

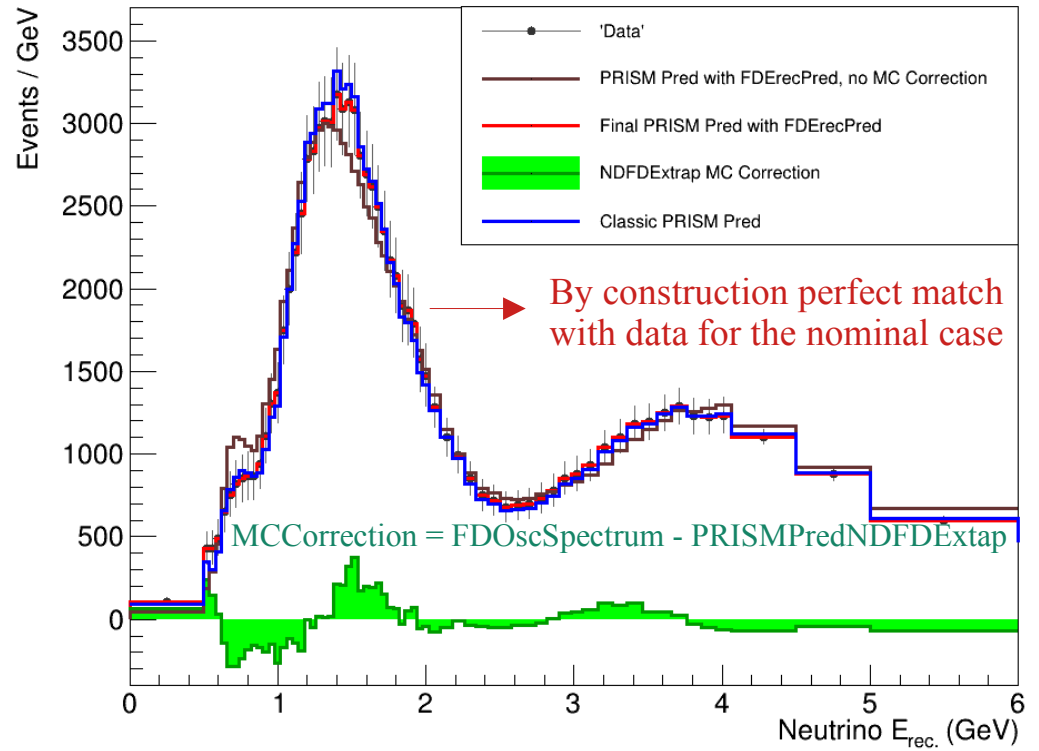
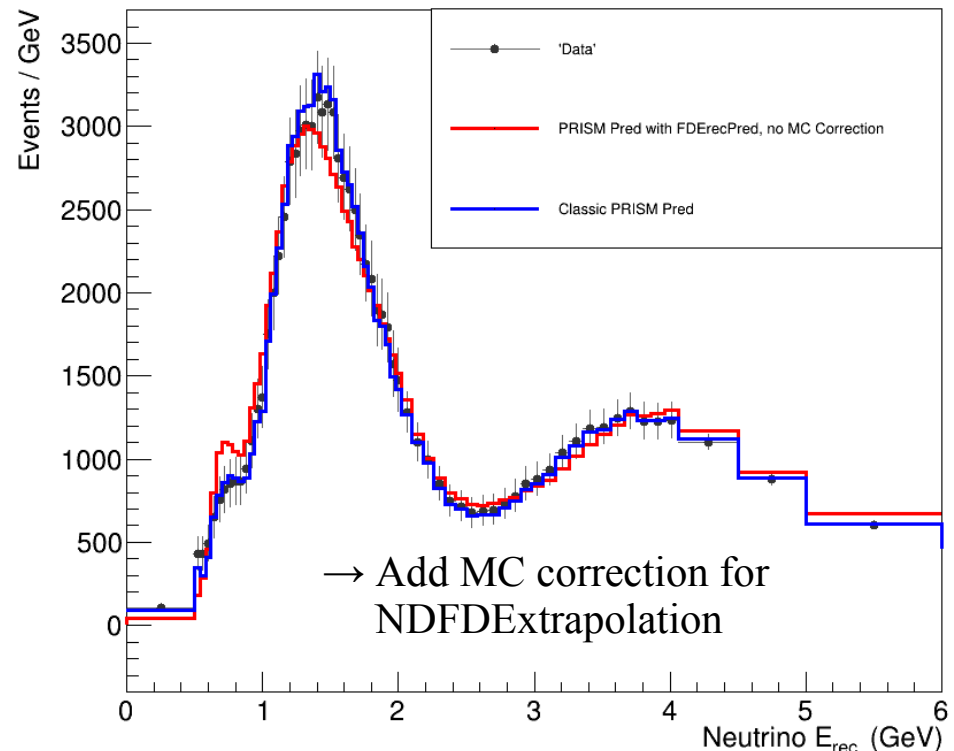
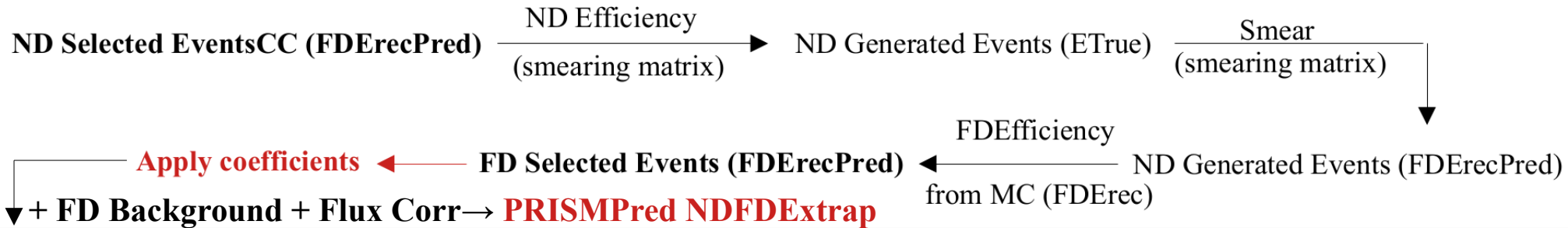
Implementation of Near \rightarrow Far Extrapolation within DUNE-PRISM Software

