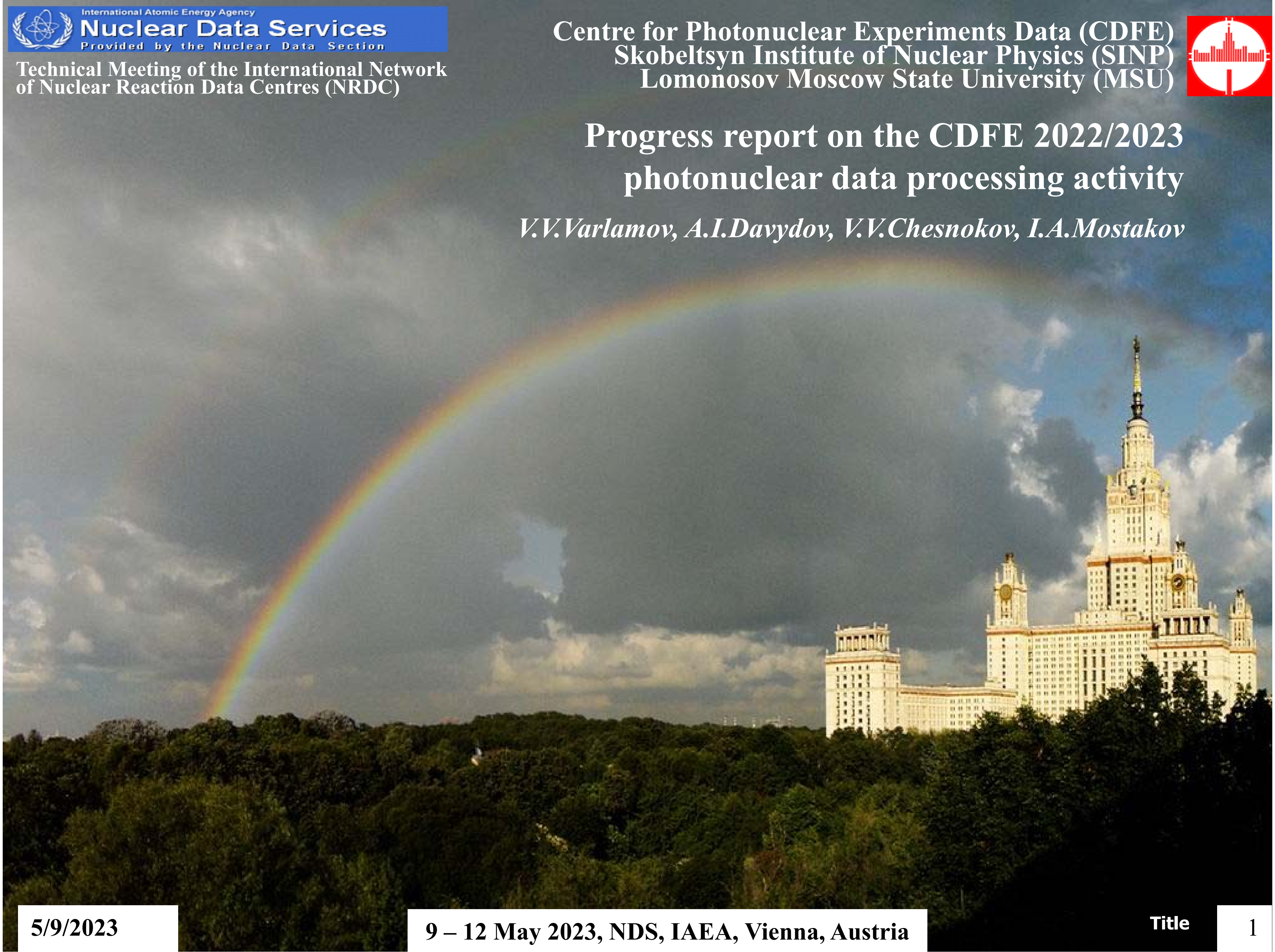
International Atomic Energy Agency
Nuclear Data Services
Provided by the Nuclear Data Section

Technical Meeting of the International Network of Nuclear Reaction Data Centres (NRDC)

Centre for Photonuclear Experiments Data (CDFE)
Skobeltsyn Institute of Nuclear Physics (SINP)
Lomonosov Moscow State University (MSU)

