# Hit Confusion Update

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# Issues Seen by Matteo

- At last FastSim meeting, Matteo showed some plots indicating that the hit merging code was messing up the DeltaE distribution in B to $\pi\pi$ events.
  - It was probably messing up other things as well.
- Starting with his plots, I've looked into what could be causing this.
- Basically considered two possibilities:
  - Too aggressive with the hit merging
  - Leaving merged hits on tracks can mess them up more than we would like

# Reminder – DeltaE in B to $\pi\pi$

**FastSim with HitMerge**
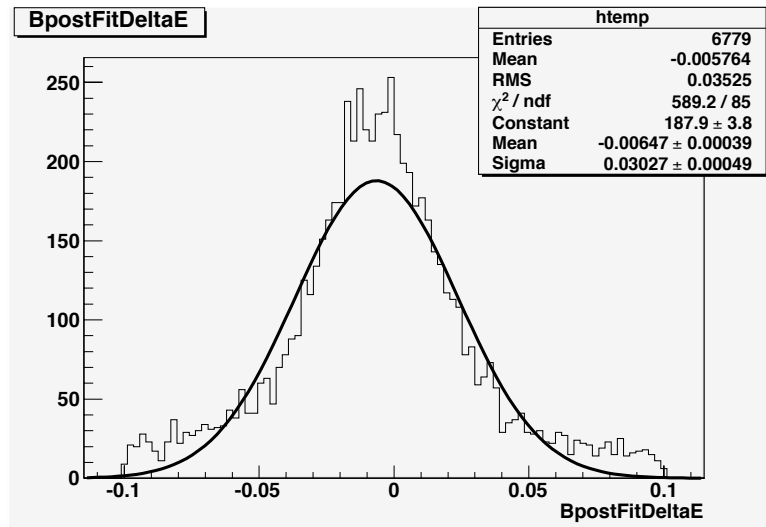
**FastSim w/o HitMerge**
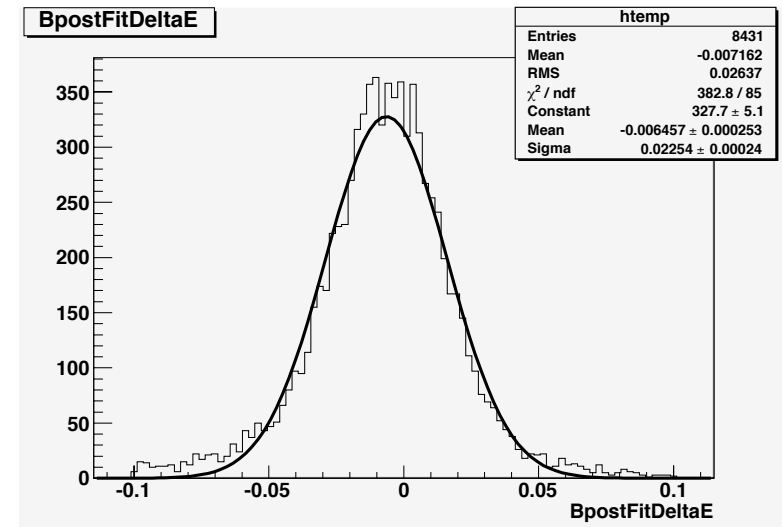
# Step 1: Reduce amount of merging

- The code in V0.0.3 would merge hits in the DCH if they were within the cell size of the DCH of each other and the resulting merged hit would be added to the higher momentum track and removed from the other track.

