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**INDC**

**INTERNATIONAL NUCLEAR DATA COMMITTEE**

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Summary Report

on the

Consultants' Meeting

on

Charged Particle and Photonuclear Reaction Data

24-26 April 1974, Vienna

Edited by

A. Calamand

Nuclear Data Section

Vienna, June 1974

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



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## Foreword

The reasons for convening a Consultants' Meeting on Charged Particle and Photonuclear Reaction Data are closely connected with the overall development of international cooperation in the compilation, evaluation and dissemination of nuclear data and are briefly outlined below.

The interest of the International Atomic Energy Agency (IAEA) in nuclear data started in the early sixties with the establishment of the International Nuclear Data Scientific Working Group (INDSWG), which was later consolidated as a continuing advisory body with the name International Nuclear Data Committee (INDC). Upon recommendation of INDSWG, the Nuclear Data Section (NDS) was formed in 1964; it implements the nuclear data programme of the IAEA and also acts as secretariat of the INDC.

Since then, the activities of the Section have been mostly related to neutron data whose compilation and evaluation are essential to fission reactor design and development. International cooperation was successfully established and has led to the present fully operational Four Neutron Data Centres network\*.

During the same period, the application of nuclear techniques has witnessed a tremendous development in many fields of science and technology. This development requires many more nuclear data, in particular non-neutron nuclear data. The general situation in this field was first surveyed in 1970 by an Agency Consultants' Meeting which led to the creation in 1972 of the International Working Group on Nuclear Structure and Reaction Data (IWGNSRD). This working group was efficient in assessing data needs in various fields of applications, in reviewing the existing compilation and evaluation activities, and in assisting the Agency in the preparation of the Symposium on Applications of Nuclear Data in Science and Technology which was convened in Paris in March 1973. The Symposium demonstrated, among other things, the broadened requirements of nuclear data users and the

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\* National Neutron Cross Section Centre (NNCSC)  
NEA Centre de Compilation de Données Neutroniques (CCDN)  
Centr po Jadernym Dannym (CJD)  
IAEA Nuclear Data Section (NDS)

need for an increased support of the compilation and evaluation of basic non-neutron nuclear data, in order to satisfy these requirements. The administrative and policy functions of the IWGNSRD, now dissolved, have been transferred to INDC, and its more technical responsibilities to various specialized groups such as this Consultants' Meeting on Charged Particle and Photonuclear Reaction Data.

Considering that the compilation and evaluation of charged particle and photonuclear reaction data, which, to date, have been accomplished mainly on an individual or national basis, would be usefully enhanced by establishing a truly international cooperation for the maximum benefit of a growing community of users, the main objectives which were achieved by the meeting, are the following:

- to briefly outline the general scope of the data needs;
- to review the present activities of the existing centres and groups involved in compilation and evaluation activities;
- to formulate policy guide-lines that the IAEA would submit to national authorities for implementation.

This summary report includes the conclusions and recommendations as well as the adopted agenda, the list of participants and the list of documents presented at the meeting.

IAEA Consultants' Meeting  
on Charged Particle and Photonuclear Reaction Data  
24 - 26 April 1974, Vienna

Status, Conclusion and Recommendations

I. Status

The present status of the compilation and evaluation of charged particle and photonuclear reaction data is as follows:

A. References

A complete file of bibliographic references is the basis of any system of data compilation and evaluation. In this regard, the reference file and keyword system for research on nuclear structure and decay and on nuclear reactions of the Oak Ridge Nuclear Data Project in the USA are currently recognized to be the most complete and adequate referencing system available. Its output consists of lists of bibliographic keyworded information which are published three times per year as "Recent References" in the Nuclear Data Sheets and which are provided on a regular basis to other nuclear data centres and groups.

In the USSR, the Nuclear Data Centre of the Leningrad Institute of Nuclear Physics at Gatchina and the Centre of the State Committee on the Utilization of Atomic Energy for Nuclear Structure and Reaction Data at the Kurchatov Institute in Moscow are contemplating the development of a bibliographic reference file based on the keyword system of the Oak Ridge Nuclear Data Project.

B. Charged Particle and Photonuclear Reaction Data

The Photonuclear Data Centre at the National Bureau of Standards in Washington, D.C. in the USA and the Charged Particle Nuclear Data Group of the Nuclear Research Centre at Karlsruhe in the Federal Republic of Germany (hereafter referred to as the US Photonuclear Data Centre and the FRG Charged Particle Nuclear Data Group) are the currently leading centres for the compilation and evaluation of these types of data. In the USSR, the Nuclear Data Centre at the Kurchatov Institute is responsible for the compilation and evaluation of these data; it serves also as an information centre for users in the Soviet Union.

a) The US Photonuclear Data Centre

- systematically abstracts, collects, and indexes data from the published literature in the field of photonuclear physics\*;
- maintains a library of digitized photonuclear cross section data;
- serves as an information center for the field of photonuclear physics;
- periodically publishes an updated cumulative index to the data published in the field and those in its files [1].