DUNE-PRISM Analysis Meeting

Ioana Caracas

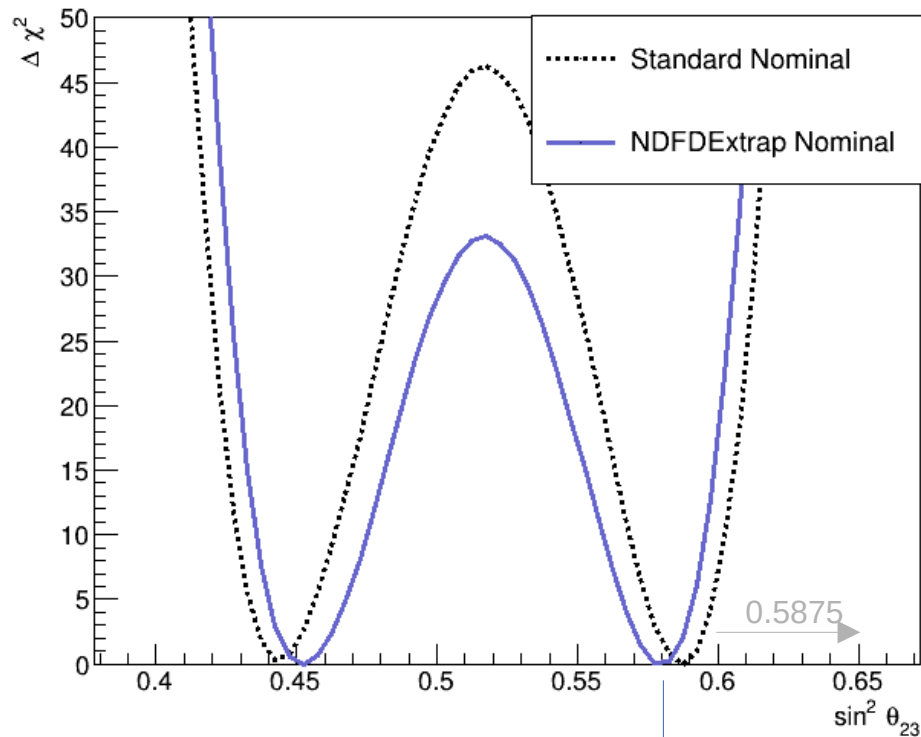
22.08.2024

Tailored PRISM Analysis with FDErecPred : applying coefficients

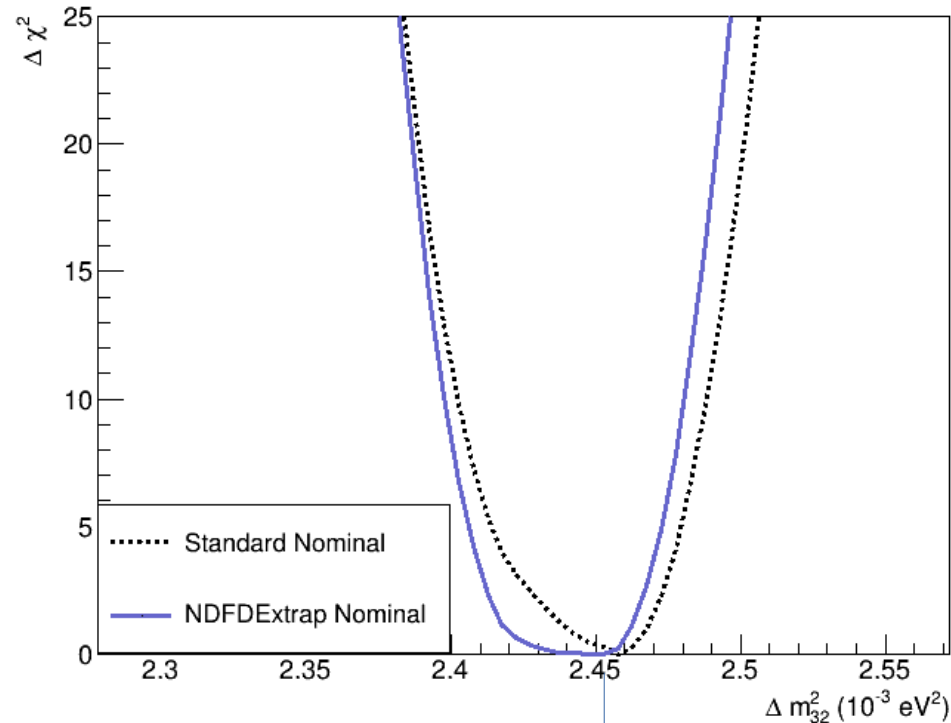


Oscillation fits – nominal (no systs) case

- Exposure 336 kt-MW-yr (7 yr in numu mode only)



