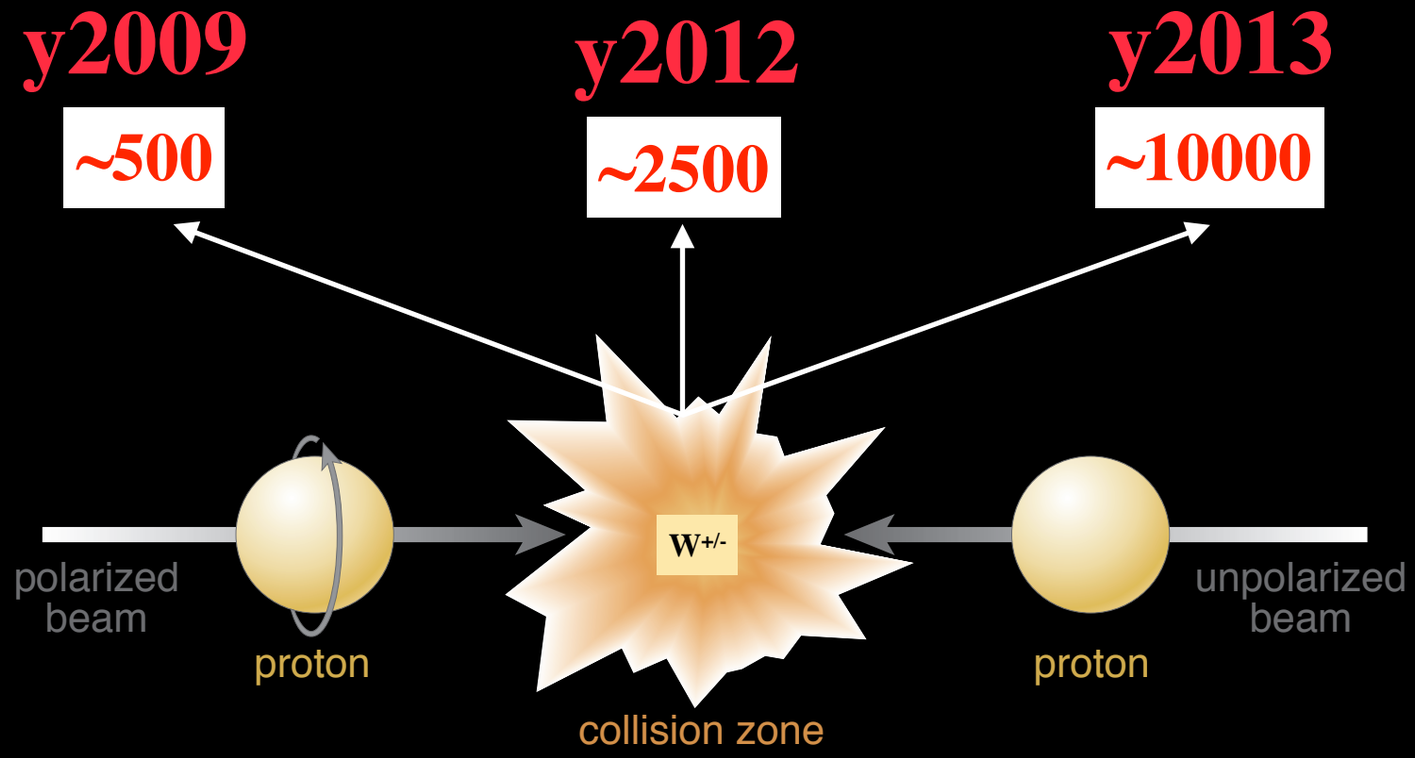
RUN 13 W A_L ANALYSIS

Devika & Jinlong



OUTLINE

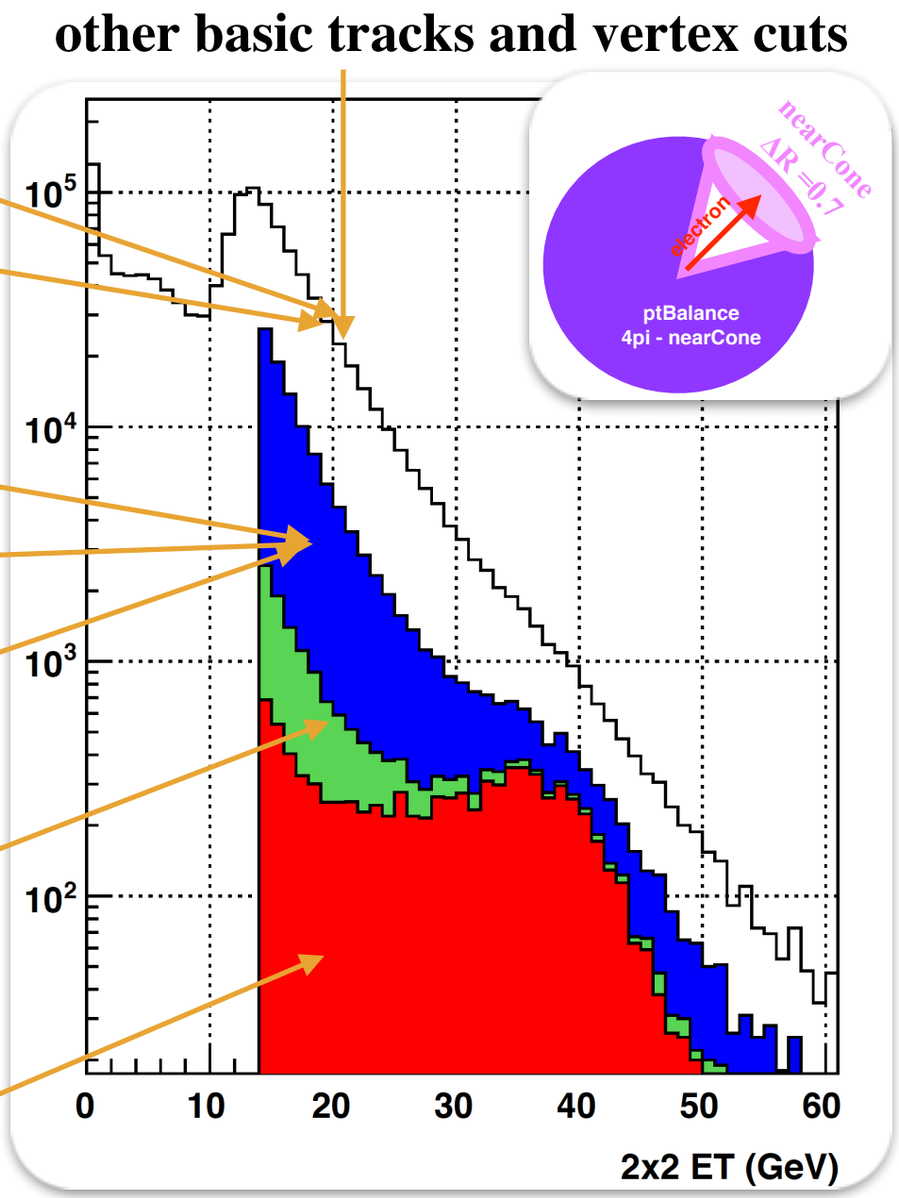
- Overview of Current Status
- Analysis Cuts
- Background Estimation
- BEMC Calibration
- Summary / Future Plans

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

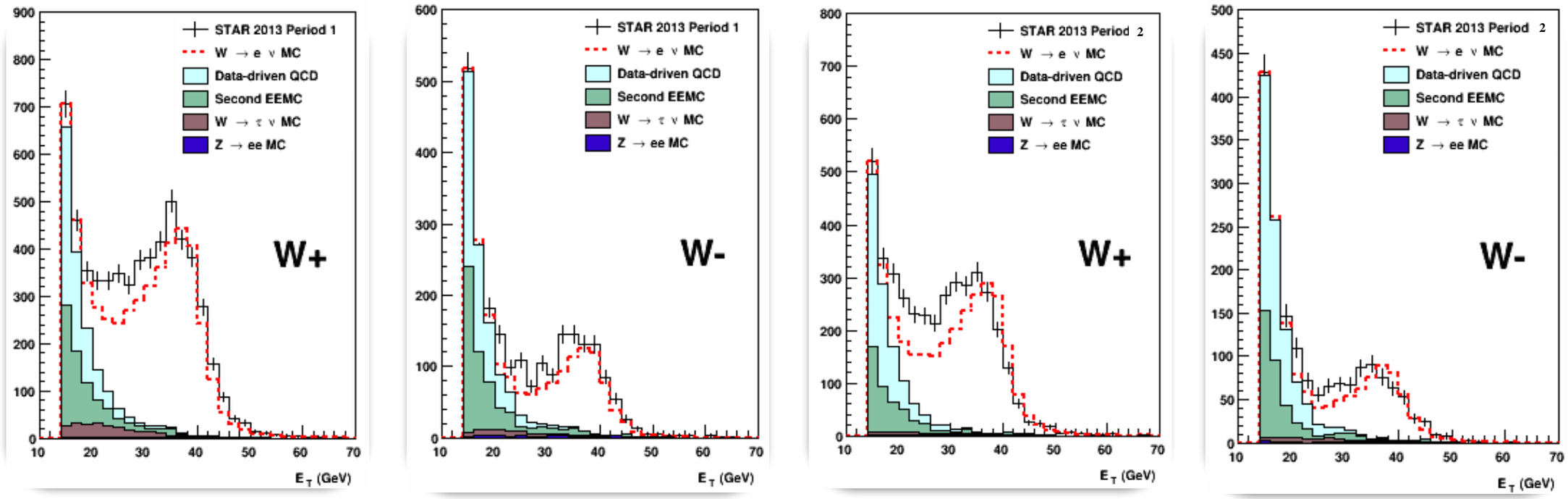
- $|Z_{vertex}| < 100$ cm
- track $P_T > 10$ GeV
- $E_{T\ (2x2)} > 14$ GeV
- $E_{T\ (2x2\ /\ 4x4)} > 95\ \%$
- $\Delta d_{\ (track\text{-}cluster)} < 7$ cm
- $E_{T\ (2x2\ /\ nearCone)} > 88\ \%$
- sign-pt balance > 14 GeV



BACKGROUND ESTIMATION

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

Period 1 **Period 2**

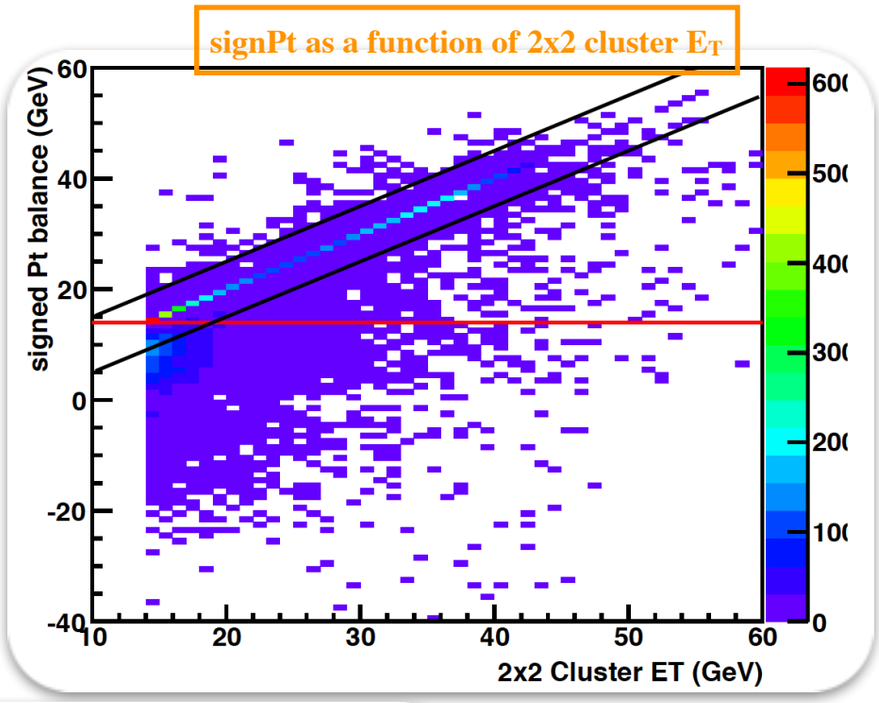


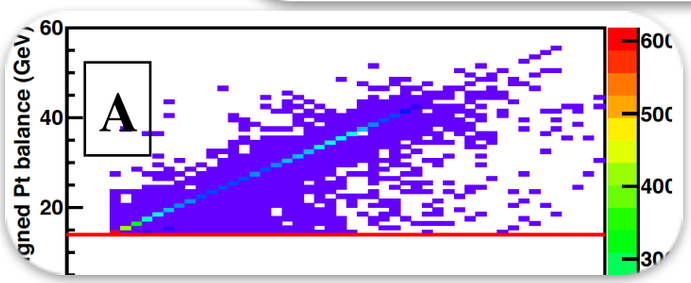
-1.1 < η < -1.1 -1.1 < η < -1.1

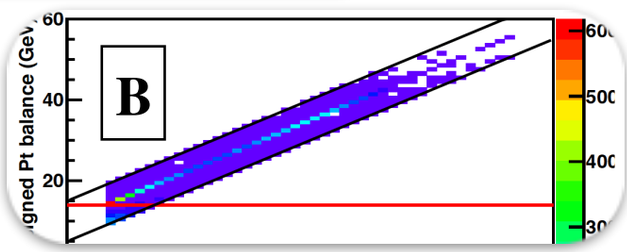
- **Large discrepancy between Data and MC.**
  - **Optimizing W-selection cuts.**
    - **Modified sign-pt balance cut.**
    - **Away E_T cut.**
  - **500 GeV BEMC calibration.**

