Implementation of Near → Far Extrapolation within DUNE-PRISM Software
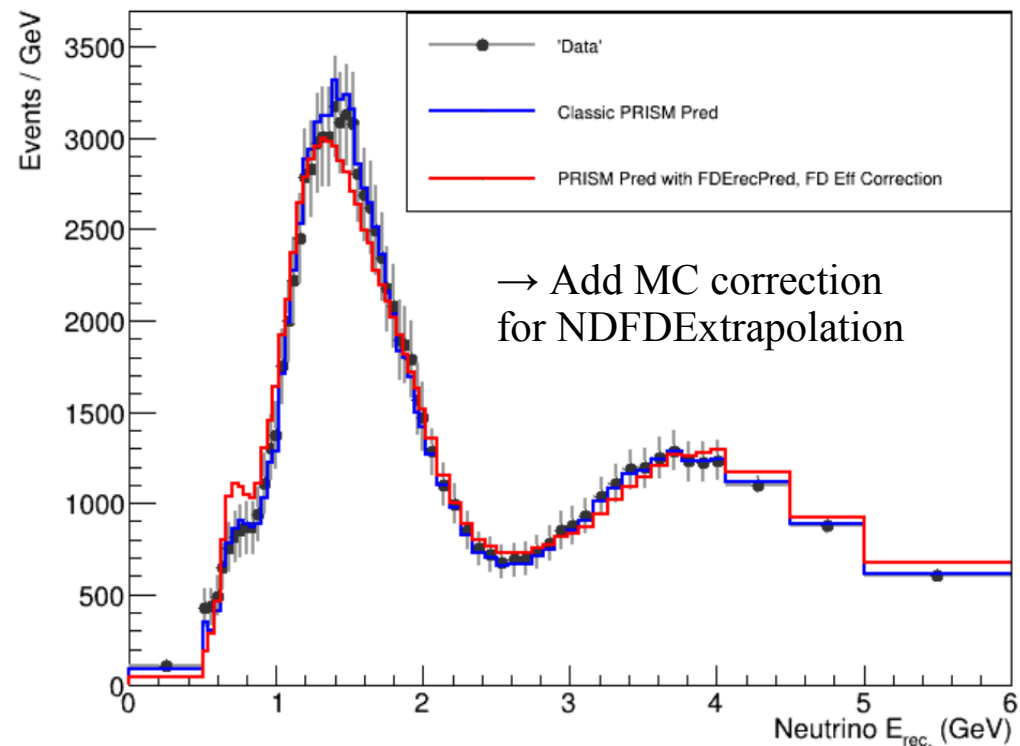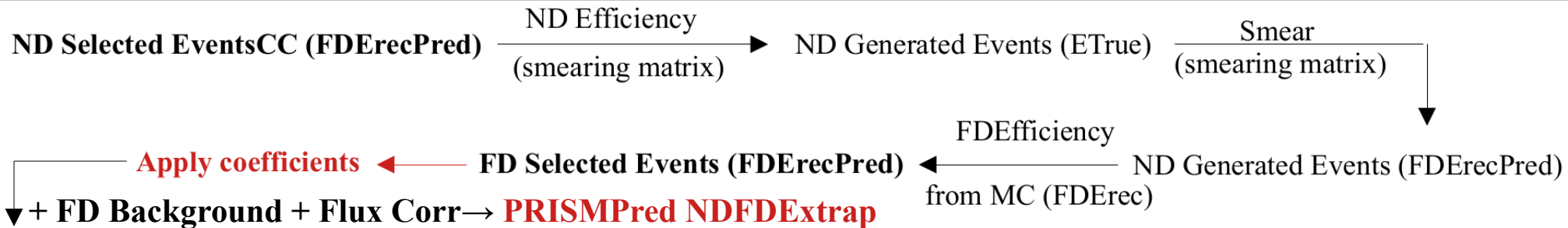
DUNE-PRISM Analysis Meeting

