Otto Schwerer 氏を囲んでの核データシンポジウム報告

Report on NRDF Symposium with Dr. Otto Schwerer

北海道大学知識メディアラボラトリー
大林　由英
Meme Media Laboratory, Hokkaido University
Ohbayasi, Yosihide

abstract

Japan Charged Particle Reaction Data Group (JCPRG) invited Dr. Otto Schwerer, Nuclear Data Section (NDS), International Atomic Energy Agency (IAEA), under the auspices of the foreign researchers receiving system of the Meme Media Laboratory, Hokkaido University. Main purposes of his invitation are, understanding the role and activities of NDS, Nuclear Data Center Network activities and EXFOR (Nuclear Reaction Data Exchange Format) database and pursuing cooperative work on the conversion of the NRDF (Nuclear Reaction Data File) format files to EXFOR files. We have aimed to enforce the responsibility of JCPRG for the compilation and the dissemination of the domestic charged particle nuclear reaction data worldwide. During his stay, we held a symposium in order to clarify the above purposes. In this report, we have shown all reports presented at the symposium on October 7, 2001, at Meme Media Laboratory, Hokkaido University.

2000 年 9 月 29 日より一ヶ月間、日本荷電粒子核反応データグループ(JCPRG)では、北海道大学知識メディアラボラトリーの外国人研究者招聘制度のもと IAEA(国際原子力機関)核データ部の Otto Schwerer 博士を招聘し「Otto Schwerer 氏との核データワークショップ」と題し共同研究を行うこととなった。

本共同研究の出発点として 10 月 7 日に行ったシンポジウムでは、以下に付記するシンポジウム案内文にもあるように 1. Schwerer 氏による IAEA を中心とした核データ活動の紹介, 2. この一ヶ月の共同研究活動方針の確認が行われ、その後約一ヶ月間の活動の方向を定め、核データ活動に対する理解を深める絶好の機会となった。
本稿はこのシンポジウムの報告を講演者の発表原稿の掲載という形で行うものである。

Otto Schwerer 氏を囲んでの核データシンポジウムのご案内

時　: 10 月 7 日 (土) 09:30 -17:30
場所: 北海道大学知識メディアラボラトリー二階コラボレーション研究室(西側)

9 月 29 日からの一ヶ月間、日本荷電粒子核反応データグループ(JCPRG)では、北海道大学知識メディアラボラトリーの外国人研究者招聘制度のもとに IAEA(国際原子力機関)核データ部の Otto Schwerer 氏を招聘し、「Otto Schwerer 氏との核データワークショップ」と題し共同研究を行う運びとなりました。

つきましては上記日程および場所においてシンポジウムを開催することとなりましたのでご案内いたします。

本シンポジウムの目的は大きく次の2つとなります。

1. Otto Schwerer 氏による IAEA を中心とした核データ活動の紹介

核反応や核構造など原子核理論研究者にも必要であろう情報の収集、管理、公開の任務を、IAEA を中心とした国際的ないわゆる核データ活動は担っています。氏には、その核データ活動の概要や、実際にどのような情報が現在サービスされているのかなどのお話をしていただきます。実際に会場で PC を数台用意し、氏の紹介したデータベースサービスの利用を試すことができるようにする予定です。

2. この一ヶ月の共同研究活動方針の確認

今回のワークショップの目的の一つとして、JCPRG が独自のフォーマットを用い収集しています国内の荷電粒子核反応データの、国際核反応データ交換フォーマット(EXFOR)への変換の作業の効率化と相互の情報交換にあります。それを含めてこの一月の活動の方針の全体での確認を取る意義をこのシンポジウムは持っています。

特に原子核物理学の若い院生の方々には 1)の核データサービスの紹介などは勉強になるのではないでしょうか？当日は会場内にドーナツ、コーヒー、フルーツ等適当な飲食もできるようにし、休憩や昼食も会場内で済ませられるようにする予定です。設置予定の PC 等を用いたデータベースサービスを皆さんに休憩時間等に利用してもらい、それを元に自由な議論の場を提供できればよいと考えております。また夕方には氏を交えた歓迎会を計画しております。皆様お忙しいとは思いますが歓迎会をも含め是非御参加下さい。

会場についての注意事項

・知識メディアラボラトリーの位置は
http://www.meme.hokudai.ac.jp/map.html をご参照ください。
建物の写真はこちら
・当ラボラトリー入り口は終日カードキーによってロックされており部外者はそのままでは入館できません。
会議中は入り口インターホンにて内線 7258 番を回していただければ中からお迎えに上がります。

・一部を除きラボ内は禁煙となっております。お煙草をお吸いになる方は一階の喫煙エリアをご利用ください。

プログラム

午前

09:30-09:45 田中 一　北海道大学名誉教授　「シンポジウム開催にあたって」
09:45-10:00 岡本浩一　日本大学文理学部講師　「Otto Schwerer 氏紹介」
10:00-11:00 Otto Schwerer IAEA 核データ部　「講演その 1」
11:00-11:15 Coffee break
11:15-12:00 千葉正喜　札幌学院大学　「N2X システムレビュー」
12:00-14:00 Lunch Time

午後

14:00-15:00 Otto Schwerer　「講演その 2」
15:00-15:15 Coffee break
15:15-16:00 能登宏　北星学園大学　「NRDF 辞書レビュー」
16:00-16:15 Coffee break
16:15-17:15 PostDoc システム開発レビュー(20min. x3)
近江弘和 北海道大学知識メディアラボラトリー
大林由英 北海道大学知識メディアラボラトリー
升井洋志 北海道大学知識メディアラボラトリー
17:15-17:30 加藤幾芳　北海道大学/JCPRG 管理運営委員長 「おわりに」.

18:00- Welcome party 「ファカルティハウス エンレイソウ」にて

Opening Address

Ladies and Gentlemen,

I would like to extend my warm welcome to Dr. Schwerer, Mr.Okamoto and the other all participants.

Our data-base activity started from 1974 as a branch of the big project on informatics. Prof. Ooizumi and I, as a member of the Council, gave a proposal at the Science Council of Japan in 1973. It was happy our proposal was realized only one year after.

I attempted to develop a new retrieval system as a problem of the proposal. It was asentence-retrieval system by two kinds of key word, where the many documents were stored . A student in graduatecourse could write his comprehensive report of nuclear three-body force in a short period using this system. Many persons of the project had much interest in my new retrieval system, because they had the impression that the information retrieval was just same as document retrieval.

After I proposed the sentence-retrieval system, I beat my brain to make a giant retrieval system for the nuclear research work by combining two kindsof the retrieval systems, sentence-retrieval system and nuclear data-retrieval system. But the plan was unrealistic. The activity of the developing group of sentence-retrieval system gradually decreased, because all the member of the group were excellent nuclear physicists and were very much busy in their own research work. Furthermore, much money was necessary in making the sentence-retrieval system. As a result of this situation, the activity continuing till now was only this data activity and also this data-activity have been continuing holding research aspect for a long time.

We would like to talk about two points for our data activity. Firstly I would like to appreciate the organizing efforts of IAEA. As well known, thequantity of nuclear data is huge. On the other hand, resultant data quantitymade by our group is not so much in every year. This gap sometimes gives us discourage for the hope of continuing our data activity. The situation might not be changed even if the data quantity would be increased by ten times. IAEA has been continuing making efforts to organize coordination and cooperation of CPND network, which has brought the global network system of the production and the use of CPND. I would like to assert that this IAEA'seffort supports our activity for long time. The support has helped to make our work continue for long time.

Next I would like to express my opinion on the data-base activity. The members of the big project started in 1974 had expressed less interest at the beginning and the audienses wre not so many even in the international meeting of infoumatics.. I once made some comment at the meeting of the project. By what means could we have intellectually had evolved until the present degree? It had been necessary for the mankind to do various actions of memorization, classification and retrieval with high level. The path of the intellectual evolution of mankind should have been the path of progress of the retrieval-power. How to get a necessary infonation has been and will be an important problem to us.

I hope and believe that this symposium will be successful in the many reports and the earnest discussion, and we get many valuable results.

Introduction to the IAEA Nuclear Data Section and its Services

Otto Schwerer
Nuclear Data Section
International Atomic Energy Agency
Vienna, Austria

Outline

*) For a detailed report on the NDS activities, see M.A.Lone and D.W.Muir, report INDC(NDS)-414 (July 2000)

The Mission of NDS

- The Nuclear Data Section (NDS) carries out the IAEA activities concerning *development* and *dissemination* of nuclear and atomic data for applications
- In addition, NDS is involved in *Technology Transfer* activities to assist scientists in developing countries

Structure of NDS

- Activities:
  - Data Center Activities
  - Nuclear Data Improvement/Development
  - Technology Transfer
  - Atomic and Molecular Data Activities
- Groups ("Units") within NDS:
  - Data Center Unit
  - Data Development Unit
  - Atomic and Molecular Data Unit
  - Computer Unit
- 18 staff (of about 2000 of whole IAEA)

Position within IAEA

- Departments of IAEA:
  - Nuclear Energy
  - Nuclear Safety
  - **Nuclear Sciences and Applications (NA)**
  - Technical Co-operation
  - Safeguards
  - Management
- Divisions within NA Department:
  - Human Health
  - **Physical and Chemical Sciences (NAPC)**
  - Agency Laboratories (Monaco, Vienna, Seibersdorf)
  - Nuclear Techniques in Food and Agriculture (joint with FAO)
- Other Sections within NAPC Division:
  - Physics, Chemistry, Isotope Hydrology

Data Center Activities

- Compilation
  - Compile new data (neutron-induced) in EXFOR and CINDA
  - Keep master files in cooperation with other centers
  - Collect evaluated and specialized libraries for users
- Online and Off-line data services with particular emphasis on meeting the needs of developing countries
  - WWW: **http://www-nds.iaea.or.at**
  - Telnet ("NDIS - Nuclear Data Information System")
  - FTP
  - Offline (CD-ROM, documents, retrievals): contact e-mail **services@iaeand.iaea.or.at**
  - In 1999, 16300 specific WWW retrievals and 2200 Telnet retrievals were performed by our users, and 2300 off-line retrievals were performed for them
- Data Center Network Co-ordination

Data Development Activities

- Main mechanism: *Co-ordinated Research Projects* (CRPs)
  - 4-10 participating groups, duration 3-5 years
  - Research contracts, research agreements
  - Research co-ordination meetings
  - Objectives: concrete product, usually a database
  - Results (data and documentation) made available (TECDOC, Web, CD-ROM)
- Other mechanisms: Advisory Group Meetings (AGM)
- Special long-term project: FENDL, was produced with a series of thematically linked AGMs

Recent Coordinated Research Projects

No	Short Title	Duration	Participants (Contracts)	Technical Officer	Status May 2000
1	Fission Yield Data (<20 MeV)	1991-96	7(1)	Lammer	Complete
2	Photon Data	1994-98	9 (3)	Oblozinsky	Completed
3	Medical Radioisotopes	1995-99	7 (3)	Oblozinsky	Completed
4	Photonuclear Data	1996-00	7 (3)	Oblozinsky	Completed
5	Fission Yield (<150 MeV)	1997-01	10 (3)	Lammer	Ongoing
6	X- and Gamma-Ray Standards	1998-01	8 (3)	Herman	Ongoing
7	Input Parameter Testing (RIPT-II)	1998-01	8 (3)	Herman	Ongoing
8	PGAA – Prompt Gamma Activation Analysis	1999-02	5(2)	Paviotti	New
9	Nuclear data for Th-U fuel cycle	2001-05	8 (3)	Proynaev	Start in 2001
10	Transport Simulation in Photon/Electron Radiotherapy	2000-03	4( )	Trkov (Andreo)	Deferred to 2001

Technology Transfer Activities

- Technical Cooperation Projects
  - Latin American "Mirror Server" Project
    Started operation at IPEN, Sao Paulo, Brazil in February 2000
  - Ghana Project: installed "Mini-data center" on WinNT workstation (part of a larger TC project "Utilization of Ghana Research Reactor-1")
- Workshops
  - Bi-annual workshops on "Nuclear Reaction data and Nuclear Reactors: Physics, Design and Safety" at ICTP Trieste, Italy (3 weeks) (all even years)
  - ICTP workshops on Nuclear Data for Science and Technology (odd years, several weeks).
    - 1999: Medical Physics
    - 2001: Accelerator Driven Waste Incineration
  - Workshops on Online Nuclear Data Services (1997, 1999)
  - Workshop on Linux for Nuclear Data Computation on PC (1999)

Atomic and Molecular Data Unit

- Databases for fusion energy and other plasma research and other applications
- Separate database server (AMDIS)
  - Numerical data: ALADDIN
  - Bibliographic data: AMBDAS
- Publications, e.g. CIAMDA
- Separate activity under NDS organisational unit

2. Nuclear Data Centers Networks

Nuclear data

- ***describe*** properties of atomic nuclei and the fundamental physical relationships governing their interactions
- ***characterize*** physical processes underlying all nuclear technologies
- ***Examples:*** cross sections, half-lives, decay modes and decay radiation properties, γ-rays from radionuclides
- ***Scope:*** all 85 natural elements with 290 stable isotopes and more than 2500 radionuclides

Applications of nuclear data

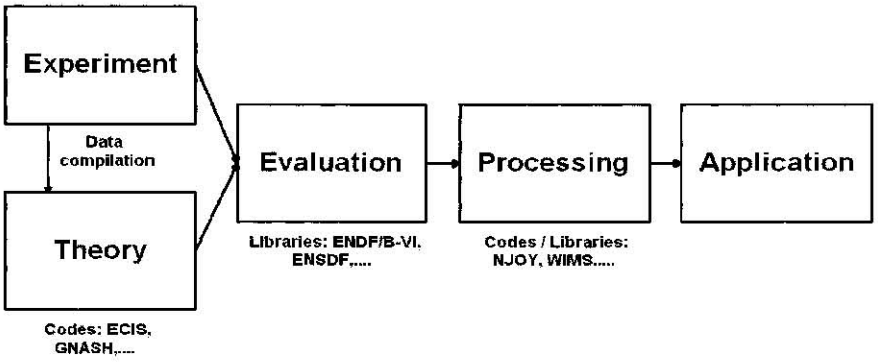
- Energy applications
  - Fission power
  - Fusion reactor technology
- Non-energy applications
  - Nuclear medicine
  - Materials analysis and process control
  - Safeguards
  - Radiation safety
  - Waste management
  - Environmental research
  - Basic research (e.g. nuclear astrophysics) and education

Nuclear data centers

- organize collection and distribution of nuclear data on a world-wide scale
- are involved in all stages of data preparation between measurement and application: compilation, review, evaluation, processing, distribution
- The work of international, regional and national nuclear data centers is co-ordinated by the IAEA in two specialized **data center networks** for maximum efficiency and work sharing

From experimental nuclear data to applications

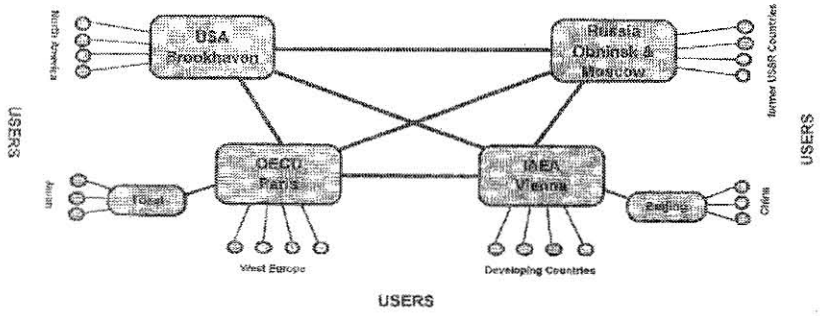
Laboratory → Data Center → User



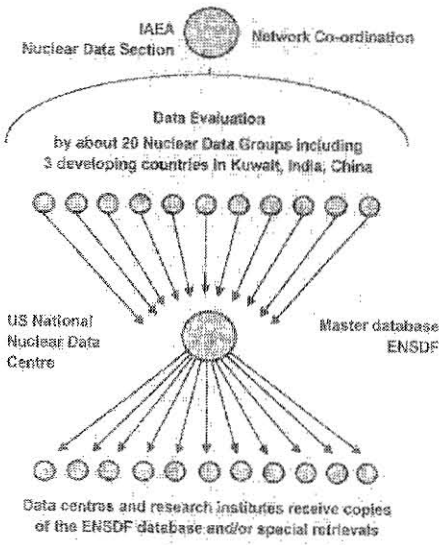
Nuclear Data Centers Networks

- **Nuclear Reaction Data Centers Network**
  - **IAEA Nuclear Data Section**, Vienna, Austria
  - **OECD NEA Data Bank**, Paris, France
  - **U.S. National Nuclear Data Center**, Brookhaven, USA
  - **Russian Nuclear Data Centers**, Obninsk and Moscow, Russia
  - **China Nuclear Data Center**, Beijing, China
  - **Japanese Nuclear Data Center**, Tokai, Japan
  - **Additional co-operating specialized centers** (Russia, Japan, Hungary, Ukraine, USA)
- **Nuclear Structure Data Centers Network**
  - **IAEA Nuclear Data Section**, Vienna, Austria (Co-ordination)
  - **U.S. National Nuclear Data Center**, Brookhaven, USA (Master database)
  - **17 data evaluation centers** in USA, Russia, Netherlands, China, France, Japan, Kuwait, Belgium, Canada, UK
  - **Data dissemination centers** (IAEA, OECD-NEA, USA, France, Sweden)

Network of Nuclear Reaction Data Centers



Network around the Evaluated Nuclear Structure Data File (ENSDF)



Web addresses of main dissemination centers

Major nuclear data dissemination centers. Additional dissemination centers with specialized scope exist e.g. in USA, Russia, Japan, Korea and other countries, and more centers contribute to data compilation and other data center functions.

Data center	Web address	Main services	Main area of responsibility
IAEA Nuclear Data Section, Vienna, Austria	http://www-nds.iaea.or.at	Reaction data, structure and decay data, reports; computer programs through OECD NEA Data Bank	IAEA member states with special emphasis on developing countries
US National Nuclear Data Center, Brookhaven, USA	http://www.nndc.bnl.gov	Reaction data, structure and decay data	USA, Canada
OECD NEA Data Bank, Issy-les-Moulineaux, France	http://www.nea.fr/html/databank/	Reaction data, structure and decay data, computer programs	OECD member states
Russian Nuclear Data Centers, Obninsk and Moscow, Russia	http://depni.npi.msu.su/cdfe/ (Center for Photonuclear Experiments Data)	Reaction data	Russia
China Nuclear Data Center, Beijing, China		Reaction data	China
Isotope Project, Berkeley, USA	http://isotopes.lbl.gov/isotopes/	Structure and decay data	
Department of Physics, Lund University, Sweden	http://nucleardata.nuclear.lu.se/nucleardata/	Structure and decay data	
Atomic Mass Data Center, Orsay, France	http://csnwww.in2p3.fr/amdc/	Structure and decay data	

Major Nuclear Data Centers

1 ● IAEA Nuclear Data Section, Vienna
2 ● OECD NEA Data Bank, Paris
3 ● U.S. National Nuclear Data Center, Brookhaven
4 ● Russian Nuclear Data Centers, Obninsk + Moscow
5 ○ U.S. Radiation Safety Information Computational Center (RSIC), Oak Ridge
6 ○ Chinese Nuclear Data Center, Beijing
7 ○ Japanese Nuclear Data Center, Tokai

3. Overview of Nuclear Data Libraries

Nuclear Data Types:

- Bibliographic data
- Experimental data
- Evaluated data
- Nuclear reaction data
- Nuclear structure and decay data

Nuclear Data Libraries at IAEA

- Most comprehensive collection of nuclear data libraries worldwide - enormous value
- More than 100 libraries
- All data available free of charge to scientists in IAEA member states, on informal request or through Internet
- Overview:
  - "Index of Nuclear Data Libraries available from the IAEA Nuclear Data Section", Report IAEA-NDS-7, ed. by H.D. Lemmel and O. Schwerer (August 1998), see also *http://www-nds.iaea.or.at/reports/nds-7.pdf*
  - IAEA Nuclear Data Guide, *http://www-nds.iaea.or.at/indg_intro.html*
- Brief documentations of contents and/or format for most libraries are published in the ***IAEA-NDS***- report series (some reports and index IAEA-NDS-0 available also online), e.g. ***IAEA-NDS-1****: EXFOR,* ***IAEA-NDS-100****: ENDF/B-VI,* ***IAEA-NDS-136****: MENDL-2*

Bibliographic data: important examples

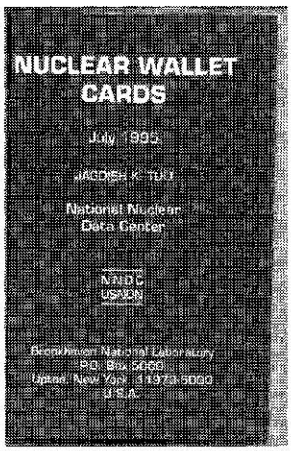
- **CINDA** (*Computerized Index of Neutron DAta*)
  - Comprehensive bibliography to neutron reaction data
  - 1935 - present
  - Published regularly as a book
- **NSR** (*Nuclear Science References*)
  - Bibliographic database for low and intermediate energy nuclear physics. Main bibliography for structure and decay data and for non-neutron reaction data
  - 1910 - present
  - Published regularly in the journal *Nuclear Data Sheets (Recent References)*

