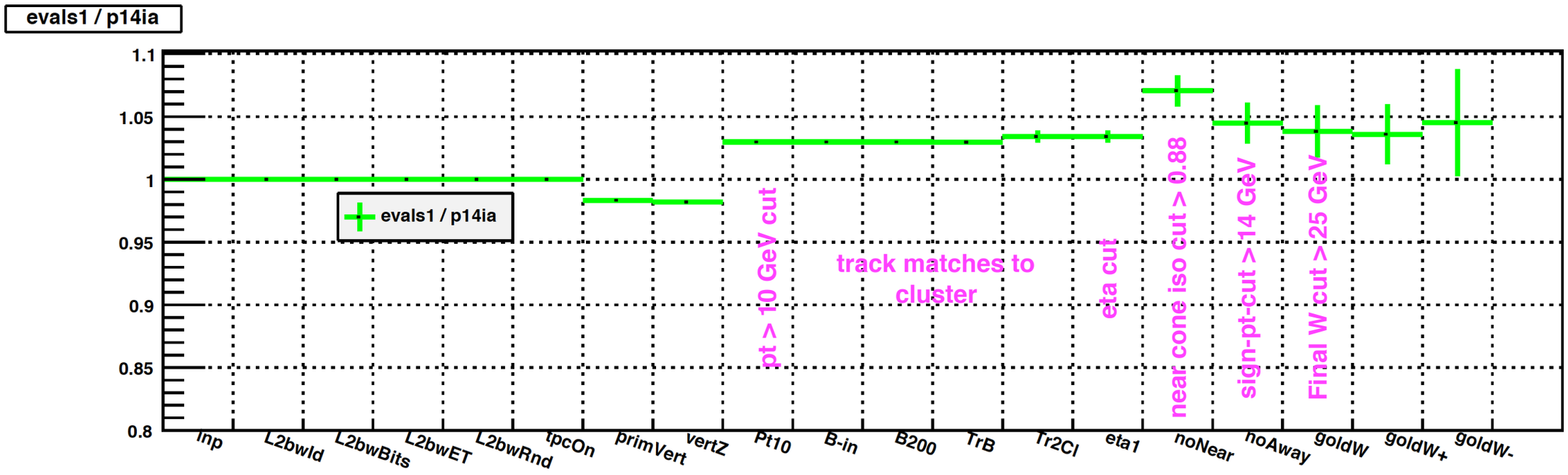
| Production | Production Library [also W-code compiled | Tracking | vertex finding | BEMC-gains | # of runs used in the comparison | # of events |
|---|---|---|---|---|---|---|
| P14ia [official run 13 - P1 (day 76-128) | SL14ia [SL14g] | Sti | PPV_W | run 12 - 200 GeV | 885 | 11.021 M |
| “evals1” | SL16b | Sti | PPV_W | run 12 200 GeV | 885 | 11.021 M |

- **All the runs which were used for the comparison compared for # events processed. Runs which processed exactly the same # of events were chosen.**

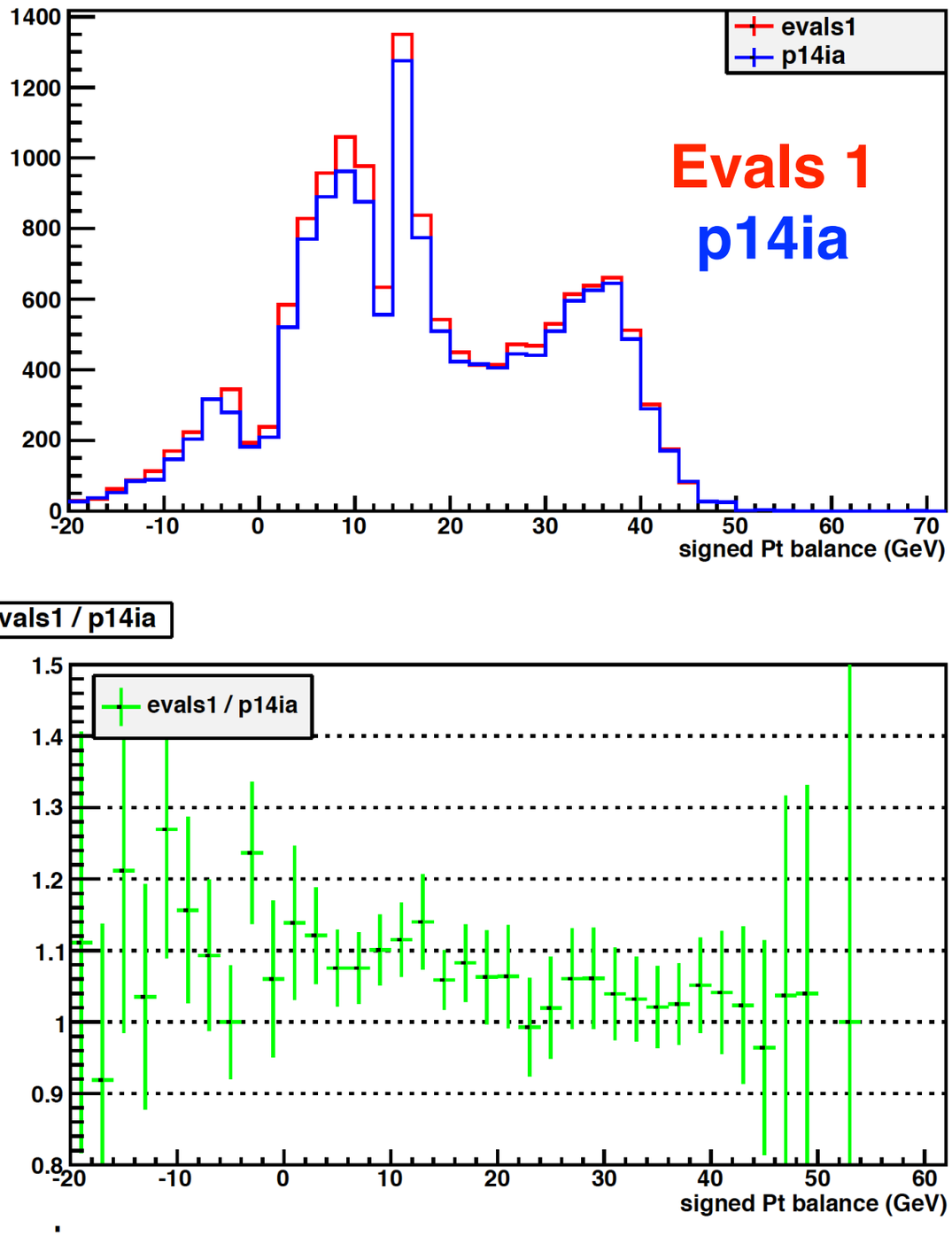
- **SL16b - https://drupal.star.bnl.gov/STAR/comp/sofi/soft-n-libs/library-release-history/2016-0#SL16b**

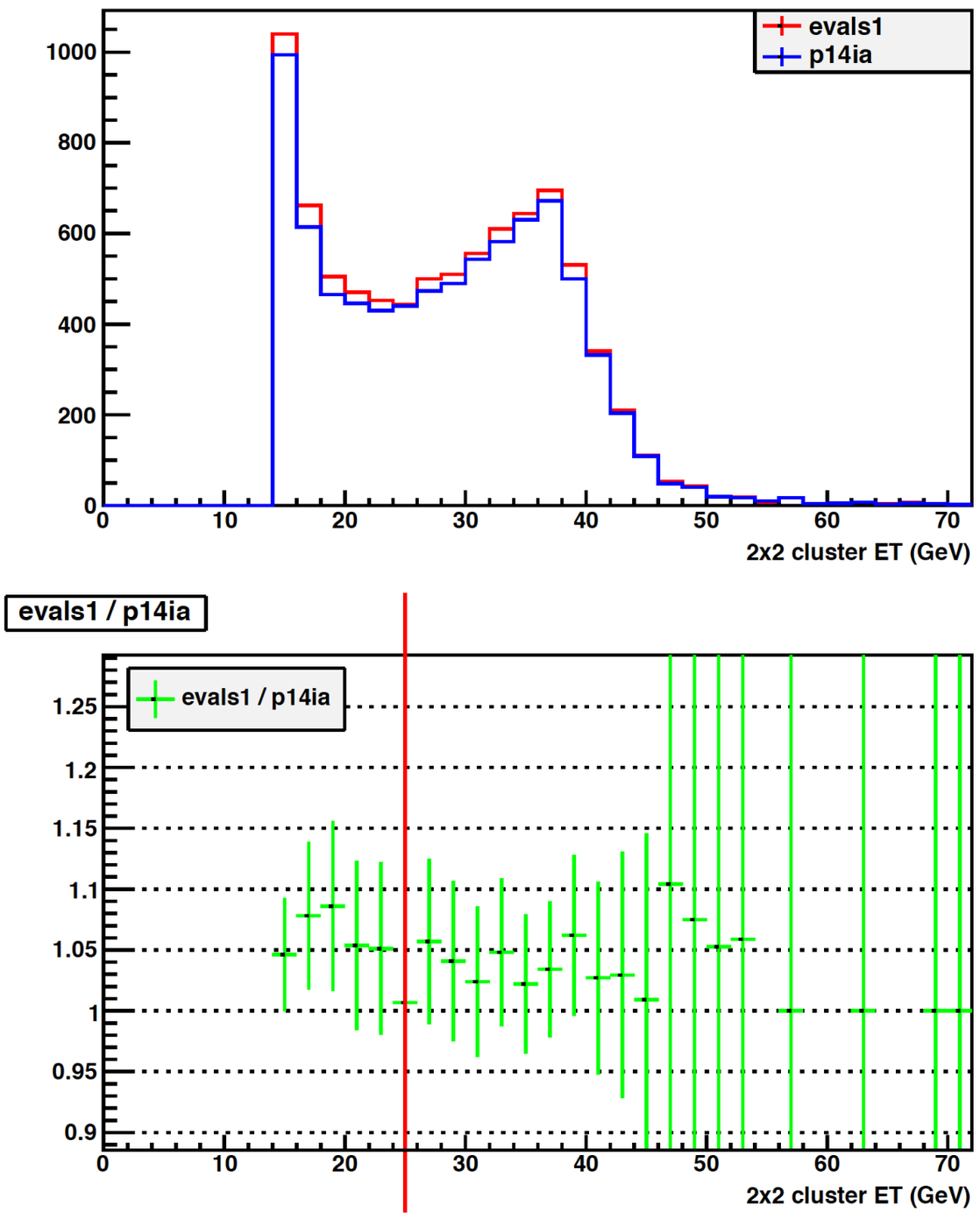
# Events Counts



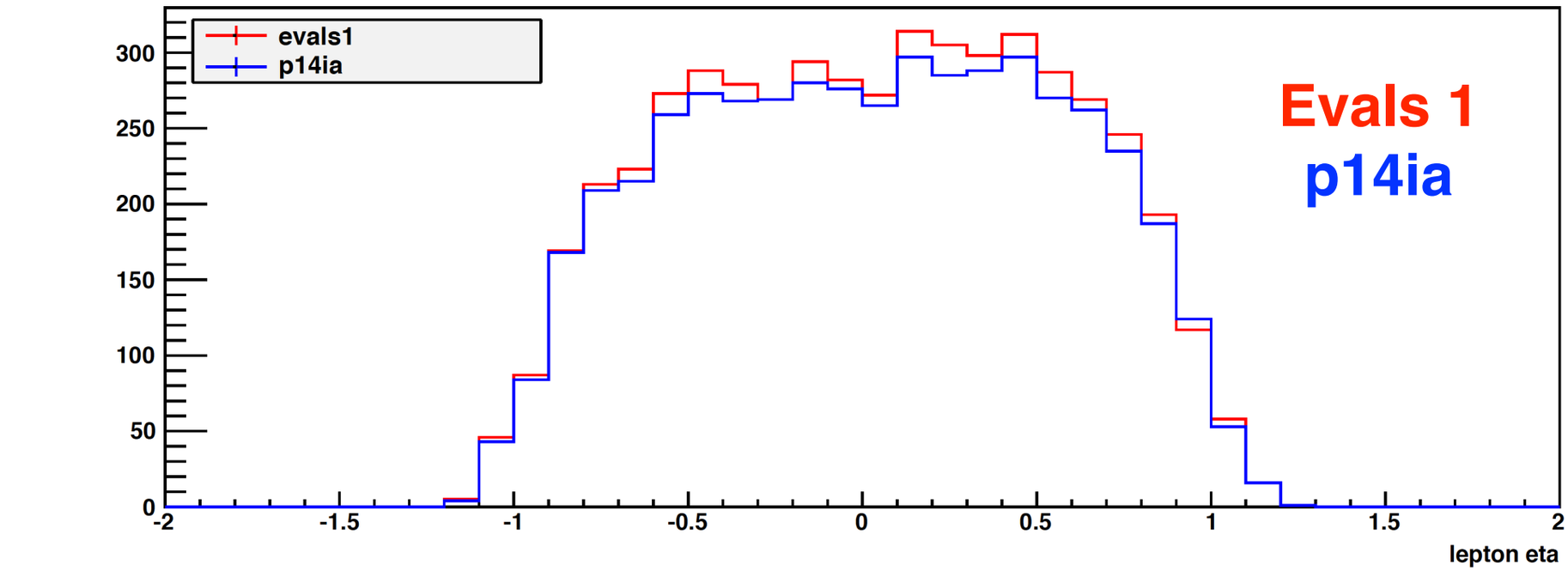



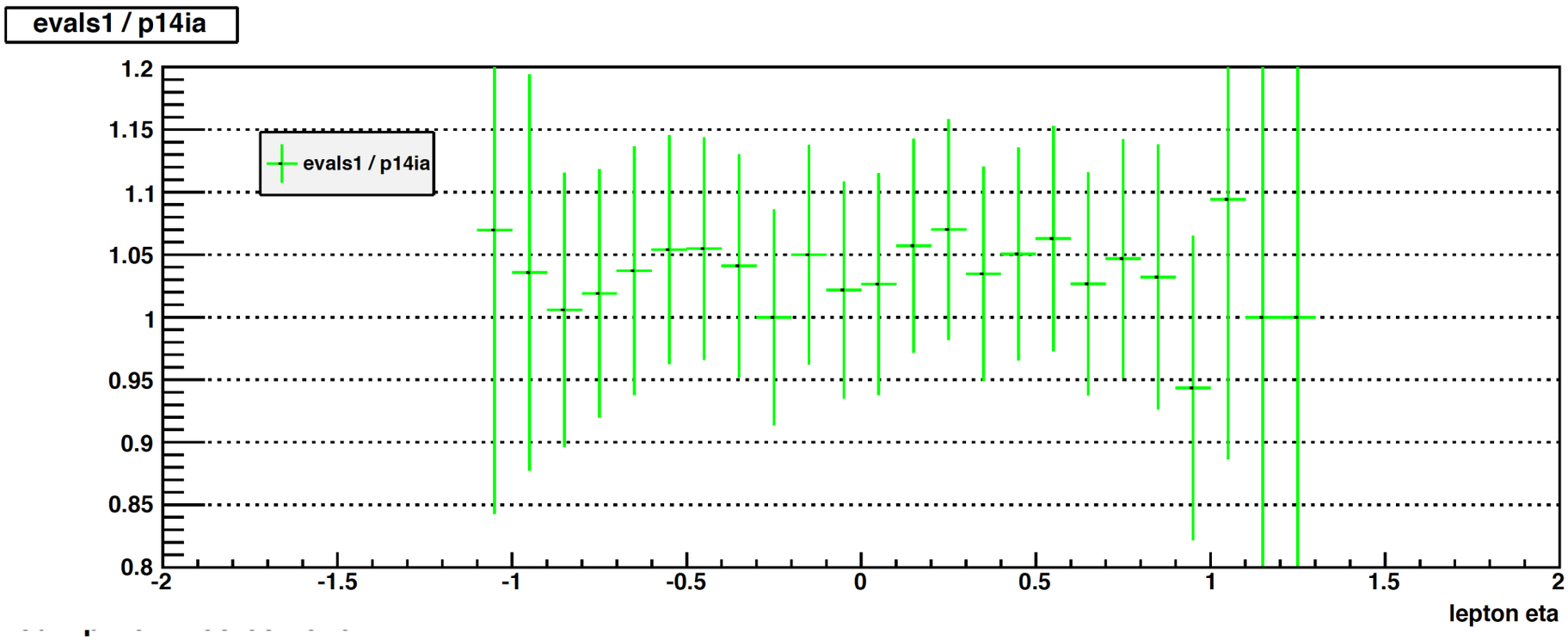
# Final W


evals1
p14ia
Evals 1
p14ia
signed Pt balance (GeV)
evals1 / p14ia
evals1 / p14ia
signed Pt balance (GeV)

