

Tracking validation

- update -

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Quality Assurance for tracking

study the tracks coming from Hough transform, before the Kalman fit

SINGLE TRACK
→ **Defined on hits**

$$\text{EFFICIENCY} = \frac{\# \text{ CORRECTLY ASSIGNED HITS}}{\# \text{ MC POINTS}}$$

$$\text{PURITY} = \frac{\# \text{ CORRECTLY ASSIGNED HITS}}{\# \text{ RECO HITS}}$$

SINGLE EVENT
→ **Defined on tracks**

$$\text{EFFICIENCY} = \frac{\# \text{ TRACKS WITH SINGLE TRACK EFF} > 80\%}{\# \text{ MC RECONSTRUCTABLE} * \text{ TRACKS}}$$

@Panda

**reconstructable means:*

- ☒ 3 hits for xy
- ☒ 2 hits for $z\phi$

- efficiency / purity must be evaluated vs (transverse) momentum, angle ...
- define “reconstructable” in a proper way

CgemBoss Algorithm → Service

- added to the algorithm class TestHoughTrack
- functions to associate MC ↔ reco MDC / CGEM points / tracks
- will be ported to a service class (now it is not in CVS)

```
int GetMdcRecoHitID( int mc_point_id, SmartDataPtr< Event::MdcMchHitCol > mdc_MC_point_Col,  
                    SmartDataPtr< MdcDigiCol > mdc_digi_Col,  
                    SmartDataPtr< RecMdcHitCol > mdc_hit_Col);
```

```
int GetMdcMCHitID( int reco_hit_id, SmartDataPtr< Event::MdcMchHitCol > mdc_MC_point_Col,  
                  SmartDataPtr< MdcDigiCol > mdc_digi_Col,  
                  SmartDataPtr< RecMdcHitCol > mdc_hit_Col);
```

```
int GetMdcRecoHitID( RecMdcHit *hit_in_vector, SmartDataPtr< RecMdcHitCol > mdc_hit_Col);
```

```
int GetCgemMCHitID( int cluster2d_id,  
                   SmartDataPtr< Event::CgemMchHitCol > cgem_MC_point_Col,  
                   SmartDataPtr< RecCgemClusterCol > cgem_cluster_Col);
```

```
int GetCgemCluster2dID( int mc_point_id,  
                       SmartDataPtr< Event::CgemMchHitCol > cgem_MC_point_Col,  
                       SmartDataPtr< RecCgemClusterCol > cgem_cluster_Col);
```

```
int GetMCTrack( RecMdcTrack *hough_track,  
               SmartDataPtr< Event::MdcMchHitCol > mdc_MC_point_Col,  
               SmartDataPtr< MdcDigiCol > mdc_digi_Col,  
               SmartDataPtr< RecMdcHitCol > mdc_hit_Col,  
               SmartDataPtr< Event::CgemMchHitCol > cgem_MC_point_Col,  
               SmartDataPtr< RecCgemClusterCol > cgem_cluster_Col,  
               std::vector< int > &associated_mc_track,  
               std::vector< int > &associated_nmdc,  
               std::vector< int > &associated_ncgem);
```