OPTIMIZING W SELECTION CUTS

Modified sing-pt balance cut

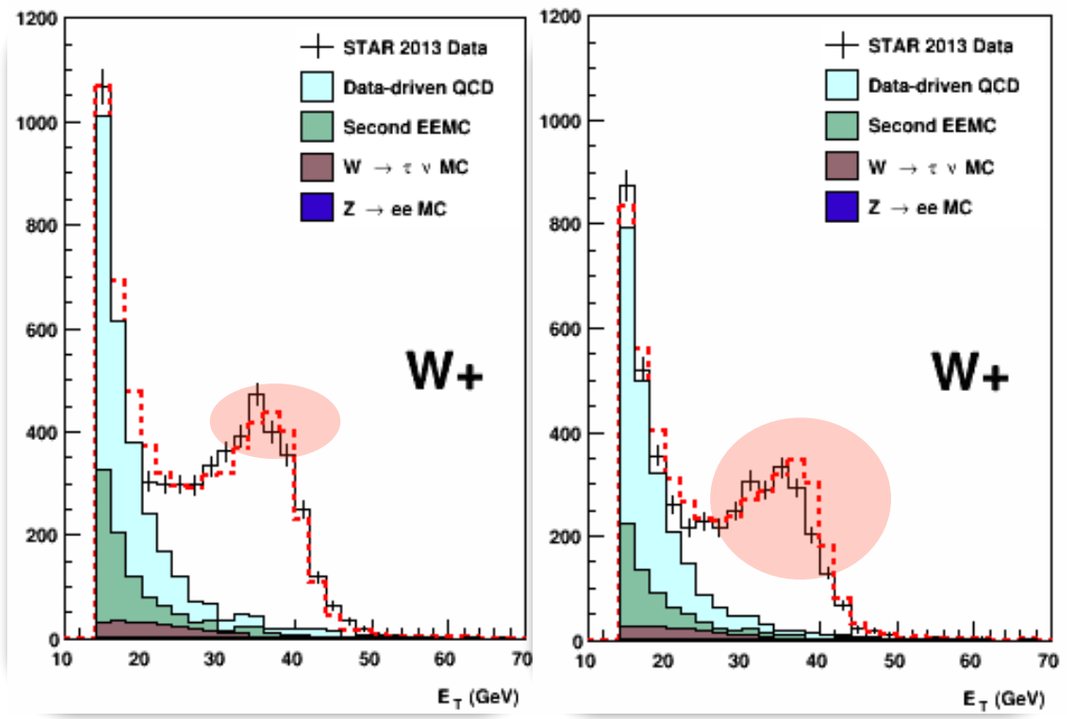


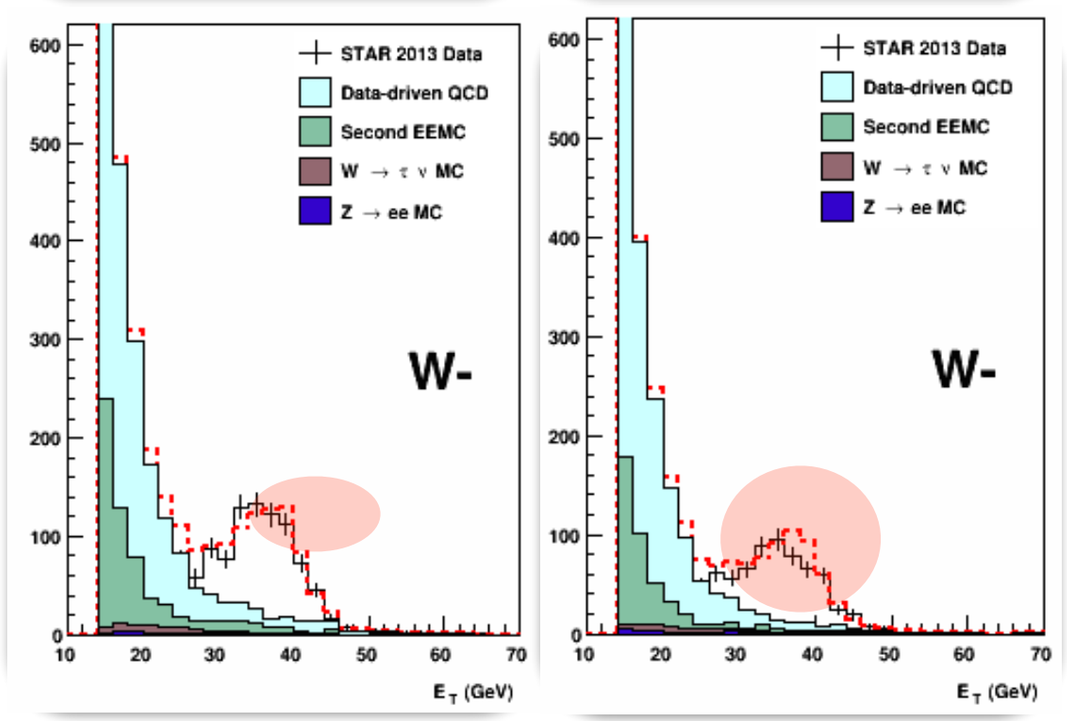




- **Significant reduction of data MC discrepancy.**
- **Not very well agree in low ET bins (below 20 GeV).**
- **Does not consist at the W-Jacobean peak position.**

Period 1 **Period 2**

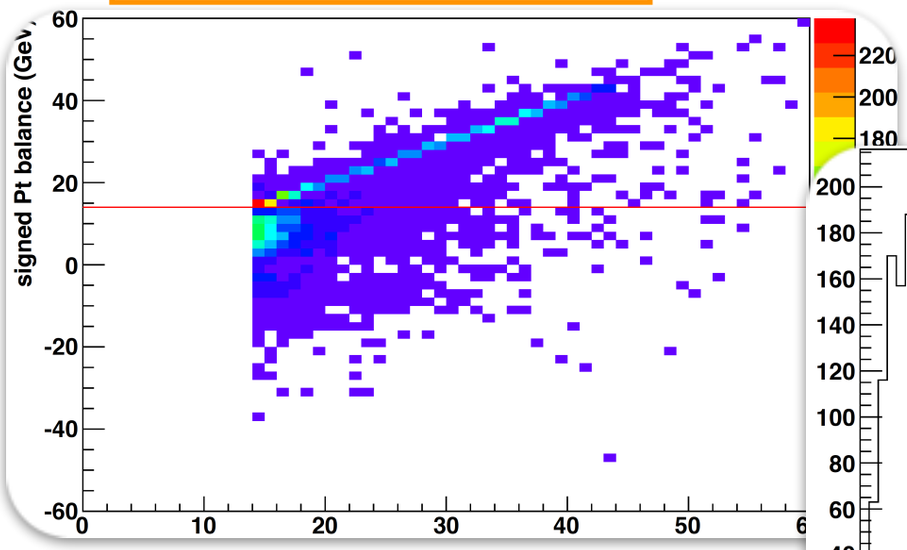




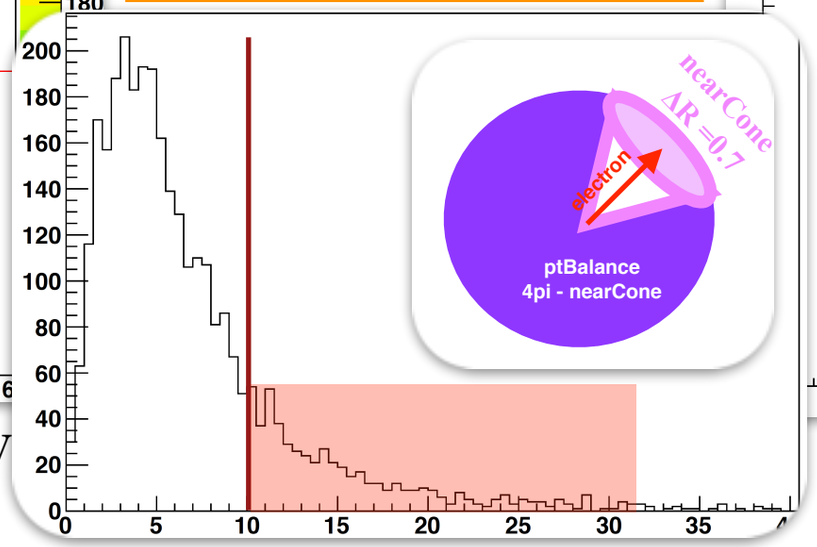
OPTIMIZING W SELECTION CUTS

Away ET cut

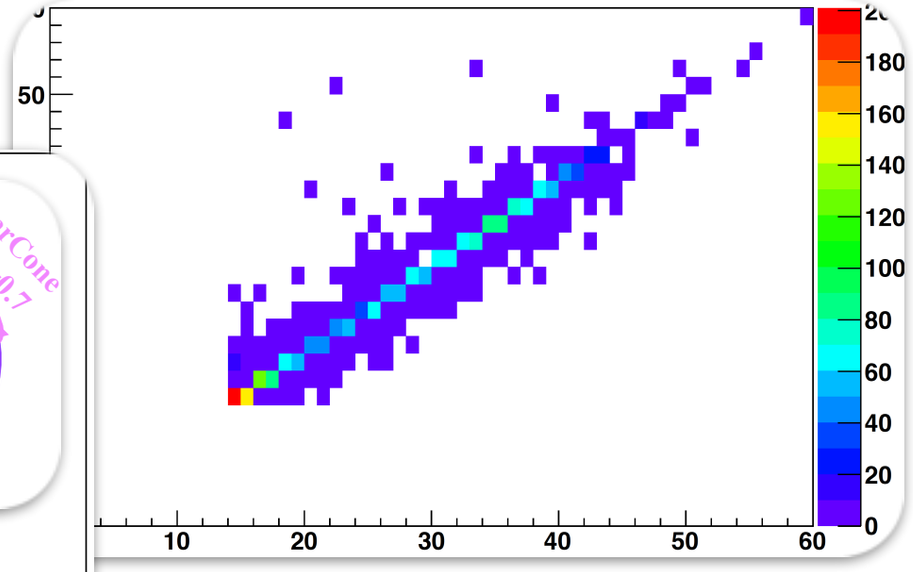
signPt as a function of 2x2 cluster E_T

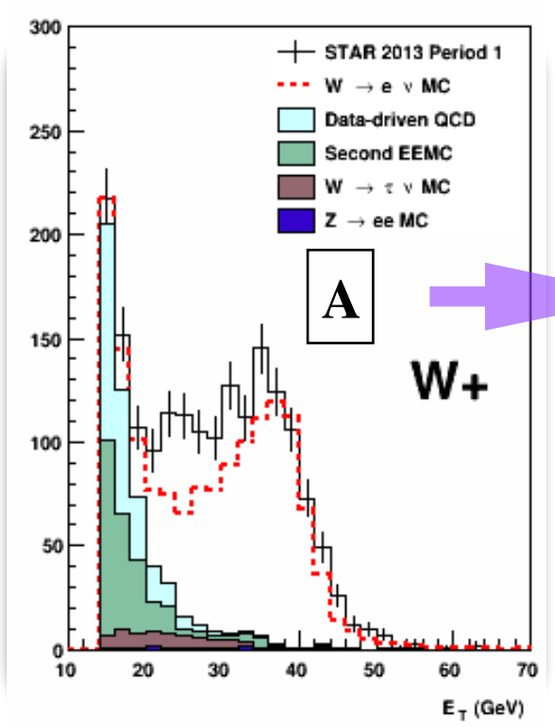


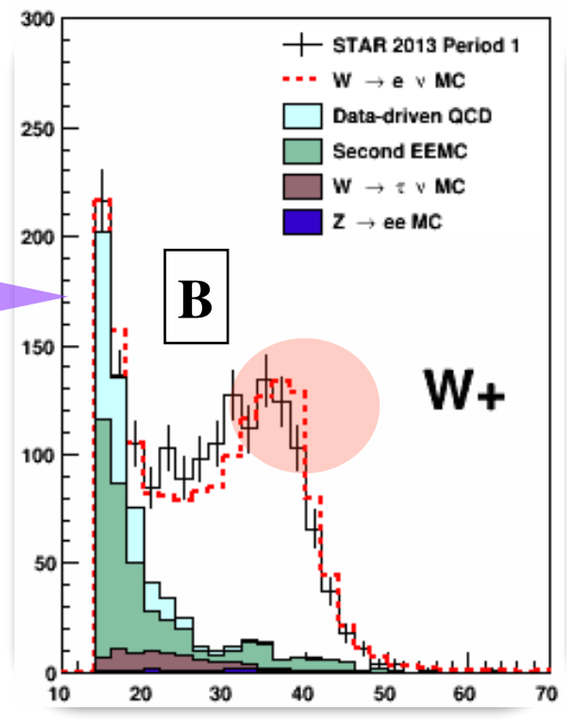
Away E_T of events which pass the sign pt balance cut



