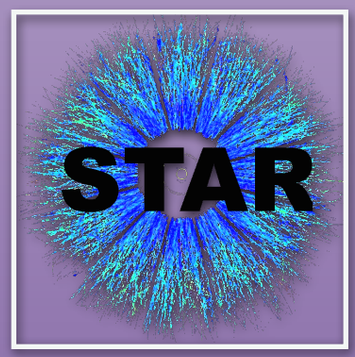
# Plans towards releasing run 13 mid-rapidity W preliminary results at INPC 2016 / SPIN 2016

Run 13 W analysis group



# Motivation

- Release of run 13 W preliminary results (AL / cross-section ratio) is one of the major steps for the STAR collaboration, in particular the SPIN PWG.

- The PHENIX collaboration has already published run 13 mid-rapidity W AL results and has released preliminary run 13 forward-rapidity W AL results.

- Due to various reasons, releasing of the STAR preliminary run 13 W results have been delayed for a while now since the run 13 W official production:

1. Run 13 pp 500 GeV BEMC calibration [Final step, systematic uncertainties].

2. PPV_defaults setting used in official embedding production. [Reproduced an unofficial version with PPV_W, but no longer important!].

3. “eta-dip” seen at mid-rapidity region [Need reproduction of both data and MC (Embedding) using STICA tracking].

# Run 13 pp 500 GeV BEMC Calibration (1)

- We have presented a summary of the Run 13 pp 500 GeV calibration to the SPIN PWG on 01-18-2016.

- A “bug” was found in the code on March 2016, which has primarily affected the “trigger options” used in the electron analysis and therefore the final gain constants.

- We had to redo the whole analysis but the various electron selection cuts were unchanged.

- Now we have obtained final gain constants / Evaluation of systematic uncertainties ongoing.

- We plan to present complete run 13 pp 500 GeV calibration including systematics uncertainties to SPIN PWG soon.

# Run 13 pp 500 GeV BEMC calibration (2)

- As for the current understanding, STICA tracking would basically improve statistics at high luminosity.
- For the calibration, how can STICA help?
    - More statistics -> less statistical uncertainty, expect larger Signal / BG.
- But as of now, we have no understanding of the track splitting / track duplicates of STICA at low momentum [Note: We use p < 10 GeV/c for the calibration].
- No strong argument that we must use for a preliminary result a STICA production to obtain the BEMC calibration gains.
- Therefore for the purpose of the run 13 W preliminary results, Run 13 BEMC calibration gains will be obtained using existing STI st_physics production.
- For a final publication, we will redo the calibration with STICA, but we do not expect a significant impact!

# "Eta-Dip" observed in mid-rapidity region

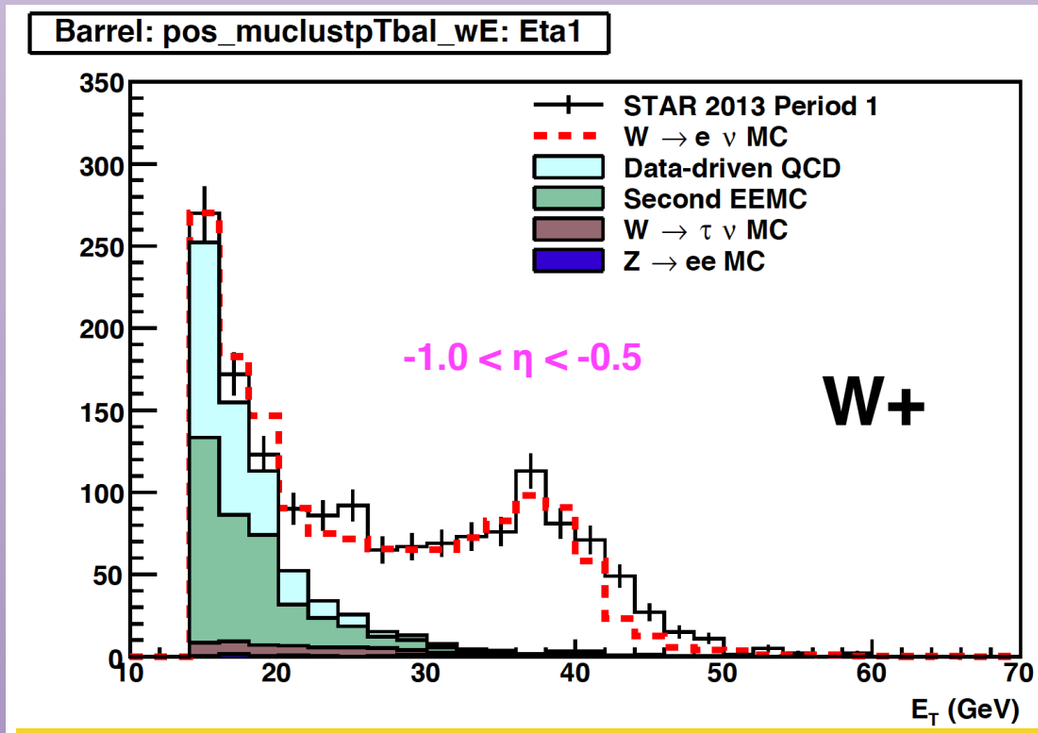
- We have observed an eta-dip (Only in data) mainly in the mid-rapidity region
- This was more pronounced in period 2 compared to to period 1.
- We have checked the track eta-distribution of final W tracks after applying all W reconstruction cuts and also of primary tracks before applying W cuts, both in data and MC.
- We realized that only the data shows such a dip in eta but not in MC.
- In addition to the "Eta dip", both data and MC in period 2 show east - west asymmetry in yield [Also seen in jet analysis!].
- Further studies showed that the "eta-dip" is actually a luminosity effect and can be recovered by using STICA tracking algorithm.
- Next couple of slides shows some of the distributions from these studies.

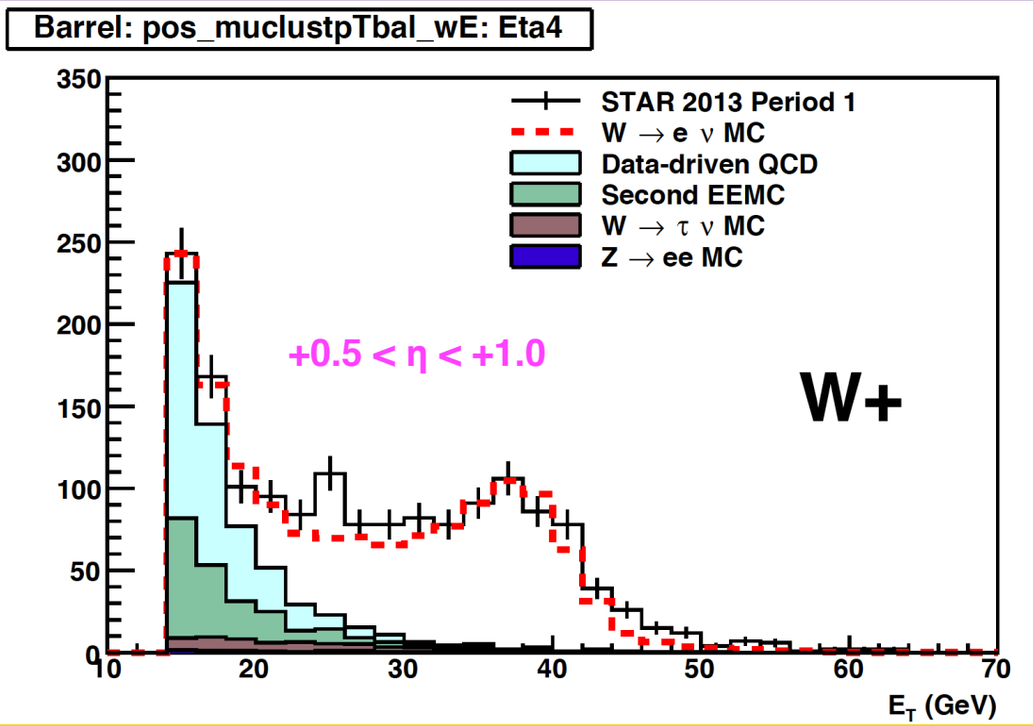
# “Eta-Dip” observed in mid-rapidity region

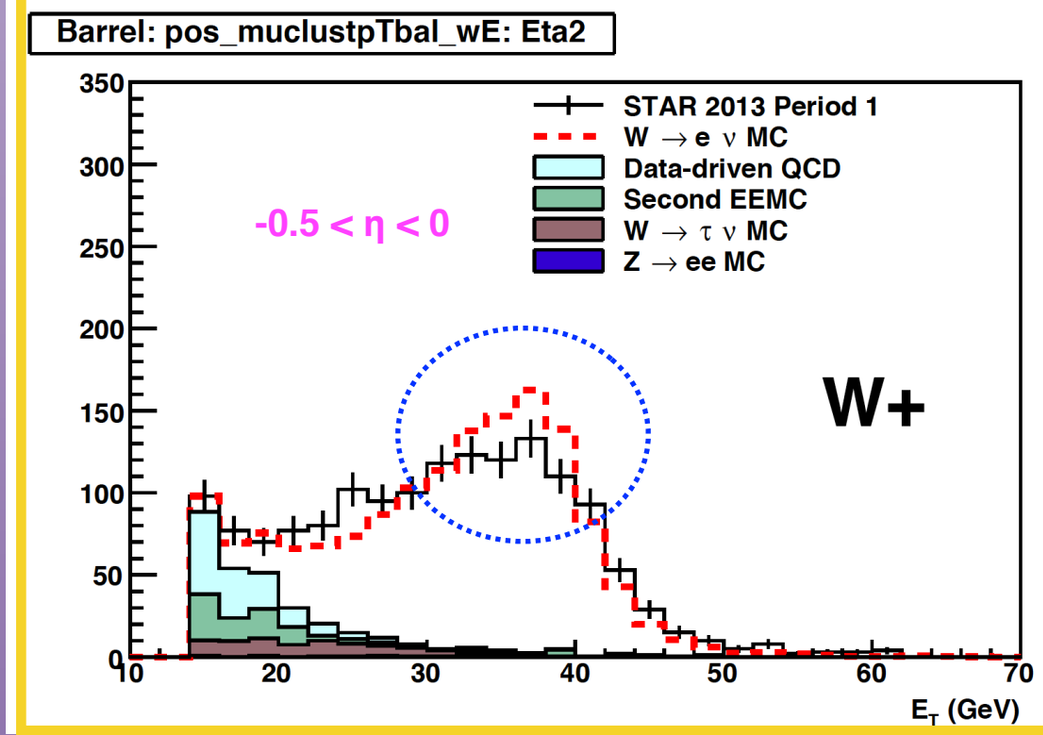
STI TRACKING

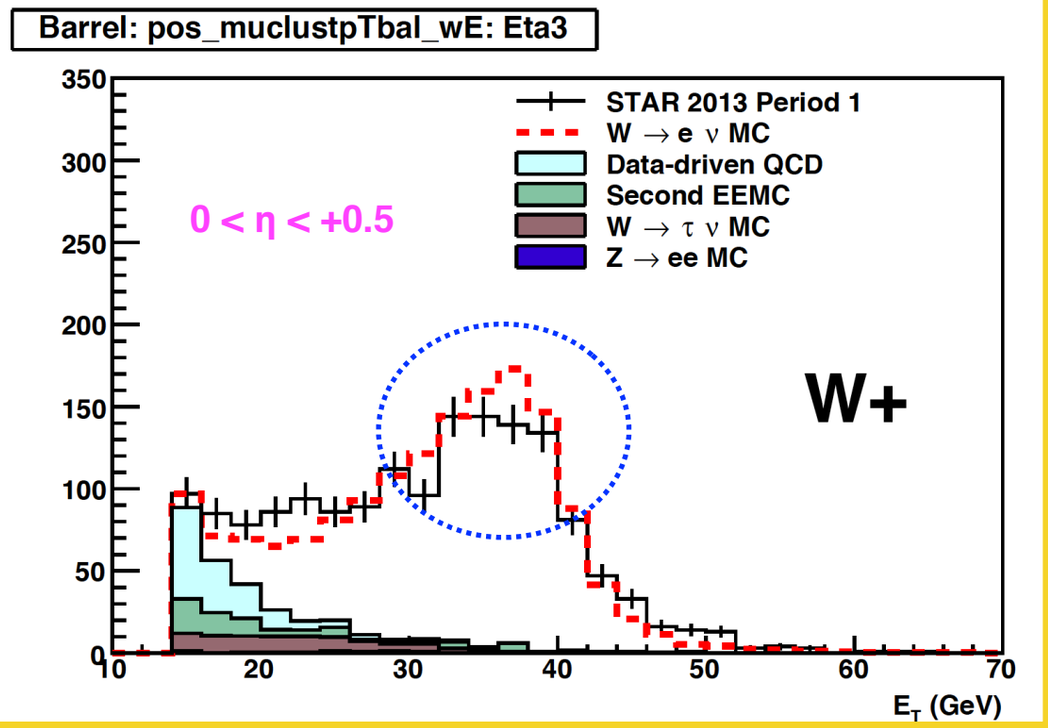
Run 13 - Period 1

**First sign of a possible “eta-dip” was observed during Data-MC comparison of W BG estimation**



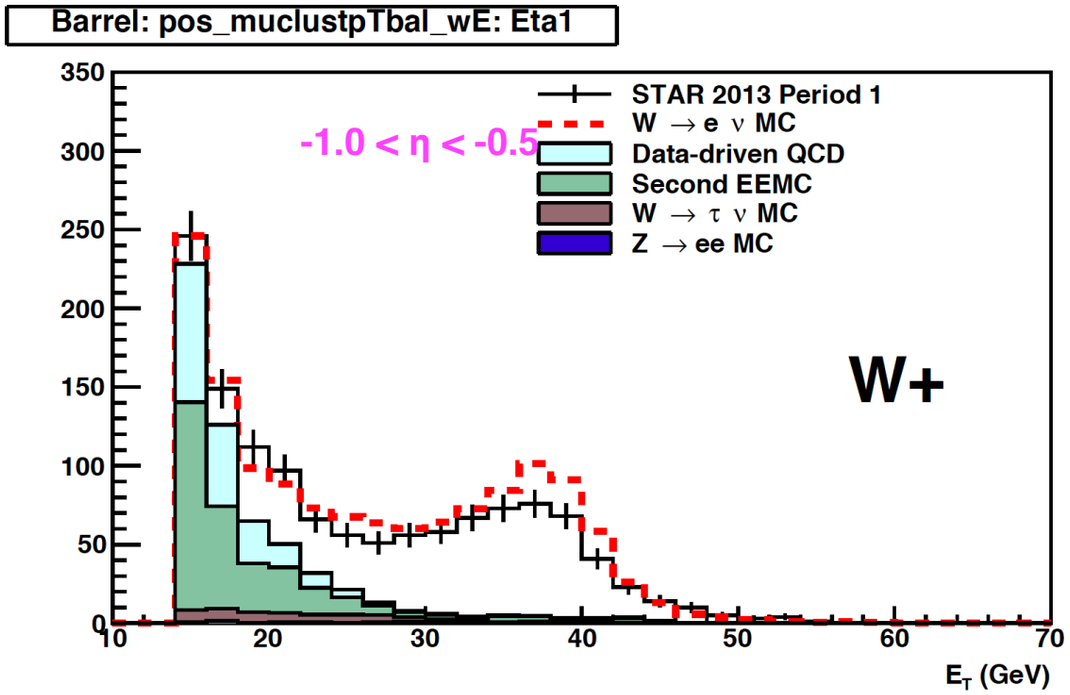



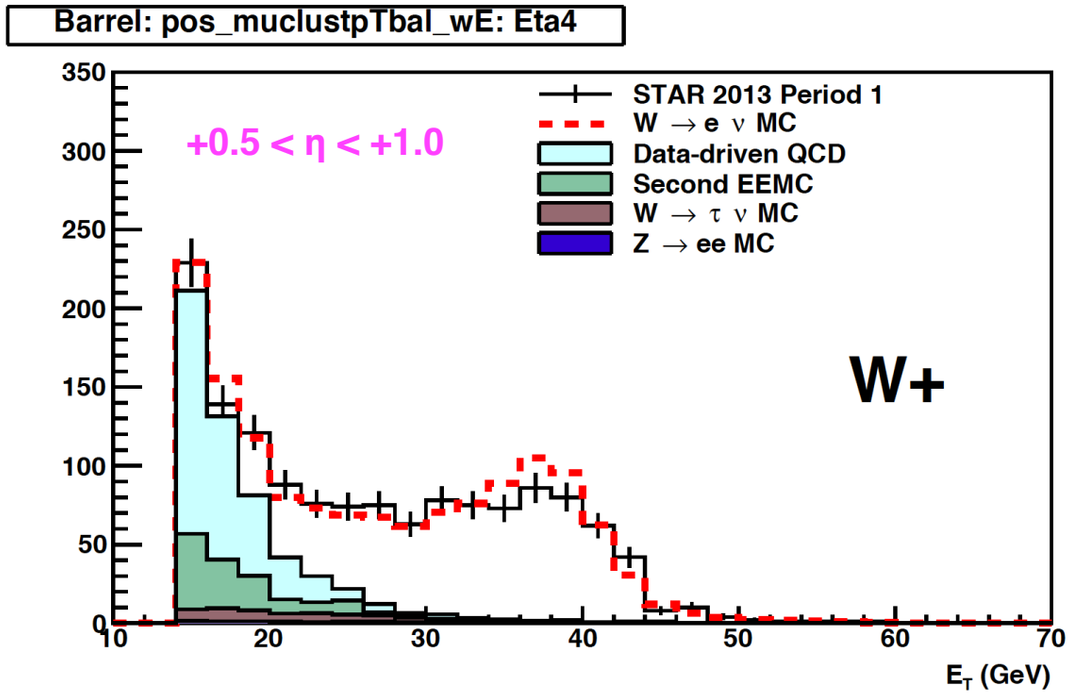
# “Eta-Dip” observed in mid-rapidity region