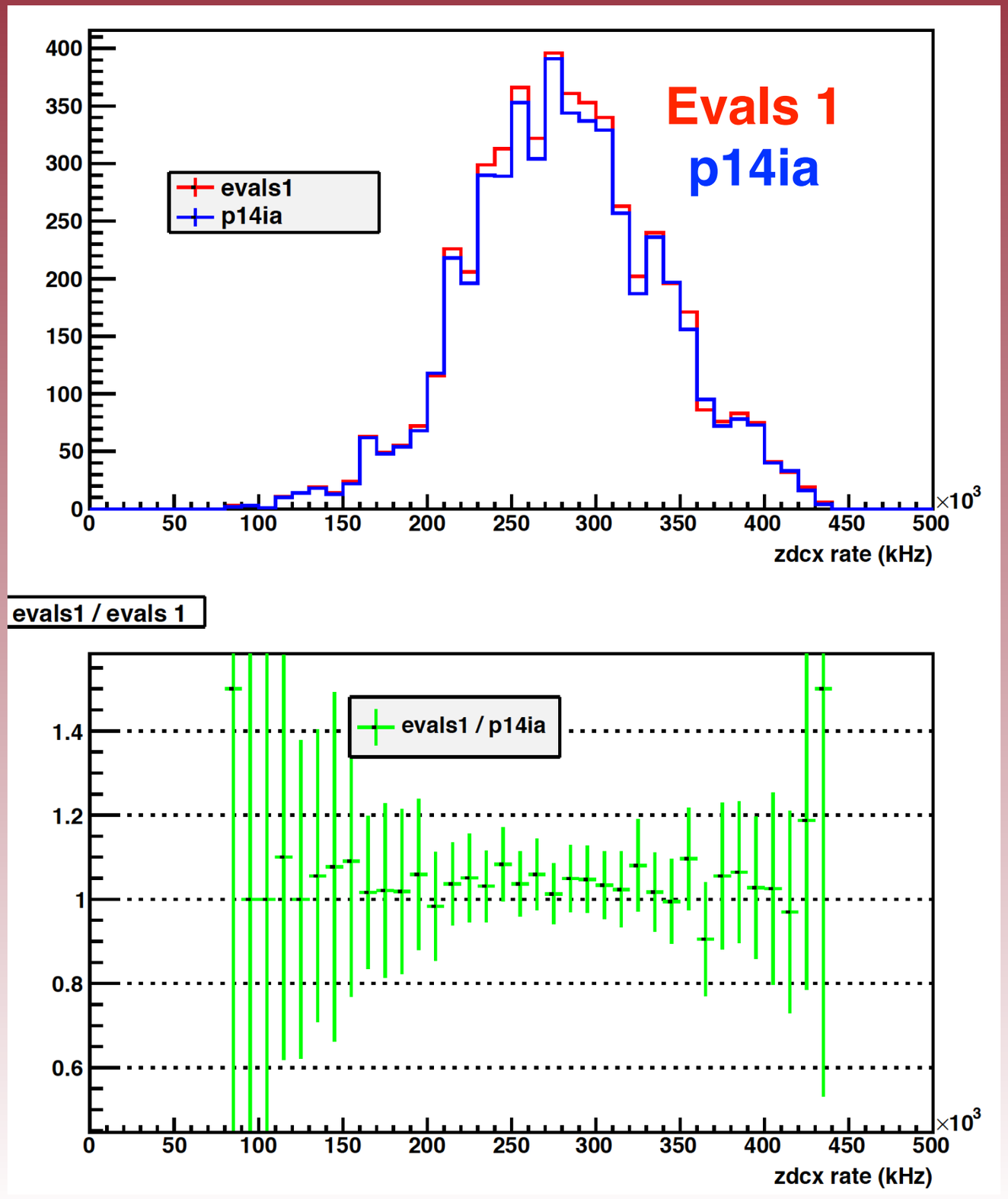

evals1
p14ia
2x2 cluster ET (GeV)
evals1 / p14ia
evals1 / p14ia
2x2 cluster ET (GeV)

# Final W Eta

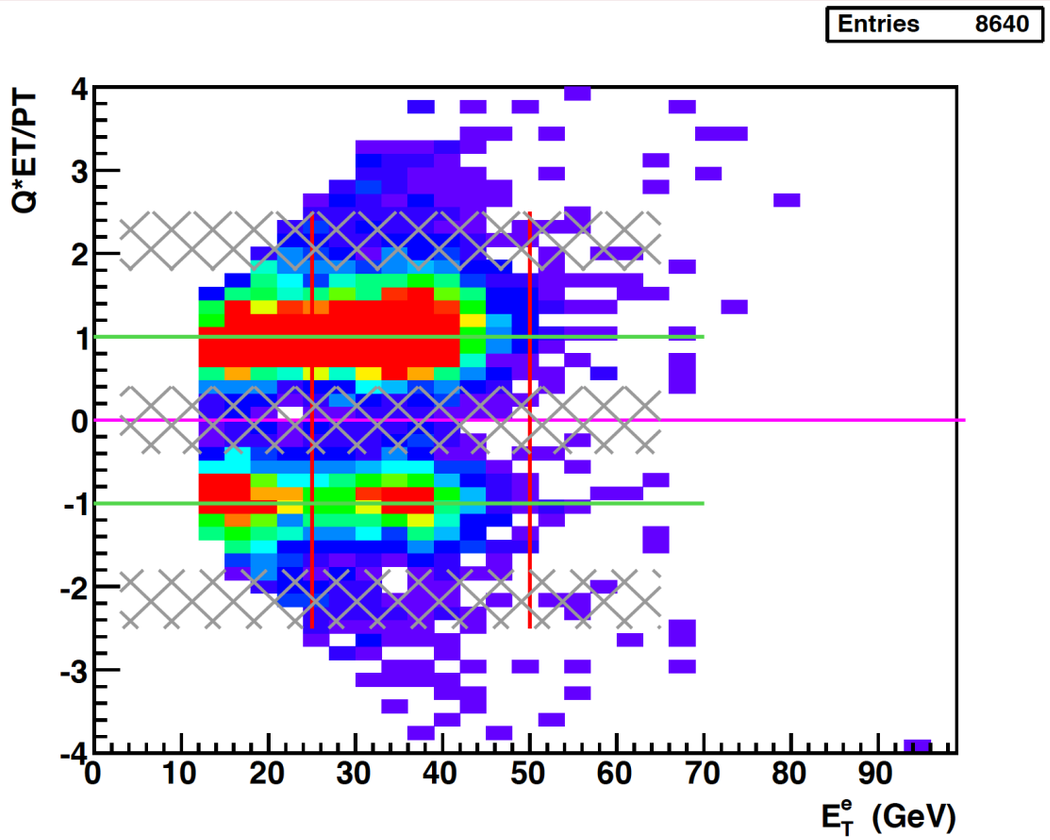

evals1
p14ia
Evals 1
p14ia
300
250
200
150
100
50
0
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
lepton eta

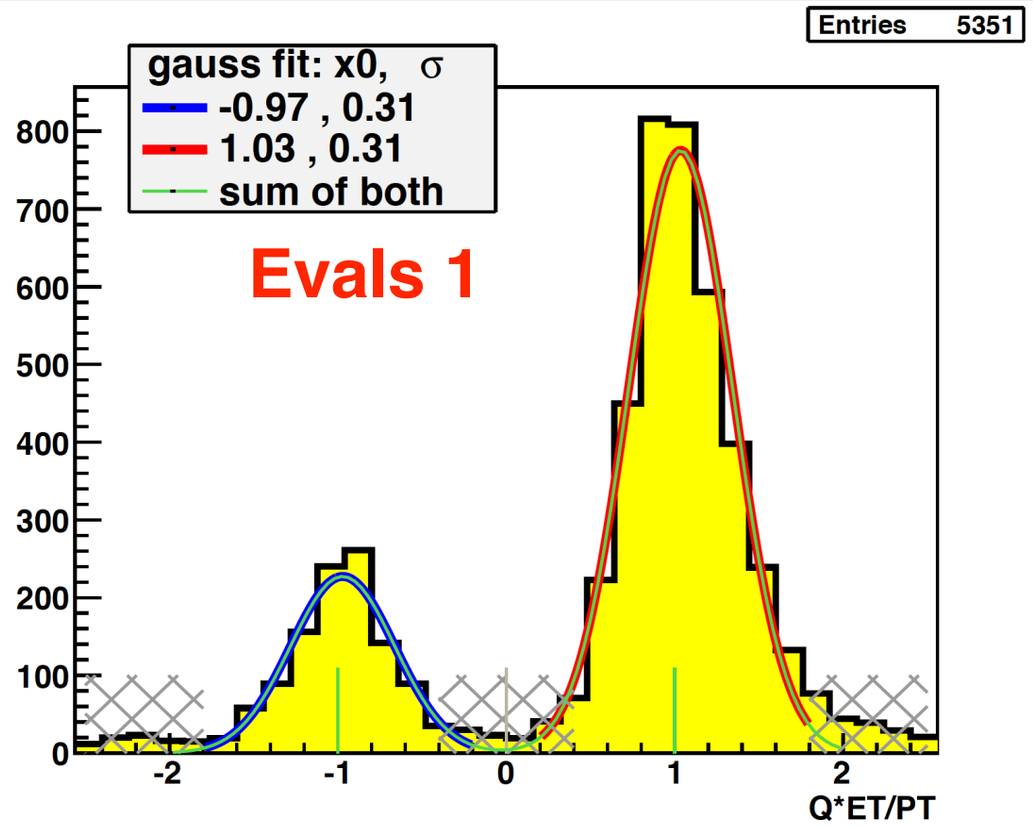

evals1 / p14ia
evals1 / p14ia
1.2
1.15
1.1
1.05
1
0.95
0.9
0.85
0.8
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
lepton eta

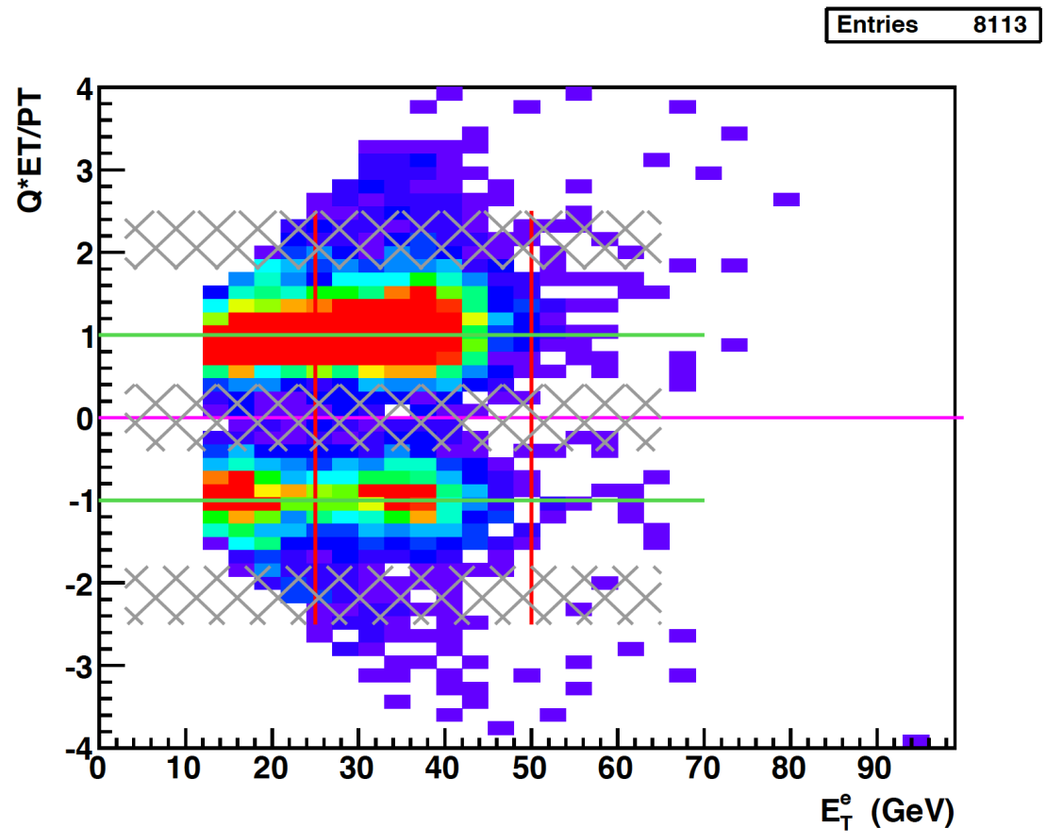
# Final W / ZDC

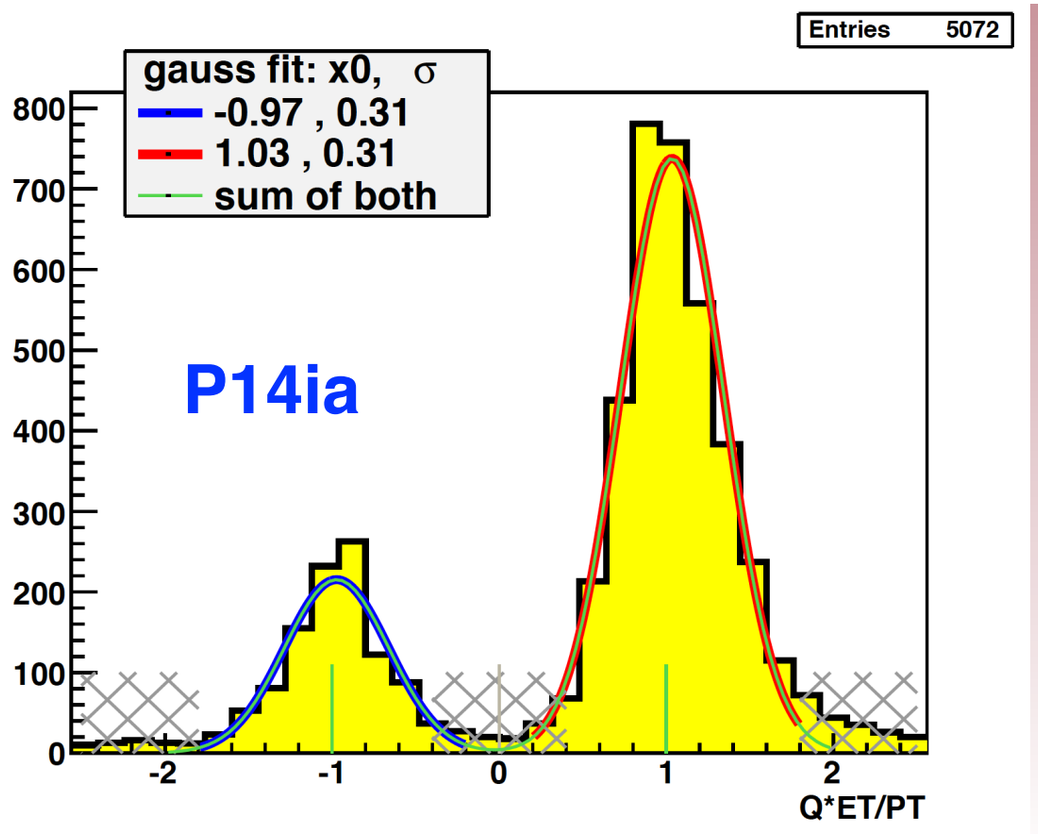

Evals 1
p14ia
evals1
p14ia
zdcx rate (kHz)
evals1 / evals 1
evals1 / p14ia
zdcx rate (kHz)

