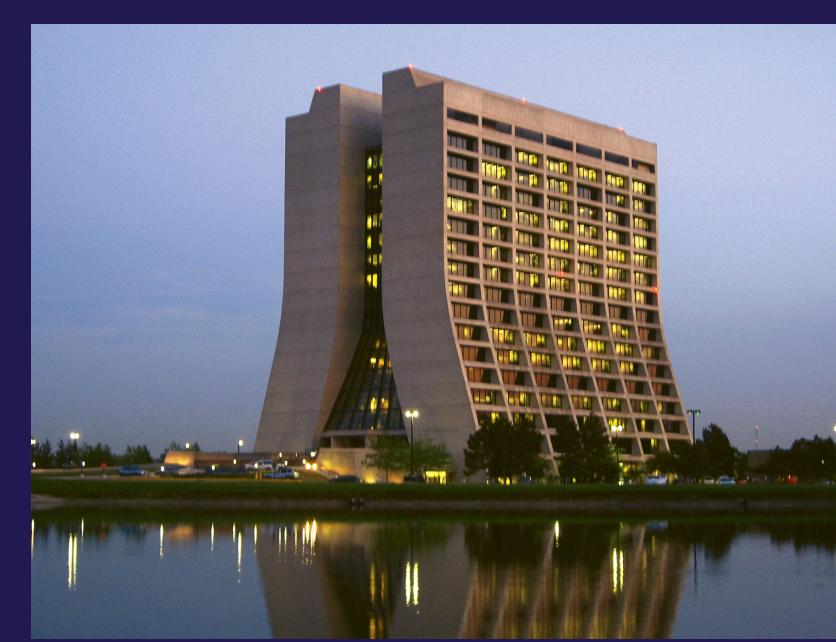




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Implications of light sterile neutrinos on currently running long-baseline and neutrinoless double beta decay experiments



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Abstract

- The results of short baseline neutrino oscillation experiments indicate the possible extension of standard model by eV-scale sterile neutrino.
- The effect of active-sterile neutrino mixing at probability level and on the mass hierarchy sensitivity of the long-baseline neutrino oscillation experiments has been investigated.
- The impact of new CP-violating phases δ_{14} and δ_{34} on the maximal CP violation exclusion sensitivity for the NO ν A experiment has also been illustrated.
- Implications of light sterile neutrino on neutrinoless double beta decay.

3+1 Oscillation Model

- The possible existence of additional eV-scale sterile neutrino (ν_s) is an important aspect in the neutrino sector.
- In presence of one sterile, the so-called 3+1 scenario, the neutrino mixing matrix can be represented by a 4×4 unitary matrix.
- Parametrization of mixing matrix requires some additional parameters, three mixing angles ($\theta_{14}, \theta_{24}, \theta_{34}$) and two phases (δ_{14}, δ_{34}).

$$\begin{bmatrix} \nu_e \\ \nu_\mu \\ \nu_\tau \\ \nu_s \end{bmatrix} = \begin{bmatrix} U_{e1} & U_{e2} & U_{e3} & U_{e4} \\ U_{\mu 1} & U_{\mu 2} & U_{\mu 3} & U_{\mu 4} \\ U_{\tau 1} & U_{\tau 2} & U_{\tau 3} & U_{\tau 4} \\ U_{s1} & U_{s2} & U_{s3} & U_{s4} \end{bmatrix} \begin{bmatrix} \nu_1 \\ \nu_2 \\ \nu_3 \\ \nu_4 \end{bmatrix}$$

$$U^{3+1} = V(\theta_{34}, \delta_{34}) R(\theta_{24}) V(\theta_{14}, \delta_{14}) R(\theta_{23}) V(\theta_{13}, \delta_{13}) R(\theta_{12})$$

- $R(\theta_{ij})(V(\theta_{ij}, \delta_{ij}))$ are the real (complex) 4×4 rotation matrices in the ij plane, with 2×2 rotation sub-matrices.

Parameter	True Value	Parameter	True Value
$\sin^2 \theta_{12}$	0.310	$\sin^2 \theta_{14}$	0.0204
$\sin^2 \theta_{13}$	0.0224	$\sin^2 \theta_{24}$	0.0163
$\sin^2 \theta_{23}$	0.58		
(LO 0.44)(HO 0.56)		$\sin^2 \theta_{34}$	0.0197
δ_{CP}	-90°	δ_{14}	-90°
Δm_{21}^2	$7.39 \times 10^{-5} \text{ eV}^2$	δ_{34}	-90°
$ \Delta m_{31}^2 $	$2.525 \times 10^{-3} \text{ eV}^2$	Δm_{14}^2	1 eV^2

- We use **GLoBES** software package along with snu plugin for degeneracies analysis.

