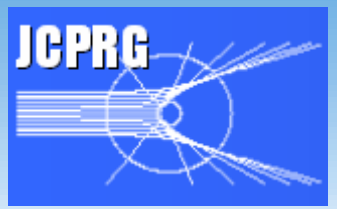


JCPRG

Asian Network for Nuclear Reaction Database

OTUKA Naohiko (大塚直彦) for *JCPRG*

Nuclear Reaction Data Centre, Hokkaido University (JCPRG)

Nuclear Data Center, Japan Atomic Energy Agency (JAEA-NDC)

http://www.jcprg.org/ ohtsuka@nucl.sci.hokudai.ac.jp

JCPRG?

Japan Charged-Particle Nuclear Reaction Data Group (*JCPRG*)

日本荷電粒子核反応数据中心

(1974.4~ founded by H. Tanaka)

Hokkaido University Nuclear Reaction Data Centre (*JCPRG*)

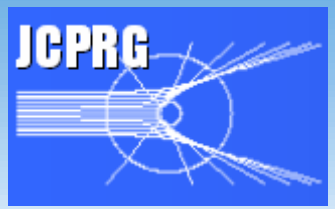
北海道大学大学院理学研究院附属原子核反応数据研究開発中心

(2007.4~, Head: K. Katō)

- R&D contraction for nuclear data with RIKEN Nishina Center
- Collaborative nuclear data education with JAEA Nuclear Data Center

Contents

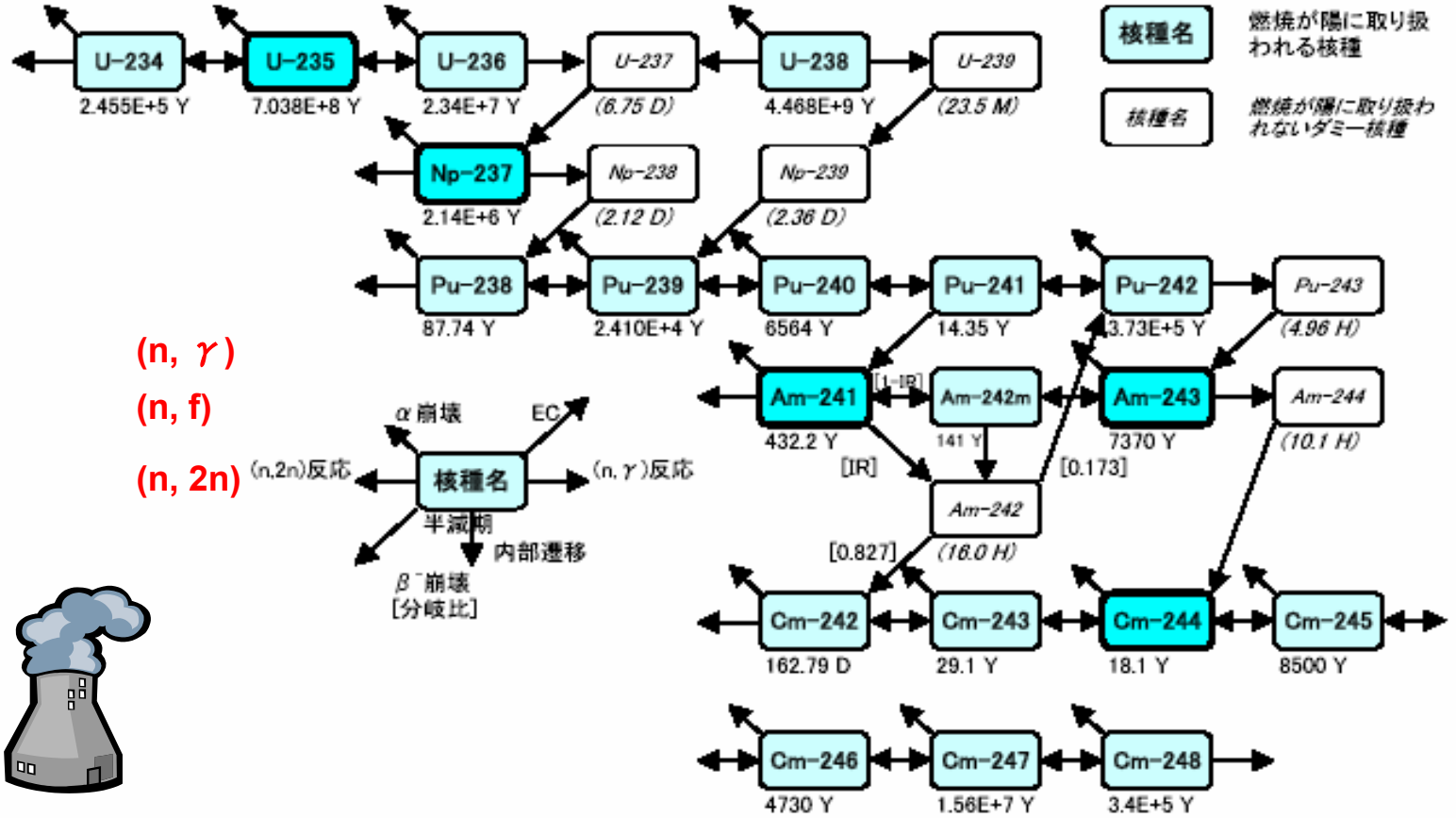
- Data compilation for nuclear science and technology
- Nuclear reaction database activity in the world
- Current Status of Data Compilation in Asia
- Asian Network for Nuclear Reaction Database



