



# Heavy Flavour Meeting

UCLA

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# Introduction and Overview

- We have been looking at the Upsilon Mass reconstruction in Au-Au 2007
- The effect of the Barrel preshower, used to reject hadrons, has been studied
- We have investigated a method of mixing the background over events
- Mixed background vs. the like sign pairs have been compared
- Future plans will be discussed

## AuAu 2007 Upsilon PID

- PID:

$$3.4e-6 \text{ dE/dx } 4.7e-6$$

$p > 3 \text{ GeV}/c$  for both tracks

$$0.5 < p/e < 1.5$$

Opening angle  $> 60$  deg

vertex  $\pm 40$  cm

$$n_{\text{hits}} > 20$$

For BEMC tower, tracks trace to tower centre

# AuAu 2007 Upsilon Trigger and Preshower

- **Trigger mimic:**

All reconstructed Pairs must satisfy the L0+L2 trigger condition, not only those in the L2Result array. We call this the “mimic trigger”

- **Preshower:**

The lowest energy track of the pair has a preshower cut applied at

$$\text{Preshower (ADC-PED)} > 15.$$

This will put the track outside the MIP energy peak.

# Using the Barrel Preshower

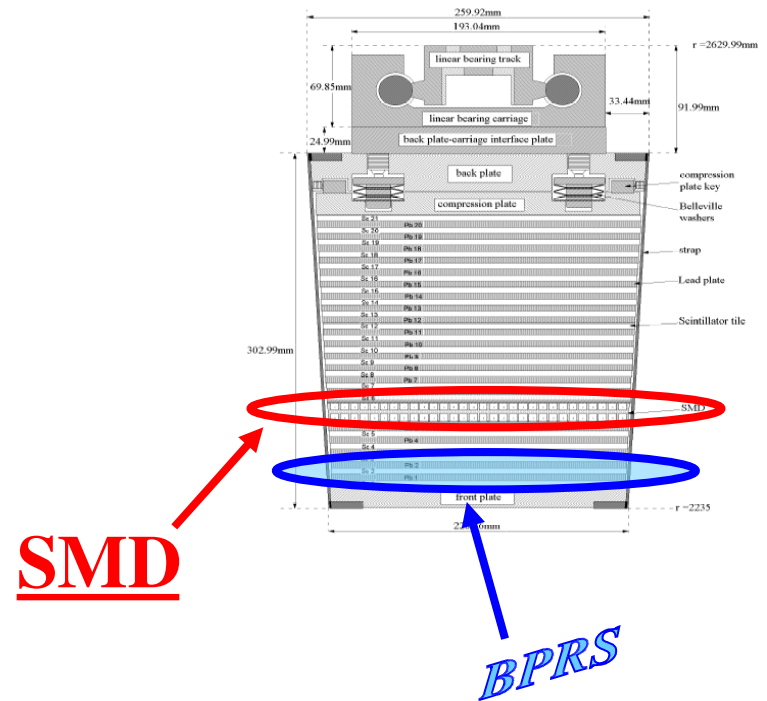
The Preshower will help in the PID of hadron and electron in the BEMC

The Barrel preshower was not incorporated into previous STAR analyses.

I have been commissioning and calibrating the Preshower to make it useful for a Heavy Flavor analysis

Currently, we have a set of calibrations and bad channels for the preshower and estimate a ~80% efficiency

The preshower was used with the 2007 AuAu Upsilon-triggered data.

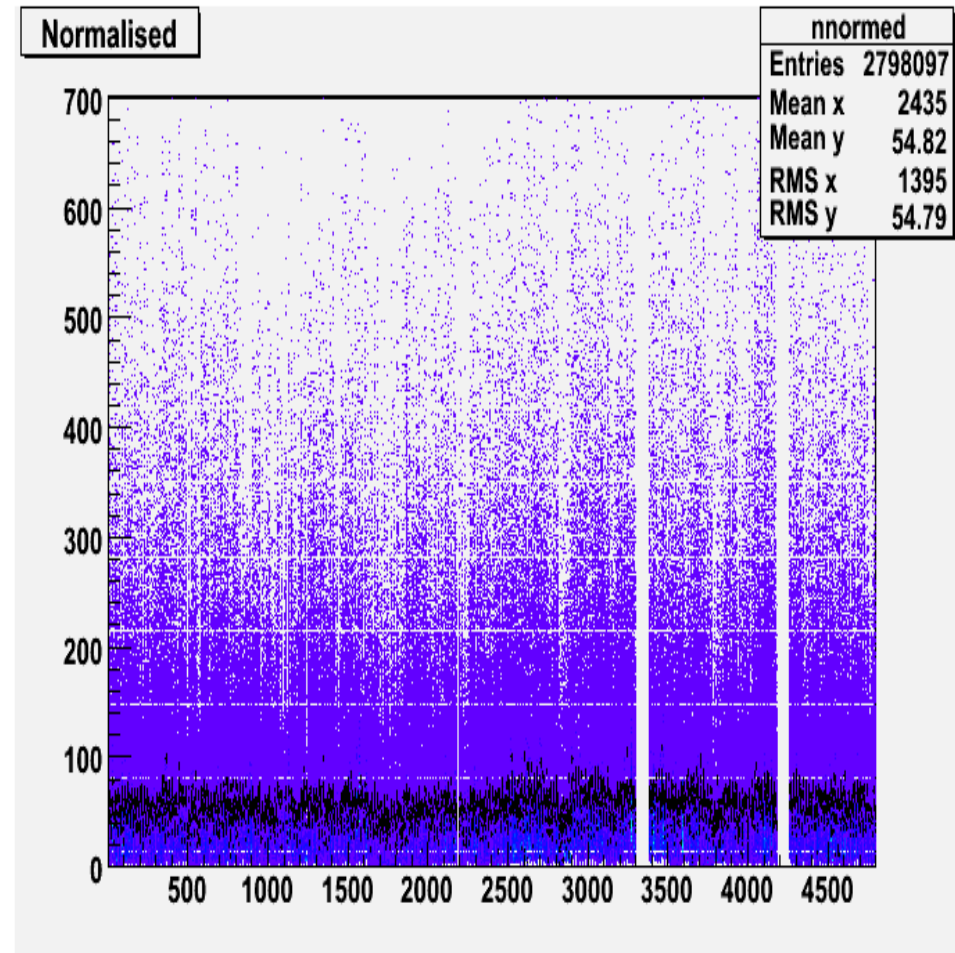
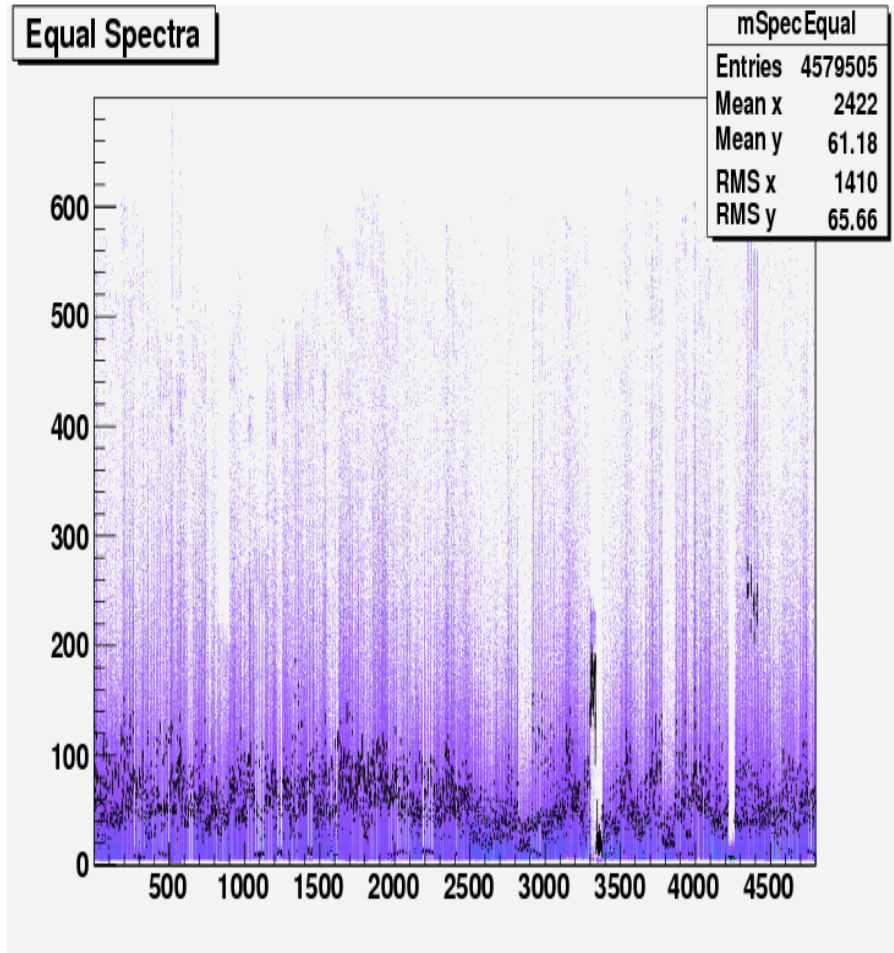




