



INTERNATIONAL ATOMIC ENERGY AGENCY

**INDC(NDS)-439**

**Distr.: SD/EL**

---

**I N D C**    **INTERNATIONAL NUCLEAR DATA COMMITTEE**

---

**Workshop  
on Nuclear Structure and Decay Data Evaluation**

**Summary Report**

IAEA Headquarters  
Vienna, Austria

18 - 22 November 2002

V.G. Pronyaev, A.L. Nichols

January 2003

---

**IAEA NUCLEAR DATA SECTION, WAGRAMER STRASSE 5, A-1400 VIENNA**

Documents in the EL series are available in only limited quantities in hardcopy form. They may be downloaded in electronic form from [http://www-nds.iaea.or.at/indc\\_sel.html](http://www-nds.iaea.or.at/indc_sel.html) or sent as an e-mail attachment. Requests for hardcopy or e-mail transmittal should be directed to [services@iaeand.iaea.org](mailto:services@iaeand.iaea.org) or to:

Nuclear Data Section  
International Atomic Energy Agency  
PO Box 100  
Wagramer Strasse 5  
A-1400 Vienna  
Austria

Produced by the IAEA in Austria  
January 2003

# **Workshop on Nuclear Structure and Decay Data Evaluation**

## **Summary Report**

IAEA Headquarters  
Vienna, Austria

18 - 22 November 2002

V.G. Pronyaev and A.L. Nichols

### **Abstract**

A summary is given of the aims and contents of the Workshop on Nuclear Structure and Decay Data (NSDD) Evaluation, including the agenda, lists of participants and their presentations, general comments and recommendations. The 1-week workshop was organized by the IAEA Nuclear Data Section, and held in Vienna, Austria, from 18 to 22 November 2002. Workshop material, including participants' presentations, computer codes, manuals and other materials for NSDD evaluators, are freely available on CD-ROM on request:

e-mail: [services@iaeand.iaea.org](mailto:services@iaeand.iaea.org)  
fax: (43-1)26007 Nuclear Data Section

post to:  
Nuclear Data Section  
Department of Nuclear Sciences and Applications  
International Atomic Energy Agency  
PO Box 100  
A-1400 Vienna  
Austria

January 2003



## CONTENTS

|  |           |
|--|-----------|
| <b>1. Workshop information .....</b>   | <b>7</b>  |
| <b>1.1. Background.....</b>  | <b>7</b>  |
| <b>1.2. Objectives and methods.....</b>  | <b>7</b>  |
| <b>1.3. Programme.....</b>   | <b>7</b>  |
| <b>1.4. Participation.....</b>   | <b>8</b>  |
| <b>2. List of participants.....</b>  | <b>9</b>  |
| <b>3. Agenda.....</b>  | <b>13</b> |
| <b>4. List of presentations available on request, in electronic format on CD-ROM<br/>or as hardcopy report .....</b> | <b>17</b> |
| <b>5. Contents of CD-ROM: workshop material.....</b>   | <b>19</b> |
| <b>6. Conclusions and recommendations.....</b>   | <b>21</b> |



## **1. Workshop information**

The International Atomic Energy Agency organized a Workshop on Nuclear Structure and Decay Data Evaluation at the IAEA Headquarters in Vienna from 18 to 22 November 2002. This workshop was directed by V.G. Pronyaev of the IAEA Nuclear Data Section.

### **1.1 Background**

Reliable evaluated nuclear structure and decay data are of vital importance in a large number of nuclear applications such as power generation, material analysis, dosimetry and medical diagnostics, as well as basic nuclear physics and astrophysics. Important features of these needs are satisfied by the work programme of the International Nuclear Structure and Decay Data (NSDD) Network, formed in 1974. The main products of this worldwide network are the recommended data files of the Evaluated Nuclear Structure Data File (ENSDF).

ENSDF represents an enormous source of nuclear data and information for basic research and applications. Maintenance and further development are vitally important, and need continuing scientific effort. The input to ENSDF from developing countries has been limited; however, the time is now appropriate for scientists from these countries to make a significant contribution to on-going efforts. The proposed workshop represents the initiation of a suitable mechanism to achieve this aim by focusing on advances in nuclear structure physics and evaluation methodologies through practical training.

