MINOS nue 9/19/2003

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Collaboration meeting

- Quick review for new people
- Comments on more recent work
- New data from SuperK and SNO

Quick Review 1

NUMI-L-714 - 2/14/2001 - Monte Carlo study of $\nu_\mu \rightarrow \nu_e$

Cluster finding algorithm.

- Various cuts on cluster energy and strips.
- Neural net estimator $Y > 0$.
- FINAL cut on Etot kept as a function of Δm^2.

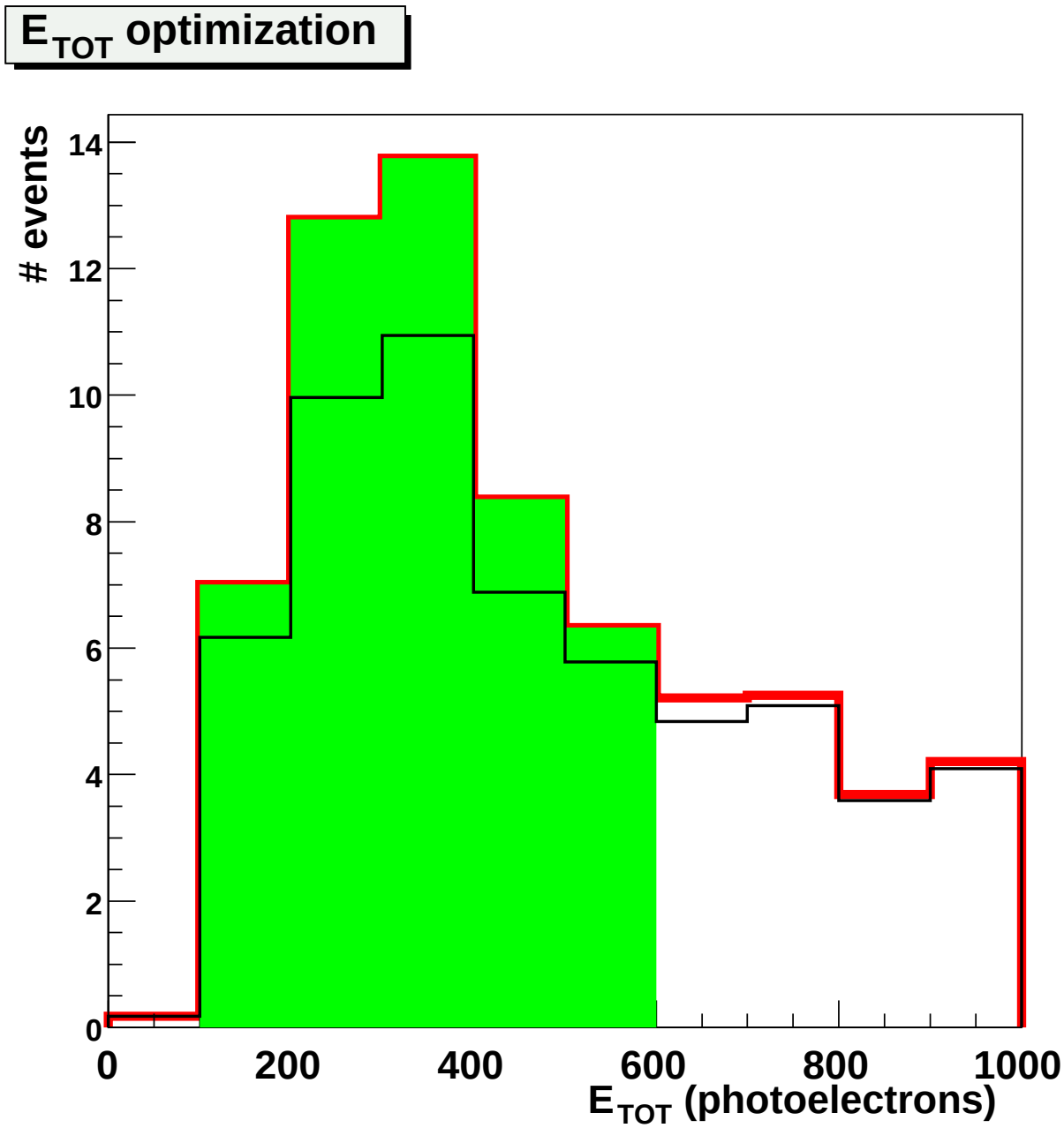
NUMI-SIM-884 - 11/4/2002 - Study of systematic on backgrounds

Argues that systematic errors on the ν_μ-CC background is important.

