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Searching for non-unitary neutrino oscillations in the present T2K and NOνA data

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The mixing of three active neutrino flavors is parameterized by the unitary PMNS matrix. If there are more than three neutrino flavors and if the extra generations are heavy iso-singlets, the effective 3×3 mixing matrix for the three active neutrinos will be non-unitary. We have analyzed the latest T2K and NOνA data with the hypothesis of non-unitary mixing of the active neutrinos. We found that the 2019 NOνA data slightly (at $\sim 1\,\sigma$ C.L.) prefer the non-unitary mixing over unitary mixing. In fact, allowing the non-unitary mixing brings the NOνA best-fit point in the $\sin^2\theta_{23} - \delta_{\rm CP}$ plane closer to the T2K best-fit point. The 2019 T2K data, on the other hand, cannot rule out any of the two mixing schemes. A combined analysis of the NOνA and T2K 2019 data prefers the non-unitary mixing at $1\,\sigma$ C.L.. We derive constraints on the non-unitary mixing parameters using the best-fit to the combined NOνA and T2K data. These constraints are weaker than previously found. The latest 2020 data from both the experiments prefer non-unitarity over unitary mixing at $1\,\sigma$ C.L. The combined analysis prefers non-unitarity at $2\,\sigma$ C.L. The stronger tension, which exists between the latest 2020 data of the two experiments, also gets reduced with non-unitary analysis.

Reference to paper (DOI or arXiv)

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