- Following a suggestion by Dave Brown, I modified the merging criteria so that the probability of merging hits drops as the hits get further apart.
  - Prob = 1 if dist = 0, drops linearly to 0 if dist = cell size
  - Same idea applied to silicon

- This should reduce the number of merges by roughly ½, and reduce the average distance moved by a hit.
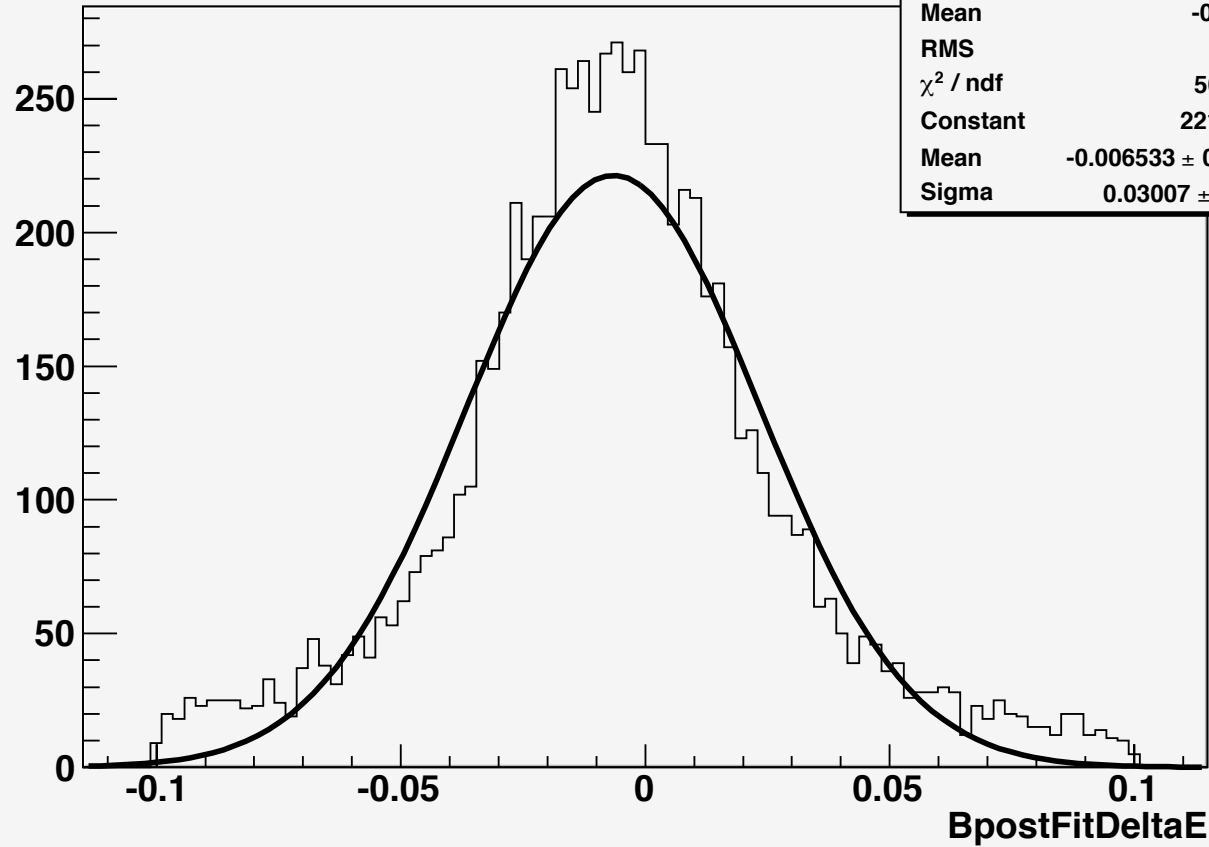
## DeltaE with modified Merging Criteria

Not a very big change in Sigma from fit. RMS is a bit smaller, and yield is greater.

