International Atomic Energy Agency

The 6th DAE-BRNS Theme Meeting on

EXFOR Compilation of Nuclear Data

Department of Physics, Bangalore University, Bangalore, India

20–24 January 2015

Introduction to EXFOR

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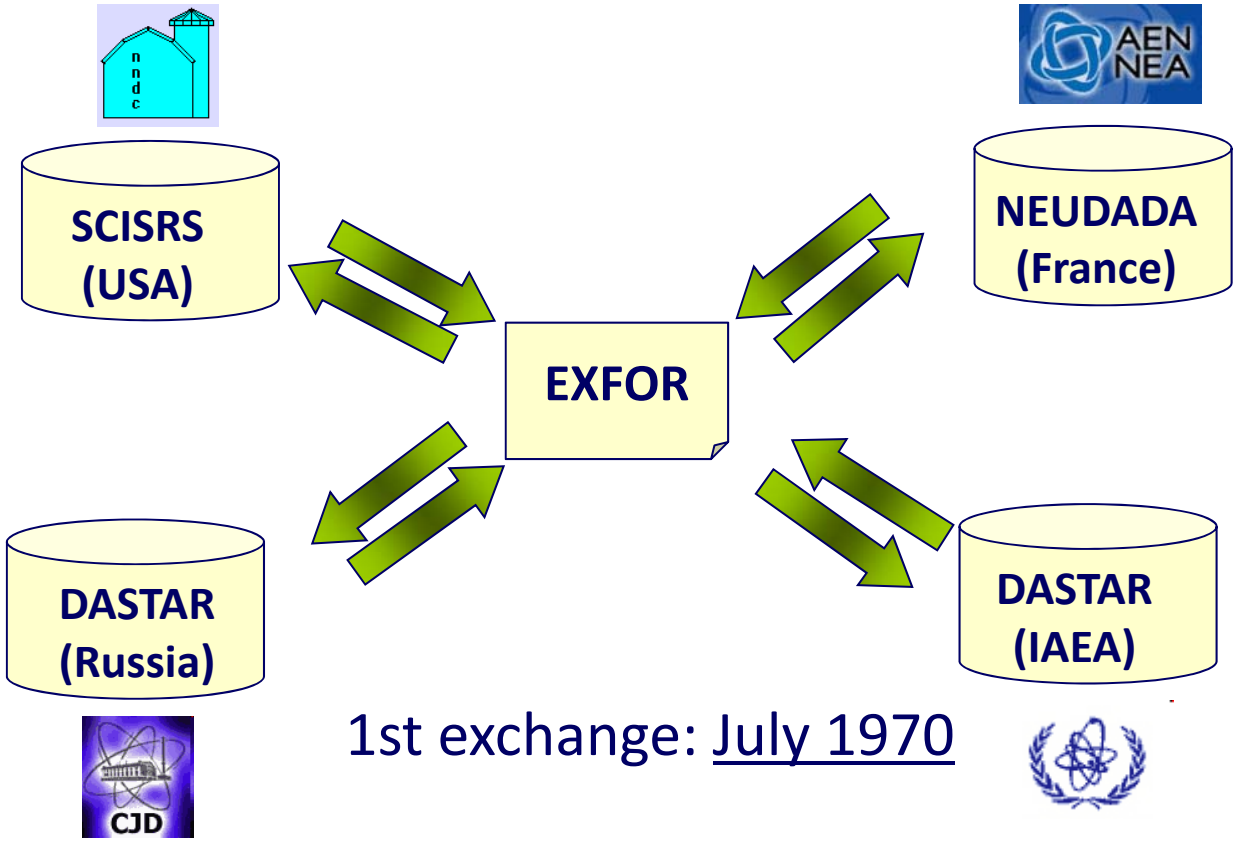
Nuclear Data Section

