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Neutrino mass hierarchy from atmospheric neutrinos

The current global analysis of neutrino oscillation experiments shows no significant information regarding the neutrino mass hierarchy, either normal or inverted. In the near future, there will be a strong experimental effort to discriminate these hierarchy options. One of the most promising methods is based on atmospheric neutrino oscillations in matter, e.g. in PINGU (Precision IceCube Next Generation Upgrade). This method requires, apart from a very large statistics, accurate theoretical calculations and a refined analysis of systematic uncertainties. In such a context, we revisit some aspects of the theoretical calculations of the event spectra, and we analyze in detail the impact of spectral shape systematics, focusing on possible error sources which may play a significant role in spectral measurements. We show that the inclusion of such systematic uncertainties may alter the prospective hierarchy sensitivity in a non negligible way, and thus deserve further, dedicated studies. We also discuss the interplay between the mixing angle θ_{23} and the PINGU sensitivity to the hierarchy.

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