

Tracking & Shower Efficiencies For Neutrino Interactions (FD)

Aaron Higuera
University of Houston

Tracking & Shower Efficiencies Modules

NeutrinoTrackingEff_module.cc

Lives at *larreco/TrackFinder*

NeutrinoShowerEff_module.cc

Lives at *larreco/ShowerFinder*

You can find the “alpha” versions at a feature branch in
LArReco/feature/higuera

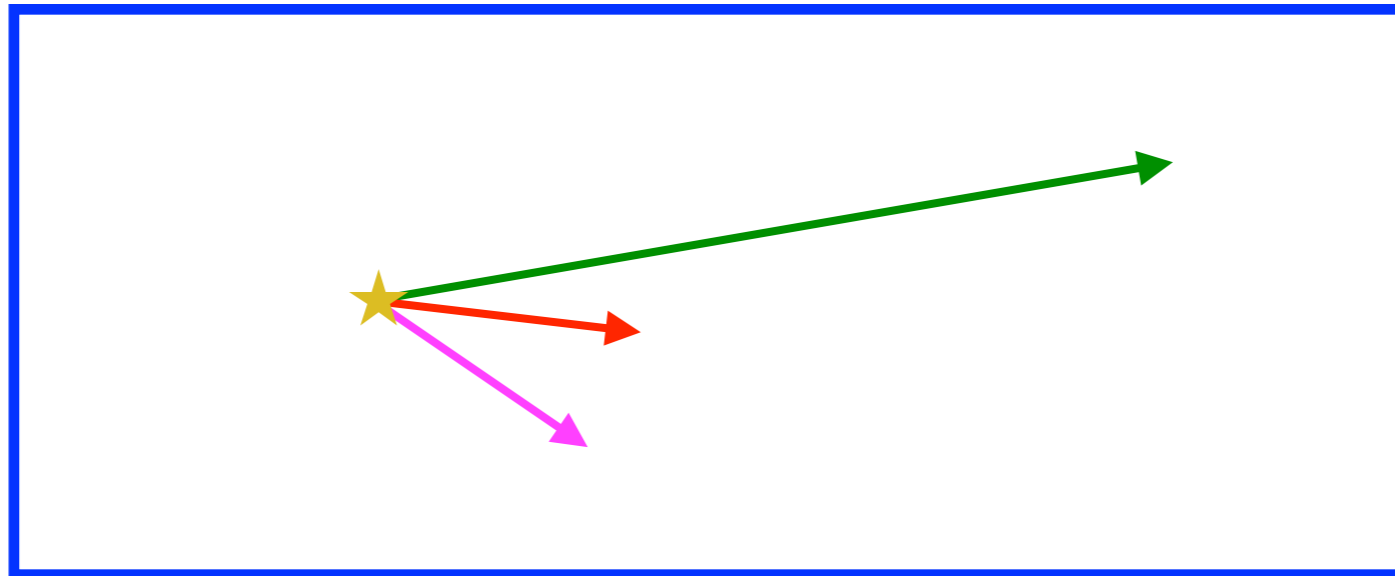
NeutrinoTrackingEff_module.cc

Calculates tracking efficiencies given a tracking module

```
31     NeutrinoTrackingEff:
32     {
33         module_type:           "NeutrinoTrackingEff"
34         outFile:               "PANDORAtest.root"
35         MCTruthModuleLabel:    "generator"
36         TrackModuleLabel:     "pandora"
37         NeutrinoPDGcode:       14
38         LeptonPDGcode:         13
39         MaxNeutrinoE:          25.0
40         SaveMCTree:            false
41     }
```

NeutrinoTrackingEff_module.cc

Is neutrino interaction within fiducial volume and is CC?



