# Background Estimation for run 13 period 1 data (first look)

[using Run 12 embedded MC sample scaled to run 13 data luminosity]

# of runs used : 933 , Total Integrated Luminosity = 125.3 pb-1

| BG Channel | Estimation |
|---|---|
| **W-> $\tau$+v** | • Branching Ratio ~ 11% , semi-leptonically ~13%<br>• Experimentally indistinguishable from W-ev decay<br>• Use PHYTIA+GEANT embedded simulation sample<br>• In asymmetry calculation contribution to the W yield is treat as signal |
| **Z -> e** | • Z ->$e^+e^-$ Background is also significant because STAR is not hermetic.<br>• Use PHYTIA+GEANT embedded simulation sample |
| **second endcap** | • EEMC has coverage 1.09<η<2 and helps to reject QCD BG with detecting jet opposite in phi.<br>• Since no Endcap on East side of STAR events with opposite jet of -2<η<-1.09 will be good signal event<br>• Run the analysis twice with and without EEMC as veto |
| **QCD** | • Events which become good signal event by one jet escape detection.<br>• use data-driven QCD BG shape as a function of ET to determine. |

# Second Endcap

## Strategy

Calculate the BG events that are rejected by the real EEMC of STAR for each eta bin and assumed to be same as the BG that would have been rejected by the fictitious "second endcap"

Method:

1. Run the whole analysis 2 times, First using ETOW as a veto in the near-side and sign pt balance cuts and then without using the ETOW in these cuts.

2.The difference in the $E^e_T$ distribution between these 2 passes of the analysis is the background rejected by using the real EEMC

3. Assume this as the same background that would have been rejected by the fictitious end cap

4. Background events rejected by the real EEMC which are measured in the positive Eta bins correspond to BG events that would be removed from the signal yield in the negative Eta bin by a fictitious EEMC on the east side of STAR

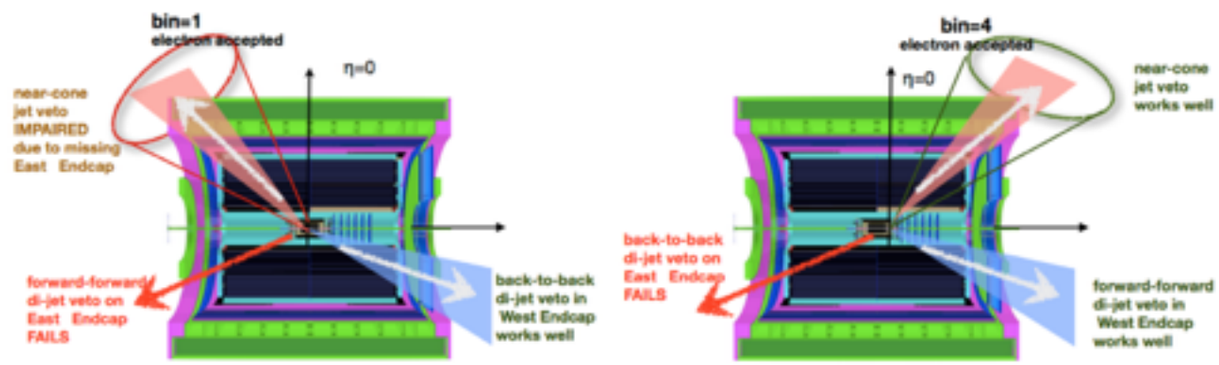
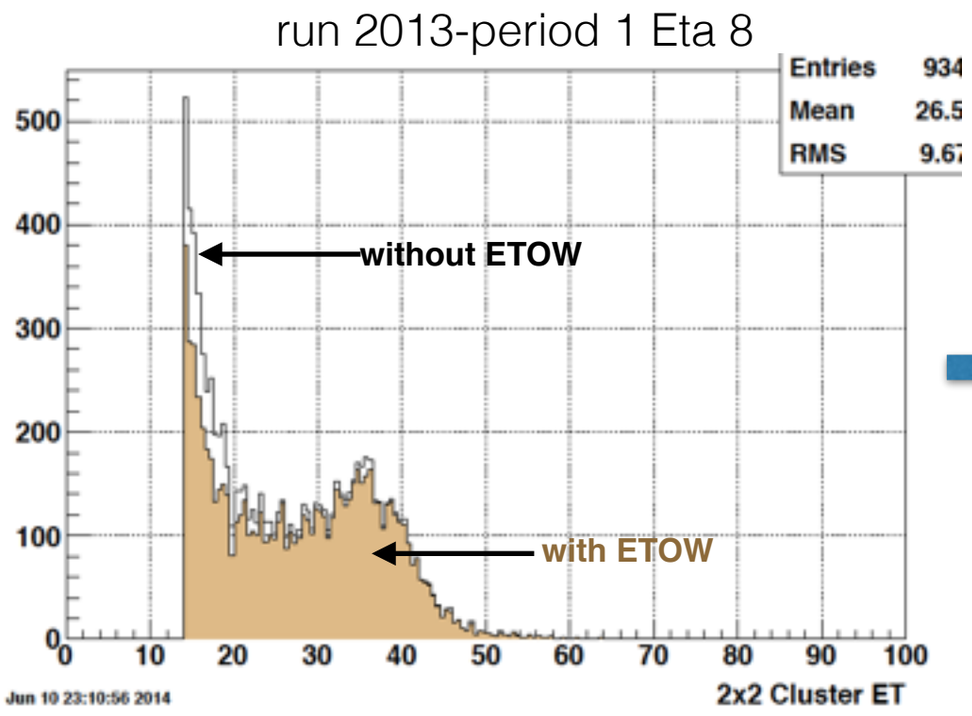


