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INDC INTERNATIONAL NUCLEAR DATA COMMITTEE

COORDINATION OF THE ATOMIC AND MOLECULAR DATA CENTRE NETWORK

Summary Report of a Consultants' Meeting
organized by the International Atomic Energy Agency,
held at IAEA Headquarters in Vienna, Austria,
13-15 June 1984

Edited by A. Lorenz

October 1984

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

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Abstract

Summary report of the Fourth A+M Data Centre Network Meeting convened by the IAEA at IAEA Headquarters, Vienna, Austria, 13-15 June 1984. The meeting was attended by seven representatives of centres from four Member States concerned with the coordination of the international management of atomic and molecular data pertinent to controlled fusion research and technology.

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A. Meeting Summary

1. Introduction

The third A+M Data Centre Network (DCN) meeting was convened by the IAEA Nuclear Data Section at IAEA Headquarters in Vienna, Austria, on 13-15 June 1984. The meeting was attended by nine representatives of data centres from Six Member State, concerned with the coordinated international management of atomic and molecular data pertinent to controlled fusion research and technology. The meeting was chaired by A. Lorenz.

The participants in this meeting are listed in Appendix 1, the Adopted Agenda is given in Appendix 2, and the papers submitted to the meeting are listed in Appendix 3. The List of Actions which resulted from this meeting is given in Appendix 4.

2. Meeting Conclusions

1. The data centres agreed to send input to the A+M Bibliographic Data Base to the IAEA on a regular basis.

2. The IAEA will continue to publish the Quarterly Bulletin using contributed input from the other centres.

3. The data centres approved the new format for the 1985 CIAMDA publication.

4. The data centres agreed to collaborate on the formulation of definitions of atomic processes for common use by the centres.

5. The data centres agreed to send compiled A+M data on tape to the IAEA in EXFOR format whenever possible.

6. The IAEA will create a master file of atomic collision data and distribute an index of the content of this data base to the other centres on a regular basis.

7. The data centres reviewed the proposed EXFOR dictionaries and agreed on a number of revisions and additions.

3. Next Meeting

In view of the more accelerated pace in the development of inter-centre organization for the exchange of atomic data, the meeting participants felt that the next network meeting should take place in a years's time. It was proposed to hold the meeting as a satellite meeting of the next ICPEAC meeting, which is to take place at Stanford University, Palo Alto, California, at the end of 24 - 30 July 1985.

B. Meeting Proceedings

1. Progress Reports

1.1. C. F. Barnett (Oak Ridge National Laboratory)

1.2. J. C. Delcroix (Laboratoire Physique des Plasmas, Orsay)

1.3. V. A. Abramov (Kurchatov Institute)

1.4. H. Tawara (IPP, Nagoya)

1.5. Y. Nakai (JAERI)

1.6. G. Ebel (Fachinformations Zentrum, Karlsruhe)

1.7. J. Hughes (Queens University, Belfast)

1.8. W.L. Wiese (US National Bureau of Standards)

Individual reports are not included in these proceedings, copies can be obtained from the IAEA A+M Data Unit.

2. Report of the A+M Data Unit

A report on the current staffing and programme status of the A+M Data Unit was presented by A. Lorenz. The report of the A+M Data Unit is included as Appendix 5.

3. Bibliographic Data

3.1. Compilation and Exchange of Bibliographic Data

Effective mid - 1984, the data input to the A+M/BDB will be supplemented by contributions from the A+M data centre network. The following transmission schedule was provisionally agreed upon:

from ORNL: 1) a monthly tape of their current input to their data base.
2) a monthly work sheet with listing of A+M reports.

from Orsay: 1) a quarterly tape of the Gaphyor input representing a three-month compilation input period.
(in Gaphyor index format)

from Nagoya and JAERI: a monthly indexed listing of a Japanese publications (including surface effects references).

from Moscow: a quarterly indexed listing of Soviet publications.

from Belfast: a monthly tape with reference to Journal Physics B and Phys. Rev. A resulting from systematic scanning of these 2 journals.

Following the transitional period of July and August (during which time trial transmissions are to be sent by ORNL and Gaphyor), regular transmission from the other centres should start in September 1984.

3.2. Status and Future of the A+M Data Bulletin

The publication of the A+M Data Bulletin is expected to continue without interruption in spite of the staff changes at the IAEA. It is expected that the input to the A+M/BDB provided by the other centres will compensate the reduced bibliographic data compilation which has been done until now by the A+M Data Unit.

3.3. Publication of the CIAMDA Index

The next publication of CIAMDA is planned for 1985. This index is proposed to be published in a new format consisting of an abbreviated reference citation and a concise description of the data. (A sample page of the proposed format is included as Attachment 1 to the A+M Data Unit progress report, Appendix 5).

Discussions on the CIAMDA 85 publication brought on the question as to which reactant sort order to use. Suggestions varied from simple alphabetical (ORNL) to one based on the Mendelejeff system (Gaphyor). It was left as an action on the A+M Data Unit to resolve this question.

Action 1

3.4. Terminology and definition of processes

Another consideration arose in the context of data centre collaboration in the exchange of bibliographic and numerical A+M data: namely the need to have a commonly agreed upon set of definitions of atomic processes.

