Investigating the New Physics scenario in P2O Experiment

ID 181
nishatfiza91@gmail.com

Nishat Fiza[a], Nafis Rezwan Khan Chowdhury[b], Mehedi Masud[c]

[a] IISERM India, [b] IFIC Valencia, [c] IBS CTPU South Korea

Introduction

- P2O is a long baseline experiment starting from Protvino accelerator complex to ORCA detector. It has a baseline of 2595 km
- Having a longer baseline, P2O will give an unparalleled sensitivity to matter effects
- Helps in probing the neutrino mass ordering, CP violation and some other BSM physics: Lorentz invariance violation (LIV) or Non-standard Interactions…

Lorentz Invariance Violation

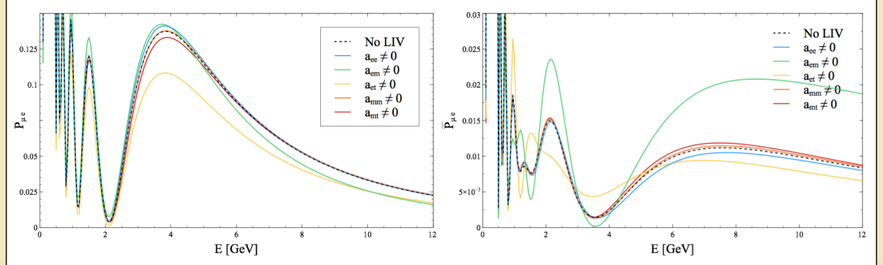
- Possible LIV at a higher scale (Planck Mass M_P) can manifest itself as perturbation at a low energy theory such as Standard Model and is suppressed by M_P.
- The Hamiltonian in presence of a LIV factor : $H = H_{vac} + H_{mat} + H_{LIV}$
- The LIV Hamiltonian has the following form:

$$H_{\mathrm{LIV}} = \begin{pmatrix} a_{ee} & a_{e\mu} & a_{e\tau} \\ a_{e\mu}^* & a_{\mu\mu} & a_{\mu\tau} \\ a_{e\tau}^* & a_{\mu\tau}^* & a_{\tau\tau} \end{pmatrix} - \frac{4}{3}E \begin{pmatrix} c_{ee} & c_{e\mu} & c_{e\tau} \\ c_{e\mu}^* & c_{\mu\mu} & c_{\mu\tau} \\ c_{e\tau}^* & c_{\mu\tau}^* & c_{\tau\tau} \end{pmatrix}$$

References

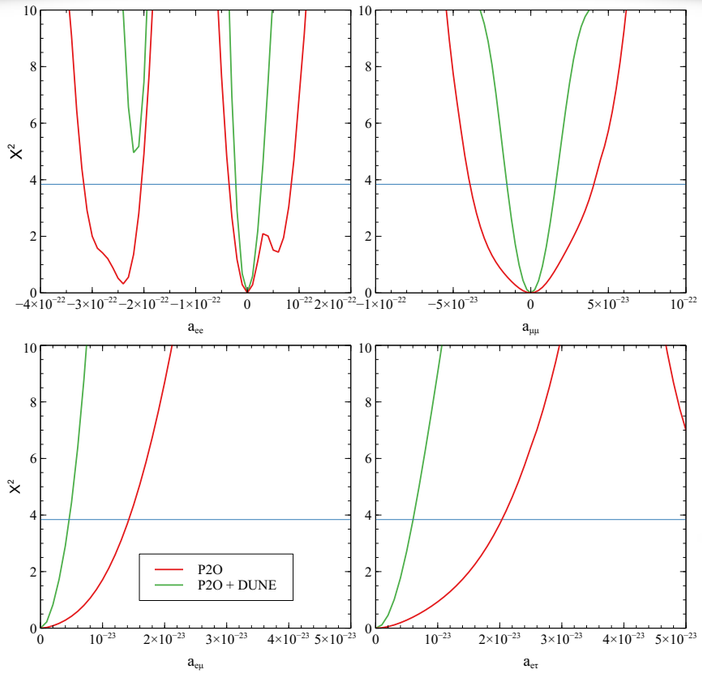
- **Letter of Interest for a Neutrino Beam from Protvino to KM3NeT/ ORCA** A. V. Akindinov et. al [10.1140/epjc/s10052-019-7259-5]
- **Exploring the intrinsic Lorentz–violating parameters at DUNE** Gabriela Barenboim, Mehedi Masud, Christoph A. Ternes, Mariam Tórtola [10.1016/j.physletb.2018.11.040]