Progress report on the CDFE 2022/2023 photonuclear data processing activity

V.V.Varlamov, A.I.Davydov, V.V.Chesnokov, I.A.Mostakov



Progress report on the CDFE 2022/2023 photonuclear data processing activity

for the Technical Meeting of the International Network of Nuclear Reaction Data Centres (9 – 12 May 2023)

V.V.Varlamov, A.I.Davydov, V.V.Chesnokov, I.A.Mostakov

This report shortly describes the main photonuclear data activity results obtained in the Centre for Photonuclear Experiments Data (CDFE) of the Russia Lomonosov Moscow State University Skobeltsyn Institute of Nuclear Physics for the period of time from the Technical Meeting of the International Network of Nuclear Reaction Data Centres (the IAEA's Headquarters, Vienna, Austria, 14 - 17 June 2022).

The CDFE total permanent stuff:
3 professional, 1 general service officer, 1 student and 1 post graduate student of the MSU Physics Faculty.

The main CDFE fields of activity were the following:

- EXFOR compilation of new photonuclear reaction data;
- correction of old data in accordance with the comments of the NRDC experts;
- photoneutron reaction cross-section evaluations;
- nuclear database service.

Centre for Photonuclear Experiments Data (CDFE)
Skobeltsyn Institute of Nuclear Physics (SINP)
Lomonosov Moscow State University (MSU)

CDFE EXFOR Compilation

5 new CDFE EXFOR m118 – m122 TRANSes
and
2 prelim.m123 and prelim.m124
have been produced and transmitted to the IAEA NDS.

All TRANSes contain both 8 new ENTRYs and 94 old ENTRYs corrected in accordance with the new EXFOR format rules and the NRDC experts, first of all, Naohiko Otsuka and Daniela Foligno, comments and recommendations.

TRANS	*Old*	New	Total
m118	*24*	-	24
m119	*27*	-	27
m120	*21*	1	22
m121	*1*	4	5
m122	*2*	2	4
All	*75*	7	82
prelim.m123	*7*	1	8
prelim.m124	*4*	-	4
Common	*86*	8	94

The main CDFE scientific activity is analysis of reliability of cross sections obtained in various experiments and evaluation of photoneutron reaction cross sections satisfied objective physical criteria

Centre for Photonuclear Experiments Data (CDFE)
Skobeltsyn Institute of Nuclear Physics (SINP)
Lomonosov Moscow State University (MSU)

Objective physical criteria of data reliability not dependent on the methods of their obtaining.

The most interesting is F_2 – effective tool for investigation of competition between three partial photoneutron reactions under discussion - (γ, 1n), (γ, 2n) and (γ, 3n).

$$F_2 = \frac{\sigma(\gamma, 2n)}{\sigma(\gamma, 1n) + 2\sigma(\gamma, 2n) + 3\sigma(\gamma, 3n) + \ldots}$$

In accordance with definition:
$F_1 < 1.00$; $F_2 < 0.50$; $F_3 < 0.33$;
$F_4 < 0.25$, $F_5 < 0.20$ …;

Theoretically calculated in the combined model of photonuclear reactions transitional ratios

$$F_i^{theor} = \sigma^{theor}(\gamma, in)/\sigma^{theor}(\gamma, Sn)$$

are used for cross section evaluation by following way

$$\sigma^{eval}(\gamma, in) = F_i^{theor}(\gamma, in) \bullet \sigma^{exp}(\gamma, Sn).$$

The evaluation method means that competition of partial reactions is described by the model and their correspondent sum $\sigma^{eval}(\gamma, Sn)$ is equal to the experimental $\sigma^{exp}(\gamma, Sn)$ reaction cross section.

Newly evaluated photoneutron reaction cross sections

It was found that for about 50 nuclei (^{51}V, ^{63,65}Cu, ^{75}As, ^{76,78,80,82}Se, ^{89}Y, ^{90,91,92,94}Zr, ^{103}Rh, ^{116,117,118,119,120,124}Sn, ^{115}In, ^{127}I, ^{129}Xe, ^{133}Cs, ^{138}Ba, ^{139}La, ^{140,142}Ce, ^{141}Pr, ^{145,148}Nd, ^{153}Eu, ^{159}Tb, ^{160}Gd, ^{165}Ho, ^{181}Ta, ^{186}W, ^{186,188,189,190,192}Os, ^{197}Au, ^{206,207,208}Pb, ^{209}Bi, and some others) experimental cross sections more-less are not reliable.

