FIRST EVO Meeting 2013

ToF-Wall Activity Report

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June 26, 2013

Overview

Clustering should improve reconstruction by grouping measurements of correlated hits coming from the same particle.
Two types of matches in the ToF-Wall:

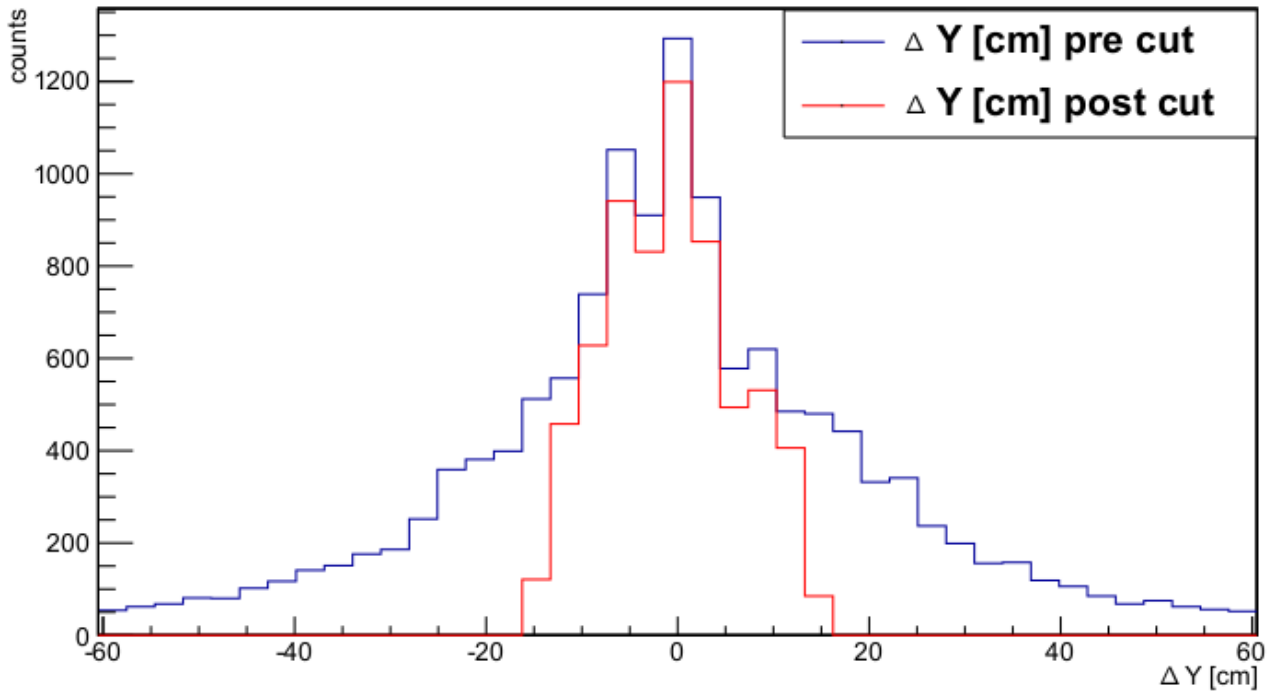
- for hits falling onto adjacent slats in the same scintillator wall (F-F, R-R clustering)
- for hits in different walls (F-R clustering)

F-F, R-R clustering

- A single particle can trigger adjacent slats in the same wall
  - it is necessary to identify these outputs as an unique hit
- These task requires to
  - select those events in neighbouring slats
  - correlate those cases for which Y coordinate and ToF are within a given range: we chose 2 σ (14 cm in Y and 2 ns in ToF)
  - to check the chosen criteria, distributions of Y and ToF differences among different hits have been evaluated and plotted

