International Atomic Energy Agency

INDC(NDS)-206/GE

INDC INTERNATIONAL NUCLEAR DATA COMMITTEE

CO-ORDINATION OF THE INTERNATIONAL NETWORK OF NUCLEAR STRUCTURE AND DECAY DATA EVALUATORS

Summary Report of a Consultants' Meeting organized by the International Atomic Energy Agency and held at Ghent, Belgium, 16-20 May 1988

Edited by J.J. Schmidt
Nuclear Data Section
International Atomic Energy Agency

October 1988

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

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ABSTRACT

The IAEA Nuclear Data Section convened the eighth meeting of the international nuclear structure and decay data network at Ghent, Belgium, 16-20 May 1988. The meeting was attended by 21 Scientists from 12 Member States and three international organizations, concerned with the compilation, evaluation, and dissemination of nuclear structure and decay data.

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FOREWORD

The international nuclear structure and decay data (NSDD) network, consisting of numerous evaluation groups and data service centres, aims at a complete and continuous nuclear structure data evaluation of all isobaric mass-chains on a six-year cycle, the continuous publication of these evaluations and their dissemination to the scientific community. The evaluated mass-chain data resulting from this concerted international effort are published in Nuclear Physics A and the Nuclear Data Sheets, and comprise the currently recommended "best values" of all nuclear structure and decay data. The international NSDD network has evolved from the pioneering work in the late fourties and early fifties by physicists from the California Institute of Technology (Pasadena), the Rijksuniversiteit at Utrecht (Netherlands) and the Nuclear Data Group (Washington and Oak Ridge). The United State effort is presently coordinated by the US Nuclear Data Center at the Brookhaven National Laboratory.

Periodic meetings of this network have the objectives to maintain the coordination of all centres and groups participating in the compilation, evaluation and dissemination of NSDD, to maintain and improve the standards and rules governing NSDD evaluation, and to review the development and common use of the computerized systems and data bases maintained specifically for this activity.

DEFINITION OF TERMS

Nuclear Structure Data: numerical values of nuclear level structure and decay parameters and associated atomic parameters of pertinence to nuclear physics techniques and methods.

Tabulation: systematic collection and transcription of numerical information without critical selection or manipulation.

Compilation: systematic collection and transcription of information on a given subject with collation and re-organization for optimal presentation to the users.

Evaluation: critical appraisal of all available information compiled on a given subject and derivation of consistent best or preferred values with their uncertainties.

Mass-chain (vertical): pertaining to properties of nuclides with a given mass number.

Selected (horizontal): pertaining to a particular nuclear property or properties for a range of nuclides.

List of Abbreviations

CAJaD	Centre for Data on the Structure of the Atomic Nucleus and Nuclear Reactions of the USSR State Committee on the Utilization of Atomic Energy, located at the Kurchatov Institute in Moscow.
CBNM	Central Bureau for Nuclear Measurements, located at Geel, Belgium.
CODEN	International code for the abbreviation of periodical titles used by ASTM, INIS and Chemical Abstracts.
CPND	Charged Particle Nuclear Data.
EBCDIC	Extended binary-coded decimal interchange code.
ENSDF	Computer-based Evaluated Nuclear Structure Data File developed by US/NDP.
EXFOR	Exchange Format, internationally used format for the exchange of experimental nuclear reaction data.
FIZ	Fachinformationszentrum Energie, Physik, Mathematik GmbH, Eggenstein-Leopoldshafen, FRG.
IAEA/NDS	Nuclear Data Section of the International Atomic Energy Agency.
INDC	International Nuclear Data Committee.
INIS	International Nuclear Information System, operated by the IAEA, to replace Nuclear Science Abstracts.
KACHAPAG	Karlsruhe Charged Particle Group.
LIYaF	Leningrad Institut Yadernoy Fiziki: Data Centre of the Leningrad Nuclear Physics Institute of the USSR Academy of Sciences.
NSR	Nuclear Structure Reference (file).
NDS	Nuclear Data Sheets.
NSDD	NSD data = Nuclear Structure and Decay Data.
US/NNDC	US National Nuclear Data Centre, located at the Brookhaven National Laboratory.
US/NDP	Nuclear Data Project located at the Oak Ridge National Laboratory.

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I. MEETING SUMMARY

A. INTRODUCTION

The eighth meeting of the International Network of Nuclear Structure and Decay Data (NSDD) Evaluators was convened by the IAEA Nuclear Data Section at Ghent in Belgium from 16 - 20 May 1988. The meeting was attended by 21 scientists from 12 Member States and 3 international organizations, representing centers and groups concerned with the compilation, evaluation and dissemination of nuclear structure and decay (NSD) data. The list of participants is given in Appendix 1.

The meeting was opened by Prof.A.Deruytter, Director of the Nuclear Physics Laboratory (NPL), Ghent, and Director of the Physics Division of CBNM Geel, on behalf of the two host institutions, NPL Ghent and CBNM Geel, and by J.J.Schmidt on behalf of the IAEA. Prof.Dr.P.von Brentano, Director of the Nuclear Physics Institute of the University of Köln, FRG, presented an introductory keynote speech on "Recent advances in in-beam nuclear spectroscopy". On Monday evening, 16 May, an IAEA welcoming cocktail was given. On Thursday, 19 May, the host institutions organised a visit to Brugge in the afternoon and an official dinner at the Laarne Castle near Ghent in the evening.

The meeting was conducted in two separate parts : six half-day sessions devoted to the organizational and technical aspects of the continuation of the NSDD network (sessions concerned with agenda items A, B, D-I chaired by J.J.Schmidt, and item C chaired by M.Bhat), and two half-day sessions devoted to the presentation and discussion of papers related to the physics and user aspects of evaluation of NSDD (organised by D.De Frenne and chaired by D.De Frenne and E.Jacobs respectively of the Nuclear Physics Laboratory, Ghent). The Adopted Agenda for the organizational part of the meeting is given in Appendix 2, and the list of papers presented during the scientific programme of the meeting is given in Appendix 3. The list of papers submitted to the meeting by the participants is given in Appendix 4. The actions which result from this meeting are listed in Appendix 5.

B. MAIN ACHIEVEMENTS OF THE MEETING

The main achievements of the organizational part of the meeting were as follows :

- The previously agreed upon goal of the NSDD network of a mass-chain evaluation cycle time of six years was re-iterated and measures to reduce the current cycle time of 8-9 years were agreed.
- Problems encountered in implementing the new format for mass-chain publications agreed upon at the Grenoble meeting which eliminates redundancy were discussed. To solve these problems, improved ways of communication between the editors and the evaluators were endorsed by the network. Those parts of an A-chain evaluation which will not appear in the publication, will be agreed upon between the editors and the evaluators at an early stage in the publication process.
- The "up-date format" for evaluations with little new data was approved by the network.

- Increased on-line access to the NSR and ENSDF data bases was noted as an important step in inter-centre data exchange and user services.
- In response to the need of the user community for a new nuclear structure handbook the network recommended a feasibility study for such a handbook to be performed before the next network meeting.

C. OBJECTIVES OF THE NSDD NETWORK

The international NSDD Network, consisting presently of 17 evaluation groups in 12 Member States, and 2 international data service centres, aims at a complete and continuous nuclear structure data evaluation of all isobaric mass chains on a six-year cycle, the continuous publication of these evaluated data in the Nuclear Data Sheets and Nuclear Physics A journals, and their dissemination to the scientific community. This international cooperative effort is coordinated by the Nuclear Data Section of the IAEA.

The periodic meetings of the international NSDD network have the objectives to maintain the coordination of all centres and groups participating in the compilation, evaluation and dissemination of NSDD, to maintain and improve the standards and rules governing NSDD evaluation, and to review the development and common use of the computerized systems and data bases maintained specifically for this activity.

All members of the international NSDD network are referred to in the text of this report by their identification code agreed at the May 1976 NSDD meeting. A current list of these centres, together with their codes and addresses, is given in Appendix 6.

II. MEETING PROCEEDINGS

A. REVIEW OF ACTIONS FROM THE LAST MEETING

The Actions resulting from the June 1986 Meeting of the NSDD Network in Grenoble (listed in Appendix 5 of the 1986 NSDD Meeting Report (INDC(NDS)-192/GE)) were reviewed. Most of the standing actions from the previous meeting were renewed, and several new actions agreed. The full list of actions agreed to at the present meeting is contained in Appendix 5.

B. REPORTS FROM NSDD NETWORK MEMBERS

Status reports presented to the meeting by the members of the NSDD Network are included as appendices in this report, as follows :

- Report from JAP/JAERI. S.Igarasi (88/1) Appendix 7
- Report from NED/UTRECHT. P.M.Endt and C.Van der Leun (88/3) Appendix 8
- Report from US/NNDC. M.Bhat (88/5) Appendix 9
- Report from FRG/FIZ. H.W.Müller (88/8) Appendix 10
- Report from CAN/TAL. B.Singh (88/9) Appendix 11
- Report from PRC/CNDC. Zhou Chunmei (88/10) Appendix 12
- Report from SWD/Lund. P.Ekström (88/11) Appendix 13
- Report from FR/CEA-Grenoble. J.Blachot (88/12) Appendix 14
- Report from KUW/ISR. A.R.Farhan (88/13) Appendix 15
- Report from USSR/CAJaD. V.A.Vukolov, F.E.Chukreev, and E.N.Shurshinov (88/15) Appendix 16
- Report from IND/Varanasi. P.C.Sood (88/16) Appendix 17
- Report from BLG/Ghent. D.De Frenne (88/17) Appendix 18
- Report from UK/Liverpool. P.D.Forsyth (in absentia) (88/22) Appendix 19.

C. EVALUATION OF NUCLEAR STRUCTURE AND DECAY DATA

C.1. Current mass-chain evaluation status

1. For A > 45, the present cycle time of 8-9 years does not meet the expectations of users and the recent goal of a cycle time of 6 years agreed to by the Network.
2. It is desirable to reduce the cycle time to about 6 years.
3. In order to achieve this cycle time or a productivity of about 36 evaluations/year the following procedure is suggested. Each centre should

a. give high priority to evaluations of A-chains older than 6 years;

b. identify those A-chains with little new data and evaluate these for publication in an "update format". This should result in greater productivity; and

c. concentrate on those A-chains with a considerable amount of new data and evaluate these with a higher priority.

C.2. Mass-chain evaluation assignments

The current assignment of A-chains agreed to at the Grenoble meeting in 1986 remains unchanged. Canada (McMaster) requested a permanent assignment of 6 mass-chains which would include A = 149,151 and four additional masses in A≈60 region. The NNDC will try to negotiate this reassignment in the near future. The NNDC will arrange temporary assignment of A-chains to suit research interests or to cover those mass-chains which are old and which the data center with a permanent responsibility for them cannot evaluate in the near future.

C.3. Evaluation of decay data for A < 45

The 1980 guidelines for extracting data for A < 45 for inclusion in the ENSDF file remain valid. For some mass-chains the ENSDF data corresponding to them have to be updated to correspond to the latest evaluation in Nuclear Physics.

D. PUBLICATION OF NUCLEAR STRUCTURE AND DECAY DATA

D.1. A<45

P.M.Endt reported that they will publish 20<A<45 in 1989 in Nucl.Phys.

D.2. A>44

M.Bhat reported that many users seem happy with the 1986 NSDD guidelines for reducing mass chain size published in the Nuclear Data Sheets. The average A-chain length of about 75 pages will allow about 30 mass chains to be published each year. Further reductions are possible. The average processing time in 1987 was 14 months with 12 months being a practical lower limit. The areas where processing time could be reduced included primarily delays with the evaluator and the reviewer. J.Tuli suggested that more cooperation from evaluators is necessary and that more outside reviewers would be helpful. M.Martin observed that outside reviewers are particularly useful in their areas of expertise.

J.Tuli summarized memo 88/4 of R.Kinsey suggesting how evaluators can influence ENSDF presentation. The new format for rotational band presentation was discussed. J.Tuli requested feedback as to whether the new format is better ; is the presentation useful; and what might be done. R.Firestone

and B.Singh suggested that BNL consider the Nucl. Phys. format for band presentation which is more compact. M.Martin expressed concern over an inconsistent policy for showing band information in the figures. J.Tuli expressed concern for the programming effort necessary to implement a new presentation.

J.Tuli discussed the new "update format" whereby mass chains with little new data would be partially updated and the reader referred to the previous evaluation. The example of A = 138, already published, was discussed as an example of this new format. The evaluator will decide when the new format is appropriate. Broad support for this new format was indicated by the NSDD members.

The 1986 formats for reducing mass chains size were discussed. Currently about 50 mass chains have been processed with this format. J.Tuli reported that the average mass chain was reduced from 115 pages to 80 pages. He observed that there was no loss of physics content, there was less redundancy, no effect on ENSDF or the evaluator, and the reviewer sees all of the data. Final layout is prepared by the editors and evaluators see the final version before publication. There has been little effect on processing time. R.Firestone suggested that the truncation process begin at the pre-review stage and that the evaluator should control the truncation process. B.Singh reported on problems with the truncation of A = 151 : some level schemes far from the stability line were deleted from presentation, and some physics related comments were deleted from presentation or garbled. These problems resulted from the large size of the mass chain and the need to shorten the publication beyond the size resulting from the established truncation guidelines. This was done by BNL without consultation with the evaluator in an attempt to meet a publication deadline. In retrospect, the evaluator should have been consulted at this stage. In future, a procedure that allows for evaluator input at the truncation stage will be followed.

M.Martin suggested that comment generation for truncated tables should be automatic from ENSDF. It was also suggested that evaluators should carefully review the truncation changes. The NSDD members recommended that BNL make the evaluators aware of ensuing truncation changes before review.

The USSR delegates discussed the need to emphasize that evaluators should comment on discrepancies and need for further work which they encounter in their evaluations. It was generally agreed that evaluators should do this in the comments section of their mass chains.

D.3. "Table of Radioactive Isotopes" and other handbooks

R.Firestone reported that the Table of Radioactive Isotopes has sold about 2000 volumes and that the 7th Edition of the Table of Isotopes sold 575 copies last year. D.De Frenne, P.Ekström, P.Endt, and others expressed strong need for a new Table of Isotopes to serve as a compact source of up-to-date information for nuclear structure physicists. R.Firestone expressed interest in producing such a book and reported that recent advances at LBL in level scheme graphics would make such a book feasible to produce in the near future. He suggested that careful planning would be necessary to constrain the book to one volume and that limited updating of ENSDF would be necessary to provide uniform, up-to-date information. It was discussed that this project might adversely affect the evaluation schedule, however it was also reported that significant demand by some data centers to obtain additional mass chain assignments might offset this. J.Tuli and M.Bhat mentioned possible difficulty in funding this book.

W.Bambynek expressed the need of the applied user for decay schemes not contained in the Table of Radioactive Isotopes. An action was placed on LBL and NNDC to investigate the feasibility and cost benefit of such a nuclear structure handbook.

