IFR Geometry optimization for muons identification

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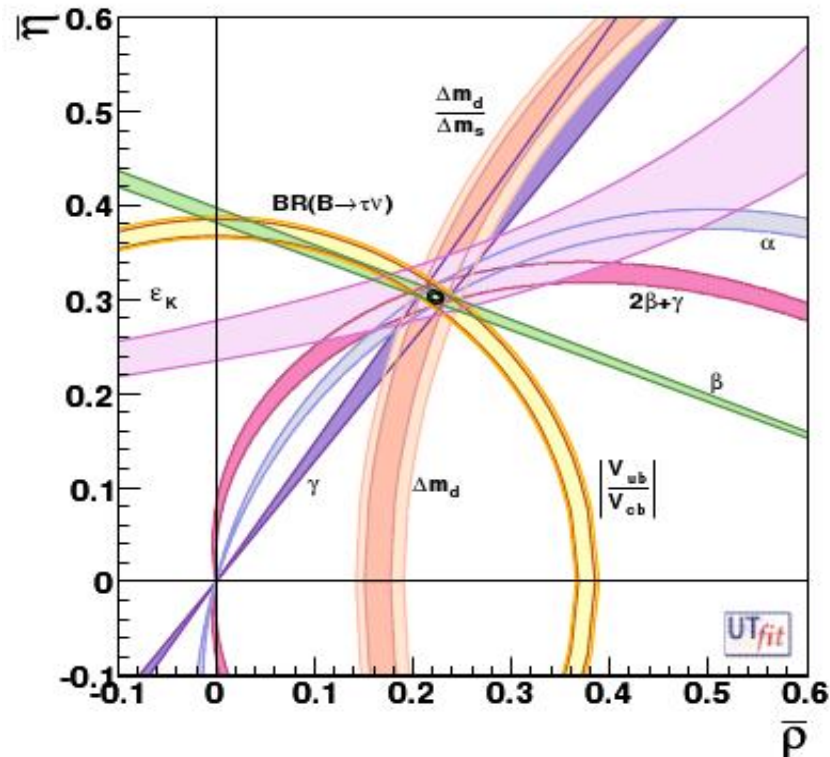
Outline

- **IFR Simulation;**

- **IFR Tracker improvements;**
  - ✔ **Hits rotation ;**
  - ✔ **Distance and new variables;**
  - ✔ **Cluster error;**

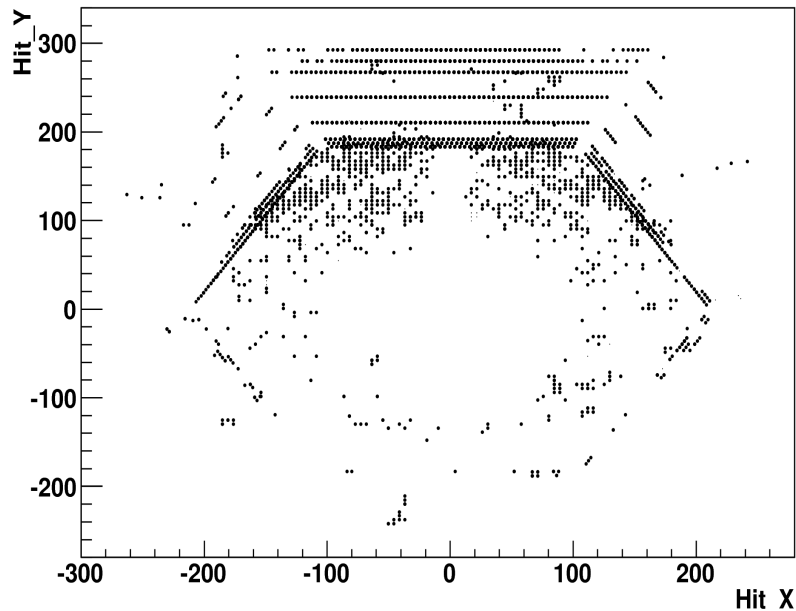- **BDT in 4 bins of muons/pions momentum;**

- **Conclusions.**

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|=|=|========|============|============|=======|=====|
|2|2|   16   |     24     |     24     |  14   | 10  |
```
$C_2' \sim 920mm$
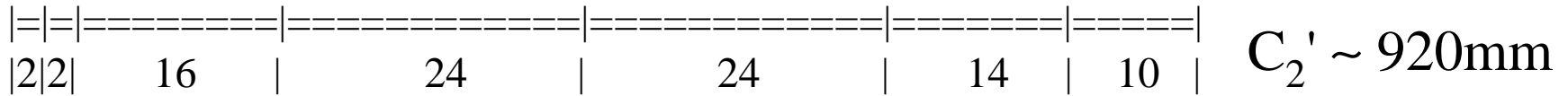
▪During the past collaboration meetings we have analyzed only the IFR simulation in one sextant of the barrel;

▪We need to adapt our code over all the sextants of the barrel;

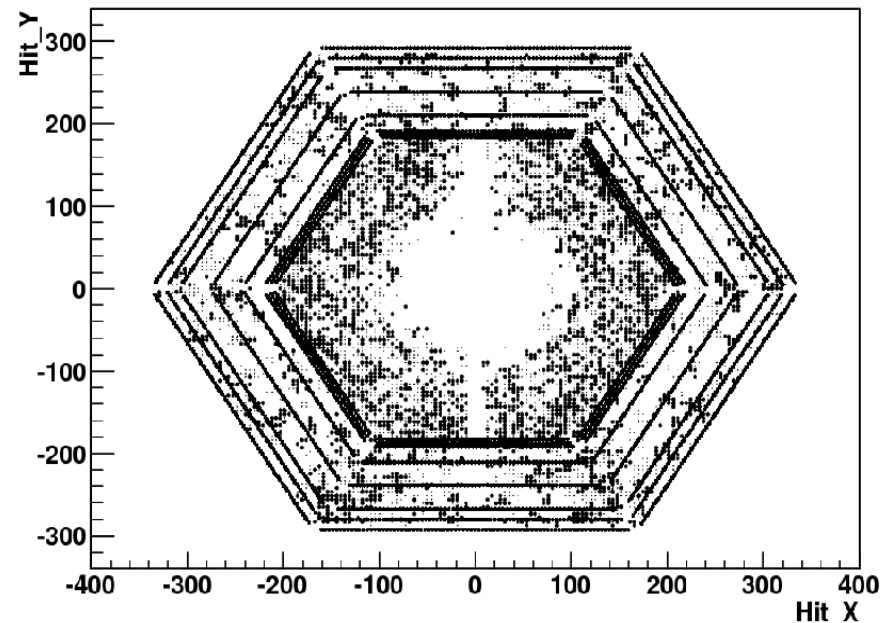▪Our goal is to check if the IFR tracking algorithm works correctly over all the sextants of the barrel.

