

Tracking studies with particle gun samples

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Samples

- Six samples of 100000 muons and six samples of 20000 pions with fixed momentum and θ generated with particle gun



$p = 1, 10, 100 \text{ GeV}$

$\theta = 13, 30, 89 \text{ degrees}$ (with p_T in $[0.1, 100] \text{ GeV}$)

Detector configuration

		cell size	sensor thickness	time resolution	spatial resolution
Vertex Detector	B	25 μm x 25 μm pixels	50 μm	30 ps	5 μm x 5 μm
	E	25 μm x 25 μm pixels	50 μm	30 ps	5 μm x 5 μm
Inner Tracker	B	50 μm x 1 mm macropixels	100 μm	60 ps	7 μm x 90 μm
	E	50 μm x 1 mm macropixels	100 μm	60 ps	7 μm x 90 μm
Outer Tracker	B	50 μm x 10 mm microstrips	100 μm	60 ps	7 μm x 90 μm
	E	50 μm x 10 mm microstrips	100 μm	60 ps	7 μm x 90 μm

Conformal tracking configuration

```
<parameter name="Steps" type="StringVec">
  [VXDCentral]
  @Collections : VBTrackerHitsMiddle, VBTrackerHitsOuter, VETrackerHitsInner
  @Parameters : MaxCellAngle : 0.01; MaxCellAngleRZ : 0.014; Chi2Cut : 60; MinClustersOnTrack : 4; MaxDistance : 0.01; SlopeZRange: 1.4; HighPTCut: 1.0;
  @Flags : HighPTFit, VertexToTracker
  @Functions : CombineCollections, BuildNewTracks
  [VXDCentralExtend]
  @Collections : VETrackerHitsInner, VETrackerHitsMiddle
  @Parameters : MaxCellAngle : 0.01; MaxCellAngleRZ : 0.007; Chi2Cut : 60; MinClustersOnTrack : 4; MaxDistance : 0.006; SlopeZRange: 1.4; HighPTCut: 1.0;
  @Flags : HighPTFit, VertexToTracker
  @Functions : CombineCollections, ExtendTracks
  [VXDMiddle]
  @Collections : VBTrackerHitsInner, VBTrackerHitsMiddle, VBTrackerHitsOuter, VETrackerHitsInner, VETrackerHitsMiddle
  @Parameters : MaxCellAngle : 0.015; MaxCellAngleRZ : 0.014; Chi2Cut : 60; MinClustersOnTrack : 4; MaxDistance : 0.02; SlopeZRange: 3.0; HighPTCut: 1.0;
  @Flags : HighPTFit
  @Functions : CombineCollections, BuildNewTracks
  [VXDMiddleExtend]
  @Collections : VETrackerHitsOuter
  @Parameters : MaxCellAngle : 0.02; MaxCellAngleRZ : 0.014; Chi2Cut : 60; MinClustersOnTrack : 4; MaxDistance : 0.01; SlopeZRange: 3.0; HighPTCut: 1.0;
  @Flags : HighPTFit, VertexToTracker
  @Functions : CombineCollections, ExtendTracks
  [VXDForward]
  @Collections : VETrackerHitsInner, VETrackerHitsMiddle, VETrackerHitsOuter
  @Parameters : MaxCellAngle : 0.03; MaxCellAngleRZ : 0.03; Chi2Cut : 60; MinClustersOnTrack : 4; MaxDistance : 0.02; SlopeZRange: 6.0; HighPTCut: 1.0;
  @Flags : HighPTFit
  @Functions : CombineCollections, BuildNewTracks
  [VXDInner]
  @Collections : VBTrackerHitsInner
  @Parameters : MaxCellAngle : 0.015; MaxCellAngleRZ : 0.015; Chi2Cut : 60; MinClustersOnTrack : 5; MaxDistance : 0.015; SlopeZRange: 3.0; HighPTCut: 1.0;
  @Flags : HighPTFit, RadialSearch
  @Functions : CombineCollections, ExtendTracks, SortTracks
  [Tracker]
  @Collections : IBTrackerHits, OBTrackerHits, IETrackerHits, OETrackerHits
  @Parameters : MaxCellAngle : 0.04; MaxCellAngleRZ : 0.03; Chi2Cut : 200; MinClustersOnTrack : 6; MaxDistance : 0.02; SlopeZRange: 6.0; HighPTCut: 1.0;
  @Flags : HighPTFit, VertexToTracker, RadialSearch
  @Functions : CombineCollections, ExtendTracks
</parameter>
```

Track matching

- To match a track to a MC particle we defined the "purity" of a track as the ratio between the **number of hits matched with the MC particle** and the **total number of hits**
- If multiple hits are associated to the same layer and same system, they are counted as one hit only
- A track is matched with the MC particle if its purity is above a given threshold

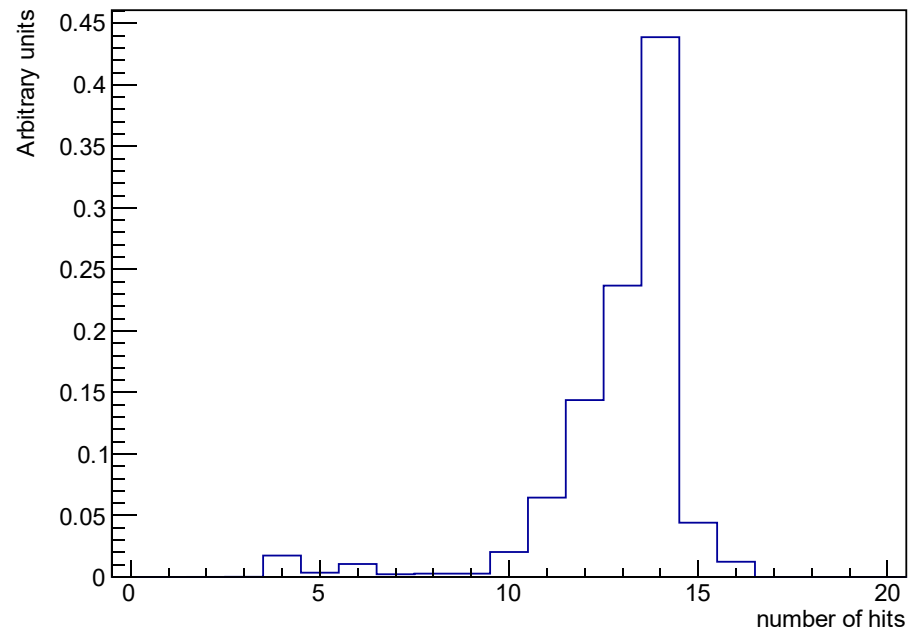
Matching condition:

Purity > 90%

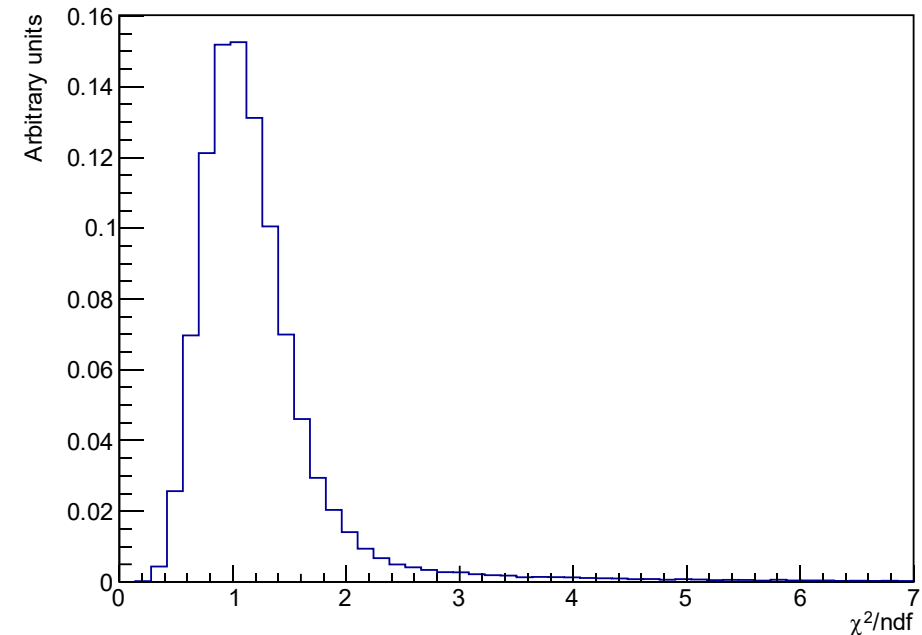
Quality cuts

- Also, a track must satisfy two quality requirements:
 - $\chi^2/\text{ndf} < 5$
 - number of hits > 5

μ sample with $p=10$ (before selection)

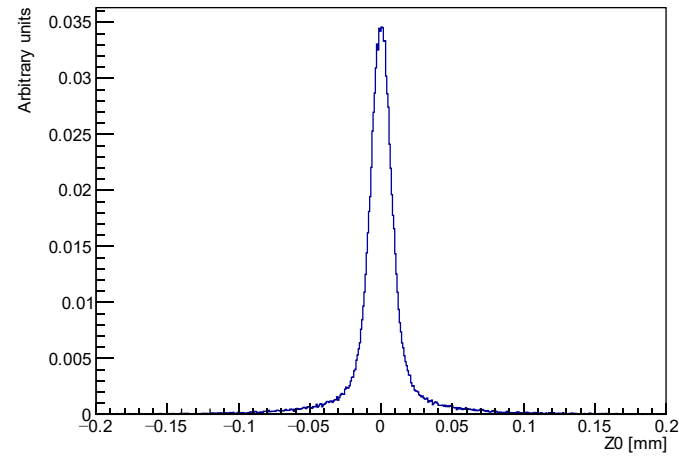


μ sample with $p=10$ (before selection)

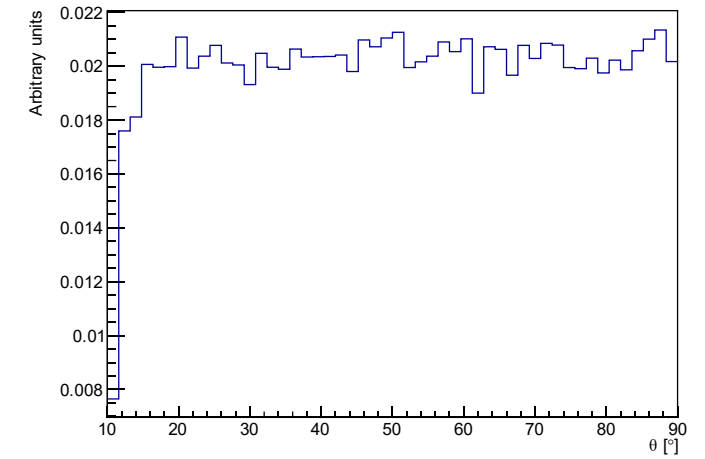


Track parameters - check

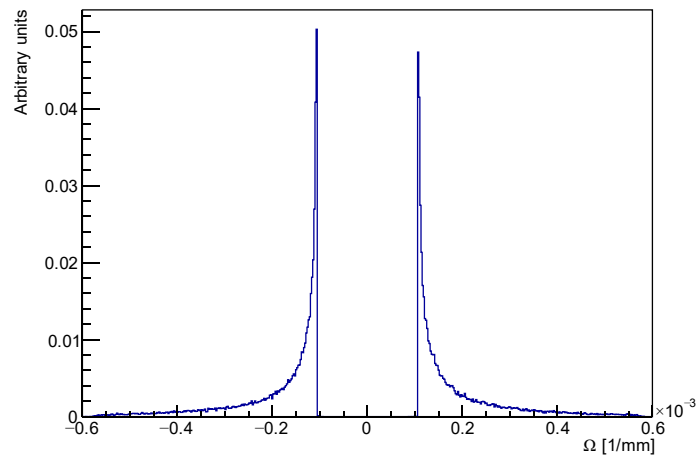
μ sample with $p=10$ (matched tracks)



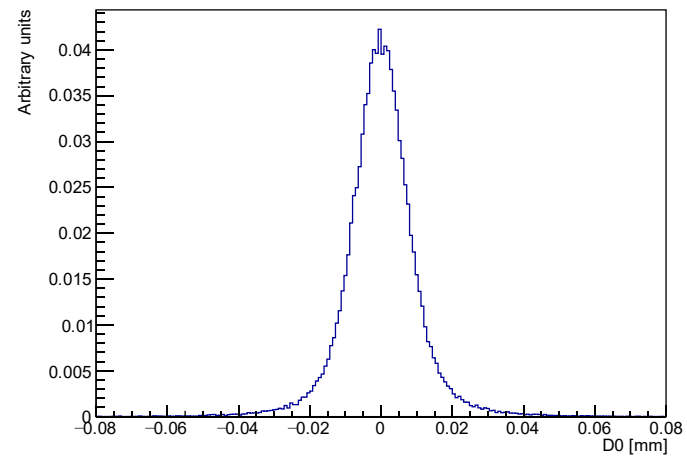
μ sample with $p=10$ (matched tracks)



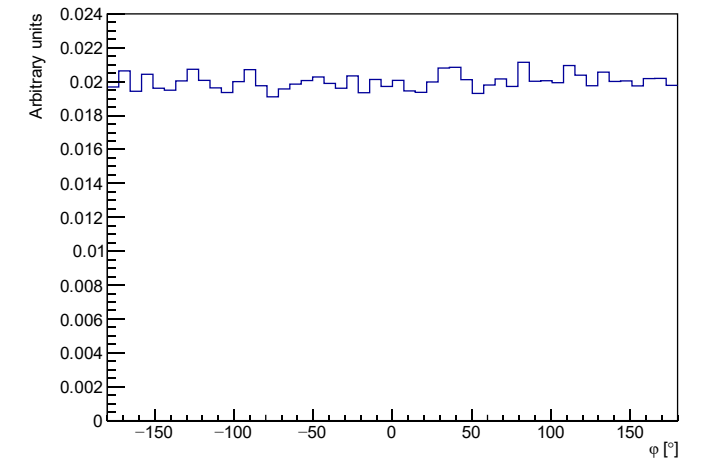
μ sample with $p=10$ (matched tracks)



