PRISM Update

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LBL Meeting
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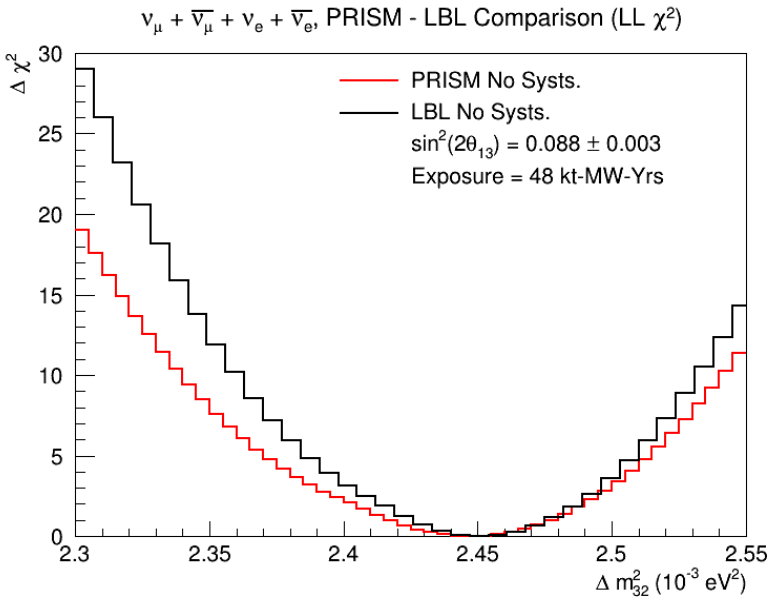
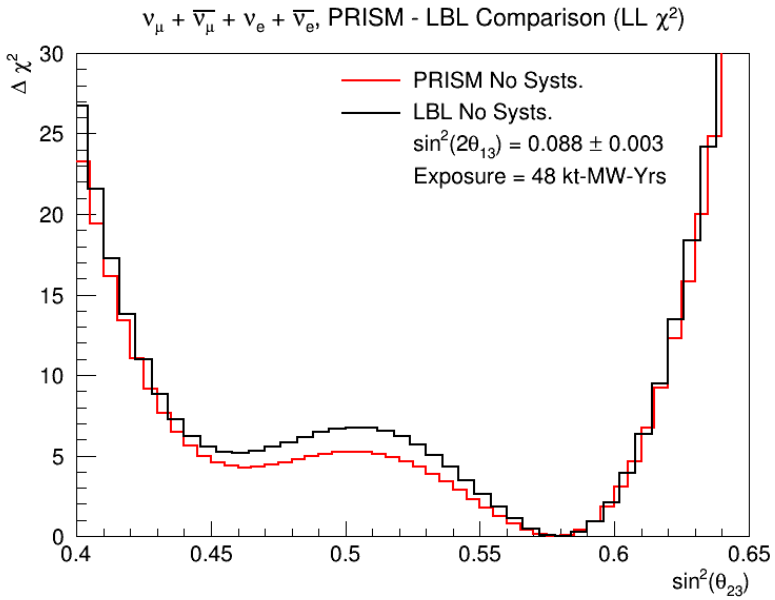
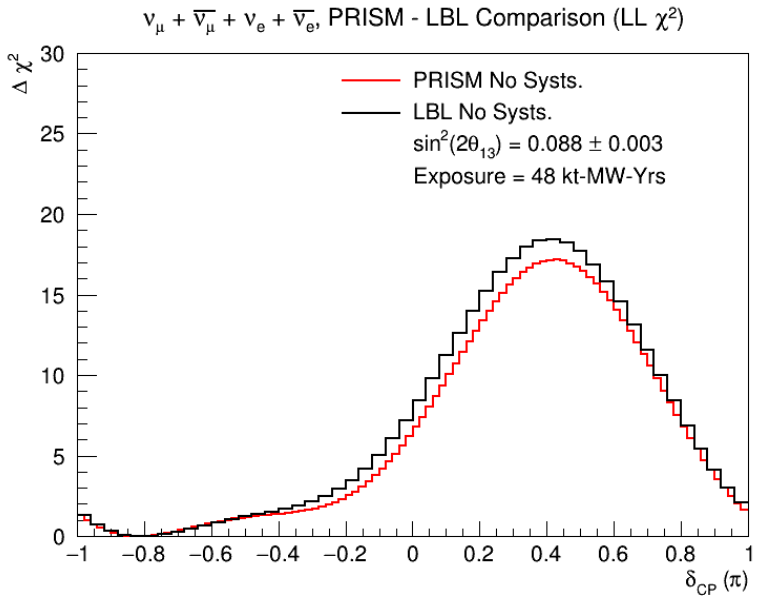
PRISM-LBL Comparisons

