The TKR-Converter as pre-shower

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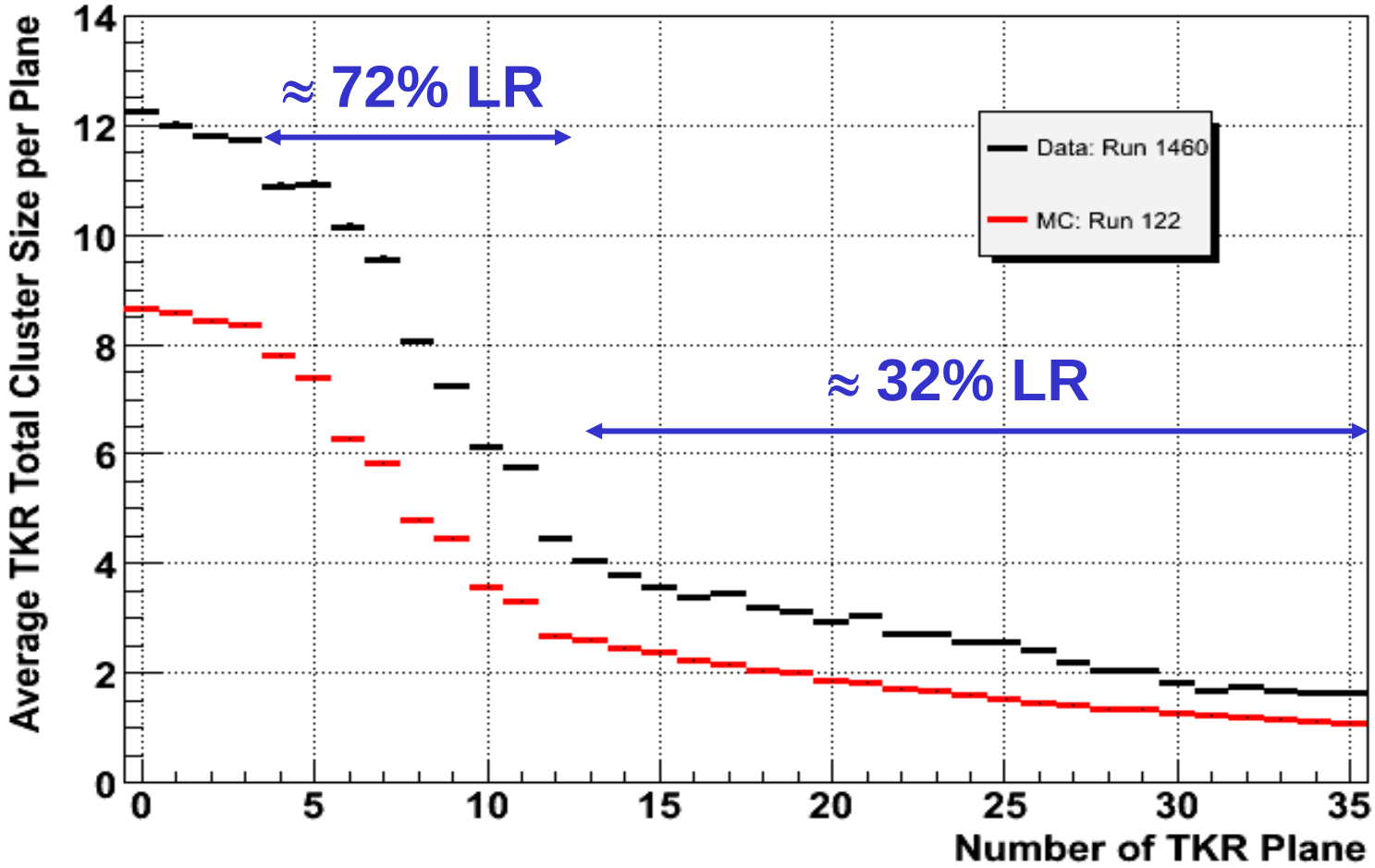
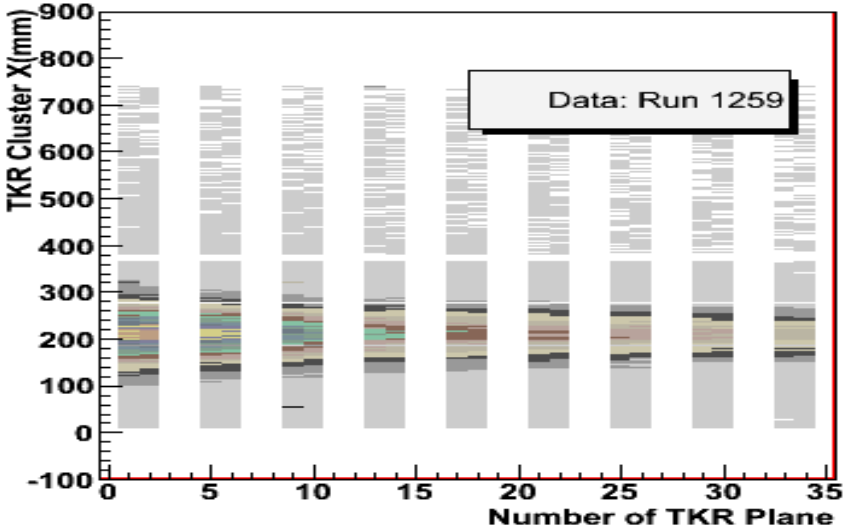
Longitudinal shower profile 5 GeV Elec

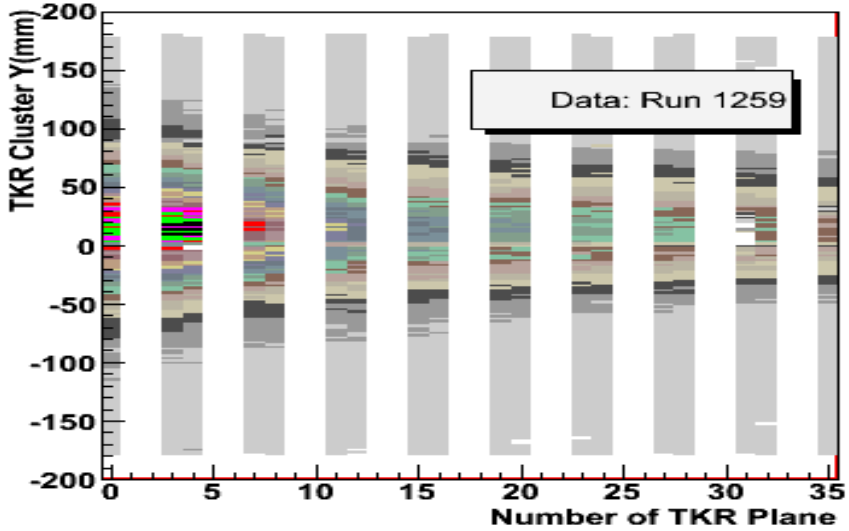
Black: Data (run 1460)

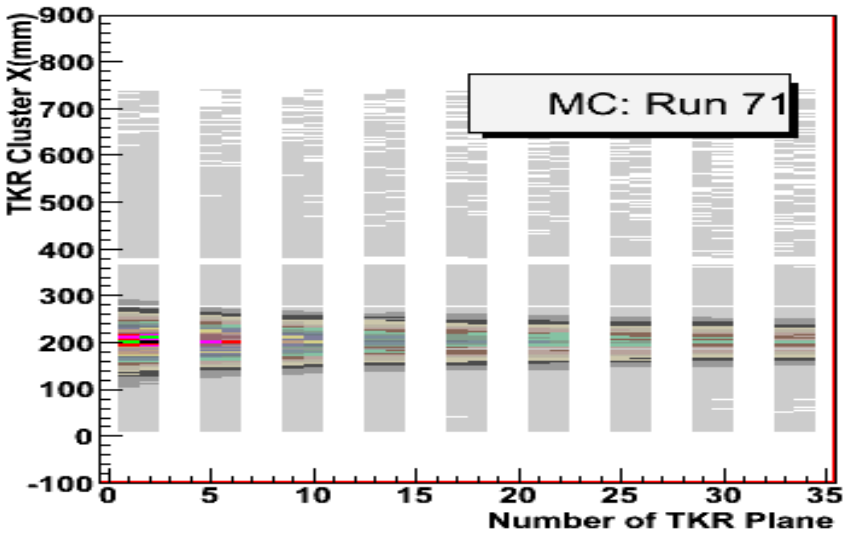
Red: MC (run 122)

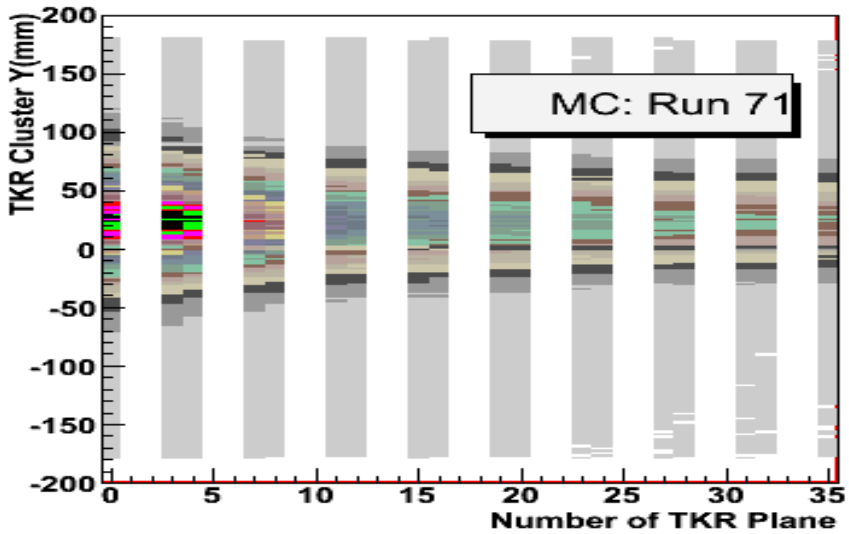


Transverse shower profile 1 GeV Elec









Possible discrepancies causes

- Number of secondary particles
- Elastic/inelastic scattering angle
- Electromagnetic shower description
- Halo beam
- Double particle in the beam
- Rough description of the media
- Charge sharing effect
- Tracking
- Recon tools
- Calibration
- Thresholds
- Noisy strip

Transverse cluster distribution

- The distances of the clusters in each view have been studied with respect to:
  - The first track (best track)
  - The first vertex (best vertex)
  - Shower axis
- Relevant distributions:
  - Cluster distance, D_i, weighted with its size, S_i,
  - The average cluster distances, $<D>$, in each event

$$< D >= \sum_{Clusters} D_i \times S_i \Big/ \sum_{Clusters} S_i$$

  - The maximum value ($D_i \times S_i$) in each event

$$Max_{\ Clusters} \left(D_i \times S_i \right)$$

Shower axis definition

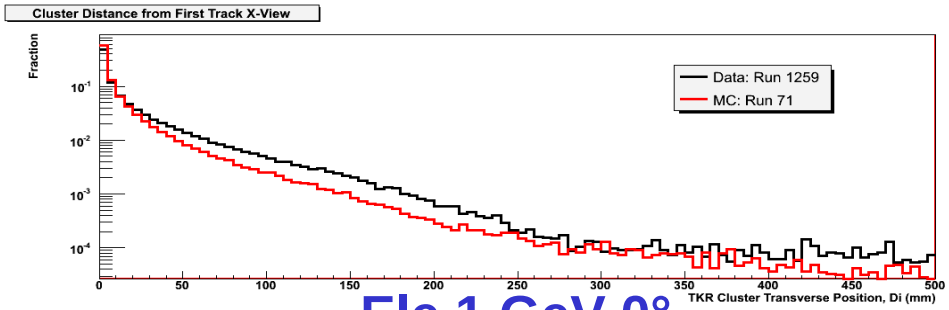
- In each view, the top Z fired plane have been identified, Z_{top}
- The top position in the X (Y) view, X_{top} (Y_{top}), is evaluated as average of the X (Y) cluster positions in the top plane in that view
- In each view, the shower axis slope is evaluated as: (in the X view)

$$Slope = \sum_{Clusters} \left(X_i - X_{top}\right) / \left(Z_i - Z_{top}\right) \times S_i \Big/ \sum_{Clusters} S_i$$

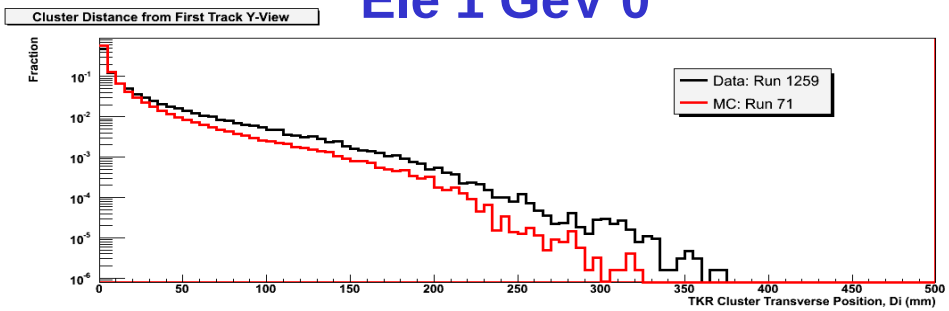
Input root files and cuts

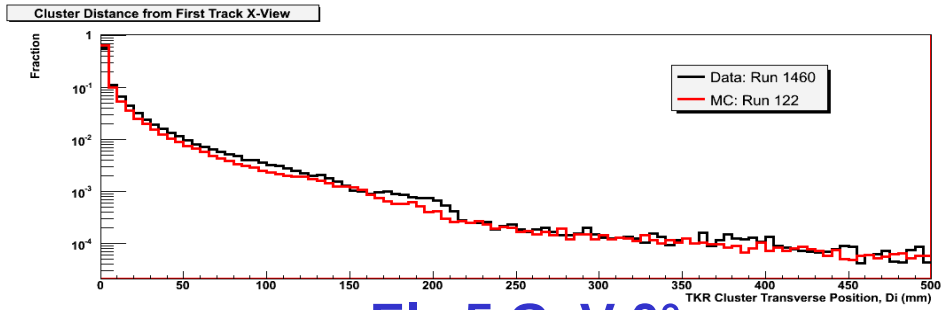
- The recon root files have been used (latest version available)
  - TkrRecon method to point
    - The cluster collection TkrCluster
    - The track collection TkrTrack
    - The vertex collection TkrVertex
- The CU has been used as standalone detector, i.e. no geometrical cuts have been imposed
  - Cuts:
    - At least one track, for the distances with the respect the first track
    - At least one vertex, for the distances with the respect the first vertex
    - At least 5 clusters in both views, for the distances with the respect the axis shower

