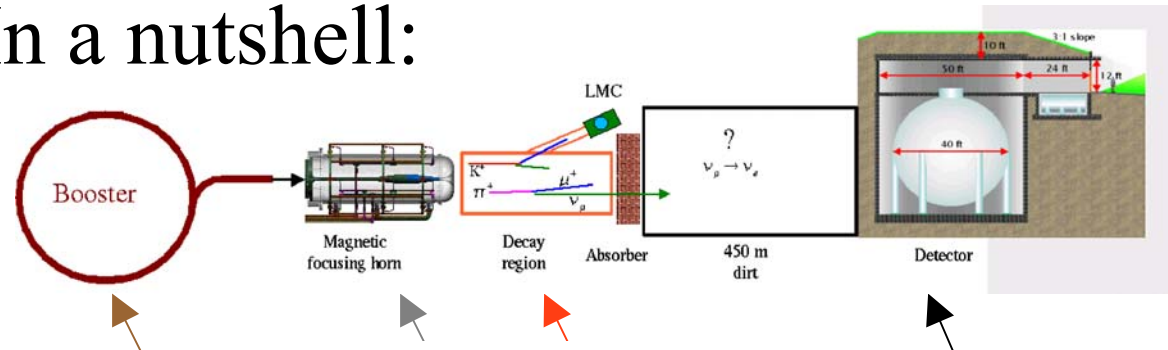
4 Pieces of Good News from MiniBooNE

1. Booster and Beam Performance
2. ν Flux and ν_μ Disappearance!
3. Progress on Detector Calibration
4. upcoming π^0 results

Janet Conrad
Bill Louis
March 03 PAC

In a nutshell:



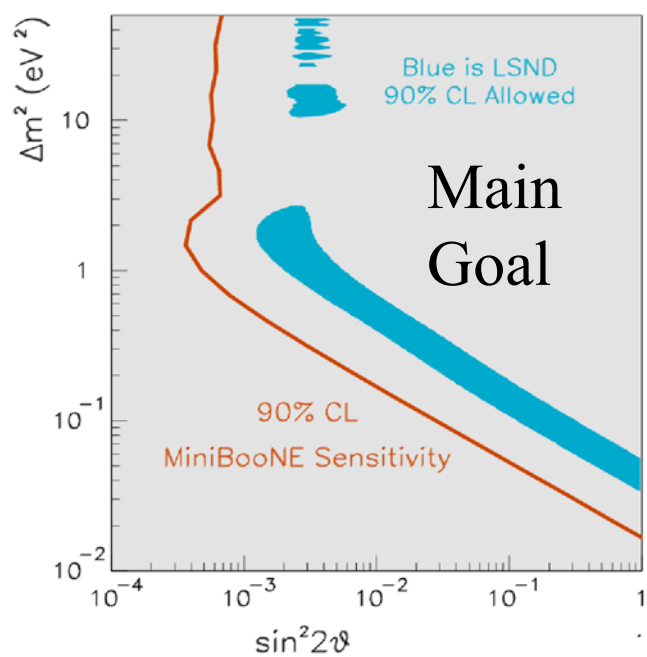
The Booster Accelerator

The Target and Horn

The Instrumented Decay Region

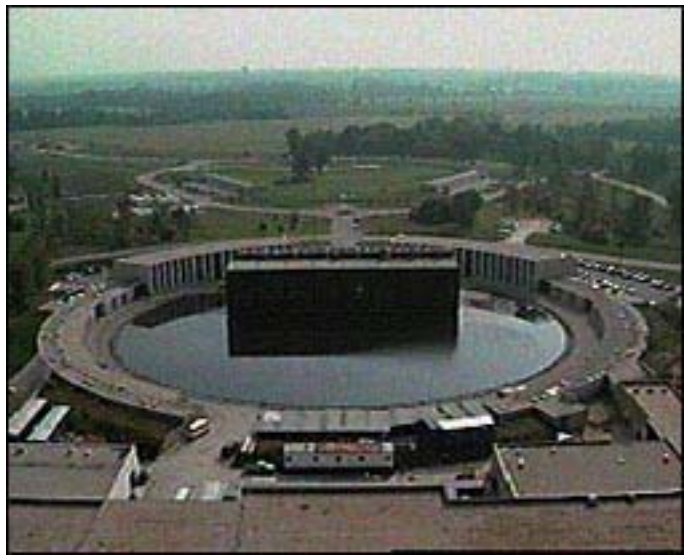
The Detector

Alabama
Bucknell
Cincinnati
Colorado
Columbia
Embry Riddle
Fermilab
Indiana
Los Alamos
Louisiana
Michigan
Princeton



The FNAL Booster

Supplies beam to every FNAL Experiment!



