Update on Slicing Methods for Pion Absorption and Charge Exchange - Thin Slice Method

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Thin slice method summary

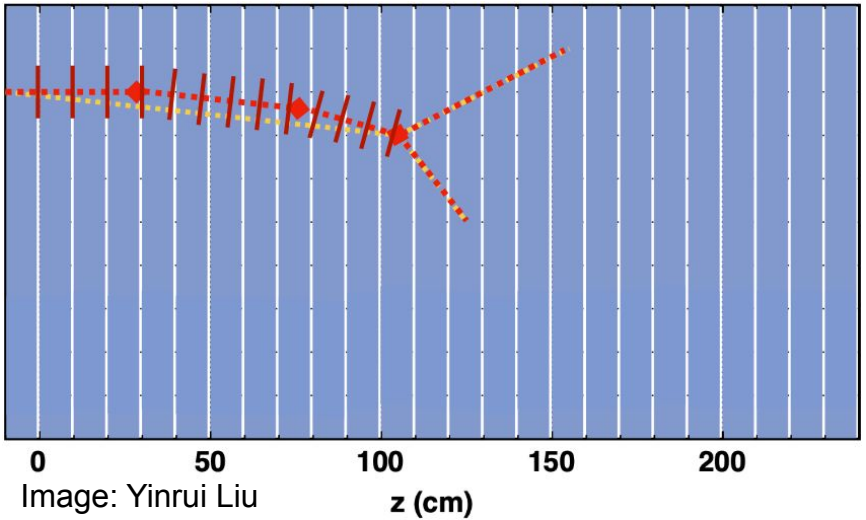


Image: Yinrui Liu

Group events into 10-cm spatial slices based on track length.

Cross section for the i-th slice is

$$\sigma(i) = \frac{M_{Ar}}{\rho t N_A} ln\left(\frac{N_{inc}(i)}{N_{inc}(i) - N_{int}(i)}\right)$$

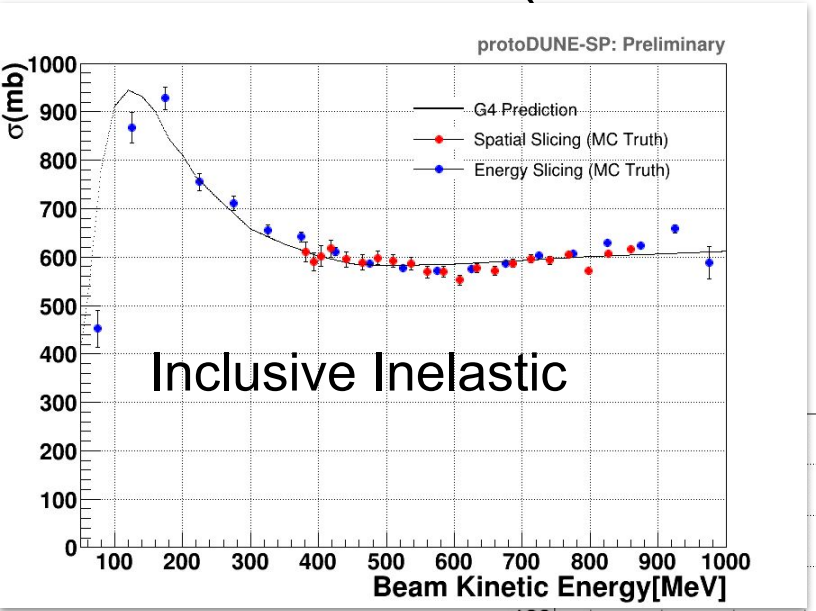
$N_{inc}(i)$: Number of beam particles incident on the i-th slice

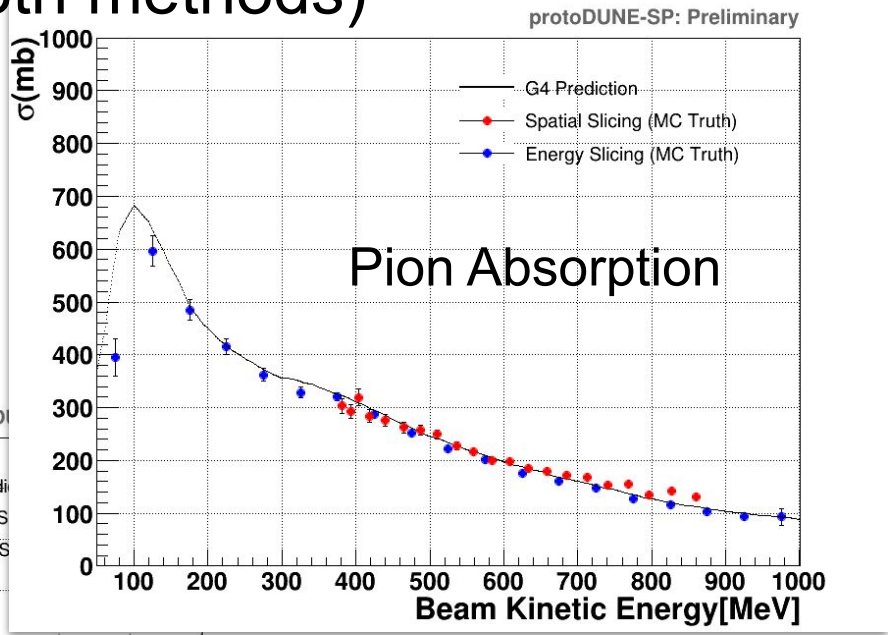
$N_{int}(i)$: Number of beam particles that interact in the i-th slice