Distance Cluster-First Track

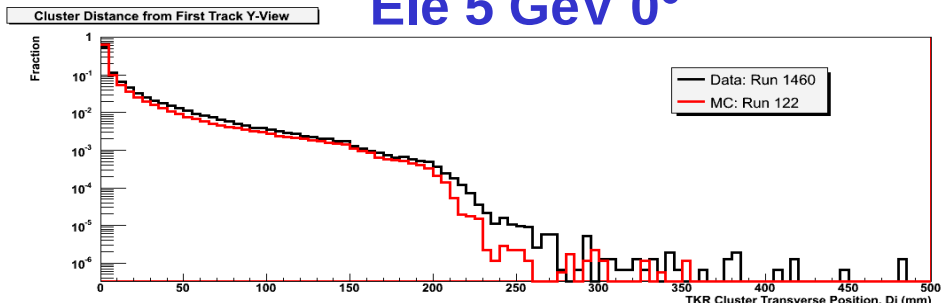


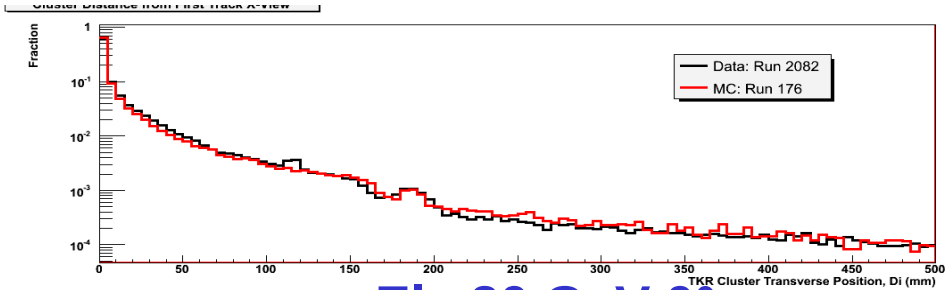
Ele 1 GeV 0°



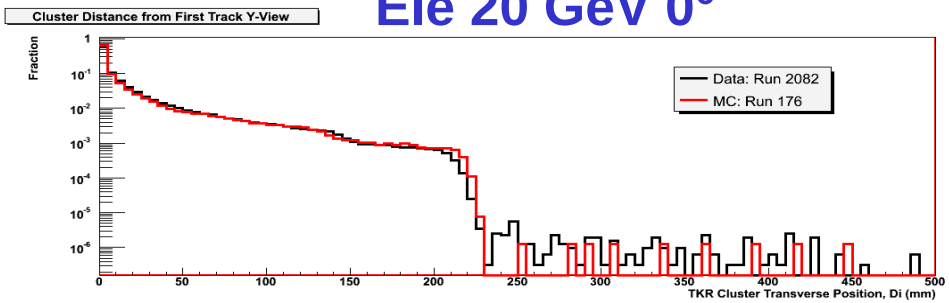


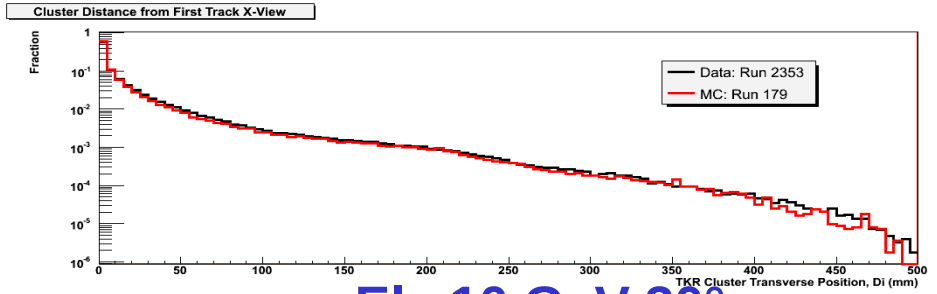
Ele 5 GeV 0°



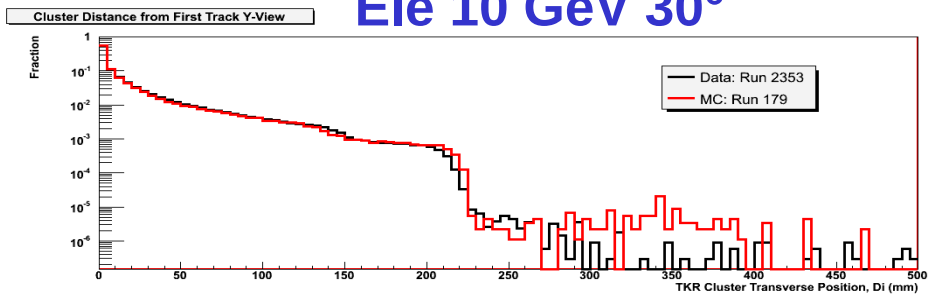


Ele 20 GeV 0°

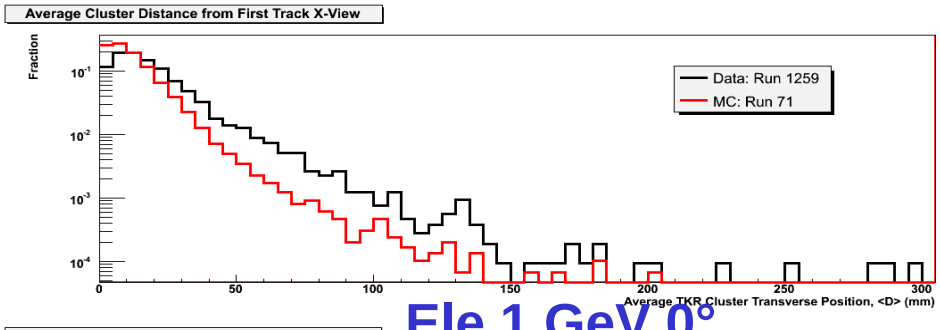




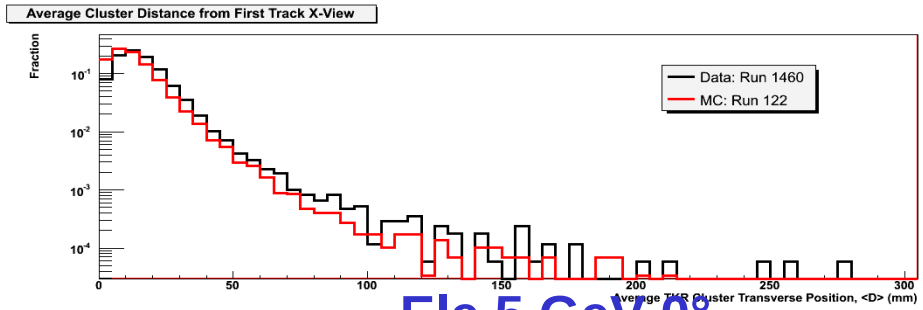
Ele 10 GeV 30°



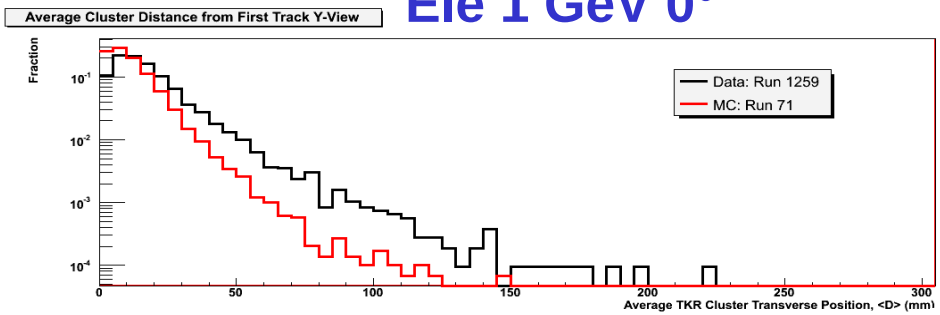
Mean Distance Cluster-First Track

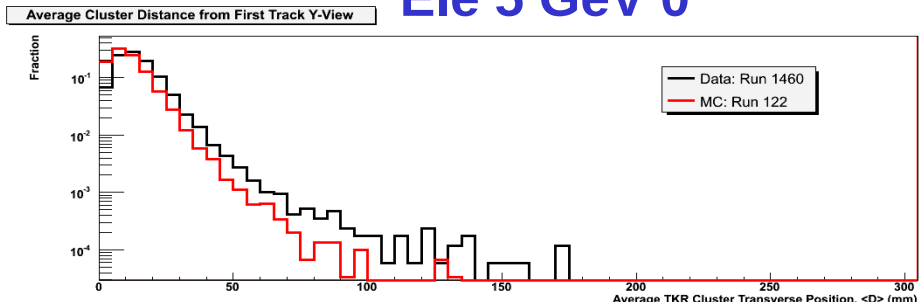


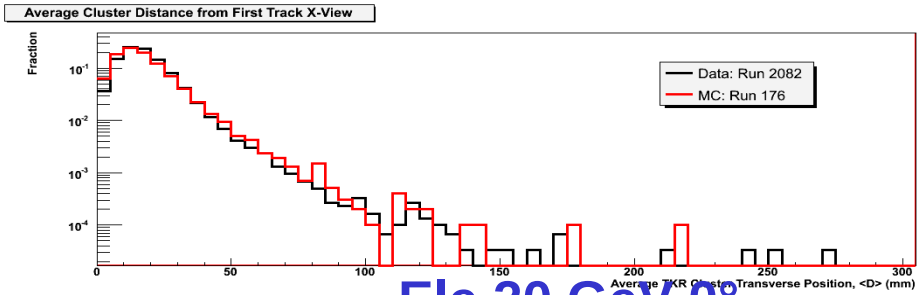
Ele 1 GeV 0°



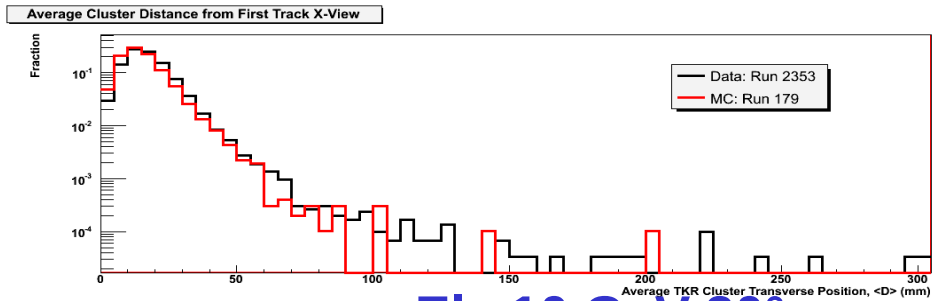
Ele 5 GeV 0°



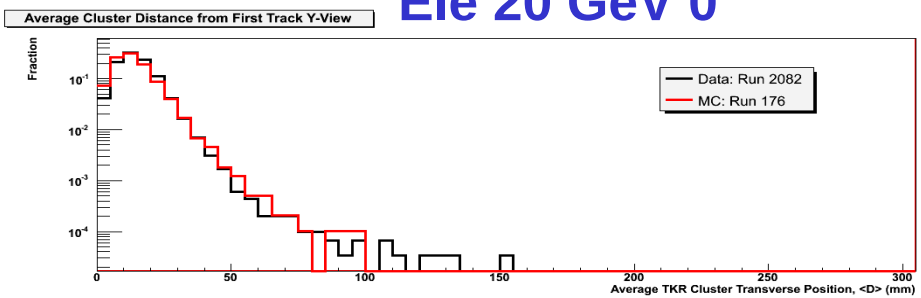


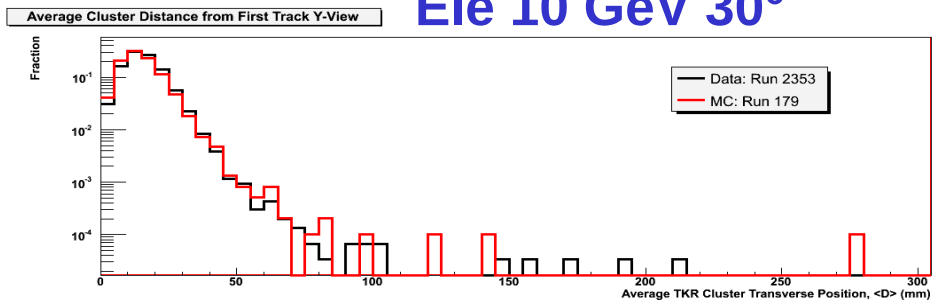


Ele 20 GeV 0°

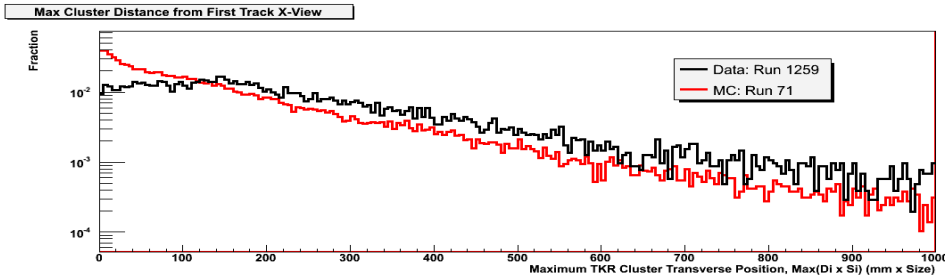


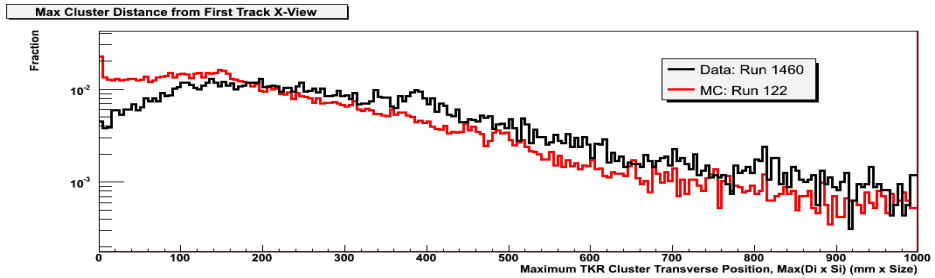
Ele 10 GeV 30°

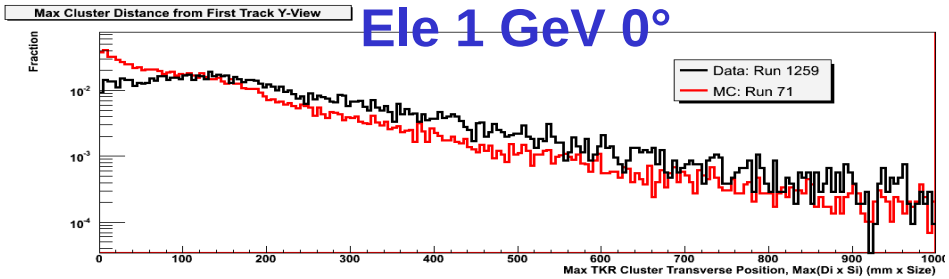




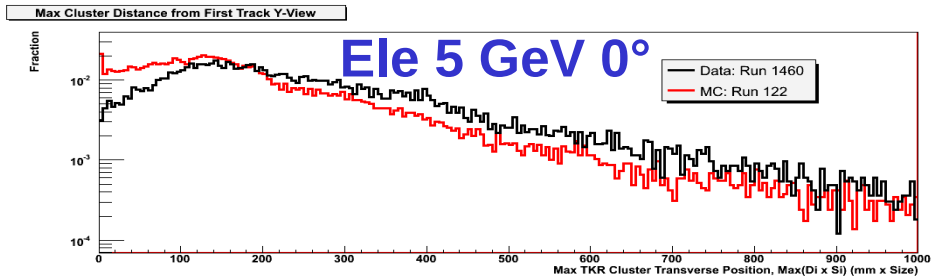
Max Distance Cluster-First Track



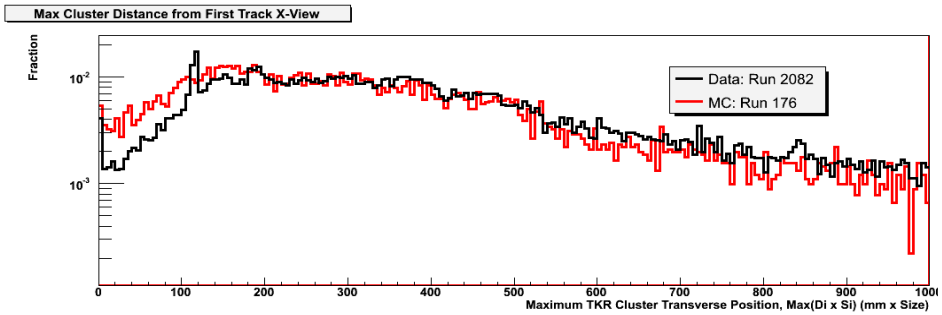


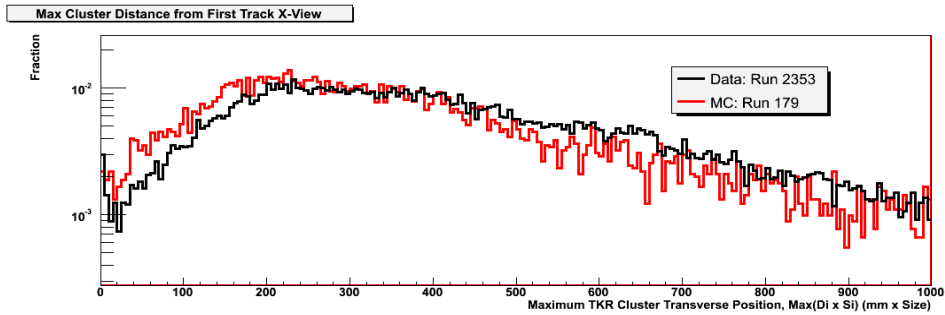


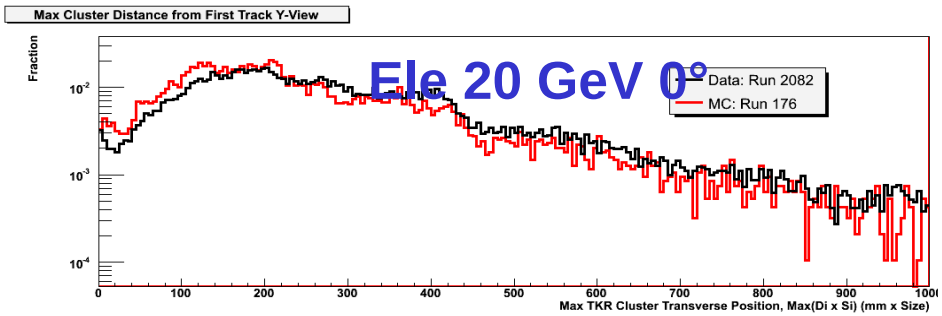
Ele 1 GeV 0°



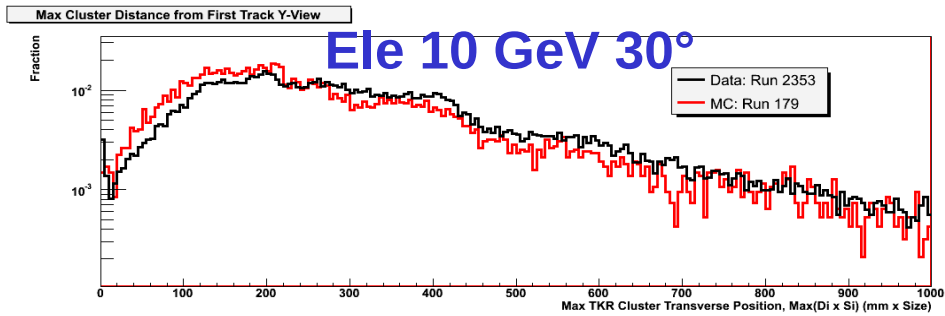
Ele 5 GeV 0°





