Cross Section for LBL

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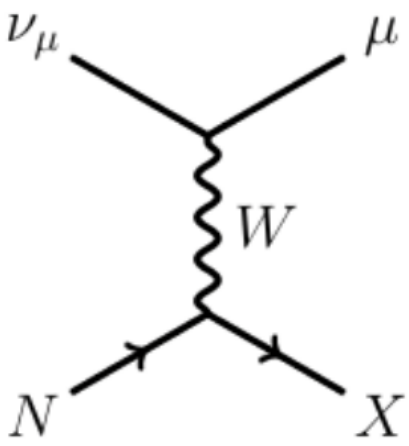
Summary

- Experimental definition: $$\sigma_\alpha = \frac{\sum_j U_{j\alpha}(N_{data,j} - N^{bkgd}_{data,j})}{A_\alpha \phi_\alpha T}$$

- **j**: index of a reconstructed E_ν bin
- **$U_{j\alpha}$**: function that accounts for unfolding from reconsructed bin j to true bin α
- **$N_{data,j}$** : number of selected events
- **$N_{data,j}^{bkgd}$** : estimated number of background events
- **A_α**: efficiency for reconstructing signal events
- **T**: number of target nucleons
- **φ_α**: flux in bin α

Summary

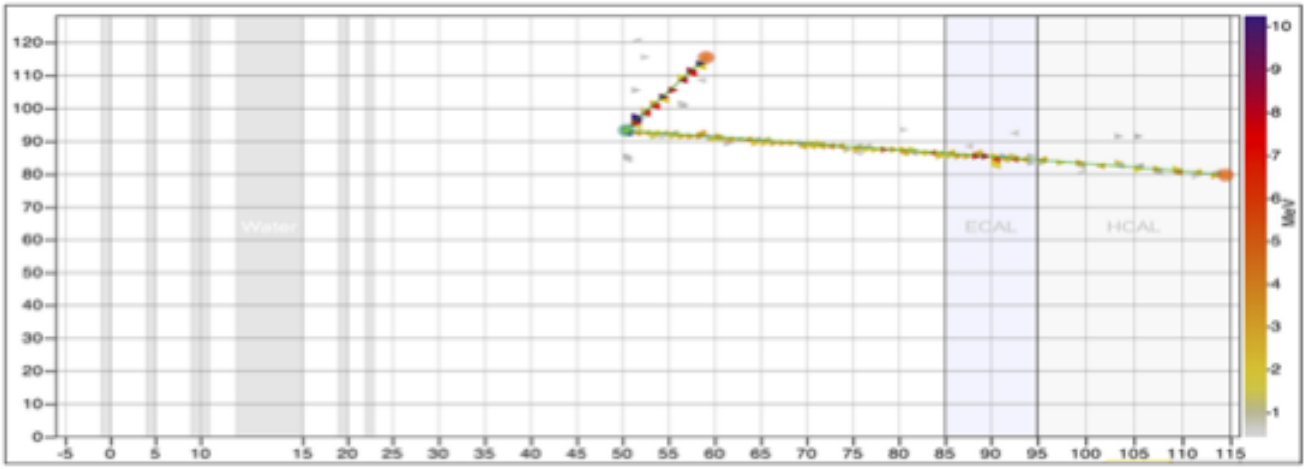
- This calculation was performed on a CC neutrino interaction
- This interaction has a charged lepton in the final state
- For ν_μ scattering -> μ^- in the final state



Summary

- Background:
  - NC events
  - wrong sign events (antineutrinos)
- 3 dominant interaction channels for ν-A scattering:
  - QuasiElastic scattering
  - Resonance production
  - Deep Inelastic Scattering

