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The need for an early anti neutrino run for NOvA

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The moderately large value of θ_{13} , measured recently by reactor experiments, is very welcome news for the future neutrino experiments. In particular, the NOvA experiment, with 3 years of neutrino run followed by an equal anti-neutrino run, will be able to determine the mass hierarchy if one of the following two favourable combinations is true: normal hierarchy with the CP phase in the lower half plane or inverted hierarchy with the CP phase in the upper half plane. In this report, we study the hierarchy reach of the first 3 years of NOvA data. Since $\sin^2(2\theta_{23})$ is measured to be non-maximal, θ_{23} can be either in the lower or higher octant. Pure neutrino data is affected by θ_{13} -hierarchy and octant-hierarchy degeneracies, which limit the hierarchy sensitivity of such data. A combination of neutrino and anti-neutrino data is not subject to these degeneracies and hence has much better hierarchy discrimination capability. We find that, with a 3 year neutrino run, hierarchy determination is possible for only two of the four octant-hierarchy combinations. Equal 1.5 year runs in neutrino and anti-neutrino modes give good hierarchy sensitivity for all the four combinations.

Summary

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