

「Victoria McLane 氏を囲んでの核データシンポジウム」報告 Report on "Nuclear Reaction Data Symposium with Ms. Victoria McLane"

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Abstract

Japan Charged-Particle Reaction Data Group (JCPRG) invited Ms. Victoria McLane, Brookhaven National Laboratory (BNL), National Nuclear Data Center (NNDC), under the auspices of the foreign researchers receiving system of the Meme Media Laboratory, Hokkaido University. The purposes of her invitation are the following: the mutual understanding of the nuclear data activities in NNDC and recent activities in JCPRG, especially the NRDF (Nuclear Reaction Data File) compilation, including several newly developed NRDF supporting systems; to learn the EXFOR (Nuclear Reaction Data Exchange Format) database itself and the EXFOR compilation; to convert North American charged-particle nuclear reaction data compiled in NRDF format to those in EXFOR format by using the web-based editor HENDEL. We held the symposium entitled "Nuclear Reaction Data Symposium with Ms. Victoria McLane" to pursue those purposes described above in the Nuclear Theory Laboratory, Graduate School of Science, Hokkaido University, February 14 in 2005. In this report we first show the program of the symposium and the outlines of the lectures given there. Then we display all the slides presented by Ms. McLane and other lecturers in their talks.

1 はじめに

日本荷電粒子核反応データグループ (JCPRG) では、2005 年 2 月 6 日から 3 月 5 日にかけて、米国立核データセンター (NNDC) の Victoria McLane 氏を、北大知識メディアラボラトリーの外国人研究者招聘制度により招聘した。

McLane 氏は長年に渡って、実験核反応データの国際標準書式 EXFOR を用いたデータ採録活動において、IAEA 核データ課の Otto Schwerer 氏とともに中心的な役割をしてこられた。今回の招聘の目的は、NNDC における核データ活動に関する理解を深めること、NRDF に関する理解を深めてもらうこと、採録システムを用いている採録者に EXFOR に関する知識を得る機会を作ること、NRDF に採録された北米産荷電粒子核反応データの EXFOR への変換を進めること、などである。

これらの目的を 1 ヶ月という限られた招聘期間内に達成するために、標記のシンポジウムが、2 月 14 日北海道大学大学院理学研究科物理学教室原子核研究室にて開催された。本稿では、まずプログラムと講演の概要を説明し、続いて講演者のスライド集を掲載することにより、このシンポジウムの報告を行う。

2 プログラムと講演の概要

時間	演題	講師
10:00-10:10	Opening	大西 明
10:10-11:30	Nuclear Data Center Network: Past, Present, Future	V. McLane
11:30-11:45	コーヒープレイク	
11:45-12:25	Introduction to JCPRG	加藤 幾芳
12:30-13:30	昼食 (ファカルティハウス エンレイソウ)	
14:00-14:30	Data input system	大塚 直彦
14:30-15:00	EXFOR/ENDF retrieval system	須田 拓馬
15:00-15:15	コーヒープレイク	
15:15-15:45	NRDF retrieval system (取消)	S. Korenov
15:45-16:15	Digitizing tool	簀口 あゆみ
16:15-16:30	Closing	能登 宏

Nuclear Data Center Network: Past, Present, Future (V. McLane)

V. McLane 氏が核データ採録活動の過去、現在、将来について講演を行った。まず、中性子のデータブック BNL325 が出版された 1950 年代、中性子データや荷電粒子データの採録がはじまった 1960 年代、それらの活動が組織化され主要なセンターやセンター網が形成された 1970 年代、を過去の部として紹介した。続いて、各センターやセンター網の現状、そしてそこで提供されているサービスの概要の現状を紹介した。特に彼女が IAEA-NDS の V. Zerkin とともに開発した、Web 上でのシステムの現状について詳しく話した。最後に CINDA 2001 や、EXFOR/ENDF/CINDA/NSR の相互利用に関する改善など将来に向けての課題を述べた。

Introduction to JCPRG (加藤 幾芳)

JCPRG の概要について JCPRG を代表して加藤が紹介した。まず、1974 年にはじまる JCPRG の歴史を、NRDF 開発の背景、採録システム、数値読取システム、利用システムの開発、国際協力の進展といった点から概観した。引き続き採録統計やグループの構成などについても紹介した。

Data input system (大塚 直彦)

大塚が採録システム HENDEL の紹介を行った。NRDF と EXFOR の書式の違いを概観し、JCPRG が当初行っていた NRDF から EXFOR への変換に際して生じた問題、その問題が、中間ファイルからの 2 書式同時生成により解決されたことを紹介した。この後、入力システムの概要とシステムを用いた採録の実績を紹介した。

EXFOR/ENDF retrieval system (須田 拓馬)

現在、JCPRG が開発を進めている実験核データと評価済核データを同時に検索・作図するシステムについて、須田氏が報告した。まず、EXFOR や ENDF から索引ファイルが作られる過程の説明があり、続いて、実際に操作されている画面の代表的な部分を紹介しながら、このシステムの機能を紹介した。

Digitizing tool (簀口 あゆみ)

グラフ数値化システム GSYS について簀口氏が報告した。まず最初にこの GSYS の開発言語となっている JAVA を用いる利点と、視覚的な環境の作成に用いられている AWT を紹介し、続いて、幾つかの GSYS の画面を実際に示しながら GSYS の機能が示された。最後に将来計画、特に AWT のかわりに Swing とよばれるツールキットを用いることで、OS によらない視覚的な環境を提供する計画があることを紹介した。

Nuclear Data Center Network Past, Present, Future

Victoria McLane

National Nuclear Data Center
Brookhaven National Laboratory
and
Hokkaido University



PAST

HISTORY

- Neutron Data Compilation
- Neutron Data Evaluation
- Charged Particle Data Compilation
- Nuclear Reaction Data Centers

Neutron Data Compilation

U.S. Neutron Cross Section Compilations

1952: AECU-2040, Neutron Cross Sections

- US AEC Neutron Cross Section Advisory Committee

1955: BNL325 1st Edition

- Neutron Cross Section Compilation Group, BNL

Neutron Data Compilation

1961

- **Sigma Center founded in U.S. at BNL.**
 - BNL-235 and BNL-400 in 1960's.

1963

- **Information Center on Nuclear Data created at Obninsk in Russia.**
 - Nuclear Constants

Neutron Data Compilation

1964

- **SCISRS database created at Sigma Center;**
 - 1st computerized compilation of nuclear reaction data.
- **Centre de Compilation de Données Neutroniques (CCDN) established at C.E.N. Saclay** by European Nuclear Energy Agency.
- **NNCSC and CCDN begin data exchange in SCISRS format.**
- **IAEA Nuclear Data Unit (NDU) established in Vienna.**

Neutron Data Compilation

1965

- **IAEA NDU joins data exchange.**

1966

- **“4-Center Network” created.**
 - Coordinated compilation of neutron reaction data on an international scale.
 - NNCSC: USA and Canada
 - CCDN: ENEA countries
 - Obninsk: USSR
 - NDS: Remainder of world

Neutron Data Evaluation

1965

- **1st Evaluated Nuclear Data File (ENDF)**
 - Designed by Henry Honeck, BNL.

1966

- **Cross Section Evaluation Working Group**
 - Under auspices of U.S. Atomic Energy Commission.

Neutron Data Evaluation

- **BROND, version 1, issued in 1985.**
- **JEF, version 1, released in 1990.**
- **JENDL**
- **CENDL**

Charged Particle Data Compilation

- Oak Ridge National Laboratory Charged Particle Data Group – McGowan
 - 4 compilations in ORNL reports (1960's).
 - Curves for light nuclides
 - Tables for intermediate nuclides.
- Karlsruhe Charged Particle Data Group.
 - Physics Data

Nuclear Reaction Data Centers

1967

- **National Neutron Cross Section Center (NNCSC) formed.**
 - Merger of Sigma Center and Cross Section Evaluation Center.
 - Responsible to US AEC.
- **NDU renamed Nuclear Data Section (NDS).**
 - Guided by International Nuclear Data Committee.

Nuclear Reaction Data Centers

1969

- **Centr Jadernykh Dannyykh (CJD) created at Obninsk.**
- **EXFOR adopted as official exchange format.**

Nuclear Reaction Data Centers

1975

- **Charged-Particle and Photonuclear Data Center Network formed.**
 - **Karlsruhe Charged Particle Data Group, Germany**
 - **Center for Atomic & Nuclear Data, Kurchatov Institute, Moscow**
 - **Photonuclear Experiments Data Center, Moscow State University**

Nuclear Reaction Data Centers

1976

➤ **National Nuclear Data Center (NNDC)
created from NNCSC.**

- Added Nuclear Structure and Decay Data responsibility.

1978

➤ **Nuclear Energy Agency Data Bank (NEADB)
formed.**

- Merger of CCDN and Computer Program Library (CPL).
- Services member countries of the NEA (except US and Canada).

Nuclear Reaction Data Centers

1979

➤ **Nuclear Reaction Data Center Network
created.**

- Merger of "4-Center" Network and Charged-Particle and Photonuclear Data Network.
- 4 "core" centers: NNDC, NEADB, NDS, CJD.



PRESENT

- Nuclear Reaction Data Centers
- Experimental Nuclear Reaction Data
- Evaluated Nuclear Reaction Data
- Nuclear Structure and Decay Data
- Bibliographic Databases
- Additional Services

Nuclear Reaction Data Centers

NRDC

- **Coordinated by IAEA NDS.**
- **Currently, 13 members centers.**
- **“Core” centers: NDS, NNDC, NEADB.**
- **Neutron, charged-particle, and photonuclear reaction data.**
- **Evaluated data in ENDF format.**

Nuclear Reaction Data Centers

Member centers:

- ✓ Cooperate on compilation, exchange, and dissemination of nuclear reaction data.
- ✓ Provide higher quality service at lower cost by avoiding duplication of effort and adopting common formats and procedures.
- ✓ Provide customer services covering wide range of nuclear data.

Nuclear Reaction Data Centers

Core centers provide easy access to:

- Experimental and evaluated nuclear reaction data.
- Nuclear structure and decay data.

All data are available on the World Wide Web, free of charge.

Experimental Nuclear Reaction Data

Data for incident projectiles ≤ 1 GeV.

- Neutron data: complete coverage.
- Charged-particle data: complete coverage from 1996.
- Photonuclear data: spotty coverage.

New:

- Reactions induced by particles with energy > 1 GeV and by fundamental particles.

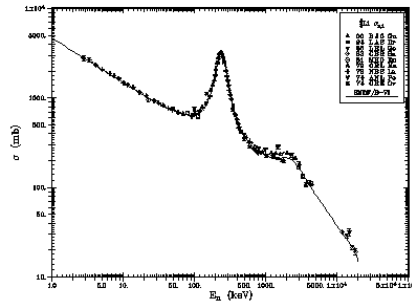
Evaluated Nuclear Reaction Data

ENDF- formatted files included:

- ✓ ENDF/B-VI
- ✓ JEF-2
- ✓ BROND-2
- ✓ JENDL-3
- ✓ CENDL-2

Plotting codes

- JANIS: from NEADB
- ZVView: from IAEA NDS



${}^6\text{Li}(n,t){}^4\text{He}$ experimental cross section data plotted with ENDF/B-VI curve using ZVView.

Nuclear Structure and Decay Data

- **ENSDF**: evaluated data.
Evaluated by members of International Nuclear Structure & Decay Data Network.
- **XUNDL**: experimental data.
- **NUDAT**: information retrieved from ENSDF, ENDF, and other files.
- **MIRD Program**: data from ENSDF in Medical Internal Radiation Dose format.

