

Study of lepton ID -- electron

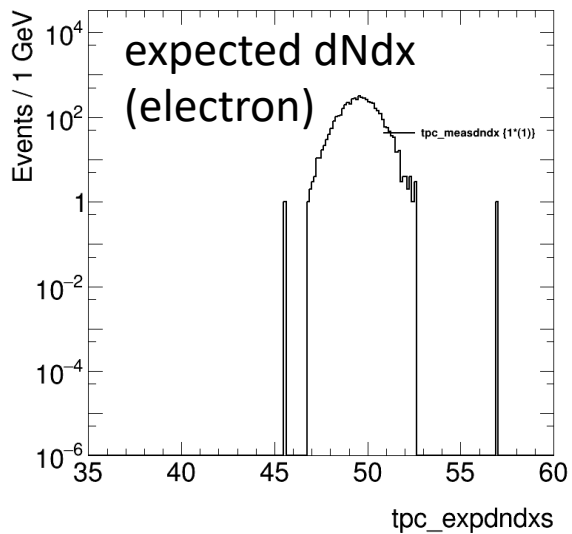
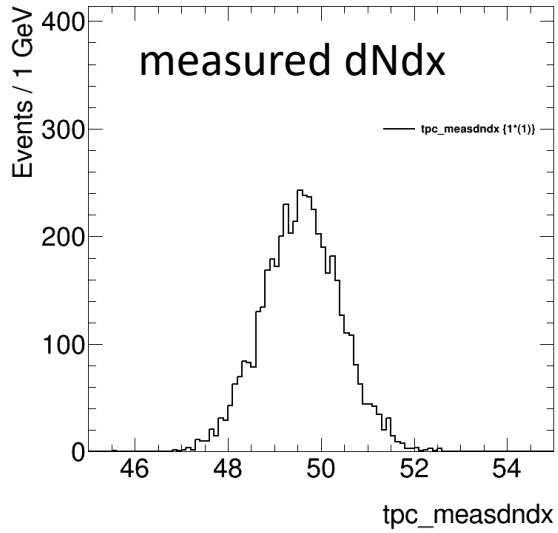
Changhua Hao, Ligang Xia

Nanjing University

Introduction

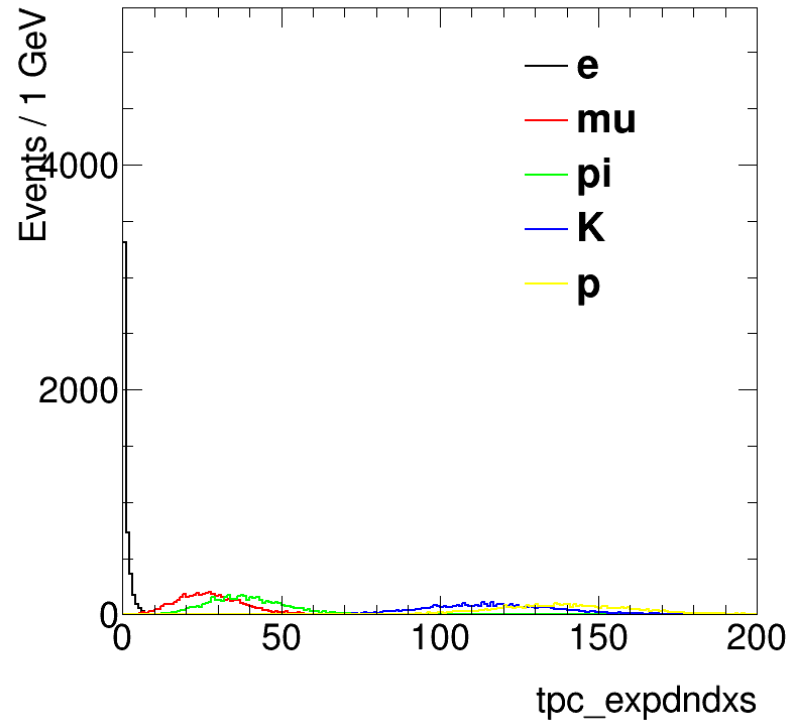
- We are interested in PID.
- **Chenguang** suggest us to study lepton ID.
 - He provides lots of help. Huge Thanks to Chenguang!!
- We begin with **electrons**.
- **The observables** that would help electron ID:
 - TPC \rightarrow $dN/dx \rightarrow \text{chi2}(dN/dx)$
 - TOF $\rightarrow \text{chi2}(tof)$
 - Ecal $\rightarrow E/p \sim 1$
- MC samples:
 - **Changhua** himself produced pure electron samples using particle gun with latest master + **Chenguang's TofRecAlg** package (\rightarrow provide TPC and TOF info)
 - available samples from **Kaili**: /cefs/higgs/zhangkl/Production/E240_eeHgg/Reco/pfa_*.root (\rightarrow provide Ecal and Hcal info)