Department of Nuclear Sciences and Applications

Experimental Data Exchange during Cold War

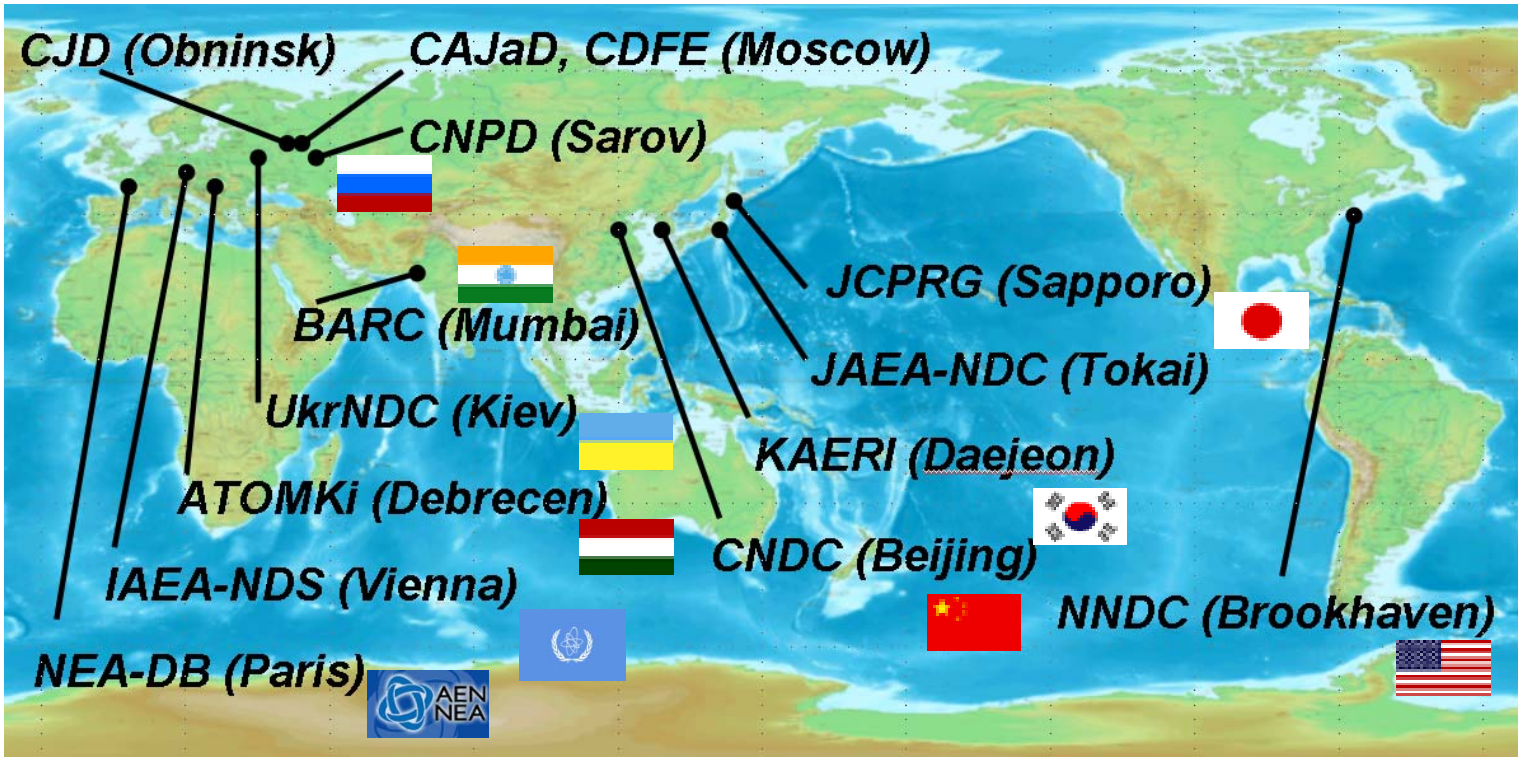


EXFOR = EXchange FORmat

Annual NRDC Meeting (1983)

17-21 October 1983 in Obninsk or Moscow

Nuclear Reaction Data Centres (NRDC)



12 centres from 8 countries and 2 international organisations
(China, Hungary, India, Japan, Korea, Russia, Ukraine, USA, NEA, IAEA)