# Barrel Preshower

ADC-PED vs. channel Uncalibrated

ADC-PED vs. channel Calibrated



# Effect of the SMD vs. Preshower

$$(dE/dx)_{[SMD(on)]} / (dE/dx)_{[SMD(off)]}$$

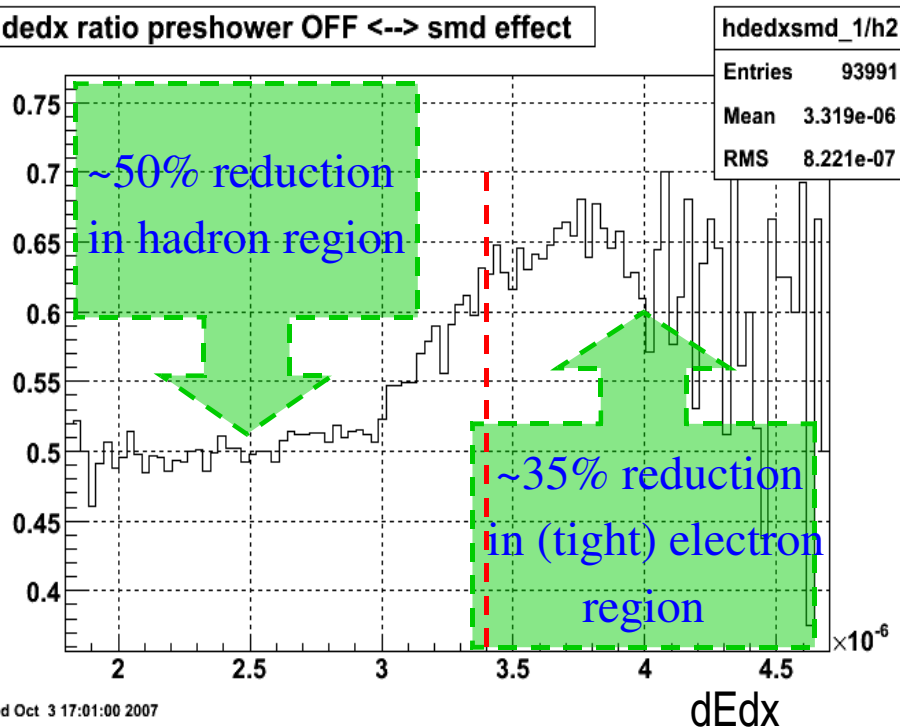
$$(dE/dx)_{[BPRS(on)]} / (dE/dx)_{[BPRS(off)]}$$