# W Charge Separation

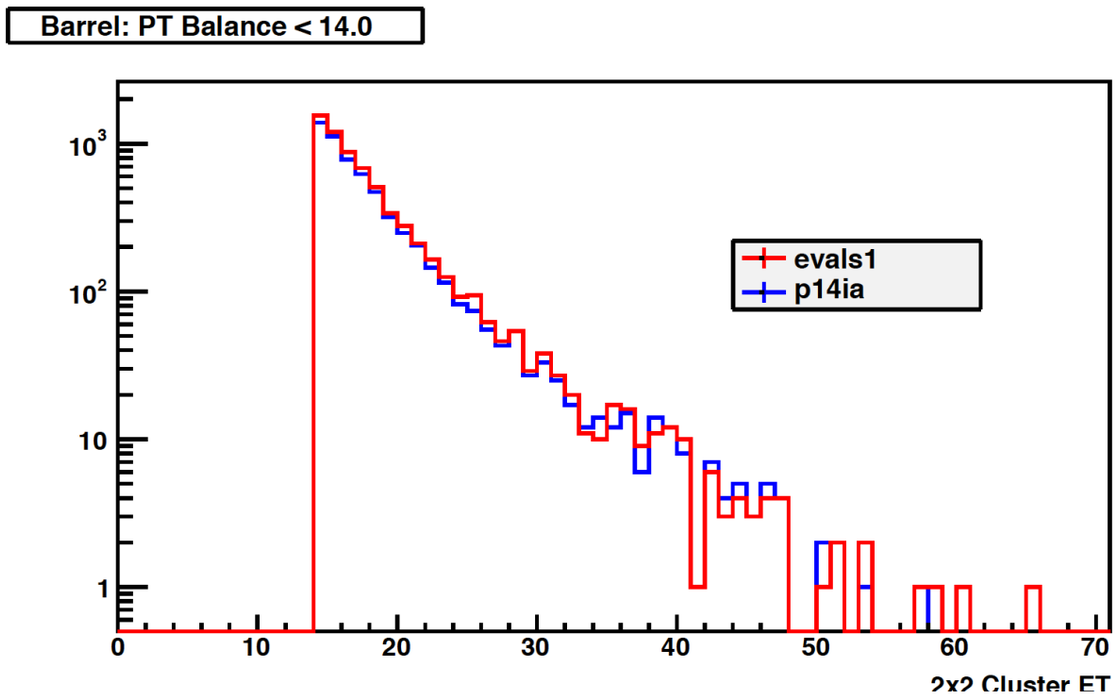


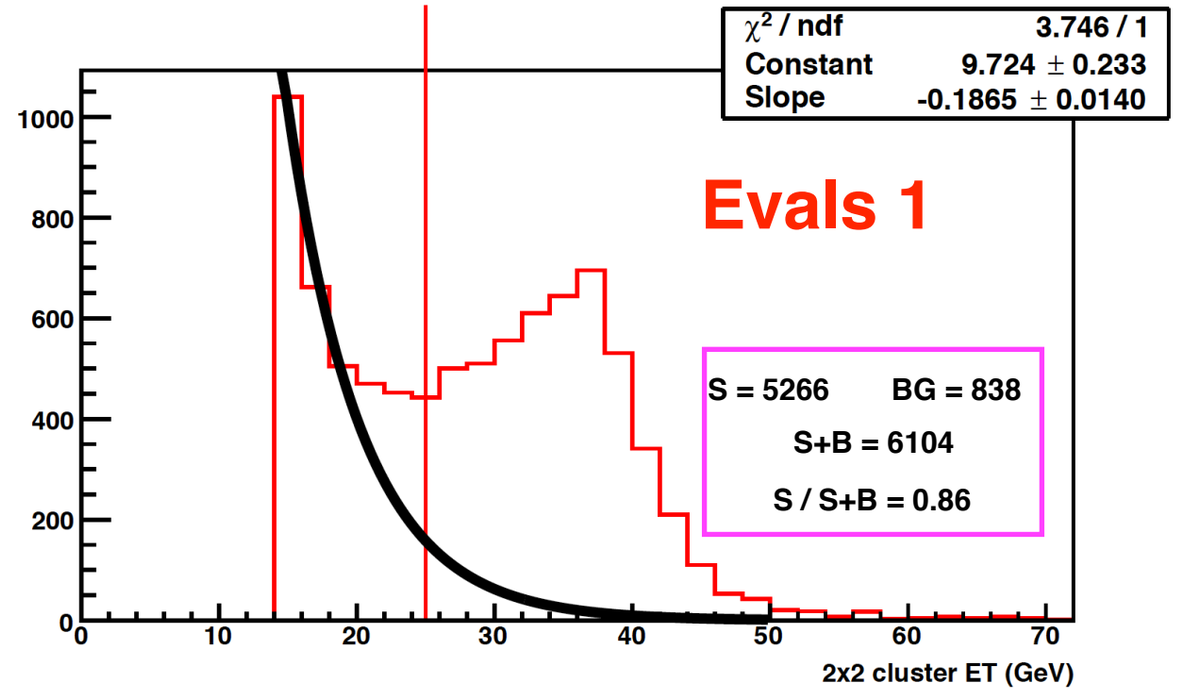



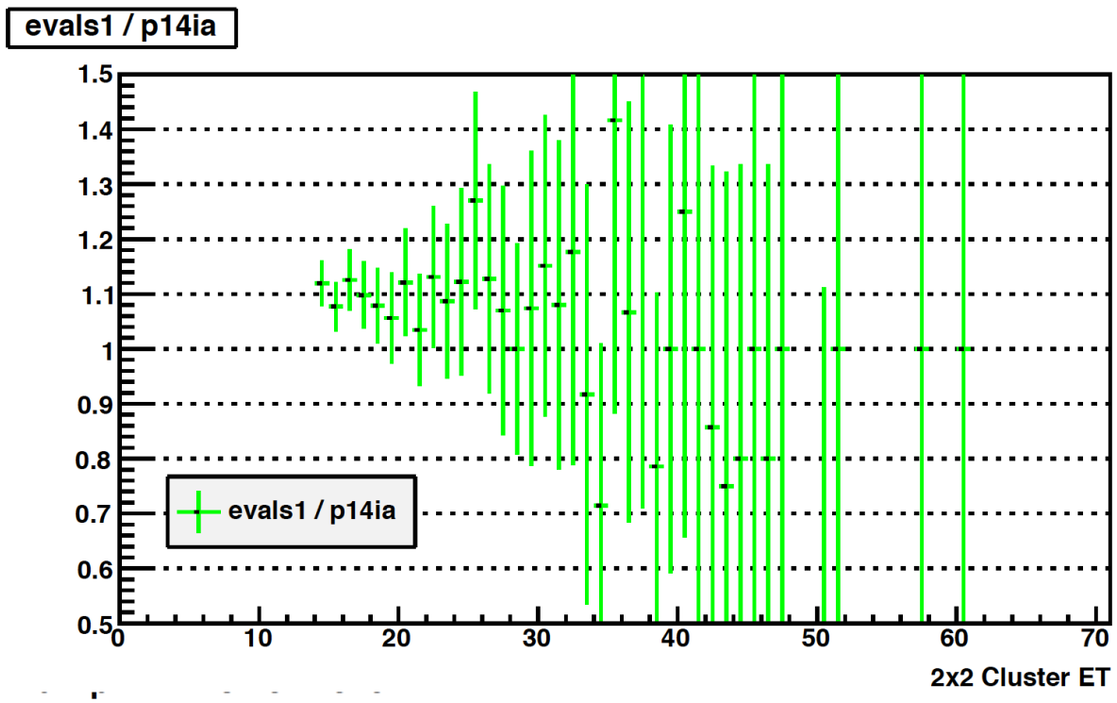



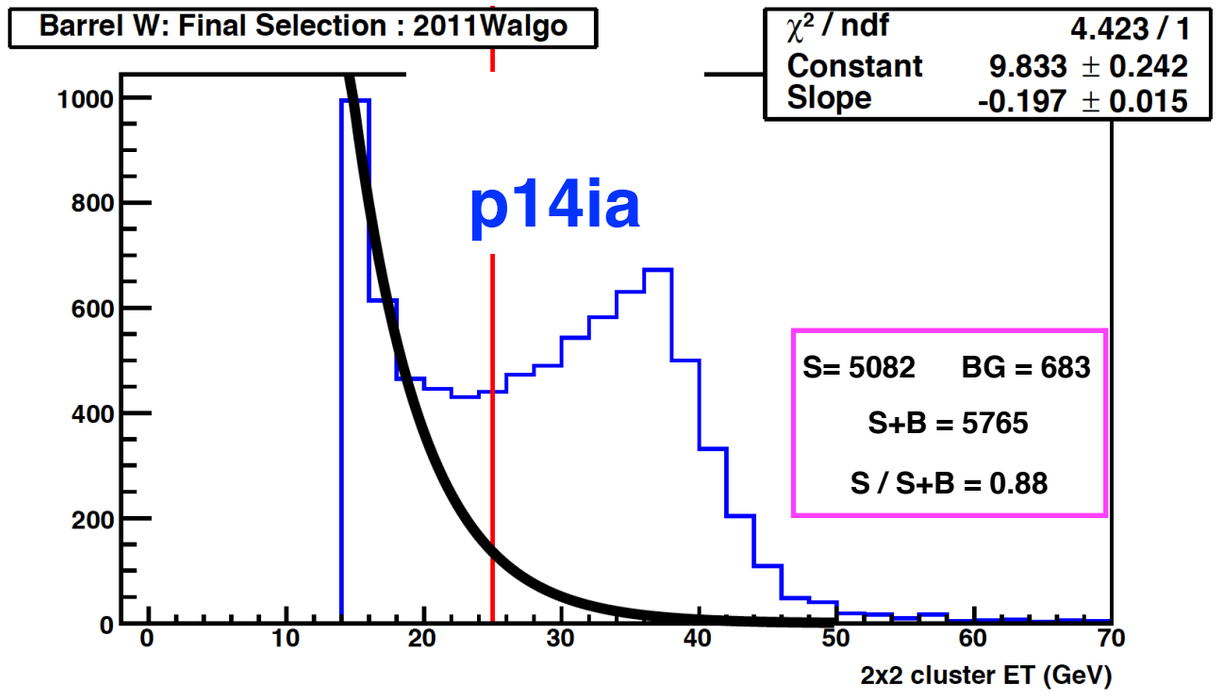



# QCD BG


Barrel: PT Balance < 14.0
evals1
p14ia
2x2 Cluster ET


$\chi^2$ / ndf 3.746 / 1
Constant 9.724 ± 0.233
Slope -0.1865 ± 0.0140
Evals 1
S = 5266 BG = 838
S+B = 6104
S / S+B = 0.86
2x2 cluster ET (GeV)


evals1 / p14ia
evals1 / p14ia
2x2 Cluster ET


Barrel W: Final Selection : 2011Walgo
$\chi^2$ / ndf 4.423 / 1
Constant 9.833 ± 0.242
Slope -0.197 ± 0.015
p14ia
S= 5082 BG = 683
S+B = 5765
S / S+B = 0.88
2x2 cluster ET (GeV)

# 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 ]

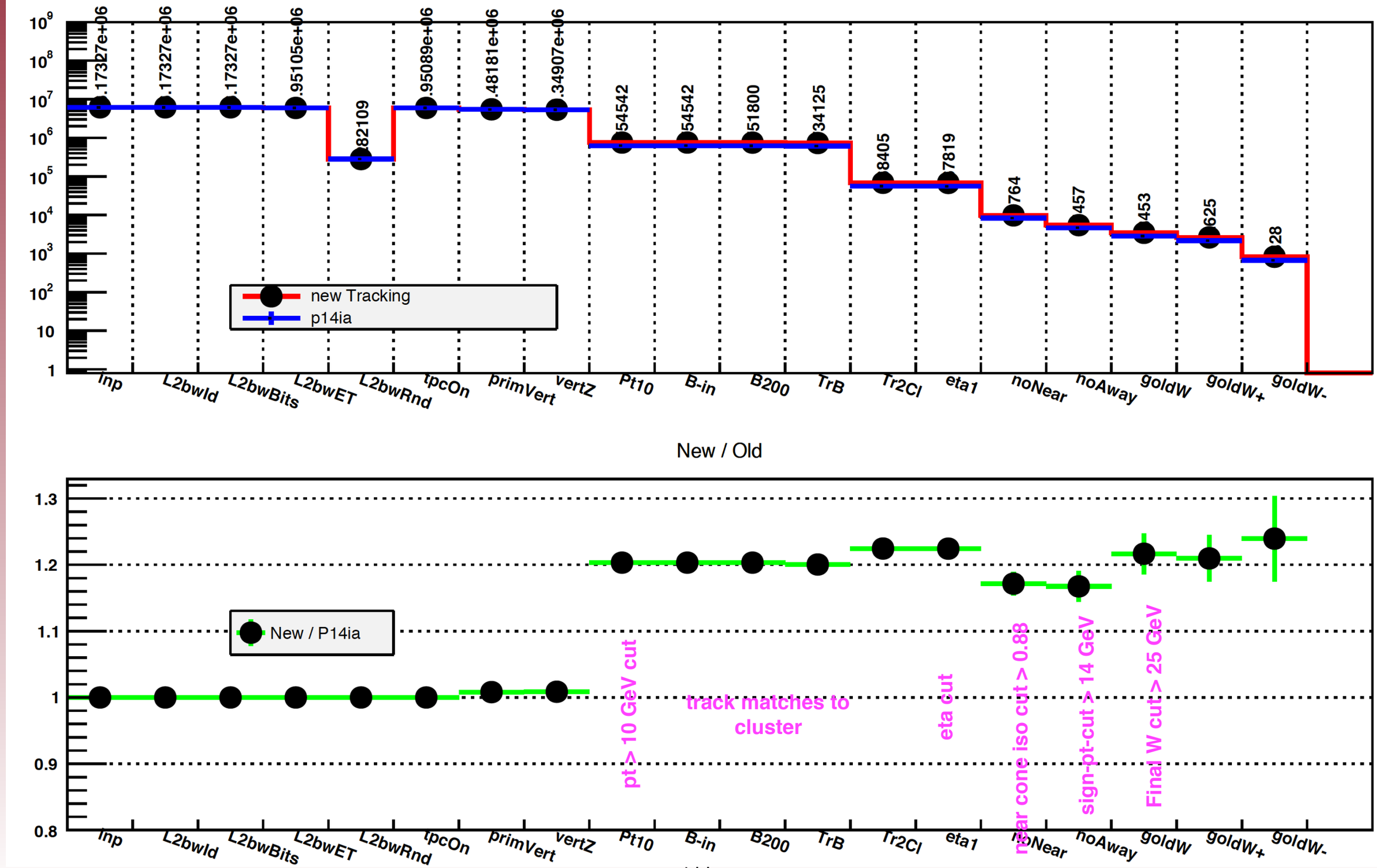
apple- to -apple comparison

# Details / Notes

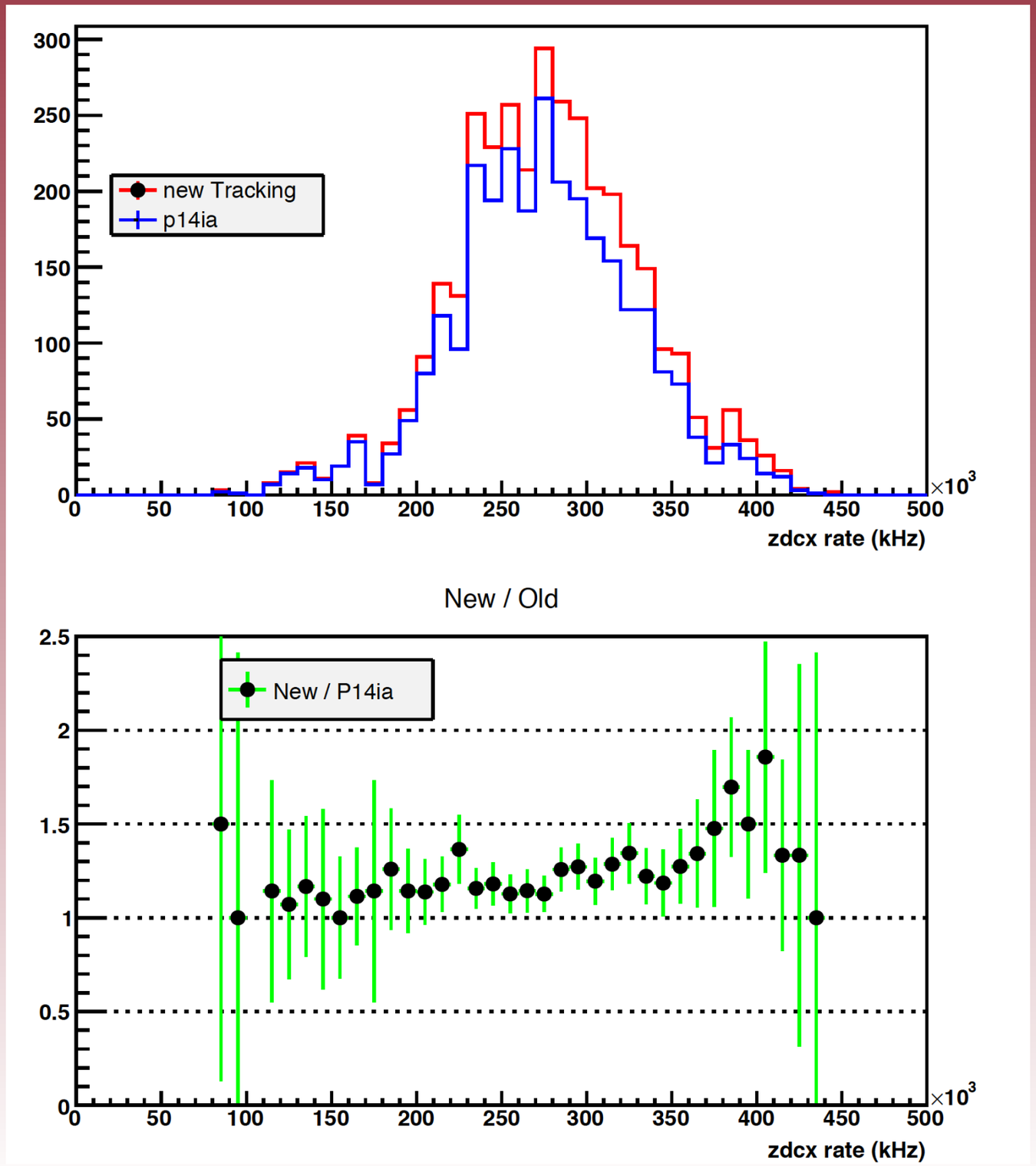
| Production | Production Library [also W-code compiled library] | Tracking | vertex finding | BEMC-gains | # of runs used in the comparison | # of events |
|---|---|---|---|---|---|---|
| P14ia [official run 13 - P2 (day 129-161) | SL14a | Sti | PPV_W | run 12 - 200 GeV | 585 | 6172606 |
| Yuri's - P2 (day 129-161) | DEV2/ TFG16a | StiCA [Yuri's code] | PPV_W | run 12 200 GeV | 585 | 6172606 |

- **All the runs which were used for the comparison compared for # events processed. I chose runs which processed exactly same # of events or runs where events differ by 1 or 2 events. Yuri's production had ~ 100 runs with only 1 or 2 events higher. Since 1-2 events difference is negligible this can be considered as apple to apple.**

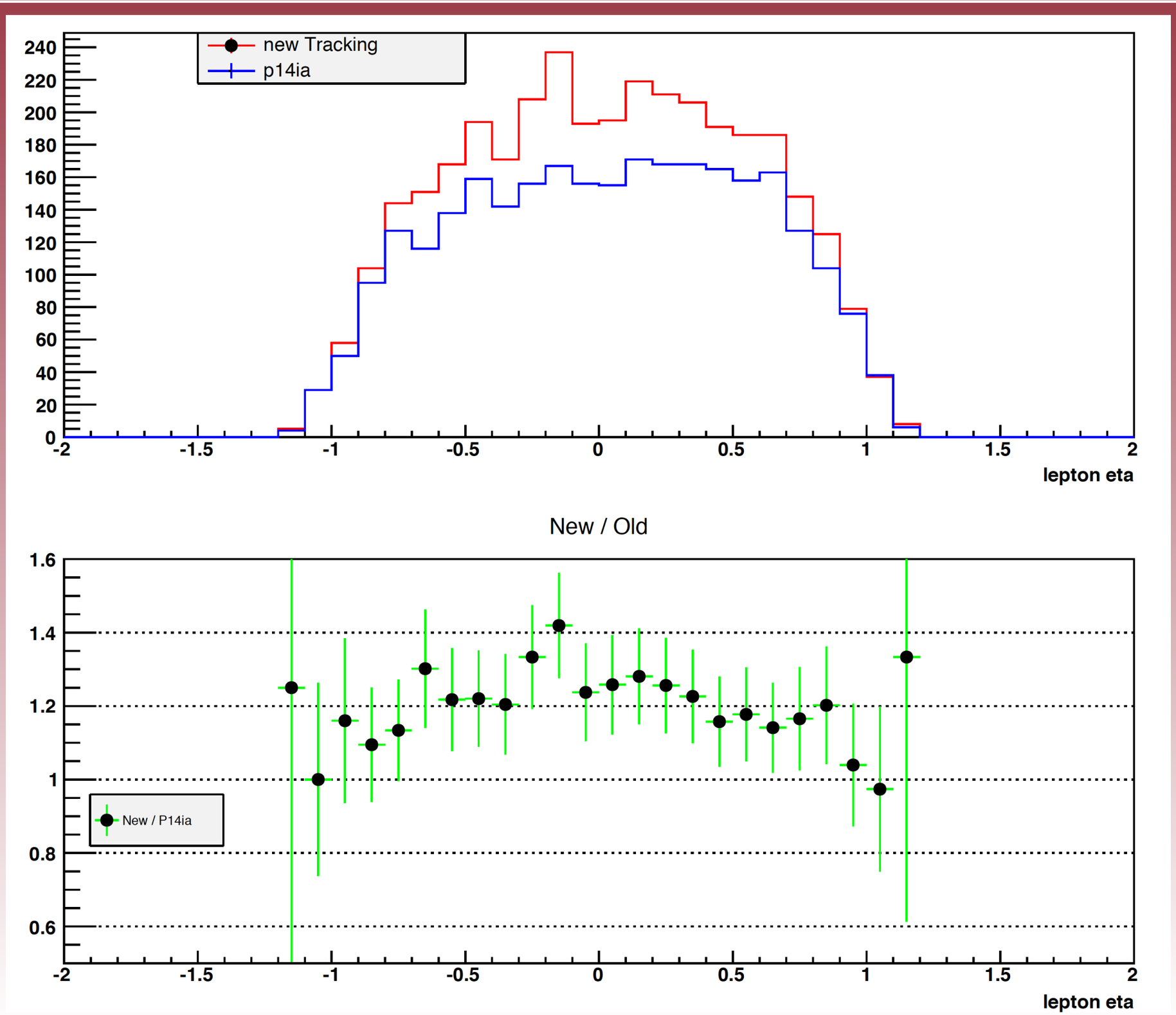
# Events Counts



# Final W per ZDC



# Final W eta


new Tracking
p14ia
240
220
200
180
160
140
120
100
80
60
40
20
0
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
lepton eta
New / Old
1.6
1.4
1.2
1
0.8
0.6
New / P14ia
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
lepton eta

# Summary

- ~20 % 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.

