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Investigating the Effects of Long-Range Force in the P2SO and T2HKK Experiments

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It is well known that the presence of Earth matter affects the neutrino oscillations through the charged and neutral current (NC) interactions, facilitated by W and Z bosons, respectively. In order to explore beyond Standard Model NC interactions, an additional Z' gauge boson can serve as a mediator for the interactions between matter and neutrinos. In our work, we examine light Z' with mass $\leq 10^{-16}$ eV, which could mediate the force between the matter in the Sun and neutrinos on Earth, referred to as the long-range force (LRF). We investigate the sensitivity of future long-baseline neutrino experiments, P2SO and T2HKK, to constrain the LRF. Specifically, our objectives are to examine the ability to establish bounds on the LRF parameters, the impact of LRF on the measurement of standard oscillation parameters, and the capacity to constrain the mass of the new gauge boson and the value of the new coupling constant responsible for LRF due to matter density in the Sun. Our analysis reveals that among various neutrino experiments, the P2SO experiment is expected to provide the most stringent bounds on the LRF parameters, including the mass of the new gauge boson and the value of the new coupling constant. Furthermore, our findings demonstrate that LRF has significant effects on the determination of standard neutrino oscillation parameters θ_{23} and $\delta_{\rm CP}$, and found that the precision of Δm^2_{31} remains unaffected by the presence of LRF in both P2SO and T2HKK.

Poster prize

Yes

Given name

Priya

Surname

Mishra

First affiliation

University of Hyderabad, Hyderabad, India

Second affiliation

Institutional email

20phph07@uohyd.ac.in

Gender

Female

Collaboration (if any)

Primary author: MISHRA, Priya (University of Hyderabad)

Co-authors: Dr GHOSH, Monojit (Center of Excellence for Advanced Materials and Sensing Devices, Ruđer Bošković Institute, 10000 Zagreb, Croatia); Dr MAJHI, Rudra (Nabarangpur College, Nabarangpur, Odisha, India); Prof. MOHANTA, Rukmani (University of Hyderabad); Mr PUSTY, Sambit Kumar (University of Hyderabad)

Presenter: MISHRA, Priya (University of Hyderabad)

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