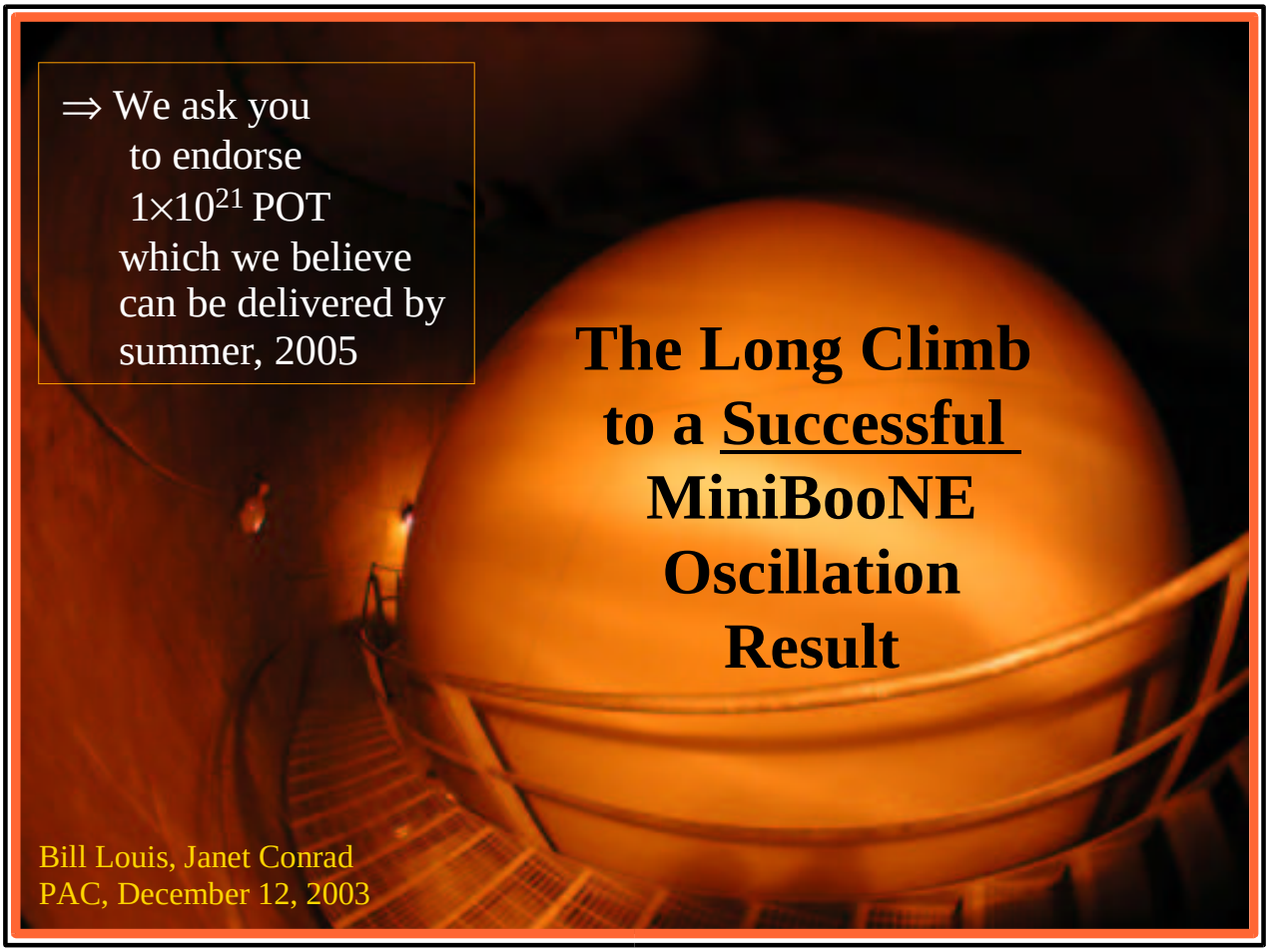


MiniBooNE Status & Run Plan

presentation to FNAL PAC, 12/12/03

Louis

- **Present Evidence for ν oscillations**
- **MiniBooNE Status**
- **Non-Oscillation Physics Results**

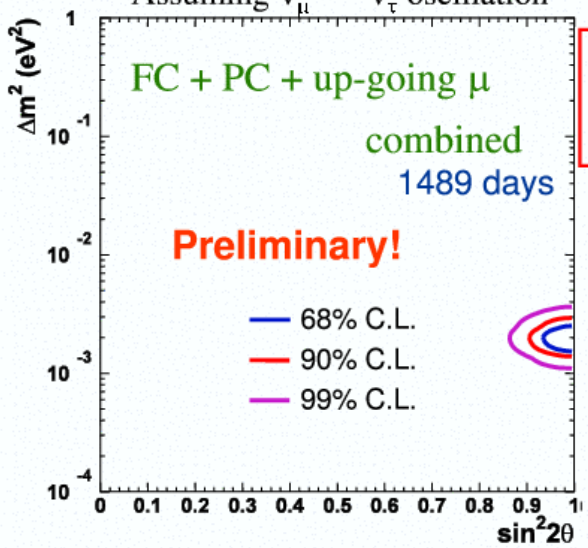
Conrad

- **Oscillation Physics**
- **MiniBooNE Run Plan**
- **EOI for Continued MiniBooNE Running**

Allowed region in Super-Kamiokande atmospheric ν data

(complete SK-I data-set)

Assuming $\nu_\mu \rightarrow \nu_\tau$ oscillation

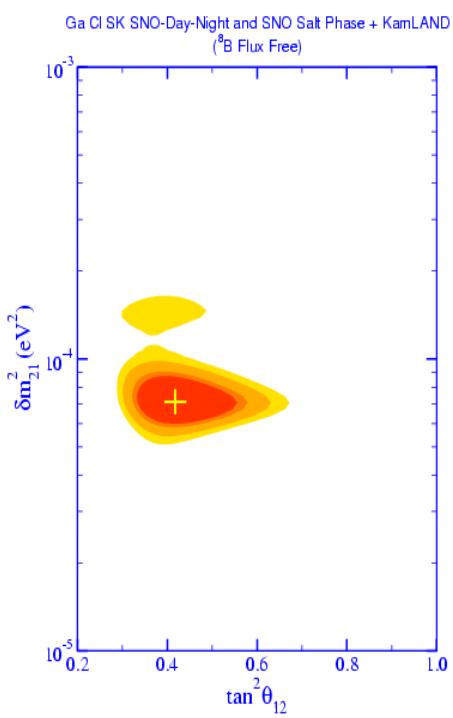


90% CL allowed region
$\sin^2 2\theta > 0.9$
$1.3\times10^{-3} < \Delta m^2 < 3.0\times10^{-3}\,eV^2$

Best fit
$(\sin^2 2\theta, \Delta m^2)$
$= (1.0, 2.0 \times 10^{-3}\ eV^2)$
$\chi^2_{min} = 170.8/170$ d.o.f.

Assuming null oscillation
$\chi^2 = 445.2/172$ d.o.f.

Allowed Solar Oscillation Regions



Balantekin &Yuksel, hep-ph/0309079

Any Hint of An Anomaly in Solar & Atmospheric?

Solar & Atmospheric Data Agree Beautifully with 3-Generation Mixing!

However, Is There Any Hint of an Anomaly?

One Example: (de Holanda & Smirnov; hep-ph/0307266)

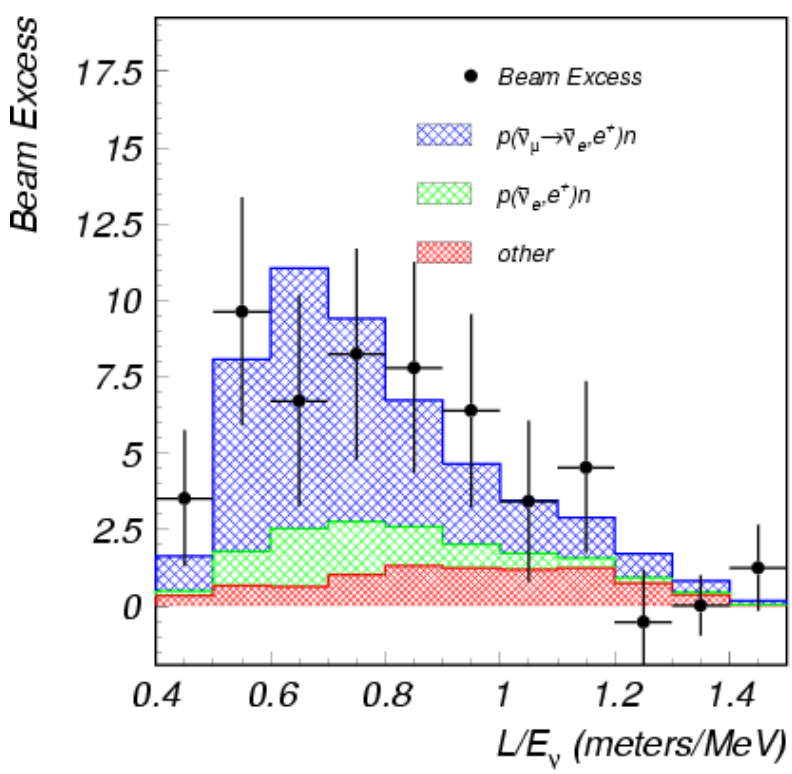
Homestake is 2-sigma low and solar energy spectrum is too flat;
Resolved with a light sterile neutrino with

$\sin^2 2\theta = (10^{-5} - 10^{-3})$

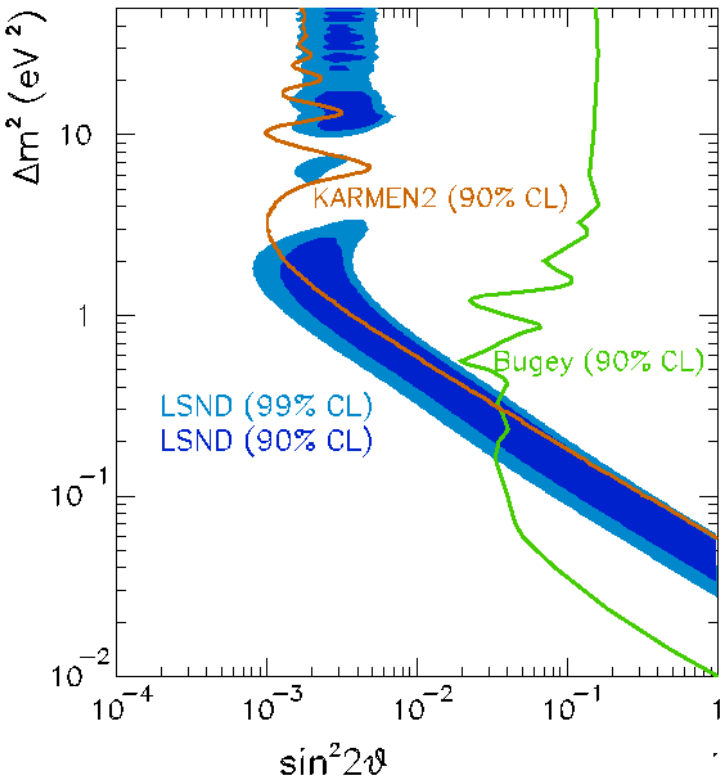
$\Delta m^2 = (2 - 10) \times 10^{-5}\ eV^2$

More Precision Data is Needed!

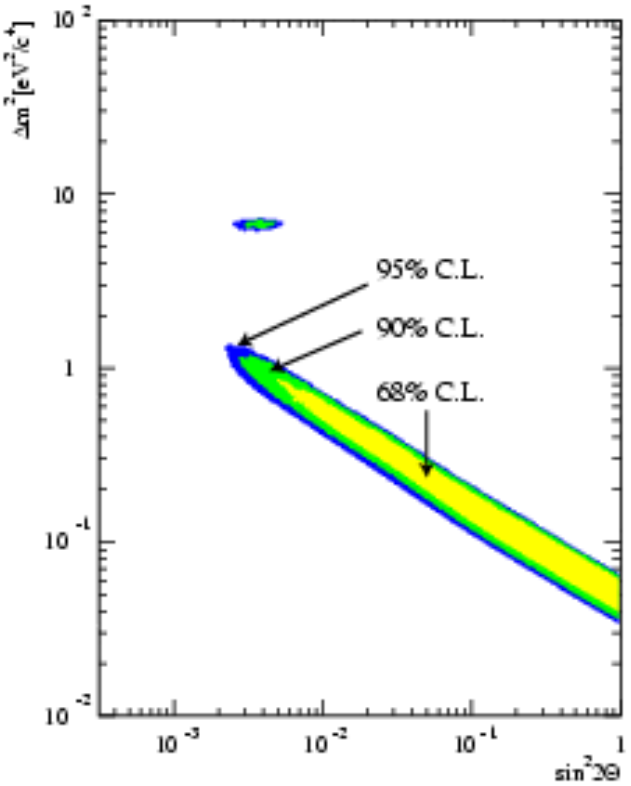
Evidence for Oscillations from LSND



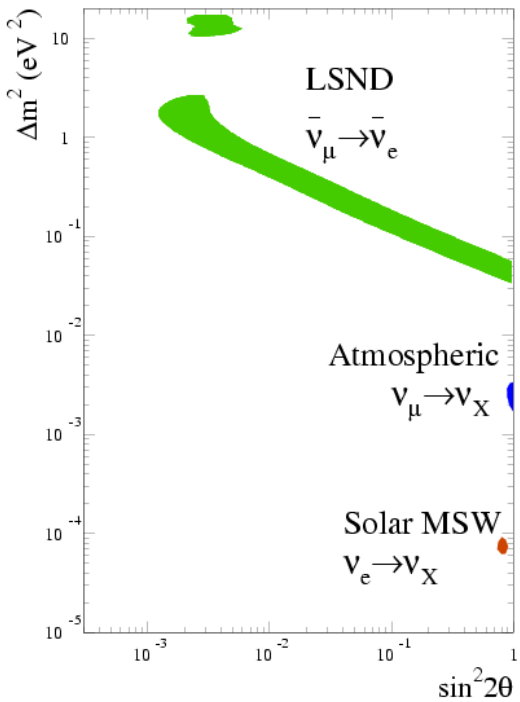
Event Excess ~ 3.8σ
Osc. Prob. ~ 3.3σ
Osc. Fit ~ 4σ



Joint KARMEN/LSND Analysis



Current State of Neutrino Oscillation Evidence



Expt.	Type	Δm^2 (eV^2)	$\sin^2 2\theta$
LSND	$\bar{\nu}_\mu \rightarrow \bar{\nu}_e$	~1	~3×10^{-3}
Atm.	$\nu_\mu \rightarrow \nu_\tau$	~2×10^{-3}	~1
Solar	$\nu_e \rightarrow \nu_{\mu,\tau}$	~7×10^{-5}	~0.8

How Can We Explain Solar, Atmospheric, & LSND?

Problem:

3 separate Δm^2 observed, which cannot be explained by 3 $m_{\nu i}$!?!

Possible Solutions:

(1) Non-Standard Interactions (e.g. Lepton # Violating Muon Decay for LSND: $\mu^+ \rightarrow e^+ \bar{\nu}_e \bar{\nu}_i$, tested by TWIST)

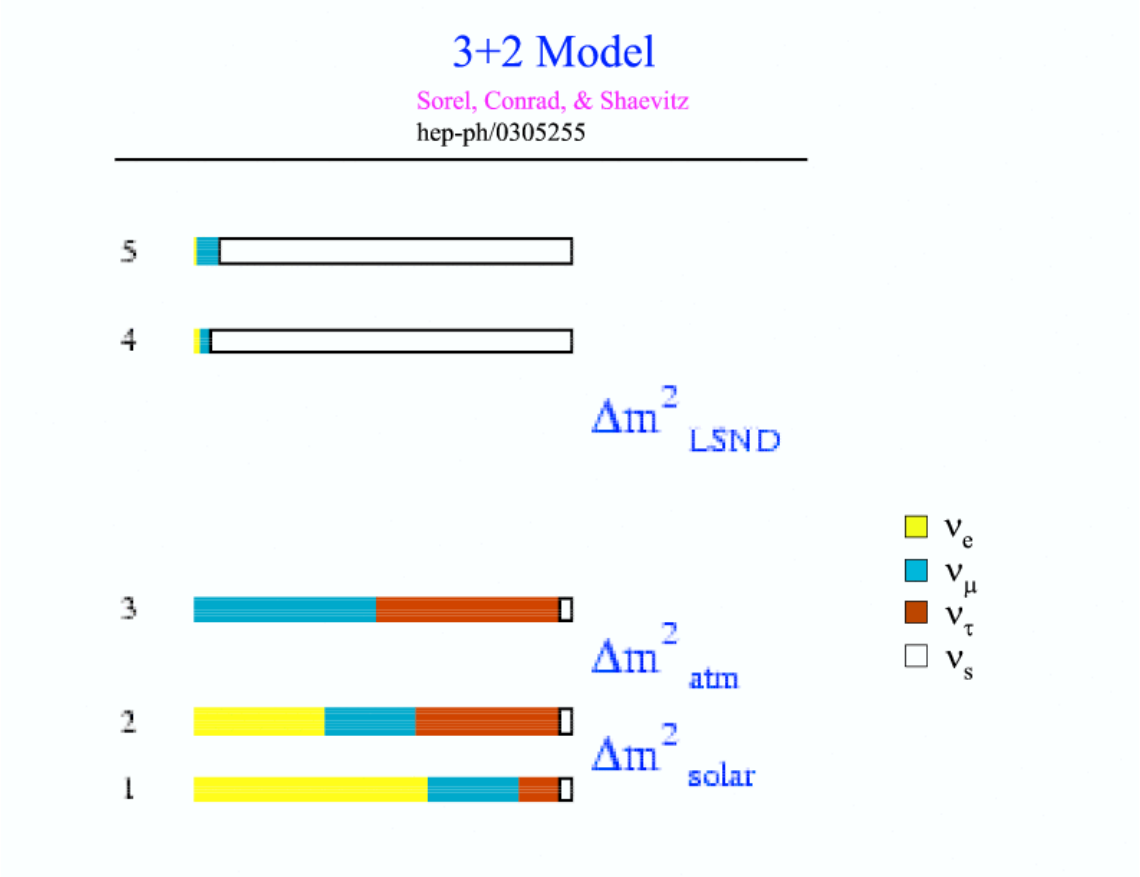
(2) Sterile neutrinos (2+2 or 3+1 or 3+2)

(3) CPT Violation ($m_\nu = m_{\bar{\nu}}$?)