8 GeV protons

MiniBooNE

Main Injector

~5×10^{20} p.o.t per year

1×10^{21} p.o.t total

pbar + protons to TeVatron

NuMI

120 GeV Fixed Target

MiniBooNE runs ***simultaneously*** *with the other programs while MI ramps...*

Booster must now run at record intensity

Challenges are radiation issues, losses

"Booster Conservation" is our primary concern

Booster Performance

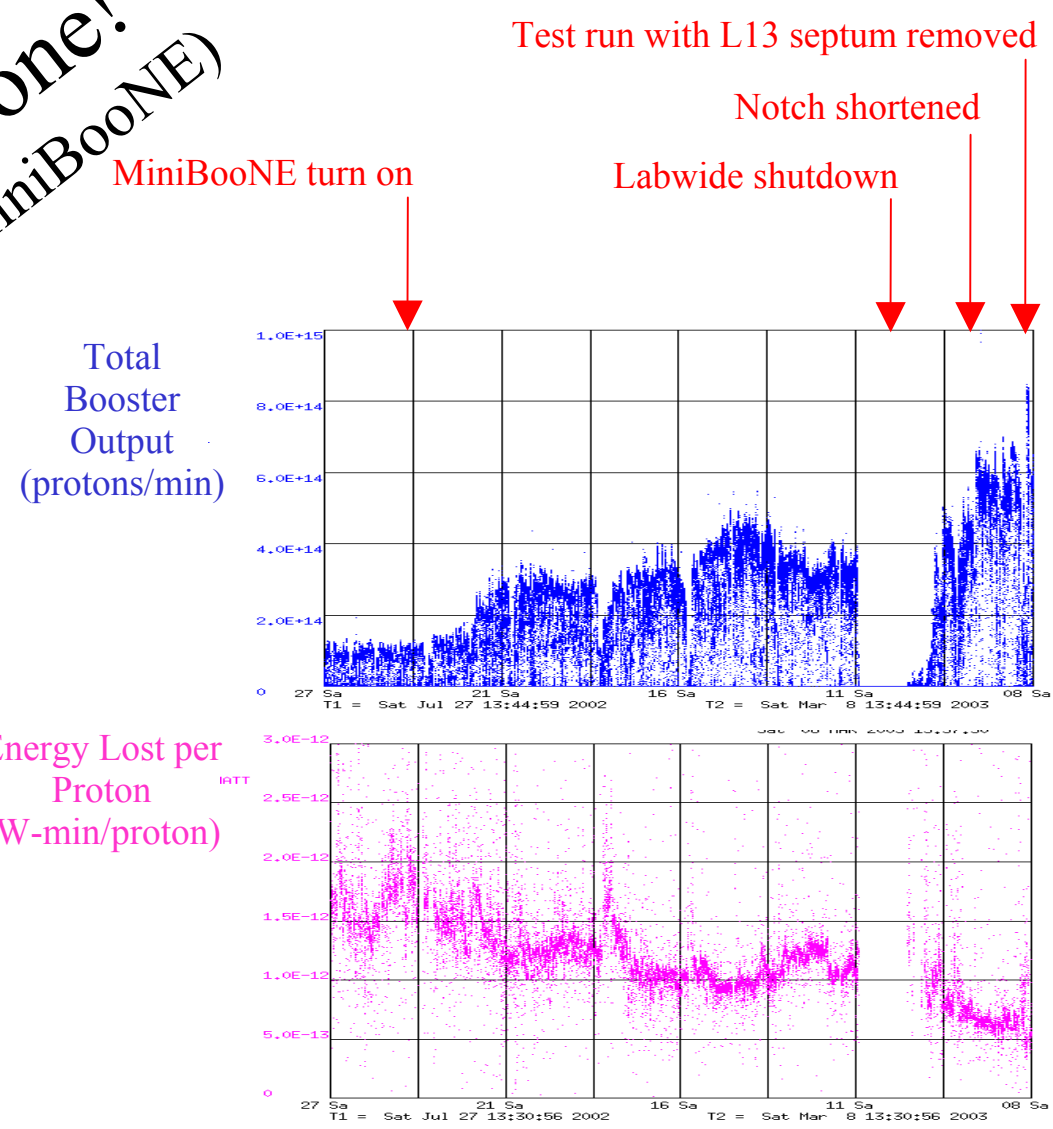
Steady increase in rate of delivered protons via ...

- Careful tuning
- Optimizing rep rate and charge per pulse

March 6: Booster record (special run with a "dogleg" removed ..).

- 5.7×10^{16} protons/hour

More protons for everyone! (including MiniBooNE)



But still a factor of 2-3 low!

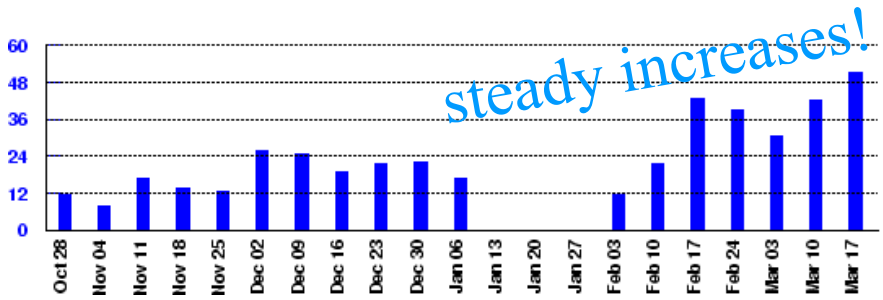
(As Eric Prebys keeps reminding us!)

Currently average ...

- $3\text{-}4 \times 10^{16}$ protons/hr

Need ~2-3 times higher rate

Goal: 10^{21} protons on target



Number of Protons on Target

To Date:	432.8 E17
Best Week:	51.4 E17
Last Week:	51.4 E17

Monday was a record day: 8.18 E 17 protons

ideas for improvements...

1) Install the collimator
2) Correct the "dogleg" problem
3) Implement transition jump
4) Improve monitoring of ramped devices
5) Investigate wide-aperture RF cavities

... and more!

The improved Booster performance is being brought to you by...

