

Pion Cross Section Updates

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Introduction

Energy reconstruction improvements

Binning optimization

Removal of 'Upstream Interaction' systematic parameter

Ongoing work

Energy Reconstruction Improvements

Energy reconstructed by taking KE from beam instrumentation (assuming pion) and subtracting $(dE/dx \cdot \text{track pitch})$ from all hits up to last

Skipping large hits (previously defined as 80 MeV)

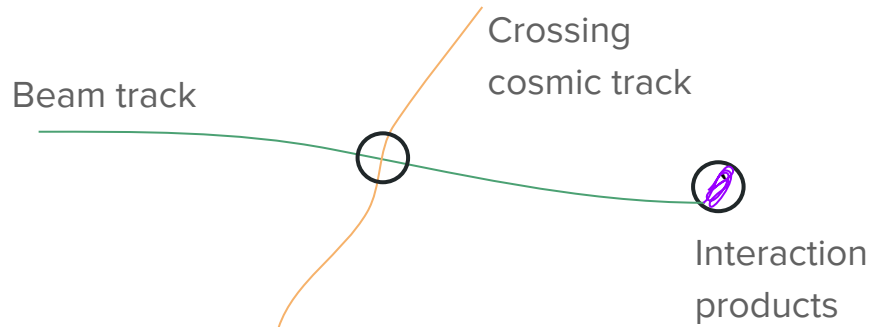
- Where do these come from?

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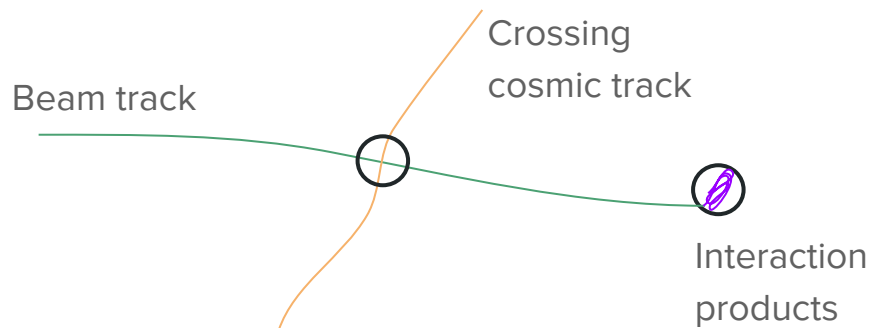


Energy Reconstruction Improvements

Energy reconstructed by taking KE from beam instrumentation (assuming pion) and subtracting $(dE/dx * \text{track pitch})$ from all hits up to last

Skipping large hits (previously defined as 80 MeV)

- Where do these come from?



Chosen arbitrarily.
Wanted to see how low I
could push this

Energy Reconstruction Improvements

Get IDEs from each hit in reconstructed beam track

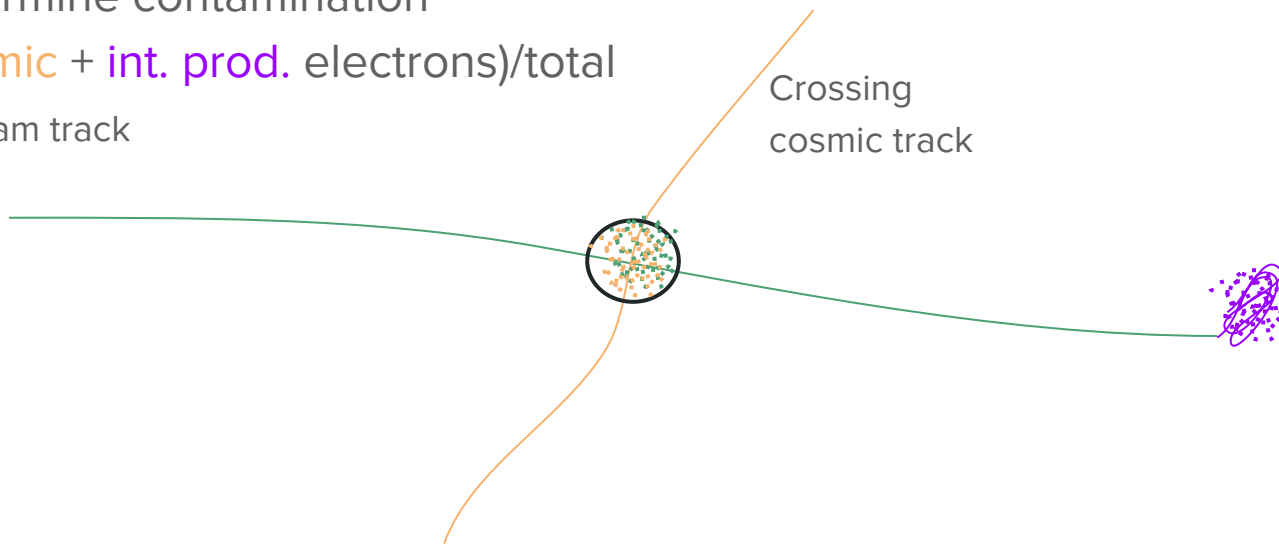
- Get number of electrons
- Source: **backtracked beam track**, **cosmic**, or **interaction products**
- Determine contamination

