Updates on PID

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Updates on FinalPIDSvc

➤ **Preliminary photon ID** ([commit](#))
- For neutral PFOs: if E_{HCAL}/E_{ECAL} < 0.1, then identify as a photon; otherwise neutron.

➤ **Additional interfaces for muon ID studies**
- Add dR_max ([commit](#)): any ΔR above it is set to be 1e10. Default: 1e10+1.
- Add options for muon hits ID ([commit](#)):
  - Options to compute χ^2 based on three minimum ΔRs.
  - Options to compute χ^2 based on the distance between extrapolated tracks and muon hits in the corresponding layer plane. Use either the first one or three of them.
- Studies ongoing by Hengne and Weiqi.

Updates on FinalPIDSvc

➢ **Mistake on angular corrections** (commit)
- The ϕ corrections should be the opposite for opposite charges, which is not considered.
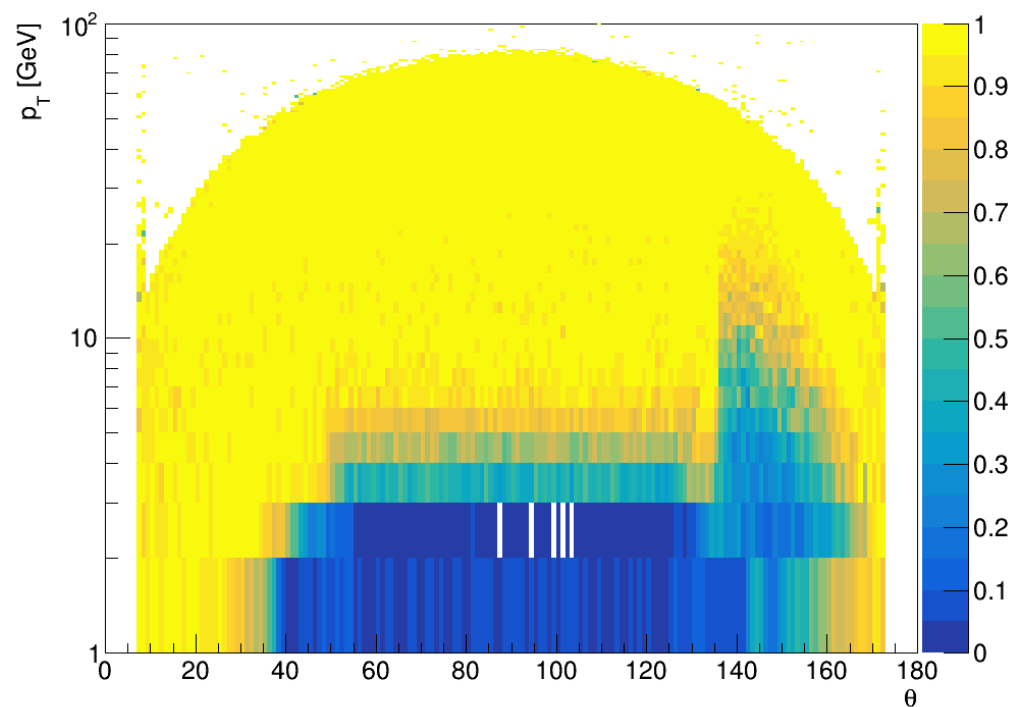- Illustrated with mmHbb samples.
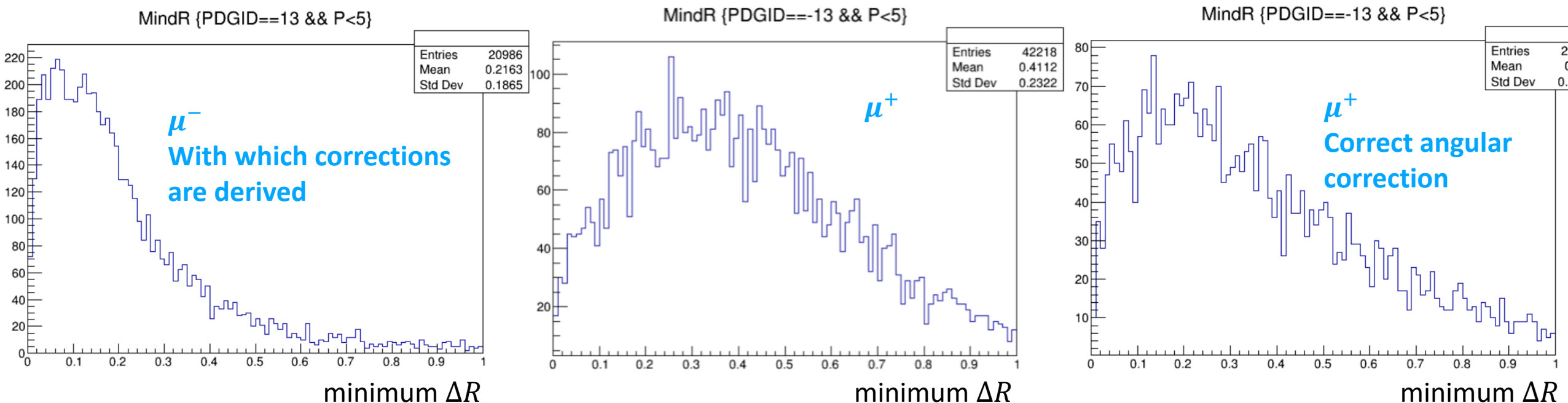
- μ^+ better but not as good as μ^-.
- In the most strict way, derive the angular corrections separately for μ^- and μ^+.
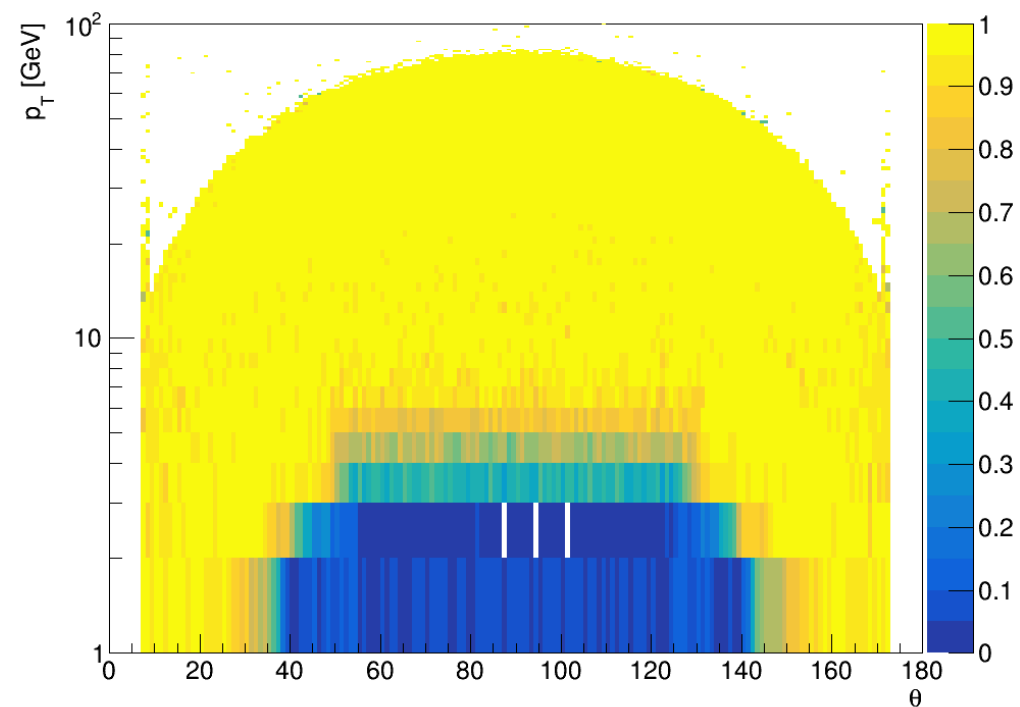
Updates on FinalPIDSvc

