Analysis of 2012 Beamtest

January 10, 2015

1 Event selection

1.1 Time analysis

1.2 Seed Analysis

1.2.1 Hits tagging

Hits are separated in 3 categories:

- ISOLATED= The hit has no neighbours in a 9 cm radius sphere
- EDGE = The hit belongs to a track segment in a 9 cm radius sphere
- CORE= all other hits

Each hit defines a neighbouring sphere of 9 cm and a principal component anlysis is done on all neighbours. The ratio w of the 2 principal axis is then used to tag the hit.

- w=0 $\rightarrow$ less than 3 neighbours, the hit is ISOLATED
- w $< 0.3 \rightarrow$ the second axis is small, most probably hits are aligned along the first axis, the hit is an EDGE one.
- w > 0.3 , the hit is in the CORE of the shower.

The figure **??** shows the distribution of w for all the hits of a 60 GeV pion run. The 3 categories clearly exhibits. On figure **??** the same ratio is shown for preselected muon candidates and preselected pions interaction in the same run.

1.2.2 MIP tagging

Once hits are sorted in thos three categories. Clusters are built plane by plane by adding hits in plane distant from less than 4 cm to an existing cluster. Two collections are built. "Interaction" clusters are built from CORE hits and "real" clusters from the other hits. Finally "Interaction" clusters of less than 5 hits are moved in the "real" collection and in paralell "real" clusters of more than 5 hits are moved in the "interaction" one.

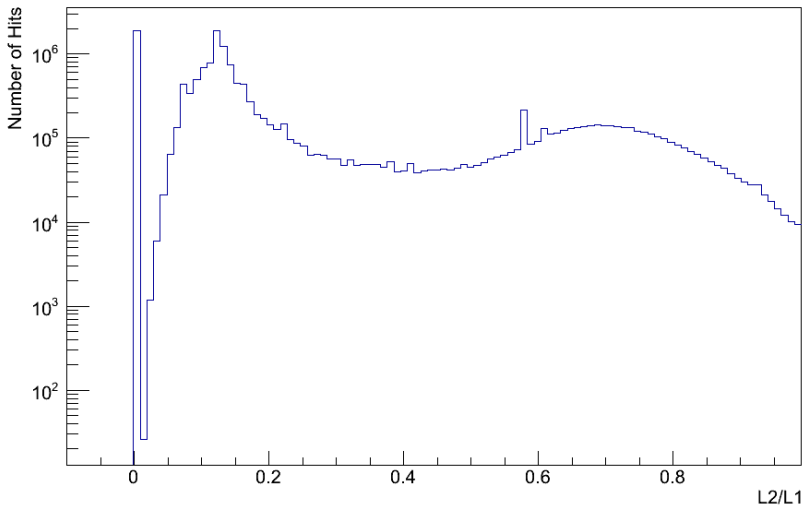

Figure 1: Ratio of L2/L1 derived from PCA of neighbours hits

The "real" collection is then used to reconstructed track segments according to this algorithm:

- Once again principal component anlysis is used for all clusters to find main direction in a 15 cm sphere around each point
- Each point is associated to existing tracks according to
  - if the track has at least 2 hits, the error of the extrapolation is taken and the point is added if
    - It is not the track path
    - it is less than 3 planes away from the end of the track
    - it is less than 5 sigma from the extrapolation
  - if the track has one hit
    - the track hit is one plane before
    - the principal axis of the cluster is used to build track parameter and point is added if it is less than 6 cm from the extrapolation
- If no association is found, a new single hit track is created with track parameters deduced from the principal component analysis of its neighbouring.

The algorithm is run handling hits from the beam entry to the end of the calorimeter. At the end , a last pass is done trying to associate single hit tracks