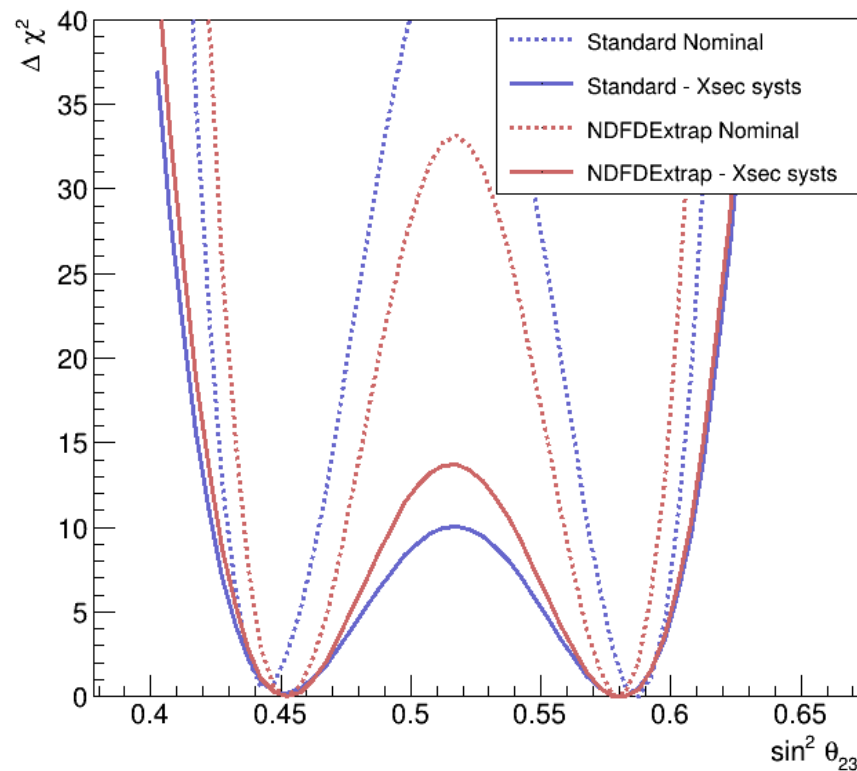
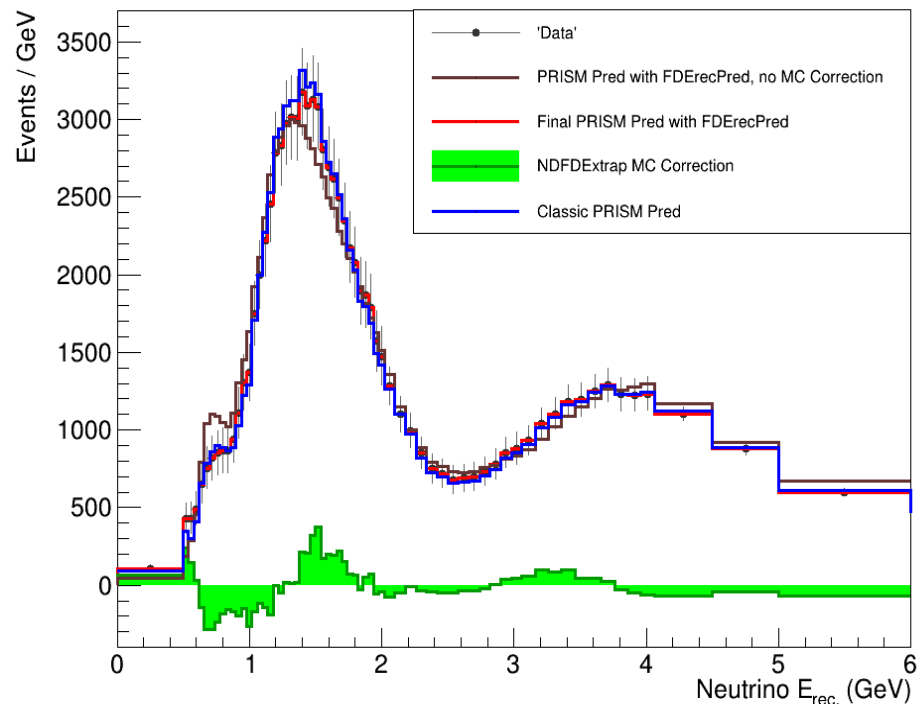
True value = 0.5799



True value = 2.4511 * 1e-3

Oscillation fits – XsecSysts

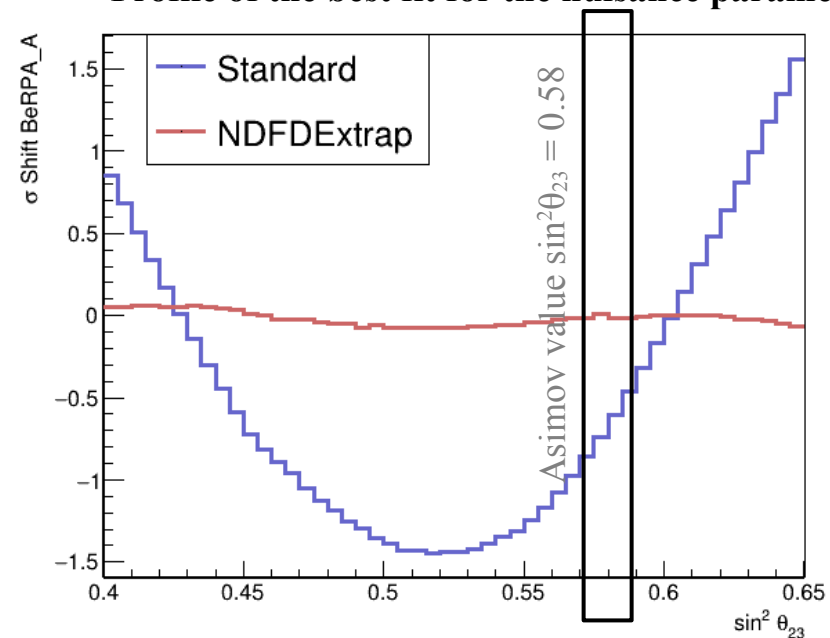
- Exposure 336 kt-MW-yr (7 yr in numu mode only)



- By construction we have a perfect match for NDFD Extrapolation in the nominal case
→ why less sensitivity reduction when systs applied?

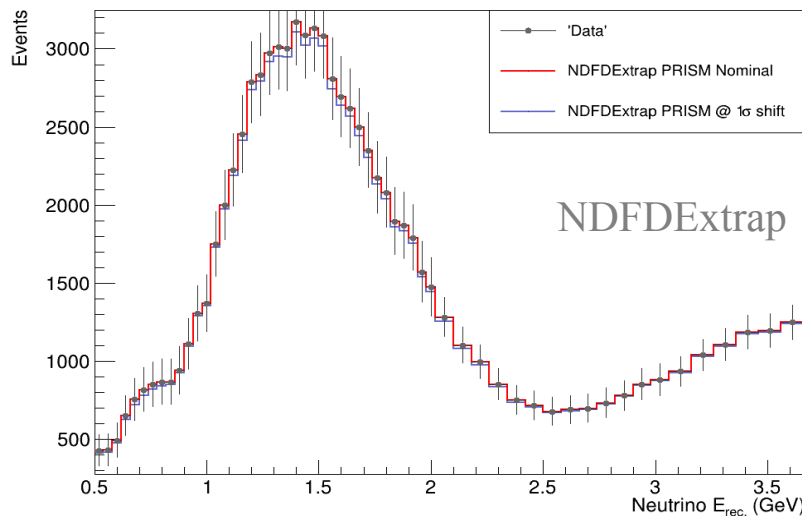
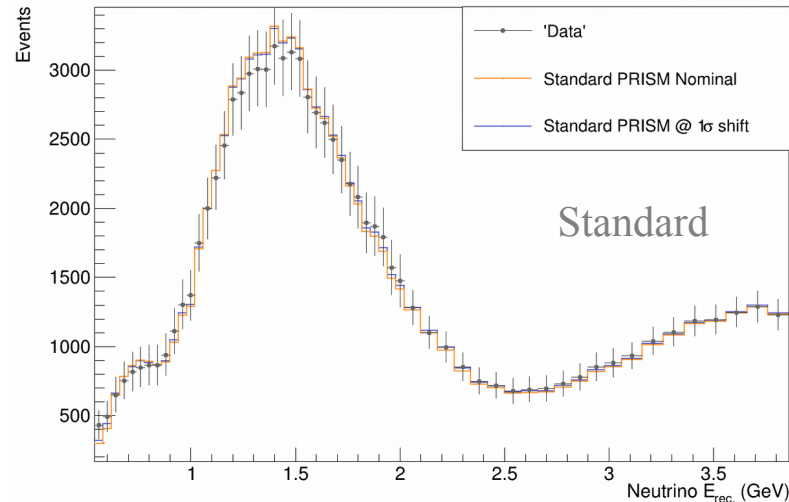
Oscillation fits – XsecSysts

