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Results of the background-free search for neutrinoless double beta decay with GERDA and challenges of the LEGEND experiment

GERDA (GErmanium Detector Array) situated in the Laboratori Nazionali del Gran Sasso (LNGS) of INFN searches for the lepton-number violating neutrinoless double beta ($0\nu\beta\beta$) decay of ^{76}Ge. Bare high-purity germanium (HPGe) detectors enriched in the double beta decay isotope ^{76}Ge are deployed in liquid argon (LAr). Background discrimination is achieved both by analyzing the time profile of the charge signal of the germanium detectors (pulse shape discrimination) and by using the instrumented LAr volume as an active veto system. A background level of $\sim 10^{-3}\,\mathrm{counts\,keV^{-1}\,kg^{-1}\,yr^{-1}}$ was reached in GERDA Phase II, which enables a background-free $0\nu\beta\beta$ search up to $100\,\mathrm{kg\,yr}$. So far, no signal was observed after $58.9\,\mathrm{kg\,yr}$ exposure. Together with Phase I data, a lower limit of $T_{1/2} > 0.9 \cdot 10^{26}$ yr (90% C.L.) [1] on the half-live of the $0\nu\beta\beta$ decay of ^{76}Ge was obtained.
The next generation $0\nu\beta\beta$ search with LEGEND (Large Enriched Germanium Experiment for Neutrinoless $\beta\beta$ Decay) will proceed in stages: LEGEND-200 will be operated at LNGS at a depth of 3500 m.w.e. and will acquire data free of background for $1000\,\mathrm{kg\,yr}$. The subsequent ton-scale stage is referred to as LEGEND-1000. The decay of ^{77m}Ge, which is produced in-situ by cosmic muon interactions, is identified as a critical background for this stage [2].
It can be identified by detecting delayed coincidences. One goal of LEGEND-200 is to assess the efficiency to tag the ^{77m}Ge production in view of LEGEND-1000.
In this talk both the GERDA results and the analysis of delayed coincidences in LEGEND will be shown.

[1] GERDA Collaboration, submitted for publication.
[2] C. Wiesinger, L. Pandola and S. Schönert,
"Virtual depth by active background suppression: Revisiting the cosmic muon induced background of GERDA Phase II"
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