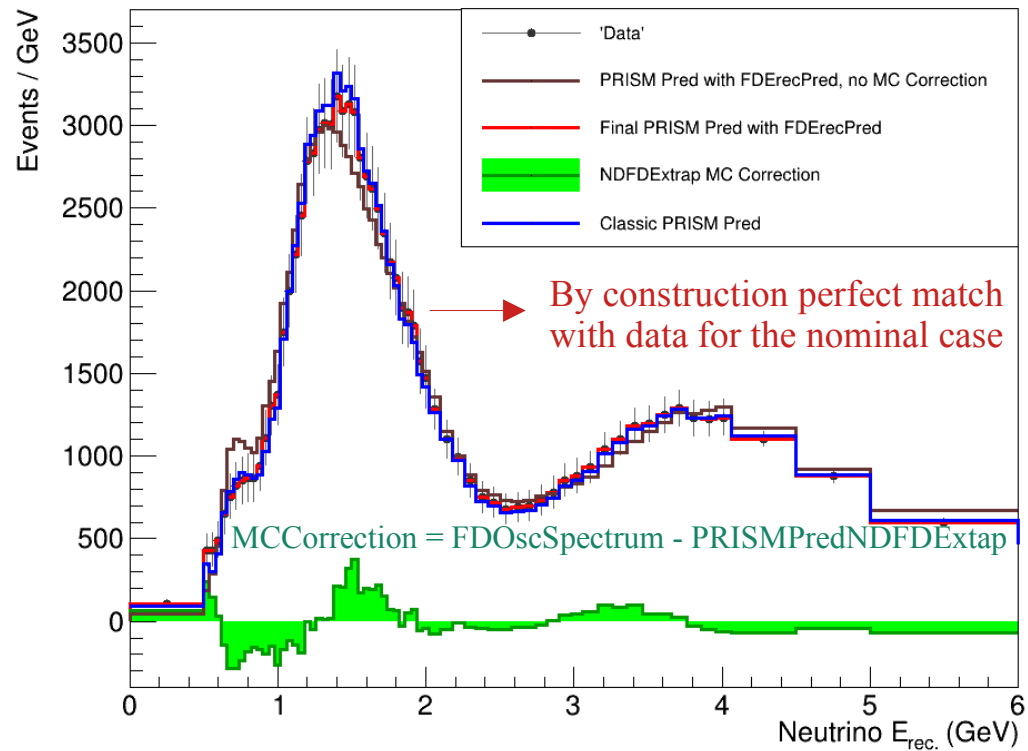Ioana Caracas   08.08.2024

Tailored PRISM Analysis with FDErecPred : applying coefficients

ND Selected EventsCC (FDErecPred) $\xrightarrow[\text{(smearing matrix)}]{\text{ND Efficiency}}$ ND Generated Events (ETrue) $\xrightarrow[\text{(smearing matrix)}]{\text{Smear}}$

Apply coefficients $\longleftarrow$ **FD Selected Events (FDErecPred)** $\longleftarrow$ ND Generated Events (FDErecPred)

FDEfficiency

from MC (FDErec)

+ FD Background + Flux Corr→ PRISMPred NDFDExtrap

→ Add MC correction
for NDFDExtrapolation

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$\quad$ + FD Background + Flux Corr→ **PRISMPred NDFDExtrap** $\qquad\qquad$ from MC (FDErec)

