

Muon system's studies: reconstruction

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First sample

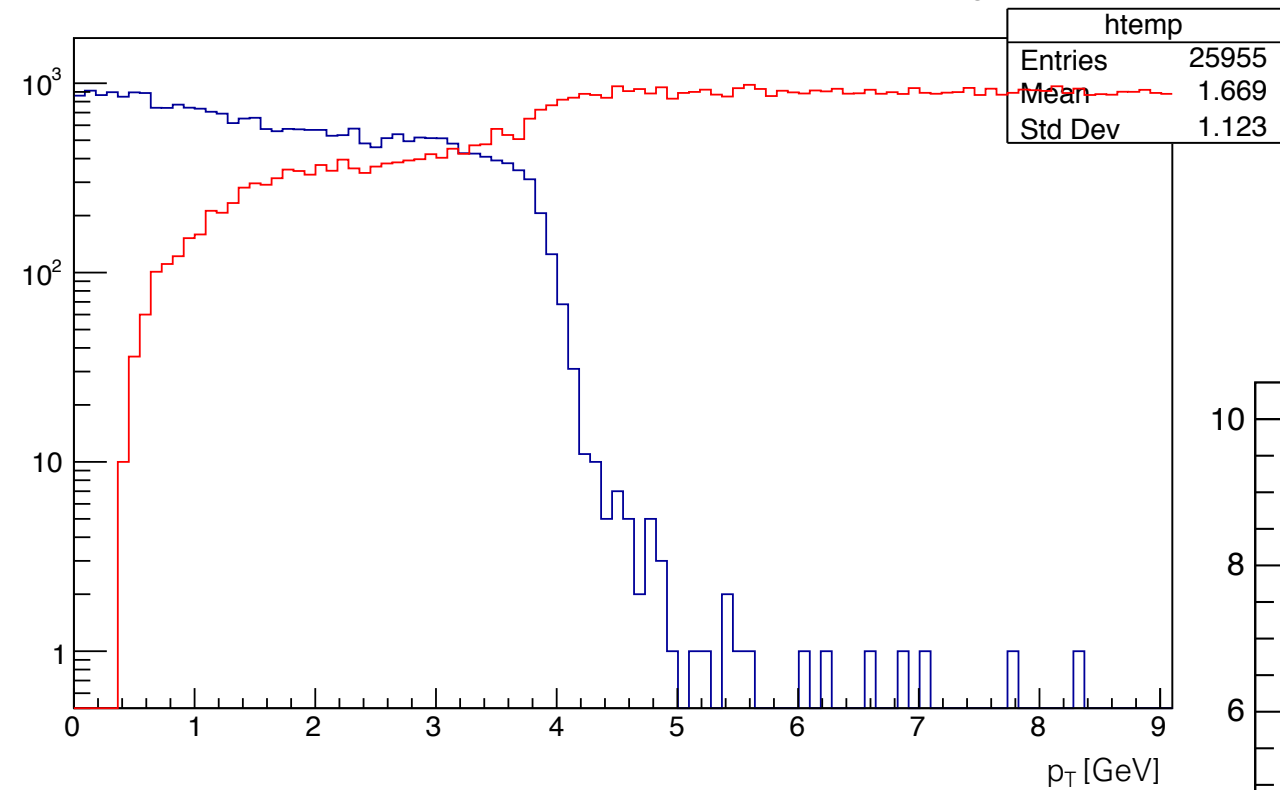
- Single muon
 - generated with p_T uniformly distributed between 0.1 and 10 GeV
 - $8^\circ < \theta < 172^\circ$
- Same sample as Massimo
- 100000 events

ISSUES

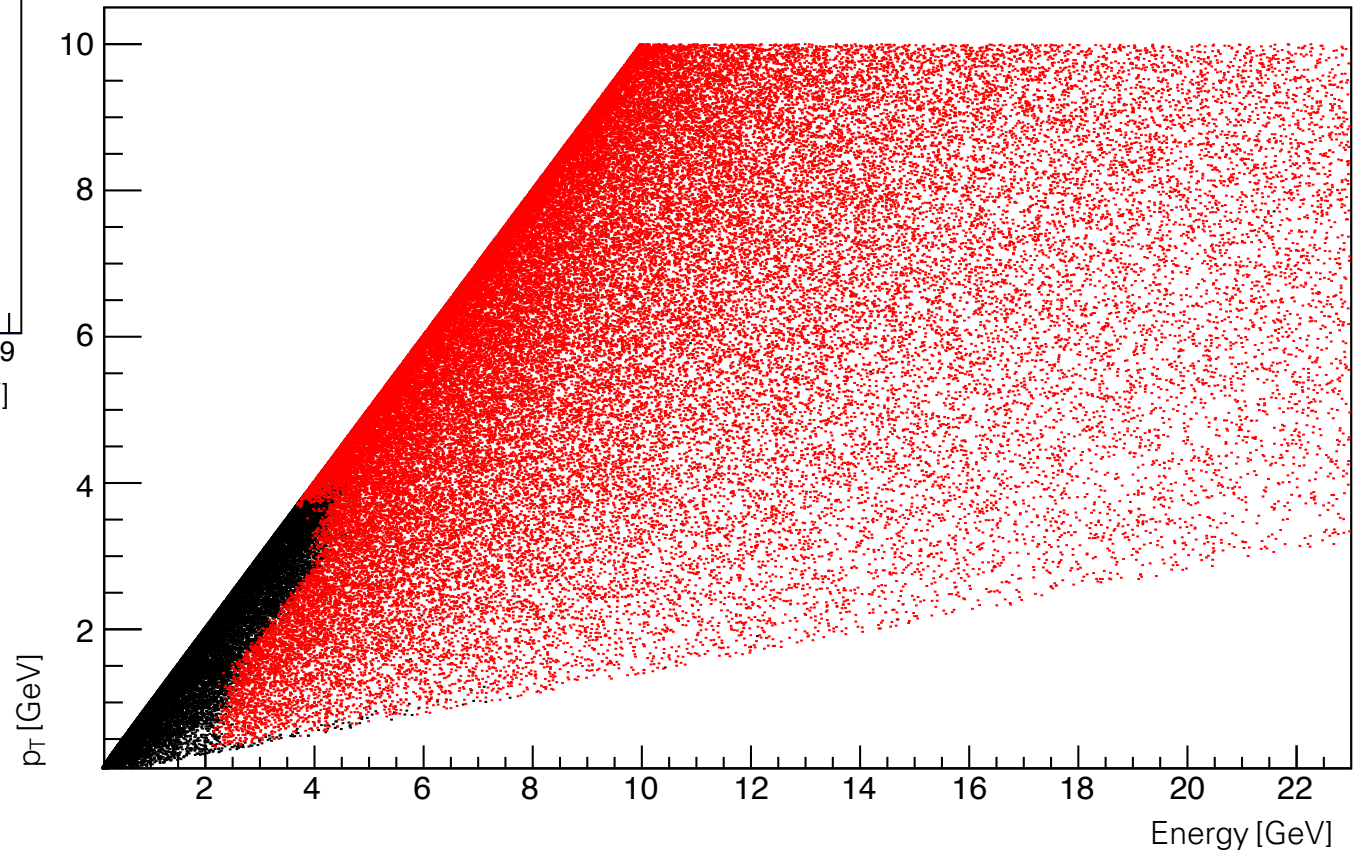
- ~75% of the muons generated reaches the muon system
- only ~63% of the muons reaching the muon system is reconstructed

	MUON	barrel	endcap	both
MU>0 (in the muon system)	74534	30982	49805	6253
MU>0 PFOCL=1 (reconstructed)	46875	15940	34610	3675
	0,63	0,51	0,69	0,59

1° issue: muons not in the muon system



Muons at low p_T ($< \sim 4$ GeV) do not reach the muon system

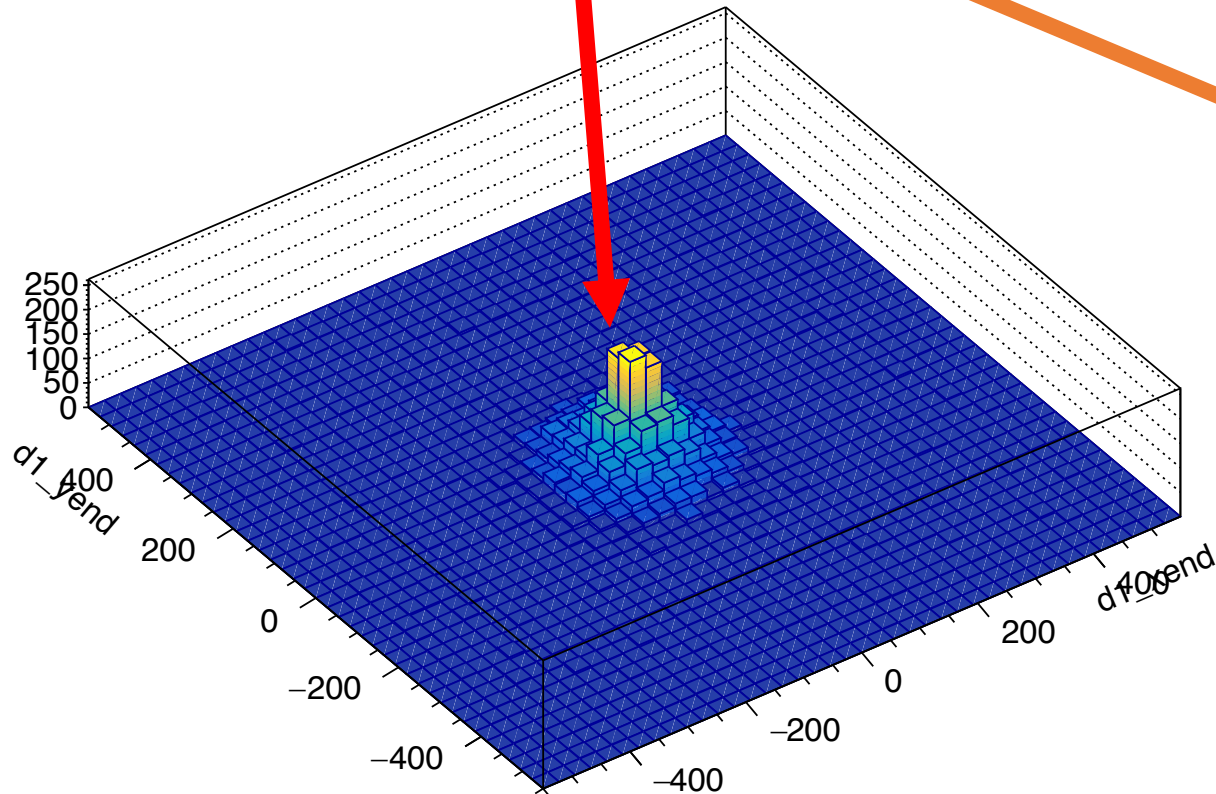


Muons are mostly stopped

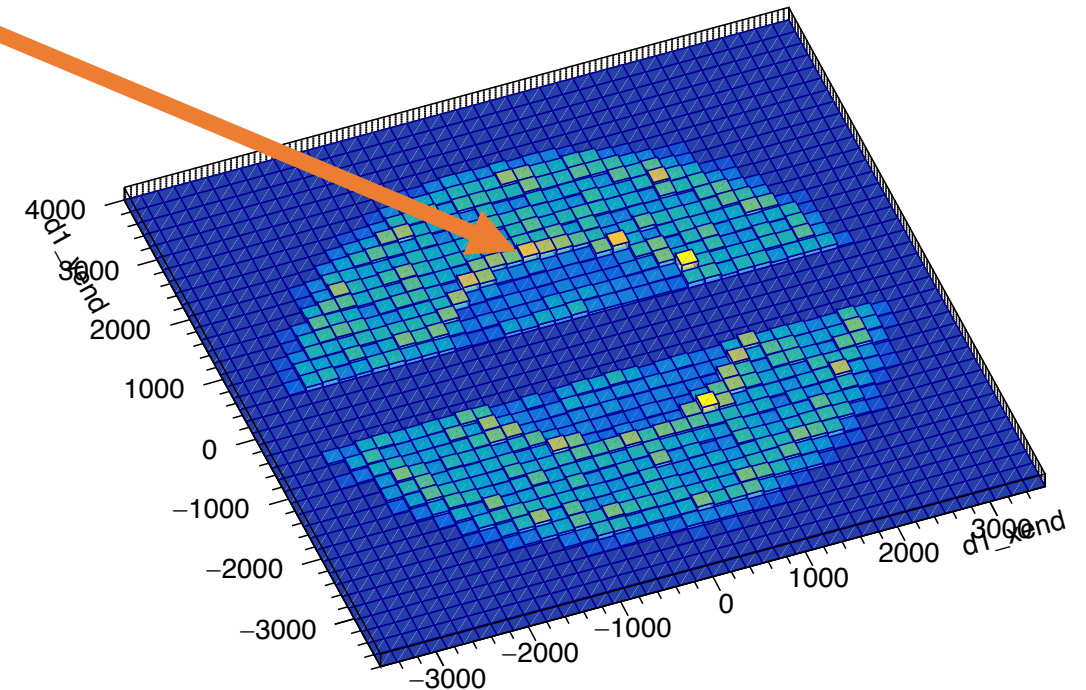
1. in the beam pipe-tracker region
2. in the ECAL