The Proton Source Department

The Beams Physics Group

The Operators

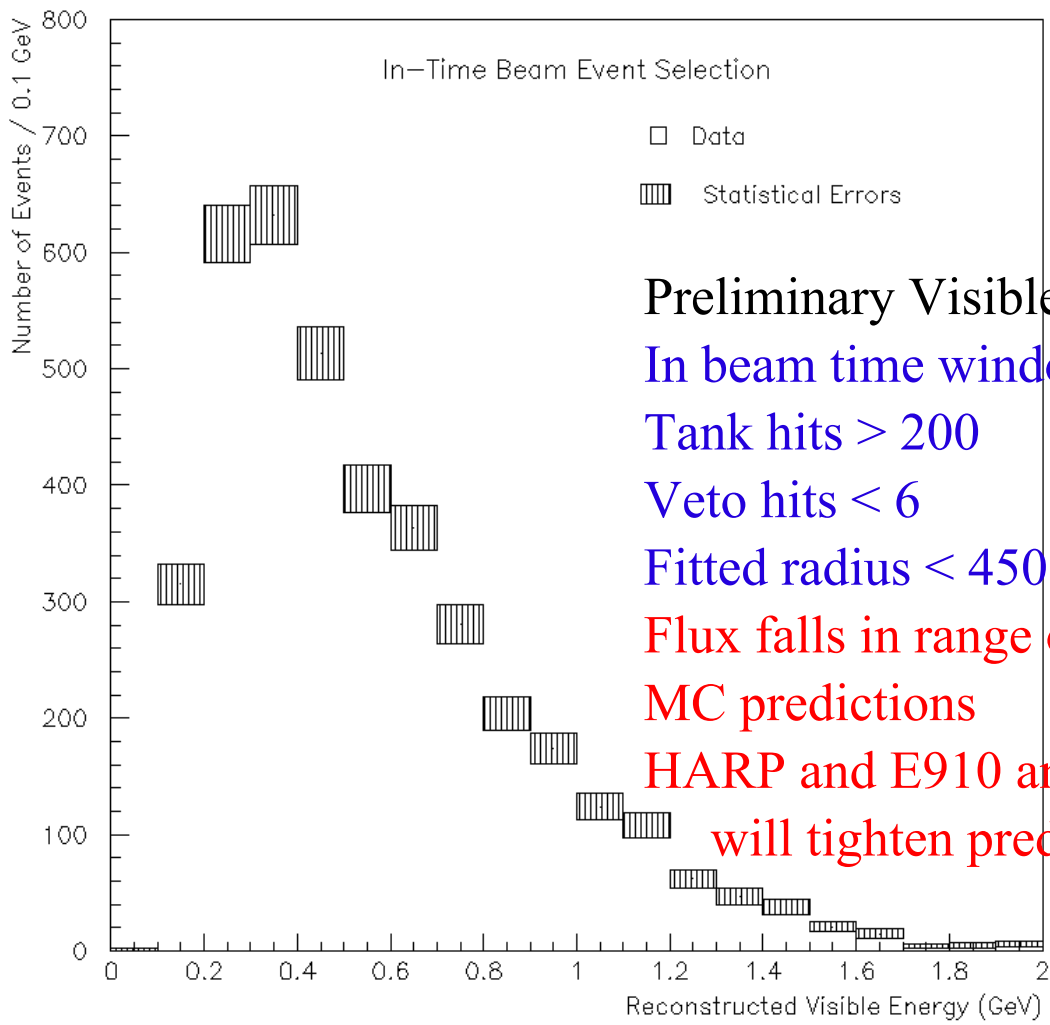
The RF Group

We are glad to be playing a role !

Beams Division Collaborators
Postdocs from Columbia & Michigan
Engineering from Princeton

"Thanks!" to the Directorate
for support of these efforts

- The 8 GeV transport line is working well
- The horn has >11M pulses with beam (~20M total) (10% of estimated horn lifetime)
- The beam energy is w/i expectation:



Preliminary Visible Energy

In beam time window

Tank hits > 200

Veto hits < 6

Fitted radius < 450

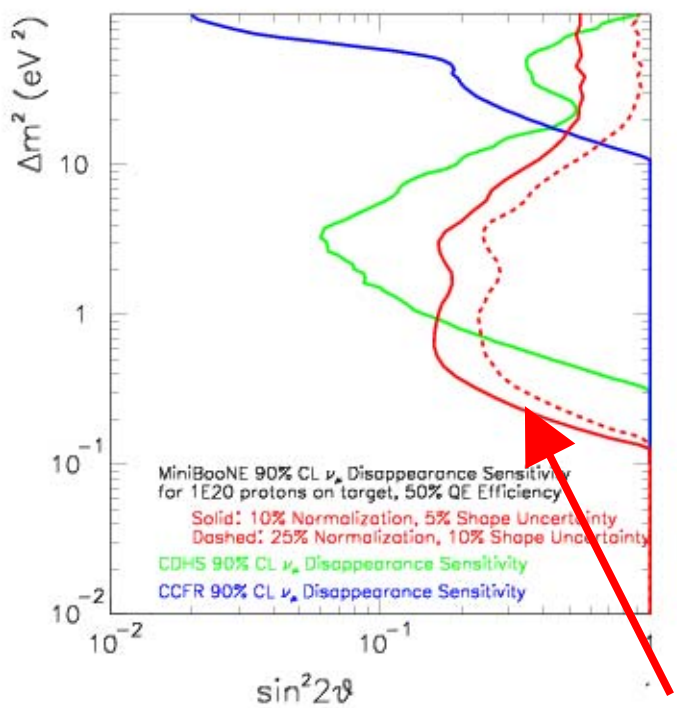
Flux falls in range of MC predictions

HARP and E910 analyses will tighten prediction

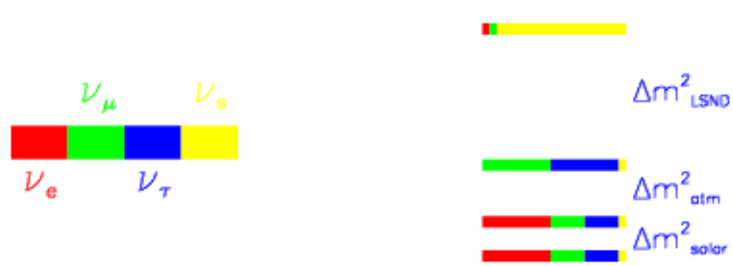
We are likely to have 100,000 ν_μ events by late summer

And do we plan to bring out with those events?

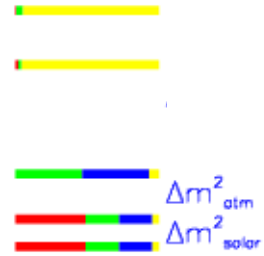
1) coherent π^0 production studies (Bill)
2) ν_μ disappearance...



