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Getting the best out of T2K and NOvA

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Neutrino oscillation physics stands at an important juncture today. With the reactor experiments having measured a moderately large value of θ_{13}, determination of the neutrino mass hierarchy and δ_{CP} are the next problems to be solved. In this work, we explore the physics potential of T2K and NOvA, with the aim of extracting as much physics as possible from them before the next generation of experiments.

At these baselines, the hierarchy-δ_{CP} degeneracy makes it difficult to measure the hierarchy independently of δ_{CP}. For
hierarchy determination, we find that the lower half plane (LHP) of δ_{CP} is favourable for NH and the upper half plane (UHP) is favourable for IH. If the favourable combinations (NH,LHP) or (IH,UHP) occur, then NOvA by itself can determine the hierarchy. If δ_{CP}
lies in the unfavourable half plane, NOvA allows a large region with wrong
hierarchy. Combined data from the planned runs of NOvA and T2K cannot determine the hierarchy even for the large θ_{13}. However, the situation improves dramatically with a moderate increase in statistics. We demonstrate that the hierarchy can essentially be determined, even for unfavourable values of δ_{CP}, if the exposures of NOvA and T2K are increased by a factor of 1.5 and 2 respectively. We find that addition of another experiment with a baseline of 130 km and beam power equivalent to T2K leads to a marginal improvement.

It would seem that an experiment with a shorter baseline (and hence small
matter effects) like T2K may be able to measure δ_{CP} without knowing
the hierarchy. We show that this is not the case. No matter how small the
matter effects, for some value of δ_{CP}, any single experiment gives a wrong hierarchy-wrong δ_{CP} solution. However, combined data from 2*T2K+1.5*NOvA can determine the correct half plane of δ_{CP}.

Financial Support Justification for Early-Stage Researchers

I am a fourth year Ph.D. student at the Indian Institute of Techonology, Bombay.
My advisor has no project funds and my institute does not provide financial assistance for foreign travel. I have applied to various funding agencies in India for financial assistance. But the assistance provided by them can only cover the air travel. Therefore, I request you to waive the registration fee and provide me with local hospitality.

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