Radius [mm]	Region	#muons stopped	
<446	Beam pipe	5692	22%
446-1500	Tracker	2999	12%
1500-1702	ECAL	2514	10%
1702-muon system	HCAL	14261	56%

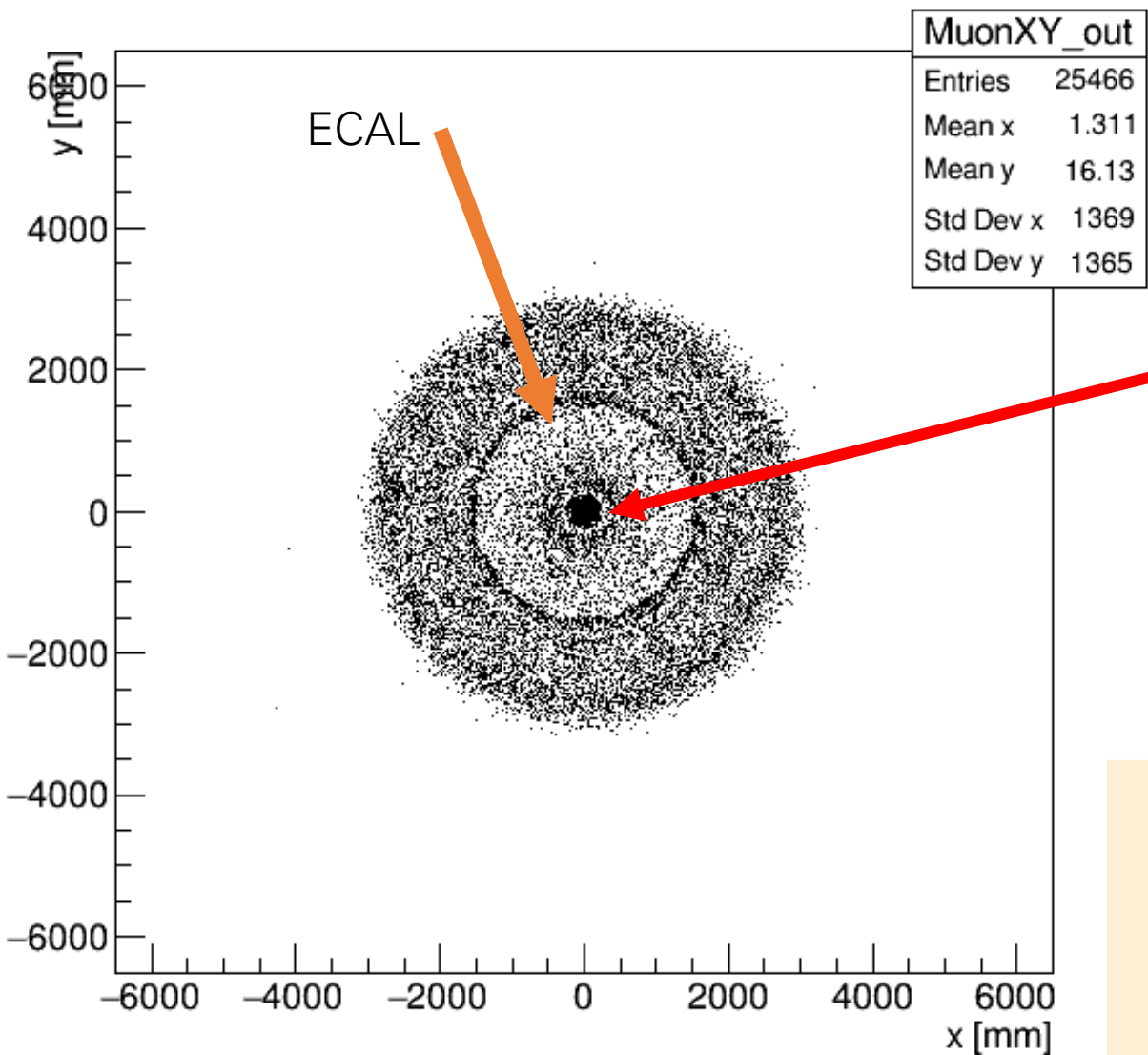
d1_yend:d1_xend {abs(d1_zend)<4179 && sqrt(d1_xend*d1_xend+d1_yend*d1_yend)<4461 && abs(d1_zend)<500 && abs(d1_xend)<500 }



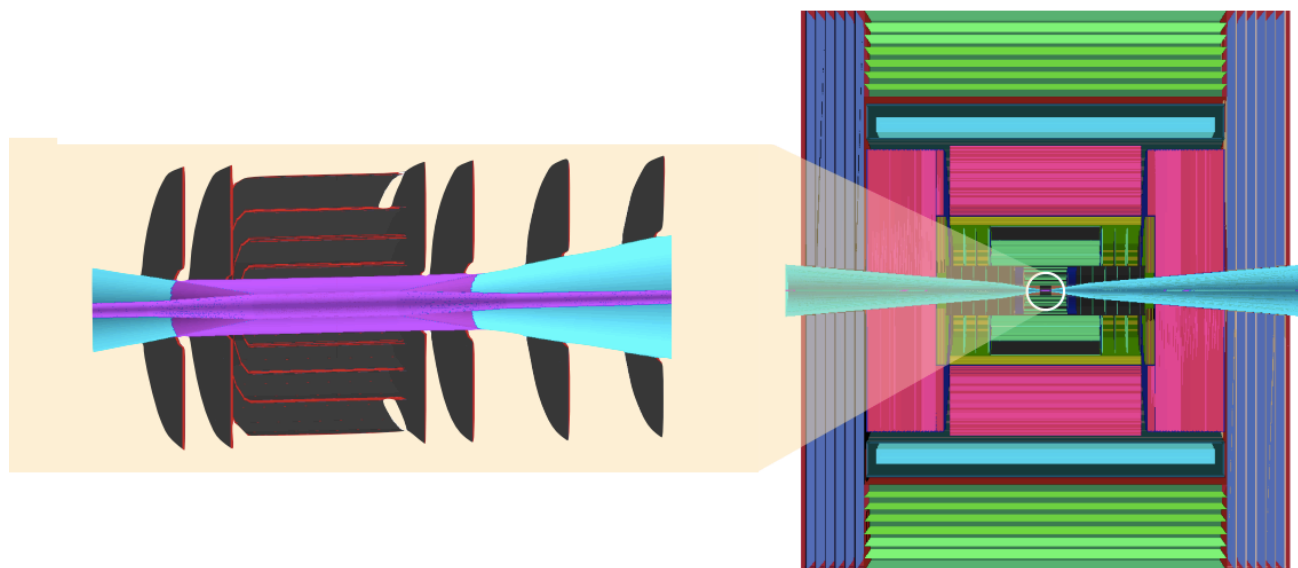
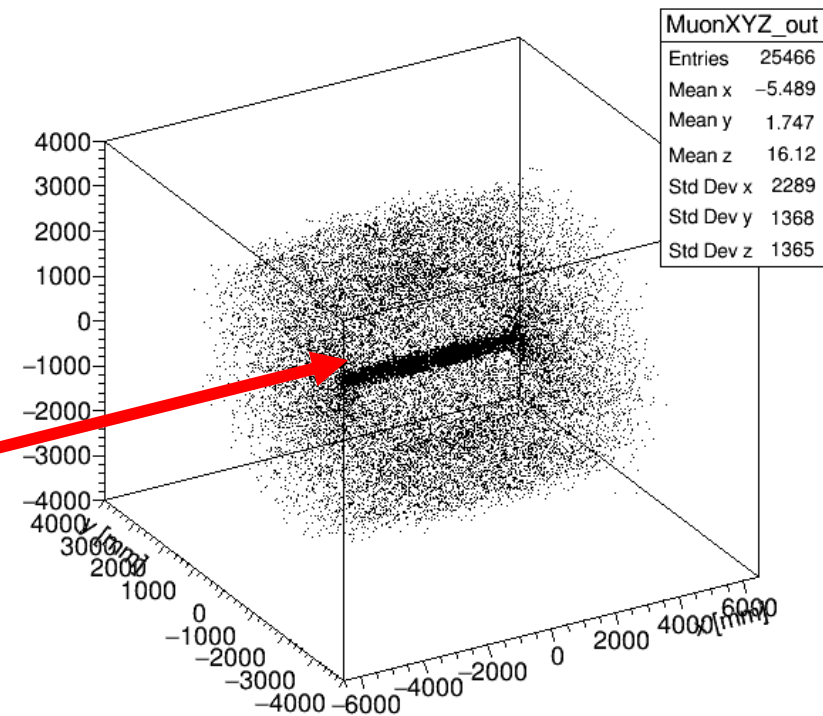
d1_yend:d1_xend {abs(d1_zend)<4179 && sqrt(d1_xend*d1_xend+d1_yend*d1_yend)<4461 && abs(d1_yend)>500 }

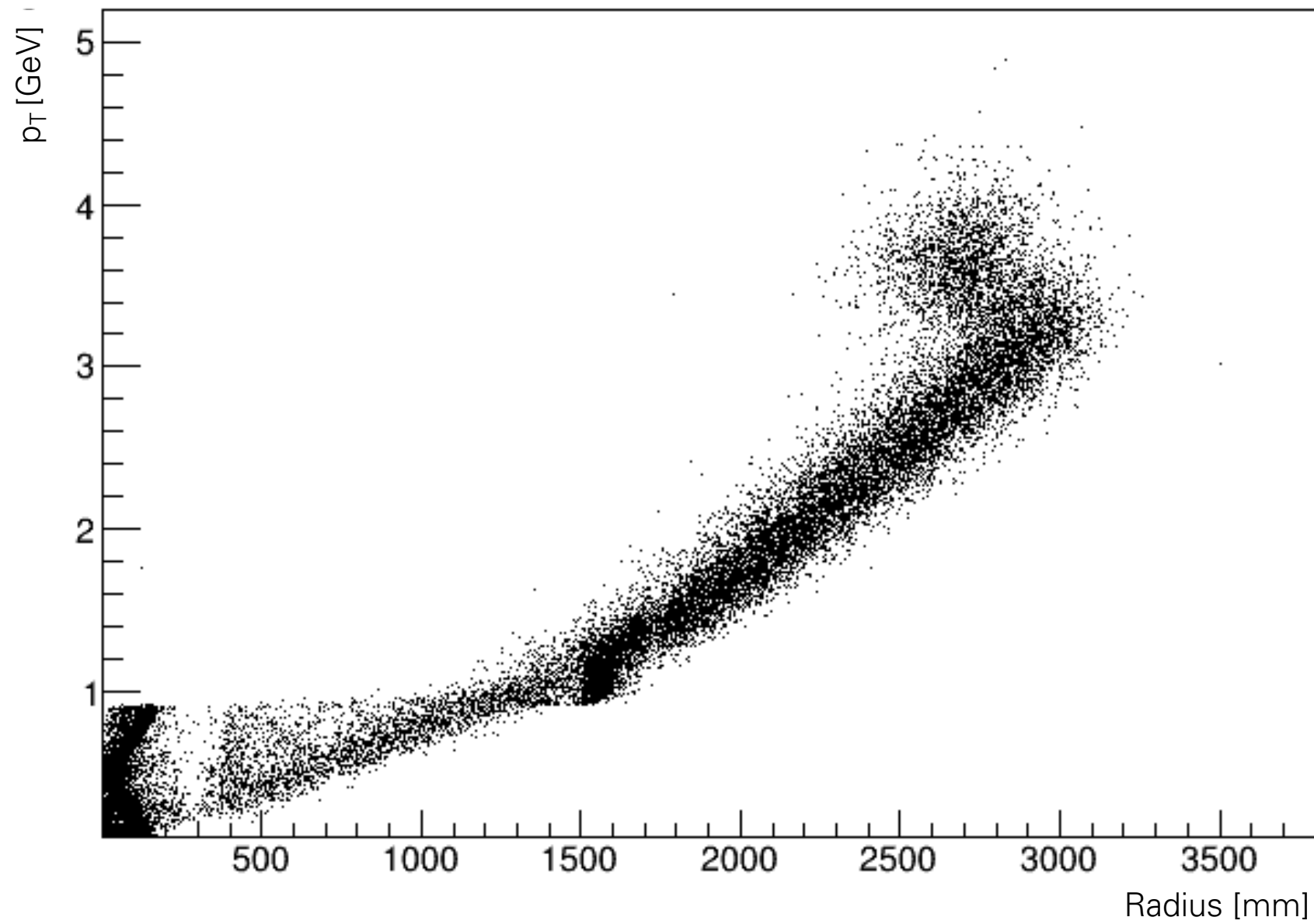


Y vs X - muons no in MUONDet



Y vs X vs Z- muons no in MUONDet





2° issue: muon reconstruction

MAGNETIC FIELD

```
<!--Normal vector for the muon barrel sensitive layers in local coordinates-->  
  <parameter name="YokeBarrelNormalVector" type="FloatVec">0 0 1 </parameter>  
  <!--The bfield in the muon barrel, units Tesla-->  
  <parameter name="MuonBarrelBField" type="float">1.5 </parameter>  
  <!--The bfield in the muon endcap, units Tesla-->  
  <parameter name="MuonEndCapBField" type="float">0.01 </parameter>
```


MUON RECONSTRUCTION ALGORITHM

1. Identification of yoke track candidates:

Cone-based clustering algorithm used.

