EXFOR.
Output for users.

Proposal for standard output.
Discussion about XML.

V. Zerkin, IAEA-NDS

Sapporo, Japan
March-2009

Objectives and Tasks of NRDC.

"The primary goal of the Network is the dissemination of nuclear reaction data and associated documentation to users"

GOAL

✓ To provide access to experimental data in format(s) appropriate for users

Do we want co-operation in data dissemination?

NRDC Centres

1

EXFOR files

Data compilation

2

from publication ..... to user via EXFOR

Co-operation:
- Common formats
- Common tools
- Common efforts
- Common result:
  good and rational

Service via Web, CD-ROM

EXFOR database

3

Data delivery

Our problem:
~35% of all data can be presented ONLY in EXFOR format !!!

Co-operation ?
- Common formats ? No
- Common tools ? No
- Co-ordination ? No
- Good result ? ?

4

We want Happy Users

Output:
- data
- bibliography
- plots

Output formats:

- EXFOR	*100%*
- C4	*~65%*
- Table	*~40%*
- X4+	*100%*
- T4	*~40%*
- R33	*~15%*
- BibTeX	*100%*
- GIF, PS	*~60%*
- other	

NRDC-2008

Accepted

WP2008-38

NDS Proposal for a Common NRDC EXFOR Web Service:

- Common output formats
- Co-operation in data dissemination systems

EXFOR: EXchange FORmat

i.e. exchange between Nuclear Data Centers

Now EXFOR - System including

- Data files in EXFOR format
- Dictionaries
- Rules and exchange procedures
- Database (s)
- Retrieval systems
- . . . . . Utilities and Applications . . . . .

60s – 80s main task: exchange data.

Now EXFOR: ~18500 Entries, +500 Entries / year

1980: 3000+500 (+16.7%)
1990: 8000+500 (+6%)
2000: 12000+500 (+4%)
2008: 18000+500 (+2.8%)

Database extension: stable

Access to data: growing

1997. Web access
1998. CD-ROM
2000. Migration to relational databases
2004. Advanced plotting
2006. New output: X4+, R33, X4±
2007. SG-30; full database in C4 format
2008. New output: X4±, XML
2009. Exchange: well established

2009. New tasks in EXFOR:

- X4-evaluated
- new EXFOR checking-code
- Web-service on PC
- . . . . . .
- develop output formats:
  - Standard output for users
  - XML (?)
  - New computational format

Now EXFOR is de-facto main output format. But it is not convenient for most of users!!!

- Who knows MS-Word file format (DOC)?
- You normally look at Web pages using Web browser, although you can also see html-source of the page…
- The same with EXFOR: it is convenient for experienced compilers to exchange data between themselves, but why data should be given in the same form for users?...

What do we offer to users beyond EXFOR format?

Output of NDS EXFOR System:

- ***EXFOR 100%***
- ***C4 ~65%***
- ***Table ~40%***
- ***X4+ 100%***
- ***T4 ~40%***
- ***R33 ~15%***
- ***BibTeX 100%***
- ***GIF, PS ~60%***
- ***other***

