

PRISMA+ Colloquium

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Lorentz-Raum 05-127, Staudingerweg 7

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Exploring new physics with the double-beta decay of nuclei

The rare decay of atomic nuclei known as neutrinoless double-beta Decay is a unique process. Here, a nucleus decays by turning two neutrons into two protons, emitting two electrons without the usual balance of antineutrinos. Therefore, two particles---two electrons---are effectively created. Neutrinoless double-beta decay is the most promising attempt to test lepton number conservation in the laboratory.

The observation of neutrinoless double-beta decay would proof that neutrinos are its own antiparticle, can clarify the origin of the prevalence of matter over antimatter in the universe, and determine the absolute neutrino mass. In spite of formidable experimental efforts, neutrinoless double-beta decay remains elusive, with half-live limits set over 10^{25} years in some nuclei.

The decay rate depends critically on the nuclear structure of the initial and final nuclei. This is encoded in the nuclear matrix element, which is key to anticipate the reach of experiments and to fully extract all physics information from a future measurement. In this PRISMA+ colloquium I will summarize the status of double-beta decay searches, and highlight recent efforts to obtain reliable nuclear matrix elements from first principles.