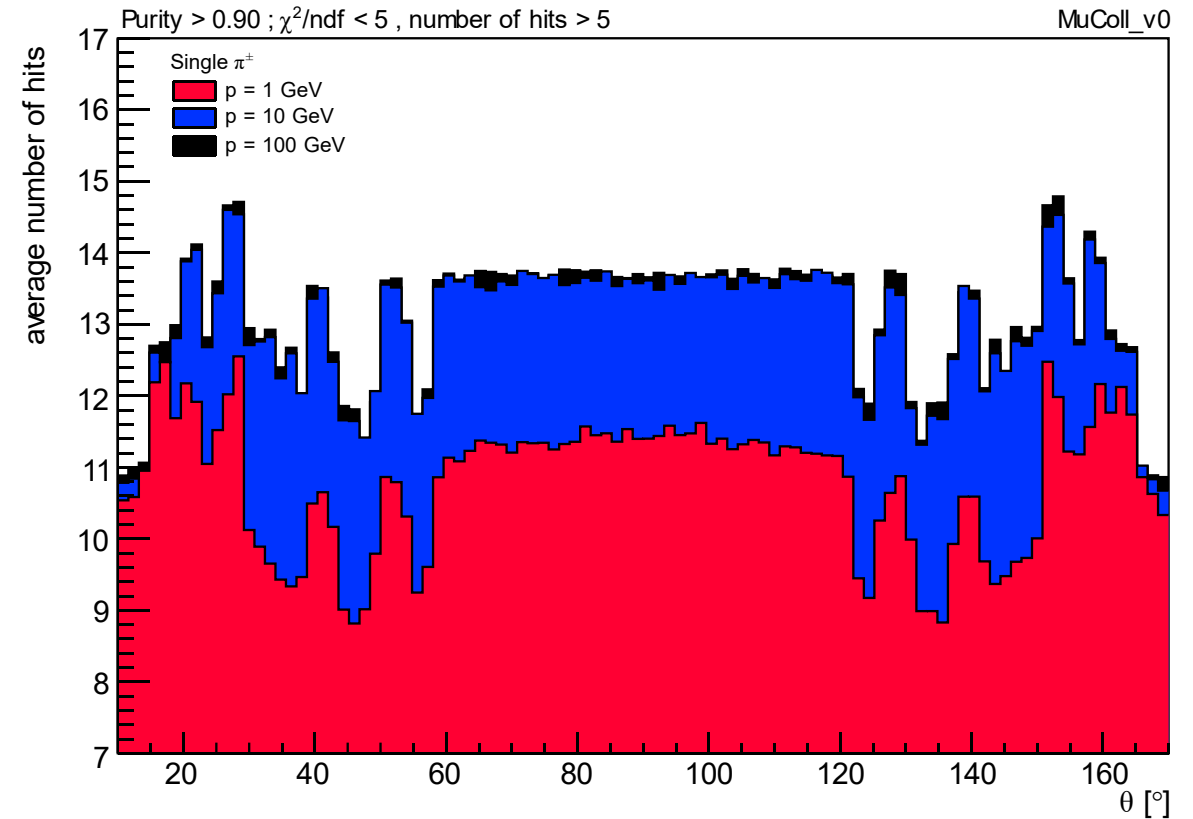
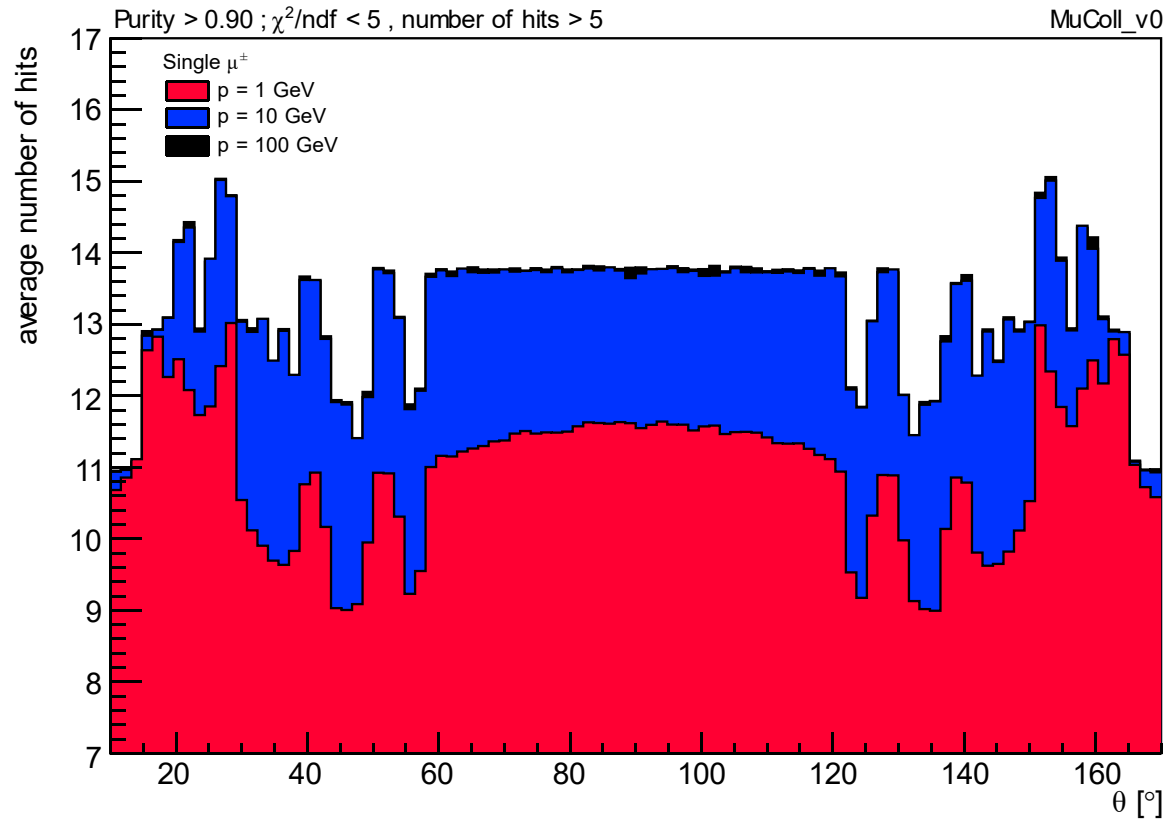
μ sample with $p=10$ (matched tracks)



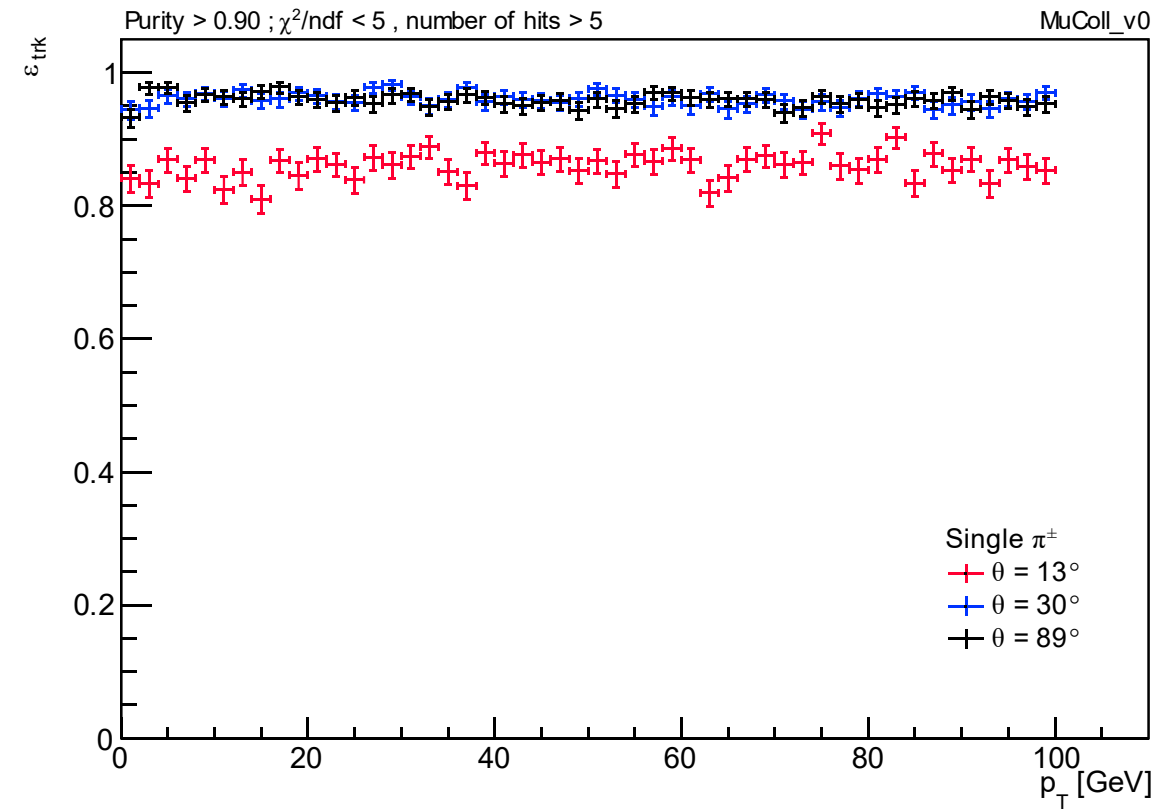
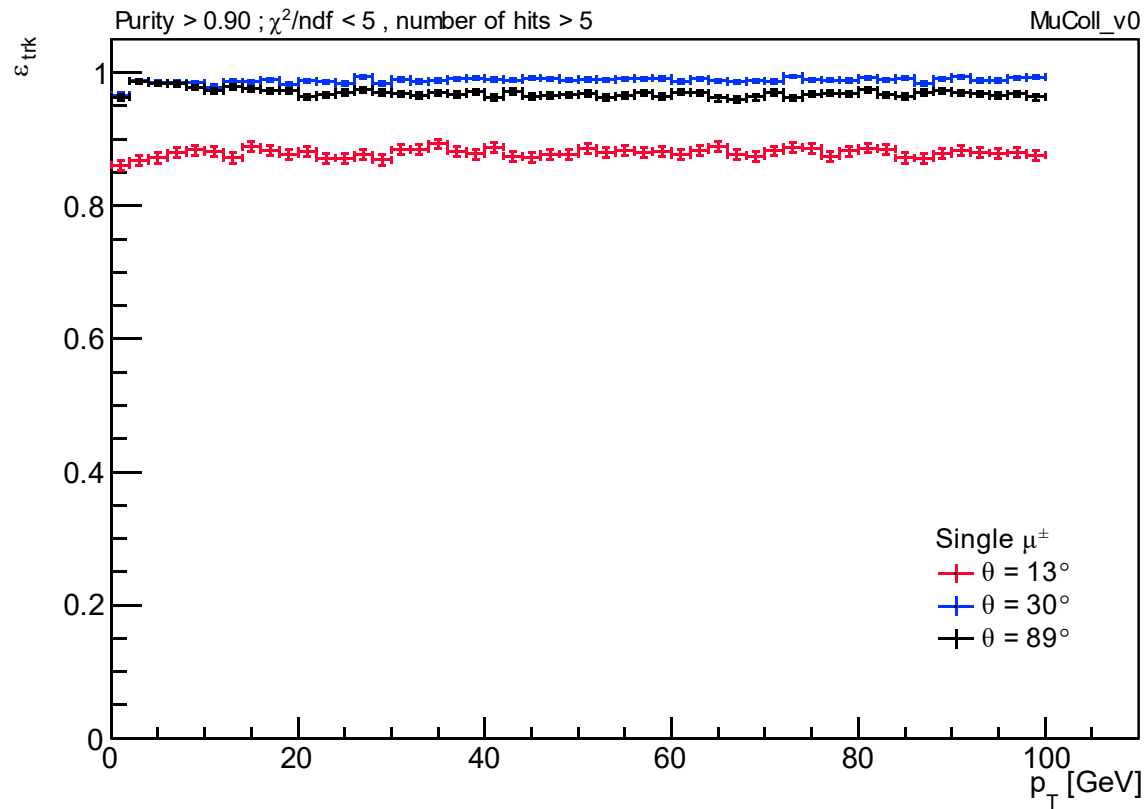
μ sample with $p=10$ (matched tracks)



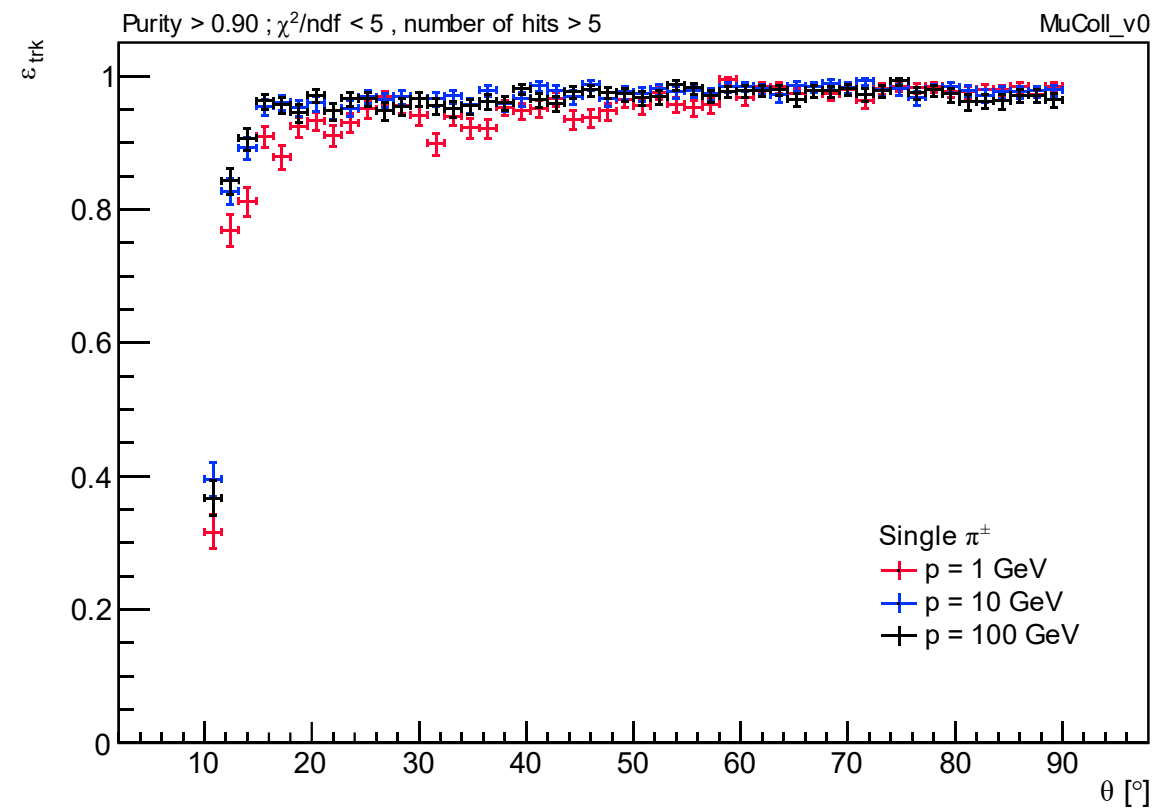
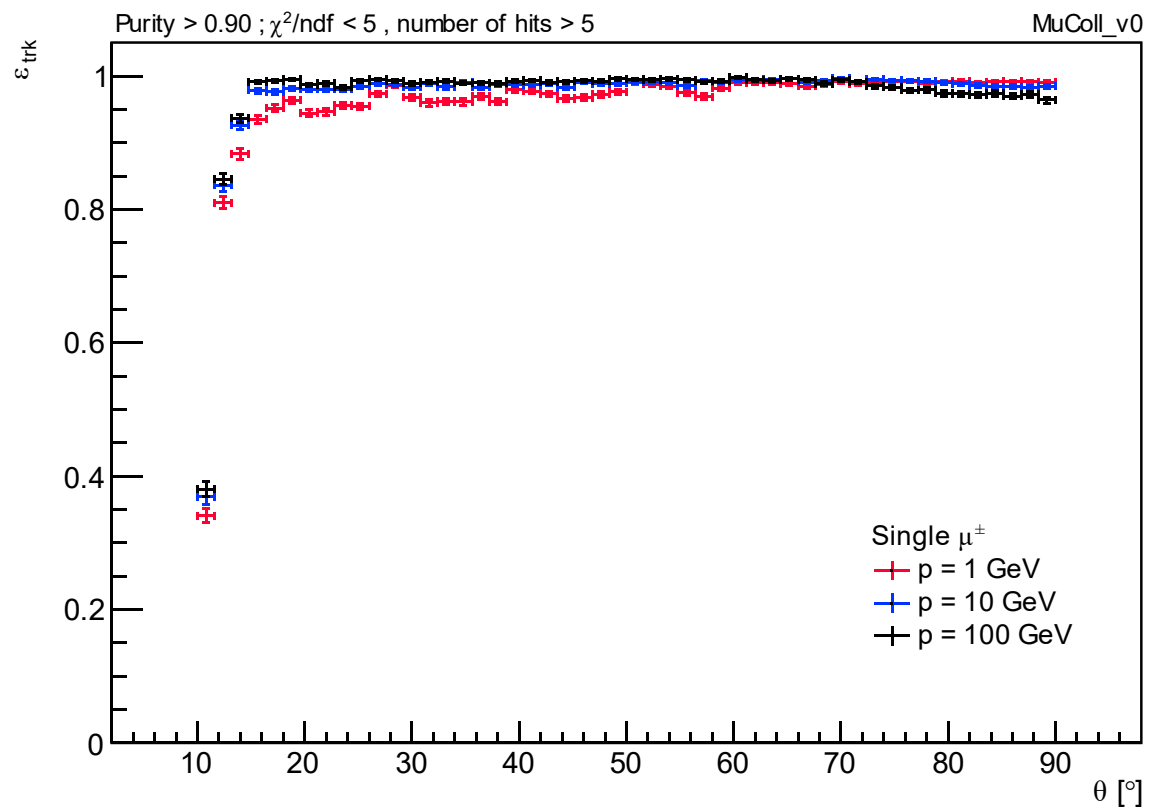
Average number of hits vs θ



