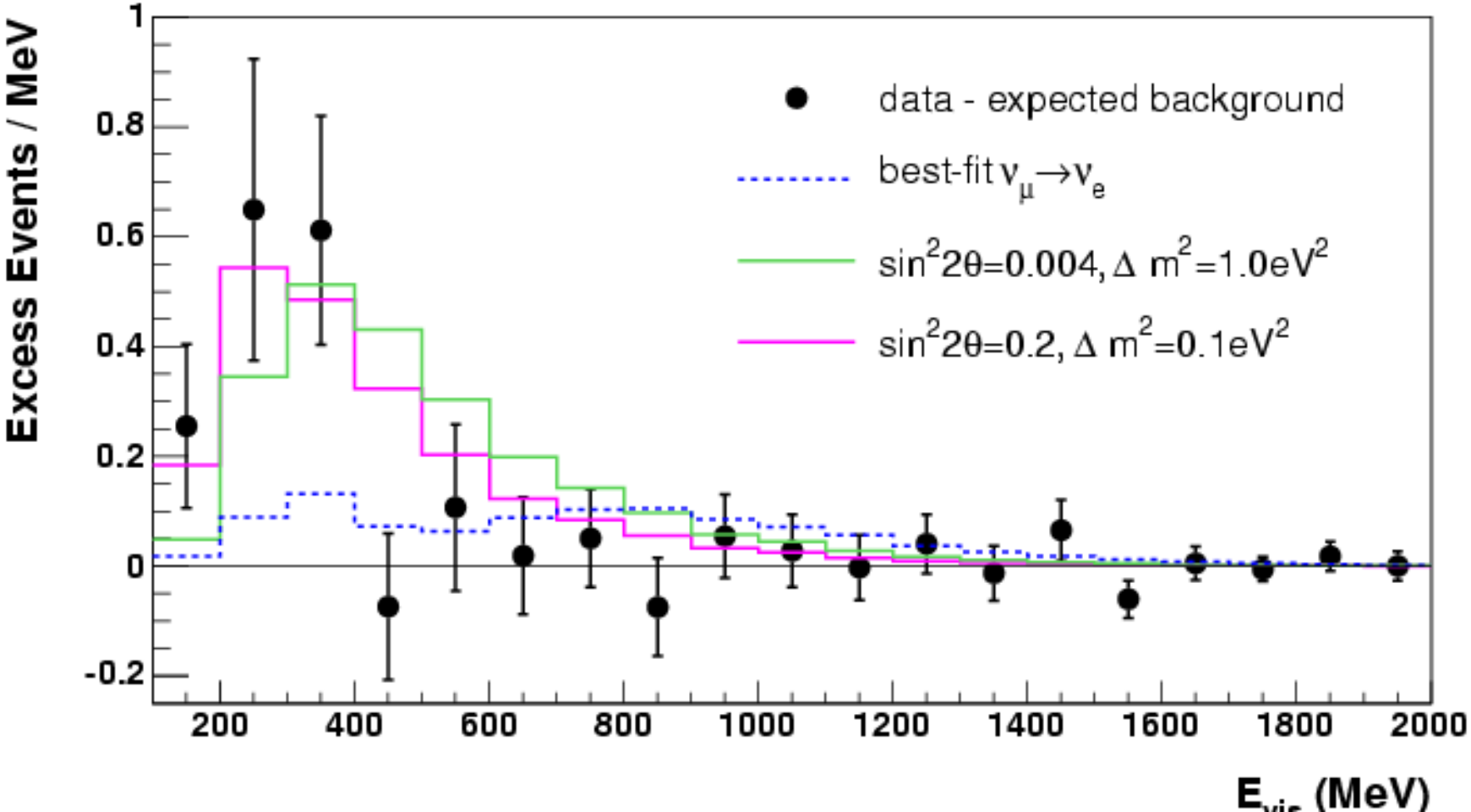
# $\nu_\mu$ and $\bar{\nu}_\mu$ Disappearance

W.C. Louis, DNP Conference, October 16, 2009

- **MiniBooNE Appearance Results (talk by Zarko Pavlovic)**
- **MiniBooNE Disappearance Results**
- **Global 3+1 Fits to World Data**
- **Preliminary MINOS Experiments**
- **Future Experiment: BooNE (talk by Geoff Mills)**
- **Conclusions**