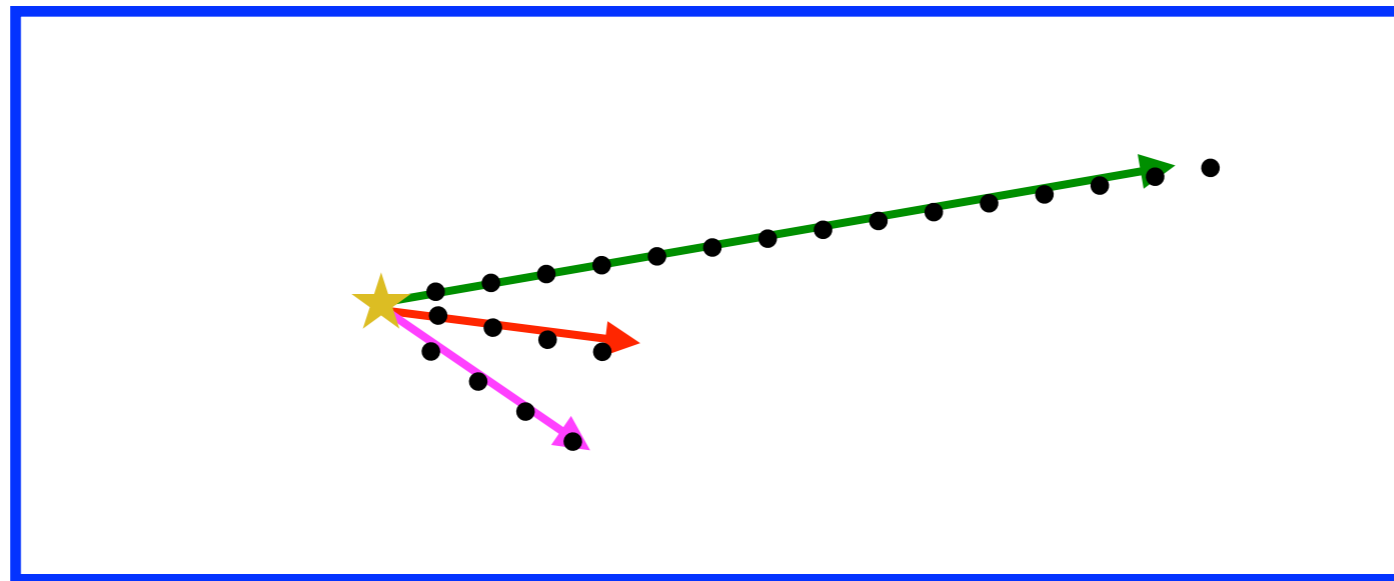
NeutrinoTrackingEff_module.cc

Is neutrino interaction within fiducial volume and is CC?

Loop over tracks, grab all hits associated to the track

Use “BackTracker” to find MCParticle

```
art::Ptr<recob::Hit> hit = track_hits[j];  
std::vector<sim::TrackID> TrackIDs = bt->HitToTrackID(hit);
```



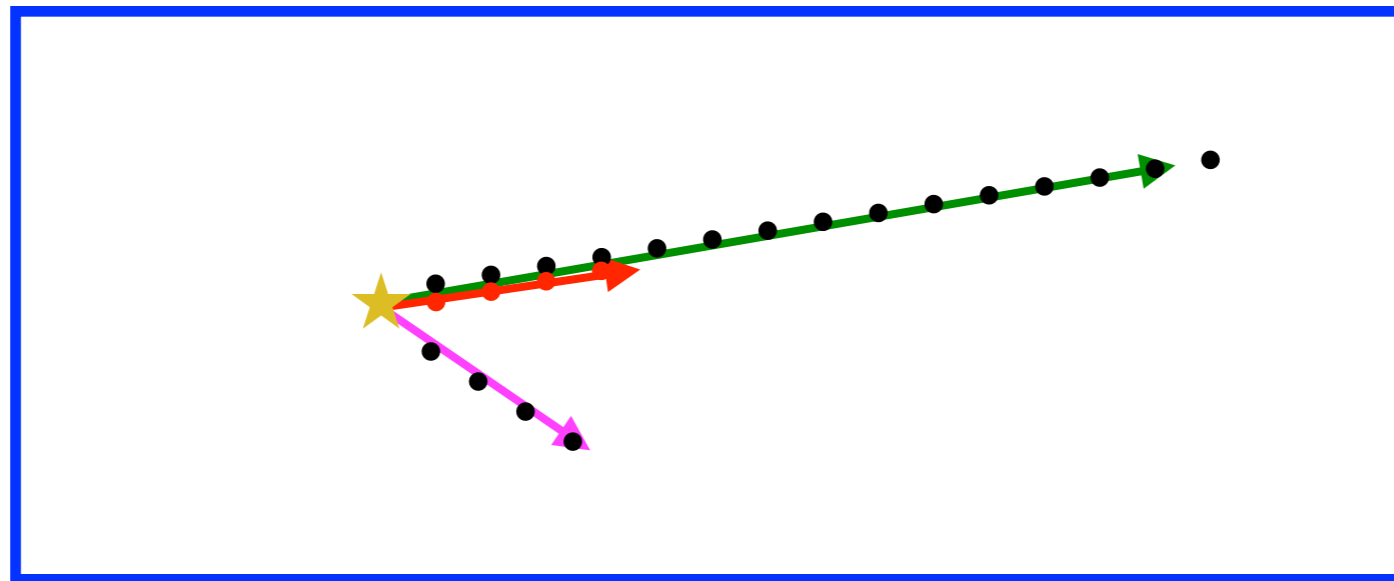
NeutrinoTrackingEff_module.cc

Neutrino interaction is within fiducial volume and is CC?

Loop over tracks, grab all hits associated to the track

Use “BackTracker” to find MCParticle

```
art::Ptr<recob::Hit> hit = track_hits[j];  
std::vector<sim::TrackID> TrackIDs = bt->HitToTrackID(hit);
```



Save the best track based on purity a.k.a Efrac

Efrac = 1.0, if all hits in the track come from the same particle

NeutrinoTrackingEff_module.cc

$$\text{Efficiency} = \frac{\text{CC events w/reco track } (\mu, \rho, \pi^\pm)}{\text{CC events Primary Particle } (\mu, \rho, \pi^\pm)}$$

