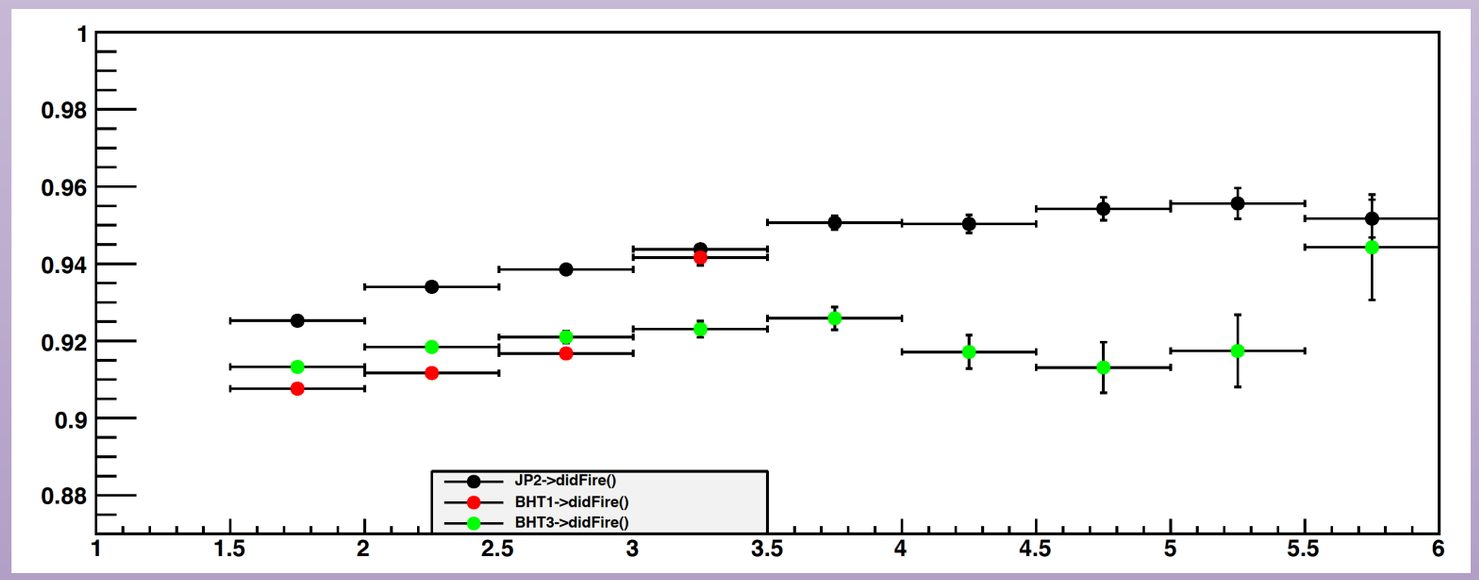
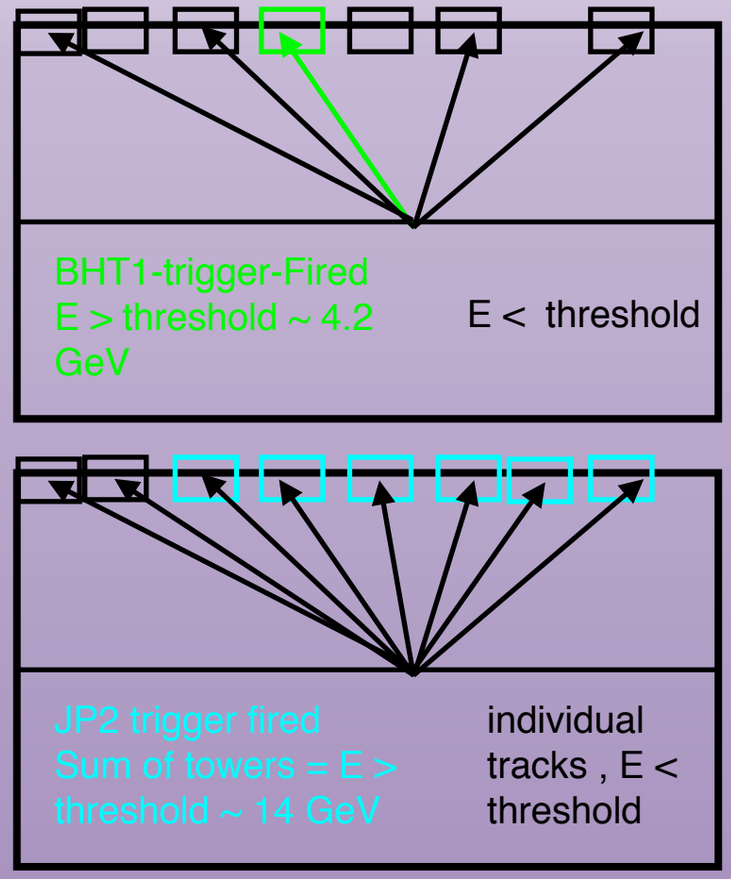
Run 13 BEMC Calibration Updates

Devika Gunarathne / Jinlong Zhang

Questions from last updates

- Systematically low E / p for HT trigger compared to JP2 trigger below the HT threshold





In high tower trigger, can tower energy of low P tracks which matches to towers where trigger was not fired, be rather low in compared to that of from a JP2 triggered event ?

Some Explanations

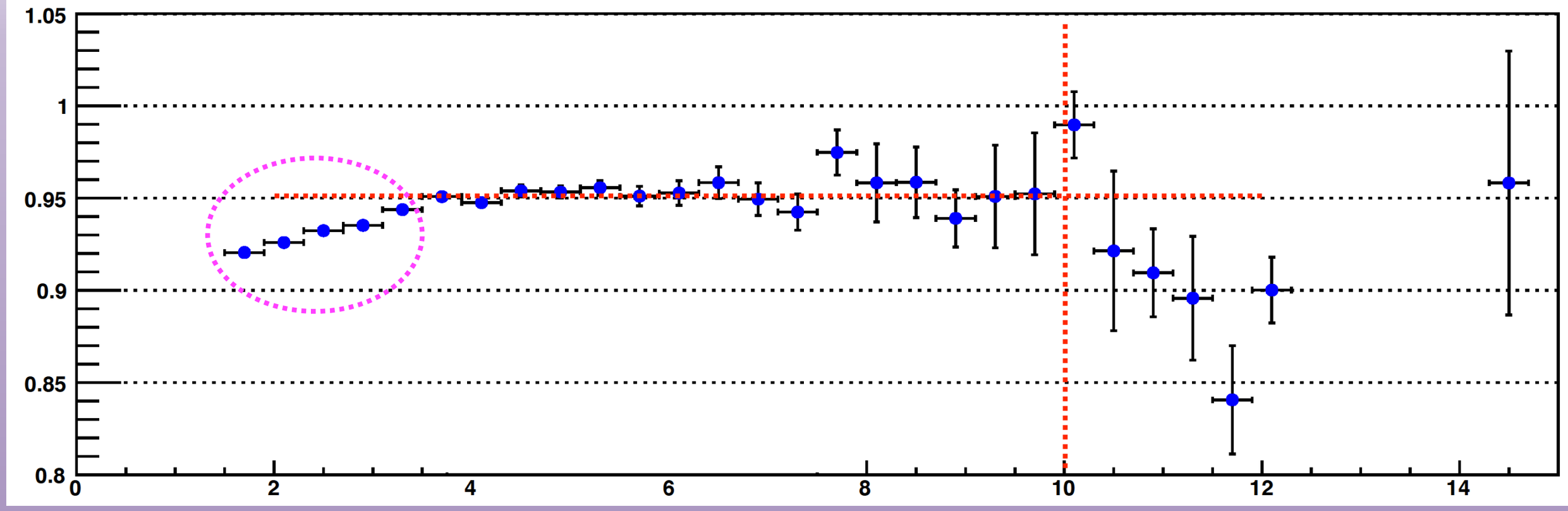
- Since JP2 trigger threshold is large than HT, also many tracks are distributed with in a close space tower energy could be contributed by additional shower leakage from neighboring towers in contrast to in HT tower triggered events where a low energetic tracks could be measured to have less energy due to shower leakage.

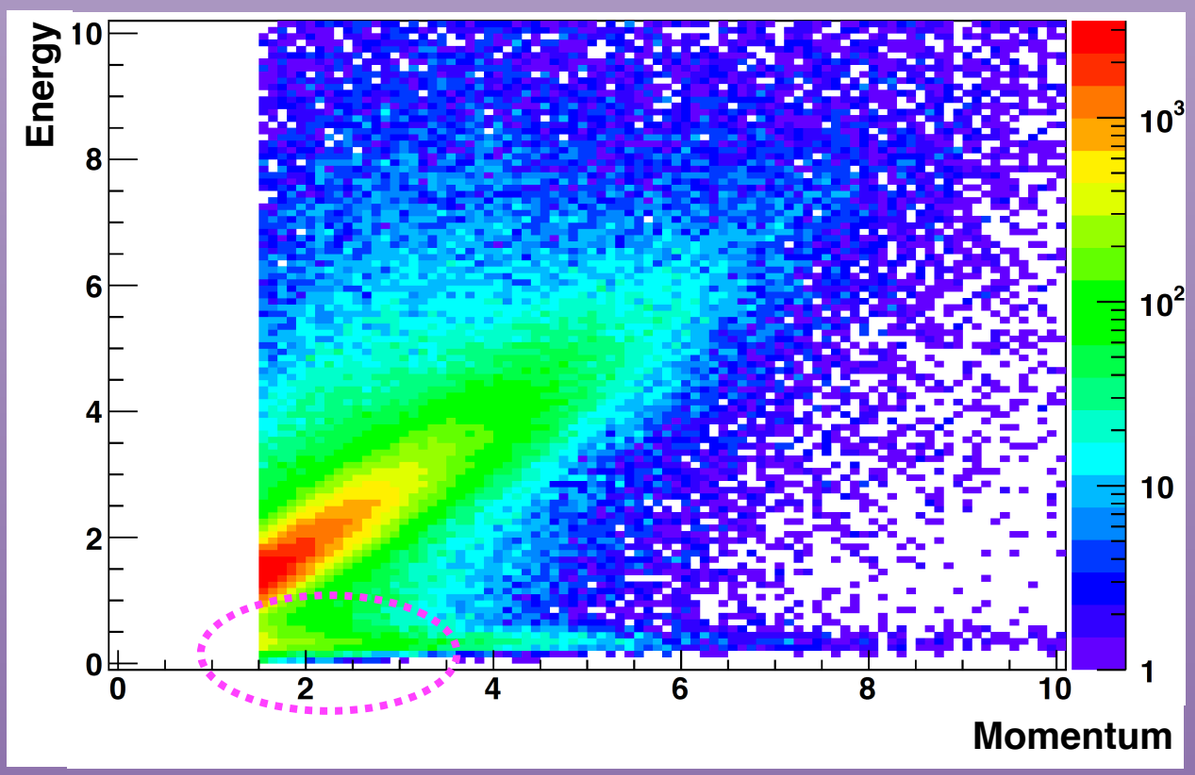
During the last update, we agreed to use both JP2 and BHT3 (below the threshold) as final trigger option!

[Include the difference as systematic from trigger option!]

Final Trigger Option

JP2->didFire() || (track P < 3 GeV && BHT3->didFire())



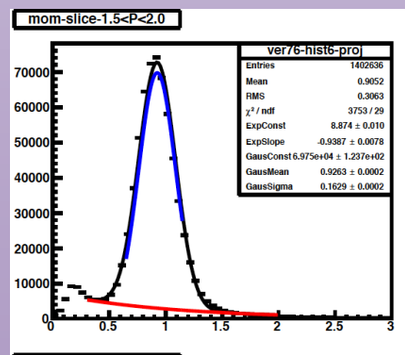


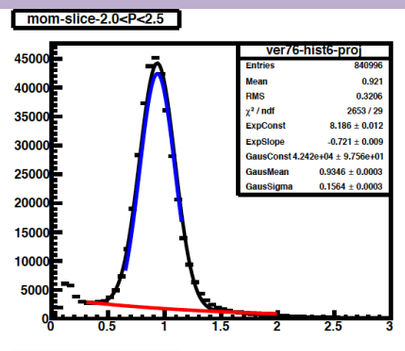
- The steady dropping behavior of E / p below P < 3.5.
- BG contribution at low P is large compared to at high P which caused for an unclean separation between signal and BG peaks.
- This variation can be included in systematic .

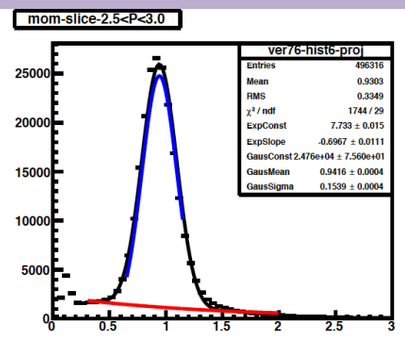
Final Trigger Option

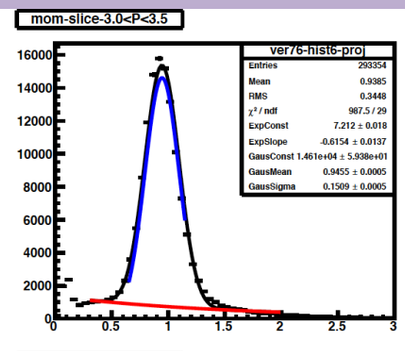
JP2->didFire() || (track P < 3 GeV && BHT3->didFire())

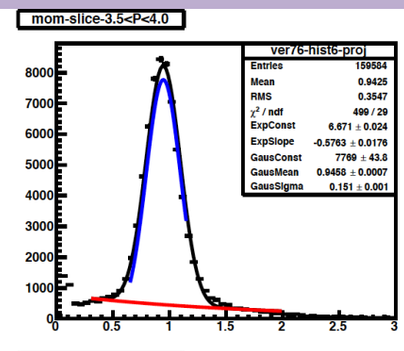
JP2->didFire()

