



## Summary of the CDFE nuclear data activity for 2011 – 2012 period of time

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*Progress Report to the IAEA Meeting  
of the International Network of Nuclear Reaction Data Centres (NRDC)  
16 – 19 April 2021, OECD/NEA Headquarters, Issy-les-Moulineaux, France*

This report contains the short review of the main fields of nuclear data activity of the Centre for Photonuclear Experiments Data (Centr Dannykh Fotoyadernykh Eksperimentov – CDFE) of Skobeltsyn Institute of Nuclear Physics of Lomonosov Moscow State University and main results obtained. All works were carried out in close co-operation with the Nuclear Science Section in the frame of the IAEA Nuclear Reaction Data Centres Network for the period of time from the IAEA Technical Meeting on the International Network of Nuclear Reaction Data Centers” (23 – 24 May 2011, IAEA, Vienna, Austria) till the spring of 2012.

### *General*

The CDFE provides scientific and educational institutes and for organization of Russian Academy of Science with nuclear reaction and nuclear spectroscopy data for basic research and various applications. CDFE services include the compilation, verification, and dissemination of modern reliable and authentic nuclear data. CDFE maintains several relational databases some of which were produced using the international data funds and another – CDFE own sources of information. All of those databases are available through the CDFE Web-site – <http://cdfe.sinp.msu.ru>.

### *Organization*

The CDFE has a status of Nuclear Data Analysis Laboratory within the Skobeltsyn Institute of Nuclear Physics of the Lomonosov Moscow State University. The total permanent staff includes the Centre head (Vladimir Varlamov), 5 professional (Igor Boboshin, Sergei Komarov, Nikolay Peskov, Mikhail Stepanov, Valery Viazovsky) and 2 general service officers. Because the CDFE exists inside Moscow University there are 3 – 4 students per year participating in nuclear data activity.

### *EXFOR Compilations*

Five new CDFE EXFOR transes **TRANS.M058 - 062** have been produced and transmitted to the IAEA NDS. All TRANSes contain both new and old corrected entries but the **TRANS.M061** was fully devoted to the correction of area M entries in accordance with

the NRDC Network experts comments and recommendations (WP21011-16, 26 of previous technical meeting). On the whole CDFE trances have been produced in the reported period 2011/2012 contain (Annex) *67 retransmitted ENTRYs (291 SUBENTs)* and **31 new ENTRYs (193 SUBENTs)**.

### ***Photonuclear Data Evaluations***

The investigations of reliability and authenticity of data for partial photonuclear reaction cross sections were continued. Using new simple objective and absolute criteria – transitional multiplicity functions  $F_i = \sigma(\gamma, in)/\sigma(\gamma, xn)$  which have definite absolute value upper limits 1.0 for  $i = 1$ , 0.5 for  $i = 2$ , 0.33 for  $i = 3$ , etc. that was shown that majority of partial cross section data obtained at Livermore (USA) and Saclay (France) are not reliable and authentic. In the frame of proposed method for partial reaction cross section evaluation new reliable and authentic data were obtained for  $^{90}\text{Zr}$ ,  $^{159}\text{Tb}$ ,  $^{165}\text{Ho}$ ,  $^{181}\text{Ta}$ ,  $^{208}\text{Pb}$  additionally to data obtained before for  $^{63}\text{Cu}$ ,  $^{89}\text{Y}$ ,  $^{115}\text{In}$ ,  $^{112,114,116,117,118,119,120,122,124}\text{Sn}$ ,  $^{197}\text{Au}$ . For all nuclei mentioned above and for reactions  $(\gamma, n)$ ,  $(\gamma, 2n)$ ,  $(\gamma, 3n)$  and  $(\gamma, sn) = (\gamma, n) + (\gamma, 2n) + (\gamma, 3n)$  (is very important for estimation of  $(\gamma, \text{abs})$  – main reaction for Giant Dipole Resonance - main features were evaluated.