Sample MIRD data table for ^{128}I

53-IODINE-128			
Half-life = 24.99 Minutes		Mar-1998	
Decay Modes: EC ⁺ β ⁺ , β ⁻			
Radiations	y(i) (Bq-s) ¹	E(i) (MeV)	y(i)×E(i)
γ 1	1.65×10 ⁰³	7.435×10 ⁻⁰¹	1.23×10 ⁰³
Kα1 X-ray	2.77×10 ⁰²	2.747×10 ⁻⁰²	7.61×10 ⁻⁰⁴
Kα2 X-ray	1.49×10 ⁰²	2.720×10 ⁻⁰²	4.05×10 ⁻⁰⁴
Kβ X-ray	9.65×10 ⁰³	3.100×10 ⁻⁰²	• 2.99×10 ⁻⁰⁴
β ⁻ 3	2.00×10 ⁰²	4.084×10 ⁻⁰¹	• 8.17×10 ⁰³
β ⁻ 4	1.54×10 ⁰¹	6.355×10 ⁻⁰¹	• 9.79×10 ⁰²
β ⁻ 5	7.57×10 ⁰¹	8.338×10 ⁻⁰¹	• 6.31×10 ⁰¹
γ 1	1.69×10 ⁰¹	4.429×10 ⁻⁰¹	7.46×10 ⁰²
γ 2	1.58×10 ⁰²	5.266×10 ⁻⁰¹	8.34×10 ⁰³
γ 5	4.04×10 ⁰³	9.695×10 ⁻⁰¹	3.92×10 ⁰³
γ 6	1.03×10 ⁰⁴	1.140	1.17×10 ⁰⁴
Listed X, γ, and γ ¹ Radiations			8.97×10 ⁰²
Omitted X, γ, and γ ¹ Radiations**			1.29×10 ⁰⁴
Listed γ, ce, and Auger Radiations			1.31×10 ⁰³
Listed Radiations			8.97×10 ⁰²
Omitted Radiations**			1.44×10 ⁰³

* Average Energy (MeV).

** Each omitted transition contributes <0.100% to ? y(i)×E(i).

Tellurium-128 Daughter, yield 6.90×10⁻⁰², is radioactive.

Xenon-128 Daughter, yield 9.31×10⁰¹, is stable.

Bibliographic Databases

Nuclear reaction data bibliography (CINDA)

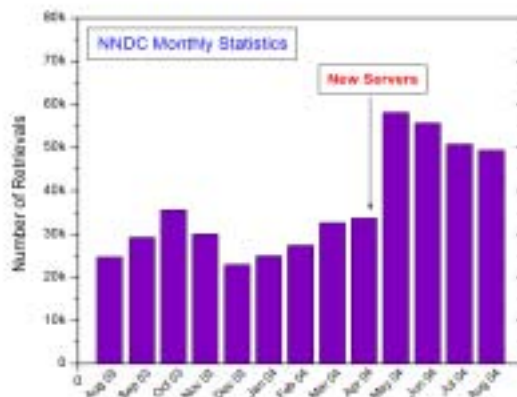
- Includes data for Neutron-induced reactions and related data (e.g., spontaneous fission).
- References blocked for a given target reaction, laboratory, work.

Bibliographic Databases

Nuclear Science References (NSR)

- Publications in low and intermediate energy nuclear physics.
 - ✓ Data may be retrieved by author, nuclide, reaction, particle, subject, and other criteria.
 - ✓ Links provided to XUNDL and ENSDF.
 - ✓ Links are provided to abstracts for several journals.
 - ✓ References entered by NNDC with compilation help from Russia and Japan.

NNDC Web Statistics 2003-2004



Additional Services

National Nuclear Data Center



Evaluation

- Fission product nuclei (joint project with KAERI).
- Coordination of CSEWG; maintenance of ENDF/B library and manuals.

Nuclear Structure and Decay Data

- Coordination of U.S. Nuclear Structure & Decay Data Network.
- ENSDF evaluation.
- Publication of **Nuclear data Sheets**.
- **Nuclear Wallet Cards**.
- Maintenance of ENSDF, XUNDL, and NSR databases.

EMPIRE Code maintenance.

Additional Services

Nuclear Energy Agency Data Bank

Computer Program Services

- Collection and distribution of
 - ✓ computer programs relevant to nuclear applications,
 - ✓ associated processed data files.

CD-Rom distribution

- CD-CINDA
- JANIS

Benchmark Calculations

- For criticality safety, accelerator driven systems, and more.

Evaluation Coordination

- Coordination of JEFF file.
- Coordination of Working Party on International Evaluation Cooperation (WPEC).

Additional Services

IAEA Nuclear Data Section



Nuclear Structure and Decay Data

- Coordination of international Nuclear Structure & Decay Data Network.

FENDL library for fusion applications.

IAEA Photonuclear Data Library.

Reference Input Parameter Library (RIPL) for theoretical calculations of nuclear reaction cross sections.

Atomic and Molecular Data

- Evaluation and dissemination of atomic and molecular data for fusion and other plasma science & technology applications.

Secretariat to International Nuclear Data Committee

Aid to developing countries

- Coordinated Research Projects.
- Technical Cooperation Projects.

Specialized Centers

CHINA

- China Nuclear Data Center, China Institute of Atomic Energy, Beijing

HUNGARY

- Cyclotron Applications Department, ATOMKI, Debrecen

JAPAN

- Japan Charged Particle Reaction Group, Hokkaido University, Sapporo
- Japan Atomic Energy Research Institute, Tokai

KOREA

- Nuclear Data Evaluation Laboratory, Korea Atomic Energy Research Institute, Taejon



Specialized Centers

RUSSIA

- Center for Nuclear Data (CJD), Obninsk
- Center for Atomic & Nuclear Data, Kurchatov Institute, Moscow
- Center for Photonuclear Experiments Data, Moscow State University Nuclear Physics Data Center
- Center for Nuclear Physics Data, Russia Federal Nuclear Center – VNIIEF, Sarov

UKRAINE

- Ukrainian Nuclear Data Center, SC Institute for Nuclear Research, Kiev

Nuclear Reaction Database

Development:

Joint effort by NNDC and NDS

Code written by:

Victor Zerkin

Nuclear Data Section,
International Atomic Energy Agency

**NUCLEAR
DATA
SERVICES**



Nuclear Reaction Databases

 EXFOR/CSISRS

 ENDF

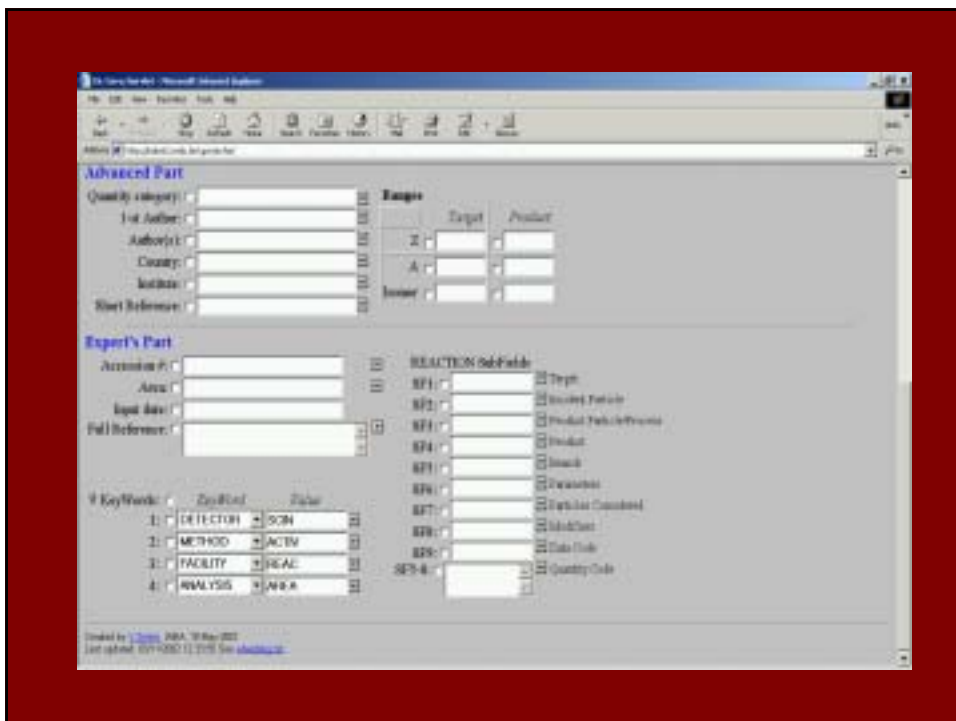
 CINDA

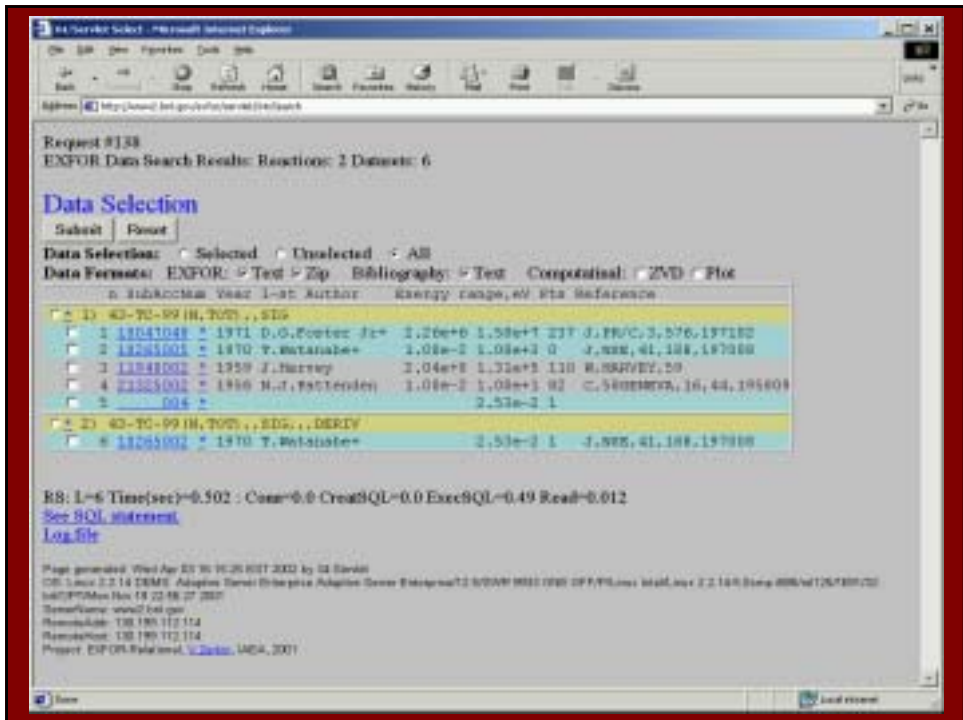
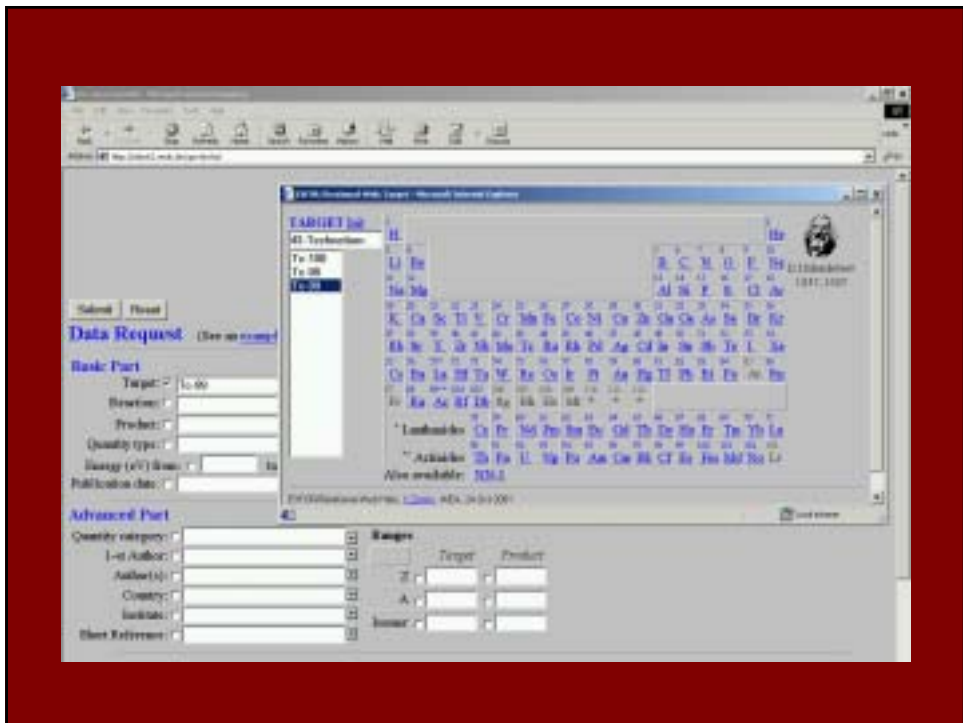
EXFOR/CSISRS Database