One sextant

All sextants
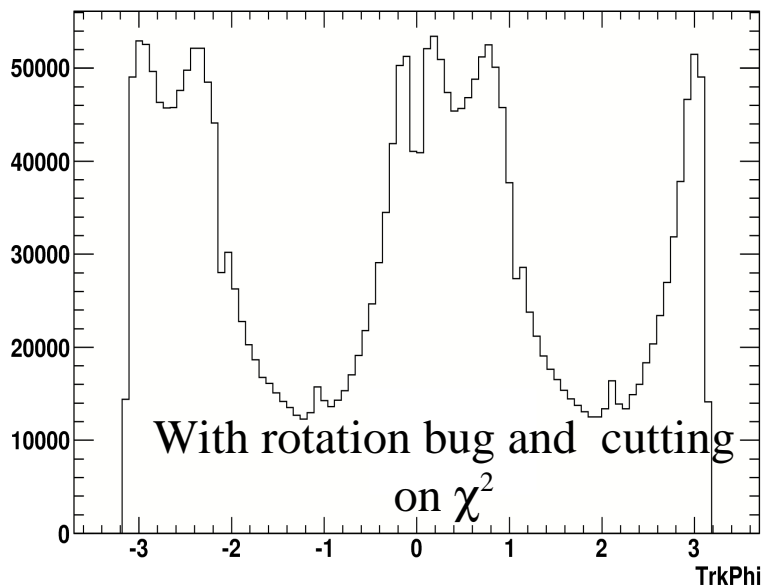
IFR track algorithm

- Simulated 200k of single muons and pions with the c_2' configuration;
- Momentum range from 0.5 to 5.0 GeV/c with flat distribution fired in all the sextants of the barrel;
- Check if bugs are present;
- Check the consistency of the tracker algorithm in the track reconstruction and in the calculation of the useful quantities used for the muons and pions discrimination over all the barrel;