Profile of the best fit for the nuisance parameter



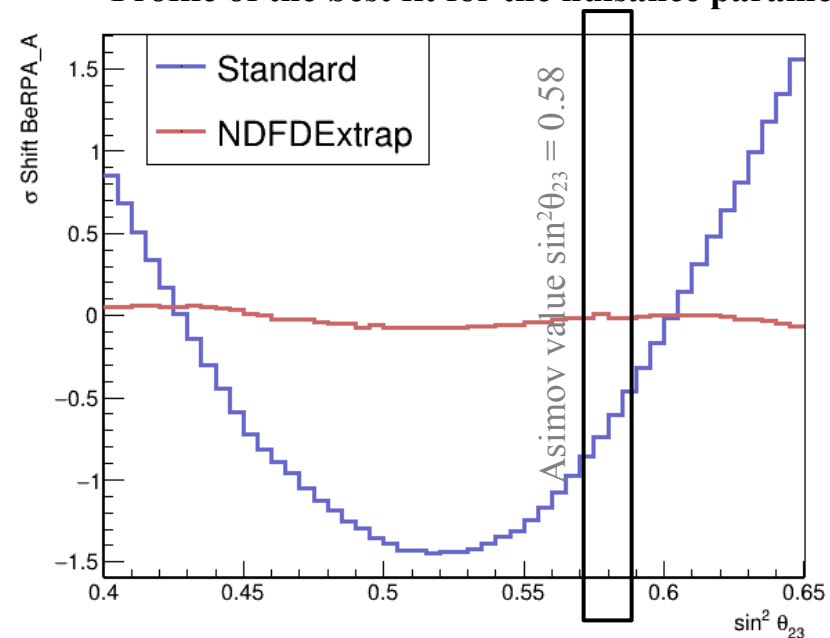
- much smaller shift (almost 0) for this particular nuisance parameter in the case of NDFDExtrap.. WHY?
- systs affect NDFDExtrap PRISM Prediction more: bigger difference between Nominal pred Vs Shifted Pred
 - nominal pred fits data perfectly by construction \rightarrow minimum Chi2 for small syst shift (close to 0)

PRSIM Predictions at Asimov values



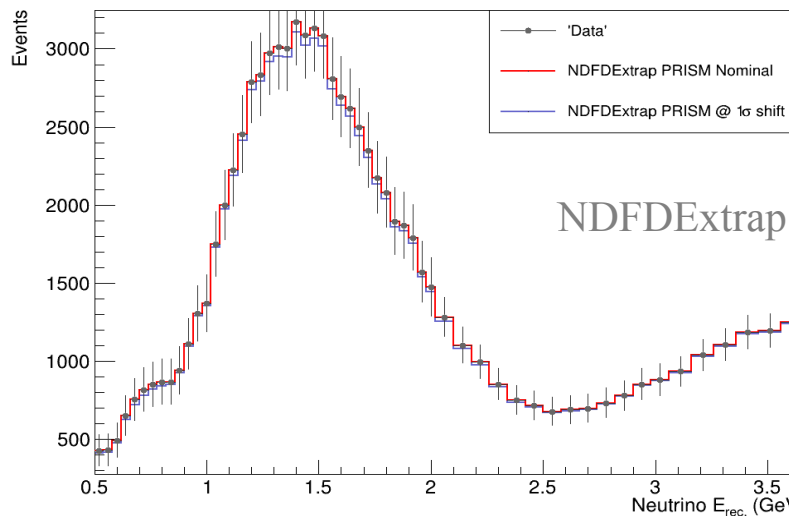
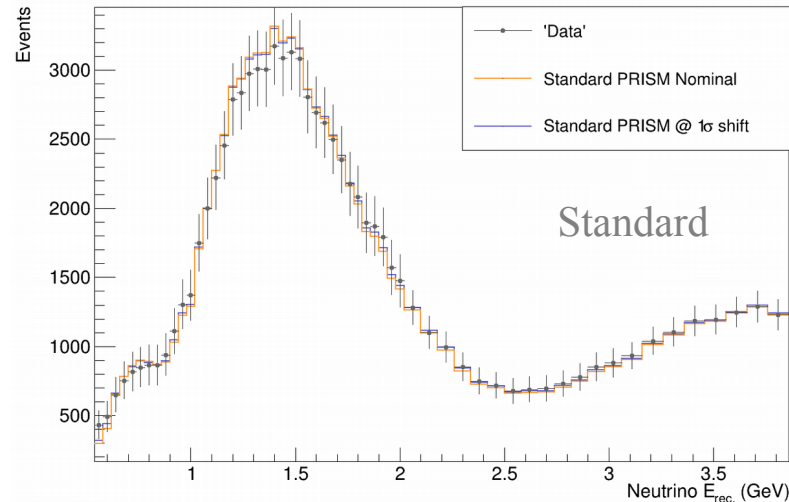
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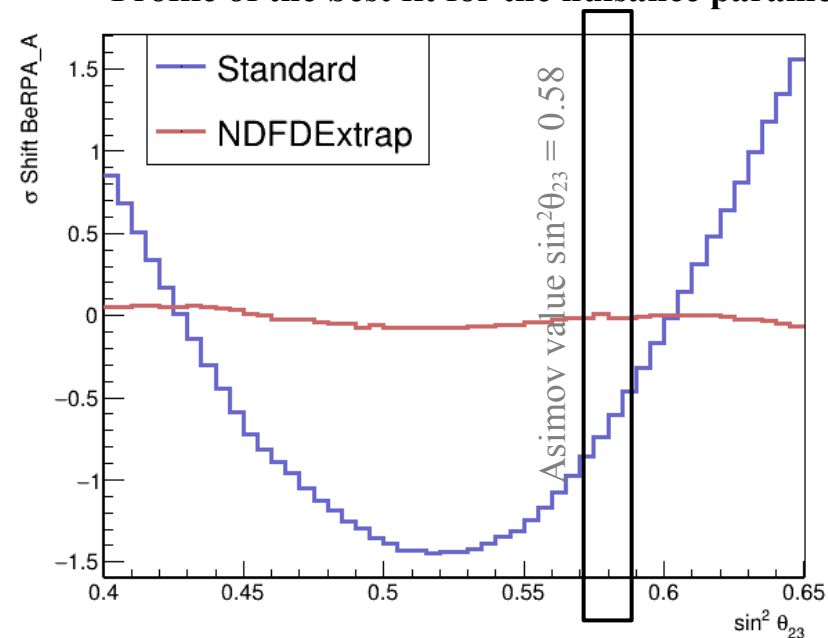
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PRSIM Predictions at Asimov values