NUMI-SIM-929 - 5/17/2003 - Optimization of beam parameters.

Some NC background in NUMI-714 could be overestimated
Optimization of target dimension and position could yield 10% improvmt.

Expected Signal/Background (ν_e appearance)



10 kt-yr, $U^2_{e3} = 0.01$, $\delta m^2 = 0.003\,\mathrm{eV}^2$, $U^2_{\mu 3} = U^2_{\tau 4}$

Problem for ν_e: background

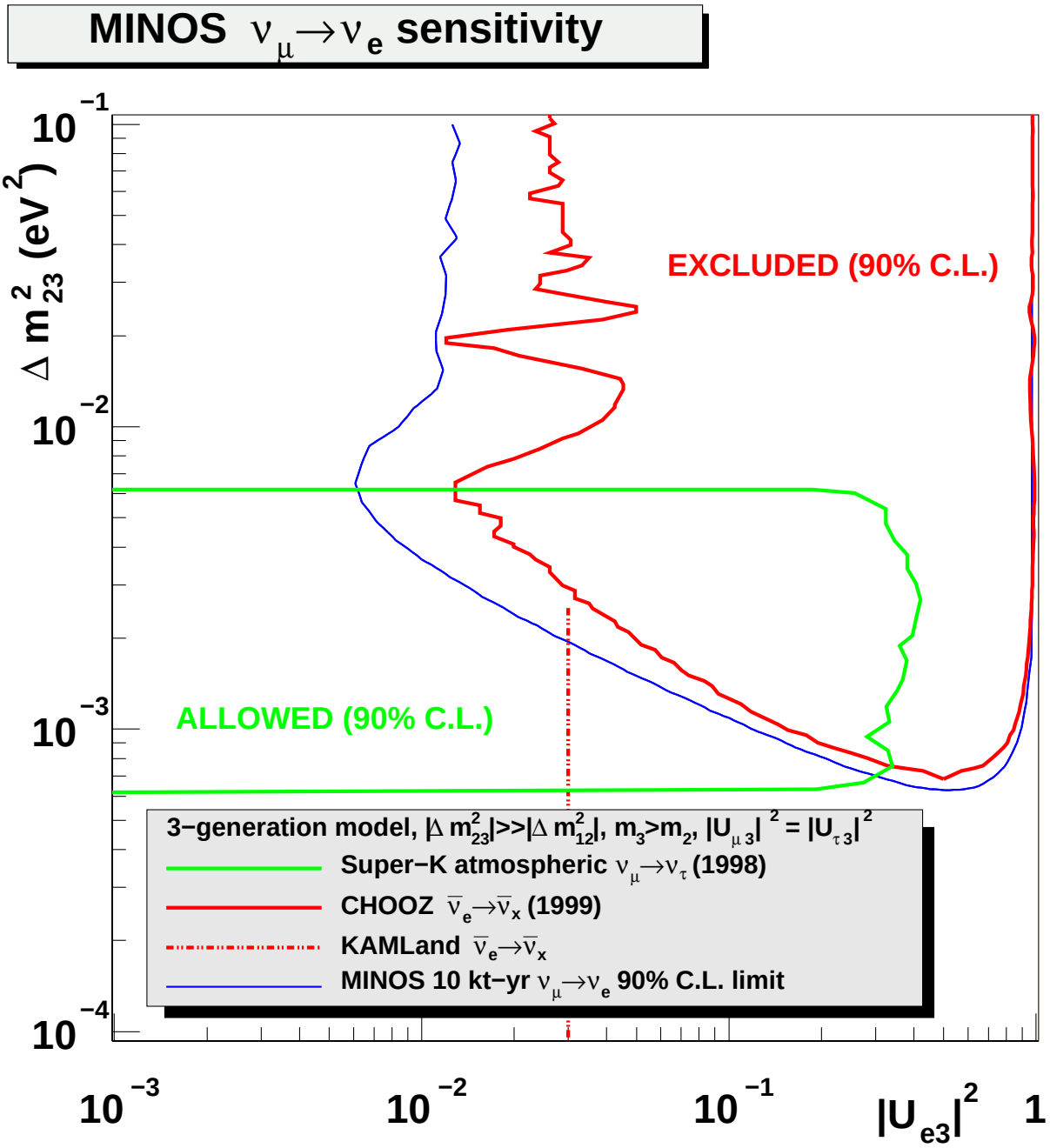
δm^2	signal	ν_e (intrinsic)	ν_μ CC	ν_τ CC	NC (E_ν <10 GeV)	NC (E_ν >10 GeV)
0.002	8	5.6	3.9	2	15.7	11.5
0.003	8.5	5.6	3.9	3	15.7	11.5
0.004	20	5.6	3.9	10	12.0	11.5