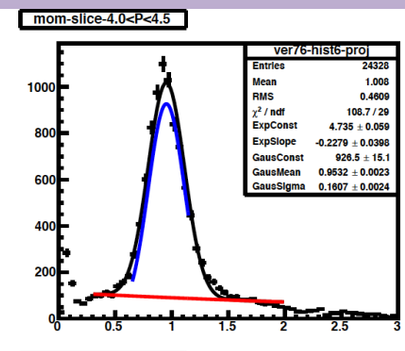


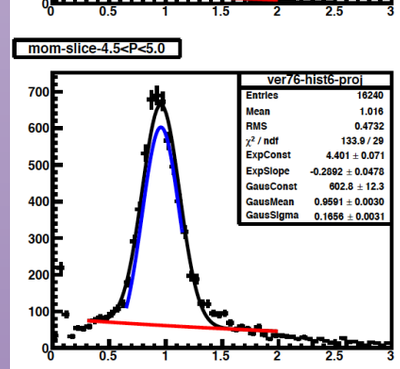


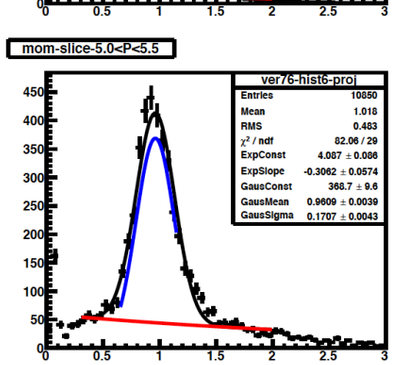


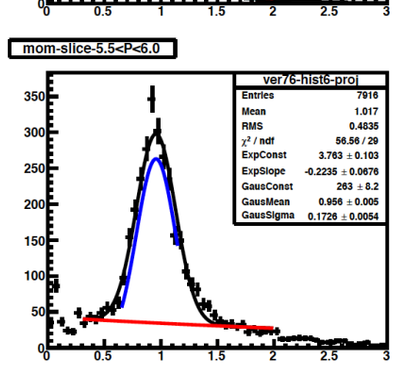


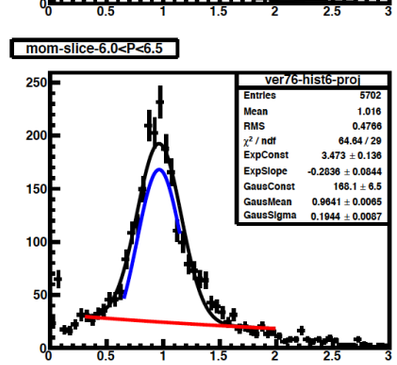


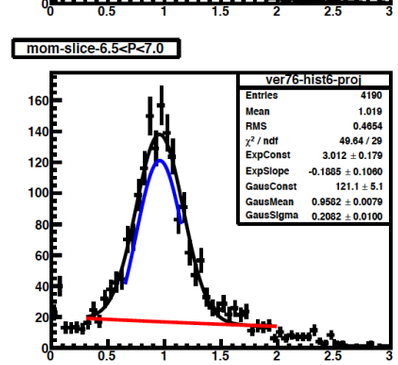


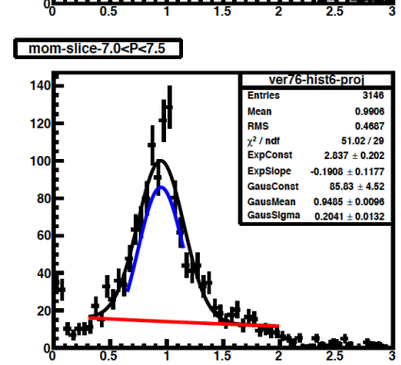


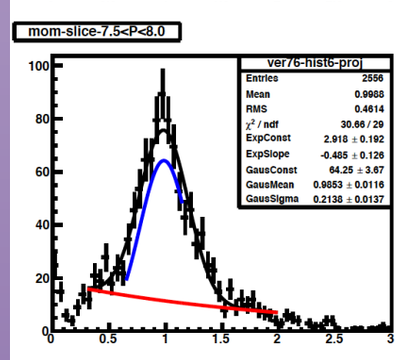


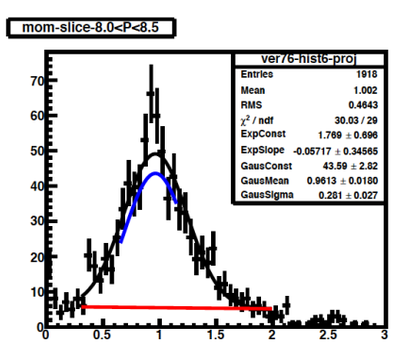


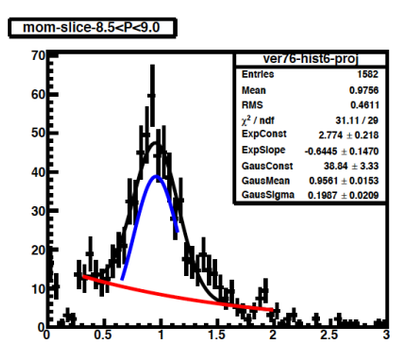


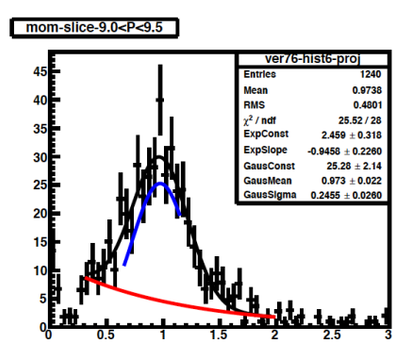


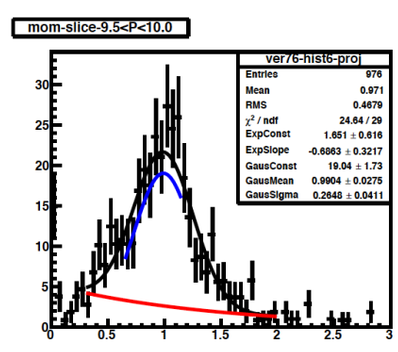








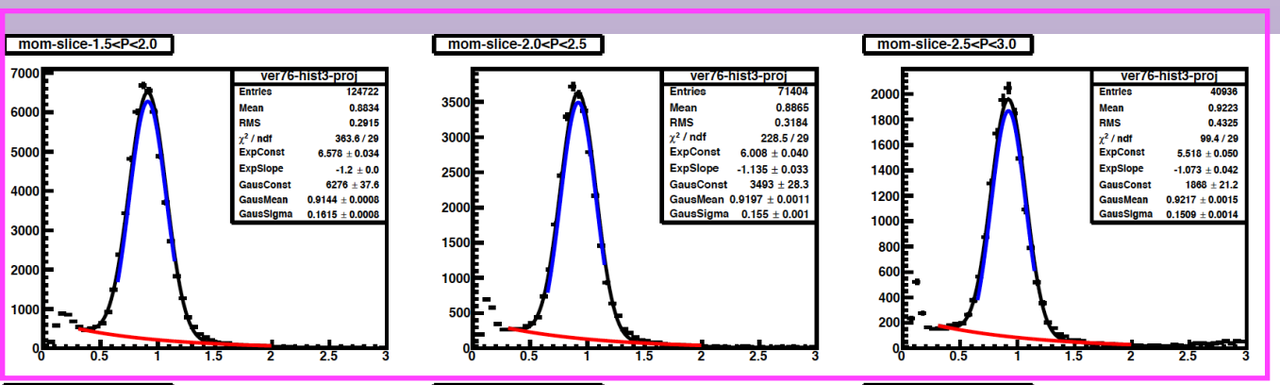




Final Trigger Option

JP2->didFire() || (track P < 3 GeV && BHT3->didFire())

BHT3->didFire() will use below track P = 3 GeV !

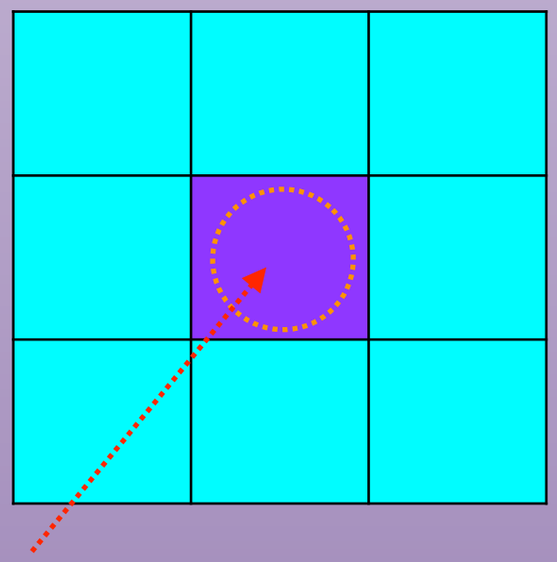


Single Tower and Cluster Method

Single tower Method

- Corrected energy of the central tower using MC simulations (based on TDR).

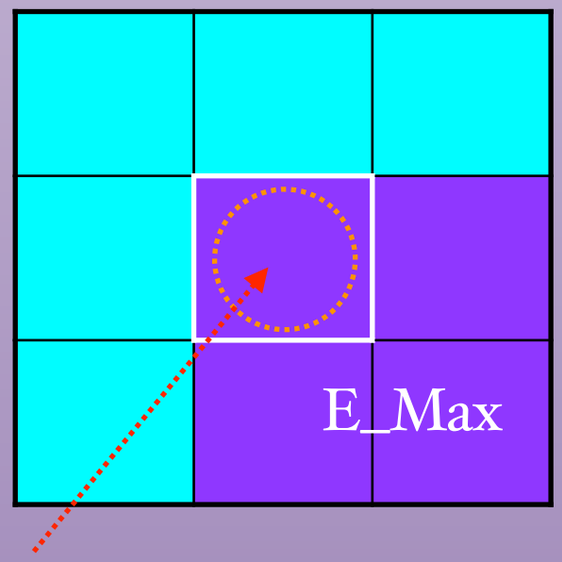
$$E / p = \frac{\text{corrected single tower } E}{\text{track } p}$$



2x2 cluster Method

- 2x2 cluster with maximum energy is selected out of 4 possible clusters.

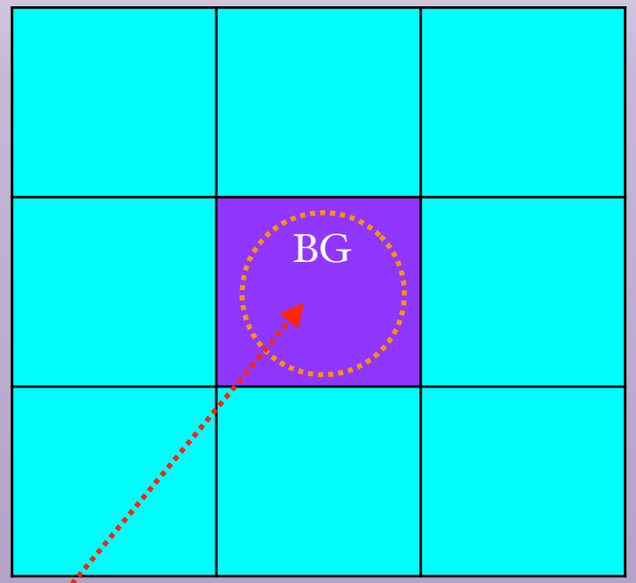
$$E / p = \frac{\text{2x2 cluster } E}{\text{track } p}$$



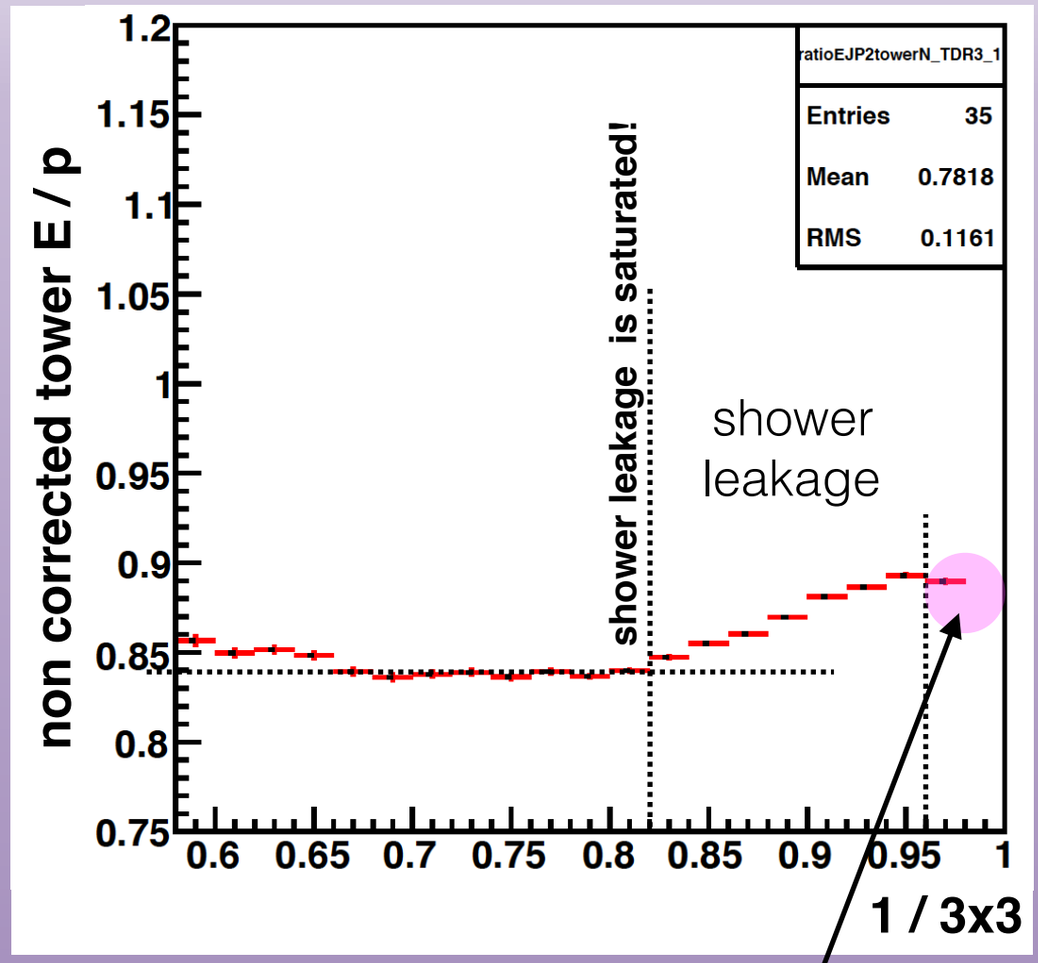
- In cluster method we use Isolation cut to remove tracks with addition BG energy deposition in the tower

Questions regarding isolation cut used in cluster method during last PWG Update

1. Explain the E / p variation vs isolation ratio for tower and cluster method



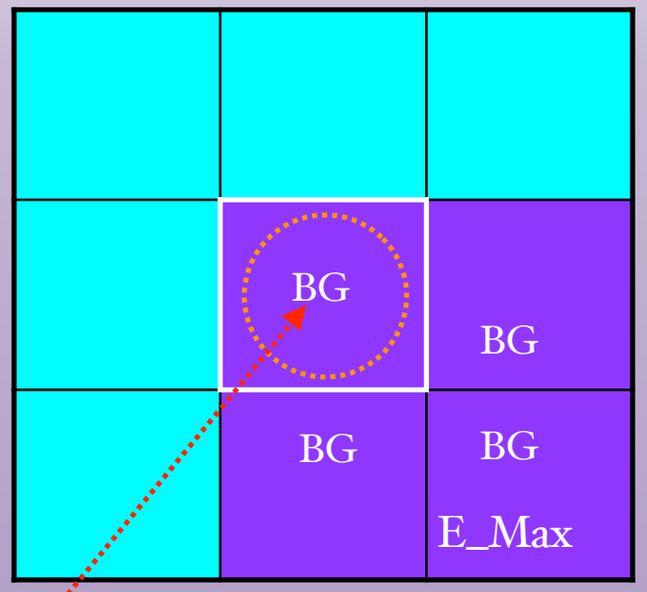
- To the left is a distribution of “non-corrected single Tower E / p as a function of 1 / 3x3 isolation ratio.
- Based on the distribution, one can see that **E / p** is stable below ratio = 0.82. This implies that shower leakage is kind of saturated at this point.
- In the case for 2x2 cluster method shower leakage is mainly compensated by the “cluster” but additional BG energy deposition (from particle like pi0) leads to larger E / p at smaller isolation ratios.

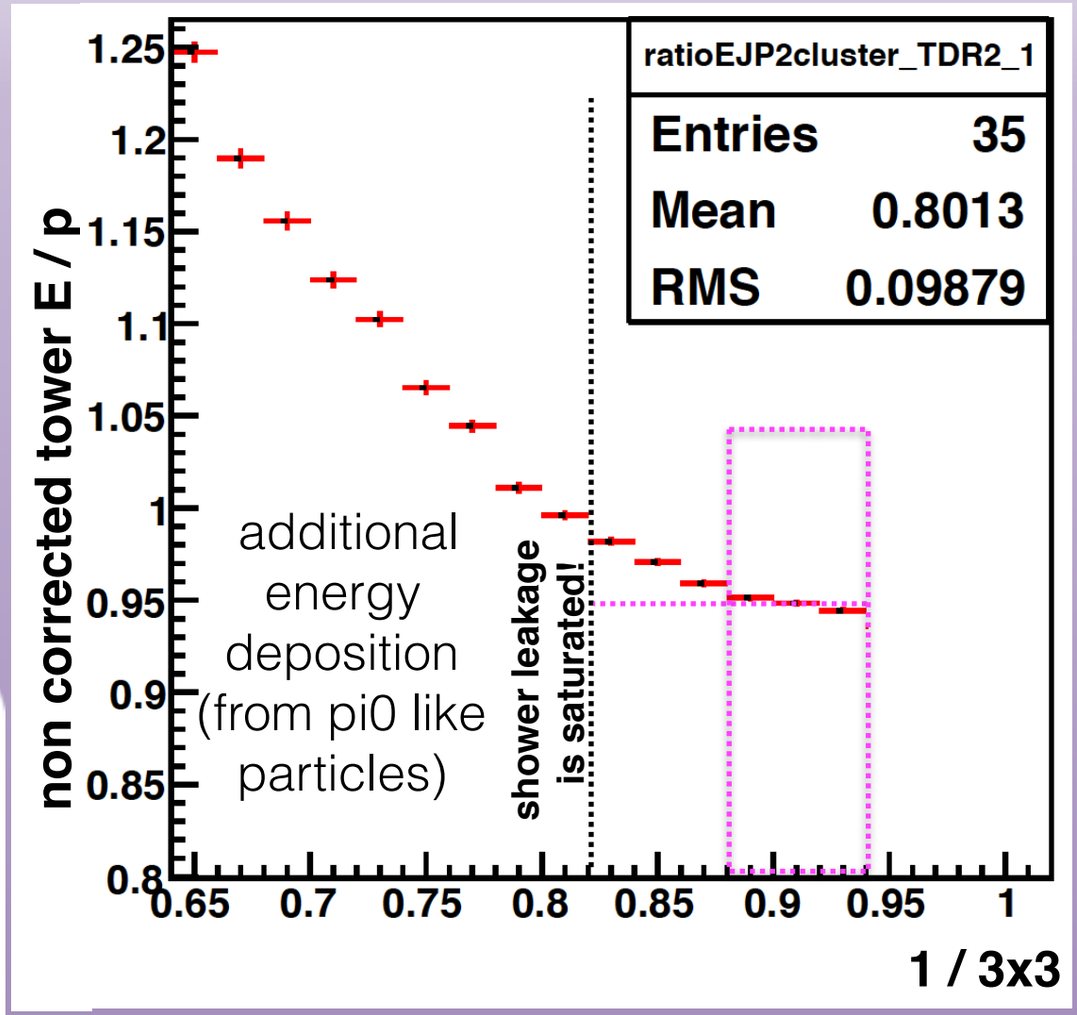


Why E / p decreases @ very high ratios ? This seems to be a statistics effect! [slide 9]