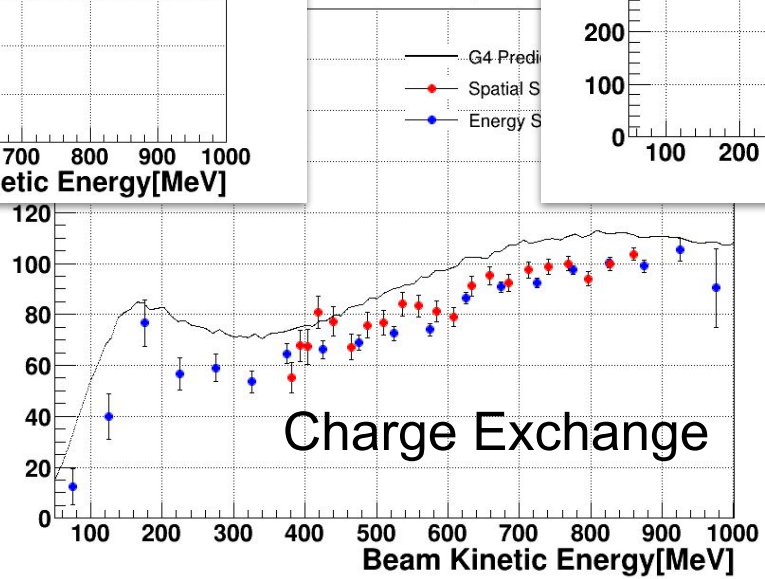
t: Slice thickness (10 cm.)

ϱ: Density of LAr

Previous results (MC Truth with both methods)







Discussion of the Energy Slicing Method can be found in my [presentation from last week]