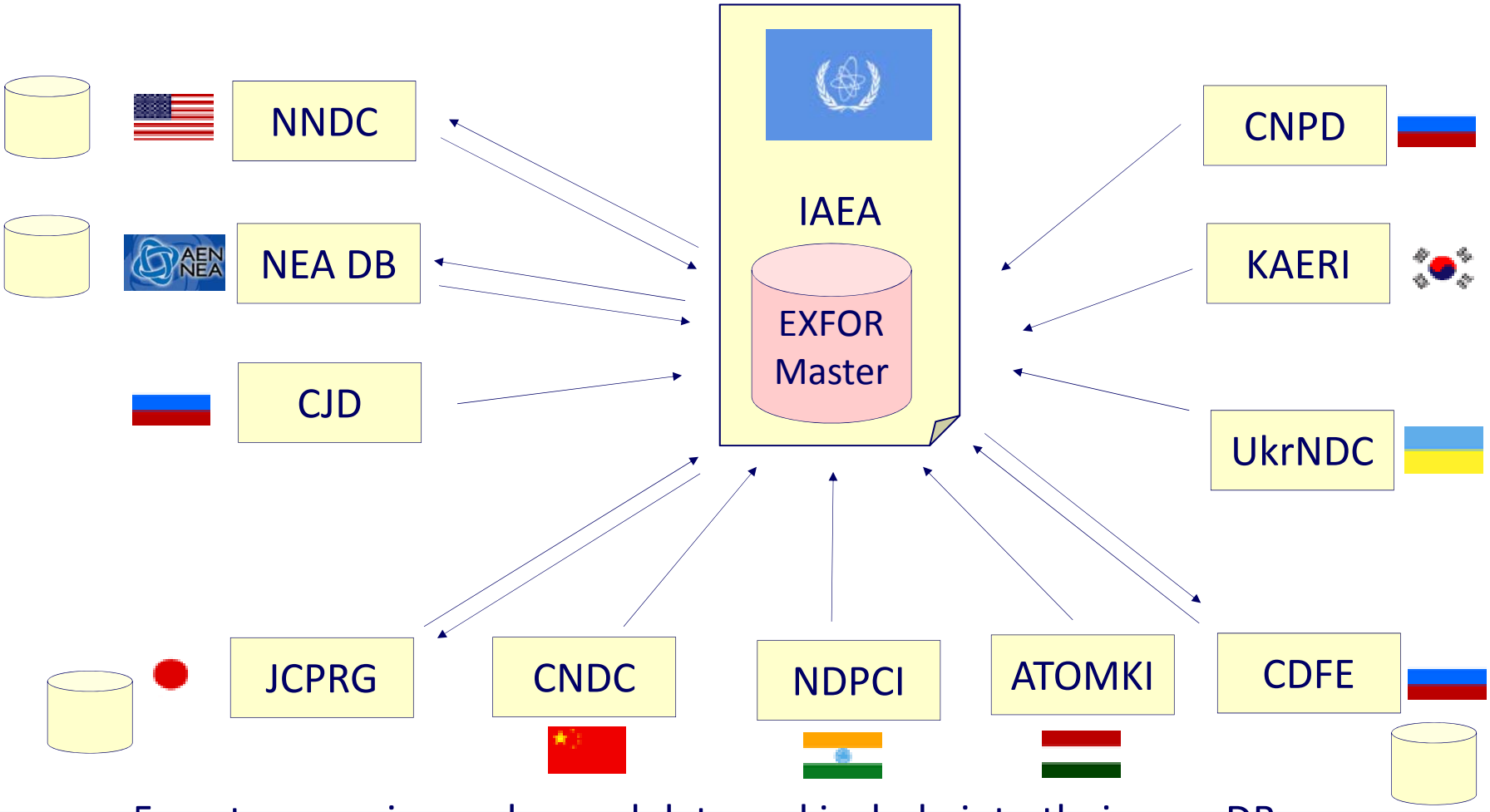
Collaborating for **EXFOR** compilation under the auspices of IAEA NDS

Annual NRDC Meeting (2013)

23-25 April 2013 in IAEA Headquarter, Vienna

Experimental Data Exchange (Present)

The current exchange structure:



5 centres receive exchanged data and include into their own DB.