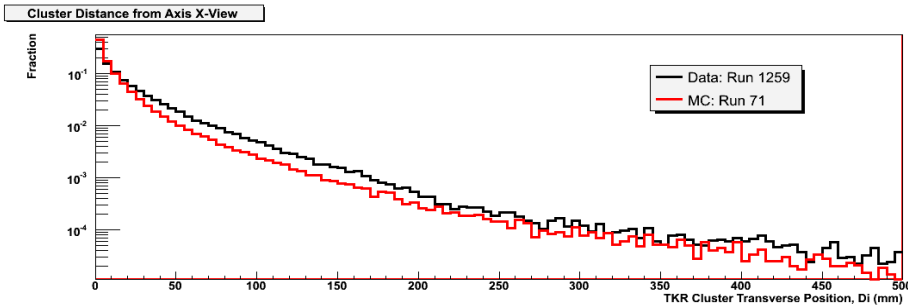


Ele 20 GeV 0°

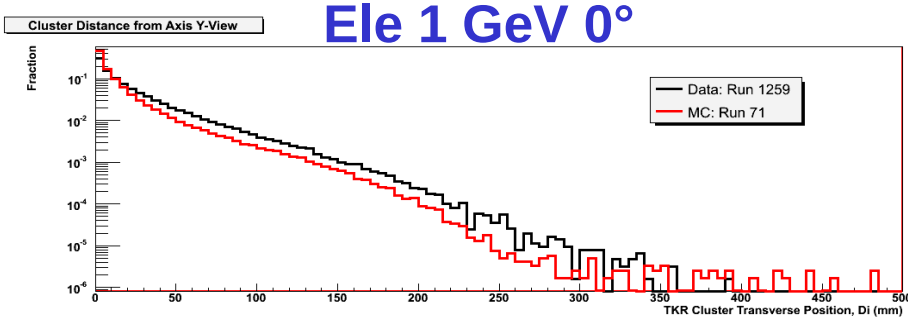


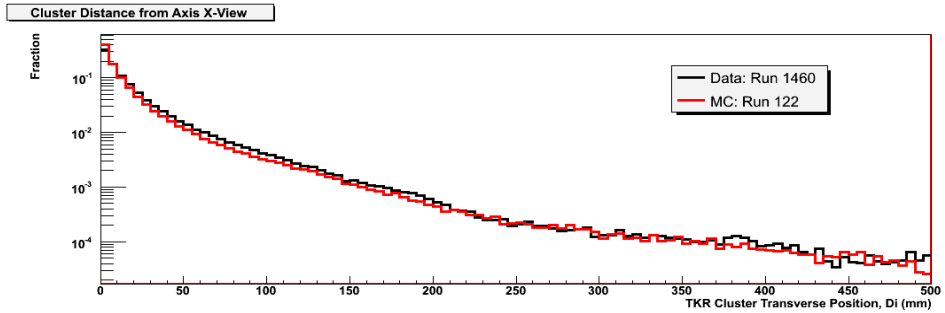
Ele 10 GeV 30°

Distance Cluster-Axis

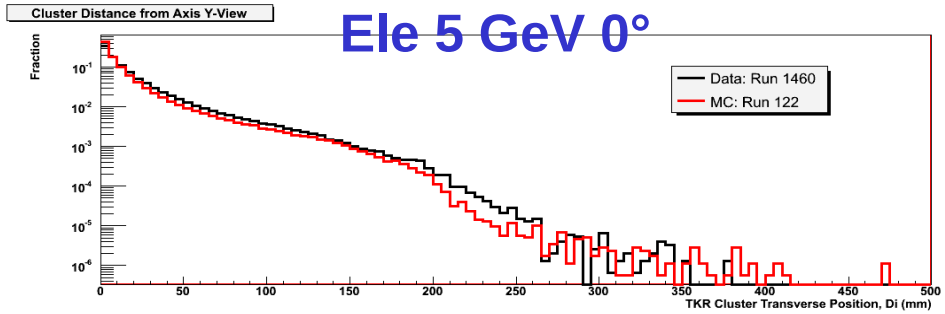


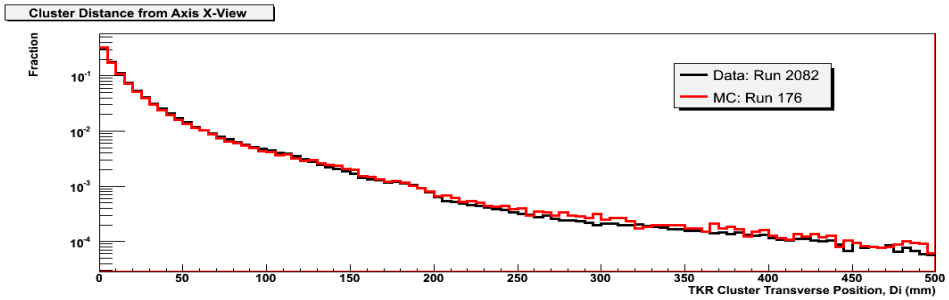
Ele 1 GeV 0°

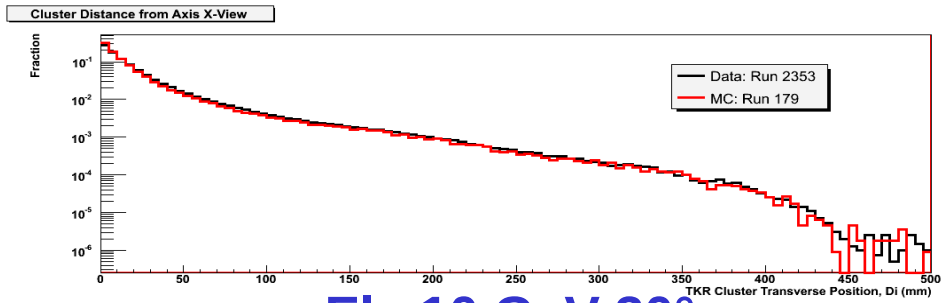


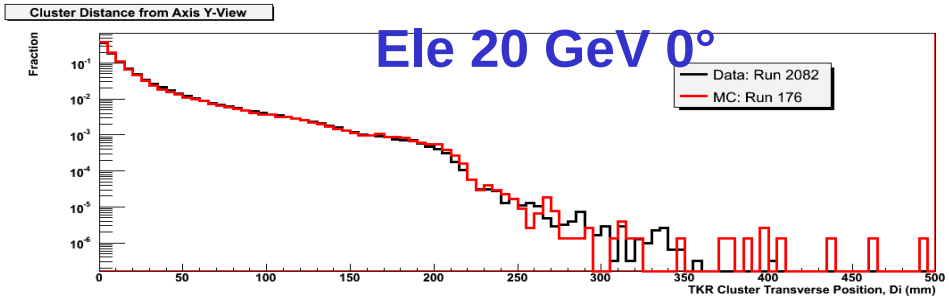


Ele 5 GeV 0°



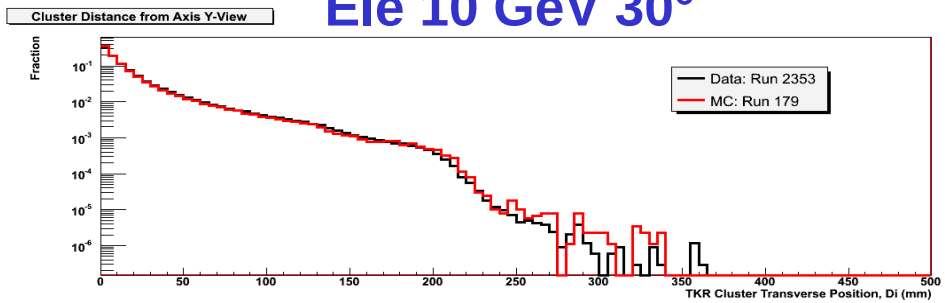




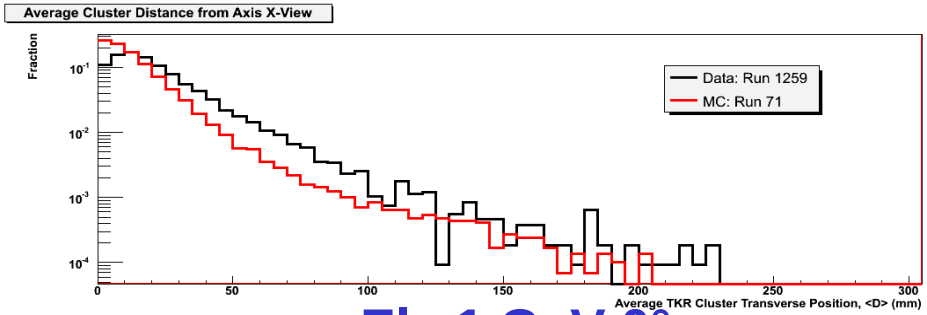


Ele 20 GeV 0°

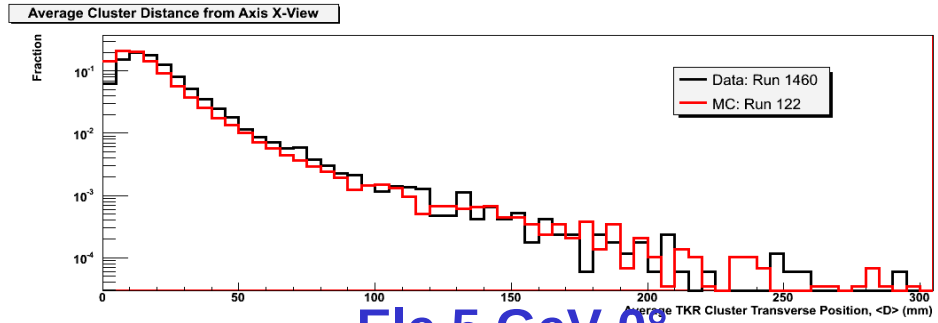
Ele 10 GeV 30°



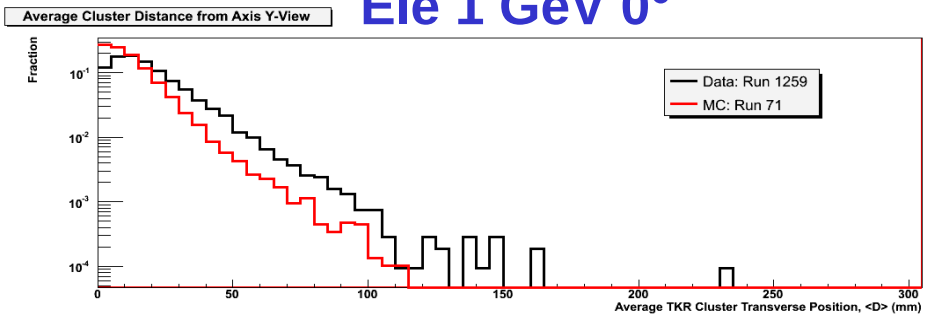
Mean Distance Cluster-Axis

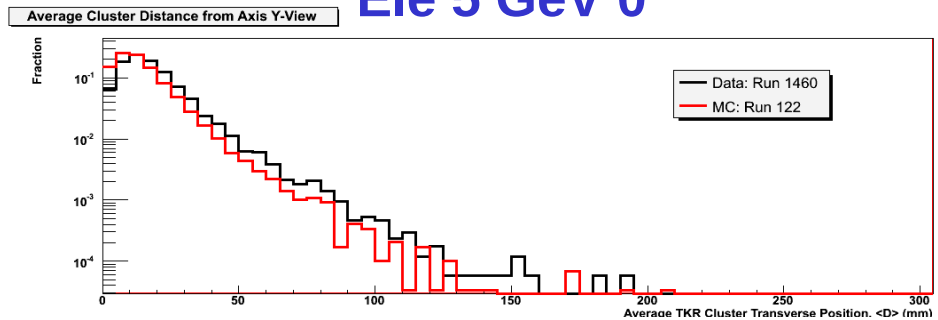


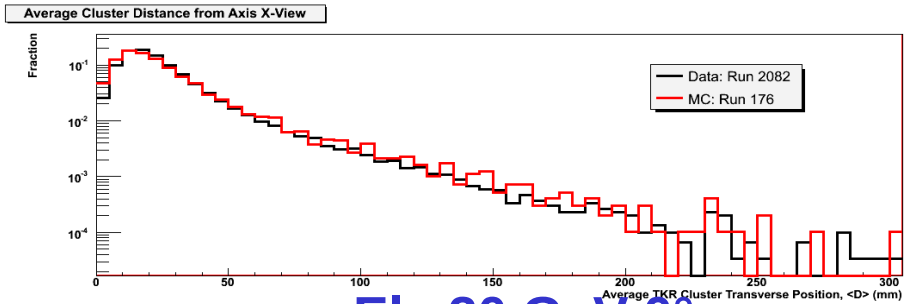
Ele 1 GeV 0°



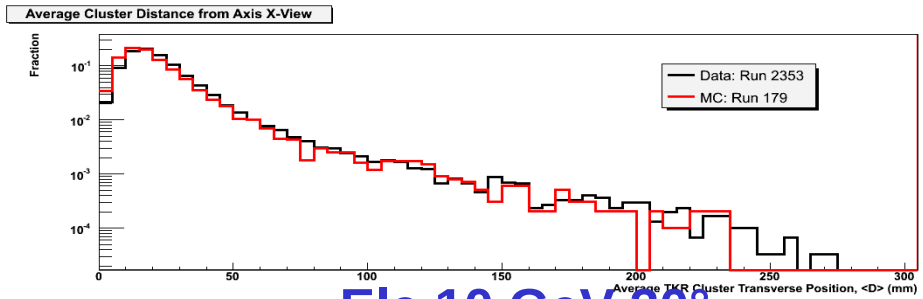
Ele 5 GeV 0°



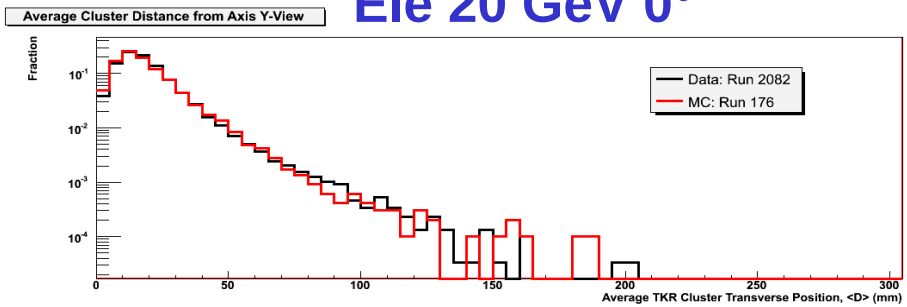


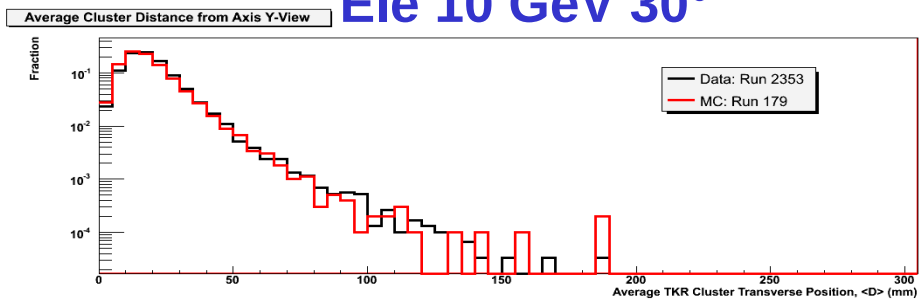


Ele 20 GeV 0°

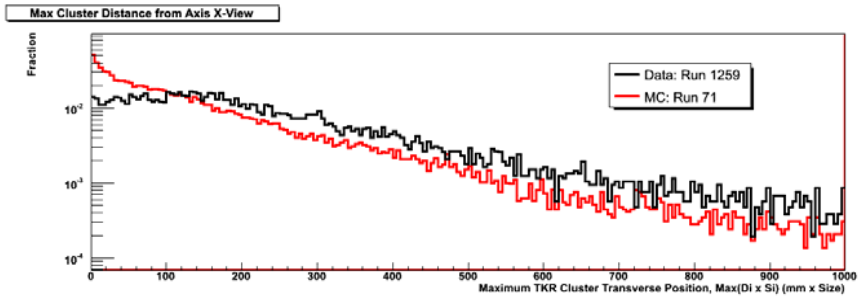


Ele 10 GeV 30°

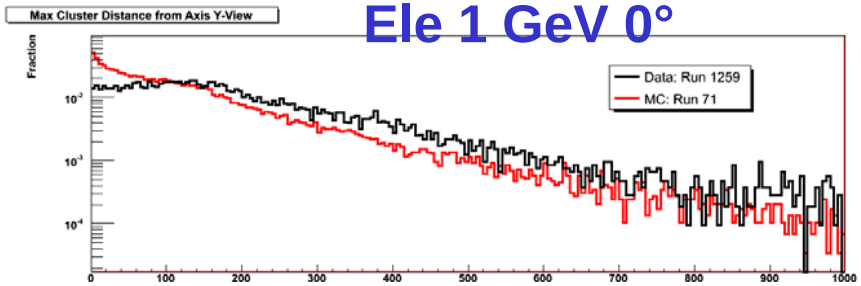


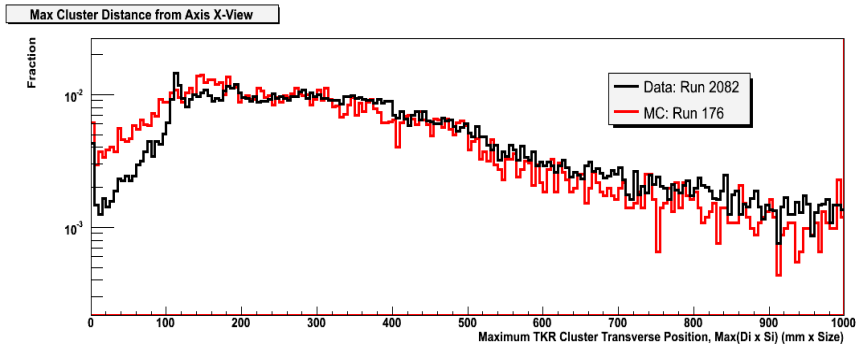


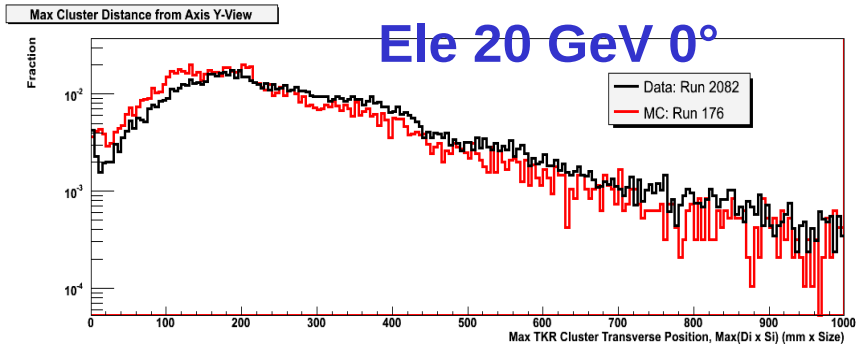
Max Distance Cluster-Axis



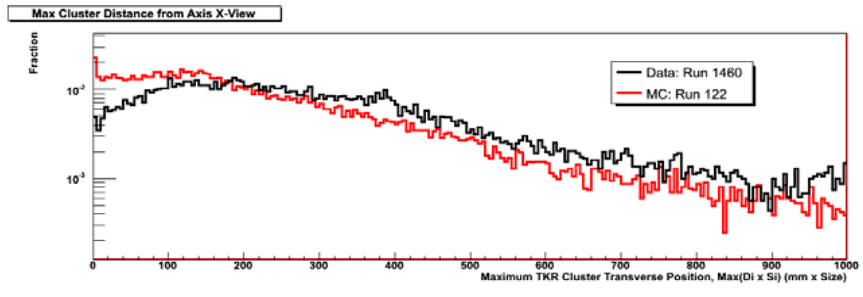
Ele 1 GeV 0°