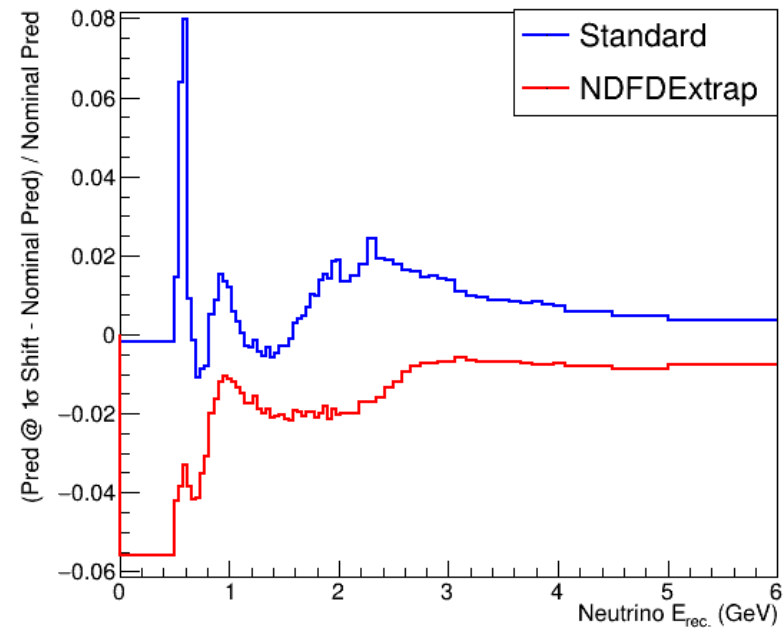
Oscillation fits – XsecSysts

Profile of the best fit for the nuisance parameter



- much smaller shift (almost 0) for this particular nuisance parameter in the case of NDFDExtrap.. WHY?
- systs applied to NDFDExtrap PRISM Prediction have a bigger impact: Nominal pred Vs Shifted Pred
 - nominal pred fits data perfectly by construction: any systematics applied to it would results in a “worse” match for the Asimov value → minimum Chi2 for small syst shift (close to 0)

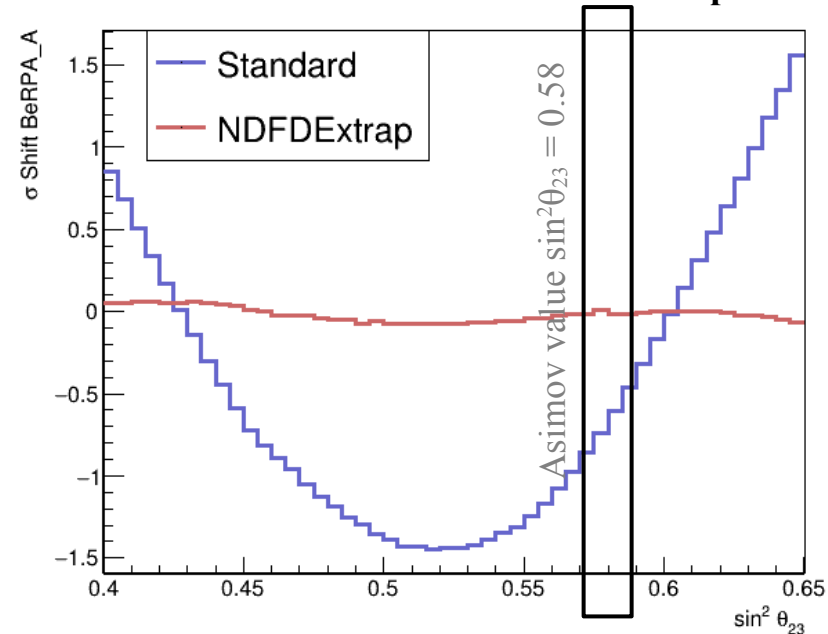
Fractional Shift: $\text{Pred(With Systs)} - \text{Pred(Nominal)} / \text{Pred(nominal)}$



- systs affect **NDFDExtrap** (on average) more than then in the **standard PRISM** case

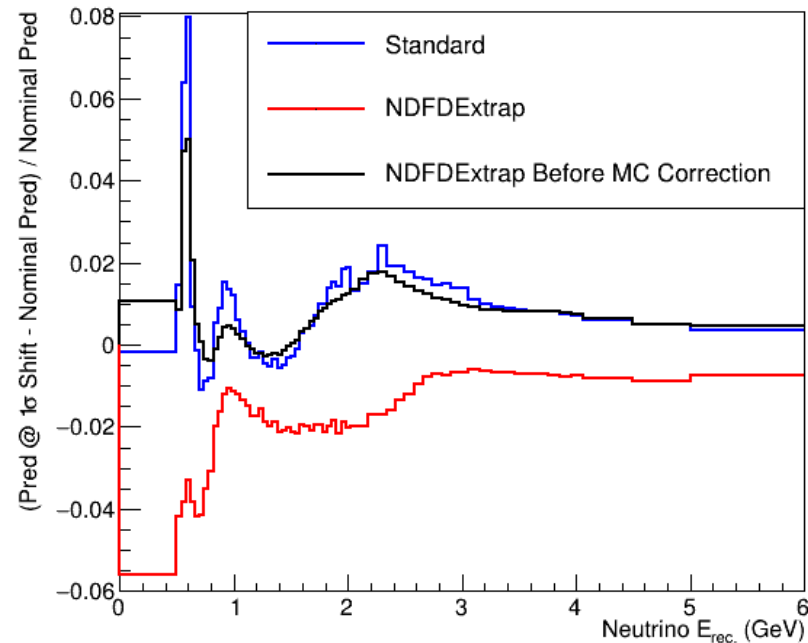
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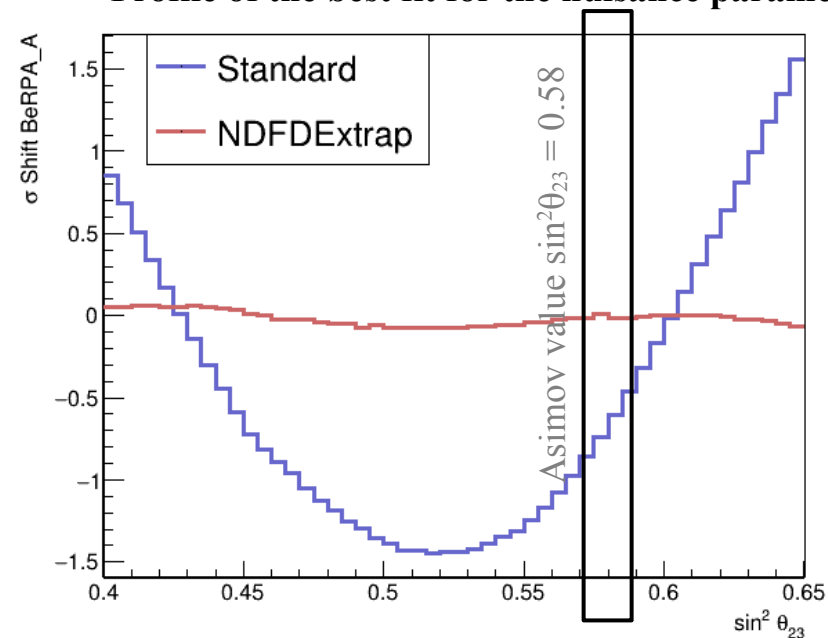
Fractional Shift: $\text{Pred(With Systs)} - \text{Pred(Nominal)} / \text{Pred(nominal)}$