Questions regarding isolation cut used in cluster method during last PWG

1. Explain the E / p variation vs isolation ratio for tower and cluster method

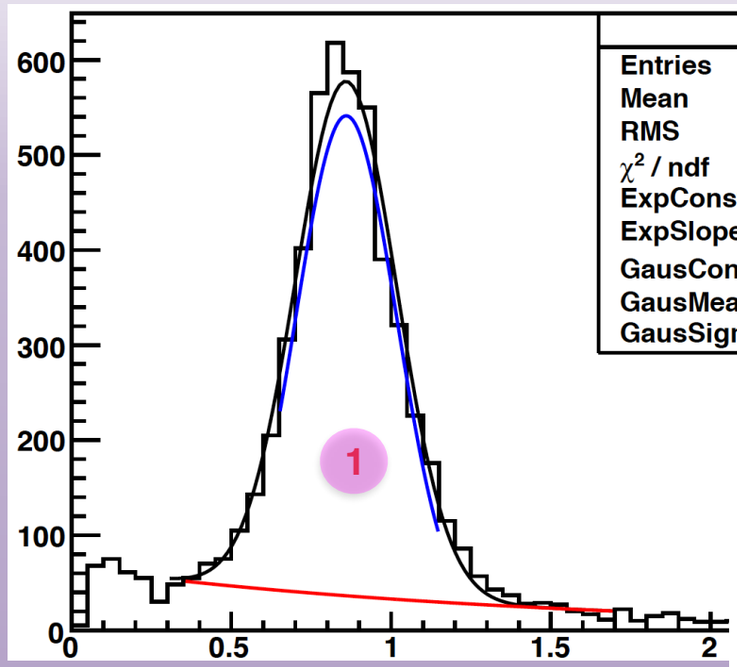


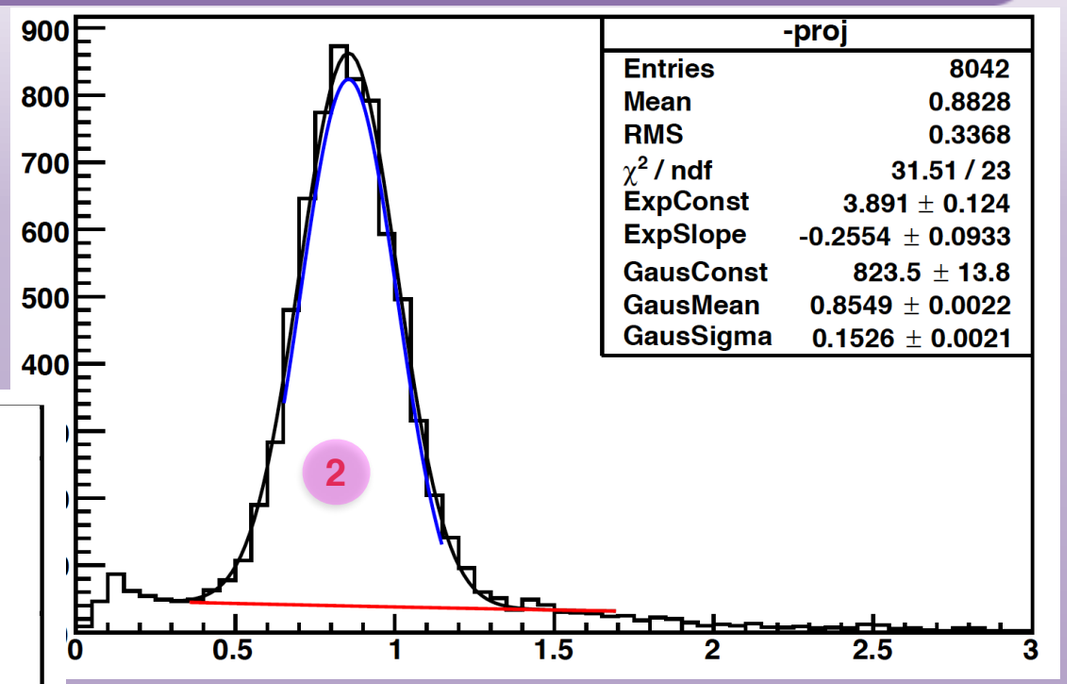


- To the left is a distribution of "non-corrected 2x2 cluster E / p as a function of 1 / 3x3 isolation ratio.
- Based on the distribution one can see that additional BG energy deposition plays a big role (since BG are coming from 4 towers instead 1).
- If BG energy comes from a single tower as shown before one could expect to have stable **E / p** above ratio = 0.82. But in this case BG still plays role up to ratio ~ 0.88. One could say when ratio ~ 0.88 cluster would have minimum additional BG energy deposition from 4 towers.

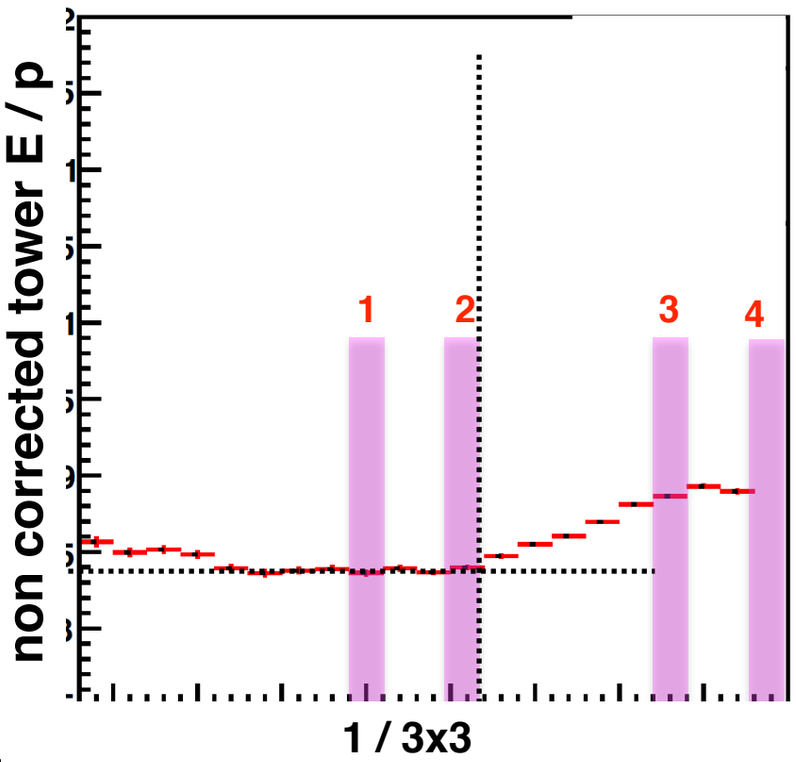
- We will use ratio = 0.82 as the isolation cut in cluster method and would like to add variation in E /p from 0.82 to 0.88 to systematic from isolation cuts.

E / p distribution for different ranges of Isolation ratio

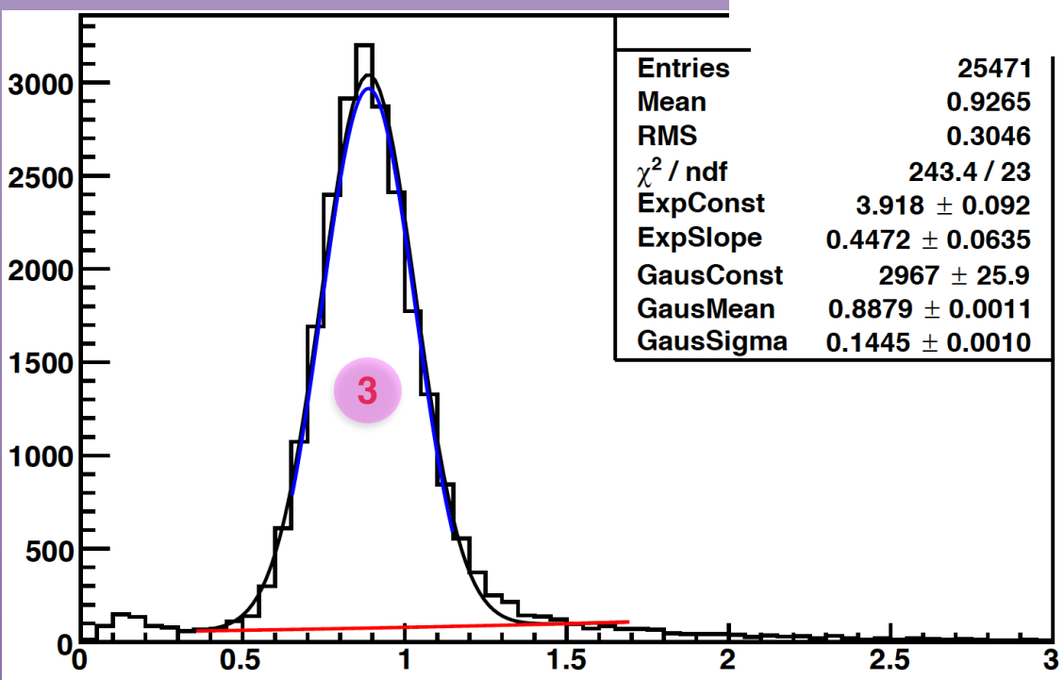


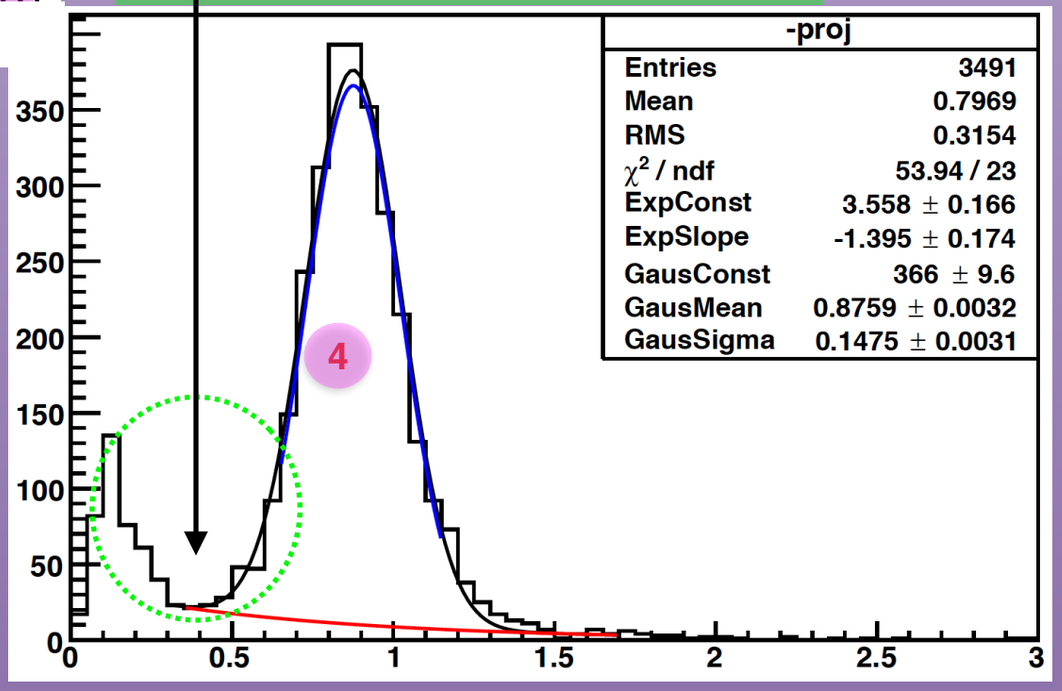


non corrected single tower

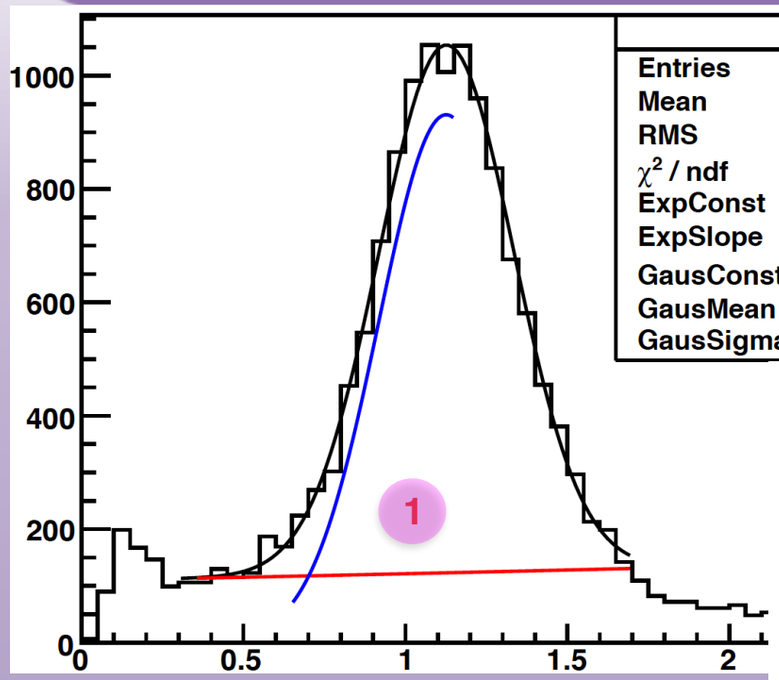


due to less statistics BG and signal peaks are not well separated!

