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Neutrino oscillations: what do we know about θ_{13}[1]

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The phenomenon of neutrino oscillations is reviewed. A new analysis tool for the recent, more finely binned Super-K atmospheric data is outlined. This analysis incorporates the full three-neutrino oscillation probabilities, including the mixing angle θ_{13} to all orders, and a full three- neutrino treatment of the Earth's MSW effect. Combined with the K2K, MINOS, and CHOOZ data, the upper bound on θ_{13} is found to arise from the Super-K atmospheric data, while the lower bound arises from CHOOZ. This is caused by the linear in θ_{13} terms which are of particualr importance in the region $L/E > 10^4$ m/MeV where the sub-dominant expansion is not convergent. In addition, the enhancement of θ_{12} by the Earth MSW effect is found to be important for this result. The best fit value of θ_{13} is found to be (statistically insignificantly) negative and given by $\theta_{13} = -0.07^{+0.18}_{-0.11}$. In collaboration with Jesus Escamilla, Vanderbilt University and David Latimer, University of Kentucky.

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