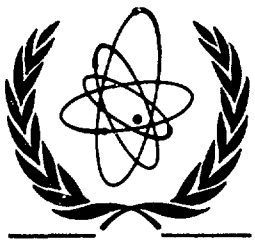
INDC(NDS)-79/LN



International Atomic Energy Agency

INDC INTERNATIONAL NUCLEAR DATA COMMITTEE

IAEA Advisory Group Meeting

on

Nuclear Structure and Decay Data for Applications

Vienna, Austria, 3-7 May 1976

SUMMARY REPORT

Edited by

A. Lorenz
Nuclear Data Section
International Atomic Energy Agency

December 1976

IAEA NUCLEAR DATA SECTION, KÄRNTNER RING 11, A-1010 VIENNA

Reproduced by the IAEA in Austria
December 1976
76-10934

INDC(NDS)-79/LN

IAEA Advisory Group Meeting

on

Nuclear Structure and Decay Data for Applications

Vienna, Austria, 3-7 May 1976

SUMMARY REPORT

Edited by

A. Lorenz
Nuclear Data Section
International Atomic Energy Agency

December 1976

Abstract

The IAEA Nuclear Data Section convened this Advisory Group Meeting on Nuclear Structure and Decay Data for Applications at IAEA Headquarters from 3 to 7 May 1976. The meeting was attended by 26 representatives from 13 countries and 2 international organizations.

The objective of this meeting was the development of an internationally coordinated system for the compilation, evaluation and dissemination of nuclear structure and decay data. The meeting succeeded in agreeing on common formats for the exchange of bibliographic and numerical nuclear structure and decay data, in establishing an international file of evaluated nuclear structure and decay data to serve as a single source of these data for the benefit of the scientific community, and in setting up a world-wide network of data centres and groups for the systematic compilation and evaluation of mass-chain data.

Table of Contents

Abstract
Table of Contents
List of Appendices
Definition of Terms
List of Abbreviations

I. Summary of the meeting

A. Introduction
B. Objectives
C. Conclusions and Recommendations

II. Summary and Highlights of Discussions

A. Opening Statements
B. International Compilation and Evaluation Effort
   Mass chain and horizontal compilations
C. Definition of Exchange System
   1. Bibliographic Data
   2. Numerical Data
D. International files of NSD Data
   1. Description of files
   2. Maintenance of files
   3. Distribution of files
   4. Flow of information
   5. Computer programmes
E. Scope, Terminology, Common Rules and Quality Control
   1. Common dictionaries
   2. Definition of terms
   3. Quality control
   4. Common evaluation rules
F. Coordination of Activities
   1. Definition of NSDD network
   2. Distribution of mass chain evaluations
   3. Publication
   4. Administrative procedures

List of Appendices

Appendix 1	List of Participants
Appendix 2	Adopted Agenda
Appendix 3	List of Papers Presented at the Meeting
Appendix 4	Actions
Appendix 5	Opening Statement by J.J. Schmidt
Appendix 6	US Position on International Cooperation in the Area of Nuclear Structure Data, N. Holden
Appendix 7	Compilation and Evaluation of Non-Neutron Nuclear Data
Appendix 8	The Tasks of the Centre for Data on the Structure of the Atomic Nucleus and Nuclear Reactions of the USSR State Committee on the Utilization of Atomic Energy (CAJaD) and Problems of Organizing International Co-operation in Connection with Data on the Structure of the Atomic Nucleus L.L. Sokolovskij, F.E. Chukreev
Appendix 9	Compilation and Processing of Information on Nuclear Structure and Reactions at the Data Centre of the Leningrad Institute of Nuclear Physics (LIYaF) USSR Academy of Sciences I.A. Kondurov, Yu.V. Sergeenkov, Yu.I. Kharitonov, B.P. Konstantinov
Appendix 10	Fysisch Laboratorium, Utrecht, C. van der Leun
Appendix 11	Participation in the Nuclear Structure Data Cooperation H. Behrens, ZAED
Appendix 12	The Gamdat File of Juelich - Present Status and Intended Work G. Erdtmann
Appendix 13	U.K. (Science Research Council), P. Twin
Appendix 14	NPL Involvement in the Evaluation of Nuclear Data A.L. Nichols
Appendix 15	Outline of UK Statement, Excluding SRC Contribution A.L. Nichols

Appendix 16 Status of the Japanese Activities on Evaluation of Nuclear Structure and Decay Data, T. Tamura

Appendix 17 Statement Concerning the activity in the Compilation and Evaluation of Nuclear Structure and Decay Data for Applications in Romania, M. Ivascu

Appendix 18 Statement on the Activity in Connection with the Compilation of Nuclear Structure and Decay Data for Applications in Hungary, D. Berényi

Appendix 19 Opening Statement, L. Carlén

Appendix 20 Nuclear Data Group of the Institute of Nuclear Research Statement, A. Marcinkowski

Appendix 21 Standards for ENSDF Data Sets

Appendix 22 The Evaluated Nuclear Structure Data File and the Decay Data File of the USSR CAJaD Centre of the State Committee on Atomic Energy, F.E. Chukreev, L.L. Sokolovskij

Appendix 23 Services Available from Nuclear Data Project to Evaluators of Nuclear Structure Data

Appendix 24 List of Possible Quantities

Appendix 25 General Criteria for International Evaluated Nuclear Data Sets

Appendix 26 General Policies - "Theory" (Nuclear Data Sheets)

Appendix 27 Addresses of Active and Potential Members of the NSDD Network

Appendix 28 Cumulated Index to A-Chains (Nuclear Data Sheets)

Appendix 29 Statement by F.E. Chukreev (CAJaD) on the Distribution of A-Chain Evaluation Responsibilities

Appendix 30 Summary of Participant Statements on Publication of Mass Chains

DEFINITION OF TERMS *

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

---

* see section II.E.2 page 12 of this report.

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.
IAEA/NDS	Nuclear Data Section of the International Atomic Energy Agency, also NDS.
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.
NSDD	NSD data = Nuclear Structure and Decay Data.
US/BNL	US National Neutron Cross Section Center, located at the Brookhaven National Laboratory.
US/NDP	Nuclear Data Project located at the Oak Ridge National Laboratory.
ZAED	Zentralstelle fuer Atomkernenergie-Dokumentation: Nuclear documentation and information centre for the Federal Republic of Germany.

I. SUMMARY OF THE MEETING

A. Introduction

This Advisory Group Meeting on Nuclear Structure and Decay Data for Applications was convened by the IAEA Nuclear Data Section on the recommendation of the International Nuclear Data Committee and of the May 1974 IAEA Specialists' Meeting on Nuclear Data for Applications. The meeting was attended by 26 scientists from 13 countries and 2 international organizations representing all centres and groups concerned with the compilation, evaluation and dissemination of nuclear structure and decay data. The list of participants is given in Appendix 1. The meeting was chaired by Dr. S. Pearlstein, head of the US National Neutron Cross Section Center.

B. Objectives

The principal objective of this meeting was the formation of an internationally coordinated network of centres, groups and individuals for the systematic compilation, evaluation and dissemination of nuclear structure and decay (NSD) data.

In particular the meeting aimed at obtaining commitments from existing centres and groups to share in the overall effort of compilation and evaluation of mass chain NSD data in order to achieve a continuous and complete evaluation of all mass chains on a four year cycle. Furthermore, as an adjunct to the establishment of the evaluation network, the meeting intended to define common bibliographic and numerical data exchange formats, discuss the concept and content of an international file of evaluated NSD data, and agree on common rules and methods of mass chain data evaluation. The Adopted Agenda is given in Appendix 2, and the list of papers presented to the meeting by the participants is given in Appendix 3.

C. Conclusions and Recommendations

While a more detailed account of the meeting proceedings is given in Part II of this report, the main achievements are summarized as conclusions and recommendations and listed below. The Actions which resulted from this meeting are listed in Appendix 4.

Conclusions

1. The meeting confirmed the need for a world-wide cooperative evaluation effort and endorsed the free exchange of nuclear structure and decay data.

2. A network of centres and groups for the evaluation of mass-chain NSD data was established, and preliminary ranges of responsibility have been assigned; of the centers represented at the meeting, ten including the original cooperating mass-chain evaluation centres, have agreed to participate in this effort, and seven others have expressed their intention to join this effort in the future.

3. The meeting decided to separate horizontal data compilations from vertical or mass-chain data compilations, and has given the responsibility to the IAEA Nuclear Data Section to maintain a compilation of horizontal NSD data compilations and evaluations, and to publish this compilation periodically.

4. The meeting agreed that bibliographic references pertinent to NSD data be initially compiled and exchanged in the format of "Recent References", an existing computerized system developed by the US/NDP and used for the storage, retrieval and publication of bibliographic NSD data. (See Recommendation 1)

5. The meeting agreed that numerical NSD data be compiled and exchanged in the format of the Evaluated Nuclear Structure Data File ENSDF, an existing computerized system developed by the US/NDP and used for the storage, retrieval and publication of numerical NSD data. (See Recommendation 2)

6. The meeting defined the nature and scope of international bibliographic and numerical NSD data files which are to serve as the universal master files for all NSD data, and the responsibilities for their maintenance and distribution.

7. The meeting agreed on a network of centres for the coordination of activities and for the dissemination of NSD data.

8. The meeting discussed the publication of NSD data, endorsed for the time being the continuation of the established NSDD publications in Nuclear Data Sheets and Nuclear Physics and welcomed the US's and the Karlsruhe group's offers to publish periodically a Wallchart of Nuclides. A Handbook of Isotopes is also planned to be published periodically by the US.

9. The meeting discussed various ways and means to maintain the uniformity and quality of NSDD evaluations, and urged all participating centres and groups to give them serious consideration. (See Recommendation 3)

10. The meeting established channels of communications between all members of the network, and assigned the IAEA/NDS to serve as the central repository of all communications and documents pertinent to the international NSD data network.

11. The meeting agreed that the next meeting of the NSDD centres and groups be convened in September or October 1977. The place being either in the USSR or in the USA.

Recommendations

The formal recommendations which have resulted from this meeting are

Recommendation 1	Initially, Recent References should be adopted as an international system for the exchange of nuclear structure and decay data references.
Recommendation 2	a. ENSDF, as described in the report ORNL-5054 (document no. AG-59/6), should be used as a preliminary system for the coding of nuclear structure and decay data.
	b. International exchange of nuclear structure and decay data should be started using ENSDF as the initial exchange format.
Recommendation 3	It is strongly recommended that evaluators devote part of their time to research programmes in order to maintain their expertise.

II. SUMMARY AND HIGHLIGHTS OF THE DISCUSSION

A. Opening Statements by Centres and Groups Represented at the Meeting

The meeting was opened by Prof. H. Glubrecht, Deputy Director General for the IAEA Department of Research and Isotopes. The position statements made by the meeting participants are included (in most cases) in their entirety as Appendices to this report. A brief summary of the order in which the statements were made, and the reference to the relevant Appendix are given below.

1. Introductory IAEA/NDS Statement. J.J. Schmidt, Appendix 5.

2. US Position on International Cooperation in the Area of Nuclear Structure Data. N. Holden, Appendix 6. (Recorded initially as AG-59/10).

3. Collective view of the European Community on the evaluation of non-neutron nuclear data. (Summary Report of European Ad-hoc Meeting held at CBNM, Geel, 8 April 1976). W. Bambynek, Appendix 7. (Recorded initially as AG-59/22).

4. Statements by the USSR representatives

a) CAJaD Centre, F.E. Chukreev, Appendix 8 (recorded initially as AG-59/11).

b) LIYaF Data Centre, I.A. Kondurov, Appendix 9 (recorded initially as AG-59/12).

5. Fysisch Laboratorium, Utrecht. Statement by C. van der Leun, Appendix 10.

6. Statements by representatives from the Federal Republic of Germany.

a) Participation in the Nuclear Structure Data Cooperation of the Zentralstelle fuer Atomkernenergie-Dokumentation (ZAED), Federal Republic of Germany. H. Behrens, Appendix 11 (recorded initially as AG-59/19).

b) The Gamdat File of Juelich - Present Status and Intended Work - G. Erdtmann, KFA Juelich. Appendix 12.

7. Statements by Representatives from the U.K.:

a) Science Research Council (SRC): P. Twin, Appendix 13.

b) National Physical Laboratory: A.L. Nichols, Appendix 14.

c) Outline of UK Statement, excluding SRC Contribution. A.L. Nichols, Appendix 15.

8. Status of the Japanese Activities on Evaluation of Nuclear Structure and Decay Data, T. Tamura, Japan Atomic Energy Research Institute, Appendix 16 (recorded initially as AG-59/16).

9. Statement Concerning the Activity in the Compilation and Evaluation of Nuclear Structure and Decay Data for Application in Romania, M. Ivascu, Appendix 17.

10. Statement on the Activity in connection with the Compilation of Nuclear Structure and Decay Data for Applications in Hungary, D. Berényi, Appendix 18.

11. Statement by the Representative from Sweden, L. Carlen, Appendix 19.

12. Statement for the Nuclear Data Group of the Institute of Nuclear Research in Poland, A. Marcinkowski, Appendix 20.

13. An offer to contribute to the mass chain data evaluation was sent by mail to the meeting by Dr. A. Shihab-Eldin, Director General of the Kuwait Institute of Scientific Research (KISR). The offer read that both KISR and Kuwait University are interested to participate in the international effort of mass chain data evaluation and willing for commitments for few mass chains.

B. International Compilation and Evaluation Effort

This agenda item, which followed immediately after the opening statements of the meeting participants, allowed for amplification and elaboration of the initial statements, and provided an opportunity to review the current situation and the basis for international cooperation. Specific discussions on the international mass-chain compilation and evaluation effort were relegated to Agenda Items C and D. Formal statements concerning NSDD activities in Member States represented at the meeting have been combined with Section A above and included in the Appendices.

The need to separate discussions on "horizontal" and "vertical" (mass chain) compilations was recognized by all participants.

- Selected (horizontal) compilation and evaluation was discussed briefly - and the conclusions of these discussions are listed below.

- Mass Chain (vertical) compilation and evaluation, was the primary subject matter of the meeting. The conclusions of these discussions are outlined in the remainder of this report.

Horizontal Compilations

1. It was agreed to consider selected (horizontal) compilation and evaluation separately from considerations given to mass-chain compilations and evaluations.

2. To ease the integration of selected evaluations into mass-chain evaluations, it was suggested that, if selected (horizontal) compilations are coded for automatic computer processing, the ENSDF format be used.

3. It was agreed that IAEA/NDS act as a central repository (Post Box) for published selected compilations and evaluations, and for computer files of selected compilations and evaluations, and that it publish and disseminate at appropriate intervals an information letter on existing and planned selected compilation and evaluation.

Action 22

4. In order to provide the basis for the first information letter on selected compilations, all representatives at the meeting were asked to submit a list of all such compilations, published or in preparation, known to them. This list, complemented by other information on hand at

the IAEA/NDS, was used to formulate the first version of the Compilation of Selected Compilation. It was distributed to members of the network for comments on 9 June 1976, and is not to be made part of these minutes. The first issue of this compilation was published in September 1976 as INDC(NDS)-80/LN.

5. All participants at the meeting were urged to send to IAEA/NDS in the future all pertinent information on horizontal compilations to be included in these lists of compilations.

Action 20

C. Definition of Exchange System

C.1. Bibliographic Data

1. Bibliographic NSD data encompass all references to conventional publications and non-conventional literature containing information on NSDD.

2. Two existing computerized bibliographic reference systems were discussed by the meeting participants, the "Recent Reference" system * and the INIS system. The following reasons for preferring the Recent Reference system were given by the participants**:

- It is specialized for NSD data, with detailed keyword vocabulary and deep indexing;
- Its structure and format is more suited for more effective coverage control and selective retrieval;
- The turnaround time (from input to publication) is faster with a smaller specialized system such as Recent References;
- Input indexing should be done in depth by nuclear physicists (as in Recent References);
- Recent References contains all old references while INIS does not;
- Recent References System is easier to use (i.e. system is more manageable).

---

* Bibliographic data storage and retrieval system developed and operated by US/NDP. Output from this system has been published periodically in Nuclear Data Sheets.

** These opinions were not shared by the representative of FRG/ZAED, whose contention was that the INIS system did in fact satisfy the requirements for a computerized bibliographic reference system for NSD data.

3. It was decided that the Recent References System be adopted as an international system for the exchange of NSD data references.

Recommendation 1

4. Although it was decided not to adopt the INIS system as the bibliographic reference system for NSD data, Behrens (FRG/ZAED) was asked to assess the applicability of the INIS system for NSDD referencing.

Action 1

5. It was also recognized that Recent References keywords are very useful, and agreed that they should be used more widely. In this context IAEA/NDS was asked to approach publishers of nuclear physics literature recommending the use of Recent References keywords in journal publications, with the exception of those journals who have already adopted them.

Action 2

6. In order to standardize the format and style of referencing, it was suggested that reference listings for selected compilations adopt the Recent References format.

7. The international NSDD bibliographic (Bib) file is therefore implied to be the total body of information contained in the Recent References System.

8. Input to the NSDD Bib file is proposed to be fed from literature scanning at US/NDP supplemented by:

- Contributions from the Soviet Union, covering Soviet scientific literature;
- Contributions from Japan covering Japanese scientific literature; and
- Contributions from East European countries covering literature from their countries (channeled initially through the CAJaD centre in the Soviet Union).

It is important that the documents scanned outside US/NDP, be available to US libraries and for checking of keywords.

9. It was urged that NSDD references coded by the Soviet Union, consisting of Soviet NSDD references to literature published during the last two years, and submitted to this meeting on magnetic tape, be critically analyzed by US/NDP so as to avoid as far as possible the development of different coding habits in different centres.

10. It was agreed that US/NDP provide adequate documentation on the Recent References System to all participants in this cooperative effort.

Action 3

11. In response to a request by Kondurov (USSR/LIYaF), Dunford (US/BNL) agreed to investigate the feasibility to have an "all upper case" Recent References exchange format coded in EBCDIC, for the exchange of NSDD references with the Soviet Union.

12. In discussing common terminology and dictionaries for the Recent References system, the need for additional CODEN descriptors for Conferences and Lab report series was expressed by the CAJaD representatives. It was agreed that upon request from the network, NDS would obtain CODEN descriptors for journals, conferences and laboratory reports not yet included in the CODEN system.

Action 9

13. It was also suggested that IAEA/NDS ask the pertinent authorities in East European countries to organize the preparation of entries to Recent References from nuclear literature published in their countries.

Action 10

C.2. Numerical Data

1. Numerical NSD data are understood to encompass all nuclear structure and decay data which are agreed to be in the scope of this international compilation, evaluation, exchange and dissemination effort. (see also section E.1 and Appendix 24).

2. It was concluded that the ENSDF format (as described in the report ORNL-5054 and presented as meeting paper AG-59/6) be adopted as the preliminary exchange format for the exchange of NSD data, and that the international exchange of NSD data be started using the ENSDF format.

Recommendation 2

3. It was suggested that the users of the ENSDF format represented at this meeting evaluate its usefulness and prepare suggestions for its improvement by the time of the next international NSDD meeting.

Action 4

4. It was agreed that US/NDP keep the documentation of the ENSDF system up-to-date, and supply this documentation to all participants in this cooperative effort.

Action 5

5. It was also requested of US/NDP to make the ENSDF file compiled at NDP available to the network, and provide associated computer programmes on request.

Action 24

6. "Standards for ENSDF Data Sets", submitted to the meeting as paper AG-59/1, is included in this report as Appendix 21.

7. The question of the adequacy of the ENSDF format for all pertinent NSD data was raised by the USSR representatives, who suggested the use of the EXFOR format for the coding of certain measured data which do not easily fit into the ENSDF format. Two alternative solutions to this problem were suggested:

- Use of the EXFOR format for experimental nuclear reaction data which normally are not part of the NSDD scope, and

- Use of the additional format features of ENSDF (described in ORNL-5054), which also includes a "free form" format.

It was also pointed out that additional quantities, descriptors and formats can be added to the existing ENSDF system.

8. On request by the USSR representatives, US/NDP agreed to review the experimental NSD input prepared by the LIYaF Data Centre in ENSDF format, which is included in INDC(CCP)-72/LN (submitted as meeting paper AG-59/20).

9. The meeting took note of the considerations given by the USSR/CAJaD centre to the computer storage of evaluated NSD data, described in meeting document AG-59/13 and included in this report as Appendix 22.

D. International Files of NSD Data

D.1. Description of the NSDD Files

1. Discussions resulted in the acceptance of two NSDD files which are to evolve from the existing file of numerical NSD data currently held by US/NDP.

2. For the initial period, the international file of evaluated nuclear structure and decay data (evaluation file), in ENDSF format, would consist of recommended values that are provided by the Nuclear Data Project.

This file will contain data for all mass chains and could contribute to the production of the Wall Chart of Nuclides and the Handbook of Isotopes (see section F.3).

3. The international working file of experimental nuclear structure and decay data (working file), in ENSDF format, would contain experimental data. These data are selected by mass chain evaluators from those experiments considered pertinent to the evaluations.

4. The current US/NDP ENSDF file of Adopted NSDD, containing data for $\sim$1000 decay schemes and a large volume of reaction data sets, is being used to produce the current "computerized" Nuclear Data Sheets. This file should serve as an interim international file of evaluated NSD data.

5. It was agreed that the content index of the current file of selected NSDD held by US/NDP should be made available to the network.

Action 12

D.2. Maintenance and Distribution of Files

1. Both of these files will be maintained and kept up-to-date by US/NDP.

2. US/BNL will be responsible for the world-wide distribution of these files.

D.3. Flow of Information

The following "summary" of the NSDD information flow has been derived from the meeting discussions, and assumes the existence of an international network of mass-chain evaluation centres, groups and individuals (see section F.1 and Table F1).

1. Mass-chain evaluators receive support in the form of selective retrievals, system documentation, etc. (see description of services from US/NDP to NSDD evaluators in Appendix 23 submitted to the meeting as paper AG-59/5) from US/NDP directly or through coordinating centres (see section F.1). Evaluation rules, dictionaries, instructions, etc. are coordinated by US/NDP, and sent out on request to mass-chain evaluators.

