



HEP 2013
Stockholm
18-24 July 2013



Contribution ID: 560

Type: **Talk presentation**

Complementarity between long-baseline and atmospheric neutrino experiments

Friday, 19 July 2013 18:10 (15 minutes)

Recent measurements have shown that the value of θ_{13} in nature is moderately large. This allows the possibility of measuring the neutrino mass hierarchy, octant of θ_{23} and CP-violating phase δ_{CP} at the next generation of neutrino oscillation experiments. Long-baseline experiments have very good energy resolution, and hence are well suited to measure the mass-square differences, mixing angles and CP phase to a high degree of precision. Atmospheric neutrino experiments can access neutrinos over a wide range of baselines and energies and can resolve the problems of determining the mass hierarchy and octant of θ_{23} , due to resonant matter effects.

The sensitivity of long-baseline experiments to the unknown neutrino oscillation parameters depends on the value of δ_{CP} in nature. In fact, for unfavourable combinations of these parameters, the capabilities of long-baseline experiments are severely limited. On the other hand, the capabilities of atmospheric neutrino experiments have been shown to be independent of δ_{CP} . We explore the reasons for the δ_{CP} -independence of atmospheric neutrino results. We then study the synergy between atmospheric and long-baseline experiments. We find that there is a marked improvement in the sensitivity of long-baseline experiments for unfavourable values of parameters, when data from atmospheric experiments are also taken into account. We present our results in the context of planned upcoming oscillation experiments.

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Session Classification: Neutrino Physics

Track Classification: Neutrino Physics