- BDT analysis performed in 4 muons/pions momentum bins.

TrkTheta

Only barrel
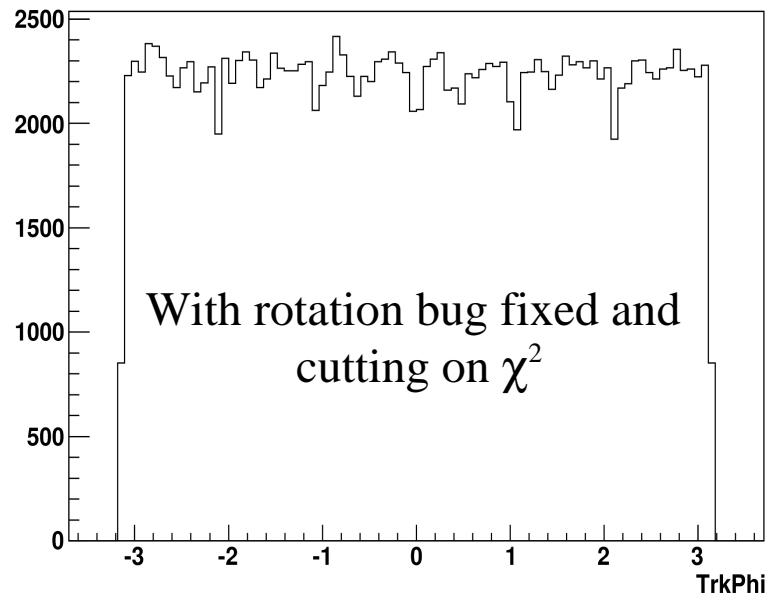
TrkPhi

All sextants

4
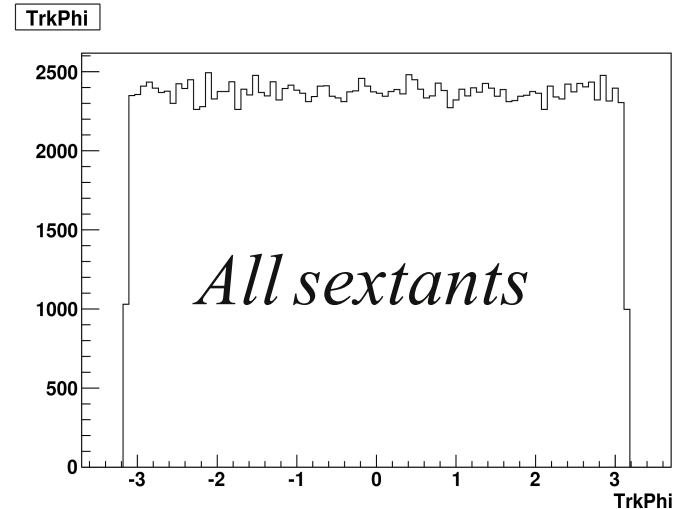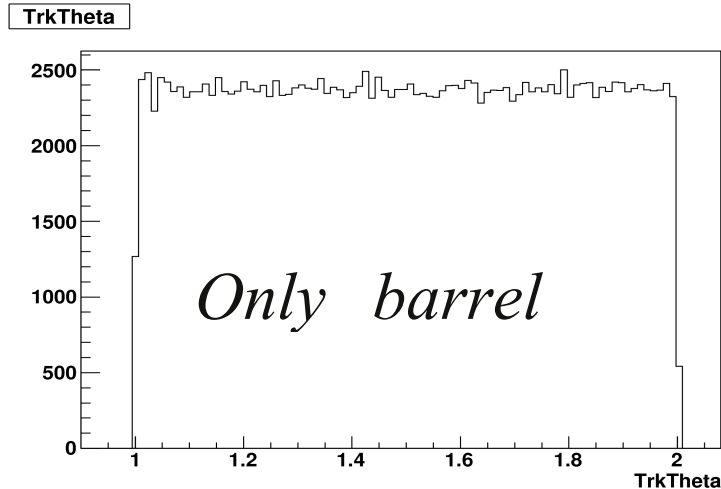
Improvement I

- Each hit is rotated and analyzed in the top sextant of the IFR;
- Find a bug in the coordinates rotation;
- Some variables computed not correctly: χ^2 distribution with large tail;
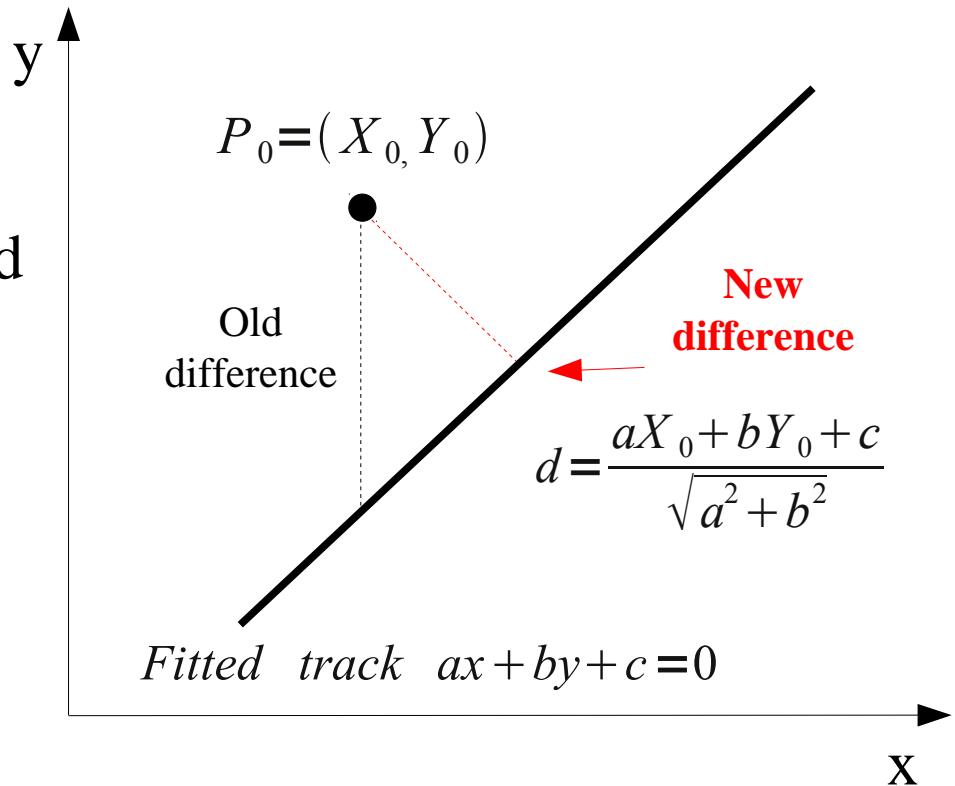- Bug Fixed.