Histograms

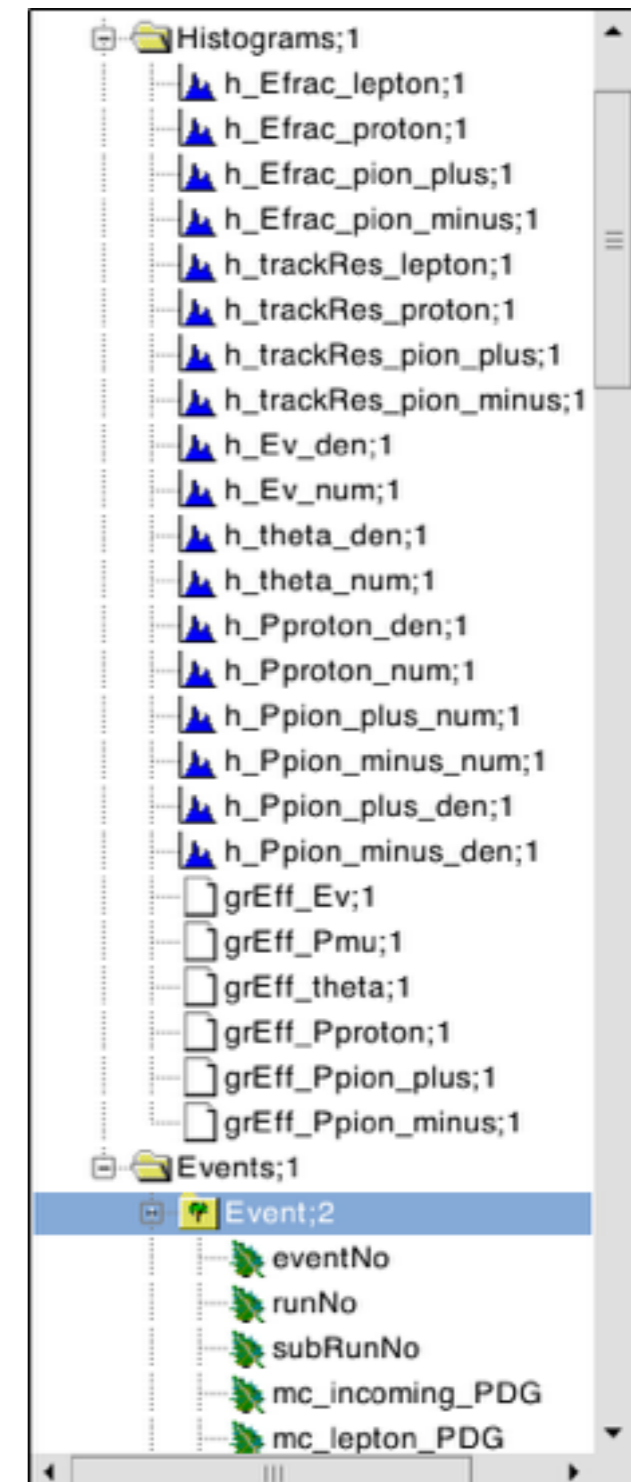
Calculate track length residuals

Purity of tracks (Efrac)