Results

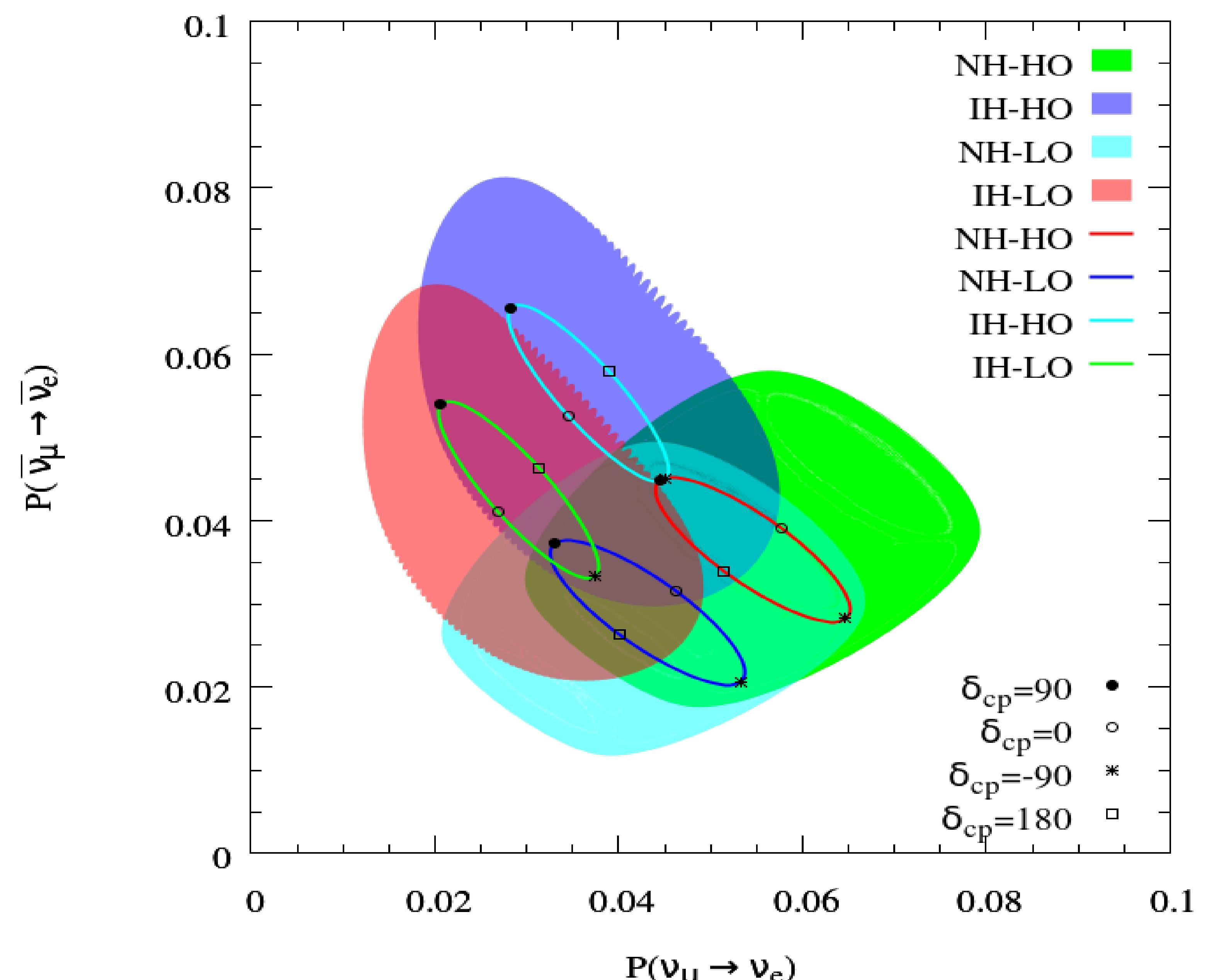


Fig.1: Bi-probability plot for NO ν A experiment.