signPt as a function of 2x2 cluster E_T







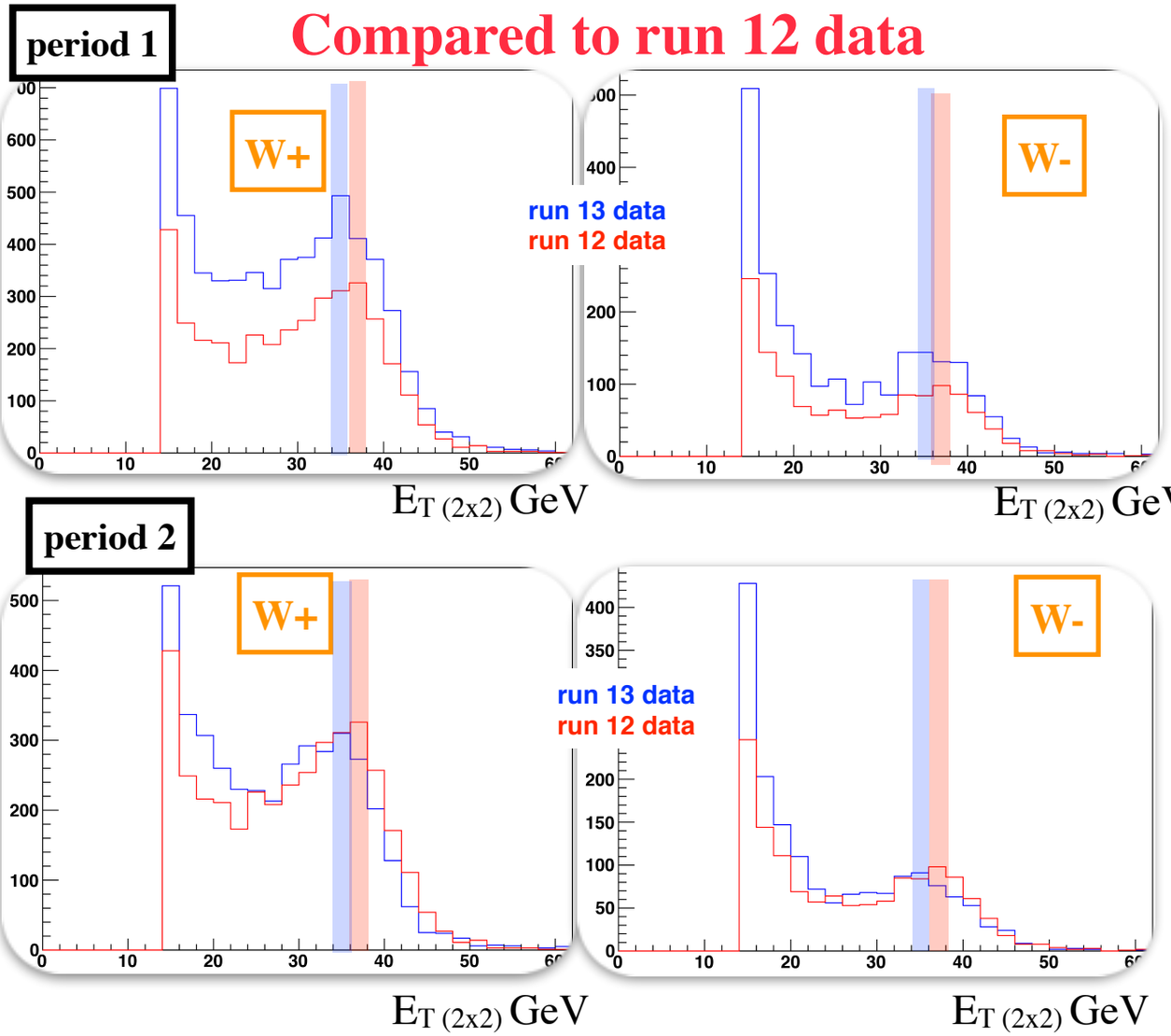
- **Similar to modified sign-pt cut.**
- **Significant reduction of data MC discrepancy.**
- **Does not consist at the W-Jacobean peak position.**

W-Jacobean Peak Position

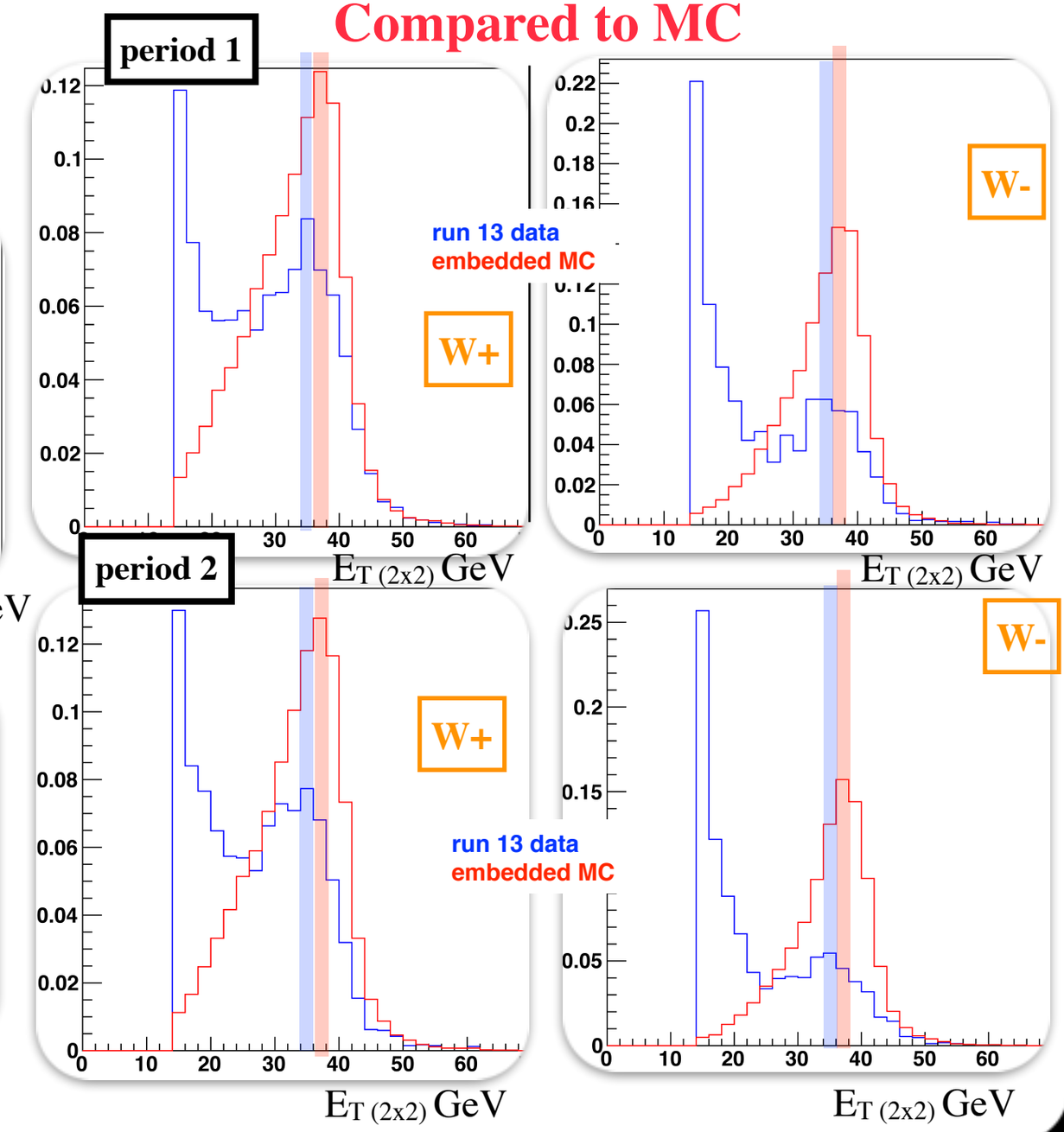
- **W-Jacobean peak position of run 13 data is shifted towards lower ET compared to Embedded MC and run12 data.**
- **This indicated the low gains in the BEMC tower calibration.**

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

Compared to run 12 data



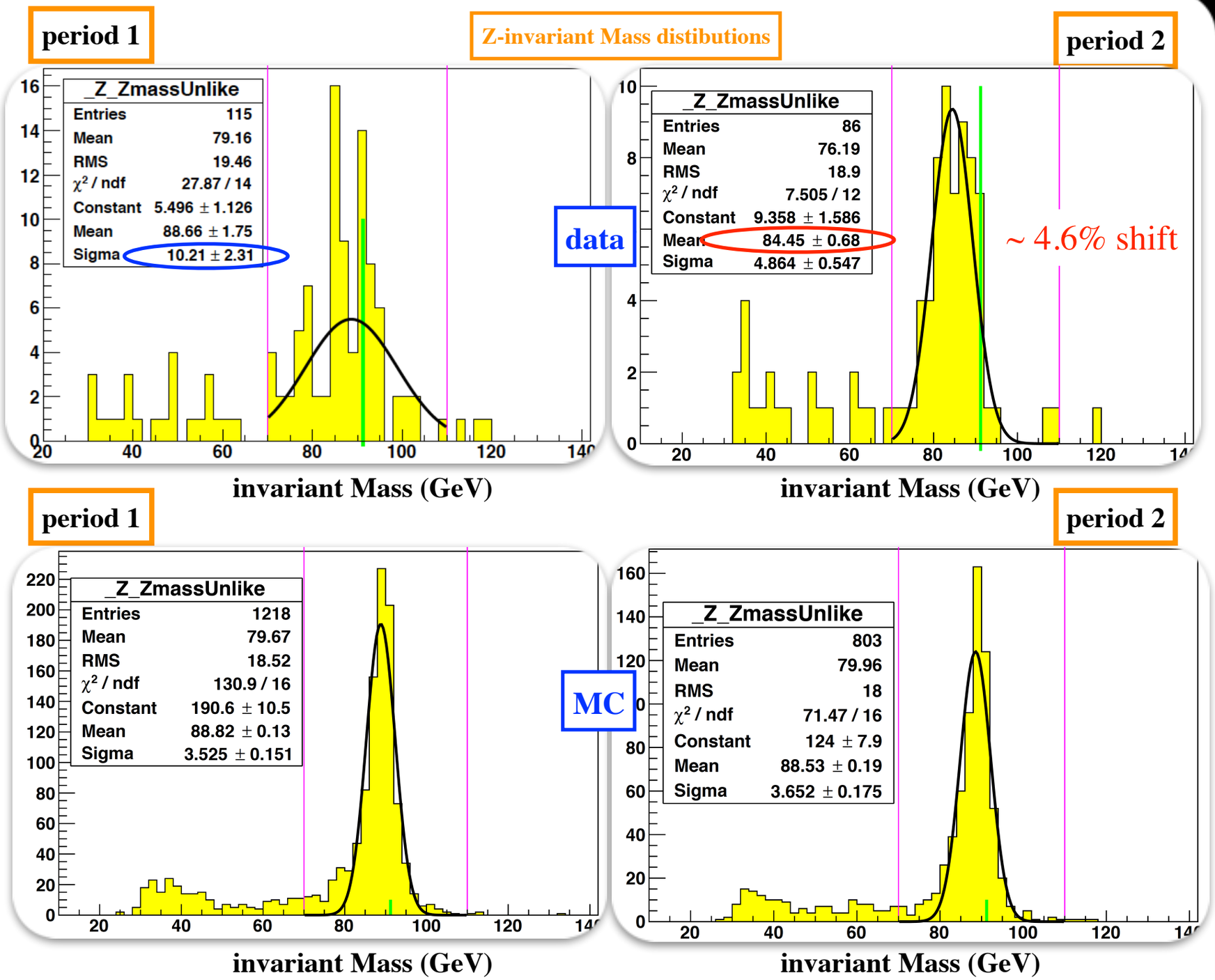
Compared to MC



Z-invariant Mass Peak Position

PDG : 91.1876 GeV

- **Run 13 data shows overall ~2% shift in Z invariant mass Peak.**
- **Another indication of low gains in BEMC tower calibration.**

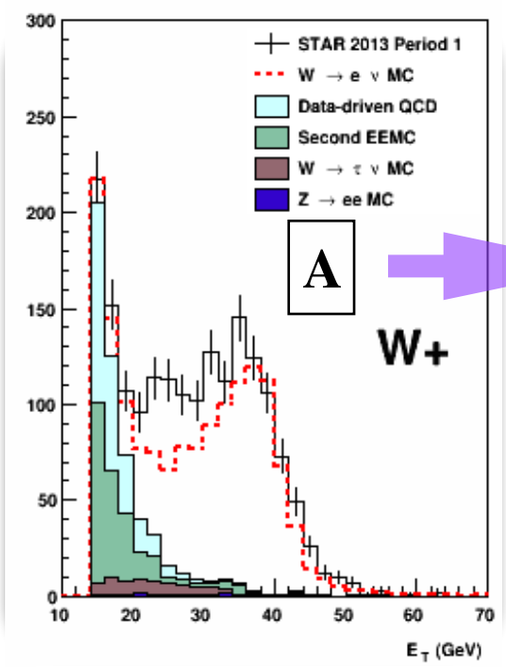


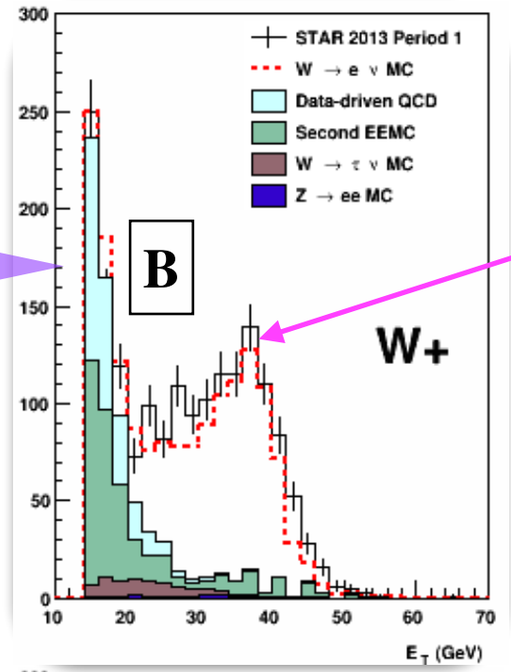
WHY WE NEED Run 13 BEMC Calibration??