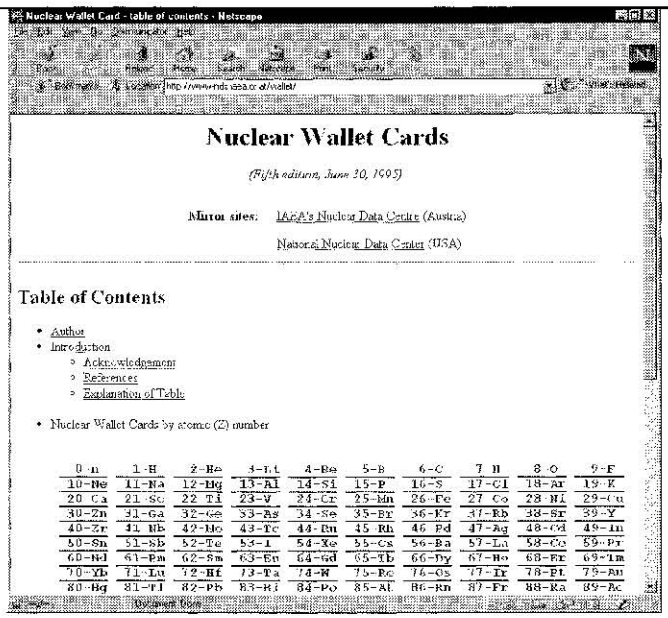
Another nuclear bibliography: INIS

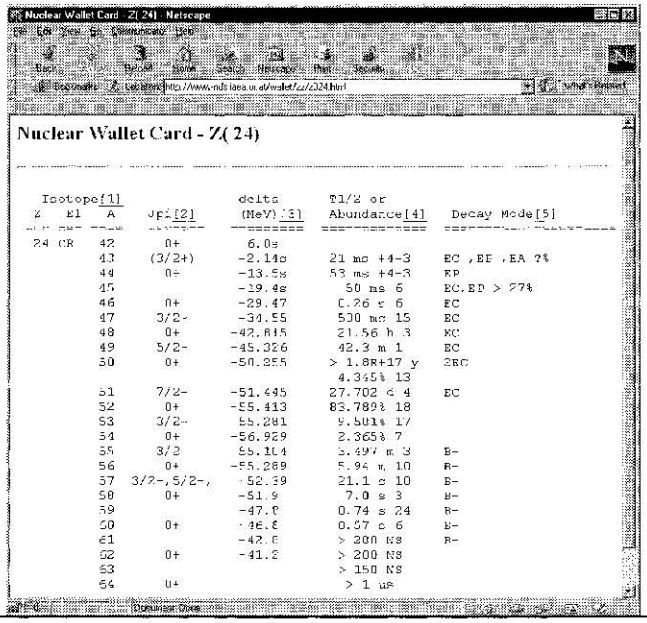
- INIS (International Nuclear Information System): a multi-gigabyte general nuclear bibliography maintained by IAEA
- **Not** specialized on nuclear data, **not** maintained by Nuclear Data Section. Wide scope, including reactor technology, nuclear law, nuclear medicine. Occasionally useful for nuclear data searches
- Available through WWW (license required, or through scientific library) or commercial CD-ROM

Nuclear Wallet Cards

- Basic properties of ground and metastable states
- Available in several formats:
  - Pocket booklet (available from US-NNDC)
  - WWW: (display of tables for each element)
  - WWW as part of NUDAT (interactive retrievals by various criteria)
  - Telnet: as part of NUDAT, same functions as in WWW





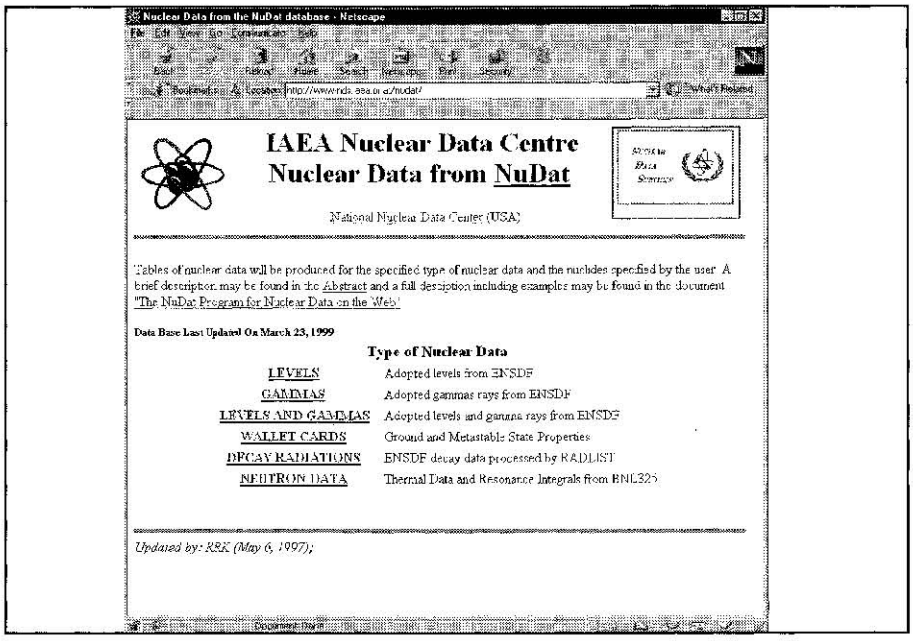


Nuclear Wallet Card - Z(24)

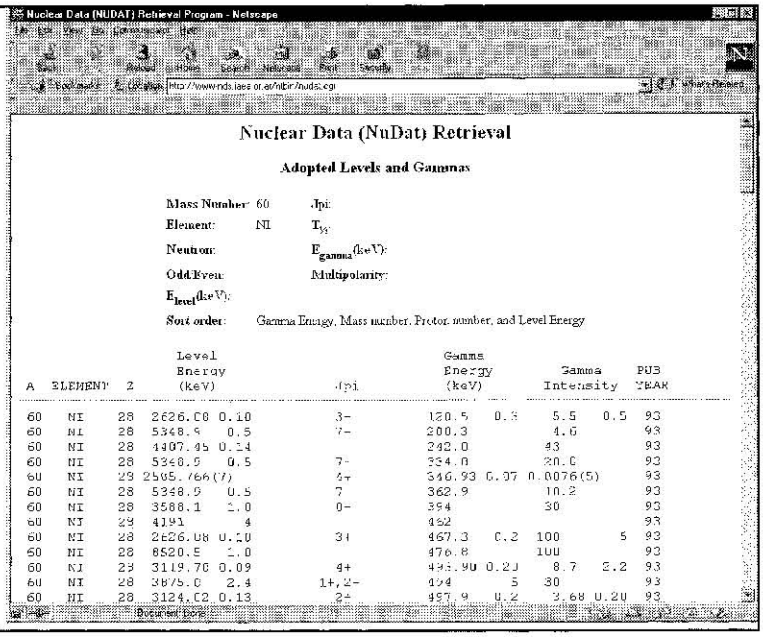
Isotope[1] Z	El	A	Jp[2]	delta (MeV)[3]	T1/2 or Abundance[4]	Decay Mode[5]
24	CR	42	0+	6.0s		
		43	(3/2+)	-2.14s	21 ms +4-3	EC ,EP ,EA ?%
		44	0+	-13.5s	53 ms +4-3	EP
		45		-19.4s	50 ms 6	EC,EP > 27%
		46	0+	-29.47	0.26 s 6	EC
		47	3/2-	-34.55	500 ms 15	EC
		48	0+	-42.815	21.56 h 3	EC
		49	5/2-	-45.326	42.3 m 1	EC
		50	0+	-50.255	> 1.8E+17 y 4.345% 13	2EC
		51	7/2-	-51.445	27.702 d 4	EC
		52	0+	-55.413	83.789% 18	
		53	3/2-	-55.281	9.501% 17	
		54	0+	-56.929	2.365% 7	
		55	3/2	-55.104	3.497 m 3	B-
		56	0+	-55.289	5.94 m 10	B-
		57	3/2-,5/2-,	-52.39	21.1 s 10	B-
		58	0+	-51.9	7.0 s 3	B-
		59		-47.0	0.74 s 24	B-
		60	0+	-45.8	0.57 s 6	B-
		61		-42.6	> 200 NS	B-
		62	0+	-41.2	> 200 NS	
		63			> 150 NS	
		64	0+		> 1 us	

NUDAT

- User-friendly extract of most important data (for applications) from ENSDF, plus thermal neutron data (cross sections and resonance integrals)
- Consists of 6 modules:
  - Levels / Gammas / Levels and Gammas / Wallet Cards / Decay Radiations / Neutron Data
- Available online through WWW and Telnet. Interactive retrievals by various criteria
- PC version can be downloaded (PCNUDAT). (Superseding 1996 CD-ROM version "Nuclear Data and References")

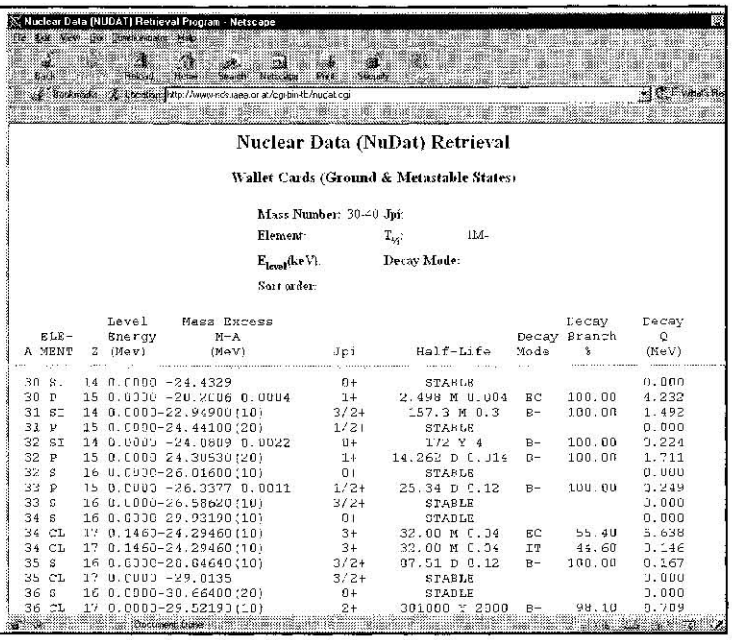


NUDAT/ Adopted Levels and Gammas for ^{60}Ni



A	ELEMENT	Z	Level Energy (keV)		Jpi	Gamma Energy (keV)		Gamma Intensity		PUB YEAR
60	NI	28	2626.08	0.10	3-	120.5	0.3	5.5	0.5	93
60	NI	28	5348.9	0.5	7-	200.3		4.6		93
60	NI	28	4107.45	0.24		242.0		93		93
60	NI	28	5348.9	0.5	7-	334.8		20.0		93
60	NI	28	2505.766(7)		4+	346.93	0.07	0.0076(5)		93
60	NI	28	5348.9	0.5	7	362.9		10.2		93
60	NI	28	3588.1	1.0	0-	394		30		93
60	NI	28	4191	4		462				93
60	NI	28	2626.08	0.10	3+	467.3	0.2	100	5	93
60	NI	28	8520.5	1.0		476.8		100		93
60	NI	28	3119.76	0.09	4+	493.90	0.20	8.7	2.2	93
60	NI	28	3875.0	2.4	1+,2-	494	5	30		93
60	NI	28	5124.62	0.13	2+	497.9	0.2	3.68	0.20	93

NUDAT/
Wallet Cards
Retrieval for
A=30-40,
$T_{1/2}$>1 min



Nuclear Data (NUDAT) Retrieval Program - Netscape

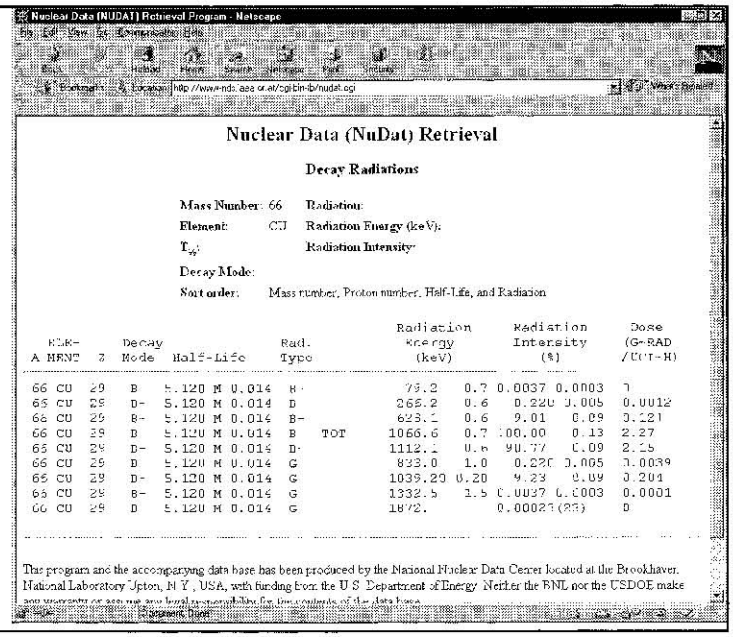
Nuclear Data (NuDat) Retrieval

Wallet Cards (Ground & Metastable States)

Mass Number: 30-40 Jpi:
Element: $T_{½}$: IM-
E_{level}(keV): Decay Mode:
Sort order:

A	ELEMENT	Z	Level Energy (Mev)	Mass Excess M-A (MeV)	Jpi	Half-Life	Decay Mode	Decay Branch %	Decay Q (MeV)
30	S.	14	0.0000	-24.4329	0+	STABLE			0.000
30	P	15	0.0000	-20.2006 0.0004	1+	2.498 M 0.004	EC	100.00	4.232
31	SI	14	0.0000	-22.9690(10)	3/2+	157.3 M 0.3	B-	100.00	1.492
31	P	15	0.0000	-24.44100(20)	1/2+	STABLE			0.000
32	SI	14	0.0000	-24.0809 0.0022	0+	172 Y 4	B-	100.00	0.224
32	P	15	0.0000	24.30530(20)	1+	14.262 D 0.014	B-	100.00	1.711
32	S	16	0.0000	-26.01600(10)	0+	STABLE			0.000
33	P	15	0.0000	-26.3377 0.0011	1/2+	25.34 D 0.12	B-	100.00	0.249
33	S	16	0.0000	-26.58620(10)	3/2+	STABLE			0.000
34	S	16	0.0000	29.93190(10)	0+	STABLE			0.000
34	CL	17	0.1460	-24.29460(10)	3+	32.00 M 0.04	EC	55.40	5.638
34	CL	17	0.1460	-24.29460(10)	3+	32.00 M 0.04	IT	44.60	0.146
35	S	16	0.0000	-28.84640(10)	3/2+	87.51 D 0.12	B-	100.00	0.167
35	CL	17	0.0000	-29.0135	3/2+	STABLE			0.000
36	S	16	0.0000	-30.66400(20)	0+	STABLE			0.000
36	CL	17	0.0000	-29.52190(20)	2+	301000 Y 2000	B-	98.10	0.709

NUDAT/
Decay
Radiations
for ^{66}Cu



Nuclear Data (NUDAT) Retrieval Program - Netscape

Nuclear Data (NuDat) Retrieval

Decay Radiations

Mass Number: 66 Radiation:
Element: CU Radiation Energy (keV):
$T_{½}$: Radiation Intensity:
Decay Mode:
Sort order: Mass number, Proton number, Half-Life, and Radiation

A	ELEMENT	Z	Decay Mode	Half-Life	Rad. Type		Radiation Energy (keV)		Radiation Intensity (%)		Dose (G-RAD /(CI-H)
66	CU	29	B	5.120 M 0.014	B+		79.2	0.7	0.0037	0.0003	?
66	CU	29	D-	5.120 M 0.014	D		265.2	0.6	0.220	0.005	0.0012
66	CU	29	B-	5.120 M 0.014	B-		623.1	0.6	9.01	0.09	0.121
66	CU	29	D	5.120 M 0.014	B	TOT	1066.6	0.7	100.00	0.13	2.27
66	CU	29	D-	5.120 M 0.014	D-		1112.1	0.6	90.77	0.09	2.25
66	CU	29	D	5.120 M 0.014	G		833.0	1.0	0.220	0.005	0.0039
66	CU	29	D-	5.120 M 0.014	G		1039.20	0.20	9.23	0.09	0.204
66	CU	29	B-	5.120 M 0.014	G		1332.5	1.5	0.0087	0.0003	0.0001
66	CU	29	D	5.120 M 0.014	G		1872.		0.00023(23)		0

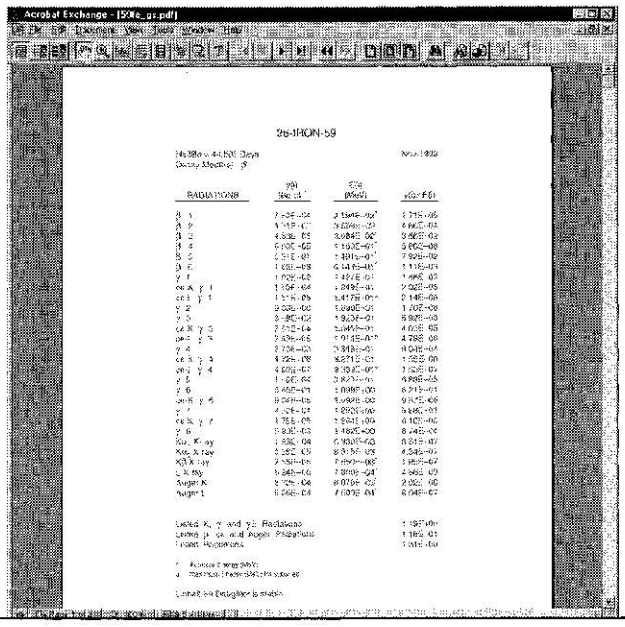
This program and the accompanying data base has been produced by the National Nuclear Data Center located at the Brookhaven National Laboratory Upton, N.Y., USA, with funding from the U.S. Department of Energy. Neither the BNL nor the USDOE make any warranty or accept any legal responsibility for the contents of the data base.