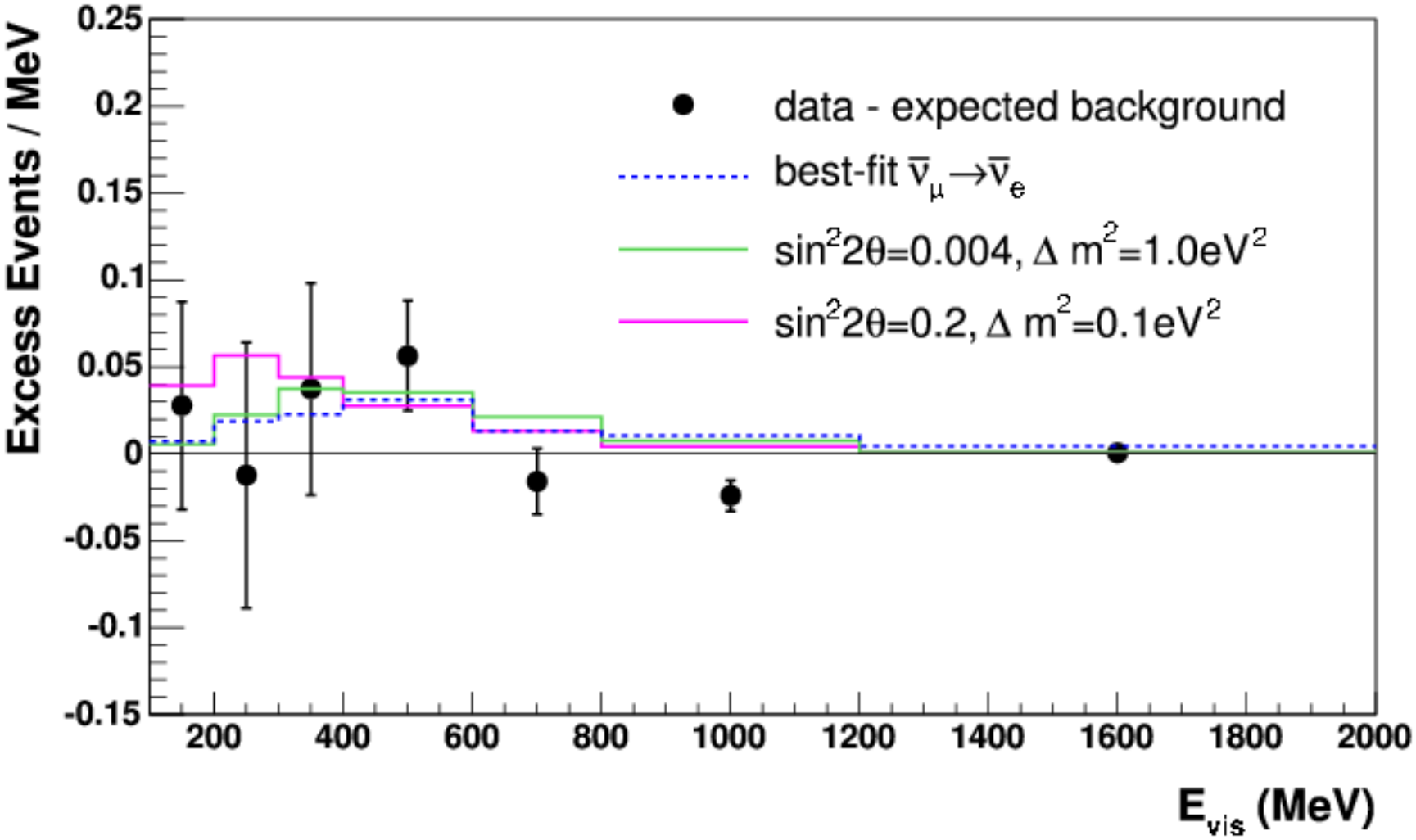
# *MiniBooNE $\nu_e$ appearance data show a low-energy excess*

