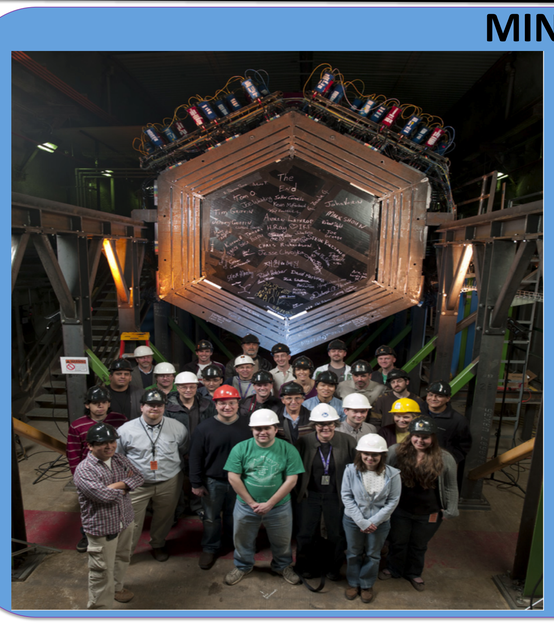
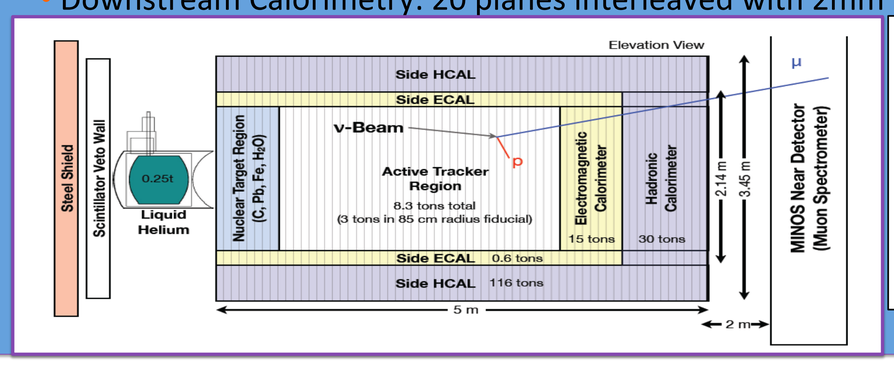
MINERvA Charge Current Inclusive Analysis

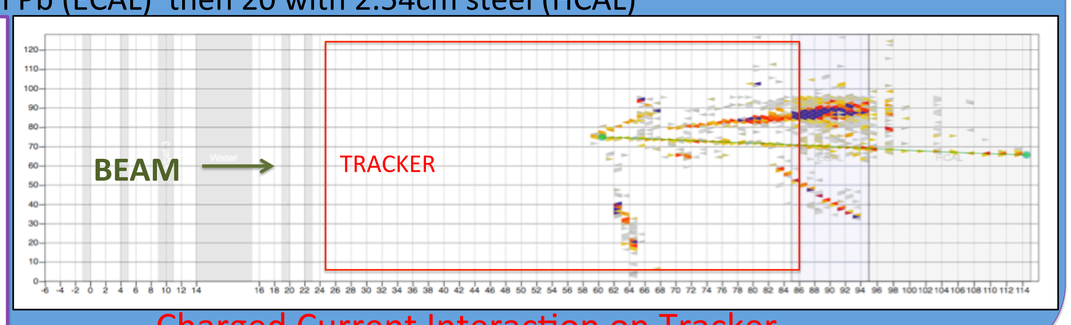
David Martinez, CBPF, on behalf of MINERνA

MINERνA is a dedicated neutrino-nucleus cross-section experiment



- Will provide important input to future neutrino oscillation experiments
- Single detector with multiple nuclear targets allows study of nuclear effects in ν interactions
- Makes use of the NuMI neutrino beam and the MINOS Near Detector at Fermilab
- Active detector: triangular scintillator bars form 1.7cm thick planes, WLS and clear fiber cables to PMT's
- Downstream Calorimetry: 20 planes interleaved with 2mm Pb (ECAL) then 20 with 2.54cm steel (HCAL)