- systs affect **NDFDExtrap** (on average) more than then in the **standard PRISM** case → this is mainly due to the MC Correction: NDFDExtrap before MC correction has smaller fractional shifts

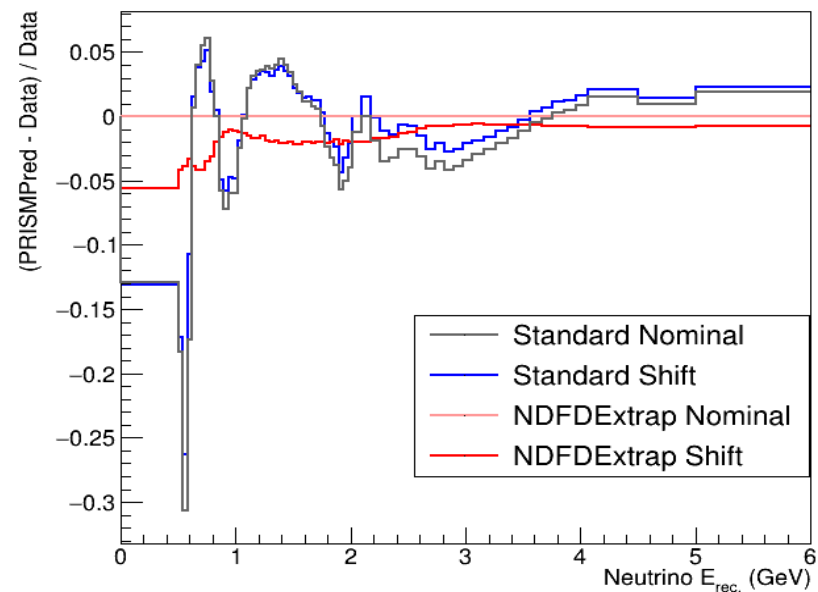
Oscillation fits – XsecSysts

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Fractional Shift: Pred(With Syst) – Data / Data

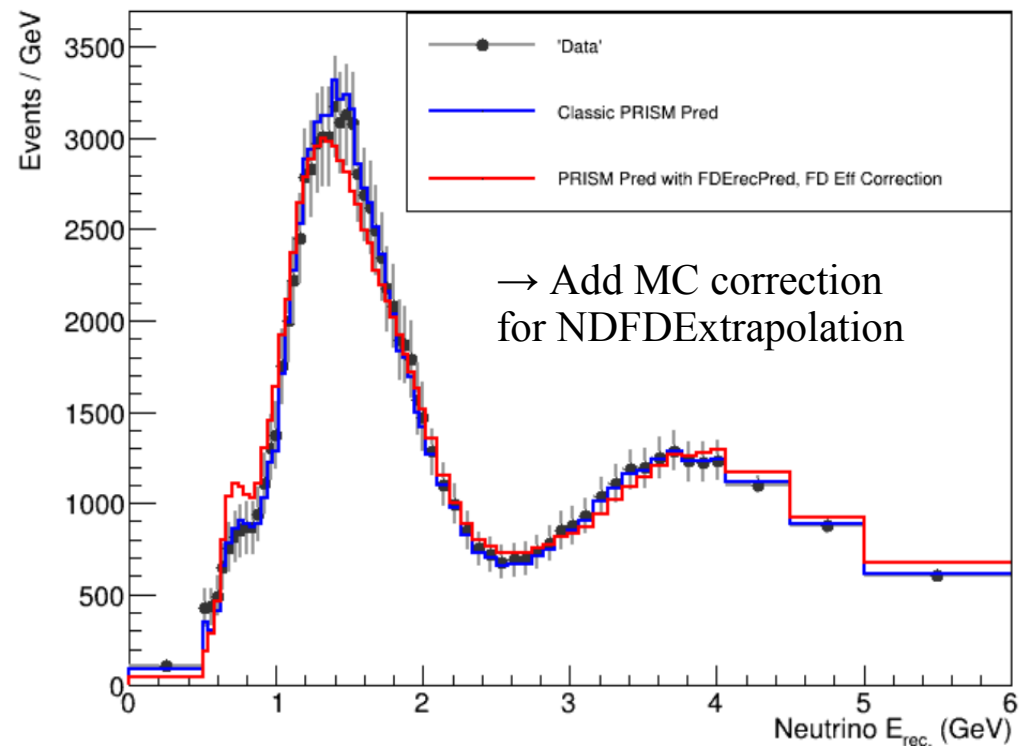
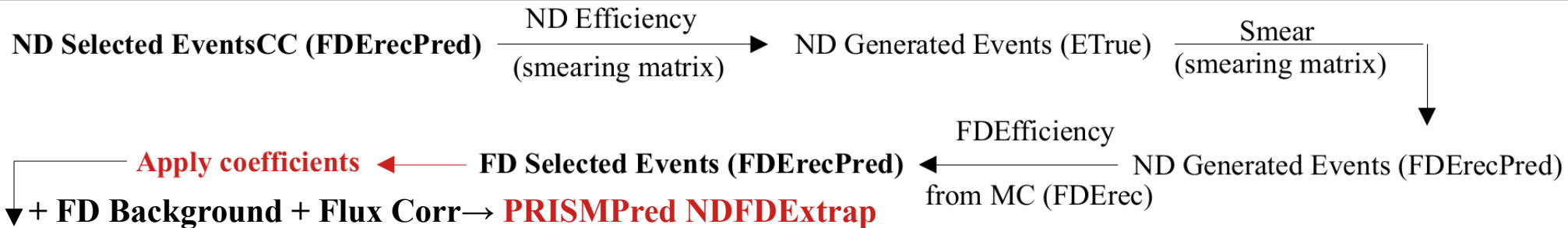


- difference between no systs vs with syst shift is much bigger in the NDFDExtrap case: systematics affect the “goodness of match” between PRISM Prediction and ‘Data’ much more
 - in the Standard case almost always a 1σ shift results in better match with data

Where we are...

