

Report by Internship of IAEA/NDS

Toshiyuki Katayama
University of Hokusei-Gakuen, Sapporo
email: katayama@hokusei.ac.jp

Abstract

A research working experience as an internship of the Nuclear Data Section, International Atomic Energy Agency, Vienna, for the total number of about two weeks, is reported.

1 Introduction

I was awarded an internship in the Nuclear Data Section (NDS) of the Division of the Physical and Chemical Science (DPCS), for the period of 6 April to 31 July 1994 at first and in the next term this was extended up to 31 December 1994. The DPCS is a division of the Department of Research and Isotopes, International Atomic Energy Agency (IAEA).

This is the report of my research working experience as the intern of IAEA/NDS. My status of the intern was cost-free. I was on a sabbatical leave for one academic year from my institute and stayed mainly at the Institute of Theoretical Physics, University of Graz, in Graz, Austria. I attended IAEA/NDS from Graz several times and stayed there a few days each. It takes two and half hours from Graz to Vienna on a bullet train. Of course we can communicate by the Internet for the other days.

2 Subjects of the Intern

I got hospitality from Dr. Hans Lemmel and Dr. Otto Schwerer in IAEA/NDS and discussed the following problems with them. Here "we" means the two staffs and "you" is me (T.K).

- We were pleased about your work on the EXFOR-NRDF exchange of Charged Particle Nuclear Data (CPND) and are looking forward to a fruitful continuation of this cooperation and close relations to the NRDF steering committee.

- We are interested to learn about nuclear data activities in Japan and whether these can be more closely connected with the one or other of our coordinated research programs and data center networks.
- We can offer you a detailed study of our newly installed online "Nuclear Data Information System (NDIS)".
- We can also offer you a survey of our collection of data libraries.
- We would appreciate it if you could bring with you Japanese charged-particle reaction data, possibly including higher energy data, and enter them here into the EXFOR system.

In addition to these subjects, I was designated as an observer of the Agency's Advisory Group on the Co-ordination of the Nuclear Reaction Data Centers, which was taken place in Paris from 25 to 27 April 1994. The meeting of the Advisory Group was held at the office of the OECD Nuclear Energy Agency, Le Seine Saint-Germain. This designation was made possible by Prof. Sueo Machi, the Deputy Director General, Department of Research and Isotopes.

In IAEA/NDS, the office is located at the 23th floor of one of buildings of the Vienna International Center, there I was able to use computer terminals of the online database system of nuclear data. Use of the online database system was also possible from University of Graz.

As a summary of the present discussion, "*Nuclear Reaction Database Activities coordinated by IAEA-NDS*" is attached in the supplement, This is the OHP manuscript which was made for the seminar held at the Institute of Nuclear Physics, Technical University of Vienna, coordinated by Prof. Helmut Leeb, and also at the Institute of Theoretical Physics, University of Graz, coordinated by Prof. Willibald Plesass.

3 The Internship of IAEA

We should note that all activities of IAEA/NDS aim at practical applications of nuclear data. This comes from the policy of IAEA.

The internship of IAEA differs much from the fellowship of academic institutes. Here I refer to some items. The cost-free intern are only accepted under the following conditions.

- - The purpose of an internship is to provide the holder with the opportunity to perform work in line with his own career or his studies and interest which will at the same time be of benefit to the Agency's programmes. The Agency may not incur any expenditure in such internships.

- - Status of an intern: Although interns will not be considered staff members of the Agency, they will be subjected to the authority of the Director General.
- - Privileges and Immunities: Interns shall not be entitled to the privileges and immunities accorded by Member States and the Host Government to the Agency's officials.

4 Closing

I think it is useful to gain practical working experience in the international organization IAEA/NDS, this is the first for me. It was a nice period to visit IAEA/NDS and OECD/NEA mainly because the installing of the new online system of nuclear data by the internet were just improved at that time. I was able to make my colleagues and students in Graz and Vienna acquainted with this online system, although they all are theoretical physicists.

Nuclear Reaction Database Activities coordinated by IAEA-NDS

T. Katayama

visiting: Inst.f.Theor.Physik, Univ.Graz, Austria

NDS (Nuclear Data Section), Dept.of Res. & Isotope, IAEA

permanent: Univ.of Hokusei-Gakuen, Sapporo, Japan

1. Introduction

- Data Compilation in Nuclear Physics
- Needs for Nuclear Databases
- What are done in IAEA ?

2. Network of Nuclear Reaction Data Centers

- Networks or Coordinations
 - Structure and Decay Data
 - Reaction Data
- Data Evaluation
- Data Exchange between Data Cenetrs
 - EXFOR** (Format and Database)
 - NRDF** (our Local Database system)

3. Online Database System: **NDIS**

- Statistics of Users
- How this system looks like ?
- How to use NDIS

4. Conclusion

IAEA-NDS Online Data Service: rnds@iaea1.bitnet
online@iaeand.iaea.or.at

Data Compilation in Nuclear Physics

H:Handbooks, C:Charts / Booklets, J:Journals
TM:Magnetic-Tapes (MT), PC:PC-diskettes
Computer Networks (Internet, Bitnet, etc.)

- H: Compilation of Cross-sections, (CERN-HERA)
I: π^+, π^- induced reactions (Aug.1983)
- H: Photonuclear Data-Abstract Sheets (NBS-IR 83),
15 vols., E.G.Fuller & H.Gerstenberg, US-NBS (1983-86)
- H: Tables of Radioactive Isotopes (LBL),
E.Browne & R.B.Firestone, John Wiley&Sons (1986)
- H: Physik Daten / Physics Data, [-> **EXFOR**]
Fachinformation zentrum Karlsruhe (1976-)
- H: Fundamental Physical Constants (Codata),
E.R.Cohen & B.N.Taylor, Nucl.Phys.**B** (Nov.1986)
- H: Review of Particle Properties (LBL),
Particle Data Group, Phys.Letters **B**. (every two years)
- H: Atomic Masses 1993,
TG.Audi & A.H.Wapstra
- C: Charts of Nuclides 1992 (JNDC),
T.Horiguchi, T.Tachibana & T.Tamura
- C: Karlsruhe Nuklidkarte (KfKZ),
W.Seelmann-Eggebert, G.Pfenning & H.Hünzel (1981)
- C: Nuclear Wallet Cards, [<- **NUDAT**]
J.K.Tuli, (US NNDC, BNL), (July 1990)
- J: Atomic Data and Nuclear Data Tables [->**EXFOR**]
- J: Nuclear Data Sheets [-> **ENSDF**]
Recent References [-> **NSR**]

Atomic Nuclei: about 92 natural elements, 300 isotopes and more than 2000 man-made radioactive isotopes, and each has many meta-stable states.

Samples form the handbook and/or Journal of

Physik Daten / Physics Data,[-> EXFOR]

Fachinformation zentrum Karlsruhe (1976-)

Datensammlung in der Physik, 3-1 (1986)

PHYS/(STN)

H.Behrens & G.Ebel, A bibliography of 1457 existing tables and compilations from all fields of physics.

Nucleon-Nucleon Scattering Data Summary Tables, 11-2

(1981), J.Bystricky & F.Lehar, contains the scattering, total c.

s. for elastic and inelastic N-N processes, & other parameters.

