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LIGHT AND MEDIUM–HEAVY NUCLEI PHOTONEUTRON REACTION CROSS-SECTIONS IN BREMSSTRAHLUNG BEAM EXPERIMENTS

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In cases for many (~50) nuclei from ^{51}V to ^{209}Bi the experimental data on photoneutron partial reactions (γ,1n), (γ,2n), (γ,3n) cross sections directly obtained using beams of quasimonoenergetic annihilation photons [1] do not satisfy objective physical criteria of data reliability [2–5]. The reasons are systematic uncertainties of experimental photoneutron multiplicity sorting method basing on partial reactions separation via measurement of neutron energies. Therefore, the experimental-theoretical method for partial reaction cross-section evaluation basing on physical criteria was used for analysis of reliability of data obtained using quite different method on the beams of bremsstrahlung [6]. Partial reaction cross sections are separated and determined in such kind experiment using statistical theory corrections to the neutron yield cross section $\sigma(\gamma,\mathrm{xn}) = \sigma(\gamma,1\mathrm{n})+2\sigma(\gamma,2\mathrm{n})+3\sigma(\gamma,3\mathrm{n})+\cdots$measured at first. Experimental cross sections of the reactions (γ,1n) and (γ,2n) are definitely unreliable in the cases of ^{51}V, ^{52}Cr, ^{59}Co, but enough reliable in the case of ^{90}Zr. The reason is that the role of two-nucleon reaction (γ,1n1p) was not taken into account, though this reaction competes with also two-nucleon reaction (γ,2n). It was shown via the results of calculation in the frame of the Combined photonuclear reaction model [5] that energy positions and amplitudes of cross sections of (γ,1n1p) and (γ,2n) reactions are very close to each other in the cases of ^{51}V, ^{52}Cr, ^{59}Co, but in the case of ^{90}Zr the value of (γ,1n1p) reaction cross section is very small and could be negligible. This conclusion is analogous to that of the preliminary investigation of the cases of ^{127}I, ^{165}Ho, ^{181}Ta [7]. It means that in the cases of relatively light nuclei ^{51}V, ^{52}Cr, ^{59}Co, as well as ^{58,60}Ni [8] the reaction (γ,1n1p) plays important role in nucleus photodisintegration but its contribution is not correctly described by statistical theory corrections.

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Section

Experimental and theoretical studies of nuclear reactions

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