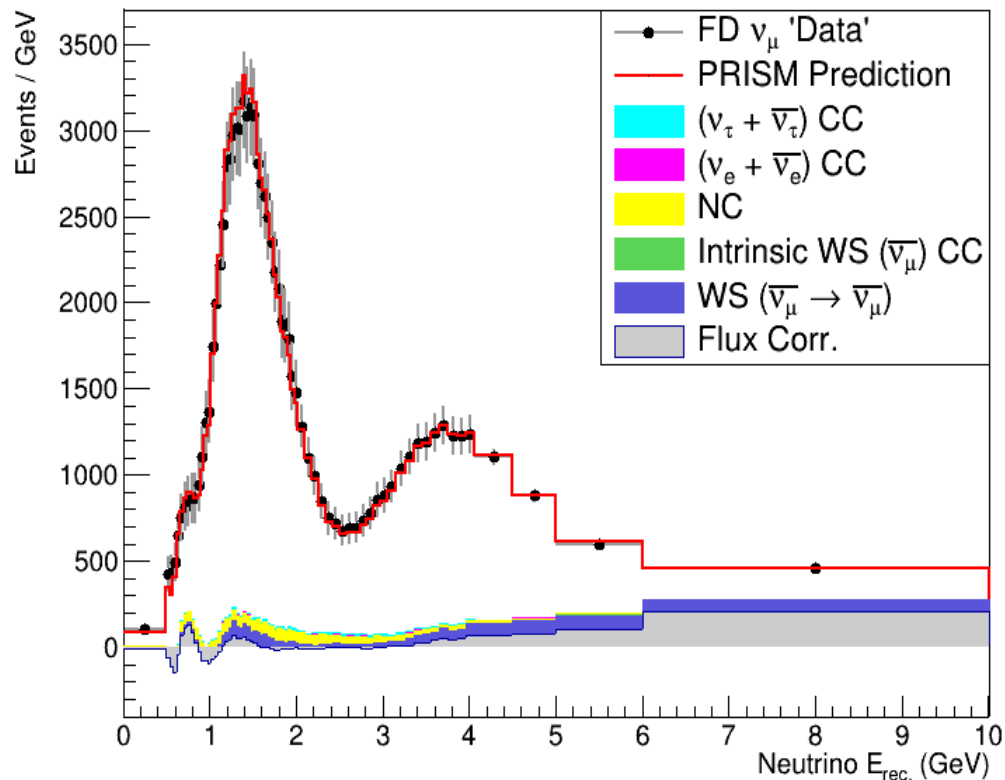
- First oscillation fits with systs (Xsec) for the current ND FD extrapolation
 - sensitivity reduced much less when xsec applied: nominal fit is constructed to be a perfect match (MC correction) → smaller systematic shifts chosen for the best fit
 - if nor MC correction: best fit point is biased even in the nominal case → we need some model correction
- Alex sent me the current “Resolution matrix” : ErecPred Vs ErecPairData
 - currently working on implementing this within PRISM analysis (almost there) and using it further as a “Network Model Correction”
 - once this is done no MC correction needed + hopefully could point towards the “correctness” of the paired data

