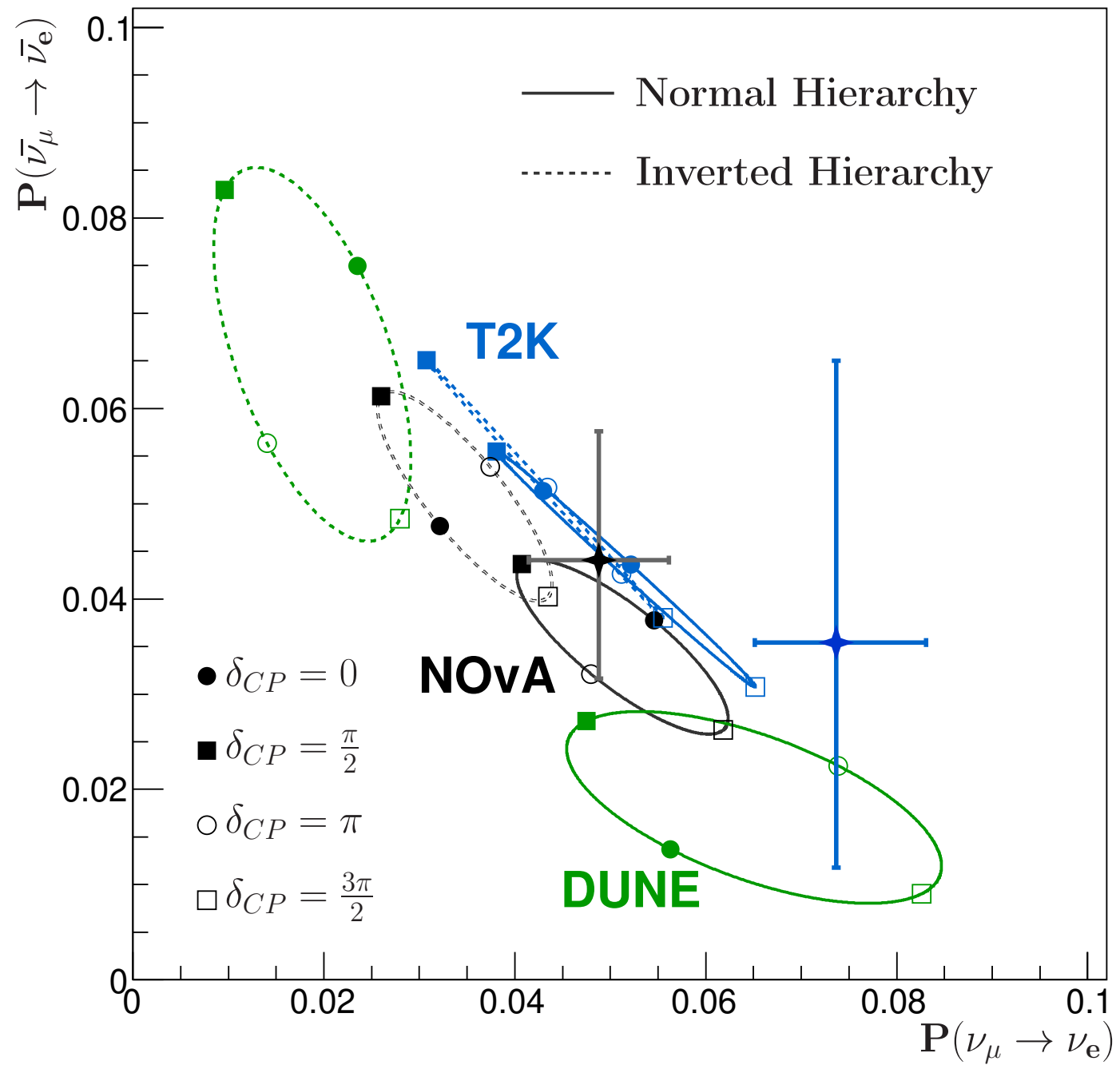


$P(\bar{\nu}_{\mu} \rightarrow \bar{\nu}_e)$ and A_{CP} measurement

Liudmila Kolupaeva

Motivation



Super rough plot

And T2K has stated making these plots!

Intro

CP asymmetry calculation through oscillation probability measurements:

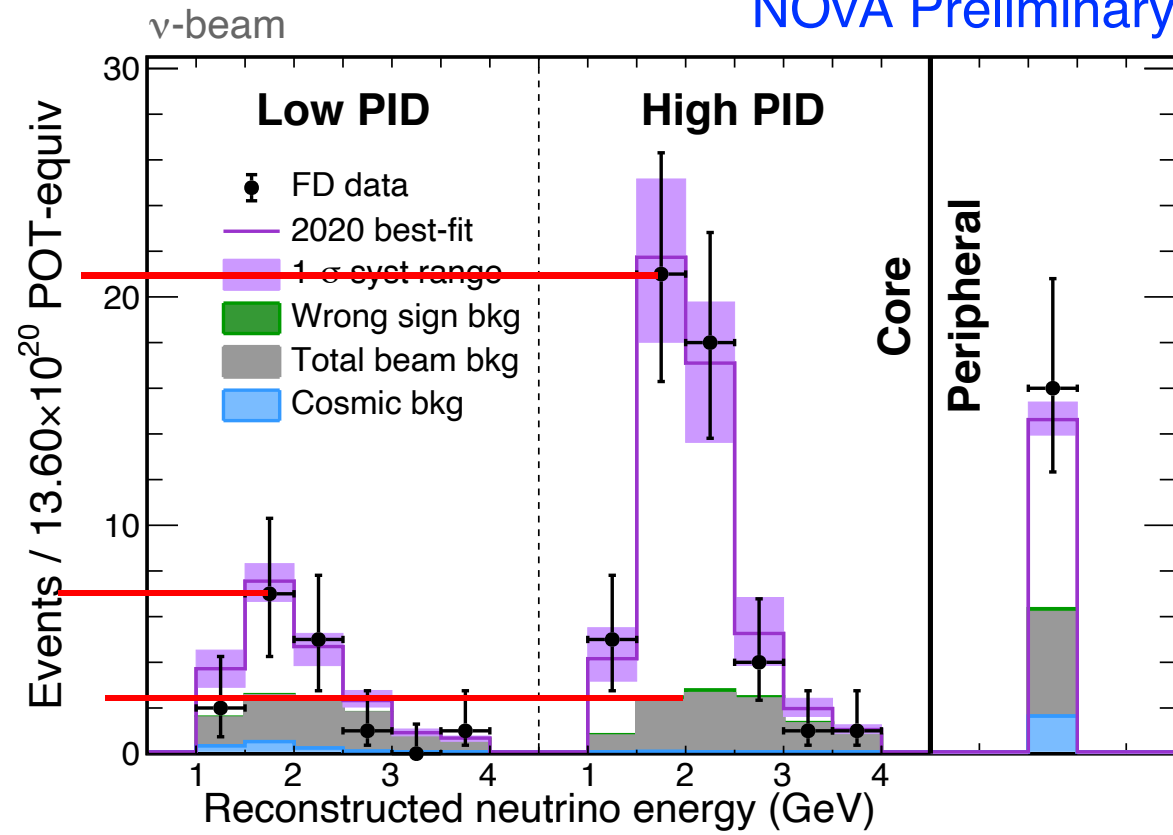
- * oscillation probability = (data - predicted bkg at best fit) / (signal prediction with $P = 1$);
- * wrong sign component is treated as bkg;
- * "Signal prediction with $P = 1$ " is collapsed 2D trueE-recoE histogram from PredictionExtrap (FD extrapolated MC prediction) that is used for the actual predictions for the analysis;
- * do this for FHC and RHC data and calculate for each data bin:

$$\frac{P(\nu_\mu \rightarrow \nu_e) - P(\bar{\nu}_\mu \rightarrow \bar{\nu}_e)}{P(\nu_\mu \rightarrow \nu_e) + P(\bar{\nu}_\mu \rightarrow \bar{\nu}_e)}$$

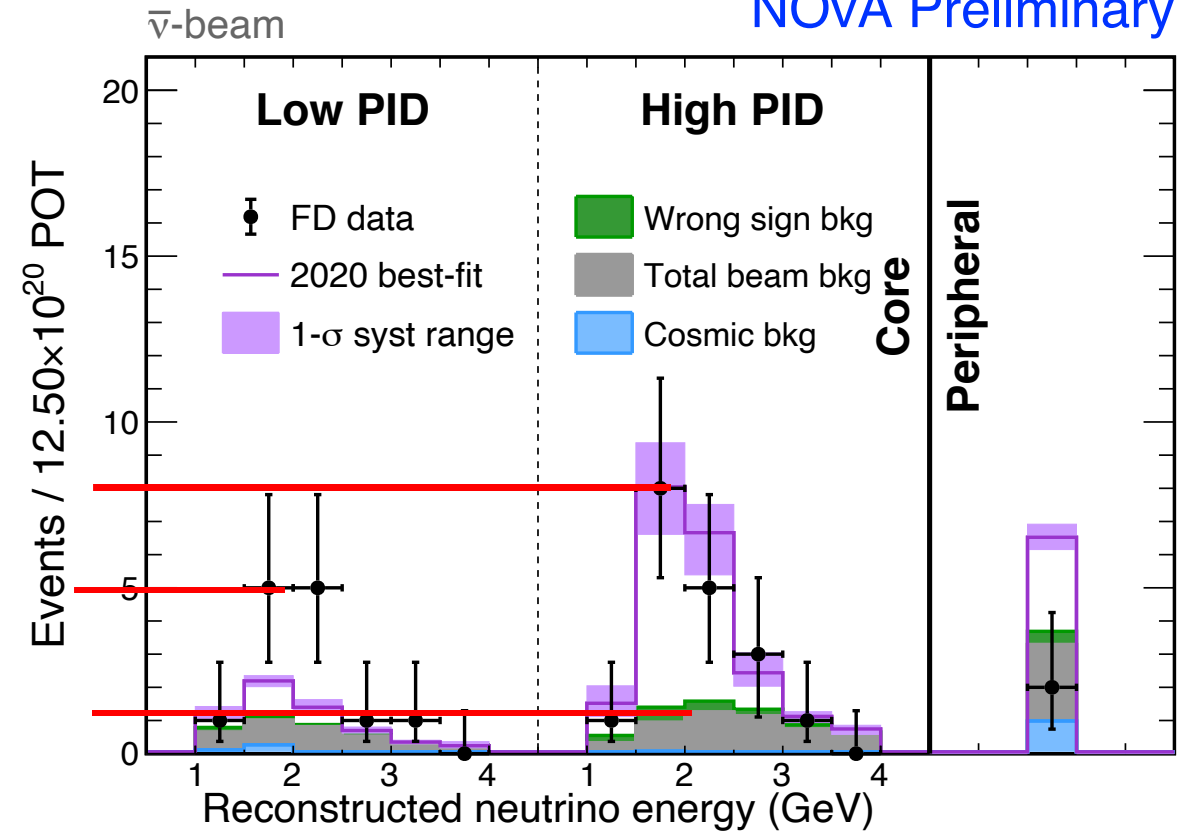
For all inputs and studies, official 2020 predictions were used.