It was agreed that atomic physics processes are defined by the initial and final states of the reactants, and that this be used as the basis for the definition of individual processes. Delcroix agreed to create a list of initial and final states for 2-element systems from the Gaphyor files and send this list to all network members.

Action 2

A similar consideration was discussed regarding terminology used to described surface phenomena. Member of the network agreed to send definitions of surface effects phenomena to Katsonis (within 2 months), who will compile a proposed common list, and distribute it for consideration at the next meeting.

Actions 3 and 4

4. Numerical Data

4.1. Exchange of Numerical Data

The objective of international data exchange is to avoid unnecessary duplication of compilation effort, and to provide a mechanism for all centres to have the same data base. In order to achieve this, IAEA has developed a format for the unambiguous exchange of numerical A+M data: the A+M EXFOR. This format has been adopted and put to use by the Belfast and JAERI data centres; the Gaphyor centre (which will start developing a numerical data capability starting in 1984) and the Kurchatov centre have expressed their intention to adopt the A+M EXFOR format. Nagoya and ORNL compile numerical data in their own formats and do not have the capability at the present time to convert their data files to the A+M EXFOR.

Both Nagoya and ORNL have offered to provide their numerical data files to IAEA in their own original formats. As time permits, IAEA will write translation programes to translate these data files into the international A+M EXFOR format. ORNL has offered to send to IAEA on a regular basis evaluated heavy particle collision data which they are compling for the publication of the new issue of the ORNL "Red Books"

All data received by IAEA will be entered and stored in a master file in EXFOR format; this file will be referred to as the A+M/NDB and will be the source file for all compiled A+M collision data.

4.2. EXFOR Index

In order to provide a means to identify the data which are stored in the A+M/NDB, the A+M Data Unit will produce a data index (similar to the CIAMDA index for bibliographic data) and distribute it periodically to the other data centres. This index will be sent to the centre network as soon as the initial version of the A+M/NDB has been established.

Action 5

A sample page of this index is reproduced at Attachment 2 of the Report of the A+M Data Unit (see Appendix 4).

4.3. Review of A+M EXFOR Dictionaries

In order to be able to exchange data between members of the A+M data centre network most effectively and unambiguously, it is of utmost necessity for all participanting centres to use the same nomenclature, terminology and definitions in their data transmissions. As such, the dictionaries used to describe the

transmitted data, together with the format structure of the encoded data, form the basis of the A+M EXFOR; both have been described in report IAEA-NDS-AM 15. The dictionaries given in that report were in the form of proposals which needed to be extended and developed by the data centre network. To achieve this, members of the network present at the meeting reviewed the proposed dictionaries and decided on the following changes:

Dictionary 1: Reference Types

No changes

Dictionary 2: Journal Codes

The following was decided:

1. All Journal Codes must be converted to codes consisting of a maximum of four digits, including the numerical digits but excluding lower case characters.

Action 6

2. Members of the network should send to the IAEA suggestions for additional journals to be included in the dictionary and corrections to existing code descriptions.

Action 7

3. For translated journals, include (transliterated) name of original journal, with a statement e.g. "translation of ...".

Dictionary 3: Report Codes

IAEA is to create a proposed Report Code Dictionary, and send it to the Network for comments and corrections.

Action 8

Dictionary 4: Institute Codes

1. The format of the institute code was decided to be composed of a 2-letter country code, followed by a three letter lab/institute code.

2. Members of the network should send to the IAEA a list of suggested institutes (together with their full title and addresses) to be included in the "Institutes" dictionary.

Action 9

Dictionary 5: Data Type Codes

The following code was added:

FIT Fitting parameters of analytical expressions

The suggestion to add codes to indicate that "data were read from curve, copied from table, or digitized from graph" was not accepted as this type of information is not used as retrieval criterion. Instead, such information can be entered as a free text format comment following the coded keywords.

Dictionary 6: Status Codes

No changes.

Dictionary 7: History Codes

No changes.

Dictionary 8: Method Codes

The network felt that this dictionary was not completely finalized, and needed more work. In addition to the prefixes T for theoretical, and X for experimental methods, it was suggested to add the prefix E for evaluation method.

The network was requested to write in suggestions for additions and general organizations of this dictionary.

Action 10

Dictionary 9: Error Type Codes

No changes

Dictionary 10: Reactant Codes

The network was not satisfied with the ordering of the reactants as proposed in IAEA-NDS-AM 15, and suggested a number of alternatives. One suggestion was to separate the elements from the molecules and list both alphabetically. IAEA was asked to propose a suggested list and distribute it to the data centres for their consideration.

Action 11

It was suggested to add TiC (Titanium Carbide) to the list of molecules.

Dictionary 11: Reaction Processes

The network felt that this dictionary must be reorganized on the basis of the initial and final states of possible reactions. Delcroix was asked to produce a proposed list of reactions on that basis.

Action 2

Dictionary 12: Quantity Codes

The following changes and additions were suggested:

change	SGV	Reaction Rate Coefficient (sigma x velocity)
add	CST	Collision Strength

Dictionary 13: Quantity Modifier

The following changes and additions were suggested:

Remove	SPA	Spectrum averaged
Add	REL	Relative data

Dictionary 14: Data Heading Codes

A complete revision of this dictionary was performed by the network members during the meeting. It will be distributed to the Network in the first Dictionary transmission.

