LBL Meeting
First look at DUNE FD VD production

Abi Peake

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Overview

- Summary of new FD VD CAF’s
- Updated plots including the FV cuts and POT scaling
- Added X/Y rotation from last update

FD VD

- Validation of DUNE FD Vertical Drift Production:

  /pnfs/dune/persistent/dunepro/caf_fd_2024/

- Using whole production for VD:

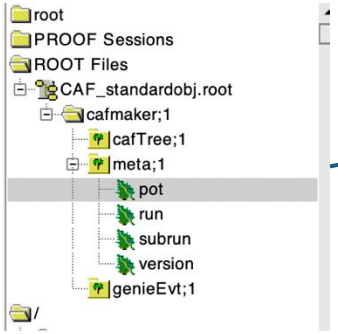
```
cafmaker_dunevd10kt_1x8x6_3view_30deg_runreco-nuenergy_geov3__prodgenie_nu_dunevd10kt_1x8x6_3view_30deg
cafmaker_dunevd10kt_1x8x6_3view_30deg_runreco-nuenergy_geov3__prodgenie_nu_numu2nue_nue2nutau_dunevd10kt_1x8x6_3view_30deg
cafmaker_dunevd10kt_1x8x6_3view_30deg_runreco-nuenergy_geov3__prodgenie_nu_numu2nutau_nue2numu_dunevd10kt_1x8x6_3view_30deg
```

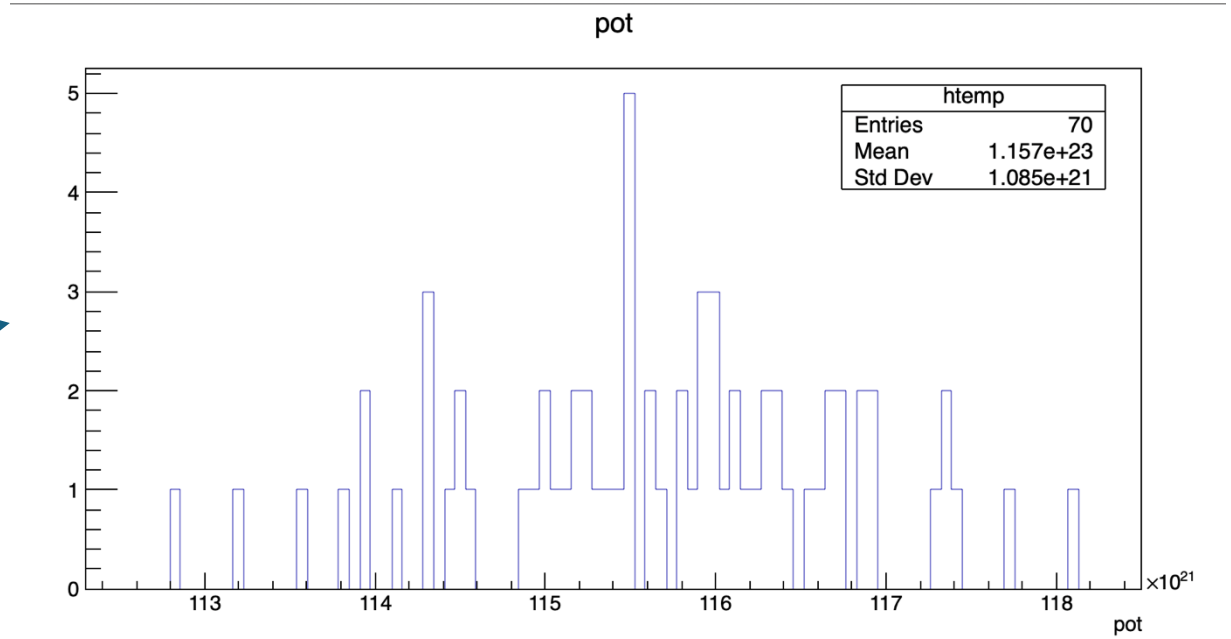
- Am not applying any oscillation weights currently, so am only using one-swap config at once
- New volume cuts applied:

```
if(fIsVD)
  isFid = (fabs(vtx.X())<300 && fabs(vtx.Y())<680 && vtx.Z()>40 && vtx.Z()<850); // vd
else
```

POT Weighting

- POT histogram given in each file:





- For each file, I divided by the POT (equivalent to one proton hitting the target)
- For each swap, there are a different number of CAFs:

- To normalize, divide by the number of CAF's per swap

Calculating Efficiency

"What proportion of MC events have been correctly reconstructed?"

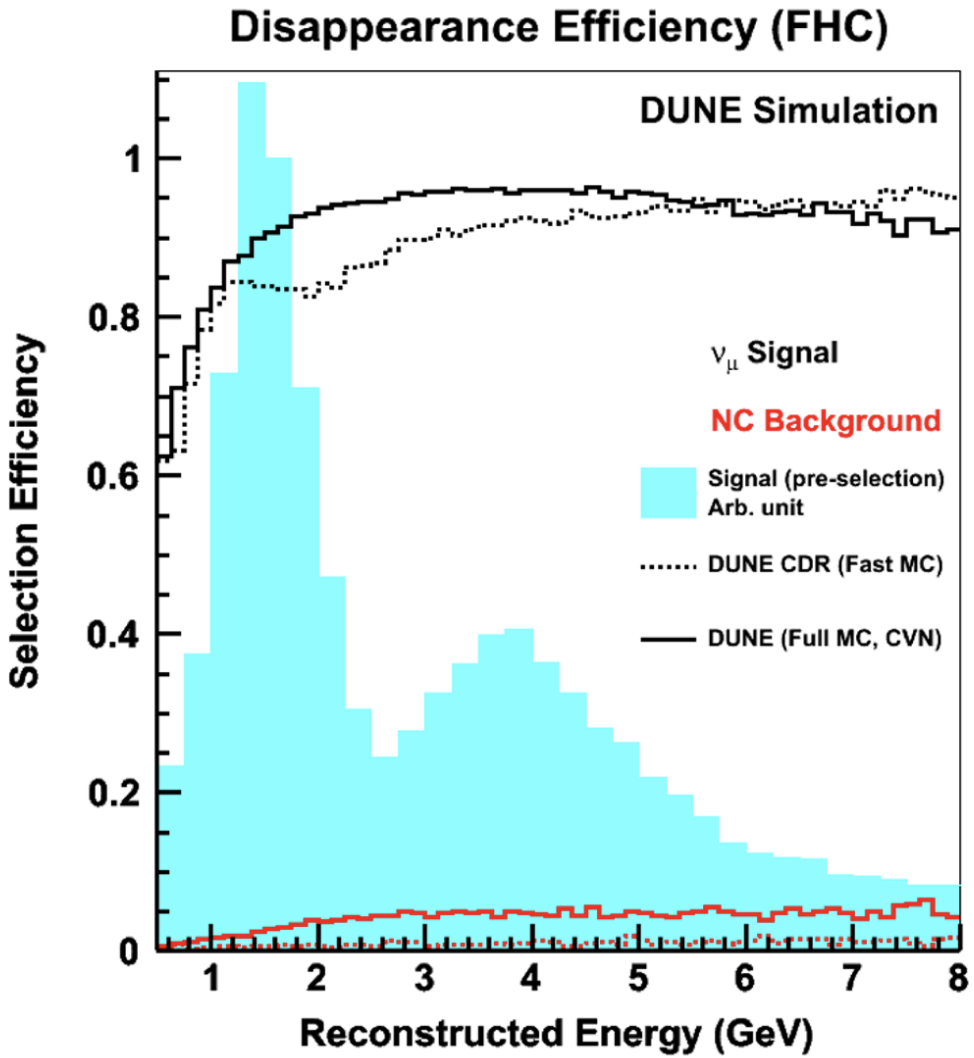
$$\text{Efficiency}_{\nu_\mu} = \frac{N_{\text{Events}}(\nu_\mu^{\text{MC}} \cap \nu_\mu^{\text{Reco}})}{N_{\text{Events}}(\nu_\mu^{\text{MC}})} = \frac{\text{N.o of reconstructed } \nu_\mu \text{ events with a CVN} > 0.5}{\text{N.o of MC. } \nu_\mu \text{events}}$$

