

IAEA Nuclear Data Section: Progress Report, 2008/09
Summary of Nuclear Data Studies by Staff of the IAEA Nuclear Data Section
1 October 2008 – 10 May 2009

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1. Staff

The authorized staff level of the Nuclear Data Section consists of a total of 17 professionals and support staff. Alan Nichols retired and Robin Forrest - new Section Head will come in July 2009.

2. Data Compilations

2.1 EXFOR and Dictionaries

Over the previous year, NDS staff have distributed 5 CPND TRANS files (D063 - D067) containing 110 new entries (78 compiled at NDS, 20 at ATOMKI, 10 at UkrNDC and 2 in India) and 46 revised entries, 8 neutron TRANS files (3130 - 3137) containing 44 new entries (32 compiled at NDS, 6 at UkrNDC, 2 entries in KAERI and 4 in India) and 431 revised entries, 1 PhND TRANS files (G018), containing 12 new entries (all compiled at UkrNDC) and 1 revised entry. The compilations consist of new literature as well as many important old references. Also, four topics (mostly lists of "old" papers) are still monitored for completeness of compilation:

1. Ion Beam Analysis,
2. Reference Input Parameter Library (RIPL),
3. Medical CRP,
4. PR/C neutron studies.

KAERI Nuclear Data Evaluation Group (KAERI-NDEL) started EXFOR compilation for neutron, charged-particle and photon induced reaction data measured in Korea on a trial basis. So far two neutron entries (31666 and 31668) have been finalized.

As of 15 May 2009, 59 TRANS files were received, checked (with feedback to the originating centres) and processed, of which 57 were final versions that were added to the master file. These final transmissions contained 582 neutron entries (89 new, 493 revised), 501 CPND entries (329 new, 172 revised) and 33 photonuclear entries (13 new, 20 revised).

NDS staff have produced and distributed two regular transmissions of the EXFOR/CINDA dictionaries (TRANS.9098-9099) in EXFOR, DANIEL (backup) and archive format.

Three lists of compilation mistakes have been updated:

- Mistakes in contents: http://www-nds.iaea.org/nrdc/exfor_err.html ;
- Mistakes in formats: http://www-nds.iaea.org/nrdc/exfor_err2.html ;
- Feedback from WPEC SG-30: http://www-nds.iaea.org/nrdc/exfor_err3.htm .

The correction process of the mistake is being monitored by NDS staff.

Almost all corrections have been finished for the 3rd list (except 6 subentries from area 1)

2.2 CINDA

CINDA Master file

The up-to-date CINDA Master File is available via the NDS compilers' Web site. An automatic update using the EXFOR database has been carried out twice (November 2008, April 2009). A Sybase-dump of the complete CINDA database was sent to NNDC. A few new CINDA lines have been prepared manually for new non-EXFOR experimental studies. Corrections to CINDA lines have also been carried out according to various feedback from users (http://www-nds.iaea.org/nrdc/cinda_err.html).

Coverage control

Under the CINDA coverage control system, NDS staff scan over 80 journal titles (mainly through the Internet) for the purpose of compilation coverage control. The current status of these compilation activities has been made available to EXFOR compilers on the NDS Web site during the course of this year.

Over 350 journal issues from 1990 to 2009 were added to the database for CINDA coverage control in late 2008/2009. Journal references that should be compiled elsewhere were also dispatched to the relevant centres (Japan, Russia, Hungary and NEADB).

All references absent from EXFOR were sent to the responsible centres for compilation, along with pdf copies of the papers, if necessary.

Other EXFOR database statistics are also available from the NDS Web site:

- contributions to EXFOR according to individual centres,
- history (Preliminary, TRANS files, database updates),
- general statistics (contents by Quantities, Targets, Reactions, etc.).

NDS continues to save articles in pdf format. Articles stored previously on the shelf at NDS are now held in electronic form. All articles compiled during this year in the other centres have been scanned and stored in pdf-format by NDS. More than 900 files were saved in pdf-format during the year.

2.3 Evaluated data libraries, files and programs

Various new or revised evaluated data libraries, files and programs for data checking, processing and graphical presentation were added to the NDS Web site and distributed on CD-ROM (see below).