- Stats-only comparisons between **PRISM** and **LBL** fits from Callum
- We should **not** see significant differences in stats-only case
- Investigating where these differences come from

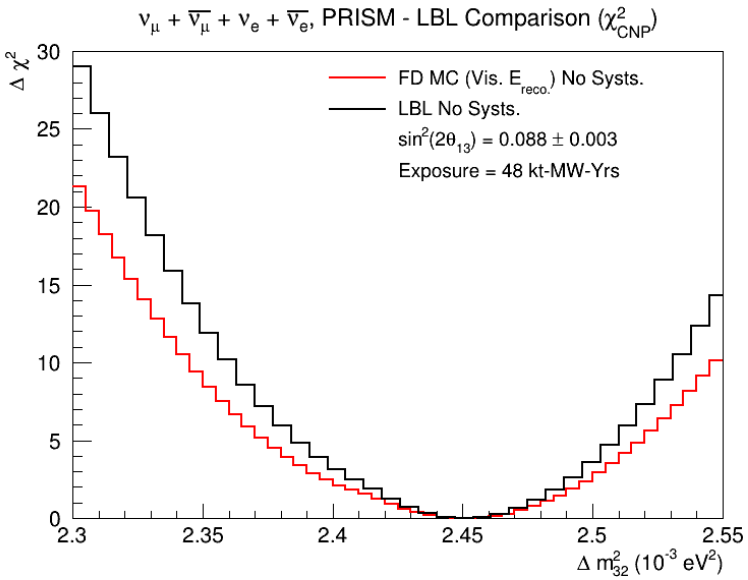


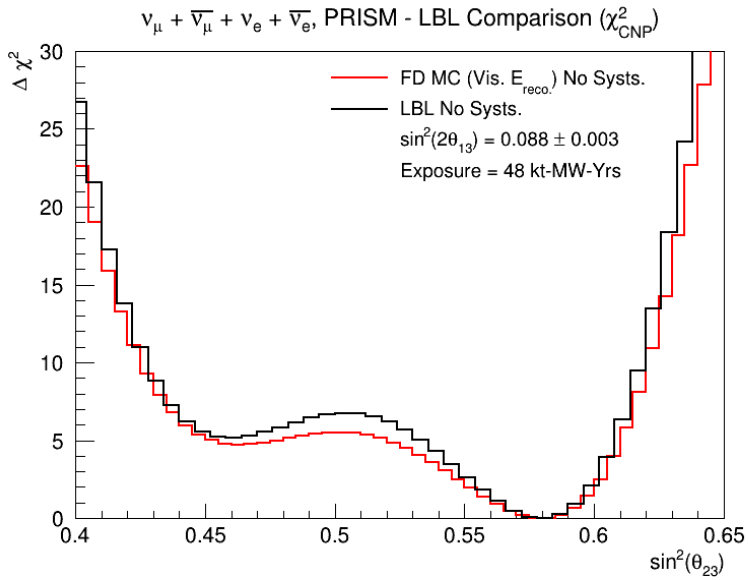


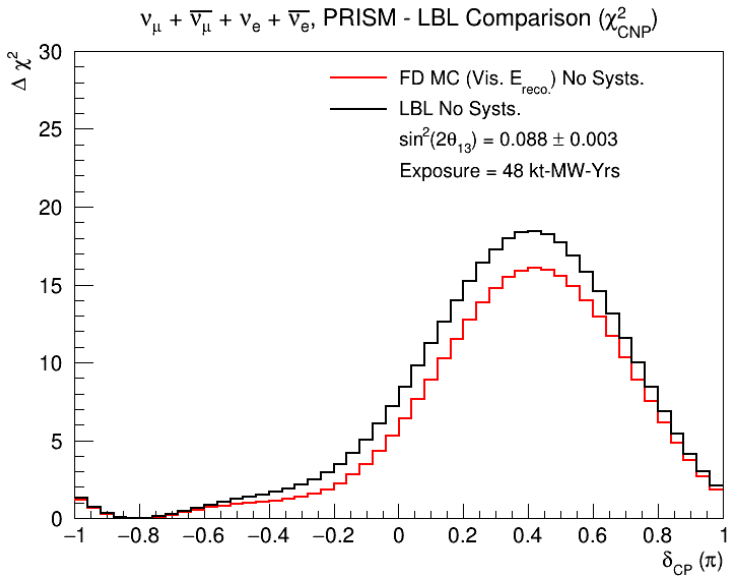


FD MC Test Fit in EVisReco

- Remove differences between PRISM framework and LBL:
  - Just fit the **FD MC** (I.e no linear combination) to FD 'data' using our framework and the same **"Visible Reco Energy"** variable
  - Still have similar level of difference