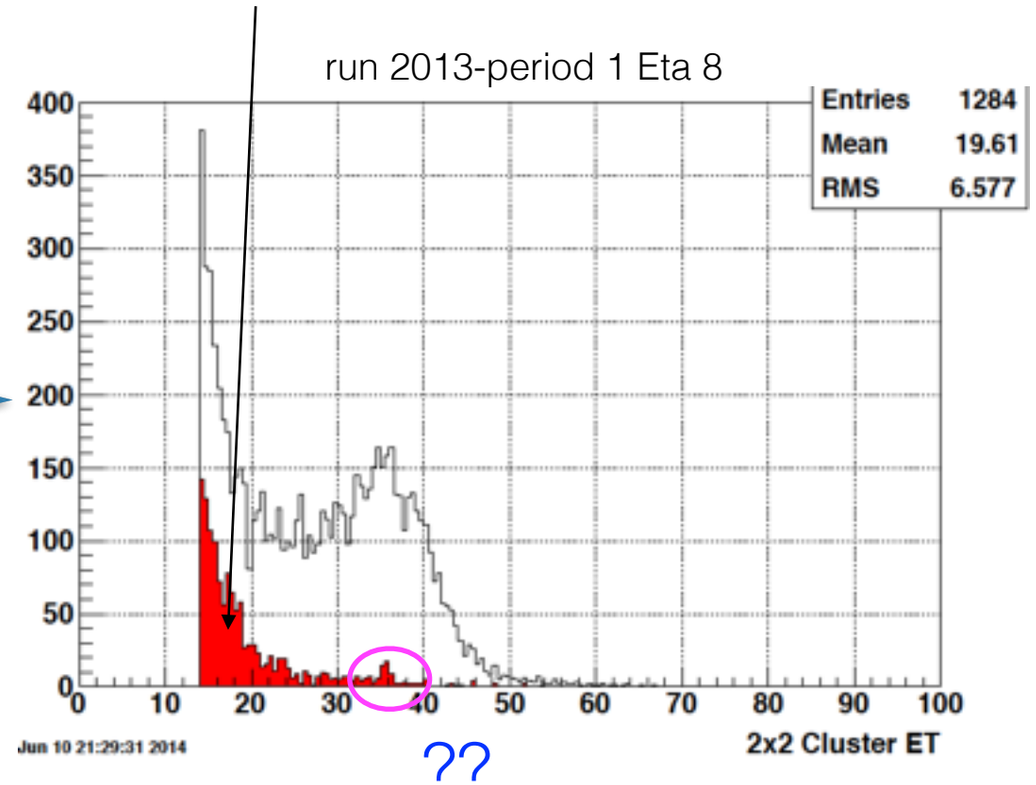

Figure 4.2: Mirror EEMC

5. Any Z contamination in this BG sample should remove using Z MC sample

- data distribution with and without EEMC in analysis cuts




- **second EEMC BG == without ETOW - with ETOW**

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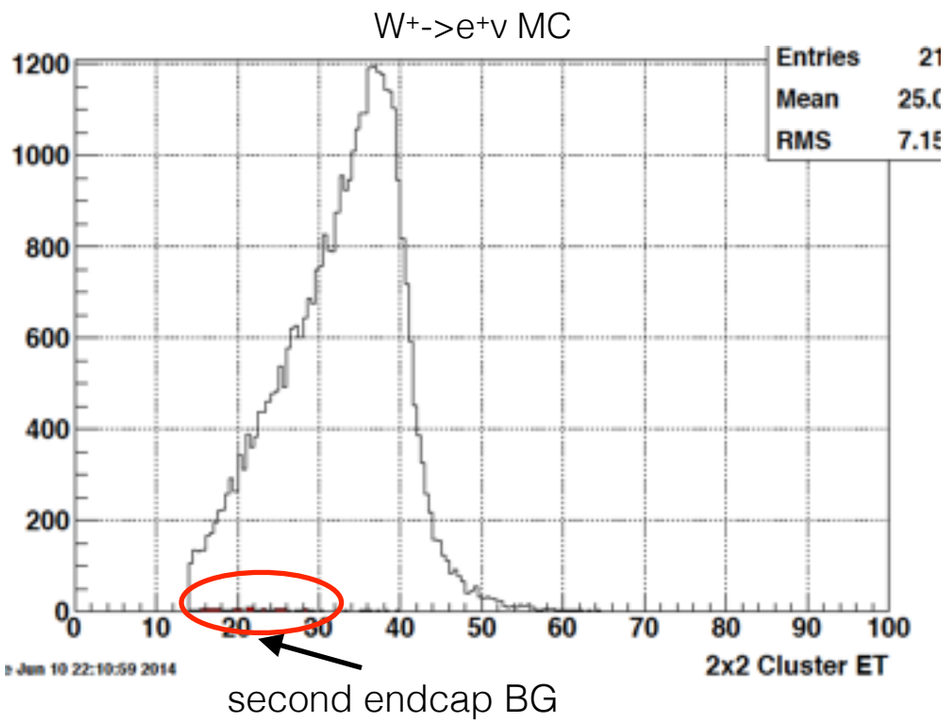
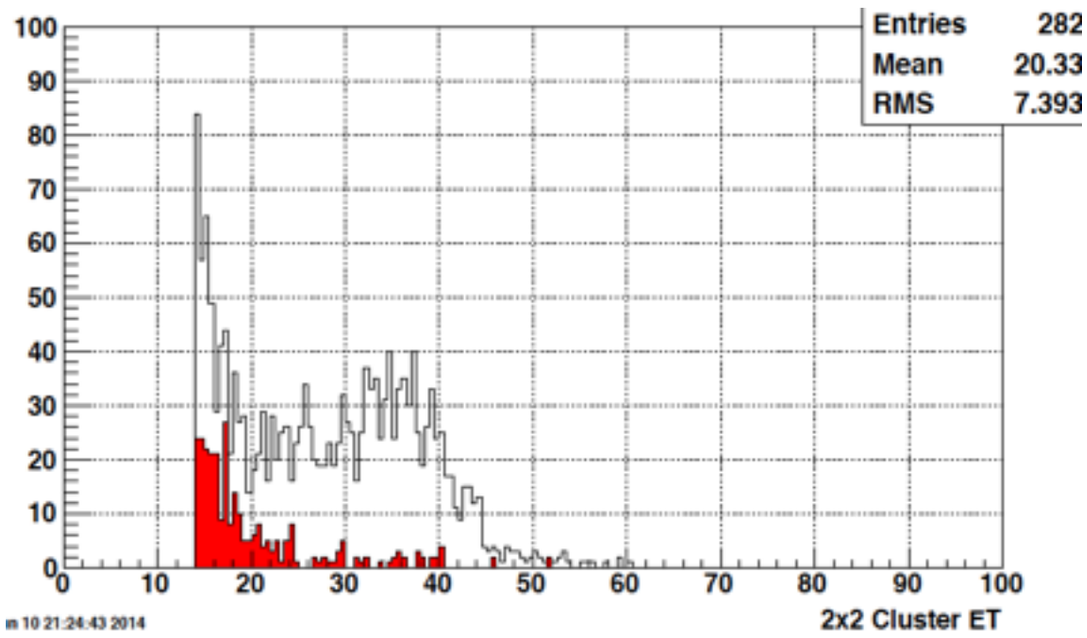
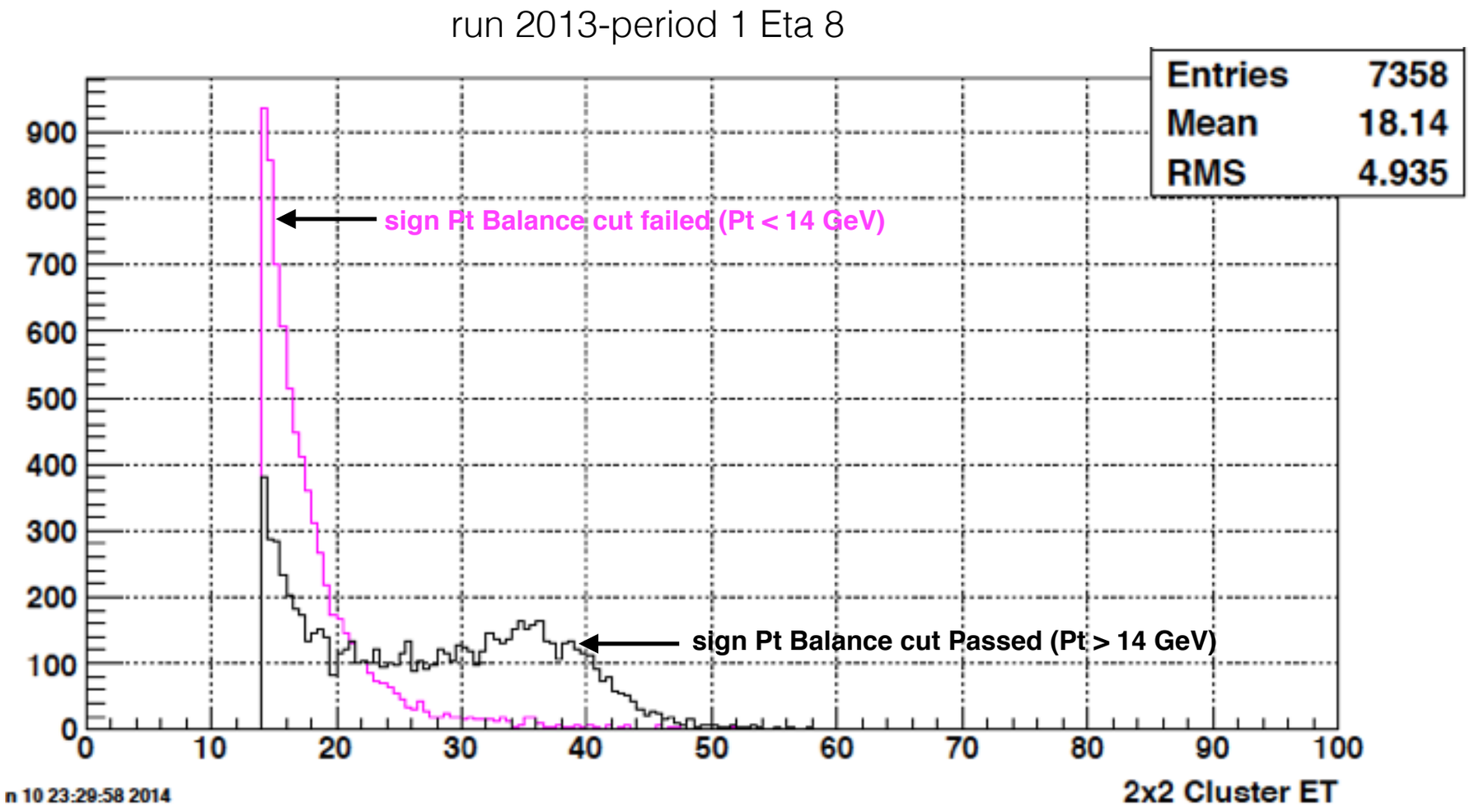
- second EEMC BG should also subtract from all the MC embedded samples

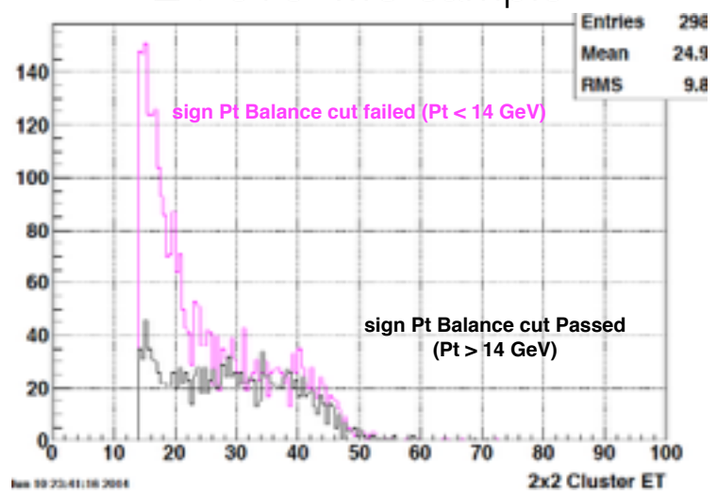


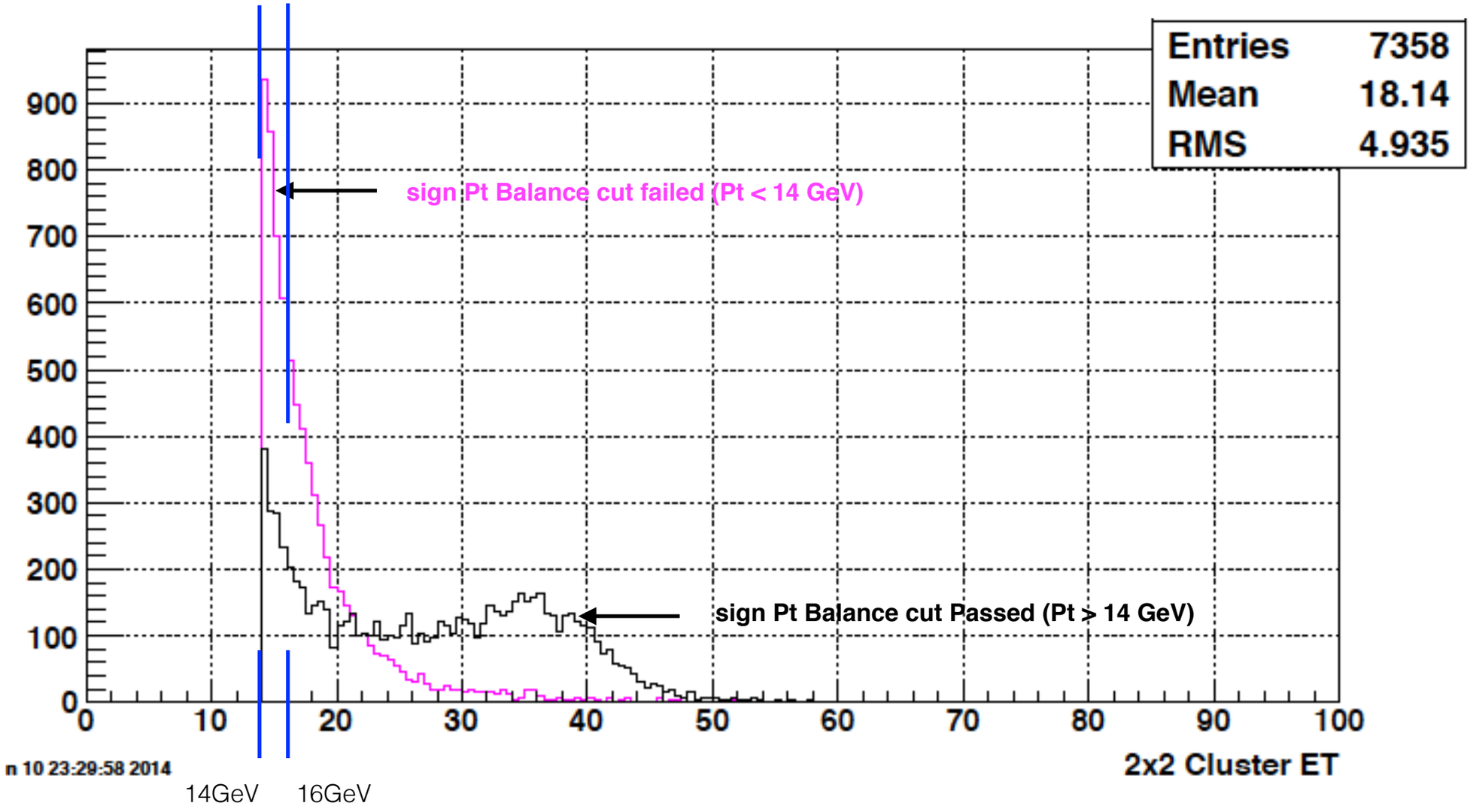
# QCD

1. Select events with an isolated e+/e- candidate passing all isolation cuts but **fails signed pt balance cut**. (this sample is dominated by QCD multi jet BG where one jets "fakes" an e+/e- and the event is rejected due to reconstructed jet opposite in phi.)
2. Remove veto identified Z->ee events from the QCD distribution. (remove events with an isolated cluster and a jet contains another 2X2 ETOW/BTOW cluster with E2x2ET> 0.5.PTjet and the invariant mass of the lepton candidate cluster and the jet is with in [70,140] GeV range)
3. Subtract any remaining Z contamination using Z->e+e- MC embedded sample




4. Normalize the QCD BG shape to the other 3 background (Z,Tau,second eemc) subtracted W yield.
5. Use W->ev embedded MC sample normalized to the integrated lumi of data to estimate the W signal in the ET region where the shape is normalized.