Region of interest in 3+1 Models used to explain LSND

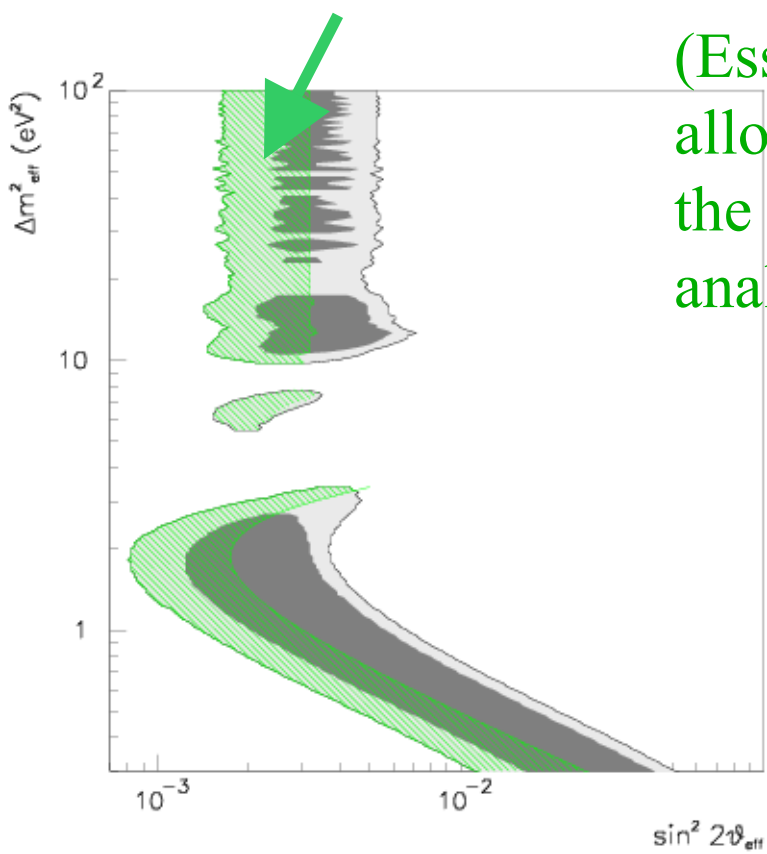


3+2



analysis by
Michel Sorel
Columbia University

Allowed region for the
3+2 "joint analysis"



(Essentially all of the allowed region from the LSND/Karmen analysis)

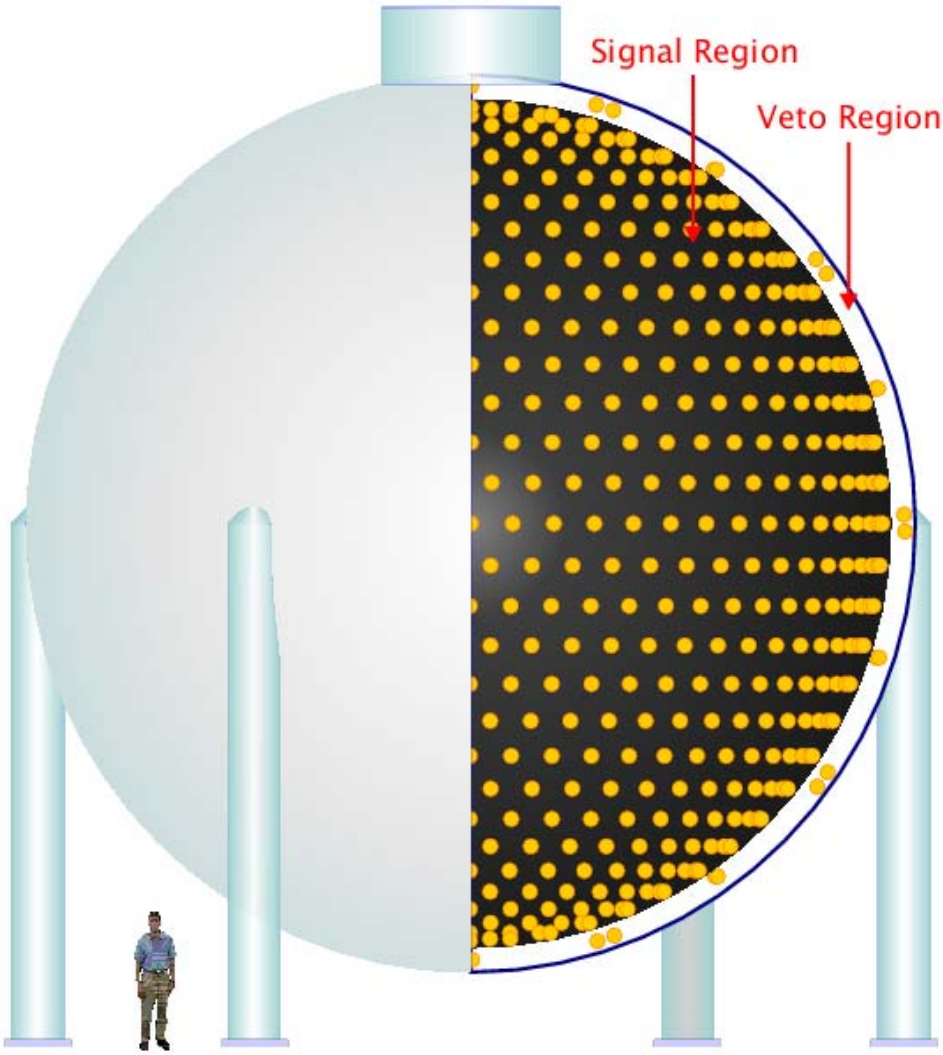
Coming soon to a preprint server near you!