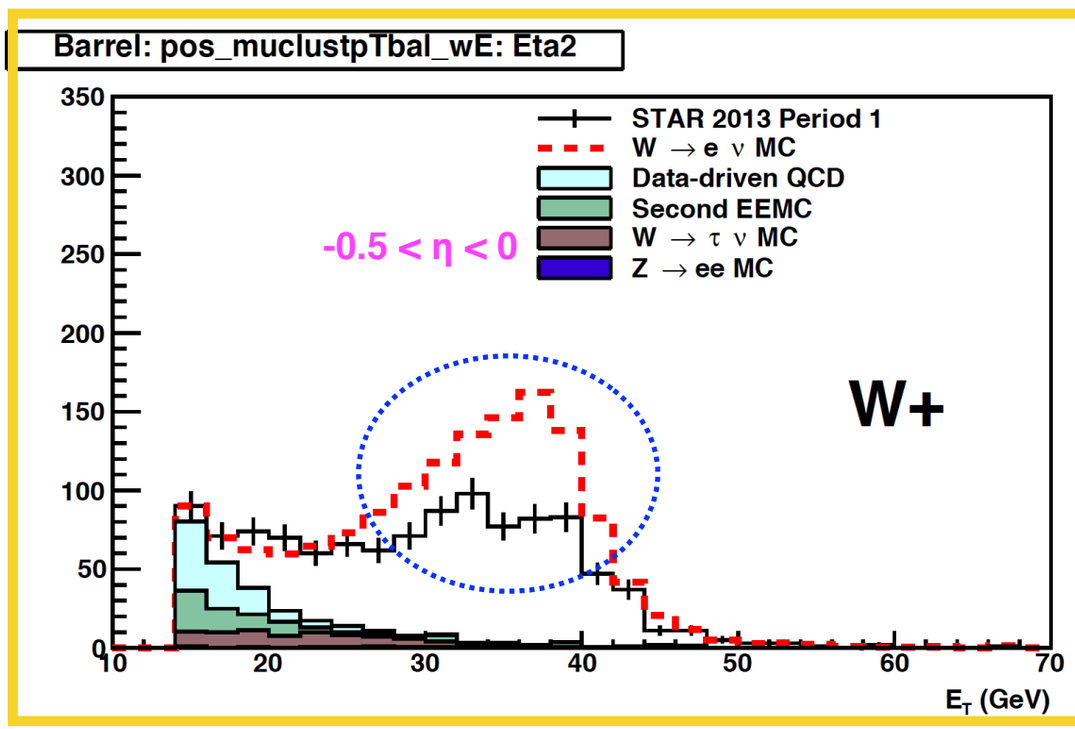
STI TRACKING

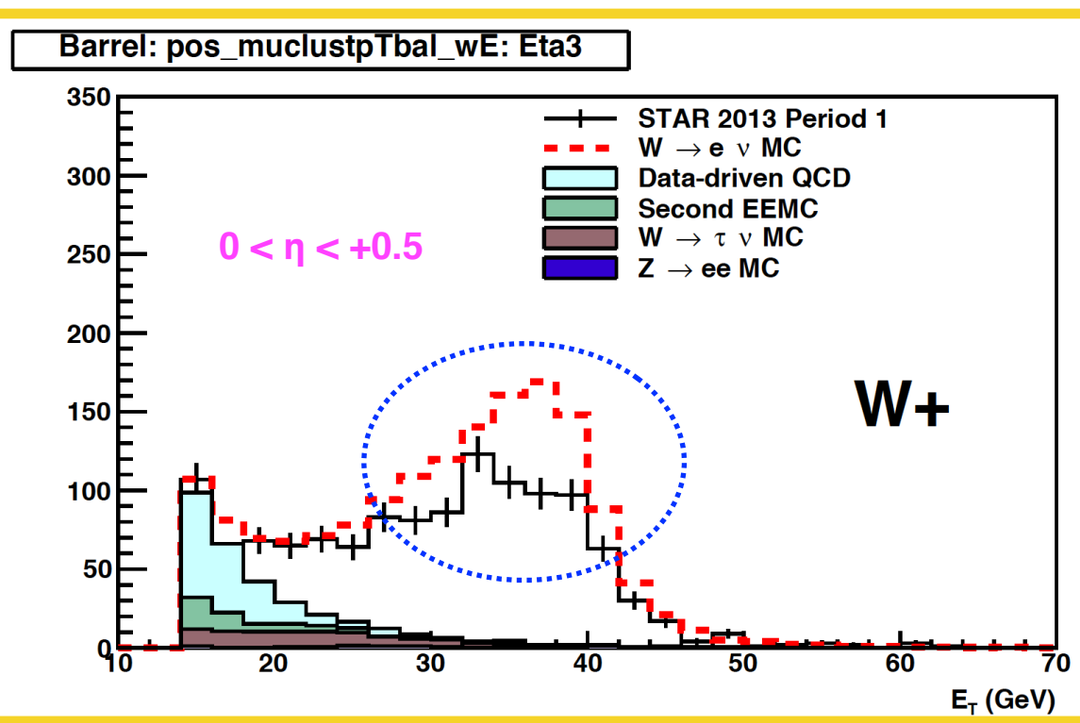
Run 13 - Period 2

**First sign of a possible “eta-dip” was observed during Data-MC comparison of W BG estimation**

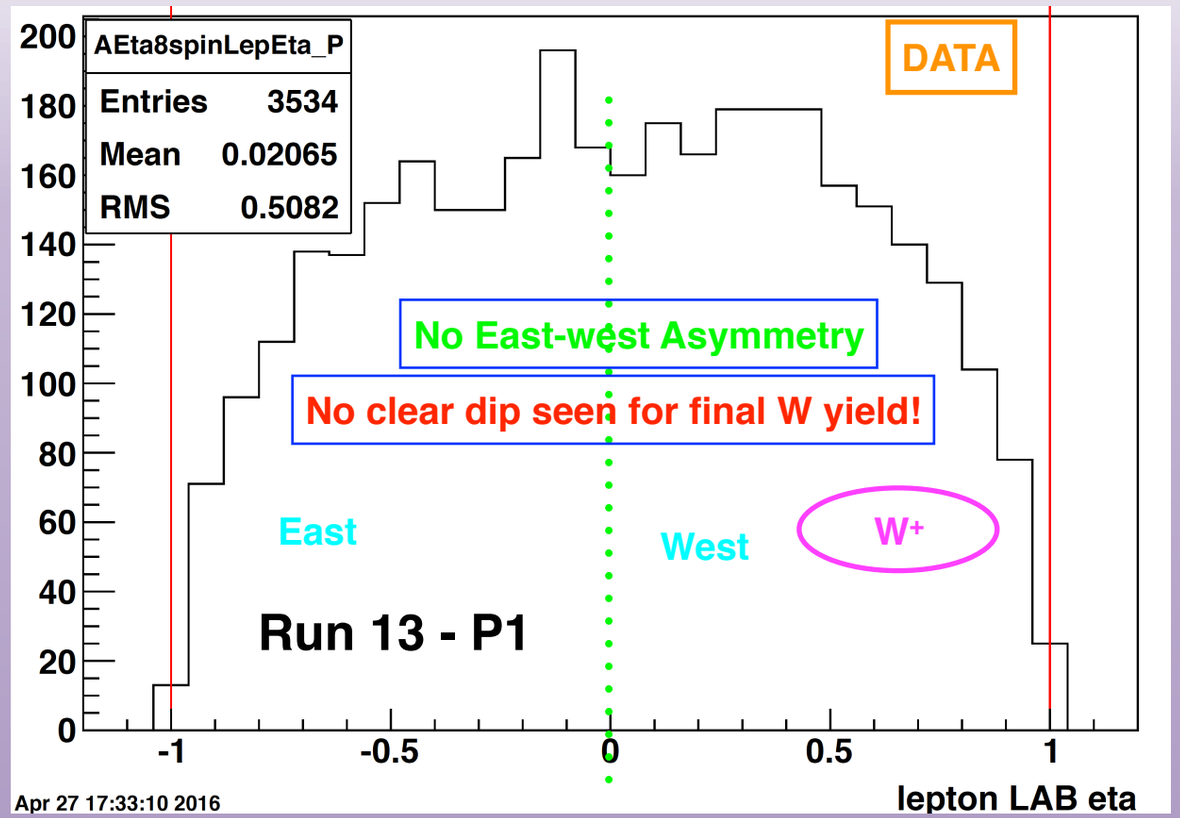


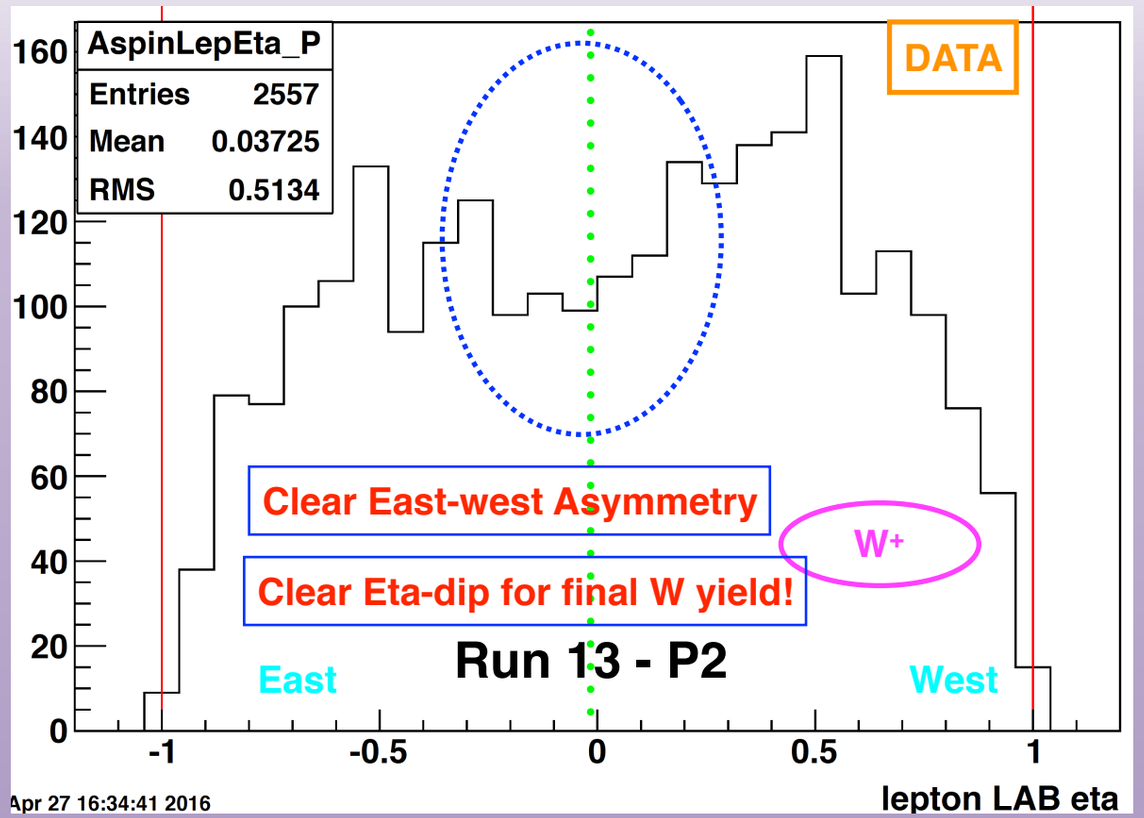



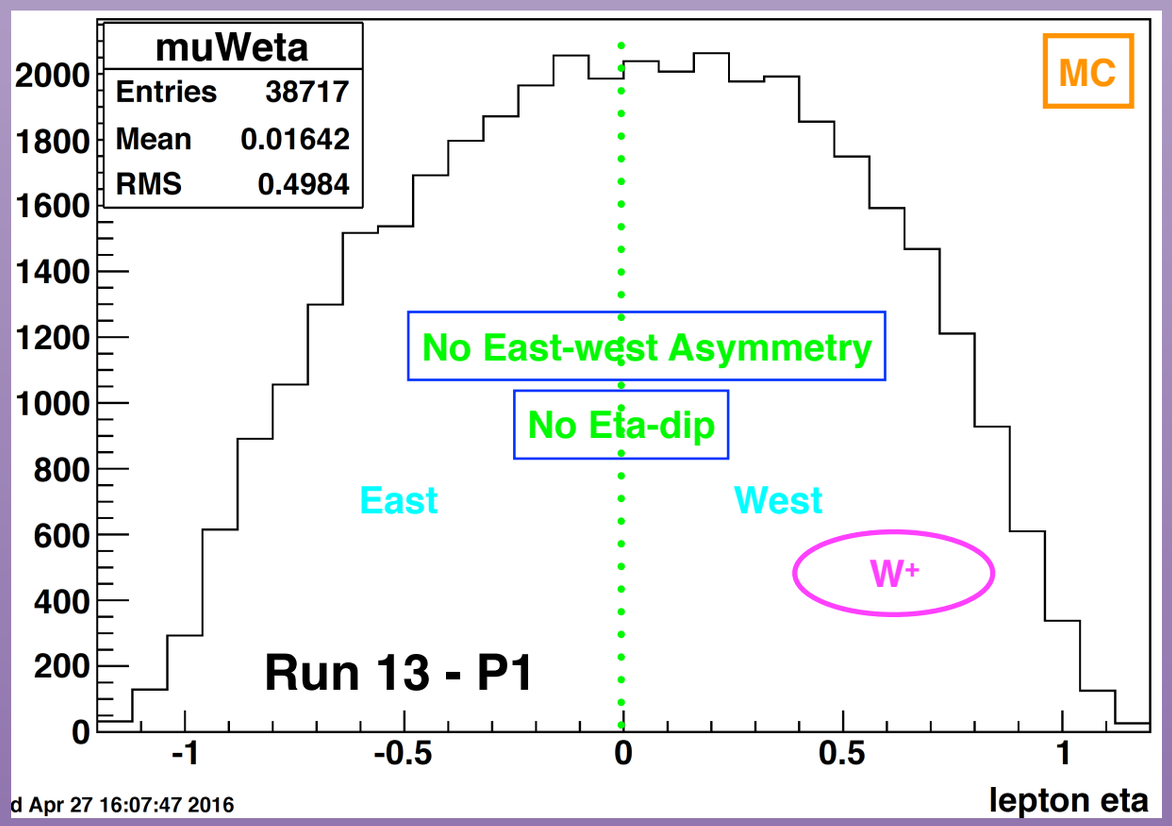



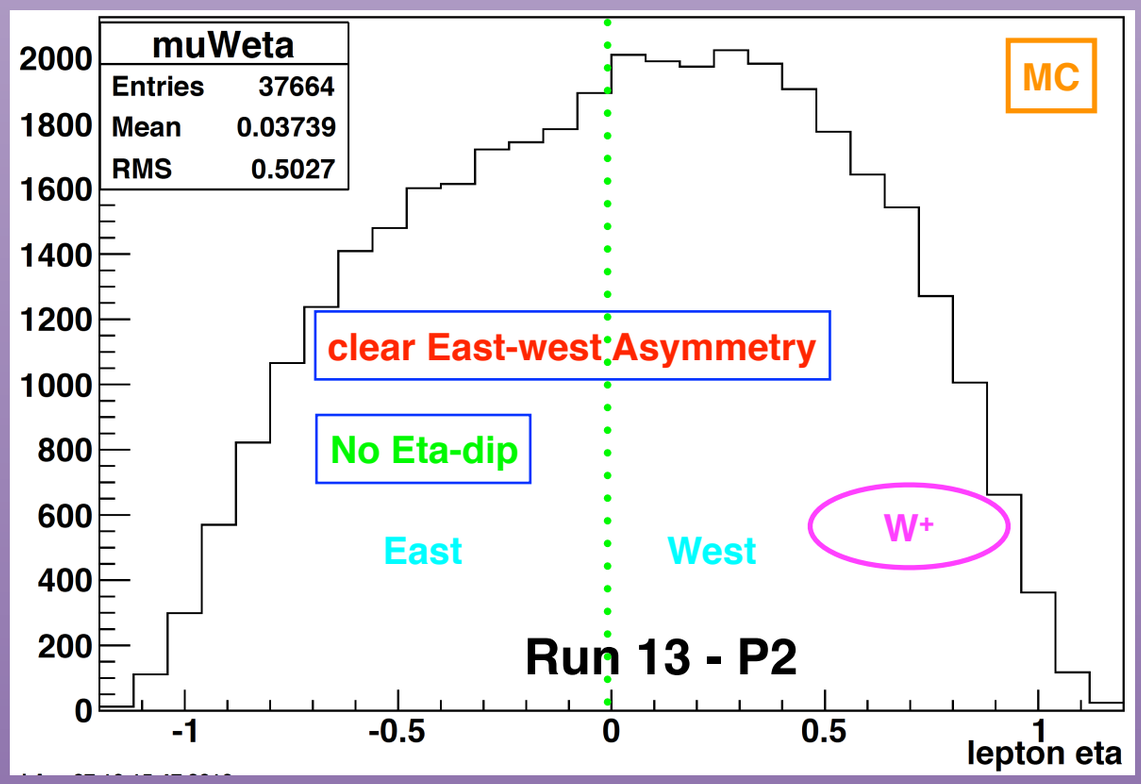



# Eta-dip Study : “Final W Eta distribution”



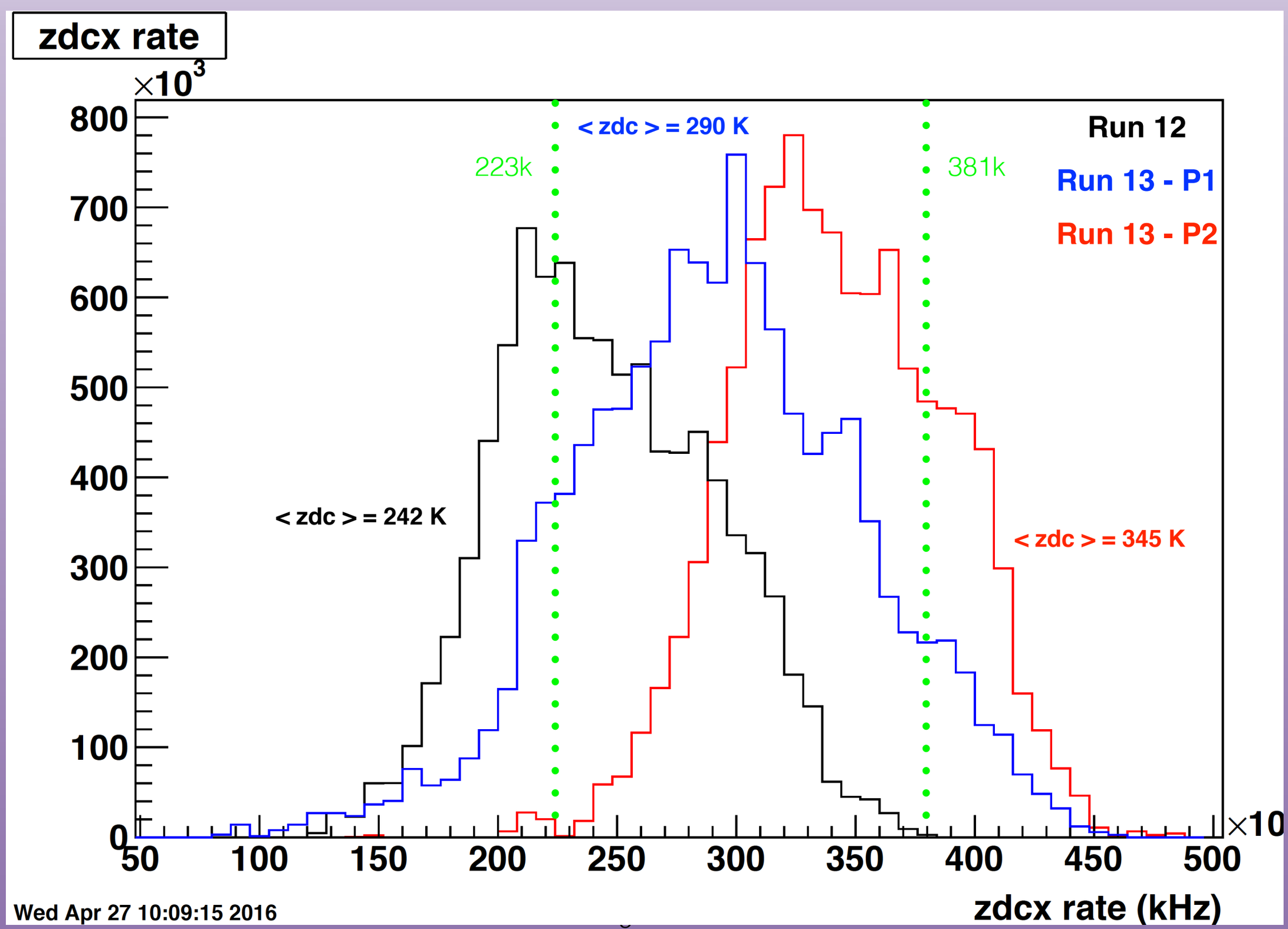



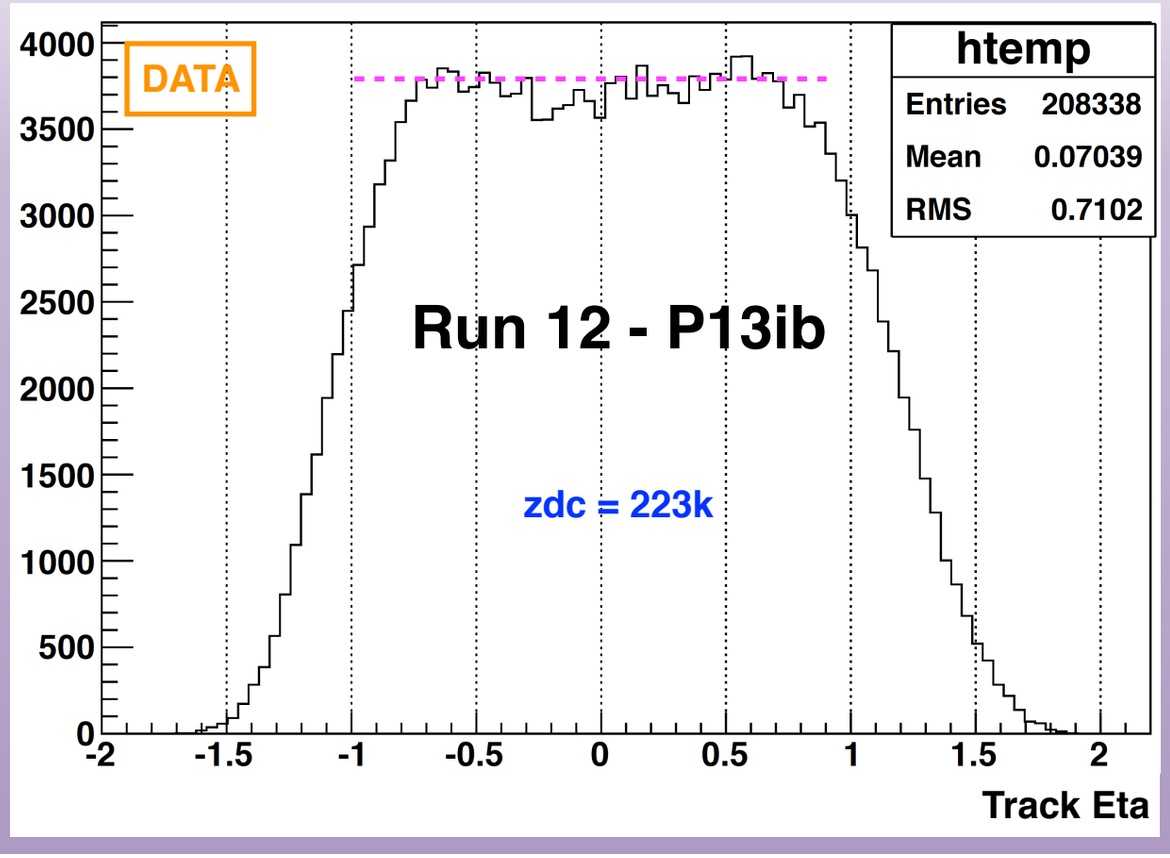



# ZDC rate distribution Run 12 / Run 13

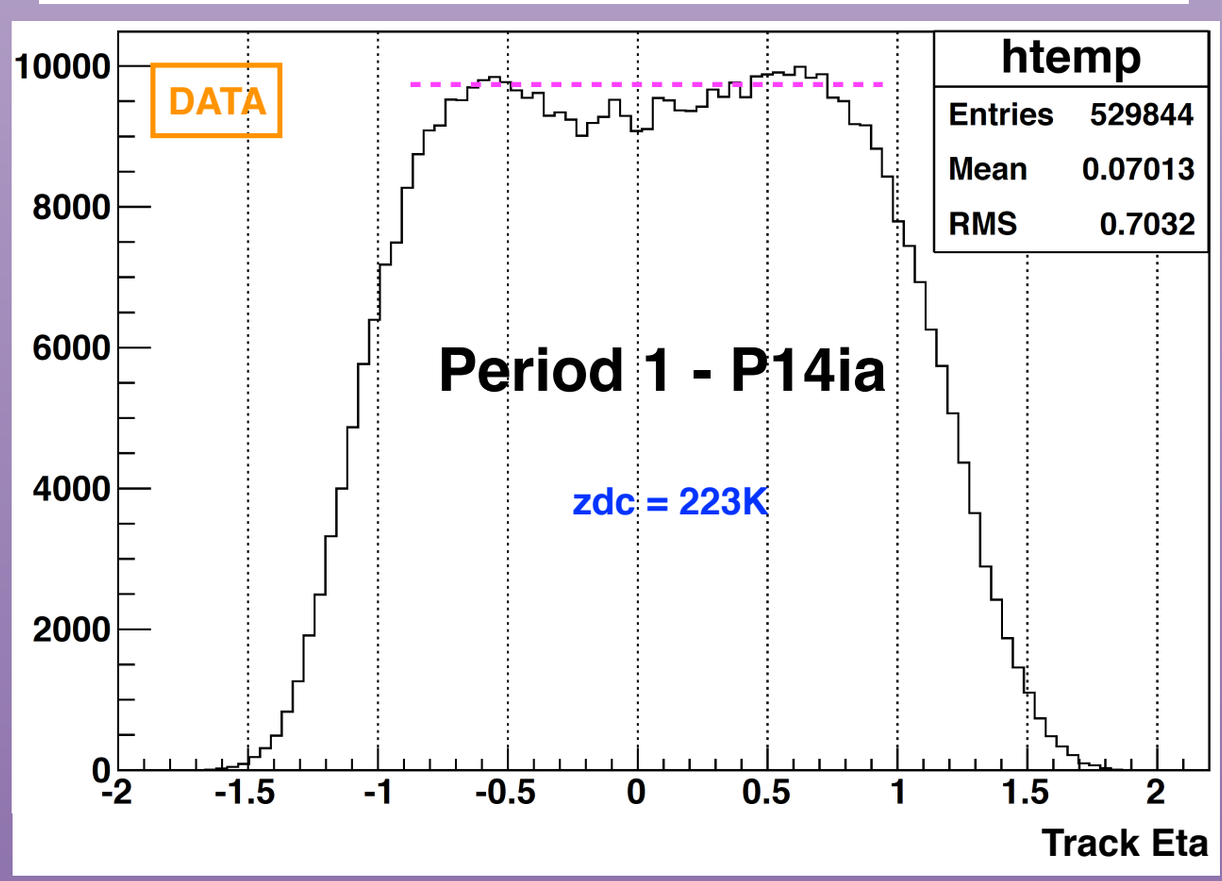
**Before looking at track level eta distributions (before applying W cuts ) consider luminosity variation from run 12 to run 13**

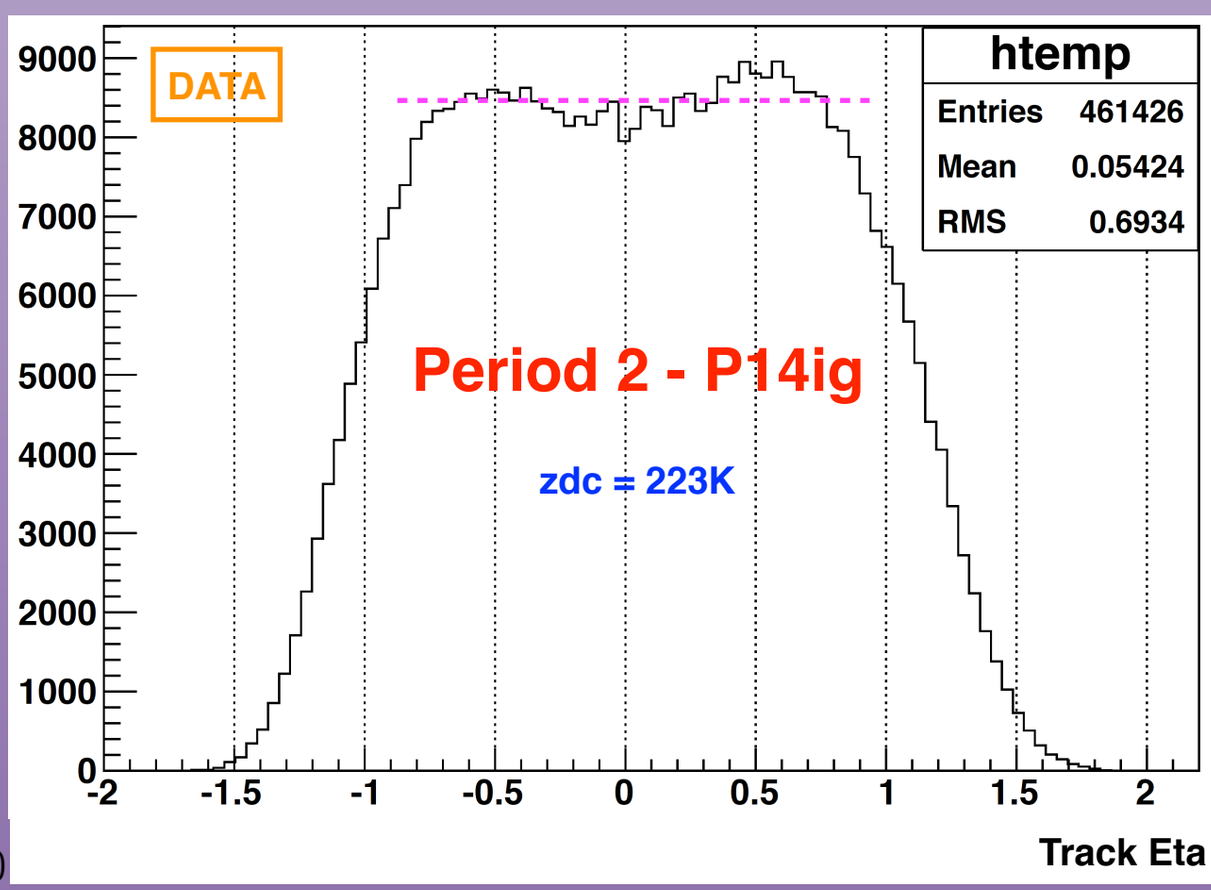


# Low Luminosity Runs - Primary Track Eta Distribution

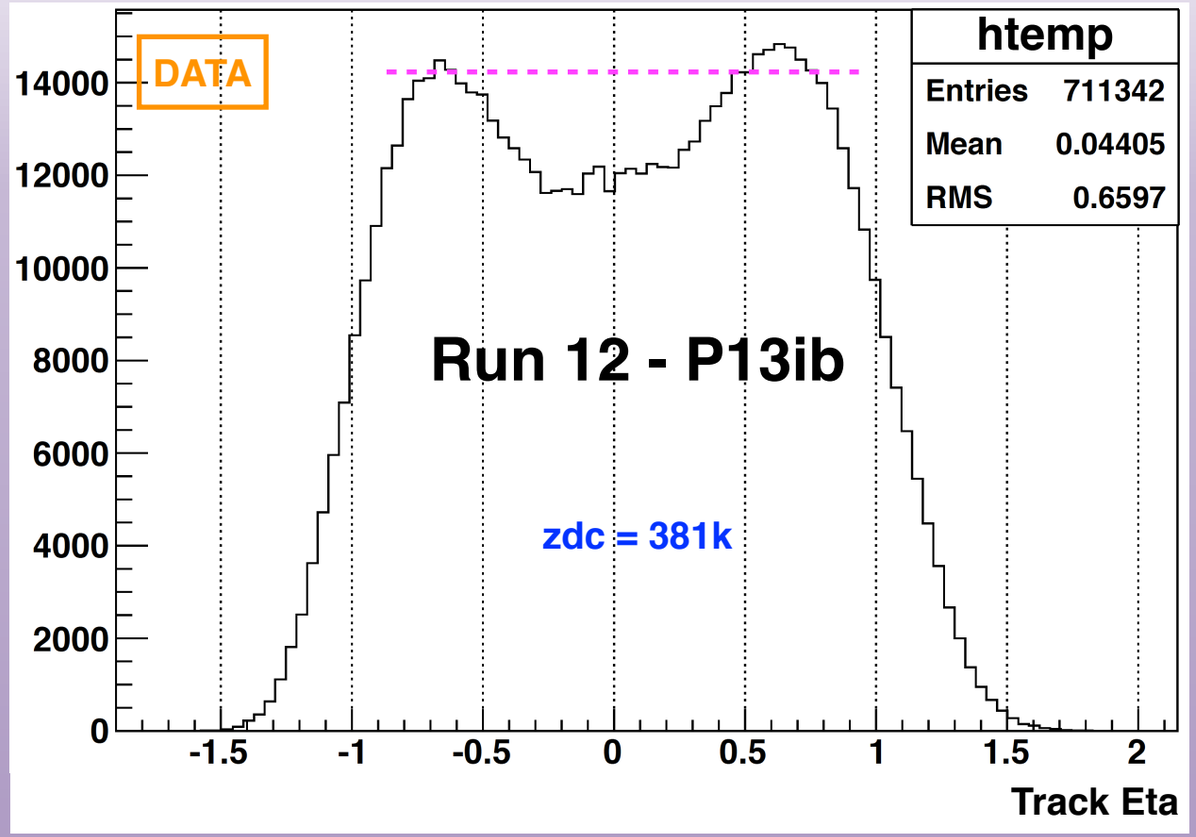



- Primary Track Eta distribution of a single run with ZDC rate noted.
- Low luminosity runs shows almost no “eta - dip”