### ***Nuclear Structure Data Evaluations***

The CDFE program of nuclear structure data evaluation was continued. Using previously developed method of joint analysis and evaluation of data on nucleon stripping and pick-up nuclear reactions new evaluated data for energies and nucleon occupation numbers were obtained both for proton and neutron subshells of 11 even-even nickel isotopes  $^{48-68}\text{Ni}$ . Data were analyzed in the frame of dispersive optical model. That was shown that systematics obtained helps to one foretell reliable single-particle energies of unstable nuclei inside the isotopic chain.

### ***Nuclear Database Service***

Some of the CDFE DB that are available through the CDFE Web-site (<http://cdfe.sinp.msu.ru>) were based on the international sources and founds of data produced and maintained by Nuclear Reaction Data Centres Network and by USA NNDC and NSDD:  
- “Nuclear Reaction Database (EXFOR)”: many data for reactions induced by photons, neutrons, charge particles and heavy ions;

- “Complete Nuclear Spectroscopy Database "Relational ENSDF" contains many nuclear spectroscopy data for all known (~3200) nuclides from the well-known international fund ENSDF (Evaluated Nuclear Structure Data File);
- “Nuclear Physics Publications ("NSR" Database)” is the really relational DB based on the data fund of NSR (Nuclear Science References).

Those databases used international sources of information but CDFE-developed powerful and flexible original Search Engines.

Other databases are CDFE-produced and maintained:

- digital “Chart of Giant Dipole Resonance Main Parameters” contains data on main parameters (energy position, amplitude, width, integrated cross section) of GDR for many nuclei;
- digital “Chart of Nucleus Shape and Size Parameters” contains data on quadrupole moments, parameters of quadrupole deformation and charge radii for many nuclei;
- “Nucleus Ground and Isomeric State Parameters” combines many useful information on the nucleus as whole and its ground and isomeric states properties (masses, binding energy, nucleon separation energy, decay mode, energy of various decays, etc);
- “Calculator and Graph Engine for Atomic nuclei Parameters and Nuclear reactions and Radioactive Decays Features” gives to one possibility for convenient calculation of: i) nucleus binding energy, ii) nucleon and nucleus separation energy, iii) decay energy, iv) reaction threshold and energy, v) nucleus fission parameters.

### ***Short-term (2012/2013) Program***

The main items of CDFE (2012/2013) program, main priorities and most important tasks are traditional and the following:

- continuation of photonuclear data compilation using EXFOR format, new TRANSES (M062, M063, etc.) production;
- correction of old ENTRIES in accordance with EXFOR coding rule changes and the NRDC Network experts comments and recommendations;
- continuation of joint analysis and evaluation of total and partial photonuclear reaction cross sections obtained using various methods in experiments with quasimonoeenergetic annihilation and bremsstrahlung photons;
- upgrading (corrections and additions) of all databases put upon the CDFE Web-site (<http://cdfe.sinp.msu.ru>).

## Annex.

The contents of new 2011/2012 CDFE's EXFOR transees  
(new and old corrected ENTRYs and SUBENTs)

