A glimpse at the standalone muon

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Standalone muons

Look at only the muon detector

- Instead of a full particle flow reconstruction, look at how good the muon detector itself can reconstruct muons

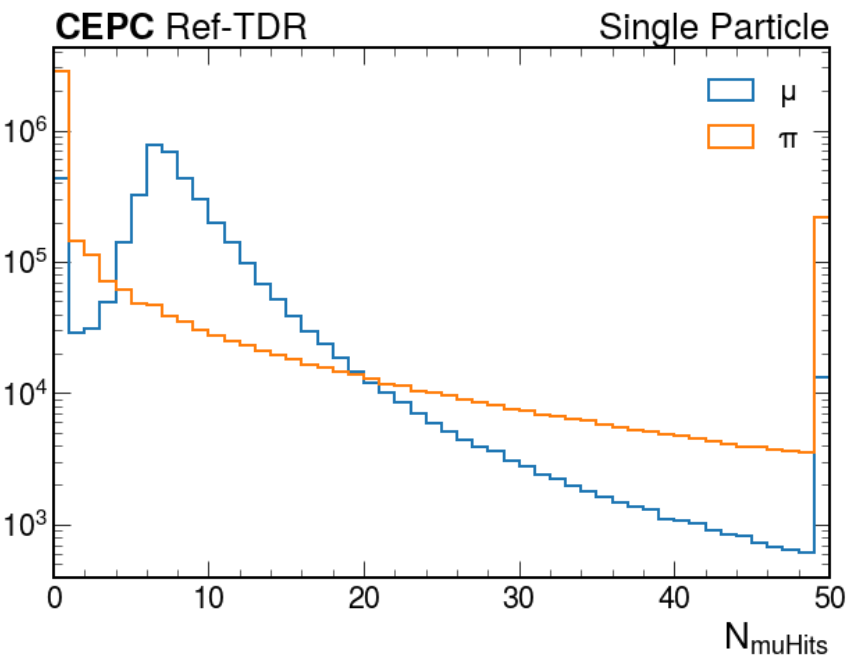
Targets

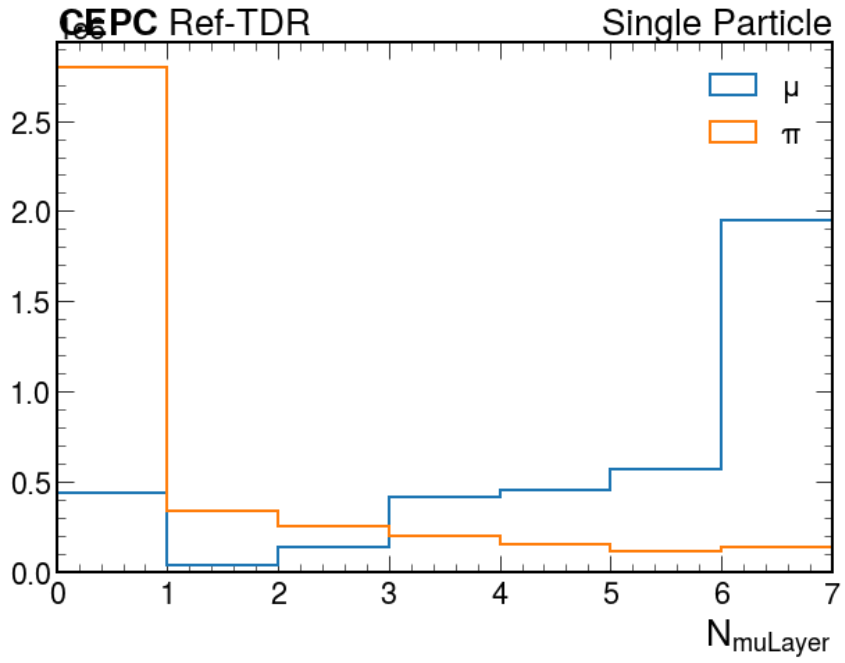
- So far, there is no tracking algorithm in the muon detector
- The main task is to distinguish muons from pions through muon detector information