Some of the 3+2 allowed models are addressable through MiniBooNE ν_μ disappearance

If LSND is correct, disapperance may identify the model!

	disappearance addresses?
3+1	**Yes!**
3+2	**Yes!**
2+2	**No ???**
CPT Violation	**Yes!**

MiniBooNE Detector



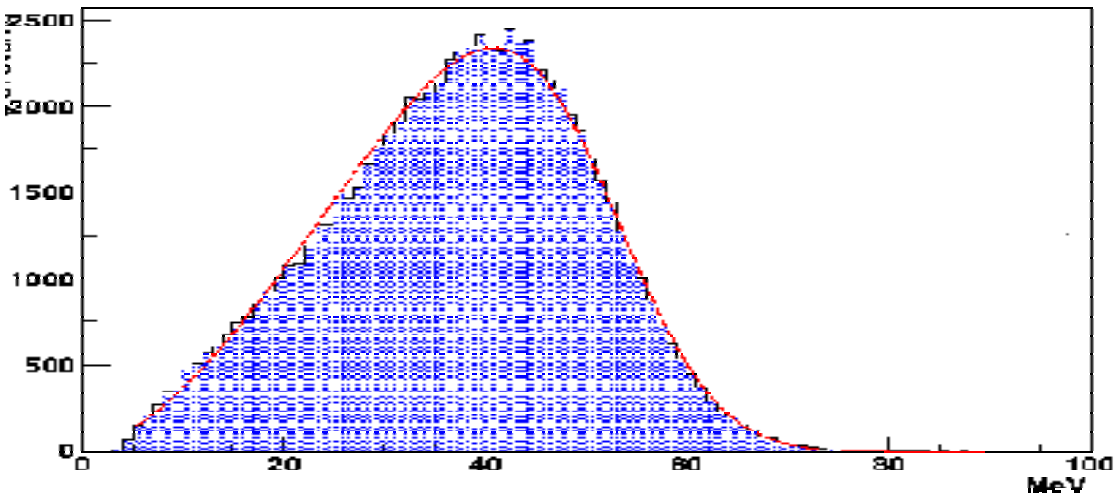
MiniBooNE Detector Status

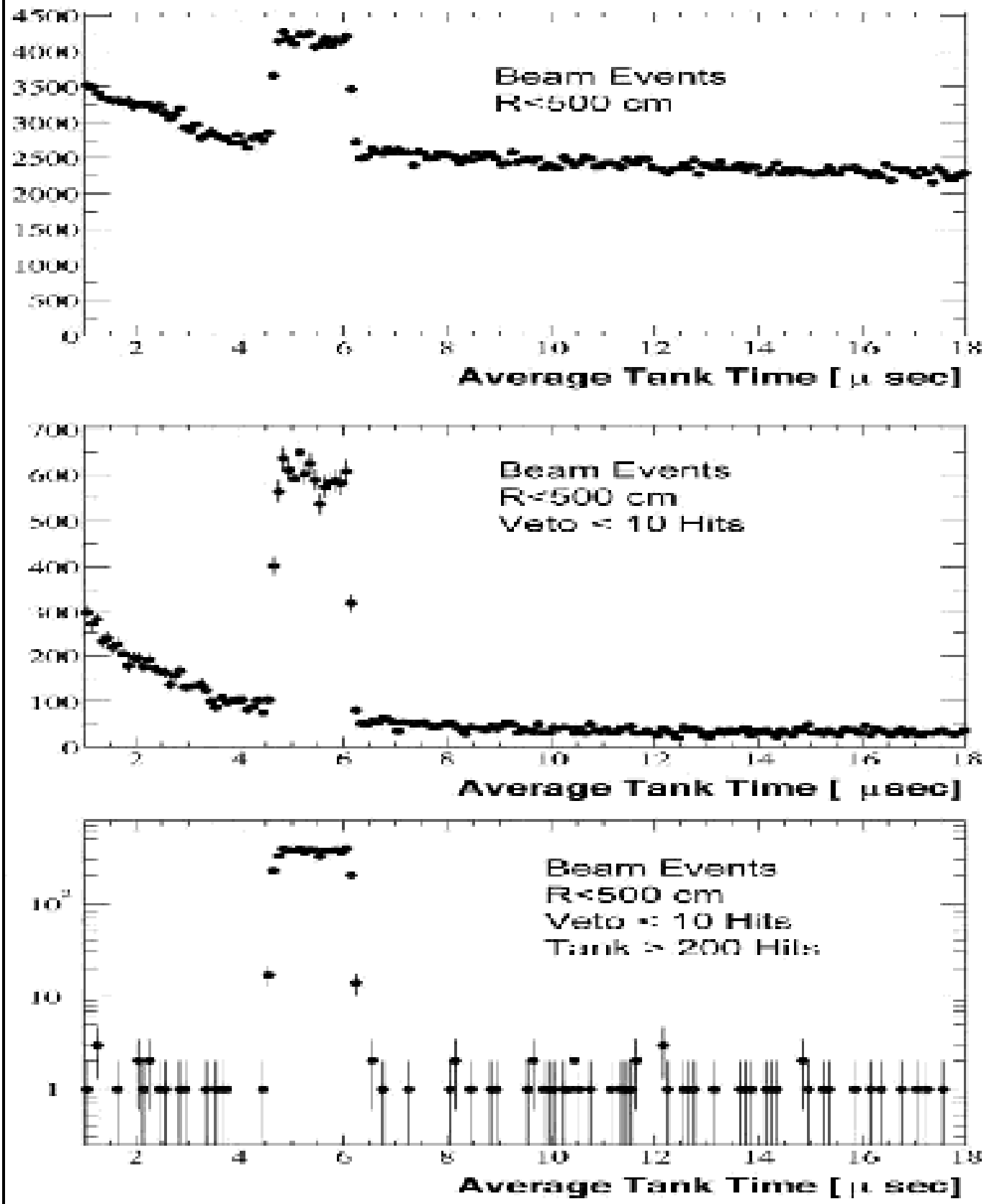
- *Detector Working Beautifully!*
- *~99% of all PMT channels working well*
- *DAQ Livetime is >99%*
- *Time, Energy, Position, & Angular Resolutions* ***Consistent with Expectations***
- ***Observing Beam Microstructure***
- *ν Event Rate Consistent with Expectations*
- *Clearly Reconstructing CC μ Events*
- ***Clearly Reconstructing NC π^0*** *Events*

