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INDC INTERNATIONAL NUCLEAR DATA COMMITTEE

Consultants' Meeting

on

Charged Particle Nuclear Data (CPND) Compilation

Vienna, 8-12 September 1975

Edited by
H.D. Lemmel

December 1975

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

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CPND-Meeting 1975

Note: A summary containing from this document the pages

5 - 6 Introduction
7 - 8 Agenda
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23-29 Conclusions and Recommendations

has been distributed separately as INDC(NDS)-71.
Annex 2 of this document on the activities of the USSR Centre for nuclear structure and reaction data has been distributed separately as INDC(CCP)-79.

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INTRODUCTION

The present meeting was a successor to the IAEA Consultants' Meeting on Charged Particle and Photonuclear Reaction Data held in Vienna 24 - 26 April 1974 [1]. This earlier meeting, considering the needs for charged particle and photonuclear reaction data documented in ref. [2], concluded:

> "that the very valuable services provided by the existing centres and groups could be usefully enhanced by establishing a coherent international cooperation in the compilation, evaluation and dissemination of these data. This cooperation would require a free international exchange of experimental as well as evaluated data between the centres and groups concerned."

The International Nuclear Data Committee considered the topic at its seventh meeting in October 1974 and concluded [ref. 3, recommendation 2.4]:

> "The Committee values the activity of the existing "non-neutron" nuclear data centres and groups and judges it important to continue this work, in most cases with increased support. It asks IAEA and its member states to support the above activity, especially the international coordination of this work and the exchange of appropriate"non-neutron" nuclear data and references, by continuing to convene meetings of "non-neutron" nuclear data centres and groups."

Since then, some essential steps towards an international cooperation in charged-particle nuclear data compilation have been made:

The charged-particle nuclear data group at Karlsruhe had prepared sample entries of charged-particle reaction data compiled in a format close to Exfor, a system which had been developed by the four neutron data centres for the exchange of neutron nuclear data [4]. The modified EXFOR system as proposed by Karlsruhe had meanwhile been reviewed by the four neutron data centres at their March 1975 meeting [5]. Also the Nuclear Data Centre at the Moscow Kurchatov Institute submitted sample entries in the format of the Karlsruhe Exfor system. Furthermore, a study group in Japan has recently developed the prototype of a Nuclear Data File. In the USA, the National Neutron Cross-Section Center has assumed responsibility for coordinating the US activities on charged-particle nuclear data with similar activities abroad.

On the basis of the conclusions of the 1974 Meeting and of the development which took place since then, the present meeting was the first to discuss technical details on an international cooperation and exchange of charged-particle nuclear data.

[1] Summary Report on the Consultants' Meeting on Charged Particle and Photonuclear Reaction Data, 24-26 April 1974, Vienna, INDC(NDS)-59, IAEA, Vienna, June 1974. For the papers submitted see INDC(NDS)-61, IAEA, Vienna, July 1974.

[2] Symposium on Nuclear Data in Science and Technology, Paris 1973, Proceedings IAEA, Vienna, 1973, and:
A. Calamand: Survey of current and future needs for charged particle and photo-nuclear reaction data, INDC(NDS)-62.

[3] Official Minutes of the Seventh INDC Meeting, Lucas Heights, 7-11 Oct. 1974, INDC-18, IAEA, Vienna, 1975.

[4] USA National Neutron Cross-Section Center, NEA Neutron Data Compilation Centre, IAEA Nuclear Data Section, USSR Centr po Jadernym Dannym: EXFOR Manual, internal distribution.

[5] Report on the Eleventh Four-Centre Meeting, Brookhaven, National Laboratory, USA, 10-14 March 1975, INDC(NDS)-68, IAEA, Vienna 1975.

Consultants' Meeting

on

Charged Particle Nuclear Data (CPND) Compilation

Vienna, 8–12 September 1975

Agenda

I. Brief review of current and planned CPND compilation activities

Bibliography, Compilation and Evaluation of CPND
- Specific user needs;
- Scope, content and format;
- Publications and services.

II. Matters of technical cooperation

A. Bibliography

1. Eperience gained from the use of "Recent References", as far as related to CPND; any changes desirable?
2. Who compiles what where?
   - Contimue centralized input?
   - Start coordinated input from different Centres and Groups?
   - Practical details for coordinated input.
3. Publications and services.

B. Compilation and Exchange of CPND

1. Principle decision whether a format close to the "neutron data EXFOR" is acceptable, mutatis mutandis, for CPND.
2. Scope and distribution of work between Centres and Groups involved.
   - Targets, projectiles, reactions, quantities;
   - Experimental, deduced, interpolated, theoretical data, thick target yields;
   - Selective versus comprehensive compilation;
   - Distribution of work defined by physics criteria (excitation function, angular distribution, etc.) and/or geographical origin of data;
   - Possible future extension of the scope (heavy ions?).
3. Technical details, contents and format.
   - Numeric information;
   - Bibliographic and experimental description;
   - Keywords, codes, retrievability (what is needed?)
   - What modifications to EXFOR are required?
   - Codes for reactions and quantities;
   - Associated parameters (standard reference values, half-lives, etc.)
   - Accession-numbers.
4. Organization of cooperation.
   - Mechanisms for exchange, compiler's and system manual, dictionaries of codes and keywords, meetings;
   - Implementation schedule.

C. Evaluation of CPND

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2. Feasibility of cooperation;
3. Common method of evaluation:

D. Service to users

III. Review of actions, conclusions and recommendations from this meeting

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	Monday afternoon:	II.A.1,2
	Tuesday morning:	II.A.3
	Tuesday afternoon:	II.B.1,2
	Wednesday:	II.B.3
	Thursday morning:	II.B.4 and II.D
	Thursday afternoon:	II.C
	Friday:	III

List of Participants

Consultants

Mr. C.L. Dunford	National Neutron Cross Section Center Brookhaven National Laboratory Upton, L.I., N.Y. 11973, USA
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Mr. H. Ohnuma	Tokyo Institute of Technology Dept. of Physics Oh-Okayama, Meguro-ku, Japan
Mr. L.L. Sokolovskij	Center for Nuclear Structure & Reaction Data of the USSR State Committee on the Utilization of Atomic Energy I.V. Kurchatov Institute of Atomic Energy Moscow, USSR

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IAEA Nuclear Data Section

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Mr. H.D. Lemmel	(Scientific Secretary)
Mr. J.R. Lemley (part-time)	
Mr. A. Lorenz (part-time)	
Mr. K. Okamoto	
Mr. J.J. Schmidt	
Mr. M. Vlasov	

List of Abbreviations used in this Document

CAJaD	Centr po dannym o stroenii atomnogo jadra i jadernykh reakcikh GKAE CCCP (Center for nuclear structure and reaction data of the USSR State Committee of the Utilization of Atomic Energy) at the Kurchatov Institute, Moscow.
CINDA	A specialized bibliography and data index on neutron nuclear data operated jointly by NNCSC, NDCC, NDS and CJD. The master file is maintained at NDCC. Publications are made by IAEA.
CJD	Centr po Jadernym Dannym, the USSR Nuclear Data Center at F.E.I. Obninsk.
Codata	Committee on Data for Science and Technology, of the International Council of Scientific Unions.
CPND	Charged-particle nuclear reaction data.
ERDA	USA Energy Research and Development Agency.
EXFOR	Exchange Format, initially developed for the international exchange of neutron nuclear data.
INDC	International Nuclear Data Committee.
INIS	International Nuclear Information System, a bibliographic system operated by the IAEA.
Japanese Study Group	Study group for information processing in nuclear physics at the Tokyo Institute of Technology.
Karlsruhe CPND Group	Charged particle nuclear data group at the Institute for Radiochemistry, Karlsruhe.
NDCC	Neutron Data Compilation Centre (Centre de Compilation de Données Neutroniques - CCDN) of the OECD Nuclear Energy Agency, at Saclay near Paris.
NDP	Nuclear Data Project at Oak Ridge for nuclear structure and decay data.
NDS	IAEA Nuclear Data Section, Vienna.
NEANDC	Nuclear Data Committee of the OECD Nuclear Energy Agency.
NNCSC	USA National Neutron Cross-Section Center at the Brookhaven National Laboratory, Upton, N.Y.
NRDF	Nuclear Reaction Data File System developed by the Japanese Study Group.

"Reaction List"
: The bibliography of the Oak Ridge CPND group, now merged with the Oak Ridge Nuclear Data Project. Published in "Atomic Data and Nuclear Data Tables".

"Recent References"
: The bibliography of the Oak Ridge Nuclear Data Project for nuclear structure data, including many references on CPND. Published in "Nuclear Data Sheets".

ZAED
: Zentralstelle für Atomkernenergie Dokumentation (documentation center for atomic energy) at Karlsruhe.

M I N U T E S

I. Brief review of current and planned CPND compilation activities

1. Mr. Münzel reports on the CPND group at Karlsruhe. See Annex 1. In summary, the activities of the Karlsruhe CPND group are:

   - compilation of "integral CPND" (that is excitation functions and thick-target yields as defined on page 23),
   - estimation of excitation functions of nuclei for which no experimental data exist,
   - publication of handbooks for integral CPND.

   No bibliography is compiled; the services of the Oak Ridge NDP and of INIS through ZAED are used.

   Data are now compiled in a modified Exfor format. See Annexes 8 to 10. The master library, for which input from other centres is welcome, will be made available to other centres for servicing users' requests for data retrievals.

   For "integral CPND" a large user community is known in various fields of application such as isotope production, surface investigations, life sciences etc.

2. In the following discussion it is estimated that the "integral CPND" include only about 5% of all CPND, and that the workload of compiling "integral CPND" seems therefore to be manageable. At least 90% of all CPND is differential data, for which a relatively small user community exists, mainly in the field of basic research.

3. Mr. Sokolovskij reports on the activities of CAJaD. See Annex 2. In summary, the activities of CAJaD are:

   - bibliographic compilation in a format close to "Recent References". See the document IAE-2403 covering references on theoretical work which is not included in "Recent References".
   - compilation of CPND, in a modified Exfor format. See Annex 11.
   - services to data users upon request.

The activities of the center are defined by a coordinating group of the State Committee on the Utilization of Atomic Energy.

CPND needed for fusion have priority.

4. Mr. Dunford reports on the CPND activities in the USA:

"The US activity in the CPND field remained unchanged since the last Consultants' Meeting in April 1974, (see INDC(NDS)-61). The reader is referred to that document for more detail.

The Charged-Particle Cross Section Data Center is located at the Oak Ridge National Laboratory and is now part of the Nuclear Data Project. The center continues to operate at a 0.5 man level.

The major activity is the compilation of a CPND bibliography. This bibliography is kept in a computerized file available to other CPND compilation centers. A Reaction List is published annually giving all new references since the last publication.

A file of experimental CPND is kept by the Center but is no longer actively maintained. No new data has been added in more than five years. Sol Pearlstein has prepared an evaluated library of CPND in ENDF format based on data systematics developed by Mr. Münzel. This library is available on request.

At the present time a complete review of the United States activities in the non-neutron nuclear data area is being carried out by the Brookhaven National Laboratory's National Neutron Cross Section Center (NNCSC) for the US Energy Research and Development Administration. The deliberations of this meeting will be of considerable importance in helping us determine the future role of the US in CPND.

NNCSC was selected to undertake this study because of its past success in organizing cooperative efforts such as the US neutron data evaluation and for its international contacts. As a part of this survey a questionnaire was sent to over 400 scientists in both the research and the applications community in order to determine their requirements. Over 100 responses were received in July and August primarily from the physics research community. A summary of the results of the survey is presented for information." See Annex 3.

5. The following discussion concerns the responsibilities of other nuclear data groups in the USA: Howerton's data center at Livermore can provide retrievals from the "Reaction List"reference file. ANC is one of the centers evaluating nuclear decay data, including those of transactinium isotopes. They have supplied some of the evaluations for ENDF/B-IV decay data for nuclear structure data, compilation and evaluation, but so far little support for CPND. - There is a loose cooperation between the NSRDS (National Standard Reference Data System) program of the National Bureau of Standards with the much larger data activities of ERDA. For example, both support the Table of Isotopes Project at Berkeley.

6. Mr. Ohnuma reports on the activities of the Japanese Study Group. See Annex 4. Summary: In 1974 a Study Group on information processing in nuclear physics was started in Japan. A Nuclear Reaction Data File (NRDF) has been designed and is being tested with various data sets as trial input. The file is to include all kinds of CPND such as angular distributions, polarization, asymmetry, excitation functions. A test-system NRDF-1 is in operation. A first revision, NRDF-2, is being designed.

   No bibliographic compilation is made; existing files are used.

7. In the discussion it is clarified that the Study Group has not got the task to start a long-term compilation activity but has the task to perform an academic study on data processing.

8. Mr. Lesca reports that the activities of NDCC are presently restricted to neutron nuclear data. Any extension of the scope has to be discussed and approved by the Steering Committee. CPND for fusion may be considered first, if at all.

9. Mr. Schmidt reports that the NDS has no manpower for CPND compilation. NDS may be able to devote about 1/2 manyear to CPND dissemination within its service area (essentially East Europe and southern hemisphere) and to coordination by meetings.

10. Concerning CPND activities in the UK, Mr. Schmidt reads out a letter by G. Dearnaley (see Annex 5), Harwell, on the use of CPND for surface materials analysis. (See Footnote.)

11. In the discussion it is stressed that the assessment of data needs is the responsibility of INDC and NEANDC.

Footnote: A relevant working paper was received only after the end of the meeting: B. Rose, "Compilation of cross-sections for ion beam analysis of materials", a working paper for the INDC Sub-Committee on Non-Energy Applications, Sept. 1975.

12. Mr. Behrens reports on the CPND activities of the ZAED at Karlsruhe. See Annex 6. ZAED is in charge of creating a national information system for physics data, including bibliographic services within INIS and retrieval services from available numerical data files.

13. In the following discussions, it is pointed out that the ZAED plans for an index to existing data compilations should be coordinated with similar plans at NDS and Codata. (Action 12)

14. Mr. Brune reports on CPND applications at Studsvik where proton microbeams are used for surface analysis. Data needs include primarily excitation functions of proton and deuteron reactions with light elements such as B, C, N, O, F, P, S, Cl.

15. Mr. Behrens reports that a group under Prof. Hauser at the university of Köln, F.R. Germany, measures and compiles low-energy CPND which lead over to atomic and molecular reaction data. The meeting felt that such data should not be discussed in the present meeting, but that the computerized compilation systems to be discussed should eventually be designed to allow for such data.

II. Bibliography

16. Dunford discusses the differences between existing nuclear data bibliographies (not considering photonuclear reactions which is a separate effort in the USA):

- "Reaction List" of the Oak Ridge CPND group
- "Recent References" of the Oak Ridge Nuclear Data Project
- "Cinda" of the neutron data centers.

The USA would not like to continue all three reference compilation systems as distinct entities but assume the responsibility for maintaining a CPND bibliography. However, no conclusions have been reached how this responsibility would be implemented and where in the USA it would be maintained. Dunford asks for comments about the desirable features of this compilation, but he suggests that the center which will be in charge of it, must be permitted to make the final decisions about the structure of the system. Multilateral bibliographic input would be desirable, in particular from the USSR and Japan.

17. In the discussions it is stressed that a unified bibliographic system for all nuclear data would be desirable but that this could not be implemented under the present conditions. None of the existing bibliographic systems is flexible enough to include all nuclear data, and simple enough to be suitable for multilateral input and file exchange. The results of the discussion are summarized in conclusions 4-10, recommendations 2-8, and actions 1-8.

18. Mr. Behrens suggests that the input to a nuclear data bibliography could eventually be retrieved from INIS. In the discussion it is agreed that this would in principle be highly desirable, but that this was not possible with the present status of INIS, as previous contacts between NDS and the IAEA INIS Section had shown. Further investigations and actions in this direction were found desirable, see conclusion 11, recommendation 6, and action 6+7.

19. The meeting discusses the requirements for a published CPND bibliography. It is understood that there is a definite need, from the application oriented users' community, for a cumulative bibliography on "integral CPND" (compare conclusions 1-3). Considering that only about 5% of the CPND literature deal with "integral CPND", such a cumulative bibliography would have a volume of one hundred pages at maximum. A regular cumulative publication at perhaps two-years intervals appears to be desirable and feasible. A bibliography on "integral CPND", which would be application oriented, has no serious overlap with "Recent References", which is mainly oriented towards basic research. See the recommendation 7.

20. Mr. Schmidt announces that the IAEA could publish the CPND bibliography on two conditions, that is: the file must be the result of a truly international effort, and the number of copies sold must be more than 1000. However, also a publication as a report of less good quality may be considered.

    Mr. Behrens announces that eventually ZAED could publish the CPND bibliography. Both, NDS and ZAED will investigate their publication possibilities (see action 8), based on a computer file provided by the USA. Several participants estimate that more than 1000 copies of a CPND bibliography could be sold.

21. Some participants express that in addition to the bibliography for "integral CPND", a cumulative publication of "Recent References" would be desirable for the use of the research community.

II. B.1 Adopting Exfor for the compilation and exchange of CPND

22. Mr. Lemmel gives a summary of the main features of the Exfor system developed by the four neutron data centres (Annex 7). It is stressed that Exfor defines an exchange format, and that each of the cooperating centres operates, according to its needs, different input, storage, computation, or output formats, which are all Exfor compatible. Exfor is flexible enough to allow for even unusual representations of experimental data, for all kinds of additional quantities and parameters, as well as for bibliographic, physics and bookkeeping information. At the same time Exfor is well enough structured that identification and processing of the information by the computer is possible.

The main problem to be discussed will be the generalization of the coding of reactions and quantities which are so far defined for neutron data only.

23. Mr. Münzel reports on the CPND Exfor system developed by the Karlsruhe CPND group. In this system, some additional keywords and codes were added to the neutron-Exfor system such, that the neutron-Exfor rules remain unchanged. A first draft of the CPND Exfor system (Annex 8) had been prepared early 1975. This had been discussed by the four neutron data centres at their meeting in March 1975, and some conclusions were issued (Annex 9). To the present meeting, a revised version of the Karlsruhe CPND Exfor system was submitted (Annex 10).

24. Mr. Ohnuma reports that a computerized conversion between the Japanese NRDF system and a modified Exfor system seems to present no principal difficulties. Details of the NRDF/Exfor compatibility must still be studied.

25. Mr. Sokolovskij presents sample entries for some CPND functions (Annex 11) prepared at CAJaD in the format of the first version of the Karlsruhe CPND Exfor system. He stresses the necessity of having an agreed common format for CPND and concludes that a modified Exfor system as suggested by Karlsruhe is well suitable for the exchange of CPND. The changes required in Exfor should not interfere with the work of the neutron data centres.

26. Mr. Dunford states that there is presently in the USA little financial support for CPND compilation. But there is strong interest to have the CPND exchange format designed as close as possible to the neutron Exfor system.

27. In the following discussions it is concluded that there is no alternative proposal and that the detailed discussions for developing a CPND exchange system should be based on the second Karlsruhe version of the CPND Exfor system. See Conclusions 13 + 14, Recommendations 13 + 14, and Actions 13 + 14.

28. The participants agree that it should be tried to have, on a long-term scale, a single Exfor system for CPND and neutron nuclear data. Therefore, the modifications of the Exfor system to be proposed should be such that there is no interference with the present neutron Exfor system. They would be implemented such that any differences between the CPND Exfor system and the present neutron-Exfor system are computer-intelligible by special keywords. Thus it is made possible that the computer programs operating the present neutron-Exfor system can gradually be expanded to include the specific CPND features, although it is recognized that decisions in this direction are up to the neutron data centers.

II. B.2 Scope of CPND compilation

29. Mr. Münzel explains the priorities of CPND compilation according to his experiences with the users community in F.R. Germany.

These are:

- excitation functions for the formation of residual nuclei in ground-state or metastable state after prompt gamma de-excitation. The residual nucleus is of primary interest, disregarding through which reaction it was formed. For practical applications the shortest life-times to be considered are in the order of magnitude of a minute.

- thick target yield data.

both for targets with $Z \geq 4$ and projectiles with $Z_p \geq 1$ and $A \geq 1$. If necessary, the restriction with respect to Z of the target material could be changed.

For building up the file for integral CPND one has to decide on the priority list for preparing input. After the comparison of different possibilities the following list was accepted:

Priority	Projectile	Lowest projectile energy of excitation function
1	p	< 50 MeV
2	α	< 100 MeV
3	d	< 50 MeV
4	He-3	< 100 MeV

First all data for p-reactions will be compiled independent of the time of publication. Then α-reactions will be considered, etc. Once a reaction-type is completed it will be kept up to data. Of course, if other reactions are compiled they will also be put on the

file. The extension of the priority list to higher energies and heavier projectiles should be discussed at a later time.

Primary interest is in experimental data. But theory and systematics are also considered to be important for deducing excitation functions for the many reactions for which no experimental data exist.

Deduced data, such as integral cross sections obtained from angular distributions are not considered (mainly due to manpower limitations), but such data would be useful.

Absolute and relative data are compiled.

It is questionable, whether within a defined scope all existing data should be compiled or whether a selection with respect to reliability would be feasible. This topic should be taken up again after more experience has become available.

30. Mr. Ohnuma explains that the Japanese Study Group is testing the NRDF system and has coded a number of complex data. No systematic compilation is yet envisaged, and therefore no priorities of reactions and quantities to be compiled have been established.

31. Mr. Sokolovskij says that the USSR needs for non-neutron nuclear data have been reported at the 1974 Meeting, see INDC(NDS)-61 page 82. Priorities are approximately in the following sequence:

    1. fission product decay data
    2. nuclear structure data
    3. decay data of radioactive nuclei
    4. activation cross-sections by charged particles and photons
    5. thick target yield data

    For such data, bibliographic and numeric data files are or will be maintained. The USSR is ready to participate in bilateral agreements on the exchange of such data, possibly on the basis of a geographical sharing of compilation workload. For the near future, the USSR is looking forward towards a data exchange with Mr. Minzel's group and with Mr. Fuller's group. It is hoped that a modified Exfor format as to be defined at this meeting, will be acceptable also to Mr. Fuller for photonuclear reaction data.

32. Mr. Dunford says that there exists in the USA the Oak Ridge compilation of CPND (action 10). However, nothing has been added to this file in the past five years. In the USA it is felt that the scope for CPND compilation should be determined by the prospective usefulness to customers. The scope outlined by Mr. Minzel appears to be suitable both for the bibliography and the numerical data compilation.

33. The meeting agrees to restrict the scope of the published bibliography and the initial CPND compilation to "integral CPND". See conclusions 1-3 and recommendation 3. The corresponding computer systems should, however, be designed such that they allow also the coding of differential CPND and photonuclear reaction data. Heavy-ion reaction data can probably be coded with the Exfor modifications agreed at the present meeting.

34. The meeting agrees that within the scope as outlined above, priority should possibly be given to data needed for specific purposes such as fusion. See conclusion 23, recommendation 21 and action 11.

II. B.3 Distribution of compilation workload

35. Mr. Münzel expresses the willingness of the Karlsruhe CPND group to continue compiling "integral CPND", subject to the availability of funds. Mr. Sokolovskij and Mr. Dunford express the willingness of the USSR and USA respectively to contribute to this effort, and a scheme of cooperation as expressed in conclusion 12, recommendations 9 - 12, and action 9 is assumed.

II. B.4 Technical details of the CPND Exfor system

36. The meeting discusses the technical details of the CPND Exfor system on the basis of the Karlsruhe proposal given in Annex 10. The results are summarized in the "Agreements about the CPND Exfor system" on page 31.

II. B.5 Organization of cooperation

37. The meeting discusses technical details of cooperation and decides to follow generally the procedures established among the four neutron data centers, as layed down in conclusions 15-17 and recommendations 15-16.

38. It is felt that the IAEA should continue to convene at regular intervals consultants meetings between the cooperating centers. The date of the next meeting is envisaged for the week 26-30 April, in the same week as the next meeting of the four neutron data centers.

II.C Evaluation of CPND

39. It was found that for CPND the problems of evaluation are different from those of neutron data. For many CPND reactions only a single measurement exists, and for many more there are no data at all. The main purpose of CPND evaluation is therefore to give the best guess of unmeasured cross-sections.

40. A CPND cross-section library in ENDF/B format has been issued by NNCSC based on Mr. Münzel's calculations published in Landolt-Börnstein, vol. 1, 5c. This library is available from the other pertinent nuclear data centres.

In general, to include CPND in the ENDF/B format requires a generalization of this format which is presently being discussed in the USA, see annex 13.

41. For some further details see conclusions 18-21, and recommendations 17-18.

II.D Service to users

42. The findings of the meeting with respect to services to data users are summarized in conclusions 22-23 and recommendations 19-21.

CONCLUSIONS AND RECOMMENDATIONS

User needs and data scope
(Agenda items I, II.B.2)

Conclusions:

C 1. The need of various users for compilations of charged-particle nuclear reaction data (CPND), in particular of integral CPND cross-sections, has been assessed in earlier meetings. It is strongly felt that the arguments given at these meetings stressing the importance of the compilation of such data, are still valid. Therefore, urgency should be given to corresponding compilation efforts.

C 2. It is realized that for data applications primarily integral CPND are needed, and such data should be given priority. The interest for differential CPND comes mainly from the research community.

C 3. In the present document, the term "integral CPND" is understood to include

- excitation functions for the formation of residual nuclei in ground-state or metastable state;
- thick target yield data;

both for targets with $Z > 4$ and projectiles of protons and heavier particles.

Recommendation:

R 1. Within the field of CPND, the compilation and exchange of "integral CPND" should be given priority.

CPND Bibliographic System
(Agenda item II.A)

Conclusions:

The meeting discussed various possibilities for creating an international CPND bibliography, and came to the following conclusions:

C 4. Since the USA offered to continue to maintain a worldwide CPND bibliography, it is suggested that a new appropriate system or a revised form of an existing system be developed in the USA, but that the following requirements expressed in the meeting be considered.

C 5. At present, there exist three nuclear data bibliographies: Cinda, Recent References, Reaction List, which are partially overlapping. For each of them some modifications would be desirable to make it suitable as an international CPND bibliography.

C 6. If a Cinda-type system is used, more space for the reaction is needed than in the neutron Cinda, in order to allow also for the coding of heavy ion reactions. This means, that either the free text comment field must be shortened to have more space for the coding of the reaction, or that the system must be expanded to more than one card per input record.

C 7. If a Recent-References type system is used, input and file should preferably be restricted to the standard BCD character-set, in order to facilitate international exchange of the file. The lab of data origin should possibly be entered in retrievable form using the Exfor lab-codes. A feature for blocking different references that refer to the same data set, is desirable such that a data-set oriented sort is possible. The data-type (experimental, theoretical, evaluated) should be entered in retrievable form.

C 8. In either case, the following features are desirable:

a) For charged-particle reactions, information should be entered in retrievable form, indicating whether the reference considered contains integral CPND or other data.

b) Publication in a compact handbook should be possible.

c) The system should be designed such that multilateral input is possible as well as easy retrievals on a variety of computers.

C 9. The new system should be capable of including, by machine conversion, the old bibliography of the Reaction List and perhaps the relevant part of Recent References, even if these machine converted entries do not fulfil all of the specifications of the new system (example: missing lab. code).

C 10. The feasibility of having a single bibliography system for all nuclear data, including neutron data, should be investigated.

C 11. It is desirable to investigate the feasibility of deriving a nuclear data bibliographic file from a more general bibliographic system, especially from INIS.

Recommendations:

R 2. The meeting appreciates the offer of the USA to continue to assume the primary responsibility, in cooperation with other data centres, for a worldwide CPND bibliographic system. It is recognized that the centre responsible for this system should decide on its structure, but it is recommended that the following features be seriously considered when developing the CPND bibliographic system:

a) Publication of a compact handbook should be possible, which should be data-set oriented rather than reference oriented.

Action 2.

b) Publication of such a handbook for "integral CPND" only should be possible.

c) A cumulative publication including earlier CPND bibliographies should be possible.

d) The coding of the CPND reactions should allow for heavy-ion reactions; retrievals should be possible for target nuclei, incident particles, outgoing particles and residual nuclei.

e) The input and the master file should employ the standard BCD character set.

f) Entries should contain the laboratory of data origin using the Exfor lab-codes.

R 3. It is recommended that CAJaD and a Japanese center regularly provide input to the CPND bibliographic system for the Russian and Japanese language publications. This input should have the general form of Recent References, until such time that the USA in consultation with the cooperating centers determines that another input format is needed.

Actions 3.+4.

R 4. Priority should be given to the coverage of journals. It should be investigated how many important data sets are published only in laboratory-reports or conference-proceedings. Depending on the outcome of such investigations, such literature should eventually be included in the CPND bibliography.

Action 5.

R 5. The bibliographic information should be freely exchanged, and the master file should be easily accessible by all cooperating centres and groups. The centre in charge should send, in regular intervals (e.g. every six months), an update tape of the CPND bibliography to the Karlsruhe CPND group and to CAJaD, and to other cooperating centres upon request.

Actions 6.+7.

R 6. It is recommended that ZAED and NDS investigate the feasibility of deriving input for a nuclear data bibliographic file from a more general bibliographic system, especially from INIS.

Action 8.

R 7. The meeting recommends the publication of a cumulative bibliography to "integral CPND". Later cumulative publications should be envisaged at two-years intervals. NDS and ZAED should investigate the technical possibilities for such publications based on a computer file provided by the USA. A draft of the bibliography should be submitted to the cooperating centres for discussion.

R 8. The published bibliography should include information on evaluated integral CPND, but references to experimental and evaluated data must be distinguishable.

Compilation and exchange of CPND
(Agenda item B.2)

The meeting discussed the scope and distribution work between the CPND compilation groups and came to the following conclusions:

C 12. The meeting recognizes the value of past compilation activities and urges the continuation and possibly the expansion of these activities. In particular, the efforts of the Karlsruhe CPND group for a systematic compilation of "integral CPND" in the Exfor format is recognized as most valuable. The recommendations of this meeting are based on the assumption that the Karlsruhe CPND group will maintain the Master Data File for "integral CPND", which would be the core of an international network of CPND compilation and exchange.

Recommendations:

R 9. Existing CPND compilation activities should possibly be expanded. They should continue within an international coordinated effort of CPND compilation and exchange. All CPND should be freely exchanged, and the computer files should be easily accessible by all cooperating centres and groups.

R 10. The Karlsruhe CPND group should maintain the CPND Master Data File. Data compiled at other centers should be sent to Karlsruhe for updating the Master Data File. The Karlsruhe CPND group should make available to the cooperating centres either copies of the entire Master Data File or copies of update tapes.

R 11. a) The Karlsruhe CPND group should continue to compile "integral CPND" except as noted below.

b) CAJaD should compile "integral CPND" produced in the USSR.

c) The USA Center should compile "integral CPND" from USA and Canada in the case that such data cannot be compiled directly from published literature, and should make such data available upon request.

Action 9. R 12. Pertinent groups in Japan as well as interested groups in other countries should investigate the feasibility of participating in the CPND compilation effort.

See also the related actions 10.-12.

The CPND Exchange Format
(Agenda item II.B.1)

Conclusions:

C 13. The Karlsruhe CPND group and CAJaD had prepared trial compilations of integral CPND in a modified Exfor format which were discussed by the four neutron data centers, and at the present meeting. It was concluded that a modified Exfor format provides suitable means for the international exchange of CPND.

C 14. The investigations of the Japanese Study Group have indicated the desirability and the feasibility of creating a CPND File which would be used by nuclear physicists in the field of basic research as well as for applied purposes.

Recommendations:

Actions 13.+14. R 13 A modified Exfor format should be used for the exchange of CPND.

R 14. The Japanese Study Group should continue its effort; the system to be developed should be operated on a long-term basis; it should be developed with due consideration for participating in the international CPND exchange.

For detailed agreements about the CPND Exfor system see page 31.

Organization of cooperation
(Agenda item II.B.4)

Conclusions:

Action 20. C 15. Generally, the mechanisms of data exchange as developed for neutron data, are adopted.

C 16. In general, the rules contained in the Exfor Manual for neutron data will apply, but an addendum will be needed for special rules required for CPND.

Action 19. C 17. The cooperating CPND centres are included in the update and exchange system of Exfor dictionaries.

Recommendations:

R 15. The IAEA should continue to coordinate the activities of CPND centers and groups, and should continue to convene, at regular intervals, consultants meetings between representatives of the cooperating CPND centers. Copies of bilateral correspondence on CPND compilation and exchange should be sent to NDS.