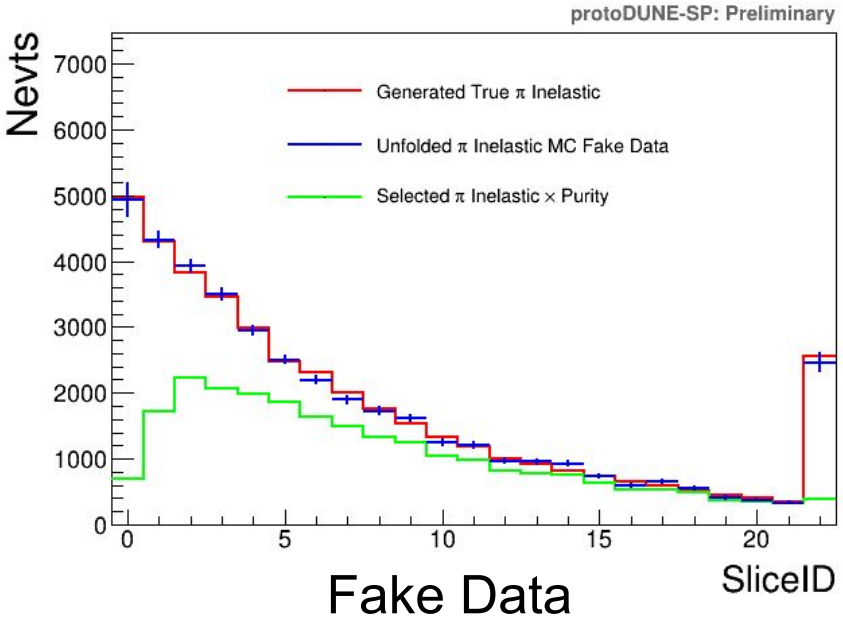
Unfolding

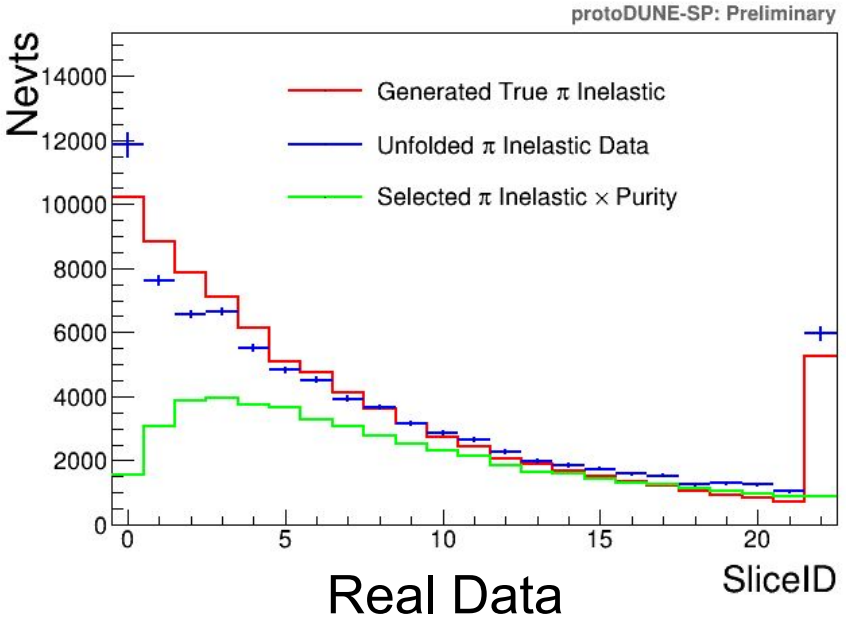
To arrive at cross sections for reconstructed MC and data, one must use an unfolding procedure. I use RooUnfold to create a response matrix between true information and (a subset of) reconstructed information, which can then be applied to either real or fake (MC) data in an attempt to recover the underlying truth information.

Fake Data - I use two-thirds of my MC sample to generate the response matrix for unfolding, and then apply this to the remaining one-third of the sample in which only the reconstructed information is considered (“fake data”)

This provides a non-trivial validation of the unfolding, and allows for robust verification against arbitrarily modified cross sections, as per Yinrui’s presentation

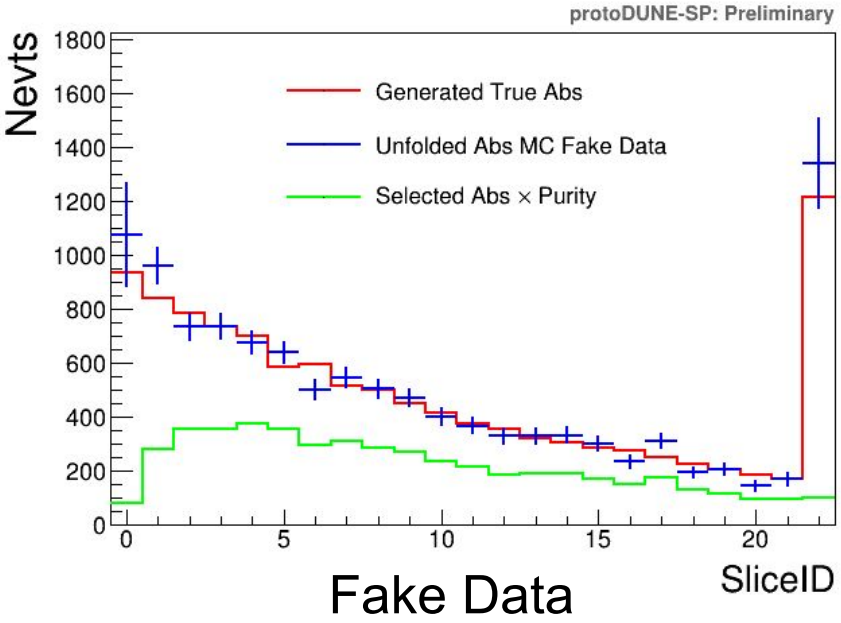
Interacting histograms - Inclusive Inelastic