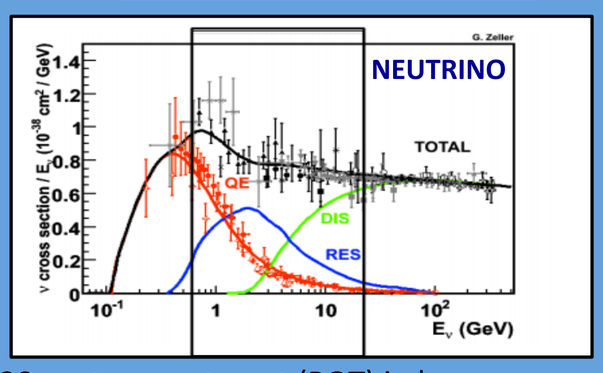


Charged Current Interaction on Tracker

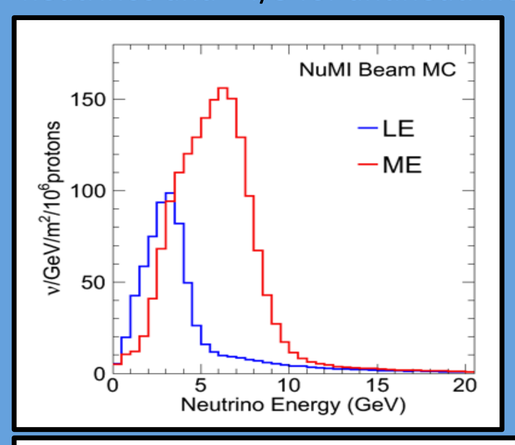
Physics Motivation

- Measure charged and neutral current event ratios
- Provide more precise cross section measurements
- Measure x-dependence of nuclear effects

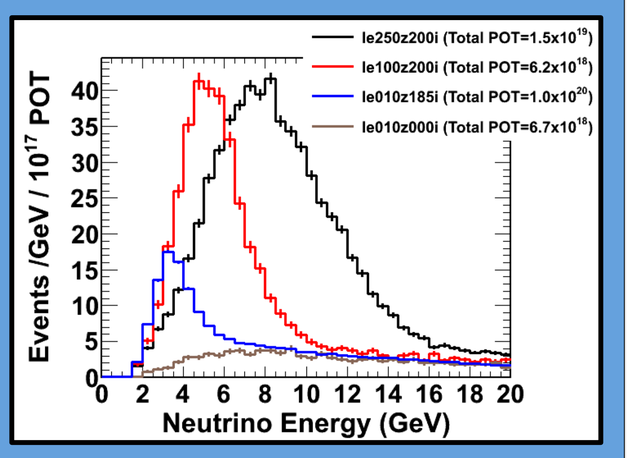
J.A. Formaggio and G.P. Zeller, "From eV to EeV: Neutrino Cross Sections Across Energy Scales", Rev. Mod. Phys., 2012.



- MINERvA has been approved for 4.9e20 protons on target (POT) in low energy mode. The data collected at the time of this analysis was 3.98 e 20 for neutrino and 1.7 e20 for antineutrino. Charged current inclusive analysis uses ~ ¼ for neutrinos and ~4/5 for antineutrinos.

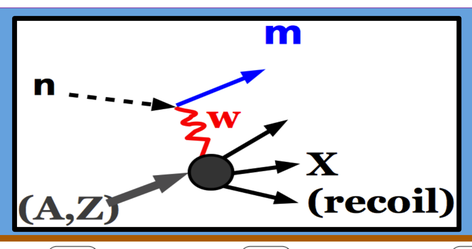


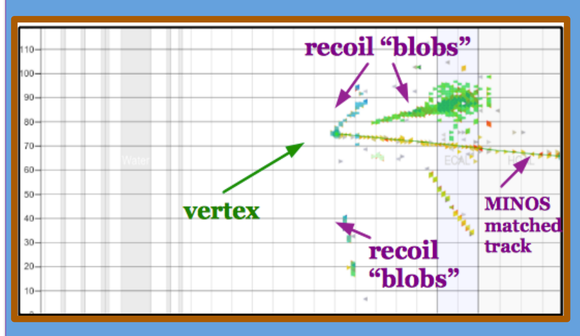
FLUKA: A. Ferrari, P.R. Sala, A. Fasso`, and J. Ranft, CERN-2005-10 (2005), INFN/TC_05/11, SLAC-R-773