Light Sterile Neutrinos?

- In (2+2) models, solar and atmospheric can be explained by a combination of active & sterile oscillations.
- In (3+1) & (3+2) models, LSND can be explained by heavier sterile neutrinos.
- There is tension with sterile neutrino models explaining all of the data, but the (3+2) model gives a reasonable fit.

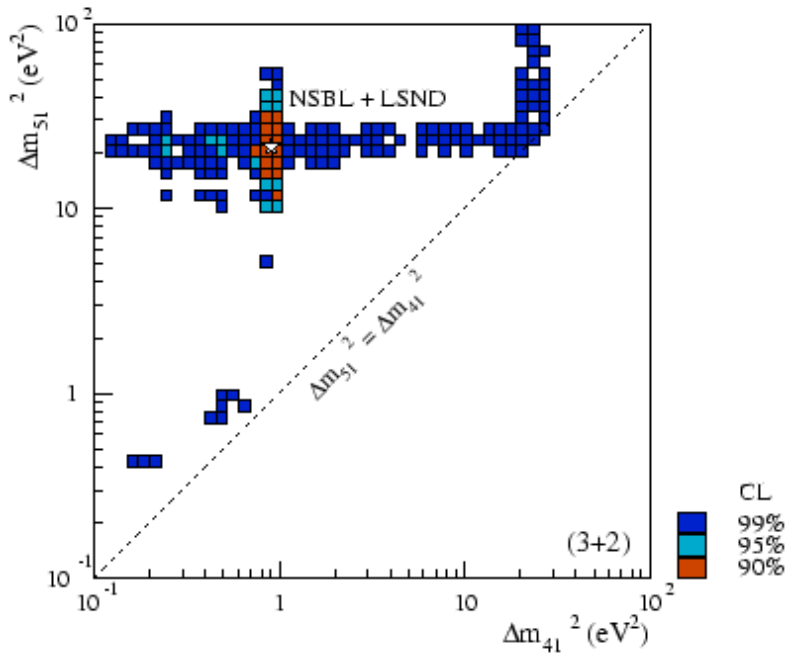
Light, sterile neutrinos could have a big impact on BBN, the r-process in Supernovae, the mass of the universe (cold, warm, or hot), pulsar kicks, and possibly dark energy.



3+2 Model

Sorel, Conrad, & Shaevitz

hep-ph/0305255



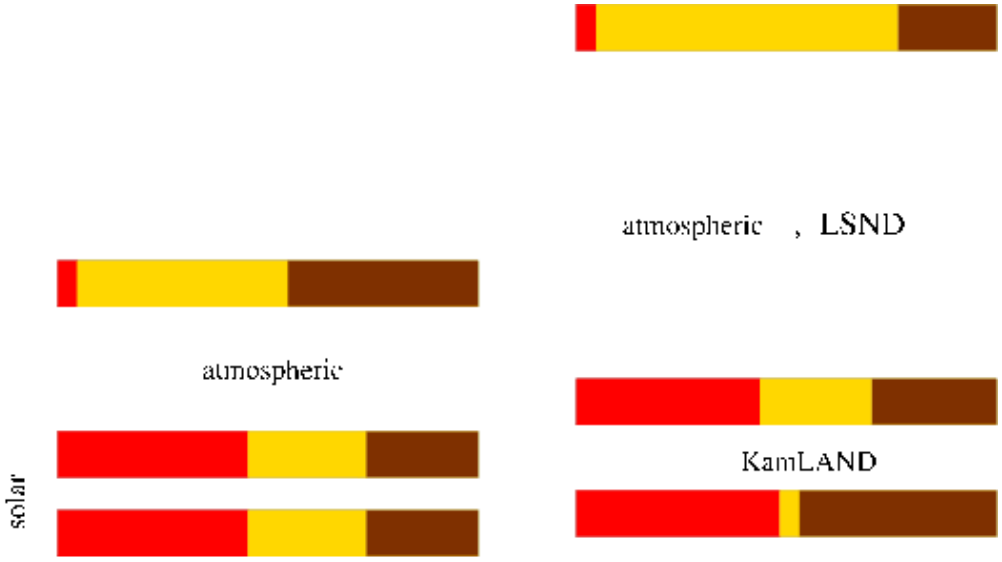
CPT Violation ?

- The possibility of CPT violation is motivated by theories of Extra Dimensions, where CPT is conserved in N dimensions but violated in 4 dimensions.
- If CPT is violated in the neutrino sector, then there are 4 independent Δm^2 and not just 2.
- CPT violation can provide a natural explanation for the baryon asymmetry of the universe.

CPT Violation Model

Barenboim, Borissov, & Lykken

hep-ph/0212116



Fundamental Questions to be Answered

(Neutrinos are still largely unknown)

x What is the Resolution of the 3-Δm^2 Paradox?

x What are the Neutrino Masses & Hierarchy?

x What are the Neutrino Mixings?

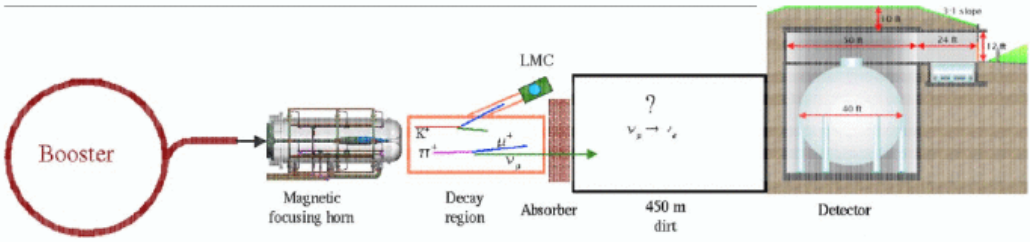
x Do Light, Sterile Neutrinos Exist?

x Is CP Conserved in the Neutrino Sector?

x Is CPT Conserved in the Neutrino Sector?

Are Neutrinos Dirac or Majorana?

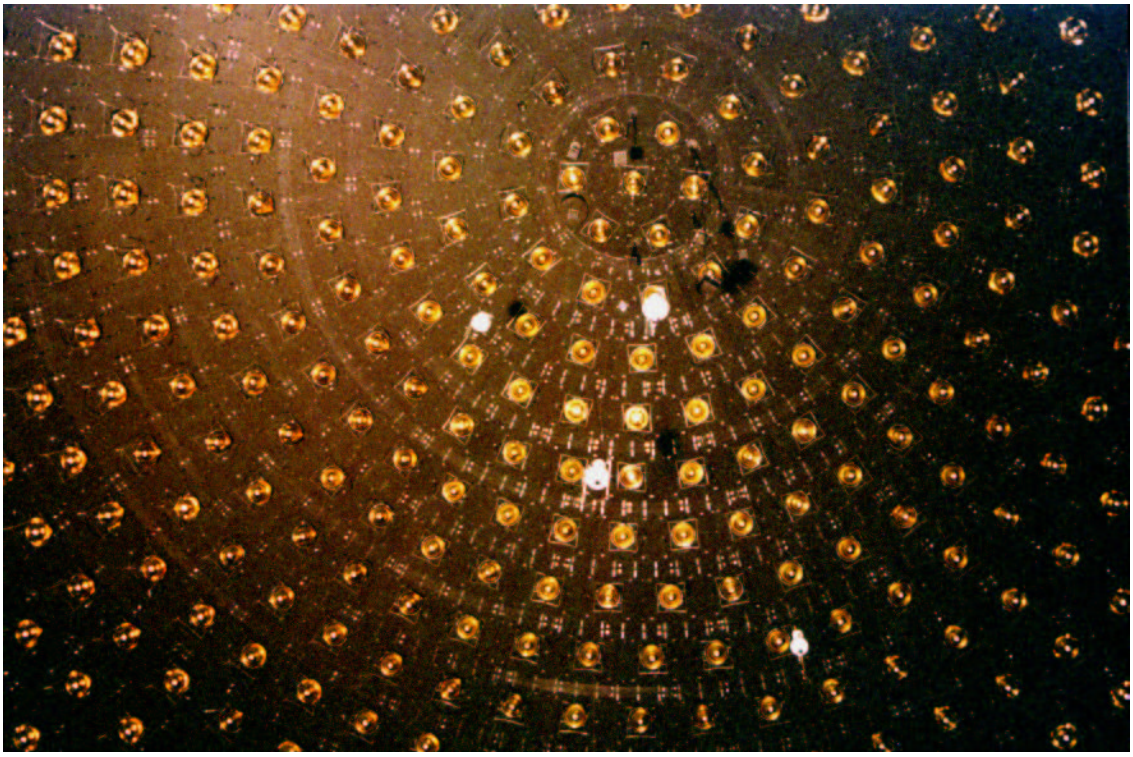
MiniBooNE - A Definitive Test of the LSND Evidence for ν Oscillations



- Booster - 8 GeV proton beam (5 x 10^{20} POT/y)
- Target - 71 cm Be
- Horn - 5 Hz, 170 kA, 143 μs, 2.5 kV, 10^8 pulses/y
- Decay Pipe - 50 m (adjustable to 25 m)
- Neutrino Distance - ~ 0.5 km
- $\langle E_\nu \rangle$ ~ 1 GeV
- $(\nu_e / \nu_\mu) \sim 3\times10^{-3}$
- Detector - 40' diameter spherical tank
- Mass - 800 (450) tons of mineral oil
- PMTs - 1280 detector + 240 veto, 8" diameter

Alabama, Bucknell, Cincinnati, Colorado, Columbia, Embry-Riddle, FNAL, Indiana, LANL, LSU, Michigan, Princeton

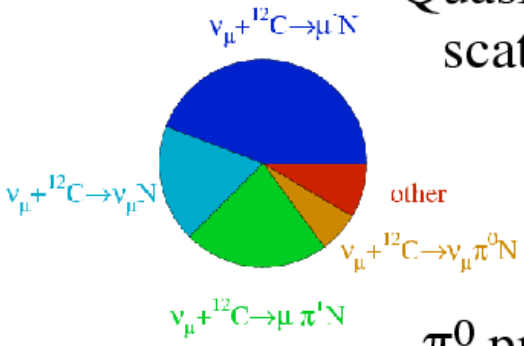
Inside the MiniBooNE Detector



MiniBooNE Monte Carlo

Quasielastic scattering

Neutral Current Events



π^0 production

NUANCE

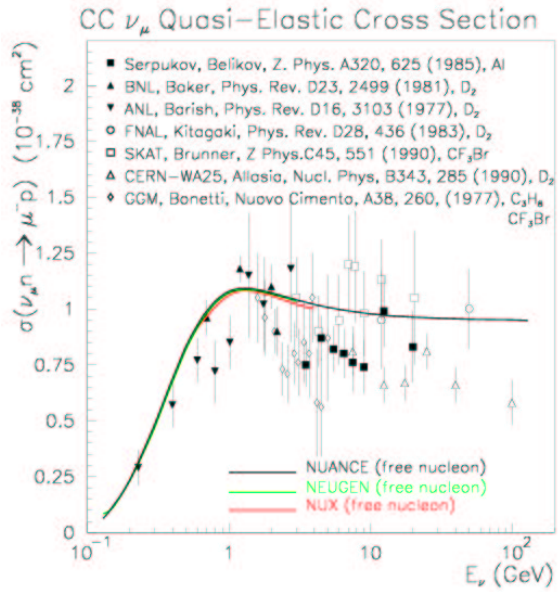
The NUANCE MC includes:

- Large library of data used as cross-check
- Full complement of final state processes
- Nuclear effects in Carbon
- Capability to compare to Jlab data

Written by Dave Casper,
Cross Checked by Sam Zeller

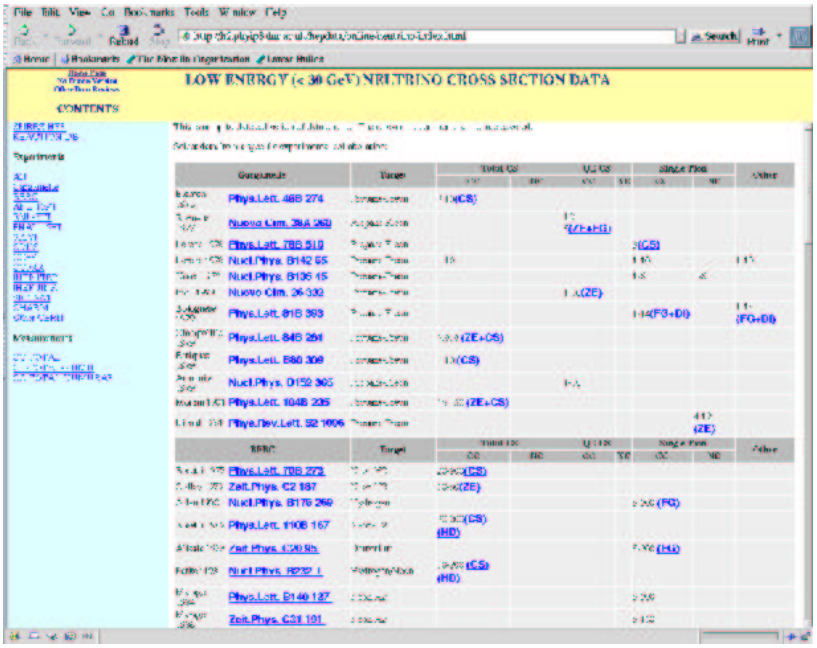
Code is *publicly available*
A world-wide collaboration.

Not a large amount of data in our region,
But there are constraints above and below...



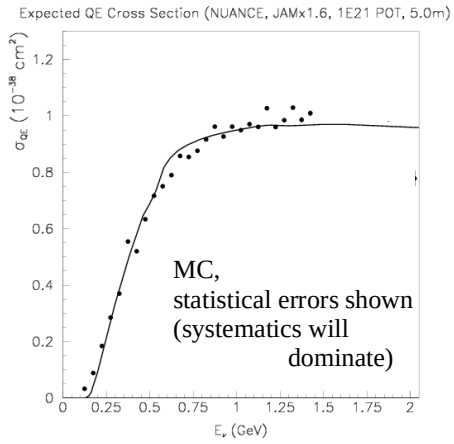
Contributions to Durham Data Base

The Durham Data base has asked for our library of past cross section measurements!