- 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.

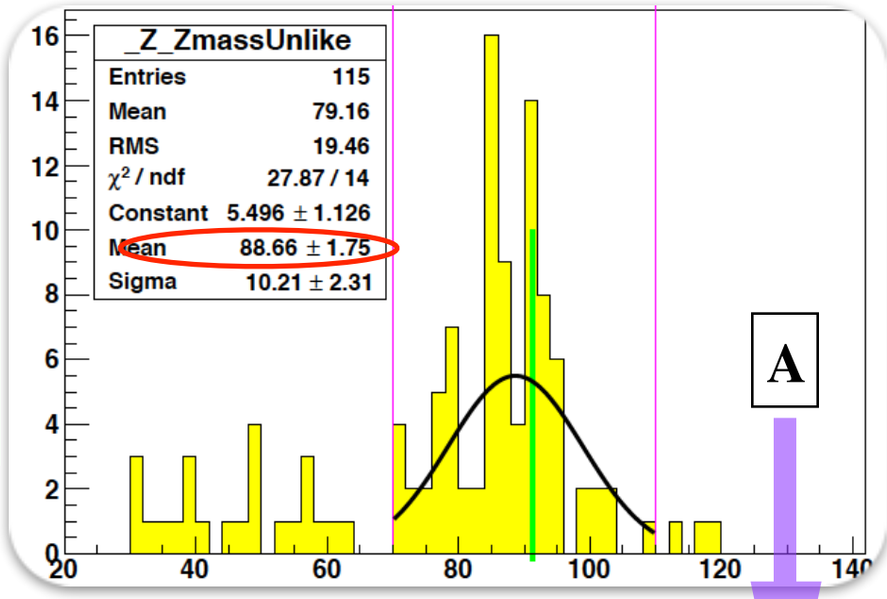
Fudge-Factor

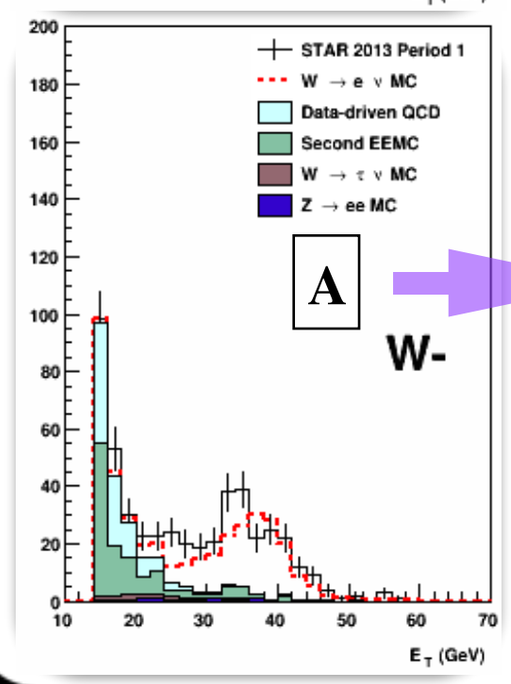
- **We applied a fudge factor [=1.03] (estimated based on the W-Jacobean Peak position shift in run 13 compared to MC and run 12) at tower level and reanalyze run 13 data.**

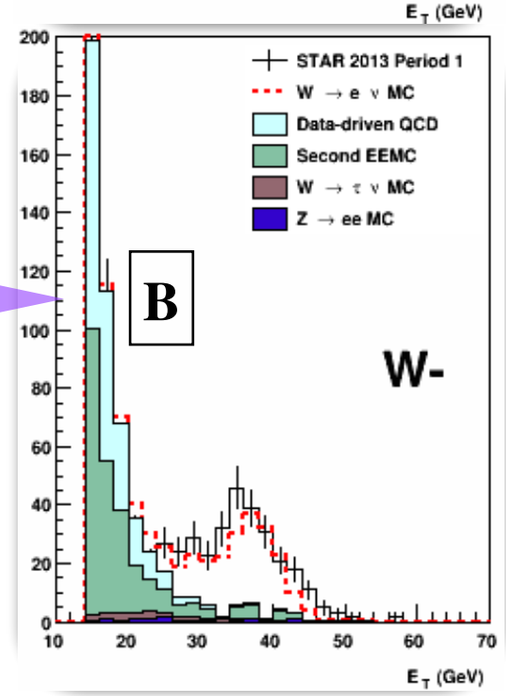




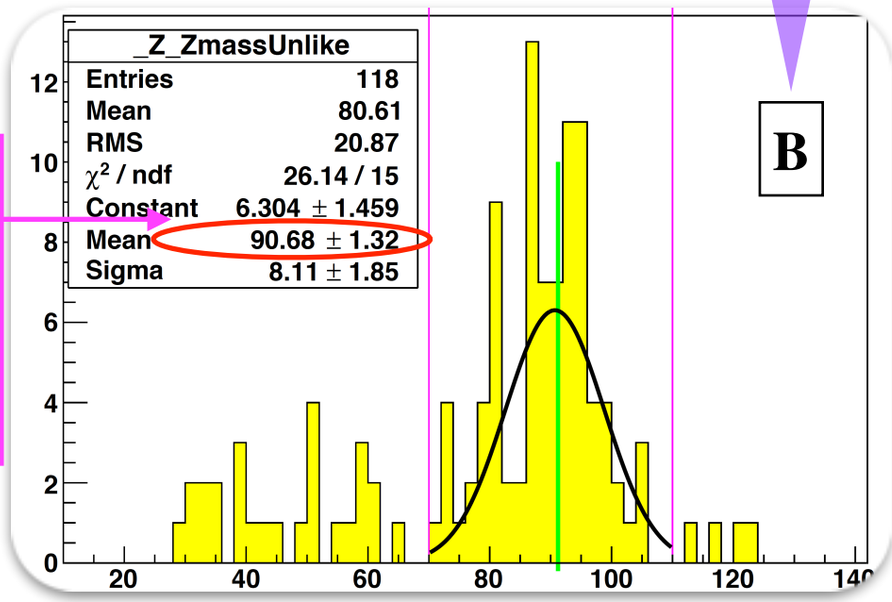
data and MC jacobean peaks aline and data-MC discrepancy reduced.







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



BEMC CALIBRATION

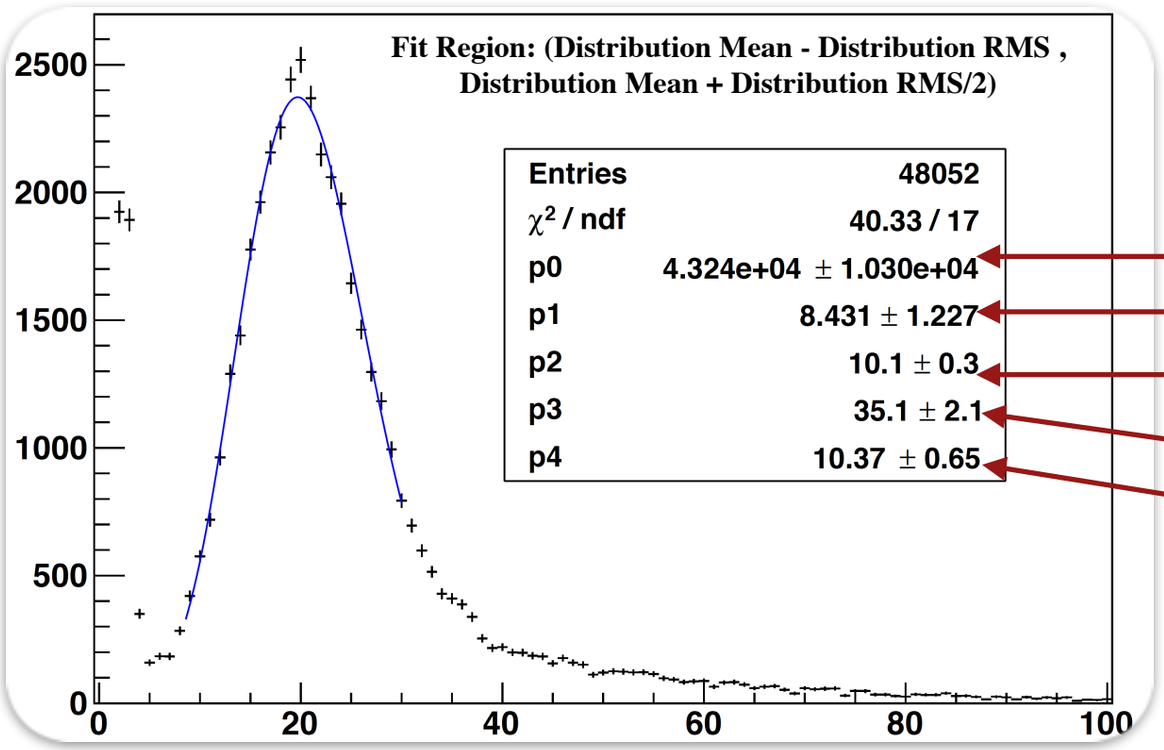
Introduction

- Calibration constants (gain) need to estimate in order to obtain the energy of calorimeter towers. **E = (ADC-ped) * 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 ~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. **gain = C_{abs} = C_{rel} / <E/P>**

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

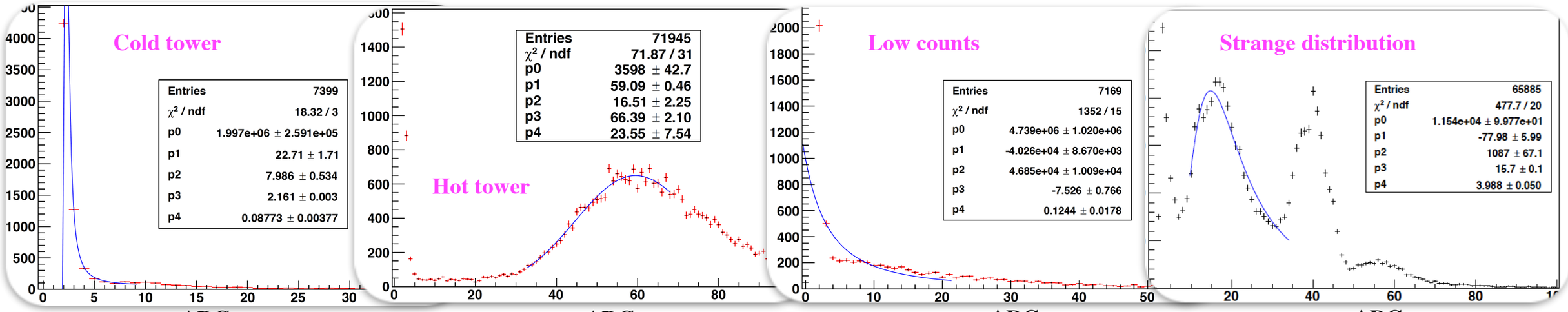
$$C_{relative} = \frac{0.264\left(1+0.056\eta^2\right)}{ADC_{MIP}\sin(\theta)}$$

MIP-ADC = Mean of the Fit function

([p0]*gaus(x,[p1],[p2]*Landau(x,[p3],[p4])