electrons: dNdx in TPC

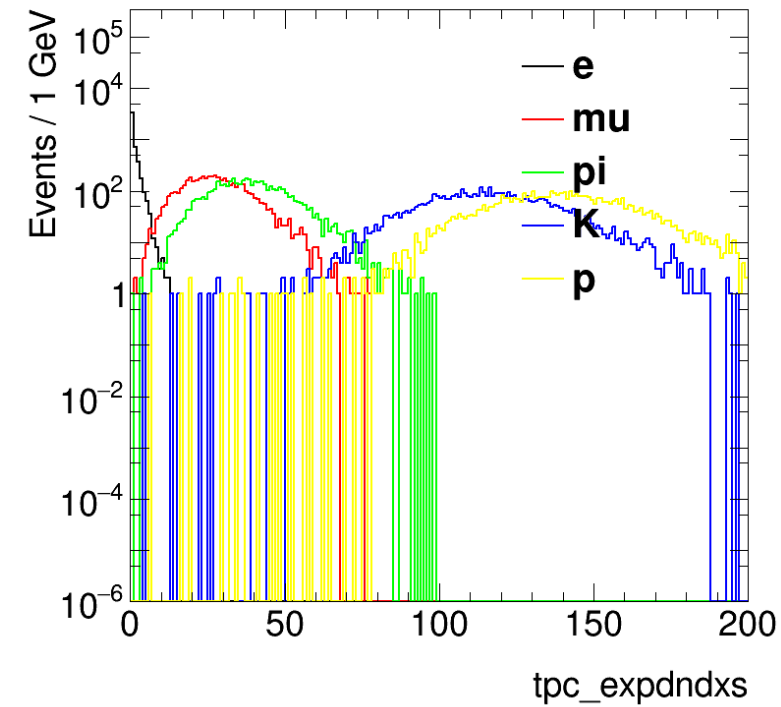


Changhua produce ~ 5000 electrons with $p=5\text{GeV}$ and $\text{angle}=45^\circ$.

chi2(dNdx)
linear scale



chi2(dNdx)
log scale



electrons: TOF (not ready)

electrons: Ecal

- Many files for each sample: [sim-digi-track-rec/ana/pfa](#)
- I'm using [pfa](#) files in the following slides.
- Many trees in a pfa file.
- I'm using [RecClusters](#).