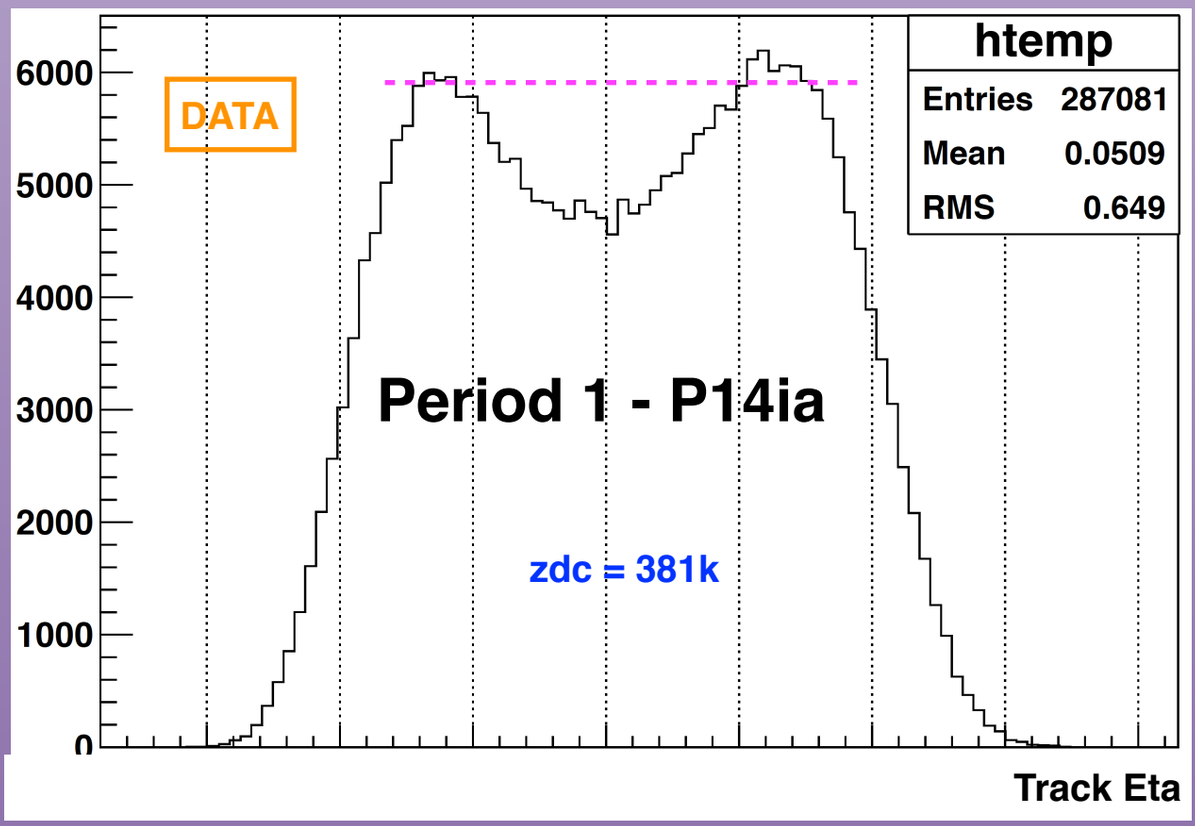


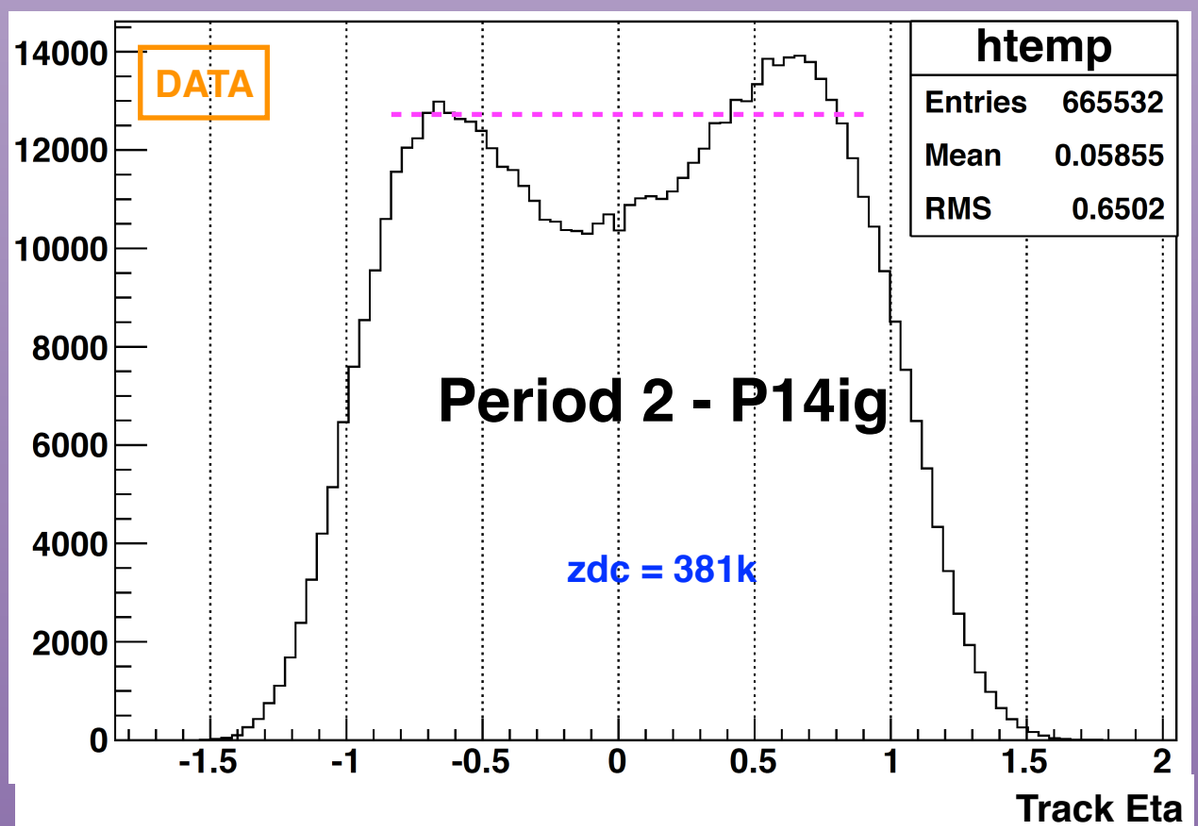



# High Luminosity Runs - Primary Track Eta Distribution

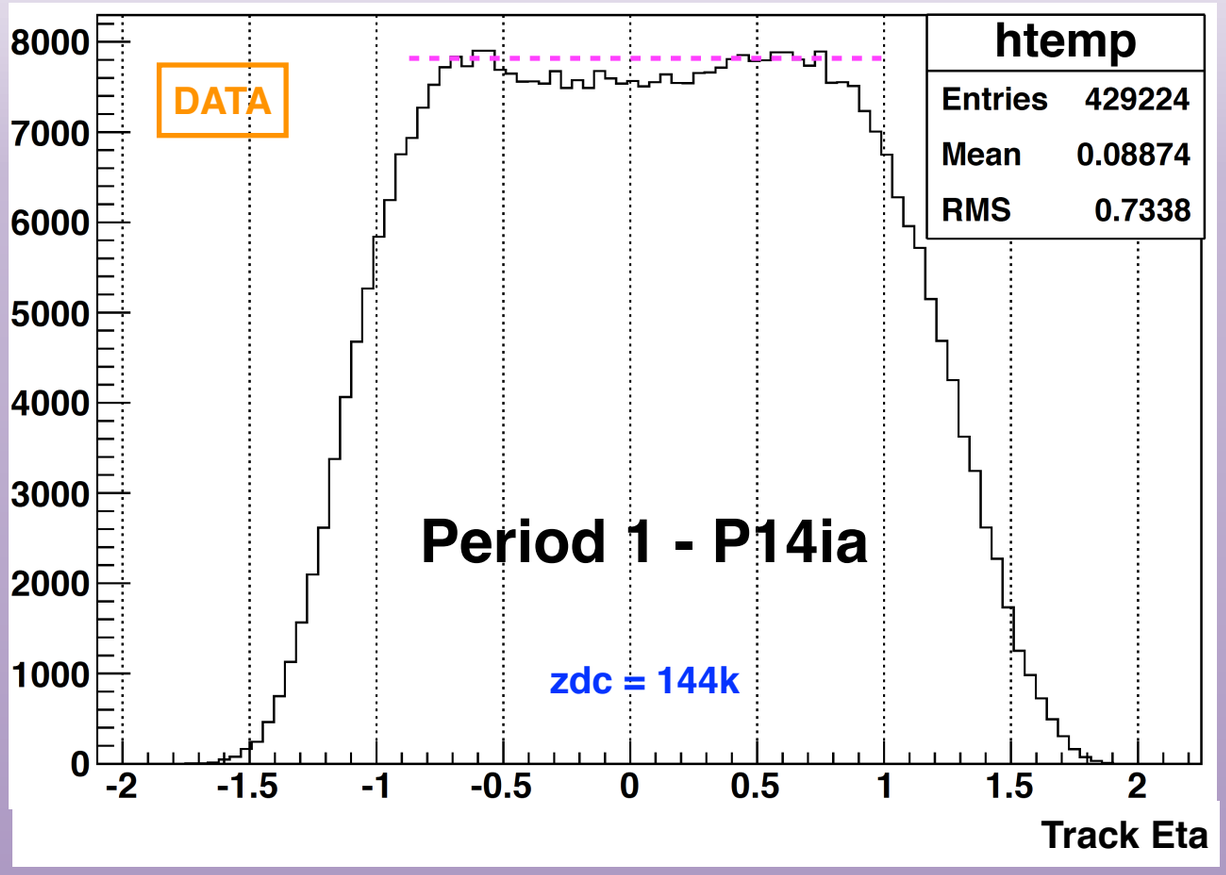


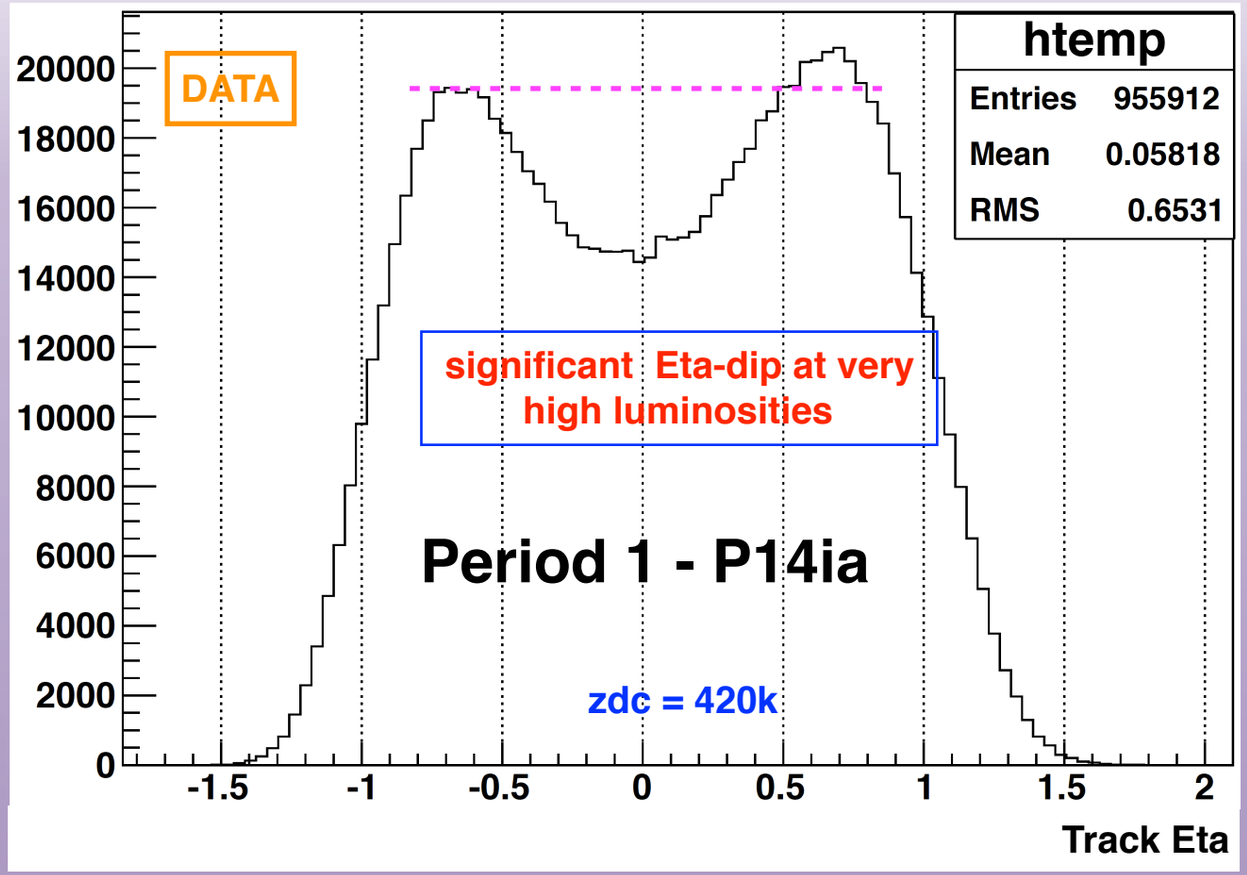

- High luminosity runs clearly shows an eta dip, even in run 12.
- But in run 12 only less than 13 % of the statistics is above 300 kHz, while in run 13 - P1 50 % of the statistics is above 300kHz and in period 2, 90 % of the statistics is above 300kHz.