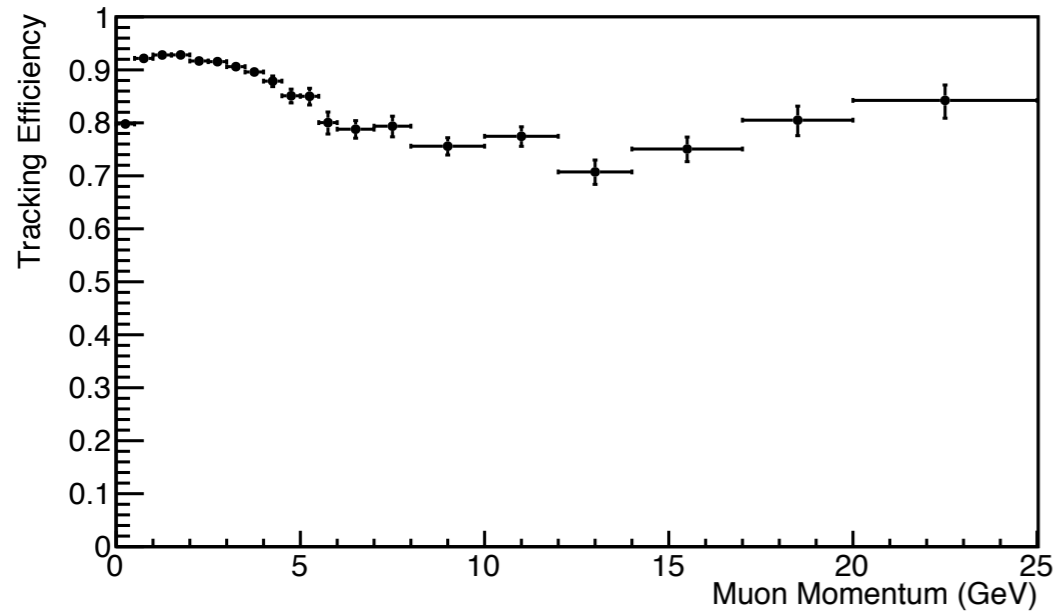
Efficiencies

Events

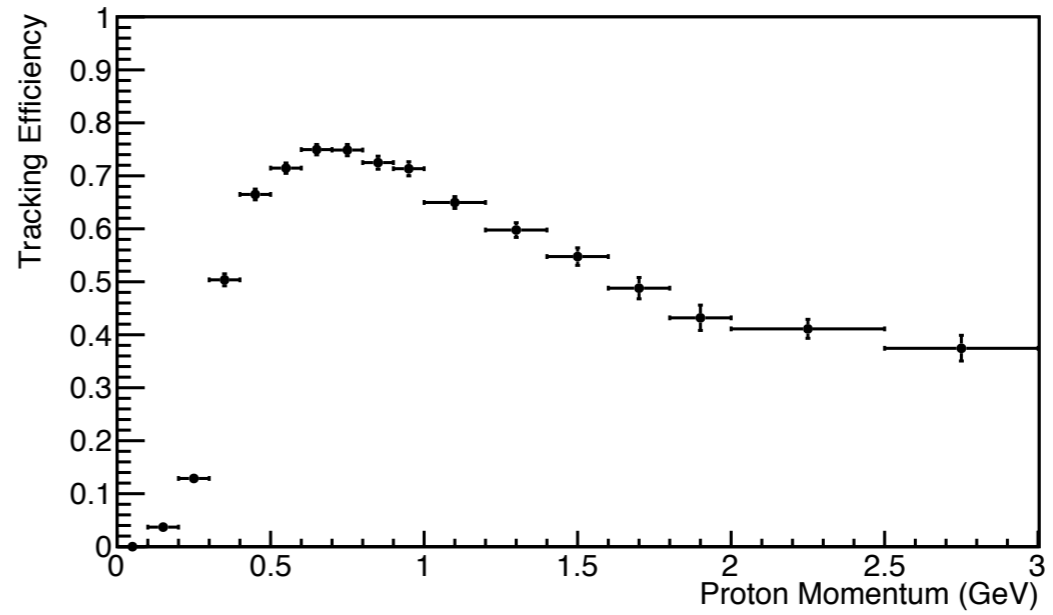
Save TTree with MC info



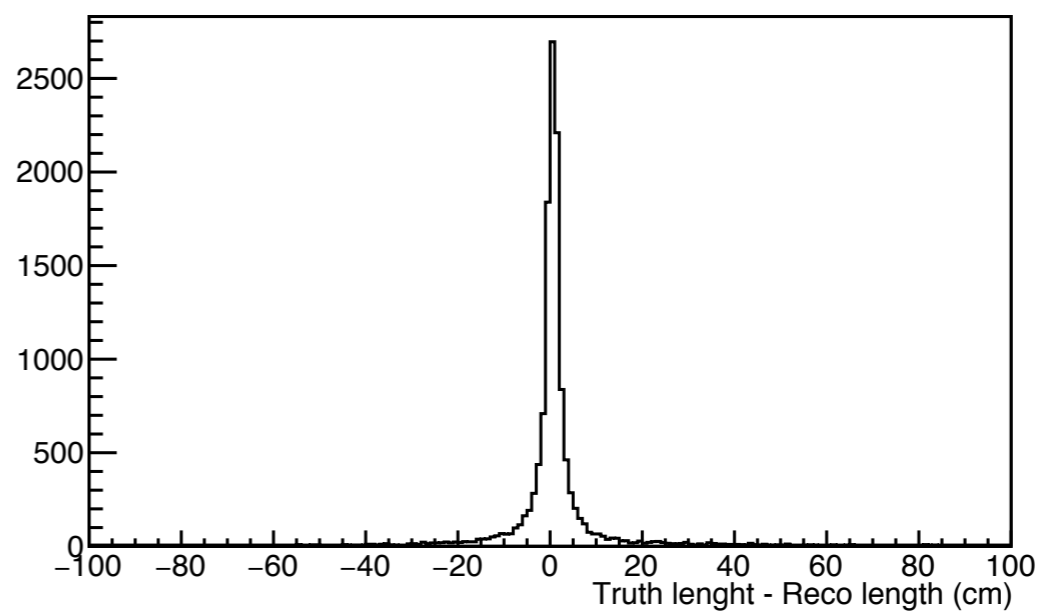
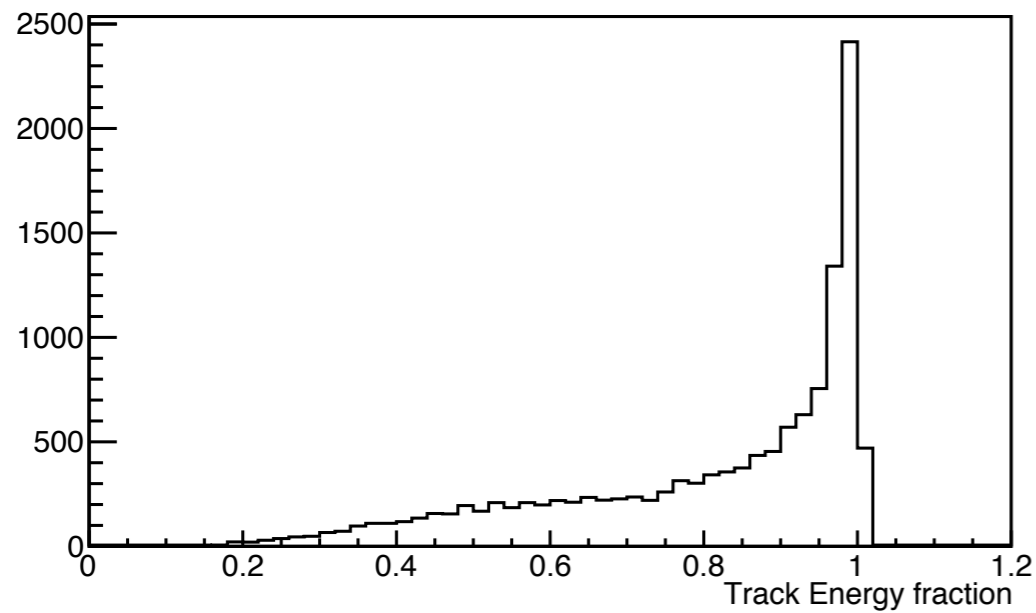
NeutrinoTrackingEff_module.cc



