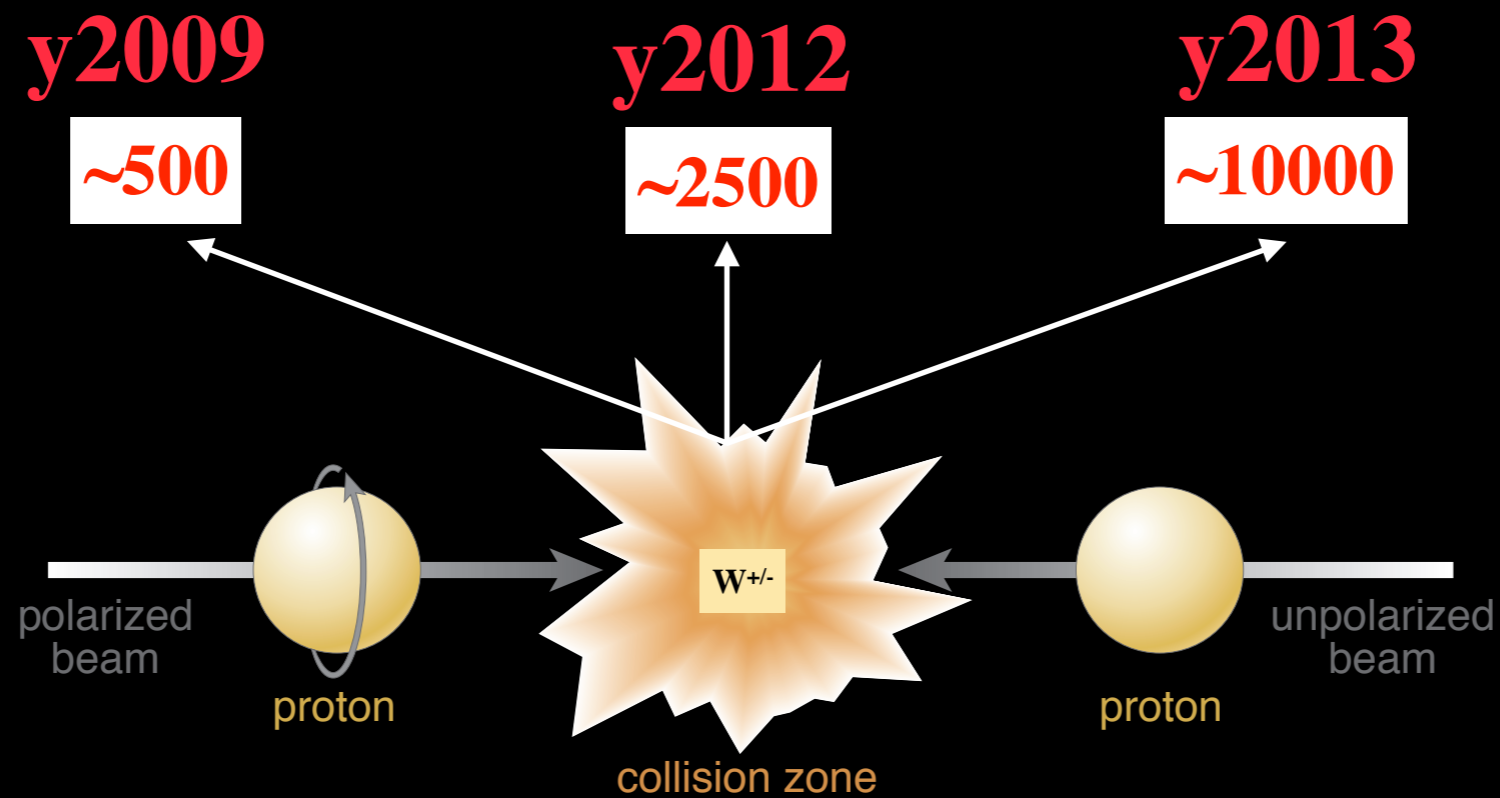


RUN 13 W A_L ANALYSIS

Devika & Jinlong



OUTLINE

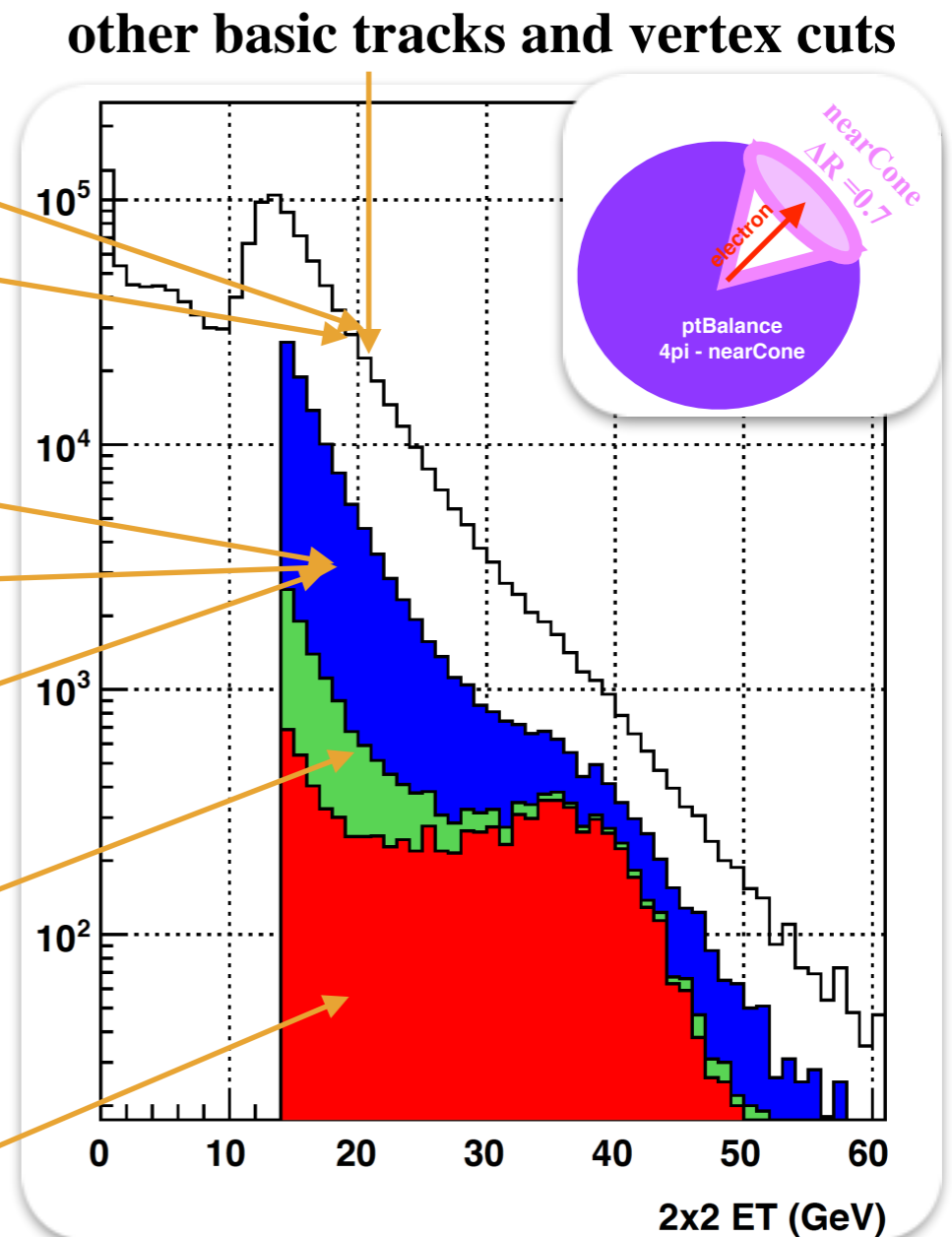
- Overview of Current Status
- Analysis Cuts
- Background Estimation
- BEMC Calibration
- Summary / Future Plans

CURRENT STATUS

- Issue with the discrepancy between data and MC.
- Optimization of various W selection cuts -> Not really the answer.
- Discrepancy between data-MC -> Mainly caused by the use of out dated (Run 9 pp200 GeV) BEMC calibration.
- Calibration process of BEMC using run 13 pp500 GeV data -> Ongoing.
- Preliminary A_L results -> Once the BEMC calibration is completed.

ANALYSIS CUTS

- $|Z_{\text{vertex}}| < 100 \text{ cm}$
- track $P_T > 10 \text{ GeV}$
- $E_T (2 \times 2) > 14 \text{ GeV}$
- $E_T (2 \times 2 / 4 \times 4) > 95 \%$
- $\Delta d_{\text{ (track-cluster)}} < 7 \text{ cm}$
- $E_T (2 \times 2 / \text{nearCone}) > 88 \%$
- sign-pt balance $> 14 \text{ GeV}$

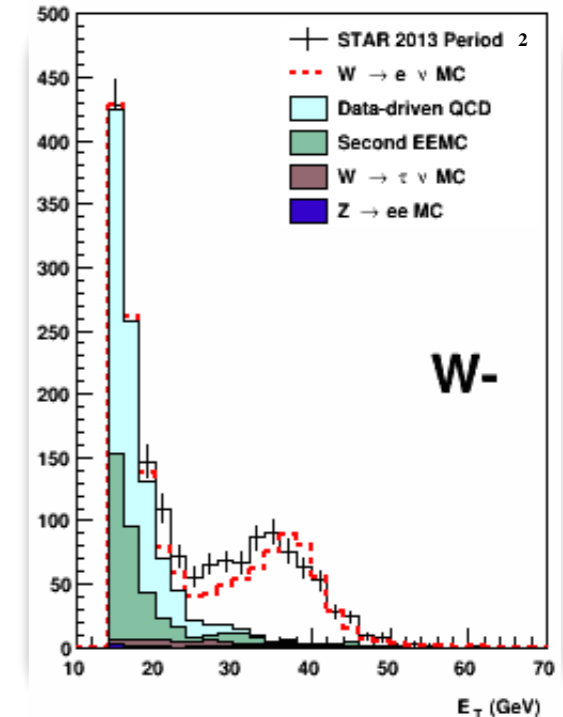
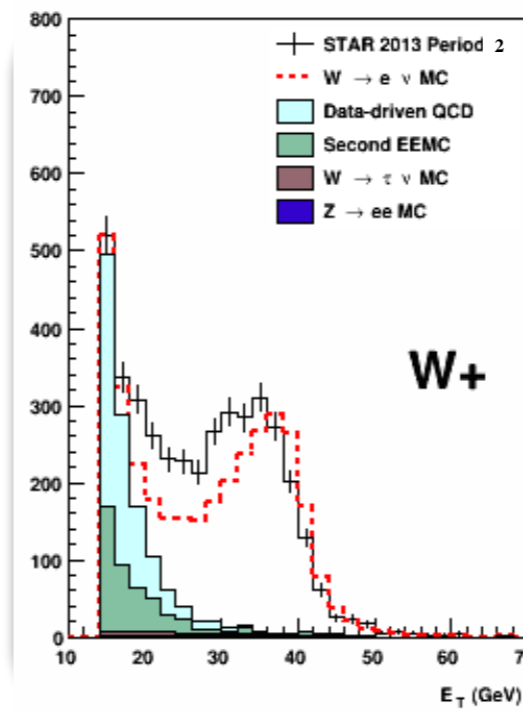
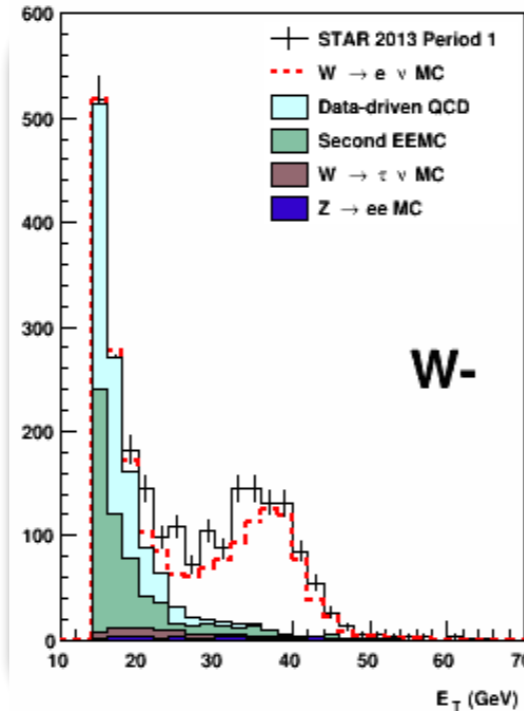
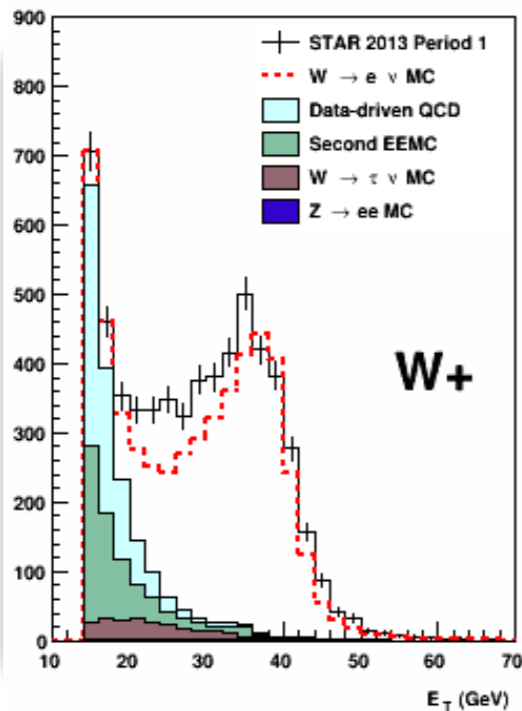


BACKGROUND ESTIMATION

2x2 cluster E_T distribution of Events which pass all W selection cuts and various BG contributions