MDC

CGEM

track

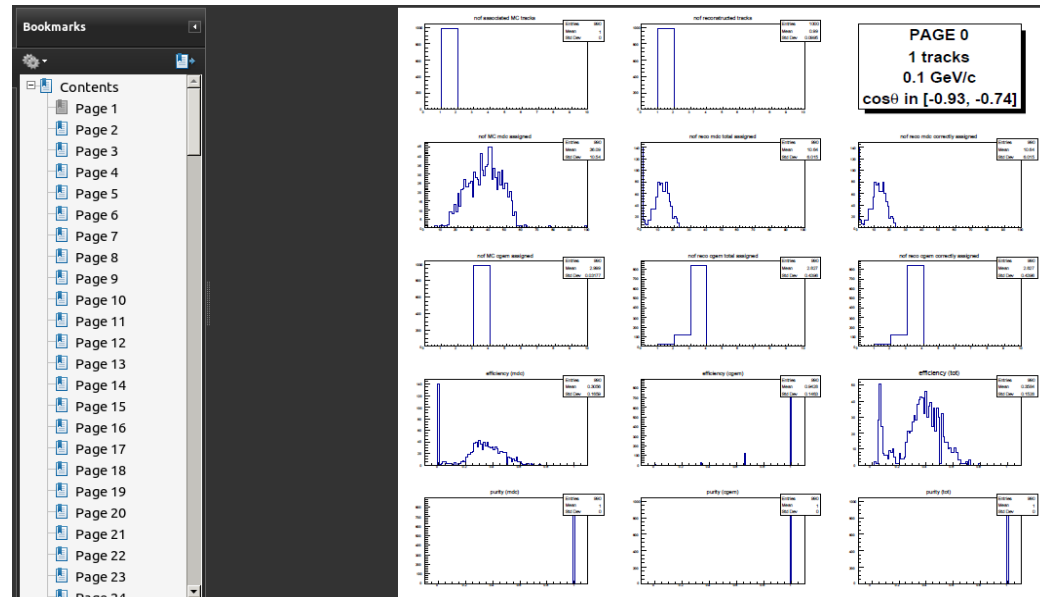
Testing sample

muons @ fixed transverse momentum

- multiplicities = 1, 2, 3, 4 tracks/event
- transverse momentum = 0.1, 0.3, 0.5, 0.7, 1 GeV/c
- $\cos(\theta)$ in $[-0.93, 0.93]$ in steps of 0.186