Same definition for $\nu_{e.}$ but for CVN score > 0.85

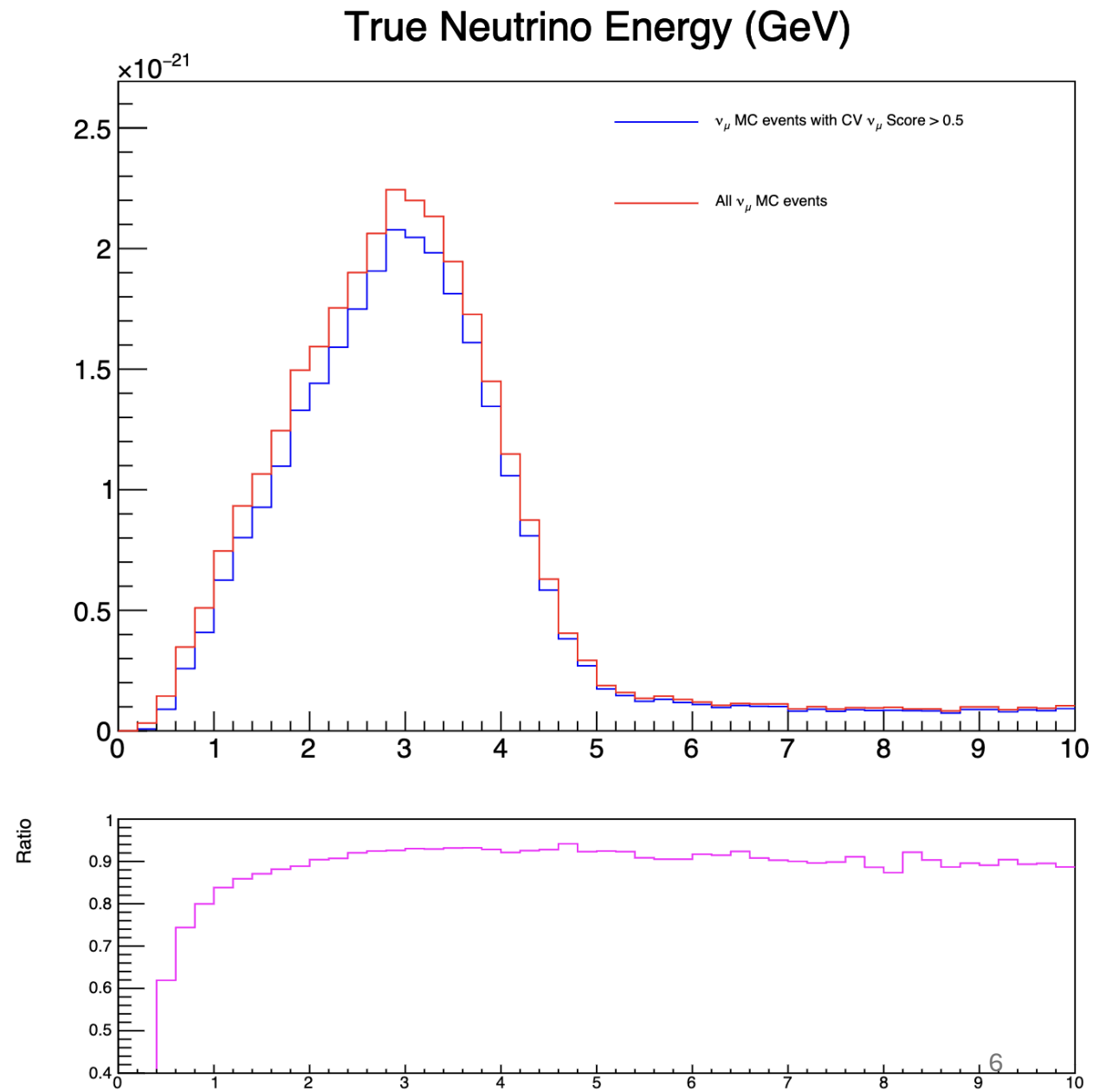
CVN score = Probability assigned in reconstruction that the event has been categorised correctly

ν_μ Energy

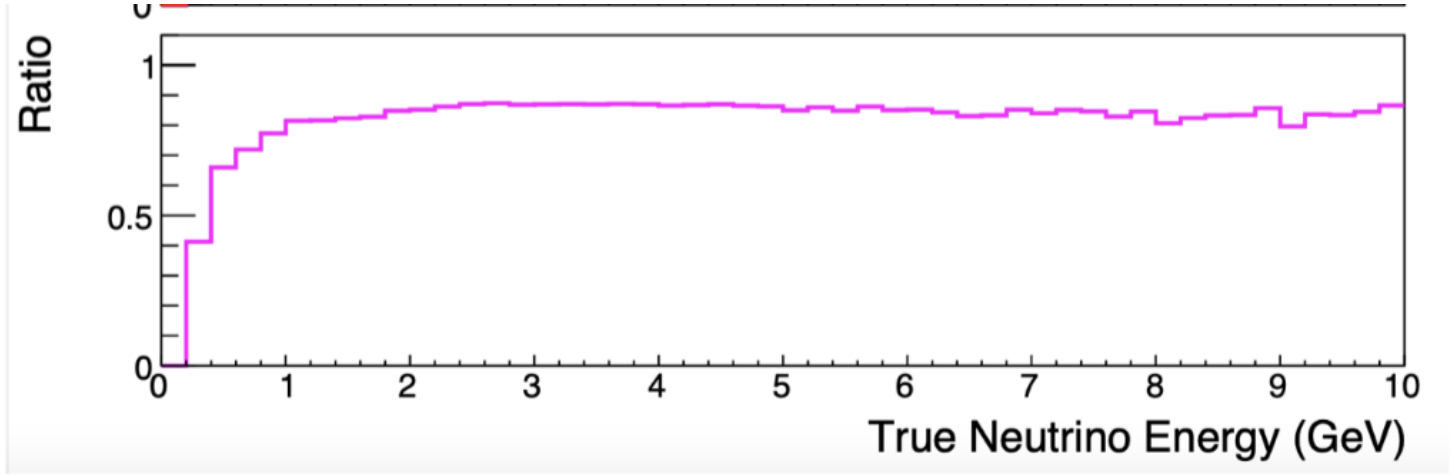
PhysRevD.102.092003,
Neutrino interaction classification with a convolutional neural network in the DUNE far detector



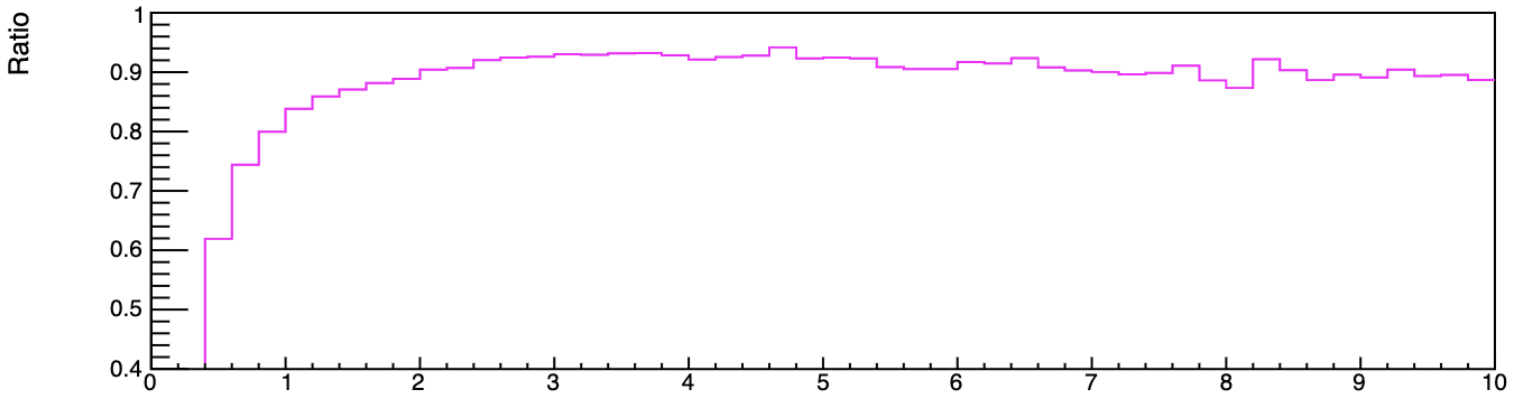
First Look (non-swap)



Ratio improved with correct FV cuts



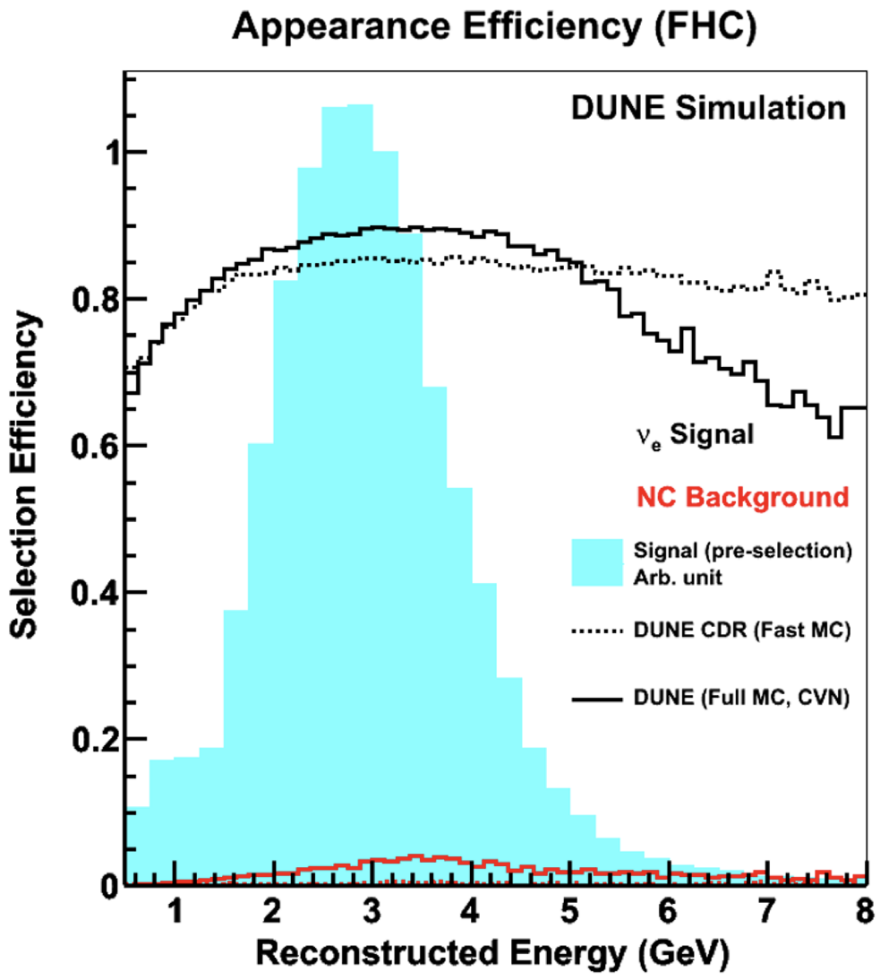
True neutrino ratio without correct POT scaling and FV cuts