Internal Conversion Coefficients and Ratios for Nuclei with

Z <= 60, 17-1 (1981), H.Hansen, 274 pages., Z > 60 (1985)

Catalog of Gamma Rays from Radioactive Decay (1983)^{29,pp.1-40}

Catalog of Alpha Particles from Radioactive Decay

(Nucl.Data Table 29) 29-1, (1985) [-> **GAMCAT**]

Atomic Data and Nuclear Data Tables,

[-> EXFOR]

Atomic Masses from (mainly) Experimental Data,

by A.H.Wapstra et al., **39**, 281-287, 1988

Nuclear Masses, by P.Möller et al., including nuclear masses as

computed by them, **39**, 225-233, 1988

Neutron Scattering Lengths, by L.Koester, H.Rauch, & E.Seymann,

49, 65-120, 1991

Beta and gamma spectra of short-lived fission products,

by G.Rudstam et al., **45**, 239-320, 1990

Library of Prompt Gamma-rays from Thermal-neutron

Capture, by Lone, **26**, 511-560, 1981, -*PC(1993)

Nonelastic Interactions of Neutron between 15 and 60 MeV with

Carbon and Oxygen, by D.J.Brenner, R.E.Prael, **41**, 71-130, 1989

Atlas of Photoneutron c.s. obtained with monoenergetic

photons, by S.S.Dietrich & B.L.Berman, **38**, 199-338, 1988

Strengths of Gamma-ray Transitions in Nuclei A = 5 - 44,

by P.M.Endt, **55**, 171-197, 1993

Recommended Energy and Intensity Values of Alpha particles

from Radioactive Decay, by A.Rytz, **47**, 205-239, 1991

Index of Nuclear Data Libraries computerized data available from the IAEA - NDS and - NDIS

NDS Nuclear Data Section

NDIS online Nuclear Data Information System), It has been implemented in 1991 to give easy access to the most recent version of the data files. Data from NDIS can be retrieved online through the computer network in the Agency's member states.

1. Neutron nuclear data, experimental
2. ENDF(evaluated neutron nuclear data) -*online
3. Neutron Nuclear Data Libraries evaluated for special Purpose:
4. Photo-nuclear data or Photo-atomic data -*online
5. Charged-particle nuclear reaction data -*online
6. Nuclear structure and decay data -*online
7. Nuclear constants, Charts of Nuclides
8. Bibliographic files, WARENDA, etc. -*online
9. Online nuclear data service

similar service

NNDC: Nat'l Nuclear Data Center of the
Brookhaven Nat'l Lab., U.S.A.

NEA.DB: Nuclear Energy Agency, Data Bank,
OECD, Paris

Data Request Statistics 1965 - 1992

Year	Experimental Data	Evaluated Data	Experimental and Evaluated Data	Documents + Bibliogr. Data	Computer* Codes	Totals per year	Totals Cumulative
1965	3	-	3	-	-	3	3
1966	40	-	40	-	5	45	48
1967	118	-	118	9	8	135	183
1968	119	-	119	16	9	144	327
1969	48	15	63	25	5	93	420
1970	95	20	115	34	8	157	577
1971	76	33	109	43	8	160	737
1972	48	23	71	60	8	139	876
1973	43	22	65	54	6	125	1 001
1974	49	24	73	61	6	140	1 141
1975	43	49	92	114	3	209	1 350
1976	34	43	77	153	9	239	1 589
1977	45	49	94	232	3	329	1 918
1978	62	71	133	193	17	343	2 261
1979	63	93	156	95	18	269	2 530
1980	40	86	128	239	42	407	2 937
1981	59	185	244	369	31	644	3 581
1982	76	174	250	403	60	713	4 294
1983	52	115	167	508	45	713	5 007
1984	54	113	167	462	38	667	5 674
1985	24	221	245	587	12	844	6 518
1986	37	93	130	407	32	569	7 087
1987	18	72	90	667	136	893	7 980
1988	34	108	142	684	67	893	8 873
1989	32	100	132	579	62	773	9 646
1990	34	199	233	520	30	783	10 429
1991	31	260	291	426	25	742	11 171
1992	22	208	230	495	129	854	12 025

* Since 1978 this category contains exclusively data processing computer programs.