$(\text{cosmic} + \text{int. prod. electrons}) / \text{total}$

Beam track

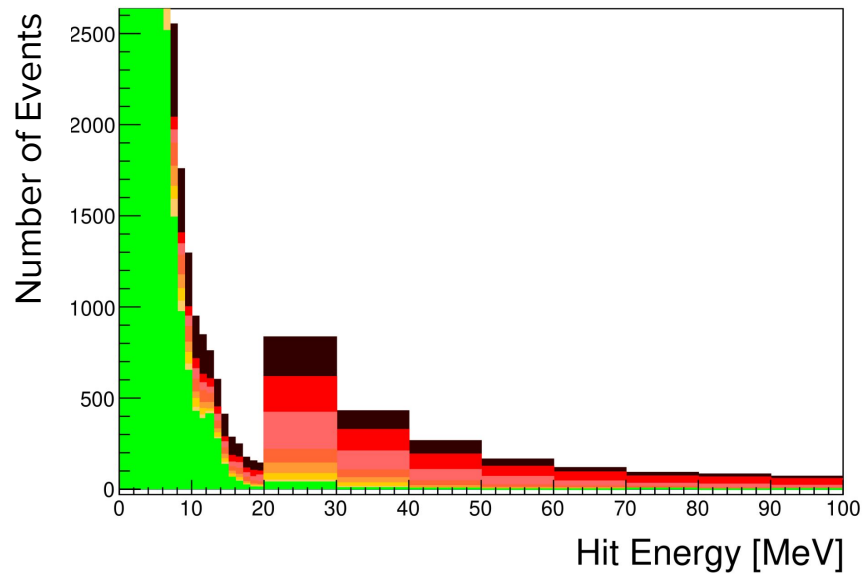
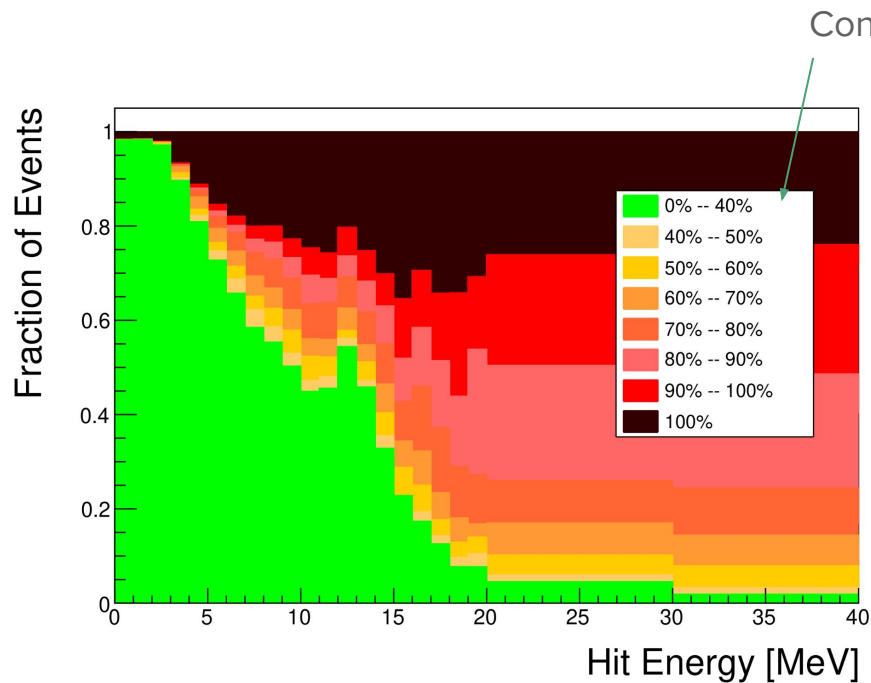
Crossing
cosmic track