Asian Four EXFOR Data Centres

China Nuclear Data Centre (CNDC)
Head: Dr. Ge Zhigang
Liaison with IAEA: Dr. Chen Guochang


Japan Nuclear Reaction Data Centre (JCPRG)
Head: Dr. M. Aikawa
+ Dr. A. Makinaga



Nuclear Data Physics Centre of India (NDPCI)
Head: Dr. Alok Saxena
Liaison with IAEA: Dr. B.Lalremurata


Korea Nuclear Data Centre (KNDC)
Head: Dr. Young-Ouk Lee
Liaison with IAEA: Mr. Sung-Chul Yang

Additional regional EXFOR compilation activity in Kazakhstan, Mongolia, Uzbekistan.

Responsibility of Indian Researchers

Indian Centre (NDPCI, coordinated by Prof. A. Saxena, BARC) is responsible to neutron, charged-particle and photonuclear reaction data measured in India.

EXFOR

IAEA
Atoms For Peace

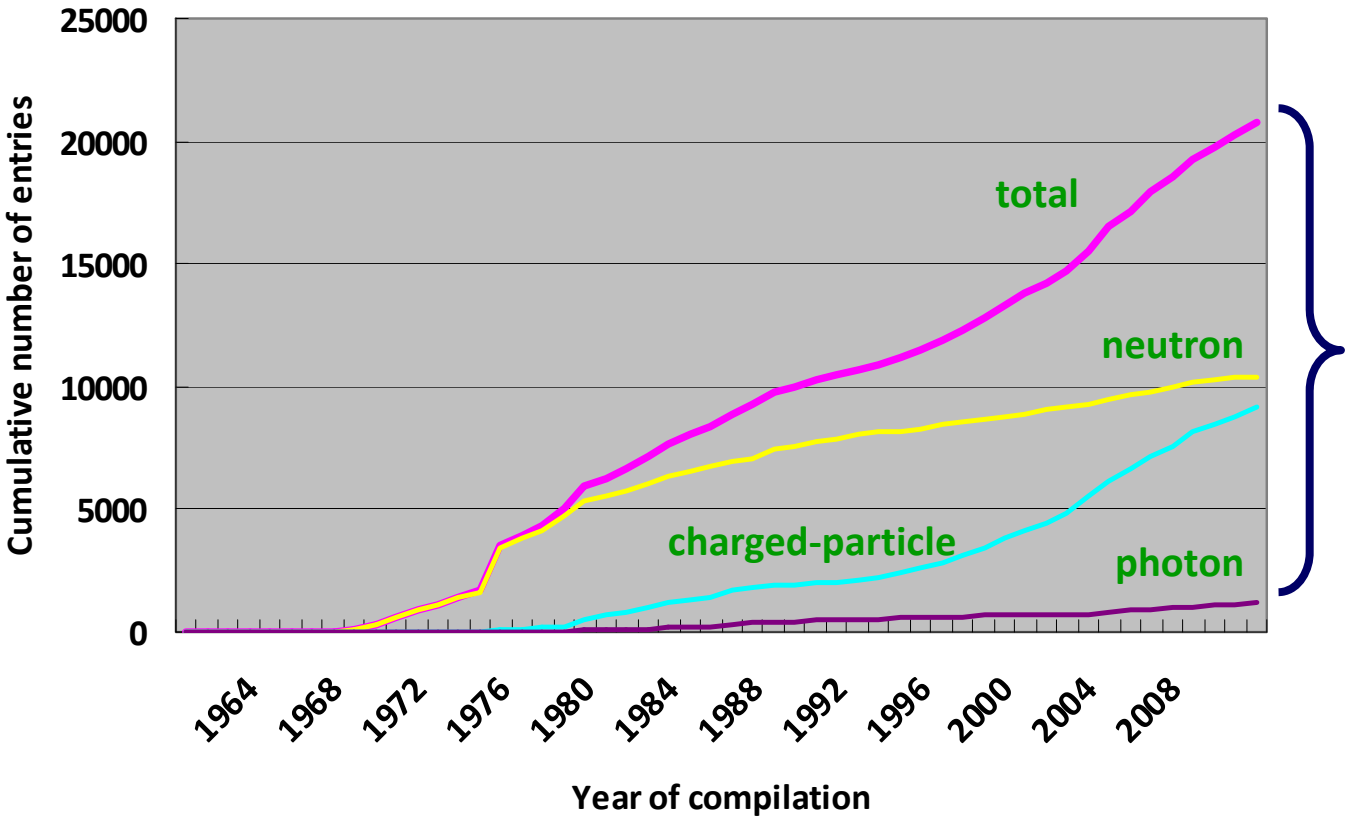
EXFOR

Users
in the world

Other centres

EXFOR

How Many Experiments in EXFOR?