REQUESTS 1989 - 1992

COUNTRY STATISTICS

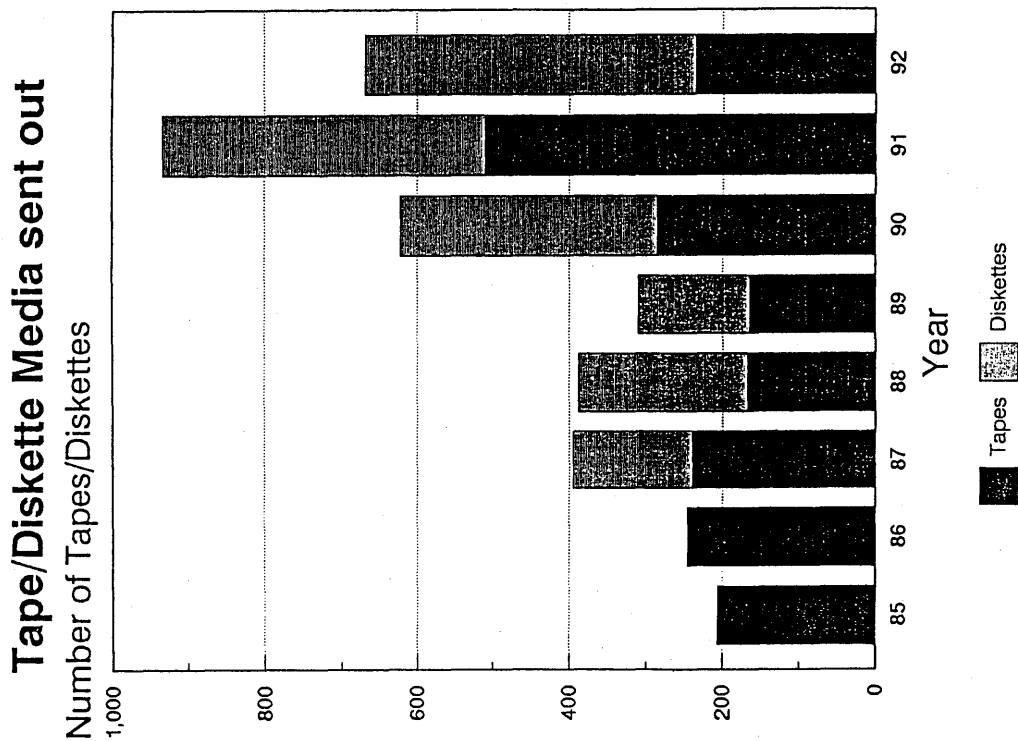
COUNTRY	TOTAL	BIBL.	CODES	DOCUM.	EVAL.	EXPT.
India	309	0	28	196	76	9
China	270	3	20	166	51	30
USA	205	1	10	148	44	2
Soviet Union	173	1	16	72	75	9
Hungary	143	1	13	84	37	8
Japan	131	0	1	115	15	0
Germany	128	0	2	97	29	0
Brazil	121	1	12	66	40	2
Poland	116	0	14	71	27	4
Czechoslovakia	108	0	7	62	34	5
Romania	87	0	7	56	23	1
Argentina	60	0	10	35	14	1
Austria	57	1	2	29	11	14
United Kingdom	57	1	2	46	7	1
German Dem. Rep.	56	0	3	41	12	0
Egypt	54	0	7	33	13	1
Yugoslavia	53	0	8	30	14	1
Pakistan	50	2	9	27	7	5
Korea	40	0	7	26	7	0
Algeria	39	0	2	26	9	2
Bulgaria	36	0	3	20	11	2
South Africa	36	0	2	22	12	0
Indonesia	35	1	1	23	8	2
Iran	35	0	1	22	11	1
Italy	34	0	1	28	5	0
Vietnam	32	1	3	15	13	0
Israel	31	0	1	20	10	0
Cuba	28	0	7	8	9	4
Thailand	27	0	3	16	8	0
Bangladesh	25	0	4	13	7	1
France	25	0	1	21	3	0
Mexico	25	0	3	13	9	0
Saudi Arabia	25	0	5	15	5	0
Australia	24	1	1	9	13	0
Belgium	24	0	0	23	1	0
Nigeria	24	0	3	16	5	0
Libya	23	0	1	14	8	0
Malaysia	22	0	2	17	3	0
Canada	20	0	1	19	0	0
Taiwan	19	0	4	9	6	0
Netherlands	16	0	0	9	7	0
Burma	17	0	1	13	3	0
Albania	14	0	2	8	4	0
Morocco	14	0	1	8	2	3
Sweden	14	0	1	12	1	0
Peru	13	0	0	6	7	0
Zaire	12	0	2	10	0	0
Kenya	11	0	1	9	1	0
Switzerland	11	0	1	4	5	1
Turkey	11	0	0	9	1	1
Finland	9	0	3	3	3	0
Sri Lanka	9	0	1	1	5	2
Zambia	9	0	2	5	2	0
Iraq	8	0	1	7	0	0
Venezuela	8	0	2	4	2	0
Bolivia	7	0	0	7	0	0
Philippines	7	0	1	5	1	0
Russia	6	0	1	3	2	0
Spain	5	0	0	5	0	0
Syria	5	0	0	4	1	0
Ghana	4	0	0	2	2	0
Portugal	4	0	0	2	2	0
Sudan	4	0	0	3	1	0
Chile	3	0	0	3	0	0
Denmark	3	0	0	3	0	0
Uruguay	3	0	1	1	1	0
Ecuador	2	0	0	2	0	0
Jordan	2	0	0	2	0	0
New Zealand	2	0	0	0	2	0
Costa Rica	1	0	0	1	0	0
Cyprus	1	0	1	0	0	0
Ivory Coast	1	0	0	1	0	0
Kuwait	1	0	0	1	0	0
Madagascar	1	0	0	1	0	0
Norway	1	0	0	1	0	0
Senegal	1	0	0	1	0	0
Swaziland	1	0	0	1	0	0
Tunisia	1	0	0	1	0	0
Uganda	1	0	0	1	0	0
United Arab Emirates	1	0	0	1	0	0
Zimbabwe	1	0	0	1	0	0

81 countries served between 1989 and 1992

NNDC On-Line Data Retrievals 1986 - 1993

	1986	1987	1988	1989	1990	1991	1992	1993	Totals
NSR	814	2521	5022	3253	5613	11517	13050	17170	58960
ENSDF	142	863	1303	850	1256	2807	3626	7161	18008
NUDAT	536	815	1492	1841	2204	4021	6710	10984	28603
CINDA	129	60	285	522	187	371	458	373	2385
ENDF		4	187	150	1019	1525	2846	5818	11549
CSISRS			459	1649	1623	1384	1613	4482	11210
Other:									
MIRD				121	53	40	141	586	941
MASSES*								144	144
PLOT				11	39	69	218	988	1325
PHYSICO				9	65	172	96	189	531
X-RAY						277	1169	933	2379
CODES								873	873
Totals	1621	4263	8748	8406	12059	22183	29927	49701	136908

* Added November 1993



What is done in the IAEA ?

- assists its 116 member States in the development of a nuclear infrastructure through the systematic transfer of nuclear data, expertise, and technology.
- **Technical Co-operation** that will promote a national self-reliance in applying nuclear science and technology.
 - human resource development [\$49.1M,1991]
 - a total of 1301 project were operational in 1991.
 - 20.43% nuclear technique in Food & Agriculture
 - 19.7% Radiation protection(13.3%), Safety of nuclear installations(3.7%) & Waste management(2.7%).
 - 18.57% Physical and Chemical Sciences
 - 16.85% Industry and Earth Sciences
 - 13.28% Human health 5.22% Nuclear power,
- **Safeguards** helps to verify that nuclear materials are not diverted for military purposes, applying 95% of the world's nuclear facilities (more than 900 installations) and materials outside the five states.
- **Nuclear Safety & Radiation Protection.**
 - Programs(OSART, ASSET, IRS, IPERS, INSARR,RAPAT, IRRT).
 - IAEA safety recommendations are used as a basis for standards and rules. Noting especially the assessing the safety of nuclear reactors of the WWER-440/230 type(1990-1992), and the radiological consequences of the Chernobyl accident(1986-1992)
- **Scientific/ Research Co-operation**
 - The Laboratories** at
 - Seibersdorf(Austria), IAEA-MEL(Monaco), ICTP(Trieste)
 - Joint FAO/ IAEA** Division of Nuclear Techniques in Food and Agriculture (1964-), to solve problems related to the Soil fertility, Irrigation & Crop production, Plant breeding & genetics, Animal production & health, Insect & pest control, Agrochemicals & residues, Food preservation.
 - Life Sciences**
 - Nuclear Medicine**
 - Radiation Biology and Radiotherapy**
 - Radiation Dosimetry**
 - Nutrition and Health**

Physical Sciences

Nuclear Physics and Instrumentation

(advice on curricula or training ,maintenance & repair)

Research Reactor support

(symposia, seminars, publications)

Fusion

ITER (Int'l. Thermonucl. Exp. Reactor) project [1987-]

Isotope Hydrology

Industrial Applications and Chemistry

to promote the transfer of nuclear and radiation technology used in industry for process optimization, trouble-shooting, environmental protection and in other fields such as medicine (radiation sterilization facility), mineral exploration & exploitation.

Nuclear Data

are numerical constants which describe the nuclear behaviour of all the atomic nuclei and their reaction processes. For each single nucleus one needs nuclear data files in *megabyte*-size or *more* and therefore in the form of voluminous computerized **databases**.

are required for **nuclear physics applications in research and industry, medicine, agriculture, geophysics**, and other fields in form of large numerical tables in handbooks, on PC diskettes or on magnetic tapes, on online computer networks.

Progress and development in nuclear sciences and technology depend on the availability of accurate nuclear data. Further research to improve the data accuracy is supported by scientific meetings and co-ordinated research programmes.