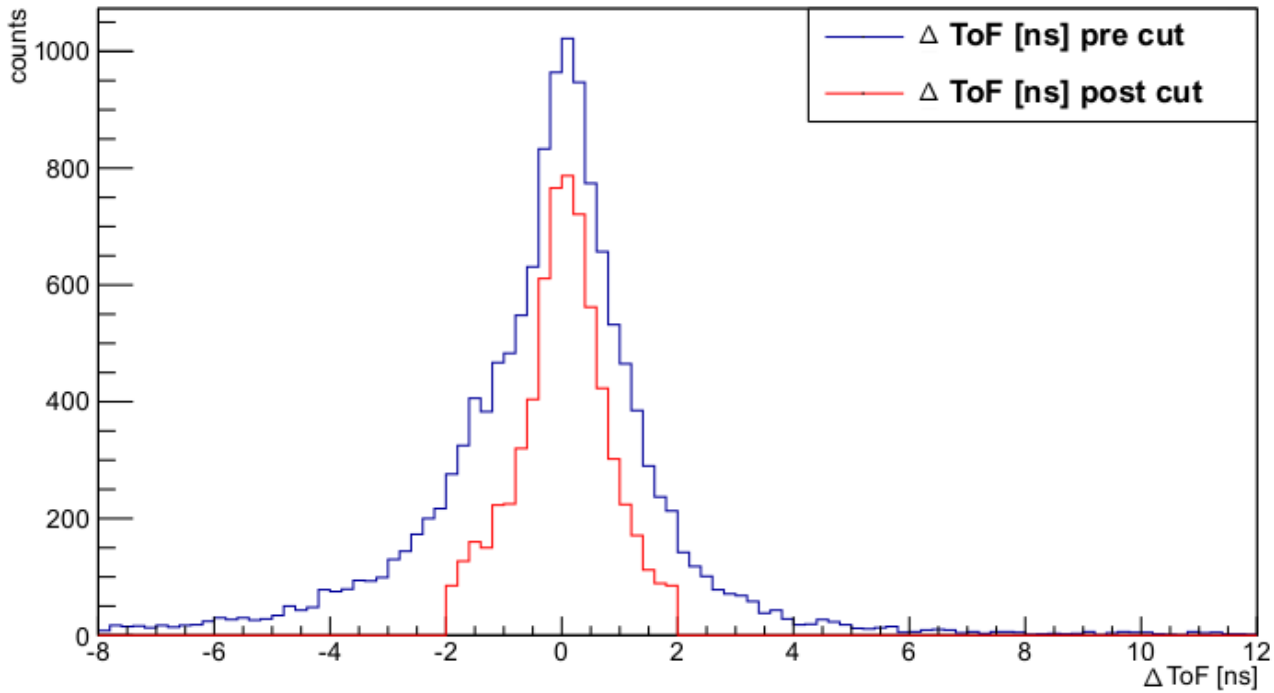
F-F, R-R clustering: Y coordinate

- comparison of Y coordinate difference (ΔY) distribution before and after the selection (slat 48)



F-F, R-R clustering: Time of Flight

- comparison of ToF difference (ΔToF) distribution before and after the selection (slat 48)

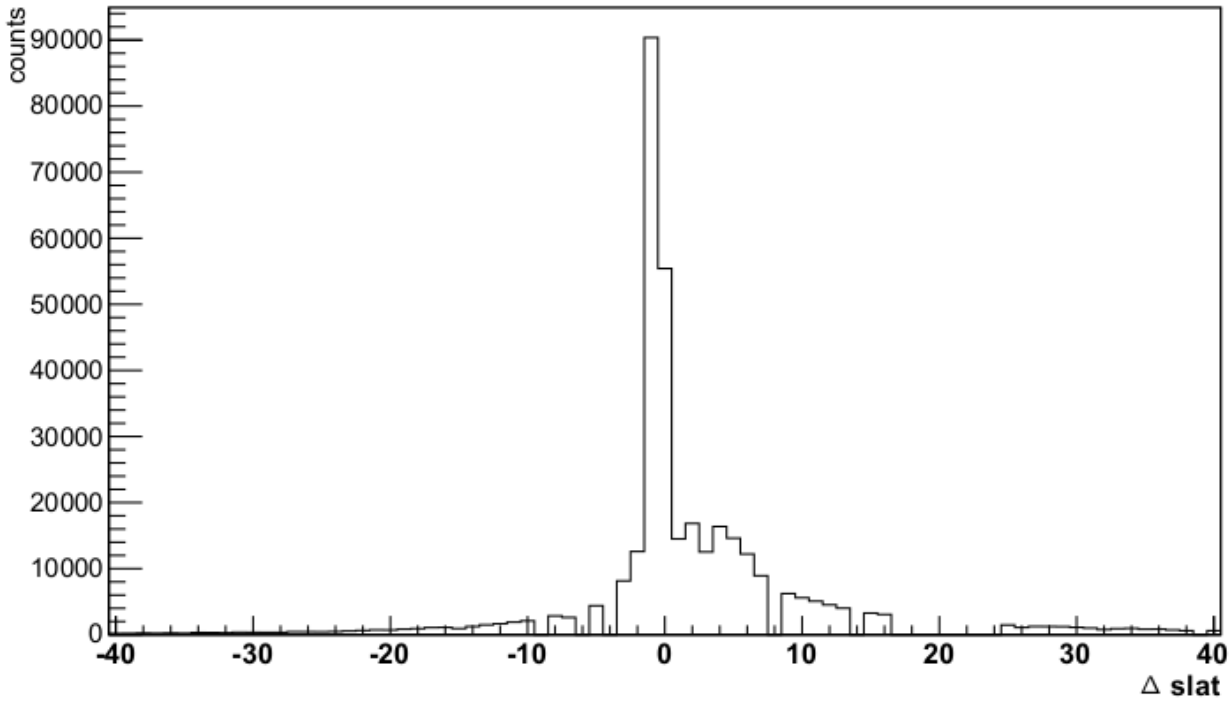


F-R clustering

- In order to identify correlated hits on different scintillator walls as a single particle, it would be possible to use, as before, the distributions of X (slat), Y and ToF differences among different hits
- Taken each hit in the front wall, we considered all the hits in the rear wall and we computed the difference in X, Y and ToF, plotting a histogram
  - the distribution peak width gives an indication of the X and Y distances and of the ToF difference for correlated hits