CLUSTER=hits inside a cone and in neighbouring layers

Centroid of the cluster is calculated.

Selection of the best track to compare with the ID track

- maxClusterCaloHits: 30
- minClusterOccupiedLayers: 2
- minClusterLayerSpan: 0
- minTrackCandidateEnergy: 7

2. Extrapolation of inner detector tracks to muon system:

Knowing the magnetic field the ID track is extrapolated using an helix

3. Matching of inner detector tracks and yoke tracks:

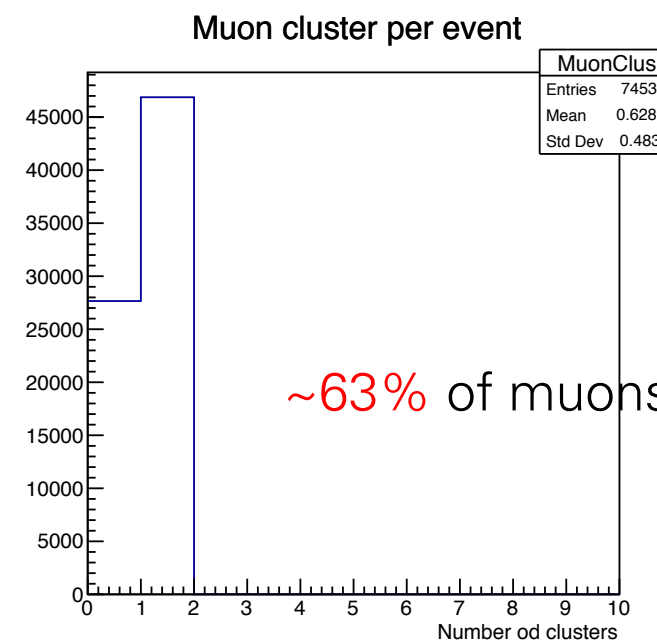
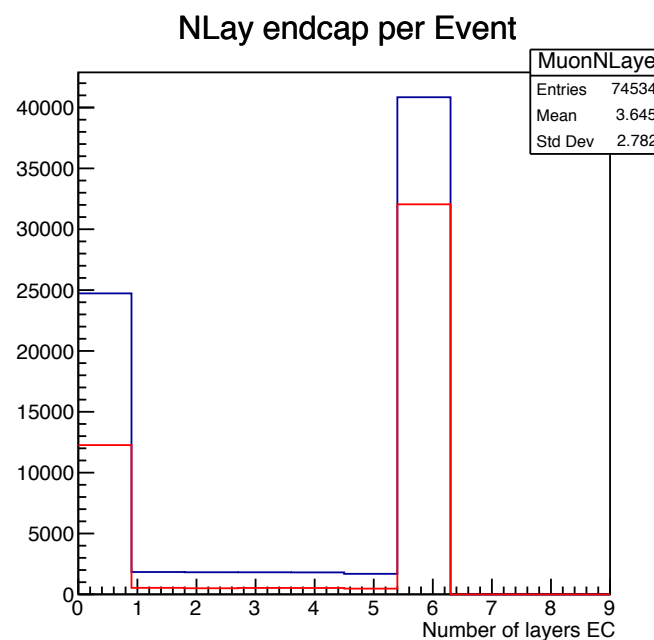
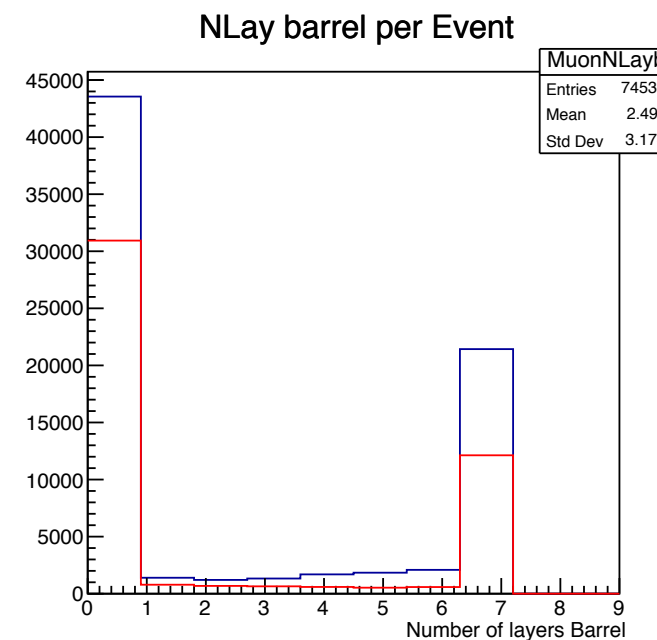
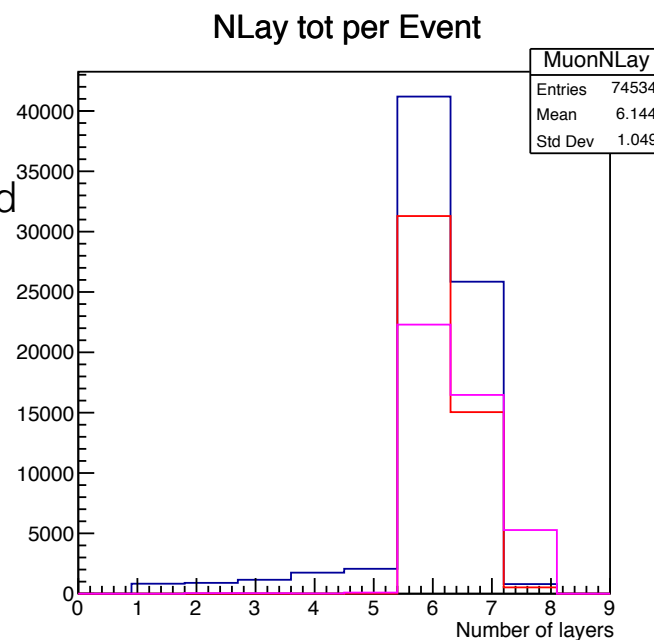
two variables are calculated

- a. the distance of closest approach of the external helix to the centroid
- b. the angle between the helix and the yoke track

- minHelixClusterAngle: 0.98
- maxDistanceToTrack: 200

4. Identification of muon calorimeter hits

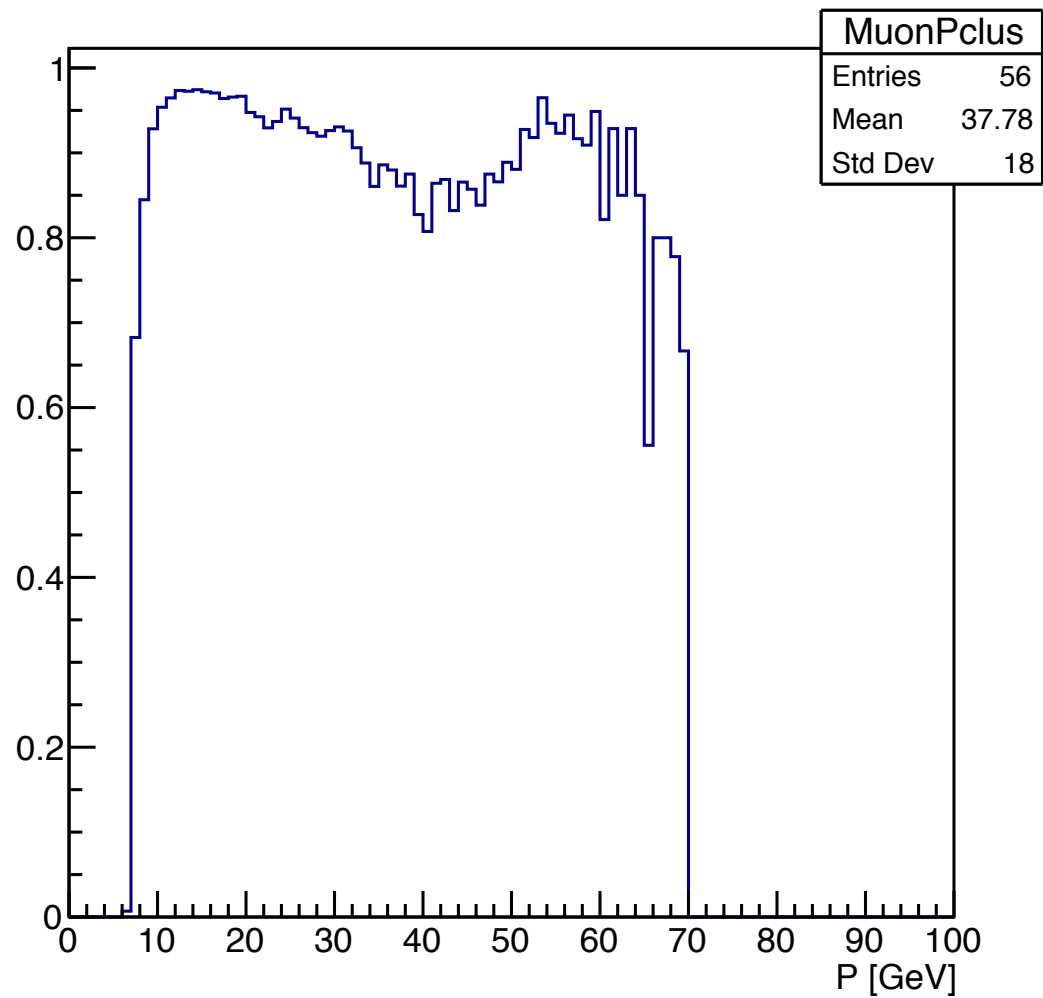
Legend:
 blue # layers for each muon
 red # layers for reconstructed muons
 pink # hits for PFO cluster