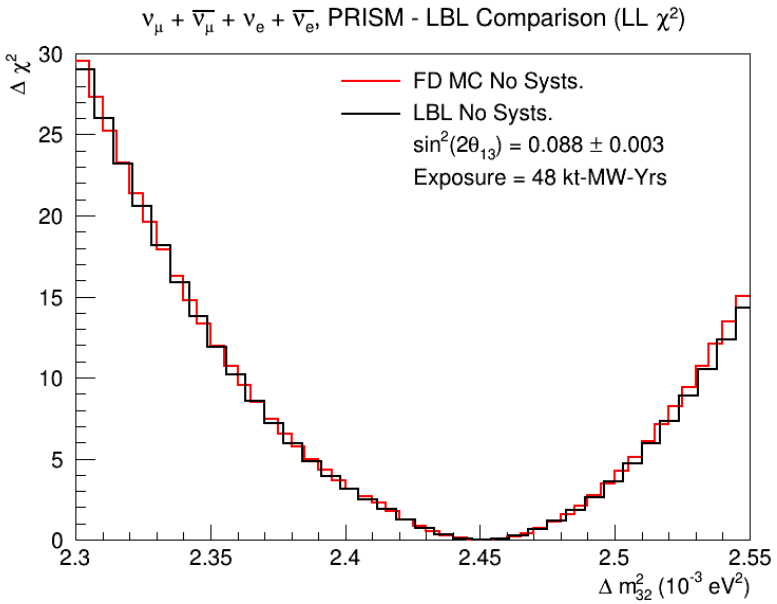


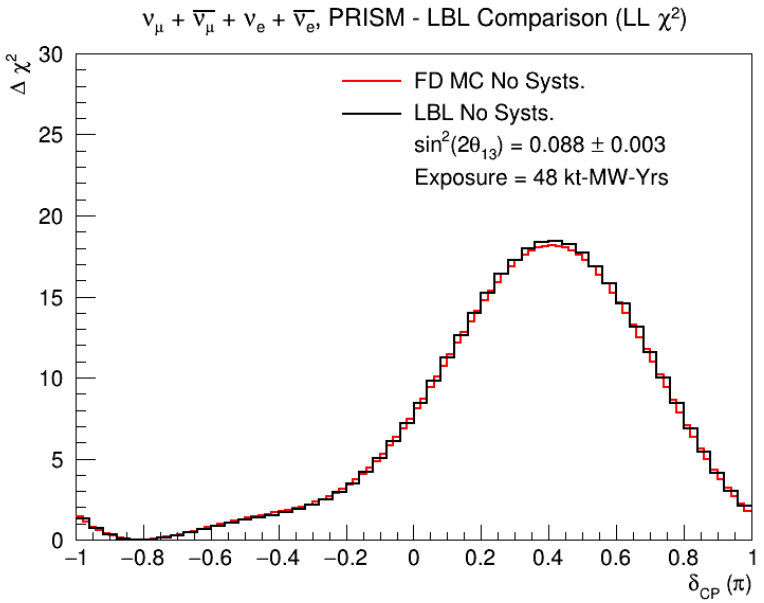


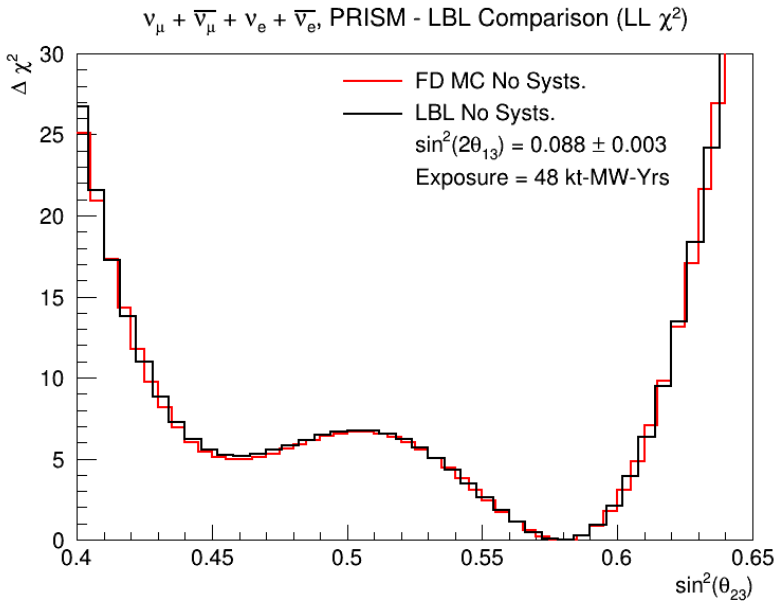


FD MC Test Fit in Neutrino EReco

- Our "Visible Reconstructed Energy" variable has **poorer resolution** than the "Reconstructed Neutrino Energy" used by LBL
- Fit **FD MC** to FD 'data' using **Reco Nu Energy** – Matches LBL exactly!
- Conclude – **same variable** and **perfect fit** to 'data' should recover LBL contours

