

NuFIT 4.1: Three-neutrino fit based on data available in July 2019

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ABSTRACT: We present updated results for our global analysis of solar, atmospheric, reactor, and accelerator neutrino data in the framework of three-neutrino oscillations. We also provide χ^2 tables for the various one- and two-dimensional projections of the global analysis. If you use these results, please refer to both [1] and [2]. Data sets which have been updated with respect to NuFIT 4.0 are marked by the “ \Rightarrow ” tag.

Solar experiments

- *External information:* Standard Solar Model [3].
- Chlorine total rate [4], 1 data point.
- Gallex & GNO total rates [5], 2 data points.
- SAGE total rate [6], 1 data point.
- SK1 full energy and zenith spectrum [7], 44 data points.
- SK2 full energy and day/night spectrum [8], 33 data points.
- SK3 full energy and day/night spectrum [9], 42 data points.
- SK4 2055-day day-night asymmetry [10] and 2860-day energy spectrum [11], 24 data points.
- SNO combined analysis [12], 7 data points.
- Borexino Phase-I 741-day low-energy data [13], 33 data points.
- Borexino Phase-I 246-day high-energy data [14], 6 data points.
- Borexino Phase-II 408-day low-energy data [15], 42 data points.

Atmospheric experiments

- *External information*: Atmospheric neutrino fluxes [16].
- IceCube/DeepCore 3-year data [17, 18], 64 data points.
- SK1-4 328 kiloton years [19], χ^2 map [20] added to our global analysis.

Reactor experiments

- KamLAND separate DS1, DS2, DS3 spectra [21] with Daya Bay reactor ν fluxes [22], 69 data points.
- Double Chooz FD-I/ND and FD-II/ND spectral ratios, with 455-day (FD-I), 363-day (FD-II) and 258-day (ND) exposures [23], 56 data points.
- Daya Bay 1958-day EH2/EH1 and EH3/EH1 spectral ratios [24], 52 data points.
- Reno 2200-day FD/ND spectral ratios [25], 26 data points.

Accelerator experiments

- MINOS 10.71×10^{20} pot ν_μ -disappearance data [26], 39 data points.
 - MINOS 3.36×10^{20} pot $\bar{\nu}_\mu$ -disappearance data [26], 14 data points.
 - MINOS 10.6×10^{20} pot ν_e -appearance data [27], 5 data points.
 - MINOS 3.3×10^{20} pot $\bar{\nu}_e$ -appearance data [27], 5 data points.
 - T2K 14.93×10^{20} pot ν_μ -disappearance data [28], 55 data points.
 - T2K 14.93×10^{20} pot ν_e -appearance data [28], 23 data points for the CCQE and 16 data points for the CC1 π samples.
- ⇒ T2K 16.3×10^{20} pot $\bar{\nu}_\mu$ -disappearance data [29], 19 data points.
- ⇒ T2K 16.3×10^{20} pot $\bar{\nu}_e$ -appearance data [29], 23 data points.
- NO ν A 8.85×10^{20} pot ν_μ -disappearance data [30], 76 data points.
 - NO ν A 8.85×10^{20} pot ν_e -appearance data [30], 13 data points.
- ⇒ NO ν A 12.33×10^{20} pot $\bar{\nu}_\mu$ -disappearance data [31], 76 data points.
- ⇒ NO ν A 12.33×10^{20} pot $\bar{\nu}_e$ -appearance data [31], 12 data points.

Description of the χ^2 data tables

We provide four gzip-compressed files, containing the χ^2 data tables for both Normal and Inverted Ordering of our global «w/o SK-atm» and «with SK-atm» analyses. Each file is divided into 21 sections, identified by a unique tag and corresponding to a particular one- or two-dimensional projections. The tags and the meaning of the data columns for each section are listed below (note that $\ell = 1$ for NO and $\ell = 2$ for IO).

N°	Section tag	1 st column	2 nd column	3 rd column
1	# T13/T12	$\sin^2 \theta_{13}$	$\sin^2 \theta_{12}$	$\Delta\chi^2$
2	# T13/DMS	$\sin^2 \theta_{13}$	$\log_{10}(\Delta m_{21}^2 / [\text{eV}^2])$	$\Delta\chi^2$
3	# T12/DMS	$\sin^2 \theta_{12}$	$\log_{10}(\Delta m_{21}^2 / [\text{eV}^2])$	$\Delta\chi^2$
4	# T13/T23	$\sin^2 \theta_{13}$	$\sin^2 \theta_{23}$	$\Delta\chi^2$

N°	Section tag	1 st column	2 nd column	3 rd column
5	# T13/DMA	$\sin^2 \theta_{13}$	$\Delta m_{3\ell}^2 / [10^{-3} \text{ eV}^2]$	$\Delta\chi^2$
6	# T23/DMA	$\sin^2 \theta_{23}$	$\Delta m_{3\ell}^2 / [10^{-3} \text{ eV}^2]$	$\Delta\chi^2$
7	# T13/DCP	$\sin^2 \theta_{13}$	$\delta_{\text{CP}} / [\text{deg}]$	$\Delta\chi^2$
8	# T23/DCP	$\sin^2 \theta_{23}$	$\delta_{\text{CP}} / [\text{deg}]$	$\Delta\chi^2$
9	# DMA/DCP	$\Delta m_{3\ell}^2 / [10^{-3} \text{ eV}^2]$	$\delta_{\text{CP}} / [\text{deg}]$	$\Delta\chi^2$
10	# T12/T23	$\sin^2 \theta_{12}$	$\sin^2 \theta_{23}$	$\Delta\chi^2$
11	# T12/DCP	$\sin^2 \theta_{12}$	$\delta_{\text{CP}} / [\text{deg}]$	$\Delta\chi^2$
12	# T12/DMA	$\sin^2 \theta_{12}$	$\Delta m_{3\ell}^2 / [10^{-3} \text{ eV}^2]$	$\Delta\chi^2$
13	# DMS/T23	$\log_{10}(\Delta m_{21}^2 / [\text{eV}^2])$	$\sin^2 \theta_{23}$	$\Delta\chi^2$
14	# DMS/DCP	$\log_{10}(\Delta m_{21}^2 / [\text{eV}^2])$	$\delta_{\text{CP}} / [\text{deg}]$	$\Delta\chi^2$
15	# DMS/DMA	$\log_{10}(\Delta m_{21}^2 / [\text{eV}^2])$	$\Delta m_{3\ell}^2 / [10^{-3} \text{ eV}^2]$	$\Delta\chi^2$
16	# T13	$\sin^2 \theta_{13}$	$\Delta\chi^2$	—
17	# T12	$\sin^2 \theta_{12}$	$\Delta\chi^2$	—
18	# T23	$\sin^2 \theta_{23}$	$\Delta\chi^2$	—
19	# DCP	$\delta_{\text{CP}} / [\text{deg}]$	$\Delta\chi^2$	—
20	# DMS	$\log_{10}(\Delta m_{21}^2 / [\text{eV}^2])$	$\Delta\chi^2$	—
21	# DMA	$\Delta m_{3\ell}^2 / [10^{-3} \text{ eV}^2]$	$\Delta\chi^2$	—

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