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

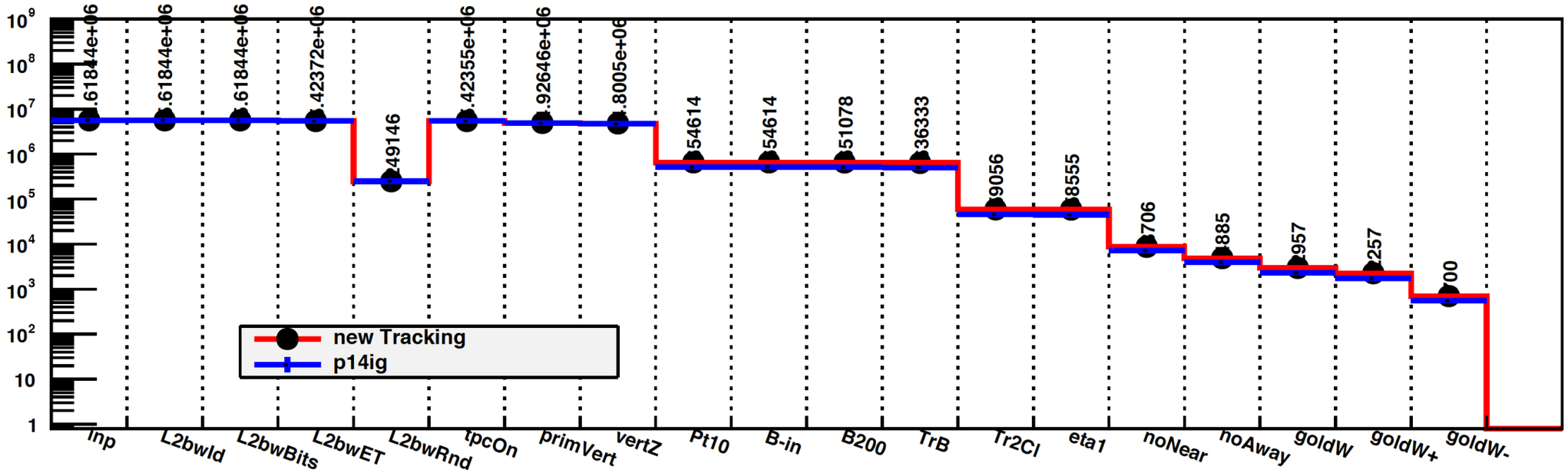
apple- to -apple comparison

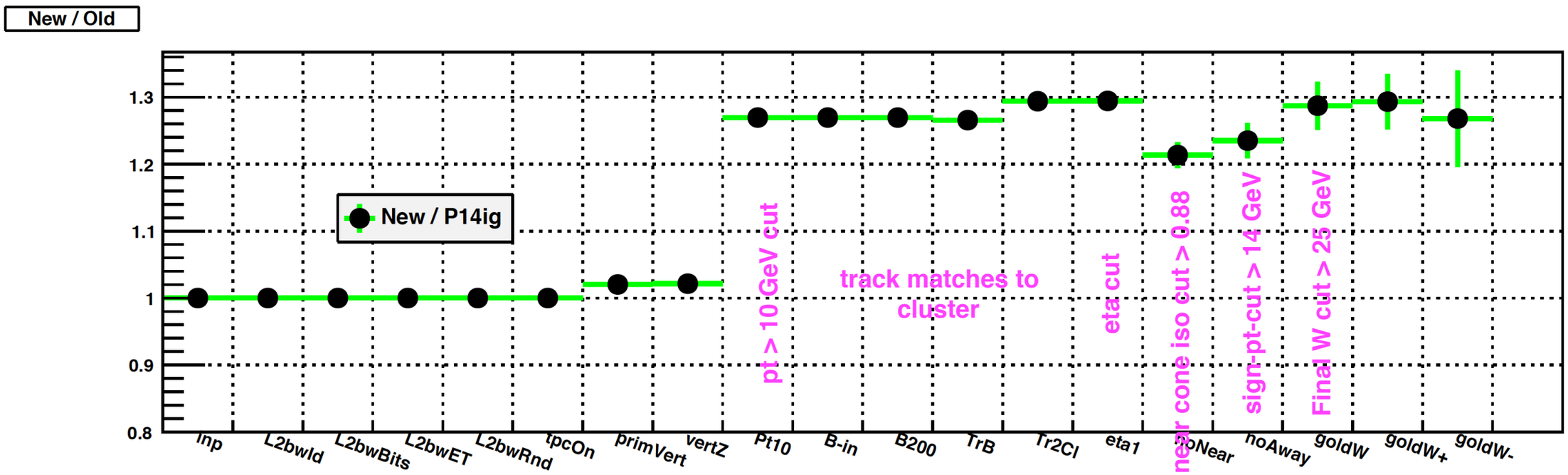
# Details / Notes

| 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) | SL14ig | 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 |

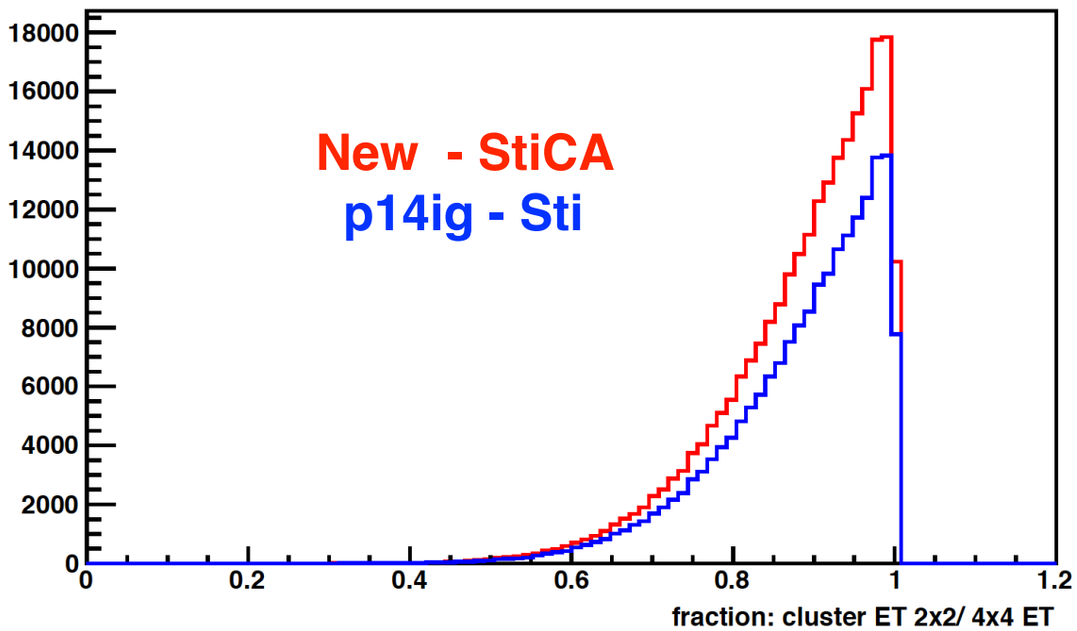
- **All the runs which were used for the comparison compared for # events processed. I chose runs which processed exactly same # of events or runs where events differ by 1 or 2 events. Yuri's production had ~ 100 runs with only 1 or 2 events higher. Since 1-2 events difference is negligible this can be considered as apple to apple.**