TrkPhi {Chi_xy<30}

With rotation bug and cutting on χ^2

TrkPhi {Chi_xy<20}

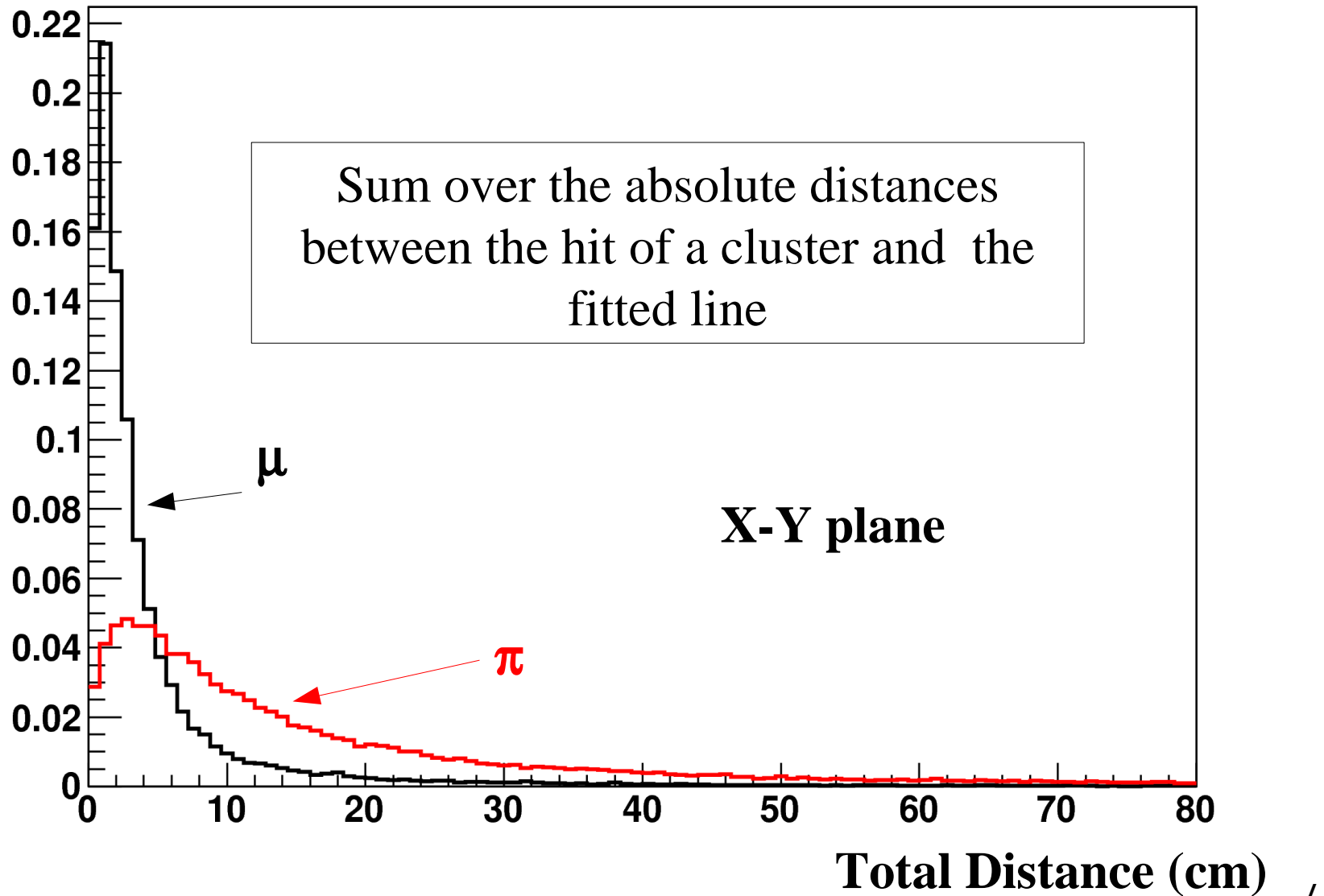With rotation bug fixed and cutting on χ^2

Improvements II

- Old χ^2 computed using the difference on the plane between a hit and the fitted track;
- New χ^2 computed using the distance between a hit and the fitted track;

- Added other two discriminant variables: the sum of total distances (Dist) and its square (Distsq) between all the hits and the fitted track;
- Computed in both, xy and zy planes;
- These variables can help the μ/π separation;