D.4. Wall Charts

M.Bhat reported that the General Electric wall chart will be finished early in 1989. The USSR group also reported that a new Russian chart is in progress. R.Firestone felt that a new wall chart from Karlsruhe would be welcomed by the nuclear physics community. H.Müller reported that this project is currently not being funded. The NSDD members encouraged Karlsruhe to revive this project if possible. A new chart of the Nuclides from JNDC and NDC JAERI is expected in 1988.

D.5. Horizontal Compilations and Evaluations

The following compilations were identified by NSDD members

a. S.Raman, 'Evaluation of BE2 values' published in ADNDT,
b. New Wapstra mass evaluation; part of mass comparison of P.Haustein to be published in ADNDT,
c. New USSR mass evaluation in progress,
d. IAEA Coordinated Research Programme on γ-Ray Standards for Detector Efficiency Calibration.
e. IUPAP coordinated evaluation of Standards for γ-ray Energy Calibration.
f. New BNL Wallet Cards due in 1989,
g. New FIZ Publications :

- Catalog of Alpha Particles from Radiactive Decay, Physics Data 29-1;
- Evaluation of the angle-integrated neutron emission cross section from the interaction of 14 MeV neutrons with medium and heavy nuclei, Physics Data 13-4;
- Shielding of Photon Radiation from Radionuclides :

Shielding Material : LEAD	Physics Data 28-2
Shielding Material : IRON	Physics Data 28-3
Shielding Material : BARYTE CONCRETE	Physics Data 28-4
Shielding Material : CONCRETE	Physics Data 28-5
Shielding Material : WATER	Physics Data 28-6

g. nuclear moments tables by P.Raghavan, Rutgers University (under preparation),
h. Nuclear Decay Data for Transuranium Nuclides by V.A.Chechin et al.

Concern was expressed by P.Endt that no new neutron cross section resonance parameter book was planned. The NSDD members also encouraged W.Bambynek to publish his new fluorescence yield evaluation. He offered to provide values to individual users on request.

E. STATUS OF NSR

M.Bhat reported that about 2500 primary and 1000 secondary updates are currently entered into the NSR file per year. In addition to keywording at BNL, considerable assistance was received from the USSR, in keywording secondary references. Japan, China and France have started to compile NSR entries, in their countries. Compliance by Phys. Rev. authors to voluntary keywording is running at 40-50%. The NSR references occupy about 350 pages of the Nuclear Data Sheets per year. They are published in three volumes and no cumulative issue has been published since 1985. P.Sood expressed concern over a lack of cumulative references which adversely effect developing countries where on-line computer access is difficult. M.Martin suggested that BNL publish a separate cumulative issue on a ≈ 3-year interval. M.Bhat offered to explore this possibility with Academic Press.

P.Ekström reported that some nuclear physics papers may not be retrievable from the NSR. He offered to give examples and BNL agreed to look into the problem. On examination, these examples were found to deal with purely theoretical work with no application to any particular nuclide. As such, in accordance with the present guidelines they are not coded into the NSR.

J.Blachot expressed difficulty with their keywording of secondary references and asked if these were useful. Considerable discussion ensued on whether secondary references should be used by evaluators and others. It was suggested that secondary sources be used only when the author is contacted. Interest was expressed that the secondary references be in the file so that researchers could search on current activity in their field and that unique, unpublished data would be available. It was noted with concern that U.S. and European laboratory reports are covered with a lower priority. The NSDD members recommended that a more complete coverage of the secondary references be obtained.

F. STATUS OF THE ENSDF SYSTEM

F.1., F.2., F.3. and F.6.

These topics have been adequately covered earlier in the meeting.

F.4. Manual for the preparation of ENSDF Data Sets

A new format record, the "Production Normalization Record" was introduced by BNL, and approved by the network. Its purpose is twofold. First, it allows the evaluator to input directly the overall intensity normalization factors NRXBR, NTXBR, and NBXBR, rather than the separate factors NR, NT, NB, and BR.

Second, for data sets with gammas, the evaluator can indicate the intensity option that should be used for the drawing corresponding to those data sets.

F.5. ENSDF Procedures Manual

The ENSDF Procedures Manual has been distributed to all Centers. Comments on any of the articles contained therein should be sent to BNL.

F.7. ENSDF output computer codes

BNL was asked to send to the network, on an annual basis, a status report on the analysis programs. This report should include, for each program, the date of the last update and the version number.

The MEDLIST program should be considered as being replaced by the program RADLST.

F.8. On-line Access

On-line access of ENSDF and other data bases at the NNDC has shown a steady increase over the past few years, with the number of users and the number of requests per user both increasing. The NNDC system has been advertised in the newsletter of several societies and has been promoted at society meetings. Several new features, including limited access with no authorization requirement, a newsletter containing announcements of conferences and the file and program availability, and an NNDC address file, have increased the usefulness of the on-line system.

Specific data bases available include NUDAT, NSR (the most heavily used), ENSDF, ENDF-B/V, and CSISRS. In addition, the analysis programs HSICC, LOGFT, and RULER will be available in the near future for use either on an ENSDF file or in an interactive mode. There are plans to make available a file containing the most recent fundamental physical constants.

NEA maintains a duplicate set of all the above files. Access to HEPNET (or its equivalent) allows access to both NEA and BNL, but not all centers have convenient access to these systems.Packet switching networks also permit access to NEA.

G. NSDD PUBLICITY AND DISTRIBUTION

G.1. ENSDF Tape Distribution

J.Tuli reported that tapes of ENSDF updates are distributed every 6 months, i.e. in February and August. Centers who fail to receive these updates should notify BNL.

G.2. Data Center Services

The USNDN services are reported in paper 88/5. FIZ NSDD services are offered and used since several years. CAJaD receives 60 enquiries from 25 Soviet organizations per year. IAEA/NDS handles NSDD requests from its service area and is developing on-line capability.

G.3. ENSDF for specific user groups

Paper 88/2 submitted by Yamaguchi was discussed. This paper pointed out problems for the applied users when normalization factors are missing from decay data sets, and when discrepancies between stated Q values and average energies (for all radiations) exist.

In response to the second point, the guidelines for evaluators should reemphasize the need for evaluators to check each decay data set for discrepancies in the energy balance by running RADLST.

In response to the first point, RADLST will be modified so that the output for decay data sets that cannot be normalized will include a prominently-displayed comment stating that the normalization is not known and that the intensities given are relative values only.

G.4. Publicity of ENSDF

W.Bambynek requested a list of data services available to users from the existing data centers, possibly by October 1988. IAEA will publish a pamphlet including a summary of various data center services. BNL has advertized ENSDF at various meetings and in the American Physical Society Nuclear Division Newsletter. An excellent advertizing brochure for Nuclear Data Sheets was distributed by Academic Press.

H. NEXT MEETING

The IAEA and the NSDD network gratefully accepted the renewed invitation by Kuwait, to hold the next meeting of the International NSDD network at the Kuwait Institute for Scientific Research in the beginning of March 1990. As back-up places LBL or BNL were suggested and agreed.

IAEA Meeting on the Coordination of the International Network of Nuclear Structure and Decay Data Evaluators

Ghent, Belgium, 16-20 May 1988

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IAEA Meeting on the Coordination of the International Network of Nuclear Structure and Decay Data Evaluators

Ghent, Belgium, 16-20 May 1988

Adopted Agenda

for the organizational part of the meeting

A. Introductory Items

1. Opening Statements
2. Election of Chairman
3. Adoption of the Agenda
4. Announcements
5. Review of Actions from last meeting

B. NSDD Network

1. Welcoming new members
2. Short report from network members
3. Report from the US NSDD Network

C. Evaluation of Nuclear Structure and Decay Data

1. Current mass-chain evaluation status
2. Mass-Chain evaluation assignments
3. Evaluation of decay data for A < 45
4. Revised guidelines for evaluators
5. Review of evaluation physics rules

D. Publication of Nuclear Structure and Decay Data

1. NSDD Publication in Nuclear Physics (A < 45)
2. Nuclear Data Sheets publications (A > 44)
   - NDS Publication status
   - Publication of A-chains with few new data: the "Update format"
   - NDS Data presentation and how evaluators can influence it
3. Table of Radioactive Isotopes
4. Wall Charts
5. Horizontal Compilations and Evaluations

E. Status of the Nuclear Structure Reference (NSR) File

(coding, documentation, format, publication)

F. Status of the Evaluated Nuclear Structure Data File (ENSDF) System

1. ENSDF Content: status
2. Conversion A < 45 data into ENSDF
3. Changes in ENSDF
4. Manual for the preparation of ENSDF Data Sets
5. ENSDF Procedures Manual
6. ENSDF Physics Computer Codes
7. ENSDF output computer codes
   - RADLST
   - Others
8. ENSDF on-line

G. NSDD Publicity and Distribution

1. Distribution of the ENSDF Data Tapes
2. Data centre services
3. ENSDF for specific user groups
4. Publicity of ENSDF

H. Next Meeting

I. Summary of Conclusions and Recommendations

List of Papers Presented during the Scientific Programme of the Meeting

Ghent, 16-17 May 1988

Opening session : Monday, 16 May, Morning

Chairman : Dr.J.J.Schmidt

Prof.Dr.P.von Brentano, University of Cologne, FRG
- Recent advances in in-beam nuclear spectroscopy

Session 1 : Monday, 16 May, Afternoon

Chairman : Dr.D.De Frenne

Prof.Dr.H.Kluge, Institut für Physik, University of Mainz, FRG
- Nuclear ground state properties from laser and Penning-trap mass spectroscopy

Dr.S.T.Van der Werf, KVI Groningen, The Netherlands
- Multi-nucleon transfer reactions

Dr.F.Hardeman, IKS, Katholieke Universiteit Leuven, Belgium
- Level mixing resonances spectroscopy (LEMS)

Session 2 : Tuesday, 17 May, Afternoon

Chairman : Dr.E.Jacobs

Prof.Dr.K.Heyde, Laboratorium voor Kernfysica, RUG, Belgium
- Use and misuse of nuclear models and nuclear systematics

Dr.S.J.Robinson, ILL Grenoble, France
- How reliable are multipole mixing ratios extracted from angular correlation measurements

Dr.L.I.Govor, Dr.A.M.Demidov, Dr.I.V. Mikhaylov, Kurchatov Institute, Moscou, USSR
- Multipole mixtures in ^{128}Te γ-transitions in (n,n'γ)-reactions

Dr.F.de Corte, INW, Rijksuniversiteit Gent, Belgium
- The expectation of an activation analyst as to the content and the quality of the Nuclear Data Sheets

List of Submitted Reports

88/1 Status report : Japan (S.Igarasi) Appendix 7

88/2 Problems encountered in Use of the ENSDF Decay Data and Simple Analysis on Them (Y.Yamaguchi, JAERI, Japan) Appendix 23

88/3 Status report : Utrecht (P.M.Endt and C. van der Leun) Appendix 8

88/4 Presentation of ENSDF Data in the Nuclear Data Sheets and how evaluators can influence it (R.R.Kinsey, NNDC Brookhaven) Appendix 22

88/5 Progress report from USA (M.R.Bhat) Appendix 9

88/6 Status of mass chain evaluations (M.R.Bhat) Appendix 21

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ACTIONS

A. STANDING ACTIONS

1. **Network** Inform the US/NNDC of errors or omissions in ENSDF, NSR, and NDS publications. The US/NNDC is requested to acknowledge these communications and inform the network members on the disposition of the suggested corrections.

2. **Network** Inform NED/Utrecht and US/UP of mistakes identified in ENSDF for mass-chains 21-44 and 5-20 respectively.

3. **Network** Send in to US/NNDC comments and suggestions on all ENSDF-related manuals as well as on symbols, abbreviations and conventions used in the NDS publications.

4. **Network** Send to M.Martin comments and suggestions on the "Guidelines for Evaluators".

5. **Network** Inform the network of any new computer codes written, and distribute them to the other members of the network.

6. **Network** The network should continue its effort to restore keywords in journals that have recently stopped using them and encourage their use in other major journals.

7. **Network** NSDD evaluators are encouraged to seek comments from their colleagues and/or experts in the pertinent mass region during the review and publication process.

B. ACTIONS ARISING FROM THIS MEETING

1. **IAEA/NDS** In collaboration with NNDC, prepare a pamphlet advertising the NSDD network. Also publicize NSDD network in the Nuclear Data Section Newsletter.

2. **Martin** Collect all existing and revised rules for J^{π} assignments in one paper and circulate it to the network before the next meeting.

3. **US/NNDC** Collect and maintain list of the names and computer addresses of NDS evaluators and send this annually to the network.

4. **Network** Communicate to evaluators all information of interest to them, e.g. evaluation procedures, using the above list. This would include NS/ - - memos from network members.

5. **Network evaluators** Send M.Martin any comments, suggestions, additions and corrections by 1 September 1988 on the "Guidelines for Evaluators" and "General Policies - Presentation of Data" recently distributed by him.

6. **Network** Identify to BNL/NNDC prospective reviewers within and outside their groups.

7. **R.Firestone J.Tuli** Investigate the desirability, feasibility and cost benefit for producing a new nuclear structure handbook.

8. **NNDC** Send to the network annually a status report with the latest version numbers and dates of ENSDF analysis codes including also the numbers of documentation reports.

9. **NNDC** Respond to the problems in the use of ENSDF encountered by Y.Yamaguchi (reference : meeting paper 88/2).