Event Display of CCQE Event

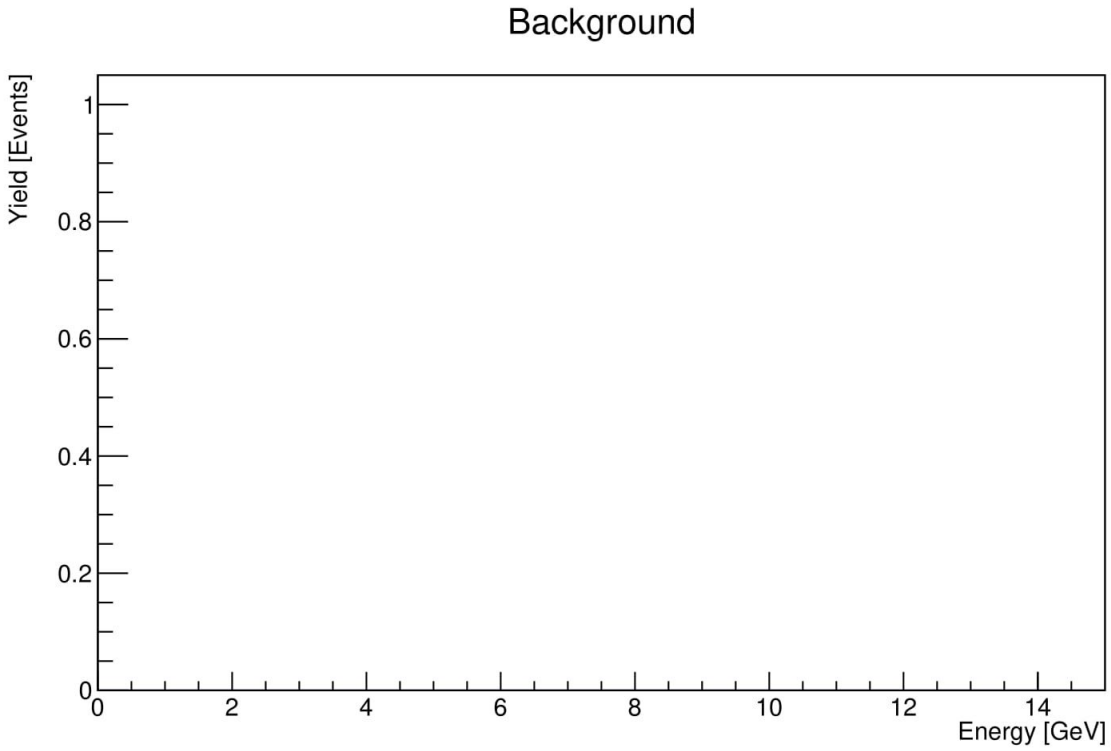


Event Selection

- We selected events for the muon neutrino CC interaction.
- Cuts used in the analyses.
  - Events with right helicity
  - Events with fiducial vertex, plausible energy and matched to MINOS
  - Events that can’t be reconstructed due to dead time
  - Events with $E_\nu < 22$ GeV