→ Add MC correction for NDFDExtrapolation

By construction perfect match with data for the nominal case

MCCorrection = FDOscSpectrum - PRISMPredNDFDExtap

Classic PRISM Prediction vs PRISM Prediction with NDFDExtrapolation
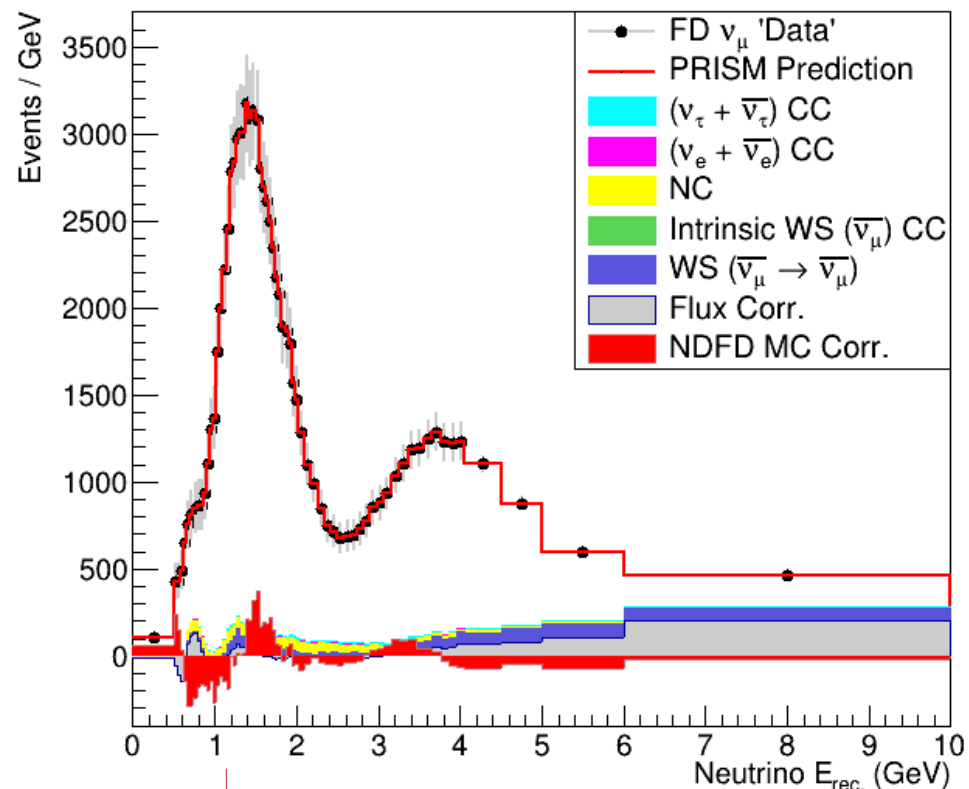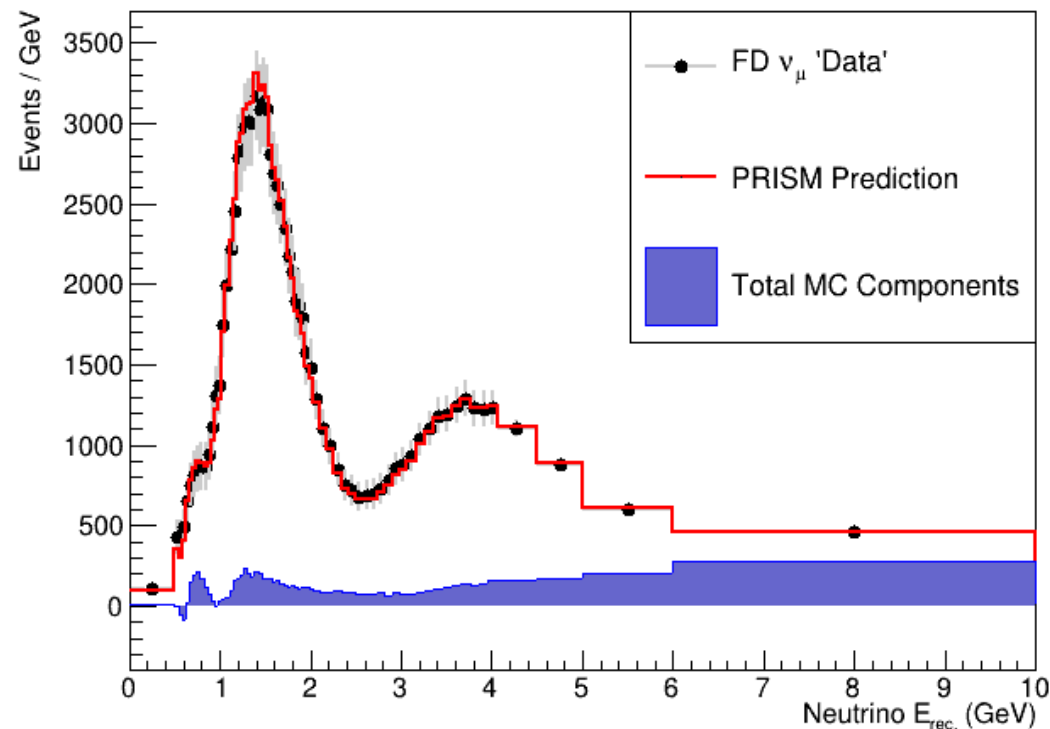
Classic PRISM Prediction