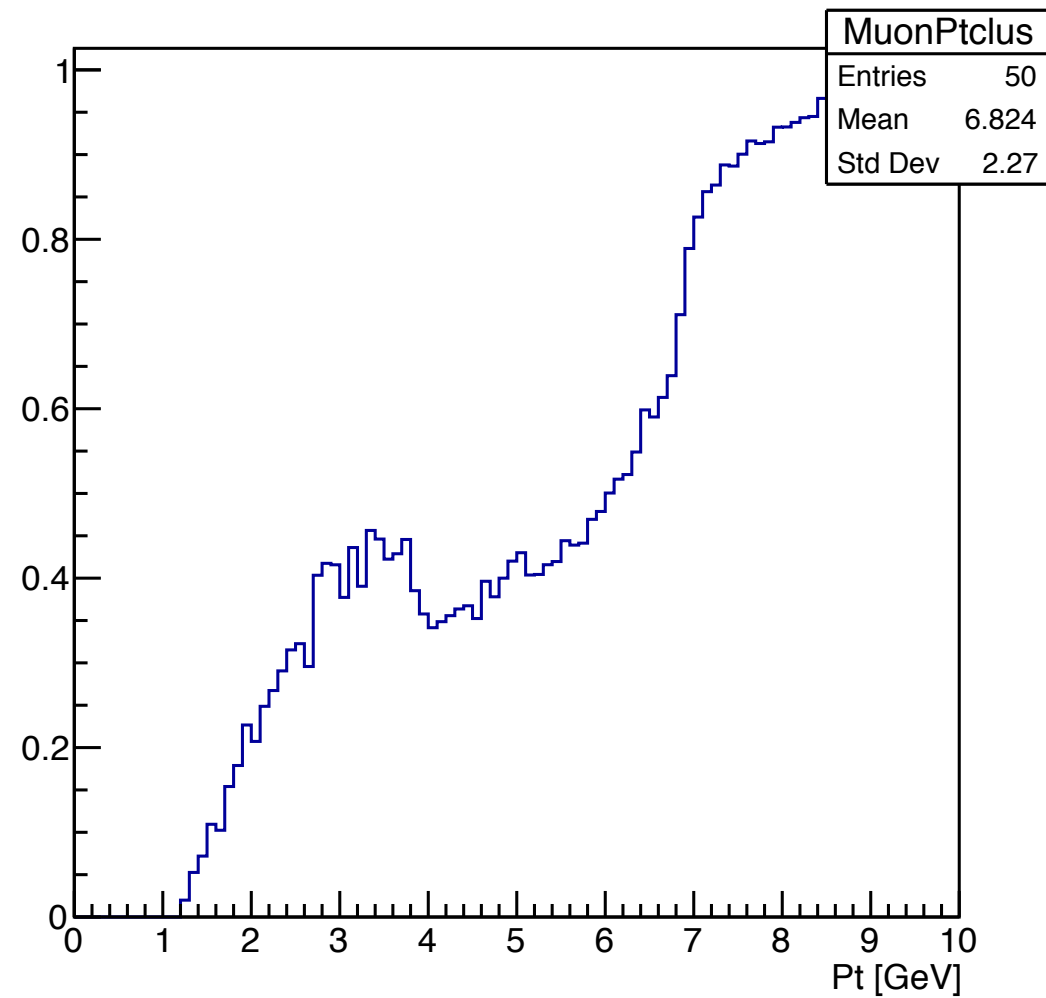
~63% of muons are reconstructed

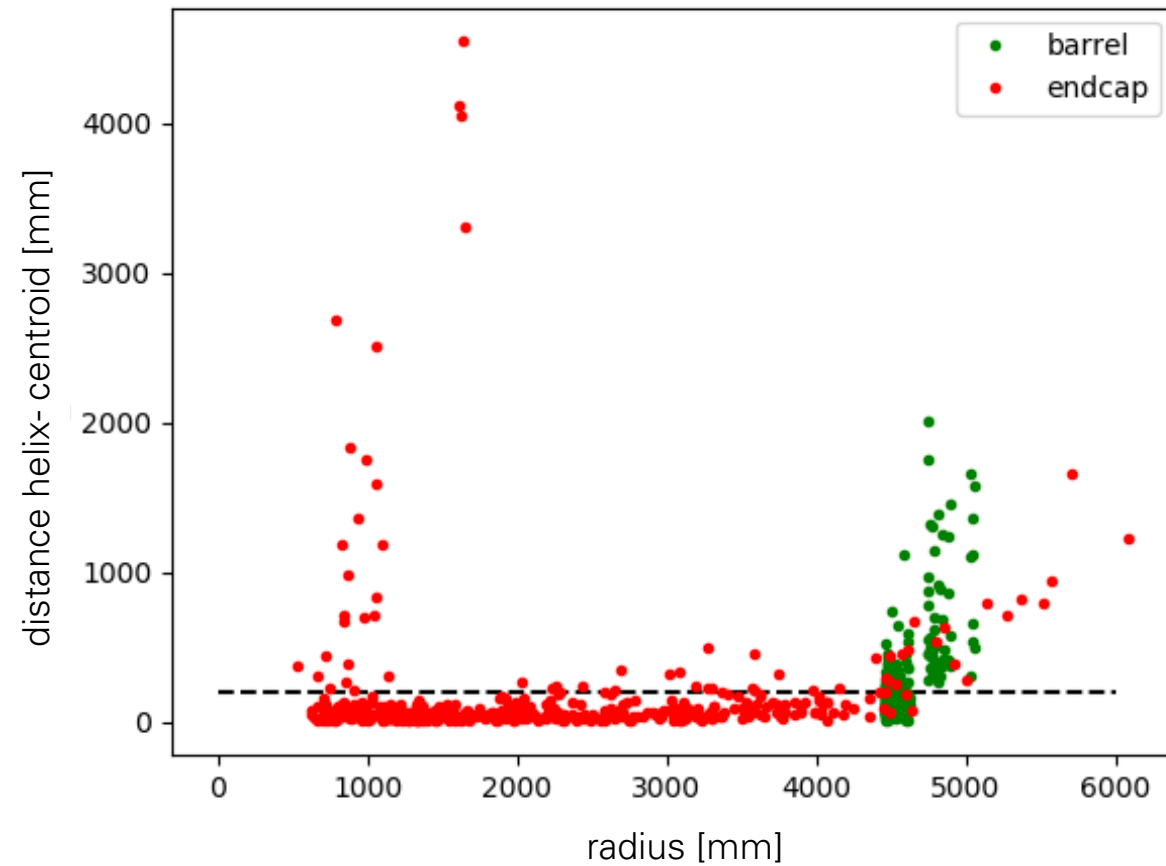
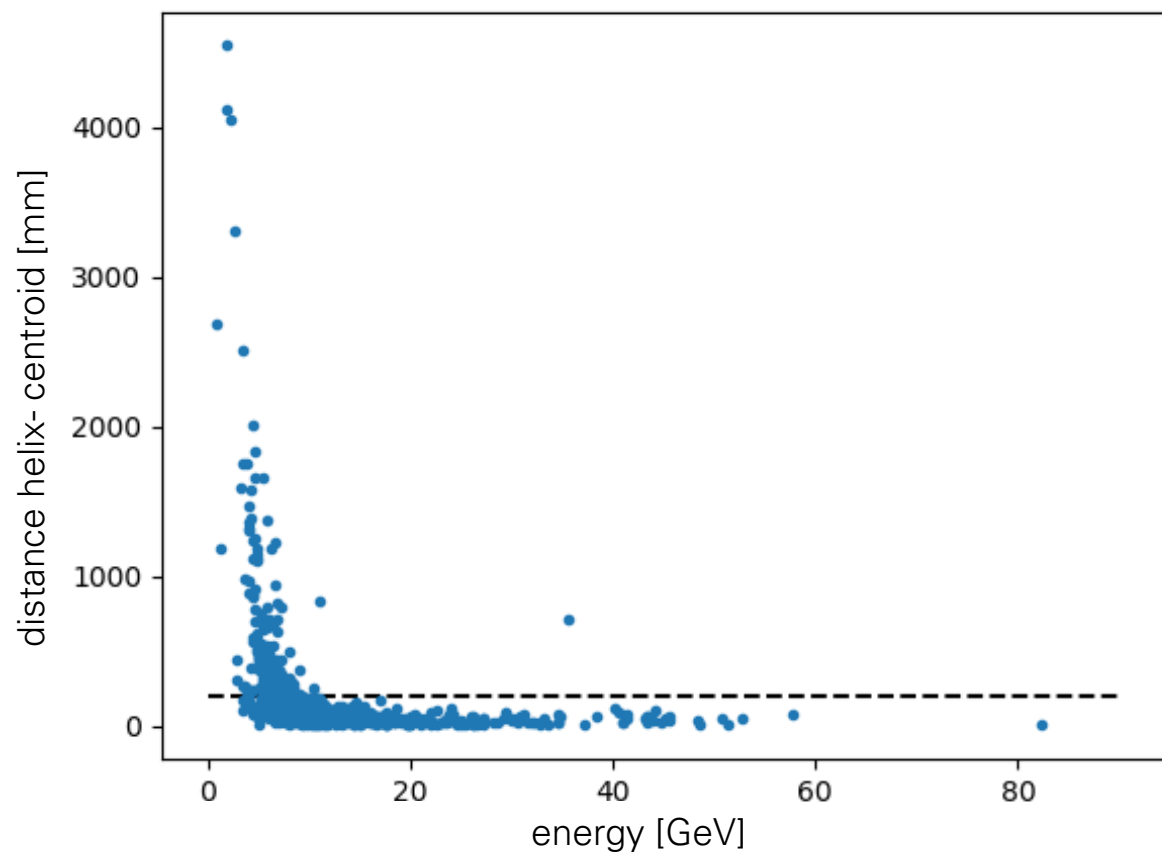
Reconstruction issue is not related to the number of hits and layers