$$P_0 = (X_0, Y_0)$$

Old difference

New difference

$$d = \frac{aX_0 + bY_0 + c}{\sqrt{a^2 + b^2}}$$

Fitted track $ax + by + c = 0$

y

x

The total distance

Sum over the absolute distances between the hit of a cluster and the fitted line
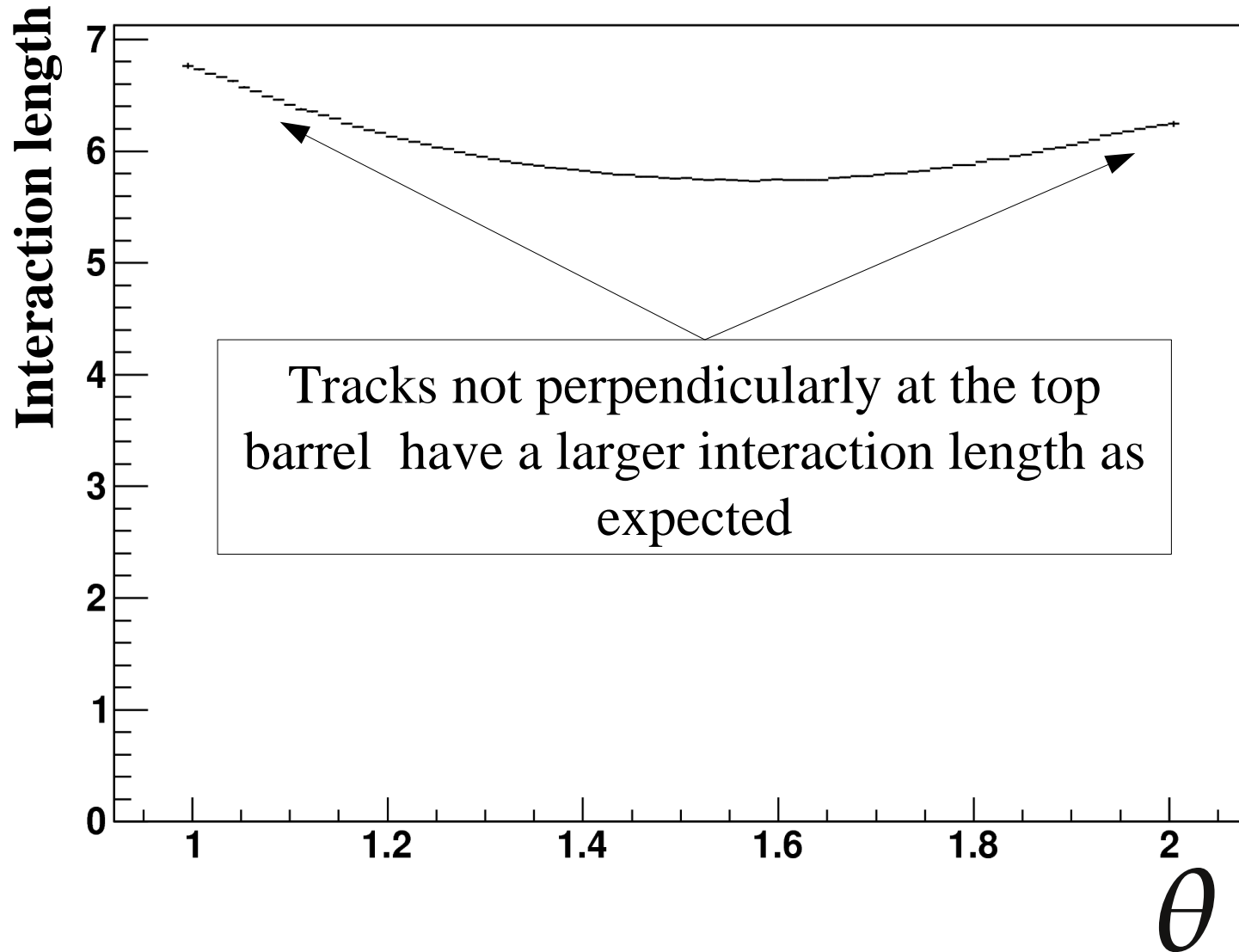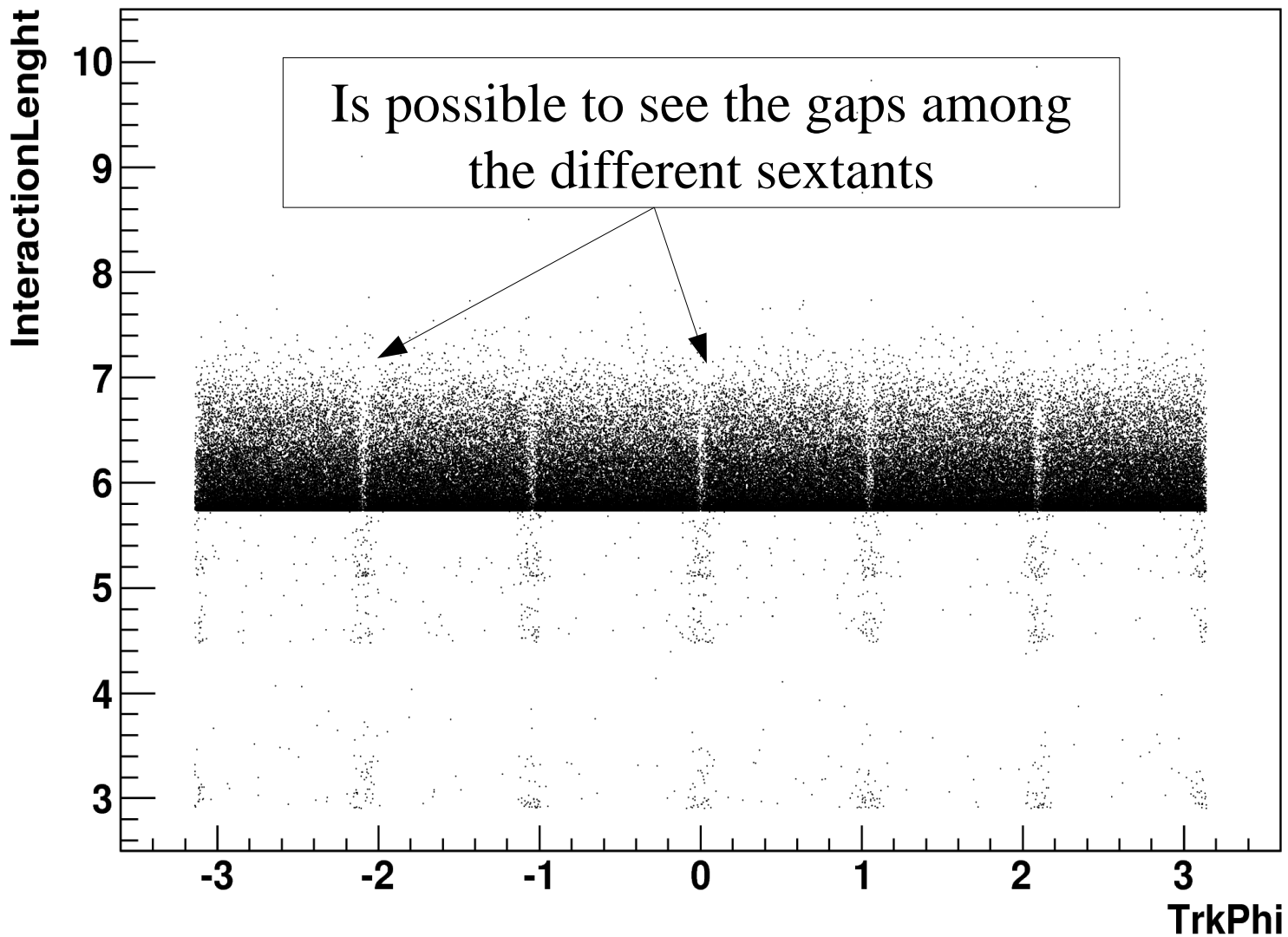
μ

X-Y plane

π

Total Distance (cm)

Improvement III

- The fitted procedure is sensible to cluster error;

- Corrected the cluster error in two situations:

  - If hits of a cluster have the same x-y coordinates but different z, we consider the error on