A total of $4 \times 5 \times 10$
= 200 scan points

For each scan step
a series of 14 histos is filled

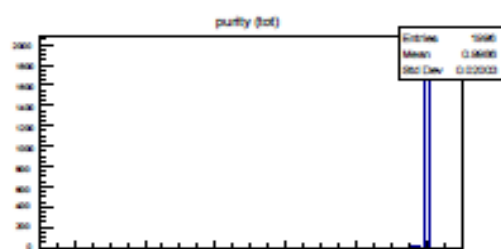
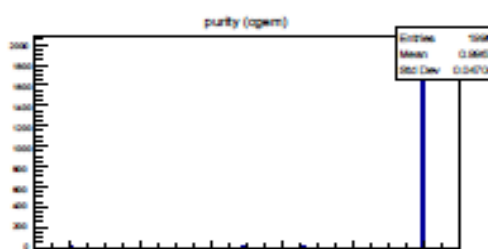
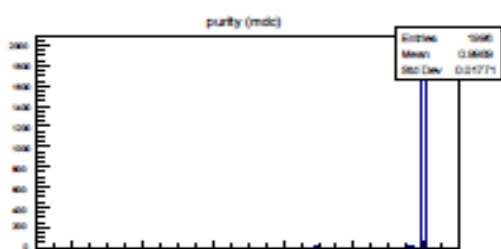
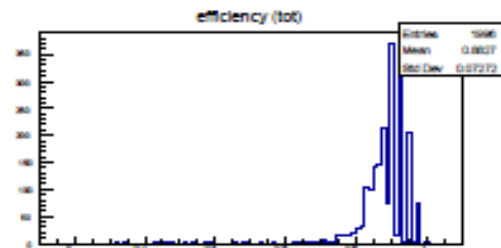
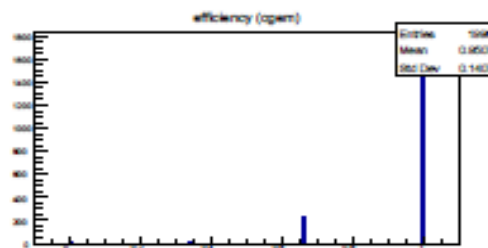
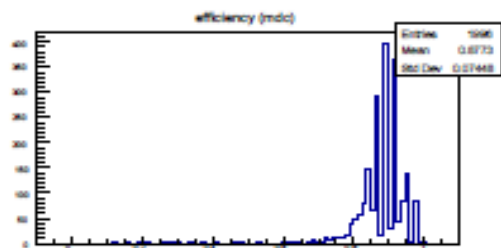
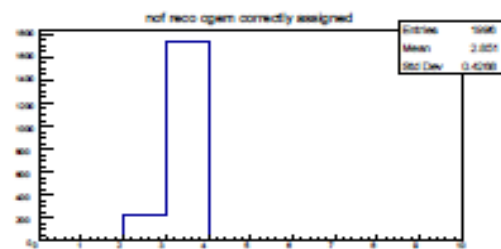
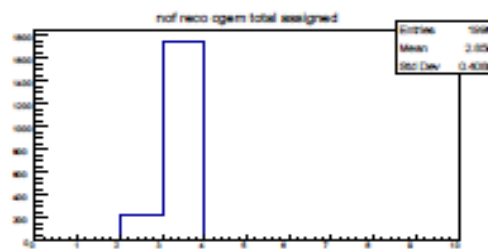
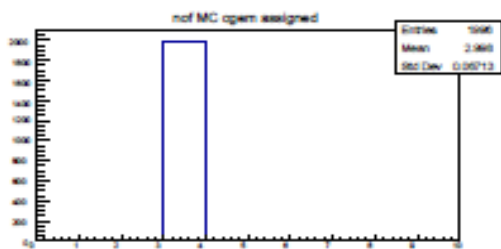
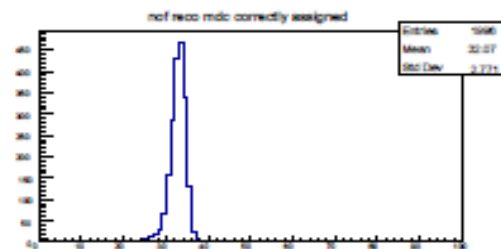
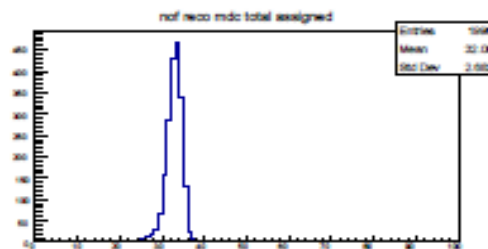
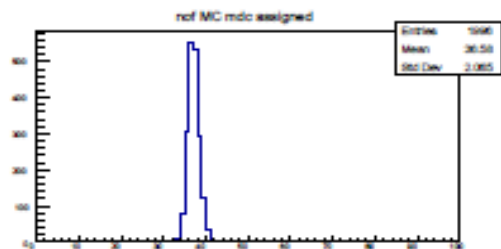
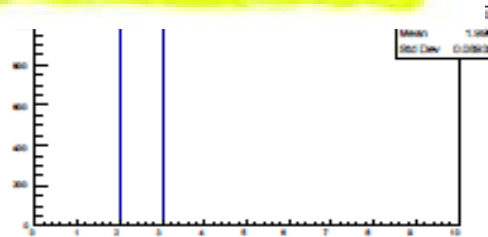
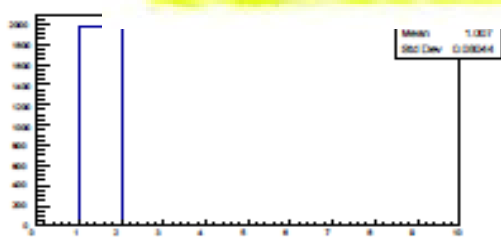


For now:

- no “reconstructable” track definition
- The reco track is associated to the MC track with which it shares the majority of the hits – no “80%” limit (or other) is set