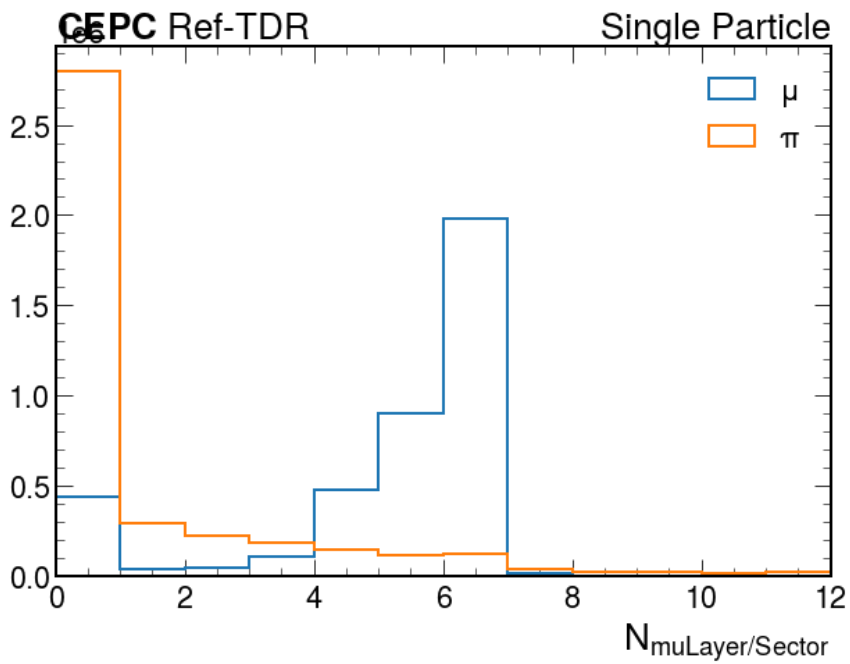
Samples

- Single particle gun samples
  - /cms/user/liugeliang/CEPC/202503/Production/ParticleGun
  - Muons & pions generated uniformly with energy from 1 GeV to 80 GeV
  - 100% sure that any muon hits detected are induced by the particle itself (or its secondary particles)

