PRESENT AND FUTURE STRATEGIES FOR 0ν-DBD SEARCHES

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Double Beta Decay (DBD) is a second order nuclear transition in which a nucleus (A,Z) decays into a nucleus (A, Z ± 2) emitting two positrons (electrons). If the transition is accompanied by the emission of 2 (anti)neutrinos, we will speak of 2νDBD, a phenomenon predicted in 1935 by Maria Goeppert-Mayer and well inserted in the framework of the Standard Model. If the 2 charged leptons come alone, then we will speak of Neutrinoless DBD (0νDBD): a Lepton Number violating process which can take place only if neutrinos are Majorana particles ($\nu = \overline{\nu}$) with a non vanishing mass.

The renewed interest shown in these days towards Neutrinoless Double Beta Decay (0νDBD) is justified by the fact that the Majorana nature of neutrinos is expected in many theories beyond the Standard Model and by the fact that we now know, thanks to the neutrino oscillation experiments, that neutrinos are in fact massive, as expected in these theories and not requested in the Standard Model. Moreover, since these experiments measure only the absolute value of the difference of the square of the neutrino masses, the discovery of 0νDBD would help to disentangle the questions that still remain unsolved: what is the absolute mass scale of the neutrinos and which mass hierarchy (normal, inverted or quasi-degenerate) is the correct one?

The scope of this paper is not only to review the present results reached in the field by the different groups and technologies worldwide, but also to illustrate and comment the (near and long-term) future strategies that experimentalists are trying to pursue to reach the needed sensitivity required to explore the inverted hierarchy neutrino mass scale and, possibly, the normal one. Special care will be devoted also in the illustration of the work still to be done in parallel by nuclear theoretical physicists, to assure the real success of the endeavour.