➢ **Mistake on track extrapolation** (commit)
- For the backward endcap, the track should be extrapolated to – z bound of the magnetic field.
- Illustrated with mmHbb samples.
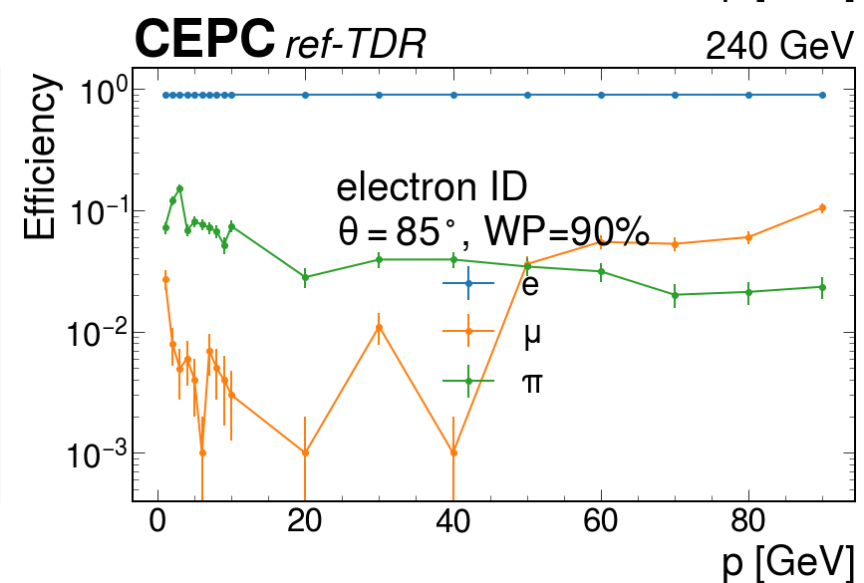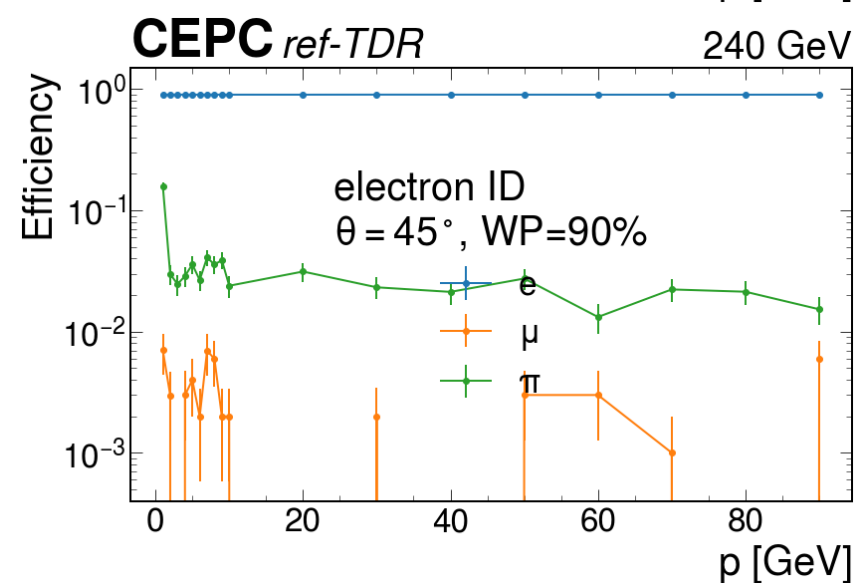