Numerator input

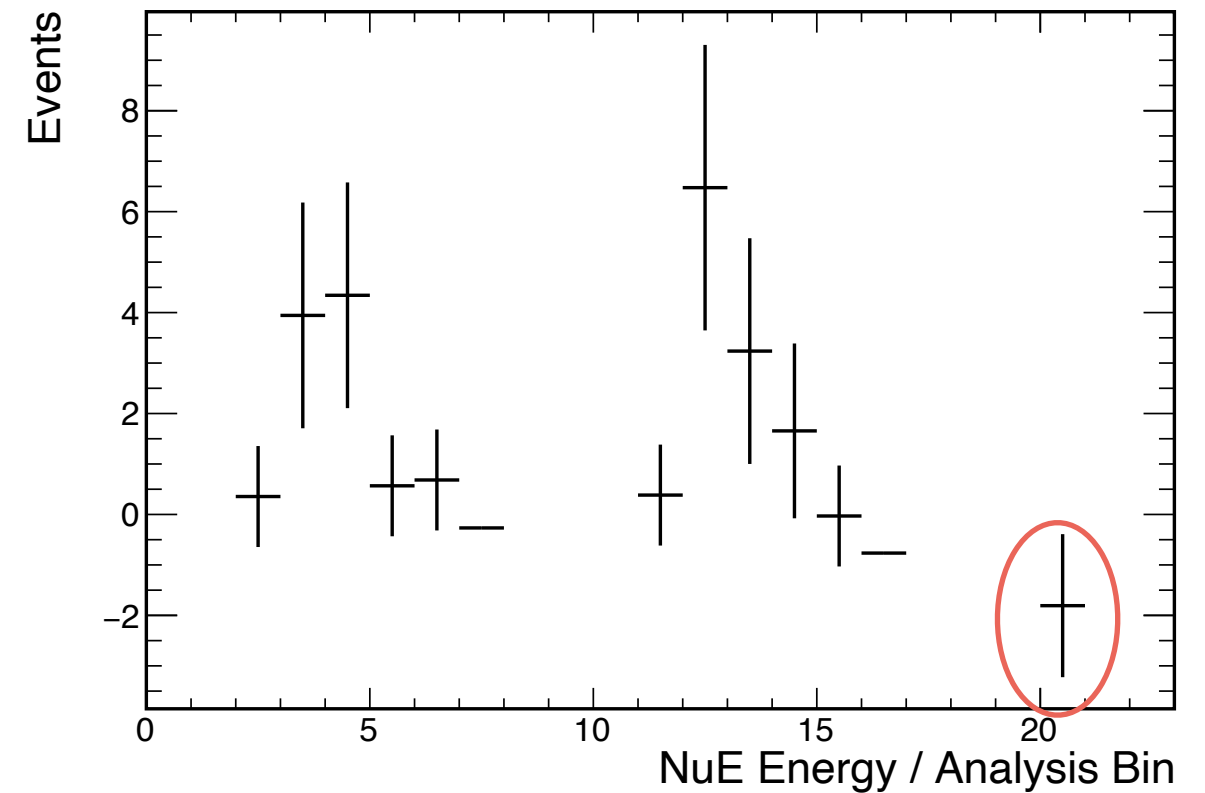
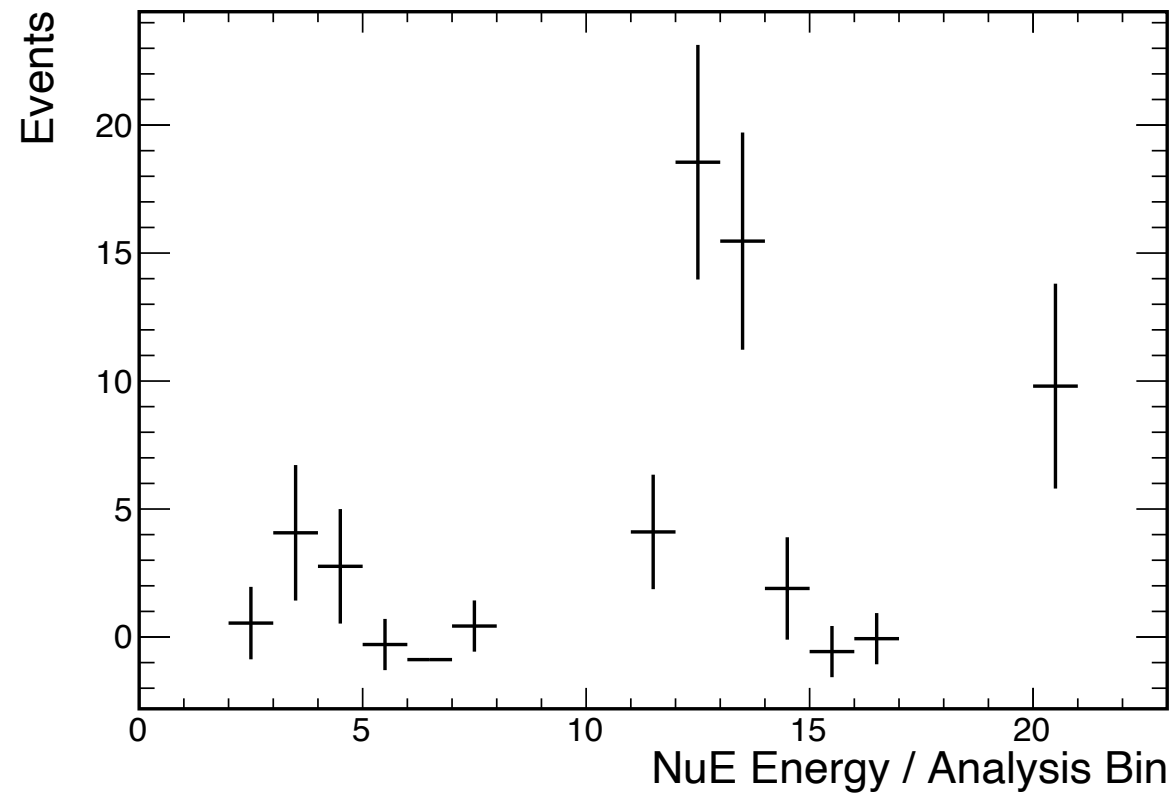
NOvA Preliminary