R 16. NNCSC should continue to maintain the Exfor Manual for neutron data; NDS should produce an addendum to it for CPND. NDS should maintain the Exfor dictionaries for neutron data and CPND.

Action 19.

CPND evaluation
(Agenda item II.C)

Conclusions:

C 18. CPND evaluation has been discussed. A detailed discussion of evaluation methods appears to be premature, but should be reconsidered at some later time.

C 19. The purpose of CPND evaluation is to give users recommended values for the quantities they are interested in. Any method of obtaining such recommended values is included in the term "evaluation". The users should be supplied also with information about the reliability of the data.

C 20. Evaluated CPND can be included in the CPND Exfor file in such a way that they can be readily distinguished from other types of data. It is however recognized that Exfor is not suitable for a comprehensive evaluated CPND library similar in concept to ENDF/B.

C 21. It was noted that a generalized ENDF format suitable for all nuclear data is being discussed in the USA.

Recommendations:

R 17. Existing CPND evaluations should be distributed to the other centers, in any suitable form but preferably on magnetic tape, along with adequate documentation.

R 18. Interested centers should send to NNCSC comments on a generalized ENDF/B system to be developed. (See Annex 13.)

Action 21.

Services to users

(Agenda item II.D)

Conclusions:

C 22. For integral CPND data a large user community prefers to have a handbook with data on their desks. In addition there will be the need for computer retrievals from the computer file, in order to have more up-to-date information.

C 23. In addition, specialized CPND publications may be needed. NDS is considering the needs for publishing a specialized compilation of CPND required for nuclear fusion development.

Recommendations:

R 19. The Karlsruhe CPND group should continue to publish compilations on "integral CPND".

R 20. The following centres should provide computer retrievals from the CPND Exfor Library to the respective service areas:

NNCSC to USA and Canada

CAJaD to USSR

ZAED to F.R. of Germany

NDCC to other European OECD countries and to Japan

NDS to its service area as defined within the neutron data cooperation.

Action 11. R 21. The compilation of specific data required for specialized publications, e.g. on CPND for fusion, should be given priority.

AGREEMENTS ABOUT THE CPND EXFOR SYSTEM

1. It is agreed that a modified Exfor system should be adopted for the compilation of CPND.

2. The general structure of the neutron Exfor system shall remain unchanged. The modifications to be made in some details of the structure and contents should not interfere with the continuing operation of the neutron-Exfor system.

3. It should be possible to handle CPND Exfor files and neutron-Exfor files with the same computer programs, although some sub-routines may be different.

4. The second version of the Karlsruhe CPND Exfor is generally adopted, however some further modifications are desirable as described in the following. items 5 - 28.

5. The information coded under the keyword REACTION shall have the following major fields:

   1. Reaction
   2. Quantity
   3. Data-Type (optional)

6. The Reaction is coded in the form

   (Z-S-A (P,N+HE3+4A) Z-S-A, Quantity, Data-Type)

   Some special rules are:

   a. The residual nucleus is usually defined as the heaviest of the reaction products. In certain cases (compare items f. and i. below) the residual nucleus is not defined.

   b. Different outgoing particles within the reaction-parentheses are separated by plus-signs.

   c. The outgoing particles are sorted such that smaller Z and A comes first. N sorts before P, and T sorts before HE3.

   d. Within the reaction-parentheses, all particles heavier than an alpha particle, are coded in the same way as the target-nucleus.

   e. A number immediately preceding a particle code indicates the multiplicity of this particle, e.g. 4A in the example above.

f. Some special reactions are coded in the following form:

(Z-S-A(P,ABS), - proton absorption

(Z-S-A (P,TOT),- total cross-section for protons

(Z-S-A(P,T+X), - emission of tritons and possibly other unidentified particles after proton absorption

In the above examples, the residual nucleus, in general, cannot be coded.

g. An unidentified complex reaction leading to a specific residual nucleus, e.g. when the target is a sample with natural isotopic abundance, is coded in the following form:

(Z-S-0(P,X)Z-S-A,-

h. Scattering may be coded as

(Z-S-A(P,P)Z-S-A,-

But when elastic, inelastic or total scattering must be distinguished, this is coded in the form

(Z-S-A(P,EL)Z-S-A,-

(Z-S-A(P,INL)Z-S-A,-

(Z-S-A(P,SCT)Z-S-A,-

i. Fission is coded as

(Z-S-A(P,F)FF,

j. The coding of the residual nucleus within the reaction is optional. For integral CPND it is obligatory, except where not appropriate.

7. The discussion of coding reactions, where the <u>sequence</u> of the outgoing particles matters, was postponed.

Action 15.

8. For the quantity, the following definition and sequence of subfields was agreed. Tests, whether this scheme is suitable for complex multidifferential quantities, have to be made.

(Reaction, Quantity, Data-Type)

Branch, Parameter, Particle-considered, Modifier

In the "branch" subfield information is given, whether it is a partial reaction. See the neutron-Exfor codes PAR MS GND CN DI etc.

In the "parameter" subfield information about integral or differential cross-sections is given. See the neutron-Exfor codes DA LEG DA/DE etc. For integral cross-sections the code SIG is introduced.

In the "particle-considered" subfield, the particle-code is entered to which the code in the "parameter" field refers. The use of this code is the same as in the neutron-Exfor.

The "modifier" subfield contains any additional information about the representation of the data, e.g. REL.

9. The Data-type field may include codes such as EXP or THEO.

10. The Karlsruhe CPND-Exfor sample presented contains pointers, attached to a data-column heading, in col. 1 instead of col. 11. It was agreed, that in transmission tapes, the pointers should be in col. 11.

11. The coding of multiple reactions within the same subentry as used in Entry 60001.003 was accepted. This formalism should not be used for any data types that are not directly interrelated.

12. The proposed coding of information under the new keyword DECAY-DATA was accepted, although there was some concern about the readability.

13. The keyword PART-DET remains reserved for use in the way of the neutron Exfor. The information format and contents as proposed by Karlsruhe is to be entered under the new keyword RAD-DET. If the keyword RAD-DET is present, the keyword DECAY-DATA is obligatory.

14. The keyword ADD-RES for additional results is accepted.

15. The keyword MONITOR as well as the format of the coded information is accepted, but the sequence of accession-number and reaction within the parentheses is inverted. The word MONITOR seems to be the best word for this keyword as long as STANDARD is not free due to its different use in the neutron-Exfor. A data-heading keyword MONIT was introduced corresponding to STAND in neutron-Exfor.

16. The coding of the institute under FACILITY was agreed as proposed, but the entering of this institute code is optional.

17. SAMPLE information, which is always regarded as essential, is entered mainly in free text.

18. Within free text abbreviations can be used to reduce the workload of compilers. But these abbreviations should be understandable, since no expansion in an output format is envisaged.

Action 16. 19. The lab and reference codes and explanations proposed by Karlsruhe are added to the dictionaries.

20. Quantity-codes: The code FCR is not necessary. The generalized meaning of IND and CUM is accepted. For outgoing particles the code COMPLEX is changed to X. The code SF is accepted for use under RAD-DET and DECAY-DATA but not for use under REACTION, where a zero indicates spontaneous reactions without an incident particle.

21. Method-codes are accepted, except HILAC which is included in LINAC which is to refer to all linear accelerators.

Action 17. 22. Length of codes. The neutron centres should investigate what restrictions in the length of codes (e.g. method or status codes) are required by their system.

23. The dictionary of method codes should get flags indicating methods which generally apply only to CPND or only to neutron data.

24. The code SID is cancelled, and the general code for solid-state detectors is used instead. Similarly, LISCIN is cancelled.

25. MISC 3 and MISC 4 are cancelled because they are superseded by the use of pointers.

26. The Library name is added in field 4 of the TRANS record.

Action 18.

27. Col. 67 which identifies the compiling data centre should no longer be restricted to numericals, and characters will be accepted for CPND Exfor. Fast action is given to the various centers to investigate whether this would cause difficulties.

A = CAJaD, B = Karlsruhe CPND group, C = NNCSC, D = NDS, Z = Japanese Study Group.

28. Discussions on the subject of CPND compilation and exchange are continued by means of "CP-Memos" similar to the "4C-Memos" in the field of neutron data. The memos are numbered in the form Memo CP-n/m, where n is the centre-identification character and m the chronological memo number within the centre.

A C T I O N S

Actions concerning the CPND bibliographic system

Action Nr.	Action on	Action
1	USA	to provide a computer file suitable for producing a compact cumulative bibliographic handbook on "integral CPND". Compare action 8 below.
2	Münzel	to send to Dunford information concerning the retrieval of references to "integral CPND" from the Reaction List of McGowan.
3	CAJaD	to regularly provide input to the CPND bibliographic system for USSR publications.
4	Ohnuma	to investigate possibilities for Japanese input to the CPND bibliographic system.
5	Münzel	to check against INIS whether lab-reports contain important CPND data which should be included in the CPND bibliography.
6	NDS	to send to ZAED the specifications required for retrieving from INIS input to a nuclear data bibliography.
7	NDS + ZAED	to investigate the feasibility of deriving input for a nuclear data bibliographic file from INIS.
8	NDS and ZAED	to investigate the technical possibilities at IAEA and ZAED respectively of publishing and distributing a cumulative CPND bibliography, from a computer file provided by the USA, and to submit a draft of this bibliography to the cooperating centers for discussion.

Actions concerning CPND compilation

9.	NDS Japanese Study Group	to contact interested Japanese groups in order to have at the next meeting a statement on the feasibility of Japanese participation in the CPND compilation effort.
10.	Dunford	to arrange for sending a tape copy of the Oak Ridge CPND Library to the Karlsruhe CPND group.
11.	NDS	to supply the CPND compilation groups with a list of CPND reactions needed for fusion.
12.	ZAED + NDS	to keep each other informed about the project "compilation of data compilations". Exchange relevant documents, indexes, etc. and inform each other about available files and about any progress in the field.

Actions about the Exfor system

13.	NDS	to send the present Exfor input check program with documentation as existing to Sokolovskij.
14.	NDS	to send to Kronenberg, Karlsruhe, all Exfor programs which have been changed and added since the last transmission of programs to him.
15.	NDS	to test the feasibility of the agreed quantity structure. This is an urgent action, and any deficiency of this quantity structure must be communicated soon, at the latest some weeks before the next meeting.
16.	NDS	to update the dictionaries with the codes agreed in connection with CPND.
17.	NDS	to investigate the actual limitations imposed by existing computer programs to the length of codes, and notify CPND centers if some of the introduced codes exceed these limitations.

18.	NNCSC NDCC NDS CJD	to investigate whether an alphabetic character instead of a numerical in column 67 and in the first position of the accession numbers causes difficulties in existing programmes. The results should soon be communicated to NDS.
19.	NDS	to send the latest version of the EXFOR dictionaries on tape to Kronenberger and Sokolovskij, and to include the cooperating CPND centres in the regular transmission of dictionary updates.

Actions about the organization of cooperation

20.	NDS	to prepare a Protocol on the CPND cooperation and circulate it for acceptance.

Actions concerning evaluated CPND

21.	All participants	to submit to NNCSC comments on desirable features of a generalized ENDF/B format.

Karlsruhe Charged Particle Group

Opening Statement

H. Münzel

In a summarizing report A. Calamand has shown, that there are many users of Charged Particle Nuclear Data (CPND) working in such different fields as Material Science, Medicine, Reactor-technology, Biology, Nuclear Physics, Chemistry, etc. According to this report the majority of these users are especially interested to get informations about the amount of activity formed during irradiations. For this purpose they need formation cross sections or thick target yields for the ground and/or the metastable states of the produced radionuclides. Therefore we, i.e. the Charged Particle Group at the Institute for Radiochemistry of the Nuclear Research Center Karlsruhe, decided to concentrate our efforts on this kind of "integral data". We are, of course, aware of the fact, that there are users who are interested in data about angular distributions etc But because about 95% of the publications dealing with CPND contain such differential data, a very large number of scientists would be needed for a complete compilation. Before starting such a program one should check very carefully, if the time saved on the side of the users justifies this effort.

The scope, content and format of the CPDN - File proposed by the Karlsruhe Charged Particle Group shall be described briefly. As already mentioned we propose, that the compilation should contain all published values for the above defined integral data. The file should include absolute and relative data as

well as evaluated data. For practical reasons we restricted the compilation to targets with $Z \geq 4$ and projectiles with $Z \geq 1$ and $A \geq 1$. The file should also contain all relevant data needed for an evaluation, like the decay data used in the analyses of the measured data.

In respect to the bibliography we will rely on the "McGowan Reaction List" and on the INIS - output.

In the moment we do not intend to evaluate recommended data from the experimental values. But we consider to check the different calculation procedures with the aim to provide the users with "calculated" excitation functions and thick target yields.

In the last year we were actively engaged in developing a format for the storage of the compiled data on a magnetic tape. After checking different possibilities we decided to go ahead with a modified version of the EXFOR - System. The proposed modifications should be discussed in detail during this meeting.

We assume that most of the users prefer strongly to have the compilation available on their desk. Therefore, the major output of our compilation efforts will be some kind of book, which should be updated periodically. We will also provide as service to german users retrievals from the file. We hope, that other Centers, like the NDS of the IAEA, will provide similar services to users outside of the FRG.

Our plans for the future are not fixed yet. Just now it is again

under discussion how many scientists should be actively engaged in the compilation of Nuclear Data at the Nuclear Research Center Karlsruhe. If funds are made available we will start now with the routine compilation of CPND within the scope outlined above using the following order of priorities:

	Projectile	Projectile-Energy
1)	p	< 50 MeV
2)	He-4	< 100 MeV
3)	d	< 50 Mev
4)	He-3	< 100 Mev

ACTIVITIES ON COLLECTION, EVALUATION AND DISSEMINATION OF NON-NEUTRON NUCLEAR DATA IN THE USSR

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ABSTRACT

The article describes the present status of collection, evaluation and dissemination of non-neutron nuclear data by the Centre for Data on the Structure of the Atomic Nucleus and Nuclear Reactions, USSR State Committee on the utilization of Atomic Energy. The structure of the Centre itself, its computer facilities and its co-operation with outside organizations are indicated and its functions and plans of activity are considered.

The Centre for Data on the Structure of the Atomic Nucleus and Nuclear Reactions (CAJaD) of the USSR State Committee on the Utilization of Atomic Energy was established in 1972 and is the organization in the USSR dealing with collection, evaluation and dissemination of non-neutron nuclear data.

The Centre not only collects data and analyses requests from users of non-neutron nuclear data but also organizes work on evaluation of data which are needed for solving scientific and technical problems and for developing fundamental research in the USSR. The evaluation work is carried out both by the Centre's staff and by qualified groups of physicists from institutes of the USSR State Committee on the Utilization of Atomic Energy, the USSR Academy of Sciences and higher educational institutions. Preparation of recommendations on uniform methods of nuclear data evaluation forms a large part of the Centre's activities.

The Centre has a 1010-V and a NOVA-1200 computer. It has a system of programmes for storage of data in the form of files on magnetic tapes and for data preparation for input into a library and formation of libraries, and also possesses a retrieval programme and a set of auxiliary programmes needed to answer data requests and to meet the Centre's needs for the intermediate stages of work.

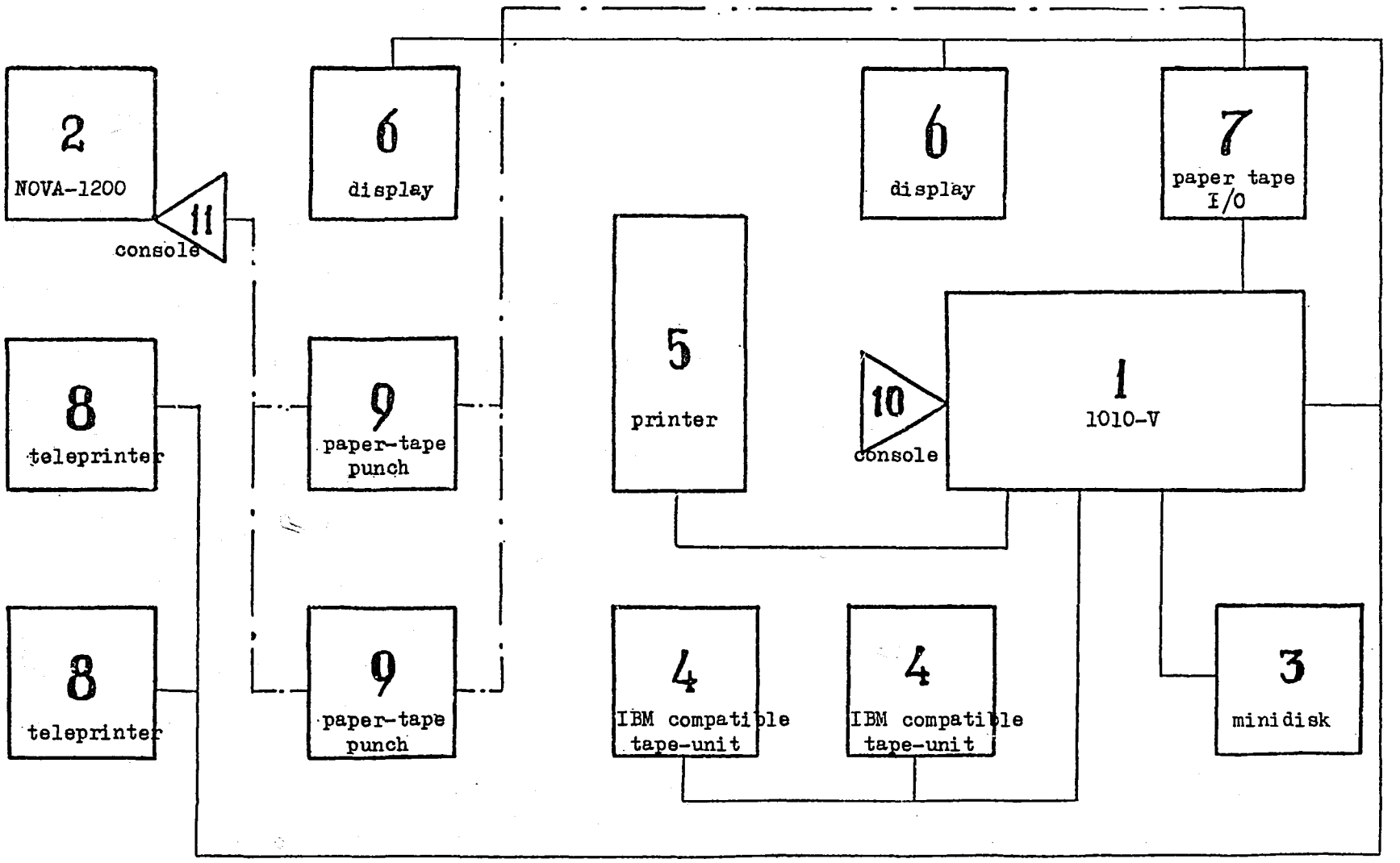
I. STRUCTURE AND TECHNICAL EQUIPMENT OF THE CENTRE

The Centre's organizational structure is determined by its functions, as reflected in the title of this article. At present, it has a staff of 15 (6 physicists and 9 technicians) forming five groups.

Analysis of Requests, Compilation and Evaluation Group

This group is responsible for generation and maintenance of files for evaluated non-neutron nuclear data and other files called for by users' requests.

It performs analysis of requests from users of non-neutron nuclear data and prepares replies to these requests. A part of the compilation and evaluation work is done by this group. In addition, one of its functions is to develop uniform methods of evaluating non-neutron nuclear data and to recommend these methods to evaluation and compilation groups in other institutes. It also carries out preliminary analysis of data received at the Centre before they go to the literature scanning group.


2
NOVA-1200
11
console
6
display
6
display
7
paper tape
I/O
5
printer
10
console
1
1010-V
8
teleprinter
9
paper-tape
punch
8
teleprinter
9
paper-tape
punch
4
IBM compatible
tape-unit
4
IBM compatible
tape-unit
3
minidisk

Literature Scanning Group

The function of the literature scanning group is to sort the information material received at the Centre (papers, preprints, reports and numerical data) in order to distribute it on the basis of subject to the groups outside the Centre which compile key-word abstracts according to the Centre's rules. The finished abstracts are returned to the scanning group, where they are finally edited and entered in the bibliographic reference file.

Mathematical Software Group

Its work includes updating and modifying system programmes for standard mathematical treatment by the 1010-V*and NOVA-1200 computers, as applicable to the Centre's functions, generation of auxiliary programmes for mechanizing preparation of information for input into the existing computer libraries, retrieval of the necessary information from both the data libraries and the bibliographic reference library, mechanization of evaluation of nuclear data and other types of processing of numerical information stored at the Centre.

Group for Technical Preparation and Processing of Information

The group transfers the information material to temporary carriers (punched tape), technically edits and corrects the material, feeds it to permanent information carriers (magnetic tape), modifies the format of the input array into a form convenient for retrieval and has custody of the mathematical software archival file and computer libraries.

Group for Maintenance of Technical Equipment

This Group's functions are to ensure steady operation of all technical equipment of the Centre, carry out preventive maintenance, modernize some modules of terminals, fabricate devices to facilitate the work of operators and duplicate information material.

Technical equipment of the Centre

The figure attached gives a block diagram of the Centre's technical equipment. At present, it has two computers, of which the 1010-V (1)* has a working storage space of 32kbyte and the following set of peripheral equipment:

- A minidisk (3) with a capacity of 800 Mbyte;
- Two NML-67 magnetic tape units (4) capable of reading tapes from IBM magnetic tape units;
- An alpha-numerical printer(5);
- Two alphanumerical display devices (6);
- A punched-tape input and output device (7):
- Two "297" teleprinters (8);
- A 192N* teleprinter (10)

The second computer (2), a NOVA-1200, has a crossing storage space of 4 K words and one ASR-33 peripheral device.

In addition, the Centre has two ES-9021* devices (9) used for punching data and bibliographic references on the preliminary carrier (eight-track punched tape).

*/ Translater's note. If these items are not of Soviet manufacture, their names should be 1010-B, 192H and EC-9021, respectively.

When necessary, the Centre makes use of the facilities of the Central Computer Complex of the I.V. Kurchatov Institute of Atomic Energy, which is equipped with BESM-6 computers. In the near future, the Centre expects to have a direct connection to these computers.

2. THE CENTRE'S CO-OPERATION WITH OUTSIDE ORGANIZATIONS

It has already been mentioned that the Centre is the main organization in the USSR dealing with collection, evaluation and dissemination of non-neutron nuclear data.

The Nuclear Data Commission of the USSR State Committee on the Utilization of Atomic Energy and its Co-ordination Group for Non-neutron Nuclear Data determine the whole activity of the Centre.

In co-operation with the Centre and on the basis of analysis of users' requests, the Co-ordination Group determines the range of problems relating to evaluation and compilation of non-neutron nuclear data to be handled by the appropriate groups at the institutes of the USSR State Committee on the Utilization of Atomic Energy, the USSR Academy of Sciences and higher educational institutions. The Co-ordination Group also prepares recommendations for the research laboratories of these institutes on the measurement of the necessary non-neutron nuclear data and may amend their research plans. The Centre is responsible for overseeing compliance with the recommendations of the Nuclear Data Commission and the Co-ordination Group.

3. COMPUTER SOFTWARE OF THE CENTRE

The Centre's technical facilities permit substantial automation of both the preparation process and the use of available data.

At present, the Centre has three types of computer library. The first is the "reference" library with bibliographic references containing information on authors and the place of publication and a short abstract prepared according to definite rules facilitating automation of the process of searching for papers on a given subject. Such references will henceforth be called abstracts for short. The second, the "data" library, includes experimental data on the properties of specific nuclei. The evaluated data available at the Centre are kept separately. Finally, the "little" library is an intermediate one and used mainly for temporary storage of information which is in the process of preparation for inclusion in the other two libraries and for filing the computer software and other textual materials.

For technical preparation and use of the above libraries there is a set of programmes, which can be divided into three parts:

- programmes for expansion of the libraries;
- duplicating and auxiliary programmes;
- programmes for work using the libraries.

4. FUNCTIONS AND PLANS OF ACTIVITY

The Centre has to provide non-neutron nuclear data for the following principal areas of data application:

- reactor engineering;
- controlled fusion research;
- technical methods for safeguards systems;
- isotopic analysis of substances by nuclear-physical methods;
- production and application of artificial radioisotopes;
- shielding and dosimetry;
- medical applications of radioisotopes;
- nuclear physics, astrophysics, etc.

In reactor engineering, a substantial part of the evaluation work will be associated with the problems of monitoring neutron fluxes inside the reactor. For this purpose, it is necessary to know:

(a) the thermal and resonance activation cross-sections of elements used as neutron detectors, and the lifetimes and decay schemes of product nuclei; the same data are needed for the elements of structural materials and nuclear fuel in order to make allowance for the background;

(b) the activation cross-sections of elements used as threshold detectors, and the lifetimes and decay schemes of the product nuclei.

One of the main functions of the Centre is to supply non-neutron nuclear data for controlled fusion research, which is being conducted intensively in the USSR. This activity requires data on the interaction cross-sections of light nuclei for energies of several MeV. Data are also needed on the gamma-ray spectra and lifetimes of nuclei generated as a result of interaction between the fusion reaction products and the elements of structural materials and materials which can be used for tritium breeding.

Data are very important for work connected with the production and application of artificial radioisotopes, for research on activation analysis using charged particles and for medical and biological research.

Apart from data on the structure of nuclei, their radioactive transformations and reaction cross-sections, data are essentially needed on the stopping power of various substances and on the paths of scattering of nuclear radiation energy in different media.

The above list of the principal areas of applied science and technology requiring non-neutron nuclear data cannot, of course, be regarded as final. The current trend of applying methods developed for the purpose of solving nuclear problems to other areas will undoubtedly give rise to new, and perhaps not even purely nuclear, functions.

The practical requirements of non-neutron nuclear data are, on the whole, reflected quite fully in the papers presented by A. Lorenz and A. Calamand at the Consultants' Meeting and the Specialists' Meeting held in April-May 1974, [INDC(NDS)-61] and the requirements of Soviet scientists do not in practice differ from those of other countries.

For the next few years the Centre's activities will be focussed on the following:

- generation and maintenance of a file of evaluated data on the properties of fission-product nuclei;
- work on a file of evaluated data on the structure of the nucleus;
- generation and maintenance of a file of experimental data on gamma radiation accompanying radioactive transformations of nuclei;
- compilation activity in the field of the charged-particle and photon beam activation cross-section and the yield of reaction products;
- generation and continuous updating of the bibliographic reference file including abstracts of papers on nuclear structure, radioactive radiations and nuclear reactions.

It is very difficult and practically impossible in the area of charged-particle-induced nuclear reactions to expand activities greatly on collection, evaluation and dissemination of non-neutron nuclear data without combining the efforts of data centres in different countries. In the absence of a clearly defined system of international co-operation it will not be possible to carry out work of sufficient quality on compilation and evaluation of non-neutron nuclear data and the work of national centres may be made substantially more difficult.

5. THE CENTRE'S ACTIVITIES IN COMPILATION OF DATA ON CHARGED-PARTICLE-INDUCED NUCLEAR REACTIONS

As we have pointed out earlier [1], during the first stage of its activities, the Centre devoted its attention mainly to generating libraries of key-word abstracts. This decision was due to the realization that no work on compilation and evaluation of experimental and theoretical digital material was possible without a good knowledge of the world literature.

The key-word abstracts are based on the format used in the Nuclear Data Project, and in the journals Nuclear Physics and Physical Review C.

Examples of the abstracts can be seen in the publications of the Centre [2] and of the Data Centre of the Leningrad Institute of Nuclear Physics [3]. These were issued in order to acquaint Soviet and foreign scientists with such abstracts; their main purpose was to obtain critical comments from scientists on the form and content of the abstracts.

At the meetings held last year at the IAEA it was recommended that samples of abstracts should be sent to Dr. D. Horen at NDP for analysis and comment. We have not yet seen the results of such analysis, although it is necessary not only for us but also for all those who are parties to this international collaboration.

The abstracts prepared in the USSR do, of course, differ in form from those of NDP. This is due to differences in the peripheral devices of their computers. However, these differences are not substantial. In the case of exchange of magnetic tapes, any code acceptable to all participants in the exchange can be used. Our view is as follows: ASCII codes are sufficient for international exchange of key-word abstracts, while adherence to only BCD or EBCDIC codes used in EXFOR will give rise to difficulties.

The possible differences in the content and syntax of abstracts are much more substantial. In Nuclear Data Sheets, abstracts of papers on nuclear reactions containing no data on the structure of the nucleus are published in the form of incomplete sheets, on the basis of which it is difficult to compare the USSR abstracts with those of NDP.

The analysis performed by the Centre has shown that the abstracts on nuclear reactions published in Nuclear Physics are sufficiently accurate in syntax and allow a relatively simple programme for selecting the necessary papers. This cannot be said of the abstracts published in Physical Review C. In our opinion, the abstracts from Physical Review are not suitable for direct input into computer storage because of very free handling of the syntax. They need remodelling, and this is what we are doing.

It has already been mentioned above that the published abstracts of Soviet works are samples. We do not intend in future to publish these abstracts, since there are special abstracting journals for such publications; we are writing and shall write abstracts on magnetic tape and provide our customers with information faster than do the abstracting journals.

The Centre's programme of retrieval of the necessary abstracts from the magnetic tape satisfies for the time being the requirements of Soviet scientists who request the Centre to make a literature search.

The Centre receives a large number of requests for preparation of literature references, and the flow of such requests is increasing rapidly. These requests are highly varied and require, as a rule, complicated selection of papers on the basis of several criteria at the same time. An ordinary request for references on charged-particle reactions usually contains several logical combinations of the AND, OR, NO type. For example, a list of references would be requested on a particular channel of nuclear reaction in the target nucleus group in a specified energy region of beam particles.

Because of the wide extent and variability of the nature of requests we do not use any internal catalogue for the bibliographic reference file, and each new request requires review of the whole tape. For this reason, we had to develop a programme which conducts the search on several requests simultaneously and gives out the results on different peripheral devices.

Our Centre now meets requests for bibliographic references from Soviet scientists and, occasionally, from scientists in the CMEA countries.

Let us consider the question of the possible methods of exchange of abstracts.

As has already been stated, our Centre is not much troubled by coding problems, since, in our opinion, they are of secondary importance.

We have been asked to consider two types of input of abstracts into the common system:

(1) centralized;
(2) co-ordinated.

Centralized input seems to mean the method in which each participant in the system prepares abstracts in its own field in the form of a text, while one participant transfers them onto the magnetic tape, maintains the master file and provides copies to all others.

Co-ordinated input would mean the method, such as is used in EXFOR, in which each participant maintains its own master file and sends copies thereof to the others.

Considering the relatively successful experience of the neutron data centres, the second method should evidently be preferable. Each abstract will contain a mark, for example in the index, indicating where it was prepared and to whom one should refer in case of difficulties with the text.

Abstracts could be exchanged every three months and uniformity in their preparation achieved within a year by correspondence.

The work on the compilation and exchange of nuclear data on charged-particle reactions can be started only when a particular format of data recording has been adopted. The EXFOR format is not suitable in its present form for recording data relating to charged-particle reactions. However, as has been shown by Professor Münzel's group, with some modification the EXFOR format can be used to record data obtained in nuclear reactions (Memo 4C-3/121). Neutron data centres, too, have no fundamental objections to making such changes (Memo 4C-1/60). Thus, the general problem of format may be deemed to have been settled. There remain only some details to be clarified. It should however be borne in mind that the existing EXFOR should be modified in such a manner as would involve the least possible complication in the work of the neutron centres.

Charged-particle-induced nuclear reactions are so much more varied than neutron reactions that it can hardly be expected that any reaction can be written in the old thesauri, which have to be updated constantly as compilation of nuclear data progresses.

The current trend in the development of research on charged-particle reactions shows that in the next few years the physics of nuclear reactions will become predominantly the physics of heavy-ion reactions. It is therefore necessary right now to try to describe the studies with heavy ions. As an experiment, we are planning to perform this work covering the studies on heavy-ion reactions in progress at the I.V. Kurchatov Institute of Atomic Energy.

At present, it is necessary to clarify the details of modification of EXFOR for application in charged-particle reactions.

1. It would be useful to recommend that the neutron data centres should, if possible, transmit to the centres participating in non-neutron data exchange all block schemes of programmes with which they prepare and decode information in EXFOR so as to accelerate and standardize input of the new format for charged particles.