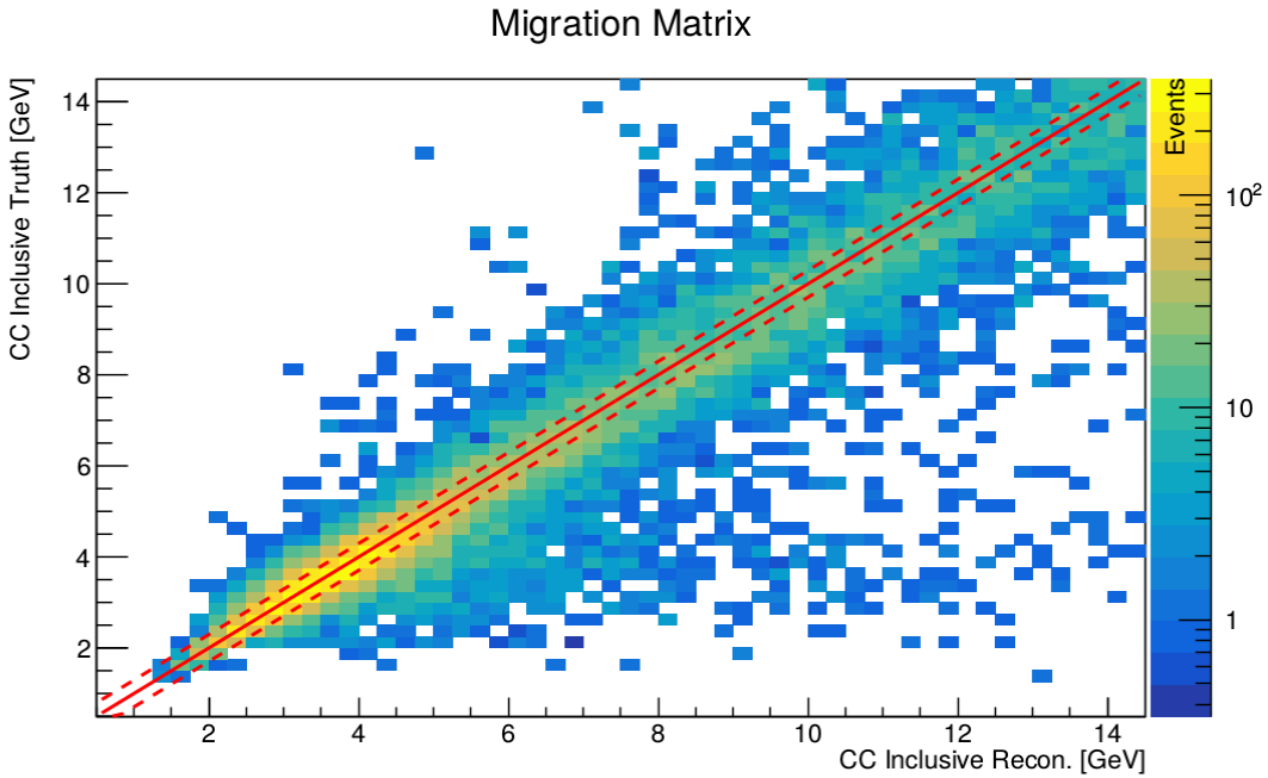
Background Subtraction

- Background prediction from GENIE simulation.



Migration matrix

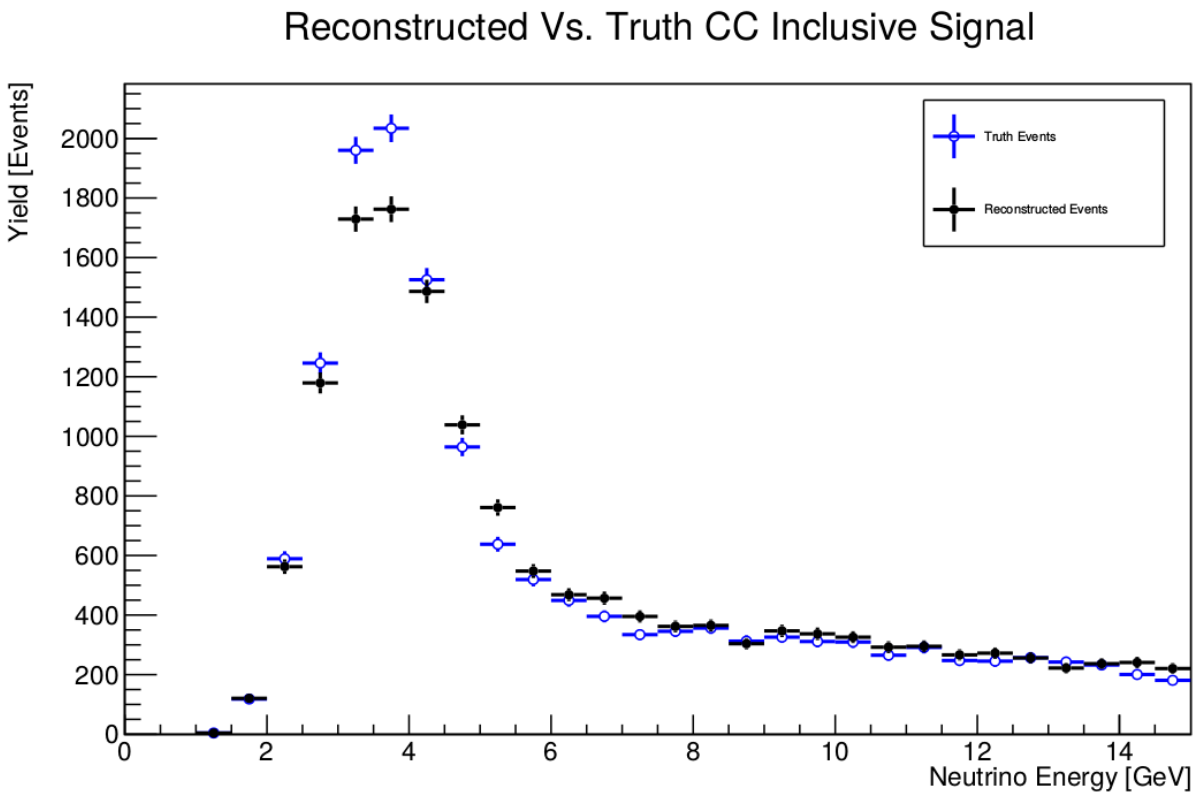
- 2D histogram:
  - x axis: reconstructed neutrino energy
  - y axis: true neutrino energy