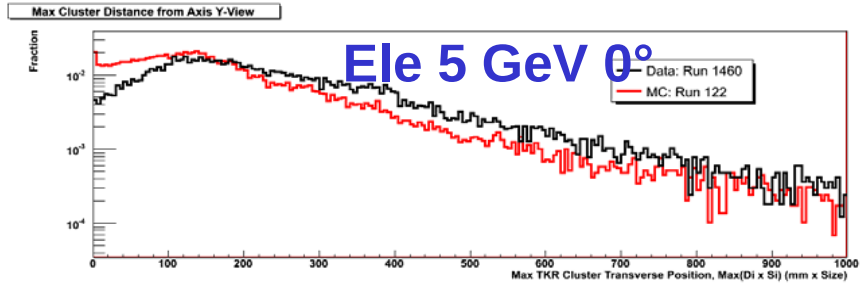


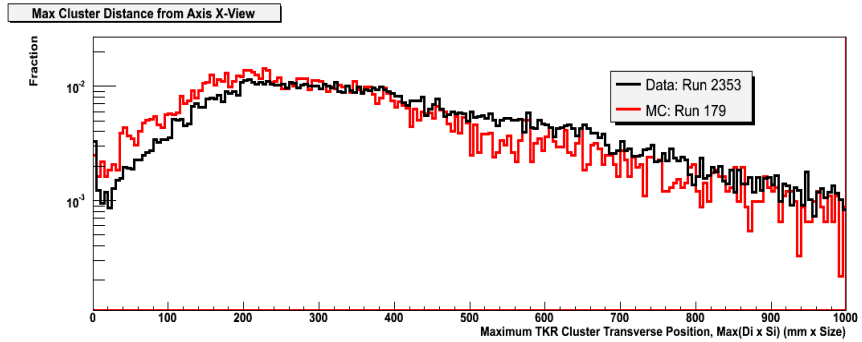


Ele 20 GeV 0°

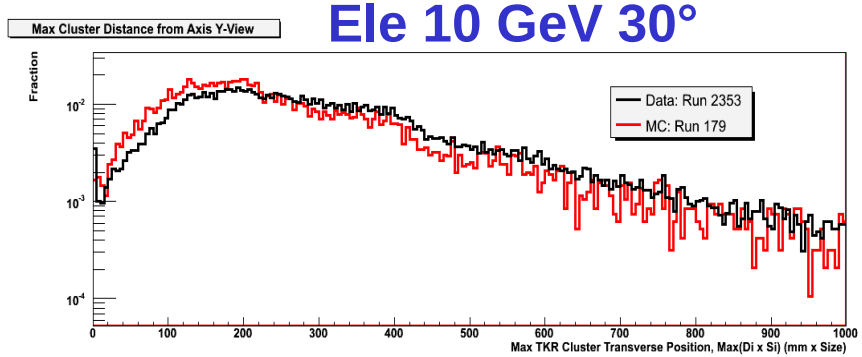


Ele 5 GeV 0°

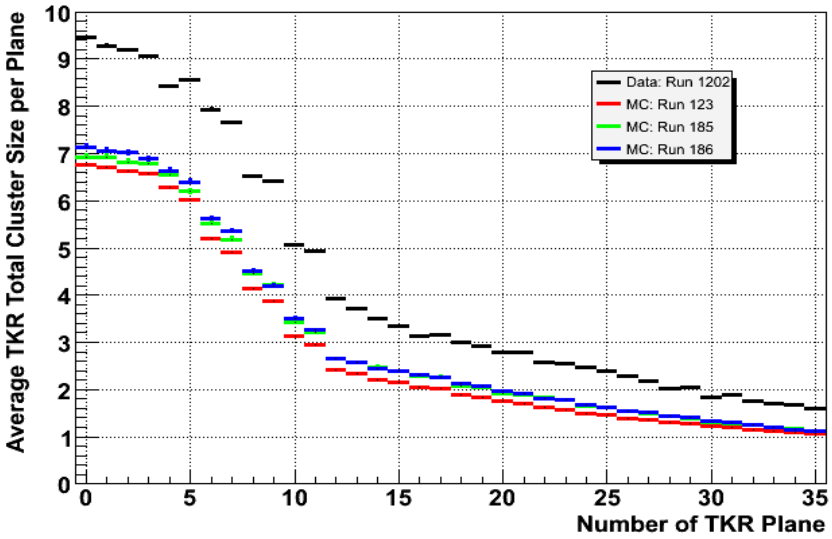


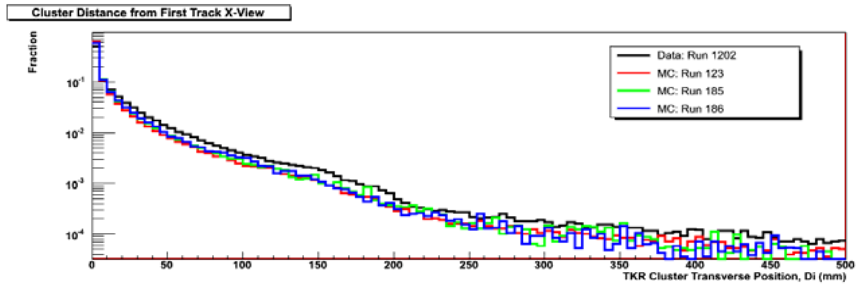


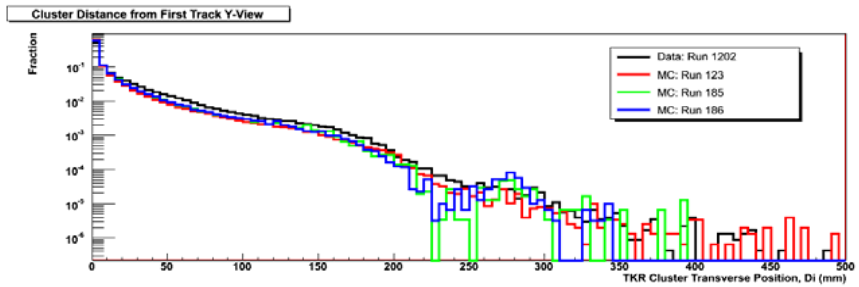
Ele 10 GeV 30°

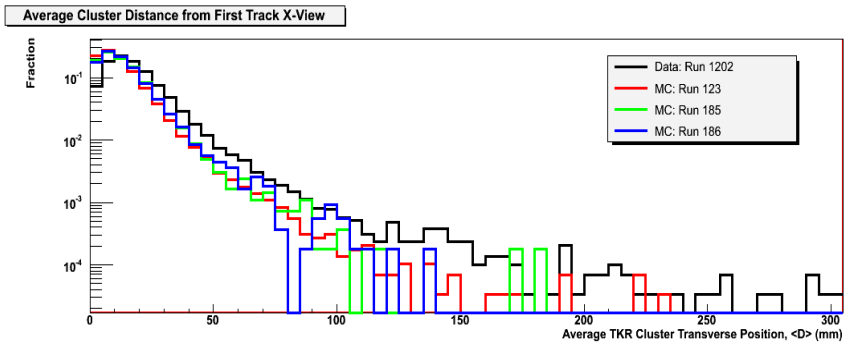


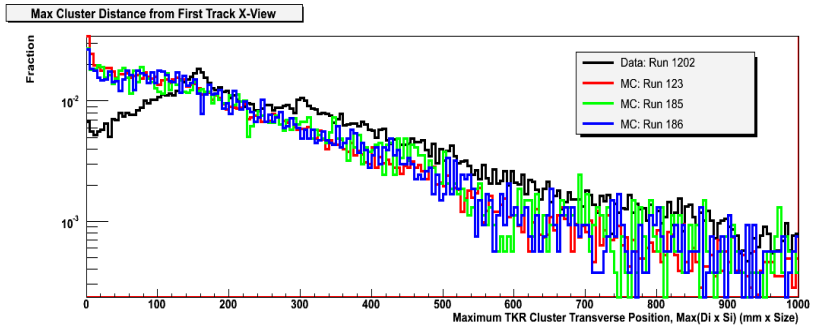
Electron 2.5 GeV 0° - Dist. Cls-Track

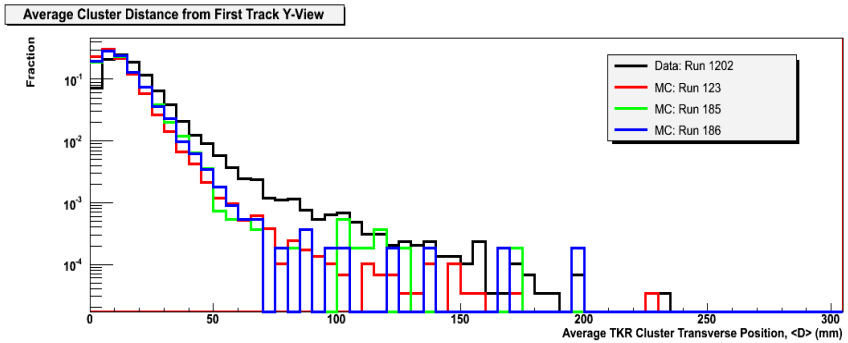


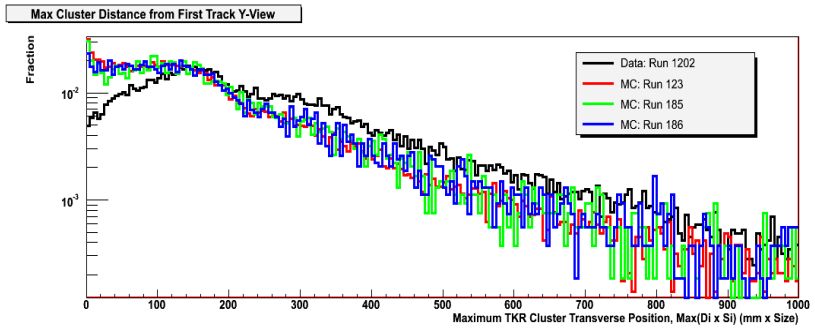






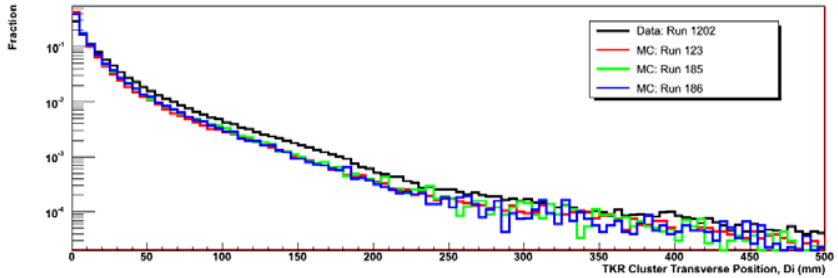




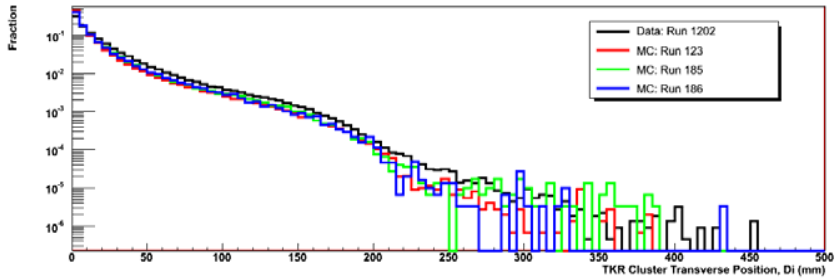


Electron 2.5 GeV 0° - Dist. Cls-Axis

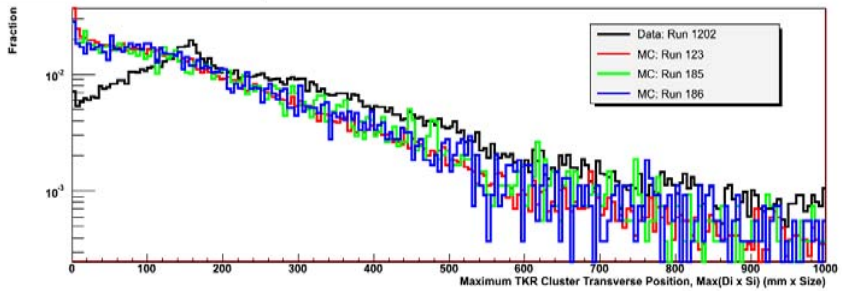
Cluster Distance from Axis X-View



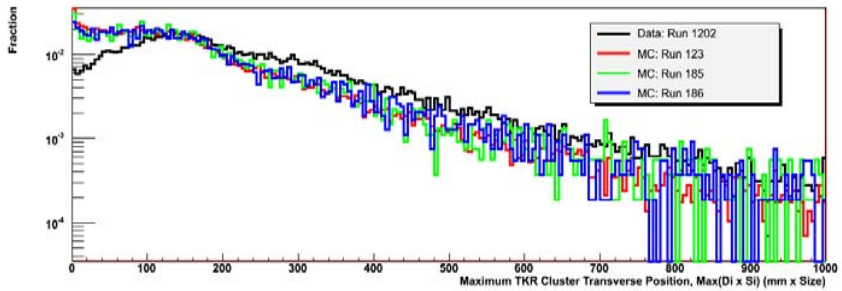
Cluster Distance from Axis Y-View



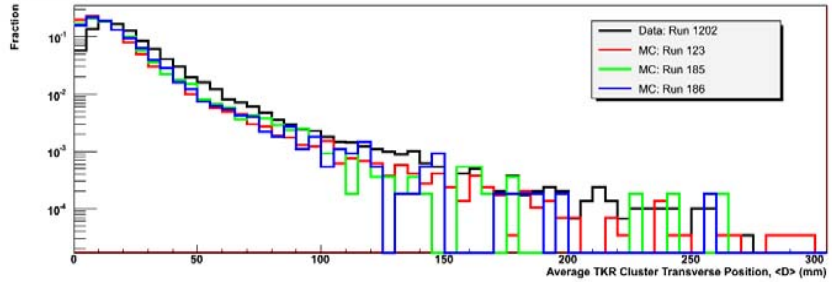
Max Cluster Distance from Axis X-View



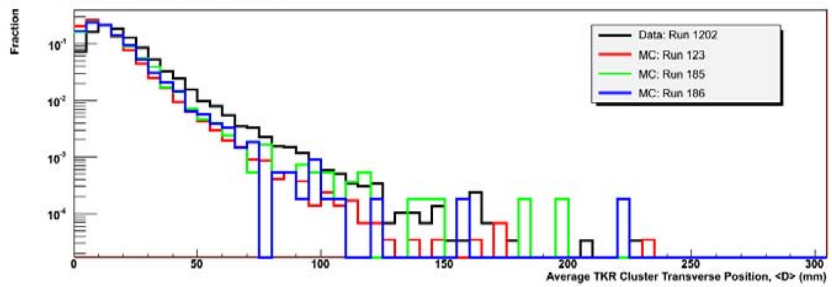
Max Cluster Distance from Axis Y-View



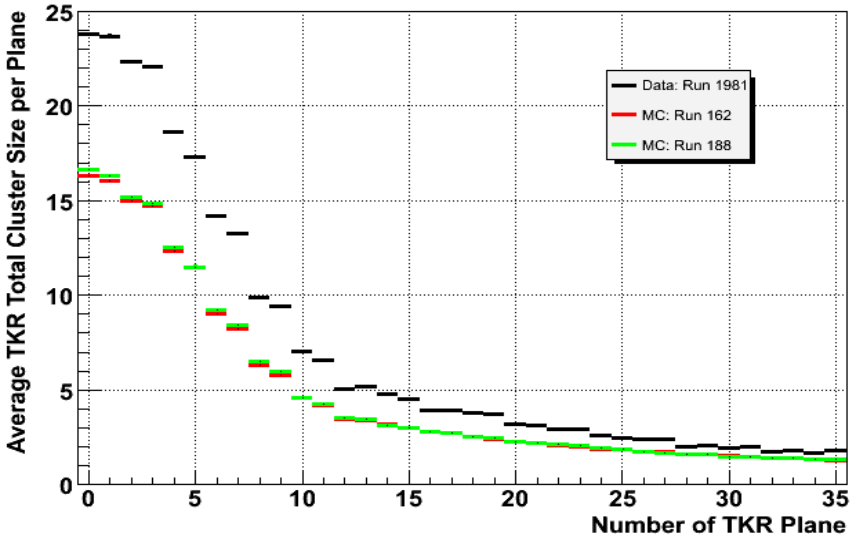
Average Cluster Distance from Axis X-View

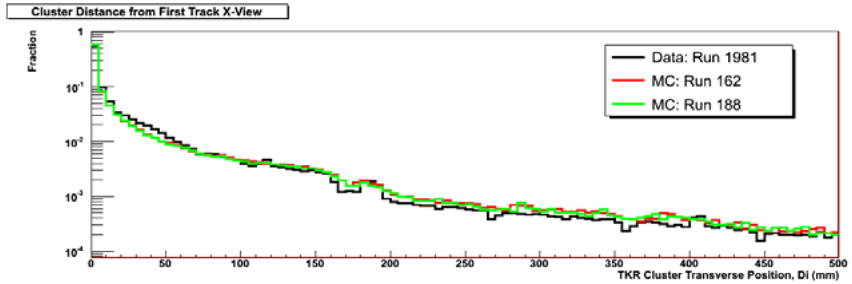


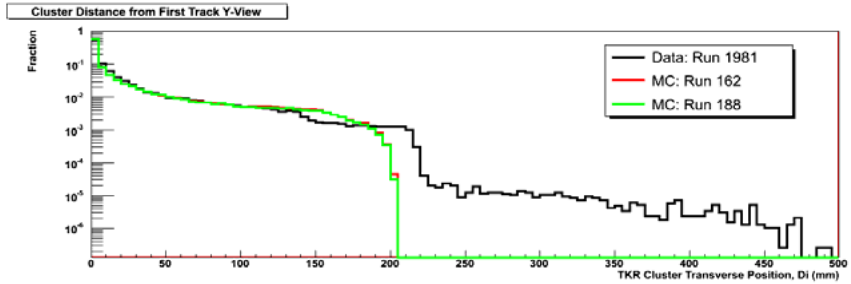
Average Cluster Distance from Axis Y-View