With greater than one hit in SMD eta and phi

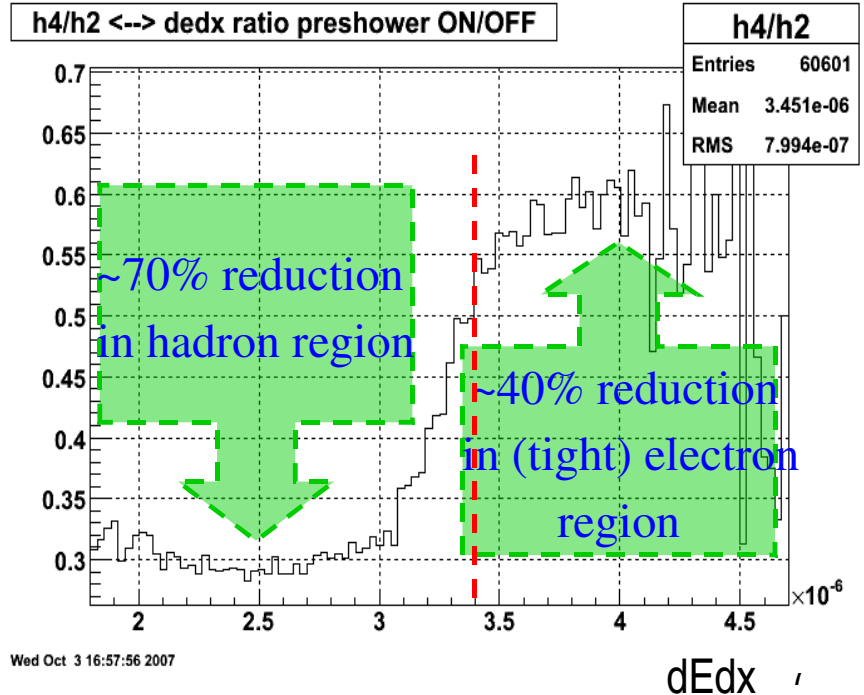
~15% rejection difference

~30% rejection difference

dedx ratio preshower OFF <--> smd effect



h4/h2 <--> dedx ratio preshower ON/OFF

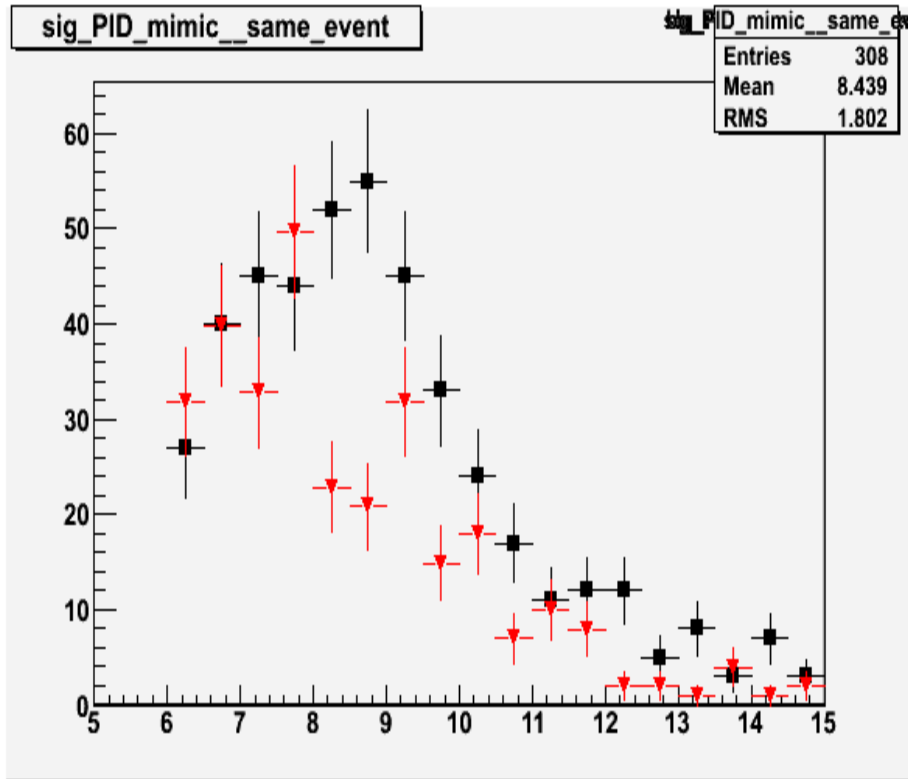


Wed Oct 3 16:57:56 2007

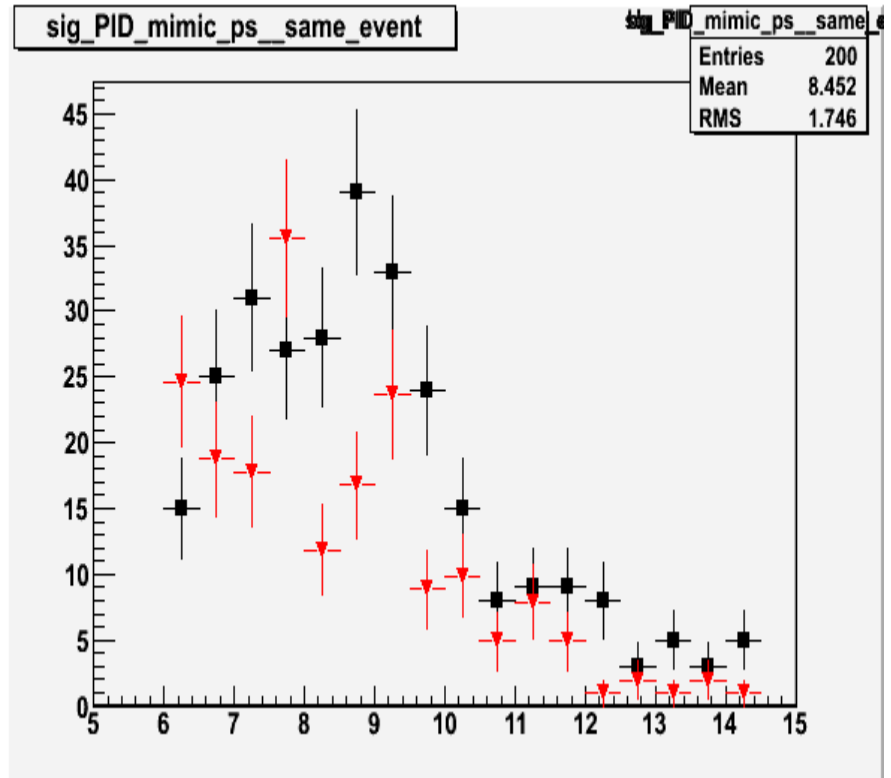
dEdx

# “Mass spectra” (Effect of cut)

No Preshower cut



Preshower Cut

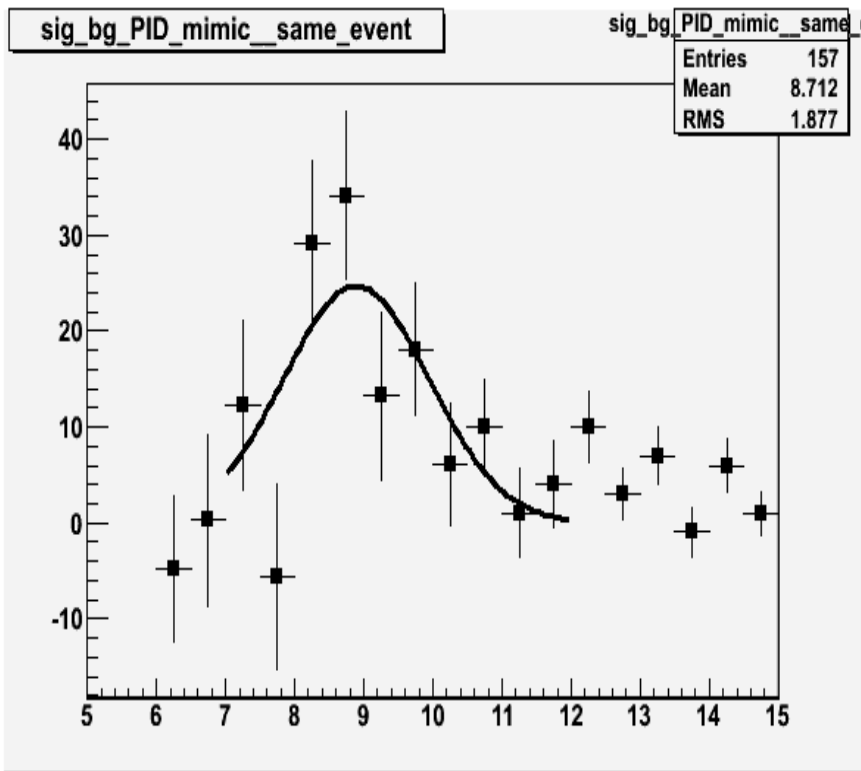


Note: Red points are background with  $2\sqrt{N_{++}N_{--}}$   
Blackpoints are likesign

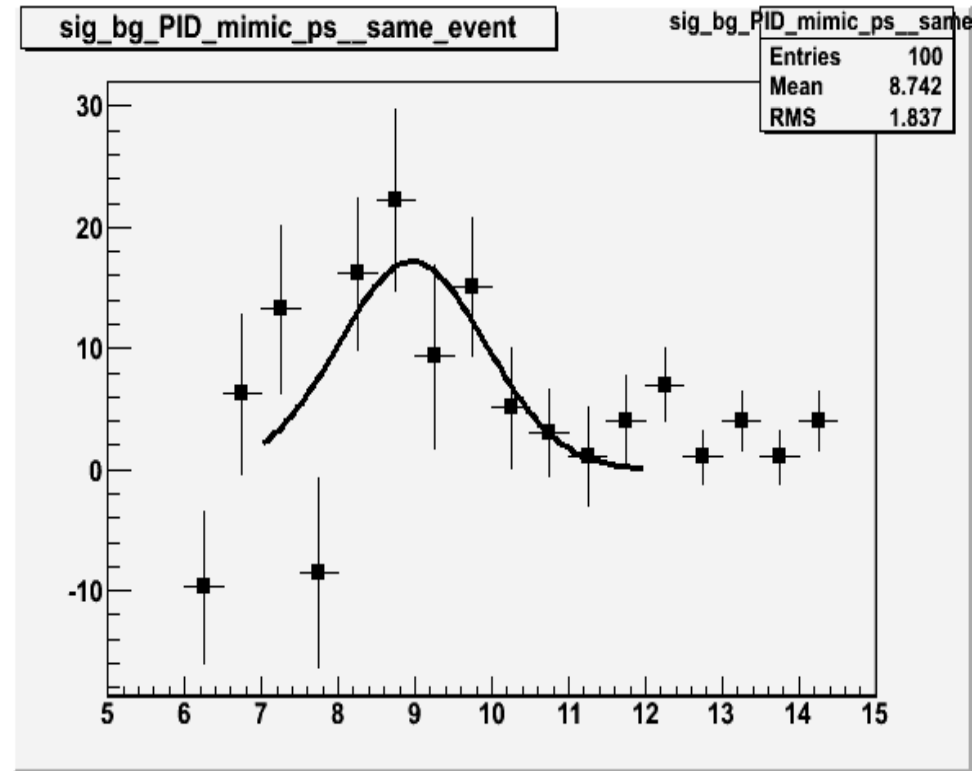


# “Mass spectra” (Effect of cut)

No Preshower cut



Preshower Cut