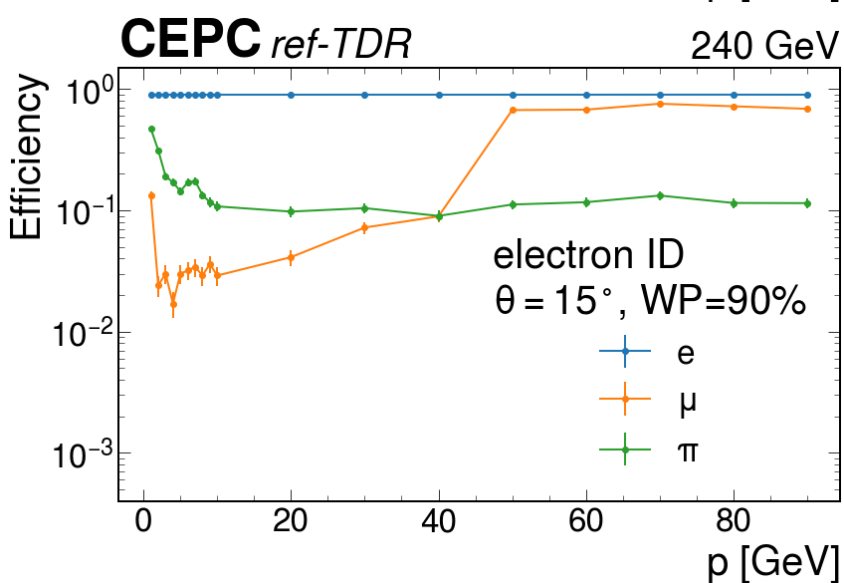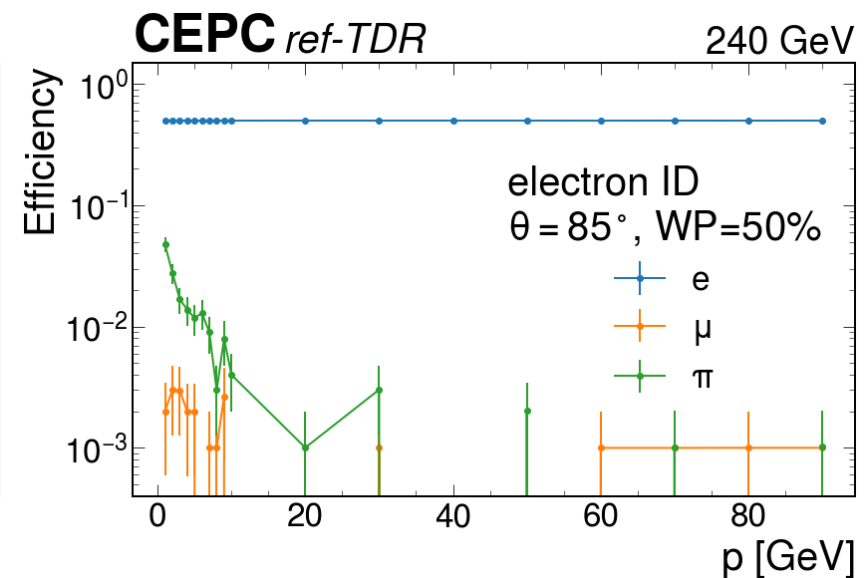
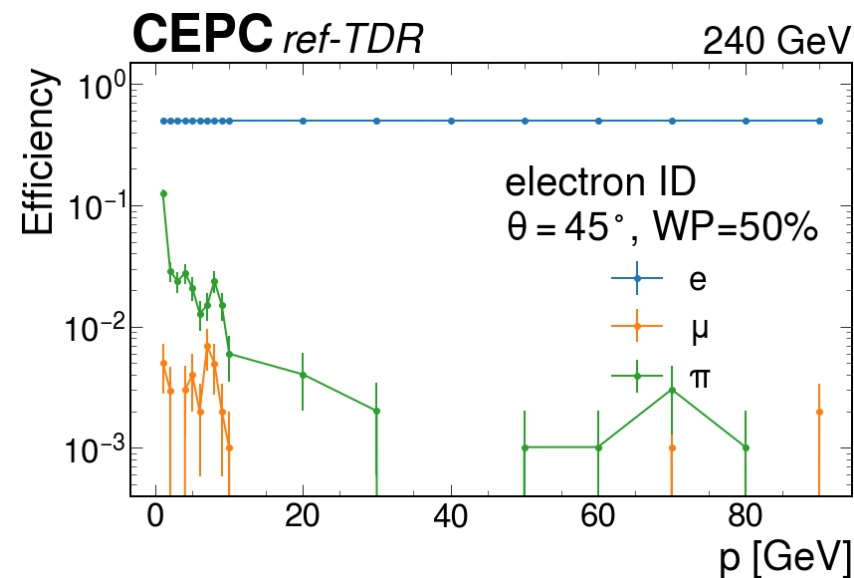**Muon hit matching efficiency for muons**
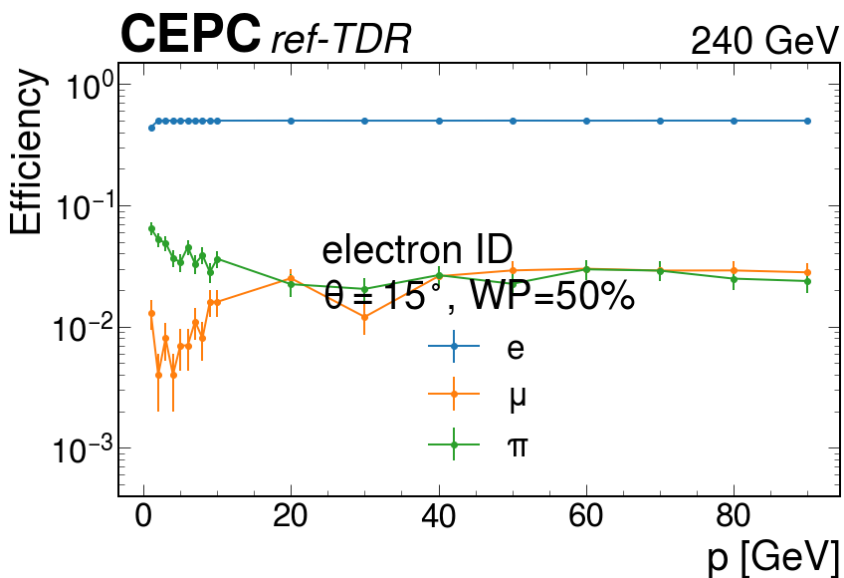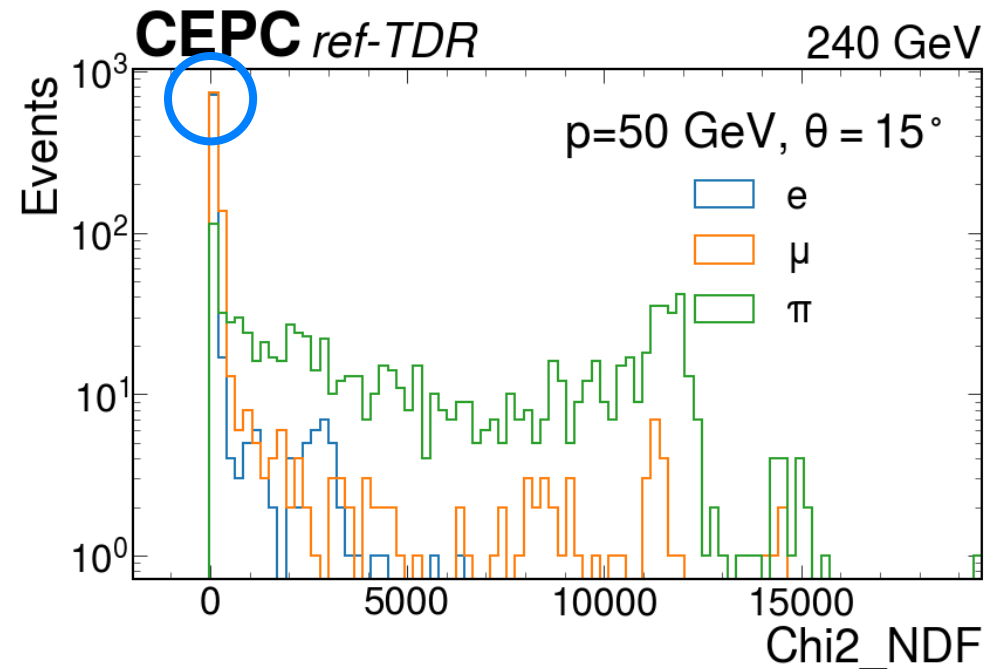