- Of each of the bin with in the $E_T$ normalization window (14-16 ) GeV,

$$\text{Normalization Factor} = \frac{(\text{W yield (3 other BG subtracted)} - \text{W signal MC yield})}{\text{nominal QCD BG yield (Z BG subtracted)}}$$

- Extend the QCD shape further in the ET (obtain the QCD yield from ET beyond 16 GeV using the normalization factor)

- Determine the final normalized QCD BG distribution shape

# Systematic Uncertainty

In terms of measuring spin asymmetries relevant quantities for the systematic uncertainty is the fraction of W candidate yield ($f$) comes from each BG process.

$f_W$ - w->ev production yield
$f_\tau$ - w-> $\tau$v production yield
$f_z$ - z->ee production yield
$f_{eemc}$ - BG estimate from second eemc
$f_{QCD}$ - BG estimate from data driven QCD shape

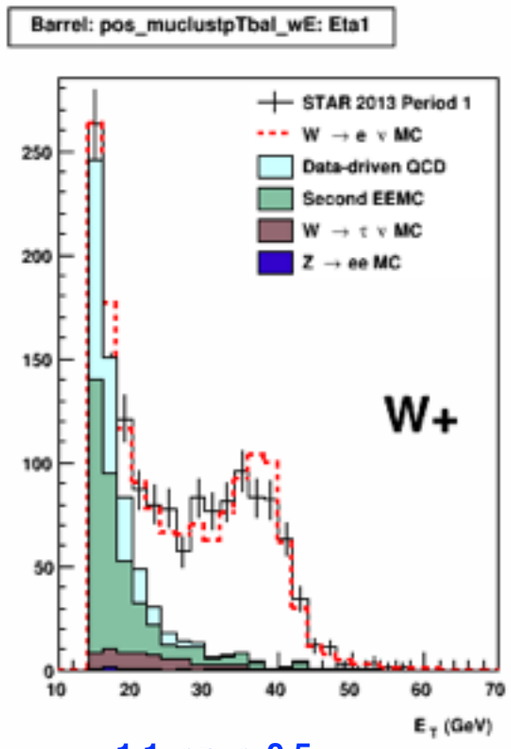
$f_W + f_z + f_{eemc} + f_{QCD} == 1$ ====> BG dilution factor $\beta = 1 - f_z + f_{eemc} + f_{QCD}$

- Estimate β by varying $f_{QCD}$ ==> Using different normalization regions ET {14 GeV , [16-20] GeV } , upper bound vary from 16 to 20 in 0.5 GeV steps & using range of possible signed Pt balance cuts to get the nominal QCD BG Pt :{ 5 GeV - 25 GeV } in 0.25 GeV steps.

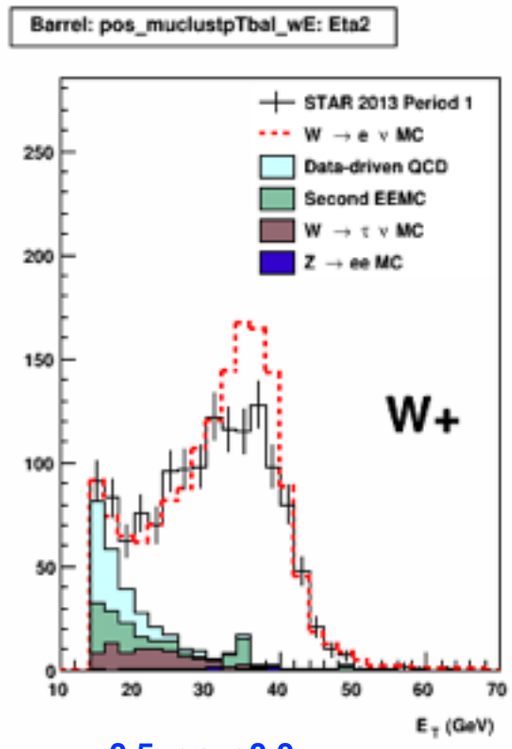
- Obtain distribution for β by varying the above parameters in each eta bin and use mean of the distribution as the central value for the asymmetry analysis and RMS as the Gaussian systematic uncertainty.

# Barrel W BG, run13 period 1

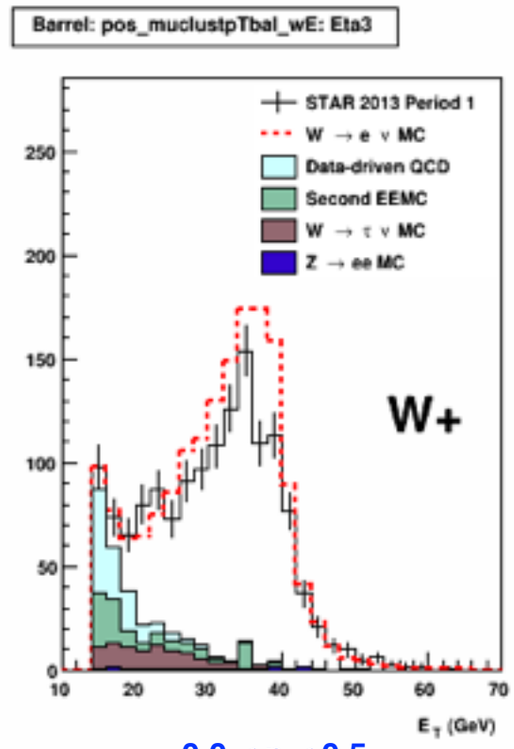
# of runs used : 933 , Total Integrated Luminosity = 125.3 pb-1



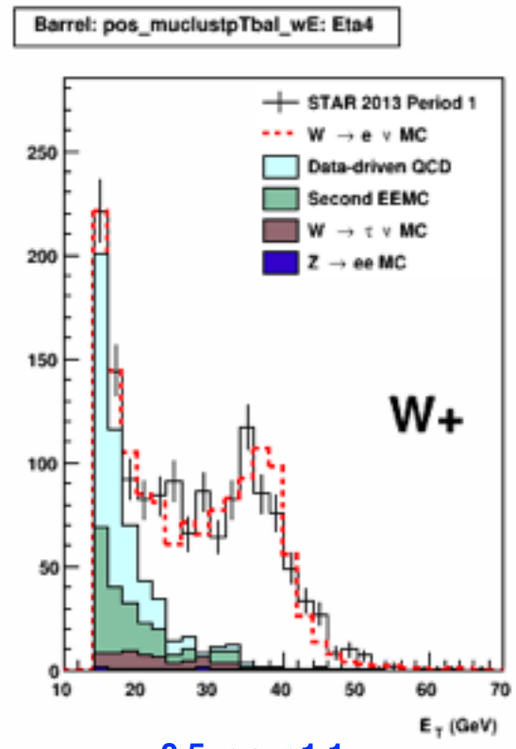

**-1.1 < η < -0.5**



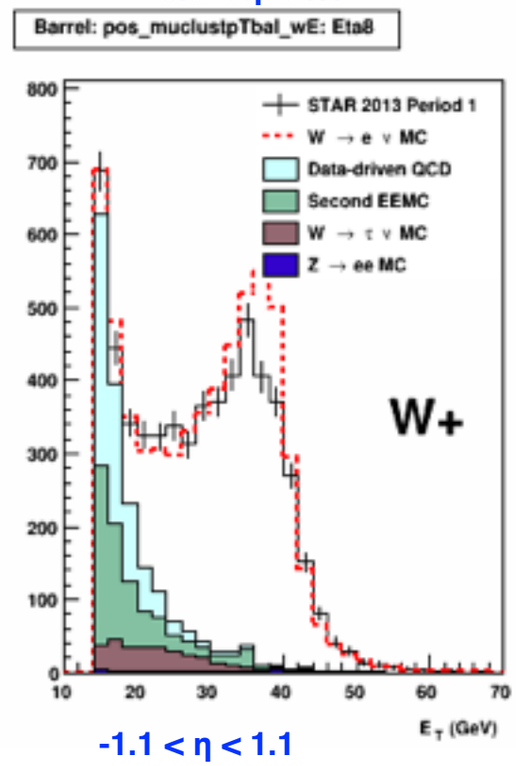

**-0.5 < η < 0.0**




**0.0 < η < 0.5**




**0.5 < η < 1.1**



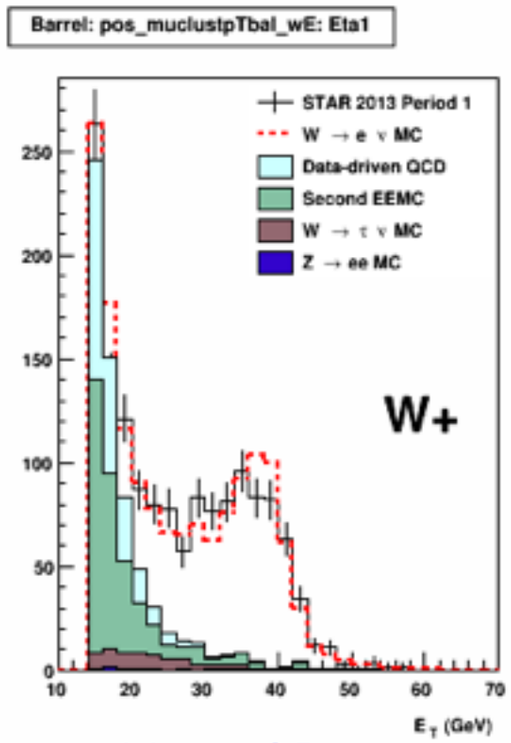

**-1.1 < η < 1.1**

**whole Mid-rapidity region**

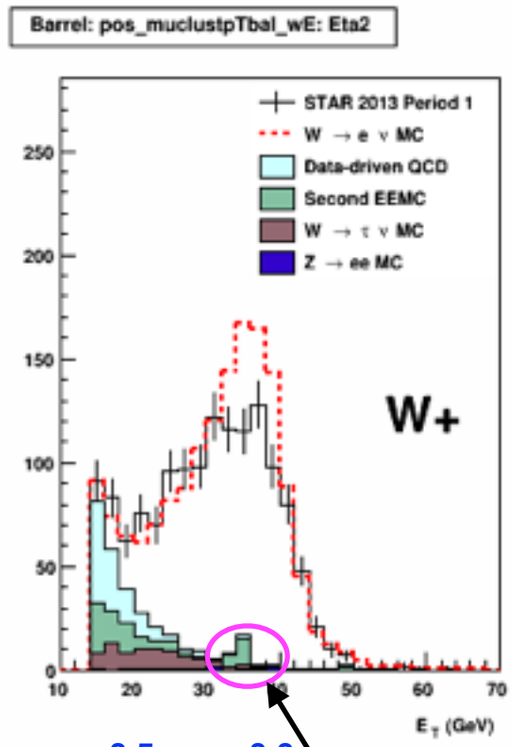
- MC samples were scaled to run13 integrated luminosity

# Barrel W BG, run13 period 1

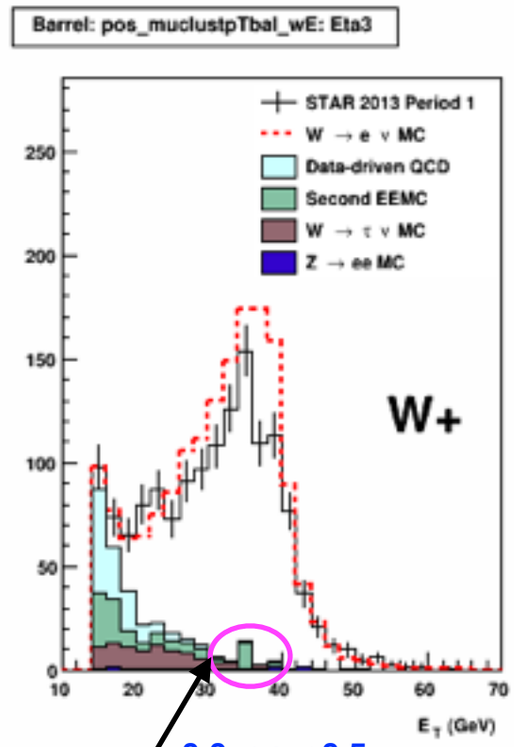
# of runs used : 933 , Total Integrated Luminosity = 125.3 pb-1