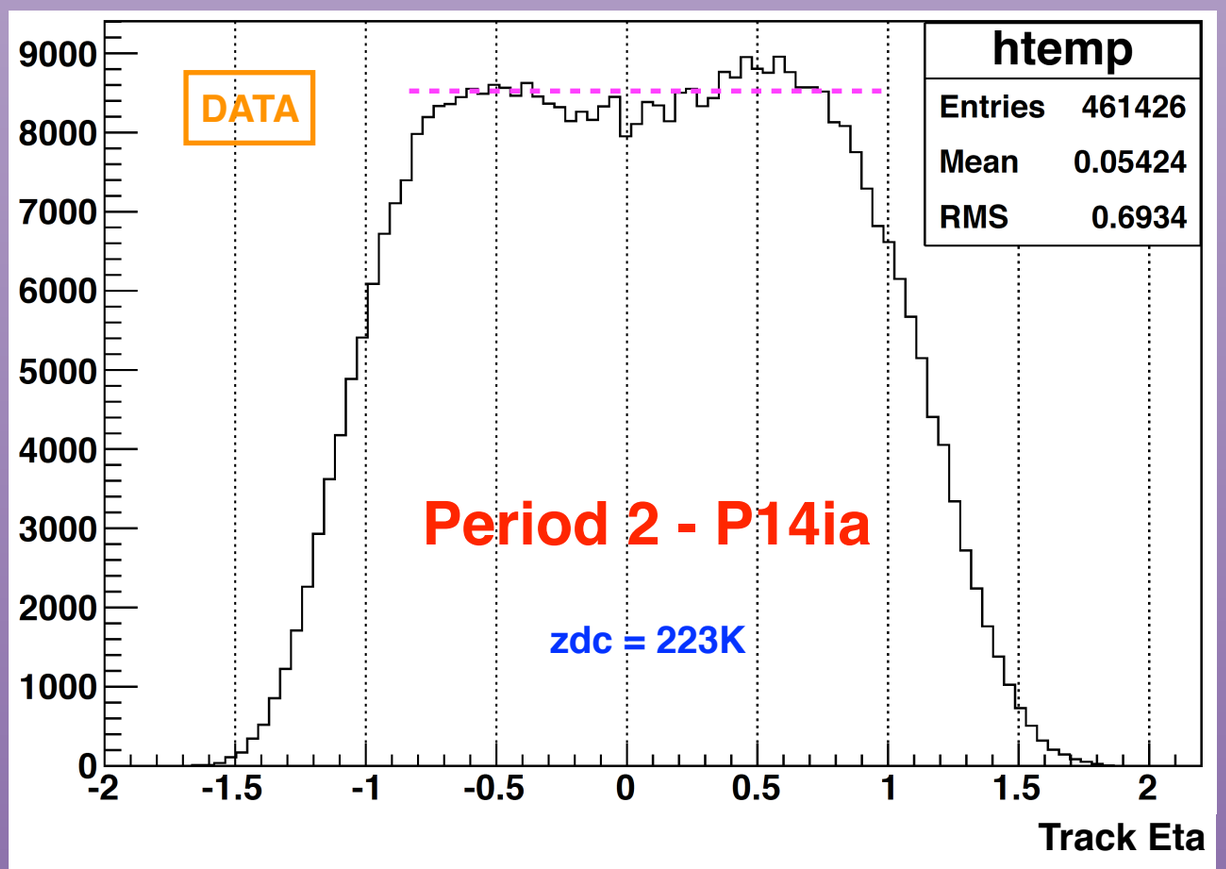


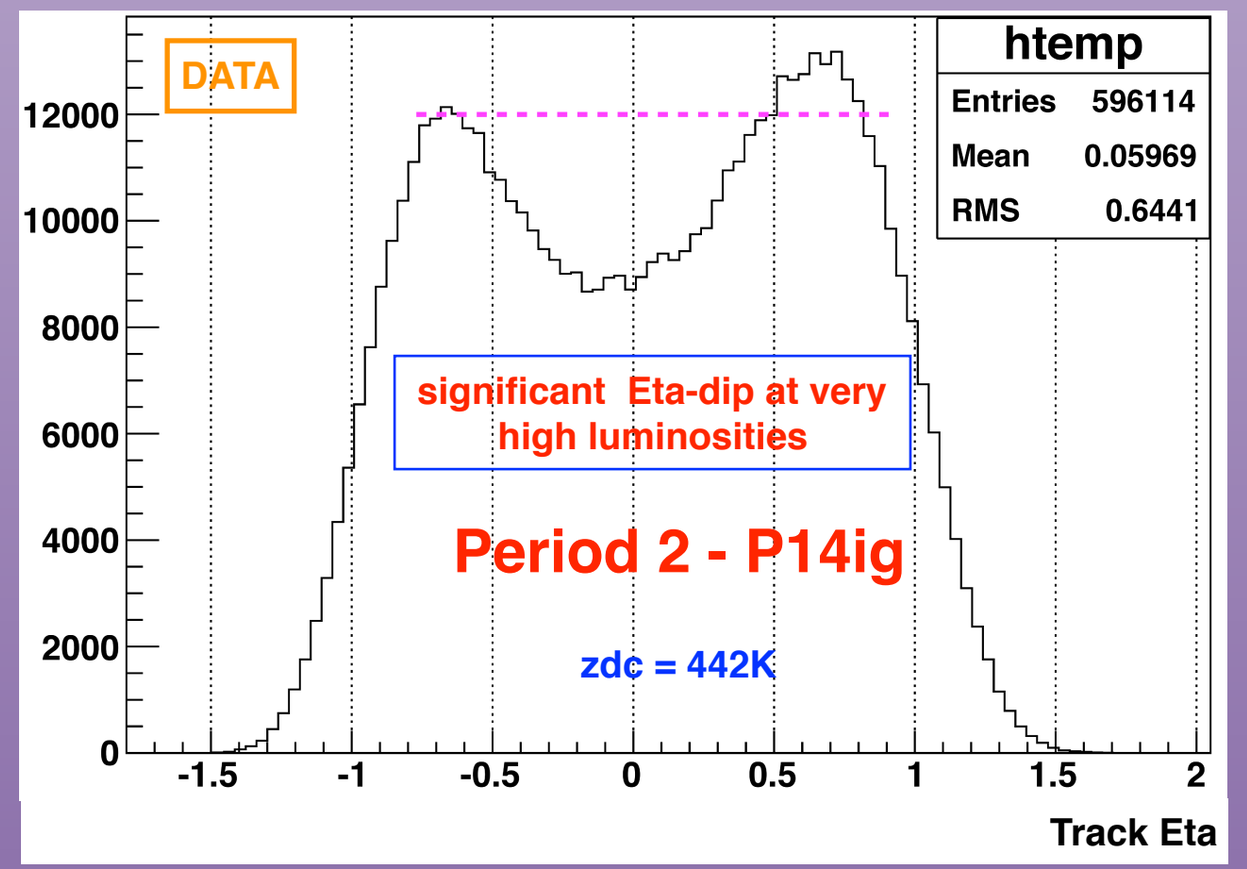



# STI - Track Eta : Luminosity Dependance

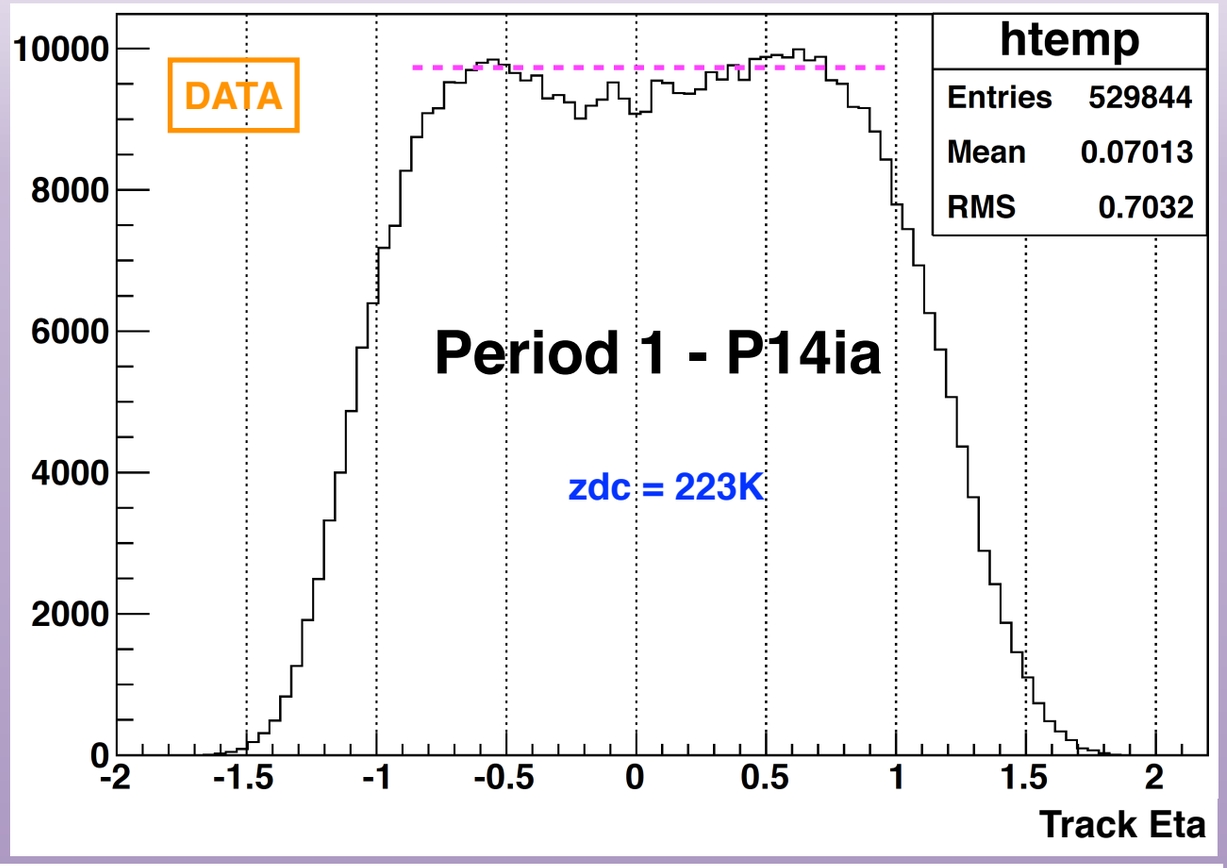


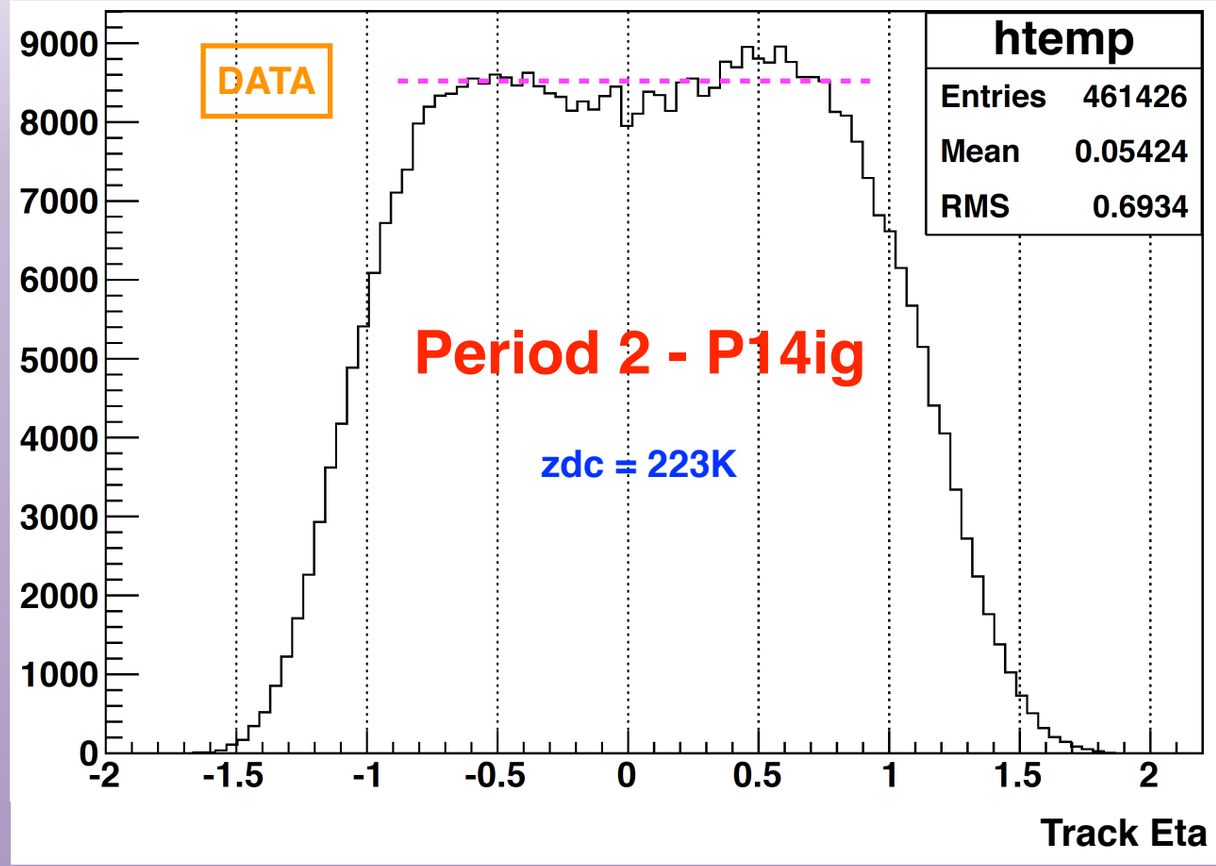



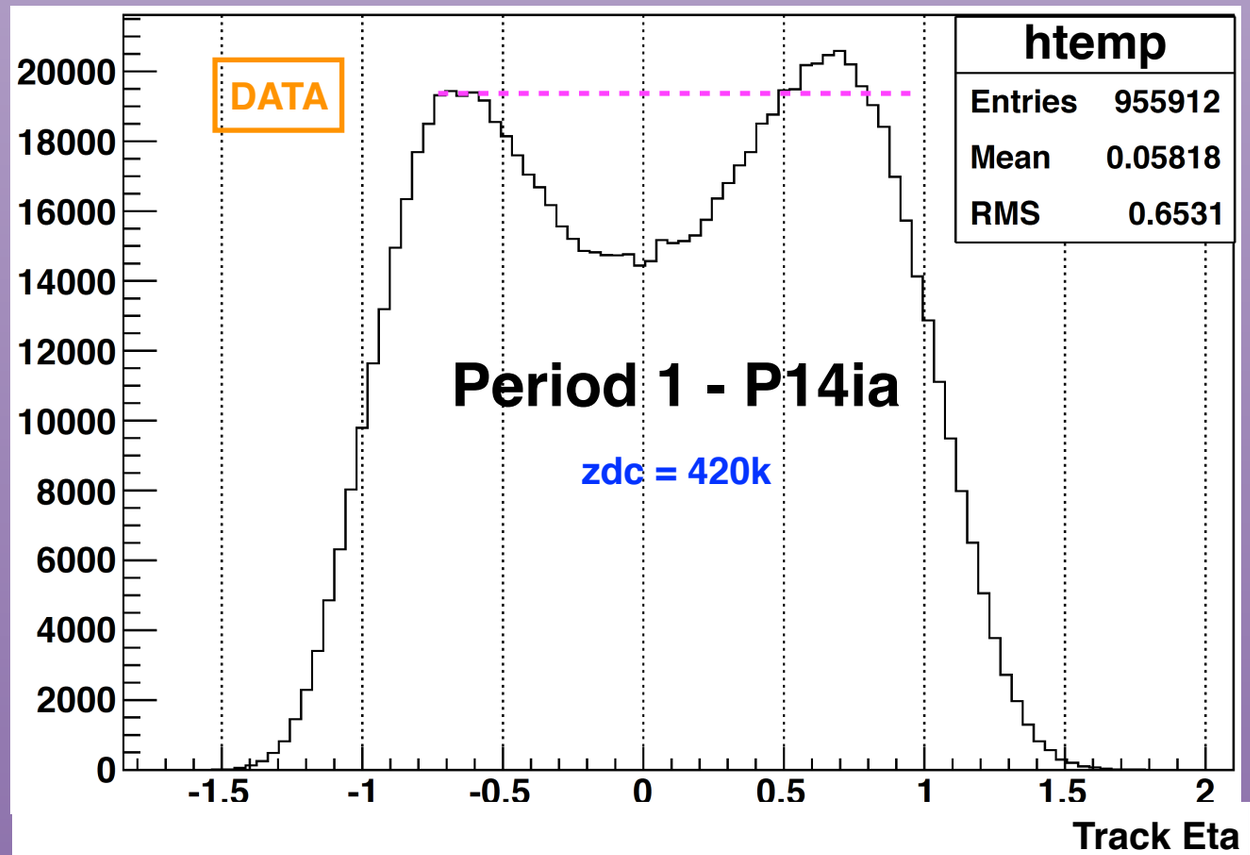



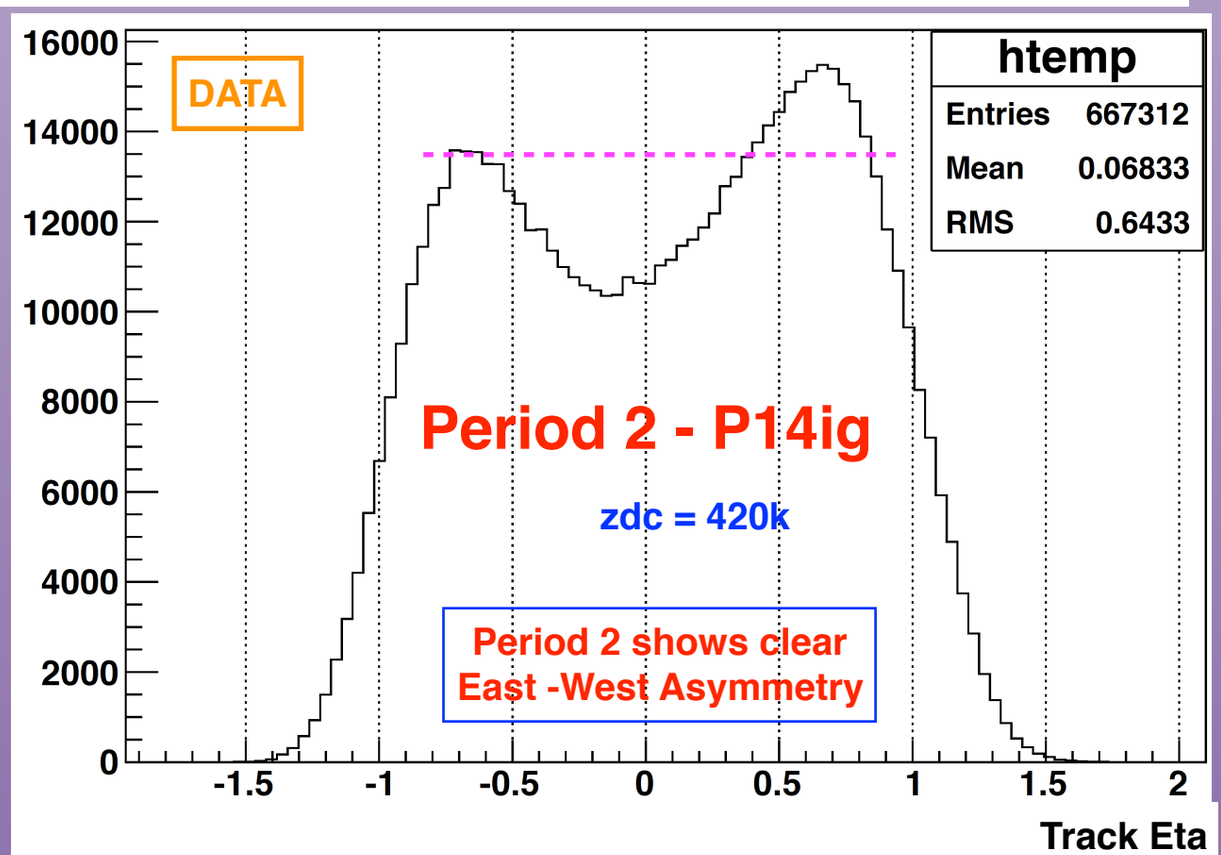



# STI - Track Eta : Same Luminosity, Period dependence



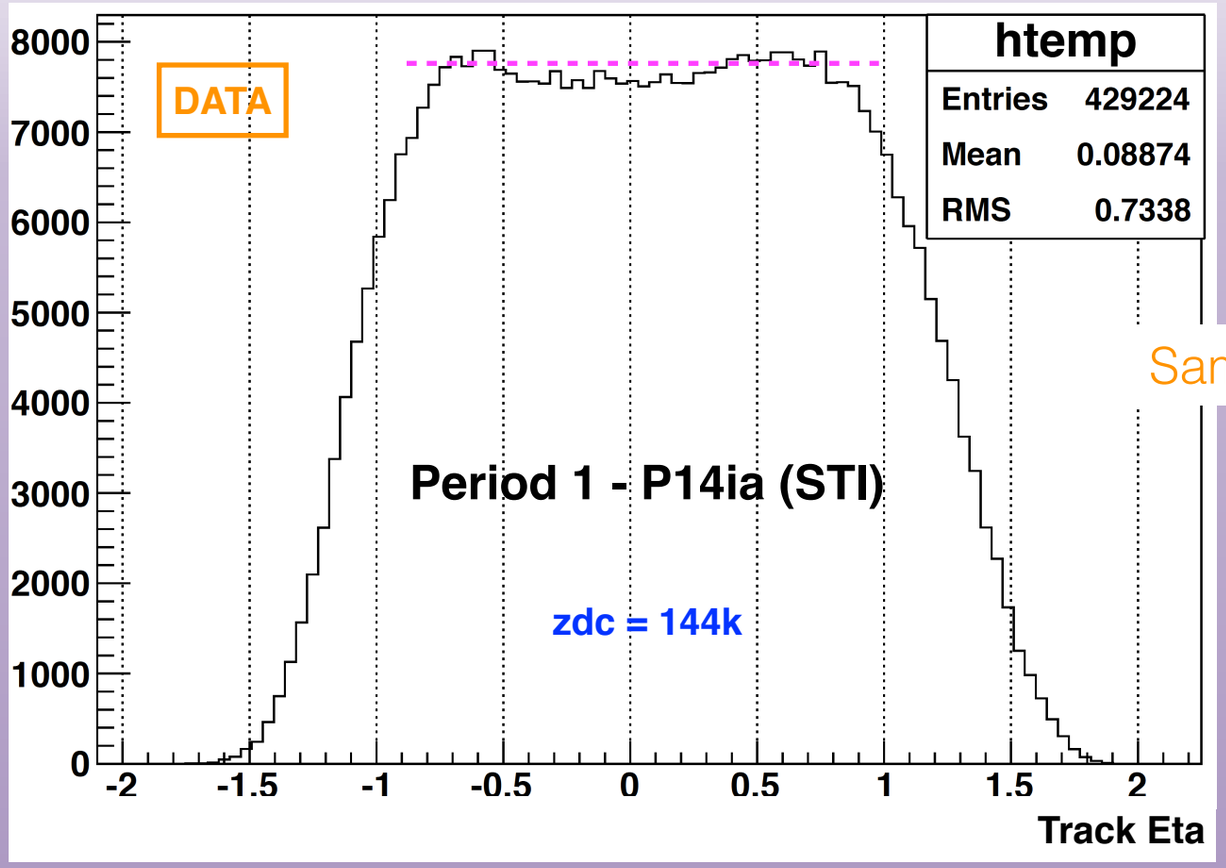



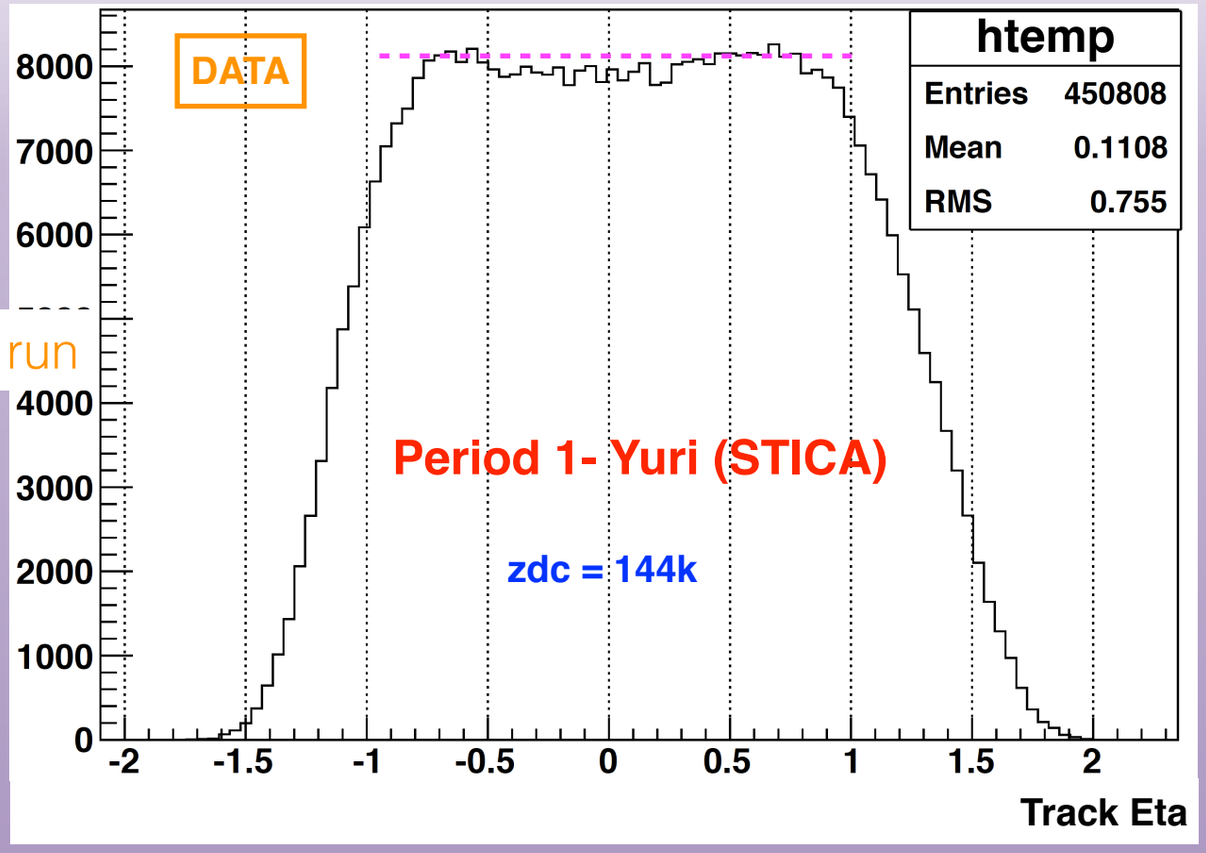
# Main Cause of the Eta-Dip

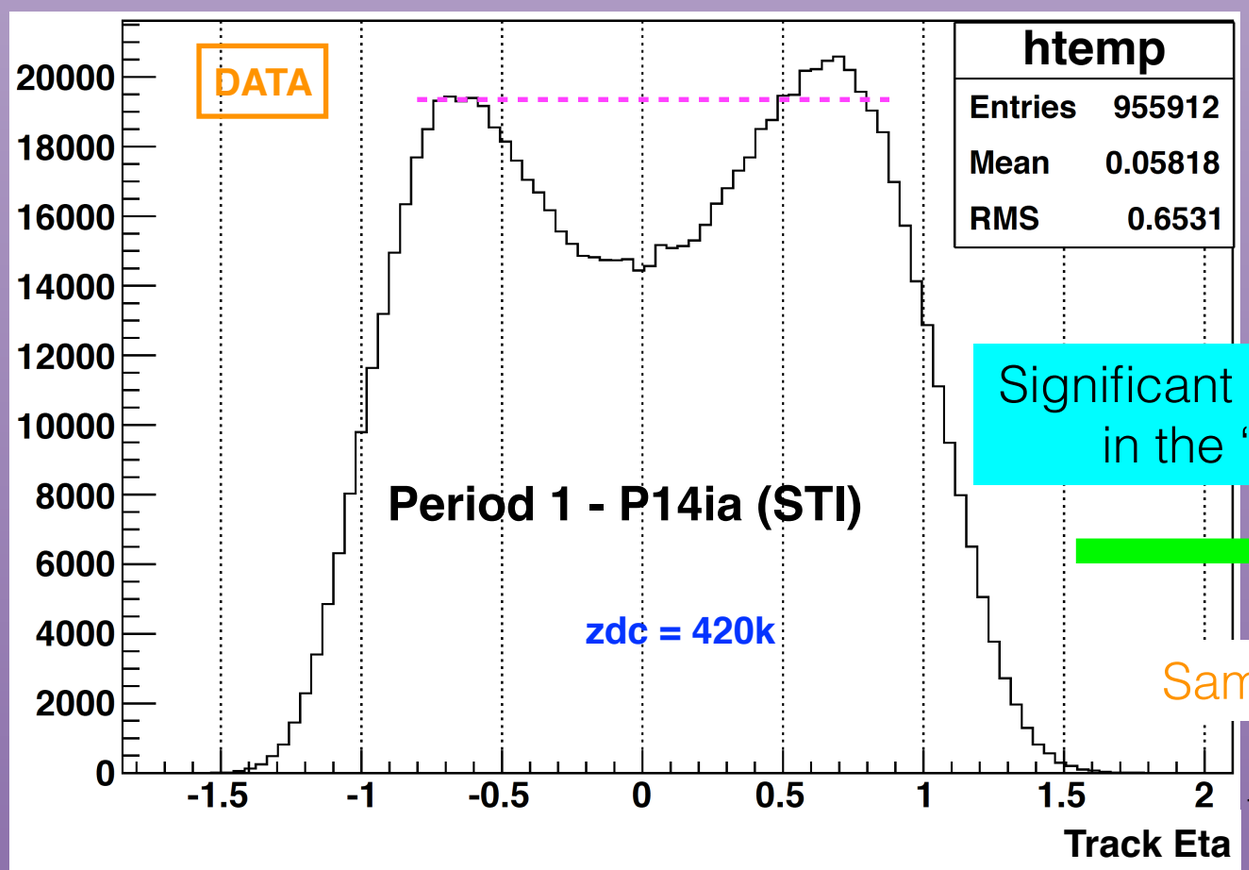
- Strong indication that the main cause of the eta-dip is the high luminosity data in run 13.
- Based on the various tests we have done so far, STICA tracking algorithm improves the track reconstruction efficiency at high luminosity [No track splitting / double counting found at high $p_T$].
- Lets look at track eta distributions from STICA in comparison to STI.

# STI vs STICA - Run 13 Period 1



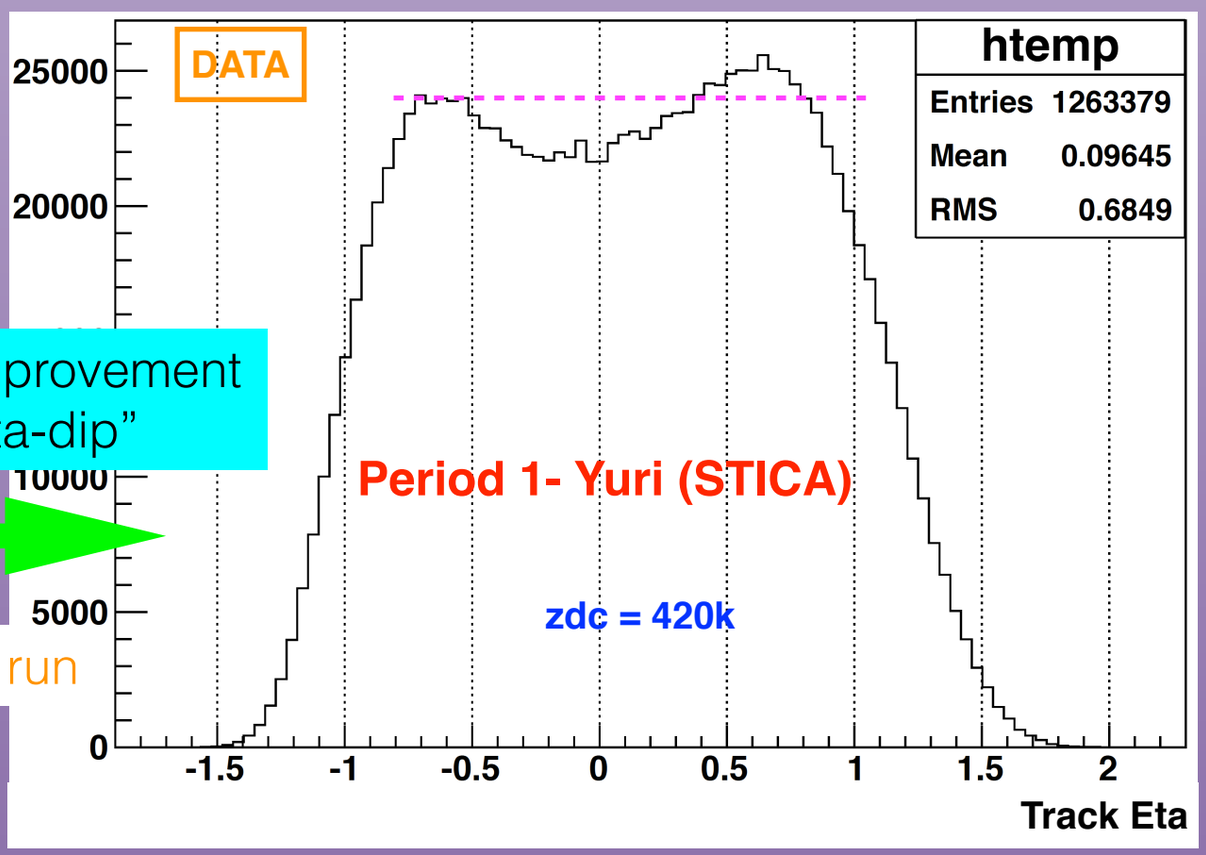

Same run



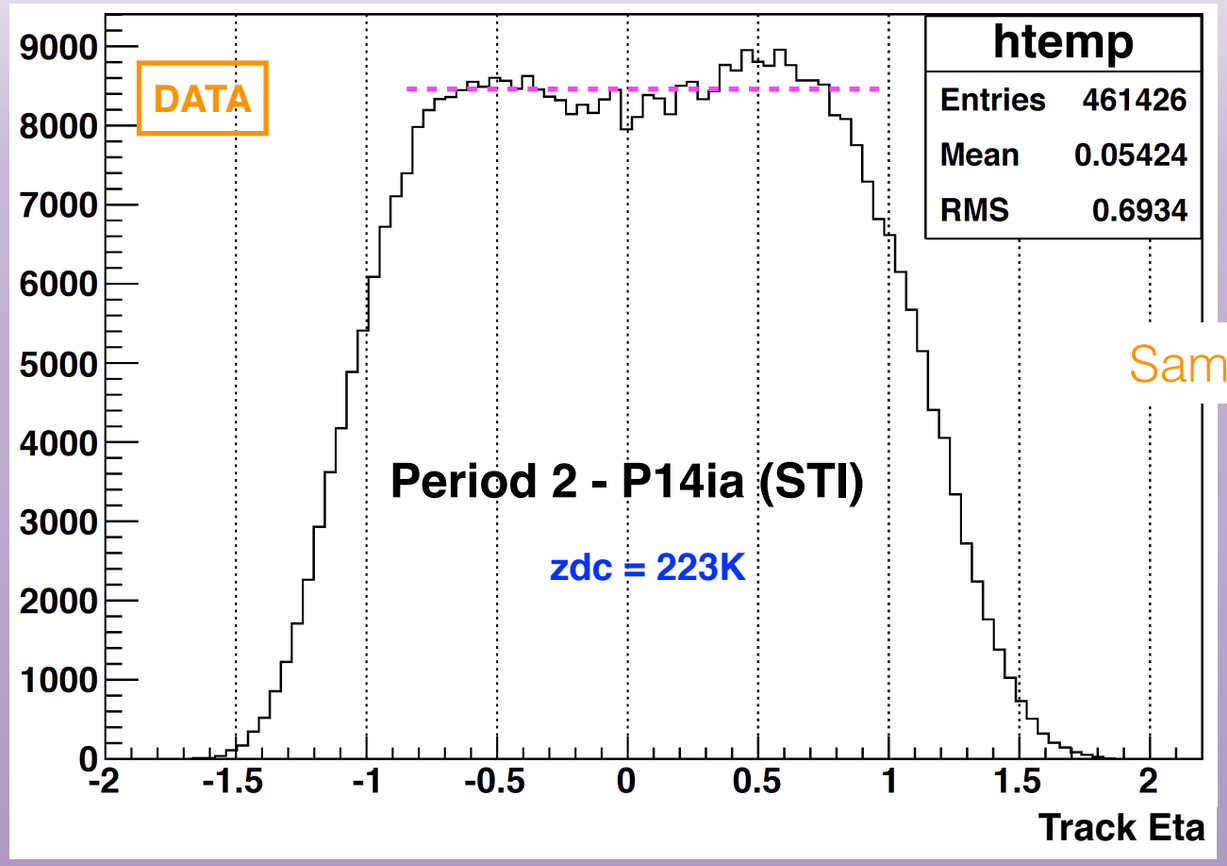




Significant improvement in the “eta-dip”