### **1.2. Objectives and methods**

The primary objective of the workshop was to familiarize nuclear physicists from both developing and developed countries with:

- (i) new experimental data that characterise the decay properties of nuclei and their nuclear structure;
- (ii) modern nuclear models;
- (iii) evaluation methodologies for nuclear structure and decay data.

Participants were introduced to criteria by which nuclear structure data are evaluated and how these data are entered into the Evaluated Nuclear Structure Data File (ENSDF). Important elements of the workshop included the use of computer codes to evaluate decay data, construction of individual files for ENSDF, and the use of these recommended data in nuclear applications. Detailed presentations were given by invited lecturers, along with a series of relevant computer exercises. The participants were also invited to contribute their own thoughts/short papers of direct relevance to the workshop.

### **1.3. Programme**

Review of modern nuclear models and new experimental data obtained at experimental installations.

Participants' presentation of their own work in the NSDD field (15+5 min per presentation).

Introduction to ENSDF and related bibliographic databases.

Introduction to the computer codes used for NSDD evaluations.

Computer exercises with practical NSDD evaluations and preparation of the data sets for inclusion in ENSDF.

Presentation of the network of NSDD evaluators, their products and communication links.

#### **1.4. Participation**

Six participants (mainly from developing countries) with full or partial support from the IAEA to cover the cost of travel and living expenses in Vienna, and 2 participants at no cost to the IAEA were selected. Selection was undertaken by Nuclear Data Section staff in consultation with the network of NSDD evaluators. Two major criteria for the selection of the participants were applied: required level of experience to work as NSDD evaluator, and possibility to join the network of NSDD evaluators in the future. Candidates completed and signed the *Application for Participation* form available on-line, and sent by mail, FAX or e-mail to the Scientific Secretary of the workshop.



## 2. List of participants



On photo from left to right: *Edgardo BROWNE-MORENO, Thomas BURROWS, Filip KONDEV, Dimiter BALABANSKI, Jagdish TULI, Vito Roberto VANIN, Ivan MITROPOLSKY Vladimir PRONYAEV, Guillermo MARTI, Ashok Kumar JAIN, Tibor KIBEDI, HUANG Xiaolong.*

### **ARGENTINA**

Mr. Guillermo V. MARTI  
Dpto. de Física – Lab. Tandar  
Comisión Nacional de Energía Atómica (CNEA)  
Avda. del Libertador 8250  
(1428) Buenos Aires

**Phone:** +54 11 6772 7073  
**Fax:** +54 11 6772 7121  
**E-mail:** Marti@tandar.cnea.gov.ar

### **AUSTRALIA**

Mr. Tibor KIBEDI  
Department of Nuclear Physics  
Research School of Physical Sciences  
and Engineering  
Australian National University  
Canberra, ACT 0200

**Phone:** +61 2 6125 2093  
**Fax:** +61 2 6125 0748  
**E-mail:** Tibor.Kibedi@anu.edu.au

### **BRAZIL**

Mr. Vito Roberto VANIN  
Departamento de Física Experimental /  
Laboratório do Acelerador Linear  
Instituto de Física  
Universidade de São Paulo  
Caixa Postal 66318 05315-970 - São Paulo, SP

**Phone:** +55 11 3091 6853 (Office)  
**Phone:** +55 11 3091 7045 (Secretary)  
**Fax:** +55 11 3091 6832  
**E-mail:** Vanin@if.usp.br

**BULGARIA**

Mr. Dimiter L. BALABANSKI  
Faculty of Physics  
University of Sofia  
J. Bouchier Str. 5  
BG-1164 Sofia

**Phone:** +359 2 6256 728  
**Fax:** +359 2 9625 276  
**E-mail:** Mitak@phys.uni-sofia.bg

**CHINA**

Mr. HUANG Xiaolong  
China Nuclear Data Center  
China Institute of Atomic Energy  
P.O. Box 275 (41)  
Beijing 102413

**Phone:** +86 10 6935 7830  
**Fax:** +86 10 6935 7008  
**E-mail:** HuangXl@iris.ciae.ac.cn

**FRANCE**

Mr. Piet VAN ISACKER  
Grand Accélérateur National d'Ions Lourds  
(GANIL)  
BP 55027  
F-14076 Caen cedex 5

