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Search for two-neutrino double electron capture on Ar-36 with DarkSide-50 detector

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Two-neutrino double electron capture is a rare nuclear decay where two electrons are simultaneously captured from the atomic shells and two neutrinos are carried away.

The measurements of the energies of the emitted particles and the half-life of the 2EC2ν decay to the ground state are of great interest to nuclear physics. The model predictions for 2EC2ν half-life are based on the evaluation of form the main source of NME. The NME calculations are complicated and have large uncertainties. Therefore, if retrieved from experiment, half-life values can serve as a test for nuclear theory. In the one model framework some constraints on the 2EC0ν NME can be derived using supposed values of the 2EC2ν NME, so the estimation of 2EC2ν half-life could help to study physics beyond the Standard Model.

This process is being studied on ^{36}Ar for the first time. We have performed a search for two-neutrino double electron capture in the KK and KL shells of ^{36}Ar using exposition of about 12 ton-day of data from the DarkSide-50 dark matter detector. As a preliminary result of the analysis, no significant excess above background was found, which allowed us to estimate that the half-life limits with CL=90%. We have also evaluated the sensitivity of the DarkSide-20k experiment, which will become operational in the next few years.

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