MiniBooNE Report

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for the MiniBooNE collaboration

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Week Summary 05 Mar – 12
Offline

- 25m absorber repair plans/work in prog
  - Lifting device built and installed!

Thanks to Dave B
crew (PPD-Mecha
for quick assemb
lifting device.

  - Begin lowering plates today, take ~1
    lower all 9 plates. Already two plates
    successfully and safely lowered today

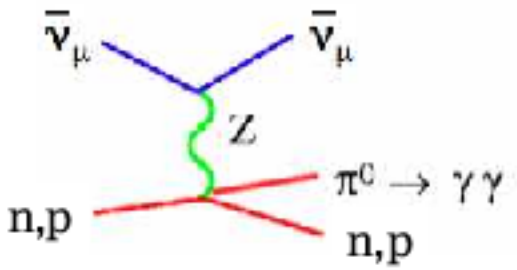
NC π^0 Production in the MiniBooNE Antineutrino Data

Background

- Started antineutrino running in Jan. 2006
- Has world's largest sample of π^0's produced by antineutrinos (~900 events) at ~1 GeV

Why study antineutrino NC π^0's?

- Single largest background to future ν_e appearance searches
- Large Cherenkov detector well-suited for π^0 ID
- Can use the same tools from neutrino analysis



NC π^0's can be created through resonant and coherent production:

Resonant NC production: $\bar{\nu}\,\mathrm{N} \rightarrow \bar{\nu}\,\Delta \rightarrow \pi^0\,\mathrm{N}$

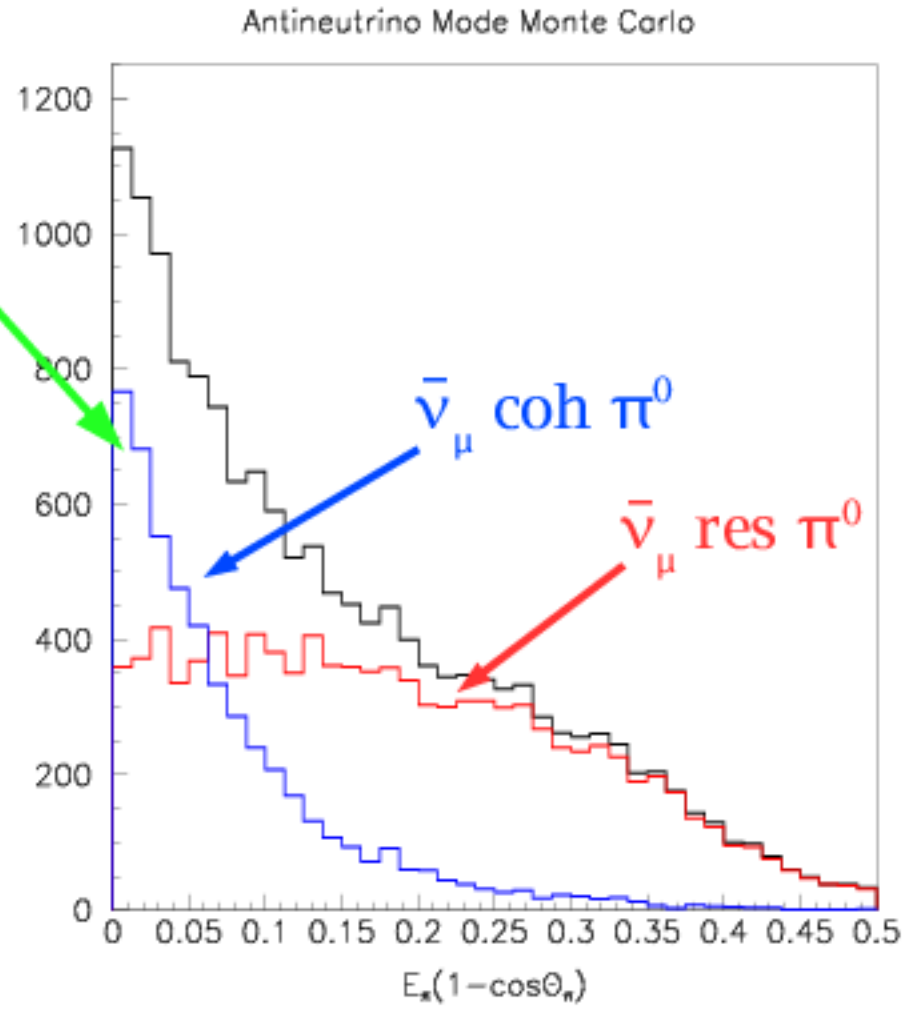
Coherent NC production: $\bar{\nu}\,\mathrm{A} \rightarrow \bar{\nu}\,\mathrm{A}\,\pi^0$