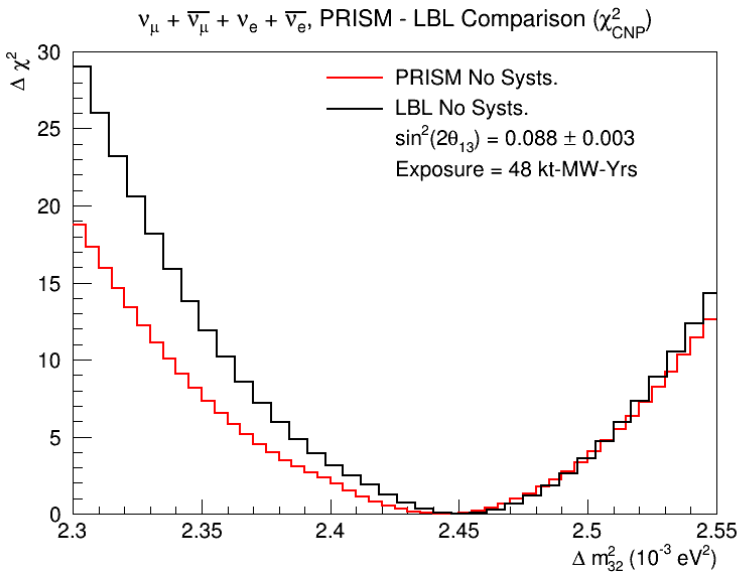


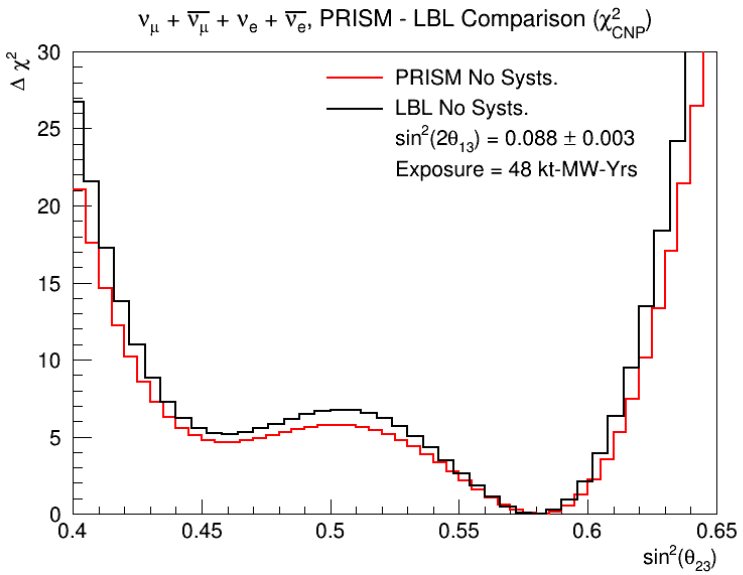


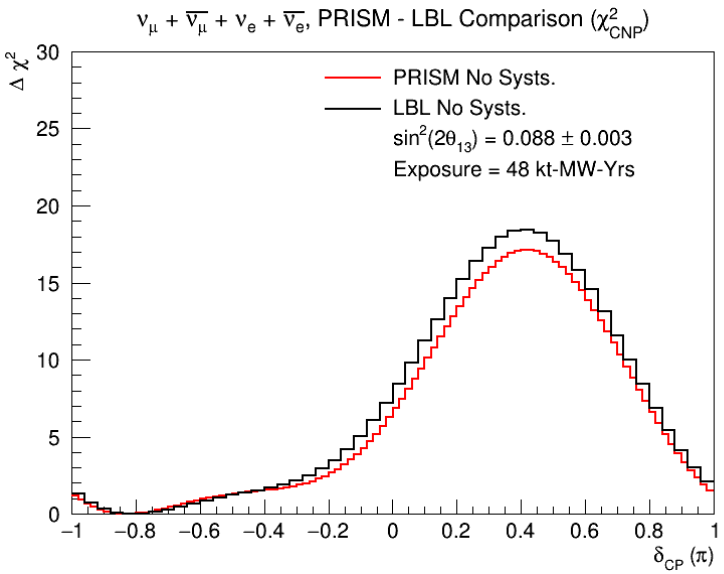


Back to a PRISM Fit

- If we go back to **reconstructed** energy, but with the **LBL Reco Nu Energy variable**, do we recover the LBL contours?
- No – poor **goodness of fit** between PRISM and 'data' still leads to differences
- Think this comes from the **unfold/smear** process