2. Charged-particle reactions are observed even now when the gamma quantum precedes the neutron. Perhaps, in fields corresponding to secondary (emerging) particles, particles should be located as the mass increases so that deviation from the established sequence would indicate that this particle emerges first.

3. In describing charged-particle reactions it should be compulsory to use the keyword SAMPLE, since charged-particle reactions are accompanied frequently by chemical transformations in the target material and knowledge of the nature of the sample during data evaluation permits independent assessment of the measurement accuracy. This section should include information not only on the sample but also on the specific density of the beam on the target, which is an indication of the intensity of the chemical transformations.

4. The word FACILITY now means only a charged-particle accelerator. It is however important to indicate the type of the chamber where the reaction under study was conducted, and, in particular, whether or not there is an inlet port, whether or not the chamber has differential pumping, and so on. The appropriate notations should be included in the thesaurus.

5. Memo 4C-3/121 (6000100100008 and 6000100100009) introduces the key-word MONITOR and refers to two reactions, one of which is unpublished. It is not understood under which SUBENTRY and according to what standard the cross-sections are calculated. It would be useful to include in such cases a column MONIT or STAND in the DATA section, which gives the standard cross-section. Otherwise comparison with other works will be very difficult.

6. HALF-LIFE should be included when the data are based substantially on this parameter. This is in fact the same as MONITOR.

7. In Memo 4C-1/60, paragraph 5, concern is expressed about what will happen if the number of centres becomes more than nine. The same question may be asked also in the case of the number of papers in the file of any centre. What will happen if the number of papers exceeds 10 000? There is no doubt that this situation is to be expected in the next 5-7 years in the case of charged-particle reactions. At present column 67 gives the number of the centre. For non-neutron centres, column 67 should contain the index C (or any other), while the centre's identification in the form of a two-digit decimal number should appear in columns 65 and 66. In future, index C may be replaced by one more position for the number of papers contained at the centre.

The above suggestions obviously do not require radical remodelling of the existing EXFOR system. The International Nuclear Data Committee should be requested, at its next meeting, to entrust to NDS the work of editing the EXFOR Manual and thesauri so that they could be used to describe data obtained in charged-particle reactions. In this case, it should perhaps be borne in mind that it may soon be the turn of data on radioactivity and structure. Maintenance and improvement of thesauri should be in the same hands in order to prevent any possible confusion. In this matter, NDS should be given full authority.

The distribution of the work on the compilation of nuclear data obtained in charged-particle reactions should, in our opinion, be based on the geographical principle. This is supported by our experience, though not very extensive, in the translation of data into the EXFOR-KFK format, which indicated the need to contact the authors directly. This would be more ample and convenient if the geographical principle is applied.

Our Centre has now received the suggestions of Dr. E.G. Fuller and Professor N. Münzel regarding exchange of experimental data of interest to the appropriate parties. The Co-ordination Group and the Centre have recognized this work as acceptable and mutually beneficial, and it has started. How is this work organized? On the basis of the recommendations of the meeting held in Vienna in April 1974 and with the agreement of Professor Münzel and the approval of the Co-ordination Group, our Centre convened a meeting which was attended by representatives of the institutes working on similar subjects (Institute of Atomic Energy, Moscow State University, Kharkov Institute of Physics and Technology, Institute of Physics and Power Engineering, etc.). The meeting was informed of the suggestion of Professor Münzel, and it was decided that researchers would submit their data in numerical form in the appropriate format. The specimen format should be provided by the Centre. However, the final version of the format is not yet available, although it is urgently needed for progress of work on the compilation of charged-particle reaction data.

It will thus be evident from the foregoing that, as regards compilation of charged-particle reaction data, the Soviet Union is prepared to participate on a mutually advantageous basis in selective compilations as, for example, in the area of data on yield from a thick target and of reactions leading to the formation of radioisotopes, since at present it is practically impossible to cover everything relating to charged-particle reactions. Any other suggestions received at the Centre will be considered, and if the Co-ordination Group approves, a decision will be taken on developing activities in the field of research concerned.

After clarifying the format, our Centre is prepared to start regular exchange of digital data within a period not exceeding six months. The frequency of the exchange can be settled by discussion. This could be once in three months or once in six months but obviously not once a week.

Apart from the lack of a uniform format, we are held up in this matter by the following circumstance. The Centre's facilities are suitable for reading IBM tapes but we are not sure that we can read any tape, since we have as yet little experience in this matter. It would be of great interest to see samples of magnetic tape recordings at the existing centres and offer them samples of our recordings, i.e. to carry out an experimental exchange in the near future. This could indicate whether or not it is necessary to acquire new equipment. The experimental tape should, of course, be accompanied by the corresponding print-out.

In the near future, the Centre does not propose substantially to develop activities on evaluation of nuclear data obtained from charged-particle reactions. In a number of cases, the Centre either carries out itself, or has other organizations carry out, selective evaluations.

As regards charged-particle reactions, especially the energy dependence of reaction cross-sections, it is necessary to make an essential distinction between two regions: resonance and smooth. Evaluation in the resonance region is very difficult, and here it may be simpler to perform an experiment than try to combine widely differing data. In the case of the smooth dependence, the neutron data evaluation methods which are being developed and which already exist can be quite useful and the experience of the neutron data centres should be taken into account.

In our opinion, the theoreticians specializing in nuclear reactions should not be forgotten. They can calculate, for example, the dependence of cross-sections on the basis of a model representation, i.e. in essence they perform an evaluation, since this calculation is then compared with experiment. Therefore, our duty here is to provide the most complete experimental material to the theoreticians so that they can choose the best model and then give the necessary evaluation.

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Report on the Nuclear Structure and Charged Particle Reaction Data Survey

T. Burrows
N. Holden
M. Bhat
C. Dunford
S. Pearlstein

August 25, 1975

The purpose of the survey was to determine how existing compilations and evaluations of nuclear structure and charged particle data are generally regarded by the scientific community and to collect constructive suggestions that might be offered. For this purpose it was not deemed necessary or practical to survey more than a reasonably-sized segment of the scientific community. An appropriate list of names was solicited from leaders in both basic and applied scientific activities. Although the majority of those contacted and those responding were engaged in basic research,we believe the survey also adequately reflects the concerns of those engaged in applied research.

SUMMARY OF SURVEY RESULTS

I. Scope and Audience of Survey

In summarizing the results of this questionnaire the following facts should be noted:

1. Approximately 410 questionnaires were sent out.
2. 135 replies were received. Several replies were the cumulative response of a research group. This number includes copies forwarded by recipients to people not on the original list.
3. The replies were broken into the following catagories:
   a. Basic research 86%
   b. Applied research 10%
   c. Evaluation 4%

Thus, the survey is heavily weighted in favor of basic research, both experimental and theoretical. It should be further noted that in basic research it was heavily weighted to structure and charged-particle research.

A copy of the questionnaire may be found in Appendix A.

II. Bibliographic Sources and Needs

A. There is a general consensus that a complete and current bibliography of nuclear structure, decay, and reaction data be maintained.

B. Bibliographic Sources in Current Use

1. Recent References and/or Charged-Particle Reaction Lists 52%
2. Nuclear Science Abstracts 25%
3. Physics Abstracts 5%
4. Others (12) 18%
5. It should be noted that most of those who replied do their own literature scanning to supplement, or in lieu of, the above sources and to maintain their private files.

C. Time Cycle of Cumulative Editions of Recent References

1.	Less than or equal to one year	50%
2.	Two years	8%
3.	Three years	8%
4.	Four years	0%
5.	Greater than or equal to five years	2%
6.	No need for cumulative editions	16%
7.	No comment	16%

Thus, there is a strong desire for an annual cumulative edition of Recent References.

D. Adequacy of Coverage of Recent References

With the exception of laboratory reports and theoretical papers, the coverage of Recent References was judged to be adequate.

E. Inclusion of Theoretical Papers in Recent References

1.	Yes	50%
2.	Yes, but separate from experimental	2%
3.	Maybe	14%
4.	No	17%
5.	No comment	16%

F. Specific Retrievals from the Current Reference File

Approximately 79% answered this question with the following results:

1.	Yes	77%
2.	No	23%

III. Experimental Data

A. There is a strong desire to have experimental data available with:

1.	Yes	67%
2.	No	28%
3.	No comment	5%

A more detailed analysis may be found in Appendix B.

B. The format for experimental data was almost equally divided between desk-top book (52%) and computer-readable files (48%). Note: of the 82 replies expressing a desire to have experimental data available, only 49 gave a preference in formats.

C. Several general conclusions about the type of experimental data desired could be drawn from the survey. Level and decay data properties were almost universally desired. Coulomb excitation, reaction cross section, excitation function, isobaric analog, and L-transfer data were strongly desired. Many replies also expressed the need for coincidence data, fission product and prompt neutron yields, and polarization data. No definite conclusions could be obtained for data relating to few-nucleon interactions since the survey had been heavily biased toward structure and charged-particle research.

IV. Recommended or Evaluated Data

A. The following compilations were found useful by those who replied:

1.	Nuclear Data Sheets	48%
2.	Chart of the Nuclides	20%
3.	Table of Isotopes	20%
4.	Others	6%
5.	Not given	6%

It should be noted the question specifically referred to items 1-3 above, and therefore was heavily weighted for these three publications. Also, as has been noted above, survey returns were heavily weighted towards basic research. Finally, many replies noted that the choice of publication was dictated by currency (e.g. Table of Isotopes was out of date so the Nuclear Data Sheets were chosen, or vice versa).

B. Evaluation Cycle Time

The suggested evaluation cycle times varied from less than or equal to one year to greater than or equal to five years with a flat distribution. Note also that 39% of the replies had no comments on the cycle time.

1.	Less than or equal to two years	19%
2.	Greater than two and less than five years	15%
3.	Greater than or equal to five years	9%
4.	More frequent than the current publications	13%
5.	No comment	36%
6.	No evaluation or recommended values	1%

C. The general conclusions drawn about the type of evaluated data desired parallel closely the conclusions drawn about the experimental data (see III.C.) with the exception that there is less of a desire for evaluated reaction data. However, there was still a strong desire for evaluated cross sections and some desire expressed for the remaining quantities discussed in III.C. Also, as noted in III.C. no definite conclusions could be drawn about few-nucleon data.

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Annex 3 USA

BROOKHAVEN NATIONAL LABORATORY
ASSOCIATED UNIVERSITIES, INC., UPTON, L.I., N.Y. 11973

TELEPHONE: (516) 345-2902, 2903, 2904

Dear Colleague:

Specialized collections of references, experimental data, and summaries of recommended values serve the interests of both the basic and the applied sciences. The Division of Physical Research of the U.S. Energy Research and Development Administration which supports a large part of these activities in the fields of nuclear structure and charged particle reaction data, has requested that a study be made to determine how the interests of the entire community can best be served. In particular, we are studying how the information contained in such publications as Recent References, Chart of the Nuclides, Table of Isotopes, Nuclear Data Sheets, Energy Levels of Light Nuclei, etc. can be made available in a more uniform way on a timely basis.

Essential to the success of this study is an informed view of the requirements of the basic and applied science communities. To aid the study in progress, your help is requested by supplying information to us relating to the attached list of questions. These questions are meant only as a guide for your reply, so you should feel free to respond in whatever form which seems suitable. Wherever possible, please rank your choices in order of their importance to your work. Please reply by August 1, 1975 to

Dr. S. Pearlstein
Building 197
Brookhaven National Laboratory
Upton, NY 11973
U.S.A.

Telephone: (516) 345-2902

Appendix A

Survey Questionnaire

Questionnaire on Nuclear Structure and Charged Particle Reaction Data

A. General

1. Name _____ Phone _____
   Affiliation _____
   _____
   _____
   _____

2. What are your current fields of interest?

3. Names of other scientists or groups who should be contacted.

4. Information which can be supplied to the user community is of three types a) Bibliographic Lists, b) Experimental Data, and c) Recommended Values. Which of these are useful in your work?

5. What nuclear quantities (and energy range where applicable) should be included in the source files above?

B. Bibliographic List

1. Do you use Recent References or the Reaction List published in Nuclear Data Sheets? If so how often?

2. Do you use any other bibliographic sources? If so, what are they?

3. Would you like cumulative publications of Recent References? How often should they appear?

4. In Recent References, is the present coverage of journals, conferences, laboratory reports adequate?

5. Should relevant theoretical papers be key-worded and included on a regular basis?

6. Is the key-word system useful to you? Can it be improved?

7. Would specific e.g., half-life or reaction type bibliographic retrievals from the current reference files be useful to you?

C. Experimental Data

1. Would you like to see measured nuclear structure and charged particle reaction data extracted, with relevant information, from the published literature and available either as a desk-top book or in a computer readable form on request?

2. Which data (see attached list) do you consider as most important for inclusion in such a file and why?

D. Recommended Values

1. Using the presently available collection of recommended values, the Chart of Nuclides, Table of Isotopes and Nuclear Data Sheets as examples, which of these comes closest to meeting your needs? How can these publications be improved to better suit your needs?

2. Which quantities on the enclosed list do you feel are absolutely essential in a set of recommended values? How frequently should these sets of recommended values be revised and why?

E. Other Comments

LIST OF POSSIBLE QUANTITIES

I. Level Properties*

A. Ground State Properties+
1. Abundances
2. Static moments of nuclear charge distribution
3. Static magnetic moments
4. Nuclidic masses

B. General Properties
1. Reduced transition probabilities
2. Deformation parameters
3. Quantum numbers
   a. J - Total angular momentum
   b. π - Parity
   c. L - Orbital angular momentum
   d. N - Principal quantum number
   e. Λ - Projection of particle angular momentum on nuclear symmetry axis
   f. T - Isospin
   g. T_z - z-component of T≠
   h. K - Rotational band quantum number

   Note: T and K are good quantum numbers only in certain regions.
4. Half-life
5. Gyromagnetic ratio
6. Per cent decay of state by various modes of decay or branching ratios
7. Configuration of state - Model dependent
8. Spectroscopic strength factors for one-nucleon stripping and pickup reactions (similar quantities for multi-nucleon reactions)
9. Average level spacing per state
10. Level density parameters
11. Level energy
12. Level widths and radiation widths

*Uncertainties to be included where applicable

+These are in addition to the general properties listed below

≠For the ground state, $T_z = (N-Z)/2$

II. Decay Data*

A. General+
   1. Coincidences
      a. Angular correlations
      b. Coincidences as a function of time
   2. Decay constants
   3. Decay energies
   4. Polarization results
      a. Circular
      b. Longitudinal
      c. Transverse
   5. Separation parameters

B. Alpha Decay
   1. Hindrance factors

C. β^- - and $(\epsilon + \beta^+)$-decay
   1. Degree of forbiddenness
   2. Fermi-Kurie plots

D. $(\epsilon + \beta^+)$-decay
   1. Electron-capture to positron ratio

E. $(\epsilon + \beta^+)$- and γ-decay
   1. Auger electron energies and intensities
   2. Fluorescence yields
   3. Internal pair formation and bremstrahlung intensities

F. γ-decay
   1. Internal conversion electron intensities and energies, conversion coefficients, and conversion coefficient ratios
   2. Multipolarities and mixing ratios

G Spontaneous Fission
   1. Fission product yield
   2. Fission channels, barriers, and number of degrees of freedom
   3. Prompt neutron yields

*Uncertainties to be included where applicable

+Includes α-, β^--, γ-, $(\epsilon + \beta^+)$-, and proton decay, delayed neutron emission, and spontaneous fission.

III. Reaction Data*

A. Coincidences
   1. Angular correlations
   2. Coincidences as a function of time
   3. Coincidences as a function of angle, magnetic field, and time

B. Coulomb Excitation

C. Cross sections as a function of energy and/or angle

D. Excitation functions

E. Fission product yields and prompt neutron yields

F. Isobaric analog resonance and state properties

G. L-transfers

H. Polarization results
   1. Tensor
   2. Vector

I. Thermal and epithermal reaction properties

J. Thick target yields

K. Yields as a function of angle, magnetic field, and temperature

IV. Few Nucleon Interactions

A. Correlation parameters

B. Coupling constants

C. Depolarization parameters

D. Mixing parameters

E. Optical model parameters ($E \geq 1$ GeV)

F. Phase shifts ($E < 1$ GeV)

G. Scattering lengths, amplitudes, and ranges

*Uncertainties to be included where applicable.

Appendix B

Availabiiity of Experimental Data Desired

	Nuclear Structure	Reaction	Both	Neither	No Comment
Basic	17 (15%)	14 (12%)	46 (41%)	31 (28%)	4 (4%)
Applied	5 (36%)	1 (7%)	6 (43%)	1 (7%)	1 (7%)
Evaluators	0 (0%)	0 (0%)	3 (50%)	2 (33%)	1 (17%)
Total	22 (17%)	15 (11%)	55 (42%)	34 (26%)	6 (5%)

Report on the Activities of the Japanese Study Group

H. Ohnuma

Tokyo Institute of Technology

History

A study group for "Information Processing in Nuclear Physics" has started in Japan in 1974 as one of the 22 subgroups in the project for "Advanced Information Processing of Large Scale over a Broad Area". This project, headed by Prof. Shimanouchi (Univ. Tokyo), has started its three-year experimental period in 1973 under a special fund from the Japanese Government.

Members

The members of our group are:

Hajime Tanaka (chairman), Department of Physics, Hokkaido Univ.

Yasuhisa Abe (acting secretary), Research Institute for Fundamental Physics, Kyoto Univ.

Mitsuo Sano (theoretical nuclear physics), Department of Physics, Osaka Univ.

Mitsuji Kawai (theoretical nuclear physics), Department of Physics, Tokyo Institute of Technology

Hidetsugu Ikegami (experimental nuclear physics), Research Center for Nuclear Physics, Osaka Univ.

Hajime Ohnuma (experimental nuclear physics), Department of Physics, Tokyo Institute of Technology

Masatomo Togashi (system engineering), Department of Physics, Hokkaido Univ.

Aim of the activity

We have agreed on the following points. As far as bibliographic information and nuclear-structure information are concerned, we should support currently working groups rather than start an entirely new project. What is needed now is a data file for charged-particle-

induced reactions. Therefore we should work on charged-particle-nuclear-reaction data preferably designing a prototype of a "Nuclear Reaction Data File" (NRDF), which will in the future supplement the "Nuclear Structure Data File" (NSDF) developed at Oak Ridge. In NRDF, experimental data such as angular distributions, polarization, asymmetries, excitation functions, etc., should be stored in digital form. Associated information such as experimental conditions should also be stored in order to make future evaluation possible.

General background

In the discussion it has been pointed out that traditional media of information exchange - such as scientific papers in journals - are becoming quite insufficient and unsatisfactory, as a result of the increasing amount of information, rising costs for publication, etc. For example, more and more the emphasis is on discussions in recent publications rather than on experimental procedure and results. This is partly due to the "page limit" policy of many journals, and partly due to the increasing number of "black boxes" in experiments. Our hope is that such a data file as we have in mind would provide us with a new medium of exchanging scientific information.

In this regard we should call attention to the following points in designing a prototype of NRDF.

(1) The system should be as flexible and versatile as possible in order to meet the demands resulting from the progress of nuclear physics and variety of requests.

(2) The system should be able to describe experimental conditions in a clear and compact way. These descriptions should include information on targets, on beam characteristics, and on detectors. The detector information should tell not only the kinds of detectors used, but also their logical structure (e.g., in coincidence, anti-coincidence, etc.)

A test system: NRDF-1

In order to obtain a general idea of the workability of NRDF, several published papers were picked up and analyzed, and the information in them was listed. After discussions among ourselves as well as with nuclear physicists outside the group and with system engineers, acceptable input, output, and retrieval forms have been tentatively decided. A test system for a HITAC-8250 computer (64-kB memory with two 15-MB disks) has been developed. This test system is called NRDF-1.

NRDF-1 is written in PL-1; it takes a total of about 50-kB memory, can be overlaid, and consists of three major parts, namely:

(1) Input routine
This part is to read in cards, interpret descriptive data, check for syntax errors,pick up items that can be used for retrieval, express input data in the form of internal networks, and store them.

(2) Output routine
This routine is to read in requests from cards or from keyboard, analyze the input command, and make proper responses. It searches for data and prints them out on request.

(3) Maintenance routine
This part is to create a data base, correct data for errors, delete data, etc. It is the most important part of the whole program and protects the data area or data file from error inputs and misoperation of the computer.

NRDF-1 has the following features that EXFOR does not have.

(a) It can handle logical arithmetics.

A + B	A or B
A * B	A and B
A - B	A and B
A / B	A or B etc.

(b) The logical structure can be as deep as one likes. This is because descriptive parts are of the form of internal networks.

```
Entry
   common data
      subentry
         common data
            subentry
               data
            subentry
               common data
                  subentry
                     data
                  subentry
                     data
            subentry
               data
```

(c) Numerals are stored as characters. This enables one to preserve significant figures - e.g., one can tell the difference between 3.0 and 3.00. This also facilitates onversion from one computer to another.

Because of these features, NRDF-1 can take more subtle and sophisticated descriptions - e.g., of detector systems. We think this is important since the information we are trying to store is not raw data in the strict sense of the word but rather a sort of processed data. In order to make further evaluation possible, it is essential to include information regarding how the raw data had been processed by the authors. We can use comments for such descriptions, but it makes data bulky and clumsy and our data file not much different from papers.

The remaining features are quite similar to those of EXFOR. We think the conversion between NRDF-1 and EXFOR very simple, although conversion from NRDF-1 to EXFOR either loses a considerable portion of the information or requires that it be put in as comments, and the information stored in a converion from EXFOR to NRDF-1 is quite incomplete.

Future plan

It has been decided recently that the special fund will be continued for three more years - that is, from 1976 to 1978. The budget of our group during this period will be about 20,000,000 yen (about $ 70,000) per year. By the end of 1976, the present computer will have been modified by (1) increasing the core memory to 128 kB, (2) attaching a 200-MB disk, and (3) adding an MT handler.

On the basis of our experience, a revised version of the system - to be called NRDF-2 - will be designed and will be working by the end of 1976. Then, we think it possible to start collecting actual data, provided that we restrict ourselves to certain specific types of reaction, such as (d.p) and (p.d) reactions, or all single-nucleon-transfer reactions. A crude estimate of the cost, memory size, running time, etc., for such a system indicates that the project is not impracticable if moderately financed by the Government.

The biggest problems before us are those associated with the input, namely:

(1) How should numerical data be collected ?
(2) Who will write down the input sheets ?
(3) How many punchers will be required to convert them to cards ?

A crude estimate tells us that about 10^6 cards/year = 4×10^3 cards/day will have to be punched if all kinds of charged-particle-induced reactions are to be compiled. This number will be reduced considerably if we select only certain types of reactions. If the reduction factor is assumed to be 10, the required punching rate will be 10^5 cards/year = 400 cards/day. This much can be taken care of by one puncher.

The estimate of 10^5 cards/year implies that approximately 10 000 data sheets have to be written per year. If inputs are derived from published papers or preprints, a single person possessing an adequate knowledge of the system and of nuclear physics may be able to write 10 sheets a day. This means five such persons would need to work full time, and at least one specialist would be needed to supervise them and check the sheets for errors.

An even much greater problem seems to be the collection of data. To start with we will have to either read graphs in papers or send special forms to be filled in by the authors. The latter is far more desirable. The form to be sent to the authors should be so arranged that the punchers could soon learn to read it an punch cards directly from it. Numerical data read from graphs should be marked to this effect. The success of our system relies heavily on the cooperation of other experimental nuclear physicists; and conversely, success of our system will make it much easier to collect data.

Once the system is in operation, we anticipate that its compatibility with most computers will allow it to be sent to several centers in Japan and to foreign centers that may desire it. Data tapes would then be sent to these centers so the information generated by the project will be accessible to most potential users. Publication of the data compilations would be technically feasible, but its practicality would have to be assessed on the basis of a survey of the need and an estimate of the cost.

Concluding remarks

Our experience tells us that no objective compilation is possible. We believe that all the compilations are biased, and involve a greater or less amount of subjective evaluation of one kind or another. Selection of keywords, for instance, is already based on a prejudice. This is the reason why input forms and the descriptive part of the data should be as flexible and versatile as possible. It would be different for an application-oriented compilation, for which methods of measurement are usually established and to some extent standardized. If a compilation has started from purely scientific interest, and its aim is to help other physicists of the same field do research in a more effective way, the system must be prepared to accept entirely new types of data obtained by a new experimental technique. Accordingly, the system has to be of evolving nature, so that it can keep up with the progress of physics.

75/76
Annex 5
Harwell

HARWELL

Nuclear Physics Division, H.8
AERE Harwell, Oxfordshire
OX11 0RA
Tel: Abingdon 4141 (STD 0235) Ext 2497
Telegrams: Aten Abingdon
Telex 83135

Date 12th June, 1975

Dr. J.J. Schmidt,
Head, Nuclear Data Section,
IAEA,
Kärntner Ring 11,
P.O. Box 590,
A-1011 Vienna,
AUSTRIA.

Dear Dr. Schmidt,

Thank you for your letter dated 30th May concerning the CPND meeting in Vienna during September. I should have been glad to accept your invitation to attend as an observer, but unfortunately the meeting coincides with an international conference on "Applications of Ion Beams to Materials" at Warwick, and of which I am Chairman. Mr. Turner regrets that he will be unable to attend, either, due to the condition of his health and the inadvisability of travelling overseas.

I have meanwhile discussed your letter and the meeting agenda with Dr. Rose. My feeling was that too much attention was being devoted to the mechanism of data compilation and too little to the ultimate user needs. In our case, we are concerned with charged particle cross-section data for use in surface materials analysis and the dissemination of information in a form accessible to materials scientists now using nuclear facilities for this purpose. We tend to put their needs (target species, ion species, energy ranges) ahead of the requirements suggested by considerations of uniformity or completeness of data. Factors such as the choice and preparation of suitable standard targets for intercomparison purposes have so far proved more pressing than the need for further data, although we anticipate that we shall discover a lack of specific data during the course of our compilation. Equally important to disseminate are the techniques of particle discrimination, pulse pile-up rejection and other methods well-known in the nuclear field, together with an awareness of the consequences of ion channelling in crystalline targets.

I hope these remarks will be helpful.

Meanwhile, we shall complete the questionnaire and return it to Mr. Calamand.

Yours sincerely,

G. Dearnaley.

G. Dearnaley.

An Information System for Physics Data in the Federal Republic of Germany

I. Objectives of the Data Information System

The ever increasing number of publications poses serious problems for scientists and engineers to extract data that are relevant to their work from the primary scientific and technical literature and to assess the accuracy of these data. They may at best do so in their special field of research, but in all other cases they have to rely on critical data compilations. Critical data compilations are defined here as compilations in which the data are not only collected and arranged in a special way but in which they are evaluated by means of definite criteria resulting in some recommended values for the user.

In many fields of physics such data compilations are lacking or do not fulfil the requirements of the users, because they are out of date or they are published in places that are not well-known. This unsatisfactory situation has been confirmed by an inquiry recently performed by the German Physical Society.

Therefore the Zentralstelle für Atomkernenergie-Dokumentation (ZAED) located at the Karlsruhe Nuclear Research Center has been commissioned by the German Federal Ministry for Science and Technology to improve this situation in a substantial way by establishing an information system for physical data. For this purpose data compilations will be provided for a number of subfields of physics which will be updated regularly. In addition a bibliography of world-wide data compilations will be published.

II. Scope of the Data Information System

Data from all fields of physics will be entered into the data information system. The data can be of experimental or theoretical type and may be represented in the form of tables, curves or parametrized formulae. In special cases an index of bibliographical references will be accepted. The following list gives representative examples of needs for data which were indicated by the inquiry of the German Physical Society. This list is not meant to be exhaustive.

High field superconductors (e.g. transition temperature, critical fields, critical current density, penetration depth, coherence length)

Low temperature properties of materials (e.g. specific heat, thermal conductivity, thermal expansion)

Glasses and amorphous solids (e.g. expansion coefficients, electrical properties, optical properties from the infrared to the ultraviolet range)

Laser materials (e.g. wavelengths of laser transitions, spectroscopic properties of rare earth ions in different host lattices)

Surfaces and thin films (e.g. adsorption properties of gases at surfaces, work functions of metals, sputtering data under ion bombardment)

Properties of semiconductors (e.g. transport properties, band edges, optical constants, exciton energies, photoconductivity, lifetimes of charge carriers)

Thermal and thermodynamic properties of solids (e.g. thermoelectric coefficients, phase diagrams of multi-component systems, thermodynamic properties at high pressures)

Magnetic properties of solids (e.g. magnetization and susceptibility of alloys and of intermetallic compounds, temperature dependence of magnetic properties, especially at phase transitions and at critical points)

Optical properties of solids (e.g. data of nonlinear optical crystals as a function of voltage, temperature and frequency; optical constants of solids and liquids in the infrared range; most important properties of widely used luminescent materials)
Hard metals (e.g. high temperature behavior, thermal conductivity, thermal expansion, electrical conductivity)
Atomic nuclei and elementary particles (e.g. anisotropy coefficients of beta and gamma transitions, nuclei radii, lifetimes of isomeric states, mass yields and fission fragment distributions in nuclear fission, coupling constants and scattering data)
Atoms (e.g. lifetimes of excited states, isotope shifts, g-factors, polarizabilities, electron collision cross sections for excitation and ionization, hyperfine structure data)
Molecules (e.g. dipole moments, cross sections for excitation and ionization, reaction cross sections, interatomic potentials, electron affinities, dissociation energies)
Macromolecules and polymers (e.g. viscoelastic, thermal, electrical and optical properties, longtime behavior, diffusion constants)
Plasmas (e.g. broadening of spectral lines in plasmas, excitation and ionization cross sections of gases, ion mobilities, transport coefficients)
Physical chemistry (e.g. kinetic parameters for reactions of radicals in the gaseous and liquid phases, equilibrium parameters of multi-component systems, absorption spectra of shortlived radicals)

III. Form of the Data Compilations

The data compilations will be published as individual booklets within a series called "Physikdaten/Physics Data" under the authorship of the compilers. The explanatory text of the compilations will be in German and English. This form of single pamphlets has the advantage of being allways at hand and of easy replacement of older editions by updated revisions. The

compilations will be distributed to research institutes, industrial laboratories, libraries and individual scientists.

Future plans envisage a computer stored data bank in which data compilations will be stored on magnetic tape in a format that allows retrieval of the data by different search criteria.

IV. Organization of the Compilation Activities

The data information system to be established will consist of a number of groups compiling the data, of a central office for the management of the system, and of a scientific advisory board.

a) The data will be collected and, if necessary, evaluated by groups of specialists working at research institutions. These groups which will be established with the assistance of the German Physical Society, should be actively engaged in the same field in which they compile data. They should be responsible for updating their compilations over a longer period of time.

b) The central office of the data information system will be located at the ZAED and will provide the following services:

1. Technical support to the compiling groups such as providing references to the relevant primary literature by means of magnetic tape services (e.g. Physics Abstracts (INSPEC), International Nuclear Information System (INIS), Nuclear Science Abstracts (NSA), Physikalische Berichte (PB) and other abstract services, if necessary). Also, if required by the groups, the full texts of the documents will be furnished.
2. To a certain extent, financial support to the compiling groups, covering expenses and a honorarium.
3. Editing, publishing and distribution of the data compilations.
4. Computer processing of the data and preparation of data tapes.

5. Coordination of the compiling activities of the different groups, organization and management of the whole data information system.

c) A scientific advisory board will be set up to point out fields in which data are needed, to assist in the selection of the compiling groups and to rewiew the data compilations.

V. Bibliography of Existing Data Compilations

In addition to the preparation of new data compilations an index of already existing compilations will be set up. Such an index of data compilations will be published in book form and maintained as a computer stored file that will allow rapid access to data compilations with regard to a specific requirement

VI. International Cooperation

The new data information system is intending to cooperate with other national and international organizations so that finally an international collaboration of the different groups in the field of data documentation may result.

Further details on this data information system can be obtained from:

Dr. H. Behrens and Dr. G. Ebel
Zentralstelle für Atomkernenergie-Dokumentation (ZAED)
Kernforschungszentrum
7501 Leopoldshafen/Germany
Telephone Nr. 07247/823800

SHORT GUIDE TO EXFOR

EXFOR - a computerized EXchange FORmat - presents in a convenient compact form experimental numerical data as well as physical information necessary to understand the experiment and interpret the data. Keywords and codes make the information computer intelligible. The structure of EXFOR is briefly described in the following.