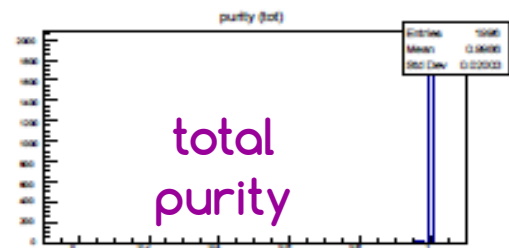
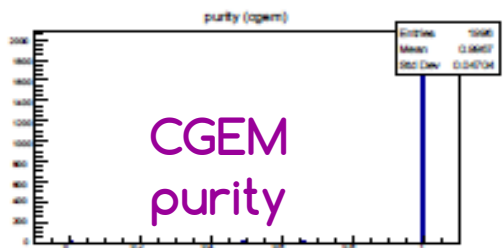
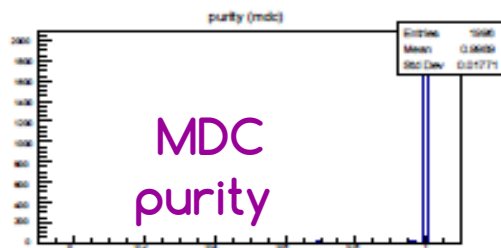
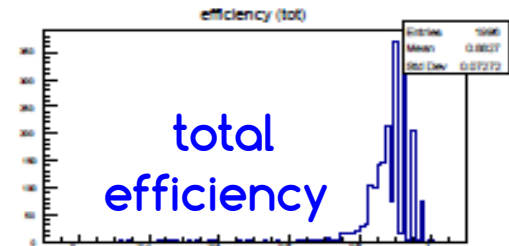
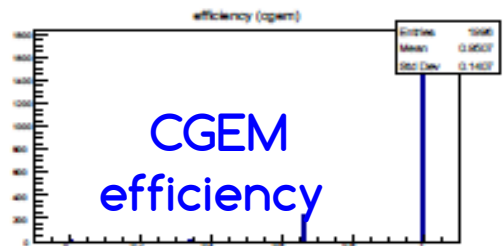
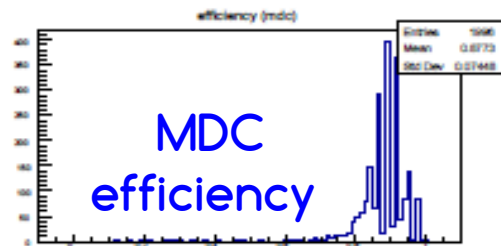
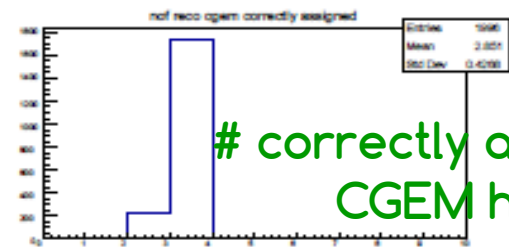
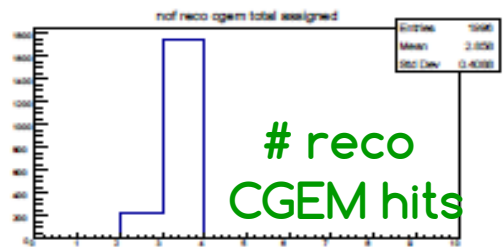
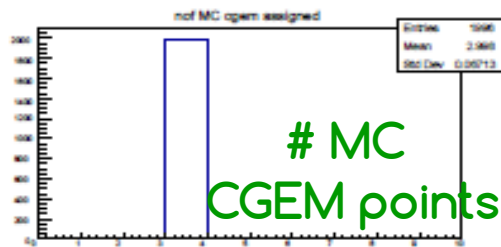
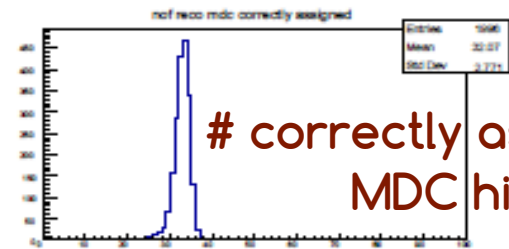
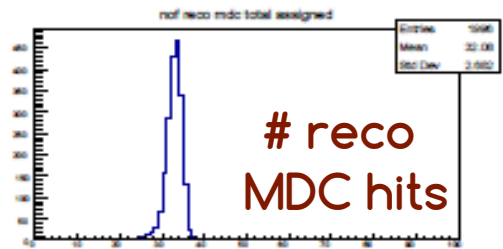
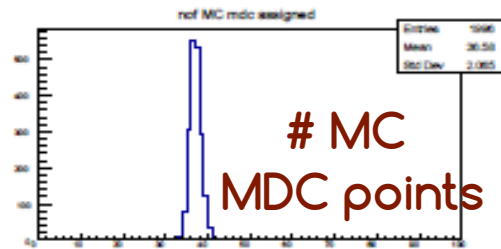
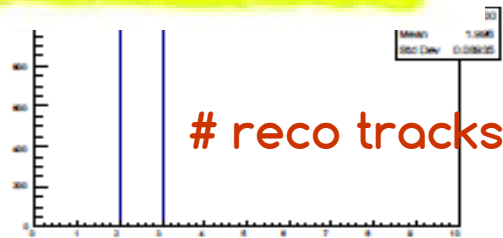
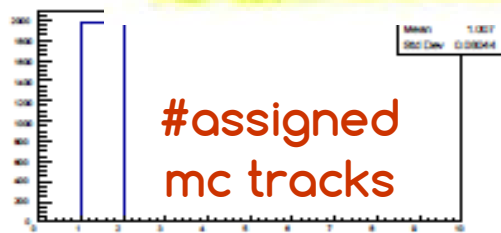
Very preliminary results