Efrac Proton



Proton Residual



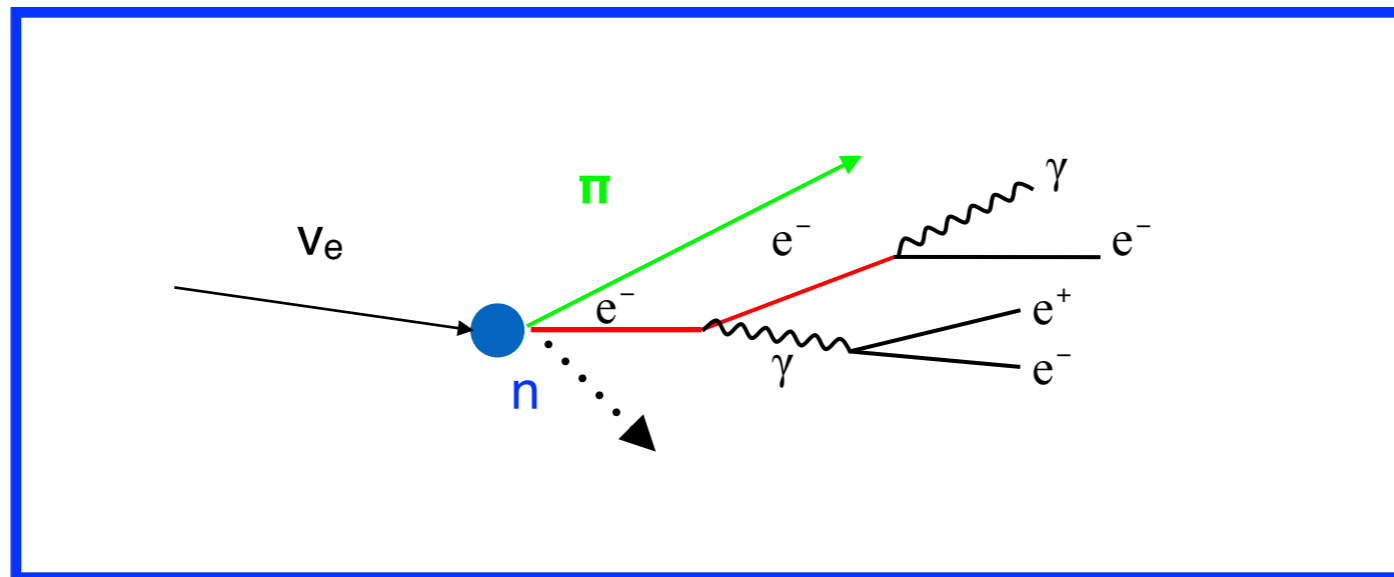
NeutrinoShowerEff_module.cc

Calculates shower efficiencies given a shower module

```
31   NeutrinoShowerEff:
32   {
33       module_type:           "NeutrinoShowerEff"
34       outFile:               "Showertest.root"
35       MCTruthModuleLabel:    "generator"
36       ShowerModuleLabel:    "emshowerdc"
37       NeutrinoPDGcode:       12
38       LeptonPDGcode:         11
39       MaxNeutrinoE:           25.0
40       MaxEfrac:               0.20
41       SaveMCTree:            true
42   }
```

