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

Co-ordination of the International Network of Nuclear Structure and Decay Data Evaluators

Summary Report of an IAEA Advisory Group Meeting

IAEA Headquarters
14-17 December 1998

Prepared by
V.G. Pronyaev

March 1999

IAEA NUCLEAR DATA SECTION, WAGRAMERSTRASSE 5, A-1400 VIENNA

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Abstract

The IAEA Nuclear Data Section convened the thirteenth meeting of the International Nuclear Structure and Decay Data Evaluators Network at the IAEA Headquarters, Vienna, 14-17 December 1998. The meeting was attended by 30 scientists from 10 Member States and 2 international organizations concerned with compilation, evaluation, and dissemination of nuclear structure and decay data. The present document contains a meeting summary, the conclusions and recommendations, the data center reports and proposals considered by the participants.

LIST OF ABBREVIATIONS

CAJaD	Centre for Data on the Structure of the Atomic Nucleus and Nuclear Reactions, Kurchatov Institute, Moscow, Russia
CBNM CEC	Central Bureau for Nuclear Measurements, located at Geel; Belgium. Now : Institute of Reference Materials and Measurements
CD-ROM	Compact disk with read-only memory.
CEC	Commission of the European Communities.
CNDC	China Nuclear Data Center, Institute of Atomic Energy (IAE) Beijing.
CPND	Charged-particle nuclear reaction data.
DBMS	Database Management System.
ENSDF	Computer-based Evaluated Nuclear Structure Data File.
Evaluation	• Mass-chain evaluation: to obtain best data for the structure and decay of all nuclides with the same mass. • Horizontal evaluation: to obtain best values of one or a few selected nuclear parameters for many nuclides irrespective of their mass.
EXFOR	Computer-based system for the compilation and international exchange of experimental nuclear reaction data.
FIZ	Fachinformationszentrum Energie, Physik, Mathematik GmbH, Eggenstein-Leopoldshafen, Germany.
IAEA/NDS	Nuclear Data Section, International Atomic Energy Agency.
ICRM	International Committee for Radionuclide Metrology.
INDC	International Nuclear Data Committee.
INEEL	Idaho Nuclear Engineering and Environmental Laboratory, USA.
INIS	International Nuclear Information System, operated by the IAEA
IP	Isotopes Project at LBNL.
IRMM	CEC Institute of Reference Materials and Measurements, Geel, Belgium.
JAERI	Japan Atomic Energy Research Institute.
KUW	Kuwait National University.
LBNL	Lawrence Berkeley National Laboratory, USA.
LIYaF	Lenigrad Institut Yadernoy Fiziki: Data Centre of the Petersburg Nuclear Physics Institute of the Russian Academy of Sciences.
NDP	Nuclear Data Project, the Oak Ridge National Laboratory.
NDS	Nuclear Data Sheets, a journal devoted to ENSDF data.
NDS	IAEA Nuclear Data Section.
NNDC	National Nuclear Data Center, Brookhaven National Laboratory, USA.
NSDD	Nuclear Structure and Decay Data.
NSR	Nuclear Science References, a bibliographic file related to ENSDF.
ORNL	Oak Ridge National Laboratory, USA.
PC	Personal Computer.
USDOE	U.S. Department of Energy.
USNDN	U.S. Nuclear Data Network.
TUNL	Triangle Universities Nuclear Laboratory, USA.
XUNDL	Experimental Unevaluated Nuclear Data List

CONTENTS

Foreword

Nuclear data are essential to the development, implementation and maintenance of all nuclear technologies. The international network of nuclear structure and decay data (NSDD) evaluators sponsored by the IAEA consists of evaluation groups and data service centers in several countries. This network has the objective of providing up-to-date nuclear structure and decay data for all known nuclides by evaluating existing experimental data.

The data resulting from this international evaluation collaboration is included in the Evaluated Nuclear Structure Data File (ENSDF) and published in the journals **Nuclear Physics A** and **Nuclear Data Sheets**. The results represent the recommended "best values" for nuclear structure and decay data quantities. The recommended values are made available to users by using various media such as on-line computer services, PC diskettes and compact disks, wall-charts of nuclides, handbooks, nuclear wallet cards, and others.

The international NSDD network has evolved from the pioneering work in the late forties and early fifties by physicists from the Berkeley Radiation Laboratory and the California Institute of Technology (USA) the Rijksuniversiteit at Utrecht (Netherlands), the Nuclear Data Group (Washington and Oak Ridge) and the Brookhaven National Laboratory (USA). The United States effort is presently coordinated by the Coordinating Committee of the U.S. Nuclear Data Program. The ENSDF master database is maintained by the US National Nuclear Data Center at the Brookhaven National Laboratory. Data from the latest version of the ENSDF are available also from other distribution centers including the IAEA Nuclear Data Section server.

Periodic meetings of the network sponsored by the IAEA Nuclear Data Section have the objectives of coordinating the work of all centers and groups participating in the compilation, evaluation and dissemination of NSDD, of maintaining and improving the standards and rules governing NSDD evaluation, and of reviewing the development and common use of the computerized systems and databases maintained specifically for this activity.

List of NSDD Meetings

Place		Date	Report
1.	Vienna, Austria	29.4. - 3.5.1974	INDC(NDS)-60
2.	Vienna, Austria	3.- 7.5.1976	INDC(NDS)-79
3.	Oak Ridge, USA	14.- 18.11.1977	INDC(NDS)-92
4.	Vienna, Austria	21.- 25.4.1980	INDC(NDS)-115
5.	Zeist, Netherlands	11. - 14.5.1982	INDC(NDS)-133
6.	Karlsruhe, Germany	3. - 6.4.1984	INDC(NDS)-157
7.	Grenoble, France	2. - 5.6.1986	INDC(NDS)-182
8.	Ghent, Belgium	16. - 20.5.1988	INDC(NDS)-206
9.	Kuwait, Kuwait	10. - 14.3.1990	INDC(NDS)-250
10.	Geel, Belgium	9. - 13.11.1992	INDC(NDS)-296
11.	Berkeley, USA	16. - 20.5.1994	INDC(NDS)-307
12.	Budapest, Hungary	14. - 18.10.1996	INDC(NDS)-363
13.	Vienna, Austria	14. - 17.12.1998	INDC(NDS)-399

Introduction

The thirteenth meeting on the Coordination of the International Network of Nuclear Structure and Decay Data (NSDD) Evaluators was held in the IAEA Headquarters, Vienna, from 14-17 December 1998. The meeting was attended by thirty participants from ten countries and two international organizations representing all major data evaluation and data dissemination centers. The list of participants is given in **Annex 1**.

The meeting was opened by D.W. Muir, Head of the Nuclear Data Section of the IAEA. He welcomed participants and introduced V. Pronyaev as the new Scientific Secretary of NSDD network coordination meetings. D.D. Sood, Director of the Division of Physical and Chemical Sciences welcomed participants on behalf of the IAEA. He emphasized that service of the users working in nuclear applications has to be considered as a first priority task for the network of NSDD evaluators.

D. De Frenne was confirmed as Chairman of the meeting.

The Evaluated Nuclear Structure Data File (ENSDF) together with its bibliographic companion, the Nuclear Science Reference (NSR) file, contain the information in computerized form on evaluated data for more than 2500 isotopes, including lifetimes and decay properties, nuclear level schemes with level excitation energies, spins, parities and branching ratios for different decay modes. These two files provide a convenient basis for the preparation of specialized, application-oriented data libraries.

The tasks of input preparation for the ENSDF and NSR databases, data processing, data retrievals and computer program development are performed presently in more than twenty data evaluation and dissemination centers. A list of ENSDF evaluation centers with evaluation responsibilities assigned for the 1999-2000 time frame is given in **Annex 2.**

A list of other centers with evaluation activities contributing to ENSDF and dissemination centers is given in **Annex 3**.

Coordination meetings of the NSDD Network are held every two years under IAEA auspices to review the results of previous two years' activities and to plan the work for the next two years. Due to rapid development of a global computer network and unification of the access to the databases through the Web, steady progress is observed in the online dissemination of the data. But new users and new applications create new requirements to the data. To improve the response in these changing conditions based on the efficient sharing of the work between all network participants, was a main task of the meeting.

Objectives of the meeting

The objectives of the meeting are the following:

Coordination of the activities of all centers participating in the evaluation, compilation and dissemination of the Nuclear Structure and Decay Data Network. The meeting should agree on a coordinated activity plan with well defined priorities for the next two years.

Review of the recent and future developments of the computerized ENSDF database with the aim of improving the quality of the database despite the decrease in manpower and the increase of new needs.

Provide for the publication of the evaluated NSDD work in "Nuclear Data Sheets" and in new electronic and other print media. A more extensive and appropriate publicity for the Network activities is desirable.

The challenge of the 21st century: which direction will our activities follow and to whom will we address them, taking into account the needs of all users, the needs of the frontier nuclear research areas, and budget limitations.

Meeting summary

Manpower

One of the important issues at this meeting was the concern of the participants about the continued decline in manpower due to worldwide funding problems and retirement of experienced evaluators. This problem can only partially be solved by the development of new computer codes which will be available in the near future and which will increase the quality of the input data. They will decrease the time needed to input the data. An increase in the quality of the data can also be obtained by bringing in experts in different fields of Nuclear Structure. The meeting agreed that these experts can be extremely useful in the creation of various specific horizontal evaluations and in the review of mass chain evaluations. Nevertheless, in the long term, recruitment of new young evaluators for the project is absolutely essential.

The long term view of the NSDD effort was discussed at length. In order to make both short- and long-term planning in a rational manner, a discussion was held as to what the ENSDF activity may look like in the year 2010. The discussion acknowledged the currently decreasing funding, aging of the evaluators, new types of measured structure data, new types of users with different demands for currency, and new media for presentation of the products.

Mass Region Assignments and Centers Evaluation Activity

The mass region assignments were reviewed. The revised list of A-chain assignment is shown in **Annex 2**. Newly assigned responsibilities are shown in **bold**. The number of ENSDF evaluators working in nuclide and mass-chain evaluations is shown by FTE in the Table. It was agreed that centers which do not contribute to ENSDF for a continuous 5 year period would no longer be considered participants of ENSDF evaluators' network.

Publicity

Methods to publicize the existence and importance of ENSDF were discussed. This includes the common display of the ENSDF name on products that include ENSDF data or which are based on ENSDF data.

NSR

The status of the NSR database and possible improvements were discussed. Suggestions should be sent to David Winchell (BNL).

ENSDF

There is an increasing desire to use ENSDF by the nuclear-structure basic research community. At present, some researchers find it somewhat awkward to extract "horizontal" information (*e.g.*, mass-dependence of a particular property of levels or decay processes) from ENSDF, because of its format. Such extractions might be aided by changes in the data storage format and/or more uniform data entry by the evaluators.

Technical Items

Many technical details were discussed. Of special interest were methods to facilitate the entry of data into ENSDF, the desire to provide more prompt access in the ENSDF format to newly published data, and the computer assistance in editing data sets.

The creation of a file of experimental unevaluated data, XUNDL (previously called UNSDF) was described which may help with the first two needs mentioned above (see proposal on "Unevaluated Nuclear Structure Data File" by D. Winchell and B. Singh).

An ENSDF editor which would address the third need mentioned above was discussed and the related manpower needs were noted (see proposal on "Specifications for an ENSDF Editor" by T. Burrows and F. Chu).

The work on preparation of a new table of internal conversion coefficients was presented (see status report on "New Calculation of Internal Conversion Coefficients" by S. Raman).

A proposal on the revision of the J^{π} assignment rules, in general and for high spin data in particular, was discussed (see "Proposed Revisions to Strong Arguments for Spin-Parity Assignments as Specified in Nuclear Data Sheets" by D. Burke and B. Singh).

A code to compute averages using the Limitation of Relative Statistical Weights method (LRSW) was presented (see corresponding paper by R. Helmer and E. Brown). The program will be distributed to NSDD members for their assessment and possible use.

The proposal by J. Blachot on the limitation of the ENSDF file to include only the adopted and decay data sets was discussed.

The backlog in compilation of high-spin data (about 550 data sets) was discussed. Two man-years' work is needed to introduce this data into the XUNDL database with use of modern technology.

Priority list of the nuclides for decay data evaluation for astrophysics presented by E. Norman, LBNL Isotope Project was discussed.

Conclusions and Recommendations

Recommendations of the AGM to the IAEA

The AGM finds the IAEA role in coordinating the worldwide network of nuclear structure and decay data centers to be most valuable. AGM strongly recommends that the IAEA continue to perform this function in the future.

The AGM recommends that the IAEA continue the sponsorship of biennial Advisory Group Meetings of the members of the NSDD network, and the publication of several useful technical documents, including the summary reports of these meetings.

The AGM urges the IAEA to recognize the special character of these biennial meetings. These meetings accomplish the major organizational tasks associated with the operation of this data network, and they provide an essential forum for addressing major scientific and technical issues expected to affect the network in the near term. To accomplish these goals, the active participation of experts representing all of the NSDD data centers in the biennial meeting is essential.

The AGM wishes to emphasize the importance of ensuring that the meeting summary reports are issued in a timely manner in order that the work of the network is conducted in an efficient manner. We strongly urge the Agency to continue to use the medium of unedited INDC reports for this purpose.

The AGM recommends that the IAEA initiate a series of Workshops on Nuclear Structure and Decay Data at the ICTP Trieste. The workshops should provide a forum for know-how transfer, particularly to scientists in developing countries, including the training of young scientists in structure and decay data evaluation methodology and its applications.

The AGM notes that the main product of the NSDD network, Evaluated Nuclear Structure Data File (ENSDF), contains data used practically everyday in any nuclear application, such as safeguards, safety, power, food, medicine, environment and many others. This file is of enormous value and it should continue to be maintained, updated and disseminated in a professional and coordinated manner.

The AGM notes that the enormous value of the ENSDF file, distributed free of charge, is often not fully appreciated. To increase user awareness of this fact, AGM recommends that the IAEA considers a mechanism aiming to label all products using ENSDF data in a style "ENSDF inside".

The AGM recommends that the IAEA consider preparing its future nuclear data program, the proposals supported by network participants for holding of Consultant's Meetings, Workshops and Coordinated Research Programs related with the evaluation and practical use of the ENSDF.

Administrative Items

Since the Utrecht group will no longer participate in this evaluation effort, a committee chaired by D. De Frenne and composed of E. Norman, R. Helmer, J. Tuli and R. Tilley will monitor the work in this area and study the future needs. Since the Nuclear Physics and ENSDF publications include some different data, this committee shall consider whether the Nuclear Physics form or content should be continued. In the interim

(i) LBNL will enter the 1998 publication on A=21-44 by Endt into ENSDF;
(ii) If any nuclide or A-chain in the range A=21-44 appears in the priority list, the NNDC will coordinate its updating.

Horizontal Evaluations

The need to develop methods for making optimum use, within ENSDF, of the results of horizontal evaluations was discussed at several points in the program. It is recognized that horizontal evaluations can be an important supplementary source of information for ENSDF evaluators in preparing a nuclide or mass-chain evaluations. Therefore, it is recommended that persons intending to perform an ENSDF-related horizontal evaluation inform the NSDD before the start of such an effort. The ENSDF file manager, in consultation with the horizontal data evaluator, will develop a plan for ultimately incorporating this horizontal evaluation into the ENSDF database. The proposal and implementation plan will be circulated to the NSDD network for comments before it is approved. Upon completion of an approved horizontal evaluation or an update to an approved horizontal evaluation, the ENSDF database manager will circulate the results to the network members for review. After network approval, the ENSDF file manager will be responsible for integration of the evaluation into individual nuclide or mass-chain evaluations, in consultation with the responsible ENSDF evaluators according to the approved plan. (See Action 6 in Annex 4).

Technical Items

The use of NN as "chemical" symbol for neutron was adopted (see proposal on "Change the Chemical Symbol for Neutron (Z=0) from "N" to "NN"" by T. Burrows).

The proposal from J. Tuli on "P-records in IT and SF Decay Data Sets" was discussed and adopted.

Formats for including ionized atom data into ENSDF were discussed and the proposed revisions by BNL were adopted as an interim format (see "ENSDF Data Sets for Ionized Atoms" proposal by T. Burrows and B. Singh).

ENSDF format and contents changes related to year 2000 were adopted (see J.K. Tuli's proposal "ENSDF Changes Related to the Year 2000").

The recommendation by J. Blachot that the ENSDF evaluators test energy released in decay channels was discussed and adopted (see Action 4 in Annex 4).

A committee, chaired by D. De Frenne and consisting of D. Burke, J. Wood, J. Tuli, Y. Akovali, C. Reich will draft a modified set of strong and weak rules for J^{π} assignments in ENSDF. They will circulate this draft and edit it for final adoption at the year-2000 meeting of the NSDD.

Next Meeting

The next NSDD Network Meeting will be held in Vienna on 14 - 17 November 2000 as it was determined by the network participants (see Action 29 in Annex 4).

To allow coordination between NSDD meetings, Denis De Frenne was elected as chairman/coordinator and Charlie Dunford as deputy chairman/coordinator through the next NSDD meeting.

ANNEXES

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Annex 2

Evaluation responsibility and effort table.

Nuclear Mass	Responsible Center	FTE 1998	FTE 1999
45-50, 57,58, **60-63***), 65-73, **86**, **88**, 94-97, 99, 136-148, 150, 152, 165, 199	National Nuclear Data Center Brookhaven National Laboratory, USA	1.5	1.9
82, 84, 85, 200-205, 207-209, 213-236 (except 215,219, 223, 227), 237-243 (odd), 245-266	Nuclear Data Project, Oak Ridge National Laboratory, USA	1.0	0.5
81, 83, 90-93, **166**, 167-187, 189, 191-193, 206, 210-212, 215, 219, 223, 227	Isotope Project, Lawrence Berkeley National Laboratory, USA	2.1	2.5-2.75
87, 153-163	Idaho National Engineering and Environmental Laboratory, USA	0.4	0.35
2,3-20	Triangle University Nuclear Laboratory, USA	1.2	0.7
1, 238-244 (even)	Center for Nuclear Structure and Reaction Data, Kurchatov Institute of Atomic Energy, Russia	0.25	0.25
130-135	Nuclear Data Center, Petersburg Nuclear Physics Institute Academy of Sciences of Russia, Russia	0.5	0.5
21-44 (see also Action 1 in Annex 4)	Fysisch Laboratorium, Utrecht, The Netherlands	0.35	0.0
51-56, **59**, 195-198	Institute of Atomic Energy + Jilin University People’s Republic of China	0.3 0.3	0.1 0.2
101, 104, 107-109, 111, 113-117	Centre d’Etudes Nucleaires, Bruyeres l'Chatel, France	0.2	0.0-0.2
118-129	Nuclear Data Center, Japan Atomic Energy Research Institute, Japan	1.5	1.5
74-80	Nuclear Data Center, Physics Department, Kuwait University, Kuwait	0.6	0.3
102, 103, 105, 106, 110, 112	Laboratorium voor Kernfysica, Gent, Belgium	0.35	0.3
64, **89**, 98, 100, 149, 151, **164**, **188**, **190**, **194**	Department of Physics and Astronomy, McMaster University, Canada	0.75	0.75

*) Former responsibility of Institute of Physics, University of Lund, preliminary reassigned to NNDC

Annex 3

Other Evaluation and Dissemination Centers

1. Other Centers with evaluation activities contributing to ENSDF.

Atomic Masses	Centre de Spectrometrie Nucleaire et de Spectrometrie de Masse, France
Nuclear Moments	Physics Department, University of Oxford, United Kingdom
Neutron Capture Gammas	Institute of Isotopes and Surface Chemistry, Chemical Research Center, Hungary
E0 Systematics	School of Physics, Georgia Institute of Technology, USA

2. Dissemination Centers

US/NNDC	National Nuclear Data Center, Brookhaven National Laboratory, USA
US/LBNL	Isotope Project, Lawrence Berkeley National Laboratory, USA
US/SJS	Center for Nuclear Information Technology, San Jose State University, USA
US/SDV	Scientific Digital Visions, Inc., San Jose, USA
US/ORNL	Nuclear Data Project, Oak Ridge National Laboratory, USA
US/TUNL	Triangle University Nuclear Laboratory, USA
France/AMDC	Centre de Spectrometrie Nucleaire et de Spectrometrie de Masse, France
Sweden/Lund	Department of Physics, Lund University, Sweden
IAEA/NDS	Nuclear Data Section, International Atomic Energy Agency, Austria
OECD/NEADB	OECD Nuclear Energy Agency Data Bank, France

Annex 4

List of Actions of 1998 NSDD Advisory Group Meeting.

No.	Responsible	Reason	Action
1	D. De Frenne, Lab. voor Kernfysica, Gent	The non-availability of the Utrecht group	Chair committee monitoring and reviewing A=21-44 progress or needs
2	D. De Frenne, Lab. voor Kernfysica, Gent	J^{π} rules established in the early 1970's	Organize committee to prepare revised J^{π} rules
3	J. Tuli, BNL/NNDC	Provide users with a more complete information. Data centers (groups) permanently working with horizontal evaluations should be listed in the Nuclear Data Sheets introductory page	Redesign front pages of NDS to include distribution centers and their contacts. List the data centers (groups) permanently working with the horizontal evaluations with separate list of their assigned responsibilities in the Nuclear Data Sheets
4	J. Tuli, BNL/NNDC	Quality assurance test	Advise evaluators to run RADLIST and comment on agreement of Q-value and sum of decay energies and X-ray intensities measured and calculated
5	J. Tuli, BNL/NNDC	Priority list evaluations has to be updated	Send priority list for nuclide and mass chain ENSDF evaluations yearly
6	J. Tuli, BNL/NNDC	Format and consistency problems could arise for certain horizontal evaluations	Coordinate between horizontal evaluators and A-chain evaluators the procedures for inserting horizontal evaluations into ENSDF
7	J. Wood, GEORGIA TECH	Incomplete data set of ρ^2(E0) in ENSDF	Provide NNDC with improved ρ^2(E0) data for inclusion in ENSDF
8	R. Helmer, INEEL	Integration into ENSDF	Coordinate with file manager the entry of DDEP results into ENSDF
9	BNL/NNDC	ENSDF analysis and checking codes need to remain current as to formats, physics requirements, and the needs of the community	Update codes for approved format changes. Add logic to LOGFT for low-energy electron capture and 3rd- and 4th-forbidden unique decays. Upgrade distributed version of RadList. Provide up-to-date PC versions of the codes
10	All network participants	Results of large activity in horizontal evaluations is not always or timely incorporated into ENSDF	Keep abreast of and solicit activities in other areas where horizontal evaluations may be appropriate for incorporation into ENSDF. Action continuing from 1996
11	All network participants	Materials of some conferences, meetings and laboratory reports related to NSDD are not always available to NSR compilers in NNDC	Assist to NNDC in coding of conferences proceedings, meeting and lab reports for NSR
12	V. Pronyaev, IAEA/NDS	Main characteristics and parameters of NSDD evaluators network has to be agreed upon and fixed	To publish NSDD network document as INDC(NDS) report after coordinating it with network participants
13	BNL/NNDC	Published versions of ENSDF are needed	Continue a journal "publication" for the mass chain evaluations

14	IAEA/NDS	Coordination of network activity between NSDD meetings and preparation to the next meeting	To nominate a chairman and deputy chairman for next NSDD meeting at the current NSDD meeting
15	Network	Misprints and errors may be found in NSR and ENSDF	Report all errors detected in NSR and ENSDF, as soon as they are found, to NNDC
16	ENSDF evaluators	To accelerate the review process	Each ENSDF evaluator should be willing to do 2 mass-chains equivalent reviews per FTE-year
17	Ch. Dunford, BNL/NNDC	Data from new Resonance Parameters Evaluation should be freely available through network	To contact directly with S. Sukhoruchkin on problem of data availability
18	BNL/NNDC	Researchers are not familiar with ENSDF format	Promote the concept that researchers should supply data to network in complete, tabular form
19	N. Stone, Oxford Univ.	Decrease of NSDD manpower in Europe	Write an information article about nuclear data evaluation in NUPECC news
20	R. Tilley, TUNL, E. Norman, LBNL/IP	To bring attention of nuclear community to the NSDD evaluation work	Write an information article about nuclear data evaluation in Physics Today
21	N. Stone, Oxford Univ. (ENDT)	Decrease of NSDD manpower in Europe	Seek ways and means to stimulate nuclear structure data evaluation in Europe
22	BNL/NNDC, LBNL/IP, SJSU/CNIT	To simplify the data input into ENSDF and the editing of ENSDF files	Research expeditious methods of producing an ENSDF input/checking (editor) program with due recognition of the limited resources of the Network
23	IAEA/NDS	To avoid duplication of the work	Prepare a plan for a coordinated non-US software development activity in consultation with the US Nuclear Data Program
24	All evaluators	Encourage specific new measurements	Indicate in the Abstract of an evaluation, gaps in data, or discrepancies that could be resolved by new measurements.
25	Data center managers	To attract young scientists to data evaluations	Consider a 50%-50% split between research and evaluation of structure data
26	NSDD network	To have input to the IAEA/NDS program for 2001-2002	To submit to the IAEA/NDS programmatic proposals for future nuclear structure related activities
27	T. Langlands, SDV	Public access to drafts and internal network documentation should be limited by network participants	To create site for network internal documentation exchange and distribution
28	V. Pronyaev, IAEA/NDS	To avoid delay with Summary Report publication	To publish NSDD98 AGM Summary report in February 1999
29	NSDD network	To choose the date for next meeting	To send to D. De Frenne dates most convenient for holding the NSDD 2000 AGM
30	NSDD network	To improve NSR	To send comments and suggestions to David Winchell at BNL

Annex 5

A. Agenda

A. Introductory Items

1. Opening statements
2. Confirmation of meeting chairman
3. Adoption of the agenda
4. Review of meeting goals
5. Accomplishment of action items set at previous meeting

B. Presentation of Activity Reports

1. Short status reports concerning mass chain evaluations, horizontal evaluations and application oriented NSDD activities

    a. NSDD activities and ENSDF evaluators reports - horizontal evaluator's reports
    b. Reports on application oriented NSDD activity

2. Data centre reports concerning dissemination and organization of on-line and off-line access to the ENSDF and its derivatives

C. ENSDF Administrative and Technical Items

0 Long Term View of the NSDD efforts

1. Administrative items
    a. Evaluation review
    b. Priorities in evaluation
    c. Evaluator manpower situation
    d. Redefinition responsibility of the groups
    e. A=21-44 status
    f. Needs and plans for horizontal evaluations
    g. Status and improvements of the NSR database

2. Technical items regarding ENSDF(Proposals/Position papers)
    a. Processing and checking codes
    b. Internal conversion coefficients
    c. Weighted averaging
    d. Log *ft* systematics
    e. Spontaneous fission
    f. Thermal neutron capture
    g. Ionized atoms
    h. JPI rules
    i. Integration of horizontal evaluations into ENSDF
    j. UNSDF
    k. XREF for gammas
    l. ENSDF: only Adopted Levels and Decay Data
    m. Decay data-Radlist
    n. Evaluation Decay data Astrophysics

3. ENSDF evaluation tools

D. ENSDF Customer Services

1. Dissemination of ENSDF data
2. Outreach, including user oriented databases
3. Documentation.

E. Concluding Items

1. Recommendations and actions
2. Next meeting

Annex 6

B. Status Reports: Evaluation Centers

B1 Status Report of Nuclear Structure and Decay Data Evaluation for A-Chain in China
Zhou Chunmei, China Nuclear Data Center, China
Huo Junde, Jilin University, China
B2 Status Report of the Nuclear Physics Laboratory at Jilin University
Junde Huo, Jilin University, China
B3 Status Report of Japanese Activities for Nuclear Structure and Decay Data Evaluation
J. Katakura, JAERI, Japan
B4 Grenoble Group Status Report
Jean Blachot, Grenoble, France
B5 IAEA Nuclear Data Section Activity Related with NSDD.
D. Muir, V.G. Pronyaev, Nuclear Data Section, IAEA, Austria
B6 Belgian Group Status Report
D. De Frenne, E. Jacobs, Belgium
B7 Status Report: Nuclear Data Project at McMaster University
B. Singh, McMaster University , Canada
B8 Nuclear Structure and Decay Data Evaluation and Related Activities at the INEEL
R.G. Helmer, Idaho National Engineering Laboratory, USA
B9 Status Report on NSDD Activity of the PNPI Data Center
I.A. Kondurov, Petersburg Nuclear Physics Institute,Russia
B10 Nuclear Data Project, Evaluation Activity Report
Y.A. Akovali, A. Artna-Cohen, J.C. Blackmon, D. Radford, M.S. Smith,C.-H. Yu ORNL, USA
B11 Isotopes Project Status Report
E.B. Norman, C.M. Baglin, E. Browne, S.Y. Chu, J.M. Dairiki
R.B. Firestone, B. Singh, LBNL, USA
B12 CAJAD activity related with ENSDF.
F.E. Chukreev, "Kurchatov Institute",Russia
B13 Status Report of Nuclear Data Center of Kuwait University
A. Farhan, E. Davis, Nuclear Data Center, Kuwait University, Kuwait.
B14 National Nuclear Data Center Activity Report
M.R. Bhat
B15 TUNL Nuclear Data Evaluation Project
D.R. Tilley, Triangle Universities Nuclear Laboratory, Dept. of Physics, North Carolina State University, Raleigh, NC
H.R. Weller, C.M. Cheves, J.H. Kelley, J.L Godwin, Dept. of Physics, Duke University, Durham, North Carolina, USA

Status Report of Nuclear Structure and Decay Data Evaluation for A-Chain in China

Zhou Chunmei
China Nuclear Data Center
China Institute of Atomic Energy
China
Huo Junde
Department of Physics, Jilin University
China

The Chinese group has permanent responsibility for evaluating and updating NSDD for A=51-56, and 195-198; temporary for A=61, 170, and 172. The status is as follows:

Updated-A	Status	Evaluators
51	NDS, 81, 183(1997)	Zhou Chunmei
	NDS, 62, 229(1994)	Zhou Chunmei
	NDS, 48, 111(1986)	Zhou Chunmei, Zhou Enchen
52	NDS, 71, 659(1994)	Huo Junde
	NDS, 58, 677(1989)	Huo Junde
53 *	submitted for publication	Huo Junde
	NDS, 61, 47(1990)	Huo Junde
54	NDS, 68, 887(1993)	Huo Junde
	NDS, 50, 255(1987)	Huo Junde
55	NDS, 64, 723(1991)	Huo Junde
	NDS, 44, 463(1985)	Zhou Enchen, Huo Junde,et al.
56 *	submitted for publication	Huo Junde
	NDS, 67, 523(1991)	Huo Junde
	NDS, 51, 1(1987)	Huo Junde,Zhou Chunmei,et al.
195 *	submitted for publication	Zhou Chunmei
	NDS, 71, 367(1994)	Zhou Chunmei
	NDS, 57, 1(1989)	Zhou Chunmei
196	NDS, 83, 145(1998)	Zhou Chunmei, Wang Gongqing
	NDS, 76, 1(1995)	Wang Gongqing, et al.
197	NDS, 76, 399(1995)	Zhou Chunmei
	NDS, 62, 433(1991)	Zhou Chunmei
198	NDS, 74, 259(1995)	Zhou Chunmei
	NDS, 60, 527(1990)	Zhou Chunmei
61	NDS, 67, 271(1992)	Zhou Chunmei
170	NDS, 50, 351(1987)	Zhou Chunmei
172	NDS, 51, 577(1987)	Wang Gongqing
176	NDS, 84, 337(1998)	E.Browne, Huo Junde

* revised evaluation has been sent to NNDC/BNL.