Period 1

Period 2



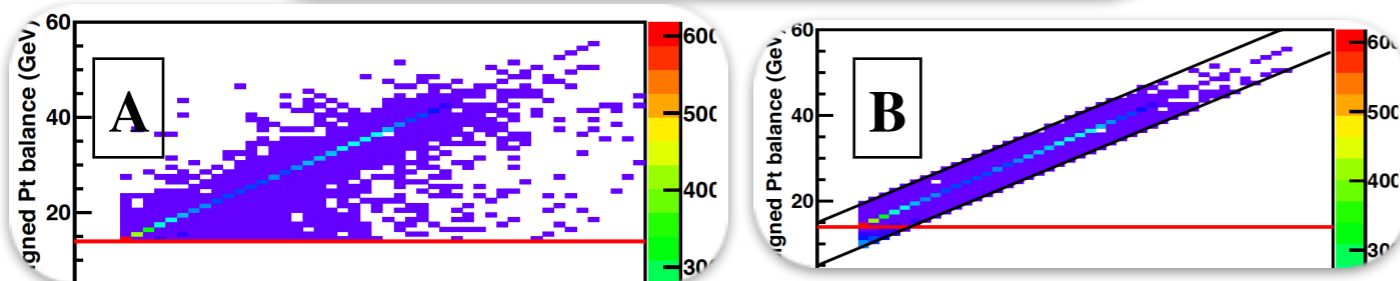
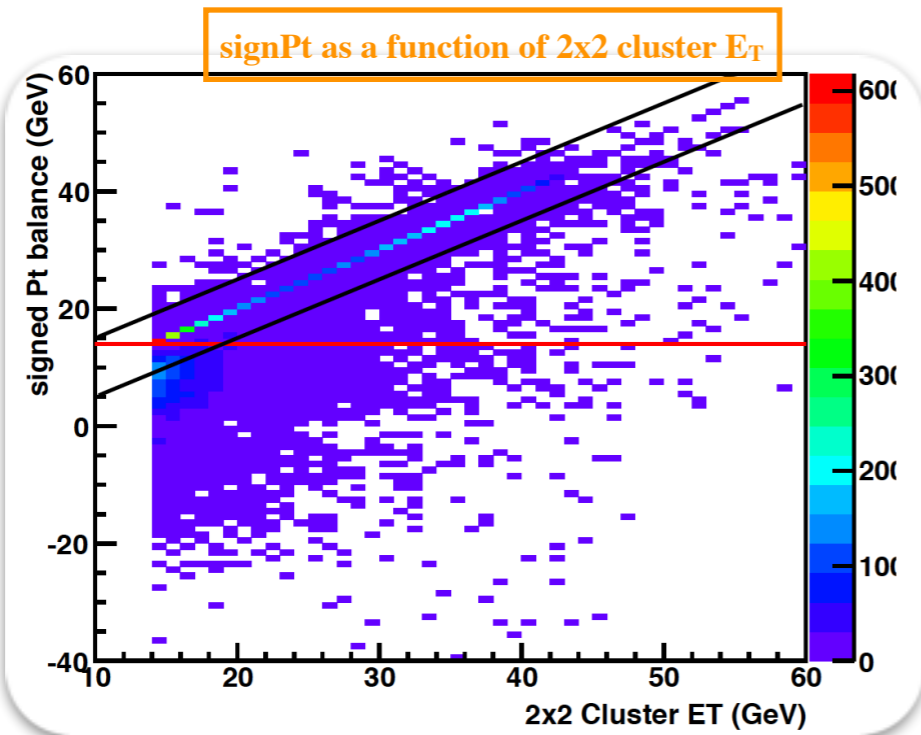
$-1.1 < \eta < -1.1$

$-1.1 < \eta < -1.1$

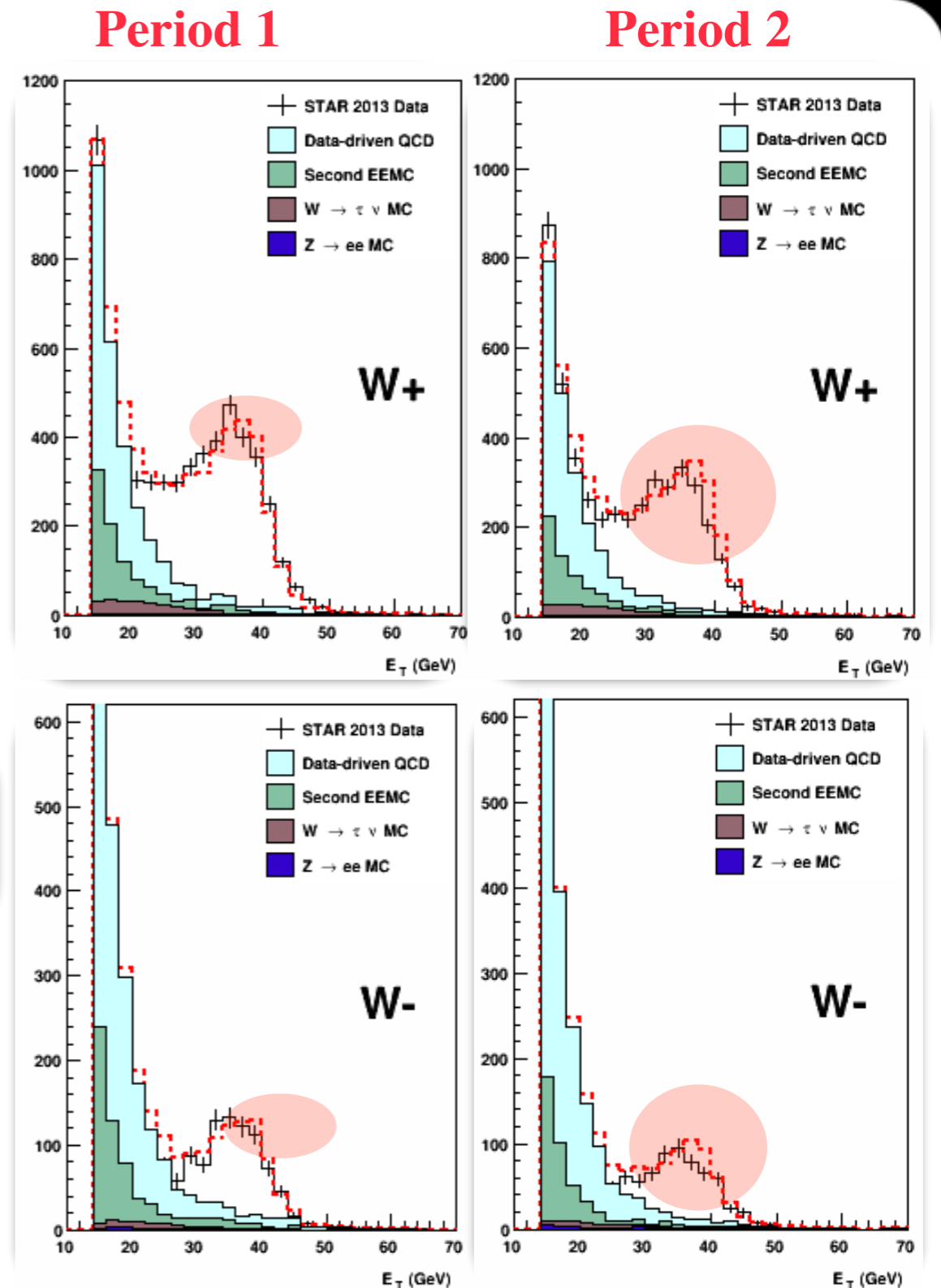
- Large discrepancy between Data and MC.
- Optimizing W-selection cuts.
 - Modified sign-pt balance cut.
 - Away E_T cut.
- 500 GeV BEMC calibration.

OPTIMIZING W SELECTION CUTS

Modified sing-pt balance cut

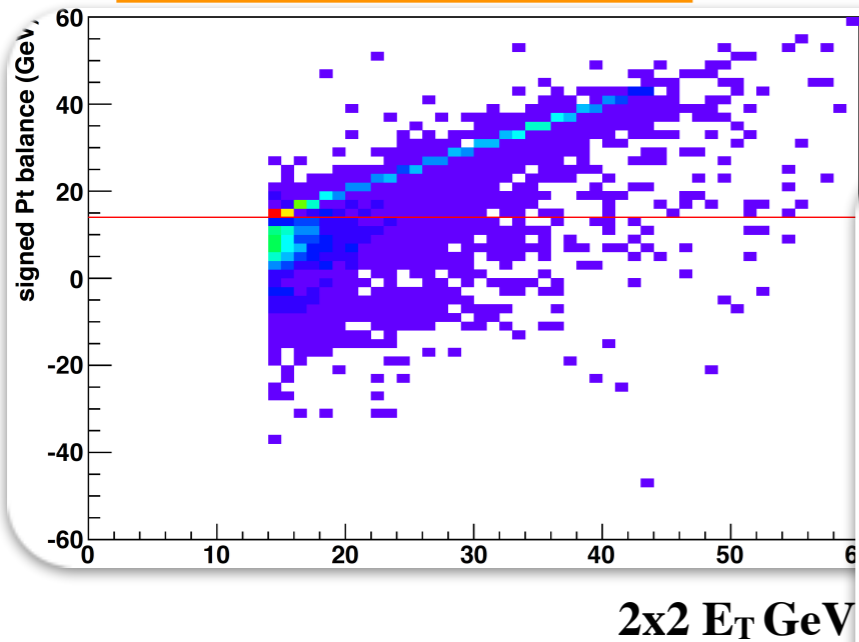


- Significant reduction of data MC discrepancy.
- Not very well agree in low E_T bins (below 20 GeV).
- Does not consist at the W-Jacobian peak position.



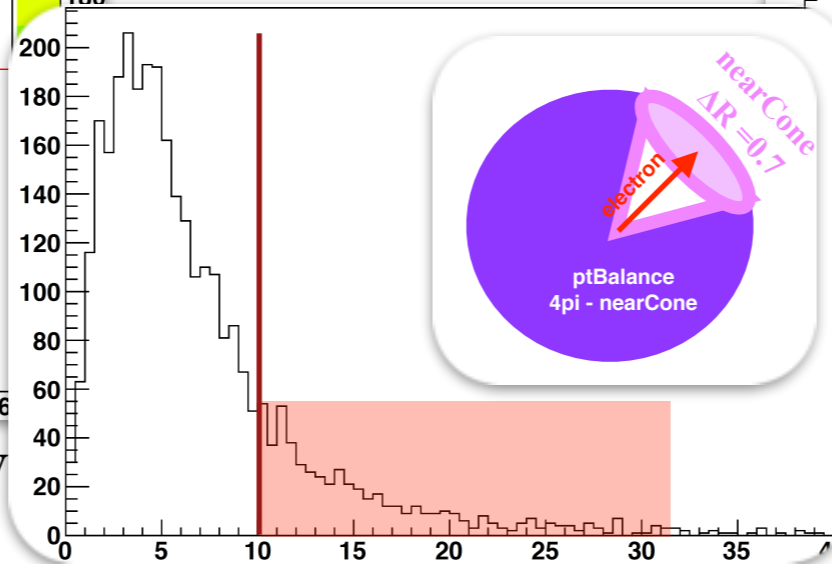
OPTIMIZING W SELECTION CUTS

signPt as a function of 2x2 cluster E_T

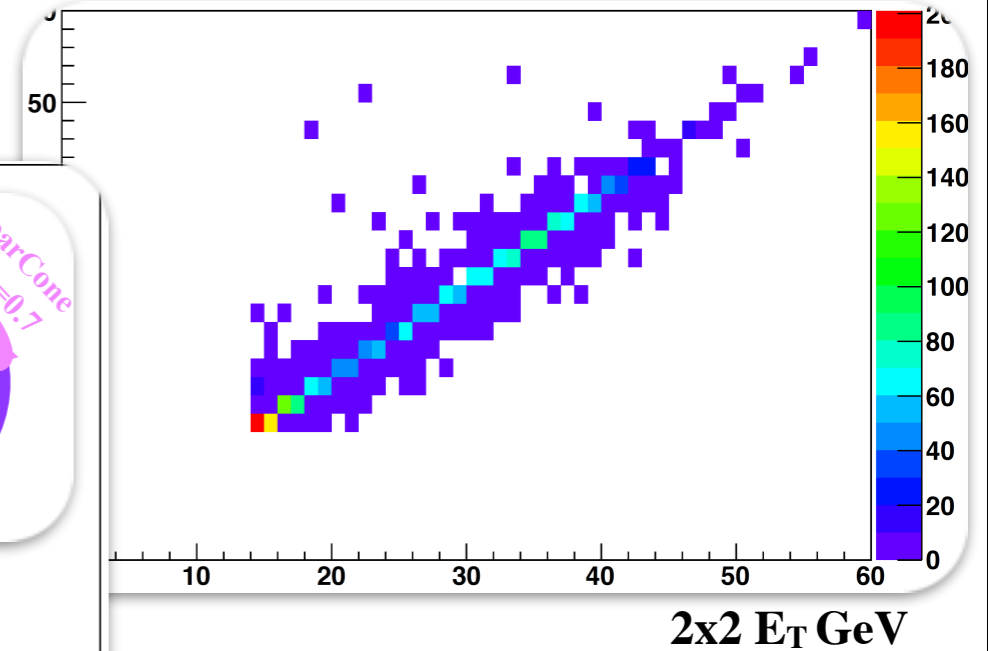


Away ET cut

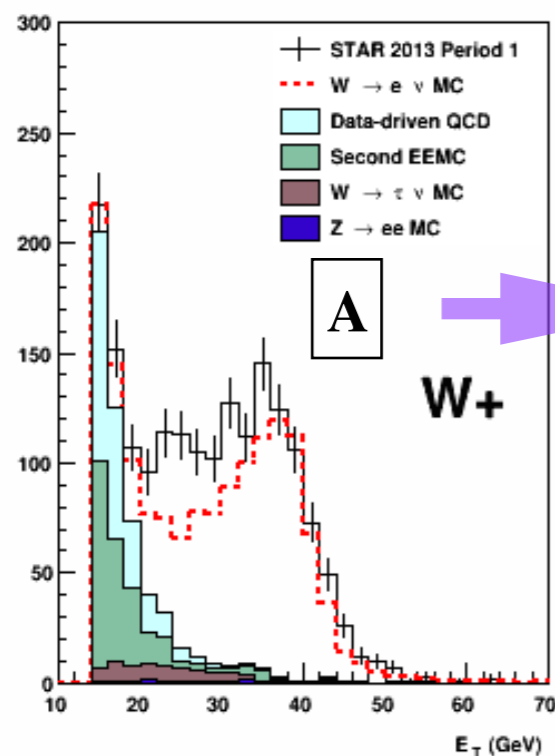
Away E_T of events which pass the sign pt balance cut



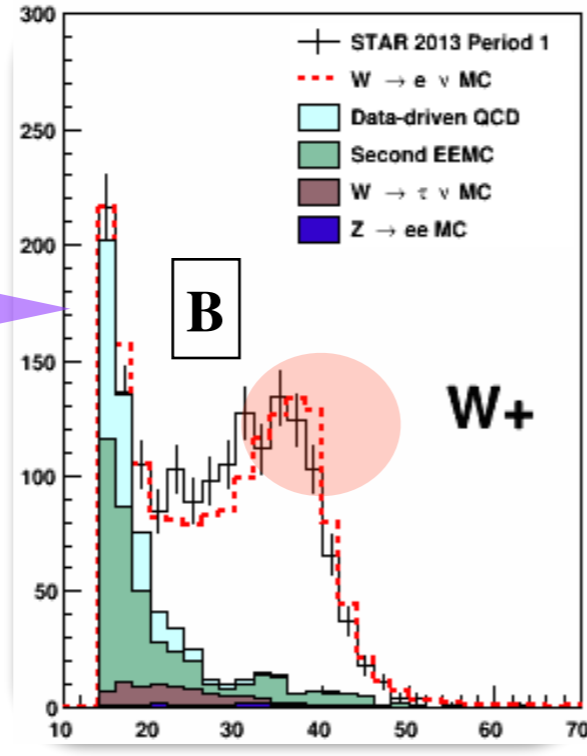
signPt as a function of 2x2 cluster E_T



away E_T GeV



W+



W+

- Similar to modified sign-pt cut.
- Significant reduction of data MC discrepancy.
- Does not consist at the W- Jacobean peak position.