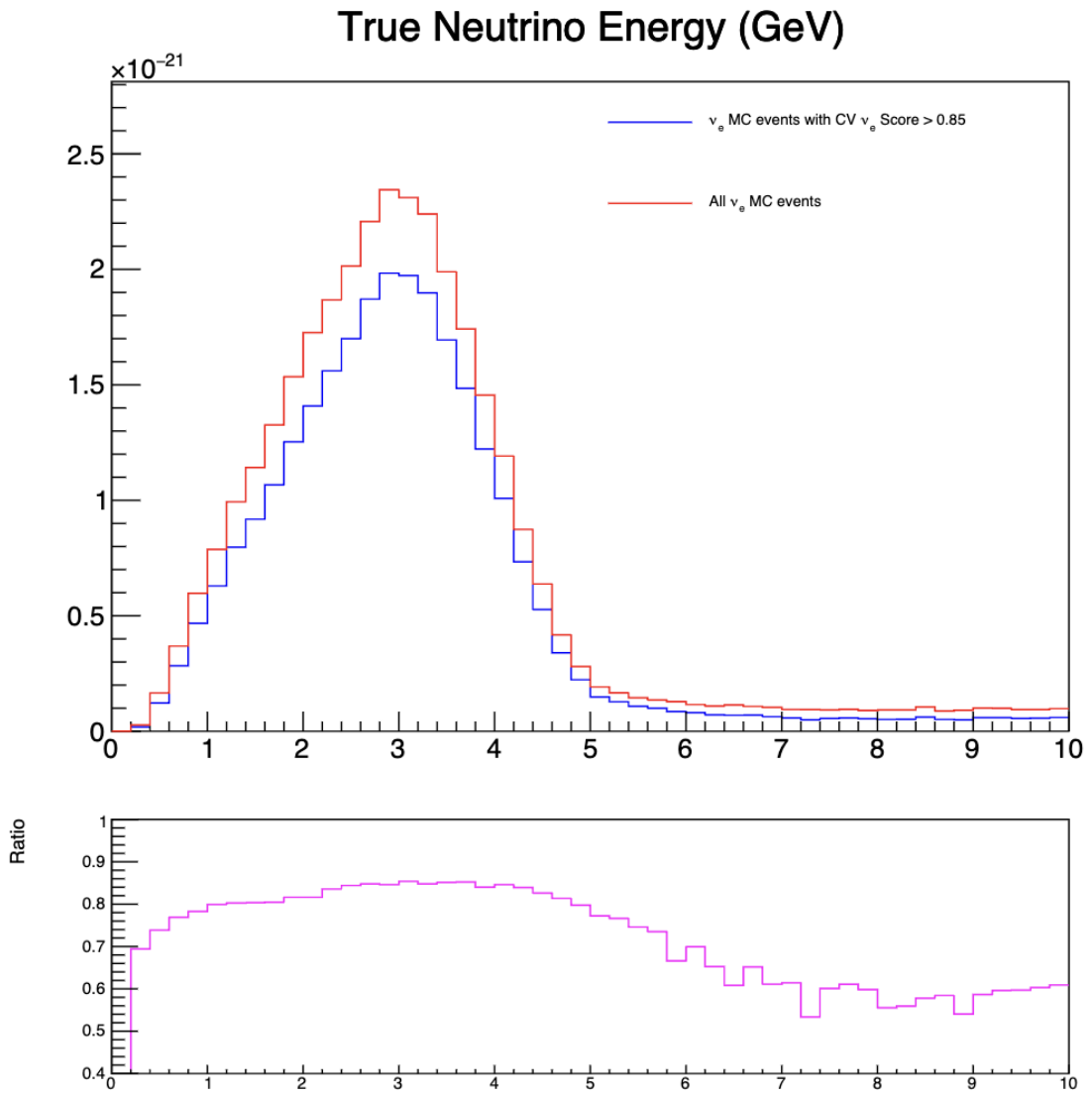
Updated version

ν_e Energy

PhysRevD.102.092003,
Neutrino interaction classification with a convolutional neural network in the DUNE far detector



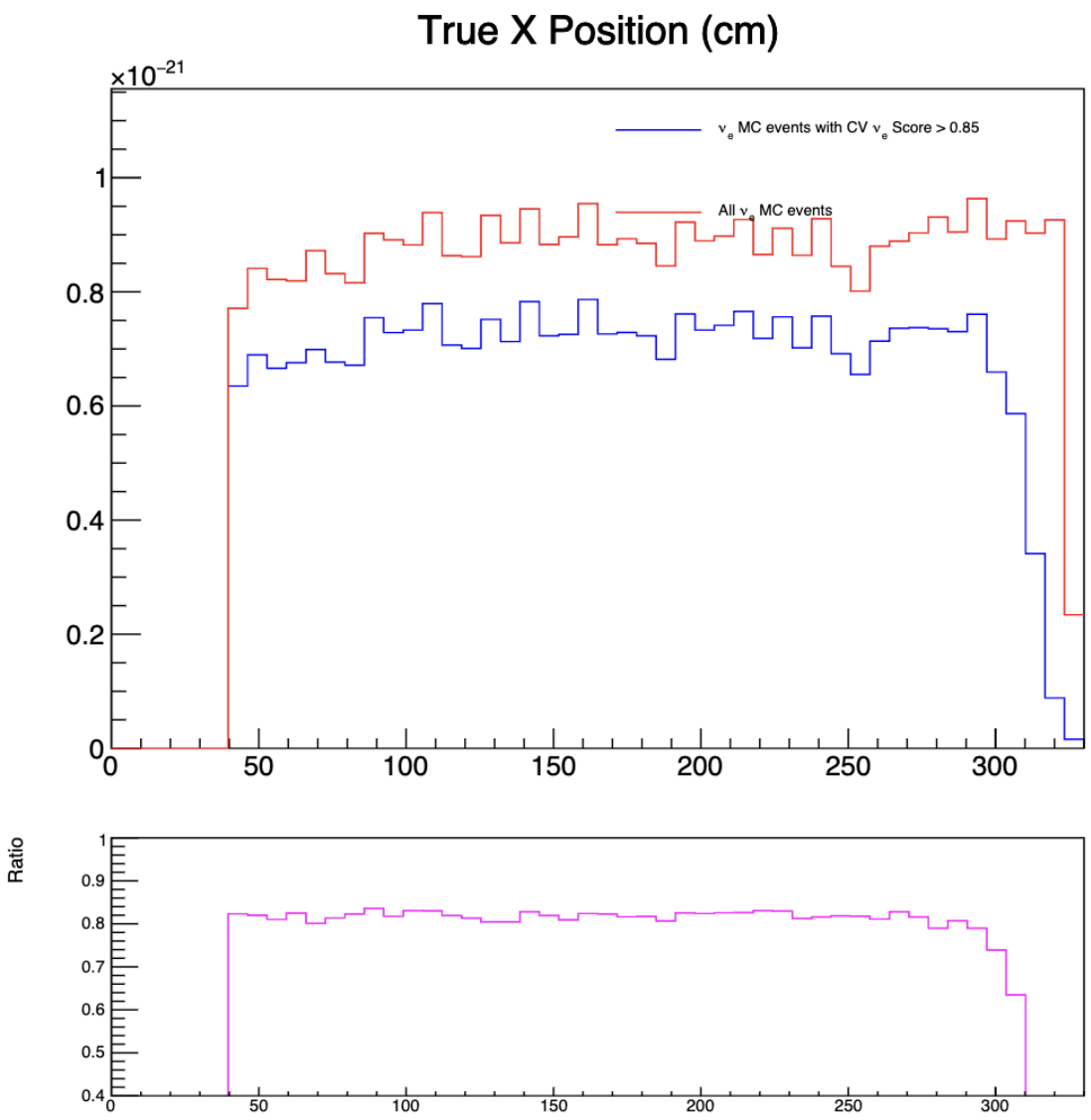
First Look (swap)