Momentum efficiency



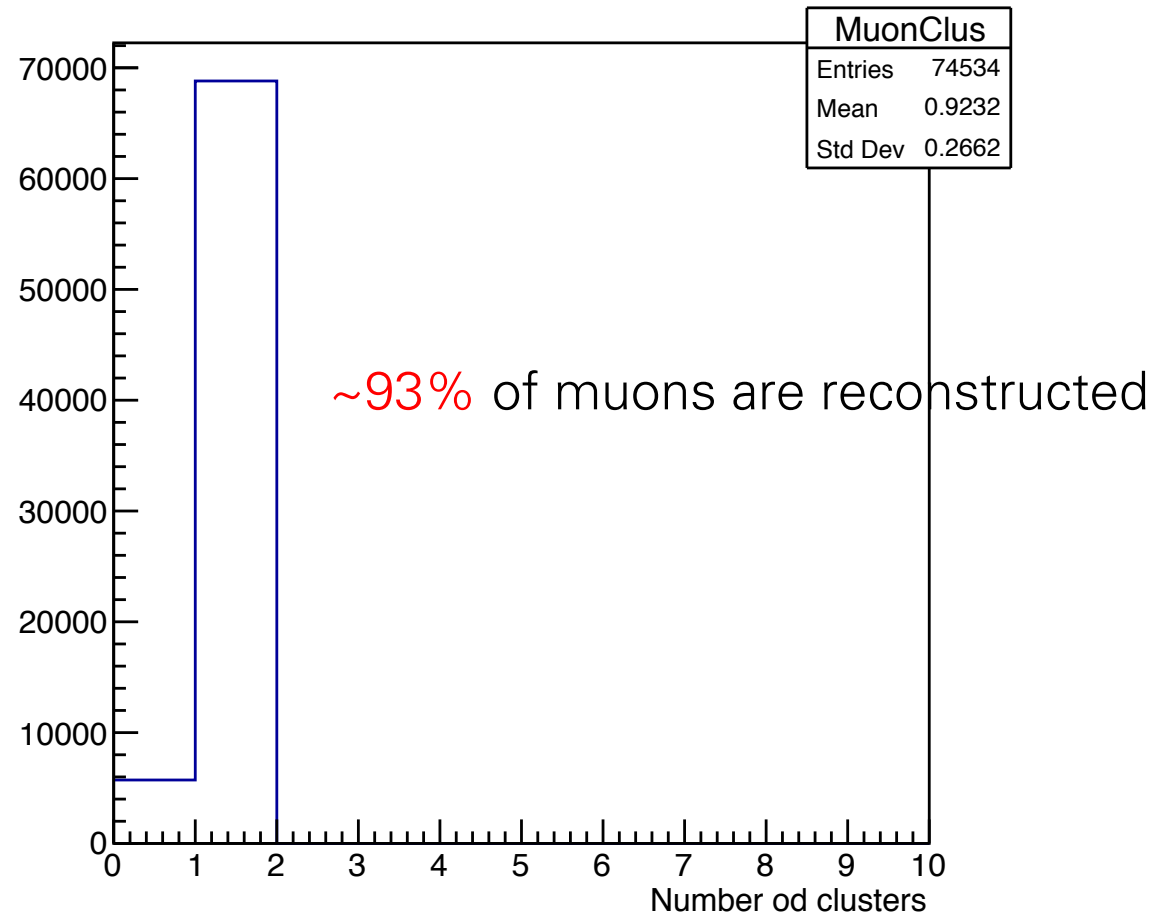
Transverse momentum efficiency



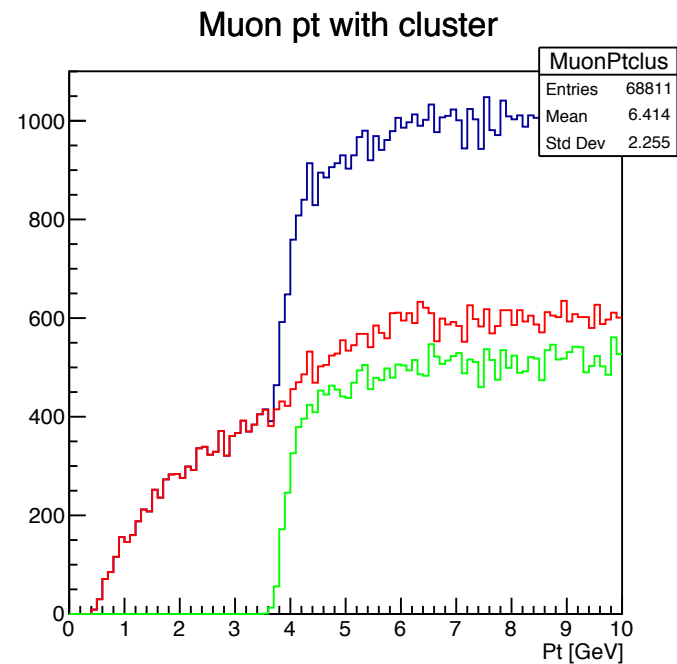
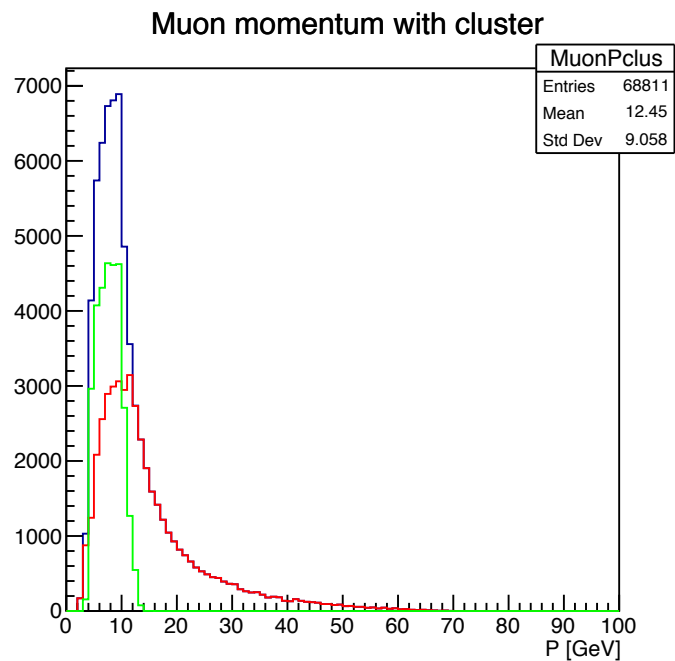
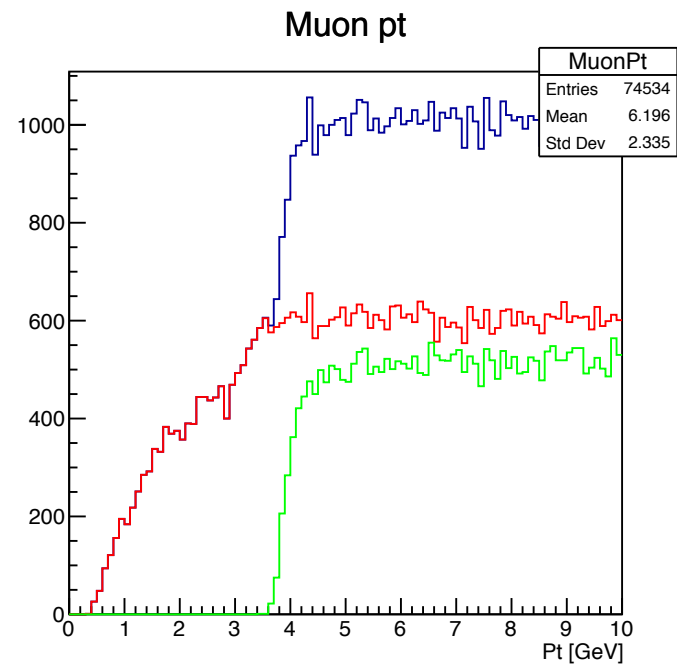
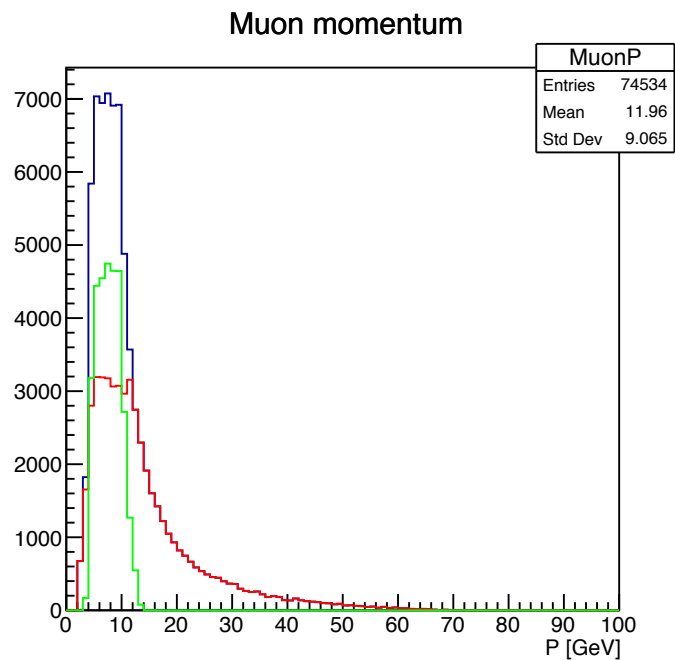


NEW PARAMETERS

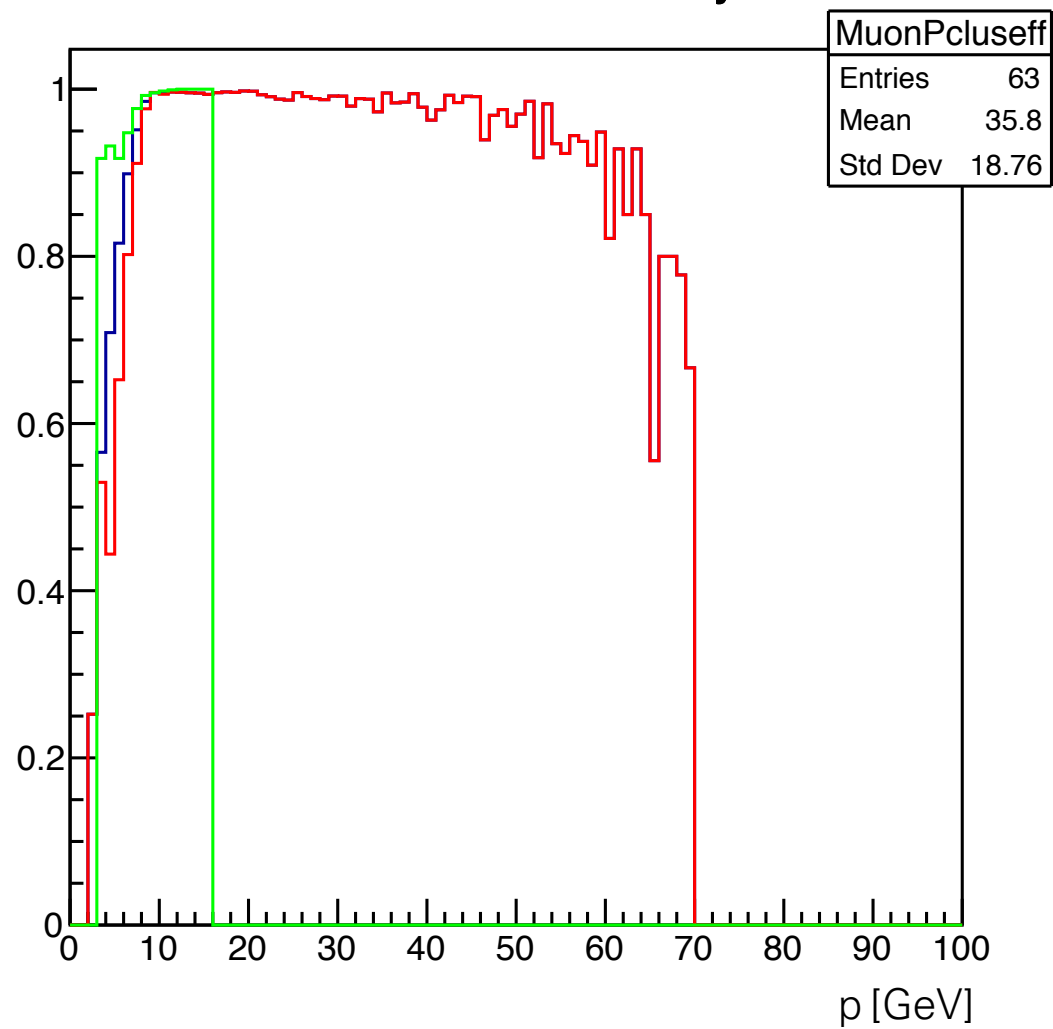
- minTrackCandidateEnergy: 0.1 GeV
- HelixClusterCosAngle: 0.5
- maxDistanceToTrack: 1000