PRISM Prediction with NDFDExtrap

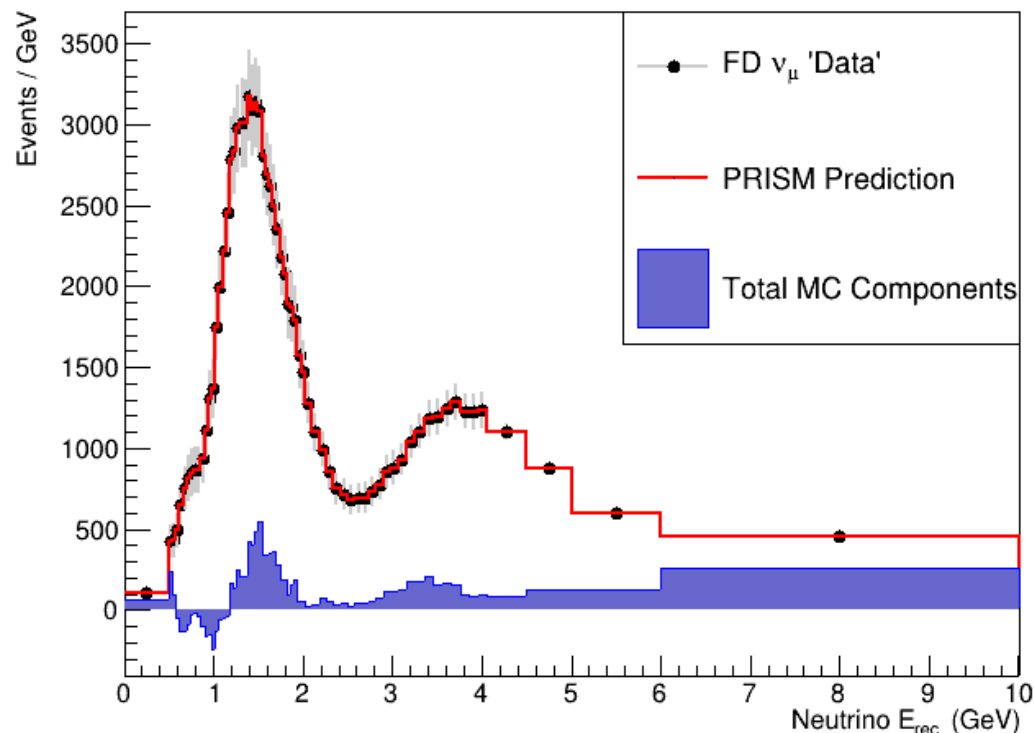Significant MC correction
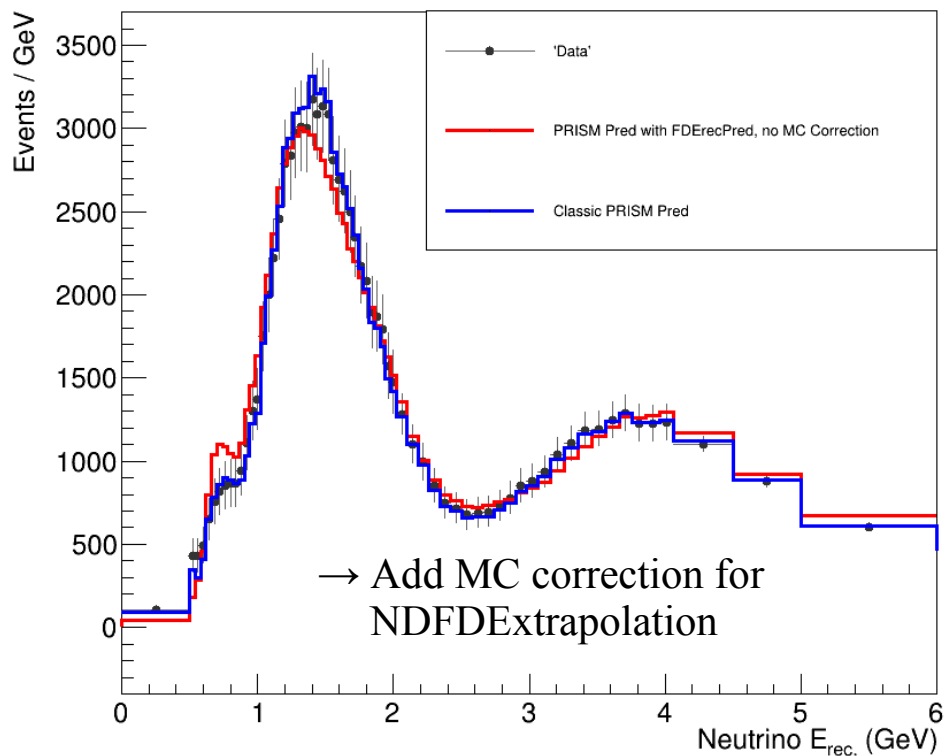