

# IAEA Nuclear Data Section 50<sup>th</sup> Anniversary

## 50 Years of Achievement

.... and some personal observations  
extended version

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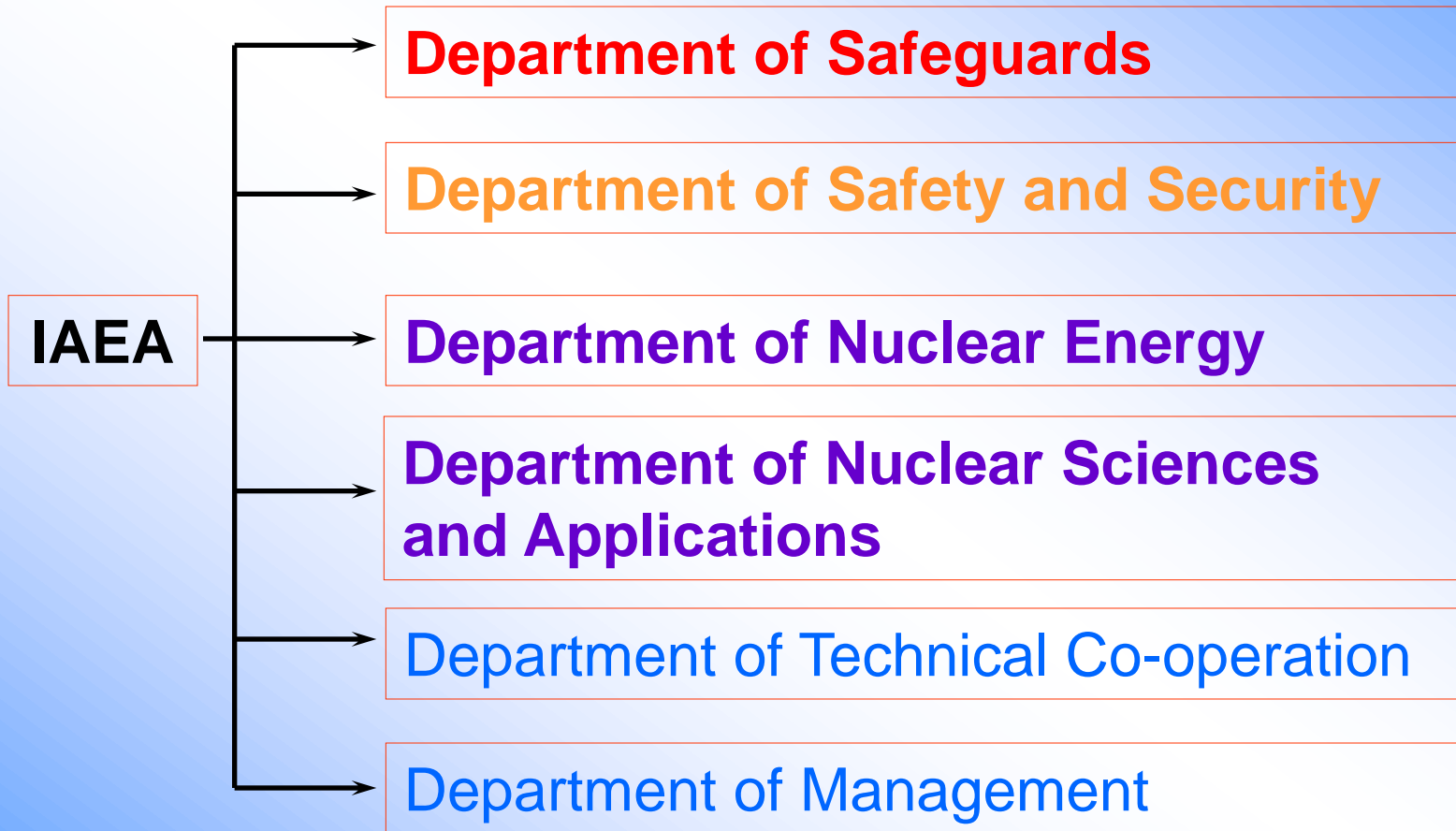
# International Atomic Energy Agency (IAEA)

## Addressing Humanitarian Concerns

### Mission Statement:

- an independent intergovernmental, science and technology-based organization, in the United Nations family, that serves as the global focal point for nuclear cooperation
- assist Member States, in the context of social and economic goals, in **planning for and using nuclear science and technology for various peaceful purposes, including the generation of electricity, and facilitate the transfer of such technology and knowledge in a sustainable manner to developing Member States**
- develop nuclear safety standards and, based on these standards, **promote the achievement and maintenance of high levels of safety in applications of nuclear energy, as well as the protection of human health and the environment against ionizing radiation**
- verify through its inspection system that States comply with their commitments, under the Non-Proliferation Treaty and other non-proliferation agreements, to use nuclear material and facilities only for peaceful purposes

# International Atomic Energy Agency



# **Nuclear Data Section: major programme links**

## **Major Programme 1**

### **Nuclear Science and Technology:**

- **Nuclear Data and Physics**

## **Major Programme 2**

### **Nuclear Techniques for Development and Environmental Protection:**

- Food and Agriculture
- Human Health
- Water Resources
- Protection of the Marine and Terrestrial Environments
- **Physical and Chemical Applications**

# Department of Nuclear Energy

## Department of Nuclear Sciences and Applications

### Division of Physical and Chemical Sciences

## Nuclear Data Section

#### Department of Nuclear Energy

Foster **the efficient and safe use of nuclear power** by supporting existing and new nuclear programmes around the world, **catalysing innovation** and **building indigenous capability in energy planning, analysis, and nuclear information and knowledge**

#### Department of Nuclear Sciences and Applications

Contribute to sustainable development in Member States by the use of nuclear sciences and their applications in food and agriculture, **human health, industry,** water resource management and **environmental monitoring and protection**

Food and Agriculture

Human Health

Programme of Action for  
Cancer Therapy - PACT

Environment

Water Resources

Radioisotope Production  
and Radiation Technology

Nuclear Science

# Nuclear Sciences and Applications

## Division of Physical and Chemical Sciences

Nuclear technologies contribute in many ways to the health, prosperity and security of both the developed and developing countries. The effective development of new nuclear technologies and the safe and economical maintenance of existing technologies both rely on a thorough understanding of the underlying physical and chemical processes.

The Division of Physical and Chemical Sciences (NAPC), located within the IAEA Department of Nuclear Sciences and Applications (NA), is responsible for carrying out Agency activities to assist and advise Member States (MS) in assessing their needs for capacity building and research and development in the nuclear sciences, as well as in supporting the MS activities for deriving benefits in specific fields, including:

- Atomic, molecular and nuclear data
- Nuclear and radiation techniques, their applications and allied instrumentation
- Utilization of research reactors and particle accelerators
- Radioisotopes and radiopharmaceuticals
- Radiation processing applications
- Radiation technology and isotopic tracers for industrial processes
- Isotope hydrology and water resources management
- Nuclear fusion

### Division of Physical and Chemical Sciences

Industrial Applications  
and Chemistry

Isotope Hydrology

Nuclear Data

Physics

Hydrology Laboratory

### Resources



Nuclear Data Services

### Mission & Role

About NA

### Upcoming Events



**Positron Emission  
Tomography in  
Research and  
Diagnostics  
16-19 May 2012  
Warsaw**

# Nuclear Data Section

- **responsible for the development and dissemination of atomic and nuclear data for applications through such activities as**
  - *provision of comprehensive, high-quality databases*
  - *data compilation and evaluation*
  - *data services, data networks and user support  
(documents, CDs, DVDs)*
  - *appropriate training by means of local, national and international workshops*
  - *development of data standards and evaluation methods*
- **scientists in Member States are assisted in their evolution of local capabilities for the generation and application of atomic and nuclear data**

# Nuclear Data Section

## Mission and Functions

### ***Objectives***

**To increase capabilities and expertise of MS to ensure the safe and economic adoption of all forms of nuclear technologies by providing rapid access to reliable atomic and nuclear data for energy and non-energy applications.**

### ***Advisory Bodies:***

***International Nuclear Data***

***Committee (INDC);***

***A&M Data Sub-committee of IFRC***

### ***Scope of Functions***

- Provide up-to-date, reliable and quality information on (a) nuclear data and (b) atomic & molecular (A&M) data
- Participate and facilitate in compilation and evaluation of data
- Refine/update data in specific areas - specialized databases
- Continuously evolve data dissemination tools
- Training workshops
- Work in tandem with other major data centres

**Nuclear data:** [www-nds.iaea.org/](http://www-nds.iaea.org/)

**Atomic and molecular data:**

[www-amdis.iaea.org/](http://www-amdis.iaea.org/)



# Collaboration, Networking and Partnership Synergies

- Nuclear Data Centres: NNDC, BNL/USA; OECD-NEA/France; IPPE, Obninsk, Russia
- Nuclear reaction data centres network (NRDC)
- A+M data centres network
- Nuclear structure and decay data evaluators network (NSDD)
- ICTP, Trieste, Italy – training workshops
- Mirror sites, 2014
  - BARC, India: [www-nds.indcentre.org.in/](http://www-nds.indcentre.org.in/)
  - CNDC, CIAE, China: [www-nds.ciae.ac.cn/](http://www-nds.ciae.ac.cn/)
- links within the IAEA

# Atomic and Nuclear Data

**Worldwide – data users demand provision of databases with high degrees of credibility and validity**

**quantity**  
**quality**

**benchmarking**  
**verification**

**– rapid access and availability**

**through international and national data centres**

**– totally reliable provision of services**

# Atomic and Nuclear Data

**Quantity + Quality + Verification + Rapid access**



**International collaboration  
between national and international data centres**



**Continuous effort**

# Atomic and Nuclear Data

## 1. Reaction data

- neutron, charged-particle and photon cross sections
- interactions with target nuclei, atoms and molecules as a function of energy of projectile

ALADDIN: atomic and molecular data

EXFOR: neutron and charged-particle data compilations

ENDF/B: national and international evaluations

# Atomic and Nuclear Data

## 2. Structure and decay data

- nuclear energy levels, half-lives and radioactive decay ( $\alpha$ ,  $\beta$ ,  $\gamma$ ), .....