Based on the co-ordination of several national nuclear data centers, **IAEA-NDS** (Nuclear Data Section) is in a unique position to provide the required nuclear data files to scientists upon request. This service, which was used by 330 institutions in 77 member states, is free of charge according to **Article III** of the Agency's Statute "*to foster the exchange of scientific and technical information on peaceful uses of atomic energy*".

Information and Technical Services(INIS)

INIS is a bibliographic database containing records of the literature published throughout the world on all peaceful applications of nuclear science and technology. It had expanded to more than 1,500,000 records in 1992, with 90,000 new records being added each year.

2. The Network of Nuclear Reaction Data Centers

- NNDC** - US National Nuclear Data Center,
BNL, Brookhaven, USA
- NEA-DB** - OECD/NEA Nuclear Data Bank,
Saclay+Paris, France
- NDS** - IAEA Nuclear Data Section,
Vienna, Austria
- CJD** - Nuclear Data Center (=Centr po Jadernym
Dannym), Obninsk, Russia
- CAJaD** - Nuclear Structure and Reaction Data
Center (Centr po Dannym o Stroenii Atomnogo
Jadra i Jadernykh Reakcih), Moscow, Russia
- CDFE** - Center for Experimental Photonuclear
Data (Centr Dannyykh Fotojad. Eksp.), Moscow,
Russia
- CNDC** - Chinese Nuclear Data Center,
Beijing, China
- ATOMKI** - Nuclear Data Group of the ATOMKI
Institute, Debrecen, Hungary
- RIKEN** - Nuclear Data Group, RIKEN (Institute of
Physical & Chemical Research),
Wako-shi, Japan
- JCPRG** - Charge-Particle Nuclear Reaction Data
Group, Sapporo, Japan
- JAERI** - Nuclear Data Center, The Japan Atomic
Energy Research Institute,
Tokai-mura, Japan

DATA EVALUATION CENTERS

- a. National Nuclear Data Center
Brookhaven National Laboratory
Upton, NY 11973, U.S.A.
Contact: C.L. Dunford
- b. Nuclear Data Project
Oak Ridge National Laboratory
Oak Ridge, TN 37831, USA
Contact: M.J. Martin
- c. Isotopes Project
Lawrence Berkeley Laboratory
Berkeley, CA 94720, USA
Contact: E. Browne/R.B. Firestone
- d. Idaho National Engineering Laboratory
E.G. & G. Idaho, Inc.
P.O. Box 1625
Idaho Falls, ID 83415, U.S.A.
Contact: R.G. Helmer
- e. Triangle University Nuclear Laboratory
Duke University
Durham, NC 27706, U.S.A.
Contact: H.R. Weller/D.R. Tilley
- f. Center for Nuclear Structure and Reaction Data
I.V. Kurchatov Institute of Atomic Energy
46 Ulitsa Kurchatov
123 182 Moscow, Russia
Contact: F.E. Chukreev
- g. Nuclear Data Center
St. Petersburg Nuclear Physics Institute
Academy of Sciences of Russia
Gatchina, Leningrad Region
188 350, Russia
Contact: I.A. Kondurov
- h. Fysisch Laboratorium
Princetonplein 5, Postbus 80.000
3508 TA Utrecht, The Netherlands
Contact: C. van der Leun
- i. Institute of Atomic Energy
P.O. Box 275 (41), Beijing
People's Republic of China
Contact: Cai Dunjiu
- j. Centre d'Etudes Nucléaires
DRF-SPH
Cedex No. 85
F-38041 Grenoble Cedex, France
Contact: J. Blachot
- k. Nuclear Data Center
Tokai Research Establishment
JAERI
Tokai-Mura, Naka-gun
Ibaraki-Ken 319-11, Japan
Contact: Y. Kikuchi
- l. Institute of Physics
University of Lund
Sölvegatan 14
S-223 62 Lund, Sweden
Contact: P. Ekström
- m. Nuclear Data Project
Kuwait Institute for Scientific Research
P.O. Box 24885
Kuwait, Kuwait
Contact: A. Farhan
- n. Laboratorium voor Kernfysica
Proeftuinstraat 86
B-9000 Gent, Belgium
Contact: D. De Frenne
- o. Tandem Accelerator Laboratory
McMaster University
Hamilton, Ontario L8S 4K1
Canada
Contact: J.A. Kuehner

EVALUATION RESPONSIBILITY

Center	Mass Chains	Center	Mass Chains
a. US/NNDC	45-50,57,58,65-73,94-97,99,136-148, 150,152,165,199	g. Russia/StP	86,88,130-135
b. US/NDP	81-85,200-205,207-209,213-236, (excepting 215,219,223,227), 237-243(odd),244-266	h. Holland	21-44
c. US/LBL	89-93,167-194,206,210-212,215,219, 223,227	i. PRC	51-56,195-198
d. US/INEL	87,153-163	j. France	101,104,107-109,111,113-117
e. US/TUNL	3-20	k. Japan	118-129
f. Russia/MOS	1,2,164,166,238-244(even)	l. Sweden	59-63
		m. Kuwait	74-80
		n. Belgium	102,103,105,106,110,112
		o. Canada	64,98,100,149,151

The Network of Nuclear Reaction Data Centers and Manpower Situation at the Centers

The network of Nuclear Data Centers

National and regional nuclear reaction data centers, co-ordinated by the International Atomic Energy Agency, co-operate in the compilation, exchange and dissemination of nuclear reaction data, in order to meet the requirements of nuclear data users in all countries. A brief summary of the data centers network is given below.

The nuclear reaction data centers:

NNDC	-	US National Nuclear Data Center, Brookhaven, USA
NEA-DB	-	OECD/NEA Nuclear Data Bank, Saclay, France
NDS	-	IAEA Nuclear Data Section
CJD	-	Centr po Jadernym Dannym (= Nuclear Data Centre), Obninsk, Russia
CAJaD	-	Centr po Dannym o Stroenii Atomnogo Jadra i Jadernykh Reakcih (= Nuclear Structure and Nuclear Reaction Data Centre), Moscow, Russia
CDFE	-	Centr Dannykh Fotojad. Eksp. (= Centre for Experimental Photonuclear Data), Moscow, Russia
CNDC	-	Chinese Nuclear Data Centre, Beijing, P.R. of China
ATOMKI	-	Nuclear Data Group of the ATOMKI Institute, Debrecen, Hungary
RIKEN	-	Nuclear Data Group, RIKEN Institute of Physical and Chemical Research, Wako-Shi, Japan
JCPRG	-	Japan Charged-Particle Nuclear Reaction Data Group, Sapporo, Japan
JAERI	-	Nuclear Data Center of the Japan Atomic Energy Research Institute, Tokai-Mura, Japan

1. Neutron Nuclear Data

- 1.a Bibliography and Data Index CINDA:
Input prepared by NNDC, NEA-DB, NDS, CJD, CNDC
Handbooks published by IAEA
Online services by NNDC, NEA-DB (and NDS from 1992)
- 1.b Experimental data exchanged in EXFOR format:
Input prepared by NNDC, NEA-DB, NDS, CJD
Online services by NNDC, NEA-DB (and NDS from 1992)
- 1.c Data Handbooks based on EXFOR published by NNDC