JCPRG

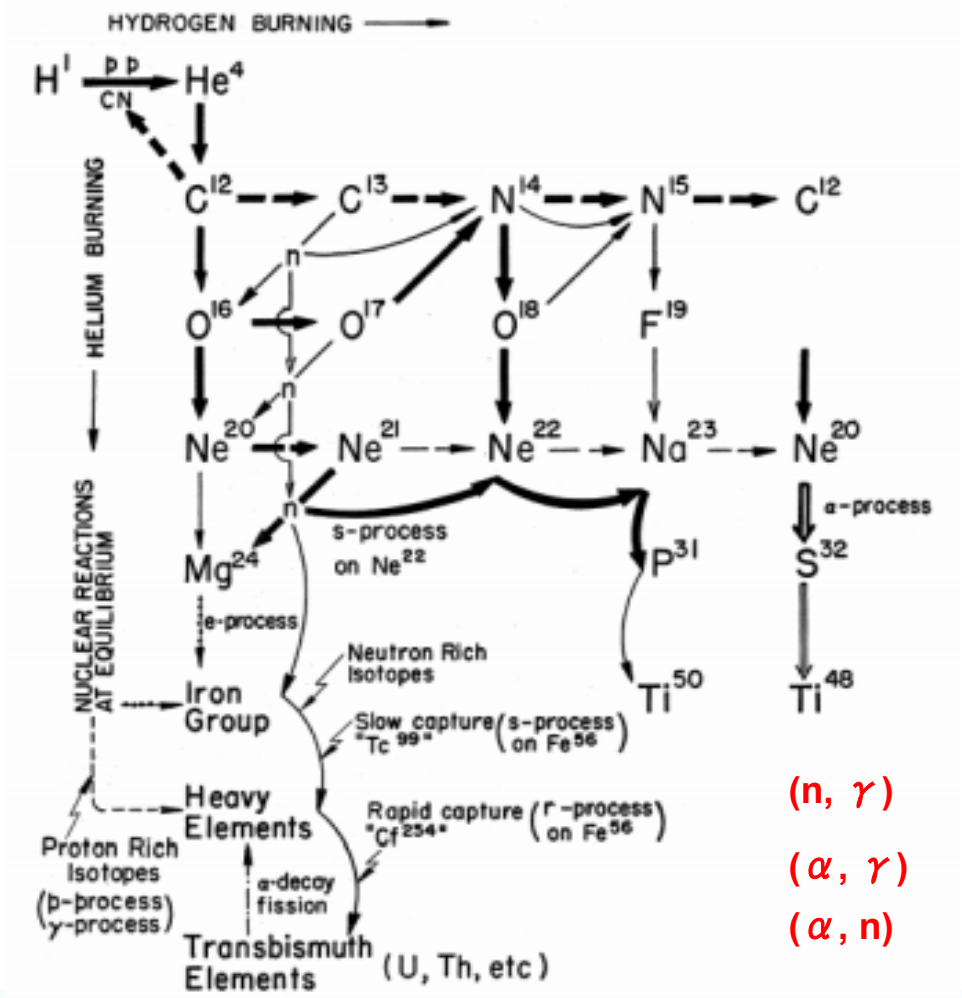
1. Data Compilation for Nuclear Science and Technology

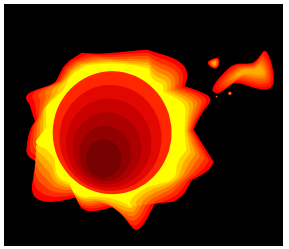
Burning Chain in Reactor Physics



Burning chain in fast breeder reactor *JOYO* - Sugino (2007), private communication

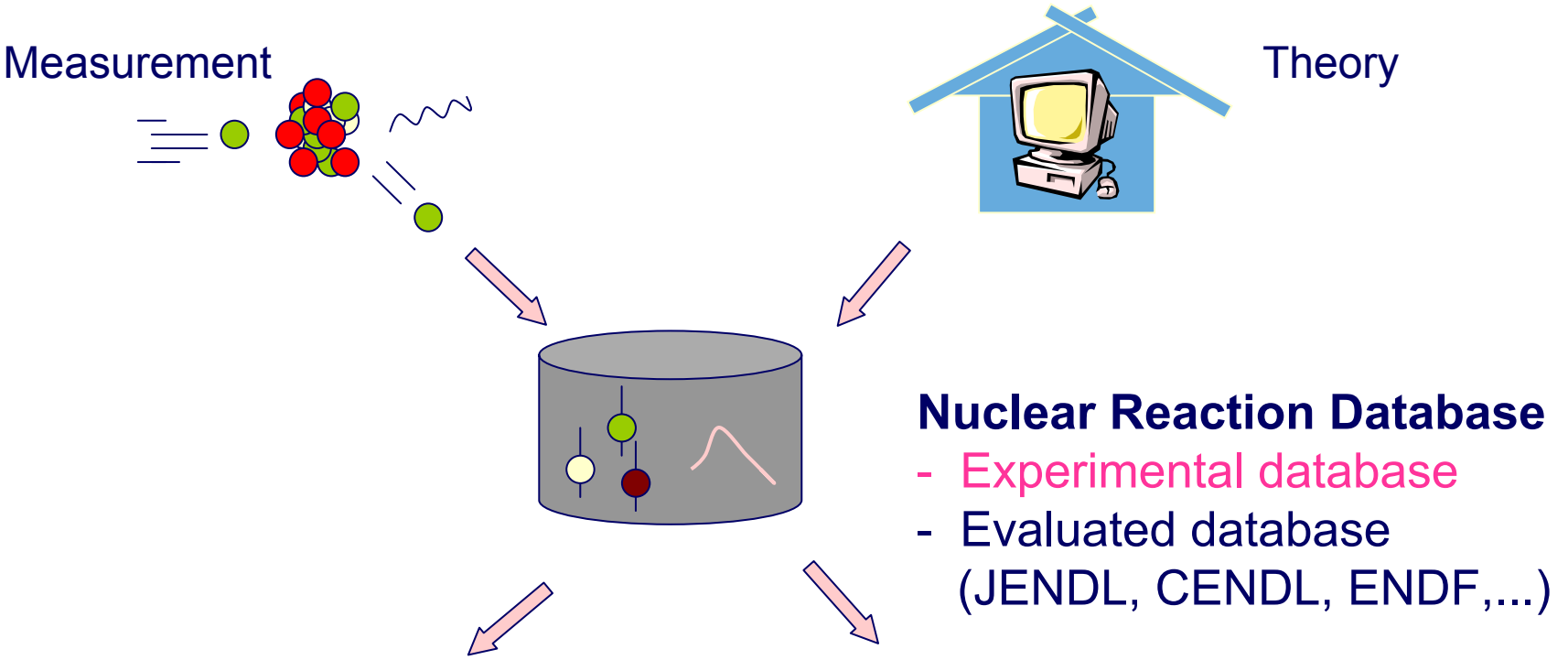
Burning Chain in Astronuclearphysics





Schematic diagram of nuclear process in stars - E. M. Burbidge et al., (B^2FH) Rev.Mod.Phys.29(1957)

Data Storage for Future Needs

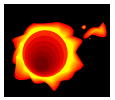


Nuclear Reaction Database
- Experimental database
- Evaluated database (JENDL, CENDL, ENDF,...)

Science:
Nuclear physics
Astrophysics,
etc...

Technology:
Nuclear energy,
Nuclear medicine,
etc...

Nuclear Reaction Database is utilized in ...



Science

- Astronuclear physics
- Nuclear physics

Technology

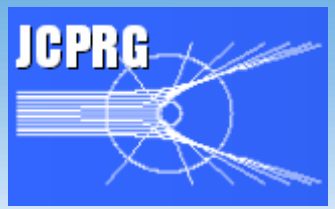
- Nuclear energy (fission, fusion, ADS)
- Medical isotope production (diagnosis, therapy)
- Shielding
- Ion-beam material analysis

- etc.

Common resource in science and technology!