NDS Web EXFOR: Output

X4+: EXFOR-interpreted, 2006

EXFOR data: http://161.5.149.76/EXFOR/A1495.002
Data retrieved from the EXFOR database version of March 06, 2009.

```
ENTRY            A1495    20031013    20040322    20050926        0000
SUBENT        A1495001    20031013    20040322    20050926        0000
BIB                 10          15
TITLE       Study of the reaction mechanism for (He3,P) reactions
            with Li-6,B-10 and C-13
AUTHOR      (J.P.Schiffer,T.W.Bonner,R.H.Davis,F.W.Prosser,Jr.)
INSTITUTE   (1USARIC)
            #(1USARIC) Rice University, Houston, TX, USA
REFERENCE   (J,PR,104,1064,195611)
            # (J,PR,104,1064,195611) Journ.: Physical Review, Vol.104, p.1064 (1956) USA
            #+      #NSR=1956SC01 #DOI=10.1103/PhysRev.104.1064
FACILITY    (VDG)
            #(VDG) Van de Graaff
SAMPLE      Target materials were evaporated on 2-mil foil backing,
            thick enough to stop the He-3 beam yet thin compared
            to the range of the proton groups studied
METHOD      (PHD)
            #(PHD) Pulse-height discrimination
DETECTOR    (SCIN) Thallium-activated CsI crystals mounted on
             DuMont 6291 photomultiplier tubes.
            #(SCIN) Scintillation detector
ERR-ANALYS  (DATA-ERR2)The pulse-height resolution of the detectors
HISTORY     (19800811C) Compilation produced by Arzamas RFNC-VNIIEF
            (20031013U) Last checking has been done.
ENDBIB              15
COMMON               1           3
DATA-ERR2
PER-CENT
4.
ENDCOMMON            3
ENDSUBENT           22
SUBENT        A1495002    20031013    20040322    20050926        0000
BIB                  5          11
REACTION    (3-LI-6(HE3,P)4-BE-8,PAR,DA)
            #(3-LI-6(HE3,P)4-BE-8,PAR,DA)  Quantity: [DAP] Partial differential cross section d/dA
SAMPLE      Metallic Li-6 enriched to 96%. 10 microg/cm2 thick.
ERR-ANALYS  (EN-ERR) Digitizing error
            (DATA-ERR) Digitizing error
            (DATA-ERR1) Some uncertainty in the cross-section was
            introduced by not knowning precisely what fraction of
```

X4土: EXFOR-interactive Tree, 2008

- ENTRY A1495 1956, J.P.Schiffer+ last-updated: 2003-10-13
  - SUBENT A1495001 last-updated: 2003-10-13
  - SUBENT A1495003 last-updated: 2003-10-13
    - BIB #bibliographic and descriptive information
      - REACTION
        - (3-LI-6(HE3,P)4-BE-8,PAR,DA)
      - SAMPLE
      - ERR-ANALYS
      - EN-SEC
      - STATUS
    - COMMON 4x1 #Constant parameters
      - Legend
      - Data

EN-ERR	E-LVL	DATA-ERR	DATA-ERR1
MEV	MEV	MB/SR	PER-CENT
0.0040	2.9	0.012	20.0

    - DATA 3x191
      - Legend

EN	Energy of Incident Projectile, Laboratory System	MEV	MeV
ANG	Angle, Laboratory System	ADEG	Angular Degrees
DATA	Partial differential cross section d/dA	MB/SR	millibarns per steradian

      - Data

EN	ANG	DATA
MEV	ADEG	MB/SR
0.8989	150.0	0.7892
0.9053	0.0	0.9892
0.9216	150.0	0.8881
0.9354	0.0	1.139
0.9518	150.0	1.036
0.9554	150.0	1.135
0.9616	0.0	1.301
0.9804	0.0	1.413
0.9971	150.0	1.271
1.006	0.0	1.625

EXFOR STANDARD OUTPUT
/under development/

Problems with EXFOR (as output format for users):

- Difficult to interpret - requires additional knowledge (structure and info)
- Data are spread through the file (Common-1, Common-N, Data-N) and not sorted (order of columns is not fixed)
- As result: difficult to write software reading EXFOR
- Existing output formats (C4, Plots, Tab,…) do not cover all EXFOR data

To write program reading EXFOR you should know:

- Structure of the file
- Dictionaries (structure and relations)
- Pointers
- Common sections (Subent-N and Subent-1)

EXFOR STANDARD OUTPUT

Goal:

To define comprehensive output format of EXFOR system: equivalent to EXFOR, but much easier to read and interpret

Mini-goal:

To deliver data to users from EXFOR in format simple for software development and easier for understanding

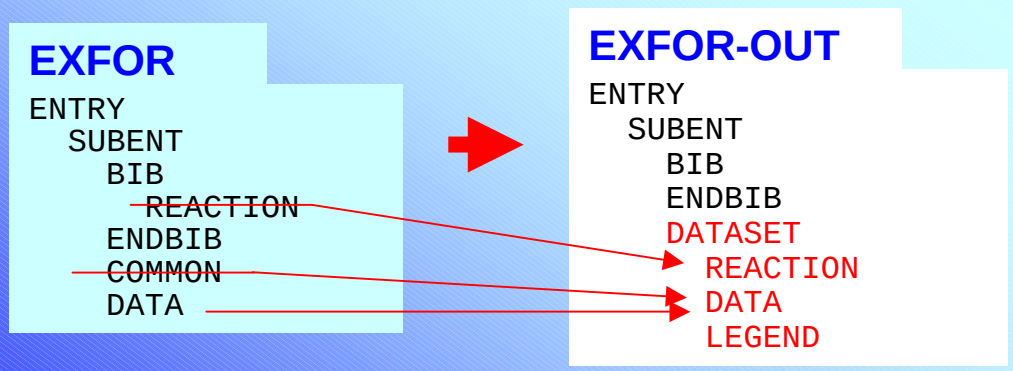
Audience:

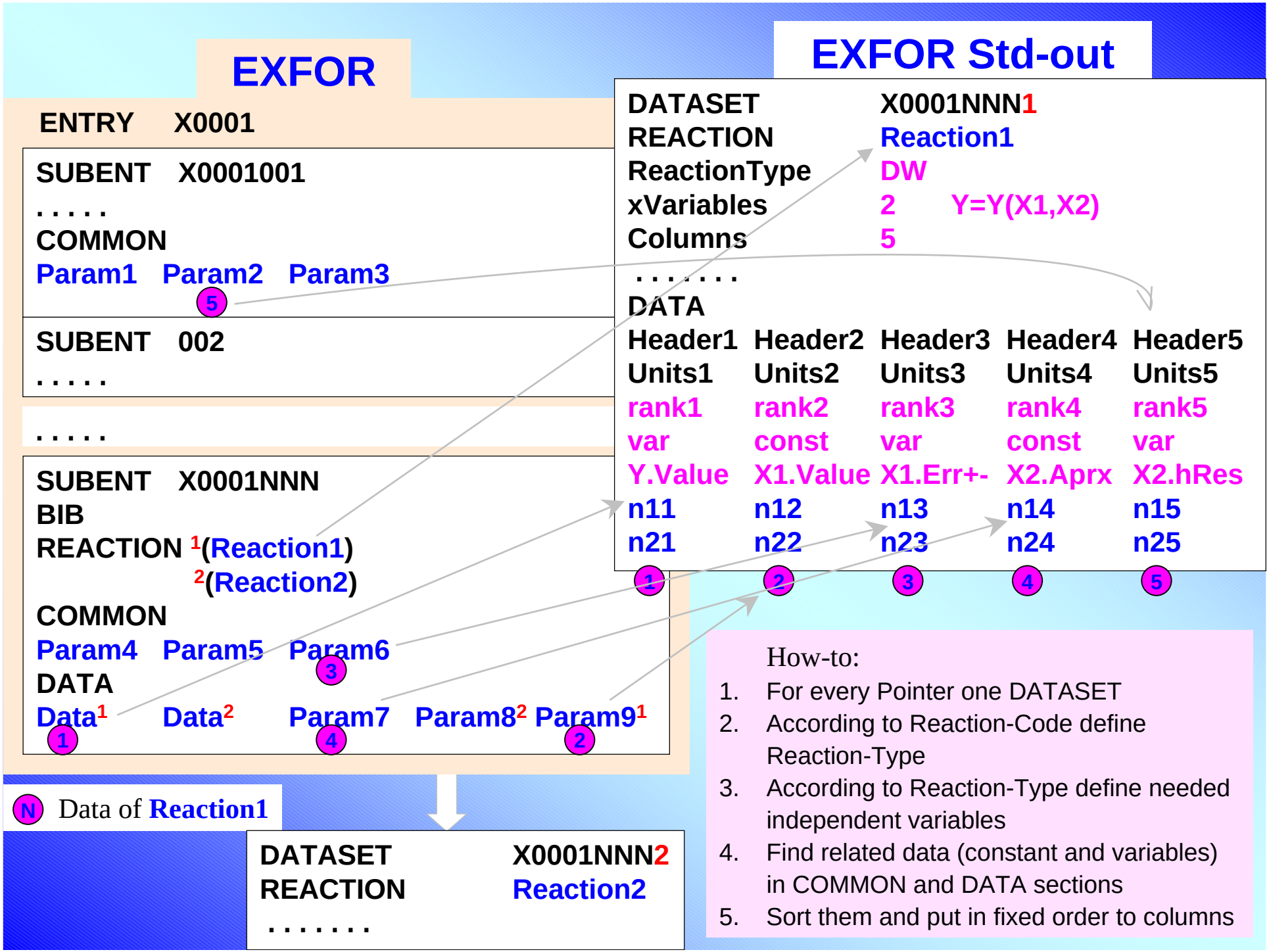
- professional evaluators, developers of model codes,… (programming)
- data centres developing retrieval/processing systems (programmers)
- regular users (?)
- all EXFOR users (?)