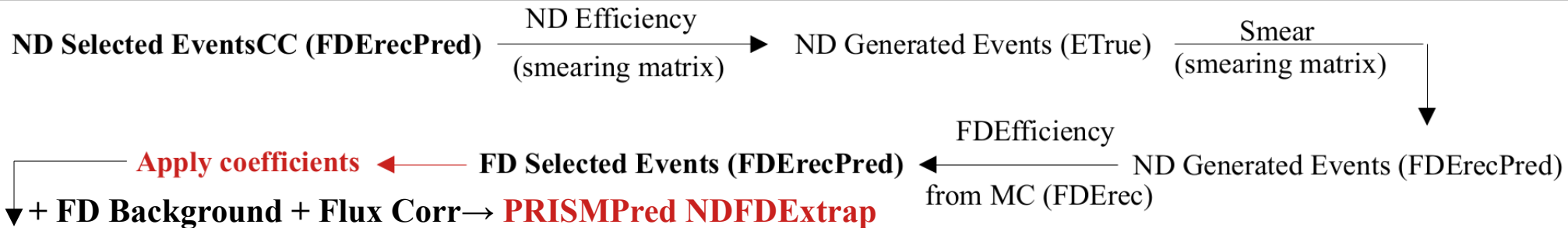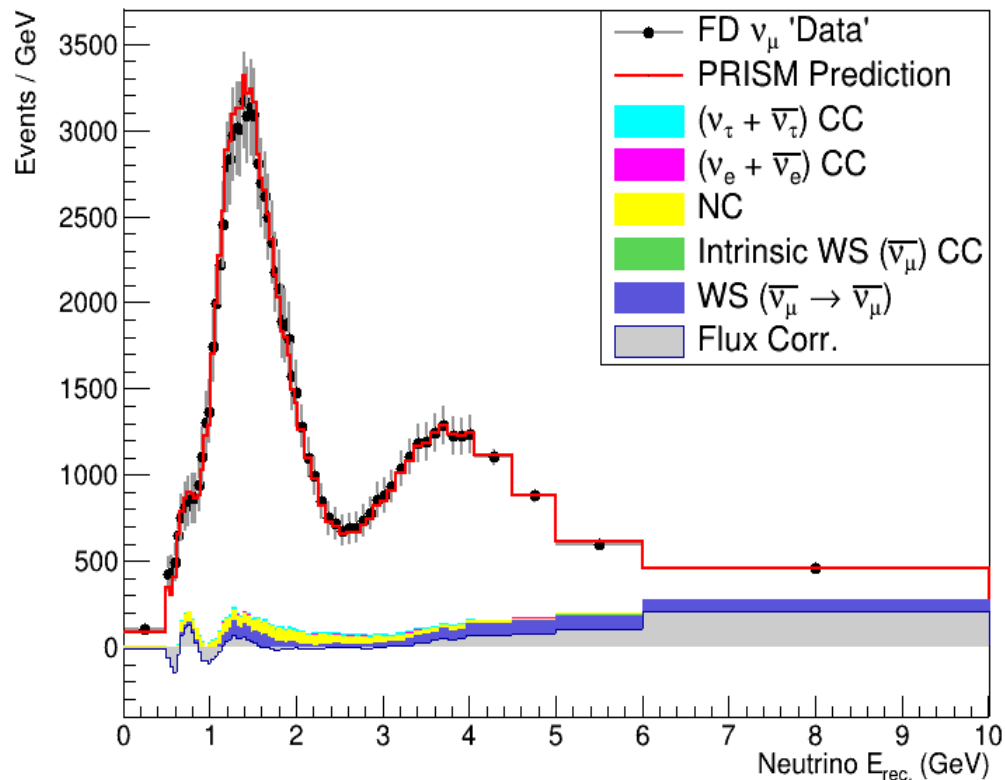
Classic PRISM Prediction vs PRISM Prediction with NDFDExtrapolation