- 1.d Evaluated data exchanged in ENDF format:
NNDC, NEA-DB, NDS, CJD, CNDC, JAERI and others. Main data libraries:

BROND-2 (Russia)	IRDF-90 (IAEA)
CENDL-2 (China)	JEF-2 (NEA)
ENDF/B-6 (USA)	JENDL-3 (Japan)

Online services for BROND, ENDF/B-6, JEF, JENDL-3 by NNDC, NEA-DB (and NDS from 1992)

- 1.e Computer retrieval services upon request of customers:
NNDC, NEA-DB, NDS, CJD
- 1.f WRENDA: compilation of requested data that are known with insufficient accuracy. Compiled by NNDC, NEA-DB, NDS, CJD, published by IAEA

2. Charged Particle Nuclear Data (including heavy-ion reaction data)

- 2.a Bibliography published by NNDC *)
- 2.b Numerical data exchanged in EXFOR format:
Input prepared by CAJaD, RIKEN, CNDC, ATOMKI (from 1992), NDS, NNDC, JCPRG
Online services by NNDC, NEA-DB (and NDS from 1992)
- 2.c Data Handbooks based on EXFOR published by NDS, CAJaD
- 2.d Computer retrieval services upon request of customers:
NNDC, NEA-DB, NDS, CAJaD

3. Photonuclear Data

- 3.a Numerical data exchanged in EXFOR format:
Input prepared by CDFE, occasional contributions from NNDC, NDS
Online services by NNDC, NEA-DB (and NDS from 1992)
- 3.b Bibliography published by CDFE
- 3.c Computer retrieval services upon request of customers:
NNDC, NEA-DB, NDS, CAJaD

*) Discontinued in 1990; partly incorporated in the bibliographic system "NSR" for nuclear structure and decay data.

Index of Nuclear Data Libraries computerized data from the **IAEA-NDS** and **IAEA-NDIS**

1. Neutron nuclear data, experimental

EXFOR -*online

All exp. neutron data and derived quantities (resonance-parameters etc.) as well as exp. fission product yield data. More than 3 million records, updated in monthly intervals.

CINDA -*online

Resonance-Integrals and thermal activation c.s. -*MT

Neutron Scattering Lengths -*MT partly

see Atomic Data & Nuclear Data Tables **49**, 65-120, 1991

2. **ENDF** (evaluated neutron nuclear data) -*online

BROND-2.2, USSR library, 1992+93

CENDL-2, China library, 1991+93

ENDF/B-6, US library, 1990+91+93

JEF-2, OECD-NEA library, 1993

JENDL-3, Japan library, 1989+91 (ENDF-5)

ENDF data processing codes -*MT,PC

The int'l agreed format for data files of evaluated neutron reaction data. ENDF was designed also for related decay, fission-product yield, photo-atomic interaction data, and the latest version of **ENDF-6** permits data for nuclear reactions induced by photons and charged particles.

3. Neutron Nuclear Data Libraries evaluated for special Purposes:

3.1. Nuclear data standards for nuclear measurements

ENDF/B-6 Standards of 1987, evaluated data for $H^1(n, n)$, $He^3(n, p)$, $Li^6(n, t)$, $B^{10}(n, \alpha)$, $C(n, n)$, $Au^{197}(n, f)$, $U^{235}(n, f)$

NEANDC/INDC Nuclear Standards File 1991

XG (X-ray, gamma-ray) Standards

Cf-252 neutron spectrum of spontaneous fission, 1987

Neutron c.s. Standards for $E \geq 20$ MeV 1991

3.2. Thermal neutron c.s., Resonance parameters, Resonance integrals

JENDL-3 Fission Product Library, 1992

H:Neutron C.S. (Academic Press), Vol.1(1981, 1984) -*online

NUDAT -*online

ENDF/B-6 Thermal Neutron Scattering Law Library, 1992

E.M.Gryntakis File 1986

3.3. Neutron reaction data for Actinides nucleides

ENDF -*online

INDL/A-83, Suppl.86/5

IAEA Nuclear Data Library of Actinide neutron data evaluations.

3.4. Fission product yields

EXFOR -* online

ENDF/B-6 fission-product yield data, 1991+93

UK Fission Product Yield Library, 1991 -* online

ASIYAD by A.F.Grashin, 1988, obtained from a theoretical thermo dynamical model.

3.5. Fission products - evaluated neutron reactions
and decay data

ENDF/B-6 cross-section and decay data -*online

JEF-1 cross-section and decay data -*online

JNDC-FP2 cross-section and decay data, Feb. 1991

by Japanese Nuclear Data Committee, contains nuclear decay data
and fission yield data for 1078 unstable and 149 stable nucleids.

3.6. Neutron induced gamma-rays
(Spectroscopy, Inelastic scattering spectra)

3.7. Neutron activation c.s. for general use

ACTV-FUS/INT (for reactor applications) ,1991, -*MT

UENDL/NAA (for activation analysis),1988, -*PC

.....

3.8. Neutron activation c.s. for dosimetry -*MT

3.9. Miscellaneous specialized neutron data
libraries

Neutron Activation for Dosimetry, 1988-1991

INGDB-90 (for geophysics applications), 1991

Nuclear data for safeguards, June 1991

.....

4. Photo-nuclear data or Photo-atomic data

EXFOR (Berman,Lib. Photonuclear Data Center, Moscow), -*online

ENDF/B-6 Photo-atomic Interaction Data, -*online

GDR (Giant dipole resonance parameters for gamma-rays), -*PC

EADL(evaluated Atomic Data Library, 1991, LLNL)

EEDL(evaluated Electron Data Library, 1991, LLNL)

EPDL(evaluated Photon Data Library, Lawrence Livermore Nat' Lab)

XCOM(Photon-c.s. for Scattering, photoelectronic absorption, pair
production, total attenuation coefficients), - *PC

5. Charged-particle nuclear reaction data

EXFOR -*online

experimental & evaluated nuclear reaction data that induced by charged particles and heavy ions. Integral c.s. and thick target yields, Differential c.s., Intermediate energy nuclear reaction data

ENDF/B-6 Charged-Particle Sub-Libraries, 1991, -*, MT, PC

ENDF/B-6 High Energy Data File, 1990/1993

CPX compiled in 1962/67 by McGowan et al. -*online(**EXFOR**)

NNDC evaluated charged particle reaction data library,

1975

Stopping power data(ESTAR, PSTAR, ASTAR), -*PC

np and pp c.s. up to 350 MeV, 1992, internationally recommended, energy-dependent partial-wave rep.

C.S. of medium mass nuclide activation ($A=40-100$) by $E = 10 - 50$ MeV protons and alpha particles,

by V.N.Levkovski, Moskva, 1991, -*online(**EXFOR**)

PNESD - Proton Nucleus Elastic Scattering, by H.Leeb, 1978

.....

Nuclear data for theomuclear fusion

ENDF/B-6 charged-particle sublibraries, 1991, including fusion reactions between d, t, He3 particles. -* MT, PC

DROSG-87, charged-particle induced neutron source reactions, angular dependences of $E(n)$ and c.s., -*MT, PC

GRAZ-87, evaluated nuclear reaction c.s. & reaction rates with light isotopes $Z=1-5$, by R.Feldbacher, 1987

.....