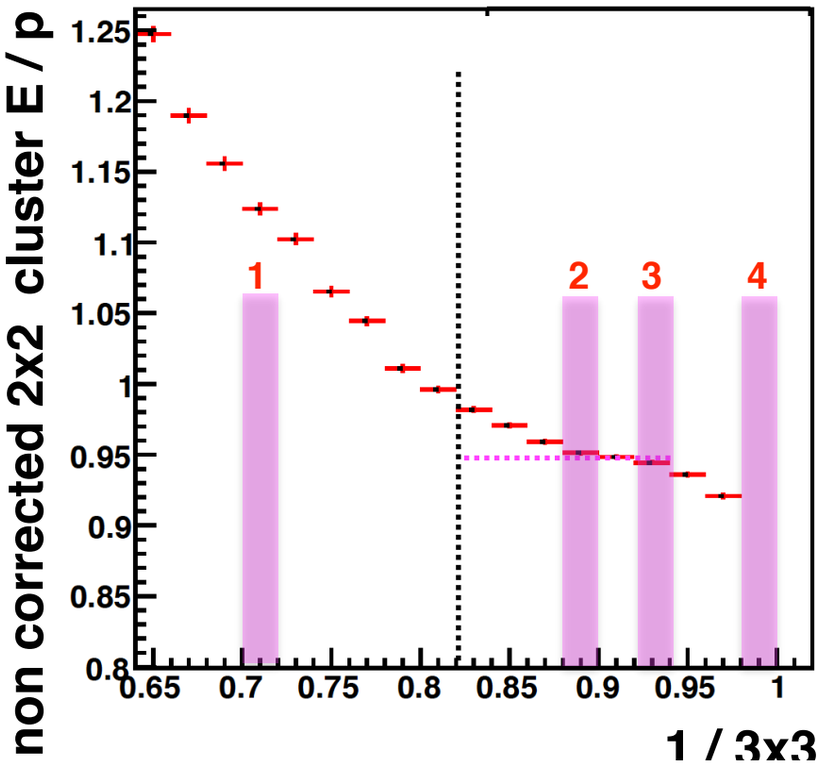


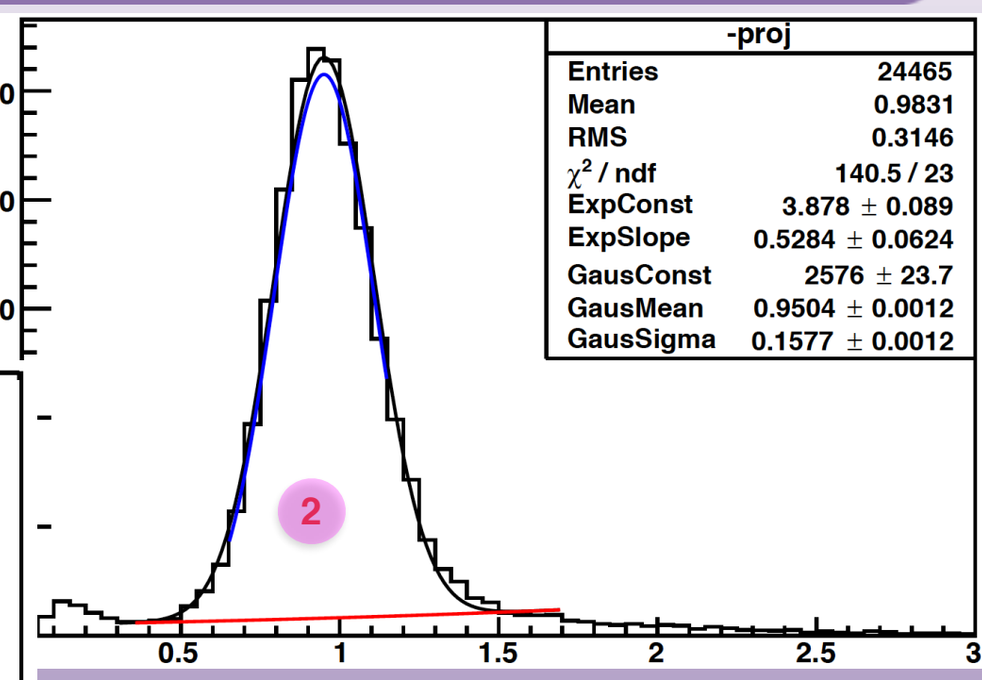


E / p distribution for ranges of ratio

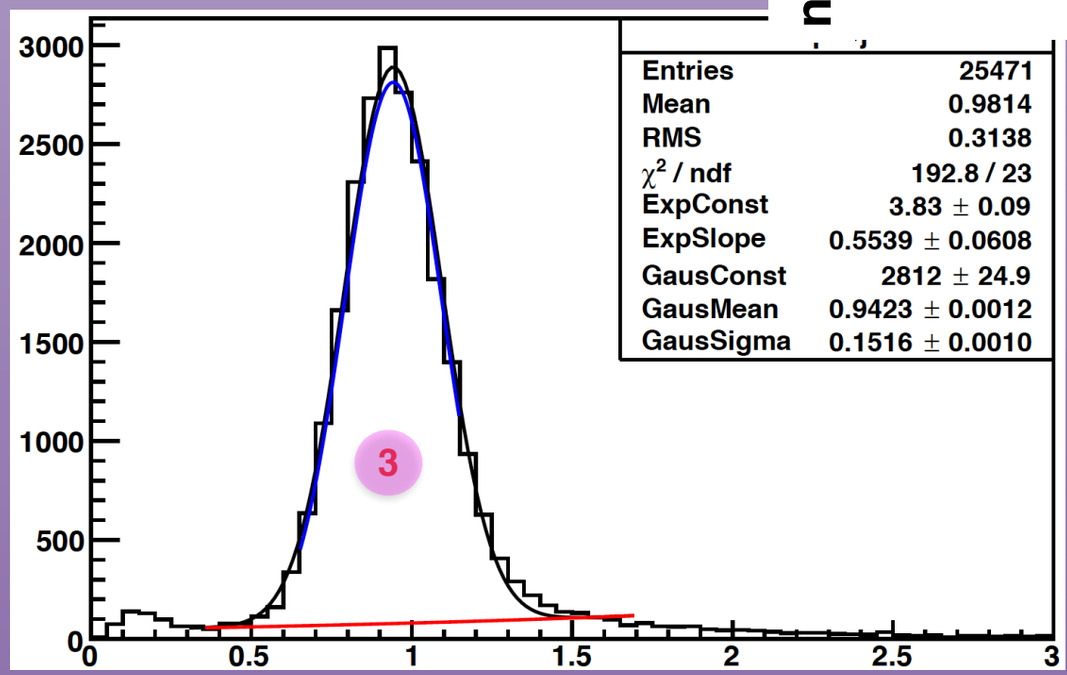


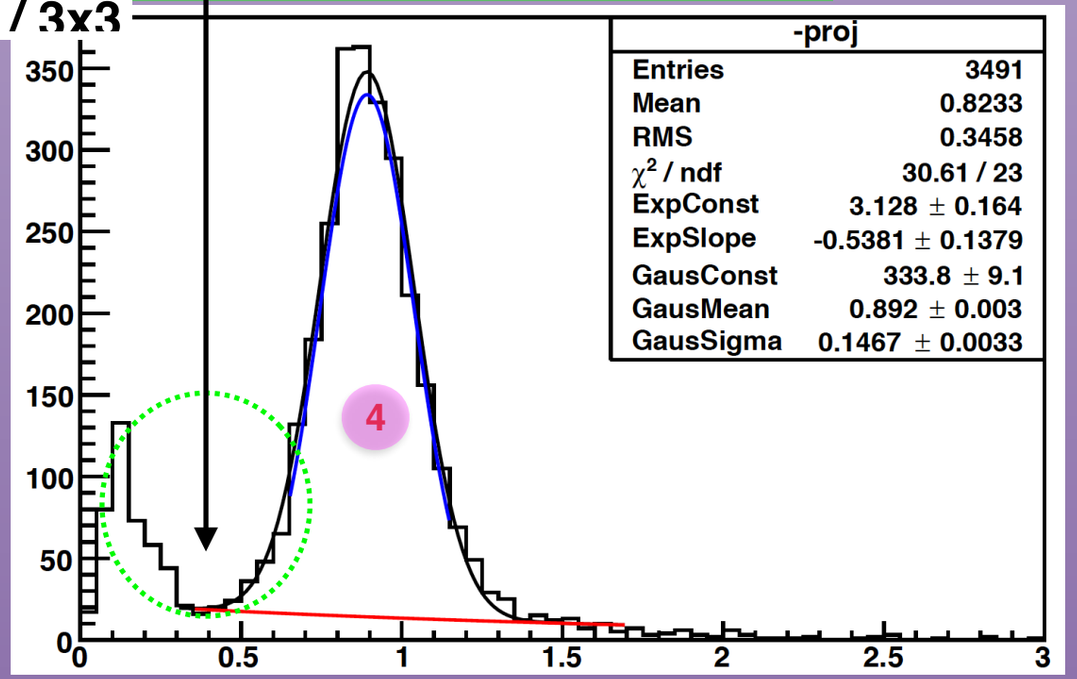
non corrected 2x2 cluster



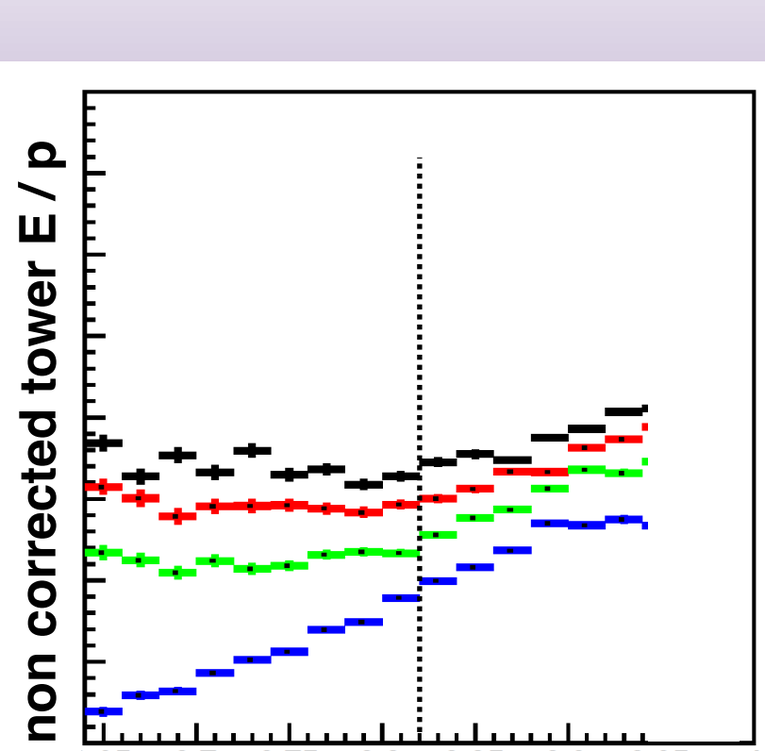


due to less statistics BG and signal peaks are not well separable!

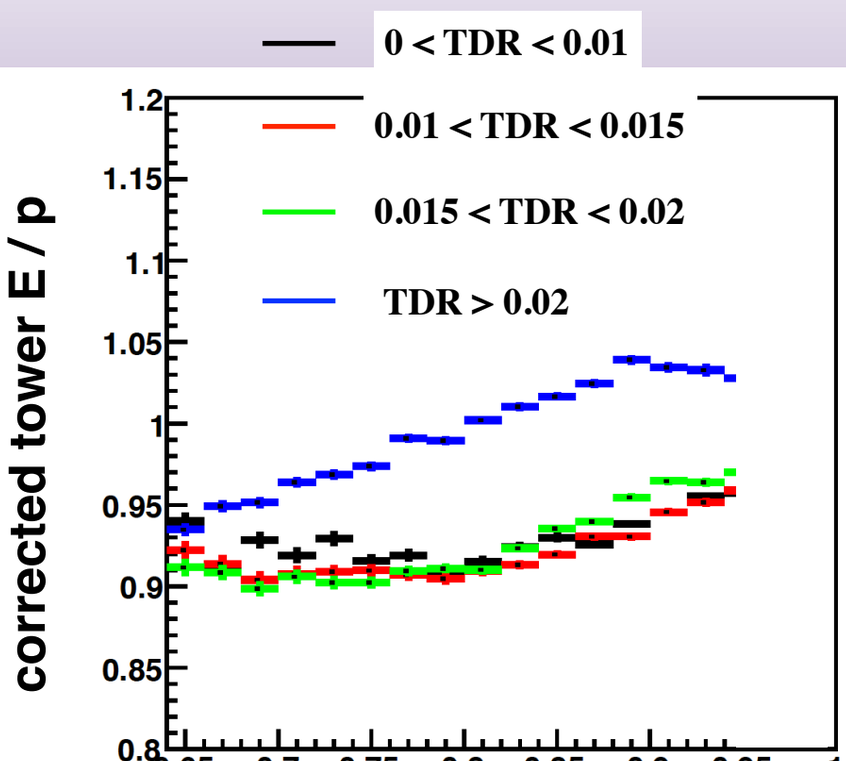




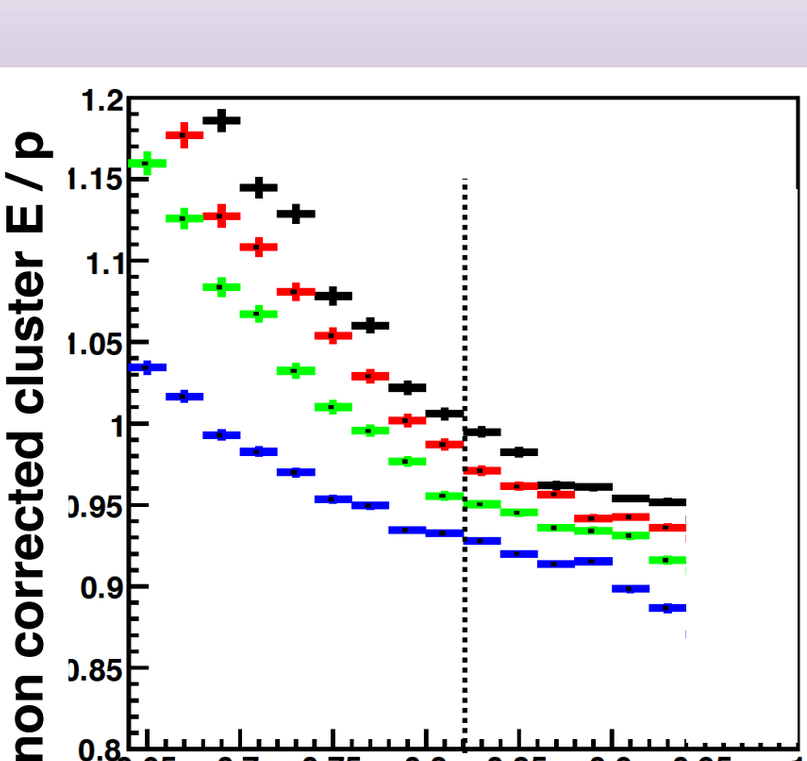
TDR Cut



1 / 3x3



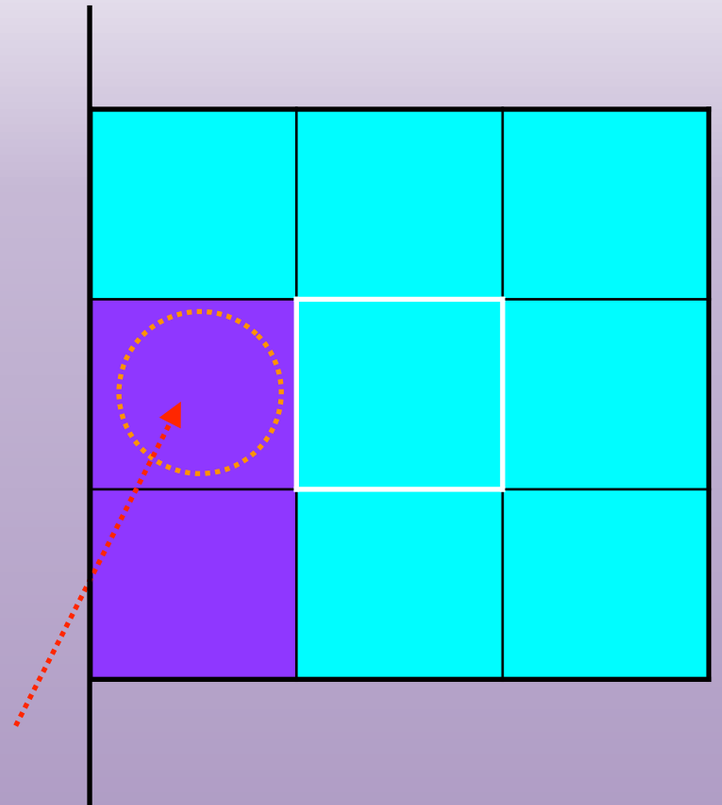
1 / 3x3

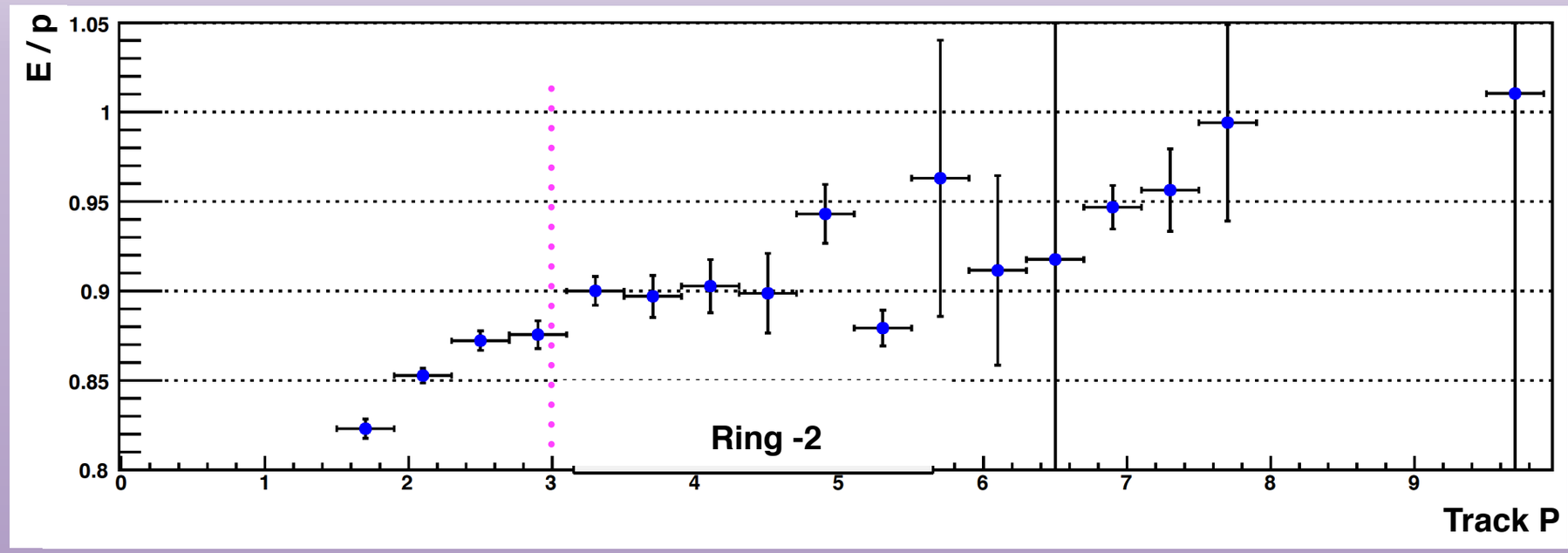


1 / 3x3

- E / p shows significant dependance on TDR cut
- MC correction do a pretty good job as for the TDR dependance.
- Since 2x2 cluster method do not use correction we will tighten this cut from 0.02 -> 0.015 in cluster method.