- EXFOR - CINDA Database and Retrieval System, data updated April 2009 (CD-ROM);
- ENDVER/GUI and EXFOR-CINDA package; Integrated Tools for ENDF-Evaluators, reproduced at April 2009.

3. Services

Web Services

Further improvements have been implemented in the Web EXFOR-CINDA-ENDF retrieval systems since the previous NRDC meeting:

- ENDF:
 - Plotting production cross section coded via MF6/MF5/sub-sections in Web
 - new evaluated libraries included in the ENDF database:
 - TENDL-2008 TALYS-based Evaluated Nuclear Data Library [page]
 - FENDL-2.1 Fusion Evaluated Nuclear Data Library, 2004
 - JEFF3.1.1 Radiative Decay Data Sub-Library, 2007
- EXFOR:
 - Advanced plot: ratios, ratios converted to cross sections using IAEA-2006 Standards
 - Dynamic request page combining Standard, Extended and Advanced requests in one page
 - Prompt-Help system
 - Extensions on Selection-page and EXFOR+: search by Author, Reaction, ENTRY
 - Search by full Reaction-code and Trans-ID
 - New Web output format X4± presenting EXFOR file as an interpreted interactive tree
 - New tools for EXFOR compilers: uploading EXFOR file and comparison with existing data in EXFOR database (includes plotting with other data and previous version of the same Entry)
- Video guide for EXFOR-ENDF

The system is functioning at NNDC, BARC (India) and IPEN (Brazil). Statistics for usage of the Web retrieval system are presented in Fig. 1.

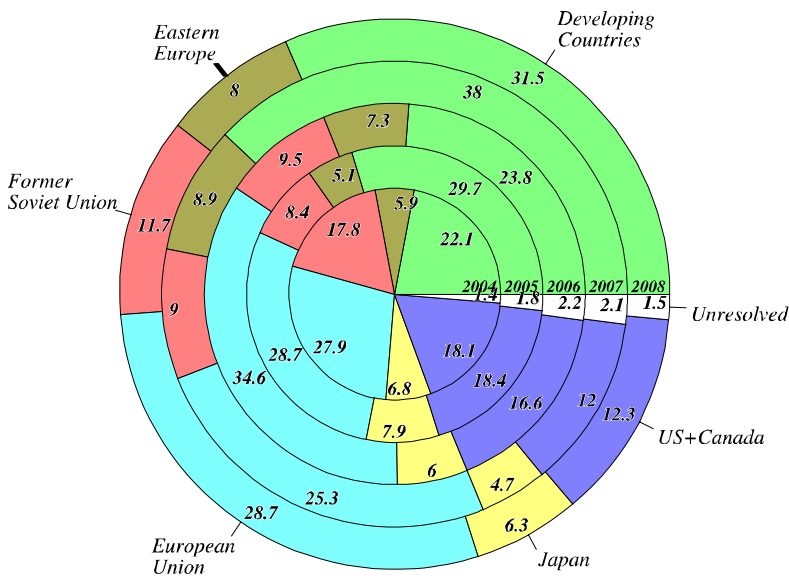
CD-ROMs

- “EXFOR/CINDA for Windows” CD issued twice;
- “EXFOR/CINDA for Applications” for Linux, Windows and Macintosh (MacOSX) issued twice; also distributed together as part of EndVer/GUI-CD and Empire-package.