ENSDF

ENDF/B

# Atomic and Nuclear Data

## 3. Plasma interaction data

- collision databases
- H neutral beam database
- particle-surface interactions

# **International Nuclear Data Committee (INDC)**

## **International Fusion Research Council Subcommittee on Atomic and Molecular Data for Fusion**

**Oversee IAEA nuclear and A+M data activities, respectively**

**Scope, as defined in 1960s:** these committees to serve as a means of promoting international cooperation in all phases of nuclear and A+M data activities of usefulness to nuclear programmes, and of advising the Director-General of the IAEA in these fields.

**Compilations, nomenclature and information exchanges; measurement and interpretation; equipment and techniques; equipment and personnel exchanges; research proposals; scientific and technical meetings; advise DG**

**..... other topics and data applications developed and added since.**

# **Nuclear Reaction Data Centres Network, past and present**

## **INDC(NDS)-324**

### **IAEA, Nuclear Data Section**

**OECD-NEA, NEA Data Bank, France**

**NNDC, Brookhaven National Laboratory, USA**

**Photonuclear Data Center, Washington DC, USA**

**Fachinformationszentrum Karlsruhe, Germany**

**Karlsruhe Charged Particle Group, Germany**

**CJD, Obninsk, Russia**

**CAJaD, Moscow, Russia**

**CDFE, Moscow, Russia**

**CNPD, Centre of Nuclear Physics Data, Sarov, Russia**

**UKRNDC, Ukrainian Nuclear Data Centre, Kiev, Ukraine**

**CNDC, Chinese Nuclear Data Centre, Beijing, China**

**ATOMKI, Debrecen, Hungary**

**RIKEN, Wako-Shi, Japan**

**JCPRG, Sapporo, Japan**

**JAEA (ex-JAERI), Tokai-Mura, Japan**

**KAERI/NDEL, Yusong, Republic of Korea**

**etc.....**



# Network of Nuclear Structure and Decay Data Evaluators, past and present

## **NNDC, Brookhaven National Laboratory, USA**

IAEA, Nuclear Data Section

ORNL, Tennessee, USA

INEL, Idaho, USA

LBNL, California, USA

Triangle University Nuclear Laboratory, North Carolina, USA

Cyclotron Institute, Texas A&M, Texas, USA

Tandem Accelerator Laboratory, McMaster University, Hamilton, Canada

CEN Grenoble, France

Laboratorium voor Kernfysics, Gent, Belgium

Kernforschungszentrum, Eggenstein-Leopoldshafen, Germany

University of Liverpool, Liverpool, UK

Fysisch Laboratorium, Utrecht, the Netherlands

Institute of Physics, Lund, Sweden

ATOMKI, Debrecen, Hungary

IFIN-HH, Bucharest-Magurele, Romania

Kurchatov Institute of Atomic Energy, Moscow, Russia

St. Petersburg Nuclear Physics Institute, Russia

Kuwait Institute of Scientific Research, Kuwait

Indian Institute of Technology, Roorkee, India

Manipal University, Karnataka, India

Institute of Atomic Energy, Beijing, China

Jilin University, Changchun, China

JAEA (ex-JAERI), Tokai-Mura, Japan

ANU, Canberra, Australia

etc.....

# A&M Data Centre Network, past and present

## **IAEA, Nuclear Data Section**

**LANL, New Mexico, USA**

**ORNL, Tennessee, USA**

**NIST, Gaithersburg, Maryland, USA**

**Princeton University, New Jersey, USA**

**Harvard-Smithsonian Centre for Astrophysics (ITAMP), Massachusetts, USA**

**GAPHYOR, Universite de Paris, France**

**Forschungszentrum Jülich, Germany**

**University of Strathclyde, Glasgow, UK**

**University College London, UK**

**ENEA, Bologna, Italy**

**Institut Atomnoi Energii, Moscow, Russia**

**National Research Centre Kurchatov Institute, Moscow, Russia**

**CJaDFEI, Obninsk, Russia**

**CNDC, Institute of Atomic Energy, Beijing, China**

**Institute of Applied Physics and Computational Mathematics, Beijing, China**

**Institute of Plasma Physics, Nagoya University, Japan**

**JAEA, Ibaraki, Japan**

**NIFS, Mukoyama, Gifu-ken, Japan**

**KAERI, Daejeon, Republic of Korea**

**National Fusion Research Institute, Yuseong-Gu, Republic of Korea**

**etc.....**

# NDU/NDS: 1964 → 1974

- definition of and problems with compilation activities, C.H. Westcott, 1963
- DASTAR/CINDU neutron data storage/retrieval system led on to EXFOR/CINDA
- CINDA began in 1965 – bibliographic index of neutron cross-section data – first published by the IAEA in 1971 (CINDA 71)
- first meeting of the International Nuclear Data Committee, Vienna, 13-17 May 1968 (although existed previously in the form of INDSWG and interim INDC)
- organisation of “four-centre” neutron data meetings, and development of EXFOR in 1969/70 (international EXperimental neutron data exchange FORmat and system)
- implementation from 1973 of symposia → consultancies → technical meetings at regular intervals (every ~ 10 years) to consider and review intermediate and longer-term nuclear data needs (exercise extended to A+M data at a later date)
- preparation and supply of samples for worldwide nuclear experiments
- modest data reviews undertaken within NDS, and published regularly in Atomic Energy Review
- regular translation of Russian nuclear data documents/papers into English for release as INDC(CCP) reports

# Data Developments, 1964 → 1974

- NDS coordination of WRENDA – World REquests list for Nuclear DAta – first release as RENDATA 72 for neutron data
- additional data request lists also maintained to focus on fusion and safeguards
- IAEA panel on fission product nuclear data, Bologna, 26-30 November 1973
- review of Pu-239/U-235 fission cross section ratio, and U-238 capture cross section/U-235 fission ratio
- Pu-239 alpha, and Pu-239 capture to fission ratio
- reviews of neutron dosimetry cross sections
- neutron standard cross sections
- regular data review of reactor burn-up physics
- prompt fission neutron spectra
- compilations of nubar data (Manero and Konshin)

# 1964 → 1974: quotes

“.... anticipated that the NDU **may** be encouraged by the INDC to continue to be involved in a **small** way in evaluation.”

## **Definition of Nuclear Data, INDC(NDU)-10, May 1969:**

in the context of (the NDU) programme, the term “nuclear data” refers to numerical and associated information pertinent to measured, deduced or calculated microscopic neutron cross sections, related fission, capture and scattering parameters, resonance and reaction parameters of neutron induced reactions, as well as other related physical constants used in reactor design.

# 1964 → 1974: quotes

H.D. Lemmel *et al.*, INDC(NDS)-01, 1968:

..... perhaps well to state some views about objectives:

(a). that data taken at considerable expense should be made available immediately to the scientific and technical community

- **by no means should they become inaccessible or lost;**

(b). that data centres should offer a variety of services, so that various data users can exploit the data files;

(c). that the local and regional data centres should be well coordinated within an international data system in order to furnish **greatest access to data with minimum duplication of effort.**

# NDS: 1974 → 1984

Expansion: after a three-year trial from January 1977 → December 1979, the programme dedicated to A&M data for fusion became part of the overall programme of the Nuclear Data Section on 1 January 1980

Quarterly issues of the International Bulletin on Atomic and Molecular Data for Fusion, from July 1977

CIAMDA: Computerised Index of A+M collision Data, later extended as

AMBDAS: Atomical and Molecular Bibliographic Data System

# NDS: 1974 → 1984

- International Nuclear Structure and Decay Data Evaluators' Network formed in 1975 (ENSDF)
- first meeting of the Nuclear Reaction Data Centres (NRDC) Network, September 1979 (amalgamation of existing charged-particle/photonuclear data centres network and “four-centre” network)
- first Nuclear Data Newsletter, September 1979
- first meeting of the A+M Data Centre Network, 9-13 May 1977
- first meeting of IFRC Subcommittee on Atomic and Molecular Data for Fusion, 19/20 January 1981 (following joint IFRC/INDC meetings)
- expansion into addressing atomic data needs in fusion research
- increased activity with respect to training courses and conferences, including inter-regional project “nuclear data techniques and instrumentation”
- launch of biennial IAEA-ICTP training workshop in 1978 dedicated primarily towards Nuclear Reaction Data and Nuclear Reactors: Physics, Design and Safety (also entitled “Nuclear Physics and Reactors”)
- addressed data requirements involving nuclear analytical techniques in geophysics
- March 1975 – move of NDS to the VIC in the 9<sup>th</sup> district



# Data Developments, 1974 → 1984

- decay data of transactinium nuclides
- intercomparison of evaluations of actinide neutron nuclear data
- atomic collision data for plasma diagnostics
- evaluation of atomic data pertinent to plasma-wall interaction processes
- International Reactor Dosimetry File, IRDF-82
- nuclear data standards for nuclear measurements
- handbook of nuclear activation cross sections
- REAL-80: intercomparison of radiation damage estimates in terms of displacement per atom
- CINDA and EXFOR extended in 1975 to accommodate compilation and dissemination of charged-particle cross-section references and data
- measurement/compilation/evaluation of fission product nuclear data: semi-annual issue of Fission Product Nuclear Data (FPND) Newsletter, beginning in November 1975 with INDC(NDS)-70