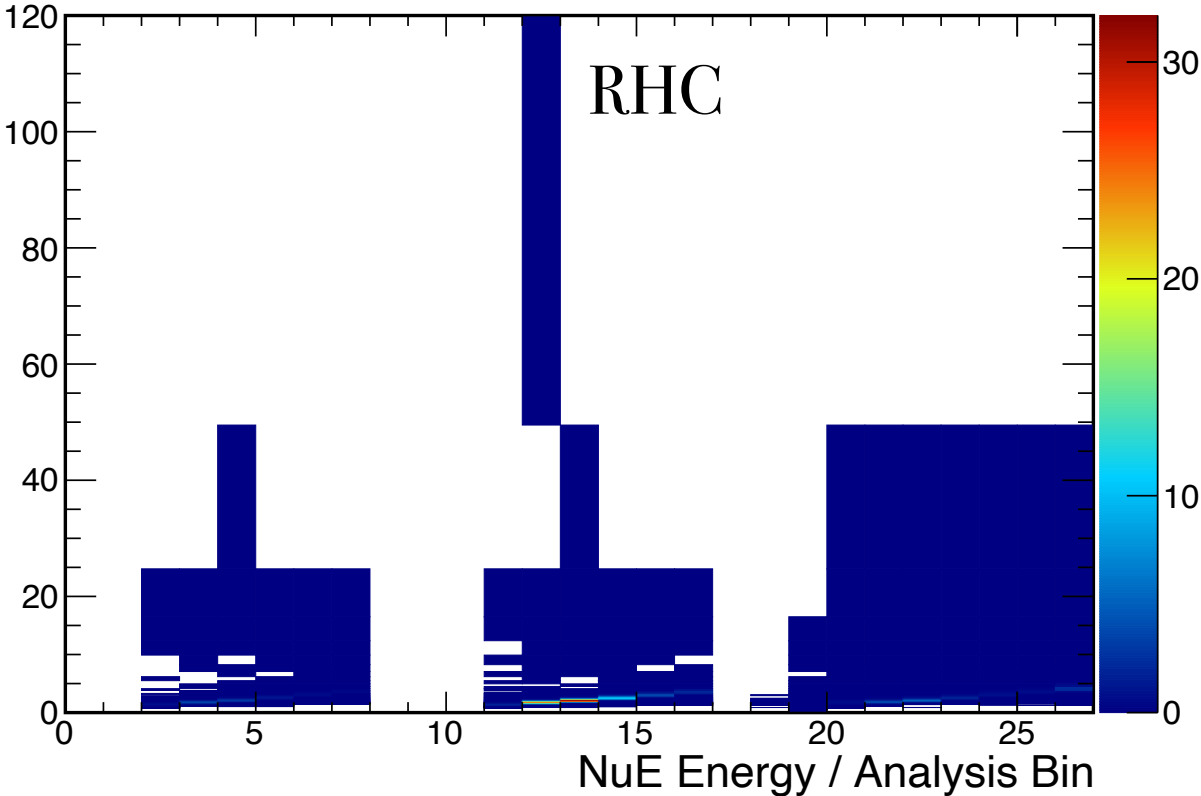
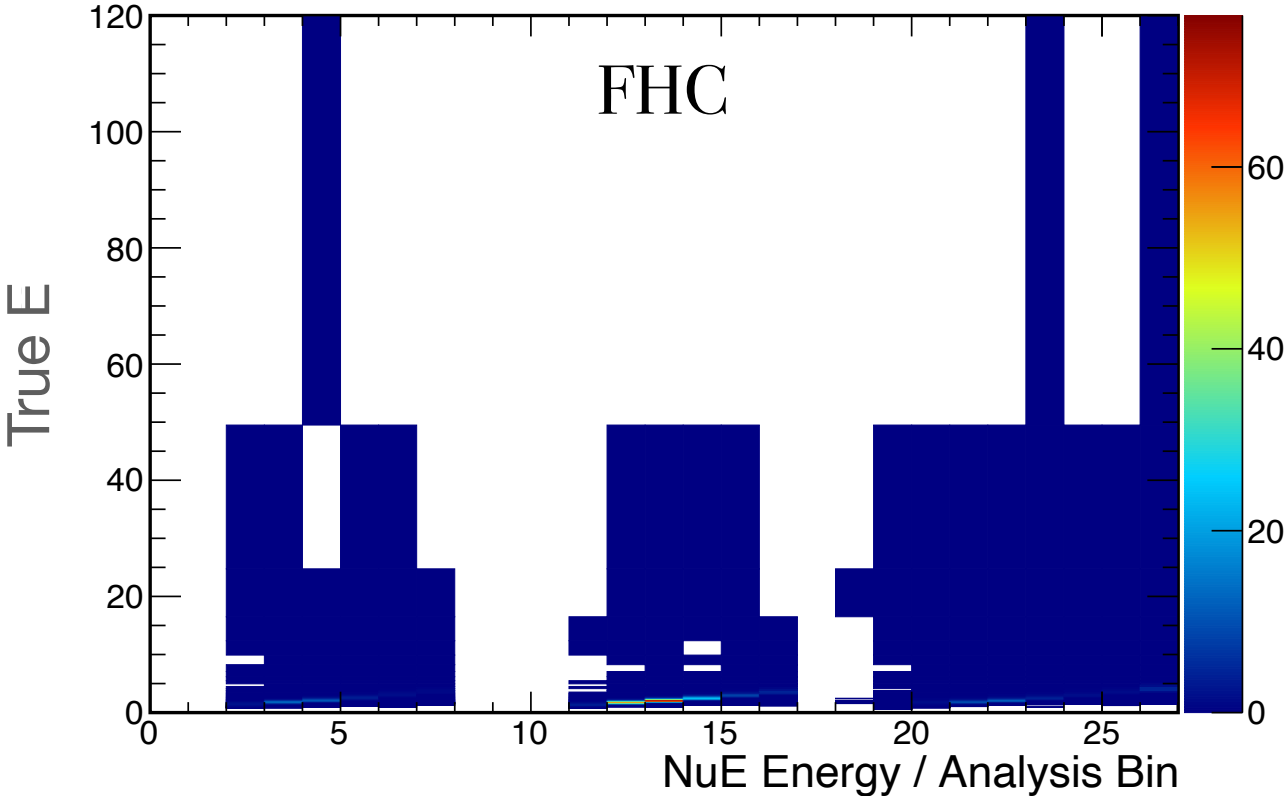
NOvA Preliminary



Measured real data "signal"

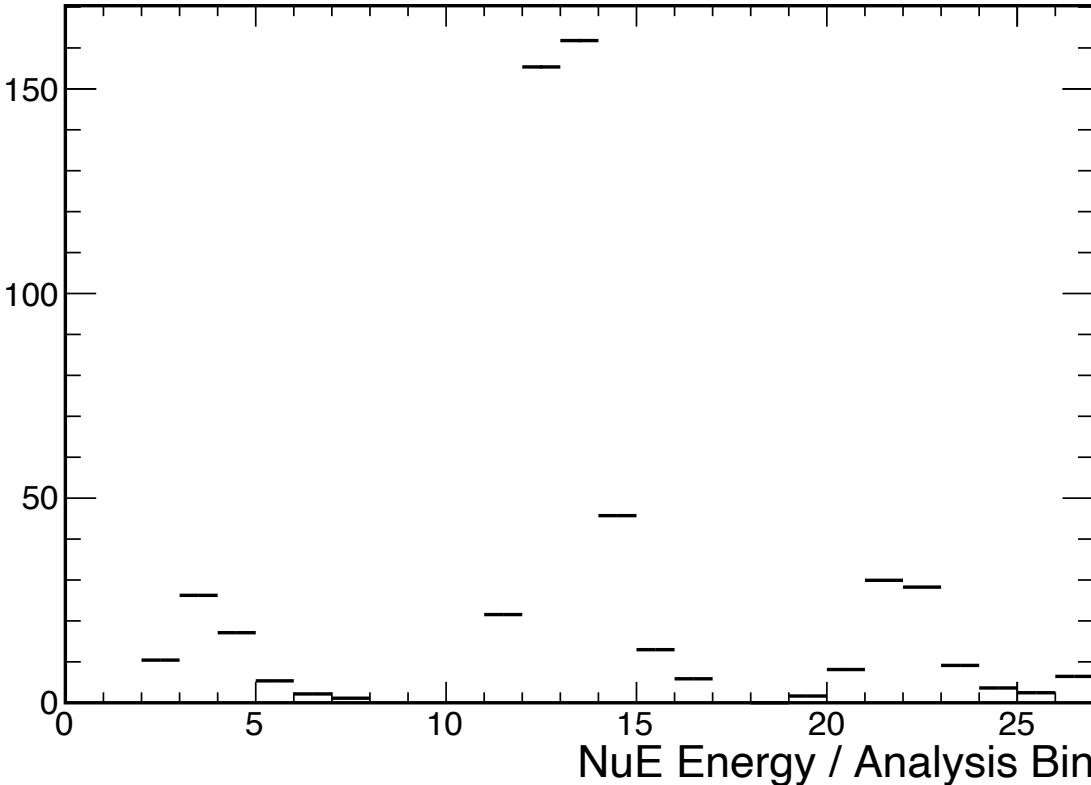
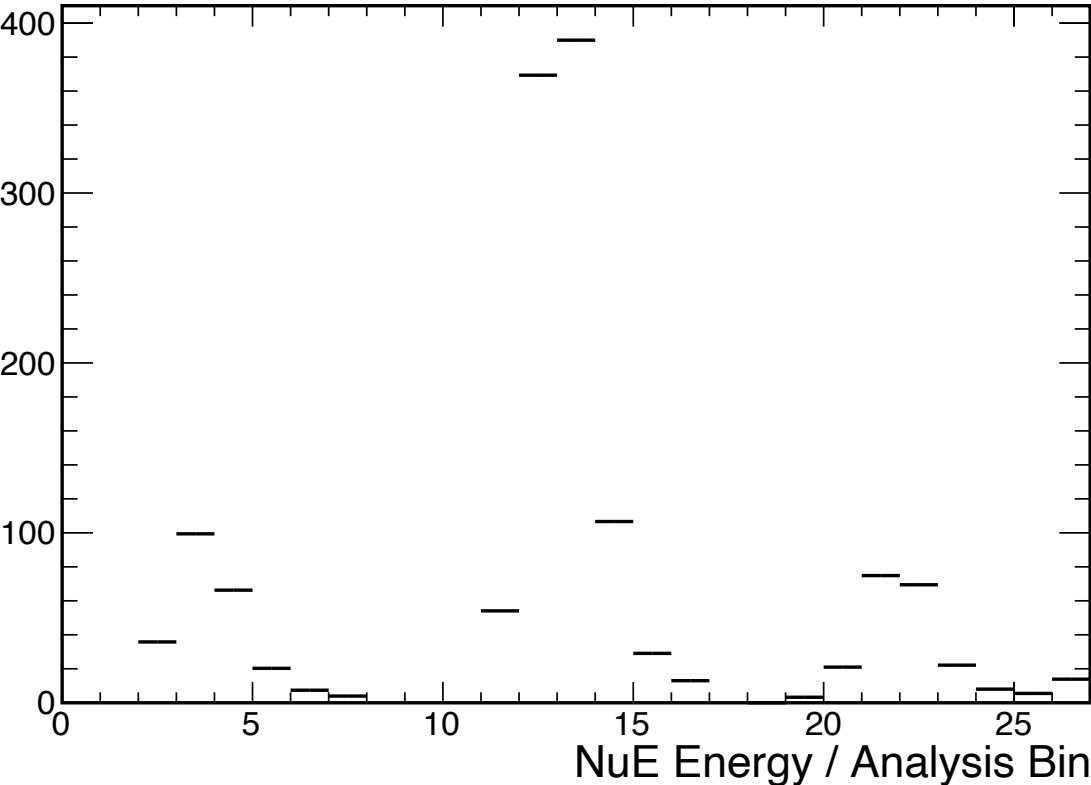