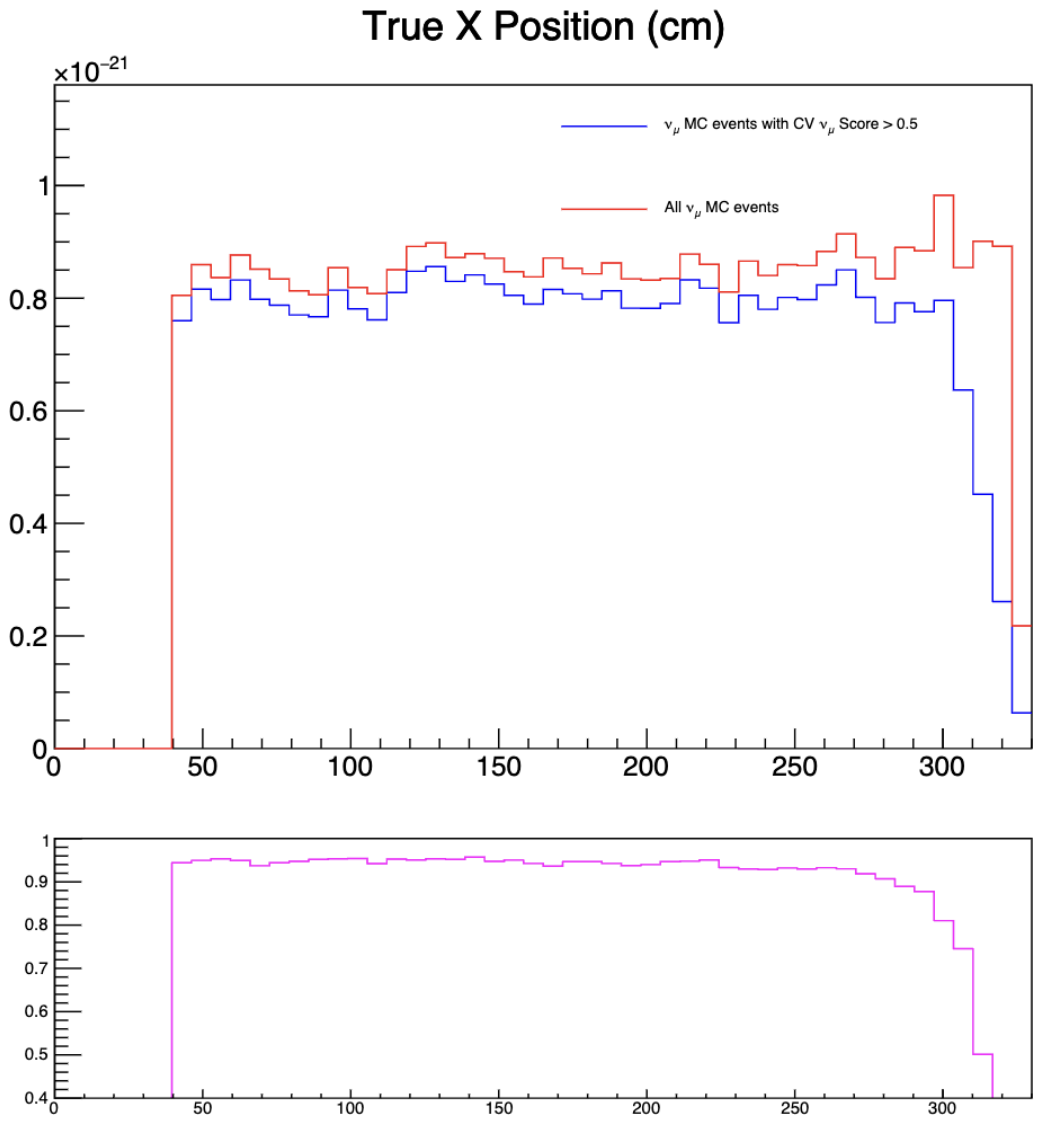
X vertex Efficiency (non-swap)

```
if(fIsVD)
  isFid = (fabs(vtx.X())<300 && fabs(vtx.Y())<680 && vtx.Z()>40 && vtx.Z()<850); // vd
else
```

nu_e



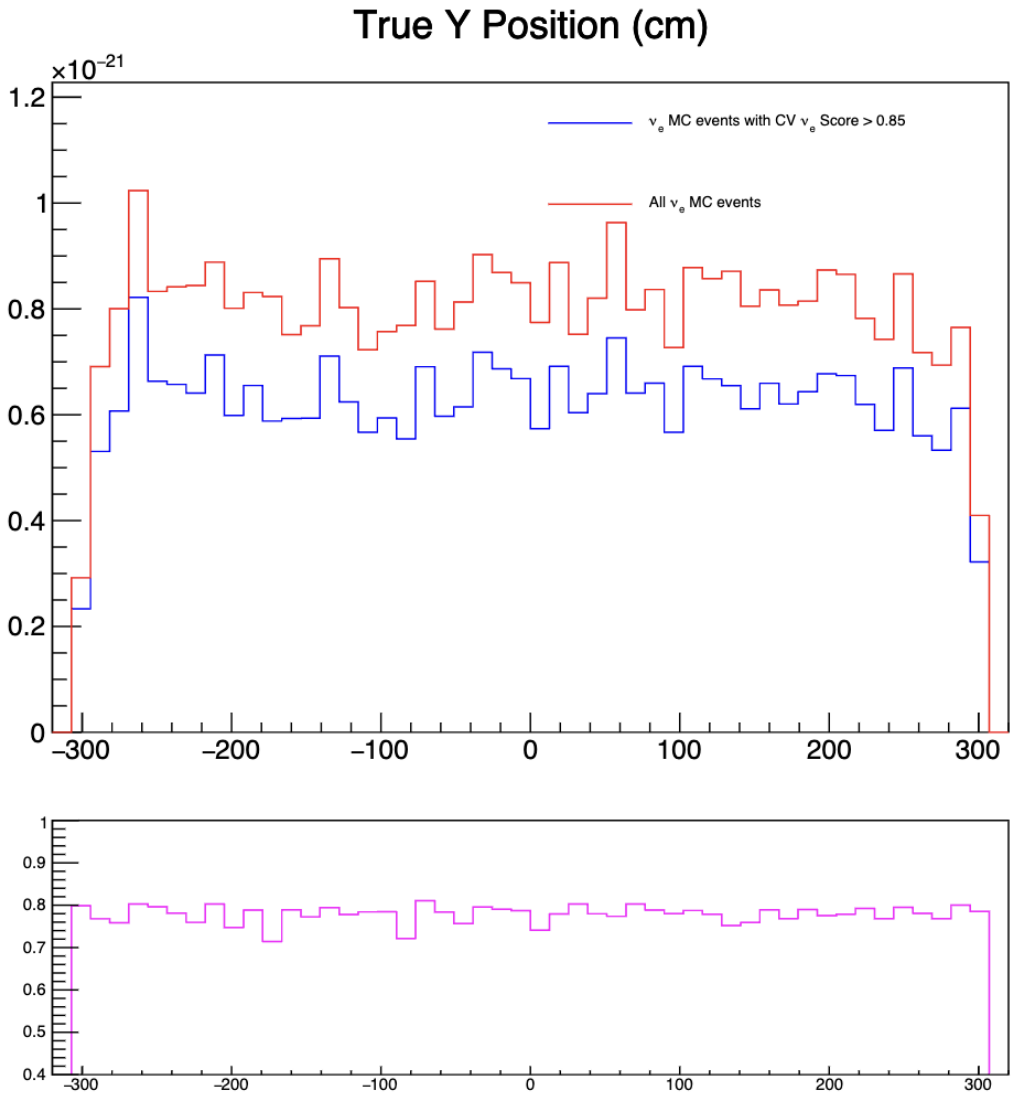
nu_mu



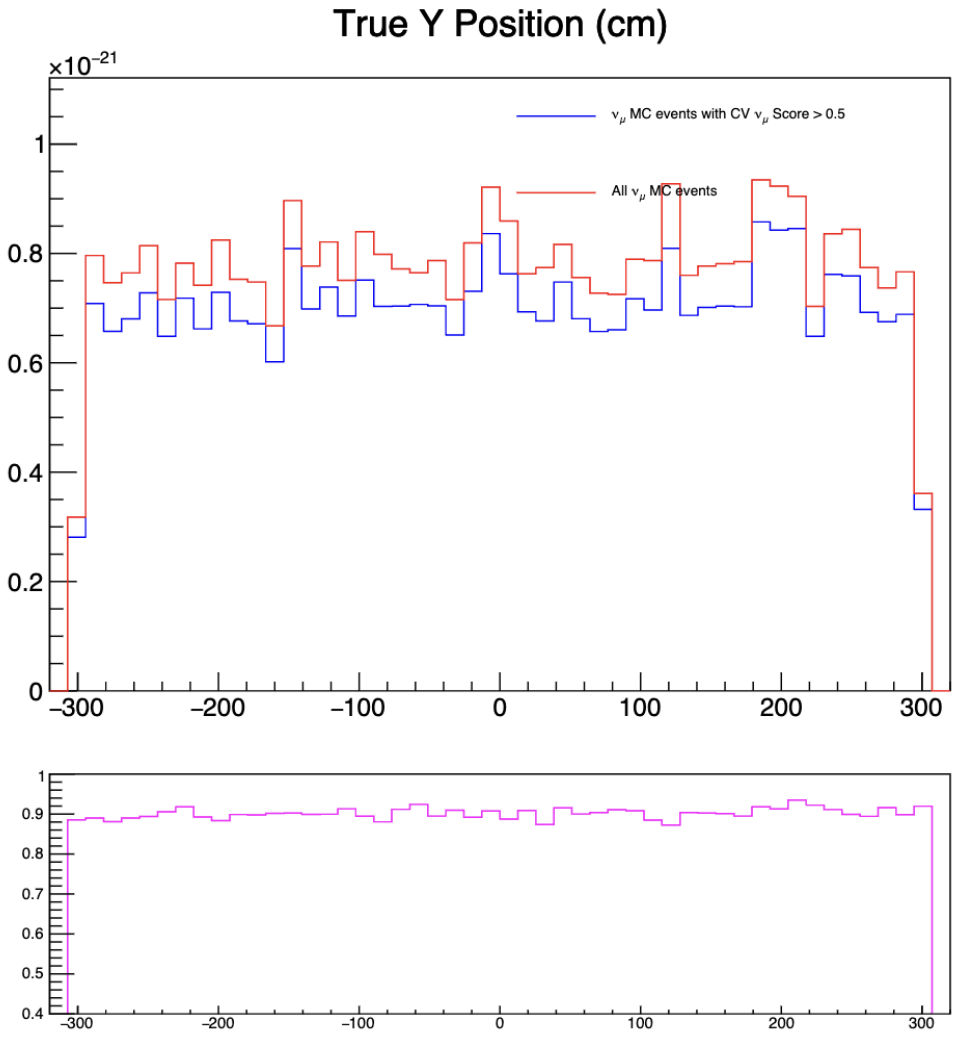
Y vertex Efficiency (non-swap)

```
if(fIsVD)
  isFid = (fabs(vtx.X())<300 && fabs(vtx.Y())<680 && vtx.Z()>40 && vtx.Z()<850); // vd
else
```