We have got no financial support from China National Nuclear Corporation and others since 1997. We have done NSDD evaluation for A-chain in our spare time since then. We take this chance of expressing our sincere appreciation of IAEA support for us to attend NSDD meeting.

Status Report of the Nuclear Physics Labratory at Jilin University

Junde Huo
Jilin University
China

I. Nuclear Data Evaluations.

1. Mass-chain evaluation

The Jilin University group has permanent responsibility for the evaluation of five mass chains (52, 53, 54, 55, and 56). Since the 1996 IAEA meeting of NSDD (Budapest, Hungary), the following mass chains have been submitted:

A=56, NDS (submitted April, 1998)

A=53, NDS (submitted August, 1998)

The evaluated work is currently in progress on A=52 last published by the Jilin University group in 1994. It is expected that it will be completed and submitted by March, 1999.

The A=176 has been published in association with the Isotopes Project at Berkeley. Jilin University group has completed the evaluation of high-spin data of the mass chain:

A=176 , NDS, 84, 337 (1998) (Joint with E. Browne)

2. Decay data evaluation

Decay data of ^{154}Eu and ^{156}Eu have been evaluated using new measured results (including the data of Jilin University)

II. HIGH-SPIN DATA MEASUREMENT

The papers of research work on high-spin measurement and systematic study at Jilin University are published as following:

1. Systematic study of spin assignments of $\pi h_{11/2} \otimes \nu h_{11/2}$ bands of doubly odd nuclei around A=130, Phys. Rev., C54 (1996) 719-730;
2. Low-spin signature inversion in ^{162}Lu, J. Phys., G22 (1996) 415-420;
3*. Deformation driving character of the 1/2-[541] orbital in ^{171}Lu , Chin. J. High Energy Phys. Nucl. Phys., 20 (1997) 313-317;
4. Low-spin identical bands in non-adjacent odd A and even-even nuclei, Chin. Phys. Lett., 14 (1997) 255-258;
5. First identification of high-spin states in ^{166}Ta, J. Phys., G23 (1997) 723-727;
6*. Superdeformed triaxial bands in ^{167}Lu, Eur. J. Phys., A1 (1998) 237-239;
7*. New rotational bands in ^{174}Ta, Eur. J. Phys., A (1998) (in press);
8. Spin assignments of yrast bands in doubly odd $^{118-132}$Cs, Phys. Rev., C (1998) (in press)

* Joint with Institute Atomic Energy, (China)

Status Report of Japanese Activities for Nuclear Structure and Decay Data Evaluation

J. Katakura
Nuclear Data Center
Japan Atomic Energy Research Institute
Japan

1 Personnel

The present members of Japanese group for the evaluation of Nuclear Structure and Decay Data are following: H. Iimura, J. Katakura, M. Kanbe, K. Kitao, S. Ohya, K. Ogawa, M. Oshima, T. Tamura, Y. Tendow. Most of them are part time evaluators. Now we have strong feeling that we should recruit new members in order to maintain the mass chain evaluation activity.

2 Mass-chain evaluation

The mass chain evaluation Japanese group has the responsibility is for A=118-129. The last publication of the mass chain and the status are listed in the following table.

Status of Mass Chain Evaluation

Mass	NDS publication	Evaluators	Status
118	NDS 75, 99 (1995)	Kitao	
119	NDS 67, 327 (1992)	Kitao, Kanbe, Ogawa	to be submitted (Ohya, Kitao)
120	NDS 52, 641 (1987)	Hashizume, Tendow, Oshima	Post review (Kitao)
121	NDS 64, 323 (1991)	Tamura, Ohya	Evaluating (Tamura)
122	NDS 71, 461 (1994)	Tamura	Evaluating (Tamura)
123	NDS 70, 531 (1993)	Ohya, Tamura	
124	NDS 80, 895 (1997)	Iimura, Katakura, Tamura, Kitao	
125	NDS 70, 217 (1993)	Katakura, Oshima, Kitao, Iimura	Pre review (Katakura)
126	NDS 69, 429 (1993)	Miyano	
127	NDS 77, 1 (1996)	Kitao, Oshima	
128	NDS 38, 191 (1983)	Kitao, Kanbe, Matumoto	Eval. to 2/92 (Kanbe) to add 92-98 info. (Kitao)
129	NDS 77, 631 (1996)	Tendow	

The NDS publication after the previous meeting is only A=124. Other evaluations are being continued, but a little bit delayed. As for A=128, Dr. Kanbe finished the work putting data as of February, 1992, into the A=128 evaluation, but time has past after his evaluation, so Dr. Kitao now works on adding the information after 1992. After Dr. Kitao's work, the evaluation will be published on NDS.

3 Computer

The evaluation work is carried out with analysis codes distributed by BNL. Those codes are operational on our IBM compatible main-frame and personal computers. Most of the codes are also operative on Macintosh.

4 Other related activities on nuclear structure and decay data evaluation

4.1 Bibliographic data compilation

Computerized compilation of Japanese references (secondary sources) is being carried out by RIKEN nuclear data group continuously. Dr. Tendow, however, retired RIKEN in 1997. He can still work on the compilation, but the future work of the compilation is not certain.

4.2 Revision of the Chart of Nuclides

The chart of Nuclides are regularly published almost very 4 years from 1977. The 6th edition was published in 1996[1] and is available from Nuclear Data Center, JAERI. The chart is characterized by inclusion of estimated values for unmeasured beta-decay partial half-life of the nuclides far from beta stability line. Those values are based on “Gross theory of beta decay” by Waseda University group. The nuclides included in the chart is about 3000 nuclides. The experimentally identified nuclides are 2683. The number of the experimentally identified nuclides included in the chart is shown in Fig. 1 as a function of year.

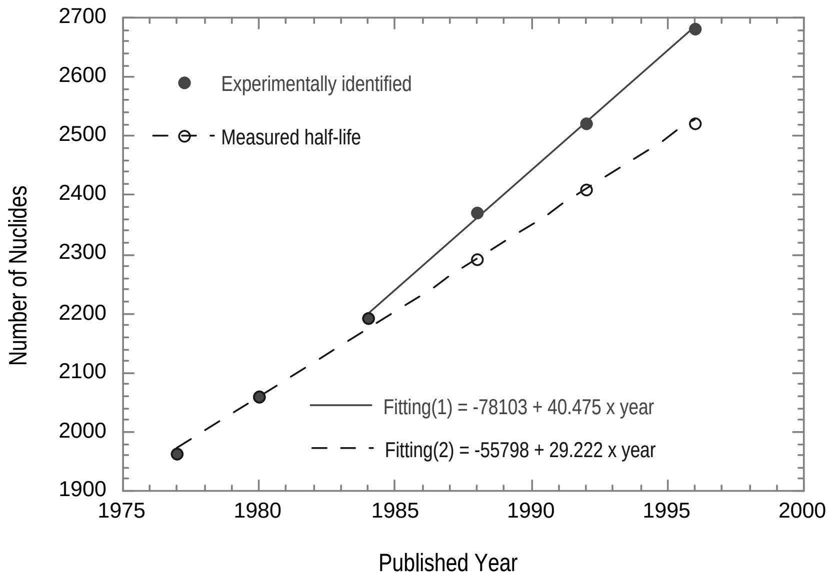

Figure 1: Number of Nuclides contained in Japanese Chart of Nuclides

As seen in this figure, about 40 nuclides are identified per year after 1984. Before the year the experimentally identified nuclides had also measured half - life. But after the year the half - life is not always measured. The number of nuclides with measured half - life steadily increase at the rate of about 30 per year from 1977, the year the first version of the Japanese Chart of Nuclides was published.

The chart is also seen on our web site: *http://wwwndc.tokai.jaeri.go.jp/CN96/index.html.*

The data collection for the 7th edition has been continued after the publication of the 6th edition. The 7th edition is scheduled to be published in 2000 fiscal year.

4.3 Gamma-rays table from ENSDF

"Natural Background Gamma-ray spectrum" data were published as a JAERI's report [2].The report includes a list of γ rays ordered in energy from natural radionuclides. The list also contains γ rays from radioactive nuclides produced in a germanium detectors and its surrounding materials by interaction with cosmic neutrons, as well as direct γ rays from interaction with the neutrons.

4.4 Fission product data library for reactor decay heat estimation

After the release of JNDC-V2 library for decay heat estimation of a nuclear reactor in 1990, the updated file is now preparing as a JENDL special purpose file with JENDL (ENDF) format for the use of application field. The file will contain half-life, Q_β value, β– and γ–decay energy values, branching ratio and spectrum data of β and γ–rays as ENDF file does. Experimental data are retrieved from ENSDF file with a little modification because the normalization of some decay data sets is not appropriately put in for making decay data file with JENDL format.

References

[1] T. Horiguchi, T. Tachibana and J. Katakura, "Chart of Nuclides 1996", Japanese Nuclear Data Committee and Nuclear Data Center, Japan Atomic Energy Research Institute (1996)

[2] T. Ichimiya, T. Narita and K. Kitao, "Natural Background Gamma-ray Spectrum-List of Gamma-Rays Ordered in Energy from Natural Radionuclides", JAERI-Data/Code 98-008, Japan Atomic Energy Research Institute (1998)

Grenoble Group Status Report

Jean Blachot
SPSMS/CENG, Grenoble
France

We have started to participate to the network since the beginning. We will give the status of our mass evaluation, after a small report on our NUBASE activity, then a description of the work on Decay Data , and we will present some points , which could be discussed during the meeting.

1. Status of publications in NDS:

101 NDS 83, 1 (1998)
103 Published one , but Gent responsability
104 NDS 64, 1 (1991)
107 NDS 62, 709 (1991)
108 NDS 81, 599 (1997)
109 NDS 64, 913 (1991) , in Review
111 NDS 81, 753 (1997) (Te)
113 NDS 83, 847 (1998)
114 NDS 75, 81 (1994)
115 NDS 67, 1 (1992) sent to BNL after corrections Comments reviewer
116 NDS 73, 81 (1994)
117 NDS 84, 115 (1998) (Sb)

2. NUBASE.

The database NUBASE is developed by the ATOMIC MASS EVALUATION (G. Audi; A.H. Wapstra) in collaboration with O. Bersillon and myself. NUBASE has been already presented at the last meeting in Budapest. The 1997 version was published in Nucl. Phys. A624, 1. Tools has been written to read the data on PC (Nucleus) and also on the Web (AMDC, LUND). Some of the data not in ENSDF at the time of the publication have already been included. LBNL has proposed to do this task in the future.

Few discrepancies are still remaining between ENSDF and NUBASE. We hope to discuss in the meeting the way and the rules to reduce them.

3. Decay data.

In collaboration with O. Bersillon we have used and also improved the RADLIST code to build decay data files. In particular the existing JEF-2 or ENDF/B-VI need improvements before to be used in some new projects.

Nuclear Data Section Activity Related with NSDD.

D. Muir, V.G. Pronyaev
Nuclear Data Section, IAEA
Austria

This report briefly summarizes Nuclear Structure and Decay Data (NSDD) related activity of the IAEA Nuclear Data Section (NDS) for the period October 1996 to September 1998.

1. Online NSDD user service.

Starting from 1997, in addition to the Telnet, the Web access to the ENSDF and derived databases is available from the NDS server. ENSDF database was regularly (twice per year) updated. The following statistics shows the user's online retrievals and accesses through Telnet/NDIS and Web to ENSDF, NSR, NUDAT, MIRD and XRAY for the reported period:

	NSR	WALLET	ENSDF	NUDAT	MIRD	XRAY	ENSDF utility codes
Telnet/NDIS retrievals (Oct1996-Mar1998)	856	-	621	1441	25	257	-
Web Acesses (Oct1996-Aug1998)	-	5966	1178	687	608	-	850

2. Offline NSDD user service.

367 hard copies of the Nuclide Charts (Knolls, Karlsruhe an JAERI) and 8 copies of PC NUDAT packages on CD-ROM were distributed on requests from users.

3. Current and planned parallel (but relevant) programs and projects.

i) NDS contribution to the IAEA Analytical Quality Control Services (AQCS) program.

Recommended half-life decay data for 30 nuclides included in the AQCS list are needed in regular updating as a reference data. The recommended half-life values presently adopted for AQCS are based on results of two IAEA Coordinated Research Projects finished in 1986 and 1991. There are no serious discrepancies with half-life central values presented now in ENSDF, but in a few cases uncertainties given in ENSDF are substantially reduced. To maintain consistency with ENSDF the following approach can be used for updating of evaluated data files for special applications: to store in the files latest, on date of evaluation, data either from ENSDF or from internationally recommended data file of "horizontal" evaluation. This also will require that ENSDF evaluators working with preparation of complete isotope or mass chain evaluation, consider the internationally recommended values with a highest priority.

ii) Coordinated Research Project on Reference Input Parameter Library (RIPL).

The files, data from which can be directly used for nuclear reaction model calculations, are prepared under this project (see IAEA-TECDOC-1034, Reference input parameter library. Handbook for calculations of nuclear reaction data, 1998). The NSDD related part includes data on atomic mass and deformations, discrete level schemes and level densities, gamma-ray strength functions. Basic NSDD libraries and files were used for generation of the RIPL and requirements to the evaluated NSDD libraries can be formulated.

iii) Coordinated Research Project on Updating of X- and Gamma-ray Decay Data Standards for Detector Calibration.

The project was started in 1998 and includes the evaluation of the half-lives, X-ray and gamma-ray energies and emission probabilities for 68 radionuclides selected as reference standards for gamma-ray spectroscopy or gamma-ray calibrations for environmental monitoring, safeguards, medical applications and material analysis.

iv) Coordinated Research Project on Development of Database for Prompt-Gamma Neutron Activation Analysis.

The project will be started in 1999 and will include evaluation of data needed in cold and thermal neutron induced Prompt Gamma Activation Analysis (PGAA) of materials in chemistry, geology, mining, archeology, environment, food analysis, medicine and other areas.

Belgian Group Status Report

D. De Frenne, E. Jacobs
University Ghent
Belgium

During the last two years the mass chain A=102 was evaluated and published while the evaluation of mass chain A=110 is almost finished. For future evaluations we will do preferentially nuclides instead of complete mass chains in the mass region for which we have permanent responsibility.

We also worked on a Nuclear Data Editor but due to personnel shortening and the changing needs of the Network we stopped this project.

The evaluation activities of our group in Belgium are since a couple of years reduced to the absolute minimum due to pressure of the scientific committees which decide on research money.

Our fundamental research program consists of (γ,γ') experiments with polarized and unpolarized bremsstrahlung in Ghent and Stuttgart on different Fe, Ni and Sn targets, and over the next years we will be very much involved in experiments with polarized protons at the AGOR accelerator of the KVI in Groningen where we plan experiments on ^{48}Ca and ^{116,124}Sn.

Status Report: Nuclear Data Project at McMaster University (October 1996 - October 1998)

B. Singh
McMaster University
Canada

Mass chain evaluation.

Since October 1996 NSDD meeting, the following mass chains have been published or submitted:

A=151, B. Singh, NDS 80, 263 (1997)
A=100, B. Singh, NDS 81, 1 (1997)
A=77, A. Farhan and B. Singh, NDS 81, 417 (1997)
A=135, Y. Sergeenkov and B. Singh, NDS 84, 115 (1998)
A=98, B. Singh, NDS 84, 565 (1998)
A=89, B. Singh, NDS (in press) (1998)
A=75, A. Farhan and B. Singh, NDS (Submitted April 98)

Mass chain A=163 evaluation by B. Singh, A. Farhan and D. Davis is in progress with expected completion at end of October 1998.

Data for superdeformed bands.

1997 update was completed in June 1997 and published by B. Singh, S.Y.F. Chu and R.B. Firestone as WWW edition and in 1997 Table of Isotopes. Another update by B. Singh is in progress.

Other activities based on user requests.

1. Log *ft* systematics over the entire mass range was completed in early 1998 and published by B. Singh, J.L. Rodriguez, S.S.M. Wong, and J.K. Tuli in NDS 84, 487 (1998).
2. Update Supplement to Level Structures in Medium-Heavy Deformed odd-odd nuclei: B. Singh, P.C. Sood and A.K. Jain, Atomic Data and Nucl. Data Tables 69, 349-58 (1998).
3. Data for Magnetic-Rotational Bands: Amita and A.K. Jain (Roorkee, India) and B. Singh. This work on compilation of magnetic dipole bands in all nuclides is in progress with expected completion by the end of1998.

Support.

Support is partly from NSERC of Canada and partly from US DOE.

Nuclear Structure and Decay Data Evaluation and Related Activities at the INEEL

R.G. Helmer
Idaho National Engineering Laboratory
USA

1. Mass-Chain Evaluations.

Within this Network, the INEEL has had the evaluation responsibility for the twelve mass chains 87 and 153-163. The participants in this work are R. G. Helmer and C. W. Reich. Since the last Network meeting in October 1996, we have submitted complete evaluations for A = 153 and 154 and these have been added to ENSDF and published in Nuclear Data Sheets. The A-chain priority list prepared in July 1997 indicated that A = 161, 162, and 163 had a significant number of new references and should be evaluated.

We are currently working on A = 162 and A = 163 is being done by B. Singh, McMaster University.

The current status of our twelve A chains, as of October 1998, is as follows:

A	Last Pub. Date	Status
87	2/91	
153	2/98	
154	9/98	
155	4/94	
156	1/92	3 nuclides updated
157	6/96	1 nuclide updated
158	3/96	
159	5/94	
160	8/96	
161	1/90	on priority list
162	9/91	on priority list - in progress
163	2/89	on priority list - in progress

2. Nuclide Evaluations.

In the last few years it has been decided that the currentness of ENSDF would be improved by allowing, and in some cases encouraging, the evaluation of the data for individual nuclides (*e.g.*, ones with new high-spin data). In response to this desire, we have submitted evaluations for nuclides not previously in ENSDF; these are ^{153}La, ^{153}Ce, ^{155}Ce, ^{155}Pr, ^{157}Nd, and ^{158}Nd.

We have also submitted nuclide evaluations for the nuclides on priority lists including ^{154}Sm, ^{154}Yb, ^{154}Lu, ^{154}Hf, ^{156}Nd, ^{156}Tm, ^{156}Yb, ^{157}Tm, ^{162}Yb, and ^{162}Lu. The A = 154 nuclides were subsequently included in the new mass-chain evaluation. Other nuclides on priority lists were submitted as parts of A-chain evaluations including ^{153}Eu, ^{153}Dy, ^{153}Yb, ^{153}Lu, ^{154}Gd, ^{154}Dy, and ^{154}Ho.

3. Decay Data Evaluation Project, DDEP.

R. G. Helmer is the coordinator of an international group that is carrying out evaluations of decay data for a group of nuclides that are important for applications. This Project was approved as part of the activities of this Network in 1994. This group includes evaluators that are not a part of this Network from France, Germany, Russia, and the United Kingdom, as well as E. Browne and J. K. Tuli who are United States participants in this Network.

The members of the Project have completed the evaluations for 29 nuclides and these will be included in a publication being prepared at Laboratoire Primaire des Rayonnements Ionisants, LPRI, France. Most of these evaluations have not yet been entered into ENSDF. Of these completed evaluations, nine have been done at the INEEL; these are ^{22}Na, ^{40}K, ^{60}Co, ^{65}Zn, ^{95}Zr, ^{95}Nb, ^{113}Sn, ^{137}Cs, and ^{139}Ce. Eckart Schoenfeld of PTB, Germany was a co-author of some of these evaluations. Another eleven radionuclides have been evaluated, but the final editing has not yet been done.

This project has been publicized at several meetings including those of the American Nuclear Society, the American Chemical Society, the International Committee of Radionuclide Metrology, and Canberra Users' Group.

4. Related Activities.

R. G. Helmer has been invited by the IAEA to participate in a Coordinated Research Project, CRP, on the evaluation of decay data for nuclides used in the calibration of Ge gamma-ray detectors. It is expected that this CRP will use the methodologies and results of the above Decay Data Evaluation Project. Therefore, these efforts will be coordinated and will not produce different results.

R. G. Helmer and Cor van der Leun (recently deceased) have prepared an evaluation of precise gamma-ray energies that are useful for the calibration of Ge gamma-ray spectrometers. It is expected that this article will be submitted for publication late in 1998. When he died in October 1997, R. L. Heath of the INEEL was preparing an electronic version of his earlier Gamma-ray Spectrum Catalogue for Ge(Li) and Si(Li) detectors. This project has been completed.

A paper on delayed neutron spectra of ^{87}Br, ^{88}Br, ^{89}Br, ^{90}Br, ^{137}I, ^{138}I, ^{139}I, and ^{136}Te has been published by R. C. Greenwood and K. D. Watts in Nuclear Science and Engineering, 126 (1997) 324.

Status Report on NSDD Activity of the PNPI Data Center

I.A. Kondurov

Data Centre of the Petersburg Nuclear Physics Institute
Russia

1. Mass-chain evaluation for ENSDF

The Center is responsible for mass-chain evaluation of the nuclei in the range A = 130 - 135. The status of the evaluation is as follows :

A-chain	Last publication	Status
A = 130	NDS 58 765 (1989)	in progress
A = 131	NDS 72 487 (1994)	+ T.Burrows, M.Bhat
A = 132	NDS 65 277 (1992)	
A = 133	NDS 75 491 (1995)	evaluated by S. Rab (ORNL)
A = 134	NDS 71 557 (1994)	
A = 135	NDS 84 115 (1998)	+ B.Singh

2. Keyword references for the NSR file

We have continued preparation of the keyword references of published in Russia papers containing experimental and calculated data on nuclear structure. These editions are: JINR(Dubna) Preprints and Communications and also Proceedings of the Conferences on Nuclear Structure and Nuclear Spectroscopy and some other nuclear structure meetings.

The references of the last 1998 Conference we are preparing now in such a form that in the text of the reference one can find an information on Web site URL, were text of appropriate pages of the Conference Proceedings is saved in .HTM and .PDF or PS.GZ formats and therefore it is available via Internet. Also we plan to prepare an electronic version of the Proceedings of the next, 1999 Conference. We have a good opportunity to do this because an editorial group of the Conference Organizing Committee works in our Institute and the Proceedings are prepared and printed here.

3. Table of Neutron Resonance Parameters

During several years a work was performed in PNPI Data Center by group of Dr. S. Sukhoruchkin in the field of collection and analysis of experimental data on neutron resonance parameters. All the published in the last 15 years data (and also unpublished but available ones) were carefully analyzed and compared taking into account differences in time-of-flight scales of spectrometers used. Deduced were values of the parameters. As a result a book “Tables of Neutron Resonance Parameters” [1] was published by Springer Verlag this year. The Tables essentially upgrade the resonance parameters data published by S. Mughabghab et al. in 1981-1984.

In this connection a question arise how to insert the neutron resonance parameters, as properties of excited states of nuclei, in the ENSDF where this information is presented very irregularly. Of course the final decision here posses to evaluators, however it would be useful to have an agreed recommendation on this procedure.

References:

[1] S.I. Sukhoruchkin, Z.N. Soroko, V.V. Deriglazov, in Springer; Landolt-Boernstein, "Numerical Data and Functional Relationships in Science and Technology", New Series, Editor in Chief: W. Martienssen; Group 1: "Elementary Particles, Nuclei and Atoms", Volume 16: "Low Energy Neutron Physics", Subvolume B, "Tables of Neutron Resonance Parameters", Edited by H. Schopper, 500p, 1998. (ISBN 3-540-63277-8).

Nuclear Data Project
Evaluation Activity Report*

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USA

This report summarizes the activities of the ORNL Nuclear Data Project since the IAEA Advisory Group meeting in October 1996. The group's future plans are also included.

The ORNL Nuclear Data Project's structure has changed greatly during the last fiscal year. The present Nuclear Data Project's responsibility includes the compilation/evaluation of astrophysics data, as well as the evaluation of nuclear structure data. The Nuclear Data Project, therefore, is composed of two groups. This change is very much in accord with the 1998 U.S. Advisory Report which recommended nuclear astrophysics to be a high priority of the U.S. Nuclear Data Program. The Nuclear Data Project staff through September 1998 is listed below.

October 1996–September 1997	October 1997-September 1998
Professional Staff:	
Murray J. Martin (e,s) (100%)	Murray J. Martin (g,s)
	Yurdanur Akovali (s) (50%)
	Jeffrey Blackmon (a) (20%)
Agda Artna-Cohen (c,s) (50%)	Agda Artna-Cohen (c,s) (50%)
	David Radford (s) (30%)
	Michael Smith (a) (20%)
	Chang-Hong Yu (s) (10%)
M. R. Schmorak (g,s)	
Technical Staff:	
Mary Ruth Lay (80%)	Mary Ruth Lay (50%)

(e) = Editor-in-Chief of the Nuclear Data Sheets (retired on July 31, 1997)
(s) = Nuclear Structure evaluator
(a) = Astrophysics evaluator
(c) = Consultant
(g) = Guest (unpaid consultant)

The Nuclear Data Project activity report is divided into two sections. The first section covers the accomplishments of the nuclear structure data group for the period of October 1996 through September 1998; the activities and accomplishments of the nuclear astrophysics data group are summarized in the second section.

* This work has been sponsored by the Oak Ridge National Laboratory, managed by Lockheed Martin Energy Research Corporation for the U.S. Department of Energy under DE-AC05-96OR22464.

A. Nuclear structure data.

I. Evaluations.

Completed work.