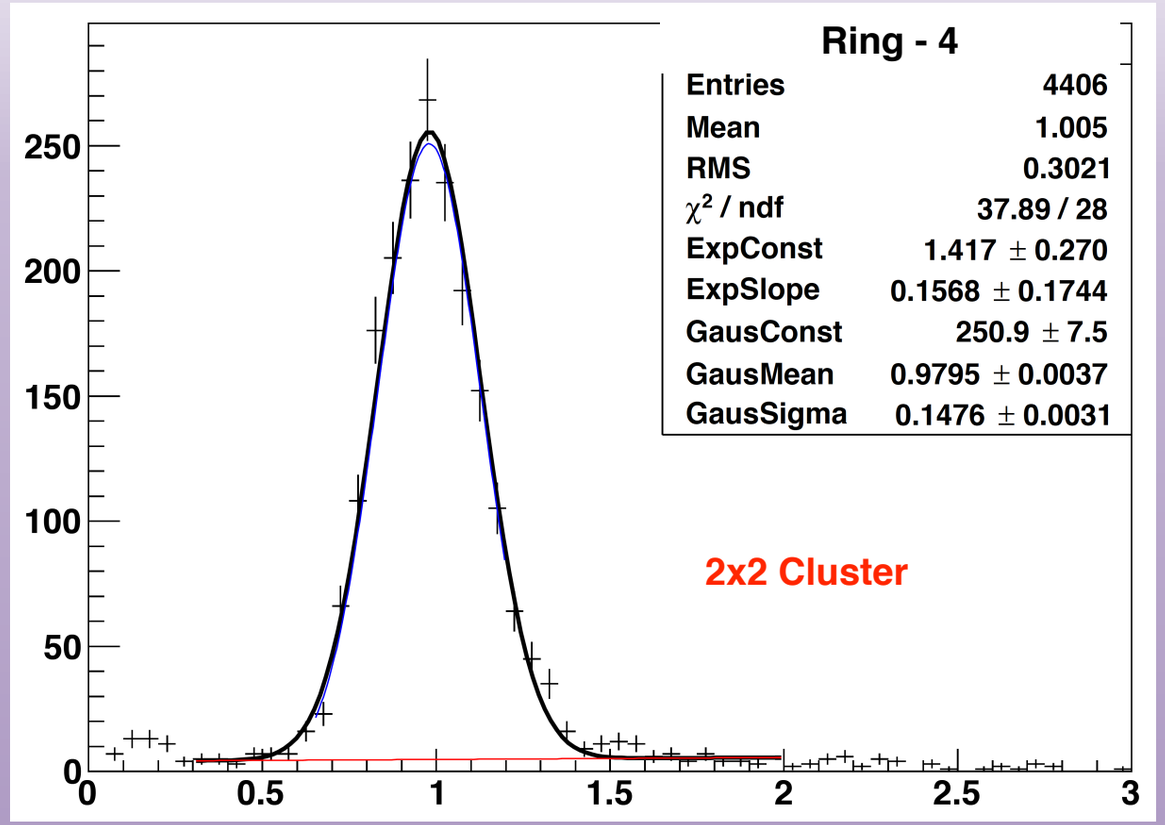
Most Forward 2 Eta rings

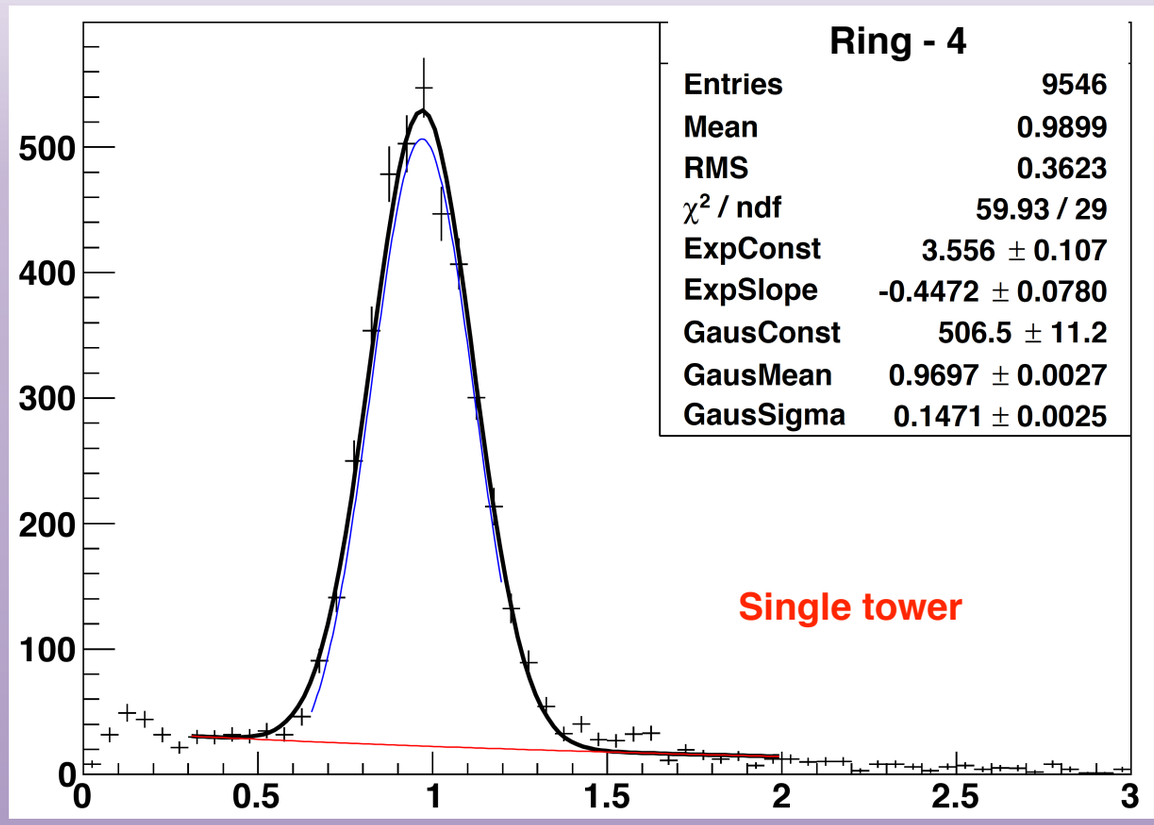


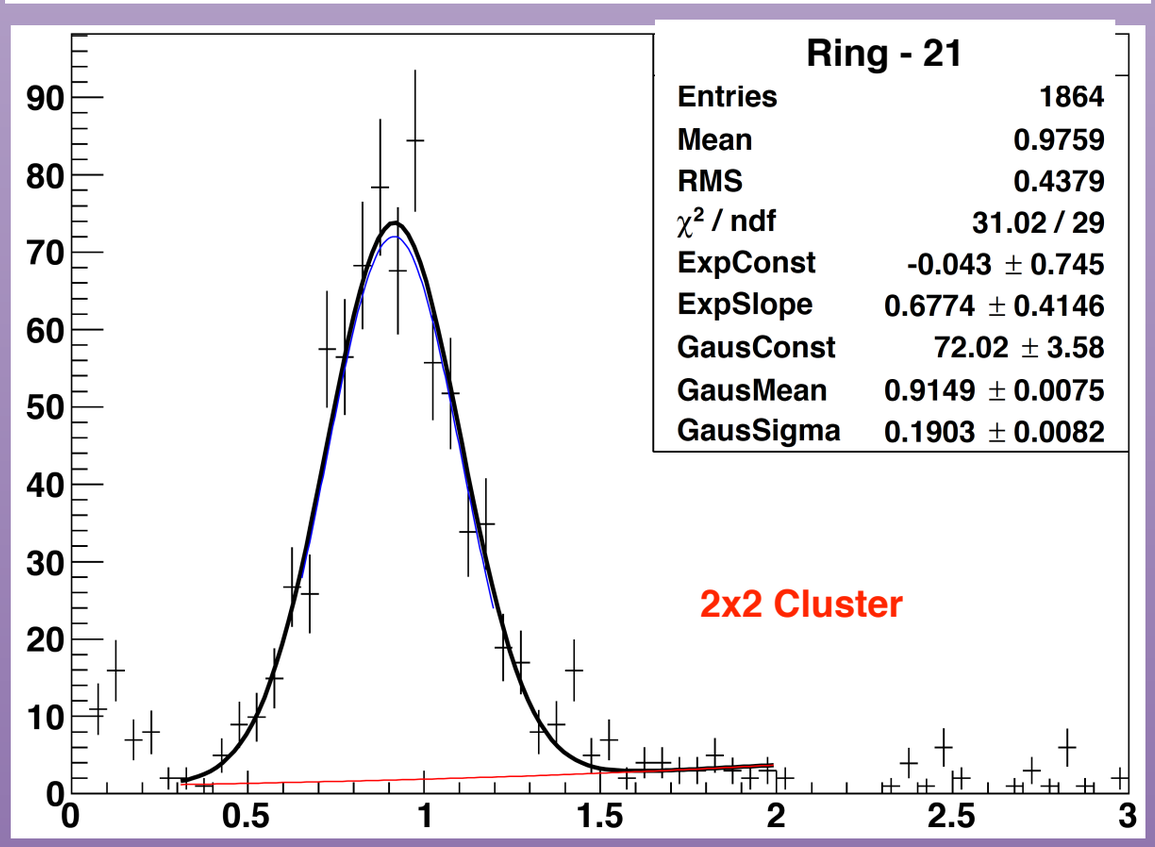


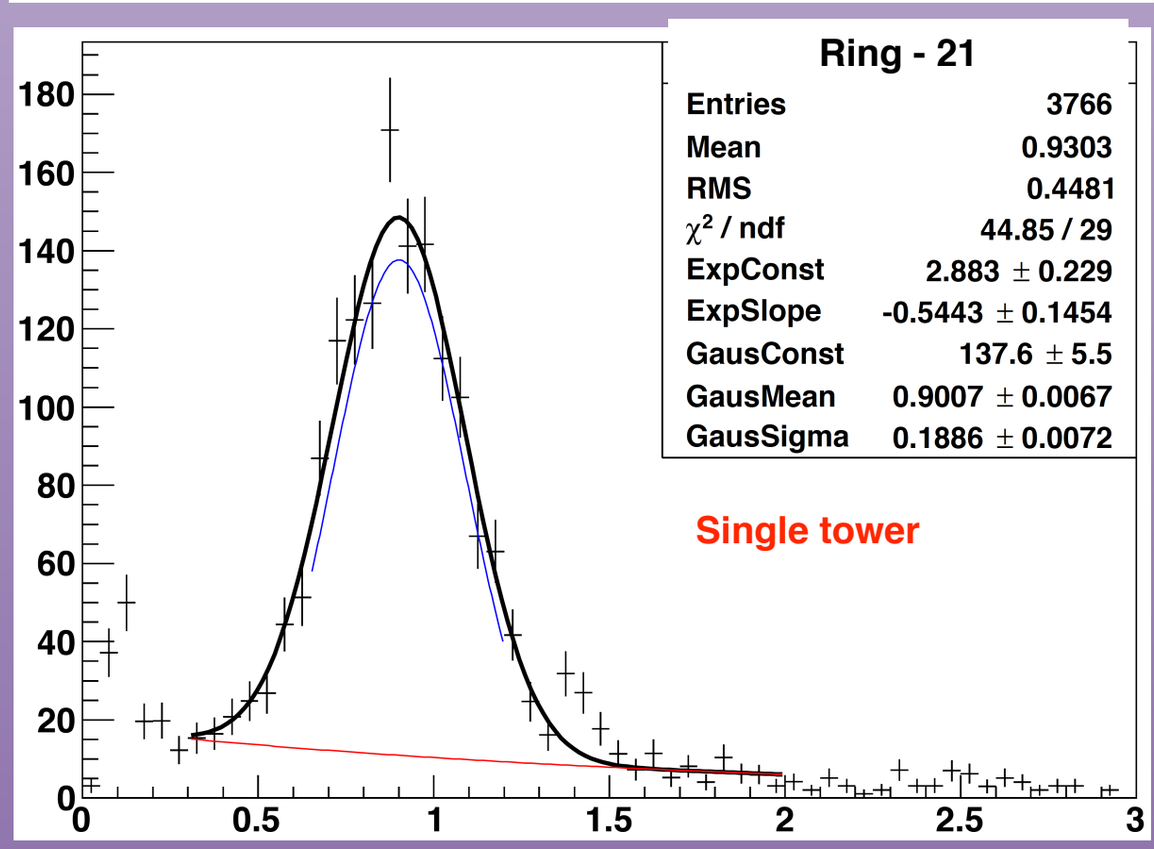
- Most forward 2 eta rings have systematically low E / p due to increased dead materials and therefore less statistics.
- 2x2 cluster method will only more BG to these two forward rings.
- Therefore Tower method will be used for most forward 2 eta rings with a lightning P cut (P cut = 3.0 GeV) than inner rings to reduce BG.