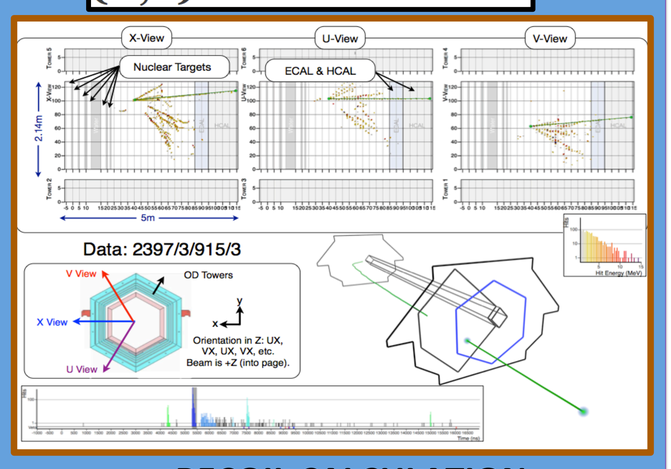


Event Reconstruction

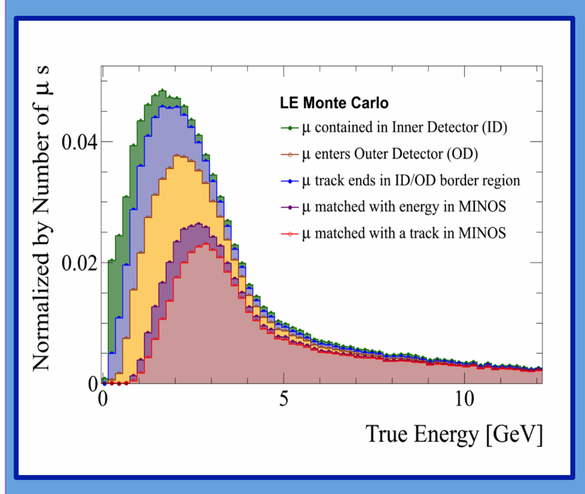
Reconstructed objects
MINOS tracks, other tracks, vertices, endpoints, blobs







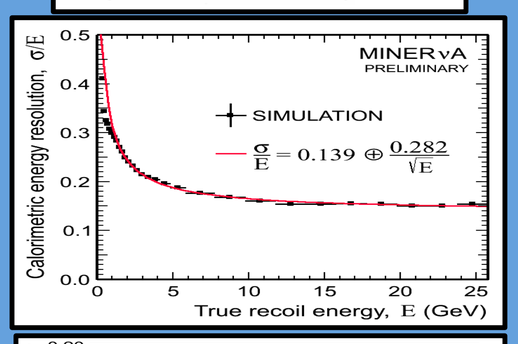
Acceptance of muons into MINOS sculpts the kinematics of the sample. Use of muons stopping in MINERvA is in development.