Denominator input



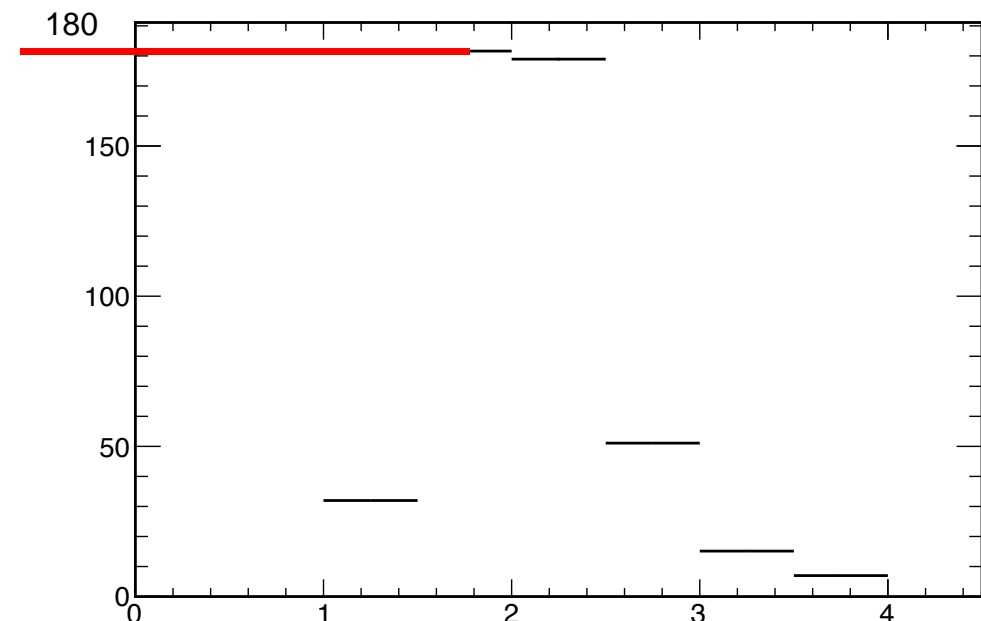
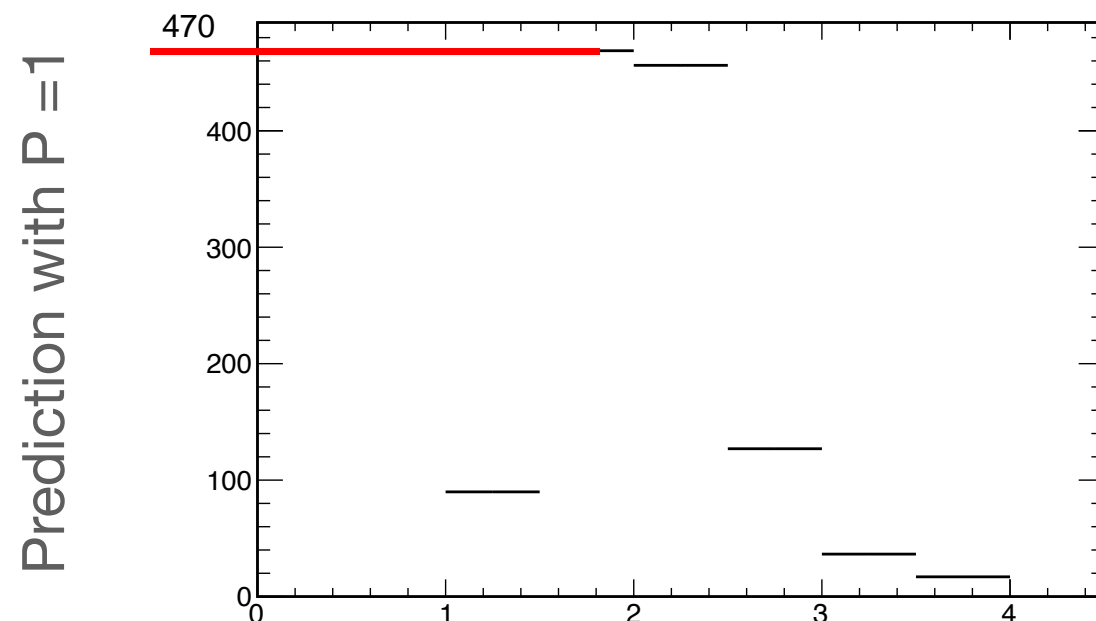
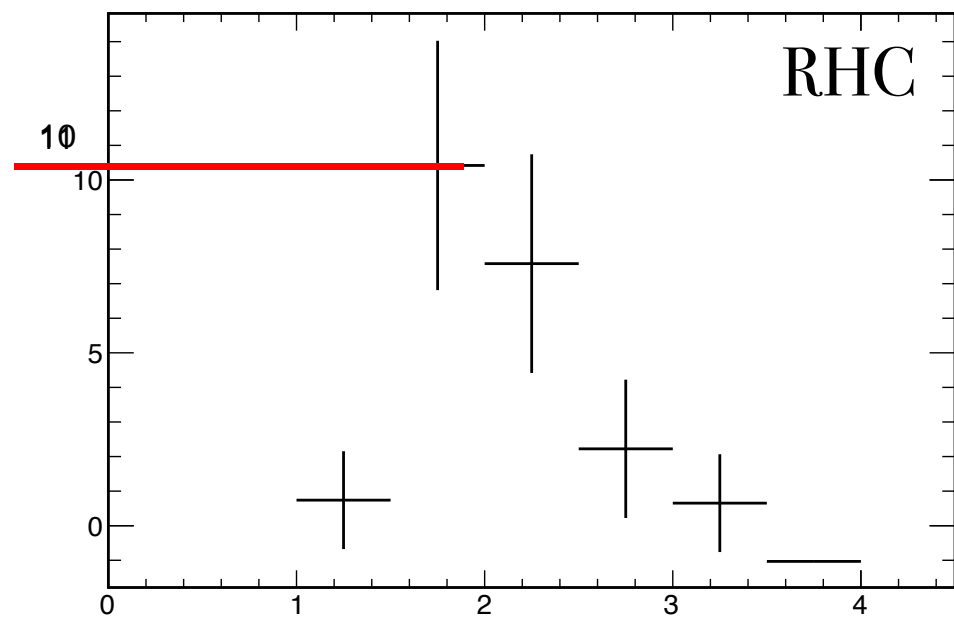
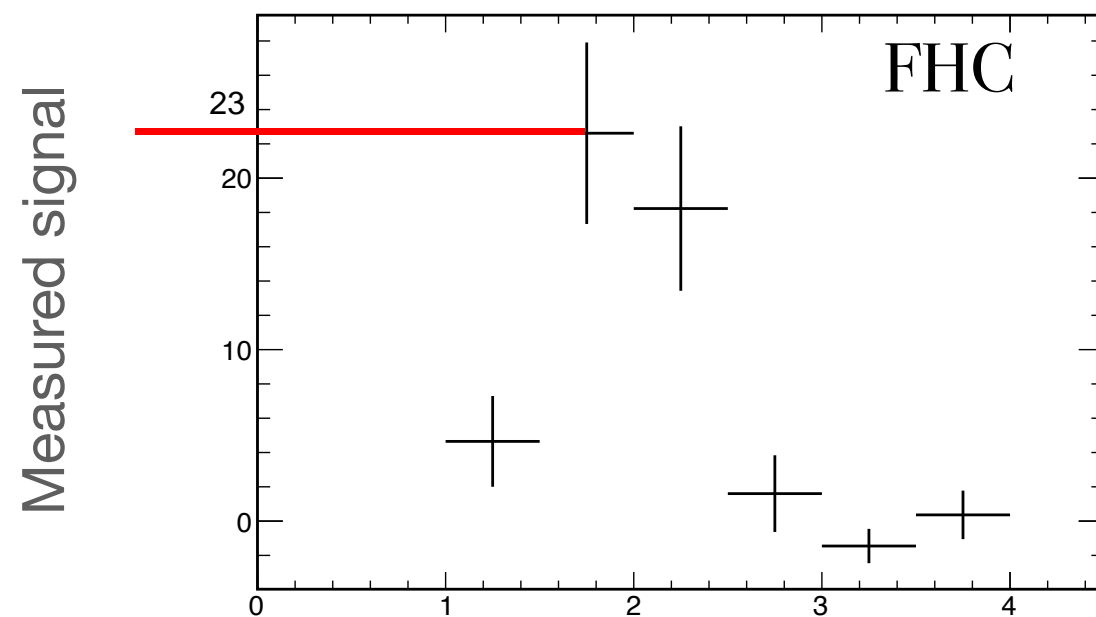
Reco E