6. Nuclear structure and decay data

ENSDF -*online, MT

evaluated nuclear structure and decay data file, published in the journal of "Nuclear Data Sheets"

NUDAT -*online

it includes for each nuclide, 1) adopted levels and gamma-ray energies, 2) half-lives and other properties of ground and meta-stable states, 3) decay radiations. These essential data have been extracted from ENSDF in a user friendly form.

NUDAT also includes thermal neutron c.s. and resonance integral data (see Chap. 3.2)

XG (X-ray and Gamma-ray) Standards for Detector Calibration an IAEA Co-ordinated Research Project(1986-1990) produced the recommended values. 1991 -*PC

Decay Data of Transactinium Nuclides

Values for half-lives and emission probabilities for alpha particles and selected gamma-rays, recommended by an IAEA Co-ordinated Research Project, 1986

ENDF/B-6 decay data, decay data library

it includes radioactive decay data for 256 nuclides, and the fission neutron spectrum of ⁹⁸Cf-252, (1993)

UKPADD-2 -* PC

Activation product decay data, by A.L.Nichols, AEA Harwell, UK, 1989-1993

PANDORA -* PC

a PC version of an ENSDF checking code to be used by ENSDF evaluators, version 5.3 (Dec. 1991)

RADLST -*MT

a code by T.W.Burrows to retrieve certain decay data from the ENSDF file, 1988

ENSGAM -* PC

A PC database for about 15000 gamma rays from 2777 radioactive nuclides derived from ENSDF by P.Ekström & L.Spanier, Lund Univ., Sweden. 1989

"Strong-Gammas" -* PC

A PC database of strong gamma-rays emitted from radio-nuclides, extracted from ENSDF by T.Ichimiya, T.Narita & K.Kato, JAERI, Japan, 1993

Blanchot Library -*MT

Decay data for heavy nuclides, fission products & activation products, with program package., by J.Blanchot, 1982

GAMCAT -* PC

gamma & alpha-rays from radioactive decay, a PC data base by Fachinformation zentrum Karlsruhe, 1990

7. Nuclear constants, Charts of Nuclides

8. Bibliographic files, WARENDA, etc.

CINDA -* online

Computerized bibliography and database Index for experimental and evaluated neutron reaction data, including (gamma,n) & (gamma,fis.), as well as an index to **EXFOR** data and to the more important evaluated neutron reaction data libraries **ENDF**.

NSR (Nuclear Structure References) -*online

A bibliography of nuclear data maintained in support of the network of nuclear structure data evaluators who produce the **ENSDF** database.

WARENDA

World requested list for measurements of nuclear data that are known with insufficient accuracy only.

WARENDA 93/94 published as INDC(SEC)-1-4.

Bibliography of integral charged-particle

nuclear data, including index to EXFOR data. -* MT

Handbook published from BNL-NCS, last issue: Dec. 1989

Photonuclear Data/Fotojadernye Dannye

A bibliography published periodically by the USSR Photonuclear Data Center in Moscow, Index 1976-1985 & 1986-1990 published in 1986 and 1993, respectively.

Photonuclear Reaction Data

A bibliographic index 1955-1992 published by JAERI, Japan. This index contains references not only for photonuclear reaction data in the narrower sense but also for the inverse reactions induced by n, p, d, t, He3, alpha and electron.

A+M/BDB (Atomic and Molecular Bibliographic Data Base)

IAEA-NDS-AM12, Vienna, Oct. 1982

IAEA-NDS-Documentation Series

An index to the IAEA-NDS-documents summarizing format and contents of nuclear data libraries.

Table 2

Nuclear Data Sheets Processing Statistics fro 1985-92

Elapsed Time (months)

Year	No. of A-chains Published	NNDC	Evaluator	Review	Editor-in-Chief	Publisher	Total Elapsed Time
1985	22	4.4	2.7	2.2	0.4	2.2	11.8
1986	22	5.2	3.6	2.8	1.0	2.2	14.7
1987	27	4.6	3.3	3.4	0.5	2.1	13.9
1988	19	3.8	3.7	3.6	0.8	2.5	14.4
1989	21	4.5	3.7	4.4	0.6	2.2	15.5
1990	29	5.2	4.5	4.9	0.7	1.7	17.0
1991	29	4.0	3.8	5.3	0.5	1.6	15.2
1992*	20	3.1	5.4	4.1	0.5	1.4	14.4
Nominal		4.0	3.0	2.5	0.5	2.0	12.0

*As of August 1992 issue.

3. Online Database System: NDIS

- Statistics of Users
- How this system looks like ?
- How to use NDIS ?

9. Online nuclear data service

NDIS (Nuclear Data Information System)

EXFOR (CSISRS) Experimental nuclear reaction data induced by neutrons, gamma-rays, and nuclei (charged-particles, heavy ions)

ENDF Evaluated neutron reaction data of the files BROND, CENDL, ENDF, JEF, JENDL.

CINDA Bibliographic and database index to experimental and evaluated neutron reaction data of EXFOR and ENDF.

ENSDF Evaluated nuclear structure and decay data.

NSR Bibliographic references to nuclear data publications relevant to the evaluation of nuclear structure and decay data.

XRAY Photo-atomic interaction data.

NUDAT Nuclear levels, decay radiations, half-lives and other properties extracted from ENSDF, plus thermal neutron c.s. and resonance-integrals.

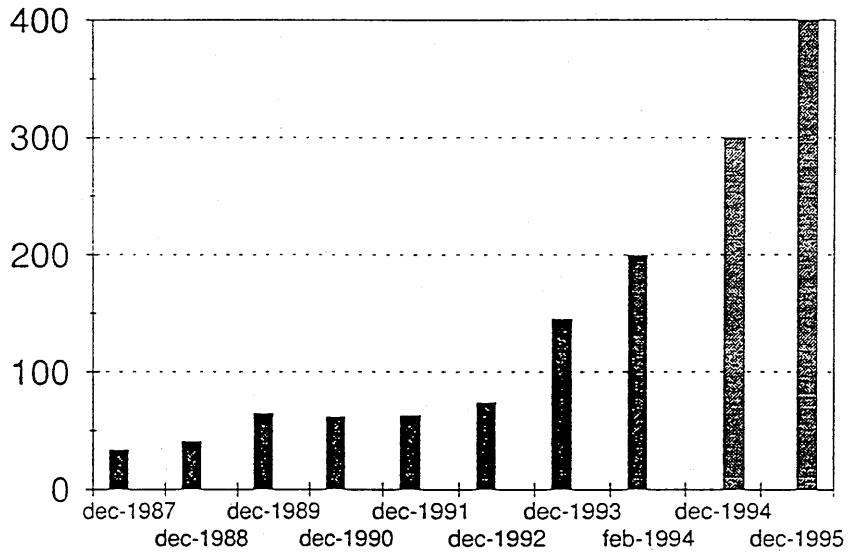
UTILITIES

NEWS, NEW_FEATURES, SAMPLE,
MAIL, CUSTOMIZE, ADDRESS, PLOT, etc.