Interaction
products



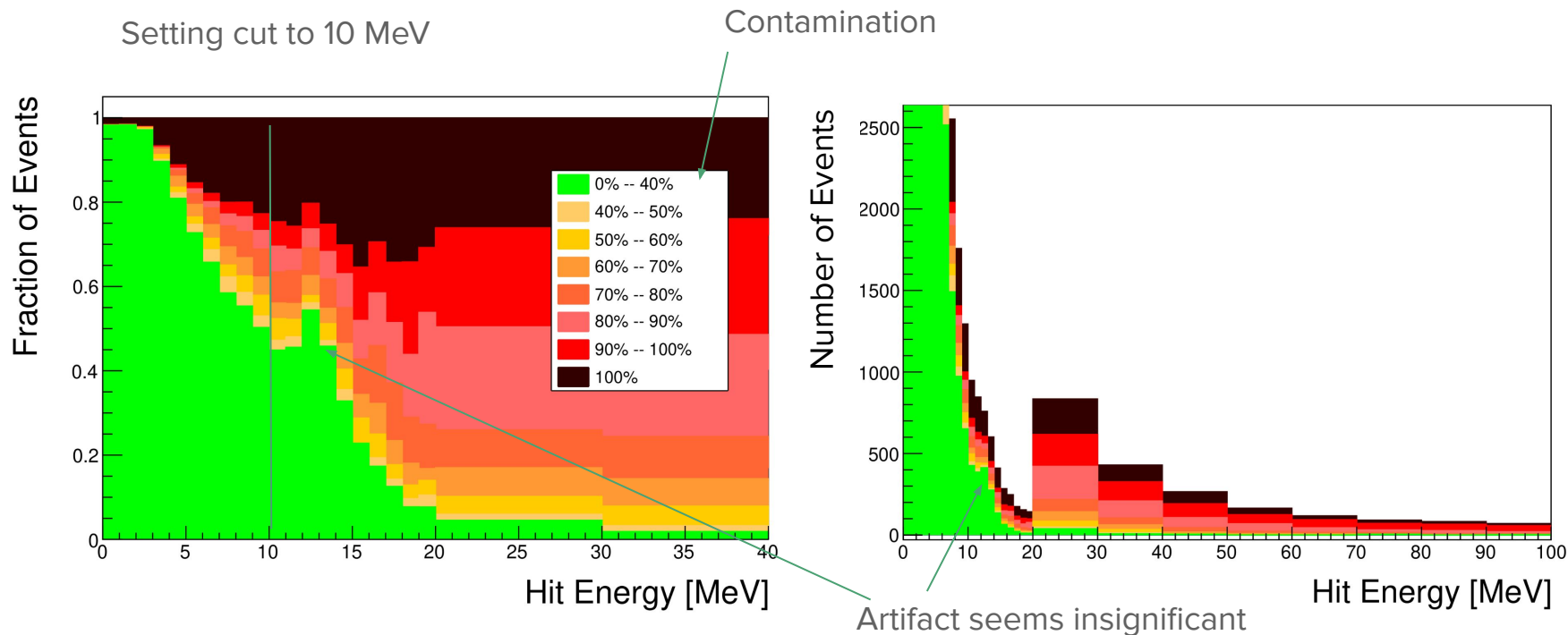
Energy Reconstruction Improvements

Example: “X% of events at deltaE have 0-40% contamination”