2. Mass-chain evaluators code the evaluated NSD data (and all pertinent supporting evidence) in the ENSDF format, which they send directly or through national coordinating centres to US/NDP.

3. Contributions from mass-chain evaluators are processed through checking programs by US/NDP. Initially US/NDP determines the material to be entered into the File of Evaluated NSD Data.

4. US/NDP publishes Nuclear Data Sheets from output from File of Evaluated NSD Data.

5. Copy of the Evaluated NSD Data File is periodically sent (timing to be decided) to US/BNL from where it is distributed to other centres and groups inside and outside the US.

6. US/BNL distributes copies of the entire File of Evaluated NSD Data or selective retrievals from this file, to the coordinating and distribution centres (see Table F1).

7. US publishes periodically the Chart of Nuclides and the Handbook of Isotopes from the latest version of the File of Evaluated NSD Data and other Sources (see Section F.3).

D.4. Computer Programmes for NSDD Files

1. Computer programmes to handle to NSDD Files will be available from US/NDP and US/BNL respectively to all NSDD centres.

2. A list of computer programmes used by US/NDP (with abstracts) will be made available to the network.

Action 11

3. The responsibility to get the computer programmes working at other centers is the concern of each center.

E. Scope, Terminology, Common Rules and Quality Control

E.1. Common Dictionaries

1. With the general intent to reach an agreement on the NSD parameters to be included in the NSDD files, a proposed list of "Possible Quantities", which resulted from the response to a questionnaire distributed in the U.S. by US/BNL, was put forward by US/BNL (see meeting paper AG-59/21). Another list of nuclear level and decay properties was presented by CAJaD representatives in the form of Tables 1 and 2 of meeting document AG-59/12 (see Appendix 9). A list of atomic data important for nuclear method applications was also put forward by Berényi (Hungary/ INR-Debrecen).

2. After discussion, the lists submitted were given to a subcommittee (Sokolovskii, van der Leun, Bertrand and Berényi). This resulted in a preliminary list of quantities which is to be used to define the initial scope of data to be included in the international exchange system.

3. This list of quantities given in Appendix 24 was agreed to be reviewed by the US/NDP staff, taking into account all proposals presented at the meeting and to be distributed to the network for comment as soon as possible.

Action 14

E.2. Definition of Terms

1. Based on the definitions proposed at the 1974 Specialists' Meeting on Nuclear Data for Applications (INDC(NDS)-60 submitted to this meeting as AG-59/14), and on the definitions used in the 1976 Meeting of the European Ad-hoc Group on Compilation and Evaluation of Non-neutron Nuclear Data (minutes of that meeting submitted to this meeting as AG-59/22), a Subcommittee (consisting of Bambynek, Nichols, Behrens, Twin and Kondurov) produced a set of definitions which was discussed and approved by the meeting. It was agreed by the participants to restrict the terminology used to these terms as far as possible. This list of definitions is included in the beginning of this report (page vii).

E.3. Quality Control

International cooperation in mass-chain evaluation implies a spreading out of the effort of the Nuclear Data Project (US/NDP) over several laboratories and groups inside and outside the U.S. Concern was expressed about the possibility of a decrease in the quality standard of the work performed by the existing network of evaluators due to such an expansion. In order to reduce the possibilities of such a deterioration, the following potential quality control measures were discussed:

Refereeing

1. One of the more effective methods of quality control which has been used by the physics community in the publication of physics papers is anonymous refereeing. Strong opinion was expressed that this method should be applied also to the publication of mass-chain evaluations. It was therefore suggested that the network should build up an international body of referees who would review mass-chain evaluations prior to their publications. The point was made that the task of any given evaluation reviewing, be subdivided among several referees according to their expertise.

Self-checking

2. Self-checking of evaluations within each group, prior to submission for publication or for inclusion in an international file, was envisaged and endorsed by all participants. The use of graduate students, if available for this task, was suggested.

Computer checking

3. US/NDP volunteered to subject all evaluations submitted in ENSDF format to consistency and error checking by computer.

4. US/NDP will attempt to perform detailed review of the first few mass-chain evaluations from each center.

Training

5. Another suggestion was to hold training sessions at US/NDP, possibly in conjunction with the annual NSDD meetings, and in general encourage visits to the major evaluation centres. In this context, the meeting was informed, that US ERDA intends to commit funds for visits to US centers (US/NDP and US/BNL) by non-US network members. Arrangements for such visits would have to be made through US/BNL, the US coordinating center.

E.4. Common Evaluation Rules

1. A Subcommittee (Nichols, Bertrand, Berényi, Behrens, Chukreev and van der Leun) reviewed the draft document on "Choice of Adopted Values for ENSDF Data Sets" (submitted to the meeting as document AG-59/2), and re-drafted these guidelines under the title: "General Criteria for International Evaluated Nuclear Data Sets". This document, as finally adopted by the meeting, is given in Appendix 25.

2. Attention was called to the methods of evaluation proposed by the Soviet CAJaD Centre, as described in report INDC(CCP)-75/LN (submitted as meeting document AG-59/25). It was suggested that the participants review the proposed methodology to evaluate measurement uncertainties and convey their comments to the authors.

Action 6

3. The meeting acknowledged and supported the introductory pages of each issue of the Nuclear Data Sheets which describes "General Policies-Theory" regarding theoretical predictions published in Nuclear Data Sheets, and the "Summary of Bases for Spin and Parity Assignments". Copy of these pages were introduced to the meeting as papers AG-59/3 and AG-59/4, and are included in this report as Appendix 26. The correctness of some statements regarding β-transitions was questioned by Behrens.

Actions 7 and 8

4. Similar acknowledgements of statements for the A=21-44 mass region, and for light nuclei (A<45) in general, which have appeared in Nuclear Physics (Nucl. Phys. A214 (1973)1, and Nucl. Phys. A235 (1975) 167) respectively, were expressed by the meeting.

5. Another reference on evaluation rules by B.S. Dzhelepov "Methods to Construct Decay Schemes of Radioactive Nuclei", which was published in the USSR by Nauka, Leningrad in 1974, was called to the attention of the meeting by the USSR representatives.

6. Discussion of meeting document AG-59/22 (see Appendix 7) "Minutes of the Meeting of a European Ad-hoc Group on the Compilation and Evaluation of Non-neutron Nuclear Data", resulted in a general recommendation by the meeting, that mass chain evaluators take part in experimental activities in order to maintain their expertise.

Recommendation 3

F. Coordination of Activities

F.1. Definition of NSDD Network

1. The NSDD network for the compilation, evaluation and dissemination of NSD data, formed to ensure evaluation of mass-chain data with a minimum of overlap, is to consist of a number of nuclear data centres and groups, contributing to the overall effort by evaluating mass-chain data, performing horizontal evaluations and/or by functioning as coordination and distribution centres.

2. Lists of active and potential participants in the international nuclear structure and decay data effort as of June 1976, are given in Table F1. A list of the addresses and heads of all pertinent centres and groups is given in Appendix 27.

Table F1

List of Active and Potential Participation in the International Nuclear Structure and Decay Data Effort as of June 1976

		Present Commitment			Potential
Centre/Group	Code	Mass Chain Evaluation	Horizontal Evaluation	Coordination and Distribution	Mass Chain Evaluation
US/BNL	1A	✓	✓	✓	
US/NDP	1B	✓	✓		
US/LBL	1C	✓	✓		
US/INEL	1D	✓	✓		
US/UP	1E	✓			
USSR/CAJAD	2A	✓	✓	✓	
USSR/LIYAF	2B	✓	✓		
NED/UTRECHT	3A	✓	✓		
NED/IKO	3B		✓		
UK/DARESBURY	4A	✓			
UK/HARWELL	4B		✓		
FRG/ZAED	5A	✓	✓	✓	
FRG/JUELICH	5B		✓		
FR/LMRI	6A		✓		
FR/CEA-Grenoble	6B		✓		
IAEA/NDS	7A			✓	
NEA/CCDN	8A			(✓)	
CBNM/GEEL	9A		✓		
POL/IBJ-Warsaw	16A		✓		
JAP/JAERI	10A		✓		✓
JAP/Hokkaido	10B				✓
SWD/Lund	11A				✓
KUW/ISR	12A				✓
ITY/CNEN-Bologna	13A				
ROM/IPA	14A				
HUN/INR-Debrecen	15A				
IND/BARC	17A				✓
GDR/TU-Dresden	18A				✓

3. The responsibilities of the major coordination and distribution centres are listed below. Services available from the US/NDP center are listed in Appendix 23.

US/BNL

The nuclear structure data compilation and evaluation activities described at this meeting are supported in the United States by the US Energy Research and Development Administration (ERDA). Because these activities take place in the US at several laboratories, ERDA has coordinated the US groups in order to increase their effectiveness and facilitate international cooperation. The BNL Center (the National Neutron Cross Section Center) has been designated as the coordinating center for the US effort and as the center to maintain liaison with non-US centers. US commitments may in some cases for conciseness refer to actions on particular US groups, but the BNL Center is responsible for follow-up and reporting progress to the international network.

USSR/CAJaD

CAJaD is the leading organization in the USSR on compilation, evaluation and dissemination of nuclear data. The USSR AESC (State Committee on Atomic Energy) Nuclear Data Commission and its Nuclear Data Coordination Group determine all of the activities of the Centre. The Coordination Group interacts with the Centre, and based on the analysis of user's needs determines the requirements for nuclear data evaluation and compilation for corresponding groups in USSR AESC Institutes, USSR Atomic Science Institutes and schools of higher education. The Coordination Group also formulates recommendations to research laboratories in institutes for the measurement of needed nuclear data and guides their research programmes. Control over implementing recommendations from the Nuclear Data Committee and Coordinating Group is the responsibility of CAJaD USSR AESC.

IAEA/NDS

Within the framework of international cooperation for the compilation and evaluation of NSD data, IAEA/NDS will continue to function as a centre of international coordination and distribution of NSD data. IAEA/NDS will continue to organize periodic meetings of the NSDD network with the aim to develop and maintain a fully international system for the compilation, evaluation and dissemination of NSD data. In addition, this centre reviews the requirements for NSD data of importance to the uses and applications of radiations and isotopes in cooperation with the International Nuclear Data Committee.

In addition to the above responsibilities, IAEA/NDS was asked by this meeting to serve as contact point for new groups or centres wanting to join the NSDD network, and to identify important discrepancies in mass chain and horizontal compilations and evaluations.

Action 23

F.2. Distribution of Mass Chain Evaluation Responsibilities

1. As a reference point for the discussions on the distribution of mass chain evaluation responsibilities, the latest "Cumulated Index to A-chains" (published as a rule on one of the introductory pages of every issue of Nuclear Data Sheets) from the May 1976 issue was introduced to the meeting. A copy of this index is reproduced as Appendix 28.

2. Extensive discussions on the sharing of the evaluation effort which is to be performed by the network resulted in preliminary statements of commitment, intent or interest by all interested centres and groups; these are given in Table F2. Initially, the International File of Evaluated Data will be comprised of evaluations from groups currently recycling mass chain evaluations.

Because of a few cases of overlapping interest, and because of the impossibility for some participants to make firm commitments at this time, definitive assignment of responsibility for specific mass ranges could not be made in the course of the meeting, to supersede the existing ranges of responsibility for mass chain evaluation.

Although it was considered by some participants that a certain amount of duplication or overlap in responsibility (particularly at the outset of this cooperative effort) is not undesirable, it was felt in general that it is in the interest of the overall efficiency to avoid duplication of labor as much as possible. Two specific areas of overlap were identified: the range of light nuclei (A=1 to A=10) and the range of heavy nuclei (A=238 to A=244), both of which have traditionally been the responsibility of US evaluation groups, and play at the same time a significant role in the development of nuclear science and technology. In particular, the interest and responsibility of the Soviet Union in these two mass regions were specifically emphasized (see Appendix 29).

3. As a consequence of these discussions, the US representatives volunteered to discuss with US/NDP evaluators the possibility to share the evaluation of the A=238-244 mass chain range with the Soviet Union.

Action 25

Table F2

Present and Intended Mass-Chain Evaluation Activities

1A	US/BNL	The mass range to be evaluated by BNL will be 136-145. It will begin in October 1976 with the evaluation of masses 141 and 142. Mass 141 is estimated to be completed by late summer 1977.
1B	US/NDP	mass-chain evaluation is a continuing effort with a long-term interest in recycling A=45-64, 101-129 and 193-263 (A=238-244 is currently under discussion). The Nuclear Data Project will provide evaluations for mass-chains in the range above A=44 that are not completed by other network members within the four-year cycle.
1C	US/LBL	will begin mass-chain evaluation probably in the mass range 146-152 between July 1977 and January 1978, after the completion of the 7th edition of the Table of Isotopes.
1D	US/INEL	The mass-chain evaluation effort is planned to be started in October 1976. The mass range will be 153 to 162.
1E	US/UP	continuing effort on an approximate four-year cycle; the higher masses in their range of responsibility (A=5-20).
2A	USSR/CAJaD	CAJaD has begun mass-chain evaluations in the ranges A=1-10, A=130-135 and A=238-244. Work now in progress is planned to be presented for the file in October 1977. It will consist of the evaluations of the mass chains A=9, A=134 and A=239. The possibility of the USSR participation in the mass-chain range A=210-230 will be investigated.
3A	NED/Utrecht	the sixth edition of the A=21-44 review is expected to be published in 1977/1978.

Table F2 (continued)

4A	UK/Daresbury	the mass region A=65-80 has been allocated (at this meeting) as the long-term responsibility of this UK centre. The first evaluations will be for A=70 and 71, followed by the masses 72-80, and finally for the mass range A=65-69. It is hoped that the first mass-chain evaluation will be completed by the end of 1977.
5A	FRG/ZAED	the mass region A=81-100 has been allocated (at this meeting) as a long-term responsibility of the ZAED. At the beginning of 1977 a scientist of ZAED will visit the US/NDP centre for a few weeks to learn from their experience. Later, in the course of 1977, ZAED plans to carry out a pilot evaluation, probably for A=86. The result of this evaluation will then be presented for discussion with other groups. After this has successfully been done, the remaining 19 mass chains would be covered in the required cycle time of four years.
10A	JAP/JAERI	NDL/JAERI has an interest in participating in the international collaboration of mass-chain evaluation activities. It is however premature to make any commitment at this meeting. NDL/JAERI will investigate the possibility of organizing a group of interested and competent physicists, as well as the practicability of its participation, and inform the network of the results. In the international NSDD network, NDL/JAERI will, for the time being, act as liaison with other groups in Japan. Long-term arrangements will be discussed meanwhile.
11A	SWD/Lund	has interest in the mass-chain region 45-60, but cannot make any commitment at the present time.
12A	KUW/KISR	Both the Kuwait Institute of Scientific Research and Kuwait University are interested to participate in the international effort of mass chain evaluation, and willing for commitments for a few mass chains. Because of Dr. Shihab-Eldin's own interest and expertise, they would like to get involved in medium mass range. An agreement has been reached with Twin (UK/Daresbury-Liverpool) to share A-chain compilation work. Kuwait will work on A=75-80.

4. The Soviet representative at the same time conveyed the intent to give consideration to slightly shifting their area of interest within the range of the light and heavy nuclei, and to look into the possibility of evaluating the mass range A=210-230.

F.3. Publications

1. The publication schedule as proposed by US/BNL, supplementing the regular publication of individual mass chain evaluations in the Nuclear Data Sheets and Nuclear Physics journals, was endorsed by the meeting participants.

2. The publications planned to be published by the US on a continuous basis are Recent References, a Handbook of Isotopes and a Wall Chart of Nuclides.

3. Recent References. The complete Recent References bibliographic file will be used to publish new references pertinent to the nuclear structure field two or three times a year. A cumulative issue of Recent References will be published periodically.

4. Handbook of Isotopes. Similar in scope to the Table of Isotopes and in a format similar to Radioactive Atoms, the Handbook of Isotopes will be published every four years, superseding the existing Table of Isotopes after its last issue projected for 1977. This handbook will include information on recommended radioactive decay schemes, major radiations, their energies and intensities and associated uncertainties for all isotopes.

5. Wall Chart of Nuclides. The Wall Chart of Nuclides will provide a quick reference source of information on ground state and isomeric state properties of all nuclides.

At the meeting, it was agreed that US/BNL and KACHAPAG at Karlsruhe should investigate coordinating the publication of the wall chart, each publishing it every four years, thus providing a new updated chart every two years.

Action 15

The meeting also noted the need to coordinate the production of wall charts in general, and recommended that all existing wall chart publication groups communicate with each other.

Actions 16 and 17

6. Publication of Mass Chain Evaluations. During the discussion on publication of NSD information, different opinions were expressed regarding the future publication of mass chain evaluations (see Appendix 30).

Although there was a consensus that publication of all NSDD evaluations (presently published in the Nuclear Data Sheets and Nuclear Physics journals) should eventually be published in one common publication, and that efforts to this end should be made by the network, current considerations involving presentation format, detail and scope of information to be included, commercial and copyright aspects, etc., preclude a quick amalgamation of these two established publications.

An interim solution which was proposed would entail coding the mass chain evaluations in the A=5-44 range after their publication in Nuclear Physics in ENSDF format, and perhaps publishing them, together with all other evaluations in one common format in the Nuclear Data Sheets.

Regarding the publication of mass-chain evaluations in Nuclear Data Sheets, it was confirmed that all publications are now produced automatically by computer from the current US/NDP file of selected NSDD (in ENSDF format). It is planned by US/NDP to improve the information content of its future Nuclear Data Sheets publications by including more supporting information.

Action 13

Notwithstanding considerations affecting the publication of mass chain evaluations, there was general agreement among the meeting participants to include all evaluated NSD data (originating from all contributing groups), coded in ENSDF format, in one single file so as to have one common international master file of evaluated NSD data which could be used to produce the above mentioned publications.

F.4. Administrative Procedures

1. In order to ease communication, all members of the network have been assigned a code (see Table F1 and Appendix 27).

2. Transmission of information pertinent to all members of the network was agreed to be sent in NS-Memoranda carrying a designator identifying the sending centre and the number of the memorandum sent by that centre. Each such memorandum should therefore bear the following heading

NS-Memorandum - xx/n

where xx is the code of the originating center and n is the number of the memorandum sent by that centre.

3. Copies of all correspondence pertinent to the network, should be sent to IAEA/NDS.

Action 26

4. IAEA/NDS has been entrusted to keep an archival copy of all correspondence and all NS-memoranda.

Appendix 1

Advisory Group Meeting on

Nuclear Structure and Decay Data for Applications

Vienna, 3-7 May 1976

List of Participants

Bambynek, W.	Bureau Central de Mesures Nucléaires C.E.C. Steenweg naar Retie B-2440 Geel, Belgium
Behrens, H.	Zentralstelle fuer Atomkernenergie-Dokumentation Kernforschungszentrum D-7514 Eggenstein-Leopoldshafen
Berényi, D.	Institute of Nuclear Research P.O. Box 51 H-4001 Debrecen
Bertrand, F.	Oak Ridge National Laboratory Oak Ridge, Tennessee, 37830, USA
Blachot, J.	Centre d'Etudes Nucléaires de Grenoble Cedex No. 85 F-38041 Grenoble Gare
Carlén, L.	University of Lund Solvegatan 14 S-223 62 Lund
Chukreev, F.E.	Institut Atomnoi Energii I.V. Kurchatova 46 Ulitsa Kurchatova Moscow D-182, USSR
Dunford, C.	Brookhaven National Laboratory National Neutron Cross Section Center Upton, New York, 11973, USA

Erdtmann, G.	Kernforschungsanlage Juelich Ges.m.b.H. Postfach 1913 D-5170 Juelich
Holden, N.E.	National Neutron Cross Section Center Brookhaven National Laboratory Upton, New York 11973, USA
Ivascu, M.	Institut de Physique Atomique de Bucarest B.P. No. 35 Bucarest, Roumanie
Kondurov, I.A.	Data Centre Leningrad Nuclear Physics Inst. Gatchina, Leningrad Region 188350 USSR
Legrand, J.	L.M.R.I. Centre d'Etudes Nucléaires de Saclay B.P. No. 2 F-91190 Gif sur Yvette France
Lorenz, A. (Scientific Sec.)	Nuclear Data Section I.A.E.A.
Marcinkowski, A.	Institut Badan Jadrowych Hoza 69 PL-00-681 Warsaw Poland
Nichols, A.L.	Chemistry Div. Bldg. 220 Atomic Energy Research Establishment Harwell, Didcot, Oxon OX11 ORA United Kingdom
Ohnuma, H.	Department of Physics Tokyo Institute of Technology Oh-Okayama, Meguro-ku Japan
Okamoto, K.	Nuclear Data Section I.A.E.A.
Pearlstein, S.	National Neutron Cross Section Center Brookhaven National Laboratory Upton, New York 11973, USA

Reffo, G.	Centro di Calcolo del C.N.E.N. Via Mazzini 2 I-40138 Bologna, Italy
Schmidt, J.J.	Nuclear Data Section I.A.E.A.
Sokolovskij, L.L.	Institut Atomnoi Energii I.V. Kurchatova 46 Ulitsa Kurchatova Moscow, D-182, USSR
Tamura, T.	Japan Atomic Energy Research Institute Division of Physics Tokai-Mura, Naka-Gun Ibaraki-Ken 319-11, Japan
Twin, P.	Oliver Lodge Laboratory University of Liverpool Liverpool L69 3BX United Kingdom
van der Leun, C.	Fysisch Laboratorium Sorbonnelaan 4 Utrecht, The Netherlands
Vonach, H.K.	Institut f. Radiumforschung und Kernphysik Boltzmanngasse A-1090 Vienna

 Appendix 2

Advisory Group Meeting

Nuclear Structure and Decay Data for Applications

Vienna, 3-7 May 1976

ADOPTED AGENDA

- Introductory Remarks and Election of Chairman
- Adoption of Agenda and meeting organization

MONDAY

A. Opening Statements

1. Introductory IAEA Statement
2. Presentation of US proposal
3. Statement of CEC position
4. Statement of USSR position
5. Statement of other countries' positions

B. International Evaluation Effort

1. Mass Chain Compilations
2. Horizontal compilation
3. Discussion of international cooperation

TUESDAY

C. Definition of Exchange System

1. Bibliographic file (Recent References)
   Content and Structure/Format
2. Numerical file (AG-59/6)
   Content and Structure/Format
3. Method of Exchange

D. Common Rules and Terminology

1. Common Dictionaries (AG 59/12, 21)
2. Definition of Terms (AG-59/14)
3. Common Evaluation Rules (AG-59/1-4)

WEDNESDAY

E. International File of Evaluated Nuclear Structure and Decay Data

1. Content
2. Structure/Format
3. Dissemination

F. Evaluated Structure Data Publications

1. Description of Publications
2. Availability and Dissemination of Publications

THURSDAY

G. Coordination of International Data Compilation and Evaluation Activities

1. Cooperating groups and their activities
2. Administrative procedures

FRIDAY

H. Summary of Conclusions and Recommendations

List of Papers Presented at the Meeting

Contrary to previous practice, where all papers presented to a meeting of this type were published in toto in a separate report, part of the papers presented to this meeting have been included into this summary report as Appendices (indicated below), the other part, consisting of the full reproduction or excerpts of published reports have not been included in this report. References to the latter category are made directly in the text of this report.