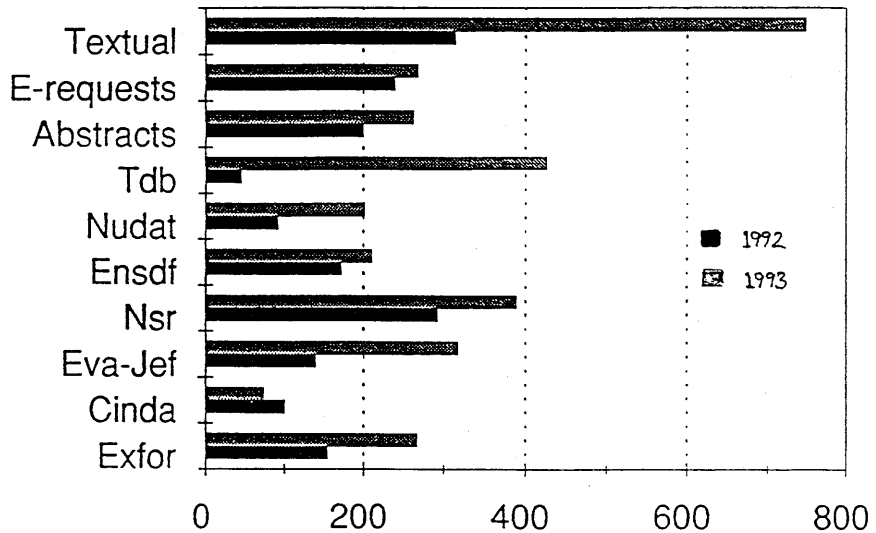
FILES

TYPE, SEND, CODES, DOCUMENTS, MASSES, etc.

Number of Online users



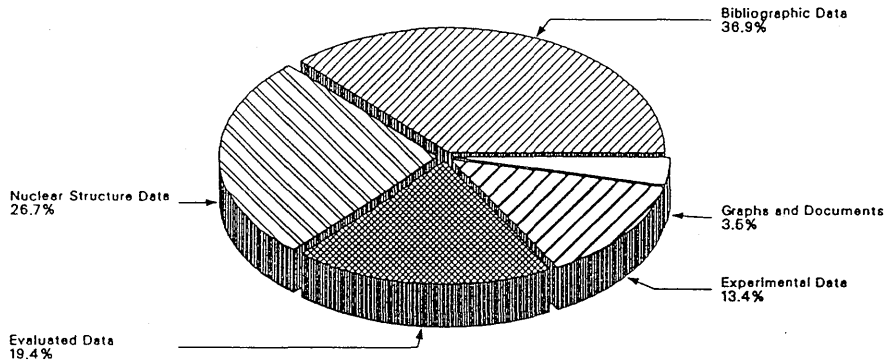
1993 usage by service



1992

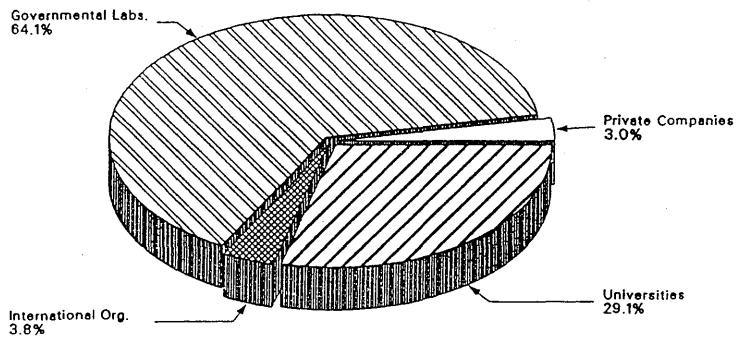
Nuclear Data Requests by Subject Category

Total number is 967



Nuclear Data Requests by Requester Category

Total number is 967



On-Line Access to the Nuclear Data Service

Network Centers

NNDC(BNL) VAX/Alpha7610 for U.S.A, Canada,
NEA-DB(OECD) VAX-6000 for the OECD countries,
IAEA-NDS VAX-4200 for the non-OECD countries.

Network Access

NNDC(BNL) IAEA-NDS
INTERNET: telnet bnln2.dne.bnl.gov iaeand.iaea.or.at
DECNET: set host BNLND2
ESNET: same as the above two

Logging In (through the VAX/VMS account)

NNDC(BNL) IAEA-NDS
Username: NNDC IAEANDS

Enter authorization code (or GUEST): GUEST

Enter your last name (or DEFAULT or ?): DEFAULT
(. . . . or ?): myname

Interactive Authorization Request

New accounts can be established during a session in which the GUEST account is used. At log-out time, the user is asked if he/she wishes to sign up to obtain authorization for your own account. Please provide your name, postal and e-mail addresses, telephone number, terminal-type, and a code of six/five characters which will be your personal authorization code.

User Interface

identical to those used in VAX/VMS
Video mode (ANSI standard): Tektronix, PostScript, Regis
Sequential mode: include non-ANSI standards

Access to NDIS
(online Nuclear Data Information System)
via INTERNET (TCP/IP):

Sample login:

TELNET IAEAND.IAEA.or.at
(or 161.5.2.2)

IAEA VAX-VMS V5.4-3

Username: IAEANDS

Welcome to VAX/VMS version V5.4-3 on node M4300
.....
.....

Enter NDS assigned authorization code (or GUEST): GUEST
(or your authorization code if you have one)

Enter your last name (or DEFAULT or?) _ _ _ _ _

Authorization

As a "GUEST", you will have 30 seconds of CPU time allocated. At the end of a GUEST session, you may sign up directly for an authorization code for full access service. (This code still needs to be activated by the NDIS manager before you can use it for future access.) Or, you may contact the IAEA Nuclear Data Section for assignment of an authorization code.

Retrieval system:

A user-friendly system provides ample help to the user who specifies the retrieval criteria in response to step-by-step prompts by the system. It also provides interactive assistance through HELP files. More detailed documentation on the system may be obtained by contacting the IAEA Nuclear Data Section.

Sample HELP Display in Video Mode

Nuclear Structure References				
RETRIEVE	NEW.FILE			
Format :	Increasing User	File :	User Terminal	
OUTPUT	NEW.FILE	FORMAT	YEAR.ORDER	DONE
Enter output file specs : ?				
<p>This option can be used to select an output file for your retrieval. Enter the full file specification (name.type as in PU239.NEW) for the file which will contain your retrieval output. If output is to go to your terminal enter a carriage return. Retrievals will be appended to last file specified if a new file specification is not given before a retrieval is done. The default output file is the user's terminal.</p>				
Use Control Z to Exit from Help				

Master Displays in Video Environment

Full Use Authorization

————— NNDC ONLINE SERVICE —————

Full Use Authorization DEC-VT Terminal 132 by 24

DATA BASES UTILITIES FILES PROBLEM HELP LOGOUT

DATA BASES - Access to searchable online data bases

<u>DATA BASES</u>	<u>UTILITIES</u>	<u>FILES</u>
NSR ENSDF NUDAT CINDA CSISRS ENDF XRAY MIRD DONE LOGOUT	NEWS SAMPLE MAIL NEW_FEATURES CUSTOMIZE ADDRESS PHYSICO PLOT DONE LOGOUT	DIRECTORY TYPE SEND CODES DOCUMENTS MASSES DELETE DONE LOGOUT