MIRD - "Medical Internal Radiation Dose"

- Based on ENSDF, data processed with code "RADLST". Input: only nuclide selection
- Output: Tables with intensities, energies and dose of all produced radiations, including X-rays, Auger electrons, etc., and decay scheme plots
- Output in HTML/GIF or PostScript
- NUDAT option "Decay radiations" provides similar function (table only)
- "Advanced" or "custom" tables: use RADLST separately (available for downloading)

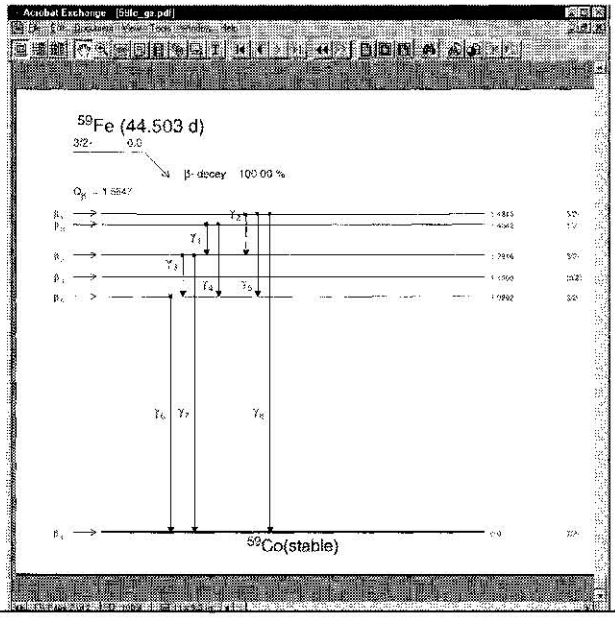
MIRD Output

("Medical Internal Radiation Dose")



MIRD Output

("Medical Internal Radiation Dose")

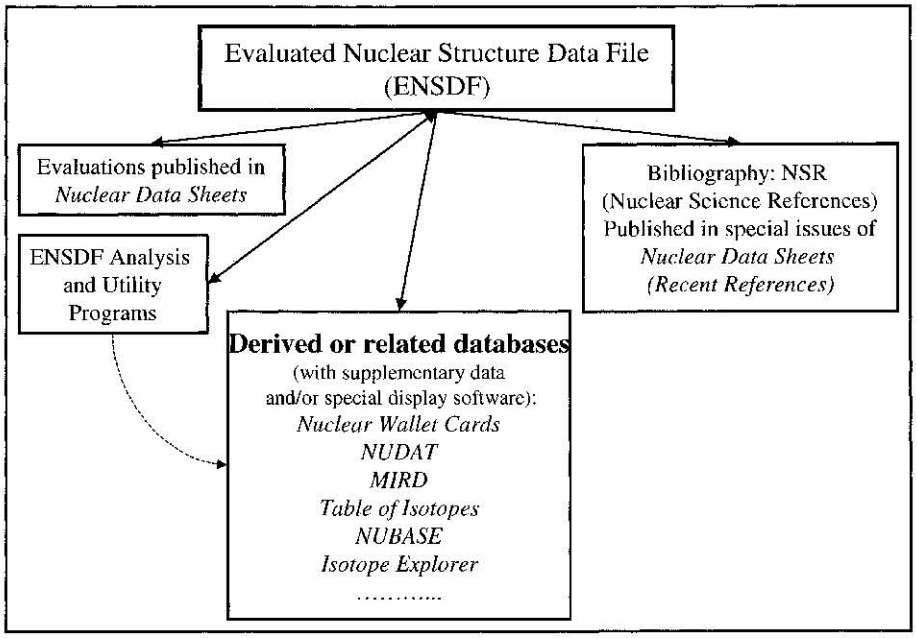


Radiation doses in MIRD, NUDAT

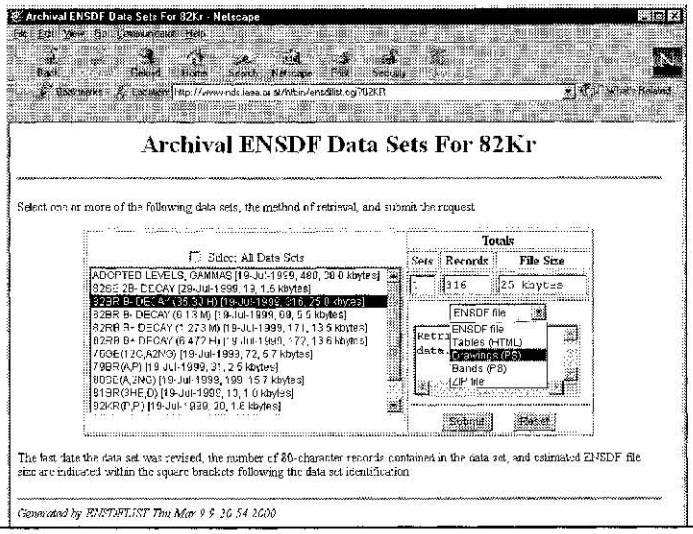
- MIRD and NUDAT calculate *Equilibrium Dose Rates* ("Dose") from ENSDF decay data
- Units: MeV/decay (MIRD), g·rad/μCi·h (NUDAT/Decay Radiations)
- 1 MeV/decay = 2.13 g·rad/μCi·h
- Reference: T.W.Burrows, *The Program RADLST* (documentation available online in PostScript)

ENSDF (Evaluated Nuclear Structure Data File)

- "Master library" for structure and decay data
- International evaluation effort coordinated by IAEA, master file maintained by US-NNDC
- Covers mass range 1 - 266
- Organized by nuclide; several "data sets" per nuclide
- Evaluations done for mass chains (e.g. A=235), published in journal *Nuclear Data Sheets*
- Special internal format
- Standard output: Tables and/or plots (ASCII, PostScript)
- Retrievals: full functionality only through Telnet, WWW interface has (so far) limited options

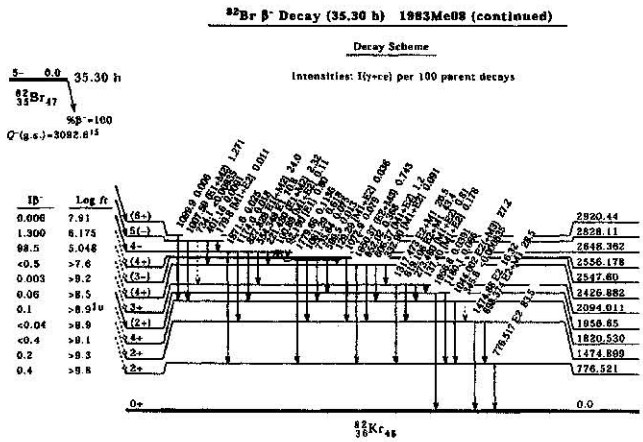


ENSDF: Data sets for ^{82}Kr



ENSDF Plot (^{82}Br β-decay)

$^{82}_{36}Kr_{46}$ $^{82}_{36}Kr_{46}$



ENSDF:
Table output

$^{82}_{36}Kr_{46}$ $^{82}_{36}Kr_{46}$

^{82}Br β⁻ Decay (35.30 h) 1983Me08 (continued)

γ(^{82}Kr) (continued)

Measurement of anisotropy of γ's emitted by oriented nuclei: 1977Ca26. Deduced δ.
Measurements of conversion coefficients: 1958Be41, 1956Wa24. Magnetic spectrometer. Measured Ice. Deduced α(exp)
from comparison with relative β spectrum. Quoted values are weighted averages of both measurements.
Iγ normalization: Σ(Iγ+ce) to g.s.=100 since g.s. β transition is highly forbidden.

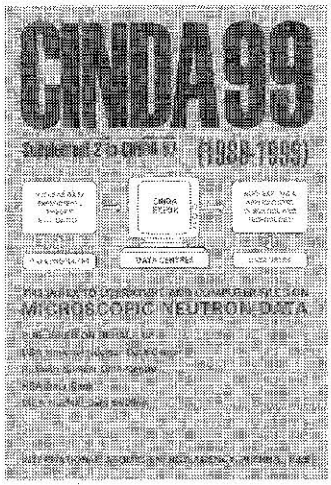
Eγ[1]	E(level)	Iγ[b]	Mult.[]	δ[]	α	Comments
82.390 *10*	2848.302	0.88[c] *4*	[E1]		0.115[d]	α(K)=0.102; α(L)=0.0110; α(M)=0.00178.
100.89 *6*	2848.302	0.064 *5*	[M1+E2]		0.5 *4*	α(K)=0.4 *4*; α(L)=0.06 *5*; α(M)=0.010 *9*.
129.29 *5*	2556.178	0.036 *7*	[M1+E2]		0.21 *15*	α(K)=0.18 *13*; α(L)=0.024 *16*; α(M)=0.004 *3*.
137.40 *5*	2094.011	0.182 *2*	[M1+E2]		0.17[d] *12*	α(K)=0.15 *10*; α(L)=0.019 *14*; α(M)=0.0031 *23*.
170.5 *2*	2828.11	0.012 *5*	[M1+E2]		0.97[d] *4*	α(K)=0.81 *4*; α(L)=0.097 *5*.
221.480[b] *2*	2848.302	2.71[b] *8*	(E1+M2)	+0.5 *3*	0.025 *15*	α(K)=0.021 *13*; α(L)=0.0025 *16*.
						δ: or Δ=+2.5 *3*.
273.180 *2*	2094.011	0.56[c] *3*	(M1+E2)	+0.18 *8*	0.0098 *4*	α(K)=0.0085 *3*; α(L)=0.00063 *4*.
332.98 *3*	2626.882	0.108 *5*	[M1+E2]		0.009[d] *4*	α(K)=0.008 *3*; α(L)=0.0008 *4*.
(346.8)	1820.330	<0.001				
401.15 *5*	2828.11	0.0109 *9*				
554.346[b] *2*	2648.302	84.1[b] *3*	E1			α(exp)=0.00069 *7*.
						<=0.00077; α(K)=0.00061.
599.3 *3*	2556.178	0.016 *5*				Iγ: the value 599.5 quoted by 1983Me08 is probably a misprint (compare 598.5γ observed by 1976Me32).
606.37	2426.882	1.45	(M1+E2)	-0.34 *10*		α=0.00144 *3*; α(K)=0.00125 *2*; α(L)=0.00013.
819.186[b] *4*	2094.011	52.0[b] *3*	E2+M1	+1.87 *6*		α(exp)=0.0015 *2*.
						δ: other: Δ=2.2 *4* from oriented nuclei (1977Ca26).
						α=0.00165; α(K)=0.00144; α(L)=0.00016.
898.374[b] *5*	1474.699	34.1[b] *3*	E2+M1	+2.1 *4*		α(exp)=0.00080 *12*.
						δ: other: δ=2.7 *3* from oriented nuclei (1977Ca26). δ(E2)/δ(M1 +δ=-1 (1973Ca18).
						α=0.00120 *2*; α(K)=0.00105 *1*; α(L)=0.00011.
(734.1)	2828.11	<0.01				
735.84 *7*	2556.178	0.09 *1*				
776.517[b] *3*	776.521	100.0[b] *16*	E2			α(exp)=0.00065 *8*.
						α=0.00093; α(K)=0.00082.
827.828[b] *6*	2848.302	28.72[b] *29*	E1(+M2)	+0.09 *4*		α(exp)=0.00028 *4*.
						α=0.00035 *1*; α(K)=0.00029 *1*.
852.02 *5*	2626.882	0.44 *2*				
1067.19 *5*	2828.11	1.52[b] *15*	(E1+M2)	+0.07 *5*		α=0.00019 *1*; α(K)=0.00019 *1*.
1344.692[b] *5*	1820.330	32.6[b] *3*	E2(+M3)	+0.05 *4*		α(exp)=0.00038 *5*.
						α=0.00040 *1*; α(K)=0.00040 *1*.
1372.9 *1*	3547.60	0.095 *19*				
1381.28 *5*	2556.178	0.74 *4*				

CINDA (Computer Index of Neutron Data)

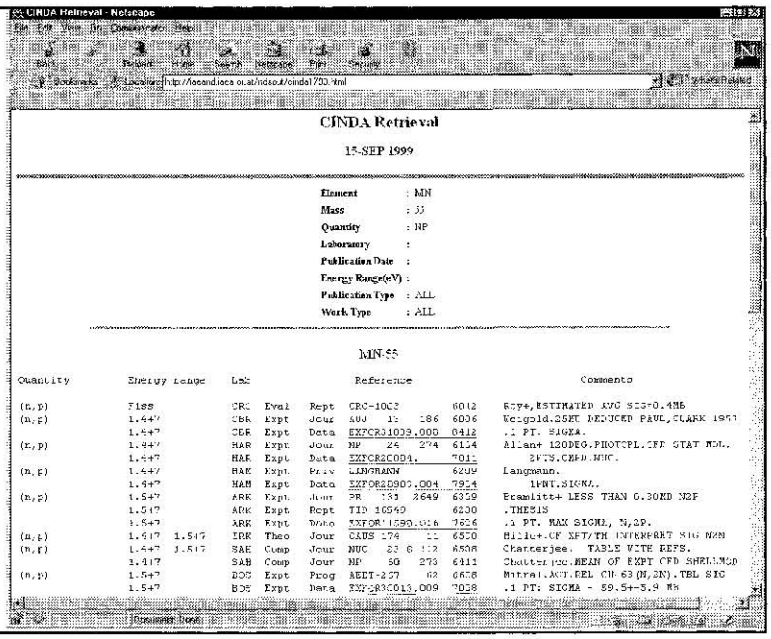
- Bibliography of neutron data (literature, inofficial publications, computer files); (γ,n), (γ,f) and spontaneous fission data also included
- Entries primarily sorted by nuclide, reaction/quantity, laboratory; therefore separate entries for each measured reaction of one publication
- Unique feature: all entries describing the same experiment are listed together ("CINDA blocks")
- Extension of database to include **charged-particle induced** and (all) **photonuclear** reactions is under preparation (2001?)

CINDA products and retrievals

- CINDA book
  - Complete file contained in several volumes:
    - Archival 1935-1987 (5 volumes)
    - CINDA97 (1988-1997)
    - CINDA99 (Supplement to CINDA97)
- Selective online retrievals through WWW and Telnet. WWW output with hyperlinks to EXFOR
- Complete file on CD-ROM about to be released



CINDA Retrieval for ^{55}Mn(n,p)



EXFOR

- Unified computerized system (library and format) by which international, regional and national data analysis centers exchange experimental nuclear reaction data
- Compilation and exchange coordinated by IAEA
- CSISRS = US implementation of EXFOR
- Coverage is complete for neutron data (in particular up to 20 MeV)
- Coverage less complete (but improving) for higher energy neutrons, charged particle-induced and photonuclear data
- More than 60 000 data sets, more than 3 million data points

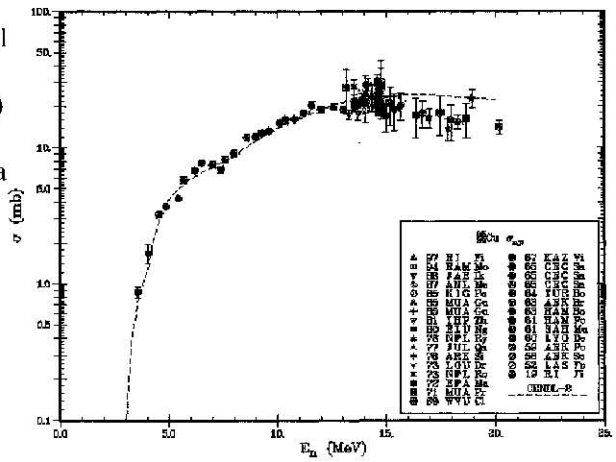
More on EXFOR

- Library contains numerical tables and structured abstract with experimental and bibliographic information
- Neutron data: bibliographic link to CINDA (non-neutron data will be added to CINDA in 1-2 years)
- Main users:
  - Evaluators (EXFOR database is starting point for all evaluations)
  - Applied users, if no evaluation available
  - Anybody measuring or calculating cross section data

Access to EXFOR

- Available for interactive retrievals through WWW and Telnet (~one reaction at a time)
- CD-ROM with retrieval program (similar functionality as WWW/Telnet)
- Complicated retrievals available individually on request from IAEA-NDS (diskette, tape, file transfer, e-mail, printout)
- Output in various formats:
  - Standard format (EXchange FORmat)
  - Computational formats for plotting and further processing
  - "Edited listing" (abbreviations expanded): on request from IAEA
  - Online plots for intercomparison with evaluated data

EXFOR Retrieval (WWW)
Plot for ^{65}Cu(n,p)
Comparison of experimental data with evaluation from CENDL-2



ENDF (Evaluated Nuclear Data File)

- ENDF-6: internationally agreed format for evaluated nuclear reaction data (and related decay data). Used for major libraries ENDF/B-VI, JEF, BROND, JENDL, CENDL, and others
- ENDF/B-VI: Version 6 of the U.S. nuclear data library and released by NNDC Brookhaven
  - Contents: for summary see report IAEA-NDS-100
  - Format Manual: IAEA-NDS-76 Rev.5 (1997) (=BNL-NCS-44945=ENDF-102)
  - Summary documentation of evaluations: BNL-NCS-17541, 4th ed. (=ENDF-201), 1991, with supplement (1996)

ENDF/B-VI Library Organization

- **ENDF/B-VI General Purpose Library** (neutron data 0-20 MeV, 320 materials from ^{1}H to ^{99}Es. ***Sept.1999 update: some materials extended to 150 MeV***)
  - Basic file
  - 300 K point data file (Resonance parameters converted to cross sections)
- **Subfiles** for *Standards, Dosimetry, Neutron activation, Fission products cs data, Actinides cs data* are included in General Purpose file but are available separately

- Other **sublibaries** for:
  - Incident charged particles ***(Additional materials added to proton sublibrary in Sept.1999 update)***
  - Decay data
  - Photo-atomic interaction
  - Thermal scattering law data
  - Fission product yields (neutron-induced and spontaneous)
  - High-energy (up to 1 GeV), incident neutrons and protons, few materials only
- Kept separately, to be requested separately (partly integrated in online service)

Access to major ENDF libraries

- Major libraries ENDF/B-VI, JEF, BROND, JENDL, CENDL available online through Telnet and WWW (interactive, retrieval by material, reaction and data type, energy)
- Various utilities for file handling, plotting, pre-processing: ENDF *Pre-Processing Codes* and *Utility Codes*, available for downloading
- CD-ROM (libraries and codes), only from IAEA *(WINENDF)*
- Output:
  - ENDF-format (all definitions coded with numerical flags)
  - Table format and plots available online

ENDF File Structure

- "Sublibrary" determines incident particle and basic data type (neutron data, proton data, decay data,...)
- Hierarchical file organization:
  - "Tape" (Unit of data release, full sublibrary or update)
    - Material (MAT number, up to 4 digits)
      - File (MF number): Data category
        - Section (Reaction Type, MT number).

File numbers (MF):
1=General information
2=Resonance parameters
3=reaction cs
4=angular distributions
5=energy distributions
6=energy-angular distributions
8=decay data
etc.

Reaction Type numbers (MT):
1=total cs
16=(z,2n) cs (z=projectile dep. on sublibrary)
102=(z,γ) cs
103=(z,p) cs
etc.

FENDL-2 (Fusion Evaluated Nuclear Data Library)

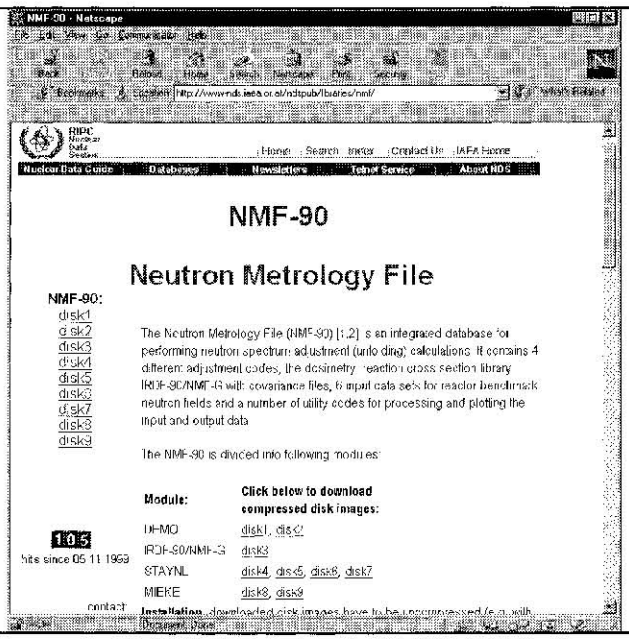
- Result of worldwide effort coordinated by IAEA
- Aimed at fusion applications (ITER project)
- Extensively tested, therefore recommended also for other applications
- Sublibraries:
  - FENDL-E/2.0: Transport: n-interactions, γ-production for 57 nuclides; photon-atom interactions for 34 elements; basic data as well as processed data for MCNP and multigroup calcs
  - FENDL/A-2.0: Activation (636 nuclides, 11000 reactions)
  - FENDL-C-2.0: Fusion (light charged-particle fusion reations)
  - FENDL/D-2.0: Decay data for 2900 nuclides
  - FENDL/DS-2.0: Neutron activation reactions from IRDF-90
- Available for downloading from IAEA web pages and on CD-ROM
  - 47 directories, 810 files, 1 Gbyte data

MENDL-2 and MENDL2-P (Medium Energy Nuclear Data Library)

- Libraries for activation and transmutation (formation of radioactive product nuclides) at indermediate energies, for 505 stable and unstable target nuclides between ^{26}Al and ^{210}Po, by Shubin et al., Obninsk, Russia
- Based largely on calculations
- MENDL-2: Neutron-induced reactions up to 100 MeV, altogether 57500 reactions
- MENDL2-P: Proton-induced reactions up to 200 MeV, altogether 87000 reactions
- Available by FTP or off-line

Databases for Reactor Dosimetry

- IRDF-90: International Reactor Dosimetry File (Version 2 of 1993): Cross sections for neutron dosimetry by foil activation, radiation damage cross sections, benchmark neutron spectra. Available for downloading
- RRDF-98: Russian Reactor Dosimetry File. Cross sections and covariance data for 22 reactions, available for downloading
- NMF-90: Neutron Metrology File. Integrated database for neutron spectrum unfolding calculations (PC codes and data). Available for downloading.



