

‘Magical’ properties of a 2540 km baseline Superbeam experiment

The three outstanding problems of neutrino physics are the determination of (a) θ_{13} , (b) mass hierarchy and (c) CP violation. All three of these can be measured by observing $\nu_{\mu} \rightarrow \nu_e$ oscillations at long baselines. Owing to various parameter degeneracies, disentangling the information on each of them is very complicated. While the proposed 7500 km long ‘magic baseline’ experiment simplifies the task considerably, the intense beam required for such an experiment seems futuristic by current standards. As an alternative, we highlight the ‘magical’ properties of the 2540 km baseline. We propose a superbeam experiment at this much shorter baseline with a narrow band NuMI-like beam, and demonstrate the ability of this single setup to distinguish between the two mass hierarchies. This, we show, is possible with a moderate exposure and by running the experiment in the neutrino mode only. Our results hold up to fairly small values of θ_{13} and irrespective of the value of the CP violating parameter. Unlike the magic baseline, it may also be possible to use this setup to measure CP violation in neutrino oscillation experiments.

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