previous   **now**

Overall lepton efficiency: electron

Overall lepton efficiency: electron

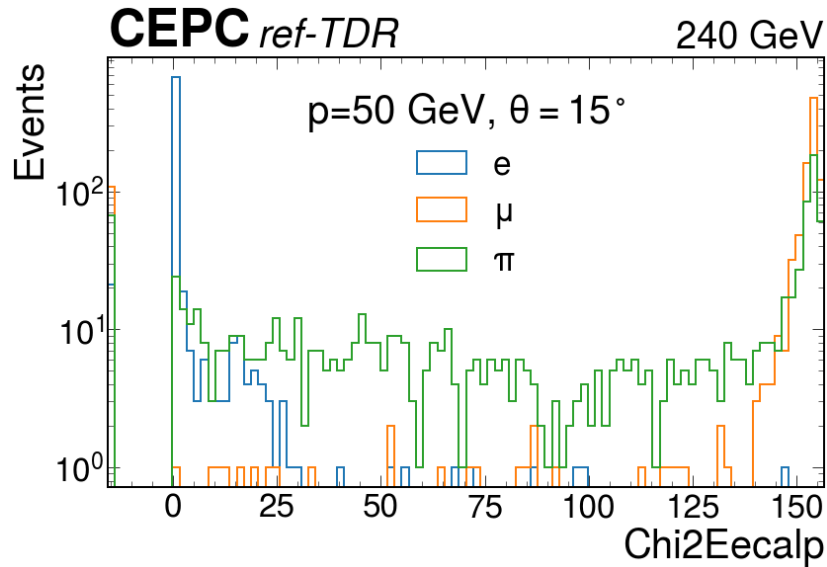**Issue at high momentum, low θ**
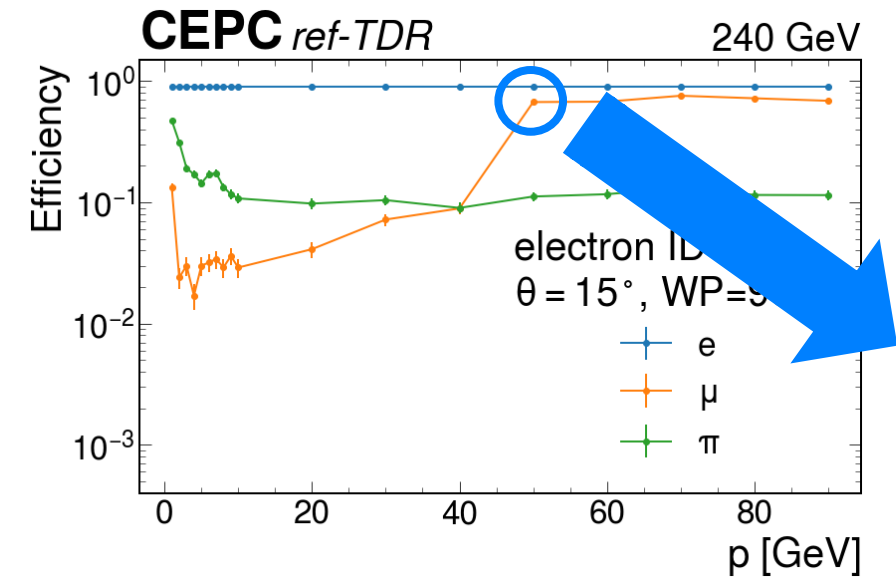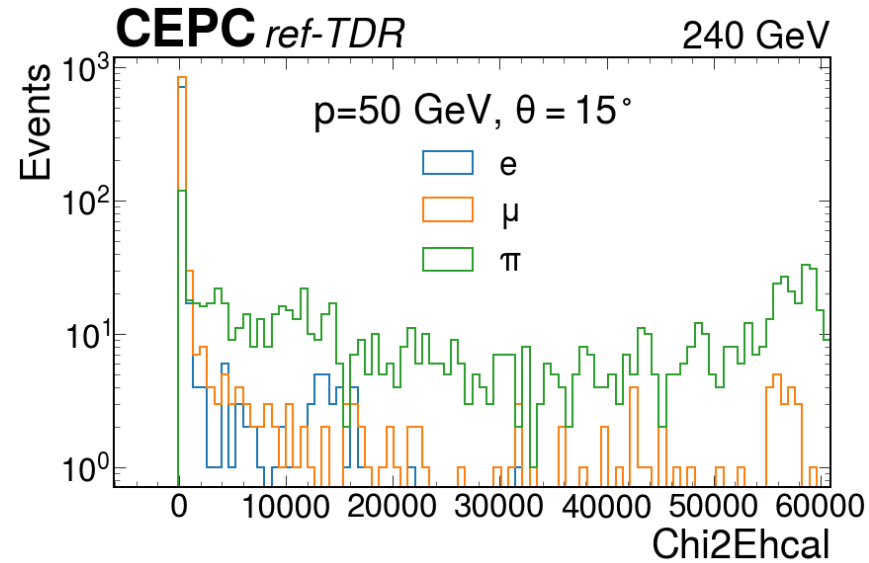