PAGE 88
2 tracks
0.7 GeV/c
cos θ in [0.56, 0.74]



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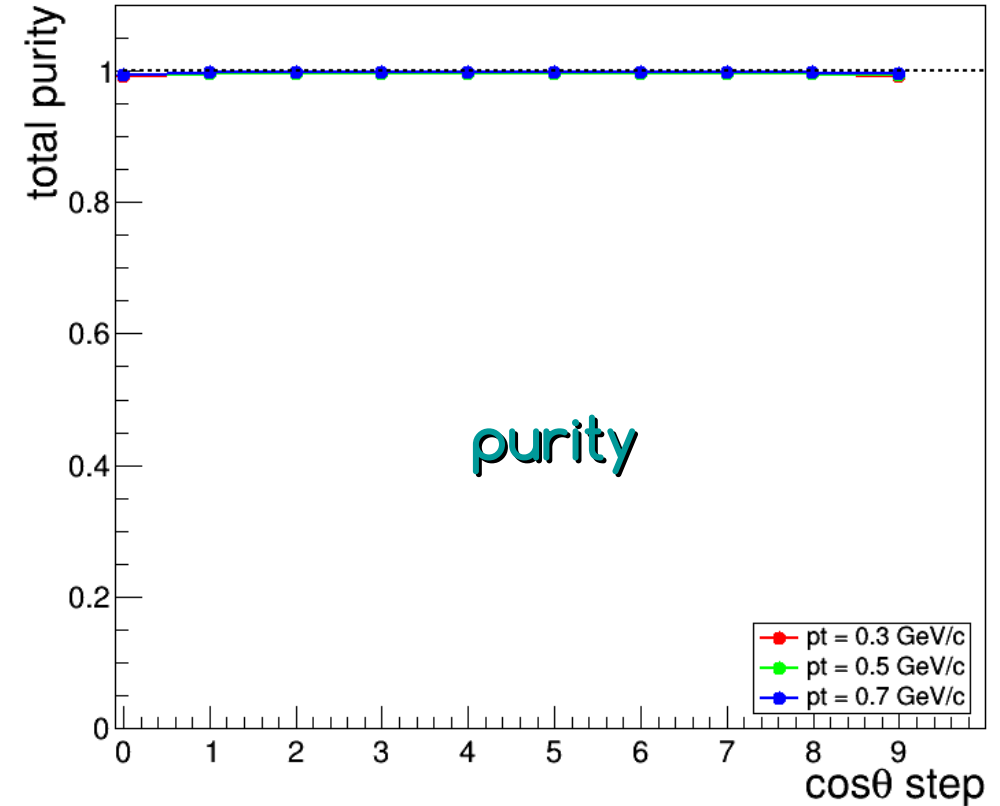
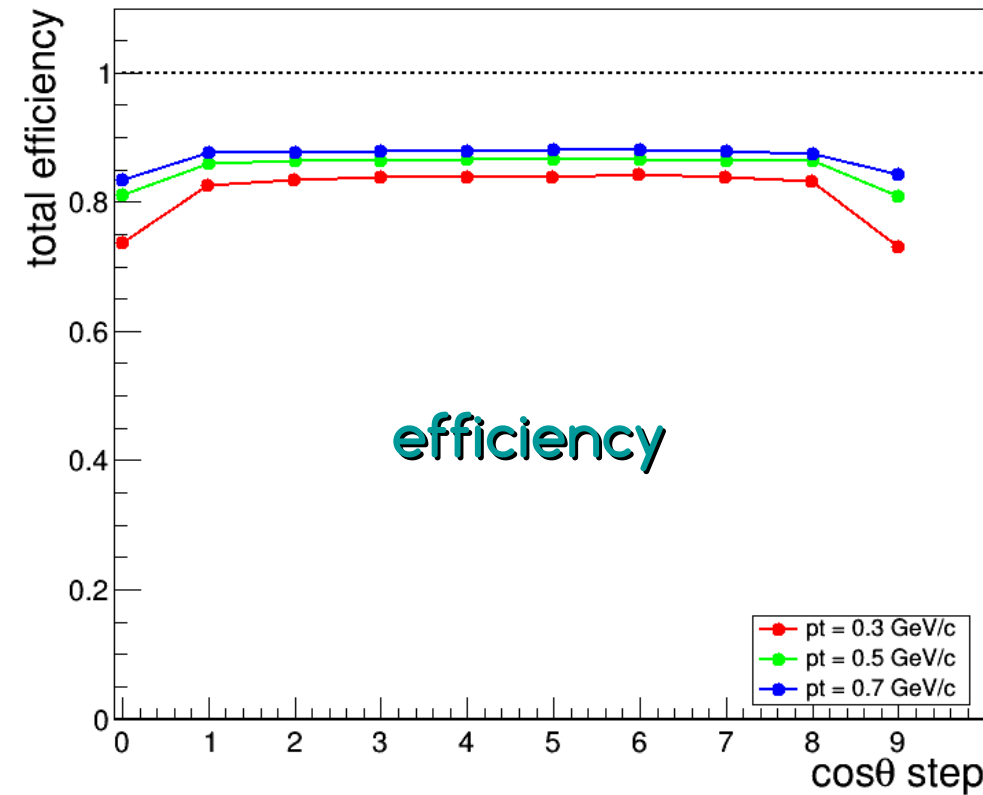