AG-59/1 Standards for ENSDF Data Sets
(included as Appendix 21)

AG-59/2 Choice of "Adopted" Values for ENSDF Data Sets
(reformulated and included as Appendix 25)

AG-59/3 General Policies - "Theory"
(included as Appendix 26)

AG-59/4 Summary of Bases for Spin and Parity Assignments - 1976
(included as Appendix 26)

AG-59/5 Services Available from Nuclear Data Project to Evaluators of Nuclear Structure Data
(included as Appendix 23)

AG-59/6 Nuclear Structure Data File. A Manual for Preparation of Data Sets, W.B. Ewbank, M.R. Schmorak .....
(not included, published as ORNL-5054)

AG-59/7 Outline of UK statement, excluding SRC contribution
A.L. Nichols
(included as Appendix 15)

AG-59/8 Table of Lifetimes of Nuclear Levels
Eh.E. Berlovich, L.A. Vajshnene, I.A. Kondurov.....
(not included, published as INDC(CCP)-89/N)

AG-59/9 Bibliothèques de Données Nucléaires de Décroissance
J. Blachot, Ch. Devillers, Ch. Fiche
(not included, published in report CEA-N-1822)

AG-59/10 US position on International Cooperation in the Area of Nuclear Structure Data
N. Holden
(included as Appendix 6)

AG-59/11 The Tasks of the Atomic and Nuclear Data Centre (CAJaD) of the USSR State Committee on the Utilization of Atomic Energy and Problems of Organizing International Co-operation in Connection with Data on the Structure of the Atomic Nucleus, L.L. Sokolovskij, F.E. Chukreev (included as Appendix 8)

AG-59/12 Compilation and Processing of Information on Nuclear Structure and Reactions at the Data Centre of the Leningrad Institute of Nuclear Physics (LIYaF) USSR Academy of Sciences
I.A. Kondurov, Yu.V. Sergeenkov, Yu.I. Kharitonov .....
(included as Appendix 9)

AG-59/13 The Evaluated Nuclear Structure Data File and the Decay Data File of the USSR CAJaD Centre of the State Committee on Atomic Energy
F.E. Chukreev, L.L. Sokolovskij
(included as Appendix 22)

AG-59/14 Summary Report of the Specialists' Meeting on Nuclear Data for Applications, 1974, A. Lorenz
(not included, published as INDC(NDS)-60/W)

AG-59/15 Die γ-Linien der Radionuklide, Band 1
G. Erdtmann, W. Soyka, Kernforschungsanlage Juelich, 1973
(not included, published as Jul-1003-AC)

AG-59/16 Status of the Japanese Activities on Evaluation of Nuclear Structure and Decay Data, T. Tamura
(included as Appendix 16)

AG-59/17 Charged Particle Activities in the Countries or Centres Represented
(to be included in report on Charged Particle Nuclear Data Meeting, April 1976, INDC(NDS)-77)

AG-59/18 Nuclear Data for Safeguards Techniques Evaluation of Gamma Ray Intensities
(not included, published report by Y.Yoshizawa et al. Dept. of Physics, Univ. of Hiroshima, Japan (1976))

AG-59/19 Participation in the Nuclear Structure Data Cooperation
H. Behrens
(included as Appendix 11)

AG-59/20 Bulletin of the Data Centre of the Leningrad Institute of Nuclear Physics (LIYaF), Issue 2
(not included, published as INDC(CCP)-72/LN)

AG-59/21 Report on the Nuclear Structure and Charged Particle Reaction Data Survey
(not included, part of published report BNL-NCS-20573 by S. Pearlstein et al., October 15, 1975)

AG-59/22 Minutes of the Meeting of a European ad hoc Group on Compilation and Evaluation of Non-Neutron Nuclear Data CBNM, Geel
(included as Appendix 7)

AG-59/23 Internal Conversion Coefficients for Atomic Numbers $Z \leq 30$, I.M. Band, M.A. Listengarten, M.B. Trzhaskovskaya
(not included, published as INDC(CCP)-92/N)

AG-59/24 The 0^+ States and Electric Monopole Transitions in Even-Even Atomic Nuclei, N.A. Voinova
(not included, published as INDC(CCP)-93/N)

AG-59/25 The Evaluation of Nuclear Data,
Yu.I. Grigoryan, L.L. Sokolovskij, F.E. Chukreev
(not included, published as INDC(CCP)-75/LN)

Appendix 4

Actions resulting from the Advisory Group Meeting on Nuclear Structure and Decay Data for Applications, Vienna, 3-7 May 1976

1.	Behrens	assess before the next NSDD meeting whether INIS can be used as a bibliographic reference system for NSDD by comparing INIS to Recent References for a few specific cases (mass chain data for A=27 and A=74, and L-shell fluorescence yields).
2.	NDS	arrange for IAEA, in cooperation with the NDP, to send official letter to publishers of pertinent nuclear physics and related journals, with the exception of journals published in the Soviet Union, requesting the adoption of the Recent References keywords system, and the sending of galley proofs to the Oak Ridge NDP for checking the keywords before publication of the articles, and inform the network on the results.
3.	ORNL/NDP	provide to the network documentation on the Recent Reference system consisting of - a complete set of keywords, - coding instructions, - input format, - internal format, and - exchange format.
3.a.	ORNL/NDP	keep the documentation of the Recent Reference system up-to-date and provide this documentation at timely intervals to the network.
4.	network	evaluate the use of ENSDF as an exchange format and prepare suggestions for its improvement before the next general meeting.
5.	ORNL/NDP	keep the documentation of the ENSDF system up-to-date and provide this documentation at timely intervals to the network.
6.	network	review the evaluation methods proposed by CAJaD, described in document AG-59/25, and communicate comments to the network before the next general meeting.

7.	Behrens	supply substantiation on inaccuracies in document no. AG-59/4 (e.g. items 15 to 18) to ORNL/NDP.
8.	ORNL/NDP	investigate the validity of Behrens' comments and inform the network accordingly.
9.	NDS	upon request from the network, obtain CODEN descriptors for journals, conferences and laboratory reports not yet included in the CODEN system.
10.	NDS	ask the pertinent authorities in Poland, Romania and Hungary and other East European countries to organize the preparation of entries to Recent References from nuclear literature published in their countries.
11.	ORNL/NDP	make available to the network a list of all computer programmes used by NDP together with abstracts.
12.	ORNL/NDP	provide to the network an index to the nuclear data files held by the NDP.
13.	participants	send comments to BNL on the desirable content of the Nuclear Data Sheets.
14.	ORNL/NDP	prepare a list of quantities on the basis of all proposals presented to the meeting, distribute it as soon as possible to the network for comment and prepare final list for eventual adoption by the network.
15.	KACHAPAG/BNL	try to coordinate the wall chart efforts at BNL and Karlsruhe, on the basis of the alternating two years publication cycle suggested by ZAED.
16.	participants	communicate to NDS all known national wall chart publication efforts.
17.	NDS	disseminate this information to all participants and arrange for existing wall chart groups to get in touch with each other.
18.	Reffo	provide information on the γ-ray tables published by Sangiust/Milan to NDS.

19.	Pearlstein	summarize the transcript of the discussions on publications, in consultation with other meeting participants concerned, and send the summary to NDS for inclusion in the meeting minutes.
20.	participants	send to NDS information on horizontal compilations, not contained in the present list.
21.	NDS	discuss the problem of duplication of FPND compilations and evaluations at the Second FPND Specialists Meeting.
22.	NDS	act as a central post box for computer files of horizontal compilations and evaluations and publish and disseminate at appropriate intervals an information letter on published, ongoing and planned horizontal compilations and evaluations. (Specify cycle time, status and content where possible).
23.	NDS	extract important discrepancies from mass chain and horizontal compilations and evaluations and bring them to the attention of appropriate groups. (e.g. INDC).
24.	ORNL/NDP	make the ENSDF file compiled at NDP available to the network, and provide associated computer programmes on request.
25.	BNL	discuss with ORNL/NDP the possibility to relinquish their responsibilities for mass chain evaluations in the A=238 to A=244 range.
26.	network	send copies of all relevant correspondence to the Nuclear Data Section.

Appendix 5

Opening Statement by J.J. Schmidt at the May 1976 NSDD Meeting

Schmidt welcomed the participants and reviewed briefly the previous efforts towards the assessment of the requirements for NSDD by the INDC, particularly its two Subcommittees for Energy and Non-Energy Applications of Nuclear Data, and towards the international cooperation in the compilation of the required data. He expressed his appreciation for the successful coordination of the national NSDD compilation and dissemination responsibilities in the USA and USSR and the interest and willingness of these and several other countries to share the work in the compilation and exchange of mass chain nuclear data, as a precondition for the success of this meeting and for future fruitful cooperation between the data centres and groups involved. He therefore wished this meeting to achieve two goals, first to agree on the cooperation in the compilation of NSDD and secondly to start to develop the technical rules and procedures for such a cooperation.

Appendix 6

IAEA Advisory Group Meeting on Nuclear Structure and Decay Data for Applications

Vienna, 3 - 7 May 1976

US position on international cooperation in the area of nuclear structure data. Presented by Dr. Norman Holden, National Neutron Cross Section Center, Brookhaven National Laboratory, USA.

I. INTRODUCTION

We appreciate being given the opportunity to present information to this meeting on the United States' efforts in the compilation and evaluation of nuclear structure data, and the US viewpoint on international cooperation in this field.

For many years now, the United States has taken part in a similar internationally cooperative effort in the neutron physics field among the so-called 4-centers.[a] As a result of this cooperation, each of the centers has been enabled to keep pace with most of the world's production of neutron data (from the viewpoint of bibliographic and compilation needs) without proposing large expansions of each center which would be unrealistic in these times of tight budgets.

It is hoped that advantages similar to those achieved by the 4 centers will be gained through cooperation in the nuclear structure area. Discussions of international cooperation in nuclear structure data activities began in 1970. Since then work has continued at many centers in many countries. As a result of these increased national efforts we believe significant commitments at this meeting can lead to substantial accomplishments through the cooperation of the various groups involved.

Our presentation will try to address directly the needs of the basic and applied research community and our philosophy for how these objectives are to be accomplished and we shall make specific recommendations to this meeting.

---

a) The National Neutron Cross Section Center, Upton, New York; the NEA Neutron Data Compilation Centre, Saclay, France; the Centr po Jadernym Dannym, Obninsk, USSR; and the IAEA Nuclear Data Section, Vienna, Austria.

II. What is Needed by the Research Community

A) Timely publications of reference material that are useful to the basic and applied research communities.

References on all work in the nuclear structure field should be compiled and best values of the appropriate quantities for all nuclides recommended. Some examples of these publications are the following:

A Wall Chart of nuclides would be updated on a two year cycle covering all nuclides.

A Handbook of Isotopes would be published on a four year cycle and would include information on radioactive decay schemes, major radiations, and intensities.

Nuclear Data Sheets would be updated on a four year cycle and would cover all mass chains. The format would be uniform and would complement more detailed versions published elsewhere.

Recent References would be published two or three times a year and would provide a timely update of literature coverage. A cumulative issue would also be published periodically.

B) Primary resource files.

1. A master file of evaluated data from which could be derived various publications should be available. Thus the various mass chain parameters as well as thermal neutron cross sections, resonance parameters, and isotopic abundances would be available.

2. A file of experimental data selected by evaluators should be available. This file could provide selected experimental values which could be published along with a recommended value to give users an indication of the status of the data. Aside from publication, this file could provide users with retrievals of the best selected experimental values of various parameters.

3. A file of bibliographic data which would include all pertinent references should be available from which Recent References would be published. In addition to the data in refereed journals which is published in Recent References, selected retrievals from the complete file could be obtained.

C) Specialized services from data centers.

Retrievals on request could be made from any of the primary resources mentioned above. These services should be especially important to evaluators. Some of these would include selected printouts from the complete indexed bibliography to nuclear structure literature and monthly listings of new nuclear structure references on their evaluation topics. Some specialized services would also be made available to the general research community such as selected printouts on given parameters.

III. How the Objectives are to be Accomplished

A) A cooperative effort should take place to accomplish these tasks. In the United States, a network of evaluators has been set up to ensure that the appropriate data are evaluated. This network includes evaluators[b] at the Brookhaven National Lab (BNL), the Idaho Nuclear Engineering Lab (INEL), Lawrence Radiation Lab at Berkeley California (LBL), the Oak Ridge National Lab (ORNL), and the University of Pennsylvania (UP). The BNL center coordinates this US cooperative effort and also acts as liaison with non-US compilation and evaluation efforts.

As a result of this IAEA meeting, it is expected that US and non-US evaluators will form a worldwide network to insure that all evaluation are updated on a timely basis with a minimum of overlap.

B) As part of this worldwide network the United States is willing to provide a number of services to the network.

A master file of evaluated nuclear structure data will be maintained.

Files of selected experimental data and bibliographic data will be maintained.

Files of related nuclear data will be maintained which are common to the publications mentioned above, e.g. thermal neutron cross sections, resonance parameters, isotopic abundances, etc.

The above mentioned publications will be printed on a timely basis.

Services will be provided to US basic and applied researchers, non-US scientists, or to the centres servicing their area.

---

b) Although the sponsoring laboratories are mentioned, participation is specifically by the National Neutron Cross Section Center (BNL), Gamma-ray Spectrum Group (INEL), Table of Isotopes (LBL), Nuclear Data Project (ORNL), and Professor F. Ajzenberg-Selove (UP).

IV. Details of Servicing and Evaluations

ORNL is willing to input and maintain the master file of nuclear structure data for all nuclides, the file of selected experimental data, and the bibliographic file. They will also provide services to evaluators who are working on mass chains and contributing input to the files. Some of these services would include consistency checking for γ data prepared in an adopted format, and automated calculation of log ft, capture ratios, conversion coefficients for the evaluator's consideration.

BNL will receive the files from ORNL and combine them with files of data on related nuclear quantities common to the publications mentioned. BNL will provide general services to US and non-US scientists either directly or through appropriate data centres.

In the past, the ORNL and University of Pennsylvania evaluation efforts in conjunction with Endt and Van der Leun at the University of Utrecht, in effect has provided coverage for all masses A = 5 to 263 and the new US cooperative effort will attempt to greatly reduce the cycle time for its range of coverage. However, they would welcome the opportunity to reduce coverage as contributions from other evaluators are forthcoming.

The US Energy Research and Development Administration wishes to foster even closer ties with non-US evaluators than now exist. On a selective basis some partial financial assistance might be provided toward travel and subsistance for visits to the US centers for information, training and collaboration. Interested parties should apply to the US coordinating center.

V. CONCLUSION

Considerable preparation for this meeting has been made by the many countries attending. We are looking forward to a successful meeting and substantial progress in international cooperation in nuclear structure data evaluation.

Minutes of the Meeting of an European ad hoc Group on

Compilation and Evaluation of Non-Neutron Nuclear Data

April 8, 1976

Central Bureau for Nuclear Measurements
(CBNM)
Geel, Belgium

Geel, April 27, 1976

The Advisory Committee on Program Management (CCMGP) of the Central Bureau for Nuclear Measurements (CBNM), Geel recommended at its meeting of January 14 and 15, 1976 that there should be a meeting of an ad hoc group together with expert cooptees in order to discuss the effort devoted to the evaluation of non-neutron nuclear data within the European Community and to provide a collective European view to be presented to the IAEA Advisory Group Meeting in Vienna, May 3-7, 1976. This ad hoc group held a meeting on April 8, 1976 at the CBNM in Geel. The list of participants is found as Annex I.

Throughout the discussions the following terms have been used:

1. data compilation: collection of experimental data;
2. data evaluation: assignment of credible values and their uncertainties after consideration of all pertinent information;
3. vertical evaluation: evaluation of nuclear properties for all nuclides with the same mass number;
4. horizontal evaluation: evaluation of a specific property for nuclides with various atomic numbers;
5. selective evaluation: evaluation of data selected according to the needs of the users. This kind of evaluation may have vertical and/or horizontal characteristics. It may even contain data not belonging to the nuclear decay (e.g. stopping power).

An introduction was given by the chairman, Mr. Y. Le Gallic, on the objective of the meeting. He underlined the necessity to reach an international cooperation in the field of compilations and evaluations coordinated by the IAEA and to provide a collective European view to be presented at the IAEA meeting in Vienna. Mr. W. Bambynek, secretary of the ad hoc group, reported on the "status quo" of the compilation and evaluation activities. The members of the ad hoc group recognized the importance and necessity of non-neutron nuclear data evaluations and the international cooperation in this field. The following statements have been made by the participants:

H. Behrens, ZAED, Karlsruhe, Germany

The ZAED intends to participate in nuclear structure compilations and evaluations in the frame of the BNL proposal (BNL-NCS-20573 (1975)). The envisaged manpower is 2-3 man year/year. They plan to perform vertical evaluations of about 20 A chains and to do some horizontal evaluations on e.g. γ-ray transition and β-decay data.

G. Erdtmann, KFA, Jülich, Germany

The actual program of the KFA does not include evaluation work. Nevertheless Mr. Erdtmann hopes that possibly he could contribute in horizontal evaluation by the up-dating of his γ-ray tables (JÜL-1003-AC) published in 1973. At the moment no formal commitment can be made for the future.

A.L. Nichols, AERE, Harwell, U.K.

The representative of the National Laboratories in the U.K. and of the Chemical Nuclear Data Committee (CNDC) states that mostly horizontal and user oriented compilations and evaluations are actually performed. For the horizontal activity 0.5 man year/year are concentrated on fission yield and on α-decay data. The user oriented evaluations are performed with 1.5 man year/year on fission products decay data in the frame of the U.K. reactor program. However, it has been stressed, that no continuity of either horizontal or user oriented evaluations can and will be guaranteed. In the case of the selected evaluations there is very little possibility of in-depth evaluations. The CNDC has suggested that the National Physical Laboratory (NPL) in Teddington might become involved in evaluation work. The NPL recognizes the need for evaluations. However, it regrets not to be in a position to undertake evaluation work, either now or in the immediate future.

P. Twin, University of Liverpool, Liverpool, UK

The representative of the Science Research Council (SRC) expressed the Council's interest and willingness to support

evaluations. At present none of the UK universities are involved in evaluations. However, there is a proposal to set up a team of evaluators based on the NSF which is being built at Daresbury where extensive computer facilities are presently available. The SRC is willing to support vertical evaluation activities with a manpower of about 1 man year/year as defined in the BNL proposal.

G. Reffo, CNEN, Bologna, Italy

Actually no activity on non-neutron nuclear data evaluations is going on in Italy. In the frame of CNEN no commitment for any evaluation manpower can be made. Nevertheless, they are interested in level schemes and branching ratios for fission products.

W. Bambynek, CBNM, Geel, Belgium

The CBNM as a service laboratory of the European Community concentrates its evaluation efforts mostly on horizontal and selective ones (e.g. $T_{1/2}$ of actinides, nuclear electron capture data). A commitment of 1 man year/year can be made.

J. Legrand, LMRI, Saclay, France

The selective evaluation activity, already started, will be continued. The results of 30 radionuclides are published in the "Table de Radionucléides". It could be discussed that these and future results might be included in the Handbook of Isotopes projected in the BNL-study. No vertical evaluations will be made. Interest was expressed in horizontal evaluations (e.g. atomic masses, β-decay, fluorescence yields) where some work will probably be done for absolute γ-ray intensities, half-lives and stopping power. The total manpower involved at LMRI is 2 man year/year.

At CEA in Grenoble Mr. J. Blachot will continue his horizontal compilation and evaluation of fission product data. The available manpower will be 0.5 man year/year.

A.H.W. Aten, IKO, Amsterdam, The Netherlands

The Utrecht group (P.M. Endt and C. van der Leun) intends to continue the vertical evaluations on their 24 A chains with a manpower of 1.5 man year/year.

Mr. H. Verheul, Vrije Universiteit, Amsterdam, performs occasionally vertical evaluations as a consultant under subcontract to ORNL with an estimated manpower of 0.2 man year/year.

A.H. Wapstra, IKO, Amsterdam, and University of Technology, Delft, The Netherlands

The 0.5 man year/year activity devoted to the horizontal evaluation of atomic masses will be continued. A new edition of the mass tables is believed to be finished within the next six months.

From the discussion which followed these statements of the participants, some points of general agreement could be deduced.

1. The importance of an international cooperation in the field of compilations and evaluations and the necessity of a cooperation on the European level in such work have been underlined.

2. It has been stressed that vertical as well as horizontal and selective evaluations have not only to be complementary but also interactive. All these kinds of evaluations can advantageously be used in a feedback procedure to eliminate ambiguous and doubtful results. Such a procedure has been applied successfully in the excellent cooperation of Mr. A.H. Wapstra with the ORNL Nuclear Data Group.

3. The effort for evaluations to be made by European institutions has been summarized in the following table. For some of the centers the final implementation awaits approval by the funding organizations involved.