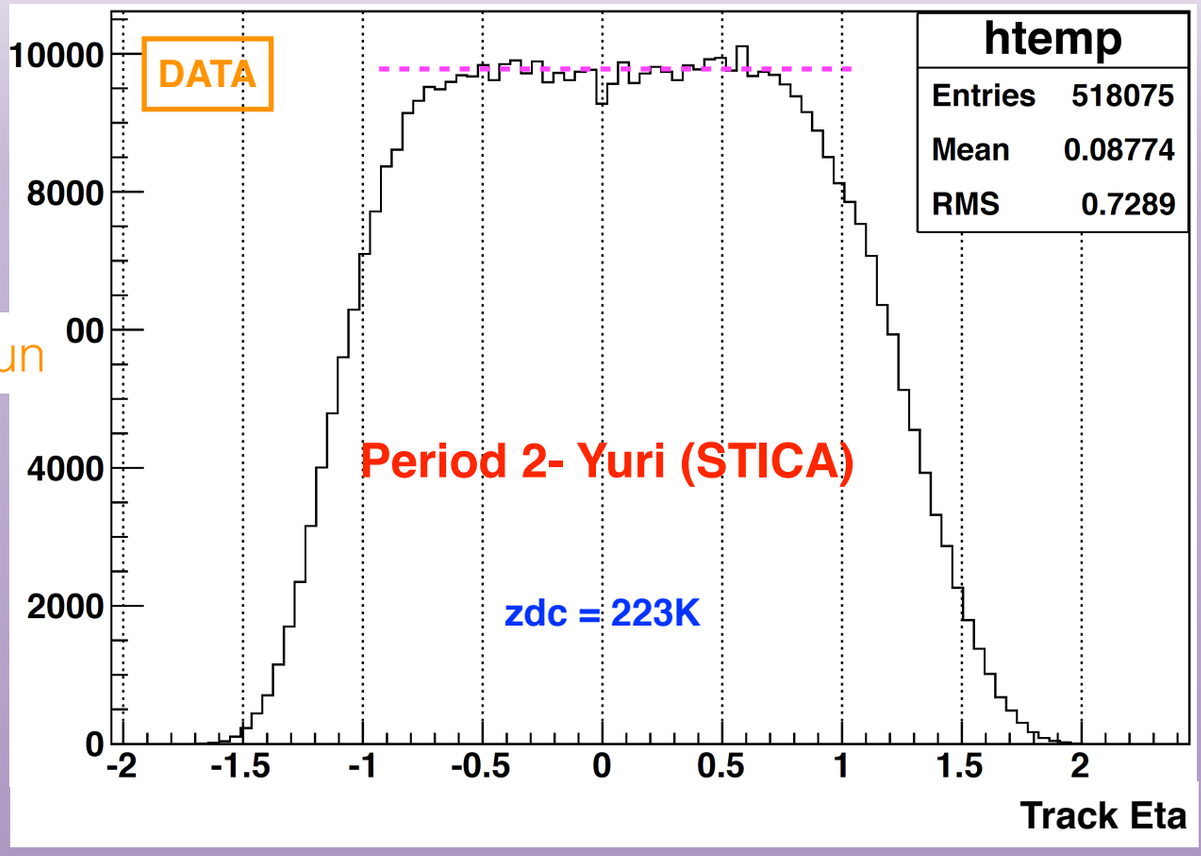
Same run

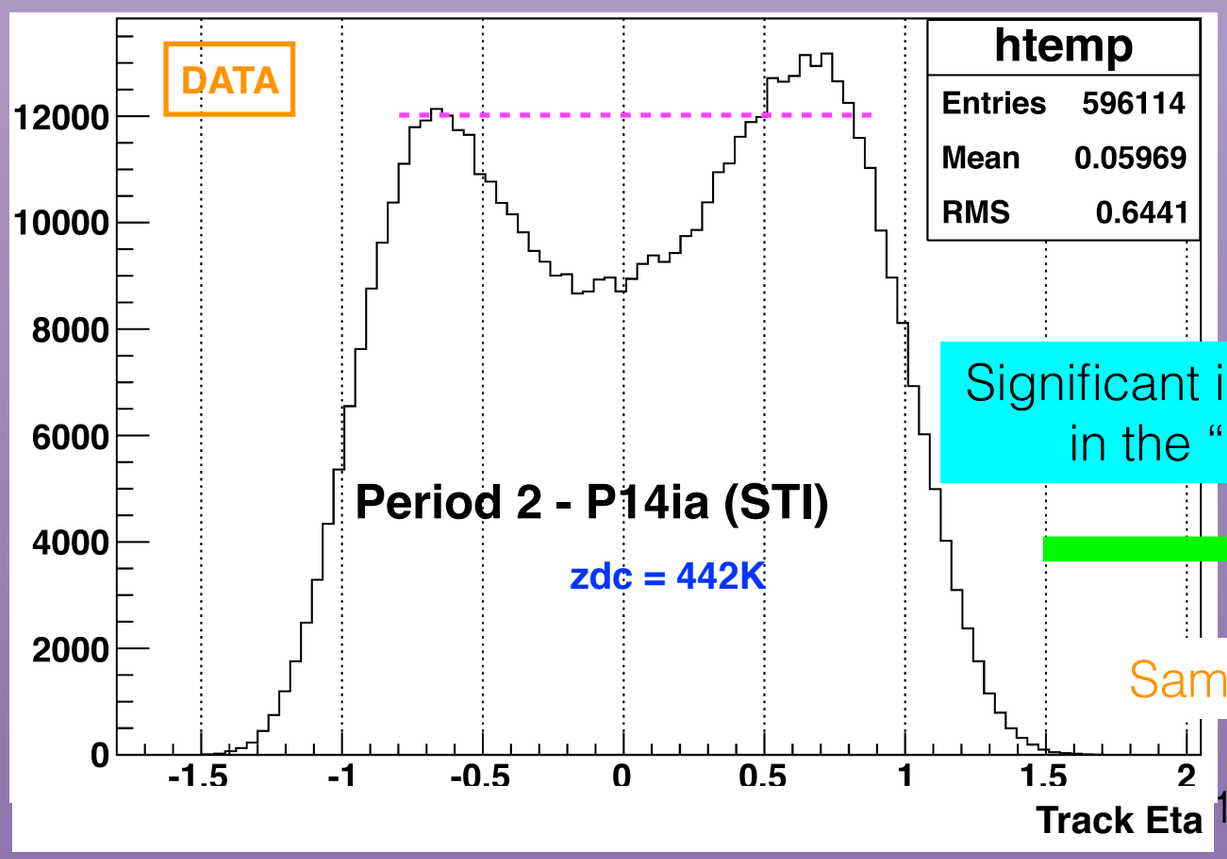


# STI vs STICA - Run 13 Period 2



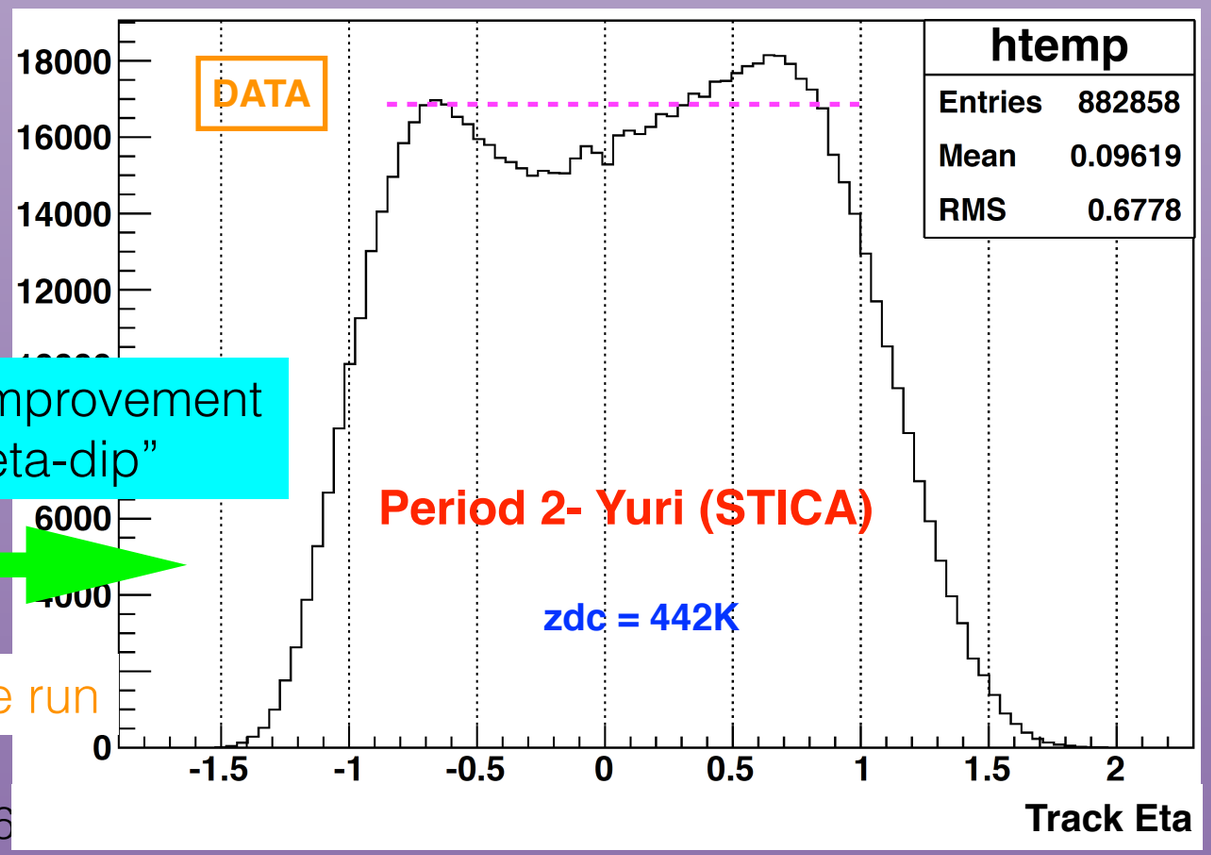

Same run



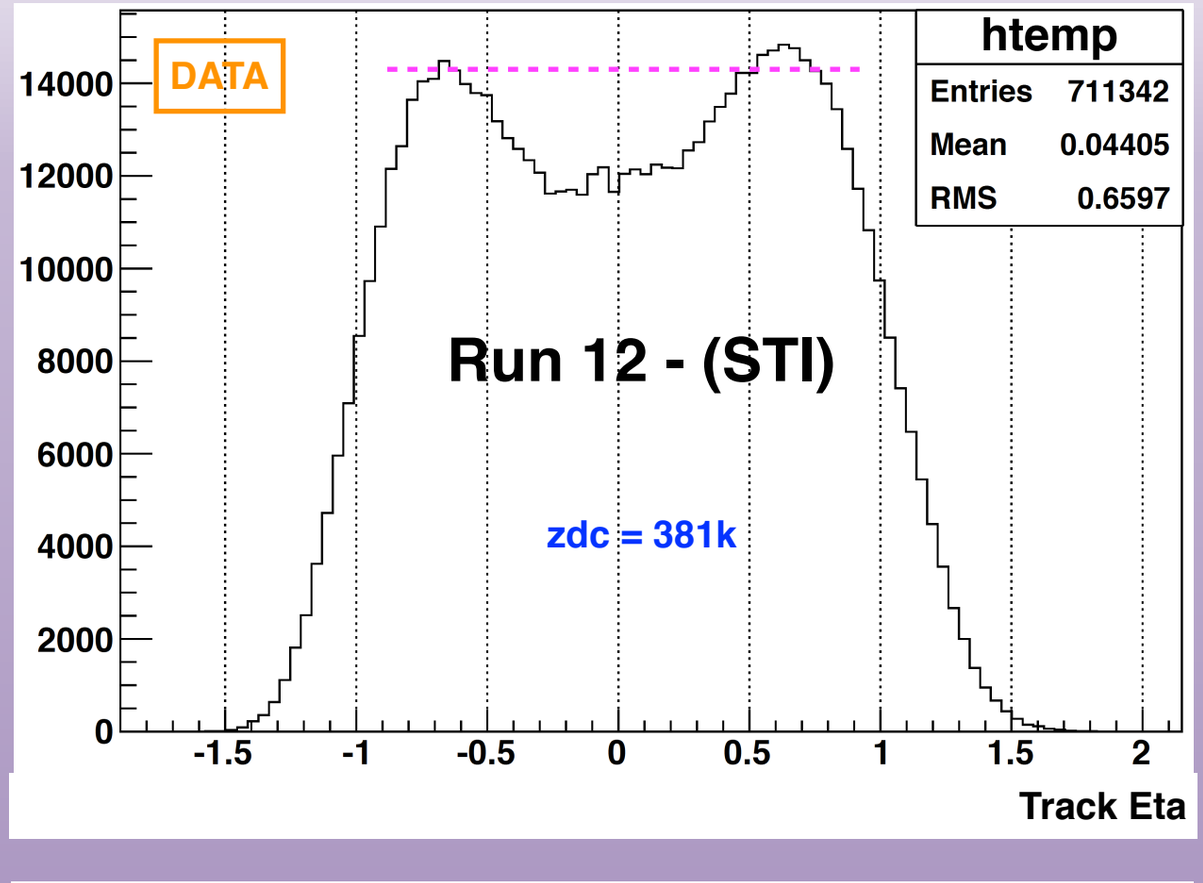

Significant improvement in the “eta-dip”

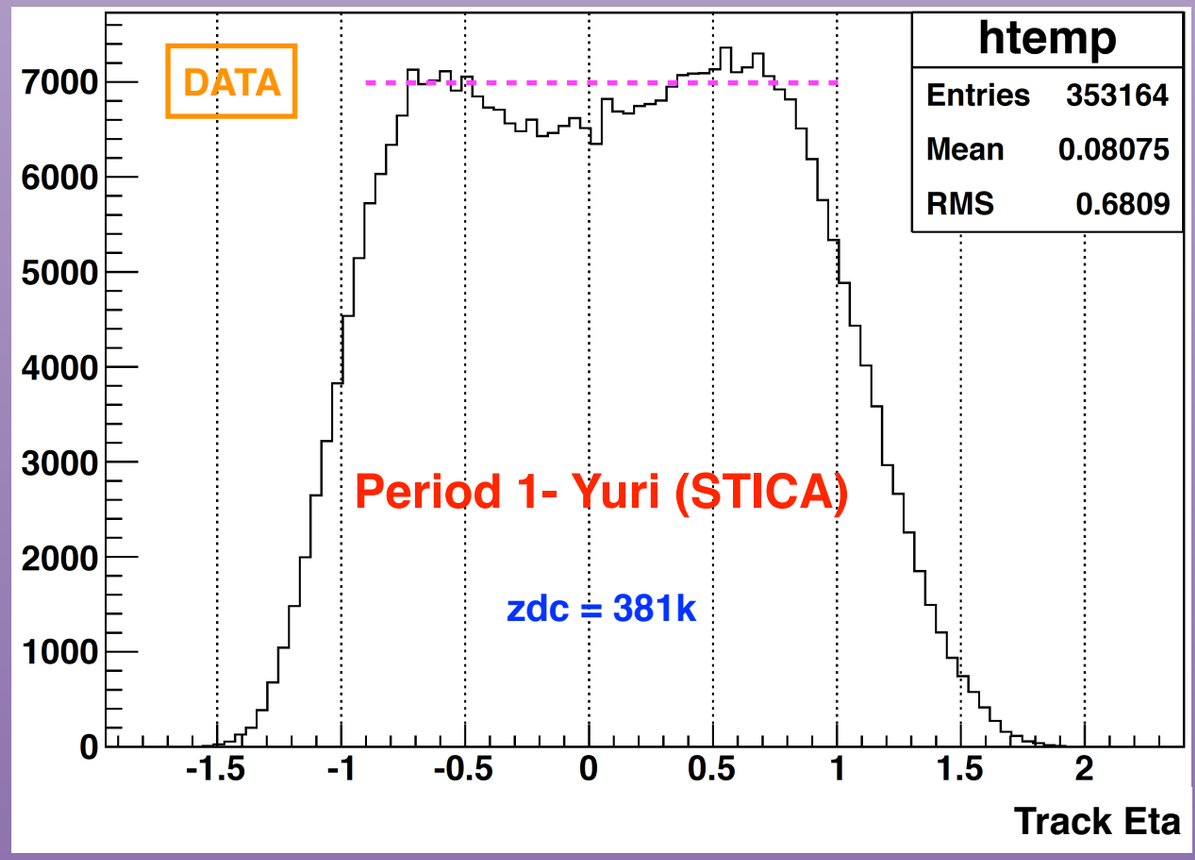
Same run

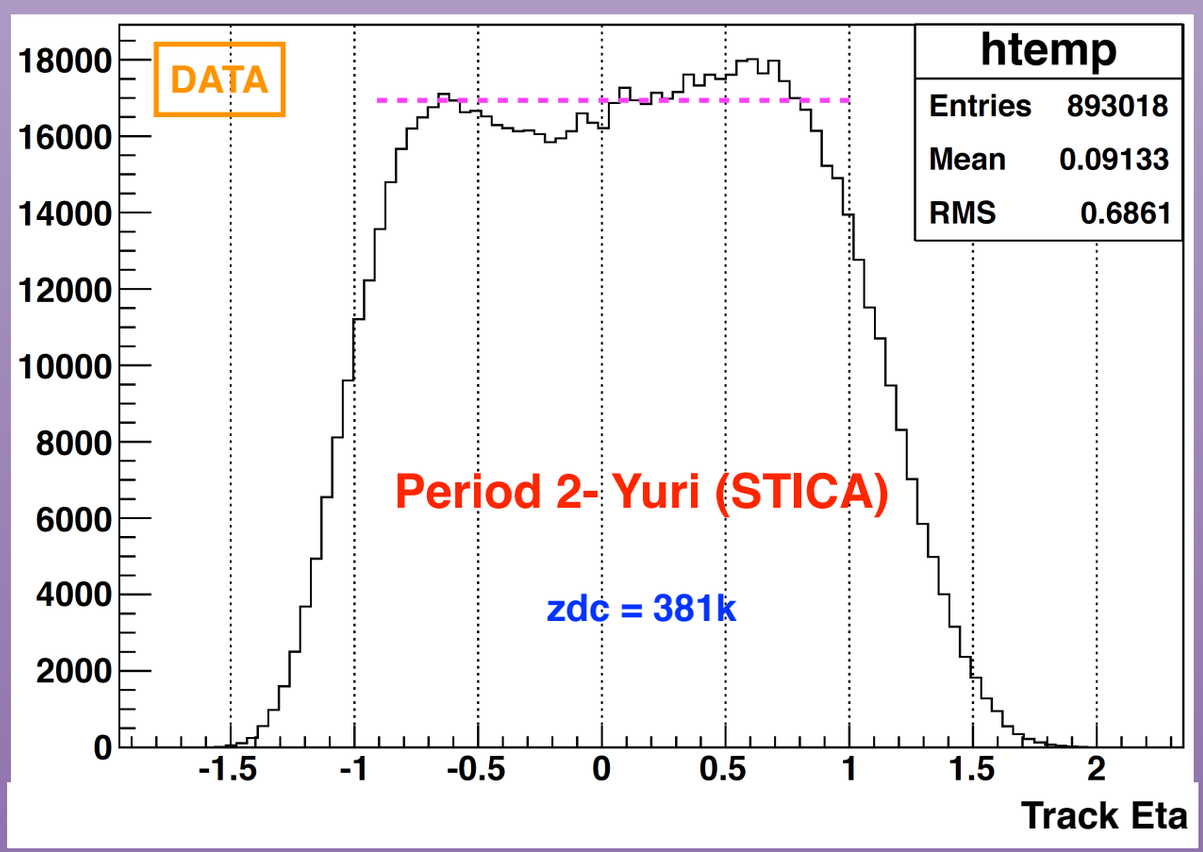


# STICA in comparison to run 12

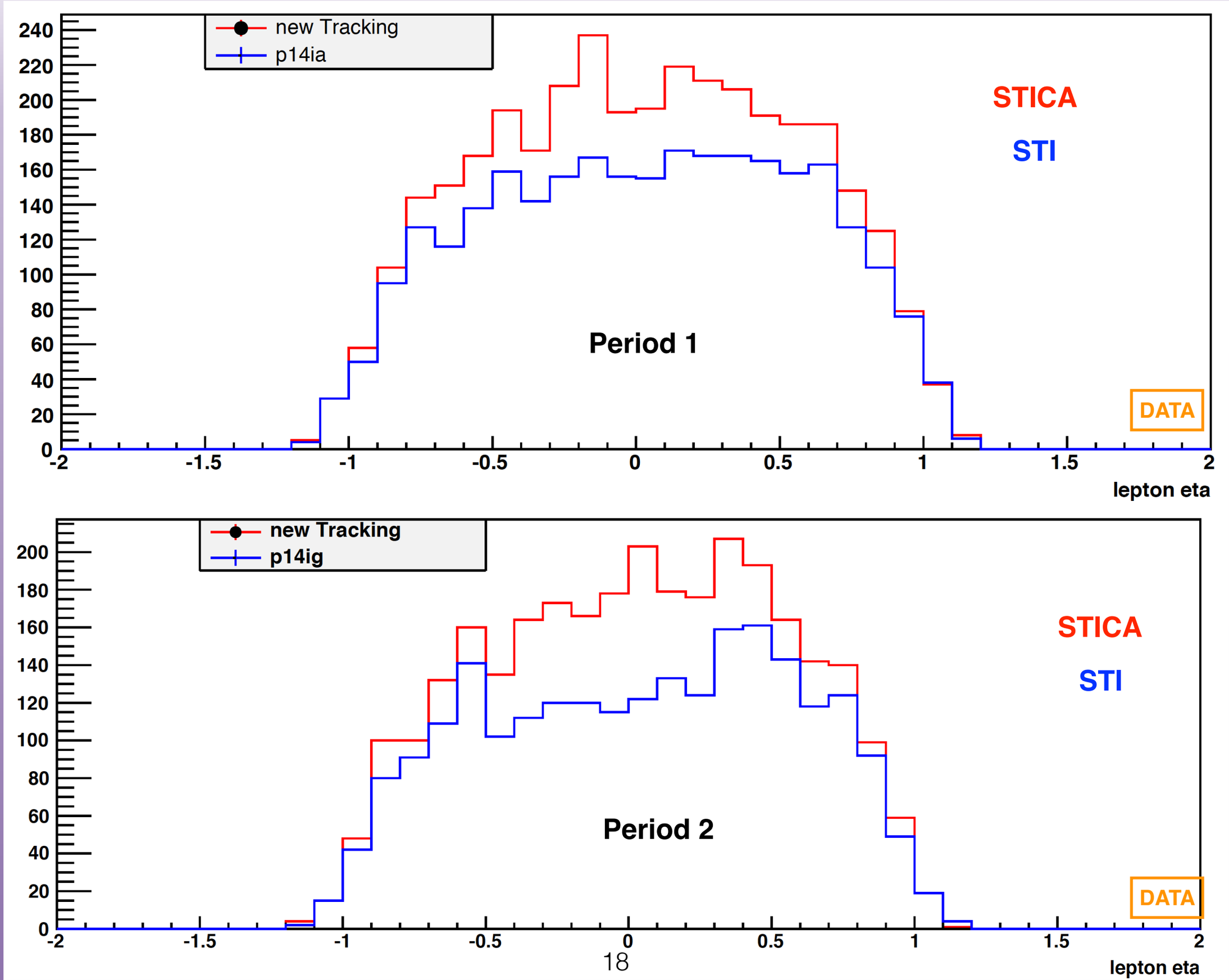
- STICA does a good job at high luminosity.
- The STICA algorithm provides a larger efficiency for Run 13 at high luminosity than the published Run 12 results.



# STI vs STICA Final W eta distributions



# Reproduction of W stream using STICA

- Need a reproduction of Data / embedding of W stream using STICA.

- When can S&C officially do this ? We cannot afford a further delay of the release of the run 13 W preliminary results [Recall PAC discussion in June 2015!].

- Since we have no time estimation from S&C, how are we proceeding to release W preliminary results @ INPC2016 and SPIN2016?

- We need to figure out an alternative strategy.

- Next couple of sides shows our our plan and our suggested alternative strategy.

# Work Plan for Releasing W AL Preliminary Results at SPIN 2016

**INPC 2016 Conference :** 11-16 Sep. 2016, Adelaide, Australia

**DNP 2016 :** 13–16 Oct. 2016,Vancouver, BC, Canada

**SPIN 2016 Conference :** 25-30 Sep. 2016, Urbana, IL, USA

| Month | Work Load | | Resources |
|---|---|---|---|
| May | Preparation for an alternative strategy | Data Production / Final BEMC gains | Alternative strategy [unofficial]<br>• DISK space<br>• STICA code |
| June | Embedding Production | Actual Analysis | Alternative strategy [unofficial]<br>• DISK space<br>• STICA code |
| July | Systematic / Final Touch | Writing Paper / Analysis notes | coffee :) |
| August | Presentations to PWG / Reviews | | Everyone's prompt comments / suggestions |

# The Alternative Strategy

- Use an unofficial production of the run 13 W data and embedding using STICA code:

  - Use of existing Yuri's Data production. [Yuri's STICA code], and produce embedding by ourselves. [Yuri has already given us his settings / library to be used for embedding and a test sample is already being produced.].

  - We have already analyzed Yuri's production and found **absolutely zero discrepancies** between EVAL STICA and Yuri's STICA in W analysis.

    https://drupal.star.bnl.gov/STAR/system/files/userfiles/3475/yuri-p1-vs-evals4.pdf

# Yuri's Answer on our Alternative Strategy

Question to Yuri: "Can TFG16a (Yuri's) production for 2013 pp510 data be used for data analysis before STAR official production with StiCA will be complete", i.e. for the W Run 13 prelim. result release

Yuri's answer: YES.

More details from Yuri :

Difference between official and private production is reproducibility of data. I (Yuri) believe that we can guarantee that Tracking Focus Group STAR library release TFG16a provides that.

**1.** TFG version of offline codes is kept in git repository (/afs/rhic.bnl.gov/star/packages/.DEV2) with tags which corresponds to a particular production.
/afs/rhic.bnl.gov/star/packages/.DEV2 $ git log --tags --simplify-by-decoration --pretty="format:%ai %d"
…
2016-02-12 13:06:04 -0500 (tag: v02-11-16, TFG16a)
…
This means that TFG16a version contains all modifications from STAR official CVS on 12 February 2016 plus modification for StiCA. The release TFG16a has been used for production 32M events from 2013 pp510W.

**2.** TFG16a release is now on /afs/rhic.bnl.gov/star/packages/DEV2/TFG16a and can be accessed via starver DEV2/TFG16a

**3.** This release has also been stored on HPSS as /home/fisyak/backup/TFG16a.050616.tz

**4.** MuDst produced for 2013 pp10W are kept on PWG disk and also stored on HPSS as /home/fisyak/reco/2013W/*/*/*.MuDst.root

**5.** We (TFG) can provide a reasonable technical support for any issues related to this production.

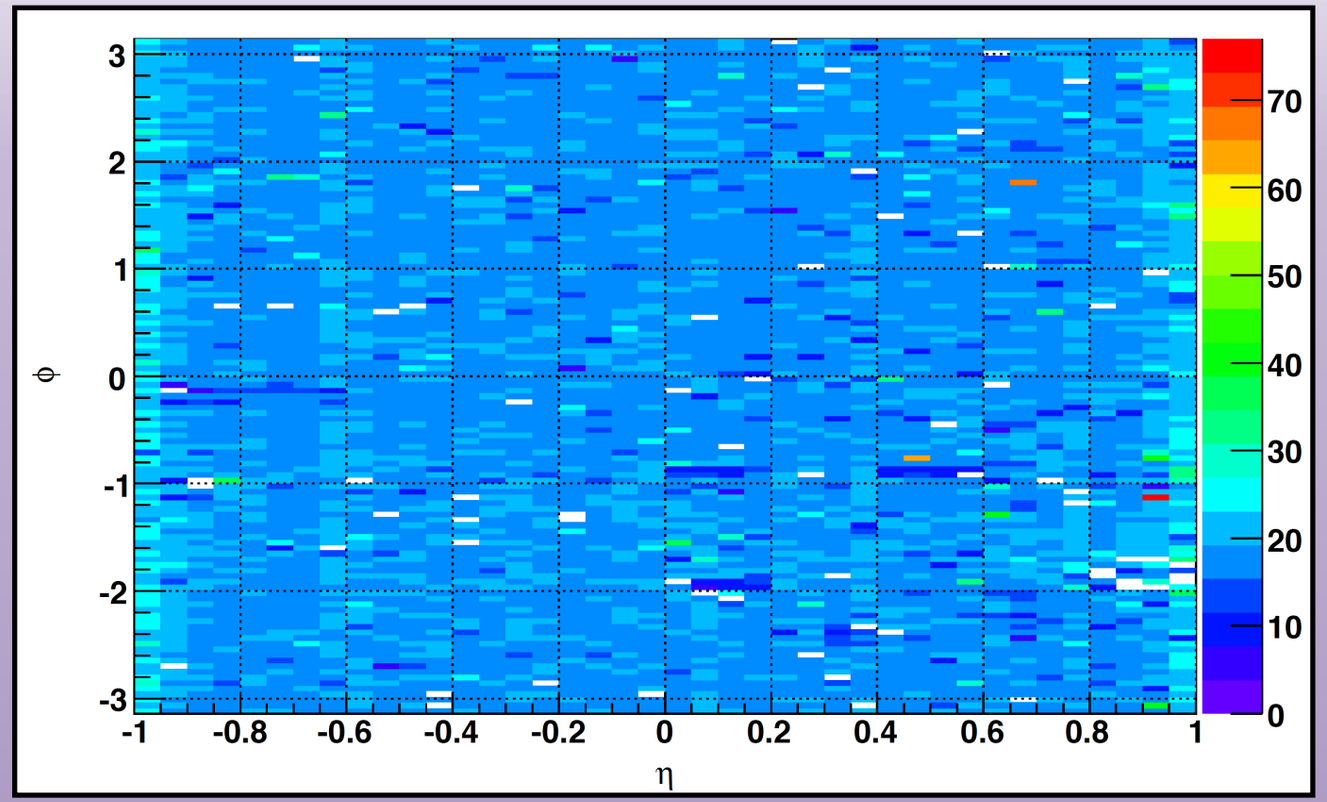
# Summary

- Run 13 W Preliminary result will be based on Yuri's production for data and MC (Embedding) unless "official" production is ready in time.
- Using Yuri's production is completely justified and ensures the need to release the W Run13 results for INPC 2016/ Spin 2016 / DNP 2016
- Determine Run 13 BEMC calibration using STI production for prelim. result release
- Finalize systematic uncertainties after embedding sample becomes available.
- SPIN PWG prelim. result presentation.
- Final / paper result based on official production.
- Writing PN / Paper draft.