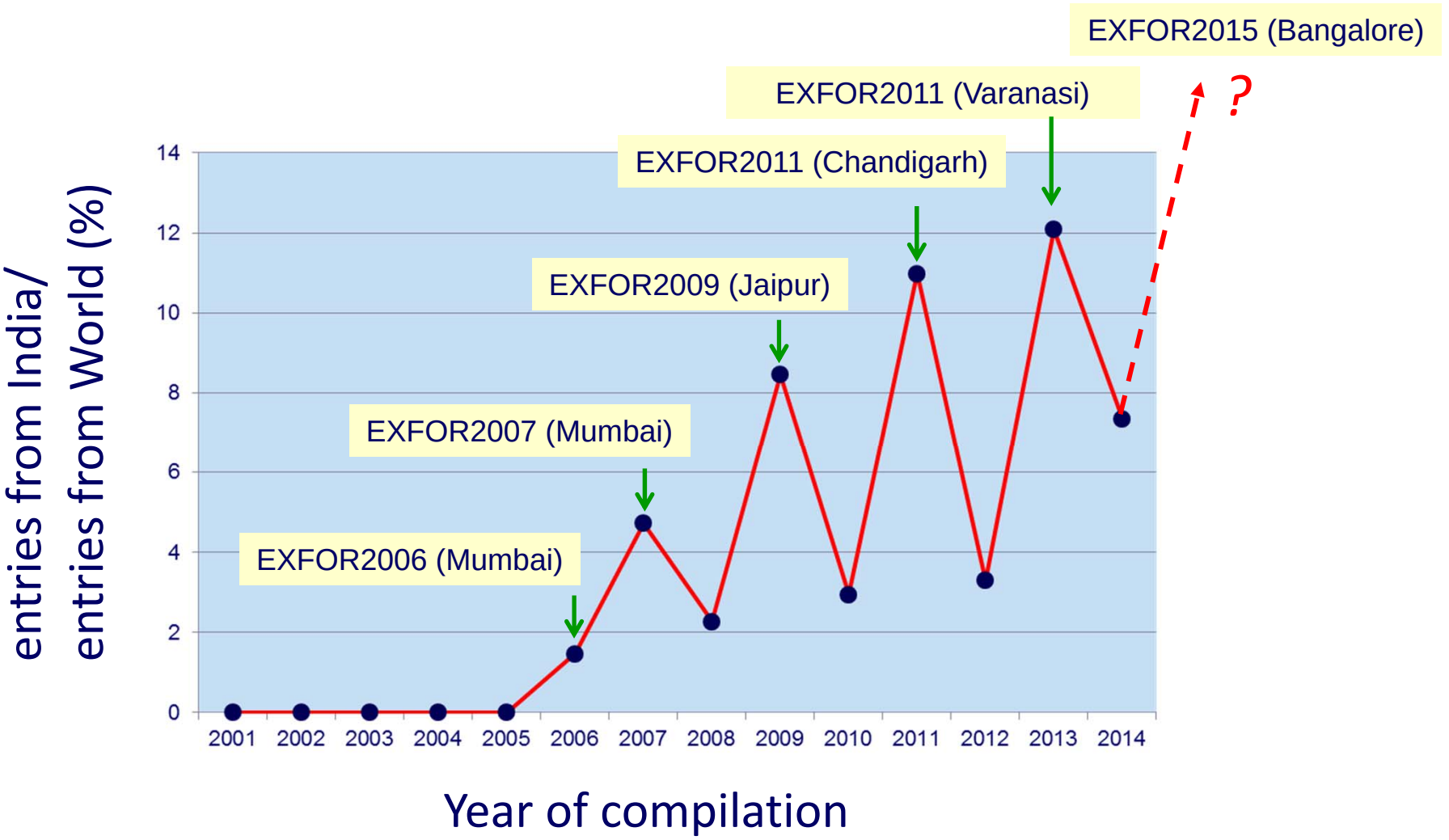
Neutron
~10 000 works

Charged-particle
~ 9 000 works

Photon
~ 1 000 works

Total
~ 20 000 works

Contribution from India to EXFOR

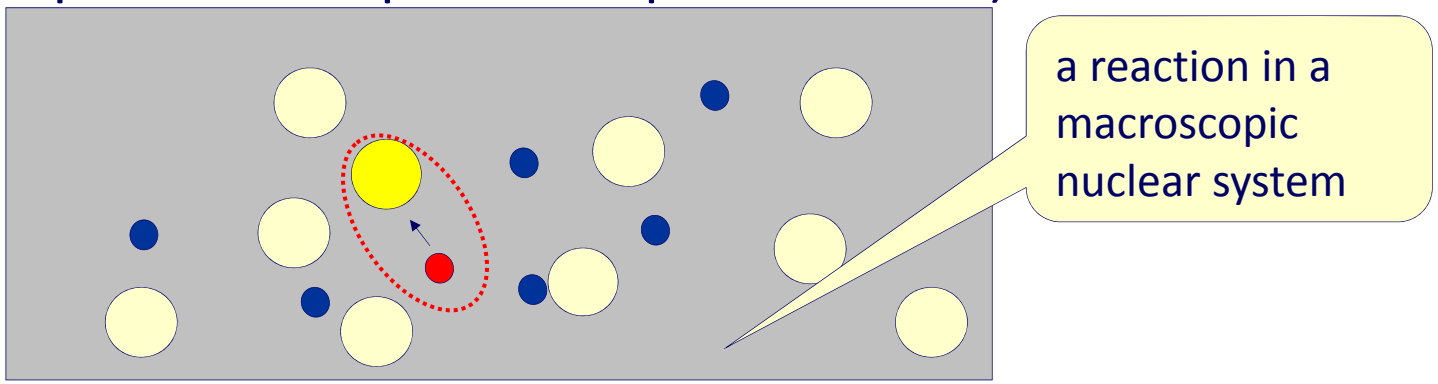


Scope of EXFOR

- EXFOR is a general purpose experimental data library.

  (c.f. ENDF – evaluated nuclear data libraries – are designed for fission and fusion energy systems. En<20 MeV)

- Data describing a microscopic nuclear reaction are considered (c.f. “per incident particle” “per reaction”).



Example of Quantities in EXFOR

- Cross section
- Differential cross section (angular, energy, double, triple, …)
- Resonance parameter
- Fission quantity (fission yield, fission neutron multiplicity, …)
- Polarization quantity (analyzing power, …)
- Thick target yield

etc.

Example of EXFOR Entry – 13597.005

```
SUBENT        13597001     950822
BIB                15         27
…
AUTHOR     (S.K.GHORAI,P.M.SYLVA,J.R.WILLIAMS,W.L.ALFORD)
TITLE      Partial neutron cross sections for 64Zn, 66Zn, 67Zn