Country	Institution	Estimated manpower [man year/year] for Vertical	Horizontal Evaluations	Selected
Germany	ZAED, Karlsruhe	2-3	0.4 [a]	
United Kingdom	Nat. Laboratories		0.5 [b]	1.5 [b, c]
	SRC	1		
The Netherlands	Rijksuniversiteit, Utrecht	1.5		
	IKO, Amsterdam		0.5	
	Vrije Universiteit, Amsterdam	0.2		
France	LMRI, Saclay			2.0 [d]
	CEA, Grenoble		0.5	
CEC	CBNM, Geel		0.5	0.5

a) These evaluations are performed by various laboratories in Germany.

b) Continuity cannot and will not be guaranteed.

c) There is very little possibility of in-depth evaluations.

d) LMRI will evaluate about 100 specially selected radionuclides.

It has been estimated that vertical evaluations of about 50-60 A chains could be treated within a 4 years period (ZAED, Germany: about 20 A chains; SRC (U.K.): 12-16 A chains; Utrecht group (The Netherlands): 24 A chains). In order to guarantee continuity of the work, a minimum of about 10 A chains per evaluation activity was thought to be necessary.

4. The participants recommended a permanent working group to coordinate the horizontal and selected evaluations of non-neutron nuclear data inside the European Community. The secretariat of this group will be helt by the CBNM.

5. It was agreed that Mr. W. Bambynek will present a summary of the discussions of the European ad hoc group meeting in Geel at the

forthcoming Vienna Advisory Group Meeting. However, definite commitments will be made by the representatives of the various laboratories.

The tentative agenda of the Vienna meeting was briefly discussed more or less point by point. That concerning points A and B is stated above. For some other points the discussion did not always result in a common position but some general remarks are listed below.

C1 : Bibliographic File: There are two systems widely used: Recent References and INIS. This seems to be a duplication of effort. For the time being the two systems ought to be used in parallel because both show advantages. However, for the long term planning a study should be made concerning their combination.

C2/3 : Numerical File and Method of Exchange: The European laboratories are very interested in obtaining an up-dated copy of each file. The mode of exchange has to be negotiated with care.

D3 : Common Evaluation Rules: Due to the fact that this subject is extremely difficult, a working group should be set up to reach agreement upon some basic evaluation rules. Such a group should be composed of experimentalists from various fields preferably with metrological experience. - Furthermore it is strongly recommended that evaluators keep part of their experimental activity in order to maintain their expertise.

E1 : Content of an International File: Such a file should contain at least the data published already in the Nuclear Data Sheets, but in addition associated atomic data should be considered, e.g. X-ray and Auger electron intensities and energies.

In addition the members of the ad hoc group were asked to supply the secretary in a written form their requests for horizontal and selective data evaluations, if possible before the Vienna meeting.

W. Bambynek
H.H. Hansen

Annex 1

List of participants

A.H.W. Aten, Jr.
Instituut voor Kernphysisch Onderzoek (IKO)
Ooster Ringdijk 18
Postbus 4393
NL-1006 AMSTERDAM

W. Bambynek
Central Bureau for Nuclear Measurements
CBNM, Euratom
Steenweg naar Retie
B-2440 GEEL

H. Behrens
Zentralstelle für Atomkernenergie-Dokumentation (ZAED)
Kernforschungszentrum Karlsruhe
D-7501 LEOPOLDSHAFEN

G. Erdtmann
Zentralinstitut für Analytische Chemie
Kernforschungsanlage Jülich (KFA)
Postfach 1913
D-5170 JULICH

H.H. Hansen
Central Bureau for Nuclear Measurements
CBNM, Euratom
Steenweg naar Retie
B-2440 GEEL

Y. Le Gallic
Laboratoire de Métrologie des Rayonnements Ionisants (LMRI)
B.P. n° 2
F-91190 GIF-sur-YVETTE

J. Legrand
Laboratoire de Métrologie des Rayonnements Ionisants (LMRI)
B.P. n° 2
F-91190 GIF-sur-YVETTE

A.L. Nichols — Chemistry Division
Atomic Energy Research Establishment (AERE)
HARWELL, Didcot, UK
Oxon, OX11 ORA

J.P. Perolat — Laboratoire de Métrologie des Rayonnements Ionisants (LMRI)
B.P. n° 2
F-91190 GIF-sur-YVETTE

G. Reffo — Centro di Calcolo del CNEN
Via Mazzini 2
I-40138 BOLOGNA

P. Twin — Department of Physics
University of Liverpool
Oliver Loge Laboratory
Oxford Street, P.O. Box 147
LIVERPOOL, L69 3BX, UK

A.H. Wapstra — Instituut voor Kernphysisch Onderzoek (IKO)
Ooster Ringdijk 18
Postbus 4395
NL-1006 AMSTERDAM
and
Interuniversitary Reactor Institute
Berlageweg 1
NL-2200 DELFT

76-3506
Translated from Russian

Appendix 8

THE TASKS OF THE CENTRE FOR DATA ON THE STRUCTURE OF THE ATOMIC NUCLEUS AND NUCLEAR REACTIONS OF THE USSR STATE COMMITTEE ON THE UTILIZATION OF ATOMIC ENERGY (CAJaD) AND PROBLEMS OF ORGANIZING INTERNATIONAL CO-OPERATION IN CONNECTION WITH DATA ON THE STRUCTURE OF THE ATOMIC NUCLEUS

L.L. Sokolovskij, F.E. Chukreev

The task of the Atomic and Nuclear Data Centre is not only to collect information about nuclear structure and radioactive transformations, and to analyse the requests of its users, but also to organize work on the evaluation of the data needed to solve scientific and technological problems and to develop fundamental research in the USSR. The evaluation is performed both by CAJaD staff and by invited qualified groups of physicists in the GKAEh institutes, the USSR Academy of Sciences and higher educational establishments. An important part of the Centre's work is the formulation of recommendations on unified methods of evaluating nuclear data.

The Centre has over three years' experience in meeting the requests of users in the Soviet Union and in a number of Socialist States of Eastern Europe; this has compelled us to make some effort now to establish in the USSR a unified system of co-operation between users, evaluators and suppliers of nuclear data. The proposed co-operation system is shown in Fig. 1.

The Centre is the leading Soviet organization for the collection, evaluation and dissemination of nuclear data. The GKAEh Nuclear Data Commission and the Nuclear Data Co-ordination Group of that Commission control all activities of the Centre. The Co-ordination Group, in co-operation with the Centre and on the basis of analysis of users' requests, outlines the spheres of activity in the evaluation and compilation of nuclear data for the groups concerned in the institutes of the GKAEh, the USSR Academy of Sciences, and the higher educational establishments. The Co-ordination Group also makes recommendations for the research laboratories of these institutes on the measurement of the required nuclear data and corrects their research programmes. Compliance with the recommendations of the Nuclear Data Commission and the Co-ordination Group is supervised by the Atomic and Nuclear Data Centre.

This organizational system of nuclear data work in the Soviet Union is not fully established yet, and not all contacts are operating efficiently yet, but we are convinced that the system will be instituted in the near future, because the tasks awaiting the Atomic and Nuclear Data Centre can be fully accomplished only if the work of all components of this system is well co-ordinated.

The Centre must supply nuclear data for the following important applied fields:

- Nuclear power engineering;
- Controlled nuclear fusion research;
- Safeguards system techniques;
- Elementary analysis of material by means of nuclear physics techniques;
- Utilization of actinide elements;
- Production and use of artificial radioactive isotopes;
- Protection and dosimetry;
- Medical applications of radioisotopes.

This list of the main applied fields of science and technology which must be supplied with nuclear data cannot, of course, be considered exhaustive. There is at present an observable trend towards introducing methods developed for the solution of nuclear physics problems into other areas of application which will no doubt pose new, perhaps even not purely nuclear, problems.

The extensive and manifold nuclear data requirements of scientists and engineers in various disciplines can evidently be satisfied only if a file of evaluated data on nuclear structure and radioactive transformations is available. Such a data file must cover, to the fullest extent possible, the quantum mechanical characteristics of the ground and excited states of all nuclei, both stable and radioactive, the modes and types of decay of nuclear states, the main mass characteristics of nuclei and the nucleon binding energies within the nucleus. It is also clear that such a file should not contain data based on any particular model conceptions, as these may only introduce an inappropriate attitude to some nuclear data.

In view of what has been said above, the Centre's activities in the years immediately ahead will be concerned with:

- The preparation of a file of evaluated nuclear structure data;
- Constant supplementing of a bibliographic reference file including abstracts of papers on nuclear structure, nuclear radiation and nuclear reactions;
- Preparation and maintenance of files of evaluated and experimental data on radioactive nuclear transformations;
- Compilation of data on charged particle beam activation cross-sections and reaction product yield ("integral" charged particle nuclear data).

Large-scale development of the collection, evaluation and dissemination of nuclear data will be very difficult unless the efforts of the centres in various countries are combined. Because of the lack of a well co-ordinated system of international co-operation the work on compiling and evaluating nuclear data cannot be done sufficiently well; this lack may even make the work of national centres considerably more difficult.

The attitude of the USSR Atomic and Nuclear Data Centre to the problems of organizing international co-operation has been explained in detail at previous IAEA meetings (April-May 1974, September 1975) [1, 2]. Here we need only mention that in our opinion the fundamental principle of international co-operation in preparing a file of evaluated data on nuclear structure and radioactive transformations and a bibliographic reference file should be that of free exchange of evaluated, experimental and bibliographical data between the co-operating centres and groups.

The USSR Centre is willing to undertake, as a contribution to the international file of evaluated data on nuclear structure and radioactive transformations, the evaluation of the following A-chains:

A = 1-10

A = 101-106

A = 238-244

In addition, the Centre is making abstracts of Soviet papers on nuclear structure, radioactive transformations and nuclear reactions available for the international bibliographic reference file.

On the basis of their experience with the exchange of neutron data, a number of scientists in the Soviet Union take a very sceptical view of the possibility of actually achieving international co-operation in the matter of free exchange of bibliographical, numberical and evaluated data; this is why they object to limiting the activities of the Centre to the A-chains mentioned above. This attitude is quite justified, since the absence of free exchange compels us to prepare a file on the nuclear structure and radioactive transformations of all A-chains for use by the scientists of our country.

REFERENCES

1. L.L. Sokolovskij, Yu.I. Fenin, F.E. Chukreev, INDC(NDS)-61/W, Vienna, July 1974, p. 82.

2. Yu.I. Grigoryan, A.E. Ignatochkin, L.L. Sokolovskij, F.E. Chukreev, INDC(NDS)-69, Vienna, 1975.

Appendix 9

76-3506
Translated from Russian

COMPILATION AND PROCESSING OF INFORMATION ON NUCLEAR STRUCTURE AND REACTIONS AT THE DATA CENTRE OF THE LENINGRAD INSTITUTE OF NUCLEAR PHYSICS (LIYaF) USSR ACADEMY OF SCIENCES

I.A. Kondurov, Yu.V. Sergeenkov, Yu.I. Kharitonov
B.P. Konstantinov Leningrad Institute of
Nuclear Physics
USSR Academy of Sciences

This paper was prepared for a meeting of the Advisory Group on Nuclear Structure and Decay Data for Applications and the second Consultants' Meeting on Charged Particle Nuclear Data Compilation, IAEA, Vienna, April-May 1976. The general purpose of these meetings was to promote international co-ordination of the compilation, evaluation and dissemination of data on nuclear structure and reactions.

Exchange of bibliographical data

1. The basis of any information system, especially of a system involving international data exchange, is a bibliographic reference file containing both a bibliographical description of documents and a description of their contents by some particular key word system suitable for automatic retrieval of documents in the file.

The following are the three bibliographical systems most widely used in nuclear data work:

CINDA - An index of papers containing neutron data;

INIS - A bibliographical system concerned mainly with the needs of nuclear technology;

NDP - The Recent References system adopted in Oak Ridge for the description of papers containing data on nuclear structure and reactions.

2. In developing a bibliographical system for basic nuclear physics research the LIYaF Data Centre adopted the NDP format because it also includes papers on neutron physics and reactions with charged particles and can be used for the description of theoretical papers on nuclear structure and reactions. This format has been under development for a long time and the NDP file contains descriptions of most papers on low- and medium-energy physics. Almost all important periodicals on nuclear physics provide descriptions of the articles in NDP key words.

3. The LIYaF Data Centre collects NDP key word descriptions of all papers on nuclear physics published in the Soviet Union. So far the Data Centre has collected and stored in machine-readable form nearly 1500 such abstracts covering the period from 1972 to the present. Some of these abstracts were published by the LIYaF Data Centre [1] (radioactivity and nuclear reactions) and the GKAEh Atomic and Nuclear Data Centre [2] (theoretical work on nuclear structure).

In keeping with the requirements of the Data Centre's information retrieval system the input routine transforms the NDP format into an internal format, in which authors, title etc. are sorted out under their respective headings; at the same time the key words are converted into a form suitable for use in retrieval instructions. Figure 1 illustrates these two formats. Retrieved information can be printed out either in the Cyrillic alphabet or in transliteration. Entries are recorded in the EBCDIC code on nine-track magnetic tape with a density of 800 bits per inch.

4. The NDP format can be used as the basis of an international bibliographic reference file on nuclear structure and reactions, including also reactions with charged particles. The modifications of and additions to the format discussed at the first Consultants' Meeting on Charged Particle Nuclear Data Compilation [3] are entirely feasible technically, and can be introduced as work proceeds. The main decision to be made is what organizational principles the system is to function on:

(a) Free exchange of information;

(b) Regional processing of documents;

(c) Co-ordinating centre (centres);

(d) *Dynamics and discipline of exchange;*

(e) Standardization of software (where possible);

(f) Procedure and frequency of publishing current and cumulative information.

5. The organization of an international bibliographical file raises the problem of a uniform global index number which can be used independently by many different groups. Such an index could then be used for automatic retrieval and elimination of duplicated entries in the individual files. The experience of the LIYaF Data Centre shows that for practical work with documents, the annual input of which does not exceed 10 000, it is sufficient to use an index showing the year (two digits), the three first letters of the first author's name and the three last digits of the number of the page on which the paper begins in the periodical, or of the number of the preprint or report if it contains only one paper.

Coincidental duplications in this system are insignificant, and are eliminated entirely by machine analysis if an agreed abbreviation of the publication's title is added to the index.

6. With regard to agreement on the abbreviation of titles of periodicals and other publications it would obviously be desirable to adopt the international CODEN system, while for encoding the proceedings of conferences and more restricted meetings the abbreviations of the EXFOR dictionary might be used.

7. The LIYaF Data Centre is ready to participate in the international bibliographical data exchange system and to contribute its proper share to the work on producing and disseminating key word abstracts of papers published in Soviet nuclear physics publications.

Exchange of numerical data

1. The total quantity of numerical data now being produced and published is so great that the presentation of all these data in machine-readable form is a daunting problem. Nevertheless, there is an urgent need for the selection of such information by some means.

The well-known publication "Nuclear Data Sheets" periodically issues a selection of the best papers on the A-chains with a partial evaluation of the measured values. At present these data are recorded in Oak Ridge on magnetic tape in the ENSDF format, which was developed specially for the presentation of data on the properties of nuclear levels and transitions between them. For this reason it can in principle be used for the presentation in machine-readable form of the results of various experimental studies of nuclear structure. The LIYaF Data Centre has attempted to keep a record of work on the characteristics of the low-excitation states of ^{134}Co in this format [4].

2. Another method of presenting the results of specific papers is "horizontal" compilation. The Data Centre collects data and keeps a file on the lifetimes of excited states of nuclei [5], nuclear moments [4], the properties of excited-state 0^+ and E0 transitions [6], and deals with problems of recording on magnetic tape data on the rotational bands of deformed nuclei [7] and on γ-decay of analog states [8].

Until now each of these "horizontal" files has had its own format, although they all describe the properties of excited nuclear states. The Data Centre has developed a unified format for the presentation of numerical data on the characteristics of levels published in specific papers. An example of an entry is shown in Fig. 2.

3. It should be noted that not one of the formats described is suitable for recording spectrograms (γ- and ß-spectra, coincidences, angular dependences). The EXFOR system comes closest to a solution to this problem, and therefore it seems reasonable to consider the question whether EXFOR could be adapted to the presentation of raw (i.e. not distorted by processing) experimental nuclear structure data, especially since periodicals cannot at present publish all raw data.

Evaluated data

1. There have recently been two trends - general evaluations and specialized evaluations - in work on the evaluation of nuclear structure data.

The general evaluations, examples of which are the Nuclear Data Sheets, Tables of Isotopes [9], and "Decay series of radioactive nuclei" [10], contain a selection of the best or averaged characteristics of ground and excited states of nuclei. As a rule they are accompaneid by a list of relevant literature and give some published values - selected by the evaluator - for the most important quantities. With this data structure the user can make a critical analysis of the information used; even though incomplete such an analysis is at least sufficient. Selections of this kind are very useful in basic research.

At the same time work on specialized evaluations is developing rapidly in response to the needs of applied research. An example of this sort of work is the file of data on the decay of over 800 nuclei [11] which was compiled to meet the needs of reactor technology.

The data presented in specialized files are essentially reference information, in the sense that they are accepted unconditionally by their users. This, of course, imposes rigorous requirements with respect to the accuracy and reliability of such data.

2. The LIYaF Data Centre, the aim of which is to provide information for basic research on nuclear physics, is interested in keeping both general and specialized files of evaluated data. Of the specialized evaluations the most important for such research are metrological data on the characteristics of nuclear radiation, which are needed for calibration measurements, and atomic physics data, such as X-ray energies, the characteristics of interaction of radiation with matter, etc.

3. The Data Centre is very interested in keeping a general file of evaluated nuclear structure data and therefore it is ready to take part in international co-operation along these lines and to carry out the evaluations for one or two mass chains with A numbers in the range 104-134. The basic principle of co-operation should, in the Data Centre's view, be free exchange of evaluated, numerical and bibliographical data.

4. When an international data file on nuclear structure is under discussion it must be decided which nuclear characteristics should be included in the file, since research on nuclear structure in radioactive decay and nuclear reactions produces a large quantity of data of varying degrees of generalization.

It may be considered that the ultimate purpose of experimental nuclear spectroscopy research is to prepare a scheme of the excited states of the nucleus being studied together with the fullest possible information on quantum characteristics for each level: energy, spin, parity, magnetic and electric nuclear moments and partial probabilities of transitions to other quantum states.

This purpose is achieved by measuring the energy, time and space distributions of the radiation associated with the process being studied. The process of deriving level schemes from the results of these measurements is carried out in several stages, in each of which the information may be distorted by model conceptions of some kind.

I. The result of the first stage of research - measurement of distributions - is a set of instrumental spectra. This information is objective for any one device because the raw data are distorted only by the design characteristics of the instrument.

II. By taking these characteristics into account within a mathematical model of the instrument it is possible to evaluate by calculation the values of the process characteristics measured; this introduces distortions due to the inaccuracy of such a model. In research on the bound states of the nucleus such characteristics are: radiation energy (E_γ, E_{CE}, E_{β^+}, E_{β^-} etc.), radiation intensity (I_γ, I_{CE} etc.), intensities of complex events ($I_{\gamma\gamma}$, $I_{\beta\gamma}$, etc.) and the dependence of these intensities on time, direction in space, polarization, magnetic field and other parameters ($I = I(t, \vartheta, H \ldots)$).

III. By taking into account the kinetics of the process and the electromagnetic nature of the radiation transitions it is possible to determine the energy of the transitions, their intensity and multipole order, and possible values of spin and parity of the states between which these transitions take place.

IV. These data are sufficient for constructing a model-independent scheme of excited nuclear states and for obtaining their quantum characteristics: energies of levels (E), their spin and parity (J^π), magnetic and electric moments (μ, Q) and the partial widths determining the transition probability.

This stage represents the highest degree of generalization of experimental data on nuclear structure. Such data can be compared with calculations based on various nuclear models in order to verify the latter.

The data of the fourth stage might form the content of a file of evaluated data on nuclear structure, but this is impossible for the following reasons:

(1) The spins and parities are not known for all levels obtained;

(2) Not all transitions obtained by measurement of decay and reaction are present in the level scheme.

Thus it will be advisable to divide the file in question into two parts: level characteristics and radioactive decay characteristics. The first part will contain the data of the third and fourth stages of investigation, the second part will give those of the second stage. Tables 1 and 2 list the nuclear characteristics which must be given in the files.

5. The question of a computer format for presenting data in the international file is of secondary importance and can be settled as work proceeds.

Computer programs for solving problems in atomic and nuclear physics

The LIYaF Data Centre is working continuously on building up a library of problem-oriented computer programs for atomic and nuclear physics work. The existence of such a library will appreciably reduce the time and effort spent both in comparing experimental results with predictions based on various models and in examining the possibilities of new nuclear models. A special feature of even the most varied problems in atomic and nuclear physics is that they have a large number of elements in common, e.g. the solution of Schrödinger's one-particle equation for a number of specific potentials, the calculation of matrix elements of various types of one-particle and two-particle operators, matrix diagonalization, various transformational functions and coefficients etc. One of the most important tasks of the Data Centre is to identify such common elements and build up a library of suitable programs. The Data Centre has made some efforts in this direction, both by enlisting the services of the scientific staff of the Institute and by large-scale co-operation with various Soviet and foreign scientific establishments.

As the programs filed in the Data Centre library are intended for use by people who may have no contacts with their authors, they must satisfy a number of special requirements. Above all, each program is accompanied by a statement of the problem, an indication of how to solve it and a description of its structure. The descriptions are quite sufficient for understanding the nature of the problems to be solved. They include a detailed list of all formulae used and explain all the quantities involved. Such descriptions are published as preprints, and short descriptions of them are published in the Data Centre Bulletin [4]. The library is adapted to the BESM-6 computer.

Using the programs in this library the Data Centre has issued tables of the Clebsch-Gordan coefficients [12], tables of electron energy eigenvalues, densities approaching zero and mean values of self-consistent fields of atoms and ions [13], and tables of internal conversion coefficients for light nuclei ($Z \leqslant 30$) [14].