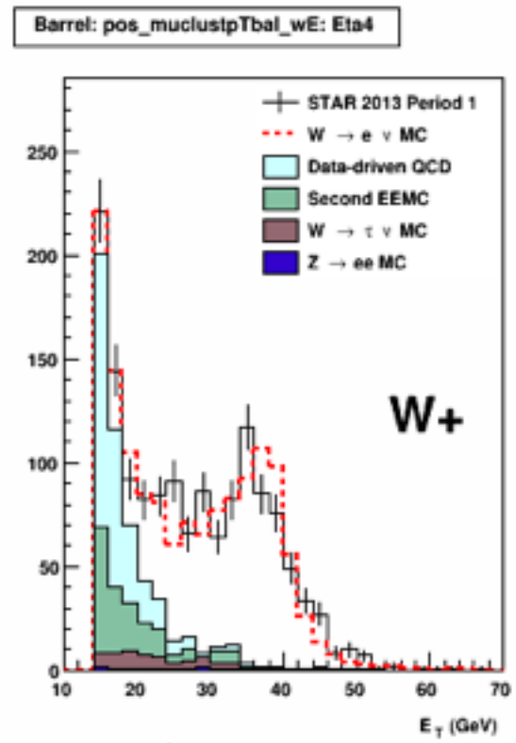

-1.1 < η < -0.5




-0.5 < η < 0.0



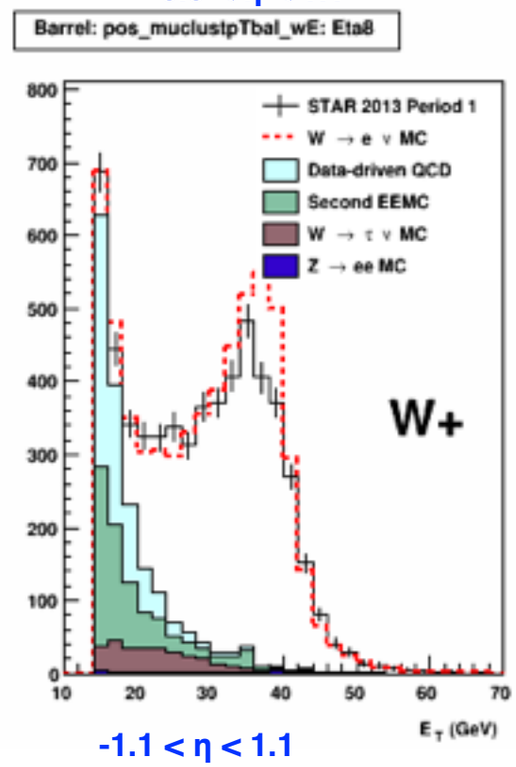

0.0 < η < 0.5




0.5 < η < 1.1

???