Data for Actinides and Fission Products

- Neutron cross sections for actinides, fission product yields, and cross sections and decay data for fission products, are included in major evaluated neutron data libraries
- Some special libraries:
  - **WIND** and **WIND-2**: For waste incineration. Neutron cross sections for U, Np, Pu isotopes up to 100 MeV. Proton data for ^{238}U. Neutron activation data for ^{239}Pu up to 2 GeV.
  - **"Maslov"** library: Evaluated neutron reaction data for Np, Pu, Am and Cm isotopes (1995-98)
  - **SGNucDat** (Nuclear Data for Safeguards). Actinides and fission products data for safeguards. Available on diskette and as handbook

RIPL (Reference Input Parameter Library for Nuclear Model Calculations)

- Result of IAEA coordinated project
- Input parameters for theoretical calculations of nuclear reaction cross sections
- Contents:
  - Atomic masses and deformations
  - Discrete level schemes
  - Average neutron resonance parameters
  - Optical model parameters
  - Level densities
  - Gamma-ray strength functions
  - Continuum angular distributions
- Available for downloading from IAEA web pages and on CD-ROM. Description available also as a handbook (IAEA-TECDOC-1034)

Alternative entry points

- Same basic data are available online (or on CD-ROM) from various sources
- Possible reasons for using alternative sources:
  - Better network connection to your location
  - Different user interface
- Possible problems:
  - Sources from outside the *Data Centers Networks* may not always be fully up-to-date
  - Some products available only commercially

Alternative entry points: Examples

- **U.S. National Nuclear Data Center** (NNDC)
  http://www.nndc.bnl.gov
  Close cooperation with IAEA-NDS, similar WWW and Telnet services
- ***Isotope Explorer***
  Software for interactive access and display of ENSDF data, from Lawrence Berkeley National Lab.(USA) and Lund Univ.(Sweden)
  http://ie.lbl.gov/isoexpl/isoexpl.htm (Windows version)
  http://www.pixe.lth.se/ensdf/ (New experim.version without installation)
- **K.A.E.R.I. Table of Nuclides** (Korea Atomic Energy Res.Inst.)
  Basic nuclear properties and cross sections
  http://atom.kaeri.re.kr/
- **T-2 Information Service**, Los Alamos, USA
  Nuclear Data Viewer and other services
  http://t2.lanl.gov/data/data.html

How to reference the data

- Data obtained from databases of the Nuclear Data Centers Networks should be properly cited
- Citation should include
  - original source of information **and**
  - database from which data were extracted (which may contain essential information not existing in a published article) with date of retrieval
- Example: How to cite the MENDL-2 library
  - Yu.N. Shubin, V.P. Lunev, A.Yu. Konobeyev, A.I. Ditjuk, "Cross-section data library MENDL-2 to study activation as transmutation of materials irradiated by nucleons of intermediate energies", report INDC(CCP)-385 (International Atomic Energy Agency, May 1995). Data library MENDL-2 received from the IAEA Nuclear Data Section
- Detailed citation guidelines for data retrieved online:
  - V. McLane, Citation Guidelines for Nuclear Data Retrieved from Databases Resident at the Nuclear Data Centers Network, Report BNL-NCS-63381 (July 1996). Available online in PostScript from *http://www-nds.iaea.or.at/ndspub/documents/online/*

4. A closer look on EXFOR

- EXFOR = EXchange FORmat
- Started 1970 for neutron-induced reaction data, 1976 extended for CPND and photonuclear data
- Forerunners: NEUDADA (NEA Data Bank), DASTAR (IAEA), CSISRS (old version from USA, covered whole world)
- 1970: Exchange agreement ("Protocol") between 4 "core" centers (NNDC, NEA-DB, IAEA-NDS, CJD) - At that time data exchange between East and West was important function of IAEA
- Today North-South exchange most important

About the format itself

- Still possible to define center-specific storage format and use EXFOR format for exchange only (NNDC calls their implementation of EXFOR "CSISRS" but it is not very different)
- Today, the center-specific format is largely defined by the choice of a *database system* to keep the master file and (usually separately) an *"index"* containing all parameters needed for retrievals - presently a hot topic among the NRDC centers
- Where does NRDF fit into this picture? (Not only question of format but also of contents, scope, definitions etc.)

Can you see the punched cards?

- EXFOR format: 80 character records with sequence numbers in column 67-79, preceded by 6 data fields of width 11
- Various output formats (or "user formats") available:
  - Computational formats (for plotting and processing)
    - "Table" format, "Line" format (NNDC)
    - X4TOC4 (by *D.E. Cullen*)
    - ZVView (internal conversion for plotting)
  - "Edited listing" formats (better layout, expansion of abbreviations)
    - XTEND (NNDC)
    - Outdated formats previously used at NDS and other centers
    - Meant for printouts, but could be revived for better electronic output

What's special about EXFOR?

- It's the compilation philosophy
- It's work-oriented, not publication-oriented, therefore it is different from most bibliographic systems, not only because it contains numerical data
- 1 entry = 1 experimental work
- This usually corresponds to several (formal and/or informal) references: a progress report, a conference contribution, a laboratory report, a final publication
- All references describing one experimental work are collected first by the EXFOR compiler. The entry then contains the latest available information extracted from all these references (e.g. experimental details from informal report with latest numerical data from final publication)

More on the specials...

- For neutron data, the complete bibliography will be found in CINDA. EXFOR may give under keyword REFERENCE
  - either only the reference where the numerical data are taken (NNDC practice), or
  - list the complete bibliography.
- When possible, authors are contacted for approval
- EXFOR entries are *alive*!
  - Authors are encouraged to submit preliminary data to EXFOR (e.g. by private communication) because **updating** (with new data and/or new references) **is a routine matter**
  - Even corrections after final publications (possibly published as *"Errata"* which are hard to find in the journals) are no problem
  - Conclusion: an EXFOR entry has a value similar to a publication and sometimes is even more up-to-date.
- EXFOR = pre-digested experimental data

EXFOR Retransmissions

- Because of its compilation philosophy, it is of greatest importance that corrected entries are distributed ("retransmitted") whenever:
  - an additional reference belonging to the same work is published
  - the author submits a correction of his results, or withdraws them
  - a mistake in the compilation is found
- To trace any such corrections, they are recorded in 2 ways:
  - "Alter flags" in col.80 (internal, for data centers only, not seen by the users)
  - Bookkeeping of changes under keyword HISTORY (cumulative)
- Unit of retransmission is subentry (always together with subentry 1)
- EXFOR distribution files between data centers (transmission files, "TRANS") usually contain both new and corrected entries

Deletions

- Entries or subentries can be **deleted** if:
  - the data can be found in another place (moved, duplicates)
  - are superseded by later data by the **same** author (cross-reference must be given) or are withdrawn by author
  - No deletion when **other** scientists say the data are superseded or wrong!
- Always some core information of a deleted entry is kept, giving the reference and the reason of deletion
- Accession number will **not** be re-used for other data
- Deletions must be transmitted in the proper way to make sure that the (sub-)entries to be deleted are removed from the master files of all centers

As close as possible to the publication

- EXFOR entries are compiled keeping as much as possible the author's style (representation of data, units, etc.) to
  - enable easy comparison with published reference and
  - help avoiding mistakes in compilation
- Very important: correctly report the reference and standard values the **author** used, do **not** replace with more recent data, so that later renormalisation is possible.
  - Standard cross sections
  - Half-lives, branching ratios! Do not misunderstand EXFOR as a chart of nuclides!
- If compiler believes that the data have a serious problem, this can be entered under keyword COMMENT ("Compiler's comment") or CRITIQUE. Clearly separate compiler's opinion from reporting the author's work.

Structure of an EXFOR file

- **TRANS** *(center-to-center exchange file) containing several entries of one basic type (neutron data* ***or*** *CPND* ***or*** *photonuclear data)*
  - **ENTRY** - *1 work, identified by 5-digit accession number (AN)*
    - **SUBENTRY** - *1 data table, identified by 8-digit sub-accession number (SAN = AN plus 3-digit number 001-999)*
      Special case: subentry 1: common information for entry
      - **BIB** *section: bibliographic and other text information (codes and free text)*
      - **COMMON** *section: common parameters for entry or subentry*
      - **DATA** *section: numerical data*
- 1 entry has between 2 and 999 subentries
- Subentry 1: BIB section (+optional COMMON section for whole entry)
- Subentries 2-999: BIB section + DATA section (+optional COMMON section for this subentry)

The BIB section

- **Keywords** (col.1-11), e.g.: REACTION, AUTHOR, REFERENCE, INSTITUTE, DETECTOR, METHOD, DECAY-DATA, etc.
- **Codes** (in parentheses starting in col.12) may contain
  - actual BIB information (abbreviations from dictionaries)
  - a link to the COMMON or DATA section
  - associated numerical data (e.g. half-lives)
- **Free text,** between cols.12-66 and following any coded information. This is plain English text and may be continued on any number of records.
- **Record identification** in cols. 67-79:
  - cols.67-74 SAN
  - cols.75-79 sequential number within subentry
  - (col.80 Alteration flag, data-center use only, normally blank)

COMMON and DATA sections

- 6 data fields each 11 cols. wide (cols. 1-66)
- Each field is headed by a **heading** (EN, EN-ERR, DATA, ERR-1, MONITOR, etc.) and **units** (MEV, MB, etc.)
- Up to 18 "logical" fields allowed (if number of fields >6, the "logical" record will be broken into 2 or 3 "physical" records - this is a good example for the usefulness of a "pretty listing" program)
- COMMON section: only 1 value per field. Successive fields are not integrally related with one another.
- DATA section: all entries in a record are integrally associated with an individual data point. Independent variables precede dependent variables.
- "Pointers" may link pieces of information from BIB, COMMON and DATA sections

REACTION codes

- Keyword REACTION contains
  - actual nuclear reaction observed (subfields 1 - 4)
  - quantity measured (subfields 5-9). Not all subfields need to be present
- `REACTION (92-U-235(N,F),,SIG)` a simple case
- `REACTION (26-FE-56(N,INL)26-FE-56,PAR,DA,G,LEG/RSD,DERIV)` not so simple
- SF 1: Target
- SF 2: Projectile. 0 = no projectile (nuclear quantity, or spont. fission data)
- SF 3: Outgoing particle(s) or "process" (e.g. TOT, EL, INL, F; X = production)
- SF 4: Residual nucleus (normally heaviest product), may have isomer code
- SF 5: Branch (e.g. PAR=partial, CUM=cumulative)
- SF 6: Parameter (e.g. SIG=integral cs, DA/DE=double-diff. cross section)
- SF 7: Particle considered (given if different from SF 3)
- SF 8: Modifier (e.g. LEG=Legendre coefficients, REL=relative data)
- SF 9: Data type (Default=EXP)

Center Identification Characters		
0	Preliminary	For internal center use (*i.e.*, not included on exchange files).
1	NNDC (Brookhaven)	Neutron nuclear data
2	NEA-DB (Paris)	Neutron nuclear data
3	NDS (Vienna)	Neutron nuclear data
4	CJD (Obninsk)	Neutron nuclear data
6	data from area 2	Data entered by NNDC; not part of the normal neutron nuclear data 2, 3, 4 series.
8	data from area 4	
9	NDS (Vienna)	Dictionary transmission (see page 6.1)
A	CAJuD (Moscow)	Charged-particle nuclear data
B	KaChaPaG (Karlsruhe)	Charged-particle nuclear data[1]
C	NNDC (Brookhaven)	Charged-particle nuclear data
D	NDS (Vienna)	Charged-particle nuclear data
E	JCPRG (Sapporo)	Charged-particle nuclear data
F	VNIIEF (Sarov)	Charged-particle nuclear data
G	NDS (Vienna)	Photonuclear data
H	NNDC (Brookhaven)	Special internal use for relativistic particle reaction data
L	NNDC (Brookhaven)	Photonuclear data
M	CDFE (Moscow)	Photonuclear data
N	NEA-DB (Paris)	Special use for memos only
O	NEA-DB (Paris)	Charged-particle nuclear data
P	NNDC (Brookhaven)	Charged-particle nuclear data from MacGowen file[2]
Q	CJD (Obninsk)	Photonuclear data
R	RIKEN	Charged-particle nuclear data
S	CNDC	Charged-particle nuclear data
T	VNIIEF/NNDC	Charged-particle nuclear data
V	NDS (Vienna)	Special use for selected evaluated neutron data 'VIEN' file.

Retrieval interfaces

- Telnet (IAEA-NDS, NNDC): grouped quantities; one target nuclide at a time
- Web (IAEA-NDS, NNDC): similar functions to Telnet
- Web (NEA-DB): somewhat more versatile, but restricted access
- CD (IAEA-NDS-CD-07, Jan. 2000): similar to IAEA-Web
- New IAEA-CD (ExforII/Access): Test version with many additional search possibilities
- Data center internal retrieval software (openVMS): programs RETREV+COFFEE: used for offline user requests

Sharing the work

- Compilation
  - Neutron data: 4 "core" centers NNDC, NEAD-DB, NDS, CJD, with additional input from China, Ukraine, ...
  - CPND: JCPRG, CAJAD, NNDC, ATOMKI, VNIIEF, with additional input by other centers
  - Photonuclear data: CDFE and some additional input
- Detailed agreements about exchange of TRANS files, communication of errors, corrections, etc.
- Communication between centers by CP-memos
- EXFOR dictionaries maintained by IAEA-NDS
- EXFOR manuals maintained by NNDC
- Substantial changes in dictionaries or manuals must be approved by NRDCs

Literature on EXFOR

- **Short Guide to EXFOR,** IAEA-NDS-1, Rev.7 (1996) by H.D. Lemmel. *(Overview of format, contents and history for users)*
- **EXFOR Basics,** BNL-NCS-63380 (IAEA-NDS-206) (2000), by V. McLane. *(Format description for users, available in PDF format from IAEA-NDS web page.)*
- **EXFOR Systems Manual,** BNL-NCS-63330 (IAEA-NDS-207) (2000), ed. by V. McLane. *(Format manual for compilers and programmers, available in PDF format from IAEA-NDS web page.)*
- **LEXFOR,** informal BNL-NCS report, ed. by V. McLane. *(Compiler's manual including physics definitions)*

Problems

- **Flexibility of the format** may cause some problems for the user and for processing the data:
  - DATA can be in any field
  - Any units can be used (milli-eV, MeV, GeV, ...)
  - Different representations for equivalent quantities (e.g. many different types of Legendre coefficients)
  - While the above problems might be solved by use of a computational format, there are many "exotic" quantities in EXFOR for which, so far, no computational format exists
- Compilation: in some centers, **manpower** is a problem. Compilation of new data is sometimes not as fast as desired. Also it is not always easy to find physicists interested in compilation work.

Recent developments and trends

- Web-EXFOR is now "hyperlinked" in 2 directions:
  - Link from CINDA to related EXFOR entry (neutron data part)
  - Link from EXFOR to electronic version of journal article (several major journals for latest years only)
- With "CINDA-2001", such possibilities will open up also for CPND and photonuclear data
- Search for new, perhaps platform-independent, database implementations of EXFOR will open up new possibilities
- "Data archiving" project (starting with Phys.Rev.C through NNDC) may open new era (actual numbers appear in EXFOR on day of journal publication, and sometimes only in EXFOR but not in printed issue)

N2X

A new version of NRDF into EXFOR translation system

CHIBA, Masaki

Sapporo Gakuin University

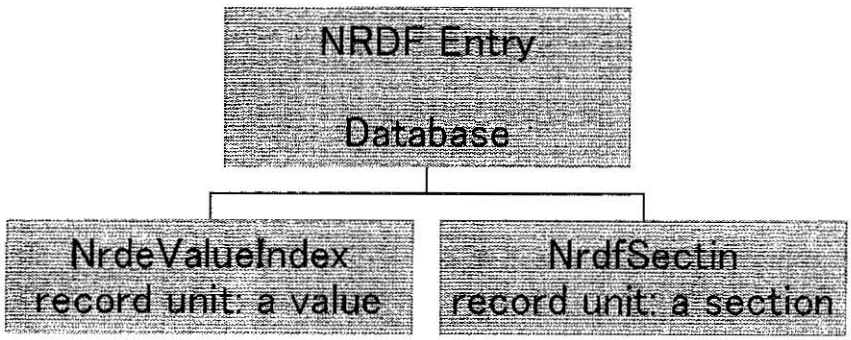
Necessity for new translation system

- Transfer from using Computer Center's machine to up to date High performance PC
- Difficulty of software system maintenance written in PL/I or FORTRAN
- Using archive dictionaries instead of EXFOR Trans dictionary

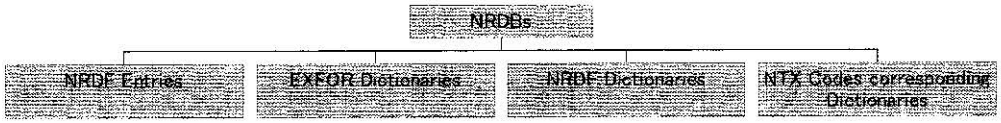
New Feature of N2X

- Programming Language:
  Smalltalk←FORTRAN
- User interface: IntelligentPad
- EXFOR codes: Archive Dictionaries
- DBMS: UniSQL←ADABAS

Structure of NRDF Entry Database



Databases Maintained for N2X



Logical structure of NRDF data

- A Entry of NRDF is called a Datastream
- A Datastream is a collection of Datasets.
- A Dataset includes a observed numerical data table and complete information describing the numerical data table.
- A Dataset is described three kind of aspects: Bibliographic Information,Experimental conditions, Observed Numerical Table and its Parameters.

Physical Structure of NRDF

- Datastream is a collection of sections which have no duplicate description
- There are three kind of sections: BIB section for bibliographic information, EXP section for experimental conditions, DATA section for a data table and its parameter values.
- DATA section has a numerical table called Data subsection.
- Dataset is a set of sections associated.

Free column format description and Data Language

- Values set is associated to information identifier.
- New Information identifiers and values may be introduced.

Most important feature

Basic Framework of Translation

EXFOR ←	NRDF
• ENTRY	• Datastream
• SUBENTRY	• DATASET
• COMMON	• DATA Section
• DATA Table	• DATASubsection
• BIB information	• Search in Dataset
• SUBENTRY 1	• Common information for all dataset in the Dataset.
• SUBENTRY other than 1	• Find from Not Common information

Essential Difference between NRDF and EXFOR

NRDF	EXFOR
• Described features of the data included in the datatable	• Identified what physical quantity is in the datatable

Basic Idea of translation(cont.)

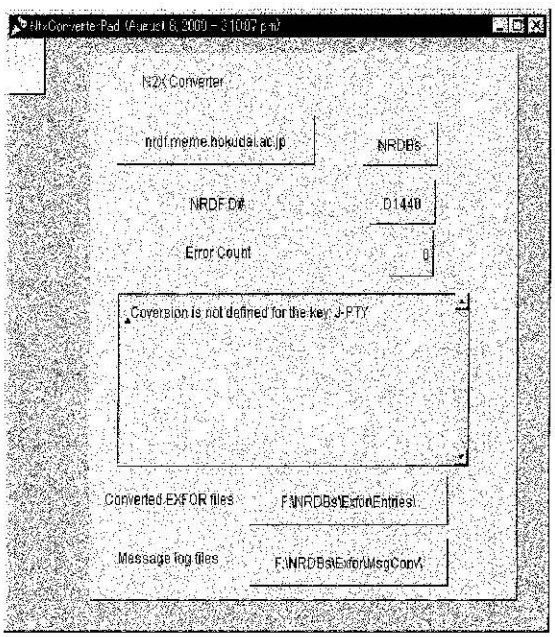
- EXFOR ←
- REACTION (Information for Physical quantities of the Data Table is concentrated in this key word)

- NRDF
- information and conditions are spread in DataHeading, RCT and other information identifier and its values.

The most difficult and important problem for me

N2X Converter PAD

- To start conversion: Just type in D# such as D1440 [Enter]
- Parameters: Address of the Database server, Database Name, Directories of Entry output and Message output files
- output: error count and messages found in the process



Utility PADs provided

- NTX Dictionary Maintenance Pad
- CPND Load Pad
- NTX Dictionary Mass Update Pad
- Exfor Dictionary Load Pad
- Exfor Archive Dictionary Load Pad
- Exfor Dictionary Search Pad
- Nrdf Dictionary Load Pad
- Nrdf Dictionary Search Pad

NRDF Dictionaries and their Role in the NRDF Compilation

NOTO Hirosi
Hokusei Gakuen University

The purpose of the talk is to explain the NRDF Dictionaries and their role in the NRDF compilation. In the latter half of the talk also presented are the correspondence between NRDF and EXFOR Dictionaries and that between their respective compilations dealing with the same experimental data of many different reaction types. Finally the maintenance and supervision procedures of the NRDF Dictionaries are depicted as a diagram.

NRDF is the abbreviation of Nuclear Reaction Data File that is a compiled database of charged particle nuclear reaction data produced with the use of Japanese nuclear reaction facilities. The NRDF Dictionaries are the core stuff of the NRDF compilation, since they define and register all the codes that underlie the coding rules and coding formats of the NRDF.

Below are shown the contents of the present talk.

NRDF Dictionaries and their Role in the NRDF Compilation

1. NRDF Dictionaries

Type of NRDF Dictionaries

① **W-type Dic.**

Words Dic. 'Words' are simple codes that can be combined to make compound codes.
【example】 INC-ENGY-LAB (compound code)
INC, ENGY, LAB are registered in the W-type Dic.

② **F-type Dic.**

Key words dictionary that defines field codes in the NRDF coding format.
【example】 ANL = CC:
ANL: a field code(Aanlysis) in F-Type Dic.

③ **V-type Dic.**

Value codes in the NRDF coding format that belong to one of 14 class categories.

④ **H-type Dic.**

contains the table headings that are tangible labels that specify their respective values in the table.

⑤ **S-type Dic.**

stores the codes that are used in the system operation.

⑥ **C-type Dic.**

contains the commands that are used when retrieving the NRDF database.

⑦ E-type Dic.
stores examples and explains how to use the retrieval commands.

The general form of the NRDF Dictionary

1) **Code Name**
2) **Expanded Form** (Explanation of the Code in free text)
3) **Comments**
4) **Control Information** (Keywords)

① **TYPE**
TYPE of this Dictionary

② **CLASS**
V-type Dic.: the codes in V-type dictionary are classified into 14 classes(Table 1).
F-type Dic.: specifies the CLASS that this field code in F-type Dictionary belongs to.
The field code also requires its value code in V-type dictionary with the same CLASS as it belongs to.
【example】 ANL = CC:
ANL: a field code(Analysis) in F-type Dic.
ANL belongs to Class '7'.
CC: a value code(Channel Coupling Method) in V-type Dic.
'CC' belongs to Class '7'.