Each EXFOR "entry" consists of two or more "subentries". The first subentry of an entry contains information which is common to all the following subentries of that entry. Each subentry may include two types of information: Descriptive text information and numerical data. Each item of descriptive text information is identified by keywords such as TITLE, STANDARD, ISO-QUANT, which may exhibit a code within parenthesis, such as (GELI), (SCIN) for the keyword DETECTOR or (TOF), (COINC) for the keyword METHOD. The meaning of most keywords is self-explanatory. The meaning of most codes is given in the free text following the code. Of particular importance is the keyword "ISO-QUANT". Under this keyword are coded the "isotope and quantity" or, in other words, the reaction and parameter measured.

EXFOR information is available in two formats:

- the "standard format" primarily designed for the international exchange of data in computer processable form, and

- the "edited format" in which coded information and data tables are edited in an easily legible form.

The EXFOR structure, the standard and edited formats are illustrated in example 1.

There are several categories of numerical data:

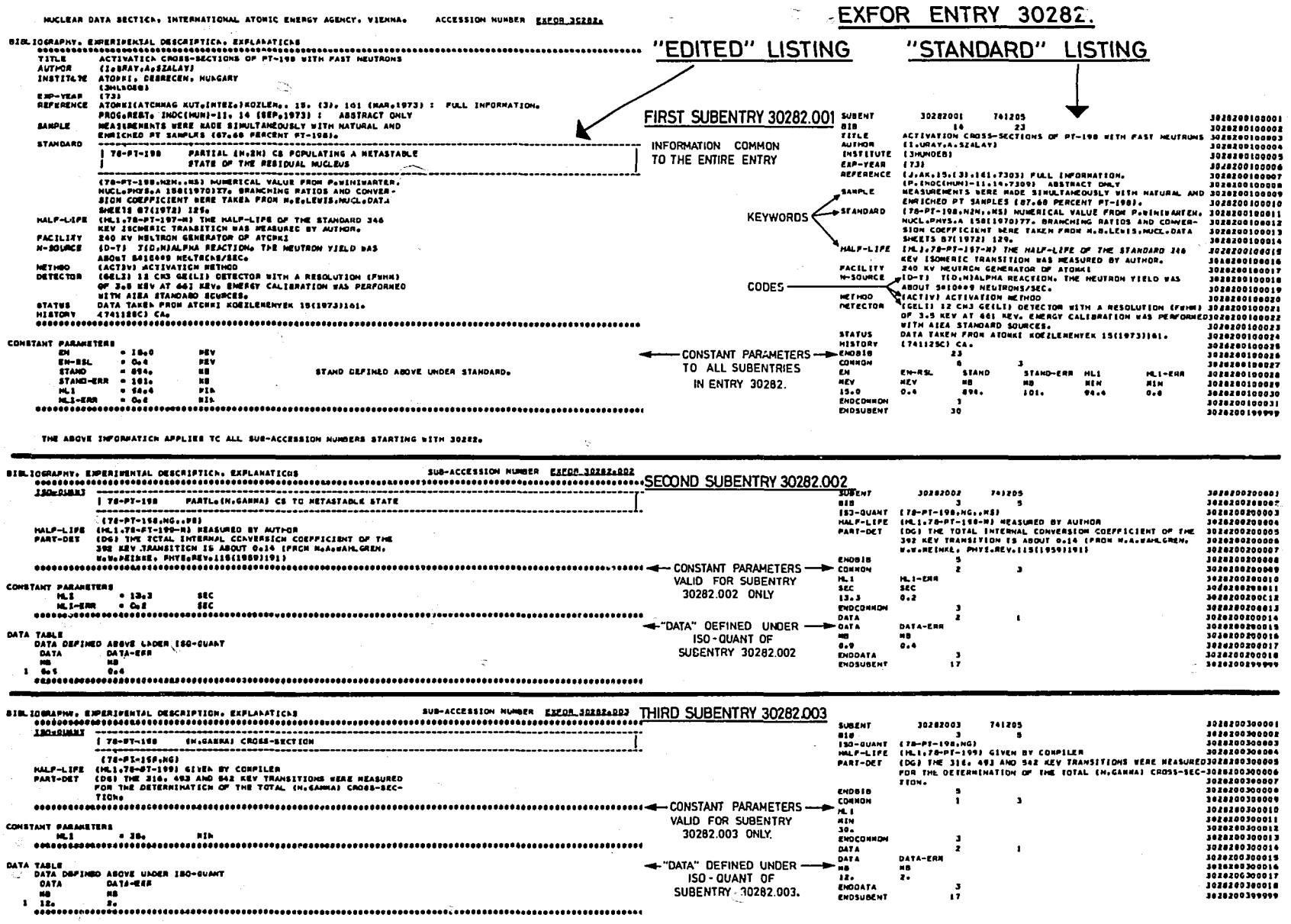
- In the DATA TABLE the numerical data of the quantity defined above under ISO-QUANT are given under DATA (or RATIO) together with the columns of independent variables, errors, etc.

- Constant numerical values which are common to the entire data table of a given subentry, are given in the CONSTANT PARAMETERS (also called COMMON in the standard format) section.

- Constant numerical values which are common to all subentries of a given entry, are given in the CONSTANT PARAMETERS (resp. COMMON) section of the first subentry of that entry.

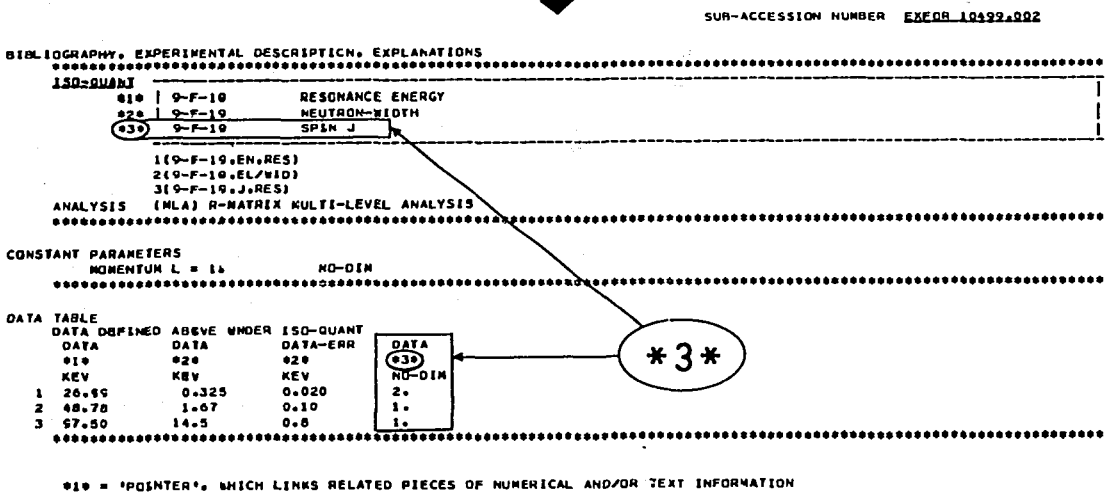
All numerical data are defined by Data-heading keywords (e.g. DATA, EN = incident neutron energy, STAND = standard) and by Data-unit keywords (e.g. EV, MB). The list of Data-heading keywords presently used is given on page 6.

Some data tables may have a more complex structure, for example there may be several ISO-QUANT per subentry; in this case each ISO-QUANT is connected to its pertinent column in the DATA TABLE by means of a "pointer", as illustrated in example 2. More generally a pointer can be used to connect related pieces of information (see example 3).

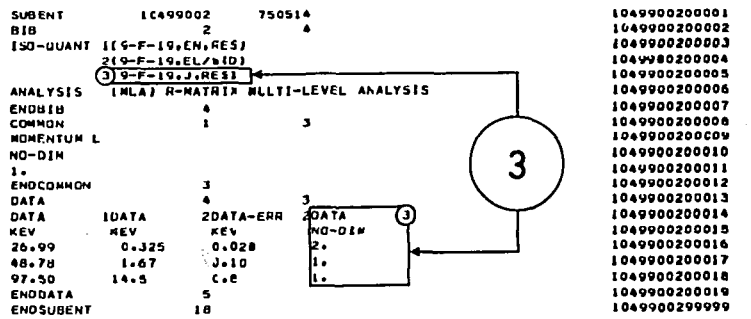

EXFOR ENTRY 30282.
"EDITED" LISTING
"STANDARD" LISTING
FIRST SUBENTRY 30282.001
INFORMATION COMMON TO THE ENTIRE ENTRY
KEYWORDS
CODES
CONSTANT PARAMETERS TO ALL SUBENTRIES IN ENTRY 30282.
SECOND SUBENTRY 30282.002
CONSTANT PARAMETERS VALID FOR SUBENTRY 30282.002 ONLY
"DATA" DEFINED UNDER ISO-QUANT OF SUBENTRY 30282.002
THIRD SUBENTRY 30282.003
CONSTANT PARAMETERS VALID FOR SUBENTRY 30282.003 ONLY.
"DATA" DEFINED UNDER ISO-QUANT OF SUBENTRY 30282.003.

EXAMPLE 1

"EDITED" LISTING



"STANDARD" LISTING



POINTERS LINK RELATED PIECES OF NUMERICAL AND/OR TEXT INFORMATION. IN THIS EXAMPLE, A POINTER (E.G. 3) LINKS AN ISO-QUANT WITH ITS CORRESPONDING DATA COLUMN.

EXAMPLE 2

"EDITED" LISTING

SUB-ACCESSION NUMBER EXFOR 30275.045

BIBLIOGRAPHY, EXPERIMENTAL DESCRIPTION, EXPLANATIONS

ISO-QUANT | 22-TI-0 DIFF.PARTL.NEUTRON-EMISSION CROSS-SECTION |

(22-TI-0,NEM,DA,PAR)

STATUS DATA WERE OBTAINED BY INTEGRATING OVER A 1 MEV INTERVAL FROM 2 TO 11 MEV THE DOUBLE DIFFERENTIAL CROSS-SECTION GIVEN IN SUBENTRY 11.

CONSTANT PARAMETERS

1 ANG	= 40.	ADEG	
2 ANG	= 60.	ADEG	
3 ANG	= 90.	ADEG	
4 ANG	= 120.	ADEG	
5 ANG	= 150.	ADEG	
EN-APRX	= 14.6	MEV	

2

DATA TABLE
DATA DERIVED ABOVE UNDER ISO-QUANT

	1 E-MIN	2 E-MAX	3 DATA-CM *1*	4 DATA-ERR *1*	5 DATA-CM *2*	6 DATA-ERR *2*	7 DATA-CM *3*	8 DATA-ERR *3*	9 DATA-CM *4*	10 DATA-ERR *4*
	MEV	MEV	MB/SR	MB/SR	MB/SR	MB/SR	MB/SR	MB/SR	MB/SR	MB/SR
1	2.	3.	30.88	0.57	24.60	0.25	26.88	0.39	25.19	0.44
2	3.	4.	22.61	0.50	14.99	0.20	14.50	0.24	13.60	0.27
3	4.	5.	13.92	0.30	9.30	0.14	7.94	0.15	6.14	0.13
4	5.	6.	10.17	0.25	7.02	0.11	6.12	0.13	2.79	0.06
5	6.	7.	6.53	0.23	5.73	0.10	4.45	0.12	2.35	0.06
6	7.	8.	7.47	0.22	5.27	0.09	3.43	0.11	1.94	0.06
7	8.	9.	5.94	0.17	4.18	0.08	2.50	0.09	1.04	0.05
8	9.	10.	3.98	0.11	3.02	0.06	1.76	0.06	0.47	0.02
9	10.	11.	2.94	0.08	2.10	0.05	0.95	0.04	0.27	0.01

	11 DATA-CM *5* MB/SR	12 DATA-ERR *5* MB/SR
1	18.06	0.69
2	8.92	0.56
3	3.11	0.40
4	2.86	0.28
5	2.76	0.36
6	1.46	0.14
7	2.46	0.28
8	1.56	0.21
9	0.42	0.10

1 = 'POINTER', WHICH LINKS RELATED PIECES OF NUMERICAL AND/OR TEXT INFORMATION

"STANDARD" LISTING

```
SUBENT        30275045     750521                                    3027504500001
BIB                2            4                                    3027504500002
ISO-QUANT     (22-TI-0,NEM,DA,PAR)                                   3027504500003
STATUS        DATA WERE OBTAINED BY INTEGRATING OVER A 1 MEV INTERVAL3027504500004
              FROM 2 TO 11 MEV THE DOUBLE DIFFERENTIAL CROSS-SECTION 3027504500005
              GIVEN IN SUBENTRY 11.                                  3027504500006
ENDBIB             4                                                 3027504500007
COMMON             6            3                                    3027504500008
ANG           1ANG         2ANG         3ANG         4ANG         5EN-APRX 3027504500009
ADEG          ADEG         ADEG         ADEG         ADEG         MEV      3027504500010
40.           60.          90.          120.         150.         14.6     3027504500011
ENDCOMMON          3                                                 3027504500012
DATA               12           9                                    3027504500013
E-MIN         E-MAX        DATA-CM      1DATA-ERR    1DATA-CM     2DATA-ERR 23027504500014
DATA-CM       3DATA-ERR    3DATA-CM     4DATA-ERR    4DATA-CM     5DATA-ERR 53027504500015
MEV           MEV          MB/SR        MB/SR        MB/SR        MB/SR    3027504500016
MB/SR         MB/SR        MB/SR        MB/SR        MB/SR        MB/SR    3027504500017
  2.          3.           30.88        0.57         24.60        0.25     3027504500018
 26.88        0.39         25.19        0.44         18.06        0.69     3027504500019
  3.          4.           22.61        0.50         14.99        0.20     3027504500020
 14.50        0.24         13.60        0.27          8.92        0.56     3027504500021
  4.          5.           13.92        0.30          9.30        0.14     3027504500022
  7.94        0.15          6.14        0.13          3.11        0.40     3027504500023
  5.          6.           10.17        0.25          7.02        0.11     3027504500024
  6.12        0.13          2.79        0.06          2.56        0.28     3027504500025
  6.          7.            6.53        0.23          5.73        0.10     3027504500026
  4.45        0.12          2.35        0.06          2.76        0.36     3027504500027
  7.          8.            7.47        0.22          5.27        0.09     3027504500028
  3.43        0.11          1.94        0.06          1.46        0.14     3027504500029
  8.          9.            5.44        0.17          4.18        0.08     3027504500030
  2.50        0.09          1.04        0.05          2.46        0.28     3027504500031
  9.          10.           3.98        0.11          3.02        0.06     3027504500032
  1.76        0.06          0.47        0.02          1.96        0.21     3027504500033
 10.          11.           2.94        0.08          2.10        0.05     3027504500034
  0.95        0.04          0.27        0.01          0.42        0.10     3027504500035
ENDDATA            22                                                3027504500036
ENDSUBENT          35                                                3027504599999
ENDENTRY           2                                                 3027599999999
```

2

IN THIS EXAMPLE, A POINTER LINKS AN ANGLE AND THE CORRESPONDING DIFFERENTIAL CROSS - SECTION.
ALSO NOTE THAT TABLES WITH MORE THAN 6 COLUMNS WHICH ARE TEDIOUS TO DECIPHER IN "STANDARD" FORMAT, ARE CLEARLY PRESENTED IN THE "EDITED" LISTING.

LIST OF DATA-HEADING KEYWORDS

KEYWORD	EXPLANATION
EN	INCIDENT NEUTRON ENERGY, LAB-SYSTEM
EN-APRX	APPROXIMATE VALUE OF INCIDENT NEUTRON ENERGY
EN-CM	INCIDENT NEUTRON ENERGY, C-M-SYSTEM
EN-MIN	LOW LIMIT OF INCIDENT N-ENERGY RANGE, LAB-SYSTEM
EN-CM-MIN	LOW LIMIT OF INCIDENT N-ENERGY RANGE, C-M-SYSTEM
EN-MAX	HIGH LIMIT OF INCIDENT N-ENERGY RANGE, LAB-SYSTEM
EN-CM-MAX	HIGH LIMIT OF INCIDENT N-ENERGY RANGE, C-M-SYSTEM
EN-DUMMY	DUMMY ENERGY, USED AS THE NUMERICAL EQUIVALENT OF AN INCIDENT NEUTRON SPECTRUM WHERE NO NUMERICAL ENERGY VALUE IS GIVEN BY THE AUTHOR
EN-RSL	INCIDENT-NEUTRON ENERGY-RESOLUTION
+EN-RSL	+UNSYMMETRIC ENERGY RESOLUTION
-EN-RSL	-UNSYMMETRIC ENERGY RESOLUTION
EN-ERR	ERROR OF MONOCHROMATIC INCIDENT-NEUTRON ENERGY OR UNCERTAINTY OF THE CENTRAL ENERGY IN AN INCIDENT NEUTRON-SPECTRUM.
EN-ERR1	ENERGY ERROR, IF MORE THAN ONE ERROR IS GIVEN. EXPLANATION UNDER 'ERR-ANALYS'.
EN-ERR2	SECOND ENERGY ERROR, IF MORE THAN ONE ERROR IS GIVEN. EXPLANATION UNDER 'ERR-ANALYS'
+EN-ERR	+ UNSYMMETRIC ENERGY-ERROR
-EN-ERR	- UNSYMMETRIC ENERGY-ERROR
EN-NRM	NORMALIZATION ENERGY. TO BE USED WHEN A DATA SET IS NORMALIZED TO ONE ENERGY ONLY.
EN-RES	RESONANCE ENERGY
EN-RES-ERR	ERROR OF RESONANCE-ENERGY
MU-ADLER	MU IN ADLER-ADLER RESONANCE-ANALYSIS. EQUIVALENT TO RESONANCE ENERGY
E	ENERGY OF OUTGOING PARTICLE, LAB-SYSTEM
E1	ENERGY OF OUTGOING PARTICLE, AS DEFINED IN BIB-SECTION
E2	ENERGY OF OUTGOING PARTICLE, AS DEFINED IN BIB-SECTION
E-APRX	
E-CM	ENERGY OF OUTGOING PARTICLE, C-M-SYSTEM
E-MIN	LOW LIMIT OF OUTGOING-PARTICLE E-RANGE, LAB-SYSTEM
E-CM-MIN	LOW LIMIT OF OUTGOING-PARTICLE E-RANGE, C-M-SYSTEM
E-MAX	HIGH LIMIT OF OUTGOING-PARTICLE E-RANGE, LAB-SYSTEM
E-CM-MAX	HIGH LIMIT OF OUTGOING-PARTICLE E-RANGE, C-M-SYSTEM
E-RSL	OUTGOING-PARTICLE ENERGY-RESOLUTION
E-ERR	OUTGOING-PARTICLE ENERGY-ERROR
E-EXC	EXCITATION-ENERGY
E-EXC-MIN	LOW LIMIT OF EXCITATION-ENERGY
E-EXC-MAX	HIGH LIMIT OF EXCITATION-ENERGY
E-LVL	LEVEL-ENERGY
E-LVL-INI	INITIAL LEVEL OF GAMMA-TRANSITION
E-LVL-FIN	FINAL LEVEL OF GAMMA-TRANSITION
E-LVL-ERR	LEVEL-ENERGY ERROR
E-LVL-MIN	LOW ENERGY-LIMIT OF A DISCRETE LEVEL-GROUP
E-LVL-MAX	HIGH ENERGY-LIMIT OF A DISCRETE LEVEL-GROUP
LVL-NUMB	LEVEL-NUMBER. TO BE USED ONLY IF OTHER INFORMATION IS NOT AVAILABLE.
Q-VAL-APRX	APPROXIMATE Q-VALUE
Q-VAL	Q-VALUE
Q-VAL-RSL	Q-VALUE RESOLUTION
Q-VAL-ERR	Q-VALUE ERROR
Q-VAL-MIN	LOWER LIMIT OF Q-VALUE
Q-VAL-MAX	UPPER LIMIT OF Q-VALUE
E-GAIN	GAIN IN NEUTRON ENERGY
E-GAIN-ERR	ERROR OF GAIN IN NEUTRON ENERGY
E-DGD	DEGREDATION IN NEUTRON ENERGY
E-DGD-ERR	ERROR OF DEGREDATION IN NEUTRON ENERGY
ANG	ANGLE, LAB-SYSTEM
ANG1	ANGLE, DEFINITION SPECIFIED IN THE BIB-SECTION
ANG2	ANGLE, DEFINITION SPECIFIED IN THE BIB-SECTION
ANG3	ANGLE, DEFINITION SPECIFIED IN THE BIB-SECTION
ANG-CM	ANGLE, C-M-SYSTEM
ANG-MIN	LOW LIMIT OF ANGLE RANGE, LAB-SYSTEM
ANG-CM-MIN	LOW LIMIT OF ANGLE RANGE, C-M-SYSTEM
ANG-MAX	HIGH LIMIT OF ANGLE RANGE, LAB-SYSTEM
ANG-CM-MAX	HIGH LIMIT OF ANGLE RANGE, C-M-SYSTEM
ANG-RSL	ANGULAR RESOLUTION
ANG-ERR	ANGLE-ERROR
COS	COSINE OF ANGLE, LAB-SYSTEM
COS-CM	COSINE OF ANGLE, C-M-SYSTEM
COS-MIN	LOW LIMIT OF COSINE-RANGE OF ANGLE, LAB-SYSTEM
COS-CM-MIN	LOW LIMIT OF COSINE-RANGE OF ANGLE, C-M-SYSTEM

KEYWORD (cont'd)	EXPLANATION (cont'd)
COS-MAX	HIGH LIMIT OF COSINE-RANGE OF ANGLE, LAB-SYSTEM
COS-CM-MAX	HIGH LIMIT OF COSINE-RANGE OF ANGLE, C-M-SYSTEM
COS-RSL	COSINE OF ANGULAR RESOLUTION
COS-ERR	COSINE OF ANGLE-ERROR
DATA	HEADING FOR COLUMN GIVING THE QUANTITY SPECIFIED UNDER 'ISO-QUANT'
DATA-CM	DATA GIVEN IN THE CENTRE OF MASS SYSTEM
DATA-APRX	APPROXIMATE VALUE OF DATUM
DATA-MIN	LOW LIMIT OF DATUM
DATA-MAX	HIGH LIMIT OF DATUM
DATA-ERR	DATA-ERROR, EXPLANATION TO BE GIVEN UNDER 'ERR-ANALYS'
DATA-ERR1	FIRST DATA-ERROR, IF MORE THAN ONE ERROR-COL IS GIVEN. EXPLANATION UNDER 'ERR-ANALYS'
DATA-ERR2	SECOND DATA-ERROR, IF MORE THAN ONE ERROR-COL IS GIVEN. EXPLANATION UNDER 'ERR-ANALYS'
DATA-ERR3	THIRD DATA-ERROR, IF MORE THAN ONE ERROR-COL IS GIVEN. EXPLANATION UNDER 'ERR-ANALYS'
+DATA-ERR	+ UNSYMMETRIC DATA-ERROR, EXPLANATN UNDER 'ERR-ANALYS'
-DATA-ERR	- UNSYMMETRIC DATA-ERROR, EXPLANATN UNDER 'ERR-ANALYS'
RATIO	HEADING FOR COLUMN GIVING THE RATIO SPECIFIED UNDER 'ISO-QUANT', OR THE QUANTITY/STANDARD RATIO
RATIO-MIN	LOW LIMIT OF RATIO
RATIO-MAX	HIGH LIMIT OF RATIO
RATIO-ERR	RATIO-ERROR
RATIO-ERR1	FIRST RATIO-ERROR, IF MORE THAN ONE RATIO-ERROR IS GIVEN. EXPLANATION UNDER 'ERR-ANALYS'
RATIO-ERR2	SECOND RATIO-ERROR, IF MORE THAN ONE RATIO-ERROR IS GIVEN. EXPLANATION UNDER 'ERR-ANALYS'
+RATIO-ERR	+UNSYMMETRIC RATIO-ERROR, EXPLANATN UNDER 'ERR-ANALYS'
-RATIO-ERR	-UNSYMMETRIC RATIO-ERROR, EXPLANATN UNDER 'ERR-ANALYS'
STAND	HEADING FOR COLUMN GIVING THE NUMERICAL VALUE ASSUMED FOR THE ISO-QUANT SPECIFIED UNDER 'STANDARD'
STAND-ERR	STANDARD-ERROR
STAND1	FIRST STANDARD-VALUE IF MORE THAN ONE IS GIVEN. EXPLANATION UNDER 'STANDARD'
STAND2	SECOND STANDARD-VALUE IF MORE THAN ONE IS GIVEN. EXPLANATION UNDER 'STANDARD'
STAND3	THIRD STANDARD-VALUE IF MORE THAN ONE IS GIVEN. EXPLANATION UNDER 'STANDARD'
STAND1-ERR	ERROR OF FIRST STANDARD-VALUE
STAND2-ERR	ERROR OF SECOND STANDARD-VALUE
STAND3-ERR	ERROR OF THIRD STANDARD-VALUE
TEMP	SAMPLE TEMPERATURE
TEMP-ERR	ERROR OF SAMPLE TEMPERATURE
ELEMENT	Z-NUMBER OF ELEMENTS. FOR FISSION-PRODUCT YIELDS ONLY
MASS	A-NUMBER OF ISOTOPES. FOR FISSION-PRODUCT YIELDS ONLY
HL	HALF-LIFE OF RESIDUAL NUCLEUS
HL1	HALF-LIFE OF NUCLEUS SPECIFIED IN THE BIB-SECTION
HL2	HALF-LIFE OF NUCLEUS SPECIFIED IN THE BIB-SECTION
HL3	HALF-LIFE OF NUCLEUS SPECIFIED IN THE BIB-SECTION
HL-ERR	ERROR OF HALF-LIFE OF RESIDUAL NUCLEUS
HL1-ERR	ERROR OF HALF-LIFE OF NUCLEUS SPECIFIED IN BIB-SECTION
HL2-ERR	ERROR OF HALF-LIFE OF NUCLEUS SPECIFIED IN BIB-SECTION
HL3-ERR	ERROR OF HALF-LIFE OF NUCLEUS SPECIFIED IN BIB-SECTION
FLAG	FLAG, MEANING OF FLAGS GIVEN UNDER THIS HEADING TO BE EXPLAINED IN BIB-SECTION UNDER 'FLAG'
NUMBER	COEFFICIENT-NUMBER OF LEGENDRE OR COSINE COEFFICIENTS
NUMBER-CM	COEFFICIENT-NUMBER OF LEGENDRE OR COSINE COEFFICIENTS WHEN THE FIT HAS BEEN DEDUCED FROM AN ANGULAR DISTRIBUTION IN WHICH THE ENERGIES ARE GIVEN IN THE CENTRE OF MASS SYSTEM
SPIN J	SPIN J OF RESONANCES, STRENGTH-FUNCTIONS, ETC.
MOMENTUM L	ANGULAR MOMENTUM L OF RESONANCES, STRENGTH-F'S, ETC.
PARITY	PARITY OF RESONANCE
STAT-W G	STATISTICAL-WEIGHT FACTOR G
MOM	LINEAR MOMENTUM OF INCOMING PARTICLES
MOM-MIN	MINIMUM LINEAR MOMENTUM OF INCOMING PARTICLES
MOM-MAX	MAXIMUM LINEAR MOMENTUM OF INCOMING PARTICLES
MISC	HEADING FOR A COLUMN WITH SUPPLEMENTARY INFORMATION FOR WHICH NO DATA-HEADING KEYWORD HAS BEEN DEFINED. EXPLANATION TO BE GIVEN UNDER 'MISC-COL' KEYWORD
MISC1	FIRST MISCELLANEOUS COLUMN - IF MORE THAN ONE IS GIVEN SAME USAGE AS -MISC-(SEE ABOVE)
MISC2	SECOND MISCELLANEOUS COLUMN -IF MORE THAN ONE IS GIVEN SAME USAGE AS -MISC-(SEE ABOVE)

Memo 4C-3/121

first issued: 3 March 1975
at 4C-Meeting
full distribution: 20 June 1975

To: Distribution

From: J. J. Schmidt and H. D. Lemmel

Subject: Non-neutron EXFOR developed at Karlsruhe

Please find attached copy of a letter from F. Kronenberger at Karlsruhe describing some modifications in the EXFOR format adopted at Karlsruhe for its extension to charged-particle induced reaction. Also attached are two sample EXFOR entries and some dictionary extensions. We submit this proposal for serious consideration at the 4C-Meeting.

The essential points are:

1. The iso-quant consists of two parts: the nuclear reaction, and the parameter of this reaction given in the DATA table. The reaction is coded in a very straight-forward way as usually given in the literature, for example:

   (79-AU-197 (A,7N)81-TL-194M, parameter given), or:

   (39-Y-89 (P,P2N)39-Y-87G+39-Y-87M, parameter given).

   The "parameter given" is along the lines of Dict.14 of the classical EXFOR but excluding the reaction code from the first quantity subfield. The code "CRO" was introduced for the integral cross section of the reaction considered. To indicate to the computer programs the revised iso-quant format, the keyword "ISO-QUANT" was replaced by a new keyword "REACTION".

   In view of the large number of possible reactions, we regard the proposed split into "reaction" and "parameter given" as absolutely necessary, and we find the proposed format suitable and recommendable. The "parameter given" would require a dictionary close to but much shorter than the classical Dictionary 14. Details are to be worked out. In the "reaction" all particle codes from Dict.13 are permitted as projectile or as outgoing particles and any nuclide codes in the Z-S-A-M form could be included as well. An extension to ions is possible as well, perhaps in the form Z-S-A-3+ or Z-S-A-1- (the use of the same symbol for separator-hyphen and ion-charge-sign is cosmetically not nice but does not lead to ambiguities). Details are to be reviewed.

2. Under "PART-DET" not only the particle type actually detected is coded, but also the nuclide emitting this particle. Decay properties are given in free text under "PART-DET". (The half-life entered here is however not computer-readable, and this seems to be a disadvantage.)

3. The keyword "RESID-NUC" is cancelled. When the residual nucleus is not stable, its definition may be ambiguous. Instead relevant nuclei are coded under "REACTION" and "PART-DET".

4. The "STANDARD" reaction is given in the same format as the reaction measured. To indicate to the computer program the revised format, the keyword "STANDARD" was changed to "MONITOR". (Perhaps the term MONITOR is used in Charged-Particles physics more generally than in neutron physics?)
5. A number of dictionary additions were proposed for method information. Mr. Kronenberger said that he was not sure whether this is really needed in coded form. As long as this is not proven we are not in favor of extending the method dictionaries.

Clearance: J. J. Schmidt

Attachment

Distribution:

S. Pearlstein (NNCSC)	5x
L.Lesca (NDCC)	5x
V.Manokhin (CJD)	5x

NDS: P.M. Attree
A. Calamand
M. Khalil
H.D. Lemmel
A. Lorenz
K. Okamoto
J.J.Schmidt
file

Note: This Memo was first issued at the 1975 4C-Meeting. To make sure that it gets the normal distribution it is issued again with only minor corrections of misprints. Some more details on the work at Karlsruhe were sent to C.Dunford (NDS-Memo 290 of 28 May 1975) for his consideration when formulating a final proposal on this matter.

Annex 8

26 February 1975

Translation of the letter from Mr. F. Kronenberger to J.J. Schmidt of 20 February 75.

Subject: Charged-Particle EXFOR Work at Karlsruhe

Dear Mr. Schmidt,

..... As enclosures I send you the extensions of the dictionaries and copies of the first two entries to our charged-particle data file. In the comments which are contained in the dictionary extensions, our wishes for changes, extensions and modifications are expressed.

Again, the most important changes compared to the EXFOR for neutron data are the following:

1. We have introduced the information keywords REACTION and MONITOR. They replace the keywords ISO-QUANT and STANDARD.

2. The information keywords PART-DET and FACILITY were modified as far as their information content is concerned. Thus, PART-DET contains Z-S-A(-M) of the product nuclide as well as of the outgoing particles if in the corresponding experiment they were both detected. FACILITY contains the type of the facility as well as its location.

The dictionaries 2, 10, 13, 16, 18, 21, 22, 23, 24 were extended.

We took the liberty to name us the center no. 6. On purpose, we did not choose "5". Please compare the enclosures with what I have written. ..... The entries 1 and 2 I shall send you as test cases in the form of a trans-tape.