Scope of Nuclear Reaction Database

- Cross section
- Angular differential cross section (dσ/dΩ)
- Energy differential cross section (dσ/dE)
- Double differential cross section (dσ/dΩ/dE)
- Triple, Quadruple,...
- Polarization (Analyzing power, polarization transfer)
- Fission fragment yield
- Thick target yield
- Resonance parameter
- Resonance integral
- Prompt gamma spectrum
- …



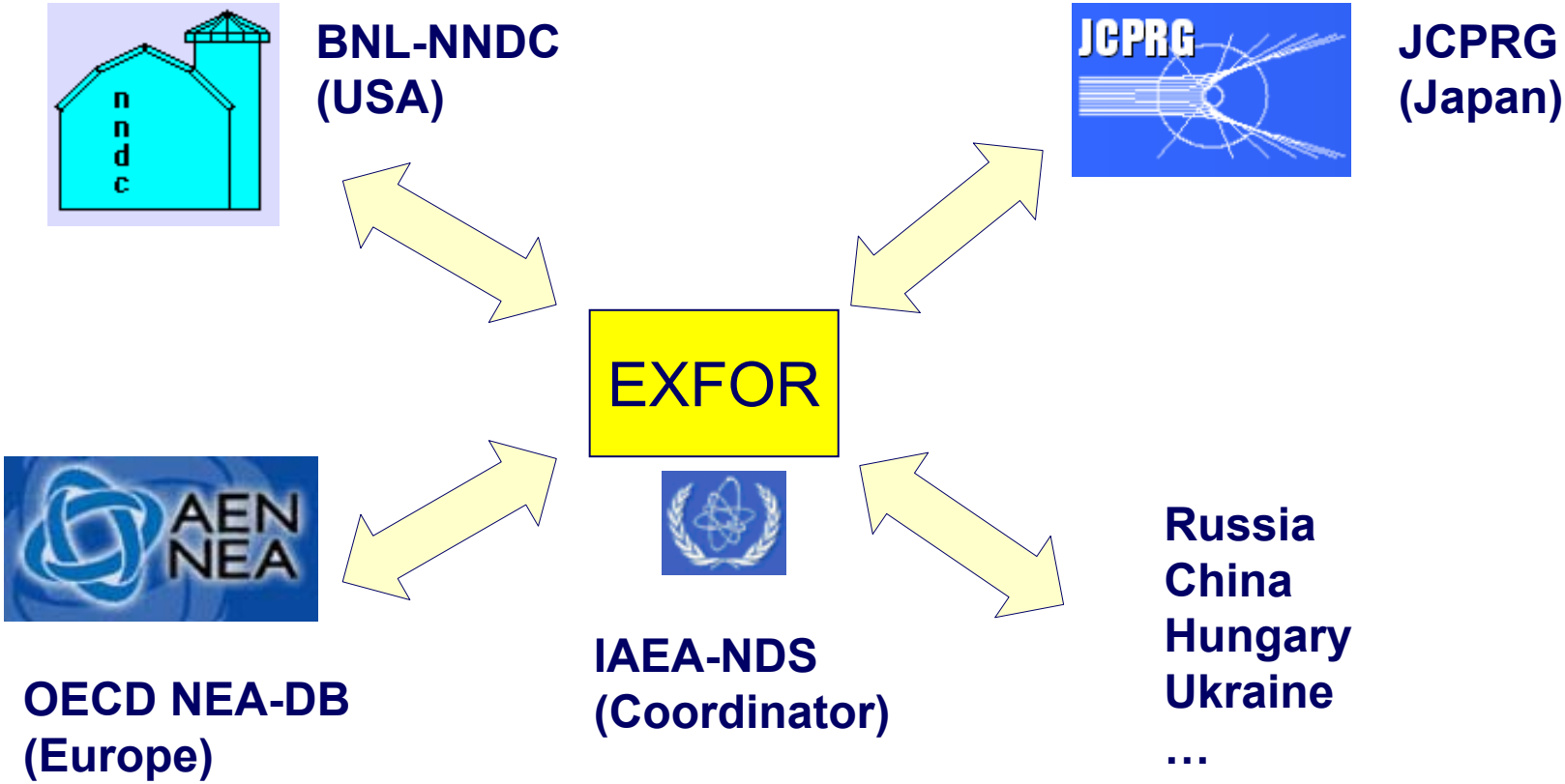
JCPRG

2. Nuclear Reaction Database Activity in the World

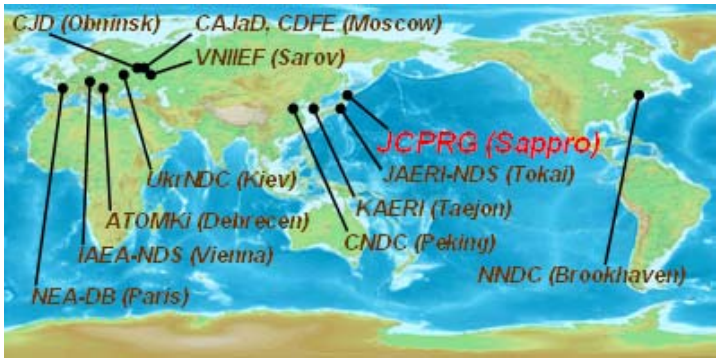
International Experimental Data Exchange

EXFOR:

EXchange FORmat for nuclear reaction data



Nuclear Reaction Data Centre Network (NRDC)



Coordinated by IAEA-NDS
(Nuclear Data Section)

- **NNDC**
- **NEA-DB**
- **IAEA-NDS**
- **CJD, CAJaD, CDFE, CNPD**
- **ATOMKI**
- **UkrNDC**
- **JCPRG (JAEA-NDC)**
- **CNDC**
- **Indian (planned)**
- **(KAERI-NDEL)**

Asian Centres

- Centres are responsible for data compilation of their area.
- JCPRG and IAEA-NDS also check data files from the world. (format, physics)

Short History of NRDC

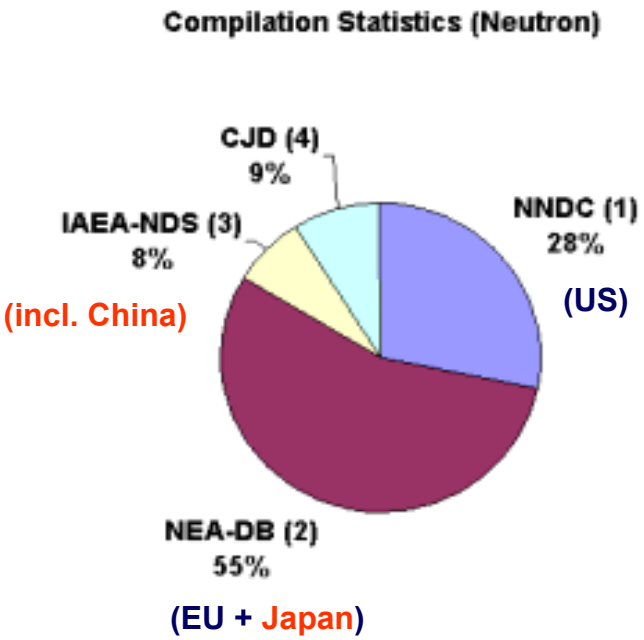
- 1964 NNDC (US), CCDN (Saclay), IAEA (Vienna), CJD (Obninsk) start exchange of experimental neutron data (4 Centres Network)
- 1975 JCPRG (Sapporo) joined into the network of charged-particle induced data compilation
- 1977 Neutron centre network and charged-particle network were merged to form NRDC (Nuclear Reaction Data Centre) Network
- 1985 CNDC (Beijing) joined into NRDC

