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Neutrino properties deduced from the double beta decay study

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Double beta decay (DBD) is a rare nuclear process of great interest due to its potential to provide information about physics beyond the Standard Model (BSM). For example, the discovery of the neutrinoless double-beta ($0\nu\beta\beta$) decay mode could give answers to fundamental issues about possible violation of the CP and Lorentz symmetries in the weak sector, lepton number violation, or about still unknown neutrino properties such as are neutrinos Dirac- or Majorana-like particles?; neutrino absolute masses; what is the correct hierarchy of the neutrino masses?; are there sterile neutrinos?, etc. Theoretically, the DBD study consists in the precisely computation of the nuclear matrix elements (NMEs) and phase space factors (PSFs) entering the DBD half-lives formulas, for different decay modes and transitions to final ground or excited states of the parent nuclei. Reliable computations of these quantities result in reliable predictions of DBD half-lives and constrains of the BSM parameters appearing in the possible mechanisms that may contribute to the $0\nu\beta\beta$ decay.
In my talk I give first a short review of the theoretical challenges in the study of $0\nu\beta\beta$ decay. Then I present a new, more reliable, approach to calculate at once the products NMEs x PSFs and I deduce new limits for the neutrino mass parameters for the light and heavy neutrino exchange scenarios.

References

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