Dictionary 15: Data Units

The following additions were made:

AN**2	Angstrom squared
KEV/AMU	Kiloelectron volt per atomic mass unit
AT/AT	Atoms per Atom

Dictionary 16: Data Centres ID

The following addition was made:

SK	Soviet Union, Kurchatov Institute, Moscow, USSR.

Dictionary 17: Keywords

No changes

It was agreed that the IAEA/A+M Data Unit will be responsible to coordinate the A+M EXFOR dictionaries, and to keep them up-to-date. Dictionary revision will be sent periodically by IAEA to all network members. New additions to dictionaries must be requested from IAEA in order to avoid confusion.

The first revised version of all dictionaries will be distributed to the Network as soon as all suggested changes will have been incorporated.

Appendix 1

Fourth Meeting of the A+M Data Centre Network

IAEA, Vienna, 13-15 June 1984

List of Participants

V.A. Abramov	Kurchatov Institute, Moscow
C.F. Barnett	ORNL, Oak Ridge
J.L. Delcroix	Universite de Paris, Orsay
G. Ebel	FIZ, Karlsruhe
S. Hayakawa	Nagoya University
J.G. Hughes	Queen's University of Belfast
K. Katsonis	IAEA
A. Lorenz	IAEA
Y. Nakai	JAERI, Japan
H. Tawara	IPP, Nagoya
W.L. Wiese	US NBS, Washington DC

Appendix 2

Fourth Meeting of the A+M Data Centre Network

IAEA, Vienna, 13-15 June 1984

Adopted Agenda

Introductory and Preliminary Items and Review of Actions from the 1982 Meeting.

1. Reports of A+M Data Centres and Groups
2. Report of the A+M Data Unit
3. Bibliographic Data
   - 3.1. Status of IAEA A+M Bibliographic Data Base
   - 3.2. Status and future of IAEA Quarterly Bulletin
   - 3.3. Next publication of CIAMDA data index
   - 3.4. Terminology and definition of processes
4. Numerical Data
   - 4.1. Exchange of Numerical Data
   - 4.2. EXFOR Index
   - 4.3. Review of A+M EXFOR Dictionaries

Appendix 3

Papers Submitted to the Meeting

(Any one of these papers are available from the IAEA Nuclear Data Section on request)

1. Copies of overhead projected transparencies summarizing the activities of the US A+M Data Centre. C.F. Barnett

2. Gaphyor progress report. J.L. Delcroix

3. Summary of 1983/1984 Activities at the Research Information Centre, IPP/Nagyoa. H. Tawara

4. Data Centre Activities on Atomic and Molecular (A+M) Data for Fusion at JAERI. Y. Nakai, T. Shirai and K. Ozawa

5. The Atomic and Molecular Database at Belfast and Daresbury. J.G. Hughes

6. AMDS: a Database System for Atomic and Molecular Physics. J.G. Hughes and F.J. Smith

7. Report on the activities of the Fachinformationszentrum Energie, Physik, Mathematik, Karlsruhe, in the field of numerical data documentation. G. Ebel

8. Data Compilation for Particle Impact Desorption. T. Oshiyama, et al

9. Analytical Cross Sections for Charge Transfer of H^+, H^- and H with Atoms and Molecules. T. Tabata, et al

10. Joint Institute for Laboratory Astrophysics, Atomic Collisions Cross Sections Data Centre: Recent Publication and Work in Progress. J.W. Gallagher

11. Spectroscopic Data for Iron. W.L. Wiese (Table of Contents of forthcoming NBS publication)

12. Program of the Sixth International Conference on Plasma Surface Interactions in Controlled Fusion Devices - IPP/Nagoya, 14-18 May 1984

13. Gaphyor - Sample retrieval of information on collisions of rare gas ions with other elements. 1 June 1984.

Appendix 4

List of Actions

1.	A+M Data Unit	Devise a proposed reactant sort order for the next publication of CIAMDA and send it to the data centres (see also Action 11).
2.	Delcroix	Create for the purpose of establishing a sorting order of reaction processes a list of initial and final states for two-element systems from the Gaphyor file, and send it to the data centres.
3.	Centre Network	Send definition of surface effects phenomena to Katsonis (IAEA) (see Action 4).
4.	Katsonis	Compile a list of surface effect phenomena definitions and distribute it to the data centres (see Action 3).
5.	A+M Data Unit	Produce an index to the atomic collision data Master File and send it to the data centres (eventually on regular basis).
6.	A+M Data Unit	Create a new Dictionary 2 for journal codes according to agreed specifications, and distribute it to data centres.
7.	Centre Network	Send to A+M Data Unit suggestions for additions to all dictionaries.
8.	A+M Data Unit	Create a new Dictionary 3 for report codes and send it to the Network for comments and corrections.
9.	Centre Network	Send to A+M Data Unit suggestions of (full titles and addresses) of institutes which should be included in Dictionary 4.
10.	Centre Network	Send to A+M Data Unit suggestions for additions and general organization of the Methods Codes Dictionary (#8).
11.	A+M Data Unit	Propose a scheme for ordering reactants in Dictionary 10 and distribute to the data centres for consideration (see also Action 1).