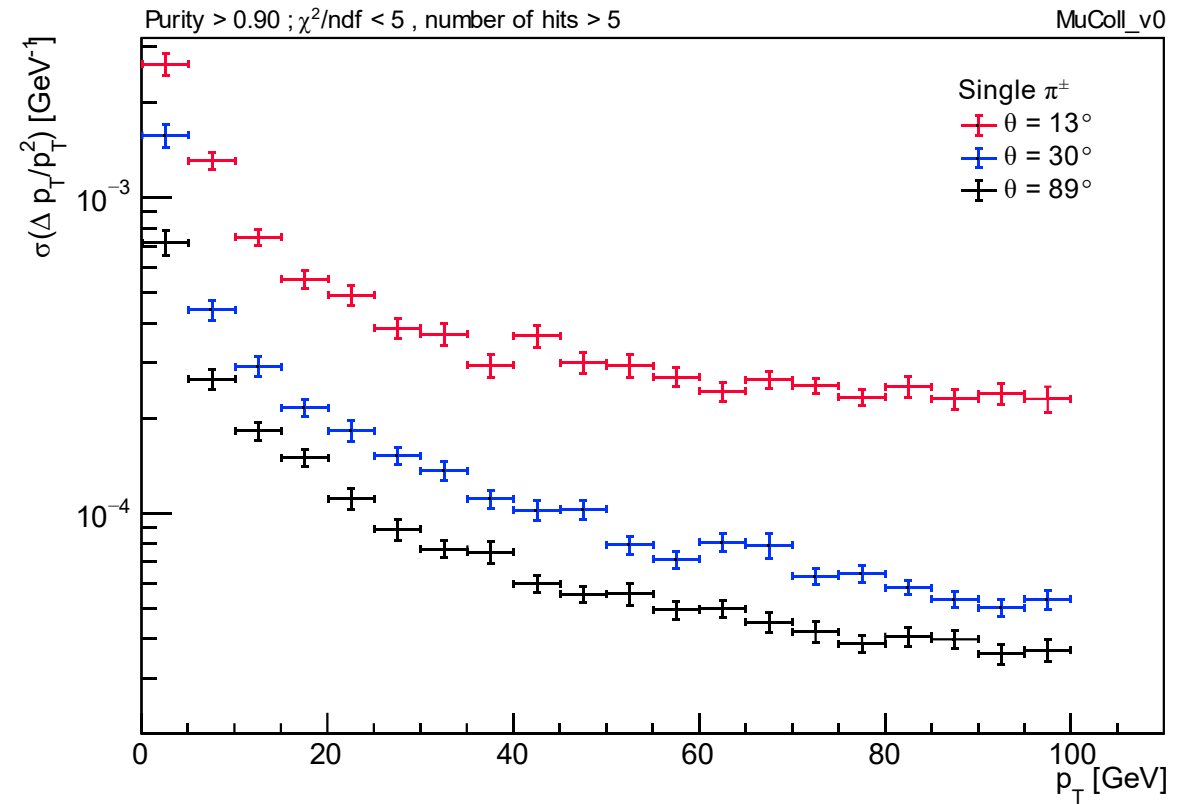
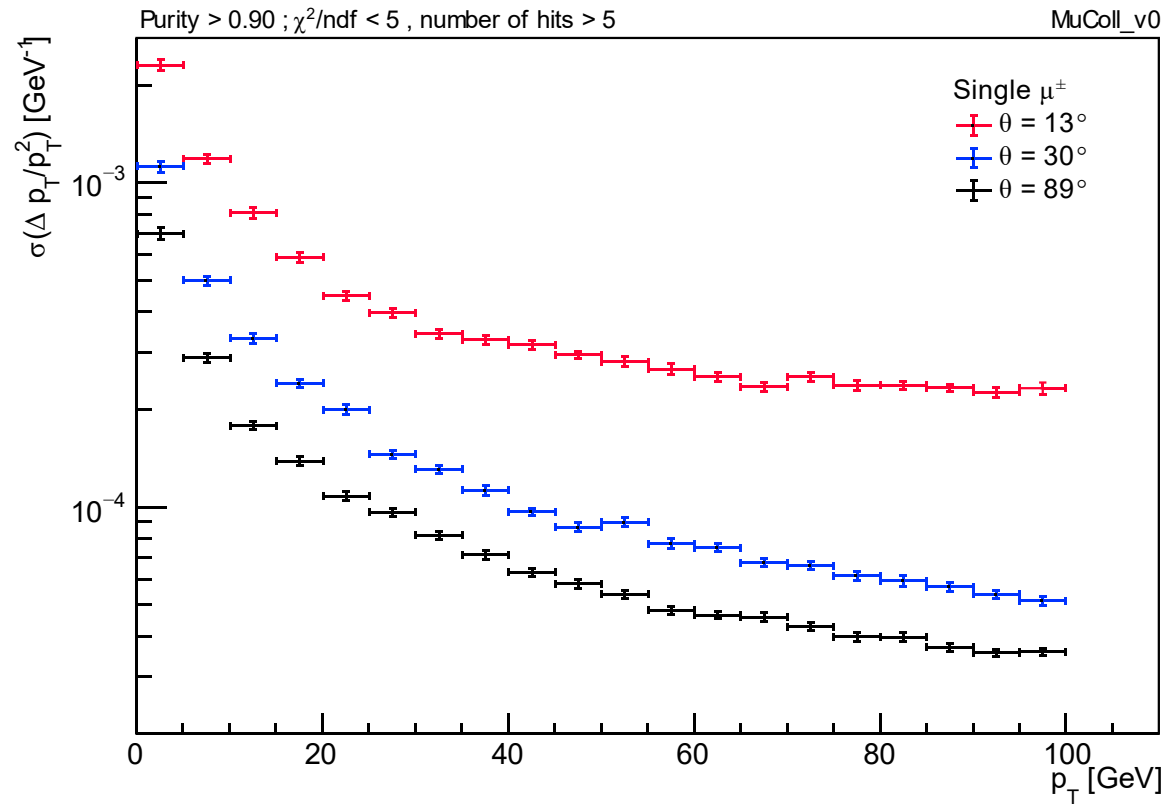
Efficiency vs p_T



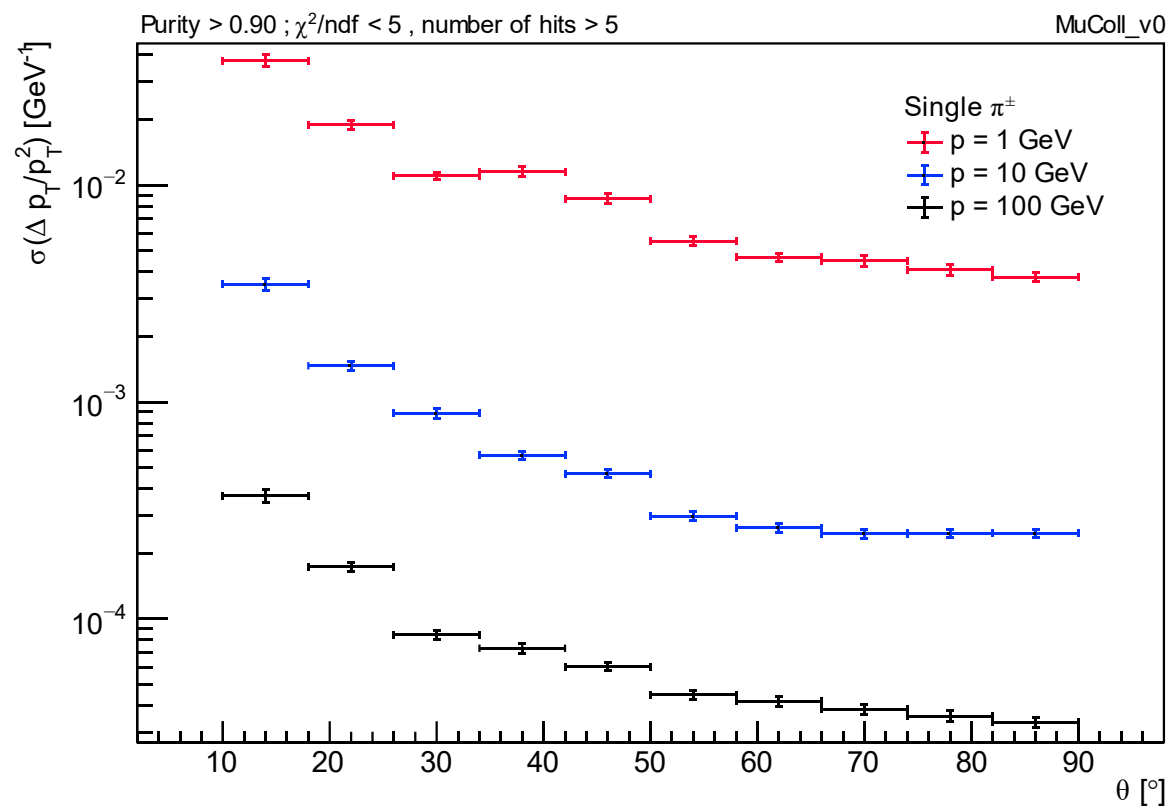
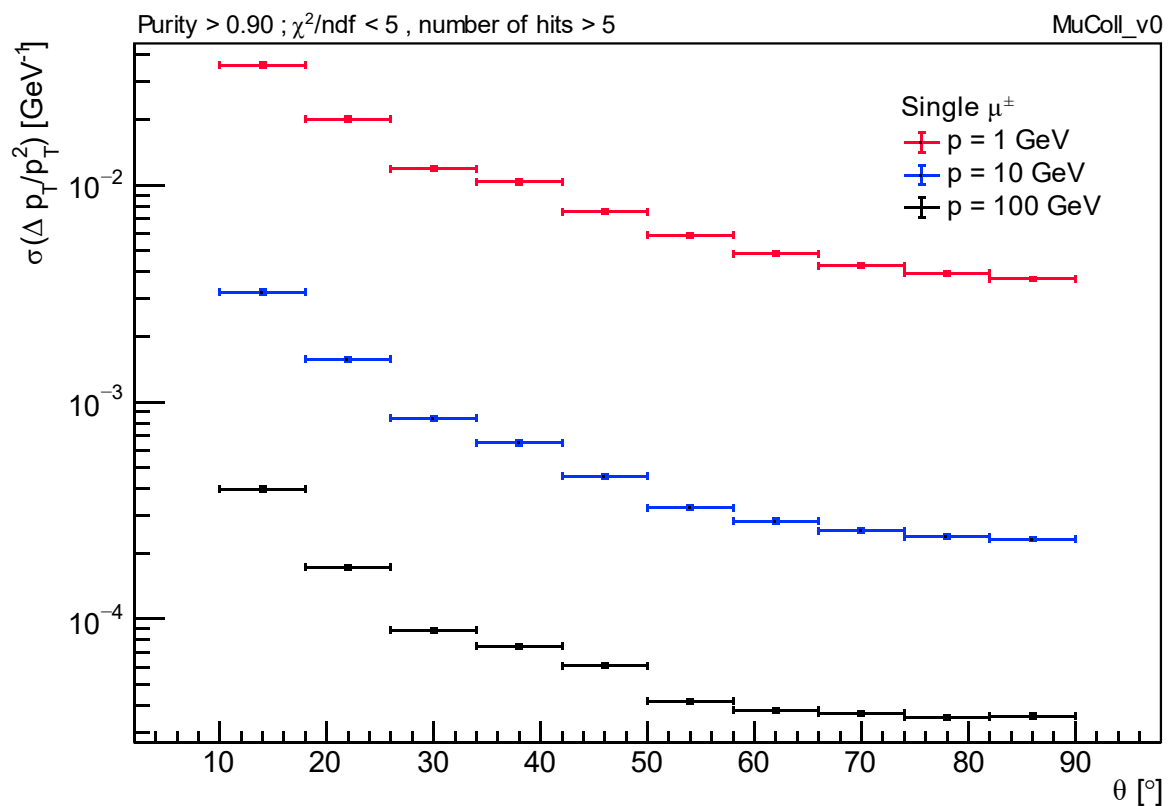
Efficiency vs θ