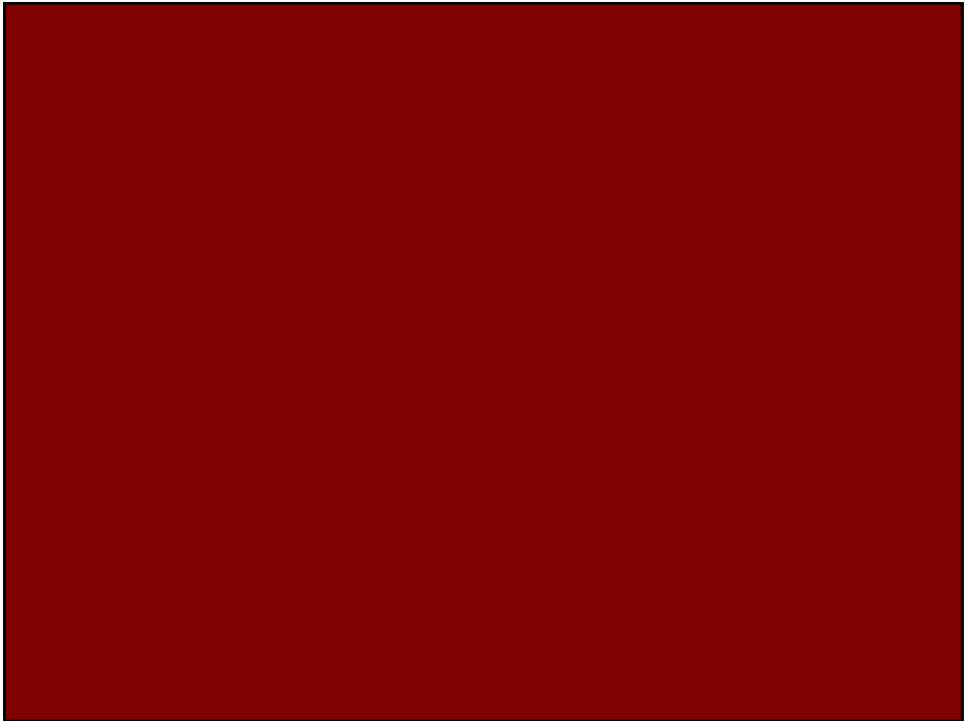
- References linked to abstracts for several journals
- Links to ENDF data.
- 3 levels of retrieval: Basic, Extended, Expert
- Complete set of help file (dictionaries)

EXFOR/CSISRS Database

- ✓ Retrieval by target, reaction, product, and other criteria.
- ✓ Output in EXFOR format or computation format.
- ✓ Data may be plotted; user has some control over format.







ENDF Database

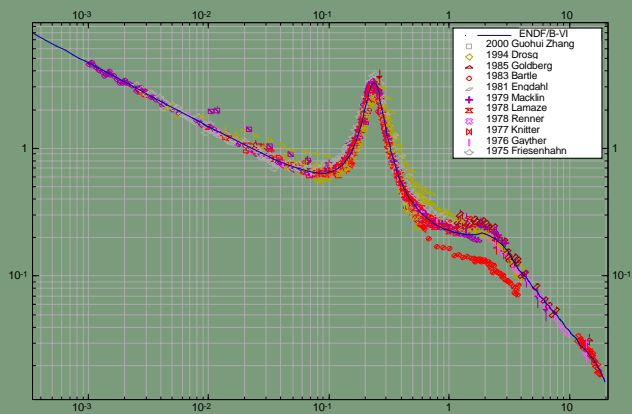
Plots available:

- for multiple libraries;
- with experimental data;
- user has some control over format.





Plotting



${}^6\text{Li}(n,t){}^4\text{He}$ experimental cross section data plotted with ENDF/B-VI curve using ZVView.

Experimental Nuclear Reaction Database

Current Status

- Web interface installed: IAEA, NNDC
- Maintenance utilities:
 - EXFOR/CSISRS and ENDF completed.
 - CINDA in Testing phase
- Documentation: **Not yet completed**

Nuclear Reaction Database

Proposal for Network Centers

- Consider participating in testing of Web-EXFOR.
- Consider installing NRDB to provide Internet Nuclear Data Services.

Future Vision

Future Improvements

CINDA2001 (currently in testing)

- ✓ References for all nuclear reactions organized as in CINDA.
- ✓ Contents closely resembles EXFOR.
- ✓ Initial database will be created from CSISRS/EXFOR library and from CINDA, as well as references imported from the Photonuclear Data Index, CDFE.

Future Improvements

CINDA2001 (future)

- Link to evaluated data.
- Link to NSR by Key Number.

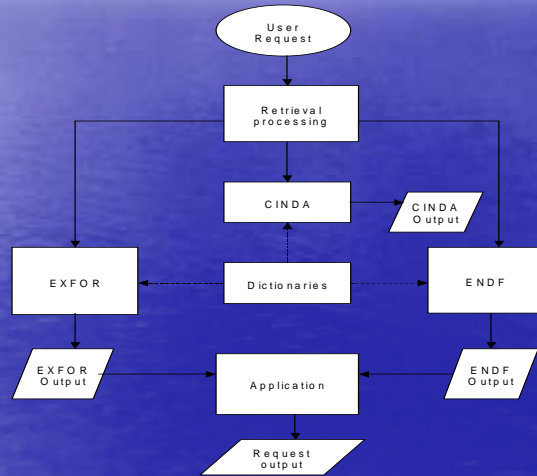
Future Improvements

Integration of retrieval input and databases.

- Creating a standard look for input.
- Creating a standard user interface to access all databases

Future Improvements

Proposal for Integrated Nuclear Reaction Database



Future Problems

- ✦ Synchronization of databases.
 - Between NNDC and IAEA.
 - With remaining Nuclear Data Centers.

Future Problems

- ✦ Keeping up with fast changing technology.
 - No one knows what the future holds.
 - Shrinking funding means fewer resources.

Japan Charged Particle Reaction Group (JCPRG)

Kiyoshi Kato

Development of NRDF (Nuclear Reaction Data File)

Since 1974,
Prof. H. Tanaka has organized a study group of charged
particle nuclear data.

The study group consisting of nuclear theorists and
experimentalists and information scientists has made an
original data base together with an own data base
management system.

The new data base has been called NRDF (Nuclear
Reaction Data File) corresponding to NSDF made by the
Oak Ridge group.

After five years for a trial, real accumulation and
compilation have been started by JCPRG.

Accumulation and compilation of charged particle data on the basis of NRDF

- 1979 - 1985

proton induced nuclear reaction data taken from issues of Nuclear Data Sheet

- 1986 ~

charged particle nuclear reaction data taken from experiments performed by using Japanese accelerators

- 2000 ~

medical nuclear data have been added to

- Data coding

1974 - 1995: coding sheets

1996 - 2000: direct input from a keyboard to a computer file

2001 ~ : HENDEL

by N. Otsuka

- Graph - reading systems

1985 ~ : GRADIS (Digitizing Graph data in association with a personal computer)

1998 ~ : SyGRD (Windows version)

2003 ~ : GRES (JAVA version)

by A. Minoguchi

NRDF Retrieval and Utility Systems

- online retrieval system in the computer center of
Hokkaido university
- CONTIP (Creative, Cooperative and Cultural Objects for
Nuclear data and Tools on IntelligentPad)
Meme laboratory of Hokkaido university
- DARPE
Main NRDF retrieval system on the internet system
by S. Korennov
- SPES and SPEC - J、NIAS (2006)
by T. Suda

International cooperation of NRDF

- 1974: extension from neutron to charged particle and
photon induced nuclear reaction data
- 1975: IAEA meeting of experts for charged particle
data (H. Ohnuma and T. Kitagawa from Japan)
- 1976: (H. Ohnuma and T. Tamura)
- 1977: At Kiev, Charged Particle Nuclear Reaction Data
CAJaD(Kurchatov), KaChaPaG(Karlsruhe)
JCPRG(Hokkaido)
- 1983: RIKEN(A. Hashizume), Medical nuclear data → 2000
- 1992; JCPRG (at NRDC meeting)

Recent NRDF activities

- 1999 ~ collaboration with Meme laboratory
- 2000: O. Schwerer (One month in Sapporo)
- Data transmission from NRDF to EXFOR

表1 NRDFデータ蓄積量

年度	作成計画		実績		累積	
	レコード量 (レコード数)	データ量 (MB)	レコード量 (レコード数)	データ量 (MB)	レコード量 (レコード数)	データ量 (MB)
1980	—	—	2,144	5.96	2,144	5.96
1981	1,912	5.74	1,824	6.31	3,968	12.77
1982	2,080	7.14	1,801	6.52	5,769	19.29
1983	2,200	7.00	2,252	6.53	8,021	25.82
1984	1,700	5.60	1,703	5.03	9,724	30.85
1985	1,800	5.60	2,179	5.50	11,894	36.35
1986	1,000	3.20	862	3.14	12,856	39.49
1987	1,100	3.50	1,264	3.16	14,220	42.65
1988	1,500	3.50	1,284	3.30	15,604	45.95
1989	1,500	3.20	1,224	3.20	16,828	49.15
1990	1,200	3.20	1,282	2.90	18,110	52.05
1991	1,000	3.00	789	2.20	18,899	54.25
1992	1,000	3.00	1,620	3.00	20,519	57.25
1993	1,000	3.00	1,096	3.09	21,615	60.34
1994	1,000	3.00	1,328	3.00	22,943	63.34
1995	1,000	3.00	200	3.00	23,143	66.34
1996	1,000	3.00	1,176	2.99	24,319	69.33
1997	1,000	3.00	595	1.60	24,914	70.93
1998	1,000	3.00	196	0.53	25,110	71.46
1999	1,000	3.00	457	1.20	25,567	72.66
2000	1,000	3.00	95	0.30	25,662	72.96
2001	1,000	3.00	360	2.20	26,022	75.16
2002	1,000	3.00	717	3.22	26,739	78.38
2003	1,000	3.00	984	6.85	27,723	85.23