75AN1631: Д.С. АНДРЕЕВ, П.А. ВОРОНОВА, К.И. ЕРОХИНА, В.С. ЗВОНОВ, А.С. МИШИН, А.А. ПАСТЕРНАК
ИЗВ. АН СССР. СЕР.ФИЗ. 39, 1631 (1975)
КУЛОНОВСКОЕ ВОЗБУЖДЕНИЕ ЯДЕР 121SB, 123SB, 123TE И 125TE.

NUCLEAR REACTIONS 121, 123 SB (12C,12C'G),E=37 MEV,(A,A'G),E=12 MEV: MEASURED DOPPLER SHIFT ATTENUATION. 123,125TE(12C,12C'G),E=37 MEV,(A,A'G),E=12 MEV: MEASURED DOPPLER SHIFT ATTENUATION. 121,123SB,125TE DEDUCED LEVELS,J,PI,B(E2),B(M1). 123TE DEDUCED LEVELS,J,PI,B(E2). ENRICHED TARGETS,GE(LI) DETECTORS.
IANFA 39 1631

ENTRY U4750002

INDEX 75AN1631

AUTHORS Д.С. АНДРЕЕВ, П.А. ВОРОНОВА, К.И. ЕРОХИНА, В.С. ЗВОНОВ, А.С. МИШИН, А.А. ПАСТЕРНАК

SOURCE ИЗВ. АН. СССР. СЕР. ФИЗ. 39, 1631 (1975)

TITLE КУЛОНОВСКОЕ ВОЗБУЖДЕНИЕ ЯДЕР 121SB, 123SB, 123TE И 125TE.

KEYWORDS R,121SB, 123SB, (12C,12C'G), (A,A'G), DOPPLE SHIFT ATTENU:R,123TE, 125TE, (12C,12C'G) (A,A'G), DOPPLE SHIFT ATTENU:L,121SB, 123SB, 125TE, LEVELS,J,PI,B(E2),B(M1):L,123TE LEVELS,J,PI,B(E2): ENRICH TARGET,GE(LI) DETECT:IANFA

ABSTRACT NUCLEAR REACTIONS 121,123SB(12C,12C'G),E=37 MEV,(A,A'G),E=12 MEV: MEASURED DOPPLER SHIFT ATTENUATION. 123,125TE(12C,12C'G),E=37 MEV,(A,A'G),E=12 MEV: MEASURED DOPPLER SHIFT ATTENUATION. 121,123SB,125TE DEDUCED LEVELS,J,PI,B(E2),B(MI), 123TE DEDUCED LEVELS,J,PI,B(E2). ENRICHED TARGETS GE(LI) DETECTORS.
IANFA 39 1631

Fig. 1 Key word abstracts

REFERENCES

1. M.P.Avotina, I.A.Kondurov, Yu.N.Novikov, Yu.V.Sergeenkov. Preprint LIYaF-65, Leningrad, 1973
2. V.M.Zhukov, L.P.Martens, Eh.E.Saperstein. Preprint IAE-2403, Moscow, 1974
3. H.D.Lemmel, ed. INDC(NDS)-69, IAEA, Vienna, 1975
4. Bulletin of the LIYaF Data Centre № 2, L., 1975
5. Eh.E.Berlovich, L.A.Vaishnene, I.A.Kondurov, Yu.N.Novikov, Yu.V.Sergeenkov. Preprint LIYaF-145, L., 1975
6. N.A.Voinova. Preprint LIYaF-230, L., 1976
7. R.B.Begzhanov, V.M.Belen'ky, S.R.Abdurakhmanov, V.K.Usharov. Radiation Processes in Atomic Nuclei. "FAN" Publishing House, Uzbete SSR, 1973
8. Yu.V.Naumov, O.E.Kraft. Gamma-Decay of Analogue Resonances. E Ch A Ya, v.6, 4, 1975
9. C.M.Lederer, J.M.Hollander, I.Perlman. Tables of Isotopes, New York - London, 1968
10. B.S.Dzhelepov, L.K.Peker, V.O.Sergeev. Radioactive Nuclei Decay Schemes. USSR A.S. Publishing House, M.—L., 1966
11. C.W.Reich, R.G.Helmer, in Nuclear Cross Sections and Technology, NBS, Washington, 1975, p.14
12. I.V.Nikitina, Yu.I.Kharitonov. Preprint LIYaF-138, L., 1975
13. I.M.Band, M.B.Trzhaskovskaya. Preprint LIYaF-90, LIYaF-91, LIYaF-92, L., 1974
14. M.A.Listengarten, I.M.Band, M.B.Trzhaskovskaya. Preprint LIYaF-235, L., 1976

156GD	KL	89	T1/2	2,21E-9	6	P	68KU1352PNRVA 165
156GD	KL	288	T1/2	1,13E-10	2	P	72WA0009NUPAB A196
156GD	KL	288	T1/2	11,3 NS	2	P	72WA0009NUPAB A196
156GD	KL	288.2	T1/2	1,11E-10	5	P	72RU0545NUPAB A191
156GD	KL	584.5	T1/2	1,42E-11	12	P	72RU0545NUPAB A191
156GD	KL	1049.5	J	0+			74KL1451PRVCA C10
156GD	KL	1050	RHO	0,41	9		67EW0191TOKYO
156GD	KL	1050	RHO	0,179	17		71RU0401NUPAB A167
156GD	KL	1050	X	0,1			69BA0147STUDSY
156GD	KL	1154	B(E2)	0,06	2	QE	65YO0273NUPHA 73
156GD	KL	1154.09	J	2		AC	72GA0017IANFA 36
156GD	KL	1168.1	J	0+			74KL1451PRVCA C10
156GD	KL	1168	X	1,8E-2	LT		69BA0147STUDSV
156GD	KL	1319.66	J	2-		AC	61CL0598NUPHA 22
156GD	KL	1511	T1/2	1,90E-10	6		68WA0304ZEPYA 211
156GD	KL	1511	G	+0,78	5	IPAC	68WE0167ASILOM
156GD	KL	1511	MU	3,12	20	IPAC	68WE0167ASILOM
156GD	KL	1715	J	0+			74GU0943PRVCA C10
156GD	KL	1852	B(E3)	4,4E-2		QE	67BL0576NUPAB A91
156GD	KL	1946,36	J	1		AC	72GA0017IANFA 36
156GD	KL	1965,88	J	1+		AC	61CL0598NUPHA 22
156GD	KL	2026,65	J	1		AC	61CL0598NUPHA 22
156GD	KL	2026,65	J	1		AC	72GA0017IANFA 36
156GD	KL	2186,0	J	1,2+		AC	61CL0598NUPHA 22

Fig. 2. Excerpt from file of data on nuclear level characteristics published in actual papers.

Table 1

Physical format for presentation of evaluated characteristics of nuclear levels

1. Energy of level
2. Quantum numbers J^{π} (T,K)
3. Moments: magnetic - μ
   electric - Q
4. Lifetime of level - $T_{1/2}$
5. Neutron, proton binding energy (for ground states)
6. Level decay characteristics:

   γ-decay: energy, intensity, multipole order, mixing ratio;

   β^--decay: energy, intensity, type of spectrum;

   EC + β^+-decay: energy, EC, intensity ($I_{\beta^+}+I_{EC}$), I_{β^+}/I_{EC}, type of spectrum;

   α-decay: energy, intensity, hindrance factor;

   For other particles: energy, intensity.

Note: The errors are given with all values; intensities are given in relative units expressed as fractions of the total sum.

Table 2

Physical format for description of evaluated characteristics of radiation accompanying decay of radioactive nuclei

1. Half-life of parent nucleus
2. Energies and intensities of γ-rays
3. Energies and intensities of internal conversion electrons for each shell
4. Energies and intensities of X-rays
5. Energies and intensities of Auger electrons
6. End-point and average energies and intensities of β^-, β^+ particles
7. Average energies and intensities of internal bremsstrahlung quanta
8. Energies and intensities of α-particles
9. Energies and intensities of neutrons
10. Energies and intensities of protons

Appendix 10

Fysisch Laboratorium, Utrecht

C. Van der Leun

The evaluation of the mass chains A=21-44 is being performed by P.M. Endt and C. van der Leun (Utrecht) as part of their research and teaching task.

The reviews, which are being published in Nuclear Physics, are aiming at the needs of fundamental nuclear physics. The format is similar to that of reviews on the A=5-20 nuclei performed by F. Ajzenberg, and differs appreciably from the A-chain presentation in the Nuclear Data Sheets. Discussions aiming at more uniformity are continuing.

The average time cycle over the last 22 years has been slightly less than five years. This cycle is somewhat arbitrary, but closely connected with the cycle of Wapstra's atomic mass table, which is used as one of the starting points. Publication of the next issue is foreseen for 1977/78. A special effort will be made to indicate in a clear and surveyable way how the reviewers arrived at the presented adopted values. Reviewers should enable the users to check the reviewers data on the basis of the original literature. It might not be superfluous to state here that evaluations and evaluators should be considered critically.

Appendix 11

Participation in the Nuclear Structure Data Cooperation

Zentralstelle fuer Atomkernenergie-Dokumentation (ZAED)

Federal Republic of Germany

H. Behrens

ZAED agrees to participate in an international collaboration effort based on division of labour with the aim of the compilation and evaluation of nuclear structure data, the basis being proposal BNL-NCS-20573 of the Brookhaven National Laboratory Study Group.

The Federal Republic of Germany is interested that this network of international collaboration will particularly result in the following products:

- to establish a file suitable for retrieval which contains the whole range of evaluated nuclear structure data
- in addition to this, files which contain the corresponding experimental and bibliographic data
- publication of the following printed items (produced from the above-mentioned magnetic tapes):

  i) handbook of isotopes
  ii) nuclear data sheets
  iii) bibliography of nuclear structure data.

In this connection it is of great importance that the magnetic tapes mentioned above are at the free disposal within the Federal Republic of Germany for retrieval and other purposes, i.e. that updated copies of files are regularly made available to ZAED. Unrestricted distribution of the printed products has to be guaranteed, too, at reasonable prices.

A wall chart of nuclides (Karlsruher Nuklidkarte) has been and will in the future be published by a group in Karlsruhe. The number of copies printed of the last edition (4th edition 1974) was 36,000 (36,000 wall charts and 36,000 folding charts), and they were distributed worldwide. It might be a point for discussion whether the part of the BNL proposal concerning the chart of nuclides has not been already covered by this Karlsruhe activity.

For the bibliographic tape we propose - different from the BNL proposal - to make use of the International Nuclear Information System (INIS) rather than of the Recent References system. Both systems, Recent References as well as INIS, contain more or less the same information. Therefore, on a long-term basis we think it desirable to reduce and remove duplication of work. During a transitional period, until a few minor technical improvements in the INIS system have been implemented (the Technical Committee Meeting on the treatments of nuclear data sources in INIS, IAEA, 1-2 April 1976 was a first step in this direction), we agree, however, to use the Recent Reference system.

Within the framework of the international collaboration aimed at, ZAED is prepared to compile and evaluate nuclear structure data of 20 mass chains. In this connection, we have a certain preference for the mass range $45 \leq A < 150$. We could start on the implementation at the beginning of 1977. Regarding manpower, we are thinking ultimately of a staff of 3 to 4, 2 to 3 of them being scientists. Depending on some uncertainties of the financial resources available, a detailed outline of the time schedule for realizing this full manpower can not be given at this moment. In every case we intend, however, to begin with a manpower of about 2.

We on our part would find it very useful, if a scientist of the ZAED could visit the Nuclear Data Group in Oak Ridge for some weeks at the beginning in order to make use of the experience and methods of this group. Following this visit, we could run a pilot-evaluation of one mass chain during the course of 1977, and the results of this could be discussed with other groups participating in the labour-sharing collaboration. From the second half of 1977 or at least from 1978 onwards we would then be in a position to compile the remaining 19 mass chains in the required time cycle of 4 years.

In order to maintain a certain standard, we think that a working group of the participating laboratories should be set up. This group should meet regularly to establish priorities, to discuss evaluating rules and exchange format questions, and to initiate continued improvements of the system. The secretariat of this group should be helt by the Nuclear Data Section of the IAEA.

Besides the vertical compilations under discussion just now, a certain number of horizontal compilations, e.g. beta or gamma decay data, could be elaborated by those groups in the Federal Republic of Germany, which are coordinated or financially supported by the ZAED in the course of its project "The establishment of an information system for physics data", or by other already existing groups (with all in all 0.4 man years).

The Gamdat File of Juelich - Present Status and Intended Work

G. Erdtmann, KFA Juelich

In radiochemical analysis work there exists a great demand for very different types of nuclear data. They are necessary for the identification of chemical elements or of radionuclides such as neutron activation products and fission products and they are required to estimate sensitivities of radiochemical analysis procedures, their interferences and for many other purposes. The data must be available in special formats - that means they must be selected and ordered according to the specific requirements of the analytical chemist. These requirements are often not fulfilled by the compilations available. For this reason we found it necessary to prepare a data compilation for γ-ray lines, which is available as a file on magnetic tape named "Gamdat-file" and in printed form as a Juel-Report. The Journal of Radioanalytical Chemistry also asked for the printing rights and at present the tables are being published in this journal. Furthermore we have made a compilation of neutron activation cross sections which at present is in print as a book.

Here mainly the γ-ray data have to be discussed.

The first file, which is actually not yet updated and still available in its original form, is described in AG 59/15, which is the copied preface and text part of our tables. It has been mainly prepared from original papers.

At present we are engaged in updating this file and we hope that a new Gamdat file will be available at the end of this year or in the beginning of 1977.

Since with Nuclear Data Sheets a great number of nuclides have been re-evaluated, we usually - with a few exceptions - now refer to the data published in this journal. However, since the data are still transferred by hand, this work is very time-consuming. Therefore we think over the possibility of applying the ENSDF-file to have immediate access to the γ-ray lists. If this is possible - we must have the allowance of the authors of this file and check the technical details - the updating of this file would be much easier and faster. If there are similar activities in other groups, we are of course very interested in a cooperation. There have been several proposals from the users of our tables for some improvements - which often include enlargements - which have to be considered for future work on this file.

As to our experience, the demands for such tables are very urgent and we have obtained a great number of requests. I think that this meeting will be the right place to discuss, how and where such γ-ray files should be prepared in the future.

Appendix 13

U.K. (Science Research Council)

P. Twin

The Nuclear Physics Board of the SRC has maintained an interest in the international co-operation in the field of Non-Neutron Nuclear Data. Through its Nuclear Structure Committee it is responsible for funding Nuclear Structure research at the Universities and at the Nuclear Structure Facility (NSF) at Daresbury.

The Nuclear Structure committee has agreed, in principle, to support vertical mass chain evaluation activity with a manpower of about 1 man year per year as defined in the BNL proposal (BNL-NCS--20573). This activity would cover around 10-15 mass chains preferably in the mass range A=60-100.

There is, at present, no vertical evaluation work in the U.K. The plan is for the evaluation team to be based at Daresbury, the site of the 30 MV tandem Van der Graaff accelerator which is under construction and due to come on-stream in 1978/9. It will be used mainly by the Universities of Liverpool, Manchester and Birmingham with smaller groups from other centres. It is envisaged that there will be at least two people concerned with the evaluations backed by advisors and various supporting staff.

Detailed proposals will be submitted to the appropriate committees of the SRC following the Vienna meeting.

Appendix 14

NPL involvement in the evaluation of nuclear data

A.L. Nichols

NPL fully recognizes the need for evaluation, both nationally and internationally, in many areas of nuclear data, and agrees in principle that there is a case for NPL and other national laboratories, together with Geel, being involved in such work.

However, it is regretted that NPL is not in a position to undertake evaluation work, either now or in the immediate future, because it has neither the necessary financial support nor, more particularly, the staff to do so. Such work would be carried out by the Division of Radiation Science. This Division has recently received 'Requirements Board' approval for its proposed programme for 1976-1979, which does not include evaluation work, and which fully commits all available resources.

Nevertheless, the Division will take into consideration, when drafting future programmes, any external pressures which may in the meantime be brought to bear upon it to participate in the evaluation of nuclear data, and it would be glad to be kept informed of the international position in this matter, particularly in respect of the involvement of national standards laboratories.

Appendix 15

Advisory Group Meeting

Nuclear Structure and Decay Data for Applications

Vienna 3-7 May 1976

Outline of UK statement, excluding SRC contribution

A.L. Nichols

The UK Chemical Nuclear Data Committee (UKCNDC), a sub-committee of the UK Nuclear Data Committee (UKNDC), is involved, amongst other things, in the evaluation of nuclear decay scheme data. This work is controlled by a request list which states the priority of tasks (see appendix)* requiring measurement, evaluation and compilation of data, determined by the needs of the UK nuclear reactor programme. Because of a lack of manpower and the immediate problem of providing useful data to aid in calculations involving, for example, after heat, inventory and fuel reprocessing, no in depth mass chain evaluation work can be done in the UK laboratories associated with UKCNDC.

However, limited effort is available in specific areas of interest. UKCNDC evaluation manpower can be sub-divided into three specific regions:

1. Fission yields are continually being evaluated by E.A.C. Crouch, AERE Harwell. This work is well documented[1-6]. Crouch evaluates fission yield data biennially and commits himself to maintaining three related data files. This requires a manpower effort of approximately 0.4 per year.

   (a) The first set of yields (the base set) are evaluated independently for each mass number. All measurements for any mass are considered and rigorously evaluated[1,2]. The evaluated fission yield with associated error for a particular nuclide is, therefore, the best evaluated data you can get for that particular nuclide from the published , measured data; Crouch refers to this as a "subjective" evaluation. A conversion code has been written so that this data file can be produced in ENDF/B format.

   (b) Crouch also maintains an "objective" data file in which, using weighting factors, the fission yields from the base set are altered to obey conservation laws[3,4,5]. This data is suitable for work requiring a complete set of fission yields.

   (c) The third data file, although separate, acts as a link between the other two files. Its evolution involves fission theory and gaussian models to fit the basic data set fission yield profiles.

The Bologna Panel meeting on fission product nuclear data[6] very clearly showed the value of maintaining and comparing separate fission yield data files produced by independent evaluators.

2. An α-decay scheme library[7] has been produced and it is hoped that it can be maintained. This evaluation by F.J.G. Rogers, AERE Harwell, aims to include every alpha emitting nuclide, listing alpha energies, alternative decay modes and half-lives. Data sources include Nuclear Data Sheets and the compilation by A. Rytz[8], but original references

---

* Appendix is not included in this report. If interested, the reader is directed to the UK Chemical Nuclear Data Evaluations Request List, report CNDC(75)P2, by J.G. Cuninghame.

have always been consulted. Alpha energies are quoted to five significant figures and, where possible, errors are quoted. Percentage of total alpha is listed to 0.001% accuracy when possible. Half-lives are for total decay and are not partial half-lives.

The most recent Rogers' evaluation includes papers published before January 1975, but the intention is to up date the file biennially.

3. An effort is being made to produce an ENDF/B formatted decay scheme file under the control of the UK Decay File sub-committee (UKDFSC) of the UKCNDC. An approximately 1.5 manpower programme of evaluation work is underway to compile data of a high priority, determined by the needs of the UK reactor programme,

(a) fission product decay scheme data,
(b) activation products of reactor structural materials
and (c) actinides

This project cannot be regarded as suitable within the definition of collaboration for this meeting. It is mainly a user of such publications as Nuclear Data Sheets and Recent References, and will not do in depth evaluations. The file is slowly being constructed and it will be several years before a satisfactory data file is available.

Summary

The UKCNDC regards the Crouch fission yield evaluations and the Harwell α decay library as suitable contributions to the horizontal evaluations as defined by Pearlstein et al.[9]. This constitutes an effort of approximately 0.5 manpower per year with biennial maintenance.

The work of the UKDFSC is greatly facilitated by the use of Nuclear Data Sheets and Recent References of the US Nuclear Data Project, and it welcomes the proposal of mass chain evaluations updated on a four-year cycle.

There can be no guarantee of the desired continuity in any of the work.

References

(1) Fission Product Chain Yields from Experiments in Thermal Reactors, E.A.C. Crouch, AERE R7209 (1973)

(2) Fission Product Chain Yields from Experiments in Reactors and Accelerators Producing Fast Neutrons of Energies up to 14 MeV, E.A.C. Crouch, AERE R 7394 (1973)

(3) Assessment of known independent yields and the calculation of those unknown in the fission of ^{232}Th, ^{233}U, ^{235}U, ^{238}U, ^{239}Pu, ^{240}Pu and ^{241}Pu, E.A.C. Crouch, AERE R7680 (1974)

(4) Chain and independent fission product yields adjusted to conform with physical conservation laws, E.A.C. Crouch, AERE R7785 (1975)

(5) Chain and independent fission product yields adjusted to conform with physical conservation laws. Part 2, E.A.C. Crouch, AERE R8152 (1976)

(6) Status of Fission product yield data for thermal reactors, W.H. Walker

Review of Fission product yield data for fast neutron fission, J.G. Cuninghame
IAEA-169, FP Nuclear Data Vol. I, Proc. of a Panel on Fission Prouct Nuclear Data, Bologna, 1973.

(7) (a) UK Nuclear Data Progress Report, April 1974 - March 1975, UKNDC (75)P71 page 66.

(b) Listing of alpha particle emitting nuclides inorder of ascending Z and A and in order of ascending alpha energy, F.J.G. Rogers, AERE R8005, to be published.

(8) A. Rytz, Atomic Data and Nuclear Data Tables, 12 (1973) 479.

(9) Study on the Compilation and Evaluation of Nuclear Structure and Charged Particle Reaction Data, S. Pearlstein, N. Holden, C. Dunford, T. Burrows, M. Bhat, BNL-NCS-20573, 1975, page 6, section 12.

Status of the Japanese activities on evaluation of Nuclear Structure and Decay Data

Tsutomu Tamura
Japan Atomic Energy Research Institute

I. Introduction

To survey the opinion of the Japanese nuclear data community on the present topic, the Japanese Nuclear Data Committee (JNDC) held ad hoc meetings. The participants of the meetings were the experimentalists, theorists and applied users of nuclear structure and decay data (NSDD). In this statement, the majority of the opinions presented in the meetings, and the present status of the JNDC to this problem are described in Sections II and III. Japanese activities in evaluation works are also given in Section IV.