# NDS: 1984 → 1994

- significant hardware-software acquisitions, assisted by NNDC staff
- international comparison of radioactive inventory calculations in fission reactors for decommissioning purposes
- international benchmark comparison of activation calculations
- international databases of high-priority nuclear cross sections and decay data
- comparison of activation measurements for fusion reactor technology

# Data Developments, 1984 → 1994

- nuclear data library for fusion applications (FENDL-1)
- activation cross sections for the generation of long-lived radionuclides of importance in fusion reactor technology
- recommended cross sections for Li atoms interacting with electrons, protons, multiply-charged ions and hydrogen molecules
- nuclear data needs for neutron therapy
- atomic and molecular data for radiotherapy
- handbook of nuclear data for borehole logging and mineral analysis
- methods of calculation of fast neutron cross sections for structural materials of fast fission and fusion reactors

# Data Developments, 1984 → 1994

- handbook of nuclear activation data – neutron, charged-particle and photonuclear activation analysis
- improvement of measurements, theoretical computations and evaluation of neutron-induced helium production cross sections
- measurement and analysis of 14-MeV neutron-induced double-differential neutron emission cross sections
- measurement and analysis of neutron emission spectra in (p,n) and ( $\alpha$ ,n) reactions for determining nuclear level densities
- International Reactor Dosimetry File, IRDF-90, version 2
- X-ray and gamma-ray standards for detector efficiency calibration

# Data Developments, 1984 → 1994

- handbook of nuclear data for safeguards, 1991
- atomic and molecular data for fusion plasma edge studies
- plasma-interaction-induced erosion of fusion reactor materials
- atomic data for medium- and high-Z fusion plasma impurities
- recommended database for state-selective electron capture
- recommended database for light ion reflection from surfaces
- validation and benchmark testing of actinide nuclear data

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# NDS: 1994 → 2004

- acquisition of relational database management system for more user-friendly access
  - creation and growth of multi-platform databases
  - significant quantitative increases seen in web site access to atomic and nuclear databases
- launch of regular IAEA-ICTP training workshops dedicated towards:
  - medical applications,
  - atomic and molecular data for fusion,
  - nuclear structure and decay data: theory and evaluation

# Data Developments, 1994 → 2004

- compilation and evaluation of fission yield data – neutron-induced fission below 20 MeV
- nuclear data library for fusion applications (FENDL-2)
- RIPL-1
- radiative cooling rates and fusion impurities
- tritium retention in plasma-facing components
- atomic and plasma-material interaction data
- charge exchange cross-section data for fusion plasma studies
- photon production data
- database of prompt  $\gamma$  rays from slow neutron capture for elemental analysis
- RIPL-2

# Data Developments, 1994 → 2004

- update of X- and  $\gamma$ -ray decay data standards
- WIMS-D data library
- International Reactor Dosimetry File, IRDF-2002
- reference neutron activation library
- charged-particle cross-section database for diagnostic radioisotopes and monitor reactions
- compilation and evaluation of photonuclear data for applications

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# NDS: 2004 → 2014

- more powerful and attractive web retrieval system implemented
- overhaul of the contents of EXFOR database – all known errors addressed
- software and data extensions to ENDF retrieval interface
- development of LiveChart software
- comprehensive electronic documentation
- rejuvenation of ENSDF mass chain evaluation effort
- mirror sites established in China and India

# Data Developments, 2004 → 2014

- A+M data for plasma diagnostics
- molecular processes in edge plasmas
- international evaluation of neutron cross-section standards
- nuclear data for the Th-U fuel cycle
- tritium inventory in fusion reactors
- RIPL-3
- nuclear data for the production of therapeutic radionuclides
- Handbook of Nuclear Data for Safeguards (Jan 2007 and Aug 2008)
- fission yields for the transmutation of minor actinide nuclear waste – neutron-based fission up to 150 MeV
- reference database for ion beam analysis
- updated decay data library for actinides
- minor actinide neutron reaction data
- nuclear data libraries for advanced systems: fusion applications (FENDL-3)

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# IAEA-NDS: Strategic Intent in 21<sup>st</sup> century

- multiplatform: Web, CD-ROM
- relational databases
- primary data: some maintained by continuously updating
- applications data: fission and fusion reactor design, **nuclear medicine**, **analytical science**, **environmental monitoring**  
— i.e. emphasis on applications-specific data

# Primary Databases

Compilations of **bibliographic** information

- references and description of contents

CINDA: Computer Index of Neutron DAta – bibliography of neutron and charged-particle cross-section data

[www-nds.iaea.org/exfor/cinda.htm](http://www-nds.iaea.org/exfor/cinda.htm)

AMBDAS: Atomical and Molecular Bibliographic DAta System – bibliographic atomic, molecular and plasma-surface interaction data for fusion research from 1950 onwards

[www-amdis.iaea.org/AMBDAS](http://www-amdis.iaea.org/AMBDAS)

# Primary Databases

Compilations of **bibliographic** information (continued)

**EXFOR**: EXchange FORmat – experimental nuclear reaction data compiled regularly through the Network of Nuclear Reaction Data Centres

[www-nds.iaea.org/exfor/exfor.htm](http://www-nds.iaea.org/exfor/exfor.htm)

**NSR**: Nuclear Science References – bibliographic database for low- and intermediate-energy physics

[www.nndc.bnl.gov/nsr/](http://www.nndc.bnl.gov/nsr/)

# Primary Databases

Evaluated atomic and nuclear data

**ALADDIN**: atomic, molecular and plasma-surface interaction data for fusion research; compiled through A&M Data Centre Network  
[www-amdis.iaea.org/infoaladdin.php](http://www-amdis.iaea.org/infoaladdin.php)

**ENDF-B6**: Evaluated Nuclear Data File – various national and international applications libraries of nuclear data; cross sections over a neutron energy range from  $10^{-5}$  eV to 20 MeV  
[www-nds.iaea.org/exfor/endl.htm](http://www-nds.iaea.org/exfor/endl.htm)

**ENSDF**: Evaluated Nuclear Structure Data File – nuclear structure and decay data for all known radionuclides; evaluated and compiled through Network of Nuclear Structure and Decay Data Evaluators (NSDD) – published in Nuclear Data Sheets  
[www.nndc.bnl.gov/ensdf/](http://www.nndc.bnl.gov/ensdf/)

**LiveChart of Nuclides**: user-friendly extracts of decay data from ENSDF, plus other highly-relevant nuclear data  
[www-nds.iaea.org/relnsd/vcharthtml/VChartHTML.html](http://www-nds.iaea.org/relnsd/vcharthtml/VChartHTML.html)

# International Data Networks

**ALADDIN**: Network of A+M Data Centres  
(for ALADDIN)

**EXFOR**: Network of Nuclear Reaction Data  
Centres (NRDC)

**ENSDF**: Network of International Nuclear  
Structure and Decay Data Evaluators  
(NSDD)

# Nuclear Data Section, 2008/09

## Data Services, Data Networks and User Support

Continuous/Recurrent

Views of Member States:

- most important feature of the NDS sub-programme
- rapid request and automatic access to all activities/databases in a user-friendly manner
- respond to all forms of training needs  
(organise official workshops, and one-to-one)



# Nuclear Data Section, 2008/09

## Data Services, Data Networks and User Support

- 1 Maintain on-line services through relational databases*
- 2 Coordinate and compile nuclear reaction data (CINDA/EXFOR), and maintain A+M and network nuclear databases*
- 3 Document and publicise available data files (IAEA(NDS)-series reports and ND Newsletter) and prepare reports on atomic and nuclear data in Member States, including translation and publication*
- 4 Provide data services to Member States – user assistance, data retrievals and dispatch, preparation and distribution of data libraries, files and NDS publications as CD-ROM and hardcopy*
- 5 Implement full range of relational databases and, in particular, develop multiplatform web and CD-ROM versions of data services*
- 6 Organise biennial review of nuclear data programme by the International Nuclear Data Committee (INDC)*

# Nuclear Data Section, 2008/09

## Data Services, Data Networks and User Support

- 7 *Organise biennial review of A+M data programme by A+M Data for Fusion Sub-committee of the International Fusion Research Council (IFRC)*
- 8 *Organise annual coordination meeting of the International Network of Nuclear Reaction Data Centres*
- 9 *Organise biennial coordination meeting of the International Network of Nuclear Structure and Decay Data Evaluators*
- 10 *Organise biennial coordination meeting of the International Network of A+M Data Centres and ALADDIN*
- 11 *Continue development of multiplatform software to exchange information between cooperating nuclear data centres, and manage shared A+M databases*
- 12 *Maintain nuclear data exchange manuals and thesaurus (CINDA/EXFOR manuals and directories), and A+M manuals and documentation (ALADDIN and AMBDIS)*

# Nuclear Data Section, 2008/09

## Data Services, Data Networks and User Support

- 13 *Organise workshops at IAEA, Vienna: data libraries and applied technologies*
- 14 *Upgrade databases and services at existing national and specialized data centres, and install nuclear data services in selected countries*
- 15 *Coordinate Agency and NEA cooperation in nuclear data activities*
- 16 *Provide support to organization of 2-week and more workshops at ICTP (two per year, if possible)*
- 17 *Support scientists from developing countries to attend the International Conference on Nuclear Data for Science and Technology, as held every three years*
- 18 *Cooperate in organization of the International Conference on the Physics of Electronic and Atomic Collisions*

# Data services, data networks and user support 2008/09

1. Collect accurate and up-to-date atomic and nuclear data, and disseminate to satisfy the needs of users from Member States
2. Co-ordinate networks of national and regional data centres, and promote the exchange of atomic and nuclear data for various applications
3. Maintain manuals and software for internationally-agreed database formats and exchange procedures
4. Improve the methods of providing information to data users, and provide training in the effective use of atomic and nuclear data through workshops

