Comments on « First joint analysis …. » dated March 8 2024 (Marco Zito)

General comments

1) This is an excellent and timely paper, I would like to congratulate the authors of the analysis and of the paper for their wonderful achievement ! I wish that along this line more precise and coherent analyses using T2K and SK will be published in the next years, with samples with larger statistics and a more refined and unified neutrino interaction models.

2) Motivation for a joint analysis. The discussion on the complementarity of the T2K and SK samples is very interesting but totally impossible to follow for a reader outside of the neutrino world without showing the leading terms in the oscillation probabilities. This is especially the case for the parameter degeneracies of the lower and upper octant and MO and delta_CP. PRL address a larger community than HEP physicists and I think this kind of comment will be raised also by the referees and by the editor. To answer it, two solutions : refer to another paper discussing these degeneracies in more detail (then the paper is less self-contained), add some explanation in the paper itself (preferred solution, for instance along the lines of the nature paper) or in the supplemental material.

3) Motivation for a joint analysis. There is another important motivation that is not stated out. Neutrino long-baseline oscillation experiments are mesuring the PMNS parameters with increasing precision, reaching the % level. However, combination of the results is typically performed by theorists, disregarding correlated uncertainties in the neutrino flux, the neutrino interaction model and the detector effects. This is shown for instance in this paper by the uncertainty on Deltam**2_32. It is important that the experimental collaborations dedicate more effort in common analysis like this one.

4) Interaction model. The neutrino interaction model is described in some detail. However I have an important question that is not answered. The T2K accelerator neutrino sample extends beyond 1 GeV into the multi-GeV region. How do the two neutrino interaction models agree in this low multi-GeV region ? Both for the total cross-section and for the most important component like CC0pi, CC1pi etc ? I suggest addressing this question in the text.

Other comments

line 188) The data from the two experiments are found to be compatible → The neutrino mixing parameters extracted from the two experiments are found to be compatible

line 233) and measures neutrinos after oscillations. I suggest removing this simplistic part of the sentence, oscillations continue forever.

Line 234) lower statistics appearance channels → subdominant appearance channels

line 240) « but measurements are not » The « but ... » is not clear to an outside reader, see general comment 2) above.

Line 283) « but largely independent parameters » The reader wonders if the results of fit of the « largely independent parameters » yield two models in agree with each other or not.

Line 355 « reasonably blind ». I do not understand what « reasonably blind » means, any qualification on blind is problematic. Is « keeping the analysis blind » a correct statement ? A related question is about the blindness of all the fits. If so, a line on this should be added around line 414.

line 394 atmospheric should not be in italic.

Line 599 CP and T in capital letters.