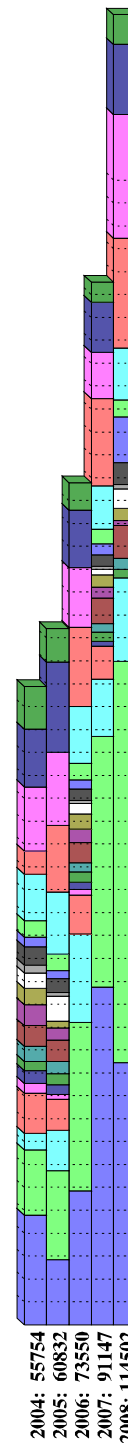
NDS+IPEN+BARC

Nuclear Data Services: Web Statistics

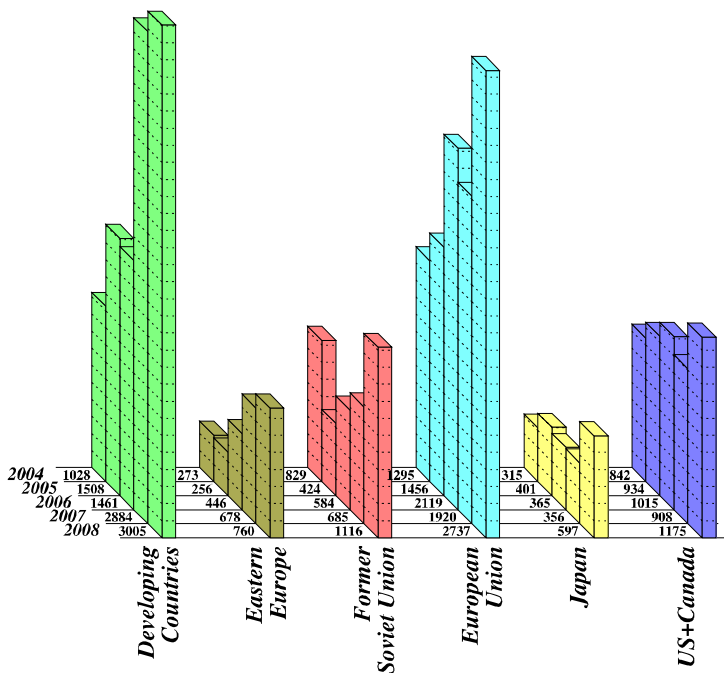
Geographical Distribution (%)



Total per Year
(Number of accesses + retrievals)



Average per Month
(Number of accesses + retrievals)



- | Service | Comment |
|-----------------------|--------------|
| Computer Codes | |
| Documents | |
| OtherData | |
| IBANDL | |
| PGAA | |
| PhotoNuclear | |
| RIPL | Theory |
| FENDL | Fusion |
| Masses | |
| IRDF | Dosimetry |
| Thermal Capture | |
| Wallet Cards | |
| Med.Radio.Prod. | |
| NGAtlas | Activation |
| RNAL | |
| ENSDF | Structure |
| MIRD | Medical |
| NUDAT | |
| CINDA+NSRBibliography | |
| EXFOR | Experimental |
| ENDF | Energy |

4. Software

CINDA software

A new version of the program to import information from the ENDF database has been discussed, improved and checked with Henriksson (NEA- Data Bank).

EXFOR software

New EXFOR Java tools (basic classes) were created. On the basis of this tool, several new pilot programs were created: production of new output formats (X4±, XML, X4Tab), new checking code. Some of these programs are already used in EXFOR Web interface.

Full EXFOR in C4 format

Full C4/X4 files were regularly produced and released (three times).

Flexible ENDF database explorer

Implements a sequential search/scan/view the data; allows the user to select the sequence of data observation “on the fly” and provides additional convenient service. Public release at the end of 2008.

5. Nuclear Data Developments

Although direct nuclear data developments are outside the immediate operations of the NRDC, we give a brief summary below.

Co-ordinated Research Projects (CRPs):

- *Reference Database for Ion Beam Analysis*: on-going.
- *Updated Decay Data Library for Actinides*: on-going.
- *Reference Database for Neutron Activation Analysis*: on-going.
- *Heavy Charged-Particle Interaction Data for Radiotherapy*: on-going.
- *Minor Actinide Neutron Reaction Data (MANREAD)*: on-going.
- *Nuclear Data Library for Advanced Systems – Fusion Devices (FENDL-3)*: on-going.

6. Publications

6.1 Journals

Measurement of the stellar cross sections for the reactions ${}^9\text{Be}(n,\gamma){}^{10}\text{Be}$ and ${}^{13}\text{C}(n,\gamma){}^{14}\text{C}$ via AMS

by A. Wallner, A. Mengoni *et al.*,
J. Phys. G: Nucl. Part. Phys. **35** (2008) 014018.164.

Exploring the reactor heat problem: Study of the beta decay of ${}^{104,105}\text{Tc}$ using the TAS technique

by A. Algara, J.L. Tain, B. Rubio, A.L. Nichols, *et al.*,
Eur. Phys. J. Special Topics **150** (2007) 383-384.