II. Opinions from the ad hoc meetings

(1) Needs of international cooperation

The participants unanimously expressed needs of the international co-operation in compilation, evaluation and dissemination of NSDD, and recognized the significance to participate in the international efforts according to our status in quo and near future.

Under the present situation, the Nuclear Data Laboratory (NDL) of JAERI should play a kernel for the coordination of Japanese activities in the international cooperation of NSDD.

(2) Mass-chain evaluation

It is a general observation that there are several researchers who can share the mass-chain evaluation works on the part-time basis. It was also stressed that the evaluator should be supported by the existing

international data centers as well as the domestic nuclear community. At present, there is no activity of this kind in Japan, and therefore, new organizing efforts must be taken for coordination, budget, and staffs.

Since most of the evaluators will have to work on the part-time basis, flexibilities in the evaluation works must be considered. Some participants emphasized that the evaluators should be encouraged to work on their own research problems as well. The experiences in both fields would contribute to fill the gap among the experimentalist, evaluators, and applied users.

(3) Evaluation

For the best use of evaluated or recommended data, it is considered essential that methods of evaluations and/or any other comments are available in appropriate form, comments in the same file or in other documents.

(4) Effective means of publication of experimental data

At the present, a large part of the nuclear data concerned are published in physics and chemistry journals. In most of these publications, however, the emphasis is placed on the discussion of the results, not on the detailed presentation of experimental procedures, treatments of the data and accuracies of the data. Laboratory reports or special documents are often very helpful for evaluation, but some of these materials are hard to obtain. With these in mind, they claim data-oriented periodicals or some other means of communications which are open to publish even small findings, corrections or confirmations of the previous data as well as large files of data.

III The present Status of JNDC

The Japanese Nuclear Data Committee, a standing committee of the Atomic Energy Society of Japan with the secretariat provided by the Nuclear Data Laboratory of JAERI, has been performing co-ordination and promotion of the nuclear data activities for the atomic energy research and development. Until recently, the majority of the data within the scope of the JNDC has been the neutron data. However, the activities in the subcommittees on safefuards techniques, decay heat evaluation, fission-products nuclear data for fast fission reactors, and on fusion reactors include non-neutron data as well as neutron data. In this context, we have already involved in NSDD (The activities of the compilation and evaluation works are described in Section IV).

The JNDC and the NDL/JAERI will take flexible measures in compliance with the requirement of the time and a new activity connected with a certain part of the present topics will be incorporated in the frame-work.

IV The Japanese activities in the evaluation works and systematics Studies.

The NSDD are presently dealt in the 3 working groups of JNDC: safeguards techniques, decay heat evaluation and FP nuclear data for fast neutron reactors.

(1) Safeguard Techniques (Group leader : Prof. K. Hisatake)

To draw up the Japanese request list of nuclear data for safeguards techniques, original requests have been reviewed critically. Evaluated values and their errors have been obtained for the data whose requested accuracies have already been attained. A. Hashizume and H. Kawakami have compiled the experimental half-life data for the 6 FP nuclides and gave evaluated values[1] to the following nuclides :

^{106}Ru, ^{133}Xe, ^{134}Cs, ^{137}Cs (1973).

Y. Yoshizawa and M. Fujioka compiled the data for gamma-ray yields per decay for several fission-product nuclides and gave evaluated values[1] to the 2 nuclides : ^{95}Zr, ^{137}Cs (1973).

A. Hashizume and H. Kawakami compiled the half-life and spontaneous fission half-life data[2] for the transuranium nuclides:

Half-life ^{238}Pu, ^{241}Pu, ^{242}Pu, ^{234}U, ^{235}U, ^{236}U

Spontaneous fission half-life ^{238}Pu, ^{239}Pu, ^{241}Pu, ^{242}Pu. (1975).

Y. Yoshizawa, H. Inoue, M. Hoshi and K. Shizumo have performed evaluation[3] of gamma-ray intensities of 11 nuclides to be used as primary standard for the efficiency calibration of Ge(Li) detectors :

^{22}Na, ^{46}Sc, ^{48}Sc, ^{48}V, ^{54}Mn, ^{60}Co, ^{95}Zr, ^{95}Nb, ^{106}Ru, ^{134}Cs, ^{203}Hg (1976).

(2) Decay heat evaluation working group (Leader:Prof. R. Nakashima)

Compilation and evaluation efforts[4] of fission-product nuclear data are being made in this working group for these two years. The data include FP mass-yield, half-life, value, decay

mode, beta-and gamma-ray spectra for each nuclide. Reacent investigations with on-line mass separators and other ingenious techniques rapidly filling users needs. Still, we have to rely on estimated values from systematics or predicted values from theories. This group have developed a program to generate estimated values of Q_β, half-life and beta-and gamma-decay modes based on the gross theory of beta decay.
(The gross theory of beta decay has been formulated by Prof. M. Yamada and his group.)

(3) Working group on fission product nuclear data for fast fission reactors (Leader : S. Iijima)

Large part of nuclear data concerned in this working group is related to fast neutron cross sections. In the process of evaluation of neutron inelastic scattering cross-sections, level property data of FP nuclides i.e., level energies, spins and parities, are important. Preliminary results of cross section evaluations for 28 nuclides have been reported[5]. An effort is being made to complete this work.

(4) Nuclear structure and decay data file

For efficient and easy storage and retrieve of the evaluated NSDD, a computerized data file is being developed. Maximum compatibility to the NSDF[6] of Nuclear Data project Group has been considered. This system is still in the stage of test for the application in the decay heat evaluation.

(5) Others

Apart from the JNDC activities, M. Sakai of Institute for Nuclear Study has been publishing the systematics of band structures[7] in even-even nuclides. This effort of compilation will be continued.
I only cited here the evaluation works near to my field and did not try to exhaust the whole activities in Japan.

Acknowledgements I would like to express my deep gratitudes to the participants of the JNDC ad hoc meetings on this topic for their cooperations.

References :

(1) K. Hisatake ed., unpublished report (1973).

(2) A. Hashizume ed., unpublished report (1975).

(3) Y. Yoshizawa, H. Inoue, M. Hoshi and K. Shizuma, unpublished report (1976) and to be published in JAERI M-report (in Japanese), Evaluation of gamma ray intensities.

(4) R. Nakashima et al., Journal of the Atomic Energy Society of Japan 17 (1975) (in Japanese), After heat from fission products.

(5) S. Igarasi et al., Proceedings of International Conference on Nuclear Cross-sections and Technology NBS special publication 425 Vol. 1 325 (1975), Evaluation of FPND for 28 important nuclides.

(6) W.B. Ewbank et al., ORNL 5054 (1975), Nuclear Structure and Data File.

(7) M. Sakai, Nuclear Data A 8 232 (1970), and Nuclear Data A 10 511 (1972), Quasi-ground, quasi-beta and quasi-gamma bands.

Statement concerning the activity in the compilation and evaluation of nuclear structure and decay data for applications in Romania

M. Ivascu

In Romania, especially in the Institute of Atomic Physics, the interest for nuclear structure data measurements has been growing. Using cyclotron and tandem accelerators, a lot of nuclear structure parameters, such as excitation energies, spins, life times and magnetic moments for $80 \leq A \leq 100$ nuclei were obtained by (α,p), (d,α), $(\alpha, nx\gamma)$ and (He, $xnyp\gamma$) reactions.

In this way the Nuclear Structure Department has at its disposal nuclear data which are measured and compiled by our department for their applications in the following applied fields:

- Element analysis of substance with the use of nuclear physics methods,
- Production and application of artificial radioactive isotopes, and
- Medical application of radioisotopes.

In the future, these fields of application will be much more developed. New facilities like 12MW reactor, post accelerator system, and an additional computer will increase the possibilities to obtain more and complete nuclear structure data. We also intend to have a permanent group of 8-10 people which will have a principal interest in mass-chain compilation and evaluation in the range of $80 \leq A \leq 100$.

Statement on the activity in connection with the compilation of nuclear structure and decay data for applications in Hungary

D. Berenyi

In Hungary we have no large scale or regular compilation and evaluation project on nuclear structure and decay data for applications. However, according to the program suggested by the INDC subcommittee on non-energy applications of nuclear data, informal meetings are organized in Hungary to search for nuclear data and compilation needs in the field of the medical applications.

In addition to this I am personally the member of the Advisory Committee for the Nuclear Data Sheets and occasionally I have a possibility to comment on the corresponding programme. Sometimes there have been some application-oriented compilations and summaries of selected data, e.g. my survey on the data for safeguards at the Paris Conference (1973) or A. Koever's work on some aspects of X-ray data.

Opening Statement

L. Carlén, Lund, Sweden

In Sweden there is no permanent group set up to perform compilation or evaluation work in the non-neutron data area.

The Nuclear Physics group at the Department of Physics, University of Lund, Sweden, has for many years been doing experimental nuclear physics involving nuclear structure and decay problems - mainly in the mass region A = 4 and A = 62.

This experimental group consists of about 10 physicists, some of which have several years experience in guiding research activities.

In the future the experimental activities will be centered around a newly delivered 3 MV Tandem Pelletron. If feasible we are very interested to include some compilation and evaluation activities in line with our research program.

Nuclear Data Group of the Institute of Nuclear Research Statement

A. Marcinkowski

The Nuclear Data Group started with the compilation and evaluation of the (p,γ) reaction data specialized for covering the needs of applied nuclear analysis methods. The choice of this activity was substantiated by the scarcity of complete, new and specialized (p,γ) reaction data compilations. The data compiled are based on level decay data obtained from (p,γ) reaction analysis and include the resonance energies, resonance widths or yields, and the most intensive decay γ-ray energies and intensities. The compiled and evaluated data will be stored on magnetic tape. The evaluated data will be also published successively in reports of the Institute of Nuclear Research.

STANDARDS FOR ENSDF DATA SETS

I. A-CHAIN COMPLETENESS

For each A-chain, there should be at least one data set for each isotope. Usually, there will be more.

II. ISOTOPE COMPLETENESS

For each nucleus, there should be at least one data set for each distinct experiment giving level information about that nucleus.

For each nucleus, there should be one, and only one, "adopted levels" data set.
By convention, if only one data set exists for a nucleus, that data set will be treated as an "adopted" data set. It should include the Q-record just as for any other "adopted" data set (see IV.A below), and properties of long-lived levels (J, π, $T_{1/2}$, etc.) should be included here even if they were not "properly" deduced from this experiment.

III. DATA SET IDENTIFICATION (ID-RECORDS)

No two distinct data sets may have the same ID-record.
Since we are using the ID-record in a "generic-key" indexing system, all data sets whose names begin with a given sequence of characters can be retrieved as a group, regardless of how the ID-records end. In general, the broadest categories should be mentioned first in the ID-record, with nuances and finer details coming later.

A. Radioactivity

For radioactivity data sets, the data set name (cols. 10-39 of the ID-record) will include the parent isotope and the type of decay (B-, IT, EC, B+, A, SF). Data bank programs will make no distinction between EC and B+ as a decay type.

Isomers should be identified by their half-life following the decay name.

Some acceptable data set names are:

```
 63NI  B-  DECAY
 99NB  B-  DECAY  (2.6 M)
 54MN  EC  DECAY
 79SE  IT  DECAY  (3.89 M)
106IN  B+  DECAY  (6.3 M)
106IN  B+  DECAY  (5.32 M).
```

III.A. Continued

Note that use of "M" to denote an isomeric state will cause problems for the NDS text editor. It is better to avoid such things as 106MIN (^{106m}In) and 114M2IN (^{114m2}In).

The half-life of the decaying level should be taken directly from the "adopted levels" data set. It is written without a hyphen.

B. Nuclear Reactions *

Wherever possible, the reaction should be given explicitly, including the target. It is not necessary to give the final state; it is contained in cols. 1-5.

Some experiments can be grouped efficiently; e.g., COUL. EXCIT. could summarize Coulomb excitation by protons, alpha particles, and heavy ions. Again, however, if it is necessary to display them separately in the Data Sheets, they must be entered into the data bank as separate data sets.

Some acceptable data set names are:

169TM(N, G)
177HG(N, G) PRIMARY GAMMAS
65CU(3HE, A)
90ZR(P, P') IAS (a ^{91}Nb data set)
COULOMB EXCITATION
(HI, XNG) REACTIONS
181TA(P, 4NG)
181TA(N, G) E = 2 KEV.

C. References

The reference field (cols. 40-74) on the ID-record should be used for no more than three key numbers. If there are more than three principal references for a data set, then the key numbers should be placed on comment cards.

When the data sets are filed into permanent storage, a special identification flag will be added, e.g., 71NDS, 74NDS for published A-chains, NBS-MJM for Murray's NBS decay data sets, etc. This special flag can then be used to help describe a request for information from ENSDF.

D. Date

The date when the data set entered the computer is automatically added by the system. You should not write anything in cols. 75-80 of the ID-record, since it will be ignored and lost.

IV. DATA SET CONTENTS

A. All Data Sets

Standard formats should be used unless there are compelling reasons to do otherwise.

Uncertainties should be given for all measured values and all adopted values whenever possible! Sometimes a general comment about uncertainties can obviate this requirement. However, no program can yet use an uncertainty which is not given on the same card with the primary quantity.

Documentation should be included in the ID-record (three key numbers or fewer), or in general comments (for the entire data set), or in specific comments (for individual data items). Since the reference list is being generated automatically, every relevant key number for an A-chain must appear in some data set. If many references are used in a data set, you should be more specific as to which data items come from each reference.

Comment Records

Comment records may contain any number of cards. The first card must contain a "blank" or "1" in col. 6. The first card contains all information needed to determine what the comment is talking about and how it is to be processed. Continuation cards must have a sequence number in col. 6. The comment text on continuation cards may begin in any column, 10-80. You should start new thoughts or sentences on a new card. Avoid hyphenating words at the ends of cards.

1. General comments (blank in col. 8) should be placed at the beginning of a data set. The comment text may begin in any column, 10-80. The NDSLIST program will preserve the spacing.

2. Data comments (record type in col. 8 and data type in cols. 10-19 of the first card) are of two types. For both types, the comment text may begin in any column, 20-80, of the first card, but NDSLIST may not preserve leading or trailing blanks. A blank in cols. 10-19 of the first card is treated the same as the letter "E".

   a) Single-item data comments contain information about a single data item on a single record in a data set. This comment record must follow the record containing the data item being explained.

   b) Footnote comments contain information about several items of the same data type in the same data set. These comments must be placed at the beginning of a data set.

IV.A.2. Continued

If a footnote applies to all entries of the given data type, only the data type is placed in cols. 10-19 of the first card of the comment record. These comments appear as footnotes to a column heading in a table.

If a footnote applies to only a few records, those records may be "tagged" in col. 77 (C-field) with any single character. The character must then be placed in parentheses following the data type in cols. 10-19, e.g., RI(A), E(*). These comments appear as footnotes to the several tagged data items in a table.

B. "Adopted Levels" Data Set

1. Q-record

The adopted data set for a nucleus must contain the Q-record for that nucleus The Q-record must contain $Q(\beta^-)$, S_n, S_p, and Q_α. A reference for the Q-values should be included in cols. 56-80. This may be a standard adjustment (71WaGo, 74WaBG) or a new key number, or both. Whenever more than one reference is used, an explanation must be given on an accompanying comment record.

2. Level Records

a) The first card is required for each level.

Energy field may be blank if the placement of the level is not established.

Spin-parity assignments are based on arguments enumerated in "Rules for Spin-Parity Assignments", published in each issue of Nuclear Data Sheets.

Half-life must be given if known. A total level width may be placed in the T-field (the dimensions — eV, keV, MeV — are used to distinguish $T_{1/2}$ from Γ). If only $B(E\lambda)\uparrow$ has been determined for the level, it should go on a second or following card. If no decay has been observed, the half-life of the level should be given as "STABLE".

Rotational bands must be connected by a comment record with "BAND(x)" in cols. 10-19, where x is a footnote letter in col. 77 of the first card of each level belonging to the band. You should do this even if only one level of the band has been identified.

Rotational bands in odd-A nuclei should be identified by Nilsson numbers if available:

BAND(A)	9/2(514)
BAND(B)	1/2(620)

A sign on the K-value is redundant and should not be given.

IV.B.2. Continued

b) Continuation cards (sequence number in col. 6) must be used in the following cases:

If a level decays by means other than 100% electromagnetic transition, the percent branching must be given. If the branching is not known precisely, an entry is still required, e.g., %IT AP 100 $ %A <= 5E-6. If only one decay branch has been observed, use, e.g., %A > 0.

If a half-life is not shown on the first card, but a B(Eλ)↑ is known from, e.g., Coulomb excitation, the B(Eλ) should be placed on a continuation card. By convention, the data types BE1, BE2, ... for a level refer to direct excitation of the level from the ground state (upward transition, i.e., B(E1)↑, B(E2)↑, ...).

Static electromagnetic moments for a level must be given if they have been determined.

Abundance and $\sigma_{n,\gamma}$ will not be given.

C. "Decay" Data Sets

1. Normalization record must be given if an absolute normalization is possible.
   NR × I_γ gives photons per 100 decays of this type.
   NT will rarely be used.
   BR × NR × I_γ gives photons per 100 decays of the parent level.

   If the NR field is blank, it is presumed to be unknown. If BR field is blank, it is presumed to be exactly 1.0.

   The normalization factors must be explained on accompanying comment cards.

2. Parent records are required for A, B-, B+, EC decay data sets, but not for IT or SF.

   Comments on properties of the parent level also belong with the "adopted levels" data set for the parent nucleus and should be shown there.

3. Gamma records always include energy. (The energy may be only approximate or it may be derived in some described way.)

   Records for unplaced γ-rays must also be included. They are placed before the first level record in the data set.

   Relative photon intensity must be given if known.

IV.C.3 Continued

Gamma-ray multipolarities and mixing ratios must be included if they are known. An assumed multipolarity is written with the word "IF", e.g., "IF E1", "IF M1 + E2".

Whenever internal conversion is important, the theoretical values will normally be given for α_T (the CC-field). Any other value must be explained in a comment. If a precision measurement is available, it should be used.

ce-data (I_{ce}, ce-ratios, measured α_i) should be given (on continuation cards) if they are very precise. Measurements given here must have a reference.

4. A beta or EC-record must be included for every established branch.

The energy field is to be filled in only if there has been a precise direct measurement. Any analysis program uses the parent record and level record to derive a decay-branch energy.

If the IB-field on an E-record is blank, then the IE-field is presumed to contain total intensity, $I_\epsilon + I_{\beta+}$. Alternatively, the total feeding to a level can be given in the TI-field.

Don't forget "1U" or "2U" in cols. 78-79 for unique transitions.

D. Reaction Data Sets

1. Level Records

Give J^π or ℓ-value if it is established or suggested by this particular reaction.

Give transition strength (C^2S or C^2S' or β) as determined from this reaction. Explain in a comment.

2. Gamma Records

See notes above for "decay" data sets.

Relative photon intensity should be given if it is available. Otherwise, relative photon branching from each level should be given. An explanation (comment on RI) must be given.

WBE:sjb

Appendix 22

76-3506
Translated from Russian

THE EVALUATED NUCLEAR STRUCTURE DATA FILE AND THE DECAY DATA FILE OF THE USSR CAJaD CENTRE OF THE STATE COMMITTEE ON ATOMIC ENERGY

F.E. Chukreev, L.L. Sokolovskij

The production of an international file of evaluated data on nuclear structure and radioactive transformations, once agreement in principle has been reached by all co-operating centres and groups to participate in such an activity, is affected primarily by the general exchange format adopted for such a file.

Obviously, such a format must be made compatible in two stages: first the "physical" format, secondly the "computer" format. By "physical format" we mean the list of data which must be included in a file of evaluated data on nuclear structure and radioactive transformations, and the general principles of their arrangement within the file. By "computer format" we mean the actual arrangement of figures, symbols and letters in the different columns of the standard card-image format. Computer formats may differ from one co-operating centre or group to the other, depending on the aims of these centres and the techniques available to them. It is important only that the data exchange itself be performed in fully compatible computer formats accepted by all centres. The various details of this format are in our opinion not so important, and almost any format can be agreed on provided that it is a computer format for general exchange.

The situation is rather more complicated where the physical format is concerned.

The ENDF-B/IV format adopted by the neutron centres was designed to solve specific problems of those centres; it is encumbered by historical traditions and cannot fully satisfy the requirements of a physical format for nuclear structure data. Use of this format to describe decay processes [1] solves only a small portion of the problems - description only of data on radioactive transformations, not of the full range of necessary quantum mechanical characteristics of the various nuclear states.

Unfortunately we are not familiar with the ENDF-B/V format, so that we cannot tell whether it is suitable for the purposes mentioned.

The format adopted by the NDP group at Oak Ridge [2] is more suitable for describing nuclear structure data, but it has one serious shortcoming - it is based on the population of the level in decay or reaction. We think it more appropriate and logical for a file of data on nuclear structure and radioactive transformations to be based on the decay of the level. Besides, the standard version of the NDP format does not include some essential quantum mechanical characteristics of the ground and excited states of nuclei (electric and magnetic moments of various orders, spontaneous fission probability) and, on the other hand, includes some nuclear characteristics based on model conceptions (L - orbital moment, S - spectroscopic factor, COIN - coincidence). No such characteristics, or as few as possible, should be included in a file of evaluated nuclear structure data.

The "physical" format adopted by the GKAEh Atomic and Nuclear Data Centre for recording evaluated nuclear structure data and its principles of organization are shown in Fig. 1 and Tables 1-7. In the development of this format account was taken not only of the interests of scientists working in applied fields, but also of those conducting basic research in nuclear physics, whom the Centre is inviting to take an active part in the evaluation of non-neutron nuclear data.

The file of evaluated data on nuclear structure is a complete collection of the individual sets of data on each nucleus of the periodic system. Within each set the form of the data is based on a specific energy state of the nucleus. The aggregate of evaluated data on a specific nucleus must include all quantum mechanical characteristics of the ground and excited states, the modes and types of decay and the most important mass characteristics of the nucleus.