**Continuous**

# Data services, data networks and user support 2008/09

- maintain services
- documentation and “publicity”
- multi-platform activities
- nuclear data mirror services in other countries
- CINDA/EXFOR compilations
- INDC and A+M Subcommittee reviews
- NRDC (yearly) and NSDD (biennial) network meetings
- NEA Data Bank/NDS co-ordination (also to avoid unnecessary duplication)
- workshops (ICTP and IAEA)
- conference support to developing countries

# Nuclear Data Section, 2008/09

## Nuclear Data Standards and Evaluation Methods

Enable users to produce evaluated nuclear data that satisfy the high accuracy and consistency demanded by emerging nuclear technologies through the production of clearly defined evaluation methods and procedures

- as appropriate extend and improve neutron cross-section standards
- maintain files of the international neutron cross-section standards, along with associated evaluation techniques
- extend contents and application of RIPL (Reference Input Parameter Library) as and when required
- maintain comprehensive decay data library of X- and gamma-ray standards for detector calibration and other applications

# Nuclear Data Section, 2008/09

## Nuclear Data for Radiotherapy Using Radioisotopes and External Radiation Sources

Improve data for medical isotope production, and for patient dose delivery calculations in radiotherapy

- as appropriate, instigate relevant CRPs on the measurement and evaluation of nuclear data for the production of existing and emerging diagnostic and therapeutic radioisotopes
- initiate CRPs to include the measurement and evaluation of decay data of existing and emerging diagnostic and therapeutic radioisotopes
- maintain a Website dedicated to nuclear data for medical applications

# Nuclear Data Section, 2008/09

## Atomic and Molecular Data for Fusion Experiments

- 1 *Prepare and coordinate annual meetings to support the International Database for Irradiated Graphite [Extrabudgetary]*
- 2 *Coordinate TM of the International Code Centres Network*
- 3 *Coordinate CRP on atomic and molecular data for plasma modelling [2005-2008]*
- 4 *Coordinate CRP on data for surface composition dynamics relevant to erosion processes [2006-2010]*
- 5 *Coordinate CRP on atomic data for heavy element impurities in fusion reactors [2006-2010]*
- 6 *Coordinate CRP on atomic and molecular data for burning plasmas*
- 7 *Coordinate CRP on characterization of size, composition and origins of dust in fusion devices [2008-2012]*
- 8 *Assessment of the needs and priorities for atomic and molecular data – 2009 and 2011*
- 9 *Coordinate CRP on spectroscopic and collisional data for W from 1 eV to 20 keV*
- 10 *Coordinate CRP on isotopic ratio diagnostics and control in burning plasmas*



# Nuclear Data Section, 2008/09

## Nuclear Data for Reactor Dosimetry and Materials Analysis

Improve the databases of differential and integral parameters, and satisfy the needs of Member States for accurate, high-quality ion beam and neutron activation analysis data

- maintenance of dosimetry data library (IRDF)
- continue development of a reference nuclear database for neutron activation analysis
- continue development of reference nuclear databases for other analysis procedures of significant potential (e.g. ion beam analysis (IBA) and particle-induced gamma-ray emission (PIGE) spectroscopy)

# Nuclear Data Section, 2008/09

## Nuclear Data for Advanced Nuclear Facilities

Improve Member States abilities to optimise plant design, and so reduce engineering margins

- data for advanced systems
- comprehensive decay data library for actinides
- initiate CRP on “Minor Actinide Neutron Reaction Data for Closed Fuel Cycle Reactor Concepts”
- develop and support reference library for neutron transport calculations for advanced systems – database for ADS

# Nuclear Data Section, 2008/09

## Nuclear Data for Advanced Nuclear Facilities

- 1 Coordinate CRP on updated decay data library for actinides [2005-2009]*
- 2 Coordinate CRP on minor actinide neutron reaction data (MANREAD) [2007-2011]*
- 3 Coordinate CRP on nuclear data library for advanced systems: fusion devices (FENDL-3) [2008-2012]*
- 4 Coordinate CRP on neutron scattering for iron, beryllium and deuterium*
- 5 Develop and support reference nuclear data libraries for advanced reactor systems, and hold technical meeting*
- 6 Review benchmarking of nuclear data for Th/U fuel cycle*
- 7 Review of new TAGS measurements, depending on their availability*
- 8 Organise major Advisory Group Meeting on long-term needs for nuclear data development*
- 9 Coordinate technical meeting on nuclear data applications and measurements for advanced reactor systems*

# Compilation, Evaluation and Dissemination of Atomic and Nuclear Data

**Atomic and nuclear databases**

**..... and much more**

*[www-nds.iaea.org](http://www-nds.iaea.org)*

*[www-amdis.iaea.org](http://www-amdis.iaea.org)*

# Website - Nuclear Data Services

[www-nds.iaea.org/](http://www-nds.iaea.org/)

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







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**Hot Topics** » ENDF/B-VII.1 • TENDL-2011 • JENDL-4 • IBANDL **News** » 2012/03/30 TENDL-2011 - TALYS Evaluated Nuclear Data Library

**NEW** **TENDL-2011** TALYS Evaluated Nuclear Data Library [page] [retrieve]  
**EMPIRE-3.1** (Rivoli) System of codes for nuclear reaction calculations, February-2012 [link]  
**ENDF-B/VII.1** U.S. Evaluated Nuclear Data Library, issued in 2011 [page] [retrieve]










Main | All | Reaction Data | Structure & Decay | by Applications | Doc & Codes | Index | Events | News

|   |  |   |
|---|--|---|
|  <b>EXFOR</b><br>Experimental nuclear reaction data  |  <b>LiveChart of Nuclides</b><br>Interactive Chart of Nuclides          |  <b>CINDA</b><br>Nuclear reaction bibliography |
|  <b>ENDF</b><br>Evaluated nuclear reaction libraries |  <b>ENSDF</b><br>evaluated nuclear structure and decay data (+XUNDL) ** |  <b>NSR</b><br>Nuclear Science References *    |

|   |  |  |   |
|---|--|--|---|
| <b>NuDat 2.6</b><br>selected evaluated nuclear structure data * | <b>RIPL</b><br>reference parameters for nuclear model calculations     | <b>IBANDL</b><br>Ion Beam Analysis Nuclear Data Library        | <b>Charged particle reference cross section</b><br>Beam monitor reactions |
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| <b>NGATLAS</b><br>atlas of neutron capture cross sections       | <b>Safeguards Data</b><br>recommendations, August 2008                 | <b>Medical Portal</b><br>Data for Medical Applications         | <b>Standards</b><br>- Neutron cross-sections, 2006<br>- Decay data, 2005  |

\* Database at the IAEA, Vienna    \*\* Database at the US NNDC

**IAEA Nuclear Data Section**

|  |   |   |  |  |   |   |   |   |
|--|---|---|--|--|---|---|---|---|
|  <b>IAEA-NDS</b><br>Mission, Staff and more |  <b>A•M</b><br>Atomic and Molecular Data |  <b>Meetings Workshops</b> |  <b>Newsletters</b> |  <b>Coordinated Research Projects</b> |  <b>Nuclear Reaction Data Center Network</b> |  <b>Nuclear Structure &amp; Decay Data Network</b> |  <b>Technical Documents INDC Reports Publications</b> |  <b>Computer Codes</b> |
|--|---|---|--|--|---|---|---|---|

**Mirrors**

**Partners**

**Events [3,4]**

**9<sup>th</sup> International Conference on Nuclear Option in Countries with Small and Medium Electricity Grids**  
June 3-6, 2012  
Zadar, Croatia

**13<sup>th</sup> International Conference on Nuclear Reaction Mechanisms**  
June 11-15, 2012  
Villa Monasteron, Varenna, Italy

# Nuclear Reaction Databases

| Database     | Contents   | Size (January-2003)   | Size (April-2013)  |
|--------------|--|---|--|
| <b>EXFOR</b> | experimental nuclear reaction data for incident neutrons, charged particles and photons  | 13,500 entries<br>97,000 data sets<br>400 Mb ASCII-text                   | 19,881 entries<br>151,661 data sets<br>539 Mb ASCII-text                   |
| <b>CINDA</b> | bibliographical references to experimental nuclear reaction data and to calculations, reviews, compilations and evaluations of neutron reaction and spontaneous fission data | 266,000 lines<br>40,500 publications<br>32,500 blocks<br>37 Mb ASCII-text | 549,000 lines<br>90,057 publications<br>287,062 blocks<br>97 Mb ASCII-text |
| <b>ENDF</b>  | collection of evaluated data libraries   | ~300 Mb ASCII<br>(5 basic libraries)                                      | ~30 Gb ASCII<br>(43 libraries)   |

## EXFOR: EXchange FORmat, EXFOR data library

- **1970** agreed format and established exchange between USA, NEA, IAEA, USSR
- contains data from **approximately 20,000** experiments
- NRDC: 13 nuclear data centres contribute ~500 new entries every year
- since 2005: global data library with central maintenance in the IAEA (NDS)
- Master File (540Mb), 52 dictionaries (2.6Mb), 2 manuals (400 pages)
- Distribution (EXFOR, X4+, C4, XML, html, plots): Web, CD/DVD ROM, FTP
- Databases: MySQL, MS-Access, SyBase
- Software: C, Java (GUI-Applications, Servlets), Fortran
- Connection (import-export) to other databases: ENDF, CINDA, NSR

# EXFOR Request Form



## Experimental Nuclear Reaction Data (EXFOR)

Database Version of April 05, 2010  
Software Version of 2010.03.05 Old interface is [\[here\]](#)



**News** X

2010/02 Improvements and extensions:

- 1) Production of isotopes coded as ELEM/MASS: filtering and quick [\[plot\]](#) , sorting T4 [\[t4\]](#) [\[t4x\]](#)
- 2) Users' definition of ENDF:MF/MT for conversion EXFOR data to format C4 and advanced plotting
- 3) Search by compiling Center-ID (expert mode)
- 4) Search by outgoing particle coded in SF3,4,7 (expert mode)

[\[History\]](#)

The EXFOR library contains an extensive compilation of experimental nuclear reaction data. Neutron reactions have been compiled systematically since the discovery of the neutron, while charged particle and photon reactions have been covered less extensively. The library contains data from **18463** experiments (see [statistics](#) and new [compilation](#)).