Distributions

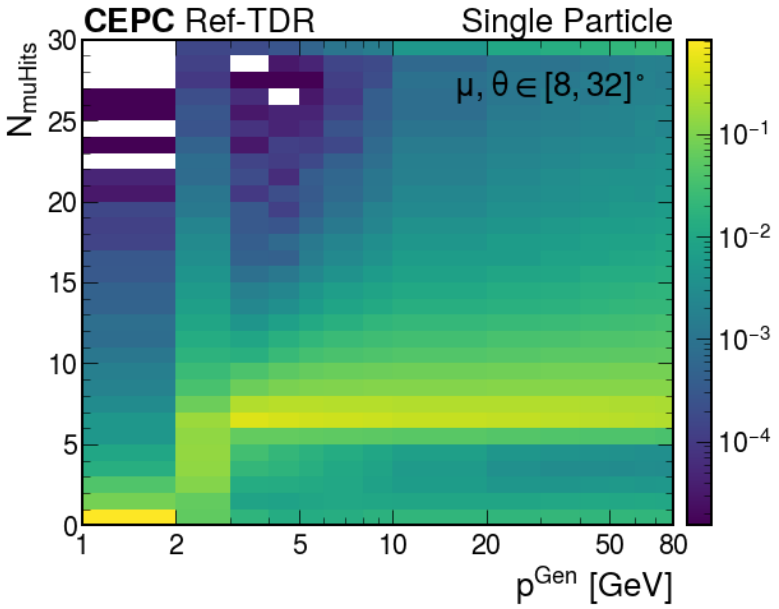


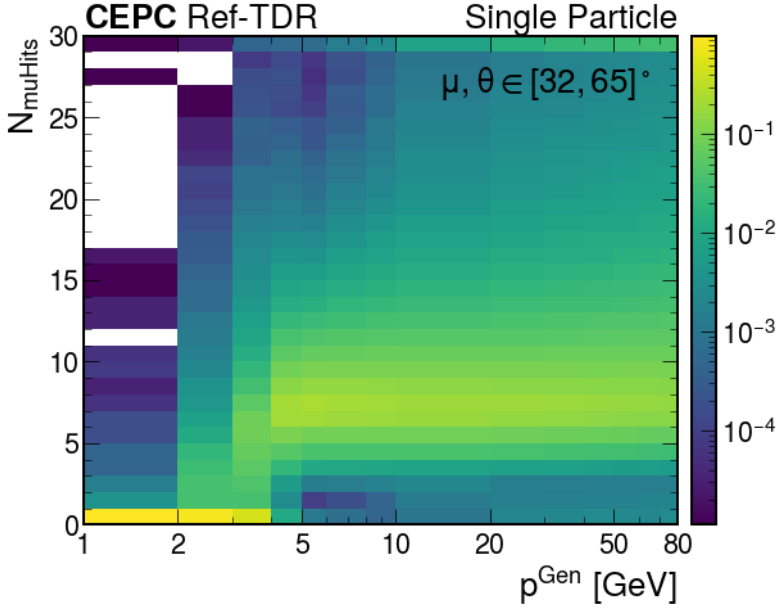


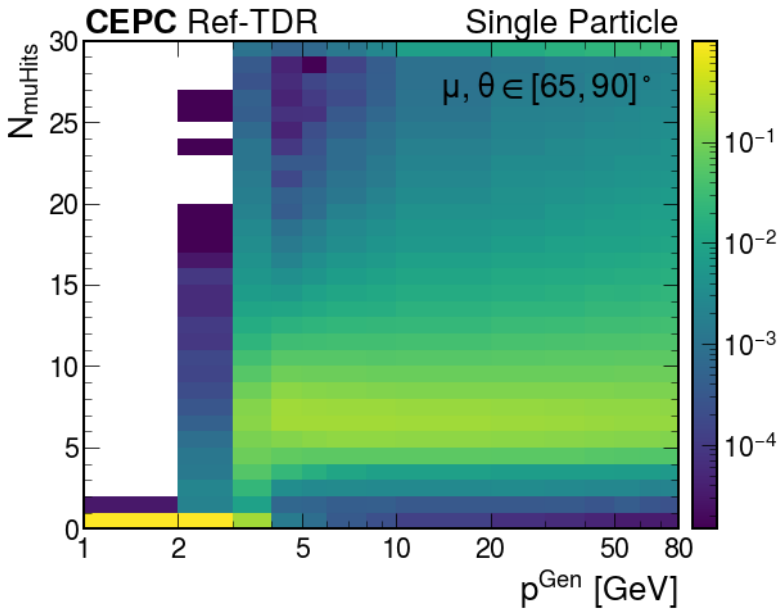


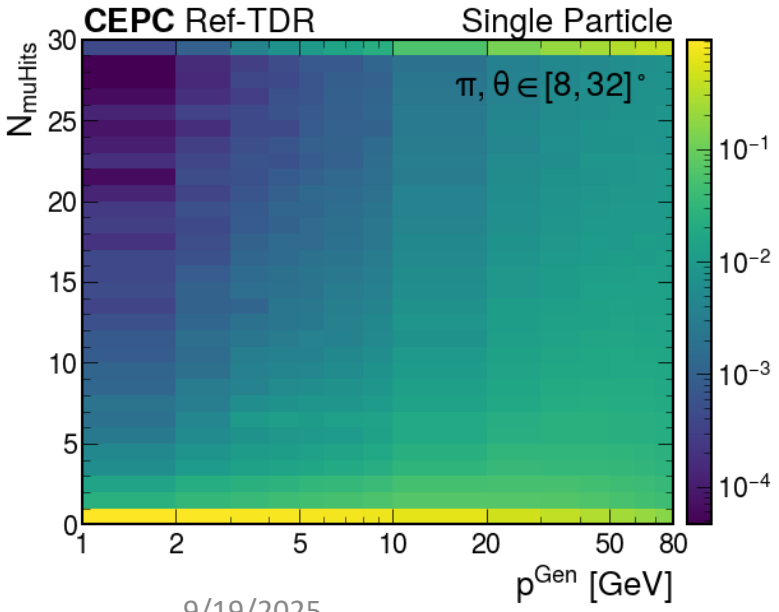
- All muon hits in one event is collected

