The need for an early anti-neutrino run of NOνA

The moderately large value of θ_{13}, measured recently
by reactor experiments, is very welcome
news for upcoming accelerator experiments. In particular,
the NOνA experiment, with 3 years of ν run followed
by an equal $\bar{\nu}$ run, will be able to
determine the mass hierarchy if one of the following
two favorable combinations is true:
normal hierarchy with $-180° \leq$
$dcp \leq 0$ or
inverted hierarchy with $0 \leq$
$dcp \leq 180°$.
In this work, we study the hierarchy reach of the
first 3 years of NOνA data.
Since $\sin^2 2\theta_{23}$ is measured to be non-maximal,
θ_{23} can be either in the lower or higher octant.
The true octant of θ_{23} has a deep impact on the
hierarchy reach of early NOνA data.
With the present
uncertainty of 10% in $\sin^2 2\theta_{13}$,
equal 1.5 year ν and $\bar{\nu}$ runs have better
hierarchy determination capability compared to a
pure 3 year ν run. Daya Bay expects to reduce
the uncertainty in $\sin^2 2\theta_{13}$ to 5%. Such a
reduction improves the hierarchy reach of a 3 year
ν run for two of the four octant-hierarchy combinations,
but still fails to give any sensitivity for the other two.
However, equal 1.5 year ν and $\bar{\nu}$ runs have reasonable
hierarchy sensitivity for all four combinations.

Primary author: Mr RAHAMAN, Ushak (IIT Bombay)

Co-authors: Mr PRAKASH, Suprabh (IIT Bombay);   Mr SANKHAGIRI, Uma Sankar (IIT Bombay)

Presenter: Mr RAHAMAN, Ushak (IIT Bombay)

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