Limited Use Authorization

————— NNDC ONLINE SERVICE —————

Limited Use Authorization DEC-VT Terminal 132 by 24
Only **BOLDFACE** Selections are Available

DATA BASES UTILITIES PROBLEM HELP LOGOUT

DATA BASES - Access to searchable online data bases

<u>DATA BASES</u>	<u>UTILITIES</u>	<u>FILES</u>
NSR ENSDF NUDAT CINDA CSISRS ENDF XRAY DONE LOGOUT MIRD	NEWS SAMPLE NEW_FEATURES DONE LOGOUT MAIL CUSTOMIZE ADDRESS PHYSICO PLOT	DIRECTORY TYPE SEND CODES DOCUMENTS MASSES DELETE

Database Retrievals

NSR - a bibliographic database

each reference is represented by an entry in the database

Sample NSR Entry

	- internal data -	- notes -
<KEYNO	>88LA05	• unique keynumber
<HISTORY	>A880516	
<CODEN	>JOUR PYLBB 202 31	• reference type
<REFERENCE>	Phys.Lett. 202B, 31(1988)	• complete citation
<AUTHORS	>S.Landowne, C.H.Dasso	
<TITLE	>Pronounced Deformation Effects on Low Energy Transfer Reactions	
<KEYWORDS	>NUCLEAR REACTIONS	• major topic
	{+154},{+144}Sm({+144Sm},X),{+154}Sm({+154}Sm,X),E(cm) ? 310-350 MeV;calculated two-neutron pickup s(q) vs E.	
		• abstract, free-text.
<SELECTORS	>T:154SM;A. T:144SM;A.	• indexing parameters
R:(144SM,X);A. T;154SM;B. R:(154SM);B.		for the inverted file
C:DSIGMA;A. C:DSIGMA;B.		used in retrievals.

Retrieval Strategy

Menus and Options (sample NSR top-menu)

Browse	Retrieve	New_file	Format	Help	Exit
Initializa	Output				
Look	Single_ref				
Extract	New_file				
Combine	Format				
Scroll_lists	Year_order				
View_lists	Scroll_lists				(* for video mode only)
Save	View_lists				(* for sequential mode only)
Recall	Done				
Done					

create lists of keynumbers satisfying user's retrieval criteria.

retrieve entries corresponding the contents of keynumber lists

BROWSE/EXTRACT Display in Video Environment

Nuclear Structure References			
BROWSE		EXTRACT	
Publication Years : <u>61-90</u>		Type : <u>All</u>	Entry Cutoff Date : <u>None</u>
NUCLIDE	TARGET	INCIDENT PARTICLE	
OUTGOING PARTICLE	SUBJECT	MEASURED QUANTITY	
DEDUCED QUANTITY	CALCULATED QUANTITY	OTHER QUANTITY	
REACTION	<u>AUTHOR</u>	KEY LIST	
DONE			
<u>AUTHOR - An author of an NSR reference.</u>			
<u>Number</u>	<u>Contents of Reference List</u>	<u>References</u>	<u>Retrieved</u>
1	A:DUNFORD	4	None
2	A:SMITH,A.	150	None
3	N:239U	331	None
4	T:240PU	228	None
5	M:FISSION	1606	None
6	C:1.AND.2	1	None
7	C:4.AND.5	29	None

BROWSE/COMBINE Sequence in Video Environment

CREATE_NEW_LIST	DONE	?
Enter First Reference List Number		
	AND	
1	OR	.
	NOT	
Edit if necessary. Press RETURN when correct.		
1	OR	2

RETRIEVE/OUTPUT Display in Video Mode

Nuclear Structure References			
RETRIEVE	OUTPUT		
Format : <u>Increasing User</u>		File : <u>User Terminal</u>	
OUTPUT	SINGLE_REF	NEW_FILE	FORMAT YEAR.ORDER DONE
Enter number of list to be retrieved - 1			
Number	Contents of Reference List	References	Retrieved
1	A:DUNFORD	4	None
2	A:SMITH,A.	150	None
3	N:239U	331	None
4	T:240PU	228	None
5	M:FISSION	1606	None
6	C:1.AND.2	1	None
7	C:4.AND.5	29	None

Video Mode Output in User Format

Nuclear Structure References		
Reference List Title : A DUNFORD		
Publication Years : 61-90	Type : All	Entry Cutoff Date : None
67LI11		
<p>Phys.Rev. 162, 107 (1967) D.Lister, A.B.Smith, C.Dunford Fast-Neutron Scattering from the 182, 184, and 186 Isotopes of Tungsten</p> <p><KEYWORDS>NUCLEAR STRUCTURE 186W,182W,184W; measured not abstracted; deduced nuclear properties.</p>		
NEXT REF	PRIOR REF	QUIT
NEXT REF - Display the next reference in the list.		

8.3.5 RETRIEVE/OUTPUT

This option will output the currently selected data record to the user's terminal or to a disk file in the selected format. The data may be sorted in a number of ways depending on the data type being output. The following table summarizes the sorting options available. The first option listed is the default.

Adopted Levels

Mass number, Proton number, Level energy
Level energy, Mass number, Proton number

Adopted Gammas

Mass number, Proton number, Level energy, Gamma energy
Level energy, Mass number, Proton number, Gamma energy
Gamma energy, Mass number, Proton number, Level energy

Adopted Levels and Gammas

Mass number, Proton number, Level energy, Gamma energy
Level energy, Mass number, Proton number, Gamma energy
Gamma energy, Mass number, Proton number, Level energy

Ground and Metastable State Properties

Mass number, Proton number, State energy, Half-life

Decay Radiations

Mass number, Proton number, Half-life, Radiation
Radiation energy, Mass number, Proton number
Radiation intensity, Radiation energy, Mass number, Proton number

Thermal Neutron Data and Resonance Integrals

Mass number, Proton number, State energy

Output Display for an Adopted Levels Retrieval in Video Environment

A	Sym	Z	Level Energy (keV)	dE %	J-Pi	Half-life	dHL %	PUB Year
22	NE	10	6345.2000	0.0142	4+	10 FS		90
22	NE	10	6636.0000	0.0256	(2,3)+	14 FS		90
22	NE	10	6691.0000	0.0598	1-			90
22	NE	10	6817.0000	0.0293	2+			90
22	NE	10	6853.4000	0.0277	1+	236 AS	17.7966	90
22	NE	10	6904.0000	0.1304	(0,1)+			90
22	NE	10	7052.0000	0.0993	1-			90
22	NE	10	7341.1000	0.0150	(3,4)+			90
22	NE	10	7342.0000	0.0817	0+			90
22	NE	10	7406.0000	0.0270	(1,3)-	62 FS	45.1613	90
22	NE	10	7423.0000	0.0180	(3,5)+	47 FS	31.9149	90
22	NE	10	7470.0000	0.2677				90
22	NE	10	7489.0000	0.0801	1-			90
22	NE	10	7644.0000	0.0523	2+	0.8 FS	37.5000	90
22	NE	10	7664.0000	0.1044	2-			90

FORWARD	BACKWARD	START	END	DONE
FORWARD - Go to the next window of scrolled information.				