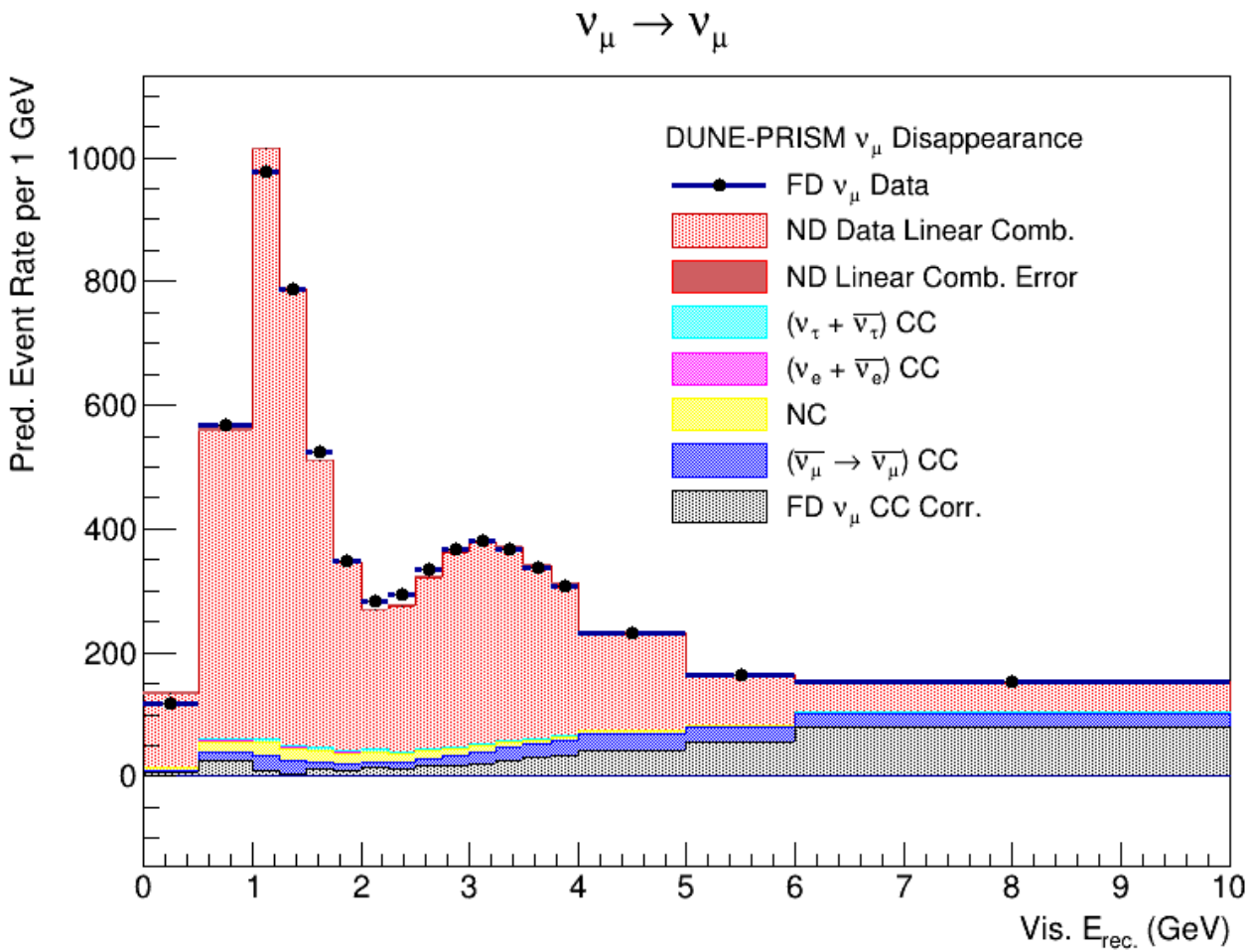






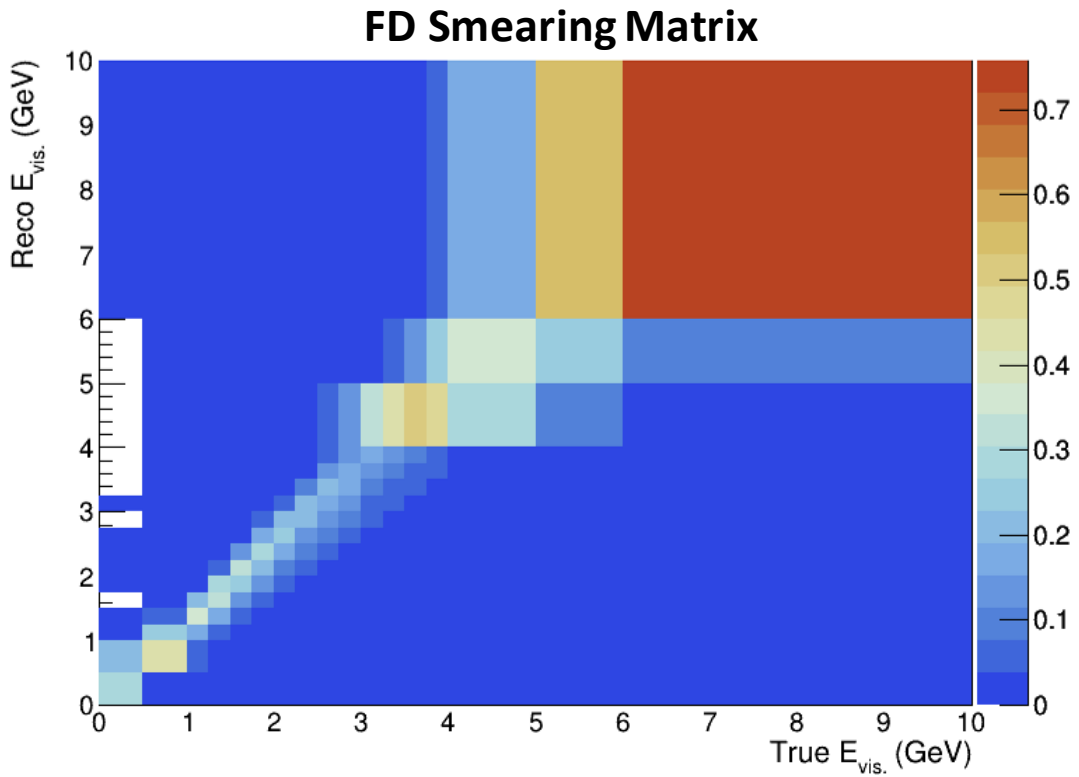
Shortcomings in the PRISM fit to 'Data'

- We have a lot of MC statistics (10 years of ND MC) - **small statistical fluctuations**
- Plot PRISM prediction and FD MC ('FD data') with their **MC stat uncertainty**
- Differences **larger** than 1-sigma error bar
- We have to unfold and **smear** our ND data before linear combination – is this the cause?