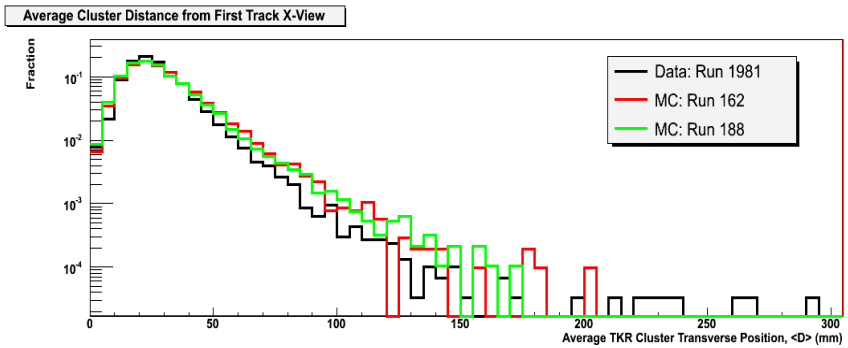


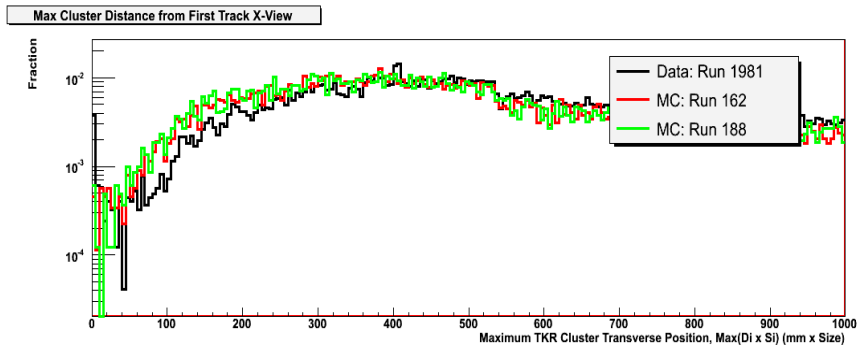
Electron 100 GeV 0° - Dist. Cls-Track

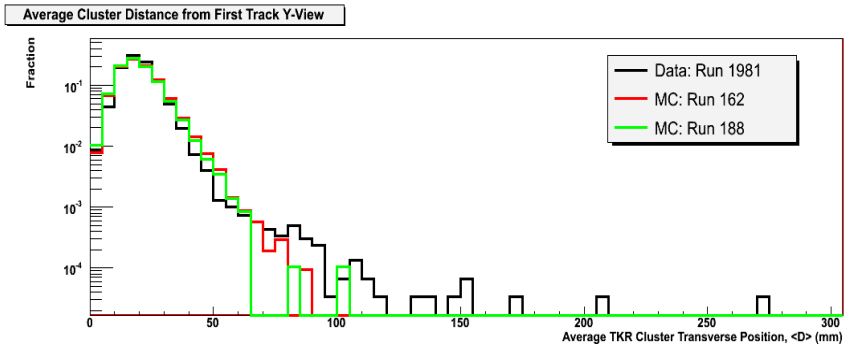


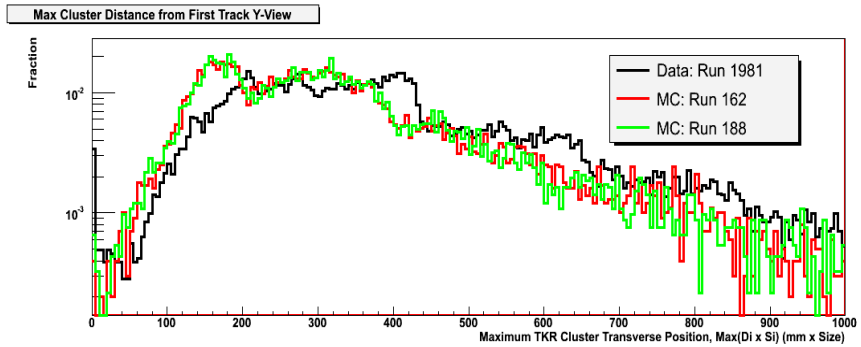




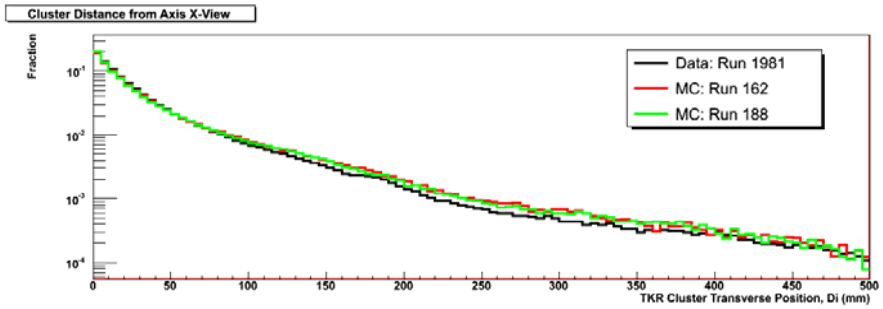


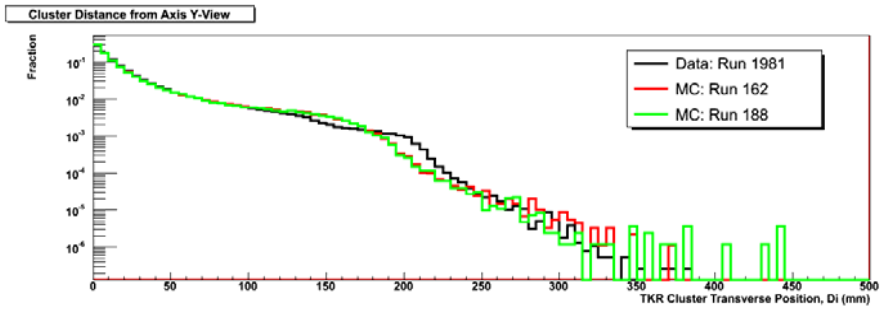


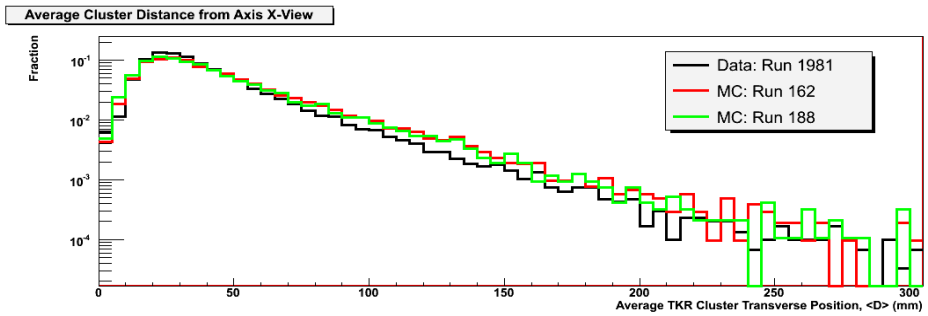


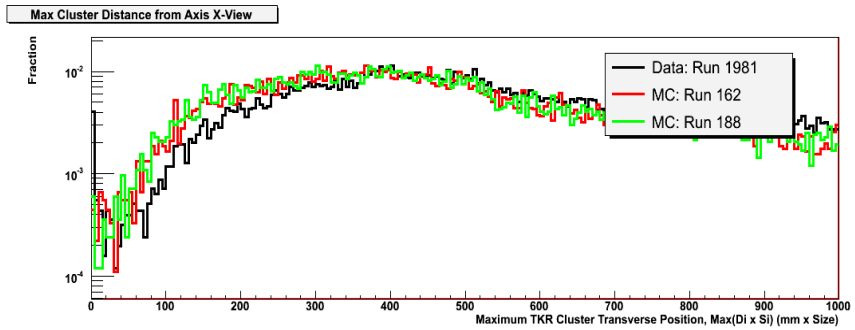


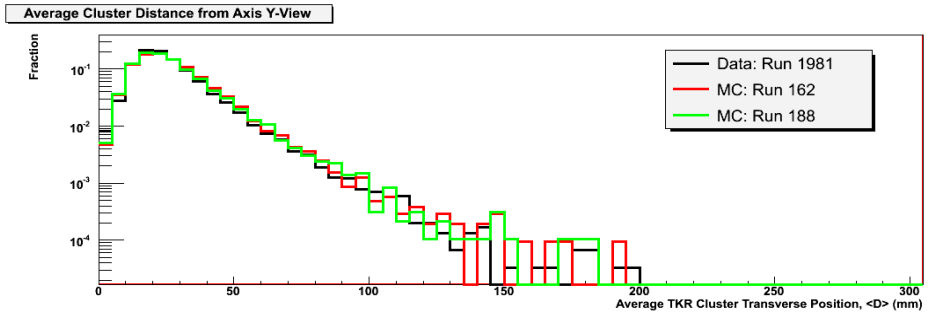
Electron 100 GeV 0° - Dist. Cls-Axis

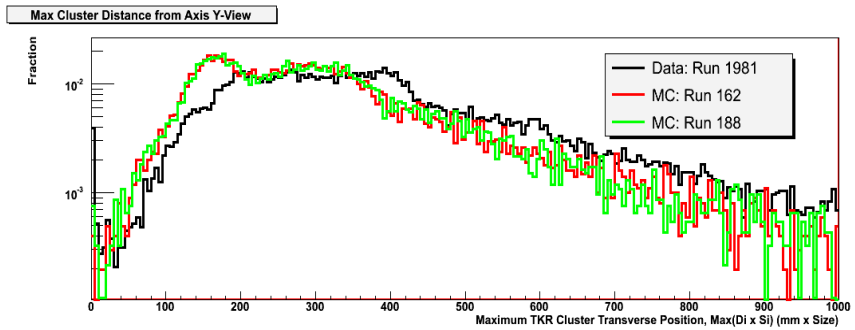










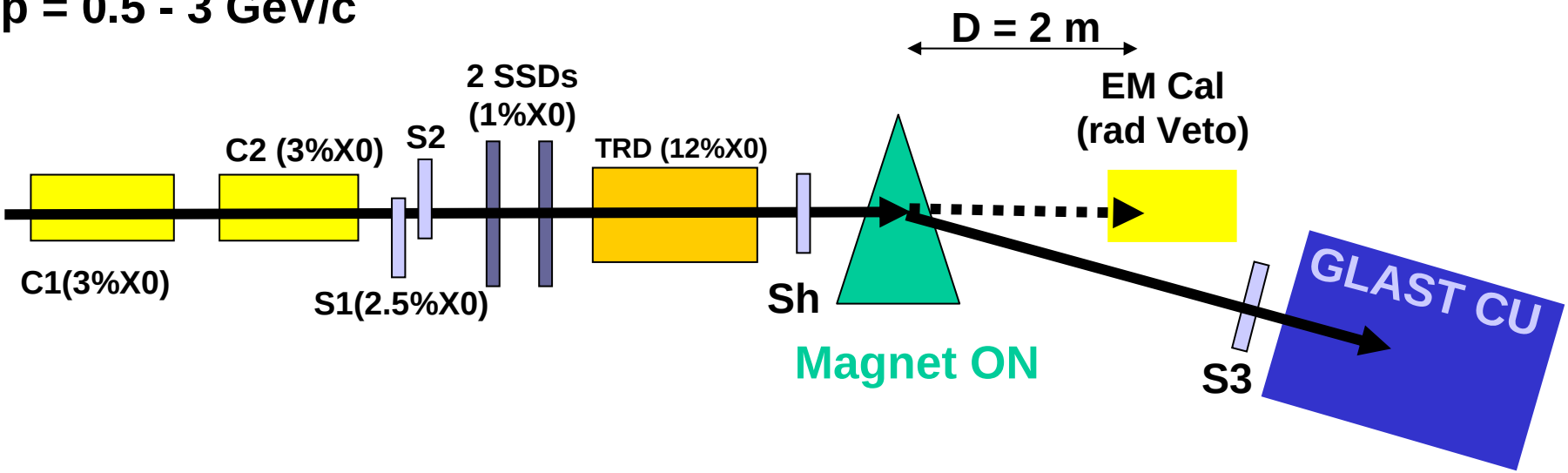


Halo beam studies

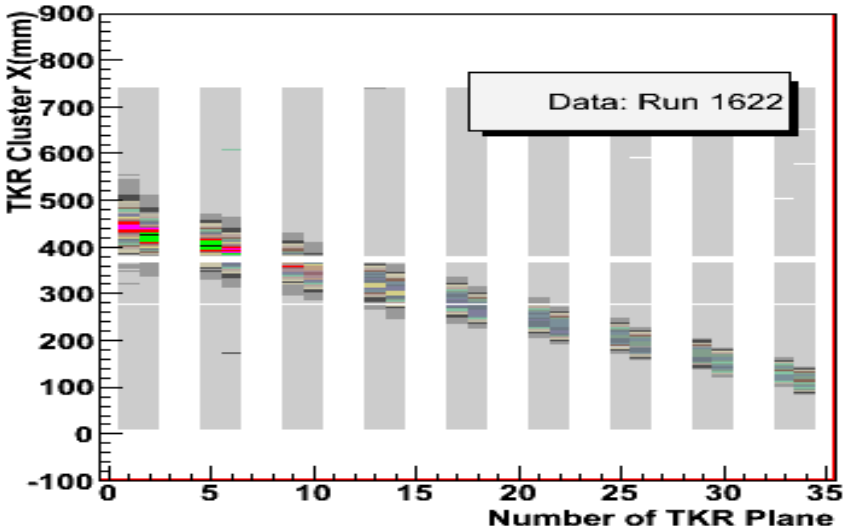
“Clean” low energy e± PS test beam set-up