Addresses of Members of the NSDD Network

(Active mass-chain evaluation centres are indicated by an asterisk, NSDD distribution centres are indicated by an +)

Code	Centre/Group		Address	Head of Project or Centre
1A	US/NNDC	*+	National Nuclear Data Centre Brookhaven National Laboratory Upton, New York 11973, USA	S. Pearlstein
1B	US/NDP	*	Nuclear Data Project Oak Ridge National Laboratory Oak Ridge, Tennessee 37830 U.S.A.	M. Martin
1C	US/LBL	*	Lawrence Berkeley Laboratory University of California Berkeley, Cal. 94720, USA	E. Browne R.B. Firestone
1D	US/INEL	*	EG and G Idaho, Inc. P.O. Box 1625 Idaho Falls, Idaho 83401, USA	C.W. Reich
1E	US/UP	*	University of Pennsylvania Philadelphia, Penn. 19174, USA	F. Ajzenberg-Selove
2A	USSR/CAJaD	*+	Institut Atomnoi Energii I.V. Kurchatova 46 Ulitsa Kurchatova Moscow, D-182, USSR	F.E. Chukreev
2B	USSR/LIYaF	*	Data Centre Leningrad Nuclear Physics Inst. Gatchina, Leningrad Region 188350, USSR	I.A. Kondurov
3A	NED/Utrecht	*	Fysisch Laboratorium P.O. Box 80 000 Princetonplein 5 3508 TA Utrecht, The Netherlands	C. van der Leun
5A	FRG/FIZ	*+	Fachinformationszentrum Energie, Physik, Mathematik GmbH Kernforschungszentrum D-7514 Eggenstein-Leopoldshafen 2 FRG	H. Behrens
6B	FR/CEA-Grenoble	*	DRF/Service de Physique CEA Cedex No. 85 F-38041 Grenoble-Gare	J. Blachot

Code	Centre/Group	Address	Head of Project or Centre
7A	IAEA/NDS	+ Nuclear Data Section International Atomic Energy Agency P.O. Box 100 A-1400 Vienna, Austria	A. Lorenz
8A	NEA/DB	+ NEA Data Bank B.P. No. 9 F-91190 Gif-sur-Yvette	N. Tubbs
9A	CBNM/Geel	Bureau Central de Mesures Nucleaires C.E.C. Steenweg naar Retie B-2440 Geel, Belgium	W. Bambynek
10A	JAP/JAERI	* Japan Atomic Energy Research Institute Division of Physics Tokai-Mura, Naka-Gun Ibaraki-Ken 319-11, Japan	S. Igarasi
11A	SWD/Lund	* University of Lund Institute of Physics Solvegatan 14 S-223 62 Lund, Sweden	P. Ekström
12A	KUW/ISR	* Kuwait Institute for Scientific Research Shuwaik, Kuwait	A.R. Farhan
19A	BLG/Gent	* Laboratorium voor Kernfysika Proeftuinstraat 86 B-9000 Gent, Belgium	D. De Frenne
20A	CAN/TAL	* Tandem Accelerator Laboratory McMaster University Hamilton, Ontario L8S 4K1	B. Singh
21	PRC/CNDC	* Institute of Atomic Energy P.O. Box 275 (41) Beijing P.R. China	Zhou Chunmai
22	IND/BHU	* Department of Physics Banaras Hindu University Varanasi - 221005 India	P.C. Sood

Status Report of Japanese Activities in Nuclear Structure and Decay Data

Sin-iti IGARASI

Nuclear Data Center
Japan Atomic Energy Research Institute

1. Managerial change of NSDD activities in Japan

Due to the retirement of Dr. T. Tamura, Dr. S. Igarasi, General Manager, JAERI/NDC, is representing Japanese group of the international network for nuclear structure data evaluation from April 1988.

2. Mass-chain evaluation schedule

The Japanese group will maintain the permanently assigned mass range of 118-129 in the year ahead on the basis of one man year per year contribution. Current evaluation schedule is

A = 119	May 1988
A = 121	May 1988
A = 177	October 1988

3. Evaluator Training

For the introduction of the recent evaluation conventions and new techniques, we hope to send some members of our group at an appropriate time to NNDC or other center.

4. Utilization of ENSDF and NSRF and their codes

Both the ENSDF and NSRF data are utilized in various fields. Most ENSDF codes sent from NNDC are run on JAERI computer FACOM M-780.

STATUS REPORT UTRECHT

P.M. Endt and C. van der Leun
Robert J. Van de Graafflaboratorium, Utrecht, The Netherlands

Energy levels of A = 21 - 44 nuclei

The seventh edition of this review article, of which the sixth has been published in Nucl. Phys. A310 (1978) 1 - 766, will most probably appear in 1989, again in Nuclear Physics. The section written up to this moment (A = 21 - 37) confirms our view that a cycle-time longer than the traditional five years is justified in view of the decreasing flow of new spectroscopic information.

The Institute of Scientific Information (USA) has recently identified the fifth edition as a "Citation Classic". For our comments p.t.o.

CC/NUMBER 11
MARCH 16, 1987

This Week's Citation Classic®

Endt P M & van der Leun C. Energy levels of $A = 21 - 44$ nuclei (V). *Nucl. Phys. A* 214:1-625, 1973.
[Fysisch Laboratorium, Rijksuniversiteit, Utrecht, The Netherlands]

The experimentally determined properties of energy levels of A = 21 - 44 nuclei are compiled and evaluated with emphasis on nuclear spectroscopy. For each of the nuclides reviewed, the available information on excitation energies, spins, parities, isospins, lifetimes or widths, and observed decay is summarized in a master table. [The *SCI*® indicates that this paper has been cited in over 915 publications.]

P.M. Endt and C. van der Leun
Fysisch Laboratorium
Rijksuniversiteit Utrecht
Utrecht, The Netherlands

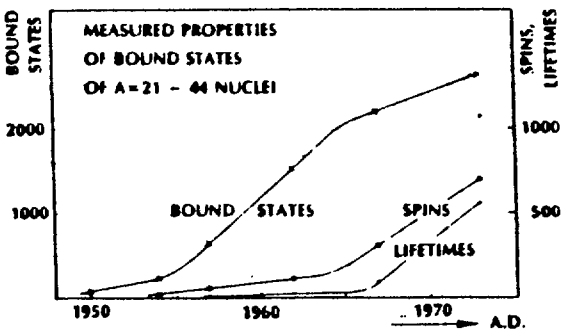
December 5, 1986

Some six years ago, the fourth edition of our review article on light nuclei was selected as a *Citation Classic*.[1] On that occasion we described the main characteristics of these articles, which also put the high citation score into perspective. These views and arguments are equally applicable to the fifth edition, but we would like to add one comment. Unlike many other modern compilations, the present review has been produced not with computers or calculators, but merely with slide rule and pencil. The current nostalgia for classical craftsmanship and grandpa's production style might be an additional reason for the high citation rate. Our review is indeed handmade.

A novelty of the fifth edition is the figure on the cover; not a girl, but a graph (see below). It is based on the data compiled in the five successive editions. It depicts how our knowledge of the structure of light nuclei has grown over the years. The three curves all start to rise more steeply at a particular point. These points represent breakthroughs that in all three cases can be related to an instrumental or technological development, such as the introduction of computers or semiconductor materials or the construction of magnetic spectrographs.

To say that scientific progress is essential for technological development is a platitude, but to say the reverse—that technological developments are just as essential for scientific progress—is less commonplace. Our simple cover graph highlights this too often underexposed side of Casimir's science-technology spiral.[2]

Finally, a rather risky undertaking: perhaps the first prediction of future *Citation Classics*! Unless the selection rules change, we expect—on the basis of a careful extrapolation—ISI to invite us to write commentaries about the next two editions[3,4] of our review in 1991 and 2001.



1. Endt P M & van der Leun C. Energy levels of Z = 11 - 21 nuclei (IV). *Nucl. Phys. A* 105:1-488, 1967. (Cited 875 times.) [See also commentary in: *Contemporary classics in physical, chemical, and earth sciences*. Philadelphia: ISI Press, 1986 p 51.]
2. Casimir H. The science-technology spiral *Haphazard reality. half a century of science*. New York: Harper & Row, 1983. p. 294-313.
3. Endt P M & van der Leun C. Energy levels of A = 21 - 44 nuclei (VI). *Nucl. Phys. A* 310:1-752, 1978. (Cited 680 times.)
4. ———— Energy levels of A = 21 - 44 nuclei (VII). *Nucl. Phys.* In press

U.S Contribution to the International Co-operation in the Evaluation of Nuclear Structure Data

M. R. Bhat
(May 16, 1988)

I. Introduction

This report reviews the evaluation of nuclear structure, decay data and related activities of the U.S Nuclear Data Network (USNDN) for the period May 1986 - May 1988. Members of the USNDN are: BNL-National Nuclear Data Center (NNDC), INEL - Nuclear Physics Branch, LBL-Isotopes Project, ORNL - Nuclear Data Project, University of Pennsylvania-Light Nuclei Energy Levels Evaluation Project, and the NBS - Photon and Charged Particle Data Center.

II. Status Report of the U.S. Nuclear Data Network (USNDN)

A. BNL-National Nuclear Data Center (NNDC)

1. Recruitment and Training of New Evaluators

H. R. Weller (Duke University) and D. R. Tilley (North Carolina State University) finished evaluating A=3 with emphasis on medium and high energy data and sent it for publication. In November 1987, they started evaluating A=4. The participation of M. M. King from the National Tsing Hua University, Taiwan is continuing; work on A=72, 73 has been completed and A=62 is being evaluated. P. C. Sood and A. N. Mantri, Banaras Hindu University, India have started evaluating A=175. They will spend about a month at the NNDC this summer and work on this evaluation.

T. W. Burrows of the NNDC was in China July 7-31, 1987. He visited Jilin University, Changchun, the Institute of Nuclear Research, Shanghai and the Institute of Atomic Energy, Beijing. A series of eight lectures on various aspects of the mass-chain evaluation were presented at Jilin and the lecture notes distributed to the physicists at the three institutions. He also had discussions on the Chinese contributions to the international effort.

2. Nuclear Structure Reference (NSR)

a. The NSR File Status

As of April 21, 1988, the NSR file contained 109612 entries. The number of primary entries is steady at about 2500/year. Primary reference coverage continues to be complete. In spite of manpower problems, secondary entries have stabilized at approximately 1000/year.

b. Improvements in the NSR file

In order to serve the interests of the NSR user community more comprehensively, NSR keywording rules have been further modified to flag Medium Energy Charged Particle Data entries. We will be able to retrieve these entries for bibliographic or other purposes. The NNDC continues to publish CPBIB issues from annual retrievals from the NSR file.

c. The NSR Publication

The Publication of the four-monthly issues of the Recent References proceeded according to schedule. In order to provide more space for the publication of A-chain evaluations in the Nuclear Data Sheets (NDS), the publication of the yearly cumulative issue has been discontinued as of 1986. The last cumulative issue for the NSR appeared in the NDS 47, No 3, March 1986 for the 1985 cumulation.

d. The NSR Coding Manual and the Coding of Russian, Japanese & Chinese Journals.

The NSR coding manual is being updated as required for the compilation effort at the NNDC. Data centers already involved in preparing NSR entries are on the distribution list.

Two tapes containing several Russian Conferences have been received from the compilers at Gatchina (USSR). A tape containing entries from Laboratory Reports have been received from the Japanese compilers at the RIKEN Data Center. After careful checking, these entries were merged into the NSR file. A preliminary coding of some Laboratory Reports from France prepared by J. Blachot (Grenoble) were reviewed and modified entries are expected from him in the near future. A physicist from the Chinese Nuclear Data Center, Beijing was at the NNDC from Sept'86 to Mar'88 being trained to code the NSR. He is expected to continue this work in China.

e. Keyword Abstracts

The NNDC continues to receive author keyword abstracts for about 40-50% of the NSR entries for Physical Review C. These are prepared for entry after major modifications by the NSR compiler.

f. NSR Services

Monthly and triannual distribution of the NSR file entries are being sent to the various data centers and evaluators according to schedule. A-chain related updates as well as the handling of evaluator key-numbers and references has proceeded smoothly. Evaluator suggested corrections to the NSR file entries continue to be made on a regular basis. In the period April'86 to May'88, 61 retrieval requests for the NSR file on varied topics were received and processed by the NNDC.

g. NSR On-Line Services

The demise of access to NSR via RECON mentioned in the last progress report has occurred. We have replaced that service with access to the NNDC online system which contains six nuclear physics data bases including NSR. The service is available via telephone or one of the following networks, HEPNET, MFENET and ARPANET.

The NNDC data base system has been upgraded to provide full author retrieval capability. However, since NSR attempts to faithfully reproduce author lists as they appear in the publication, the indexing may contain several variations for a single author. More than 2/3 of the retrievals performed by online users come from this data base. For the period April 1986 through March 1988, users have made ~ 5020 NSR retrievals.

3. The Evaluated Nuclear Structure Data File (ENSDF)

a. The ENSDF Status

The ENSDF is being continuously updated on the basis of new evaluations and correction of errors noted either in using the data file with physics

processing codes or brought to the attention of the NNDC by users. Corrections for A=74-80 (Kuwait) and A=153-162 (INEL) were received and implemented as part of the clean-up initiated by the NNDC in April 1984. Radioactivity data for A=33-44 evaluated at LBL were reviewed by Endt and Van der Leun and included in the ENSDF in Nov'87.

The ENSDF is distributed twice a year; once in February and in August. Usually only those A-chains that have been modified since the last distribution are sent out, however, those data centers which have requested the complete file will continue to receive the full ENSDF.

Since the evaluations of mass chains A<45 are not automatically entered into the ENSDF, a procedure was established at the NSDD meeting in 1980 for the conversion of the evaluated data for these A-chains into the ENSDF format. The division of responsibility for this conversion as agreed at Grenoble in June 86 is as follows:

Center	A-Range	Status
US/NNDC	A=5-12	Conversion up to date
US/NDP	A=13-26	Conversion for A=25-26 done by Ewbank in 1981. Conversion for A=13-24 promised in Sep'86; yet to be done.
FR/Grenoble	A=27-32	Conversion up-to-date
US/LBL	A=33-44	Conversion up-to-date

The current status of the mass-chains A>45 in the ENSDF is shown in Fig. 1. This also shows those A-chains that are being evaluated and/or have been submitted for publication.

b. The Nuclear Data Sheets (NDS) Publication

In 1986 22 A-chains were published in the NDS and 27 were published in 1987. Problems related to the large size of the A-chains appearing in the NDS were discussed at the Grenoble NSDD meeting and a new set of guidelines were approved for the publication format. This new format eliminated redundant presentation of data without sacrificing any essential information and a 33% reduction in the average size of the A-chains has been possible (see Table 1). Adoption of this new format would also allow yearly publication of a larger number of A-chains σ 30 for a total NDS publication of 2500 pages if