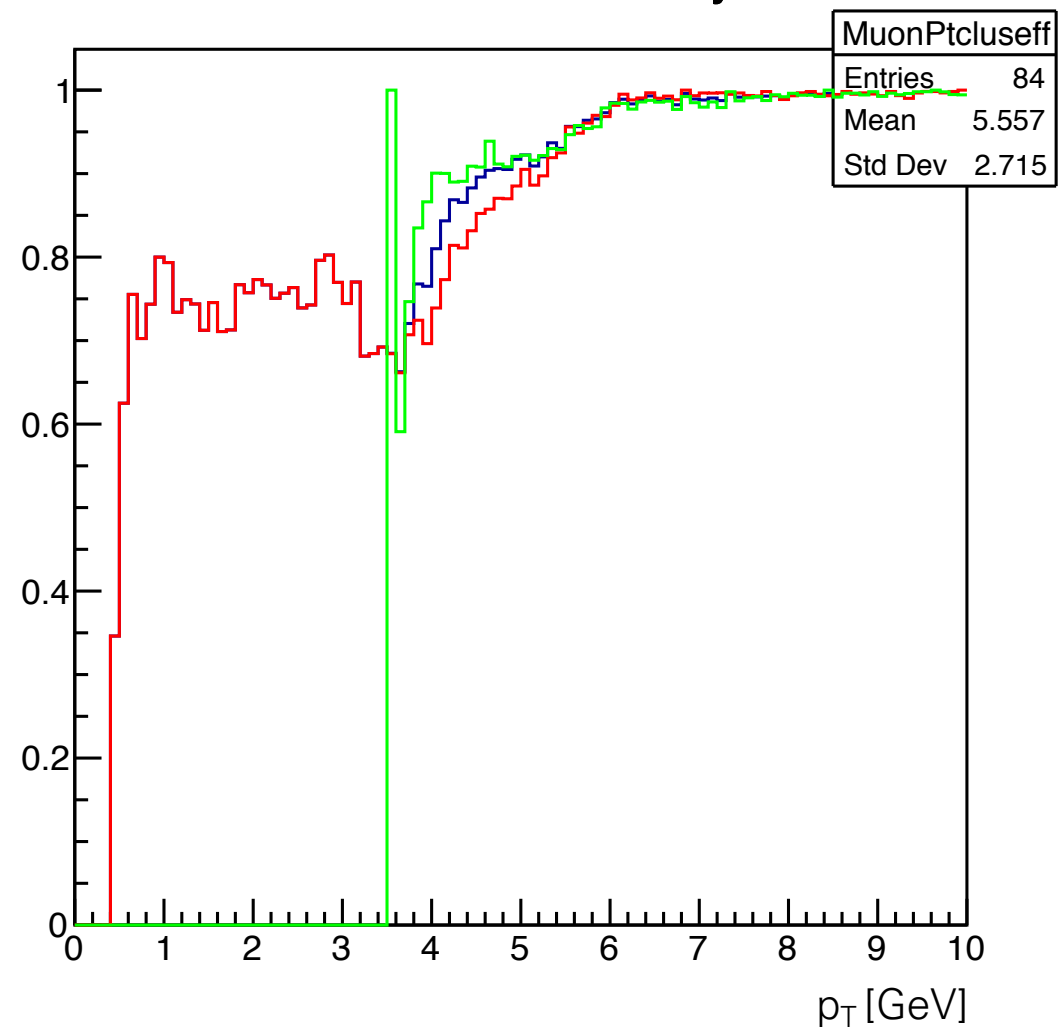
Legend:
green barrel
red endcap



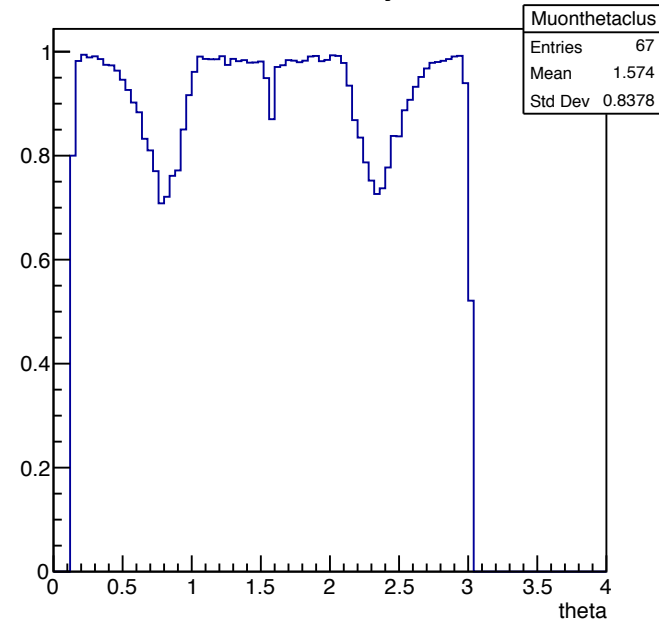
Muon cluster efficiency vs P



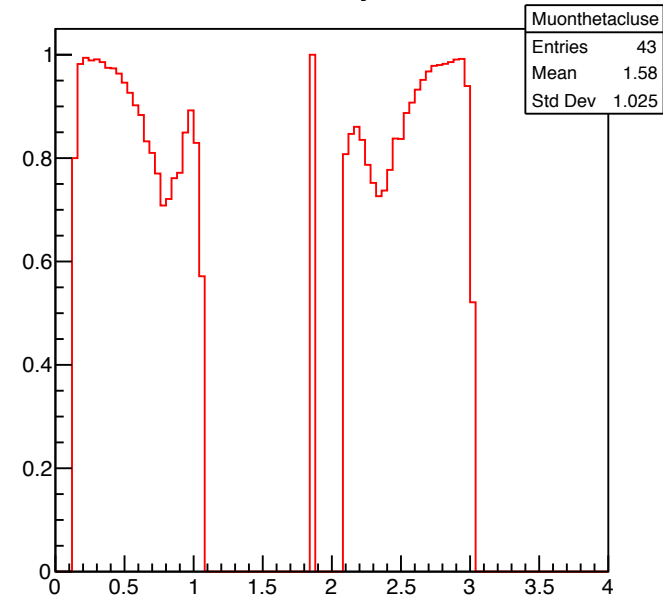
Muon cluster efficiency vs Pt



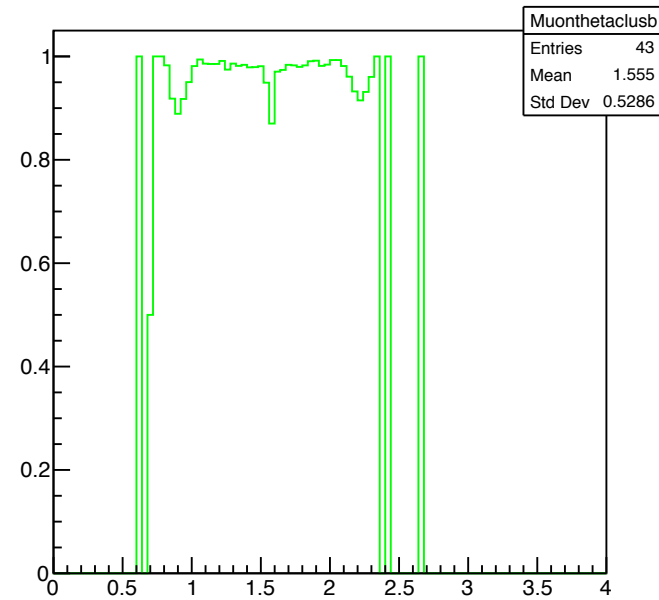
Cluster Efficiency vs theta



Cluster Efficiency vs theta EC



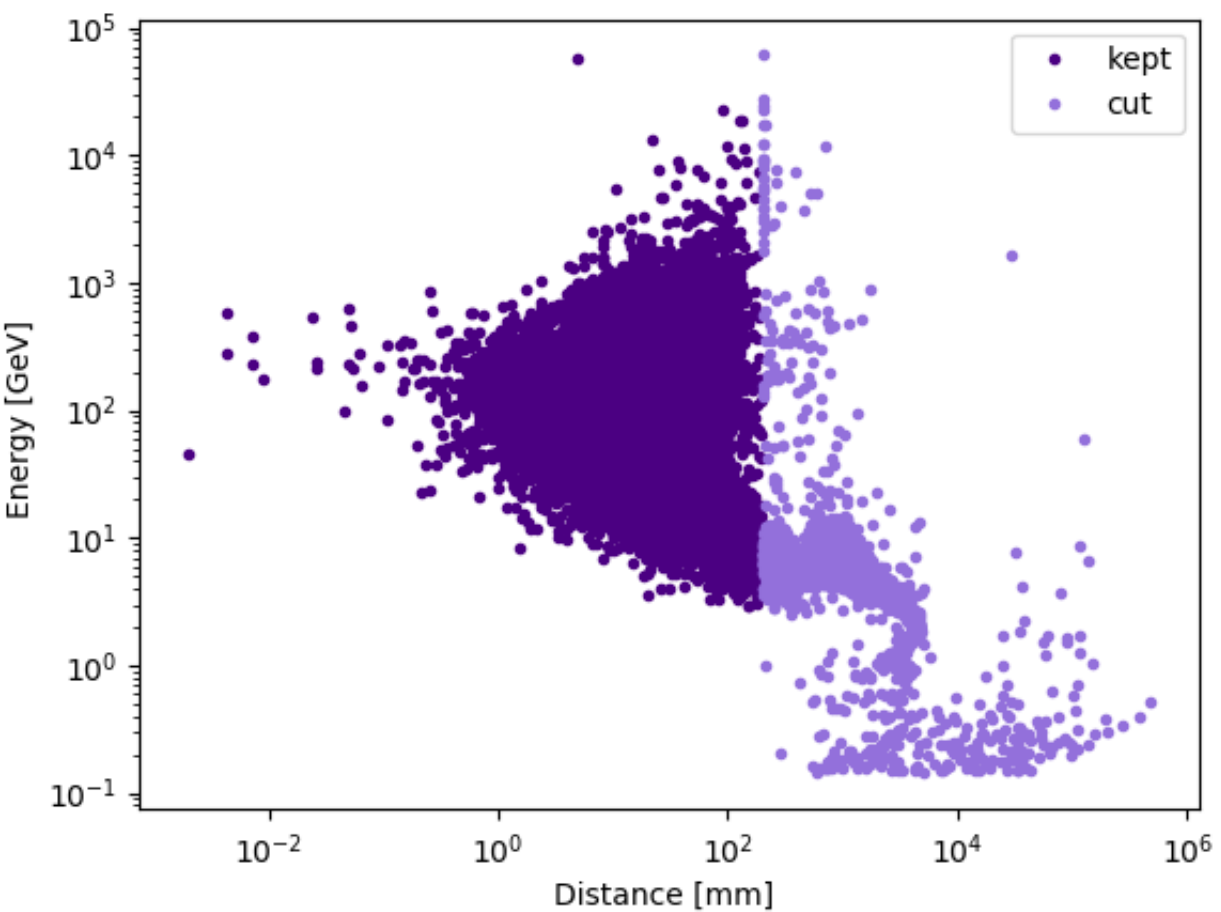
Cluster Efficiency vs theta BARREL



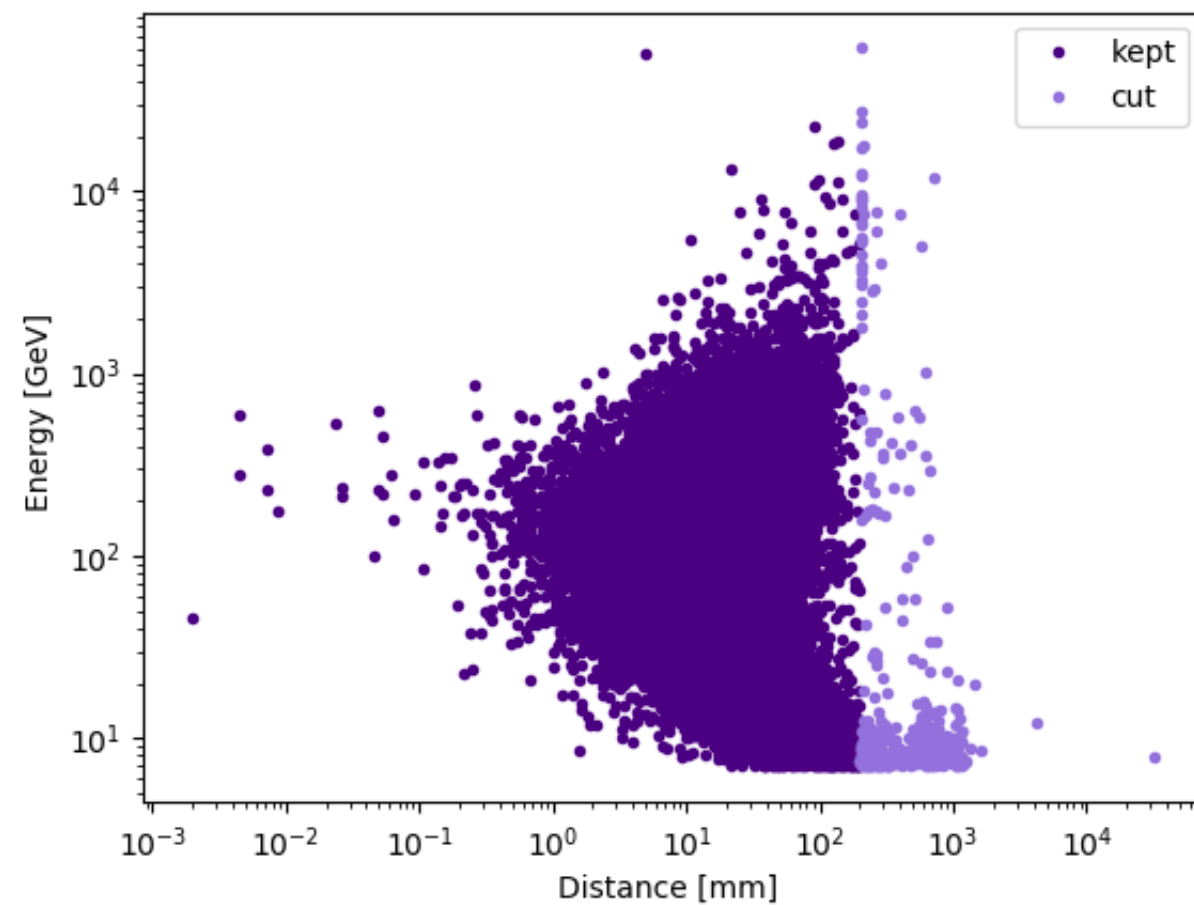
Second sample

- Single muon
 - generated with p_T uniformly distributed between 0.1 and 180 GeV
 - $8^\circ < \theta < 172^\circ$
- To reproduce CLIC results
- 100000 events

