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PHYSICAL CRITERIA OF DATA RELIABILITY AND SYSTEMATIC UNCERTAINTIES OF PHOTONEUTRON REACTION CROSS SECTIONS

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The problem of significant disagreements [1] between partial photoneutron reaction cross sections obtained using the method of neutron multiplicity-sorting at Livermore (USA) and Saclay (France) was investigated in detail. As a rule for 19 nuclei from ^{51}V to ^{238}U$(\gamma, 1\mathrm{n})$ reaction cross sections are larger at Saclay, but $(\gamma, 2n)$ cross sections vice versa larger at Livermore. The averaged Saclay/Livermore ratio $\mathrm{R} = \sigma_{\mathrm{S}}^{\mathrm{int}} / \sigma_{\mathrm{L}}^{\mathrm{int}}$ of integrated cross sections is equal to $\mathrm{R}_1 = 1.08$ for $(\gamma, 1\mathrm{n})$ reaction but $\mathrm{R}_2 = 0.83$ for $(\gamma, 2\mathrm{n})$ reaction.

Using the objective physical criteria for data reliability [2] it was found that there are several quite different reasons for systematic uncertainties obtained. For many nuclei it was shown that the main reason of those is unreliable sorting of many neutrons between $1\mathrm{n}, 2\mathrm{n}$ and, $3\mathrm{n}$ channels because of definite shortcoming of the method of neutron multiplicity-sorting [1,2]

Four very interesting cases were investigated in detail: data for three nuclei for which the differences between R_1 and R_2 are very large $\left(^{127}\mathrm{I}\,(\mathrm{R}_1 = 1.34 \text{ and } \mathrm{R}_2 = 1.08)\,, ^{181}\,\mathrm{Ta}(1.25 \text{ and } 0.89), \text{and } ^{208}\mathrm{Pb}(1.22 \text{ and } 0.77)\right)$ and for ^{75}As for which those ratios are also large but very close to each other, $\mathrm{R}_1 \approx \mathrm{R}_2 \approx 1.22$. For all four nuclei mentioned the neutron yield reaction cross sections $(\gamma, \mathrm{xn}) = (\gamma, 1\mathrm{n}) + 2(\gamma, 2\mathrm{n}) + 3(\gamma, 3\mathrm{n}) + \ldots$ obtained at Saclay and Livermore are significantly different at photon energies before the threshold B2n of $(\gamma, 2n)$ reaction, where one has no multiplicity sorting problems. Using the experimental-theoretical method for evaluation of partial photoneutron reaction cross sections [2] it was shown that the main reason of such type significant differences of data is that at Livermore many neutrons from the reaction $(\gamma, 1\mathrm{n})$ were lost.

In the case of nucleus ^{51}V[3,4] it was found that additionally to unreliable sorting of many neutrons between $1\mathrm{n}, 2\mathrm{n}$ and, $3\mathrm{n}$ channels because of definite shortcoming of the method of neutron multiplicity-sorting the another reason for systematic disagreements is that the contribution of proton reaction $(\gamma, 1\mathrm{n}1\mathrm{p})$ was not taken into account.

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