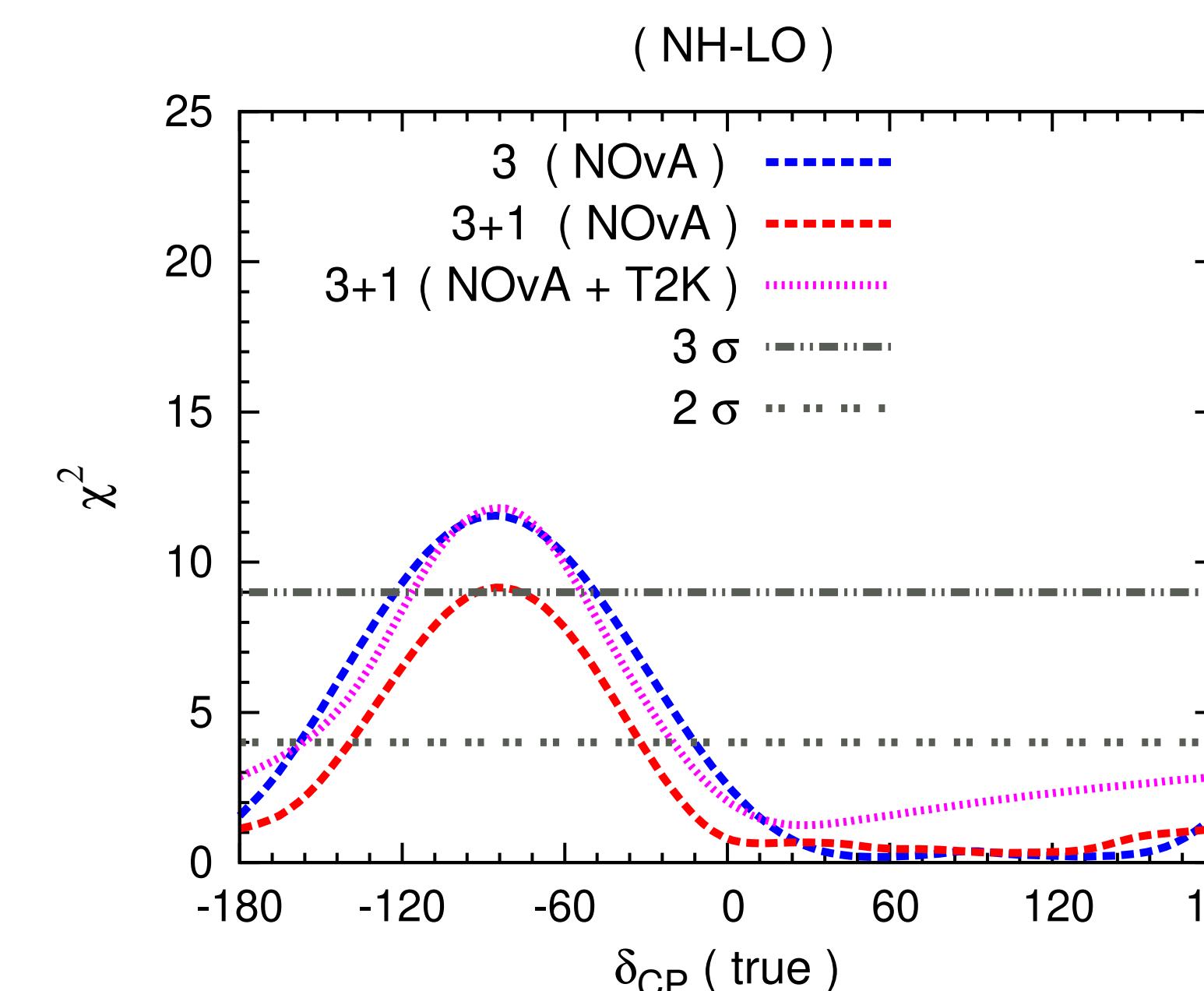


Fig.2: Mass hierarchy Sensitivity for NO ν A and T2K experiments.