**Note: Preshower cut only made on low energy track**  
**Both have like-sign background subtraction**

# Background from multiple events

Pairing like-sign tracks in that event suffers from low statistics causing background fluctuations

A method to improve statistics is to take tracks paired over events. We use a method from NA50 where the “shape” of the multiple event background is normalised to the like-sign  $2\sqrt{N_{++}N_{--}}$

**Pros:** Smooths the fluctuations, reduces errors, removes correlations\*

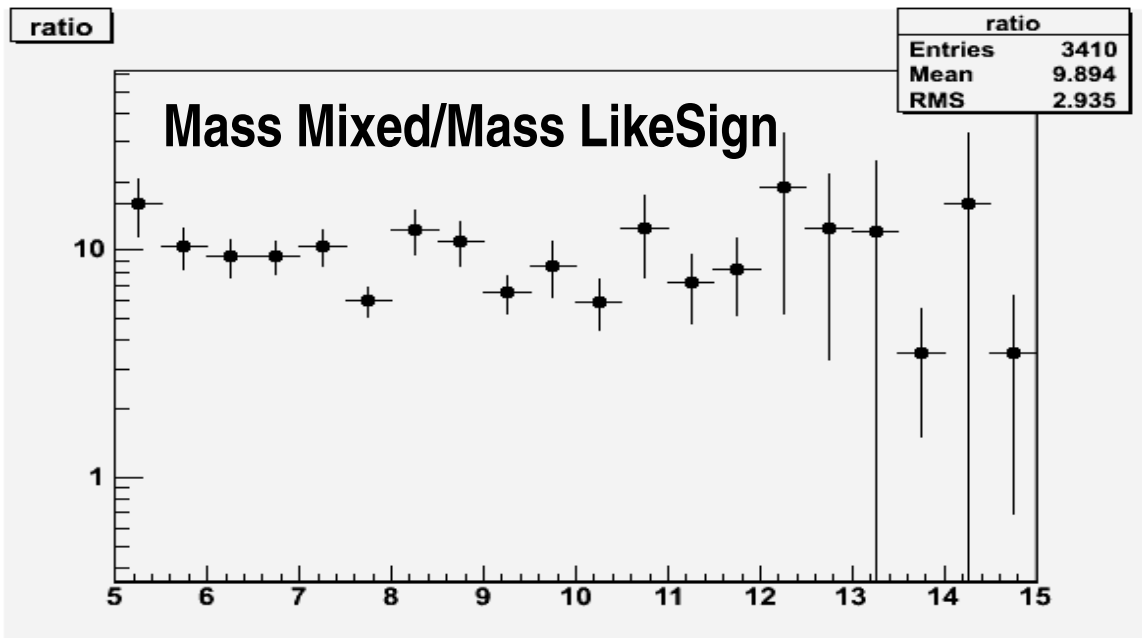
**Cons:** Normalisation not an exact combinatorial relation. Uses normalised Like-Sign distribution for overall normalisation.

