SEARCH FOR β^+EC AND ECEC PROCESSES IN ^{74}Se

Barabash A.S.[1], Brudanin V.B.[2], Klimenko A.A.[2], Konovalov S.I.[1], Rakhimov A.V.[2], Rukhadze E.N.[3], Rukhadze N.I.[2], Shitov Yu.A.[2], Štekl I.[3], Umatov V.I.[1], Warot G.[4]

[1] NRC "Kurchatov institute" ITEP,Moscow, Russia; [2] Joint Institute for Nuclear Research, Dubna, Russia; [3] Institute of Experimental and Applied Physics, CTU in Prague, Prague, Czech Republic; [4] Laboratoire Souterrain de Modane, Modane, France

E-mail: rukhadze@jinr.ru

Search for double beta decay processes (β^+EC, EC/EC) of ^{74}Se was performed at the Modane underground laboratory (LSM, France, 4800 m w.e.) using an ultra-low-background HPGe detector OBELIX with sensitive volume of 600 cm^3 [1] and a sample of natural selenium. The sample of natural selenium was powder with a total mass of 1.6 kg containing ~ 0.89% (~ 14.24 g) of ^{74}Se. Selenium was filled in a circular Teflon box and placed on the end cap of HPGe detector. The measurement of selenium sample was lasted during 3040 h. The efficiency of measurement was obtained by using Monte Carlo simulations performed on the base of GEANT 4 and GEANT 3 and then tested by measurement of low active samples placed on the end cap of Obelix detector. Low active samples were prepared on the base of La_2O_3 powder containing ~ 0.09% of ^{138}La ($T_{1/2} \approx 1.02\times10^{11}$ yr) and had activities of −19.3 and 61.8 Bq. The method of efficiency calibration for low background measurements with low active samples was described in details in [2].

The main goals of present investigation were searches for radiative 0νECEC decay of ^{74}Se into the ground 0^+ state of ^{74}Ge, 2νECEC decay of ^{74}Se into 2^+_1, 596 keV and 2^+_2,1204 keV exited states of ^{74}Ge, and β^+EC decay into 2^+_1, 596 keV excited state of ^{74}Ge. Based on preliminary calculations of experimental data new limits on β^+EC and ECEC decays of ^{74}Se into ground 0^+, 2^+_1, 596 keV and 2^+_2,1204 keV exited states of ^{74}Ge was obtained. They are ranged from $T_{1/2} \sim 1\times10^{19}$ yr (90% CL) to $T_{1/2} \sim 5\times10^{19}$ yr (90% CL) and significantly improved previous experimental limits [3, 4].

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