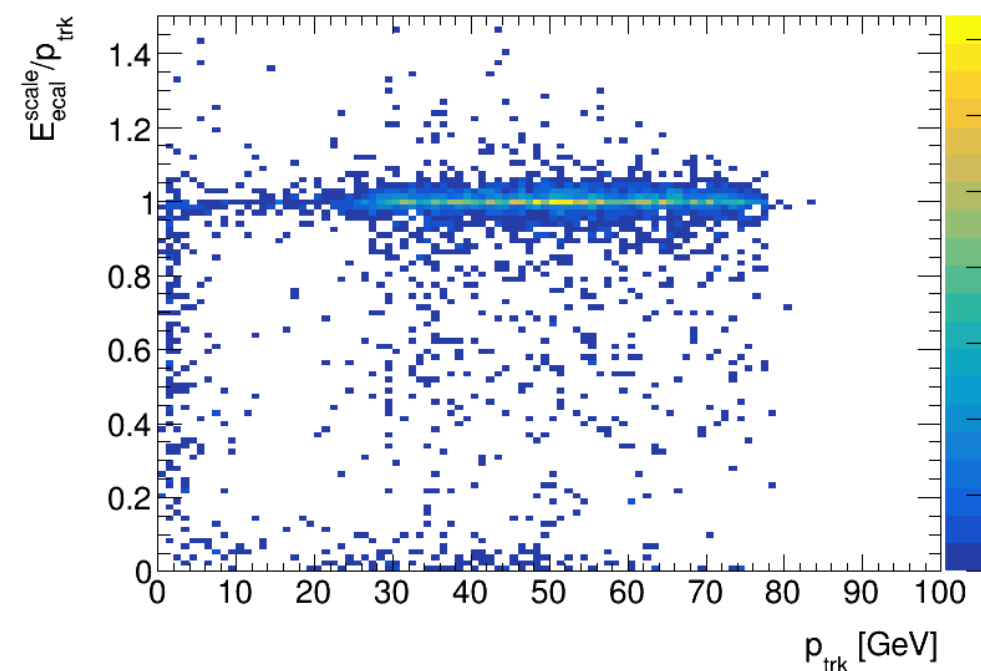
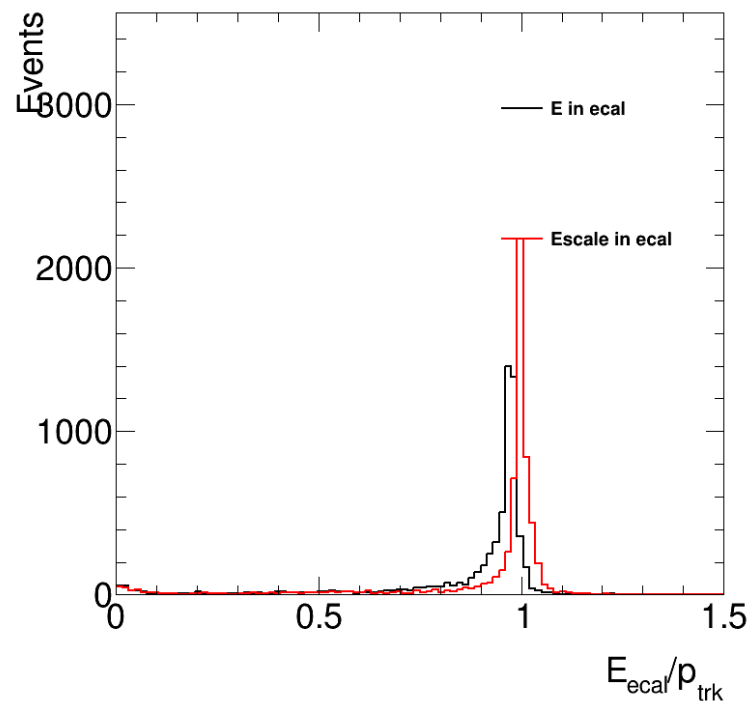
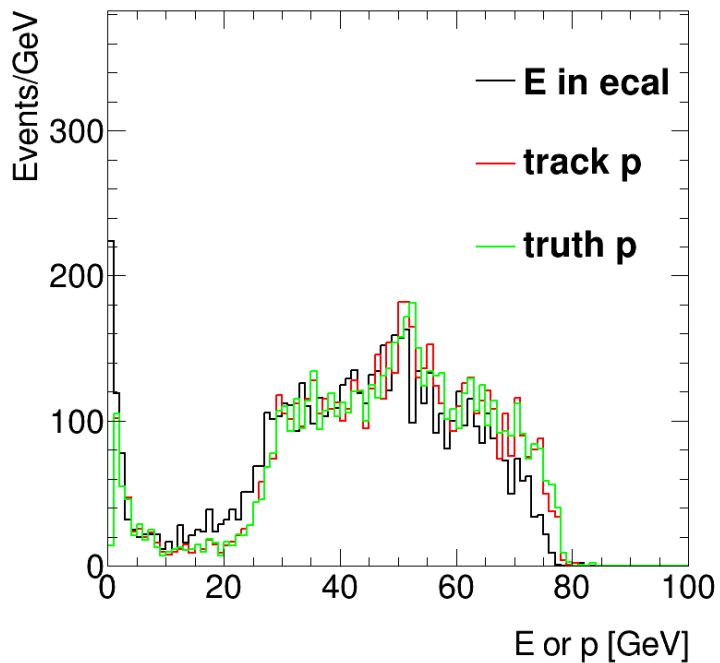
```
002 ~/higgs/analysis/test_samples]$ll
```

```
kialg physics          4096 Nov 22 09:42 .
kialg physics          4096 Nov 22 09:41 ..
kialg physics      2766057 Nov 22 09:41 ana_E240_eeHgg_00047.root
kialg physics 133798773 Nov 22 09:12 dig_E240_eeHgg_00011.root
kialg physics          1438 Nov 22 09:12 events.C
kialg physics      139599 Nov 22 09:12 events.h
kialg physics   90185834 Nov 22 09:42 pfa_E240_eeHgg_00011.root
kialg physics   65677976 Nov 22 09:12 rec_E240_eeHgg_00011.root
kialg physics 6135659115 Nov 22 09:11 sim_E240_eeHgg_00010.root
kialg physics          1448 Nov 22 09:24 tree_rec.C
kialg physics      80386 Nov 22 09:24 tree_rec.h
```

```
TFile**      pfa_E240_eeHgg_00011.root
TFile*      pfa_E240_eeHgg_00011.root
OBJ: TTree   PF0      PF0 : 0 at: 0x563ecf79a900
OBJ: TTree   Track    Track : 0 at: 0x563ed0740760
OBJ: TTree   LocalMax  LocalMax : 0 at: 0x563ed09e25a0
OBJ: TTree   Hough    Hough : 0 at: 0x563ed0c59ac0
OBJ: TTree   SimBarHit SimBarHit : 0 at: 0x563ed0eedc40
OBJ: TTree   TrackAxis TrackAxis : 0 at: 0x563ed1245080