Unfolding

- Remove the known effects of measurement resolutions, systematic biases, and detection efficiency to determine the "true" distribution.

- We use the migration matrix (M_{ab}), the reconstructed energy (R_a), and the true neutrino energy (T_b).



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Efficiency & Flux

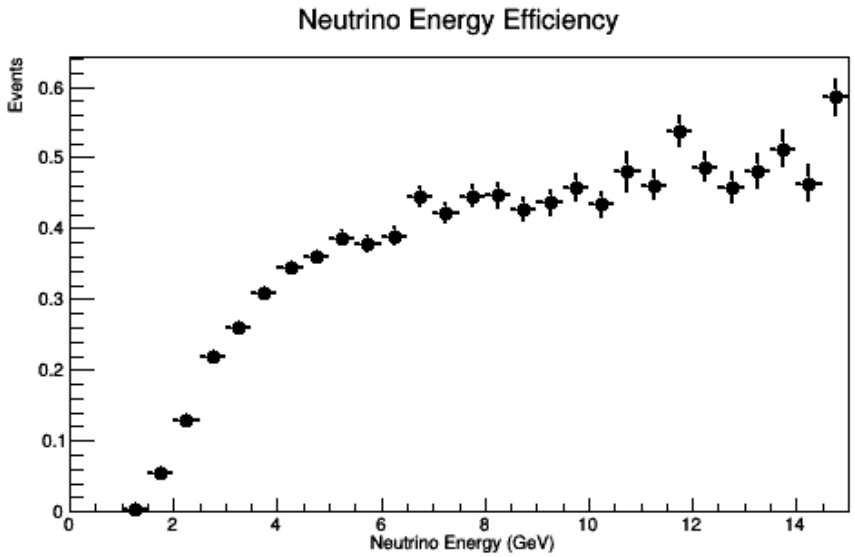
- Efficiency

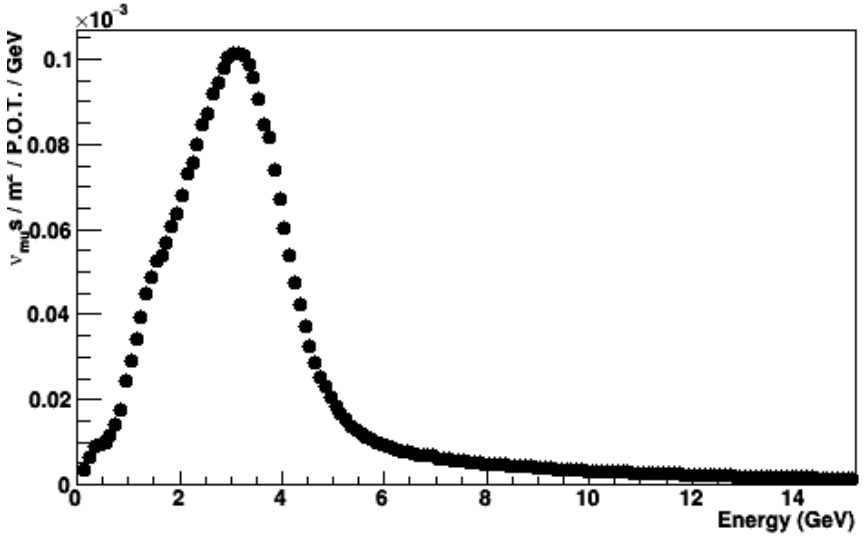
$$A_\alpha = Efficiency = \frac{N^{selected}_{CCInclusive,\alpha}}{N^{Total}_{CCInclusive,\alpha}}$$

