Contribution ID: **348** Type: **Talk**

Neutrino Magnetic Moments in Left-Right Symmetric Model

Wednesday 14 December 2022 11:15 (15 minutes)

The establishment of non-zero neutrino masses by the phenomenon of neutrino oscillations provides a clear-cut indication of the existence of neutrino magnetic moments. We provide the neutrino magnetic moments in the presence of right-handed current effects within the Left-Right Symmetric Model (LRSM). The effects of Dirac and Majorana phases on the cancellation of the magnetic moments for various choices of left-handed (U) and right-handed (V) neutrino mixing matrices are shown in detail. The discussion is focused on the idea of considering right-handed neutrino mixing equal to the well-known PMNS matrix in the left-handed neutrino sector, leading to the vanishing contribution of Dirac magnetic moments while providing a sizeable contribution to Majorana magnetic moments. The role reversal feature is found when we consider right-handed mixing as a conjugate of its left-handed counterpart, leading to vanishing Majorana magnetic moments. Moreover, for the right-handed neutrino mixings as a transpose of the left-handed mixings, both Dirac and Majorana components of magnetic moment exist. Currently the value of neutrino magnetic moment is reported by the XENON1T detector at a 90% confidence of $\mu_\nu \in (1.4, 2.9) \times 10^{-11} \mu_B$ [1]. Thus, the study of magnetic moments in the presence of the right-handed current effect may shed light on the Dirac or Majorana nature of neutrinos. Our results show that, even though certain values of the Majorana phases can eliminate neutrino magnetic moments, the presence of a maximal CP-violating phase in the neutrino mixing matrix, as favored by the discrepancy between T2K results and reactor measurements in neutrino oscillations, require that at least one neutrino have a large nonzero magnetic moment.

[1] E. Aprile et al. (XENON), Phys. Rev. D 102, 072004 (2020), 2006.09721.

Session

Neutrino Physics

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Session Classification: WG7 - Neutrino Physics