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Corrigendum

Corrigendum to "An alternative method of determining the neutrino mass ordering in reactor neutrino experiments" [Phys. Lett. B 772 (2017) 179–183]

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There was an error in incorporating the expression of the probability, given in eq. (16) of our article [1], in the code used for the statistical analysis of the simulated JUNO data performed in [1]. As a consequence, Fig. 1 and the sensitivity on $\sin^2\theta_{12}$ reported in the article are incorrect. They are corrected here using updated best fit values and 3σ allowed ranges of the relevant neutrino oscillation parameters, obtained in the recent global analysis of the neutrino oscillation data in ref. [2]. The other ingredients of the statistical analysis are the same as in [1]. In Fig. 1, left panel, we show the 1σ, 2σ, 3σ and 4σ allowed regions (for 1 degree of freedom) in the plane $\Delta m^2_{\rm atm}$–X^2 assuming normal ordering. The red point represents the best fit point, which corresponds by construction to the best fit values of $\sin^2\theta_{12} = 0.305$ and $\Delta m^2_{\rm atm} = 2.522$ eV^2 from [2]. In Fig. 1, right panel, the presence of a second local χ^2 minimum at $\sim 4\sigma$ C.L. at $X^2 = 1 - (\sin^2\theta_{12})_{\rm BF} = 0.695$ (and $|\Delta m^2_{\rm atm}| = 2.565 \times 10^{-3}$ eV^2), associated with spectrum with inverted ordering, is also seen. For the difference between the χ^2 minima in the NO and IO cases we find $\chi^2_{\rm min}(IO) - \chi^2_{\rm min}(NO) = 14.5$. This implies that the type of neutrino mass ordering can be established at 3.8σ C.L.

Performing a similar analysis but assuming the inverted ordering to be the "true" one we obtain $\chi^2_{\rm min}(NO) - \chi^2_{\rm min}(IO) = 15.8$, i.e., that the type of neutrino mass ordering can be established at $3.975\sigma \cong 4\sigma$ C.L.

These confidence levels are somewhat higher that the 3σ C.L. which the analyses using the standard method [4] (and performed under the same conditions) typically give (see, e.g., [3]). The reason the alternative method employed in our analysis leads to a somewhat stronger rejection of the "wrong" ordering can be related to the fact that i) we have neglected matter effects in the oscillations of reactor $\bar{\nu}_e$, which, although small, have to be taken into account given the exceptionally high precision of JUNO experiment, and ii) we have not taken into account the small difference between the baselines of the reactors which provide the flux of $\bar{\nu}_e$ for JUNO.

Our results show that the sensitivity to the neutrino mass ordering that can be achieved employing the proposed alternative method of determination of the ordering in any case is not worse than the sensitivity that can be achieved using the standard approach [4]. The precision with which $\sin^2\theta_{12}$ can be determined using the proposed alternative approach matches the precision that can be reached utilising the standard method [5]: we find that $\sin^2\theta_{12}$ can be determined with 1σ relative uncertainty of 0.49% in both cases of "true" spectrum considered. The precision on $\Delta m^2_{\rm atm}$, which is determined simultaneously with $\sin^2\theta_{12}$ (or X^2) is also exceptionally high: assuming NO (IO) spectrum to be the true one we get for the 1σ relative uncertainty 0.15% (0.14%).

These results confirm the conclusion reached in [1] that the considered novel method of determination of the neutrino mass ordering (spectrum) can be used as a complementary method of the ordering (spectrum) determination independently of, and on a equal footing with, the standard method.

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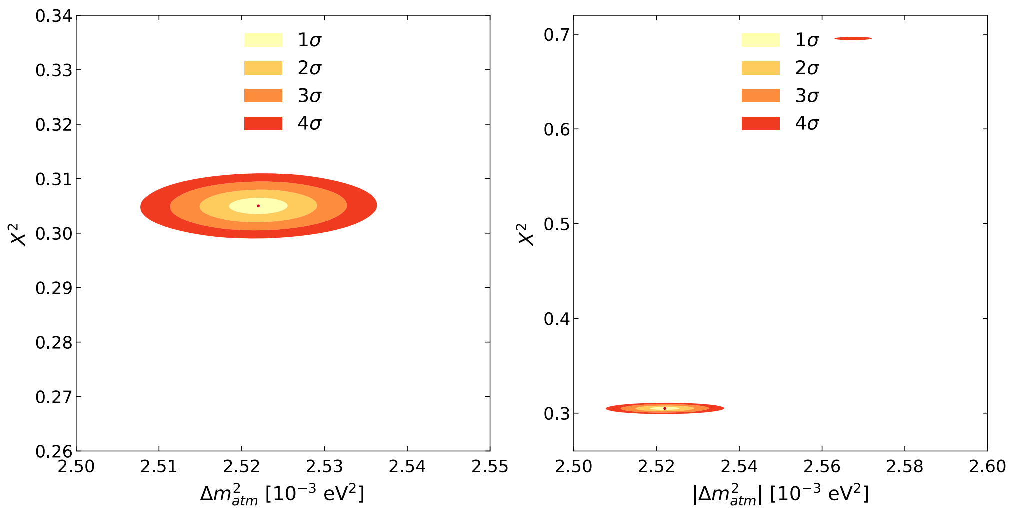

Fig. 1. The 1σ, 2σ, 3σ and 4σ C.L. contours in the $\Delta m^2_{\rm atm} - X^2$ plane obtained in a statistical analysis of prospective (simulated) reactor neutrino data from JUNO detector. The prospective data were generated assuming NO neutrino mass spectrum and statistics corresponding to 3.6×10^3 GW kton yr (for further details see [1]). The second minimum seen in the right panel at approximately 4σ C.L. at $X^2 = 0.695$ corresponds to IO neutrino mass spectrum.

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References

[1] S.M. Bilenky, F. Capozzi, S.T. Petcov, Phys. Lett. B 772 (2017) 179, arXiv:1701.06328 [hep-ph].
[2] F. Capozzi, et al., Phys. Rev. D 101 (2020) 116013, arXiv:2003.08511.
[3] F. Capozzi, E. Lisi, A. Marrone, arXiv:2006.01648.
[4] S.T. Petcov, M. Piai, Phys. Lett. B 533 (2002) 94, arXiv:hep-ph/0112074, [5].
[5] S. Choubey, S.T. Petcov, M. Piai, Phys. Rev. D 68 (2003) 113006, arXiv:hep-ph/0306017.