BEMC CALIBRATION

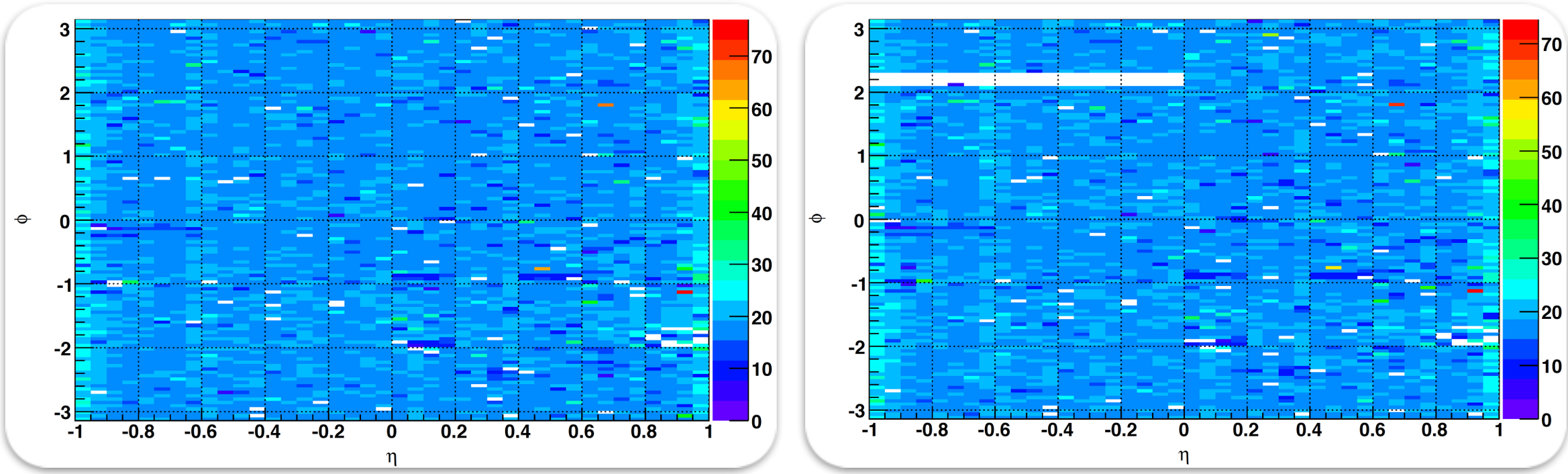
Relative Calibration : Tower QA



Period 1

Eta-Phi map of tower MIP-ADCs

Period 2



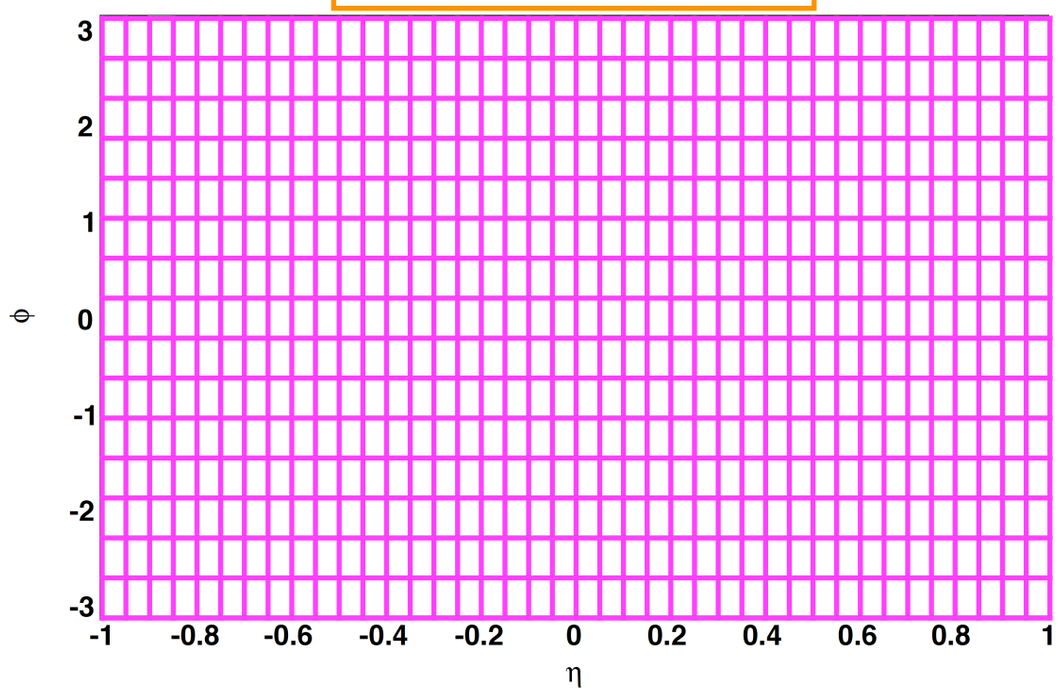
BEMC CALIBRATION

Absolute Calibration : Electrons

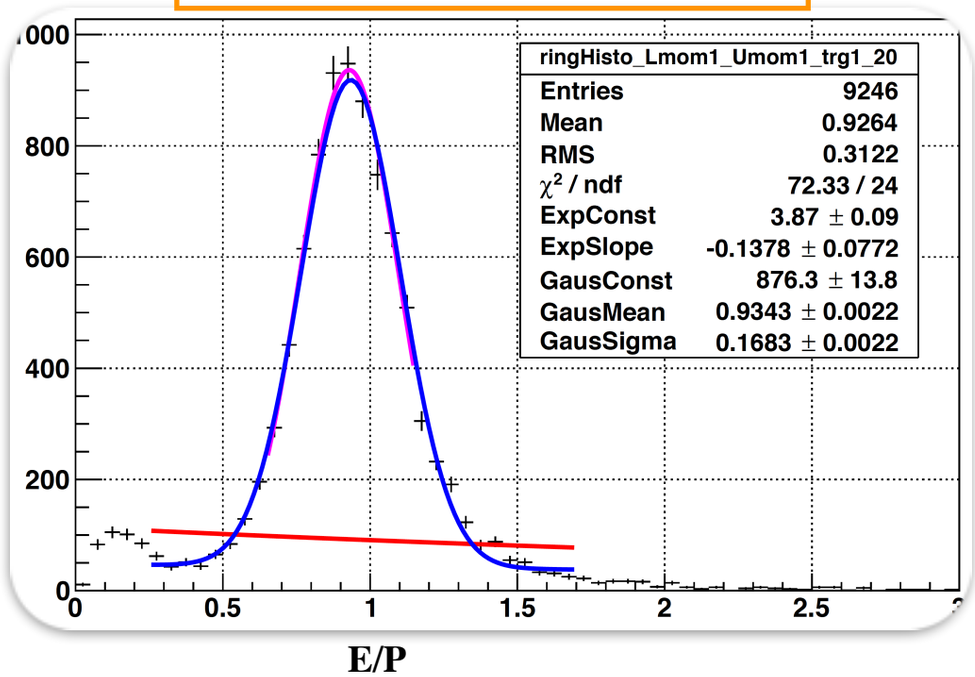
- We use e's tracks that pointed to calorimeter towers to obtain E/P value.
- Group e's by eta rings (120 towers at same eta) and crate slices. (8 towers in each crate in same eta).
- Use HT trigger options to get E/P distribution in each eta ring and Fit with appropriate fitting function.
- Extract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

Fit Function : "gaus+expo"

BEMC detector 2D eta phi slices



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

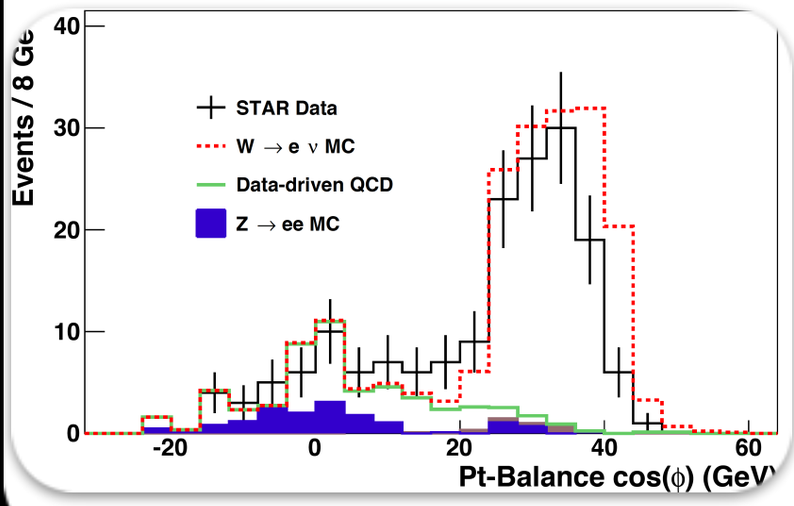


FORWARD RAPIDITY W A_L ANALYSIS

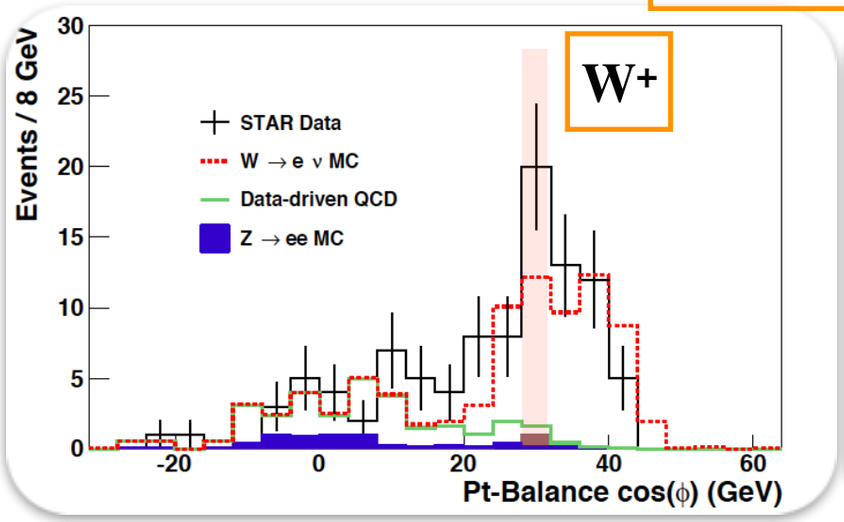
REQUIREMENT

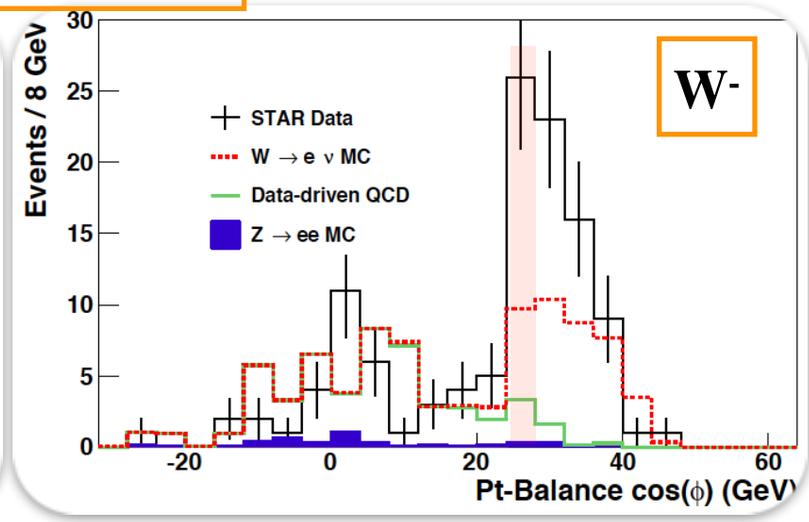
- Forward/backward regions more sensitive to flavor separation, but low cross section.
- Detectors performance get worse: less TPC hits, Unstable Endcap EMC.
- Discrepancy between Data and Embedding get worse than Run 12.
- Similar Endcap tower gain calibration issue with Barrel ??

Run 12



Run 13- Period 1



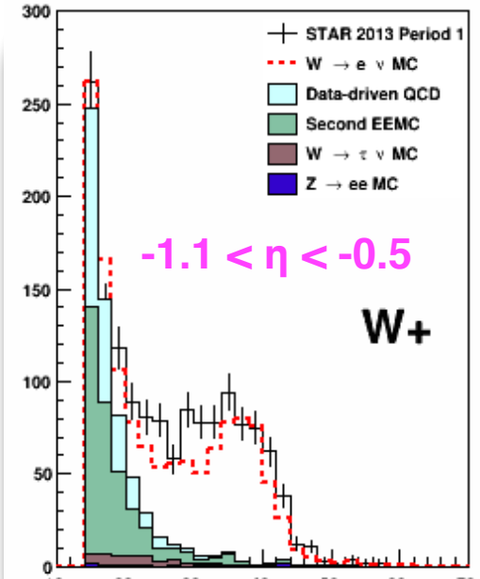


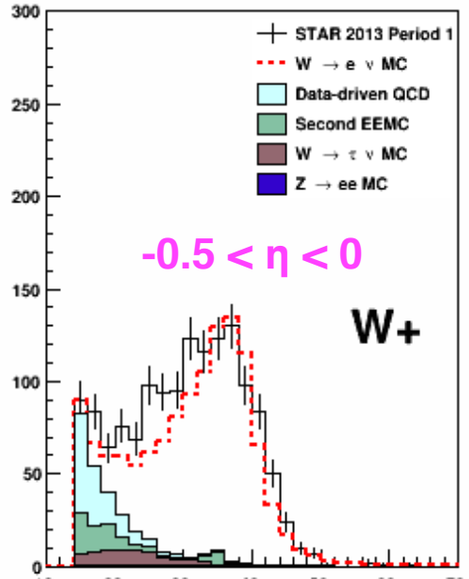
SUMMARY

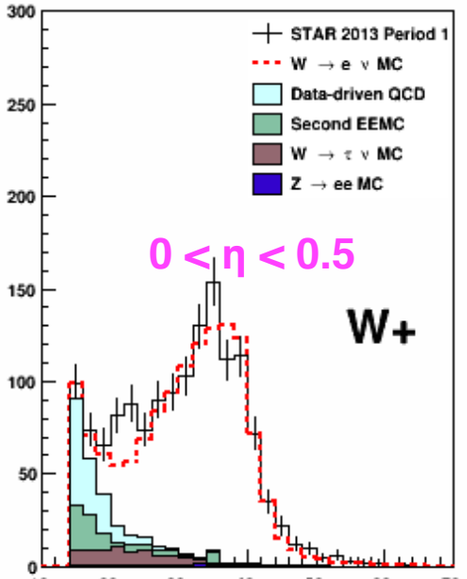
- Still trying to improve Data/MC agreement.
- Focusing on BEMC calibration, several issues in discussion.
- Improve ENDCAP analysis, (New calibration??)
- Release preliminary A_L results, BARREL+ENDCAP.
- Separated analysis using FGT is ongoing and will release separated preliminary result.

