

Confidence in the Neutrino Mass Hierarchy

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Analyses of neutrino mass hierarchy determinations at future experiments determine an expected $\Delta\chi^2$. As the hierarchy is a discrete choice, and not a continuous degree of freedom, this $\Delta\chi^2$ does not obey Wilks' theorem. As a consequence it does not follow a χ^2 distribution and its square root is not the number of sigmas of confidence that can be expected. I will present a simple formula for s as a function of the expected value of $\Delta\chi^2$.

Summary

I will review Wilks' theorem, which is used to relate $\Delta\chi^2$ to the confidence in a null hypothesis. I will then explain why Wilks' theorem does not apply to the neutrino mass hierarchy. I will show that $\Delta\chi^2$ obeys a Gaussian distribution even considering the effects of nuisance parameters. I will then use this distribution to answer 3 questions: (1) What is the probability that a fit of the data to the true hierarchy yields a lower χ^2 than a fit to the false hierarchy? (2) With what confidence does the median experiment determine the hierarchy? (3) What is the probability of determining the hierarchy with s sigmas of confidence?

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