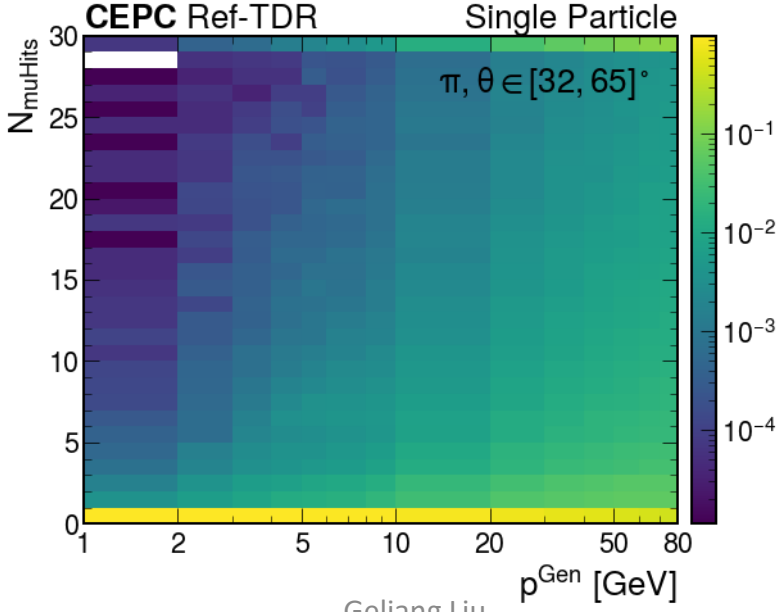
Multi-dimensional distributions: N_{muHits}