Critical evaluations of nuclear structure data pertaining to all nuclei with mass numbers 152, 193, 202, 216, 220, 224, 228 and 246 have been completed, and adopted data, levels, spin, parity and configuration assignments are presented in the following publications:

- Nuclear Data Sheets for A=152 , Nucl. Data Sheets 79, 1 (1996)
- Nuclear Data Sheets for A=216 , Nucl. Data Sheets 80, 157 (1997)
- Nuclear Data Sheets for A=220 , Nucl. Data Sheets 80, 187 (1997)
- Nuclear Data Sheets for A=224 , Nucl. Data Sheets 80, 227 (1997)
- Nuclear Data Sheets for A=228 , Nucl. Data Sheets 80, 723 (1997)
- Nuclear Data Sheets for A=202 , Nucl. Data Sheets 80, 647 (1997)
- Nuclear Data Sheets for A=193 , Nucl. Data Sheets 83, 921 (1998)
- Nuclear Data Sheets for A=246 , Nucl. Data Sheets 84, 901 (1998)

An extensive review of alpha decay data from all doubly-even nuclei has been completed and published in Nucl. Data Sheets 84, 1 (1998). This evaluation, which has a different mission than the traditional mass-chain evaluations, includes recommendations for half-lives and decay branchings of parent nuclei, as well as energies and intensities of alpha radiations. Nuclear radius parameters for their daughter nuclei and alpha-hinderance factors are calculated. Based on systematic behavior of the calculated radius parameters, irregularities indicating incorrect data and their probable causes are discussed. This systematic study is utilized also to calculate some unmeasured properties of observed alpha transitions and to predict some nuclear properties, such as half-lives, branchings and alpha intensities, for yet unobserved alpha decays of some neutron-deficient nuclei. The radius parameters for odd and odd-odd nuclei (which are essential for hindrance factor calculations) are to be obtained from local trends of the radius parameters for even-even nuclei.

Evaluations of nuclei with mass numbers 248, 249, 251, 253, 255, 257, 259, 261, 263, and 265 have been completed and submitted to the Brookhaven National Laboratory National Nuclear Data Center. These evaluations have not been reviewed.

Work in progress.

Nuclei with even-mass numbers 208, 252, 256, 260 and 264 are being evaluated.

Future plans for nuclear structure evaluations.

The nuclear structure data evaluations for the heavy-mass region will be completed with evaluations of the A=250, 254, 258, 262 and 266 nuclei.

In accordance with the 1998 U.S. Advisory Report recommendations, and as an integral part of ORNL's forefront research program in nuclear structure physics, the nuclear structure data evaluations have been redirected. As soon as the work for the heavy-mass region is completed, instead of the traditional mass-chain evaluations, the following tasks will be taken:

- Nuclear-structure information for nuclei important to current research programs, in particular for nuclei in the far-from-beta-stability regions on both the neutron- and the proton-rich sides, will be evaluated.

- Systematic studies will be extended to evaluations of other nuclear properties with the purpose of providing a guide to researchers and evaluators and as a means of gaining new insight into nuclear structure phenomena. Horizontal evaluation of nuclear states will be the first of these planned studies.

II. Reviews and editing.

Nuclear structure data evaluations for nuclei with mass 51, 58, 77, 84, 100, 101, 108, 120, 137, 146, 151, 186, 194, 224, 228 and 238 were reviewed and edited.

The high-spin data for nuclei with 64 and 163 mass numbers were reviewed and edited. The horizontal evaluation of alpha decay from even-even nuclei was reviewed.

The evaluations appearing in the Table of Isotopes for nuclei with mass numbers 21-120 and A>121 were reviewed.

III. Database development.

We have set up a FTP/www server site on the ORNL Physics Division local area-network for compilation and distribution of nuclear-structure data. The data on this site are in the "RadWare" "Graphical Level Scheme" format, which is very widely used by the international reaction gamma/nuclear structure community. Members of this community are being encouraged not only to make use of this service, but also to contribute their own data by anonymous FTP. Contributed data use the same format, accompanied by additional information describing, for example, the experiment(s) that generated the level scheme, the names and institutions of the researchers involved, and references to any publications of the data. Contributed data will not be evaluated in any formal way, but simply checked for internal consistency.

As of September 30, 1998, the response to the site in terms of the number of contributed level schemes has been somewhat limited, resulting in only 24 schemes. It is hoped that efforts to publicize the service and to encourage RadWare users to submit their schemes will increase the activity. Efforts in this area are being coordinated with those of other centers to begin a compilation of non-evaluated nuclear structure data from recent publications.

A selection of RadWare-format level schemes created from ENSDF files, by means of a conversion program, have also been placed on the site with the intent of generating a displayed level scheme. The response of RadWare users (nuclear structure experimentalists) has been very encouraging, with an average of about three file retrievals per day. There have been retrievals from at least 78 different computers over the past five months. Some restrictions in the present design of the RadWare format exist, if tabulation of data is requested. Extensions to the RadWare format to allow greater compatibility with ENSDF-type data are planned for the near future.

On-line conversion of selected data sets from ENSDF-format to RadWare format is also being developed, with the aim of using this method to replace the present archive of ENSDF-converted schemes.

The RadWare software for data analysis is also available to users. Documentation for Radware is given at http://radware.phy.ornl.gov.

Summary of the nuclear structure evaluations.

Previous responsibilities of nuclear data project:

Evaluations of nuclear structure information for nuclei with A>200;
Scientific editorship of the Nuclear Data Sheets;
Text editorship of the Nuclear Data Sheets.

Redirected responsibilities:

Evaluation of nuclear structure information that is of importance to community's research programs for nuclei in the far-from-beta-stability regions;
Horizontal evaluation of structure properties for nuclei in the far-from-beta-stability regions on both neutron- and proton-rich sides.

B. Nuclear astrophysics data.

Overview.

We have a new program of evaluating and disseminating nuclear data of vital importance for studies in nuclear astrophysics. Research programs in nuclear astrophysics address some of the most fundamental questions in nature about the origins of the elements, about the formation and evolution of the solar system, the sun, the stars, and the galaxy. Measurements in the nuclear laboratory form the empirical foundation for the sophisticated theoretical models of these astrophysical systems. In many cases, however, new nuclear physics measurements are not rapidly disseminated to the research community nor rapidly incorporated into astrophysical models. For this reason, progress in many fundamental problems in nuclear astrophysics can be significantly aided by more effectively utilizing nuclear data. Our effort addresses this problem by providing new evaluations of important reactions and disseminating them to the research community in user-friendly formats that are easily incorporated into astrophysics models. Our evaluation work is initially focused on capture reactions on radioactive isotopes on the proton-rich side of stability-reactions that are important for understanding the element synthesis and energy generation in stellar explosions. Our work utilizes the latest advances in Internet- and www-based information services to disseminate evaluated data to the astrophysics research community. Lists of nuclear astrophysics data projects for the previous two fiscal years, and proposed projects for the current fiscal year, are given below.

Accomplishments.

A www site was established for nuclear astrophysics data. This site has the first electronic dissemination of one of the most important compilation of reaction rates (see below), links to other web sites relevant to nuclear astrophysics data work, and information on organizational activities in the nuclear data community. The address of this site is http://www.phy.ornl.gov/astrophysics/data/data.html.

The first electronic dissemination of one of the most important compilations of reaction rates by G.R. Caughlan and W.A. Fowler [1] was provided. This site gives the information as originally published - the reaction rates in text format and in tabular values of rates versus temperature - as well as a downloadable FORTRAN subroutine of all ^{16}O of the reaction rates and their inverses.

Analytic expressions were generated for the $^{14}O(\alpha,p)^{17}F$ and $^{17}F(p,\gamma)^{17}Ne$ stellar reaction rates by using the most recent indirect experimental measurements of relevant reaction parameters. These reactions can occur in the extremely hot, dense astrophysical environments where hydrogen is expected to burn explosively, such as nova explosions, supernova explosions, and X-ray bursts. Both reactions are targeted for measurements at ORNL's Holifield Radioactive Ion Beam Facility in the near future, and this evaluation work is an integral part of our preparation for these measurements. Our work gives the first complete expression for the $^{14}O(\alpha,p)^{17}F$ rate incorporating recent experiment information, and corrects an error (as large as 13% at high temperatures) in the previously published $^{17}F(p,\gamma)^{18}Ne$ rate. A paper on this work has been published [2].

The usefulness of our posting of the Caughlan and Fowler reaction rates was extended by adding GIF and Postscript plots of each of the rates. A technique to automatically generate plots of such reaction rates was developed, so future modifications may be done with ease. The temperature derivatives of these reaction rates were also calculated which are important for coupling nucleosynthesis calculations to hydrodynamics simulations to provide more accurate modeling of stellar explosions. These very complex rate derivatives are posted online in a text format, along with a downloadable fortran subroutine. We also created a graphical user interface based on the chart of the nuclides to allow users to search for rates of interest. Members of the research community have informed us that this online rate compilation has been very useful to their work.

Our new evaluations of the $^{14}O(\alpha,p)$ and $^{17}F(p,\gamma)$ reactions were posted on our www site. We utilized the two most popular formats for analytical rate expressions that are currently used in astrophysics models.

Evaluations of the 12 reactions of greatest importance to the synthesis of isotopes in the early universe [4] were posted on our www site for the first time, in a format that can easily input into astrophysics models.

The U.S. Astrophysics Task Force which was chaired by M. Smith of ORNL, submitted a proposal to the DOE for Nuclear Astrophysics Data work involving five national laboratories (ANL, LBNL, LLNL, LANL, ORNL) and one university (University of California at Santa Cruz). A funding decision on this proposal is still pending. Previous efforts in organizing nuclear astrophysics data activities led by ORNL have included an extensive documentation of the overlap of expertise of the nuclear data community with the needs of the nuclear astrophysics community [5].

Future plans.

The $^{17}O(p,\alpha)^{14}N$ reaction is very important in determining the relative abundance of oxygen isotopes in the envelopes of red giant stars, which can be used as a tracer of the convection process occurring in these stars. This reaction is also important for interpreting oxygen isotope anomalies observed in meteorites. A recent measurement of this rate [3] changed the previous rate estimates by more than a factor of 10 at certain temperatures. Our work will give a complete expression for the current $^{17}O(p,\alpha)^{14}N$ rate incorporating all experimental information that can then be easily incorporated into astrophysics models. The final rate and plots will be posted online. This work was initiated in 1998 and will be completed in 1999.

A new evaluation of the cross sections for the 19 reactions of greatest importance to the study of the solar interior was made by Adelberger et al. [6]. These cross sections will be converted by ORNL into reaction rates in an analytical format, input into astrophysics models, compare the analytical approximations with the rates derived from numerical integration, determine the rate uncertainties from the cross section uncertainties, and examine the differences between these new rates and previous rates. Reaction Rates for these 19 reactions and differences between these new rates and previous rates will be posted in our www site.

A Nuclear Astrophysics Bibliography was initiated. It is being produced and will be posted on our www site. This will be a useful resource for producing evaluations of nuclear reaction and structure information important for astrophysics. This bibliography will include references to astrophysical journals and reports which are outside the normal scope of Nuclear Science References. The first phase of this project, which will include over 1000 references, will be completed and posted online in FY99, and it is anticipated that this bibliography will grow steadily in time.

Our future plans include evaluating reactions important for explosive hydrogen burning studies, such as $^{18}F(p,\gamma)^{19}Ne$ and $^{18}F(p,\alpha)^{15}O$, collaborating with Argonne National Laboratory on evaluations of explosive hydrogen burning reactions on isotopes with mass between 30 - 50, and continuing to provide disseminated data to the research community in user-friendly formats.

References.

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Isotopes Project Status Report

E.B. Norman (Project Leader)
C.M. Baglin, E. Browne, S.Y. Chu, J.M. Dairiki (to 7/1997)
R.B. Firestone, B. Singh (to 10/1997)
Lawrence Berkeley National Laboratory
USA

The Isotopes Project is heavily committed to both the Evaluation and Dissemination aspects of nuclear structure and decay data; these activities are reported in separate sections of this report.

I. Nuclear structure and decay data evaluation (October 1996 - October 1998).

1. Mass chain responsibility.

Permanent (43 chains): A = 81, 83, 89-93, 167-194, 206, 210-212, 215, 219, 223, 227.
Temporary (11 chains): A = 59, 76, 79, 80, >266.

2. Personnel.

The group's data evaluation effort has ranged from 2.4 to 2.1 FTE during the period covered by this report. In addition, two guests have spent sabbatical leave with the Isotopes Project: Professor Jacob Gilat (Israel) and Professor Alice Wu (Taiwan). Both are experimentalists (high spin physics and nuclear astrophysics, respectively) and both were interested in spending part of their time on evaluation. Dr. Wu has already prepared ^{26}Al and ^{57}Ni decay evaluations, and Dr. Gilat worked on the $A \geq 266$ chains. An ongoing collaboration with Gabor Molnar (Hungary) is concerned with the preparation of evaluated (n,γ) data. The group is also indebted to Jean Zipkin for the preparation of many high-spin or (n,γ) data sets.

3. Evaluation accomplishments (since last Meeting).

a) Mass chains.

Submitted:	89 (75% LBNL), 90, 91, 93, 135 (75% LBNL), 176, 192, 206.
Published:	81, 89 (75% LBNL), 90, 93, 135 (75% LBNL), 176, 186, 192, 194.
In Progress:	167, 174, A>265 (8 chains; all of the 11 nuclides in these chains have been evaluated, but formatting has not yet been completed).

b) Nuclides.

(i) Nuclides far from stability (prepared in collaboration with the NUBASE group, France).

Recent advances in experimental capabilities have resulted in "first observations" of many nuclides far from stability; the data sets for these are usually small, but their timely inclusion in ENSDF is of obvious importance.

Evaluated data sets for ~120 nuclides observed experimentally, but previously absent from ENSDF, have been prepared and entered into ENSDF.

Data sets for an additional 114 such nuclides have been prepared, and will be submitted in the near future for inclusion in ENSDF.

(ii) Other complete nuclide evaluations.

Several of these are 'priority nuclide' evaluations; others were undertaken because significant, newly-published information could be promptly included in ENSDF with modest time outlay (improving the timeliness of the file), because α-decay parent information needed to be revised (for internal consistency of the file), or because no evaluation for the nuclide had previously been published.

- ^{170}Ta (published); ^{170}Lu, ^{179}Ir (in press).
- ^{81}Y, ^{88}Mo*, ^{88}Tc, ^{92}Rh, ^{92}Ru, ^{106}Sb* (unpublished; added to ENSDF).
- ^{169}Ta*, ^{170}Yb, ^{170}Pt, ^{171}Ir, ^{186}W, ^{186}Hf (in progress)
- Several additional 'priority' nuclides (for A=90, 91), which were subsequently included in mass chains listed above.

* - priority nuclide.

4. Data sets.

a) Decay data collaboration nuclides.

These data are very much needed for applied research and detector calibration. (^{75}Se, ^{188}Re, ^{192}Ir and ^{194}Ir, all are now included in ENSDF).

b) Decays of astrophysical interest.

Nucleosynthesis calculations require up-to-date and accurate nuclear decay and structure data (^{26}Al ε decay - in ENSDF, ^{44}Ti, ^{57}Ni - in review).

c) Spontaneous fission decay data sets (21 nuclides added to ENSDF).

This is an active research area, and researchers have indicated that the timely inclusion of such data in ENSDF is important to them.

Te:	A=131
I:	A=135
Xe:	A=140, 141, 142, 143, 144
Ba:	A=140, 142, 143, 144, 145, 146, 147, 148
La:	A=145, 147, 148
Ce:	A=149
Nd:	A=151, 15

d) High spin.

Superdeformed nuclides (LBNL-McMaster Collaboration): the July 1997 annual update of all SD data (~70 nuclides) was completed and submitted for inclusion in ENSDF.

A=211 high spin update added to ENSDF.

e) Miscellaneous decay data sets (36 nuclides added to ENSDF).

α decay 9 nuclides	11 data sets
β decay 7 nuclides	-
ε decay 14 nuclides	15 data sets
p decay 2 nuclides	3 data sets
εp, βn decays	4 nuclides

f) (n, γ) horizontal evaluation.

US-Hungary Science and Technology collaboration with G. Molnar (Institute of Isotopes, Budapest, Hungary). Evaluated (thermal n,γ,) data sets have been completed for 43 nuclides (i.e., all those produced using stable targets with $Z \leq 20$); these are currently being reviewed by Dr. Molnar. Subsequently, they will be submitted for inclusion in ENSDF.

5. Ground state properties updates.

Ground state property information of the following character has been added to ENSDF for selected nuclides:

$T_{1/2}$ for nuclides whose $T_{1/2}$ was previously unknown;
$T_{1/2}$ data previously in Wallet Cards but not in ENSDF;
grossly revised $T_{1/2}$ data (e.g., for ^{44}Ti);
new or revised %βn, %εp, etc.

6. Reviews of evaluation.

Mass Chains: A = 102, 108, 115.
Decay Data Collaboration Nuclides: ^{3}H, ^{7}Be, ^{14}C, ^{22}Na, ^{35}S, ^{36}Cl, ^{40}K, ^{60}Co, ^{65}Zn, ^{95}Nb, ^{111}In, ^{113}Sn, ^{137}Cs, ^{139}Ce, ^{140}La, ^{143}Pr, ^{153}Sm, ^{153}Gd, ^{207}Bi.

7. Compilation.

During 1996 and 1997, in response to high-spin researchers' desire for more timely access to data sets from recent publications, 208 high-spin data sets were compiled in ENSDF format by Jean Zipkin, and promptly posted on the Web. These data sets, along with 113 high-spin data sets (accessible on-line from NNDC) compiled in 1995 in conjunction with the preparation of the 8th Edition of the Table of Isotopes, have been transmitted to Balraj Singh (McMaster University) for his consideration for inclusion in a new high-spin data base containing compiled (i.e., unevaluated) high-spin data sets. A significant number of these data sets contain information which has not yet been evaluated and added to ENSDF.

8. PC software for evaluation.

With the impending demise of LBNL's central VAX VMS computers, PC (Windows 95/NT, Fortran) versions of five programs originally written for use on that system have been created and also made available on the Web. These are BALANCE 2.0, ENDIT 2.0 (ENSDF file line editor), Betas 2.0, XICC 2.0 and LogFT 2.0 (interactive calculation of log *ft* and EC/B+ values). Preparation of a PC version of the program GAMUT has commenced.

II. Data dissemination.

1. World Wide Web.

The Isotopes Project has continued to expand its data dissemination efforts on the WWW. Linked home pages for access to data from the Table of Isotopes, nuclear astrophysics, high-spin nuclear structure, radioactive decay, atomic masses, capture gamma, fission, and other topics have been developed. These home pages can be accessed from the WWW at http://ie.lbl.gov/toi.html. Data are provided in text, Postscript, and Portable Document Format. Approximately 4500 separate users per month submitted over 860,000 data requests last year. The usage since 1995 is summarized in Figure 1.

1.1. Astrophysics home page.

The Nuclear Astrophysics home page at http://ie.lbl.gov/astro.html includes a comprehensive bibliography of references to literature of interest to researchers in the nuclear astrophysics community. Links are provided when the reference or data is available in electronic form. Stellar nucleosynthesis data from Hoffman and Woosley, Thielemann et al., and others are available in text and Postscript format from the home page. Approximately 600 users access this page each month.

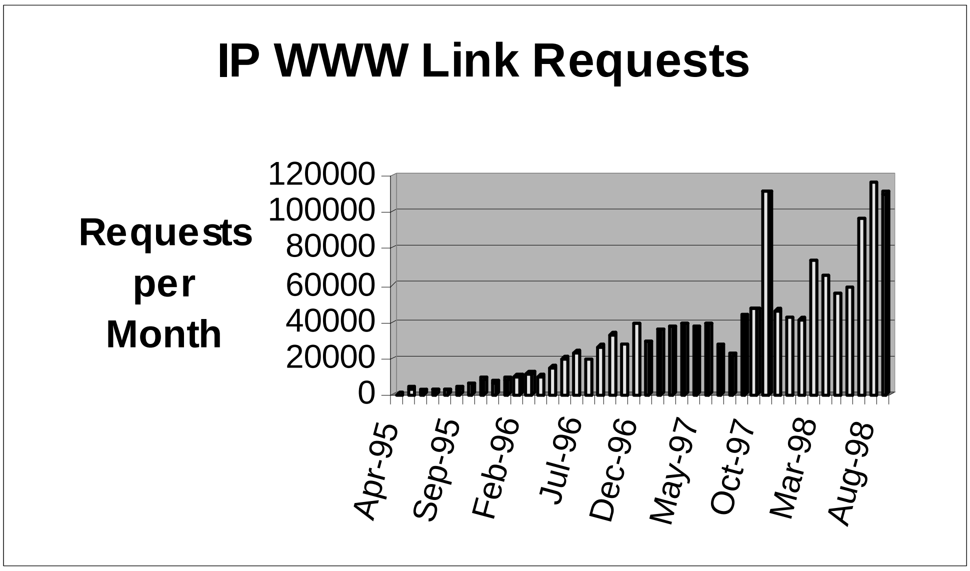

Fig. 1. Usage of Isotopes Project WWW sites 4/95 – 9/98

1.2. High-spin and nuclear structure home page.

An electronic edition of the Table of Superdeformed Nuclear Bands and Fission Isomers is available from the High-Spin and Nuclear Structure home page at http://ie.lbl.gov/hspin.html. This home page also provides reference lists and links to information of interest to nuclear structure researchers. About 400 users access this page each month.

1.3. Decay data home page.

The decay data home page at http://ie.lbl.gov/decay.html provides summary mass-chain decay schemes and nuclear charts from the Table of Isotopes; energy-ordered tables of gamma rays from radioactive decay; alpha and gamma energy and intensity standards; data from the 1986 edition of the Table of Radioactive Isotopes; and links to information of interest to users of decay data. Approximately 600 users access this page each month.

1.4. Atomic masses home page.

The atomic mass home page at http://ie.lbl.gov/toimass.html provides access to the experimental atomic mass tables of Audi et al. and 14 calculated mass tables. Approximately 700 users access this page each month.

1.5. Thermal neutron capture home page.

The Thermal Neutron Capture home page at http://ie.lbl.gov/ng.html was developed jointly by the Isotopes Project and the Institute for Isotope and Surface Chemistry, Hungary. Lone et al. gamma-ray yield data, ENSDF (n,γ) E=Thermal data for A>44, LBNL/Hungary (n,γ) compilation for A<45, isotopic abundances, and thermal neutron cross sections are available from this site. Approximately 300 users access this page each month.

1.6. Fission home page.

The Fission home page at http://ie.lbl.gov/fission.html contains fission yields compiled by England and Rider and spontaneous fission data from ENSDF. Approximately 200 users access this page each month.

1.7. Other data.

Additional home pages for atomic data, elemental data, education, nuclear moments, interaction of radiation with matter are also available. These pages attract over 2000 users per month.

2. Isotope Explorer.

http://ie.lbl.gov/isoexpl/isoexpl.htm. In addition, it is available on the Table of Isotopes CD-ROM. About 1300 users express interest in this program each month. ENSDF datasets for about 300,000 isotopes were downloaded by Isotope Explorer users during the past year. Month-to-month usage fluctuates substantially. Isotope Explorer 2.0 was released for Windows 95/NT in 1998 replacing VuENSDF. The program can download ENSDF data from the Isotopes Project Server, or the Table of Isotopes CD-ROM. The ENSDF format data can be displayed as level scheme drawings, Nuclear Data Sheet style tables, plots, or on nuclear charts. The data can be selected by level properties (E, J^{π}, half-life), gamma-ray coincidence relationships, or nuclear structure and band assignments. Tables can be displayed with complete comments and may be sorted by column. The keyword abstracts for the references can also be retrieved by Isotope Explorer from the WWW or Table of Isotopes CD-ROM and displayed. Print preview and print capabilities are available for all Isotope Explorer display modes.

Experimental and theoretical chart databases, containing a variety of ground-state and isomer properties, are provided with Isotope Explorer for the nuclear chart mode. Users can also easily generate personal databases for use with the chart. These data can be displayed on a chart colored by the magnitude of selected properties. A script language is provided to perform calculations with the chart databases and to search the ENSDF file by data property. Data on the chart are linked directly to ENSDF, when applicable, and the underlying ENSDF datasets can be accessed with the mouse. A small navigation window is provided to assist users in moving about the chart. Isotope Explorer 2.0, a tour of its capabilities, and the user manual can be downloaded from the WWW. Usage since 1996 is summarized in Figure 2.

3. LBNL/Lund Isotope Explorer NSR server.

The LBNL/Lund Isotope Explorer NSR Server on the WWW supersedes the Nuclear Data and References CD-ROM in 1996. This information can be accessed from mirror servers at LBNL (http://128.3.5.61:6023/welcome.htm), and Lund (http://130.235.92.206:6023/welcome.htm). References from the Nuclear Science Reference file can be selected by any combination of author, nuclide, keynumber, data, reaction, keyword, and data type. References satisfying the selection criteria are selected by the Isotopes Project or Lund server and the keyword abstracts are returned to the user and displayed. Currently aver 3000 reference requests are processed each month. A sample Isotope Explorer NSR server window is shown in Figure 3.

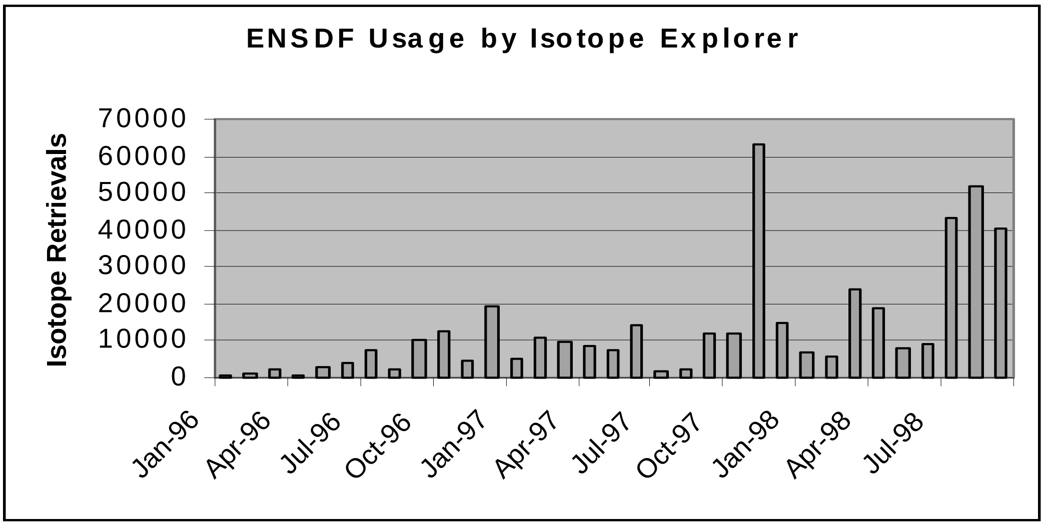

Figure 2. Usage of Isotope Explorer 6/96 – 9/98

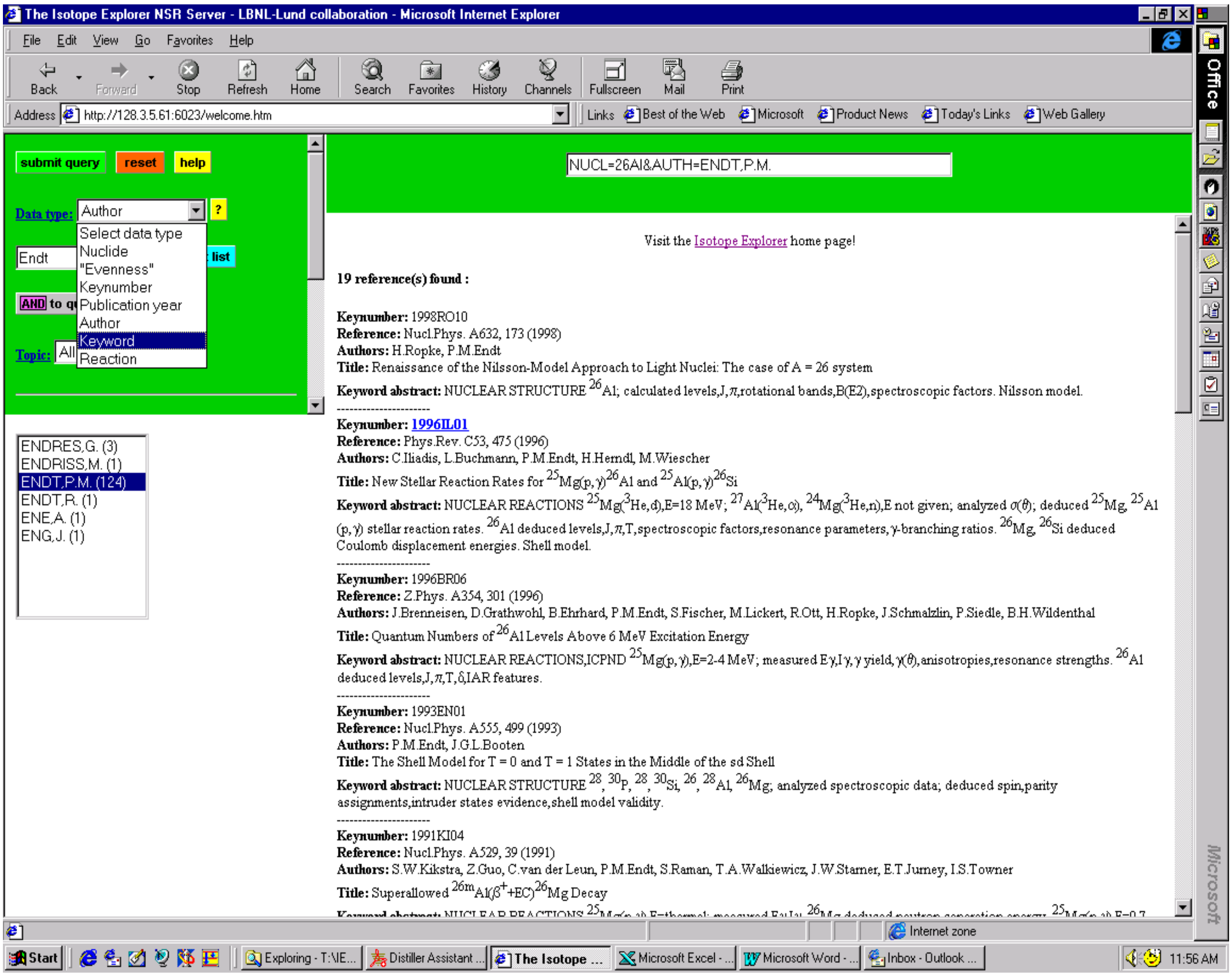

Figure 3. Sample Nuclear Science Reference search

4. LBNL/Lund WWW Table of Radioactive Isotopes.

The LBNL/Lund Table of Radioactive Isotopes on he WWW can be accessed at http://nucleardata.nuclear.lu.se/Database/toi. Gamma-ray and alpha-particle data from ENSDF and the Table of Isotopes can be searched by combination of energy and nuclide range. Additional information, including x-ray, Auger, and continuous radiations, will be added in 1999. This service has been provided for about 6 months with usage gaining rapidly. Nearly 8000 users accessed the Table of Radioactive Isotopes in September, 1998.