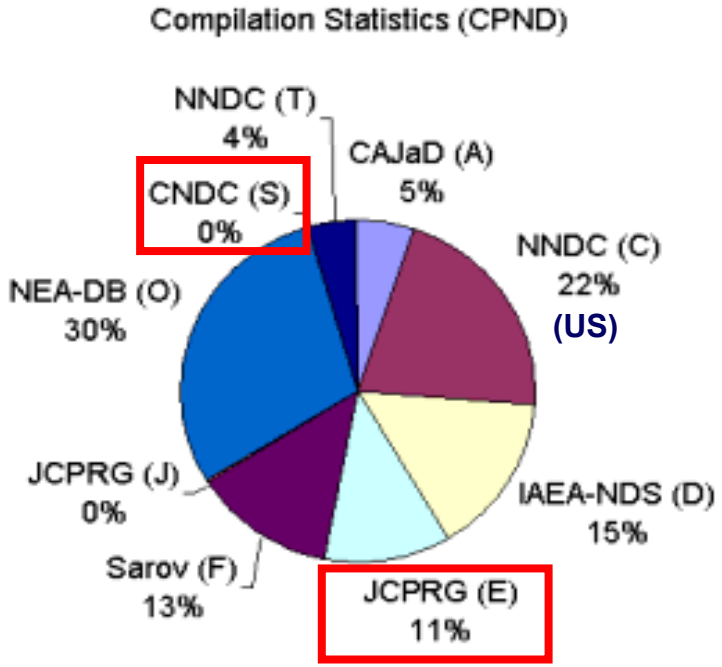
Responsible Area and Data Type

Data Centre	Area of facility, Incident particle
ATOMKI	Debrecen, Brussels, Jülich (CP=*C*harged *P*article)
CAJaD	Former Soviet Union (CP)
CDFE	World (γ)
CJD	Former Soviet Union (n)
CNDC	China (n, CP)
CNPD	World (Light charged particle)
JCPRG	Japan (CP, γ)
NEA-DB	OECD countries (n, CP)
NNDC	USA + Canada (n, CP, γ)
UkrNDC	Ukraine (n, CP, γ)
IAEA-NDS	"Rest of the World" (n, CP)

Compilation Statistics (EXFOR, 2003-2006)

Neutron induced reaction data (1050 works)





Charged-particle induced reaction data (3000 works, of which 10% is from JCPRG)

Photo-nuclear data (138 works)

How many publications of experimental reaction data are in China??

Example of EXFOR entry

PHYSICAL REVIEW C 71, 014604 (2005)

Quasielastic scattering of ^{6}He on ^{9}Be at 25 MeV/nucleon

Y. L. Ye,[1,*] D. Y. Pang,[1] D. X. Jiang,[1] T. Zheng,[1] Q. J. Wang,[1] Z. H. Li,[1] X. Q. Li,[1] Y. C. Ge,[1] C. Wu,[1] G. L. Zhang,[1] Q. Y. Hu,[1] J. Wang,[1] Z. Q. Chen,[1] A. Ozawa,[2,†] Y. Yamaguchi,[2] R. Kanungo,[2] and I. Tanihata[2,‡]
[1]*School of Physics and MOE Key Laboratory of Heavy Ion Physics, Peking University, Beijing, China*
[2]*RIKEN, 2-1 Hirosawa, Wako, Saitama 351-0198, Japan*
(Received 14 August 2004; published 13 January 2005)

```
SUBENT        E1931002   20061122                                E193100200001
BIB                 4         13                                E193100200002
REACTION  1(4-BE-9(2-HE-6,EL)4-BE-9,,DA)                        E193100200003
           Quasielastic scattering (Elastic + Little influence of E193100200004
           5/2- state at 2.43 MeV and7/2- state at 6.76 MeV)    E193100200005
          2(4-BE-9(2-HE-6,EL)4-BE-9,,DA,,RTH)                   E193100200006
           Quasielastic scattering (Elastic + Little influence of E193100200007
           5/2- state at 2.43 MeV and7/2- state at 6.76 MeV)    E193100200008
EN-SEC     ANG-CM is polar angle between beam and 6He in center E193100200009
           of mass system                                       E193100200010
ERR-ANALYS (ERR-S) Statistical uncertainty                      E193100200011
STATUS     (TABLE) Data (Fig.7, p014604-5 in reference for      E193100200012
                   Rutherford ratio, not shown for absolute cross E193100200013
                   section) received from Y.L.Ye by e-mail      E193100200014
                   (2005.05.07)                                 E193100200015
ENDBIB              13         0                                 E193100200016
NOCOMMON             0         0                                 E193100200017
DATA                 5        10                                 E193100200018
ANG-CM     ANG-RSL    DATA-CM   1ERR-S     1DATA-CM   2         E193100200019
ADEG       ADEG       MB/SR      MB/SR      NO-DIM              E193100200020
  2.500E+00  2.500E+00  2.550E+05  6.940E+04  2.190E+00         E193100200021
  5.000E+00  2.500E+00  2.650E+04  5.120E+03  7.560E+00         E193100200022
  7.500E+00  2.500E+00  3.150E+03  7.800E+02  5.120E+00         E193100200023
  1.000E+01  2.500E+00  1.160E+03  1.690E+02  6.180E+00         E193100200024
  1.250E+01  2.500E+00  2.650E+02  1.080E+02  3.510E+00         E193100200025
  1.370E+01  4.570E+00  2.170E+02  1.080E+01  3.920E+00         E193100200026
  2.070E+01  8.180E+00  6.890E+01  4.640E+00  6.120E+00         E193100200027
  2.640E+01  4.560E+00  2.820E+01  5.090E-01  7.350E+00         E193100200028
  3.320E+01  7.850E+00  1.230E+01  2.350E-01  7.650E+00         E193100200029
  4.970E+01  7.760E+00  1.790E+00  5.280E-02  5.330E+00         E193100200030
ENDDATA            12         0                                 E193100200031
ENDSUBENT          30         0                                 E193100299999
```

Access to EXFOR from Users

JCPRG

IAEA-NDS

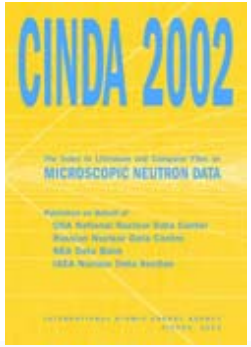
NNDC

NEA-DB

80,000~90,000 searches / year

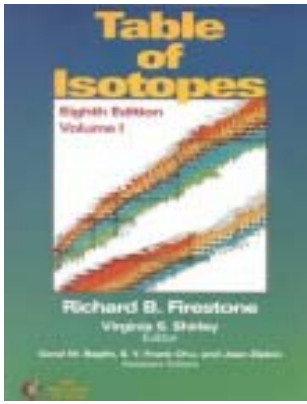
CD and Book are also available.