With cordial grettings also from Dr. Muenzel,

F. Kronenberger

cc/Alain
Joe
Koichi
Pamela

Annex 8

EXFOR INTERNAL DICTIONARY UPDATE 750209

"The identification field cols. 67–80 could not be reproduced due to poor quality of the original."

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ALTER                                  CHARGED PARTICLES, KARLSRUHE
*COMMENT 1)ISO-QUANT,CMPD-QUANT AND NUC-QUANT IS NOT USED IN THE
*          CASE OF CHARGED PARTICLE INDUCED REACTIONS. THESE
*          KEY WORDS ARE REPLACED BY 'REACTION'.
*        2)'PART-DET' IS OBLIGATORY, BECAUSE THE PARTICLE DETECTED
*          IS IN GENERAL NOT OBVIOUS FROM 'REACTION'. THE DECAY
*          PROPERTIES OF THE DETECTED PARTICLES SHOULD BE GIVEN.
*        3)THE HALF-LIFE OF THE DETECTED PARTICLE SHOULD BE GIVEN
*          UNDER 'PART-DET' AND NOT UNDER 'HALF-LIFE'.
*        4)THE PRODUCT NUCLEUS SHOULD BE MENTIONED UNDER
*          'REACTION' AND/OR 'PART-DET' BUT NOT UNDER 'RESID-NUC'.
REACTION  KEYWORD + CODED INFORMATION IN PARENTHESES OBLIGATORY
          FOR CHARGED PARTICLE INDUCED REACTIONS.
          UP TO 6 SUBFIELDS  (SF1(SF2,SF3)SF4,SF5,SF6)
          SF1 TARGET NUCLIDE Z-S-A(-MX) (SEE 'ISO-QUANT')
          SF2 PROJECTILE                (SEE DICT 13)
          SF3 OUTGOING PARTICLE         (SEE DICT 13)
          SF4 PRODUCT NUCLIDE Z-S-A(-MX)(SEE 'ISO-QUANT')
          SF5 QUANTITY MEASURED         (SEE DICT 10)
          SF6 MODIFIER                  (SEE DICT 12)
          SF1,SF2,SF3,SF4 AND SF5 OBLIGATORY. A FREE TEXT
          EXPLANATION HAS TO BE ADDED, IF ONE OR MORE OF THESE
          SUBFIELDS ARE BLANK.
          SUBFIELD 6 IS OPTIONAL
          THE RULES FOR COMBINATIONS OF DIFFERENT OUTGOING
          PARTICLES OR PRODUCT NUCLIDES ARE SIMILAR TO THE RULES
          APPLICABLE IN 'ISO-QUANT'. IF SF5 OR SF6 CONTAINS
          MORE THAN ONE CODE A SLASH IS USED FOR SEPARATION
MONITOR   KEYWORD OBLIGATORY EXCEPT WHEN NOT RELEVANT. CODED
          INFORMATION (UP TO 5 SUBFIELDS) AND FREE TEXT.
          SF1 TO SF4 REACTION USED AS MONITOR NOTATION AS GIVEN
          IN 'REACTION' SF1 TO SF4.
          SF5 TYPE OF DATA USED FOR MONITORING (SEE DICT 10)
          SF1 TO SF4 ARE OBLIGATORY, SF5 OPTIONAL.
CRO       (CROSS SECTION) CROSS SECTION FOR THE FORMATION OF THE
           SPECIFIED PRODUCT NUCLIDE OR THE SPECIFIED REACTION-
           TYPE (X,Y).
TTY       (THICK-TARGET-YIELD) THICK-TARGET-YIELD FOR THE
           SPECIFIED PRODUCT NUCLIDE
FCR       (FISSION CROSS SECTION)
FY        (FISSION YIELD) INDEPENT, CUMULATIVE AND ISOBARIC CHAIN
            YIELD SEE MODIFIER (DICT 12)
XR        (X-RAYS)
COMPLEX   (UNDEFINED OUTGOING PARTICLES) IF THE AUTHOR DOES NOT
           STATE THE KIND AND NUMBER OF THE OUTGOING PARTICLES
           IN CHARGED PARTICLE INDUCED REACTIONS OR IF AMBIGUITY
           EXISTS IN RESPECT TO THE REACTION TYPES INVOLVED
COMP      DATA OBTAINED FROM PUBLICATION BY THE COMPILER,
          CHECKED, BUT NOT APPROVED BY THE AUTHOR
CURVE     TABULAR DATA OBTAINED FROM A CURVE WITH A DATA-POINT
            READER
HILAC     (HEAVY ION LINEAR ACCELERATOR)
ISOCYC    (ISOCHRONOUS-CYCLOTRON)
SYNCYC    (SYNCHROCYCLOTRON)
REC       (CROSS SECTIONS OR YIELDS DETERMINED BY THE COLLECTION
          OF RECOILS)
DIDI      (RANGE OF RECOILS MEASURED WITH THICK-TARGET-THICK-
          CATCHER-ARRANGEMENT)
DIDU      (RANGE OF RECOILS MEASURED WITH THICK-TARGET-THINN-
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            CATCHER-ARRANGEMENT)
DUDI        (RANGE OF RECOILS MEASURED WITH THINN-TARGET-THICK-
            CATCHER-ARRANGEMENT)
DUDU        (RANGE OF RECOILS MEASURED WITH THINN-TARGET-THINN-
            CATCHER-ARRANGEMENT)
HEJET       (COLLECTION BY HE-JET)
CHSEP       (CHEMICAL SEPARATION)
ASEP        (SEPARATION BY MASS SEPARATOR)
SITA        (SINGLE TARGET IRRADIATIONS)
STTA        (STACKED TARGET IRRADIATIONS)
INTE        (IRRADIATIONS WITH INTERNAL BEAM)
EXTE        (IRRADIATIONS WITH EXTERNAL BEAM)
EDEG        (ENERGY-DEGRADATION BY FOILS) ENERGY-DEGRADATION OF THE
             BEAM BEFORE HITTING THE TARGET ARRANGEMENT
MONSEP      (SEPARATE MONITORFOIL)
MONMIX      (MIXED MONITOR) MONITOR AND TARGET COMBINED AS CHEMICAL
             COMPOUND OR MIXTURE OR MONITOR REACTION HAS THE SAME
             TARGET NUCLIDE AS THE REACTION GIVEN UNDER 'REACTION'.
BCINT       (BEAM CURRENT INTEGRATED) CODEWORD USED ONLY IF VALUES
             GIVEN IN THE DATA SECTION ARE BASED ON THIS
             MEASUREMENT
GEMUC       (GEIGER MUELLER COUNTER)
SIC         (SI-SOLID-STATE DETECTOR)
*COMMENT 'SCIN' SHOULD BE USED FOR SOLID SCINTILLATION COUNTER,
*           LIKE NAJ, ONLY.
LISCIN      (LIQUID SCINILLATION COUNTER)
ARCOI       (ANNIHILATION RADIATION COINCIDENCE COUNTER)
GAREA       (PHOTOPEAK-AREA ANALYSIS)
INTANG      (INTEGRATION OF ANGULAR DISTRIBUTION)
*COMMENT  THE MEANING OF THE CODE 'EN' SHOULD BE EXTENDED TO
*         'ENERGY OF INCIDENT PROJECTILE, LAB-SYSTEM'. THIS
*         EXTENSION SHOULD ALSO APPLY TO THE OTHER CODEWORDS,
*         WHICH CONTAIN 'EN', LIKE 'EN-CM'.
MISC3       THIRD MISCELLANEOUS COLUMN -IF MORE THAN ONE IS GIVEN
               SAME USAGE AS -MISC-(SEE ABOVE)
MISC4       FOURTH MISCELLANEOUS COLUMN -IF MORE THAN ONE IS GIVEN
               SAME USAGE AS -MISC-(SEE ABOVE)
ENDALTER



 NUMBER OF RECORDS CHANGED =      0
 NUMBER OF RECORDS DELETED =      0
 NUMBER OF RECORDS INSERTED =    95
 NUMBER OF RECORDS OBSOLETED =     0
 NUMBER OF RECORDS EXTINCTED =     0
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DICTION                1      700703   SYSTEM-IDENTIFIERS
ENDDICTION            45
DICTION                2      750209 INFORMATION IDENTIFIER KEYWORDS
TITLE       KEYWORD OBLIGATORY EXCEPT WHEN NOT RELEVANT.
            FREE TEXT ONLY.
AUTHOR      KEYWORD + ALL NAMES IN PARENTHESES OBLIGATORY.
INSTITUTE   KEYWORD + CODED INFORMATION IN PARENTHESES OBLIGATORY.
            SEE DICTIONARY 3 FOR INSTITUTES.
EXP-YEAR    KEYWORD OPTIONAL.  IF KEYWORD PRESENT, THEN TWO DIGIT
            YEAR IN PARENTHESES OBLIGATORY.
REFERENCE   KEYWORD + CODED INFORMATION IN PARENTHESES OBLIGATORY.
            UP TO 6 SUBFIELDS IN CODE.
            SEE DICTIONARY 4 FOR REFERENCE-TYPE
            SEE DICTIONARY 5 FOR JOURNALS
            SEE DICTIONARY 6 FOR REPORTS
            SEE DICTIONARY 7 FOR CONFERENCES AND BOOKS
ISO-QUANT   KEYWORD + CODED INFORMATION IN PARENTHESES OBLIGATORY.
            ISO-QUANT MAY BE REPLACED BY CMPD-QUANT OR NUC-QUANT.
            UP TO 5 SUBFIELDS IN CODE.
            THE ISOTOPE IS GIVEN IN THE FIRST SUBFIELD IN THE FORM
              (Z-S-A) IF IT IS IN GROUND-STATE, RESPECTIVELY
              (Z-S-A-M1) IF IT IS IN THE FIRST OR
              (Z-S-A-M2) IF IN THE SECOND METASTABLE STATE.
              (Z-S-A-M)  IF IT IS IN A METASTABLE STATE AND UN-
            CERTAIN WHETHER FIRST OR SECOND ETC.
            SEE DICTIONARY 8 FOR ELEMENT-SYMBOLS
            SEE DICTIONARY 10 FOR PROCESS/PARAMETER
            SEE DICTIONARY 11 FOR FUNCTION
            SEE DICTIONARY 12 FOR MODIFIER
            SEE DICTIONARY 13 FOR PARTICLE
            SEE DICTIONARY 14 FOR QUANTITY
CMPD-QUANT  REPLACES ISO-QUANT WHEN QUANTITY GIVEN REFERS TO A
            CHEMICAL COMPOUND.  CODED INFORMATION IN PARENTHESES
            OBLIGATORY.  CODING FORMALISM SAME AS UNDER ISO-QUANT,
            BUT A-NUMBER REPLACED BY 3-CHARACTER COMPOUND CODE.
            SEE DICTIONARY 9 FOR COMPOUNDS
NUC-QUANT   REPLACES ISO-QUANT WHEN QUANTITY GIVEN DOES NOT REFER
            TO THE NEUTRON-TARGET NUCLEUS.  CODED INFORMATION IN
            PARENTHESES OBLIGATORY.  CODING-FORMALISM SAME AS UNDER
            ISO-QUANT.
*COMMENT 1)ISO-QUANT,CMPD-QUANT AND NUC-QUANT IS NOT USED IN THE
*          CASE OF CHARGED PARTICLE INDUCED REACTIONS. THESE
*          KEY WORDS ARE REPLACED BY 'REACTION'.
*        2)'PART-DET' IS OBLIGATORY, BECAUSE THE PARTICLE DETECTED
*          IS IN GENERAL NOT OBVIOUS FROM 'REACTION'. THE DECAY
*          PROPERTIES OF THE DETECTED PARTICLES SHOULD BE GIVEN.
*        3)THE HALF-LIFE OF THE DETECTED PARTICLE SHOULD BE GIVEN
*          UNDER 'PART-DET' AND NOT UNDER 'HALF-LIFE'.
*        4)THE PRODUCT NUCLEUS SHOULD BE MENTIONED UNDER
*          'REACTION' AND/OR 'PART-DET' BUT NOT UNDER 'RESID-NUC'.
REACTION    KEYWORD + CODED INFORMATION IN PARENTHESES OBLIGATORY
            FOR CHARGED PARTICLE INDUCED REACTIONS.
            UP TO 6 SUBFIELDS  (SF1(SF2,SF3)SF4,SF5,SF6)
            SF1 TARGET NUCLIDE Z-S-A(-MX) (SEE 'ISO-QUANT')
            SF2 PROJECTILE                (SEE DICT 13)
            SF3 OUTGOING PARTICLE         (SEE DICT 13)
            SF4 PRODUCT NUCLIDE Z-S-A(-MX)(SEE 'ISO-QUANT')
            SF5 QUANTITY MEASURED         (SEE DICT 14)
            SF6 MODIFIER                  (SEE DICT 12)
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SF1,SF2,SF3,SF4 AND SF5 OBLIGATORY. A FREE TEXT EXPLANATION HAS TO BE ADDED, IF ONE OF MORE OF THESE SUBFIELDS ARE BLANK.
SUBFIELD 6 IS OPTIONAL
THE RULES FOR COMBINATIONS OF DIFFERENT OUTGOING PARTICLES OR PRODUCT NUCLIDES ARE SIMILAR TO THE RULES APPLICABLE IN 'ISO-QUANT'. IF SF5 OR SF6 CONTAINS MORE THAN ONE CODE A SLASH IS USED FOR SEPARATION

STANDARD KEYWORD OBLIGATORY EXCEPT WHEN NOT RELEVANT. FREE TEXT OR CODED INFORMATION IN PARENTHESES PLUS POSSIBLY FREE TEXT, CODING FORMALISM SAME AS UNDER ISO-QUANT.

MONITOR KEYWORD OBLIGATORY EXCEPT WHEN NOT RELEVANT. CODED INFORMATION (UP TO 5 SUBFIELDS) AND FREE TEXT.
SF1 TO SF4 REACTION USED AS MONITOR NOTATION AS GIVEN IN 'REACTION' SF1 TO SF4.
SF5 TYPE OF DATA USED FOR MONITORING (SEE DICT 19)
SF1 TO SF4 ARE OBLIGATORY, SF5 OPTIONAL.

'METHOD', 'FACILITY', 'DETECTOR', 'ANALYSIS'.
AT LEAST ONE OF THESE KEYWORDS MUST BE PRESENT. IF A PERTINENT CODE IN THE RELEVANT DICTIONARY EXISTS, THEN KEYWORD AND CODE SHOULD BE GIVEN.

METHOD KEYWORD OBLIGATORY EXCEPT WHEN NOT RELEVANT. FREE TEXT OR CODED INFORMATION IN PARENTHESES PLUS FREE TEXT.
SEE DICTIONARY 21

FACILITY KEYWORD OBLIGATORY EXCEPT WHEN NOT RELEVANT. FREE TEXT OR CODED INFORMATION IN PARENTHESES PLUS FREE TEXT.
SEE DICTIONARY 19

DETECTOR KEYWORD OBLIGATORY EXCEPT WHEN NOT RELEVANT. FREE TEXT OR CODED INFORMATION IN PARENTHESES PLUS FREE TEXT.
SEE DICTIONARY 22

ANALYSIS KEYWORD OBLIGATORY EXCEPT WHEN NOT RELEVANT. FREE TEXT OR CODED INFORMATION IN PARENTHESES PLUS FREE TEXT.
SEE DICTIONARY 23

N-SOURCE KEYWORD OPTIONAL, FREE TEXT OR CODED INFORMATION IN PARENTHESES PLUS FREE TEXT
SEE DICTIONARY 19

INC-SPECT KEYWORD OPTIONAL. FREE TEXT ONLY.

SAMPLE KEYWORD OPTIONAL. FREE TEXT ONLY.

GEOMTRY OBSOLETE,(MAY EXIST IN ENTRIES FROM 1972 OR EARLIER)

PART-DET THE PARTICLE DETECTED MUST BE EVIDENT EITHER FROM 'ISO-QUANT' OR FROM 'PART-DET'. IF KEYWORD PRESENT, THEN CODED INFORMATION IN PARENTHESES OBLIGATORY.
SEE DICTIONARY 13

EN-SEC KEYWORD OPTIONAL, FREE TEXT ONLY.

RESID-NUC KEYWORD OPTIONAL. FREE TEXT ONLY.

CORRECTION KEYWORD OPTIONAL, FREE TEXT ONLY

ERR-ANALYS KEYWORD OBLIGATORY. FREE TEXT OR HEADING OF RELEVANT ERROR-COLUMN IN PARENTHESES PLUS FREE TEXT

COMMENT KEYWORD OPTIONAL. FREE TEXT ONLY

HALF-LIFE KEYWORD OPTIONAL TO EXPLAIN HALF-LIVES GIVEN IN COMMON OR DATA. FREE TEXT OR (HL1,Z-S-A-M) WITH OR WITHOUT FREE TEXT.

MISC-COL KEYWORD OPTIONAL. IF KEYWORD PRESENT THEN COLUMN-HEADING 'MISC', 'MISC1' OR 'MISC2' ETC. IN PARENTHESES IS OBLIGATORY.

FLAG KEYWORD OPTIONAL. IF KEYWORD PRESENT THEN THE FLAG NUMBER IN PARENTHESES IS OBLIGATORY.

TABLE-NR KEYWORD OPTIONAL. IF KEYWORD PRESENT THEN THE TABLE-

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          NUMBER IN PARENTHESES IS OBLIGATORY.
STATUS    KEYWORD OBLIGATORY EXCEPT WHEN THE SOURCE OF THE DATA
          IS GIVEN UNDER 'REFERENCE' AND NO OTHER 'STATUS'
          INFORMATION APPLIES.  CODE FROM DICT 16 IN PARENTHESES
          PLUS FREE TEXT.  FREE TEXT ALONE IF NO CODE APPLIES.
HISTORY   KEYWORD + CODED INFORMATION IN PARENTHESES OBLIGATORY
          GIVING A DATE IN THE FORM YYMMDD PLUS A ONE CHARACTER
          ACTION-CODE. THE DATE IS OBLIGATORY, THE ACTION-CODE IS
          OPTIONAL. THE ALLOWED ACTION-CODES ARE FOLLOWING
          R - DATA RECEIVED AT THE CENTRE
          C - COMPILED AT THE CENTRE
          L - ENTERED INTO LIBRARY
          T - CONVERTED FROM PREVIOUS COMPILATION
          E - TRANSMITTED TO OTHER CENTRES
          A - IMPORTANT ALTERATIONS
          U - UNIMPORTANT ALTERATIONS
          D - ENTRY OR SUBENTRY DELETED. THIS MUST BE FOLLOWED BY
              FREE TEXT JUSTIFYING THE DELETION
ENDDICTION          134
DICTION               3     740418   INSTITUTES
ENDDICTION          745
DICTION               4     700109  TYPE OF REFERENCE
ENDDICTION            7
DICTION               5     740418   JOURNALS
ENDDICTION          525
DICTION               6     740418
ENDDICTION          462
DICTION               7     740418  BOOKS AND CONFERENCES
ENDDICTION          632
DICTION               8     730426 ELEMENTS
ENDDICTION          105
DICTION               9     731023   COMPOUNDS
ENDDICTION           31
DICTION              10     750209 QUANT-FIELD 1 (PROCESSES+PARAMS)
TOT       TOTAL
          ------------------------------------------------------------
EL        ELASTIC SCATTERING
INL       INELASTIC SCATTERING
THS       THERMAL SCATTERING
SCT       TOTAL SCATTERING
BAS       BOUND-ATOM SCATTERING
FAS       FREE ATOM SCATTERING
COH       COHERENT SCATTERING
INC       INCOHERENT SCATTERING
RAD       SCATTERING RADIUS
CRO       (CROSS SECTION) CROSS SECTION FOR THE FORMATION OF THE
           SPECIFIED PRODUCT NUCLIDE OR THE SPECIFIED REACTION-
           TYPE (X,Y).
TTY       (THICK-TARGET-YIELD) THICK-TARGET-YIELD FOR THE
           SPECIFIED PRODUCT NUCLIDE
FCR       (FISSION CROSS SECTION)
FY        (FISSION YIELD) INDEPENT, CUMULATIVE AND ISOBARIC CHAIN
           YIELD SEE MODIFIER (DICT 12)
          ------------------------------------------------------------
NON       NONELASTIC
ABS       ABSORPTION
          ------------------------------------------------------------
NG        N,GAMMA
ING       INELASTIC GAMMA
GEM       GAMMA-EMISSION
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N2N         N,2N
N3N         N,3N
N4N         N,4N
NEM         NEUTRON-EMISSION
NPR         NEUTRON-PRODUCTION
            ------------------------------------------------------------
NP          N,P
NNP         N,NP
N2P         N,2P
PEM         PROTON-EMISSION
ND          N,D
NND         N,ND
NT          N,T
NNT         N,NT
N3          N,HE3
NN3         N,NHE3
NA          N,ALPHA
NNA         N,NALPHA
N2A         N,2ALPHA
AEM         ALPHA-EMISSION
NX          CHARGED-PARTICLES EMISSION
            ------------------------------------------------------------
NF          N,FISSION
ALF         ALPHA
ETA         ETA
NU          NU
            ------------------------------------------------------------
PCS         PEAK CROSS-SECTION AT RESONANCE
WID         RESONANCE-WIDTH
ARE         RESONANCE AREA
STF         STRENGTH-FUNCTION
D           AVERAGE LEVEL-SPACING
EN          ENERGY (SPECIAL USE FOR EN,RES = RESONANCE ENERGY)
J           SPIN J OF RESONANCES,STRENGTH-FUNCTIONS,ETC.
PTY         PARITY OF RESONANCE
L           ANGULAR MOMENTUM L OF RESONANCES,STRENGTH-FUNCTIONS ETC
G           STATISTICAL WEIGHT FACTOR
            ------------------------------------------------------------
ANU         ADLER-ADLER NU(EQUIVALENT TO HALF TOTAL WIDTH)
AGT         ADLER-ADLER TOTAL SYMMETRY COEFFICIENT
AHT         ADLER-ADLER TOTAL ASYMMETRY COEFFICIENT
AGC         ADLER-ADLER CAPTURE SYMMETRY COEFFICIENT
AHC         ADLER-ADLER CAPTURE ASYMMETRY COEFFICIENT
AGF         ADLER-ADLER FISSION SYMMETRY COEFFICIENT
AHF         ADLER-ADLER FISSION ASYMMETRY COEFFICIENT
            ------------------------------------------------------------
LDP         LEVEL-DENSITY PARAMETER
TEM         NUCLEAR TEMPERATURE
SCO         SPIN-CUT-OFF FACTOR
SF          SPONTANEOUS FISSION
ENDDICTION          76
DICTION             11      730717 QUANT-FIELD 2 (FUNCTION)
ENDDICTION          22
DICTION             12      730717 QUANT-FIELD 3 (MODIFIERS)
ENDDICTION          59
DICTION             13      750209    PARTICLES
G           (GAMMAS) EXCEPT DECAY GAMMAS
N           (NEUTRONS)
P           (PROTONS)
D           (DEUTERONS)
```

```
T           (TRITONS)
HE3         (HE-3)
A           (ALPHAS) HE-4
FF          (FISSION FRAGMENTS)
            ------------------------------------------------------
            ABOVE CODES ARE USED IN THE FOURTH QUANTITY SUBFIELD
            AND UNDER 'PART-DET'.
            THE CODES BELOW ARE USED ONLY UNDER 'PART-DET'.
            ------------------------------------------------------
DG          (DECAY GAMMAS) USED FOR GAMMAS EMITTED FROM METASTABLE
            STATES AND FOR GAMMAS FOLLOWING A PARTICLE-EMITTING
            DECAY (E.G. BETA DECAY)
XR          (X-RAYS)
AR          (ANNIHILATION RADIATION)
B-          (DECAY BETA-)
B           (DECAY BETAS) UNSPECIFIED WHETHER B+ OR B-
B+          (DECAY BETA+) POSITRONS
E           (ELECTRONS) OTHER THAN DECAY BETAS
RCL         (RECOIL NUCLEUS)
RSD         (RESIDUAL NUCLEUS)
PN          (PROMPT NEUTRONS)
DN          (DELAYED NEUTRONS)
COMPLEX     (UNDEFINED OUTGOING PARTICLES) IF THE AUTHOR DOES NOT
             STATE THE KIND AND NUMBER OF THE OUTGOING PARTICLES
             IN CHARGED PARTICLE INDUCED REACTIONS OR IF AMBIGUITY
             EXISTS IN RESPECT TO THE REACTION TYPES INVOLVED
NONE        (NO INFORMATION AVAILABLE)
ENDDICTION          31
DICTION             14      740418  QUANTITIES
ENDDICTION         443
DICTION             16      750209   STATUS
PRELM       (PRELIMINARY DATA) DATA LABELLED BY AUTHOR AS PRELIM'RY
              FREE TEXT= AUTHOR'S INFORMATION ABOUT FINALIZING THE
                         DATA.
              ALSO TO BE USED FOR 'DATA NOT TO BE QUOTED PRIOR
                                  TO PUBLICATION'.
SPSDD       (DATA SUPERSEDED) DATA SUPERSEDED BY AUTHOR'S REVISION,
              AND REVISED DATA ENTERED IN LIBRARY.
              FREE TEXT= CROSS-REFERENCE TO SUPERSEDING DATA TABLE
DEP         (DEPENDENT DATA)
              FREE TEXT= CROSS-REFERENCE TO THE INDEPENDENT DATA
                         FROM WHICH DEPENDENT DATA WERE OBTAINED.
              EXAMPLE= GAMMA-WIDTH WHEN OBTAINED BY SUBTRACTION
                       FROM INDEPENDENTLY MEASURED TOTAL-WIDTHS
                       AND NEUTRON-WIDTHS.
APRVD       (APPROVED BY AUTHOR) PROOF-COPY HAS APPROVED BY AUTHOR
              AND AUTHOR'S CORRECTIONS HAVE BEEN ENTERED.
              FREE TEXT= NAME AND DATE OF APPROVAL
UNOBT       (DATA UNOBTAINABLE FROM AUTHOR)
              FREE TEXT= EXPLANATION WHY UNOBTAINABLE
SCSRS       (DATA CONVERTED FROM SCISRS-1) STATUS INFORMATION IS
              INCOMPLETE DUE TO AUTOMATIC CONVERSION FROM SCISRS-1
OUTDT       (NORMALIZATION OUT-OF-DATE)
              FREE TEXT= REASON OR CROSS-REFERENCE TO RENORMALIZED
                         DATA TABLE
RNORM       (DATA RENORMALIZED) DATA RENORMALIZED BY OTHER THAN
              AUTHOR.
              FREE TEXT= EXPLANATION OF RENORMALIZATION AND CROSS-
                         REFERENCE TO AUTHOR'S ORIGINAL DATA.
              NOTE= ONLY TO BE USED FOR NON-TRIVIAL RENORMALIZATN
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                  BY AN EVALUATOR. COMPILATION CENTRES SHOULD
                  GENERALLY STORE THE AUTHOR'S ORIGINAL
                  NORMALIZATION.
COMP        DATA OBTAINED FROM PUBLICATION BY THE COMPILER,
            CHECKED, BUT NOT APPROVED BY THE AUTHOR
CURVE       TABULAR DATA OBTAINED FROM A CURVE WITH A DATA-POINT
              READER
ENDDICTION            36
DICTION               18      750209  FACILITY
CCW         (COCKCROFT-WALTON ACCELERATOR)
LINAC       (ELECTRON LINEAR ACCELERATOR)
ICTR        (INSULATED CORE TRANSFORMER ACCELERATOR)
VDG         (VAN DE GRAAFF)
VDGT        (TANDEM VAN DE GRAAFF)
HILAC       (HEAVY ION LINEAR ACCELERATOR)
CYGFF       (CYCLOGRAAFF)
CYCLO       (CYCLOTRON)
ISOCYC      (ISOCHRONOUS-CYCLOTRON)
SYNCH       (SYNCHROTRON)
SYNCYC      (SYNCHROCYCLOTRON)
BETAT       (BETATRON)
MICRT       (MICROTRON)
DYNAM       (DYNAMITRON)
OSCIP       (PILE OSCILLATOR)
CHOPF       (FAST CHOPPER)
CHOPS       (SLOW CHOPPER)
SELVE       (VELOCITY SELECTOR)
SPECM       (MASS SPECTROMETER)
SPECD       (DOUBLE MASS SPECTROMETER)
SPECC       (CRYSTAL SPECTROMETER)
ENDDICTION            21
DICTION               19      730426  NEUTRON SOURCE
ENDDICTION            21
DICTION               21      750209  METHOD
COINC       (COINCIDENCE)
PHD         (PULSE-HEIGHT DISCRIMINATION)
DIFFR       (DIFFRACTION)
REFL        (TOTAL REFLECTION FROM MIRRORS)
MAGFR       (MAGNETIC FIELD ROTATION)
TOF         (TIME-OF-FLIGHT)
SLODT       (SLOWING-DOWN-TIME)
CADMB       (CADMIUM BATH)
MANGB       (MANGANESE BATH)
ACTIV       (ACTIVATION)
REAC        (REACTIVITY MEASUREMENT)
BURN        (BURN-UP)
ASSOP       (ASSOCIATED PARTICLE)
PLSED       (PULSE DIE-AWAY)
REC         (CROSS SECTIONS OR YIELDS DETERMINED BY THE COLLECTION
            OF RECOILS)
DIDI        (RANGE OF RECOILS MEASURED WITH THICK-TARGET-THICK-
            CATCHER-ARRANGEMENT)
DIDU        (RANGE OF RECOILS MEASURED WITH THICK-TARGET-THINN-
            CATCHER-ARRANGEMENT)
DUDI        (RANGE OF RECOILS MEASURED WITH THINN-TARGET-THICK-
            CATCHER-ARRANGEMENT)
DUDU        (RANGE OF RECOILS MEASURED WITH THINN-TARGET-THINN-
            CATCHER-ARRANGEMENT)
HEJET       (COLLECTION BY HE-JET)
CHSEP       (CHEMICAL SEPARATION)
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ASEP        (SEPARATION BY MASS SEPARATOR)
SITA        (SINGLE TARGET IRRADIATIONS)
STTA        (STACKED TARGET IRRADIATIONS)
INTB        (IRRADIATIONS WITH INTERNAL BEAM)
EXTB        (IRRADIATIONS WITH EXTERNAL BEAM)
EDEG        (ENERGY-DEGRADATION BY FOILS) ENERGY-DEGRADATION OF THE
             BEAM BEFORE HITTING THE TARGET ARRANGEMENT
MONSEP      (SEPARATE MONITORFOIL)
MONMIX      (MIXED MONITOR) MONITOR AND TARGET COMBINED AS CHEMICAL
             COMPOUND OR MIXTURE OR MONITOR REACTION HAS THE SAME
             TARGET NUCLIDE AS THE REACTION GIVEN UNDER 'REACTION'.
BCINT       (BEAM CURRENT INTEGRATED) CODEWORD USED ONLY IF VALUES
             GIVEN IN THE DATA SECTION ARE BASED ON THIS
             MEASUREMENT
ENDDICTION          40
DICTION             22      750209    DETECTORS
GEMUC       (GEIGER MUELLER COUNTER)
GLASD       (GLASS DETECTOR)
TRD         (TRACK DETECTOR) ALL WHICH ARE NOT GLASS
SOLST       (SOLID-STATE DETECTOR)
SID         (SI-SOLID-STATE DETECTOR)
GELI        (GERMANIUM-LITHIUM DETECTOR)
THRES       (THRESHOLD DETECTOR)
MOXR        (MOXON-RAE DETECTOR)
HORBU       (HORNYAK BUTTON DETECTOR)
SCIN        (SCINTILLATION DETECTOR)
*COMMENT 'SCIN' SHOULD BE USED FOR SOLID SCINTILLATION COUNTER,
*         LIKE NAJ, ONLY.
LISCIN      (LIQUID SCINILLATION COUNTER)
STANK       (SCINTILLATOR TANK)
MTANK       (MODERATING TANK DETECTOR)
CSICR       (CESIUM-IODIDE CRYSTAL)
NAICR       (SODIUM IODIDE CRYSTAL)
LONGC       (LONG COUNTER)
PROPC       (PROPORTIONAL COUNTER)
TELES       (COUNTER TELESCOPE)
FISCH       (FISSION CHAMBER)
BPAIR       (ELECTRON-PAIR SPECTROMETER)  FOR GAMMAS
ARCOI       (ANNIHILATION RADIATION COINCIDENCE COUNTER)
ENDDICTION          23
DICTION             23      750209     ANALYSIS
AREA        (AREA ANALYSIS)
GAREA       (PHOTOPEAK-AREA ANALYSIS)
SHAPE       (SHAPE ANALYSIS)
4PI1A       (4PI TIMES DIFFERENTIAL CROSS-SECTION AT ONE ANGLE)
SLA         (SINGLE LEVEL ANALYSIS)
MLA         (MULTILEVEL ANALYSIS)
INTANG      (INTEGRATION OF ANGULAR DISTRIBUTION)
ENDDICTION           7
DICTION             24      750209 DATA-HEADING KEYWORDS
*COMMENT  THE MEANING OF THE CODE 'EN' SHOULD BE EXTENDED TO
*         'ENERGY OF INCIDENT PROJECTILE, LAB-SYSTEM'. THIS
*         EXTENSION SHOULD ALSO APPLY TO THE OTHER CODEWORDS,
*         WHICH CONTAIN 'EN', LIKE 'EN-CM'.
EN           INCIDENT NEUTRON ENERGY, LAB-SYSTEM
EN-CM        INCIDENT NEUTRON ENERGY, C-M-SYSTEM
EN-MIN       LOW LIMIT OF INCIDENT N-ENERGY RANGE, LAB-SYSTEM
EN-CM-MIN    LOW LIMIT OF INCIDENT N-ENERGY RANGE, C-M-SYSTEM
EN-MAX       HIGH LIMIT OF INCIDENT N-ENERGY RANGE, LAB-SYSTEM
EN-CM-MAX    HIGH LIMIT OF INCIDENT N-ENERGY RANGE, C-M-SYSTEM
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EN-DUMMY	DUMMY ENERGY. USED AS THE NUMERICAL EQUIVALENT OF AN INCIDENT-NEUTRON SPECTRUM WHERE NO NUMERICAL ENERGY VALUE IS GIVEN BY THE AUTHOR
EN-RSL	INCIDENT-NEUTRON ENERGY-RESOLUTION
+EN-RSL	+UNSYMMETRIC ENERGY RESOLUTION
-EN-RSL	-UNSYMMETRIC ENERGY RESOLUTION
EN-ERR	ERROR OF MONOCHROMATIC INCIDENT-NEUTRON ENERGY OR UNCERTAINTY OF THE CENTRAL ENERGY IN AN INCIDENT NEUTRON-SPECTRUM.
EN-ERR1	ENERGY ERROR, IF MORE THAN ONE ERROR IS GIVEN. EXPLANATION UNDER 'ERR-ANALYS'.
EN-ERR2	SECOND ENERGY ERROR, IF MORE THAN ONE ERROR IS GIVEN. EXPLANATION UNDER 'ERR-ANALYS'
+EN-ERR	+ UNSYMMETRIC ENERGY-ERROR
-EN-ERR	- UNSYMMETRIC ENERGY-ERROR
EN-NRM	NORMALIZATION ENERGY. TO BE USED WHEN A DATA SET IS NORMALIZED TO ONE ENERGY ONLY.
EN-RES	RESONANCE ENERGY
EN-RES-ERR	ERROR OF RESONANCE-ENERGY
MU-ADLER	MU IN ADLER-ADLER RESONANCE-ANALYSIS, EQUIVALENT TO RESONANCE ENERGY
E	ENERGY OF OUTGOING PARTICLE, LAB-SYSTEM
E-CM	ENERGY OF OUTGOING PARTICLE, C-M-SYSTEM
E-MIN	LOW LIMIT OF OUTGOING-PARTICLE E-RANGE, LAB-SYSTEM
E-CM-MIN	LOW LIMIT OF OUTGOING-PARTICLE E-RANGE, C-M-SYSTEM
E-MAX	HIGH LIMIT OF OUTGOING-PARTICLE E-RANGE, LAB-SYSTEM
E-CM-MAX	HIGH LIMIT OF OUTGOING-PARTICLE E-RANGE, C-M-SYSTEM
E-RSL	OUTGOING-PARTICLE ENERGY-RESOLUTION
E-ERR	OUTGOING-PARTICLE ENERGY-ERROR
E-EXC	EXCITATION-ENERGY
E-EXC-MIN	LOW LIMIT OF EXCITATION-ENERGY
E-EXC-MAX	HIGH LIMIT OF EXCITATION-ENERGY
E-LVL	LEVEL-ENERGY
E-LVL-INI	INITIAL LEVEL OF GAMMA-TRANSITION
E-LVL-FIN	FINAL LEVEL OF GAMMA-TRANSITION
E-LVL-ERR	LEVEL-ENERGY ERROR
E-LVL-MIN	LOW ENERGY-LIMIT OF A DISCRETE LEVEL-GROUP
E-LVL-MAX	HIGH ENERGY-LIMIT OF A DISCRETE LEVEL-GROUP
Q-VAL	Q-VALUE
Q-VAL-ERR	Q-VALUE ERROR
Q-VAL-MIN	LOWER LIMIT OF Q-VALUE
Q-VAL MAX	UPPER LIMIT OF Q-VALUE
E-GAIN	GAIN IN NEUTRON ENERGY
E-GAIN-ERR	ERROR OF GAIN IN NEUTRON ENERGY
E-DGD	DEGREDATION IN NEUTRON ENERGY
E-DGD-ERR	ERROR OF DEGREDATION IN NEUTRON ENERGY
ANG	ANGLE, LAB-SYSTEM
ANG1	ANGLE, DEFINITION SPECIFIED IN THE BIB-SECTION
ANG2	ANGLE, DEFINITION SPECIFIED IN THE BIB-SECTION
ANG3	ANGLE, DEFINITION SPECIFIED IN THE BIB-SECTION
ANG-CM	ANGLE, C-M-SYSTEM
ANG-MIN	LOW LIMIT OF ANGLE RANGE, LAB-SYSTEM
ANG-CM-MIN	LOW LIMIT OF ANGLE RANGE, C-M-SYSTEM
ANG-MAX	HIGH LIMIT OF ANGLE RANGE, LAB-SYSTEM
ANG-CM-MAX	HIGH LIMIT OF ANGLE RANGE, C-M-SYSTEM
ANG-RSL	ANGULAR RESOLUTION
ANG-ERR	ANGLE-ERROR
COS	COSINE OF ANGLE, LAB-SYSTEM
COS-CM	COSINE OF ANGLE, C-M-SYSTEM
COS-MIN	LOW LIMIT OF COSINE-RANGE OF ANGLE, LAB-SYSTEM