MiniBooNE QE Cross Section Expectation

Because we obtain E_ν^{QE} w/ 10% resolution:



Very large event sample:

MB	550k	(by 2005)
FINeSSE	145K	(2006-7)
Minerva	335K	(2006-9)

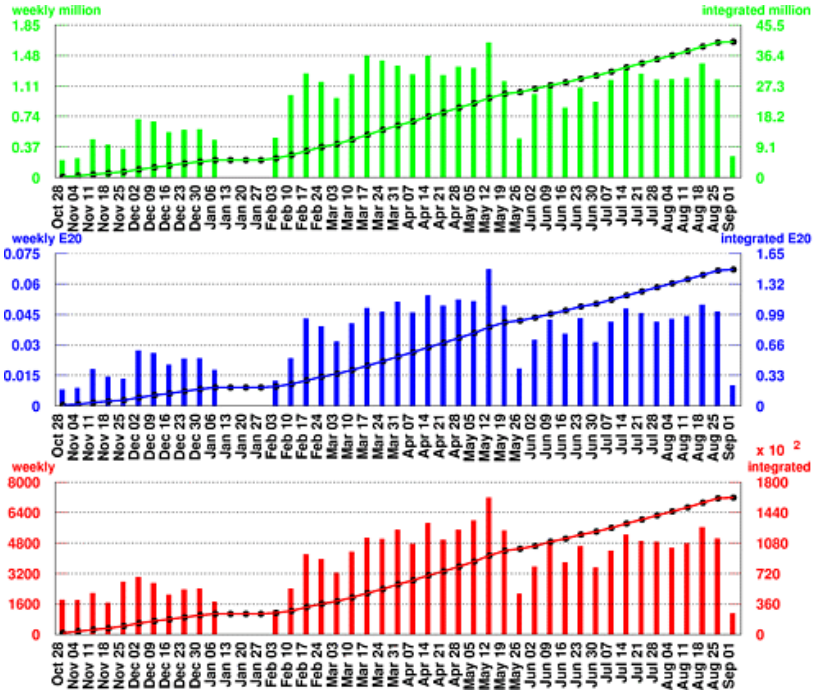
- Excellent QE purity
- <2% event $\bar{\nu}$ contamination
- small incoming ν angle (allows Q^2 recon)

- The same energy range as SK atmospheric & off axis experiments
- Carbon nuclear effects, Similar to Oxygen (for SK)
- Study nuclear effects at low energies (20% of events)
- Extract QE cross section at high energies

MiniBooNE Status

- **Beamline & Detector Working Beautifully!**
- **Booster proton intensity within a factor of 2 of goal**
- **~99% of all PMT channels working well**
- **DAQ livetime is ~ 99%**
- **Time, energy, position, & angular resolutions consistent with expectations**
- **Neutrino event rate consistent with expectations**
- **Clearly reconstructing CC μ events & NC π^0 events & NC elastic events**

First Year Of MiniBooNE Operations



Number of Horn Pulses

To date: 40.54 million

Largest week: 1.63 million

Latest week: 0.25 million

Number of Protons on Target

To date: 1.4769 E20

Largest week: 0.0671 E20

Latest week: 0.0101 E20

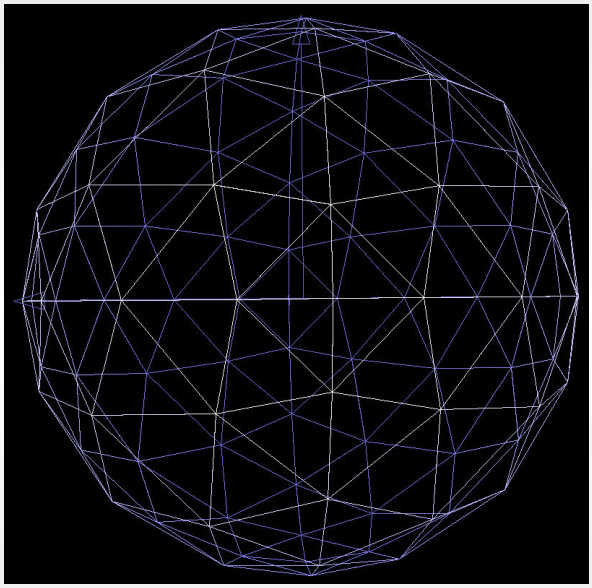
Number of Neutrino Events

To date: 161838

Largest week: 7192

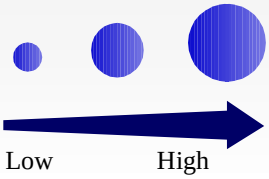
Latest week: 1091

Muon Decay Candidate

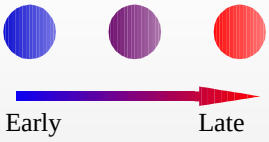


Each frame is 25 ns with 10 ns steps.

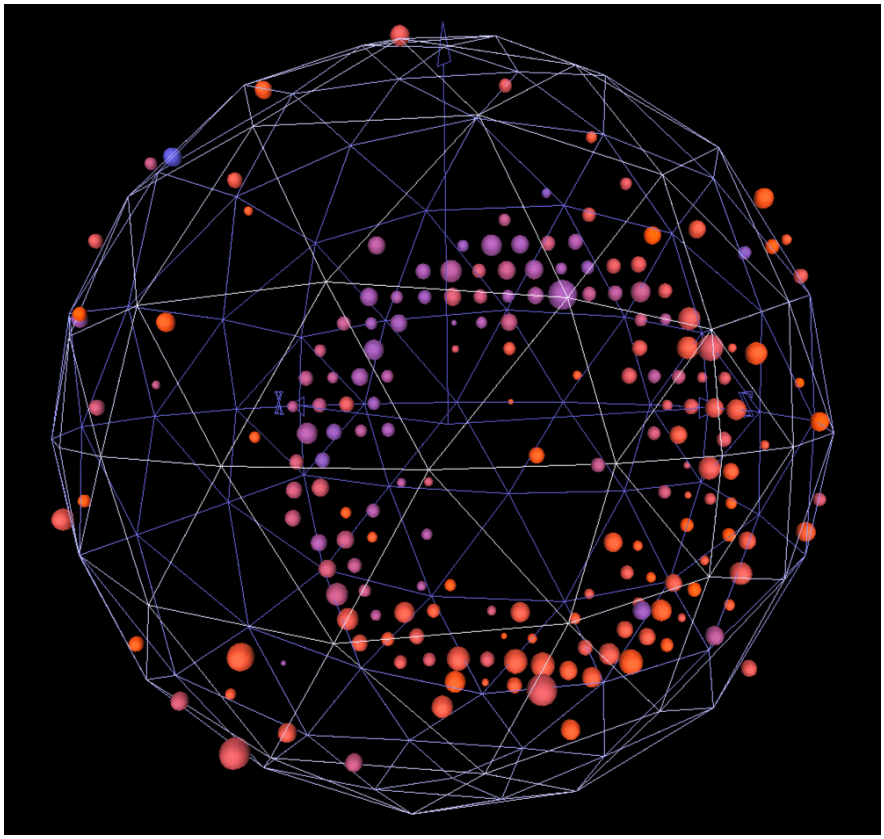
Charge (Size)



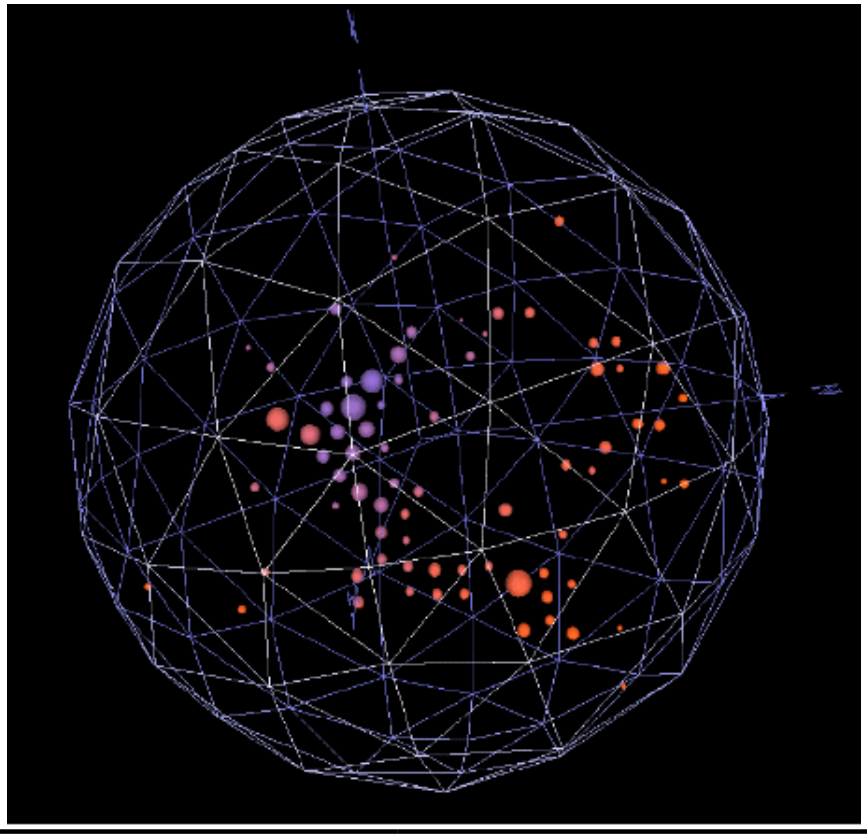
Time (Colour)



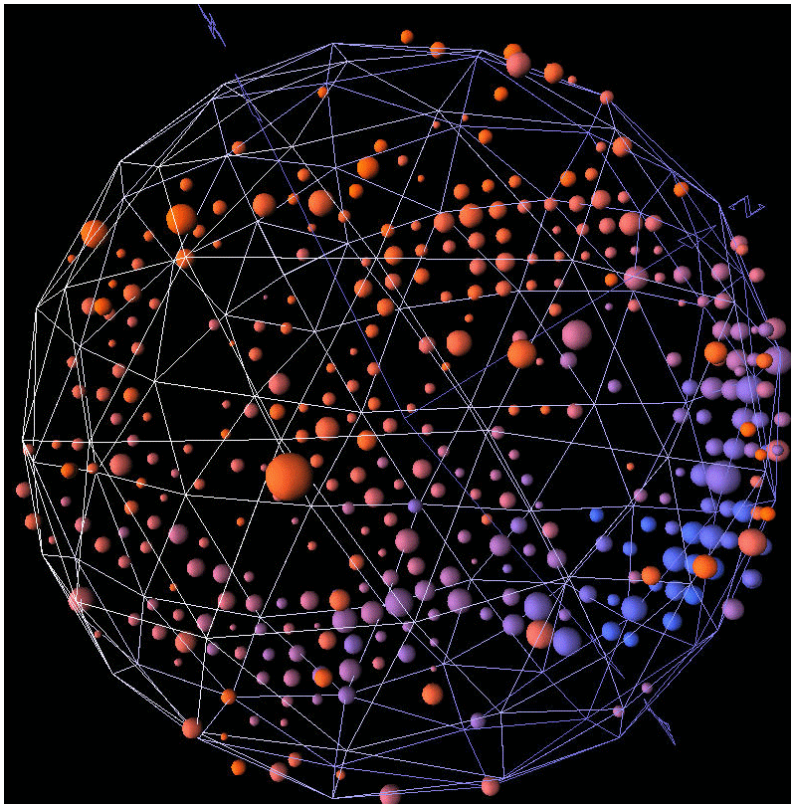
Typical Muon-Neutrino Event



Typical Michel Electron Event

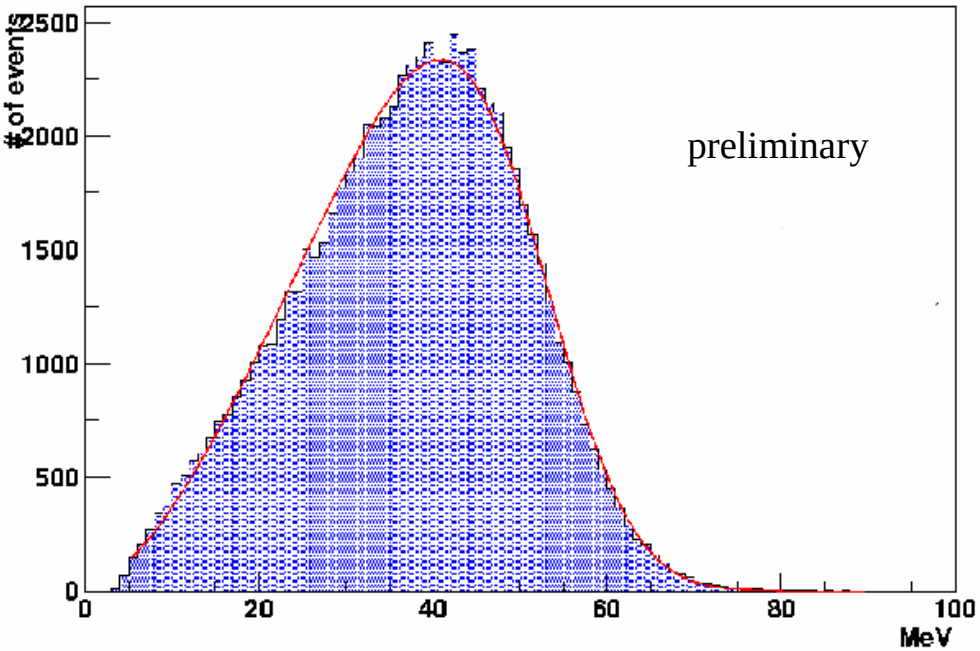


"Typical" π^0 Event



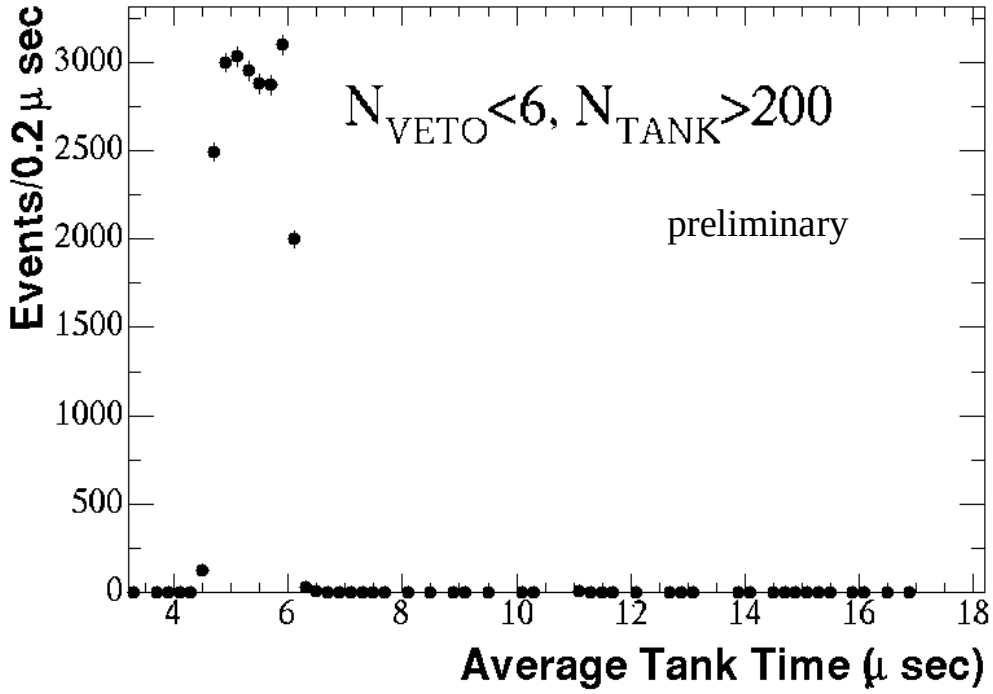
Energy Calibration

(Use Michel electrons from muon decay to determine energy scale & resolution. Resolution ~ 14.8% at 52.8 MeV endpoint.)

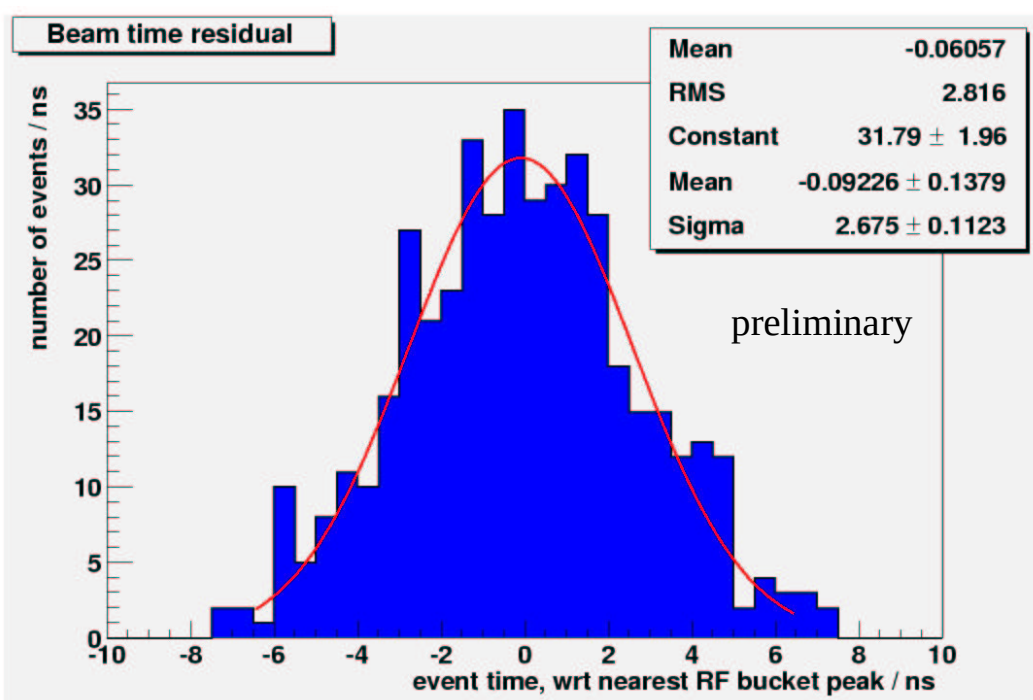


Neutrino Events Are Very Clean!

