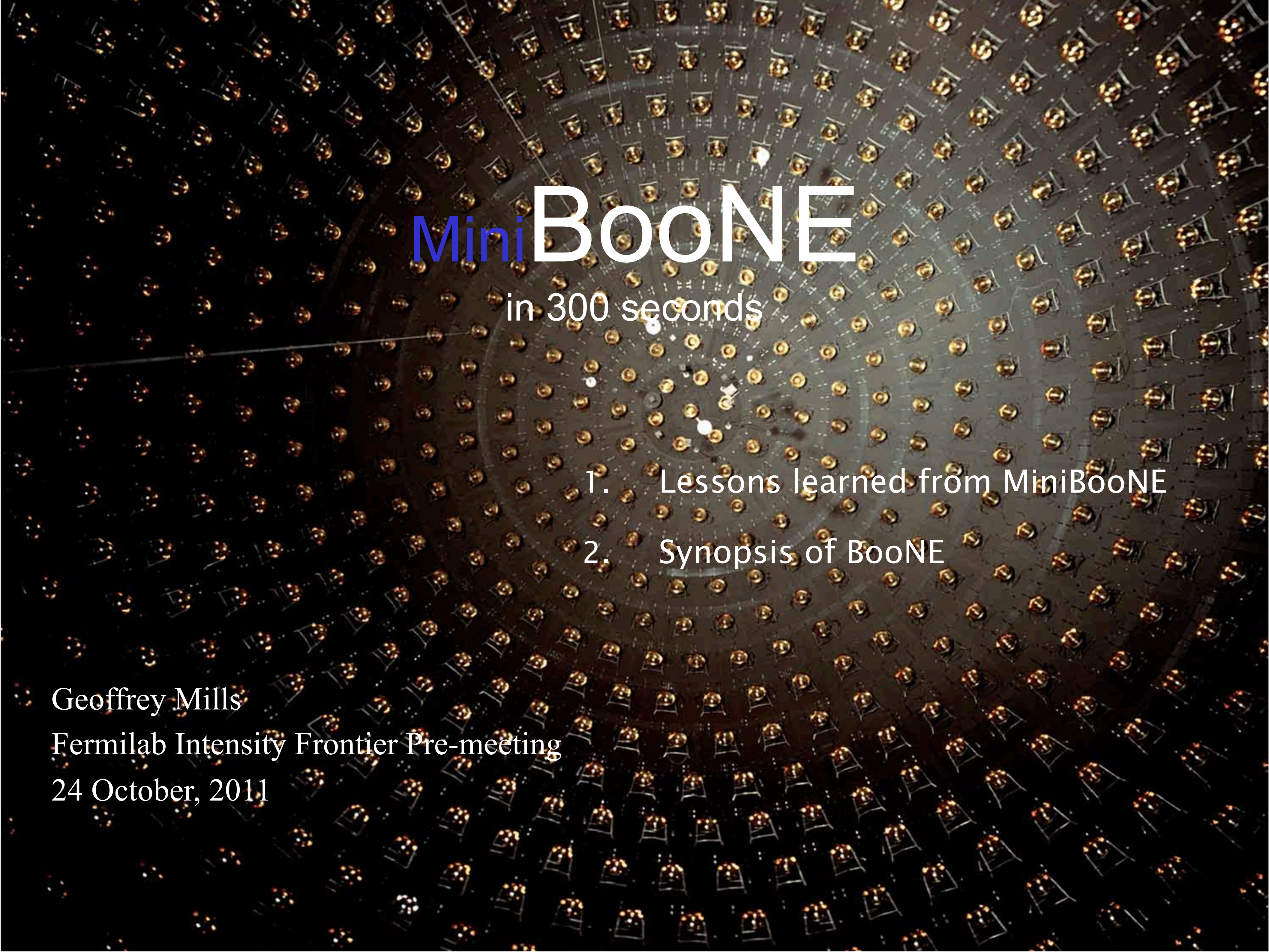


MiniBooNE

in 300 seconds

