

# NuFIT 3.1: Three-neutrino fit based on data available in November 2017

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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  $\chi^2$  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 3.0 are marked by the “ $\Rightarrow$ ” tag.

## Solar experiments

$\Rightarrow$  *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 2365-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.

## Reactor experiments

- ⇒ KamLAND separate DS1, DS2, DS3 spectra [19] with Daya-Bay reactor  $\nu$  fluxes [20], 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 [21], 56 data points.
- ⇒ Daya-Bay 1230-day EH2/EH1 and EH3/EH1 spectral ratios [22], 70 data points.
- ⇒ Reno 1500-day FD/ND spectral ratios [23], 26 data points.

## Accelerator experiments

- MINOS  $10.71 \times 10^{20}$  pot  $\nu_\mu$ -disappearance data [24], 39 data points.
- MINOS  $3.36 \times 10^{20}$  pot  $\bar{\nu}_\mu$ -disappearance data [24], 14 data points.
- MINOS  $10.6 \times 10^{20}$  pot  $\nu_e$ -appearance data [25], 5 data points.
- MINOS  $3.3 \times 10^{20}$  pot  $\bar{\nu}_e$ -appearance data [25], 5 data points.
- ⇒ T2K  $14.93 \times 10^{20}$  pot  $\nu_\mu$ -disappearance data [26], 55 data points.
- ⇒ T2K  $14.93 \times 10^{20}$  pot  $\nu_e$ -appearance data [26], 39 data points.
- ⇒ T2K  $7.62 \times 10^{20}$  pot  $\bar{\nu}_\mu$ -disappearance data [26], 55 data points.
- ⇒ T2K  $7.62 \times 10^{20}$  pot  $\bar{\nu}_e$ -appearance data [26], 23 data points.
- NO $\nu$ A  $6.05 \times 10^{20}$  pot  $\nu_\mu$ -disappearance data [27], 18 data points.
- NO $\nu$ A  $6.05 \times 10^{20}$  pot  $\nu_e$ -appearance data [27], 10 data points.

## Description of the $\chi^2$ data tables

We provide two gzip-compressed files (one for Normal and one for Inverted Ordering) containing the  $\chi^2$  data tables for our global analysis. 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).

$N^\circ$	Section tag	1 <sup>st</sup> column	2 <sup>nd</sup> column	3 <sup>rd</sup> 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	$\sin^2 \theta_{13}$	$\sin^2 \theta_{23}$	$\Delta\chi^2$
5	# T13/DMA	$\sin^2 \theta_{13}$	$\Delta m_{3\ell}^2 / [10^{-3} \text{ eV}^2]$	$\Delta\chi^2$
6	# T23/DMA	$\sin^2 \theta_{23}$	$\Delta m_{3\ell}^2 / [10^{-3} \text{ eV}^2]$	$\Delta\chi^2$

$N^\circ$	Section tag	1 <sup>st</sup> column	2 <sup>nd</sup> column	3 <sup>rd</sup> column
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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