| TRANS.M058   |                      | TRANS.M059          |                       | TRANS.M060          |                      | TRANS.M061          |                     | TRANS.M062          |                     |
|--|----------------------|---------------------|-----------------------|---------------------|----------------------|---------------------|---------------------|---------------------|---------------------|
| ENT N  | SUB N                | ENT N               | SUB N                 | ENT N               | SUB N                | ENT N               | SUB N               | ENT N               | SUB N               |
| M0186  | 11                   | M0036               | 11                    | M0198               | 2                    | M0073               | 13                  | M0501               | 5                   |
| M0203  | 1                    | M0076               | 2                     | M0258               | 2                    | M0134               | 3                   | M0832               | 5                   |
| M0280  | 1                    | M0081               | 8                     | M0473               | 6                    | M0173               | 2                   | M0833               | 4                   |
| M0306  | 1                    | M0082               | 4                     | M0817               | 1                    | M0377               | 12                  | M0835               | 6                   |
| M0310  | 1                    | M0087               | 12                    | M0822               | 2                    | M0384               | 2                   | M0835               | 2                   |
| M0811  | 11                   | M0089               | 4                     | M0823               | 9                    | M0501               | 5                   | M0836               | 9                   |
| M0812  | 4                    | M0172               | 3                     | M0824               | 3                    | M0535               | 2                   | M0837               | 2                   |
| M0813  | 2                    | M0177               | 5                     | M0825               | 14                   | M0555               | 1                   | M0838               | 5                   |
|  |                      | M0178               | 13                    | M0826               | 3                    | M0557               | 13                  | M0839               | 6                   |
|  |                      | M0186               | 11                    | M0827               | 11                   | M0589               | 3                   | M0840               | 5                   |
|  |                      | M0198               | 8                     | M0828               | 2                    | M0680               | 1                   | M0841               | 4                   |
|  |                      | M0199               | 2                     | M0829               | 3                    | M0711               | 1                   | M0842               | 18                  |
|  |                      | M0201               | 13                    | M0830               | 3                    | M0721               | 1                   |                     |                     |
|  |                      | M0202               | 3                     | M0831               | 5                    | M0737               | 2                   |                     |                     |
|  |                      | M0295               | 15                    |                     |                      | M0762               | 1                   |                     |                     |
|  |                      | M0296               | 3                     |                     |                      | M0764               | 1                   |                     |                     |
|  |                      | M0297               | 6                     |                     |                      | M0765               | 1                   |                     |                     |
|  |                      | M0298               | 8                     |                     |                      | M0771               | 1                   |                     |                     |
|  |                      | M0299               | 6                     |                     |                      | M0774               | 2                   |                     |                     |
|  |                      | M0479               | 2                     |                     |                      | M0775               | 1                   |                     |                     |
|  |                      | M0529               | 2                     |                     |                      | M0777               | 1                   |                     |                     |
|  |                      | M0539               | 11                    |                     |                      | M0778               | 1                   |                     |                     |
|  |                      | M0619               | 13                    |                     |                      | M0779               | 1                   |                     |                     |
|  |                      | M0749               | 2                     |                     |                      | M0787               | 1                   |                     |                     |
|  |                      | M0803               | 2                     |                     |                      | M0795               | 2                   |                     |                     |
|  |                      | M0804               | 1                     |                     |                      | M0811               | 1                   |                     |                     |
|  |                      | M0807               | 2                     |                     |                      |                     |                     |                     |                     |
|  |                      | M0814               | 5                     |                     |                      |                     |                     |                     |                     |
|  |                      | M0815               | 11                    |                     |                      |                     |                     |                     |                     |
|  |                      | M0816               | 16                    |                     |                      |                     |                     |                     |                     |
|  |                      | M0817               | 25                    |                     |                      |                     |                     |                     |                     |
|  |                      | M0818               | 2                     |                     |                      |                     |                     |                     |                     |
|  |                      | M0819               | 2                     |                     |                      |                     |                     |                     |                     |
|  |                      | M0820               | 3                     |                     |                      |                     |                     |                     |                     |
|  |                      | M0821               | 5                     |                     |                      |                     |                     |                     |                     |
| Total  |                      |                     |                       |                     |                      |                     |                     |                     |                     |
| New: 3<br>corr.: 5   | New: 17<br>corr.: 15 | New: 9<br>corr.: 26 | New: 71<br>corr.: 170 | New: 10<br>corr.: 4 | New: 55<br>corr.: 11 | New: 0<br>corr.: 26 | New: 0<br>corr.: 75 | New: 11<br>corr.: 1 | New: 65<br>corr.: 5 |
| <b>Total numbers of: new ENTRYs: 33</b><br><b>new SUBENTs: 208</b><br><i>retransmitted ENTRYs: 67</i><br><i>retransmitted SUBENTs: 291</i> |                      |                     |                       |                     |                      |                     |                     |                     |                     |