**Phone:** +33 2 3145 4565  
**Fax:** +33 2 3145 4421  
**E-mail:** Isacker@ganil.fr

**INDIA**

Mr. Ashok Kumar JAIN  
Department of Physics  
Indian Institute of Technology  
Roorkee – 247 667, Uttaranchal

**Phone:** +91 1332 85753  
**Fax:** +91 1332 73560  
**E-mail:** AJainfph@iitr.ernet.in

**RUSSIA**

Mr. Ivan Andreevich MITROPOLSKY  
Petersburg Nuclear Physics Institute  
Orlova Roscha, Gatchina  
Leningrad district, 188300

**Phone:** +7 812 7146044  
**Fax:** +7 812 7131347  
**E-mail:** Mitrplsk@pnpi.spb.ru

**UNITED STATES OF AMERICA**

Mr. Edgardo BROWNE-MORENO  
Isotopes Project  
MS 50A-1148  
Lawrence Berkeley National Laboratory  
University of California  
1 Cyclotron Road, Berkeley, CA 94720

**Phone:** +1 510 486 7647  
**Fax:** +1 510 486 5757  
**E-mail:** EBrowne@lbl.gov

Mr. Thomas W. BURROWS  
Building 197D  
National Nuclear Data Center  
Brookhaven National Laboratory  
P.O. Box 5000  
Upton, NY 11973-5000

**Phone:** +1 631 344 5084  
**Fax:** +1 631 344 2806  
**E-mail:** nndctb@bnl.gov  
**E-mail:** Burrows@bnl.gov

Mr. Filip G. KONDEV  
Nuclear Applications and Nuclear Data Program  
Technology Development Division  
Argonne National Laboratory  
9700 South Cass Avenue  
Argonne, IL 60517

**Phone:** +1 630 252 4484  
**Fax:** +1 630 252 5287  
**E-mail:** [Kondev@anl.gov](mailto:Kondev@anl.gov)

Mr. Jagdish K. TULI  
Building 197D  
National Nuclear Data Center  
Brookhaven National Laboratory  
P.O. Box 5000  
Upton, NY 11973-5000

**Phone:** +1 631 344 5080  
**Fax:** +1 631 344 2806  
**E-mail:** [Tuli@bnl.gov](mailto:Tuli@bnl.gov)

**IAEA, Vienna, AUSTRIA**

Mr. Vladimir G. PRONYAEV  
Scientific Secretary of the Workshop  
IAEA Nuclear Data Section  
Wagramer Strasse 5  
P.O. Box 100  
A-1400 Vienna

**Phone:** +43 1 2600 21717  
**Fax:** +43 1 26007  
**E-mail:** [V.Pronyaev@iaea.org](mailto:V.Pronyaev@iaea.org)

Mr. Alan L. NICHOLS  
Section Head  
IAEA Nuclear Data Section  
Wagramer Strasse 5  
P.O. Box 100  
A-1400 Vienna

**Phone:** +43 1 2600 21709  
**Fax:** +43 1 26007  
**E-mail:** [A.Nichols@iaea.org](mailto:A.Nichols@iaea.org)

Mr. P. Kevin McLAUGHLIN  
IAEA Nuclear Data Section  
Wagramer Strasse 5  
P.O. Box 100  
A-1400 Vienna

**Phone:** +43 1 2600 21723  
**Fax:** +43 1 26007  
**E-mail:** [P.McLaughlin@iaea.org](mailto:P.McLaughlin@iaea.org)



### **3. Agenda**

#### **Monday, 18 November**

- |             |   |
|-------------|---|
| 9:30-9:45   | Opening, announcements  |
| 9:45-10:30  | ENSDF: evaluation philosophy – evaluated nuclear structure and decay data file (by J. Tuli)   |
| 10:30-11:00 | Break   |
| 11:00-11:45 | Policies adopted in the analysis of data for ENSDF (by J. Tuli)   |
| 11:45-12:30 | Bibliographic databases in support of NSDD evaluations (NSR, CINDA) and NSR as a main source (by T. Burrows) and INIS (by W. Mandl) |
| 12:30-13:45 | Lunch   |
| 13:45-15:15 | Nuclear structure models – part 1 (by P. Van Isacker)   |
| 15:15-15:30 | Coffee break  |
| 15:30-18:15 | Participants' presentation of their work (25 min presentation + 5 min discussion each)  |