**Use Help, Examples, Dynamic sections**

### Request

Examples: [1](#) [2](#) [3](#) [4](#) [5](#) [6](#) [7](#)

Target

Reaction   on combinations (ratios,...)

Quantity

Product

Energy from

Author(s)

Publication year

Accession #

[Extended](#)  
[Keywords](#)  
[Expert](#)

### Options

Exclude superseded data

... search of Products

... listing only

... prompt-Help

... # (Entry#, Subent#)

**Z,A**

**Reaction Sub-Fields**

**Feedback and User's Input**

**Clone Request:**

### Tip of the day: video-guide

How-to video-guide

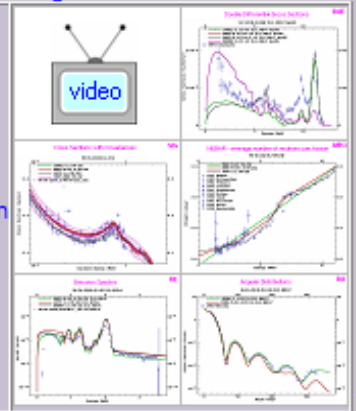
- Plot EXFOR-ENDF double differential cross-sections

Advanced plotting

- Cross sections
- Angular distribution
- Emission spectra
- Double differential
- NUBAR

Default

- Map



# EXFOR Output Form

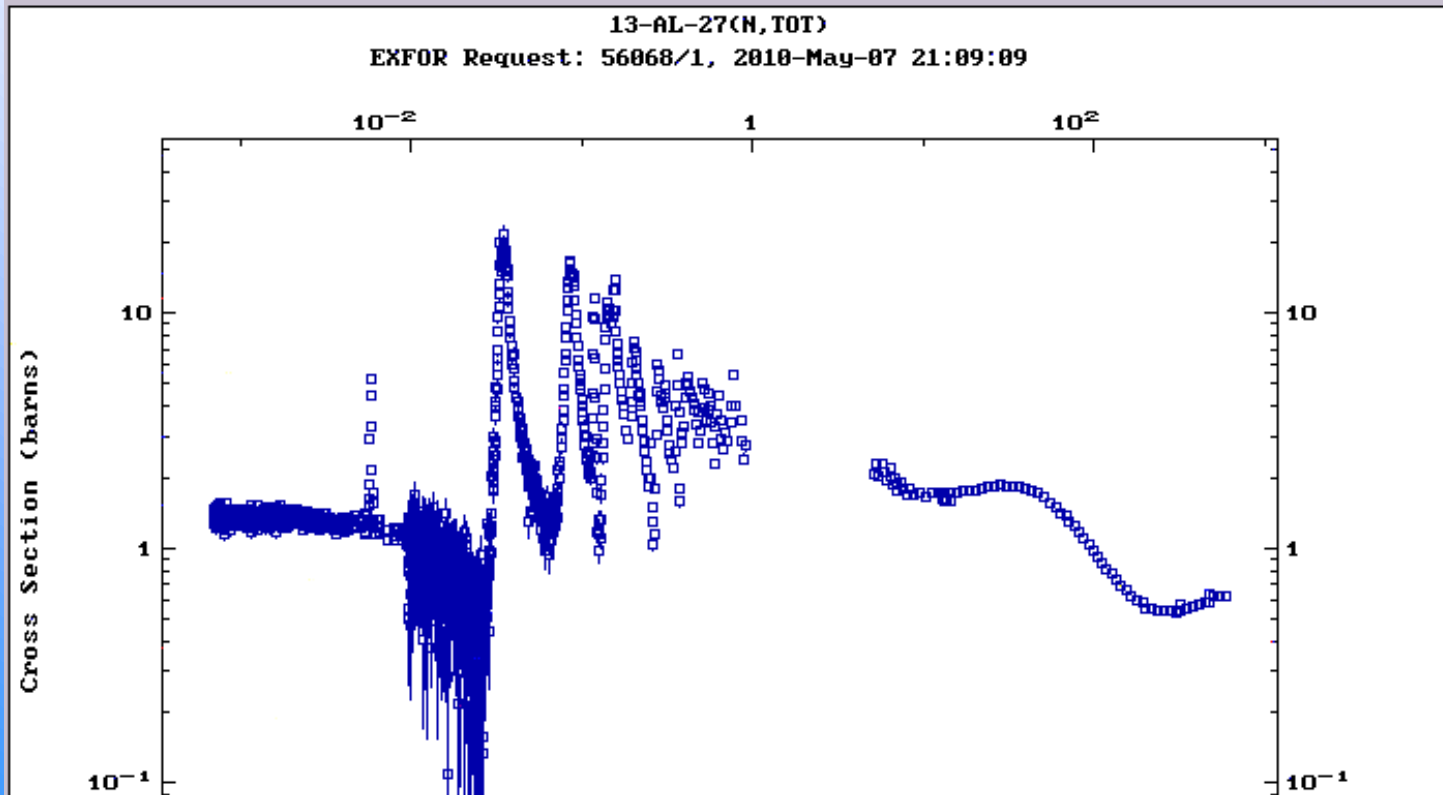
EXFOR Request #56068/1816

## Output Data

| Format               | <u>Data</u> (Size)                    |
|----------------------|---------------------------------------|
| EXFOR                | Text (212Kb) ZIP (34Kb) Generate: X4± |
| Bibliography         | html (15Kb) BibTeX (5Kb)              |
| <i>Computational</i> |                                       |
| C4                   | C4 (315Kb) C4.ZIP (23Kb) LST (99Kb)   |

Output data

Search similar evaluated data



ENDF Find and add to the plot evaluated data

- 1) 13-AL-27(N,TOT),,SIG
- 2) Use my data [example]

See: [plotted data](#) (194Kb)

Obtain plotted data

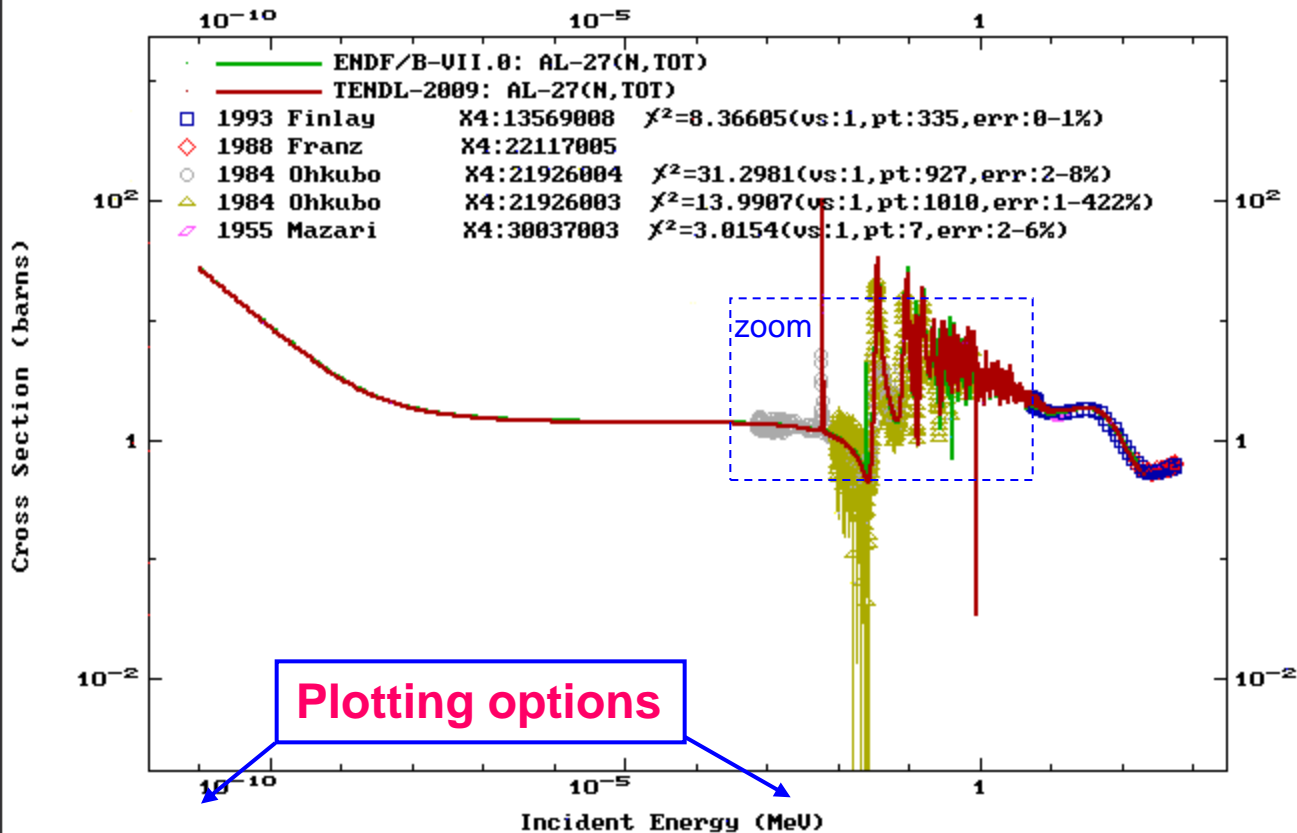


# ENDF Output Form with interactive Web ZVView Plotting

Select data for plotting

## Cross Section

ENDF Request 2776, 2010-May-07, 21:22:26  
EXFOR Request: 56068/1, 2010-May-07 21:09:09



