Contribution ID: **177** Type: **Parallel talk**

Effect of large extra dimension in future long baseline neutrino experiments

Tuesday 15 October 2024 14:45 (15 minutes)

The upcoming long-baseline experiments, like P2SO, DUNE, T2HK, T2HKK, etc. are highly promising experiments concerning the accurate measurement of various neutrino oscillation parameters. At present, we are looking for a tangible explanation for neutrino masses that are not zero, something that the Standard Model cannot provide. The Large Extra Dimension (LED) theory is one of the strong arguments with regard to the neutrino masses. Historically, LED has been used to explain gravity and the hierarchy problem in particle physics. In the context of neutrinos, the LED model proposes the presence of a right-handed neutrino in a fifth dimension to account for small, non-zero neutrino masses. In this work, we have shown the effect of LED parameters, the LED compactification radius (R_{ED}) and smallest neutrino mass m_0 in the future experiments like P2SO, and the combination of DUNE, T2HK and P2SO. Our results indicate that P2SO provides a stronger constraint on R_{ED} at the 90% confidence level (C.L.) compared to DUNE and T2HK. Furthermore, the synergy between DUNE, T2HK, and P2SO yields even tighter bounds on R_{ED} at the 90% C.L. than P2SO alone. Furthermore, we have demonstrated how systematic uncertainty affects the bound, demonstrating an exponentially declining variation up to 20% systematic uncertainty before remaining unchanged thereafter. In our work, we have also shown the effect of R_{ED} on the sensitivity of CP violation, mass hierarchy and octant of atmospheric angle. The result shows a significant difference in the sensitivities which can be probed in future long baseline experiments.

Track type

Neutrino Physics

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Session Classification: Parallel - Neutrino