nu_e



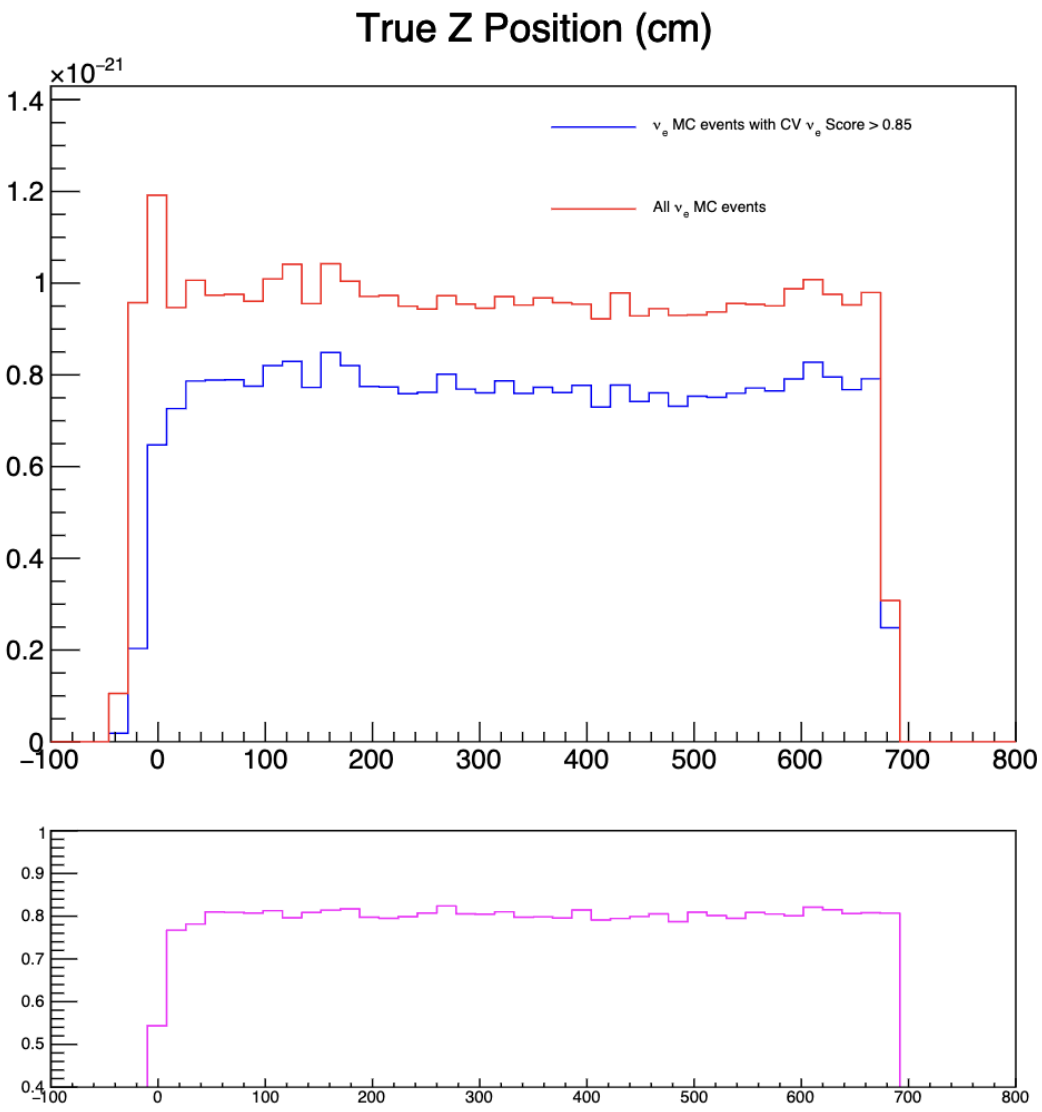
nu_mu



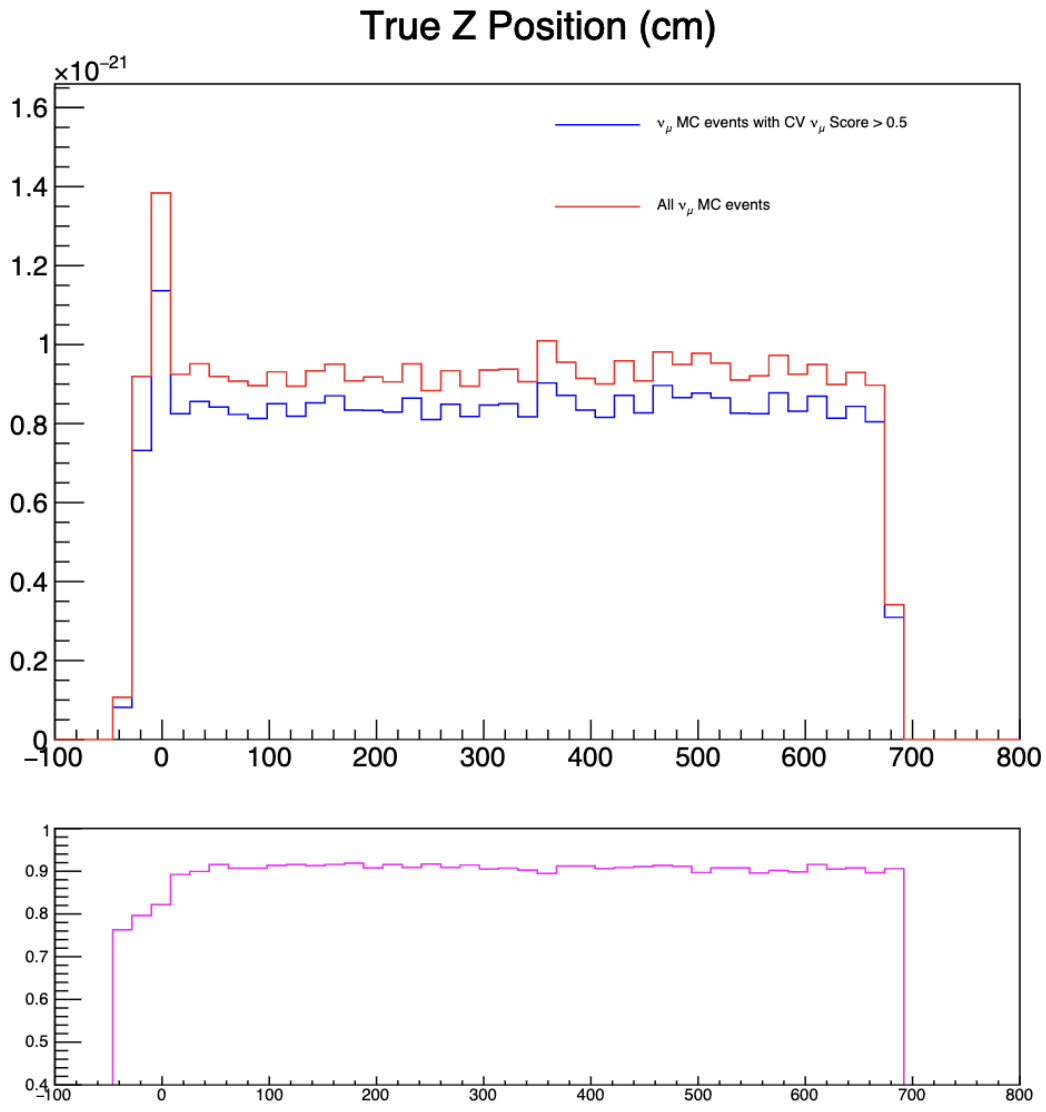
Z vertex Efficiency (non-swap)

```
if(fIsVD)
  isFid = (fabs(vtx.X())<300 && fabs(vtx.Y())<680 && vtx.Z()>40 && vtx.Z()<850); // vd
else
```