Cut on distance

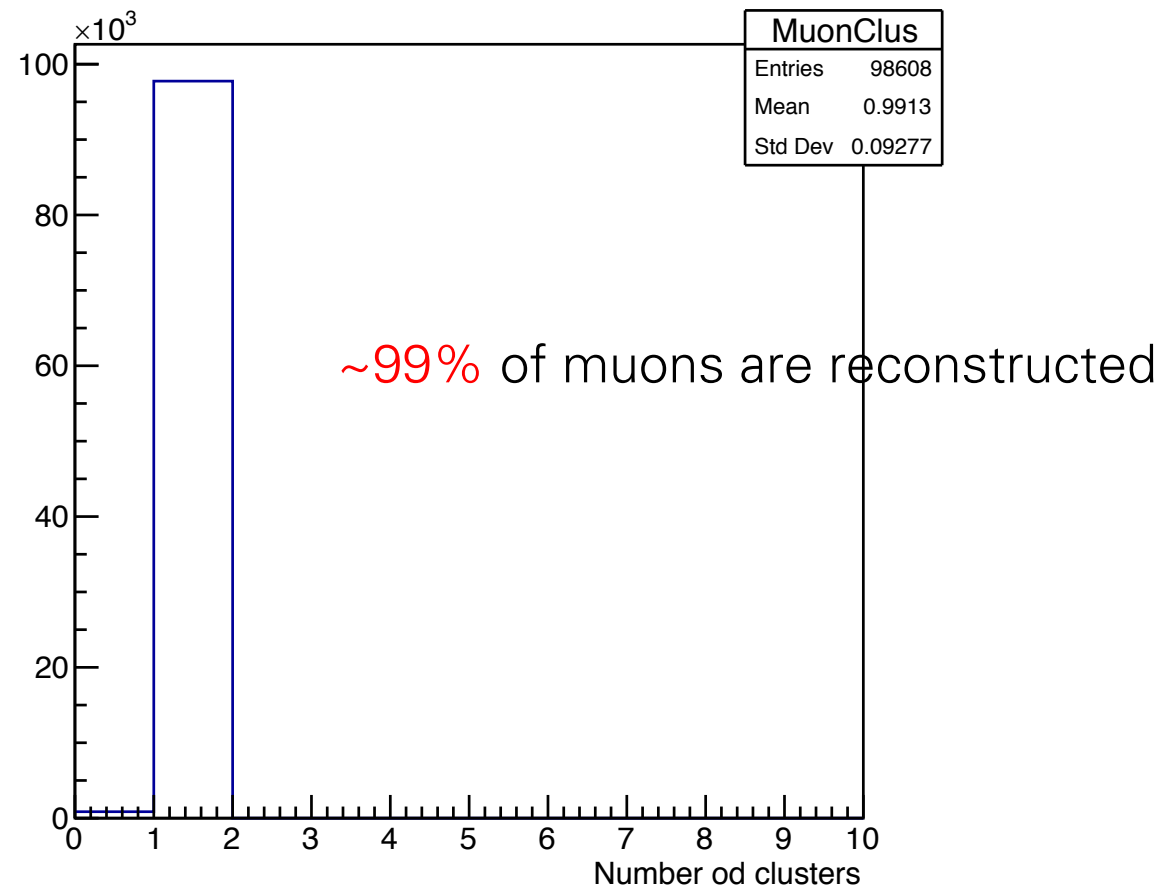


Cut on distance + energy + angle

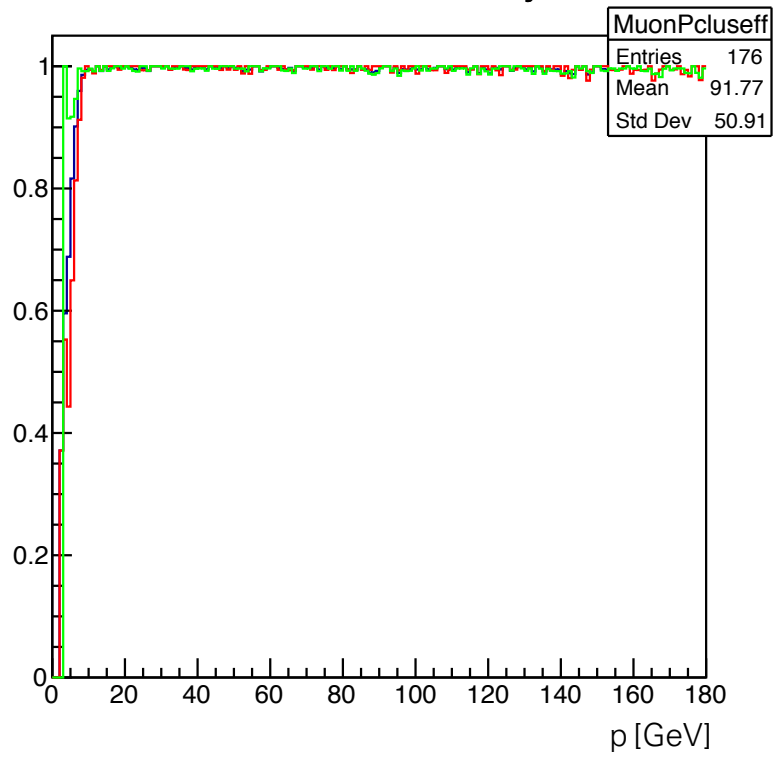


With the new parameters

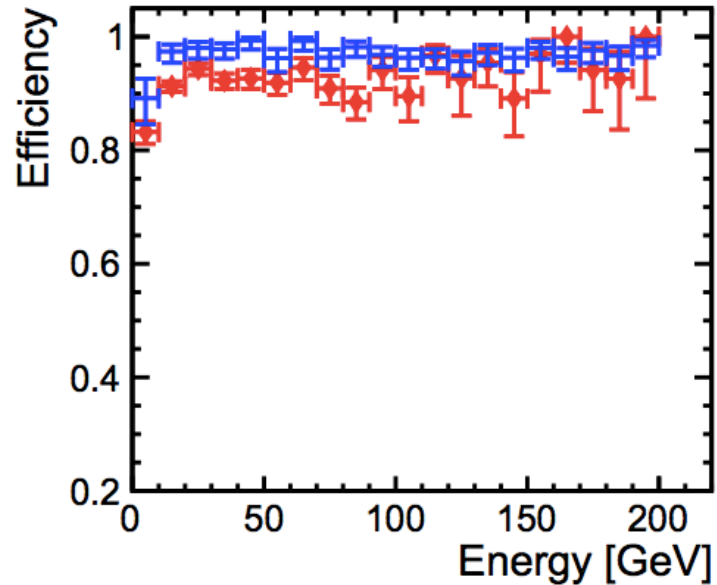
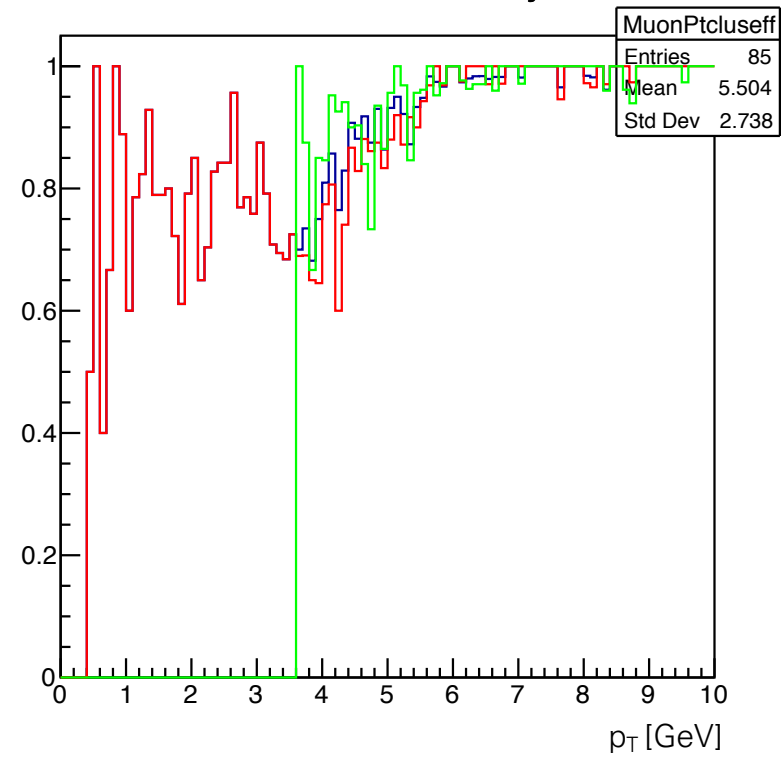
- minTrackCandidateEnergy: 0.1 GeV
- HelixClusterCosAngle: 0.5
- maxDistanceToTrack: 1000