NeutrinoShowerEff_module.cc

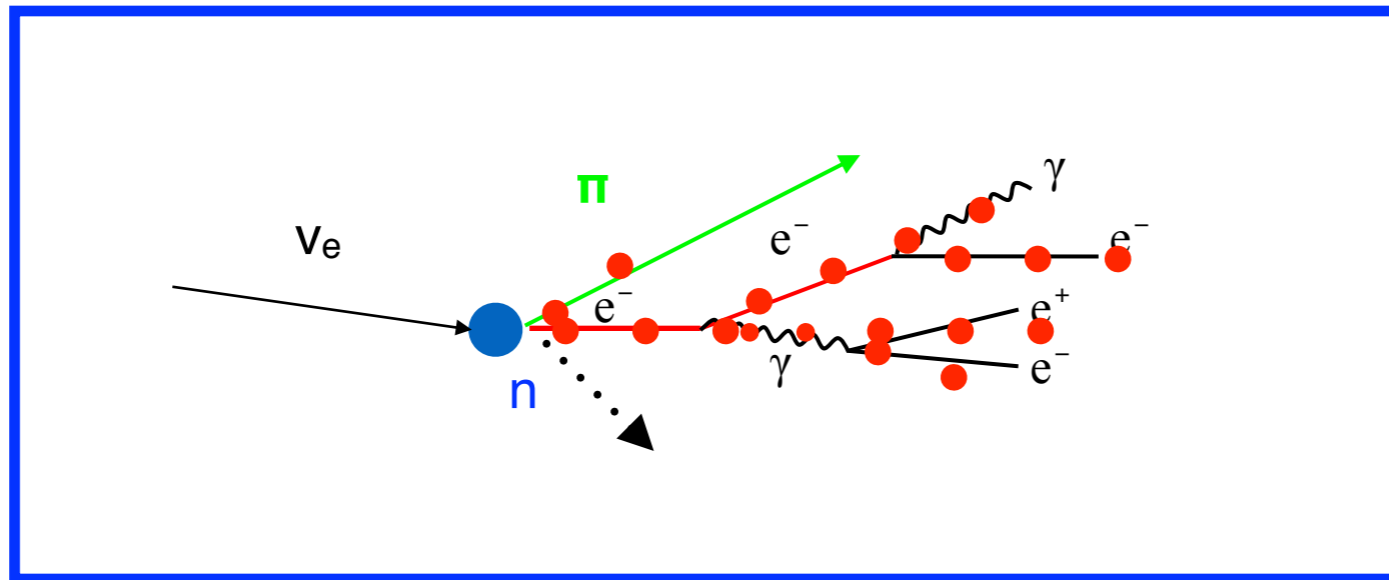
Is neutrino interaction within fiducial volume and is CC?



NeutrinoShowerEff_module.cc

Is neutrino interaction within fiducial volume and is CC?
Loop over showers grab all hits associated to the shower
Use “BackTracker” to find MCParticle

```
art::Ptr<recob::Hit> hit = shower_hits[j];  
std::vector<sim::TrackID> TrackIDs = bt->HitToTrackID(hit);
```



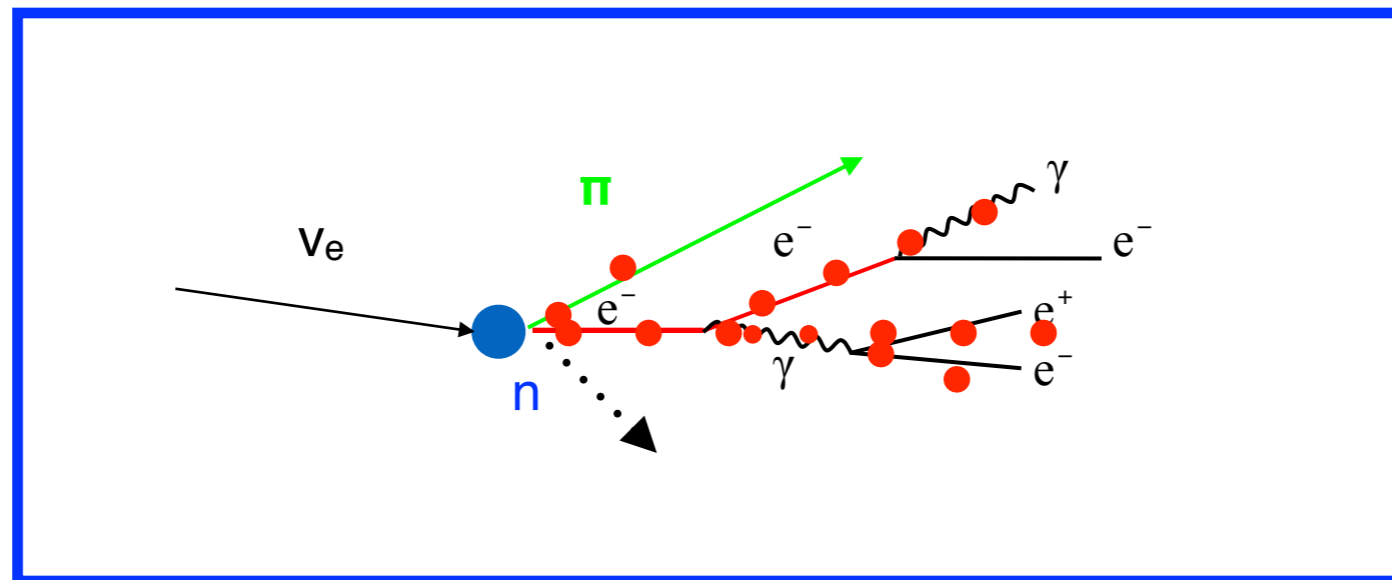
NeutrinoShowerEff_module.cc

Is neutrino interaction within fiducial volume and is CC?