Appendix 5

Report of the IAEA A+M Data Unit

A. Lorenz

A. A+M Data Unit Staff and IAEA A+M Data Programme

As a result of a recent administrative decision to reduce the staff of the Nuclear Data Section, the post which has been occupied by K. Katsonis had to be given up. In effect, this has reduced the staff of the A+M Data Unit to two professional (P) and two clerical (G) staff, of which only one P and one G devote full time to A+M data. This is the situation as of mid-year 1984. With regard to personnel, D. Gremillet has left the A+M Data Unit at the beginning of 1984 and will be replaced by J.G. Hughes from Queen's University of Belfast as of 1 August 1984. K. Katsonis, who has been with the A+M data programme of the Agency from the beginning, will leave the IAEA mid-year 1984 to assume a position in the Gaphyor A+M data centre at Orsay. As a result of these personnel changes, the programmatic emphasis of the A+M Data Unit will need to be re-appraised in the light of priority needs of the fusion community and contributing committments of the other A+M data centres.

At the present time, the Agency's A+M programme consists of the following principal activities:

- assessment of data needs and research coordination and support
- development of the A+M EXFOR for the storage and exchange of data, and the establishment of a numerical A+M data base, and
- continuous compilation of bibliographic reference data into the A+M/BDB (Bibliographic Data Base), and the publication of the A+M Data Bulletin.

While the first activity is performed exclusively by the Agency, the other two rely on the cooperation of other A+M data centres. Until now, the bibliographic reference compilation and the publication of the A+M Data Bulletin has depended almost exclusively on the input prepared by K. Katsonis; as a result of the Unit's staff changes, however, it will be necessary to rely to a large extent on the other data centres to scan some of the literature, and supply part of the input to the A+M/BDB on a systematic and continuous basis.

In order to be able to provide the best available numerical A+M data to the fusion research community, it is necessary to have the data assembled in a form that is easily processed for printing, graphing, or prepared for automatic computer input. Independent of priorities and requirements of individual data centres, it is to the advantage of each data centre to have such a data base to satisfy their own national or regional requirements. As each individual centre is hard put (especially

in these days of budgetary restrictions) to collect, compile and evaluate all of the required data on its own, it has everything to gain and nothing to loose to enter into co-operative agreements with the other centres and benefit from the work performed by them. This can only be achieved if all centres agree to use common formats for the effective and efficient exchange of the required data. As the centre which has been given the responsibility to create and maintain such a data base, the Agency's A+M Data Unit can only achieve this objective if it has the full support and cooperation of the other A+M data centres. As described below, the A+M Data Unit has developed and implemented the A+M EXFOR exchange format for atomic collision data, and the first transmissions in this format have taken place. It is hoped that in the course of these June 1984 meetings agreements will be reached by the A+M data centres to share the work to be done and to exchange these data on a systematic basis.

B. Bibliographic A+M Data

1. Status of the A+M Bibliographic Data Base

The IAEA A+M Bibliographic data base (A+M/BDB) system, that is used to produce the IAEA Data Bulletin and bibliographic indexes, such as CIAMDA, as well as to generate selected retrievals, has been completed and fully documented (see IAEA-NDS-AM-12 "Description of the IAEA Data Base of Bibliographic Data", IAEA-NDS-AM-13 "IAEA Data Base for Bibliographic A+M Data: Files, Description, Program Documentation, System Logic", and IAEA-NDS-AM-14 "IAEA Data Base for Bibliographic A+M Data: Data Base Management Procedures"). The A+M/BDB continues to be updated quarterly by the systematic scanning of 137 journals. The A+M/BDB contains now approximately 50 000 indexed citations to published articles, reports and books.

2. Publication of the Quarterly IAEA Bulletin on A+M Data

The IAEA A+M Data Bulletin has continued to be published on a quarterly basis, and is now distributed to approximately 1 100 scientists and institutions in 26 Member States.

3. A+M Data Index

In order to provide a quick overview of the existing A+M data literature, IAEA/NDS has created an A+M Data Index which lists in one consise information line the collision partners, energy range, reference citation and first author for each published reference to measured or calculated atomic collision data sets. A sample page of this index is attached (Attachment 1). The index has been created using the complete bibliographic data base contained in the A+M/BDB. The advantage of such an index is the ease of scanning an extremely large body of information without the need to refer to other tables or listings. Although the information content of each line is limited, the basic information given is enough to identify the indexed data set for anyone familiar with the atomic collision field.

In addition to be an index to numerical data published in the literature, the same index format can be produced from A+M EXFOR listings and used to advertise the availability and location of the actual numerical data, with specifications as to the size of the data set, whether the data are recommended, and any other information that can be given in an abbreviated form. A sample page of the index extracted from recent data transmissions from Belfast and Nagoya is attached (Attachment 2).

4. Future CIAMDA Publications

One of the criticism of the CIAMDA 80 format has been that it is awkward to scan. While this format (separating the body of the index into indexation, titles, and author listing) has been found adequate for the A+M Data Bulletin, which contains only 200 - 300 references in each issue, it becomes unwieldy when thousands of references must be scanned. The objectives of the Bulletin and of the Index are also different: the Bulletin is a current awareness publication, informing the reader of what is new, the Index on the other hand is designed as a reference to all of the existing information, requiring a quick access format. Thus, not only are the format requirements different, but so are the contents of the publications themselves. An index only needs an abbreviated citation, and a concise description of the data.