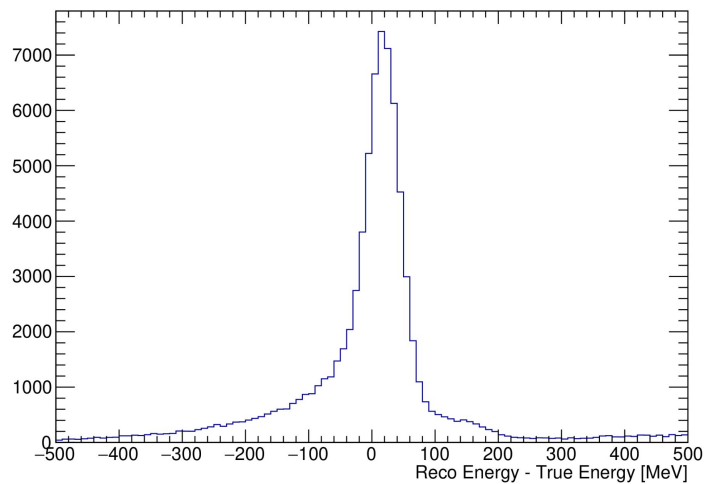
Energy Reconstruction Improvements

Example: “X% of events at deltaE have 0-40% contamination”

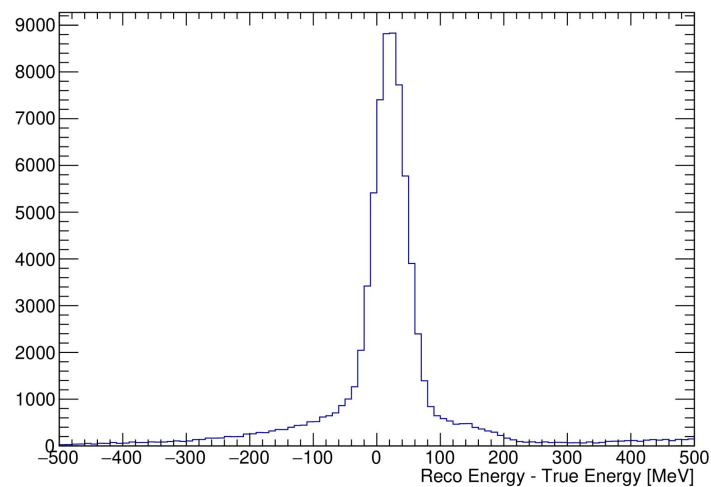


Energy Reconstruction Improvements

80 MeV Threshold



10 MeV Threshold

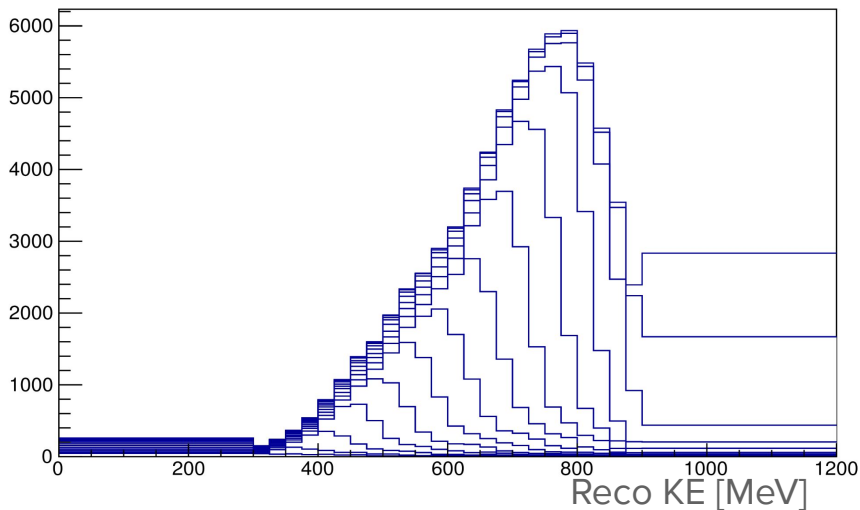


Binning Improvements

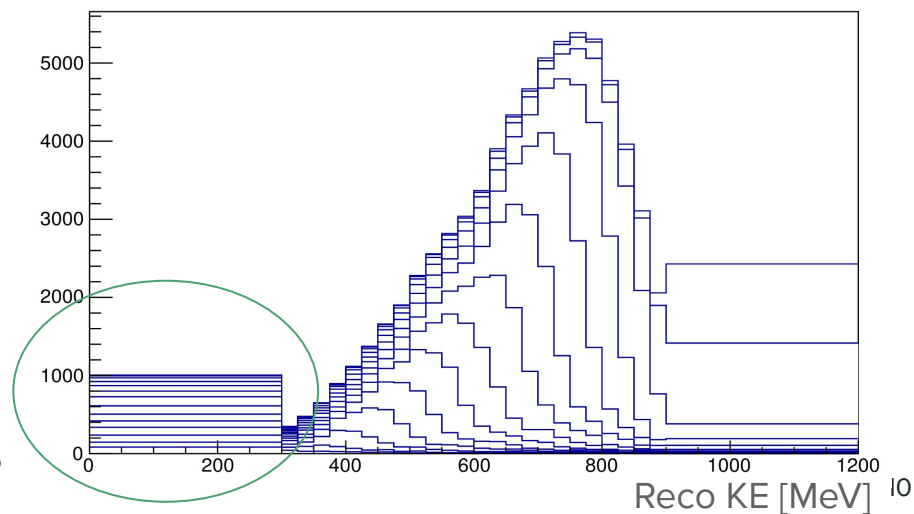
Large overlaps would often result in fit pushing various signal regions to 0 (the limit; this is bad for error propagation)

New reconstruction has better behavior → can push to finer binning (reco 25 MeV, true 50 MeV)