Total χ^2/ndf
Cannot distinguish electron and muon
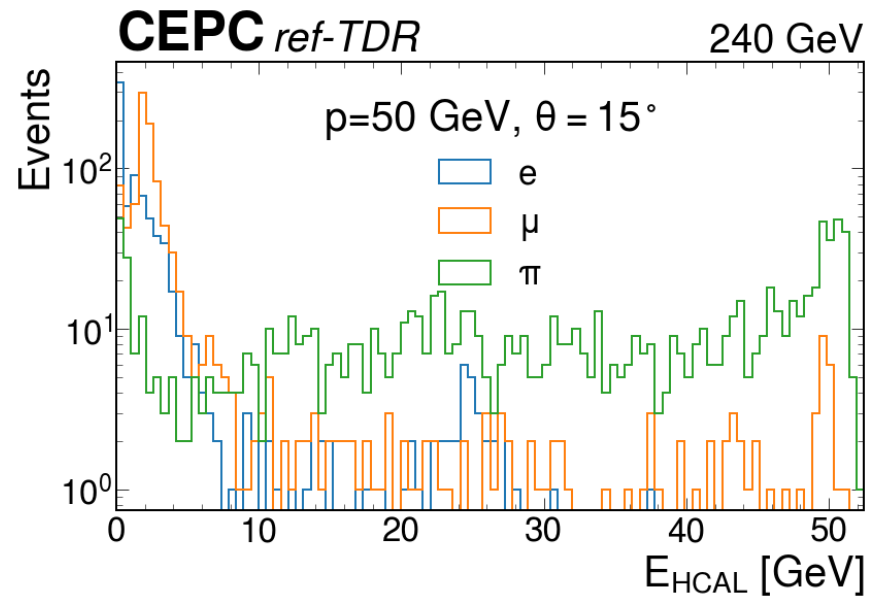
Overall lepton efficiency: electron