Table 1

Size of the A-chains Published in the NDS

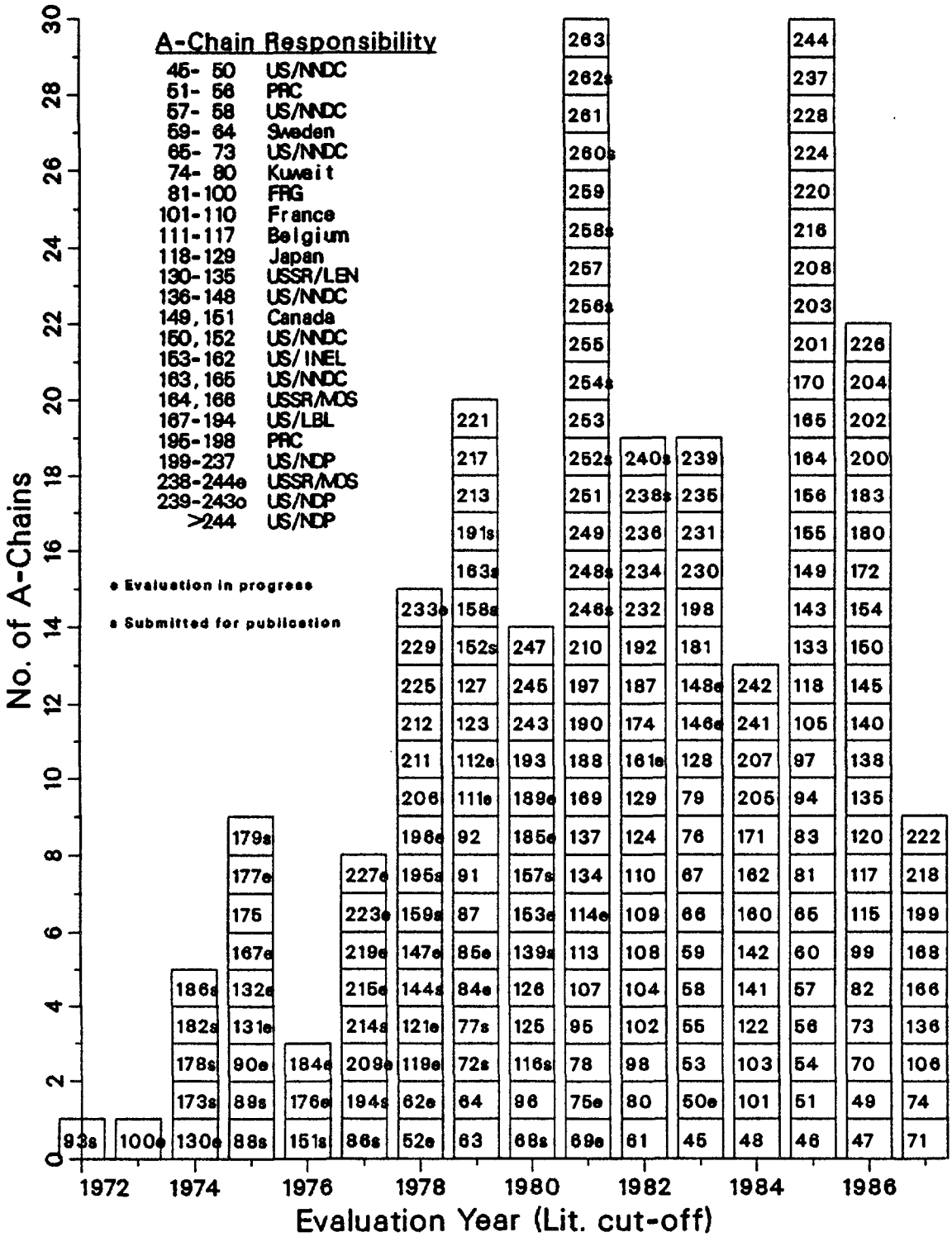
Year	NDS Vols	No. of A-chains	No. of Pages/A-chain
1985	43-46	22	114
1986*	47-49	22	98
1987	50-52	27	76

*New guidelines for the NDS publication format followed since June 1986.

A-Chain Status in ENSDF

Center - ALL

18-APR-88



there is an increase in the productivity of the network. This would reduce the evaluation cycle time to about 7 years.

A new "UPDATE" format was proposed and discussed at the USNDN meeting in October 1987. It is planned to publish A-chain evaluations which contain relatively little new data in this format. The evaluated data file of the A-chain will be complete and up to the current standards, however, only the following sections will be published.

(i) Drawing 1, the skeleton scheme.

(ii) Index page, identical to the current index, with the addition of a column showing which experimental data sets have new information. All data set I.D.'s will be listed, whether or not they contain new information.

(iii) Adopted Levels, Gammas tables for all nuclides.

(iv) The data sets which contain significant new information (whether or not the new information is "significant" will be the evaluator's decision). These should be prepared in the same manner as presently done and they will be treated the same as is presently done, that is, tables and drawings will be given just as they are now.

(v) All references cited in the publication.

As an example, the A=138 evaluation was recently published in the update mode in the January 1988 issue of the NDS. It was also emphasized that an A-chain should not be published more than once in the "update" mode so that the user will not have to look at more than two issues of the NDS to get all the information on an A-chain.

The processing statistics for A-chains published in the NDS for 1985-1987 are shown in Table 2. In addition to the average elapsed time spent in the various steps of processing A-chains nominal times are shown. The NNDC continually reviews A-chain processing to make it as efficient as possible and deliver reviewed evaluations of good quality quickly. Excessive time taken by some evaluators in returning their A-chains to the NNDC and the time spent in

Table 2

Nuclear Data Sheets Processing Statistics for 1985-1987

		Elapsed Time (months)					
Year	No. of A-chains	NNDC#	Evaluator	Review	Editor-in-chief	Publisher	Total
1985	22	4.4	2.7	2.2	0.4	2.2	11.8
1986	22	5.2	3.6	2.8	1.0	2.2	14.7
1987	27	4.6	3.3	3.4	0.5	2.1	13.9
Nominal		5.5	3.0*	2.5*	1.0*	2.0	14.0

#Total processing time for preparing pre-review and post-review copies, implementing post-review and final corrections and getting author approval for changes made according to the new guidelines.

*Includes time in transit

review continue to be problems. These can be reduced only with the active cooperation of the persons involved. Evaluators can help by submitting clean evaluations corrected for format and physics errors and by responding promptly and completely to the questions or comments by the reviewer or editors.

A new publicity brochure approved by the NSDD network was distributed by the publisher of the NDS in Feb' 87.

c. Status of the NDS Production Pipeline

At present there are 24 A-chains in the production pipeline. Information on the status of the NDS production pipe-line has been sent to the members of the NSDD net work every month beginning in January 1987. This lists the A-chains being processed leaving out those that have been sent to the publisher. The different stages of processing of an A-chain are shown along with dates when it was received at the NNDC or sent from here. If the evaluators find that the NNDC has not received material mailed by them or vice versa they are requested to contact us immediately to trace it and/or send duplicates to avoid delays in processing evaluations. The processing codes have been made as efficient as possible by including many automatic features. Efforts are also made to smooth out the processing load in spite of the evaluations arriving at the NNDC in groups with dormant periods in between. The number of A-chains submitted for publication in the last four years is as follows:

Year	No. of A-chains
1984	24
1985	25
1986	24
1987	25

d. The ENSDF Coding Manual

A new edition of the ENSDF coding manual BNL-NCS-51655-Rev.87 by J. K. Tuli was distributed in 1987.

e. The ENSDF Procedures Manual

The ENSDF Procedures Manual was sent to the members of the NSDD network and other interested physicists in February 1988. T. W. Burrows contributed two articles on "Getting started on mass-chain evaluations" and "Other evaluations, compilations and theory papers" to the Procedures Manual. J. K. Tuli wrote a paper on "γ-ray intensity normalization for radioactive decays in Nuclear Data Sheets" for the Manual. Future additions to the manual will be sent when they become available.

f. ENSDF On-line Service

In addition to the NUDAT numerical data base mentioned in the previous progress report, we have added access to the ENSDF data base to the NNDC on-line system. Output can be generated in either the ENSDF format or in the "table" format generated by the TREND program. This service was initiated in July 1986. Since that time 1120 retrievals have been made from the ENSDF data base. From April 1986 through March 1988, ~ 1450 retrievals have been made from the NUDAT data base by on-line users.

We are currently testing the use of graphical displays in our on-line service. A module has been added to the on-line system to generate level diagrams and decay schemes from ENSDF data sets. Users with terminals capable

of processing either TEKTRONIX or POSTSCRIPT instructions can use this service.

C. L. Dunford spent a week in June'87 at the Nuclear Energy Agency Data Bank in Saclay, France installing and checking out the on-line access programs and the data base developed at the NNDC. The NNDC will continue to maintain and provide updates of these programs and the on-line data bases.

4. Mass-chain Evaluations and Other Related Activities

A=46,47,49,57,143,145 and 150 evaluated by the NNDC were published in 1986 and A=70,136,140 and 165 appeared in the 1987 NDS. A=71,138 were published in 1988 and A=68,139,144,152 and 163 have been submitted for publication. Work is in progress on A=50,69,146,147 and 148.

Apart from the evaluation of mass-chains, the NNDC physicists' effort has been directed towards improving NDS production and processing codes, ENSDF code development and the writing of manuals. Some NNDC evaluators have also collaborated with their colleagues in the Physics and Chemistry Departments at Brookhaven, Lawrence Berkeley Laboratory, Oak Ridge National Laboratory and Vanderbilt University in carrying out research on nuclear structure and decay data.

5. Nuclear Structure Related Publications

Nuclear Wallet Cards published and distributed in January 1985 continues to be in great demand. Initial printing of 10,000 copies has almost been exhausted. Additional printings were ordered for distribution by ORTEC and the German Physical Society. The contents of the Nuclear Wallet Cards were recast in a suitable format and sent to the Nuclear Data Section, IAEA for inclusion in the "Handbook of Nuclear Activation Data" published in 1987. Request for this data base has also been received from Prof. Bujdoso of the Hungarian National Atomic Energy Commission for their forthcoming publication, "Handbook of Radioanalytical Chemistry." There are plans to bring out a new edition of the Wallet Cards in early 1989.

6. The ENSDF Related Codes

A new code RADLST has been written and checked out by T. W. Burrows and distributed. This code has all the features of MEDLST with additional capabilities such as calculation of the spectra and energy deposition due to internal bremmstrahlung in electron capture and β decay. Detailed documentation on this code BNL-NCS-52142 (Feb. 1988) has been distributed recently. The other ENSDF processing codes continue to be maintained by the NNDC; their current status is given in Table 3.

7. User Services

The NNDC provides the following services to the NSDD network evaluators on a routine basis:

(i) Monthly NSR updates to all evaluation centers for A-chains assigned to them.

(ii) Complete NSR list at the start of an A-chain evaluation.

(iii) Copies of references to evaluators (with help from the NDP for older references).

(iv) ENSDF updates are sent twice a year.

Table 3

Status of ENSDF Physics Processing Codes
(May 1988)

Code	Function	Fortran-77	IBM-PC	Documentation
FMTCHK	Format check of a file in ENSDF format	I	yes	no
TREND	Displays ENSDF data in tabular form	I	yes	no
PREND	Constructs level diagrams from the ENSDF data sets	D		no
DELTA	Analyzes angular correlation data	D	yes	yes
GTOL	Least-squares fit to γ energies to determine level energies and feedings	I	yes	yes
HSICC	Interpolates internal conversion coefficients	I	yes	yes
LOGFT	Calculates logft	I	yes	yes
RADLST	Calculates atomic and nuclear radiations and checks energy balance	I		yes
PANDORA	Physics check of the ENSDF data sets. Helps with adopted gammas and XREF	I	*	yes
RULER	Calculates reduced transition probabilities	I	yes	yes
INSDF	Interactive program to create and check ENSDF sets	D		no
GABS	Calculates uncertainties of absolute γ- intensities	D		yes
ADDGAM	Adds γ's in adopted set	I	yes	no
SPINOZA	Physics check of the ENSDF data sets	I		no
GAMUT	Assembles adopted levels, gammas from reaction and decay data sets			

I-machine independent version D- machine dependent version *- not written using MDC Standard format

(v) NSR updates are sent once in four months. Number of references added to the NSR since the last publication of the respective evaluations are sent twice a year.

(vi) Special retrievals from the NSR and the ENSDF.

(vii) Maintain the ENSDF physics processing codes and send corrections and updates.

(viii) A plot of the new NSR references vs. mass number and table giving the number of new references added since the last evaluation are sent every six months.

(ix) On-line access to the NSR, ENSDF, NUDAT (a file containing numeric data extracted or derived from ENSDF and the Nuclear Wallet Cards), CINDA (Computer Index of Neutron Data), CSISRS (Cross Section Information Storage and Retrieval System containing experimental neutron, photon and charged particle reaction data) and ENDF (Evaluated Nuclear Data File) maintained by the NNDC has been available for some time to the net work evaluators and other users of NSR, ENSDF, NUDAT.

B. Mass-Chain and Related Activities at INEL. (R. G. Helmer, M. A. Lee and C. W. Reich)

1. Mass-Chain Evaluation

Within the International Nuclear Structure and Decay Data Evaluation Network, INEL has the evaluation responsibility for the ten mass chain in the region $153 < A < 162$. Two individuals, funded at a level of approximately 0.8 Full-Time Equivalents, are involved in the mass-chain evaluation effort. The current status of the mass chain within our area of responsibility is summarized as follows:

A-Chain	Status (according to currency)
153	underway [prev.-NDS 37 (1982)]
161	underway [prev.-NDS 43 (1984)]
157	submitted for publication, Aug. 1987
158	submitted for publication, Sept. 1987
159	NDS 53 (1988)
154	NDS 52 (1987)
155	NDS 50 (1987)
156	NDS 49 (1986)
160	NDS 46 (1985)
162	NDS 44 (1985)

As is evident from this listing, our mass-chain evaluation effort presently satisfies one of the objectives of the international evaluation network, namely currency of the mass-chain publications $<$ 5 years.

All data sets are prepared on IBM-AT personal computers using a standard word-processing program. The processing codes FMTCHK, GTOL, HSICC, LOGFT and RULER are run on this same PC. PANDORA is run on a MicroVax II which has a data link to the PC.

2. Related Activities

a). The NSDD Meeting in Grenoble, June 1986.

At the previous meeting of the International NSDD Evaluation Network, held in June 1986 at Grenoble, France, a paper was presented that dealt with

certain problems in the evaluation of nuclear decay information to produce β-intensity values. In order to provide for somewhat wider distribution of the contents of this presentation, it has been published as an INEL laboratory report. The reference is

"Evaluation of Beta Intensity Data in Nuclear Decay Schemes: Comments on some Pitfalls", C. W. Reich, U. S. DOE Report EGG-2497 (Feb., 1987).

At the Grenoble meeting of the NSDD, C. W. Reich was assigned the responsibility for preparing a chapter on data evaluation for deformed nuclei to be incorporated into an ENSDF Procedures Manual. This task has been completed and the resulting contribution, entitled

"Nuclear Structure and Decay Data Evaluation Procedures and Guidelines for Strongly Deformed Nuclei",

has been included in ENSDF Procedures Manual, which has recently been issued as an informal report, BNL-NCS-40503, by the NNDC at Brookhaven.

b. The Evaluated Nuclear Data File/B (ENDF/B).

At the present time, effort is underway to produce an upgraded version, Version VI, of the Evaluated Nuclear Data File/B (ENDF/B), the accepted base of evaluated nuclear data for reactor research and technology activities within the U.S. As a participant in this activity, we at INEL have the primary responsibility for preparing the evaluated nuclear decay data to be included in this File. In order to avoid, to the largest extent practicable, the proliferation of data files based on the same information but containing trivially different values for certain quantities and nuclides, we have chosen to utilize ENSDF as the source file for our data, modifying individual values where deemed appropriate and augmenting them with specialized quantities specific to the needs of ENDF/B. The nuclides are broadly grouped into three categories: Activation Products (149 nuclides); Actinides, including members of the associated decay chains (102 nuclides); and Fission Products ($\sim$750 nuclides). At present, work on the Activation Products has been completed and work on the Actinides has begun.

c. Other Evaluations.

We are also currently involved in other evaluations, namely:

- γ-ray energies for detector calibration, under the auspices of the Commission on Atomic Masses and Fundamental Constants of the International Union of Pure and Applied Physics; and

- γ-ray emission probabilities for radionuclides used for detector calibration as part of an IAEA Coordinated Research Program.

The results of these efforts should be available in late 1989 for use of the A-chain evaluators.