COS-CM-MIN	LOW LIMIT OF COSINE-RANGE OF ANGLE, C-M-SYSTEM
COS-MAX	HIGH LIMIT OF COSINE-RANGE OF ANGLE, LAB-SYSTEM
COS-CM-MAX	HIGH LIMIT OF COSINE-RANGE OF ANGLE, C-M-SYSTEM
COS-RSL	COSINE OF ANGULAR RESOLUTION
COS-ERR	COSINE OF ANGLE-ERROR
DATA	HEADING FOR COLUMN GIVING THE QUANTITY SPECIFIED UNDER 'ISO-QUANT'
DATA-CM	DATA GIVEN IN THE CENTRE OF MASS SYSTEM
DATA-APRX	APPROXIMATE VALUE OF DATUM
DATA-MIN	LOW LIMIT OF DATUM
DATA-MAX	HIGH LIMIT OF DATUM
DATA-ERR	DATA-ERROR. EXPLANATION TO BE GIVEN UNDER 'ERR-ANALYS'
DATA-ERR1	FIRST DATA-ERROR, IF MORE THAN ONE ERROR-COL IS GIVEN. EXPLANATION UNDER 'ERR-ANALYS'
DATA-ERR2	SECOND DATA-ERROR, IF MORE THAN ONE ERROR-COL IS GIVEN. EXPLANATION UNDER 'ERR-ANALYS'
+DATA-ERR	+ UNSYMMETRIC DATA-ERROR. EXPLANATN UNDER 'ERR-ANALYS'
DATA-ERR3	THIRD DATA-ERROR, IF MORE THAN ONE ERROR-COL IS GIVEN. EXPLANATION UNDER 'ERR-ANALYS'
-DATA-ERR	- UNSYMMETRIC DATA-ERROR. EXPLANATN UNDER 'ERR-ANALYS'
RATIO	HEADING FOR COLUMN GIVING THE RATIO SPECIFIED UNDER 'ISO-QUANT', OR THE QUANTITY/STANDARD RATIO
RATIO-MIN	LOW LIMIT OF RATIO
RATIO-MAX	HIGH LIMIT OF RATIO
RATIO-ERR	RATIO-ERROR
RATIO-ERR1	FIRST RATIO-ERROR, IF MORE THAN ONE RATIO-ERROR IS GIVEN. EXPLANATION UNDER 'ERR-ANALYS'
RATIO-ERR2	SECOND RATIO-ERROR, IF MORE THAN ONE RATIO-ERROR IS GIVEN. EXPLANATION UNDER 'ERR-ANALYS'
+RATIO-ERR	+UNSYMMETRIC RATIO-ERROR. EXPLANATN UNDER 'ERR-ANALYS'
-RATIO-ERR	-UNSYMMETRIC RATIO-ERROR. EXPLANATN UNDER 'ERR-ANALYS'
STAND	HEADING FOR COLUMN GIVING THE NUMERICAL VALUE ASSUMED FOR THE ISO-QUANT SPECIFIED UNDER 'STANDARD'
STAND-ERR	STANDARD-ERROR
STAND1	FIRST STANDARD-VALUE IF MORE THAN ONE IS GIVEN. EXPLANATION UNDER 'STANDARD'
STAND2	SECOND STANDARD-VALUE IF MORE THAN ONE IS GIVEN. EXPLANATION UNDER 'STANDARD'
STAND1-ERR	ERROR OF FIRST STANDARD-VALUE
STAND2-ERR	ERROR OF SECOND STANDARD-VALUE
TEMP	SAMPLE TEMPERATURE
TEMP-ERR	ERROR OF SAMPLE TEMPERATURE
ELEMENT	Z-NUMBER OF ELEMENTS, FOR FISSION-PRODUCT YIELDS ONLY
MASS	A-NUMBER OF ISOTOPES, FOR FISSION-PRODUCT YIELDS ONLY
HL	HALF-LIFE OF RESIDUAL NUCLEUS
HL1	HALF-LIFE OF NUCLEUS SPECIFIED IN THE BIB-SECTION
HL2	HALF-LIFE OF NUCLEUS SPECIFIED IN THE BIB-SECTION
HL3	HALF LIFE OF NUCLEUS SPECIFIED IN THE BIB-SECTION
HL-ERR	ERROR OF HALF-LIFE OF RESIDUAL NUCLEUS
HL1-ERR	ERROR OF HALF-LIFE OF NUCLEUS SPECIFIED IN BIB-SECTION
HL2-ERR	ERROR OF HALF-LIFE OF NUCLEUS SPECIFIED IN BIB-SECTION
HL3-ERR	ERROR OF HALF-LIFE OF NUCLEUS SPECIFIED IN BIB-SECTION
FLAG	FLAG. MEANING OF FLAGS GIVEN UNDER THIS HEADING TO BE EXPLAINED IN BIB-SECTION UNDER 'FLAG'
NUMBER	NUMBER. USED TO SPECIFY INDICES, E.G. COEFF-NUMBERS, LEVEL-NUMBERS ETC.
NUMBER-CM	COEFFICIENT-NUMBER OF LEGENDRE OR COSINE COEFFICIENTS WHEN THE FIT HAS BEEN DEDUCED FROM AN ANGULAR DISTRIBUTION IN WHICH THE ENERGIES ARE GIVEN IN THE CENTRE OF MASS SYSTEM

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SPIN J      SPIN J OF RESONANCES, STRENGTH-FUNCTIONS, ETC.
MOMENTUM L  ANGULAR MOMENTUM L OF RESONANCES, STRENGTH-F'S, ETC.
PARITY      PARITY OF RESONANCE
STAT-W G    STATISTICAL WEIGHT FACTOR G
MISC        HEADING FOR A COLUMN WITH SUPPLEMENTARY INFORMATION
            FOR WHICH NO DATA-HEADING KEYWORD HAS BEEN DEFINED.
            EXPLANATION TO BE GIVEN UNDER 'MISC-COL' KEYWORD
MISC1       FIRST MISCELLANEOUS COLUMN - IF MORE THAN ONE IS GIVEN
               SAME USAGE AS -MISC-(SEE ABOVE)
MISC2       SECOND MISCELLANEOUS COLUMN --IF MORE THAN ONE IS GIVEN
               SAME USAGE AS -MISC-(SEE ABOVE)
MISC3       THIRD MISCELLANEOUS COLUMN --IF MORE THAN ONE IS GIVEN
               SAME USAGE AS -MISC-(SEE ABOVE)
MISC4       FOURTH MISCELLANEOUS COLUMN -IF MORE THAN ONE IS GIVEN
               SAME USAGE AS -MISC-(SEE ABOVE)
            ------------------------------------------------------
            NOTE= * IN COL.66 IDENTIFIES THOSE KEYWORDS WHICH MAY
                  BE USED ONLY FOR INDEPENDENT VARIABLES.
ENDDICTION          148
DICTION              25      730122      DATA UNIT KEYWORDS
ENDDICTION           98
 ECJ
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MEMO 4C-1/60

Date: June 9, 1975

From: C. L. Dunford

Subject: Four-Centres Repsonse to 4C-3/121 concerning the KFK Non-neutron EXFOR.

The following discussion represents a consensus of opinion expressed at the 11th Four-Centres Meeting during the discussion of the KFK proposal for a non-neutron EXFOR. Most attention will be paid to the ISO-QUANT keyword and its structure. However, other changes to the current EXFOR will be discussed.

It was strongly felt that no changes to the present EXFOR will be made until new proposals are tested and justified. Therefore any non-neutron data coded in EXFOR will be maintained as a separate library. However, it was recognized that a single system is desirable in the long term. Therefore it was felt that it may be necessary to correct old EXFOR entries for any format changes.

1. ISO-QUANT - The KFK proposal is not compatible with the current EXFOR. It was felt that the philosophy of the KFK proposal was an improvement on the present EXFOR system but required some modification.

a). The keyword "REACTION" should be used to replace "ISO-QUANT". ISO-QUANT would disappear after conversion of old EXFOR entries.

b). Structure of the coded information
(FLD1, (FLD2, FLD3), FLD4, FLD5, FLD6).

FLD1 - Target nucleus coded as presently in EXFOR

FLD2 - Projectile coded using Dictionary 13. This dictionary must be expanded to include heavier than incident alpha particles. (eq. LI7, C12, U238 etc.) Note that the atomic number is not included as in FLD1.

FLD3 - Reaction using the reaction definition parts of Dictionary 10. All codes like EL,INL,TØT,ABS, ING etc would be used in this field as single, 3 character codes. Reactions which are characterized by the emission of one or more particles would use the particle codes of Dictionary 13 separated by a delimiter (a slash is recommended). An integer preceeding a particle code would represent multiple emission of that particle.

NNP → (N, N/P)
N4N → (N, 4N)
PP2N → (P, P/2N)

FLD4 - Parameters and Functions combines parts of Dictionary 10 with Dictionary 11. Codes included in this field would be ALF, NU, WID etc., from Dictionary 10 and adding CRØ, TTY etc.

FLD5 - Modifiers same as present EXFOR using Dictionary 12.

FLD6 - Particle same as present EXFOR using Dictionary 13.

c) Our modifications to the KFK proposal are such as to permit heavy ion reactions to be coded, permit multiparticle emission to be handled in a machine readable way and eliminate redundancy (for example the final nucleus is not necessary to code). If required, the final nucleus should be given with the keyword RESID-NUC.

EXAMPLES

(39-Y-89 (P,N) 40-ZR-89, CRØ)	KFK
(39-Y-89, (P,N), CRØ)	PROPOSED
(39-Y-89 (P,P2N) 39-Y-87M, CRØ)	KFK
(39-Y-89 (P,P/2N), CRØ, MS)	PROPOSED
(39-Y-89 (P,P5N) 39-Y-84, CRØ)	KFK
(39-Y-89, (P,P/5N), CRØ)	PROPOSED
(8-Ø-16, (N,EL), WID/RED)	PROPOSED

2. PART-DET - KFK proposal is reasonable but we propose that the particle detected appear first and the nucleus follow so that the change from current EXFOR is a simple addition instead of an insertion. It also seems reasonable that the quantity described in the keyword be the first piece of coded information.

EXAMPLES

(40-ZR-89,. AR,DG)	comment 1 + 2	KFK
(AR,40-ZR-89)	comment 1	PROPOSED
(DG,40-ZR-89)	comment 2	
(39-Y-87M, DG)		KFK
(DG,39-Y-87-M)		PROPOSED

3. FACILITY Under present EXFOR rules of coding, only in exceptional circumstances would the lab code for a facility be different for the lab code of the institute. We could accept the KFK proposal to add a lab code field under FACILITY, but it should be used only if different from INSTITUTE. Multiple facilities if appropriate must be coded as FACILITY (DYNAM, 1USAANL) (SYNCYC, 1CANMCG)

4. STANDARD - Only one keyword either STANDARD or MONITOR should be finally adopted. MONITOR is almost unused in neutron physics except in the phrase "flux monitor". I am not familiar with the terminology on these words in other branches of nuclear physics. Eventual use of both will be confusing. We suggest that the keyword STANDARD* be used.

5. Area code - We will have to do something about the assignment of area codes. With the eventual demise of the SCISRS translation series 5-8 will be available. But what happens if the number of centers becomes greater than 9?

6. MISC - The use of multiple MISC columns to code various sums and ratios of cross sections is not a good practice (see 60001003) and is illegal in EXFOR. Each should be coded properly in a separate subentry or in a single subentry using the "multiple ISO-QUANT" concept.

S. Pearlstein

1h
Distribution: L. Lesca (5 copies)
J.J. Schmidt (5 copies)
V. Manokhin (5 copies)
NNCSC

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ALTER                                CHARGED PARTICLES, KARLSRUHE          00000010
DICT     2                                                                 00000020
*COMMENT 1)ISO-QUANT,CMPO-QUANT AND NUC-QUANT ARE NOT USED IN THE          00000030
*          CASE OF CHARGED PARTICLE INDUCED REACTIONS. THESE               00000040
*          KEYWORDS ARE REPLACED BY 'REACTION'.                            00000050
*        2)'PART-DET' IS OBLIGATORY, BECAUSE THE PARTICLE DETECTED         00000060
*          IS IN GENERAL NOT OBVIOUS FROM 'REACTION'. THE DECAY            00000070
*          PROPERTIES OF THE DETECTED PARTICLES SHOULD BE GIVEN            00000080
*          UNDER 'DECAY-DATA'.                                             00000090
*        3)THE HALF-LIFE SHOULD BE GIVEN UNDER 'DECAY-DATA' AND            00000100
*          NOT UNDER 'HALF-LIFE'.                                          00000110
*        4)THE PRODUCT NUCLEUS SHOULD BE MENTIONED UNDER                   00000120
*          'REACTION' AND/OR 'PART-DET' BUT NOT UNDER 'RESID-NUC'.         00000130
REACTION KEYWORD + CODED INFORMATION IN PARENTHESES OBLIGATORY             00000140
         FOR CHARGED PARTICLE INDUCED REACTIONS.                           00000150
         UP TO 7 SUBFIELDS  (SF1(SF2,SF3)SF4,SF5,SF6,SF7)                  00000160
         SF1 TARGET NUCLIDE Z-S-A(-MX) (SEE 'ISO-QUANT')                   00000170
         SF2 PROJECTILE                (SEE DICT 13)                       00000180
         SF3 OUTGOING PARTICLE(S)      (SEE DICT 13)                       00000190
         SF4 PRODUCT NUCLIDE Z-S-A(-MX)(SEE 'ISO-QUANT')                   00000200
         SF5 QUANTITY MEASURED         (SEE DICT 10)                       00000210
         SF6 MODIFIER                  (SEE DICT 12)                       00000220
         SF7 CLASSIFICATION            (SEE DICT.12)                       00000230
         SF1,SF2,SF3,SF4,SF5 AND SF7 OBLIGATORY. A FREE TEXT               00000240
         EXPLANATION HAS TO BE ADDED, IF ONE OR MORE OF THESE              00000250
         SUBFIELDS ARE BLANK.                                              00000260
         SUBFIELD 6 IS OPTIONAL                                            00000270
         THE RULES FOR COMBINATIONS OF DIFFERENT OUTGOING                  00000280
         PARTICLES OR PRODUCT NUCLIDES ARE SIMILAR TO THE RULES            00000290
         APPLICABLE IN 'ISO-QUANT'. DIFFERENT TYPES OF                     00000300
         OUTGOING PARTICLES IN SF3 MUST BE SEPARATED BY BLANKS,            00000310
         E.G. A P 2N. IF SF5, SF6 OR SF7 CONTAIN MORE THAN                 00000320
         ONE CODE A SLASH IS USED FOR SEPARATION.                          00000330
ADD-RES  KEYWORD OPTIONAL. FREE TEXT OR CODED INFORMATION IN               00000340
         PARENTHESES PLUS FREE TEXT                                        00000350
MONITOR  KEYWORD OBLIGATORY EXCEPT WHEN NOT RELEVANT. CODED                00000360
         INFORMATION UP TO 13 SUBFIELDS IN PARENTHESES PLUS                00000370
         FREE TEXT.                                                        00000380
         SF1 ACCESSION NUMBER OF MONITOR REACTION IN EXFOR                 00000390
             FILE                                                          00000400
         SF2 TO SF5 MONITOR REACTION, NOTATION AS GIVEN                    00000410
             IN 'REACTION' SF1 TO SF4.                                     00000420
         SF6 FIRST AUTHOR OF PUBLICATION, ADDITIONAL AUTHORS               00000430
             ARE NOTED BY +. EXAMPLE, LANGE+,                              00000440
         SF7 TO SF11 OR SF12 REFERENCE, NOTATION AS GIVEN IN               00000450
             'REFERENCE'.                                                  00000460
         NEXT SUBFILED (SF12 OR SF13) OPTIONAL INFORMATION                 00000470
             ABOUT THE DATA, AS EVALUATED OR RECOMMENDED DATA.             00000480
             (SEE DICT 12)                                                 00000490
PART-DET THIS KEYWORD MAY CONTAIN (IF NOT OBVIOUS FROM                     00000500
         'ISO-QUANT') SEVERAL SUBFIELDS, GIVING EITHER THE                 00000510
         NUCLIDE OBSERVED AND THE TYPE(S) OF RADIATION                     00000520
         DETERMINED OR THE PARTICLE(S) DETECTED. IF KEYWORD                00000530
         PRESENT, THEN CODED INFORMATION IN PARENTHESES                    00000540
         OBLIGATORY. SEE DICTIONARY 13.                                    00000550
DECAY-DATA KEYWORD OPTIONAL. IF KEYWORD PRESENT, THEN CODED                00000560
         INFORMATION IN PARENTHESES OBLIGATORY. THE SUBFIELDS              00000570
         ARE SEPARATED BY COMMAS (SF1,SF2, .... )                          00000580
         SF1 NUCLIDE Z-S-A(-MX) (SEE 'ISO-QUANT')                          00000590
```

KARLSRUHE CPND-EXFOR SECOND VERSION

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                SF2 HALF-LIFE (- ERROR), EXAMPLE ,17.3HR-0.3HR,                  00000600
                     OR ,17.3HR,                                                 00000610
                SF3 TYPE OF RADIATION  (SEE DICT. 13)                            00000620
                SF4 ENERGY OF RADIATION IN KEV                                   00000630
                SF5 ABUNDANCE OF RADIATION PER DECAY                             00000640
                SF... SF3,SF4 AND SF5 MAY BE REPEATED AS OFTEN AS                00000650
                     NECESSARY                                                   00000660
                FREE TEXT OPTIONAL.                                              00000670
    REL-REF     KEYWORD OPTIONAL. CODED INFORMATION UP TO 8 SUBFIELDS            00000680
                IN PARENTHESES PLUS FREE TEXT.                                   00000690
                IN SF1 THE REASON FOR CITING THE REFERENCE IS GIVEN              00000700
                (SEE DICT. 20). IF THE CODE 'N' IS USED A FREE TEXT IS           00000710
                OBLIGATORY.                                                      00000720
                SF2 FIRST AUTHOR OF PUBLICATION, ADDITIONAL AUTHORS              00000730
                     ARE NOTED BY +.                                             00000740
                SF3 TO SF8 REFERENCE, NOTATION AS GIVEN IN 'REFERENCE'           00000750
    *COMMENT    THE KEYWORD 'REL-REF' REFERS TO PUBLICATIONS WHICH               00000760
    *           ARE RELEVANT TO AN ENTRY  OR A SUBENTRY, FOR INSTANCE            00000770
    *           TO THOSE PUBLICATIONS WHICH ARE INCLUDED IN AN                   00000780
    *           EVALUATION.                                                      00000790
    DICT    3                                                                    00000800
    1USASTB     (STATE UNIVERSITY OF NEW YORK, STONY BROOK, N.Y)                 00000810
    1USANAL     (FERMI NATIONAL LAB.,BATAVIA, ILLINOIS)                          00000820
    2JAPNII     (NIIGATA UNIV., NIIGATA)                                  374    00000830
    DICT    5                                                                    00000840
    NC          (NUOVO CIMENTO) NUOVO CIMENTO SER.10                2ITY  296    00000850
                STARTING WITH VOL.1(1955) UNTIL VOL.39 NO.4 (1965)               00000860
    NC/A        (NUOVO CIMENTO A) NUOVO CIMENTO SECTION A,SER.10    2ITY  298    00000870
                STARTING WITH VOL.40 NO.1(1965) UNTIL VOL.70(1970)        299    00000880
                SER.11 STARTING WITH VOL.1(1971)                                 00000890
    NC/B        (NUOVO CIMENTO B) NUOVO CIMENTO SECTION B,SER.10    2ITY    1    00000900
                STARTING WITH VOL.40 NO.1(1965) UNTIL VOL.70(1970)        2      00000910
                SER.11 STARTING WITH VOL.1(1971)                                 00000920
                UNTIL VOL.61(48) AND FROM VOL.71(58)                      401    00000930
    PPS/A       (PROC.PHYS.SOC.(LONDON)SECT.A) PROCEEDINGS OF THE   2UK  402    00000940
                 PHYSICAL SOCIETY,LONDON,SECTION A                               00000950
                 EXISTING VOL.62 JAN.1949 - VOL.70 DEC.1957                      00000960
    PRS/A       (PROC.ROY.SOC.,LONDON,SER.A) PROCEEDINGS OF THE     2UK  419    00000970
                 ROYAL SOCIETY,LONDON,SERIES A,MATHEMATICAL AND                  00000980
                 PHYSICAL SCIENCES                                               00000990
    DICT    6                                                                    00001000
    CERN-       (CERN EUROP.ORG.FOR NUCL.RES.) CERN EUROPEAN    2ZZZCER  264    00001010
                ORGANIZATION FOR NUCLEAR RESEARCH                                00001020
    DICT    10                                                                   00001030
    CRO         (CROSS SECTION) CROSS SECTION FOR THE FORMATION OF THE           00001040
                 SPECIFIED PRODUCT NUCLIDE OR THE SPECIFIED REACTION-            00001050
                 TYPE (X,Y).                                                     00001060
    TTY         (THICK-TARGET-YIELD) THICK-TARGET-YIELD FOR THE                  00001070
                 SPECIFIED PRODUCT NUCLIDE                                       00001080
    FCR         (FISSION CROSS SECTION)                                          00001090
    FY          (FISSION YIELD) INDEPENDENT, CUMULATIVE AND TOTAL CHAIN          00001100
                  YIELD SEE MODIFIER (DICT 12)                                   00001110
    PY          (PRODUCT YIELD) IN CASE OF CHARGED PARTICLE REACTIONS            00001120
                  THIS CODEWORD IS USED WHENEVER CRO, TTY, FCR OR FY             00001130
                  CANNOT BE APPLIED, E.G. AVERAGE CROSS SECTION FOR A            00001140
                  LIMITED ENERGY RANGE. EXPLANATORY FREE TEXT IS                 00001150
                  OBLIGATORY.                                                    00001160
    DICT    12                                                                   00001170
    BIN         BINARY                                                    46     00001180
```

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IND         INDEPENDENT YIELD OF THE PRODUCT NUCLIDE VIA DIRECT      56  00001190
             FORMATION ONLY                                              00001200
CUM         CUMULATIVE YIELD, I.E. YIELD OF THE PRODUCT NUCLIDE          00001210
              VIA DIRECT FORMATION AND RADIOACTIVE DECAY                 00001220
*COMMENT    THE MODIFIER IND AND CUM ARE USED FOR ALL KINDS OF           00001230
*           NUCLEAR REACTIONS.                                          00001240
*COMMENT    CODEWORDS FOR CLASSIFICATION                             60  00001250
EXP         EXPERIMENTAL DATA                                           00001260
THEO        CALCULATIONS BASED ON THEORY                                00001270
EVAL        EVALUATED DATA                                              00001280
RECOM       RECOMMENDED DATA                                            00001290
DICT      13                                                            00001300
XR          (X-RAYS)                                                 17  00001310
COMPLEX     (UNDEFINED OUTGOING PARTICLES) IF THE AUTHOR DOES NOT    26  00001320
             STATE THE KIND AND NUMBER OF THE OUTGOING PARTICLES        00001330
             IN CHARGED PARTICLE INDUCED REACTIONS OR IF AMBIGUITY      00001340
             EXISTS IN RESPECT TO THE REACTION TYPES INVOLVED           00001350
EC          (ELECTRON CAPTURE)                                          00001360
SF          (SPONTANEOUS FISSION)                                       00001370
DICT      16                                                            00001380
COMP        DATA OBTAINED FROM PUBLICATION BY THE COMPILER,          33  00001390
            CHECKED, BUT NOT APPROVED BY THE AUTHOR                     00001400
CURVE       TABULAR DATA OBTAINED FROM A CURVE WITH A DATA-POINT        00001410
              READER                                                    00001420
CPX-CURVE   DATA OBTAINED FROM A CURVE WITH A DATA-POINT READER      37  00001430
            BY K.F.MCGOWAN ET AL., PUBLISHED IN                         00001440
            ORNL-CPX-1 (1964) FOR PRODUCTION OF MN,FE,CO.               00001450
            ORNL-CPX-2 (1964) FOR PRODUCTION OF NI,CU.                  00001460
            NUCL.DATA,A1 (1966) FOR PRODUCTION OF LI,BE,B               00001470
            NUCL.DATA,A2 (1966) FOR PRODUCTION OF C.                    00001480
            NUCL.DATA,A3 (1967) FOR PRODUCTION OF N,O.                  00001490
DICT    18                                                              00C015C0
HILAC       (HEAVY ION LINEAR ACCELERATOR)                           6  00001510
ISOCYC      (ISOCHRONOUS-CYCLOTRON)                                  8  00001520
SYNCYC      (SYNCHROCYCLOTRON)                                       9  00001530
DICT    20            ADDITIONAL RESULTS / RELATED REFERENCES            00001540
RANGE       (RANGE OF RECOILS MEASURED)                                 00001550
DECAY       (DECAY PROPERTIES OF THE PRODUCT NUCLIDE)                   00001560
IRAT        (ISOMERIC RATIO)                                            00001570
ANGD        (ANGULAR DISTRIBUTION)                                      00001580
            ------------------------------------------------------      00001590
E           REFERENCE USED IN THE EVALUATION                            00001600
C           CRITICAL REMARKS                                            00001610
N           NOTE, SEE NEXT FREE TEXT                                    00001620
DICT    21                                                              00001630
REC         (CROSS SECTIONS OR YIELDS DETERMINED BY THE COLLECTION   15  00001640
            OF RECOILS)                                                 00001650
HEJET       (COLLECTION BY HE-JET)                                      00001660
CHSEP       (CHEMICAL SEPARATION)                                       00001670
ASEP        (SEPARATION BY MASS SEPARATOR)                              00001680
SITA        (SINGLE TARGET IRRADIATIONS)                                00001690
STTA        (STACKED TARGET IRRADIATIONS)                               00001700
INTB        (IRRADIATIONS WITH INTERNAL BEAM)                           00001710
EXTB        (IRRADIATIONS WITH EXTERNAL BEAM)                           00001720
EDEG        (ENERGY-DEGRADATION BY FOILS) ENERGY-DEGRADATION OF THE     00001730
             BEAM BEFORE HITTING THE TARGET ARRANGEMENT                 00001740
MONSEP      (SEPARATE MONITORFOIL)                                      00001750
MONMIX      (MIXED MONITOR) MONITOR AND TARGET COMBINED AS CHEMICAL     00001760
             COMPOUND OR MIXTURE OR MONITOR REACTION HAS THE SAME       00001770
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          TARGET NUCLIDE AS THE REACTION GIVEN UNDER 'REACTION'.          00001780
BC INT    (BEAM CURRENT INTEGRATED) CODEWORD USED ONLY IF VALUES          00001790
           GIVEN IN THE DATA SECTION ARE BASED ON THIS                    00001800
           MEASUREMENT                                                    00001810
DICT   22                                                                 00001820
GEMUC     (GEIGER MUELLER COUNTER)                                  1     00001830
SID       (SI-SOLID-STATE DETECTOR)                                 4     00001840
LI SCI N  (LIQUID SCINILLATION COUNTER)                                   00001850
ARCOI     (ANNIHILATION RADIATION COINCIDENCE COUNTER)                    00001860
IOCH      (IONISATION CHAMBER) FOR ALPHA-MEASUREMENT                      00001870
COIN      (COINCIDENCE COUNTER ARRANGEMENT)                               00001880
DICT   23                                                                 00001890
GAREA     (PHOTOPEAK-AREA ANALYSIS)                                 2     00001900
INTANG    (INTEGRATION OF ANGULAR DISTRIBUTION)                     6     00001910
DICT   24                                                                 00001920
*COMMENT  THE MEANING OF THE CODE 'EN' SHOULD BE EXTENDED TO        1     00001930
*         'ENERGY OF INCIDENT PROJECTILE, LAB-SYSTEM'. THIS               00001940
*         EXTENSION SHOULD ALSO APPLY TO THE OTHER CODEWORDS,             00001950
*         WHICH CONTAIN 'EN', LIKE 'EN-CM'.                               00001960
MI SC3    THIRD MISCELLANEOUS COLUMN -IF MORE THAN ONE IS GIVEN     138   00001970
             SAME USAGE AS -MISC-(SEE ABOVE)                              00001980
MISC4     FOURTH MISCELLANEOUS COLUMN -IF MORE THAN ONE IS GIVEN          00001990
             SAME USAGE AS -MISC-(SEE ABOVE)                              00002000
DATA      HEADING FOR COLUMN GIVING THE QUANTITY SPECIFIED                00002010
          UNDER 'ISO-QUANT' OR 'REACTION'                                 00002020
RATIO     HEADING FOR COLUMN GIVING THE RATIO SPECIFIED UNDER             00002030
          'ISO-QUANT' OR 'REACTION', OR THE QUANTITY/STANDARD             00002040
SUM       HEADING FOR COLUMN GIVING THE SUM SPECIFIED UNDER         102   00002050
          'REACTION'                                                      00002060
SUM-ERR   SUM-ERROR. EXPLANATION UNDER 'ERR-ANALYS'                       00002070
+SUM-ERR  +UNSYMMETRIC SUM-ERROR. EXPLANATION UNDER 'ERR-ANALYS'          00002080
-SUM-ERR  -UNSYMMETRIC SUM-ERROR. EXPLANATION UNDER 'ERR-ANALYS'          00002090
ENDDICTION                                                                00002100
ENDALTER                                                                  00002110
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SAMPLE ENTRY