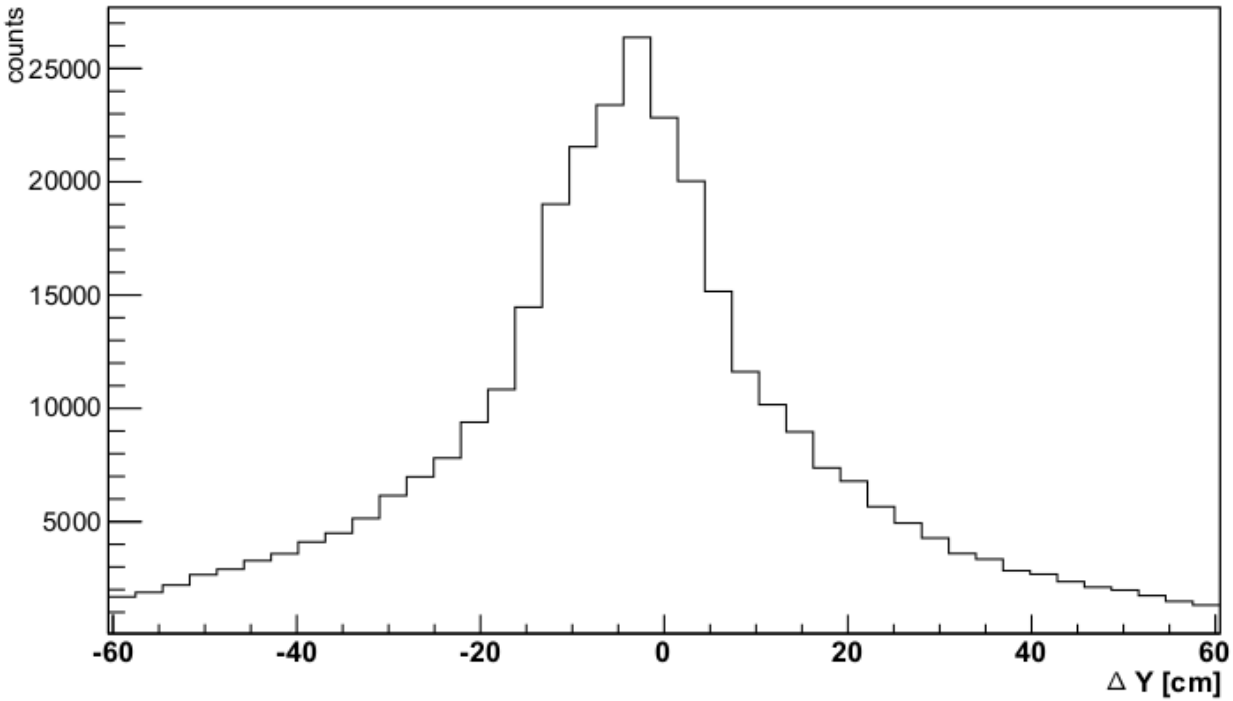
F-R clustering: X coordinate

- Slat difference (Δ *slat*) distribution (slat 48)