Production of ${}^{230}\text{U}/{}^{226}\text{Th}$ for Targeted Alpha therapy via Proton Irradiation of ${}^{231}\text{Pa}$

by A. Morgenstern, O. Lebeda, J. Stursa, F. Bruchertseifer, R. Capote, J. McGinley, G. Rasmussen, M. Sin, B. Zielinska and C. Apostolidis,
Anal. Chem. **80** (2008) 8763-8770.

Development of Covariance Capabilities in EMPIRE Code

by M. Herman, M.T. Pigni, P. Oblozinsky, S.F. Mughabghab, C.M. Mattoon, R. Capote, Young-Sik Cho and A. Trkov,
Nucl. Data Sheets **109** (12) (2008) 2752 – 2761.

An Investigation of the Performance of the Unified Monte Carlo Method of Neutron Cross Section Data Evaluation

by R. Capote and D.L. Smith,
Nucl. Data Sheets **109** (12) (2008) 2768 – 2773.

Covariances of Prompt Fission Neutron Spectra

by I. Kodeli, R. Capote and A. Trkov,
Nucl. Data Sheets **109** (12) (2008) 2840 – 2845.

Evaluation of Tungsten Nuclear Reaction Data with Covariances

by A. Trkov, R. Capote, I. Kodeli, L. Leal,
Nucl. Data Sheets **109** (12) (2008) 2905 – 2909.

A new formalism for reference dosimetry of small and nonstandard fields

by R. Alfonso, P. Andreo, R. Capote, M. Saiful Huq, W. Kilby, P. Kjall, T.R Mackie, H. Palmans, K. Rosser, J. Seuntjens, W. Ullrich and S. Vatnitsky,
Med Phys. **35** (11) (November 2008) 5179 – 5186.

Experimental study of the ${}^{91}\text{Zr}(n,\gamma)$ reaction up to 26 keV

by G. Tagliente, R. Capote, A. Mengoni, *et al.*,
Phys. Rev. **C78** (2008) 045804.

The measurement of the ${}^{206}\text{Pb}(n,\gamma)$ cross section and stellar implications

by C Domingo-Pardo, R Capote, A Mengoni, *et al.*,
J. Phys. G: Nucl. Part. Phys. **35** (2008) 014020.

Neutron capture cross section of ^{14}C of astrophysical interest studied by Coulomb breakup of ^{15}C

by T. Nakamura, N. Fukuda, N. Aoi, N. Imai, M. Ishihara, H. Iwasaki, T. Kobayashi, T. Kubo, A. Mengoni, T. Motobayashi, M. Notani, H. Otsu, H. Sakurai, S. Shimoura, T. Teranishi, Y.X. Watanabe and K. Yoneda
Phys. Rev. C79 (2009) 035805.

Covariance analyses of self-shielding factor and its temperature gradient for Uranium-238 neutron capture reaction

by N. Otuka, A. Zukeran, H. Takano, G. Chiba, M. Ishikawa,
J. Nucl. Sci. Technol. 45 (2008) 195.

JENDL Actinoid File 2008 and Plan of Covariance Evaluation

by O. Iwamoto, T. Nakagawa, N. Otuka, S. Chiba, K. Okumura,
Nucl. Data Sheets 109 (2008) 2885.

JENDL Actinoid File 2008

by O. Iwamoto, T. Nakagawa, N. Otuka, S. Chiba, K. Okumura, G. Chiba, T. Ohsawa, K. Furutaka,
J. Nucl. Sci. Technol. 46 (2009) 510-528

Nuclear Data Sheets for A=96

by D. Abriola and A.A. Sonzogni,
Nucl. Data Sheets 109 (2008) 2501 – 2655.

Towards a prediction of fission cross sections on the basis of microscopic nuclear inputs

By S. Goriely, S. Hilaire, A.J. Koning, M. Sin and R. Capote
Phys. Rev. C79 (2009) 024612.

Deformation-dependent Tamura-Udagawa-Lenske multistep direct model

By H. Wienke, R. Capote, M. Herman and M. Sin
Phys. Rev. C78 (2008) 064611.