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ENTRY            60002      750904                                  6000200000001
SUBENT        60002001      750904                                  6000200100001
BIB                 12          16                                  6000200100002
TITLE        MEASUREMENT AND EQUILIBRIUM STATISTICAL-MODEL           6000200100003
             CALCULATION OF EXCITATION FUNCTIONS OF THE AU-197(A,XN) 6000200100004
             REACTIONS IN THE ENERGY RANGE FROM 16 TO 103 MEV        6000200100005
AUTHOR       (H.E.KURZ, E.W.JASPER, K.FISCHER, F.HERMES)             6000200100006
INSTITUTE    (2GERBON)                                               6000200100007
REFERENCE    (J,NP/A,168,129,71)   KARLSRUHE CPND EXFOR              6000200100008
METHOD       (STTA,EXTB)                                             6000200100009
FACILITY     (ISOCYC,2GERKFK)      SECOND VERSION                    6000200100010
DETECTOR     (GELI)                                                  6000200100011
SAMPLE       (79-AU-197)                                             6000200100012
ERR-ANALYS   THE ERRORS ESTIMATED FOR THE CROSS SECTIONS ARE LESS    6000200100013
             THAN 10 PER CENT AND THOSE FOR THE ENERGY ARE LESS      6000200100014
             THAN 1 MEV                                              6000200100015
ANALYSIS     'AREA')                                                 6000200100016
STATUS       (COMP,CURVE)                                            6000200100017
HISTORY      (750127C)MZ                                             6000200100018
ENDBIB              16           0                                   6000200100019
NOCOMMON                                                             6000200100020
ENDSUBENT           19           0                                   6000200199999
SUBENT        60002002      750904                                  3336000200200001
BIB                  3           3                                   6000200200002
REACTION     (79-AU-197(A,N)81-TL-200,CRO,,EXP/THEO)                 6000200200003
PART-DET     (81-TL-200,DG)                                          6000200200004
DECAY-DATA   (81-TL-200,26.1HR,DG,368.,0.94)                         6000200200005
ENDBIB               3           0                                   6000200200006
NOCOMMON                                                             6000200200007
DATA                 2          10                                   6000200200008
EN           DATA                                                    6000200200009
MEV          MB                                                      6000200200010
    16.3          1.3                                                6000200200011
    18.6          7.9                                                6000200200012
    20.8         20.3                                                6000200200013
    22.9         23.5                                                6000200200014
    25.9         18.3                                                6000200200015
    28.5         10.8                                                6000200200016
    33.6          7.3                                                6000200200017
    36.7          5.4                                                6000200200018
    39.6          4.5                                                6000200200019
    42.5          3.3                                                6000200200020
ENDDATA             12                                               6000200200021
ENDSUBENT           20           0                                   6000200299999
SUBENT        60002003      750904                                  3336000200300001
BIB                  3           3                                   6000200300002
REACTION     (79-AU-197(A,2N)81-TL-199,CRO,,EXP/THEO)                6000200300003
PART-DET     (81-TL-199,DG)                                          6000200300004
DECAY-DATA   (81-TL-199,7.5HR,DG,208.,0.119)                         6000200300005
ENDBIB               3           0                                   6000200300006
NOCOMMON                                                             6000200300007
DATA                 2          15                                   6000200300008
EN           DATA                                                    6000200300009
MEV          MB                                                      6000200300010
    18.6         11.                                                 6000200300011
    20.8         85.                                                 6000200300012
    21.9        152.                                                 6000200300013
    22.9        200.                                                 6000200300014
    24.8        390.                                                 6000200300015
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    25.9       396.                                                    6000200300016
    26.7       540.                                                    6000200300017
    28.5       654.                                                    6000200300018
    29.5       650.                                                    6000200300019
    32.9       450.                                                    6000200300020
    36.1       203.                                                    6000200300021
    39.1       107.                                                    6000200300022
    42.         71.                                                    6000200300023
    47.4        50.                                                    6000200300024
    52.4        37.5                                                   6000200300025
ENDDATA              17                                                6000200300026
ENDSUBENT            25           0                                    6000200399999
SUBENT         60002004      750904                                   3336000200400001
BIB                   3           6                                    6000200400002
REACTION    ((79-AU-197(A,3N)81-TL-198-M,CRO,,EXP/THEO)+               6000200400003
            (79-AU-197(A,3N)81-TL-198-G,CRO,,EXP/THEO))               6000200400004
PART-DET    (81-TL-198-M,DG)                                          6000200400005
            (81-TL-198-G,DG)                                          6000200400006
DECAY-DATA  (81-TL-198-M,1.9HR,DG,587.,0,602)                         6000200400007
            (81-TL-198-G,5.3HR,DG,676.,0.09)                          6000200400008
ENDBIB                6           0                                    6000200400009
NOCOMMON                                                              6000200400010
DATA                  2           8                                    6000200400011
EN          DATA                                                      6000200400012
MEV         MB                                                        6000200400013
    29.5      131.                                                    6000200400014
    32.9      546.                                                    6000200400015
    36.1      918.                                                    6000200400016
    39.1     1071.                                                    6000200400017
    42.       870.                                                    6000200400018
    47.4      410.                                                    6000200400019
    52.4      231.                                                    6000200400020
    61.5      130.                                                    6000200400021
ENDDATA              10                                               6000200400022
ENDSUBENT            21           0                                   6000200499999
SUBENT         60002005      750904                                   3336000200500001
BIB                   3           3                                   6000200500002
REACTION    (79-AU-197(A,P 3N)80-HG-197-M,CRO,,EXP/THEO)              6000200500003
PART-DET    (80-HG-197-M,DG)                                          6000200500004
DECAY-DATA  (80-HG-197-M,23.8HR,DG,134.,0.419)                        6000200500005
ENDBIB                3           0                                   6000200500006
NOCOMMON                                                              6000200500007
DATA                  2           8                                   6000200500008
EN          DATA                                                      6000200500009
MEV         MB                                                        6000200500010
    39.1        1.6                                                   6000200500011
    42.         3.2                                                   6000200500012
    44.8        6.7                                                   6000200500013
    49.9       23.1                                                   6000200500014
    59.3       58.9                                                   6000200500015
    67.8       66.2                                                   6000200500016
    77.4       63.1                                                   6000200500017
    86.2       52.6                                                   6000200500018
ENDDATA              10                                               6000200500019
ENDSUBENT            18           0                                   6000200599999
SUBENT         60002006      750904                                   3336000200600001
BIB                   3           3                                   6000200600002
REACTION    (79-AU-197(A,4N)81-TL-197,CRO,,EXP/THEO)                  6000200600003
PART-DET    (81-TL-197,DG)                                            6000200600004
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DECAY-DATA (81-TL-197,2.8HR,DG,152.,0.11,DG,308.,0.054)                  6000200600005
ENDBIB                3           0                                      6000200600006
NOCOMMON                                                                 6000200600007
DATA                  2          13                                      6000200600008
EN          DATA                                                         6000200600009
MEV         MB                                                           6000200600010
    40.3      199.                                                       6000200600011
    43.       632.                                                       6000200600012
    45.7     1106.                                                       6000200600013
    50.7     1065.                                                       6000200600014
    53.       796.                                                       6000200600015
    55.2      581.                                                       6000200600016
    57.6      392.                                                       6000200600017
    59.8      275.                                                       6000200600018
    62.       197.                                                       6000200600019
    64.       157.                                                       6000200600020
    66.       135.                                                       6000200600021
    68.       122.                                                       6000200600022
    70.       114.                                                       6000200600023
ENDDATA              15                                                  6000200600024
ENDSUBENT            23           0                                      6000200699999
SUBENT         60002007      750904                                  3336000200700001
BIB                   3           6                                      6000200700002
REACTION    ((79-AU-197(A,5N)81-TL-196-M,CRO,,EXP/THEO)+                 6000200700003
            (79-AU-197(A,5N)81-TL-196-G,CRO,,EXP/THEO))                  6000200700004
PART/DET    (81-TL-196-M,DG)                                             6000200700005
            (81-TL-196-G,DG)                                             6000200700006
DECAY-DATA  (81-TL-196-M,1.4HR,DG,695.,0.905)                            6000200700007
            (81-TL-196-G,1.8HR,DG,611.,0.164)                            6000200700008
ENDBIB                6           0                                      6000200700009
NOCOMMON                                                                 6000200700010
DATA                  2          13                                      6000200700011
EN          DATA                                                         6000200700012
MEV         MB                                                           6000200700013
    45.7      50.                                                        6000200700014
    50.7     261.                                                        6000200700015
    53.      540.                                                        6000200700016
    55.2     852.                                                        6000200700017
    57.6    1076.                                                        6000200700018
    59.8    1137.                                                        6000200700019
    62.      981.                                                        6000200700020
    64.      862.                                                        6000200700021
    66.      694.                                                        6000200700022
    68.      536.                                                        6000200700023
    70.      442.                                                        6000200700024
    79.3     226.                                                        6000200700025
    86.1     161.                                                        6000200700026
ENDDATA              15                                                  6000200700027
ENDSUBENT            26           0                                      6000200799999
SUBENT         60002008      750904                                  3336000200800001
BIB                   4           7                                      6000200800002
REACTION    (79-AU-197(A,6N)81-TL-195,CRO,,EXP/THEO)                     6000200800003
PART-DET    (81-TL-195,DG)                                               6000200800004
DECAY-DATA  (81-TL-195,1.2HR,DG,562.,0.083)                              6000200800005
COMMENT     THE GAMMA-ABUNDANCE IS AN ESTIMATED VALUE ONLY. THE          6000200800006
            ERRORS OF THE CROSS SECTIONS ARE THEREFORE PRESUMABLY        6000200800007
            HIGHER THAN STATED IN ERR-ANALYS. (COMMENT BY THE            6000200800008
            COMPILER)                                                    6000200800009
ENDBIB                7           0                                      6000200800010
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NOCOMMON                                                                    6000200800011
DATA                    2          10                                       6000200800012
EN          DATA                                                            6000200800013
MEV         MB                                                              6000200800014
    59.8        61.                                                         6000200800015
    62.        266.                                                         6000200800016
    64.        560.                                                         6000200800017
    66.        672.                                                         6000200800018
    68.        850.                                                         6000200800019
    70.        943.                                                         6000200800020
    73.7       828.                                                         6000200800021
    79.3       608.                                                         6000200800022
    82.7       500.                                                         6000200800023
    86.1       374.                                                         6000200800024
ENDDATA               12                                                    6000200800025
ENDSUBENT             24           0                                        6000200899999
SUBENT          60002009      750904                                  3336000200900001
BIB                    3           3                                        6000200900002
REACTION    (79-AU-197(A,7N)81-TL-194-M,CRO,,EXP/THEO)                      6000200900003
PART-DET    (81-TL-194-M,DG)                                                6000200900004
DECAY-DATA  (81-TL-194-M,33.MIN,DG,749.,0.74,DG,735.,0.26)                  6000200900005
ENDBIB                 3           0                                        6000200900006
NOCOMMON                                                                    6000200900007
DATA                    2          10                                       6000200900008
EN          DATA                                                            6000200900009
MEV         MB                                                              6000200900010
    73.7        68.                                                         6000200900011
    77.5       181.                                                         6000200900012
    81.        196.                                                         6000200900013
    84.4       377.                                                         6000200900014
    87.8       398.                                                         6000200900015
    91.        413.                                                         6000200900016
    94.2       423.                                                         6000200900017
    97.3       321.                                                         6000200900018
   100.3       315.                                                         6000200900019
   103.3       286.                                                         6000200900020
ENDDATA               12                                                    6000200900021
ENDSUBENT             20           0                                        6000200999999
SUBENT          60002010      750904                                  3336000201000001
BIB                    4           6                                        6000201000002
REACTION    (79-AU-197(A,8N)81 TL-193,CRO,,EXP/THEO)                        6000201000003
PART-DET    (81-TL-193,DG)                                                  6000201000004
DECAY-DATA  (81-TL-193,23.MIN,DG,325.,0.13)                                 6000201000005
COMMENT     THE GAMMA-ABUNDANCE WAS ESTIMATED. THE ERRORS OF THE            6000201000006
            CROSS SECTIONS ARE THEREFORE PRESUMABLY LARGER THAN             6000201000007
            GIVEN IN ERR-ANALYS. (COMMENT BY THE COMPILER)                  6000201000008
ENDBIB                 6           0                                        6000201000009
NOCOMMON                                                                    6000201000010
DATA                    2          6                                        6000201000011
EN          DATA                                                            6000201000012
MEV         MB                                                              6000201000013
    87.8        65.                                                         6000201000014
    91.        161.                                                         6000201000015
    94.2       252.                                                         6000201000016
    97.3       286.                                                         6000201000017
   100.3       295.                                                         6000201000018
   103.3       271.                                                         6000201000019
ENDDATA                8                                                    6000201000020
ENDSUBENT             19           0                                        6000201099999
ENDENTRY              10           0                                        6000299999999
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ENTRY          70001      750623                                   7000100000001
SUBENT      70001001      750623                                   7000100100001
BIB               11          19                                   7000100100002
TITLE       EXITATION FUNCTIONS FOR (P,N)- AND (P,2N)-REACTIONS     7000100100003
            ON CADMIUM'S ISOTOPES                                   7000100100004
AUTHOR      (E,A,SKAKUN,A,P,KLYUCHAREV,YU,N,RAKIVNENKO,             7000100100005
            I,A,ROMANY)                                             7000100100006
INSTITUT    (4CCPUFT)                                               7000100100007
REFERENCE   (J,IZV,39,24,75) IZV,AKAD, NAUK SSSR,SER,FIZ,,          7000100100008
            V,39,P 24  1975,                                        7000100100009
FACILITY    (HILAC,4CCPUFT)                                         7000100100010
COMMENT     OF COMPILER,WE USED (HILAC),BECAUSE DICTIONARY 18       7000100100011
            HAVE NOT WORD FOR PROTON ACCELERATOR,                   7000100100012

DETECTOR    (SCIN,NAJCR)                                            7000100100013
ERR-ANALYS  UNCERTAINTIES INCLUDE RANDOM ERROR OF PHOTOPEAK-AREA    7000100100014
            AND DECAY CURVE ANALYSIS AS WELL AS SISTEMATIC          7000100100015
            ERRORS ASSOCIATED WITH COUNTER EFFICIECIES AND          7000100100016
            SPREAD IN BEAM ENERGY, ERRORS IN DECAY SCHEME ARE NOT   7000100100017
            INCLUDED,                                               7000100100018
ANALYSIS    (GAREA)                                                 7000100100019
STATUS      (COMP)                                                  7000100100020
COMMENT     OF COMPILER,ACCELERATORS! EMAX 9 AND 21 MEV             7000100100021
ENDBIB            19                                                7000100100022
NOCOMMON                                                            7000100100023
ENDSUBENT         22                                                7000100199999
SUBENT      70001002      750623                                    7000100200001
BIB               4           7                                     7000100200002

REACTION    (48-CD-110(P,N)49-IN-110+49-IN-110M,CRO)                 7000100200003
SAMPLE      91,5 PER CENT 110-CD                                    7000100200004
PART-DET    (49-IN-110,DG) HALF-LIFE 69 MIN                         7000100200005
            657 KEV PHOTONS,1,0 PER DECAY                           7000100200006
            (49-IN-110M,DG) HALF-LIFE 4,9 HR                        7000100200007
            885 KEV PHOTONS,0,95 PER DECAY                          7000100200008
METHOD      (STTA,INTB,BCINT)                                       7000100200009
ENDBIB            7                                                 7000100200010
NOCOMMON                                                            7000100200011
DATA              3          12                                     7000100200012
EN          DATA       DATA-ERR                                     7000100200013
MEV         MB         MB                                           7000100200014
   6,5       108,        32,4                                       7000100200015
   7,3       168,        51,                                        7000100200016

   8,        250,        75,                                        7000100200017
   8,5       312,        93,5                                       7000100200018
   9,0       340,       102,                                        7000100200019
  11,8       597,       179,                                        7000100200020
  13,7       544,       163,                                        7000100200021
  15,2       262,        79,                                        7000100200022
  17,        146,        43,8                                       7000100200023
  18,3       102,        30,3                                       7000100200024
  19,7        73,        21,9                                       7000100200025
  20,9        64,        19,2                                       7000100200026
ENDDATA          14                                                 7000100200027
ENDSUBENT        26                                                 7000100299999
SUBENT      70001003      750623                                    7000100300001

BIB               4           7                                     7000100300002
REACTION    (48-CD-110(P,2N)49-IN-109+49-IN-109M,CRO)                7000100300003
METHOD      (STTA,INTB,BCINT)                                       7000100300004
SAMPLE      91,5 PER CENT 110-CD                                    7000100300005
PART-DET    (49-IN-109M,DG) HALF-LIFE 1,3 MIN                       7000100300006
            658 KEV PHOTONS,1,0 PER DECAY                           7000100300007
            (49-IN-109,DG)  HALF-LIFE 4,3 HR                        7000100300008
            203 KEV PHOTONS,0,775 PER DECAY                         7000100300009
ENDBIB            7                                                 7000100300010
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NOCOMMON                                                                7000100300011
DATA                3           9                                       7000100300012
EN          DATA     DATA-ERR                                           7000100300013
MEV         MB       MB                                                 7000100300014

 13,7       105,      21,                                               7000100300015
 15,2       371,      74,5                                              7000100300016
 17,        511,     102,                                               7000100300017
 17,7       558,     112,                                               7000100300018
 18,3       604,     121,                                               7000100300019
 19,        638,     127,                                               7000100300020
 19,7       668,     133,                                               7000100300021
 20,3       660,     132,                                               7000100300022
 20,9       672,     134,                                               7000100300023
ENDDATA            11                                                   7000100300024
ENDSUBENT          23                                                   7000100399999

SUBENT        70001004     750623                                       7000100400001
BIB                4           6                                       7000100400002
REACTION   (48-CD-111(P,N)49-IN-111,CRO)                                7000100400003
METHOD     (STTA,INTB,BCINT)                                            7000100400004
SAMPLE     93,9 PER CENT 111-CD                                         7000100400005
PART-DET   (49-IN-111,DG)   HALF-LIFE 2,81 D                            7000100400006
           172 KEV PHOTONS,1,0 PER DECAY +                              7000100400007
           247 KEV PHOTONS,1,0 PER DECAY                                7000100400008
ENDBIB             6                                                    7000100400009
NOCOMMON                                                                7000100400010
DATA               3          16                                        7000100400011
EN          DATA     DATA-ERR                                           7000100400012
MEV         MB       MB                                                 7000100400013

    4,3        4,6       0,69                                           7000100400014
    5,2       27,5       4,13                                           7000100400015
    5,9       66,6      10,                                             7000100400016
    6,7      134,       20,2                                            7000100400017
    7,3      226,       33,8                                            7000100400018
    8,       300,       45,                                             7000100400019
    8,5      377,       56,5                                            7000100400020
    9,       430,       64,5                                            7000100400021
    9,8      489,       73,4                                            7000100400022
   11,8      696,      104,                                             7000100400023
   13,7      481,       72,                                             7000100400024
   15,2      250,       37,5                                            7000100400025
   17,       140,       21,                                             7000100400026
   18,3       82,       12,3                                            7000100400027

   19,7       72,       10,8                                            7000100400028
   20,9       61,        9,15                                           7000100400029
ENDDATA            18                                                   7000100400030
ENDSUBENT          29                                                   7000100499999
SUBENT        70001005     750623                                       7000100500001
BIB                4           7                                       7000100500002
REACTION   (48-CD-111(P,2N)49-IN-110+49-IN-110M,CRO)                    7000100500003
METHOD     (STTA,INTB,BCINT)                                            7000100500004
SAMPLE     93,9 PER CENT 111-CD                                         7000100500005
PART-DET   (49-IN-110,DG) HALF-LIFE 69 MIN                              7000100500006
           657 KEV PHOTONS, 1,0 PER DECAY                               7000100500007
           (49-IN-110M,DG) HALF-LIFE 4,9 HR                             7000100500008
           885 KEV PHOTONS, 0,95 PER DECAY                              7000100500009

ENDBIB             7                                                    7000100500010
NOCOMMON                                                                7000100500011
DATA               3           7                                       7000100500012
EN          DATA     DATA-ERR                                           7000100500013
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MEV         MB          MB                                          7000100500014
  11,8       17,          5,1                                       7000100500015
  13,7      332,         100,                                       7000100500016
  15,2      628,         188,                                       7000100500017
  17,       711,         214,                                       7000100500018
  18,3      790,         237,                                       7000100500019
  19,7      917,         274,                                       7000100500020
  20,9      718,         216,                                       7000100500021
ENDDATA              9                                             7000100500022
ENDSUBENT           21                                             7000100599999

SUBENT        70001006     750623                                   7000100600001
BIB                  4          7                                  7000100600002
REACTION    (48-CD-112(P,N)49-IN-112+49-IN-112M,CRO)                7000100600003
METHOD      (SITA,INTB,BCINT)                                       7000100600004
SAMPLE      94,9 PER CENT 112-CD                                    7000100600005
PART-DET    (49-IN-112M,DG) HALF-LIFE 21 MIN                        7000100600006
            157 KEV PHOTONS,1,0 PER DECAY                           7000100600007
            (49-IN-112,DG) HALF-LIFE  14,4 MIN                      7000100600008
            617 KEV PHOTONS,0,0595 PER DECAY                        7000100600009
ENDBIB               7                                              7000100600010
NOCOMMON                                                            7000100600011
DATA                 3          17                                  7000100600012
EN          DATA        DATA-ERR                                    7000100600013
MEV         MB          MB                                          7000100600014

   4,7       17,          5,1                                       7000100600015
   5,2       53,         15,9                                       7000100600016
   5,9       96,         28,8                                       7000100600017
   6,4      163,         48,9                                       7000100600018
   6,8      220,         66,                                        7000100600019
   7,3      321,         95,2                                       7000100600020
   7,8      375,        112,5                                       7000100600021
   8,2      483,        145,                                        7000100600022
   8,7      544,        163,                                        7000100600023
   9,       600,        180,                                        7000100600024
  12,5      680,        204,                                        7000100600025
  14,       426,        128,                                        7000100600026
  15,6      295,         88,5                                       7000100600027
  17,       190,         57,                                        7000100600028
  18,3      135,         40,4                                       7000100600029
  19,7      110,         33,                                        7000100600030
  20,9       96,         28,8                                       7000100600031
ENDDATA              19                                             7000100600032
ENDSUBENT            31                                             7000100699999
SUBENT        70001007     750623                                   7000100700001
BIB                  4          6                                  7000100700002
REACTION    (48-CD-112(P,2N)49-IN-111,CRO)                          7000100700003
METHOD      (SITA,INTB,BCINT)                                       7000100700004
SAMPLE      94,9 PER CENT 112-CD                                    7000100700005
PART-DET    (49-IN-111,DG)  HALF-LIFE 2,82 D                        7000100700006
            172 KEV PHOTONS,1,0 PER DECAY  +                        7000100700007
            247 KEV PHOTONS,1,0 PER DECAY                           7000100700008
ENDBIB               6                                              7000100700009

NOCOMMON                                                            7000100700010
DATA                 3          7                                   7000100700011
EN          DATA        DATA-ERR                                    7000100700012
MEV         MB          MB                                          7000100700013
  11,8       17,          2,54                                      7000100700014
  13,7      332,         49,6                                       7000100700015
  15,2      628,         94,                                        7000100700016
  17,       711,        107,                                        7000100700017
  18,3      790,        118,                                        7000100700018
  19,7      917,        138,                                        7000100700019
  20,9      718,        107,                                        7000100700020
ENDDATA              9                                              7000100700021
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ENDSUBENT          20                                                    7000100799999

SUBENT        70001008     750623                                        7000100800001
BIB                4          5                                         7000100800002
REACTION    (48-CD-113(P,N)49-IN-113M,CRO)                              7000100800003
METHOD      (SITA,INTB,BCINT)                                           7000100800004
SAMPLE      90,2 PER CENT 113-CD                                        7000100800005
PART-DET    (49-IN-113M,DG)  HALF-LIFE 99,4 MIN                         7000100800006
            393 KEV PHOTONS,1,0 PER DECAY                               7000100800007
ENDBIB             5                                                    7000100800008
NOCOMMON                                                                7000100800009
DATA               3          15                                        7000100800010
EN          DATA        DATA-ERR                                        7000100800011
MEV         MB          MB                                              7000100800012
   4,7       4,6          0,69                                          7000100800013
   5,        11,3         1,7                                           7000100800014

   5,9       29,          4,35                                          7000100800015
   6,5       59,          8,85                                          7000100800016
   7,3       85,         13,3                                           7000100800017
   7,8      109,         16,3                                           7000100800018
   8,5      127,         19,                                            7000100800019
   9,       140,         21,                                            7000100800020
  10,9      140,         21,                                            7000100800021
  13,5       56,          8,4                                           7000100800022
  15,2       26,          3,9                                           7000100800023
  16,7       16,          2,4                                           7000100800024
  18,3       14,          2,1                                           7000100800025
  19,5       13,          1,95                                          7000100800026
  20,9       14,          2,1                                           7000100800027
ENDDATA           17                                                    7000100800028

ENDSUBENT         27                                                    7000100899999
SUBENT        70001009     750623                                        7000100900001
BIB                4                                                  7000100900002
REACTION    (48-CD-113(P,2N)49-IN-112+49-IN-112M,CRO)                   7000100900003
METHOD      (SITA,INTB,BCINT)                                           7000100900004
SAMPLE      90,2 PER CENT 113-CD                                        7000100900005
PART-DET    (49-IN-112M,DG) HALF-LIFE 21 MIN                            7000100900006
            157 KEV PHOTONS,1,0 PER DECAY                               7000100900007
            (49-IN-112,DG)  HALF-LIFE 14,4 MIN                          7000100900008
            617 KEV PHOTONS,0,0595 PER DECAY                            7000100900009
ENDBIB             7                                                    7000100900010
NOCOMMON                                                                7000100900011
DATA               3          7                                         7000100900012
EN          DATA        DATA-ERR                                        7000100900013

MEV         MB          MB                                              7000100900014
  12,5      423,         127,                                           7000100900015
  14,       755,         216,                                           7000100900016
  15,6      910,         272,                                           7000100900017
  17,      1105,         332,                                           7000100900018
  18,3     1056,         318,                                           7000100900019
  19,7      984,         296,                                           7000100900020
  20,9      917,         274,                                           7000100900021
ENDDATA           9                                                     7000100900022
ENDSUBENT         21                                                    7000100999999
SUBENT        70001010     750623                                        7000101000001
BIB                5                                                  7000101000002
REACTION    (48-CD-114(P,N)49-IN-114M,CRO)                              7000101000003
METHOD      (STTA,INTB,BCINT)                                           7000101000004

SAMPLE      97,3 PER CENT 114-CD                                        7000101000005
PART-DET    (49-IN-114M,DG) HALF-LIFE 50 D                              7000101000006
            192 KEV PHOTONS,0,965 PER DECAY                             7000101000007
FLAG        (1,) UPPER LIMIT                                            7000101000008
ENDBIB             6                                                    7000101000009
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NOCOMMON                                                                  7000101000010
DATA                    4               7                                 7000101000011
EN          DATA         DATA-ERR        FLAG                             7000101000012
MEV         MB           MB              NO-DIM                           7000101000013
  3.8         0.1           0.1            1.                             7000101000014
  5.9        29.            4.35                                          7000101000015
  7.7       150.           22.5                                           7000101000016
  9.        270.           40.5                                           7000101000017
 11.8       226.           33.9                                           7000101000018

 19.         41.            6.5                                           7000101000019
 20.9        41.            6.5                                           7000101000020
ENDDATA                 9                                                 7000101000021
ENDSUBENT              20                                                 7000101099999
SUBENT        70001011      750623                                        7000101100001
BIB                     4               5                                 7000101100002
REACTION    (48-CD-114(P,2N)49-IN-113M,CRO)                               7000101100003
METHOD      (STTA,INTB,BCINT)                                             7000101100004
SAMPLE      97.3 PER CENT 114-CD                                          7000101100005
PART-DET    (49-IN-113M,DG) HALF-LIFE 99.4 MIN                            7000101100006
            393 KEV PHOTONS,1.0 PER DECAY                                 7000101100007
ENDBIB                  5                                                 7000101100008
NOCOMMON                                                                  7000101100009
DATA                    3              11                                 7000101100010

EN          DATA         DATA-ERR                                         7000101100011
MEV         MB           MB                                               7000101100012
   9.8        18.            2.7                                          7000101100013
  10.9        74.           11.1                                          7000101100014
  11.8        88.           13.2                                          7000101100015
  13.7       201.           30.                                           7000101100016
  14.5       183.           27.2                                          7000101100017
  16.2       204.           30.6                                          7000101100018
  16.7       179.           26.8                                          7000101100019
  18.3       190.           28.5                                          7000101100020
  19.        162.           24.4                                          7000101100021
  20.3       190.           28.5                                          7000101100022
  20.9       145.           21.8                                          7000101100023
ENDDATA                13                                                 7000101100024