Efficiency in each α-th neutrino energy bin

- Flux

We have to rebin the flux (Φ) to the neutrino energy bins and change the units





Target Normalization and Cross Section Calculation

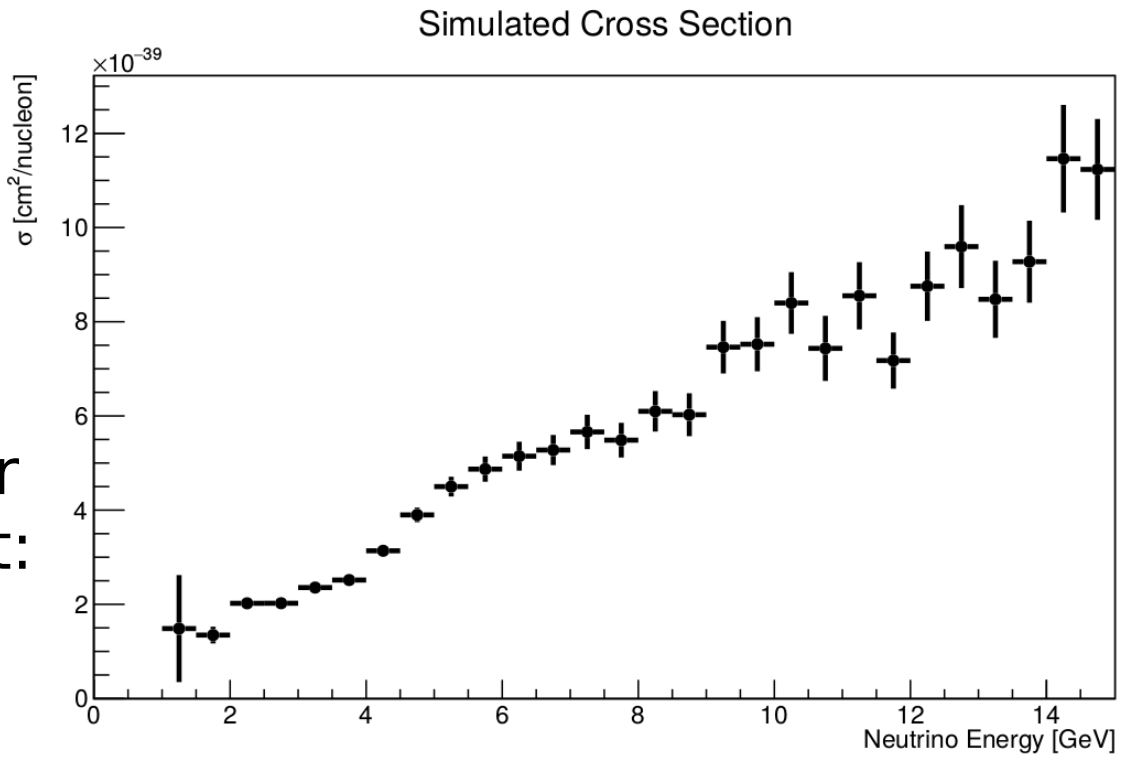
We divide the unfolded, efficiency corrected distribution with the number of targets in CC channel:

$$\sigma_\alpha = \frac{\sum_j U_{j\alpha}(N_{data,j} - N^{bkgd}_{data,j})}{A_\alpha \phi_\alpha T}$$

T=3.174846 10^{30}

The simulation was done with a number of protons on target:

N_{pot}=1.79 10^{19}



Thank you!!