- 1) 13-AL-27(N,TOT),,SIG
- 1993 R.W.Finlay,
- 1988 J.Franz,
- 1984 M.Ohkubo
- 1984 M.Ohkubo
- 1955 M.Mazari,
- 2) ENDF/B-VII.0: AL-27(N,TOT)
- 3) TENDL-2009: AL-27(N,TOT)

4) Use my data [example]

Columns: x y [dy [dx]]

|      |       |        |
|------|-------|--------|
| 1.5  | 2.336 | 0.384  |
| 2    | 2.788 | 0.268  |
| 2.33 | 2.96  | 0.4    |
| 2.5  | 2.399 | 0.283  |
| 3    | 2.424 | 0.197  |
| 4.04 | 2.496 | 0.065  |
| 5.06 | 2.222 | 0.065  |
| 5.5  | 2.304 | 0.1659 |

Type:  Curve  Points

Title: My data

Multiply by: X: 1e6 Y: 1e-3

See: [plotted data](#) (743Kb)

Log:  XY  X  Y Lin:  XY  X  Y Auto-range:  XY  X  Y Page: >> << Zoom: <> >> Grid:  V  H 0  V  H Pts:  Txt  Box  PL

Legend  Authors  Info+  Manual options: [+]

Data for plotting: [ZVD](#) (724Kb), [send to ZVView](#); [download ZVView](#); [upload](#) and plot your ZVD file

# LiveChart

Half life color code, value in seconds:

0 8.2E-4 1.4E-2 4.6E-2 1.E-1 2.3E-1 0.5 0.9 1.8 3.5 6.2 12 23.5 43 83.4 1.6E2 2.9E2 6E2 1.3E3 3E3 8.6E3 3.4E4 1.4E5 1.1E6 3E7 1E8



Show Filter

Visible Nuclides: 2934

Lock info panel

Nuclide

single selection

zoom and move

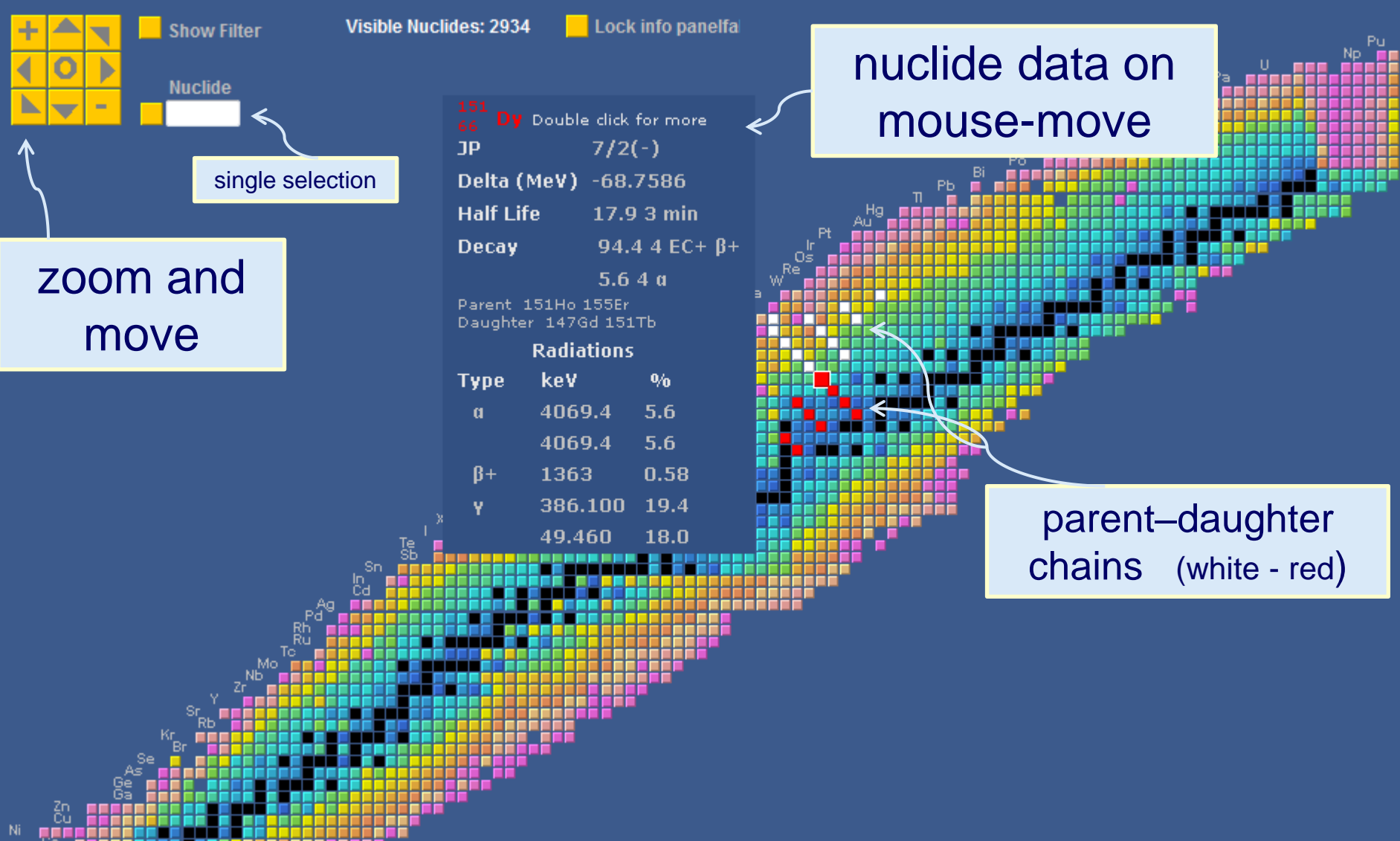
nuclide data on mouse-move

**<sup>151</sup><sub>68</sub>Dy** Double click for more  
JP 7/2(-)  
Delta (MeV) -68.7586  
Half Life 17.9 3 min  
Decay 94.4 4 EC+ β+  
5.6 4 α  
Parent <sup>151</sup>Ho <sup>155</sup>Er  
Daughter <sup>147</sup>Gd <sup>151</sup>Tb

**Radiations**

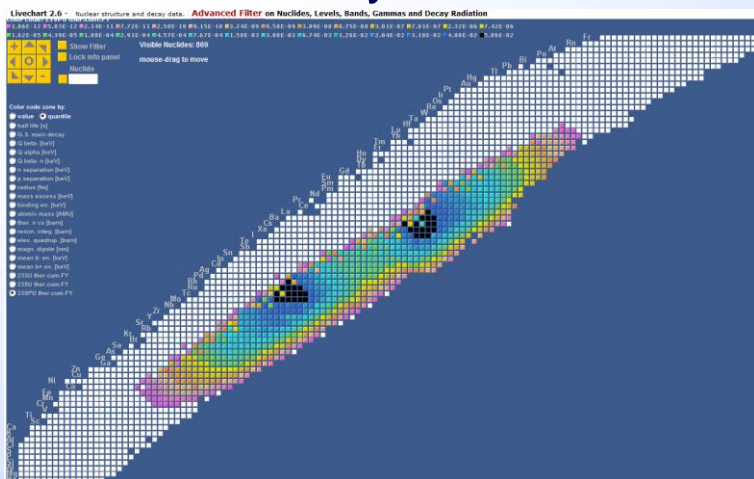
| Type | keV     | %    |
|------|---------|------|
| α    | 4069.4  | 5.6  |
| α    | 4069.4  | 5.6  |
| β+   | 1363    | 0.58 |
| γ    | 386.100 | 19.4 |
| γ    | 49.460  | 18.0 |

parent-daughter chains (white - red)