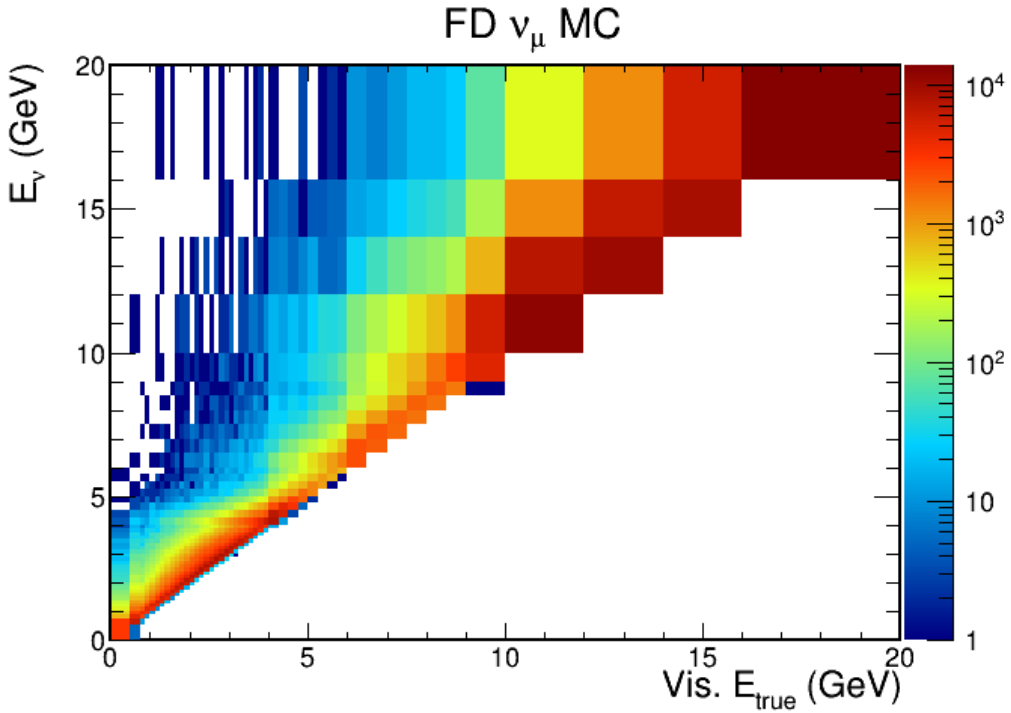
Is it the Smearing Matrices?

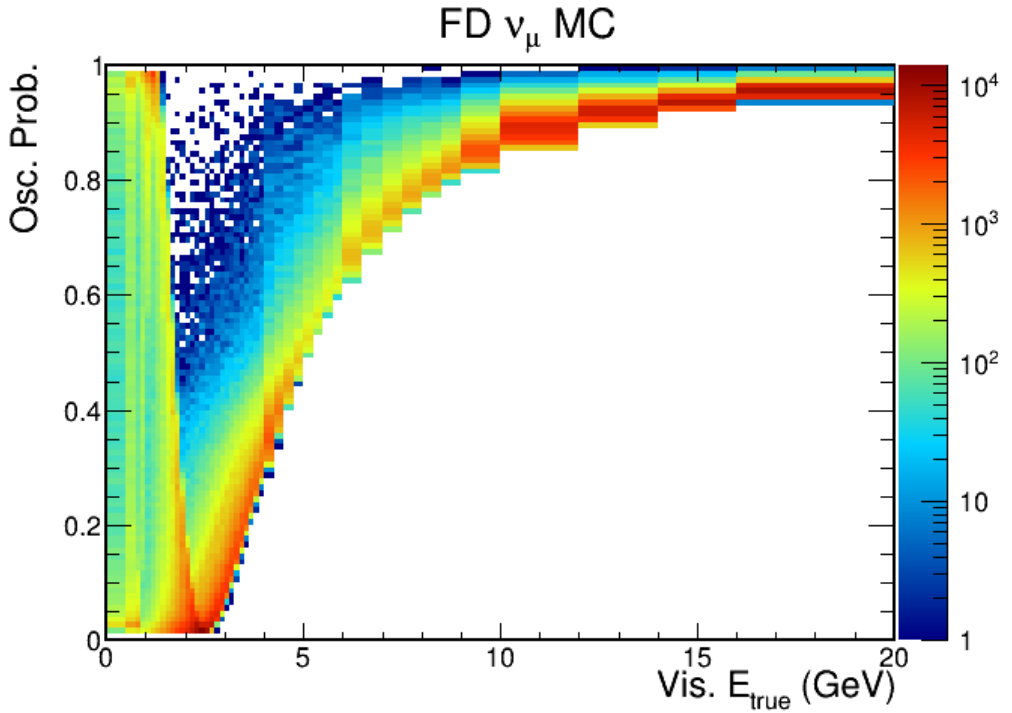
- Oscillation probability can **vary across a EVisTrue bin**
- Perhaps not binning FD smearing matrix finely enough causes the discrepancies?