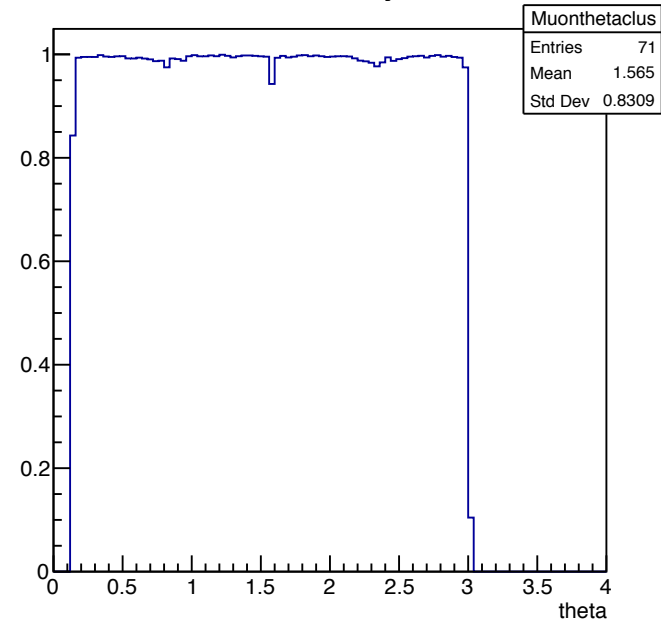
Muon cluster efficiency vs P



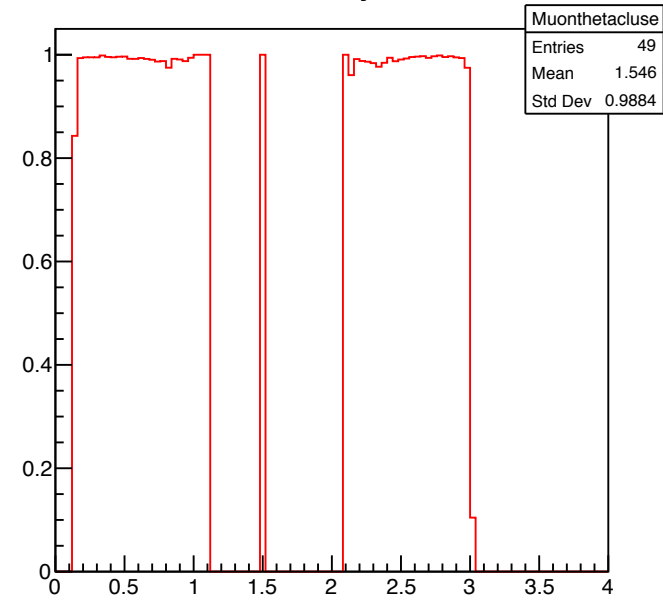
Muon cluster efficiency vs Pt



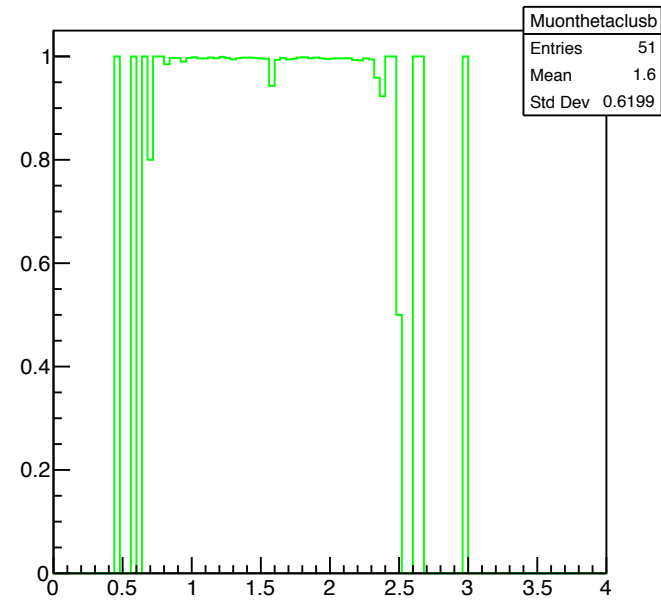
Cluster Efficiency vs theta



Cluster Efficiency vs theta EC

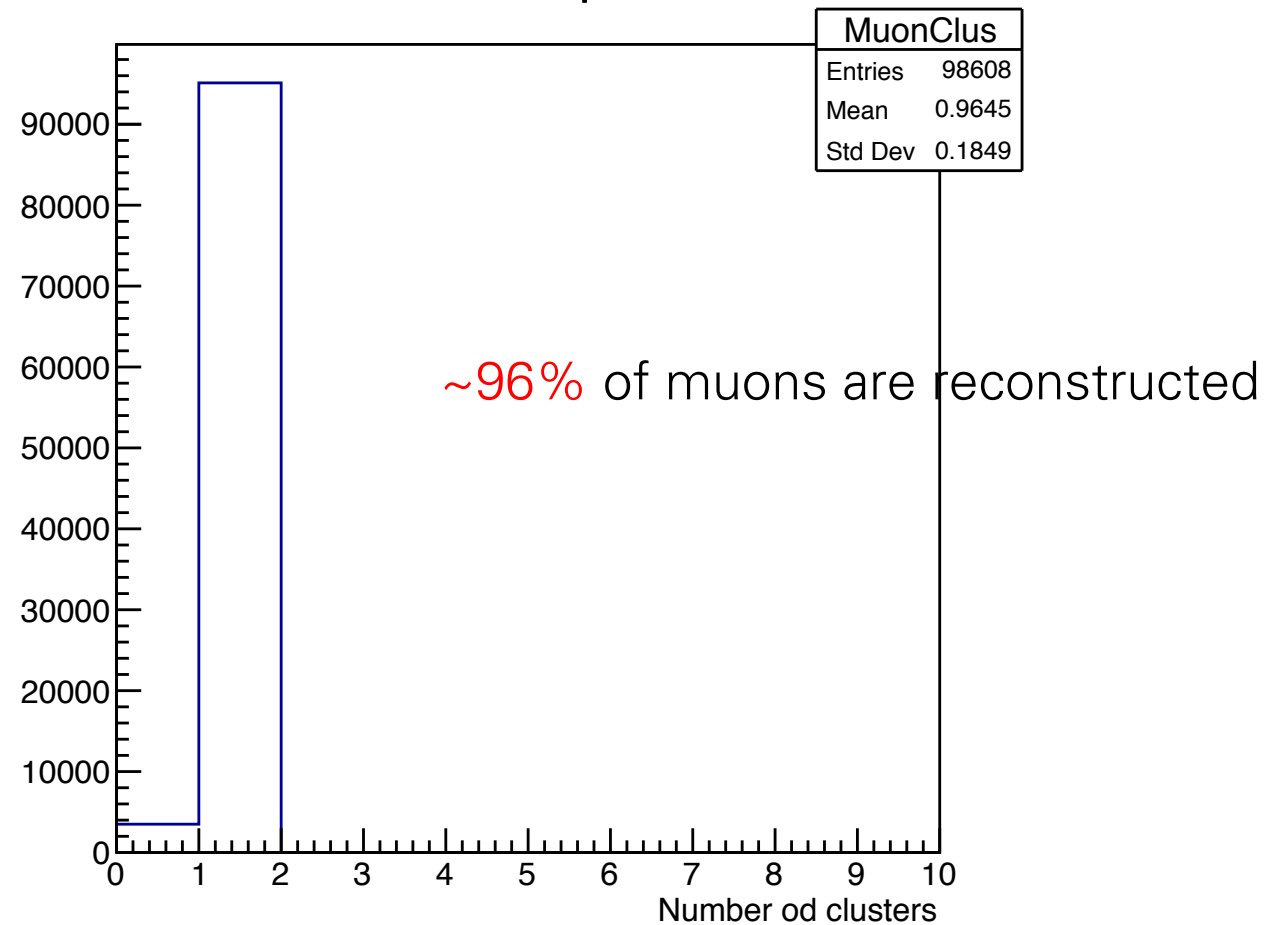


Cluster Efficiency vs theta BARREL

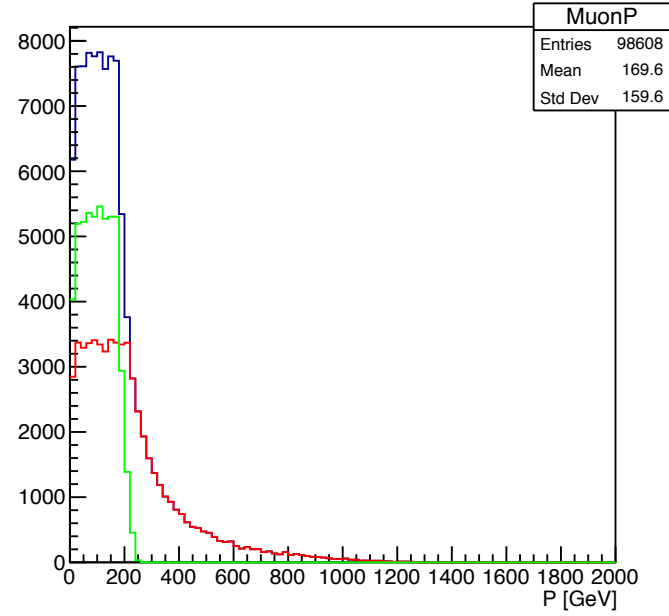


With CLIC parameters

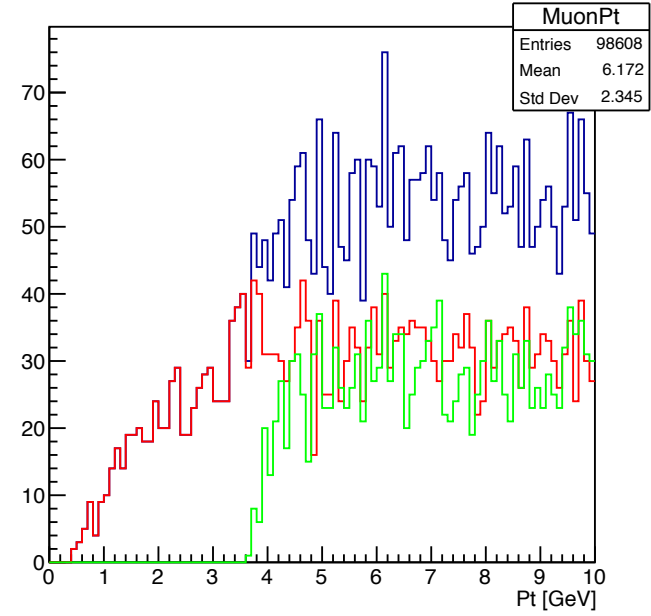
- minTrackCandidateEnergy: 7 GeV
- HelixClusterCosAngle: 0.98
- maxDistanceToTrack: 200



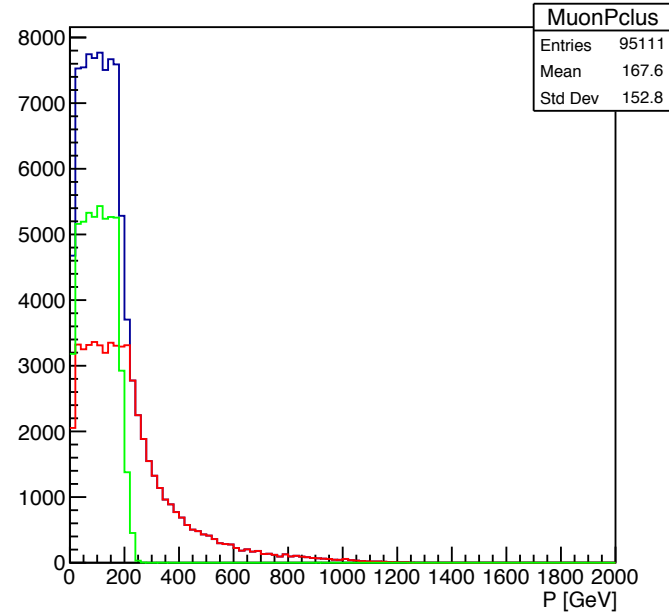
Muon momentum



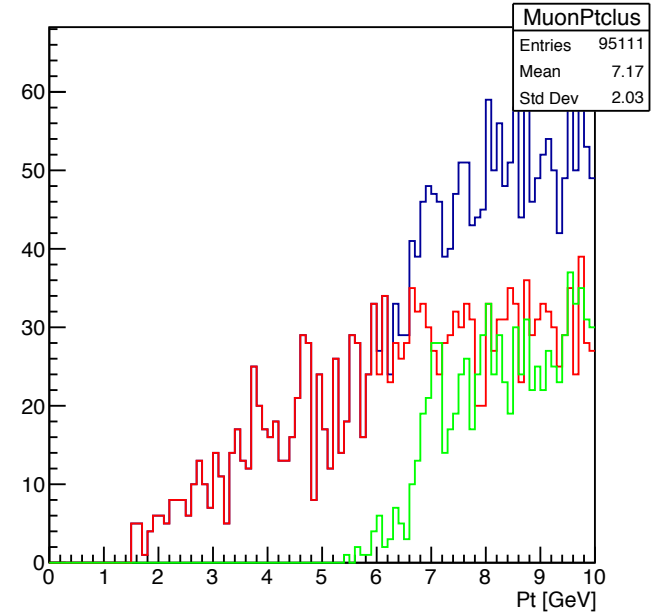
Muon pt



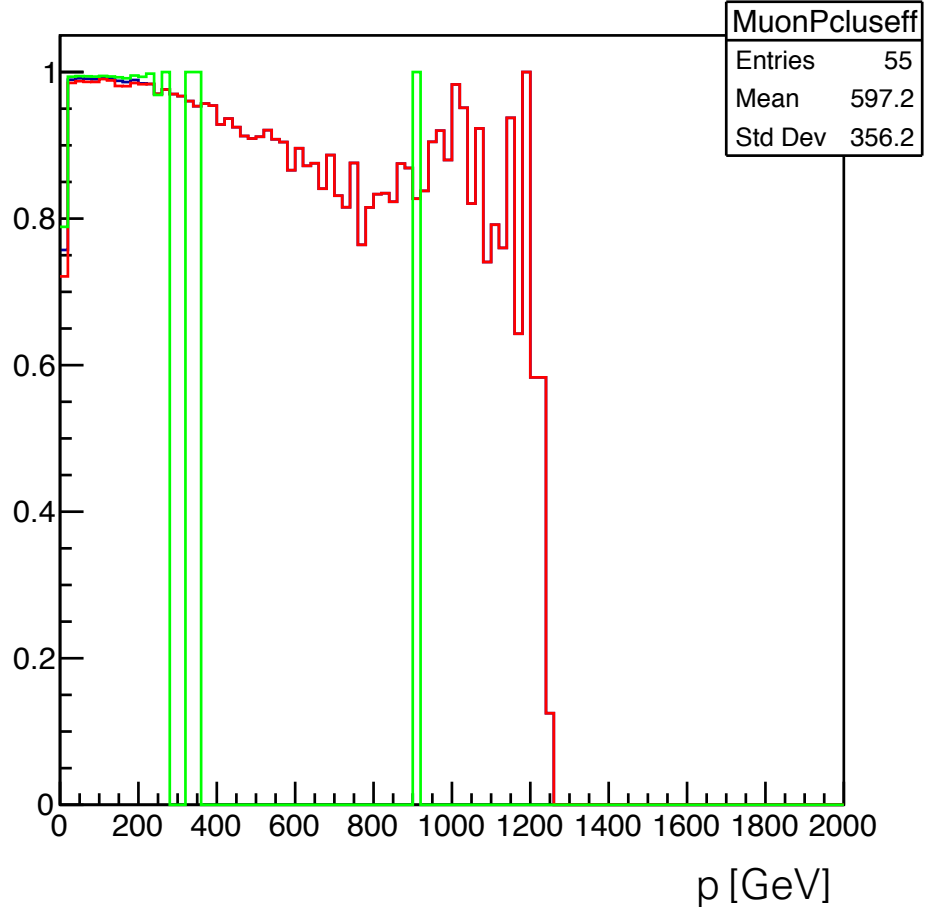
Muon momentum with cluster



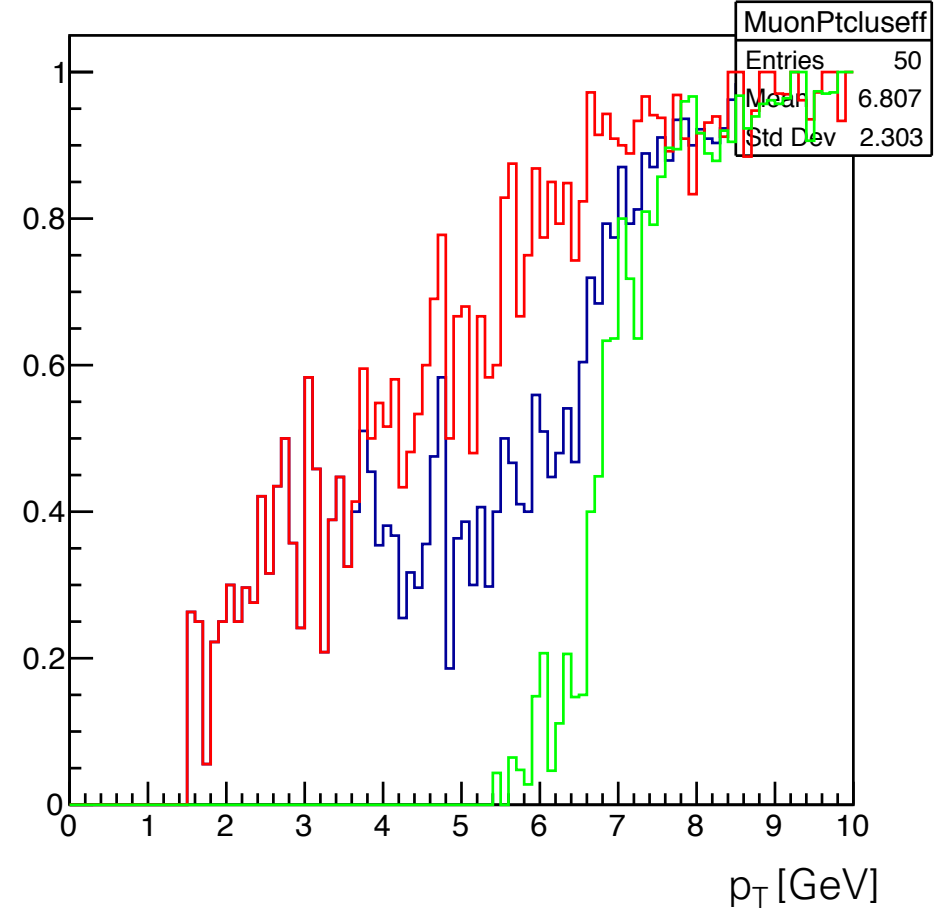
Muon pt with cluster



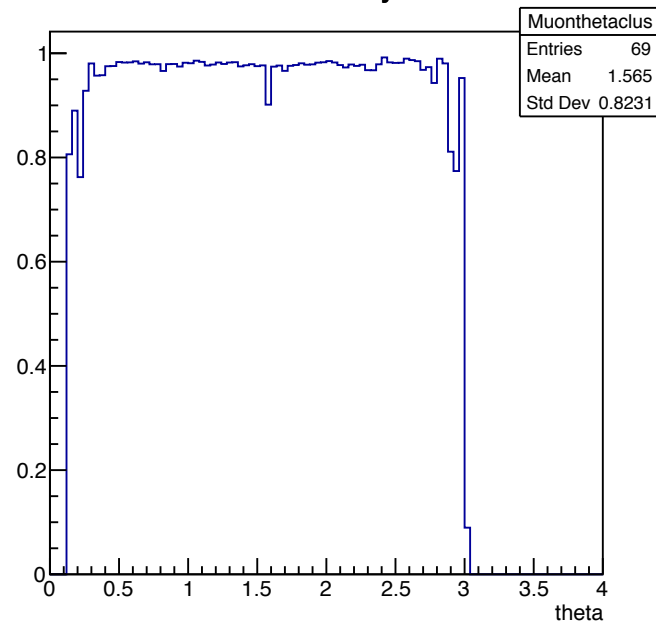
Muon cluster efficiency vs P



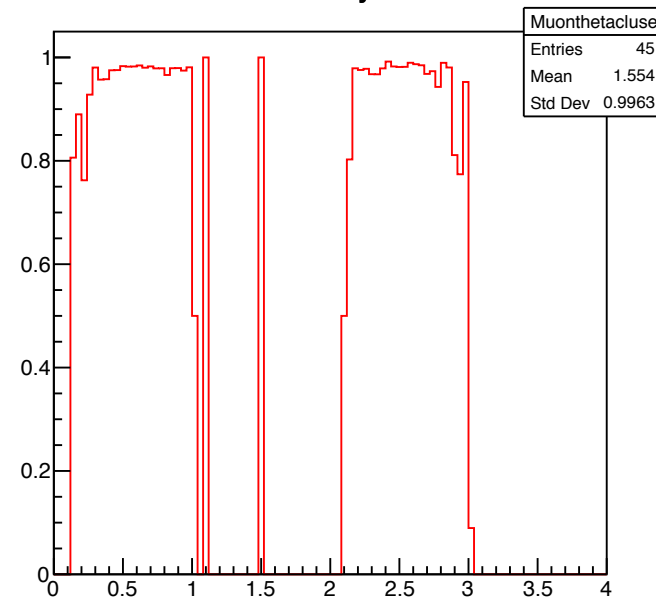
Muon cluster efficiency vs Pt



Cluster Efficiency vs theta



Cluster Efficiency vs theta EC



Cluster Efficiency vs theta BARREL