Resolution vs p_T



Resolution vs θ



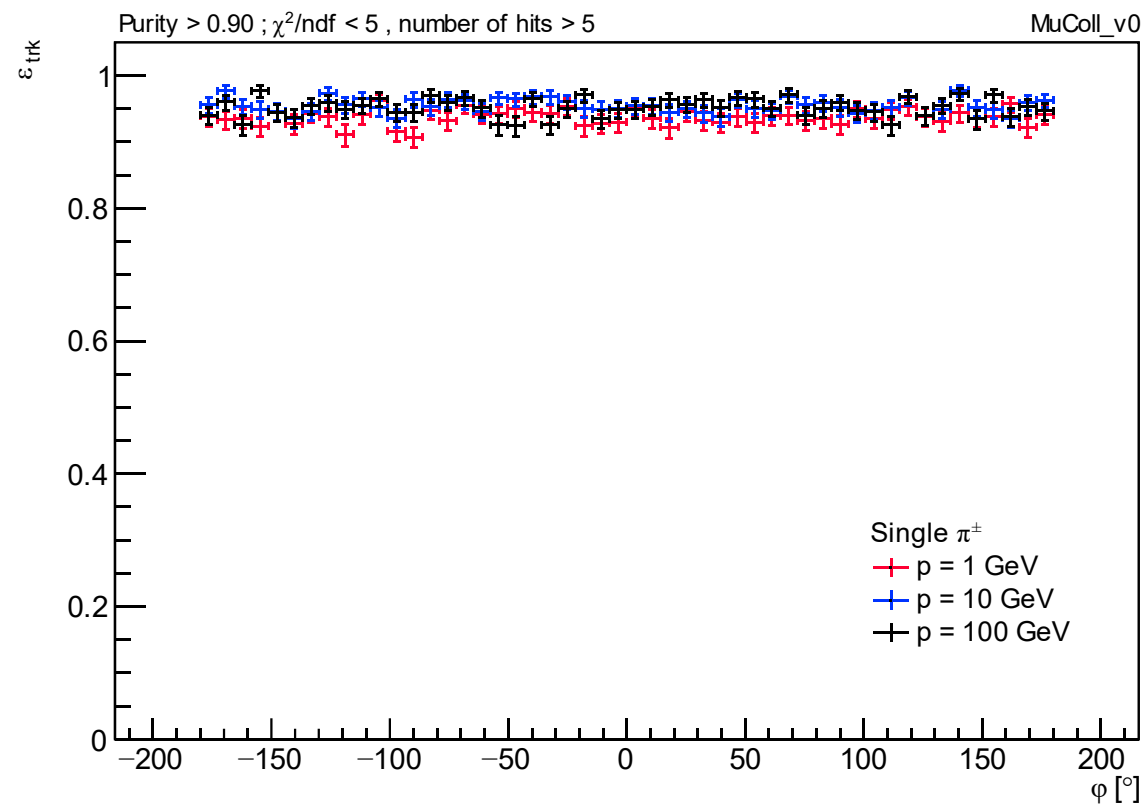
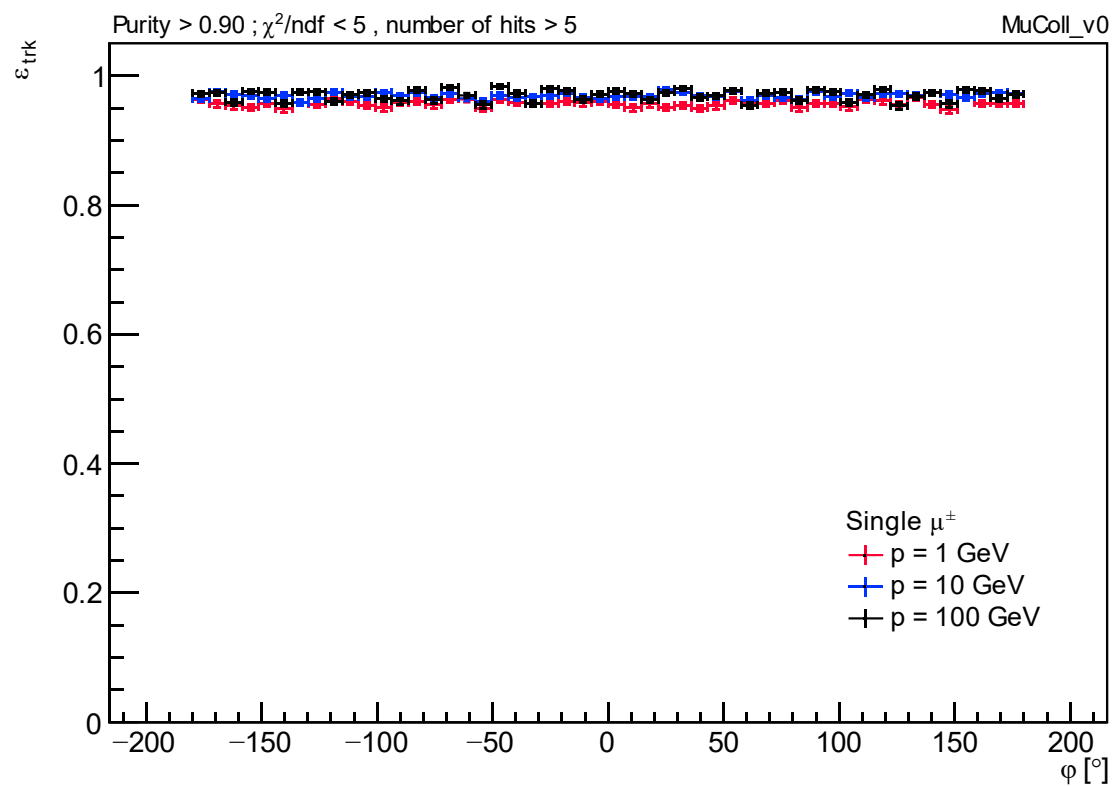
Confluence page

We are preparing a Confluence page to collect some significant plots for the detector studies:

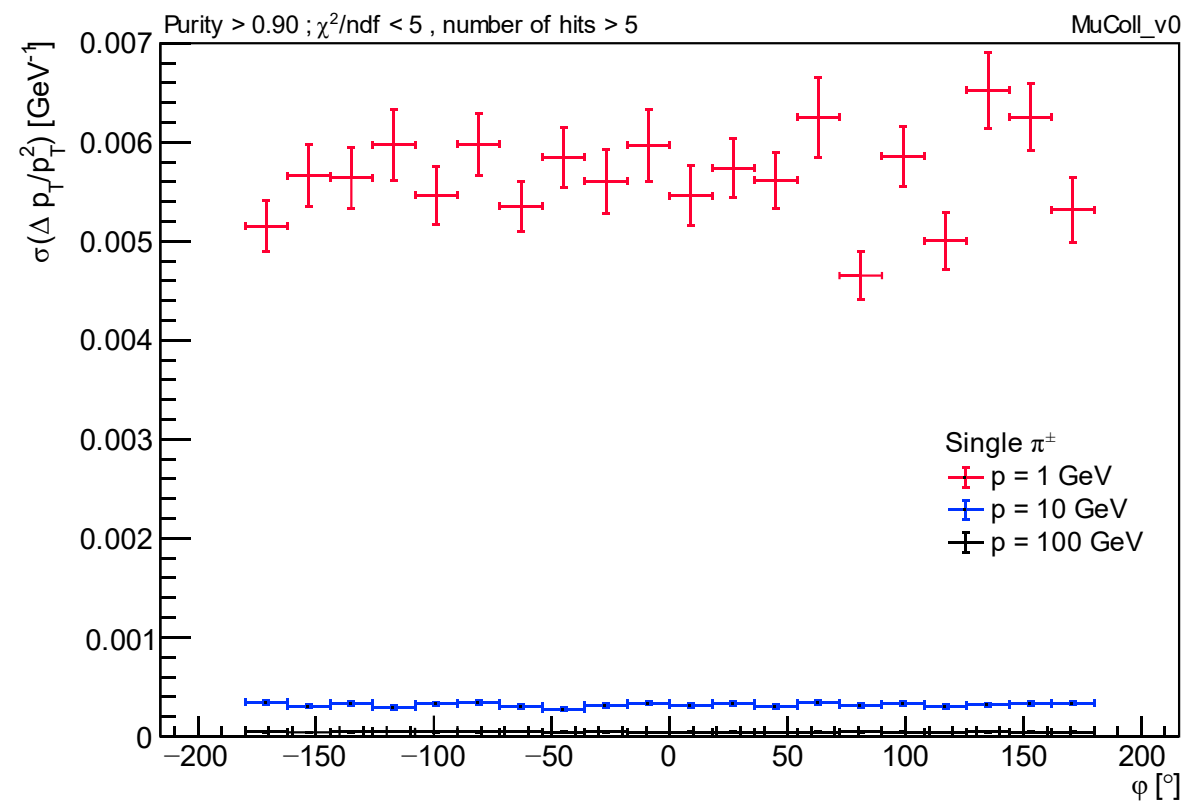
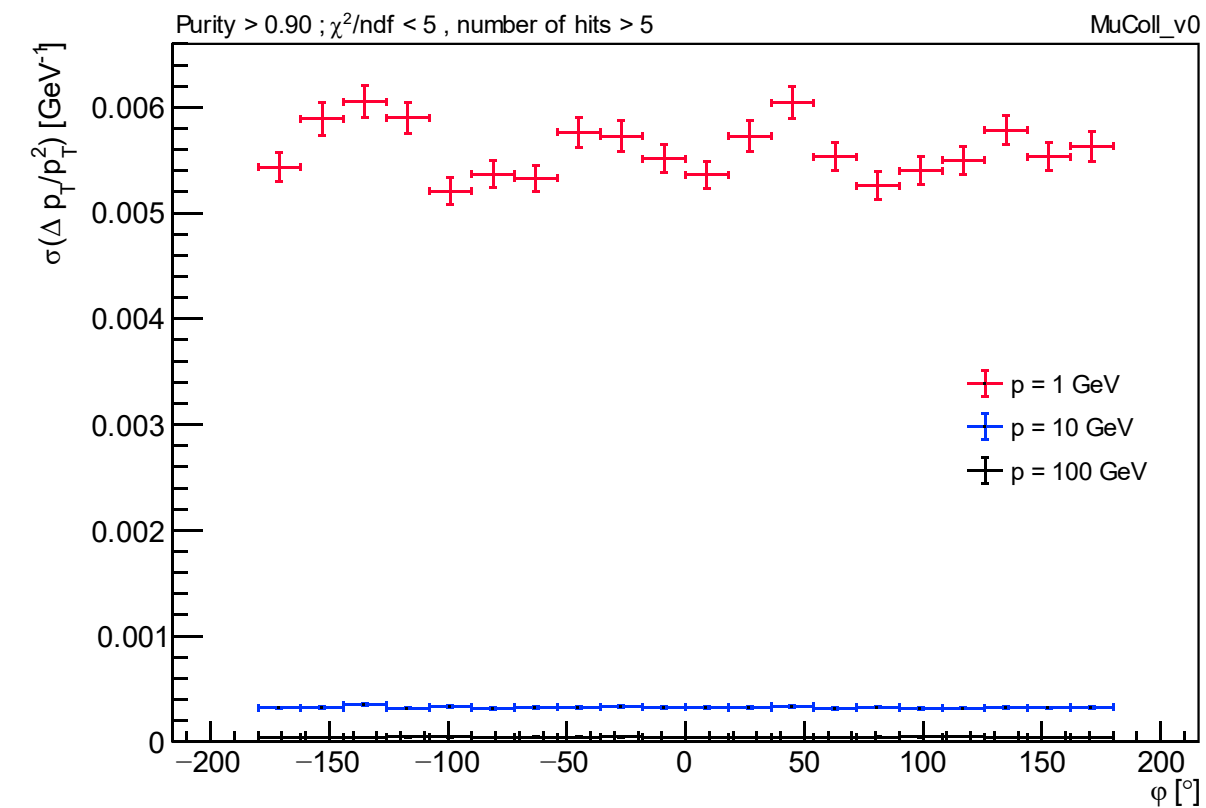
<https://confluence.infn.it/display/muoncollider/Muon+Collider+Detector>