**A.A. Aguilar-Arevalo et al., PRL 102, 101802 (2009)**

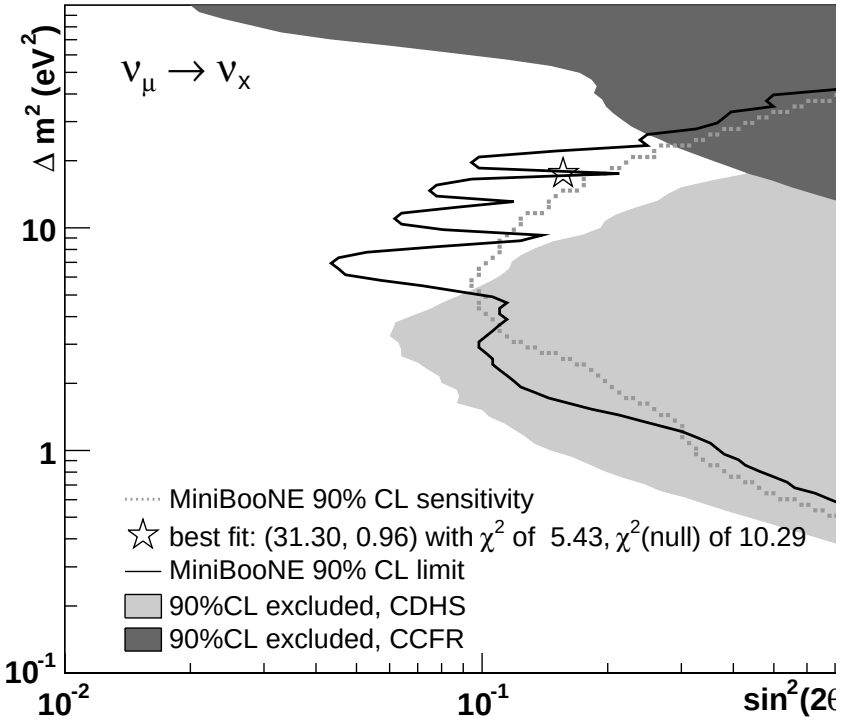


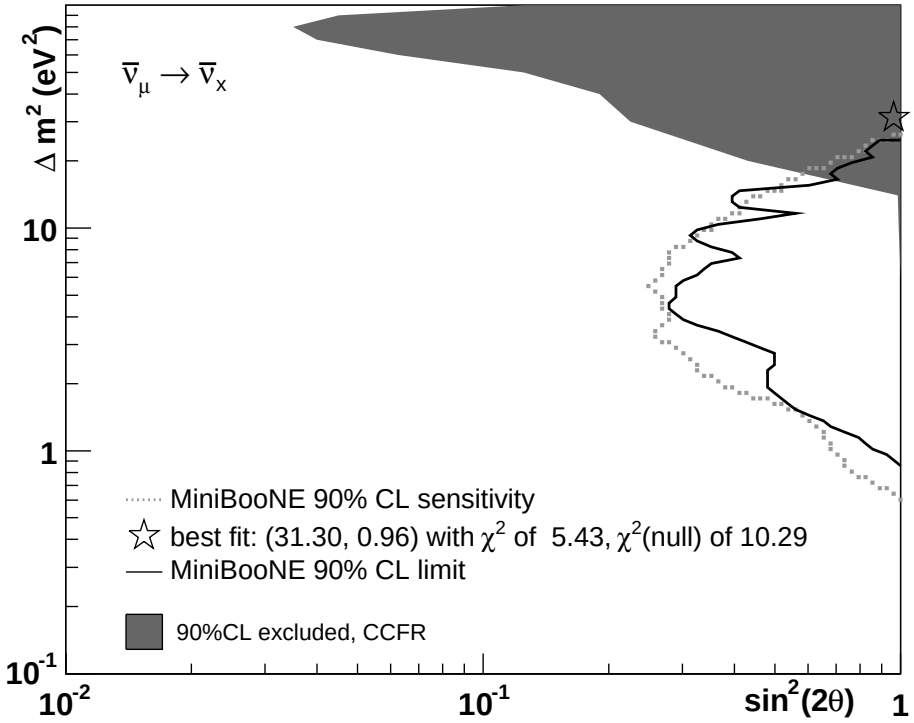
# *MiniBooNE $\bar{\nu}_e$ appearance data are inconclusive at present but are consistent so far with LSND*

