World Academy of Science, Engineering and Technology
International Journal of Nuclear and Quantum Engineering
Vol:16, No:10, 2022

# Double Beta Decay Experiments in Novi Sad

**Authors :** Nataša Todorović, Jovana Nikolov

**Abstract :** Despite the great interest in $\beta^-\beta^-$ decay, $\beta^+\beta^+$ decays are rarely investigated due to the low probability of detecting these processes with available low-level equipment. If $\beta^+\beta^+$, $\beta^+$EC, or ECEC decay occurs in a thin sample of a material, the positrons will be stopped and annihilated inside the material, leading to the emission of two or four coincidence gamma photons energy of 511 keV. The paper presents the results of measurements of double beta decay of $^{64}$Zn, $^{50}$Cr, and $^{54}$Fe isotopes. In the first experiment, 511-keV gamma rays originating from the annihilation of positrons in natural zinc were measured by a coincidence technique to obtain a non-zero value for the (0ν+2ν) half-life. In the second experiment, the result of measuring double beta decay of $^{50}$Cr is presented, which suggests a result other than zero at 95% CL and gives the lowest limit for the half-life of this process. In the third experiment, neutrino-less ECEC decay of $^{54}$Fe was examined. Under the decay theory, gamma rays are emitted whose energy does not coincide with the energies of gamma rays emitted by nuclei from known discrete excited states. Iron shield of an internal volume of 1 $m^3$ and thickness of 25 cm served as a source for measuring the (0ν+2ν) process in $^{54}$Fe, whose yield in natural iron is 5.4%. We obtain the lower limit for the half-life for $^{54}$Fe: T(0ν, K, K)>4.4x$10^{20}$ yr, T(0ν, K, L)>4.1x$10^{20}$ yr, and T(0ν, L, L)>5.0x$10^{20}$ yr. For $^{50}$Cr limit for the half-life is T(0ν+2ν)>1.3(6)x$10^{18}$ yr, and for $^{64}$Zn T(0ν+2ν, ECβ+)=1.1(0.9)x$10^9$ years.

**Keywords :** neutrinoless double beta decay, half-life, $^{64}$Zn, $^{50}$Cr, and, $^{54}$Fe
**Conference Title :** ICRANP 2022 : International Conference on Recent Advances in Neutrino Physics
**Conference Location :** New York, United States
**Conference Dates :** October 06-07, 2022