

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

Investigation of double beta decay processes (EC/EC,  $\beta^+$ /EC,  $\beta^+ \beta^+$ ) of  $^{106}\text{Cd}$  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  $2040 \text{ mm}^2 \times 6 \text{ mm}$  each. The total sensitive volume of detectors is as large as  $400 \text{ cm}^3$ . The total mass of the detectors is  $\sim 3 \text{ kg}$ . The detectors are mounted one over another together with double beta emitters in a common cryostat. Double beta emitters were  $\sim 50 \mu\text{m}$  thick foils of  $^{106}\text{Cd}$  (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 ( $^{60}\text{Co}$ ). The detector part of TGV-2 was surrounded by a copper shielding ( $>20 \text{ cm}$ ), a steel airtight box against radon, a lead shielding ( $>10 \text{ cm}$ ), and an antineutron shielding made of borated polyethylene (16 cm). Two experimental runs were performed to search for double beta decay of  $^{106}\text{Cd}$ . In the first run 12 samples of  $^{106}\text{Cd}$  with a total mass of  $\sim 10 \text{ g}$  and 4 samples of natural Cd with a total mass of  $\sim 3.2 \text{ g}$  were measured during  $\sim 1 \text{ yr}$ . In the second run 16 samples of  $^{106}\text{Cd}$  with a total mass of  $\sim 13.6 \text{ g}$  were studied during  $\sim 1.5 \text{ yr}$ . 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  $2\nu\text{EC}/\text{EC}$  decay of  $^{106}\text{Cd}$  to the ground  $0^+$  state of  $^{106}\text{Pd}$ . The search for  $0\nu\text{EC}/\text{EC}$  resonance decay of  $^{106}\text{Cd}$  was based on the analysis of  $\text{KX}(\text{Pd}) - \gamma_{2741} \text{ keV}$  and  $\text{KX}(\text{Pd}) - \gamma_{2229} \text{ keV} - \gamma_{511.9} \text{ keV}$  coincidences. Investigations of other branches of  $^{106}\text{Cd}$  decay – EC/EC decay to the  $2^+, 511.9 \text{ keV}$  and  $0^+, 1334 \text{ keV}$  excited states of  $^{106}\text{Pd}$ , and  $\beta^+/\text{EC}$ ,  $\beta^+ \beta^+$  decays to the ground and excited states of  $^{106}\text{Pd}$  were based on the analysis of  $\text{KX}-511 \text{ keV}$ ,  $\text{KX}-622 \text{ keV}$ ,  $511 \text{ keV}-511 \text{ keV}$  and  $511 \text{ keV}-622 \text{ keV}$  coincidences. New limits (at 90% CL) on half-lives of  $0\nu\text{EC}/\text{EC}$  resonant decay of  $^{106}\text{Cd}$  –  $T_{1/2} > 1.7 \times 10^{20} \text{ yr}$  and  $2\nu\text{EC}/\text{EC}$  decay of  $^{106}\text{Cd}$  ( $0^+ \text{g.s.} - 0^+ \text{g.s.}$ ) –  $T_{1/2} > 4.2 \times 10^{20} \text{ yr}$  were obtained in a preliminary calculation of data accumulated in the TGV-2 experiment.

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