nu_e



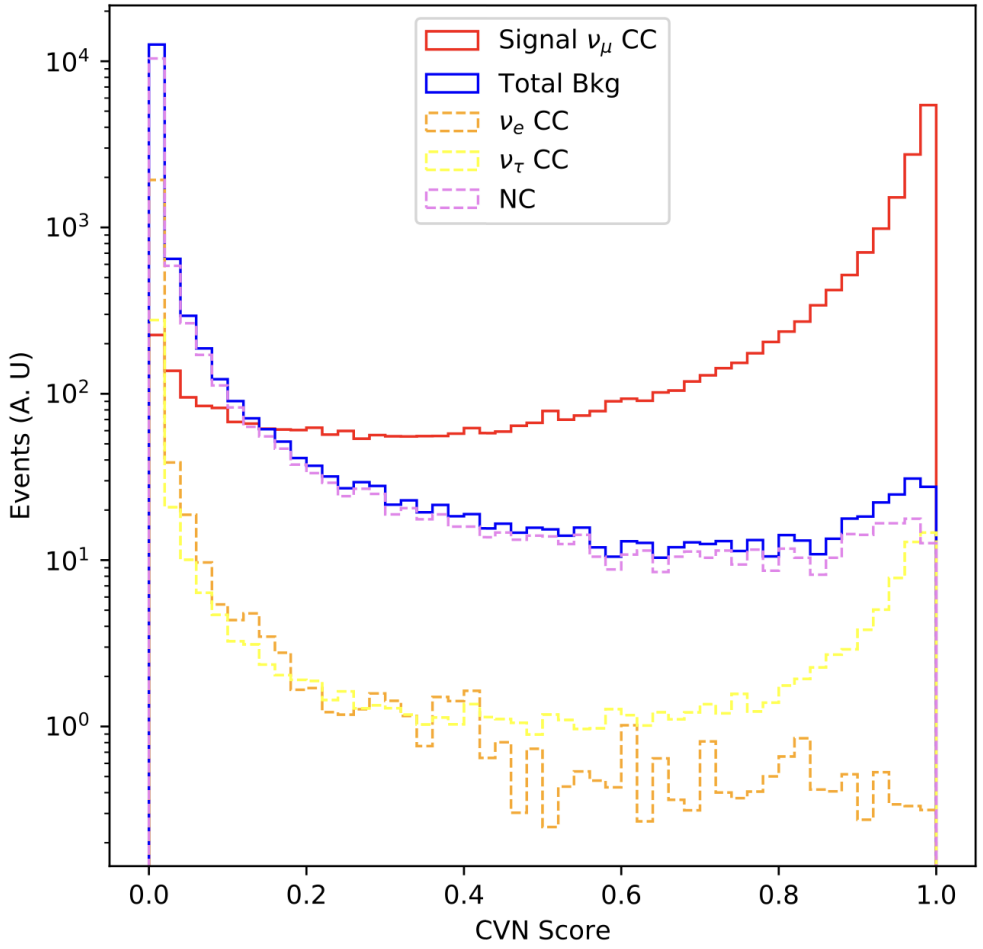
nu_mu



Selecting ν_μ - non swap

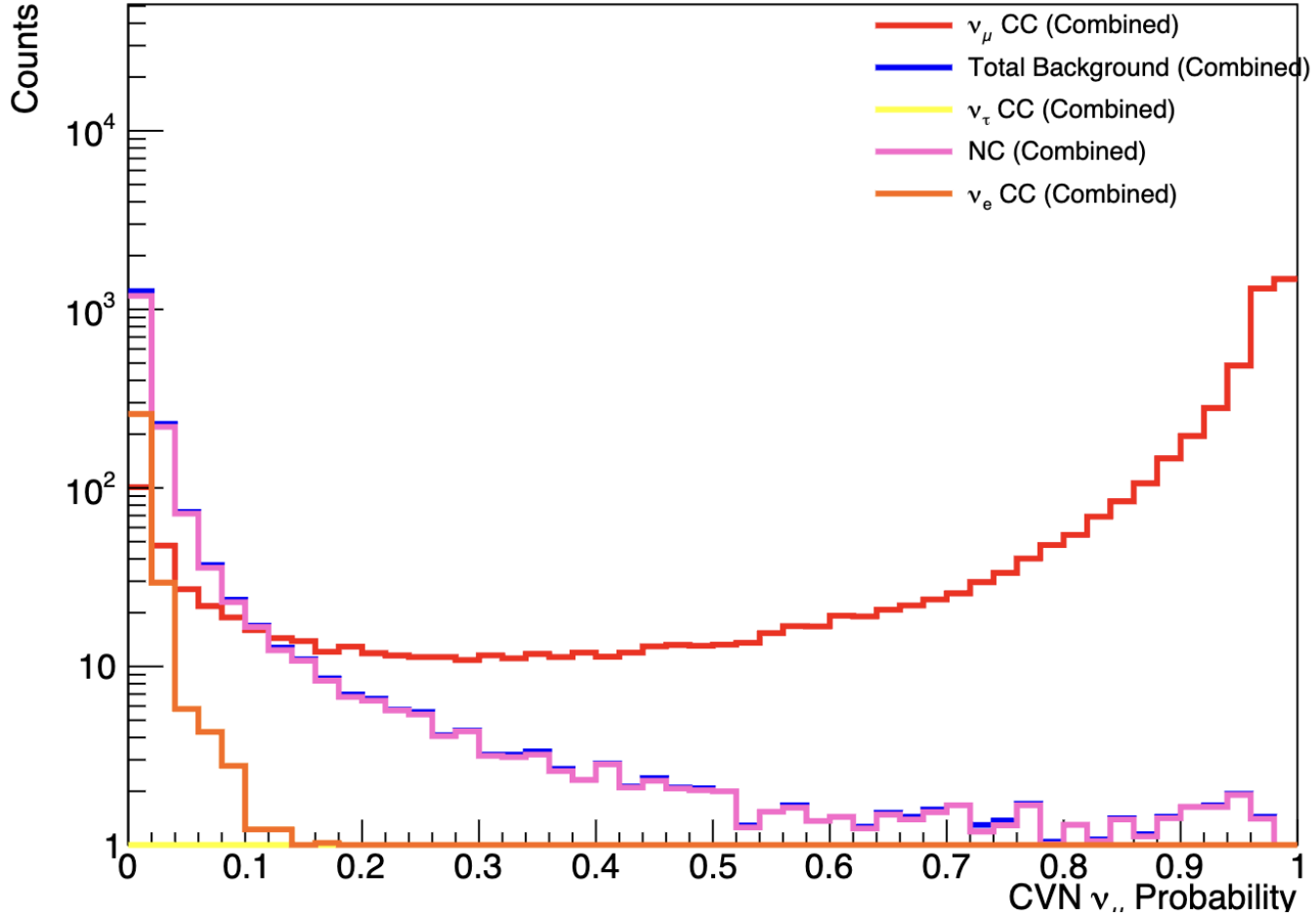
```
if(fIsVD)
  isFid = (fabs(vtx.X())<300 && fabs(vtx.Y())<680 && vtx.Z()>40 && vtx.Z()<850); // vd
else
```

VD TDR (page 2-44)