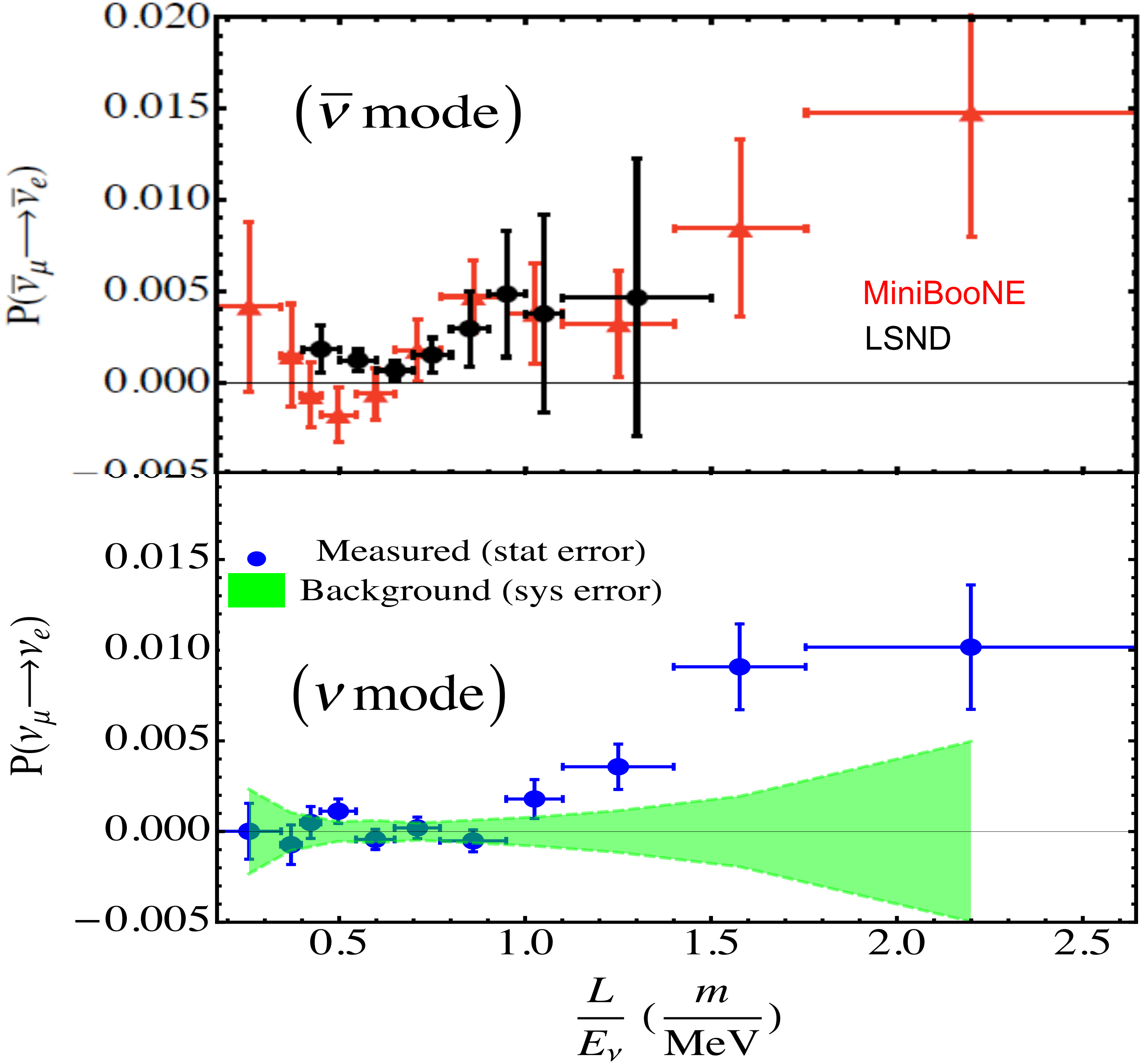
1. Lessons learned from MiniBooNE
2. Synopsis of BooNE