BACKUP

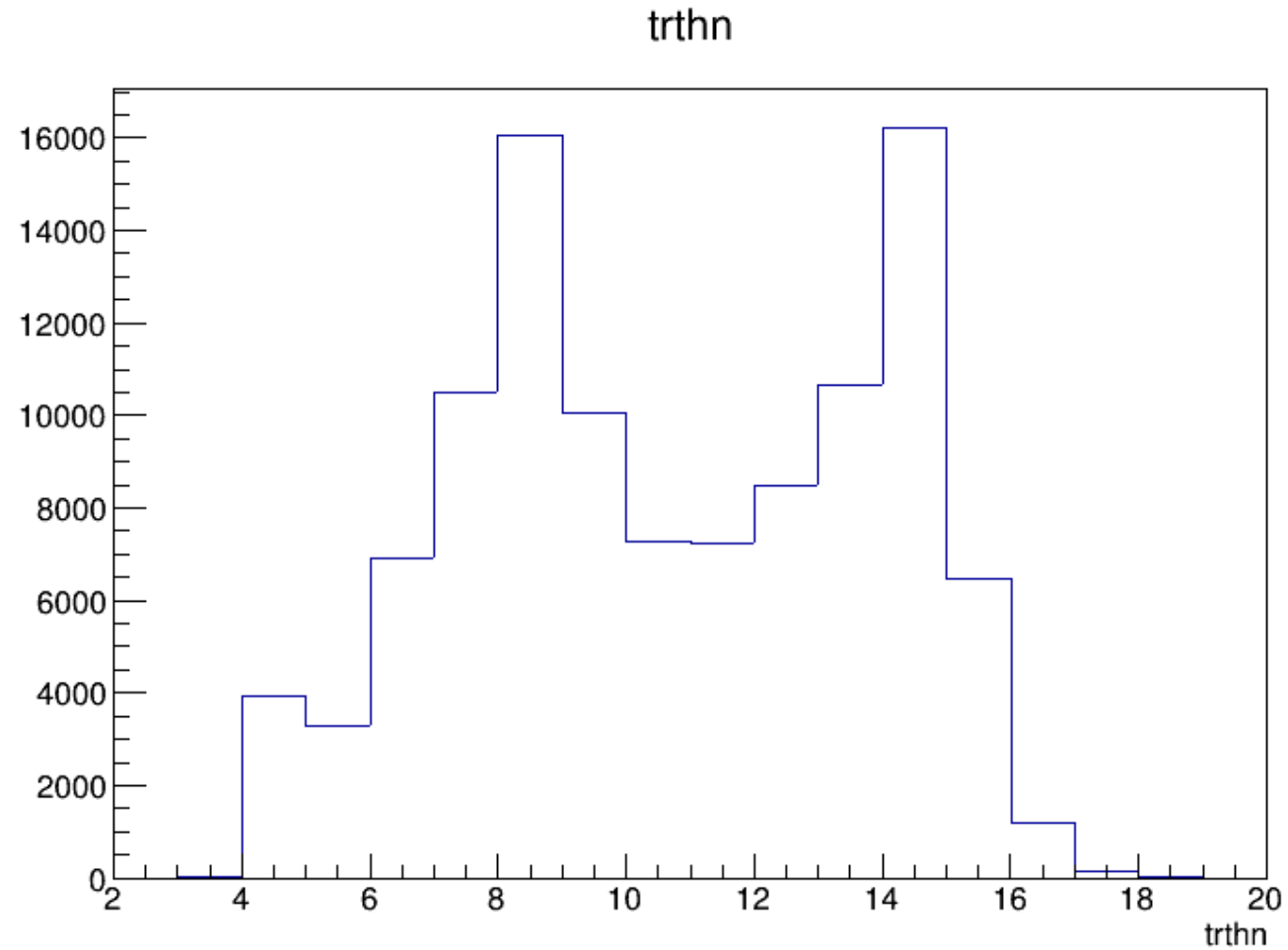
Efficiency vs φ

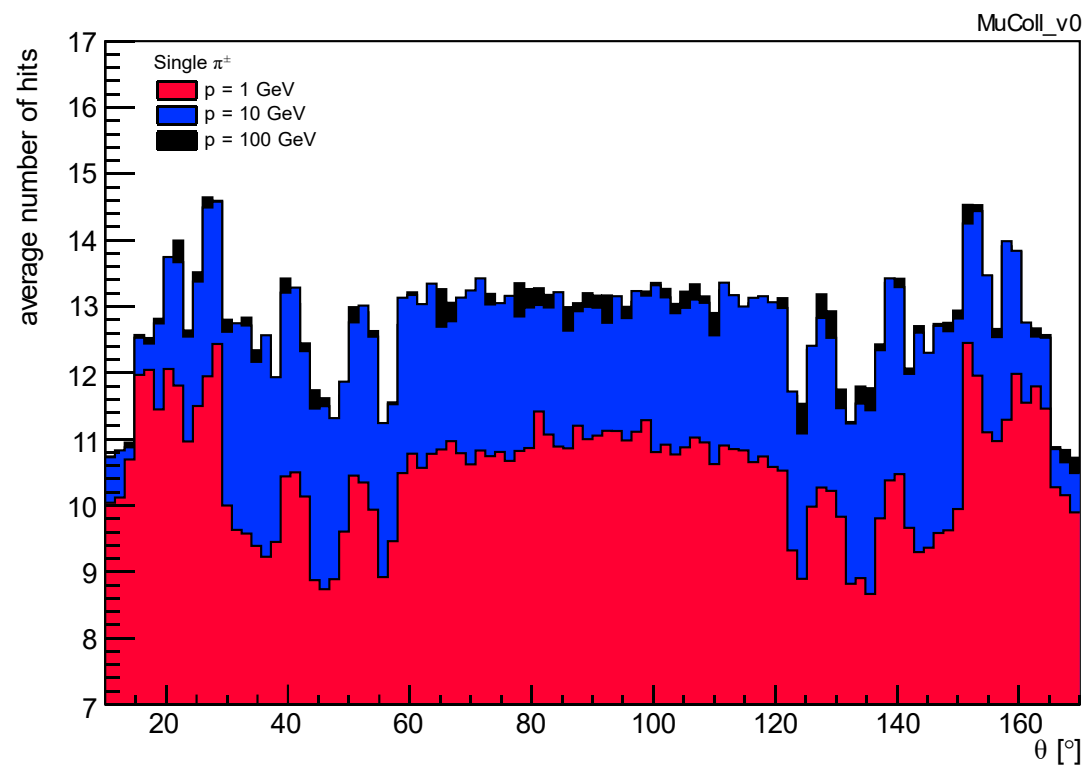
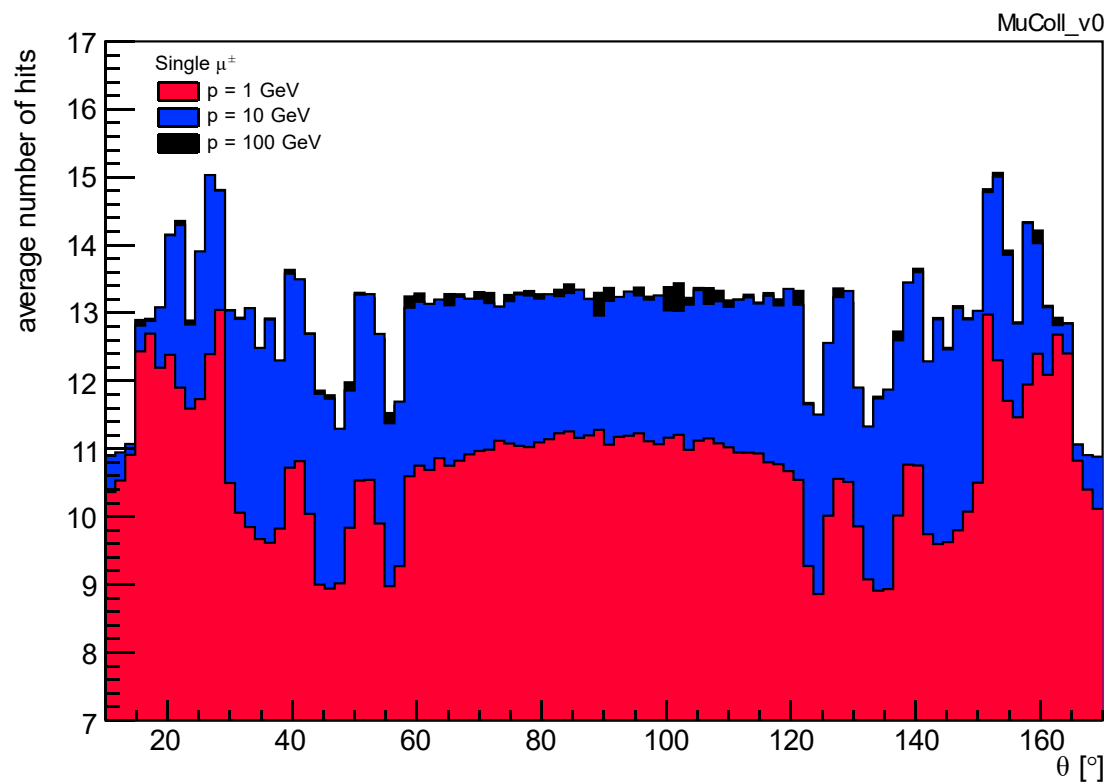


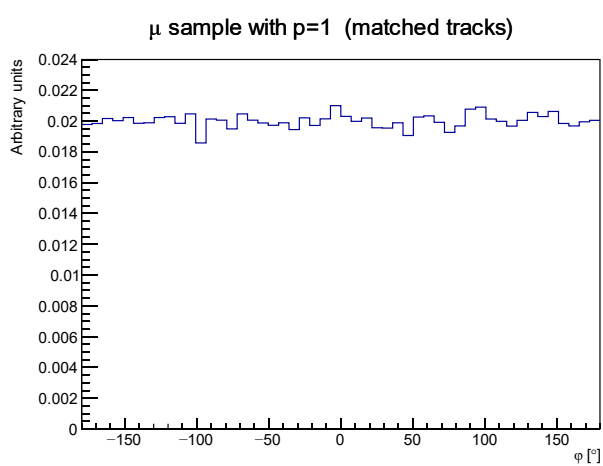
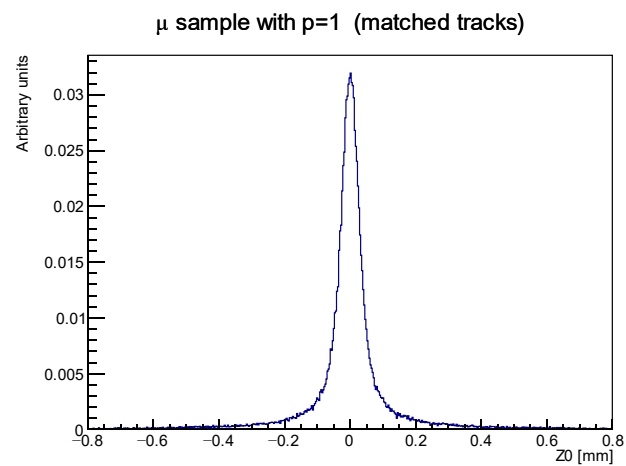
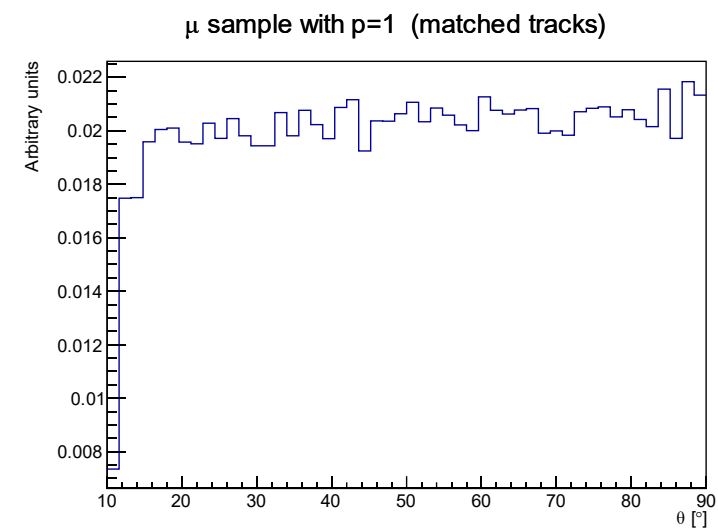
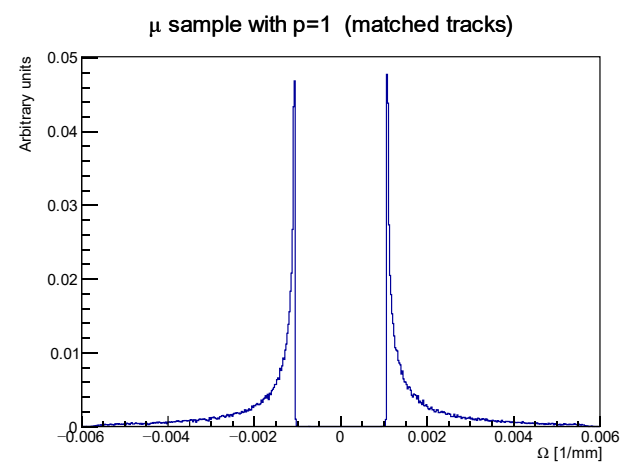
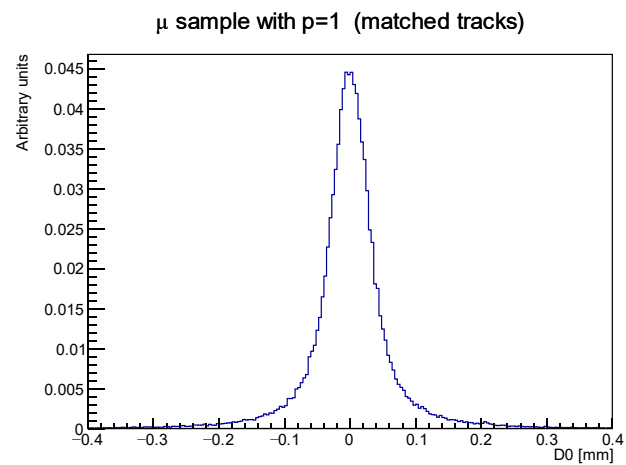
Resolution vs φ

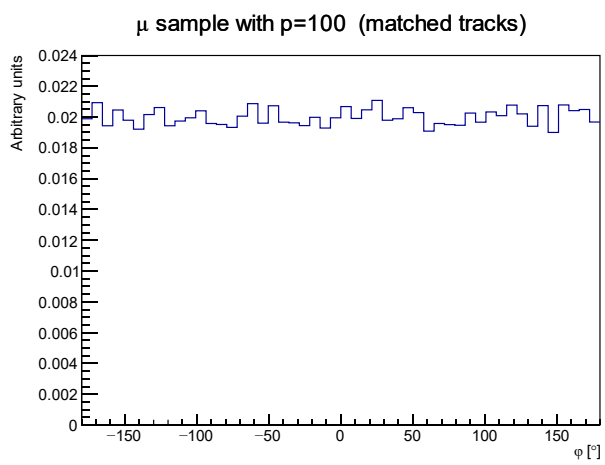
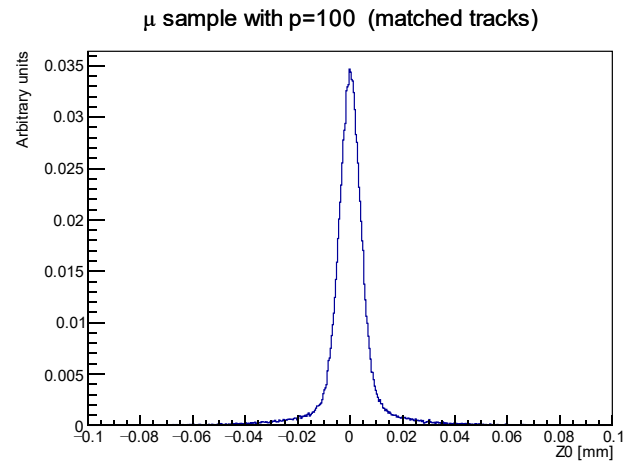
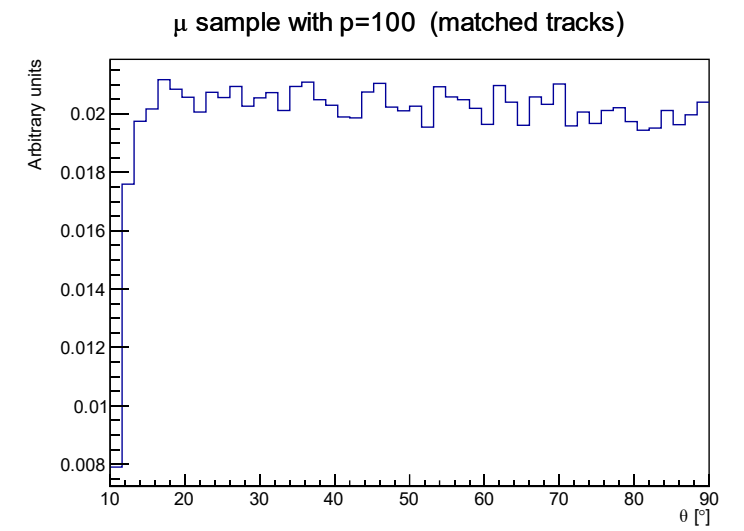
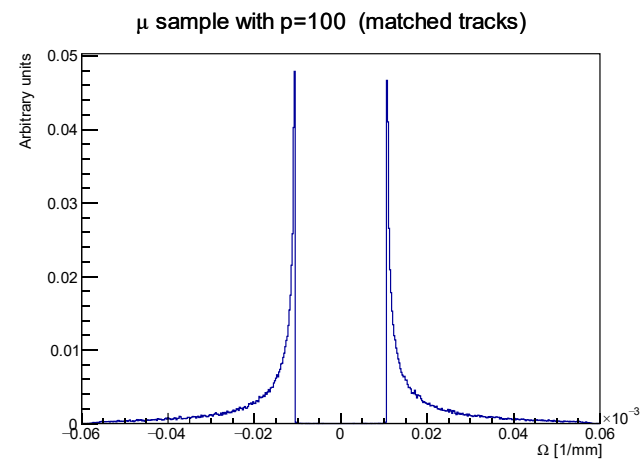
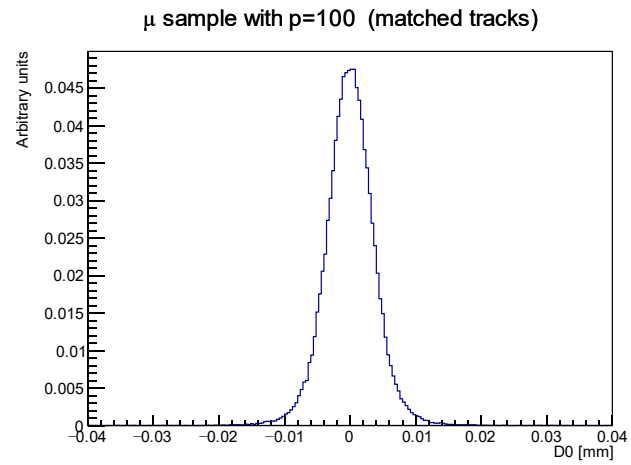