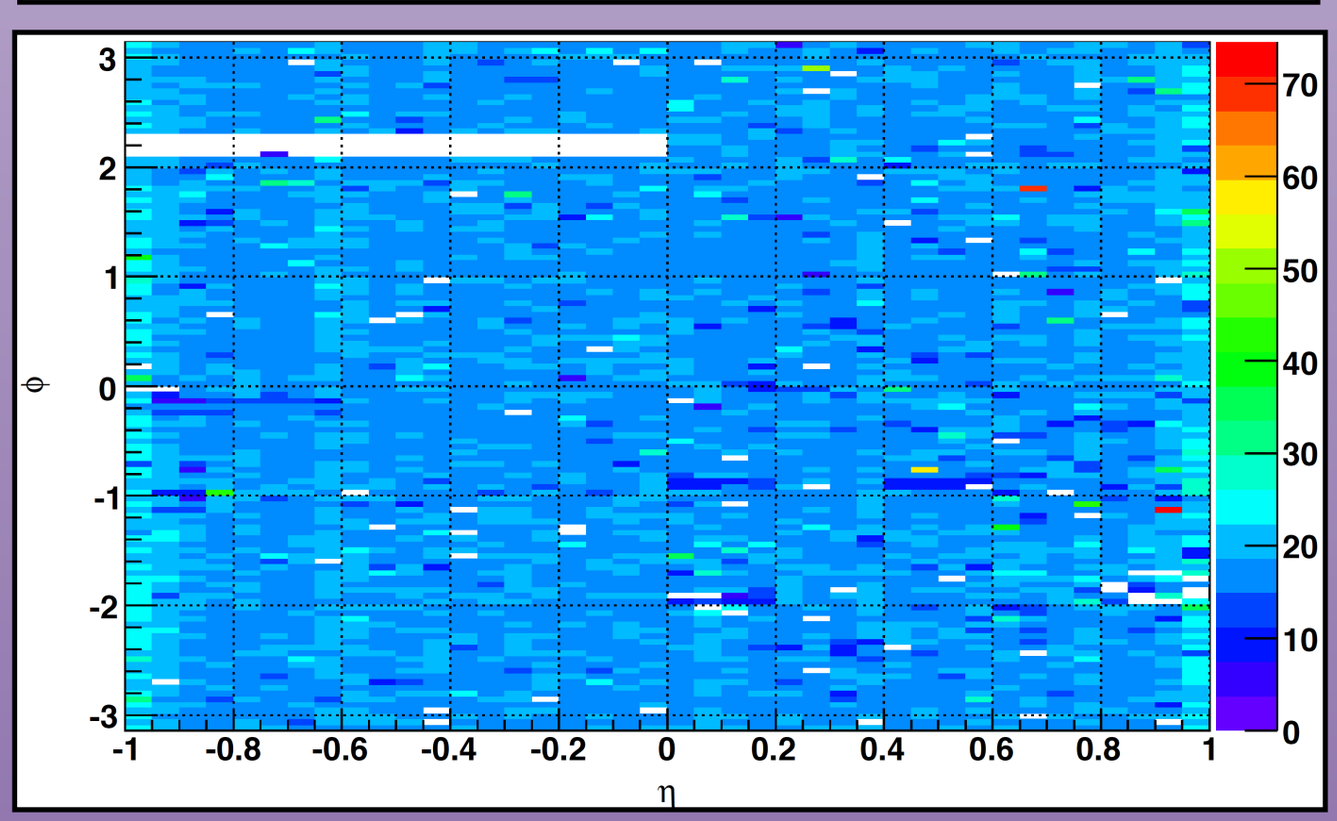
# BACK-UP

# In Run 13 Period 2 a BEMC modulo was missing in the East side!

P 1

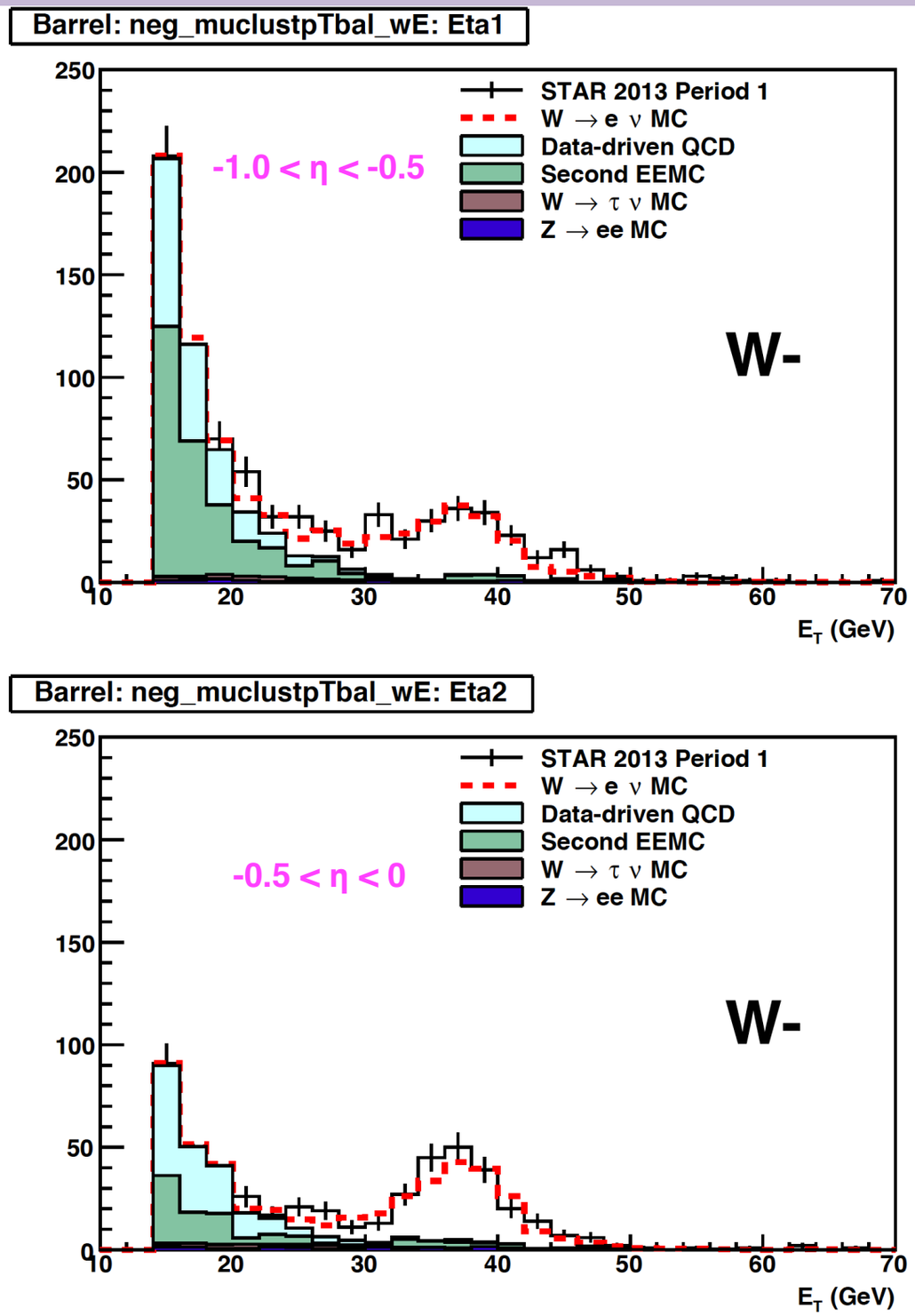


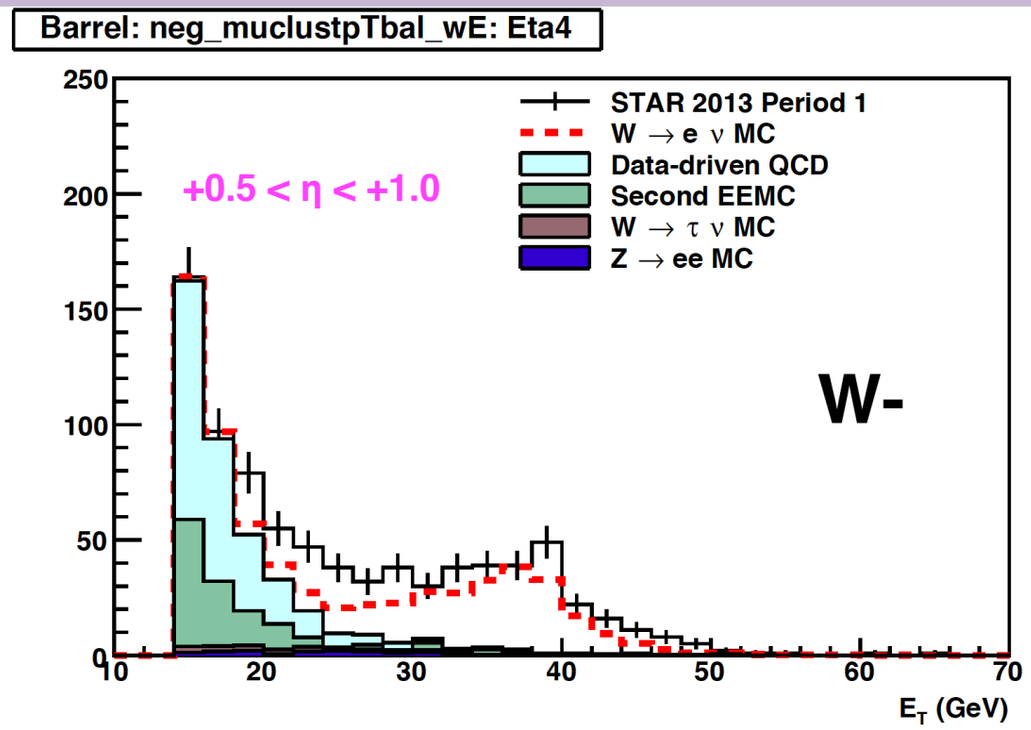

P 2



# W- "Eta-Dip" : Period 1

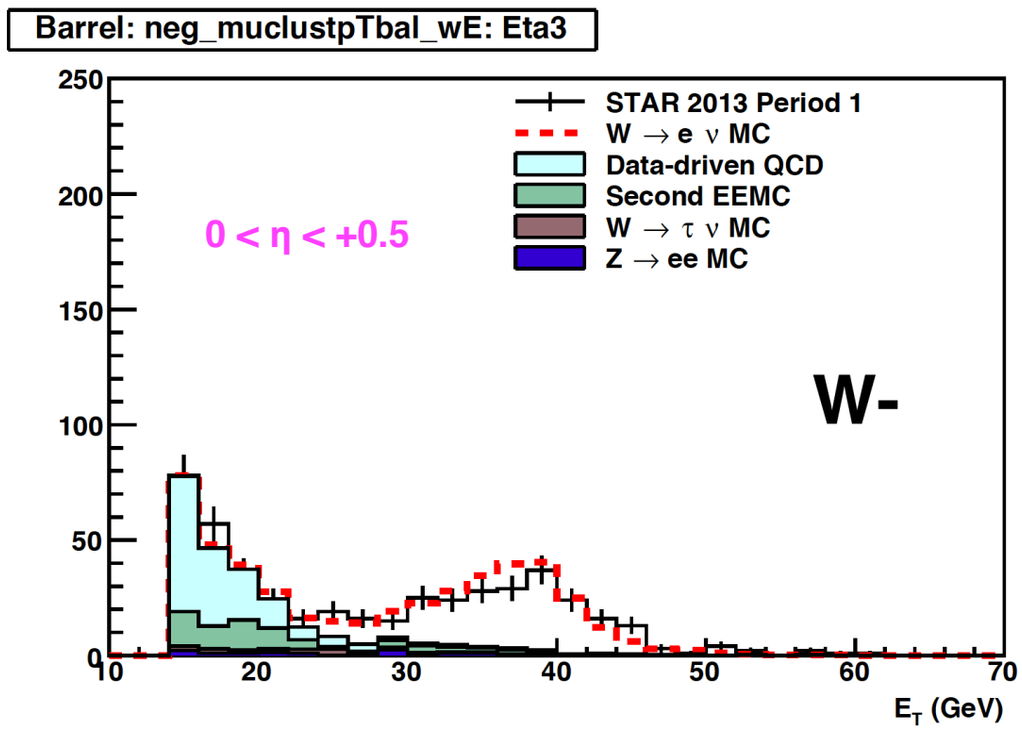
## Run 13 - Period 1



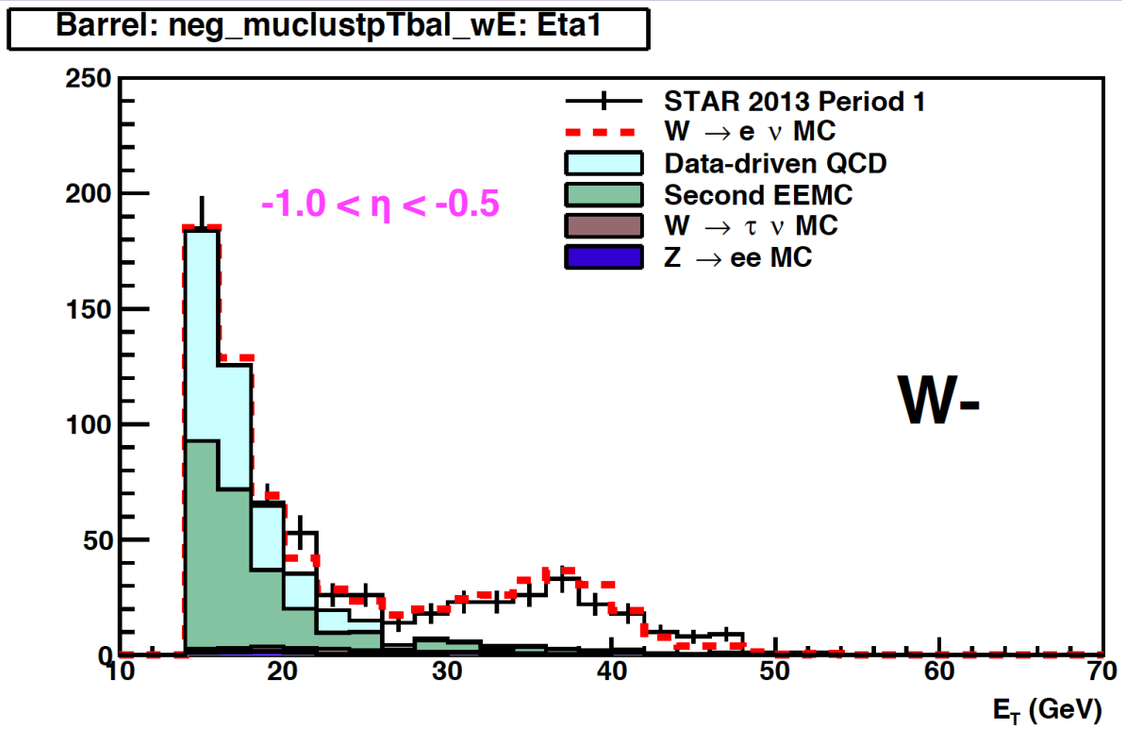


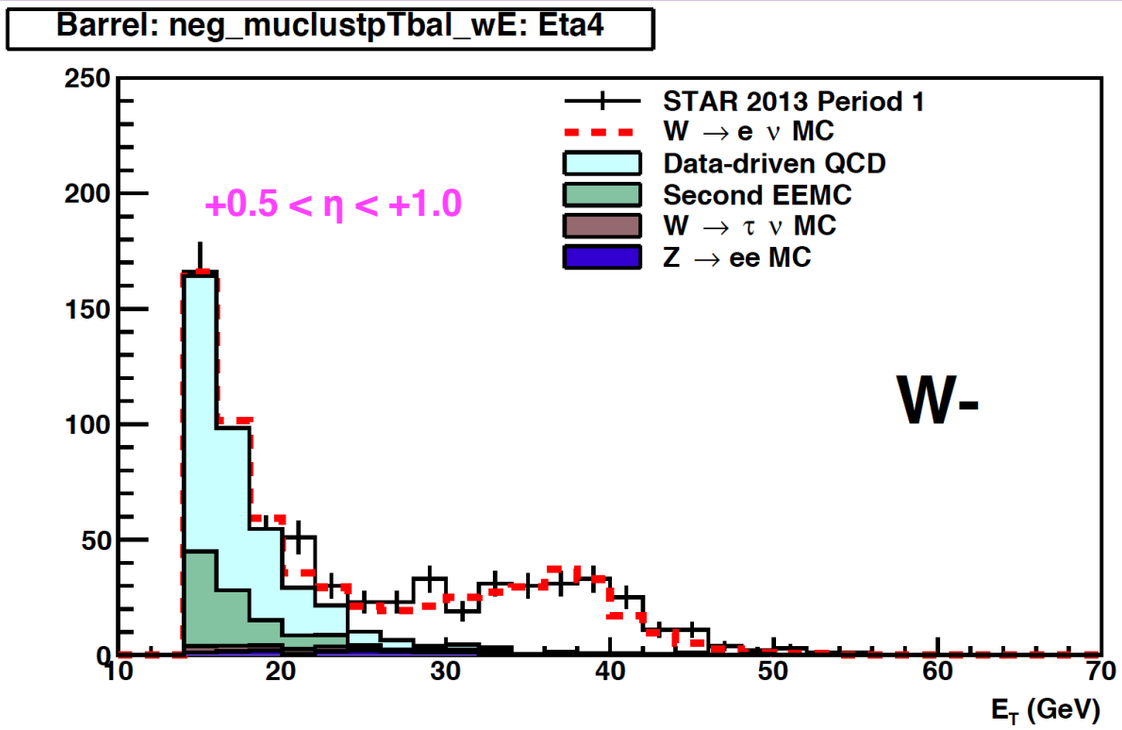


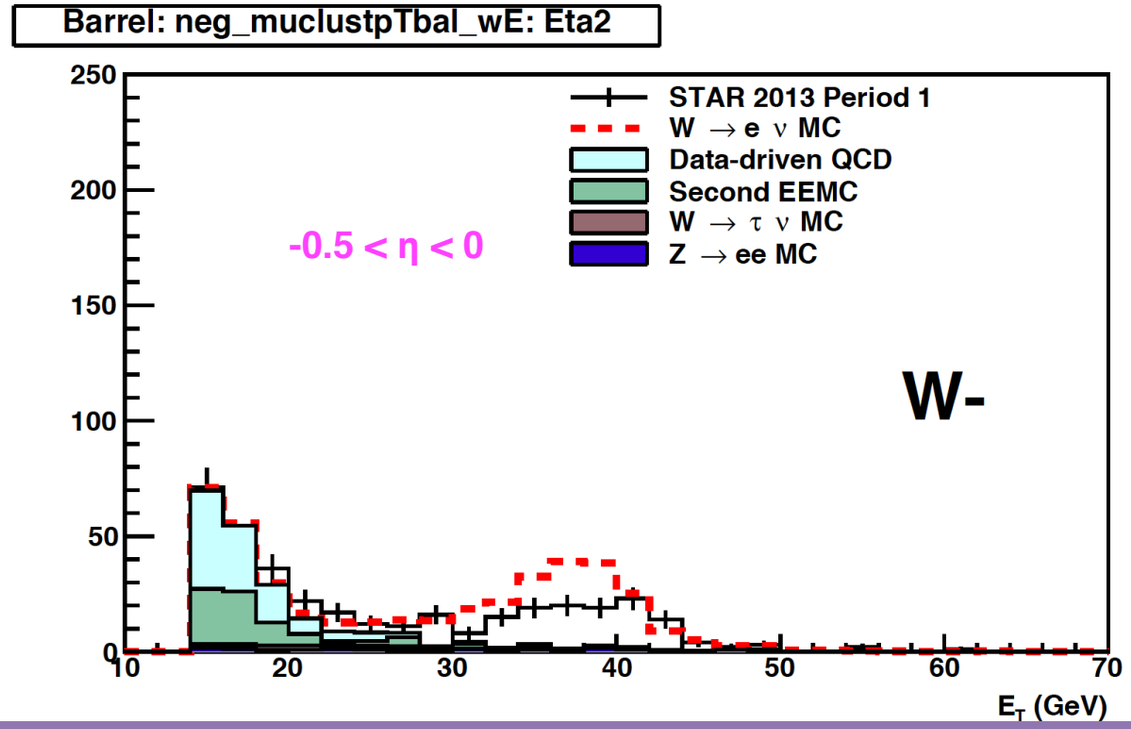


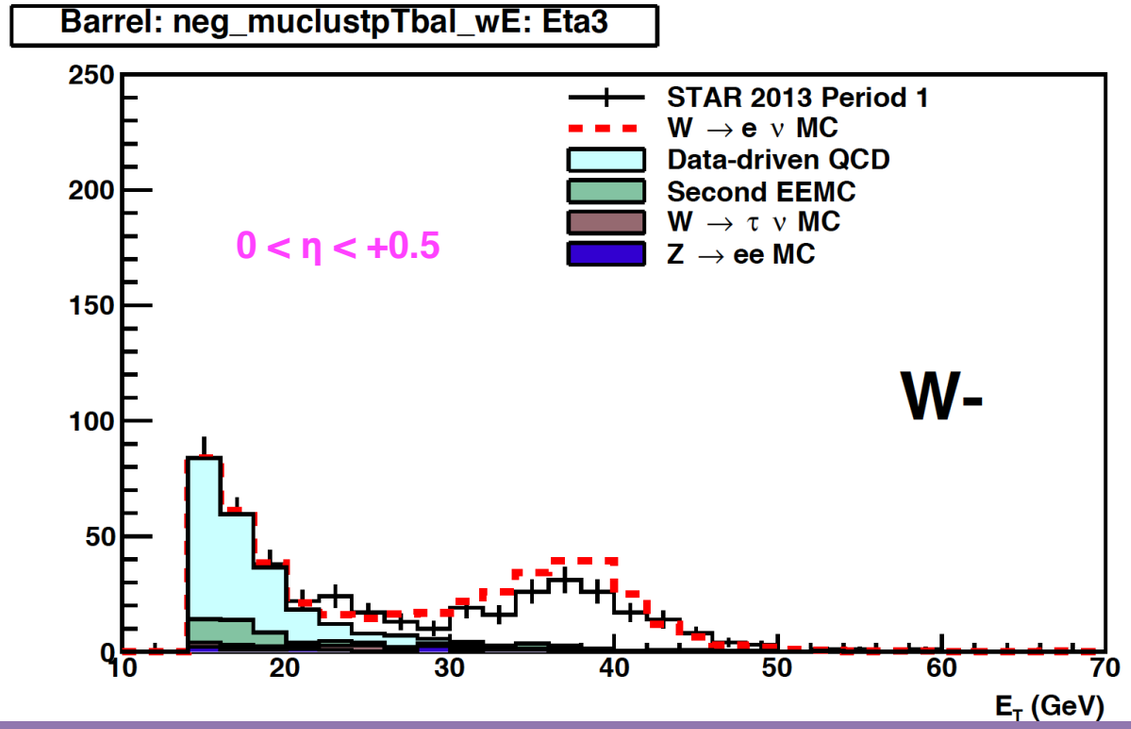
# W- “eta-dip” - Period 2

## Run 13 - Period 2

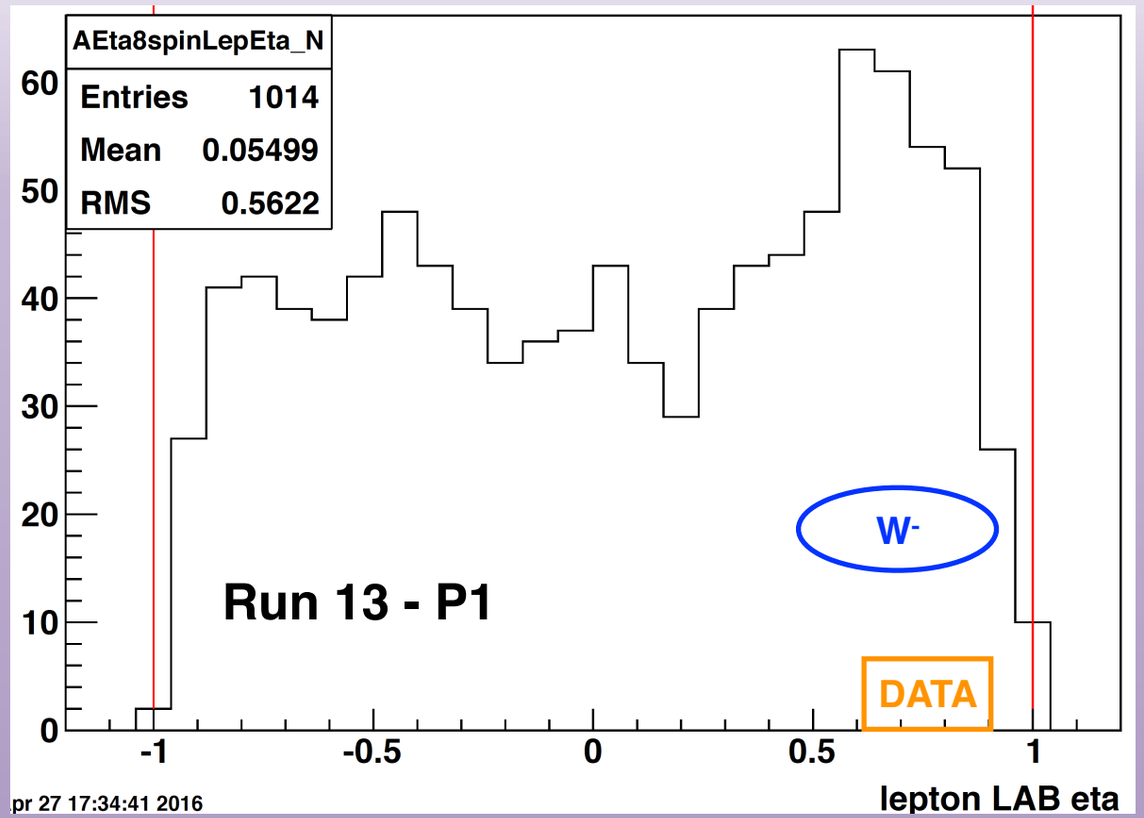


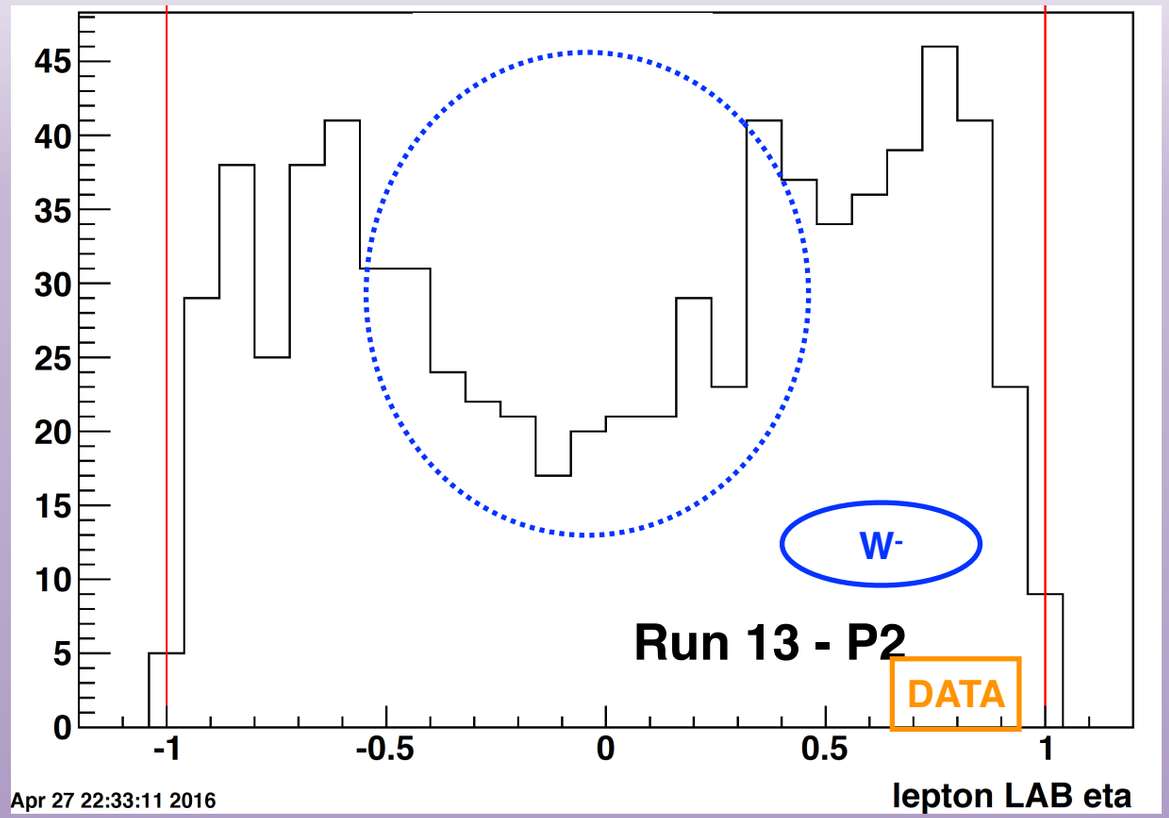



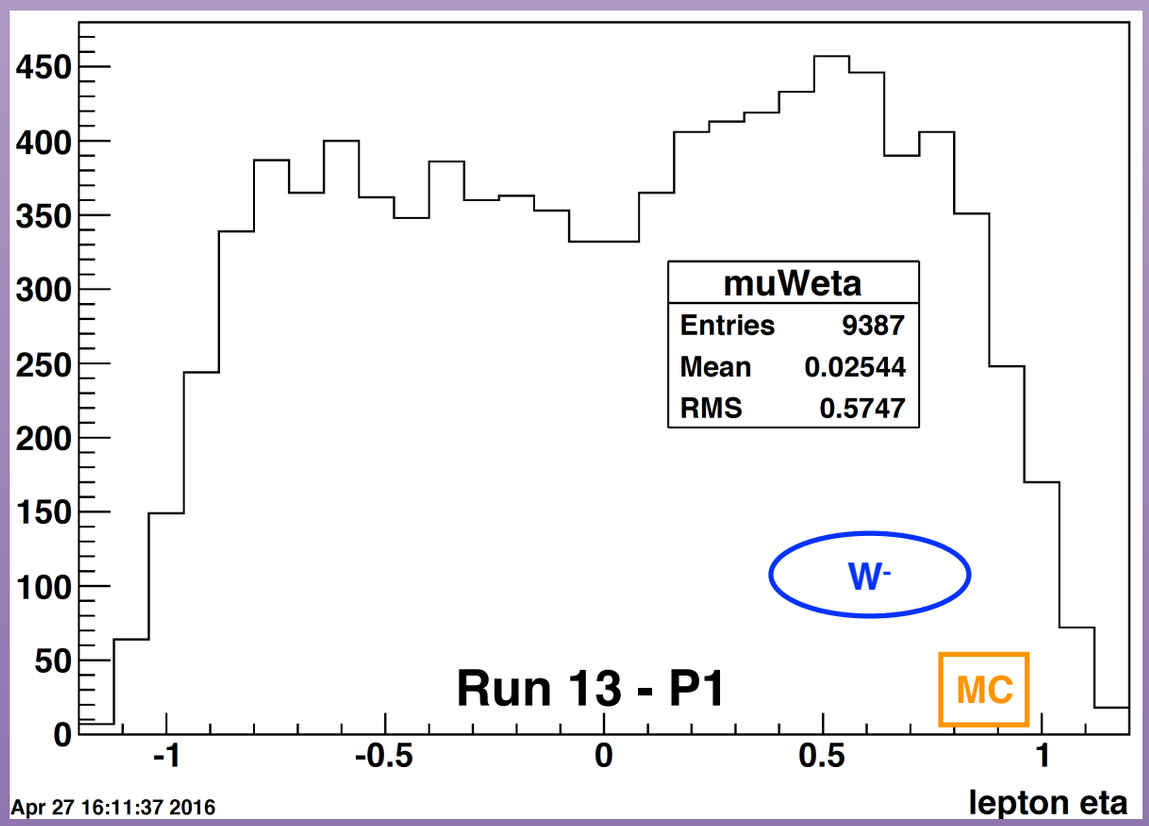



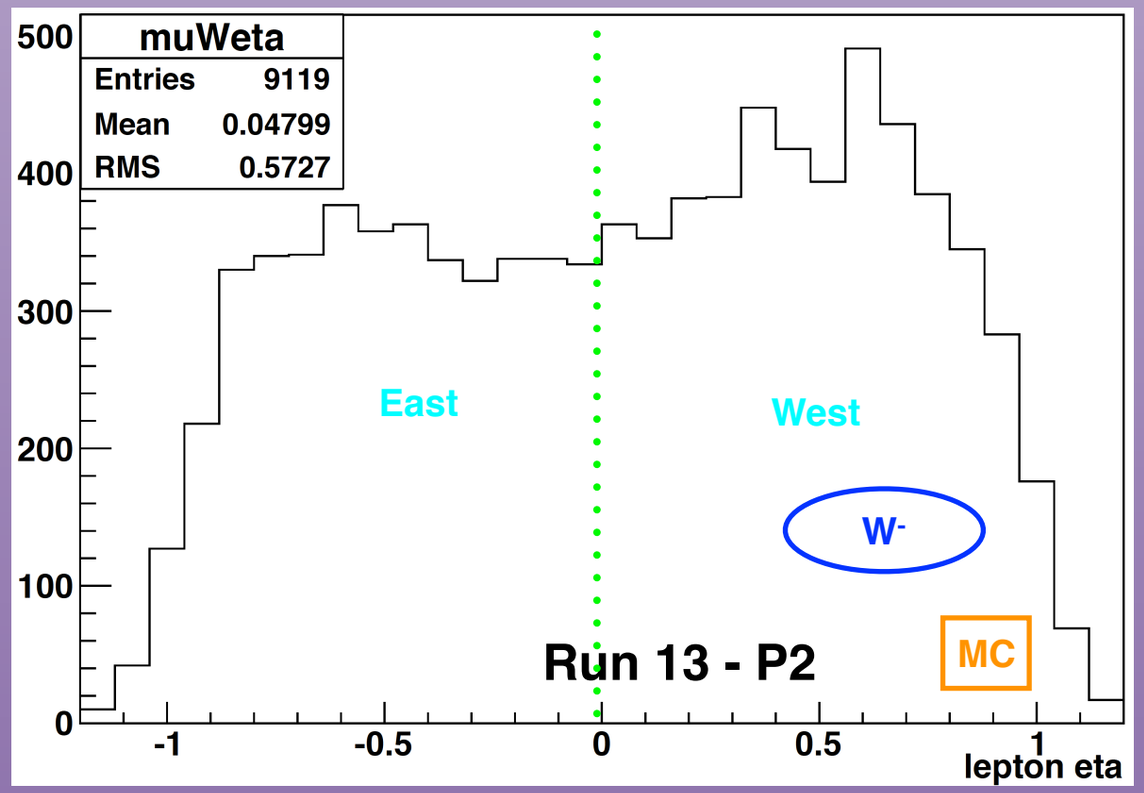