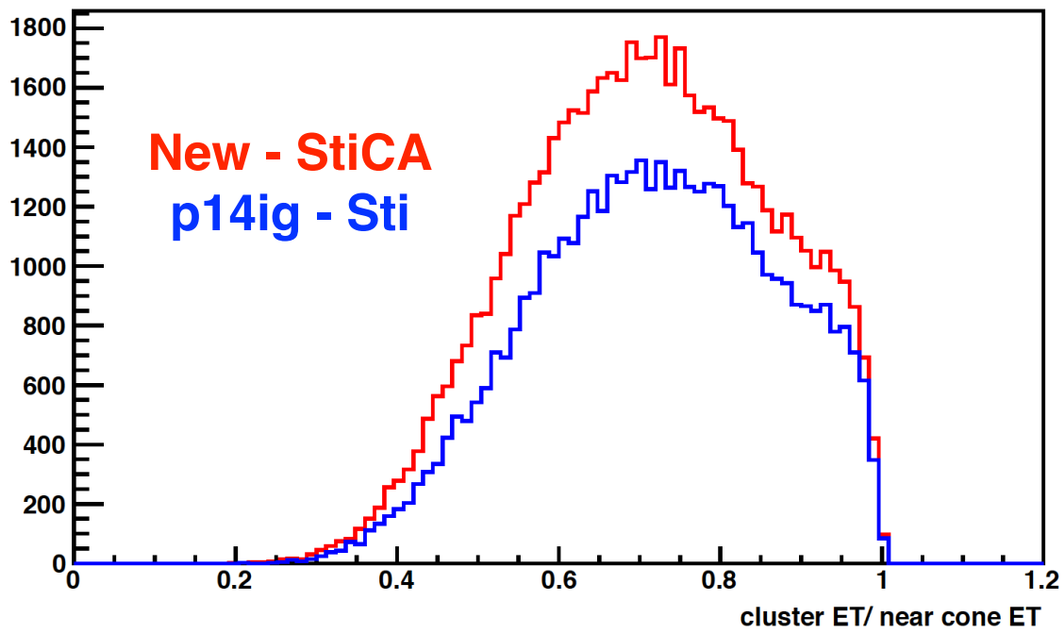
# Events Counts

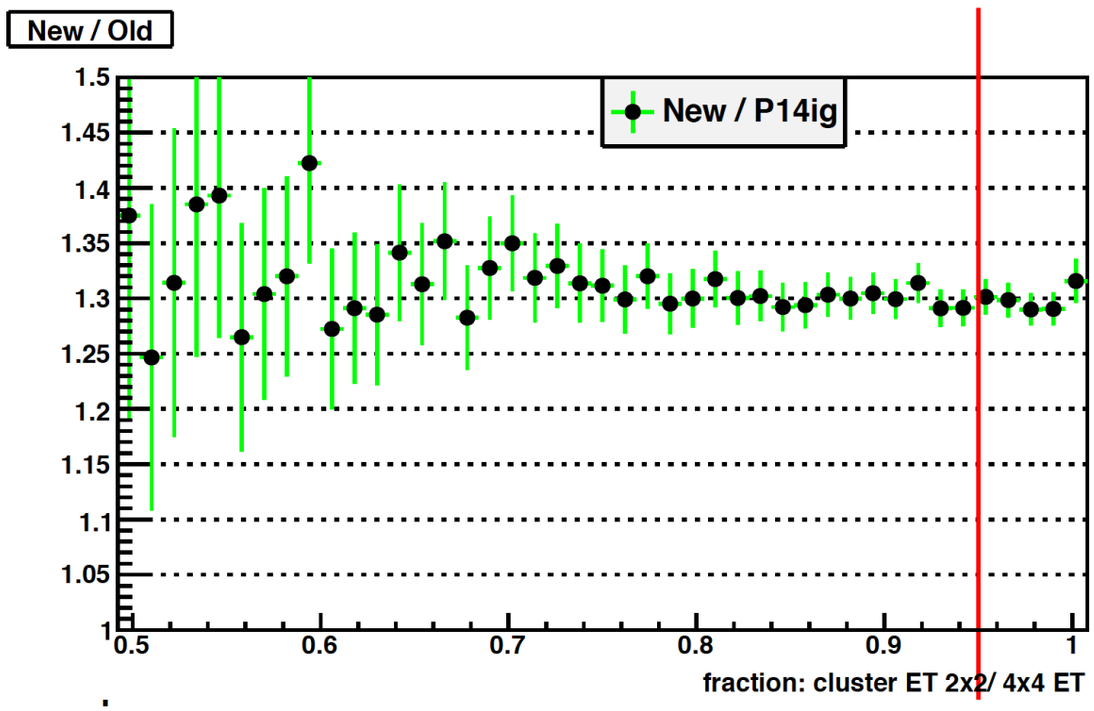


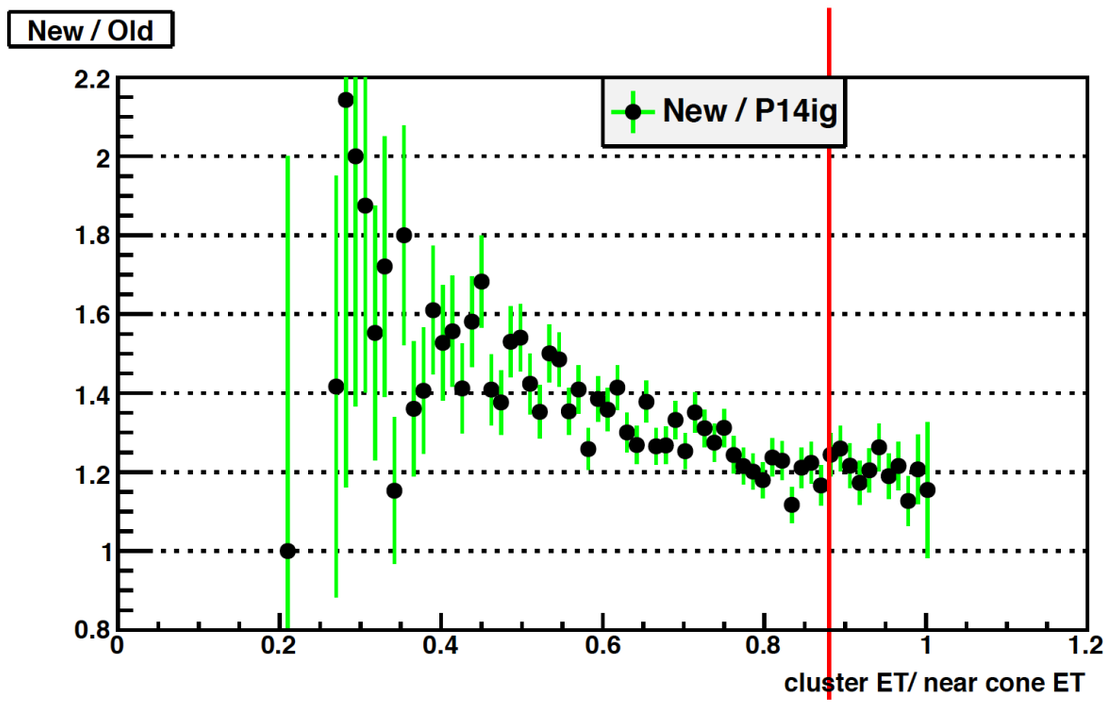



# Isolation cuts

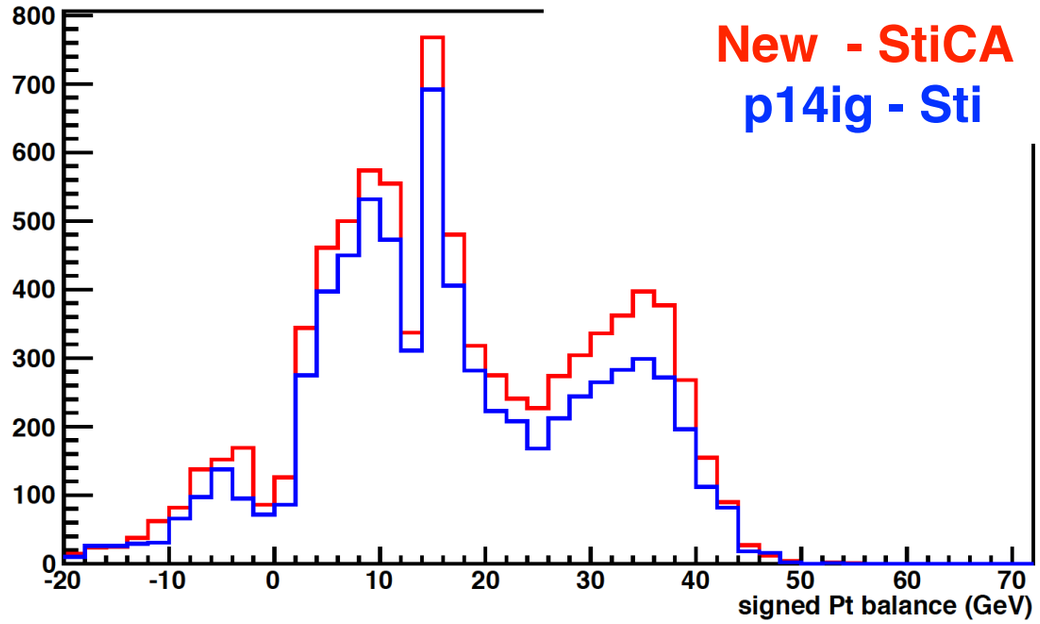


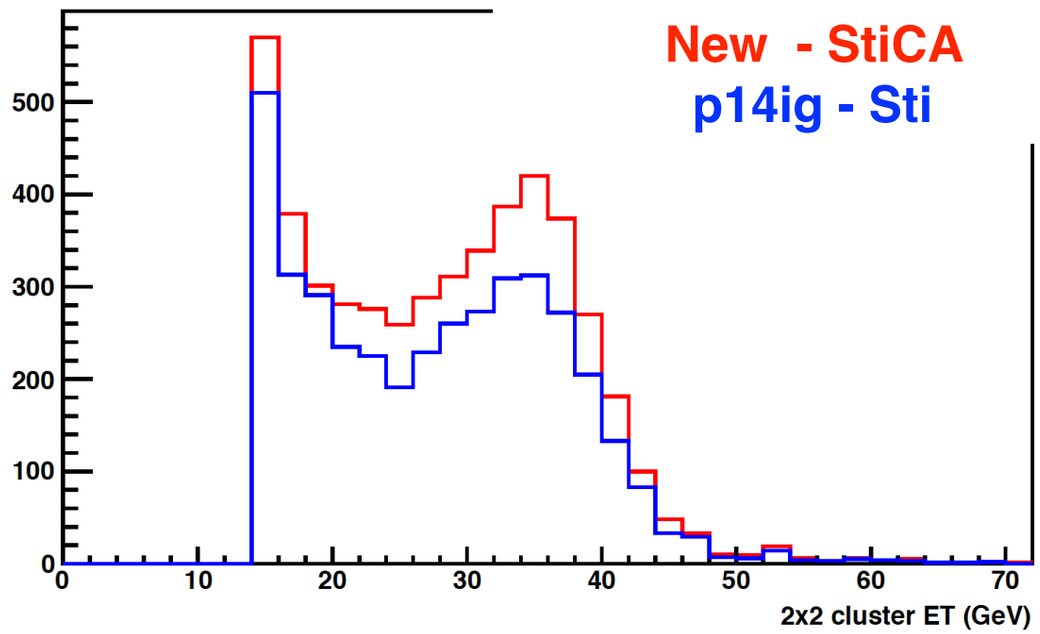



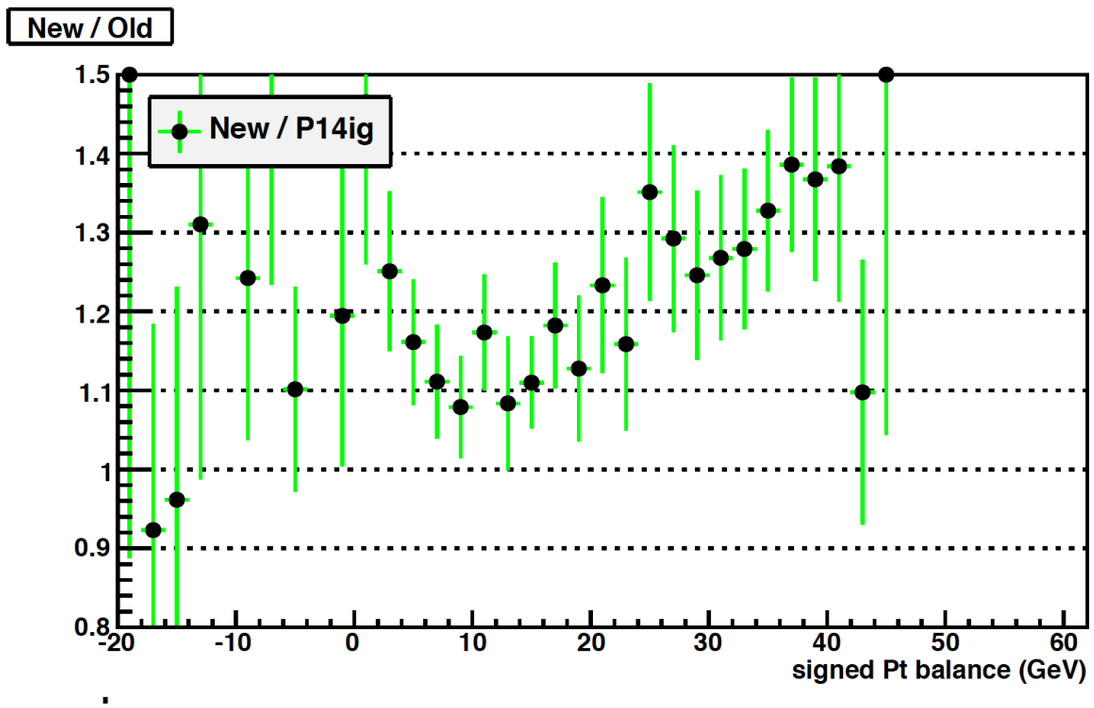



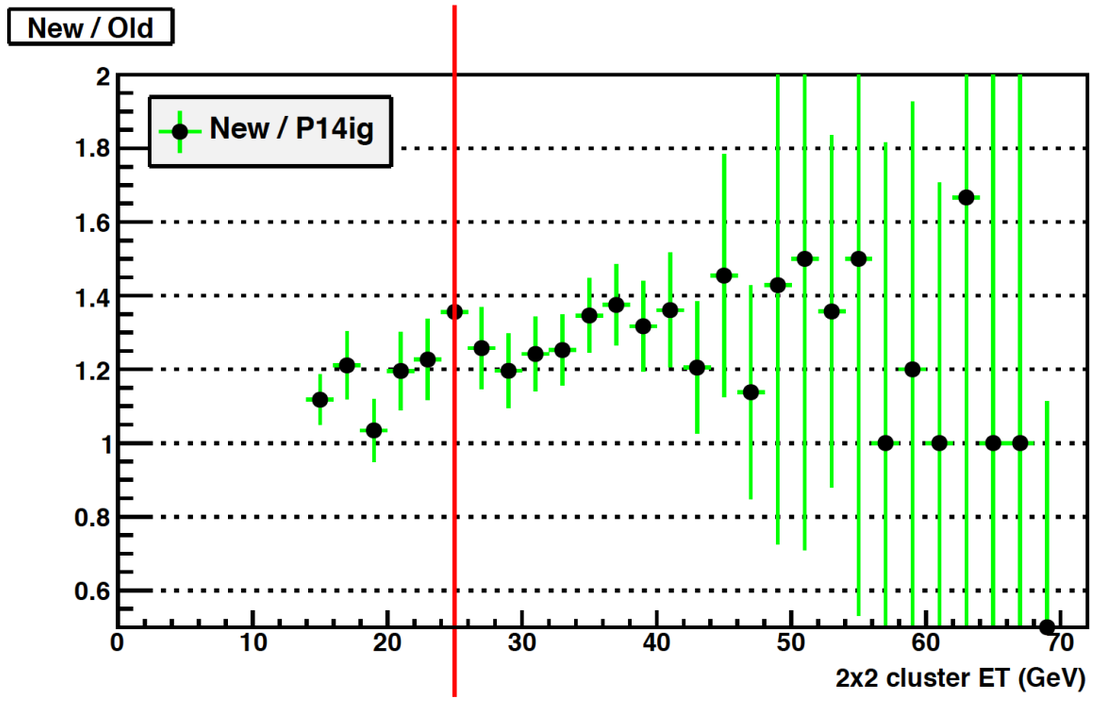



# Sing Pt , Final W

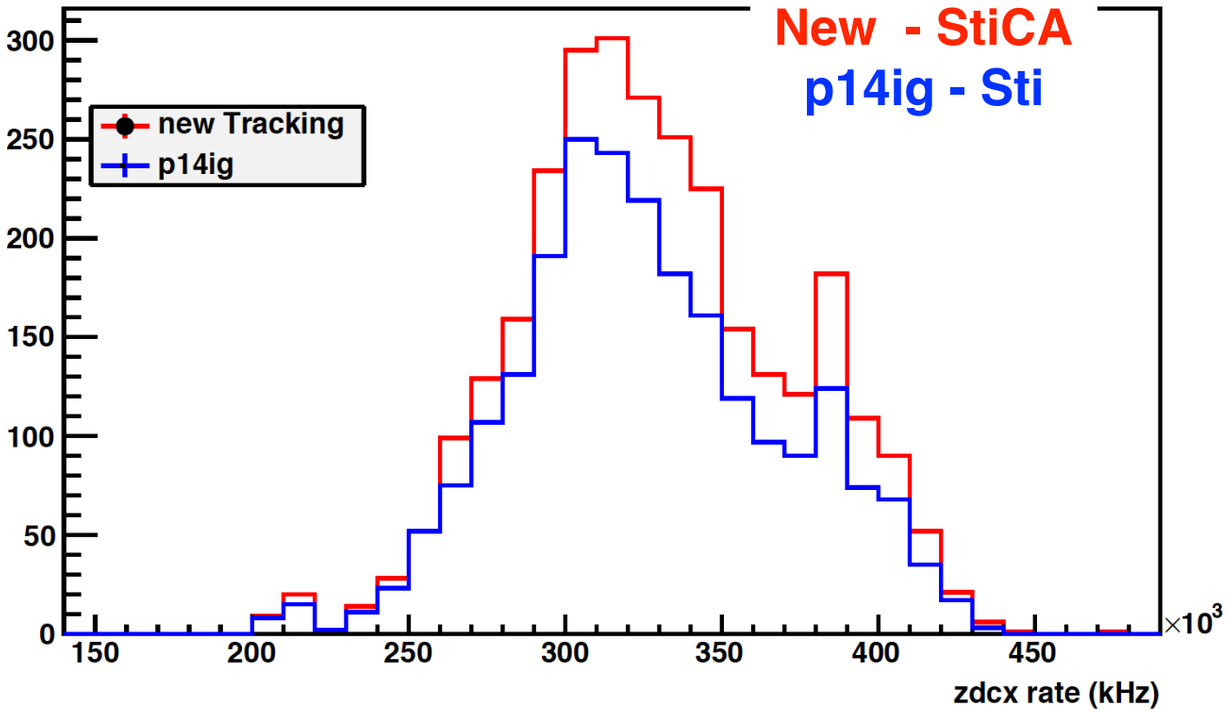


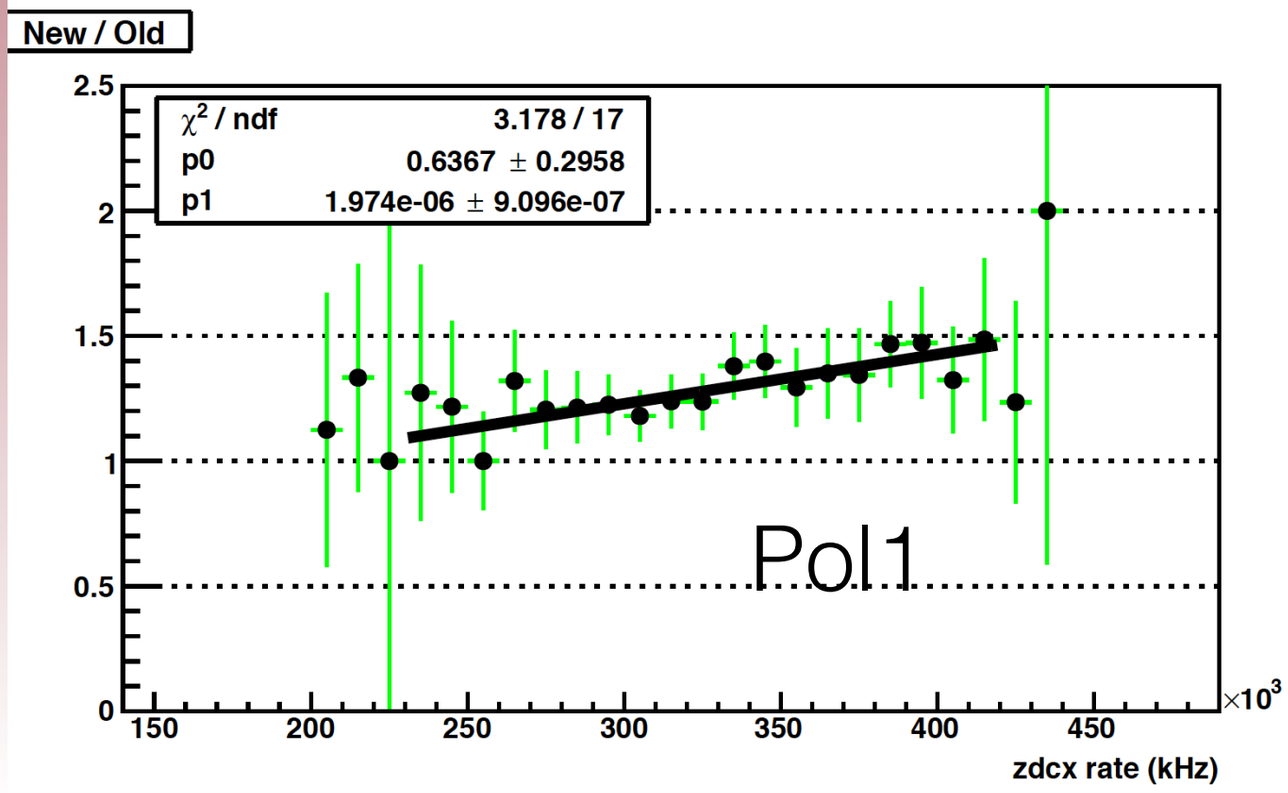



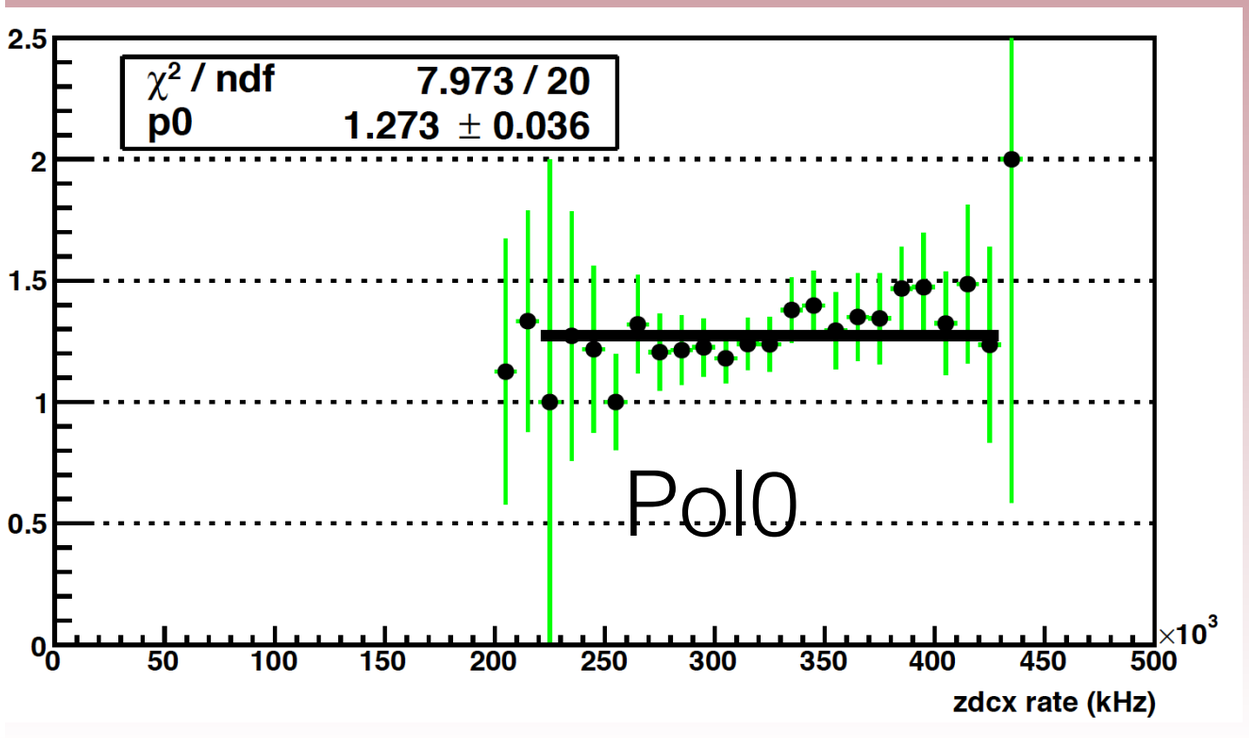



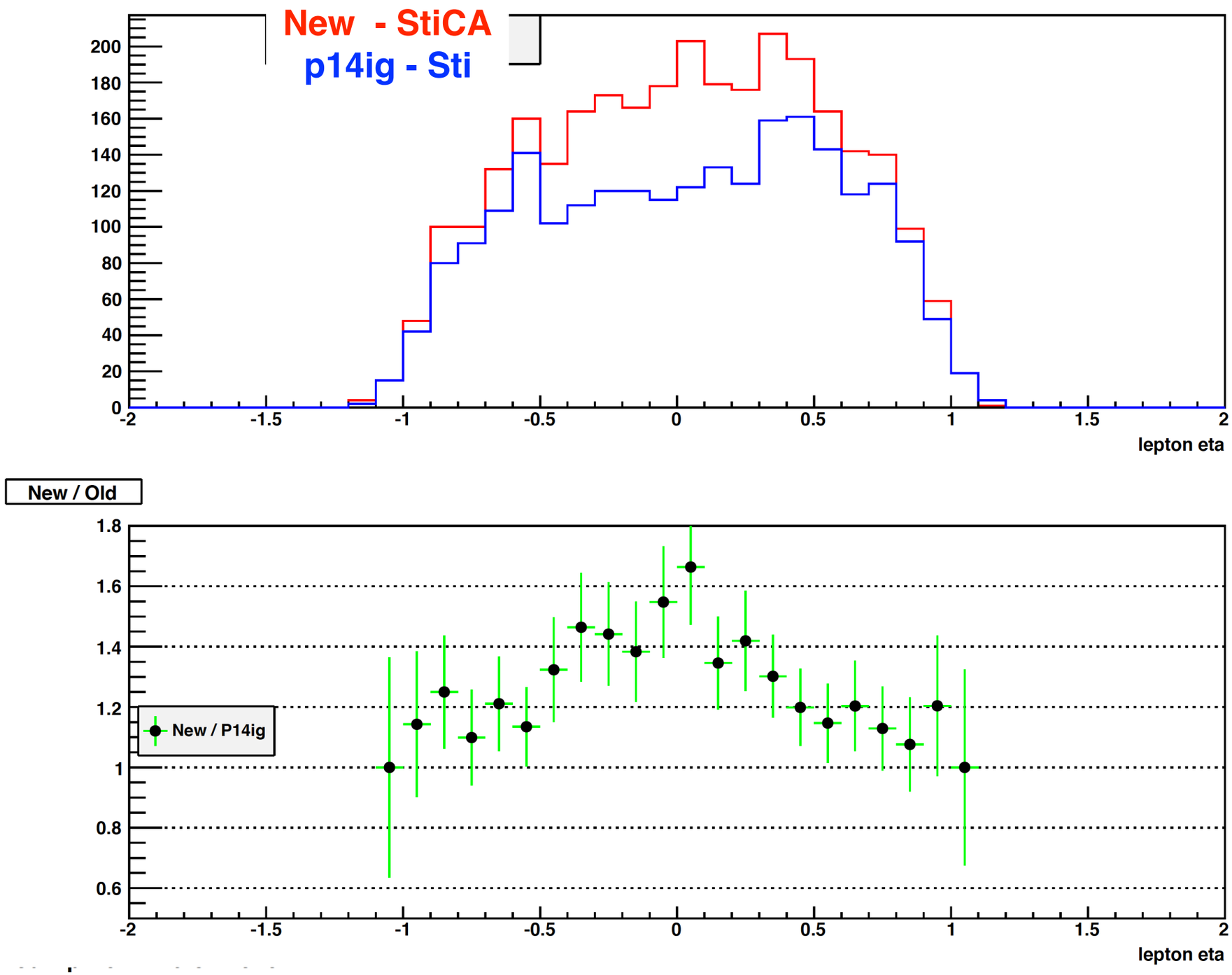
