Inclusive neutrino cross section measurements at MINERνA

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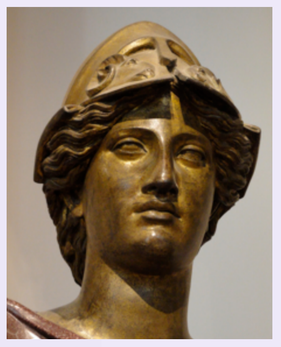
on behalf of MINERνA



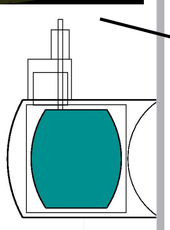
Physics Goals

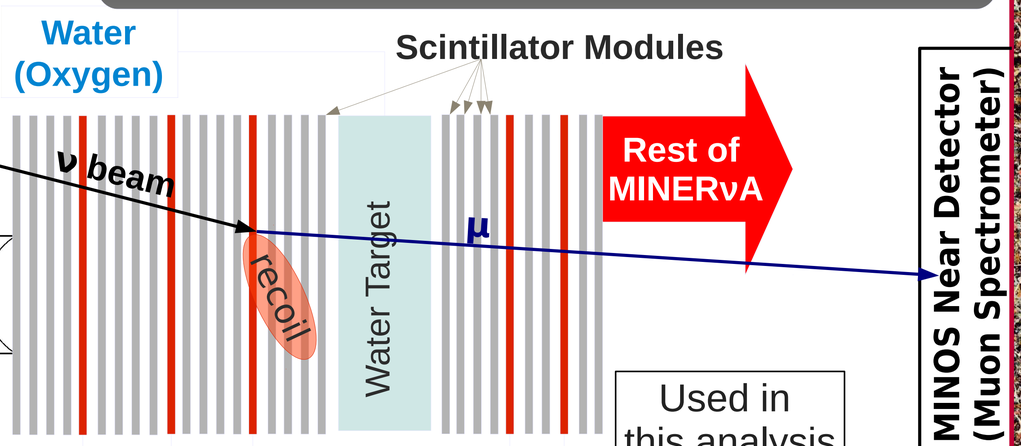
- Measure charged and neutral current event ratios
- Provide more precise cross section measurements
- Measure x-dependence of nuclear effects
- Contribute to world effort to extract x-, Q^2- dependence of nuclear parton distribution functions
- Measure final state multiplicities
- Measure hadronic energy

Each as a **function of the interaction nucleus**

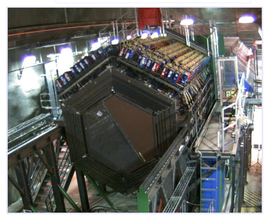
Nuclear Targets in MINERνA

Liquid Helium

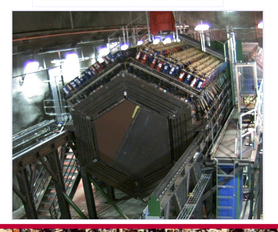




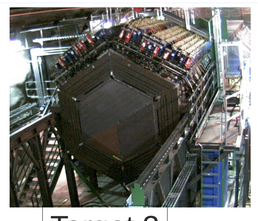
Iron / Lead



Lead / Iron

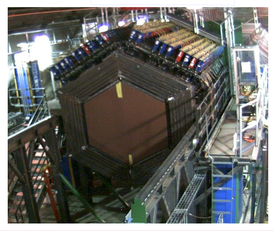


Carbon / Lead / Iron



Target 3

Lead



Iron / Lead

Target 5

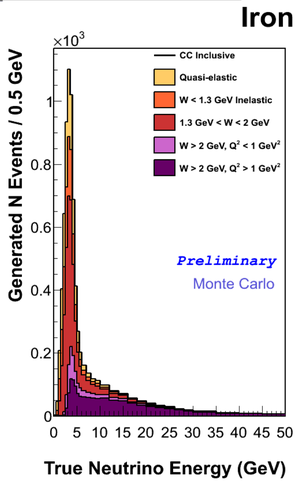
Kinematic Selection

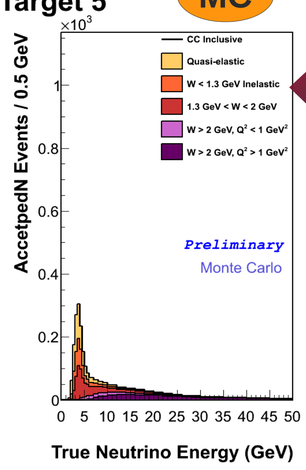
Acceptance of muons into MINOS sculpts the kinematics of the sample. Use of muons stopping in MINERνA is in development.