Projection on X-axis

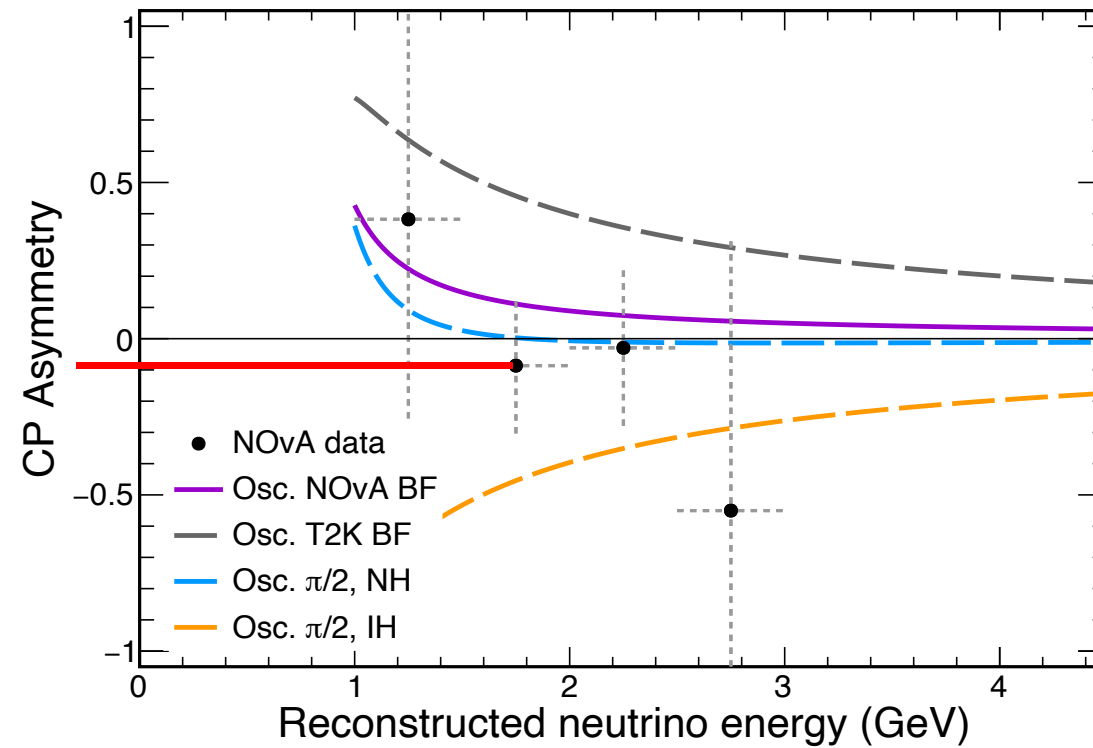
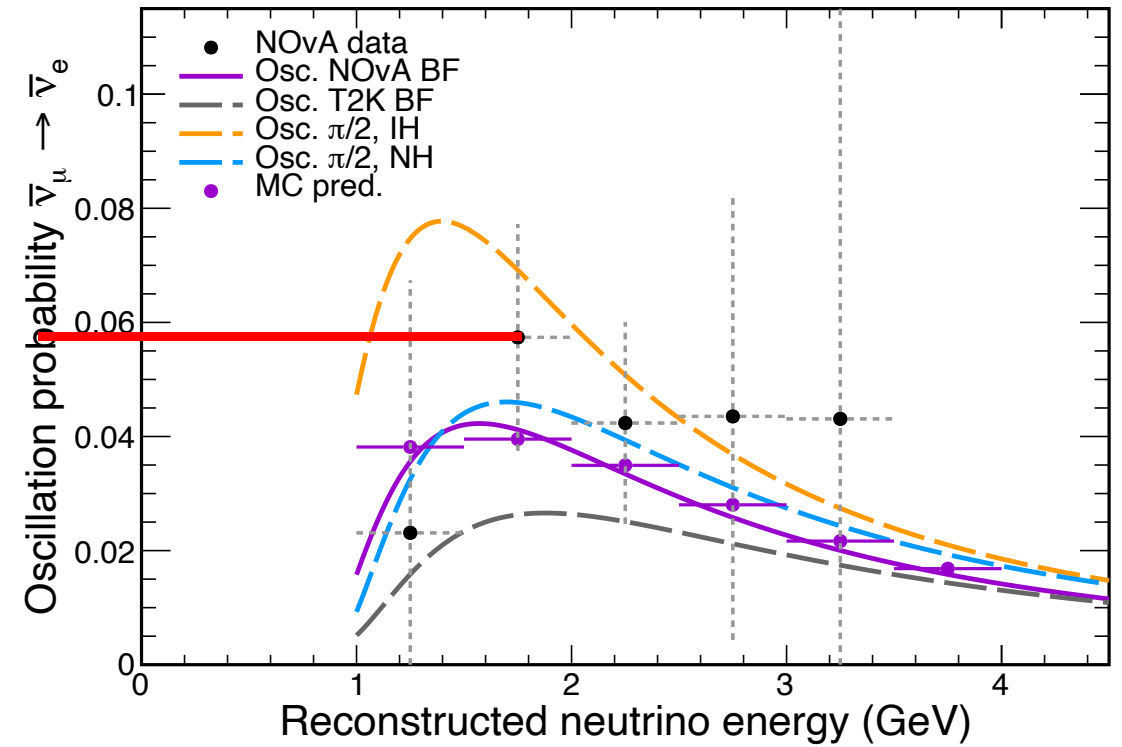
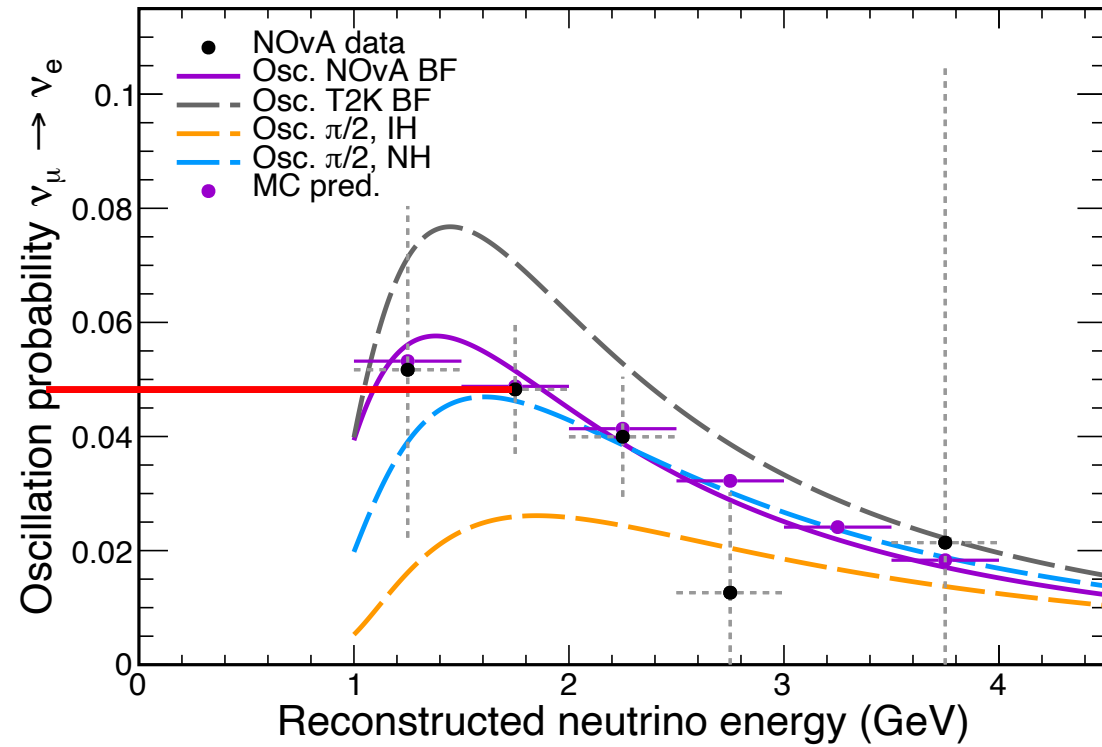


But!

- * Stat. fluctuations are still significant in data.
- * It was decided to make Prob. and A_{CP} plots with RecoE axis w/o split into Low and High CVN bins and drop Peripheral bin for a while (see the version of all plots with initial axis in docdb 49782).