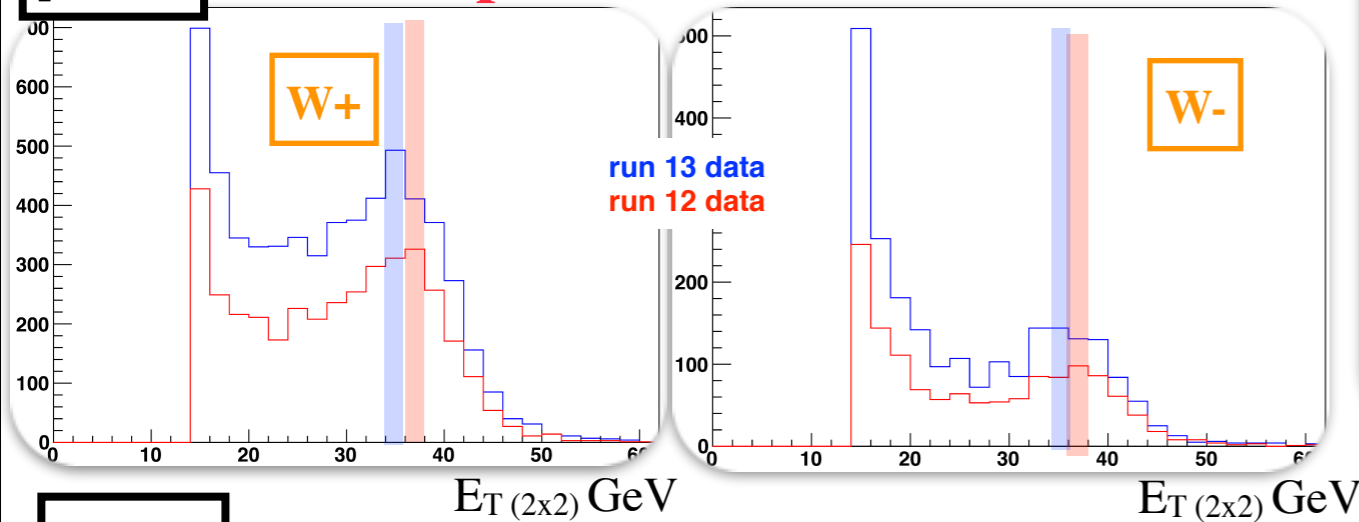
W-Jacobeian Peak Position

- W-Jacobeian peak position of run 13 data is shifted towards lower ET compared to Embedded MC and run12 data.
- This indicated the low gains in the BEMC tower calibration.

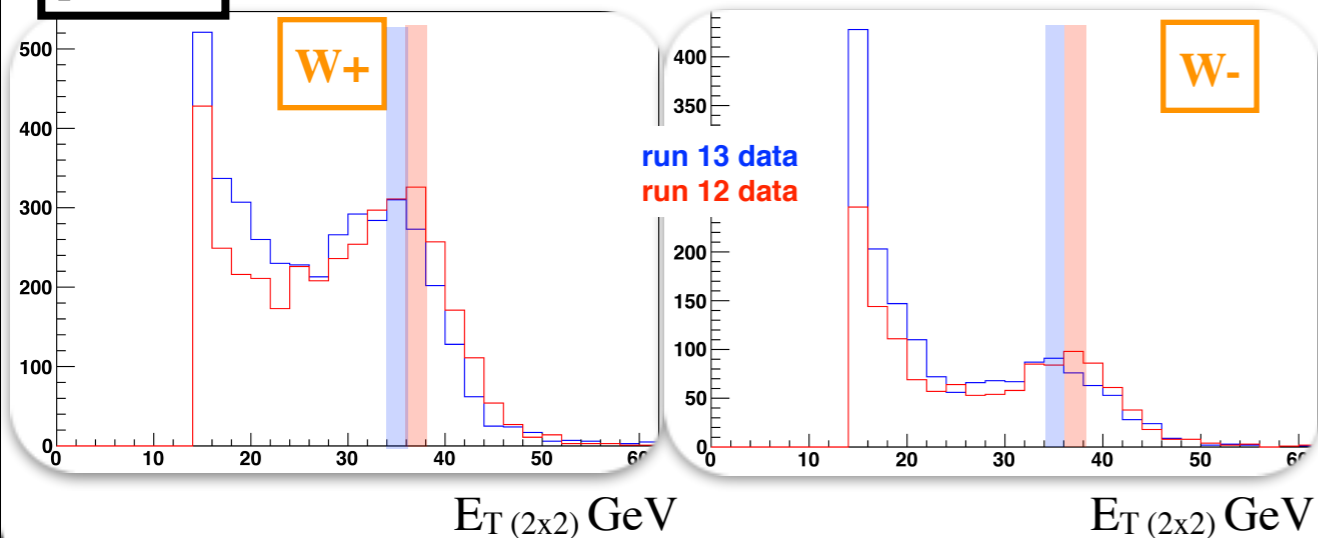
2x2 cluster E_T distribution of Events which pass all W selection cuts

period 1

Compared to run 12 data

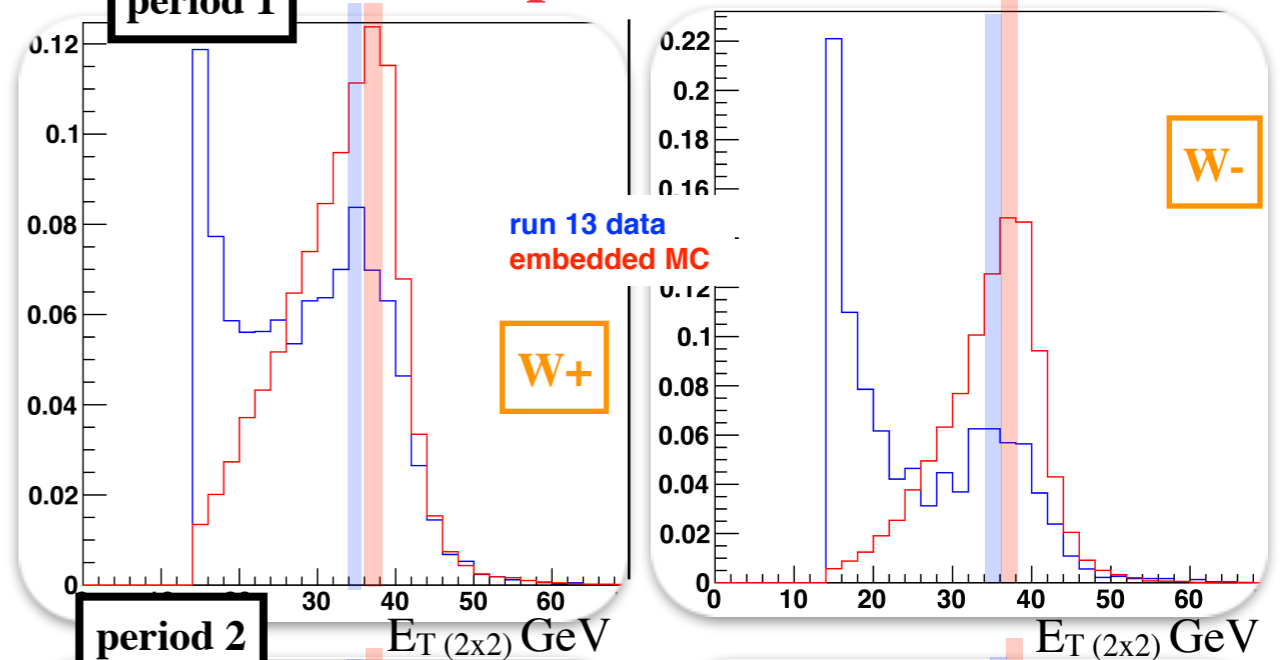


period 2

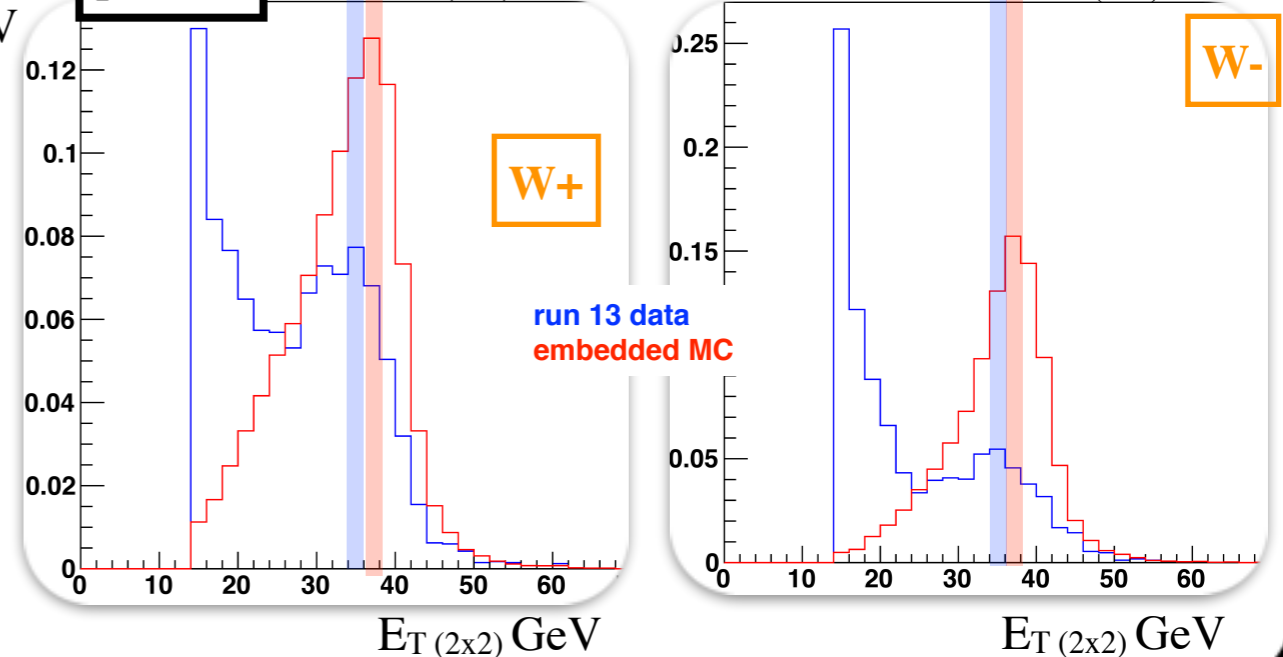


Compared to MC

period 1



period 2

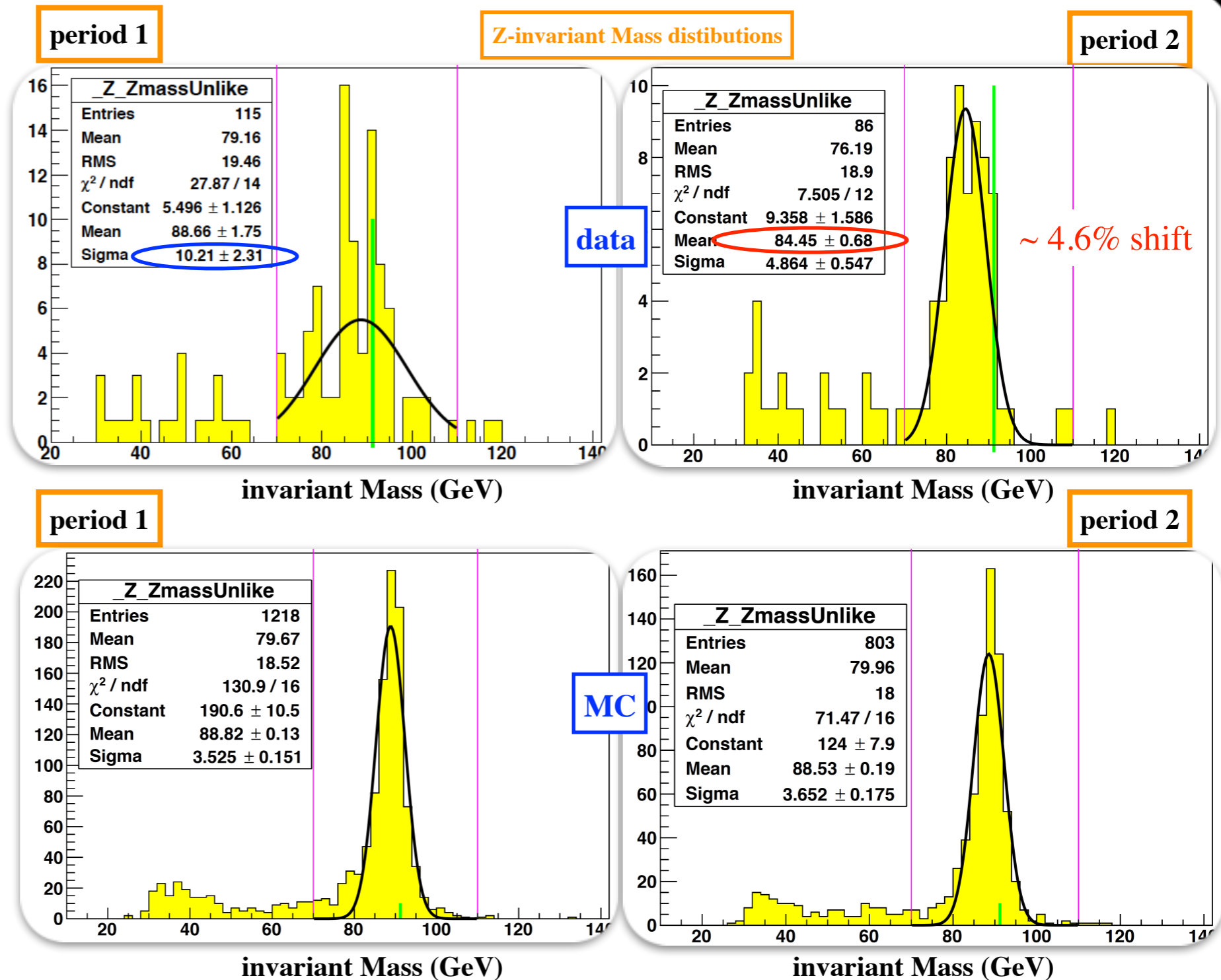


Z-invariant Mass Peak Position

PDG : 91.1876 GeV

- Run 13 data shows overall $\sim 2\%$ shift in Z invariant mass Peak.