            and 68Zn between 14.2 and 18.2 MeV
FACILITY   (DYNAM)
INC-SOURCE (D-T) deuterons on titanium tritide.
SAMPLE     Natural zinc sample.
METHOD     (ACTIV,MOMIX)
…
ENDSUBENT          34
SUBENT        13597005     950217
BIB                 2          2
REACTION   (30-ZN-67(N,P)29-CU-67,,SIG)
DECAY-DATA (29-CU-67,62.01HR,DG,185.,0.470)
ENDBIB              2
NOCOMMON            0          0
DATA                5          5
EN         DATA       DATA-ERR   MONIT      MONIT-ERR
MEV        MB         MB         MB         MB
14.2        82.         5.       122.0        0.65
15.2       106.         6.       108.0        1.96
16.2       125.         8.        90.0        1.75
17.2       141.        21.        72.0        1.41
18.2       230.        30.        59.5        1.26
ENDDATA             7
ENDSUBENT          14
```

80-columns ASCII file

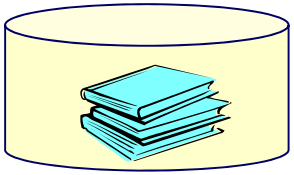
Data From Experimentalists to EXFOR Users

Experiment

Publication

Articles

Journal scan



List of articles

Compilation

EXFOR
(Draft)

