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Neutrinoless double beta decay in Left-Right symmetric model

In this talk, I will mainly discuss the neutrinoless double beta decay ($0\nu\beta\beta$) within the Left-Right Symmetric Model (LRSM), focusing on three critical aspects: (1) the enhancement or suppression of $0\nu\beta\beta$ rates in specific parameter spaces of new physics (NP) degrees of freedom, (2) constraints on NP parameters from current and future experiments, and (3) the impact of nuclear matrix element (NME) uncertainties on interpreting these constraints.
To be specific, I will talk about
1. Parameter-Dependent Contributions of NP in LRSM
The LRSM introduces multiple mechanisms: the standard light neutrino mass term (m_ν), the η-mechanism (mediated by right-handed currents and heavy neutrinos), and the λ-mechanism (driven by $W_L - W_R$ mixing). We systematically study the enhancement or suppression of $0\nu\beta\beta$ rates by NP degrees of freedom in different parameter spaces.
2.Experimental Constraints and Future Sensitivities
We combine current $0\nu\beta\beta$ experiments (KamLAND-Zen, GERDA, CUORE, etc.) to derive the constraints of LRSM parameters and compare them with those from collider and cosmology searches. Similarly, the sensitivities of future $0\nu\beta\beta$ experiments to LRSM parameters will also be discussed quantitatively.
3.Nuclear Matrix Element Uncertainties
In deriving experimental constraints or future sensitivities, we consider the impact of the NME uncertainties, arising from approximations in nuclear structure models (e.g., QRPA, shell model) and short-range correlations, which alter the constraints of NP parameters by one order of magnitude at most. In LRSM, the η- and λ-mechanisms depend differently on NMEs, leading to degeneracies in parameter constraints. Multi-isotope studies (e.g., ^{76}Ge, ^{130}Te, ^{136}Xe) are proved to be critical to mitigate these uncertainties, as they provide complementary information to disentangle NP contributions.
In summary, the LRSM offers a dynamic framework where NP contributions are modulated by M_{W_R} and m_N. Current experiments constrain TeV-scale NP, while future $0\nu\beta\beta$ campaigns will probe deeper into the parameter space, contingent on improved NME calculations. Resolving the interplay between NP mechanisms, nuclear theory uncertainties, and multi-channel experimental data quanlitatively is essential to advance our understanding of neutrino properties and fundamental symmetries.

Secondary track

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