Tailored PRISM Analysis with FDErecPred : applying coefficients

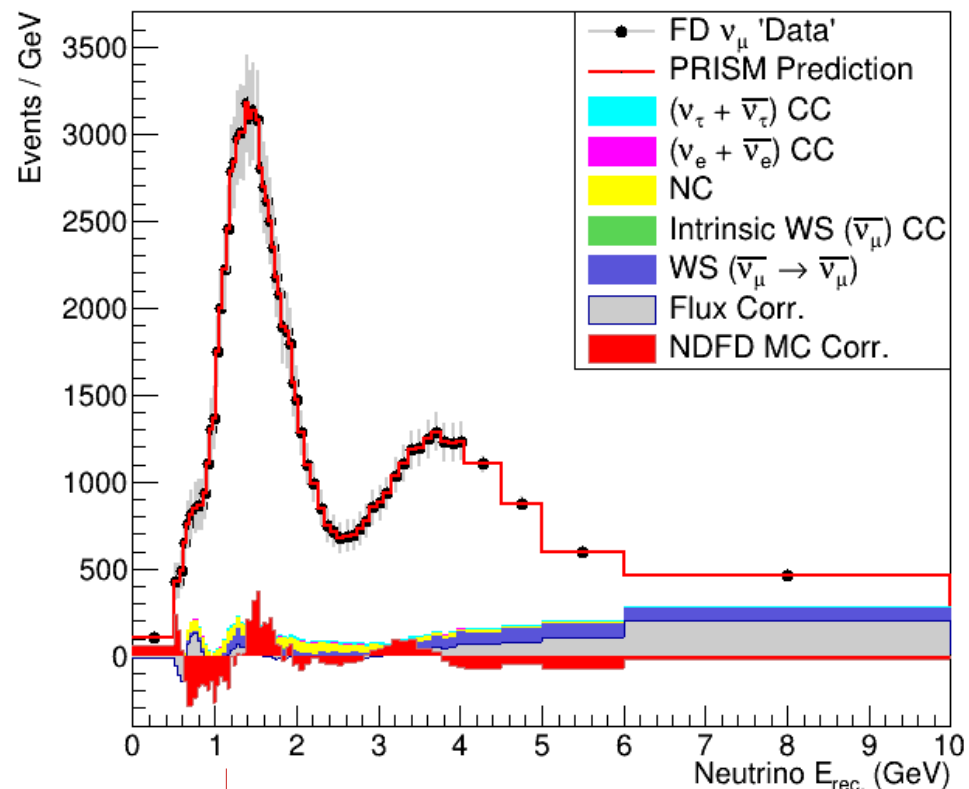


Classic PRISM Prediction vs PRISM Prediction with NDFD Extrapolation

Classic PRISM Prediction



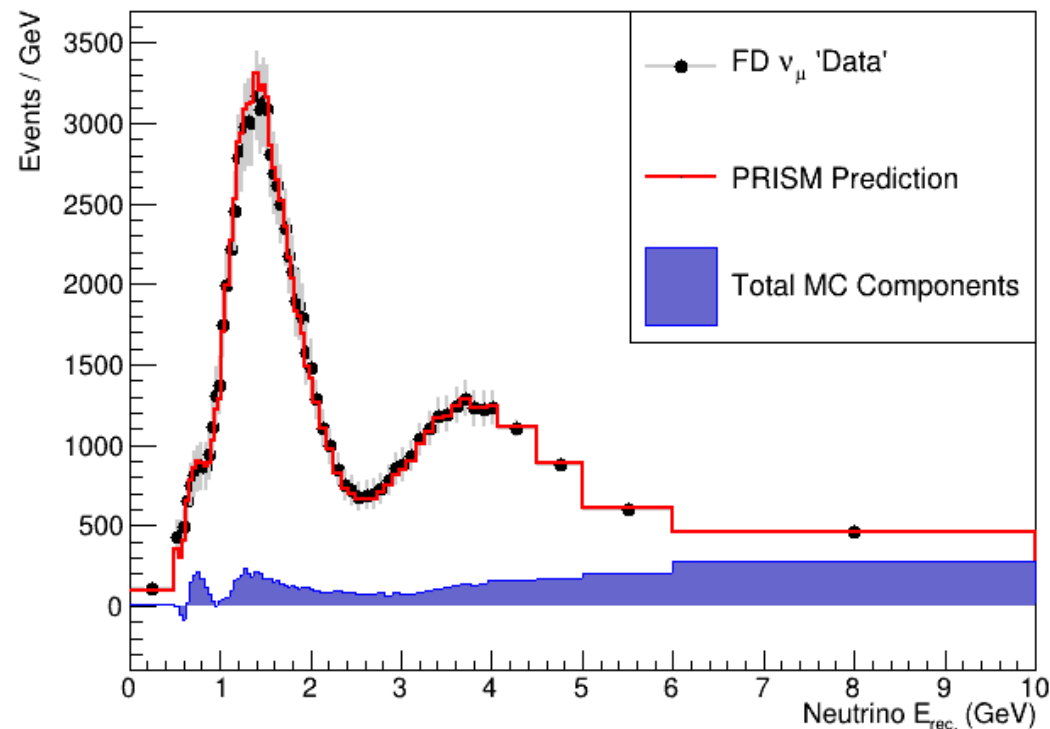
PRISM Prediction with NDFD Extrapolation



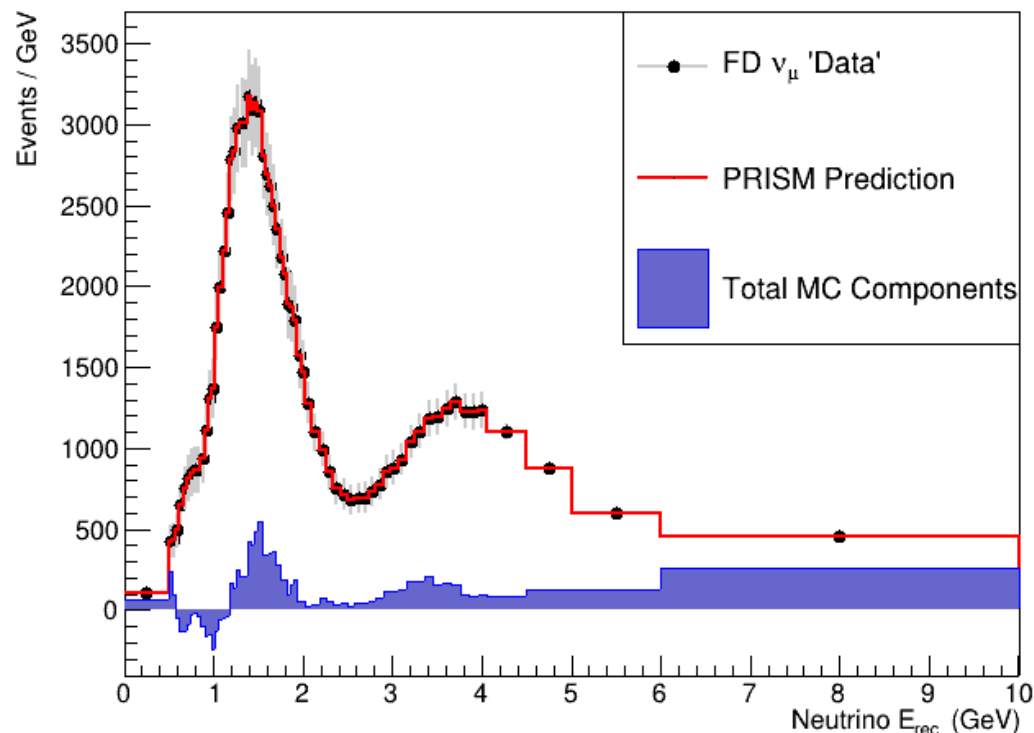
Significant MC correction

Classic PRISM Prediction vs PRISM Prediction with NDFDExtrapolation

Classic PRISM Prediction



PRISM Prediction with NDFDExtrapolation



- Perfect match between PRISM Prediction with NDFDExtrapolation (by construction) but more MC components \rightarrow would probably be affected by systematics more..
- Nominal oscillation fit should result in perfect (no biased) minimum

Questions / Discussions

- Is this the MC correction we want to have in the end? ($MCCorrection = FDOscSpectrum - PRISMPredNDFDExtap$)
 - By definition we would have perfect match between this prediction and FD data for the nominal case
 - Would probably end up using more MC dependency than before
 - Should we add a similar “MC Correction” for the classic PRISM prediction for a 1 to 1 comparison?
 - Would some “network provided resolution: same events from the network as a function of ErecPred and ErecCAFFD be useful? – use this resolution instead of the MC correction?
- Why do we have the bump / bias at 1 GeV? Is this network related? Could it be improved?
- Mainly for Alex and Radi (can discuss tomorrow as well as on slack): would it make sense to have some FDEfficiency (FDErecPred) rather than FDEfficiency (FDEredCAFs) that we use now? – this is not the reason for the 1 GeV bump

Ideas / suggestions are more than welcome :)

Network Resolution / Smearing Matrix