Review,
correction

EXFOR

Database

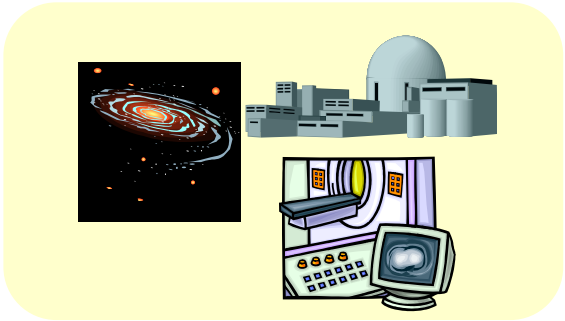
Processing
and output

Internet
CD-ROM, DVD

EXFOR
Users

Application

Planning
of new
experiment



Entry Number

- Each EXFOR Entry is identified by Entry number
  (ID for each experimental *work*).

- Entry number has one area character and 4 digits number.

Example

Entry 41123: 1123th EXFOR entry from area 4

Entry C0453: 453th EXFOR entry from area C

- area 4: Neutron data from former USSR
- area C: charged-particle data from US+Canada

Subentry Number

- One Entry is a set of Subentries.
- Each subentry is characterized by subentry number (subaccession number).
- Subentry 001 is a set of common information applicable to all subentries (e.g., title, authors, institute, experimental facility, detector)
- Subentry 002, 003,… are assigned to data sets.

Subentry Number (cont)

Example:

An Indian neutron EXFOR entry (EXFOR 33023)

(B.K. Nayak et al., Phys.Rev.C78(2008)061602)

33023.001:

Common information (title,author,…)

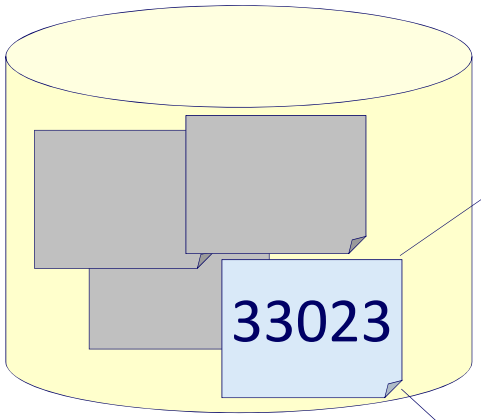
33023.002:

Data set for ^{233}Pa(n,f)/^{235}U(n,f) x-section ratio

33023.003:

Data set for ^{233}Pa(n,f) x-section

Subentry Number (cont)