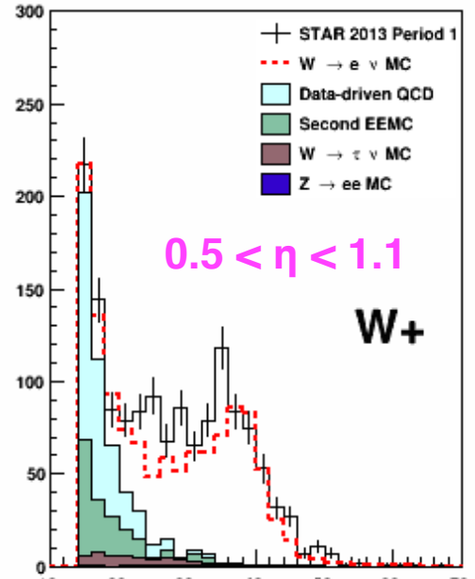
BACK UP

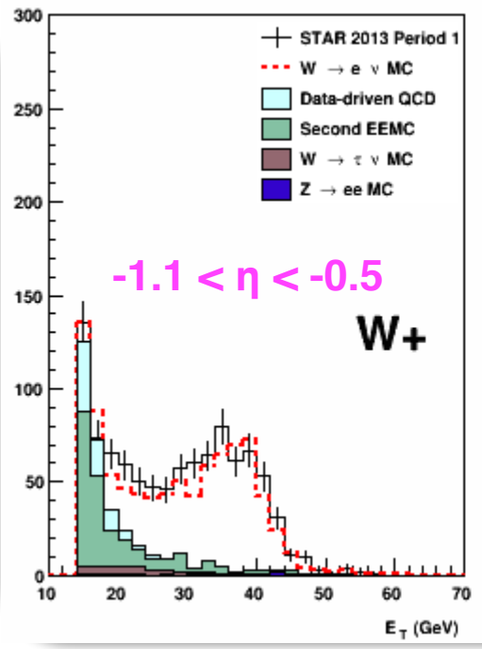
BG 4 ETA BINS- PERIOD 1

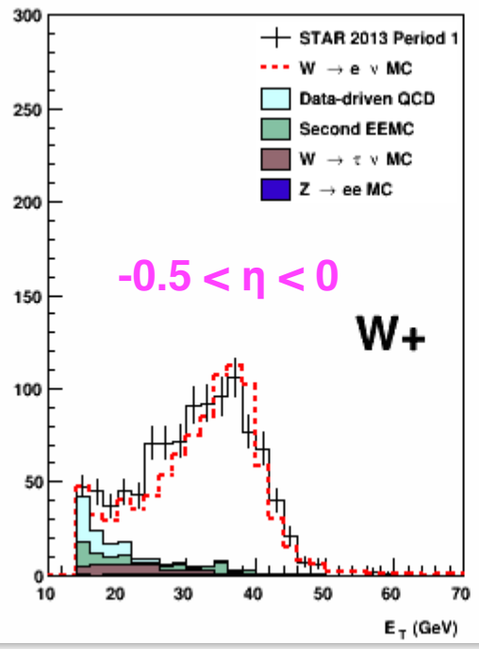


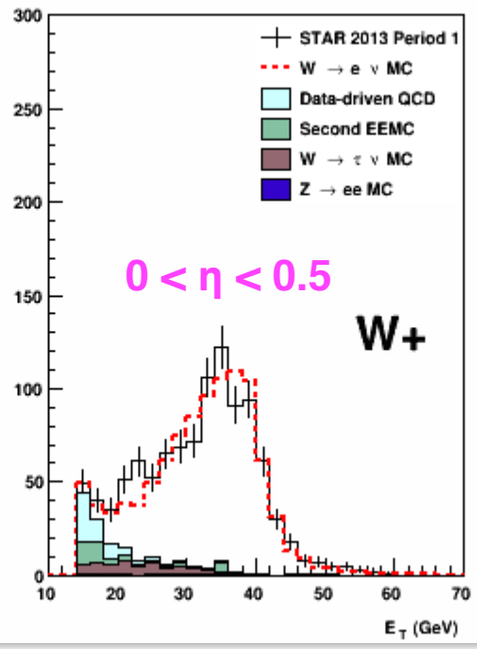


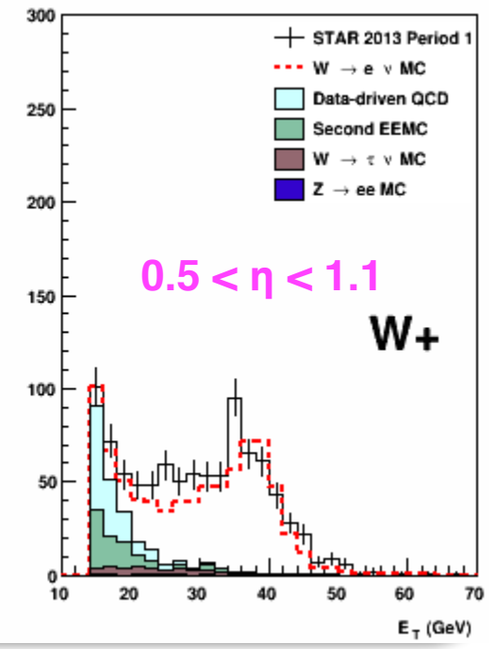




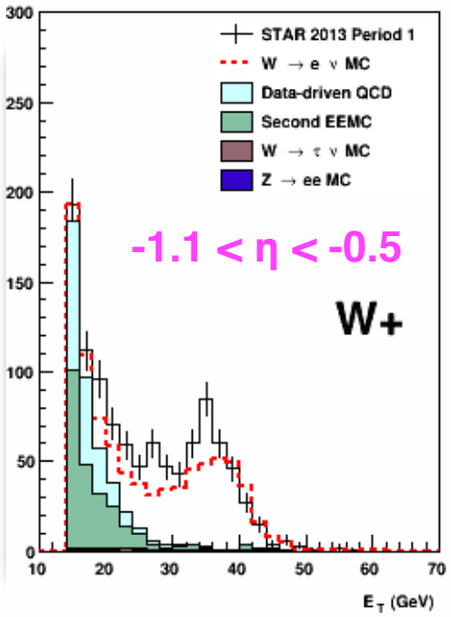


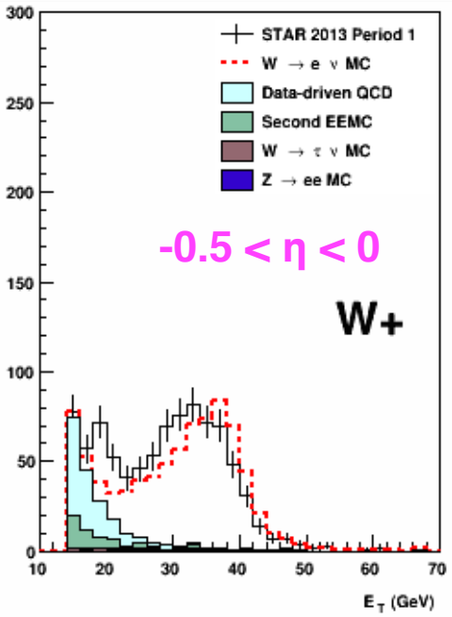


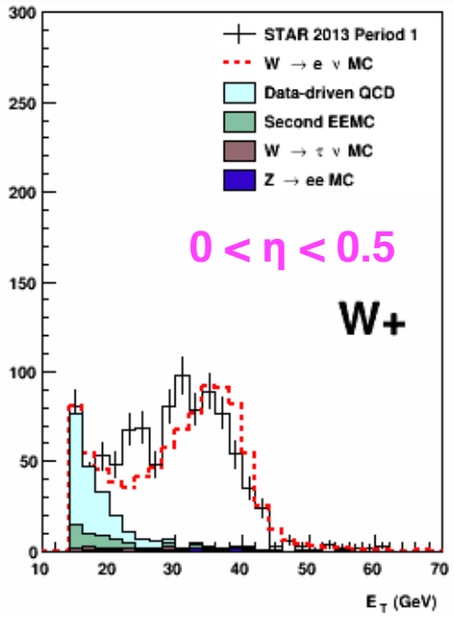


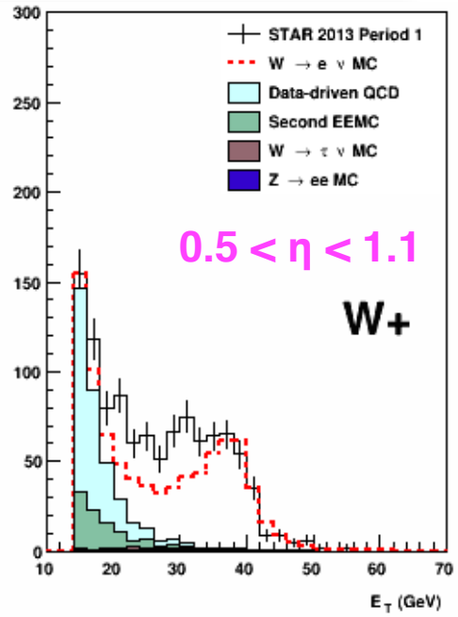


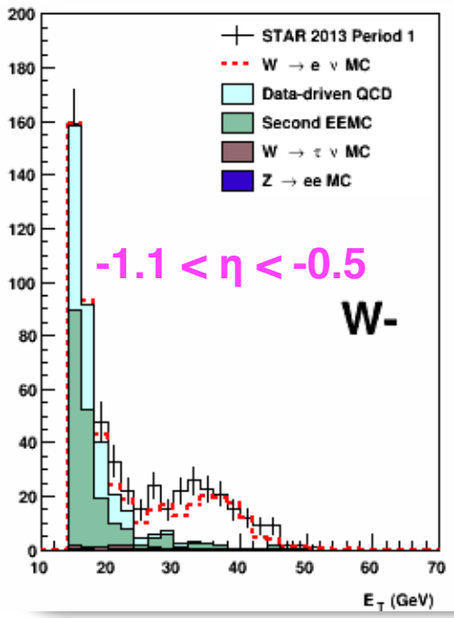
BG 4 ETA BINS- PERIOD 2

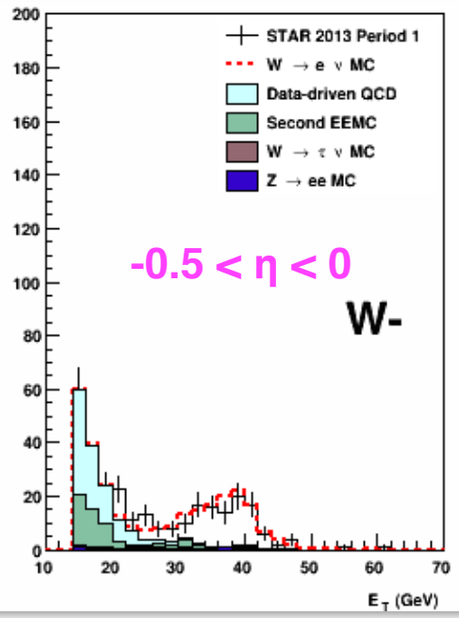