# Final W per ZDC



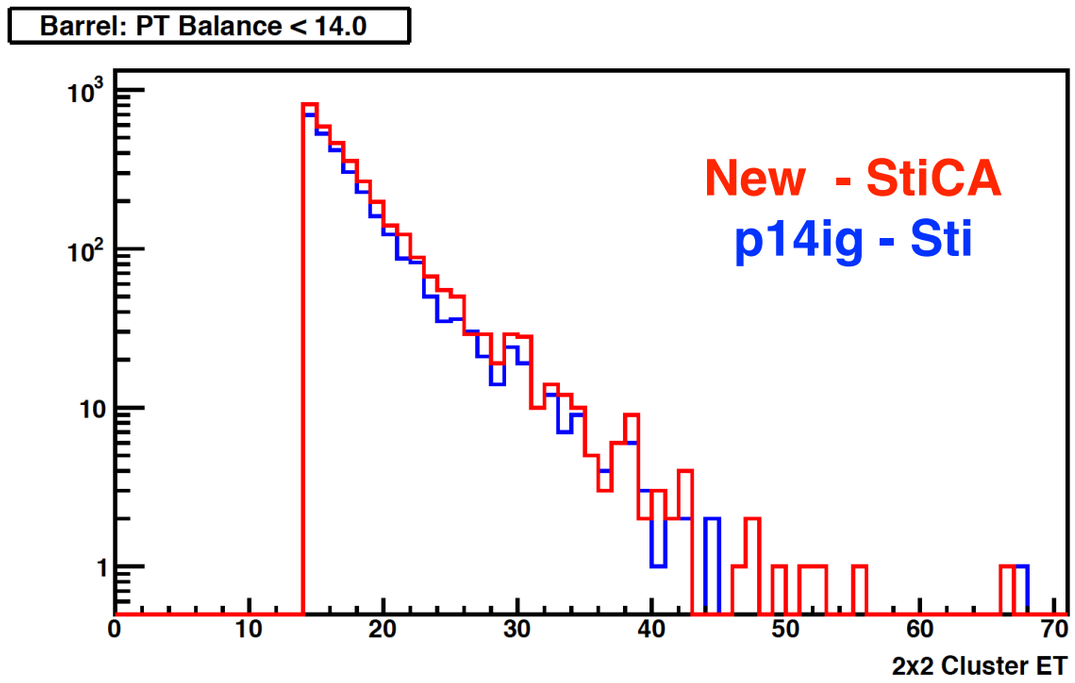



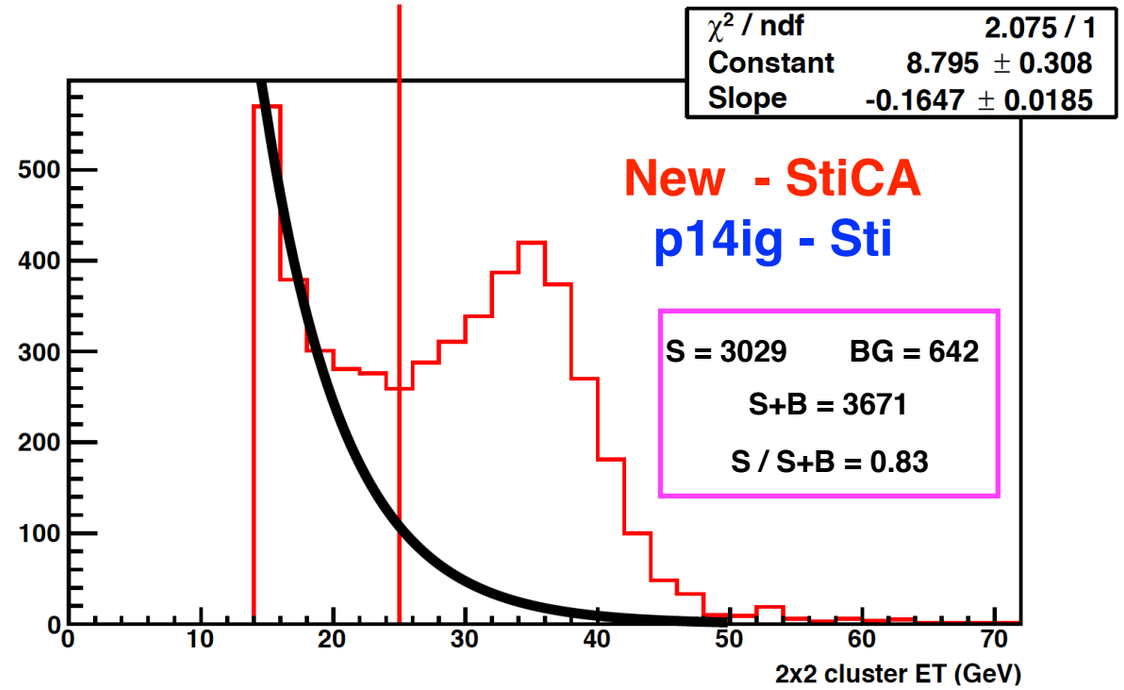



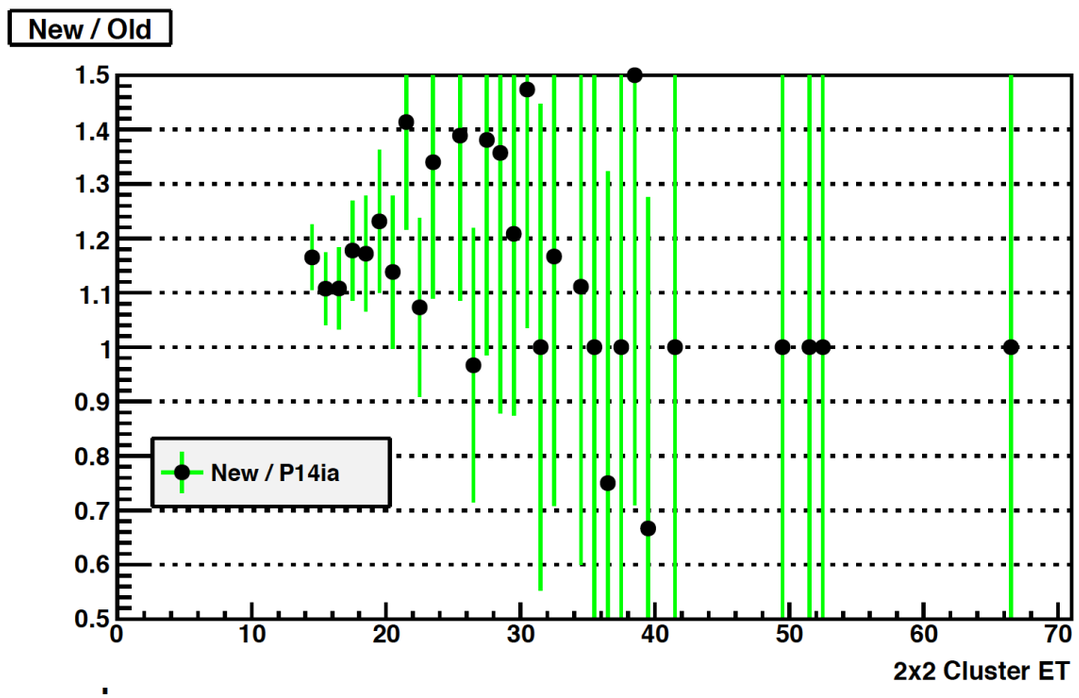
# Final W Eta

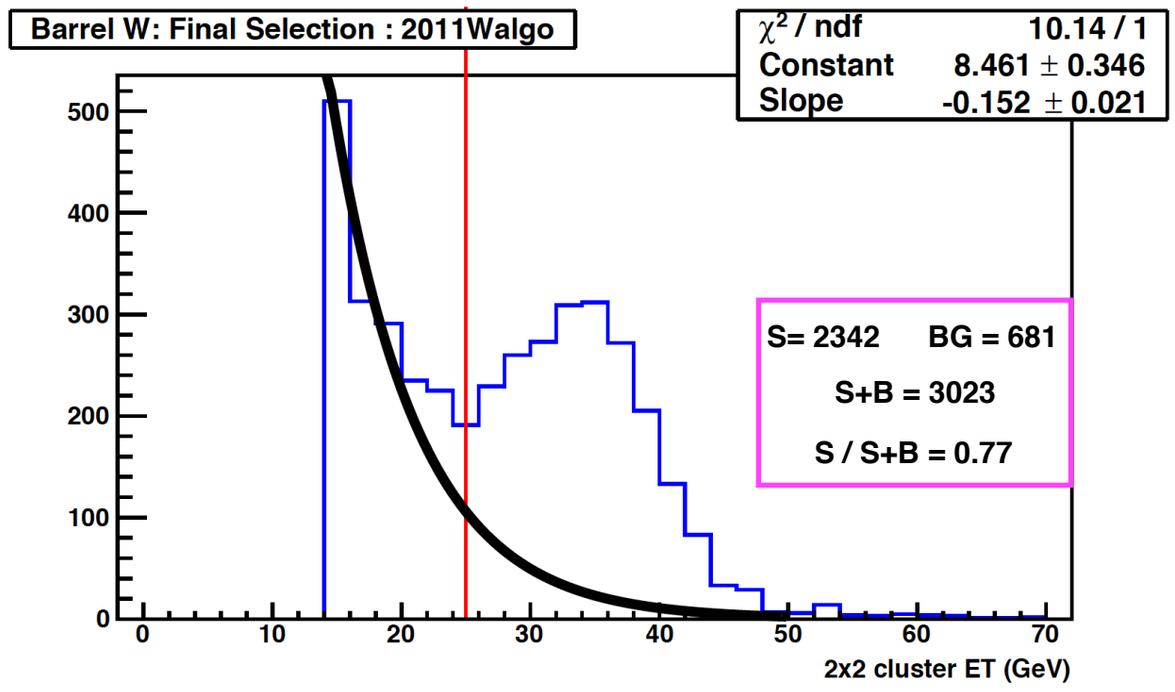


# QCD BG

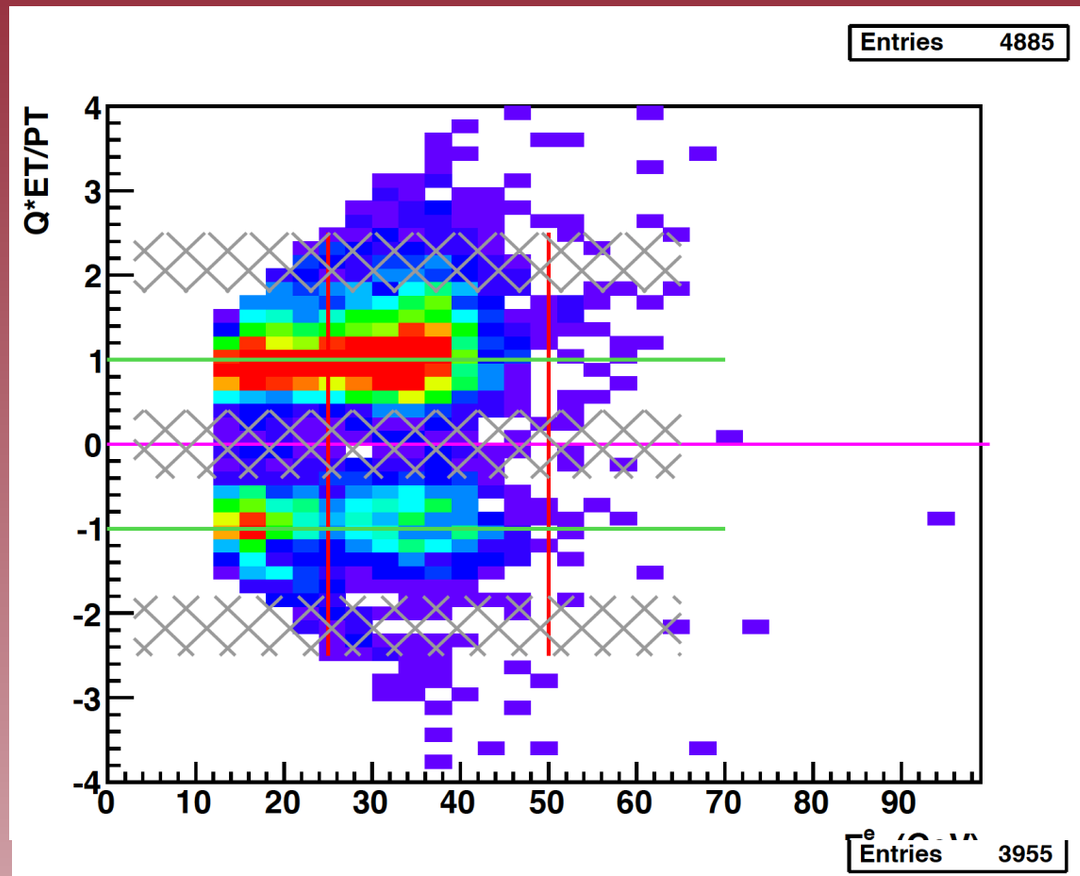

Barrel: PT Balance < 14.0
New - StiCA
p14ig - Sti
2x2 Cluster ET

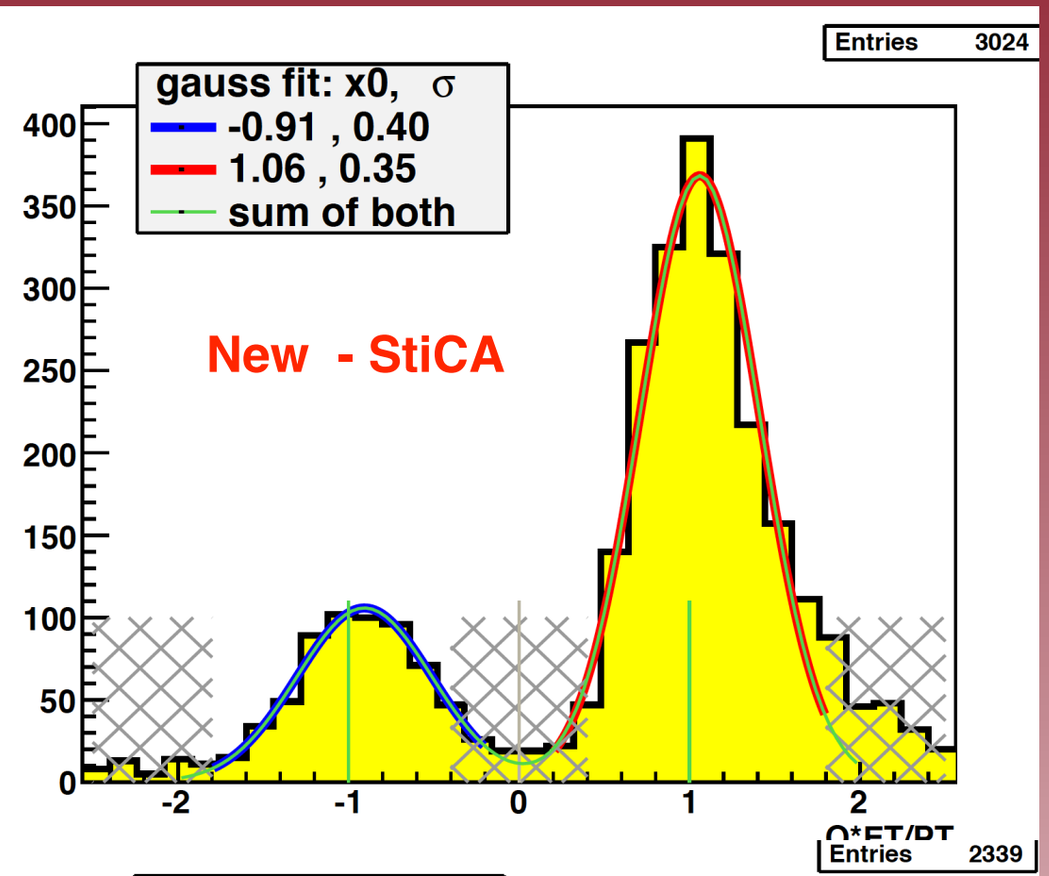

χ² / ndf 2.075 / 1
Constant 8.795 ± 0.308
Slope -0.1647 ± 0.0185
New - StiCA
p14ig - Sti
S = 3029 BG = 642
S+B = 3671
S / S+B = 0.83
2x2 cluster ET (GeV)

