



The CDFE 2017/2018 Progress Report on the results of photonuclear data compilation and evaluation.

V.V.Varlamov, A.I.Davydov, V.D.Kaydarova, M.E.Stepanov

Progress report to the Technical Meeting of the International Network of Nuclear Reaction Data Centres at the Global Centre for Nuclear Energy Partnership (GCNEP), Bahadurgarh, Haryana, India from 1 to 4 May 2018.

The report contains review of the Russia Lomonosov Moscow State University Skobeltsyn Institute of Nuclear Physics Centre for Photonuclear Experiments Data (Centr Dannykh Fotoyadernykh Eksperimentov - CDFE) main results for the period of time from the Technical Meeting of the International Network of Nuclear Reaction Data Centers (NRDC) at the IAEA Headquarters in Vienna, Austria, from 23 to 26 May 2017 concern new photonuclear data compilations and old data corrections, analysis and evaluation of photonuclear data obtained in various experiments and nuclear data service in the whole.

General

The main CDFE responsibility in the NRDC Network is compilation and processing of photonuclear data. The main CDFE scientific activity is joint evaluating of photonuclear data obtained in various experiments.

The CDFE total permanent staff includes now three professional, three general service officers and two students of the MSU Physics Faculty.

The CDFE maintains several nuclear databases available through the CDFE Web-site – <http://cdfe.sinp.msu.ru> for solving the main task - dissemination of international nuclear data for providing Lomonosov Moscow State University (Skobeltsyn Institute of Nuclear Physics, primarily) and scientific and educational institutes and organizations of Russian Academy of Science for basic research, education and various applications.

EXFOR Compilation

7 new CDFE EXFOR **trans.m088 – 094** TRANSEs and 1 *prelim.m095* TRANS have been produced and transmitted to the IAEA NDS.

All TRANSEs contain both **32** (37) new ENTRYs and **55** (107) *old* ENTRYs corrected with the kind help of Svetlana Dunaeva in accordance with the new EXFOR format rules and the comments and recommendations of the NRDC experts, first of all Naohiko Otsuka and Manuel Bossant.

New and old trances contents

TRANS	Old	New	Total
m088	18	4	22
m089	2	4	6
m090	2	1	3
m091	3	2	5
m092	1	14	15
m093	1	7	8
m094	28	0	28
<i>prelim.m095</i>	52	5	50
All	55 (107)	32 (37)	79 (129)

Photonuclear Data Evaluation

In addition to activity in photonuclear data compilation and the CDFE continued the program of investigation of reliability partial photoneutron reaction cross sections obtained in various experiments using specially proposed objective physical criteria of data reliability. In addition to many nuclei investigated before (for example $^{63,65}\text{Cu}$, ^{80}Se , ^{89}Y , ^{94}Zr , ^{115}In , ^{116}Sn , ^{133}Cs , ^{138}Ba , ^{141}Pr , ^{159}Tb , ^{165}Ho , ^{181}Ta , ^{186}W , ^{208}Pb , ^{209}Bi) in the frame of the IAEA Coordinated Research Project N F41032 “Updating the Photonuclear Data Library and generating a reference database for Photon Strength Functions” (Research Contract N 20501 “Evaluation of Partial and Total Photoneutron Reactions Cross Sections Using New Objective Physical Data Reliability Criteria”) 12 new nuclei were investigated (^{59}Co , $^{76,78,82}\text{Se}$, $^{90,91,92}\text{Zr}$, ^{98}Mo , $^{140,142}\text{Ce}$, ^{141}Pr , ^{153}Eu).

For all 12 nuclei using experimental-theoretical method for evaluation of reliable partial $((\gamma, 1n), (\gamma, 2n), (\gamma, 3n))$ and total photoneutron reaction $(\gamma, \text{tot}) = (\gamma, 1n) + (\gamma, 2n) + (\gamma, 3n)$ reactions cross sections were obtained.