ENDSUBENT              23                                                 7000101199999
SUBENT        70001012      750623                                        7000101200001
BIB                     4               6                                 7000101200002
REACTION    (48-CD-116(P,N)49-IN-116M,CRO)                                7000101200003
METHOD      (STTA,INTB,BCINT)                                             7000101200004
SAMPLE      90.5 PER CENT 116-CD                                          7000101200005
PART-DET    (49-IN-116M,DG) HALF-LIFE 54 MIN                              7000101200006
            1293 KEV PHOTONS,0.85 PER DECAY +                             7000101200007
            2112 KEV PHOTONS,0.15 PER DECAY                               7000101200008
ENDBIB                  6                                                 7000101200009
NOCOMMON                                                                  7000101200010
DATA                    3              15                                 7000101200011
EN          DATA         DATA-ERR                                         7000101200012
MEV         MB           MB                                               7000101200013

   4.5         1.5           2.25                                         7000101200014
   5.2         6.7           1.                                           7000101200015
   5.9        20.            3.                                           7000101200016
   6.7        37.            5.55                                         7000101200017
   7.3        61.            9.15                                         7000101200018
   8.         85.           12.7                                          7000101200019
   8.5       123.           18.4                                          7000101200020
   9.        147.           22.                                           7000101200021
  11.5        90.           13.5                                          7000101200022
  13.5        37.            5.55                                         7000101200023
  15.2        24.            3.6                                          7000101200024
  16.7        18.            2.7                                          7000101200025
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  18.3        16.             2.4                                    70001012000026
  19.5        14.             2.1                                    70001012000027

  20.9        15.             2.25                                   70001012000028
ENDDATA              17                                              70001012000029
ENDSUBENT            28                                              70001012999999
SUBENT         70001013      750623                                   70001013000001
BIB                   4            5                                70001013000002
REACTION     (48-CD-116(P,2N)49-IN-115M,CRD)                         70001013000003
METHOD       (STTA,INTB,BCINT)                                       70001013000004
SAMPLE       90.5 PER CENT 116-CD                                    70001013000005
PART-DET     (49-IN-115M,DG) HALF-LIFE 4.5 HR                        70001013000006
             335 KEV PHOTONS,0.95 PER DECAY                          70001013000007
ENDBIB               5                                               70001013000008
NOCOMMON                                                             70001013000009
DATA                 3            7                                 70001013000010

EN           DATA        DATA-ERR                                    70001013000011
MEV          MB          MB                                          70001013000012
   11.5       195.          29.4                                     70001013000013
   13.5       289.          43.4                                     70001013000014
   15.2       319.          48.                                      70001013000015
   16.7       287.          43.1                                     70001013000016
   18.3       279.          41.9                                     70001013000017
   19.5       243.          36.4                                     70001013000018
   20.9       210.          31.5                                     70001013000019
ENDDATA              9                                               70001013000020
ENDSUBENT           17                                               70001013999999
ENDENTRY            13                                               70001999999999
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ENTRY            70002      750711                                          70002000000 1
SUBENT        70002001      750711                                          70002001000 1
BIB                12            21                                         70002001000 2
TITLE         (YIELDS FOR ISOTOPES BA-133M AND BA-133,ISOMERIS              70002001000 3
              RATIOS IN REACTIONS CS-133(P,N)BA-133M,G AND                  70002001000 4
              CS-133(D,2N)BA-133M,G)                                        70002001000 5
AUTHOR        (P,P,DMITRIEV,G,A,MOLIN,M,V,PANARIN)                          70002001000 6
INSTITUT      (4CCPFEI)                                                     70002001000 7
REFERENCE     (J,AE,35,61,73) ATOMNAJA ENERGIJA V,35,P,61,1973              70002001000 8
FACILITY      (CICLO,4CCPFEI) EPMAX=22,1,EDMAX=22,5 MEV                     70002001000 9
MONITOR       (29-CU-65(D,2N)30-ZN-65)P,P,DMITRIEV,N,N,KRASNOV,             70002001001 0
              ATOMNAJA ENERGIJA,V,18,P,184,1965                             70002001001 1
              (29-CU-65(P,N)30-ZN-65) N,N,KRASNOV,P,P,DMITRIEV,             70002001001 2
              ATOMNAJA ENERGIJA,V,20,P,57,1966                              70002001001 3

DETECTOR      (SCIN,NAJCR)                                                  70002001001 4

ERR-ANALYS    UNCERTAINTIES INCLUDE RANDOM ERROR OF PHOTOPEAK-AREA          70002001001 5
              AND DECAY CURVE ANALYSIS AS WELL AS SISTEMATIC                70002001001 6
              ERRORS ASSOCCIATED WITH COUNTER EFFICIECIES AND               70002001001 7
              SPREAD IN BEAM ENERGY, ERRORS IN DECAY SCHEME ARE NOT         70002001001 8
              INCLUDED,                                                     70002001001 9
ANALYSIS      (GAREA)                                                       70002001002 0
METHOD        (SITA,EXTB,EDEG,MONSEP,CHSEP)                                 70002001002 1
STATUS        (COMP)                                                        70002001002 2
SAMPLE        TARGETS - CS(CL) AND CS(NO3)                                  70002001002 3
ENDBIB             21                                                       70002001002 4
NOCOMMON                                                                    70002001002 5
ENDSUBENT          22                                                       70002001999 9

SUBENTRY      70002002      750711                                          70002002000 1
BIB                2             3                                          70002002000 2
REACTION      (55-CS-133(P,N)56-BA-133,TTY)                                 70002002000 3
PART-DET      (56-BA-133,DG) HALF-LIFE 7,2YR                                70002002000 4
              356+382 KEV PHOTONS,0,77 PER DECAY                            70002002000 5
ENDBIB             3                                                        70002002000 6
NOCOMMON                                                                    70002002000 7
DATA               3             6                                          70002002000 8
EN            DATA        DATA-ERR                                          70002002000 9
MEV           MKK/MKA*HR  MKK/MKA*HR                                        70002002001 0
  8,3          0,055        0,008                                           70002002001 1
 11,4          0,24         0,036                                           70002002001 2

 13,5          0,39         0,059                                           70002002001 3
 17,0          0,505        0,077                                           70002002001 4
 19,2          0,55         0,083                                           70002002001 5
 22,1          0,565        0,061                                           70002002001 6
ENDDATA            8                                                        70002002001 7
ENDSUBENT          16                                                       70002002999 9
SUBENT        70002003      750711                                          70002003000 1
BIB                2             3                                          70002003000 2
REACTION      (55-CS-133(P,N)56-BA-133M,TTY)                                70002003000 3
PART-DET      (56-BA-133M,DG) HALF-LIFE 38,9 HR                             70002003000 4
              276 KEV PHOTONS,0,17 PER DECAY                                70002003000 5
ENDBIB             3                                                        70002003000 6
NOCOMMON                                                                    70002003000 7
DATA               3             6                                          70002003000 8

EN            DATA        DATA-ERR                                          70002003000 9
MEV           MKK/MKA*HR  MKK/MKA*HR                                        70002003001 0
  8,3          28,          3,9                                            70002003001 1
 11,4         174,         26,2                                            70002003001 2
 13,5         311,         46,8                                            70002003001 3
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 17.0       438.          65.8                                    7000200300014
 19.2       470.          71.                                     7000200300015
 22.1       502.          37.8                                    7000200300016
ENDDATA                 8                                        7000200300017
ENDSUBENT              16                                        7000200399999
SUBENT          70002004      750711                             7000200400001
BIB                     2             3                          7000200400002
REACTION    (55-CS-133(D,2N)56-BA-133M,TTY)                      7000200400003
PART-DET    (56-BA-133M,DG) HALF-LIFE 38.9 HR                    7000200400004
            276 KEV PHOTONS,0.17 PER DECAY                       7000200400005
ENDBIB                  3                                        7000200400006
NOCOMMON                                                         7000200400007
DATA                    3             6                          7000200400008
EN          DATA         DATA-ERR                                7000200400009
MEV         MKK/MKA*HR   MKK/MKA*HR                              7000200400010
  9.1         105.           13.9                                7000200400011
 12.4         495.           74.                                 7000200400012
 14.1         860.          130.                                 7000200400013

 16.6        1345.          202.                                 7000200400014
 19.8        2060.          310.                                 7000200400015
 22.4        2370.          358.                                 7000200400016
ENDDATA                 8                                        7000200400017
ENDSUBENT              16                                        7000200499999
SUBENT          70002005      750711                             7000200500001
BIB                     2             3                          7000200500002
REACTION    (55-CS-133(D,2N)56-BA-133,TTY)                       7000200500003
PART-DET    (56-BA-133,DG) HALF-LIFE 7.2 YR                      7000200500004
            356+382 KEV PHOTONS,0.77 PER DECAY                   7000200500005
ENDBIB                  3                                        7000200500006
NOCOMMON                                                         7000200500007
DATA                    3             6                          7000200500008
EN          DATA         DATA-ERR                                7000200500009
MEV         MKK/MKA*HR   MKK/MKA*HR                              7000200500010
  9.1         0.11           0.015                               7000200500011
 12.4         0.48           0.075                               7000200500012
 14.1         0.87           0.13                                7000200500013
 16.6         1.16           0.18                                7000200500014
 19.8         1.81           0.27                                7000200500015
 22.4         2.2            0.33                                7000200500016
ENDDATA                 8                                        7000200500017
ENDSUBENT              16                                        7000200599999
ENDENTRY                5                                        7000299999999
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ALTER                                   CHARGED PARTICLES. KARLSRUHE
DICT     2
*COMMENT 1)ISO-QUANT.CMPD-QUANT AND NUC-QUANT ARE NOT USED IN THE
*          CASE OF CHARGED PARTICLE INDUCED REACTIONS. THESE
*          KEYWORDS ARE REPLACED BY 'REACTION'.
*        2)THE PARTICLE OR NUCLIDE DETECTED MUST BE EVIDENT EITHER FROM
*          'ISO-QUANT', 'REACTION', 'PART-DET', OR 'DECAY-DATA'.
*        3)THE HALF-LIFE SHOULD BE GIVEN UNDER 'DECAY-DATA' AND
*          NOT UNDER 'HALF-LIFE'.
*        4)THE PRODUCT NUCLEUS SHOULD BE MENTIONED UNDER
*          'REACTION' AND/OR 'PART-DET' BUT NOT UNDER 'RESID-NUC'.
REACTION  KEYWORD + CODED INFORMATION IN PARENTHESES OBLIGATORY
          FOR CHARGED PARTICLE INDUCED REACTIONS.
          UP TO 9 SUBFIELDS  (SF1(SF2,SF3)SF4,SF5,SF6,SF7,SF8,SF9)
          SF1 TARGET NUCLIDE Z-S-A(-MX)  (SEE 'ISO-QUANT')
          SF2 PROJECTILE                 (SEE DICT 13)
          SF3 OUTGOING PARTICLE(S)       (SEE DICT 13)
          SF4 PRODUCT NUCLIDE Z-S-A(-MX)(SEE 'ISO-QUANT')
          SF5 BRANCH
          SF6 QUANTITY MEASURED          (SEE DICT 10)
          SF7 PARTICLE
          SF8 MODIFIER                   (SEE DICT 12)
          SF9 CLASSIFICATION             (SEE DICT.12)
          THE SUBFIELDS ARE OBLIGATORY IF RELEVANT. A FREE TEXT
          EXPLANATION HAS TO BE ADDED, IF ONE OR MORE OF THESE
          SUBFIELDS ARE BLANK.
          THE RULES FOR COMBINATIONS OF DIFFERENT OUTGOING
          PARTICLES OR PRODUCT NUCLIDES ARE SIMILAR TO THE RULES
          APPLICABLE IN 'ISO-QUANT'. DIFFERENT TYPES OF
          OUTGOING PARTICLES IN SF3 MUST BE SEPARATED BY + ,
          E.G. 2N+P+A. IF SF5 TO SF9 CONTAIN MORE THAN
          ONE CODE A SLASH IS USED FOR SEPARATION.
FACILITY  THE FIRST SUBFIELD OF THE KEYWORD GIVING THE TYPE OF THE
          FACILITY (SEE DICT. 18) IS OBLIGATORY EXCEPT WHEN NOT
          RELEVANT. THE SECOND SUBFIELD GIVING THE LOCATION OF THE
          FACILITY (SEE DICT. 3) IS OPTIONAL. CODED INFORMATION IN
          PARENTHESES AND/OR FREE TEXT.
ADD-RES   KEYWORD 'ADDITIONAL RESULTS' OPTIONAL. FREE TEXT OR CODED
          INFORMATION IN PARENTHESES PLUS FREE TEXT (SEE DICT. 20).
MONITOR   KEYWORD OBLIGATORY EXCEPT WHEN NOT RELEVANT. CODED
          INFORMATION UP TO 13 SUBFIELDS IN PARENTHESES PLUS
          FREE TEXT.
          SF1 TO SF4 MONITOR REACTION, NOTATION AS GIVEN
              IN 'REACTION' SF1 TO SF4.
          SF5 ACCESSION NUMBER OF MONITOR REACTION IN EXFOR
              FILE
          SF6 FIRST AUTHOR OF PUBLICATION, ADDITIONAL AUTHORS
              ARE NOTED BY +. EXAMPLE. LANGE+,
          SF7 TO SF11 OR SF12 REFERENCE, NOTATION AS GIVEN IN
              'REFERENCE'.
          NEXT SUBFIELD (SF12 OR SF13) OPTIONAL INFORMATION
              ABOUT THE DATA, AS EVALUATED OR RECOMMENDED DATA.
              (SEE DICT 12)
RAD-DET   KEYWORD AND CODED INFORMATION IN PARENTHESES ARE OBLIGATORY
          IF THE NUCLIDE OBSERVED IS NOT OBVIOUS FROM 'REACTION' OR
          'DECAY-DATA'. THE FIRST SUBFIELD GIVES THE NUCLIDE AND THE
          ADDITIONAL SUBFIELDS THE TYPES OF THE RADIATION OBSERVED.
          (SEE DICT. 13).
          IF KEYWORD PRESENT THE DATA FOR OBSERVED RADIATION HAS TO
          BE GIVEN UNDER 'DECAY-DATA'.
DECAY-DATA KEYWORD OPTIONAL. IF KEYWORD PRESENT, THEN CODED
          INFORMATION IN PARENTHESES OBLIGATORY. THE SUBFIELDS
          ARE SEPARATED BY COMMAS (SF1,SF2, .... )
          SF1 NUCLIDE Z-S-A(-MX) (SEE 'ISO-QUANT')
          SF2 HALF-LIFE
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            SF3 TYPE OF RADIATION  (SEE DICT. 13)
            SF4 ENERGY OF RADIATION IN KEV
            SF5 ABUNDANCE OF RADIATION PER DECAY
            SF... SF3,SF4 AND SF5 MAY BE REPEATED AS OFTEN AS
                 NECESSARY
            FREE TEXT OPTIONAL.
REL-REF     KEYWORD OPTIONAL. CODED INFORMATION UP TO 8 SUBFIELDS
            IN PARENTHESES PLUS FREE TEXT.
            IN SF1 THE REASON FOR CITING THE REFERENCE IS GIVEN
            (SEE DICT. 20). IF THE CODE 'N' IS USED A FREE TEXT IS
            OBLIGATORY.
            SF2 FIRST AUTHOR OF PUBLICATION, ADDITIONAL AUTHORS
                 ARE NOTED BY +.
            SF3 TO SF8 REFERENCE, NOTATION AS GIVEN IN 'REFERENCE'
*COMMENT    THE KEYWORD 'REL-REF' REFERS TO PUBLICATIONS WHICH
*           ARE RELEVANT TO AN ENTRY  OR A SUBENTRY, FOR INSTANCE
*           TO THOSE PUBLICATIONS WHICH ARE INCLUDED IN AN
*           EVALUATION.
DICT     3
1USASTB     (STATE UNIVERSITY OF NEW YORK, STONY BROOK, N.Y)
1USANAL     (FERMI NATIONAL LAB.,BATAVIA, ILLINOIS)
2JAPNII     (NIIGATA UNIV., NIIGATA)
DICT     5
NC          (NUOVO CIMENTO) NUOVO CIMENTO SER.10                  2ITY
            STARTING WITH VOL.1(1955) UNTIL VOL.39 NO.4 (1965)
NC/A        (NUOVO CIMENTO A) NUOVO CIMENTO SECTION A,SER.10      2ITY
            STARTING WITH VOL.40 NO.1(1965) UNTIL VOL.70(1970)
            SER.11 STARTING WITH VOL.1(1971)
NC/B        (NUOVO CIMENTO B) NUOVO CIMENTO SECTION B,SER.10      2ITY
            STARTING WITH VOL.40 NO.1(1965) UNTIL VOL.70(1970)
            SER.11 STARTING WITH VOL.1(1971)
            UNTIL VOL.61(48) AND FROM VOL.71(58)
PPS/A       (PROC.PHYS.SOC.(LONDON)SECT.A) PROCEEDINGS OF THE     2UK
             PHYSICAL SOCIETY,LONDON,SECTION A
             EXISTING VOL.62 JAN.1949 - VOL.70 DEC.1957
PRS/A       (PROC.ROY.SOC.,LONDON,SER.A) PROCEEDINGS OF THE       2UK
             ROYAL SOCIETY,LONDON,SERIES A,MATHEMATICAL AND
             PHYSICAL SCIENCES
DICT     6
CERN-       (CERN EUROP.ORG.FOR NUCL.RES.) CERN EUROPEAN       2ZZZCER
            ORGANIZATION FOR NUCLEAR RESEARCH
DICT    10
SIG         (CROSS SECTION) CROSS SECTION FOR THE FORMATION OF THE
             SPECIFIED PRODUCT NUCLIDE OR THE SPECIFIED REACTION-
             TYPE (X,Y).
TTY         (THICK-TARGET-YIELD) THICK-TARGET-YIELD FOR THE
             SPECIFIED PRODUCT NUCLIDE
FY          (FISSION YIELD) INDEPENDENT, CUMULATIVE AND TOTAL CHAIN
              YIELD SEE MODIFIER (DICT 12)
PY          (PRODUCT YIELD) IN CASE OF CHARGED PARTICLE REACTIONS
              THIS CODEWORD IS USED WHENEVER CRO, TTY, FCR OR FY
              CANNOT BE APPLIED, E.G. AVERAGE CROSS SECTION FOR A
              LIMITED ENERGY RANGE. EXPLANATORY FREE TEXT IS
              OBLIGATORY.
DICT    12
BIN         BINARY
IND         INDEPENDENT YIELD OF THE PRODUCT NUCLIDE VIA DIRECT
             FORMATION ONLY
CUM         CUMULATIVE YIELD, I.E. YIELD OF THE PRODUCT NUCLIDE
              VIA DIRECT FORMATION AND RADIOACTIVE DECAY
*COMMENT    THE MODIFIER IND AND CUM ARE USED FOR ALL KINDS OF
*           NUCLEAR REACTIONS.
*COMMENT    CODEWORDS FOR CLASSIFICATION
EXP         EXPERIMENTAL DATA
THEO        CALCULATIONS BASED ON THEORY
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EVAL        EVALUATED DATA
RECOM       RECOMMENDED DATA
DICT    13
XR          (X-RAYS)
X           (UNDEFINED OUTGOING PARTICLES) IF THE AUTHOR DOES NOT
             STATE THE KIND AND NUMBER OF THE OUTGOING PARTICLES
             IN CHARGED PARTICLE INDUCED REACTIONS OR IF AMBIGUITY
             EXISTS IN RESPECT TO THE REACTION TYPES INVOLVED
EC          (ELECTRON CAPTURE)
SF          (SPONTANEOUS FISSION)
DICT    16
COMP        DATA OBTAINED FROM PUBLICATION BY THE COMPILER,
            CHECKED, BUT NOT APPROVED BY THE AUTHOR
CURVE       TABULAR DATA OBTAINED FROM A CURVE WITH A DATA-POINT
               READER
CPX-CURVE   DATA OBTAINED FROM A CURVE WITH A DATA-POINT READER
            BY K.F.MCGOWAN ET AL., PUBLISHED IN
            ORNL-CPX-1 (1964) FOR PRODUCTION OF MN,FE,CO.
            ORNL-CPX-2 (1964) FOR PRODUCTION OF NI,CU.
            NUCL.DATA,A1 (1966) FOR PRODUCTION OF LI,BE,B
            NUCL.DATA,A2 (1966) FOR PRODUCTION OF C.
            NUCL.DATA,A3 (1967) FOR PRODUCTION OF N,O.
DICT    18
LINAC       (LINEAR ACCELERATOR)
ISOCYC      (ISOCHRONOUS-CYCLOTRON,AVF-CYCLOTRON)
SYNCYC      (SYNCHROCYCLOTRON)
DICT    20              ADDITIONAL RESULTS / RELATED REFERENCES
RANGE       (RANGE OF RECOILS MEASURED)
DECAY       (DECAY PROPERTIES OF THE PRODUCT NUCLIDE)
IRAT        (ISOMERIC RATIO)
ANGD        (ANGULAR DISTRIBUTION)
            ------------------------------------------------------
E           REFERENCE USED IN THE EVALUATION
C           CRITICAL REMARKS
N           NOTE, SEE NEXT FREE TEXT
DICT    21
REC         (CROSS SECTIONS OR YIELDS DETERMINED BY THE COLLECTION
            OF RECOILS)
HEJET       (COLLECTION BY HE-JET)
CHSEP       (CHEMICAL SEPARATION)
ASEP        (SEPARATION BY MASS SEPARATOR)
SITA        (SINGLE TARGET IRRADIATIONS)
STTA        (STACKED TARGET IRRADIATIONS)
INTB        (IRRADIATIONS WITH INTERNAL BEAM)
EXTB        (IRRADIATIONS WITH EXTERNAL BEAM)
EDEG        (ENERGY-DEGRADATION BY FOILS) ENERGY-DEGRADATION OF THE
             BEAM BEFORE HITTING THE TARGET ARRANGEMENT
MONSEP      (SEPARATE MONITORFOIL)
MONMIX      (MIXED MONITOR) MONITOR AND TARGET COMBINED AS CHEMICAL
             COMPOUND OR MIXTURE OR MONITOR REACTION HAS THE SAME
             TARGET NUCLIDE AS THE REACTION GIVEN UNDER 'REACTION'.
BCINT       (BEAM CURRENT INTEGRATED) CODEWORD USED ONLY IF VALUES
             GIVEN IN THE DATA SECTION ARE BASED ON THIS
             MEASUREMENT
DICT    22
GEMUC       (GEIGER MUELLER COUNTER)
ARCOI       (ANNIHILATION RADIATION COINCIDENCE COUNTER)
IOCH        (IONISATION CHAMBER)
COIN        (COINCIDENCE COUNTER ARRANGEMENT)
DICT    23
GAREA       (PHOTOPEAK-AREA ANALYSIS)
INTANG      (INTEGRATION OF ANGULAR DISTRIBUTION)
DICT    24
*COMMENT  THE MEANING OF THE CODE 'EN' SHOULD BE EXTENDED TO
*          'ENERGY OF INCIDENT PROJECTILE, LAB-SYSTEM'. THIS
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*           EXTENSION SHOULD ALSO APPLY TO THE OTHER CODEWORDS,
*           WHICH CONTAIN 'EN', LIKE 'EN-CM'.
DATA         HEADING FOR COLUMN GIVING THE QUANTITY SPECIFIED
             UNDER 'ISO-QUANT' OR 'REACTION'
RATIO        HEADING FOR COLUMN GIVING THE RATIO SPECIFIED UNDER
             'ISO-QUANT' OR 'REACTION', OR THE QUANTITY/STANDARD
SUM          HEADING FOR COLUMN GIVING THE SUM SPECIFIED UNDER
             'REACTION'
SUM-ERR      SUM-ERROR. EXPLANATION UNDER 'ERR-ANALYS'
+SUM-ERR     +UNSYMMETRIC SUM-ERROR. EXPLANATION UNDER 'ERR-ANALYS'
-SUM-ERR     -UNSYMMETRIC SUM-ERROR. EXPLANATION UNDER 'ERR-ANALYS'
MONIT        HEADING FOR THE COLUMN GIVING VALUES FOR THE MONITOR.
ENDDICTION
ENDALTER
```

BROOKHAVEN NATIONAL LABORATORY

MEMORANDUM

DATE: July 30, 1975

TO: Task Force on Generalized ENDF Format

FROM: C. L. Dunford

SUBJECT: Results of Task Force Meeting July 15-16 at ORNL

I am enclosing a discussion of the organization of a generalized evaluated nuclear data file. In particular, I will explore the definition of the logical units of such a data file. At the same time, I will attempt to draw some conclusions about the ENDF format as we had agreed to do at the meeting. The final section of the enclosure will consist of some general statements about the structure of these logical units. However, I will defer in detail to Bob MacFarlane to prepare a discussion on this point. One general comment on the future ENDF. If we are proceeding on the assumption that there exists only one file, from which all special purpose evaluated data files will be derived, then the concept of the General Purpose file consisting of only complete evaluations must disappear. The evaluator would be responsible for seeing that any new data entered is compatible with what currently exists in the file.

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Distribution:

R. Howerton
R. MacFarlane
S. Pearlstein
F. Perey
R. Roussin

I. Background on File Organization

First, I would like to introduce the concept of a "key" which is fundamental to all data base management systems. A key is a numeric or alphanumeric descriptor which is used to define the contents of a logical unit of information in the data base. A key or a combination of keys can be used to define and retrieve sections from the data base. Therefore a set of keys must be defined such that they are unique and comprehensive. In the following sections, I will attempt to define a set of keys for nuclear data.

II. Interpretation of Present Formats

The ENDF/B system can be interpreted as having three keys.

1. MAT - target nucleus
2. MF - property
3. MT - reaction or other quantity

The ENDL format which was proposed as a successor to ENDF/B has the following keys.

1. ZA - target nucleus
2. Y_i - incident particle
3. Y_o - outgoing particle whose property is being described
4. C - reaction or structure designator
5. I - reaction property
6. S - reaction modifier
7. $X_{i=1,4}$ - up to four parameters defined by S

It is clear from this comparison that ENDF/B is much to restrictive. The only way to generalize ENDF without extreme difficulties is to expand the meaning of the three keys as I proposed in my December 1974 Memo. One quickly runs out of integers if MAT stands for projectile, target, and target state all at one time.

The ENDL system is far more comprehensive using six independent and one dependent key ($X_{i=1,4}$). The two major deficiencies of the ENDL system is the lack of a key for the state of the target and the use of a dependent key.

III. Keys Proposed for a Generalized ENDF/B

A large part of the Task Force Meeting was devoted to describing the types of nuclear data to be considered. In general the bounds on the type of information to be stored are:

1. No complex projectile, that is one for which the state of the projectile must be given.
2. Only information about the initial and final properties of the nuclear system are important.

Within these restrictions, the following nine keys seem to be adequate.

1. Projectile
2. Target nucleus
3. Target nucleus excitation energy
4. Process identifier
5. Process modifier
6. Residual nucleus
7. Residual nucleus excitation energy
8. Product whose property is tabulated
9. Property being tabulated

Projectile - neutron, proton, electron, etc. or none.

Target nucleus - isotope, element, compound or alloy (may be parent isotope in radioactive decay data)

Process identifier - (?, Total), (?, 2p), (?, Xn), (β^+ decay), (α decay) and such special information like resonance parameters, S(α, β) and level structure.

Process modifier - isomer production, cross section ratio etc. (much restricted compared to ENDL's S-parameter)

Product whose property is tabulated - generally a light particle such as γ, neutron, β^- etc. but in the case of recoil spectra, it could be a heavy nucleus.

Property being tabulated - cross section, secondary distributions, energy deposits, etc.

The meaning of the remaining three keys is obvious. It is clear that the residual nucleus is redundant if projectile, target and reaction are known (or if parent and decay mode are known). However, it is possible for a process to be complex or indeterminate in which case the residual nucleus must be given. (See fourth example below.)

IV. Comparison of Proposed File Structure with Others.

key	ENDF/B	ENDL
1	No	Yes (Y_1)
2	Yes (MAT)	Yes (ZA)
3	No (separate MAT)	No
4	Yes (MT)	Yes (C)

(cont'd)

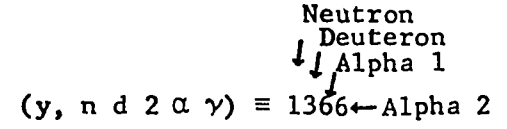
Key	ENDF/B	ENDL
5	No (separate MT)	Yes (S)
6	No	Yes (S=5)
7	No	Yes (S=5)
8	Partially (MF)	Yes (Y_o)
9	Yes (MF)	Yes (I)

Serious difficulties can arise when a single key is used to serve several functions which is the case in general in ENDF/B. That fact is one of the two major difficulties in generalizing ENDF/B.

V. Construction of keys

It is not clear to me in most cases whether the keys should be simple alphanumeric codes or whether integer equivalents are preferable. For the keys giving excitation energies, clearly a floating point number is required. The process modifier and property keys should be integer equivalents.

We spent considerable time discussing the construction of the process identifier. Although this discussion was very useful as an aid to exploring the range of data types, I have reached the conclusion that our final product was too restrictive. We will have to adopt a set of numerical equivalents. As part of the organization of this table a way must be found to tell whether a given particle is one of the products of a reaction. ENDF/B does this in a primitive way (neutrons or no neutrons). ENDL is somewhat better, but still breaks down when looking for a given charged particle. Something like Table 3 of the ENDL documentation will need to be constructed, perhaps using more digits to describe a multi-particle final system. For example the reaction descriptor for



In the ENDL system the particle order in the reaction designator is important. For example, (y,npγ) is different from (y,pnγ). If it is not possible to determine anything but (y,npγ) + (y,pnγ) we must be able to enter such a sum cross section easily. This can be done by using a "Process modifier" key which says "particle order not known".

VI. Examples of Use of Keys

1. Fe (n,Tot) σ(E)
   /N/FE/0.0/TOT/ / / / / /

2. Am^{241M}(n,Xf) σ(E)
   /N/AM-241/.0486/Xf/ / / / / /

(cont'd)

3. $O^{16}(p,p'\gamma)$ 6.13 Mev level excitation $\frac{d\sigma_p}{d\Omega}(E,\theta)$

/P/O-16/0.0/pγ/Level Excitation/ O-16/6.13/P/$\frac{d\sigma}{d\Omega}$/

4. Ti(n,?) Sc^{46} σ(E)

/N/TI/0.0/ / /SC-46/0.0/ /σ(E)

5. $Nb^{93}(n,n'\gamma)$ Isomer production 29 kev level σ(E)

/N/NB-93/0.0/nγ/Isomer Production/NB-93/.029/ /σ(E)

6. $Nb^{93}(n,n'\gamma)$ $\sigma(E,E_\gamma)$

/N/NB-93/0.0/nγ/ / / /γ/$\sigma(E,E_\gamma)$

7. Tm^{183} β^- decay γ-spectrum

/ /TM-183/0.0/β^-/ / / /γ/$N(E_\gamma)$

8. Fe(n,p) Recoil spectrum

/N/Fe/0.0/p/ / / /Fe/$N(E_{Fe})$

Resonance parameters should be treated as an exception to the generalized file structure. Each logical unit would describe several rather than a single nuclear reaction.

9. Pu^{239} MLBW resonance parameters

/N/PU-239/0.0/Res/MLBW/ / / / /

VII. Structure of a Section

The structure of a section will be dependent on the function being described and its parameterization. I think much of the ENDF/B structure as extended in my December Memo could be carried over to the generalized file. Perhaps multiplicities should not be included in the section with secondary distribution functions but have their own section. (In many cases the multiplicity is energy independent and uniquely defined for a reaction).

Each section may have multiple subsections when more than one functional representation is required for the property description. There should be shortened form for indicating default conditions such as isotropic angular distributions or equal probability energy distributions.

It is important that the format recognize the unity between discrete and continuum representations. In particular, all secondary distributions should be given in terms of a sum over discrete (delta functions) values and a continuum.

The TAB1 record should be generalized so that the unit of information is variable length. For example the units may be

1. $E,\sigma(E)$ (2 per unit)
2. $E,\sigma(E), \frac{d^2\sigma(E)}{dE^2}$ (3 per unit)
3. $E,\sigma(E), \Delta\ \sigma(E)$ (3 per unit)
4. E_r, g, Γ, Γ_n, Γ_γ, Γ_f (6 per unit)

Finally the structure of a resonance parameter record should be such that the parameters and any smooth background cross section should be in the same section.

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