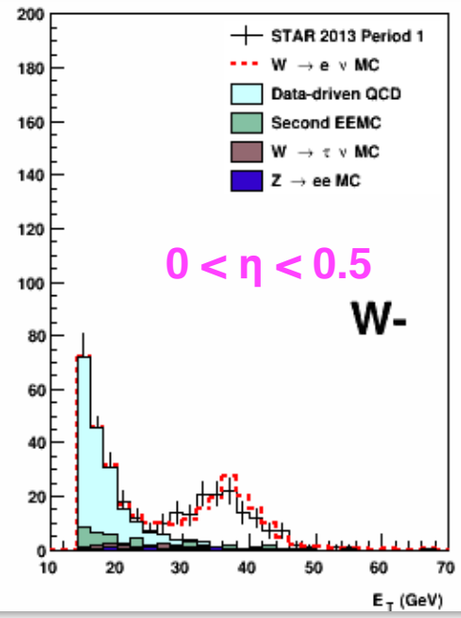


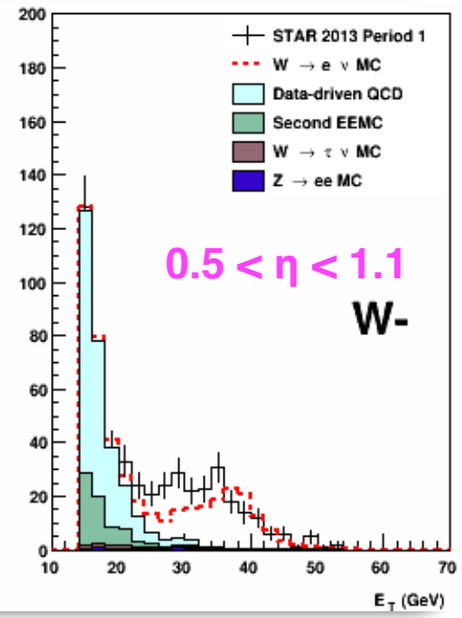




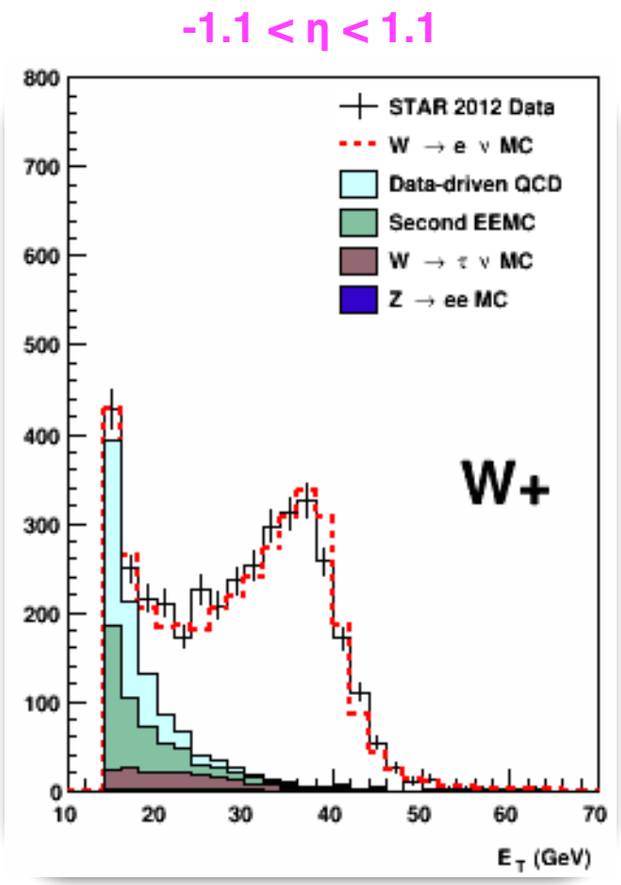


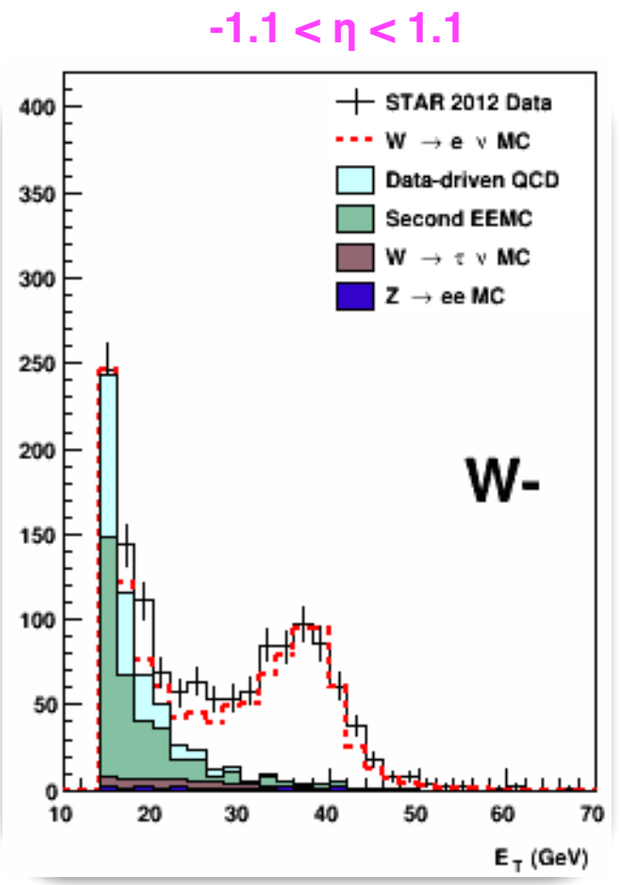




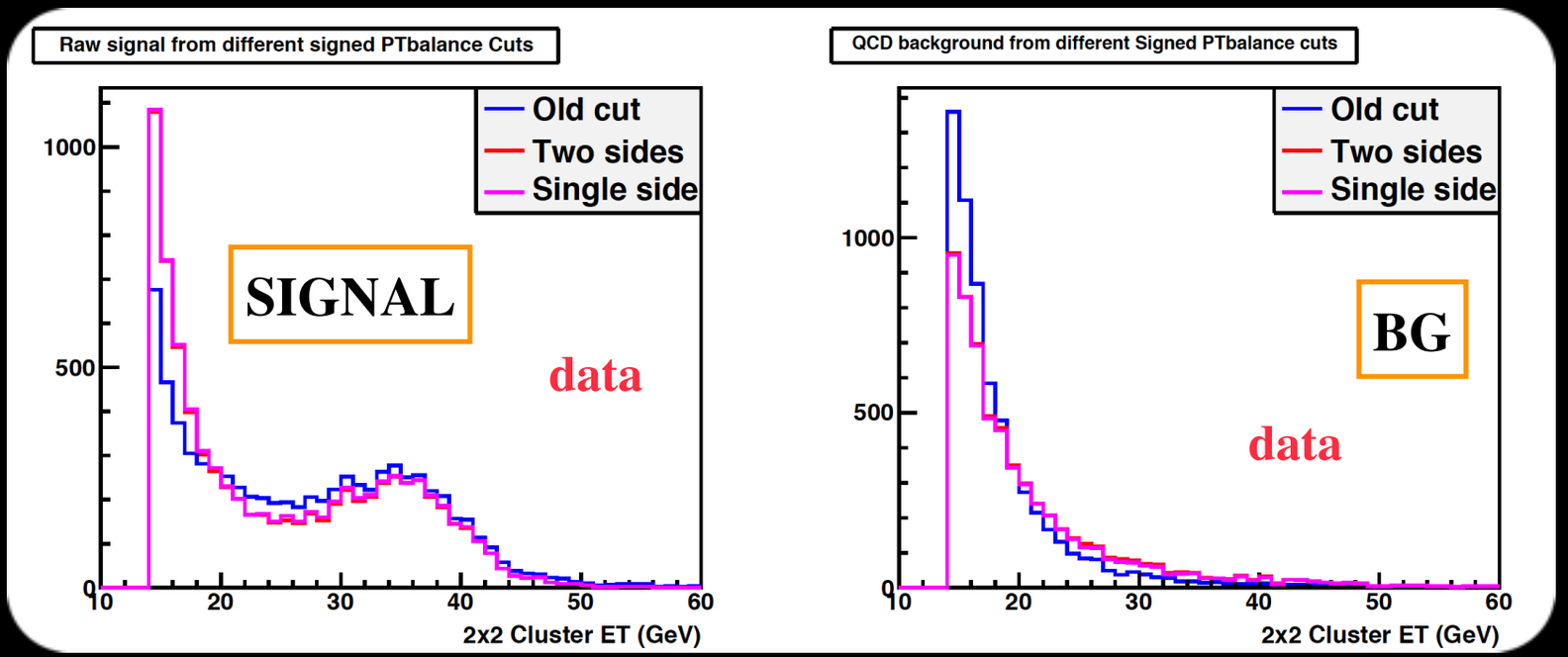


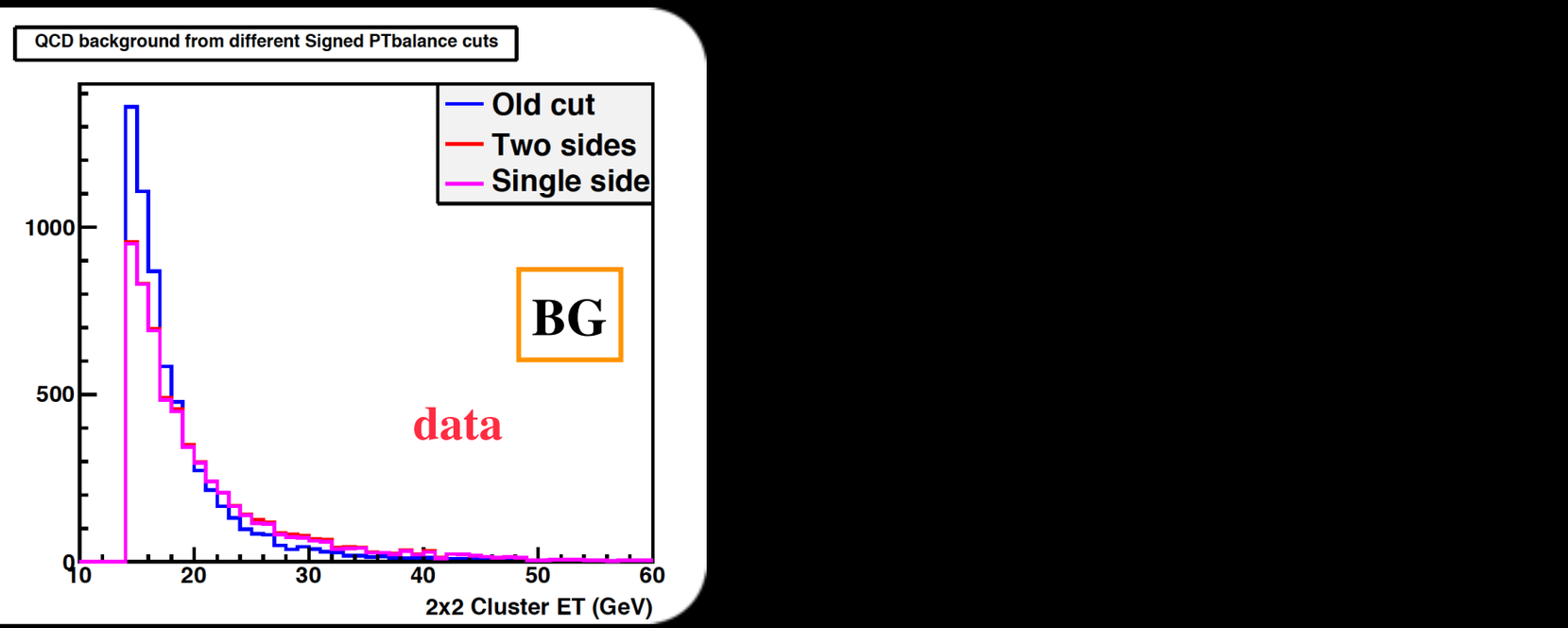
RUN 12 BG

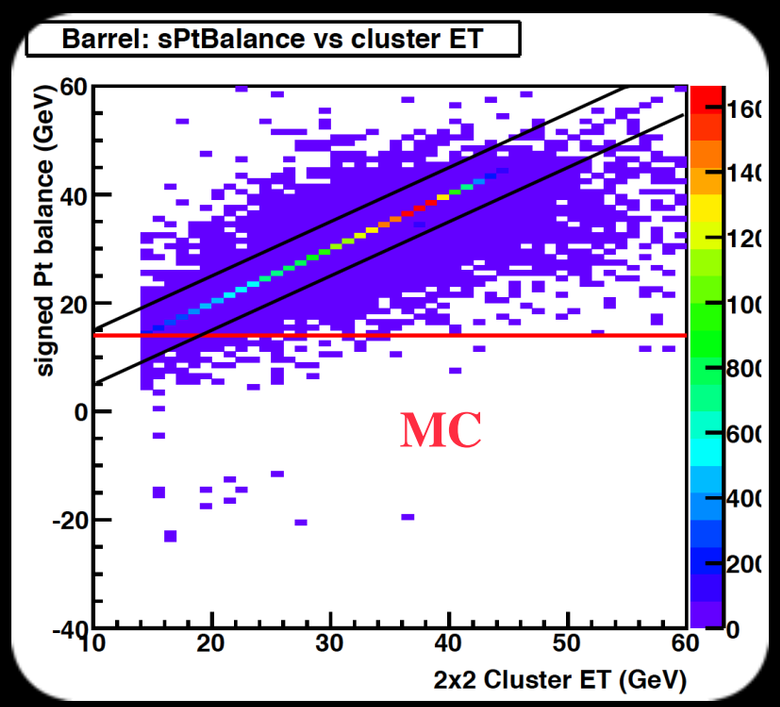

-1.1 < η < 1.1
STAR 2012 Data
W → e ν MC
Data-driven QCD
Second EEMC
W → τ ν MC
Z → ee MC
W+
E_T (GeV)

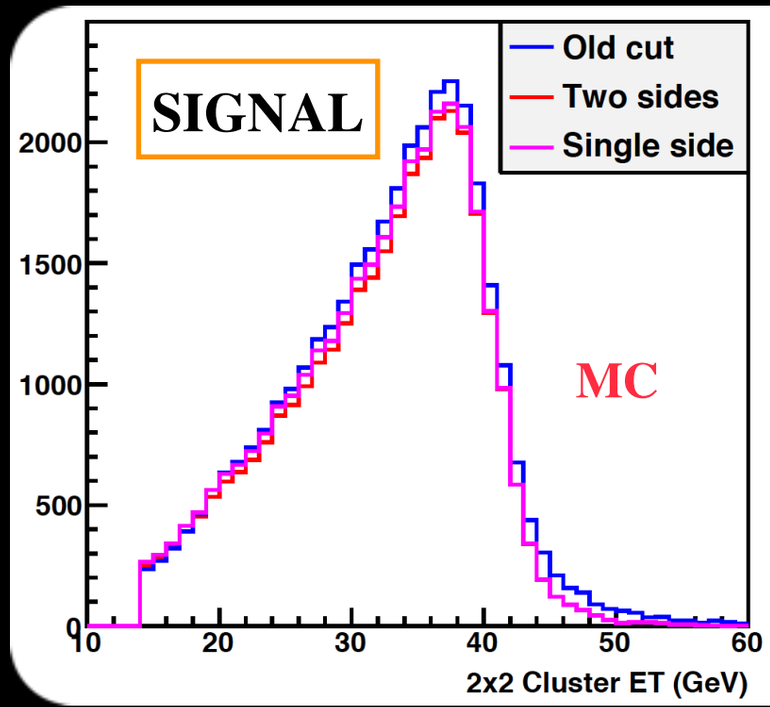

-1.1 < η < 1.1
STAR 2012 Data
W → e ν MC
Data-driven QCD
Second EEMC
W → τ ν MC
Z → ee MC
W-
E_T (GeV)