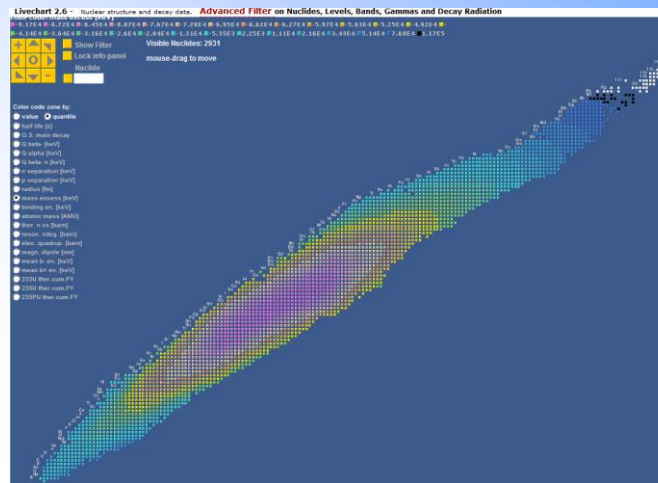


# LiveChart colour code - examples

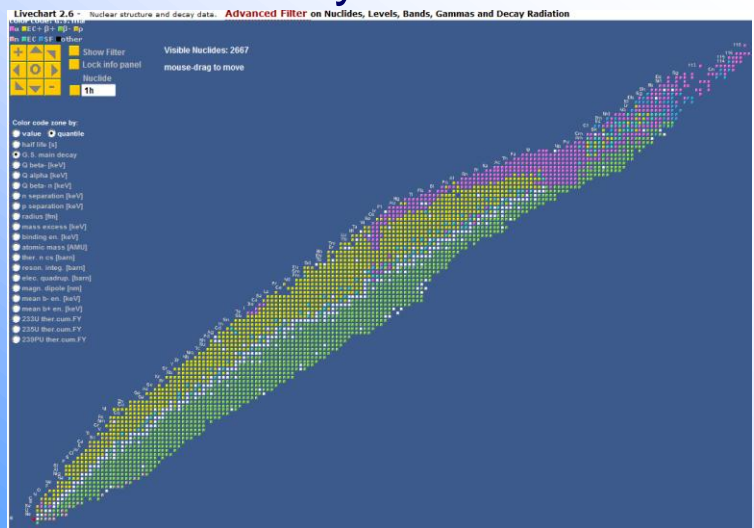
## Fission yields



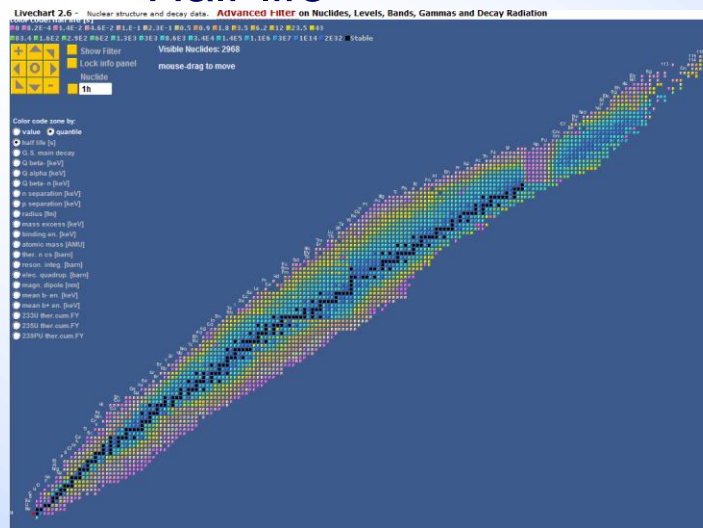
## Mass excess



## Decay mode



## Half-life



# Examples of queries

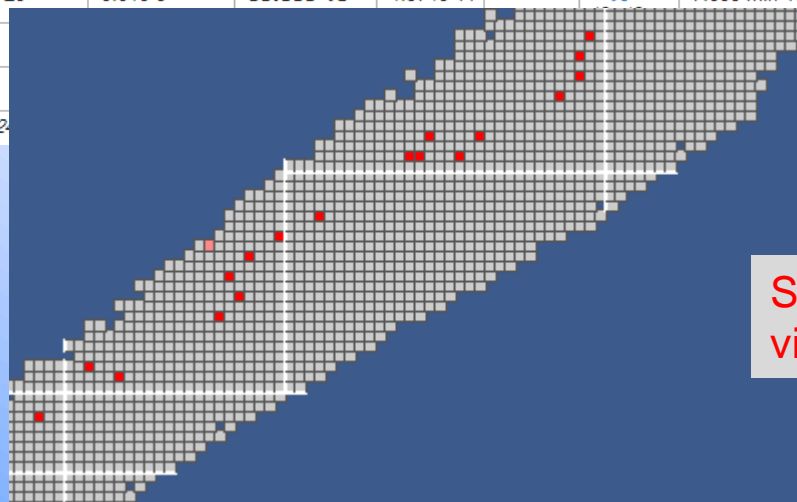
**Selection of nuclides with half-lives between 1 and 10 mins, emitting  $\beta^+$  with energy between 1 and 2 MeV**

## LEVELS - Bands - Decay Radiations

Energy  $0 \leq \text{keV} \leq 47,300$   
 Decays B.R.  $\leq \% \leq$   Only Ground State and Metastables  Isospin  
 Half Life  $1 \text{ min} \leq T_{1/2} \leq 10 \text{ min}$   Stable   $J^\pi$   weak order   $\pi$  any  
 Magn. dipole  $\mu$   $-20 \leq \mu_N \leq 38$   Electr. quadrupole  $Q$   $219 \leq \text{barn} \leq 64$   
 Decay radiation Energy  $1000 \leq \text{keV} \leq 2000$   key lines  $2$  Intensity  $60 \leq \% \leq 100$  type  $\beta^+$  process shell  
 End point  $0 \leq \text{keV} \leq 8,723$    $1.2 \leq \log FT \leq 24.3$    $0.077 \leq \text{Hindrance} \leq 6.077$

### Electron Capture and Beta+

| Fed level  | Jp   | Energy EC        | Avg Energy $\beta^+$ | Intensity EC | Intensity $\beta^+$ | LogFT     | Unforb. | Parent                     | $T_{1/2}$    | E [keV]   | Jp order | Decay                       | $Q_{gs \rightarrow gs}$ | Daughter                   |
|------------|------|------------------|----------------------|--------------|---------------------|-----------|---------|----------------------------|--------------|-----------|----------|-----------------------------|-------------------------|----------------------------|
| 498.01 5   | 3/2+ | (3415.285) 17    | 1076.7 79            | 26.7 9       | <b>60.3 19</b>      | 4.691 18  |         | <sup>113</sup> Sb<br>51 62 | 6.67 min 7   | 0.0       | 5/2+     | ec $\beta^+$ 100 %          | 3913.295 17402          | <sup>113</sup> Sn<br>50 63 |
| 670.1 3    | 1+   | (3500.721) 2     | 1099 6               | 2.80 24      | <b>70 6</b>         | 4.4 1     |         | <sup>60</sup> Zn<br>30 30  | 2.38 min 5   | 0.0       | 0+       | ec $\beta^+$ 100 %          | 4170.821 1769           | <sup>60</sup> Cu<br>29 31  |
| 0.0        | 0+   | (3573.784) 3585  | 1142.7 19            | 5.49 6       | <b>80.9 4</b>       | 4.75 1    |         | <sup>78</sup> Br<br>35 43  | 6.45 min 4   | 0.0       | 1+       | ec $\beta^+$ $\geq 99.99$ % | 3573.784 3585           | <sup>78</sup> Se<br>34 44  |
| 0.0        | 0+   | (3656.639) 3059  | 1188.6 14            | 24.3 2       | <b>73.2 3</b>       | 4.525 13  |         | <sup>118</sup> Sb<br>51 67 | 3.6 min 1    | 0.0       | 1+       | ec $\beta^+$ 100 %          | 3656.639 3059           | <sup>118</sup> Sn<br>50 68 |
| 2167.5 3   | 2+   | (3746.555) 500   | 1212.08 20           | 0.516 5      | <b>99.333 13</b>    | 4.9746 11 |         | <sup>38</sup> K            | 7.636 min 18 | 0         | 3+       | ec $\beta^+$ 100 %          | 5914.055 347            | <sup>38</sup> Ar<br>18 20  |
| 0.0        | 0+   | (3731.489) 19933 | 1224.4               |              |                     |           |         |                            |              | 0.0       | 1+       | ec $\beta^+$ 100 %          | 3731.489 19933          | <sup>134</sup> Ba<br>56 78 |
| 3189.33 14 | 6+   | (3853.051) 300   | 1264.00              |              |                     |           |         |                            |              | 616.28 6m | (7)+     | ec $\beta^+$ 100 %          | 6426.101 225            | <sup>42</sup> Ca<br>20 22  |
| 0.0        | 0+   | (3958.896) 872   | 1316.0 2             |              |                     |           |         |                            |              | 0.0       | 1+       | ec $\beta^+$ 100 %          | 3958.896 872            | <sup>62</sup> Ni<br>28 34  |



Selected nuclides visualised on Livechart

# Gamma spectroscopy : peak identification


Nuclides with half-lives between 10 and 100 days, emitting  $\gamma$  with energy between 450 and 500 keV. The  $\gamma$  must be the most intense line (key-line)

key-line condition

Half Life 10 d  $\leq T_{1/2} \leq$  100 d  Stable   $J^\pi$   weak order   $\pi$  any  
 Magn. dipole  $\mu$   $-20 \leq \mu_N \leq 38$   Electr. quadrupole Q  $-219 \leq \text{barn} \leq 64$   
 Decay radiation Energy  $450 \leq \text{keV} \leq 500$   key lines Intensity 0  $\leq \% \leq$  100 type  $\gamma$  process any shell any  
 $\beta$  End point 0  $\leq \text{keV} \leq$  8,723  $1.2 \leq \log FT \leq$  24.3  $\alpha$  0.077  $\leq$  Hindrance  $\leq$  6,077

| Gamma       |       |             |       |             |           |        |           |                   |                             |                  |               |          |          |                      |                             |  |
|-------------|-------|-------------|-------|-------------|-----------|--------|-----------|-------------------|-----------------------------|------------------|---------------|----------|----------|----------------------|-----------------------------|--|
| Start level | Jp    | Final Level | Jp    | Energy      | Intensity | Mixing | Multipol. | Tot. Conv. Coeff. | Parent                      | T <sub>1/2</sub> | E [keV]       | Jp order | Decay    | Q <sub>gs → gs</sub> | Daughter                    |  |
| 1084.85 17  | 21/2+ | 631.33      | 15/2+ | 453.59 20   | 68 3      |        | E2        | 0.0248            | <sup>179</sup> Hf<br>72 107 | 25.05 d 25       | 1105.74 16 m2 | 25/2-    | IT 100 % | 1105.74              | <sup>179</sup> Hf<br>72 107 |  |
| 477.612 3   | 1/2-  | 0.0         | 3/2-  | 477.6035 20 | 10.44 4   | 0.20   | M1(+E2)   | 7.3E-7 11         | <sup>7</sup> Be<br>4 3      | 53.22 d 6        | 0.0           | 3/2-     | ec 100 % | 861.893 71           | <sup>7</sup> Li<br>3 4      |  |
| 189.18 4    | 5/2+  | 0.0         | 7/2+  | 189.18 0    | 81 0      | 1.70   | M1+E2     | 0.0005 0          | <sup>181</sup> Hf<br>72 107 | 10.00 d 0        | 0.0           | 4/0      | 0 100 %  | 189.18 0             | <sup>181</sup> Tm<br>72 107 |  |

# Tab with Data and Tools Sorted by Application



The screenshot shows a web application interface with a navigation menu at the top and a list of application categories below. The navigation menu includes tabs for 'Main', 'All', 'Reaction Data', 'Structure & Decay', 'by Applications' (which is highlighted in blue), 'Doc & Codes', 'NDS-Internal', 'Index', and 'Events'. The list of application categories is as follows:

- ⌵ **Reactor Physics (particle transport, fuel cycle, transmutation, shielding)**
- ⌵ **Atomic and molecular data for fusion research**
- ⌵ **Ion Beam and Thin Layer Activation Analysis**
- ⌵ **Dosimetry reactions**
- ⌵ **Activation analysis**
- ⌵ **Nuclear Medicine**
- ⌵ **Neutron Source Reactions**

At the bottom of the interface, there are two footnotes: '\*Database at the IAEA, Vienna' and '\*\*Database at the US NNDC'.