Resulted central values for osc. probabilities and A_{CP}



No error bars yet

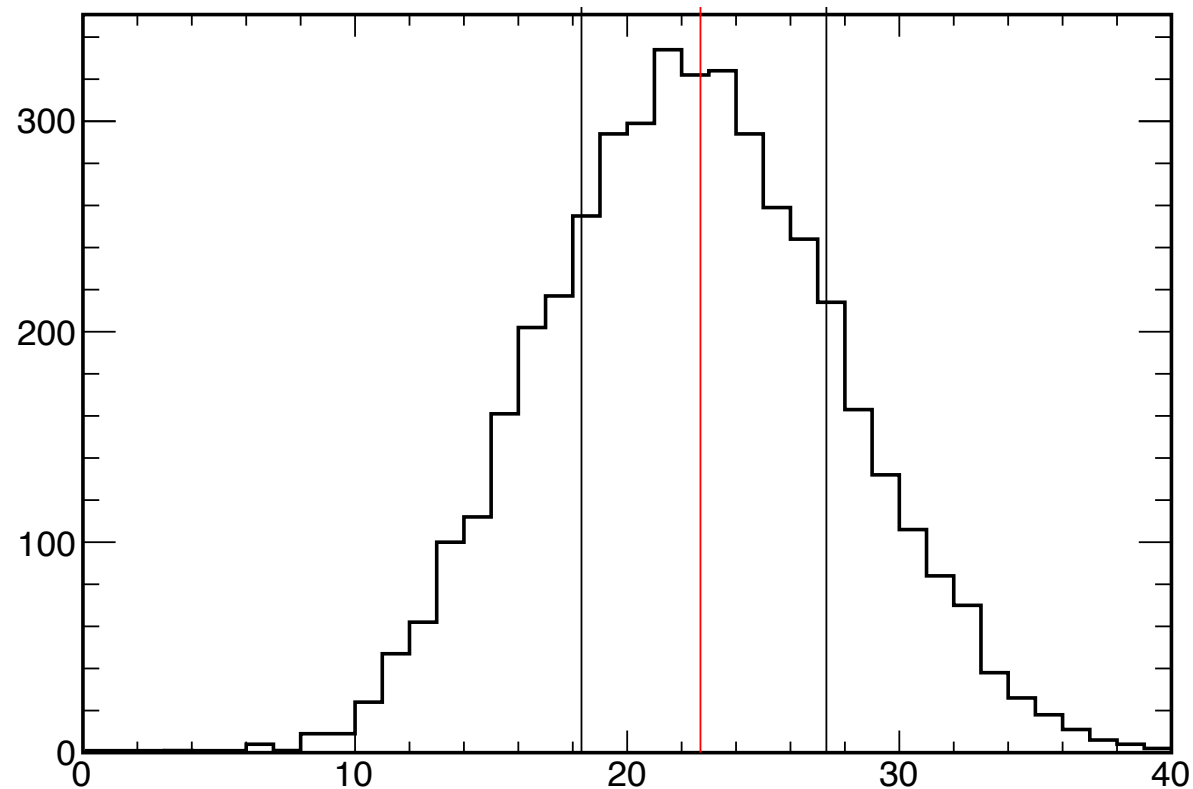
Error bar calculations

NB! Starting here no real FD data were used.

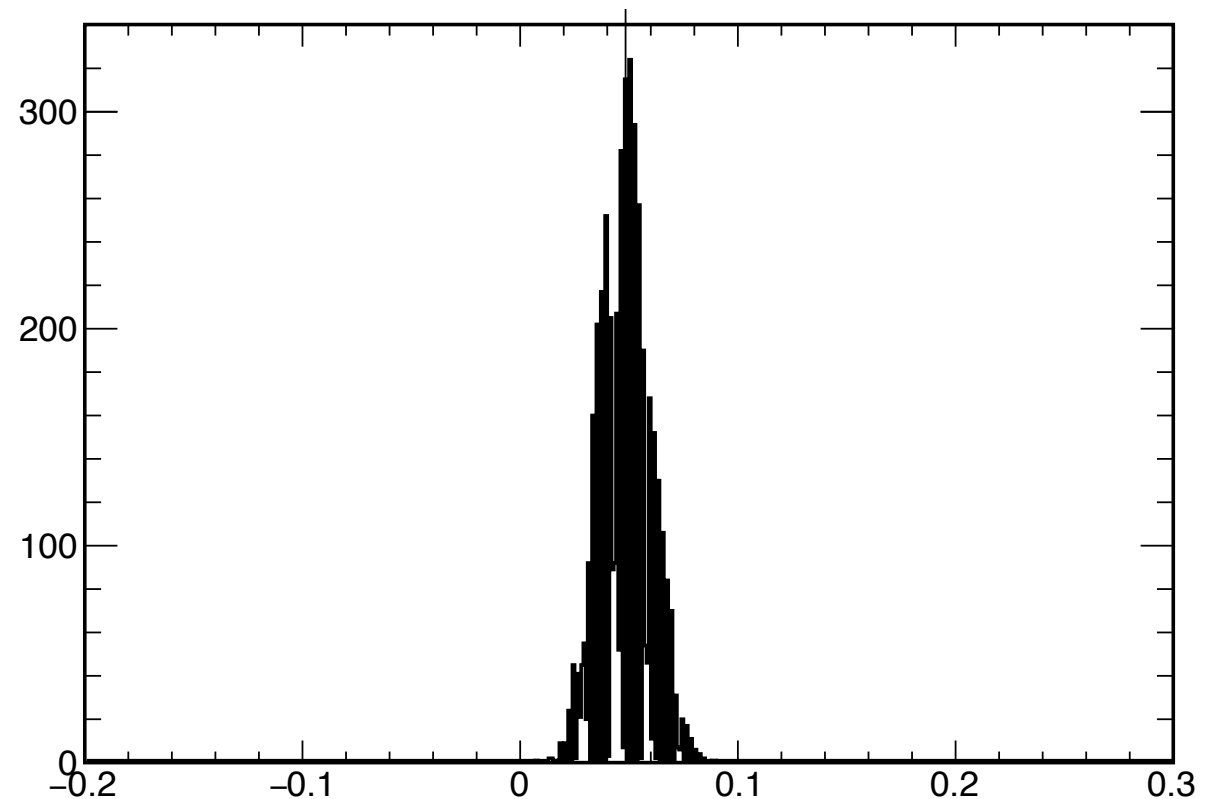
- * It was decided to use Poisson fluctuations and assign the region with 68% of experiments to the error bar.
- * Each pseudo-experiment goes through the same chain as it was described in the previous section. For bkg. calculation each experiment is fitted.
- * In total there are 5'000 pseudo-experiments.

Example for the bin 1.5-2.0 GeV

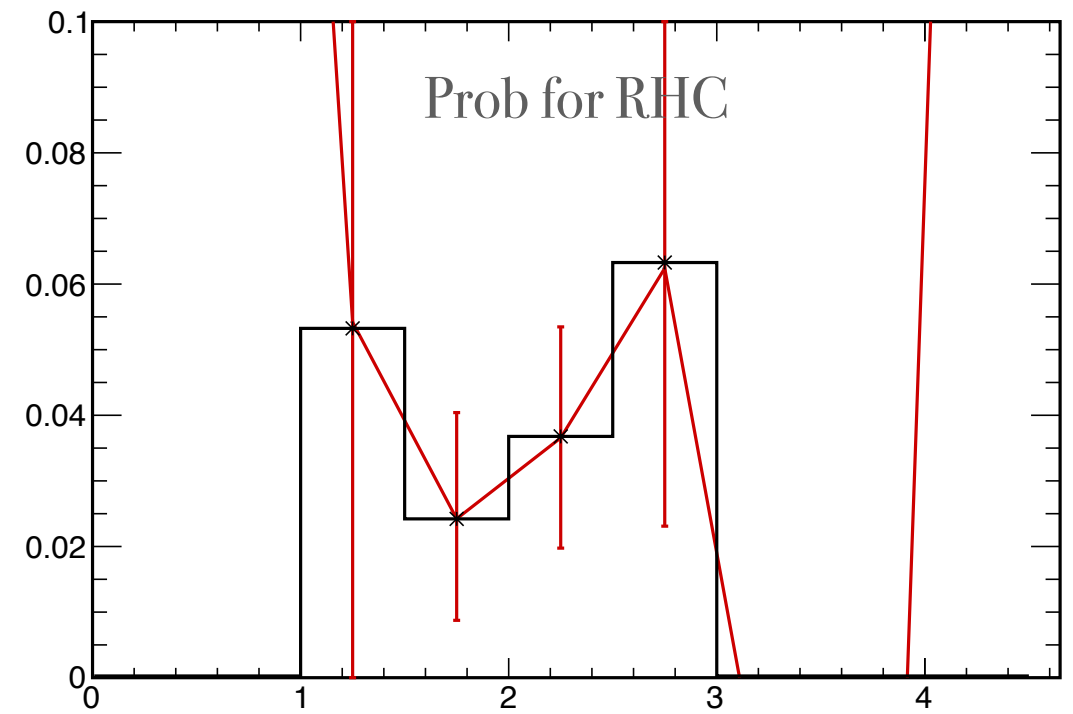
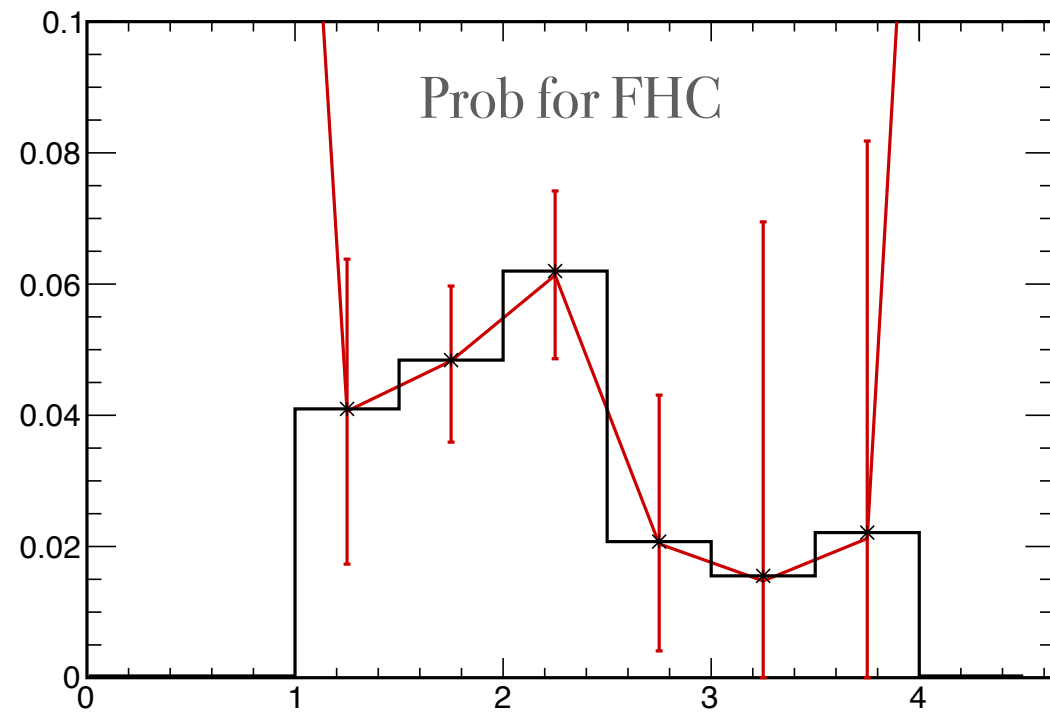
Extracted signal