Geoffrey Mills
Fermilab Intensity Frontier Pre-meeting
24 October, 2011

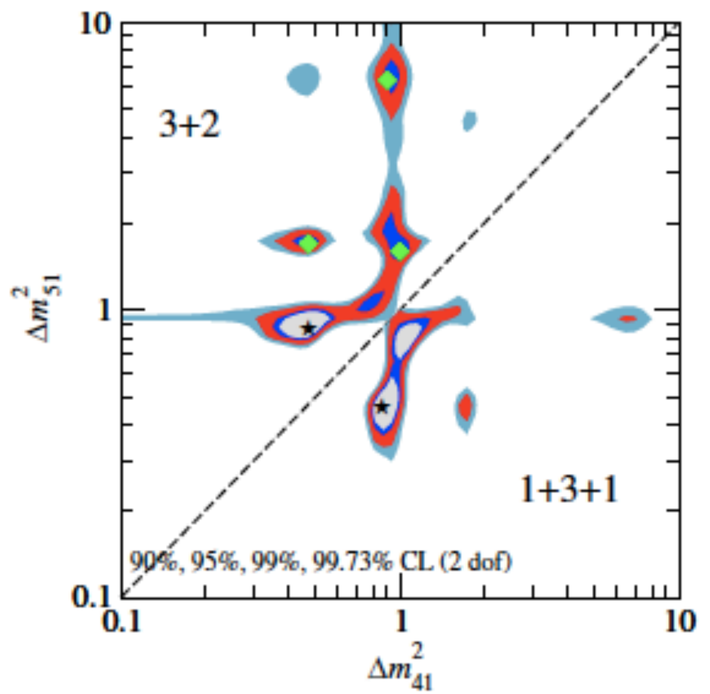
MiniBooNE Lessons Learned

- Intensity, intensity, **intensity!!!!**
  - Proposal: 3 year run ➔ Reality: 9 year run
- Systematic errors difficult in wide-band neutrino beams:
  - Neutrino-nucleus cross sections not measured well enough
  - Flux difficult to measure directly
- Oscillation experiments: two identical detectors!
  - Detector response systematic errors large

MiniBooNE & LSND Appearance Results



3+2 global fit T. Schwetz, SNAC 2011



3+2 SBL oscillations

appearance:

$$P_{\nu_\mu\to\nu_e} = 4\,|U_{e4}|^2|U_{\mu4}|^2\sin^2\phi_{41} + 4\,|U_{e5}|^2|U_{\mu5}|^2\sin^2\phi_{51} + 8\,|U_{e4}U_{\mu4}U_{e5}U_{\mu5}|\sin\phi_{41}\sin\phi_{51}\cos(\phi_{54}-\delta)$$

disappearance:

$$P_{\nu_\alpha\to\nu_\alpha} \approx 1 - 4\sum_{i=4,5}|U_{\alpha i}|^2\sin^2\phi_{i1} - 4\,|U_{\alpha4}|^2|U_{\alpha5}|^2\sin^2\phi_{54}$$

$$[\phi_{ij} \equiv \Delta m^2_{ij}L/4E]$$

- phase $\delta \equiv \arg\left(U^*_{e4}U_{\mu4}U_{e5}U^*_{\mu5}\right) \to$ CP violation Karagiorgi et al. 06; Maltoni, TS 07

	Δm^2_{41}	$\|U_{e4}\|$	$\|U_{\mu4}\|$	Δm^2_{51}	$\|U_{e5}\|$	$\|U_{\mu5}\|$	δ/π	$\chi^2/130$
3+2	0.47	0.128	0.165	0.87	0.138	0.148	1.64	110.1
3+2'	0.47	0.117	0.201	1.70	0.151	0.101	1.39	114.4
3+2'	1.00	0.133	0.163	1.60	0.122	0.079	1.48	114.4
3+2'	0.90	0.123	0.163	6.30	0.135	0.091	1.67	115.0
1+3+1	0.47	0.129	0.154	0.87	0.142	0.163	0.35	106.1

Compatibility 10^{-6}?