(Signature: π^0 which is distinctly forward-scattered)

K2K results predict this peak will be missing

K2K set an upper limit of 0.60×10^{-2} on the xsection ratio of coh pion production to the total CC interaction at 90% CL

Ref:
Phys. Rev. Lett.
95, 252301 (2005)



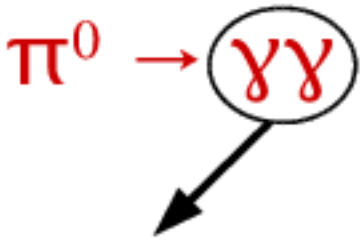
MiniBooNE NC π^0 Selection

pre-cuts:

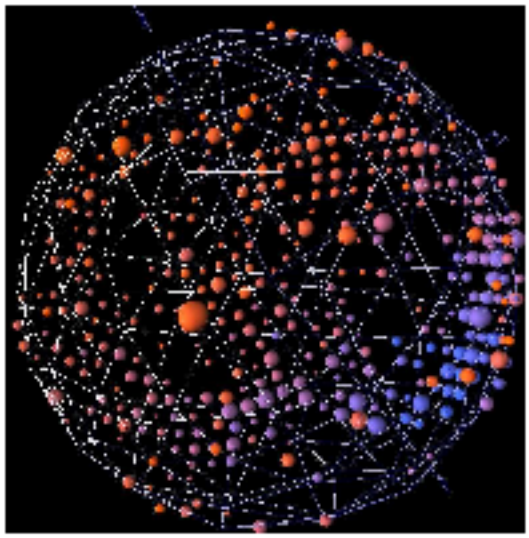
- event in beam time window (ν event)
- # veto hits < 6 (eliminates cosmic rays)
- # tank hits > 200 (above Michel endpoint)
- event radius < 500 cm (fiducial cut)

NC π^0 analysis cuts:

- one sub-event (no decaying μ, NC)
- eμ likelihood prefers e hypothesis (EM-like)
- eπ likelihood prefers π^0 hypothesis (2 ring)