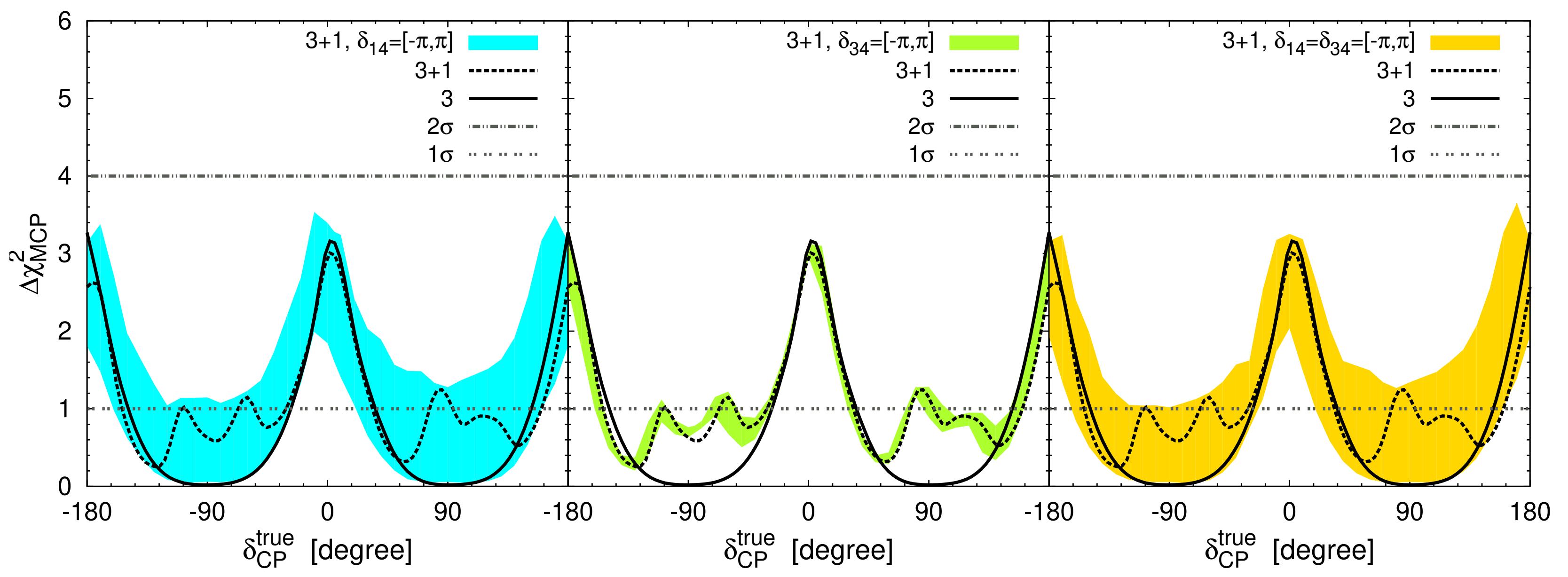


Fig.3: Maximal CP violation exclusion sensitivity for the NO ν A experiment.

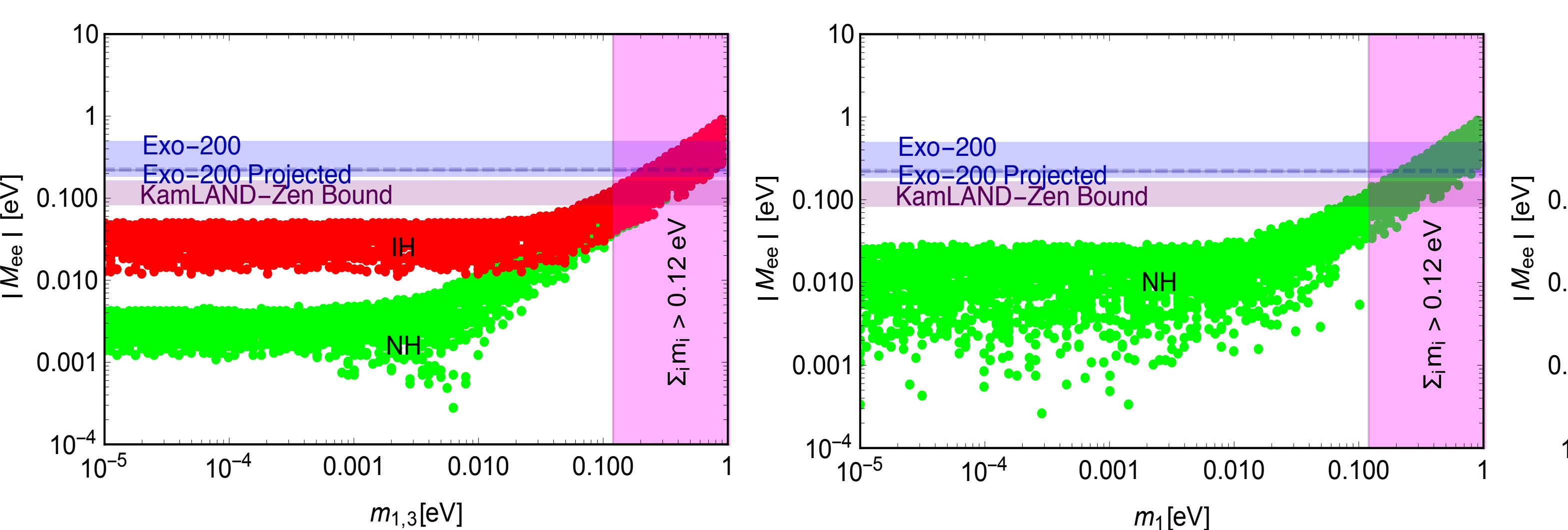


Fig.4: Variation of the effective Majorana mass parameter $|M_{ee}|$ with the lightest neutrino mass.