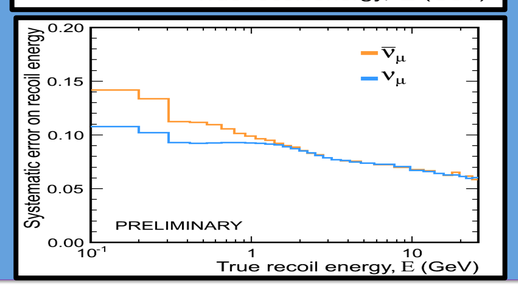


RECOIL CALCULATION

$$\text{calorimetric } E_{\text{recoil}} \equiv \alpha \times \sum_i c_i E_i$$

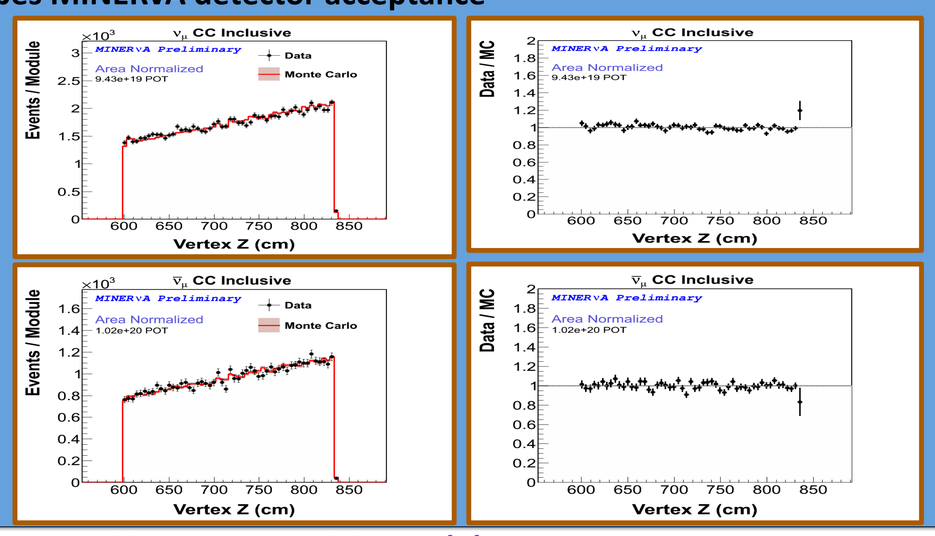
$$i = \{\text{tracker, ECAL, HCAL, OD}\}$$





Preliminary Results

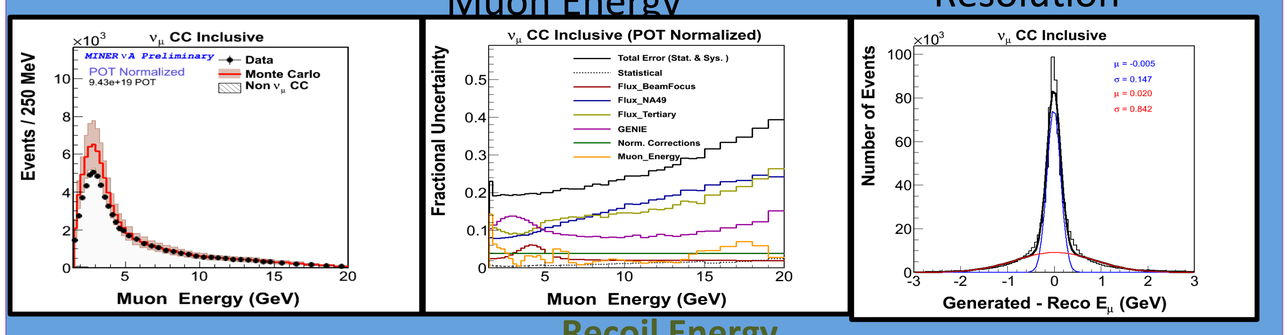
❖ **Vertex Z probes MINERvA detector acceptance**



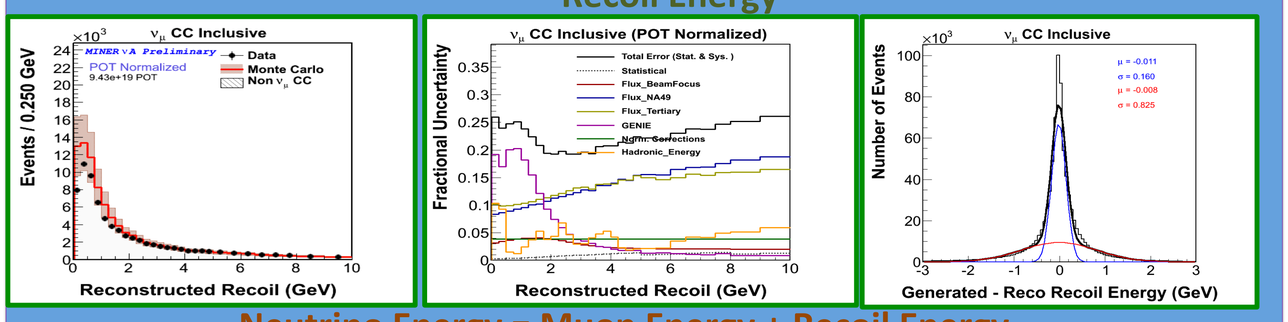
Kinematic Variables

MINERvA charged current inclusive results use neutrino and antineutrino data . For neutrino and antineutrino data we search for a muon reconstructed in the MINOS near detector with a vertex within MINERvA fiducial volume.