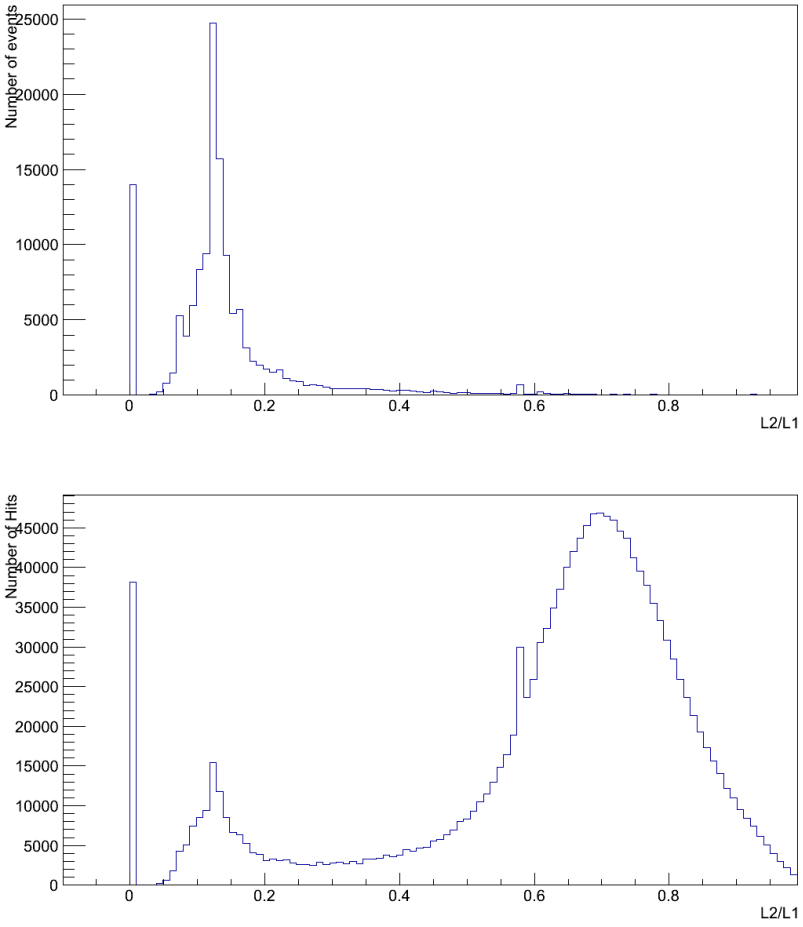

Figure 2: Ratio of L2/L1 for preselected muon tracks (top) and preselected showers (bottom)

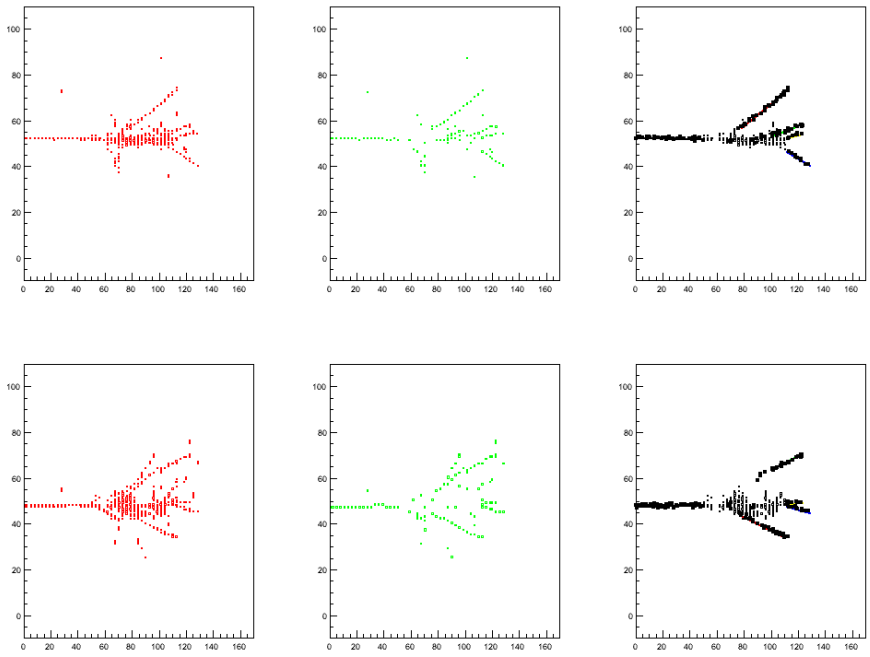

Figure 3: 60 GeV Pion interaction display. The left (red) column shows the hits position in (Z,X) and (Z,Y) projection. The midle (green) column shows the "real" collection of clusters projection. Finally on the right, track segments, MIP hits (black) and 3D clusters of CORE hits are shown

and previously unselected hits to valid segments. Finally all hits belonging to a cluster associated to a track segment is tagged MIP. The figure **??** shows the result of the different steps of the algorithm.

The track segments can also be used to dicriminate muons and elctrons from hadrons, using the ration of the total track length over the total number of hits. The figure **??** shows this ratio. The peak at zero corresponds to electron with no MIP exiting from the shower. The 1.4 peak is due to muons with a hit multiplicity ~ 1.6 and finally hadron showers have a low ratio up to 0.7. Events are tagged:

- ELECTRON if R<1E-4
- MUON if R> 0.75

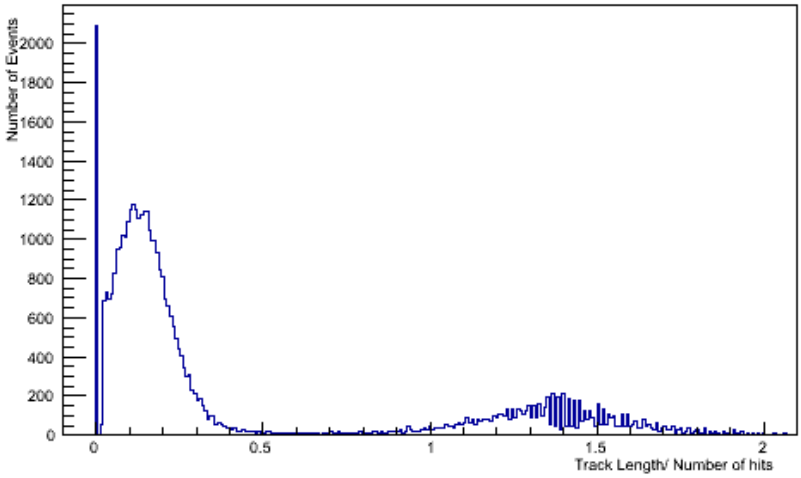

Figure 4: Ratio of total tracks length over the total number of hits per event in a 60 Gev Pion run