**A.A. Aguilar-Arevalo et al., PRL 103, 111801 (2009)**



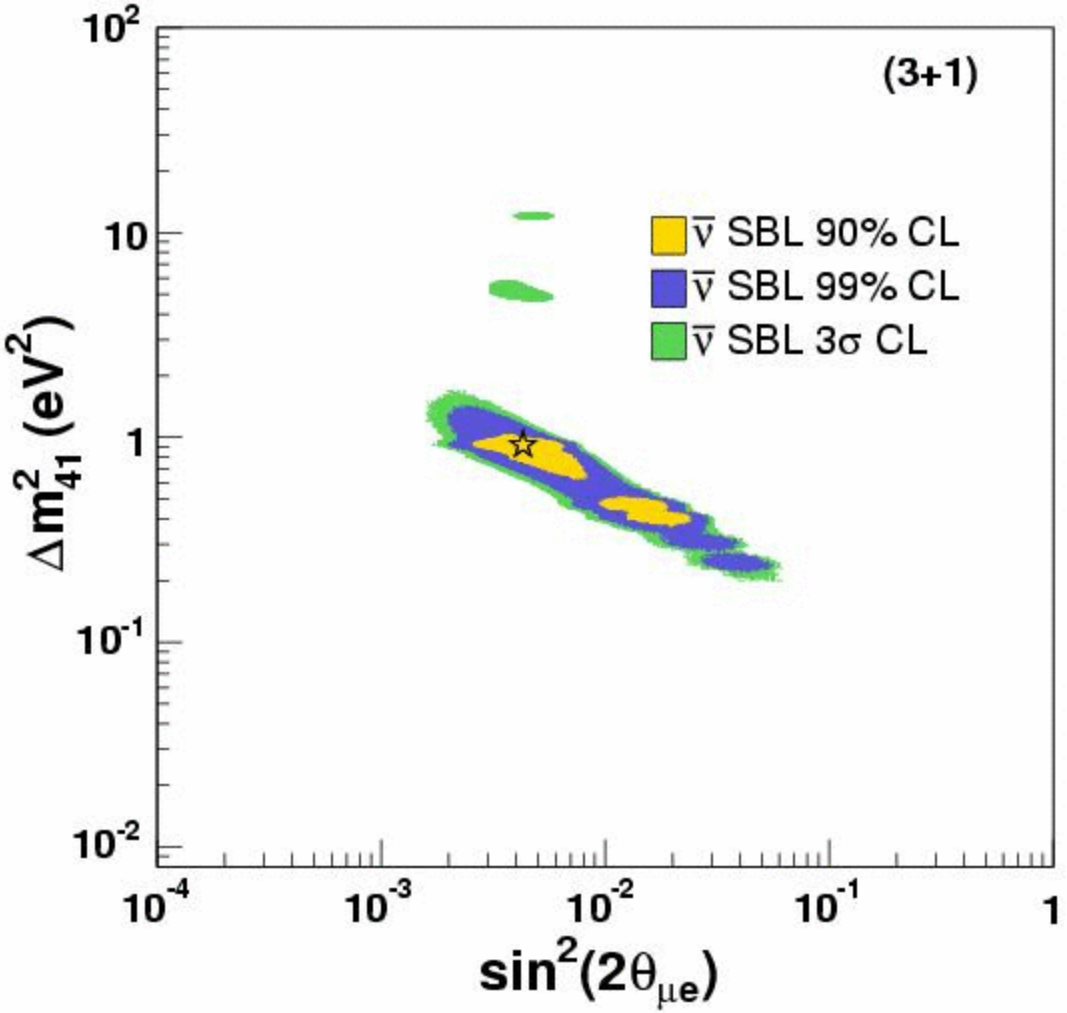
## A.A. Aguilar-Arevalo et al., PRL 103, 061802 (2009)