New reliable evaluated data were prepared for including into the EXFOR database, maintained both in the Web-sites of:

- the IAEA NDS (<https://www-nds.iaea.org/exfor/exfor.htm>);
- the USA NNDC (<http://www.nndc.bnl.gov/exfor/exfor.htm>);
- the CDFE (<http://cdfe.sinp.msu.ru/exfor/index.php>).

Main Publications

The correspondent talks were presented at the 67th Meeting on Nuclear Spectroscopy and Atomic Nucleus Structure, «Nucleus 2017», 12 – 15 September 2017, Almaty, Kazakhstan.

Correspondent articles were submitted to the 68th Meeting on Nuclear Spectroscopy and Atomic Nucleus Structure), July 01-06, 2018, Voronezh, Russia and to the journals Physical Review C, European Physical Journal A, EPJ Web of Conference, Physics of Atomic Nuclei and Bulletin of the Russian Academy of Sciences, Journal of Faculty of Physics of Lomonosov Moscow State University, Memoirs of the Faculty of Physics of Lomonosov Moscow State University.

Articles published by the CDFE on all area in 2017 – 2018 are 16:

1. V. Varlamov, B. Ishkhanov, V. Orlin. Reliability of $(\gamma,1n)$, $(\gamma,2n)$, and $(\gamma,3n)$ cross-section data on ^{159}Tb . Phys. Rev. C, 95, N5 (2017) 054607.
2. V.Varlamov, B.Ishkhanov, V.Orlin. Experimental and evaluated photoneutron cross sections for ^{197}Au . Phys Rev. C 96, N4 (2017) 044606.
3. V.V.Varlamov, A.I.Davydov, B.S.Ishkhanov. Photoneutron cross sections for ^{59}Co : Systematic uncertainties of data from various experiments. Eur. Phys. J. A, 53 (2017) 180.
4. Vladimir Varlamov, Boris Ishkhanov, Vadim Orlin, Nikolai Peskov, Mikhail Stepanov. Photoneutron reaction cross sections from various experiments – analysis and evaluation using physical criteria of data reliability. EPJ Web of Conferences, 146 (2017) 05005.
5. B.S.Ishkhanov, V.N.Orlin, N.N.Peskov, V.V.Varlamov. Photoneutron reactions in the range of Giant Dipole Resonance. Physics of Particles and Nuclei, 48, N1 (2017) 76 – 83.
6. V.V.Varlamov, B.S.Ishkhanov. Modern status of photonuclear data. Physics of Atomic Nuclei, 80, N5 (2017) 957 - 967.
7. V.V.Varlamov, B.S.Ishkhanov, V.N.Orlin. Evaluated cross sections for photoneutron reactions on the isotope ^{116}Sn and spectra of neutrons originating from these reactions. Physics of Atomic Nuclei, 80, N6 (2017) 1106 – 1118.
8. V.V.Varlamov, A.I.Davydov, V.N.Orlin, N.N.Peskov. Physical criteria of the reliability of data on the photodisintegration of the ^{89}Y nucleus. Bull. Rus. Acad. Sci. Phys., 81, №6 (2017) 664 - 669.
9. V.V.Varlamov, V.N.Orlin, and N. N. Peskov. Cross sections of the photoneutron reaction for ^{141}Pr and ^{186}W nuclei, estimated from physical criteria of data reliability. Bull. Rus. Acad. Sci. Phys., 81, №6 (2017) 670 - 678.

10. V. V. Varlamov, B. S. Ishkhanov, A. A. Kuznetsov, V. N. Orlin, A. A. Prosnjakov. Influence of models of the atomic nuclei on the estimated cross sections of photoneutron reactions on ^{116}Sn . *Memoirs of the Faculty of Physics of Lomonosov Moscow State University*, N3, 2017, 173202.

11. Varlamov V.V., Barbaryan V.A., Peskov N.N. Comparison of partial photoneutron reaction cross sections reliability for $^{140,142}\text{Ce}$. Abstracts of the International Conference «Nucleus-2017» (67th Meeting on Nuclear Spectroscopy and Atomic Nucleus Structure), September 12-15, 2017, Kazakhstan, Almaty, RSE INP, p. 26 – 27.