III. Publications and invited talks (since last Meeting).

1. Mass chain or nuclide evaluations (hard copy).

- Nuclear Data Sheets for A=194, E. Browne and B. Singh, Nuclear Data Sheets 79, 277 (1996).
- Nuclear Data Sheets for A=81, Coral M. Baglin, Nuclear Data Sheets 79, 447 (1996).
- Nuclear Data Sheets for A=93, Coral M. Baglin, Nuclear Data Sheets 80, 1 (1997).
- Nuclear Data Sheets for A=186, Coral M. Baglin, Nuclear Data Sheets 82, 1 (1997).
- Nuclear Data Sheets for A=90, E. Browne, Nuclear Data Sheets 82, 379 (1997).
- Nuclear Data Sheets for A=135, Yu.V. Sergeenkov and B. Singh, Nuclear Data Sheets 84,115 (1998).
- Nuclear Data Sheets for 170Ta, Coral M. Baglin, Nuclear Data Sheets 84, 323 (1998).
- Nuclear Data Sheets for A=176, E. Browne and J. Huo, Nuclear Data Sheets 84, 337 (1998).
- Nuclear Data Sheets for A=192, Coral M. Baglin, Nuclear Data Sheets 84, 717 (1998).
- Nuclear Data Sheets for A=89, B. Singh, Nuclear Data Sheets 85, 1 (1998).

2. CD-ROM publication based on ENSDF and NSR.

Table of Isotopes, 8th Edition, CD-ROM Update, John Wiley & Sons, Inc., NY, R.B. Firestone, Coral M. Baglin, S.Y. Frank Chu, April 1998.

3. Invited talks on nuclear data.

- "Future Directions in Nuclear Data Publication", R.B. Firestone, S.Y.F.Chu, L.P. Ekstrøm, and H. Nordberg, Proceedings of 9th International Symposium on Capture Gamma-ray Spectroscopy and Related Topics, Budapest, Hungary, 1996 (to be published).
- "The Table of Isotopes -- 8th Edition and Beyond", R.B. Firestone, Joint American Nuclear Society and European Nuclear Society 1996 International Conference, Washington, DC, November, 1996, Transactions 375, 117 (1996).
- "Methods and Procedures for Evaluating Radioactive Decay Data", E. Browne, Joint American Nuclear Society and European Nuclear Society 1996 International Conference, Washington, DC, November, 1996, Transactions 375, 116 (1996).
- "Exploring the Isotopes", R.B. Firestone, S.Y.F. Chu, and H. Nordberg, American Chemical Society, San Francisco, CA, April 15, 1997.
- "High-Spin Nuclear Structure Data on the Internet, B. Singh and R.B. Firestone, American Chemical Society, San Francisco, CA, April 15, 1997.
- "Evaluation of Decay Data: Quality and Uniformity", E. Browne and R.G. Helmer, American Chemical Society, San Francisco, CA, April 15, 1997.
- "Nuclear Astrophysics Data on the Internet", E.B. Norman, 2nd Oak Ridge Symposium on Atomic and Nuclear Astrophysics, Oak Ridge, TN, Dec. 4, 1997 (in press).
- "Nuclear Astrophysics Data on the Internet", R.B. Firestone, S.Y.F. Chu and E.B. Norman, Nuclei in the Cosmos 98, 6-11 July 1998, Volos, Greece (in press).

4. Research Publications.

- Identification of Gamma Transitions in ^{147}Ba, ^{149}Ce, and ^{151,153}Nd, B.R.S. Babu, S.J. Zhu, A.V. Ramayya, J.H. Hamilton, S.Y. Chu et al., Phys. Rev. C54, 568 (1996)
- Observation of Cold Fission in ^{242}Pu Spontaneous Fission, Y.X. Dardenne, R. Aryaeinejad, S.J. Asztalos, B.R.S. Babu, K. Butler-Moore, S.Y. Chu et al., Phys. Rev. C54, 206 (1996).
- Probes of Pairing Correlations by Heavy-Ion Two-Neutron Transfer Reactions, J.O. Rasmussen, S.Y. Chu, M.A. Stoyer, L.F. Canto, R. Donangelo and P. Ring, Phys. Rep. 264, 325 (1996).
- Galactic Confinement Time of Iron-Group Cosmic Rays Derived from the ^{54}Mn Chronometer, K. Zaerpoor, Y.D. Chan, E.B. Norman et al., Phys. Rev. Lett. 79, 4306 (1997).
- Reflection Asymmetric Shapes in the Neutron-Rich ^{140,143}Ba Isotopes, S.-Z. Zhu, M.-G. Wang, S.Y. Chu et al., Chin. Phys. Lett. 14, 569 (1997).
- High Spin Octupole Correlations in the N=85, ^{139}Xe and ^{141}Ba Isotones, S.J. Zhu, J.H. Hamilton, S.Y. Chu et al., J. Phys. (London) G23, L77 (1997).
- Angular Momenta of Fragments in the ^{252}Cf Spontaneous Fission, G.M. Ter-Akopian, Yu.Ts. Oganessian, S.Y. Chu et al., Bull. Russ. Acad. Sci.Phys. 61, 149 (1997).
- Cold Binary and Ternary Fragmentations in Spontaneous Fission of ^{252}Cf, A.V. Ramayya, J.H. Hamilton, S.Y. Chu et al., Nuovo Cim. 110A, 1073 (1997).
- Identification of the $\nu 3/2^{-}$[521] Band in ^{153}Nd and the γ-Transitions in ^{149}Nd, J.K. Hwang, A.V. Ramayya, S.Y. Chu et al., Int. J. Mod. Phys. E6, 331 (1997).
- Yields of Fragment Pairs and Other Characteristics of Spontaneous ^{252}Cf Fission, G.M. Ter-Akopian, Yu.Ts. Oganessian, S.Y. Chu et al., Bull. Russ. Acad. Sci. Phys. 61, 587 (1997).
- On the Half-Life of ^{44}Ti, E.B. Norman, E. Browne, Y.D. Chan, I.D. Goldman, R.-M. Larimer, K.T. Lesko, M. Nelson, F.E. Wietfeldt and I. Zlimen, Nucl. Phys. A621, 92c (1997).
- Radioisotope Yields from 1.85-GeV Protons on Mo and 1.85- and 5.0-GeV Protons on Te, D.W. Bardayan, M.T.F. da Cruz, M.M. Hindi, E.B. Norman et al., Phys. Rev. C55, 820 (1997).
- α-Particle Induced γ-Ray Transitions in Light Elements, R.K. Heaton, H.W. Lee, B.C. Robertson, E.B. Norman, K.T. Lesko and B. Sur, Phys. Rev. C56, 922 (1997).
- Identification of ^{109}Mo and Possible Octupole Correlations in ^{107,109}Mo, J.K. Hwang, A.V. Ramayya, S.Y. Chu, J. Gilat et al., Phys. Rev. C56, 1344 (1997).
- Weak Gamma Rays from the Electron-Capture Decay of ^{194}Au, R.R.P. Teixeira, I.D. Goldman, E. Browne, A.O. Macchiavelli, E.B. Norman et al., Phys. Rev. C56, 2320 (1997).
- Half-Life of ^{44}Ti, E.B. Norman, E. Browne, Y.D. Chan, I.D. Goldman, R.-M. Larimer, K.T. Lesko, M. Nelson, F.E. Wietfeldt, and I. Zlimen, Phys. Rev. C57, 2010 (1998).
- Identification of New Negative-Parity Levels in ^{152,154}Nd, X.Q. Zhang, J.H. Hamilton, J. Gilat et al., Phys. Rev. C57, 2040 (1998).
- Cross Sections for the ^{17}O(n,p)^{17}N and ^{17}O(n,d)^{16}N Reactions at 14 MeV, E.B. Norman and B. Sur, Phys. Rev. C57, 2043 (1998).
- Cosmic-Ray Half-Life of ^{144}Pm, K. Zaerpoor, E.B. Norman et al., Phys. Rev. C57, 2046 (1998).
- Identification of the γ Transitions in Tc and Cs Products of ^{252}Cf Fission and Possible $(7/2)^{+}$[413] Bands in $^{105-109}$Tc Isotopes, J.K. Hwang, J. Gilat, S.Y. Chu, et al., Phys. Rev. C57, 2250 (1998).
- Cold (Neutronless) a Ternary Fission of ^{252}Cf, A.V. Ramayya, J.H. Hamilton, S.Y. Chu et al., Phys. Rev. C57, 2370 (1998).
- Close Doublet Structures in ^{103}Mo, ^{109,111}Ru and Neighbours: Rotation-alignment for the Half-filled h11/2 subshell ? , J.K. Hwang, A.V. Ramayya, S.Y. Chu, J. Gilat et al., J. Phys. (London) G24, L9 (1998).

- Electron Capture Decay of ^{116}In and Nuclear Double Beta Decays, M. Bhattacharya, A. Garcia, M.M. Hindi, E.B. Norman, O. Civitarese, J. Suhonen et al., Phys. Rev. C58, 1247 (1998).
- Search for Strange Matter by Heavy Ion Activation, M. C. P. Isaac, E. B. Norman, L. S. Schroeder, F. S. Stephens et al., Phys. Rev. Lett. 81, 2416 (1998).
- Neutron Capture Cross Section of ^{44}Ti, R. Ejnisman, I. D. Goldman, K. S. Krane, E.B. Norman et al., Phys. Rev. C58, 2531 (1998).

CAJAD activity related with ENSDF.

F.E. Chukreev
CAJAD, "Kurchatov Institute"
Russia

Data evaluation

Before our Budapest-1996 meeting, new evaluation for A=238 was finished, but review was received in October 1998 only. This is detailed review, which is investigating now by authors (October 1998). After all needed corrections will be included and all discords will be excluded, new A=238 evaluation will be included in ENSDF.

New evaluation for A=242 was finished now, but I can not say that have creative satisfactory. This evaluation required from us to go through the thick bushes of misprints and errors. New experimental data is very little. The majority of these data are regarding to ^{242}Am. But authors' interpretation for the results of their investigation of ^{241}Am(n,γ) reaction, for which the best equipment and materials were used, is not convincing. The new evaluation for A=242 will be sent after all needed corrections for A=238 will be finished. Our evaluation plan includes mass chain 88.

Data dissemination.

We approach step by step to WWW network. We had plan to create CAJaD site in the year. But financial crisis in August 1998 take off my money. We will have possibility to create the special site, when financial situation will be improved.

I would like to thank the collaborators of NNDC Drs. J.K.Tuli, T. Burrows and R. Kinsey for their codes PANDORA, FMTCHK, ENSDAT. I can not imagine the preparation of data sets without these codes.

Status Report of Nuclear Data Center of Kuwait University

A. Farhan, E. Davis
Nuclear Data Center, Kuwait University
Kuwait.

This report reviews the evaluation activities of the Kuwaiti Group for the period (Oct.1996 - Oct.1998).

1. Manpower.

Dr. Ameenah Farhan and Dr. Edward Davis (both from the Physics Dept.), are working as part time researcher for the center.

2. Mass Chain Evaluation.

1- A=77, A. Farhan and B. Singh, NDS 81, 417 (1997).
2- A=75, A. Farhan and B. Singh, (submitted April 1998).
3- A=163, B. Singh, A. Farhan and E. Davis (in progress, scheduled to be submitted by the end of Oct, 1998)

3. Support.

The center is funded by Kuwait University, Physics Department.

National Nuclear Data Center Activity Report

M. R. Bhat

This report reviews the evaluation of nuclear structure, decay data and related activities of the National Nuclear Data Center (NNDC) for the period August 1996 to October 1998. The name of the person with lead responsibility for each of the sections is underlined.

I. New Evaluations for ENSDF:

(M.R. Bhat, T.W. Burrows, J.K. Tuli)

Evaluations submitted for updating ENSDF:

In 1996: 84

In 1997: 66,146; ^{65}Zn, ^{69}Ge, ^{94}Mo, ^{96}Zr, ^{137}Ba, ^{138}Ba
Decay Data: ^{143}Pr

In 1998: 57; ^{141}Eu, ^{143}Nd

Evaluations in Progress: 139,148, ^{145}Sm

Number of evaluations reviewed:

In 1996: 5 A-chains, 5 nuclides, and 2 high-spin data evaluations

In 1997: 3 A-chains

In 1998: 8 A-chains, 7 nuclides

II. Database Maintenance:

1. The Evaluated Nuclear Structure Data File (ENSDF):

(M.T. Blennau, P. Dixon, J.K. Tuli)

The ENSDF is continuously updated on the basis of new evaluations submitted; details of processing these are given in Section III.1. The current status of mass-chains for A > 44 is shown in Fig. 1. The ENSDF is distributed twice a year; generally in February and August. It is distributed in two forms, as a complete file as well as an update file in which only those data sets that have been modified since the last distribution are included. Users may also update their local databases easily by using the WWW ENSDF access. Superdeformed bands and high-spin evaluations submitted by network evaluators have also been added to the ENSDF and are available to users via the online system and WWW access. Following the discussion at the last NSDD meeting in Budapest, the NNDC cleaned up the entire ENSDF. All errors flagged by the FMTCHK program that could be corrected without the intervention of the evaluator were rectified. The evaluation of A=20 published by the TUNL group in *Nuclear Physics A* was added to the ENSDF.

Nuclear Wallet Cards and NuDat databases are also updated periodically to include additions to the ENSDF. NuDat is distributed along with ENSDF. NuDat was converted from DEC Datatrieve to an ISAM database and both PCNuDat and NuDat use the same database.

2. The Nuclear Science References (NSR):

(C.L. Dunford, J. Tallarine, D.F. Winchell)

Compilation of nuclear science articles has continued, with keywords being assigned when appropriate. All articles from *Physical Review C*, *Nuclear Physics A*, and *The European Physical Journal A* are assigned keynumbers and entered into the database. About 70 other journals are regularly scanned. Monthly and four-monthly distributions continue to be sent to various data centers. Secondary source entries prepared by groups at RIKEN Data Center, Japan and Gatchina, Russia have been received and merged into the database.

A new full-time staff member was hired by NNDC in August 1997 to maintain the NSR. During the last year, procedures for entering information have been streamlined, reducing the amount of time needed to get entries into the database. Part of this has been due to the increased use of web access to tables of contents and articles for journal scanning and file preparation.

In December 1997 the NSR keynumber scheme was changed to include the full year (i.e., 1997Ab01 rather than 97Ab01) in order to avoid potential year 2000 problems. The whole database was reformatted and loaded.

Web-based retrieval from NSR became available in 1997. Where possible, entries retrieved via the web contain links to online abstracts and text. Thus, it is possible to go seamlessly from the NSR abstract to the article abstract and the full text for the *Physical Review C* articles in the APS database. From the keynumber of an ENSDF evaluation in the NSR, a user can also access the corresponding evaluation in the ENSDF.

By the end of 1998, NSR will begin using the recently assigned chemical symbols for elements 104-109. Keyword and selector fields for old entries will be retroactively updated with the symbols.

Development of a relational data-based version of NSR is underway. This is being used to explore the use of a different platform and new database and connectivity options. It is possible that a public version of this database will be available on the web by the end of the year.

Plans are underway to update the author keyword preparation package distributed by *Physical Review C.* User surveys concerning the scope and usability of NSR will be carried out in 1999.

III. Data Dissemination:
(T.W. Burrows, C.L. Dunford, R.R. Kinsey)

The data available from the NNDC are disseminated in hard copy and magnetic media and through online access via TELNET, the World Wide Web (WWW), and anonymous FTP.

1. Processing New Evaluations (Hard copy, TELNET, WWW):
New evaluations submitted to the NNDC are checked by the format and physics checking codes and errors are corrected. A hard copy of the evaluation is sent for review and for final checking by the editor. The final corrected evaluations are published as the *Nuclear Data Sheets* by Academic Press in eleven issues per year. The December issue is devoted to Recent References which are the yearly updates to the NSR. Academic Press is continuing to make available the contents of each NDS issue on the web as Adobe Portable Document (PDF) files. There are 20 new evaluations (15 A-chains + 5 nuclides) in the processing pipe-line at present.

2. Nuclear Wallet Cards (Hard copy, FTP, WWW):
The 1995 Edition of the Nuclear Wallet Cards was published with a literature cut-off date of June 30, 1995. The contents of the Wallet Cards have been available on the WWW and FTP sites since September 1, 1995 and are updated every six months coinciding with the ENSDF distribution. Out of the 10,000 hard copies printed, only about 200 are left and the NNDC is considering publishing a new edition of the Wallet Cards in 1999. Hard copy, HTML, PostScript, and PDF versions will be produced.

3. Online Data Services (FTP, TELNET, WWW):
The total number of retrievals in 1997 was 125,249 compared to 119,726 in 1996 and 87,868 in 1995 for an average yearly increase of 15%. NuDat is now the most popular with 28% of the total retrievals through September 1998 compared to 21% for NSR. The web is now the most popular method of accessing the NNDC systems with 57% of the retrievals through September 1998 compared to 50% and 31% in the same periods for 1997 and 1996.

Improvements and additions to the Online Services since the last NSDD meeting include the following:

a. FTP, TELNET, or WWW:
   i. Documentation:

      Data Citation Guidelines added (PDF available for FTP and WWW). [FTP, TELNET, WWW]

      NNDC Online Data Service manual updated. [FTP, TELNET, WWW]

      The NSR Coding Manual was updated and a PDF version made available (FTP and WWW only). [FTP, TELNET, WWW]

   ii. ENDF (Evaluated Nuclear Data File): Overlay plotting capability added. [TELNET, WWW]

   iii. ENSDF: The IUPAC recommended chemical symbols for Z=104-109 were implemented. [TELNET, WWW]

   iv. MIRD:

The 1996 atomic data of Schoenfeld and Janssen are now used to calculate Auger-electron and X-ray intensities and the 1995 Update to the Atomic Masses are now used.

The IUPAC recommended chemical symbols for Z=104-109 were implemented. [TELNET, WWW]

The PostScript output for MIRD was improved and options for HPGL and Tektronix eliminated. [TELNET, WWW]

v. NSR keynumbers were expanded to eight characters to solve the Y2K problem [TELNET, WWW]

vi. NuDat was converted from DEC Datatrieve to an ISAM database and both PCNuDat and NuDat use the same database. [FTP, TELNET, WWW]

vii. The Y2K problem of CSISRS/EXFOR was solved. [TELNET,WWW]

b. World Wide Web:

i. CINDA (Computer Index to Neutron Data) was added. Subsequent upgrades included links to the APS Link Manager for Physical Review journals from 1985 on and to CSISRS/EXFOR.

ii. ENDF was added.

iii. ENSDF was improved to allow retrievals by atomic and neutron number and by datasets. A simple ENSDF link manager, allowing a retrieval of a mass or nuclide through the web without using forms, was released and has been extensively used through the TUNL A=3-20 Isotope Explorer page, the Lund/Berkeley Q-value calculator page, and others.

iv. The web CSISRS/EXFOR developed at the IAEA Nuclear Data Section was added and upgraded to provide links to the APS Link Manager for Physical Review journals from 1985 on and to other CSISRS/EXFOR entries.

v. A preprint of Nicholas Stone’s Table of New Nuclear Moments was made available in Microsoft, PostScript, and PDF formats.

vi. NSR was added. Subsequent upgrades included links to the APS Link Manager for Physical Review journals from 1985 on and to current evaluations contained in ENSDF. A simple NSR link manager, allowing the retrieval of an NSR entry or a redirection to the APS Link Manager was released.

vii. The Thermal Neutron Capture Gammas were updated in May 1997. A simple form to retrieve by energy range was later added.

viii. User outreach: The NNDC is the host for the US Nuclear Data Program homepage.

c. TELNET:

i. CSISRS was upgraded to allow overlay plotting of experimental and evaluated data and the entry of energy-cross section pairs to add to the plot.

ii. ENDF was upgraded to allow overlay plotting of experimental and evaluated data and the entry of energy-cross section pairs to add to the plot.

iii. ENSDF: PostScript plotting option was improved.

4. Current Activities:

a. Client/Server Registry System: The NNDC has been participating in a Small Business Innovative Research (SBIR) grant with Scientific Digital Visions (SDV), Inc. to develop client/server registry systems for the databases resident at the NNDC. Starting with the NSR and ENSDF databases, these systems will allow an application on the client computer to query a registry on the NNDC computer for database updates of specific interest to a user and download the pertinent information. A demonstration application in Java (NSR Evaluator Profiler) has been developed by SDV.

b. Cooperative Development: The NNDC has been collaborating with SDV and San Jose State University (SJSU) in developing interfaces between client applications and the databases resident at the NNDC. An example of this is MacNuclide 2.0x which allows queries of the NSR and NuDat databases.

c. ENSDF:

i Investigation of serving high-quality tables and plots of ENSDF data over the web for those users who do not have access to the Isotope Explorer.

ii Development of an experimental (unevaluated) nuclear structure data base starting with high-spin data. [TELNET, WWW]

d. NSR is being used as a test bed to study relational databases, Standard Query Language (SQL), and Active Server Pages (ASP).

5. Future Plans:

a. One small database (X-RAY) and the two utility modules QCALC and PHYSCO still remain to be ported to the web from the TELNET Online Data Service.

b. Upgrade, where necessary, current web interfaces to provide the full capabilities of their TELNET counterparts.

c. For MIRD, add an HTML/GIF output option [WWW] and develop methods to retrieve the data by decay chain (e.g., ^{232}Th and all its daughters). [TELNET, WWW]

d. Solve the Y2K problem for the remaining databases (CINDA, ENSDF). [TELNET, WWW]

e. Update the Nuclear Wallet Cards and the Thermal Neutron Capture Gammas. For the Thermal Capture Gammas, add tables of absolute intensities ordered by target. [WWW]

IV. <u>User Services & Network Support</u>:
(T.W. Burrows, M.T. Blennau, <u>V. McLane</u>, J. Tallarine)

The ENSDF analysis and checking codes continue to be maintained and improved; recent improvements made in them and their current status is given in a separate report accompanying this contribution.

The NNDC provides many services to the international Nuclear Structure and Decay Data (NSDD) network evaluators and others on a routine basis. At present they are:

i. Monthly NSR updates are sent to those evaluation centers that still request them, for the A-chains assigned to them.

ii. Complete NSR and ENSDF retrievals are sent at the start of an evaluation to those who cannot access online the NSR or the ENSDF from the NNDC, the NEA Data Bank, Saclay, or the NDS, IAEA; others have to do their own retrievals.

iii. Copies of hard-to-get references are sent to evaluators (with help from the NDP for older references).

iv. ENSDF updates are sent twice a year.

v. NSR updates are sent once in every four months.

vi. The ENSDF physics processing codes are maintained; and corrections and updates are sent periodically.

vii. Special retrievals are made from the NSR and the ENSDF. Requests for for these specialized retrievals are satisfied on a case-by-case basis. Users are encouraged to take advantage of the full potential of the NNDC online system; only if their needs cannot be met by the system then their requests are processed in-house.

viii. ENSDF, NSR, NUDAT updates are sent to the IAEA Nuclear Data Section, the NEA Databank, the Obninsk Data Center, and Slavutych on a regular basis.

V. <u>Publicity for Network Activities & User Outreach</u>:

The following is a list of items done to publicize the network activities, and its products & services:

- Information on the products and services available from the NNDC and other members of the U.S. Nuclear Data Program (USNDP) is given on their WWW homepages with cross-links amongst them.

- Every issue of the NDS contains a brief description of the databases maintained at the NNDC and how to access them.

- The NNDC online system was installed at the nuclear data center at Obninsk, Russia. Mirror sites of the NNDC web pages for ENSDF, the Nuclear Wallet Cards, etc., were established at the Slavutych Data Center, Ukraine in 1997.

- The NNDC personnel gave the following talks to improve user awareness of the online data services:

  INTERNET AND THE NATIONAL NUCLEAR DATA CENTER, T.W. Burrows, American Chemical Society National Meeting, San Francisco, April 13-17, 1997.

  STATUS AND FUTURE TRENDS IN NUCLEAR DATA, C.L. Dunford, International Conference on the Physics of Nuclear Science and Technology, Long Island, NY, October 5-8, 1998.

  NUCLEAR DATA ONLINE AT THE NNDC, V. McLane, International Conference on the Physics of Nuclear Science and Technology, Long Island, NY, October 5-8, 1998.

  DATA DISSEMINATION ACTIVITIES OF U.S.NUCLEAR DATA PROGRAM, T.W. Burrows, APS/DNP Fall Meeting, Santa Fe, NM, October 29-31, 1998.

- There were a number of exchange visits between members of the Network in order to share their special expertise, learn about the practices and procedures of host data centers and share information pertaining to all aspects of nuclear data activities. These visits relevant to nuclear structure data activities are listed in Table 1.

Table 1
Exchange Visits Between Data Centers
October 15, 1998

Visitor	Host	Duration	Purpose
T.W.Burrows(NNDC)	IAEA/NDS	9/7/96 - 10/19/96	Work on software development for the Agency's online services and attend Workshop on WWW Activities.
J.Blachot (Grenoble, France)	NNDC	6/28/97 - 7/31/97	To work on ENSDF & related databases. Review some selected evaluations & evaluate a few selected high-priority nuclides.
Y. Sanborn (NNDC)	IAEA/NDS	10/19/97 - 10/31/97	To understand and advise the IAEA/NDS on their current computer setup & learn how their computer operations and procedures can benefit NNDC.
G.Molnar (Inst.of Isotopes,Budapest, Hungary)	NNDC	11/22/97 - 11/26/97	Review of thermal neutron capture gamma rays and capture cross sections.
T.W.Burrows (NNDC)	IAEA/NDS	11/28/97 - 12/14/97	Work on software development for Agency's online data services & instruct at the Workshop on Online Data Services.
T.W.Burrows (NNDC)	IAEA/NDS	12/7/98 - 12/11/98	Consultant on WWW data dissemination.