**Improved results soon from MiniBooNE/SciBooNE Joint Analysis!**

# *3+1 Global Fit to World Antineutrino Data*

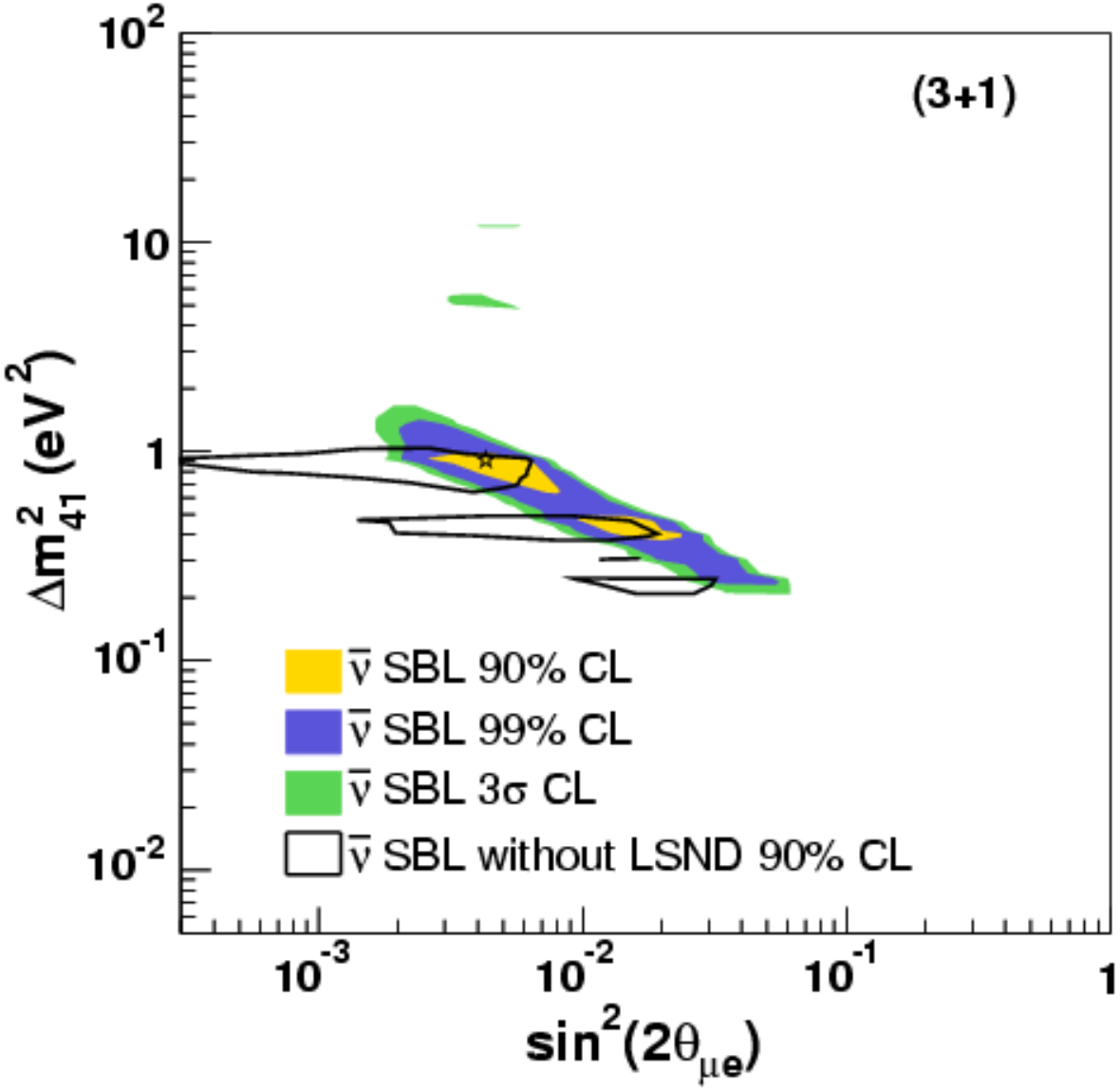



**G. Karagiorgi et al., arXiv:0906.1997**

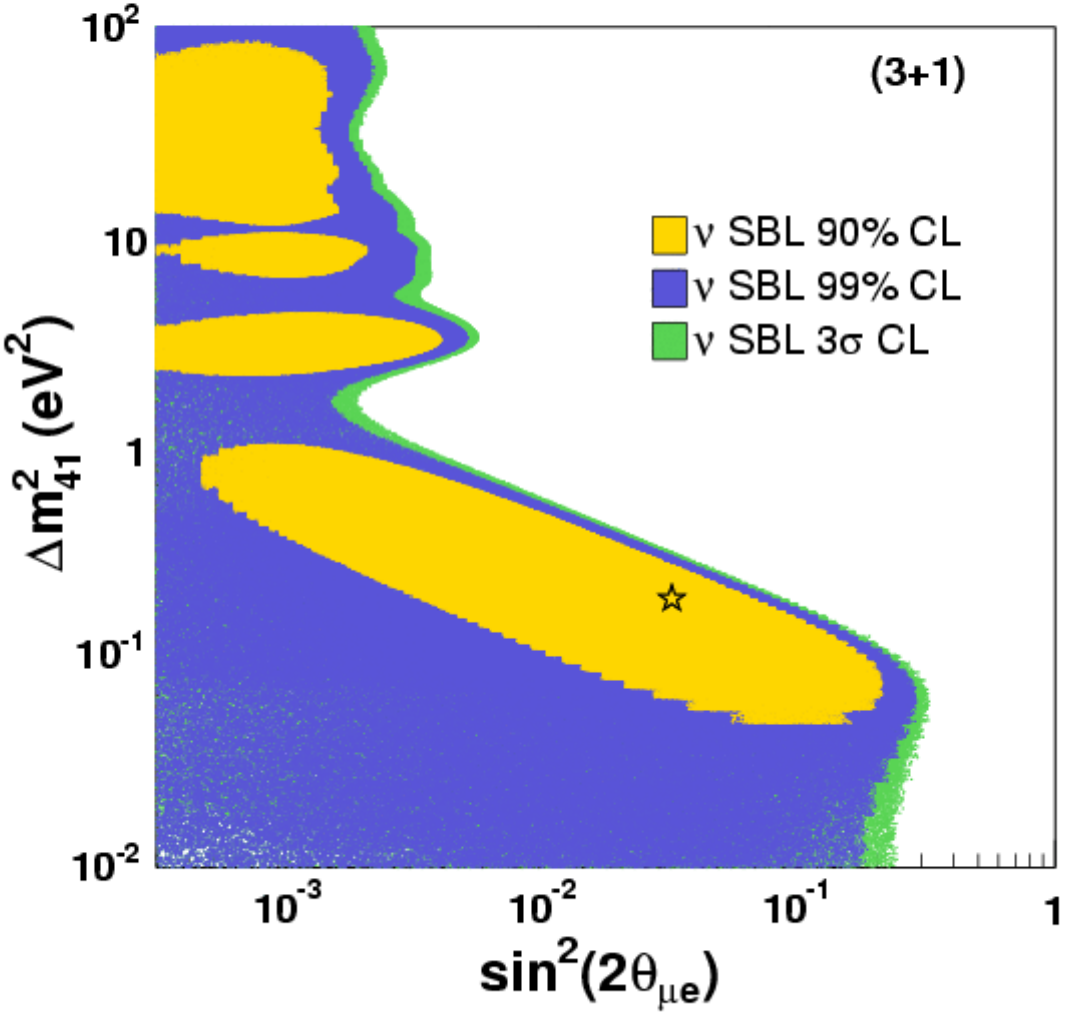
**Best 3+1 Fit:**
**$\Delta m^2_{41} = 0.915$ eV$^2$**
**$\sin^2 2\theta_{\mu e} = 0.0043$**
**$\chi^2 = 87.9/103$ DOF**
**Prob. = 86%**

**Predicts $\bar{\nu}_\mu$ & $\bar{\nu}_e$ disappearance of $\sin^2 2\theta_{\mu\mu} \sim 35\%$ and $\sin^2 2\theta_{ee} \sim 4.3\%$**