EXFOR STANDARD OUTPUT

Main Features:

1. Formatted (fixed columns) text
2. Keywords, codes, free-text from EXFOR, but
   + interpreting information from dictionaries
3. No pointers
4. New level: Dataset – includes all information related to one reaction: reaction-code, interpretation, data-section and legend
5. Data-section contains data from EXFOR DATA and COMMON sections
6. Data columns are sorted (fixed order)
7. Legend contains codes and interpretation of data (includes, e.g. basic-units and conversion factors)




EXFOR
ENTRY X0001
SUBENT X0001001
. . . . .
COMMON
Param1 Param2 Param3
5
SUBENT 002
. . . . .
. . . . .
SUBENT X0001NNN
BIB
REACTION 1(Reaction1)
2(Reaction2)
COMMON
Param4 Param5 Param6
3
DATA
Data1 Data2 Param7 Param8 2 Param9 1
1 4 2
EXFOR Std-out
DATASET X0001NNN1
REACTION Reaction1
ReactionType DW
xVariables 2 Y=Y(X1,X2)
Columns 5
. . . . . .
DATA
Header1 Header2 Header3 Header4 Header5
Units1 Units2 Units3 Units4 Units5
rank1 rank2 rank3 rank4 rank5
var const var const var
Y.Value X1.Value X1.Err+- X2.Aprx X2.hRes
n11 n12 n13 n14 n15
n21 n22 n23 n24 n25
1 2 3 4 5
How-to:
1. For every Pointer one DATASET
2. According to Reaction-Code define Reaction-Type
3. According to Reaction-Type define needed independent variables
4. Find related data (constant and variables) in COMMON and DATA sections
5. Sort them and put in fixed order to columns
N Data of Reaction1
DATASET X0001NNN2
REACTION Reaction2
. . . . . .