③ **DATE**
the date when this code was registered or the date of the last alteration.

④ **SOURCE**
the SOURCE where the code is cited from.

⑤ **COUNTRY**
the COUNTRY code

⑥ **BASE**
the number on which a system of numbers is founded.
【example】USEC (MICRO-SEC) BASE = SEC , RATE = 1.00E-06;

⑦ **RATE**
the amount of the code compared to BASE.
【example】USEC (MICRO-SEC) BASE = SEC , RATE = 1.00E-06;

⑧ **FLAG**

specifies a OBSOLETE code.
【example】DELTA-ANG-CORRL FLAG = O

⑨ **REFERENCE**
specifies a new code if the OBSOLETE code is revised.

⑩ **UNIT**

⑪ **PHQ**
represents that a code(heading) in H-type Dictionary refers to a physical quantity(CLASS '7') in V-type Dictionary.

Table.1

CLASS number	Categories	CLASS number	Categories
1	Institutes	8	Targets
2	Journals	9	'YES' and 'NO'
3	Reaction Types	10	Unknown, Uncertain, Indefinite
4	Accelerators	11	Optical Model Potential Parameters
5	Detectors	12	Miscellaneous
6	Analyses	13	Particles
7	Physical Quantities	14	Units

The Format Type

✧ Text Format Type

```
ENGY
            Energy
            /+TYPE=V;CLASS=7;DATE=1988-07-14
ENGY-EMT
            ENERGY OF OUTGOING PARTICLE
            /+TYPE=V;CLASS=7;DATE=1984-05-11
ENGY-EMT-CM
            Energy of the emitted particle in the center-of-mass system
            /+TYPE=V;CLASS=7;DATE=1988-07-14
ENGY-EMT-LAB
            Energy of the emitted particle in the laboratory system
            /+TYPE=V;CLASS=7;DATE=1988-07-14
ENGY-EXCS
            ENERGY EXCESS
            /+TYPE=V;CLASS=7;DATE=1984-05-11
ENGY-GAMMA
            ENERGY OF GAMMA-RAYS(IN GAMMA-RAY TRANSITION OR GAMMA DECAY)
            /+TYPE=V;CLASS=7;DATE=1984-05-11
ENGY-SIGMA-INT
            INT(SIGMA*E**N)DE
            /+TYPE=V;CLASS=7;DATE=1984-05-19
ENGY-SPEC
            ENERGY SPECTRUM
            /+TYPE=V;CLASS=7;DATE=1984-05-19
```

✧ Table Format Type

code	explanation	type	comments	classes	flag	Reference	source	country	base	rate	date
ENGY	Energy	V		7							1988-07-14
ENGY-EM	ENERGY OF OUTGOING PARTICLE	V		7							1984-05-11
ENGY-EM	Energy of the emitted particle in the center-of-mass system	V		7							1988-07-14
ENGY-EM	Energy of the emitted particle in the laboratory system	V		7							1988-07-14
ENGY-EX	ENERGY EXCESS	V		7							1984-05-11
ENGY-GA	ENERGY OF GAMMA-RAYS(IN GAMMA-RAY TRANSITION OR GAMMA-DECAY)	V		7							1984-05-11
ENGY-SIG	INT(SIGMA*E**N)DE	V		7							1984-05-19
ENGY-SPE	ENERGY SPECTRUM	V		7							1984-05-19
EON	EURONUCLEAR	V	EURONUCLEAR (EXTINCT MAY 1966	2	O		EXFOR	2UK			1984-05-25
EPL	EARTH AND PLAN. SCI. LETT.DATE =84-05-25	V		2			EXFOR	2NED			
ESJ	J.ENG.SCI.(SAUDI ARABIA)	V	JOURNAL OF ENGINEERING SCIENCES, U.OF RIYADH	2	O		EXFOR	3SAR			1984-05-25
ETP	EXP.TECH.PHYS.	V	EXPERIMENTELLE TECHNIK DER PHYSIK	2	O		EXFOR	3GER			1984-05-25
EV	ELECTRON-VOLT	V		14							1984-05-11
EV*10**-3	Milli eV	V		14							1988-06-30
EWSR	Energy weighted sum rule	V		7,12							1994-10-04
EXC-ENGY	EXCITATION ENERGY(of the final state)	V		7							1988-07-14

Save and Storage Method

- File on PC's
- VSAM on mainframes

2. The Role of the Dictionaries

1. to define and control the codes which are used in the NRDF compilation.

2. The compilation and the retrieval are carried out, looking up the controlled codes in the NRDF dictionaries.

3. Updating the NRDF dictionaries continually, we can increase the quality of the NRDF database and expand the compiling data area in varieties of recently developed new fields of charged nuclear reactions, and make the NRDF database up to date and more useful to the nuclear physicists.

3. NRDF Coding Formats

Coding Form

<<Standard NRDF Coding Form of Nuclear Reactions>>

```
¥¥BIB,1:
D#=Dnnnn:
 . . .
RCTS=(target(projectile,ejectile)residual):
¥¥EXP,1:
RCT=(target(projectile,ejectile)residual):
RTY=(...):
¥¥EXP,1:
PH(,)=(...):
¥¥DATA,1:
 . . .
¥DATA:
heading
(unit) ...
 ..... ...
¥END:
¥¥END:
```

Problems in the Coding Formats

4. NRDF Coding Syntax

5. Coding Procedures

1. Coding Sheets
2. Coding Editor
3. Data Entry System

Problems in the Coding Procedures

6. Correspondence between EXFOR Dictionaries and NRDF Dictionaries

表2. EXFOR Dictionaries (Tables of Dictionaries)

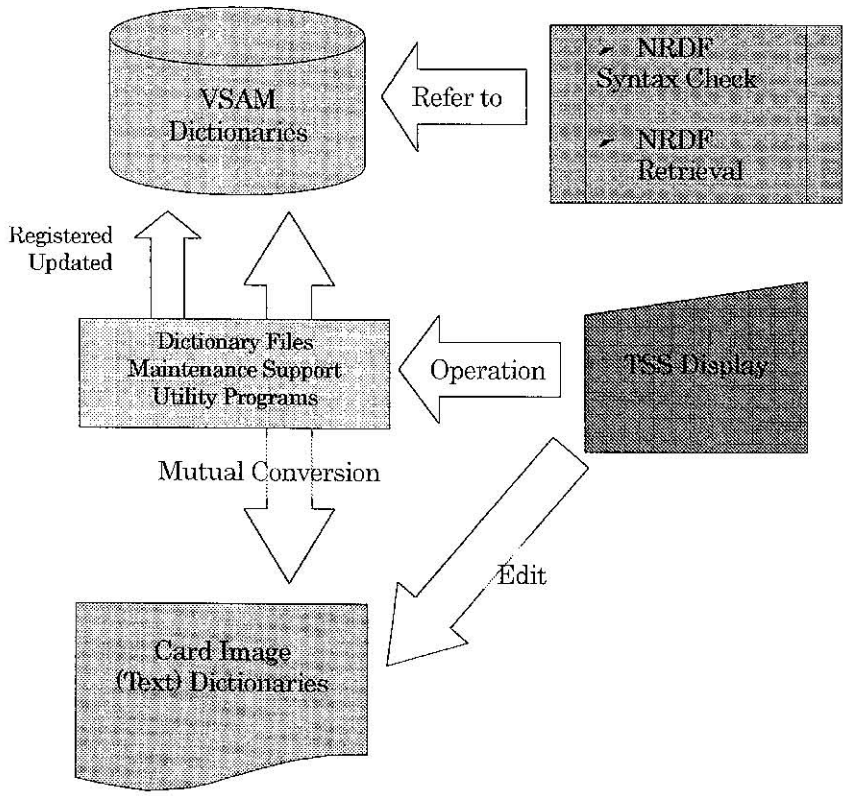
Number	Name	Code length	Expansion provided	NRDF counterpart	備考欄
1	System Identifiers	≦10		S	
2	Information Identifiers	≦10	yes	P	
3	Institutes	5 to 7	yes	V(1)	
4	Reference Type	1	yes		項目を起こす必要あり
5	Journals	≦6	yes	V(2)	
6	Reports	≦11			項目を起こす必要あり
7	Conferences and Books	≦10	yes		項目を起こす必要あり
8	Elements	≦6	yes	V(13)	
9	Chemical Compounds	7 to 10	yes	V(8)*	項目を起こす必要あり
13	Particles	≦3	yes	V(13)	
15	History	1	yes		
16	Status	≦5	yes	flag*	項目を起こす必要あり
17	Rel-Ref	≦1	yes	flag*	項目を起こす必要あり
18	Facility	≦5	yes	V(4,5)	
19	Incident Source	≦5	yes		
20	Additional Results	≦5	yes		
21	Method	≦5	yes	V(3,5,8)*	
22	Detectors	≦5	yes	V(5)	
23	Analysis	≦5	yes	V(6)	
24	Data Headings	≦10		F,V(7,12)	H 項辞書を新規作成してはどうか?
25	Data Units	≦10		V(14)	対応に留意する
27	Nuclides	≦10		V(13)	表記法をどうするか
28	Incident Particles (REACTION SF2)	≦3	yes	V(13)	クラス分けの必要はあるのか?
29	Product Particles (REACTION SF2)	≦3	yes	V(13)	クラス分けの必要はあるのか?
30	Process (REACTION SF4)	≦3		V(3)*	
31	Branch (REACTION SF5)	≦5		V(3)*	
32	Parameter (REACTION SF6)	≦3		V(7)*	
33	Particles Considered (REACTION SF7)	≦3	yes		
34	Modifiers (REACTION SF8)	≦3		V(7,6)*	
35	Data Type (REACTION SF9)	≦5	yes	flag*	項目を起こす必要あり
36	Quantities (REACTION SF5-8)	≦44	yes	flag,V(7)*	
37	Result	≦5	yes	V(7)*	
42	Cinda Quantities	≦3	yes		

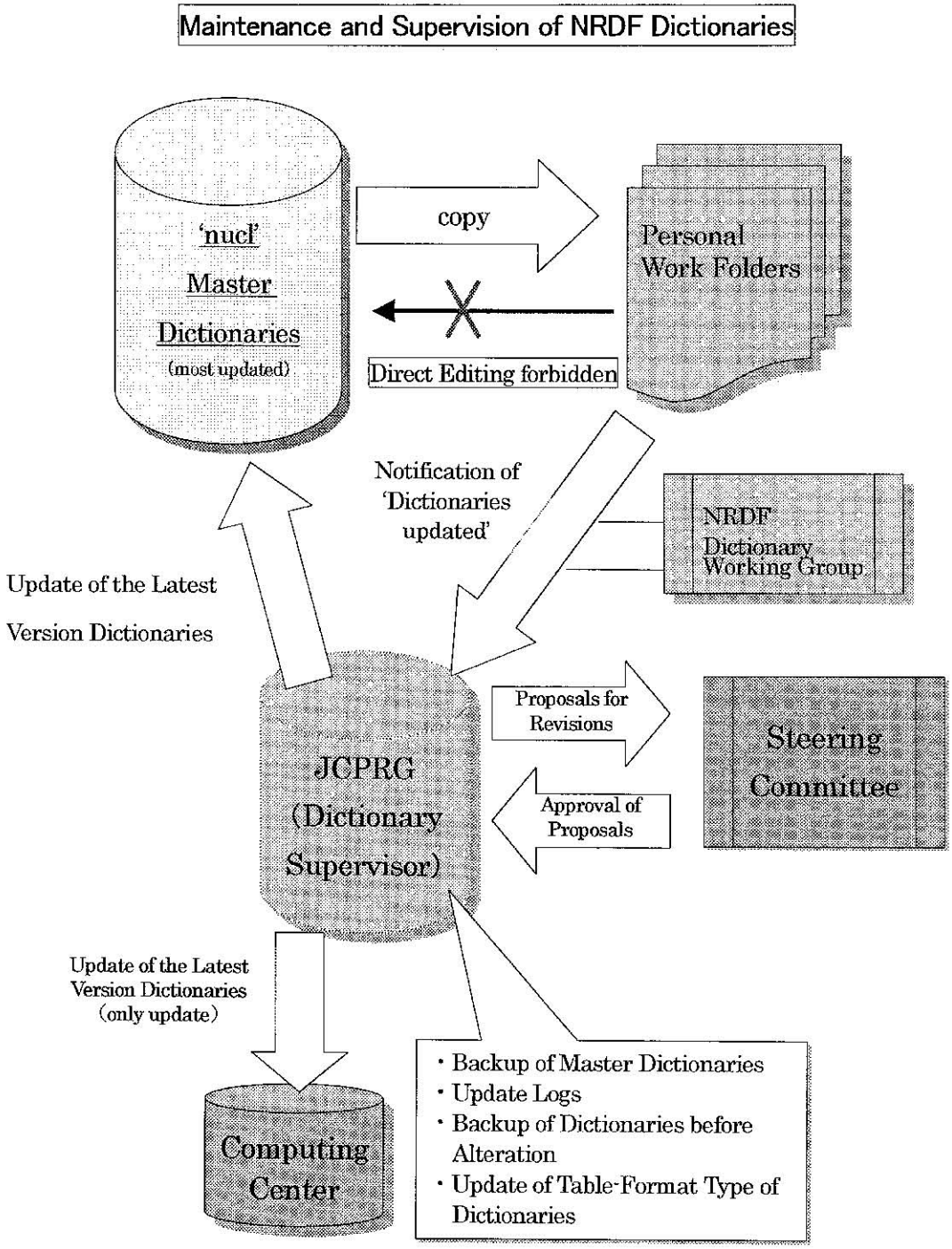
*)「『NRDF 辞書』の該当クラスで部分的に対応している」と考えられる。
(注 1)「Expansion provided」欄の'yes'は、記録が2行以上に伸びても良いことを表わす。
(注 2)「NRDF counterpart」欄には現行の NRDF 辞書(S,F,V)との対応を示してある。V()内の数字は、それによって NRDF の V 型辞書に属している項目値が分類されているクラス番号を表わす。

7. Coding Examples in EXFOR and NRDF

8. Maintenance of NRDF Dictionaries

Maintenance ans Supervision of NRDF Dictionaries(Up to Now)




Maintenance and Supervision of NRDF Dictionaries
'nucl'
Master
Dictionaries
(most updated)
copy
Personal
Work Folders
Direct Editing forbidden
Notification of
'Dictionaries
updated'
NRDF
Dictionary
Working Group
Update of the Latest
Version Dictionaries
JCPRG
(Dictionary
Supervisor)
Proposals for
Revisions
Approval of
Proposals
Steering
Committee
Update of the Latest
Version Dictionaries
(only update)
Computing
Center
・Backup of Master Dictionaries
・Update Logs
・Backup of Dictionaries before
Alteration
・Update of Table-Format Type of
Dictionaries

9. Future Problems in the NRDF Compilation

4. NRDF Coding Syntax

表5. <NRDF Source Data>

<NRDF 原始データ>	::=	<情報区>$_{1n}$ ¥¥END; <自由文記述欄>	0)
<情報区>	::=	<¥BIB 情報区>	
又は	::=	<¥EXP 情報区>	
又は	::=	<¥DATA 情報区>	
<¥BIB 情報区>	::=	<¥BIB 制御文><情報区本体>	
<¥EXP 情報区>	::=	<¥EXP 制御文><情報区本体>	
<¥DATA 情報区>	::=	<¥DATA 制御文><情報区本体>	
<¥BIB 制御文>	::=	¥¥BIB, <データセット一覧>;	
<¥EXP 制御文>	::=	¥¥EXP, <データセット一覧>;	
<¥DATA 制御文>	::=	¥¥DATA, <データセット一覧>;	
<データセット一覧>	::=	<データセット識別番号><データセット識別番号 2>$_{0n}$	
<データセット識別番号>	::=	<正整数 2>	
又は	::=	<正整数 2>~<正整数 2>	
<データセット識別番号 2>	::=	<データセット識別番号>	
<正整数 2>	::=	2 桁以内の正整数	
<情報区本体>	::=	<項>$_{1n}$	
<項>	::=	<文>	
又は	::=	<表>	
又は	::=	<注釈>	
<文>	::=	<単文>	
又は	::=	<複文>	
<単文>	::=	<項目名> = <項目値>	
<複文>	::=	(<単文><単文 2>$_{0n}$)	1)
又は	::=	(<単文><単文 2>$_{0n}$) <連結子>	1)
<単文 2>	::=	<単文>	
<連結子>	::=	<ポインタ><ポインタ 2>$_{0n}$	
<ポインタ 2>	::=	<ポインタ>	
<ポインタ>	::=	<英数字>$_{13}$	
<英数字>	::=	<英字>	
又は	::=	<数字>	
<英字>	::=	A~Z	
<数字>	::=	0~9	
<項目名>	::=	F 型辞書に登録されているコード名	
<項目値>	::=	<単値>	
又は	::=	<複値>	
<単値>	::=	<値>	
又は	::=	<値><連結子>	
<複値>	::=	(<単値><単値 2>$_{0n}$)	
又は	::=	(<単値><単値 2>$_{0n}$) <連結子>	

	又は	::= <単値><単値 3>$_1^n$	2)
<単値 2>		::= <単値>	
<単値 3>		::= +<単値>	2)
<値>		::= <値コード>	
	又は	::= <人名>	
	又は	::= <数値>	
	又は	::= <数値><単位名>	
	又は	::= <拡張記号>	
	又は	::= /<自由文>/	
<値コード>		::= V 型辞書に登録されているコード名	
	又は	::= <単語><単語 2>$_0^n$	
	又は	::= X	3)
<単語>		::= W 型辞書に登録されているコード名	
<単語 2>		::= <単語>	
<人名>		::= <名前>	
	又は	::= <名前><空白>JR.	
<名前>		::= <単名><単名 2>$_0^n$	
<単名>		::= <英字>$_1^n$	
<単名 2>		::= <単名>	
<空白>		::= 1 文字の空白	
<数値>		::= X	3)
	又は	::= <単数値>	
	又は	::= <複数値>	
	又は	::= <拡張数>	
<単数値>		::= <単数>	
	又は	::= <単数><パリティ>	
<単数>		::= <数>	
	又は	::= <数>?	
<数>		::= <正数>	
	又は	::= <符号><正数>	
<符号>		::= +	
	又は	::= -	
<正数>		::= <単純数>	
	又は	::= <複合数>	
<単純数>		::= <数字>$_1^n$	
	又は	::= <F 型実数>	
	又は	::= <E 型実数>	
<F 型実数>		::= <数字>$_1^n$.<数字>$_0^n$	
	又は	::= <数字>$_0^n$.<数字>$_1^n$	
<E 型実数>		::= <F 型実数>E<数字>$_1^n$	
	又は	::= <F 型実数>E<符号><数字>$_1^n$	
<複合数>		::= <単純数><演算>$_1^n$	
<演算>		::= <演算子><単純数>	
	又は	::= <演算子><複合数 2>	
<演算子>		::=	

	又は	::= -	
	又は	::= *	
	又は	::= /	
	又は	::= **	
<複合数 2>		::= (<単純数><演算 2>$_{1:n}$)	
<演算 2>		::= <演算>	
	又は	::= <演算子><複合数 3>	
<複合数 3>		::= (<単純数><演算>$_{1:n}$)	
<パリティ>		::= <符号>	
	又は	::= <符号>?	
<複数値>		::= <単数値>~<単数値>	
	又は	::= <単数値> ><単数値>	4)
	又は	::= <単数値> <整数>	
<拡張数>		::= ><単数値>	
	又は	::= <<単数値>	
	又は	::= ~<単数値>	5)
	又は	::= ++<単数値>	
<単位名>		::= V 型辞書(クラス 14)に登録されているコード名	
<拡張記号>		::= <核反応>	
	又は	::= <順次崩壊過程>	
	又は	::= <核分裂>	
	又は	::= <核融合>	
	又は	::= <核反応積>	
	又は	::= <核反応比>	
	又は	::= <核反応差>	
	又は	::= <巻年頁>	
<核反応>		::= <単粒子>(<単粒子><複粒子><複粒子 2>$_{0:n}$)<残粒子>	6)
<単粒子>		::= <粒子>	
	又は	::= <反粒子>	
<粒子>		::= V 型辞書(クラス 13)に登録されているコード名	
	又は	::= <質量数><原子>	
<質量数>		::= <数字>$_{1:n}$	
<原子>		::= V 型辞書(クラス 13)に登録されているコード名	
<反粒子>		::= V 型辞書(クラス 13)に登録されているコード名	
	又は	::= A<粒子>	7)
<複粒子>		::= <単粒子>	
	又は	::= <数字>$_{1:n}$*<粒子>	
	又は	::= <粒子数コード>*<粒子>	8)
<粒子数コード>		::= V 型辞書に登録されている<中性子数>、<陽子数>、<電荷>コード	
<残粒子>		::= <単粒子>	
	又は	::= X	
<複粒子 2>		::= ,<複粒子>	
<順次崩壊過程>		::= <核反応>,<核反応 2>0n,<核反応 3>	
<核反応 2>		::= <単粒子>(<空白>,<複粒子><複粒子 2>0n)<残粒子>	