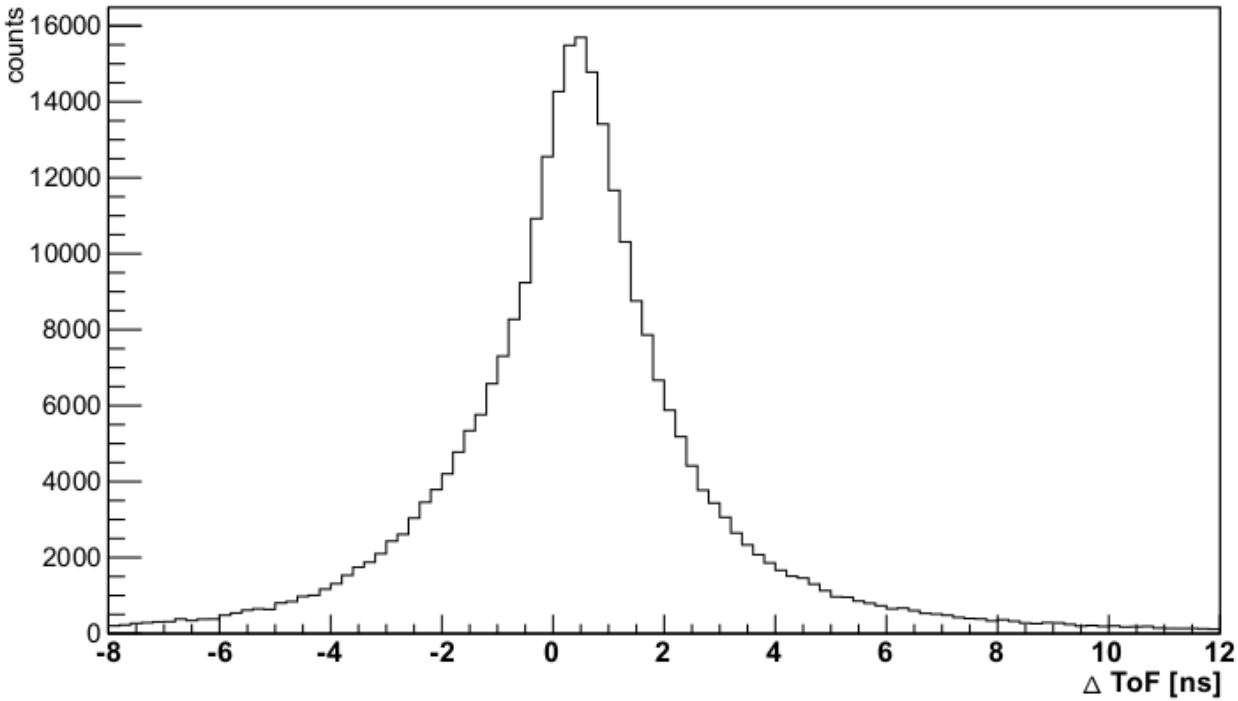
F-R clustering: Y coordinate

- Y coordinate difference (ΔY) distribution (slat 48)



F-R clustering: Time of Flight

- ToF difference (ΔToF) distribution (slat 48)



F-R clustering

However, it is difficult to decide which threshold has to be adopted to associate hits

- the quantities considered up-to-now vary between the two walls depending on the impinging angle (X, Y and ToF) and velocity (ToF) even if the particle that produced the signal is the same
- impinging angles, turn out to be better indicators

F-R clustering

Neglecting elastic multiple-scattering in low density materials along the path, the elevation angle can be expressed in terms of hit coordinates and Length of Flight (LoF) given by the product of velocity, v, and ToF

$$\sin(\theta_y) \approx \frac{Y}{LoF} = \frac{Y}{v\ ToF}$$

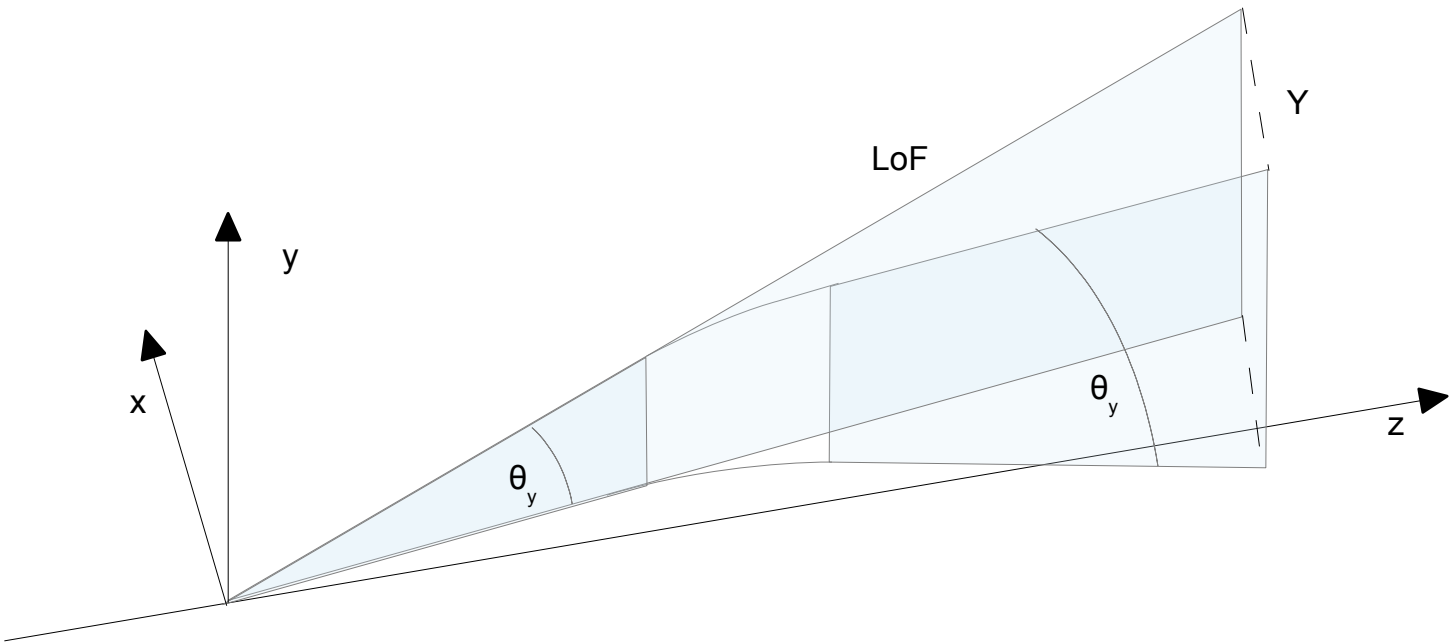
being θ_y the track angle with respect to the horizontal plane (x-z), defined as

$$\theta_y = \arctan\left(\frac{v_y}{\sqrt{v_x^2 + v_z^2}}\right)$$

- since velocity is not available before reconstruction, the quantity $v\ \sin(\theta_y)$ has been considered across the two scintillator planes

$$v\ \sin(\theta_y) \approx \frac{Y_{front}}{ToF_{front}} \approx \frac{Y_{rear}}{ToF\,rear}$$