# *3+1 Global Fit to World Antineutrino Data w/o LSND*



# *3+1 Global Fit to World Neutrino Data*

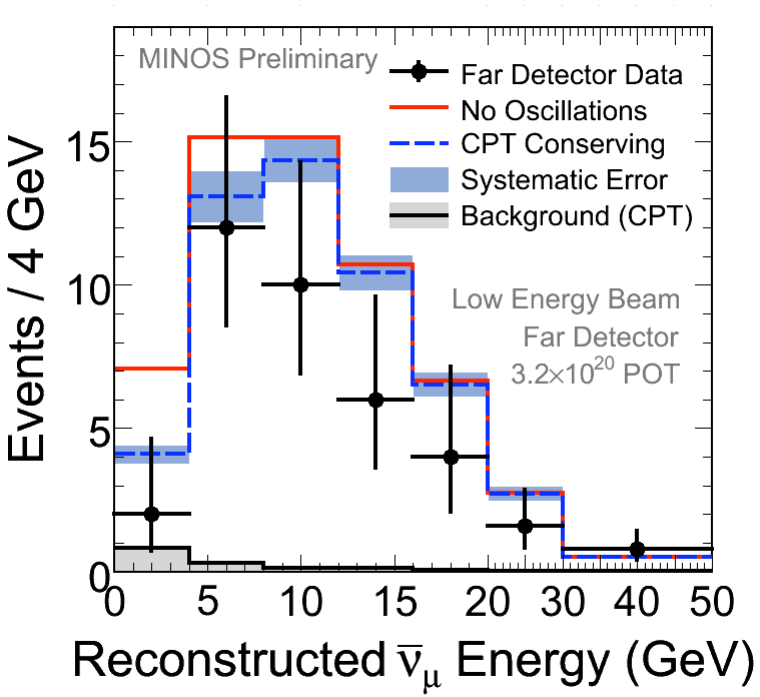


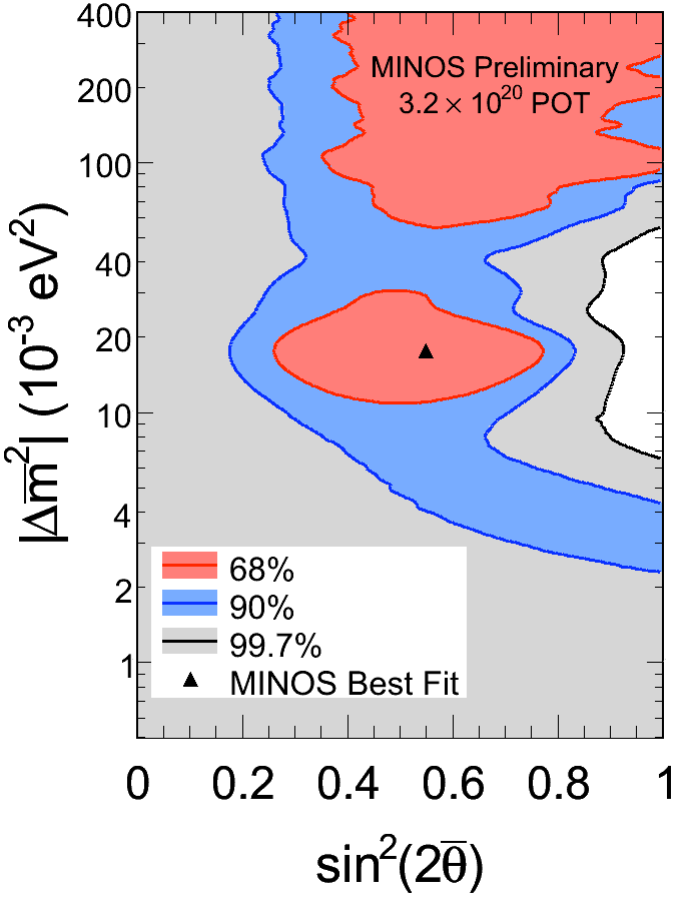

**G. Karagiorgi et al., arXiv:0906.1997**

**Best 3+1 Fit:**
**$\Delta m_{41}^2$ = 0.19 eV$^2$**
**$\sin^2 2\theta_{\mu e}$ = 0.031**
**$\chi^2$ = 90.5/90 DOF**
**Prob. = 46%**