<核反応 3>	::=	<核反応 2>	
	又は ::=	<核分裂>	
	又は ::=	<核融合>	
<核分裂>	::=	<単粒子>(<単粒子>,FISSN)	
<核融合>	::=	<単粒子>(<単粒子>,<空白>)<残粒子>	
	又は ::=	<単粒子>(<単粒子>,X)<残粒子>	
<核反応積>	::=	<核反応>*<核反応>	9)
<核反応比>	::=	<核反応>/<核反応>	9)
<核反応和>	::=	<核反応>+<核反応>	9)
<核反応差>	::=	<核反応>-<核反応>	9)
<巻年頁>	::=	<数値>(<数値>)<数値>	
<表>	::=	¥DATA; <項目行><単位行><データ行>[n] ¥END;	
<項目行>	::=	<項目欄>[n]	
<項目欄>	::=	<ヘッダ名><空白>[n]	
<ヘッダ名>	::=	H 型辞書に登録されているコード名	10)
<単位行>	::=	<単位欄>[n]	
<単位欄>	::=	(<単位名>)<空白>[n]	
<データ行>	::=	<データ欄>[n]	
<データ欄>	::=	<データ><空白>[n]	
<データ>	::=	<コード値>	
	又は ::=	<数値>	
	又は ::=	<数値><連結子>	
	又は ::=	<連結子>"	
<注釈>	::=	/*<注釈文>*/	
<自由文>	::=	<英文 1>	
<英文 1>	::=	次の条件を満たす任意の文字列。	
		「/」と「;」とを含まない。	
	又は ::=	<連結子><英文 1>	
<注釈文>	::=	<英文 2>	
	又は ::=	<連結子><英文 2>	
<英文 2>	::=	次の条件を満たす任意の文字列。	
		「*/」と「;」とを含まない。	

0) <自由文記述欄>は、廃止とする。<自由文>は、該当箇所に直接埋め込んで行く。

1) 現在のところ使用されているコーディングシートには、<複文>は使用されていない。

2) 「+<単値>」は構文規則に入れずに、「採録時の約束」と考える。

【例】

DET-SYS=(MAG+PLST-SCT);

3) X は、「未知」、「不確定」或は、「欠損値」を表わす。

4) <単数値>‥><単数値>の記法は認めない。必要な場合には、「-->」の前の項目と後の項目を見出しとして設ける。

5) ～<単数値>に於いて、「～」はアスキーコードでは、「[」を用いる。

6)、7) 他の用例と抵触しないかどうか検討を加える。

8) 粒子放出の記述に於いて、粒子の多自由度の表記法の拡張として、「『数を表わす項目』*『粒子名』」を認める。

9) EXFOR に倣って２つの反応の四則演算を導入する。

10) 表の見出し(ヘッダ)用のコードを登録した「H 型辞書」を新規に整備する。

7. Coding Examples in EXFOR and NRDF

1) Elastic Scattering(弾性散乱)

REACTION (target(projectile ,EL))	

【例 1】Reduced Width(特定のエネルギー領域の共鳴幅の平均)

REACTION (target(projectile ,EL) ,WID/RED, ,AV)	RCT=(target(projectile ,projectile)target); RTY=(ELA-SCATT); PHQ=(REDUCED-WDTH); /* The averaged resonance-width of a specified type in a specifiedenergy-range. */ (※) /* ……*/のように、ポインタ(例えば、'1') のない注釈は、直前の文の項目値に対するものである。

【例 2】Elastic Resonance Scatterng(弾性共鳴散乱断面積)

REACTION (target(N ,EL) ,PAR ,SIG , ,RES)	RCT=(target(N ,N)target); RTY=(ELA-SCATT'1'); /* '1' :elastic resonance scattering */ PHQ=(XSECTN); (※)現在のところ、「F 型辞書」項目値、RTY(「反応の型」)に結合する「V 型辞書」クラス 3 (反応の型)には、「弾性共鳴散乱」を指定する項目値は登録されていない。このクラスに現在登録されているコード RESN は「共鳴反応」と定義されている。

【例 3】Elastic Scattering Angular Distribution(弾性散乱角分布)

REACTION (target(projectile ,EL) , ,DA)	RCT=(target(projectile ,projectile)target); RTY=(ELA-SCATT); PHQ=(ANGL-DSTRN);

2) Inelastic Scattering(非弾性散乱)

REACTION (target(projectile ,INL))	

【例 4】Total Inelastic Cross Section(全非弾性散乱断面積)

REACTION (target(projectile ,INL)target , ,SIG)	RCT=(target(projectile ,projectile)target); RTY=(INEL-SCATT); PHQ=(TOT-XSECTN);

【例 5】Partial Inelastic γ Production Cross Section(非弾性 γ 生成部分断面積)

REACTION (target(projectile ,INL)target ,PAR ,SIG ,G)	RCT=(target(projectile ,projectile)target); RTY=(INEL-SCATT); DET-PARTCL=(GAMMA); PHQ=(XSECTN); (※)NRDF では、部分断面積の「部分」を明示しないことが多い。

【例 6】Double Differential Inelastic Cross Section
二重(放出粒子の角度とエネルギーに関する)非弾性微分断面積

REACTION (target(projectile ,INL)target , ,DA/DE)	RCT=(target(projectile ,projectile)target); RTY=(INEL-SCATT); PHQ=(DSIGMA/DOMEGA/DE);

3) Emission, Production, Rearrangement Reaction Cross Section
(放出断面積、生成断面積、組替え反応)

REACTION (target(projectile ,ejectile)residual)	
【例 7】Proton-Induced γ Production Cross Section(陽子誘起γ生成断面積)	
REACTION (target(P ,X)0-G-0 , SIG)	RCT=(target(P ,GAMMA)X); RTY=(X'1'); /* '1': gamma-production reaction */ DET-PARTCL=(GAMMA); PHQ=(TOT-RCT-XSECTN);
【例 8】Neutron-Induced Neutron Emission Cross Section(中性子誘起中性子放出断面積)	
REACTION (target(N ,X)0-NN-1 ,EM ,SIG) (※)放出断面積は、反応生成断面積から弾性散乱を除いたもの。	RCT=(target(N ,N)X); RTY=(X'1'); /* '1': neutron emission reaction */ DET-PARTCL=(N); PHQ=(XSECTN);
【例 9】Emitted Proton Angular Distribution(放出陽子の角分布)	
REACTION (target(N ,N+P) ,DA ,P)	RCT=(target(N ,N ,P)X); RTY=(X'1'); /* '1': proton emission reaction */ DET-PARTCL=(P); PHQ=(ANGL-DSTRN);
【例 10】Angular Correlation between Neutron and Emitted Proton(中性子と放出陽子の間の角相関)	
REACTION (target(N ,N+P) ,COR) 注釈	RCT=(target(N ,N ,P)residual); RTY=(X'1'); /* '1': proton emission reaction */ DET-PARTCL=(P ,N); PHQ=(ANGL-CORRL); /*注釈*/
【例 11】α-Selective Partial Cross Section(α粒子選択的部分断面積)	
REACTION (target(P ,P+A)residual ,PAR ,SIG ,A)	RCT=(target(P ,P ,ALPHA)residual); RTY=(X'1'); /* '1': alpha emission reaction */ DET-PARTCL=(ALPHA); PHQ=(XSECTN);
【例 12】α Differential Cross Section by Rearrangement Reaction 組替え反応によるα粒子微分断面積(角分布)	
REACTION (3-LI-6(N ,T)2-HE-4 ,DA ,A)	RCT=(6LI(N ,T)4HE); RTY=(RRG-RCT); DET-PARTCL=(ALPHA); PHQ=(ANGL-DSTRN);
【例 13】γ Angular Distribution by Rearrangement Reaction(組替え反応によるγ線の角分布)	
REACTION (3-LI-6(N ,T)2-HE-4 ,DA ,G)	RCT=(6LI(N ,T)4HE); RTY=(RRG-RCT); DET-PARTCL=(GAMMA); PHQ=(ANGL-DSTRN);

4) Sequential Decay(順次崩壊過程)

REACTION
(target(projectile ,ejectile1+ejectile2+...)residual ,SEQ)

【例 14】順次的崩壊過程 12C(n ,α)9Be(α)5He(n)α に於けるα生成部分断面積

REACTION(6:C-12(N ,A+A+N)2-He-4 ,SEQ ,SIG)

(※)順次的崩壊の順序は、SF5 に SEQ を記した上で、SF3 に ejectile1+ejectile2+...のように書くことによって表記する。左に記載されている粒子から順次的に放出されることを示す。

```
¥¥EXP,1;
RCT=(12C(N ,ALPHA )9BE ,( ,ALPHA )5HE ,  ,N )ALPHA);
RTY=(SQNTL-RCT'1');
/* '1': sequential decay */
DET-PARTCL=(ALPHA);
PHQ=(XSECTN-YLD);
¥¥DATA,1;
RSD=ALPHA;
```

(※1)順次的崩壊の順序は、RCT=(projectile ,ejectile1 ,ejectile2 ,...); のように記述し、更に RTY=(SQNTL-RCT); を指定することによって示される。
左に記載されている ejectile$n$ (n=1,2,...)から順次的に放出されることを示す。
(※2)順次的過程の反応式 RCT=(reaction1 ,reaction2,...) の書式は、今回新規に提案されているものである。

5) Fission(核分裂)

核分裂に於いては、エネルギー分布と同時に、質量の収量と電荷分布が測定される。核分裂破片は 1 次破片、核分裂生成物は最終的な生成物という意味合いで使用される場合が多い。しかし、境界は固定的ではないし、しばしば核分裂破片は、両者を含んだ意味で使用される。又、しばしば核分裂破片は、すべての電荷を許す質量数のみによって指定される。通常、核分裂生成物は質量数と電荷によって指定される。

REACTION (target(projectile ,F)ELEM/MASS)

【例 15】Z と A が「変数生成核種」として指定された 1 次核分裂生成の直接或は、独立の収量

REACTION (target(N ,F)ELEM/MASS ,IND ,FY)

```
¥¥EXP,1;
RCT=(target(N ,FISSN));
RTY=(FISSN);
PHQ=(YLD);
¥¥DATA,1;
RSD=X'1';
/* Detected produced particles are tabulated under the
 headings A and Z in the table */
¥DATA;
A          Z          YLD
(NODIM) (NODIM) (MB)
...        ...        ...
¥END;
```

【例 16】励起準位にある残留核がその後、1 次γ線放出と核分裂で崩壊する部分断面積

REACTION (target(N ,G+F) ,SEQ ,SIG)

```
RCT=(target(N , GAMMA ,FISSN));
RTY=(FISSN ,SQNTL-RCT);
DET-PARTCL=(GAMMA);
PHQ=(XSECTN-YLD);
```

【例 17】核分裂非対称
「核分裂破片の重い分裂片に対する最尤質量」の「核分裂破片の軽い分裂片に対する最尤質量」に対する比

REACTION ((target(N ,F) ,AP ,HF)/(target(N ,F) ,AP ,LF)) (※)「AP」、「HF」、「LF」は、それぞれ「分裂片の最尤質量」、「重い核分裂片」、「軽い核分裂片」を表す。	RCT=((target(N ,FISSN)X1')/(target(N ,FISSN)X2')): /* X1': the heavier fission fragments. X2': the lighter fission fragments. */ RTY=(FISSN): PHQ=(X3'): /* X3': fission asymmetry = the ratio of the mean mass of the heavier fission fragment to the mean mass of the lighter fission fragment. The mean mass means the most probable mass of fission fragments. */ (※)反応に関する拡張書式として「反応比」を導入した。

6) Compound Nuclear Process(複合核過程)

理論的考察によって部分断面積に対する複合核過程からの寄与が特定出来る場合。

REACTION (target(projectile ,ejectile)residual ,CN)	

【例 18】複合核経由の部分断面積

REACTION (target(N ,P)residual ,CN ,SIG) 注釈 (※1)注釈文を添える。 (※2)もし著者が(n ,p)全反応断面積を測定し、「この反応過程は完全に複合核過程である」と述べている場合には「CN」は使用しない。この記載は部分断面積を意味するからである。	RCT=(target(N ,P)residual): RTY=(CMPD-RCT): DET-PARTCL=(P): PHQ=(XSECTN):

7) Fusion(核融合)

REACTION (target(projectile ,X)Z-S-A) (※)荷電粒子核反応では、複合核の生成がはっきりしない場合には、「核融合」をしばしば用いる。	RCT=(target(projectile ,X)residual): RTY=(FUSN): DET-PARTCL=(...): PHQ=(...):

8) Spallaion(核破砕)

幾つかの粒子が直接相互作用によって標的核から放出され、残留核を励起状態に置く。残留核はその後核子又は核子のクラスタを蒸発させる。

REACTION (target(projectile ,X)Z-S-A)	

【例 19】核破砕過程から、測定粒子を指定することによって得られる個々の断面積

REACTION (Z-S-A(P ,4N+3P+A)Z'-S'-A', ,SIG)	RCT=(target(P ,4*N ,3*P ,ALPHA)residual): RTY=(SPAL): DET-PARTCL=(N ,P ,ALPHA): PHQ=(XSECTN):

【例 20】何らかの理論的な考察によって、測定断面積の部分が核破砕に割当てられる場合

REACTION (Z-S-A(P ,X)Z'-S'-A' ,SPL ,SIG)	RCT=(target(P ,X)residual): RTY=(SPAL): DET-PARTCL=(...): ANL=(...): PHQ=(XSECTN):

【例 21】核破砕に対して、「変数生成核種」書式を採用して、「放出中性子数」、「放出陽子数」を変数としてコーディングする。	【例 21】核破砕に対して、「放出中性子数」、「放出陽子数」を変数としてコーディングする。この場合は「データ情報区」の表の「見出し項目行」には、「NNBR」(「中性子数」)と「Z」(「陽子数」)を指定する。状況によっては、「A」(「質量数」)や「ELM」(「元素」を「見出し欄」として指定することもあり得る。
REACTION(Z-S-A(P ,XN+YP)ELEM/MASS,...) この場合は「データ情報区」の表の「見出し項目行」には、「N-OUT」、「P-OUT」、「ELEMENT」、「MASS」を「見出し欄」として指定する。	RCT=(target(P,NNBR*N ,Z*P)residual): RTY=(SPAL): DET-PARTCL=(N ,P): /* Detected particles are coded in ¥DATA */ ANL=(...): PHQ=(X'1'): /* '1': Measured quantities (including neutron number (NNBR), proton number (Z) and other quantity X (headed DATA)) are coded in ¥DATA. */ ・・・ ¥DATA: NNBR Z A ELM DATA'1' (NODIM) (NODIM) (NODIM) (NODIM)(unit) ・・・ ¥END: /* '1':Measured quantity X is coded under the field headed DATA in ¥DATA. */ (※1)粒子の多重度として「変数」*「粒子」を導入した。 【例】NNBR*N ,Z*P (※2)現在、「ELM」は「V 型辞書」クラス 13「粒子」には登録されていない。

9) Spallation and High Energy Fission(核破砕と高エネルギー核分裂)

高エネルギーでの原子核の分解は、幾つかの場合には、核破砕か核分裂かのどちらかの過程で進行する。

【例 22】核破砕断面積

REACTION (6-C-12(P ,X) ,SPL ,SIG)	RCT=(12C(P ,X)): RTY=(SPAL): PHQ=(XSECTN):

【例 23】高エネルギー核分裂断面積

REACTION (6-C-12(P ,X) ,FIS ,SIG) (※)もし、著者が全分解か与えられた残留核の生成を測定し、「反応は完全に核破砕又は核分裂のどちらかによって進行している」との記載があれば、SPL 又は FIS は指定しない。これらの修飾子は部分断面積を意味しているからである。	RCT=(12C(P ,X)): RTY=(FISSN): PHQ=(FISSN ,XSECTN):

10) Polarization Reaction(偏極核反応)

標的核と入射粒子の偏極に対応する。

【例 24】放出粒子の角度に関する(微分)スピン偏極確率

REACTION (target(projectile ,ejectile)residual , ,POL/DA)	RCT=(target(projectile ,ejectile)residual): RTY=(POL-RCT): DET-PARTCL=(...):

	ANL=(...); PHQ=(POL); /* The spin-polarization parameter probability with respect to angle of emission */ ・・・ ¥DATA; THTL　POL/ANGL (NODIM) (NODIM) ・・・ (※)現在、表の「見出し項目名」として「POL/ANGL」は未定義である。
【例 25】分解能	
REACTION (target(projectile ,ejectile)residual , ,POL/DA ,ANA)	RCT=(target(projectile ,ejectile)residual); RTY=(POL-RCT); DET-PARTCL=(...); ANL=(...); PHQ=(ANALPW);
【例 26】スピン相関パラメタ(Ayy)	
REACTION (target(projectile ,ejectile)residual, ,POL/DA ,AYY)	RCT=(target(projectile ,ejectile)residual); RTY=(POL-RCT); DET-PARTCL=(...); ANL=(...); PHQ=(SPIN-CORRL-PARA); ・・・ ¥DATA; THTC AYY (DEG) (NODIM) ・・・ (※)物理量(PHQ)「SPIN-CORRL-PARA」に対して、その1つの成分であるAyyを表の「見出し項目名」「AYY」として新規に設定することを提案している。
【例 27】Lamb shift 法による偏極入射粒子源、及び偏極標的	
INC-SOURCE　(POLTR ,LAMB) (※)BIB(書誌情報区)の「情報識別子」欄に、項目名「INC-SOURCE」を指定する。	¥¥EXP,1; POL-TGT=...%; POL-PRJ=...%; ION-SOURCE=/Lamb-shift ion source /; RCT=(target(projectile ,ejectile)residual); RTY=(POL-RCT); DET-PARTCL=(...); ANL=(...); PHQ=(...); ・・・ ¥¥DATA,1; ・・・
11) Decay Data(崩壊データ)	
DECAY-DATA　((flag)nuclide ,half-life ,radiation)	

【例 28】準安定状態の核種からの崩壊γ線

DECAY-DATA (60-ND-139-M ,5.5HR ,DG ,708./738. ,0.64)	¥¥EXP.1; RCT=(target(projectile ,ejectile)139ND); RTY=(X'1'); /* '1': Gamma decay from the residual nucleus */ DET-PARTCL=(GAMMA); PHQ=(HALF-LIFE ,X'2'); /* '2': the total abundance of two gamma rays */ ¥¥DATA.1; RSD=139ND; /* Metastable state*/ ENGY-GAMMA=(708KEV ,738KEV); ¥DATA; HALF-LIFE DATA'1' (HOUR) (NODIM) 5.5 0.64 ¥END; /* DATA'1': the total abundance of both gamma rays from the metastable nucleus */
	(※) /* Metastable state*/のように、ポインタ(例えば、'1') のない注釈は、直前の文の項目値に対するものである。

12) Two or More Channels (複数個のチャネルが寄与している場合)

残留核に2つ以上の異なるチャネル(例えば、(P ,A)と(P ,2N+2P))が寄与していることが明らかであるが著者は残留核のみを考察しているときは、SF5には、「UND」(undefined reaction channel)と指定する。この場合、SF3は放出粒子の単なる和を表しているが、SF4が異なるチャネルを経由して形成された可能性があることを暗示する。	

【例 29】'α粒子的'なチャネルを経由して残留核が形成される。

REACTION (Z-S-A(P ,2N+2P)Z'-S'-A' ,UND ,SIG)	RCT=(target(P ,2*N ,2*P)residual); RTY=(X'1'); /* The reaction channel is undefined*/ DET-PARTCL=(N ,P); PHQ=(XSECTN);
【例 30】反応チャネルが定義されているかどうか不明なときには、著者が指定しているように書く。しかし、SF5にはDEFを括弧に入れて記入する。	**【例 30】**反応チャネルが定義されているかどうか不明なときには、著者が指定しているように書く。注釈を書くことが望ましい。
REACTION (Z-S-A(P ,2N+2P)Z'-S'-A' ,(DEF) ,SIG)	RCT=(target(P ,2*N ,2*P)residual); RTY=(X'1'); /* It is not clear whether the reaction channel is defined or not, although the reaction channel is given by the author. */ DET-PARTCL=(N ,P); PHQ=(XSECTN);

Demonstration of Graph Reading System using Image Analysis Software

Reading Numerical Data from Graph Printed in Theses

Hirokazu OHMI

Meme Media Laboratory, Hokkaido University

How to get numerical data

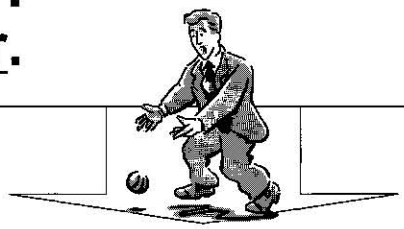
- Best things to get the numerical data is to get directly from experimenter (or authors of theses).

However, all experimental data cannot get from authors under the present condition in Japan.

