SEARCH FOR SINGLE AND TRI-NUCLEON DECAYS OF ^{76}Ge IN GERDA

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Single- and multi-nucleon decays, violating baryon number conservation, are predicted in several extensions of the Standard Model. The main goal of the GERDA (GERmanium Detector Array) experiment was to search for the neutrinoless double-beta decay of ^{76}Ge. Beside this, many other GERDA results of searching for various processes beyond the Standard Model were obtained. Among them, a possible manifestation of the inclusive, i.e. mode independent, decay of a single neutron and proton as well as specific modes of tri-nucleon decays in ^{76}Ge is investigated.

GERDA explores the possible disappearance of a single nucleon in ^{76}Ge by looking for the β-decay of the ^{75}Ge ground state to an excited state of ^{75}As in coincidence with the γ-ray emitted in the subsequent ^{75}As de-excitation. Proton decay could populate first the unstable ^{75}Ga nucleus that later decays by β-emission to ^{75}Ge. The tri-nucleon ppp-, ppn-, and pnn-decays of ^{76}Ge lead to ^{73}Cu, ^{73}Zn, and ^{73}Ga nuclei, respectively. These nuclei are unstable and eventually proceed by the β-decay of ^{73}Ga to ^{73}Ge (stable). Searching for the ^{73}Ga decay, which dominantly populates the 66.7 keV ^{73m}Ga state, is considered. Our analysis also includes nnn-decay occurring through ^{73m}Ge.

No signal candidates were found for either single or tri-nucleon decays of ^{76}Ge. This leads to lifetime limits for the inclusive decay of a single nucleon in ^{76}Ge: for neutrons $\tau_n > 1.5 \times 10^{24}$ yr and for protons $\tau_p > 1.3 \times 10^{24}$ yr at 90% CI. This is the first limit obtained for ^{76}Ge. The limit on the sum of the decay widths of the four inclusive tri-nucleon decays was obtained that corresponds to a lower lifetime limit of 1.2×10^{26} yr (90% CI). This result improves previous limits for tri-nucleon decays by one to three orders of magnitude.