**Predicts $\nu_\mu$ & $\nu_e$ disappearance of $\sin^2 2\theta_{\mu\mu}$ ~ 3.1% and $\sin^2 2\theta_{ee}$ ~ 3.4%**

# *Initial MINOS $\overline{\nu}_\mu$ Disappearance Results*

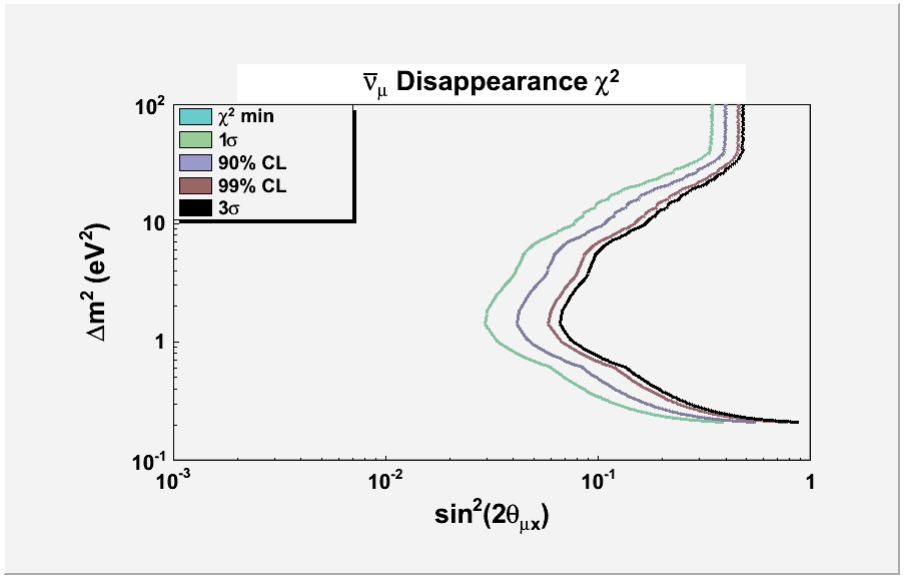


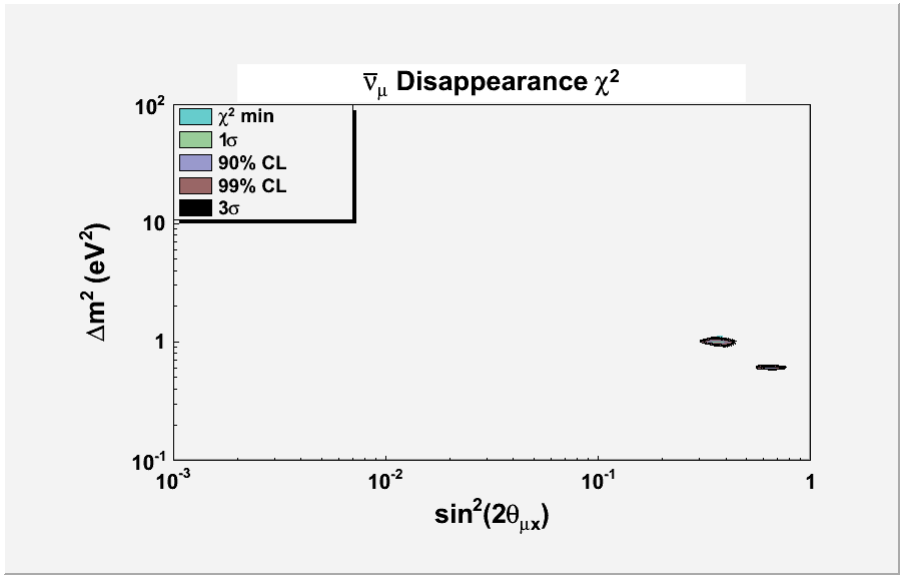
# *Future: BooNE*

- BooNE involves building a second MiniBooNE detector at (or moving MiniBooNE to) a location ~200 m from the target
- With two detectors, many of the systematic errors will cancel, giving excellent sensitivity for both appearance and disappearance!

**$\bar{\nu}_\mu$ Disappearance Sensitivity**




**Allowed region for $\Delta m^2$ =0.915 eV$^2$ and $\sin^2 2\theta_{\mu\mu}$=35%**



# Conclusions

- **All antineutrino data fit very well to a simple 3+1 model. (LSND is alive & well!) However, there is tension between neutrino & antineutrino data. (CPT Violation?)**
- **The global fit to the world antineutrino data predicts large $\bar{\nu}_\mu$ disappearance, which will be tested soon by MINOS and SciBooNE/MiniBooNE.**
- **BooNE, which involves building a near MiniBooNE detector, will be able to search for $\bar{\nu}_\mu$ disappearance with high sensitivity.**

# Backup Slides

# *Low-energy excess vs $E_{vis}$*

With $E_{vis}$ Best Fit (0.04 $eV^2$, 0.96)