Loop over showers grab all hits associated to the shower

Use “BackTracker” to find MCParticle

```
art::Ptr<recob::Hit> hit = shower_hits[j];  
std::vector<sim::TrackIDE> TrackIDs = bt->HitToTrackID(hit);
```



Save the best shower based on shower contains primary lepton (electron) and purity a.k.a Efrac contamination

Efrac contamination = 0.0, if all hits in the shower come from EM activity. Efrac contamination = noEM energy/total shower energy

NeutrinoShowerEff_module.cc

$$\text{Efficiency} = \frac{\text{CC events w/reco shower (e)}}{\text{CC events}}$$

Histograms

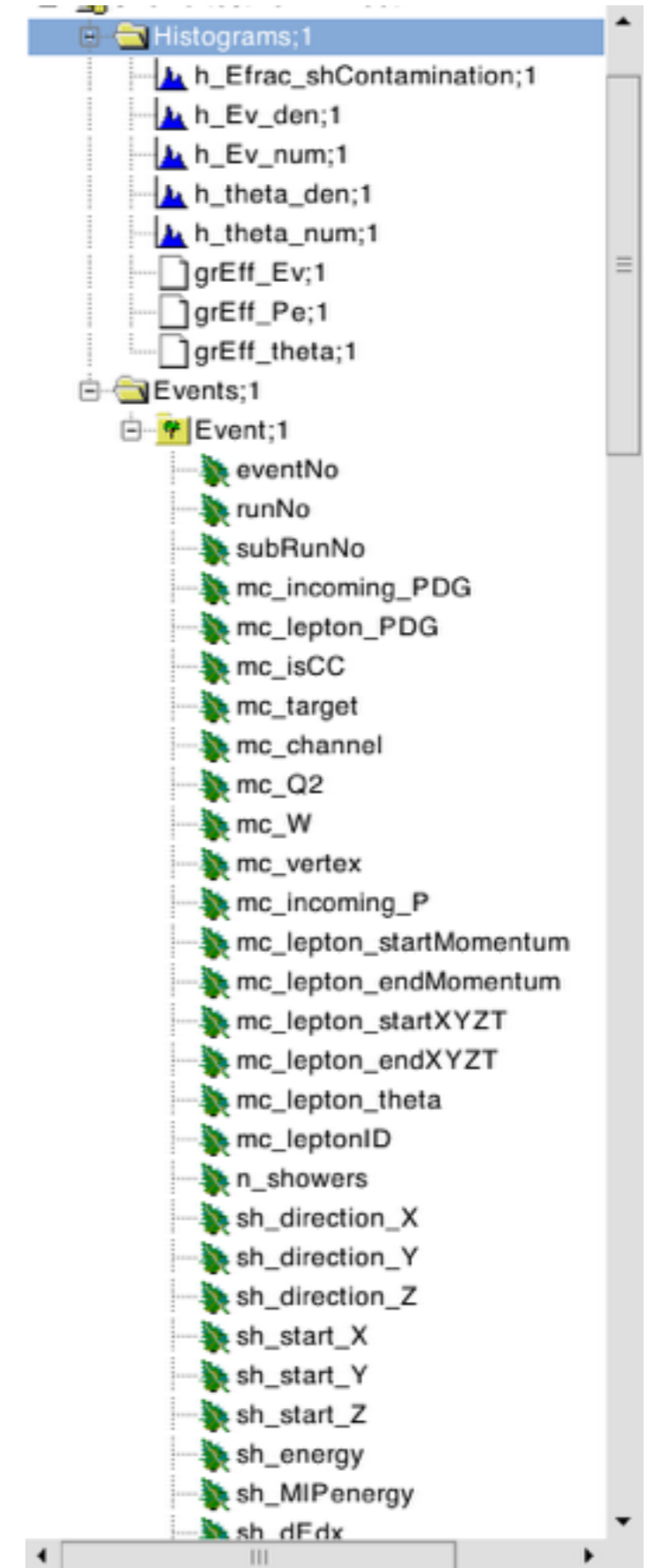
Calculate track length residuals

Purity of Shower (Efrac_shContamination)