the position x equal to the strip length divided by sqrt of 12 (one strip of 4cm ~1.2cm);

  - If hits of a cluster have the same x-y coordinates but different z, we set the error on the z position equal to 20 cm (approximation).
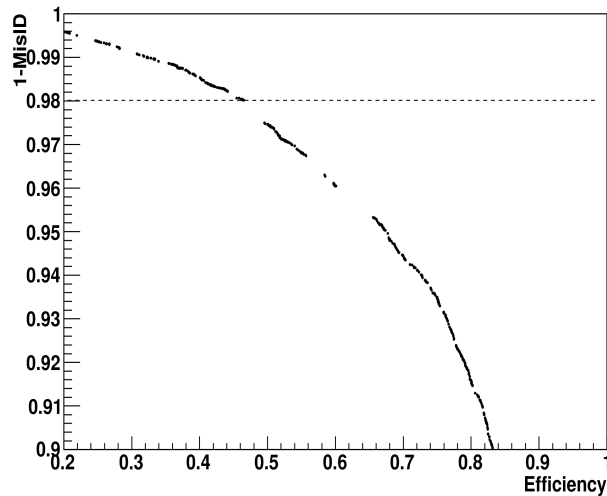
Interaction length vs theta

Tracks not perpendicularly at the top barrel have a larger interaction length as expected
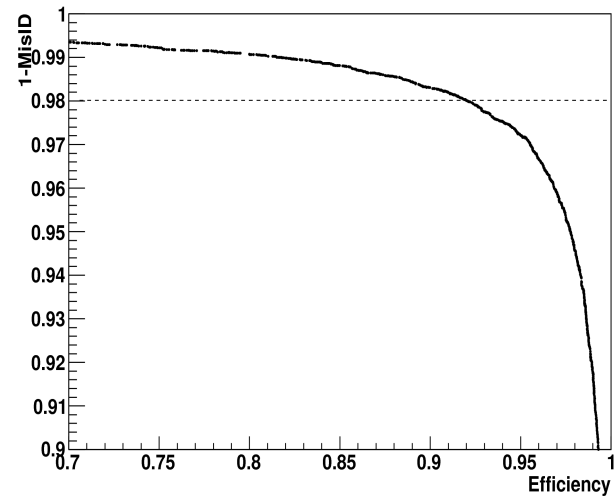
Is possible to see the gaps among the different sextants

BDT optimization

- BDT optimization performed in 4 momentum bins;
- No noise simulated.