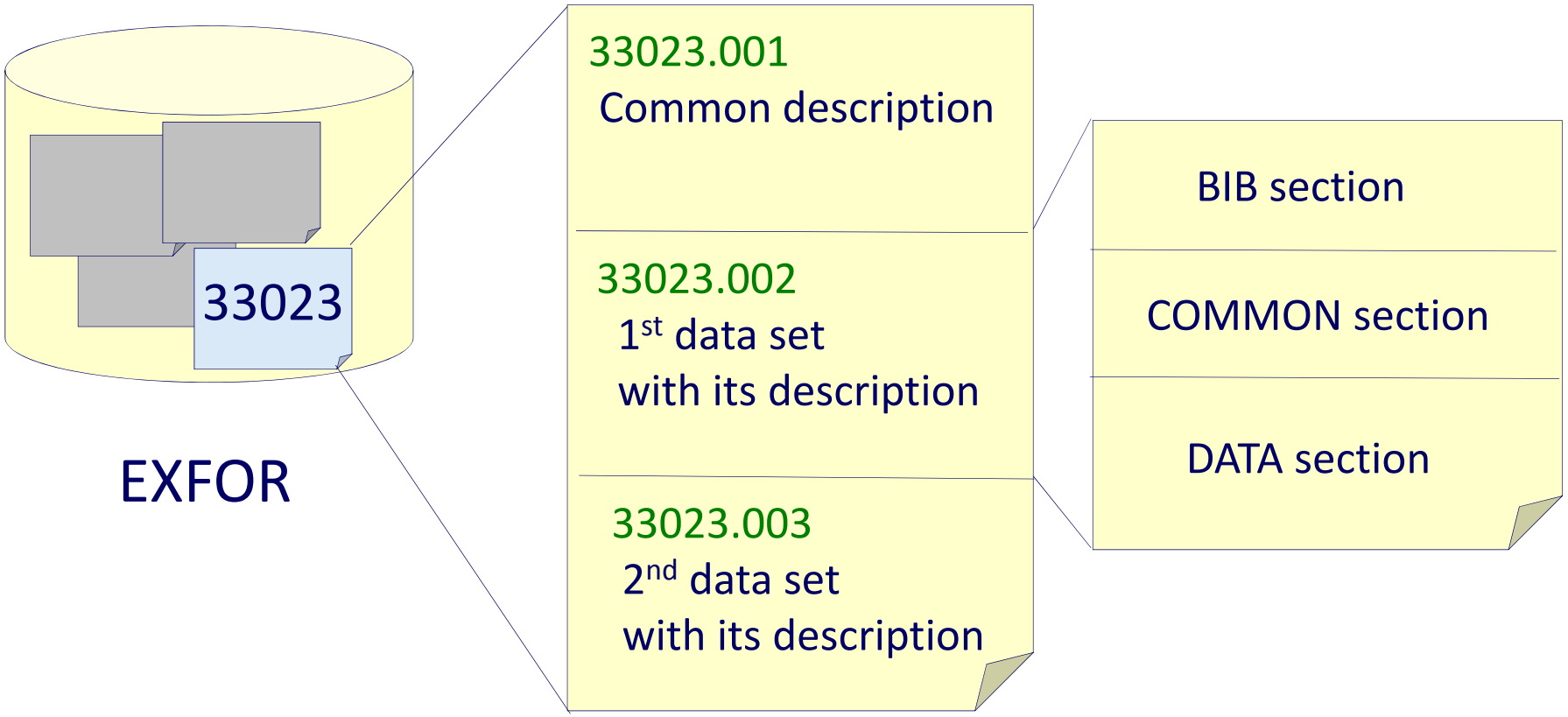
EXFOR

33023.001
Common description

33023.002
1st data set
with its description

33023.003
2nd data set
with its description

BIB, COMMON and DATA Section



Example of BIB Section

```
          11                                                    66              80
---------+---------+---------+---------+---------+---------+---------+---------+
TITLE      Systematic study of (n, p) reaction cross sections      33034001     3
..
AUTHOR     (B.Lalremruata, N.Otuka, G.J.Tambave, V.K.Mulik,        33034001     5
…
INSTITUTE  (3INDIND) Mizoram University, Aizawl                    33034001     8
…
REFERENCE  (J,PR/C,85,024624,2012)                                 33034001    10
FACILITY   (CCW,3INDPOO)                                           33034001    12
...
STATUS     (TABLE) Table V of Phys.Rev.C85(2012)024624              33034001    57
           (APRVD) B.Lalremruata (2012-03-15)                      33034001    58
HISTORY    (20110516C) Ranjita Mandal                              33034001    59
…
```

Keyword

Description

- Parenthesized coded information
- Free text information

Example of COMMON and DATA Section

```
          11                                                    66            80
---------+---------+---------+---------+------
COMMON                   1          3
E-LVL
MEV
 0.0
ENDCOMMON                3          0
DATA                     3         22
ANG-CM     DATA-CM    DATA-ERR
ADEG       MB/SR      MB/SR                                     D6213   2    17
…
  74.76      0.327      0.023                                   D6213   2    24
  80.18      0.258      0.024                                   D6213   2    25
  85.53      0.171      0.018                                   D6213   2    26
  90.01      0.153      0.016                                   D6213   2    27
…
ENDDATA                 24          0                           D6213   2    40
…
```

COMMON section

Headings and units

DATA section

E_{level} (MeV)	θcm (deg)	dσ/dΩ (mb/sr)	Δdσ/dΩ (mb/sr)
0.0	74.76	0.327	0.023
	80.18	0.258	0.024
	85.53	0.171	0.018
	90.01	0.153	0.016

Plan of Lectures and Exercises

Formats I: Formats for experimental description

Editor I: Input of experimental description

Formats II: Formats for data description

Editor II: Input of data description

Digitization

Formats III: Formats for data table

Editor III: Input of data table

Checking tool

Each block of lecture is followed by exercises for the common article and article booked by you.