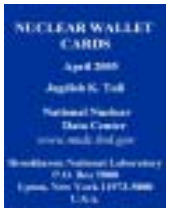
(CINDA: A Bibliographical data base for nuclear reaction works)

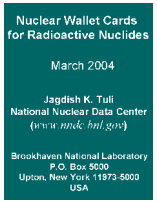


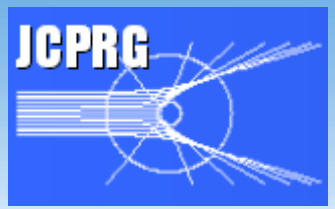
International Network of Nuclear Structure and Decay Data Evaluators (NSDD)

- NNDC ORNL LBNL INEL TUNL ANL
- IIT
- St. Petersburg
- Utrecht
- China *A*=195~198
- CEN
- Japan *A*=118~129
- Lund
- Kuwait
- Gent
- Ontario





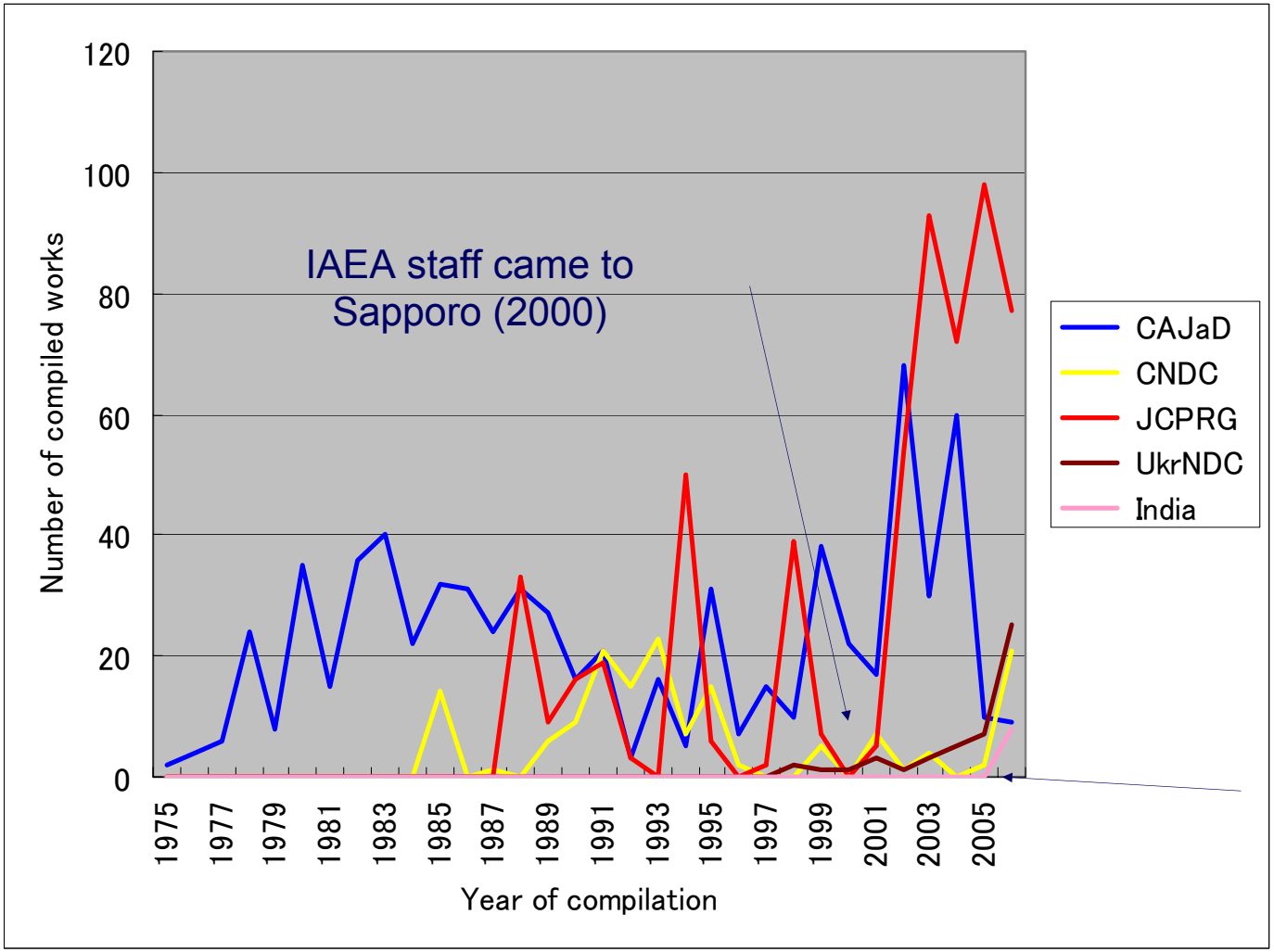




JCPRG

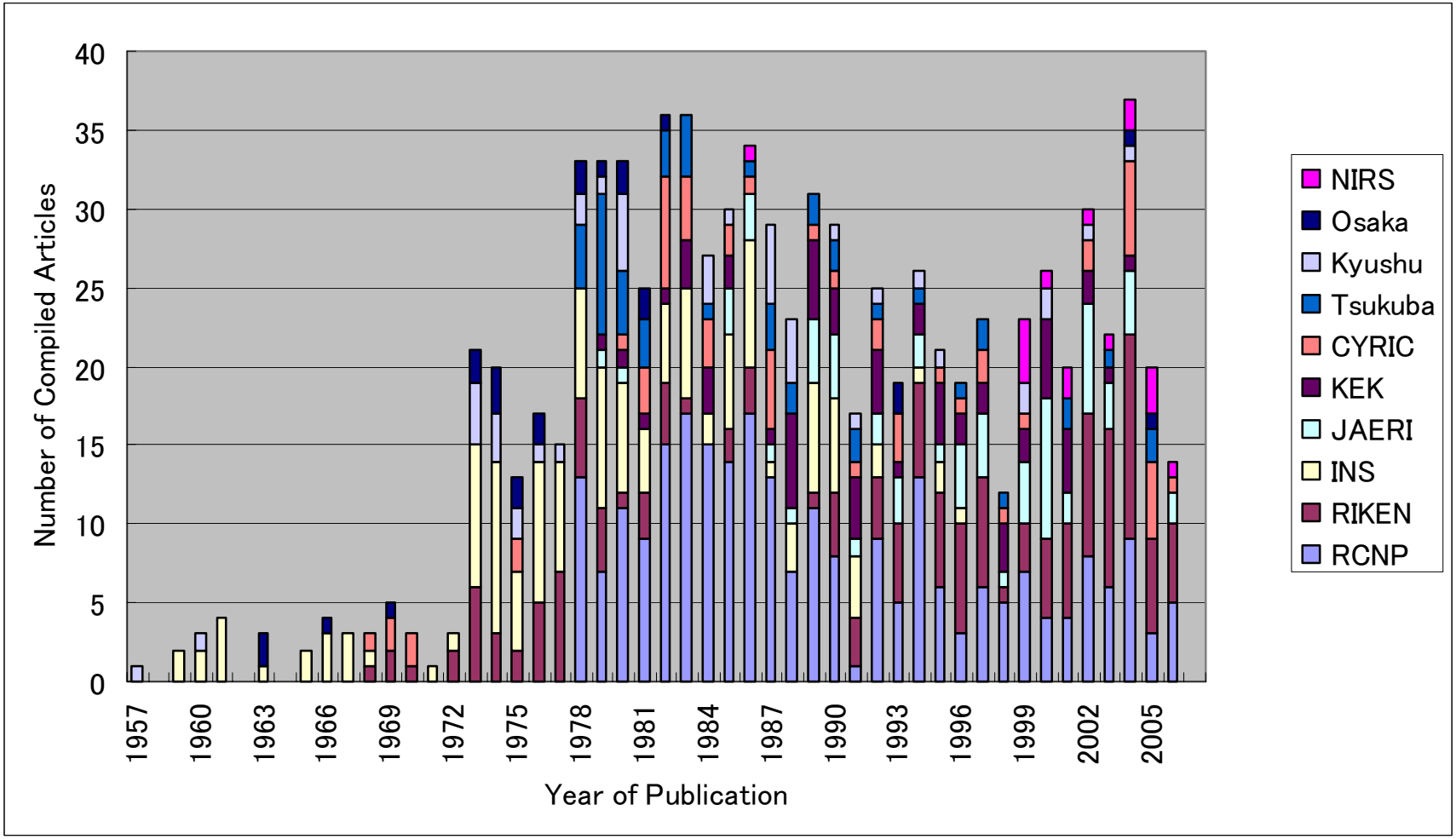
3. Status of Data Compilation in Asia

Statistics (Regional CPND Centres)



IAEA staff came to Beijing and Mumbai (Sept. 2006)

Compilation Statics (Japan, CPND)



Data Compilation in China

- *Huangshan Mountains Meeting* (May 1985)

  - IAE-CP (CPND Group at CIAE) held a working meeting about compilation in EXFOR at Huangshan Mountains.

  - 15 works were transmitted to the World batch via IAEA (The first batch from China

  - Now probably Chinese experts of data compilation are retired...

15 CPND compilations from China (in 1985)