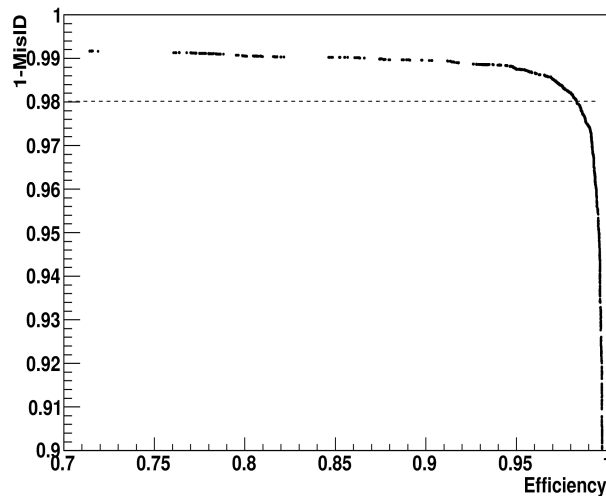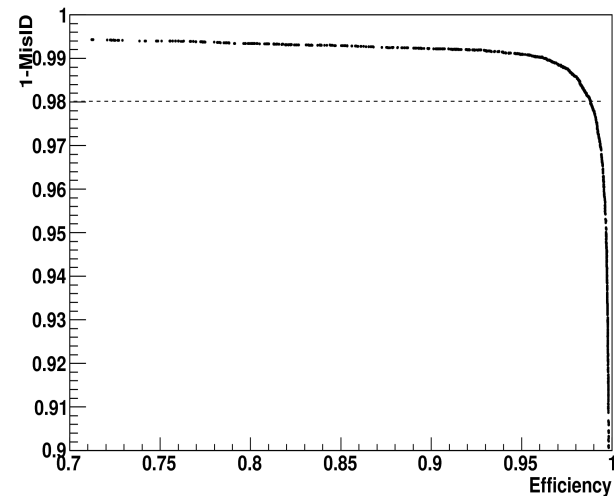
▪Muon efficinecy extracted for each momentum bin requiring a pion mis-ID of 2%
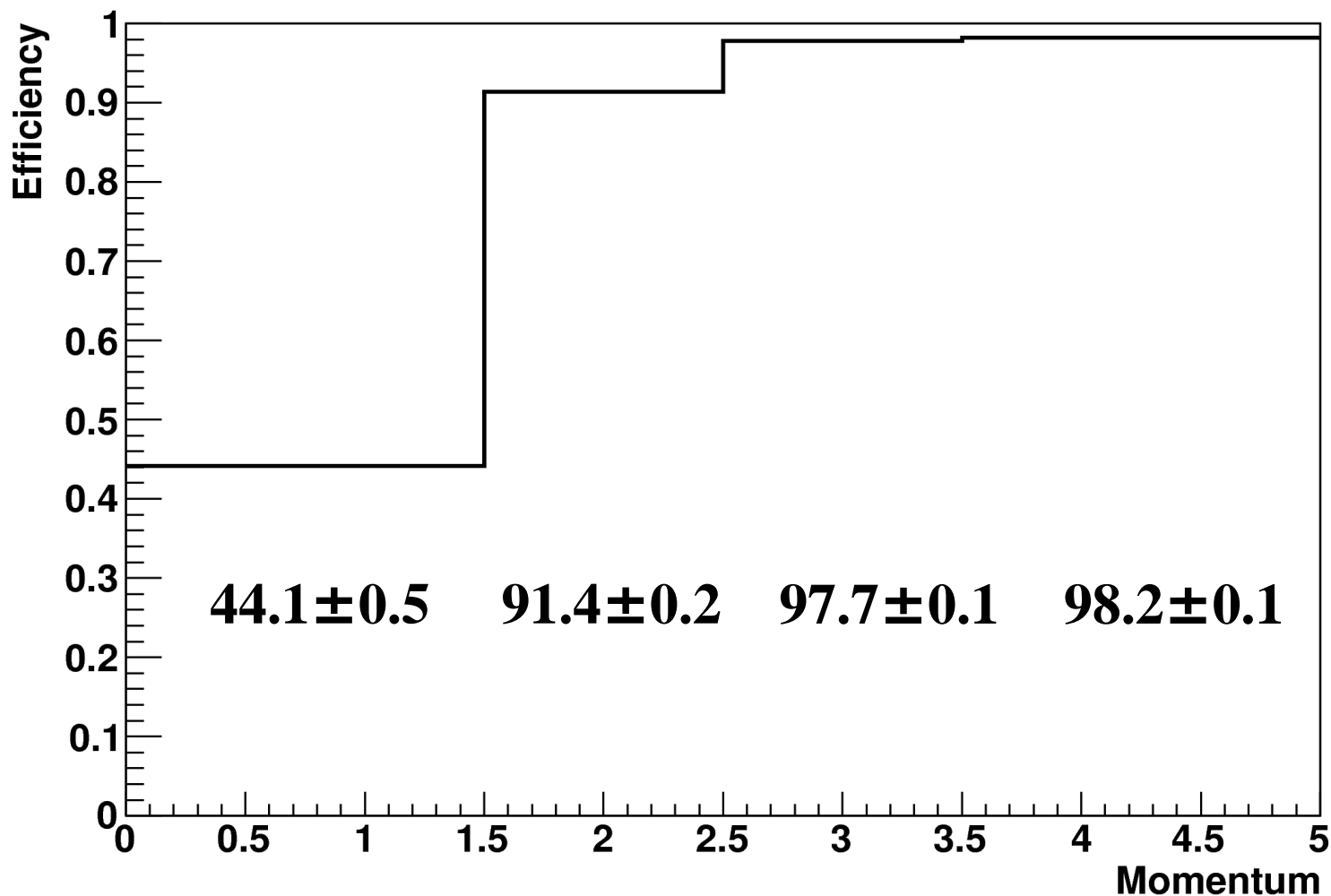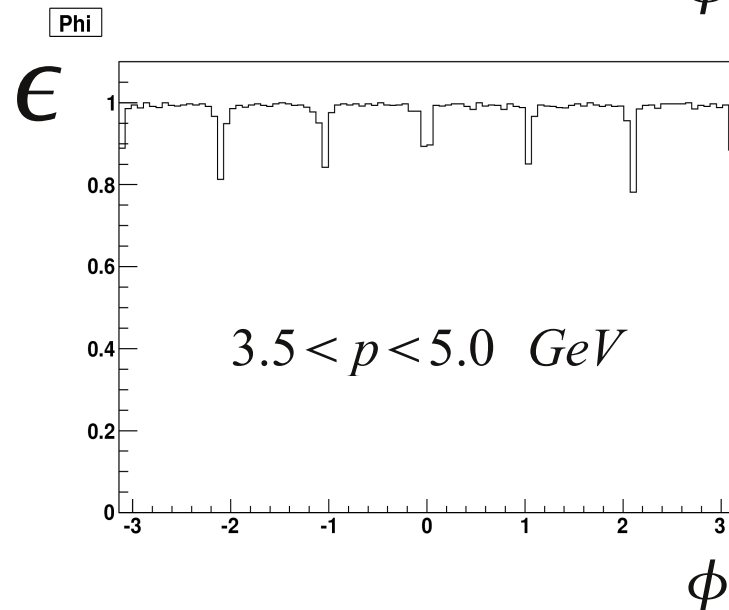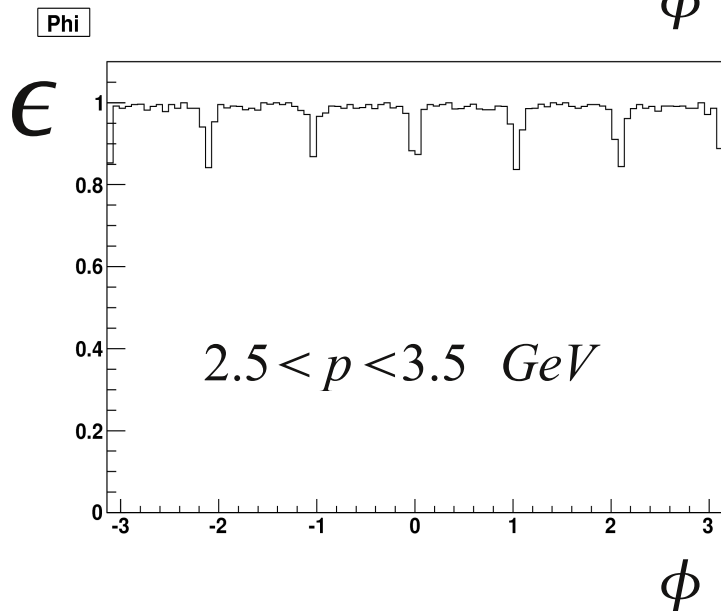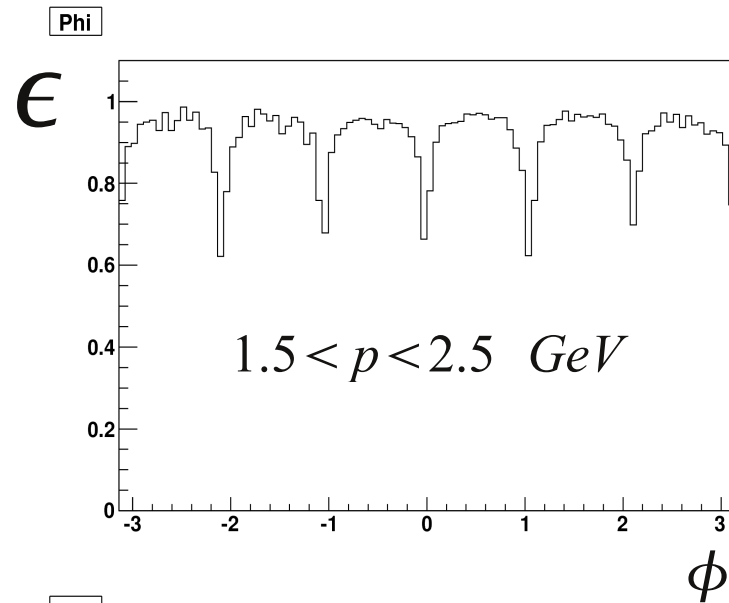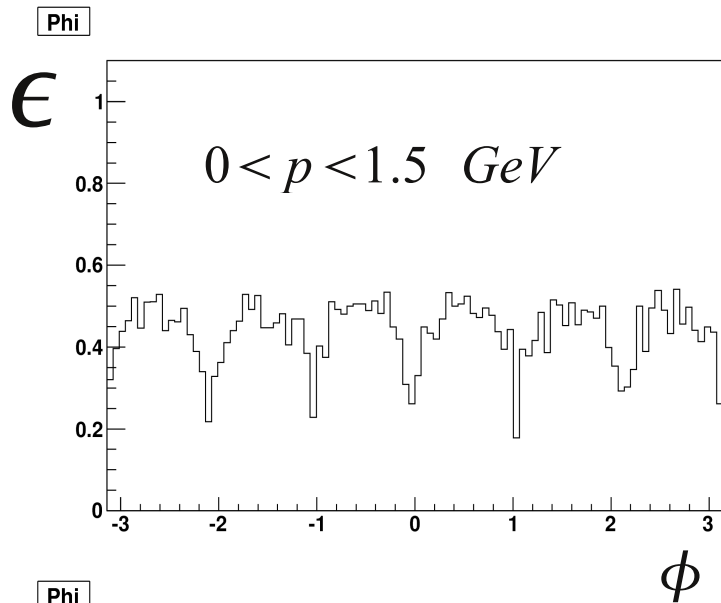
Muon Efficiency vs Phi

Conclusions

- The IFR tracker algorithm works correctly over all sextants of the barrel;

- Corrected some bugs and introduced some new discriminant variables;

- Need to validate our tracker in the Forward and Backward regions;

- Need to create a PID-Table for FastSim;

- Start to look at the prototype.