Tower - cluster method - E / p distributions

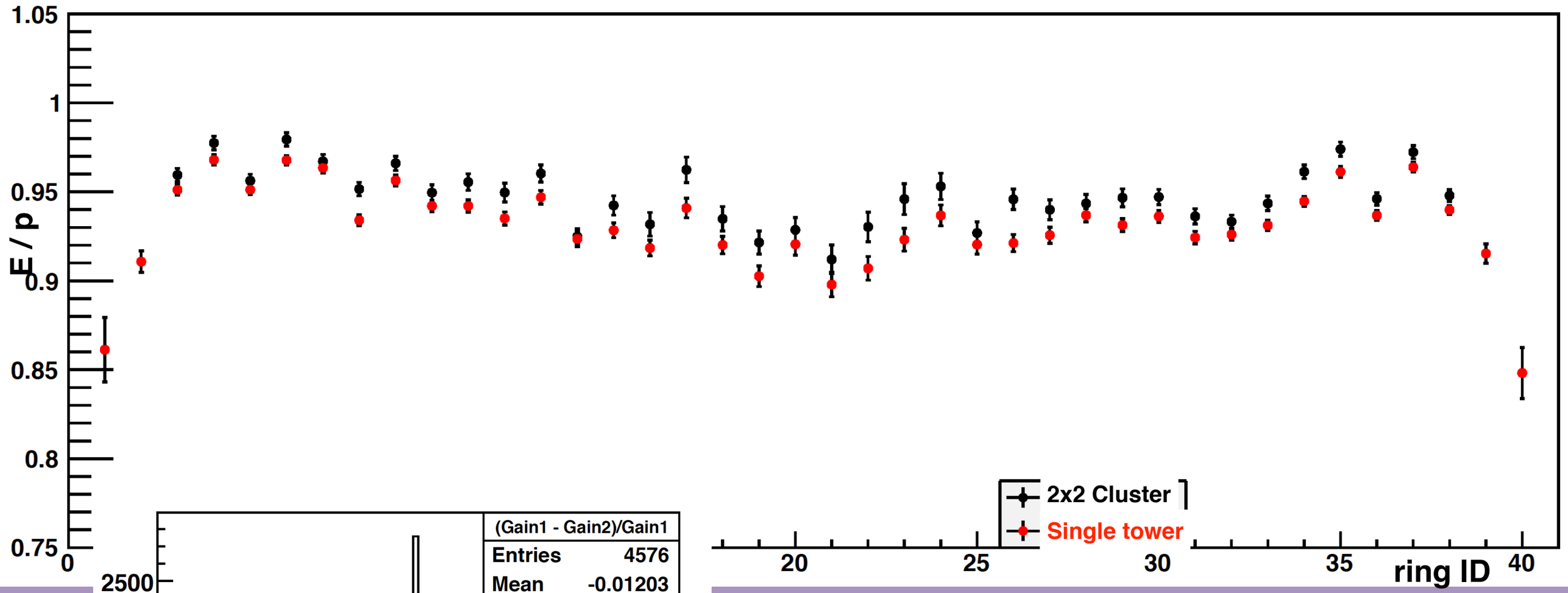


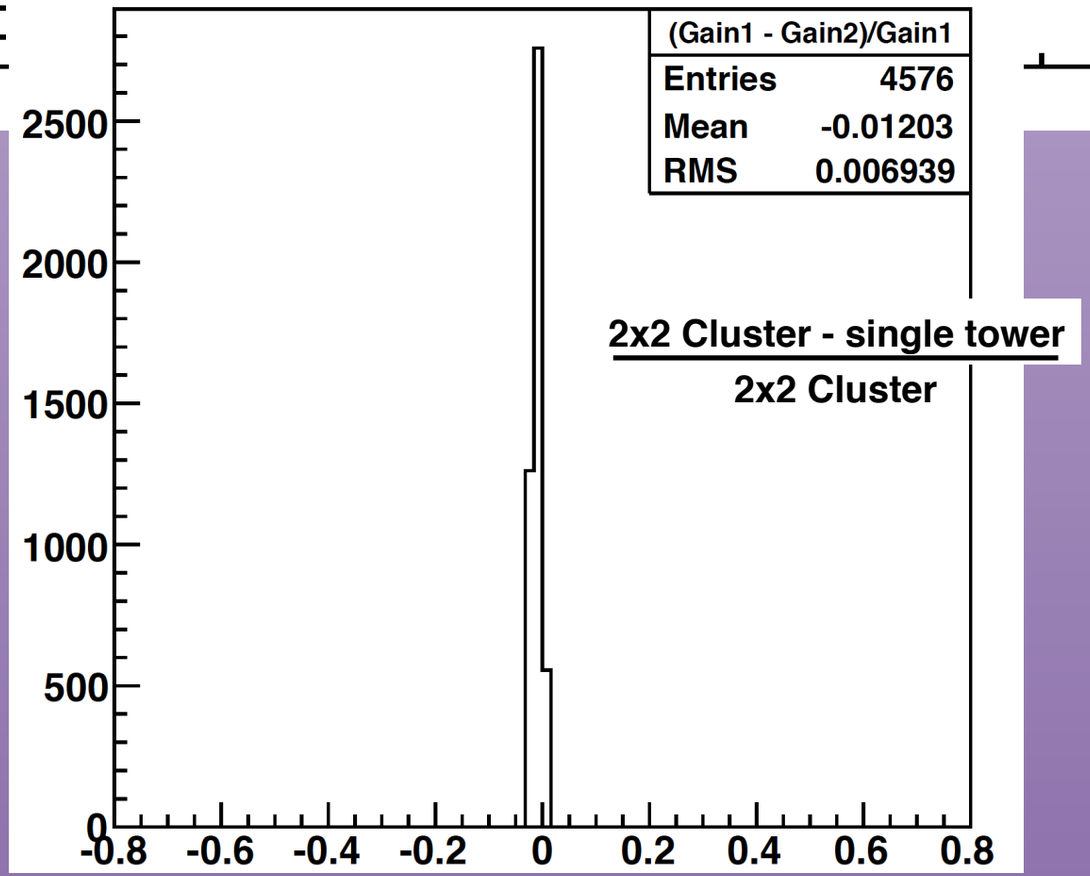






E / p fit values in rings

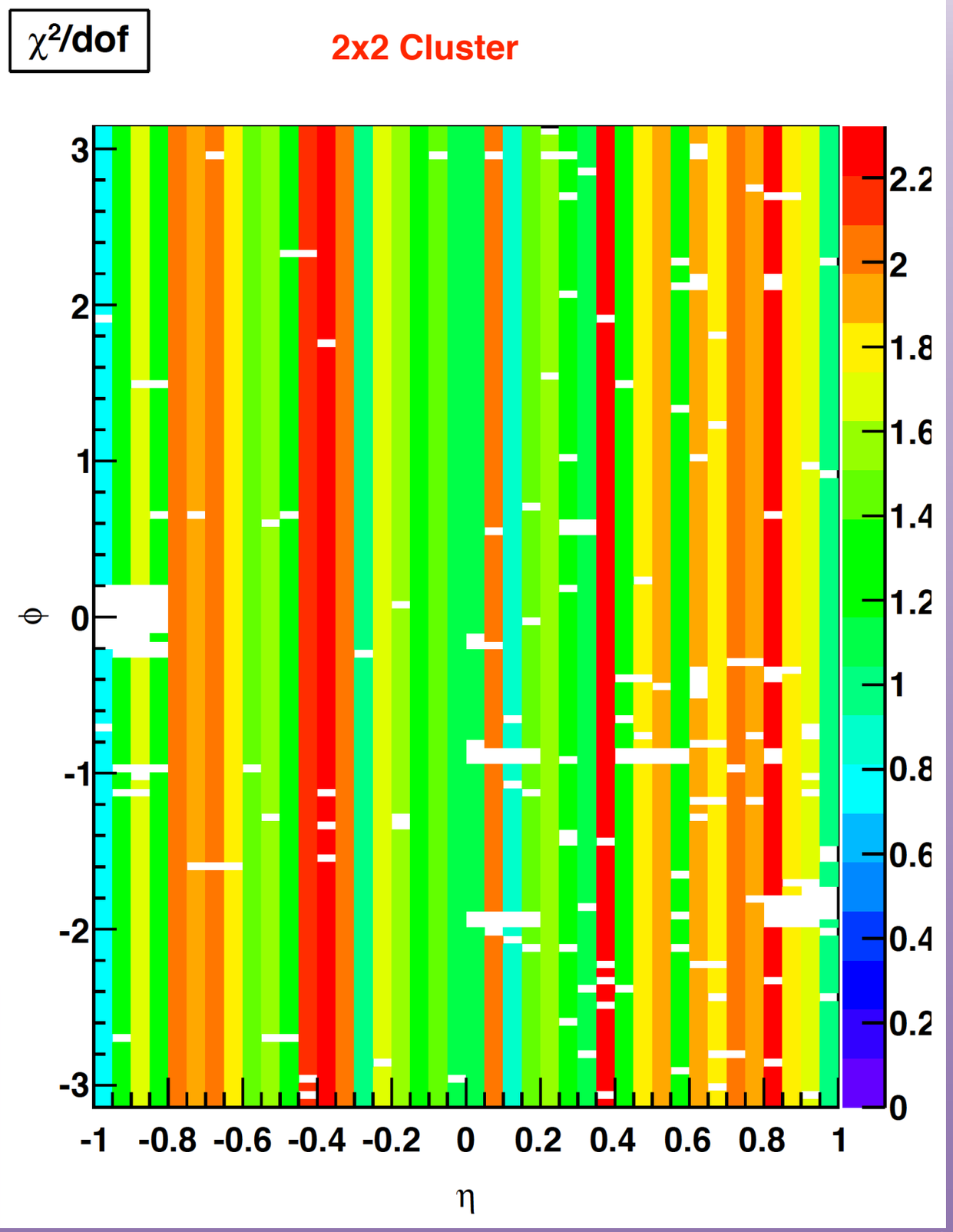


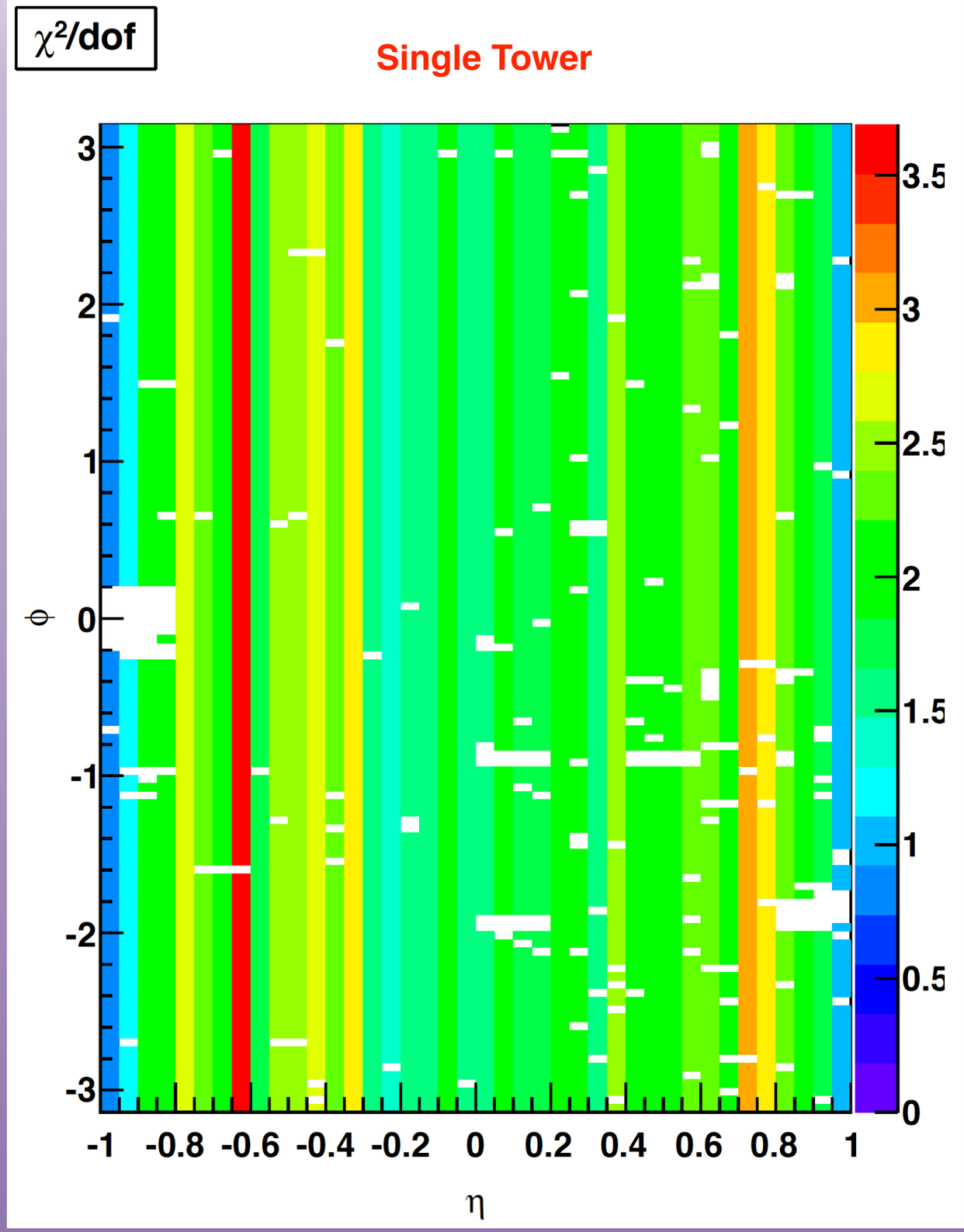


2x2 Cluster - single tower
2x2 Cluster

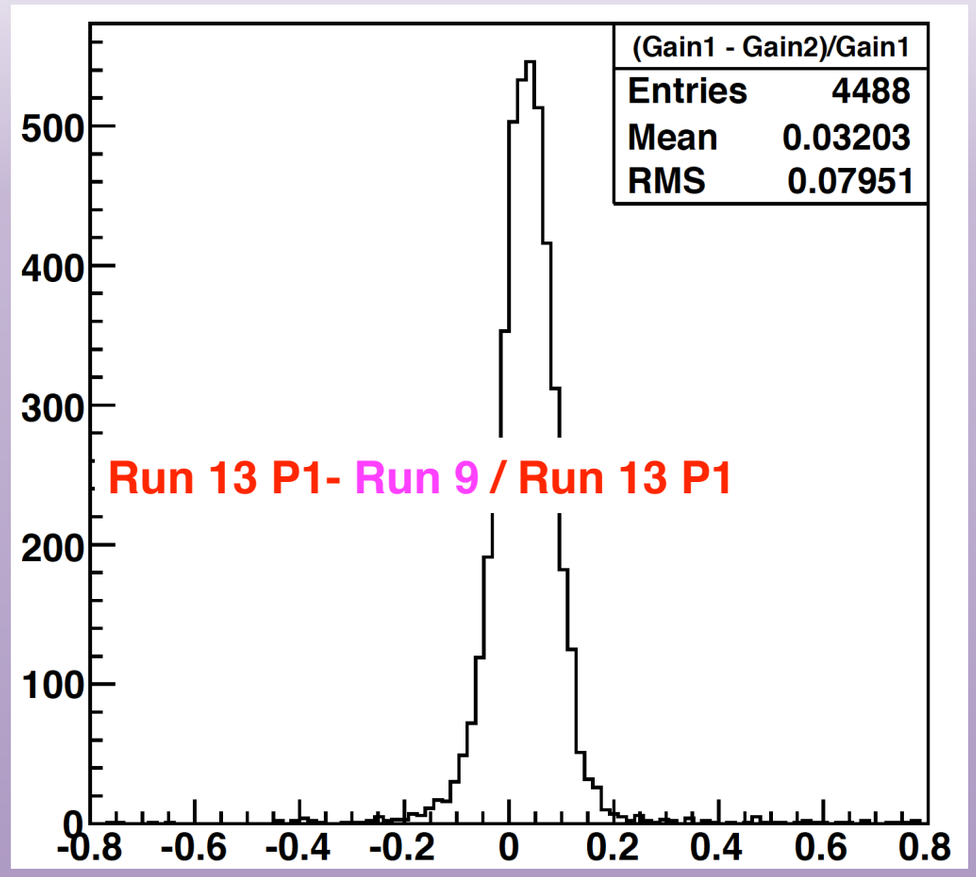
- Single tower method gains are 1.2 % larger than 2x2 cluster method gains.!