Issue at high momentum, low θ

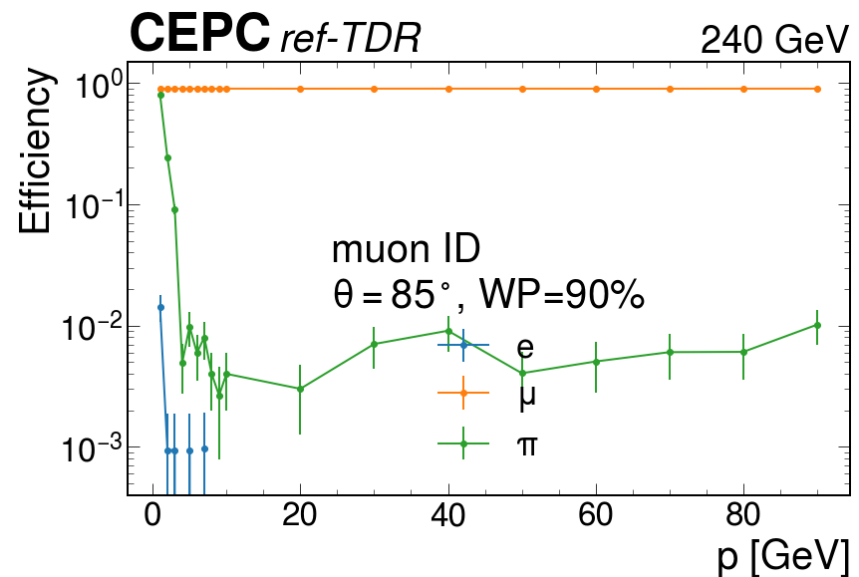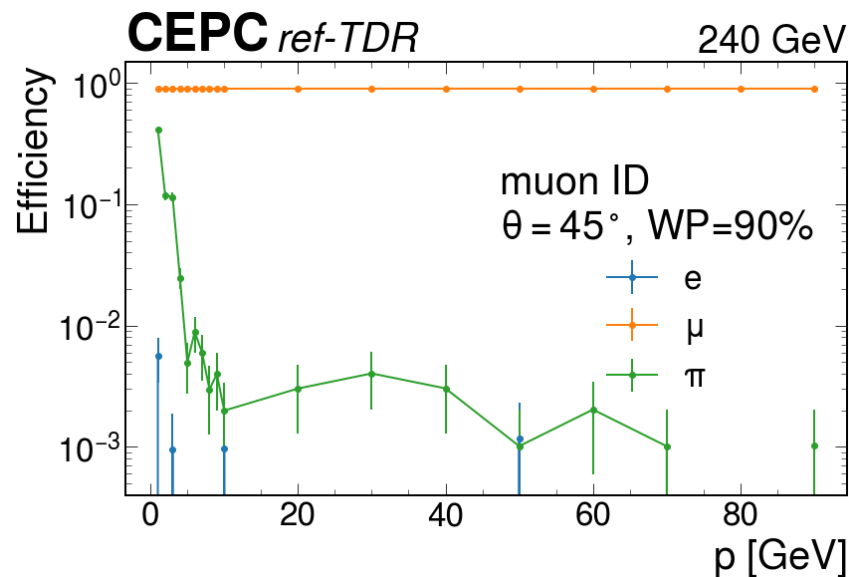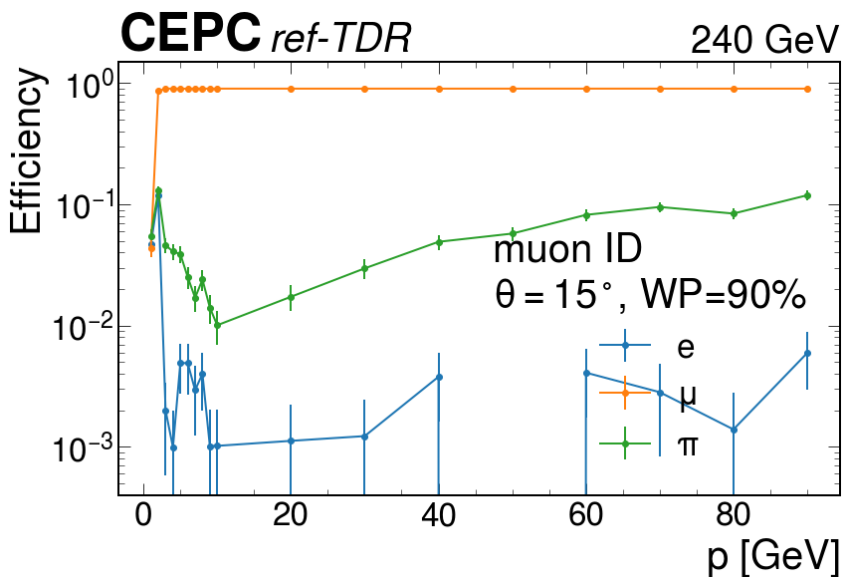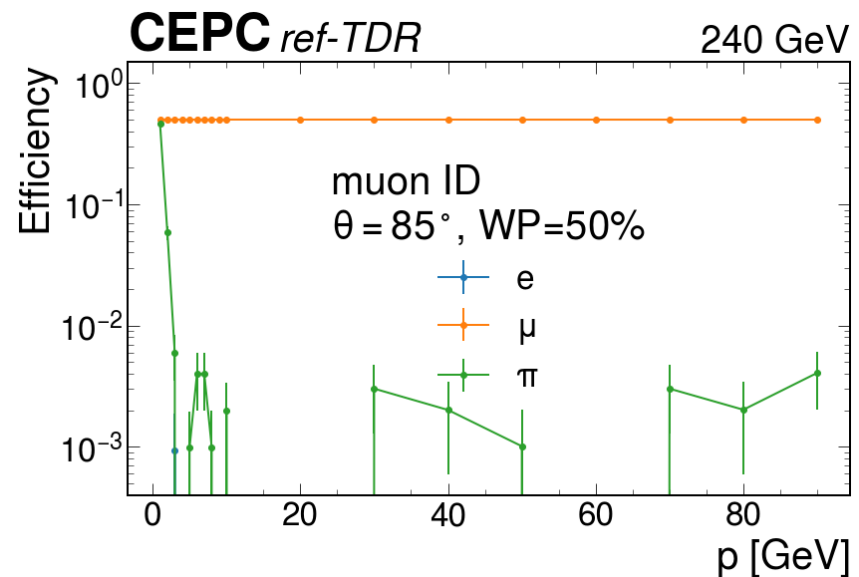