Synopsis of BooNE Proposal:

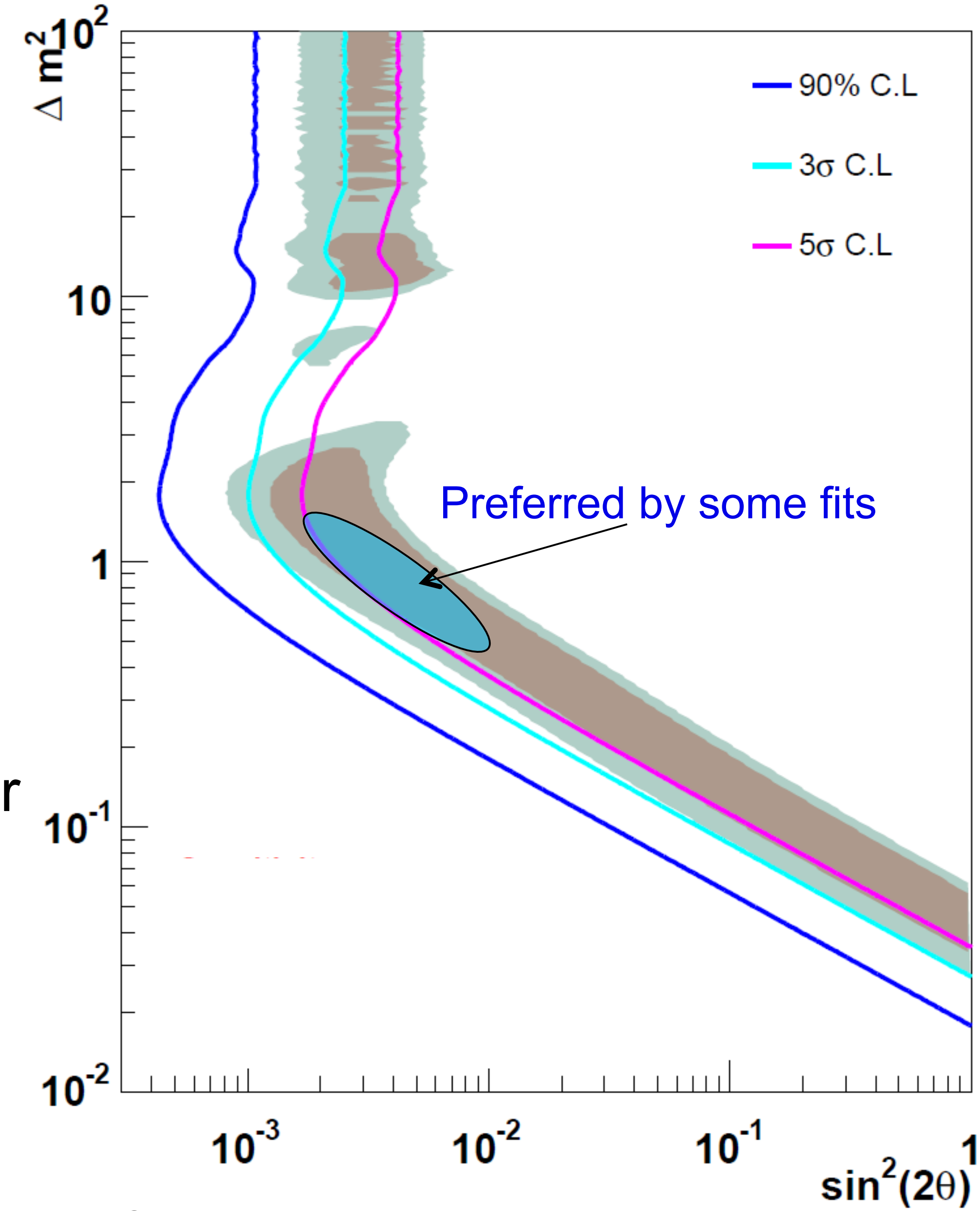
- A number of anomalies have appeared in neutrino data in E and L regions corresponding to a $\Delta m^2 \sim 1$ eV^2
- Predominantly from single detector experiments…
- There is a possibility that the some of the effects are due to oscillations between sterile neutrinos and active neutrinos
- A definitive two-detector experiment is warranted
- BooNE would be such an experiment

1-2 years of operation!