Example of DATASET

```
#DATASET        13970003
#NOW            2009/02/24:14:25:08
#SUBENT         13970003   20050225
#ENTRY          13970      20050225
#AUTHOR1        S.A.Long+
#YEAR           1998
#X4REF1         J,PR/C,57,3191,1998
#REFERENCE1     Jour: Physical Review, Part C, Nuclear Physics, Vol.57, p.3191 (1998)
#REACTION       73-TA-181(N,P)72-HF-181,,DA/DE
#D4REAC         R0#
#C4Reaction     (N,P),DA/DE
#ReactionType   DAE
#Quantity       Double diff.cross section d2/dA/dE
#xVariables     3
#+              Y = Y(X1,X2,X3)
#COLUMNS        6
#HEADER         7          6          12
!DATA          -DATA-ERR   EN         EN-RSL      E-EXC       ANG
!MB/SR/MEV     MB/SR/MEV   MEV        MEV         MEV         ADEG
!Y.Value       Y.Err-      X1.Value   X1.Resl+-   X2.Value    X3.Value
!0.1           0.901       1.1        1.922       2.1         3.1
!variable      variable    const      const       variable    variable
!1.0E-9        1.0E-9      1000000.0  1000000.0   1000000.0   1.0
!B/SR/EV       B/SR/EV     EV         EV          EV          ADEG
#DATA             162         6          12
 0.03934       0.08472     300.       3.          0.2394      1.2
 0.02584       0.1355      300.       3.          1.703       1.2
 0.06289       0.08472     300.       3.          3.043       1.2
 0.236         0.1016      300.       3.          4.624       1.2
 0.5784        0.08472     300.       3.          6.077       1.2
 0.9543        0.1016      300.       3.          7.408       1.2
 1.449         0.08472     300.       3.          9.101       1.2
 1.69          0.1016      300.       3.          10.67       1.2
 2.033         0.1355      300.       3.          12.13       1.2
 1.968         0.1186      300.       3.          13.59       1.2
 2.107         0.08472     300.       3.          15.05       1.2
 2.331         0.1694      300.       3.          16.39       1.2
 . . . . . .
 . . . . . .
```

```
. . . . . .
 2.393       0.2622      300.         3.          33.6         13.7
 2.508       0.295       300.         3.          35.1         13.7
#ENDDATA        162          6
#Legend          6           12
#
#COL-1          : Data         : variable
#+   Rank       : 0.1          : Y.Value
#+   Type       : 21           : 0.1
#+   Header     : DATA         : [Data: data]
#+   Units      : MB/SR/MEV    : [millibarns per steradian per MeV]
#+   BasicUnits: B/SR/EV      : Conv.Factor=1.e-09
#
#COL-2          : Error        : variable
#+   Rank       : 0.901        : Y.Err-
#+   Type       : 21           : 0.901
#+   Header     : -DATA-ERR    : [Uncertainty: -error]
#+   Units      : MB/SR/MEV    : [millibarns per steradian per MeV]
#+   BasicUnits: B/SR/EV      : Conv.Factor=1.e-09
#
#COL-3          : Data         : constant
#+   Rank       : 1.1          : X1.Value
#+   Type       : 41           : 2.1
#+   Header     : EN           : [Incident energy: energy]
#+   Units      : MEV          : [MeV]
#+   BasicUnits: EV           : Conv.Factor=1.e+06
#
#COL-4          : Error        : constant
#+   Rank       : 1.922        : X1.Resl+-
#+   Type       : 41           : 2.922
#+   Header     : EN-RSL       : [Uncertainty: +-resolution]
#+   Units      : MEV          : [MeV]
#+   BasicUnits: EV           : Conv.Factor=1.e+06
#
#COL-5          : Data         : variable
#+   Rank       : 2.1          : X2.Value
#+   Type       : 53           : 3.1
#+   Header     : E-EXC        : [Secondary energy: excitation energy]
#+   Units      : MEV          : [MeV]
#+   BasicUnits: EV           : Conv.Factor=1.e+06
#
#COL-6          : Data         : variable
#+   Rank       : 3.1          : X3.Value
#+   Type       : 61           : 4.1
#+   Header     : ANG          : [Angle: angle] Angle of outgoing
particle
#+   Units      : ADEG         : [Angular Degrees]
#
#ENDDATASET     13970003
```

Example of DATASET (continued)

```
REQUEST          62001   20081104          3     150853                0  0    0
ESBIRATME SH ENESBR AE ENDDM EEEE
 #DATASET         103200023
 #NOW             2009/02/24:19:23:49
 #SUBENT          10320002   19991005
 #ENTRY           10320      20020823
 #AUTHOR1         G.R.Norman+
 #YEAR            1972
 #X4REF1          J,CJP,50,2385,197210
 #REFERENCE1      Jour: Canadian Journal of Physics, Vol.50, p.2385 (1972)
 #REACTION        13-AL-27(N,TOT),,SIG,,RES
 #D4REAC          R0#
 #C4Reaction      (N,TOT),SIG,,RES
 #ReactionType    CSR
 #Quantity        Cross section at resonance
 #xVariables      1
 #+               Y = Y(X1)
 #COLUMNS         2
 #HEADER          7           2           12
 !DATA          EN-RES
 !B             MEV
 !Y.Value       X1.Value
 !0.1           1.1
 !variable      variable
 !1.0           1000000.0
 !B             EV
 #DATA             20          2           12
  2.4           0.79
  1.2           0.85
  . . . . . . . . . . .
  0.55          3.62
 #ENDDATA          20          2
 #Legend           2           12
 #COL-1          : Data         : variable
 #+   Rank       : 0.1          : Y.Value
 #+   Type       : 21           : 0.1
 #+   Header     : DATA         : [Data: data]
 #+   Units      : B            : [Barns]
 #COL-2          : Data         : variable
 #+   Rank       : 1.1          : X1.Value
 #+   Type       : 32           : 1.1
 #+   Header     : EN-RES       : [Resonance parameter: energy] Resonance energy
 #+   Units      : MEV          : [MeV]
 #+   BasicUnits: EV           : Conv.Factor=1.e+06
 #ENDDATASET     103200023
```