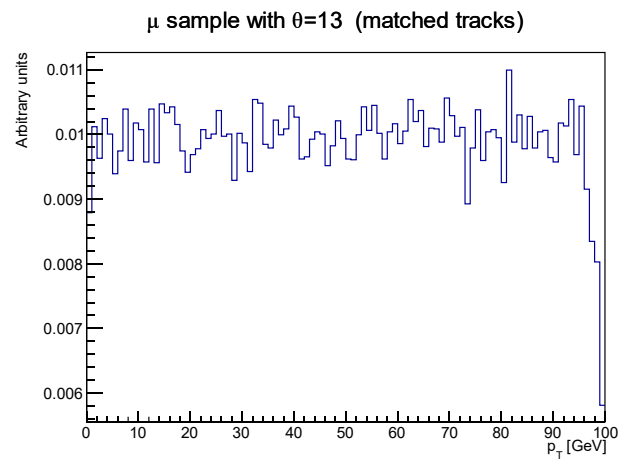
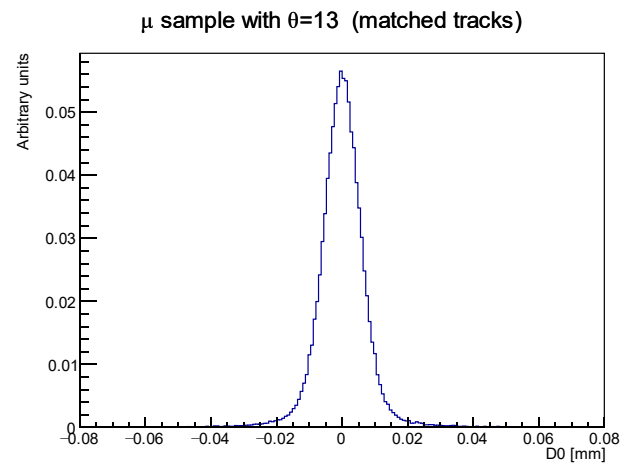
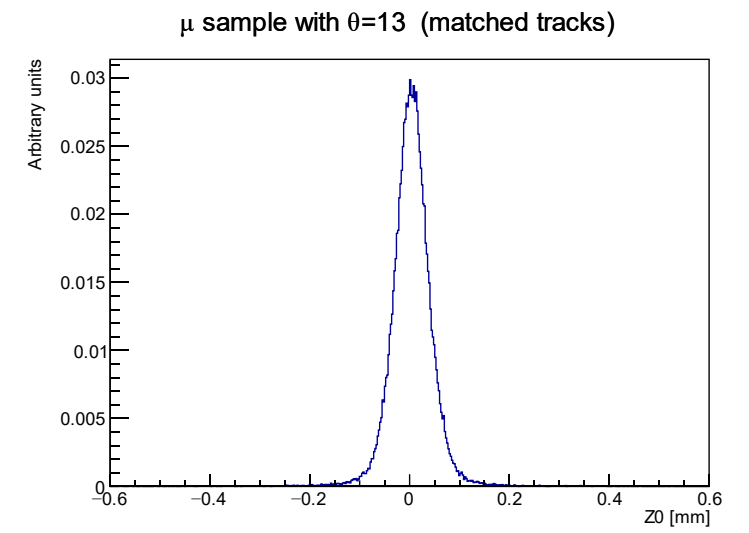
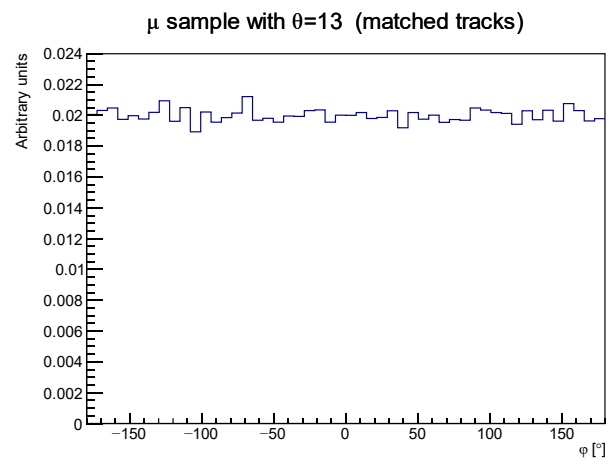
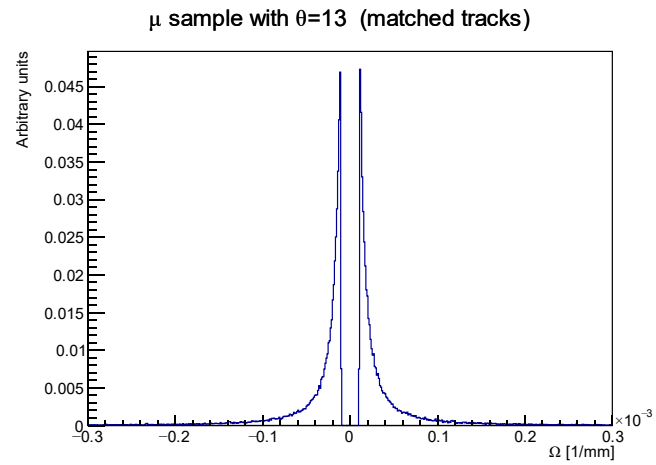
Number of hits $\theta=90^\circ$

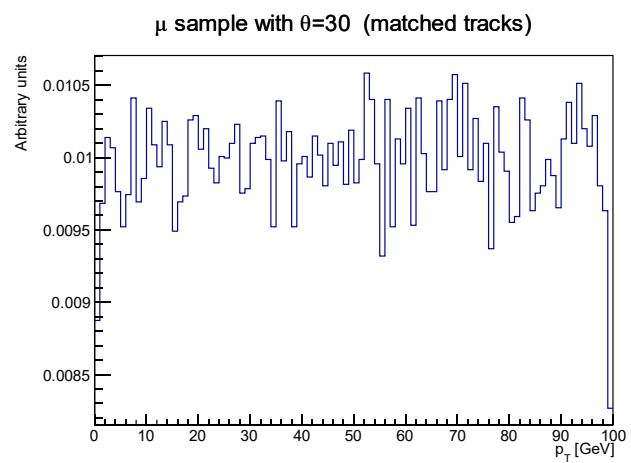
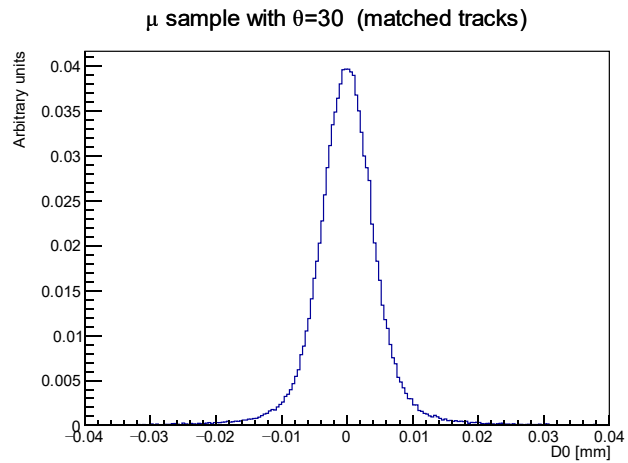
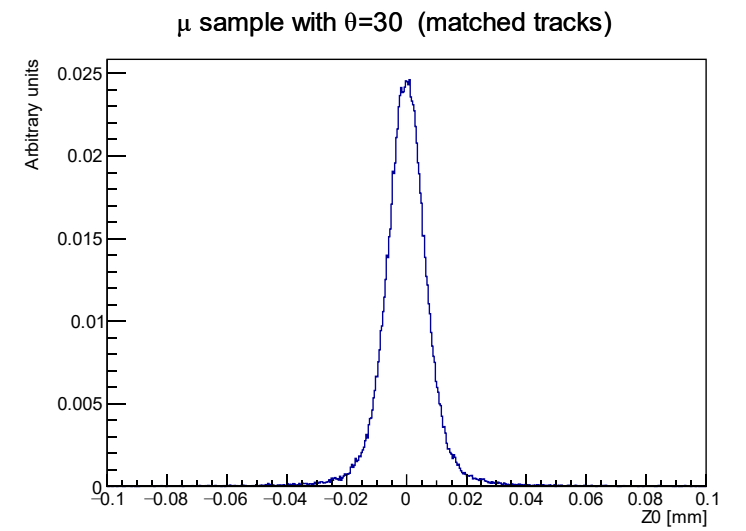
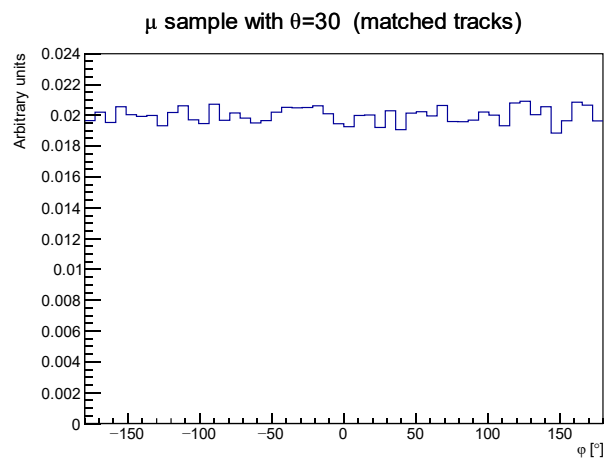
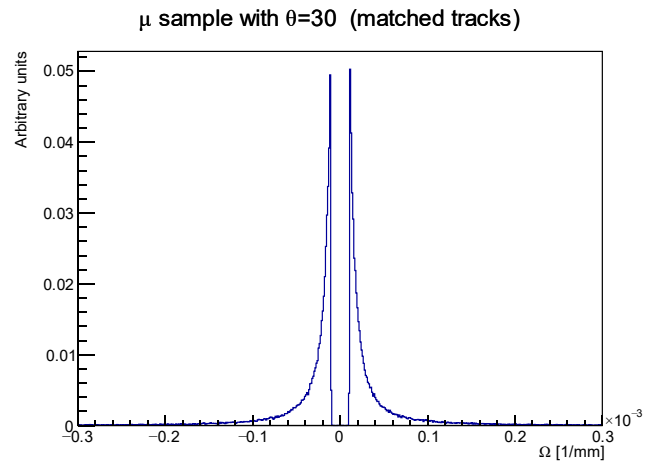


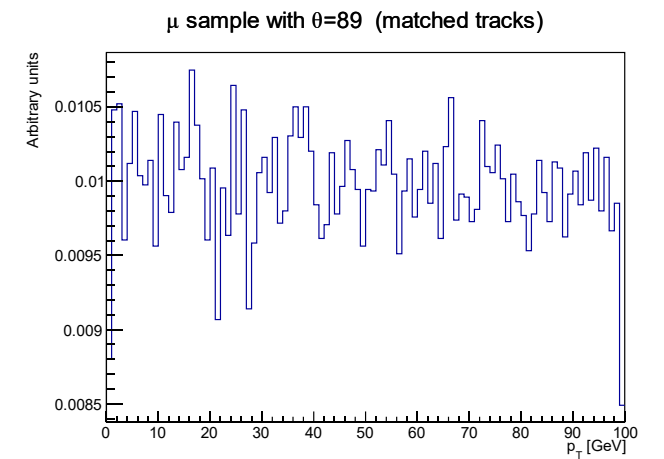
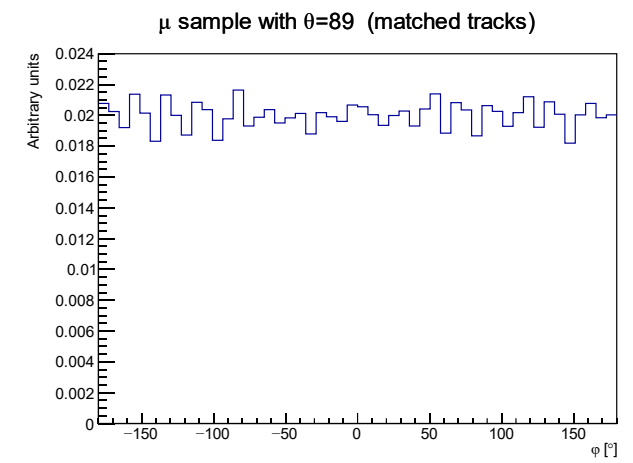
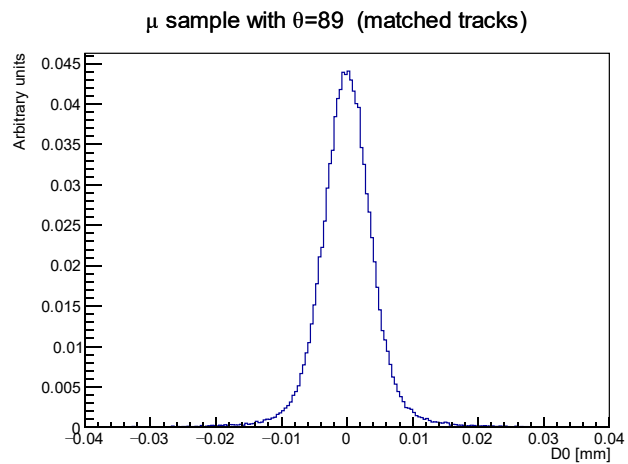
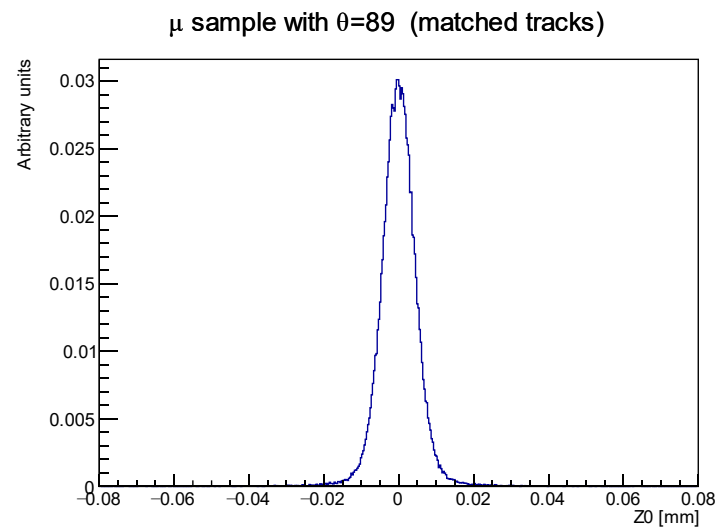
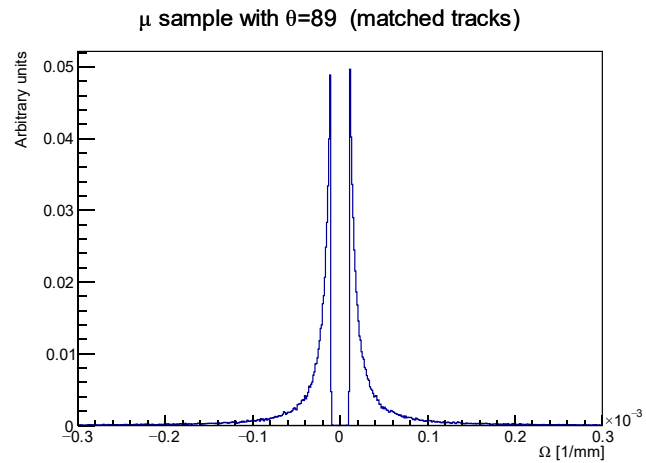