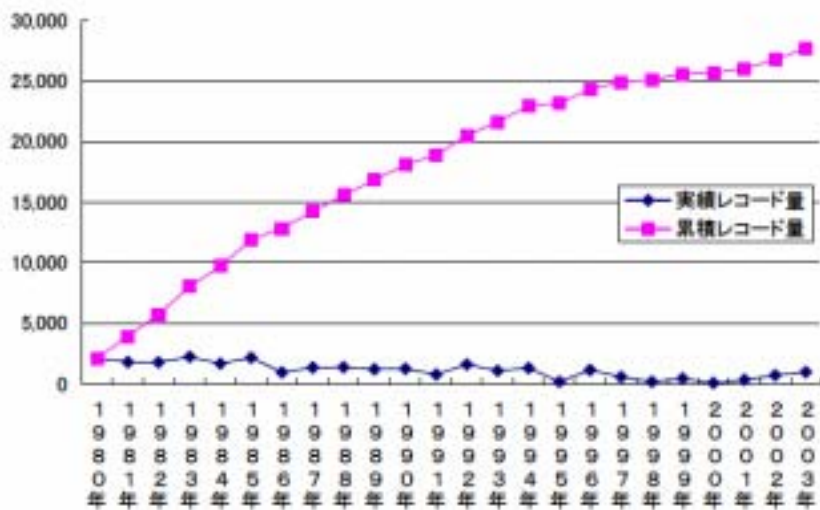


図1 NRDF各年度収録実績レコード数と累積レコード数

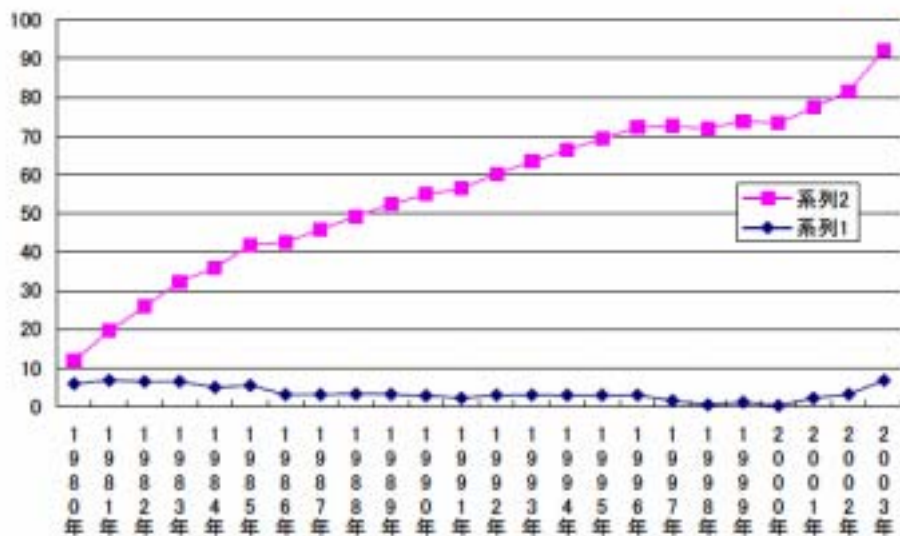
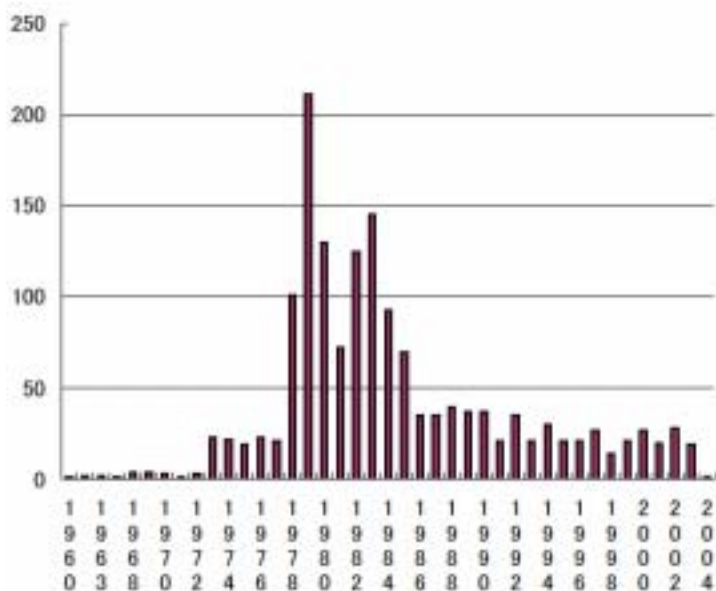


図2 NRDF各年度収録実績データ量と累積データ

図 3

論文件数



Advisory committee :

- Yasuhisa ABE (Yukawa Institute for Theoretical Physics, Kyoto Univ.)
- Yoshinori AKAISHI (Institute for Particle and Nuclear Studies, KEK)
- Yasuo AOKI (Univ. of Tsukuba)
- Junsei CHIBA (Institute for Particle and Nuclear Studies, KEK)
- Akira HASEGAWA (Japan Atomic Energy Research Institute)
- Masayasu ISHIIHARA (Institute of Physical and Chemical Research)
- Ichiro KATAYAMA (Center for Nuclear Study, Univ. of Tokyo)
- Kiyoshi KATŌ (Hokkaido Univ.)
- Mitsuji KAWAI (Kyushu Univ.)
- Shunpei MORINOBU (Kyushu Univ.)
- Tetsuo NORO (Kyushu Univ.)
- Hajime OHNUMA (Chiba Institute of Technology)
- Koichi OKAMOTO (Nihon Univ.)
- Hikonojo ORIHARA (Cyclotron and Radioisotope Center, Tohoku Univ.)
- Tejiro SAITOH (Laboratory of Nuclear Science, Tohoku Univ.)
- Hajime TANAKA (Hokkaido Univ.)
- Yoshihiko TENDOW (Museum of Future Science and Technology)

Executive committee :

Kiyoshi KATŌ (Chairman, Hokkaido Univ.)
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Hiroshi NOTO (Hokusei-Gakuen Univ.)
Akira OHNISHI (Hokkaido Univ.)
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Masatsugu ISSE (Hokkaido Univ.)
Sergei KORENNOV (Hokkaido Univ.)
Chie KUROKAWA (Hokkaido Univ.)
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Ryusuke SUZUKI (Hokkaido Univ.)

(2) Data input :

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(3) NRDF system maintenance :

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Naohiko OTUKA (Hokkaido Univ.)

(4) Transmission of EXFOR files :

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Hiroshi NOTO (Hokusei-Gakuen Univ.)

Naohiko OTUKA (Hokkaido Univ.)

(5) New retrieval-plot system (DARPE) development :

Sergei KORENNOV (Hokkaido Univ.)

Kenichi NAITO (Hokkaido Univ.)

Naohiko OTUKA (Hokkaido Univ.)

(6) IntelligentPad-based database development :

Yoshihide OHBAYASHI (Muroran Institute of Technology)

(7) Editor-compiler development :

Naohiko OTUKA (Hokkaido Univ.)

Access of NRDF

(year)	(times)
--------	---------

2000	448
------	-----

2001	497
------	-----

2002	550
------	-----

2003	1,167
------	-------



HENDEL

Web-based input system
for nuclear reaction data compilation

OTUKA Naohiko

Nuclear Data Centre
Japan Atomic Energy Research Institute (JAERI)
(Vicki Symposium, Hokkaido University – Feb.14, 2005)



Background

- Translation from NRDF to EXFOR
 - NRDF - EXFOR relation is not simple.
- Manpower
 - Permanent staffs are not available in JCPRG.
 - Students do not have time to learn data formats.
- Change of Computer Facility
 - Large scale computer to Linux PC and Windows

Comparison : NRDF and EXFOR

NRDF

```

YYBIB,1[54;
D#=D1829;
TITLE=/Measurement and calculation of
radioactivities of spallation
products
by high-energy heavy ions;/
ATH=(H.YASHIMA'1', Y.UWAMINO'2',
H.IWASE'1',
H.SUGITA'1', T.NAKAMURA'1',
S.ITO'2',
A.FUKUMURA'3');
INST-ATH=(2JPNTOH'1', 2JPNIPC'2',
2JPNIRS'3');
REF=RCA;
VLP=91(2003)689;
YYEXP,1[54;
ACC=SYN;
INST-ACC=2JPNIRS'8';
/* '8' HIMAC facility */
DET-PARTCL=GAMMA;
DET-SYS=(HPGE'9',IC'10');
    
```

EXFOR

```

BIB          9          13
TITLE      Measurement and calculation of
           radioactivities of spallation
           products by high-energy heavy
           ions
AUTHOR      (H.Yashima, Y.Uwamino, H.Iwase,
           H.Sugita, T.Nakamura, S.Ito,
           A.Fukumura)
INSTITUTE   (2JPNTOH,2JPNIPC,2JPNIRS)
REFERENCE   (J,RCA,91,(12),689,200312)
PART-DET    (DG)
FACILITY    (SYNCH,2JPNIRS) HIMAC
           facility
DETECTOR    (HPGE)
           (IOCH)
STATUS      (APRVD)
HISTORY     (20040408C)
ENDBIB      42          0
    
```

Translation from NRDF to EXFOR

- N2X (NRDF to EXFOR) translator system

Developed by Prof. M. Chiba
Fortran 77+PL/I+ADABAS (Data Base Manager)

- Structure of NRDF and EXFOR

NRDF: Field = Value
DET-PARTCL=P;

➡ EXFOR: Information Identifier & Value

PART-DET (P)

Problems in translation (I)

- Code scheme of physical quantity

A NRDF code corresponding to many EXFOR codes

- Example 1 (Branch):

NRDF: SIGMA

➡ EXFOR: ,SIG? CUM,SIG? IND,SIG? PAR,SIG?...

- Example 2 (Particle considered):

NRDF: DSIGMA/DOMEGA/DOMEGA

➡ EXFOR: ,DA/DA,P/P? ,DA/DA,A/A? ,DA/DA,P/A?...

Problems in Translation (II)

- Coded information not in NRDF:

REL-REF, MONIT-REF, RESULT, DECAY-DATA,
DECAY-MON, METHOD, ERR-ANALYSIS, ...

... Add code by hand after automatic translation

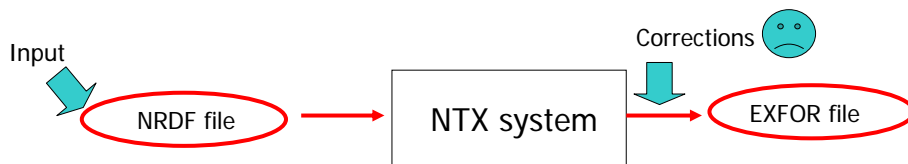
- Physical quantities not in EXFOR:

Optical potential, High energy data (RHIC),
Hyper nuclei, Spectroscopic factor, ...

... Write CP-Memo or put NOSUBENT?

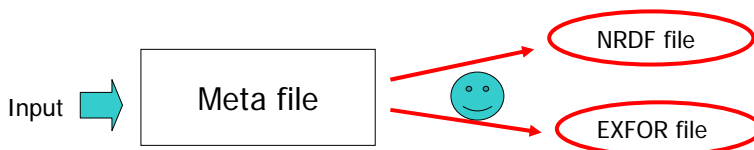
Procedure with NTX system

1. Compilation in NRDF (Students)
2. Translation to EXFOR (Secretary)
3. Add and correct translated file by hand (Professors?)



Solution in new input system

- Give information in **meta file**
It contains all information for NRDF and EXFOR)
- Translate meta file to both formats
 - 1) Meta files are loaded into the system.
 - 2) System outputs NRDF & EXFOR simultaneously.



Example of meta file (II)

```
#####
# rc: reaction
#####
rc: 0:71
rc: 1:none
rc: 2:P
...
rc:65:XSECTN          <= Physical quantity code for NRDF
rc:66:none
rc:67:CUM,SIG        <= Physical quantity code for EXFOR
rc:68:none
...
#####
# ta: target
#####
ta: 0:16
ta: 1:X
ta: 2:none
ta: 3:ELM
ta: 4:none
ta: 5:SLD             <= Physical form of target (Code in NRDF, Free text in
EXFOR)
ta: 6:none
ta: 7:X
ta: 8:none
ta: 9:SELF
```

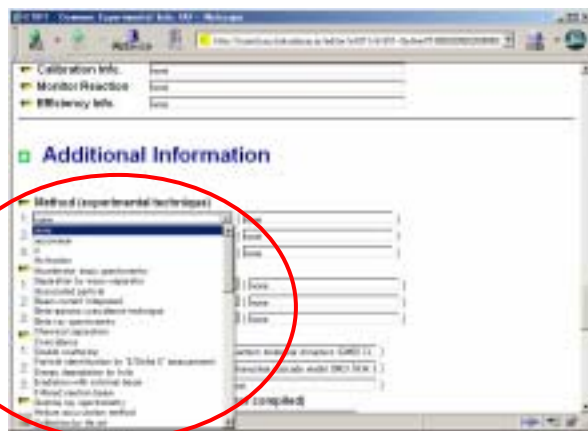
Code in meta files

Category	NRDF	EXFOR
A) Same	1USABNL	(= 1USABNL)
B) Different, but convertible	CYC SCT	(-> CYCLO) (-> SCIN)
C) Different, not convertible	FISSN-YLD TTY	PRE,FY ,PY,DA,TT/IPA
D) No dictionary in NRDF (or EXFOR)	SLD (Activation<-)	(-> Sol.target) ACTIV

(We must input codes without brackets to meta file.)