- MC samples were scaled to run13 integrated luminosity

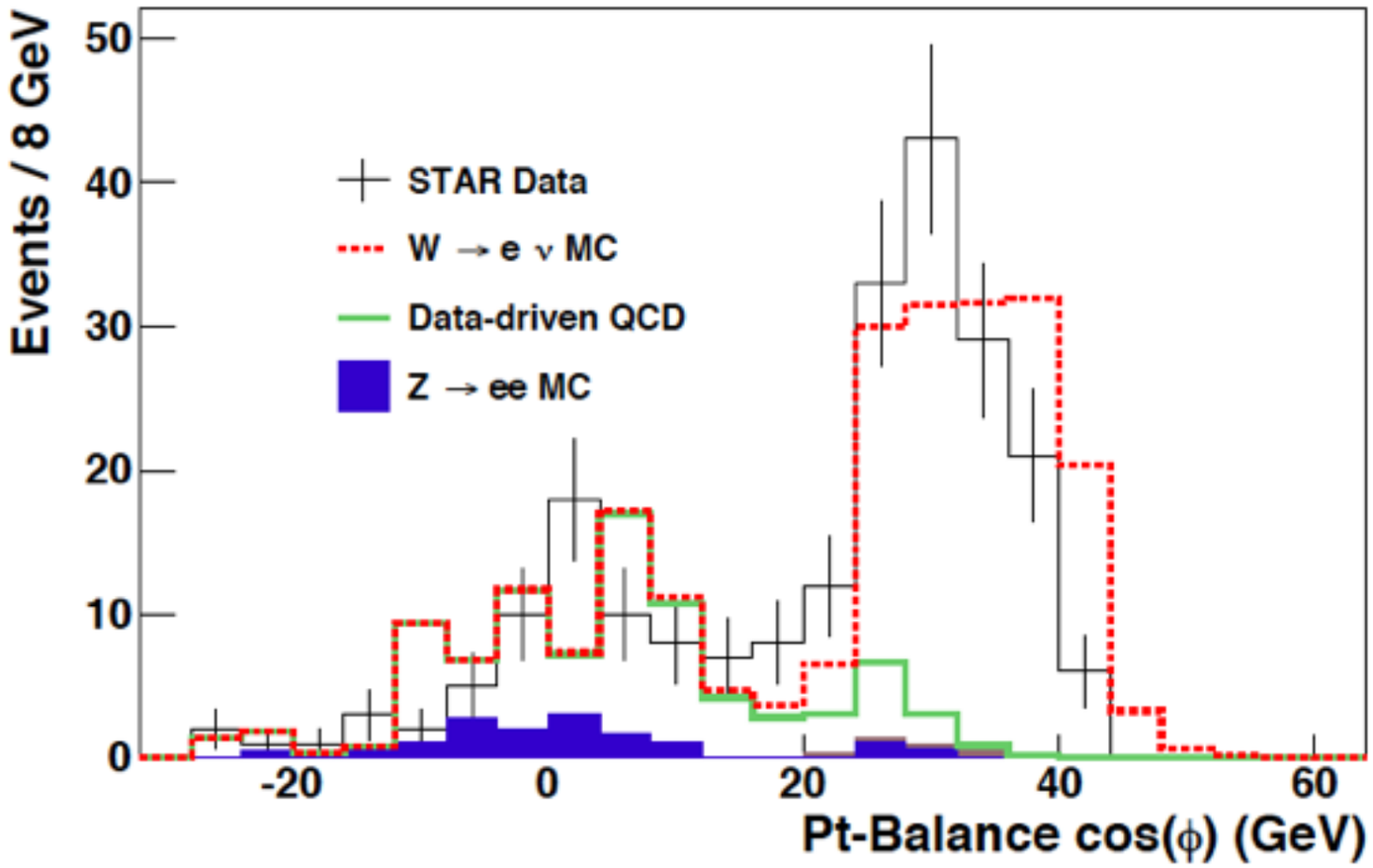



-1.1 < η < 1.1

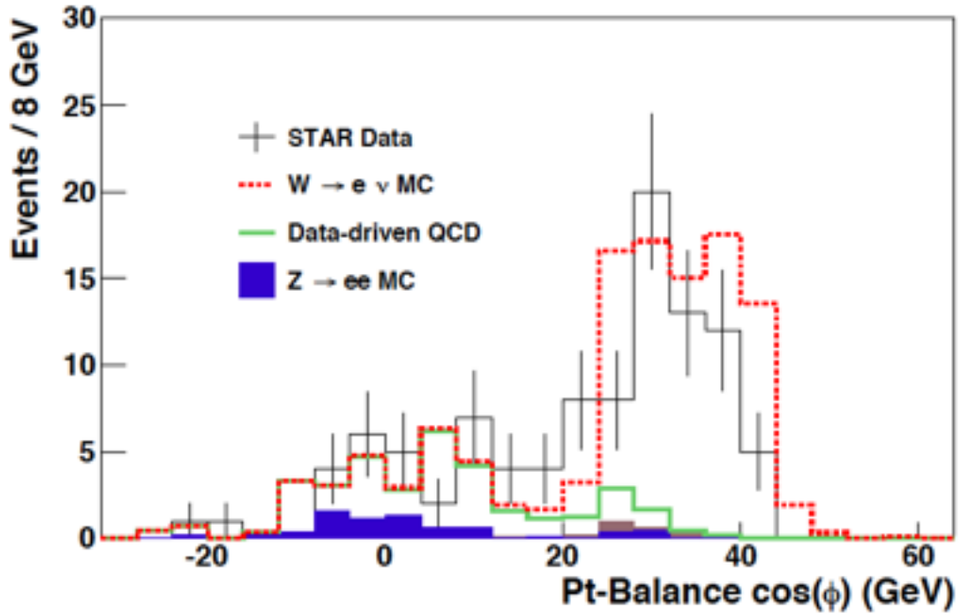
**whole Mid-rapidity region**

# EEMC BG

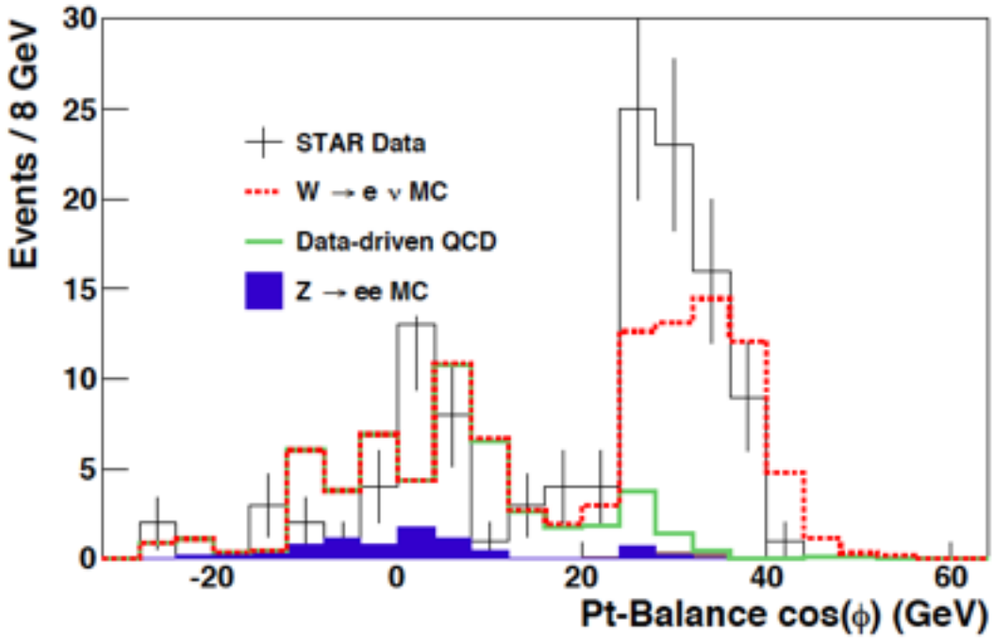
**Total**



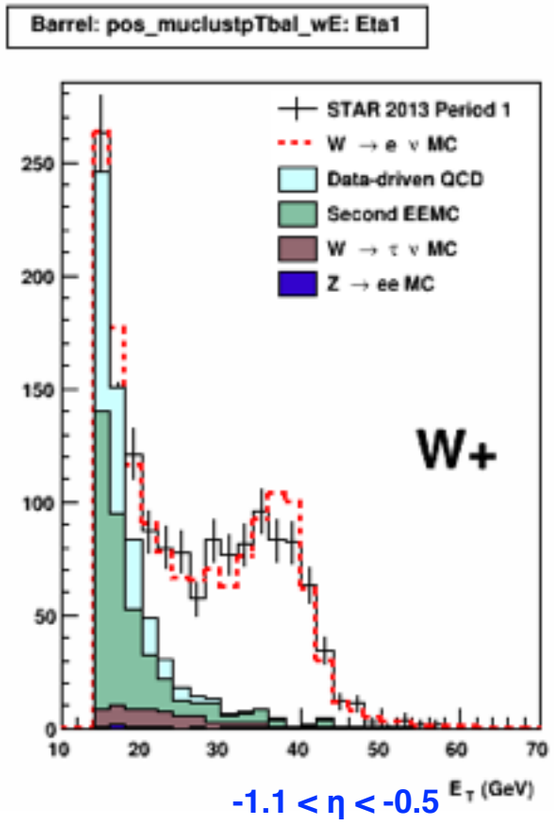

**Q=positive**




**Q=negative**



## run-13 period 1 - $\mathcal{L}$= 125.3 pb-1

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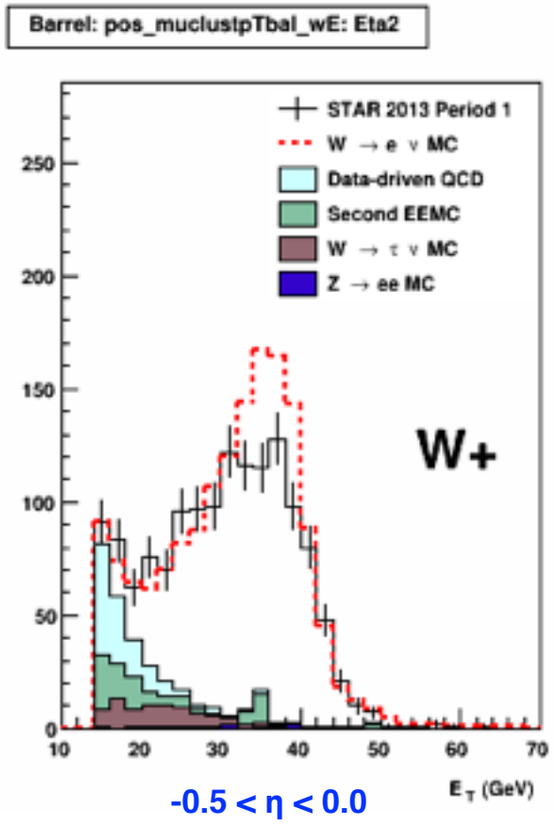


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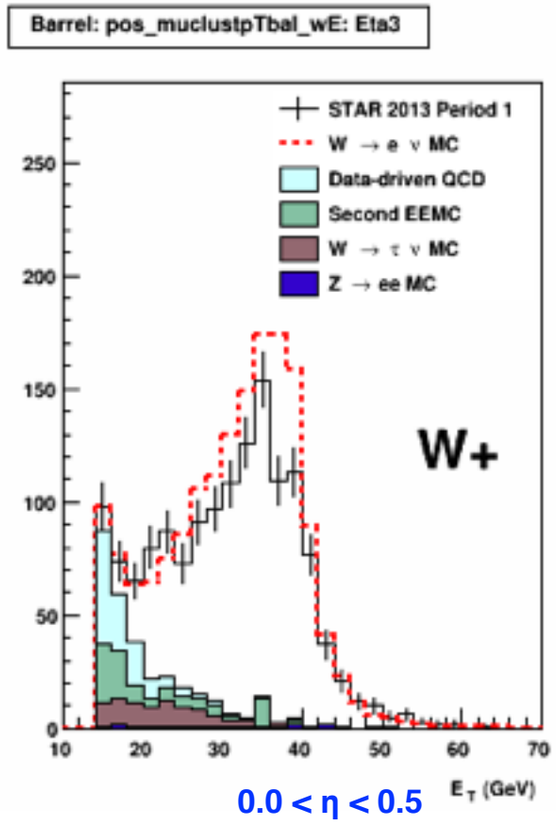


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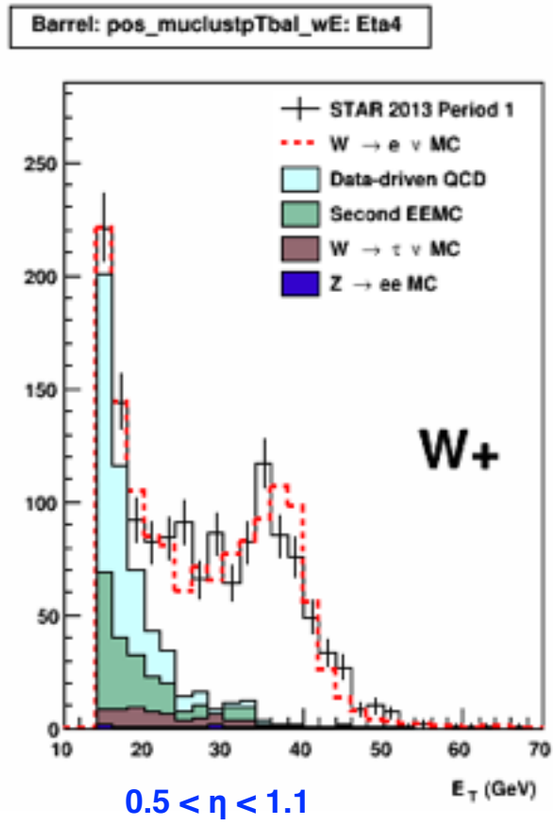
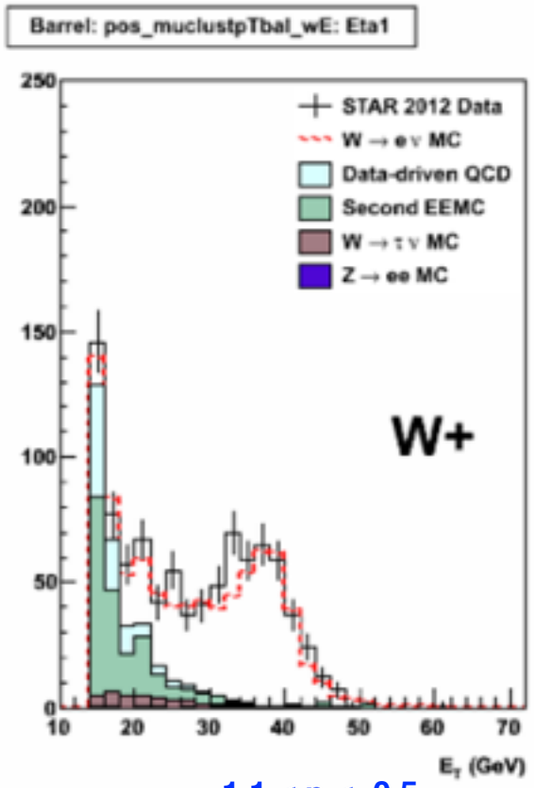
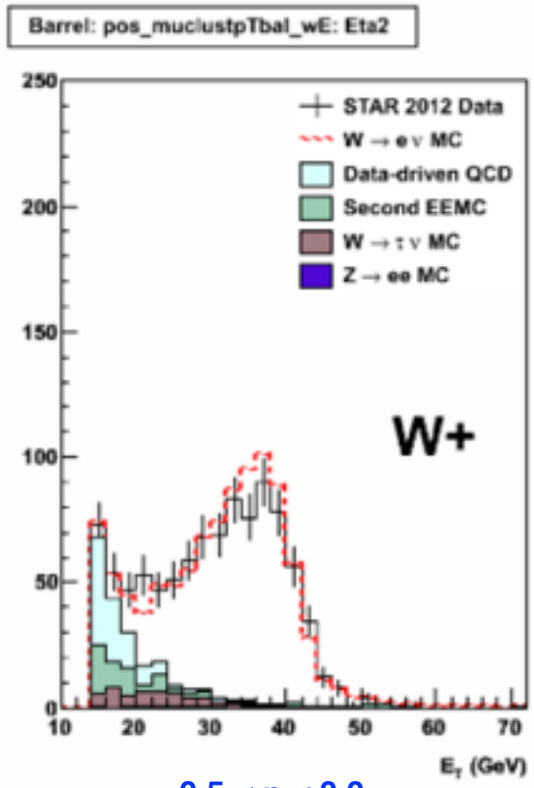



