EVALUATION OF RELIABLE PARTIAL PHOTONEUTRON REACTION CROSS SECTIONS FOR ^{139}La

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The majority of partial and total photoneutron reaction cross sections were obtained at Livermore (USA) and Saclay (France) using quasimonoenergetic annihilation photons and the neutron multiplicity sorting based on its energy measurement. Using physical criteria of partial photoneutron reaction cross sections reliability it was found out [1–4] that for many nuclei (^{91,94,96}Zr, ^{115}In, $^{112-124}$Sn, ^{159}Tb, ^{181}Ta, ^{197}Au, ^{208}Pb) those data are nor reliable. It was shown that many data under discussion do not satisfy to proposed objective data reliability criteria: in various photon energy ranges the ratios $F_2 = \sigma(\gamma, 2n)/\sigma(\gamma, xn) = \sigma(\gamma, 2n)/\sigma[(\gamma, 1n) + 2(\gamma, 2n) + 3(\gamma, 3n) + \ldots]$ have physically unreliable values larger 0.50 and at the same time ratios $F_1 = \sigma(\gamma, 1n)/\sigma(\gamma, xn)$ have physically forbidden negative values. That means that experimental neutron multiplicity sorting has been done erroneously because of large systematic uncertainties. Using the experimental–theoretical method [1, 2] for reliable partial reaction cross section evaluation ($\sigma^{eval}(\gamma, in) = F^{theor}_i \bullet \sigma^{exp}(\gamma, xn)$) new data for reactions (γ, 1n) and (γ, 2n) (γ, 3n) free of such kind uncertainties were evaluated for many nuclei. It means that competition between partial reactions is in accordance with the combined model of photonuclear reactions [5, 6] and their sum $\sigma^{eval}(\gamma, xn)$ is equal to $\sigma^{exp}(\gamma, xn)$ free from neutron multiplicity sorting problems mentioned above. It was obtained that the new evaluated data noticeably differ from the correspondent experimental once.

Data for partial reactions (γ, 1n) and (γ, 2n) cross sections on ^{139}La [7, 8] obtained in two experiments in Saclay were analyzed. It was obtained that data obtained in both experiments (Livermore and Saclay) generally satisfy objective physical data reliability criteria. But data for both reaction cross sections are not reliable because:
– ratios F^{exp}_i obtained for data from both experiments [7, 8] are near F^{theor}_i calculated in the model [5, 6] only at energies below ~ 20 MeV;
– at larger energies one can see noticeable disagreements between F^{exp}_i and F^{theor}_i: for both experiments $F^{exp}_1 > F^{theor}_1$ and $F^{exp}_2 < F^{theor}_2$.

New cross sections for (γ, 1n) and reactions on ^{139}La were evaluated using experimental–theoretical method [1, 2]. New data for total photoneutron reaction $\sigma(\gamma, Sn) = \sigma[(\gamma, 1n) + (\gamma, 2n) + (\gamma, 3n) + \ldots]$ were obtained also. The deviations of evaluated partial reactions cross sections from experimental ones were discussed. It was shown that the main reason of those deviations is unreliable moving the parts of neutrons from (γ, 1n) reaction to (γ, 2n) reaction at energies ~ 19–22 MeV and vice versa from (γ, 2n) reaction to (γ, 1n) reaction at energies ~ 22–25 MeV .

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