F-R clustering: θ_y



F-R clustering

The possibility to use a similar expression for the horizontal angle has been explored even if it involves further geometrical approximations (strighting back the horizontal deflection of the magnetic field)

$$\sin(\theta_x) \approx \frac{X}{LoF_{xz}} = \frac{X}{v_{xz}\ ToF}$$

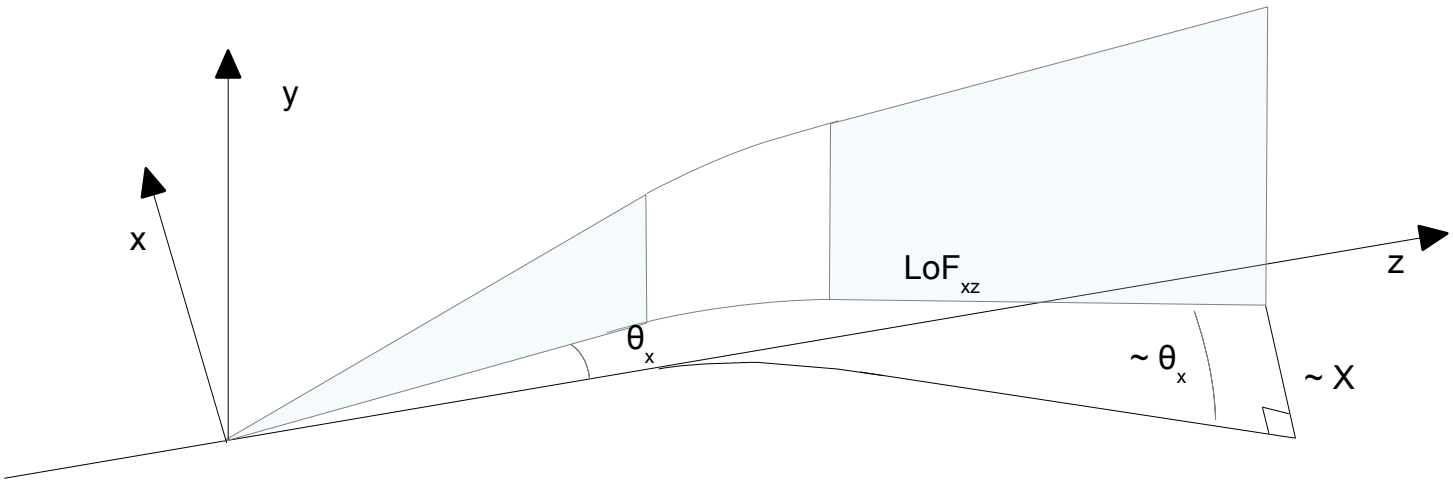
being θ_x the track projection angle onto the horizontal plane (x-z), defined as

$$\theta_x = \arctan\left(\frac{v_x}{v_z}\right)$$

- analogously to the previous case, the quantity $v_{xz}\ \sin(\theta_x)$ has been taken into account

$$v_{xz}\ \sin(\theta_x) \approx \frac{X_{front}}{ToF_{front}} \approx \frac{X_{rear}}{ToF_{rear}}$$