At $|U_{e3}|^2 = 0.01$

Baseline LE beam.

10 kton·years.

Expected Limits
(ν_e appearance)



List of analysis tasks for $\nu_\mu \rightarrow \nu_e$

- Cross sections in the Monte Carlo.
- Recalculate the physics reach for MINOS with new improved reconstruction software.
- Simulate and analyze the background spectrum in the near detector. Determine effects that will limit the systematic uncertainty on the background to the electron signal.

  We made no study of near detector in NUMI-714. Assumed 10% sys. error on background.
- Introduce calibration data from the recent calibration runs of a test module at CERN into the analysis.
- Blind Analysis

New data from SuperK and SNO

- SuperK (some slides)

  Complete SK-I data set (1489 days)

  Better Monte Carlo and refit

  90% C.L.

  Old: $\delta m^2_{32} = 0.0025 + 0.0014 - 0.0009 eV^2$

  New: $\delta m^2_{32} = 0.0020 + 0.001 - 0.0007 eV^2$

  Old naive limit: $\sin^2 2\theta_{13} < 0.12$ 90% C.L.

  New naive limit: $\sin^2 2\theta_{13} < 0.20$ 90% C.L.

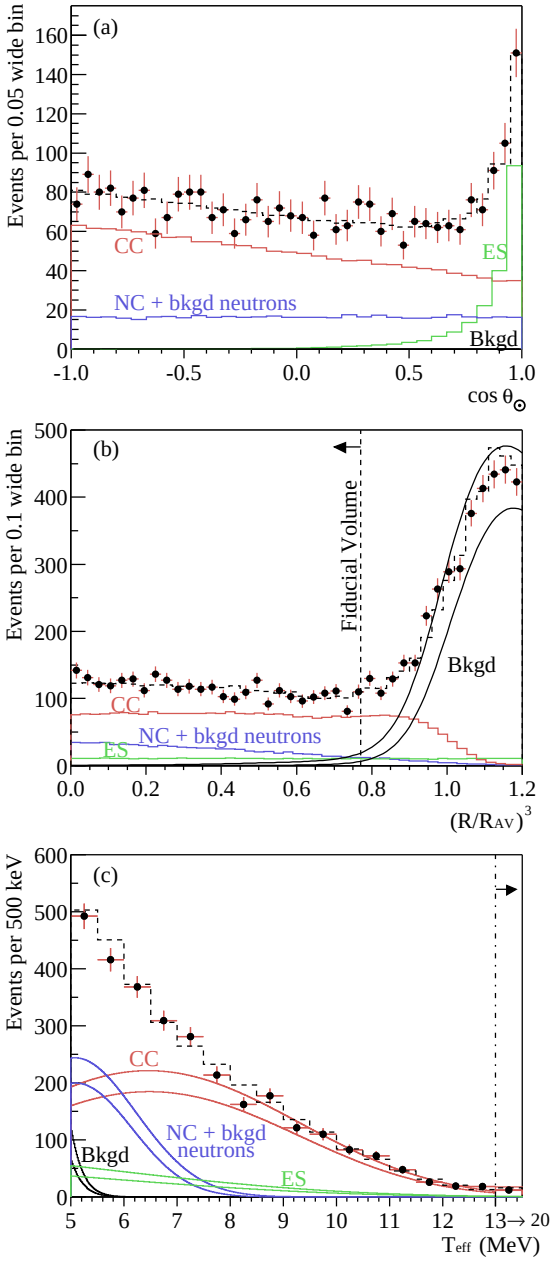
- New SNO data with Salt

  Better values for Solar parameters.

  Global fit to 3 ν mixing.