(Neutrino Signal to Cosmic-Ray Background ~ 1000 to 1!)

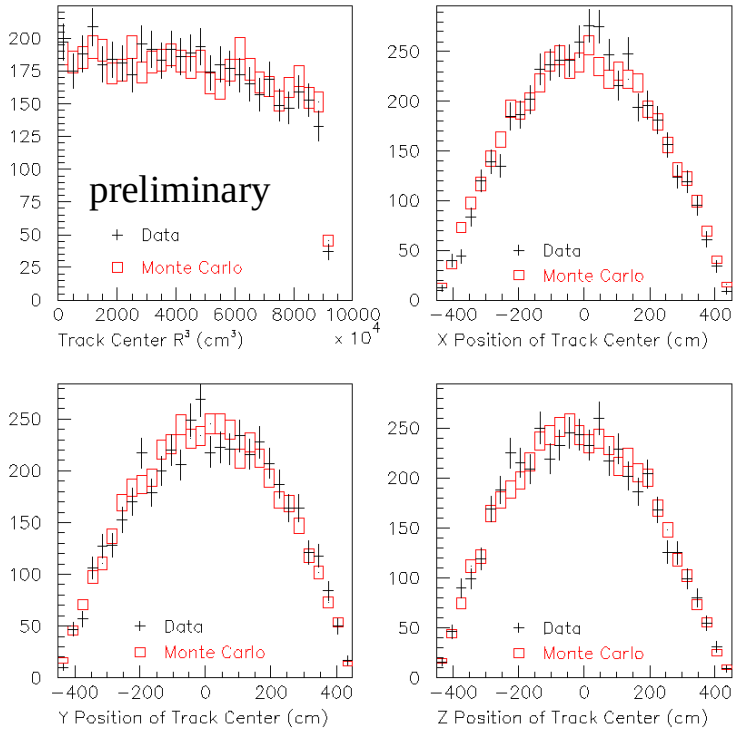


Beam Timing With Respect To RF Bucket

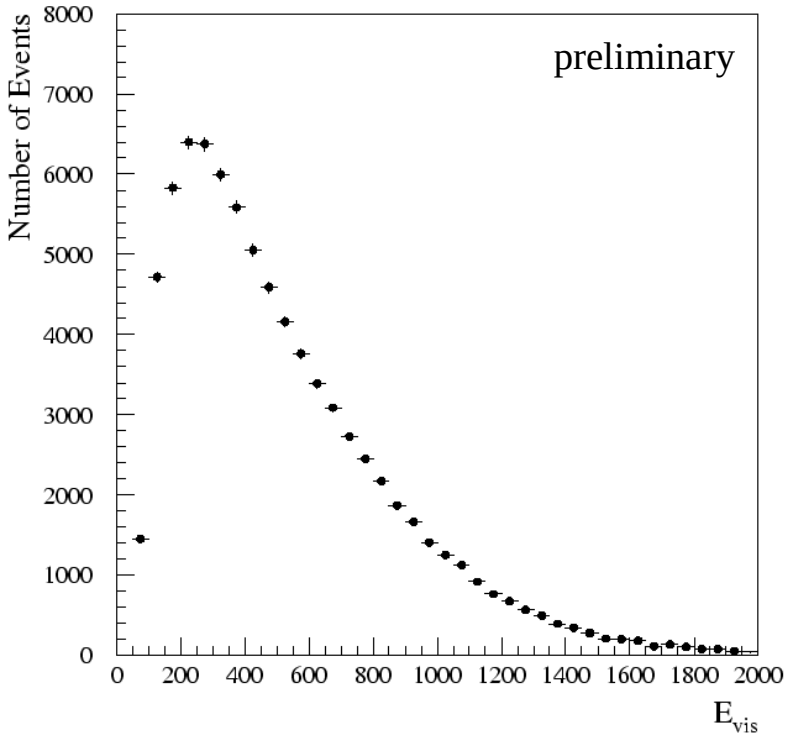


Spatial Distribution of Neutrino Events

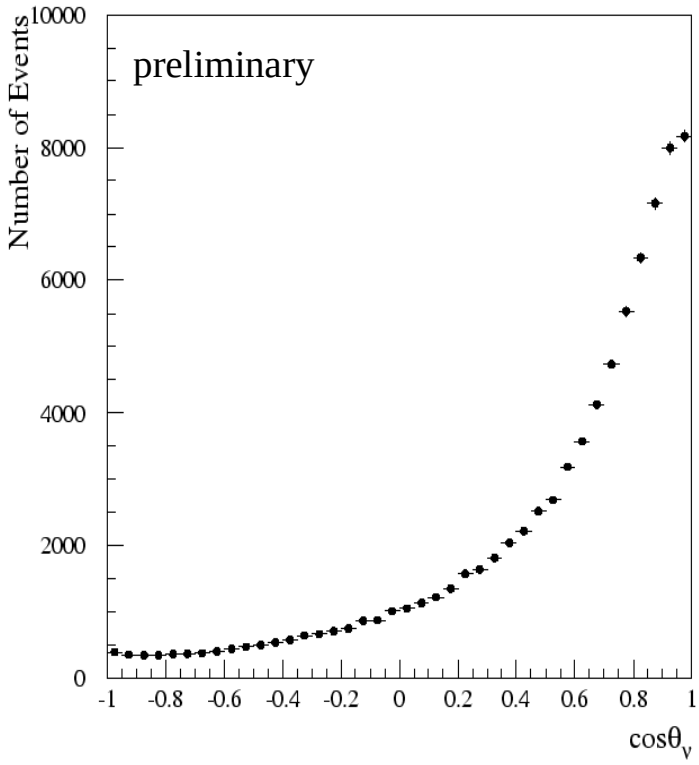
(Good Agreement Between Data & MC)



Neutrino Event Visible Energy Distributon



Neutrino Event Angular Distribution



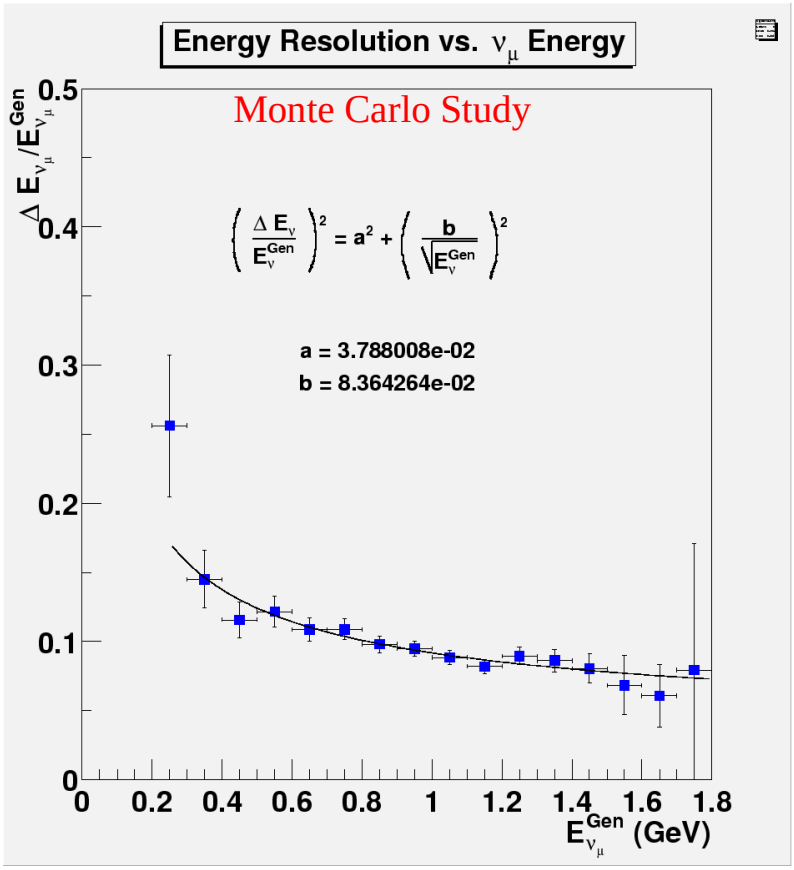
I. CC QE Events ν_μ C -> μ^- p C*

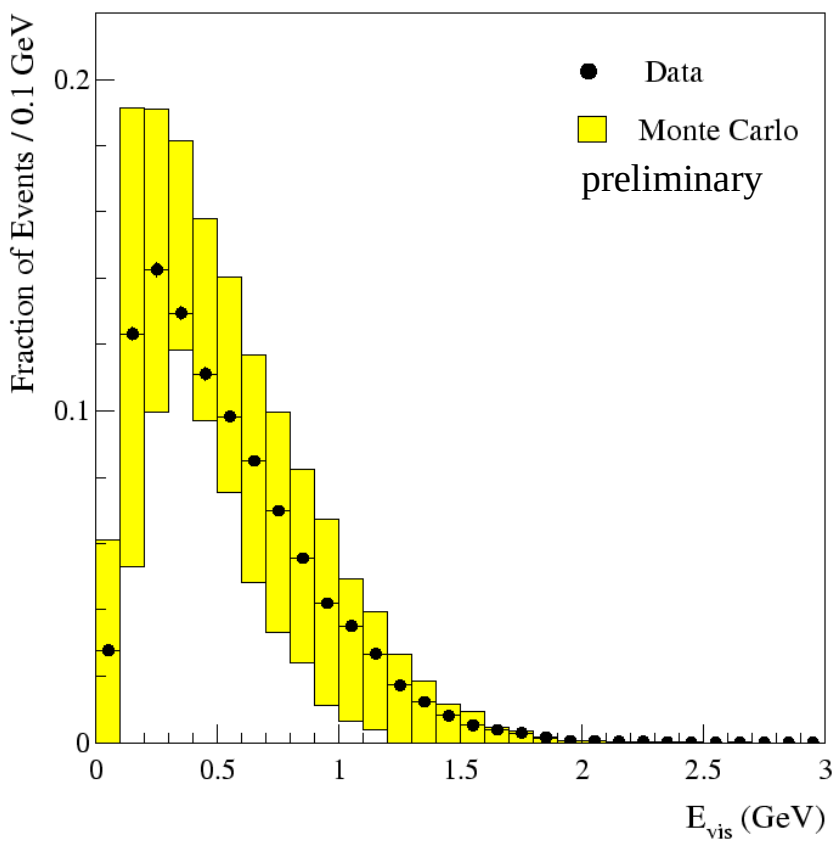
Important for ν_μ Disappearance

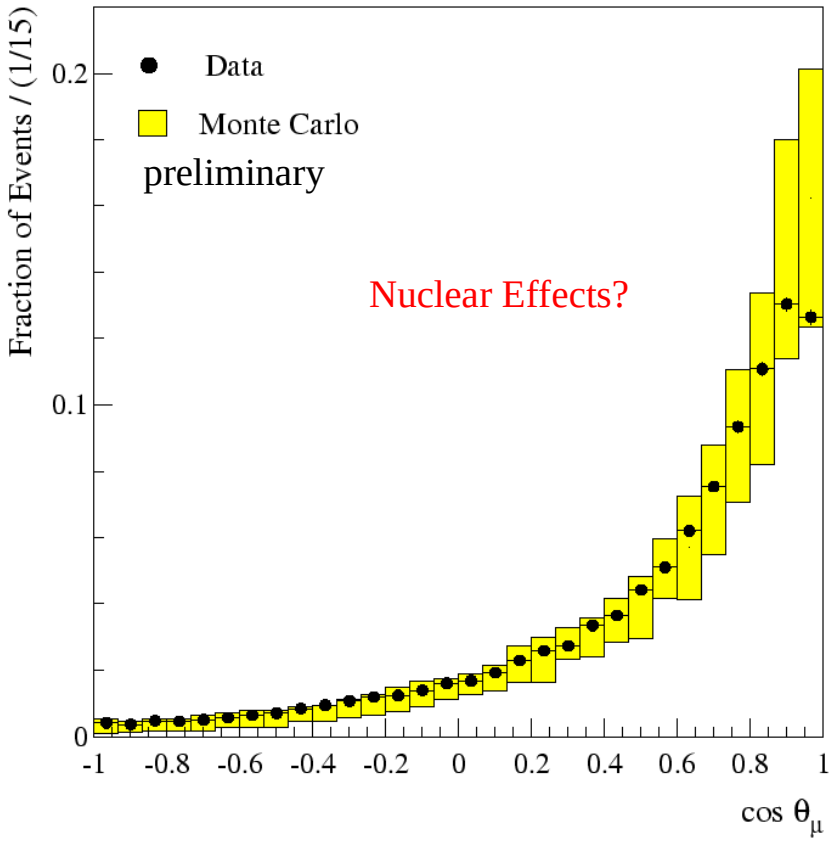
Important for ν_e Appearance

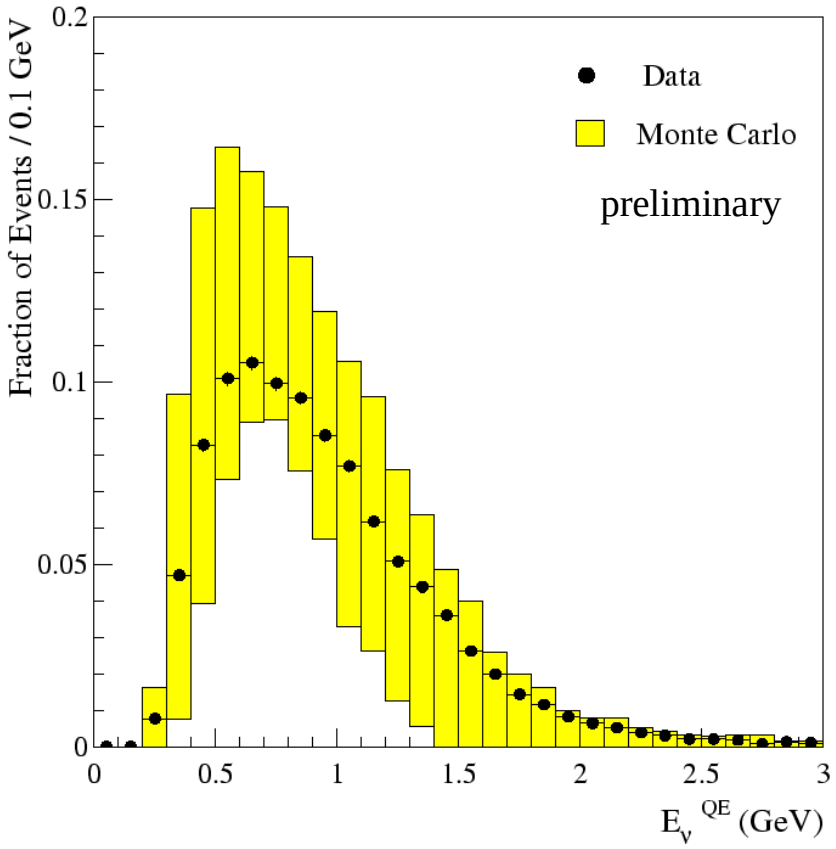
Selection: Single ring event, consistent with a muon

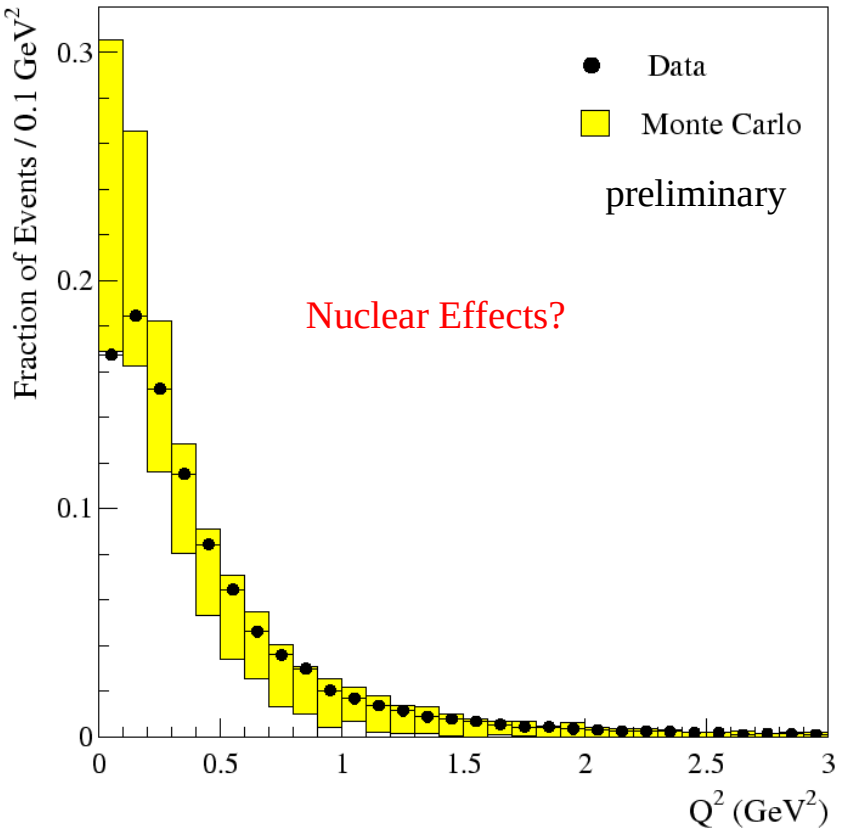
Data/MC shape comparison only


Energy Resolution vs. ν_μ Energy
Monte Carlo Study
$\left(\frac{\Delta E_\nu}{E_\nu^{Gen}}\right)^2 = a^2 + \left(\frac{b}{\sqrt{E_\nu^{Gen}}}\right)^2$
a = 3.788008e-02
b = 8.364264e-02
$\Delta E_{\nu_\mu}/E_{\nu_\mu}^{Gen}$
$E_{\nu_\mu}^{Gen}$ (GeV)