Advantages (I)

- Compilation without dictionary, manuals ...!



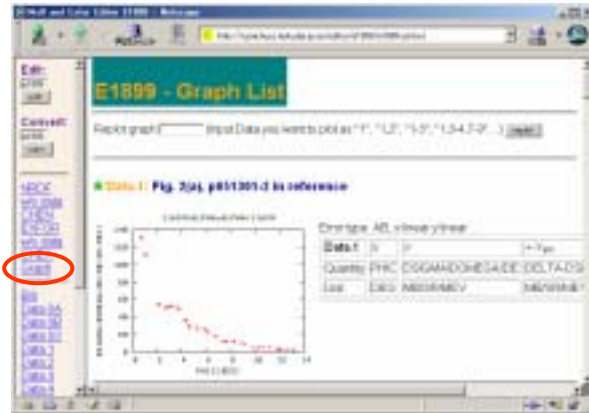
Advantages (II)

- Checking program runs automatically!



Advantages (III)

- Numerical data are visualized automatically!



Requirements

- Language: perl + javascript
- Software : Apache
gnuplot+chex (optional)
- Dictionary: NRDF
EXFOR TRANS
EXFOR DANIEL
(optional)



of input (new references)

1988: 33	1992: 29	1997: 0	2001: 0
1989: 17	1993: 26	1998: 31	2002: 75
1990: 8	1994: 0	1999: 9	2003: 73
1991: 19	1995: 6	2000: 12	2004: 43



Search and Plot System for EXFOR and JENDL, “SPES”

Takuma Suda
Masayuki Aikawa
(VBL, Hokkaido Univ.)
and
Naohiko Ohtsuka
(JAERI)

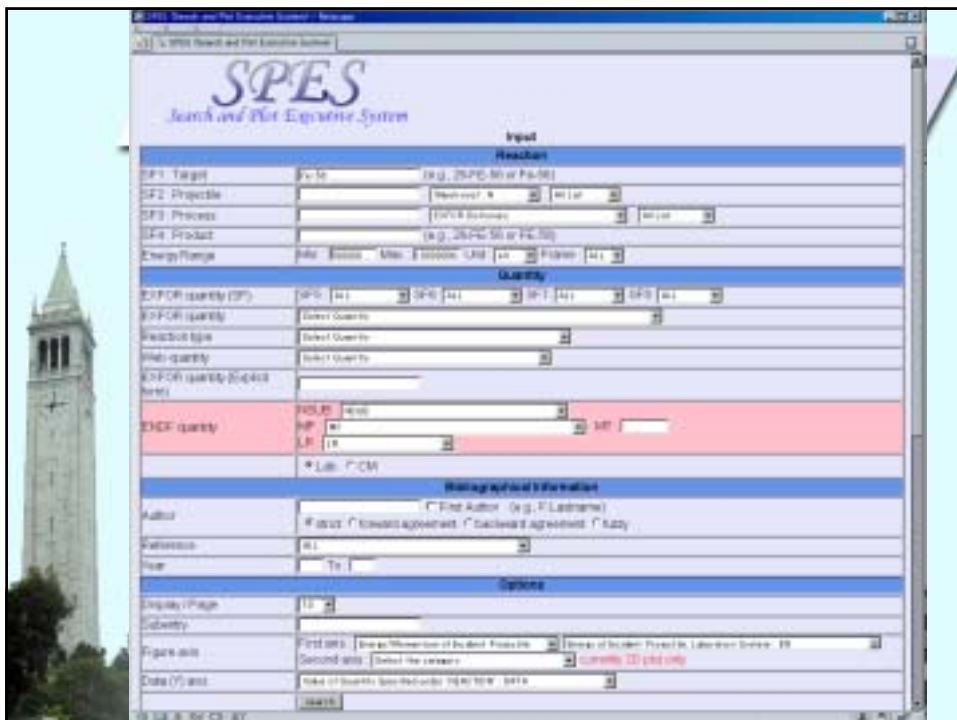
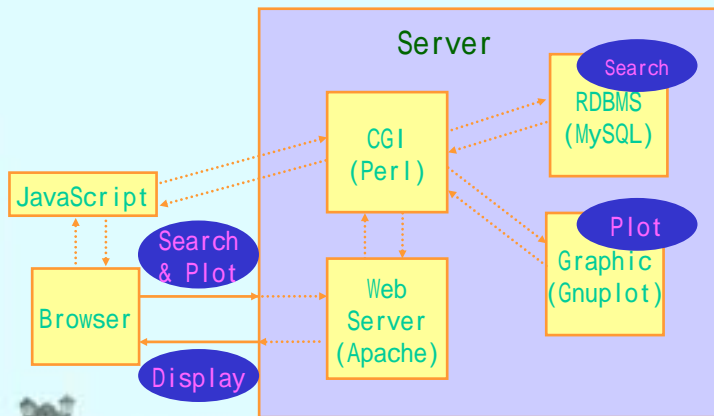


System

Functions

Prospects

System



Preparation for Search

- Semi-Automatic Transformation by using Perl Script
 1. EXFOR CSV
 - EXFOR files
 - Dictionary files(TRANS, Daniel Archive)
 2. CSV Table Records(MySQL)

EXFOR CSV(1)

EXFOR files(entry 1-9,A-)

```
TRANS      E000  20081219  100000000000
ENTRY      E1799  20081219  179900000001
SUBENT     E1799001 20081219  179900100001
BIB        E1799001 20081219  179900100002
TITLE      E1799001 20081219  179900100003
AUTHOR     E1799001 20081219  179900100004
INSTITUTE  E1799001 20081219  179900100005
INSTITUTE  E1799001 20081219  179900100006
INSTITUTE  E1799001 20081219  179900100007
INSTITUTE  E1799001 20081219  179900100008
INSTITUTE  E1799001 20081219  179900100009
INSTITUTE  E1799001 20081219  179900100010
INSTITUTE  E1799001 20081219  179900100011
INSTITUTE  E1799001 20081219  179900100012
INSTITUTE  E1799001 20081219  179900100013
INSTITUTE  E1799001 20081219  179900100014
```

Perl Script

SF1

EXFOR CSV(2)

Dictionary Files(TRANS, Daniel archive)

```

DICTION 24 200310 Data Headings 38008 24 1
***** 38008 24 2
+NOTE+ Characters and digits in Column 08 are used for 38008 24 3
computerized checking of the field sequence 38008 24 4
24.2 "ANG-NRM" "Angle at which ..... " "" "" 38008 24 5
"E-LVL-NRM" "Level Energy ..... " "" "" " When a partial 38008 24 6
ANG-NRM angle at which normalization was made 38008 24 7
E-LVL-NRM Level Energy Used for Normalization 38008 24 8
24.3 When a partial cross section is specified under 38008 24 9
"DATA" "Value of Quantity ..... " "" "" 38008 24 10
Energy of the outgoing gamma ray or particle group for 38008 24 11
normalization value when a partial cross section is 38008 24 12
specified under "MONITOR" 38008 24 13
36.1 Energy of First Outgoing Particle Used for Normalizati 38008 24 14
E-NRM Energy of First Outgoing Particle Used for Normalizati 38008 24 15
E-LVL-NRM Level Energy Used for Normalization 38008 24 16
E-ANG-NRM Incident Projectile Energy Used for Normalization 38008 24 17
EN-CE-NRM Inc.Proj. Energy (in c.m.) Used for Normalization 38008 24 18
EN-NRM Incident Projectile Energy Used for Normalization 38008 24 19
Used when a data set is normalized at one energy only. 38008 24 20
EN-NRM-MAX Upper Limit of Incident En. Range for Normalization 38008 24 21
EN-NRM-MIN Lower Limit of Incident En. Range for Normalization 38008 24 22
EN-NRM-MIN-MAX Incident Proj.En. for Normalization, see "MONITOR" 38008 24 23
EN-NRM-MIN-MAX-MIN Incident Proj.En. for Normalization, see "MONITOR" 38008 24 24
EN-NRM-MIN-MAX-MAX Incident Proj.En. for Normalization, see "MONITOR" 38008 24 25
  
```

Perl Script

CSV Table Records

24.2	dictionary24			
"ANG-NRM"	"Angle at which	" "" ""		
"E-LVL-NRM"	"Level Energy	" "" ""		
36.1	ANG-NRM	Angle at which normalization was made		
"(CUM),SIG", "B"	E-LVL-NRM	Level Energy Used for Normalization		
AUTHOR	"E1799001", "S"	"MICHIMASA"		
SF1	"E1799002", "12 MG 24"			
	10001001	R.W.	HOCKENBURY	
	10001001	Z.M.	BARTOLOME	

Perl Script

Display of List

- Access to MySQL server
 - The list of EXFOR and ENDF code is loaded from MySQL server.
 - List is automatically updated if MySQL records are changed.