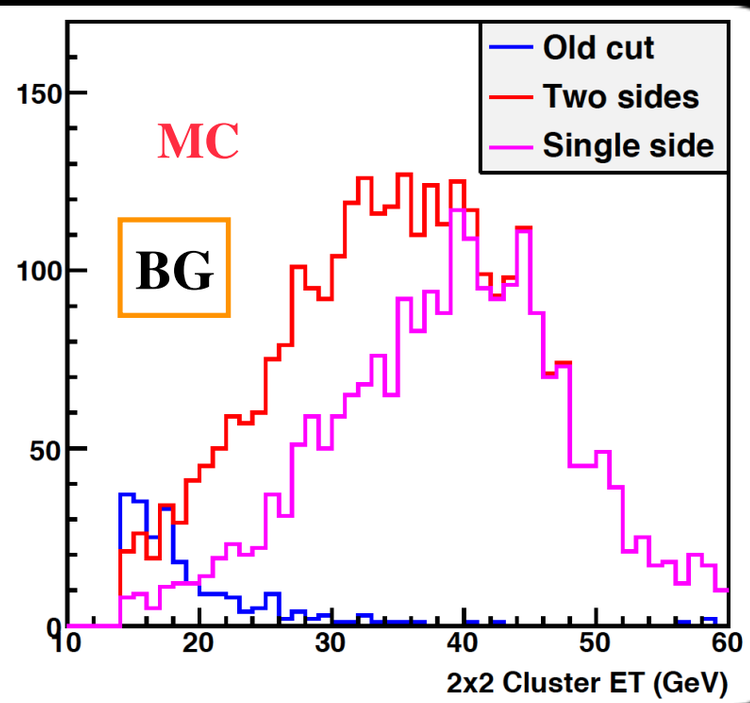
Modified-signPT cut-MC

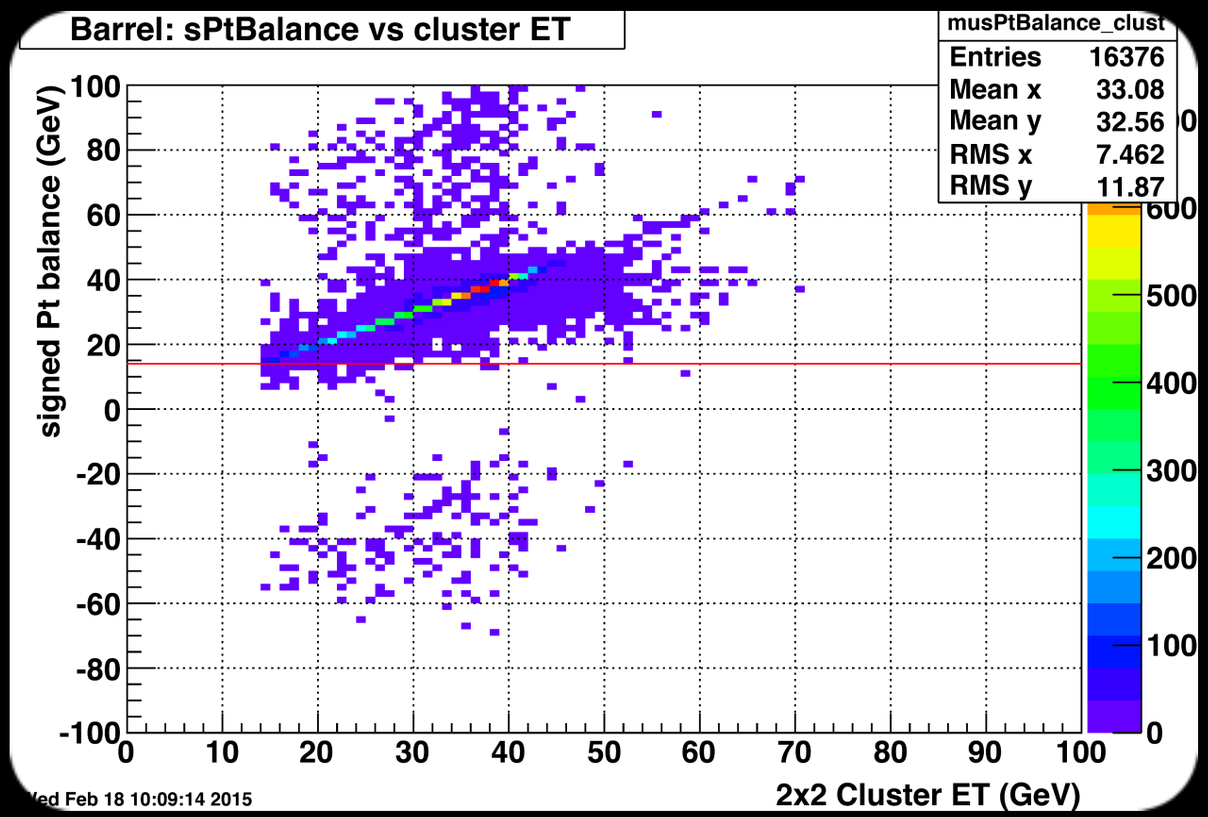




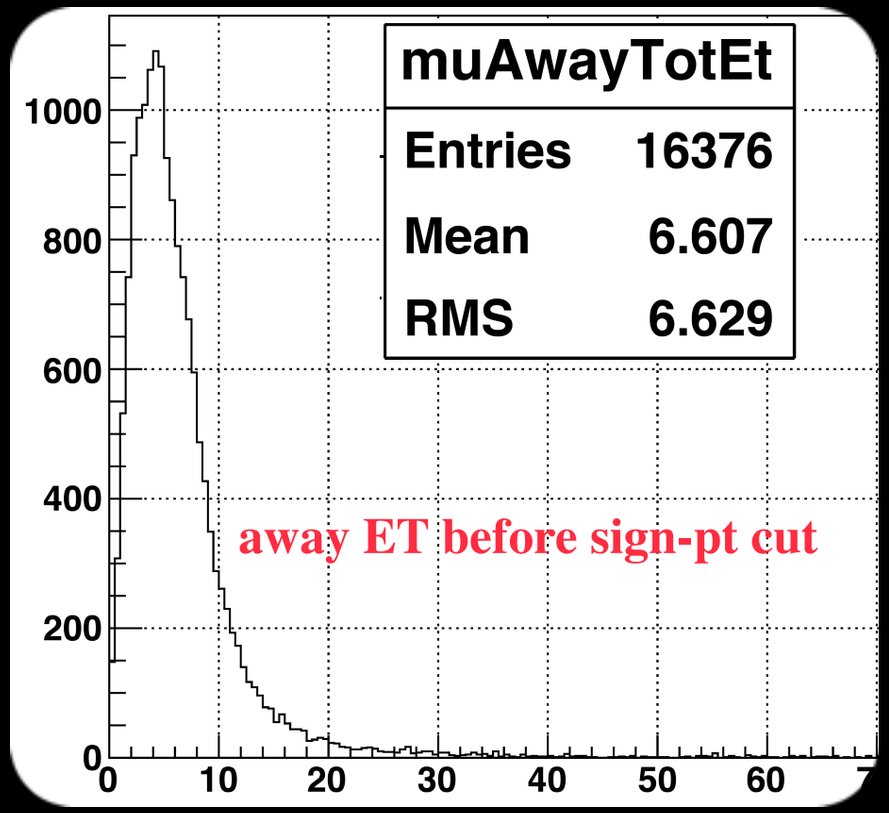


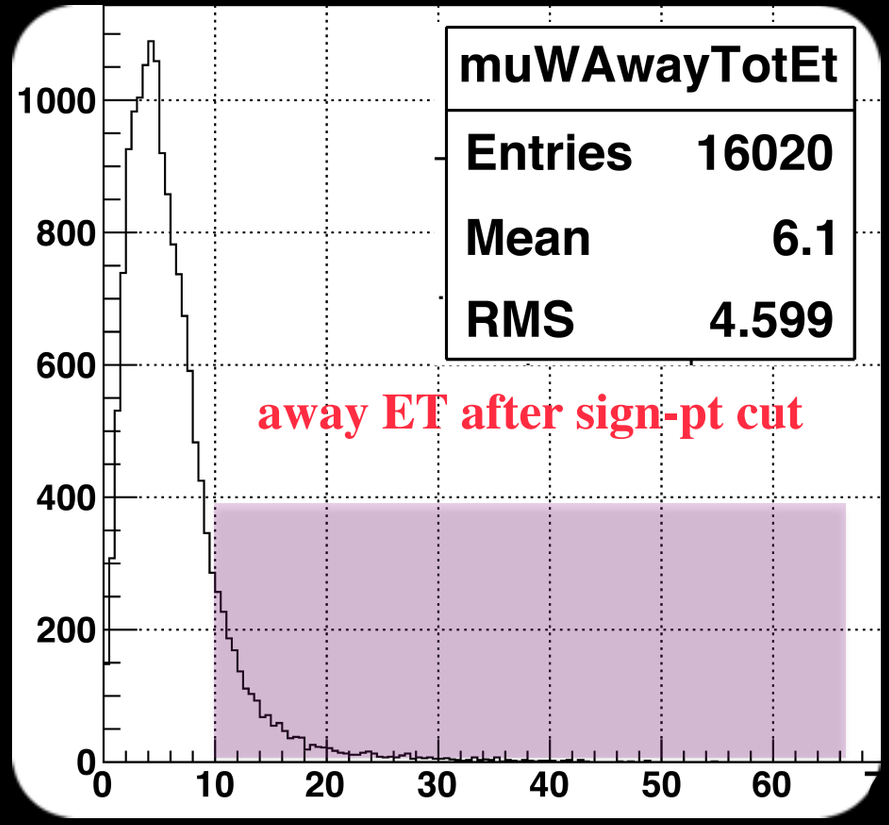






awayET cut - MC





MIP Cuts

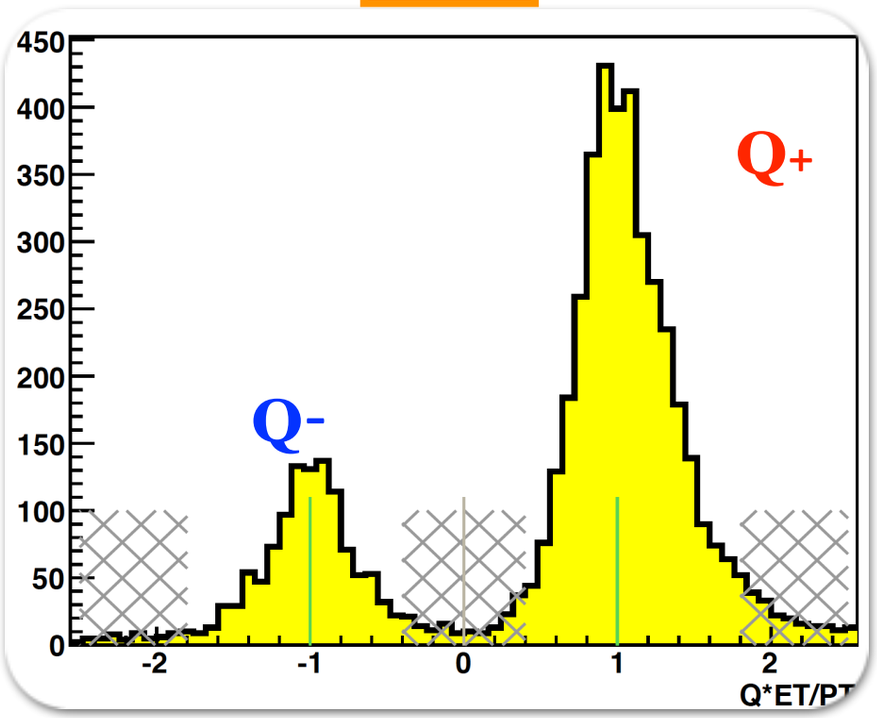
- Vertex Rank > 1e6
- |vertex-Z| < 30 cm
- only one track per tower per event
- Track momentum > 1 GeV/c
- (ADC-ped) > 1.5 ped RMS
- Track must enter and exit the same tower
- Highest E neighboring tower in 3x3 cluster < 2 GeV

CALIBRATION OF TPC

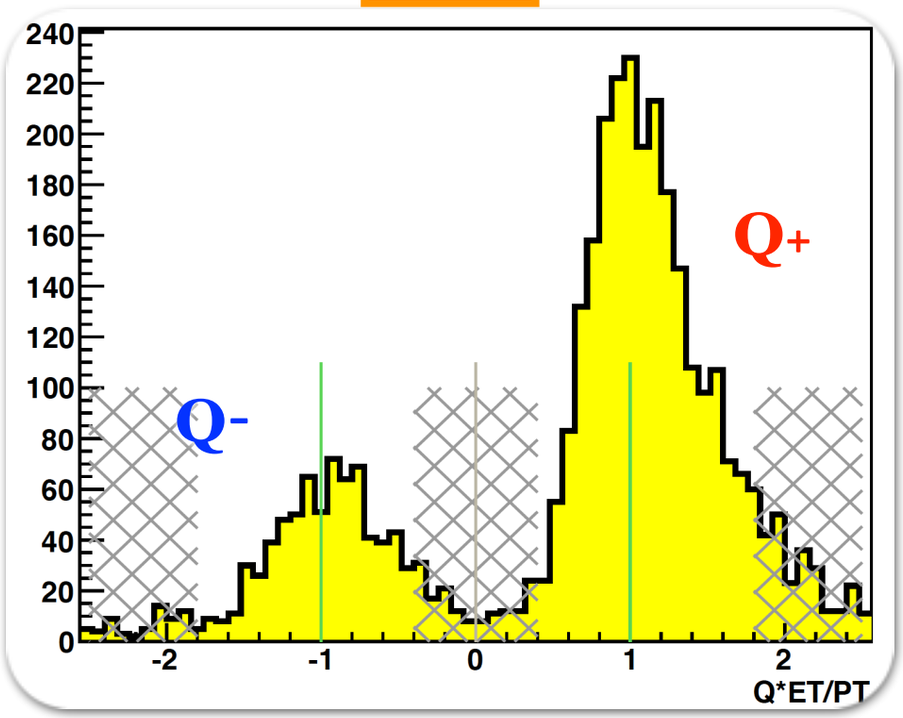
TPC

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

period 1



period 2



PERIOD 2 ENDCAP BG