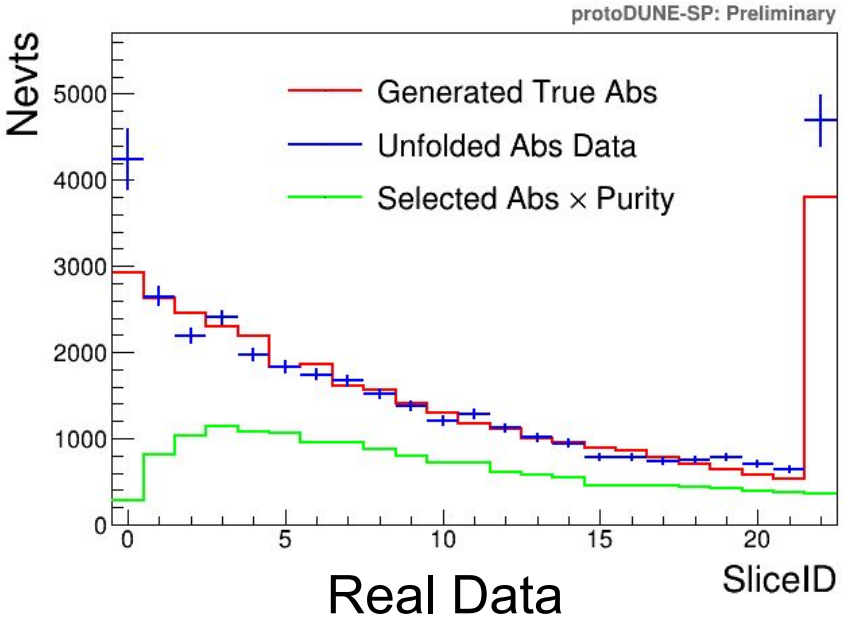




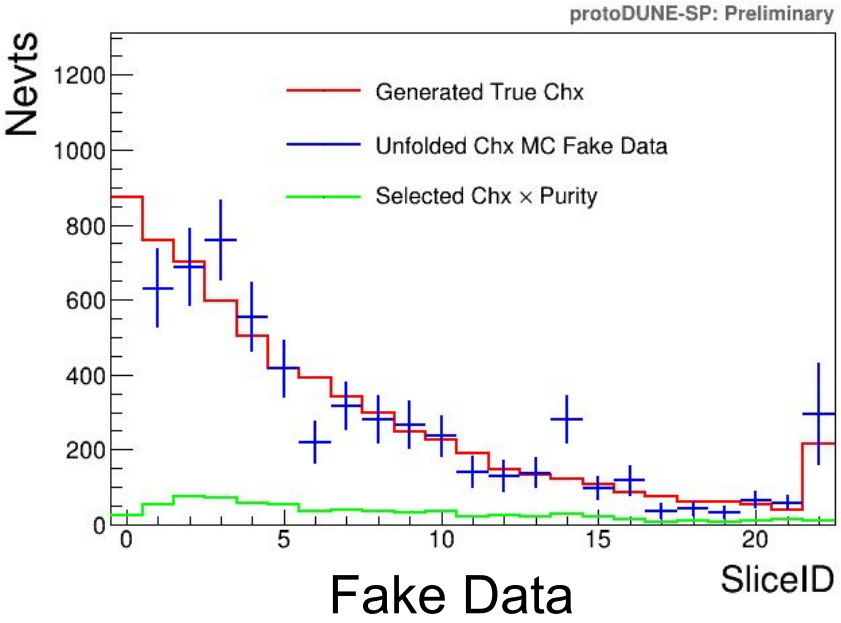
4-5 iterations of RooUnfold gives a χ^2 of roughly 1 for fake data

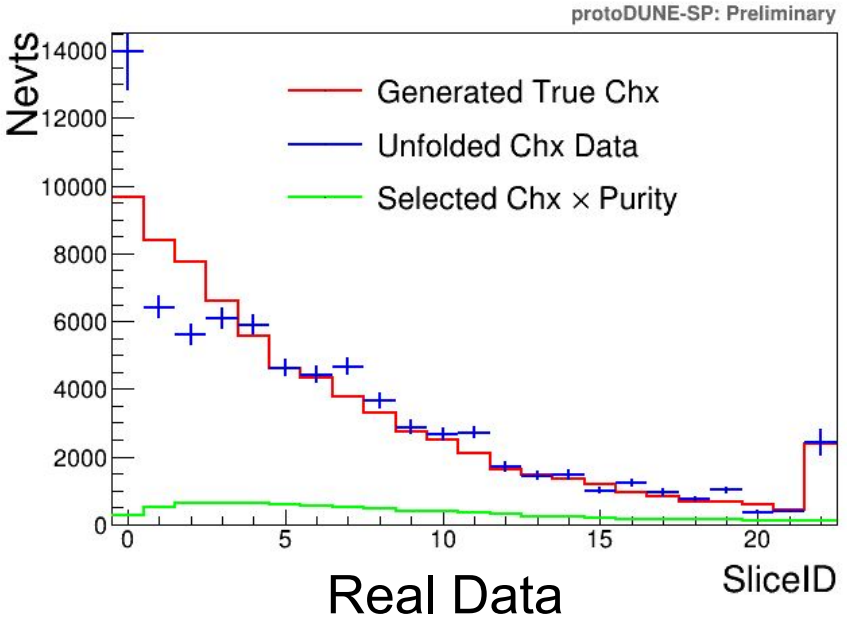
Interacting histograms - Pion Absorption