As the next publication of CIAMDA is planned for 1985, it is proposed to produce this index in the form of the Data Index described above (see Attachment 1). The full information, as originally contained in CIAMDA 80, as well as author ordered lists can always be obtained on request from the IAEA. In addition, the current version of the Data Index can always be searched for selective retrievals, and be provided as a free service to the users. Also, as all of the "full information" has been published in issues of the Bulletin since the production of CIAMDA 80, it would seem unnecessary to reproduce the contents of all of the 16 Bulletins (1980-1984) in one publication.

5. Compendium for Plasma-Wall Interaction Information

The Plasma-Surface Data CRP, conducted by R.A. Langley, and terminated in 1981, has resulted in a compendium of information on plasma-surface interaction. This compendium recently updated by the original contributing authors, and refereed for publication, will be published in a Special Issue of the IAEA Fusion journal in Summer 1984.

In this compendium, reviews of particle-solid processes pertinent to modelling plasma-wall interactions are presented, and sets of recommended data are given. Analytic formulae are used where possible otherwise data are presented in the form of tables and graphs. The incident particles considered are e^-, H, D, T, He, C, O and self ions. The materials include the metals: aluminium, copper, molybdenum, stainless steel, titanium and tungsten and the non-metals: carbon and TiC.

C. Numerical Data

1. CRP on A+M Collision Data

The second meeting of the participants in the IAEA Coordinated Research Programme (CRP) on Atomic Collision Data for Diagnostics of Magnetic Fusion Plasmas was convened by the IAEA Nuclear Data Section on 30 August - 2 September 1983 at the Institute of Plasma Physics, Nagoya University, Nagoya.

The objectives of CRP meetings are:

- to review the status of the data for those processes and reactants identified by the fusion community to have high priority;
- to assess the accuracy and validity of those data;
- to decide which of the required data can now be considered to be in a satisfactory state; and
- to identify those data which can be generated experimentally, calculated theoretically, or represented by empirical formulae.

The results of these annual surveys are designed to give overall guidelines for the work to be performed by the CRP participants as well as to provide new data input to the body of recommended collision data.

The third meeting of this group was to be held in Vienna, 18-20 June 1984.

2. Development of the A+M EXFOR

The basic version of the A+M EXFOR format for the exchange of atomic collision data has been completed by the end of 1983, and its description, published in IAEA-NDS-AM-15 ("The EXFOR Manual for Atomic Collision Data", February 1984 version), was distributed to the A+M Data Centre Network at the beginning of 1984. The use of the A+M EXFOR format internally by the data centres is optional. At the IAEA the EXFOR format is used both for data exchange as well as for internal storage.

The A+M EXFOR system consists of the format description, dictionaries of keywords and abbreviations used in the coding of EXFOR entries, and of the basic checking program which processes (checks the correctness of) transmission tapes received from other centres and creates EXFOR entries from new input. In addition, development has started on a program to create a Data Index from the EXFOR data file (see B.3. above and Attachment 2).

3. Recommended A+M Collision Data

The procedures to arrive at recommended data are described in INDC(SEC)-84 (January 1983), Report of the Second Meeting of the IFRC Subcommittee on A+M Data for Fusion. These procedures are designed to produce in unique sets of recommended data. As defined by the IFRC Subcommittee:

The IAEA numerical data base shall comprise "recommended" data, consisting of appropriately annotated unique data sets for each required species and reaction in the form of cross sections, (Maxwellian averaged) reaction rates, and/or parametric fits on the data, which should be released to the fusion research community in the most suitable and required formats. The data should be presented in tabular and graphical form in hard-copy reports, and in the form of computer listings or tapes.

4. Data Transmission and Exchange

The EXFOR data exchange format is designed for the unambiguous exchange of data between centres. This requires not only the initial agreement (and committments) of data centres to use the format, but also an implicit agreement on the cooperative use, maintenance and development of EXFOR dictionaries. Although initial dictionaries have been proposed in the basic version of the A+M EXFOR (see IAEA-NDS-AM-15), these are in most cases undeveloped and incomplete. The development and maintenance of dictionaries requires a systematic cooperative effort, which is accomplished at data centre meetings, and eventually by mail. One of the data centres, maintains the master file of the dictionaries and acts as coordinator, accepts new entries and distributes dictionary updates to the other data centres.

In an established intercentre agreement, the exchange of data between centres can proceed either via the coordinating centre or directly between centres. In the first alternative, centre A sends a transmission tape to the coordinating centre which then distributes it to the other centre; in the second alternative, centre A sends the same tape to all of the other centres, including the coordinating centre.

So far, IAEA has received two trial transmission tapes from Belfast; both have cleared the checking programme, and are merged in a provisional "A+M EXFOR Master File". The Data Index produced from this Mater File is available separately.

Although A+M data are stored at IPP at Nagoya in their internal AMDIS format, data index information on the current content of the AMDIS file has been transmitted to IAEA (on request) and translated into the IAEA Data Index format. The Nagoya file content has been merged with the data index of the Belfast transmission tapes; the combined index represents at this stage the currently compiled A+M collision data at these two centres.