# Website - Nuclear Data Services

[www-nds.iaea.org/](http://www-nds.iaea.org/)

International Atomic Energy Agency

## Nuclear Data Services

Provided by the Nuclear Data Section

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**Hot Topics** » ENDF/B-VII.1 • TENDL-2011 • JENDL-4 • IBANDL **News** » 2012/03/30 TENDL-2011 - TALYS Evaluated Nuclear Data Library

**NEW** **TENDL-2011** TALYS Evaluated Nuclear Data Library [page] [retrieve]  
**EMPIRE-3.1** (Rivoli) System of codes for nuclear reaction calculations, February-2012 [link]  
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Main | All | Reaction Data | Structure & Decay | by Applications | Doc & Codes | Index | Events | News

|   |  |   |
|---|--|---|
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| <b>ENDF</b><br>Evaluated nuclear reaction libraries | <b>ENSDF</b><br>evaluated nuclear structure and decay data (+XUNDL) ** | <b>NSR</b><br>Nuclear Science References *    |

|  |  |  |   |
|--|--|--|---|
| <b>NuDat 2.6</b><br>selected evaluated nuclear structure data ** | <b>RIPL</b><br>reference parameters for nuclear model calculations     | <b>IBANDL</b><br>Ion Beam Analysis Nuclear Data Library        | <b>Charged particle reference cross section</b><br>Beam monitor reactions |
| <b>PGAA</b><br>Prompt gamma rays from neutron capture            | <b>FENDL-2.1</b><br>Fusion Evaluated Nuclear Data Library, Version 2.1 | <b>Photonuclear</b><br>cross sections and spectra up to 140MeV | <b>IRDF-2002</b><br>International Reactor Dosimetry File                  |
| <b>NGATLAS</b><br>atlas of neutron capture cross sections        | <b>Safeguards Data</b><br>recommendations, August 2008                 | <b>Medical Portal</b><br>Data for Medical Applications         | <b>Standards</b><br>- Neutron cross-sections, 2006<br>- Decay data, 2005  |

\* Database at the IAEA, Vienna    \*\* Database at the US NNDC

**IAEA Nuclear Data Section**

|  |   |                           |                    |                                      |   |   |  |                       |
|--|---|---------------------------|--------------------|--------------------------------------|---|---|--|-----------------------|
| <b>IAEA-NDS</b><br>Mission, Staff and more | <b>A•M</b><br>Atomic and Molecular Data | <b>Meetings Workshops</b> | <b>Newsletters</b> | <b>Coordinated Research Projects</b> | <b>Nuclear Reaction Data Center Network</b> | <b>Nuclear Structure &amp; Decay Data Network</b> | <b>Technical Documents INDC Reports Publications</b> | <b>Computer Codes</b> |
|--|---|---------------------------|--------------------|--------------------------------------|---|---|--|-----------------------|

**Mirrors**

**Partners**

**Events [3,4]**

**9<sup>th</sup> International Conference on Nuclear Option in Countries with Small and Medium Electricity Grids**  
June 3-6, 2012  
Zadar, Croatia

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June 11-15, 2012  
Villa Monasteron, Varenna, Italy

# Compilation, Evaluation and Dissemination of Atomic and Nuclear Data

**Atomic and nuclear databases**

**..... and much more**

*[www-nds.iaea.org](http://www-nds.iaea.org)*

*[www-amdis.iaea.org](http://www-amdis.iaea.org)*



**selective personal recollections**

**1976 and onwards**

# IAEA Nuclear Data Section

1964 → **Nuclear Data Unit**, Carl H. Westcott/Bill Good

## **Nuclear Data Section:**

|                       |  |             |
|-----------------------|--|-------------|
| <b>1969 → 1992</b>    | <b>Joe Schmidt</b>                       | <b>22 y</b> |
| <b>1992 → 1993</b>    | <b>Valya Konshin (Division Director)</b> | <b>1 y</b>  |
| <b>1993 → 1995</b>    | <b>Charlie Dunford</b>                   | <b>2 y</b>  |
| <b>1995 → 1996</b>    | <b>Pavel Obložinský (Acting head)</b>    | <b>1 y</b>  |
| <b>1996 → 2001</b>    | <b>Doug Muir</b>                         | <b>5 y</b>  |
| <b>2001 → 2009</b>    | <b>Alan Nichols</b>                      | <b>7½ y</b> |
| <b>2009 → to date</b> | <b>Robin Forrest</b>                     |             |

# **Joe Schmidt**

## **1931 - 2014**



**1995: introduced to me as “the father of nuclear data” by John Rowlands (ex-AEEW, UK and CEA, France), another highly respected and sadly missed nuclear physicist and nuclear data specialist**

# IAEA Nuclear Data Newsletter, September 1992

quote:

Dr. J.J. Schmidt has retired. He was the head of the IAEA Nuclear Data Section for more than 22 years from 1969 to 1992. **More than anyone else he promoted international cooperation in the field of nuclear data. The International Nuclear Data Committee, data centre networks, specialists meetings to assess data needs, training courses, and research contracts are some of the keywords of his activities, which were notably successful due to his broad knowledge, initiative, and exceptionally friendly personality .....**

# **International Conference on Nuclear Data for Science and Technology: cooperation and co-sponsorship of the IAEA, Nuclear Data Section**

- 1978** Harwell, UK: International Conference on Nuclear Physics and Nuclear Data for Reactors and Other Applications
- 1982** Antwerp, Belgium: International Conference on Nuclear Data for Science and Technology
- 1985** Santa Fé, USA: International Conference on Nuclear Data for Basic and Applied Science
- 1988** Mito, Japan: International Conference on Nuclear Data for Science and Technology
- 1991** Jülich, Federal Republic of Germany
- 1994** Gatlinburg, USA
- 1997** Trieste, Italy
- 2001** Tsukuba, Japan
- 2004** Santa Fé, USA
- 2007** Nice, France
- 2010** Jeju Island, Republic of Korea
- 2013** New York, USA
- 2016** Bruges, Belgium

**International Conference on Nuclear Data for Science and Technology  
13-17 May 1991, Forschungszentrum Jülich, Federal Republic of Germany**



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|                       |   |             |
|-----------------------|---|-------------|
| <b>1969 → 1992</b>    | <b>Joe Schmidt</b>                        | <b>22 y</b> |
| <b>1992 → 1993</b>    | <b>Valya Konshin (Divisions Director)</b> | <b>1 y</b>  |
| <b>1993 → 1995</b>    | <b>Charlie Dunford</b>                    | <b>2 y</b>  |
| <b>1995 → 1996</b>    | <b>Pavel Obložinský (Acting head)</b>     | <b>1 y</b>  |
| <b>1996 → 2001</b>    | <b>Doug Muir</b>                          | <b>5 y</b>  |
| <b>2001 → 2009</b>    | <b>Alan Nichols</b>                       | <b>7½ y</b> |
| <b>2009 → to date</b> | <b>Robin Forrest</b>                      |             |

**International Conference on Nuclear Data for Science and Technology**  
**13-17 May 1991, Forschungszentrum Jülich, Federal Republic of Germany**  
**Charlie Dunford , Joe Schmidt, and Hans Lemmel**





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**Robin Forrest and Pavel Obložinský**

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Charlie Dunford, Joe Schmidt, Hans Lemmel, Doug Muir, Robin Forrest,  
Pavel Obložinský and me ..... and Valya Konshin**



# **Nuclear Data Section at play**

for five days from 13 to 17 May 1991, the present and all (until now) future leaders of the Nuclear Data Section were together

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Remarkable?

Unique!

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**Joe Schmidt, Charlie Dunford, Doug Muir, Alan Nichols and Robin Forrest, along with Hans Lemmel, Pavel Obložinský and Valya Konshin (amongst 328 people from 37 countries)**



# **IAEA Nuclear Data Section 50 Years of Achievement**

**..... and some personal observations**

**Assistance in the assembly of this presentation is gratefully acknowledged from  
Lidija Vrapcenjak, Marco Verpelli and Viktor Zerkin,  
Nuclear Data Section, IAEA, Vienna, Austria**

**Dedicated to all those involved in the work of the Nuclear Data  
Unit and Nuclear Data Section since their orderly conception and  
creation in the 1960s**

*International Nuclear Data Committee  
IAEA, Vienna, Austria, 2 June 2014*