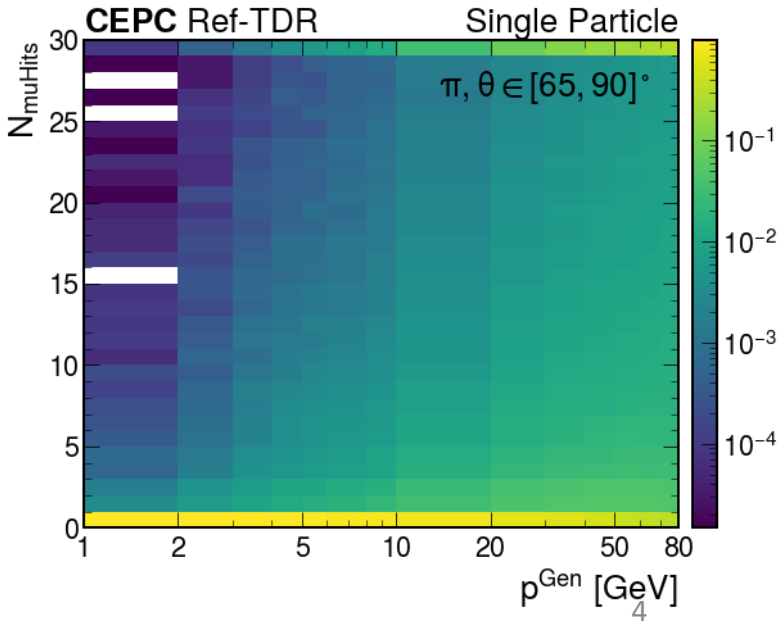




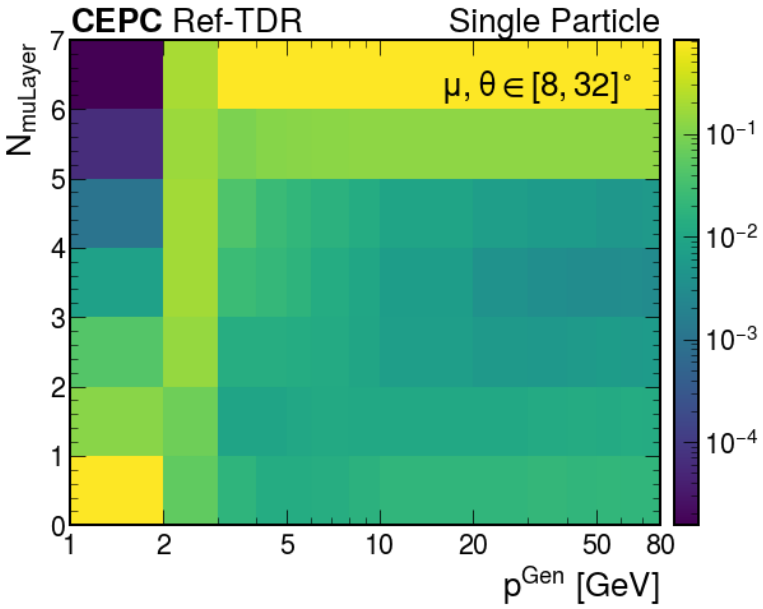


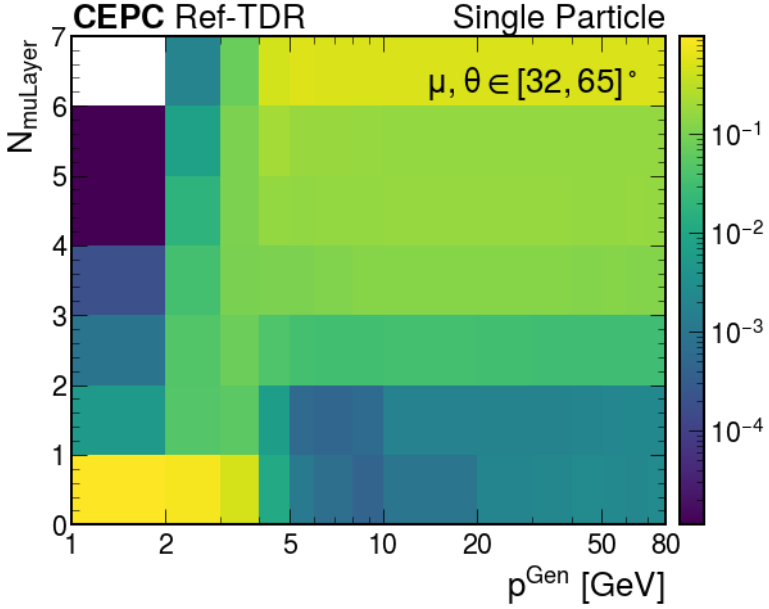