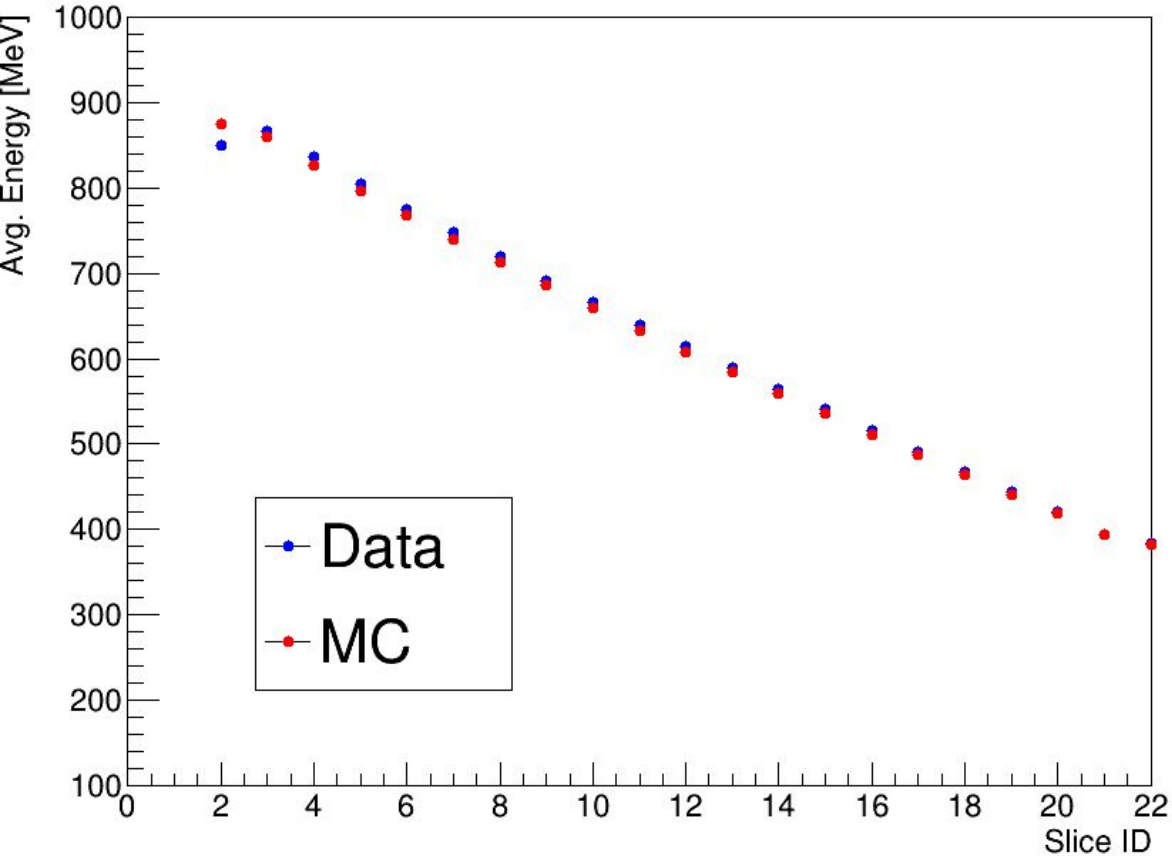


Interacting histograms - Charge Exchange





Mapping Slice ID to Energy

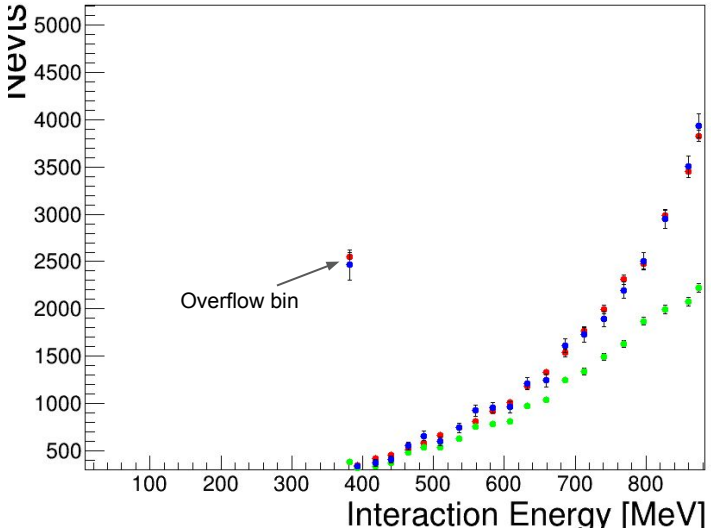


To map the slice ID to an energy for the cross section, we determine the average energy of a pion that interacts in that slice