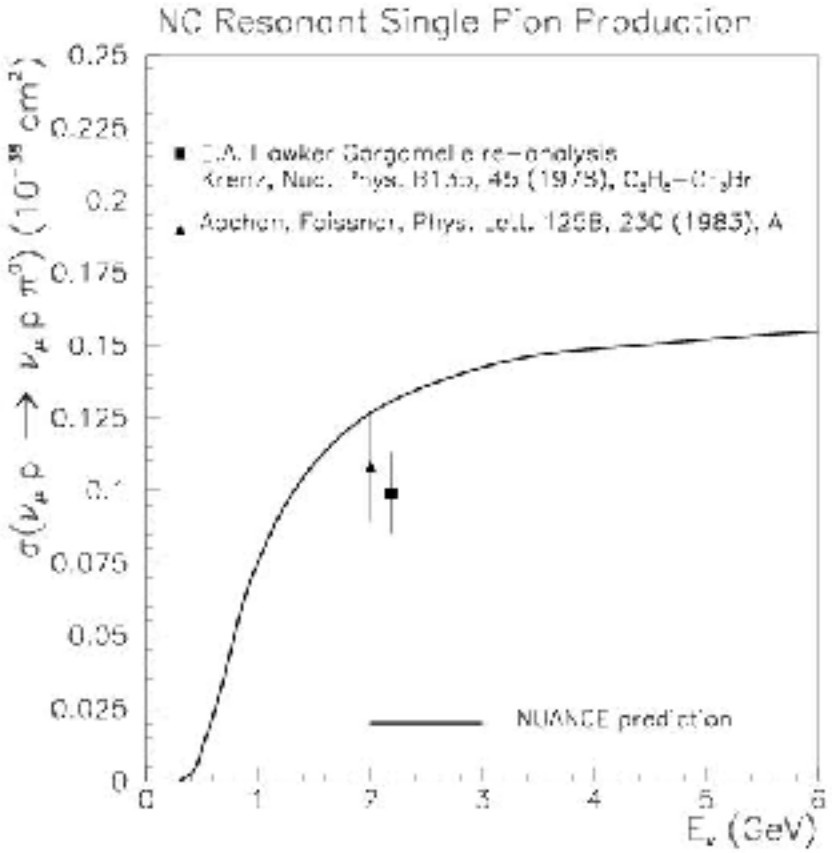
2 ring fit:
determine E, direction
of each Cherenkov ring
→ decay kinematics



$$m_\pi^2 = 2E_{\gamma 1}E_{\gamma 2}(1-\cos\theta_{12})$$

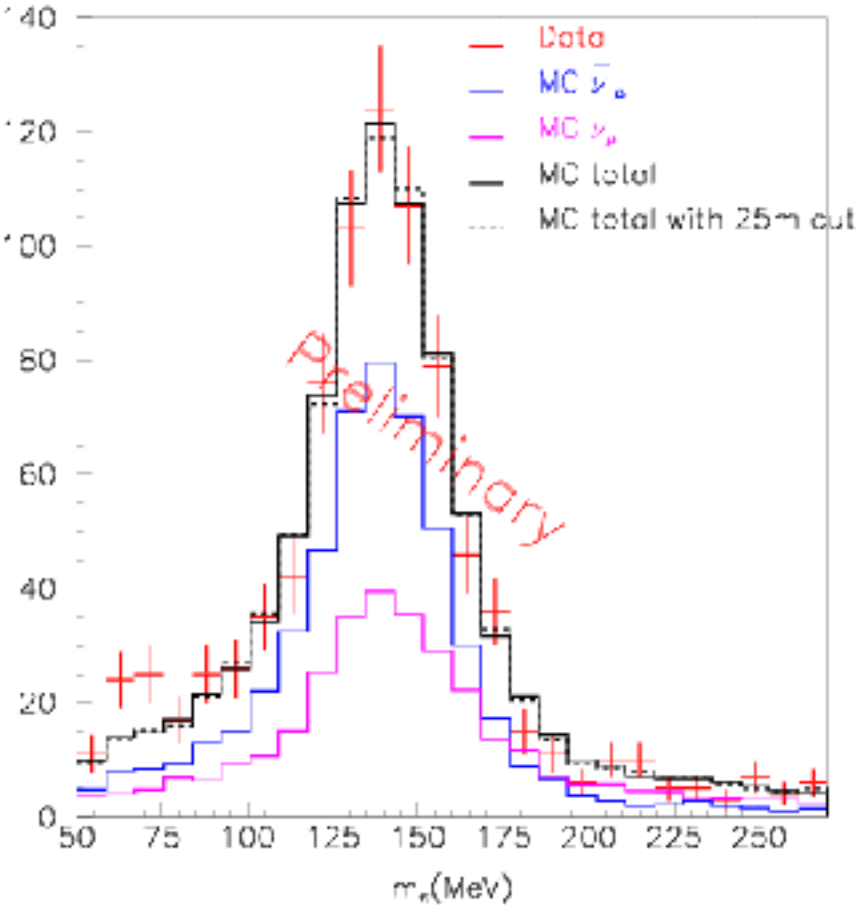
Notes:

- The data used is ALL of the antineutrino data
- The MC (May 06 Baseline) does not have absorber effects explicitly simulated
- We perform a 25m cut test, in which all neutrinos downstream of the 25m absorber have been eliminated
- Besides overall normalization, absorber effects produce more neutrinos at lower energies, which do not affect π^0 kinematics (higher energy production threshold)

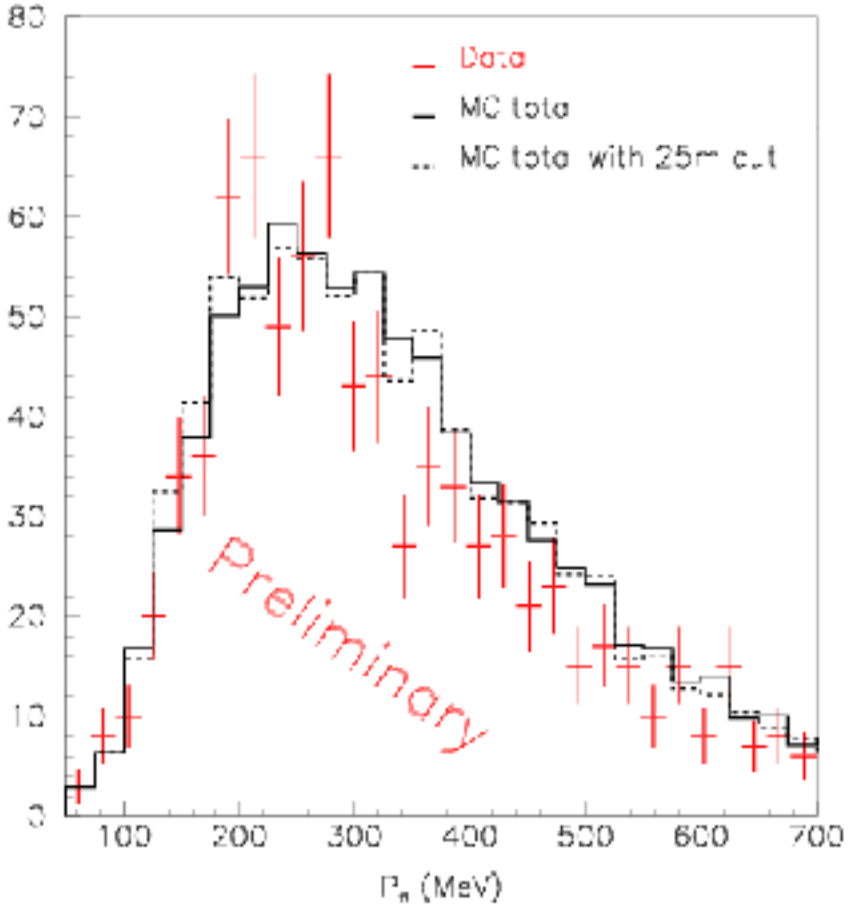


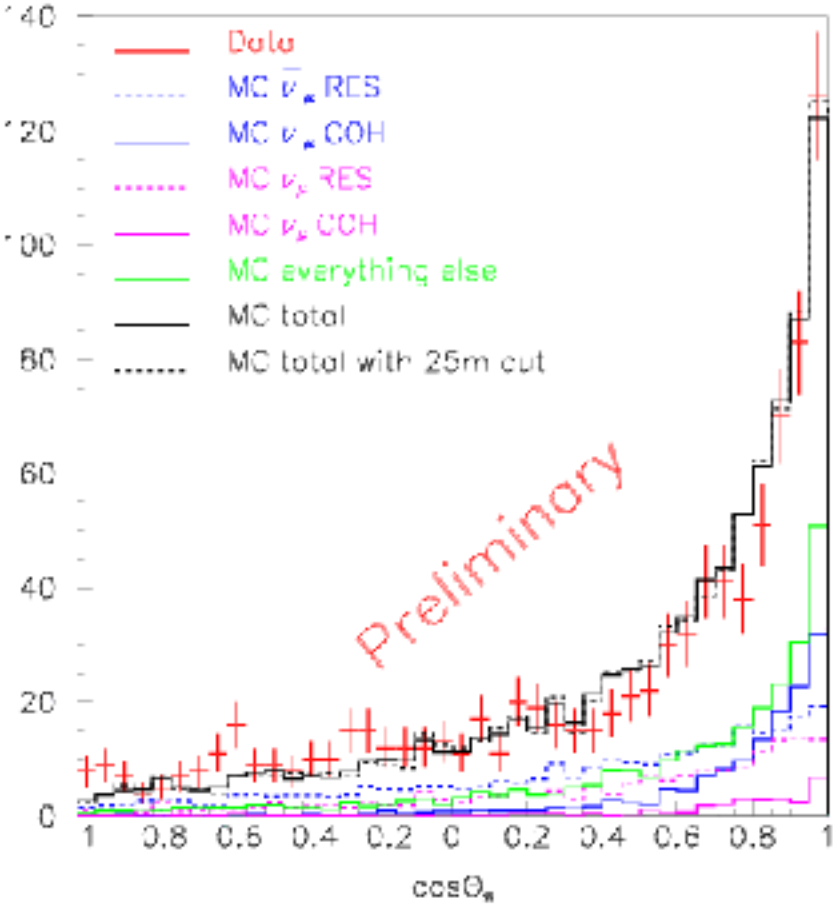
- The following plots have been relatively normalized