01 Li Zhichang+	Yuanzineng Kexue Jishu 3(1977)229
02 Liang Qichang+	Yuanzineng Kexue Jishu 1(1977)10
03 Mao Zhenlin+	Conf. on Low Energy Nucl. Phys.3(1972)
04 Yuan Rongfang+	Chin. J. Nucl. Phys. 3(1981)155
05 Jiang Chenglie+	Conf. on Low Energy Nucl. Phys.3(1972)
06 Sun Hancheng+	Yuanzineng Kexue Jishu 3(1984)329
07 Yan Chen+	Chin. J. Nucl. Phys. 2(1980)137
08 Sun Hancheng+	Yuanzineng Kexue Jishu 2(1981)185
09 Ma Weiyi+	Chin. J. Nucl. Phys. 2(1980)239
10 Shen Wenqen+	High Energ.Phys.Nucl.Phys.1(1977)70
11 Tao Zhenlan+	Canadian Nucl Technol.45(1987)
12 X.Long+	NST-001 (1985)
13 Long Xianguan+	NST-003 (1989)
14 Tao Zhenlan+	Chin. J. Nucl. Phys. 3(1981)242
15 Tao Zhenlan+	Yuanzineng Kexue Jishu 5(1983)506

(Yuanzineng Kexue Jishu=Atomic Energy Science and Technology)

Many articles written in Chinese

Chinese Journals Selected by CNDC

Coverage of Chinese journals by CNDC *(added at 2006 NRDC meeting)*

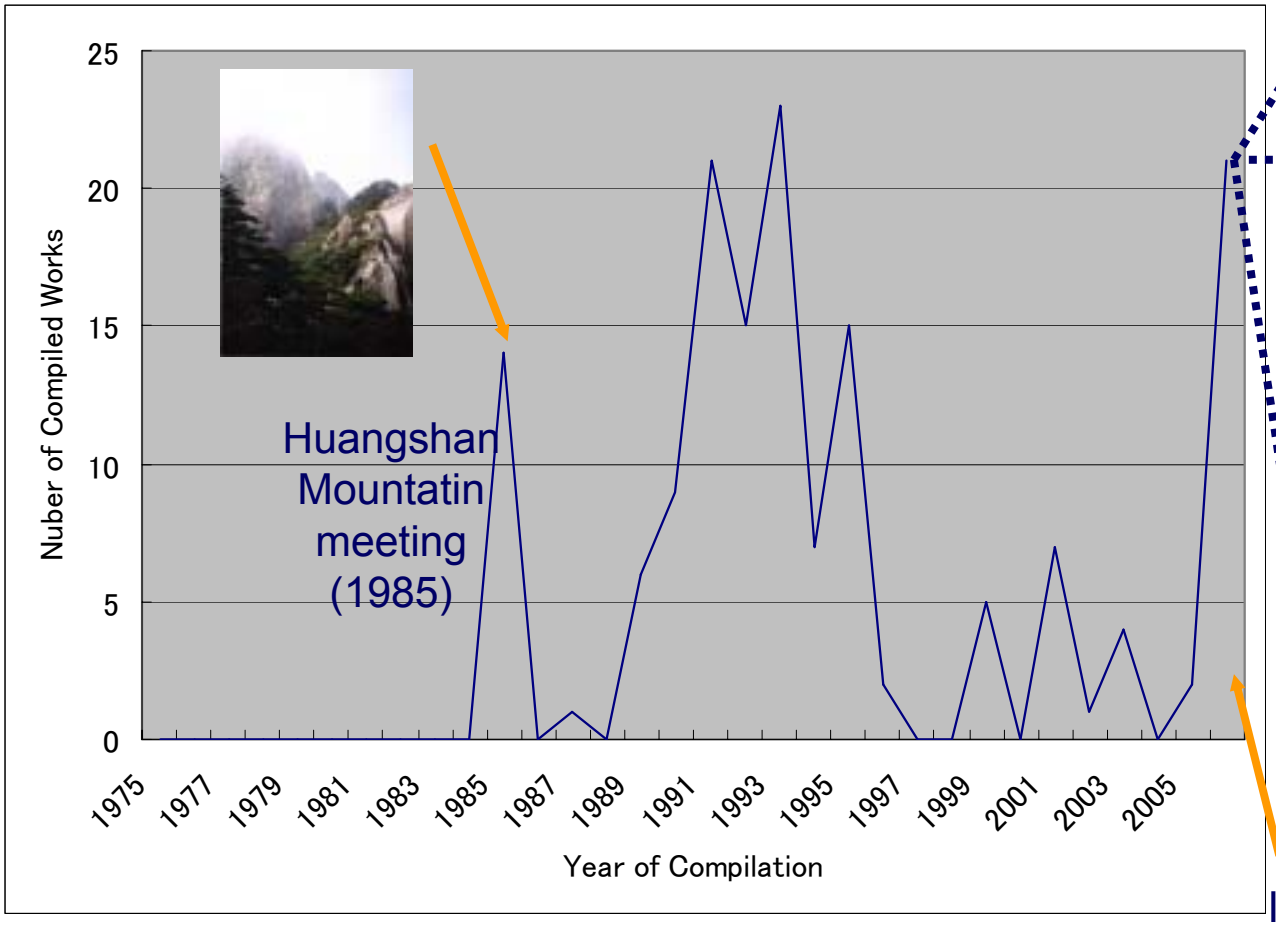
CNDC agreed to cover the following Chinese journals on a regular basis, and to compile all relevant papers in EXFOR:

Dictionary 5 code	Journal title	Language
CST	Atomic Energy Science and Technology	Chinese
NPR (to be added)	Nuclear Physics Review	Chinese
PHE	High Energy Physics and Nuclear Physics	Chinese
HFH	Journal of Nuclear and Radiochemistry	Chinese
NTC	Nuclear Techniques	Chinese
CPL	Chinese Physics Letters	English
CNDP	Communication of Nuclear Data Progress	English
CNST	Nuclear Science and Techniques	English
ASI	Acta Physica Sinica	English
CPH	Chinese Physics	English

5 journals are *in Chinese* (not in English)

→Difficult to compile and circulate by IAEA-NDS for member countries.
Only Chinese researchers can do it!

Data Compilation in China (Cont'd)



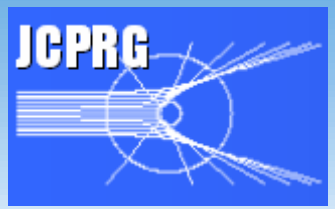
Other Asian Countries

- **India**

  - Indian compilation activity was recently formed.
  - Compiler workshop was held at Bhabha Atomic Research Center. (2006 and 2007. Lecturers are from IAEA-NDS.)
  - About 40 scientists were attended.
  - They are interested in compilation of Indian heavy-ion data.

- **Korea**

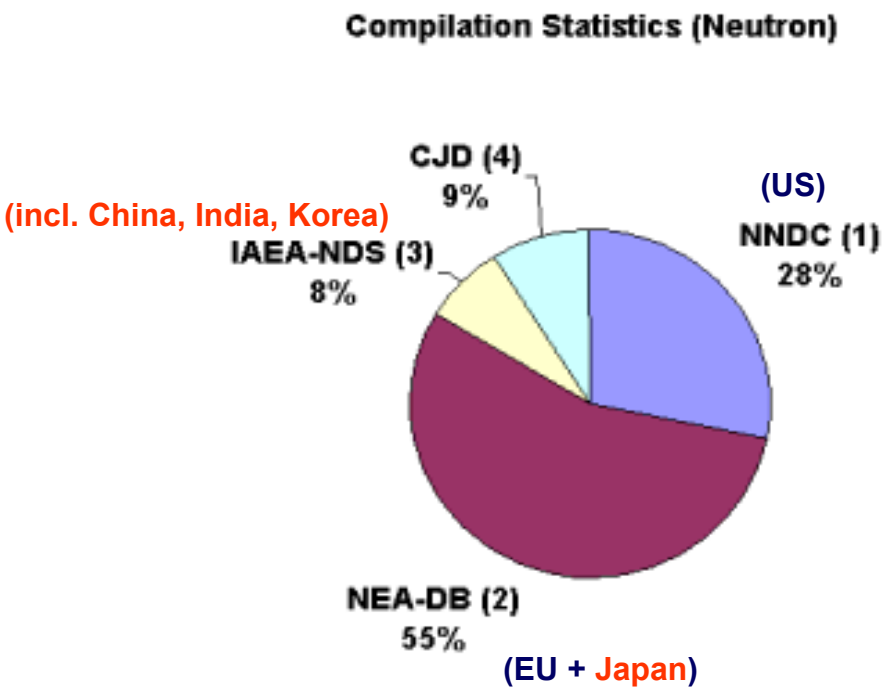
  - There are some facilities in Korea:
    Electron linac (65 MeV, Pohang), Van de Graaf (KIGAM),
    AVF cyclotron (45 MeV proton, KNU), Tandem VdG (Seoul)
  - J. Kor. Nucl. Soc. and J. Kor. Phys. Soc. are scanned by IAEA.
  - There is *no* compilation activity in Korea.

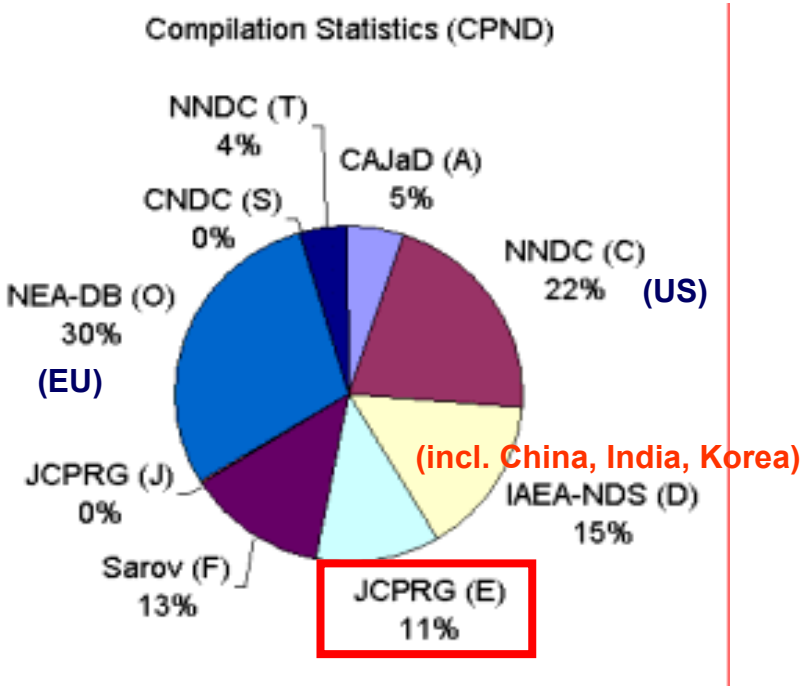


JCPRG

4. Asian Network for Nuclear Reaction Database

Tri-polar Structure of Data Production (US, Europe, Asia)





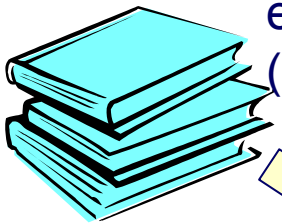
- USA → National Nuclear Data Center (NNDC)
- Europe → OECD NEA Data Bank (NEA-DB)
- Asia → ??

Collaboration in Asian Countries for Nuclear Reaction Database

- Compilation of data from their own countries with assistance from JCPRG.
- Training and/or workshop of compilation.
- JCPRG and IAEA-NDS can offer compilers software for data compilation (free of charge)

What Should Data Compilers Do?

Input of bibliography and
experimental condition
(~1 week after publication)

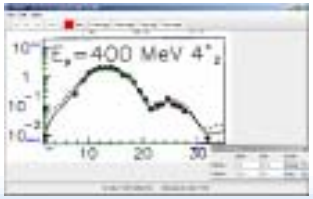


Data Compiler
with EXFOR editors

Numerical data
from Experimenters

- Checking
- Author proof

Release
(~6 months
after
publication)



Digitization if data is not available
(old data, silent authors…)

Relation between Insitute and Data Centre (Example: RCNP/JCPRG)

RCNP-Z-678
2007. 6. 8

1.Experiment

This is the call for new proposals as well as updated proposals for experiments at the RCNP Cyclotron Facility. They may be

...