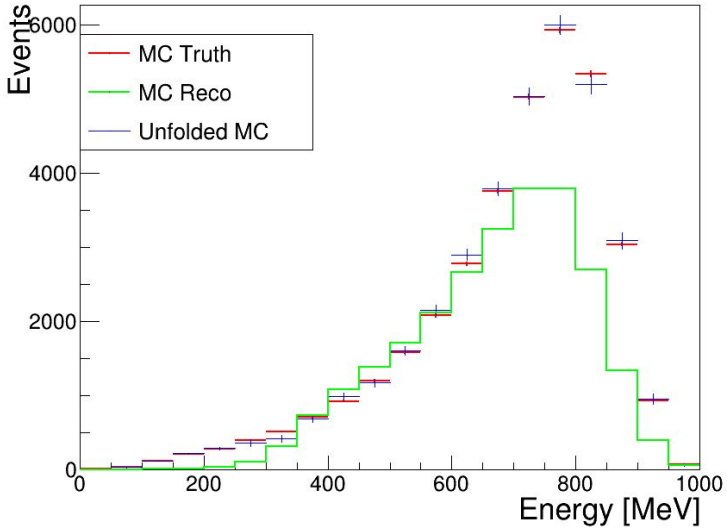
Except for the first and last slices, this gives an almost linear fit, and agrees closely between data and MC.