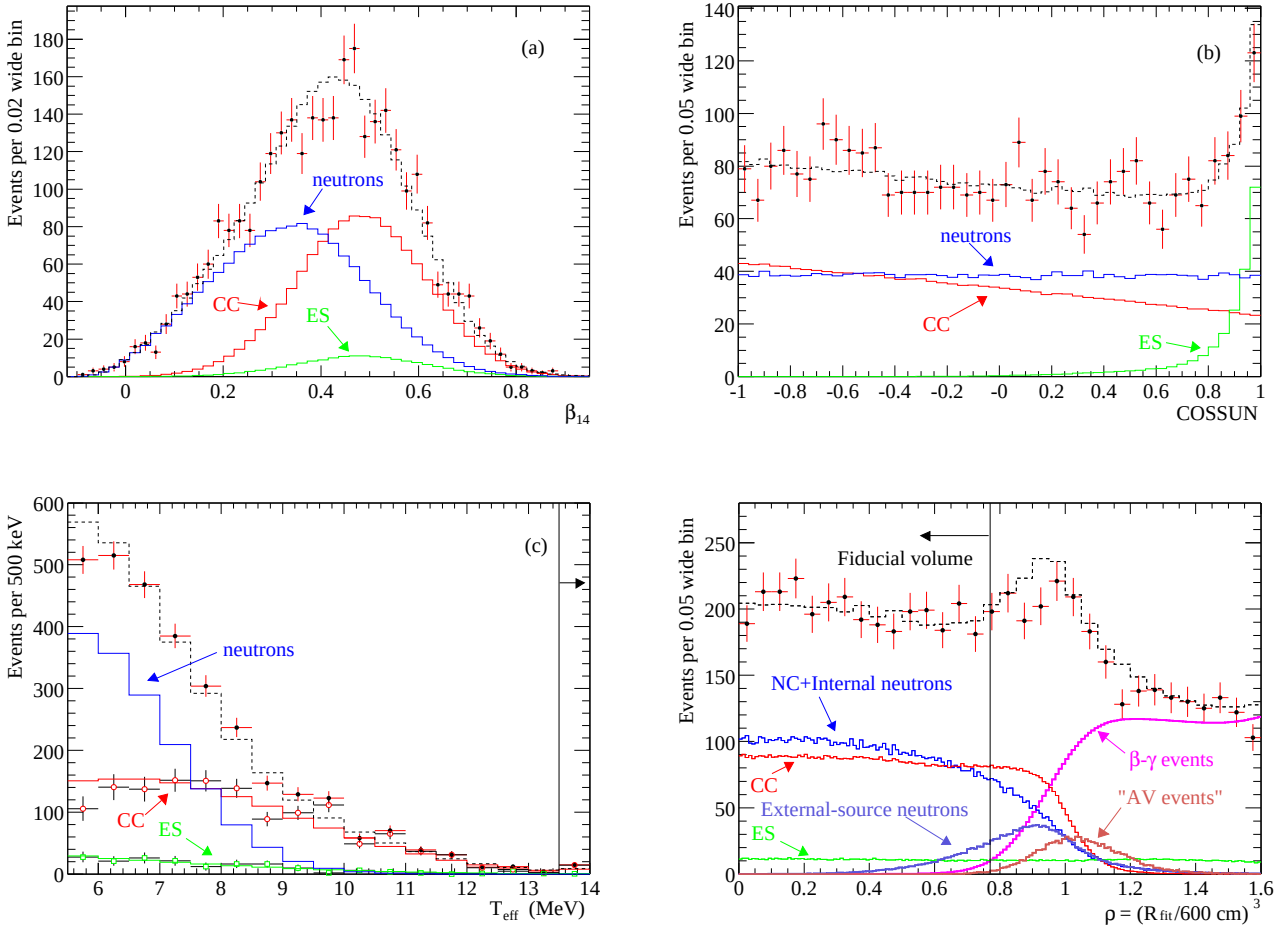
SNO summary 1

Old SNO: PRL 89, 011301 (2002)



SNO summary 2

New SNO: nucl-ex/0309004 (2003)



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SNO summary 3

Old SNO: PRL 89, 011301 (2002)

New SNO: nucl-ex/0309004 (2003)

Salt improves NC efficiency by factor 3.

Salt also makes neutron signal on Cl more isotropic.

Allows extraction of flux without any assumption on spectrum.