# Next Step: Removing Stray Hits

- The merging criteria modification doesn't really do the trick.
- I believe the issue is that the merged hits that remain on a track are always on that track and used in the fit, even if they have been moved a considerable distance.
- A real PatRec program would probably not include these hits on the track.
- To test this, I added some code (post-Reconstruction) that loops over the HoTs on a track and determines the unbiased residual / residual error for each HoT.
- If this value is greater than 5 (tunable), the HoT is removed from the TrkRecoTrk and it is refit
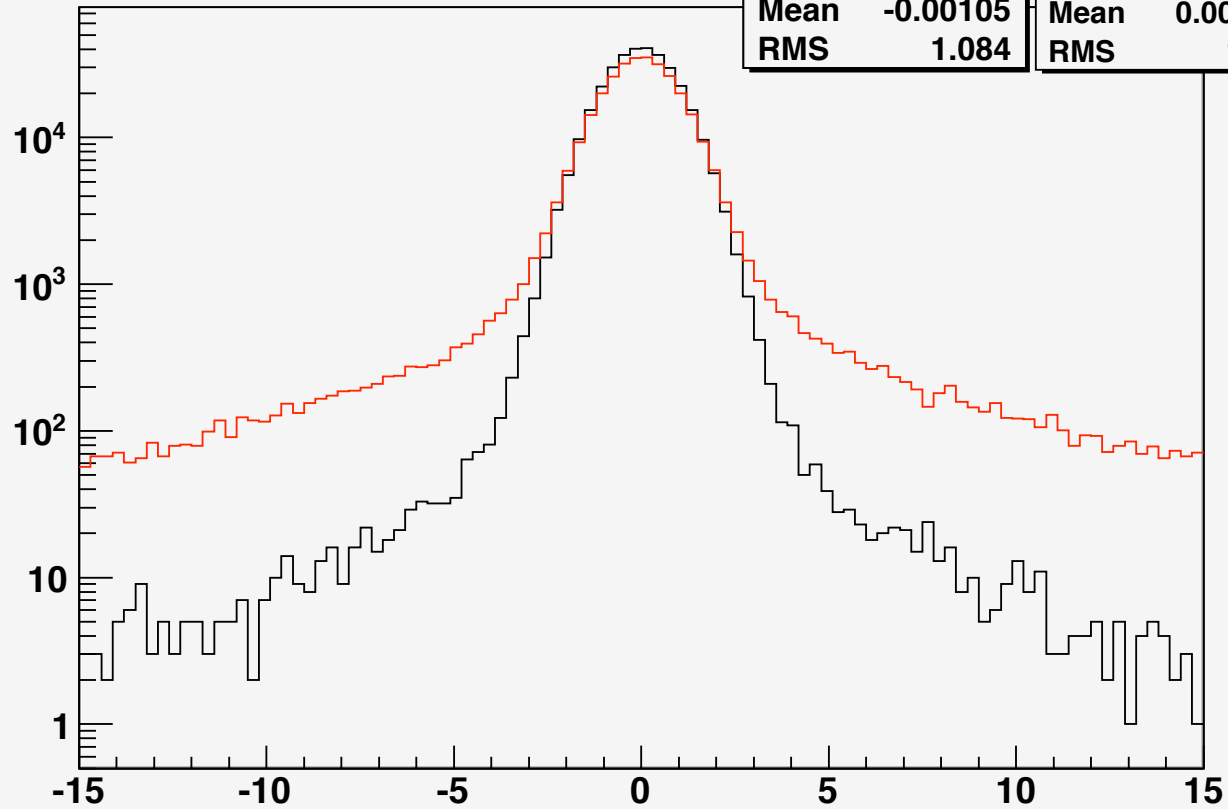
## Unbiased Residuals