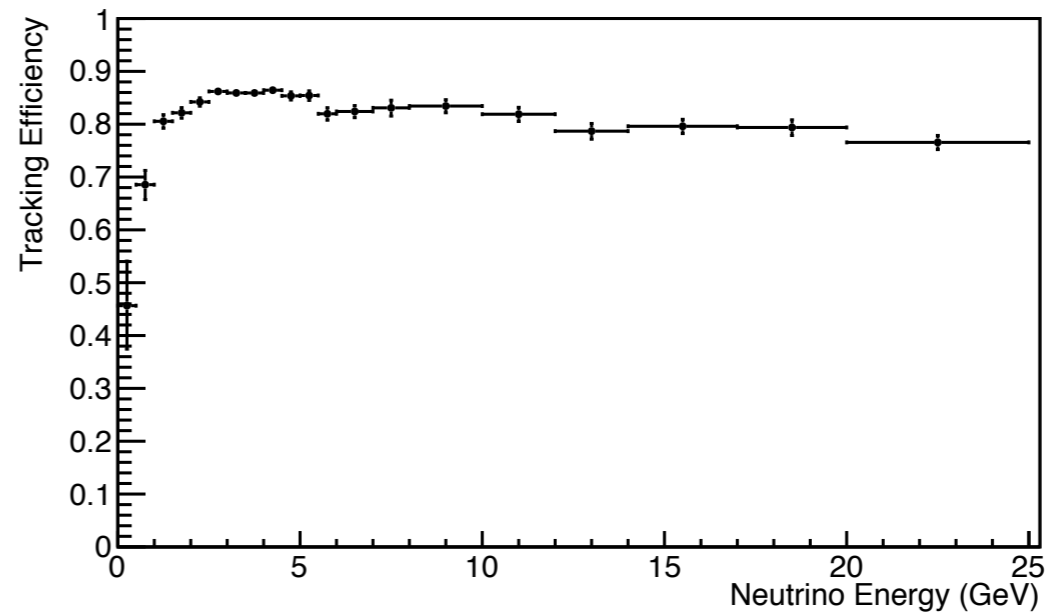
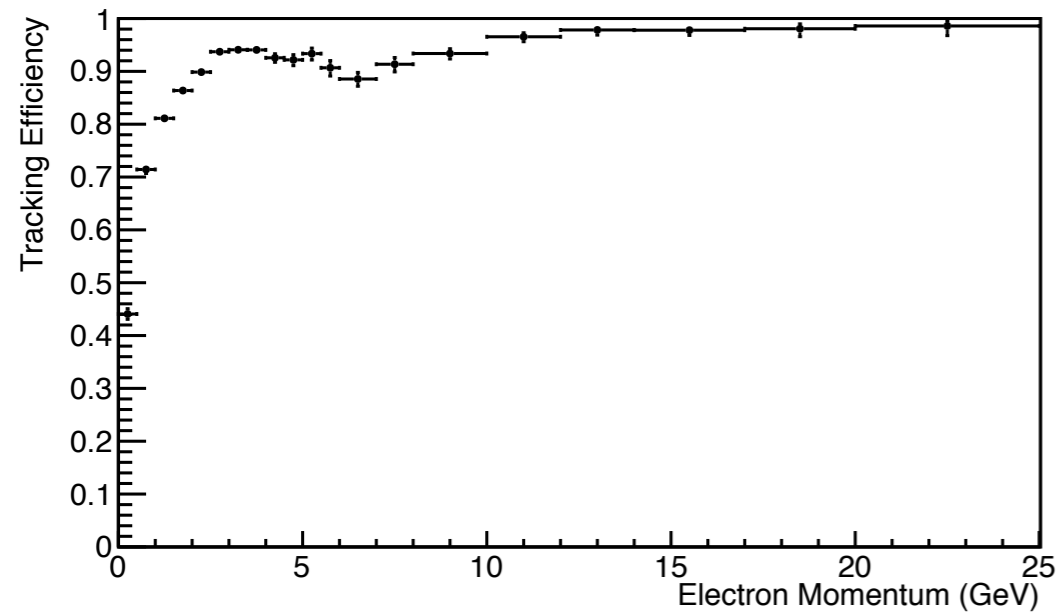
Efficiencies

Events

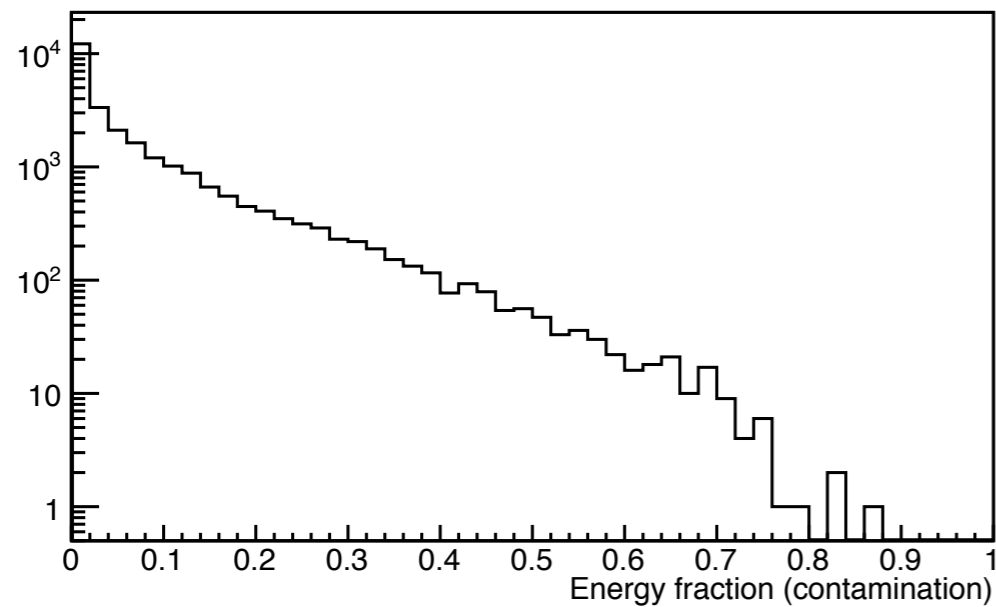
Save TTree with MC & showers info



NeutrinoShowerEff_module.cc



Efrac Lepton



dE/dx
shower energy
shower direction, etc
are available in the TTree

The End