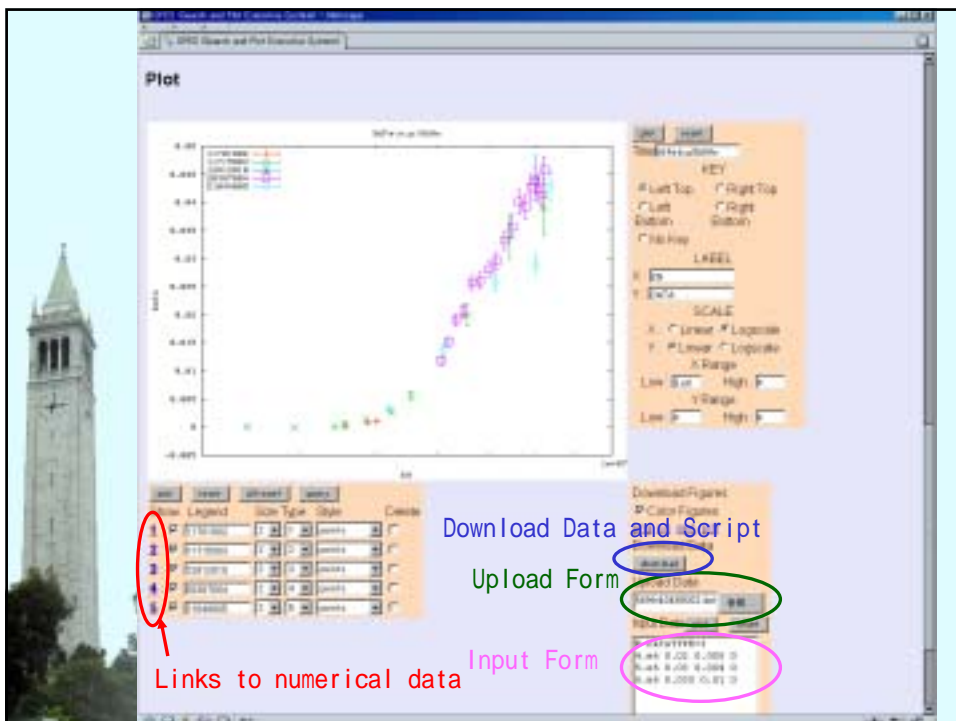
Retrieval Options

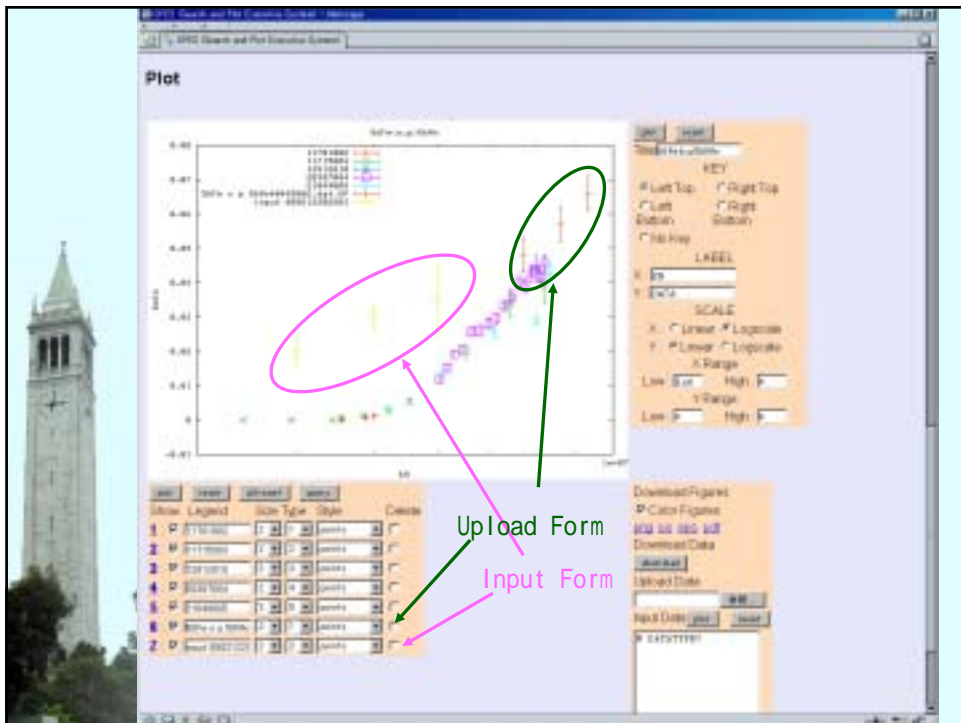
- Experimental Information
 - Target(SF1),Projectile(SF2),Process(SF3),Product(SF4),Energy of Projectile
- Physical Quantity
 - Individual SFs : SF5, SF6, SF7, SF8
 - Classification by Category (Based on Daniel Archive)
 - Direct input of EXFOR (e.g., POL/DA,,ANA)
- Bibliographical Information
 - Author, Journal, Publication year, ...
- Other options
 - subentry, Data Headings, Number of list to be displayed

↑
necessary for plot
(X-axis and Y-axis)

Retrieval

- Display of Result
 - subentry, reaction, first author, reference
 - ordered by reaction
 - Links to EXFOR files





Plot

- Using “Gnuplot”
 - Choice of Title, Name of Axes, Range of x and y, ...
- Access to Database
 - Adjustment of unit irrespective of individual dimensions used in EXFOR files
 - Links to numerical data
- File transfer via CGI
 - Input of numerical data by hand
 - Upload of numerical data
 - Download of figure by “png”, “ps”, “eps”, & “pdf” format
 - Download of data and plot script



Prospects

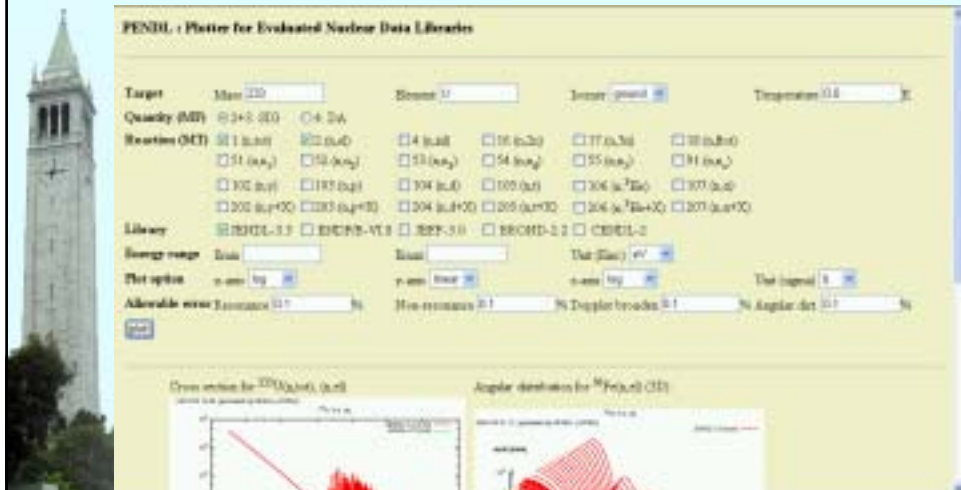


Future Developments

- Cross-Retrieval from various database; EXFOR and ...
 - JENDL, NRDF, ...
- Cross-Plotting of Evaluated and Experimental Data
- SPES will be completed in 2006.

PENDL

PENDL will be combined with SPES!



The image shows a screenshot of the PENDL software interface, titled "PENDL - Plotter for Evaluated Nuclear Data Libraries". On the left side of the interface, there is a vertical image of a tall, white stone tower with a green roof. The software interface includes several control panels:

- Target:** Mass Beam Isotope Temperature
- Quantity (dB):** 2+0 (dB) 4 (dB)
- Reaction (OCT):** A grid of checkboxes for reactions such as $^{230}\text{Au}(n,\alpha)^{229}\text{Au}$, $^{230}\text{Au}(n,p)^{229}\text{Au}$, $^{230}\text{Au}(n,d)^{229}\text{Au}$, $^{230}\text{Au}(n,t)^{228}\text{Au}$, $^{230}\text{Au}(n,^3\text{He})^{228}\text{Au}$, $^{230}\text{Au}(n,^4\text{He})^{227}\text{Au}$, $^{230}\text{Au}(n,^6\text{Li})^{226}\text{Au}$, $^{230}\text{Au}(n,^7\text{Li})^{225}\text{Au}$, $^{230}\text{Au}(n,^9\text{Be})^{224}\text{Au}$, $^{230}\text{Au}(n,^{10}\text{B})^{223}\text{Au}$, $^{230}\text{Au}(n,^{11}\text{B})^{222}\text{Au}$, $^{230}\text{Au}(n,^{12}\text{C})^{221}\text{Au}$, $^{230}\text{Au}(n,^{13}\text{C})^{220}\text{Au}$, $^{230}\text{Au}(n,^{14}\text{N})^{219}\text{Au}$, $^{230}\text{Au}(n,^{15}\text{N})^{218}\text{Au}$, $^{230}\text{Au}(n,^{16}\text{O})^{217}\text{Au}$, $^{230}\text{Au}(n,^{17}\text{O})^{216}\text{Au}$, $^{230}\text{Au}(n,^{18}\text{O})^{215}\text{Au}$, $^{230}\text{Au}(n,^{19}\text{F})^{214}\text{Au}$, $^{230}\text{Au}(n,^{20}\text{Ne})^{213}\text{Au}$, $^{230}\text{Au}(n,^{21}\text{Ne})^{212}\text{Au}$, $^{230}\text{Au}(n,^{22}\text{Ne})^{211}\text{Au}$, $^{230}\text{Au}(n,^{23}\text{Ne})^{210}\text{Au}$, $^{230}\text{Au}(n,^{24}\text{Mg})^{209}\text{Au}$, $^{230}\text{Au}(n,^{25}\text{Mg})^{208}\text{Au}$, $^{230}\text{Au}(n,^{26}\text{Mg})^{207}\text{Au}$, $^{230}\text{Au}(n,^{27}\text{Al})^{206}\text{Au}$, $^{230}\text{Au}(n,^{28}\text{Si})^{205}\text{Au}$, $^{230}\text{Au}(n,^{29}\text{Si})^{204}\text{Au}$, $^{230}\text{Au}(n,^{30}\text{Si})^{203}\text{Au}$, $^{230}\text{Au}(n,^{31}\text{Si})^{202}\text{Au}$, $^{230}\text{Au}(n,^{32}\text{S})^{201}\text{Au}$, $^{230}\text{Au}(n,^{33}\text{S})^{200}\text{Au}$, $^{230}\text{Au}(n,^{34}\text{S})^{199}\text{Au}$, $^{230}\text{Au}(n,^{35}\text{S})^{198}\text{Au}$, $^{230}\text{Au}(n,^{36}\text{S})^{197}\text{Au}$, $^{230}\text{Au}(n,^{37}\text{Cl})^{196}\text{Au}$, $^{230}\text{Au}(n,^{38}\text{Cl})^{195}\text{Au}$, $^{230}\text{Au}(n,^{39}\text{Cl})^{194}\text{Au}$, $^{230}\text{Au}(n,^{40}\text{Ar})^{193}\text{Au}$, $^{230}\text{Au}(n,^{41}\text{Ar})^{192}\text{Au}$, $^{230}\text{Au}(n,^{42}\text{Ar})^{191}\text{Au}$, $^{230}\text{Au}(n,^{43}\text{Ar})^{190}\text{Au}$, $^{230}\text{Au}(n,^{44}\text{K})^{189}\text{Au}$, $^{230}\text{Au}(n,^{45}\text{K})^{188}\text{Au}$, $^{230}\text{Au}(n,^{46}\text{K})^{187}\text{Au}$, $^{230}\text{Au}(n,^{47}\text{Ca})^{186}\text{Au}$, $^{230}\text{Au}(n,^{48}\text{Ca})^{185}\text{Au}$, $^{230}\text{Au}(n,^{49}\text{Ca})^{184}\text{Au}$, $^{230}\text{Au}(n,^{50}\text{Ca})^{183}\text{Au}$, $^{230}\text{Au}(n,^{51}\text{Sc})^{182}\text{Au}$, $^{230}\text{Au}(n,^{52}\text{Sc})^{181}\text{Au}$, $^{230}\text{Au}(n,^{53}\text{Sc})^{180}\text{Au}$, $^{230}\text{Au}(n,^{54}\text{Ti})^{179}\text{Au}$, $^{230}\text{Au}(n,^{55}\text{Ti})^{178}\text{Au}$, $^{230}\text{Au}(n,^{56}\text{Ti})^{177}\text{Au}$, $^{230}\text{Au}(n,^{57}\text{Ti})^{176}\text{Au}$, $^{230}\text{Au}(n,^{58}\text{Ti})^{175}\text{Au}$, $^{230}\text{Au}(n,^{59}\text{V})^{174}\text{Au}$, $^{230}\text{Au}(n,^{60}\text{V})^{173}\text{Au}$, $^{230}\text{Au}(n,^{61}\text{V})^{172}\text{Au}$, $^{230}\text{Au}(n,^{62}\text{V})^{171}\text{Au}$, $^{230}\text{Au}(n,^{63}\text{Cr})^{170}\text{Au}$, $^{230}\text{Au}(n,^{64}\text{Cr})^{169}\text{Au}$, $^{230}\text{Au}(n,^{65}\text{Cr})^{168}\text{Au}$, $^{230}\text{Au}(n,^{66}\text{Cr})^{167}\text{Au}$, $^{230}\text{Au}(n,^{67}\text{Cr})^{166}\text{Au}$, $^{230}\text{Au}(n,^{68}\text{Mn})^{165}\text{Au}$, $^{230}\text{Au}(n,^{69}\text{Mn})^{164}\text{Au}$, $^{230}\text{Au}(n,^{70}\text{Mn})^{163}\text{Au}$, $^{230}\text{Au}(n,^{71}\text{Mn})^{162}\text{Au}$, $^{230}\text{Au}(n,^{72}\text{Fe})^{161}\text{Au}$, $^{230}\text{Au}(n,^{73}\text{Fe})^{160}\text{Au}$, $^{230}\text{Au}(n,^{74}\text{Fe})^{159}\text{Au}$, $^{230}\text{Au}(n,^{75}\text{Fe})^{158}\text{Au}$, $^{230}\text{Au}(n,^{76}\text{Fe})^{157}\text{Au}$, $^{230}\text{Au}(n,^{77}\text{Co})^{156}\text{Au}$, $^{230}\text{Au}(n,^{78}\text{Co})^{155}\text{Au}$, $^{230}\text{Au}(n,^{79}\text{Co})^{154}\text{Au}$, $^{230}\text{Au}(n,^{80}\text{Co})^{153}\text{Au}$, $^{230}\text{Au}(n,^{81}\text{Ni})^{152}\text{Au}$, $^{230}\text{Au}(n,^{82}\text{Ni})^{151}\text{Au}$, $^{230}\text{Au}(n,^{83}\text{Ni})^{150}\text{Au}$, $^{230}\text{Au}(n,^{84}\text{Ni})^{149}\text{Au}$, $^{230}\text{Au}(n,^{85}\text{Cu})^{148}\text{Au}$, $^{230}\text{Au}(n,^{86}\text{Cu})^{147}\text{Au}$, $^{230}\text{Au}(n,^{87}\text{Cu})^{146}\text{Au}$, $^{230}\text{Au}(n,^{88}\text{Zn})^{145}\text{Au}$, $^{230}\text{Au}(n,^{89}\text{Zn})^{144}\text{Au}$, $^{230}\text{Au}(n,^{90}\text{Zn})^{143}\text{Au}$, $^{230}\text{Au}(n,^{91}\text{Ga})^{142}\text{Au}$, $^{230}\text{Au}(n,^{92}\text{Ga})^{141}\text{Au}$, $^{230}\text{Au}(n,^{93}\text{Ga})^{140}\text{Au}$, $^{230}\text{Au}(n,^{94}\text{Ge})^{139}\text{Au}$, $^{230}\text{Au}(n,^{95}\text{Ge})^{138}\text{Au}$, $^{230}\text{Au}(n,^{96}\text{Ge})^{137}\text{Au}$, $^{230}\text{Au}(n,^{97}\text{As})^{136}\text{Au}$, $^{230}\text{Au}(n,^{98}\text{As})^{135}\text{Au}$, $^{230}\text{Au}(n,^{99}\text{As})^{134}\text{Au}$, $^{230}\text{Au}(n,^{100}\text{Se})^{133}\text{Au}$, $^{230}\text{Au}(n,^{101}\text{Se})^{132}\text{Au}$, $^{230}\text{Au}(n,^{102}\text{Se})^{131}\text{Au}$, $^{230}\text{Au}(n,^{103}\text{Br})^{130}\text{Au}$, $^{230}\text{Au}(n,^{104}\text{Br})^{129}\text{Au}$, $^{230}\text{Au}(n,^{105}\text{Br})^{128}\text{Au}$, $^{230}\text{Au}(n,^{106}\text{Kr})^{127}\text{Au}$, $^{230}\text{Au}(n,^{107}\text{Kr})^{126}\text{Au}$, $^{230}\text{Au}(n,^{108}\text{Kr})^{125}\text{Au}$, $^{230}\text{Au}(n,^{109}\text{Tl})^{124}\text{Au}$, $^{230}\text{Au}(n,^{110}\text{Tl})^{123}\text{Au}$, $^{230}\text{Au}(n,^{111}\text{Tl})^{122}\text{Au}$, $^{230}\text{Au}(n,^{112}\text{Pb})^{121}\text{Au}$, $^{230}\text{Au}(n,^{113}\text{Pb})^{120}\text{Au}$, $^{230}\text{Au}(n,^{114}\text{Pb})^{119}\text{Au}$, $^{230}\text{Au}(n,^{115}\text{Bi})^{118}\text{Au}$, $^{230}\text{Au}(n,^{116}\text{Bi})^{117}\text{Au}$, $^{230}\text{Au}(n,^{117}\text{Po})^{116}\text{Au}$, $^{230}\text{Au}(n,^{118}\text{Po})^{115}\text{Au}$, $^{230}\text{Au}(n,^{119}\text{At})^{114}\text{Au}$, $^{230}\text{Au}(n,^{120}\text{At})^{113}\text{Au}$, $^{230}\text{Au}(n,^{121}\text{Rn})^{112}\text{Au}$, $^{230}\text{Au}(n,^{122}\text{Rn})^{111}\text{Au}$, $^{230}\text{Au}(n,^{123}\text{Ac})^{110}\text{Au}$, $^{230}\text{Au}(n,^{124}\text{Ac})^{109}\text{Au}$, $^{230}\text{Au}(n,^{125}\text{Th})^{108}\text{Au}$, $^{230}\text{Au}(n,^{126}\text{Th})^{107}\text{Au}$, $^{230}\text{Au}(n,^{127}\text{Pa})^{106}\text{Au}$, $^{230}\text{Au}(n,^{128}\text{Pa})^{105}\text{Au}$, $^{230}\text{Au}(n,^{129}\text{U})^{104}\text{Au}$, $^{230}\text{Au}(n,^{130}\text{U})^{103}\text{Au}$, $^{230}\text{Au}(n,^{131}\text{Np})^{102}\text{Au}$, $^{230}\text{Au}(n,^{132}\text{Np})^{101}\text{Au}$, $^{230}\text{Au}(n,^{133}\text{Pu})^{100}\text{Au}$, $^{230}\text{Au}(n,^{134}\text{Pu})^{99}\text{Au}$, $^{230}\text{Au}(n,^{135}\text{Am})^{98}\text{Au}$, $^{230}\text{Au}(n,^{136}\text{Am})^{97}\text{Au}$, $^{230}\text{Au}(n,^{137}\text{Cm})^{96}\text{Au}$, $^{230}\text{Au}(n,^{138}\text{Cm})^{95}\text{Au}$, $^{230}\text{Au}(n,^{139}\text{Bk})^{94}\text{Au}$, $^{230}\text{Au}(n,^{140}\text{Bk})^{93}\text{Au}$, $^{230}\text{Au}(n,^{141}\text{Cf})^{92}\text{Au}$, $^{230}\text{Au}(n,^{142}\text{Cf})^{91}\text{Au}$, $^{230}\text{Au}(n,^{143}\text{Es})^{90}\text{Au}$, $^{230}\text{Au}(n,^{144}\text{Es})^{89}\text{Au}$, $^{230}\text{Au}(n,^{145}\text{Fm})^{88}\text{Au}$, $^{230}\text{Au}(n,^{146}\text{Fm})^{87}\text{Au}$, $^{230}\text{Au}(n,^{147}\text{Md})^{86}\text{Au}$, $^{230}\text{Au}(n,^{148}\text{Md})^{85}\text{Au}$, $^{230}\text{Au}(n,^{149}\text{No})^{84}\text{Au}$, $^{230}\text{Au}(n,^{150}\text{No})^{83}\text{Au}$, $^{230}\text{Au}(n,^{151}\text{Lr})^{82}\text{Au}$, $^{230}\text{Au}(n,^{152}\text{Lr})^{81}\text{Au}$, $^{230}\text{Au}(n,^{153}\text{Rf})^{80}\text{Au}$, $^{230}\text{Au}(n,^{154}\text{Rf})^{79}\text{Au}$, $^{230}\text{Au}(n,^{155}\text{Ta})^{78}\text{Au}$, $^{230}\text{Au}(n,^{156}\text{Ta})^{77}\text{Au}$, $^{230}\text{Au}(n,^{157}\text{W})^{76}\text{Au}$, $^{230}\text{Au}(n,^{158}\text{W})^{75}\text{Au}$, $^{230}\text{Au}(n,^{159}\text{Re})^{74}\text{Au}$, $^{230}\text{Au}(n,^{160}\text{Re})^{73}\text{Au}$, $^{230}\text{Au}(n,^{161}\text{Os})^{72}\text{Au}$, $^{230}\text{Au}(n,^{162}\text{Os})^{71}\text{Au}$, $^{230}\text{Au}(n,^{163}\text{Ir})^{70}\text{Au}$, $^{230}\text{Au}(n,^{164}\text{Ir})^{69}\text{Au}$, $^{230}\text{Au}(n,^{165}\text{Pt})^{68}\text{Au}$, $^{230}\text{Au}(n,^{166}\text{Pt})^{67}\text{Au}$, $^{230}\text{Au}(n,^{167}\text{Au})^{66}\text{Au}$, $^{230}\text{Au}(n,^{168}\text{Au})^{65}\text{Au}$, $^{230}\text{Au}(n,^{169}\text{Hg})^{64}\text{Au}$, $^{230}\text{Au}(n,^{170}\text{Hg})^{63}\text{Au}$, $^{230}\text{Au}(n,^{171}\text{Tl})^{62}\text{Au}$, $^{230}\text{Au}(n,^{172}\text{Tl})^{61}\text{Au}$, $^{230}\text{Au}(n,^{173}\text{Pb})^{60}\text{Au}$, $^{230}\text{Au}(n,^{174}\text{Pb})^{59}\text{Au}$, $^{230}\text{Au}(n,^{175}\text{Bi})^{58}\text{Au}$, $^{230}\text{Au}(n,^{176}\text{Bi})^{57}\text{Au}$, $^{230}\text{Au}(n,^{177}\text{Po})^{56}\text{Au}$, $^{230}\text{Au}(n,^{178}\text{Po})^{55}\text{Au}$, $^{230}\text{Au}(n,^{179}\text{At})^{54}\text{Au}$, $^{230}\text{Au}(n,^{180}\text{At})^{53}\text{Au}$, $^{230}\text{Au}(n,^{181}\text{Rn})^{52}\text{Au}$, $^{230}\text{Au}(n,^{182}\text{Rn})^{51}\text{Au}$, $^{230}\text{Au}(n,^{183}\text{Ac})^{50}\text{Au}$, $^{230}\text{Au}(n,^{184}\text{Ac})^{49}\text{Au}$, $^{230}\text{Au}(n,^{185}\text{Th})^{48}\text{Au}$, $^{230}\text{Au}(n,^{186}\text{Th})^{47}\text{Au}$, $^{230}\text{Au}(n,^{187}\text{Pa})^{46}\text{Au}$, $^{230}\text{Au}(n,^{188}\text{Pa})^{45}\text{Au}$, $^{230}\text{Au}(n,^{189}\text{U})^{44}\text{Au}$, $^{230}\text{Au}(n,^{190}\text{U})^{43}\text{Au}$, $^{230}\text{Au}(n,^{191}\text{Np})^{42}\text{Au}$, $^{230}\text{Au}(n,^{192}\text{Np})^{41}\text{Au}$, $^{230}\text{Au}(n,^{193}\text{Pu})^{40}\text{Au}$, $^{230}\text{Au}(n,^{194}\text{Pu})^{39}\text{Au}$, $^{230}\text{Au}(n,^{195}\text{Am})^{38}\text{Au}$, $^{230}\text{Au}(n,^{196}\text{Am})^{37}\text{Au}$, $^{230}\text{Au}(n,^{197}\text{Cm})^{36}\text{Au}$, $^{230}\text{Au}(n,^{198}\text{Cm})^{35}\text{Au}$, $^{230}\text{Au}(n,^{199}\text{Bk})^{34}\text{Au}$, $^{230}\text{Au}(n,^{200}\text{Bk})^{33}\text{Au}$, $^{230}\text{Au}(n,^{201}\text{Cf})^{32}\text{Au}$, $^{230}\text{Au}(n,^{202}\text{Cf})^{31}\text{Au}$, $^{230}\text{Au}(n,^{203}\text{Es})^{30}\text{Au}$, $^{230}\text{Au}(n,^{204}\text{Es})^{29}\text{Au}$, $^{230}\text{Au}(n,^{205}\text{Fm})^{28}\text{Au}$, $^{230}\text{Au}(n,^{206}\text{Fm})^{27}\text{Au}$, $^{230}\text{Au}(n,^{207}\text{Md})^{26}\text{Au}$, $^{230}\text{Au}(n,^{208}\text{Md})^{25}\text{Au}$, $^{230}\text{Au}(n,^{209}\text{No})^{24}\text{Au}$, $^{230}\text{Au}(n,^{210}\text{No})^{23}\text{Au}$, $^{230}\text{Au}(n,^{211}\text{Lr})^{22}\text{Au}$, $^{230}\text{Au}(n,^{212}\text{Lr})^{21}\text{Au}$, $^{230}\text{Au}(n,^{213}\text{Rf})^{20}\text{Au}$, $^{230}\text{Au}(n,^{214}\text{Rf})^{19}\text{Au}$, $^{230}\text{Au}(n,^{215}\text{Ta})^{18}\text{Au}$, $^{230}\text{Au}(n,^{216}\text{Ta})^{17}\text{Au}$, $^{230}\text{Au}(n,^{217}\text{W})^{16}\text{Au}$, $^{230}\text{Au}(n,^{218}\text{W})^{15}\text{Au}$, $^{230}\text{Au}(n,^{219}\text{Re})^{14}\text{Au}$, $^{230}\text{Au}(n,^{220}\text{Re})^{13}\text{Au}$, $^{230}\text{Au}(n,^{221}\text{Os})^{12}\text{Au}$, $^{230}\text{Au}(n,^{222}\text{Os})^{11}\text{Au}$, $^{230}\text{Au}(n,^{223}\text{Ir})^{10}\text{Au}$, $^{230}\text{Au}(n,^{224}\text{Ir})^{9}\text{Au}$, $^{230}\text{Au}(n,^{225}\text{Pt})^{8}\text{Au}$, $^{230}\text{Au}(n,^{226}\text{Pt})^{7}\text{Au}$, $^{230}\text{Au}(n,^{227}\text{Au})^{6}\text{Au}$, $^{230}\text{Au}(n,^{228}\text{Au})^{5}\text{Au}$, $^{230}\text{Au}(n,^{229}\text{Hg})^{4}\text{Au}$, $^{230}\text{Au}(n,^{230}\text{Hg})^{3}\text{Au}$, $^{230}\text{Au}(n,^{231}\text{Tl})^{2}\text{Au}$, $^{230}\text{Au}(n,^{232}\text{Tl})^{1}\text{Au}$.
- Library:** ENDF-6.0 ENDF-6.0-V1.0 ENDF-6.0 ENDF-6.0 ENDF-6.0 ENDF-6.0
- Energy range:** Min Max Unit (eV)
- Plot option:** none log none none none none none
- Allowable error:** 1% 5% 10% 20% 50% 100% 200% 500% 1000%

