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New prospects in the search for neutrinoless double beta decay of ^{96}Zr

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Currently-running and planned neutrinoless double beta decay (0ν-DBD) experiments aim to reach an experimental sensitivity in terms of half-life at the order of 10^{27}–10^{28} yr to probe the inverted neutrino hierarchy using a short list of isotopes –^{76}Ge, ^{100}Mo, ^{130}Te and ^{136}Xe. However, ^{96}Zr is also a promising nuclide due to its high energy transition ($Q_{2\beta}$ = 3.35 MeV) that helps to overcome the issue with the environmental gamma-radioactivity (up to 2.6 MeV) and internal beta-active nuclides from U/Th decay chains (up to 3.27 MeV). The high transition energy is also favorable from a theoretical point of view, as the expected half-life for 0ν-DBD is proportional to $(Q_{2\beta})^5$.
Here we present the first complex study of Cs_2ZrCl_6 (CZC) scintillating crystals in terms of their chemical- and radio-purity, scintillating performance and pulse-shape discrimination ability. The low-background measurements with two CZC crystals (11 g and 24 g) over 456.5 days, supported their high radiopurity leading to a counting rate of 0.17 $(kg{\cdot}keV{\cdot}yr)^{-1}$ at the $Q_{2\beta}$ of ^{96}Zr. Limits on different DBD modes of ^{96}Zr were set at the level $T_{1/2} \sim 10^{17}$-10^{20} yr (90% C.L.). The detailed analysis of the internal background components was performed to be used in further developments of Cs_2ZrCl_6 detectors and to optimize the future experiment.

Submitted on behalf of a Collaboration?

No

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