Left version of the plot shows kinematics of generated events; right shows accepted events.

Iron of Target 5

MC

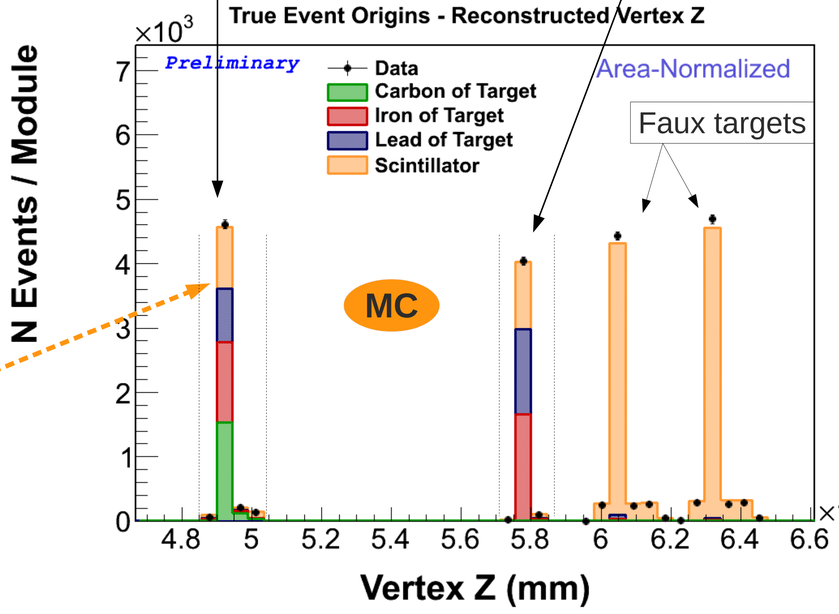




Event Selection

Events must have a muon reconstructed in MINOS with a negative charge and a vertex near a nuclear target.

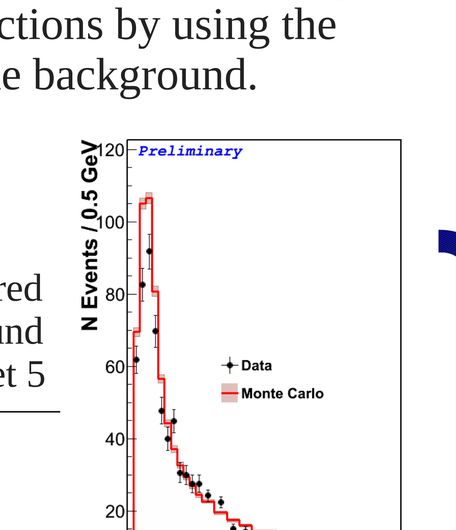
Background is events in scintillator that are accepted in passive target sample.



Forming a Ratio

Flux and detector systematic errors ~cancel because targets are in the same detector and beam.

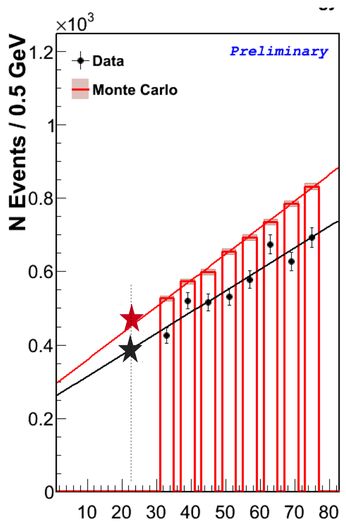
Iron and lead occupy different X:Y regions, but we mitigate errors due to acceptance differences by using regions of tracker (CH) as reference. Regions are called "faux targets".



Data-Driven Background Subtraction

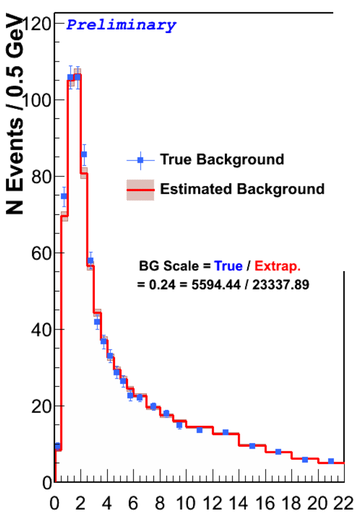
Scintillator events in the lead/iron/carbon samples obscure nuclear dependence.

We subtract the scintillator spectrum without using Monte Carlo cross section predictions by using the tracking region to predict the background.