The Data indexes of the Belfast transmissions and of the Nagoya file content have been merged and represent at this stage the currently compiled A+M collision data of these two centres.

5. Data Fitting: Analytical representation of charge transfer cross sections for fully stripped ions on hydrogen and helium atoms.

Analytical approximation for the charge exchange cross section in H^+ + H and He^{2+} + H collision system have been earlier provided by Riviere. Although compact in their form, these approximations have subsequently been found not quite suitable for analytic rate coefficient calculations. Moreover, two diferent functional forms have been used for the cross section at low and high energies. From the point of view of fusion applications, a unique functional form is desirable for the cross sections of all the collision ion-atom pairs under consideration. Polynomial representations are preferable for such applications. Therefore fitted charge exchange cross sections are represented by the following expression:

$$\sigma_{cx} = \sum_{n=0}^{N} a_n (\ln E)^n \qquad (1)$$

where a_n are fitting parameters. The functional form has also been used previously to represent analytically charge exchange cross sections for other systems.

The fitting parameters of (1) for collisions of H with light fully stripped ions (Z 14) have been calculated by K. Katsonis (A+M Data Unit) in collaboration with R. Janev. Calculation of fitting parameters for collisions of He with light ions of fusion interest (He^{2+}, Li^{3+}, C^{6+}, O^{8+}) and a unified analytical representation of the charge transfer cross-sections for Z 14 has been started. This work will be submitted for publication to the Agency's Fusion Journal.

Reaction	Process	E-min	E-max	Un	Meth	Reference	First author	ISN.source
He*+Rb	HZ	1.0E+01	1.0E+02	eV	THEO	J,JAP,37,2928,66	Sheldon J. W.	6490.CI
He*+Rb	HZ				THEO	J,JP/B,1,18,67	Bell K. L.	8659.CI
He*+Rb	HZ				EXP	J,JP/B,11,927,78	Johnson C.	9971.CI
He*+Rb*	HZ				EXP	J,PL/A,51A,5,75	Keiser G. M.	11827.CI
He*+Rb	HZ	0.0E+00	1.0E+01	eV	EXP	J,SPJE,43,35,76	Dmitriev S.	15324.CI
He*+Rb*	HZ				EXP	J,SPJE,43,35,76	Dmitriev S.	15324.CI
He(1+)+Rb	HZ	1.0E+04	1.0E+05	eV	THEO	J,JCP,68,2427,78	Tiwary S. N.	825.05
He(2+)+Rb	HZ	1.0E+05	1.0E+07	eV	THEO	J,PRA,4,955,71	Garcia J. D.	13107.CI
He(2+)+Rb	HZ	1.0E+05	1.0E+07	eV	EXP	J,PRA,11,1607,75	McDaniel F. D.	13702.CI
He*+Sr	HD	0.0E+00	1.0E+01	eV	EXP	J,PRL,26,599,71	Schearer L.	14309.CI
He*+Sr	HD	0.0E+00	1.0E+01	eV	EXP	J,PRA,10,1380,74	Schearer L.	13624.CI
He+Sr(1+)	HD	0.0E+00	1.0E+01	eV	THEO	J,JP/B,8,2708,75	Giusti-Suzor A.	9581.CI
He+Sr*	HS				EX/TH	J,OS1,36,13,74	Shabanova	11276.CI
He+Sr	HX				EXP	J,PL/A,65A,215,78	Fahey D. W.	11908.CI
He*+Sr	HX	0.0E+00	1.0E+01	eV	EXP	J,PRA,10,1380,74	Schearer L.	13624.CI
He*+Sr	HX	0.0E+00	1.0E+01	eV	EXP	J,PRL,26,599,71	Schearer L.	14309.CI
He+Sr(1+)	HX				EXP	J,UFZr,19,1943,74	Shpenik O.	15600.CI
He+Sr(1+)*	HX				EXP	J,ZP,259,371,73	Weber E. W.	16459.CI
He+Sr(1+)	HX				EXP	J,ZTF,45,79,75	Zapesochnyij	15915.CI
He+Sr(1+)*	HX				EXP	J,ZP,260,341,73	Weber E. W.	16460.CI
He(2+)+Sr	HX	1.0E+05	1.0E+07	eV	THEO	J,PRA,4,955,71	Garcia J. D.	13107.CI
He*+Sr	HZ	0.0E+00	1.0E+01	eV	EXP	J,PRL,26,599,71	Schearer L.	14309.CI
He*+Sr	HZ	0.0E+00	1.0E+01	eV	EXP	J,PRA,10,1380,74	Schearer L.	13624.CI
He*+Sr	HZ	0.0E+00	1.0E+01	eV	EXP	J,PRL,22,629,69	Schearer L. D.	14261.CI
He(1+)+Sr	HZ				EXP	J,IVUZF,20,137,77	Zhukov V. V.	6382.CI
He(1+)+Sr	HZ	0.0E+00	1.0E+01	eV	EXP	J,PRL,31,1168,73	Arrathoon R.	14413.CI
He(2+)+Sr	HZ	1.0E+05	1.0E+07	eV	THEO	J,PRA,4,955,71	Garcia J. D.	13107.CI
He(2+)+Sr	HZ	1.0E+05	1.0E+07	eV	EXP	J,PRA,8,1258,73	Li T. K.	13419.CI
He(2+)+Sr	HZ	1.0E+05	1.0E+07	eV	EXP	J,PRA,11,1607,75	McDaniel F. D.	13702.CI
He(2+)+Sr	HZ	1.0E+05	1.0E+07	eV	EXP	J,PRA,13,992,76	Awaya Y.	13866.CI
He*+Y	HD	0.0E+00	1.0E+01	eV	EXP	J,CPL,43,175,76	Gerard K.	6059.CI
He(1+)+Y	HF	0.0E+00	1.0E+01	eV	EXP	J,JP/B,7,L332,74	Littlewood I. M.	9318.CI
He*+Y	HZ	0.0E+00	1.0E+01	eV	EXP	J,CPL,43,175,76	Gerard K.	6059.CI
He(1+)+Y	HZ	0.0E+00	1.0E+01	eV	EXP	J,JP/B,7,L332,74	Littlewood I. M.	9318.CI
He(1+)+Y	HZ	0.0E+00	1.0E+01	eV	EXP	J,PRL,31,1168,73	Arrathoon R.	14413.CI
He(2+)+Y	HZ	1.0E+05	1.0E+07	eV	EXP	J,PRA,9,267,74	McKnight R. H.	13497.CI
He(2+)+Y	HZ	1.0E+05	1.0E+07	eV	EXP	J,PRA,11,1607,75	McDaniel F. D.	13702.CI
He(2+)+Y	HZ	1.0E+05	1.0E+07	eV	EXP	J,PRL,32,1155,74	Cue N.	14425.CI
He(1+)+Zr	HX	1.0E+05	1.0E+07	eV	EXP	J,PRL,29,329,72	Saltmarsh M. J.	14366.CI
He(1+)+Zr	HX	1.0E+05	1.0E+07	eV	EXP	J,PRL,29,329,72	Saltmarsh M. J.	14366.CI
He(2+)+Zr	HX	1.0E+05	1.0E+07	eV	THEO	J,PRA,4,955,71	Garcia J. D.	13107.CI
He(2+)+Zr	HZ	1.0E+05	1.0E+07	eV	EXP	J,PRA,8,1258,73	Li T. K.	13419.CI