KEY: TTree   SimBarHit;2 SimBarHit [current cycle]
KEY: TTree   SimBarHit;1 SimBarHit [backup cycle]
KEY: TTree   MCParticle;1 MCParticle
KEY: TTree   LocalMax;1  LocalMax
KEY: TTree   RecLayers;1 RecLayers
KEY: TTree   Hough;1 Hough
KEY: TTree   Cone;1 Cone
KEY: TTree   TrackAxis;1 TrackAxis
KEY: TTree   Axis;1 Axis
KEY: TTree   HalfCluster;1 HalfCluster
KEY: TTree   Tower;1 Tower
KEY: TTree   RecClusters;1 RecClusters
KEY: TTree   Track;1 Track
KEY: TTree   PF0;1 PF0
```

electrons: Ecal

- **truth matching**: the relative difference between (electron truth p) and (EcalCluster associated track p) is less than 5%.
- **Ecal cluster** has two energy variables: EcalClus_E and EcalClus_Escale (the latter seems better).
- A few events with very low E/P are probably due to wrong truth matching or Ecal leakage (further study needed).



Summary

- Have a first look at electrons (dNdx, tof and Ecal)
- Will try combine them into a single PID variable using ML
- We need helps on producing MC samples:
 - **Option1**: particle gun → TPC → TOF → Ecal (how?)
 - **Option2**: Kaili's MC → run dNdx/tof algorithm → add them to PFA (how?)
- For muonID, we also need info from the muon counter.