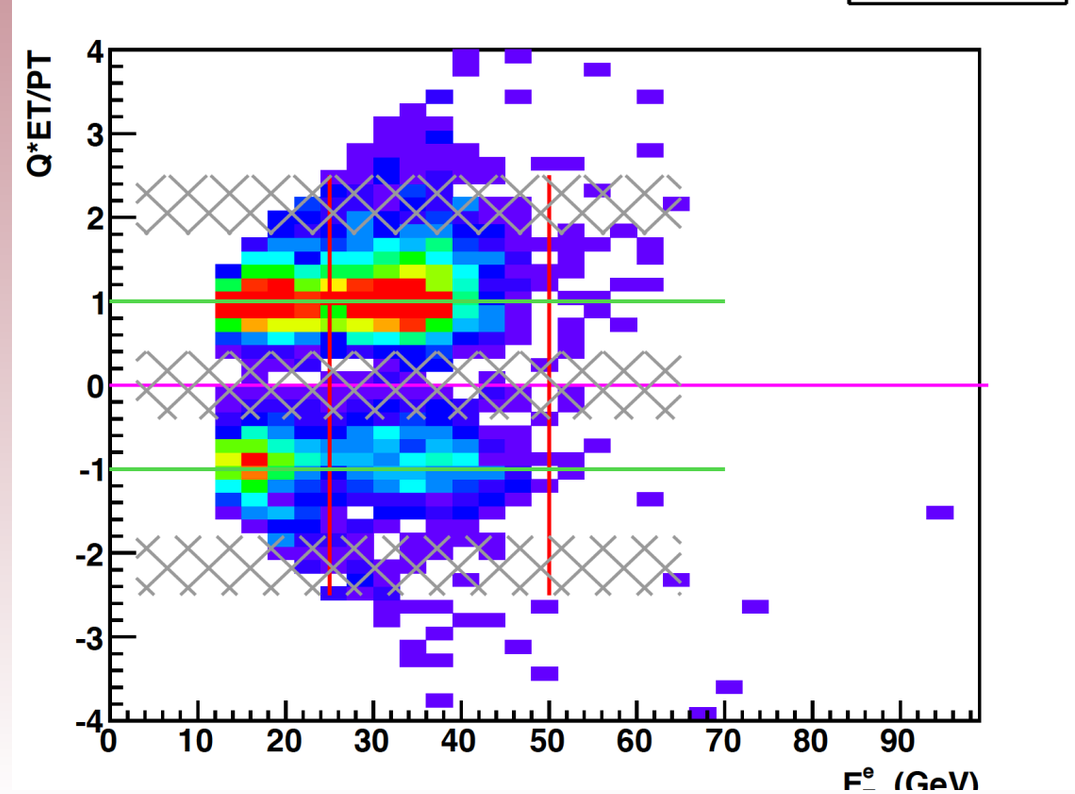

New / Old
New / P14ia
2x2 Cluster ET

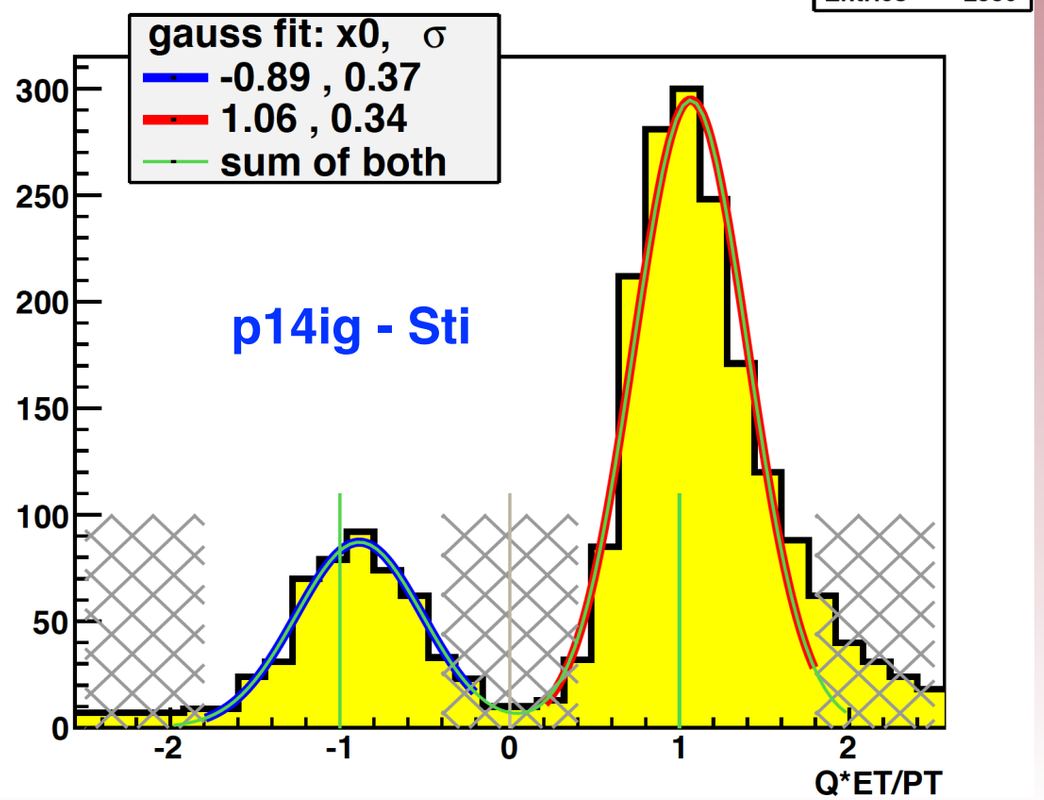

Barrel W: Final Selection : 2011Walgo
χ² / ndf 10.14 / 1
Constant 8.461 ± 0.346
Slope -0.152 ± 0.021
S= 2342 BG = 681
S+B = 3023
S / S+B = 0.77
2x2 cluster ET (GeV)

# W -Charge Sign - Separation



# Summary

- ~30 % enhancement in tracks above Pt = 10 GeV and similar enhancement in final W [> 25 GeV] tracks.

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

- Significant improvement in signal to background ratio .

# Summary_all

- STICA tracking shows significant improvement in W tracking and final W efficiency.

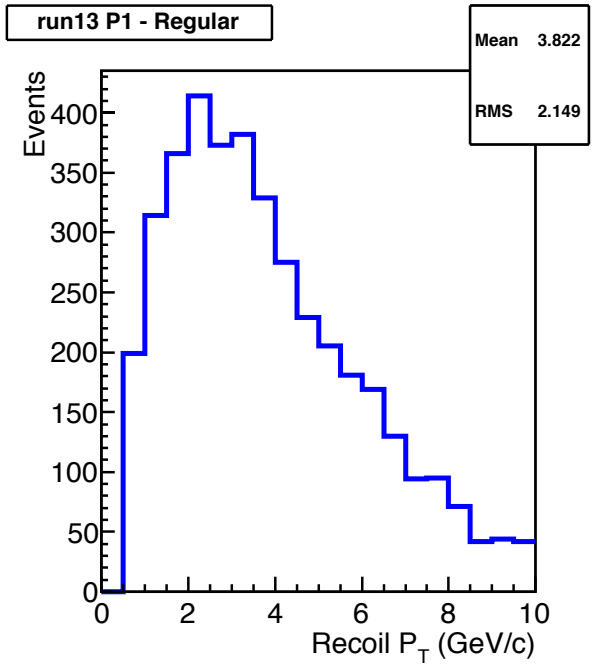
- The improvement increases with increasing luminosity.

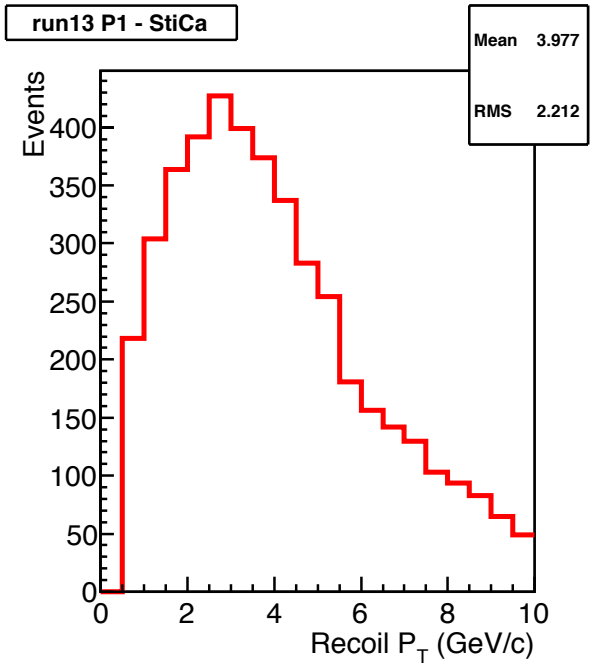
- Reproduction of Run 13 data with STICA+PPV_W settings is needed !

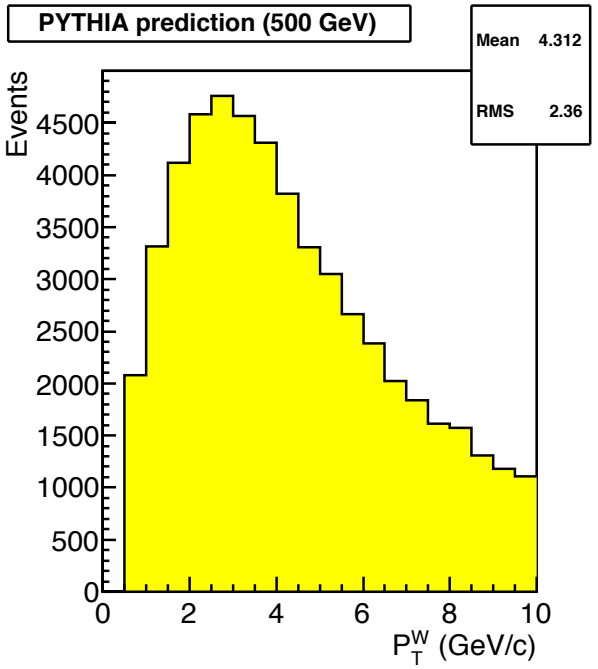
# Analysis from Salvatore

reconstruction of the W-recoil

# Production comparison




**Regular:** Sti official production (SL14a)

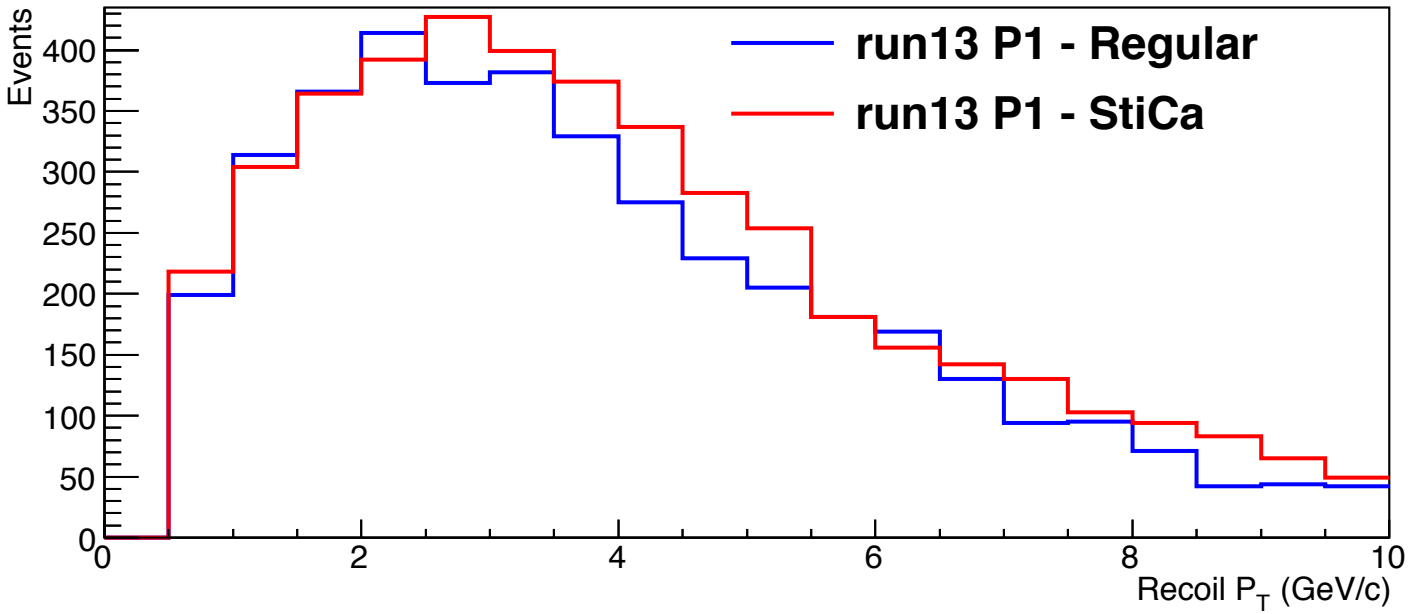
**StiCa:** Yuri's StiCa private production (dev2)

**All W reconstruction cuts applied**

**No Pt correction done!**

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

# Production comparison




**Regular:** Sti official production (SL14a)

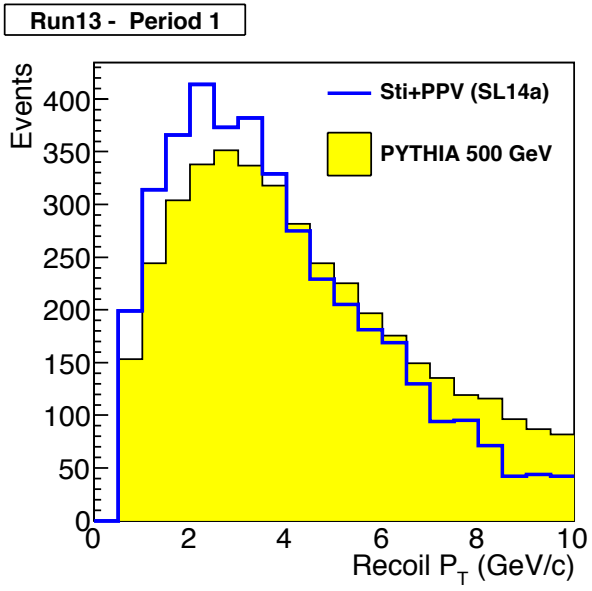
**StiCa:** Yuri's StiCa private production (dev2)

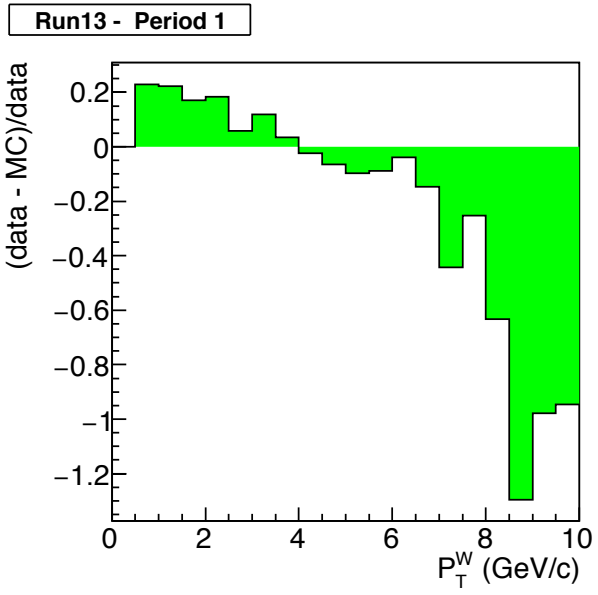
**All W reconstruction cuts applied**

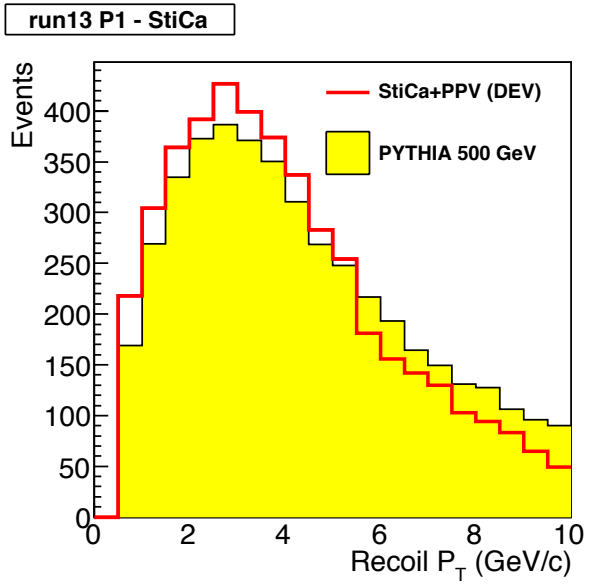
**No Pt correction done!**

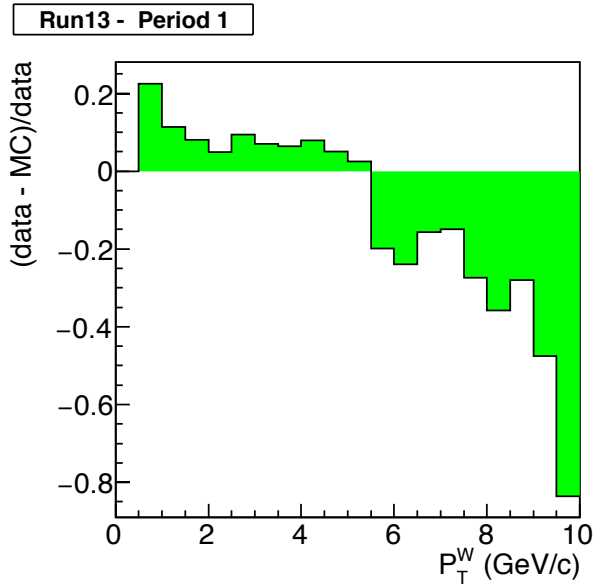
- Overall ratio StiCa(Yuri's)/Sti(regular) = 1.11 after W reco. cuts for run 13 period 1
- StiCa W-Pt peak and distribution shifted to the right... lets compare to expectation