Events in the tracking region extrapolated to nuclear target region to predict spectrum of scintillator events

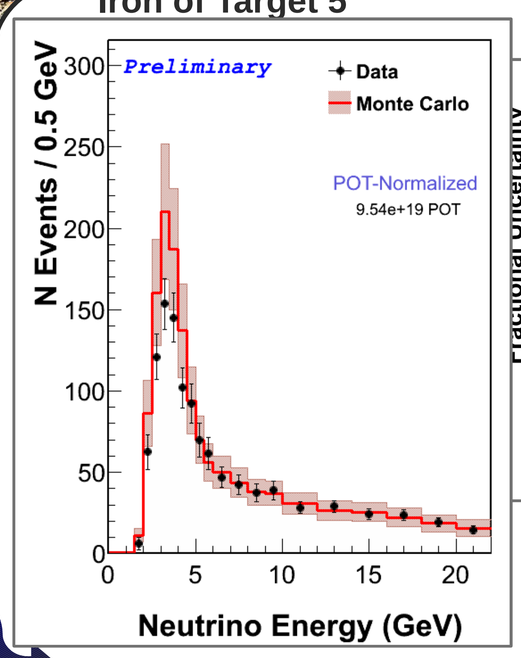
Background estimate compared to true background for Iron of Target 5

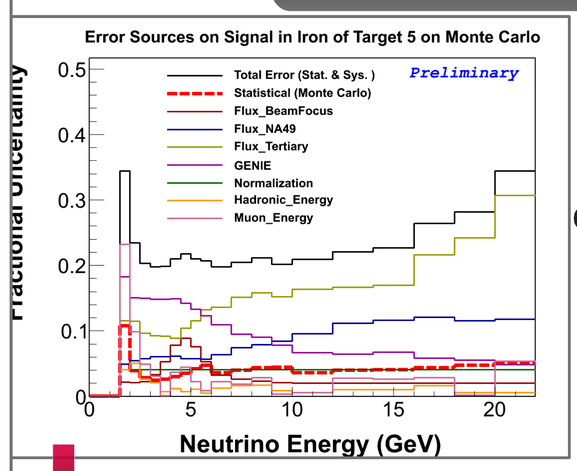


Background estimate in Monte Carlo compared to data for Iron of Target 5

Preliminary Results

Iron of Target 5

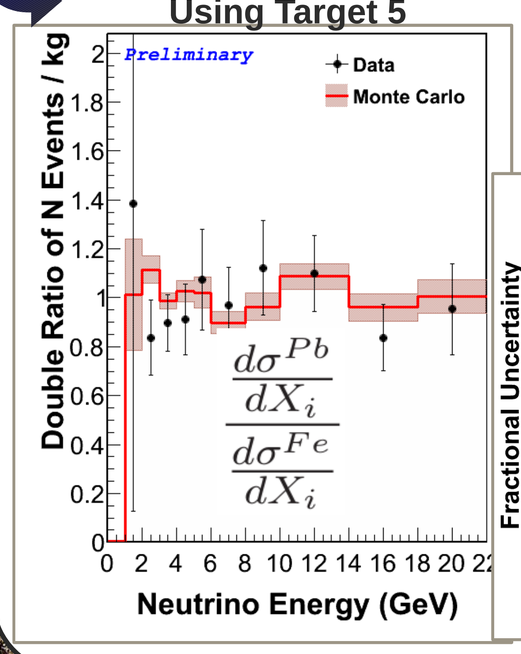


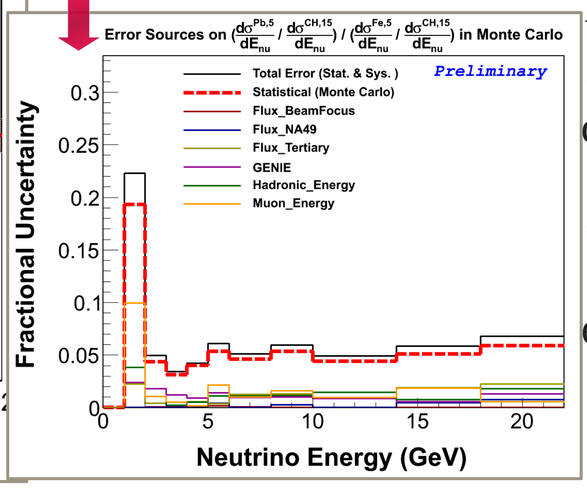


Systematic errors decrease dramatically after taking the ratio.
Statistical errors dominate the ratio measurement.

Data-MC discrepancy in peak is consistent for all nuclei and is presumably due to imperfect simulation of flux. Ratio is insensitive to this effect.

Using Target 5





This analysis uses ~25% of the data on disk, and does not combine samples from different targets. Utilizing the full event sample will lower statistical errors on data by a factor of ~3.