Data
Monte Carlo
preliminary
Fraction of Events / 0.1 GeV
E_{vis} (GeV)


Fraction of Events / (1/15)
0.2
0.1
0
Data
Monte Carlo
preliminary
Nuclear Effects?
-1
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
1
cos θμ


Fraction of Events / 0.1 GeV
0.2
0.15
0.1
0.05
0
Data
Monte Carlo
preliminary
0
0.5
1
1.5
2
2.5
3
Eν QE (GeV)



II. NC π^0 ν_μ C -> ν_μ π^0 n C*

Contributions from:

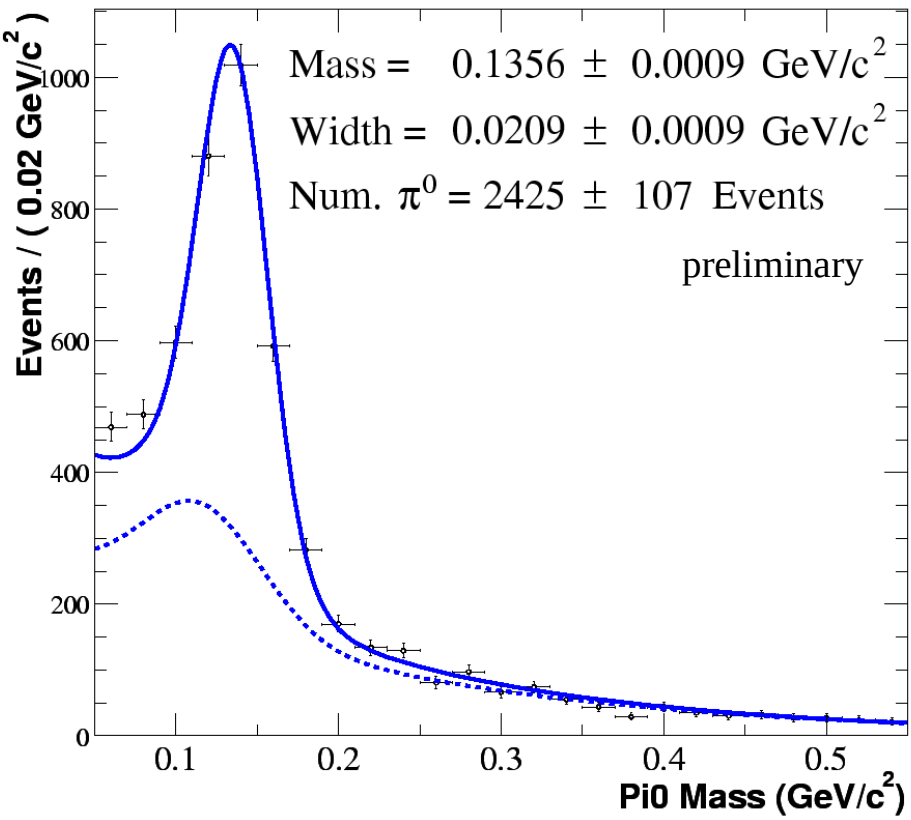
Resonance Production

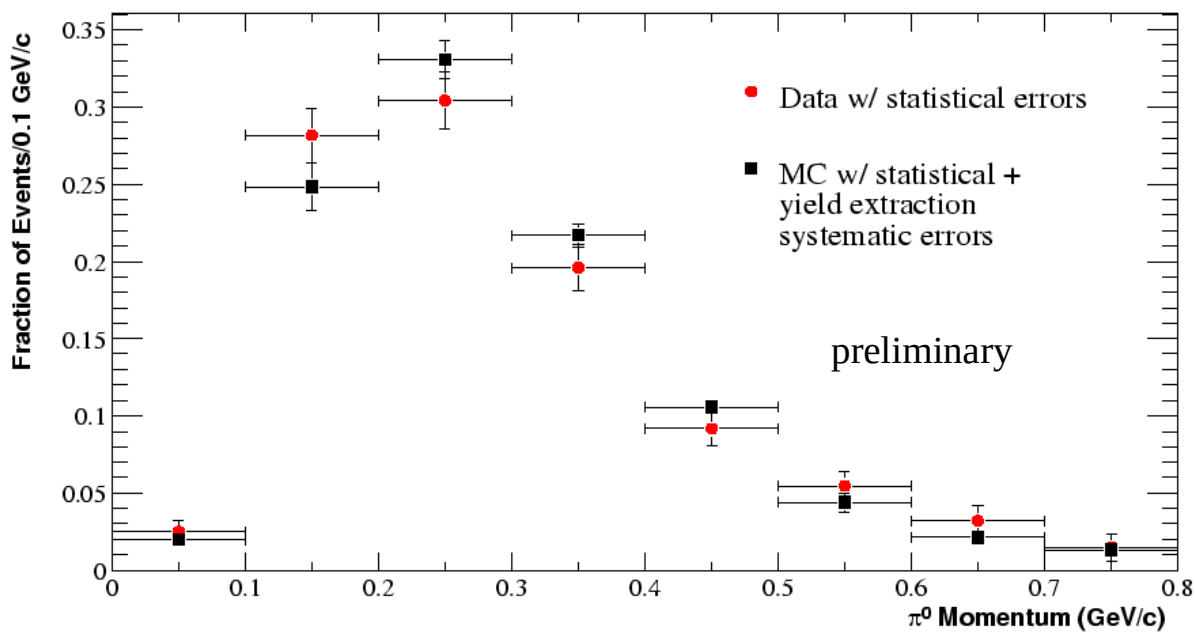
Non-Resonance Production

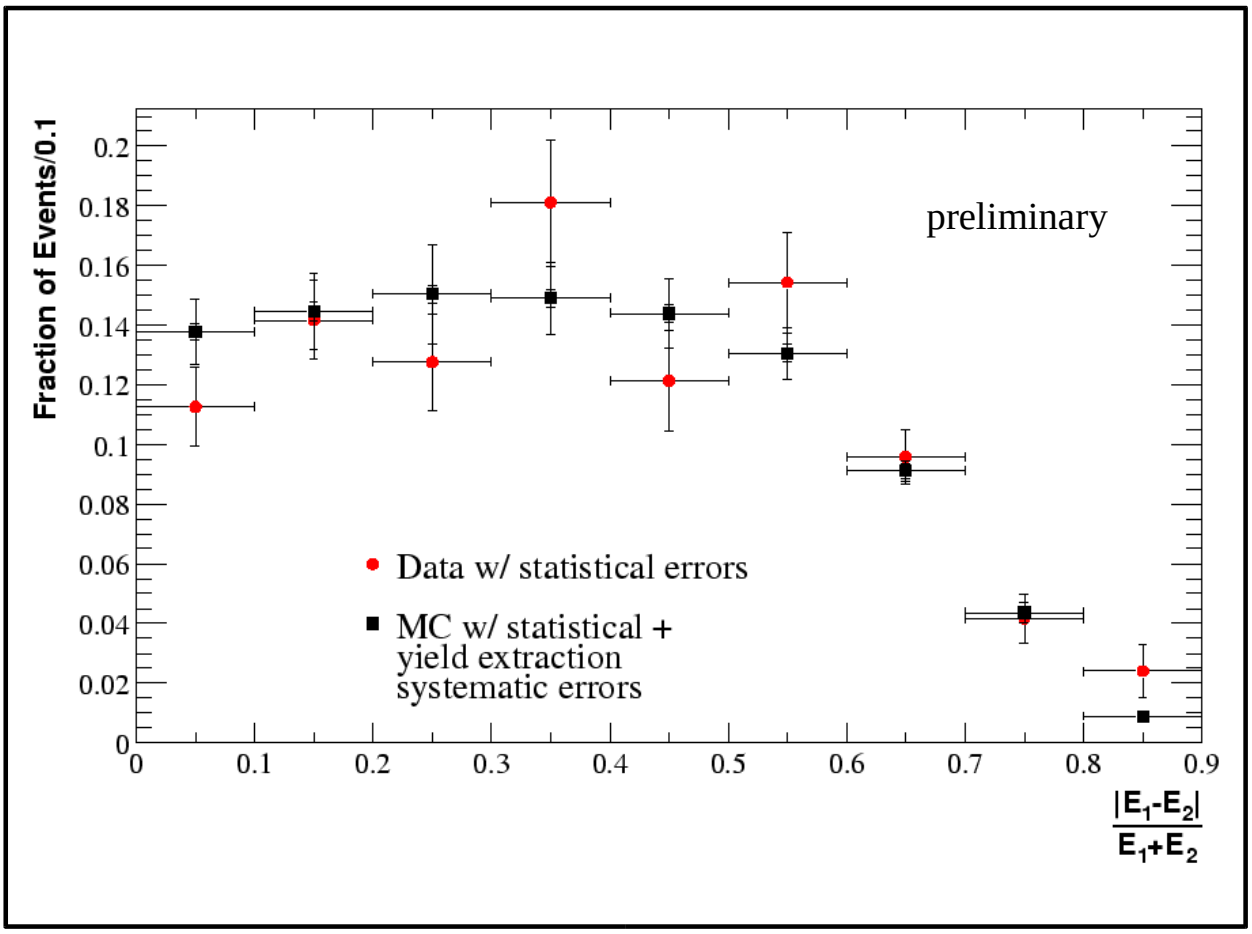
Coherent Production

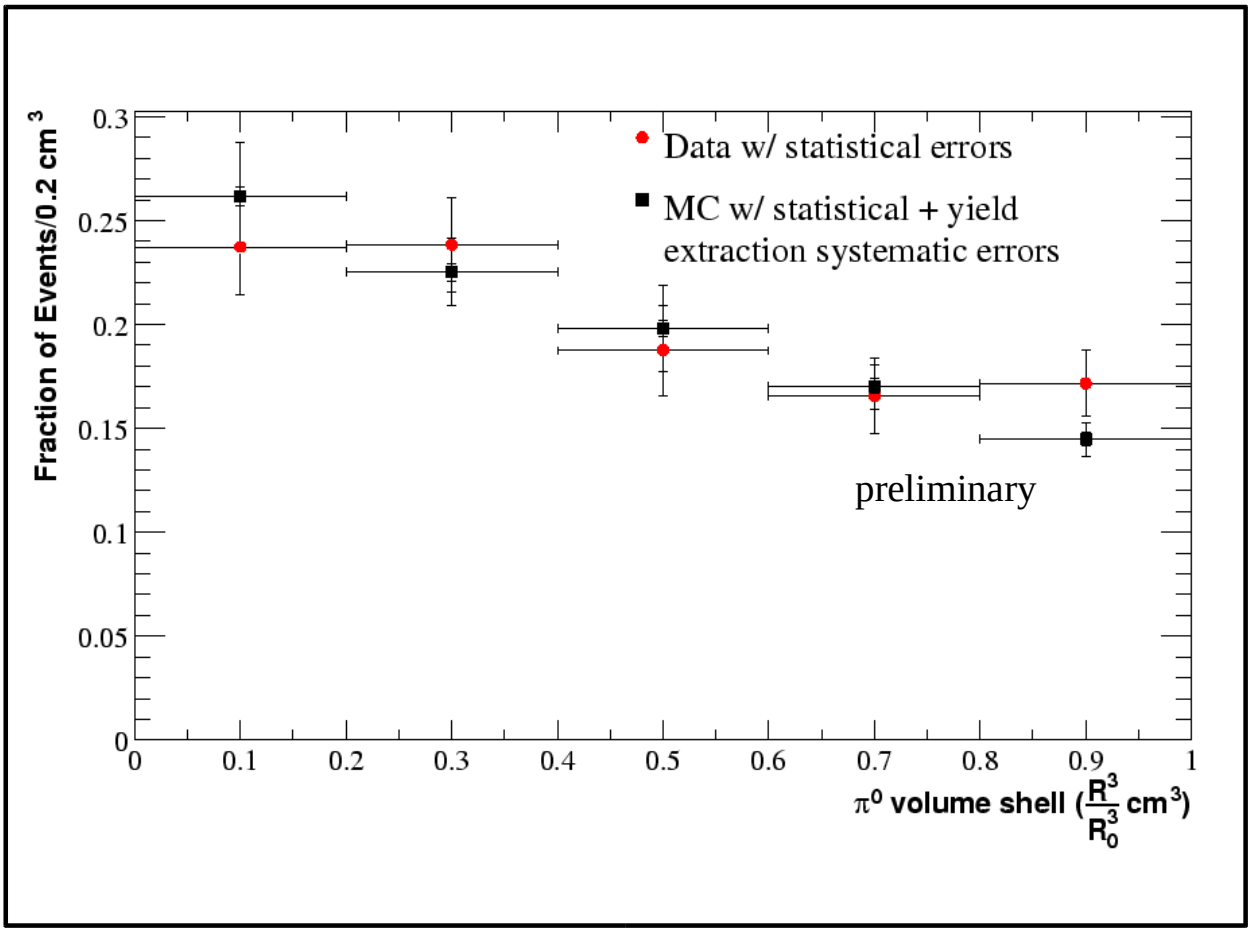
Selection: 2 rings with >40 MeV per ring

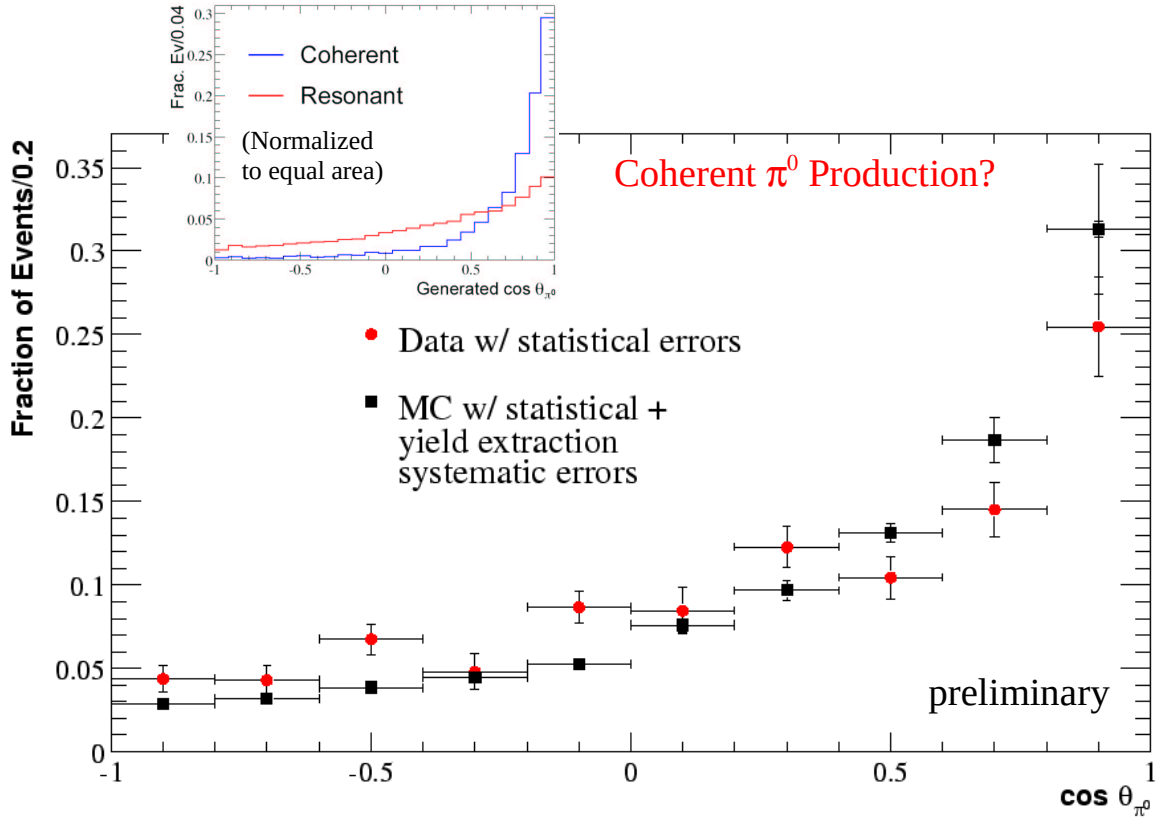
Data/MC shape comparison only


Mass = 0.1356 ± 0.0009 GeV/c^2
Width = 0.0209 ± 0.0009 GeV/c^2
Num. π^0 = 2425 ± 107 Events
preliminary
Events / (0.02 GeV/c^2)
Pi0 Mass (GeV/c^2)