0.5 < η < 1.1

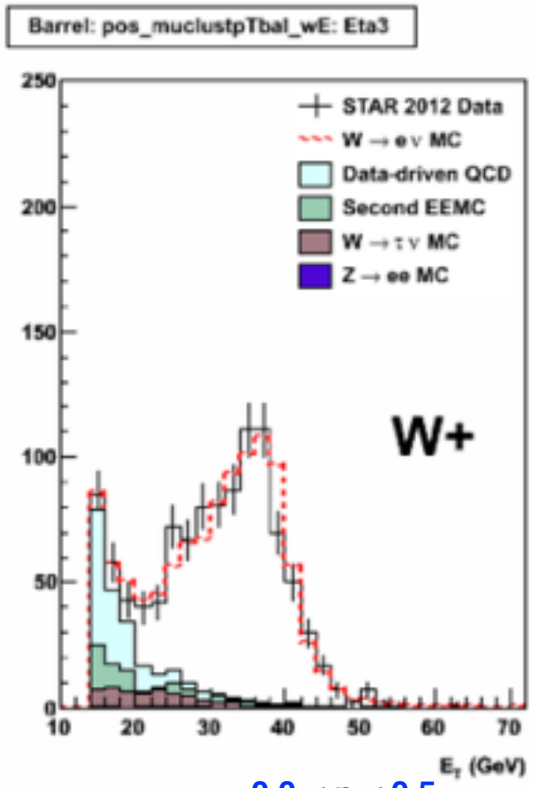
## run 12 - $\mathcal{L}$ = 77.4 pb-1



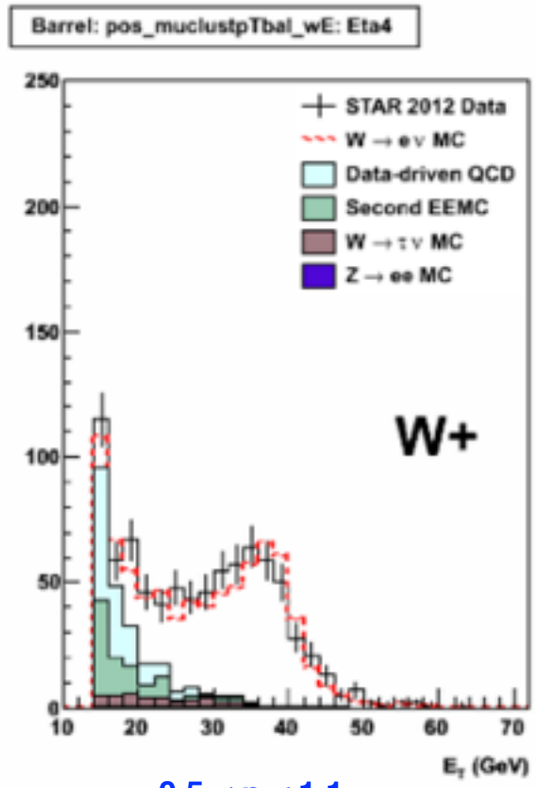

-1.1 < η < -0.5




-0.5 < η < 0.0

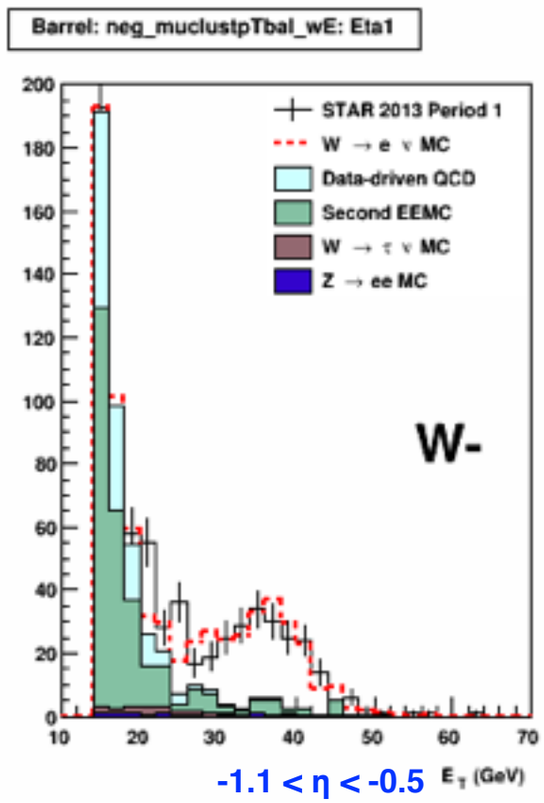



0.0 < η < 0.5




0.5 < η < 1.1

## run-13 period 1 - $\mathcal{L}$= 125.3 pb-1

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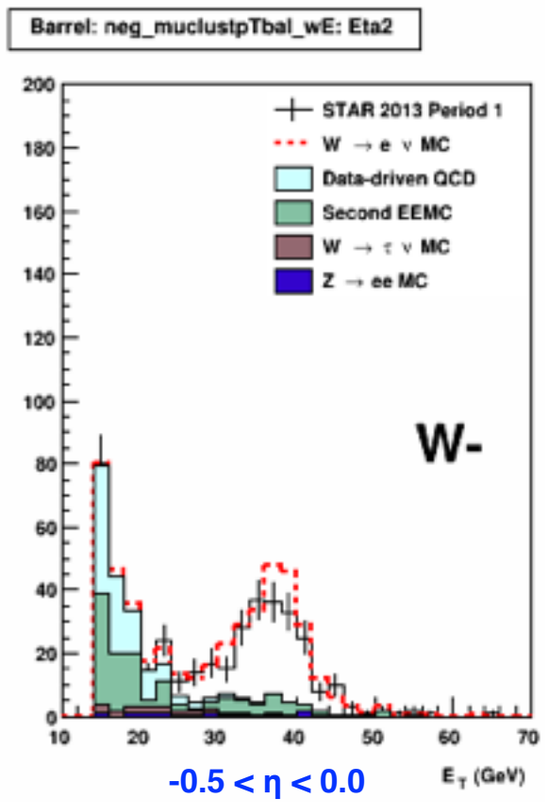


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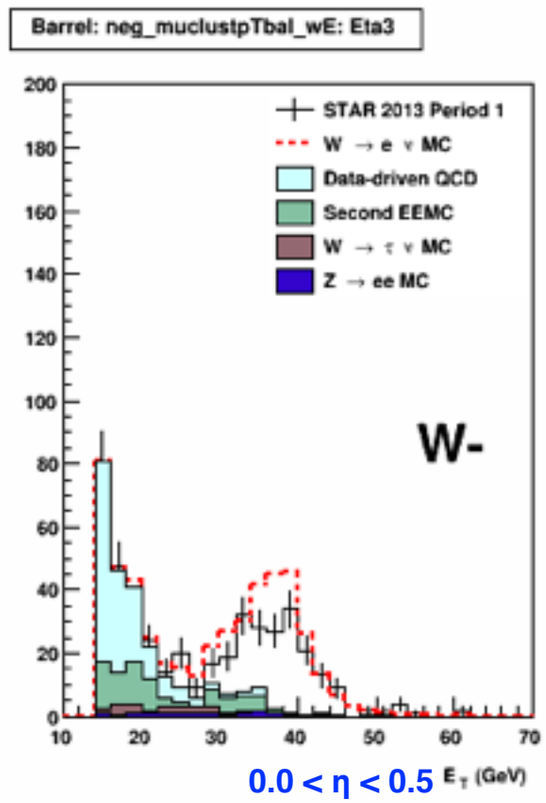
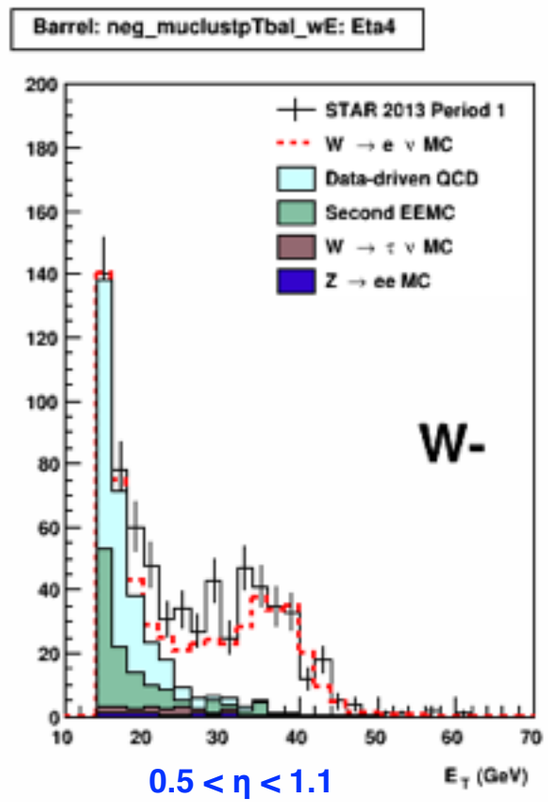
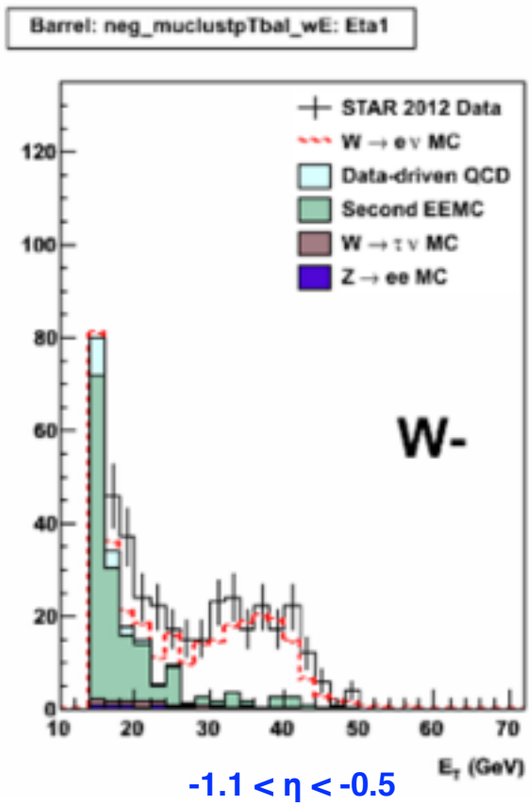



0.0 < η < 0.5




0.5 < η < 1.1

## run 12 - $\mathcal{L}$ = 77.4 pb-1

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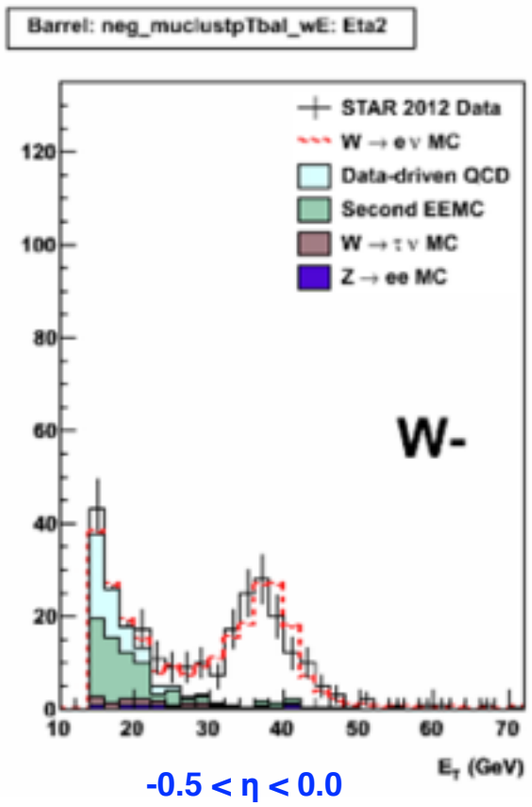
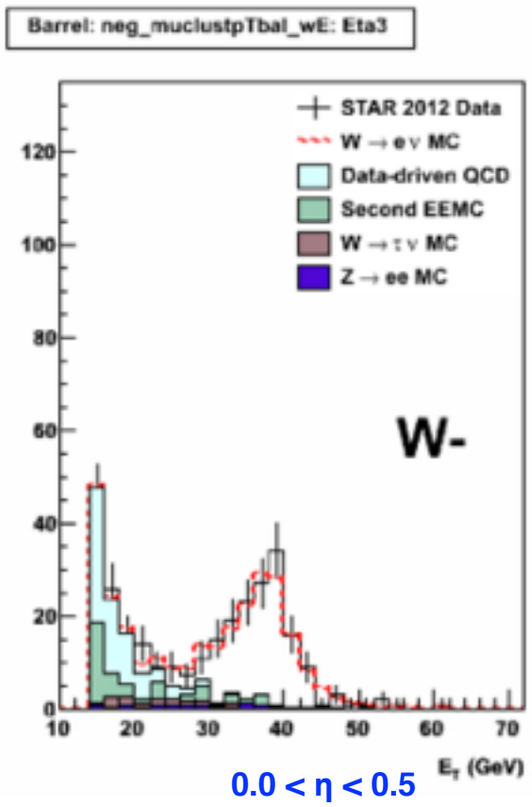



