Contribution ID: **15** Type: **not specified**

Experiment TGV-2 –search for double beta decay of 106Cd

Investigation of double beta decay processes (EC/EC, β+/EC, β+ β+) of 106Cd was performed at the Modane underground laboratory (4800 m w.e.) using a low-background spectrometer TGV-2 (Telescope Germanium Vertical). The detector part of the TGV-2 is composed of 32 HPGe planar type detectors with the sensitive volume of 2040 mm2 x 6 mm each. The total sensitive volume of detectors is as large as 400 cm3. The total mass of the detectors is ˜3 kg. The detectors are mounted one over another together with double beta emitters in a common cryostat. Double beta emitters were ˜50 μm thick foils of 106Cd (enrichment 75%) with a diameter of 52 mm inserted between the entrance windows of the neighbouring detectors. The distance between the detectors and the emitters was about 1.5 mm. The energy resolution of detectors ranged from 3.0 to 4.0 keV at 1332 keV (60Co). The detector part of TGV-2 was surrounded by a copper shielding (>20 cm), a steel airtight box against radon, a led shielding (>10 cm), and an antineutron shielding made of borated polyethylene (16 cm). Two experimental runs were performed to search for double beta decay of 106Cd. In the first run 12 samples of 106Cd with a total mass of ˜10 g and 4 samples of natural Cd with a total mass of ˜3.2 g were measured during ˜1 yr. In the second run 16 samples of 106Cd with a total mass of ˜13.6 g were studied during ˜1.5 yr. Additional experimental runs were performed with 16 samples of natural Cd and without samples to measure background in the regions of interest. The coincidences between two characteristic KX-rays of palladium detected in neighbouring detectors were analyzed to search for 2νEC/EC decay of 106Cd to the ground 0+ state of 106Pd. The search for 0νEC/EC resonance decay of 106Cd was based on the analysis of KX(Pd) –γ2741 keV and KX(Pd) –γ2229 keV –γ511.9 keV coincidences. Investigations of other branches of 106Cd decay –EC/EC decay to the 2+,511.9 keV and 0+,1334 keV excited states of 106Pd, and β+/EC, β+ β+ decays to the ground and excited states of 106Pd were based on the analysis of KX-511 keV, KX-622 keV, 511 keV-511 keV and 511 keV-622 keV coincidences. New limits (at 90% CL) on half-lives of 0νEC/EC resonant decay of 106Cd–T1/2 > 1.7 × 10ˆ20 yr and 2νEC/EC decay of 106Cd (0+g.s. –0+g.s.) –T1/2 > 4.2 × 10ˆ20 yr were obtained in a preliminary calculation of data accumulated in the TGV-2 experiment.
This work was partly supported by RFBR under grant 08-02-00790.

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