The Center is currently preparing a comprehensive atlas on photonuclear reaction data to be published in three sections starting early in 1975.

b) The FRG Karlsruhe Charged Particle Nuclear Data Group

- compiles and evaluates excitation functions of charged-particle induced nuclear reactions. The more recent results of these efforts are being published in 3 volumes of the new Landolt-Boernstein handbook series [2];
- is taking steps towards the digitalization of these data.

The participants also recognized the recent compilations of charged particle and photonuclear reaction cross sections performed by two Swedish groups at Lund and Studsvik [3] and the intention of the Lund group to compile photonuclear data for higher photon energies up to about 1 GeV.

## II. Conclusion

Considering the broad current and future needs for charged particle and photonuclear reaction references and data, which have been documented e.g. in ref. [4], the participants believe 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.

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\* Photonuclear physics data are defined to be any experimental results that give information about the electromagnetic matrix element connecting the ground state of a nucleus with any excited state of the continuum.

### III. Acknowledgement

The participants acknowledge the recommendations of the INDC and express their appreciation to the IAEA Nuclear Data Section for convening this meeting and for all steps it has taken in the past and will take in the future towards implementing an international system for the compilation, evaluation and exchange of such data.

- [1] "Photonuclear Reaction Data, 1973". NBS Special Publication 380.
  
- [2] Landolt-Boernstein, new series, Springer Verlag  
Vol. I, 5a includes Q-values for 64 reaction types with 25 different projectiles (666 pages, Spring 1973)  
Vol. I, 5b includes 1800 excitation functions for charged particle induced reactions (493 pages, Summer 1973)  
Vol. I, 5c includes a systematic of excitation functions for nuclear reactions induced by p, d,  $^3\text{He}$  and  $\alpha$ . (about 250 pages, in print).
  
- [3] I. Lorenzen and D. Brune "Excitation functions for charged particle induced reactions in light elements".  
B. Buelow and B. Forkman "Photonuclear cross-sections"; two chapters of the forthcoming IAEA Handbook on Nuclear Activation Cross Section Data to be published in summer 1974.
  
- [4] - Nuclear Data in Sciences and Technology (Proc.Symp.Paris, 1973) IAEA, Vienna (1973). 2 volumes.  
- A. Calamand "Survey of current and future needs for charged particle and photonuclear reaction data", Report INDC(NDS)-62.

#### IV. Recommendations

In order to ensure continuity, quality, completeness and the maximum benefit to the growing community of users of charged particle and photonuclear reaction data in science and technology, the participants make the following recommendations:

##### A. References

In order to facilitate the transfer of bibliographic information on charged particle and photonuclear reaction data, compilation groups which are contemplating the development of reference systems should consider adopting the keywords and reference system of the Oak Ridge Nuclear Data Project building on the expertise acquired by this Project. The Project's references master file should be provided to nuclear data centres such as that at the Kurchatov Institute and upon request also to neutron data centres.

##### B. Charged particle and photonuclear reaction data

1. The existing centres and groups involved in the compilation and evaluation of charged particle and photonuclear reaction data are strongly urged to continue their efforts and to build up and maintain computer files of these data.
2. Groups interested in the compilation and evaluation of charged particle and photonuclear reaction data should be encouraged to do so in close consultation with the US Photonuclear Data Center and the FRG Charged Particle Nuclear Data Group. Research groups in these fields should be asked to supply their results to these centres and groups on a regular basis, preferably in digitized form. One might envisage this flow of data to take place via direct communication to these two data centres or through regional data centres such as the Nuclear Data Centre at the Kurchatov Institute whichever way is most efficient.
3. The participants strongly recommend that the content of the master files resulting from this international effort be made available to the entire user community. As far as the numerical data are concerned, this might be most conveniently achieved by utilizing the well established dissemination mechanisms such as the neutron data centres and other centres such as the Nuclear Data Centre at the

Kurchatov Institute. It is therefore recommended that these centres, should they request it, be supplied with the master files of the US Photonuclear Data Centre and of the FRG Charged Particle Nuclear Data Group.

4. The participants urge all centres concerned that, in the exchange of experimental and evaluated charged particle and photonuclear reaction data, strong consideration be given to studying and employing existing widely used computer formats.

5. In view of the immensely large volume of measured data on angular and energy distributions of secondary particles in charged particle nuclear reactions, the participants recommend that the INDC be asked to investigate, whether, in addition to energy dependent cross section data, there is a real applied need to justify and demand the systematic inclusion of angular and energy distribution data in the scope of an international compilation effort.