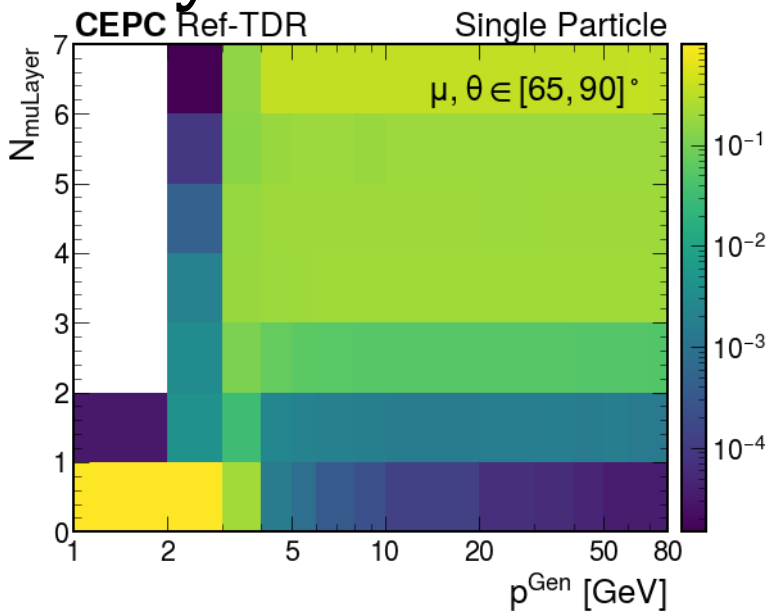


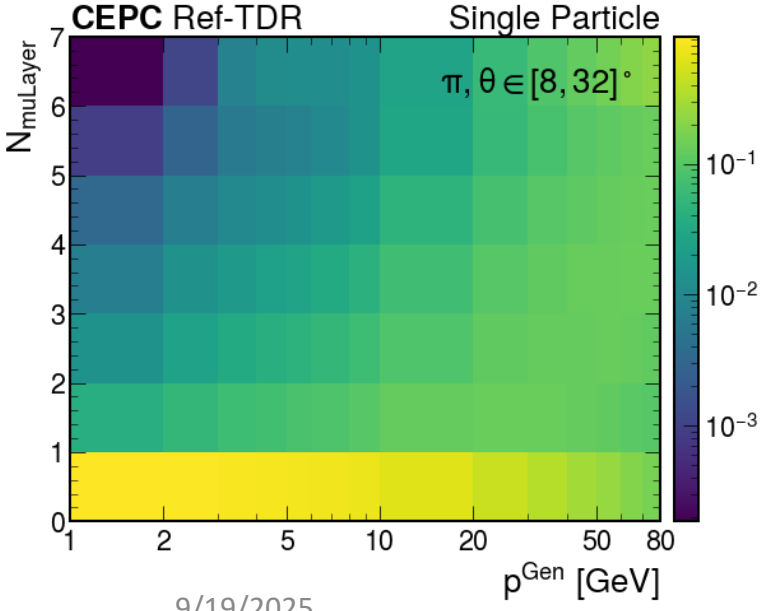


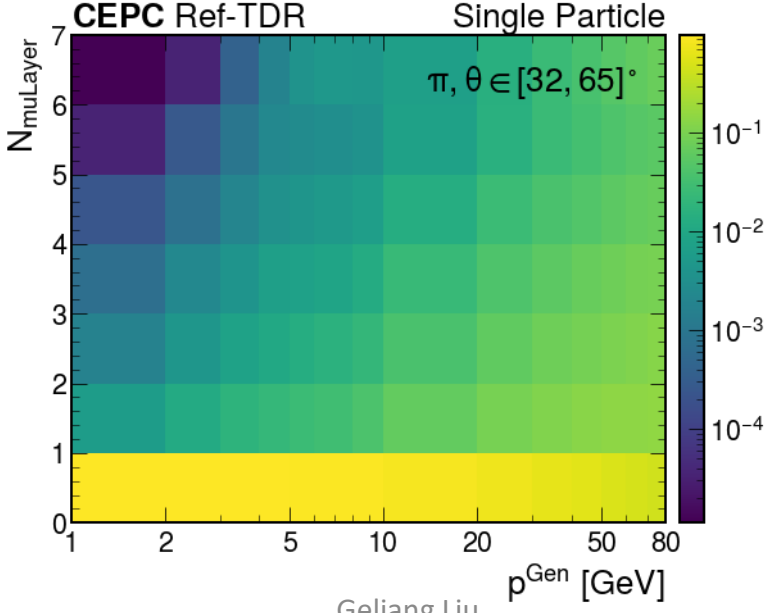
Multi-dimensional distributions: N_{layer}

