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Statistical Methods for the Neutrino Mass Hierarchy Determination

In the next decades several experiments will attempt to determine the neutrino mass hierarchy, i.e. the sign of Δm_{31}. Since the two hierarchies are non-nested hypotheses, $\Delta\chi^2 = \chi^2_{IH} - \chi^2_{NH}$ does not follow a one-degree-of-freedom chi-square distribution (for example, it can be negative): it is possible to prove that, under certain assumption, it follows a Gaussian distribution with $\sigma = 2\sqrt{\Delta\chi^2}$; these assumptions seem to be verified for reactor neutrino experiments, at least in some simplified cases, but, for example, not for accelerator neutrino experiments. I will discuss the possible definitions of sensitivity, using both the Bayesian and the frequentist perspectives, how they should be modified if the conditions for Gaussianity are not fulfilled, and in which cases the two procedure used to treat the pull parametrs (marginalization and minimization) yield the same $\Delta\chi^2$. I will focus on the advantages and disadvantages of the different approaches proposed, and in particular on their physical interpretations.

Experimental Collaboration

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