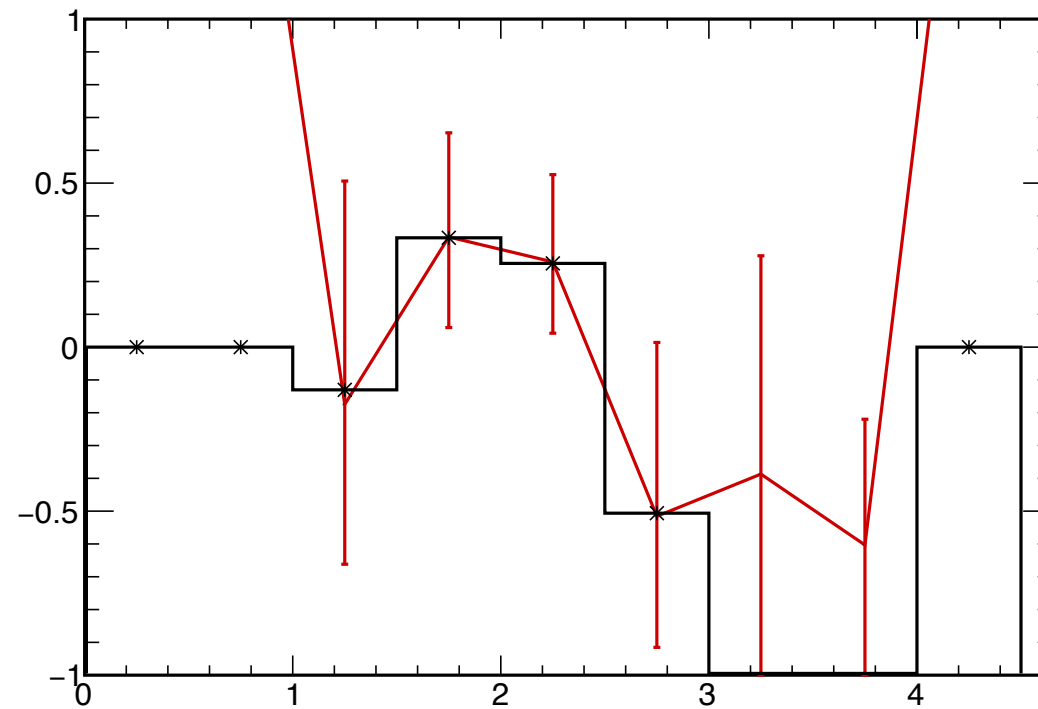
Oscillation probabilities



Resulted statistical error bars for new "data"



A_{CP}



Taking into account the systematics

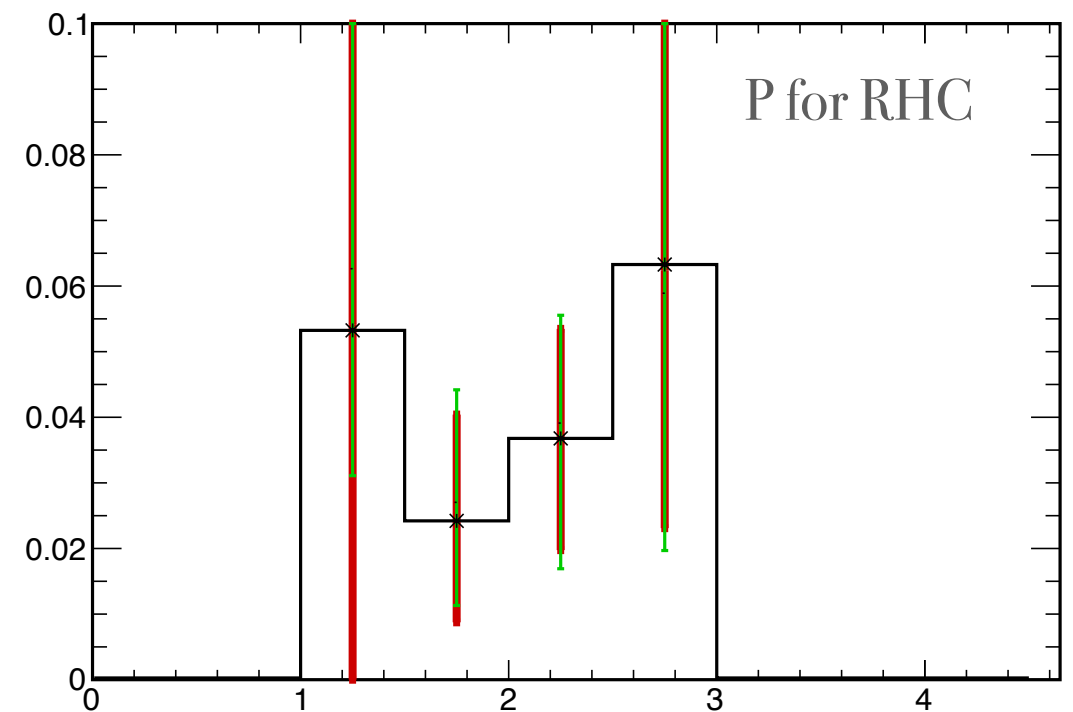
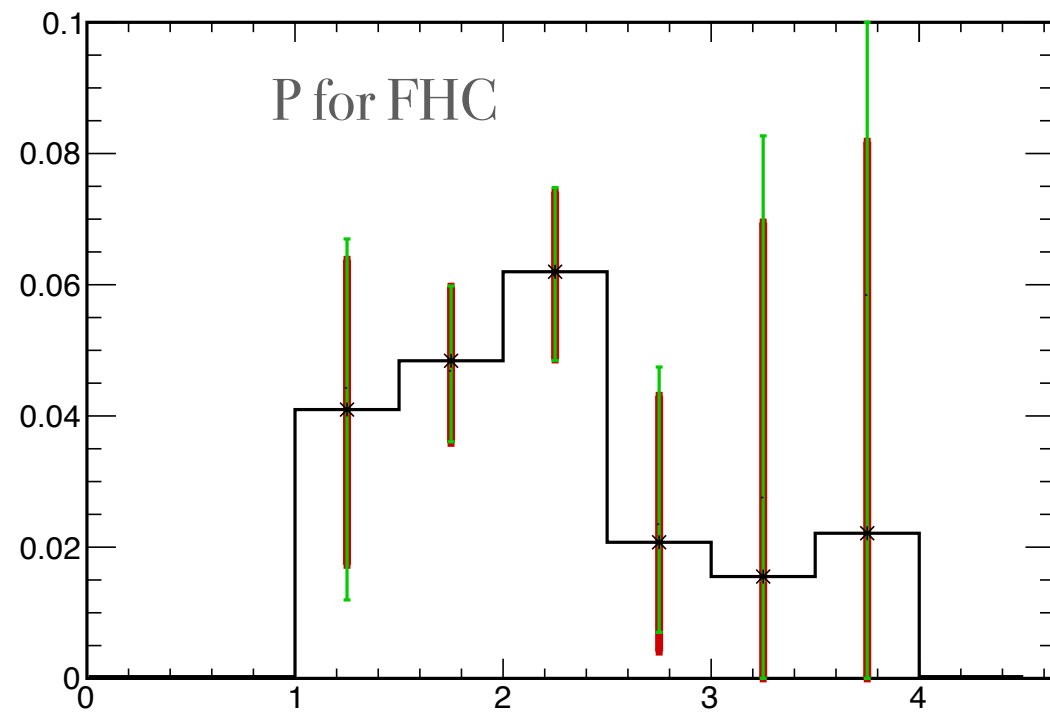
In order to take into account also the systematic effect, the following procedure is proposed.

During the background calculation step for each pseudo-experiment:

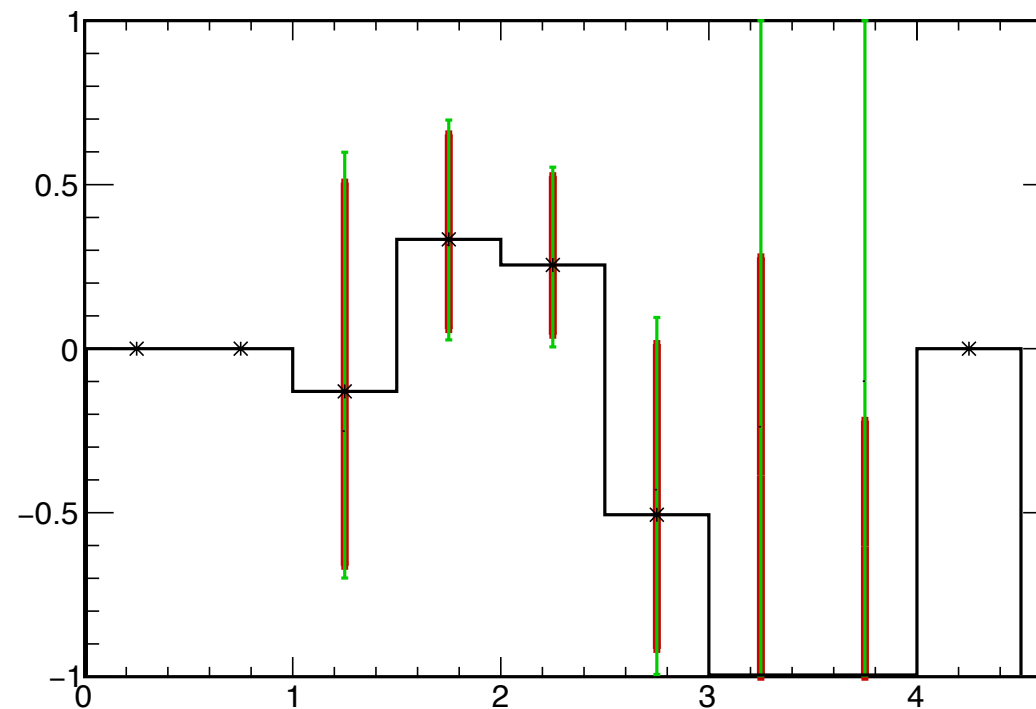
- * oscillation parameters were played with gaussian 1σ taken as error size in 2020 (3% for Δm_{32}^2 and 7% for θ_{23} , for $\delta_{CP} \pm \pi$ range was used);
 - * total systematic error for the background was taken as 6% for FHC and RHC, the scaling factor for histogram was played around 1 with this value as 1σ error;
 - * after all these changes Poisson fluctuations were applied to the total background histogram.
- Modified bkg is subtracted from the pseudo-experiment spectra.