As the next best thing we (JCPRG) get the numerical data from graphs printed in paper (and also electric theses such as PDF files).

How to read the numerical data from graphs

- Most popular method is to use a digitizer.



It is very important to decrease human error in using this method.

e.g. When operator gets numerical value at a point, operator's hand must hold steady at this point.

New method for reading the numerical data from graphs

- To decrease human error, we create new numerical data reading system based on popular Image Analysis Software.

  - NIH Image (for Macintosh Computer)
  - Scion Image (for Microsoft Windows Computer)

Nuclear Reaction Database framework on Meme Media architecture

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JAPAN

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Information architecture research

Nuclear Data Symposium
Oct. 7, 2000, Meme Media
Lab, Sapporo

Objective: Investigation of "generic" software framework to treat computational resources.

E.g.) The notion of "Hyper-Link" .

We need to think the future to make "generic" architectures!

What/How do we treat computational resources
5/10/15.. years later!

Nuclear Data Symposium
Oct. 7, 2000, Meme Media Lab, Sapporo

Estimation: what should I prepare?

Typical spec. for the High-end PC.

	Now	10 years later
CPU	1GFlops	1TFlops
RAM	250MB	0.25TB
HDD	10GB	10TB
Network	1~100Mbps	1~100Gbps

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What's the starting point?

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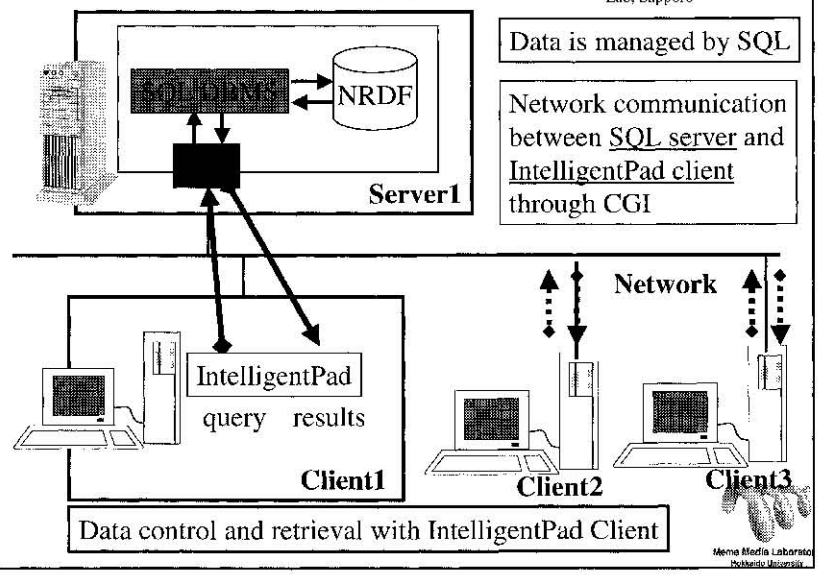

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Hokkaido University

What's IntelligentPad?

Nuclear Data Symposium
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Lab, Sapporo

- **Object oriented system construction architecture**

  Pad: 'paper' like graphical object on the screen
  Each pad has a function with metaphorical

- **Synthetic "media" architecture : "Meme media"**

  Any computer resources are made from 'synthetic' use of primitive Pads

  Meme : elementary set to construct our culture
  <–> gene
  「Selfish gene」, R. Dawkins

For the programmers

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Although, the study of IntelligentPad is still continued as information technology framework research, currently there are several kind of "IntelligentPad" software package are available as "mile-stone" packages.

Basically pad components are built by primitive programming p language (C++, Smalltalk, Java,...). We adopt C++ version of IntelligentPad for our implementation of nuclear data applications.

Media-based architecture

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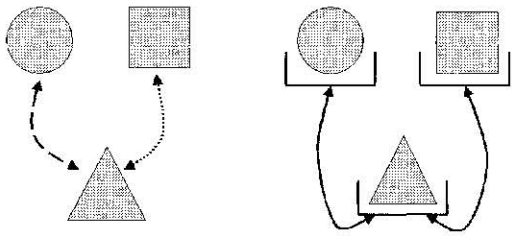

(a) object-oriented architectures (b) media-based architectures

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Connection between each pads

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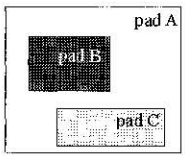
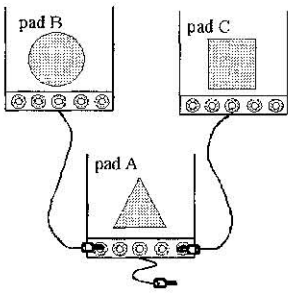


(a) a composite pad



(b) logical structure of linkage among the three pads

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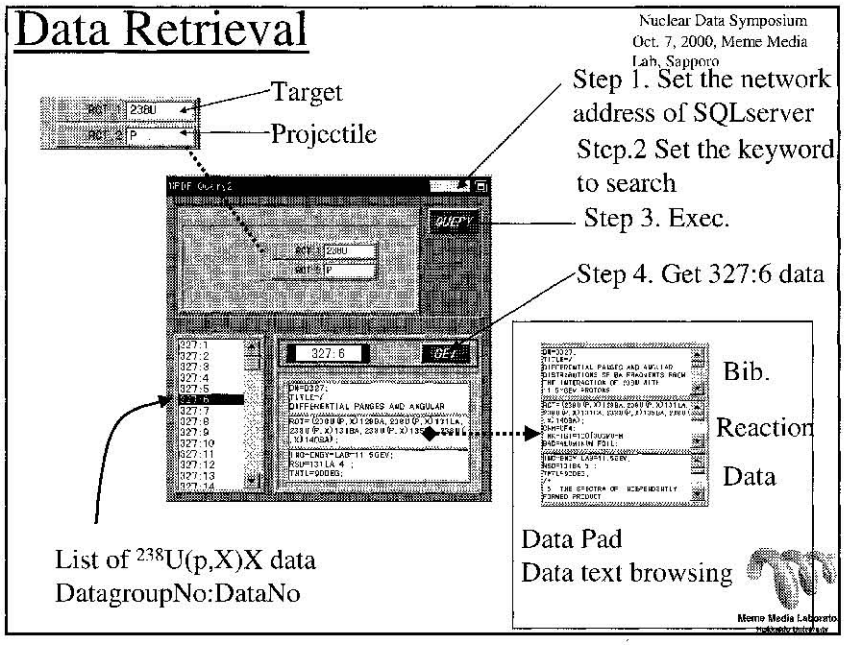
Data Retrieval
Nuclear Data Symposium
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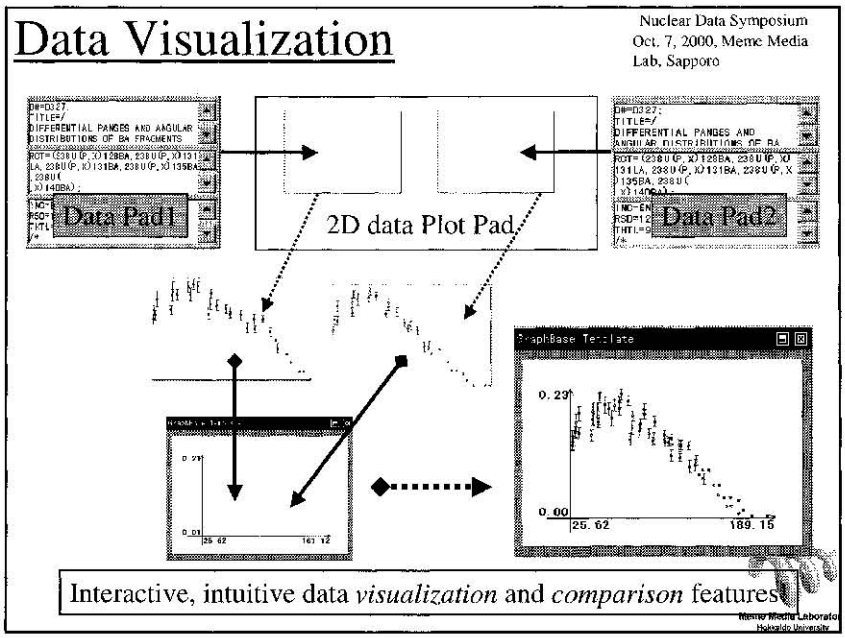
Lab, Sapporo
Target
Projectile
Step 1. Set the network address of SQLserver
Step.2 Set the keyword to search
Step 3. Exec.
Step 4. Get 327:6 data
Bib.
Reaction
Data
Data Pad
Data text browsing
List of 238U(p,X)X data
DatagroupNo:DataNo
Meme Media Laboratory
Hokkaido University


Data Visualization
Nuclear Data Symposium
Oct. 7, 2000, Meme Media
Lab, Sapporo
Data Pad1
2D data Plot Pad
Data Pad2
GraphBase Template
0.29
0.00
25.62
189.15
Interactive, intuitive data visualization and comparison features
Meme Media Laboratory
Hokkaido University

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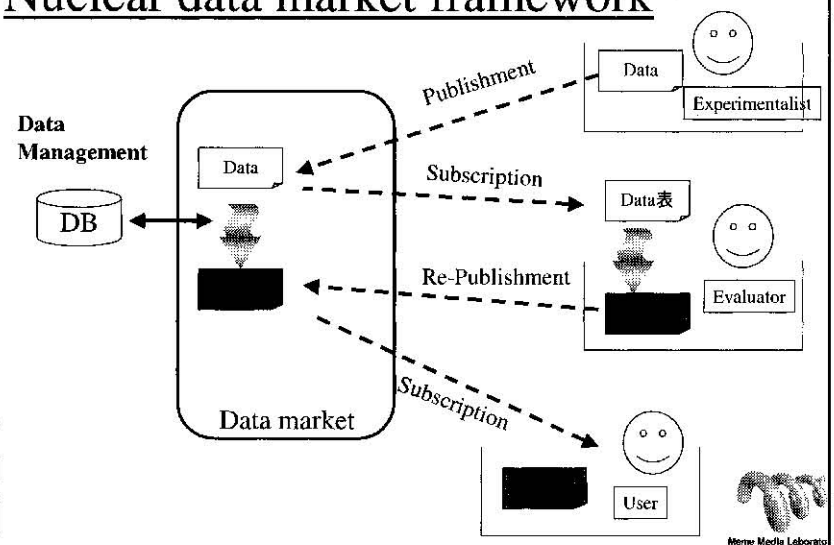
Oct. 7, 2000, Meme Media
Lab, Sapporo

Nuclear data market framework



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Hokkaido University

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Concepts

- **Media based architecture**

  Standardized relationship among "medialized" data

- **Access architecture**

  Navigation, Sharing among users, co-operation…,etc.

- **Unified "media" description format**

  From compilation stage to end-user stage!

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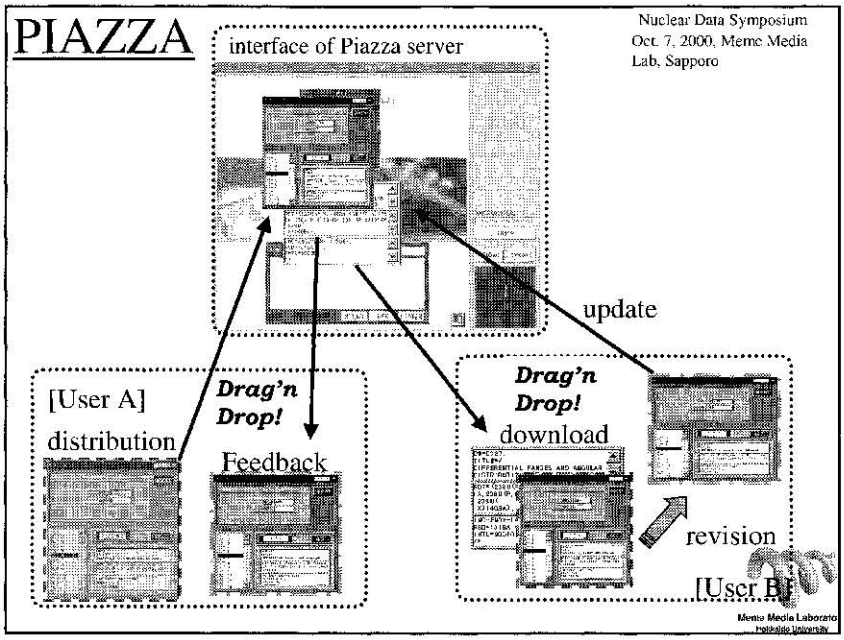
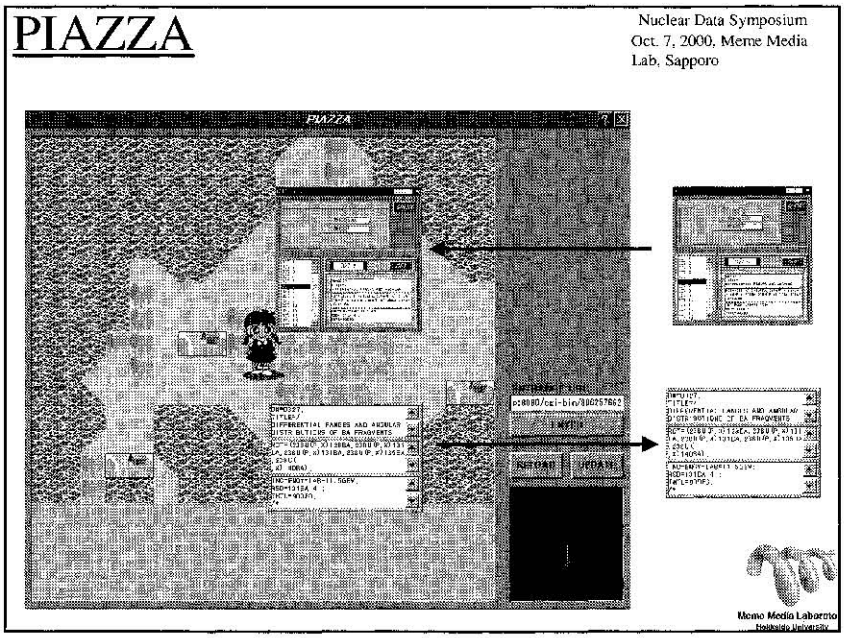

PIAZZA
interface of Piazza server
Nuclear Data Symposium
Oct. 7, 2000, Meme Media
Lab, Sapporo
update
[User A]
distribution
Drag'n
Drop!
Feedback
Drag'n
Drop!
download
revision
[User B]
Meme Media Laboratory
Hokkaido University


PIAZZA
Nuclear Data Symposium
Oct. 7, 2000, Meme Media
Lab, Sapporo
Meme Media Laboratory
Hokkaido University

Concepts

Nuclear Data Symposium
Oct. 7, 2000, Meme Media Lab, Sapporo

- **Media based architecture**

  Standardized relationship among "medialized" data

- **Access architecture**

  Navigation, Sharing among users, co-operation…,etc.

- **Unified "media" description format**

  From compilation stage to end-user stage!

XML/XSL based data/format description

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- Nuclear Data Description Modeling Language : NDML (DTD for nuclear data)
- XSL style sheet for, EXFOR format, Word, LaTeX, html, …,etc.
- Name space (translation dictionary)
- Other technologies to treat semi-structured data.

Let's imagine what we can do!

E.g., Automatic creation of bibliographic data from authors paper.

These framework essentially helps the compilation activities

Summary

Current our research for the nuclear data is based on,

- **Media based architecture/ by IntellingetPad,**
- **Access architecture/ by Piazza,**
- **Unified "media" description format/by semi-stuructured document technologies.**

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- Current IntelligentPad on C++ package is available freely via, http://www.pads.or.jp

- We are going to release "mile-stone" package for Nuclear reaction data retrieval system by using above IntelligentPad, hopefully including EXFOR, in the next year.

-We consider the semi-structure description format of nuclear reaction data.

Development of a Search System of NRDF on WWW

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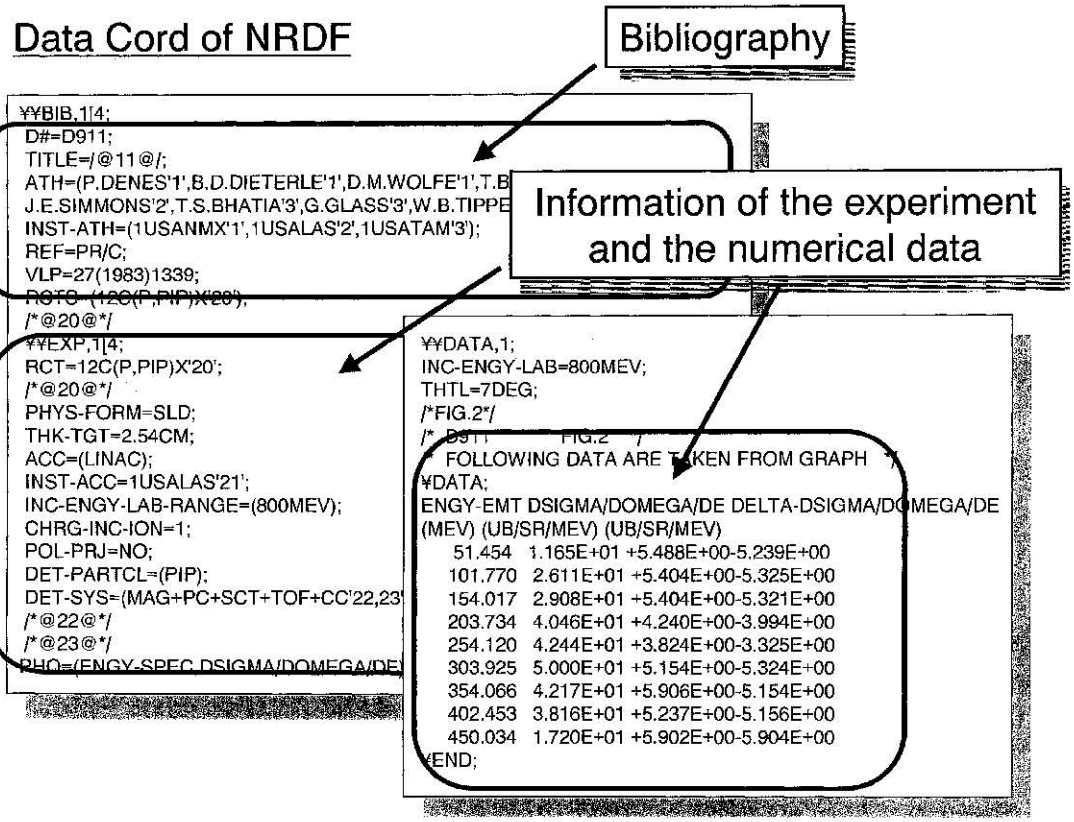
Nuclear Reaction Data File (NRDF)

The compilation of NRDF is started in 1974. It is a domestic nuclear data base of charged particle reactions organized by Japan charged particle reaction group (JCPRG).

