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Neutrinoless-double beta decay and its potential to investigate neutrino properties

Abstract.
Neutrinoless double beta decay (0νDBD) is a nuclear process which is permitted within theories more general than the Standard Model (SM) in its original formulation. The discovery of this double-beta decay (DBD) mode would confirm the lepton number violation and the nature of neutrinos (Majorana particles) and could provide important information about neutrino properties still unknown until now (neutrino mass scale, mass hierarchy, existence of sterile neutrinos), deviations from the CP and Lorentz symmetries, etc. Theoretically, the 0νDBD study consists in the derivation of the half-life formulas in different approximations and for different possible mechanisms that can contribute to its occurrence and the precisely computation of the nuclear matrix elements (NMEs) and phase space factors (PSFs) entering these formulas, for different decay modes and transitions to final ground or excited states of the daughter nuclei. Accurate computations of these quantities result in reliable predictions of half-lives and constraints of the beyond SM parameters associated to these possible mechanisms.
In my talk I give first a short review of the theoretical challenges in the study of 0νDBD decay and of the broad potential of this decay mode to investigate physics beyond SM. Then I present a new, more reliable, approach to calculate the products NMEs x PSFs by a direct computation and I present new limits for the neutrino mass parameters for the light and heavy neutrino exchange scenarios. Also, I show how possible deviations from the Lorentz symmetry in the neutrino sector can be investigated within the DBD study.

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Collaboration name

Primary author: Prof. STOICA, Sabin (International Center for Advanced Training and Research in Physics (CIFRA))

Presenter: Prof. STOICA, Sabin (International Center for Advanced Training and Research in Physics (CIFRA))

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