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The Nuclear Matrix Elements for 0nbb-Decay: Current Status

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Nuclear physics is important for extracting useful information from the neutrinoless double beta decay data. Interpreting existing results as a measurement of efective Majorana neutrino mass depends crucially on the knowledge of the corresponding nuclear matrix elements (NMEs) that govern the decay rate. The NMEs for neutrinoless double beta decay must be evaluated using tools of nuclear structure theory. There are no observables that could be directly linked to the magnitude of neutrinoless double beta decay NMEs and, thus, could be used to determine them in an essentially model independent way. To this end, we review the sophisticated nuclear structure approaches which have recently been developed, and which give confidence that the required nuclear matrix elements can be reliably calculated employing different methods. Subject of interest are the accuracy and reliability of calculated NMEs associated with different neutrinoless double beta decay mechanisms (light and heavy neutrino exchange, R-parity breaking SUSY mechanisms). New results and analysis performed within the QRPA with a restoration of isospin symmetry are presented as well. Further, it is shown that it is possible to disentangle the various mechanisms and unambiguously extract the important neutrino-mass scale, if all the signatures of the reaction are searched for in a sufficient number of nuclear isotopes.

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