ENSDF STATUS (A>44)

9-OCT-1998

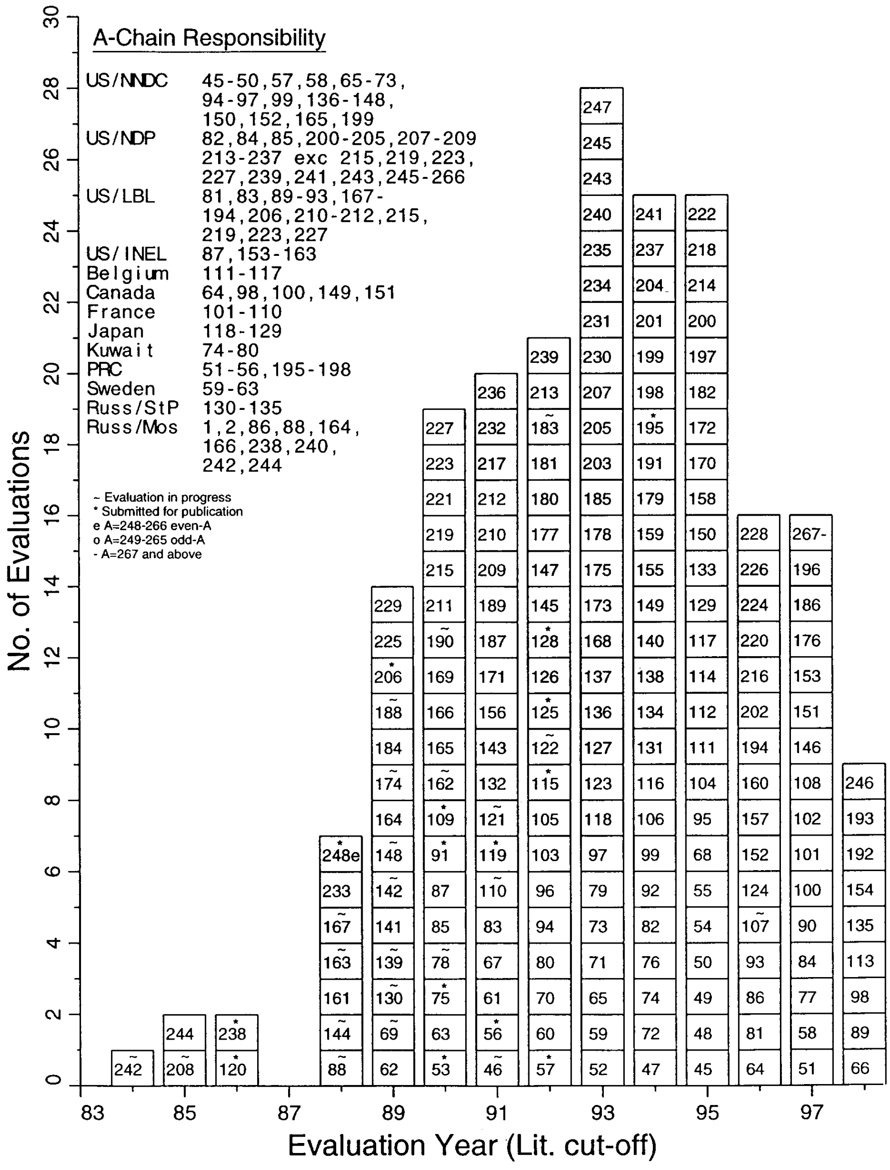

Fig. 1

TUNL Nuclear Data Evaluation Project

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USA

I. Evaluations.

TUNL is responsible for data evaluations in the mass range A = 3 - 20. The current status of these evaluations is summarized below:

Nuclear	Mass Publication/Status	Comments
A = 3	Nucl. Phys. A474, 1 (1987)	TUNL
A = 4	Nucl. Phys. A541, 1 (1992)	TUNL*
A = 5 - 10	Nucl. Phys. A490, 1 (1988)	Penn**
A = 5	Preliminary version mailed Feb. 1998	TUNL*
A = 6	Preliminary version scheduled for late 1998	TUNL
A = 11 - 12	Nucl. Phys. A506, 1 (1990)	Penn**
A = 13 - 15	Nucl. Phys. A523, 1 (1991)	Penn**
A = 16 - 17	Nucl. Phys. A564, 1 (1993)	TUNL
A = 18 - 19	Nucl. Phys. A595, 1 (1995)	TUNL
A = 20	Nucl. Phys. A636, 247 (1998)	TUNL***

* Co-authored with G. M. Hale, Los Alamos National Laboratory
** Professor Fay Ajzenberg-Selove, University of Pennsylvania
*** Co-authored with S. Raman, Oak Ridge National Laboratory

Since the last NSDD/IAEA meeting in 1996, a review of the A = 20 nuclides, in collaboration with S. Raman of Oak Ridge National Laboratory, was completed and published as noted above. Evaluations for A = 5, (in collaboration with G.M. Hale of Los Alamos National Laboratory) and A = 6 were completed. A preliminary version was issued for A = 5 in Feb 1998. Release of A = 6 is planned for late 1998 in collaboration with H.M. Hoffman of the Universität Erlangen-Nürnberg. An evaluation for A = 7 is in progress. An "Energy Levels of Light Nuclei, A = 5 - 7" review is planned for submission to Nuclear Physics A in 1999.

II. ENSDF.

ENSDF files which consist of adopted levels, decay data and reaction data are presently being prepared at TUNL by J.H. Kelley. The A = 3, 4, 16 and 17 ENSDF files have been updated to include data from the past TUNL reviews, and a file that reflects the most recent TUNL publication for A = 20 has been accepted. An ENSDF file which reflects information from the A = 5 preprint has been prepared, and a file for A = 6 is expected to come shortly after the release of the A = 6 preprint.

III. World wide Web services.

TUNL continues to develop new WWW services for the nuclear science and applications communities. During the past year C.M. Cheves implemented a new design that emphasizes convenient access to individual A = 3 - 20 nuclides as well as to categories of information. The most recent evaluations (modified versions of "Energy Levels of Light Nuclei" publications) are available in pdf for A = 3, 5 - 10, 16 - 20. Energy Level Diagrams are provided for A = 4 - 20 nuclei. A new feature has been added which provides descriptions of important research published since the last full evaluation. References are divided into categories of level information, reaction information, decay information, and other properties, with experimental and theoretical subdivisions for each. These "Update lists" are currently online for A = 6 nuclei; lists for other nuclei are being prepared. This item represents the beginning of a new initiative by the TUNL group to provide to the nuclear community via our WWW page a continuously updated guide to important new work that has appeared in the literature since the most recent published review for each nuclide.

IV. Related activities.

TUNL makes extensive use of the Nuclear Science References services at NNDC. It supplements these resources by its own continued scanning of the literature, compiling bibliographical listings for relevant A = 3 - 20 experimental and theoretical work, utilizing the resources of the Triangle Area libraries, Monthly Updates from NNDC, Current Contents on Diskette with Abstracts, and Physics Abstracts.

This work is supported by the United States Department of Energy, Office of High Energy and Nuclear Physics, under:
Grant No. DE-FG02-97ER41033 (Duke University) and
Grant No. DE-FG02-97ER41042 (North Carolina State University).

Annex 7

C. Status Reports : Projects and Other Activities

C1. Advanced Technologies for Accessing and Disseminating Nuclear Data
Tracy L.M. Langlands, Robert A. Sutton, U.S.A.

C2. The MacNuclide Nuclear Data Project
Craig A. Stone and Erik E. Miyake, U.S.A.

C3. Decay Data Evaluation Project Report
Richard Helmer, USA

C4. Nuclear Structure & Decay Data (NSDD) - Network Coordination
M.R. Bhat

C5. Review of Log *ft* Values in Beta Decay.
B. Singh, Canada

C6. Status Report on Recommended Standards for Gamma-ray Energy Calibration
R..G. Helmer, USA and C. Van der Leun, The Netherlands

C7. Status of ENSDF Analysis and Utility Codes
Thomas W. Burrows, USA

C8. New Calculation of Internal Conversion Coefficients
S. Raman, U.S.A.

C9. Report of the Activity of the Radionuclide Data Center
V.P. Chechev, Russia

C10. Data Evaluation for Radionuclides of Interest in Astrophysics within the framework of the International Decay Data Evaluation Project (DDEP)
E. Norman, USA

C11. Conversion of Utrecht Evaluations of Nuclides with A=21-44 to ENSDF
E. Norman, USA

C12. Horizontal Evaluation of Thermal Neutron Capture Gamma-ray Data
G.L. Molnár, Hungary, R.B. Firestone, USA

Advanced Technologies for Accessing and Disseminating Nuclear Data

Tracy L.M. Langlands, Robert A. Sutton
Scientific Digital Visions, Inc.
San Jose, CA, U.S.A.

Scientific Digital Visions is developing software technologies that support the U.S. and international nuclear data programs. Much of our effort has been supported by the Small Business Innovation Research (SBIR) Program at the U.S. Department of Energy, a program that provides early funding for the development of strategic technologies. This program has allowed us to develop new Internet technologies, database technologies and scientific data management tools. Collaborations have been established with the National Nuclear Data Center (NNDC) and San Jose State University to facilitate the development of these technologies, tailoring them to the needs of the nuclear data community. The collaboration with the NNDC has produced new methods of accessing information in the Nuclear Science References (NSR), Evaluated Nuclear Structured Data File (ENSDF), and NuDat databases. Our collaboration with San Jose State University has focused on testing and evaluating software that interacts with the NNDC databases through software applications such as MacNuclide. Our goal is to further improve the access and dissemination of large-scale nuclear databases over the Internet.

Development of nuclear data software for desktop computers has created considerable problems for the nuclear data community. The desktop computer has allowed us to exploit new developments in user interactivity and graphics, but it has forced us to create databases that are derived from the NNDC databases. Infrequent updating of these secondary databases has traditionally diminished the utility of existing nuclear data software.

We are developing technologies that improve the methods of accessing the NNDC databases from desktop computers. A key component of this technology is known as a registry system. This software is located on the NNDC server and tracks the addition, deletion, and modification of nuclear data in the relevant databases. Remote applications, known as user profilers, communicate with the registry system which responds by sending a list of records that have changed. The user profiler then requests specific records to be transferred to the desktop computer. The volume of information stored in the databases is substantial. Also, users may only be interested in a subset of the data. Filters are used to limit the information transferred from the NNDC. These filters, which are known as profiles, can be created in two ways. One method for defining a profile is to interact with a nuclear data application such as MacNuclide. The application can define which nuclides and information are of interest to the user based on how the user interacts with the application. In another method, the user can specify which databases and key information to track. The profiler then downloads only that information which is of interest to the user. More importantly, nuclear data applications can use this technology to automatically update the local databases. We have implemented this technology for the ENSDF, NSR, and NuDat databases.

We have recently begun development on technologies in three key areas of nuclear data: scientific graphics and electronic publishing, the accurate and consistent management of scientific data, and Java database systems. Research in these areas is sponsored by the Department of Energy through the SBIR program. Although it is too early at this time to disclose details of these projects, we envision their eventual use at the NNDC and in nuclear data applications within the nuclear data community.

Scientific Digital Visions, Inc. would like to recognize the efforts of the National Nuclear Data Center and San Jose State University. Funding has been provided by the U.S. Department of Energy under grants DEFG03-96ER82275, DE-FG03-98ER82666, DE-FG03-98ER82665, and DE-FG03-98ER82664.

For further information on these technologies, please contact Tracy Langlands by e-mail at tracy@sdv.vip.best.com or by telephone at (408)289-8494.

The MacNuclide Nuclear Data Project

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Center for Nuclear Information Technology
San Jose State University, San Jose, CA 95192-0101
U.S.A.

This report describes significant advances that have been made in the MacNuclide project during the last two years. Version 1.0 of the software is available for the MacOS and Windows'95 operating systems while the recently released Version 2.0 is available only on the MacOS. Approximately 2,000 copies of the software are now in use throughout the world, received as a free download through the web site at www.macnuclide.com. An upcoming release of the software will run on most of the operating systems and platforms in use.

Version 2.0 of MacNuclide was released during late spring of 1998. Our goals in developing version 2.0 were to provide a comprehensive overhaul of the underlying software architecture, converting the code from C to C++, provide modest improvements in functionality, implement changes to the graphical user interface, but primarily to prepare the code for a larger conversion into Java. We have released this version to provide an early test of design changes and network access technologies. The defined nuclide attributes were expanded considerably. We have included methods to select groups of nuclides on the basis of chemical classifications (e.g., lanthanides), their membership in naturally-occurring decay chains (e.g., uranium decay series), nuclides of astrophysical importance, nuclides with magic numbers of neutrons or protons, and nuclides that lie along the valley of stability or which are neutron rich or neutron deficient. Skeleton level schemes were modified to include improved management of displayed properties. The latter accomplishments are primarily due to technologies developed by Scientific Digital Visions and made available to the project.

We are pleased to announce that MacNuclide is now a platform-independent application. A new version of MacNuclide has been written in Java and should run on any computer that supports Java. Approximately 70% of the functionality has been implemented at the time this report was prepared. Chart displays and interactivity are in place along with skeleton level scheme display and other elements of the graphical user interface. The software is currently driven by a hard-wired database containing a list of known elements. This has facilitated development of the internal data architecture and data searching methods. Within the next two months the database will be formally installed and tested. The software has been successfully tested on the MacOS, Windows, Linux and Solaris operating systems, covering most of the desktop computer market. We anticipate that a fully-operational version of Java MacNuclide will be available via the web site www.macnuclide.com by the end of January, 1999.

Extended capabilities are under development through a partnership with Scientific Digital Visions and the National Nuclear Data Center (NNDC). Nuclear properties are processed using a proprietary technology under development by Scientific Digital Visions. The technologies allow a comprehensive definition of the data, including units and uncertainties. This company has also partnered with the NNDC to develop new internet technology to access information in the various NNDC databases. Its initial use in MacNuclide will be to access specific information about a nuclide in the ENSDF, NSR or NuDat databases. Later improvements will include automatic updating of the local database(s). Other technologies to be implemented through these partnerships include advanced management of databases and scientific graphics.

The authors wish to acknowledge the efforts of the National Nuclear Data Center and Scientific Digital Visions, Inc., and the funding provided by the U.S. Department of Energy under grant DE-FG03-91-ER40630.

A free copy of the latest released version of MacNuclide can be obtained through the web site www.macnuclide.com. Further information or requests for preliminary releases can be made by contacting the authors by electronic mail at cstone@macnuclide.com.

Decay Data Evaluation Project Report

Richard Helmer
Idaho National Engineering Laboratory
USA

This program was approved at the 1994 meeting of the international Nuclear Structure and Decay Data Network for the purpose of providing high-quality evaluations of the decay data for a selected group of about 250 radionuclides that are useful in various applications of nuclear technology. A secondary goal of the project was to involve persons outside of the existing ENSDF evaluation organization and thereby expand the available manpower.

This project currently includes Marie-Martine Be, Laboratoire Primaire des Rayonnements Ionisants, LPRI, France; Eckart Schoenfeld, Physicalisch-Technische Bundesanstalt, PTB, Germany; Desmond MacMahon, United Kingdom; Valery Chechev, Khlopin Radium Institute, Russia; Alan Nichols, AEA Technology, United Kingdom; and from the Unted States Edgardo Browne, Lawrence Berkeley National Laboratory, LBNL, Richard Helmer, Idaho National Engineering and Environmental Laboratory, INEEL, and Jagdish Tuli, Brookhaven National Laboratory, BNL. This group in coordinated by Richard Helmer.

The members of this group have agreed on a set of evaluation procedures to be used, a standard form for presenting the results, a standard presentation of the discussion of how the evaluation was carried out, and a review process. It is expected that all of the resulting evaluations will be published in three forms. The first will be their inclusion in a new Table of Radionuclides to be published at LPRI as a French-German project to continue LPRI's earlier publication Table de Radionucleides. The second publication form will be to integrate these results into ENSDF; this will be more complex due to the need to edit the associated adopted data sets. The third form of publication is planned to be a laboratory report which includes the comments and discussions of the evaluators which explain the decisions made in the evaluation process.

At this time the radionuclides for which evaluations have been completed, including the post-review editing, are ^{3}H, ^{14}C, ^{22}Na, ^{26}Al, ^{35}S, ^{36}Cl, ^{40}K, ^{55}Fe, ^{60}Co, ^{65}Zn, ^{68}Ge, ^{68}Ga, ^{75}Se, ^{95}Zr, ^{95}Nb, ^{109}Cd, ^{111}In, ^{113}Sn, ^{125}I, ^{137}Cs, ^{139}Ce, ^{141}Ce, ^{143}Pr, ^{169}Yb, ^{188}Re, ^{192}Ir, ^{194}Ir, ^{198}Au, and ^{207}Bi. Only a few of these have been entered into ENSDF and many of them have not yet been produced in ENSDF format. Over ten more radionuclides have been evaluated and reviewed, but are not yet in final form.

Nuclear Structure & Decay Data (NSDD) Network Coordination

M.R. Bhat
October 15, 1998

I. New Evaluations & Resources:

We note with regret the demise of our colleagues, C. van der Leun and Yu. V. Sergeenkov. They will be sorely missed by the members of the network which is poorer by their loss. A number of experienced evaluators have also retired recently, and more may do so in the near future. The network has not been able to recruit and train new, younger evaluators. These problems should be of concern to the network and its future and merit serious discussion at the December '98 meeting.

Tables 1-3 summarize the evaluation activities of the NSDD network for the calender years 1996-1998 along with the resources in full-time-equivalent (FTE) devoted to this activity at each center. The total FTE for the network are:

11.8 (1996), 9.6 (1997), and 9.9 (1998).

All these numbers are approximate, because for some data centers we do not know the FTE, or even if we know the numbers, it is not clear how much of this is diverted into other projects. The total number of new evaluations submitted, however, are much less than what can be expected from these FTEs. Some gains in efficiency of evaluations have been made in the update mode, where new data are incorporated into the old evaluations without reworking them *ab initio*. This of course assumes that the old evaluation is of good quality and consistent with network standards. Evaluations that get the new data into the ENSDF should have the highest priority in network activities. The low productivity of evaluations and the lack of recruiting and training of new younger evaluators in the network should be of concern to all. Finding a new permanent home for the evaluation of A=21-44, hitherto done by the Utrecht group, should also be discussed.

It is estimated that the U.S. members and McMaster University will contribute a total of 6.7 FTE towards nuclear structure and decay data evaluations for the ENSDF in 1999. Other members of the network are requested to provide similar estimates between now and the NSDD meeting in December, for planning future network activities.

II. Reorganization of U.S.Nuclear Data Program:

The U.S. Nuclear Data Program (USNDP) has undergone a number of changes beginning in August '95 to the present. These changes are both functional and organizational, and a brief summary of these changes in so far as they affect the international NSDD activities are as follows.

The USNDP activities are divided into three categories, viz., A. Nuclear Structure & Decay, B. Nuclear Reactions, and C. Data Dissemination. The USNDP and especially its reaction component will provide data support to the needs of five areas of basic research supported by the USDOE/ER, viz., 1. Nuclear Astrophysics, 2. Radioactive Ion Beams, 3. High Energy Heavy-Ion Interactions, 4. High Energy Electron Interactions, and 5. High-Spin Physics. The nuclear structure and decay data component has had basic research orientation since its inception, and will continue to do so. Both categories of nuclear data are used in applied technology. As the applied uses get more sophisticated, and the criteria for data modeling and testing get more

demanding, it is found that new and complex basic data are needed. It is also expected that basic data from these new areas of research will rejuvenate activities such as data evaluations, nuclear model codes, data testing and related activities. Thus, users are seeing the beginnings of new data from highly ionized atoms, and radioactive ion beams studies which are expected to increase in both quality and quantity in the next few years. Opening up of these new regions of nuclides, that could not be studied with experimental techniques available till now, will provide incentives for new developments in nuclear theory, data evaluations, and applications. Developments in computer technology have made new types of data
dissemination possible enabling data centers to provide services for a range of users- from a novice to an expert. The changes in the USNDP are set to take full advantage of these developments in basic research and computer technology and provide better user services.

The USNDP activities in the three categories listed above are each managed by a Working Group. These working groups are supervised by a Coordinating Committee, made up of one representative from each organization participating in the nuclear data program. Its purpose is to organize the work of the program and to interface with the Steering Committee which consists of six members from the nuclear data user community and two representatives of the nuclear data program to provide external oversight of the program and advise on its priorities. Task Forces are formed as needed to address specific needs of the USNDP and the users. At present there are three of them, for High-Spin, Astrophysics, and Radioactive Ion Beams (RIB).

The High-Spin Task Force had its first meeting at the Nuclear Structure ’98 meeting, August 10-15, 1998, at Gatlinburg, TN. There was discussion about forming and maintaining an unevaluated nuclear structure database. A follow-up meeting on this subject is planned at the APS/DNP meeting in Santa Fe, NM, October 29-31, 1998.

The Astrophysics Task Force has had a number of meetings to plan, initiate, and implement cooperative nuclear data activities involving the nuclear data and astrophysics communities. Web sites providing access to nuclear data of interest to the astrophysics users have been set up at the T-2 Nuclear Information Service (LANL), LBNL Nuclear Astrophysics Data (LBNL), and the ORNL Astrophysics Program (ORNL). A joint proposal for a new coordinated U.S. Nuclear Astrophysics Data Program has been submitted by ANL, LBNL, LLNL, LANL, ORNL, and the University of California at Santa Cruz, and is being reviewed.

The RIB Task Force, in consultation with the RIB projects at ANL, ORNL, and others has initiated a program of nuclear model calculations to predict the yields of radionuclides far from stability in (p,xn), (p,fission), and (n,fission) reactions, to optimize experimental conditions for the production of RIBs. Model calculations of radioactivity produced within the target/shielding experimental configurations have also been done. This work has also involved extensive research and development of nuclear model codes using the latest advances in nuclear theory and evaluation techniques. The results of this work may be accessed through the web site of the T-2 Nuclear Information Service (LANL).

A pilot database of relativistic heavy ion reaction data has been started at the NNDC in support of the high energy heavy-ion interactions data program, and may be accessed through the NNDC web site.

Further details of the activities of the USNDP, its Task Forces and organizational units may be found in the USNDP home page on the web at the URL: http://www.nndc.bnl.gov/usndp/

Table 1

Nuclear Structure Data Evaluations Submitted in 1996
October 15, 1998

Data Center	A-chains + Cont.Eval/FTE	High-Spin/FTE	Decay Data/FTE
BNL(USA)	84+.../1.5	.../0.15	.../0.1
INEL(USA)	.../0.5	^{154}Dy,Nd,Er	
LBNL(USA)	81,93+.../0.6	^{90}Mo,^{91}Ru,^{211}At,Rn,Th; ^{163}Dy,Er,Tm,Yb,Lu; & Superdeformed Bands*/0.7	^{75}Se,^{188}Re,^{194}Ir/0.25
NDP(USA)	.../1.0	.../0.5	...
TUNL(USA)	20/1.0 (prelim. version on WWW)	...	...
KISR(Kuwait)	.../0.4	...	...
CEA(France)	101+.../0.3	^{114,116}Te	...
Ghent(Belgium)	.../0.5	...	...
Utrecht U. (The Netherlands)	...	...	...
JAERI(Japan)	120,124/2.0(?)	...	...
CAJaD(Russia)	238/0.5	...	...
LIYaF(Russia)	.../0.5	...	...
McMaster U. (Canada)	64,100/0.4	Superdeformed Bands*/0.1	...
CNDC(PRC)	51/0.3	...	...
Jilin U.(PRC)	.../0.2	...	.../0.2
Nat'l Tsing Hua U.(Taiwan)	86/0.3	...	...

*Joint evaluation LBNL, McMaster Univ. for 62 nuclides, A=81-87, 129-137,142-155,189-198

Table 2
Nuclear Structure Data Evaluations Submitted in 1997
October 15, 1998

Data Center	A-chains, Nuclides/Total FTE	Decay Data
BNL(USA)	66,146;^{65}Zn,^{69}Ge,^{94}Mo,^{96}Zr,^{137}Ba, ^{138}Ba/1.25	^{143}Pr
INEL(USA)	153,154;^{155}Ce,Pr;^{156}Pr,Nd,Tm,Yb;^{157}Nd,Tm; ^{158}Nd;^{162}Yb,Lu/0.5	
LBNL(USA)	90,91,135%,176,192;Superdeformed Bands*, Data sets for A=21-240/1.9	^{26}Al,^{192}Ir
NDP(USA)	193,246;Systematics of α-decay data for all even-even nuclei/0.6	...
TUNL(USA)	20/1.0 (submitted to *Nuc.Phys.* & ENSDF)	...
KISR(Kuwait)	.../0.6	...
CEA(France)	113,115;^{111}Te,^{117}Sb; Data sets for A=10-257/0.35	...
Ghent(Belgium)	102/0.3	...
Utrecht U. (The Netherlands)	...	...
JAERI(Japan)	.../0.8	...
CAJaD(Russia)	.../0.5	...
LIYaF(Russia)	135%/0.5	...
McMaster U.(Canada)	98;Superdeformed Bands*/0.5	...
CNDC(PRC)	196/0.3+	...
Jilin U.(PRC)	.../0.2+	...
Nat'l Tsing Hua U.(Taiwan)	.../0.3+	...

*Joint evaluation LBNL, McMaster U.
% Joint evaluation LIYaF, LBNL
+FTE assumed to be same as in 1996

Table 3

Nuclear Structure Data Evaluations Submitted in 1998
October 15, 1998

Data Center	A-chains, Nuclides/Total FTE
BNL(USA)	57;^{141}Eu, ^{143}Eu/1.5
INEEL(USA)	.../0.4
LBNL(USA)	89*,206,^{81}Y,^{92}Rh,^{92}Ru,^{170}Lu,^{170}Ta,^{179}Ir/2.1
NDP(USA)	248,249-265(odd)/1.0
TUNL(USA)	5+,6+/1.2
Kuwait U.(Kuwait)	75$/0.6
CEA(France)	109/0.2
Ghent(Belgium)	.../0.35
Utrecht U. (The Netherlands)	21-44%
JAERI(Japan)	125,128,119/1.5
CAJaD(Russia)	.../0.25
LIYaF(Russia)	.../?
McMaster U. (Canada)	89*,75$/0.5
CNDC(PRC)	195/0.3
Jilin U.(PRC)	56,53/?
Nat'l Tsing Hua U.(Taiwan)	...

*Joint evaluation LBNL, McMaster U.
+Sent for comments/suggestions
$Joint evaluation Kuwait U., and McMaster U.
%Published in *Nuclear Physics* A633,1 (1998)

Review of Log *ft* Values in Beta Decay.

B. Singh
McMaster University
Canada

All log*ft* values (about 20,000) for beta decay branches were extracted from ENSDF of August 1997 version. Some new values from recent literature were added also. A large number (about 80%) of the values in the file corresponded to transitions which were either too weak to be reliable, especially in complex level schemes, or were between levels of tentative J^{π}'s. The remaining 20% (about 3900 cases) were divided into allowed and forbidden categories according to the classification scheme of Konopinski. Centroid, width, minimum and maximum values for each category were determined. Global plots for the distribution of each category of beta transition were generated. In addition log*ft* values were plotted against A, N and Z for allowed and first-forbidden transitions.

These systematics represent a complete review after the one done in 1963 by Gleit et al.. which considered about 900 beta transitions, including weak and those between levels of tentative spin-parities. The global plot generated in this study should provide an updated log*ft*-distribution plot for the purpose of Nuclear Physics textbooks which at present use the outdated 1963 histogram of Gleit et al.

This work was published in NDS 84, 487-563 (1998) by B. Singh, J.L. Rodriguez (McMaster), S.S.M. Wong (Toronto) and J.K. Tuli (BNL).

Status Report on Recommended Standards for Gamma-ray Energy Calibration

R.G. Helmer, Idaho National Engineering Laboratory, USA
C. Van der Leun, Fisisch Laboratorium, The Netherlands

A manuscript on this topic has been prepared. It is expected that this work will be submitted for publication early in 1999 when a last set of experimental data has been re-analyzed by the authors of that work. The current abstract for this manuscript follows.

A consistent set of gamma-ray energies, generally with uncertainties of less than 10 ppm, is recommended for use in the energy calibration of γ-ray spectra. The energy scale used for the previously recommended standards (1979) has been modified to take into account subsequent adjustments in the fundamental constants (-7.71 ppm) and in the γ-ray wavelengths deduced from a revised estimate of the lattice spacing of Si crystals (+1.91 ppm). On this revised energy scale, the strong line from ^{198}Au has an energy of 411802.05 $\pm$ 0.17 eV, which is 2.4 eV (or 5.80 ppm) lower that the 1979 value. A significant improvement has come from the reduction in the uncertainty in the wavelength-to-keV conversion factor from 2.6 to 0.3 ppm. The γ-ray energies reported here are all on this 'wavelength' scale and range from 24 to 4806 keV. The criteria for the selection of γ-rays to include are described. The list of γ-ray energies recommended for calibration, especially for Ge semiconductor detectors, has values for about 260 γ-rays from 50 radionuclides and two (n,γ) reactions. Also, γ-ray energies are given for about 70 additional lines, including 5 other radionuclides.

Status of ENSDF Analysis and Utility Codes

Thomas W. Burrows
National Nuclear Data Center, Brookhaven National Laboratory
USA

Content:

A. Major improvements.

1. ENSDAT:

- Maximum Z is now defined up to 115.
- The ability to use commands on cards following a dataset has been added.
- Chemical symbols for Z's 104 to 109.