Data w/ statistical errors
MC w/ statistical + yield extraction systematic errors
preliminary
Fraction of Events/0.1 GeV/c
π^0 Momentum (GeV/c)

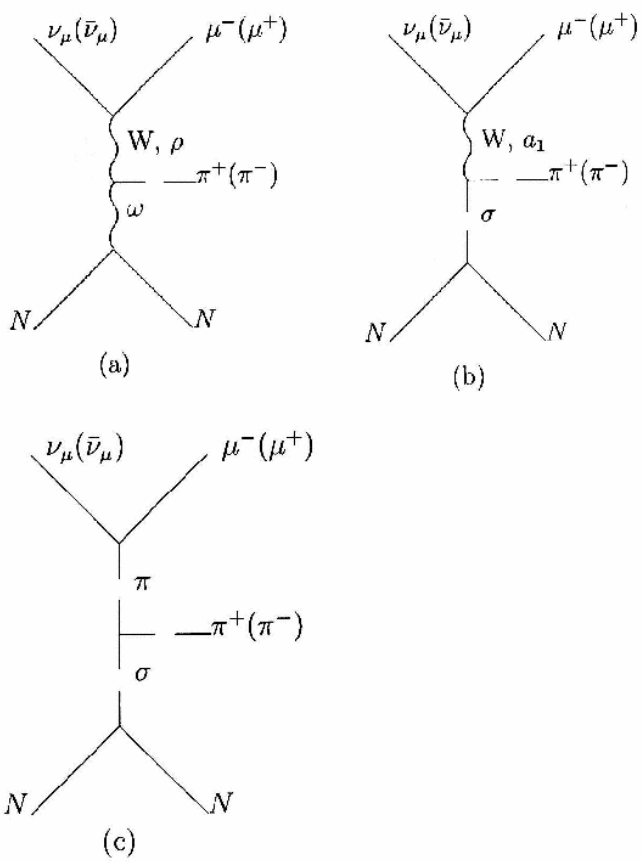

Fraction of Events/0.1
preliminary
Data w/ statistical errors
MC w/ statistical + yield extraction systematic errors
$\frac{|E_1-E_2|}{E_1+E_2}$


Fraction of Events/0.2 cm^3
Data w/ statistical errors
MC w/ statistical + yield extraction systematic errors
preliminary
π^0 volume shell ($\frac{R^3}{R_0^3}$ cm^3)



Coherent π^0 Production

Paschos & Kartavtsev (hep-ph/0309148) predict a much smaller cross section than Rein & Sehgal (Nucl. Phys. B223 (1983) 29)



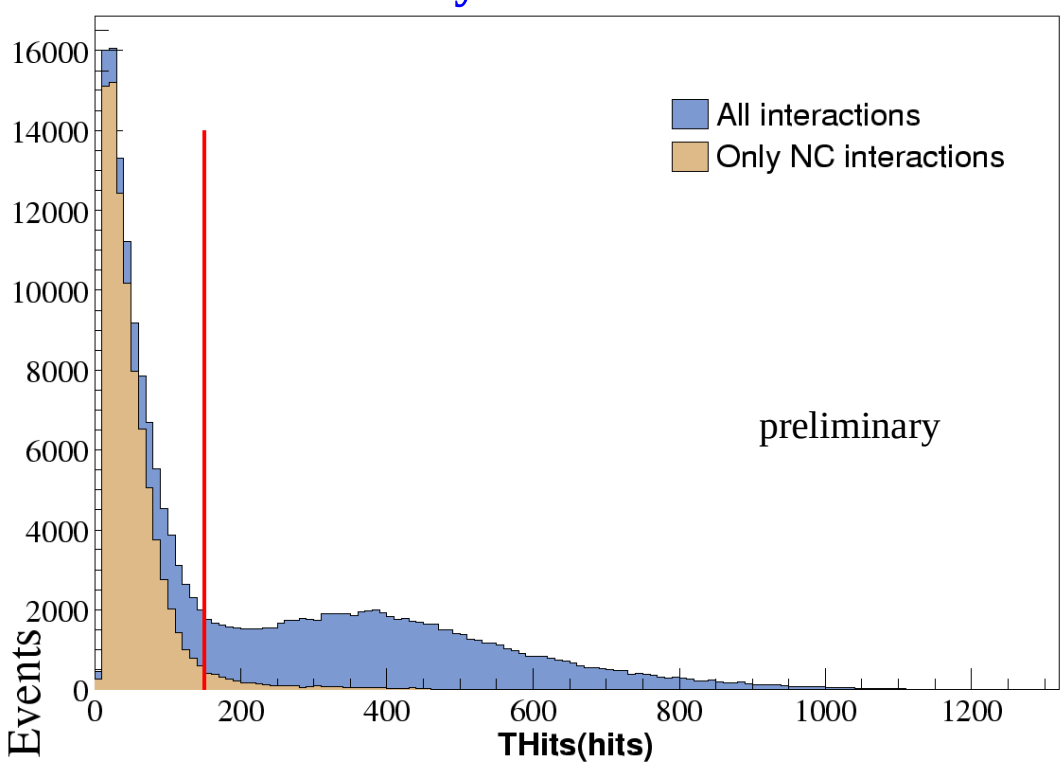
III. NC Elastic ν_μ C -> ν_μ p B*

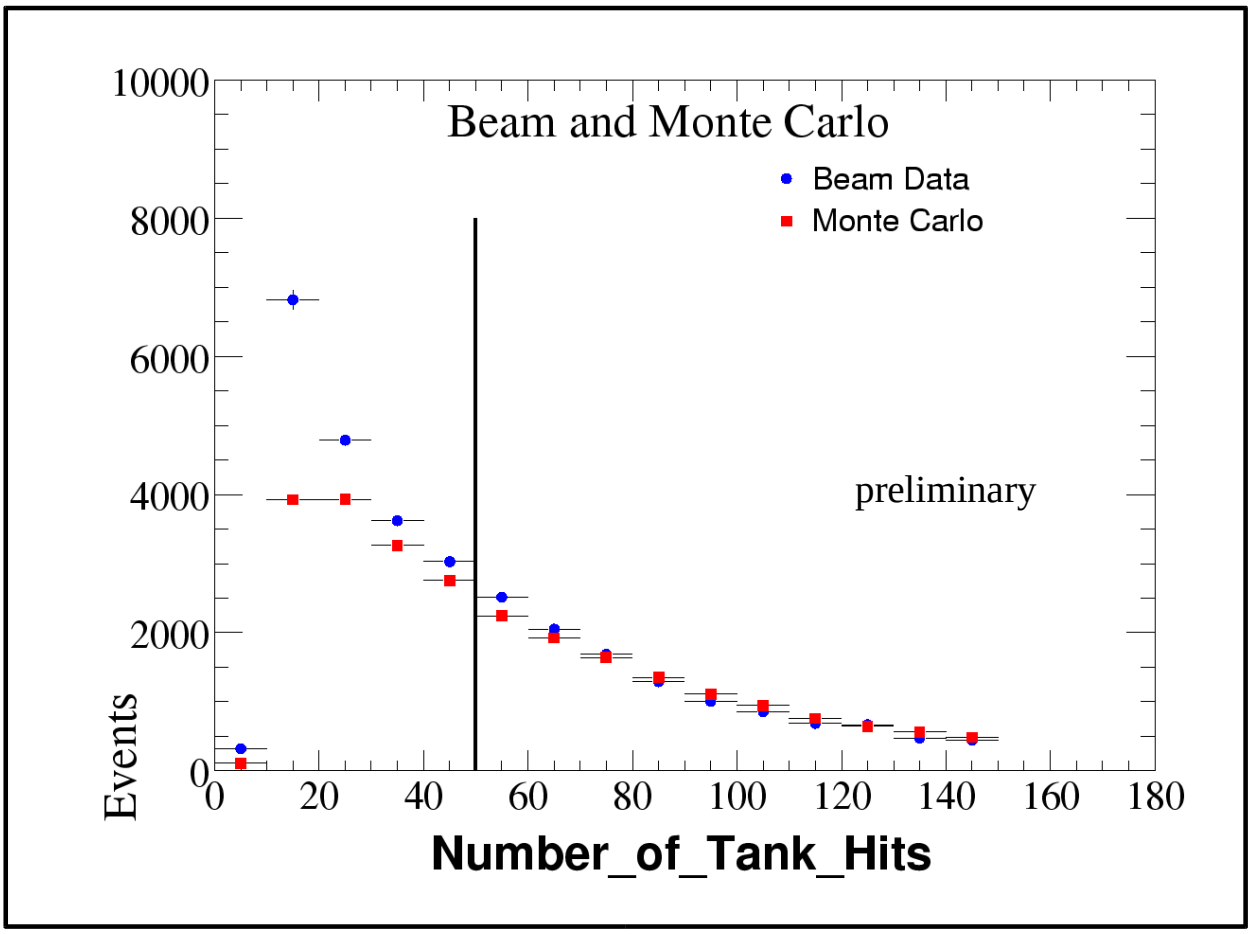
Allows the determination of Δs, the strange quark contribution to the nucleon spin

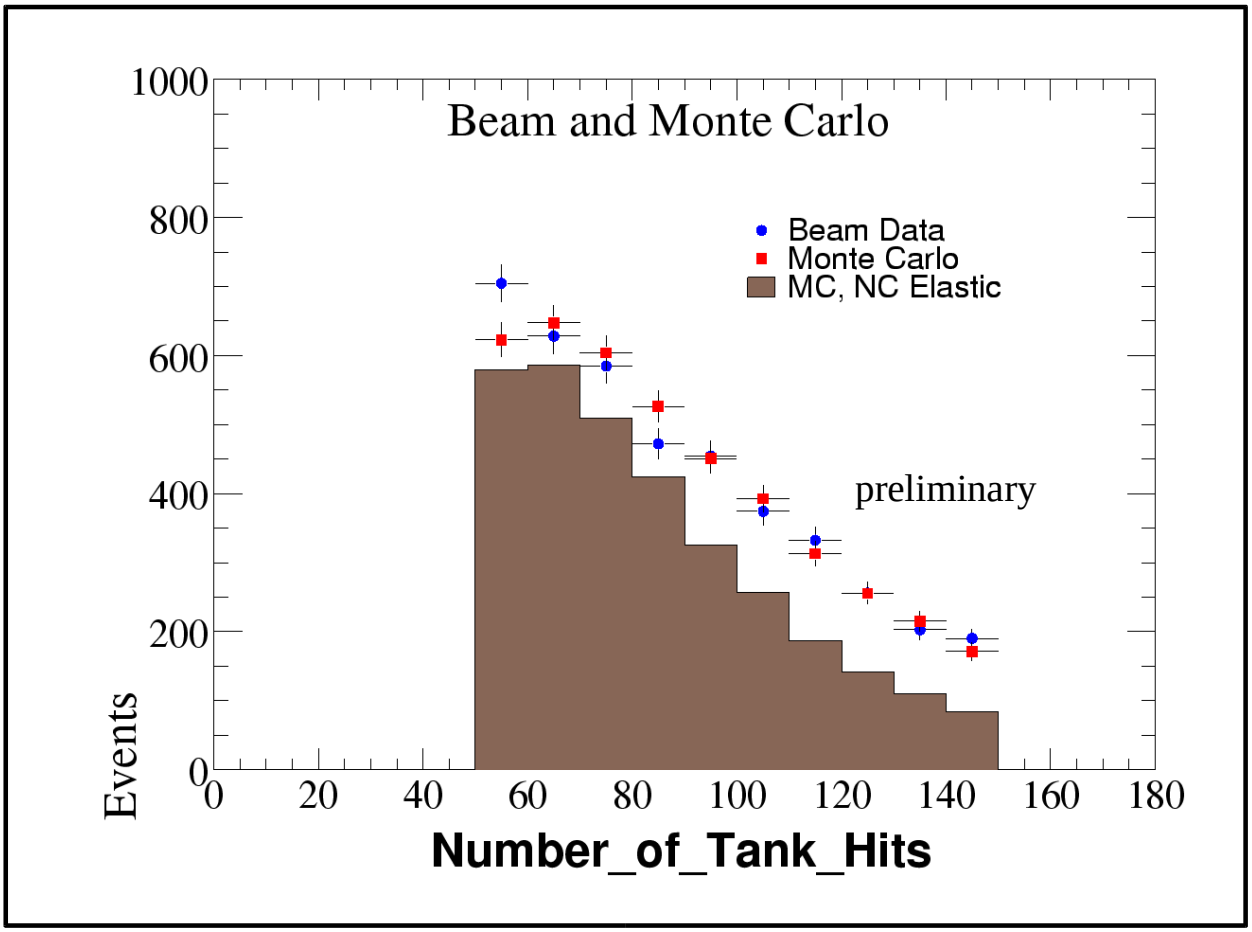
Selection: #PMT hits < 150

Data/MC shape comparison only

1 & only 1 subevent



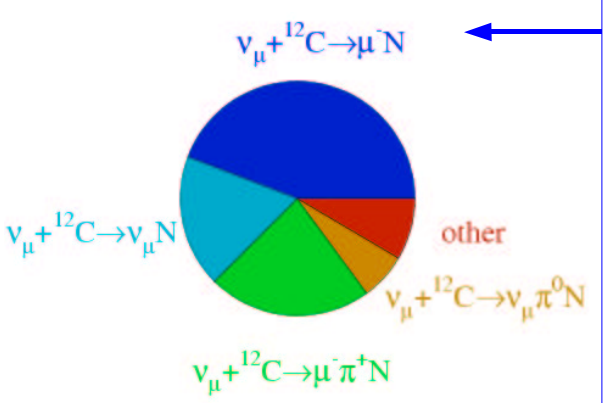

Beam and Monte Carlo
Beam Data
Monte Carlo
preliminary
Events
Number_of_Tank_Hits
0
2000
4000
6000
8000
10000
0
20
40
60
80
100
120
140
160
180


Beam and Monte Carlo
Beam Data
Monte Carlo
MC, NC Elastic
preliminary
Events
Number_of_Tank_Hits
0
200
400
600
800
1000
0
20
40
60
80
100
120
140
160
180

Outline of our Case for 1×10^{21} POT:

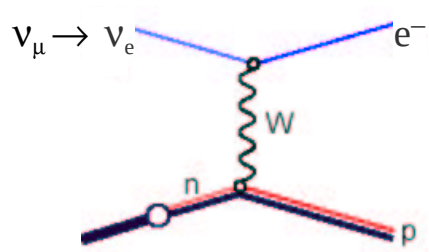
* Understanding the ν_μ event rate
* Relative oscillation signal & background rates
* The case for 1×10^{21} POT
* Obtaining 1×10^{21} POT
* Thoughts about the future
* What we need from you <u>today</u>

Progress on Understanding ν_μ Events

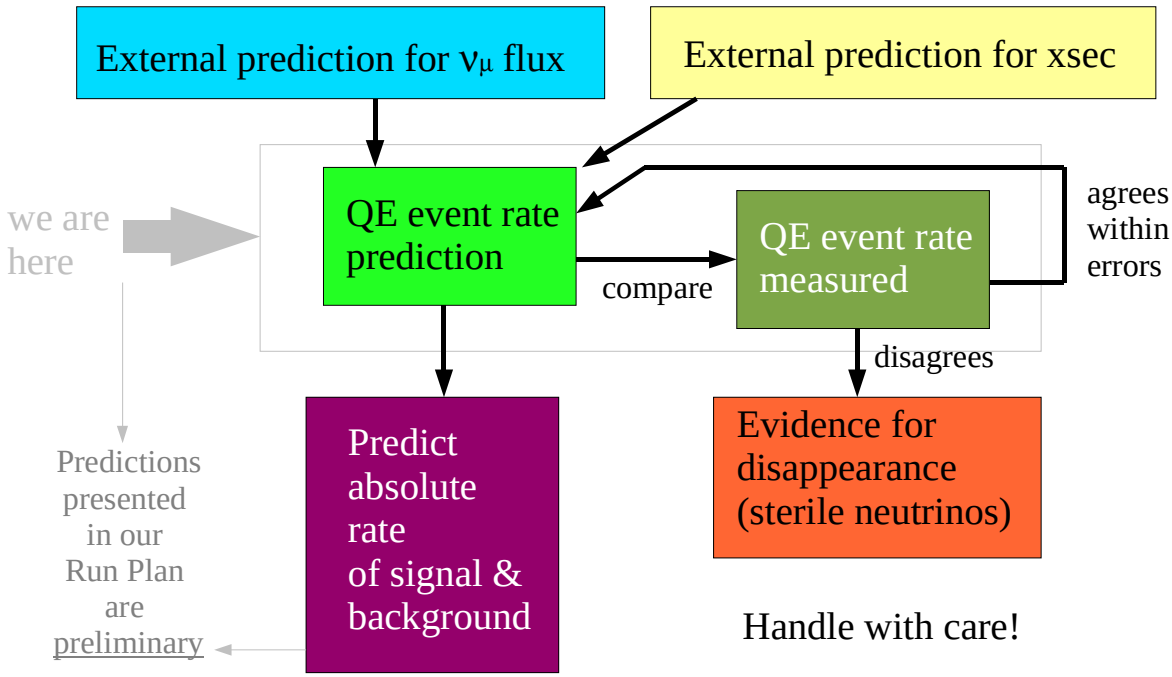


Quasi-elastic events:

- The bulk of events in detector
- Our signal:



The Process:



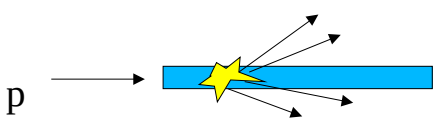
External prediction for νμ flux

Depends on:

- Prediction of π's production from our Be target

I'll give a progress report...

