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Search for the evidence of 209Bi(γ,p5n)203Pb reaction in 60MeV and 80MeV photon beams

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The simplest photonuclear reaction (γ,n) usually takes place through the well-known mechanism of giant dipole resonance. For a large number of stable nuclei, the energy differential cross-section of this reaction has been successfully measured. The experimental evidence for the (γ,2n) reaction is much poorer, while for reactions where three or more neutrons are emitted (usually denoted by (γ,xn)), the values of the cross-sections can be obtained from theoretical calculations mostly. For reactions in which a charged particle, such as a proton, in the simplest case, is emitted (single or in addition to one or more neutrons) there is much poorer experimental evidence. The probability of emission of a charged particle in the interaction of nuclei with high-energy photons is significantly lower than the emission of neutrons due to the existence of the Coulomb barrier. It is a reason why experimental data concerning (γ,pxn) are insufficient in the literature.
In several recently published papers, photonuclear reactions with a target of natural bismuth (monoisotope 209Bi) were studied. Irradiation of some heavy elements by the photons having energies up to 80 MeV, will give several products of (γ,xn) reactions. The emission of protons or other charged particles is less probable due to the Coulomb barrier.
In this paper, an attempt was made to gain experimental evidence of Bi-209(γ,p5n)Pb-203 nuclear reaction by comparison of intensities of gamma lines following EC decay of Bi-203 and Pb-203. Pb-203 can be formed by (γ,p5n) nuclear reaction, but it is certainly created after the decay of Bi-203, obtained in Bi-209(γ,6n)Bi-203 reaction. After activation of the target from natural bismuth in photon beams of maximum energies of 60 MeV and 80 MeV, several gamma spectra were successively measured. Based on selected gamma lines from the measured spectra, the activities of Pb-203 and Bi-203 were monitored to assess the probability ratio for the occurrence of (γ,6n) and (γ,p5n) nuclear reactions. Furthermore, if some quantitative data concerning the probability of the mentioned reactions can be extracted, it can be a good way to compare the obtained result with theoretical predictions, which is done in this paper.

Authors: BARDAK, Jelena (Faculty of Sciences, University of Novi Sad); KRMAR, Miodrag (Physics Department, University Novi Sad); Dr JOVANČEVIĆ, Nikola (Faculty of Sciences, University of Novi Sad); Dr KNEŽEVIĆ, David (Institute of Physics Belgrade); MITROFANOV, Semen (FLNR); Dr TETEREV, Yu. G. (Flerov Laboratory of Nuclear Reactions, Joint Institute for Nuclear Research, Dubna, Russia); MEDIĆ, Žarko (Institute of Physics, Belgrade)

Presenter: BARDAK, Jelena (Faculty of Sciences, University of Novi Sad)

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