Classic PRISM Prediction

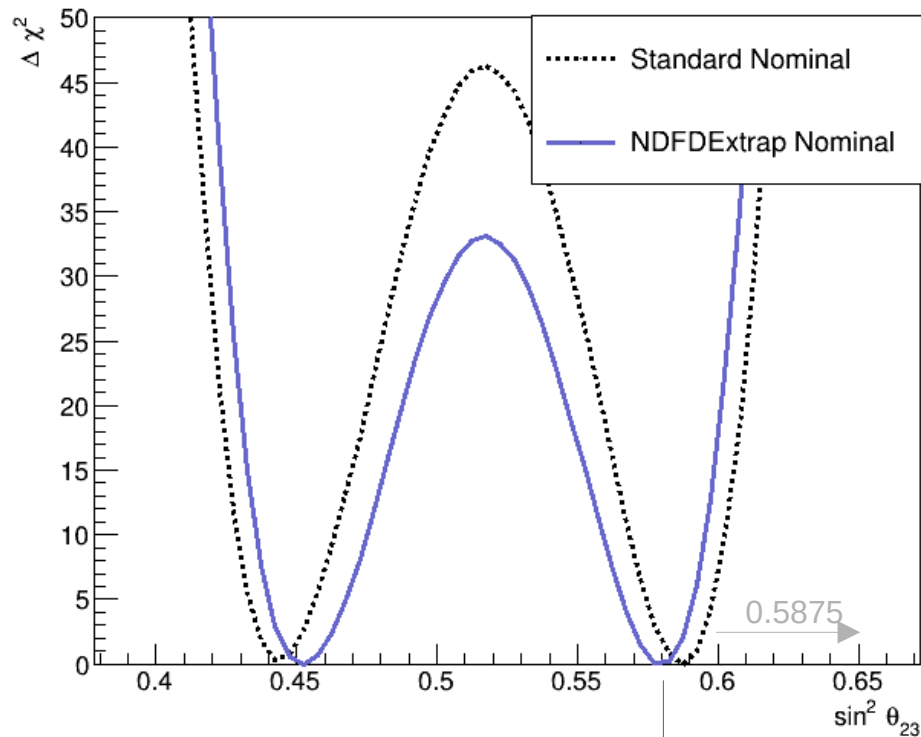**PRISM Prediction with NDFDExtrap**
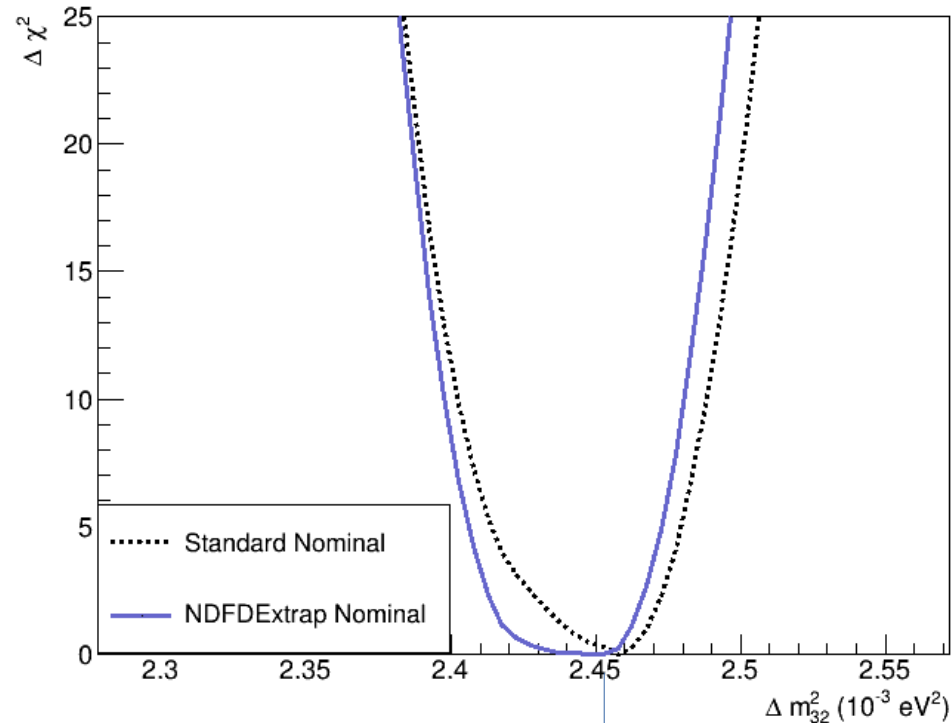

- Perfect match between PRISM Prediction with NDFDExtrap (by construction) but more MC components → would probably be affected by systematics more..