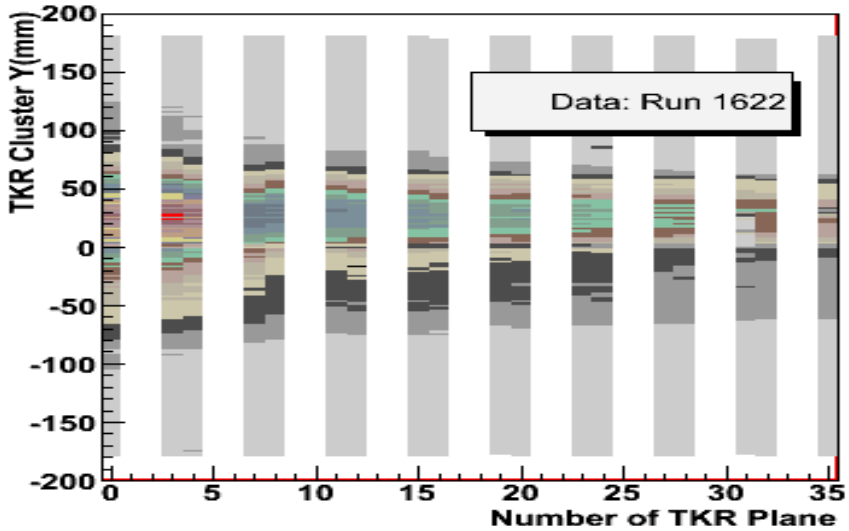
Beam: negative/positive polarity

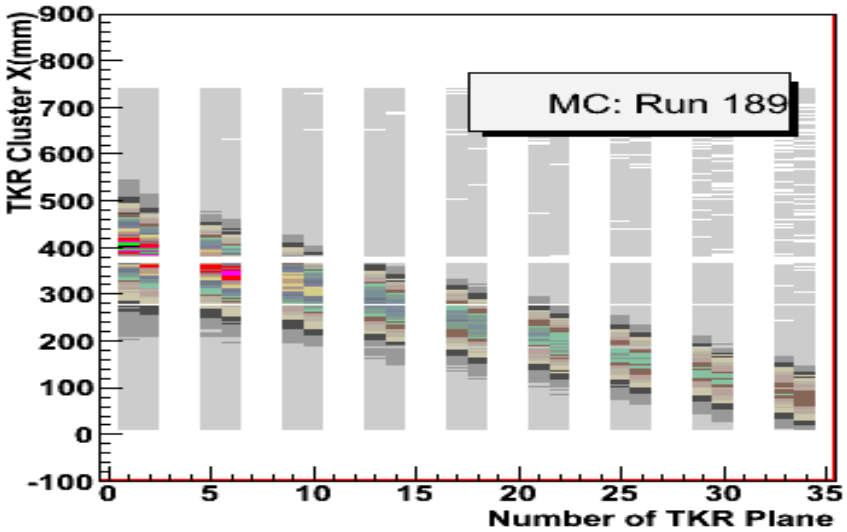
p = 0.5 - 3 GeV/c

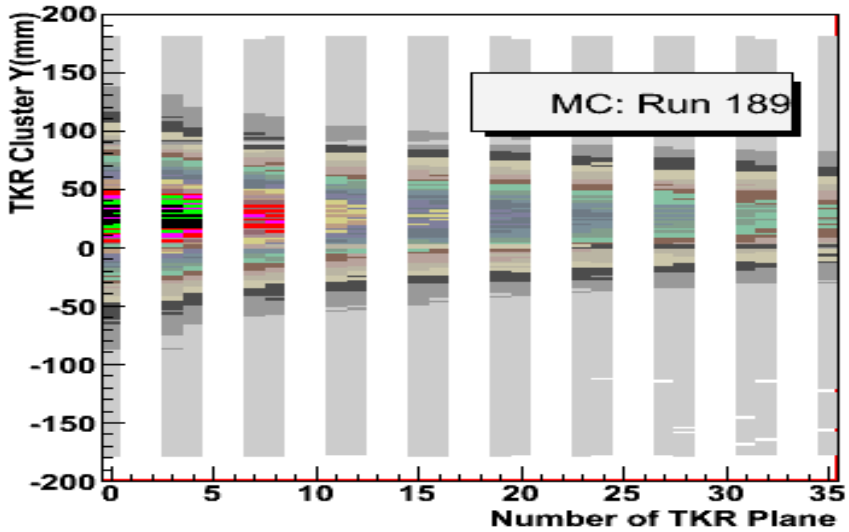


Positron 1 GeV, -35°

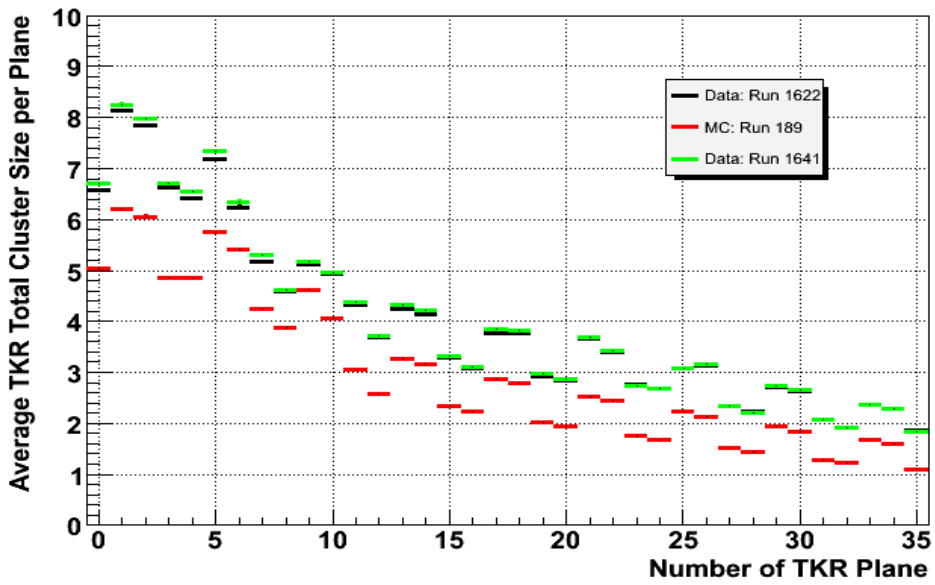


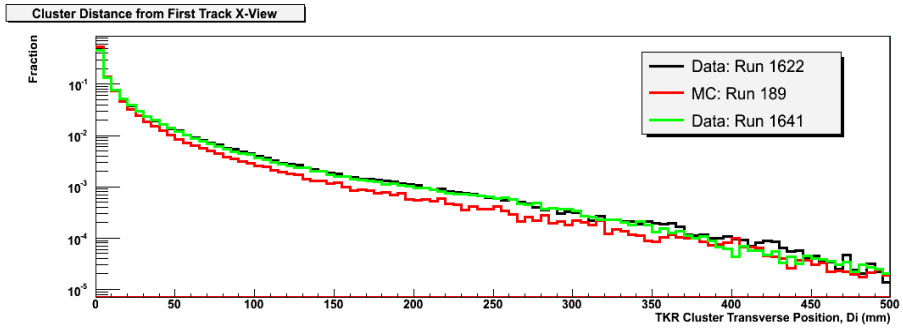


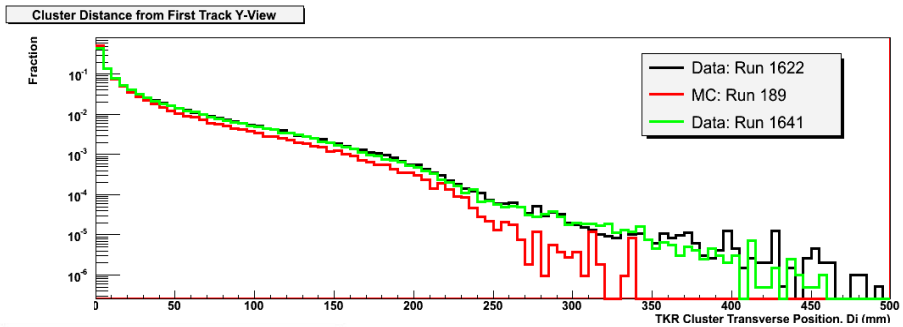


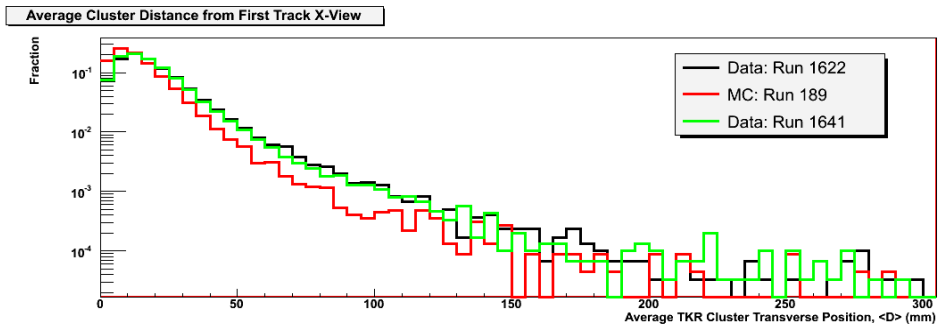


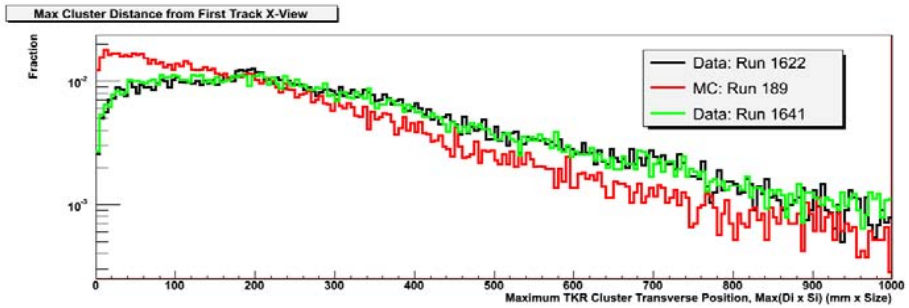
Pos/Ele 1 GeV -35° - Dist. Cls-Track

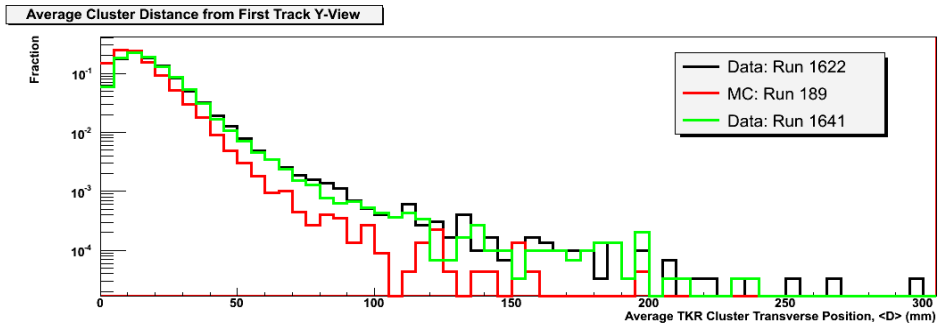


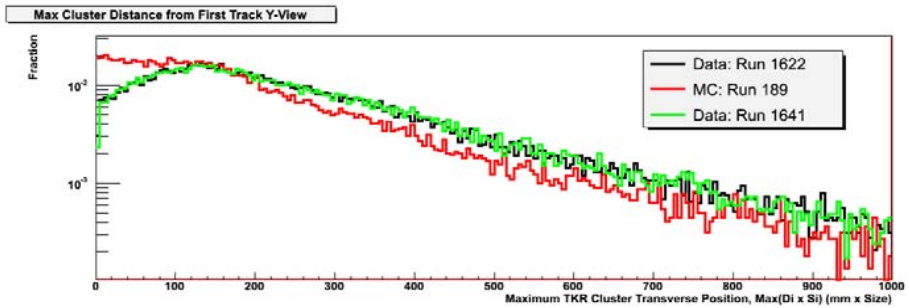




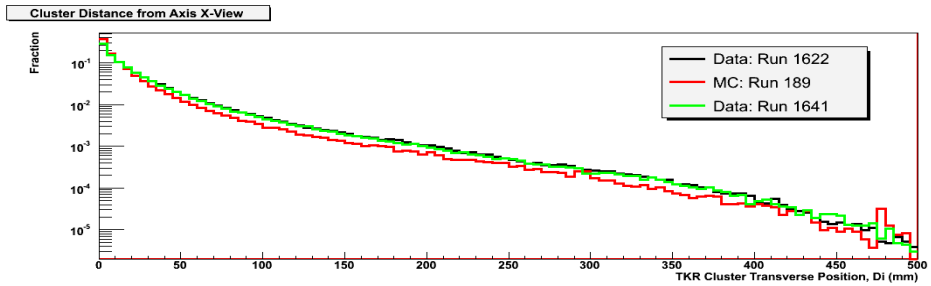


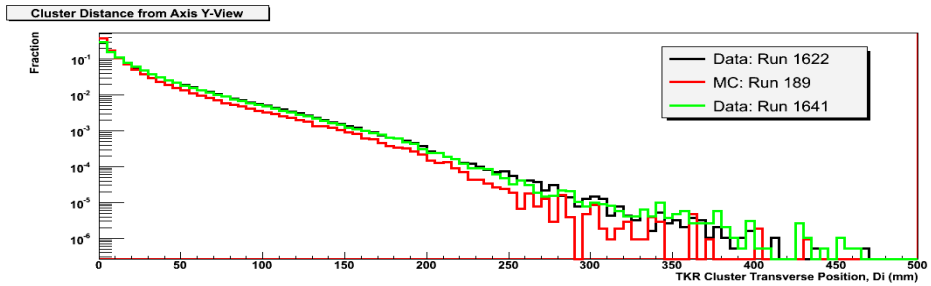


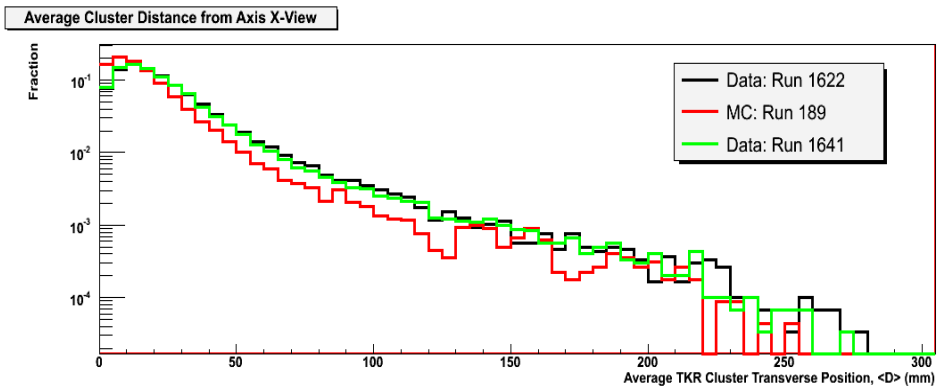


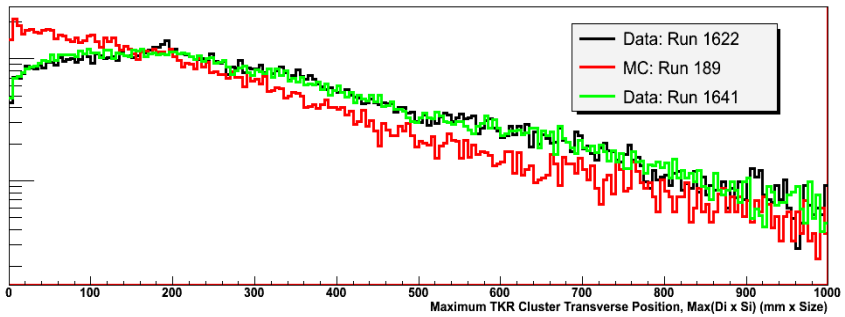


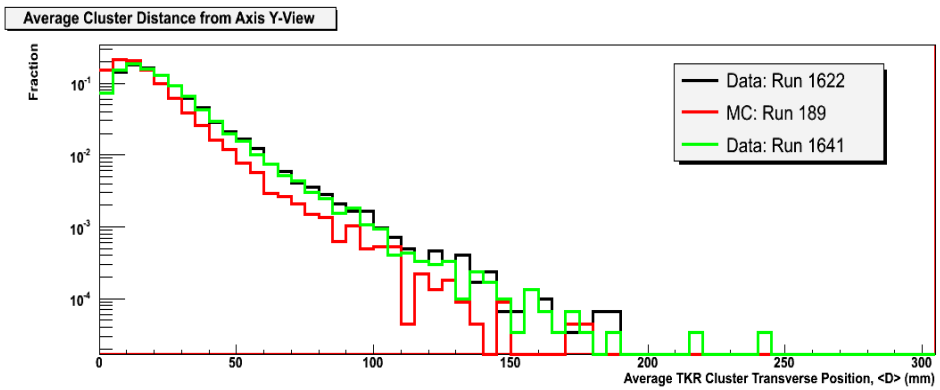
Pos/Ele 1 GeV -35° - Dist. Cls-Axis

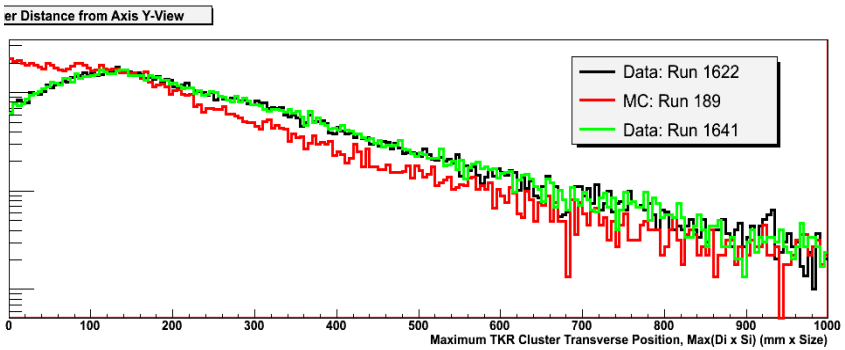








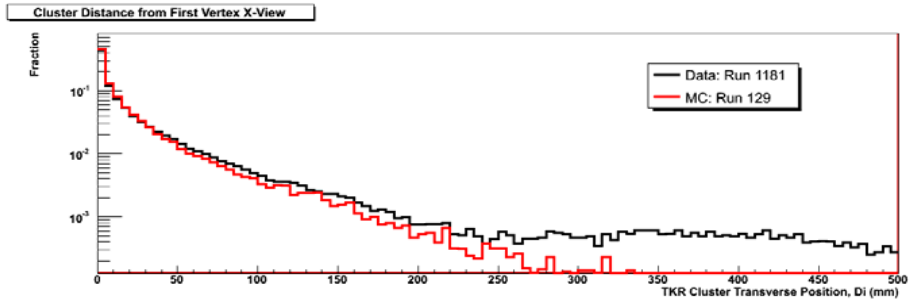


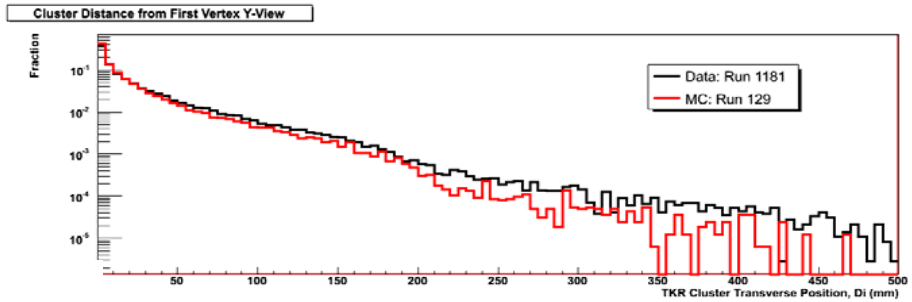


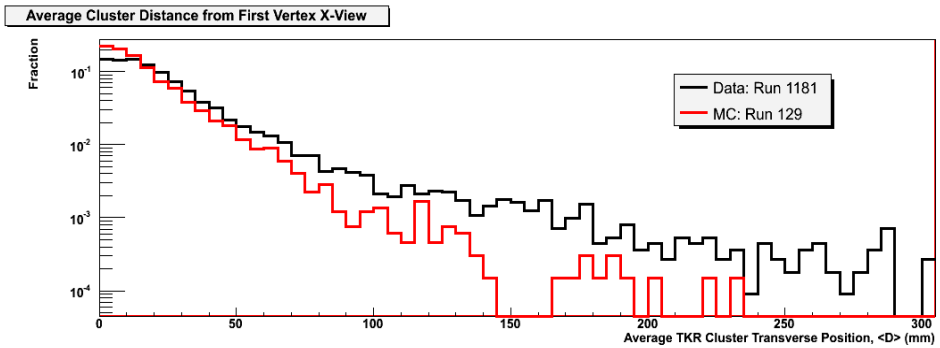
Photon (2.5 GeV ele.) Dist. Cls – First Vertex

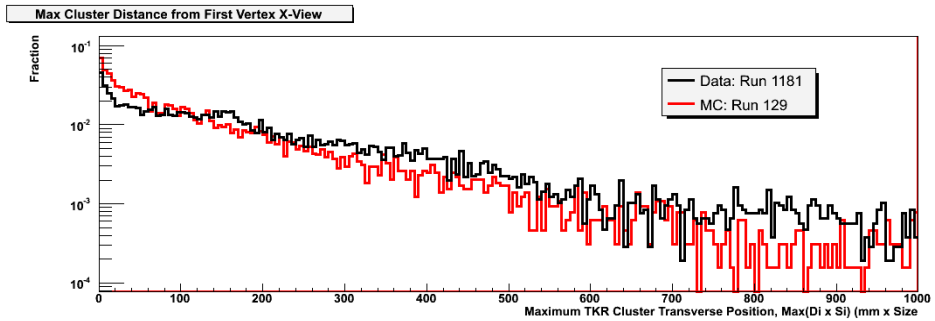
Remarks:

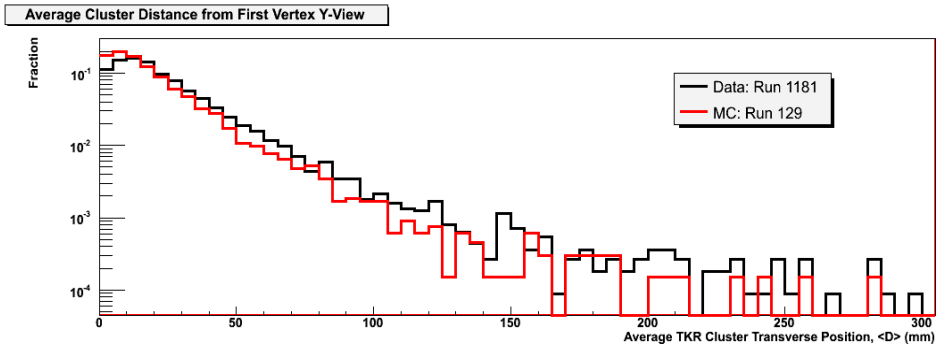
1. **There are extra clusters the data due to the pion punch through in Tower 3**
2. **The dump position was not the best one**

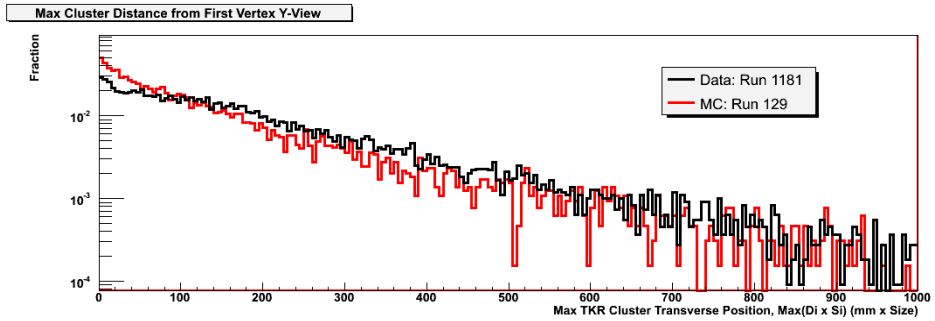








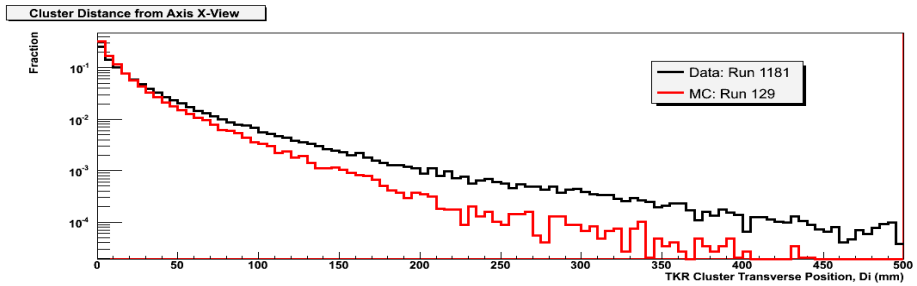


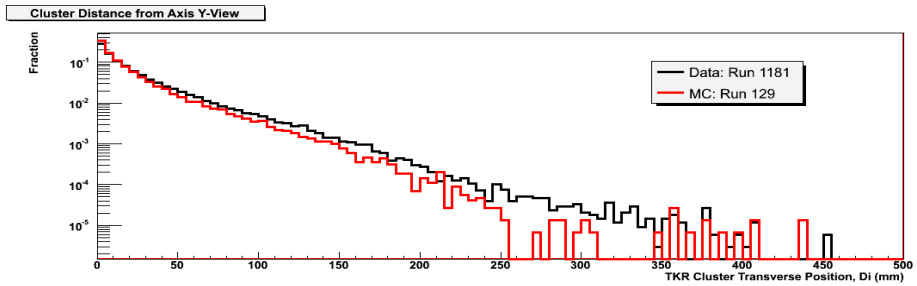


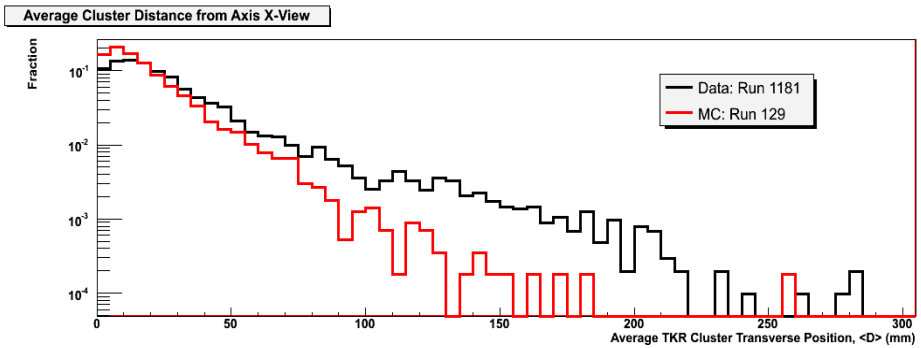
Photon (2.5 GeV ele.) Dist. Cls – Axis

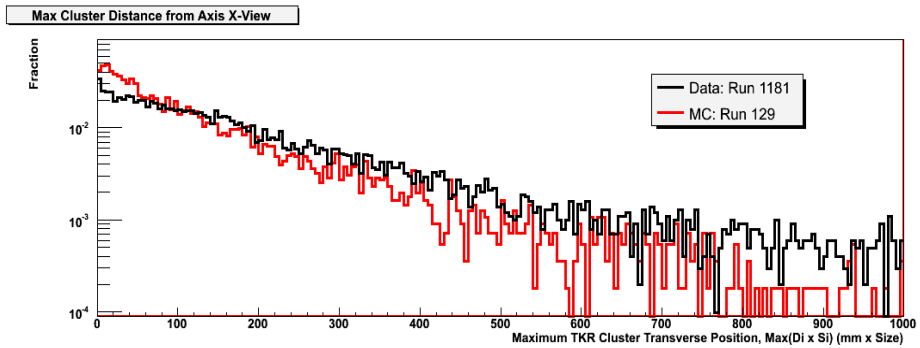
Remarks:

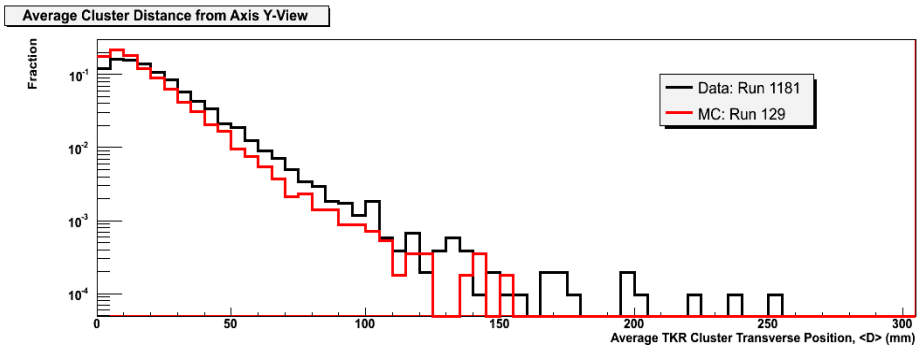
1. **There are extra clusters the data due to the pion punch through in Tower 3**
2. **The dump position was not the best one**

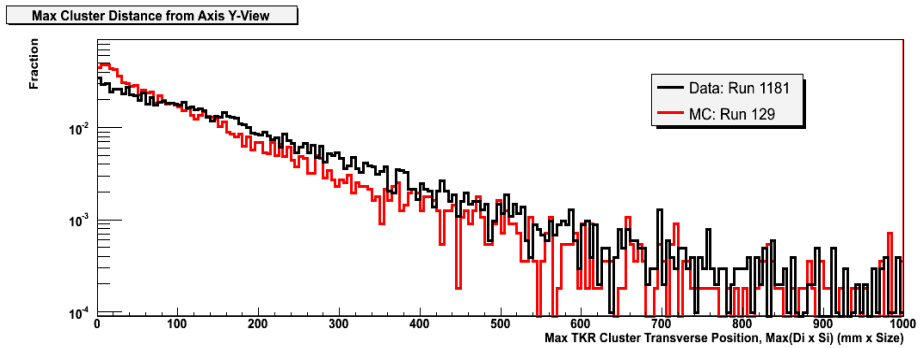








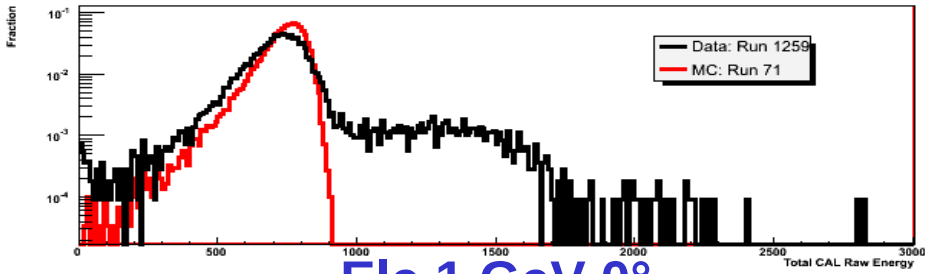




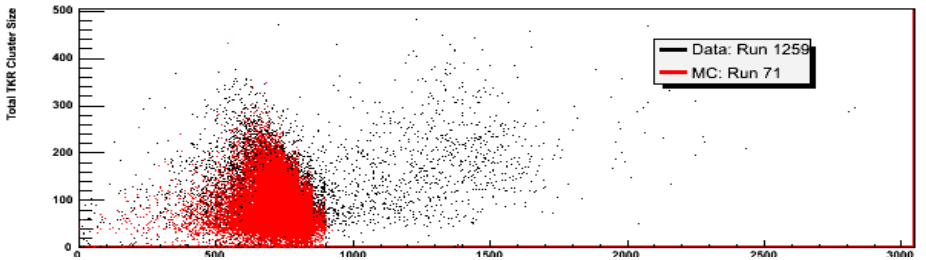
Search for double particles in the beam

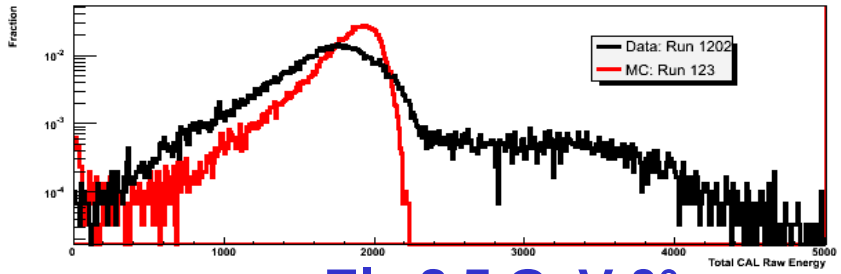
- The Cal Raw Energy has been studied by mean of CalRecon method
  - The Total Raw Energy has been evaluated by adding the average energy of the two faces for the best range from CalXtalRecData method
- A cut has been used to avoid double particles
  - The Cal Raw Energy should be less than a maximum value for a given beam energy
    - For instance, CalRawEnegy<900 for 1 GeV