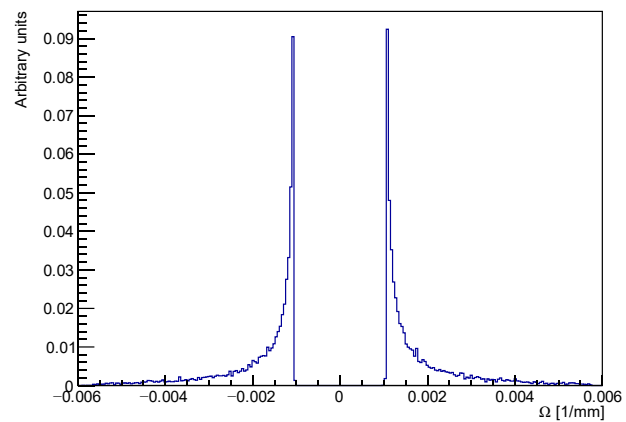




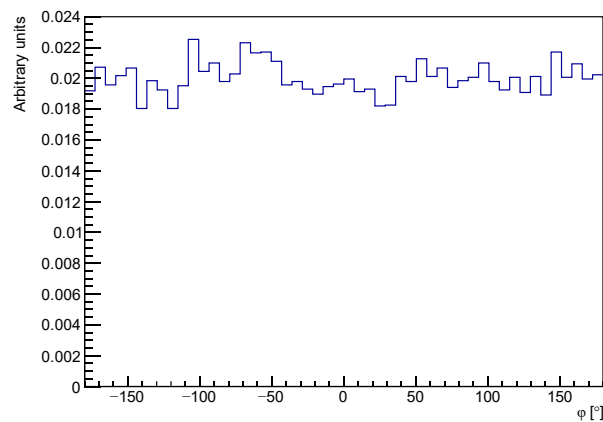




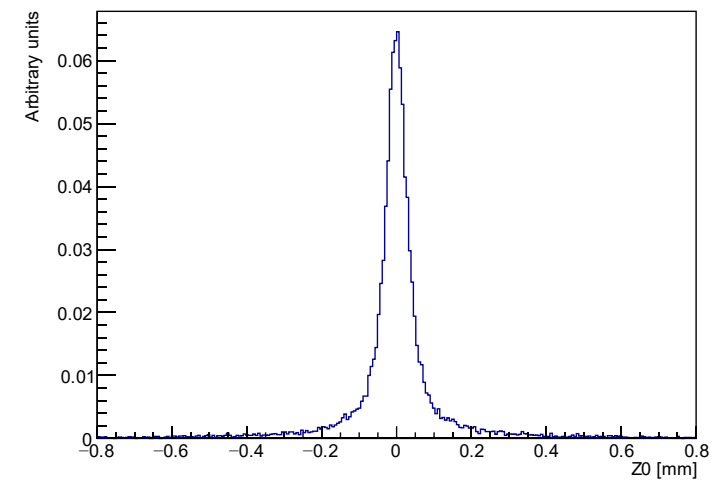
π sample with p=1 (matched tracks)



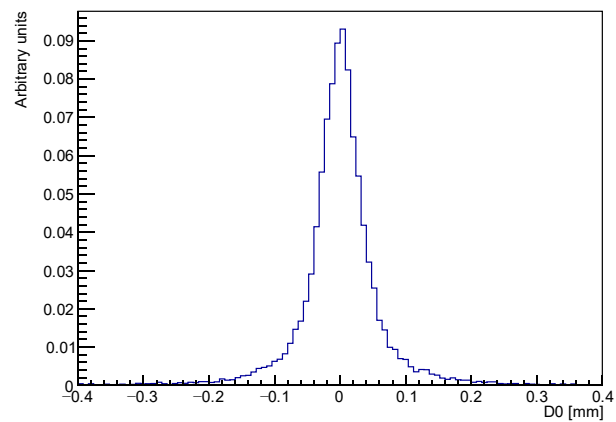
π sample with p=1 (matched tracks)



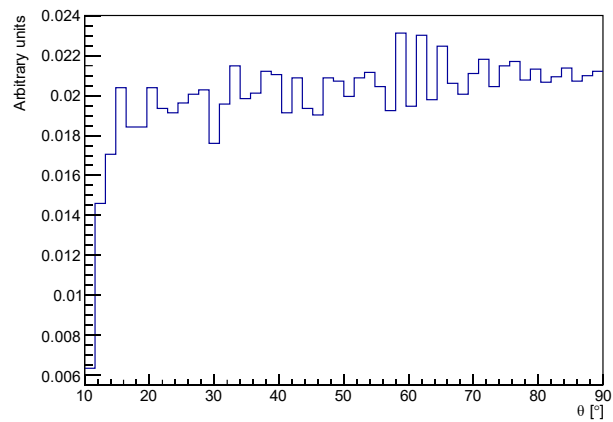
π sample with p=1 (matched tracks)

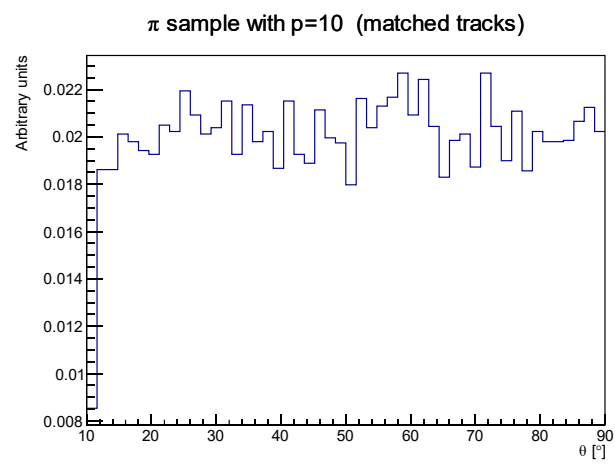
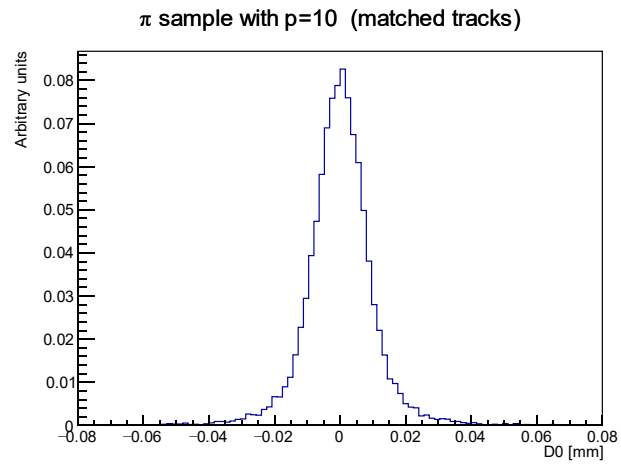
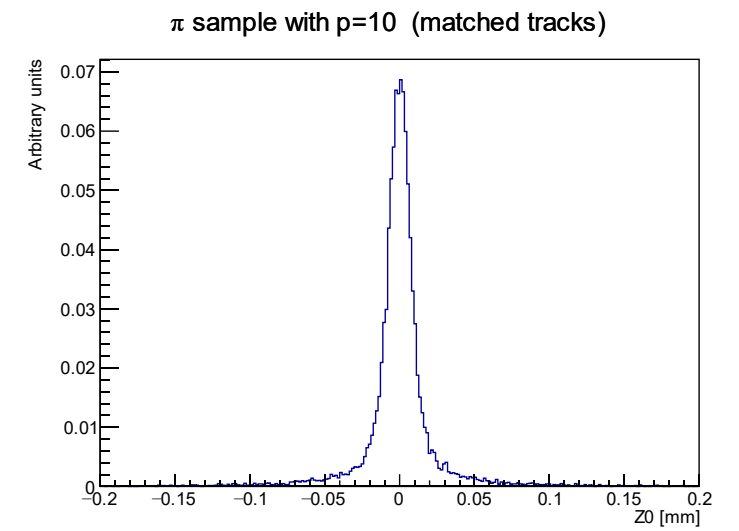
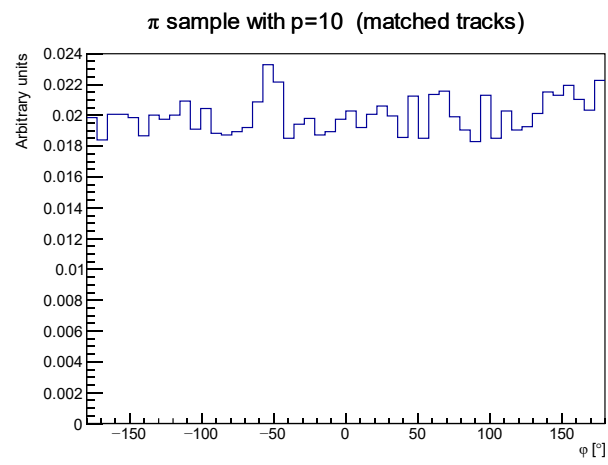
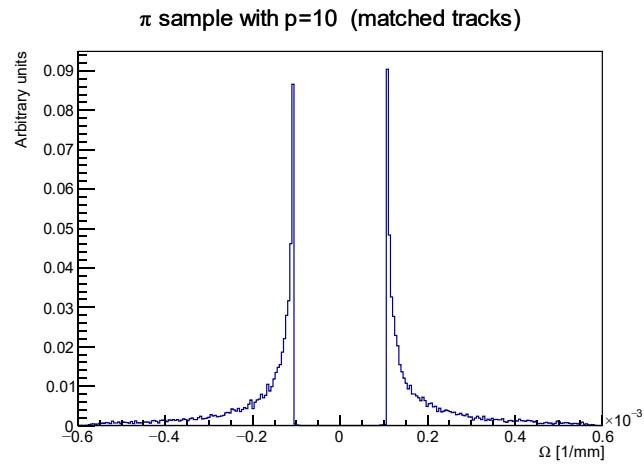


π sample with p=1 (matched tracks)

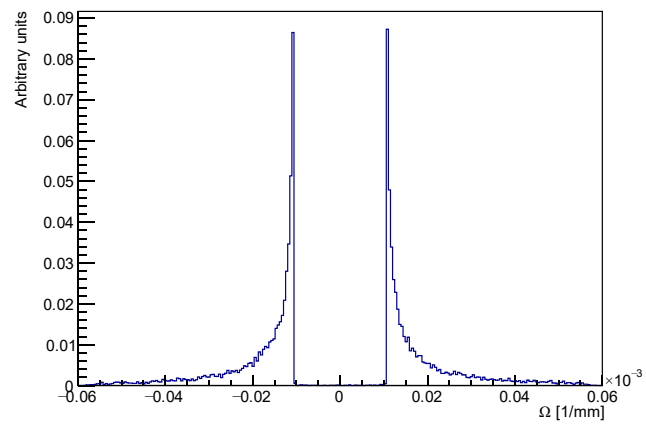


π sample with p=1 (matched tracks)

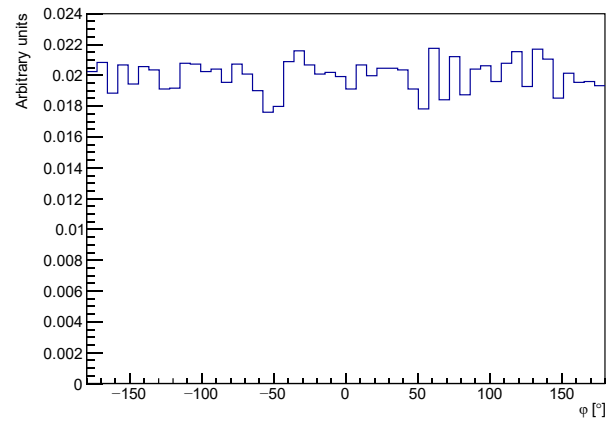




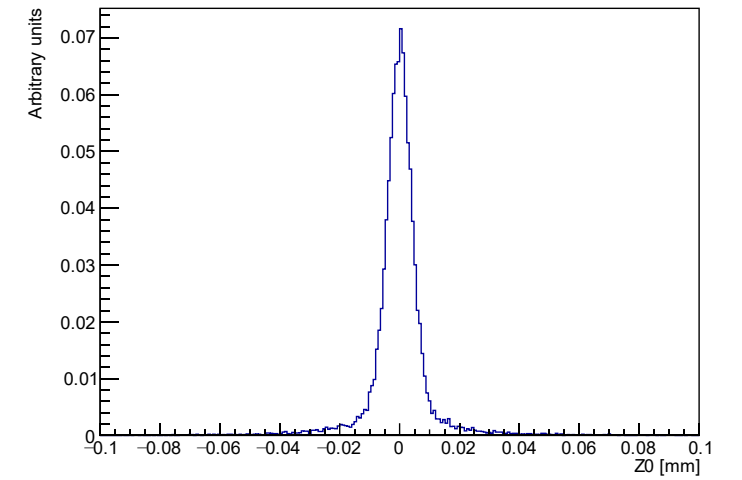
π sample with p=100 (matched tracks)



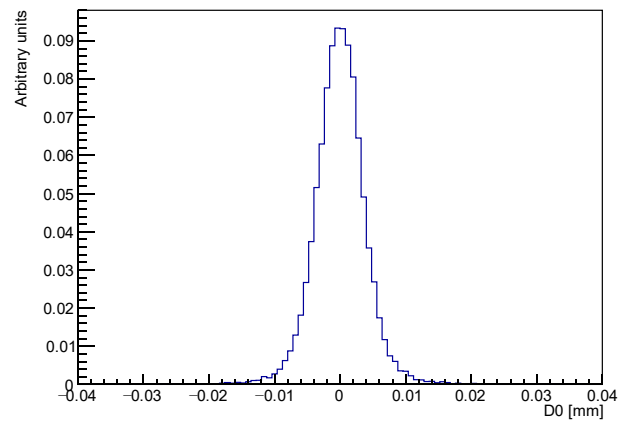
π sample with p=100 (matched tracks)