New Detector Location at 200 meters

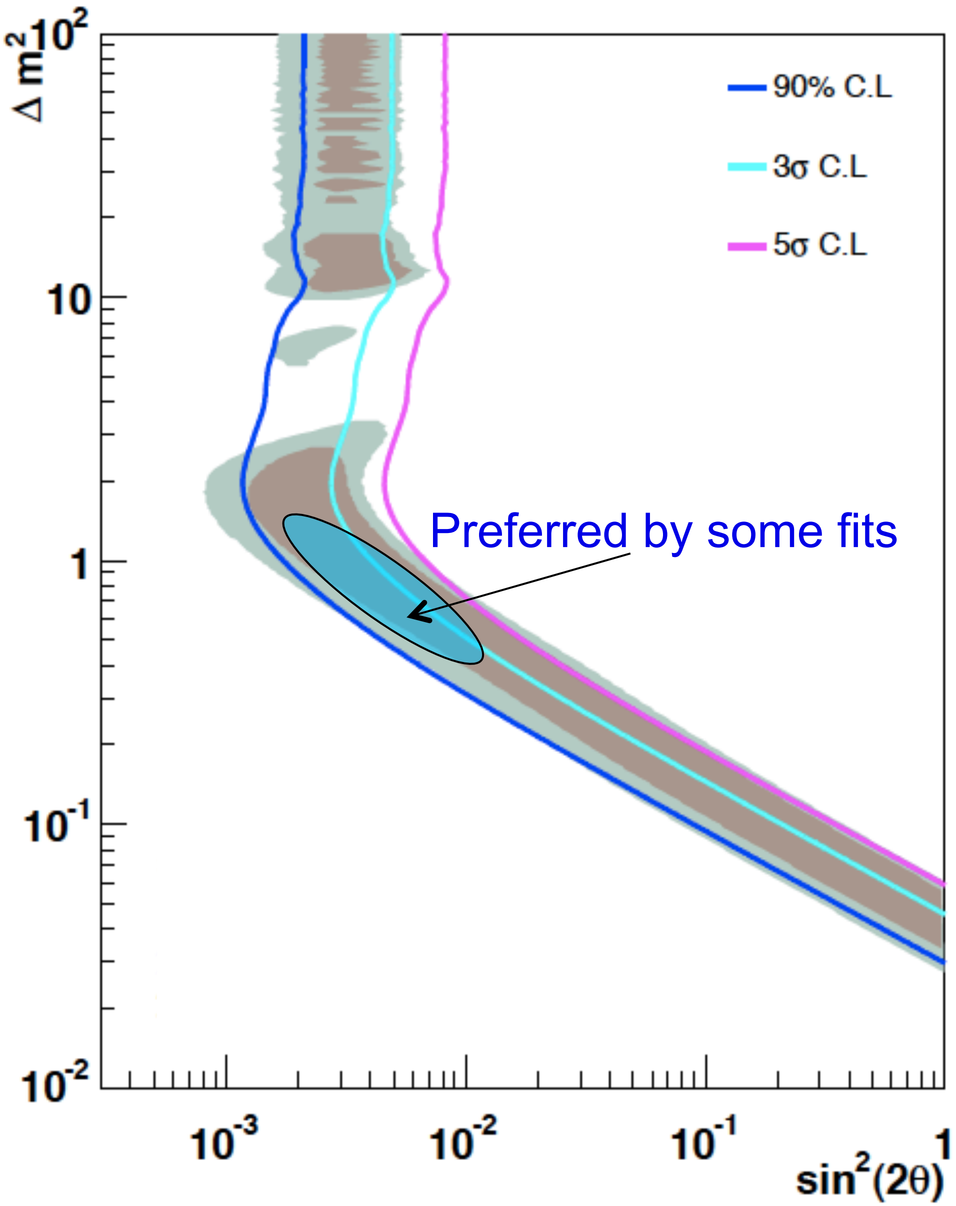
Sensitivity with Near/Far Comparison

- Near/Far comparison sensitivity
  - ➢Near location at 200 meter
    - ✓ 1×10^{20} pot ~1 yr of running
  - ➢ Full systematic error analysis
    - ✓Flux, cross section, detector response