- Nominal oscillation fit should result in perfect (no biased) minimum

Oscillation fits – nominal (no systs) case

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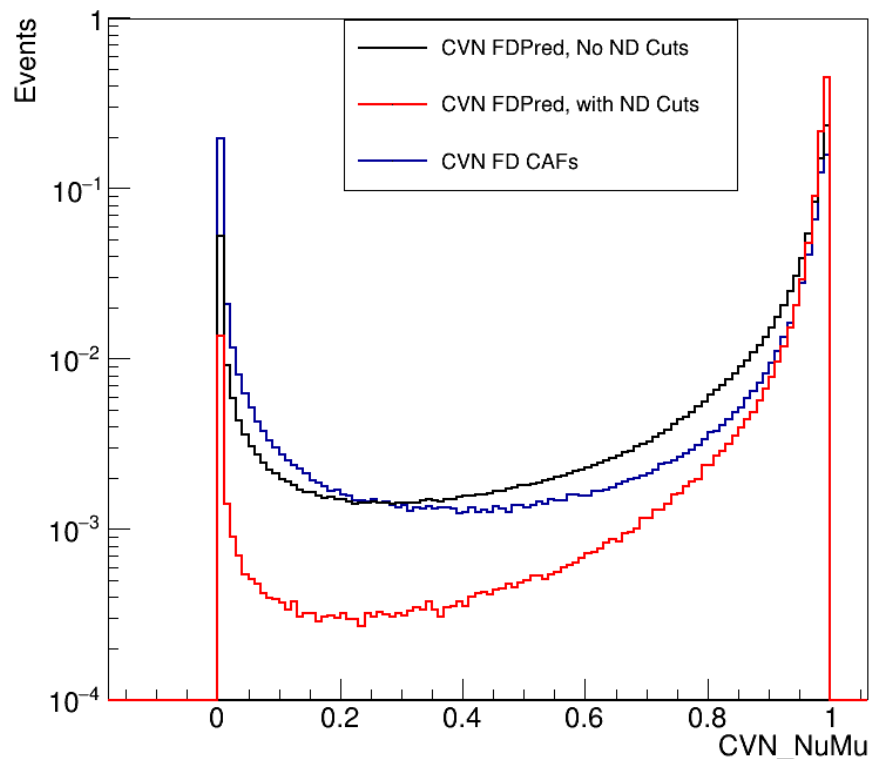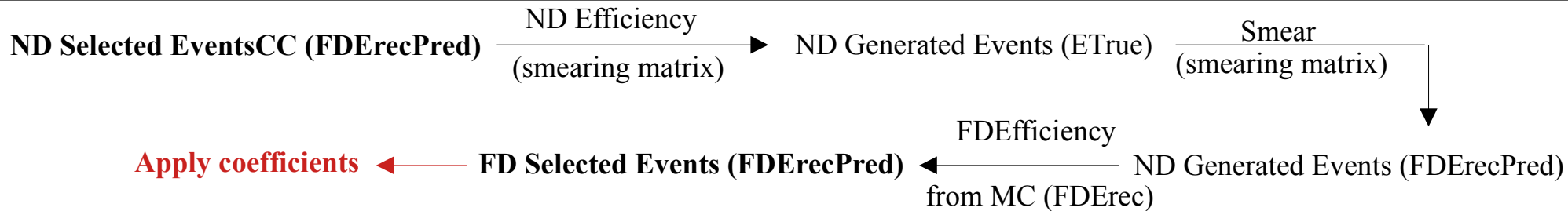

True value = 0.5799

True value = 2.4511 * 1e-3

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 :)

FD Efficiency (FDErecPred)

ND Selected EventsCC (FDErecPred) $\xrightarrow[\text{(smearing matrix)}]{\text{ND Efficiency}}$ ND Generated Events (ETrue) $\xrightarrow[\text{(smearing matrix)}]{\text{Smear}}$ ⟶