Energy Calibration

Use Michel electrons from μ decay to
determine energy scale & resolution

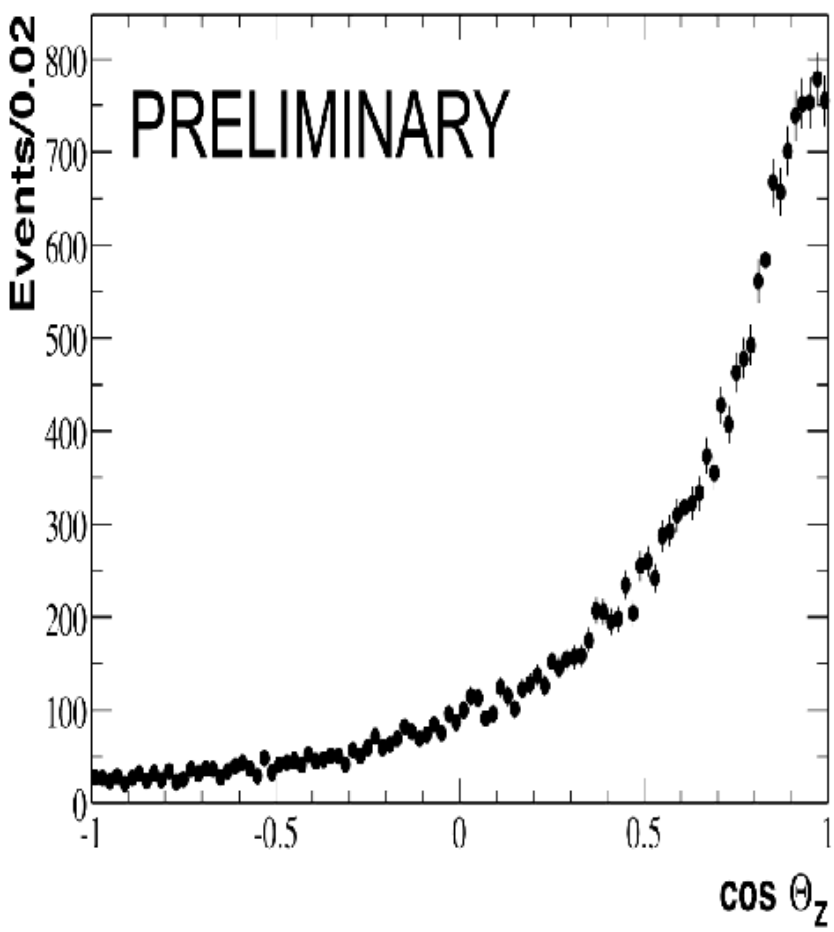
Resolution ~ 14.8% at 52.8 MeV endpoint



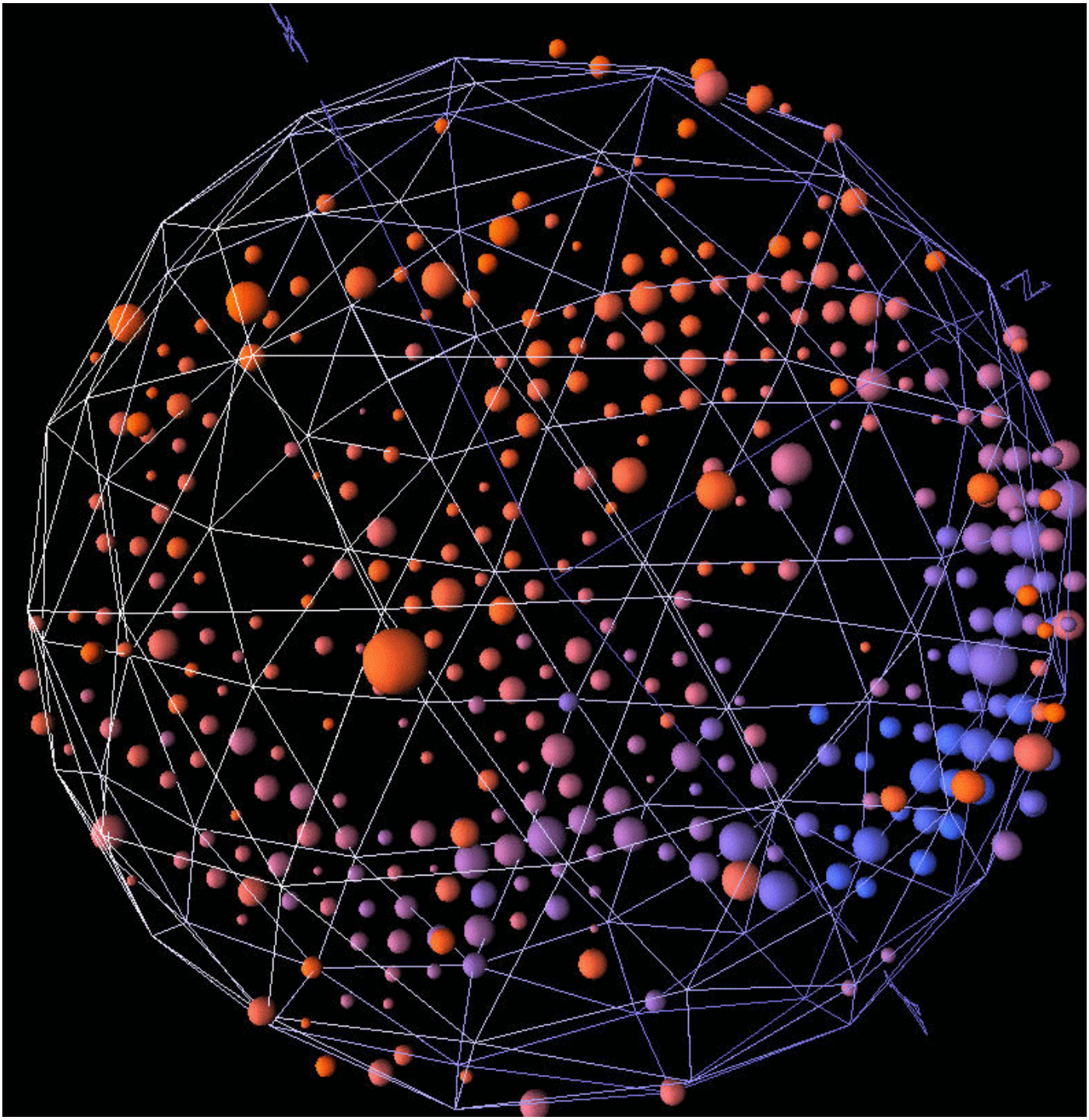

Beam Events
R<500 cm
Average Tank Time [μ sec]
Beam Events
R<500 cm
Veto < 10 Hits
Average Tank Time [μsec]
Beam Events
R<500 cm
Veto < 10 Hits
Tank > 200 Hits
Average Tank Time [μ sec]

Angular Distribution for ν Events

Events are along ν beam direction!