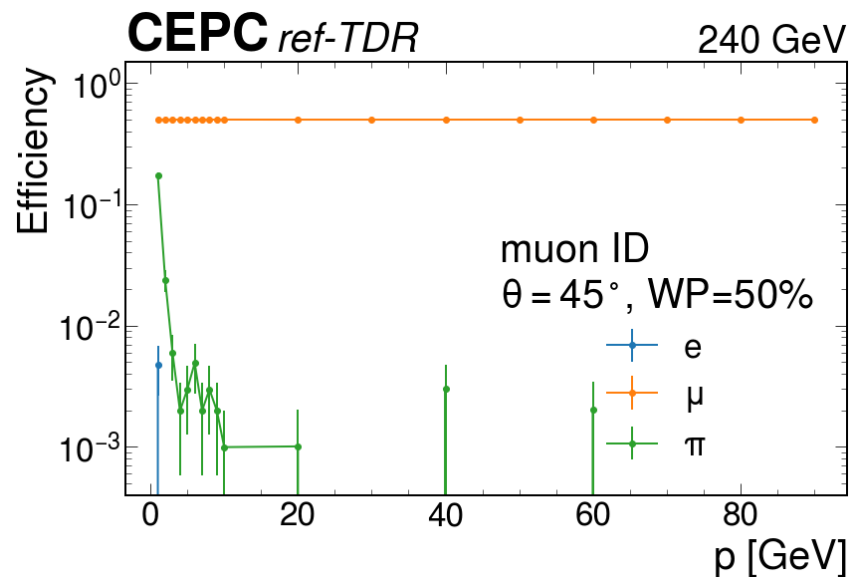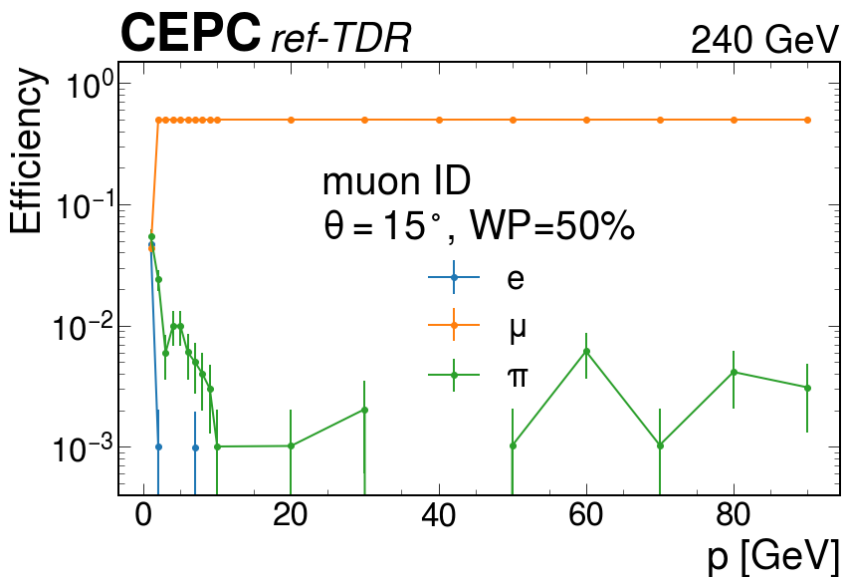χ^2/ndf from E_{ECAL}/p
Should have enough
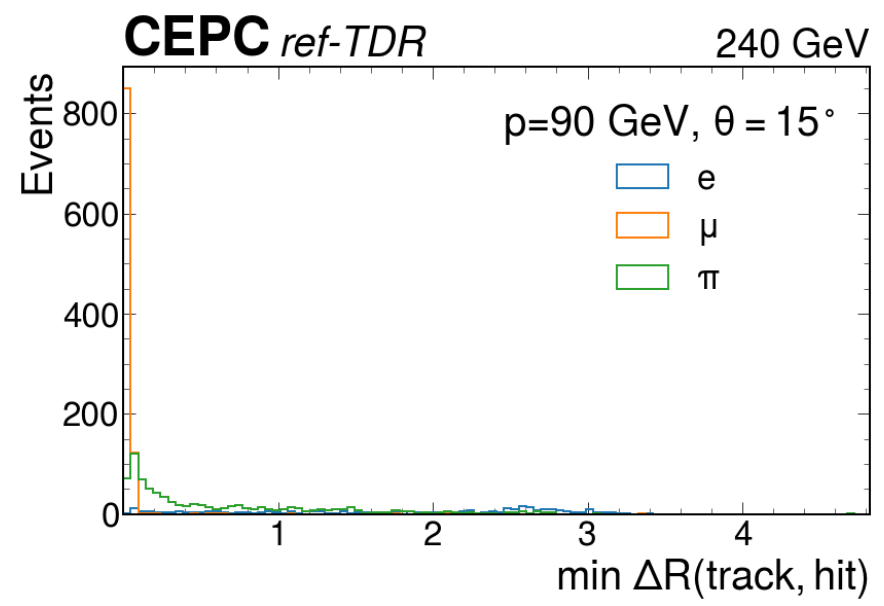separation power