-0.5 < η < 0.0

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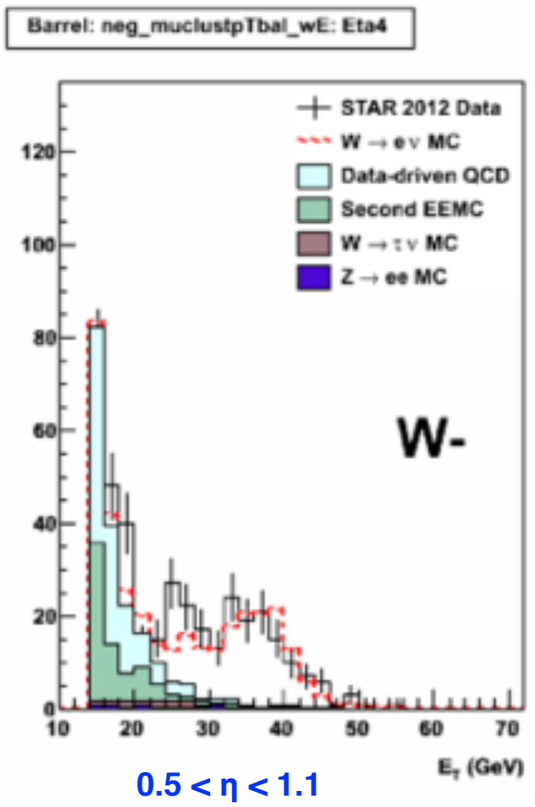
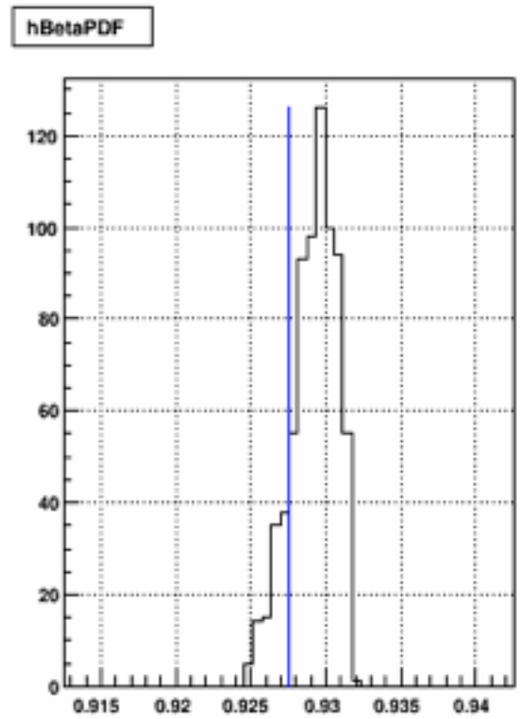



0.5 < η < 1.1

## run-13 period 1 - $\mathcal{L}$= 125.3 pb-1

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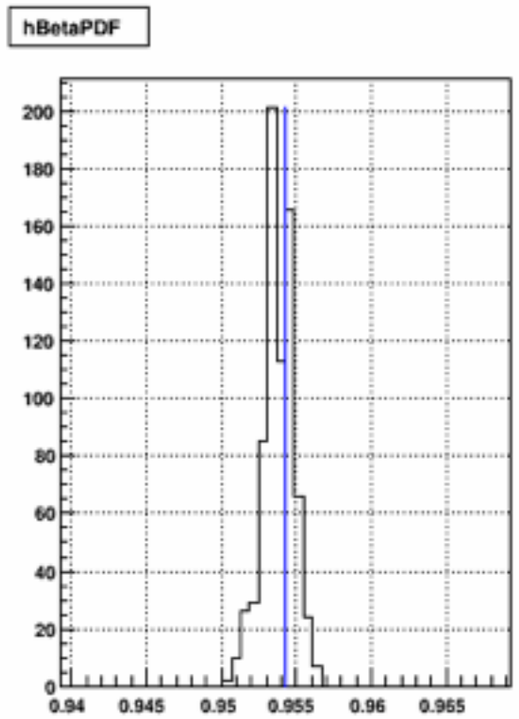


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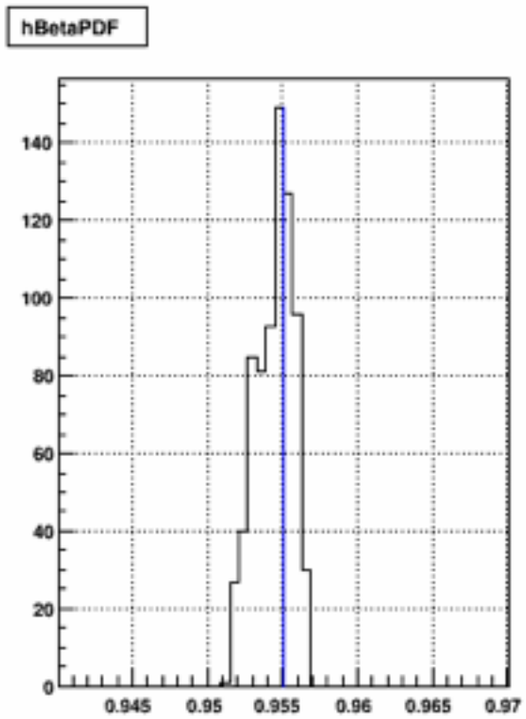


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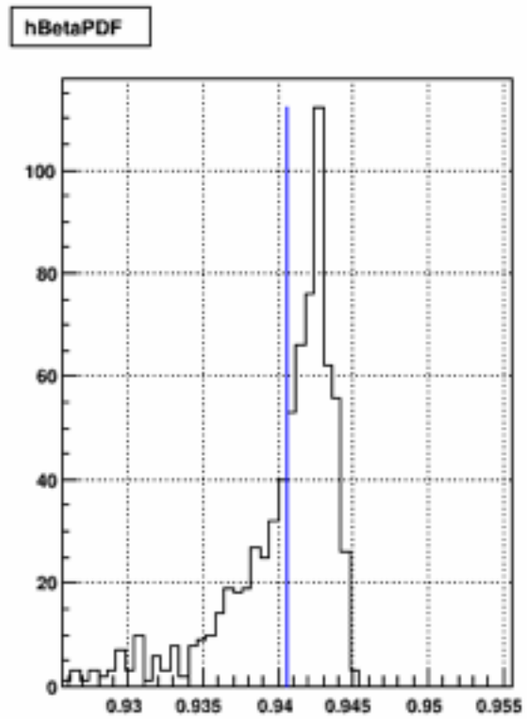
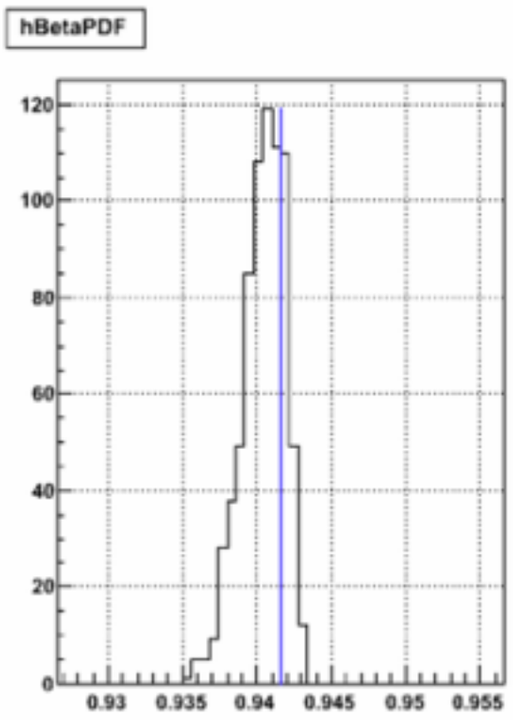
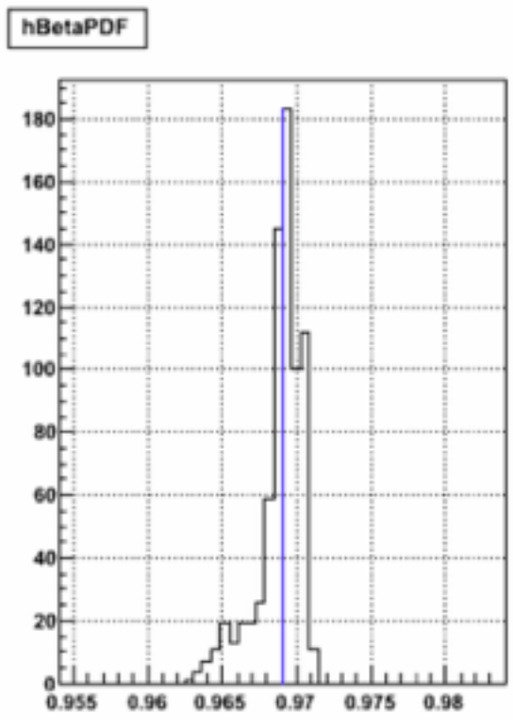



0.5 < η < 1.1

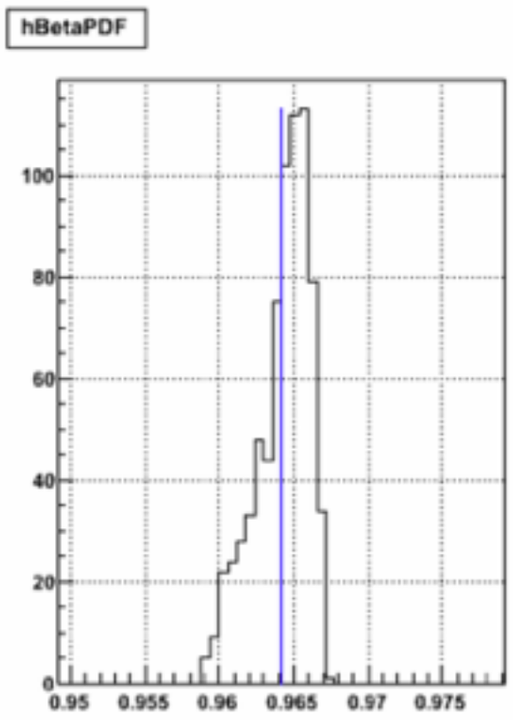
## run 12 - $\mathcal{L}$ = 77.4 pb-1




-1.1 < η < -0.5




-0.5 < η < 0.0

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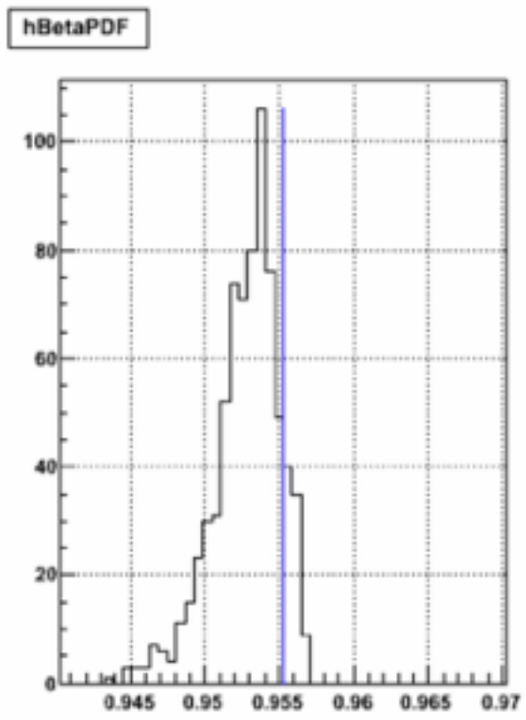
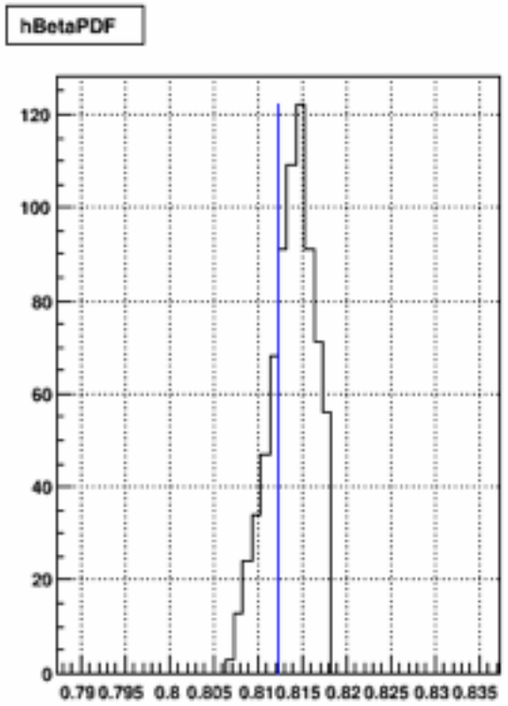