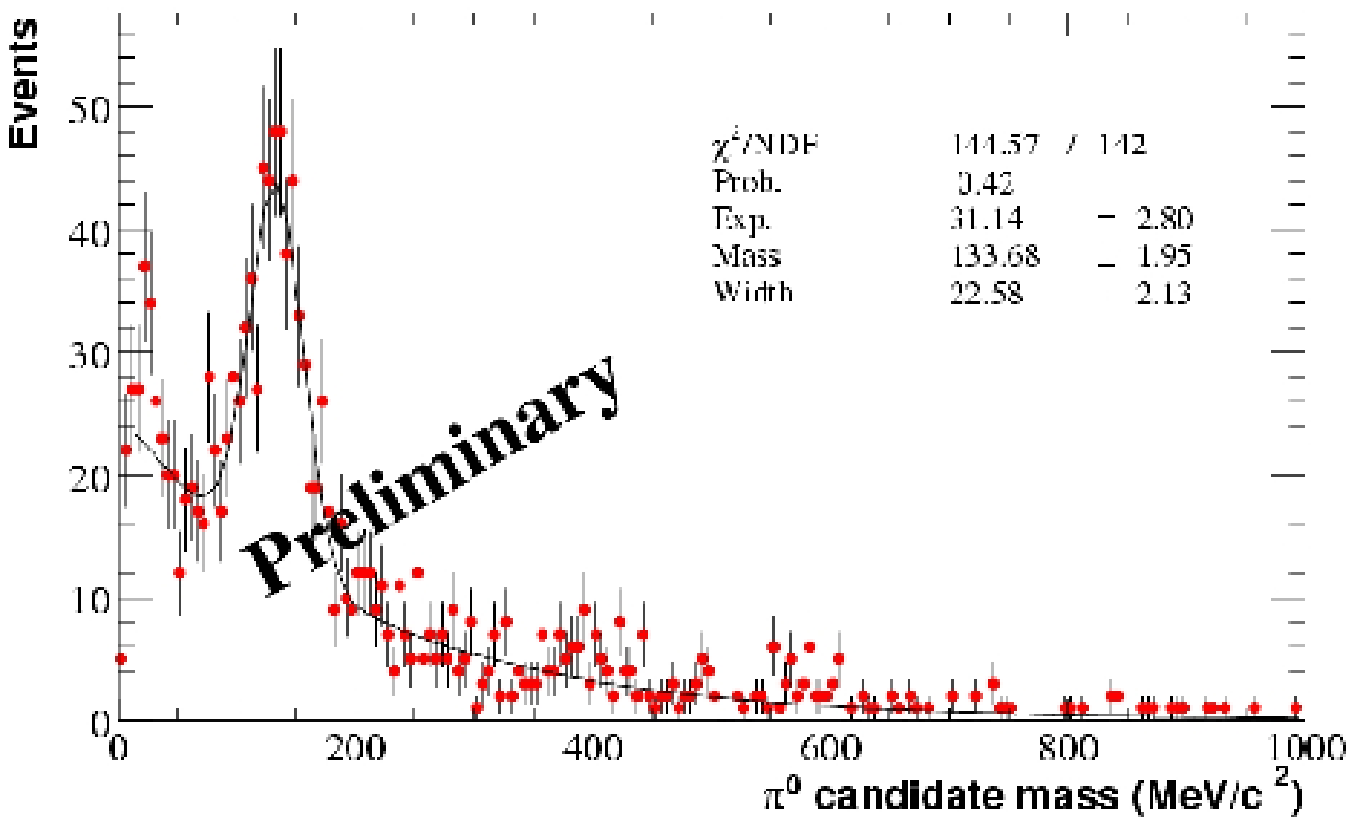


π^0 Candidate Event

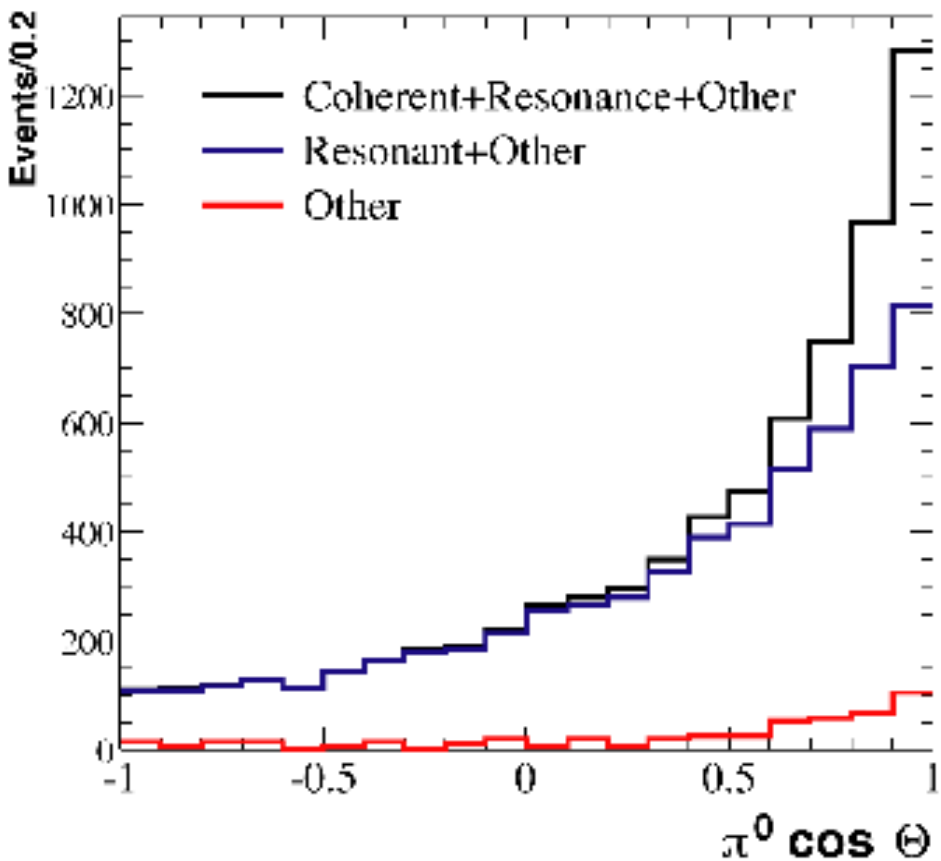


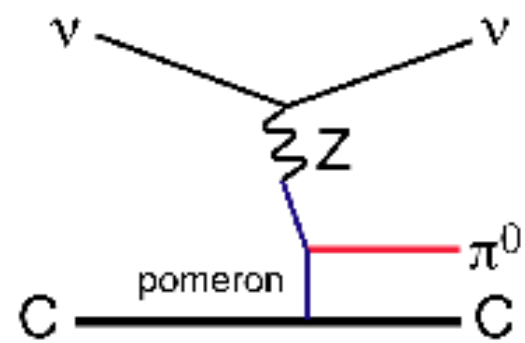
π^0 Reconstruction

1 subevent with R < 450 cm
time within beam spill
tank hits > 200 & veto hits < 6
> 10 photoelectrons per ring



Coherent π^0 Production on Carbon





NUANCE model:
Predicts forward excess due to coherent production shoul be seen.

Other processes:
Rate and shape are flux-dependent.

Coherent π^0 Production on Carbon

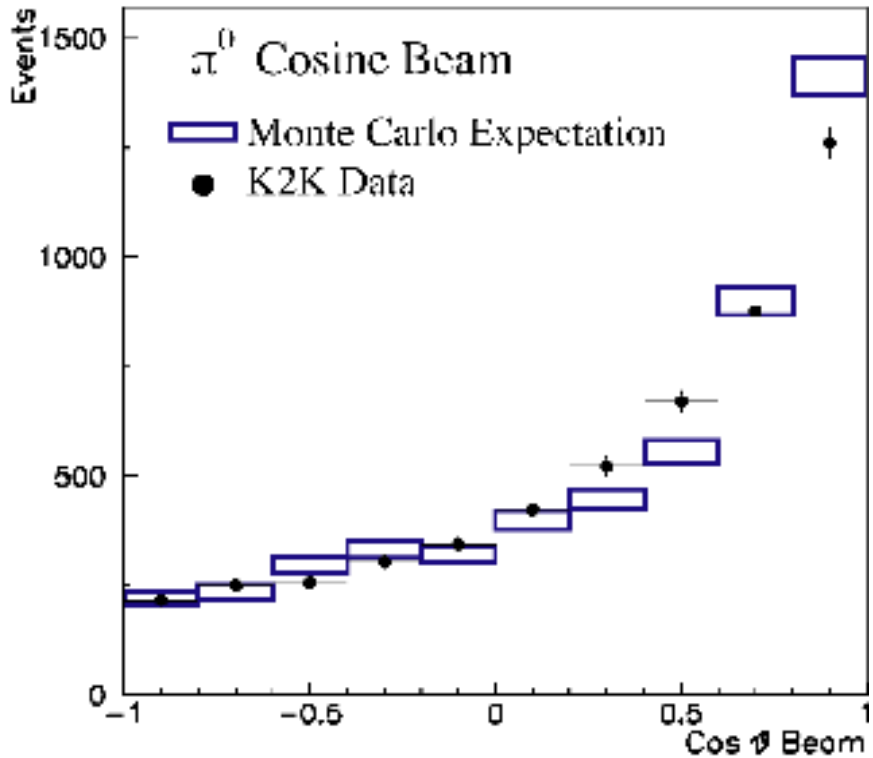
Why are π^0s interesting?

1. Measures NC rate:
   Rate+Cross Section bounds sterile content of disappearence.

2. Background to ν_e appearance

Primary production mechanisms:
- Resonant (Δ production)
- Coherent
- Multi-pion production

Angular Distribution of π^0s in K2K 1Kt Detector



Mechanism are characterized by different angular distributions.
Analysis of cos θ can yield information on rates of individual channels

Conclusions

- *MiniBooNE Beamline & Detector Are Working Beautifully!*
- *Have Collected ~50K ν Events (~10% of $5x10^{20}$ Yearly Goal)*
- *Booster Intensity Is Steadily Increasing*
  (Proton Intensity Now Within 2.5 of Goal)
- *MiniBooNE Needs at Least 10^{21}* ***POT to Provide a Definitive Test of LSND***
- ***First*** *σ & ν_μ –> ν_x Results in ~2003*
- ***First*** *ν_μ –> ν_e Results in ~2005*
- ***If MiniBooNE Confirms LSND, Then Build a 2nd Detector at a Different Distance (BooNE!)***