Resolution of EVisTrue

- Oscillation probability can **vary across a EVisTrue bin**
- See right plot - wide range of oscillation probabilities for a single EVisTrue bin
- Large spread of probabilities around 1.5 GeV - 3.5 GeV





Next Steps

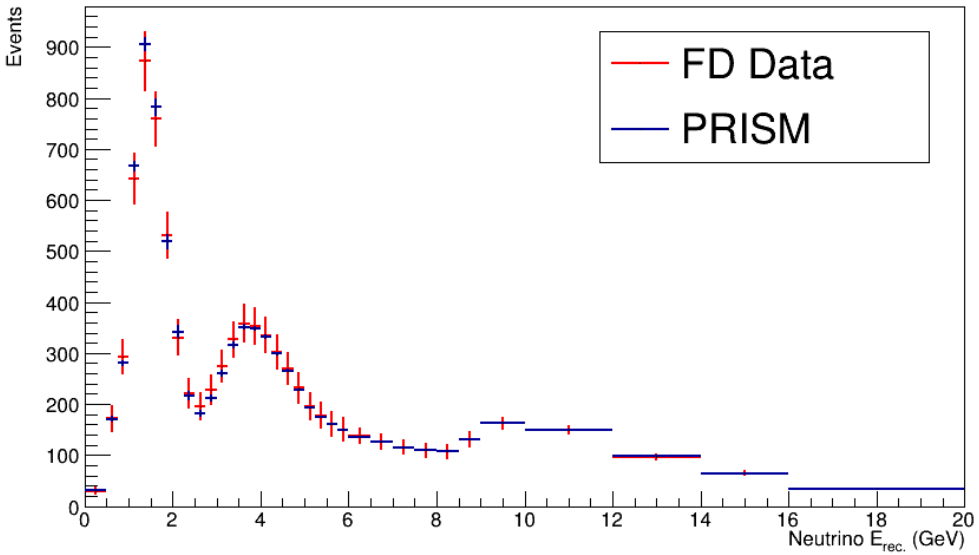
- PRISM and LBL fits can be consistent – provided we:
  - Use the **same analysis variable**
  - Remove **statistical uncertainty** on the prediction
  - Achieve a perfect **asimov-like fit**
- Investigating **different binning options** for unsmear/smear process
- Will look into **2D analysis axes** (e.g. ELep v EHad)
- May struggle to get a completely fit perfect for this unsmear/smear method and we don't necessarily want to use the LBL EReco variable

Thanks for Listening!

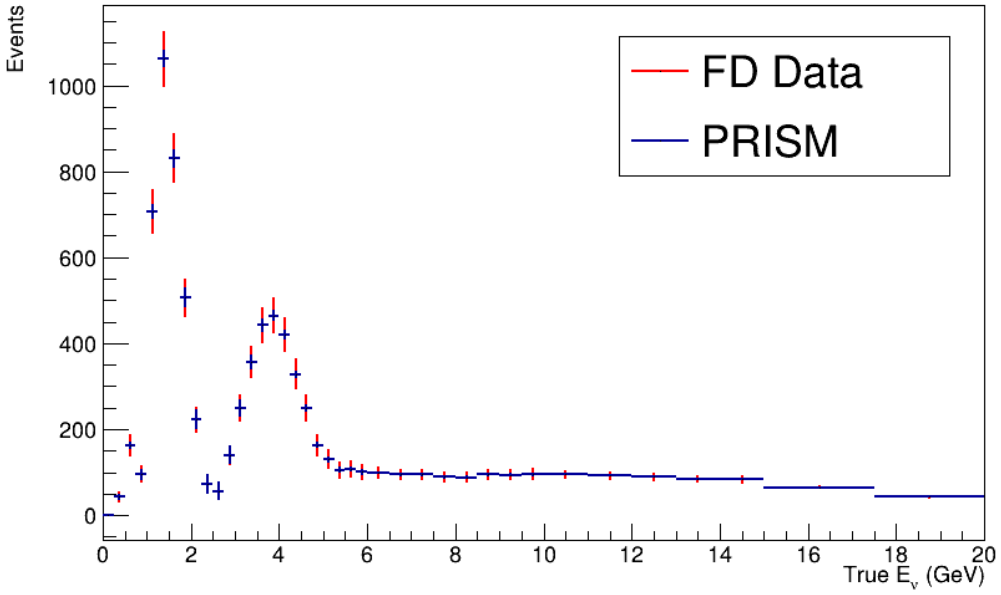
Backup: ETrue PRISM Fit

- Try working in ETrue – still do unfold/smear and efficiency correction, but **smearing matrices** are now **purely diagonal**
- Get a much **better match** between (cheated) PRISM and FD 'data'

Reco



True



Backup: ETrue PRISM Fit

- Now fit ETrue PRISM prediction to FD 'data' (also in ETrue)
- Compare to FD MC fit to 'data' (labelled 'LBL') - seen this gives equivalent results to LBL in our framework
- *Almost identical!*