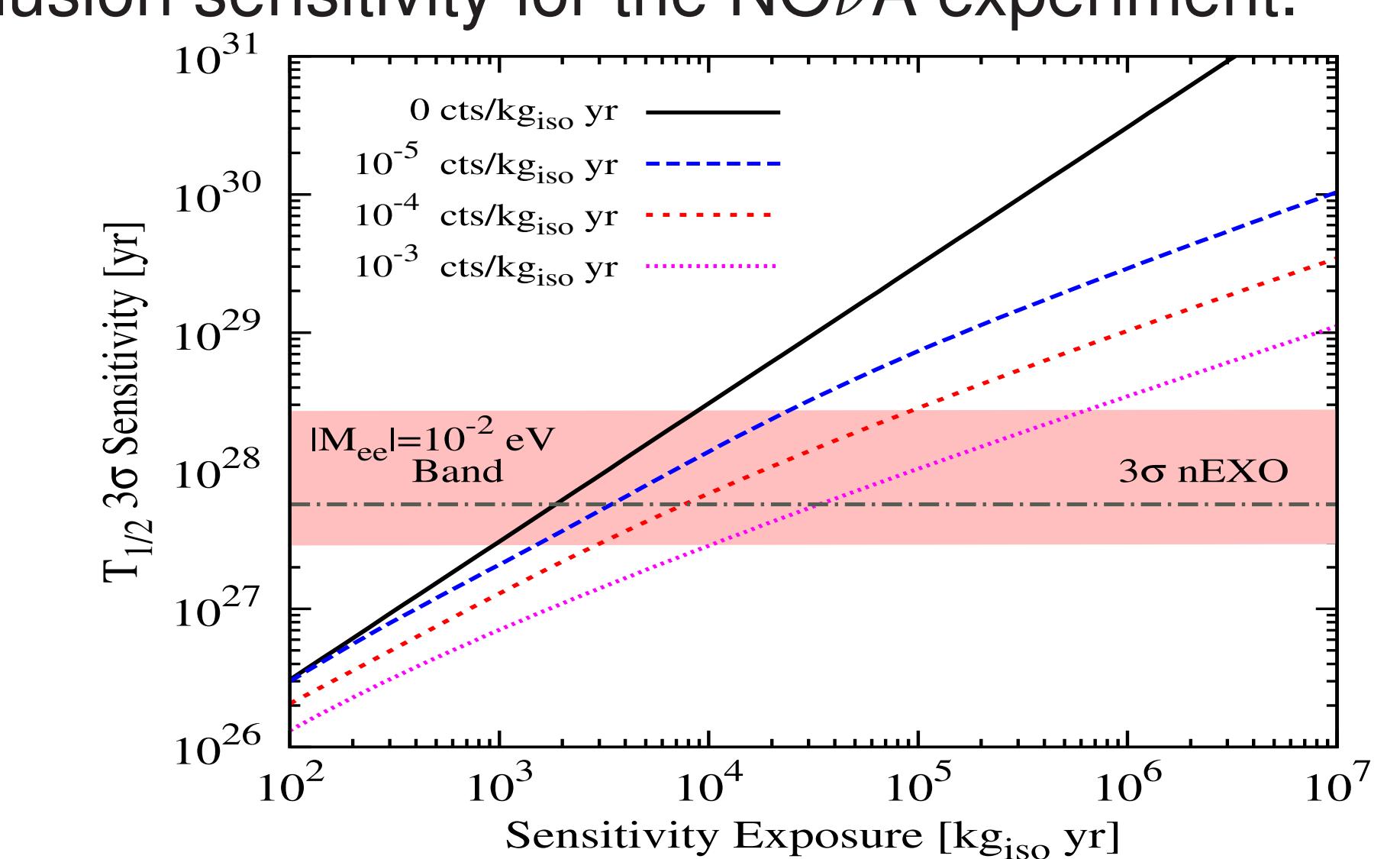


Fig.5: ¹³⁶Xe discovery sensitivity plot.

Conclusions

- Sterile neutrino gives rise to new kinds of degeneracies among the oscillation parameters.
- MH sensitivity of NO ν A experiment decreases in presence of sterile neutrino. The synergy of NO ν A and T2K increases the δ_{CP} coverage.
- The sensitivity to maximal CP violation affected due to sterile neutrino. Also, the implication of sterile neutrino on neutrinoless double beta decay have shown.

References

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- S.K. Agarwalla, S.S. Chatterjee, A. Dasgupta and A. Palazzo, JHEP **02**(2016), 111 doi:10.1007/JHEP02(2016)111 [arXiv:1601.05995].