2. FMTCHK:

- Expanded allowed types of WIDTH's.
- Expanded allowed mixtures of decay modes.
- NUCID A and Z are checked against A and Z calculated from the parent and decay mode for decay data sets.
- For adopted data sets with no PN record and any data set with option 6 on PN record, check for existence of one gamma with RI=100 for each set of de-exciting gammas.
- Upgraded to IUPAC symbols for Z>103 and added warning message for the old formalism.

3. NSDFLIB:

- Modified to handle IUPAC chemical symbols between Z=104 and 109 inclusive. Extended allowed range of Z's from 112 to 199.

4. PANDORA:

- In case of unique parent/daughter JPI all mults must be valid.

B. Minor improvements.

1. COMTRANS:

- Column footnotes were not capitailized.
- The comments data set did not terminate properly if the last section was a funding acknowledgement.
- The comments dataset had extra blanks in the comments section if the continuation cards began with them.
- 16- and 32-bit versions available for Windows/MS-DOS

2. ENSDAT:

- Multiplicative constants in intensity footnotes can now be given in exponential form if that is shorter.
- Partial updates to prepare for Y2K.
- HF was not placed correctly on the Alpha drawing.
- Usage of the % sign in the XREF field is allowed.
- Exponential parent branching value is now correct.
- The command GENCOM was missing.
- 16- and 32-bit versions available for Windows/MS-DOS

3. FMTCHK:

Many - See http://www.nndc.bnl.gov/nndcscr/ensdf_pgm/utility/fmtchk/readfmtc.me for details.

4. NSDFLIB:

- Corrected error in IZEL when mixed alphanumeric symbol (e.g. "1S") passed to it.
- Changed IOVRFLW to IVRFLW for ANSI standard considerations.

5. RULER:

- Corrected range error in OUT2ON.
- Changed calls to VAX TIME/DATE routines to handle Y2K problem.

6. PANDORA:

- Ignore blanks following "FL=".

7. TREND:

- Illegal column footnote when given as the final table comment caused the program to bomb for gamma tables with intensity flags given.

C. MS-DOS versions.

With the exceptions of COMTRANS and ENSDAT, the MS-DOS versions of the ENSDF analysis and utility codes maintained by the NNDC are up to 4½ years behind the OpenVMS and ANSI-standard versions. The MS-DOS versions will be brought up to current levels by the end of 1998. The following changes are planned in this update:

- DEC Visual FORTRAN will be used instead of Microsoft FORTRAN 5.1.
- Distribution will only be done through the World Wide Web and anonymous FTP except in special circumstances.

D. Codes no longer maintained.

With the advent of the program ENSDAT, the programs PREND and TREND are no longer being maintained and upgraded.

E. Codes from other centers.

No upgrades have been received for distribution from the Isotopes Project, LBNL (GABS, GAMUT, SPINOZA) since October, 1993. The program DELTA from Lund University, Sweden has not been upgraded since April, 1993; however, this code does not use the ENSDF format and probably needs no upgrades.

F. Projected upgrades.

1. All codes:

- Implement ENSDF format changes agreed to at the Vienna NSDD meeting.
- With the exception of COMTRANS, FMTCHK, and ENSDAT, the codes need to be checked for the change in chemical symbols for the high-Z elements.

2. ALPHAD:

- Investigate numerical methods of calculating non-Gaussian probability distributions.

3. LOGFT:

- Add coding for properly calculating higher orders of forbiddenness (3rd and 4th).
- Investigate calculating log*ft*'s for completely ionized atoms.

4. RadList:

- Bring the current distributed version (5.5, Oct. 1988) up to the present in-house version (5.7f, Oct. 1998).
- Produce 32-bit version for Windows/MS-DOS.

G. Tables:

ANALYSIS CODES				
CODE	FUNCTION	VERSION NO./DATE	MS-DOS	DOCUMENTATION
ALPHAD	Calculates α R_0's, HF's and theoretical $T_S(\alpha)$'s	1.4 940930	1.4 940930	No (See "Read Me" file)
DELTA	Analyzes angular correlation data.	1.01 930415	1.01 930415	LUNFD/(NFFR-3048) 1-27
GABS	Calculates absolute ΔI_γ's	VIIa 930827	VIIa 930827	PROGRAM GABS. E Browne, Lawrence Berkeley Laboratory. Adapted for IBM PC by C.M. Baglin (Sept. 1991.Unpublished)
GAMUT	Creates adopted levels, gammas from source data sets.	[a,b] 8809	No	LBL-26024
GTOL	Determines level energies from a least-squares fit to E_γ's & feedings.	6.2 931126	6.2 931126	BNL-NCS-23375/R LUNFD/(NFFR-3049) 1-27
HSICC	Interpolates internal conversion coefficients	11(13) 960304	11(12) 940815	Nucl. Data **A4**, 1 Nuclear Data Tables **A9**, 119 BNL-NCS-23375/R
LOGFT	Calculates log*ft*	7(15) 950325	7(14) 930903	Nucl. Data Tables **A10**, 206
NSDFLIB	Support subprograms for many codes	1.5b 981008	1.4c 950404	Yes
PANDORA	Physics check of ENSDF data sets. Aids with adopted gammas & XREF.	6.4a 950225	6.2 941129	Yes
RadList	Calculates atomic & nuclear radiations. Checks energy balance.	5.5 881005	No	BNL-NCS-52142
RULER	Calculates reduced transition probabilities	1.20a 980306	1.19 940429	Yes
SPINOZA	Physics check of an ENSDF data set	1(4)[a,b] 930809	No	Unknown

[a] Program as received from the author;.
[b] Program contains Open-VMS extensions of ANSI FORTRAN 77.

UTILITY CODES				
Code	Function	Version No./Date	Windows/ Ms-Dos	Documentation
ADDGAM	Adds gammas to adopted data set	1(3) 930414	1(3) 930414	No (See "Read Me" file)
COMTRANS	Converts the text comments of an ENSDF dataset to a "rich text format"	3.0[a] 980617	3.0[b] 980617	No (See "Read Me" file)
ENSDAT	Produces tables and drawings	6.81[a] 981016	6.81[b] 981016	No (See "Read Me" file)
FMTCHK	ENSDF format checking	8.7d 981009	1.4a 950421	No (See "Read Me" file)
NSDFLIB	Support subprograms for many codes	1.5b 981008	1.4c 950404	Yes
PREND	Constructs level schemes from ENSDF data sets	2.5a[c] 940328	No	No (See "Read Me". file)
TREND	Tabular display of ENSDF data.	6.20 961022	6.14 931129	No (See "Read Me" file)

[a] Executable versions for MS-DOS and Open-VMS only.
[b] 16 and 32 bit versions.
[c] Program contains Open VMS extensions of ANSI FORTRAN 77.

The latest version of this report is maintained at http://www.nndc.bnl.gov/nndcscr/ensdf_pgm/code_status.html.

New Calculation of Internal Conversion Coefficients

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Currently, the most widely used Internal Conversion Coefficients (ICC) tables are those by Hager and Seltzer [1], Rösel et al. [2], and Band and Trzhaskovskaya [3]. In all cases, the calculation of electron wave functions is carried out in the framework of the Dirac-Fock theory with statistical consideration of exchange interaction patterned after Slater (the DFS method).

Computations of ICC in the framework of the DFS method are quite reliable for nuclear transitions with relatively high gamma energy (conversion electron energy of several tens of keV or higher) and moderate $L \leq 2$. In these cases, there is reasonable agreement between theory and experiment (discrepancy of 1-2% for the K shells) unless the nuclear transition is strongly hindered. The situation worsens for higher multipolarity transitions.

In the cases of low gamma energy and high L transitions, the situation is more dramatic. The theoretical ICC results obtained by using different approximations in atomic field calculations differ in a significant manner. Therefore, a very important step consists in choosing the proper theoretical model. For example, even for the K shell and E3 and M4 transitions, available theoretical and experimental ICC data differ by a few percent; this discrepancy is several times greater than the experimental uncertainty. A model of great promise and sophistication is the Dirac-Fock atomic model (DF model) with exact consideration of the exchange interaction between atomic electrons as well as between these electrons and the free electron receding to infinity during the conversion process. The DF model give results that are closer to the experimental data.

At the Oak Ridge National Laboratory, a group consisting of Band, Trzhaskovskaya, Nestor, and Raman have implemented a computer code for calculating the ICC values. This code calculates Dirac-Fock wave functions with the options of (a) no consideration of the hole, (b) the "frozen-core" approximation, and (c) a self-consistent-field calculation of the wave functions for the ions. With this code, these authors are now preparing a new table of ICC values for $10 \leq Z \leq 112$. The energy grid will be the same as in Ref. [3]. This work is expected to appear in print in the year 2000.

References.

1. Hager, R. S., Seltzer, E. C., Nucl. Data A4, 1 (1968).
2. Rösel, F., Fries, H. M., Alder, K., Pauli, H. C., At. Data Nucl. Data Tables 21, 91 (1978).
3. Band, I. M., Trzhaskovskaya, M. B., Tables of Gamma Ray Internal Conversion Coefficients for K, L and M Shells, $10 \leq Z < 112$ (in Russian), (LNPI, Leningrad, 1978).

Report of the Activity of the Radionuclide Data Center

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Russia

1. Measurements of decay data.

Experimental Determination of KX-ray and Soft Gamma-Ray Emission Probabilities in Decays of ^{153}Gd, ^{155}Eu and ^{169}Yb (finished).

2. Horizontal evaluations of decay data:

a) 1996 half-life evaluations for 42 radionuclides used for X-ray and gamma-ray detector calibration (by Chechev, V.P.).
b) Evaluations of decay data within the framework of DDEP cooperation: ^{3}H, ^{14}C, ^{35}S, ^{36}Cl, ^{111}In (finished), ^{57}Co, ^{99}Mo, ^{99m}Tc, ^{170}Tm (in progress).
c) Re-evaluating of half-lives, X- and gamma-ray energies and emission probabilities for ^{44}Ti, ^{57}Co, ^{67}Ga, ^{85}Kr, ^{99}Mo, ^{99m}Tc, ^{111}In, ^{129}I, ^{133}Ba, ^{154}Eu, ^{155}Eu, ^{170}Tm, ^{203}Hg (within the framework of CRP task, in progress).

3. Other related activities on nuclide data:

a) Development of database for NUCLIDE GUIDE and NUCLIDE CHART, PC system, containing short information of all known nuclides. For radioactive nuclides it includes the evaluated half-lives, mass excesses, decay energies (with uncertainties) and some other characteristics (radiation energies and emission probabilities) without uncertainties.
b) Making (together with Atominform, Moscow) the International Chart of Nuclides (wall-type) on the basis of the above Database and nuclear data reported by CNDC (China), M.S.Antony (France) and NDC JAERI (Japan) (the 1st version is finished).

4. ISTC Project No.1227.

ISTC Project No.1227 "Transuranium Radionuclides: Producing Highly Enriched Isotope Samples, Measuring Emission Probabilities Of Radiations And Decay Data Evaluation" is submitted for consideration to the International Science and Technology Centre from three participating institutions (VNIIEF, Sarov, and KRI and VNIIM, St.Petersburg). It includes measurements of the alpha- and gamma-emission probabilities for ^{238}Np, ^{241}Am, ^{242m}Am, $^{243-248}$Cm and re-evaluations of decay data for the 20 transuranium radionuclides.

5. Translations.

Translating to English the Russian reference book "Evaluated Values of Nuclear Characteristics of Transuranium Nuclides" by V.P.Chechev et al., Energoatomizdat, Moscow, 1988 (in progress).

6. Publications.

1. Egorov, A.G., Chechev, V.P., Nucl. Instr. Meth. in Phys.Res. A339 (1994) 248.
2. Golashvili, T., Chechev, V.P., Lbov, A., NUCLIDE GUIDE, Moscow, Atominform, 1995.
3. Chechev, V.P.. Egorov A.G., Shchukin, G.E., Appl. Radiat. Isot. 47 (1996) 329.
4. Chechev, V.P.., In: Proceedings of the International Symposium "Advances in α-, β - and γ - Ray Spectrometry", Pushkin (St.Petersburg, Russia), September, 1996. CIEMAT, Madrid (1997) 87.
5. Chechev, V.P., Refinement of the recommended values of half-lives of 42 radionuclides used for calibration of X-ray and gamma-ray detectors. In:Voprosi Atomnoi Nauki i Tekhniki. Ser. Fizika jadernikh reactorov, 1997, TIJAS-XI. Special issue (in Russian), p.149-152.
6. Chechev, V.P., Evaluation of decay and radiation characteristics of ^{3}H, ^{36}Cl, ^{111}In radionuclides. In: Abstracts for 48th Conference on Nuclear Spectroscopy and Atomic Nucleus Structure. Moscow, 1998, p.287 (in Russian).
7. Chechev, V.P.. Izmeritelnaya Tekhnika, N 8, 1998 (in Russian)

Data Evaluation for Radionuclides of Interest in Astrophysics within the framework of the International Decay Data Evaluation Project (DDEP)

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USA

There is growing interest around the world in nuclear astrophysics and the need for data evaluation in this subfield has been widely recognized. In response to this need of the research community, a portion of the decay evaluation effort at LBNL is temporarily shifting toward radionuclides of interest in astrophysics. In 1994, nuclear scientists from France, Germany, the United Kingdom, and the United States joined their efforts to evaluate decay data for radionuclides specifically used in applied research and detector calibrations. E. Browne, C.M. Baglin, and S-C. Wu (on sabbatical leave from Tsing Hua University, Taiwan), from LBNL are particpants in this project. After establishing a uniform approach for the analysis of discrepant data, and adopting common sources of theoretical values (e.g., gamma-ray internal conversion coefficients) to support the construction of decay schemes, the collaboration distributed among its members the work on about 250 radionuclides. Each evaluation is being reviewed by members of the collaboration, and is ultimately produced in two styles: that of the Table de Radionucleides (LPRI), and in the Evaluated Nuclear Structure Data File (ENSDF) format.

LBNL has proposed to add to the original list put together by the DDEP the following radionuclides of interest in astrophysics: ^{56}Ni, ^{57}Ni, ^{60}Fe, ^{81}Kr, ^{91}Nb, ^{98}Tc, ^{138}La, ^{143}Pm, ^{176}Lu, and ^{180}Lu. Other radionuclides of interest in astrophysics, which were already included on this list, are: ^{26}Al, ^{44}Ti, ^{92,92m}Nb, ^{99}Tc, ^{129}I, ^{180m}Hf, ^{210}Po, ^{210}Bi, ^{232}Th, ^{235}U, ^{238}U.Based upon input from the astrophysics community, other radioniclides of astrophysical interest may be added in the future.

The evaluations, some of which have been published in a laboratory report (PTB-6.11-97-1, Braunschweig, October 1997), will also be submitted to the Nuclear Data Section of the International Atomic Energy Agency (IAEA), and to the National Nuclear Data Center (NNDC), Brookhaven National Laboratory, for inclusion in their respective databases. The evaluation of ^{26}Al (S-C. Wu and E. Browne) was done in 1997, and those of ^{57}Ni (S-C. Wu, LBNL) and ^{44}Ti (E. Browne, LBNL) have been completed and submitted for review in October 1998.

Conversion of Utrecht Evaluations of Nuclides with A=21-44 to ENSDF

E. Norman
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USA

The energy levels of A=21-44 nuclides were capably evaluated for many years by Endt and van der Leun at Utrecht University, the Netherlands. A full publication[1] was published in 1990 and updated[2] in 1998. Unfortunately, Utrecht can no longer continue this effort. The evaluation of the A=21-44 region is very important to research in diverse areas such as nuclear astrophysics, neutron capture, and many other subjects. It would be very unfortunate if the evaluation of this mass region were to come to an end.

The Isotopes Project has long been interested in the A=21-44 region through its efforts on the Table of Isotopes. Pieter Endt spent the summer of 1988 in Berkeley discussing his evaluation techniques for this region. The group played a major role in converting the 1990 publication into ENSDF format and adding complete radioactive decay datasets that were not available in the original evaluation..

The Isotopes Project has agreed to convert the A=21-44 data from the 1998 publication into ENSDF format and this effort has already begun. In the process of this work, we will determine the manpower level that would be required in the future to continue the evaluation of data in this mass range. Since evaluation of A=21-44 is consistent with the increasing nuclear astrophysics interest of the Isotopes Project, we would like to be considered for taking on the responsibility for evaluating A=21-44 when the Network wishes to make an assignment for this work. The Utrecht A=21-44 evaluations concentrated mainly on level properties and was performed outside the framework of ENSDF. If the Isotopes Project were given this assignment, we would intend to completely evaluate level, gamma, and decay data and provide it in ENSDF format.

1. Energy levels of A=21-44 nuclei, P.M. Endt, Nucl. Phys., A521, 1 (1990).
2. Supplement to Energy Levels of A = 21-44 Nuclei, P.M. Endt, Nucl. Phys., A633, 1 (1998).

Horizontal evaluation of thermal neutron capture gamma-ray data

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R.B. Firestone
Isotopes Project, LBNL, USA

1. Introduction

New, application-driven effort
Framework: US-Hungarian Joint Research Project
Continuing effort -- IAEA CRP

2. Three major steps

(a) Pre-evaluation of capture gamma-ray data (LBNL)

Capture data for isotopes of light elements $Z \leq 20$
^{1}H-^{48}Ca -- done!

Adopted rules

- Single set for each nuclide
  - ✓ best data set adopted
  - ✓ may add from others if clearly superior
- ENSDF2 format
- E_γ - w/o Doppler correction
  - ✓ Sn from fit to level scheme (Audi in comment)
- I_γ in author's units
  - ✓ normalisation to sum of gs intensities
  - ✓ include systematic uncertainty
- Cross-sections etc.
  - ✓ σ_0 from Mughabghab
  - ✓ g-factor
  - ✓ resonance integral
- Abundance (half-life)
- General comments
  - ✓ detector, intensity scale, references
- Footnotes
  - ✓ if from different set, etc.
  - ✓

(b) Survey of capture cross sections (LBNL)

Table of Isotopes' corrections of errors in Mughabghab file.
Quality of data - usually good for dominating isotope!
One standard deviation uncertainty < 5% for 69 elements
< 1 % for 15 elements
1-2 % for 24 elements
2-5 % for 30 elements
5-10 % for 9 elements

>10% for 2 (Kr, Xe)

(c) Measurement of gamma-ray production cross sections (Budapest)

(n,γ) measurements at Budapest prompt-gamma facility.
Neutron guide, Compton-suppressed spectrometer.

- 79 elements (H to U) and ^{2}H, ^{235}U isotopes
- $\sigma_0 I_\gamma$ measured relative to $H(n,\gamma)$
  internal standard (Cl-, H-, N-compound)
  21 elements still in progress
- I_γ per 100 captures deduced, using σ_0
- σ_0 deduced for isomers
- E_γ, I_γ: good agreement for light nuclides
  Comparison above Ca - in progress

3. Expected benefits

(a) Enhance integrity and quality of ENSDF

- gamma rays and cross sections
- consistent, unique sets of pri., sec. gammas
- better cross sections (short-lived isomers)

(b) Better data for basic science

- Nuclear structure:
  completeness of decay schemes
- Nuclear astrophysics:
  isomer production, branchings

(c) Useful tool for applications

- Chemical analysis (PGAA)
- NCT for cancer
- Nuclear waste transmutation?

4. End product

Prompt Gamma-Ray Spectrum Catalogue

- Hardcopy - LBNL Report (1999)
- CD-ROM with spectra
- Include in WWW Table of Radioactive Isotopes
  Include data in ENSDF

Annex 8

D. Proposals/Position Papers

D1. UNSDF (Unevaluated Nuclear Structure Data File)
D. Winchell, USA and B. Singh, Canada

D2. ENSDF Data Sets for Ionized Atoms. Summary of Proposals and Discussions
T.W. Burrows, USA and B. Singh, Canada.

D3 ENSDF changes related to the year 2000
J.K. Tuli, USA

D4. Horizontal Compilations and Evaluations: A Proposal for Adoption
J.K. Tuli, USA

D5. P-records in IT and SF Decay Data Sets: A Proposal for Adoption
J.K. Tuli

D6. Change the chemical symbol for neutron (Z=0) from "N" to "NN".
T. Burrows, USA

D7. Proposals for Adoption
J.Blachot, France

D8. Use of ENSDF/Nuclear Data Sheets in Horizontal Evaluations: A Study of Electric Monopole Transition Strength.
J. Wood, USA

D9. Proposal on Distribution and Use of Code to Compute Averages Using the Limitation of Relative Statistical Weights Method.
R. G. Helmer and E. Browne, USA

D10. Proposed Revisions to Strong Arguments for Spin-Parity Assignments as specified in Nuclear Data Sheets (NDS)
Dennis Burke and Balraj Singh, Canada.

D11. Specifications for an ENSDF Editor
*T.W. Burrows and F.Y. Chu, U*SA

D12. J^{π} and Multipolarity Assignments in (HI,$xnypz\alpha\gamma$) Reactions
J.C. Waddington and B. Singh, Canada

D13. Search for Optimum Approach to Evaluating Data with Different Consistency
V.P. Chechev, Russia

UNSDF (Unevaluated Nuclear Structure Data File)

D. Winchell
Brookhaven National Laboratory, USA
B. Singh
McMaster University, Canada

A trial database UNSDF (Unevaluated Nuclear Structure Data File) has been set up at BNL for the purpose of archiving compiled, unevaluated data sets prepared (in ENSDF format) from recent high-spin publications. This database will also include unpublished, but fully analyzed high-spin level schemes contributed by the research community. It is intended that retrievals from this database would be accessible to the users in a manner similar to ENSDF retrievals. Such a database could also serve as a depository of horizontal compilations and/or compilations of low-spin data in ENSDF format.

(Editor’s note: At this meeting UNSDF was renamed XUNDL).

ENSDF Data Sets for Ionized Atoms. Summary of Proposals and Discussions

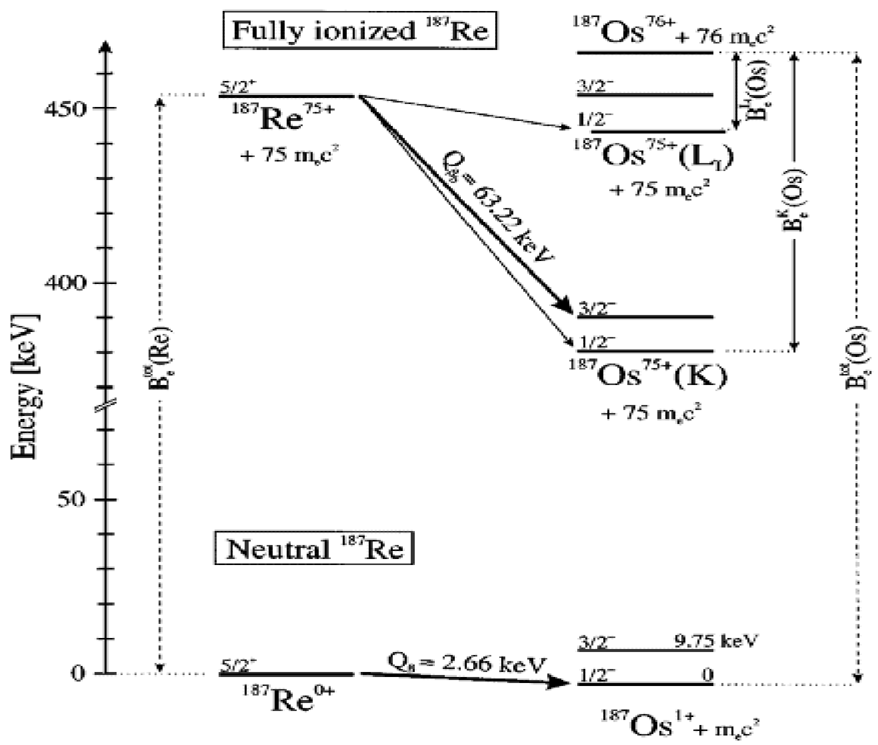
T.W. Burrows
Brookhaven National Laboratory, USA
B. Singh
McMaster University, Canada.

At the April 1998 meeting of the U.S. Nuclear Data Program, Balraj Singh introduced a proposal for format changes to allow for ENSDF data sets for ionized atoms. Following that meeting discussions were held between Balraj, Charles Reich and Dick Helmer (INEEL/USA), and Tom Burrows, Bob Kinsey, and Jag Tuli (BNL/USA). More recently, the discussions were continued via e-mail with the addition of Dave Winchell (BNL/USA) to the group. This has resulted in the introduction of suggested revisions to the proposal and critiques of both proposals which are summarized below.

The importance of these data are summarized in the preamble of the initial proposal:

> With the advent of a heavy-ion storage ring at GSI, it has become possible to strip all outer electrons from an atom. For some ionized atoms, the nuclear decay characteristics; *e.g.*, $T_{1/2}$, level scheme, *etc*. undergo major changes. Two main examples published in recent literature are for ^{187}Re β^- decay[1] and ^{163}Dy β^- decay[2]. The half-life of fully ionized ^{187}Re decreases by a factor of about a billion from that of the neutral atom while neutral ^{163}Dy is stable and occurs in nature. Since these factors have implications in nuclear structure as well as in astrophysics, these must be included in ENSDF with appropriate retrieval criteria.

Example of a Bound-state β^- Decay Scheme



Proposals, Revisions, and Discussions

I. ENSDF data sets for ionized atoms (B. Singh, McMaster University, 10/26/1998)

With the advent of a heavy-ion storage ring at GSI, it has become possible to strip all outer electrons from an atom. For some ionized atoms, the nuclear decay characteristics *e.g.* $T_{1/2}$, level scheme, *etc*. undergo major changes. Two main examples published in recent literature are for ^{187}Re β- decay[1] and ^{163}Dy β- decay[2]. The half-life of fully ionized ^{187}Re decreases by a factor of about a billion from that of the neutral atom while neutral ^{163}Dy is stable and occurs in nature. Since these factors have implications in nuclear structure as well as in astrophysics, these must be included in ENSDF with appropriate retrieval criteria. A possible format for ENSDF data set for such nuclides is given below where I0 and I1 (columns 78-79) are labels for gs and first excited state, respectively, of ionized atom (I=ionized, 0=gs, 1=first excited state):

```
187OS    187RE B- DECAY:IONIZED ATOM   96BO37
187OS C  BOUND STATE B- DECAY OF BARE 187RE (75+ CHARGE STATE)
187OS C  96BO37 (ALSO 97NO07,97KL06,97WE08): DECAY OF FULLY IONIZED 187RE
187OS2C  NUCLEI CIRCULATING IN A STORAGE RING.  ...............
187OS C  T1/2 OF 187RE ION (75+ CHARGE STATE)=32.9 Y 20
187RE  P  0+Y          5/2+            32.9 Y 20              73.0    10 I0
187RE CP E$ Y AP 455, GS OF 187RE ION (75+ CHARGE STATE)
187RE CP Q-$ FOR K-SHELL BOUND-STATE DECAY. FOR L-SHELL Q-=9.1 KEV
187OS  N                        1.0
187OS  L  0+X          1/2-                                                  I0
187OS CL E$ X AP 382, GS OF 187OS ION (75+ CHARGE STATE) WITH AN
187OS2CL ELECTRON IN THE K SHELL
187OS  B               WEAK                11  AP                            1U?
187OS  L  10+X         3/2-                                                  I1
187OS CL E$ 9.75 LEVEL OF 187OS ION (75+ CHARGE STATE) WITH
187OS2CL AN ELECTRON IN THE K SHELL
187OS  B               100               7.87  3
187OS  G  9.75                                                                 S
187OS  L  61+X         1/2-                                                  I0
187OS CL E$ GS OF 187OS ION (75+ CHARGE STATE) WITH AN
187OS2CL ELECTRON IN THE L SHELL
187OS  B               ?                                                       ?
187OS CB IB$ VERY WEAK BRANCH

187RE    ADOPTED LEVELS, GAMMAS
187RE  L 0.0          5/2+             4.35E10 Y 13
187RE  L  0+Y         5/2+             32.9 Y    20                          I0
187RE2 L %B-=100
187RE CL E$ Y AP 455, GS OF 187RE ION (75+ CHARGE STATE)

187OS    ADOPTED LEVELS, GAMMAS
187OS  XA187RE B- DECAY:IONIZED ATOM
187OS  L  0+X          1/2-                                                  I0
187OSX L XREF=A
187OS CL E$ X AP 382, GS OF 187OS ION (75+ CHARGE STATE) WITH AN
187OS2CL ELECTRON IN THE K SHELL
187OS  L  10+X         3/2-                                                  I1
187OSX L XREF=A
187OS CL E$ 9.75 LEVEL OF 187OS ION (75+ CHARGE STATE) WITH AN
187OS2CL ELECTRON IN THE K SHELL
187OS  L  61+X         1/2-                                                  I0
187OSX L XREF=A
187OS CL E$ GS OF 187OS ION (75+ CHARGE STATE) WITH AN
187OS2CL ELECTRON IN THE L SHELL

----------------------------------------------------------------------------
163HO    163DY B- DECAY:IONIZED ATOM   92JU01
163HO C  BOUND STATE B- DECAY OF {+163}Dy{+66+} ION
163HO C  92JU01: T1/2 MEASURED BY STORING BARE 163DY 66+ IONS IN A HEAVY-ION
163HO2C  STORAGE RING.  .......................
163HO C  T1/2({+163}Dy{+66+})=47 +5-4 D
163DY  P  0+Y          5/2-            47 D   +5-4            50.3    10 I0
163DY CP E$ GS OF 163DY ION (66+ CHARGE STATE)
163DY CP Q-$ FOR K-SHELL BOUND-STATE DECAY. FOR L-SHELL Q-=1.7 KEV
163HO  N                        1.0
163HO  L  0+X          7/2-                                                  I0
163HO CL E$ GS OF 163HO ION (66+ CHARGE STATE) WITH AN
163HO2CL ELECTRON IN THE K SHELL
163HO  B               100

163DY    ADOPTED LEVELS, GAMMAS
163DY  L 0.0          5/2-             STABLE
163DY  L 0+Y          5/2-             47 D     +5-4                         I0
163DY2 L %B-=100
```

```
163DY CL E$ Y AP 450, GS OF 163DY ION (66+ CHARGE STATE)

163HO    ADOPTED LEVELS, GAMMAS
163HO  XA163DY B- DECAY:IONIZED ATOM
163HO  L  0+X          7/2-                                              I0
163HOX L XREF=A
163HO CL E$ X AP 350, GS OF 163HO ION (66+ CHARGE STATE) WITH
163HO2CL AN ELECTRON IN THE K SHELL
```

II. ENSDF data sets for ionized atoms - suggested revisions (T.W. Burrows, R.R. Kinsey, J.K. Tuli, and D.F. Winchell, 11/23/1998).