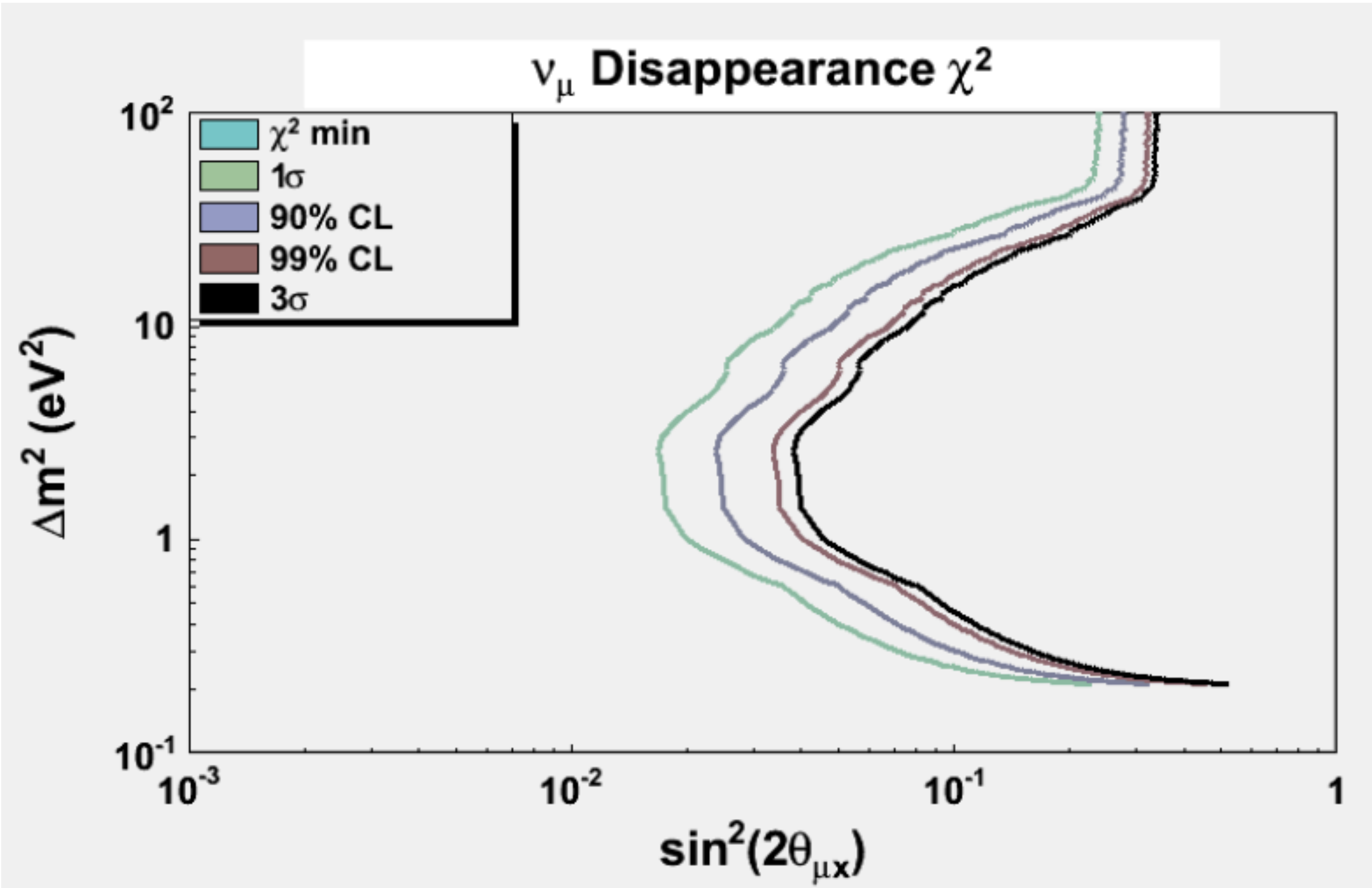


Sensitivity with Near/Far Comparison Anti-nu Mode

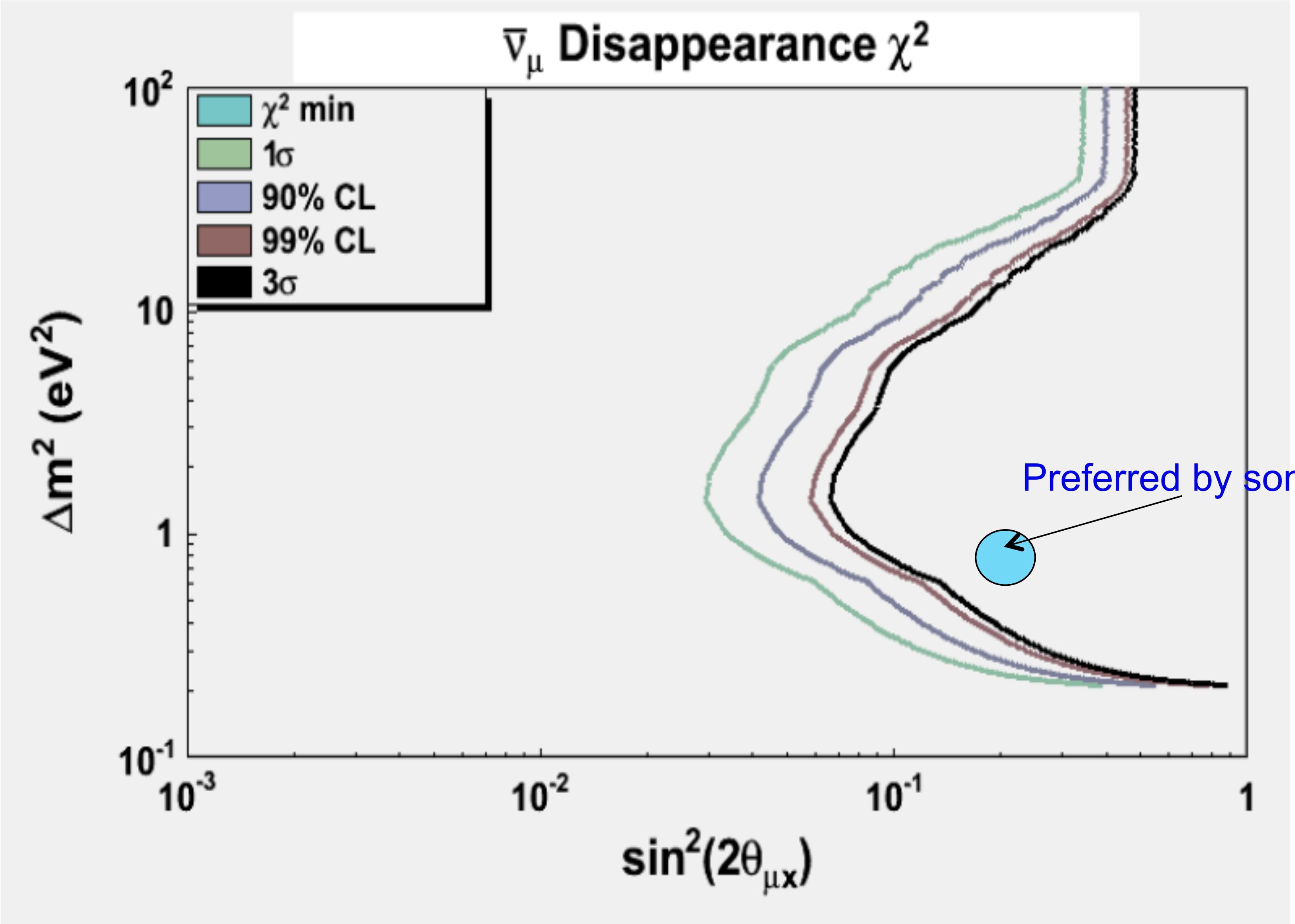
- Near/Far comparison sensitivity
  - ➢ Near location at 200 meter
    - ✓ $1x10^{20}$ pot ~1 yr of running
  - ➢ Full systematic error analysis
    - ✓ Flux, cross section, detector response



