

**PROGRESS REPORT ABOUT the PHOTO-NUCLEAR DATA EVALUATION
ACTIVITY in 1999**

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Abstract. The present work is intended to continue the evaluation of the photonuclear cross-section for the main materials what were proposed by the 2-nd CRP-Meeting on "Compilation and Evaluation of Photonuclear Data for Applications" (23-26 June 1998, LANL, Los Alamos, USA).

The general purpose of this research is to improve the theoretical methods for the calculations and the evaluations of the differential and integral photonuclear cross-sections in the wide excitation energy up to 20 MeV. On that base for the U-234, U-236, Pu-238, Pu-239, Pu-241 elements the evaluated data files were prepared. Some modifications were performed for the Th-232, U-233, U-235 and U-238 evaluated photonuclear data files.

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The quasiparticle-phonon model created for deformed nuclei was adopted for the analysis and description a photoabsorption cross-section in the excitation energy range up to 20 MeV. The statistical model was used for the analysis the experimental data about the (γ, n) , $(\gamma, 2n)$, and (γ, fiss) reactions.

On the base of the EXFOR library and information published in different journals it was compiled and analysed the experimental data concerning the U-234, U-236, Pu-238, Pu-239 and Pu-241 nuclei.

From analysis of experimental data the modern set of the parameters needed for the theoretical description the photonuclear cross-sections in a wide gamma-ray energy range was obtained and used to produce the complete evaluated data files for fissile nuclei: U-234, U-236, Pu-238, Pu-239 and Pu-241.

The preliminary version of evaluated photonuclear data files for the U-234, U-236, Pu-238, Pu-239 and Pu-241 elements was created in ENDF-6 format and presented in the IAEA Nuclear Data Section (October 1999) for the intercomparison with another similar data in the frame of the CRP-Meeting on "Compilation and Evaluation of Photonuclear Data for Applications" (LANL, June 1998). Those files include the evaluated photonuclear data sets for:

1/451 – description of file;

- 1/452 – total number of neutrons per fission;
- 1/455 – delayed neutron data;
- 1/456 – prompt neutron number per fission;
- 1/458 – energy realized in fission process;
- 2/151 – radius of nucleus only;
- 3/1 - total gamma-cross section;
- 3/2 - elastic gamma-cross section;
- 3/3 - photoabsorption c-s;
- 3/4 - photo-single neutron c-s;
- 3/16 - photo-double neutron c-s;
- 3/18 - photofission c-s;
- 3/91 - photo-single neutron c-s through continuum;
- 4/2 - angular distribution for elastic process;
- 4/16 - angular distribution for (γ , 2n) process;
- 4/18 - angular distribution for photofission process;
- 4/91 – angular distribution for (γ , 1n) process through continuum;
- 5/16 - energy distribution for (γ , 2n) process;
- 5/18 - energy distribution for photofission process;
- 5/91 – energy distribution for (γ , 1n) process through continuum;

Some modifications were performed for the Th-232, U-233, U-235 and U-238 evaluated photonuclear data files prepared in previous year. Now these files have the same content and formatted presentation as the files for mentioned above elements.

In progress we performed the evaluation for the Np-237, Am-241, Am-243, Cm-243, Cm-244 and Cm-245 elements. Up to the end of 1999 the similar presentation as above mentioned will be performed for Np-237, Am-241, Am-243, Cm-243, Cm-244 and Cm-245 elements.

The photonuclear data processing by the Njoy-system was performed for the Th-232, U-233, U-234, U-235, U-236, U-238, Pu-238, Pu-239 and Pu-241 elements. The original data were processed to “gendf” and “acer”-format presentation for future data testing. For that process some additional information was inserted to original evaluated data files.

Experiment and analysis

New experimental results concerning the measurements of photofission cross section for the Pu-238, Pu-240 and Pu-242 elements were obtained and analyzed. New set of the theoretical parameters needed for the description of photofission cross section were adopted from that analysis. The article was prepared and sent to J., YF (1999) for publication.

Cross section for production of radioisotopes

In the gamma-ray energy range up to 70 MeV the photonuclear cross section for production of radioisotopes needed for the PET task were produced using a combination of fitting of experimental data and theoretical calculations. The list of that is:

C12(γ , n), N14(γ , n), O16(γ , n), F19(γ , n), Ne-nat(γ , 2n+p), S32(γ , np), Fe54(γ , np),
Cu63(γ , n), Cu65(γ , n), Ga-nat(γ , n), Pr141(γ , n). We are going to transform these data to the endf-6 format presentation.

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For that task some data for photo-neutron production (cross section and angular-energy distribution) for the Be-9 and Ta-181 target was obtained and used in the MCNP-calculation.

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