F-R clustering: θ_x



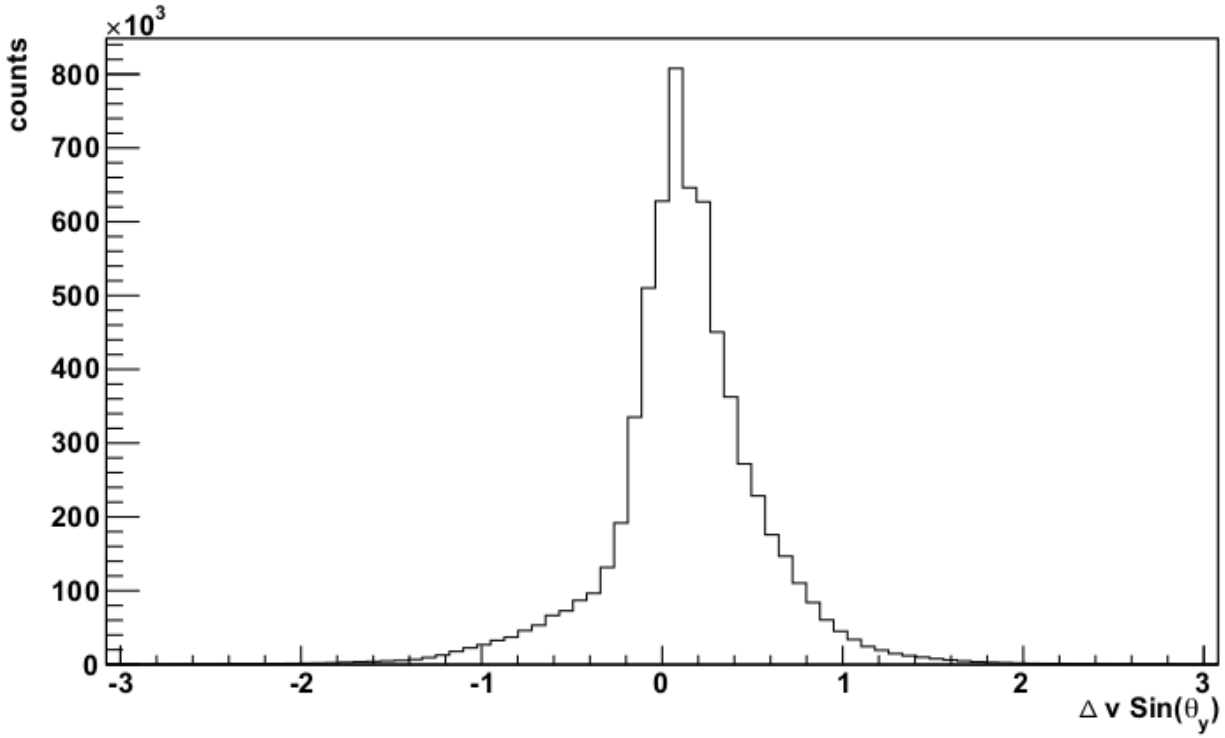
F-R clustering: cut thresholds

In order to choose the proper selection cuts, we considered the difference distributions for those events with one hit on front and one on rear walls only

- we fitted the difference distributions with a gaussian curve
- we assumed as cut values 2 σ

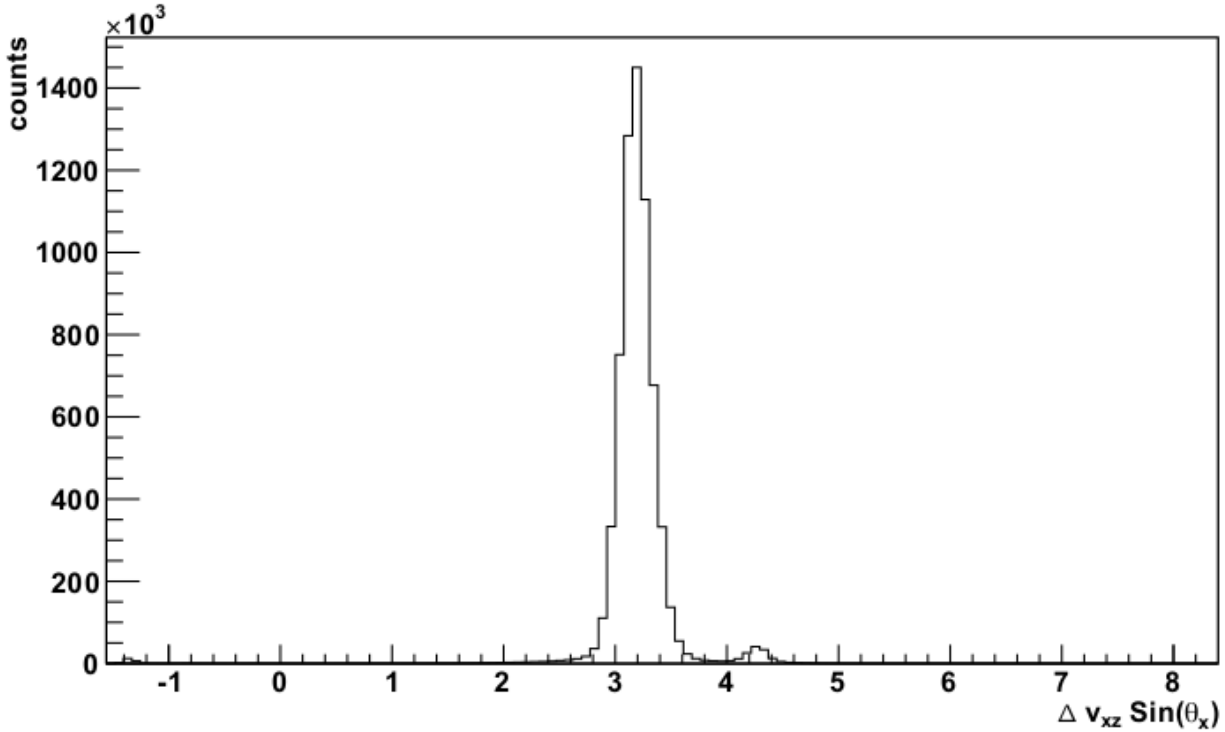
F-R clustering: θ_y

- $\Delta\, v\, \sin(\theta_y)$ distribution (2 σ corresponds to 0.486486)



F-R clustering: θ_x

- $\Delta\, v_{xz}\ \sin(\theta_x)$ distribution (2 σ corresponds to 0.27694)