χ^2/ndf from E_{HCAL}
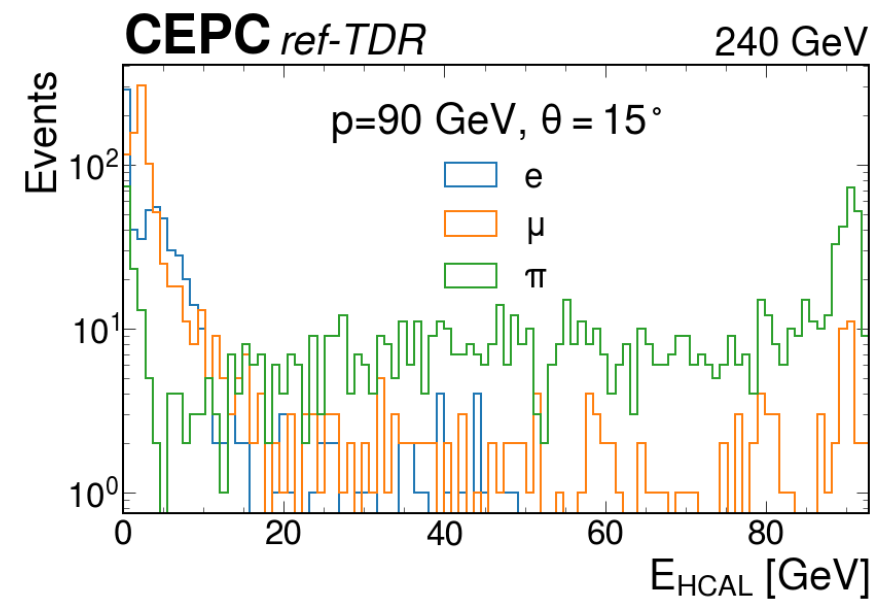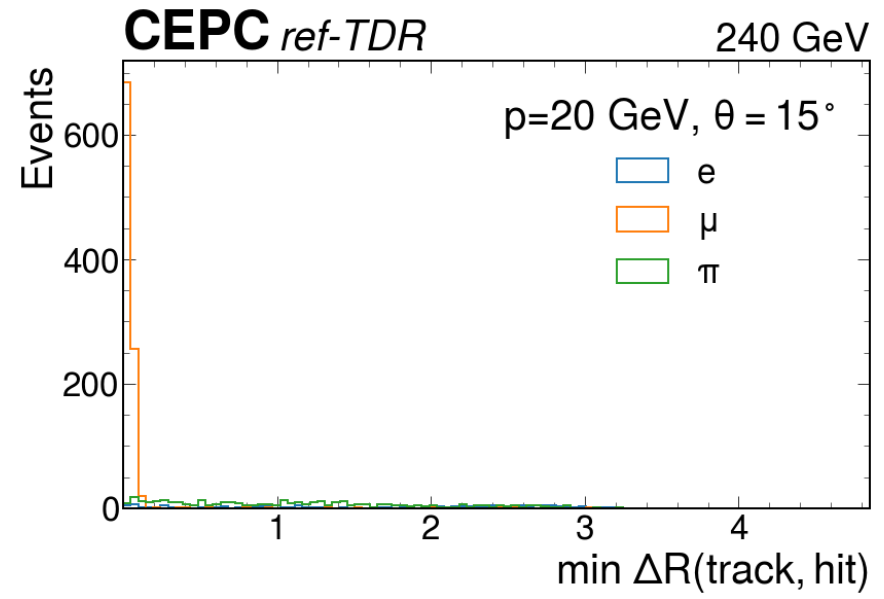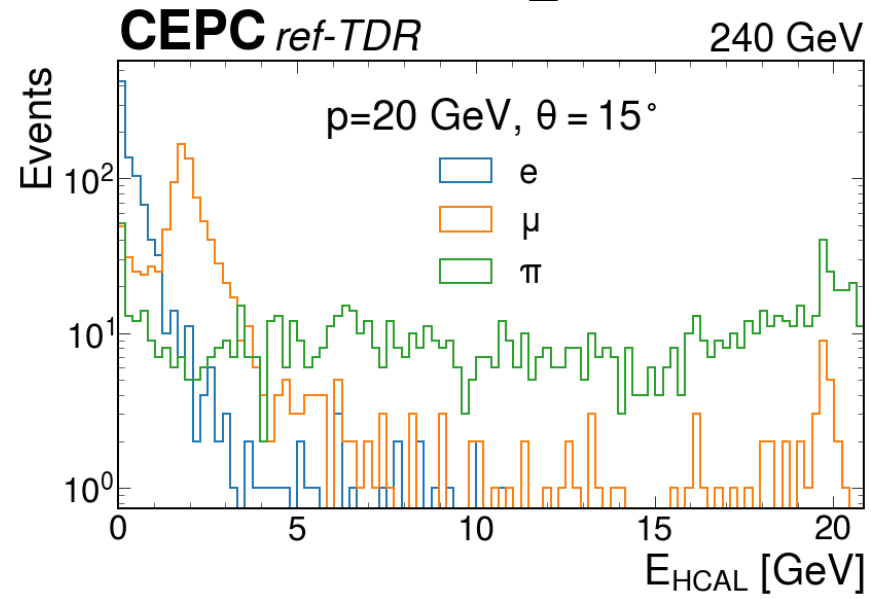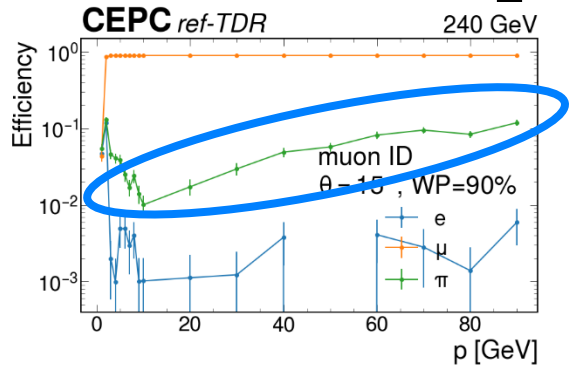This is what mixes things up.

Original distribution of E_{HCAL}
Very little separation power, but
should not make things worse.
**Need to optimize the parameters
in the χ^2 computation.**

Overall lepton efficiency: electron

Overall lepton efficiency: electron

Performance getting worse

High energy pions may penetrate endcap HCAL, and leaves hits in muon detectors.

What to do next

➢ **Optimization of parameters in χ^2 computation**
- Focus on $\mathrm{E_{HCAL}}$
- Can Changhua manage this?
- After discussion with Ligang, it would be more reasonable to have cuts on $(\chi^2 - \mathrm{ndf})/\sqrt{2\mathrm{ndf}}$, instead of χ^2/ndf

➢ **More variables to be used in muon hits ID**
- Being managed by Hengne and Weiqi
- Not sure if this can catch up with TDR, but definitely worth doing it even later.

➢ **For TDR draft**
- What plots are needed? Are efficiency plots enough?
- Do we need to generate more particle gun samples to fill the 0% efficiency points?