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## Photonuclear reactions: results, problems and new data

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Cross sections of partial photoneutron reactions  $(\gamma, 1n)$ ,  $(\gamma, 2n)$ , and  $(\gamma, 3n)$ , as well as of total reactions  $\sigma(\gamma, sn) = \sigma(\gamma, 1n) + \sigma(\gamma, 2n) + \sigma(\gamma, 3n)$  and those of photoneutron yields  $\sigma(\gamma, xn) = \sigma(\gamma, 1n) + \sigma(\gamma, 3n)$  $2\sigma(\gamma, 2n) + 3\sigma(\gamma, 3n)$  collected in the international nuclear reaction database [1] are widely used in nuclear physics basic research to study various features of electromagnetic interactions and resulted in founding collective states in atomic nuclei, obtaining various giant resonances, first of all Giant Dipole Resonance (GDR) [2, 3]. Various characteristics of those resonances such as energy position, absolute value, integrated cross section and moments, parameters of GDR configurational and isospin splitting, and others, were determined [2, 3]. Total accuracy of those quantities is arbitrarily low because the results of different photonuclear experiments are significantly different both in shape and absolute value. Disagreements about 100 percents (in many cases larger) are known and are definitely systematic for partial reactions [4, 5]. Using digital crosssection data from the database [1] and experimental-theoretical method for evaluation partial reaction cross sections meeting objective physical criteria of reliability [5] it was shown that for about 70 nuclei from  ${}^{51}V$ to <sup>209</sup>Bi obtained using beams of quasimonoenergetic annihilation photons and bremsstrahlung many experimental cross sections under discussion are not reliable because contain significant systematic uncertainties of various types due to discrepancies in methods of neutron multiplicity identification and characteristics of  $\gamma$ -quanta sources, neutron detectors and devices for  $\gamma$ -quanta beam monitoring [4]. The data disagreements are systematized, the reasons of those are analyzed, new reliable cross sections of partial and total reactions are presented.

- 1. IAEA Nuclear Data Секция database "EXFOR. Experimental nuclear reaction data", http://www-nds.iaea.org/exfor.
- 2. B.L. Berman et al., Rev. Mod. Phys. 47, 713 (1975).
- 3. B.S. Ishkhanov et al., Interaction of electromagnetic radiation with atomic nuclei. Izdatel'stvo Moskovskogo Universiteta, Moscow, Russia. 1979.
- 4. V.V. Varlamov et al., Atom. Data and Nucl. Data Tables, 161, 101697 (2025).
- 5. V.V. Varlamov et al., Bull. Rus. Acad. Sci. Phys., 87, 1188 (2023).

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