10 MeV Threshold



80 MeV Threshold



Upstream Interaction Systematic

Last presentation I mentioned including a systematic that directly controls the number of interactions upstream of the TPC (the majority of non-signal events)

This becomes highly correlated in the fit with the signal parameters

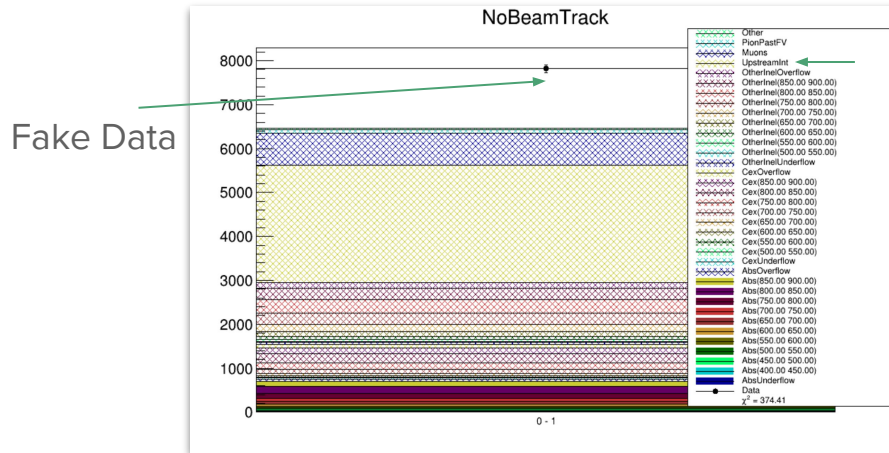
- The total number of events is constrained, so increasing (nearly) all types of events by the same factor has no effect

Can the signal parameters alone handle an increase in the number of interactions upstream?