Spokespersons are requested to send the numerical data to the Japan Charged-Particle Reaction Data Group (JCPRG) in order to add them to the data base after completing their experiments.
URL of JCPRG is http://www.jcprg.org/.

The next B-PAC meeting will be held on August 6 (Monday), 2007.

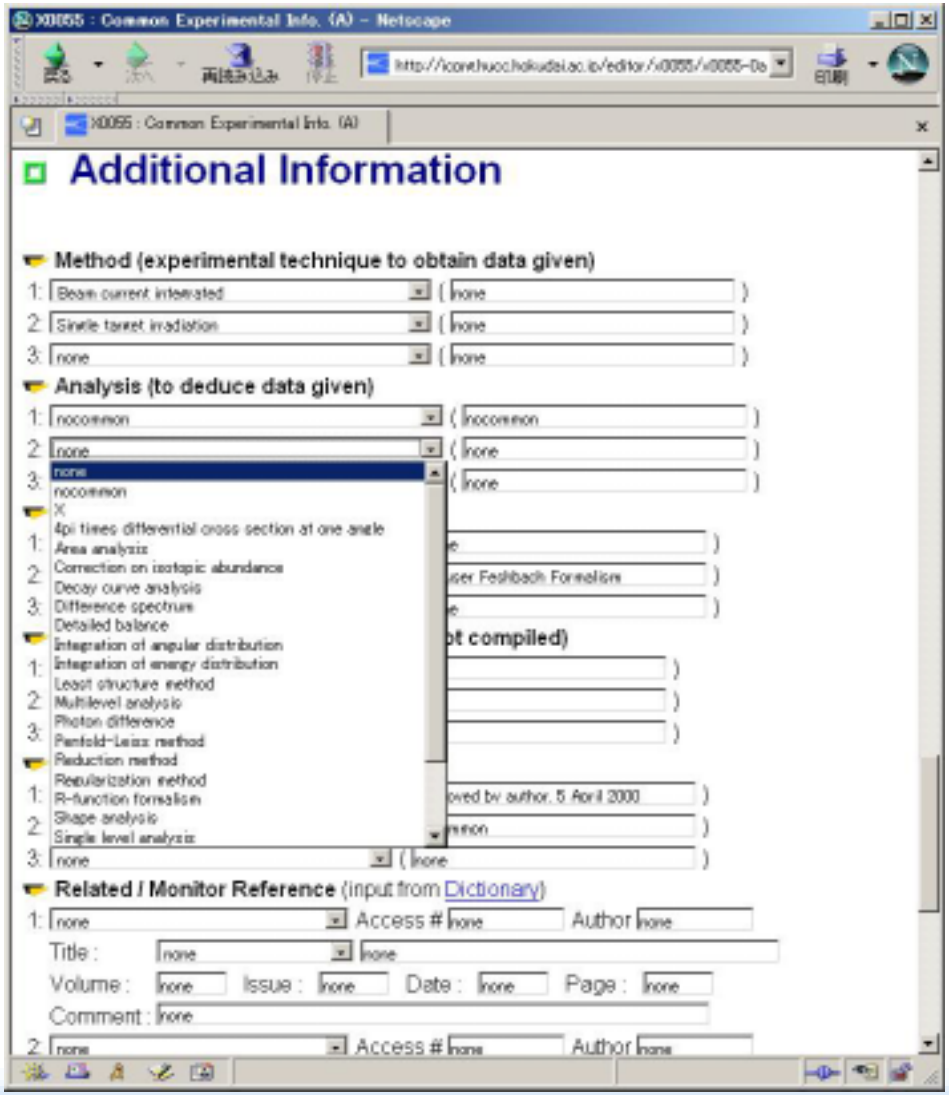
...

Mailing address for Proposals is following. Electronic submission is strongly recommended.

Director **Tadafumi Kishimoto**
Research Center for Nuclear Physics(RCNP), Osaka University,
...

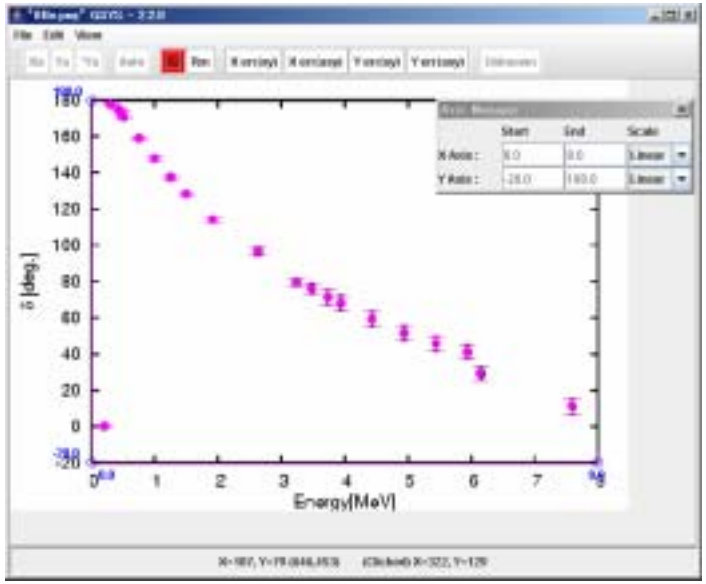
Advantage for Researchers:
- Database works to increase citation of their articles.
-Database works as an appendix of the main publication.
etc....

Editor for Data Compilation



Web-based editor developed by JCPRG (Another standalone editor is available at IAEA-NDS.)

Data Point Digitizer



Usually we obtaine numerical data from authors. But sometimes we are forced to digitized data points from figures.
(old articles, no reply from authors....)

Collaboration between Japan and China (Example)

1. Scan major Chinese Journals and choose articles relevant to nuclear reaction database (by China) (or you may choose articles from your facilities)

2. Send relevant articles (and data points) to Japan (by China)

3. Prepare drafts of data files with the copies (by Japan)

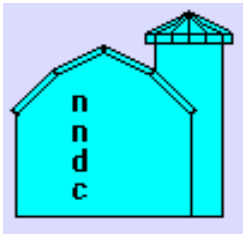
4. Check the drafts with authors (by China)

5. Correct and finalized data files

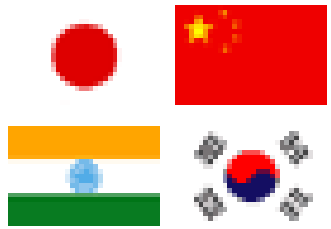
6. Submit data files to IAEA-NDS

7. Dissemination to the world (by IAEA-NDS)

Asian Group in Nuclear Data Production (future)



USA



Asian Group

EXFOR

Europe

IAEA-NDS (Coordinator)

Russia
Hungary
Ukraine
…