- Another indication of low gains in BEMC tower calibration.

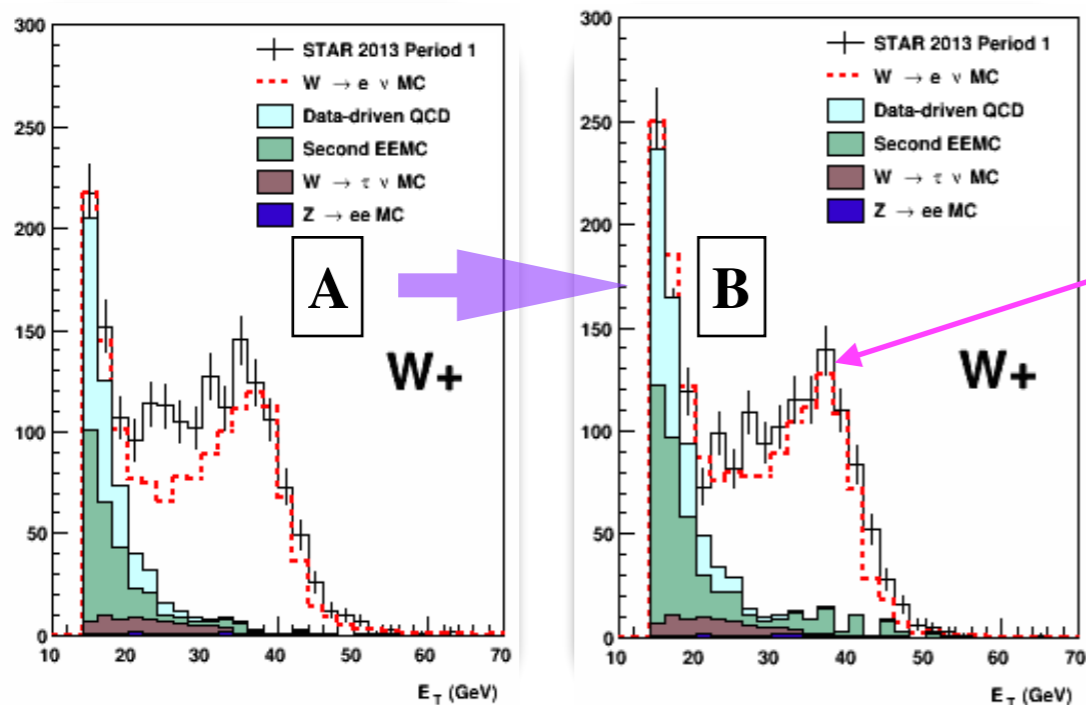


WHY WE NEED Run 13 BEMC Calibration??

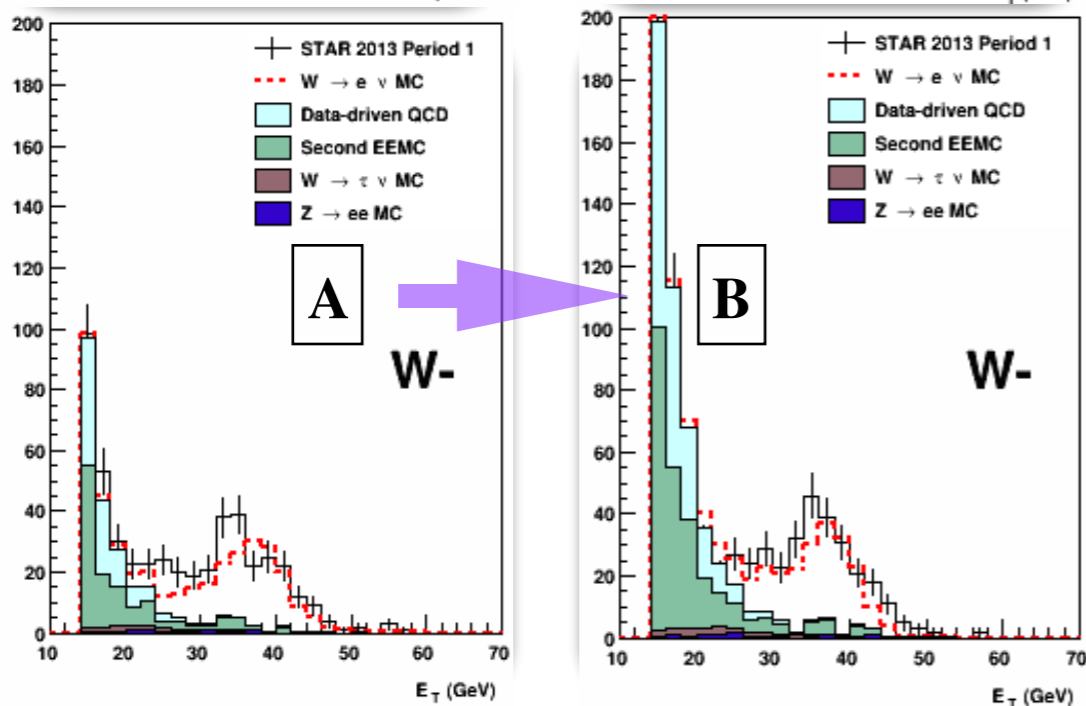
- ❖ So far there has been **NO pp500 GeV BEMC calibration** done at STAR.
- ❖ Run 12 W analysis used run 9 pp200 GeV calibration done by Matt Walker and others.
- ❖ The total **integrated luminosity** is increased from run 9 to **run 12** by factor of **6** and to **run 13** by factor of **19**.
- ❖ An **updated calorimeter calibration** is clearly **needed** several years after the last calibration was done for the release of preliminary and in particular published results.
- ❖ Run 12 pp200 GeV calibration recently completed by Kevin and significant gain change from 200 to 500 GeV is expected.
- ❖ In run 13 we observe that the **reconstructed invariant Z mass peak** is shifted by **~ 4.6%** towards low mass compare to embedded MC.
- ❖ Reconstructed **W Jacobean Peak position** in **run 13 data** sample (both period 1 and 2) is **shifted** compared to embedded MC and run 12 data.

Fudge-Factor

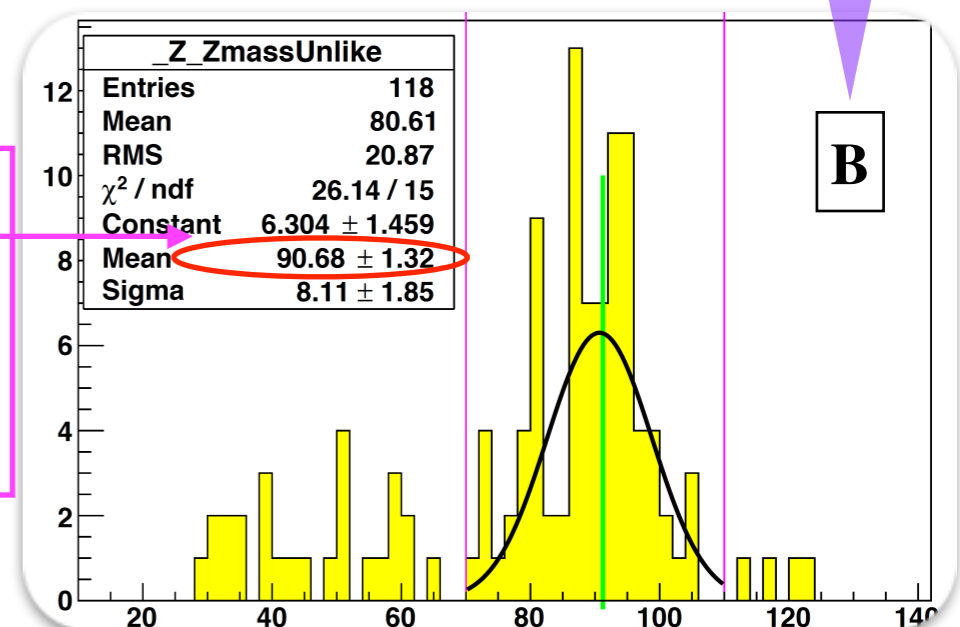
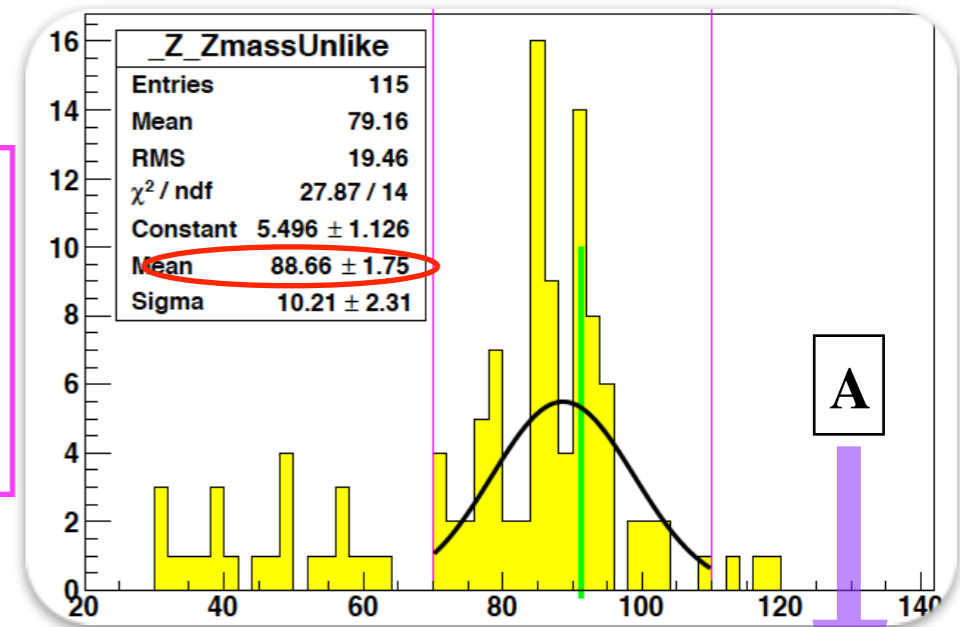
- We applied a fudge factor [=1.03] (estimated based on the W-Jacobian Peak position shift in run 13 compared to MC and run 12) at tower level and reanalyze run 13 data.



data and MC jacobean peaks aline and data-MC discrepancy reduced.



Z - invariant mass peak value is closer to PDG value. (91.1876 GeV)



BEMC CALIBRATION

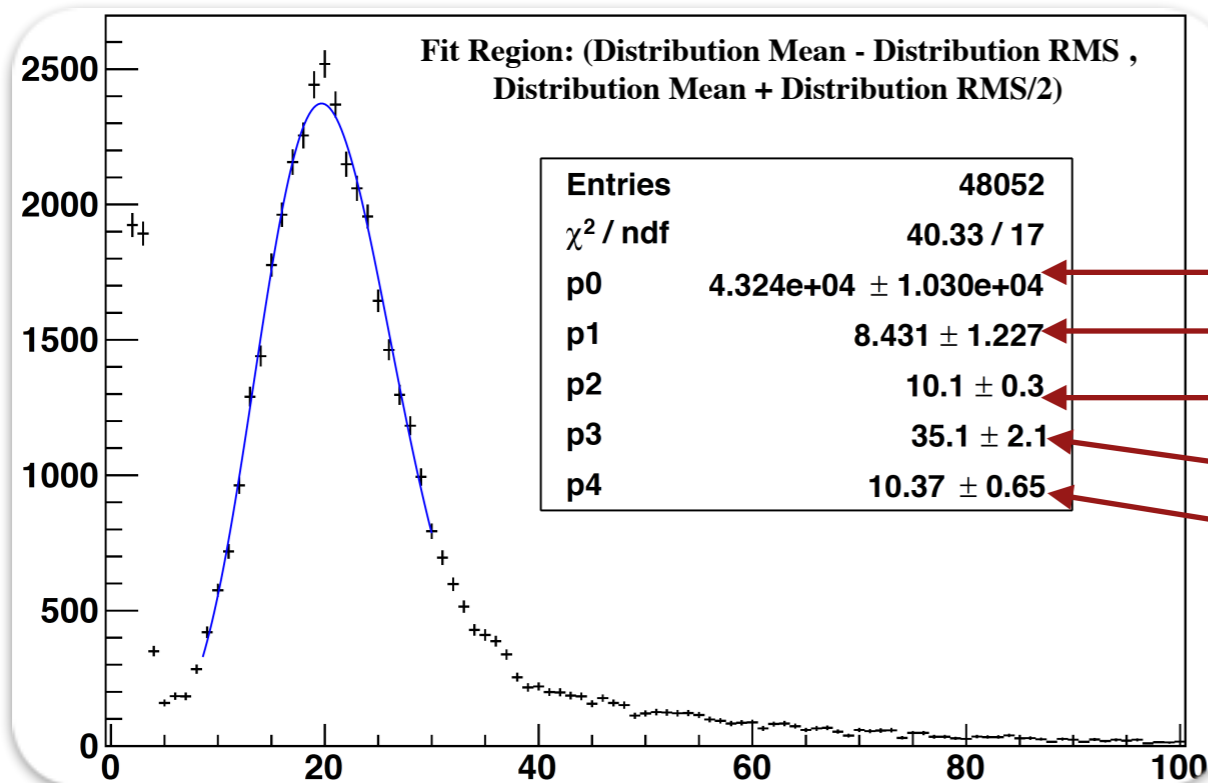
Introduction

- Calibration constants (gain) need to estimate in order to obtain the energy of calorimeter towers. $E = (\text{ADC-ped}) * \text{gain}$
- Best way to calibrate calorimeter towers is to use abundant electrons tracks pointing to each tower. [since e's deposit all of their energy in to the towers with $E/P \sim 1$]
- But we do not have that many e's tower by tower.
- Obtain relative calibration using plenty of MIPs which are available tower by tower.
- Use E/P from electrons to adjust the relative constant and obtain the absolute gain. $\text{gain} = C_{\text{abs}} = C_{\text{rel}} / \langle E/P \rangle$

BEMC CALIBRATION

Relative Calibration : MIPS

- Obtain MIP ADC distribution of each tower.
- Fit it with a function [“gaus*Landau”] which best describe the signal and background regions.
- Obtain the mean of the fit as the MIP ADC value.
- Use the formula to calculate relative calibration constant for each tower.