- Fake data test

Upstream Interaction Systematic

Raised number of upstream interactions by factor of ~ 2 , fit without the systematic parameter

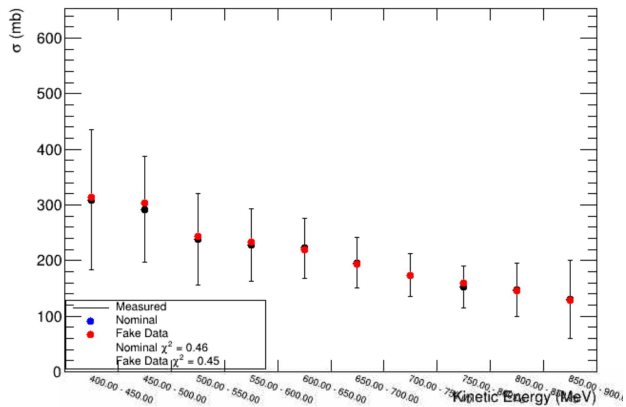


Upstream Interaction Systematic

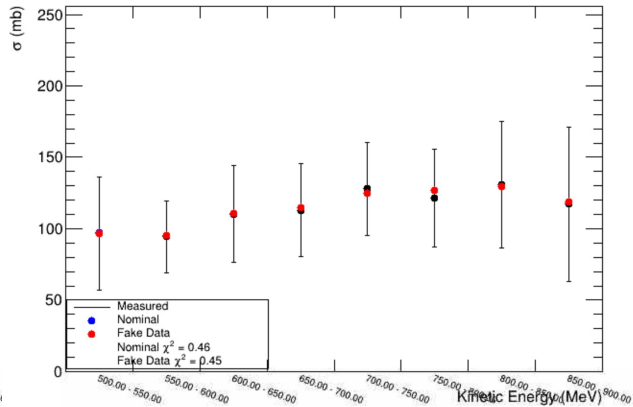
Has very small effect on the extracted cross section (compared to as extracted from fake data and nominal MC – overlapping here)

Can remove this parameter

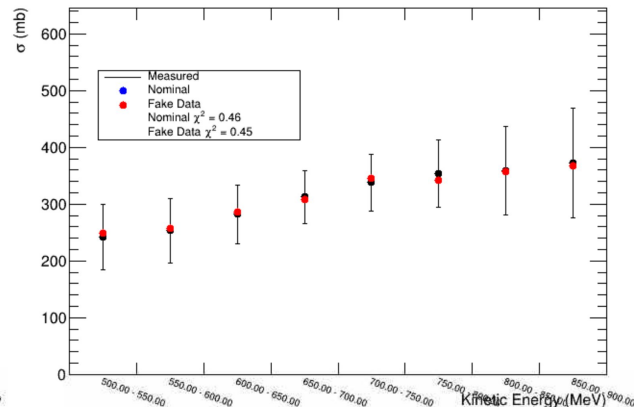
Absorption



Charge Exchange



Other



Ongoing Work

Investigating energy loss systematic

- Essentially changes the rate of pions scraping the beam line & losing energy before TPC

Will work to back-up the assumptions I made regarding SCE systematics

Thank you for listening

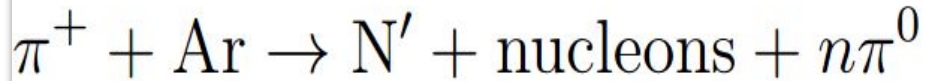
Backup Slides

Signal Definition

Absorption:



Charge Exchange:



Other:



Note: Considering a threshold of 150 MeV/c on the charged pions due to our inefficiency in identifying these → Signal events can contain charged pions < 150 MeV/c

Measure exclusive and total (not independent)

Analysis Strategy

Start with samples of pions/muons from beam and bin events according to event selection (see backup)

- Categories: No beam track, Failed Beam cuts, Past fiducial vol, Interactions, Michels
- Binned in various observables: ending Z position, reconstructed energy at interaction

Parameterize MC according to set of signal, flux, and systematic parameters

- Signal: interactions at specific energy
- Flux: relative number of muons/pions
- Systematics: will discuss later