43-8

3

Very preliminary results

- multiplicity = 4 tracks/event
- transverse momentum = 0.3, 0.5, 0.7 GeV/c
- $\cos(\theta)$ in $[-0.93, 0.93]$ in steps of 0.186

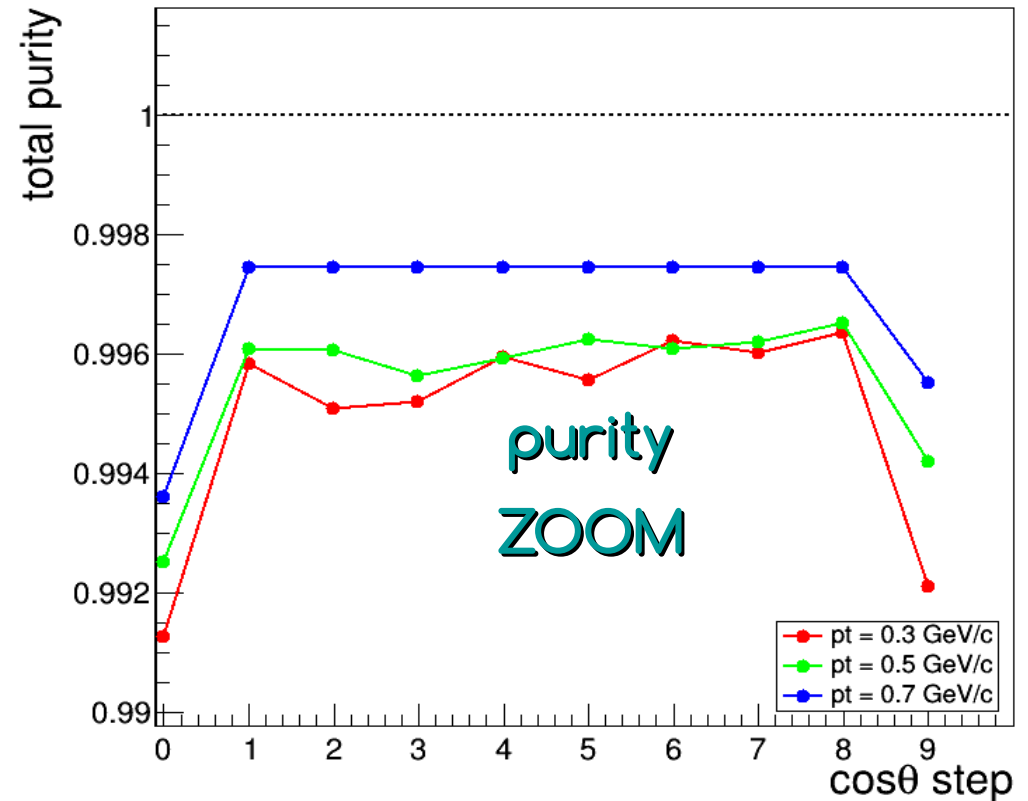
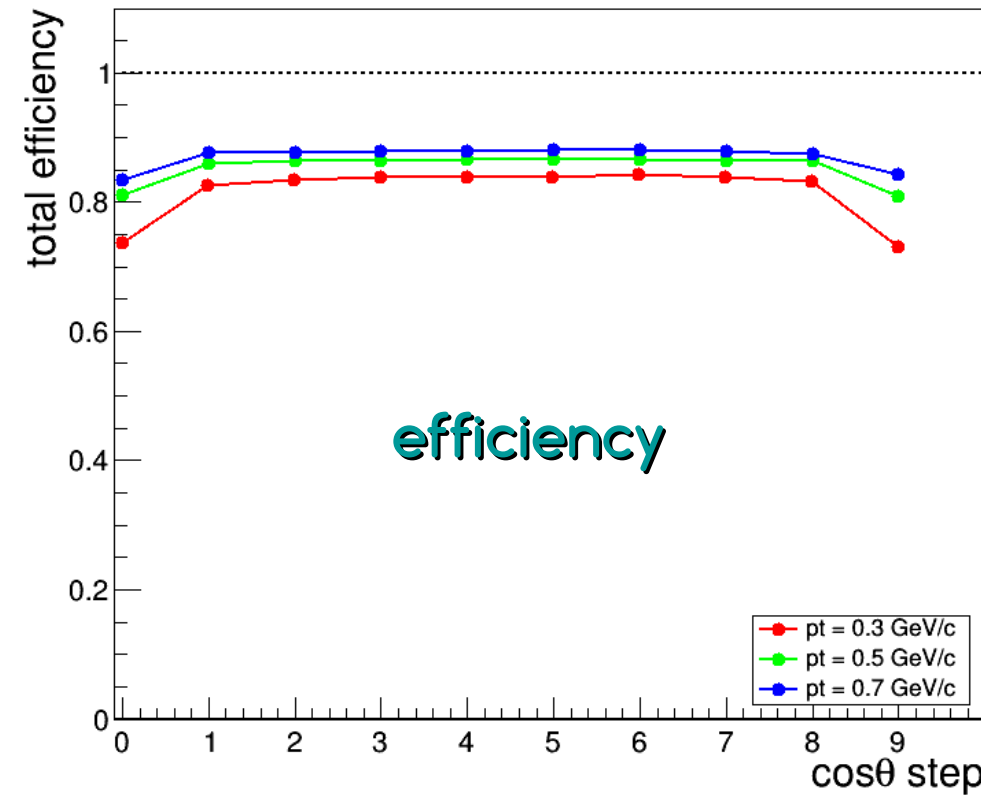


efficiency / purity lower with decreasing pt
efficiency / purity lower fwd / bwd

- skipped two pt steps:
 - $pt = 0.1$ GeV/c has loopers \rightarrow need to increase the range of histos
 - $pt = 1$ GeV/c not possible due to E_{cms} limited to 3.097 GeV (? - need to verify)

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Summary

- The machinery for track validation is ready
- (possibly) will share the functions in a service class on CVS
- I already tested it on the whole sample, but need to fix some bugs before plotting the graphs for QA for all the points (e.g. 0.1 GeV/c)
- need to add the correct definition for “reconstructable” track
- add pull distributions of track parameters

Thank You!