OLD SNO (Flux of ^8B neutrino measured with each reaction type)

	Events	Flux $10^6/cm^2/sec$ ^8B Constr.	Flux $10^6/cm^2/sec$ NO ^8B Constr.
CC	1967^{+62}_{61}	$1.76^{+0.06}_{-0.05}(st)^{+0.09}_{-0.09}(sy)$	–
ES	264^{+26}_{-26}	$2.39^{+0.24}_{-0.23}(st)^{+0.12}_{-0.12}(sy)$	–
NC	576^{+49}_{-49}	$5.09^{+0.44}_{-0.43}(st)^{+0.46}_{-0.43}(sy)$	$6.42^{+1.57}_{-1.57}(st)^{+0.55}_{-0.58}(sy)$

NEW SNO (Flux of ^8B neutrino measured with each reaction type)

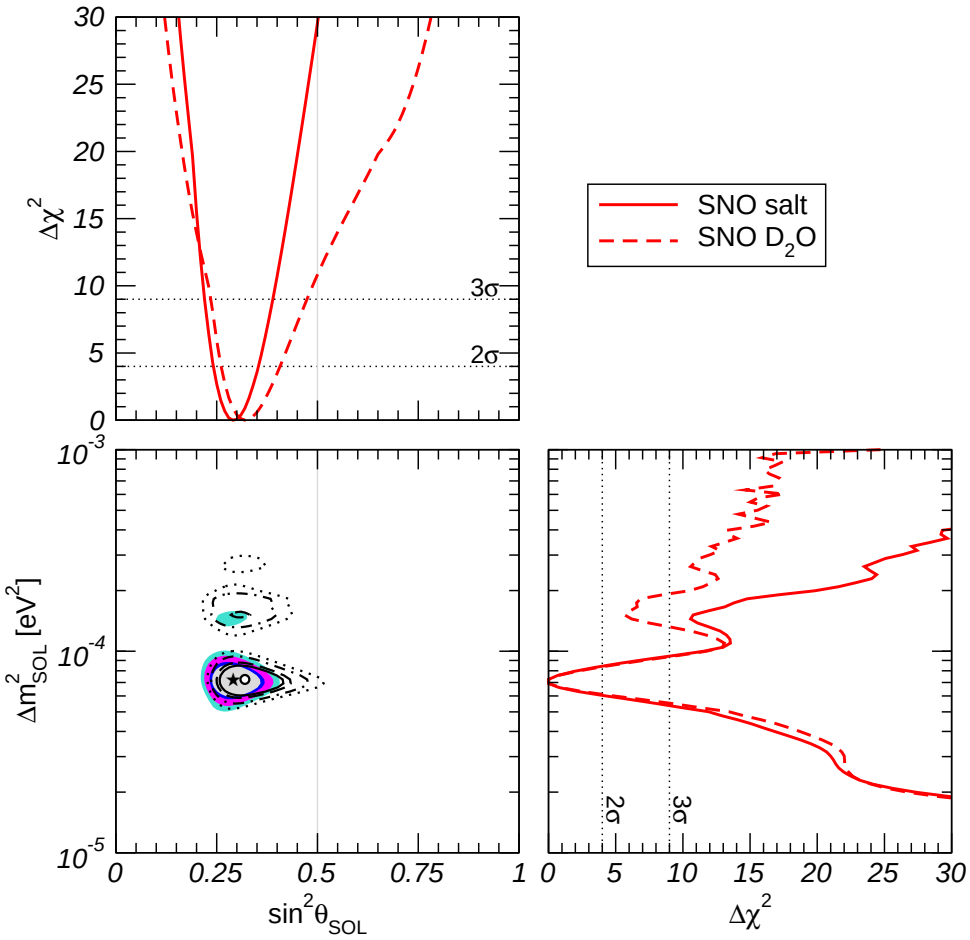
	Events	Flux $10^6/cm^2/sec$ ^8B Constr.	Flux $10^6/cm^2/sec$ NO ^8B Constr.
CC	1339^{+64}_{62}	$1.70^{+0.07}_{-0.07}(st)^{+0.09}_{-0.10}(sy)$	$1.59^{+0.08}_{-0.07}(st)^{+0.06}_{-0.08}(sy)$
ES	170^{+24}_{-20}	$2.13^{+0.29}_{-0.28}(st)^{+0.15}_{-0.08}(sy)$	$2.21^{+0.31}_{-0.26}(st)^{+0.10}_{-0.10}(sy)$
NC	1344^{+70}_{-69}	$4.90^{+0.24}_{-0.24}(st)^{+0.29}_{-0.27}(sy)$	$5.21^{+0.27}_{-0.27}(st)^{+0.38}_{-0.38}(sy)$
EX	84^{+34}_{-34}	–	–

SNO Implications

GLOBAL FIT paper: Maltoni, Schwetz, Tortola, Valle, hep-ph/0309130.