- Signal region fit with the Gaussian function
- BG is well fit with the landau function

Constant
 Gauss Mean
 Gauss Sigma
 Landau MP value
 Landau sigma

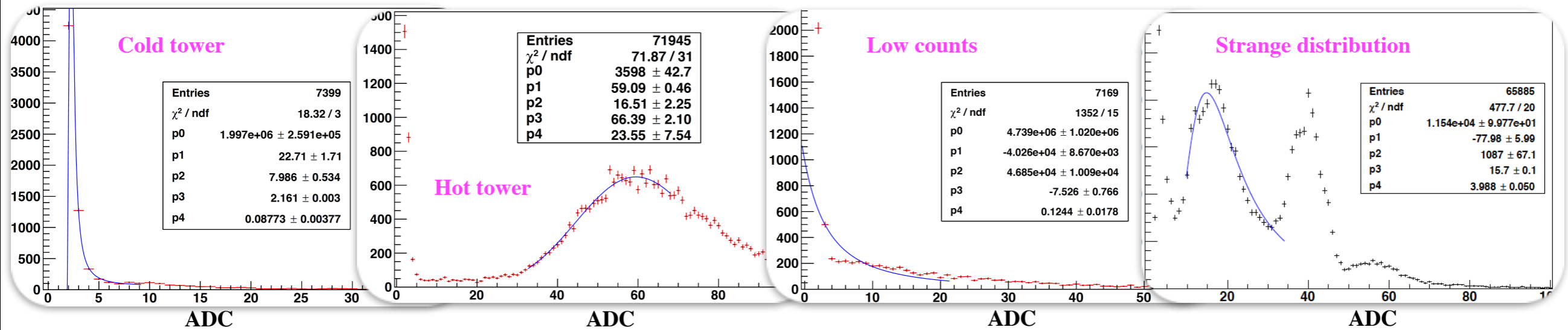
$$C_{relative} = \frac{0.264(1 + 0.056\eta^2)}{ADC_{MIP} \sin(\theta)}$$

MIP-ADC = Mean of the Fit function

$$([p0]*\text{gaus}(x,[p1],[p2])*Landau(x,[p3],[p4]))$$

BEMC CALIBRATION

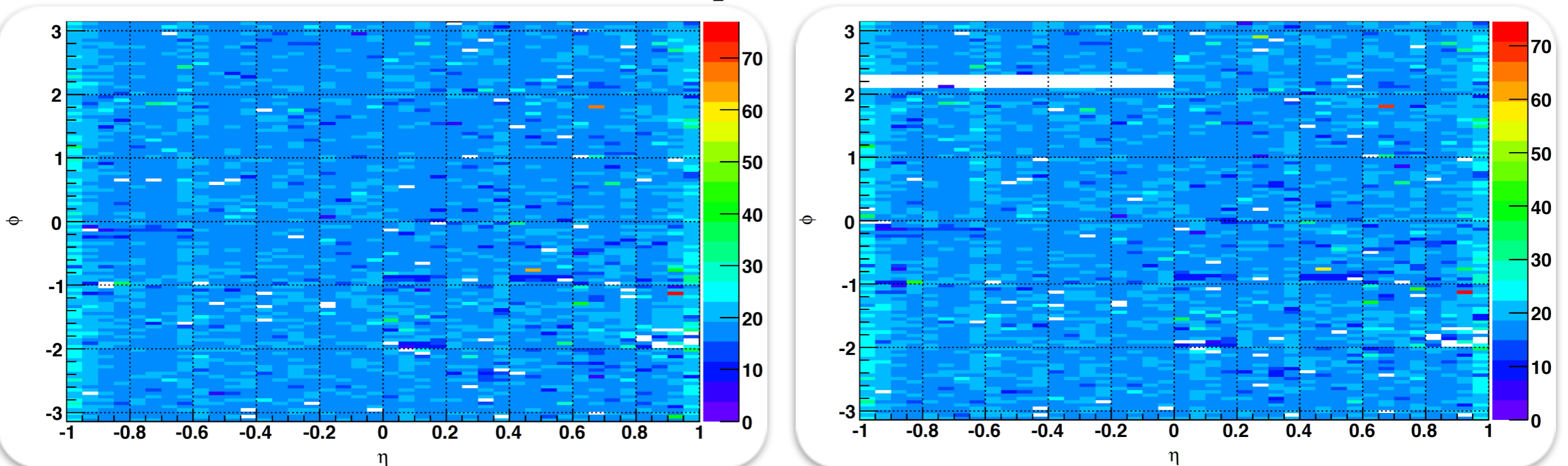
Relative Calibration : Tower QA



Period 1

Eta-Phi map of tower MIP-ADCs

Period 2

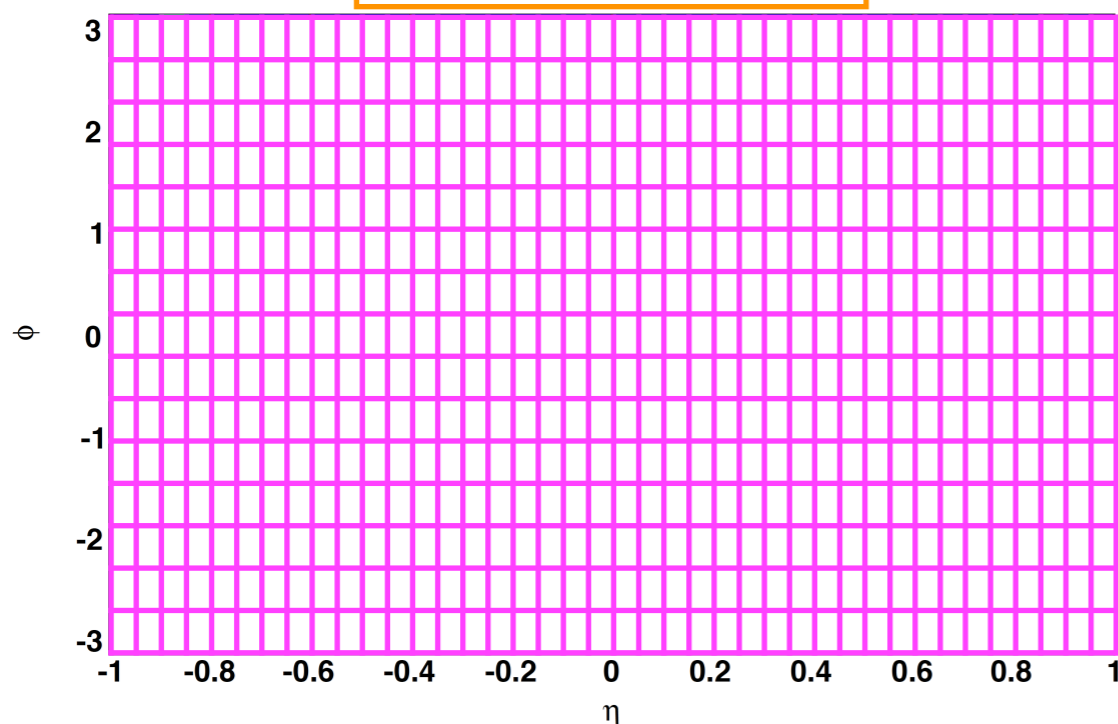


BEMC CALIBRATION

Absolute Calibration : Electrons

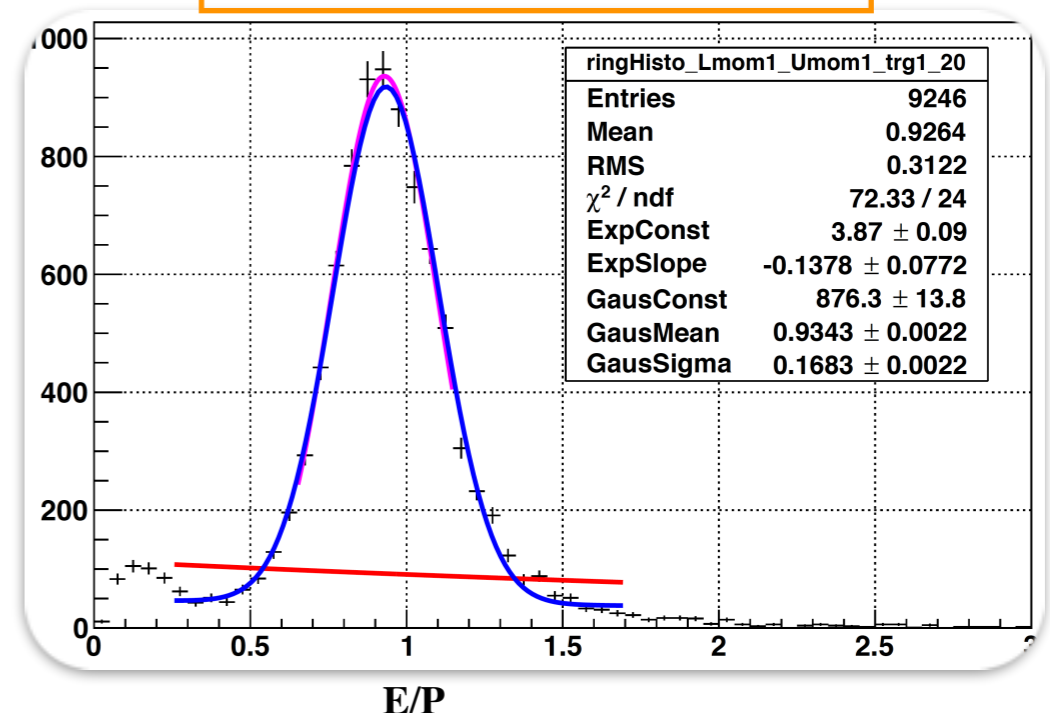
- We use e's tracks that pointed to calorimeter towers to obtain E/P value.
- Group e's by eta rings (120 towers at same eta) and crate slices. (8 towers in each crate in same eta).
- Use HT trigger options to get E/P distribution in each eta ring and Fit with appropriate fitting function.
- Extract mean E/P value from the fit function.

BEMC detector 2D eta phi slices



Fit Function : "gaus+expo"