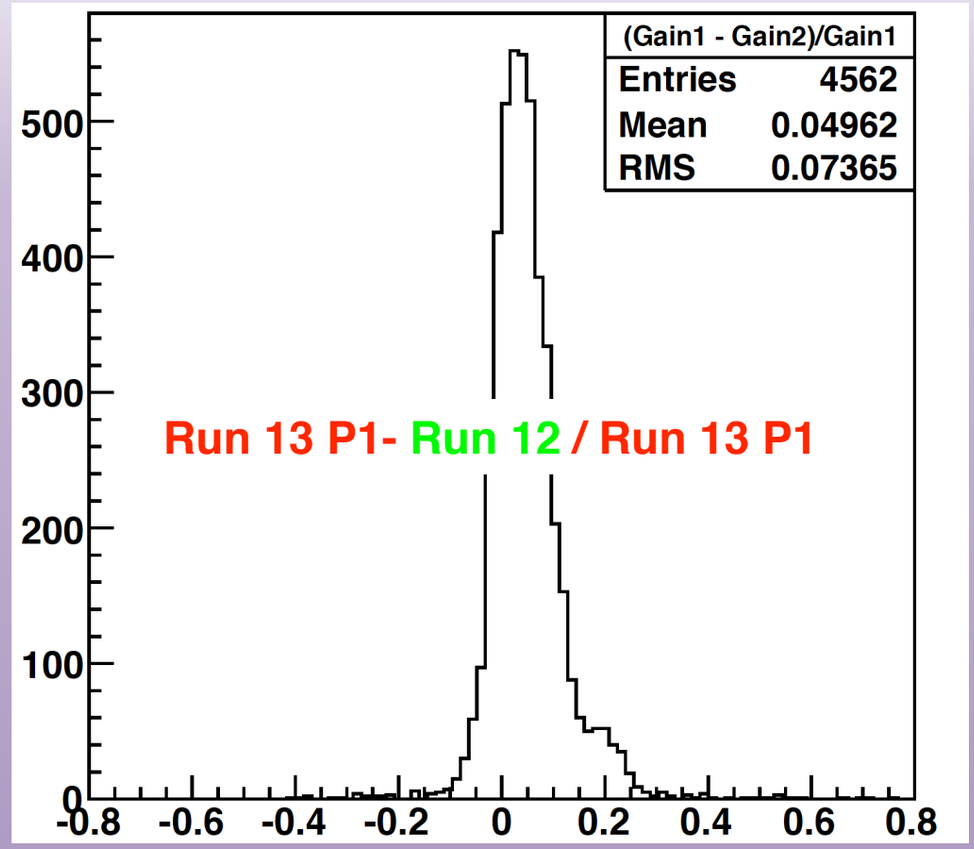
chi2/dof from fitting

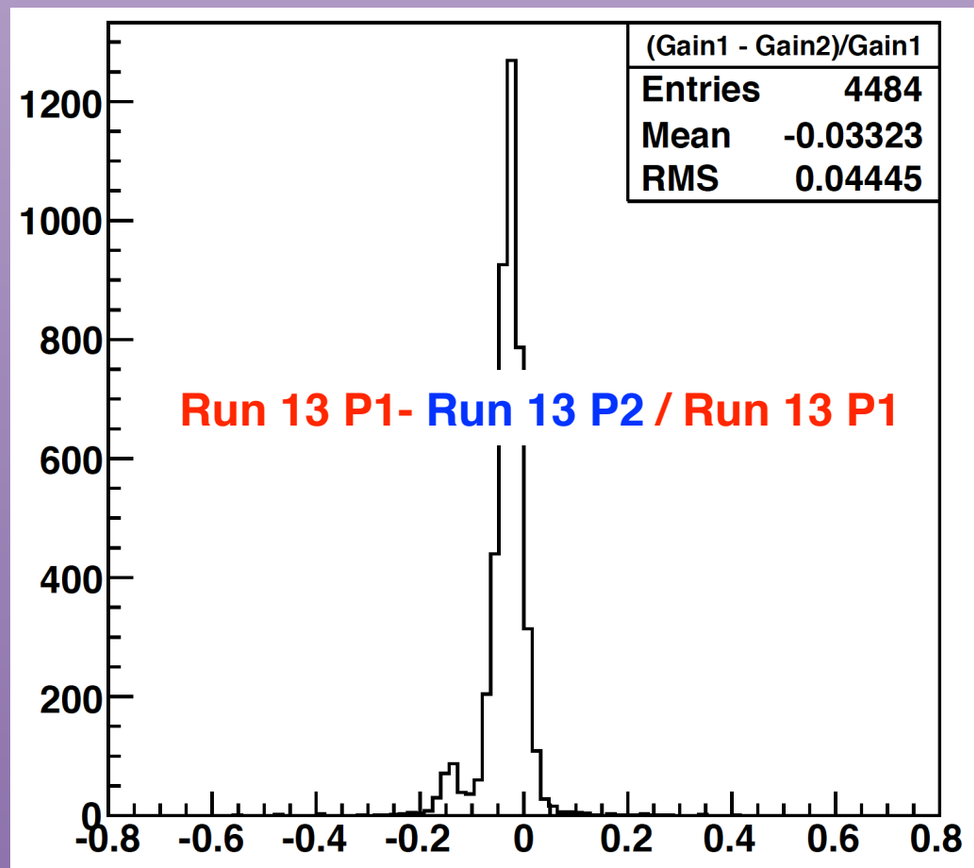




Absolute Gain comparisons

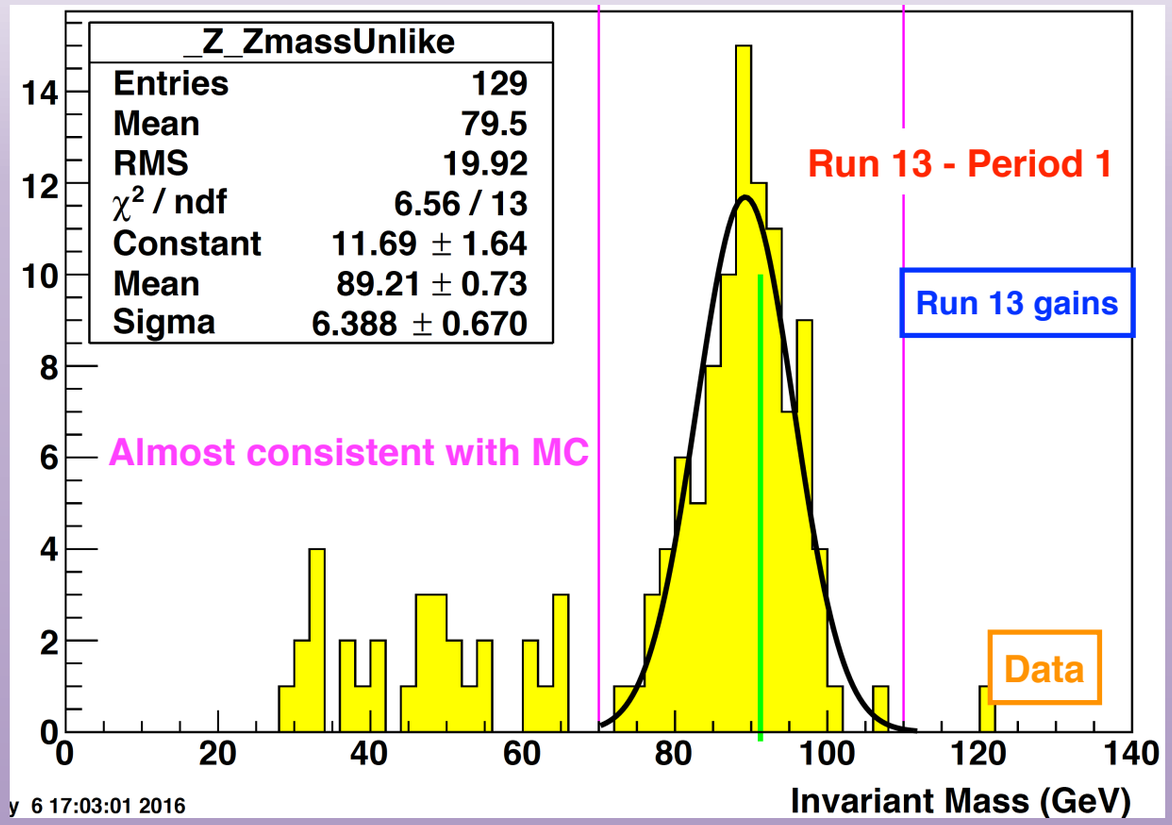


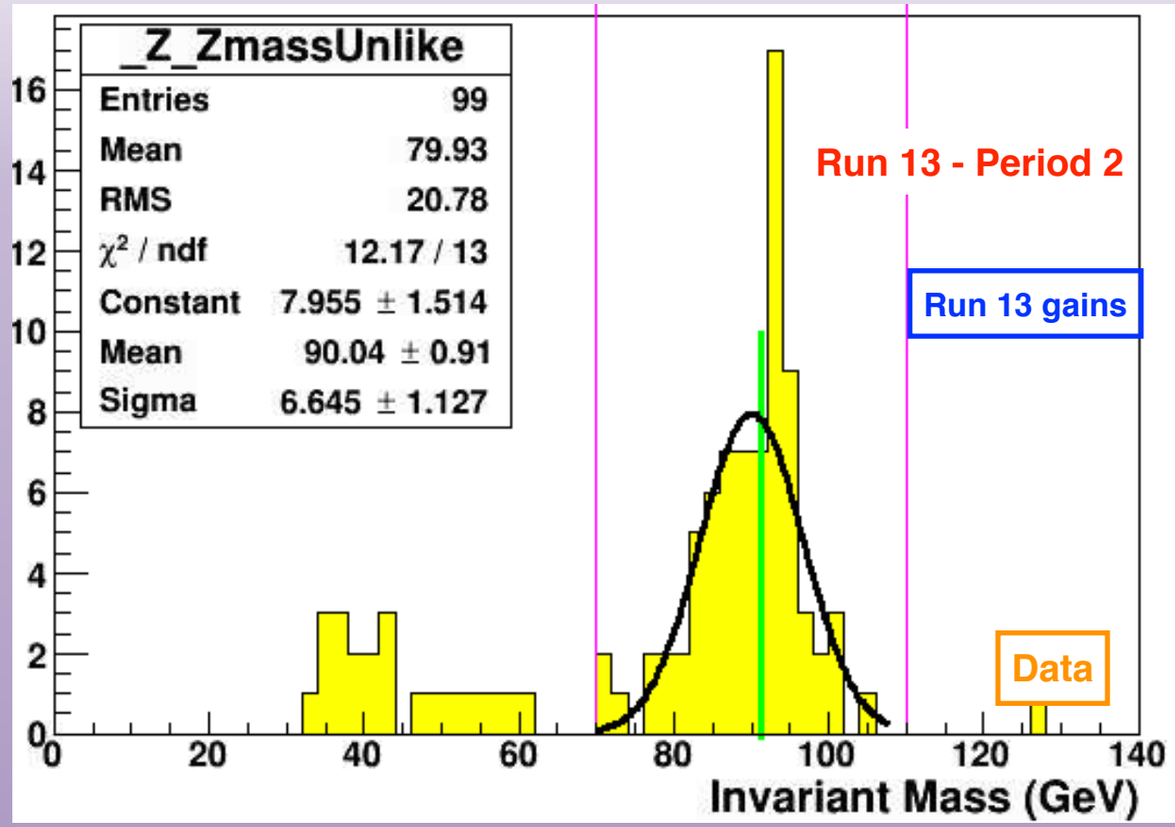


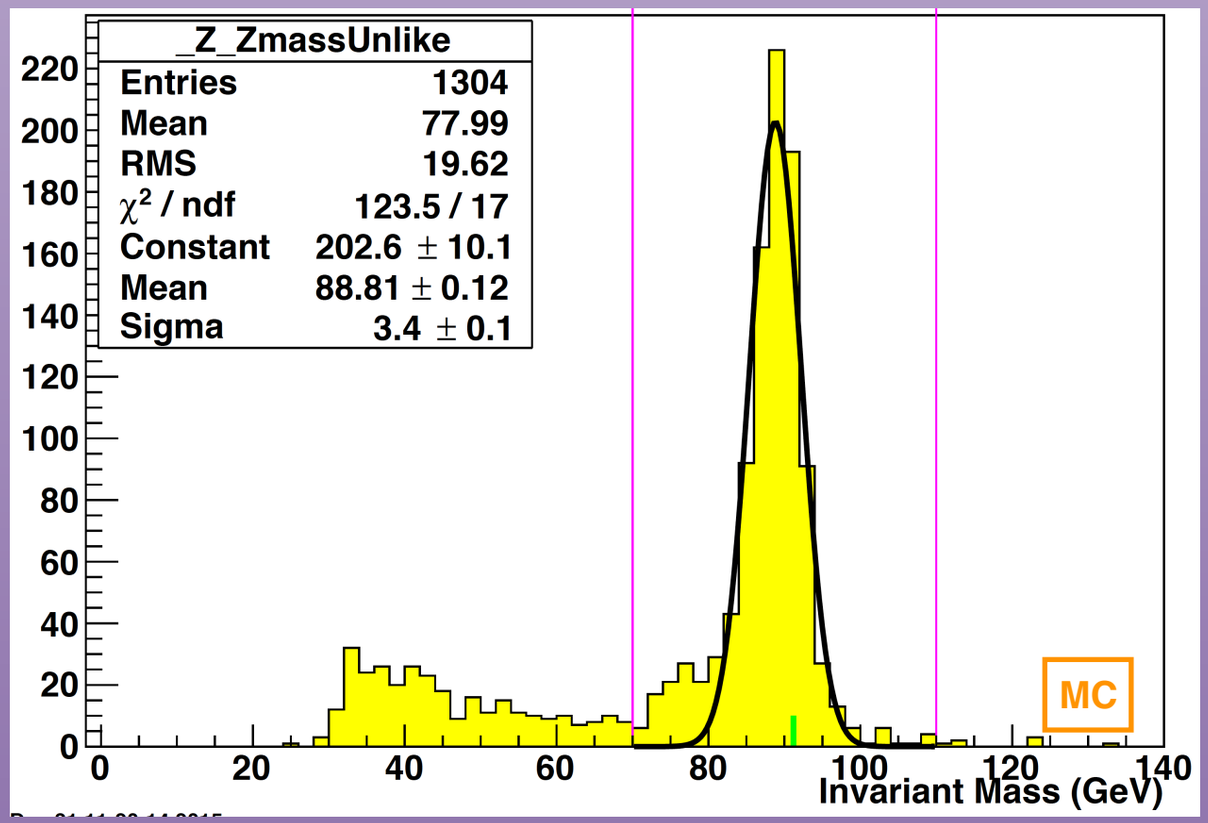


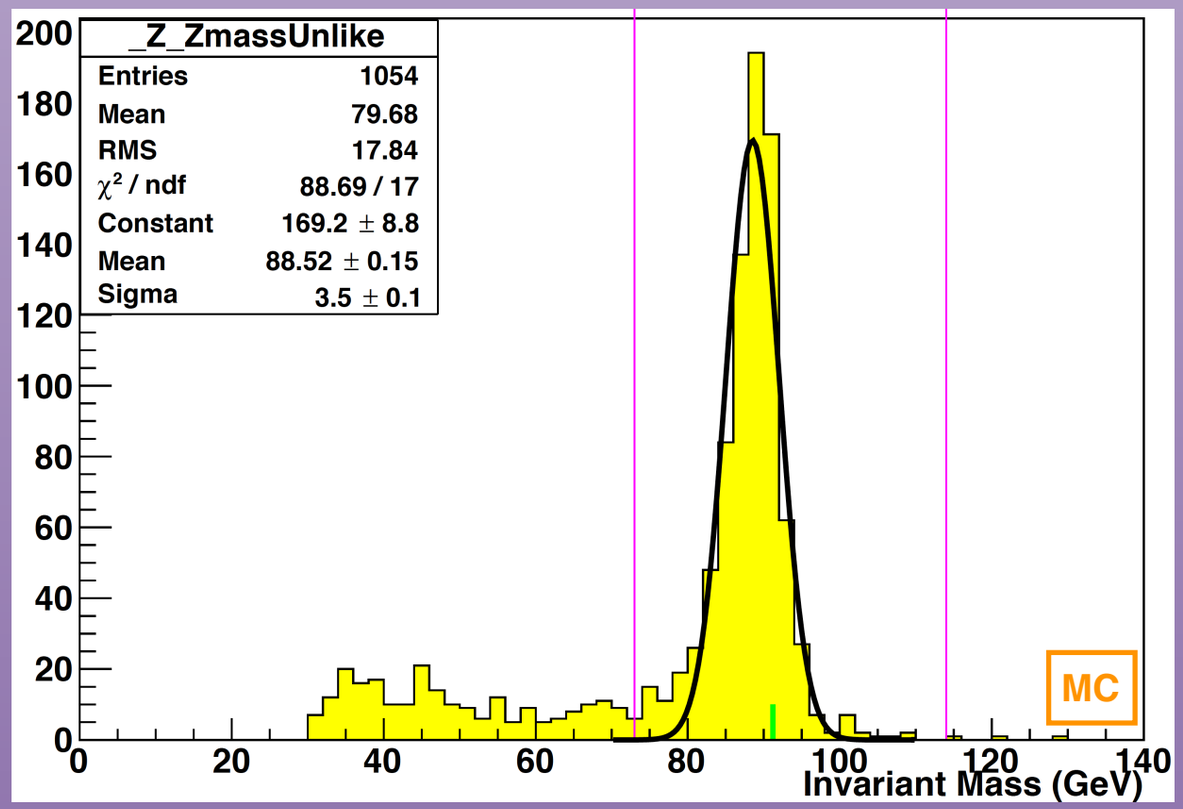
	Run 12 200	Run 13 - P1 500	Run 13 - P2 500	Run 13 P2 MIPADC	Run 13 P2 Z-mass
Run 9 200	**< 2** %	**> 3 %**	**> ~ 6%**		
Run 12		> ~ 5%	> ~ 8%		
Run 13 P1 500			> ~ 3.3%		
Run 13 P1- MIPADC				**< ~2%**	
Run 13 P1- Z-mass (run-9					**< ~2%**