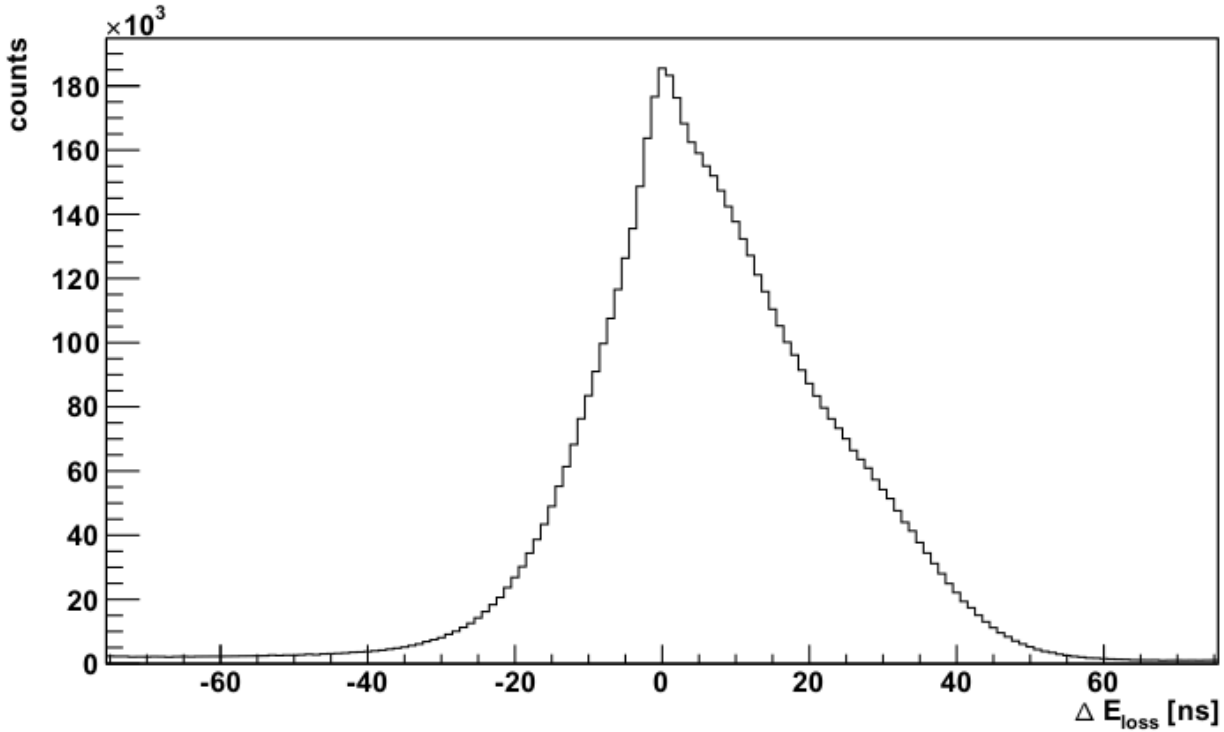


F-R clustering: E_{loss}

- Only after in-plane clustering, E_{loss} on front and rear planes can be compared
- However at the moment we are considering events with one hit on front and one on rear walls to have an indication of the distribution shape
- For those events we computed, as usual, the difference in energy loss between the two planes