Include all solar data + KamLAND in 2ν fit.

90%, 95%, 99%, 3sig. Colors (salt), lines (no-salt)

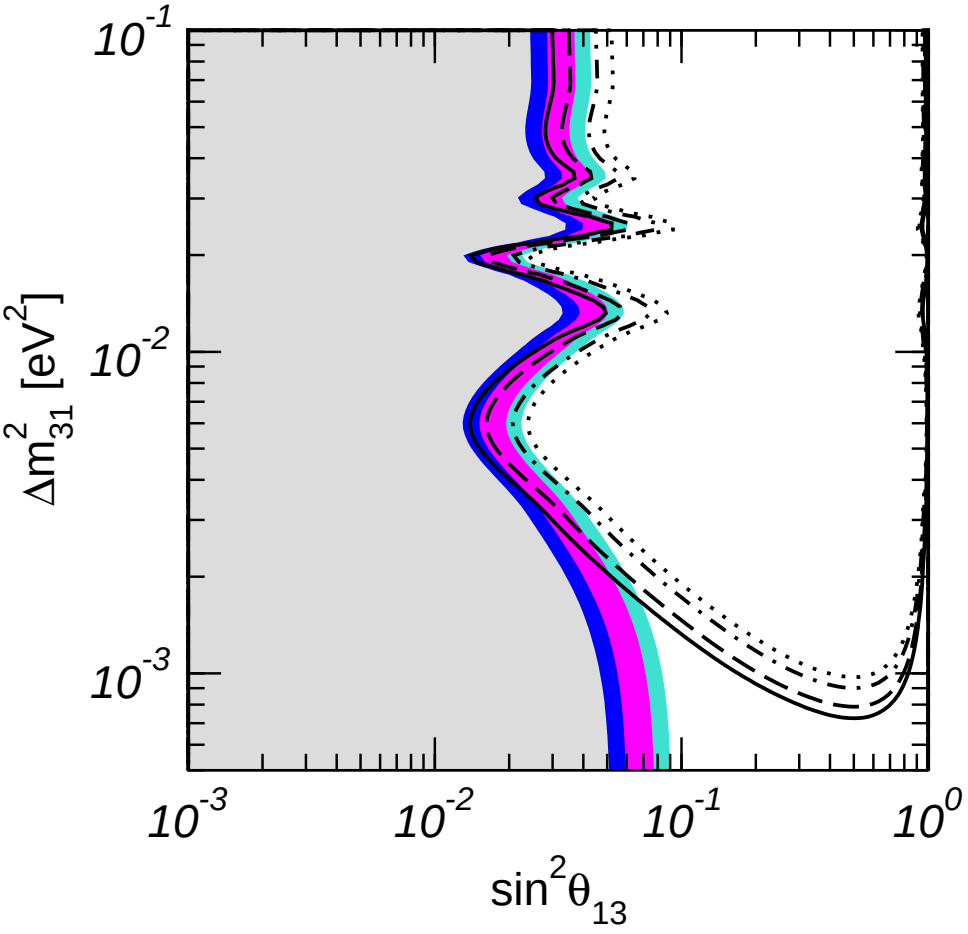


best fit: $\sin^2\theta_{sol} = 0.29$, $\Delta m^2_{sol} = 7.5 \times 10^{-5} eV^2$.

SNO Implications on θ_{13}

Include all CHOOZ+solar+KamLAND in 3ν fit.

90%, 95%, 99%, 3sig. Colors (all), lines (CHOOZ)



90% C.L.

Using plot: $\sin^2\theta_{13} < 0.025$ for
$\Delta m^2_{atm} = 2.0 \times 10^{-3} eV^2$.

Global(including atm): $\sin^2\theta_{13} < 0.022$