First look at new VD production

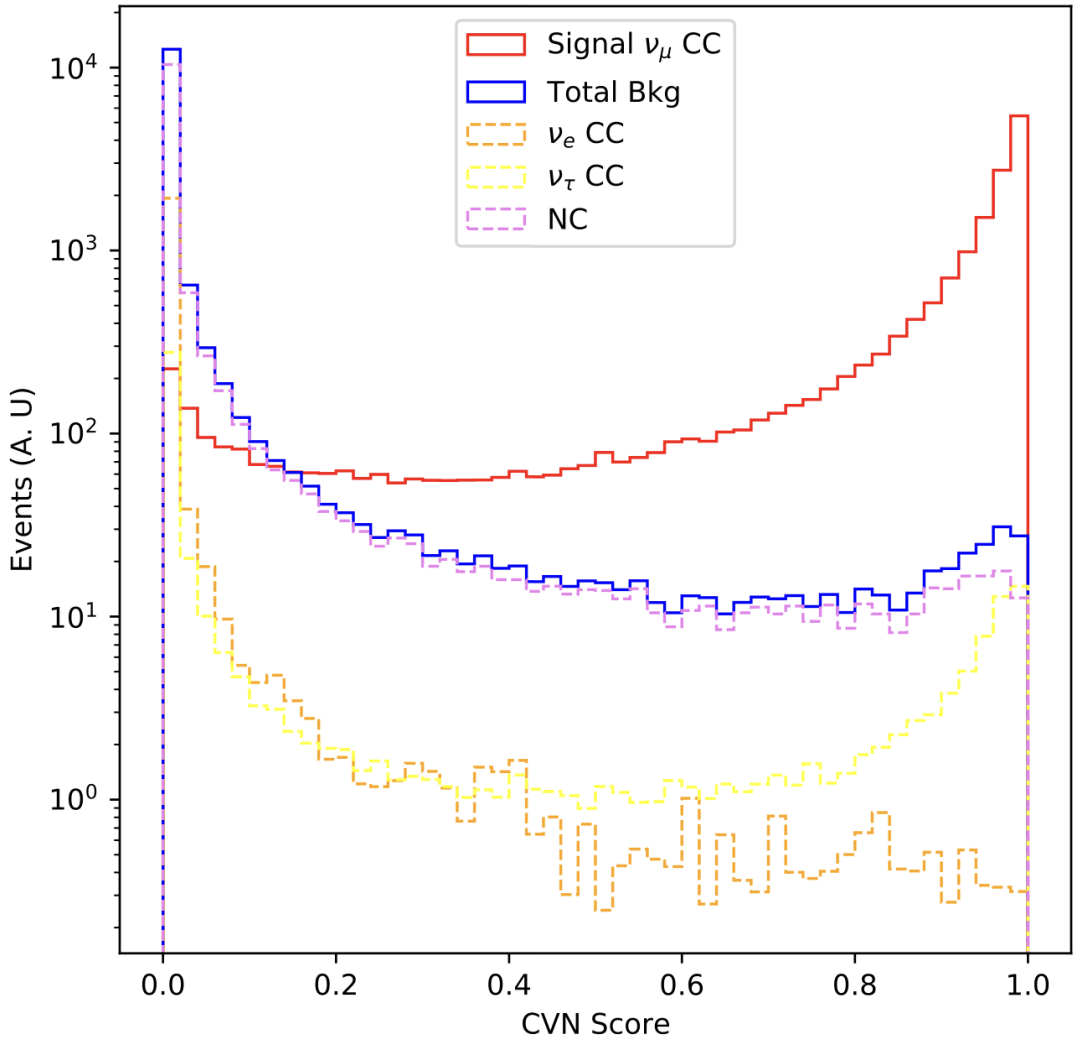
Combined CVN ν_μ Probability

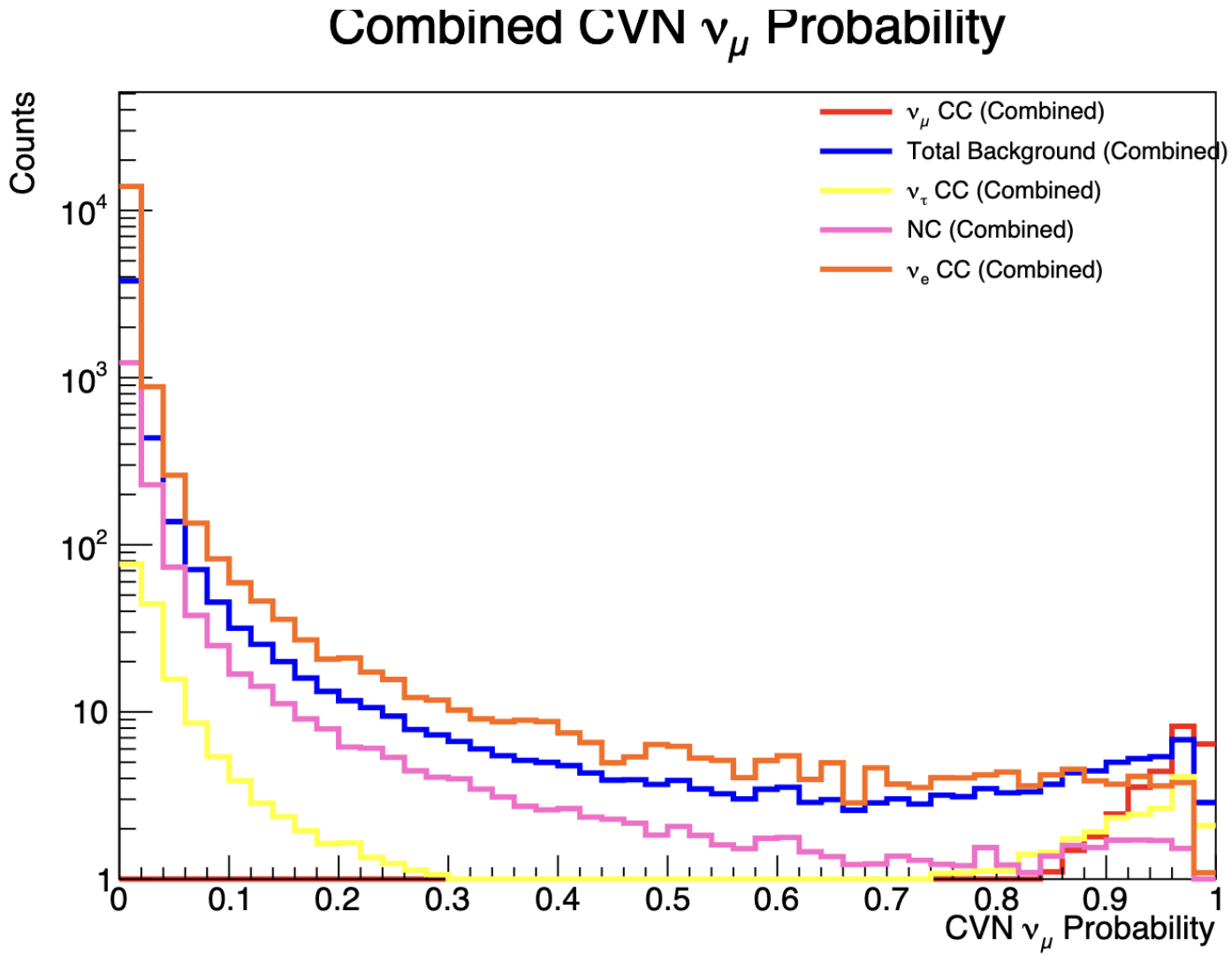


Selecting ν_μ - swap

```
if(fIsVD)
  isFid = (fabs(vtx.X())<300 && fabs(vtx.Y())<680 && vtx.Z()>40 && vtx.Z()<850); // vd
else
```

VD TDR (page 2-44)