An investigation of the performance of the unified Monte Carlo method of neutron cross section data evaluation

By R. Capote and D.L. Smith
Nucl. Data Sheets 109 (2008) 2768 – 2773

6.2 Conference Presentations and Proceedings

**Applications of the total absorption technique to reactor decay heat calculations:
Study of the beta decay of $^{102,104,105}\text{Tc}$**

by A. Algora, D. Jordan, J.L. Tain, B. Rubio, J. Agramunt, A.B. Perez-Cerdan, L. Caballero, E. Nácher, A. Krasznahorkay, M.D. Hunyadi, J. Gulyás, A. Vitéz, M. Czatlós, L. Csige, J. Äystö, H. Penttilä, S. Rinta-Antila, I. Moore, T. Eronen, A. Jokinen, A. Nieminen, J. Hakala, P. Karvonen, A. Kankainen, U. Hager, T. Sonoda, A. Saastamoinen, J. Rissanen, T. Kessler, C. Weber, J. Ronkainen, S. Rahaman, V. Elomaa, K. Burkard, W. Hüller, L. Batist, W. Gelletly, T. Yoshida, A.L. Nichols, A. Sonzogni and K. Peräjärvi (invited)

paper), presented at 13th International Symposium on Capture Gamma-ray Spectroscopy and Related Topics (CGS-13), 25 – 29 August 2008, Cologne, Germany; Proc. 13th Int. Symp. Capture Gamma-ray Spectroscopy and Related Topics, J. Jolie, A. Zilges, N. Warr and A. Blazhev (Eds), AIP Conference Proceedings Vol. 1090 (2009) pp. 207-214, American Institute of Physics, Melville, New York, ISBN 978-0-7354-0623-0.

Maintaining the quality and credibility of a large nuclear database through extended multinational initiatives

by A.L. Nichols, S. Dunaeva, A. Trkov and V. Zerkin, **to be published** in proceedings of 2nd International Conference, Current Problems in Nuclear Physics and Atomic Energy (NPAE-Kyiv2008), 9 – 15 June 2009, Kiev, Ukraine.

Nuclear Data Activities at the International Atomic Energy Agency

by M.A. Kellett, published in book prepared for 50th Anniversary of the Karlsruhe Nuclide Chart, pp. 214-220, European Commission JRC Report, Eds: G. Pfennig, C. Normand, J. Magill, Th. Fanghänel, EUR 23420 EN - 2008.

Measurements of fission cross-sections of actinides at n_TOF

by N. Colonna, A. Mengoni, *et al.*, published in proceedings CANDIDE workshop, 16-18 October 2007, NEMEA-4 Conference: Neutron Measurements, Evaluations and Applications, Nuclear data needs for Generation –IV and accelerator driven systems, 65 – 70, Ed: A. Plompen, EUR 23235 EN – 2008.

Nuclear Structure activities at the IAEA-NDS

by D. Abriola,
Poster presentation at Nuclear Structure Conference 2008, East Lansing, Michigan, USA, 3 – 6 June 2008.

Evaluation of tungsten isotopes in the fast neutron range including cross section covariance estimation

By R. Capote, A. Trkov, I. Kodeli, E. Soukhovitskii, L.C. Leal, M. Herman and D.W. Muir, in proceedings of Int. Conference on Nuclear Data for Science and Technology (ND 2007), Nice, France, Apr. 22-27, 2007. Les Ulis Cedex A, France, EDP Science, 2008, p.689-692.

New cross section measurements for neutron-induced reactions on Cr, Ni, Cu, Ta and W isotopes obtained with the activation technique,

By V. Semkova, R. Capote, R. Jaime Tornin, A.J. Koning, A. Moens and A.J.M. Plompen in proceedings of Int. Conference on Nuclear Data for Science and Technology (ND 2007), Nice, France, Apr. 22-27, 2007. Les Ulis Cedex A, France, EDP Science, 2008, p.559-562.

7. Workshops 2008/2009

- Workshop on A&M Data for Fusion Applications, ICTP Trieste, Italy, 20 to 30 April 2009, IAEA Workshop Director: R.E.H. Clark.

8. Visits and Inter-centre Cooperation

- V. Zerkin and N. Otsuka (IAEA/NDS) to JCPRG, Hokkaido University, Japan, 14-30 March 2009: Utilization of EXFOR.