See the result of these changes on the next slide.

Resulted error bars for new "data": statistics and systematics.

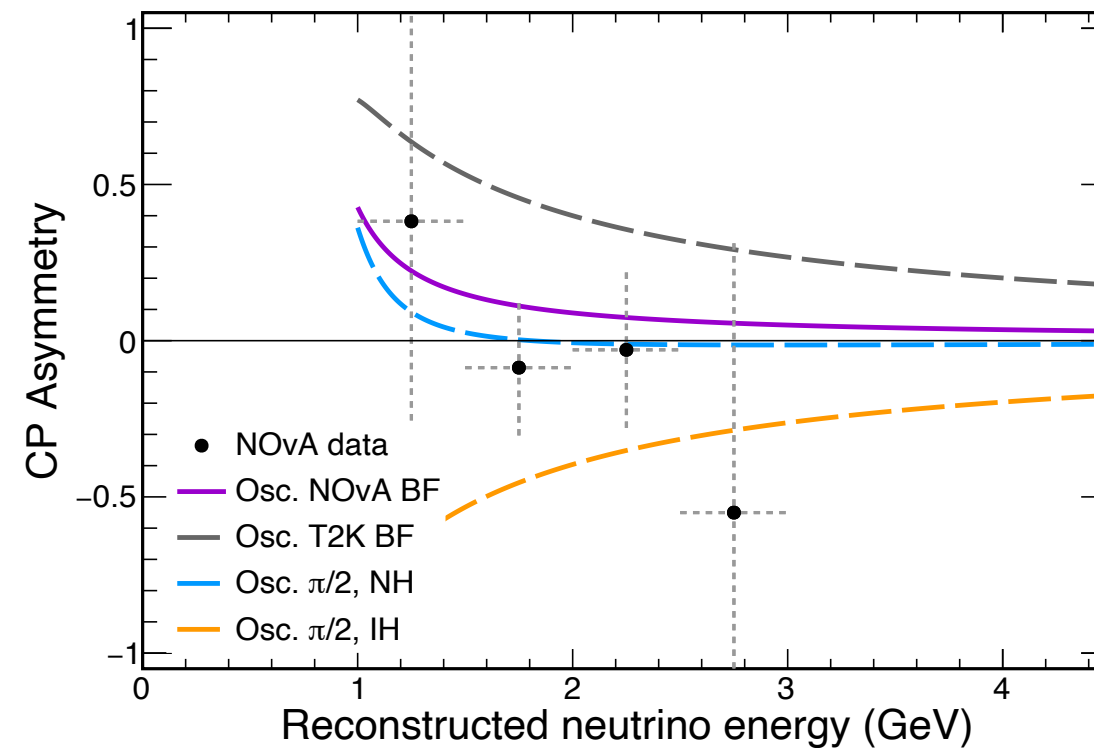
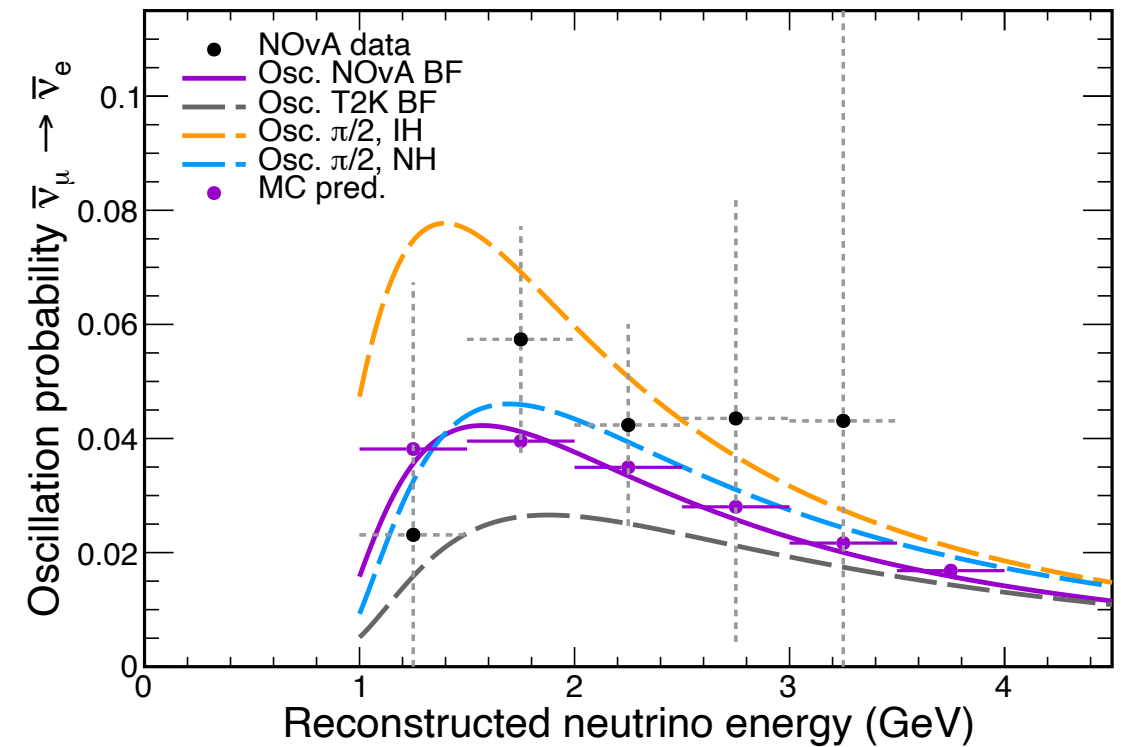
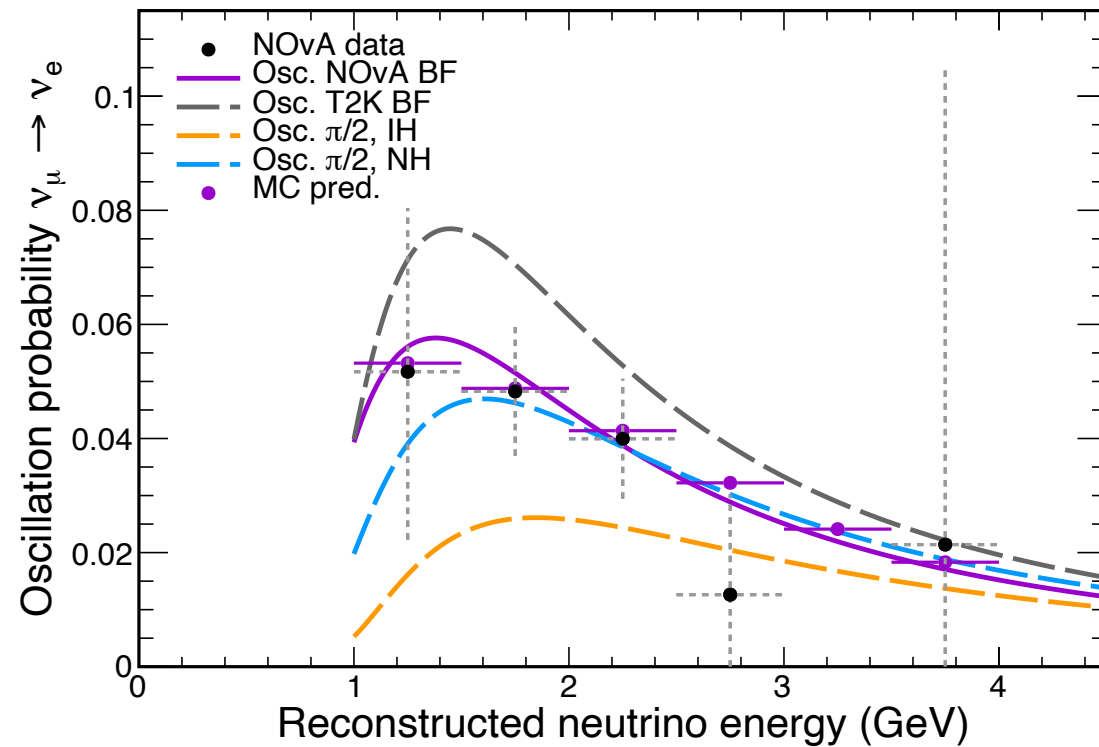


A_{CP}



Red: statistics
Green: + systematics

I'm asking for permission to produce error bars with real data to complete these plots



... and make blessed plots