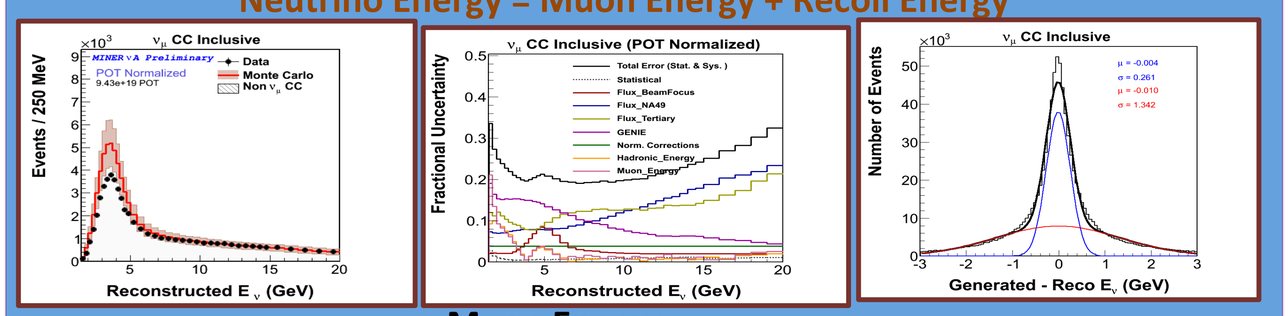
Muon Energy Resolution



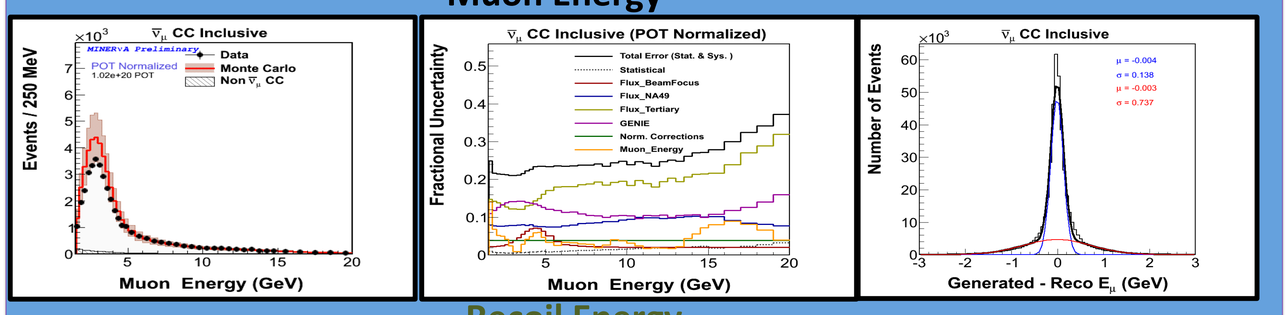
Recoil Energy



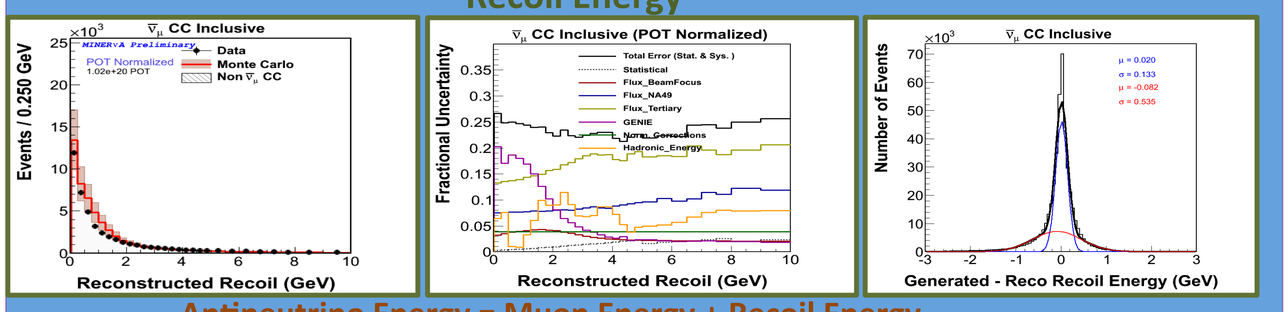
Neutrino Energy = Muon Energy + Recoil Energy



Muon Energy



Recoil Energy



Antineutrino Energy = Muon Energy + Recoil Energy