...Poorly known.

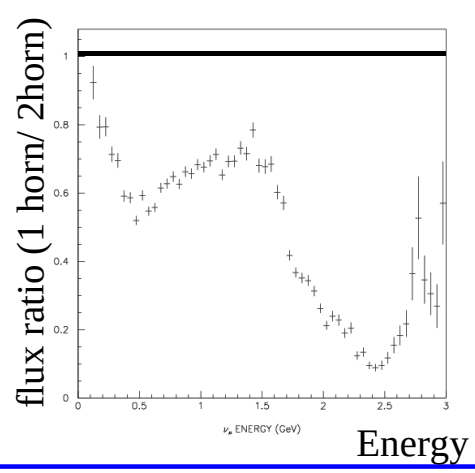


$$\pi^+ / K^+ \rightarrow \mu^+ \nu_\mu$$
$$\hookrightarrow e^+ \bar{\nu}_\mu \nu_e$$
$$K^+ / K_L^0 \rightarrow \pi\, e\, \nu_e$$

- Horn focussing and decay channel design

MOU:
Reduce the design to 1 horn,
Increase the p.o.t. accordingly

We model our beam region w/ Geant 4,
we check the model via beamline monitors



Production of secondaries:

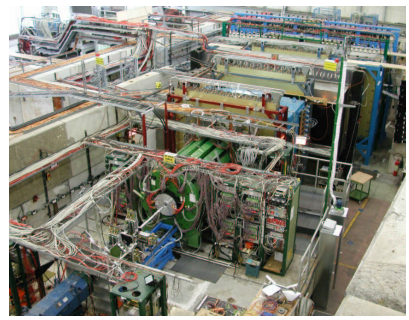
- Standard Generators -- **GFLUKA** (used in our proposal) or MARS

- Fit-your-own -- from a collection of (inconsistent) experiments from 1960's-80's , mostly > 12 GeV, all on Be targets
  - K2K used data for 12+ GeV, corrected to Al (K2K fit)
  - We include the single 10 GeV data set (**JAM** fit)
  - Requires we extrapolate

- BNL E910, recent (1990's) data on Be target
  - Not perfect. *no 8 GeV data*
  - But not bad! 6 and 12 GeV, 4π detector
  - Requires we interpolate

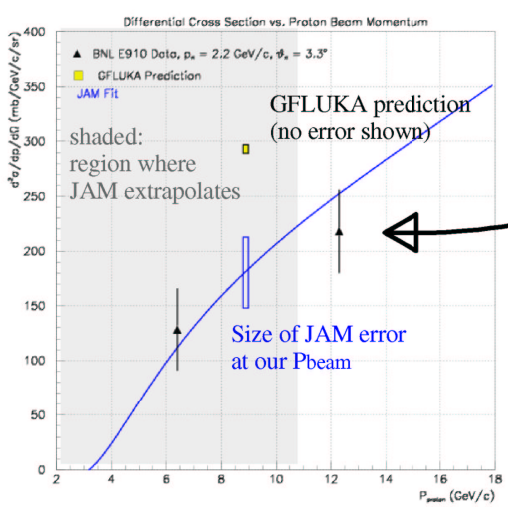
→ Analysis still in progress

- HARP (CERN)
  - Data taken with MiniBooNE target slugs!
  - 8 GeV, huge data sample!
    no extrapolation or interpolation!
  - results in late spring/early summer



Our fits use a parameterization originally suggested by Sanford & Wang

$$\frac{d^2\sigma}{dpd\Omega} = W_1 P_\pi^{W_2}(1-\frac{P_\pi}{P_p}) \times e^{\frac{-W_3 P_\pi^{W_4}}{P_p^{W_5}} - W_6\theta_\pi(P_\pi - W_7 P_p cos^{W_8}\theta_\pi)}$$



This is the state of the art right now.

E910 data is preliminary & not in JAM fit!

New fits will be available as soon as 17 GeV E910 analysis is complete.

interpolation is always better than extrapolation.

In the end, actual measurement!
⇒ HARP!

External prediction for ν_μ flux → Taken from JAM fit

+

External prediction for xsec → Taken from the Nuance studies

↓

QE event rate prediction → The MiniBooNE observed event rate is $\Rightarrow$ $\times 1.5$ higher than prediction

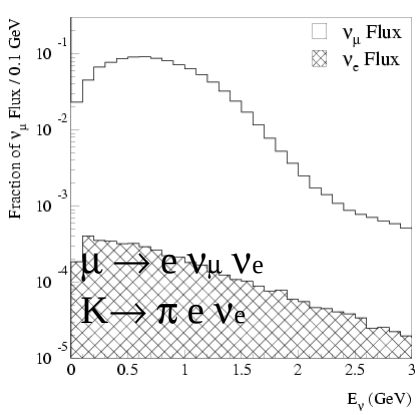
Data lie <u>between</u>
JAM (present default) and GFLUKA (proposal default)

We base our Run Plan on the <u>measured</u>, not predicted rate.

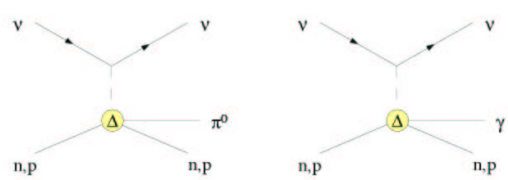
Rates of Backgrounds and Signal

Examples of backgrounds:

Intrinsic Events:



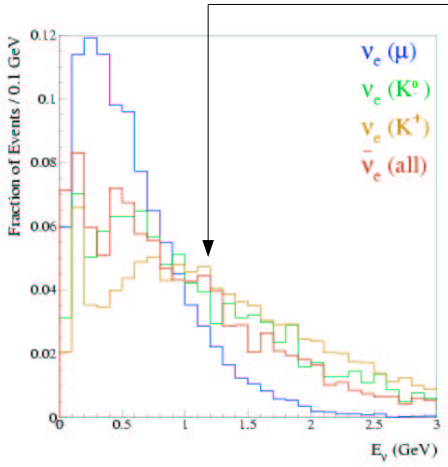
Mis-identified Events:



Changes from the proposal:
- muon mis-id is <u>negligible</u>
- Δ radiative decay is important

All background predictions are tied to <u>measurements</u> at MiniBooNE

Systematic Error on Intrinsic ν_e Events:



From Kaons:

- data from HARP on production
- high energy $\nu_{e(\mu)}$ events in detector
- events in the LMC detector

5% for $K^{\pm}$ (proposal: 10%)

6% for K^0 (proposal: 10%)

From muons:

detector picks out very forward decays

strong correlation $E_\nu \Rightarrow E_\pi$

From E_π, $\Rightarrow E_\mu$

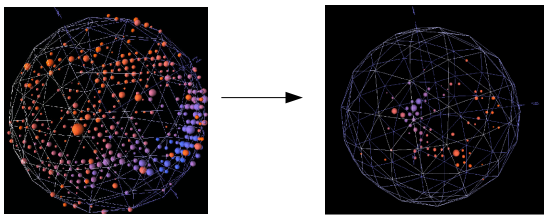
From $E_\mu \Rightarrow \nu_e$

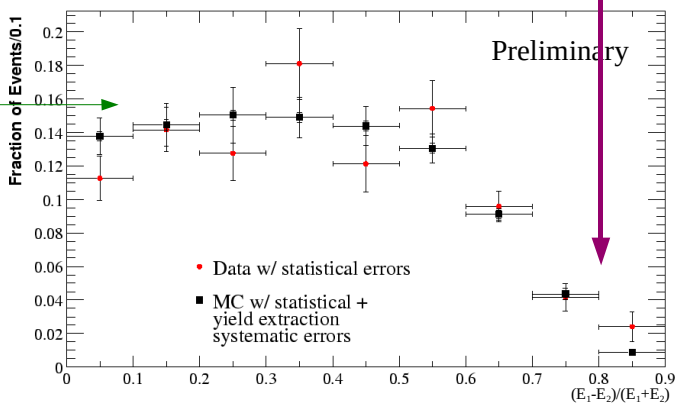
5% for muons (proposal:5%)

Systematic Error from Mis-identified π^0's:

1) Asymmetric decay -- only reconstruct one ring

2) high momentum events -- overlapping rings





- Extrapolate from measured π^0's *(needs full statistics!)*

5% from pion mis-id (proposal: 5%)

Systematic Error from $\Delta \rightarrow N\gamma$:

Small branching ratio: 0.56 ± 0.04, but...

- We have a lot of events!
- Nuclear effects poorly known (as w/ NC π^0)
- γ looks <u>just like</u> e^- in detector
- BR is poorly known.

Luckily: Constrained indirectly by resonance π^0 data

Was not in the NUANCE Monte Carlo

20% systematic error

(7% from BR, 15% from nuclear effects)

The signal vs. background

What we are looking for:

events with a single electron and perhaps nuclear break-up

In the energy range $\lesssim$ 1.25 GeV (high Δm^2 LSND is ruled out)

Isolating the signal:

<u>Pre-cuts</u>: number of tank & veto hits, fiducial region, 1 sub-event

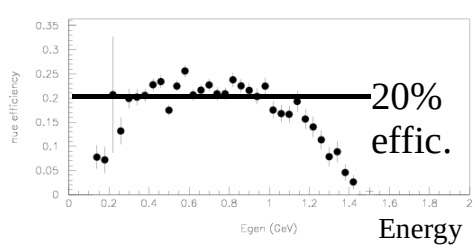
<u>ID cuts</u>: neural net variables ... e-mu net and e-pi net

<u>Kinematic cuts</u>: E<1.25 GeV, scattered lepton angle <0.956, π^0 mass fit < 72 MeV

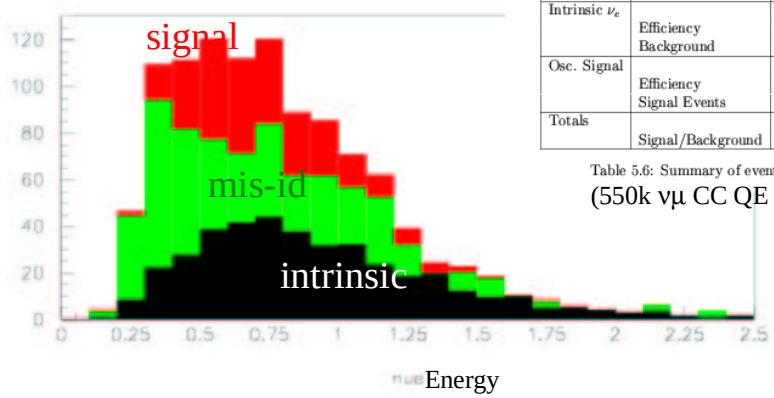
We use Minuit to find the cuts that optimize the significance

Cutting Hard on Backgrounds Hurts the Signal Efficiency:

- This is about ×2 lower than the proposal
- Improving the efficiency is a top priority



Relative rate
of signal
& Background:



Process		Proposal Estimate	Current Estimate
ν_μ CC QE			
	Total Rate	500,000	553,000
	Background	500	8
ν_μ NC π^0			
	Total Rate	50,000	110,000
	Background	500	290
$\Delta \to N\gamma$			
	Total Rate	—	1080
	Efficiency	—	7.5%
	Background	—	80
Intrinsic ν_e			
	Efficiency	50%	14%
	Background	1500	350
Osc. Signal			
	Efficiency	50%	20%
	Signal Events	1000	300
Totals			
	Signal/Background	1000/2500 = 0.40	300/780 = 0.38

Table 5.6: Summary of event statistics with optimized cuts.

(550k νμ CC QE events $\Rightarrow 1\times10^{21}$ p.o.t.)

Down by ~ ×3.
(more or less...
down ×2 from horn,
up by ×2 from POT
down by × 2 from eff.
down by ×1.5 from flux)

How long will the analysis take?

While we have a lot of tools in place, there is a lot to do!

Verify data quality	complete (now in monitoring mode)
Time & Charge Calibration	nearly complete (studying non-linearities)
Energy Calibration	well underway
Tuning the oil optical model	underway
Verifying reconstruction algorithms	underway
Verifying/improving PID algorithms	just underway
Measuring backgrounds/tuning MC	just starting
Search for an electron excess	when we get the above done!

Summer, 2005

The Case for 1 $\times 10^{21}$ POT

What is decisive?

Sensitivity to oscillations which equals or exceeds LSND?

An observed signal (throughout LSND allowed) has significance equal or greater than the APS/PRL criteria for *evidence* (3σ)

An excess with the expected energy dependence for oscillations?

Capability of ruling out LSND at a very high CL with a null result?

Demonstration of inconsistency by comparing joint allowed regions with those from individual experiments?

And, numerically, what are the requirements?

What I will show:

With 5×10^{20} POT...

- **Signal: Covers LSND 90% CL at $<3\sigma$, & cannot resolve shape of oscillation**
- **Null result: joint analysis allows portions of LSND**

With requested statistics (1×10^{21} POT) ...

- **Signal: Covers LSND 90% @ 4-5σ & can resolve high vs. low Δm^2**
- **Null Result: Excludes LSND at 99% CL**

We are not asking to be the best that we can be

$\Rightarrow$ Systematic Errors = Statistical Error at 2×10^{21}

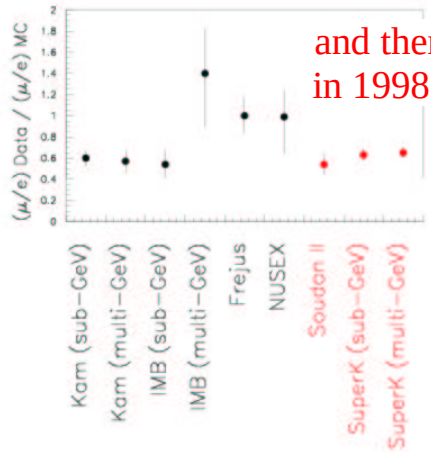
We are asking for no more than what we feel is both realistic & enough.

Today vs. 1997

" *You are making too big of a deal.*
Everyone knows that LSND (atmospheric) is wrong.
Isn't THE 2-3σ disagreement you get
from 5×10^{20} POT (Frejus and NUSEX)
enough to reject a result doesn't fit our theories??! "

Obviously, it is due to some experimental error!

Atmospheric Oscillations

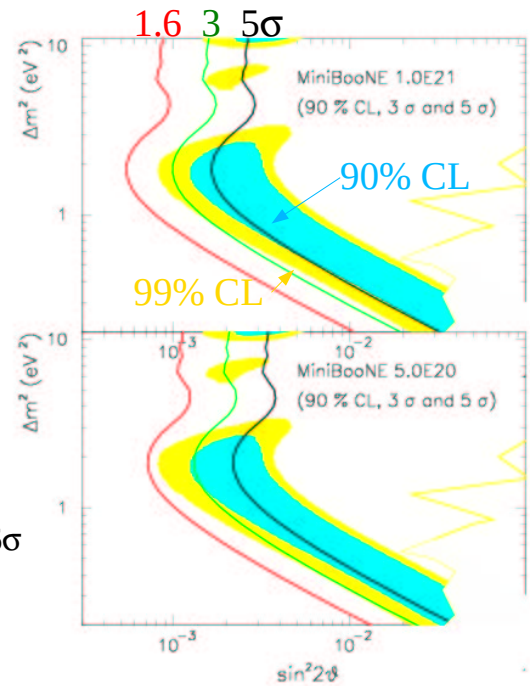


and then in 1998...