Since speedy production of the nuclear structure data file can scarcely be expected for the present and since it is nevertheless very important for many lines of applied research to have information about radioactive transformation chains and about the radiation accompanying these transformations, it has been decided to begin work on the radioactive transformation file in our Centre simultaneously with that on the nuclear structure data file. Another reason why such a file is needed is that a large proportion of the experimental data currently available on radioactive emissions, especially in fission products, cannot be related to a certain level or to the emitting nucleus.

The radioactive transformation file is based on the specific energy state of the parent nucleus. The structural organization of such a file is shown in Fig. 2. The data mentioned in Tables 2-7, and discussed above, are entered on the γ, β^-, β^+ etc. cards.

Table 1

Q-card

Z	...		
Symbol	...		
A	...		
Abundance	...	±	... (%)
Energy of β^--decay (with sign)	...	±	... (keV)
Energy of β^+-decay (with sign)	...	±	... (keV)
Energy of α-decay (with sign)	...	±	... (keV)
Neutron binding energy	...	±	... (keV)
Mass defect	...	±	... (keV)

Table 2

L-card
(Ground and excited states)

Energy of state	...	±	... (keV)
Spin and parity, J^π	...		
Half-life[1], $T_{\frac{1}{2}}$	...	±	... (s)
Magnetic dipole moment	...	±	... (n.m)[2]
Electric quadrupole moment	...	±	... ($e^2 \cdot b$)
Higher-order moments	...	±	...

1/ If only the total level width is known the quantity $\hbar/\Gamma$ should be taken for the half-life ($T_{\frac{1}{2}}$).

2/ Units of nuclear magnetons.

Table 3

G-card

Energy of γ-quanta	...	±	...	(keV)
Multipole order of transition		...		
Mixing ratio	...	±	...	(%)
Fraction of the given transition (γ-rays + CE) out of all possible transitions (γ + CE, $ß^+$, $ß^-$, α, sf etc.) from this level	...	±	...	(%)
Fraction of the given transition (γ-rays + CE) out of all (γ + CE) transitions from this level	...	±	...	(%)
Fraction of photons in this transition	...	±	...	(%)
Energy of final state[3/]	...	±	...	(keV)

CE-card

Conversion coefficients:

α - total	...	±	...	
α - K	...	±	...	
α - LI	...	±	...	
α-LII	...	±	...	
.....	...	±	...	
.....	...	±	...	

Table 4

$ß^-$-card

Maximum energy of electrons	...	±	...	(keV)
Type of spectrum		...		
Fraction of the given $ß^-$-group out of all possible transitions (γ + CE, $ß^+$, $ß^-$, α, sf etc.) from this level	...	±	...	(%)
Fraction of the given $ß^-$-group out of all $ß^-$-groups from this level	...	±	...	(%)
logft	...	±	...	
Energy of level in daughter nucleus in which the given $ß^-$-transition occurs	...	±	...	(keV)

3/ The energy of the final state is indicated so that any misprints may be noticed.

Table 5

β^+(EC)-card

Maximum energy of neutrino	...	± ...	(keV)
Type of spectrum		...	
Fraction of β^+-transitions ($I_{\beta^+}/I_{\beta^+} + I_{EC}$)	...	± ...	(%)
Fraction of the given β^+-group out of all possible transitions (γ + CE, β^+, β^-, α, sf etc.) from this level	...	± ...	(%)
Fraction of the given β^+-group out of all β^+-groups from this level	...	± ...	(%)
logft		...	
Energy of level in daughter-nucleus in which the given β^+-transition occurs	...	± ...	(keV)

Table 6

α-card

Energy of α-group	...	± ...	(keV)
Hindrance factor		...	
Fraction of the given α-group out of all possible transitions (γ + CE, β^+, β^-, α, sf etc.) from this level	...	± ...	(%)
Fraction of the given α-group out of all α-groups from this level	...	± ...	(%)
Energy of level in daughter-nucleus in which the given α-transition occurs	...	± ...	(keV)
Fraction of spontaneous fission out of all possible transitions (γ + CE, β^+, β^-, α etc.) from this level	...	± ...	(%)

Table 7

D-card
(decay involving emission of particles other than α, ß, γ)

Particle energy	...	± ...	(keV)
Reduced emission width	...	± ...	(Wigner units)
Fraction of the given transition out of all possible transitions (γ + CE, $ß^+$, $ß^-$, α, sf etc.) from this level	...	± ...	(%)
Z of particle	...		
Symbol of particle	...		
A of particle	...		
Z of residual nucleus	...		
Symbol of residual nucleus	...		
A of residual nucleus	...		
Energy of level in daughter nucleus in which the given transition occurs	...	± ...	(keV)

REFERENCES

1. C.W. Reich, IAEA Advisory Group Meeting on Transactinium Isotope Nuclear Data, Review paper B7, Karlsruhe, 3-7 November, 1975.

2. Nuclear Structure Data File, NDP, ORNL, INDC(NDS)-61/W, p. 40, 1974.

Appendix 23

Services Available from Nuclear Data Project to Evaluators of Nuclear Structure Data

1. Selected printouts from the complete indexed bibliography to nuclear structure literature.
2. Regular (monthly) collections of new nuclear structure references on particular topics.
3. "Backup" document service for items not available in less specialized libraries.
4. Well-developed file structure for nuclear structure information, and assistance with preparing new data for inclusion.
5. Printouts, on request, of particular sections of the Evaluated Nuclear Structure Data File (ENSDF).
6. Automated consistency checking for ENSDF γ-data prepared in standard format.
7. Automatic calculation of log ft, capture ratios, conversion coefficients, etc., for consideration by evaluator.
8. Semiautomatic page layout of ENSDF data for publication in Nuclear Data Sheets.
9. Semiautomatic preparation of drawings for publication in Nuclear Data Sheets.
10. Automatic preparation of reference lists from Nuclear Data Sheets printout.

April 6, 1976

List of possible quantities

(only two first positions)

I. Common properties

1. Z
2. Symbol
3. A
4. Abundances
5. β^--decay energy
6. β^+-decay energy
7. α-decay energy
8. Neutron-binding energy
9. Proton-binding energy
10. Nuclidic masses

II. Level properties

1. Excitation energy
2. Spin and parity, J^{π}
3. Isospin - T
4. Half-life ($T_{1/2}$) for $A \geq 45$
   Mean lifetime or total widths for $A < 45$
5. Magnetic dipole moments
6. Electric quadrupole moments
7. Higher moments
8. Deduced quantum numbers
   a) L - orbital angular momentum
   b) N - principal quantum number
   c) K - rotational band quantum number
9. Model description

Atomic data important from the point of view of the application of nuclear methods (associated nuclear data)

1. Absorption coefficients (α, β, γ, x, heavy ion)

2. x-ray energies and intensities in radioactive decays

3. Auger-electron energies and intensities in radioactive decays

4. Fluorescence yields from the different shells and subshells (important for the measurement and calculation of parameters in electron capture decays and sometimes in internal conversion processes).

5. Ionization cross sections for the interaction of energetic particles and radiations with matter (important for the calculation of doses and also in analysis of materials.)

General criteria for international evaluated nuclear data sets

The general criteria listed below should be regarded as forming an interim document, to act as a guideline to people involved in international nuclear data evaluations.

A. The choice of a single collection of numbers that best summarize the results obtained from a nuclear reaction and/or decay should be made by competent evaluators. The judgement and discretion of the individual evaluators must play an essential role in this choice.

B. Whenever possible, the following criteria apply:

1. That data available in the open literature should be used by the evaluator to produce the "best", evaluated data.

2. If there are two or more measurements of comparable accuracy, the evaluator adopts a value obtained by an appropriate averaging technique. Complete documentation should indicate which measurements were used in the evaluation, how they were combined and what the associated uncertainty means. Uncertainty of the adopted value should be the larger of "internal" and "external" errors. Reference to omitted measurements should be preserved.

3. In some cases it may be necessary to use one of a number of consistent measurements instead of average values; such specific data should be clearly labelled. Reference to omitted measurements should be preserved.

4. If there is no agreement amongst the available accurate measurements (e.g. if the data deviate by more than three times the combined errors), it will usually be difficult to adopt a "best" value. All available measurements must be included in ENSDF with discrepancies clearly pointed out.

5. All major decisions made by the evaluator, and his evaluation procedures should be described.

GENERAL POLICIES – "THEORY"

A reference "Theory 67Xy01" indicates theoretical predictions computed by the authors of 67Xy01. A reference "Theory" alone indicates a determination by the compiler of theoretical predictions described below.

Internal Conversion Coefficients

Theoretical conversion coefficients are obtained by spline interpolation (68HSe1) from tables of Hager and Seltzer (68HSe1) for the K–, $L_{1...3}$–, $M_{1...5}$–shells and of Dragoun, Plajner, and Schmutzler (71DrPl) for the (N+O+...)–shells. For the $N_{1...5}$–subshells, values are obtained by graphical interpolation from tables of Dragoun, Pauli, and Schmutzler (69DrPa). For K–, $L_{1...3}$–shells, conversion coefficients for transitions outside the E_γ–, Λ–, or Z–ranges of Hager and Seltzer are obtained as follows. for $E_\gamma \approx 1500$–2600 keV and for Λ= E5, M5, by polynomial interpolation from tables of Sliv and Band (56Sl44, 58Sl94); for $E_\gamma > 2600$ keV, by graphical interpolation from tables of Trusov (72Tru1); for Z = 25–29, by polynomial interpolation from tables of Rose (58Ro60). For E0–transitions, K/L_1 and L_1/L_2 ratios are obtained by graphical interpolation from tables of Hager and Seltzer (69HSe1).

Angular Distribution and Correlation Coefficients

The coefficients $A_K(\delta)$ required for analysis of directional correlation, polarization correlation, directional distribution, and polarization distribution data are obtained as described by Steffen (71St47, 71St48). In particular, we adopt the phase convention for the mixing ratio, δ, defined by this author (70Kr03). Particle parameters required for the analysis of correlation and distribution data involving conversion electrons are obtained by graphical interpolation from tables of Hager and Seltzer (68HSe2). The expression for the deorientation coefficient required to account for intermediate unobserved mixed radiations is given by Anicin (72An20).*

A tabulation of gamma-gamma directional coefficients is given by Taylor, et al. (71TaSi). These authors use the Steffen phase convention.

Penetration Parameters

Penetration parameters required for the analysis of internal conversion data and angular correlation or distribution data involving electrons are obtained by graphical interpolation from tables of Hager and Seltzer (69HSe1).

Internal Pair Conversion Coefficients

Theoretical internal pair conversion coefficients for Λ = E1, M1, E2 are obtained by graphical interpolation in Z, E from tables of Lombard, et al. (68Lo16).

β–Decay Rate Probabilities

Log *ft* values, capture–to–positron ratios, and electron–capture ratios for allowed, first–forbidden unique, and second–forbidden unique transitions are obtained as described by Gove and Martin (71GoMa). This reference also contains a tabulation of log *f* values and total capture–to–positron ratios for allowed and first–forbidden unique transitions.

Atomic Processes

X–ray fluorescence yields are obtained from Bambynek et al. (72BaCr).

Electron binding energies are taken from Bearden and Burr (67BeBu).

α–Decay Hindrance Factors

The α–hindrance factors (the ratio of the measured partial half–life for α–emission to the theoretical half–life) are obtained from the spin–independent equations of Preston (47Pr17). The nuclear radius for each even–even nucleus was determined by defining, for the g.s. to g.s. α–transition hindrance factor, HF ≡ 1. For odd–A and odd–odd nuclei, the radius was chosen to be the average of the radii for the adjacent even–even nuclei (72ElSc). In the few cases where only one adjacent even–even radius was known, that value was corrected for the $A^{1/3}$ mass dependence and used in the calculation.

Electromagnetic Transition Rates

The Weisskopf single–particle estimates for the half–lives of electric and magnetic multipole radiation of energy E_γ are (52Bl97)

$$T_{1/2W}(EL) = 0.190 \left(\frac{L}{L+1}\right)\left(\frac{3+L}{3}\right)^2 \frac{[(2L+1)!!]^2}{A^{2L/3}} \left(\frac{164.44}{E_\gamma(\text{MeV})}\right)^{2L+1} \times 10^{-21} \text{ s}$$

$$T_{1/2W}(ML) = 3.255\ A^{2/3}\ T_{1/2W}(EL)$$

for nuclear radius $1.2\ A^{1/3} \times 10^{-13}$ cm.

Unweighted and Weighted Averages

If $x_1 \pm \Delta x_1$, $x_2 \pm \Delta x_2$, ... $x_n \pm \Delta x_n$ are n independent measurements of a given quantity, Δx_i being the uncertainty in x_i, then the weighted average of these measurements is $\bar{x} \pm \Delta\bar{x}$, where $\bar{x} = W\Sigma x_i/(\Delta x_i)^2$, $W = 1/\Sigma(\Delta x_i)^{-2}$ and $\Delta\bar{x}$ is the larger of $(W)^{1/2}$ and $[W\Sigma(\Delta x_i)^{-2}(\bar{x}-x_i)^2/(n-1)]^{1/2}$.

The unweighted average of these same measurements is given by $\bar{x} \pm \Delta\bar{x}$, where $\bar{x} = \Sigma x_i/n$, $\Delta\bar{x} = [\Sigma(\bar{x}-x_i)^2/n(n-1)]^{1/2}$.

*As pointed out by these authors, most earlier references which discuss this coefficient define it incorrectly

References are listed on page v.

GENERAL POLICIES – "THEORY" continued

References for page IV:

47Pr17 M. A. Preston – Phys. Rev. 71, 865 (1947); The Theory of Alpha–Radioactivity

52Bl97 J. M. Blatt, V. F. Weisskopf – Theoretical Nuclear Physics, John Wiley and Sons, Inc., New York, p. 627 (1952)

56Sl44 L. A. Sliv, I. M. Band – Coefficients of Internal Conversion of Gamma Radiation, Part I, Academy of Sciences of the USSR Press, Moscow, Leningrad (1956); 57 ICC K1, Univ. Illinois, Urbana, Ill.

58Ro60 M. E. Rose – Internal Conversion Coefficients, North–Holland Publishing Co., Amsterdam (1958)

58Sl94 L. A. Sliv, I. M. Band – Coefficients of Internal Conversion of Gamma Radiation, Part 2, L–Shell, Acad.Sci.USSR, Moscow, Leningrad (1958); Report 58 ICC L1, Univ. Illinois, Urbana, Ill. (1958)

67BeBu J. A. Bearden, A. F. Burr – Rev. Mod. Phys. 39, 125 (1967); Reevaluation of X–Ray Atomic Energy Levels

68HSe1 R. S. Hager, E. C. Seltzer – Nucl. Data A4, 1 (1968); Internal Conversion Tables. Part I: K–, L–, M–Shell Conversion Coefficients for Z = 30 to Z = 103

68HSe2 R. S. Hager, E. C. Seltzer – Nucl. Data A4, 397 (1968); Internal Conversion Tables. Part II: Directional and Polarization Particle Parameters for Z=30 to Z=103

68Lo16 R. J. Lombard, C. F. Perdrisat, J. H. Brunner – Nucl. Phys. A110, 41 (1968); Internal Pair Formation and Multipolarity of Nuclear Transitions

69DrPa O. Dragoun, H. C. Pauli, F. Schmutzler – Nucl. Data Tables A6, 235 (1969); Tables of Internal Conversion Coefficients for N–Subshell Electrons

69HSe1 R. S. Hager, E. C. Seltzer – Nucl. Data Tables A6, 1 (1969); Internal Conversion Tables. Part III: Coefficients for the Analysis of Penetration Effects in Internal Conversion and E0 Internal Conversion

70Kr03 K. S. Krane, R. M. Steffen – Phys. Rev. C2, 724 (1970); Determination of the E2/M1 Multipole Mixing Ratios of the Gamma Transitions in Cd^{110}

71DrPl O. Dragoun, Z. Plajner, F. Schmutzler – Nucl. Data Tables A9, 119 (1971); Contribution of Outer Atomic Shells to Total Internal Conversion Coefficients

71GoMa N. B. Gove, M. J. Martin – Nucl. Data Tables A10, 205 (1971); Log–f Tables for Beta Decay

71St47 R. M. Steffen – LA–4565–MS (1971); Angular Distributions and Correlations of Radiation Emitted from Oriented Nuclei

71St48 R. M. Steffen – Proc. Int. Conf. Angular Correlations in Nuclear Disintegration, Delft, Netherlands (1970), H. van Krugten, B. van Nooijen, Eds., Wolters–Noordhoff Publ., Groningen, p. 1 (1971); Angular Distributions and Correlations of Nuclear Radiations in Nuclear Spectroscopy

71TaSi W. H. Taylor, B. Singh, F. S. Prato, R. McPherson – Nucl. Data Tables A9, No. 1, 1 (1971); A Tabulation of Gamma–Gamma Directional–Correlation Coefficients

72An20 I. V. Anicin, R. B. Vukanovic, A. H. Kukoc – Nucl. Instrum. Methods 103, 395 (1972); The New Feature of 1–3 Directional Correlations with Mixed Unobserved Transitions

72BaCr W. Bambynek, B. Crasemann, R. W. Fink, H.–U. Freund, H. Mark, C. D. Swift, R. E. Price, P. Venugopala Rao – Rev. Mod. Phys. 44, 716 (1972); X–Ray Fluorescence Yields, Auger, and Coster–Kronig Transition Probabilities

72ElSc Y. A. Ellis, M. R. Schmorak – Nucl. Data Sheets B8, 345 (1972); Survey of Nuclear Structure Systematics for A ⩾ 229

72Tru1 V. F. Trusov – Nucl. Data Tables 10, 477 (1972); Internal Conversion Coefficients for High–Energy Transitions

SUMMARY OF BASES FOR SPIN AND PARITY ASSIGNMENTS - 1976

PROPOSITIONS ON WHICH STRONG ARGUMENTS ARE BASED

Ground States

1. The ground state of an even-even nucleus has $J^\pi = 0^+$.
2. Spin determinations by such techniques as atomic-beam resonance, paramagnetic resonance, electron-spin resonance, and optical spectroscopy give correct values.

Gamma Transitions

3. The agreement of the measured value of a single conversion coefficient with the theoretical value for a multipolarity which is well separated from the value for any other multipolarity determines the transition multipolarity.
4. In all other cases if there is no other evidence for multipolarity, agreement of two or more measured conversion coefficients or ratios with theoretical values is necessary in order to establish the multipolarities of a transition and its mixing ratio.
5. Since E0 transitions can proceed only by conversion or pair production, pure E0 is ruled out if photons are observed.
6. Lower limits for empirical $T_{1/2}$-values show that:
($T_{1/2w}$ is the Weisskopf single-particle estimate)

If the γ half-life is:		The transition is not:
<0.1	$T_{1/2w}$(M1)	M1
<1.0	$T_{1/2w}$(M2)	M2
<0.1	$T_{1/2w}$(M3)	M3
<0.033	$T_{1/2w}$(M4)	M4
<100	$T_{1/2w}$(E1)	E1
<0.001	$T_{1/2w}$(E2)	E2
<0.01	$T_{1/2w}$(E3)	E3

7. Appreciable mixing may occur only for the following retardations:

Multipolarity	Retardation over $T_{1/2}$ (Weisskopf)	Retardation over $T_{1/2}$ (Empirical Limit)	Component to be Admixed
E1	$>10^8$	$>10^6$	M2
E1	$>10^{10}$	$>10^8$	E3
M1	>10	>100	E2
M2	$>10^3$	$>10^3$	E3

Beta Transitions§

8a. If 3.6<log ft<5.9, the transition is allowed: $\Delta J=0$ or 1, $\Delta\pi=+$ (no change in parity). For the mass region around Z=82, the upper limit should be lowered to 5.1.
8b. If 3.6<log ft<6.4, the transition is not $0^+\rightarrow 0^+$. Superallowed ($\Delta T=0$) $0^+\rightarrow 0^+$ transitions have log ft in the range 3.48 to 3.50. Isospin forbidden ($\Delta T=1$) $0^+\rightarrow 0^+$ transitions have log ft>6.4.
9. If $\log f^{1u}t < 8.5$,* $\Delta J = 0, 1$; $\Delta\pi = \pm$.
10. If $\log ft < 11.0$, $\Delta J = 0, 1$; $\Delta\pi = \pm$ or $\Delta J = 2$, $\Delta\pi = -$.
11. If $\log ft < 12.8$, $\Delta J = 0, 1, 2$; $\Delta\pi = \pm$.
12. If $\log f^{1u}t \geq 8.5$† and if the Fermi plot has the curvature corresponding to a shape factor (p^2+q^2), then the transition is first-forbidden unique ($\Delta J = 2$, $\Delta\pi = -$).
See "β-Decay Rate Probabilities" on page iv. (Note that log $f^{1u}t$=log $f't$+1.079).

$\gamma\gamma$ Directional Correlation

$$W(\theta) = \sum_{k\ \text{even}} A_k P_k(\cos\theta).$$

13. If a gamma-gamma directional-correlation experiment yields $A_2 \approx +0.36$ and $A_4 \approx +1.1$, then the spin sequence is $0\rightarrow 2\rightarrow 0$.
14. Results of $\gamma\gamma(\theta)$ are strong evidence for excluding spin sequences for which the theoretical A_2 or A_4 falls well outside the experimental range.

$\beta\gamma$ Directional Correlation

$$W(\theta) = \sum_{k\text{-even}} A_k(\beta)A_k(\gamma)P_k(\cos\theta).$$

15. If $|A_2(\beta)| \geq 0.1 (A_4 = 0)$, the transition is not allowed. The converse is not true.
16. If $A_4(\beta) \neq 0$, the transition is neither allowed nor first-forbidden.
17. If $A_4(\beta) = 0$, the transition is allowed or first-forbidden.

$\beta\gamma$ Polarization Correlation

$$P(\theta) = \frac{\sum_{k\text{-odd}} A_k(\beta)A_k(\gamma)P_k(\cos\theta)}{W(\theta)}.$$

18. In allowed transitions,

if $A_1(\beta) > 0$, $J_i = J_f$ or $J_f + 1$;
if $A_1(\beta) < 0$, $J_i = J_f$ or $J_f - 1$.