F-R clustering: E_{loss}

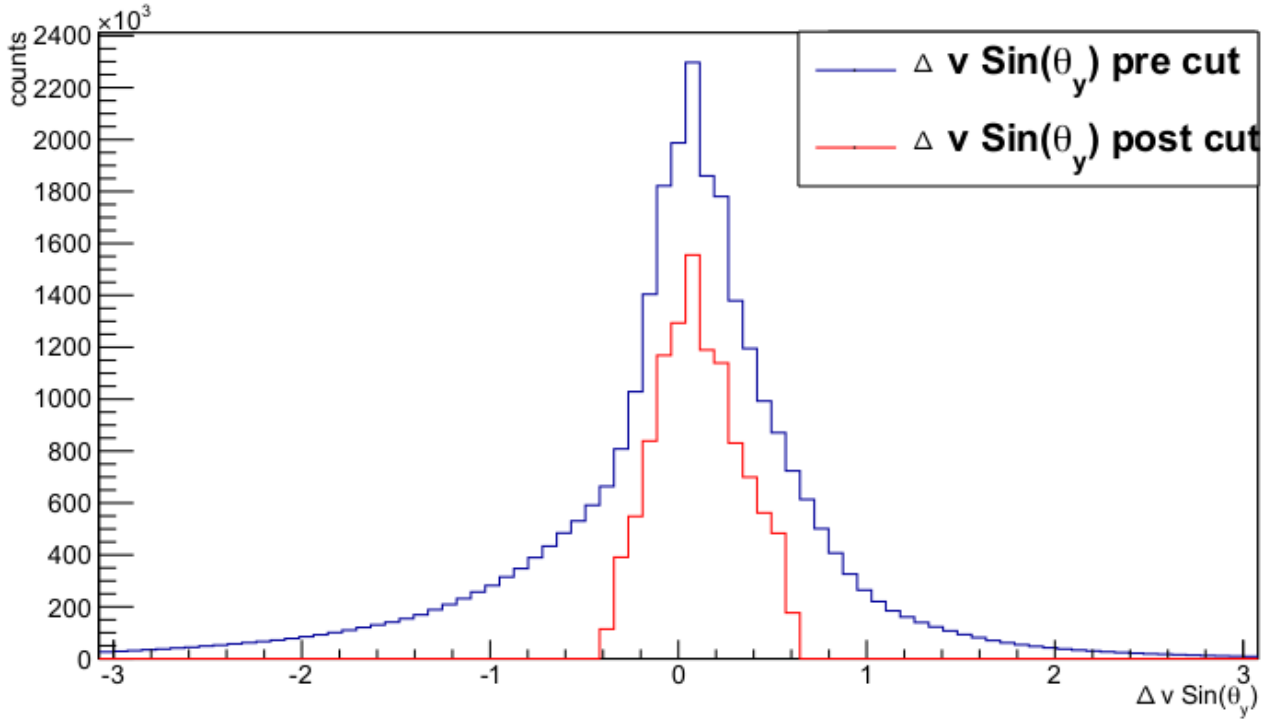
- ΔE_{loss} distribution



- The distribution shows that energy loss is not a very good discriminant for clustering
- A better comparison should be based on the kinetic energy, retrieved from the invertion of the Bethe-Bloch formula

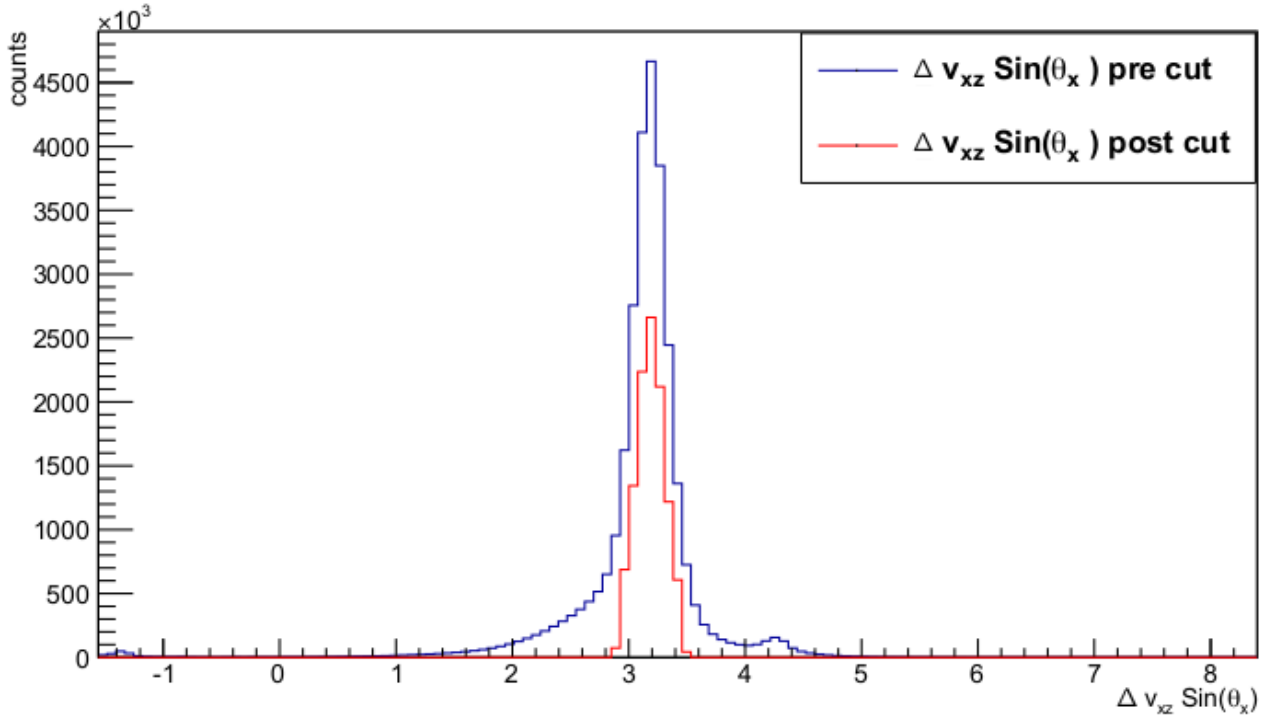
F-R clustering: cut application

- Clustering criteria have been applied to $\Delta\, v\, \sin(\theta_y)$



F-R clustering: cut application

- Clustering criteria have been applied to $\Delta\, v_{xz}\ \sin(\theta_x)$



Clustering Steps

Clustering Steps

1. In-plane clustering F-F, R-R
2. Cross-plane clustering F-R

To be tested with MC data
To be implemented in low level reconstruction

Pedestal calibration update

- To improve the match beetwen data and MC, pedestal evaluation has been varied
  - the mean values of the pedestal distributions have been adopted

THE END

Thanks for your attention