# W- final W eta distributions

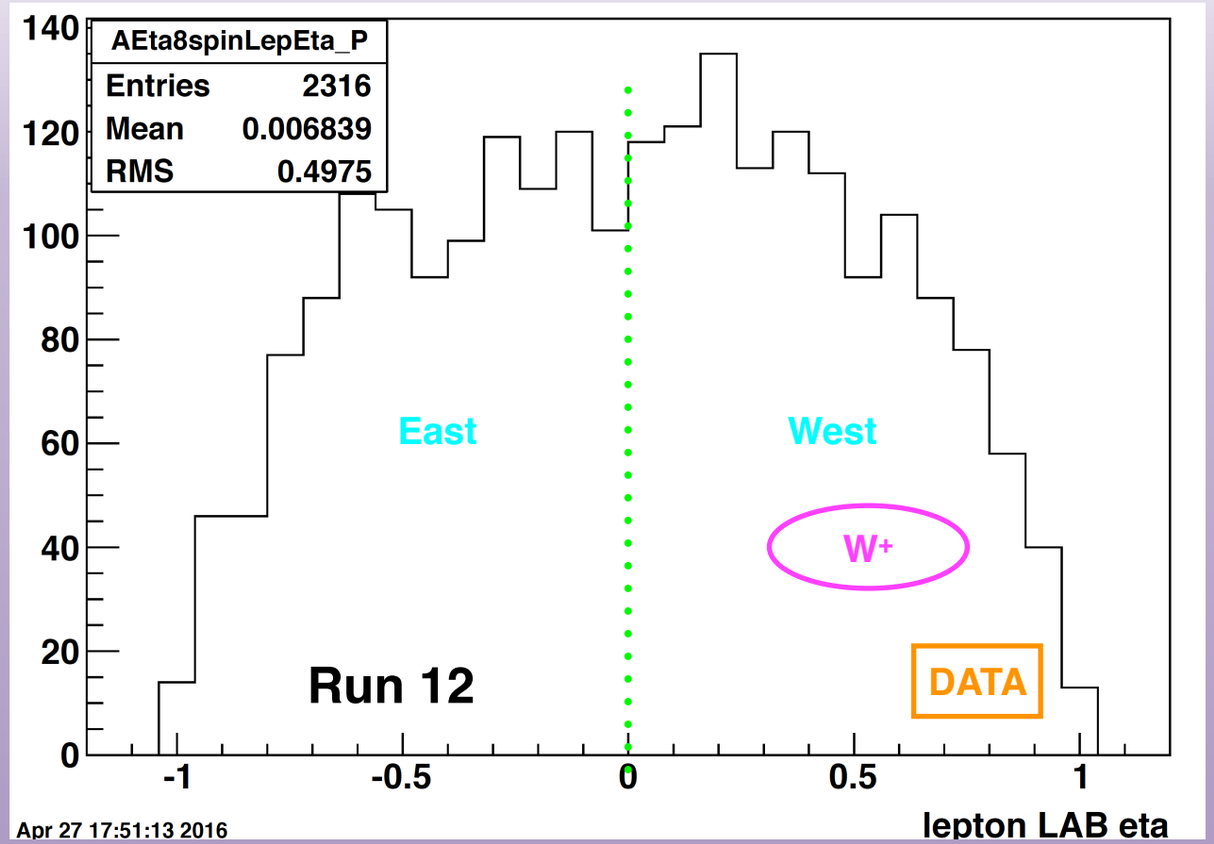


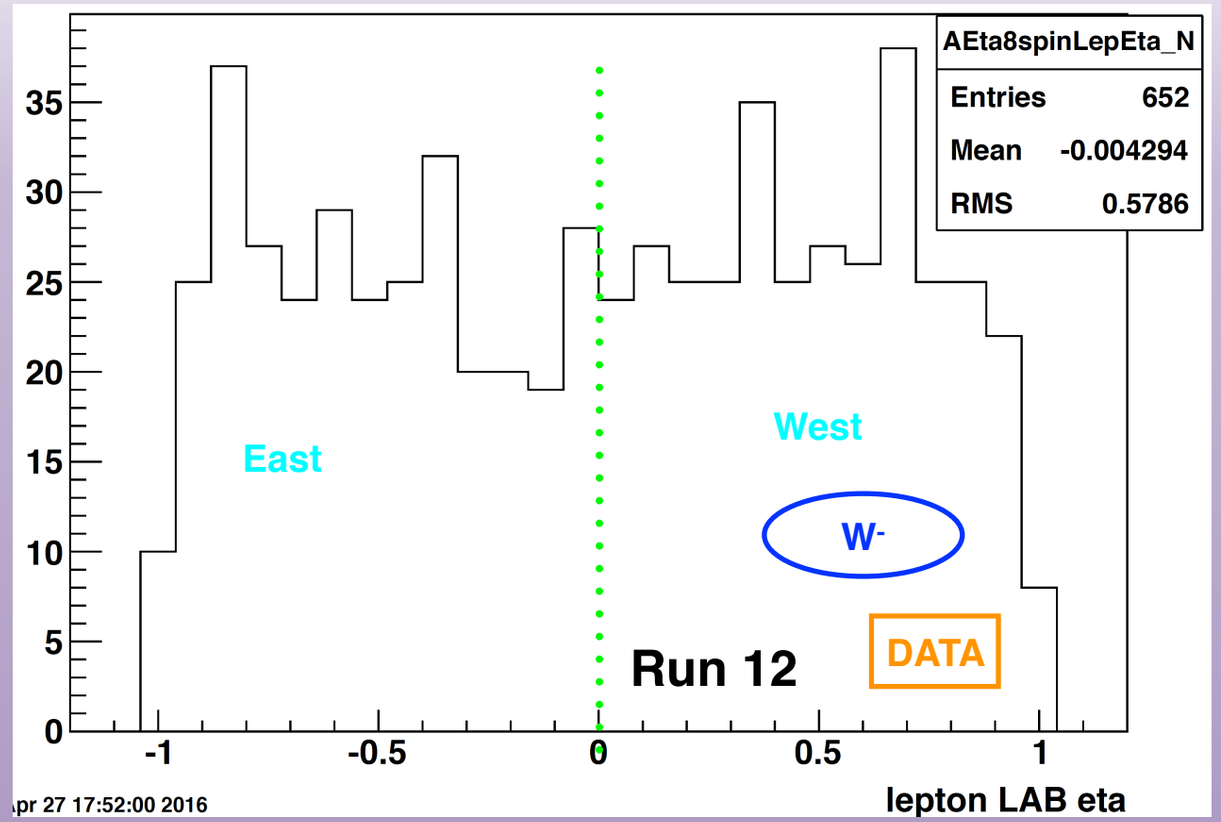



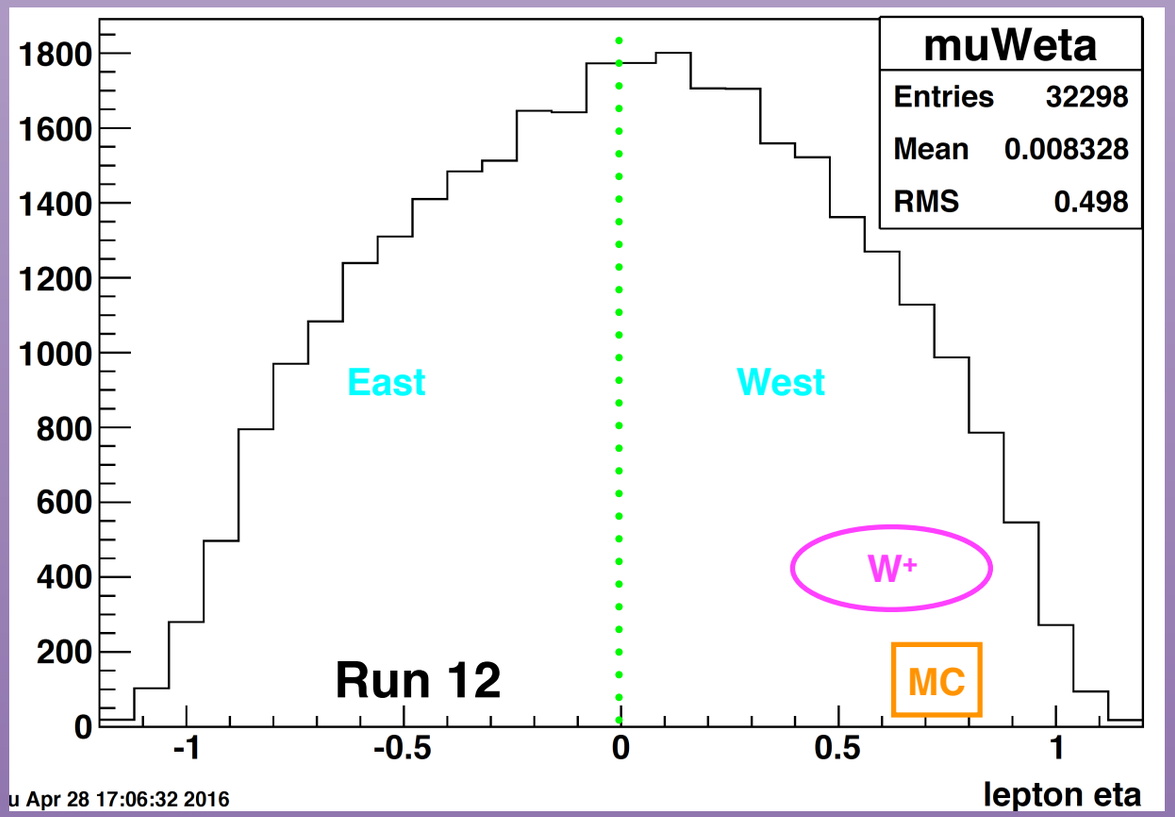



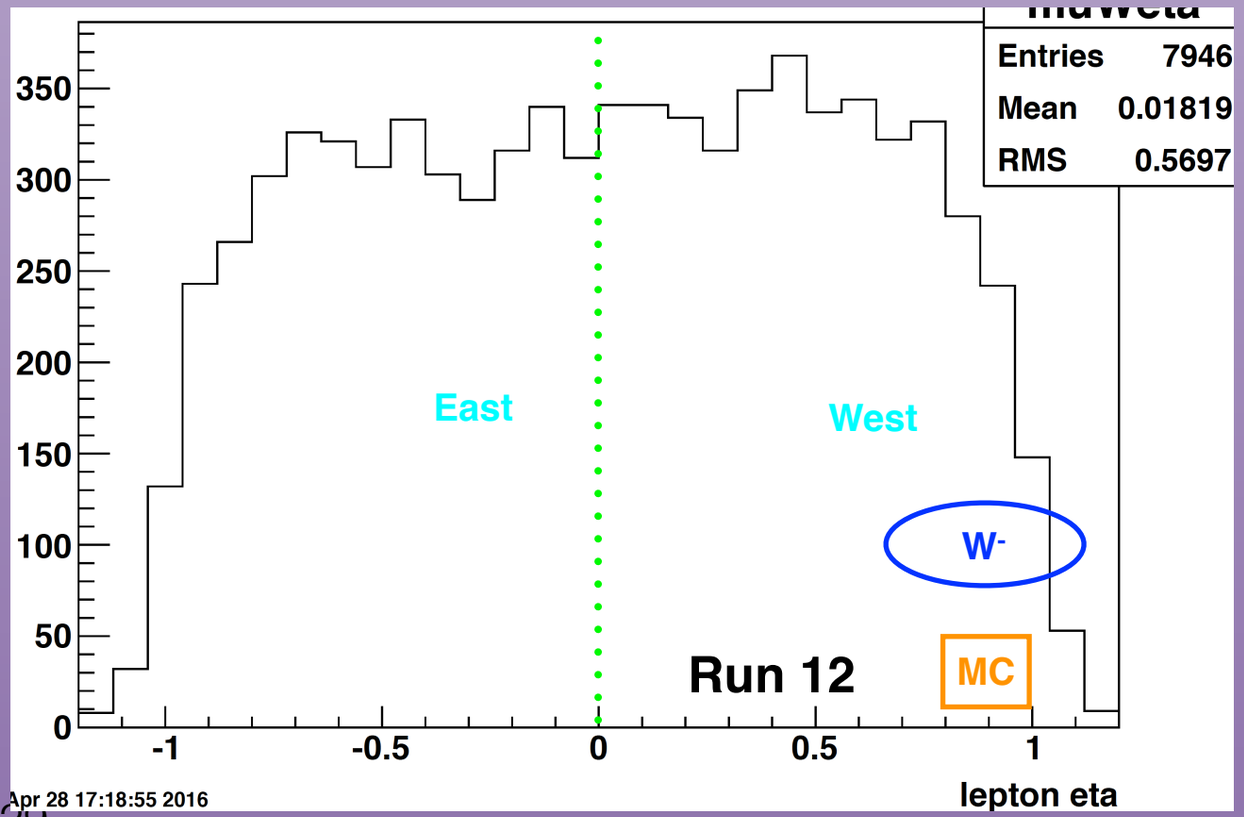



# Run 12 - Final Eta distributions

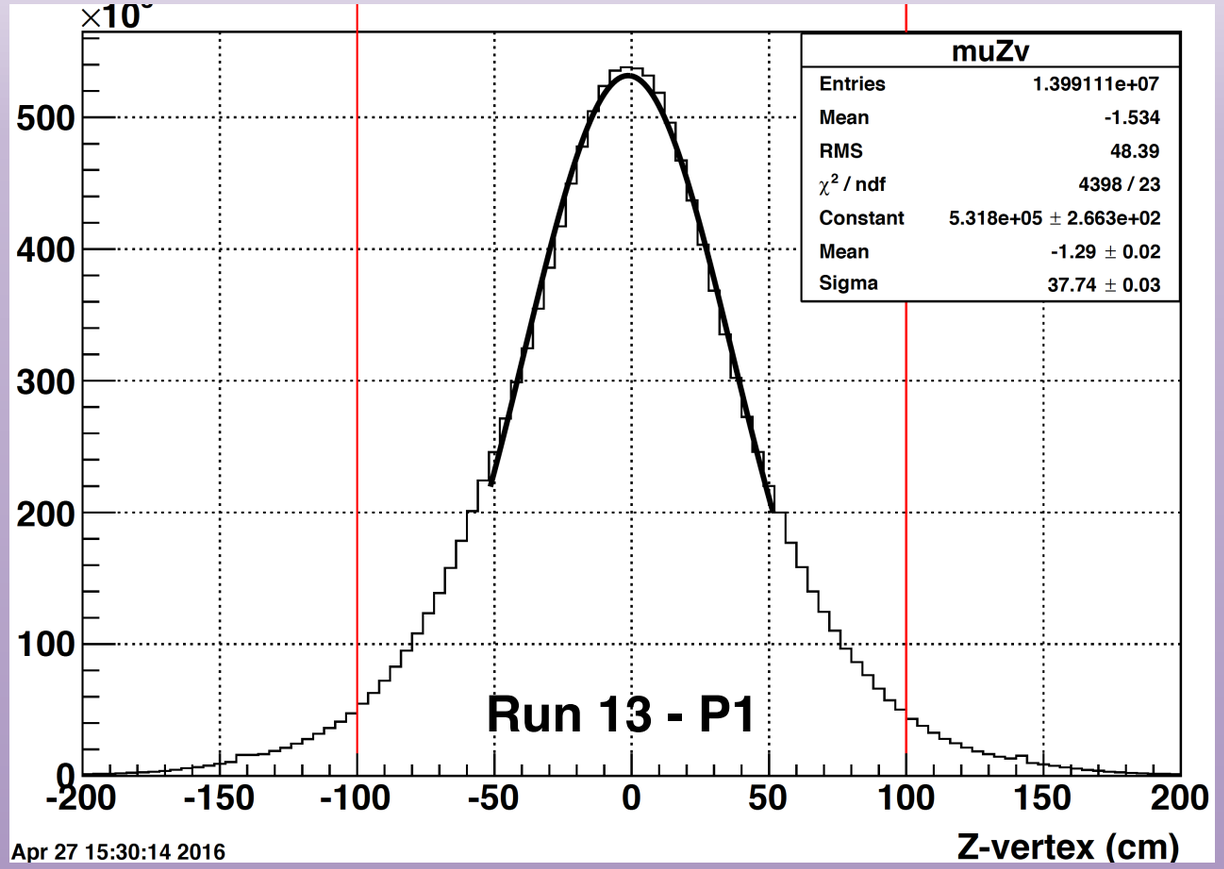


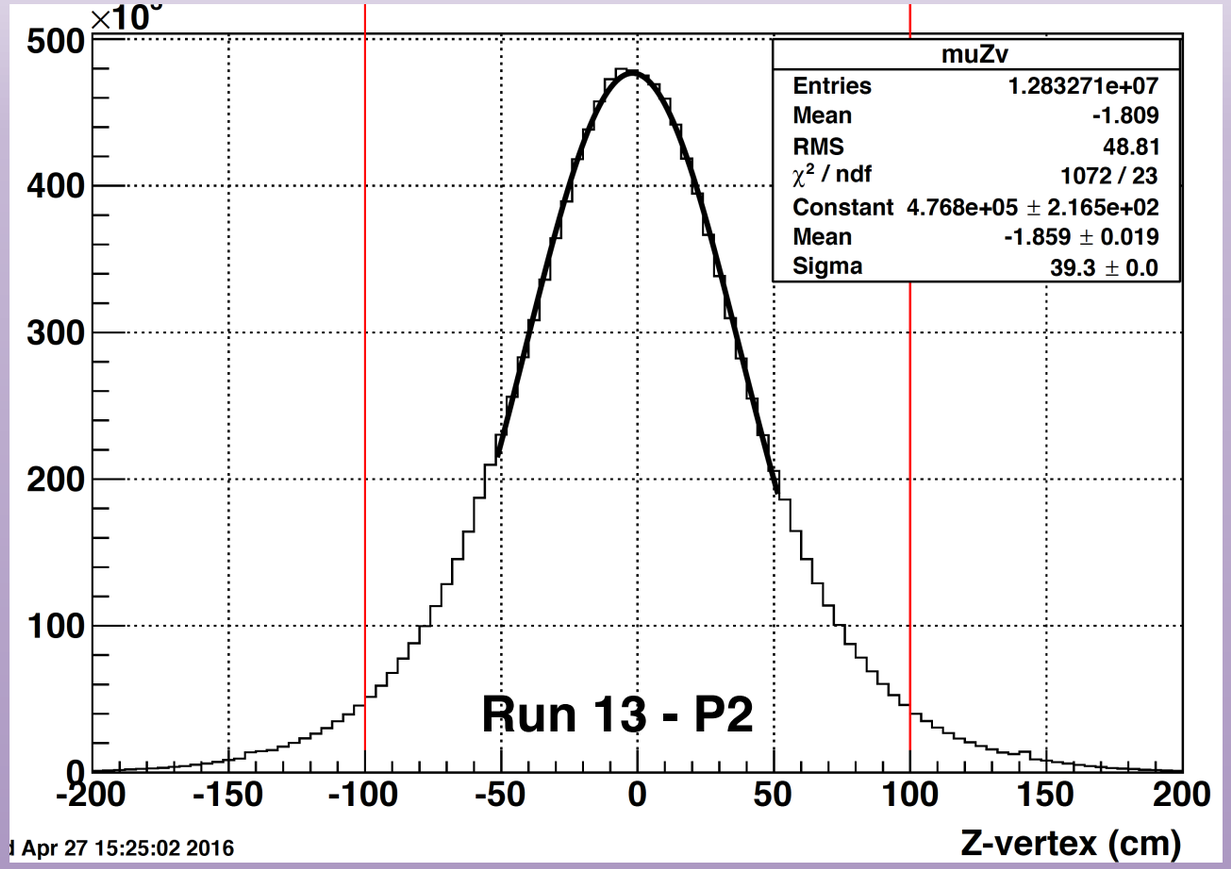



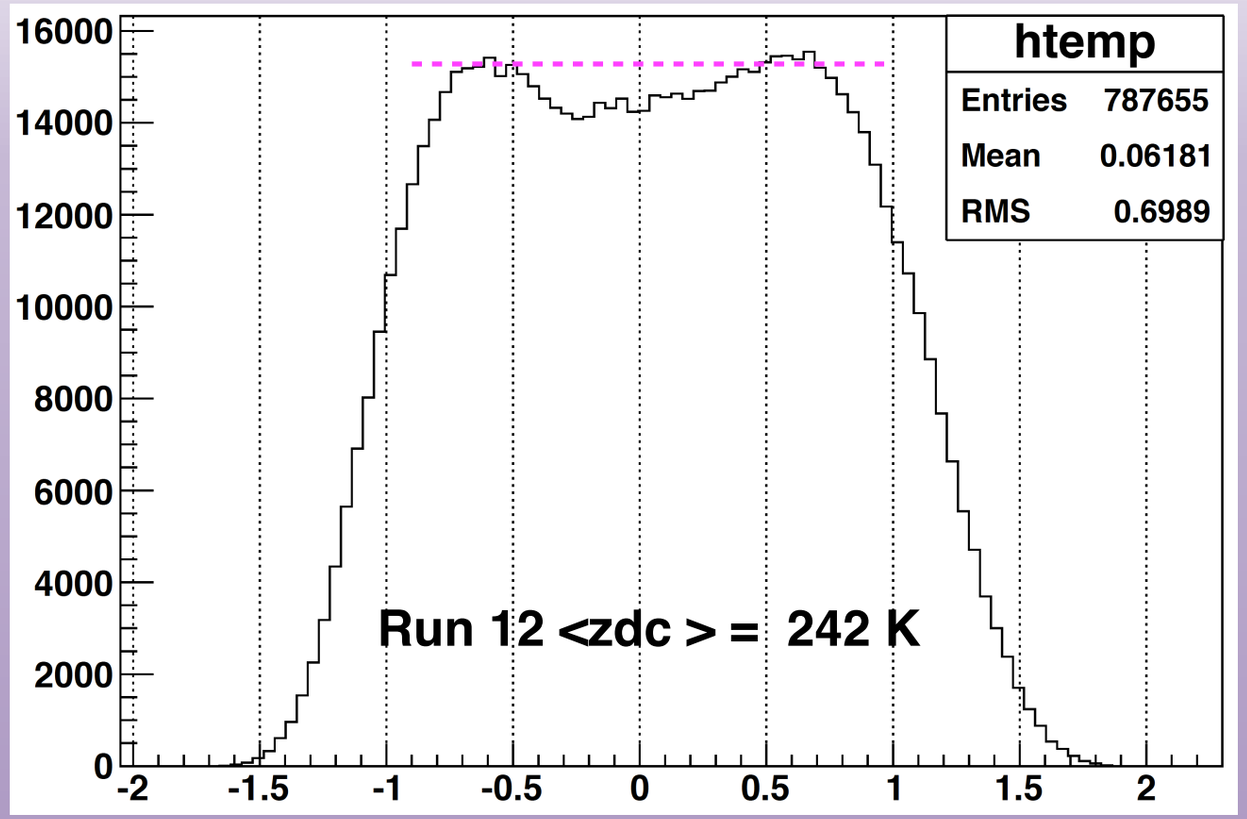
# Z-vertex

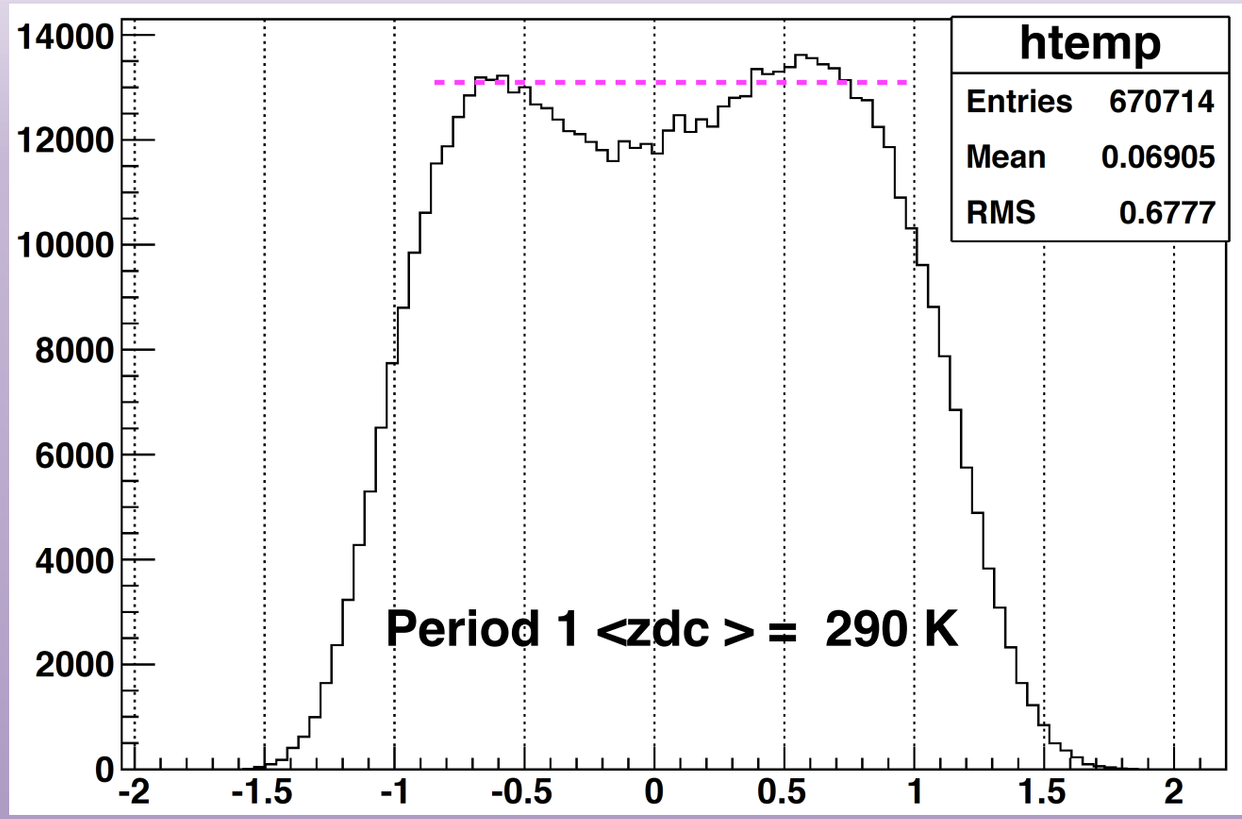


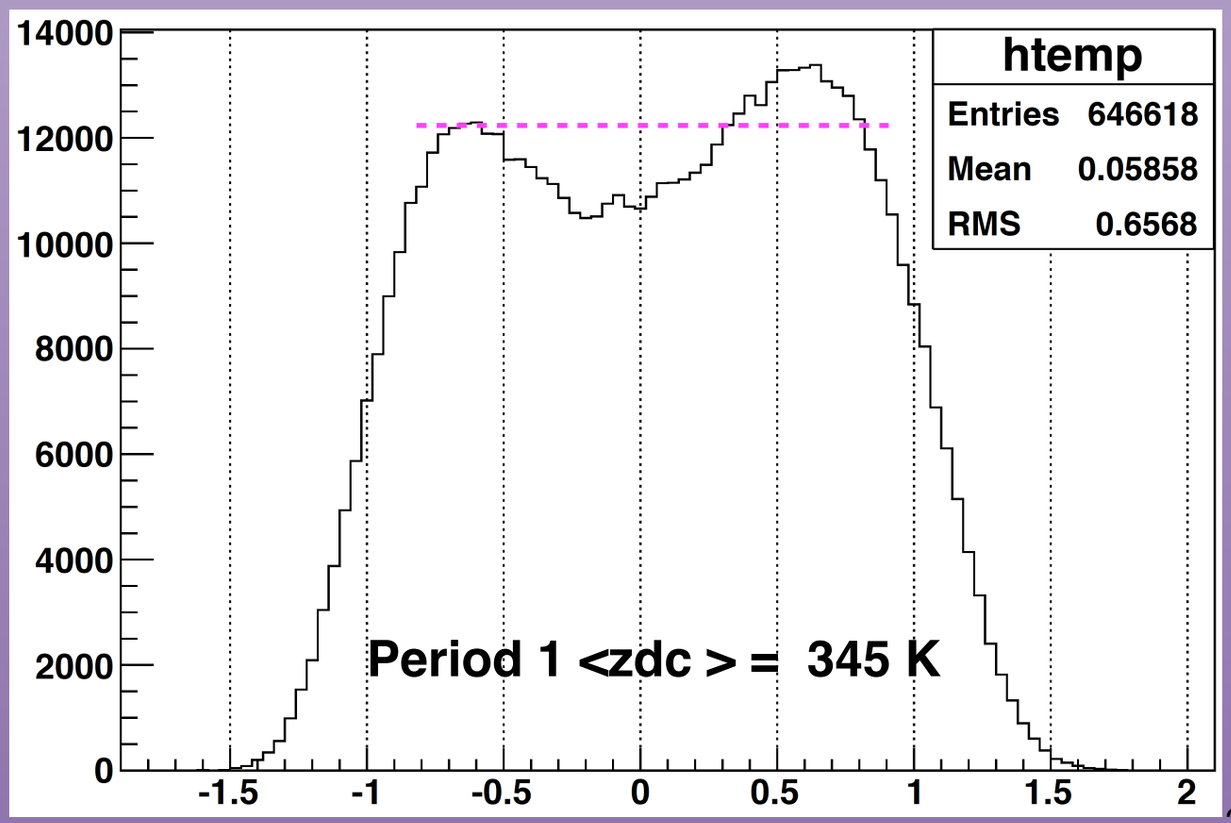




- Since the <Z_vertex> of the collision point is generally in the east side of the STAR and since we use symmetric Z_vertex cut in general we have a asymmetry in yield between east and west.
- In period 2 Z_vertex moved more to east by ~30% compared to Period 1. [This could also be caused by the HFT]

