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Neutrino mass and hierarchy determinatiion from new physics

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We present a detailed discussion on neutrinoless double beta decay within a class of left-right symmetric models where neutrino mass originates by natural type II seesaw dominance. The spontaneous symmetry breaking is implemented with doublets, triplets and bidoublet scalars. The fermion sector is extended with an extra sterile neutrino per generation that helps in implementing the seesaw mechanism. The presence of extra particles in the model exactly cancels type-I seesaw and allows large value for Dirac neutrino mass matrix M_D . The key feature of this work is that all the physical masses and mixing are expressed in terms of neutrino oscillation parameters and lightest neutrino mass thereby facilitating to constrain light neutrino masses from neutrinoless double beta decay. With this large value of M_D new contributions arise due to; i) purely left-handed current via exchange of heavy right-handed neutrinos as well as sterile neutrinos, ii) the so called λ and η diagrams. New physics contributions also arise from right-handed currents with right-handed gauge boson W_R mass around 3 TeV. From the numerical study, we find that the new contributions to neutrinoless double beta decay not only saturate the current experimental bound but also give lower limit on absolute scale of lightest neutrino mass and shows NH pattern of mass hierarchy is favorable..

Summary

The seesaw mechanisms that explain light neutrino masses require them to be Majorana particles which violates lepton number by two units. This lepton number violation can be observed at Large Hadron Collider through same-sign dilepton events and at low energy experiments by the rare process like neutrinoless double beta decay provided the seesaw scale is low. The canonical seesaw mechanism requires the existence of SM gauge-singlet sterile neutrinos at very high energy scales which can not be accessible to any experiment in foreseeable future. Therefore, it is essential to explore alternative low scale seesaw mechanisms which offer direct testability at the LHC and other low-energy experiments. We propose a new framework where the new physics contributions can be expressed in terms of neutrino oscillation parameters. One important aspect of this framework is that one can get lower bound on abosolute scale of lightest neutrino mass and mass hierarchy by analyzing the new physics contributions to neutrinoless double beta decay. We also interlink neutrinoless double beta decay with cosmology, beta decay and neutrino oscillation.

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