C. LAWRENCE BERKELEY LABORATORY - Isotopes Project

1. Mass-Chain Evaluation. (E. Browne, R.B. Firestone, V.S. Shirley, and B. Singh)

The LBL Isotopes Project is responsible for evaluating mass chains with $167 \leq A \leq 194$ and for converting $33 \leq A \leq 44$ to ENSDF format. Responsibility for the following mass chains has been temporarily reassigned: A=170,172 to China, A=175,176 to India, and A=177 to Japan. A summary of the current evaluation status of LBL mass chains is given in the table below:

Status of LBL Mass-Chain Assignments

Mass Chain	Publication Year	Status
33-44	1978	Sent 7-87 (LBL)*
167	1976	(8-88) (LBL)
168	1980	In press(LBL)
169	1982	Published (LBL)
170	1987	Published (China)
171	1984	Published (LBL)
172	1987	Published (China)
173	1975	submitted 10-15-87 (LBL)
174	1984	Published (LBL)
175	1976	(India)
176	1976	(India)
177	1975	(Japan)
178	1974	Submitted 5-87 (LBL)
179	1976	Submitted 9-87 (LBL)
180	1987	Published (LBL)
181	1984	Published (LBL)
182	1975	Submitted 5-87 (LBL)
183	1987	Published (LBL)
184	1977	Submitted 4-88 (LBL)
185	1981	Published (LBL)
186	1974	Submitted 9-87 (LBL)
187	1982	Published (LBL)
188	1981	Published (LBL, Kuwait)
189	1981	Published (LBL)
190	1982	Published (LBL)
191	1980	Published;(4-88 for 2nd cycle) (LBL)
192	1983	Published (LBL)
193	1981	Published (LBL)
194	1977	Submitted 10-20-87 (LBL)

*Radioactivity data.

Seven mass-chain evaluations were submitted by LBL between 1/1/87 and 12/31/87, and two evaluations were published. Radioactivity data for $33 \leq A \leq 44$, evaluated at LBL in 1986, and recently adapted for ENSDF were reviewed by Endt and Van der Leun and sent to BNL for inclusion in the ENSDF file. These data are to be combined with "Adopted Levels, Gammas", adapted into ENSDF format from Endt and Van der Leun's 1978 evaluation of A=21-44. The French evaluation group is collaborating with LBL on the conversion process, and has already sent ENSDF files for A=33-38 to LBL and BNL. The Isotopes Project is currently evaluating mass chains for A=167, 184, and A=191, and expects to submit them in the Spring of 1988. The group recently added Balraj Singh, formerly with the Kuwait evaluation group, but now dividing his time between the LBL and the McMaster evaluation groups.

2. Major Horizontal Evaluations.

a. Table of Radioactive Isotopes (E. Browne, R.B. Firestone, and V.S. Shirley) John Wiley & Sons, Inc. 1986, ISBN Number: 0-471-84909-X.

This book, tailored to the needs of applied users in industry, biology, medicine, and other fields, but also serving as an indispensable reference for nuclear physicists and chemists, contains 1056 pages and sells for $59.95. Sales through August 1986 were 1508 volumes.

b. Table of Isotopes, 7th edition (C.M. Lederer and V.S. Shirley, editors, E. Browne, J.M. Dairiki, and R.E. Doebler principal authors). John Wiley & Sons, Inc., 1978, ISBN Number 0-471-04179-3.

This 1630-page book, which contains nuclear structure data not presented in the Table of Radioactive Isotopes, is an excellent complement to the latter. The Table of Isotopes was reprinted in 1986 and currently sells for $48.50. 9587 volumes were sold through August 1986, and sales for the past year were 575 volumes. These books can be obtained through book stores or directly from the publisher. The addresses of the U.S. distribution centers for John Wiley & Sons, Inc. are given below.

JOHN WILEY & SONS, INC.
Eastern Distribution Center
1 Wiley Drive
Somerset, New Jersey 08873
(201) 469-4400
Telex: 833434
Cable: JONWILE SMOT

JOHN WILEY & SONS, INC.
Western Distribution Center
1530 South Redwood Road
Salt Lake City, Utah 84104
(801) 972-5828
Telex: 388308

3. Evaluation Methodology (E. Browne and R.B. Firestone)

The Isotopes Project has a continuing interest in developing methods for evaluating nuclear data in order to improve efficiency and the quality of the evaluations. The group's contributions to the mass-chain evaluation effort are described below:

a. Methods and Procedures for Analyzing Nuclear Data.

One important goal of the nuclear-data evaluation effort is to maximize the amount of information that can be extracted from the data. This requires the use of well-thought out and rigorous procedures, which often include statistical analyses of data. The Isotopes Project continues to do research in this field, making its results available for publication by BNL in the ENSDF Procedures Manual, and for further distribution to the members of the Nuclear Data Network. The following papers are published in the ENSDF Procedures Manual:

i. E0 Transition Probabilities (R.B. Firestone)
ii. Calculated Uncertainties of Absolute γ-ray Intensities and Decay Branching Ratios (E. Browne)

The propagation of experimental uncertainties into particle emission probabilities derived from decay schemes is important for calculating average radiation energies per disintegration. This topic is being studied at LBL, and results have been published in Nuclear Instruments and Methods in Physics Research.

b. Computer Codes

The Isotopes Project develops computer codes for implementing new or revised methods and procedures, and maintains a library of codes for evaluating nuclear data for ENSDF. These codes are available in the Berkeley ENSDF Evaluation Program Library (BEEP). Codes SPINOZA and GABS are now being distributed by BNL to members of the Nuclear Data Network. The code GAMUT was sent to BNL recently, but documentation is still pending.

c. Electronic File-Transfer to BNL.

The Isotopes Project routinely sends mass-chain evaluations to BNL electronically via the computer network HEPnet. Both the pre-and post-review

editing of the mass-chain files are done at LBL, and the corrected files are transferred to BNL. This procedure, which the group proposed in 1985[1], eliminates almost entirely the need for editing at BNL, and results in a significant time saving for the publication process.

4. Remote Access to databases and computer code packages.

Computer guest accounts are available for use of the LBL-VAX/8650 computer cluster, which provides access to the LBL/ENSDF and BNL databases and to the LBL Physics Program Library (PPL). The latter is a subset of interactive programs from BEEP. There is no charge for this service, and those interested in using it may contact:

E. Browne or R.B. Firestone
Lawrence Berkeley Laboratory
Isotopes Project
Bldg. 50A, Room 6102
Berkeley, California 94720
Telephone: (415) 486-6152

17 guest accounts have been issued to remote users so far, and about 100 logins on these accounts were recorded during the period 11-86 to 10-87. The Isotopes Project also processes requests for data from remote users, and performed 5 database searches during the same period. Data were transmitted by both magnetic tape and via BITNET (EARNET in Europe).

D. ORNL - Nuclear Data Project Activity Report

This report covers the period from May, 1986 to April 1988.

1. Mass-Chain Evaluations

a. Mass chains 199, 200, 201, 202, 204, 216, 220, 222, 224, 226, 228, and 237 have been published.

b. Mass chains 214, 246-266 (even A) have been submitted to BNL.

c. Mass chains 209, 233, 249-263 (odd A) are being worked on.

2. Mass-Chain Review/Editing

The NDP staff provided reviews of the mass chains 46, 56, 68, 70, 71, 73, 74, 89, 93, 106, 118, 120, 135, 136, 138, 140, 151, 154, 155, 157, 158, 159, 163, 165, 168, 170, 172, 178, 182, 183, 238, and 242.

3. Other Activities

The following Network publications have been authored by members of the NDP staff.

Alpha-Decay Hindrance Factors, M. R. Schmorak.

General Policies, Presentation of Data, M. J. Martin

Guidelines for Evaluators, M. J. Martin

[1] Proposal for improving transit in mass-chain processing with electronic computer file transfer, Edgardo Browne and Richard B. Firestone, memorandum presented at the US Nuclear Data Network (USNDN) Meeting, Idaho Falls, November 1985.

Phase Conventions for Mixing Ratios in Electromagnetic Transitions from Angular Correlations and Angular Distributions, M. J. Martin

E. University of Pennsylvania

Since the last report, energy levels of A=13-15 (NP A449, 1 (1986)), and A=16-17 (NP A460,1 (1986)) were published in 1986. Evaluations of A=18-20 (NP A475, 1 (1987)) were published in 1987. Preprints of A=5-6 were sent out for comments in August 1987 and the preprints of A=7-8 were sent out in November 1987. The preprints of A=9-10 will be sent out in the summer of 1988. Work is in progress on A=11.

F. NBS Photon and Charged Particle Data Center (E. Saloman, J. H. Hubbell and M. J. Berger)

A systematic graphical comparison has been made between the experimental photon attenuation coefficients in the data base at the NBS Photon and Charged Particle Data Center and (a) a corresponding set of theoretical values based on Scofield's photo - effect calculations and theoretical scattering cross sections that include binding effects, and (b) a set of recommended semi-empirical values from Henke. This comparison covers the energy region from 100 eV to 100 KeV and atomic numbers from 1 to 92. It has been published in Atomic Data and Nuclear Data Tables, 38, 205-262 (1988).

At energies above 1 keV, agreement between theory and experiment is rather good except for some special situations which prevent the accurate description of the measured samples as free atoms. These include molecular effects near absorption edges and solid-state and crystal effects (for example for silicon).

A computer-readable database has been prepared of the available experimental photon attenuation coefficients at energies from 100 eV to 10 GeV, which can be used on a personal computer for further analyses and comparisons of these data. This data base includes 20,000 data points from more than 500 independent experiments.

FACHINFORMATIONSZENTRUM ENERGIE PHYSIK MATHEMATIK GMBH

Status Report

H.-W. Müller, H. Behrens

1. Status of Mass Chain Evaluation

Since the last network meeting in Grenoble 1986, five mass chains have been published. The status of mass chain evaluations is as follows:

A = 82, 83, 88, 93, 99	published
A = 86, 89	post review
A = 84, 85, 87	evaluation in progress

With A = 89, the first run through our mass range was finished. A = 86 opened the second evaluation cycle.

2. Data Dissemination

The databases ENSDF, MEDLIST and NSR are offered online via telecommunication networks. These files were updated after the tapes from BNL had been received (ENSDF and MEDLIST twice per year, NSR 3-times per year).

In addition to the online offer, also some offline requests for NSR, ENSDF and MEDLIST data have been answered.

Contents of online files (September 1987):

ENSDF:	ADOPTED datasets	2,368
	levels	68,143
	gammas	61,111
	total number datasets	9,911
	levels	194,637
	gammas	218,404
	compare ENSDF master file:	
	datasets	10,077
	records	749,825
MEDLIST:	datasets	2,262
	records	92,784
NSR (Januar 1988)	documents	108,041

3. Other activities

a) Database GAMCAT

A new database GAMCAT has been created which comprises the computerized versions of the "Catalog of Gamma Rays from Radioactive Decay" by U. Reus and W. Westmeier (At. Data Nucl. Data Tables 29,1 and 19,193 (1983)) and the "Catalog of Alpha Particles from Radioactive Decay" by W. Westmeier and A. Merklin (Physics Data 29-1 (1985)). Both catalogs are based essentially on the Nuclear Data Sheets. A retrieval system has been developed which allows the retrieval of gammas or alpha particles by several quantities, e.g. energy, half-life, intensity. Online access is possible at the Fachinformationszentrum Karlsruhe (FIZ). Currently, a Personal Computer version is developed.

Contents:

2,326 radionuclei
47,000 gamma rays
1,900 alpha particle branches

b) Our series PHYSICS DATA has been continued. The following issues have been published:

Catalog of Alpha Particles from Radioactive Decay
W. Westmeier, A. Merklin
PHYSICS DATA 29-1 (1985)

Evaluation of the angle integrated neutron emission
Cross sections from the interaction of 14 MeV neutrons with medium and heavy nuclei
A. Pavlik and H. Vonach (1988)
PHYSICS DATA 13-4 (1988)

Shielding of Photon Radiation from Radionuclides
Abschwächung der Photonenstrahlung von Radionukliden
R. Dorner, H.-G. Vogt
Part 2: Shielding Material: LEAD
PHYSICS DATA 28-2 (1986)

Part 3: Shielding Material: IRON
PHYSICS DATA 28-3 (1986)

Part 4: Shielding Material: BARYTE CONCRETE
PHYSICS DATA 28-4 (1986)

Part 5: Shielding Material: Ordinary CONCRETE PHYSICS DATA 28-5 (1986)

Part 6: Shielding Material: WATER
PHYSICS DATA 28-6 (1986)

Status of mass-chain evaluation at McMaster University, Canada
(May 1988)

The second mass chain from the group, A=151, was submitted for publication in December 1986. It has now been through the review procedures and is in the final stages of publication. Due to a wealth of experimental data available for this mass chain, this is about double the length of a normal size mass chain. A substantial amount of data was procured through private communications. These data, although, of very good quality will probably never be submitted for publication by the experimenters, which makes it important to include these in detail in the NDS.

The mass chain A=100 has been temporarily assigned to McMaster. The work on this mass chain represents a major revision since the last evaluation of this mass chain was published about 15 years ago and also there has been an upsurge of experimental activity for A=100 nuclides for the past five years or so. We expect to submit the completed evaluation for publication in Fall 1988.

The granting situation has not improved over the past three years or so. The available grant can still support only about 0.5 FTE person. For a grant beyond March 1989, an application will be submitted to NSERC, Canada in Fall 1988 asking for an increased funding to support at least one FTE. In order to justify additional funding in this application, we would like to increase our mass chain responsibility (in addition to the present A=149, 151) probably to include some low A ($A<74$) mass chains. The final acceptance will, of course, depend on the availability of funds.

STATUS ON EVALUATION OF NUCLEAR STRUCTURE AND DECAY DATA IN CHINA

Zhou Chunmei
Chinese Nuclear Data Center
Institute of Atomic Energy
P.O.Box 275 (41), Beijing
People's Republic of China

China is permanently responsible for the mass chains 51-56 and 195-198, and temporarily for 170 and 172.

Financial Support and Person

The project is funded by Bureau of Science and Technology, Ministry of Nuclear Industry, China.

The basical members are four part-time (≈1.5 full-time) physicists from Institute of Atomic Energy, Beijing, Physics Department of Jilin University, Changchun, and Institute of Nuclear Research, Shanghai.

Mass Chain Evaluation

In recent years, our efforts have been concentrated on the evaluations of mass chain. The status of evaluation at present is as follows:

A=51, 54, 55, 56, 170, 172	Published
A=195	Prereview
A=52	completed
A=196, 198	in work

We will be through the first evaluation cycle by the end of 1989.

We wish also to maintain the same region in A=51-56 and 195-198 in the future.

Evaluation Procedure

All evaluation procedures used by us are from National Nuclear Data Center, Brookhaven National Laboratory. We hope to introduce new techniques in the evaluation and utilization of NSDD made available in the network.