Cal Raw Energy Vs. TKR Cluster Size

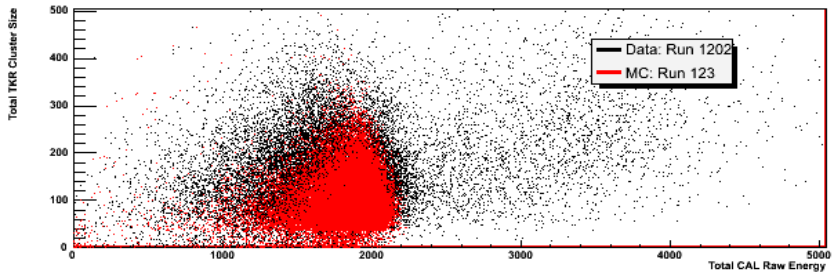


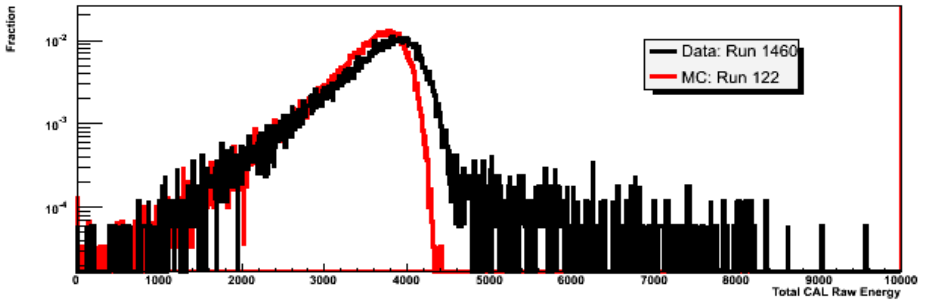
Ele 1 GeV 0°



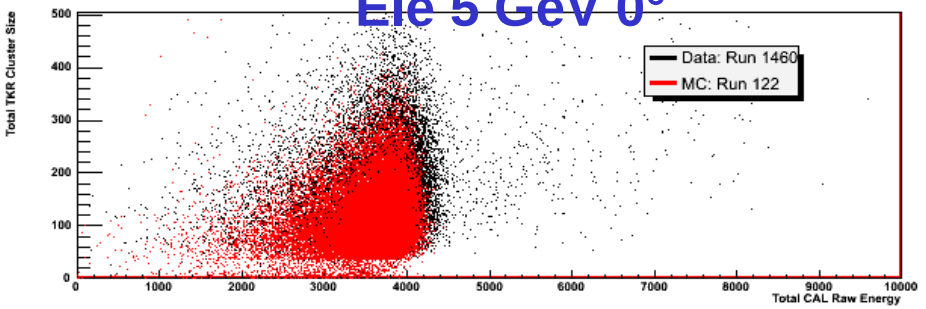


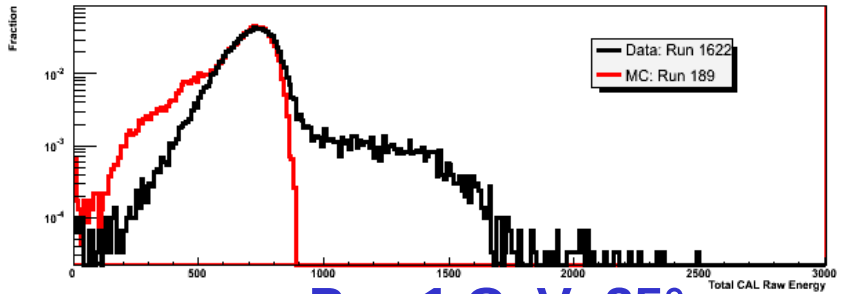
Ele 2.5 GeV 0°



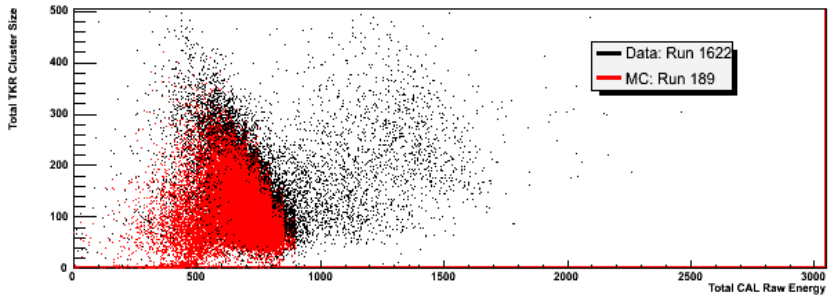


Ele 5 GeV 0°

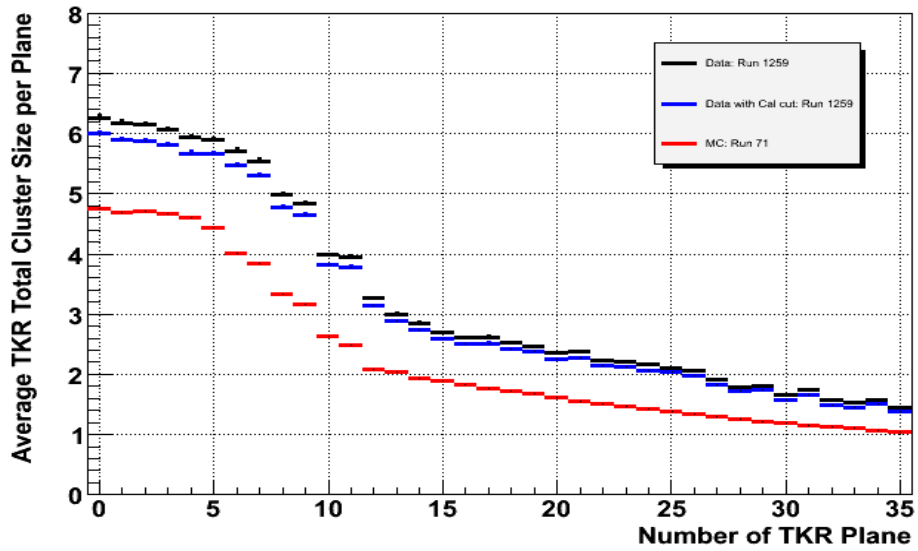


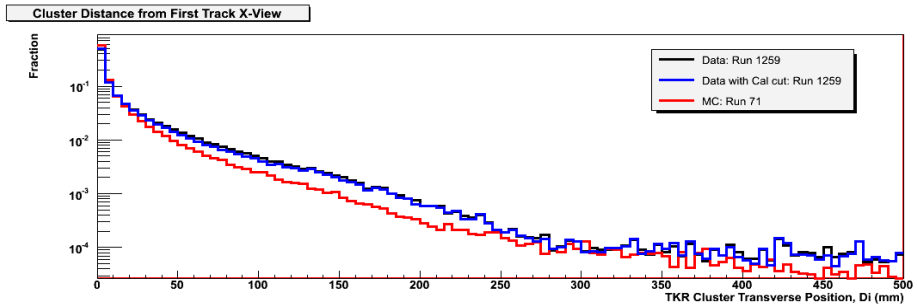


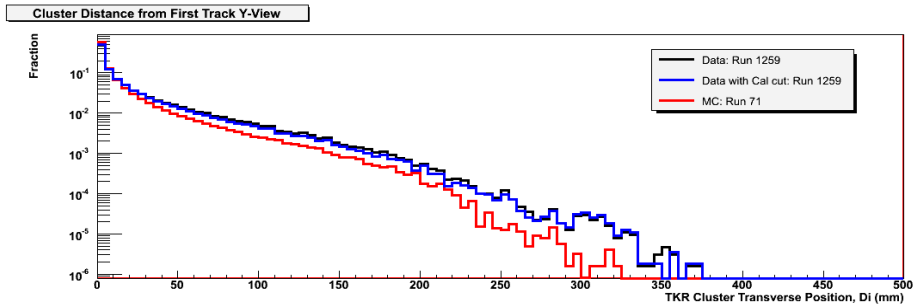
Pos 1 GeV -35°

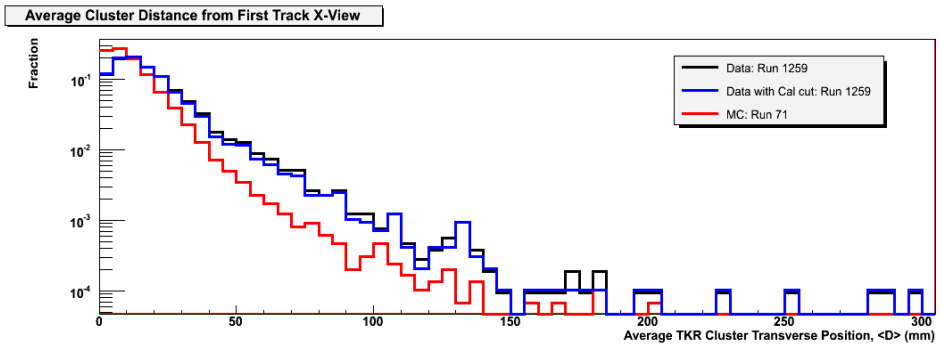


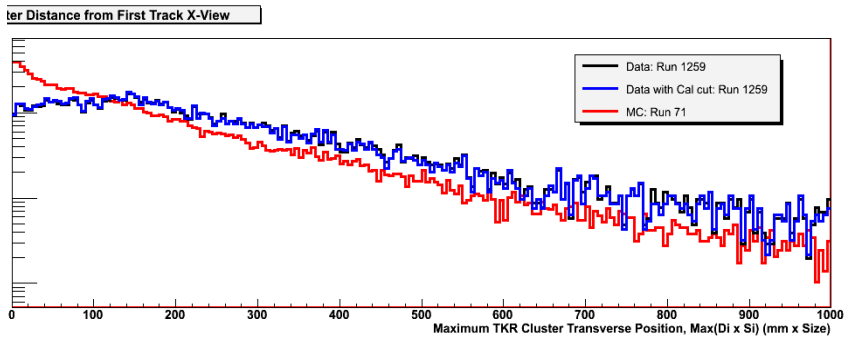
Electron 1 GeV

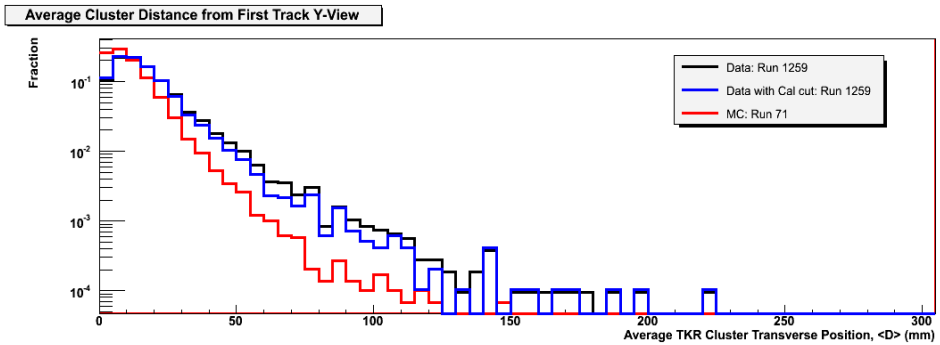


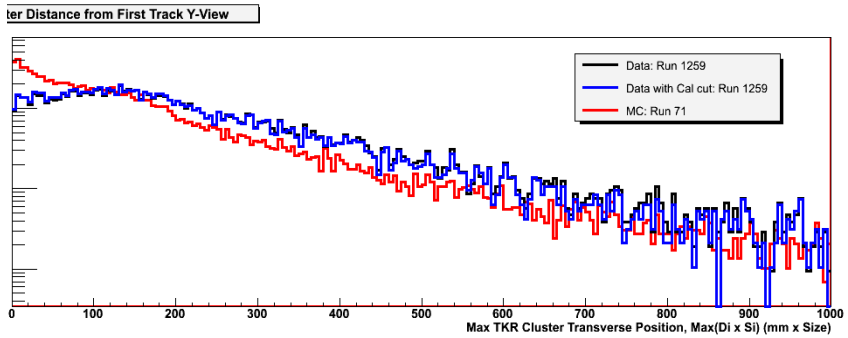






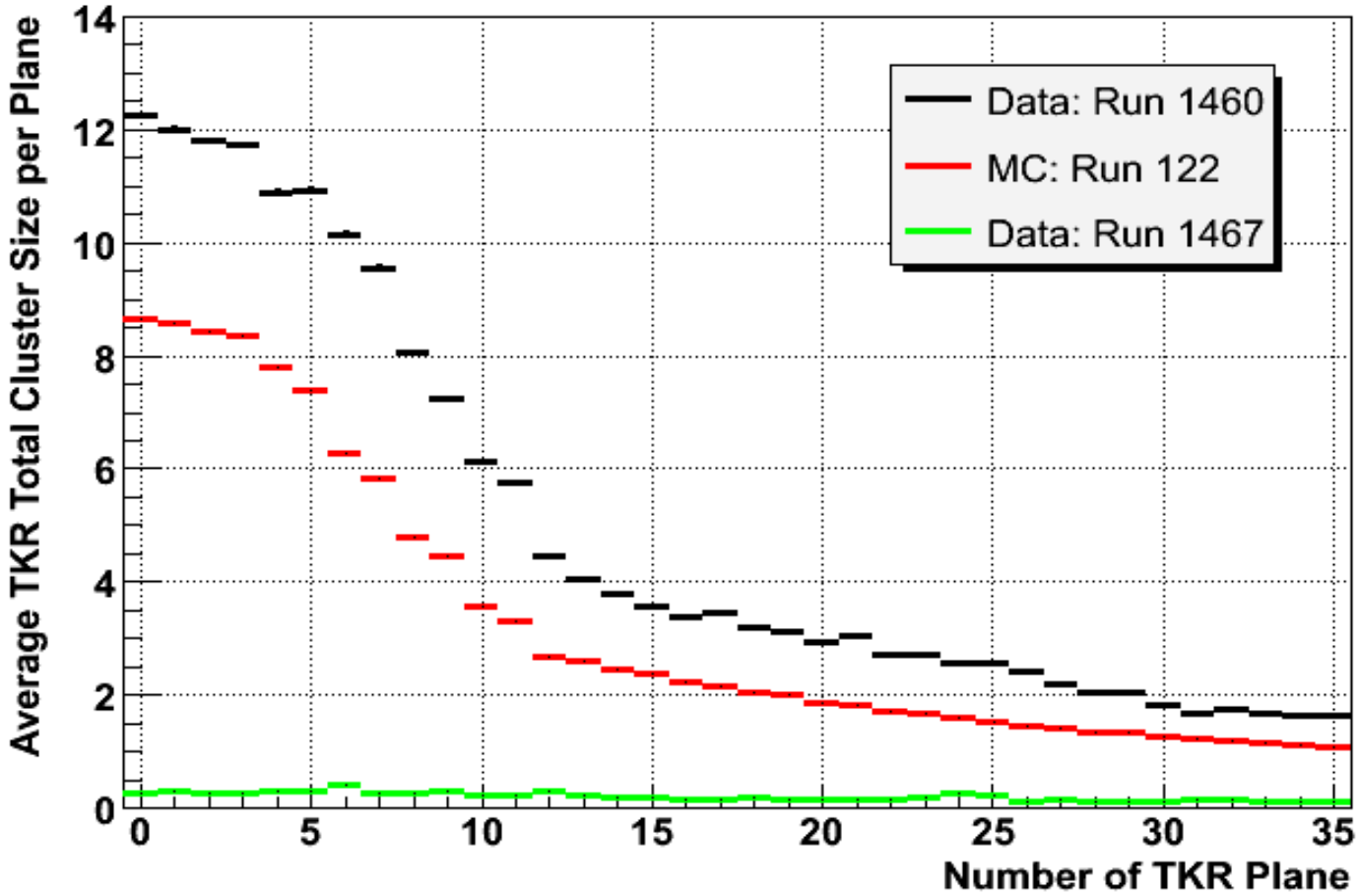






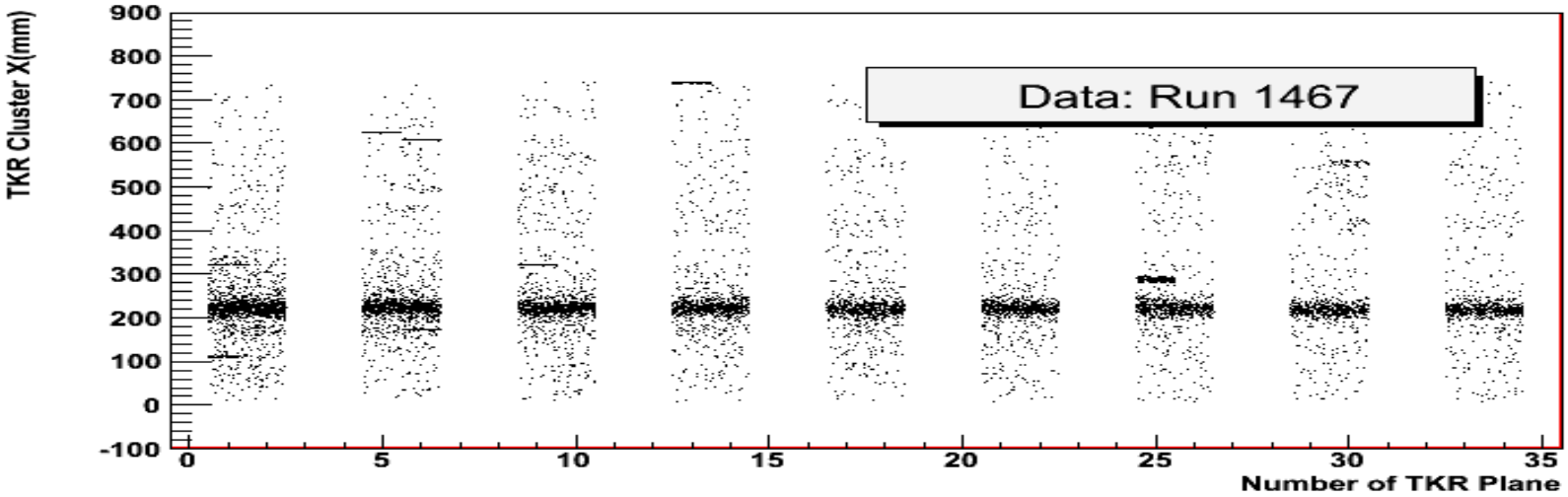
Noisy Strip studies

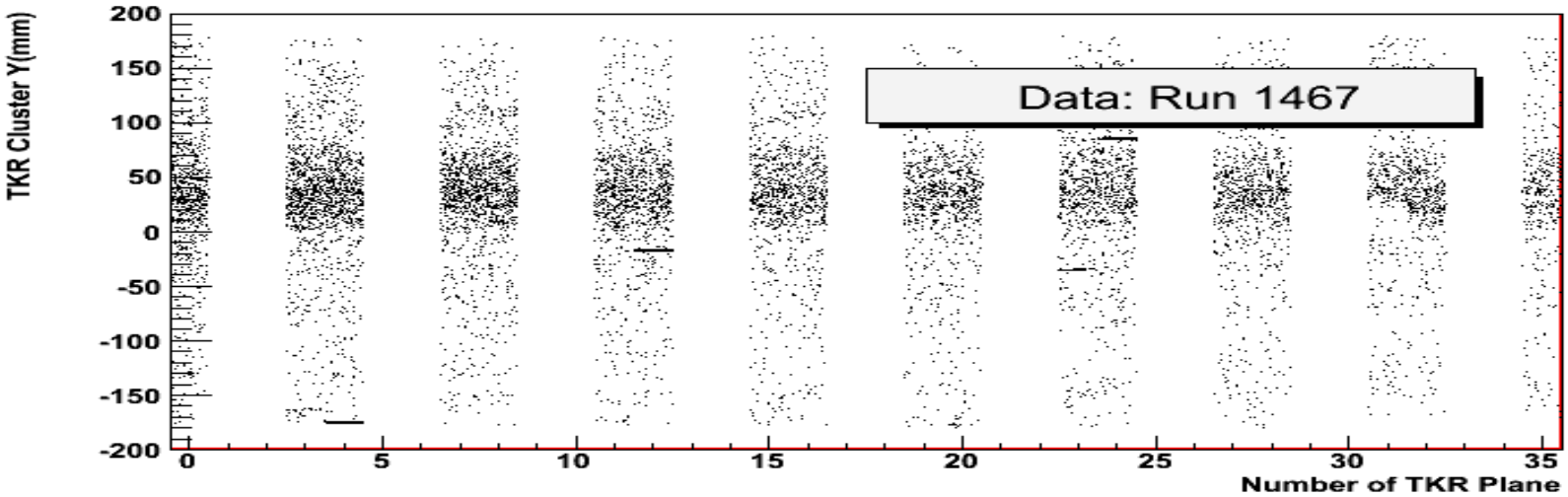
- **The noisy strip contribution to the shower profile could be studied from run with uncorrelated trigger**
- **The Run 1467 (5 GeV electrons) has been analyzed with the usual Macro**



Run 1467: Cluster map

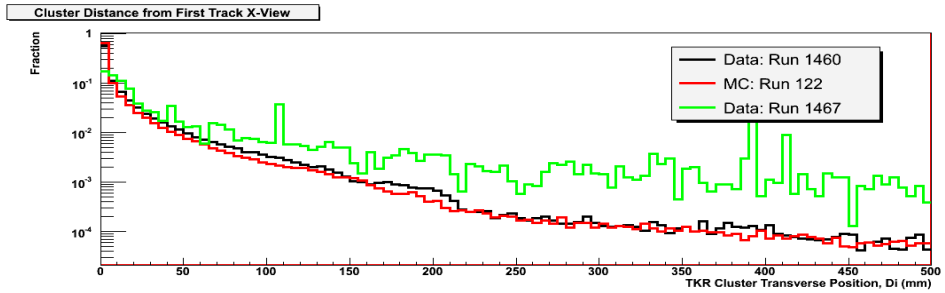
The beam is still there!

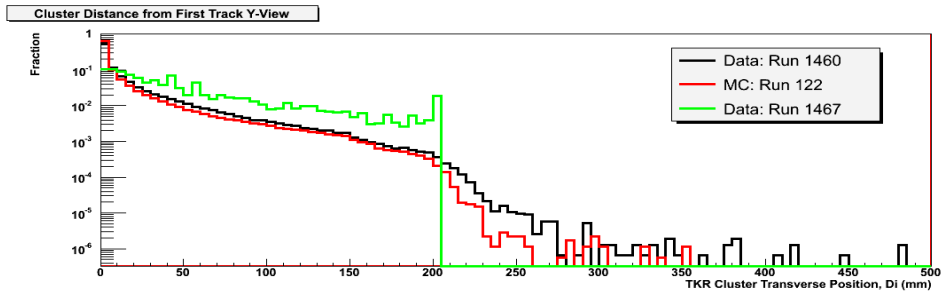


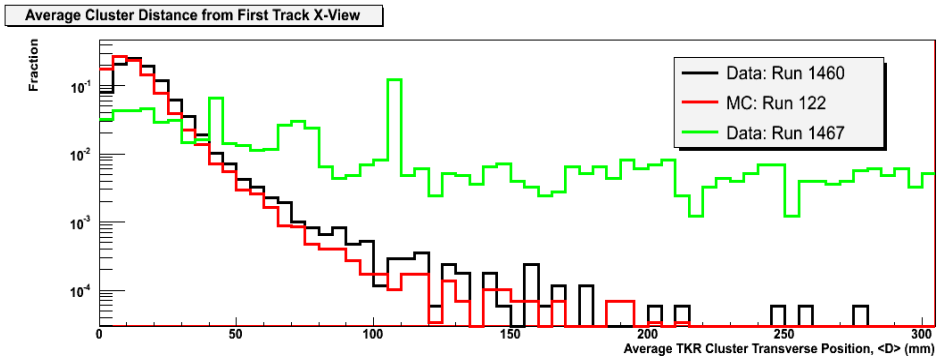


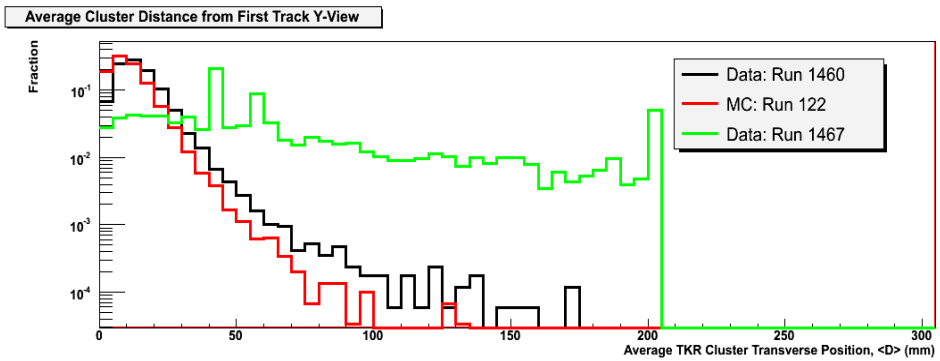
Cluster distance – “Fake First Track”

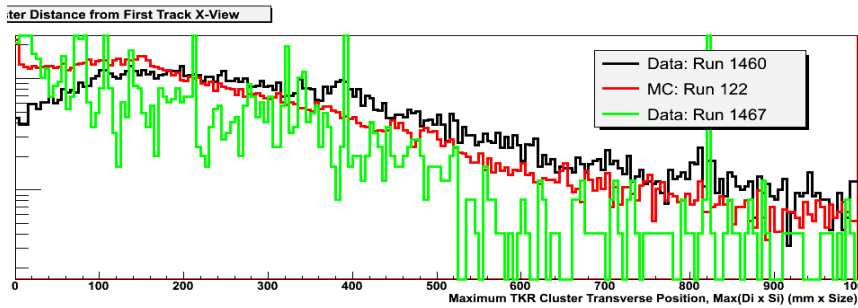
The Fake First Track in the Run 1467 has been set by using the average values of Position and Direction as in the Run 1460

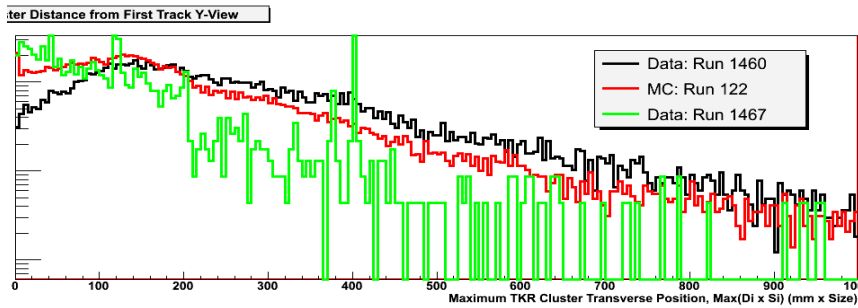






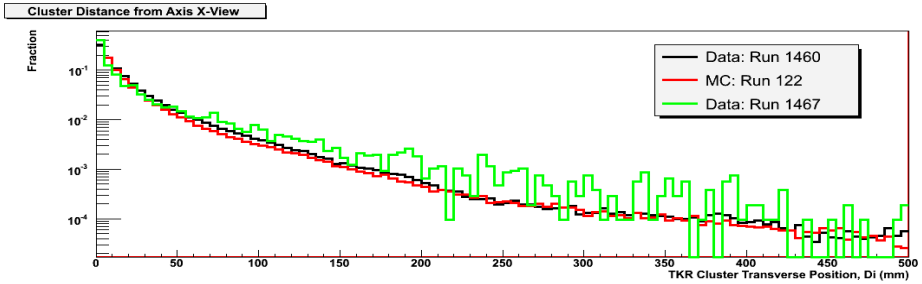


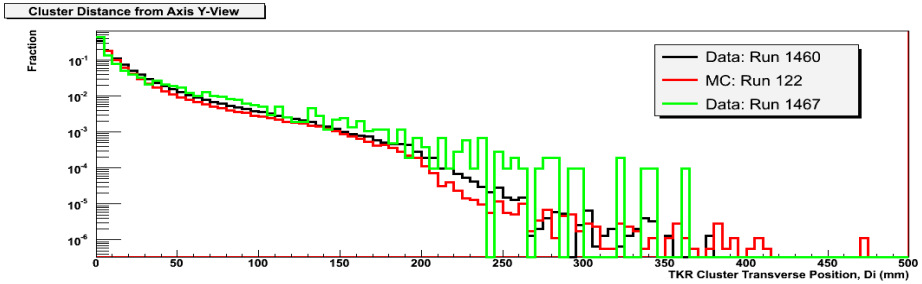


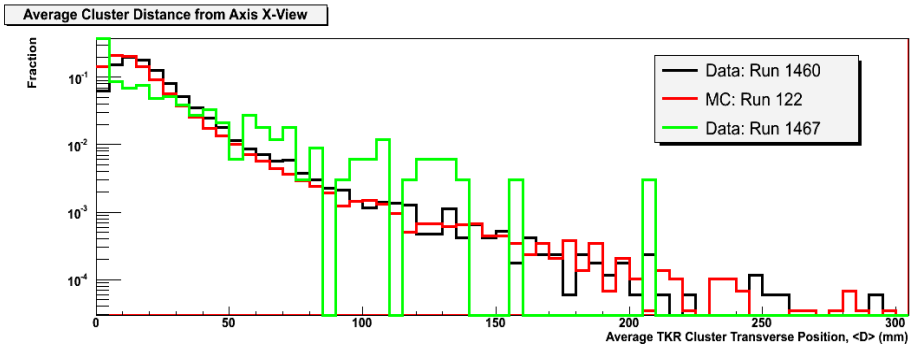


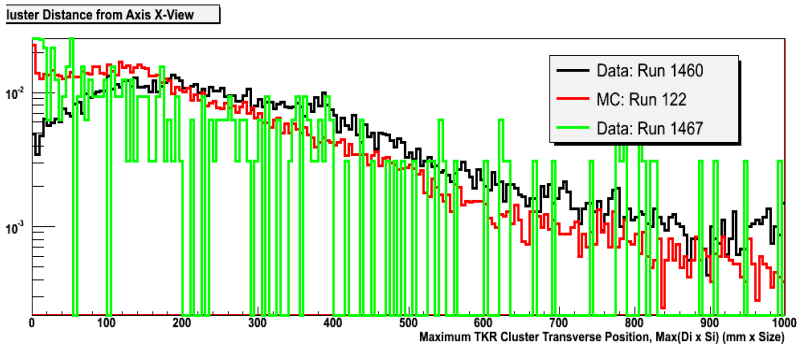
Cluster Distance – Shower Axis

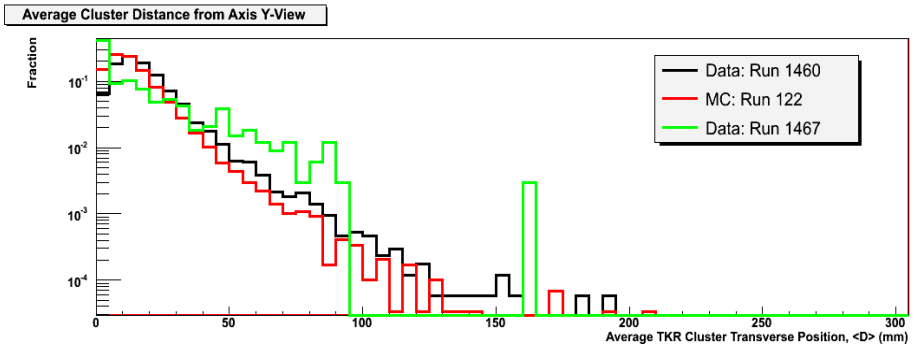
The distributions have been normalized to unit area!

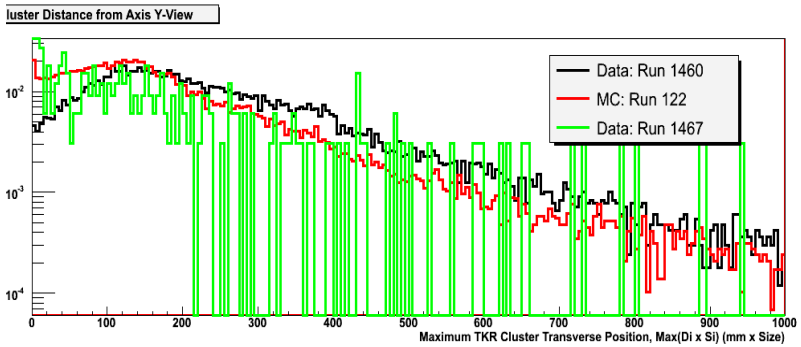












Conclusions

- The EM shower in the transverse plane is narrower in the MC
  - The discrepancy increases as the energy decreases
  - Double particles do not affect the width of the shower at low energy, even though the longitudinal shower profile is little bit lower
  - The electromagnetic interactions should be reviewed at low energy
- Low cuts in G4 are not enough to reduce the discrepancies
- The halo beam does not explain the discrepancies, at least at 1 GeV
- It seems there is a problem in the Tracking Alg, in particular for high energy electrons, maybe due to large clusters in the bottom planes
- The calibrations do not affect the behavior of the shower profile in the data, maybe in the MC
- At high energy the cluster size could be increased due to the sharing effect, when large energy is deposited in a small region of the silicon detector
  - For vertical tracks about 10% of the charge is shared in the neighboring strips
- Low threshold to fired strips could increase the EM shower size
- The current MC includes thicker W layer
  - The next MC will generate less secondary particles, maybe they can go away from the primary electron and the EM shower could be larger