At the bottom, there are two plots:

- Cross section for $^{230}\text{Au}(n,\alpha)^{229}\text{Au}$ (dB)**: A plot showing the cross section in dB versus energy in eV. The y-axis ranges from 0 to 100, and the x-axis ranges from 0 to 10000. A red line shows the cross section, which starts at approximately 100 dB at 0 eV and decreases as energy increases, reaching about 10 dB at 10000 eV.
- Angular distribution for $^{230}\text{Au}(n,\alpha)^{229}\text{Au}$ (dB)**: A plot showing the angular distribution in dB versus energy in eV. The y-axis ranges from 0 to 100, and the x-axis ranges from 0 to 10000. A red shaded area represents the angular distribution, which is centered around 0 degrees and becomes wider and more irregular as energy increases.

GSYS

Development and usage of a software to read-in and digitize the graphical data

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³ Nuclear Data Center, Japan Atomic Energy Research Institute (JAERI)

⁴ KBMJ, Inc. Engineer

- A quarter of the amount of the data kept in NRDF(Nuclear Reaction Data File) is obtained by digitizing the graphical data.
- It is necessary to use a good system which can be operated easily by anyone and read-in the numerical data precisely.



GSYS

(Graphical data digitizing system
developed by Dr. K. Arai)

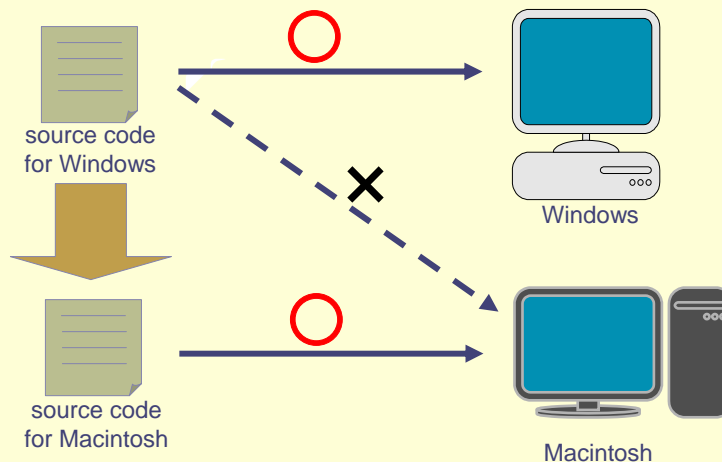
Features of GSYS

- OS-independent software
- Users can operate using mouse and keyboard
- Anyone can digitize the graphical data easily and precisely.

“GSYS” is the **Java** application software with advanced GUI (Graphical User Interface) toolkit, **AWT** (Abstract Window Toolkit).

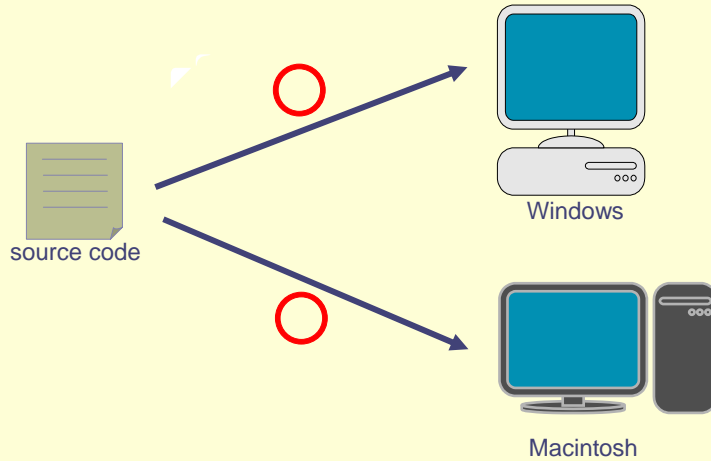
Features of Java

- traditional programming language



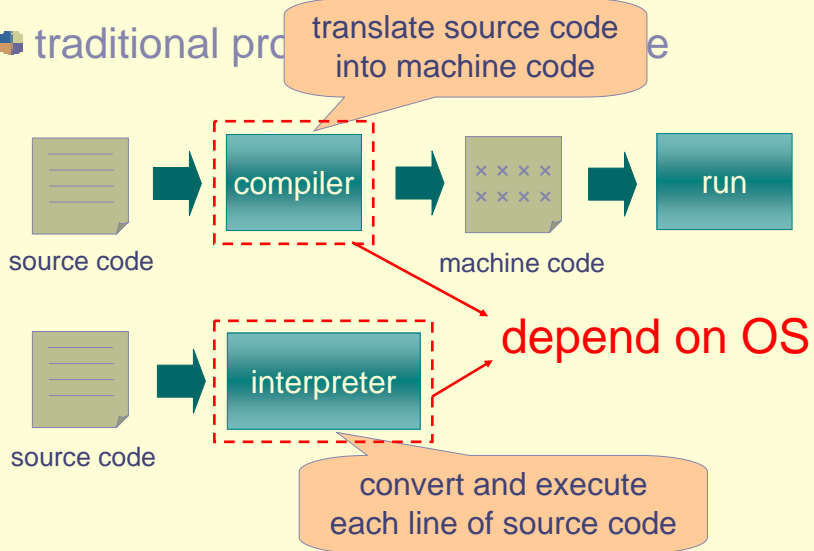
Features of Java

Java programming language



Features of Java

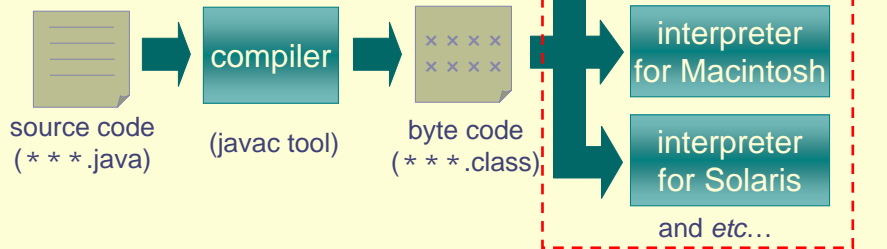
traditional programming language



Features of Java

Java programming language

Write Once,
Run Anywhere.



Java system

source code
(*.java)

byte code
(*.class)

Java2 SDK
(Java2 Software Development Kit)

compiler · debugger

Java API(class library)

JVM

For Windows, Solaris and Linux,
Java2 SDK and JRE are available
from java.sun.com.
(Sun Microsystems web site)

For Macintosh, Mac OS X includes
the full version of Java 2 SDK.
For the Classic Mac OS, SDK and
JRE are available from
developer.apple.com/java.

JRE
(Java Runtime Environment)

Operating System

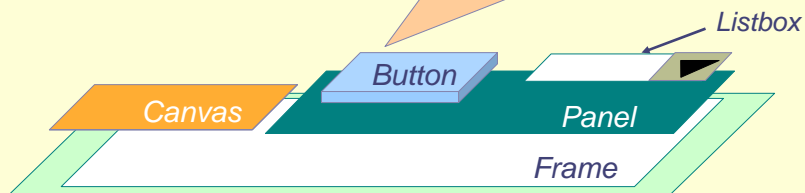
Features of AWT

- AWT is OS-independent GUI toolkit for Java.
- AWT is designed to provide a common set of GUI design tools that work on various OSs.

GUI programming by AWT

- Components: Anything that can be put onto user interface including components like windows, buttons, check boxes, dialog boxes, lists, menus, scrolls.
- Container: A component that can contain other components. Standalone windows.

Some components can handle the event (like key press and mouse click).



Main frame of GSYS (Windows2000)

control panel (Button tool)

information panel (Textfield tool)

main panel (Canvas tool)

GSYS running on two different OSs

Windows 2000

Vine Linux 3.0

How to use GSYS

- Install Java system.
- Download GSYS class files.
- Prepare image files.
(PNG or GIF or JPEG files)
- Input the command “ java Gsys ”.

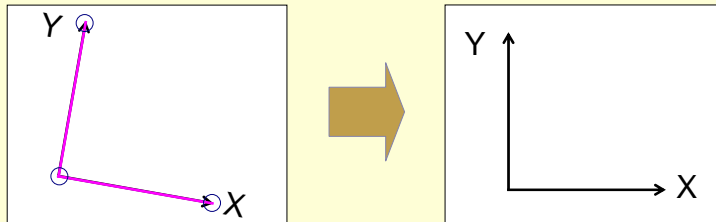
Keys and Buttons

<i>Button</i>	<i>Key</i>	<i>Button</i>	<i>Key</i>
+F (zoom in a loaded picture)		Rem (remove the data)	Esc
-F (zoom out a loaded picture)		Data (call data output window)	O
R.F (restore default picture size)	R	X err(sy) (symmetric X error bars)	F1
Ad (add the data)	A	X err(asy) (asymmetric X error bars)	F2
Ma (mark the data)	M	Y err(sy) (symmetric Y error bars)	F3
Mo (move the data)	V	Y err(asy) (asymmetric Y error bars)	F4

Future issues

- Adopt the new marker
cross (\times) or asterisk ($*$)

- Image skew correction



Future issues

- Load the data file and plot the data points as markers on an image to compare the data points in the data files with those on an image visually.

Future issues

• AWT Swing

- Swing is the new GUI toolkit for Java
- By using Look and Feel plug-in provided by Swing, a GUI designed on one OS would look similar when it is displayed on another OS.