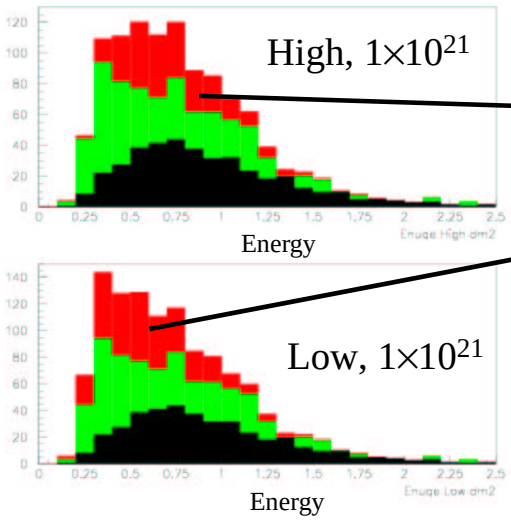
Coverage of LSND

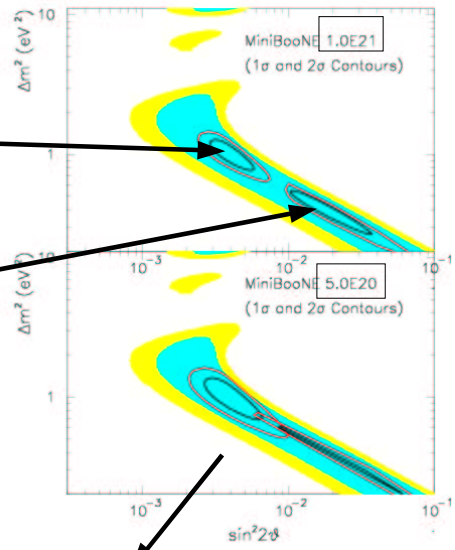
1×10^{21} POT:
Good coverage:
90% LSND allowed at > 4σ

5×10^{20} POT:
90% CL LSND @ ~3σ
Only just covers at LSND 99% CL at <1.6σ



Differentiating high vs low Δm^2





at 5×10^{20} POT, we cannot observe the distinctive shape of an oscillation signal or resolve high vs low Δm^2

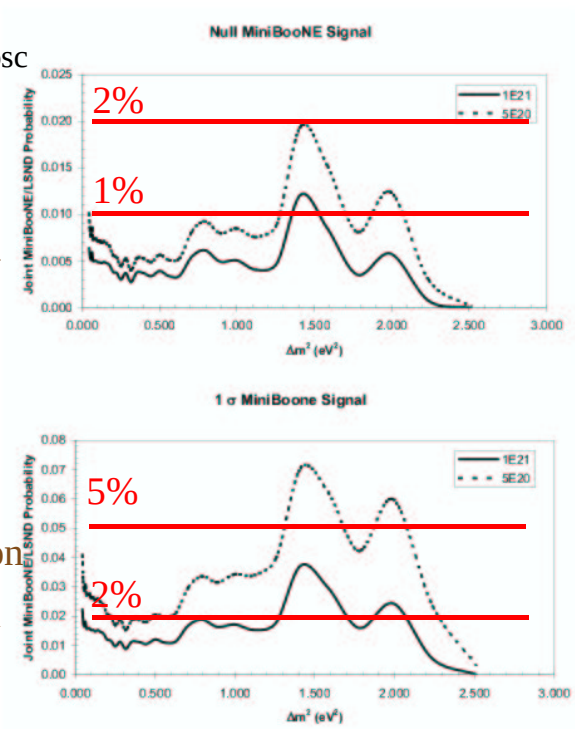
if we see an excess, we cannot say definitively what it is

Do a joint analysis...
Form a χ^2 for the agreement of Posc to find joint probability

$\Rightarrow$ Depends upon assumed Δm^2, since L/E is not the same!

Top: MiniBooNE null signal

Bottom: 1σ background fluctuation (16% probability for upward fluctuation)

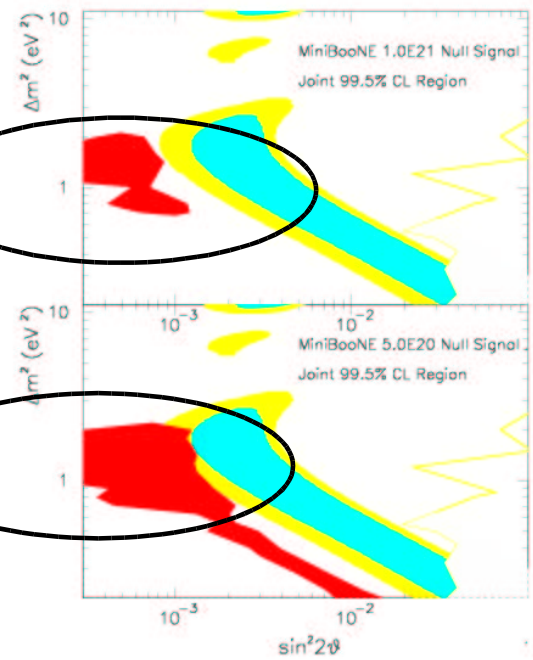


For a Null Result

Converting to an allowed region:

The ~3σ
allowed region
from a joint analysis

The lack of overlap shows
the two experiments are inconsistent



At 5×10^{20} POT, an overlap
region remains!

if the goal is to kill LSND in the event of no signal, we need 1×10^{21}.

In principle MiniBooNE is Win-Win:

If we see a null result, we have cleared the oscillation picture
If we see a signal, we have opened the door to new physics

Summary: *Why 1×10^{21} POT?*

- Coverage of all of LSND at $\gtrsim 4\sigma$
- Ability to distinguish high vs. low Δm^2
- Excludes LSND at 99% CL for a null result

(Even excludes at $>2\sigma$ given a 1σ background fluctuation!)

Results with 5×10^{20} POT
- do not achieve these goals
- leave important <u>open issues</u>

The Losing Scenario is that MiniBooNE is indecisive

Our physics arguments are sound.

Our goals have not changed
since the MOU.

That leaves one remaining
question...

Is 1 ×10^{21} POT Possible?

The Village Crier

national accelerator laboratory

Operated by Universities Research Association Inc. Under Contract with the United States Atomic Energy Commission

VOL. 3, NO. 45 DECEMBER 20, 1973

THE BOOSTER ACCELERATOR

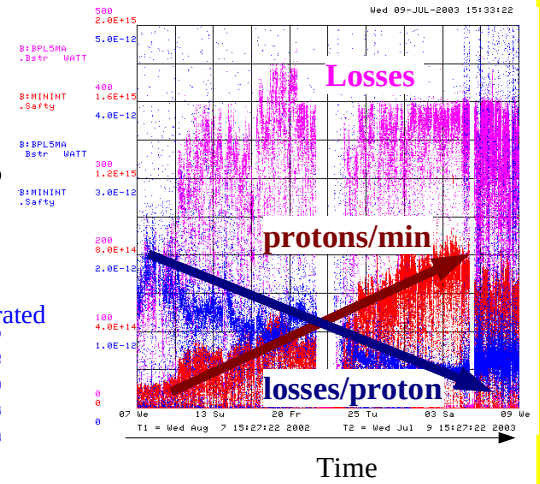
Since May, 1971, the Booster Accelerator has taken 200 million electron volt protons from the Linac and "boosted" their energy to 8 billion electron volts. They are then injected into the Main Accelerator. The Booster synchrotron is about 500 feet in diameter. Twelve "bunches" of Booster protons are required to fill the Main Accelerator.

In December, 1970, the last Booster magnet was installed in the completed tunnel began in 1969. Staff members continue to improve performance of the Booster.

The Booster is 30 years old
It is running at ×10 design purpose.
It can deliver even more protons!

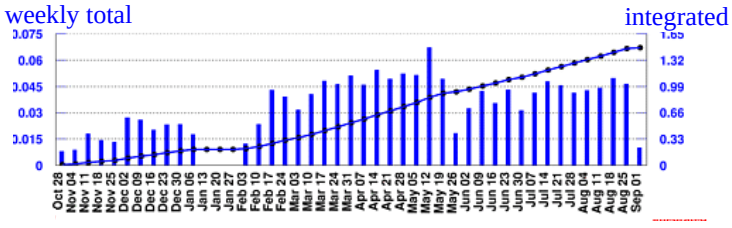
The Problem is...

Uncontrolled Losses in the Booster Tunnel



Running prior to the Autumn, 2003 shutdown:

Best running was ×2 too low

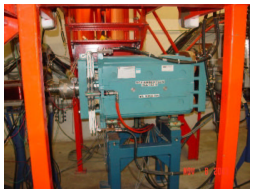


Over the past year,
Accelerator Division has

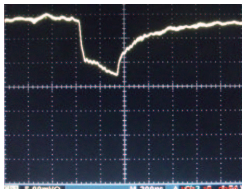
Run many beam studies
Made many equipment tests
Done necessary simulations

and found a lot of solutions...

Solutions in Linac & Booster -- Installed During Shutdown:



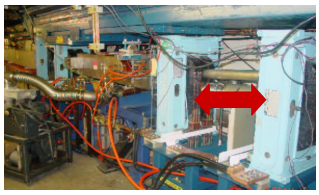
New Lambertson



Notching in Linac

Collimator System

4 Large Aperture Magnets in MI8 line



Dog-Leg Extension

MP01 Supply

New Damper

&
LCW Upgrade,
Vacuum Upgrade,
Profile Monitor,
Beam Whacker,
Hose replacement,
Better survey,

We now expect to achieve the needed factor of 2-3
(Needed by MiniBooNE & also NuMI!)

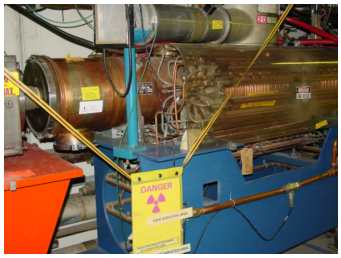
Acknowledgements & Kudos:

This has been a very big effort.

MiniBooNE Universities have been happy to participate.

- Proton Source Dept.
- Mechanical Support
- Technical Division
- The RF Department
- The LCW Group
- The Alignment Group
- EE Support
- Operations
- Taft Engineering
- Bartoszek Engineering
- ES&H
- MI Group
- External Beams

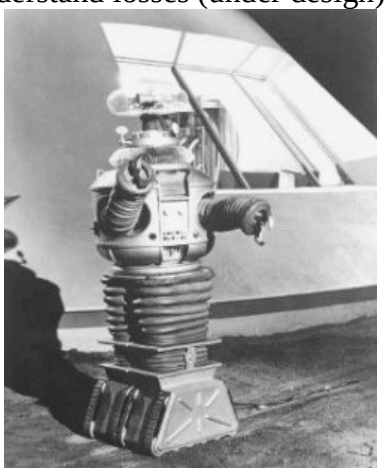
Build Larger RF Cavities
(Prototype: January 2004)



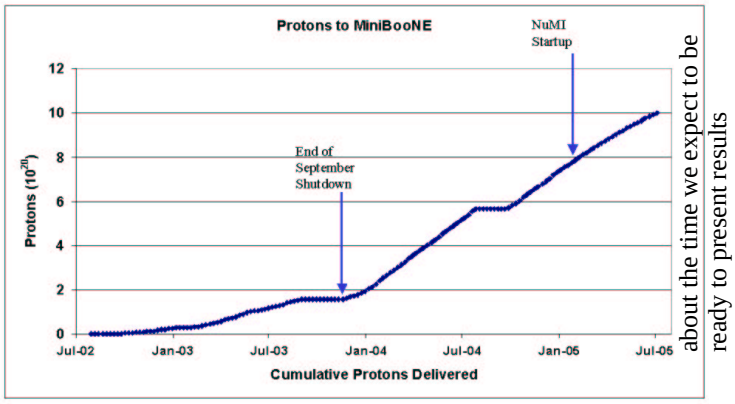
Work on Monitoring Programs:

But Wait! There's *More*...

Build a Radworker Robot to help understand losses (under design)



These extra improvements represent crucial contingency...



With reasonable estimates for delivery,
we achieve 1×10^{21}POT
BUT
MiniBooNE running will overlap with NuMI Startup

Fermilab Today

Tuesday, November 18, 2003

Calendar

Only 3 days until the lab-wide party!

Tuesday, November 18
2:00 p.m. Fermilab Long Range Planning Committee Open Session: Accelerator R&D - One West
* Introduction (S. Geer)
* R&D at A0 and SCRF R&D (H. Edwards)
* MUCOOL and Neutrino Factory R&D (A. Bross)
* Magnet R&D (J. Strait)
* Accelerator Theory, Simulation and the Student Program (M. Syphers)
* University Perspective (C. White)
* Prototype Recommendations (S. Geer)
THERE WILL BE NO DIRECTOR'S COFFEE BREAK TODAY
THERE WILL BE NO ACCELERATOR PHYSICS AND TECHNOLOGY SEMINAR TODAY

Wednesday, November 19
3:30 p.m. DIRECTOR'S COFFEE BREAK - 2nd Flr X-Over
4:00 p.m. Fermilab Colloquium - 1 West
Speaker: C. de Duve, Rockefeller University/ Christian de Duve Institute, Brussels
Title: Singularities in the Origin and Evolution of Life

Cafeteria

Proton Committee Report Now Available Online

On October 26, Fermilab's Proton Committee reported to Fermilab Director Mike Witherell their advice on the use of protons at Fermilab through the end of the decade. Witherell formed the 11-member committee in February. Dave Finley, chair of the committee, noted "The committee is important because it brought together the providers of protons and the major users of protons, and tried to come up with a reasonably achievable projection of what can be done." The complete report is available online.

Dave Finley

Conclusions include:
1) The reliance of the Linac on a single vendor for power tubes represents a significant vulnerability.
2) MiniBooNE and NuMI can run at the same time given a few sensible modifications to the Booster.
3) The Beams Division should prepare to use the Main Injector to support Antiproton, NuMI and Fixed Target at once.
4) The Beams Division needs a clear plan for providing the multiple batches to the Main Injector required for NuMI without creating large losses in the Booster.
5) The lab has to figure out how to collaborate with the largely untapped resources represented by the university groups.

Director's Corner

Good Morning!

On Friday we are holding a party for the entire Fermilab community to celebrate 20 years of physics with the Tevatron in addition to the many accomplishments of the last year. We are restarting accelerator operations after a shutdown in which a remarkable amount of carefully planned work on the accelerator complex was completed. CDF and D0 reported their new physics results at the Lepton-Photon Symposium in August, which was another notable success. The NuMI, LHC, and CMS projects advanced right on schedule. Finally, we had the best safety record in the history of the laboratory during fiscal year 2003.

Mike Witherell

We have great prospects for new physics in the year ahead, from CDF and D0, MiniBooNE, CDMS, Auger, and Sloan. Come help us celebrate and look forward to the year ahead.

Announcements

Virtual Ask-a-Scientist Tonight!
DZero's Greg Davis and Harald Fox will be the feature scientists tonight on Virtual Ask-a-Scientist. The online chat session will take place from 7:00 to 9:00 p.m. Central Time. Participants can log on to

(your endorsement of these plans would be beneficial)

How to run with NuMI *has been addressed!*
The Proton Committee Report.
&
a White-paper submitted to Beams Division

The upgrades are straightforward
&
are in progress

Can we do it?

YES!

And the Future?

We are in the process of planning for the future,
But there are enough unknowns to make this difficult

The lay of the neutrino landscape changes quickly
The understanding of proton delivery post 2005 is still under study

Possibilities Under Study:

- Antineutrino Running
- 25m Absorber Running
- Running with FINeSSE

The goal: develop a reasonable, flexible long-term plan by early summer

What We Need Today

We ask the PAC: Please endorse...

1) The MiniBooNE run continue until we reach 1×10^{21} POT

2) The 2005 accelerator shutdown occur in late summer,
to allow us to complete the run.

This POT goal is
⇒ guided by the physics argument
⇒ it is technically feasible

AND...

...It's IMPORTANT

Consider:

- 2-3σ with Positive resolution
  - J/ψ (charm) shoulder at Brookhaven
  - Tau lepton at SLAC
  - Solar neutrino oscillations
  - CP violation in the K system

  …….

- 2-3σ with Negative resolution
  - Mono-jets at CERN Collider
  - 17 keV neutrino
  - g-2 discrepancy with theory
  - High Q^2 results at HERA

  ……..……..

NONE WERE EXPECTED.
SOME WERE APPLAUDED-ON-ARRIVAL &
SOME WERE REJECTED-OUT-OF-HAND.

THOSE WHICH PROVED TRUE HAVE CHANGED OUR FIELD.

2-3σ is not enough.
We need to know the answer.

We need 10^{21} POT to achieve the answer

it's reasonable
it's achievable
it's important