π^0 Kinematics

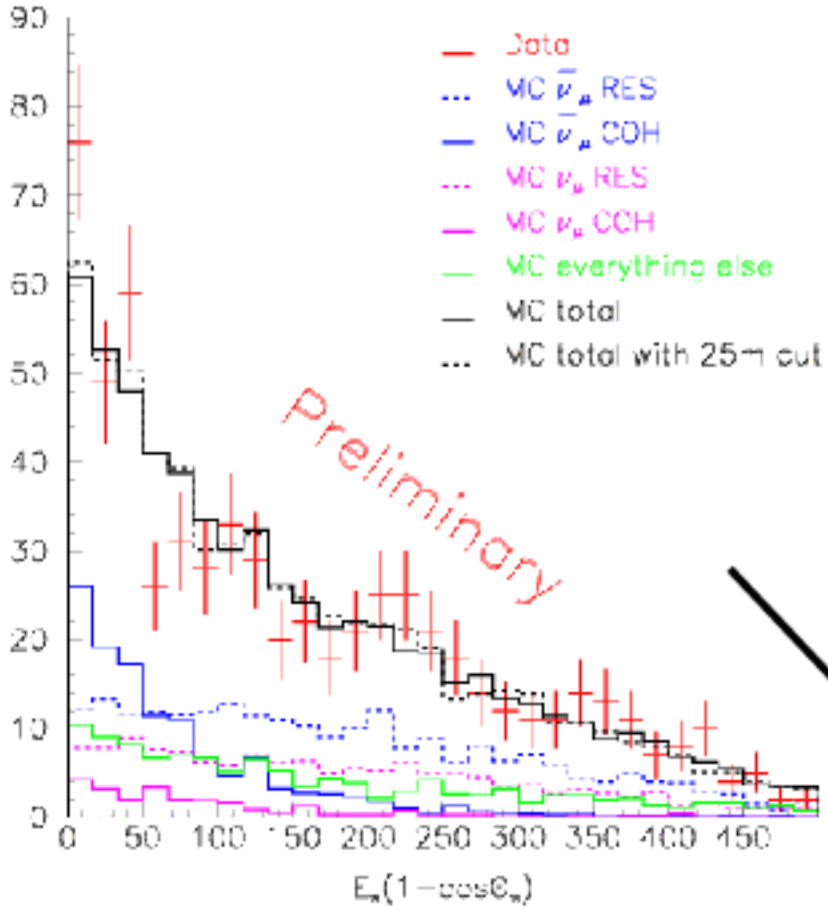


MiniBooNE's resolution on the π^0 mass peak ($\Delta m \sim 22$ MeV) is comparable to K2K's ($\Delta m \sim 20$ MeV) at 10% photocathode coverage compared to 40% for K2k



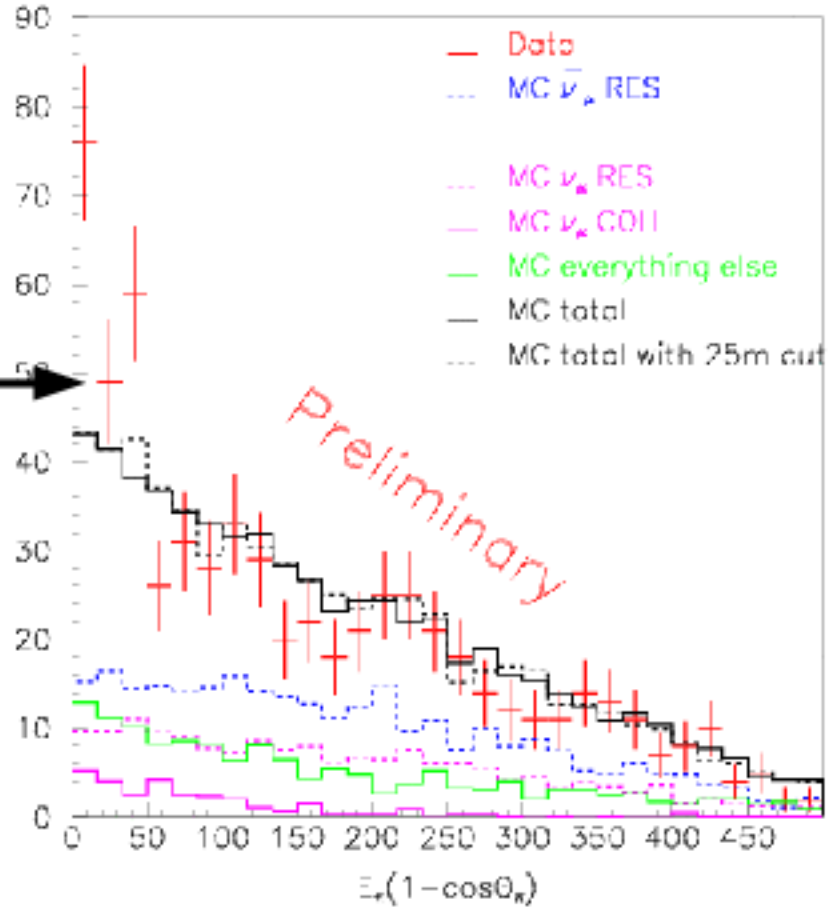


(θ_π is the angle of the outgoing π^0 in the lab wrt to the antineutrino direction)



Removing $\bar{\nu}_\mu$ COH contribution

Suggestive of antineutrino NC coherent π^0 production



Summary

- There are indeed π^0's produced in our antineutrino data!
- There is good agreement between data and uncorrected MC for π^0's; new updated MC expected within a few weeks
- Kinematic distributions are what we expect
- The data suggests antineutrino NC coherent π^0 production
- The π^0 analysis remains statistics limited and more antineutrino data will help in addressing the NC coherent π^0 production question
- We will start up with 50m absorber running which will be useful for cross section normalization as well as this analysis

Acknowledgments

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