Decay data set:

1. ID record:

The ionization state of the atom would be in square brackets following the nuclide symbol in the DSID field.

2. Parent record:

a. Energy field: level energy of the parent nucleus
b. Half-life field: half-life for the decay of the ionized itom
c. Q-value field: nuclear ground-state to ground-state value
d. New field (77-80): ionization state.

3. Level records:

a. Energy field: level energy of the daughter nucleus
b. MS field: atomic electron shell or subshell in which the emitted β^- particle is captured.
c. A new quantity, "ION", giving the ionization state would be required on an "S L" record following the level record.

Daughter Adopted Levels, Gammas:

The adopted levels would be cross-referenced to the observed states in the ionized atom decay dataset.

Parent Adopted Levels, Gammas:

The half-life and decay branching of the ionized atom decay would be given as comments (analagous to the current practice for half-lifes which differ due to chemical effects). This should be regarded as an interim solution; after more experience is gained, methods of giving this data on level continuation records should be derived.

Examples:

^{187}Re

```
187OS    187RE[+75] B- DECAY          96BO37
187OS C  BOUND STATE B- DECAY OF BARE 187RE (75+ CHARGE STATE)
187OS C  96BO37 (ALSO 97NO07,97KL06,97WE08): DECAY OF FULLY IONIZED 187RE
187OS2C  NUCLEI CIRCULATING IN A STORAGE RING.  ...............
187OS C  T1/2 OF 187RE ION (75+ CHARGE STATE)=32.9 Y 20
187RE  P  0            5/2+              32.9 Y 20            2.663     19+75
187OS  N                        1.0
187OS  L  0            1/2-                                                K
187OSS L ION=+75
187OS  B                WEAK               11  AP                          1U?
187OS  L  9.75         3/2-                                                K
187OSS L ION=+75
187OS  B                100              7.87  3
187OS  G  9.75                                                               S
187OS  L  0            1/2-                                                L1
187OSS L ION=+75
187OS  B                                                                     ?

187RE    ADOPTED LEVELS, GAMMAS
187RE CL BAND(A)$5/2[402]?
187RE  L        0.0   5/2+             4.35E10 Y 13                       A
```

```
187RE2 L %B-=100$%A LT 0.0001
187RE CL $%B-({+187}Re{++75})=100; T1/2({+187}Re{++75})=32.9 20 Y

187OS    ADOPTED LEVELS, GAMMAS
187OS CL BAND(A)$1/2[501] BAND
187OS CL BAND(B)$3/2[512] BAND
187OS  XA187RE B- DECAY
187OS  XB187IR EC DECAY
187OS  XC186OS(N,G) E=THERMAL
187OS  XD187RE(D,2NG), 187RE(P,NG)
187OS  XECOULOMB EXCITATION
187OS  XF189OS(P,T)
187OS  XG186OS(D,P)
187OS  XH187OS(D,D')
187OS  XI188OS(D,T),(T,A)
187OS  XJ187RE[+75] B- DECAY
187OS  L        0.0   1/2-             STABLE                            A
187OSX L XREF=ABCDEFGHIJ
187OS  L     9.746 24 3/2-              2.38 NS 18                       B
187OSX L XREF=BCDFJ
```

^{163}Dy

```
163HO    163DY[+66] B- DECAY          92JU01
163HO C  BOUND STATE B- DECAY OF {+163}Dy{+66+} ION
163HO C  92JU01: T1/2 MEASURED BY STORING BARE 163DY 66+ IONS IN A HEAVY-ION
163HO2C  STORAGE RING.  ......................
163HO C  T1/2({+163}Dy{+66+})=47 +5-4 D
163DY  P  0+Y          5/2-              47 D   +5-4           -2.565    14+66
163HO  N                        1.0
163HO  L  0            7/2-                                                K
163HOS L ION=+66
163HO  B                100

163DY    ADOPTED LEVELS, GAMMAS
163DY  L 0.0         5/2-            STABLE
163DY CL $%B-({+163}Dy{+66+})=100; T1/2({+163}Dy{+66+})=47 +5-4 D

163HO    ADOPTED LEVELS, GAMMAS
163HO  XA163HO IT DECAY (1.09 S)
163HO  XB163ER EC DECAY
163HO  XC162DY(P,P) IAR
163HO  XD162DY(3HE,D),(A,T)
163HO  XE163DY(D,2NG),(P,NG)
163HO  XG164ER(POL T,A)
163HO  XI165HO(P,T)
163HO  XJ163DY[+66] B- DECAY
163HO CL BAND(A)   7/2(523).  A=11.12, B=-0.313 EV
163HO  L 0.0         7/2-            4570 Y    25
163HO2 L %EC=100
163HO3 L FLAG=A$XREF=-(C)
```

III. ENSDF data sets for ionized atoms - summary of discussions.

In the initial discussions at and following the April 1998 U.S. Nuclear Data program meeting, T.W. Burrows noted that anything following a colon (":") in the DSID field of the Identification Record is treated as a comment in the ENSDF manual and that, as proposed, the DSID could not distinguish between a fully ionized atom and partially ionized atom decay data sets. The alternate contained in the revisions was suggested at this time. Concern was also expressed at this time that the representation of level energies in the proposal could be confusing and possibly misleading and there were discussions as to what should actually be contained in the parent and daughter Adopted Levels, Gammas data sets.

On November 20, 1998 members of the NNDC staff met to review what was discussed in April and continued on from there. This resulted in the suggested revisions which were distributed for comments (T.W. Burrows (BNL/USA), R.G. Helmer (INEEL/USA), R.R. Kinsey (BNL/USA), B. Singh (McMaster/Canada), J.K. Tuli (BNL/USA), and D.F. Winchell (BNL/USA)). The subsequent discussions centered on the following main points:

1. Specification of level energies: for daughter as well as parent.
2. Specification of correct Q value on parent record.
3. Specification of $T_{1/2}$ and (%) decay modes so that these are retrievable quantities.

4. Updating of computer programs to handle calculations of level energies, Q values, Log*ft*, and ICC's, and drawing of decay-scheme to show such decays as realistically as possible (something like Fig. 1 in [1]).

Decay data set parent record:

Original proposal:

```
187RE  P  0+Y          5/2+               32.9 Y 20              73.0    10 I0
187RE CP E$ Y AP 455, GS OF 187RE ION (75+ CHARGE STATE)
187RE CP Q-$ FOR K-SHELL BOUND-STATE DECAY. FOR L-SHELL Q-=9.1 KEV
```

Suggested revision:

```
187RE  P  0            5/2+               32.9 Y 20             2.663     19+75
```

Discussion:

1. The original proposal suggested using "0+Y" (Y=E_{level}(^{187}Re g.s.)+75m_ec^2) for the parent level energy, giving the Q_β- value for K-shell bound-state decay, and introducing a new field in columns 78 and 79 of the record to indicate that this is for an ionized atom and the nuclear level energy (*e.g.*, "I0" for the ground-state ionized atom). The use of the dummy variables "Y" and "X" here and on the Level Records is not meant to be a permanent solution. In the absence of appropriate computer codes (at present) to calculate proper energies, this is just one of the ways of distinguishing, in ENSDF, level and parent records of ionized atoms from those of neutral atoms.

Some of the possible problems with this presentation are:

a. "0+Y" could be confusing since "Y" generally denotes an unknown value in ENSDF.
b. Calculation and presentation may be difficult both due to the non-numeric parent level energy and Q-value which is only given for K-shell bound-state decay.

2. The suggested revision retains the nuclear level energy and neutral atom Q-value as in a normal decay data set and defines a new field in columns 77-80 for the ionization state of the atom (*e.g.*, +75 in this example). This would allow for the proper computation of the ionized atom parent level energy:

$E_{level}(^{187}Re^{+75})=E_{level}(^{187}Re\ g.s.)+75m_ec^2$,

and with the suggested revisions for the Level Record allow the calculation of the transition energies to the populated states.

A problem noted with this presentation was that the ionized atom parent level energy and Q-value would not be readily apparent by just looking at the ENSDF data set.

Decay Data Set Level Records:

Original Proposal:

```
187OS  L  0+X          1/2-                                                 I0
187OS CL E$ X AP 382, GS OF 187OS ION (75+ CHARGE STATE) WITH AN
187OS2CL ELECTRON IN THE K SHELL
```

Suggested Revision:

```
187OS  L  0            1/2-                                                 K
187OSS L ION=+75
```

Discussion:

1. The original proposal suggested using "0+X" for the daughter level energy (X=E_{level}(^{187}Os)+B^{tot}(Os)-B^K for the ground state of ^{187}Os with an electron in the K shell

and using the MS field to indicate that this is an ionized atom and the state of ^{187}Os populated (*e.g.*, "I0" in this example). As noted above, the use of the dummy variable "X" is not meant as a permanent solution. The energies as given in the original proposal also correspond to those given by the authors in the original paper.

In addition to the problem noted above in the presentation of the parent level energy, There is the additional potential problem in the various codes having to deal with two "unknown" quantities ("X" and "Y").

2. The suggested revision would retain the nuclear level energy in the energy field and use the MS field to indicate the electron shell/subshell in which the emitted β^- was captured. This along with the suggested revision for the Parent Record would allow both the calculation of the ionized atom level energy and the transition energy between parent and daughter:
   a. $E_{level}(^{187}Os{+}75\ g.s.)=E_{level}(^{187}Os)+B_{tot}(Os)-B^K$.
   b. $E_{tran}=E_{level}(^{187}Re^{+75})+Q_\beta-(^{187}Re)-E_{level}(^{187}Os^{+75}\ g.s.)$.

   In addition a new quantity "ION" would be defined giving the daughter ionization state and placed on an "S L" record. Again, a problem with this suggestion is that the daughter level energy is not readily apparent by looking at the ENSDF data set.
3. Other suggestions for the Level Record energy were to give the energy as "E+BE" (analagous to "E+SN" for thermal neutron and resonance capture data sets) or "E+BT-BK" where BT=B^{tot}(Os) and BK=B^K(Os).

Specification of $T_{1/2}$ and (%) decay modes in parent adopted levels, gammas data set:

Original proposal:

```
187RE  L 0.0          5/2+             4.35E10 Y 13
187RE  L  0+Y         5/2+             32.9 Y    20                          I0
187RE2 L %B-=100
187RE CL E$ Y AP 455, GS OF 187RE ION (75+ CHARGE STATE)
```

Suggested Revision:

```
187RE  L        0.0   5/2+              4.35E10 Y 13                        A
187RE2 L %B-=100$%A LT 0.0001
187RE CL $%B-({+187}Re{++75})=100; T1/2({+187}Re{++75})=32.9 20 Y
```

Discussion:

1. The original proposal suggested the addition of an additional Level Record to the parent Adopted data set containing the level energy and half-life as given on the Parent and using the MS field to identify this as an ionized atom state. A Continuation Record would contain the decay mode(s) for this state. It was noted in the discussions that the ionized atom state is not a different level from the neutral atom state and that this presentation would be confusing.
2. In the suggested revision, it was proposed that the decay mode(s) and half-life be given as Comments on the parent adopted level as an interim solution until formats can be devised to give this information on a Continuation Record. This means that until these formats are proposed and adopted, the decay mode(s) and half-life would not be retrievable.

Updating of Computer Programs:

For either proposal several ENSDF codes would require modifications as would database and retrieval codes. The consensus of the authors of the suggested revisions was that the revised format would be easier to implement and, probably, more flexible.

References.

[1] F. Bosch, T. Faestermann, J. Friese, F. Heine, P. Kienle, E. Wefers, K. Zeitelhack, K. Beckert, B. Franzke, O. Klepper, C. Kozhuharov, G. Menzel, R. Moshammer, F. Nolden, H. Reich, B. Schlitt, M. Steck, T. Stöhlker, T. Winkler, and K. Takahashi, Phys. Rev. Letters, 77, 5190-5193 (1996), “Observation of Bound-State β^- Decay of Fully Ionized ^{187}Re: ^{187}Re-^{187}Os Cosmochronometry”.(http://ojps.aip.org/).

[2] M. Jung, F. Bosch, K. Beckert, H. Eickhoff, H. Folger, B. Franzke, A. Gruber, P. Kienle, O. Klepper, W. Koenig, C. Kozhuharov, R. Mann, R. Moshammer, F. Nolden, U. Schaaf, G. Soff, P., Spädtke, M. Steck, Th. Stöhlker, and K. Sümmerer, Phys. Rev. Letters, 69, 2164-2167 (1992), “First observation of bound-state β^- decay”. (http://prola.aps.org/abstract/PRL/v69/p2164_1).

ENSDF changes related to the year 2000

J. K. Tuli
National Nuclear Data Center, Brookhaven National Laboratory

The key numbers in NSR have been changed to 8 characters to accommodate the 4-character year, as 1991. The corresponding changes that are needed in the ENSDF data sets occur only in the Q and ID records. For the Q record, the current format can accommodate the 8-character key numbers, so no format change is needed. For the ID records the following changes are proposed:

1. The 'DATE' field stays the same size, 6 characters, but instead of YYMMDD, it is changed to YYYYMM. (The day is no longer specified).
2. The 'PUB' field is reduced in size from 10 to 9 characters (col 66-74).
3. The 'DSREF' is expanded to 26 characters, allowing 3 key numbers with two commas.

Horizontal Compilations and Evaluations: A Proposal for Adoption

J. K. Tuli
National Nuclear Data Center, Brookhaven National Laboratory

All evaluation groups within the Network and other research groups that may provide data to this Network for inclusion in ENSDF are requested that they consult NNDC before a compilation/evaluation activity (other than updating mass chains or nuclides) is undertaken. The goal of this consultation will be:

1. To determine if such an activity, if undertaken by Network evaluators, is justified in terms of the goals of the Network and will be best utilization of the very limited evaluation manpower within the Network. This will allow consideration of any adverse effects and benefits to ENSDF from such an activity.
2. To determine whether the final product can be integrated into ENSDF, and, if so, how the scope or format of the proposed evaluation/compilation can be structured to optimize its usefulness to ENSDF.

P-records in IT and SF Decay Data Sets: A Proposal for Adoption

J. K. Tuli
National Nuclear Data Center, Brookhaven National Laboratory

It is proposed that the 'P' records also be required in IT and SF decay data sets. This will make these decay data modes consistent with other decay modes and the evaluators will be able to give "adopted" E, J^{π}, $T_{1/2}$, Q(P) values on the 'P' records which can be some what different than those given on the 'L' record in the data set.

Other topics for discussions:

1. Evaluation submission and review procedure - intimated to evaluators in 1997.
2. Evaluation checking prior to submission - re-emphasized.

Change the chemical symbol for neutron (Z=0) from "N" to "NN".

T. Burrows
National Nuclear Data Center, Brookhaven National Laboratory

Reasons:

1. Both neutron (Z=0) and nitrogen (Z=7) have the same chemical symbol "N" in ENSDF. This means that the atomic number cannot be uniquely obtained from the chemical symbol for neutron or nitrogen nuclides and could result in incorrect indexing or calculations.
2. NSR currently uses "NN" for neutron. Therefore, the change would improve the consistency between the two systems.

Impact.

Minimal. There are only three adopted datasets (A=1,3,4) and one decay dataset (1N B-DECAY). Only the database systems and a few of the ENSDF checking and analysis codes would have to be modified.

Proposals for Adoption

J. Blachot
SPSMS/CENG, Grenoble
France

1. Keep in the ENSDF data base only the Adopted levels and the decay data.

We have not done a complete survey and hope that those responsible for the network will do so; but we have discussed with many users of ENSDF. Physicists only need and use the ADOPTED LEVELS, GAMMAS and the DECAY DATA. I agree that the evaluator needs to work on the reaction works but they can store these data in their own format (ENSDF if they like) but these don't need to comply with all the ENSDF formatting rules. These data do not need to be available to the users?

2. Decay data.

Much of the data sets need modification before entering correct value in some of the tests of the Radlist code.(The IT decay, the BR and the NB of the normalization record seem the main problems) The evaluators would have to insert their comments of the decay data sets and the results of the Radlist tests.

3. Redefine the responsibility of the groups.

- The groups should submit revisions before some deadline.
- Provide each group space on the Web in which their on-going work can be stored.
- Redefine the procedure of revisions between evaluation.

4. Find a way to have a "XREF" for the gammas.

Some evaluators are doing that very well but it should avoid making numerous footnotes and references. This makes it time consuming to read tables.

5. Continue the biannual distribution of the ENSDF library.

It would be appropriate if this distribution follows a consistent rule, i.e. always provide data on compressed (.zip) files without changing the name of the mass file with every distribution!

6. A modern data file for ENSDF.

The structure of ENSDF is almost the same as the beginning .(80 Characters record, etc.). Why not to start to study a more modern way to do the work and to do that step by step. If the network adopt my point 1, the change would be easier.

Use of ENSDF/Nuclear Data Sheets in Horizontal Evaluations: A Study of Electric Monopole Transition Strength.

J. Wood
Georgia Institute of Technology
USA

Recently, a review of E0 transition strength entitled "Electric monopole transitions from low-energy excitations in nuclei" by J. L. Wood (Ga Tech), E. F. Zganjar (LSU), C. De Coster and K. Heyde (Inst. Theor. Phys., Gent) has been completed. The abstract for this review reads: "Electric monopole (E0) properties are studied across the entire nuclear mass surface. Besides an introductory discussion of various model results (shell model, geometric vibrational and rotational models, algebraic models); we point out that many of the largest E0 transition strengths are associated with shape mixing. We discuss in detail the manifestation of E0 transitions and present extensive data for: single-closed shell nuclei, vibrational nuclei, well-deformed nuclei, nuclei that exhibit sudden ground-state changes, and nuclei that exhibit shape coexistence and intruder states. We also give attention to light nuclei, odd-A nuclei, and illustrate a suggested relation between electric monopole transition strength and isotopic shifts."

To compile the data for this review we used values quoted in original articles if only a single source existed. When values depended upon multiple sources, evaluations in Nuclear Data Sheets were used as far as possible. In a significant number instances the necessary input data for generating an E0 transition strength were available but this had not been done in NDS. The approximate distribution of input to the 144 values quoted is: from original articles (50); from NDS (23); from input data available in NDS (25); from NDS data plus original sources (26); from P.M. Endt, At. Data Nucl. Data Tables Vol. 55, p. 171 (1993) for light nuclei (10). The most notable deficiency in NDS is that conversion coefficient data are sometimes inadequate: Some α(total) values are given based on a δ(E2/M1) measurement, even when α(K) has been measured. In other instances the evaluator(s) appear to be unwilling, or unable, to deal with the E0 properties.

Proposal on Distribution and Use of Code to Compute Averages Using the Limitation of Relative Statistical Weights Method.

R.G. Helmer and E. Browne
Idaho National Engineering Laboratory
USA

We propose that the NNDC circulate a PC code to compute averages applying the Limitation of Relative Statistical Weights (LRSW) method, along with information on its merits and a description on how to use it.

This method was extensively used in the Coordinated Research Program (CRP) on the Measurement and Evaluation of X- and Gamma-ray Standards for Detector Efficiency Calibration, which was organized by the IAEA Nuclear Data Section [IAEA report TECDOC-619, September 1991]. It is also being used by the current Decay Data Evaluation Project.

As all evaluators are aware, often the measured values that they have to evaluate are discrepant. When these results are combined, they may produce a large range of recommended values, depending on the methods of analyses that the various evaluators applied - a situation that can only confuse data users. The obvious solution to this problem is to be able to identify the systematic errors from the published papers and thus discard the corresponding data, but this is rarely possible. Consequently, several "ad hoc" methods have been developed to analyze in systematic ways discrepant data [M. U. Rajput and T. D. MacMahon, Nucl. Instr. & Meth. A312 (1992) 289]. One of these is the Limitation of Relative Statistical Weights method, which several groups have chosen for general use.

The LRSW method is based on the premise that for a discrepant set of values "at least two measured values must contribute significantly to any proper evaluation". For a set of three or more discrepant values, this method requires that no single measurement should have a relative statistical weight greater than 50%. If one such measured value exists, its uncertainty is increased to reduce its statistical weight to 50%. Then, the final weighted average with its corresponding uncertainty and reduced χ^2 are computed. Finally, the LRSW method recommends the weighted or the unweighted average, depending on whether the uncertainties in these average values allow them to overlap each other. If the set of data consisted of just two discrepant values, the LWRS method recommends the unweighted average. If the data are not discrepant, the ordinary weighted average is recommended by this method.

The available code was original written by T. D. MacMahon and has been modified by E. Browne to give a detailed output showing each step in the process, identifying statistical outliers, calculating weighted averages, unweighted averages, and the reduced χ^2. The code can process in the same run data from several quantities (e.g., gamma-ray intensities) entered with a specific format into the input file.

Proposed Revisions to Strong Arguments for Spin-Parity Assignments as specified in Nuclear Data Sheets (NDS)

Dennis Burke and Balraj Singh
McMaster University
Canada.

1. Suggested new proposition (For "Deformed Regions - Band Structure"):

"For a single-nucleon transfer reaction the characteristic pattern of experimental cross sections among rotational band members (fingerprint) can be used to assign a set of levels as specific J^{π} members of a band based on a particular Nilsson configuration, if the fingerprint agrees well with that predicted by the Nilsson model wave functions (using calculated DWBA single-particle cross sections) and is distinct from those expected for other configurations in the mass region."

Explanatory sentence: "This method is even stronger if angular distributions giving unique L values, and/or vector analyzing powers distinguishing between L+1/2 and L-1/2 values, support the assignments for one or more of the levels."

Supporting argument:
This method of assigning bands on specific configurations has a very good track record. Some of the examples are: ^{173}Yb, ^{175}Yb, ^{157}Tb, or ^{159}Tb where early single-nucleon transfer studies used this technique to assign many levels not previously known, and these assignments have since been "confirmed" by other experiments using what the Nuclear Data Sheets considers as "Strong Arguments". It should be noted that the fingerprint method, already, includes evidence of type yz in Proposition # 31 (presently a strong argument in NDS, but see item # 3 below), but in addition must have C^2S values forming a unique pattern.

2. Proposed update to Proposition # 24:

"For Z LT AP 50 and Z AP 82, if the vector analyzing power for a single-nucleon transfer reaction shows a clear preference between J=L+1/2 and J=L-1/2 and if the L value is known, then the J value is determined. The limitation in the regions of applicability results from a lack of measurements in other regions rather than an expected or observed violation."

The words "For Z LT AP 50 and Z AP 82," should be removed, and also the explanatory sentence below, as there are now many measurements in other mass regions (e.g. ^{153}Pm (Phys Rev., C18, 693 (1978)) and ^{147}Nd (Can. J. Phys., 55, 1697 (1977)) and these show no significant violations.

3. Proposed revision of Propositions #30 ("yz" part), #31 and #32.

These propositions are currently considered as strong arguments in NDS, and this should perhaps be reconsidered. For example, if a spin value for one level were known, these propositions permit two other levels which happen to have "reasonable" excitation energies to be assigned as specific spin members of a rotational band, even though these levels may not be related in structure to the known level. All that is required is that the excitation energy be about the right value to fit "regional trends" of inertial parameter, or decoupling parameter (for K=1/2 bands). This may work all right if the level density is very low, so that there is no overlapping in energy of rotational bands, but this is seldom the case in heavy deformed nuclei. In many cases this approach can be very unsafe, considering the level densities observed. It is suggested that these arguments be considered only as weak arguments.

Specifications for an ENSDF Editor

T.W. Burrows and F.Y. Chu
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USA

In the August 1994 NSDD meeting an action item was placed on us to develop specifications for an ENSDF editor or input/checking program. The specifications for this editor follow. In addition, a need has been recognized for a tools to convert data (*e.g.*, formatted ASCII text, LaTeX, or ASCII-gls files) into basic ENSDF datasets and this is discussed following the specifications. The preferred language for both the ENSDF editor and the tools for conversion should be Java; however, at the present stage of Java development, this may not be possible.

I. ENSDF editor.

The ENSDF editor should be able to work on existing ENSDF-formatted data or allow the user to create ENSDF datasets. Some of the features of this editor should be:

A. Input/output options:

ENSDF-formatted files.

B. Viewing/printing options:

1. ENSDF;
2. NDS-style tables and drawings, including the summary drawings that used to appear in NDS;
3. Isotope Explorer style drawings;
4. RadWare-style drawings;

C. Merging datasets.

Primarily designed for creating or updating Adopted and High-Spin datasets but should not be restricted to these.

1. Multi-set displays both tabular and graphical with editing and drag and drop capabilities.
2. Automatic addition of X records and XREF when applicable.
3. Computational tools (*e.g.*, weighted averages or LRSW).

D. Ability to add, delete, or replace datasets.

E. Editing:

1. Tabular (NDS-style):
a. Hiding or displaying all fields and records including those usually not displayed in NDS and initial and final levels;
b. Sorting capabilities (*e.g.*, Level ordered or gamma-energy ordered gamma tables;
c. Editing for all fields, comments, footnotes, *etc.*;
d. Display and editing of related data (*e.g.*, gammas or radiations associated with a level).
2. Graphical (NDS, Isotope Explorer, and RadWare styles):
a. Drag and drop to change placement of levels, gammas, and radiations or gamma final levels;
b. Display and editing of data associated with a specific level, gamma, or radiation.

F. Format, syntax, and consistency checking:

1. Basic:
a. Record and field syntax and format checking;
b. Dataset consistency and completeness checking.

2. Advanced:

a. Internal consistency checking for a complete mass-chain or nuclide evaluation

b. It is proposed that physics analysis and additional consistency checking be accomplished by the editor sending the data to BNL or other mirror sites by HTTP and BNL returns the results for display and incorporation by the editor.

i. Analysis: GTOL, HSICC, LOGFT, *etc.*

ii. Consistency: Comparison with Audi-Wapstra masses and the master ENSDF database; Checking of keynumbers.

G. Links between datasets and records for semiautomatic updating.

Examples:

1. Updating of X records when a DSID is changed;
2. Updating of decay dataset P record when Adopted dataset values change.

H. Project management tools.

1. Keep track of what has been changed and results of checking.
2. Final review before submission - all necessary checking is done and reported.

With the limited resources of the NSDD community, the development of the editor should probably be done in stages with an immediate goal of producing a useful but of limited functionality.

Stage	Goals
1	Basic editing of a single dataset or small group of datasets Design of internal formats Input/Output Viewing/Printing: ENSDF Tabular editing Basic checking
2.	Add printing and graphics capabilities Viewing/Printing: NDS-style tables and drawings, including the summary drawings that used to appear in NDS; Isotope Explorer style drawings; RadWare-style drawings Graphical editing Move toward editing of a complete mass chain or nuclide Merging datasets Adding, replacing, and deleting datasets Internal consistency checking for a complete mass-chain or nuclide evaluation
3	Complete steps for editing of a complete mass chain or nuclide Links between datasets and records for semiautomatic updating Establish Internet connections to BNL for additional advanced checking Add project management tools

Components of some of the tools already developed or under development for data dissemination may be of use in the ENSDF editor.

