Activation Cross Section Measurement of the (n,2n) Reaction on ^{203}Tl at 16.4 MeV, 18.9 MeV and Theoretical Calculations via the EMPIRE code

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Neutron-induced reaction studies are a key component of considerable significance for basic research in nuclear physics and applications in nuclear technology, medicine and industry. The enrichment of nuclear data available in literature for neutron-induced reactions on Tl isotopes is of great importance, not only because of the wide use of Thallium in many practical applications, but also for the elucitation of the plethora of discrepancies among the existing experimental data of the ^{203}Tl(n,2n)^{202}Tl reaction cross section, especially in the energy region above 14 MeV.

Hence, the aim of the present work was the experimental and theoretical study of the cross section of the ^{203}Tl(n,2n)^{202}Tl reaction, implementing the activation method and the EMPIRE code, respectively. The monoenergetic neutron beams, which irradiated natural TlCl pellet targets, at 16.4 MeV and 18.9 MeV, were generated at the 5.5 MV Tandem accelerator of N.C.S.R. "Demokritos", using the ^{3}H(d,n)^{4}He reaction. The ^{203}Tl(n,2n)^{202}Tl reaction cross section was deduced with respect to the ^{197}Au(n,2n)^{196}Au and ^{27}Al(n,α)^{24}Na reference reactions. The target and reference foil assemblies were placed at a distance of ~1.5 cm from the tritium target, where the angular acceptance is ± 23.5° and the produced neutrons are practically isotropic and monoenergetic. A BF_3 detector located at ~3m from the neutron source, monitored the fluctuation of the neutron beam flux. The induced activity of the samples, after the irradiation, was measured with HPGe (80%) detectors, properly shielded with lead blocks, thus reducing natural radioactivity's contribution. The gamma-ray self-absorption and the estimation of the neutron flux through the reference foils were calculated by Monte Carlo simulations applying the MCNP code. The results of the theoretical calculations for the ^{203}Tl(n,2n)^{202}Tl reaction cross section with the code EMPIRE will be discussed in comparison with the neighbouring reactions ^{197}Au(n,2n)^{196}Au and ^{191}Ir(n,2n)^{190}Ir reactions, which have been investigated in the past and reveal the same theoretical parametrization [1,2].

[1] *A.Kalamara et al.*, ^{197}Au(n,2n) reaction cross section in the 15-21 MeV energy range. *Phys.Rev.*C97(2018)034615.

[2] *A.Kalamara et al.*, ^{191}Ir(n, 2n) and ^{191}Ir(n, 3n) reaction cross sections in the 15–21 MeV energy range. *Phys.Rev.*C98(2018) 034607.