\*Note: Removing correlations may be a 'con' not a 'pro' if there are like-sign correlations.

# Event selection

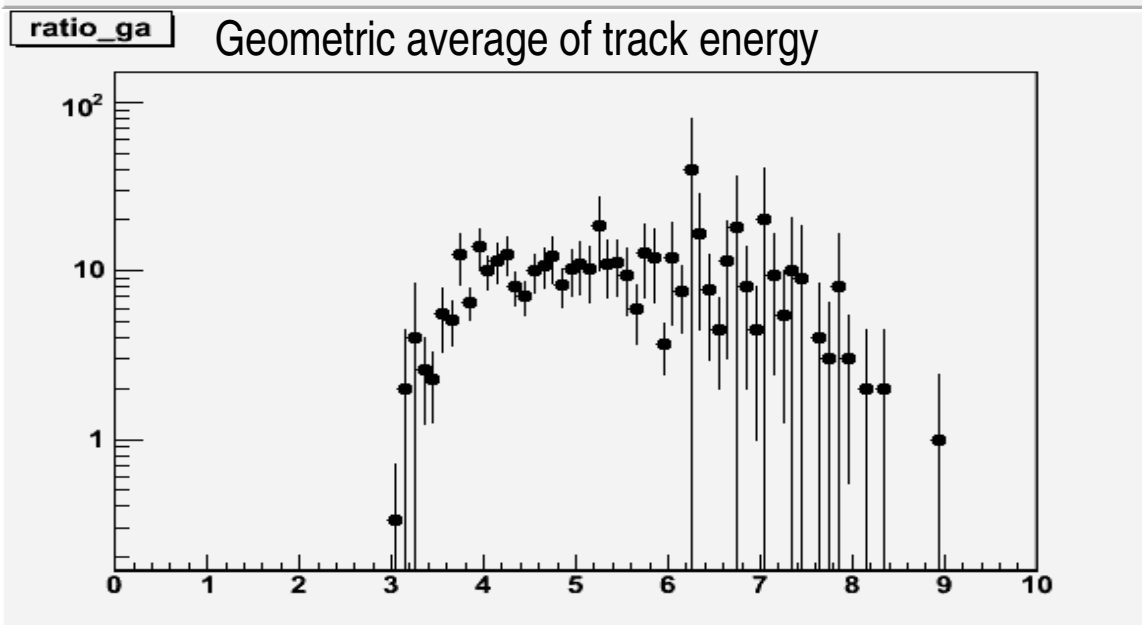
- For this method to work we have to be careful how we add events to pair over and how we pair as we are using triggered data with L0 L2 selections it is not a pure combinatorial sample
- Only add events with similar properties to event you wish to mix. A database of event properties was made and the following rules applied:
  - 1) Multiplicity binned was binned in 10 bins from 0-1000 tracks per event
  - 2) Vertex binned binned in 8 10 cm. bins -40cm to 40cm
- We mark the highest track in each event and never pair high tracks with high tracks and the same for low tracks to avoid a trigger bias

# Mixed vs. LikeSign ratios



Ratio of the un-normalised Mixed distribution to the Like sign distribution

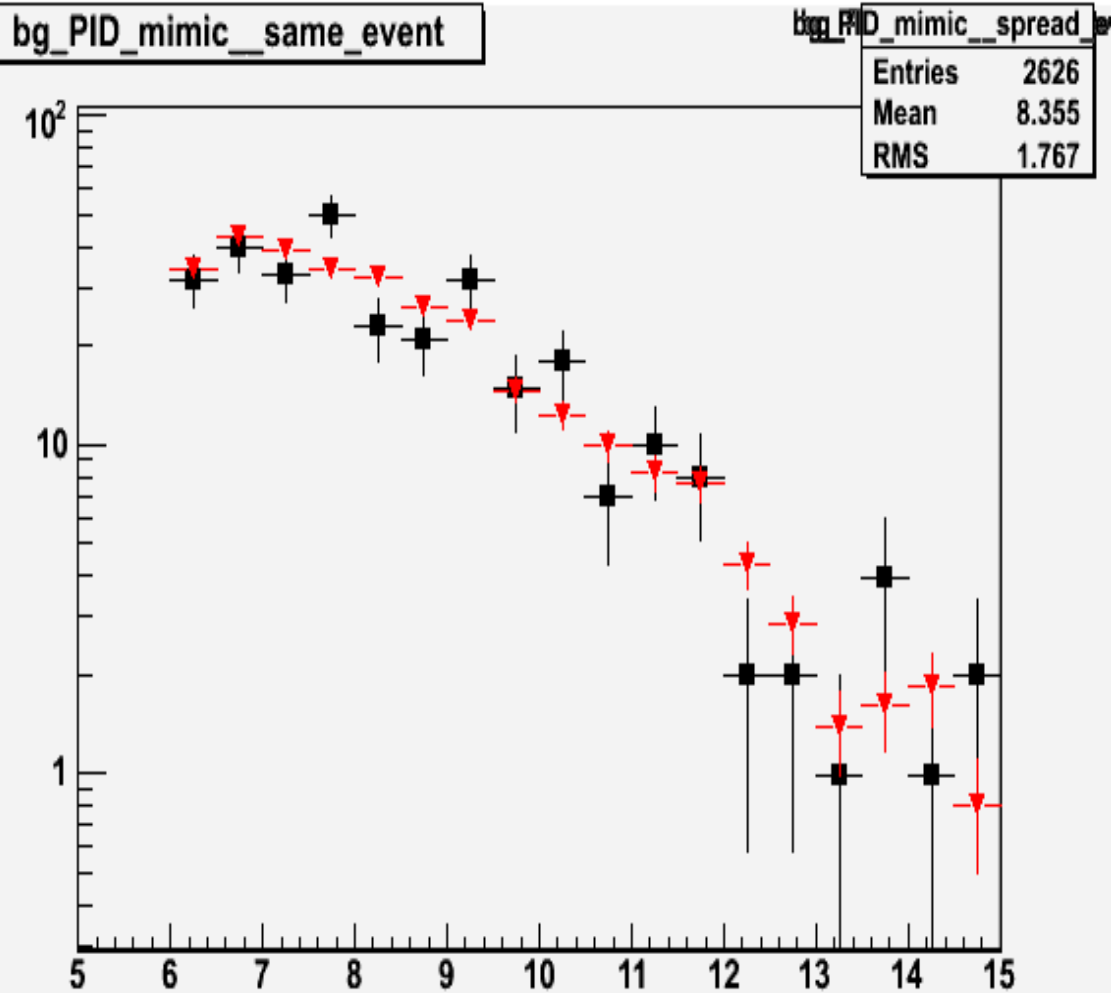
Note: Seems flat within mass range  
10 times more mixed than like-sign