Apply coefficients ⟵ **FD Selected Events (FDErecPred)** $\xleftarrow[\text{from MC (FDErec)}]{\text{FDEfficiency}}$ ND Generated Events (FDErecPred)
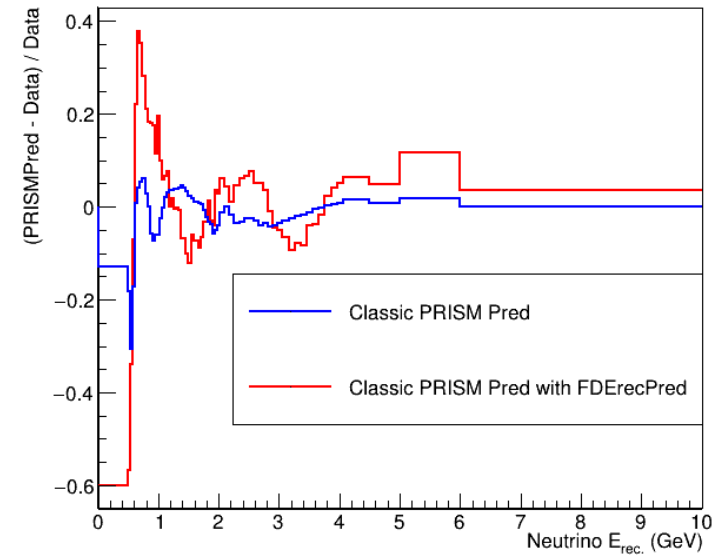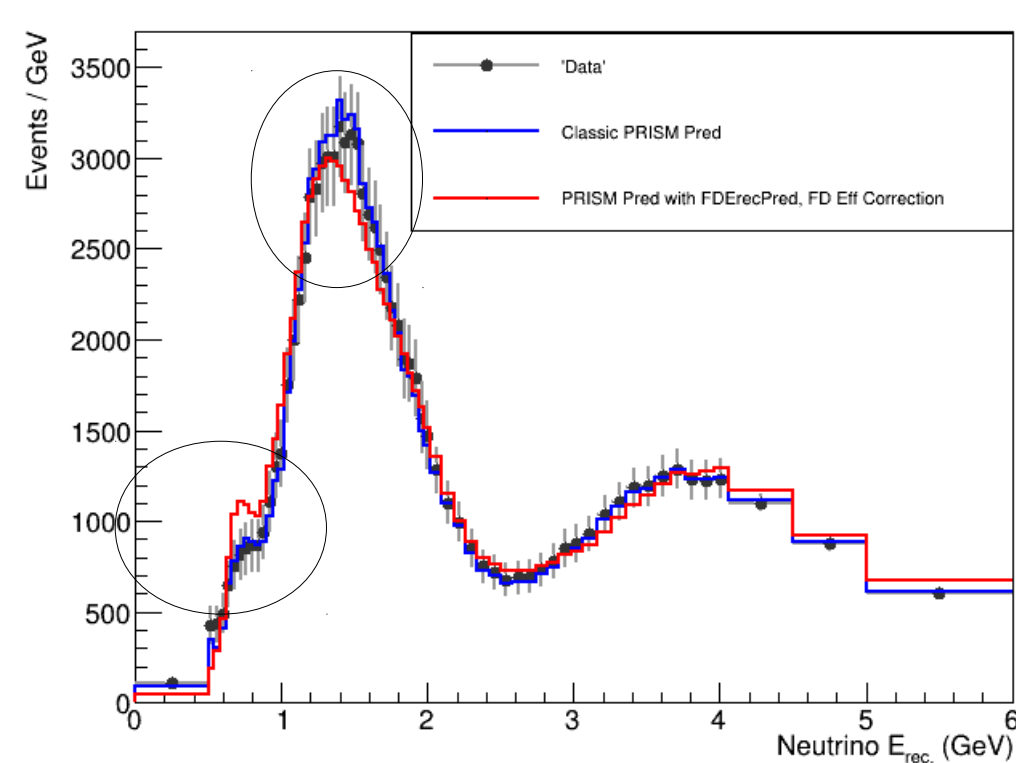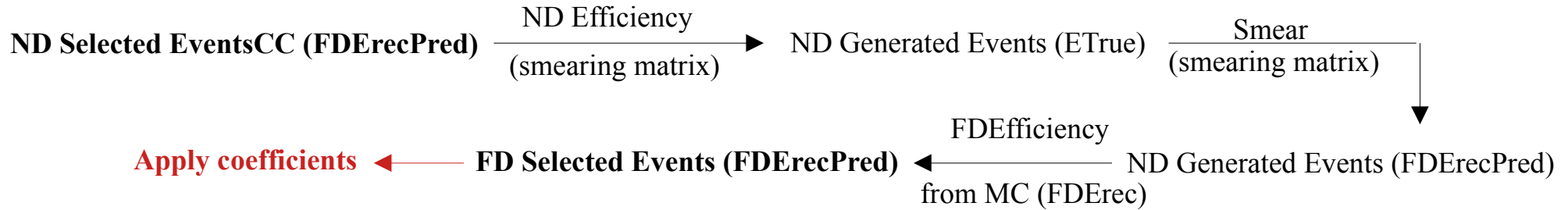

– we need to apply efficiency correction for all generated events (not only for those with ND Cuts)
– CVN score for events with no ND cuts is not reliable → network was not trained with this events

Idea/question: should one train the network for all events and save the corresponding CVN scores, but keep on using the FDErecPred for selected events (ND Cuts) only?

– ideally CVN FDPred would look "same" as CVN FDCAFs → FDEfficiency (FDErecPred) correction would have the same shape + magnitude as FDEfficiency(FDErec)

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Tailored PRISM Analysis with FDErecPred : applying coefficients

ND Selected EventsCC (FDErecPred) $\xrightarrow{\text{ND Efficiency} \atop \text{(smearing matrix)}}$ ND Generated Events (ETrue) $\xrightarrow{\text{Smear} \atop \text{(smearing matrix)}}$

Apply coefficients $\longleftarrow$ **FD Selected Events (FDErecPred)** $\xleftarrow[\text{from MC (FDErec)}]{\text{FDEfficiency}}$ ND Generated Events (FDErecPred)

– should we go for MC correction at this point ?