#### **Tuesday, 19 November**

- |             |  |
|-------------|--|
| 9:00-10:30  | Nuclear structure models – part 2 (by P. Van Isacker)  |
| 10:30-10:45 | Coffee break   |
| 10:45-12:30 | ENSDF: Format (by J. Tuli)   |
| 12:30-14:00 | Lunch  |
| 14:00-15:30 | Computer codes to aid in evaluation, checking and testing of NSDD evaluations, including format checking (FMTCHK): installation and running of codes (by T. Burrows) |
| 15:30-15:45 | Coffee break   |
| 15:45-18:00 | Participants' presentation of their work (25 min presentation + 5 min discussion each)   |

### Wednesday, 20 November

- 9:00-9:45 Relevant IAEA Co-ordinated Research Projects: Evaluation of Decay Data (by A. Nichols)
- 9:45-10:45 Network of NSDD evaluators – coordination of evaluation work (by V. Pronyaev – 15 min about IAEA role; J. Tuli – 45 min about the network of NSDD evaluators)
- 10:45-11:00 Coffee break
- 11:00-12:30 ENSDF: Radioactive Decay Evaluation (by E. Browne)
- 12:30-14:00 Lunch
- 14:00-15:45 ENSDF: Nuclear Reactions Evaluation (by J. Tuli)
- 15:45-16:00 Coffee break
- 16:00-17:00 HSICC: calculation of internal conversion coefficients – installation and running of the code. Other sources of ICC data, *e.g.* Rösel *et al.*, Band *et al.* (by T. Burrows)
- 17:00-18:00 GTOL – code for analysis of data on gamma-ray transitions with least-squares adjustment and intensity balance: installation and running of the code (by T. Burrows)

### Thursday, 21 November

- 9:00-10:15 Evaluation of nuclear structure data from nuclear reactions. XUNDL – file for unevaluated data (by J. Tuli)
- 10:15-10:45 Coffee break
- 10:45-12:30 ENSDF: Generation of Adopted Data Set (by E. Browne)
- 12:30-14:00 Lunch
- 14:00-16:00 LOGFT – code to calculate of  $\log ft$ ,  $I_{\beta^+}$  and  $I_{\epsilon}$ , and average  $E_{\beta^\pm}$  values: installation and running of the code (by T. Burrows)
- 16:00-16:15 Coffee break
- 16:15-18:00 PANDORA – code for checking of physical consistency of the data, combining data sets, and data renormalisation: installation and running of the code (by J. Tuli)

**Friday, 22 November**

- |             |  |
|-------------|--|
| 9:00-10:45  | Test running of realistic evaluators' exercises (E. Browne, J. Tuli and T. Burrows)                                |
| 10:45-11:00 | Coffee break   |
| 11:00-12:30 | Test running of realistic evaluators' exercises – continued (E. Browne, J. Tuli and T. Burrows)                    |
| 12:30-14:00 | Lunch  |
| 14:00-15:00 | NSDD - concluding technical discussions (E. Browne, J. Tuli, T. Burrows, A. L. Nichols and V. Pronyaev)            |
| 15:00-15:30 | Round-table discussions, review of workshop by participants and lecturers – suggestions for improvements/deletions |





**4. List of participants' presentations available on request in electronic format on CD-ROM (+) or as hardcopy report (\*)**

*P. Van Isacker, lectures on "Nuclear Structure: Part I - Single Particle Models; Part II – Collective Models" (\*)*

*J. Tuli, lectures on Evaluated Nuclear Structure Data File (ENSDF), evaluation philosophy and policy, ENSDF format, technique of evaluation, computer codes in the support of NSDD evaluation (+, many)*

*W. Mandl, invited lecture on bibliographic database INIS*

*T. Burrows, lectures on bibliographic databases and computer codes in support of NSDD evaluation (+)*

*E. Browne, lectures on methodology of the NSDD evaluations (\*)*

*A.L. Nichols, "Relevant IAEA Co-ordinated Research Projects: evaluation of decay data" (+)*