Ratio of Average energy per pair un-normalised Mixed / LikeSign

Seems that the mixed data is falling off under the 4.5 GeV range

# Scaled Mixed Event vs. Like Sign Bkg



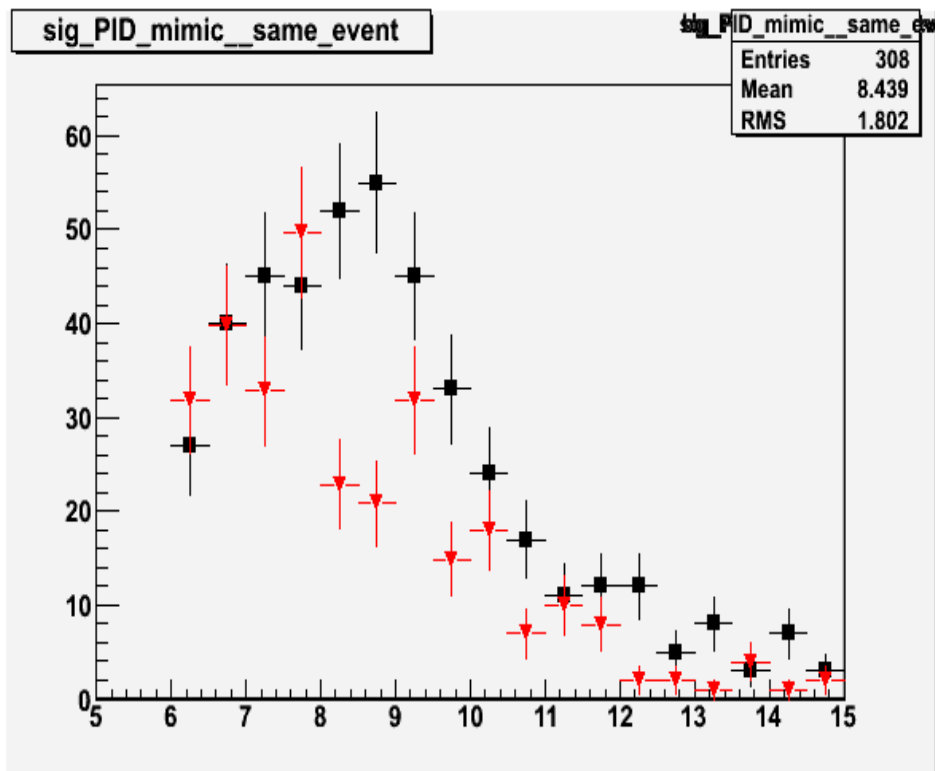
Multiple event normalised  
to like-sign background  
(RED)

overlaid with :

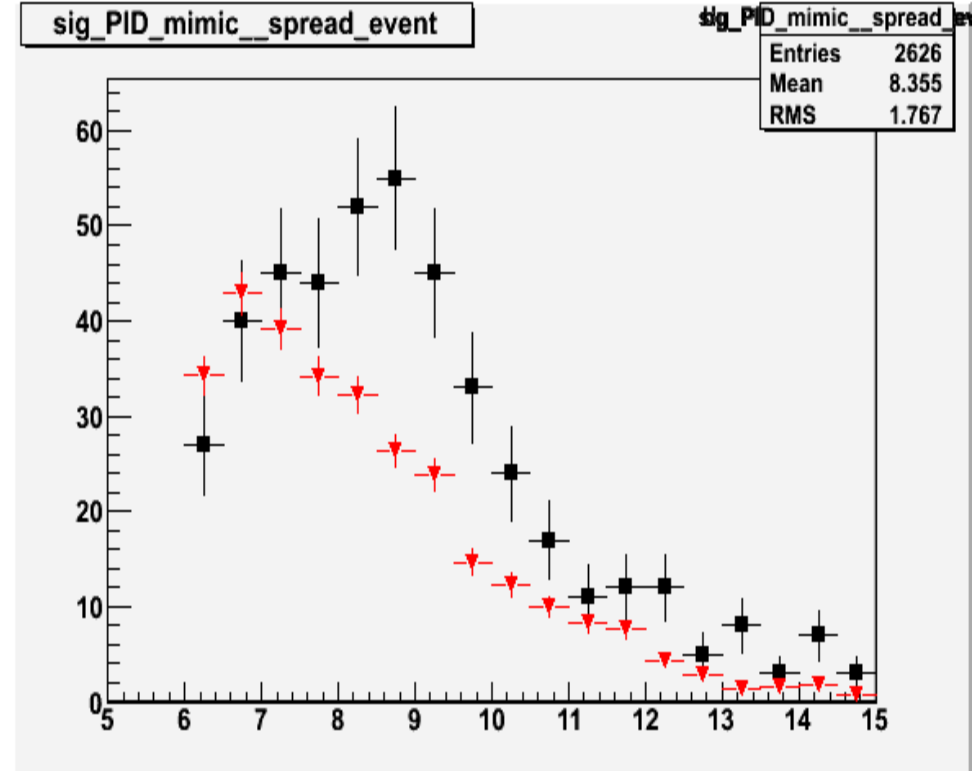
LikeSign background with  
absolute normalisation  
 $2\sqrt{N_{++}N_{--}}$   
(BLACK)