Reaction	Process	Quantity	E-Min	E-Max	Units	Type	Method	Reference	Author	Exfor	Data	R
e+Xe	ION	SIG	5.00E+02	5.00E+03	EV	EXP	XST	J,JP/B,13,1249,80	Nagy P.	UB00067011	11	
e+Xe(+1)	ION	SIG	2.07E+01	8.30E+02	EV	EXP	XCB	J,JP/B,13,1877,80	M-?Duller, A.	JN00002040	38	
e+Xe(+3)	ION	SIG	3.92E+01	1.48E+03	EV	EXP	XCB	J,PR/A,27,724,83	Gregory, D.C.	JN00003086	50	
e+Xe(+6)	ION	SIG	8.87E+00	1.48E+02	EV	EXP	XCB	J,PR/A,27,2338,83	Gregory, D.C.	JN00003093	41	
e+Zn	ION	SIG	5.00E+00	5.00E+00	EV	EXP	XBE	J,JCP,44,916,66	Pottie, R.F.	JN00009165	1	
e+Zn	ION	SIG	1.00E+01	1.00E+04	EV	CALC	TBA	J,PRA,16,62,77	McGuire E.J.	UB00077007	25	
e+Zn	ION	SIG	1.10E+03	1.00E+05	EV	CALC	TBA	J,PRA,26,125,82	McGuire E.J.	UB00075005	16	
e+Zn	ION	SIG	1.80E+01	2.00E+03	EV	EXP	XCB	J,PRA,25,737,82	Rogers W.T.	UB00068001	17	
e+Zn(+1)	ION	SIG	1.82E+00	2.07E+02	EV	EXP	XCB	J,PR/A,25,737,82	Rogers, W.T.	JN00003103	24	
e+Zr	ION	SIG	1.00E+01	1.00E+04	EV	CALC	TBA	J,PRA,16,62,77	McGuire E.J.	UB00077013	25	
e+Zr	ION	SIG	3.48E+01	9.88E+02	EV	EXP	XCB	J,PRA,27,762,83	Falk R.A.	UB00061002	46	
e+Zr(+3)	ION	SIG	3.48E+01	9.87E-01	EV	EXP	XCB	J,PR/A,27,724,83	Falk, R.A.	JN00003073	46	
Ar+H	CHT	SIG	1.02E+05	1.02E+05	EV	EXP	XST	J,PRA,19,504,79	Crandall D.H.	UB00035013	1	
H+B	CHT	SIG	9.93E+03	2.90E+04	AU	CALC	TCTM	J,JP/B,12,919,79	Salop A.	UB00040001	4	
H+B	CHT	SIG	4.05E+05	1.62E+06	EV	CALC	TCTM	J,PRA,16,531,77	Olsen R.E.	UB00039002	6	
H+B	CHT	SIG	4.05E+05	1.62E+06	EV	CALC	TCTM	J,PRA,16,531,77	Olsen R.E.	UB00039003	6	
H+B	CHT	SIG	4.05E+05	1.62E+06	EV	CALC	TCTM	J,PRA,16,531,77	Olsen R.E.	UB00039001	5	
H+B	CHT	SIG	3.61E-09	9.04E-08	ERG	CALC	TCCC	J,JP/B,11,699,78	Olsen R.E.	UB00038001	31	
H+B	CHT	SIG	7.50E+05	2.50E+06	EV	EXP	XST	J,JP/B,12,3763,79	Goffe T.V.	UB00033005	6	
H+B	CHT	SIG	1.85E+05	2.50E+06	EV	EXP	XST	J,JP/B,12,3763,79	Goffe T.V.	UB00033004	9	
H+B	CHT	SIG	1.85E+05	2.50E+06	EV	EXP	XST	J,JP/B,12,3763,79	Goffe T.V.	UB00033003	9	
H+B	CHT	SIG	1.10E+05	2.10E+06	EV	EXP	XST	J,JP/B,12,3763,79	Goffe T.V.	UB00033002	9	