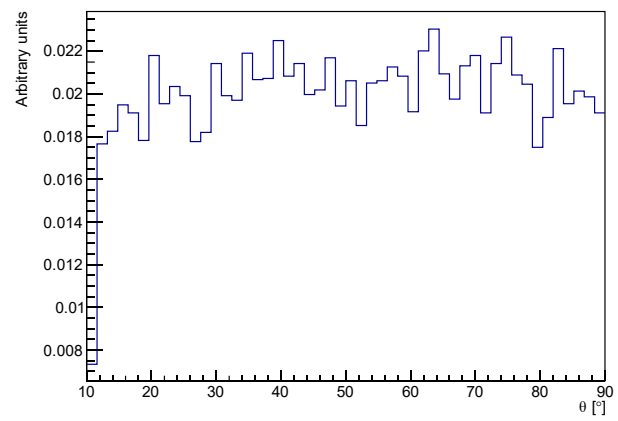
π sample with p=100 (matched tracks)

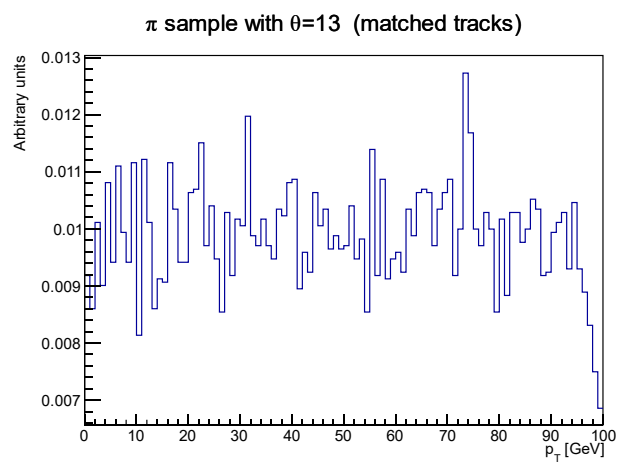
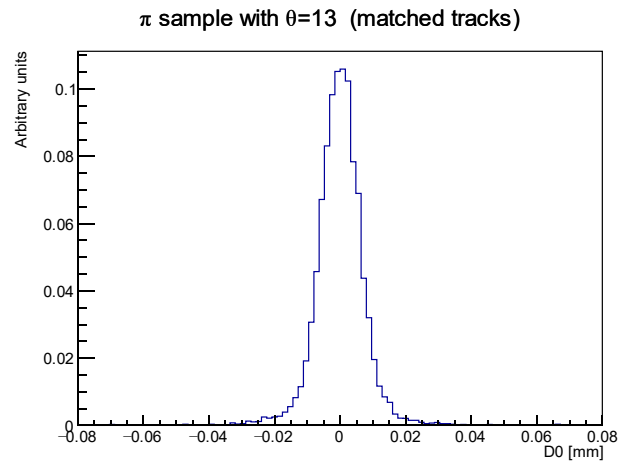
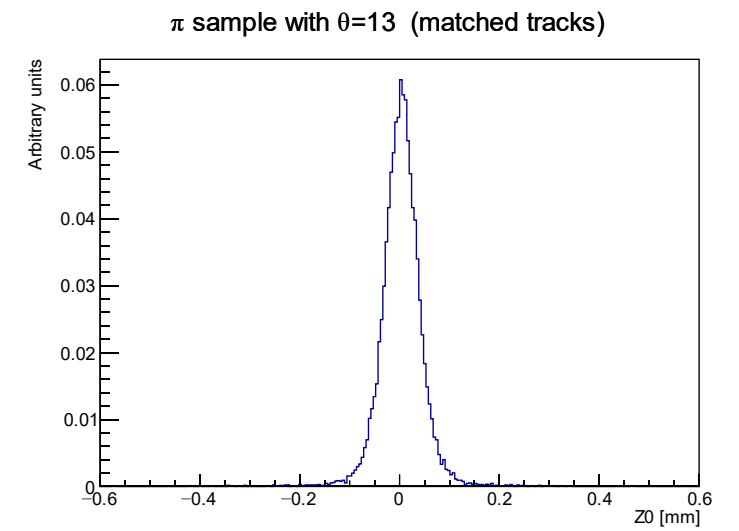
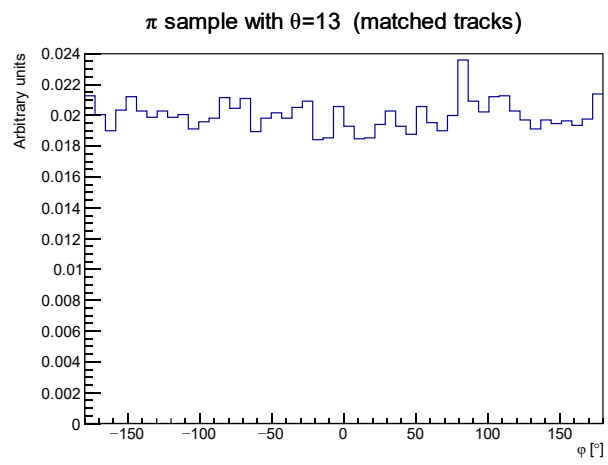
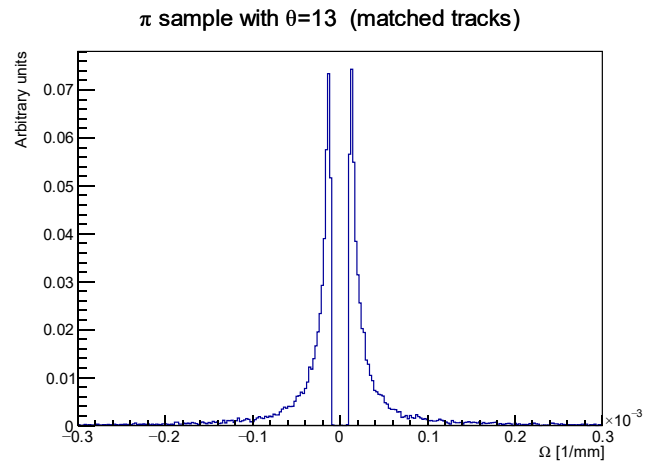


π sample with p=100 (matched tracks)

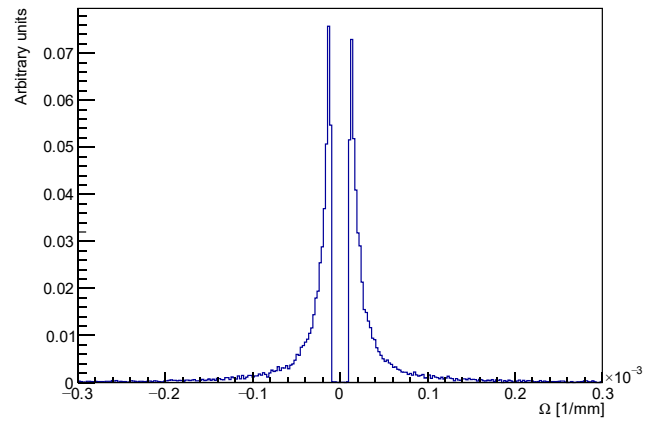


π sample with p=100 (matched tracks)

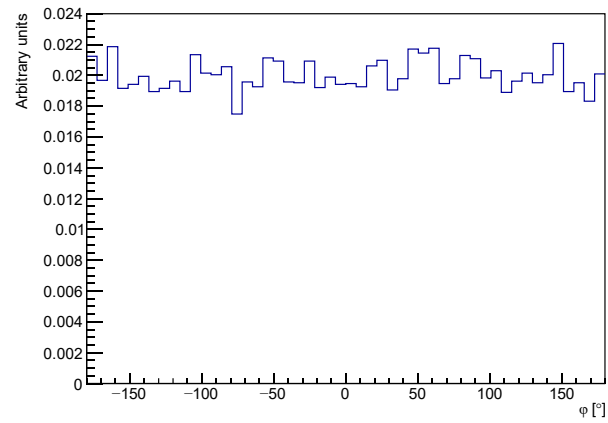




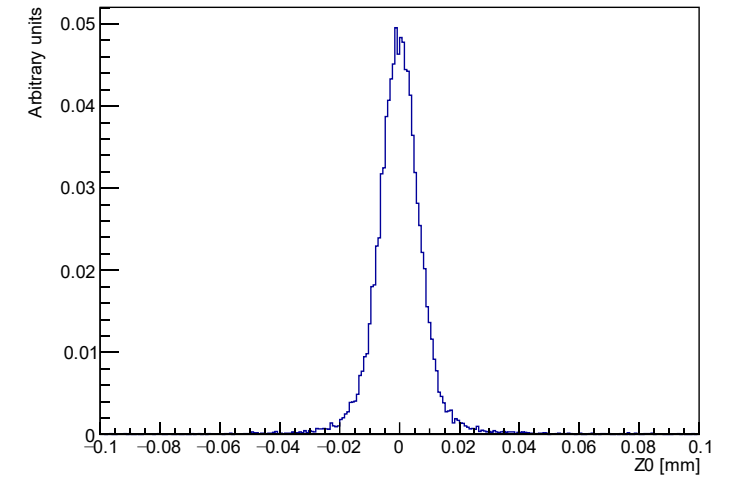
π sample with $\theta=30$ (matched tracks)



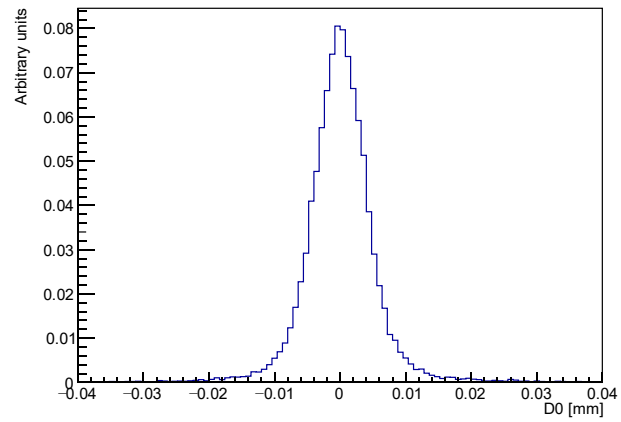
π sample with $\theta=30$ (matched tracks)



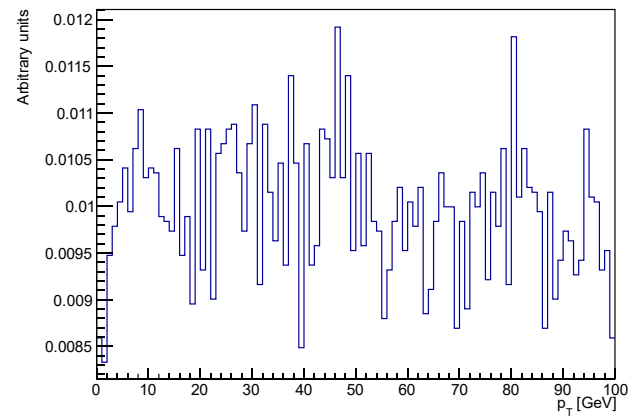
π sample with $\theta=30$ (matched tracks)



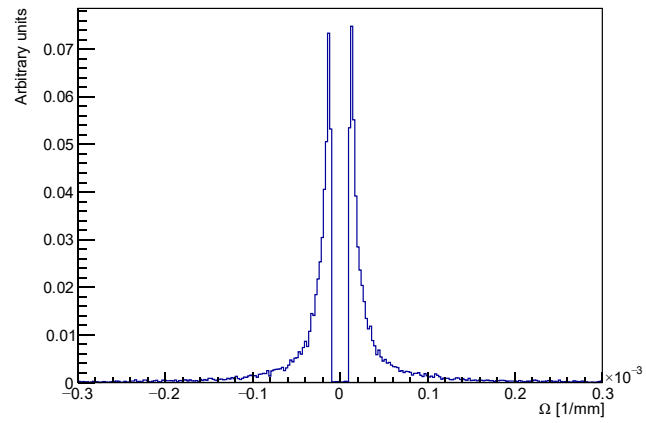
π sample with $\theta=30$ (matched tracks)



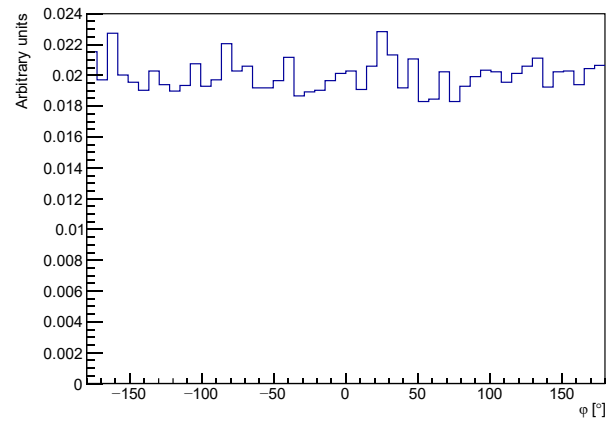
π sample with $\theta=30$ (matched tracks)



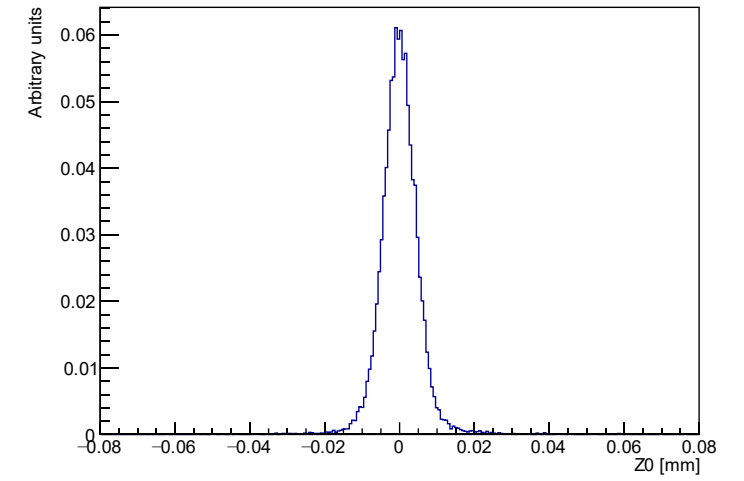
π sample with $\theta=89$ (matched tracks)



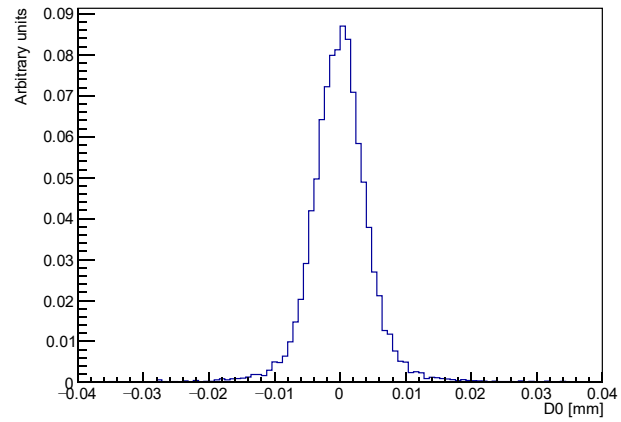
π sample with $\theta=89$ (matched tracks)



π sample with $\theta=89$ (matched tracks)



π sample with $\theta=89$ (matched tracks)



π sample with $\theta=89$ (matched tracks)