Also does not give energies below ~400 MeV

Slicing method comparison - Inelastic inclusive

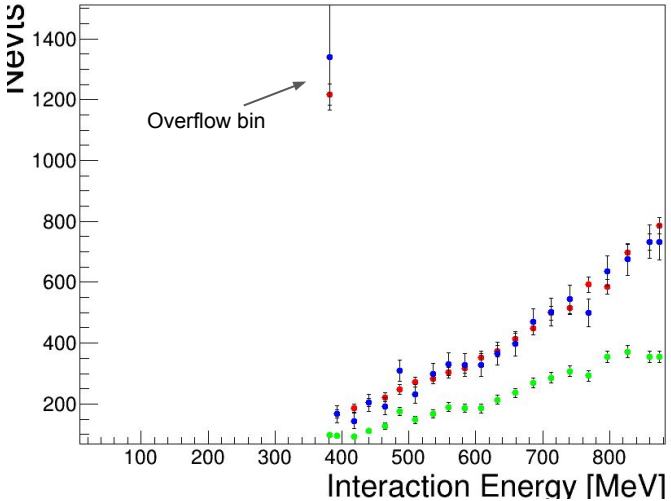


Thin Slice Method

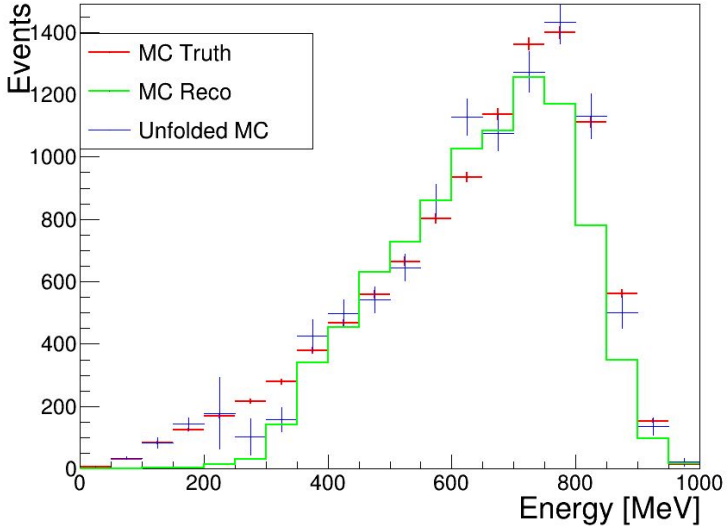


Energy Slice Method

Slicing method comparison - Pion Absorption

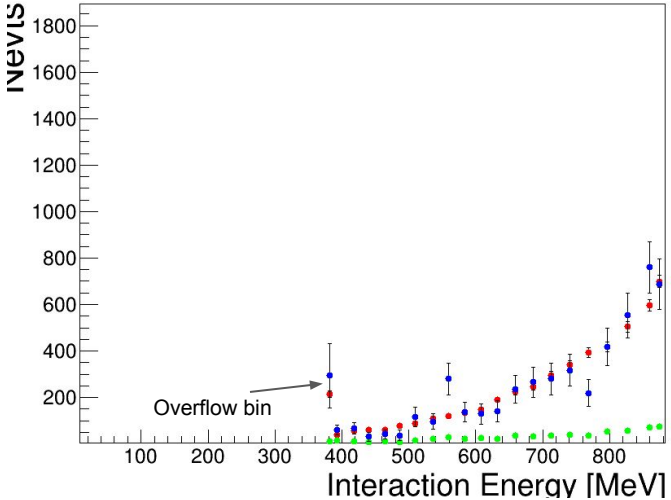


Thin Slice Method

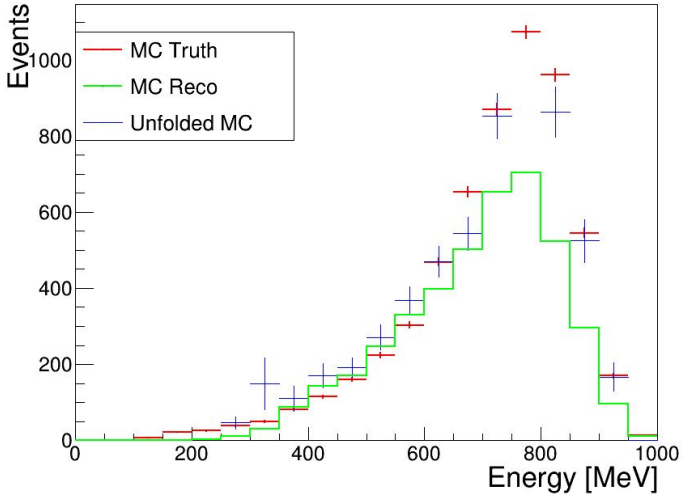


Energy Slice Method

Slicing method comparison - Charge Exchange

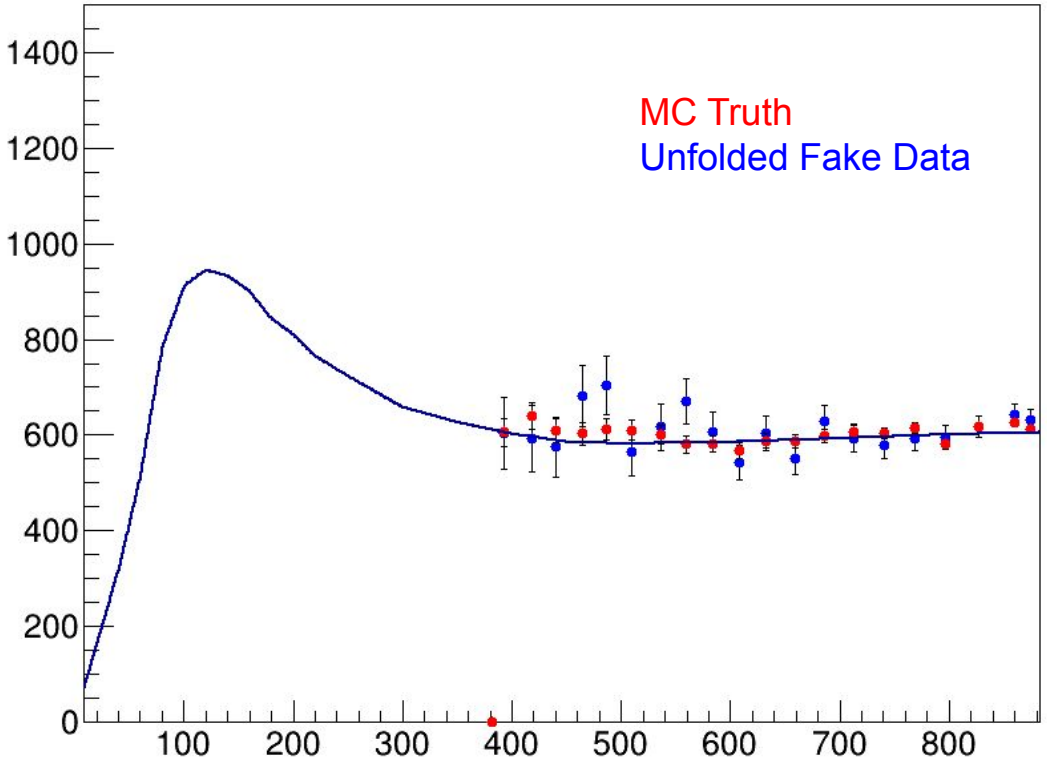


Thin Slice Method