19. If $A_3(\beta) \neq 0$, the β-transition is not allowed. The converse is not always true.

Reactions

20. Low-energy Coulomb excitation is predominantly E2 excitation.
21. Coulomb excitation determines J^π if the excitation probability agrees with the calculated values of Alder et al., Kgl. Danske Videnskab. Selskab, Mat.-Fys. Medd. 32, No. 8 (1960).
22. The spin of the state resulting from thermal-neutron capture is equal to the spin of the target nucleus plus or minus 1/2.
23. Primary γ's from neutron capture are E1, M1, E2, or M1+E2.
24. If the angular distribution in a single-nucleon transfer reaction can be fitted with a unique ℓ-value, the spin of the final state J_f is related to the spin of the inital state J_i by

$$\vec{J}_f = \vec{J}_i + \vec{\ell} + \vec{1/2}$$

with parity change if ℓ is odd.
25. For $Z \lesssim 50$ and $Z \approx 82$, if the vector analyzing power for a single-nucleon transfer reaction shows a clear preference between $J = \ell + 1/2$ and $J = \ell - 1/2$ and if the ℓ-value is known, then the J-value is determined.

The limitation in the regions of applicability results from a lack of measurements in other regions rather than an expected or observed violation.

§S. Raman and N. B. Gove, Rules for Spin and Parity Assignments Based on Log *ft* Values, Phys. Rev. C7, 1995 (1973)
*(log $f't < 7.4$)
†(log $f't \geq 7.4$)

SUMMARY OF BASES FOR SPIN AND PARITY ASSIGNMENTS - 1976 continued

PROPOSITIONS ON WHICH STRONG ARGUMENTS ARE BASED continued

Magnetic Moments

26. In nonrotational regions, if the known spin and magnetic moment of a level lead to an expected shell-model state by use of the Schmidt diagram, the level parity is determined.

27. In rotational regions, if the known spin and magnetic moment of a level agree with theoretical values for only one expected Nilsson level, the level parity is determined.

Deformed Region – Band Structure

Symbol	Evidence
D	Data from β- or γ-transitions suggest $J^\pi = 2^+$
x	The level is Coulomb excited
y	The level energy is given by the rotational level-energy formula
z,z′	The inertial parameter, decoupling parameter, fits the local trend

In terms of the above types of evidence, the following rules can be stated for nuclei in the rotational regions, $90 \leqslant N \leqslant 112$, and $Z > 87$.

28. For the first excited state in an even-even nucleus, x or Dz is sufficient to assign a spin and parity of 2^+.

29. A level may be assigned to the ground-state rotational band on evidence of type xz or yz, provided the ground-state spin is well known.

30. A level may be assigned to a rotational band on evidence of type yz, provided at least one member of the band has well-known spin.

31. For K = 1/2 bands, yz′ is sufficient evidence to assign spins to the levels.

Alpha Decay

32. In odd-A nuclei, levels connected by α-transitions have the same spin and parity if the hindrance factor is less than 4.

33. For α-decay between two states, one of which has J = 0, the parity change is given by $\Delta\pi = (-1)^{\Delta J}$.

PROPOSITIONS ON WHICH WEAK ARGUMENTS ARE BASED

1. In cases where gammas of one multipolarity "cluster" in one time region in the half-life vs. energy plot, as is true for M4's, other γ's whose half-lives fall in this cluster may be assigned the corresponding multipolarity.

2. In cases where cluster of two multipolarities occupy one time region, e.g., M1 and E2, a new gamma of which the half-life falls in this region may be assigned one of the two multipolarities or a mixture of the two.

3. Whenever $\Delta J \geqslant 2$, an appreciable part of the gamma transition proceeds by the lowest possible multipole order.

This statement is based on the scarcity of counter-examples and the observation that few E2 γ's are as slow as M3's, few M2's as slow as E3's, etc.

4. Low-lying states of odd-A nuclei have shell-model spins and parities except in the regions where deformations appear. This argument is much stronger when supported by expected cross-section strengths (C^2S) in single-nucleon transfer reactions.

It is recognized that some shell-model predictions are stronger than others. For example, the shell model would mildly deny that the ground-state J^π of the 39th proton be $3/2^-$, but emphatically deny its being $3/2^+$ However, we have not included this distinction here and consider that all shell-model arguments are weak.

5. The spin and parity of a parent state may be inferred from the measured properties of its assumed isobaric analog resonance, and vice versa.

6. In regions of nuclear deformation, the Nilsson model can be used to limit the possible spins and parities.

7. Statements similar to 4 and 6 based on other models.

8. Statements based on interpolation or extrapolation of regional trends.

9. All statements connected with the nonobservation of expected transitions.

Appendix 27

Addresses of Active and Potential Members of the NSDD Network

Code	Centre/Group	Address	Head of Project or Centre
1A	US/BNL	National Neutron Cross Section Center Brookhaven National Laboratory Upton, New York 11973, USA	S. Pearlstein
1B	US/NDP	Nuclear Data Project Oak Ridge National Laboratory Oak Ridge, Tennessee, 37830, USA	W.B. Ewbank
1C	US/LBL	Lawrence Berkeley Laboratory University of California Berkeley, Calif. 94720, USA	M. Lederer
1D	US/INEL	Idaho National Engineering Lab. 550 Second Street Idaho Falls, Idaho, 83401, USA	R.L. Heath
1E	US/UP	University of Pennsylvania Philadelphia, Penns. 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 Sorbonnelaan 4 Utrecht, The Netherlands	C. Van der Leun
3B	NED/IKO	IKO Inst. for Nuclear Research 18 Oosterringdijk P.O. Box 4395 Amsterdam-1006, The Netherlands	A.H. Wapstra

Code	Centre/Group	Address	Head of Project or Centre
4A	UK/Daresbury	Oliver Lodge Laboratory University of Liverpool Liverpool L69 3BX, UK	P. Twin
4B	UK/Harwell	Chemistry Div. Bldg. 220 Atomic Energy Research Establishm. Harwell, Didcot, Oxon OX11 ORA United Kingdom	A.L. Nichols
5A	FRG/ZAED	Zentralstelle f. Atomkernenergie-Dokumentation Kernforschungszentrum D-7514 Eggenstein-Leopoldshafen	H. Behrens
5B	FRG/Juelich	Kernforschungsanlage Juelich Ges.m.b.H. Postfach 1913 D-5170 Juelich	G. Erdtmann
6A	FR/LMRI	Centre d'Etudes Nucleaires de Saclay B.P. No. 2 F-91190 Gif sur Yvette, France	J. Legrand
6B	FR/CEA-Grenoble	Centre d'Etudes Nucleaires de Grenoble Cedex No. 85 F-38041 Grenoble Gare	J. Blachot
7A	IAEA/NDS	Nuclear Data Section International Atomic Energy Agency P. O. Box 590 A-1011 Vienna, Austria	J.J. Schmidt
8A	ENEA/CCDN	NEA Neutron Data Compilation Centre B.P. No. 9 F-91190 Gif sur Yvette, France	L. Lesca
9A	CBNM/Geel	Bureau Central de Mesures Nucleaires C.E.C. Steenweg naar Retie B-2440 Geel, Belgium	W. Bambynek

Code	Centre/Group	Address	Head of Project or Centre
10A	JAP/JAERI	Japan Atomic Energy Research Inst. Division of Physics Tokai-Mura, Naka-Gun Ibaraki-Ken, 319-11, Japan	T. Tamura
10B	JAP/Hokkaido	Department of Physics Hokkaido Univ. Sapporo, Hokkaido, Japan	H. Tanaka
11A	SWD/Lund	University of Lund Solvegatan 14 S-223 62 Lund, Sweden	L. Carlen
12A	KUW/ISR	Kuwait Institute for Scientific Research Shuwaik, Kuwait	A. Shihab-Eldin
13A	ITY/CNEN-Bologna	Centro di Calcolo del C.N.E.N. Via Mazzini 2 I-40138 Bologna	G. Reffo
14A	ROM/IPA	Institut de Physique Atomique de Bucarest B.P. No. 35 Bucarest, Roumanie	M. Ivascu
15A	HUN/INR-Debrecen	Institute of Nuclear Research P.O. Box 51 H-4001 Debrecen, Hungary	D. Berenyi
16A	POL/IBJ-Warsaw	Institut Badan Jadrowych Hoza 69 PL-00-681 Warsaw, Poland	A. Marcinkowski
17A	IND/BARC	Bhabha Atomic Research Centre Trombay, Bombay 400 085, India	M.K. Mehta
18A	GDR/TU-Dresden	Sektion Physik Technische Universitaet Dresden Mommsenstr. 13 DDR- 8027 Dresden, German Dem. Republic	D. Seeliger

Appendix 28

NUCLEAR DATA SHEETS

CUMULATED INDEX TO A-CHAINS

A	Nuclei	Reference	Date
1	H		
2	H		
3	He	NP A251,1	1975
4	He	NP A206,1	1973
5		NP A227,5	1974
6	Li	NP A227,25	1974
7	Li	NP A227,53	1974
8	Be	NP A227,77	1974
9	Be	NP A227,111	1974
10	B	NP A227,139	1974
11	B	NP A248,1	1975
12	C	NP A248,1	1975
13	C	NP A152,3	1970
14	N	NP A152,42	1970
15	N	NP A152,93	1970
16	O	NP A166,1	1971
17	O	NP A166,61	1971
18	O	NP A190,1	1972
19	F	NP A190,56	1972
20	Ne	NP A190,105	1972
21	Ne	NP A214,13	1973
22	Ne	NP A214,31	1973
23	Na	NP A214,57	1973
24	Mg	NP A214,80	1973
25	Mg	NP A214,111	1973
26	Mg	NP A214,135	1973
27	Al	NP A214,158	1973
28	Si	NP A214,182	1973
29	Si	NP A214,212	1973
30	Si	NP A214,231	1973
31	P	NP A214,250	1973
32	S	NP A214,271	1973
33	S	NP A214,293	1973
34	S	NP A214,313	1973
35	Cl	NP A214,332	1973
36	S,Ar	NP A214,350	1973
37	Cl	NP A214,370	1973
38	Ar	NP A214,388	1973
39	K	NP A214,410	1973
40	Ar,Ca	NP A214,428	1973
41	K	NP A214,457	1973
42	Ca	NP A214,483	1973
43	Ca	NP A214,508	1973
44	Ca	NP A214,532	1973
45	Sc	B4-237	1970
46	Ca,Ti	B4-269	1970
47	Ti	B4-313	1970
48	Ti	B4-351	1970
49	Ti	B4-397	1970
50	Ti,Cr	B3-5,6-1	*
51	V	B3-5,6-37	1970
52	Cr	B3-5,6-85	1970
53	Cr	B3-5,6-127	1970
54	Cr,Fe	B3-5,6-161	1970
55	Mn	B3-3,4-1	*
56	Fe	B3-3,4-43	1970
57	Fe	B3-3,4-103	1970
58	Fe,Ni	B3-3,4-145	*
59	Co	NDS 17,485	1976
60	Ni	NDS 16,317	1975
61	Ni	NDS 16,1	1975
62	Ni	NDS 13,443	1974
63	Cu	NDS 14,119	1975
64	Ni,Zn	NDS 12,305	1974
65	Cu	NDS 16,351	1975
66	Zn	NDS 16,383	1975
67	Zn	NDS 16,417	1975
68	Zn	NDS 14,155	1975
69	Ga	NDS 17,193	1976
70	Zn,Ge	B8-1	1972
71	Ga	NDS 10,205	1973
72	Ge	NDS 11,121	1974
73	Ge	NDS 13,305	1974
74	Ge,Se	NDS 17,519	1976
75	As	NDS 16,25	1975
76	Ge,Se	ENSDF	*
77	Se	NDS 9,229	1973
78	Se,Kr	NDS 15,107	1975
79	Br	NDS 15,257	1975
80	Se,Kr	NDS 15,289	1975
81	Br	NDS 15,137	1975
82	Se,Kr	NDS 15,315	1975
83	Kr	NDS 15,169	1975
84	Kr,Sr	B5-109	1971
85	Rb	B5-131	1971
86	Kr,Sr	B5-151	1971
87	Sr	B5-457	1971
88	Sr	ENSDF	*
89	Y	NDS 16,445	1975
90	Zr	NDS 16,55	1975
91	Zr	B8-477	1972
92	Zr,Mo	B7-299	1972
93	Nb	B8-527	1972
94	Zr,Mo	NDS 10,241	1973
95	Mo	B8-29	1972
96	Mo,Ru	B8-599	1972
97	Mo	NDS 10,1	1973
98	Mo,Ru	NDS 11,157	1974
99	Ru	NDS 12,431	1974
100	Mo,Ru	NDS 11,279	1974
101	Ru	NDS 10,47	1973
102	Ru,Pd	ENSDF	*
103	Rh	NDS 13,337	1974
104	Ru,Pd	ENSDF	*
105	Pd	NDS 11,449	1974
106	Pd,Cd	NDS 13,397	1974
107	Ag	B7-1	1972
108	Pd,Cd	B7-33	1972
109	Ag	B6-1	1971
110	Pd,Cd	B5-487	1971
111	Cd	B6-39	1971
112	Cd,Sn	B7-69	1972
113	In	B5-181	1971
114	Cd,Sn	NDS 16,107	1975
115	Sn	NDS 16,195	1975
116	Cd,Sn	NDS 14,247	1975
117	Sn	ENSDF	*
118	Sn	NDS 17,1	1976
119	Sn	ENSDF	*
120	Sn,Te	NDS 17,39	1976
121	Sb	B6-75	1971
122	Sn,Te	B7-419	1972
123	Sb	B7-363	1972
124	Sn..Xe	NDS 10,91	1973
125	Te	B7-465	1972
126	Te,Xe	NDS 9,125	1973
127	I	B8-77	1972
128	Te,Xe	NDS 9,157	1973
129	Xe	B8-123	1972
130	Te..Ba	NDS 13,133	1974
131	Xe	NDS 17,573	1976
132	Xe,Ba	NDS 17,225	1976
133	Cs	NDS 11,495	1974
134	Xe,Ba	NDS 15,203	1975
135	Ba	NDS 14,191	1975
136	Xe..Ce	NDS 13,191	1974
137	Ba	NDS 15,335	1975
138	Ba,Ce	ENSDF	*
139	La	NDS 12,139	1974
140	Ce	NDS 12,343	1974
141	Pr	NDS 10,151	1973
142	Ce,Nd	NDS 10,309	1973
143	Nd	NDS 13,229	1974
144	Nd,Sm	NDS 16,231	1975
145	Nd	NDS 12,203	1974
146	Nd,Sm	NDS 14,413	1975
147	Sm	ENSDF	*
148	Nd,Sm	ENSDF	*
149	Sm	ENSDF	*
150	Nd..Gd	ENSDF	*
151	Eu	ENSDF	*
152	Sm,Gd	ENSDF	*
153	Eu	NDS 10,429	1973
154	Sm..Dy	ENSDF	*
155	Gd	NDS 15,409	1975
156	Gd,Dy	ENSDF	*
157	Gd	NDS 9,273	1973
158	Gd,Dy	NDS 12,245	1974
159	Tb	NDS 9,435	1973
160	Gd,Dy	NDS 12,477	1974
161	Dy	NDS 13,493	1974
162	Dy,Er	NDS 17,97	1976
163	Dy	B8-295	1972
164	Dy,Er	NDS 11,327	1974
165	Ho	NDS 11,189	1974
166	Er	NDS 14,471	1975
167	Er	NDS 17,143	1976
168	Er,Yb	NDS 11,385	1974
169	Tm	NDS 10,359	1973
170	Er,Yb	NDS 15,371	1975
171	Yb	NDS 11,549	1974
172	Yb	NDS 15,497	1975
173	Yb	NDS 14,297	1975
174	Yb	NDS 10,515	1973
175	Lu	ENSDF	*
176	Hf	ENSDF	*
177	Hf	NDS 16,135	1975
178	Hf	NDS 13,549	1974
179	Hf	NDS 17,287	1976
180	Hf,W	NDS 15,559	1975
181	Ta	NDS 9,319	1973
182	W	NDS 14,559	1975
183	W	NDS 16,267	1975
184	W	ENSDF	*
185	Re	NDS 12,533	1974
186	W,Os	NDS 13,267	1974
187	Os	NDS 14,347	1975
188	Os	NDS 10,553	1973
189	Os	NDS 12,397	1974
190	Os,Pt	NDS 9,401	1973
191	Ir	NDS 9,479	1973
192	Os,Pt	NDS 9,195	1973
193	Ir	B8-389	1972
194	Pt	B7-95	1972
195	Pt	B8-431	1972
196	Pt,Hg	B7-395	1972
197	Au	B7-129	1972
198	Pt,Hg	B6-319	1971
199	Hg	B6-355	1971
200	Hg	B6-387	1971
201	Hg	B5-561	1971
202	Hg	B5-581	1971
203	Tl	B5-531	1971
204	Hg,Pb	B5-601	1971
205	Tl	B6-425	1971
206	Pb	B7-161	1972
207	Pb	B5-207	1971
208	Pb	B5-243	1971
209	Bi	B5-287	1971
210	Po	B5-631	1971
211	Po	B5-319	1971
212	Po	B8-165	1972
213	Po	NDS 10,597	1973
214	Po	ENSDF	*
215	At	ENSDF	*
216	Po,Rn	NDS 17,329	1976
217	Rn	NDS 10,611	1973
218	Rn	ENSDF	*
219	Fr	ENSDF	*
220	Rn,Ra	NDS 17,341	1976
221	Ra	NDS 10,625	1973
222	Ra	ENSDF	*
223	Ra	ENSDF	*
224	Ra,Th	NDS 17,351	1976
225	Ac	NDS 10,643	1973
226	Ra,Th	ENSDF	*
227	Th	ENSDF	*
228	Th	NDS 17,367	1976
229	Th	B6-209	1971
230	Th,U	B4-543	1970
231	Pa	B6-225	1971
232	Th,U	B4-561	1970
233	U	B6-257	1971
234	U	B4-581	1970
235	U	B6-287	1971
236	U,Pu	B4-623	1970
237	Np	B6-539	1971
238	U,Pu	B4-635	1970
239	Pu	B6-577	1971
240	Pu	B4-661	1970
241	Am	B6-621	1971
242	Pu,Cm	B4-683	1970
243	Am	ENSDF	*
244	Pu,Cm	NDS 17,402	1976
245	Cm	ENSDF	*
246	Cm	NDS 17,410	1976
247	Bk	ENSDF	*
248	Cm,Cf	NDS 17,426	1976
249	Cf	ENSDF	*
250	Cf	NDS 17,436	1976
251	Cf	ENSDF	*
252	Cf,Fm	NDS 17,450	1976
253	Es	ENSDF	*
254	Cf,Fm	NDS 17,460	1976
255	Fm	ENSDF	*
256	Fm	NDS 17,468	1976
257	Fm	ENSDF	*
258	Fm,No	NDS 17,473	1976
259		ENSDF	*
260		NDS 17,476	1976
261		ENSDF	*
262		NDS 17,477	1976
263		ENSDF	*

EXPLANATION

The cumulated index gives, for each mass value A, the most recent compilation of experimental information on levels of nuclei with that A-value.

NUCLEI The beta-stable member(s) of this A-chain

REFERENCE NP = Nuclear Physics
NDS 9,125 = Nuclear Data Sheets, vol.9, p.125
B4-269 = Nuclear Data Sheets B4, 269
B1-4-85 = Nuclear Data B1-4-85

ENSDF Preliminary summaries of recent results may be obtained as computer printout from the Evaluated Nuclear Structure Data File of the Nuclear Data Project

DATE The year in which the compilation was published

* Indicates that a revision is in progress

Appendix 29

Statement by F. Chukreev (CAJaD) on the distribution of A-chain evaluation responsibilities

At this meeting the Soviet delegation represents the interests of the USSR and not of some small group of Soviet scientists.

The new Five-year Plan for the development of the economy of our country has foreseen considerable allocations for research in the field of controlled thermonuclear fusion and for the development of nuclear energy technology. It is entirely natural therefore, that under these conditions the Soviet Union must carry on independent research and perform evaluations of nuclear structure and decay data in the two A-ranges of importance, namely in the range of light nuclei and in the range of heavy nuclei. Therefore, we cannot agree to leave the entire effort of nuclear (structure and decay) data evaluation in these two A-ranges in one set of hands, even if these are extremely qualified.

We are prepared to give careful consideration to the proposed suggestion concerning the evaluation of nuclear data in the A=210-230 range, and are prepared to consider a slight shift in the range of light and heavy nuclei with regard to our proposals. However, I would like to emphasize once more, that we shall perform the evaluations in the A-ranges indicated above * and we shall be prepared to make the results of this work available to the entire international scientific community in the framework of the discussed cooperation.

---

* See Table F3

Appendix 30

Summary of participant statements on publication of mass chains

(In this Appendix NDS means Nuclear Data Sheets and NP means Nuclear Physics)

Pearlstein: All masses should be published in NDS. Where A=5-44 appear in Nuclear Physics in narrative form the results could be coded into ENSDF and published without extensive supporting evidence in NDS. Since the results will be produced from the established ENSDF-NDS link, the publication format will be the same as for other mass chains included in NDS. The presentation of NSDD in a common format in a common publication is a useful service to the scientific community.

Blachot: Considered inclusion of Utrecht information in ENSDF to be important; utilization of the computer link between ENSDF and NDS seemed logical.

Berenyi: Felt that it would be best from the user viewpoint to find all mass chain data in the same periodical.

Behrens: Same as Berenyi.

Nichols: Same as Berenyi.

Twin: Same as Berenyi.

Bambynek: States that if future NDS contain expanded information as in older NDS, combining work published in NDS and NP into a single journal would not be unreasonable.

Erdtmann: Appeared to favor summary sheets and data sheets without reprinting data included in previous NDS.

Ivascu: Viewed the presentations in Nuclear Physics as being of primary importance.

Ohnuma: Seemed to favor two presentations; one detailed and one brief.

Van der Leun: Stated that publication formats for A=21-44 are becoming similar to those used in NDS. Referral to only two different periodicals should not be a great difficulty. Commercial aspects should be investigated such as the effect of NDS overlap of material published in Nuclear Physics, which produces significant profit for the North Holland Publishers.