Nuclear Structure and Decay Data Evaluation in Sweden

Peter Ekström and Jacquette Lyttkens

Sweden is responsible for the mass chains 59-64 and temporarily for A=90.

Financial support and personnel

The project is funded (one full-time post) jointly by the Swedish Nuclear Power Inspectorate (SKI), the National Defence Research Establishment (FOA), the National Committee for Used Nuclear Fuel (NAK), Studsvik Energiteknik and Vattenfall. The post has, during the last two years, been partly vacant and partly shared between Per Andersson, Mats Bergström, Peter Ekström, Jacquette Lyttkens and Michael Österlund.

Mass-chain evaluation

Since the last NSDD meeting work on A=90 has been in progress. The evaluation is near completion, and it should be submitted within a few months. The long time to complete the evaluation is partly due to the fact that the person mainly responsible for the evaluation has left. In addition A=90 is one of the mass chains with the most data sets and references, and work on the NSR database (see below) has been given higher priority.

Computer programs

All codes necessary for the mass chain evaluation have been converted to run on the new VAX 8200 computer.

A system for the on-line retrieval of nuclear structure references from part of the NSR file has been designed and implimented on the local computer. The data base contains all primary NSR entries from 1975 and all secondary entries from 1980, and it is available free of charge to the Swedish nuclear physics community via the university computer network SUNET. A manual on the use of the data base has been prepared.

Services to NSDD users

In addition to the NSR on-line service mentioned above, we continue to distribute γ-ray catalogues and to offer e.g. MEDLIST output to Swedish NSDD users.

Status Report on French Activities in Nuclear Structure and Decay Data

Jean BLACHOT
CEA, IN2P3 GRENOBLE

1. Mass-chain Evaluation Schedule

Since the last NSDD meeting, the status of the evaluation is summarized as :

Published	:	A=117	NDS 50,63 1987
		A=115	NDS 52,565 1987
Under review	:	A=116	
Finished	:	A=114	

will be completed by end of 1988 : A=111
A=113

2. Utilization of ENSDF and NSR

ENSDF is utilized since the beginning as a source Data for the CEA file.

Now ENSDF and NSR are available on line at the NEA Data Bank in Saclay. Most of the laboratories in the fundamental research are starting to use them.

KUWAIT NUCLEAR DATA GROUP

Status Report for the period June 1986 - May 1988

In order to ensure continued success of this project, a proposal had been submitted to Kuwait Foundation for Advancement of Science (KFAS) for financial support in May 1986. The grant was approved for the period September 1986 - September 1989.

One full time equivalent manpower is working for the project.

Mass A=74 was published in June 1987.

Mass A=77 was submitted in February 1988 in the progress of prereview.

Mass A=75 will be submitted for review in Fall 1988/1989.

A proposal for financial support will be submitted to KFAS for the three year period starting from September 1989.

ACTIVITIES RELATING TO THE EVALUATION OF NUCLEAR STRUCTURE AND DECAY DATA CARRIED OUT BY THE CAJAD

(The USSR State Committee for Utilization of Atomic Energy)

V.A.Voukolov, F.E.Chukreev, E.N.Shurshikov

Over a period of 1986-1987 the CAJAD kept on making its evaluation of nuclei structure data in the sphere of its responsibility. In this time interval the evaluations were completed for mass chains A=3 (April 1986), A=238 (April 1987), A=1 (July 1987), A=240 (March 1988) and A=4 (April 1988).

At this point the formal report could be finished but it seems to us reasonable to inform participants of the Meeting on our considerations concerning the content of ENSDF and Nuclear Data Sheets.

In the last few years we try to construct "Adopted Levels, Gammas" systems, relying not on an authors interpretation of experimental data but on an independing interpretation of all existing experimental material. We cannot "boast" of great successes in this direction but there are several observations which we would like to share with you.

Many nuclei being part of our sphere responsibility have a very high density of levels, so high that the experimental accuracy in measurements of gamma-quantum energies turns out to be insufficient to place transitions with confidence. In many instances we observe that transitions declared by authors of experiments and evaluations as nonlocated, are located perfectly well in the system of levels; but in this case the interpretation of spins and other level characteristics should change.

Information on j-j coincidences, conversion coefficients, correlation dependences which could supplement knowledge on transition energies, is extremely deficient.

Let us examine Ho^{166} as an example. In $^{165}Ho(n,\gamma)$ reaction the gamma-quanta energies of "primary" (250 quanta) and "secondary" emissions were measured. The errors of measured values in the both cases were approximately of the same order of magnitude. And if nucleus levels are restored by values of "primary" - energies, the emission ways these levels should be determined by locating "secondary" quanta data in the available decay scheme.

The "GTOL" program modification has made it possible for us to locate over 150 quanta from the list of "secondary" quanta earlier nonlocated; note, that these quanta were mainly located among levels with energies up to 1 MeV. In such a way the "Adopted Levels, Gamma" scheme was constructed, based on energy relations, attracting information on spins and parities of levels. Bearing in mind that a possible location of certain quanta has a multiplicity from 2 to 8, it is difficult to talk about unambiguity of the decay scheme obtained having no additional information on j-j coincidences and multipolarities of transitions.

The situation with experimental data similar to the case with Ho^{166} is found not seldom at all. It is worthwhile for us to indicate, if necessary, in ENSDF and, correspondinly, in "Nuclear Data Sheets" as commentaries to "Adopted Levels, Gammas", the shortage of experimental data, showing whether one or another of experiments will be desirable, which could stimulate the work of physicists-experimentalists. In our opinion, an introduction of such comments, on the one hand, will undoubtedly require from valuers additional efforts in the analysis of experimental materials and, on the other hand, "Nuclear Data Sheets" will become more interesting for scientific community, permitting the uncertainties in substantiation of evaluated data to be eliminated and their reliability ot be increased.

STATUS REPORT ON NSDD NETWORK ACTIVITY IN INDIA

P.C.SOOD and A.N.MANTRI
Banaras Hindu University, Varanasi 22/005

We were offered temporary mass chain assignment for A = 175 and A = 176 in April 1986. Based on this offer, we made two proposals for support, one from DAE/India and the other (major) one from US held India Rupee fund. While India-US proposal is still being processed two years later, DAE support become available in late 1987. We started on our A = 176 assignment in early 1988. Available literature scanning and partial implementation of relevant computer codes with the locally available resources has been proceeding over the past four months. We plan to spend the next six weeks starting 23 May 1988 with NNDC in Brookhaven. While the first couple of weeks will primarily serve as the training period, we aim to complete over the following months our A = 176 mass chain evaluation. We look forward, thereafter, to have regular mass chain assignment to put the NSDD Network activity in India on a continuing basis.

STATUS REPORT BELGIAN GROUP

D. De Frenne, E. Jacobs
Laboratorium voor Kernfysica
86, Proeftuinstraat B-9000 Gent, Belgium

1. Mass-chain evaluations.

The evaluation effort was continued since the last Grenoble meeting and the evaluation on A = 106 was published in NDS53, 73 (1988). The mass evaluation of A = 112 is almost finished. This evaluation is the last of a series of six masses for which we have taken the responsibility. In the second half of 1988 we will start the re-evaluation of mass A = 102.

2. Computer programs.

A second version of the data entry/editing program written in FRAMEWORK I by Dr. A. De Clercq for IBM/ PC-XT compatible personal computers, is now available for FRAMEWORK II. The new program can be obtained on request and runs on IBM/ PC-XT and AT compatible personal computers.

Status Report : United Kingdom

P.D. Forsyth (Liverpool University)

Unfortunately the situation in the United Kingdom has not changed over the last couple of years. Dr. B.H. Patrick at the A.E.R.E. Harwell has been trying to obtain funding for evaluation work from the nuclear industry. Recently he obtained a promise of such funding and it seemed hopeful that it might be possible to start up evaluation work at Liverpool again. However, apparently due to last minute cutbacks in funding, the promise of funds was withdrawn. In view of this it seems unlikely that evaluation work will be restarted in the foreseeable future.

Statement on CBNM's Activity in Evaluation and Compilation of Deacay Data during 1986 and 1988

W. Bambynek

Radionuclide Data

The available nuclear- and associated atomic-data sources frequently used in radionuclide measurements were critically reviewed. Compilations and evaluations from the following fields were considered : nuclear structure and radioactive decay, alpha particles, nuclides decaying by electron capture, gamma rays, internal conversion, associated atomic physics. An invited lecture was held at the First International Summer School on Low-Level Measurements and their Applications to Environmental Radioactivity, La Rábida, September 1987. (Bambynek, W. Radionuclide Data, in M. Garcia-León and G. Madurga (eds.), *Low-Level Measurements and their Applications to Environmental Radioactivity*, Proc. of the First International Summer School, La Rábida, Spain, 27 Sept. to 9 Oct. 1987, World Sci. Publ. Co., Singapore, 1988, p. 37).

Evaluations of X- and Gamma-Ray Emission Probabilities

In the frame of an IAEA Coordinated Research Project on X- and Gamma-Ray Standards for Detector Efficiency Calibration the X-ray emission probabilities of the radionuclides selected by the CRP members (^{51}Cr, ^{54}Mn, ^{55}Fe, ^{57}Co, ^{58}Co, ^{65}Zn, ^{75}Se, ^{85}Sr, ^{88}Y, ^{93}Nb^{m}, ^{109}Cd, ^{111}In, ^{125}I, ^{137}Cs, ^{133}Ba, ^{139}Ce, ^{152}Eu, ^{154}Eu, ^{198}Au, ^{203}Hg, ^{207}Bi) (Christmas, P., A.L. Nichols and A. Lorenz (1987), INDC(NDS)-196/GE) are beeing reevaluated.

STATUS OF MASS-CHAIN EVALUATIONS

May 16, 1988

A Mass-Chain Published
(A) Mass-Chain Submitted for Publication
[A] Mass-Chain Evaluation in Progress

Center	Assignment	1985#	1986#	1987#	1988#
BNL	45-50,57,58 65-73, 136-148,150, 152,163,165	48,141	46,47,49,57,143 145,150	70,136,140,165	71,138,(68),(139),(144), (152),(163),[50],[69],[146], [147],[148]
INEL	153-162	160,162	156	154,155	(157),(158),(159),[153], [161]
LBL	167-194			180,183	168,(173),(178),(179), (182),(186),(191),(194) [167],[184],[185],[189]
ORNL	199-237, 239,241,243, 245-263	203,205,241	201,208,216-220- -224-228,237	200,202,204,222 226,218	199,(214),[209],[233], (246-262e), [245-263]
U of Penn	5-20	11,12	13,14,15,16,17	18,19,20	(5),(6),(7),(8),(9),(10),[11]
UK			65†		
Kuwait	74-80			74	(77),[75]

#Nuclear Data Sheets issue year.

†Joint evaluation by N. J. Ward (U.K.) and J. K. Tuli (BNL)

STATUS OF MASS-CHAIN EVALUATIONS

May 1, 1988

A Mass-Chain Published
(A) Mass-Chain Submitted for Publication
[A] Mass-Chain Evaluation in Progress

Center	Assignment	1985#	1986#	1987#	1988#
FRG	81-100	81,94,97	83,99	82	(86),(88),(89),(93),[84],[85],[87]
FR-BLG	101-117	101,103	105	117,115	106,(116),[111],[112],[114]
Japan	118-129,177*		122	118,120	[119],[121],[177]
USSR	1-4,130-135, 164,166,238, 240,242,244	242	164,133, 244	135,166	(238),(240),[3],[4],[130],[131],[132]
Sweden	59-64,90*		60		[90]
Canada	149,151,100*,64*	149			(151),[100]
The Netherlands	21-44				Done 1978; a new evaluation is in progress
China	51-56, 170*,172*, 195-198	55	51	54,56,170,172	(52),(195),[196]
Taiwan	72*,73*,62*			73	(72),[62]
India	175*,176*				[175]

#Nuclear Data Sheets issue year
*Temporary assignment.

STATUS OF MASS-CHAIN EVALUATIONS
(May 1, 1988)

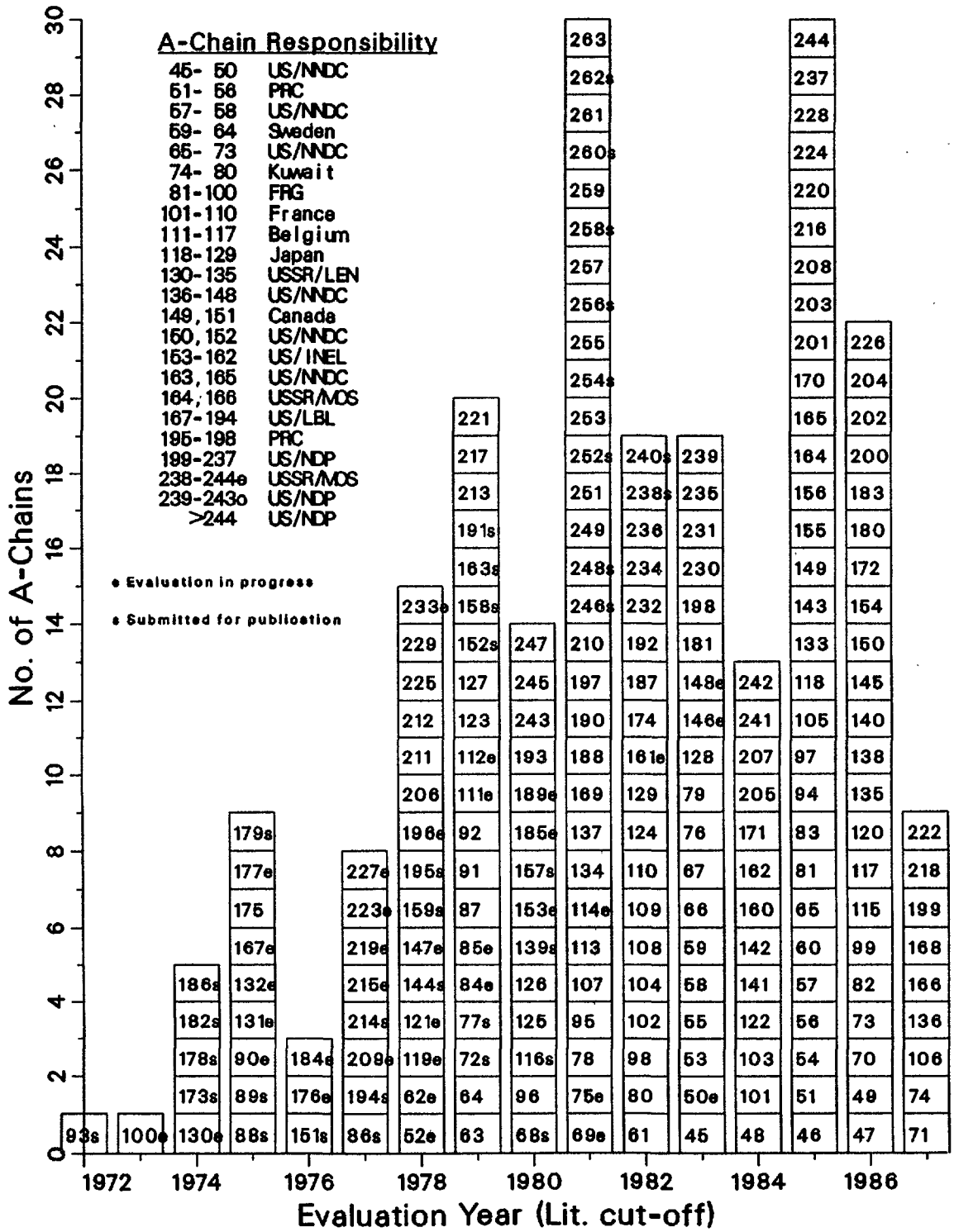
Center	Number of Mass Chains: Assigned	Published # 1980	1981	1982	1983	1984	1985	1986	1987	1988	In Progress or Review 1988	Older Than 1982 Lit. Cut-off And Not Being Worked On
BNL	34	2	1	1	2	6	2	7.5	4	2	10	1
INEL	10	1	0	1	1	1	2	1	2		5	0
LBL	28	2	4	3	1	3	0	0	2	1	12	5
ORNL	61	2	23	3	6	1	3	4	6	1	5	20
UP	16	2	3	2	9	6	2	5	3		7	0
UK		2	2	1	2	0	0	0.5	-		-	
Kuwait	7	1	1	2	0	1	0	0	1		2	1
FRG	20	3	0	1	2		3	2	1		5	5
France/ Belgium	17	0	1	2	1	2	2	1	2	1	3	2
Japan	12+1*	1	1	2	2	1	0	1	2		3	4
USSR	12	0	2	0	1	1	1	3	2		4	1
Sweden	6+1*	0	1	0	2	0	0	1	-		1	2
Canada	2+2*	-	-	0	0	0	1	0	-		2	0
Utrecht	24	-	-	-					-		-	
China	10+2*	-	-	0			1	1	4		3	1
Taiwan	2*								1		2	0
India	2*								-		1	0
									Total		65	42