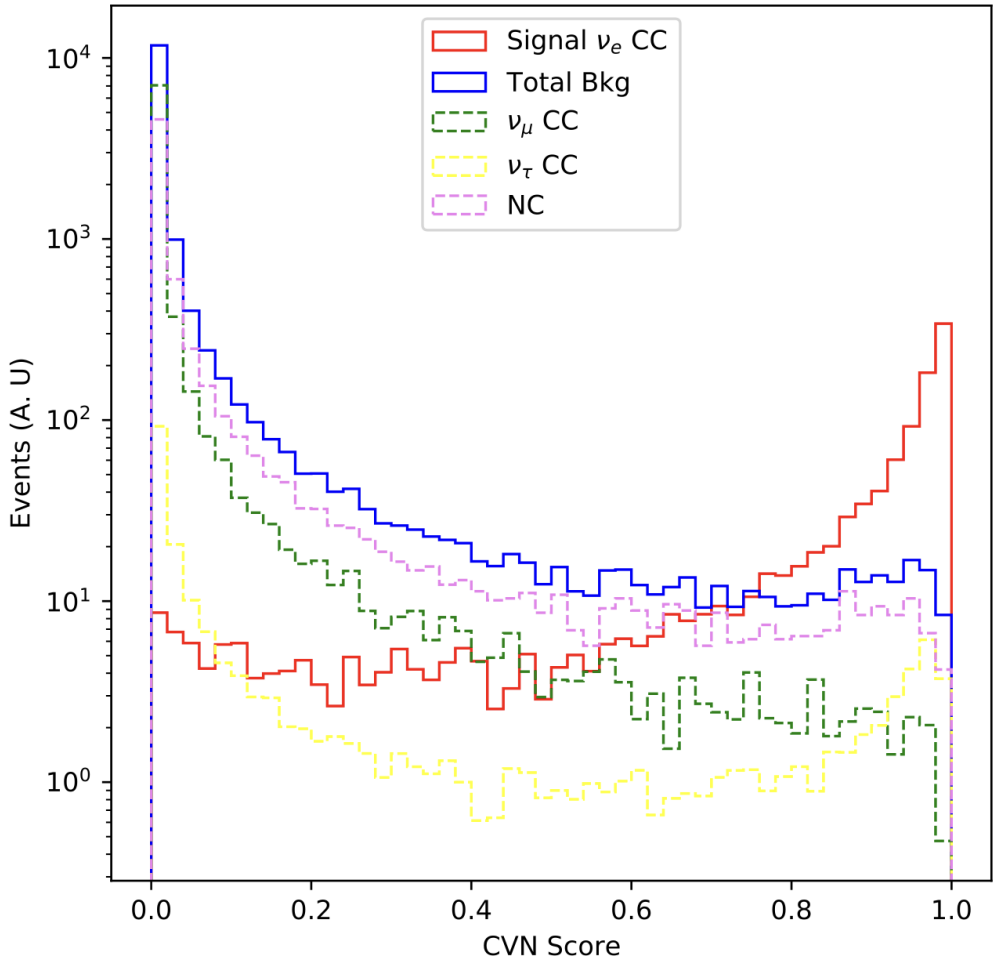


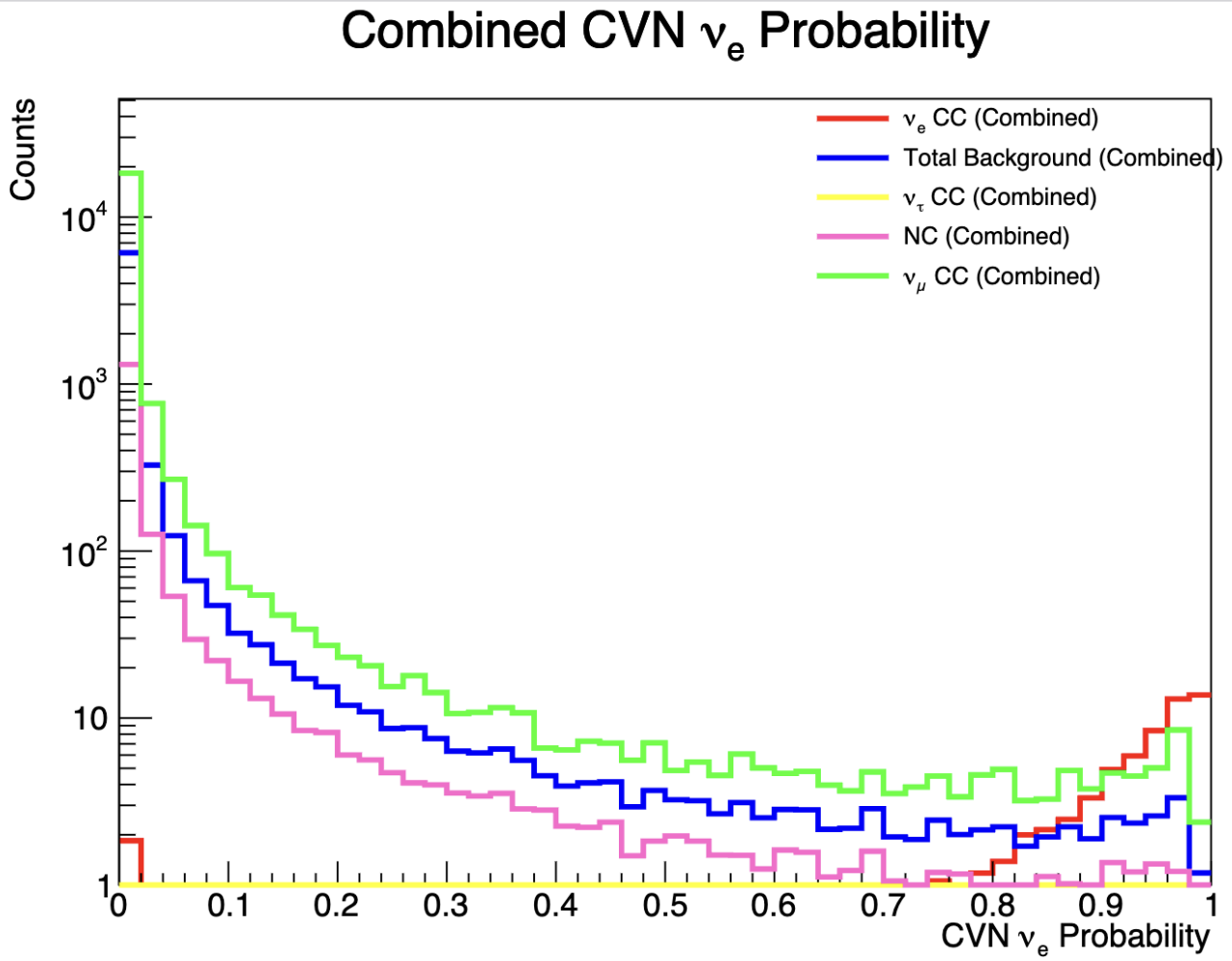
Selecting ν_e – non swap

```
if(fIsVD)
  isFid = (fabs(vtx.X())<300 && fabs(vtx.Y())<680 && vtx.Z()>40 && vtx.Z()<850); // vd
else
```

First look at new VD production

VD TDR (page 2-44)



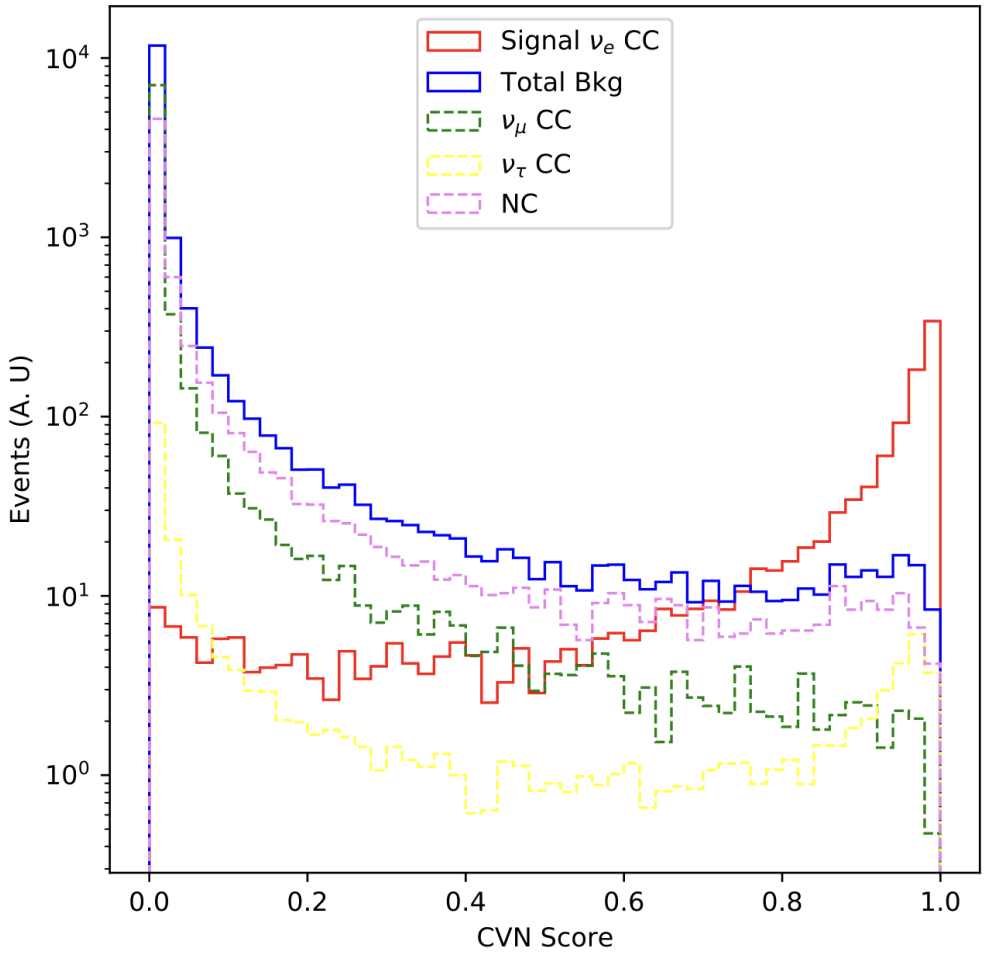


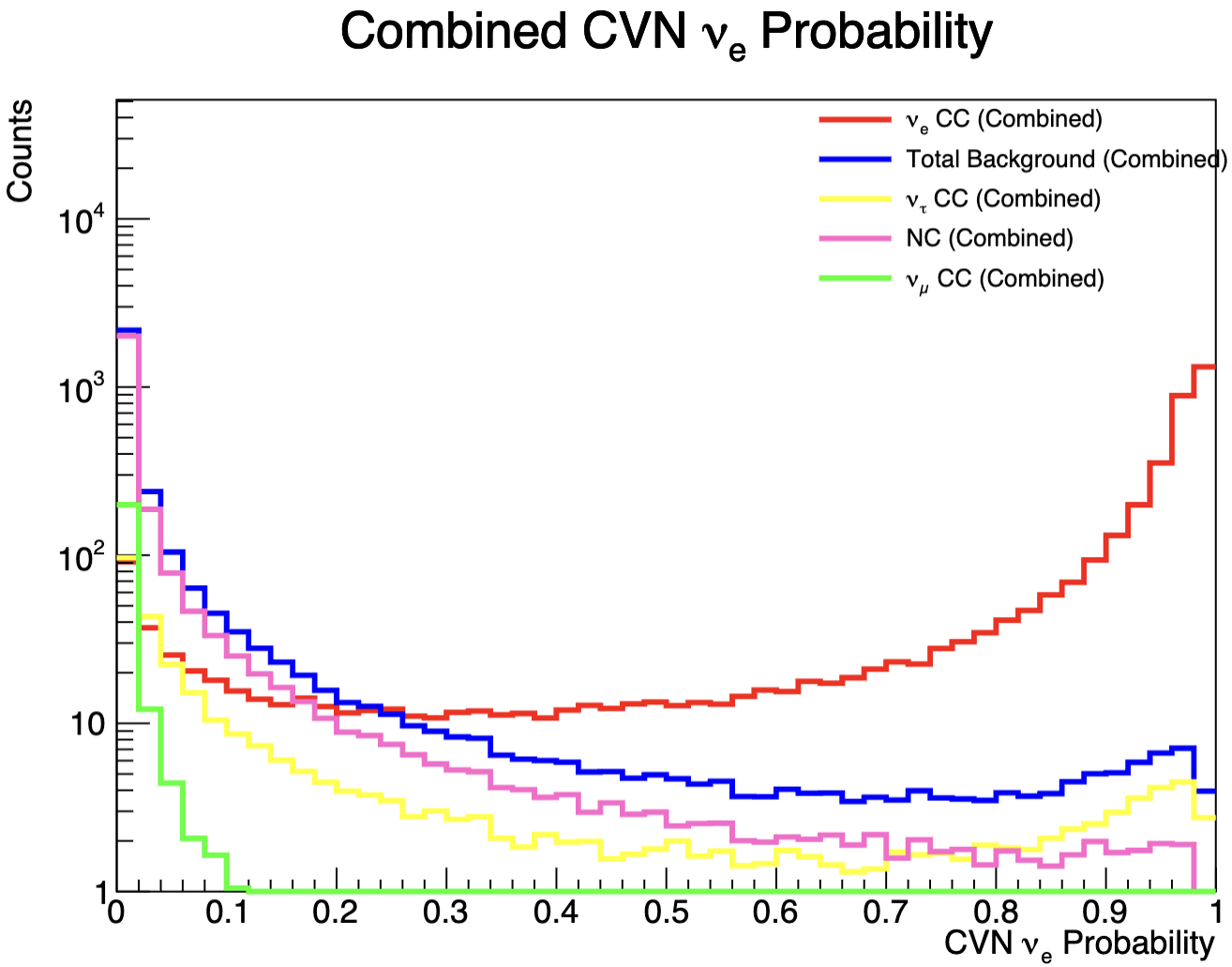
Selecting ν_e - swap

```
if(fIsVD)
  isFid = (fabs(vtx.X())<300 && fabs(vtx.Y())<680 && vtx.Z()>40 && vtx.Z()<850); // vd
else
```

First look at new VD production

VD TDR (page 2-44)





Summary

- First look at new DUNE FD VD Production
- Update fiducial volume cuts
- Added POT scaling
- Follow up task to fully implement POT scaling in MaCh3