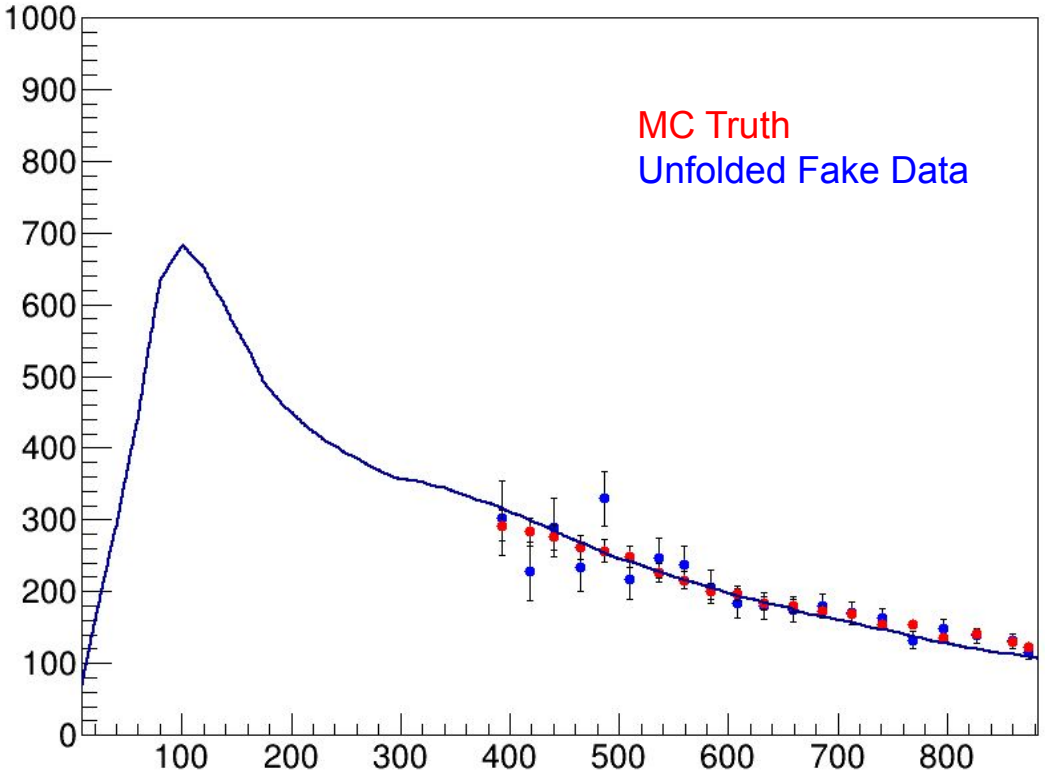


Energy Slice Method

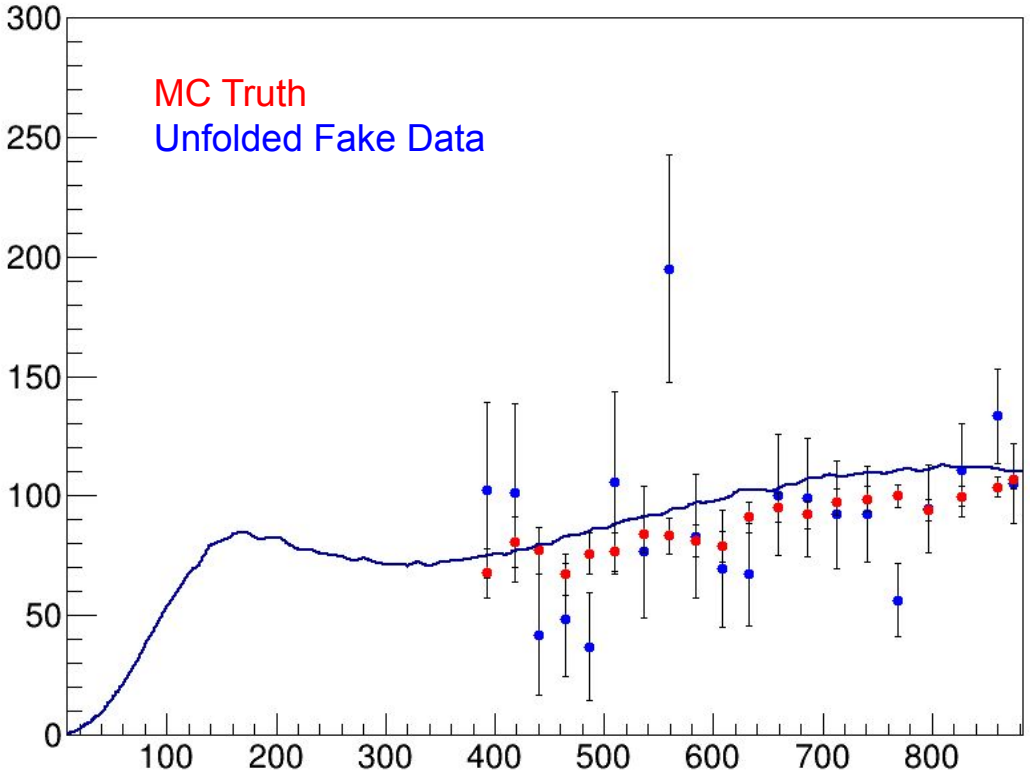
Fake data cross section - Inclusive Inelastic



Fake data cross section - Pion Absorption



Fake data cross section - Charge Exchange



To Do

Iron out treatment of overflow bins with RooUnfold

Extend thin slice method below 400 MeV

- -Investigate distribution of energy within a slice
- -Averaging may obscure energy regions with low statistics

Study MC/data discrepancy in this low energy region