typical e's E/P distribution of inner eta ring

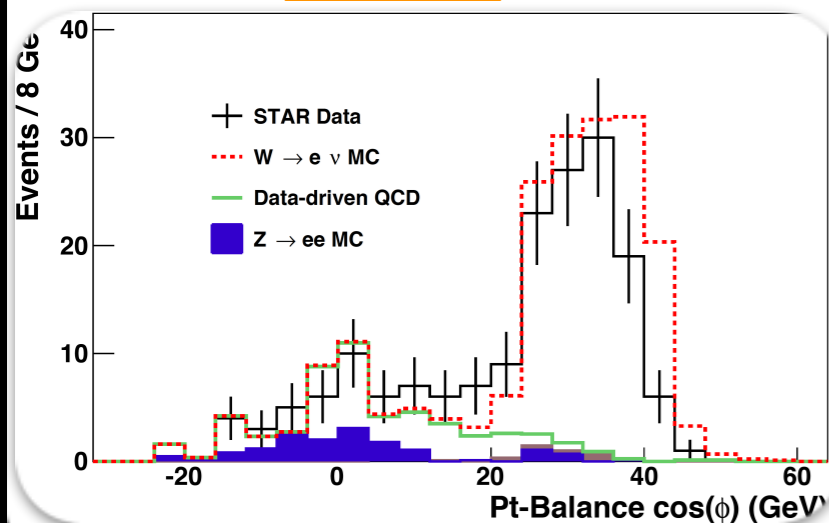


FORWARD RAPIDITY W_{A_L} ANALYSIS

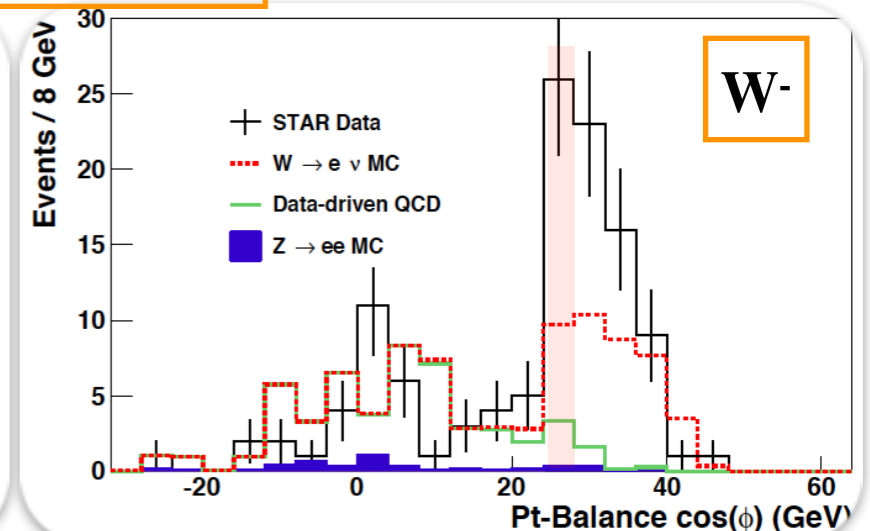
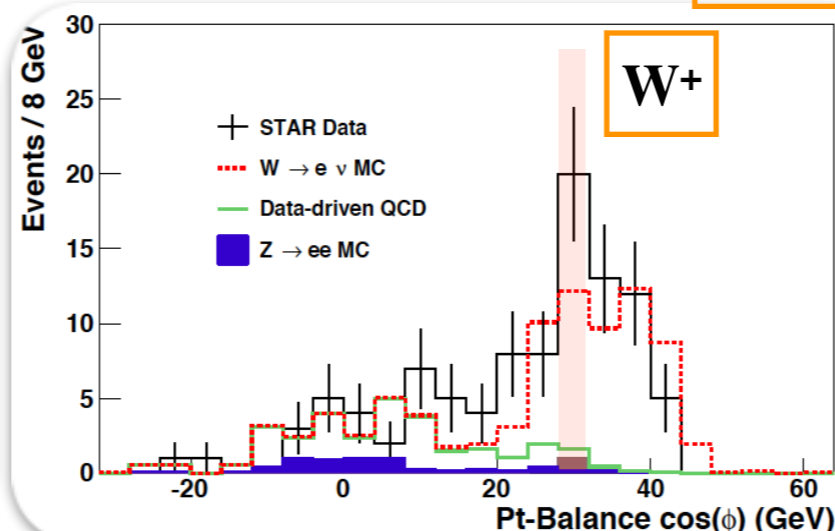
REQUIREMENT

- Forward/backward regions more sensitive to flavor separation, but low cross section.
- Detectors performance get worse: less TPC hits, Unstable Endcap EMC.
- Discrepancy between Data and Embedding get worse than Run 12.
- Similar Endcap tower gain calibration issue with Barrel ??

Run 12



Run 13- Period 1

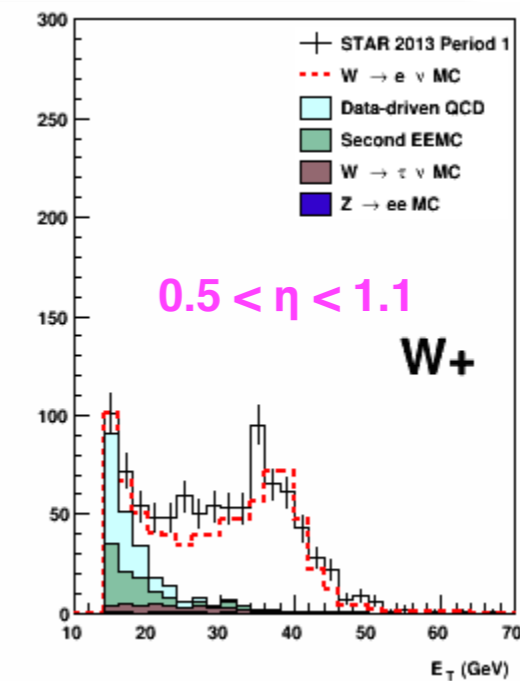
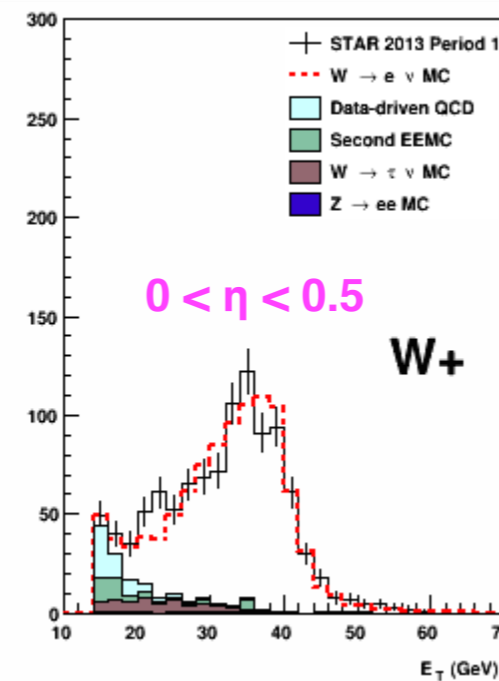
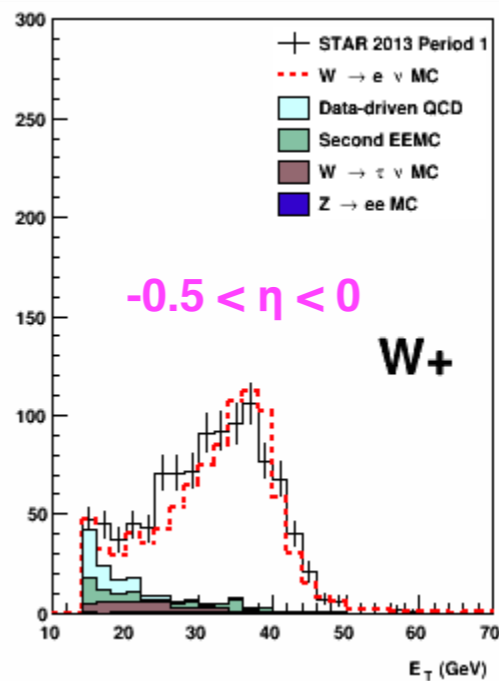
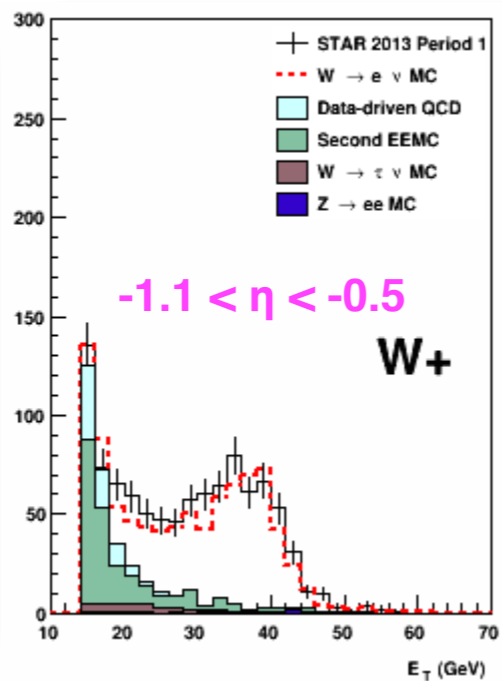
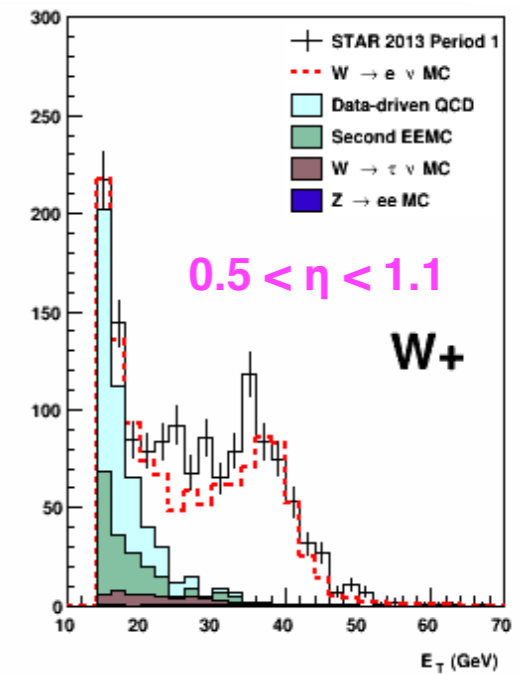
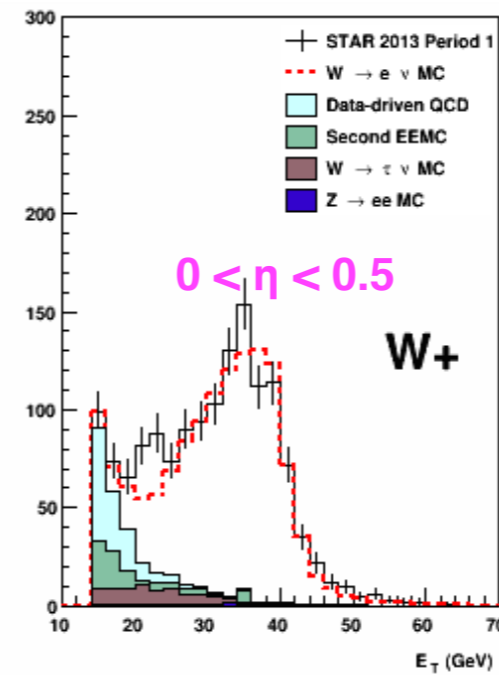
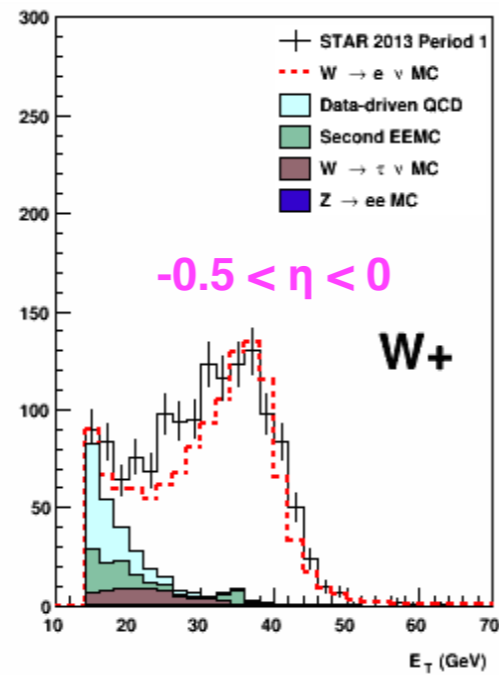
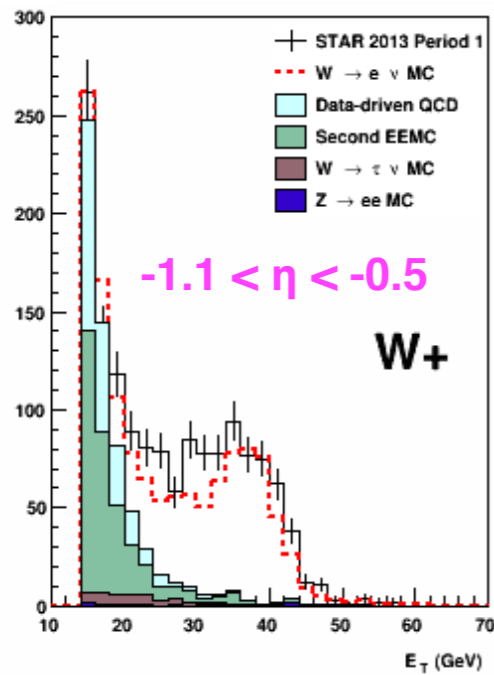


SUMMARY

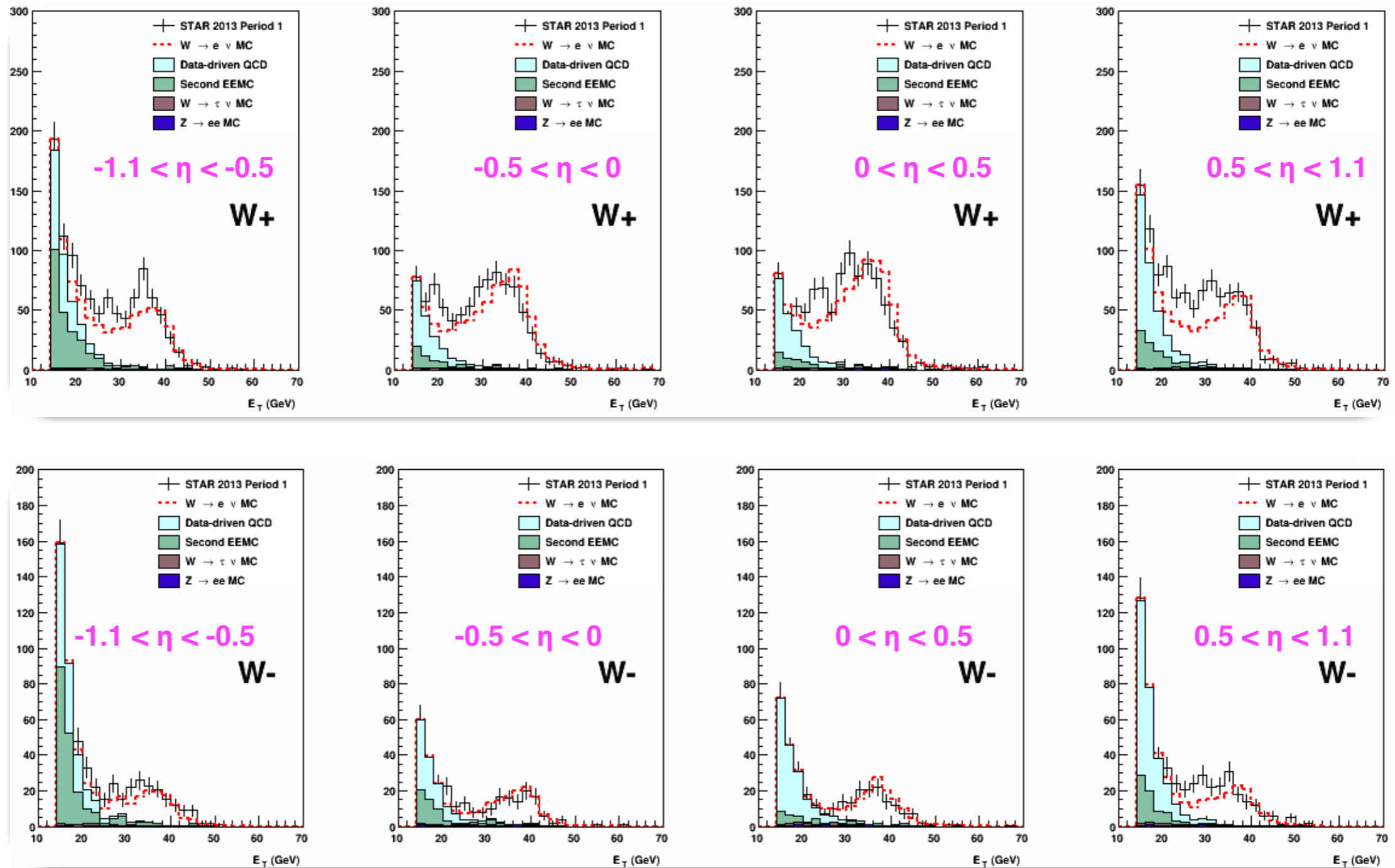
- Still trying to improve Data/MC agreement.
- Focusing on BEMC calibration, several issues in discussion.
- Improve ENDCAP analysis, (New calibration??)
- Release preliminary A_L results, BARREL+ENDCAP.
- Separated analysis using FGT is ongoing and will release separated preliminary result.