Neutrino Disappearance Sensitivity with Detector at 200 Meters



Antineutrino Disappearance Sensitivity with Detector at 200 Meters



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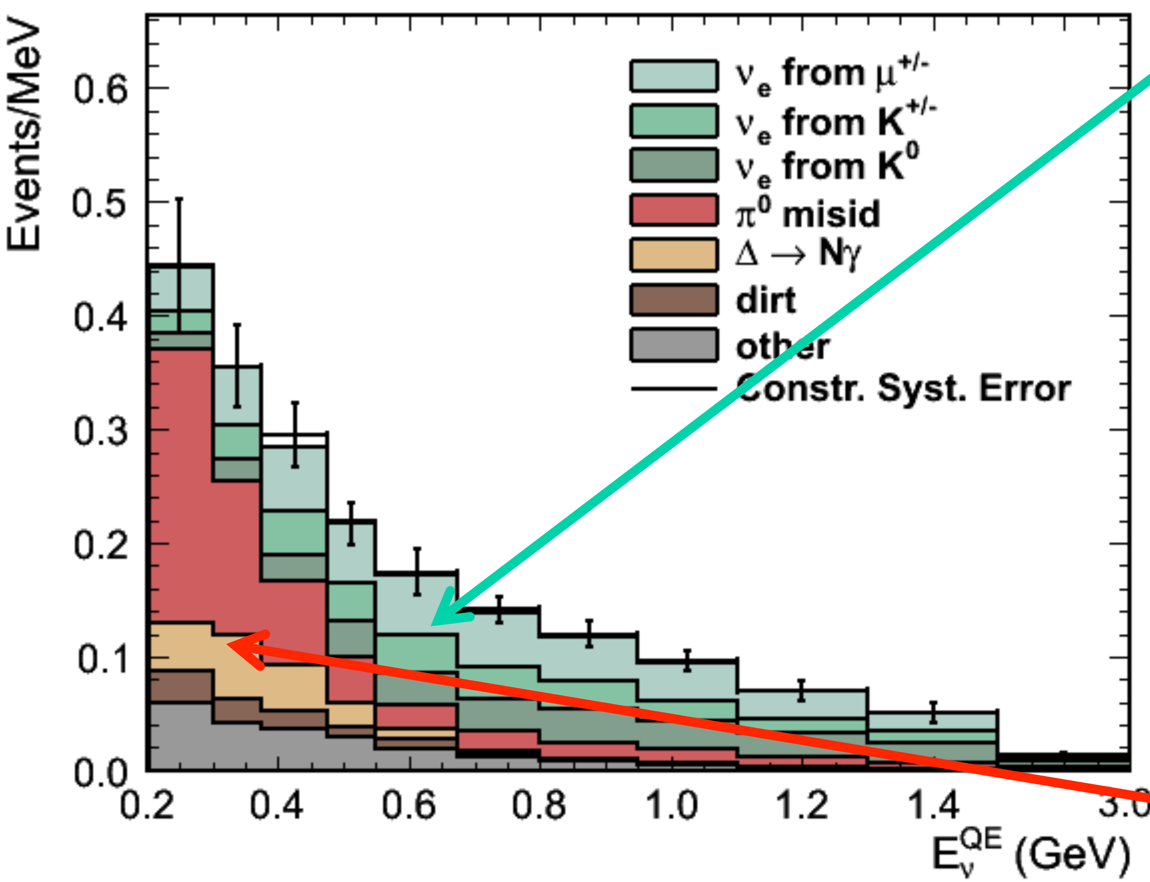
Backup

MiniBooNE Backgrounds: antineutrino mode



Intrinsic ν_e

π^0 mis-id

Current issues in analysis:

- All current 3+1(2) ignore ν_e disappearance
- Dominant error below 500 MeV is due to uncertainties in detector response

BooNE Proposal

Sep 14, 2011

Gantt Chart