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Global Analysis of Neutrino Oscillations and Mass Constraints in the Era of Subpercent Precision

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The landscape of neutrino physics is entering a transformative phase, driven by unprecedented experimental precision and expanding data from diverse probes. In this work, we present a comprehensive update of global three-neutrino (3ν) oscillation parameters, reflecting measurements available up to early 2025. Key results include a sub-percent determination of the atmospheric mass splitting $|\Delta m^2|$ and refined constraints on θ13 and θ23. At the same time, the elusive unknowns—mass ordering, CP violation, and θ23 octant—remain open, with only weak statistical preferences. On the non-oscillation front, we update upper bounds on absolute neutrino masses from β-decay, neutrinoless double β-decay, and cosmological observations, noting emerging tensions that hint at either hidden systematics or new physics beyond the standard cosmological model. With JUNO and other next-generation experiments on the horizon, the coming years will test the coherence of the 3ν paradigm at the subpercent level. This evolving precision frontier opens new avenues to probe the fundamental nature of neutrinos and their connections to the broader structure of the universe.

Neutrino Properties

Global analysis of neutrino masses and mixings

Neutrino Telescopes & Multi-messenger

Global analysis of neutrino masses and mixings

Neutrino Theory & Cosmology

Global analysis of neutrino masses and mixings

Data Science and Detector R&D

Global analysis of neutrino masses and mixings

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