BACK UP

BG 4 ETA BINS- PERIOD 1

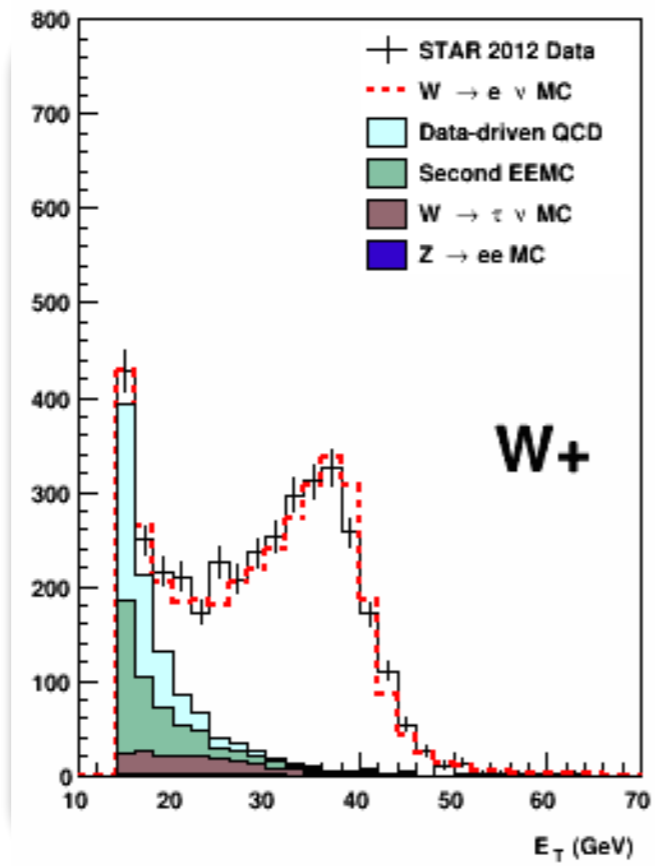


BG 4 ETA BINS- PERIOD 2

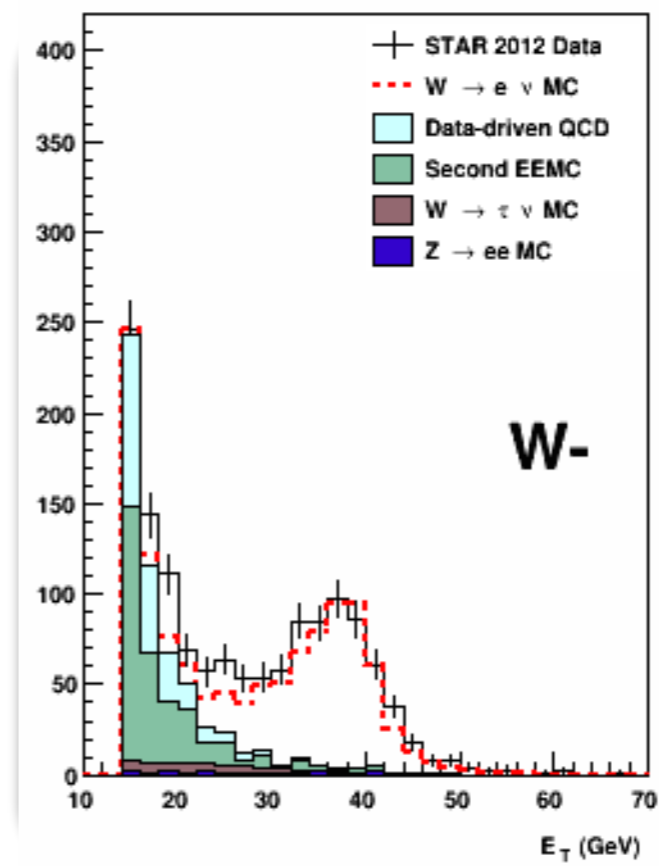


RUN 12 BG

$-1.1 < \eta < 1.1$

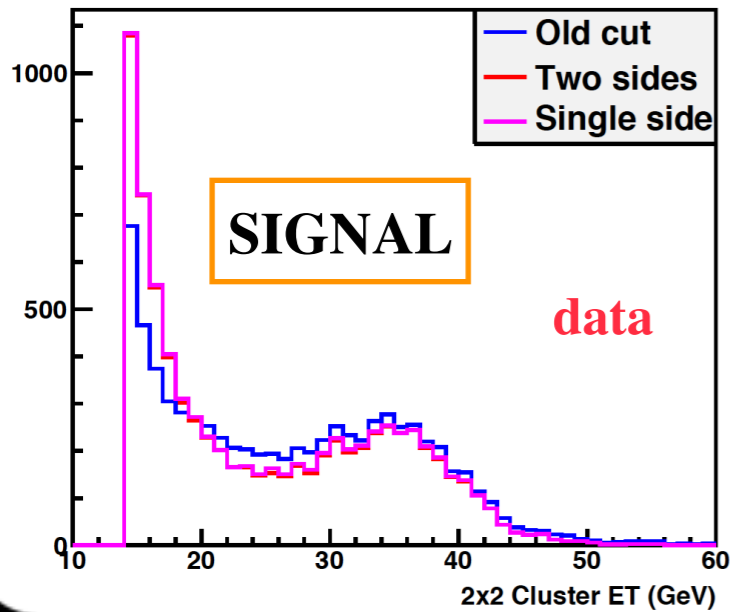


$-1.1 < \eta < 1.1$

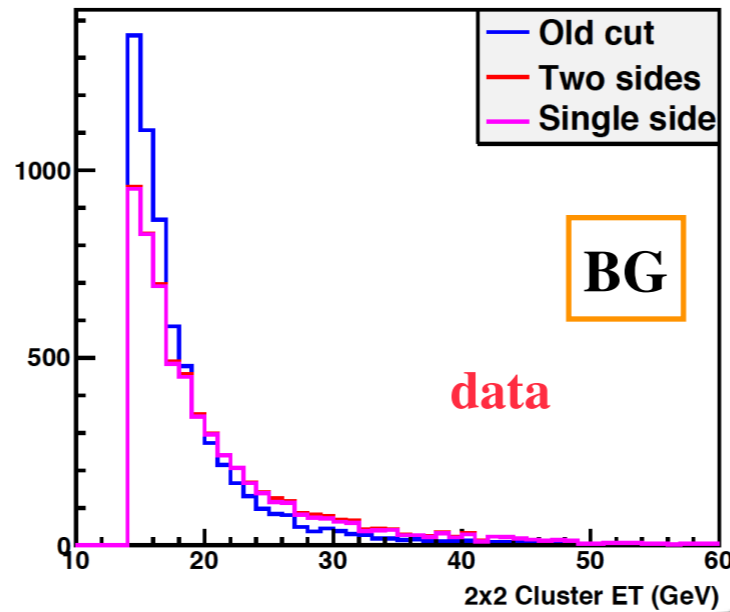


Modified-signPT cut-MC

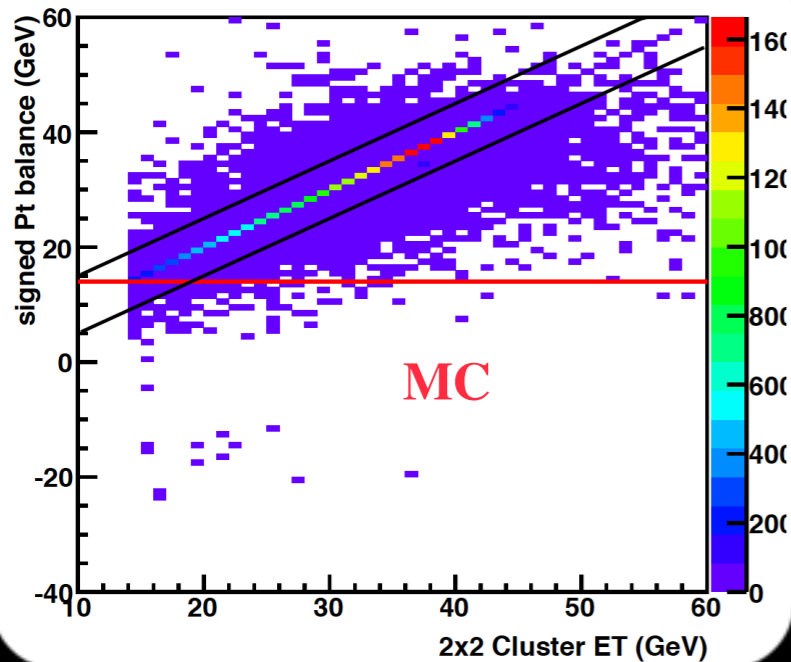
Raw signal from different signed PTbalance Cuts



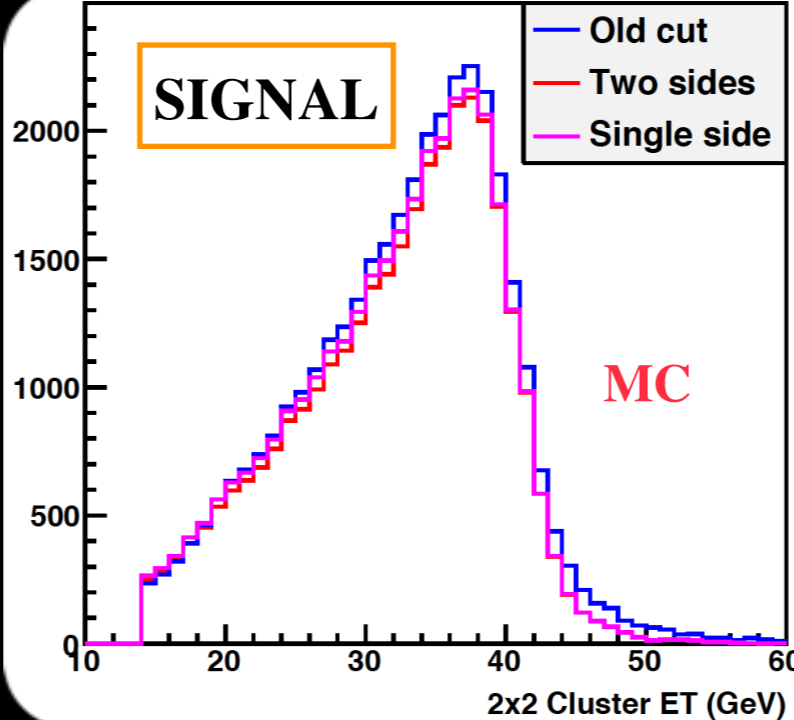
QCD background from different Signed PTbalance cuts



