Impact of Non-Unitary Mixing on Physics
Potential of Long Baseline Experiments

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1. Motivation

Why do we look for deviation from unitarity of PMNS matrix?

For more details: see talk by Filipe R. Joaquim and flash talk by Johannes Rosskopp
2. Non-Unitary Mixing Formalism

Non-unitary neutrino matrix

- The general form of effective unitary neutrino mixing matrix

\[
U_{\text{eff}} = \begin{pmatrix}
N_{3 \times 3} & \Theta_{3 \times n} \\
R_{n \times 3} & S_{n \times n}
\end{pmatrix},
\]

(1)

with active neutrino mixing matrix

\[
N_{3 \times 3} = (1 - \frac{1}{2} \Theta^\dagger \Theta) U_{\text{PMNS}} = (1 - \eta) U_{\text{PMNS}}
\]

- Oscillation probability,

\[
P_{\alpha\beta}(E, L) = |\langle \nu_\beta | \nu_\alpha(L) \rangle|^2 = \left| \left( N e^{-i \mathcal{H}_m^N L} N^\dagger \right)_{\beta\alpha} \right|^2.
\]

(3)

3. Effect on $\nu_\mu \rightarrow \nu_e$ Oscillation Channel

At probability level

NU parameters in 21 sector significantly affect $\nu_\mu \rightarrow \nu_e$ oscillation channel

Soumya C., "Sensitivity limits on NU parameters at LBL experiments" [in preparation]

MonteCUBE Simulation
4. Sensitivity limit of NO$_{\nu}$A to NU parameters

For $\delta_{CP} = -90^\circ$, sensitive to values of $\eta_{21} < 0.034$ at 1$\sigma$ C. L.
5. Effect of NU mixing on sensitivities of NOνA

Mass Hierarchy
NU phase play crucial role in the sensitivity studies.

Octant

CP-Violation

S. et.al JPG 45,9,095003 (2018)

MonteCUBE Simulation
6. Conclusions

Analysed the impact of NU mixing on sensitivities of NO\(\nu\)A and found that:

- NU parameters in 21 sector play crucial role in \(\nu_\mu \rightarrow \nu_e\) oscillation channel.
- NU mixing significantly affect the sensitivities of NO\(\nu\)A to determine current unknowns in neutrino sector.
- The sensitivities are crucially depend up on the new CP-violating phase in NU mixing.
THANK
YOU