Impact on High Energy Probes - comparison to MC

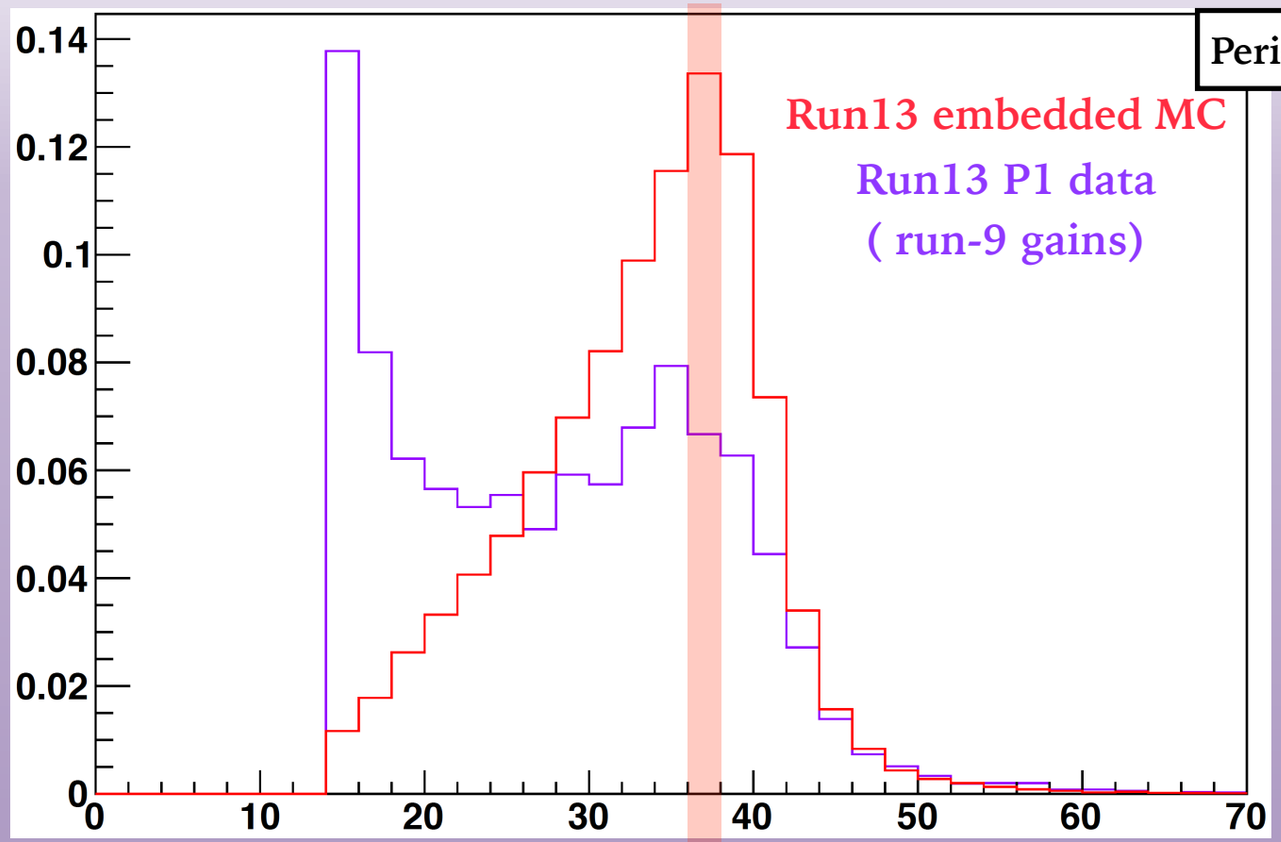


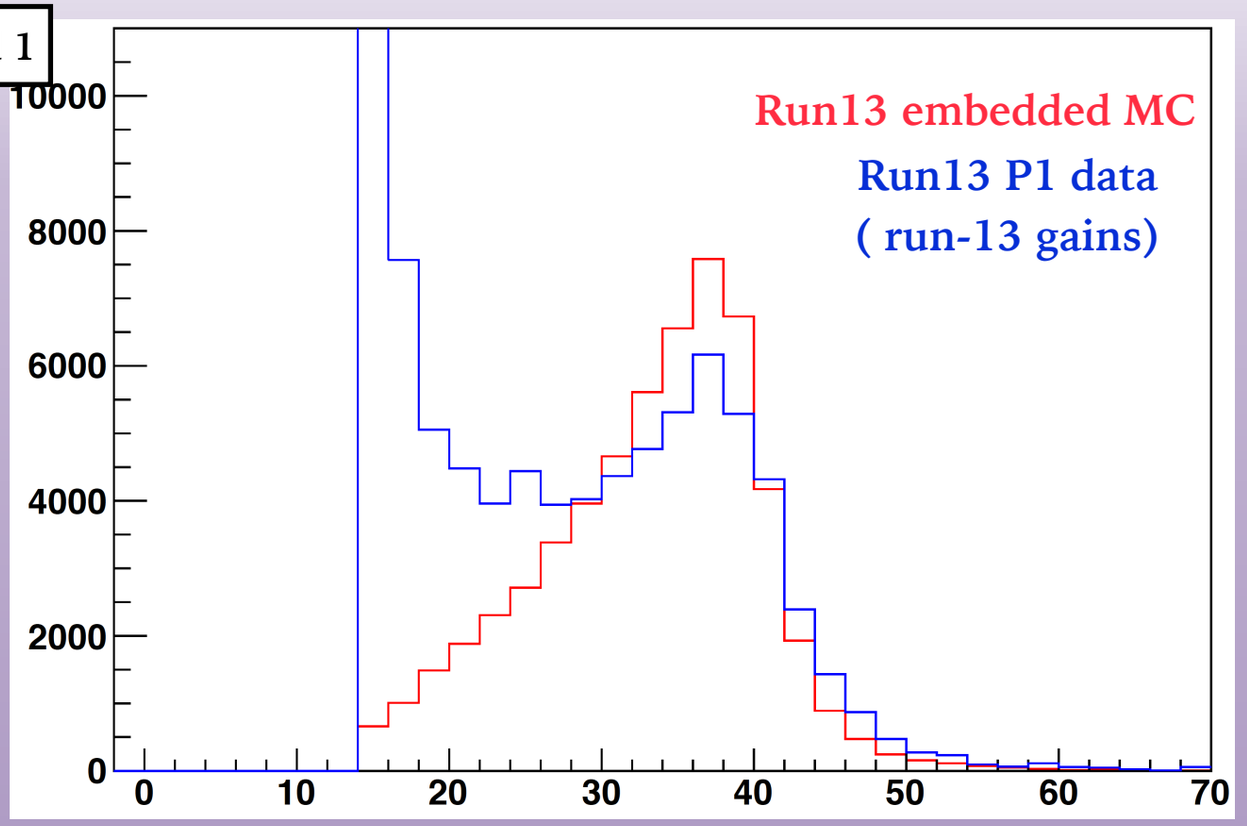


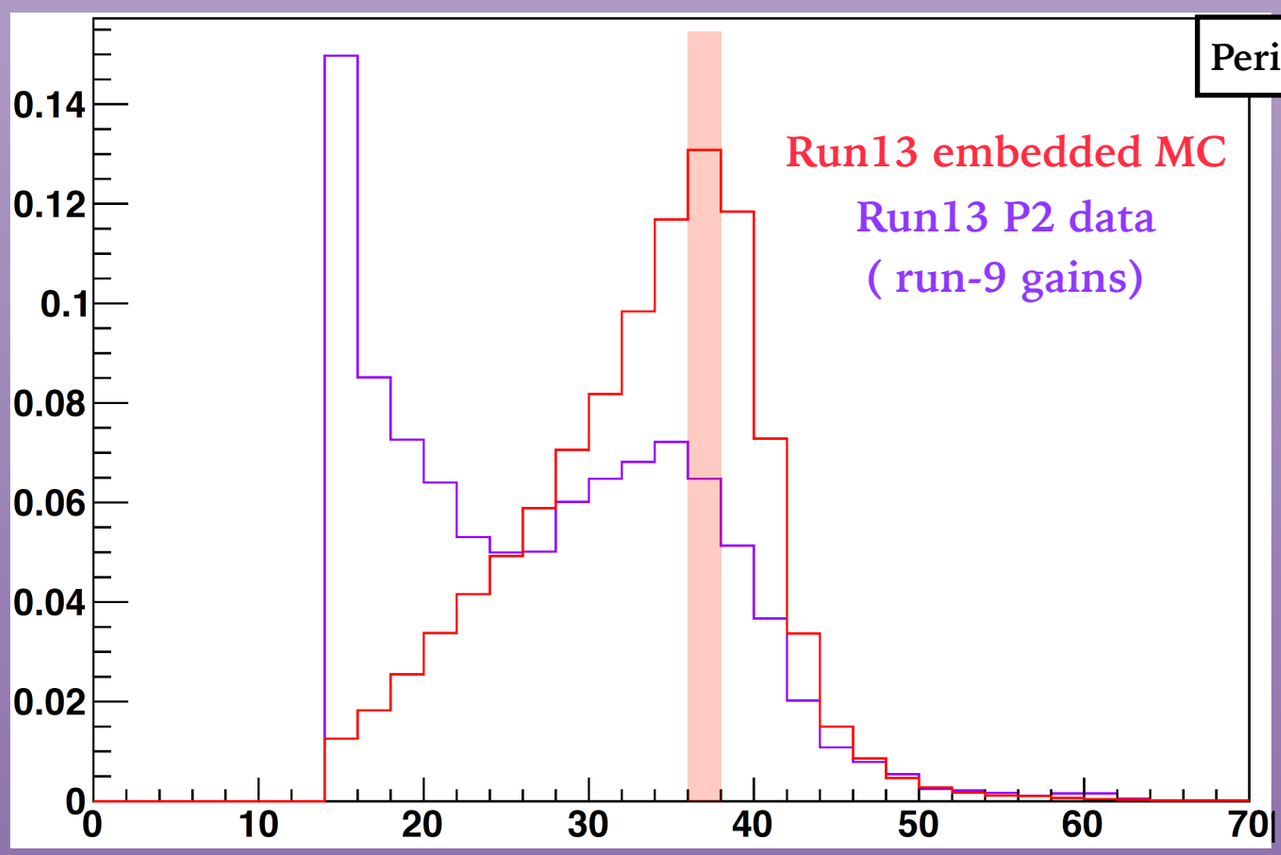


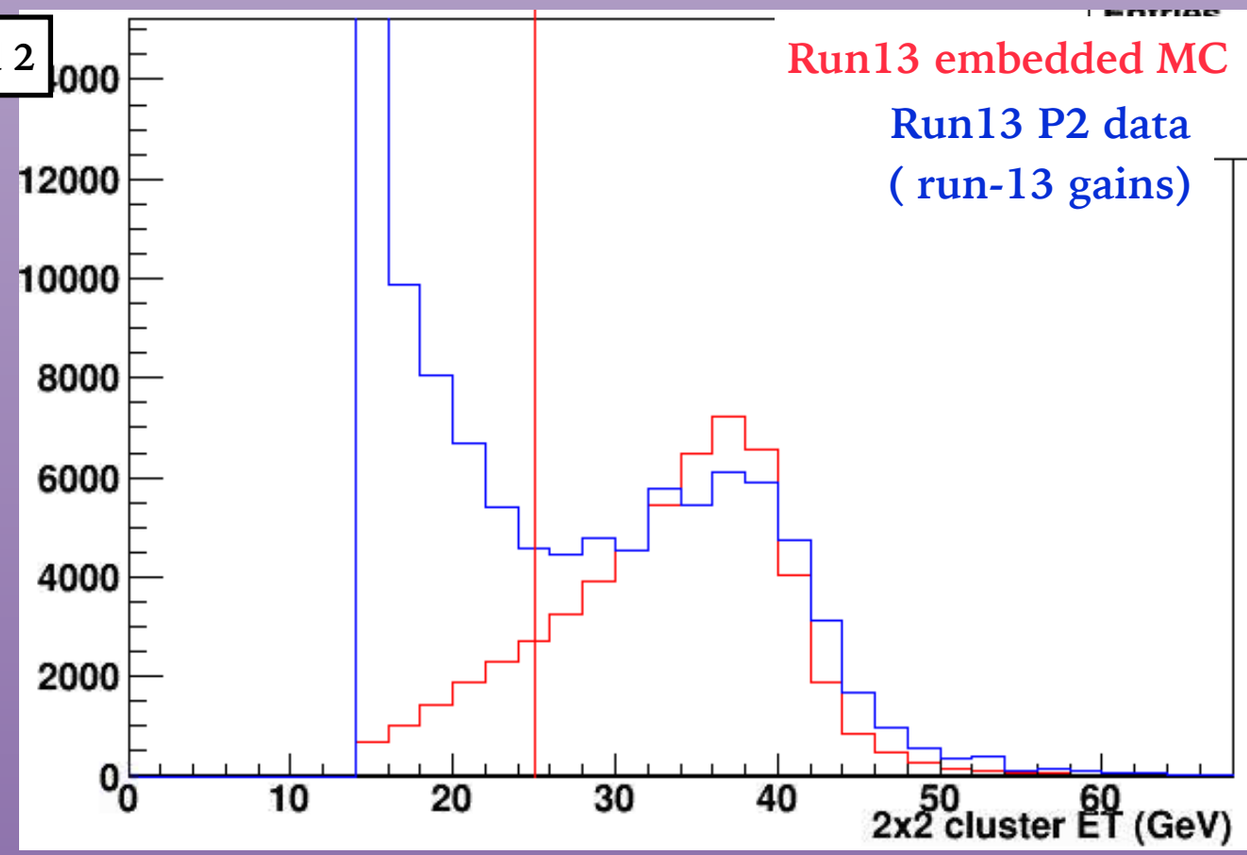


W Jacobean Peak

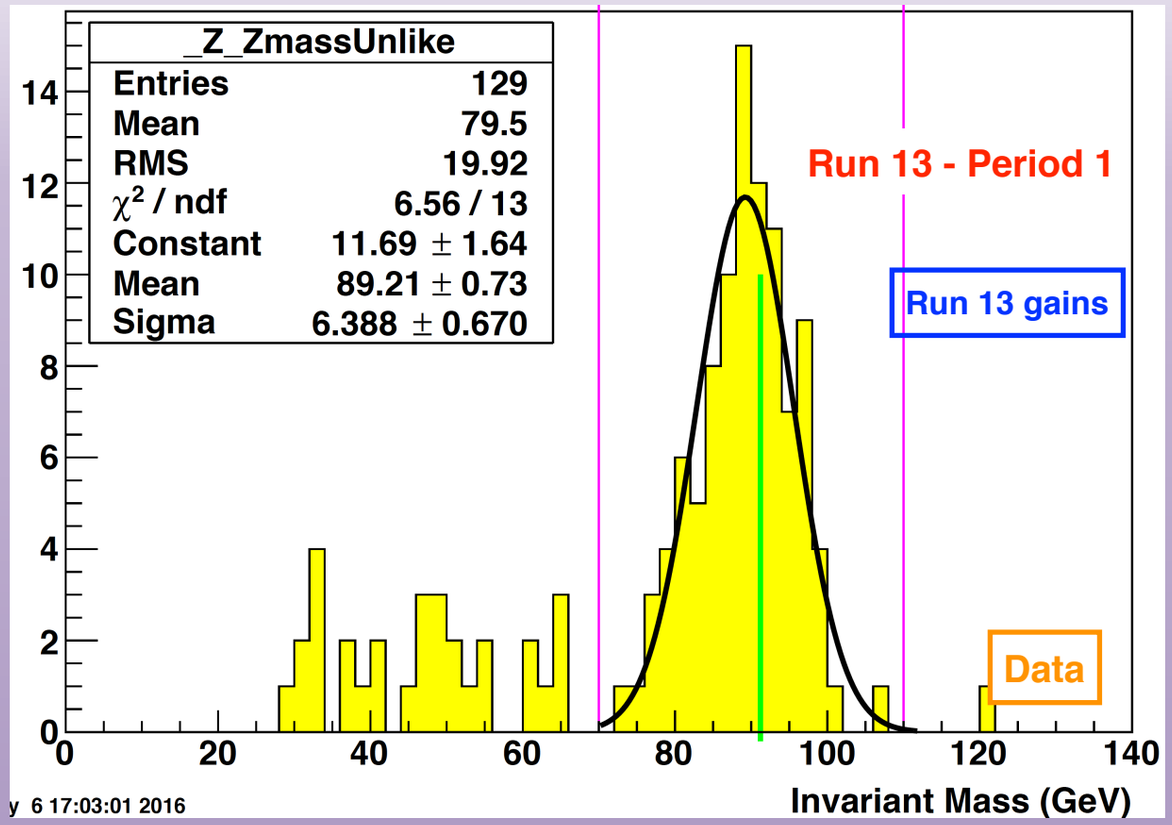


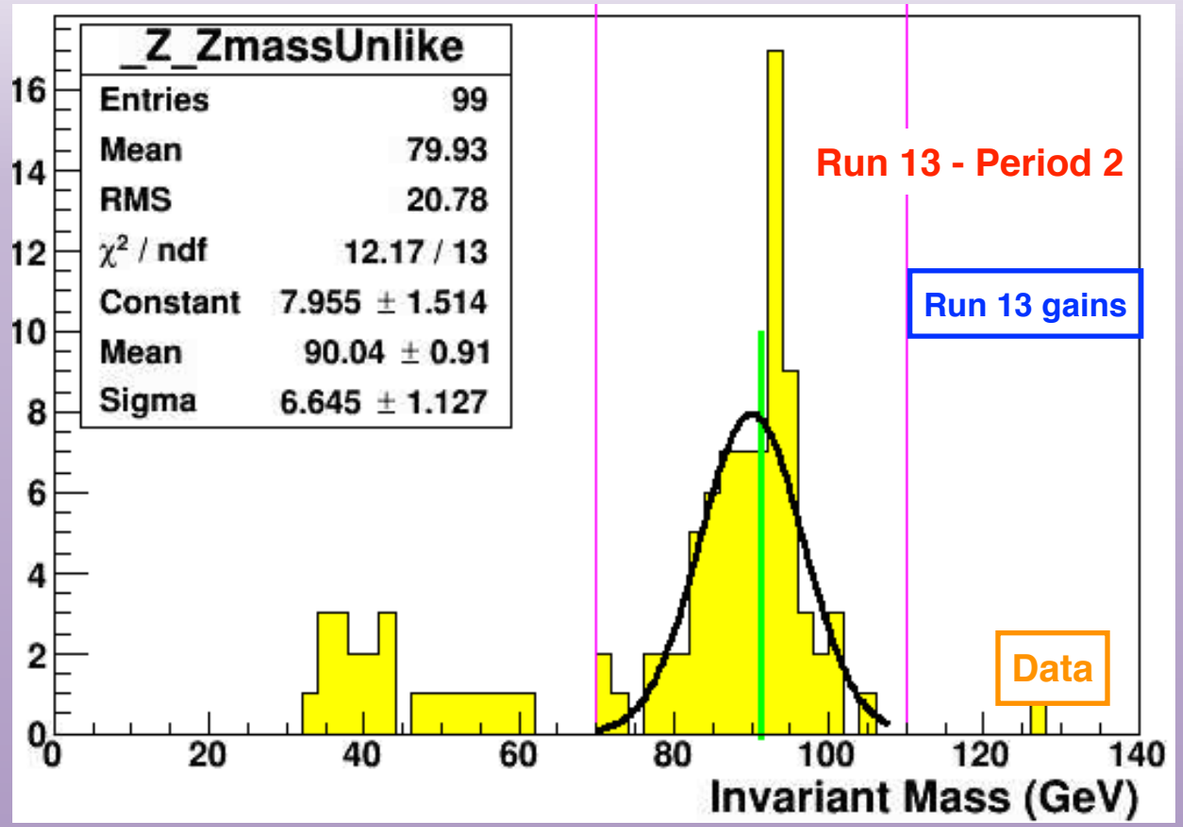


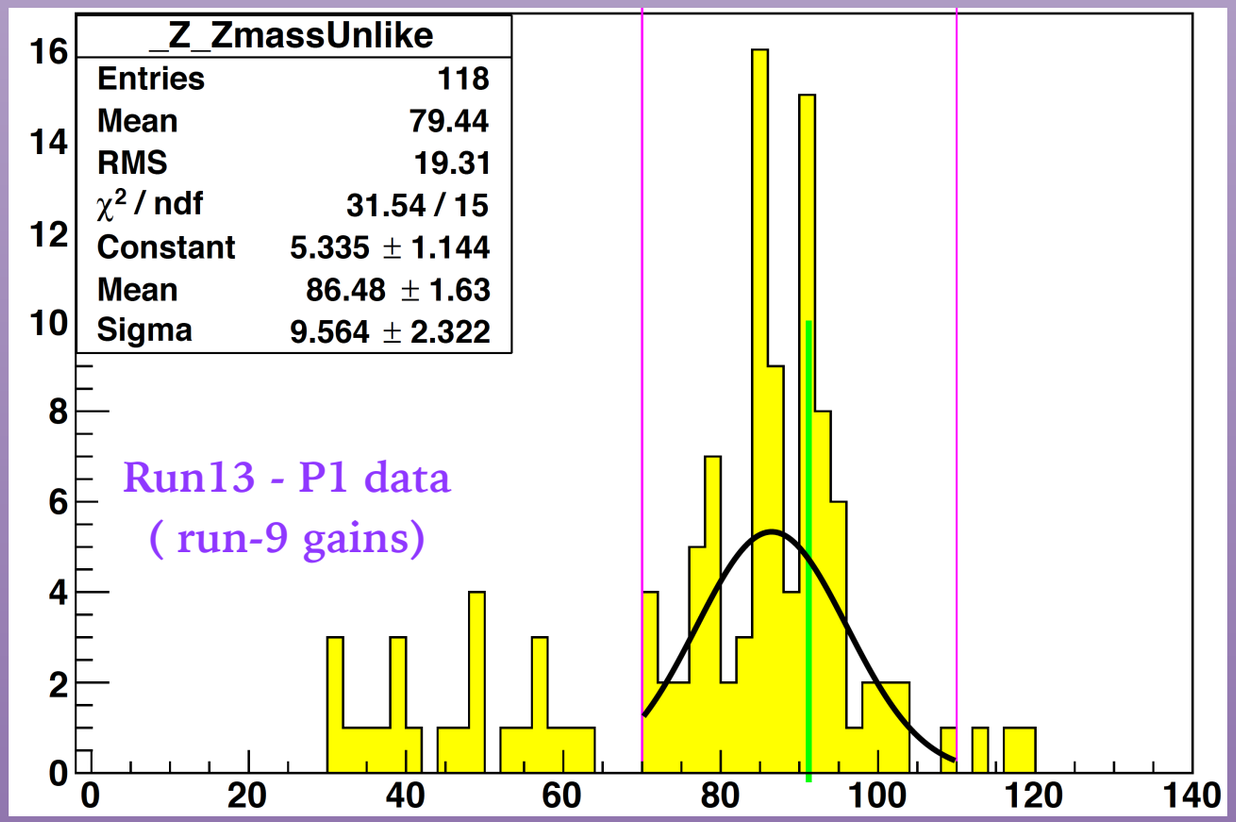


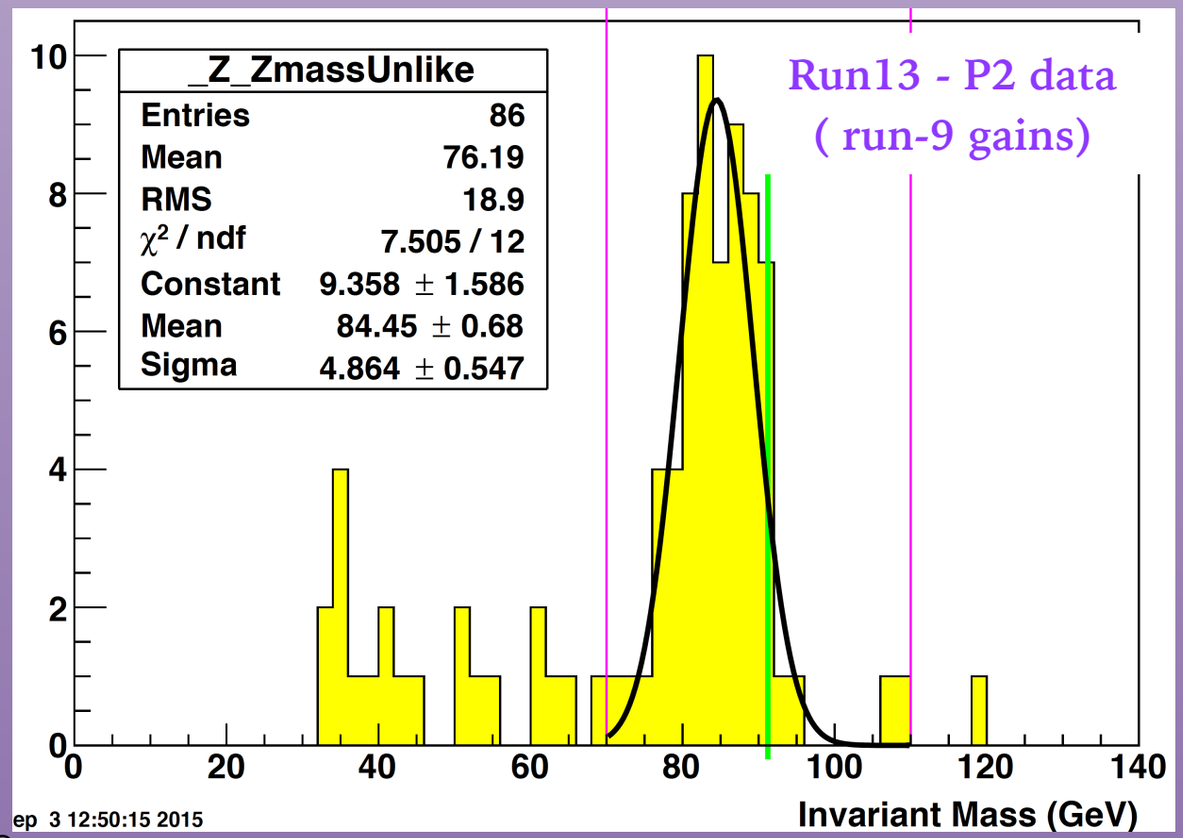


Impact on High Energy Probes-comparison to run 9 gains









Systematic analysis Probes

1. Trigger dependance [JP2 vs BHT3 at P< 3.0]

2. Low P dependance , [2.0 < P < 3.5]

3. Isolation cut dependance

4.TDR dependance [0.01- 0.02]

5. Eta dependance [Ring 1 -40]

6. Single Tower vs 2x2 Cluster dependance.

Summary

- Run 13 BEMC calibration is based on two methods for consistency check and evaluation of systematic uncertainties: 2x2 cluster method and Corrected Single-Tower method.

- Both methods are consistent at the level of 1.2% = Assign as systematic uncertainty for BEMC energy calibration

- Calibration derived at lower energies is consistent with high-energy probes (Z) within 1.5 %.

- Run 13 BEMC preliminary gain tables are ready to be used for run13 analyses.

- Systematic analysis are on going!