# Track Eta of a run with <ZDC> of each year

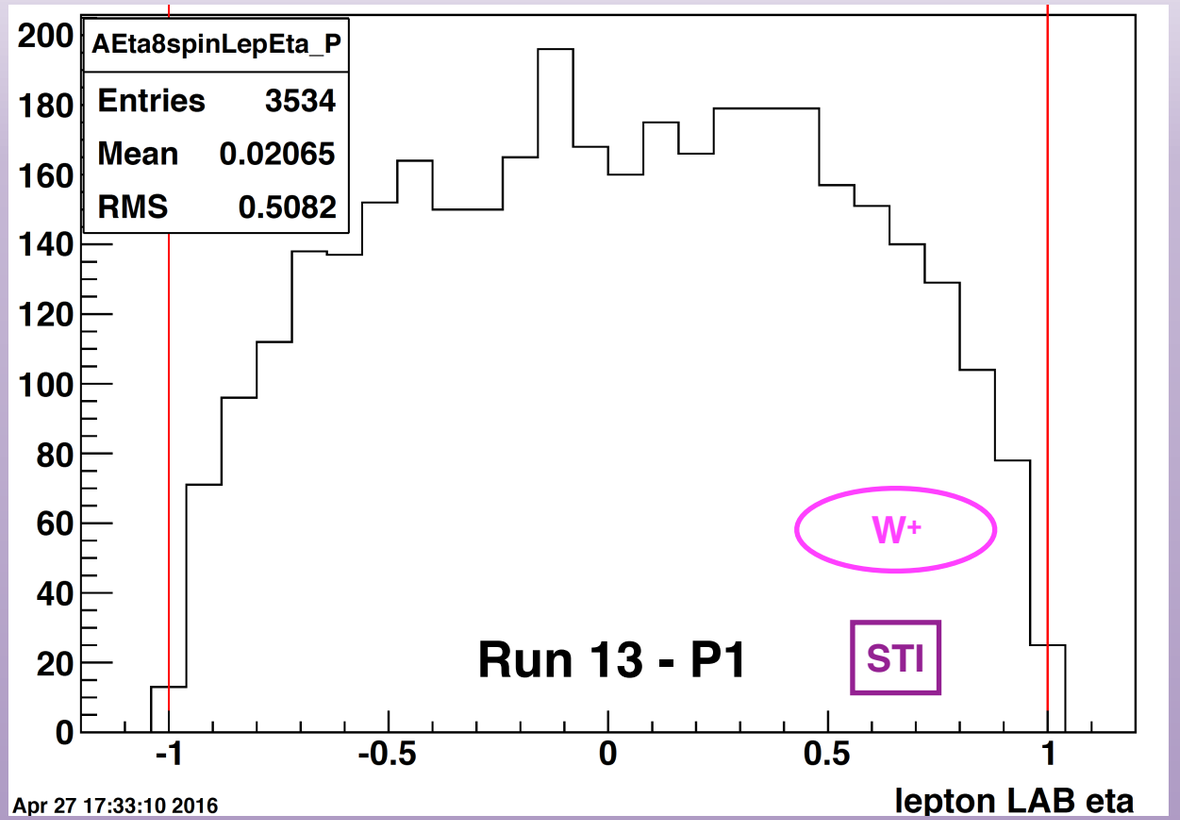


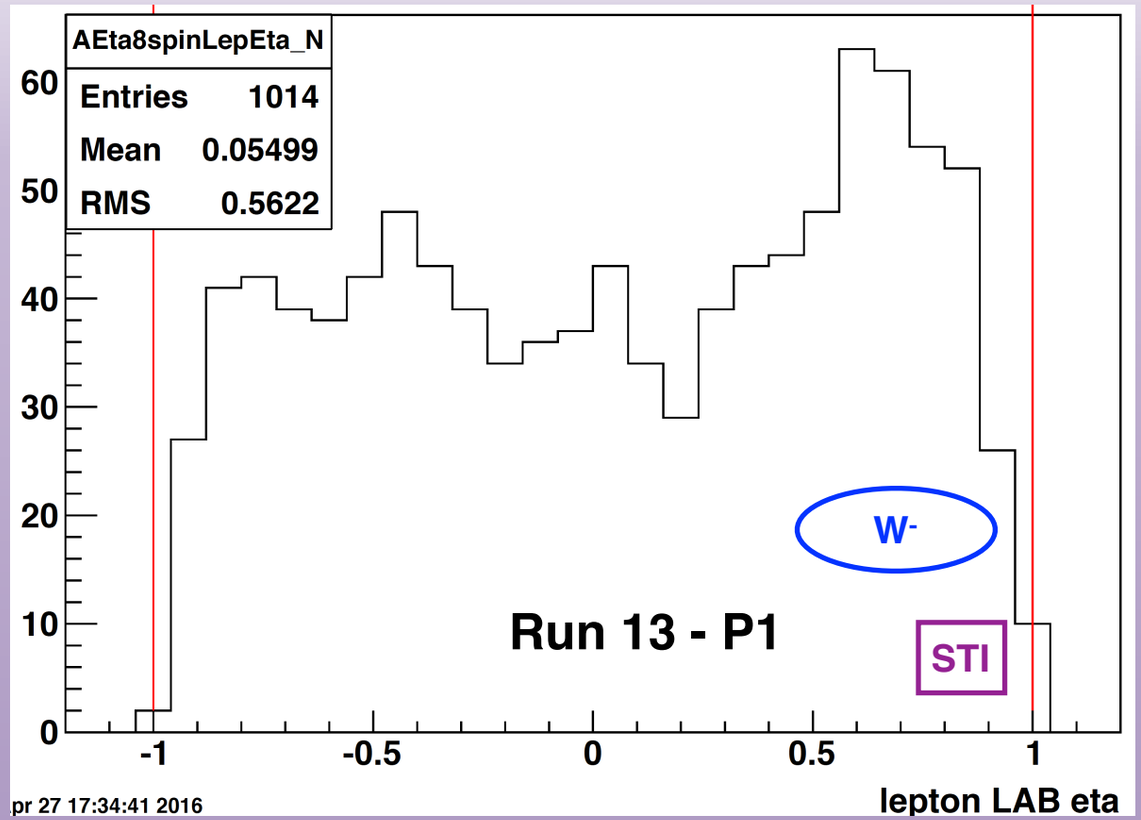



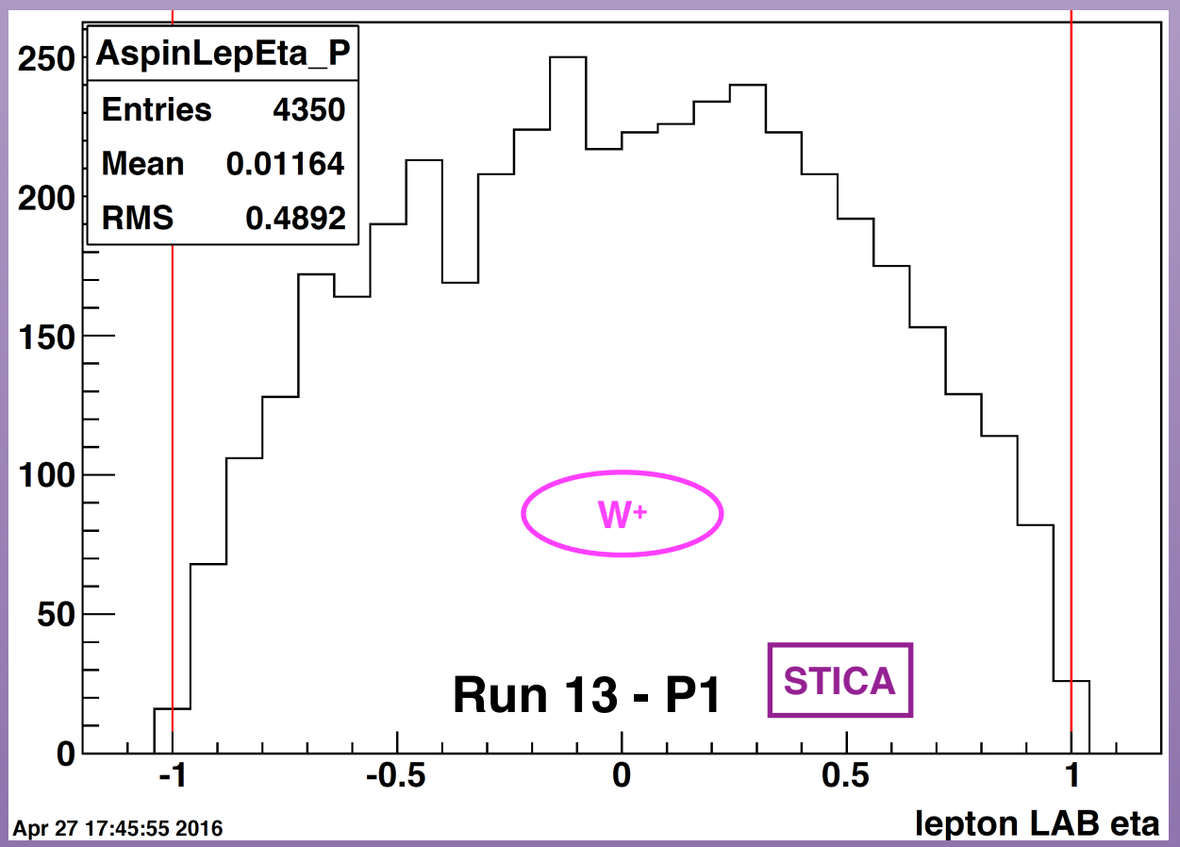



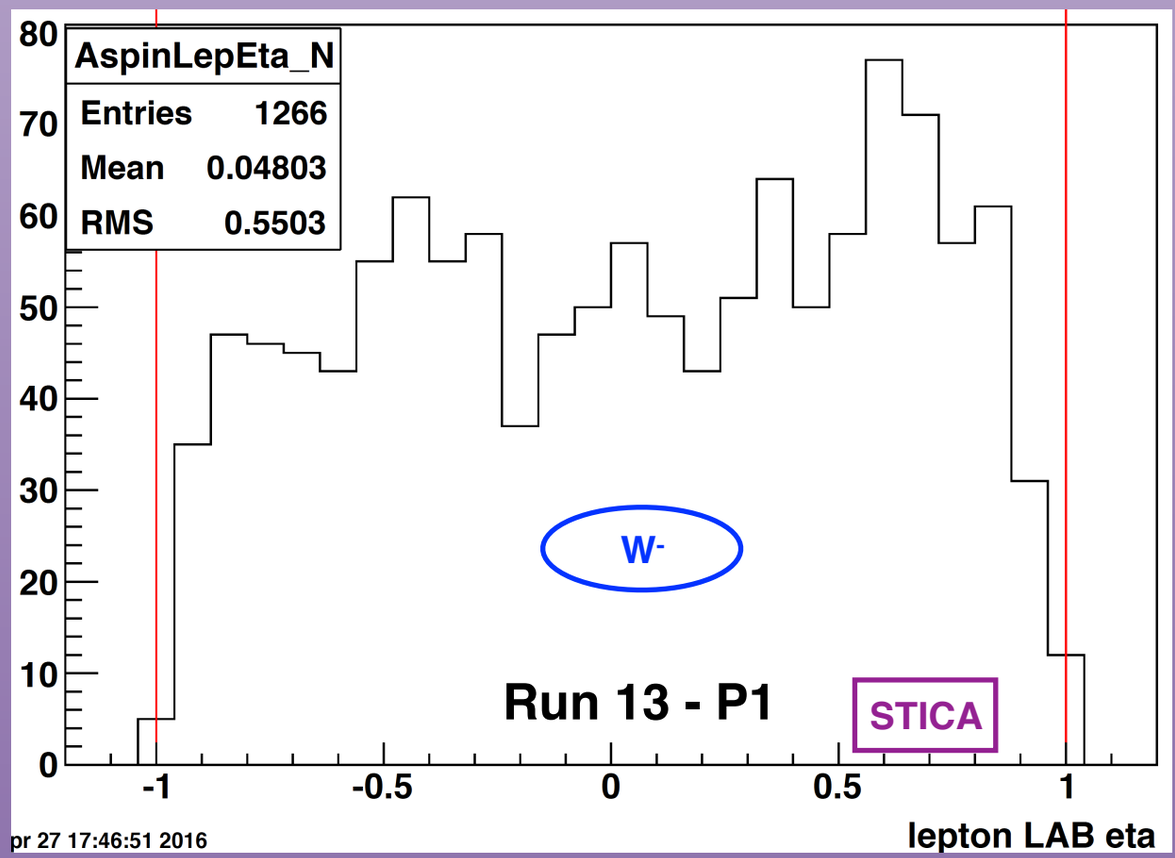
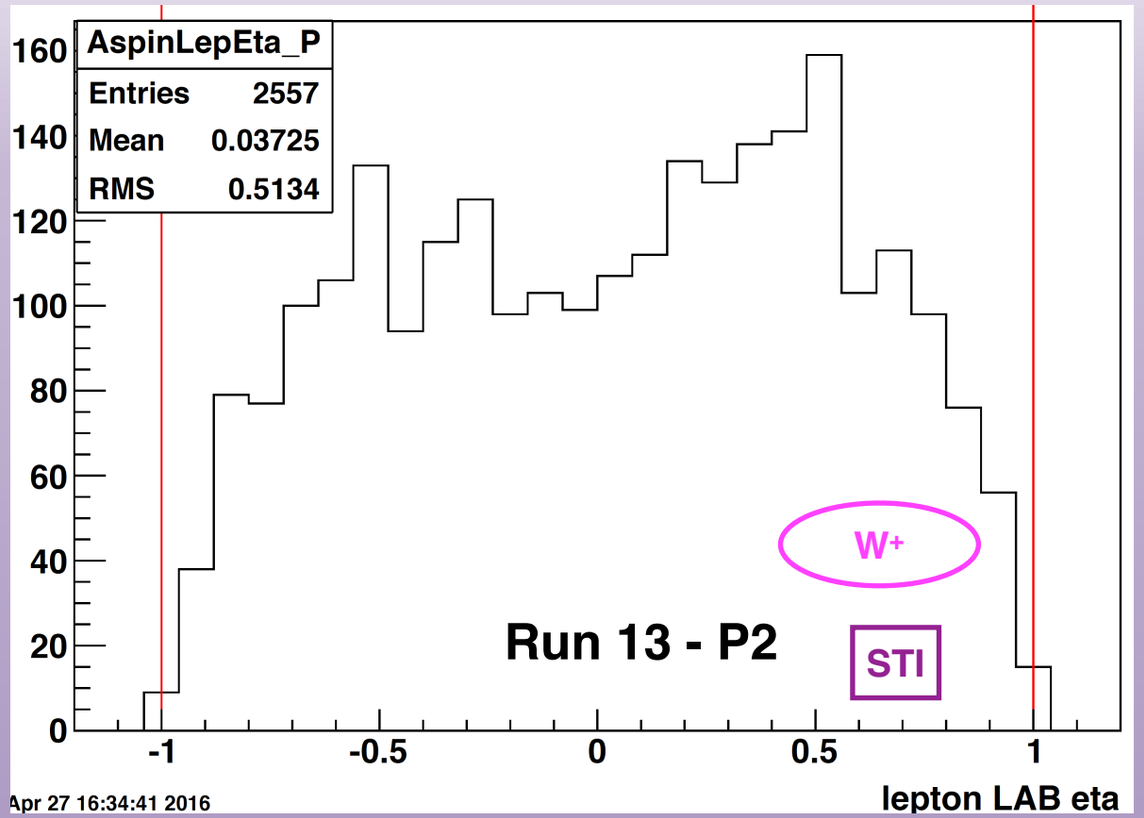
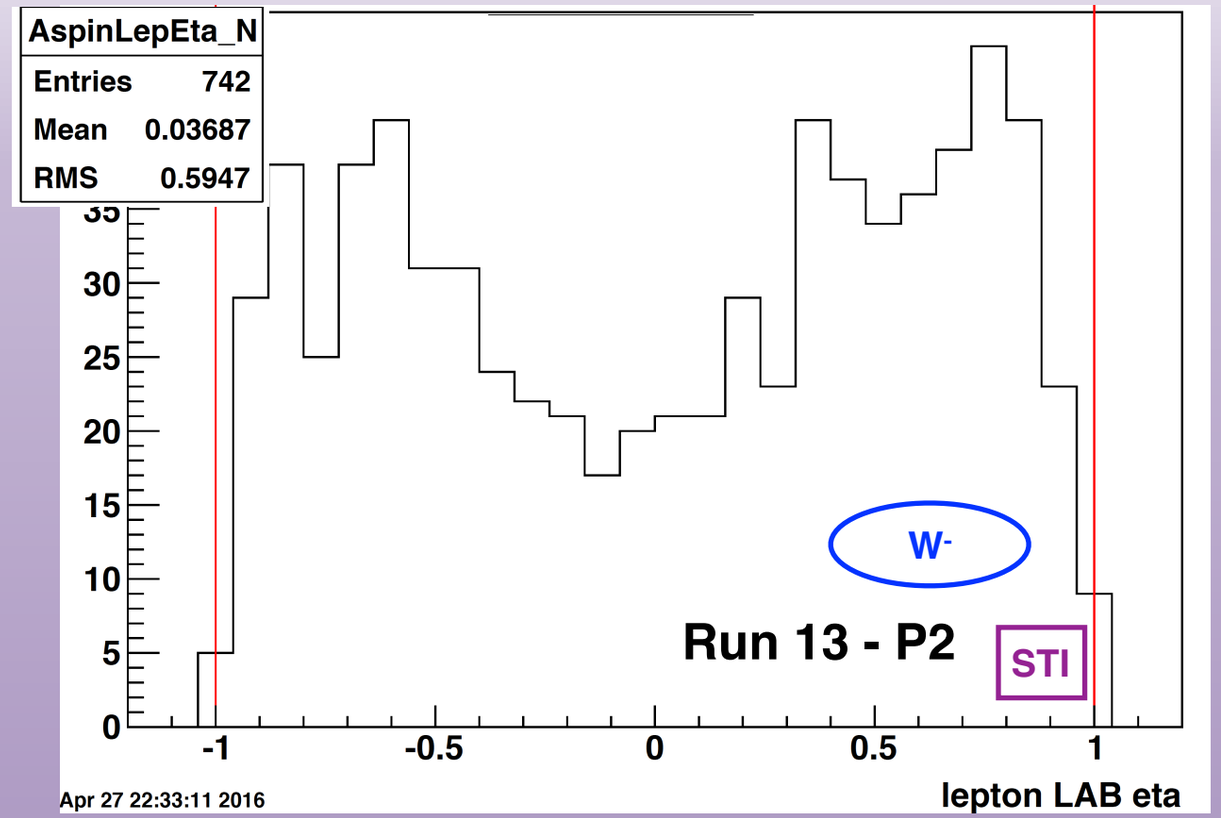
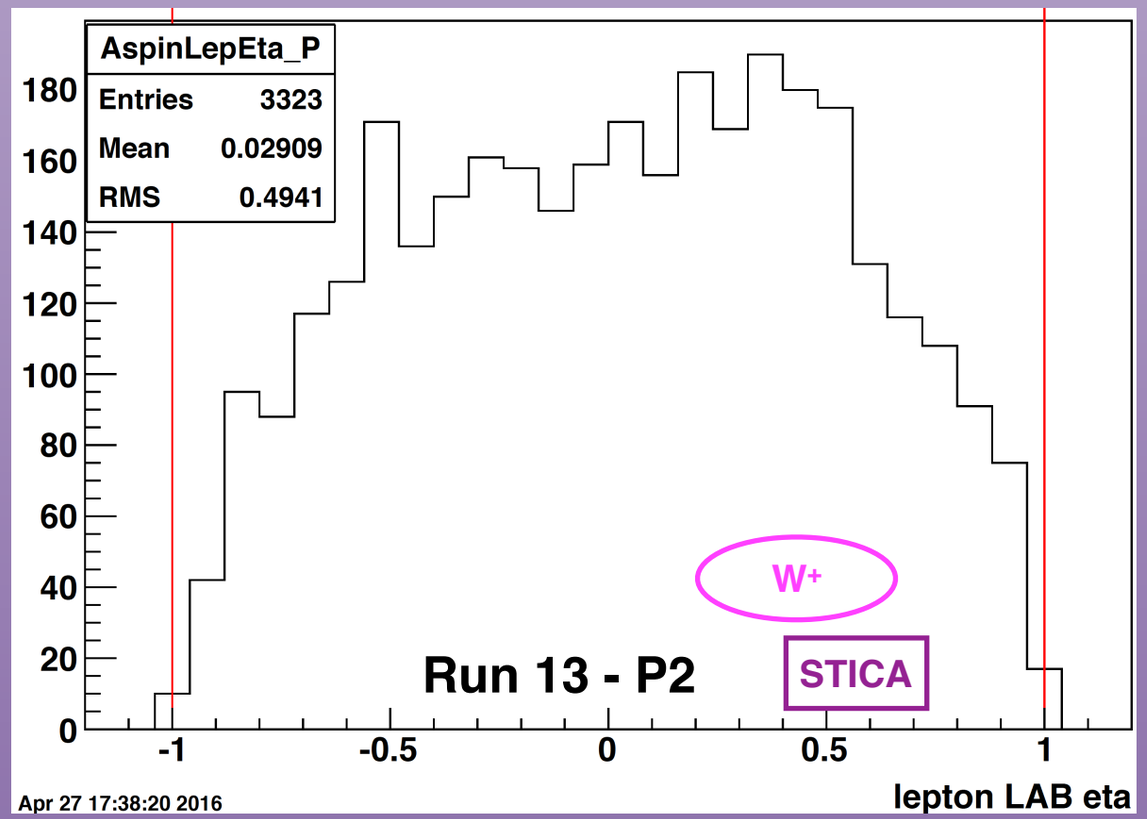
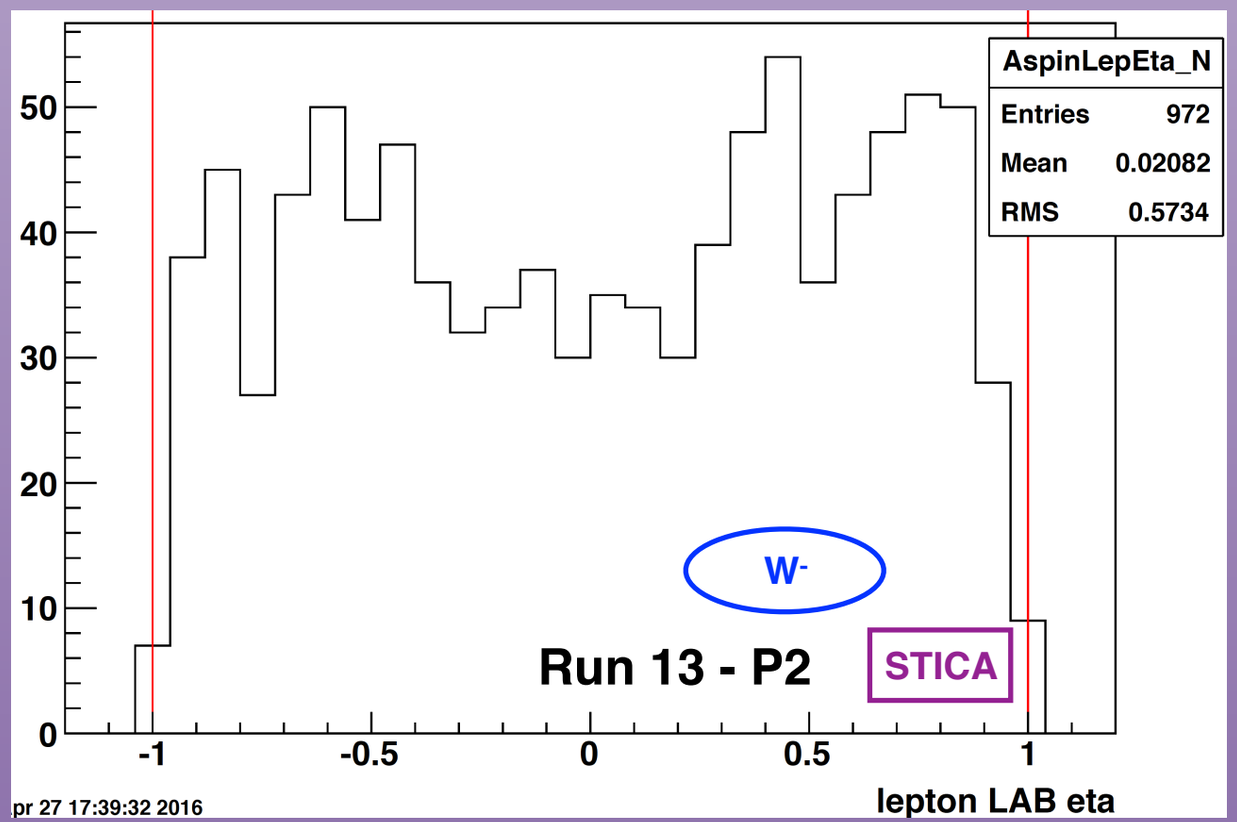

- A single run with zdc matching to avg of the each year / period.
- Eta dip increases with the zdc.
- Almost no asymmetry in the yield between east - west in run 12 and it started to appear run 13 P1 [supporting structure] and shows clearly in P2 [HFT itself]

# Final W -Eta STI-vs STICA - Period 1






# Final W -Eta STI-vs STICA - Period 2