Change in the probability in presence of the LIV parameters



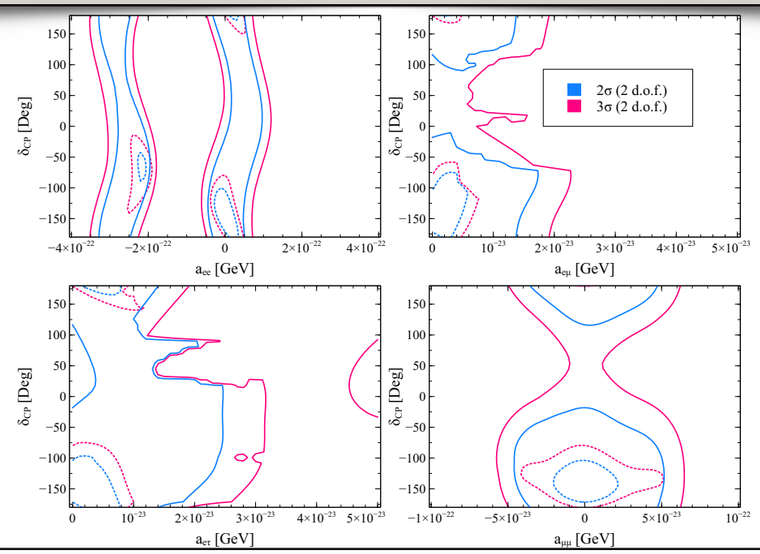
- Probability calculated for P2O baseline. Black dotted line without the effect of LIV
- Coloured curves show the probability in presence of LIV

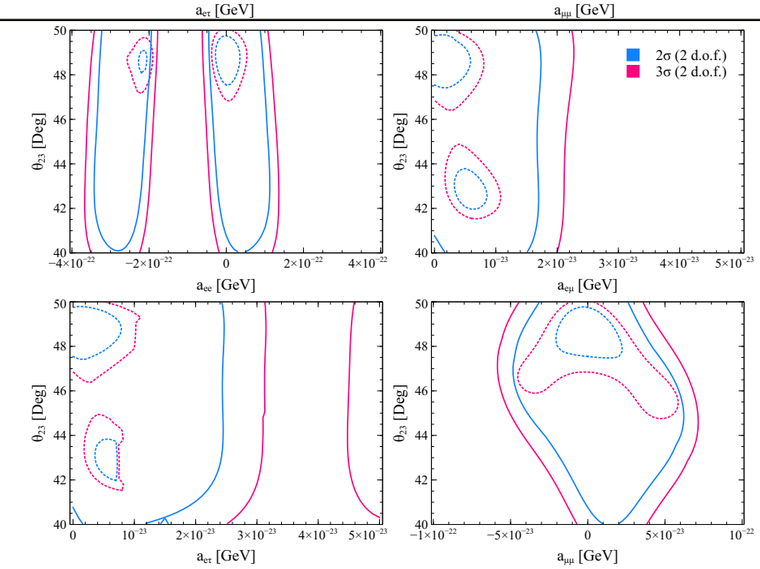
Chi square estimation for individual parameters



- Estimation of χ^2 after marginalising over test δ_{13}, test θ_{23}, test Δm^2_{31} and relevant test $\varphi_{\alpha\beta}$
- The blue curve marks the 95% confidence level

Chi square correlation with the oscillation parameters





- Estimation of χ^2 after marginalising over test δ_{13}, test θ_{23}, test Δm^2_{31} and relevant test $\varphi_{\alpha\beta}$
- The solid lines are the chi square contours for P2O data and the dotted lines are the same for P2O and DUNE data combined

Conclusion

- Matter effect gives a degeneracy in a_{ee}
- DUNE+P2O projected data gives a tighter bound