The program of evaluation of reliable partial photoneutron reaction cross sections using the experimental-theoretical method based on objective physical criteria was continued.

New evaluations were carried out using the relevant data obtained in experiments with bremsstrahlung for ^{51}V, ^{59}Co, ^{58,60}Ni, ^{112,114,119}Sn, ^{127}I, ^{165}Ho, and ^{181}Ta. It was found out that in many cases cross sections obtained using corrections of neutron yield cross sections based on statistical model also are not reliable because of some shortcomings of such procedure.

At the same time it was found out that experimental cross sections obtained for ^{159}Tb and ^{197}Au using beams of laser Compton backscattering photons and the flat efficiency detector are satisfied physical criteria of reliability.

2022/2023 Main Publications
(Eur.Phys.J., Phys.Atom.Nucl., Bull.Rus.Acad.Sci., MSU Phys.Bull.)

1. V.V.Varlamov, A.I.Davydov. Experimental and evaluated data on photodisintegration of ^{197}Au. Physics of Atomic Nuclei, 85, N1 (2022) 1 - 11.

2. V.V.Varlamov, A.I.Davydov, V.N.Orlin. Reliability of photonuclear experiments results for ^{58}Ni. Physics of Atomic Nuclei, 85, N4 (2022) 316 - 327.

3. V.V.Varlamov, A.I.Davydov, V.N.Orlin. New evaluated data on photonuclear reactions cross sections for ^{60}Ni. Physics of Atomic Nuclei, 85, N5 (2022) 411 - 424.

4. V.V.Varlamov, A.I.Davydov, V.N.Orlin. The specific features of photoneutron reactions on ^{58}Ni. Eur. Phys. J. A 58 (2022) 123 (10 pages).

5. V.V.Varlamov, A.I.Davydov. Reliability of ^{159}Tb partial photoneutron reaction cross sections obtained in various experiments. Physics of Atomic Nuclei, 85, N6 (2023) 361 - 371.

6. V.V.Varlamov, A.I.Davydov, V.N.Orlin. Similarity and distinctions of ^{58,60}Ni photodisintegration processes. Bull. Rus. Acad. Sci. Phys. (2023), in print.

7. V.V.Varlamov, A.I.Davydov, V.N.Orlin. Partial photoneutron reaction cross sections in experiments with bremsstrahlung. Bull. Rus. Acad. Sci. Phys. (2023), *in print*.

8. V.V.Varlamov, A.I.Davydov, I.A.Mostakov, V.N.Orlin. Cross sections of partial photoneutron reactions on ^{59}Co in experiments with bremsstrahlung. Physics of Atomic Nuclei, (2023), *in print*.

9. V.V.Varlamov, A I.Davydov, V.N Orlin. Status of the results of photonuclear experiments. Moscow University Physics Bulletin. Physics and Astronomy, № 3 (2023), *in print*.

10. A.I. Davydov1, V.V. Varlamov, V.N. Orlin. Cross sections of partial photoneutron reactions: the problems with reliability and new data. Moscow University Physics Bulletin. Physics and Astronomy, № 3 (2023), *in print*.

Short-term (2023/2024) CDFE Program

The main items of CDFE (2023/2024) program, main priorities and most important tasks are traditional and the following:

- continuation of new photonuclear data compilation using EXFOR format, production of new TRANSes (M125, M126, etc.);

- correction of old ENTRYs in accordance with new EXFOR coding rule changes and the NRDC Network experts's comments and recommendations;

- continuation of analysis and evaluation using objective physical criteria of total and partial photonuclear reaction cross sections obtained in various experiments, carried out using different sources of photons (quasimonoenergetic annihilation photons, laser Compton backscattering photons, bremsstrahlung photons).

Centre for Photonuclear Experiments Data (CDFE)
Skobeltsyn Institute of Nuclear Physics (SINP)
Lomonosov Moscow State University (MSU)

THANKS A LOT
FOR ATTENTION!