#Nuclear Data Sheets Issue Year
*Temporary assignment

A-Chain Status in ENSDF

Center - ALL

18-APR-88



PRESENTATION OF ENSDF DATA IN THE NUCLEAR DATA SHEETS AND HOW EVALUATORS CAN INFLUENCE IT

R. R. Kinsey
(May 12, 1988)

There are a number of things that the evaluator can do to improve the presentation of the data in the Nuclear Data Sheets. Some of the information presented here merely informs the evaluator how the data will be handled by the processing codes and translators so that the evaluator can take advantage of that information. The following is a list in no particular order of importance of this information.

1) Footnotes are generated as they are encountered in the data set. This includes footnotes created by the data such as normalization factors from the N card and comments on multiple placement and intensities from flags on the G cards. The comments on multiple placement will always come last in the footnotes at the end of a table since they will always be encountered last. However, the evaluator is free to rearrange the other footnotes in the dataset, including the placement of the N card, to improve the presentation. For example, the footnotes can be arranged to reflect the order in which they are encountered by the reader.

2) A given footnote should not be used more than once in a table. If the footnote applies to more than one data field then multiple SYM's should be used on the footnote comment card. SYM as used here and in the formats manual refers to the alphabetic codes used to name the formatted data fields in the manual.

3) Footnotes can only be used with a SYM corresponding to one of the allowed data fields on one of the six formatted data cards used to make a data table. Any other use, such as trying to footnote quantities on data continuation records, only results in the comment being lost.

4) The evaluator has total control of the order of the data sets in the cross reference table and column in the adopted levels table. That order is the order in which the cross-reference records are placed in the adopted dataset. It has nothing to do with the character, DSSYM, which is used on that record and as a parameter in the XREF expression. Since only the first fourteen datasets are given a unique symbol, it is important in some cases for the evaluator to determine which datasets will be lumped together under the 'O' symbol. It is also very important that the DSID field on the cross-reference record exactly match the DSID used for that dataset.

5) Any adopted dataset which includes BAND footnotes will cause a drawing showing the bands (and gammas if present) to be created. The title of the band will be the comment appearing on the first card of the band footnote but not including the rest of the comment about the band which may appear on comment continuation records. Thus, the band footnote may be quite extensive but the title may be very short. The order of the bands in the drawing will be the order of the bands in the dataset. If the evaluator wishes to order the footnotes in one way and present the bands in a different order then the evaluator must communicate this to the production staff at either the pre-review or post review stage of production.

6) A special form of the footnote comment allows relabeling of the standard label heading of a formatted field. This form, SYM followed by LABEL= in the comment field, is presently limited to the S field of the L card. The

evaluator must make sure when using this form to limit the size of the new heading or the table will look ridiculous. In general, the number of printed characters in the new label should be no more than the maximum width of the data in the column. Enter any other information such as angles and units in another footnote on the S field.

7) A DSID continuation record is now allowed. The evaluator should be aware of several pitfalls currently involved with using this form. The first and most important is that the DSID field on the DSID card (this does not include the continuation field) must be unique for each dataset since the database will only keep one unique DSID. The second is that a very long title in the tables generated from a long DSID may not fit on the page and no decision has been made on how to handle this. The third is that there is no specification on where or how to split the DSID from one card to the next. Finally, these extra long DSID's could create a problem in displaying data retrieved on-line.

8) Evaluators should be aware that data continuation cards with an 'S', for Suppress, in column 6 will be suppressed in the final publication. The information on these cards is presented in the pre-review and review copies but not in the final galley and publication. The evaluator should make sure that any codes that are used to insert calculated quantities into datasets on data continuation cards use 'S' and not '2'. Older datasets may still use '2' and these must be changed.

The ENSDF publication is unique in that the copy submitted by the evaluator is translated by a computer code before it is published. Historically, this was based on only having upper case characters on punched cards and the publication was to be in standard upper and lower case characters and include a number of Greek characters as well. This means that the evaluator must be aware of what the translator program is going to do with the text. In addition, we'll include a few notes on punctuation. Some of this material has been circulated before but we'll cover it again since the problems continue to occur.

1) Any 'word' containing a lower case character will not be translated. This is especially useful for proper names. The other side of this is that any 'word' in all upper case characters which is not found in the translation dictionary will be converted to all lower case. This is also why we need to know if you have included any nonstandard all upper case mnemonics in your evaluation. See Appendix D in the ENSDF format manual for the translation dictionary.

2) Any comment field on any comment card which uses the lower case 'c' or 't' in column 7 rather than the upper case 'C' or 'T' will have no translations done on that comment field. The evaluator is then responsible for any special characters codes, seeing that the fourth character of a keynumber is lower case, and all capitalization. This can be useful in the essentially straight text of the address fields and funding acknowlegement in the COMMENTS dataset.

3) The difference between 'C' and 'T' comment cards is that the 'T' cards comment will be output using fixed character spacing as in a table or typewriter (thus 'T') whereas the 'C' comment uses publication quality variable character spacing. Using 'T' comments for text looks bad and should be avoided.

4) In a comment field TI will always translate as I(gamma+ce) even if the evaluator is referring to the TI field on an E card. There is one and only one translation for each code word. In cases of conflict, the most common has been chosen. In this example, the evaluator must use 'I(B+EC)' and not TI in a comment field even though the SYM is still TI.

5) Because of the need to translate E2 as E2, E4 as E4, etc., it is necessary that numbers in comment fields and on data continuation cards use the '+' sign in the exponent of numbers given using the engineering notation such as 1.547E+3.

6) The translation of material after 'CONF=' for shell model configurations is very difficult and while numerous examples are given in the manual there always seems to be some way of presenting the information which is not covered by them. However, one common problem which the evaluators can take care of is to include the proper number and nesting of parenthesis. Only the information within the first encountered set of parenthesis will be put through this special translation. Therefore, CONF=((P,1/2(512))(N,3/2(523))) will translate correctly while CONF=(P,1/2(512))+(N,5/2(624)) will not.

7) The code for the degree sign is DEG and not DEGREE as is commonly done.

8) Within parenthesis, keynumbers are seperated by commas and no spaces. Otherwise, keynumbers in a list are treated like any other list, that is, in a list of more than two items a comma and a space seperate the items and the word 'and' precedes the last item.

9) The code for g.s. is 'GS' and not 'G.S.'. The only place to use 'G.S.' is at the end of a sentence since 'GS.' translates as 'g.s..'.

10) In referring to other references which the evaluator wishes to bring to the readers notice, 'Other:' is used with a single reference and 'Others:' with a list of two or more. These words should be capitalized, so if other information precedes them, that information should end with a period and not any other form of punctuation.

Problems Encountered in Use of the ENSDF Decay Data and Simple Analysis on Them

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1. Introduction

Although the Evaluated Nuclear Structure Data File, ENSDF, is aimed principally at being used in fundamental research field, the decay data included in the file are expected to provide useful basis for some application fields. Recently, two radiation data books, Table of Radioactive Isotopes/1/ and ICRP Publication 38/2/, were published and have been widely used in the application fields since then. Both the radiation data books rely heavily on the decay data of the ENSDF as their source data. This fact demonstrates a usefulness of the ENSDF for the work in application in addition to in fundamental research to a great extent.

The radiation data being used in application fields are, in general, provided in a prepared form such as the above mentioned radiation data books or an intermediate data file specifically designed for each application field. Because of this, up-to-date information of the ENSDF on radiation data is hardly reflected to the use in application, unless the intermediate file is updated for every regular revision of the data file. The revision of the ENSDF being regularly made is potentially providing us more reliable basis on the decay data for the application fields as well as for the fundamental research field. When consider the fact, how to efficiently reflect the revision of the decay data set to the application is an important subject for the NDS project in addition to the revision of the data itself.

Recently, the author has developed a computer code RADCAL with which radiation data are derived from the decay data in ENSDF format for using in radiological dose assessment. The development is aimed at maintaining radiation data in responding to the revision of the ENSDF as mentioned above. During the course of the development of the code,

however, some problems are encountered in the use of the ENSDF decay data. They seeme to be common obstacles in the use of ENSDF decay data. In order to resolve the problems, simple analysis have been made from the viewpoint of the use in application especially for deriving the radiation data for radiological assessment. In this note, we describe the findings of the analysis and intend to make some suggestion for the NDS project from them.

2. Analysis of the decay data set dealing with intensity balance of transitions

First of all, the degree of internal consistency of the level scheme has been analyzed by comparing the sum of intensities of the transitions either comming from a parent nuclide or feeding a ground state of daughter nuclide to a branching ratio presented in each decay data set. The analysis have been made for all decay data sets of the ENSDF version as of September 1987. The results are summarized in Table 1 where number of decay data sets are given in each range of degree of discrepancies between the sum of intensities and the branching ratio.

As can be seen in this table, for some 15 % of 2554 data sets(only those of alpha, beta, and IT decay modes which a parent card is provided for) stored in the ENSDF, the sum of intensities of transitions comming from a parent nuclide is appeared to be zero, that is, the level schemes have not been deduced. In the case where the intensities are given, more than 10 % discrepancies between the sum and branching ratio are observed for some 8 % of the data sets. The similar tendencies are observed in the analysis made also for the transitions feeding the ground state or metabolic state of a daughter nuclide.

In order to analyze the cause of the discrepancies, the detail of decay data set has been checked for those in which a significant discrepancy between the sum and the branching ratio has been observed. From the checking, it has been recognized that lack of normalization factor to be given in each deacy data set is responsible for the discrepancies to some extent. There are a large number of decay data sets for which normalization factors are not given, that is, the columns for filling the factors remain very often blank. Even for the

Table 1. Distribution of ENSDF decay data sets categorized in terms of completeness of level scheme

Degree of discripancy*)	Number of decay data sets					
	For transitions from parent nuclide			For transitions to G.S. or M.S.		
	Total	Half life < 10 min.	Half life > 10 min.	Total	Half life < 10 min.	Half life > 10 min.
< 1 %	1593	755	838	1508	708	800
1 -- 5 %	283	136	147	207	94	113
5 --10 %	87	45	42	81	43	38
10 -- %	215	143	72	342	282	160
No transition given	376	316	60	316	268	48
Total	2554	1395	1159	2554	1395	1159

*) Discrepancy between the sum of intensities of the transitions either comming from a parent nuclide or feeding the ground or

well established decay data one or more normalization factors are not given. Even in case of 60-Co, for example, one normalization factor among three is left to be blank.

For deriving the radiation data from the decay data sets of which normalization factors are missing, the factors must be assumed using an appropriate "rule". A computer program MEDLIST is distributed by the BNL/NNDC as a utility program of ENSDF for deriving the radiation data from the decay data in the ENSDF format. In this code, the following assumptions are used for filling the lack of normalization factor;

Normalization Factor	Assumption
NR (gamma ray intensity)	Assumed to be 1 if missing
NT (gamma + c.e.)	The same value as NR if missing
BR (branching ratio)	Assumed to be 1 if missing
NB (beta or EC intensity)	1/BR is assumed if missing.

While the derivation of radiation data on the assumptions has been successfuly made for a majority of the decay data sets, erroneous results are also observed for a considerable number of data sets. The following is an extreame case of such an erroneous result observed in the decay data of 185-Ir.

For the decay data of 185-Ir, while the branching ratio is given as 1.0, three normalization factors remain blank. And beta or EC intensities comming from the parent nuclide are also not given. By using the above mentioned assumption, all the three normalization factors have been assumed to be 1. Then, the sum of total intensities feeding the ground or metabolic state of the daughter nuclide has been derived. The sum of gamma intensities calculated is 1459%/decay. Apparently, the assumed normalization factor misleads such an unacceptable sum of gamma intensities. For the decay data set, the evaluator has, on the other hand, made a following comment;

> A large number of transitions are not placed on level scheme; the sum of photon intensities of these unplaced transitions is 274 in relative units given here (RI(97.4G)=60.2). If these unplaced gammas do not decay to ground state, the normalization factor by

equating the total (gamma+c.e.) intensities of transitions known to feed the g.s. to 100 % yields an absolute normalization factor of 0.069 7. ---------- Since the decay scheme is incomplete, no attempt has been made to deduce EC feeding.

From this comment, it is understood that the evaluator has intentionaly not given the normalization factors because of incompleteness of the level scheme and he did not expect the user to use the above mentioned assumptions to derive photon intensities.

In this example, from the evaluator's viewpoint, lack of normalization factor is thought to represent an insufficient information to deduce a level scheme. However, from the user's viewpoint, the values derived with the above mentioned assumption are treated as recommended ones, since the assumption is suggested to use by the data distributor through the utility computer program. This mismatching on the normalization factor between the evaluator and the user in application fields may lead erroneous use of the decay data, unless the user make careful examination on an appropriateness of normalization factors for each decay data set.