12. Varlamov V.V., Kaydarova V.D., Peskov N.N. Evaluation of reliable partial photoneutron cross sections for ^{139}La . Abstracts of the International Conference «Nucleus-2017» (67th Meeting on Nuclear Spectroscopy and Atomic Nucleus Structure), September 12-15, 2017, Kazakhstan, Almaty, RSE INP, p. 28.

13. Varlamov V.V., Davydov A.I., Peskov N.N. New partial photoneutron reaction cross sections for ^{90}Zr in the region of GDR. Abstracts of the International Conference «Nucleus-2017» (67th Meeting on Nuclear Spectroscopy and Atomic Nucleus Structure), September 12-15, 2017, Kazakhstan, Almaty, RSE INP, p. 29.

14. Varlamov V.V., Orlin V.N., Peskov N.N. Photoneutron energy spectra from ^{181}Ta , ^{208}Pb , and ^{209}Bi , and the problem of partial photoneutron reaction cross section reliability. Abstracts of the International Conference «Nucleus-2017» (67th Meeting on Nuclear Spectroscopy and Atomic Nucleus Structure), September 12-15, 2017, Kazakhstan, Almaty, RSE INP, p. 31.

15 Varlamov V.V., Davydov A.I. New photoneutron reaction cross section data for ^{153}Eu and ^{165}Ho . Abstracts of the International Conference «Nucleus-2018» (68th Meeting on Nuclear Spectroscopy and Atomic Nucleus Structure), July 01-06, 2018, Russia, Voronezh, submitted.

16. V.V. Varlamov, A.I. Davydov, B.S. Ishkhanov, V.N.Orlin. The reliability of photoneutron cross sections for $^{90,91,92,94}\text{Zr}$. *European Physical Journal A*, submitted.

Participation in the IAEA CRP

The Research Contract N 20501 “Evaluation of Partial and Total Photoneutron Reactions Cross Sections Using New Objective Physical Data Reliability Criteria” in the frame of the Coordinated Research Project N F41032 “Updating the Photonuclear Data Library and generating a reference database for Photon Strength Functions”.

Nuclear Database Service

On the Web-site (<http://cdfe.sinp.msu.ru>) the CDFE maintains several nuclear databases produced using data funds of Nuclear Reaction Data Centres Network, USA NNDC and NSDD and those of CDFE:

- “Nuclear Reaction Database (EXFOR)”;
- “Complete Nuclear Spectroscopy Database "Relational ENSDF”;
- “Nuclear Physics Publications ("NSR" Database)”;
- “Nucleus Ground and Isomeric State Parameters” (many useful information (masses, binding energy, nucleon separation energy, decay mode, energy of various decays, etc) on the nucleus as whole and its ground and isomeric states properties);
- “Photonuclear Data Index since 1955”.

There are also three digital charts:

- “Chart of Giant Dipole Resonance Main Parameters” (energy position, amplitude, width, integrated cross section of GDR);
- “Chart of Nucleus Shape and Size Parameters” (data on quadrupole moments, parameters of quadrupole deformation and charge radii);
- “Chart of Atomic Nuclei” (main characteristics).

The very convenient “Calculator and Graph Engine for Atomic nuclei Parameters and Nuclear reactions and Radioactive Decays Features” (possibility for calculation of various parameters and characteristics of nuclei, nuclear reactions and nuclear decays).

Short-term (2018/2019) Program

The main items of CDFE (2018/2019) program, main priorities and most important tasks are traditional and the following:

- continuation of new photonuclear data compilation using EXFOR format, new TRANSES (M096, M097, etc.) production;
- correction of old ENTRIES in accordance with new EXFOR coding rule changes and the NRDC Network experts comments and recommendations;
- continuation of analysis and evaluation using objective physical criteria of total and partial photonuclear reaction cross sections obtained in various experiments;
- upgrading of all databases put upon the CDFE Web-site (<http://cdfe.sinp.msu.ru>).