II. Creating ENSDF datasets.

Several steps would be involved in creating ENSDF datasets from data in other formats. These are:

A. User prepares an ASCII input file from:

1. LaTeX table;
2. Scanned and OCR files;

3. Table generated by cutting and pasting from a PDF file.

B. Generate an ASCII table from this file.

C. Edit the resultant table:

1. Assign column fields such as Gamma Energy, Level Energy, Spins, *etc.*;
2. Edit the table to align columns and rows properly;
3. Check the errors and automatically correct them by the field property;
4. Final editing;
5. There should be sorting capability to facilitate checking.

D. Generate the ENSDF-formatted dataset from the ASCII table or from an ASCII-gls dataset.

E. Edit the ENSDF-formatted dataset:

1. Level/decay/band drawings
    a. Compare drawing with published article, if possible.
    b. Correct errors by dragging gammas, radiations, or levels.
    c. If necessary, go back to step C to correct the problem and regenerate the dataset.
2. Tabular displays
    a. Display level, gamma, and radiations tables of the dataset
    b. Add comments to the tables

F. Do a least-squares fit of the level energies and use existing codes to do the format checking.

If an Internet connection is available, the dataset can be sent to BNL for checking and the report returned for display.

Steps A and B will have to be done manually in many cases, although David Radford has done some program development to automate the conversion from PDF to ENSDF. LBNL has some experience in this process and plans to begin a programming effort soon in support of the high-spin compilation effort.

J^{π} and Multipolarity Assignments in (HI,*xnypzαγ*) Reactions

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In heavy ion compound nuclear experiments (HI,*xnypzαγ*), the multipolarity of the γ transitions and the relative spin and parities of the levels are generally determined through the measurement of angular distributions, angular correlations and linear polarization of γ-rays and through measurement of internal conversion coefficients.

Angular distributions

1. The angular distributions of g-rays, W(θ), is a measurement of the intensity as a function of the angle θ with respect to the beam direction or to the nuclear spin axis:

$$W(\theta) = \sum A_K P_K(\cos\theta) \text{ , where K is even.}$$

2. The values of the A_2 and A_4 coefficients depend on ΔJ, the mixing ratio (δ(L+1)/L) and the degree of alignment. For high spin states the distributions are largely independent of spin.
3. The degree of alignment, σ/J, is usually determined through a measurement of W(θ) for a number of known ΔJ = 2 transitions. In actual practice many authors use σ/J = 0.3 for the degree of alignment. Here σ = half-width of the Gaussian describing the m-state population. The attenuation caused by the degree of alignment affects only the magnitudes of A_2 and A_4. Level lifetimes are assumed to be small so that alignment is maintained.
4. Angular distribution measurements alone may be used to deduce ΔJ but not Δπ.
5. Typical values of A_2 and A_4 are given in the table below (σ/J = 0.3 assumed). The angle θ is measured relative to the beam direction. If θ were with respect to spin axis, then sign of A_2 is reversed.

Table 1: Angular Distributions.

ΔJ	Multipolarity	Sign of A_2	Sign of A_4	Typical Values A_2	A_4
2	quadrupole	+	-	+0.3	-0.1
1	dipole	-		-0.2	0.0
1	quadrupole	-	+	-0.1	+0.2
1	dipole + quadrupole	+ or -	+	+0.5 to -0.8	0.0 to +0.2
0	dipole	+		+0.35	0.0
0	quadrupole	-	-	-0.25	-0.25
0	dipole + quadrupole	+ or -	-	+0.35 to -0.25	0.0 to -0.25

Angular correlations (or DCO, directional correlations of γ-rays from oriented states of nuclei)

6. DCO measurements involve the determination of the coincidence intensities for two γ-rays, one of known multipolarity γ_K and the other of unknown multipolarity γ_U. The g-rays are detected at two angles θ_1 and θ_2 with respect to the beam direction. The coincidence intensities are determined as two-dimensional areas, $I(\theta_1\theta_2\gamma_K\gamma_U)$ and $I(\theta_1\theta_2\gamma_U\gamma_K)$ where in the former case γ_K is detected at angle θ_1 and γ_U at angle θ_2.
7. The DCO ratios are then defined as

$$R = I(\theta_1\theta_2\gamma_K\gamma_U) / I(\theta_1\theta_2\gamma_U\gamma_K)$$

8. As with angular distributions, these ratios are insensitive to spin for high spin states but are sensitive to relative spins and multipolarities.

9. The angles θ_1 and θ_2 are generally determined by the geometry of the array. The values of R given below are typical for an array with detectors at 37^o and 79^o. An alignment of $\sigma/J = 0.3$ has been assumed.

ΔJ_γ ^{gate,} Multipolarity	ΔJ_γ	Multipolarity	Typical R(DCO)
2, quadrupole	2	quadrupole	1.0
2, quadrupole	1	dipole	0.56 (θ_1=37^o , θ_2 = 79$^{o)}$
2, quadrupole	1	dipole + quadrupole	0.2 to 1.3 (θ_1=37^o , θ_2 = 79$^{o)}$
2, quadrupole	0	dipole	1.0
2, quadrupole	0	dipole + quadrupole	0.6 to 1.0 (θ_1=37^o , θ_2 = 79$^{o)}$
1, dipole	2	quadrupole	(1/0.56) (θ_1=37^o , θ_2 = 79^o)
1, dipole	1	dipole	1.0
1, dipole	0	dipole or -	-1/0.56

Linear polarization of γ-rays.

10. A Compton polarimeter apparatus allows the measurement of relative intensities of radiation scattered in planes perpendicular to and parallel to the reaction plane (plane defined by the beam direction and incident gamma ray).
11. Determination of γ-ray polarization may differentiate between electric and magnetic radiations and combined with correlation data allows determination of $\Delta\pi$. See Kim et al.

Internal conversion coefficient data.

12. Conversion coefficients or subshell ratios may be obtained from electron spectra or from γ-ray intensity balances.
13. The interpretation of internal conversion coefficient data is as given in earlier rules in NDS for spin and parity assignments. Note that electron data usually give K-, L- ... conversion coefficients or sub-shell ratios whereas intensity balance arguments give total conversion coefficients.
14. If $T_{1/2}$ (level) is known or a limit can be assumed (based on coincidence resolving time, for example), RUL (recommended upper limits for Weisskopf estimates) may serve to eliminate the M2 option for a $\Delta J = 2$ quadrupole transition.
15. From systematics of population of high-spin states (yrast or near yrast), the spins are generally assumed to be in ascending order as the excitation energy increases.
16. If the level structure is collective (regular cascade pattern), intraband $\Delta J = 2$ transitions are considered to be of E2 type, and $\Delta J = 1, 0$ transitions with significant admixtures to be of M1 + E2 type. If the transition is pure dipole ($\delta(Q/D)=0$) is most often E1 since a small E2 admixture in the M1 transition is expected for the intraband $\Delta J = 1$ transitions. The small deformation Magnetic-rotational (M1) bands present exceptions to this rule.
17. Such assignments may not be made in non-collective (irregular) structures.
18. The presence of strongly coupled (deformation alignment) bands allows assignment of relative spins and parities of the band members. The presence of a measurable quadrupole admixture in the $\Delta J = 1$ cascading transitions is required to prove that all the states have the same parity. This is because nuclei with octupole deformation may be two rotational $\Delta J = 2$ sequences of opposite parity connected by cascading E1 transitions.
19. In strongly coupled bands, (deformation aligned) a comparison of experimentally deduced value of g_K (from mixing ratio δ(E2/M1) and assumed g_R and Q_0) with that calculated on the basis of a proposed quasi-particle configuration may lead to the assignment of parity to a band.

20. A comparison of experimental and calculated Routhians and particle alignments (from cranked shell-model calculations) for suggested quasi-particle configurations may give information about the parity of a rotational band.

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Search for Optimum Approach to Evaluating Data with Different Consistency

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To derive a recommended value and uncertainty from a discrepant set of data is the important problem for the evaluators. In recent years a number of data evaluation procedures have been proposed. A review and testing of these methods has been made in [1,2].

At present it is recognized that one of the very useful methods for evaluating data is the procedure of a limitation of relative statistical weights (LWM) [3]. On the basis of this method a computer program LWEIGHT has been developed by E. Browne and T.D. MacMahon [4]. It uses also the Chauvenet's criterion [5] for rejecting outliers and it works successfully in evaluating discrepant data when $1< \chi^2/(n-1)<2$. However for a number discrepant data sets with $\chi^2/(n-1)>2$ the LWEIGHT choice of an unweighted mean gives rise to doubt (see my “Remarks on the LWEIGHT program”).

Now there is a possibility to make corrections in programs and to unite the best findings in searches for an optimum approach to evaluating data with different consistency. It can be made being based on testing of different statistical procedures and a proposal of the use of tS [6] or a modified Bayesian procedure (MBAYS) [2] to give the most reliable uncertainties for recommended values as well as on a successful use the LWM method by CRP in 1991 and in the LWEIGHT program.

I have examined the data sets with different consistency which cover measurement results for half-lives of about 50 radionuclides [6,7]. There is not a single universal statistical procedure for producing recommended averages for all sets of data both consistent and discrepant. Therefore we have developed, in collaboration with A. Egorov, the computer program EV1NEW that uses several procedures of the program of T.D. MacMahon [4] and includes the LWM method as one of the component steps.

The principles of our program consist in a successive motion from the initial collection of all available experimental results to the final data set which is used for calculating the recommended value. By that the final uncertainty depends on a degree of the data inconsistency [7]. For rejecting some results the program gives only recommendation: the decision is adopted by the evaluator ("Yes" or "No").

The first step from the initial data set ("0") to the data set "1" consists, if necessary, in omitting unreliable or revised later measurement results. The next step ("1" $\rightarrow$ "2") is connected with the estimation of contributions of the different experimental results to the total c^2 value. In this step the evaluator can reject one or two statistical outliers (see the example for ^{155}Eu, Table 1). In forming the data set ("3") the possible adjustment of the uncertainty of one of the results occurs due to applying the above-mentioned LWM method.

Table 1

Experimental values of ^{155}Eu half-life (in days)

Reference	Data set "1" χ^2=334.9 $(\chi^2)_6^{0.05}$=14.1	Data set "2" χ^2=6.14 $(\chi^2)_5^{0.05}$= 12.6	Data set "3" χ^2=5.68 $(\chi^2)_5^{0.05}$ =12.6
98Si**	1739(8)	1739(8)	1739(8)
93Th04	1735(22)	1735(22)	1735(22)
92Un01	1739.0(5)	1739.0(5)	1739(7)[b]
83Wa26	1737(23)	1737(23)	1737(23)
74Da24	1708(18)	1708(18)	1708(18)
72Em01	1812(4)	Omitted [a]	-
72Su09	1653(51)	1653(51)	1653(51)
70Mo23	1698(74)	1698(74)	1698(74)

[a] The value from 72Em01 has been omitted on the basis of statistical considerations.
[b] The rule “of 50%” weight leads to a significant increase of the 92Un01 uncertainty.

It can be noticed that in [6,7] the rule of "50 % weight" has not been used in evaluating some radionuclide half-lives (in particular, ^{155}Eu). This possible deviation from the LWM rule is foreseen in the program for the cases of an considerable improvement of experimental technique.

The final phase of our program is directed to obtaining the "best" value through resulting "3" set of selected data. The program allows to compare results obtained with the different statistical procedures [1,2] but it chooses the weighted mean as an evaluated value expanding the final uncertainty in dependence of the χ^2 value. The modification of this program which is in progress includes the five ways of adjusting the final uncertainty with increasing χ^2 and the three modes of classification of discrepant data sets by means of comparing χ^2 to the tabulated value $(\chi^2)_{n-1}^{0.05}$ for the significance level 0.05 (Table 2).

Table 2.

Distribution of 48 data sets for half-lives on degree of discrepancy determined by χ^2 value, and recommended uncertainty of the evaluated value.

Mode of set	Degree of data discrepancy (on χ^2 value)	Number of sets	Recommended uncertainty
(1)	$\chi^2 \le (n-1)$	12	σ (internal uncertainty)
(2)	$(n-1)<\chi^2\le(\chi^2)_{n-1}^{0.05}$	7	$S=\sigma\times[\chi^2/(n-1)]^{1/2}$ (external uncertainty)
(3)	$(\chi^2)_{n-1}^{0.05}<\chi^2 \le 10(\chi^2)_{n-1}^{0.05}$	25	$t_{n-1}^{0,68}\times S$ (expanding S for low n) or $\sigma\times[\chi^2/(n-2)]^{1/2}$ (MBAYS uncertainty)
(4)	$\chi^2>10(\chi^2)_{n-1}^{0.05}$	4	$\sigma\times[\chi^2/(n-3)]^{1/2}$ (BAYS uncertainty)

This approach is based on the computational experiment of Kafala et al. [2] which has determined a MBAYS procedure as the most reliable for evaluating discrepant data and on the assumption that the discrepancy of data is connected with partial or total incorrectness of the experimental uncertainties. Two extreme modes of the final uncertainty of the weighted mean correspond to consistent data sets (σ) and greatly discrepant data sets when the Bayesian procedure is used supposing a random distribution of misestimations of the experimental uncertainties. The intermediate cases (the most number) correspond to the use of an external uncertainty or the MBAYS procedure. It should be noticed that the uncertainty values for the intermediate mode (3) (tS and MBAYS) practically coincide for $n \geq 4$ and therefore have been united.(Here t is the Student's coefficient for (n-1) degrees of freedom and the confidence level 0.68 (for details see [6,7])).

Half-lives of radionuclides corresponding to data sets with $\chi^2 > 10(\chi^2)_{n-1}^{0.05}$ can be recommended for additional measurements.

Also this approach allows to avoid an unweighted mean which is not acceptable for averaging measurement results with quite different accuracy.

In figures 1-3 the results of different evaluations for half-lives of ^{90}Sr, ^{99}Mo and ^{111}In are compared each with other and with available experimental data.

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Appendix

Remarks on the LWEIGHT Program

by V.P. Chechev

The LWEIGHT program works successfully in evaluating discrepant data when $1< \chi^2/(n-1)<2$. However for a number discrepant data sets with $\chi^2/(n-1)>2$ the LWEIGHT choice of an unweighted mean (UWM) gives rise to doubt.

1) In many cases, when there are available early measurement results with large uncertainties, a choice of UWM means, in fact, an ascription of EQUAL WEIGHTS both old experimental results with small accuracy and the best experimental data.
2) As a consequence the recommended average does not agree with the best experimental results. Expanding the uncertainty of the recommended UWM to include latter results does not save the situation as the obtained large uncertainty of the recommended value does not correspond the modern experimental level.
3) Rejecting old experimental results leads to a choice of a weighted mean (WM) and improves the situation but sometimes this procedure brings in the big element of subjectivity.
4) Uniformity of evaluations is violated in using both WM and UWM for different evaluations. Expanding the final uncertainty for greatly discrepant data can be provided with other methods (MBAYS and BAYS) or by the 1991 CRP method including the lowest uncertainty value for WM (but not for UWM).

*See figures 1-3.

Conclusion:

UWM should not be used for averaging the values with different accuracy.

* Editor's Note: The figures are included for illustration purposes only. They were produced by the editor from transparencies.

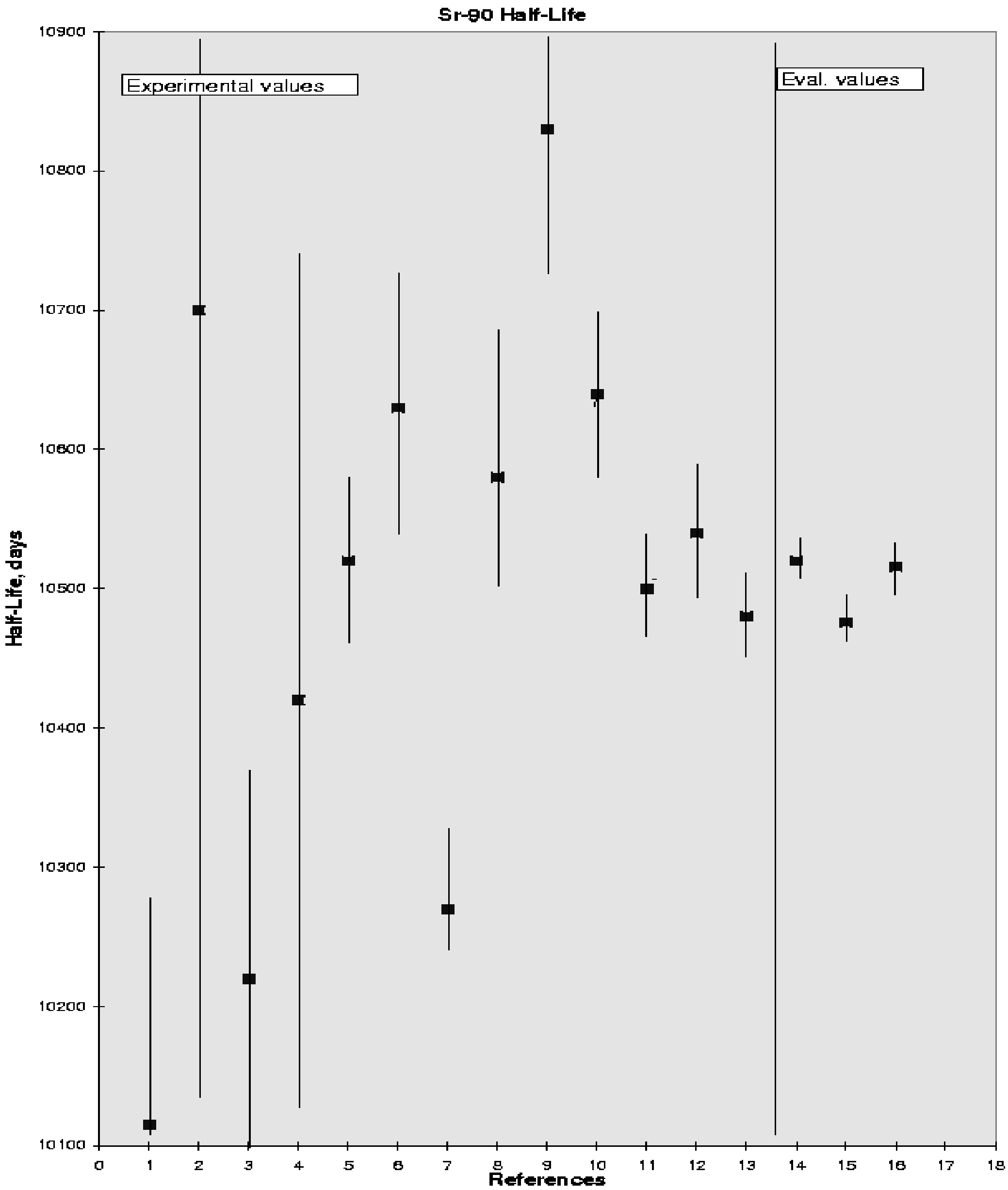

Fig. 1. Legend for References.

Experimental values:	1 - 55Wi	2 - 58An	3 - 65Fl	4 - 65Fl’	5 - 65An	6 - NBS
	7 - 78La	8 - 83Ra	9 - 85De	10 - 89Ko	11 - 91Sc	12 - 94Ma
	13 - 96Wo;					

Evaluated values:

14 - EV1NEW for 12 experimental values (Ref. 7 rejected), MBAYS, $T_{1/2}$=10520(15)

15 - LWEIGHT for 13 experimental values, WM, external uncertainty, $T_{1/2}$=10476(28)

16 - Wood and Lucas for 7 experimental values (Ref. 2, 3, 4, 5, 11, 12, 13), critical review, expanding uncertainty, $T_{1/2}$=10516(21).

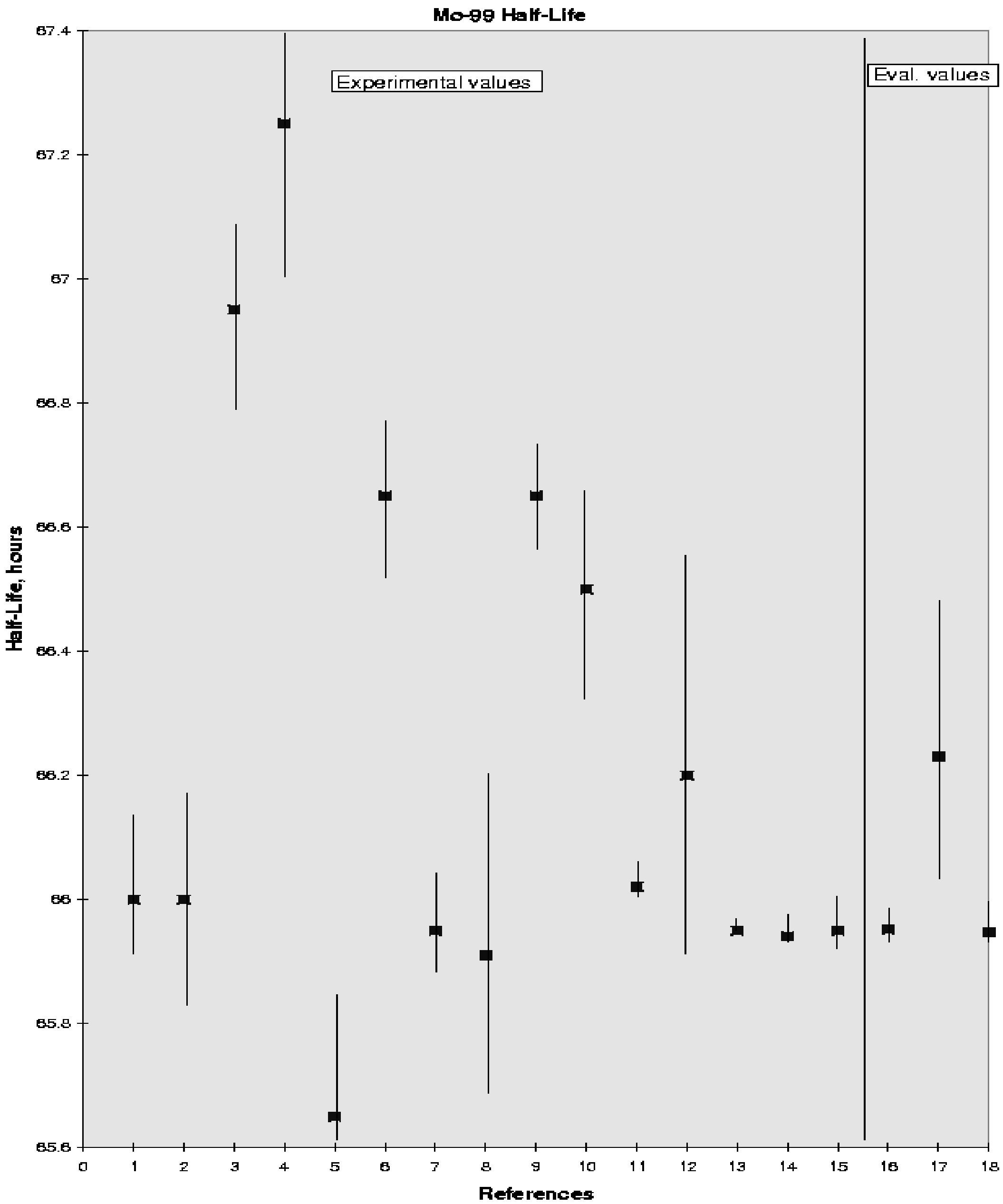

Fig. 2. Legend for References.

Experimental values: 1 - 47Se 2 - 57Gu 3 - 57Wr 4 - 58Pr 5 - 61Ne 6 - 65Gr 7 - 67Ba 8 - 67Ba' 9 - 68Re 10 - 71Ba 11 - 72Em 12 - 79Di 13 - 80Ho 14 - 82Ho, 92Un 15 - 83Wa;

Evaluated values: 16 - EV1NEW for 15 experimental values, BAYS, $T_{1/2}$=65.952(20)
17 - LWEIGHT for 15 experimental values, UWM, no outliers, $T_{1/2}$=66.23(29)
18 - LWEIGHT for 4 experimental values (Ref. 11, 13, 14, 15), WM, external uncertainty, $T_{1/2}$=66.947(16).

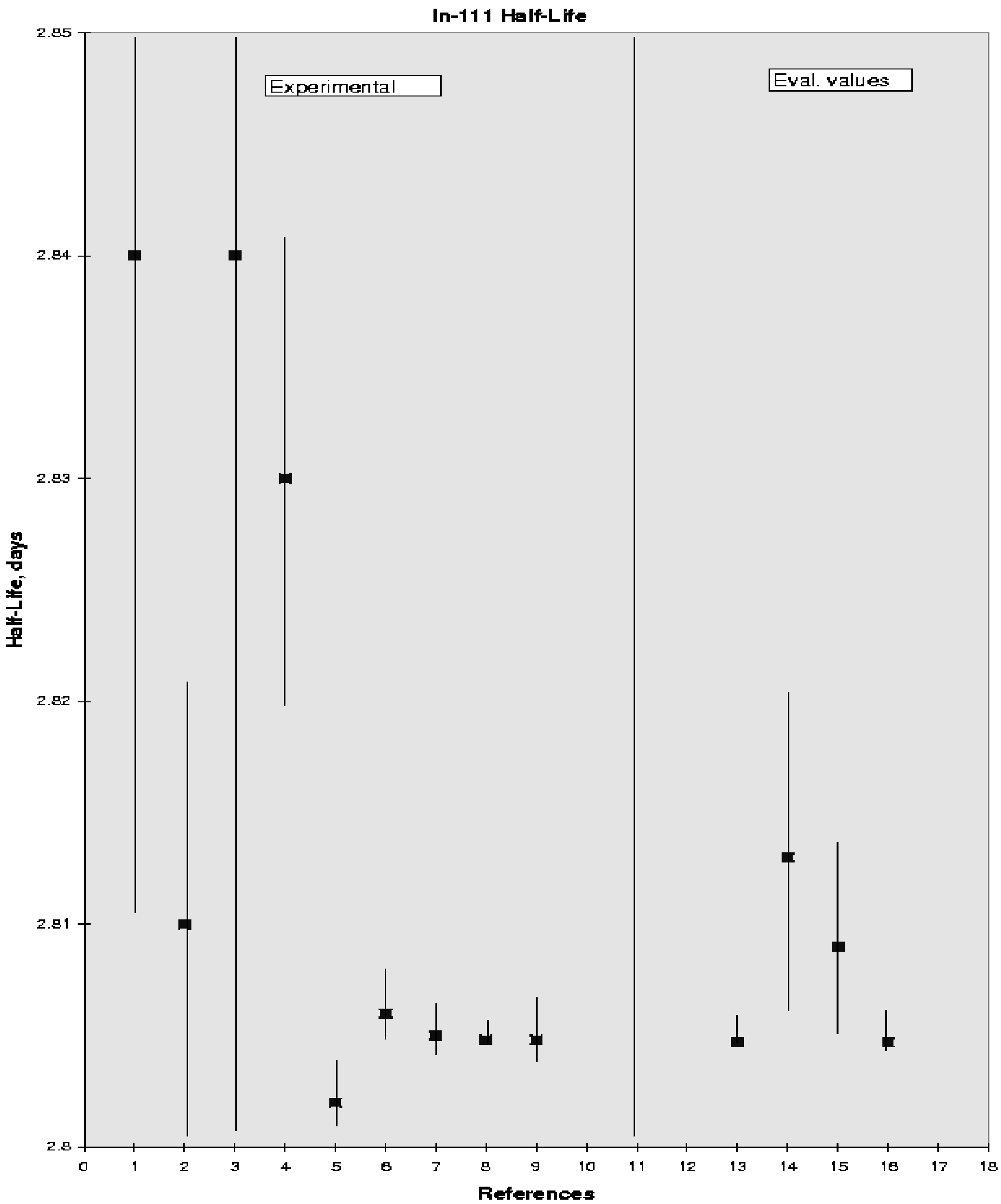

Fig. 3. Legend for References.

Experimental values: 1 - 49He 2 - 57Ma 3 - 68Li 4 - 72Em 5 - 78La 6 - 80Ho 7 - 83Wa 8 - 86Ru 9 - 92Un; 10 - 68Sm with 2.96(8)

Evaluated values:
13 - EV1NEW for 10 experimental values, MBAYS, $T_{1/2}$=2.8047(4)
14 - LWEIGHT (I) for 8 experimental values (Ref. 2, 3, 4, 5, 6, 7, 8, 9), UWM, $T_{1/2}$=2.813(8)
15 - LWEIGHT (II) for 7 experimental values (Ref. 2, 4, 5, 6, 7, 8, 9), UWM, $T_{1/2}$=2.809(4)
16 - LWEIGHT (III) for 6 experimental values (Ref. 2, 5, 6, 7, 8, 9), UWM, $T_{1/2}$=2.813(8).

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