# Production comparison



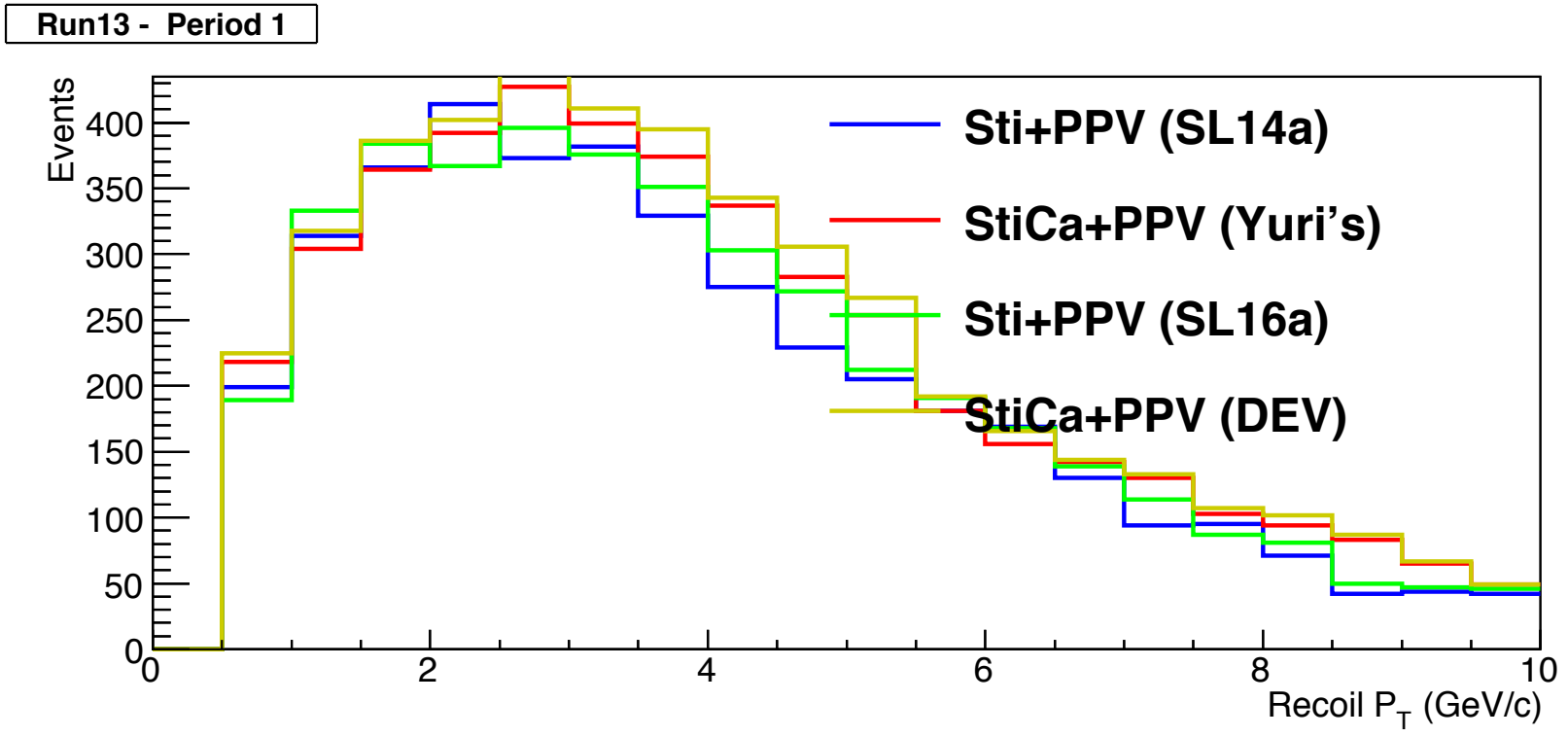




**StiCa peak on top of the prediction peak**

**→ less correction needed!**

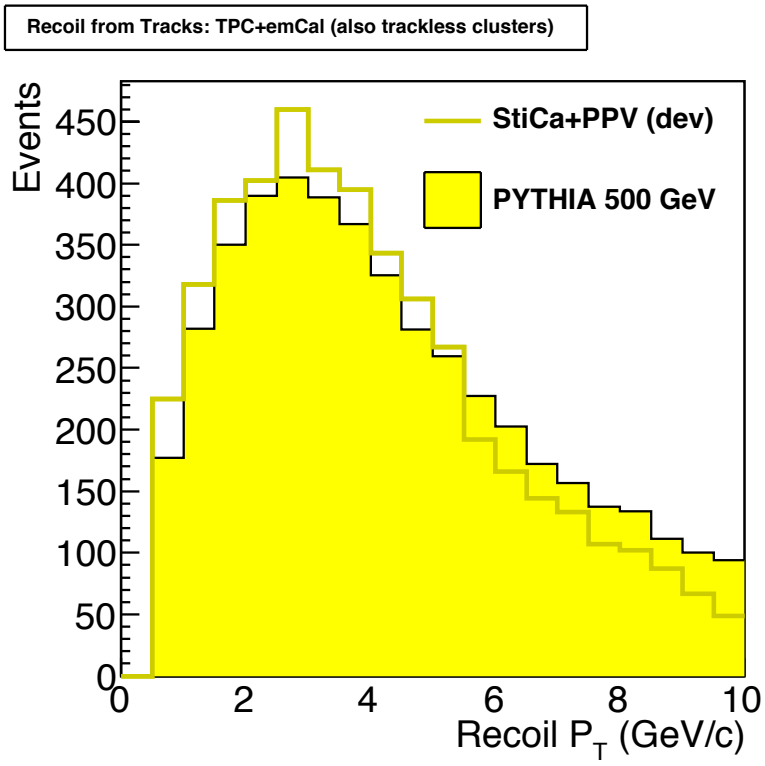
# Lets look at all the TEST productions

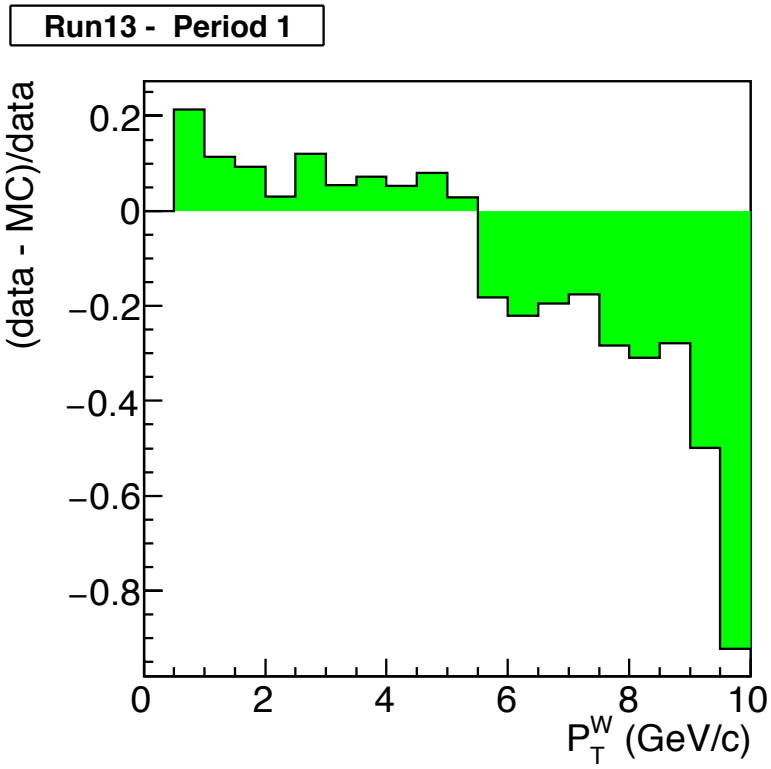
# Production comparison




**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

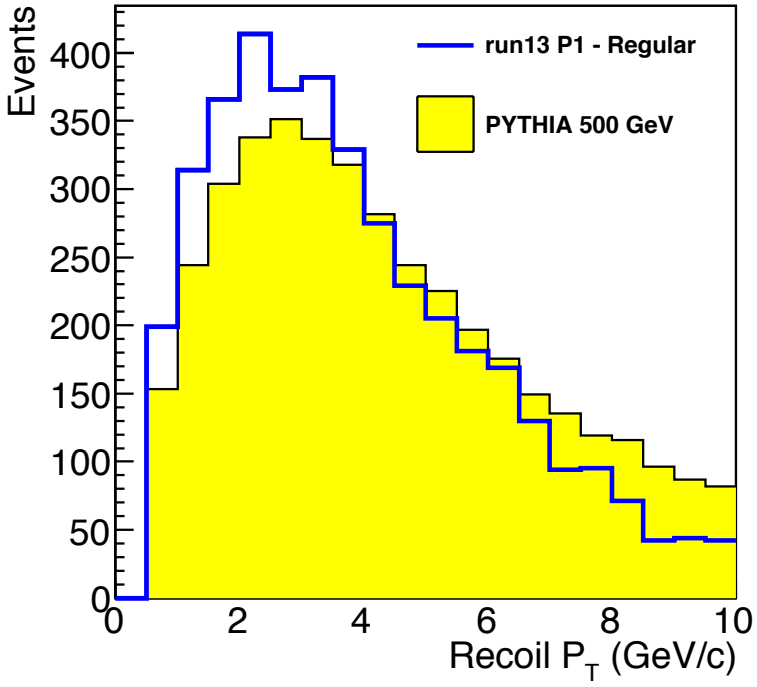


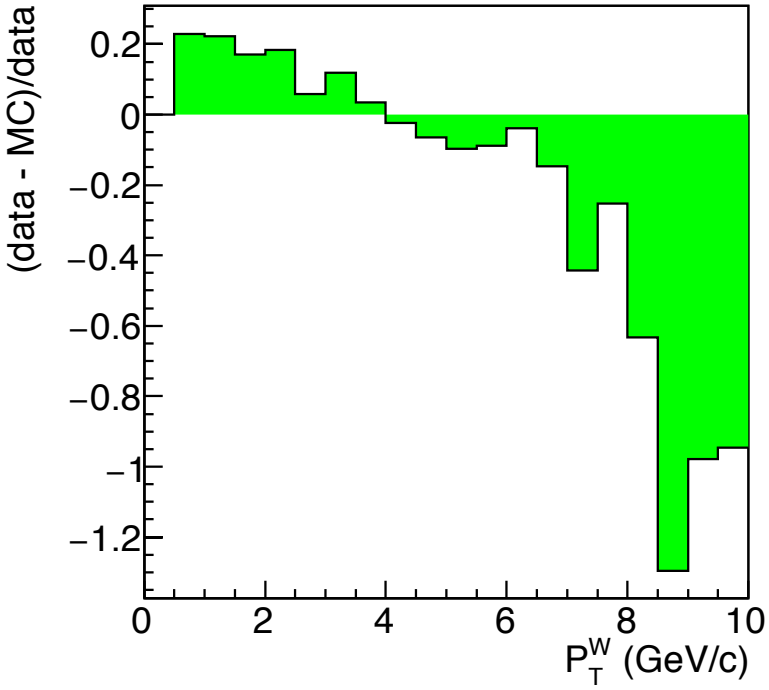




**StiCa+PPV:** test production evals4

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

# Sti+PPv: official current production (SL14a)

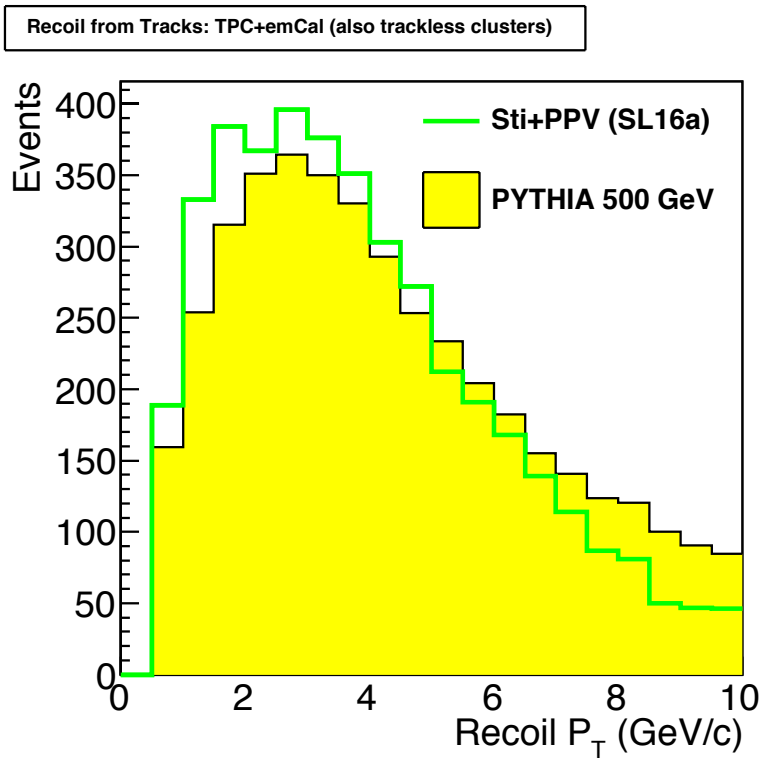


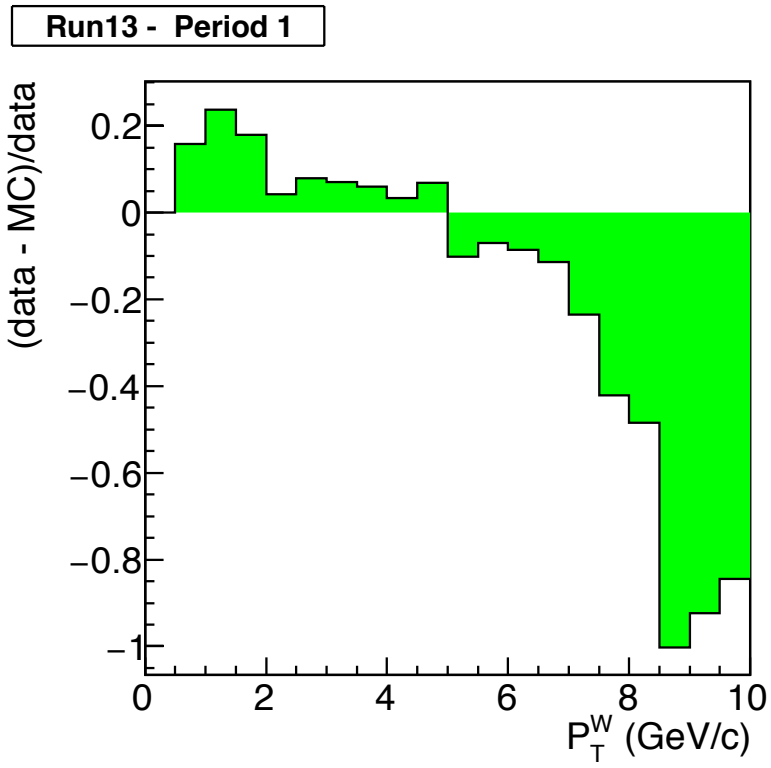




**Regular:** Sti official production (SL14a)

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

# Sti+PPv: evals1

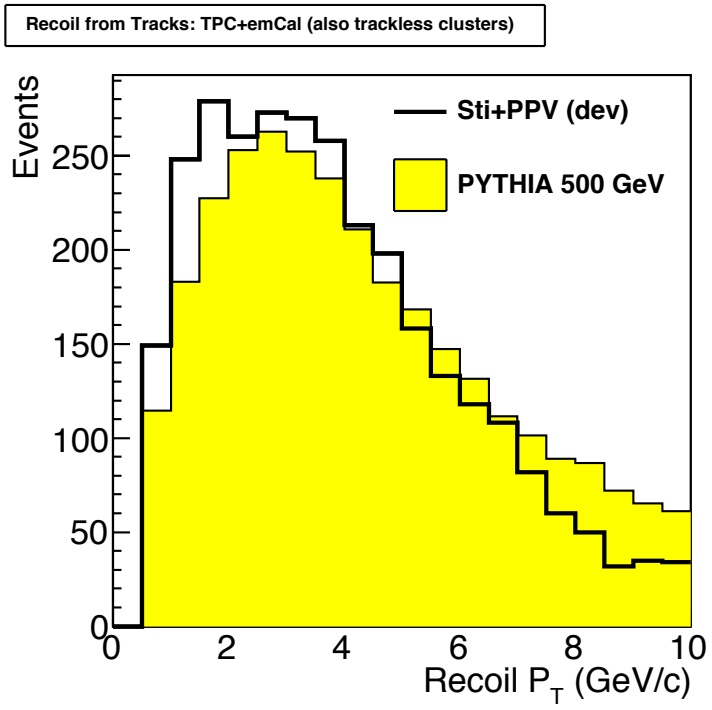


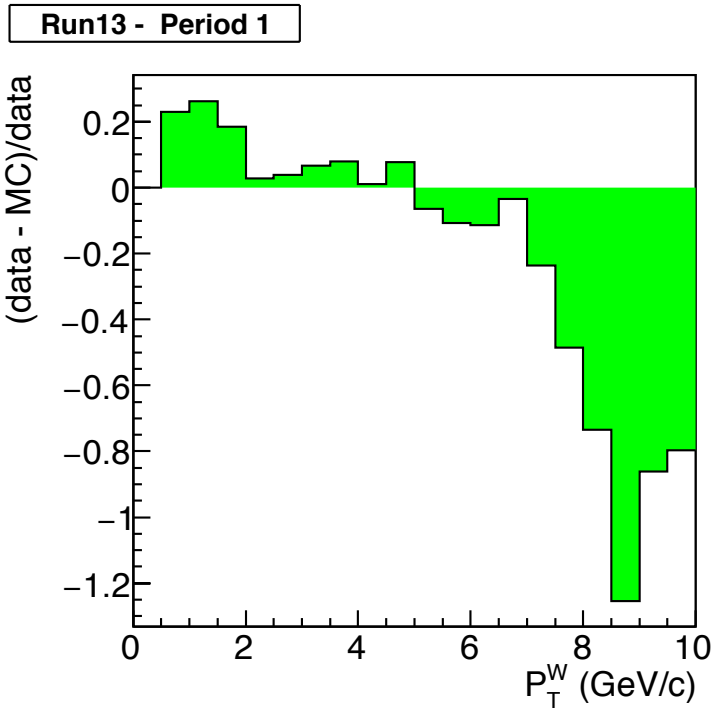




**TEST Evals1:** Sti+PPV test production (SL16a)

**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