#### C. General recommendations, implementation

The participants ask the Director General of the IAEA, after consultation with the INDC, to take the appropriate steps in order to implement these recommendations and to communicate them to the national authorities and professional societies concerned. In view of the urgency of these problems, the participants are concerned that the Governments which will be approached respond at their earliest convenience so that the proposed international cooperation can be implemented with the least possible delay for the benefit of the entire nuclear community. The assistance of INDC members and liaison officers in approaching the pertinent professional societies in their countries would be helpful.



Consultants' Meeting on Charged Particle  
and Photomuclear Reaction Data

Vienna, 24 - 26 April 1974

LIST OF PARTICIPANTS

Consultants

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Nuclear Data Section

Consultants' Meeting on  
Charged Particle and Photonuclear Reaction Data

Vienna, 24-26 April 1974

Adopted Agenda

- I. Survey of current and future needs for charged particle and photonuclear reaction data (paper to be prepared by the Nuclear Data Section).
- II. Review of activities of existing compilation centres and groups.
  1. Scope and format of the compilations (references, data and associated information).
  2. Publications and services to users.
  3. Completeness of existing compilations.
  4. Existing collaborations.
- III. Feasibility of international cooperation in the compilation and exchange of charged particle and photonuclear reaction references and data.
- IV. Feasibility and functions of an international data information bureau.
- V. Conclusions and recommendations.



LIST OF DOCUMENTS

The documents marked with a ✓ are published in INDC(NDS)-61 together with documents presented at the Specialists' Meeting on Nuclear Data for Applications (29 April - 3 May 1974, Vienna), the summary report of which is published as INDC(NDS)-60.

1. Survey of current and future needs for charged particle and photonuclear reaction data, by A. Calamand (Paper presented to the meeting\*).
2. "Photonuclear Physics 1973, Where We Are and How We Got There", by E. Fuller  
Reprint from the Asilomar Conference on Photonuclear Reactions & Applications, March 26-30, 1973.
3. Photonuclear Reaction Data, 1973 - NBS Special Publication 380. U.S. Department of Commerce, National Bureau of Standards, issued March 1973.
4. Photonuclear Reactions, by E. Hayward. NBS Monograph 118. U.S. Department of Commerce, National Bureau of Standards, issued August 1970.
5. Summary of Compilation and Evaluation Activities (Photonuclear Reactions). Excerpt from recent USNDC meetings.
6. The Photonuclear Data Centre, March 1974.  
(Description of the centre activities).
7. Charged Particle Cross Section (CPX) Data Center computer - based files.
8. Charged-Particle Cross Section Data Center.  
(Dates and Titles of Publications)
9. Nuclear cross sections for charged-particle-induced reactions, N and O, compiled by H.J. Kim, W.T. Milner, and F.K. McGowan. NUCLEAR DATA, Section A, Volume 3, Number 2, September 1967.  
(Sample).
10. Reaction List for Charged-Particle-Induced Nuclear Reactions Z = 1 to Z = 98 (H to Cf), July 1972 - June 1973.  
by F.K. McGowan and W.T. Milner  
ATOMIC DATA AND NUCLEAR DATA TABLES 12, 499-583(1973).

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\* Revised version published as INDC(NDS)-62.

11. Computerized Libraries of Nuclear Data, by S. Pearlstein  
March 1, 1974.
12. Generalized EXFOR Isoquants (Nuclear Data Section proposal  
reproduced from Four Centres Memo 4C-3/93.)
13. Nuclear Data Section Short Guide to EXFOR.
14. Principles of constructing systematized, bibliographic nuclear  
data files, by A.I. Abramov - Report INDC(CCP)-29/L.
15. Photonuclear Cross Sections, by B. Buelow and B. Forkman.
16. Excitation Functions for Charged-Particle-Induced Reactions  
in Light Elements, by J. Lorenzen and D. Brune.  
(Documents 15 and 16 are two chapters of the forthcoming IAEA  
Handbook on Nuclear Cross Section Data for Activation Analysis).
17. Nuclear Structure Data File - Preliminary Specifications -  
March 29, 1974, by the Nuclear Data Project.
18. Memo of March 20, 1974 from W.B. Ewbank to the Nuclear Data  
Project Compilers.
19. The Digital Data Files of the Photonuclear Data Center,  
by H.M. Gerstenberg.
20. Landolt-Boernstein - New series - Springer Verlag
  - Band I 5a - Q-values for 64 reaction types with 25 different  
projectiles.
  - Band I 5b - 1800 excitation functions for charged-particle  
induced reactions
  - Band I 5c - Systematics of excitation functions for nuclear  
reactions induced by p, d,  $^3\text{He}$  and  $\alpha$  particles  
by H. Muenzel et al.
21. The State of Work on Non-Neutron Nuclear Data in the USSR, by  
L.L. Sokolovskij, Yu.I. Fenin and F.E. Chukreev.