# Unlike sign vs. backgrounds

Unlike vs. Like-sign normed  
to 2srt(N--N++)



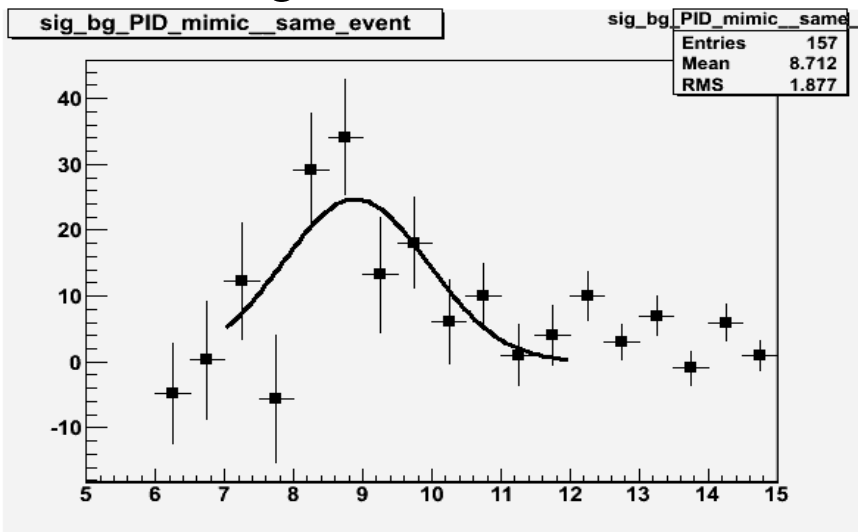
Unlike vs. Background over multi  
event scaled to normed Like-sign



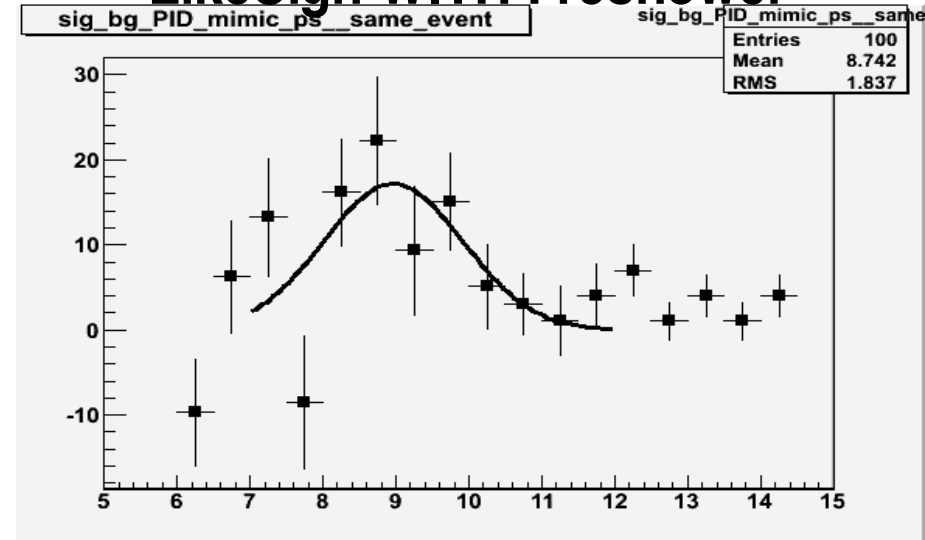


# “Subtracted Mass Distributions”

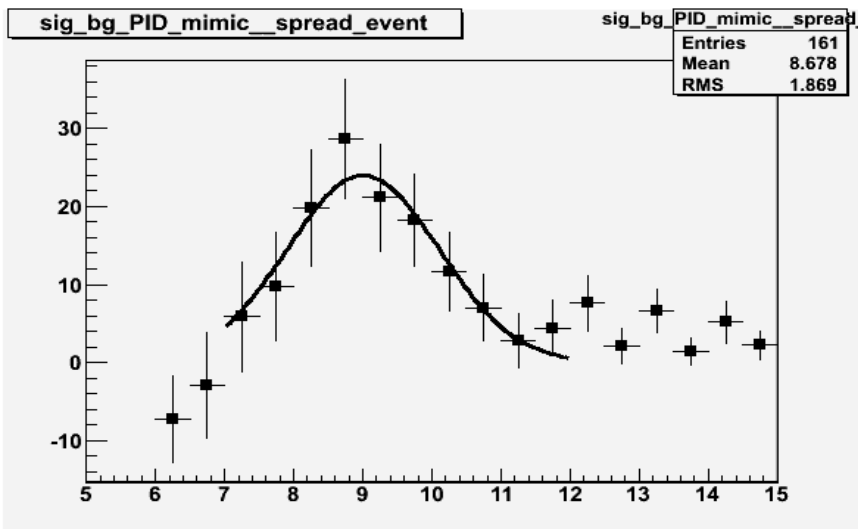
## LikeSign NO Preshower



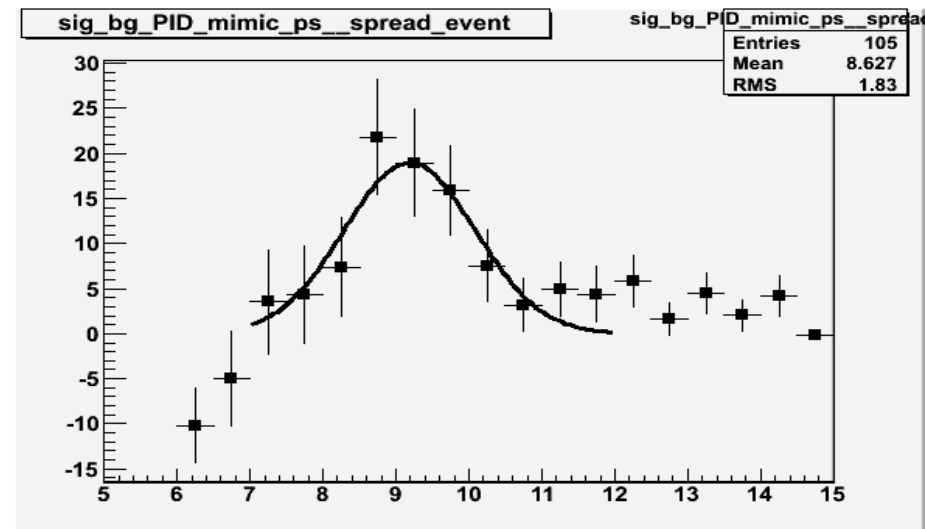
## LikeSign WITH Preshower



## Mixed NO Preshower



## Mixed WITH Preshower



# Fits

Like-Sign No Preshower:

Fit Mean: 8.8Gev +/- .99

Sum of bins 8GeV to 10GeV: 89

Mixed No Preshower:

Fit Mean: 9.0 +/-1.0

Sum of bins 8GeV to 10GeV: 97

Like-Sign With Preshower:

Fit Mean: 8.9GeV +/- .95

Sum of bins 8GeV to 10GeV: 54

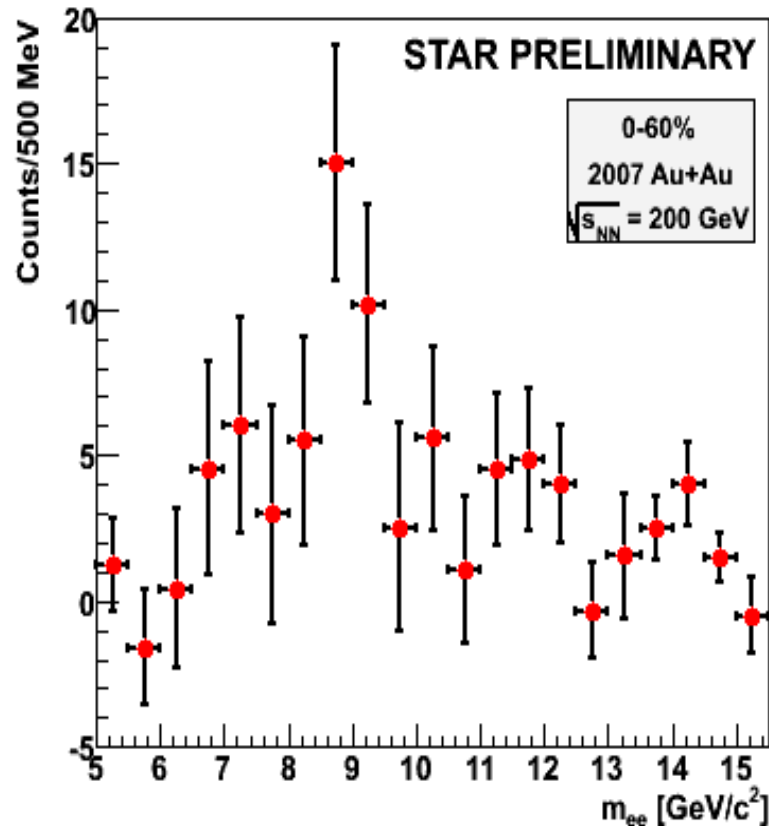
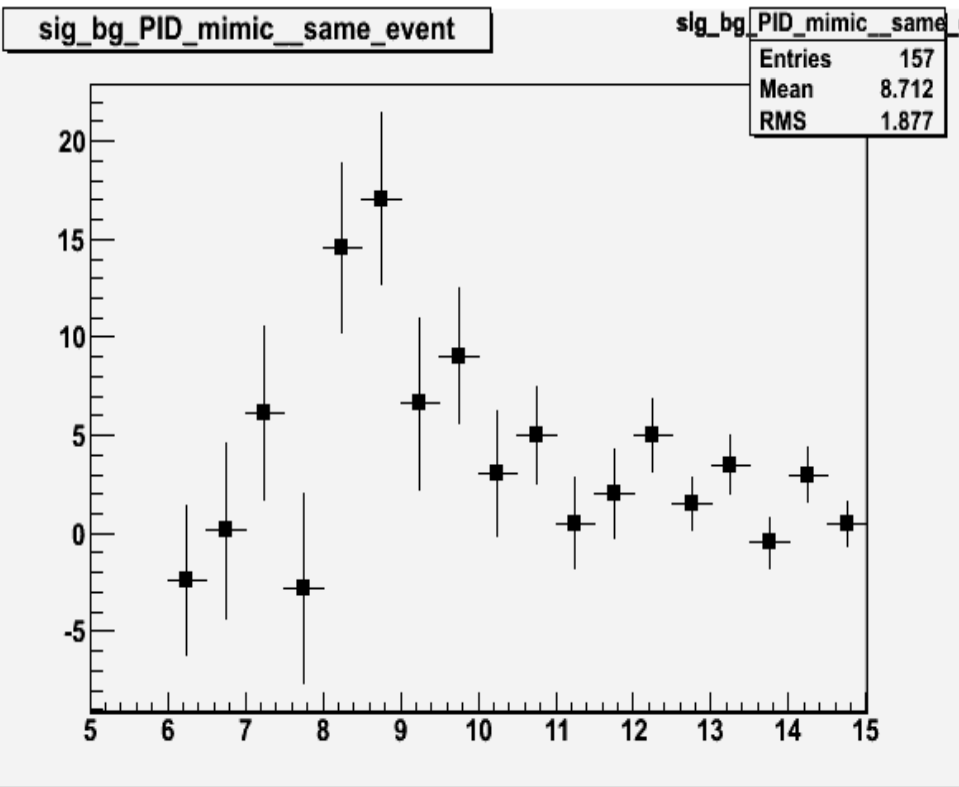
Mixed With Preshower:

Fit Mean: 9.1GeV +/- .9

Sum of bins 8GeV to 10GeV: 68

# Comparison of A&M with UC Davis for systematics

Subtracted spectra with Likesign backgrounds in both plots



Counts, Scaled by 0.5, at 500MeV per bin

Debasish Das 05/13/08

Scaled by 0.5, 500 MeV per bin

# Conclusion

- The preshower currently does not have a dramatic effect. However having additional methods of extracting the signal, it can act as a systematic check and give confidence in the signal
- The background mixing over events method seems to show promise of reducing the fluctuations from the low statistics background

# Future plans

- Simulation
- The next step is to look at simulations and embedding
- Check preshower response in simulation with calibrations
- Obtain correction for yields and compare to p-p data
- See how the mixed background compares in simulation
  
- Improvement to Preshower cuts
- Use tower by tower MIP value in preshower to improve resolution