0.5 < η < 1.1

## run-13 period 1 - $\mathcal{L}$= 125.3 pb-1

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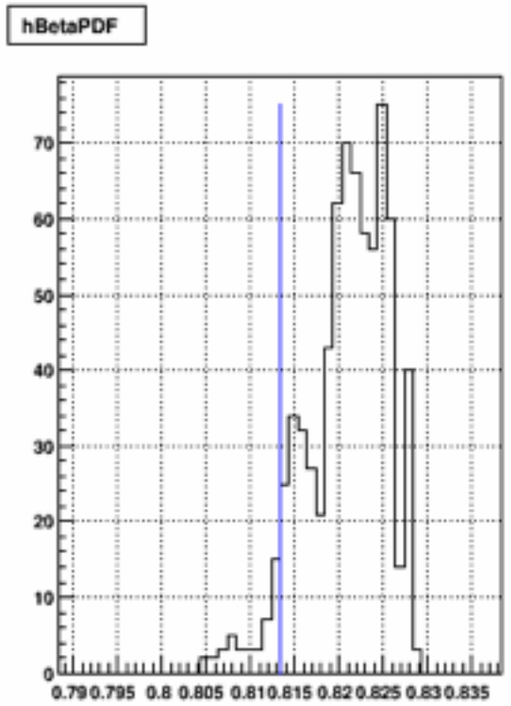


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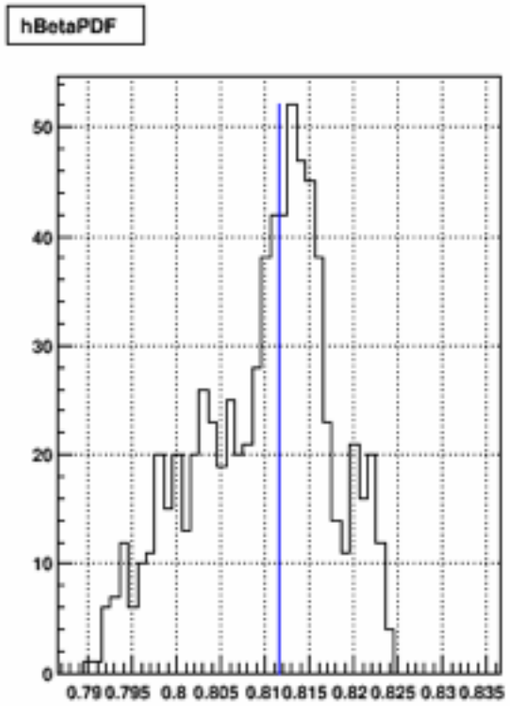
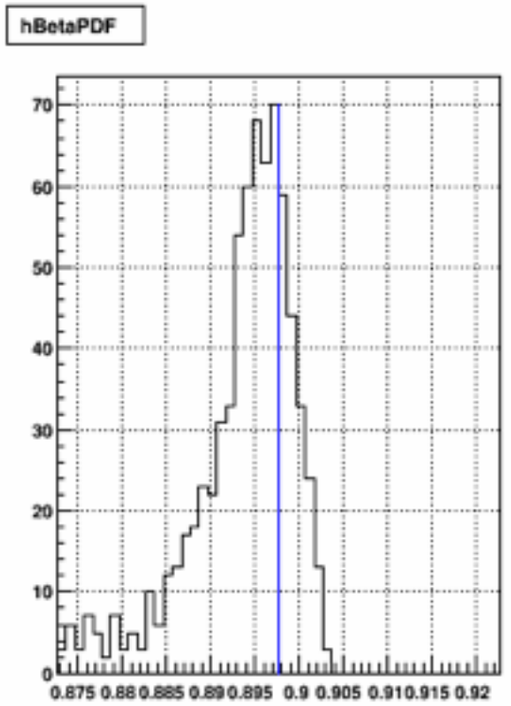
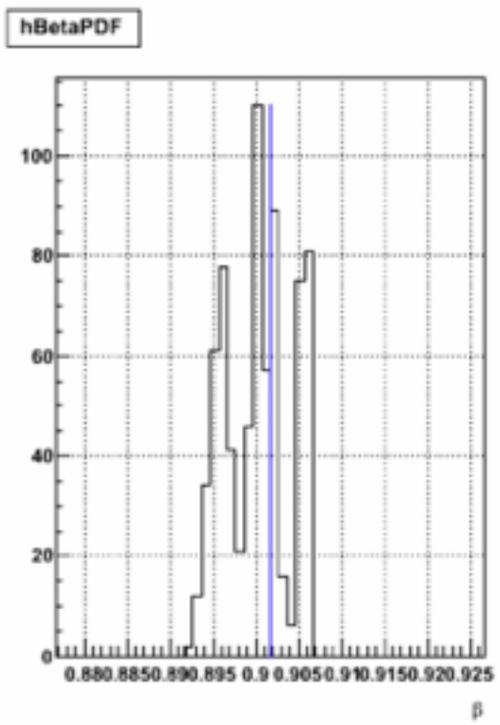



0.0 < η < 0.5

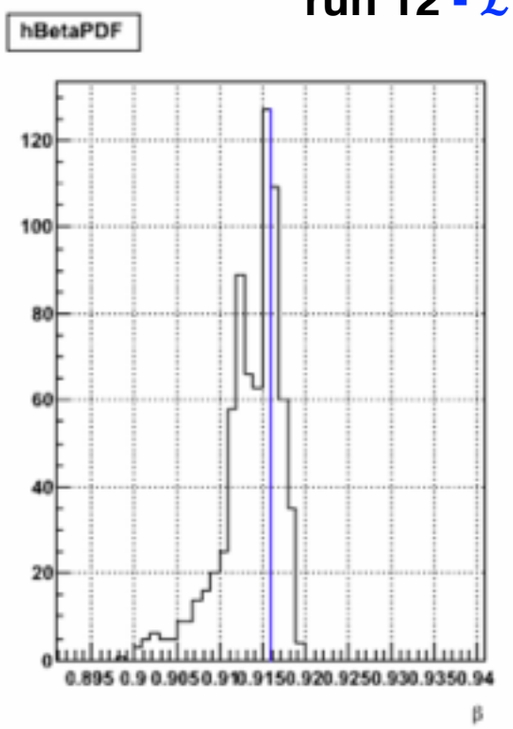



0.5 < η < 1.1

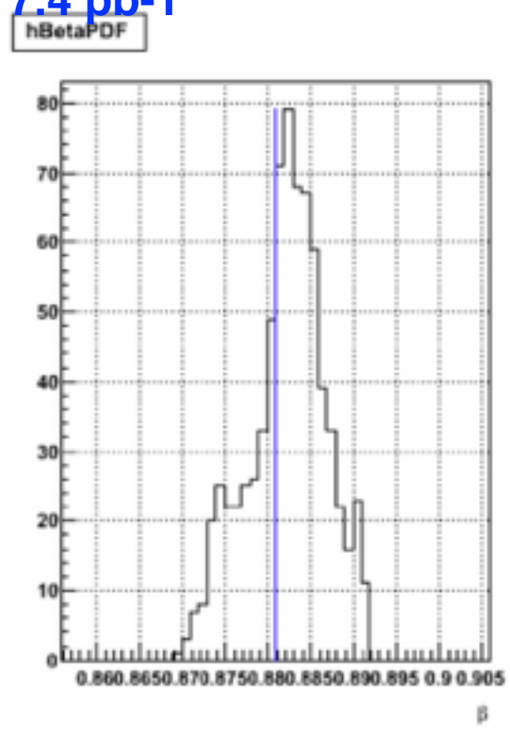
## run 12 - $\mathcal{L}$ = 77.4 pb-1



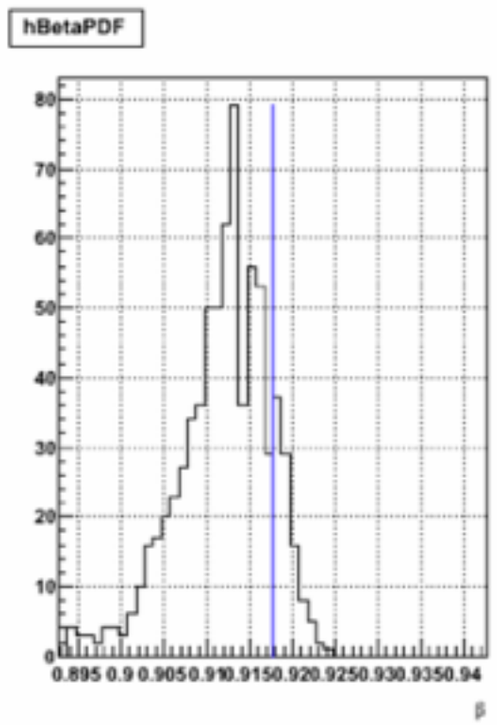

-1.1 < η < -0.5




-0.5 < η < 0.0




0.0 < η < 0.5




0.5 < η < 1.1

# run13 period 1 yield / BG summary

| tarPhysEtaBin | rawYield | qcdBkgd | secondEEMC | zeeBkgd | wTauYield | totalBkgd | wYield | beta +/- err | +syst | -syst |
|---|---|---|---|---|---|---|---|---|---|---|
| W | 727 | 10.84 | 36 | 5.84 | 15.96 | 52.68 | 674.32 | 0.928 +/- 0.009 | 0.008 | 0.009 |
| 2 | 998 | 10.77 | 27 | 7.87 | 23.2 | 45.64 | 952.36 | 0.954 +/- 0.005 | 0.005 | 0.01 |
| 3 | 996 | 9.71 | 28 | 7.03 | 26.6 | 44.74 | 951.26 | 0.955 +/- 0.006 | 0.004 | 0.009 |
| 4 | 743 | 20 | 17 | 7.15 | 18.22 | 44.15 | 698.85 | 0.941 +/- 0.006 | 0.011 | 0.024 |
| 8 | 3472 | 48.49 | 99 | 26.94 | 84.2 | 174.43 | 3297.57 | 0.950 +/- 0.003 | 0.004 | 0.006 |
| | | | | | | | | | | |
| W | 249 | 6.37 | 35 | 5.36 | 5.16 | 46.73 | 202.27 | 0.812 +/- 0.026 | 0.012 | 0.016 |
| 2 | 232 | 8.86 | 28 | 6.44 | 5.73 | 43.3 | 188.7 | 0.813 +/- 0.025 | 0.025 | 0.027 |
| 3 | 227 | 12.32 | 22 | 8.46 | 6.51 | 42.78 | 184.22 | 0.812 +/- 0.023 | 0.025 | 0.049 |
| 4 | 308 | 12.91 | 13 | 5.6 | 6.51 | 31.51 | 276.49 | 0.898 +/- 0.013 | 0.016 | 0.044 |
| 8 | 1032 | 35.2 | 96 | 23 | 23.91 | 154.2 | 877.8 | 0.851 +/- 0.010 | 0.01 | 0.016 |