H+B	CHT	SIG	1.10E+05	1.60E+06	EV	EXP	XST	J,JP/B,12,3763,79	Goffe T.V.	UB00033001	8	
H+B	CHT	SIG	1.04E+04	3.17E+04	EV	EXP	XST	J,PRA,19,504,79	Crandall D.H.	UB00035001	5	
H+B	CHT	SIG	1.52E+04	4.78E+04	EV	EXP	XST	J,PRA,19,504,79	Crandall D.H.	UB00035002	5	
H+B	CHT	SIG	6.22E+04	6.22E+04	EV	EXP	XST	J,PRA,19,504,79	Crandall D.H.	UB00035004	1	
H+B	CHT	SIG	2.03E+04	5.98E+04	EV	EXP	XST	J,PRA,19,504,79	Crandall D.H.	UB00035003	4	
H+B	CHT	SIG	2.70E+02	2.16E+06	EV	CALC	TDWA	J,PRA,19,1538,79	Ryufuku H.	UB00032003	14	
H+B	CHT	SIG	3.00E+03	3.50E+04	EV	EXP	XST	J,JP/B,12,4159,79	McCullough R.W.	UB00037001	16	
H+B	CHT	SIG	2.40E+04	2.40E+04	EV	EXP	XST	J,PRA,21,139,80	Gardiner L.D.	UB00036002	1	
H+B	CHT	SIG	1.60E+04	1.60E+04	EV	EXP	XST	J,PRA,21,139,80	Gardiner L.D.	UB00036001	1	
H+B	CHT	SIG	3.20E+04	3.20E+04	EV	EXP	XST	J,PRA,21,139,80	Gardiner L.D.	UB00036003	1	
H+Ba	CHT	SIG	1.40E+04	3.50E+04	EV	EXP	XST	J,JP/B,12,4159,79	McCullough R.W.	UB00037007	7	
H+Be	CHT	SIG	2.25E+02	1.80E+06	EV	CALC	TDWA	J,PRA,19,1538,79	Ryufuku H.	UB00032002	14	
H+C	CHT	SIG	1.10E+04	3.33E+04	AU	CALC	TCTM	J,JP/B,12,919,79	Salop A.	UB00040002	4	
H+C	CHT	SIG	1.00E-09	4.01E-07	ERG	CALC	TCCC	J,PRA,16,1811,77	Salop A.	UB00045001	15	
H+C	CHT	SIG	3.07E+04	3.07E+04	EV	CALC	TCCM	J,PRA,14,579,76	Olsen R.E.	UB00044001	1	
H+C	CHT	SIG	1.00E-09	1.00E-07	ERG	CALC	TCCC	J,JP/B,11,699,78	Olsen R.E.	UB00038002	28	
H+C	CHT	SIG	4.50E+05	1.80E+06	EV	CALC	TCTM	J,PRA,16,531,77	Olsen R.E.	UB00039004	6	
H+C	CHT	SIG	4.50E+05	1.80E+06	EV	CALC	TCTM	J,PRA,16,531,77	Olsen R.E.	UB00039007	6	
H+C	CHT	SIG	3.07E+04	3.07E+04	EV	CALC	TCCM	J,PRA,14,579,76	Olsen R.E.	UB00044003	1	
H+C	CHT	SIG	4.50E+05	1.80E+06	EV	CALC	TCTM	J,PRA,16,531,77	Olsen R.E.	UB00039006	6	
H+C	CHT	SIG	4.50E+05	1.50E+06	EV	CALC	TCTM	J,PRA,16,531,77	Olsen R.E.	UB00039005	5	
H+C	CHT	SIG	3.07E+04	3.07E+04	EV	CALC	TCCM	J,PRA,14,579,76	Olsen R.E.	UB00044002	1	
H+C	CHT	SIG	1.00E+05	2.10E+06	EV	EXP	XST	J,JP/B,12,3763,79	Goffe T.V.	UB00033007	11	
H+C	CHT	SIG	1.00E+05	1.75E+06	EV	EXP	XST	J,JP/B,12,3763,79	Goffe T.V.	UB00033006	10	