No Merging – Black

With Merging – Red

# "Weeding" hits

- Approximately 16% of the tracks need to have hits weeded off and subsequently re-fit.
  - Still need to check what it is with HitMerge turned off
- The effect is basically like having a very loose pattern recognition program and then using the full power of the fitter to remove hits.
- This may not, however, be the most efficient solution for FastSim.
  - I mostly wanted to see if this was the real issue
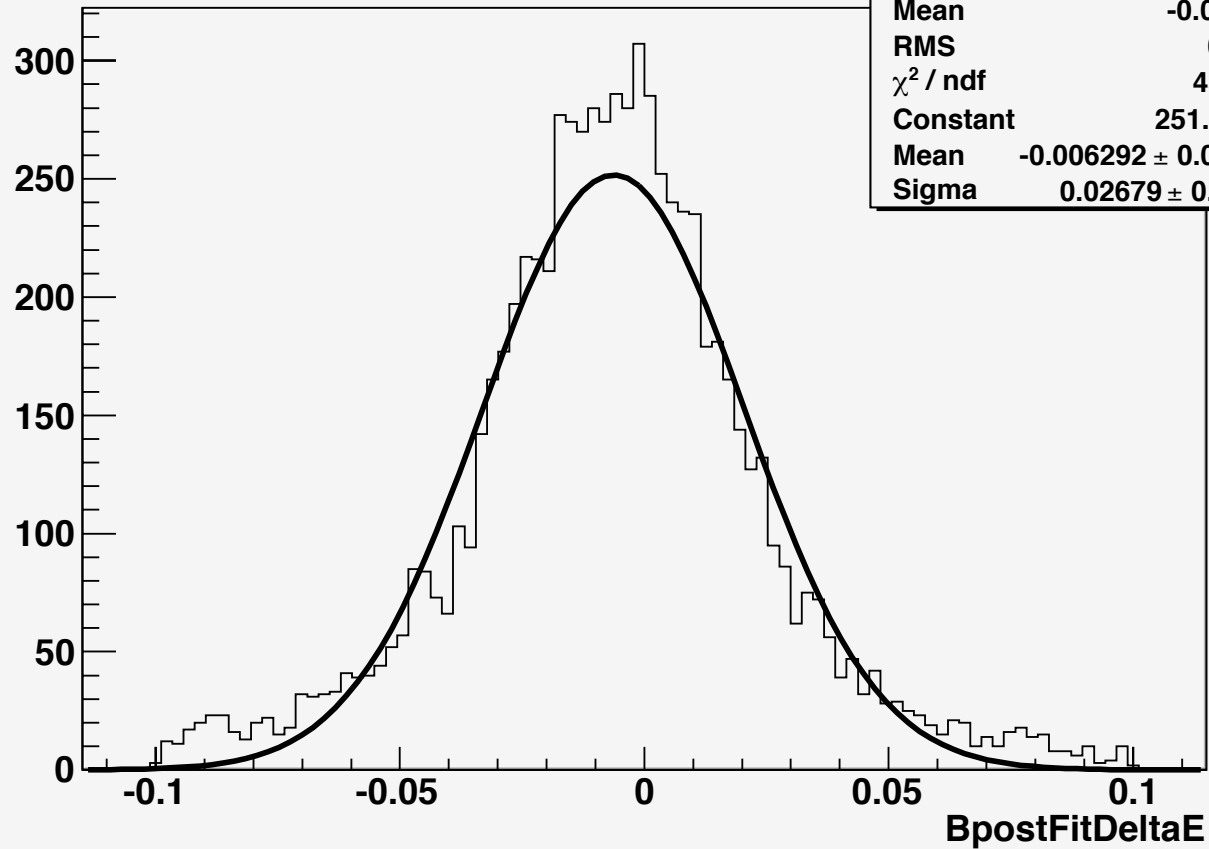
## DeltaE with hit "weeding"

This actually has a smaller sigma than what Matteo showed last time for the BaBar GEANT4 MC, although this is the SuperB configuration

# Conclusions

- I think the HitMerge code was doing what it was supposed to do, BUT it really needs some sort of PatRec emulation.
  - Really shouldn't be run by itself as-is
- I'm not sure where the best place to put the PatRec code will be:
  - Pre-Reco
    - Faster
    - Will require a parameterized "road" that will necessarily be detector configuration dependent.
  - Post-Reco
    - Pokier
    - Totally detector configuration independent
    - In "fastfit" mode, would only use the hits outside the HoT to get the track resolution