3. Analysis of the decay data dealing with energy balance between total radiation energy and Q value

In the preceeding paragraph, the analysis have been made within the frame-work of the level scheme, that is, all photon transitions are assumed to be placed on the level scheme. There are, however, some gamma transitions which are not placed as seen in the comment of 185-Ir decay data mentioned above. So is the case for almost all decay data sets of the ENSDF except for those of simple decay scheme. The unplaced gamma represents the incompleteness of the decay scheme, since the inclusion of the unplaced gamma may sometimes cause a drastic change in the level scheme.

For judging the importance of the unplaced gamma against the transitions placed on each of level schemes, a calculated total radiation energy of a decay including neutrino energy has been compared with the Q value. For the calculation of the total release energy, the RADCAL code is used, in which the number of vacancies of atomic electron shell due to the gamma transition are calculated

Table 2. Radiation energy emission followed to the decay of 155-Eu*)**)

	Radiation energy / decay Unplaced gamma included	not included
beta	4.61 E+01 keV (1.71 E+02)	4.61 E+01 keV (1.71 E+02)
gamma	5.31 E+01	5.31 E+01
c.e.	4.77 E+02	1.69 E+01
X-ray	1.04 E+02	1.14 E+02
Auger e.	6.10 E+02	4.83 E+00
Total	1.29 E+03 (1.42 E+03)	1.32 E+02 (2.57 E+02)

*)The values in parenthes is the radiation energy including neutrino energy
**)Q value ; 2.527 E+02 keV

Table 3. Lists of unplaced-gamma presented in the decay data of 155-Eu*)

Energy (keV)	Intensity (%/decay)
10.40	3.87 E-04
12.7	1.05 E-03
13.8	2.10 E-03
24.56	8.20 E-04
40.75	2.82 E-03
107.6	4.26 E-04

*)No data on internal conversion coefficient and multipolarity is given for the transitions

refering to internal coversion coefficient table. In case of multipolarity of gamma transition is unknown, an appropriate assumption such as E2 multipolarity for the nuclide of an atomic number greater than 50 is made in this code.

The examination has been carried out for some decay data sets which seem to have an internal consistency according to the analysis summarized in Table 1. As a result, significant discrepancies between the total energy and Q value are observed for a few decay data sets, although, for almost all the decay data, the contribution of unplaced gamma to the total energy is negligible. As an example of the problems encountered, the results for the decay of 155-Eu are shown in Table 2 together with those not considered with the unplaced gamma. The energies and intensities of the unplaced gammas are given in Table 3. As shown in Table 2, the calculated total radiation energy with the inclusion of the unplaced gamma shows five times higher energy than the Q value, while the total energy calculated without unplaced gamma gives a good agreement with the Q value, only 2% discrepancy. Major cause of the discrepancy is due to a contribution from X-ray and Auger electrons corresponding to the unplaced gamma. The photon intensities of the unplaced gamma itself are negligibly small as can be seen in Table 3. However, once the contribution from the X-ray and Auger electrons are taken into account for the calculation of total energy, completeness of the level scheme become questionable.

4. Concluding remarks

Two kinds of simple analysis were made from the viewpoint of application of the ENSDF decay data. The analysis made are on completeness of the level scheme and on unplaced gamma dealing with energy balance of the decay data. From the analysis, considerable number of decay data sets still have the problems to be resolved. Consequently we still have to make a careful check in use of the ENSDF decay data. Because of this, the use of the ENSDF is limited for only skilled people working in the fundamental research field.

The problems mentioned in this note come mainly from insufficiency of available data, therefore, continuing effort to accumulate and evaluate the decay data are essential to resolve the difficulties to use the ENSDF. In addition to the effort, the findings described

above indicate that it is required to settle the data screening method to check an internal consistency in terms of intensity and energy balance. If such a screening is settled on a common basis among the evaluators and the users, the difficulties or erroneous use of the ENSDF would be prevented to a great extent.

Acknowledgement

The author wish to his thanks for Dr. K.KITAO of National Institute of Radiological Sciences for his helpful suggestion on this work.

References

1. International Commission on Radiological Protection, "Radionuclide Transformations; Energy and Intensities". ICRP Publication 38.Ann. ICRP 11-13 (1983)
2. Browne,E. and Firestone,R.B. "Table of Radioactive Isotopes". (New York: Wiley Interscience) (1986)

Level Mixing Spectroscopy: a new technique for measuring nuclear quadrupole moments

Short note on LEMS written by F. Hardeman, I.K.S. Leuven.

In order to study nuclear quadrupole moments of nuclear states, there are various techniques. However, in the μs - ms - lifetime range, almost no measurements have been performed. Also, for high spins, the best known method (TDPAD) becomes difficult, and requires a lot of beamtime. Both problems can be overcome by applying the LEMS - method.

Level Mixing Spectroscopy studies the quadrupole interaction of isomers in solids that provide an axially symmetric electric field gradient. The isomers are produced and oriented by nuclear reaction. They recoil into the solid host that provides the electric field gradient, and during their lifetime, they are submitted to a combined quadrupole and magnetic dipole interaction. This magnetic interaction is due to an externally applied magnetic field. The magnetic field is misaligned with respect to the symmetry axis of the field gradient. For small misalignment angles, one obtains the Level Mixing Resonances (LMR - ref. 1). Indeed, one can show that resonances occur in the time integrated angular distribution of the radiation originating from the decaying isomer as a function of the magnetic field. The position of these resonances permits to determine the Q.Vzz/g - ratio with great precision. At high spins however, this technique becomes very difficult. An other handicap is that single crystals are needed to apply this method.

For large misalignment angles, the resonances disappear, and one observes a smooth curve as a function of the magnetic field. At zero field, only the quadrupole interaction is present, and it reduces the anisotropy to a value only depending on the geometry of the experiment. At high field, the quadrupole interaction is decoupled, and the system is completely ruled by the magnetic interaction. If the beam axis coincides with the magnetic field axis, one observes the full anisotropy. The transition between the low field and the high field "regime" still permits to obtain the Q.Vzz/g - ratio, but with reduced precision (ref. 2). It can be shown that the curve - shape is almost independent of the spin value.
The features of TDPAD, LMR and LEMS are summarized in the table.

The low and high field values are used to determine the relative importance of the k=2 and the k=4 components in the angular

quantity	TDPAD	LMR	LEMS
Timing	yes	no	no
High spins	difficult	difficult	"easy"
Measured quantity	$Q.V_{zz}$	$Q.V_{zz}/g$	$Q.V_{zz}/g$
Statistical requirements	"hard"	"hard"	"easy"
Lower lifetimes	10 – 100 ns	100 ns	10 – 100 ns
Upper lifetimes	μs	ms	ms
Accuracy	1 %	1 %	5 – 10 %
Radiation damage	very sensitive	sensitive	not very sensitive

distribution. This is not reliable if all observed transitions in the decay of the isomer have mixed multipolarities with δ unknown. On the other hand, if both a pure and an admixed transition occur, one can determine the mixing ratio of the transition out of the amplitude of the LEMS - curve.

As a conclusion, one can say that LEMS is the only method that is to be applied for very high spins in the μs - ms lifetime range if TDPAD is not possible. Even if TDPAD is possible, LEMS still is good to get a fast result, although with reduced precision. This reduced precision however usually is not too important as the main problem still remains the calibration of the electric field gradient value.

References

1. See e.g.: R. Coussement et al., Hyp. Int. 23(1985)273
   P. Put et al., Phys. Lett 103A(1984)151
   I. Berkes et al., Phys. Rev. C30(1984)2026

2. See e.g.: G. Scheveneels et al.
   Int. Conf. on Nucl. Structure through Static and Dynamic Moments (Melbourne, Australia, August 1987)
   F. Hardeman et al. to be published in Nucl. Instr. and Methods

ENSDF ANALYSIS PROGRAM STATUS as of 4-12-88

PROGRAM	VERSION #	IBM,CDC,DEC,VAX	IBM-AT	DOCUMENTATION
LIBRARY:				
F77STR	4(2)	ALL	YES	YES
NSDCNV	2(3)	ALL	YES	YES
NSDMTH	1	ALL	YES	YES
UTILITY:				
ADDGAM	1(2)	ALL	YES	NO
TREND	5(3)	ALL	YES	YES
SETMDC	6(13)	ALL	YES	YES
HSMRG	6(3)	ALL	YES	NO
BLDHST@	3(2)	ALL	YES	NO
SEQHST@	3(2)	ALL	YES	NO
FMTCHK	6(115)	ALL	YES	YES
PREND		DEC	NO	YES
INSDF		DEC	NO	YES
ANALYSIS:				
DELTA	1	ALL	NO	YES
GABS	o	ALL	NO	YES
GAMUT	o	VAX	NO	NO
GTOL	5(6)	ALL	YES	YES
HSICC	10(7)	ALL	YES	YES
LOGFT	6(4)	ALL	YES	YES
RADLST	5.4g*	ALL	NO	YES
RULER	1(8)	ALL	YES	YES
PANDOR	3(3)*	ALL	o	YES
SPINOZA	1(2)	ALL	NO	NO

* Indicates recent updates (since 3/88).
o Indicates programs as received from outside.
@ Used for conversion between direct/sequential access of HS-icc table.

ON-LINE ACCESS

J. Tuli

On-line access to computerized numeric and bibliographic nuclear physics information is presently available through the National Nuclear Data Center (NNDC) at Brookhaven National Laboratory to users in the United States and Canada. Similar services may be available from a member of the International Network for Nuclear Structure Data Evaluation (page iv) nearest to you.

ACCESS: PHYSNET/HEPNET,MILNET,MFENET networks or remote modem and commercial telephone (300 to 1200 BAUD).
No special authorization is required to access the NNDC address list, on-line newsletter, mail facility, and HELP files to get acquainted with the system. Contact NNDC for authorizations to access data bases listed below.

DATA FILES:

NSR - Nuclear Structure Reference file contains bibliographic information for low and intermediate energy nuclear physics, covering the period 1910 to the present. The data file is updated monthly.

ENSDF - Evaluated Nuclear Structure Data File containing evaluated experimental data on nuclear level properties, radiations, radioactive decay and reaction data for $1 < A < 263$.

NUDAT - Nuclear Data has evaluated numeric data extracted or derived from the ENSDF and the Nuclear Wallet Cards.

CINDA - Computer Index of Neutron Data contains bibliographic references to neutron reaction data.

CSISRS - Cross Section Information Storage and Retrieval System contains experimental neutron, photon and charged particle reaction data.

ENDF - Evaluated Nuclear Data File contains evaluated nuclear reaction and decay data.

RETRIEVAL SYSTEM: A user-friendly system provides ample help to the user who specifies retrieval criteria in response to step-by-step prompts by the system. A user's guide to the on-line services, BNL-NCS-39756 is also available. The output can be obtained on the user terminal or saved as a computer file and transferred to the user's computer for later use.

For more information contact:

ON-LINE ACCESS
National Nuclear Data Center
Brookhaven National Laboratory
Upton, NY 11973
Tele: (516) 282-2901 or FTS: 666-2901

2. Publication of Mass Chains in "Update" Mode (J. Tuli)

A proposal to handle publication of those mass chain evaluations which contain relatively little new information is presented. It is proposed that these evaluations be published in an update mode. In the update mode, only the following information will be published.

a) Drawing 1, the skeleton scheme.
b) Index page, identical to the current index, with the addition of a column showing which experimental data sets have new information. All dataset I.D.'s will be listed, whether or not they contain new information.
c) Adopted Levels, Gammas tables for all nuclides.
d) The datasets which contain significant new information (whether or not the new information is "significant" will be the evaluator's decision). These should be prepared in the same manner as presently done and they will be treated the same as is presently done, that is, tables and drawings will be given just as they are now.
e) All references cited in the publication.

An example for publication of the A=138 evaluation in the update mode is enclosed.

The following points were emphasized by the F&P subcommittee.

a) A mass chain should not be published more than once in the update mode. That is, once published in this mode, the full evaluation would be published for the next cycle even if there is no significant new information. At no stage will a reader thus have to look at more than two issues of the NDS to get the complete evaluation.
b) The reference to the earlier full evaluation should be given on the cover page of the update.
c) Even though publication is to be in the update mode, the evaluator should still make certain that the datasets are brought up to current standards.
d) In ENSDF, the complete mass chain should be replaced. It is only in NDS that it would appear as an update.

This proposal will have the following benefits.

a) More of the contents of the average issue of NDS will contain new information, and it will be easier for the reader to quickly identify what is new.
b) The number of published pages per mass chain will be decreased, thus allowing more mass chains to be published per year.
c) Once an evaluator determines that a mass chain can be published in the update mode, the evaluation time for that mass chain should be reduced, more mass chains can be updated, and the average age of the mass chains in ENSDF can be reduced.
d) The evaluator should have more time to concentrate on those mass chains which have large amounts of significant new data.

The editors request the assistance of the evaluators in identifying mass chains that could be published in an update mode. The evaluators themselves are in the best position to recognize, during the course of an evaluation, whether the mass chain could be so published. By making use of the NSR output, for example by identifying the experimental references, it may be possible to tell even before beginning an evaluation whether it is likely to require full publication or whether the update mode will suffice.

III. Standard One-Card Record Formats

J. Tuli

6A. THE Production Normalization RECORD

(Must follow N record)

Field (Col.)	Name	Description	Reference
1–5	NUCID	Nucleus (Daughter/Product) identification	V.1
6		Blank	
7	P	Letter "P" (for production) is required	
8	N	Letter "N" is required	
9		Must be blank	
10–19	NR×BR	Multiplier for converting relative *photon* intensity (RI in the GAMMA record) to *photons* per 100 decays of the parent. (Normally NR×BR). If left blank (NR DNR)×(BR DBR) from N record will be used for normalization.	V.9
20–21	UNC	Standard uncertainty in NR×BR	V.11
22–29	NT*BR	Multiplier for converting relative *transition* intensity (including conversion electrons) [TI in the GAMMA record] to *transitions* per 100 decays of the parent. (Normally NT×BR) If left blank (NT DNT)×(BR DBR) from N record will be used for normalization.	V.9
30–31	UNC	standard uncertainty in NT×BR	V.11
42–49	NB×BR	Multiplier for converting relative β^- and ϵ intensities (IB in the B− record; IB, IE, TI in the EC record) to intensities per 100 decays. If left blank (NT DNT)×(BR DBR) from N record will be used for normalization.	V.9
50–55	DNB×BR	Standard uncertainty in NB	V.11
78–79	OPT	Intensity Option. Option as to what intensity to display in the drawings in the *Nuclear Data Sheets*. The available options are given below (default option 6):	

Option number	Intensity displayed	Comment in drawing
1	TI	Relative I(γ+ce)
2 or 3	RI(1+α)	Relative I(γ+ce)
5	RI×NR×(1+α)	I(γ+ce) per 100 (mode) decays
6	RI×BR×NR×(1+α)	I(γ+ce) per 100 parent decays
7,8	TI×NT	I(γ+ce) per 100 (mode) decays
9	TI×NT×BR	I(γ+ce) per 100 parent decays
10	RI×NT×BR	I(γ) per 100 parent decays
11	RI	Relative I(γ)
12	RI	Relative photon branching from each level
13	RI	% photon branching from each level