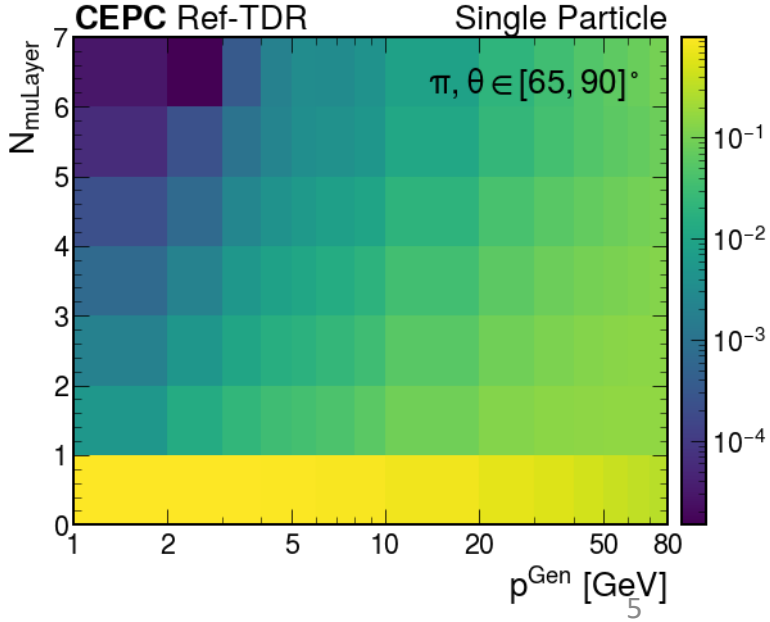








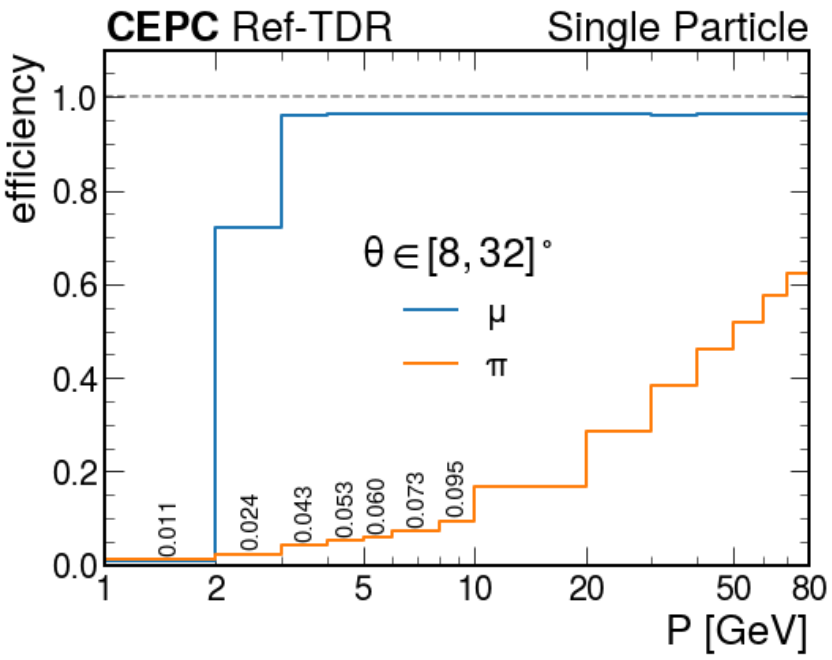


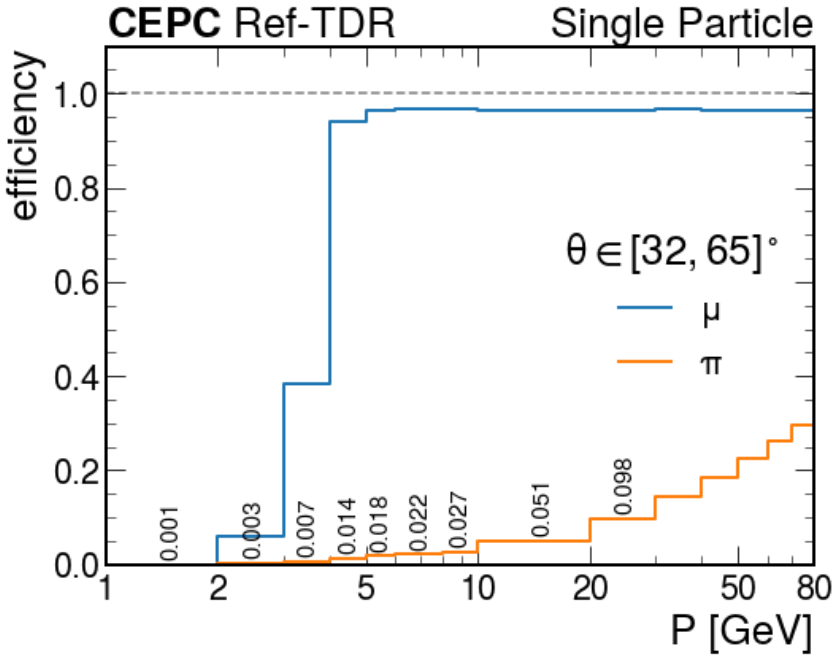


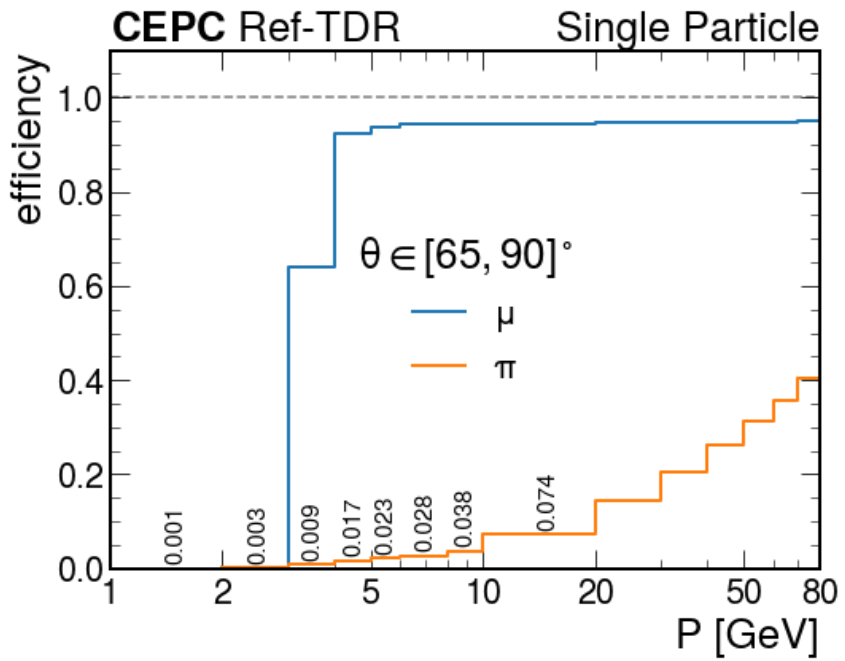
Muon tagging

Require the number of penetrated superlayers to be at least 3

- The same requirement used by the muon group (Xiaolong Wang)



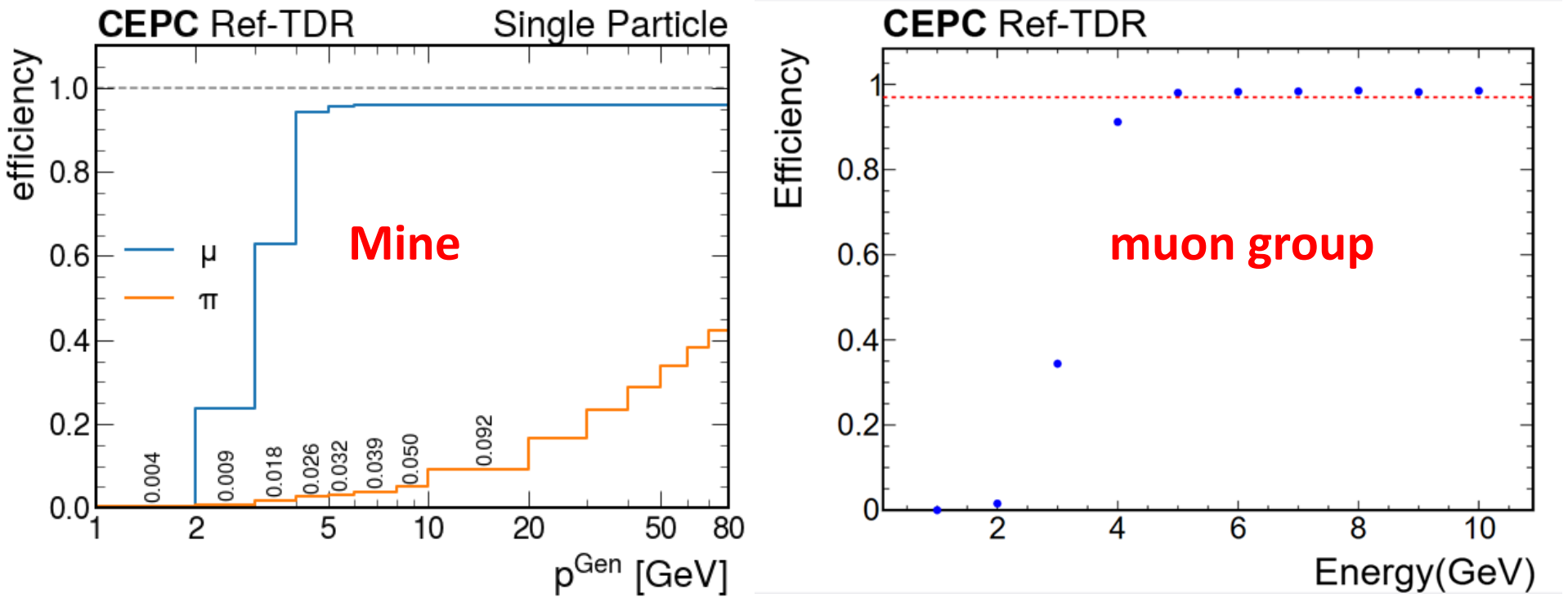




- At very low momentum, muons cannot enter the muon detector.
- From 2-4 GeV, the efficiency sees the turn-on.
- Pion misidentification rate is very high at high momentum: high-energy pions can penetrate calorimeters and enter the muon detector.

Muon tagging

Comparison with the results from the muon group



- In general compatible in terms of muon tagging efficiency.
- They claim the pion misidentification rate to be 0.75%, satisfying the requirement of below 1%.
  - Not entirely sure how this is computed. Probably in the jet environment?

Backup: muon energy loss in calorimeters