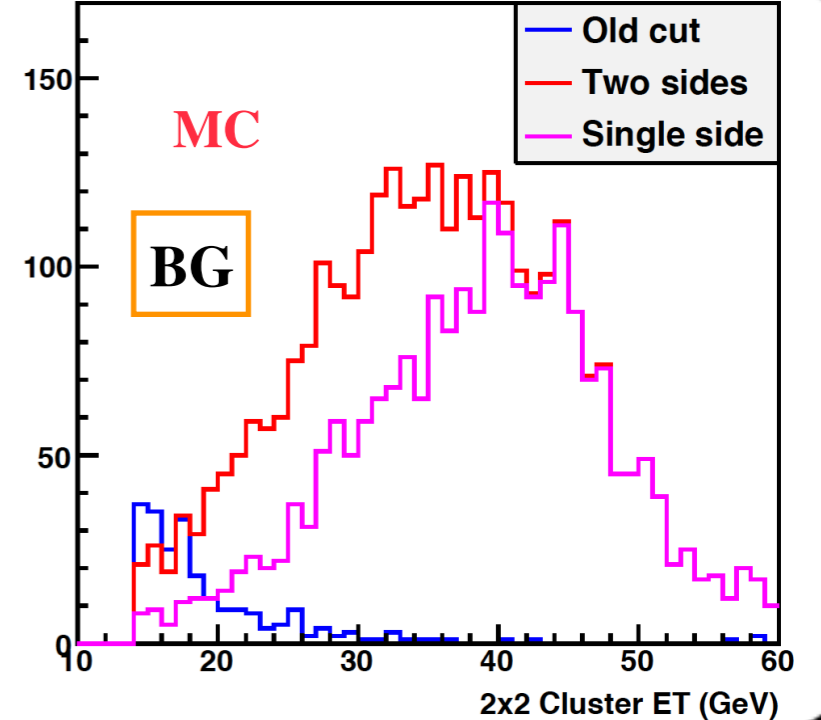
Barrel: sPtBalance vs cluster ET

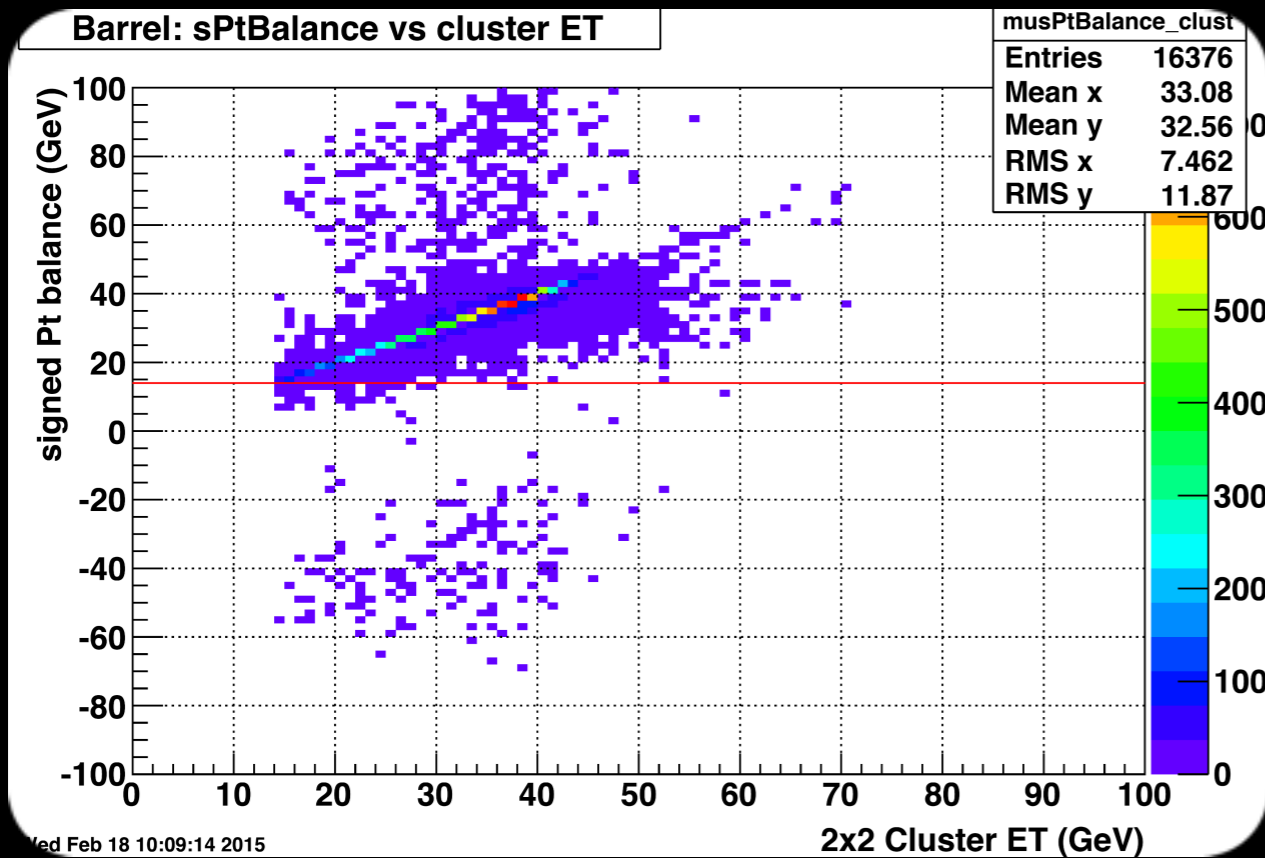


SIGNAL

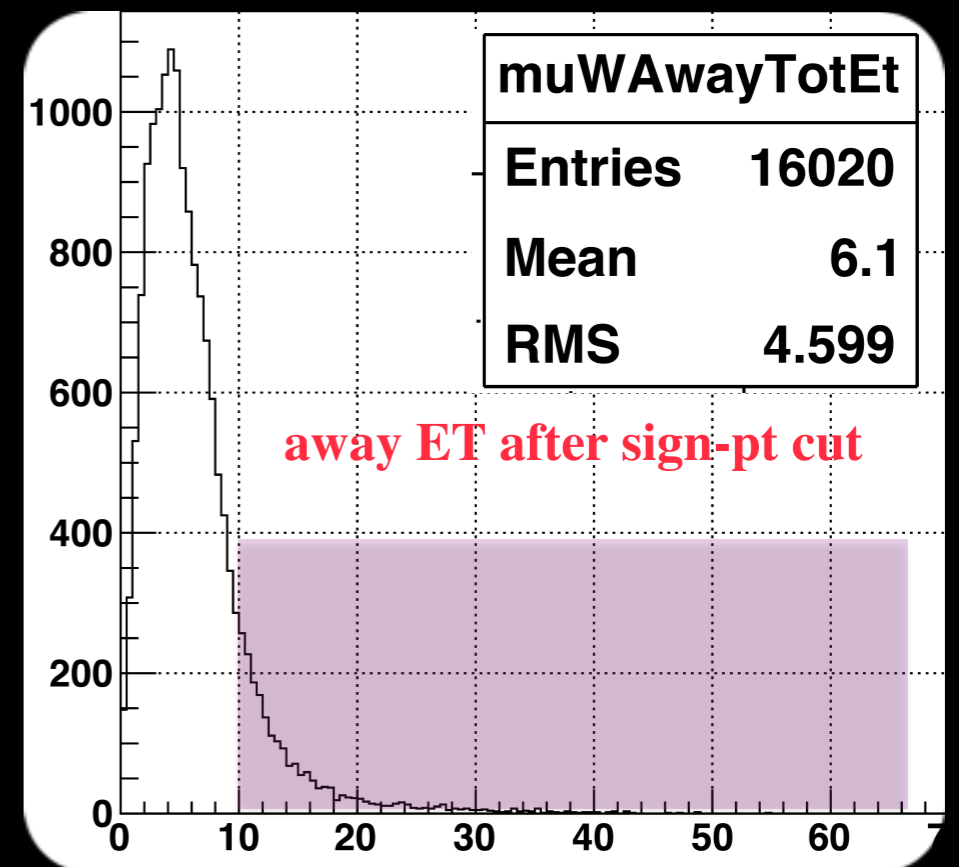
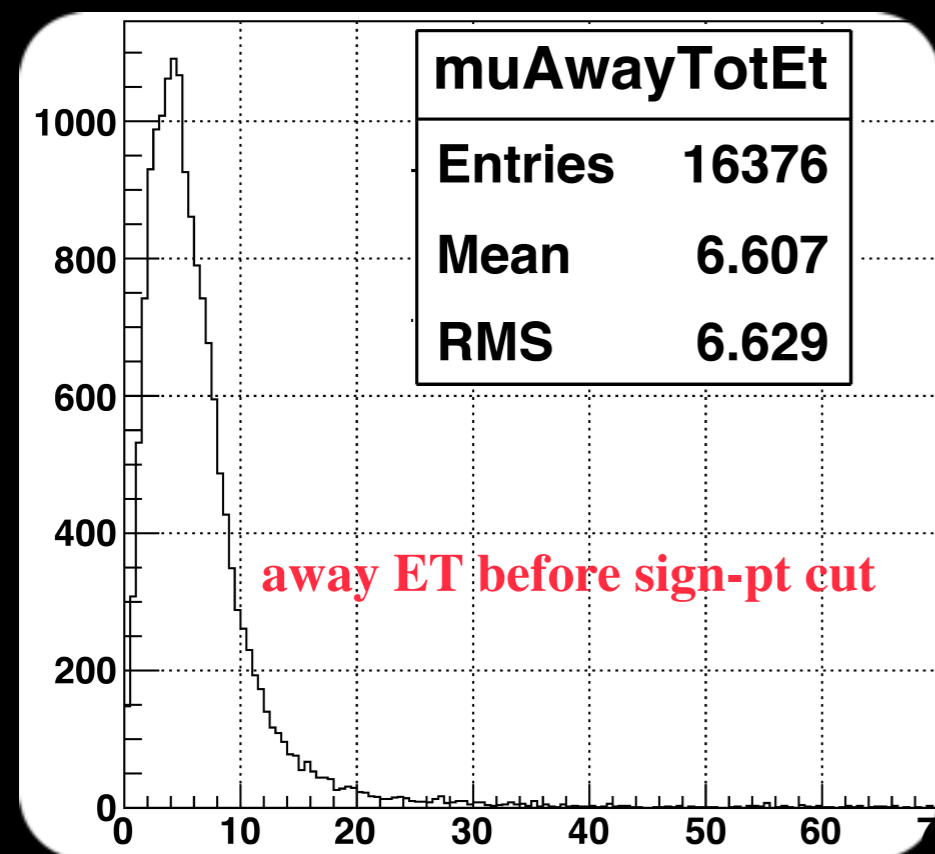


MC





awayET cut -
MC



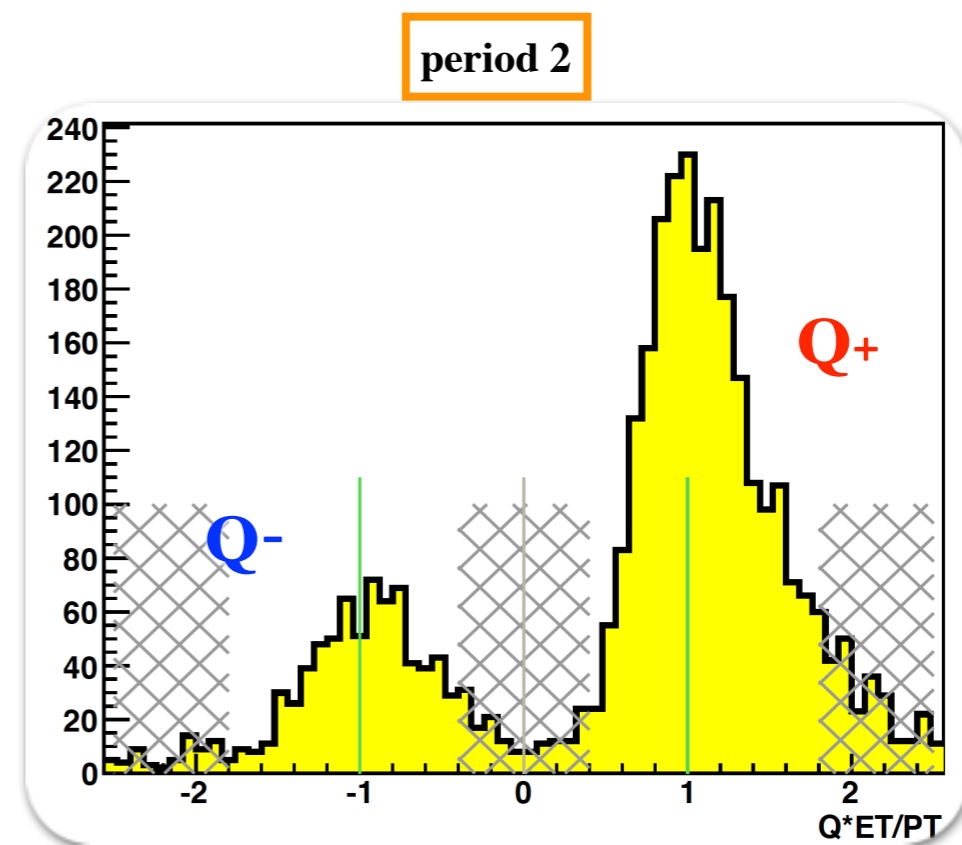
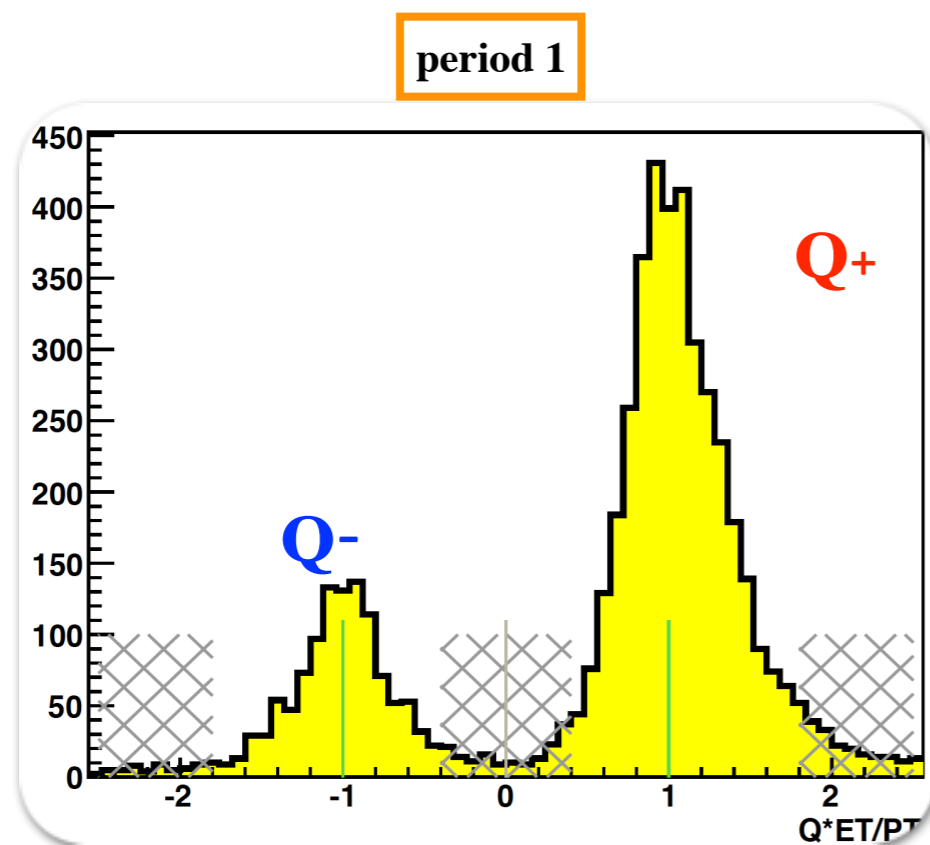
MIP Cuts

- Vertex Rank $> 1e6$
- $|\text{vertex-Z}| < 30$ cm
- only one track per tower per event
- Track momentum > 1 GeV/c
- (ADC-ped) > 1.5 ped RMS
- Track must enter and exit the same tower
- Highest E neighboring tower in 3x3 cluster < 2 GeV

CALIBRATION OF TPC

TPC

- TPC calibration is completed for both period 1 and period 2.



PERIOD 2 ENDCAP BG