*V.G. Pronyaev, lecture on the IAEA role in the co-ordination of the international Network (NSDD Network Document)(+)*

*V.R. Vanin, "A bootstrap method for analysis of discrepant data sets"(+)*

*J.V. Marti, "Activities of the H.I. group at the TANDAR laboratory"(+)*

*T. Kibedi, G.D. Dracoulis, A.P. Byrne, P.M. Davidson, "The evolution of shape co-existence in  $Z < 82$  nuclei" (+)*

*F.G. Kondev, "Excited structures in neutron deficient Pt, Au and Hg nuclei"(+)*

*A.K. Jain, "Tilted axis rotation in  $^{136}\text{Ce}$  and shape effects"(\*)*

*I.A. Mitropolsky, "Systematics of rotational bands in odd nuclei on the basis of variable-moment-of-inertia model"(\*)*



## 5. Contents of CD-ROM: workshop material

Most of the material distributed during the workshop was bulky (manuals, tutorials, etc.) or in appropriate to produce as paperwork (computer codes, inputs for test cases), and therefore CD-ROMs were prepared with all this information available in electronic form (HTML, PDF and ASCII). These CD-ROMs contain all the necessary information and codes required to prepare evaluations for ENSDF:

1. this INDC(NDS)-439 report,
2. all manuals, reports and tutorial exercises for the preparation of evaluated data sets for ENSDF,
3. all computer codes with descriptions for the preparation of evaluated data sets for ENSDF - given as FORTRAN sources in ANSI77 standard and as FORTRAN sources and executable for Linux, MS Windows and Open VMS; status of codes: frozen version prepared by T. Burrows (November 2002), and version that can be updated from November 2002 are available from NNDC Web site:  
<http://www.nndc.bnl.gov/nndc/nndcnsdd.html#programs>
4. additional data files and materials needed for evaluation work: tables of atomic masses, new theoretical evaluation of internal conversion coefficients (ICC), etc.

CD-ROM is freely available on request From the IAEA Nuclear Data Section:

*e-mail:* [services@iaea.org](mailto:services@iaea.org)

*fax:* (43-1)26007 Nuclear Data Section

*post to:*

Nuclear Data Section

Department of Nuclear Sciences and Applications

International Atomic Energy Agency

PO Box 100

A-1400 Vienna

Austria



## 6. Conclusions and recommendations

The first IAEA Workshop on Nuclear Structure and Decay Data Evaluation was considered by the participants to have been extremely successful. Experience accumulated during this pilot workshop will allow IAEA staff to organize and hold two-week workshop with more participants at the ICTP Trieste in November 2003.

The following important recommendations were formulated by the participants:

- more time should be devoted to the practical exercises: probably one week of exercises is needed for two-weeks workshop; time used for the presentation of examples can be reduced appropriately;
- tutorials need to be developed that include a recommended sequence of operations to be used in the evaluation of data sets for the same mass chain (test cases). These test cases should be used by all lecturers and tutors during their presentations and in exercises;
- participants should be encouraged to present their own work at the beginning of the workshop;
- exercises require the full creative involvement of the participants, and should not be always undertaken as an “end-of-day activity”. These exercises should be carried out when appropriate, and linked closely to test cases and realistic cases selected by participants;
- end result of the workshop for each participant should be either completed evaluation(s) or good progress in the preparation of an evaluation





---

Nuclear Data Section  
International Atomic Energy Agency  
P.O. Box 100  
A-1400 Vienna  
Austria

e-mail: [services@iaeand.iaea.org](mailto:services@iaeand.iaea.org)  
fax: (43-1) 26007  
cable: INATOM VIENNA  
telex: 1-12645  
telephone: (43-1) 2600-21710

---

Online: TELNET or FTP: [iaeand.iaea.org](http://iaeand.iaea.org)  
username: IAEANDS for interactive Nuclear Data Information System  
usernames: ANONYMOUS for FTP file transfer;  
FENDL2 for FTP file transfer of FENDL-2.0;  
RIPL for FTP file transfer of RIPL;  
NDSOVL for FTP access to files saved in "NDS" Telnet session.

Web: <http://www-nds.iaea.org>

---