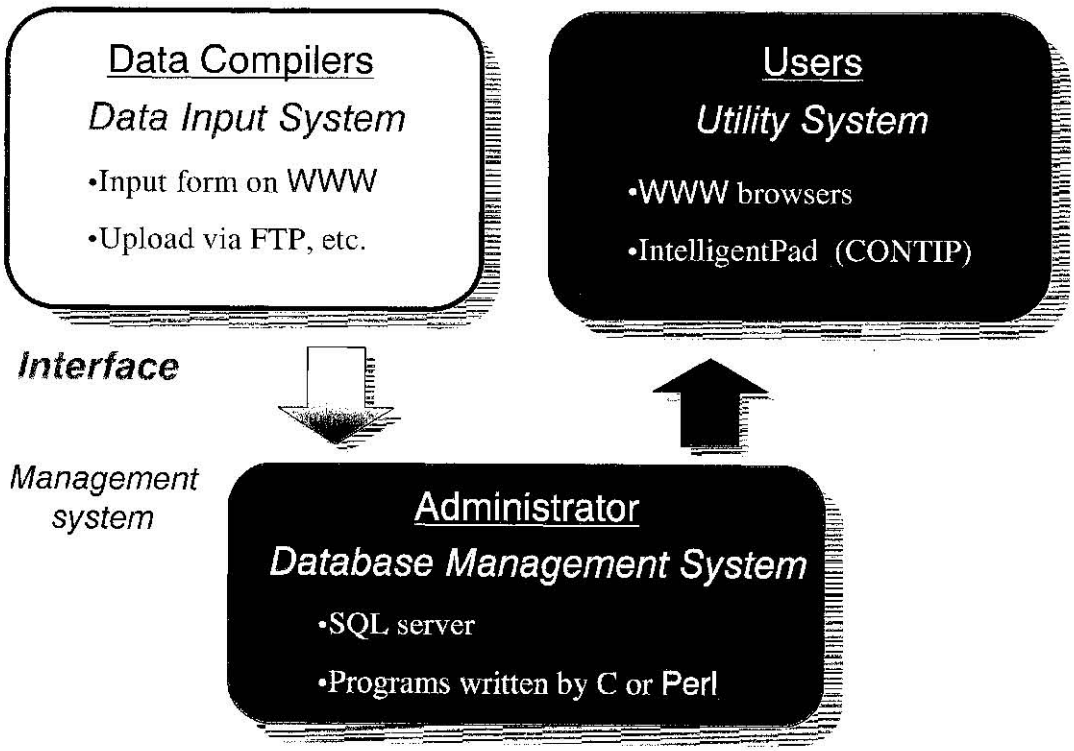
Features and Characteristics

- A nuclear reaction data base using originally formatted cord
- The contents are domestic nuclear (charged particle) reaction data
- Flexibility for data accumulation
- Scientific data base including the information for the experiment itself, besides the bibliography
- About 1,500 articles are accumulated
- International contribution of nuclear data.
  (NRDF is transferred to the EXFOR format)

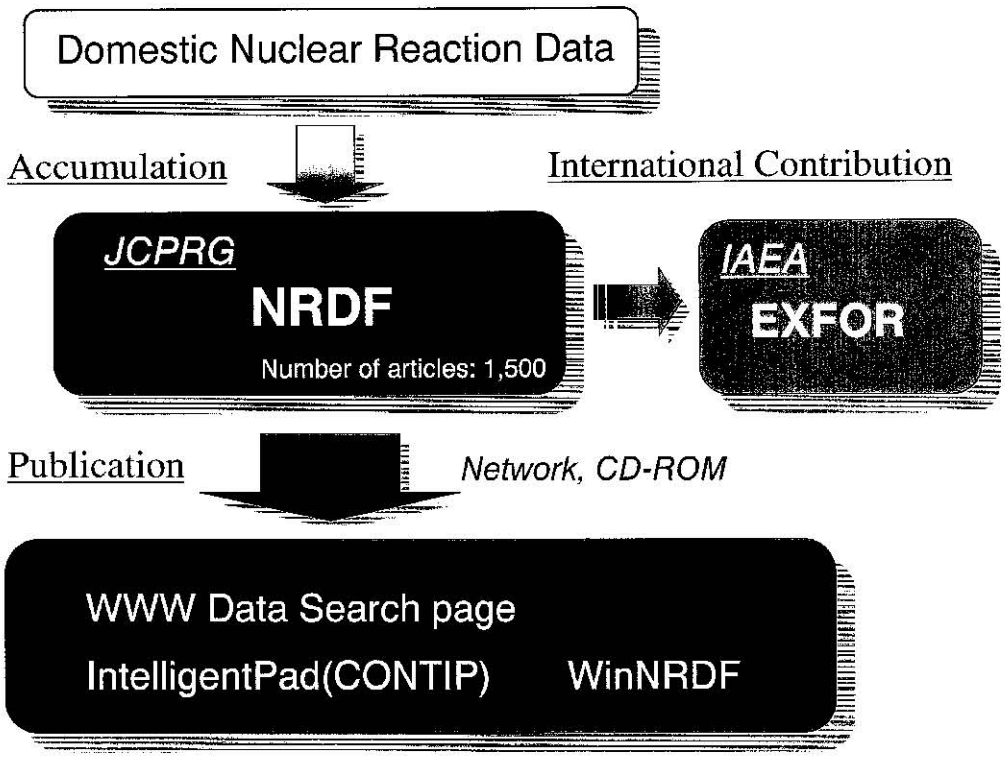
Data Cord of NRDF



Accumulation and Utilization of Nuclear Data



The Placement of NRDF



What would we do to construct a comfortable environment for compilers and users?

Our answers

- A friendly *interface* ··· **WWW browser**
  - •Simple input method by "form"
  - •Multi-functionality for HTML-file browsing
- More powerful architecture ··· IntelligentPad "CONTIP"
  - •Interactive data comparison using a feature of IntelligentPad
  - •Circulation of data and applications using a circulating technique of Pad

Development of Search and Entry System on WWW

- Search system

  http://nrdf.meme.hokudai.ac.jp/tools/nrdf_search.html

- Entry system – ***under construction***

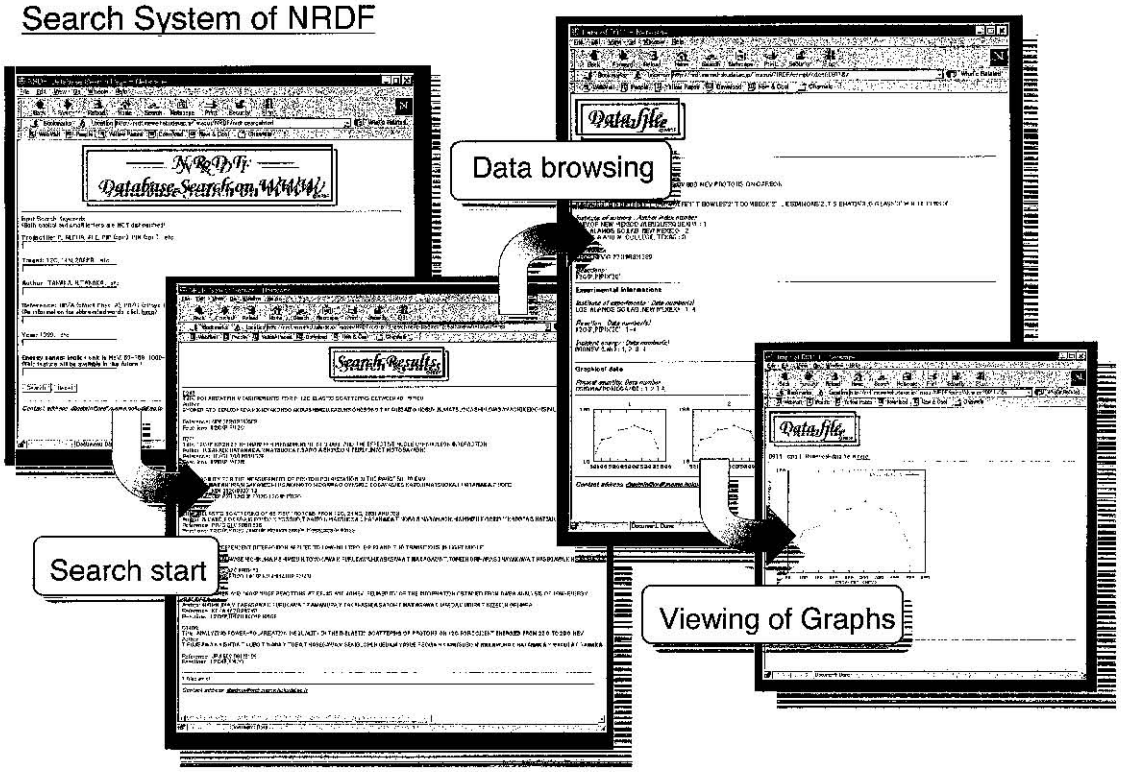
Advantages

- Easy operation

  – common user interface (WWW browser) –

- Graph-data visualization
- Simpleness in the development of systems
- Rapid data circulation by the network
- Platform-free for the compilers and users

Search System of NRDF



Showing the bibliography and the information of experiments

To get the NRDF cord, click here

Easy to see the title, the authors and so on

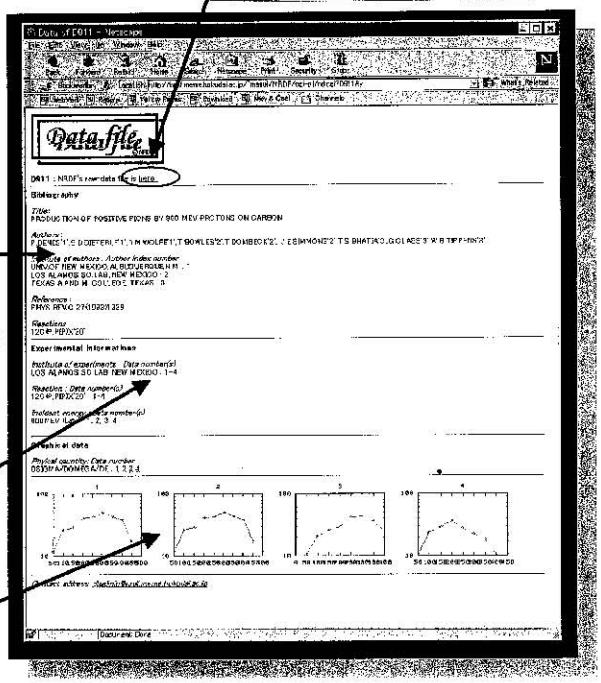
TITLE:
PRODUCTION OF POSITIVE PIONS BY ...

Authors:
P.DENES'1', B.D.DIETERLE'1',...

Institute of authors : Author index number
UNIV OF NEW MEXICO, ALBUQUWQUE N.M : 1

Each number of the information of the experiment corresponds to graph data

Thumbnails of graphs



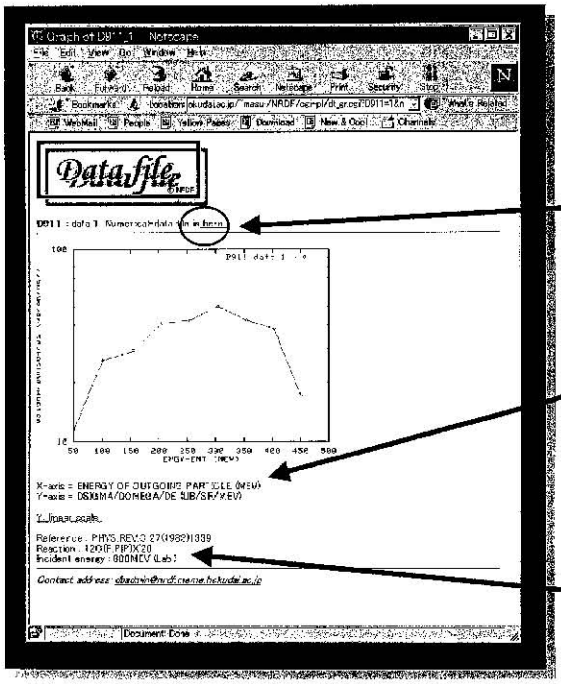
Data-Browsing Page

More detailed information of the data

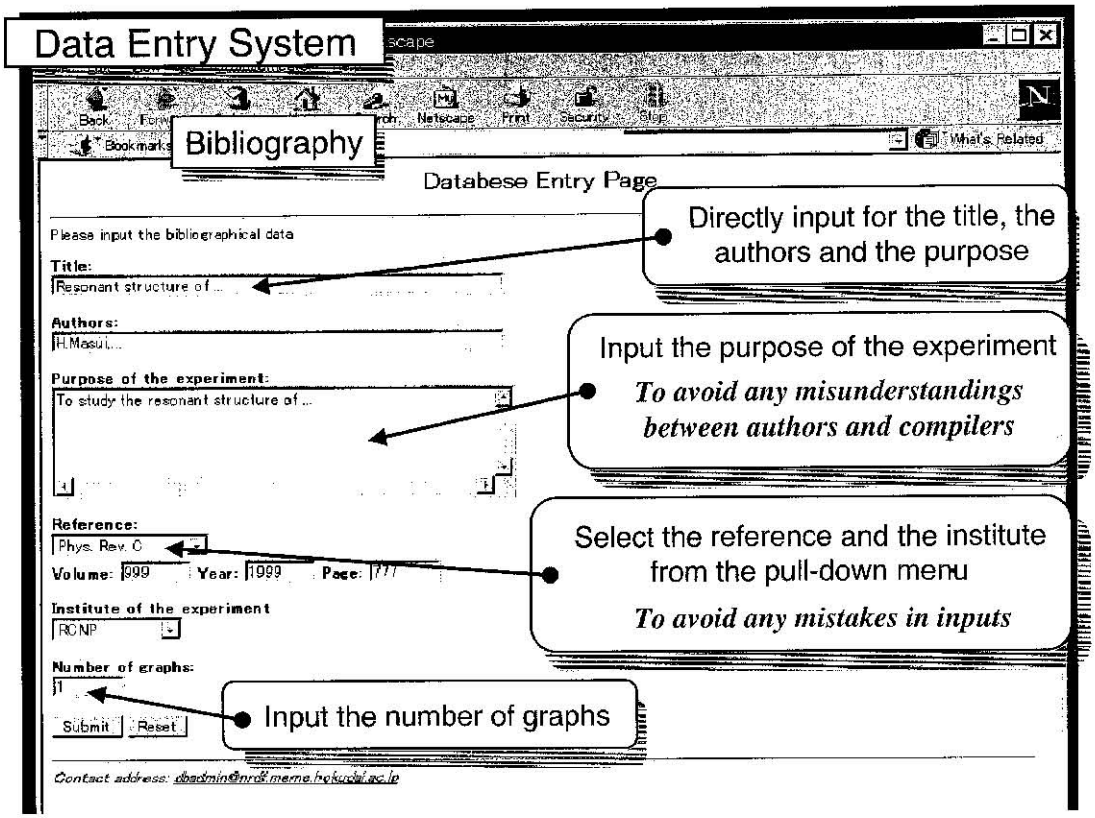
To get the numerical data, click here

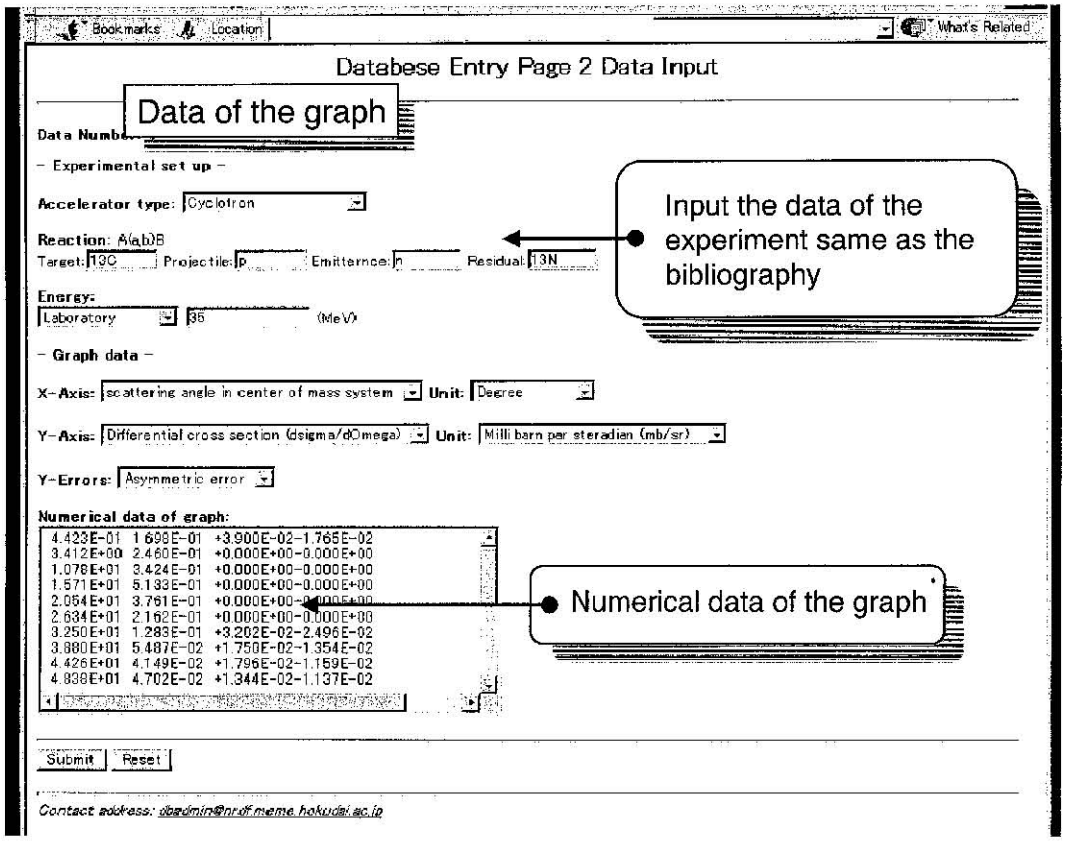
Attributes of X- and Y- axis corresponding to dictionary

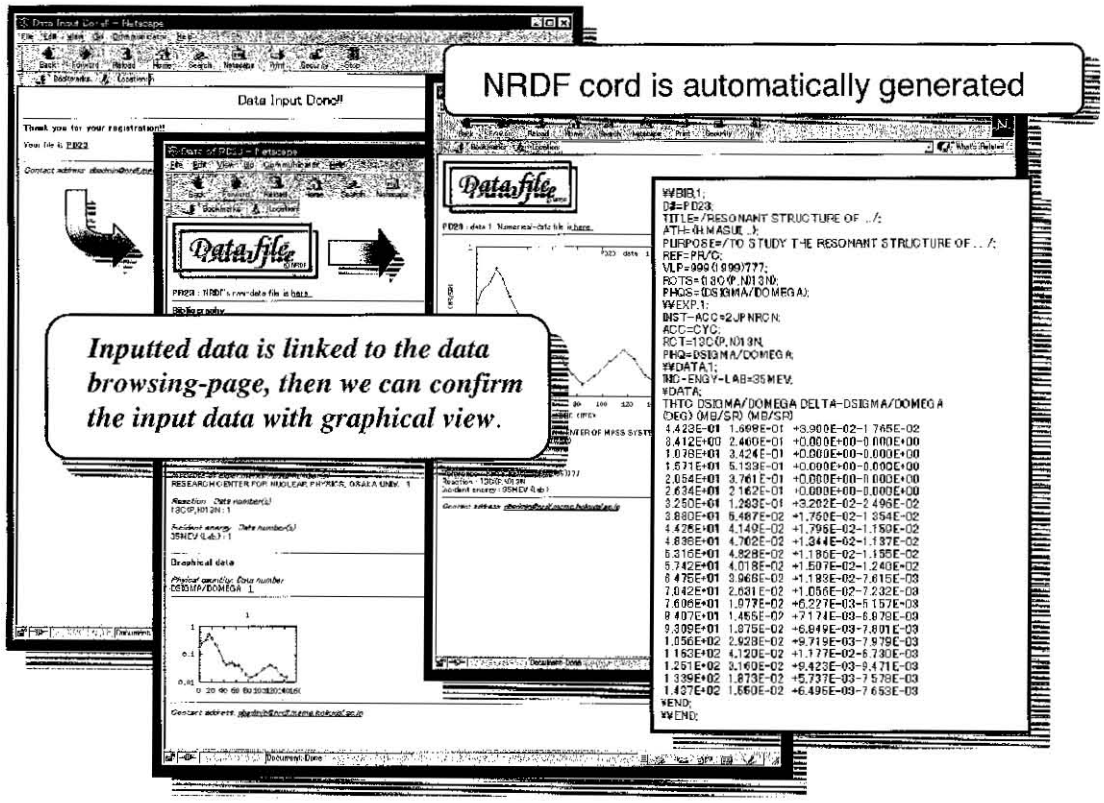
Information of the experiment



Graph-Display Page


Data Entry System
Bibliography
Databese Entry Page
Please input the bibliographical data
Title:
Resonant structure of ...
Authors:
H.Masui...
Purpose of the experiment:
To study the resonant structure of ...
Reference:
Phys. Rev. C
Volume: 999
Year: 1999
Page: 777
Institute of the experiment
RCNP
Number of graphs:
1
Submit
Reset
Contact address: dbadmin@nrdf.meme.hokudai.ac.jp
Directly input for the title, the authors and the purpose
Input the purpose of the experiment
To avoid any misunderstandings between authors and compilers
Select the reference and the institute from the pull-down menu
To avoid any mistakes in inputs
Input the number of graphs


Databese Entry Page 2 Data Input
Data of the graph
Data Numbe
- Experimental set up -
Accelerator type: Cyclotron
Reaction: A(a,b)B
Target: 13C
Projectile: p
Emitternce: n
Residual: 13N
Energy:
Laboratory
35
(MeV)
- Graph data -
X-Axis: scattering angle in center of mass system
Unit: Degree
Y-Axis: Differential cross section (dsigma/dOmega)
Unit: Milli barn per steradian (mb/sr)
Y-Errors: Asymmetric error
Numerical data of graph:
4.423E-01 1.698E-01 +3.900E-02-1.765E-02
3.412E+00 2.460E-01 +0.000E+00-0.000E+00
1.078E+01 3.424E-01 +0.000E+00-0.000E+00
1.571E+01 5.133E-01 +0.000E+00-0.000E+00
2.054E+01 3.761E-01 +0.000E+00-0.000E+00
2.634E+01 2.162E-01 +0.000E+00-0.000E+00
3.250E+01 1.283E-01 +3.202E-02-2.496E-02
3.880E+01 5.487E-02 +1.750E-02-1.354E-02
4.426E+01 4.149E-02 +1.796E-02-1.159E-02
4.838E+01 4.702E-02 +1.344E-02-1.137E-02
Submit
Reset
Contact address: dbadmin@nrdf.meme.hokudai.ac.jp
Input the data of the experiment same as the bibliography
Numerical data of the graph



Summary and Future Developments

- Individual "nuclear data management system"

  Both of systems work on any HTTP server with CGI

  Basis of nuclear data utilization

- Development of applications on IntelligentPad

  P41 Y. Ohbayasi et.al. and P43 S. Aoyama et. al. in this conference

  Future possibility of nuclear data

- Automatic transformation to other data format

  e.g. EXFOR

  International contribution