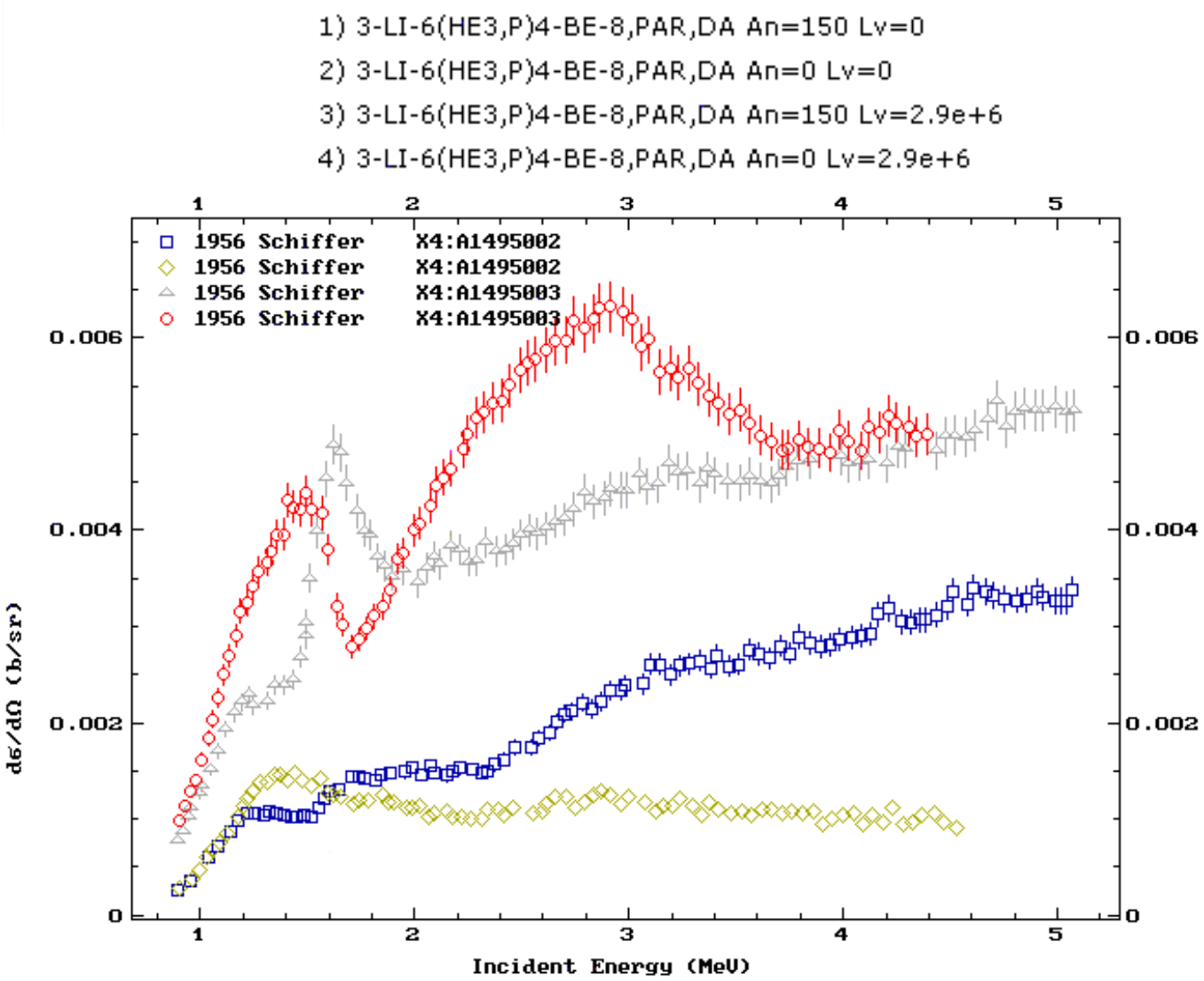
Example-2 of DATASET

Contra-example, when separation to DATASET's is not reasonable

A possible solution is to have one dataset, but with several Data headers, e.g.

DATA-EN
DATA-WID
DATA-SIGR

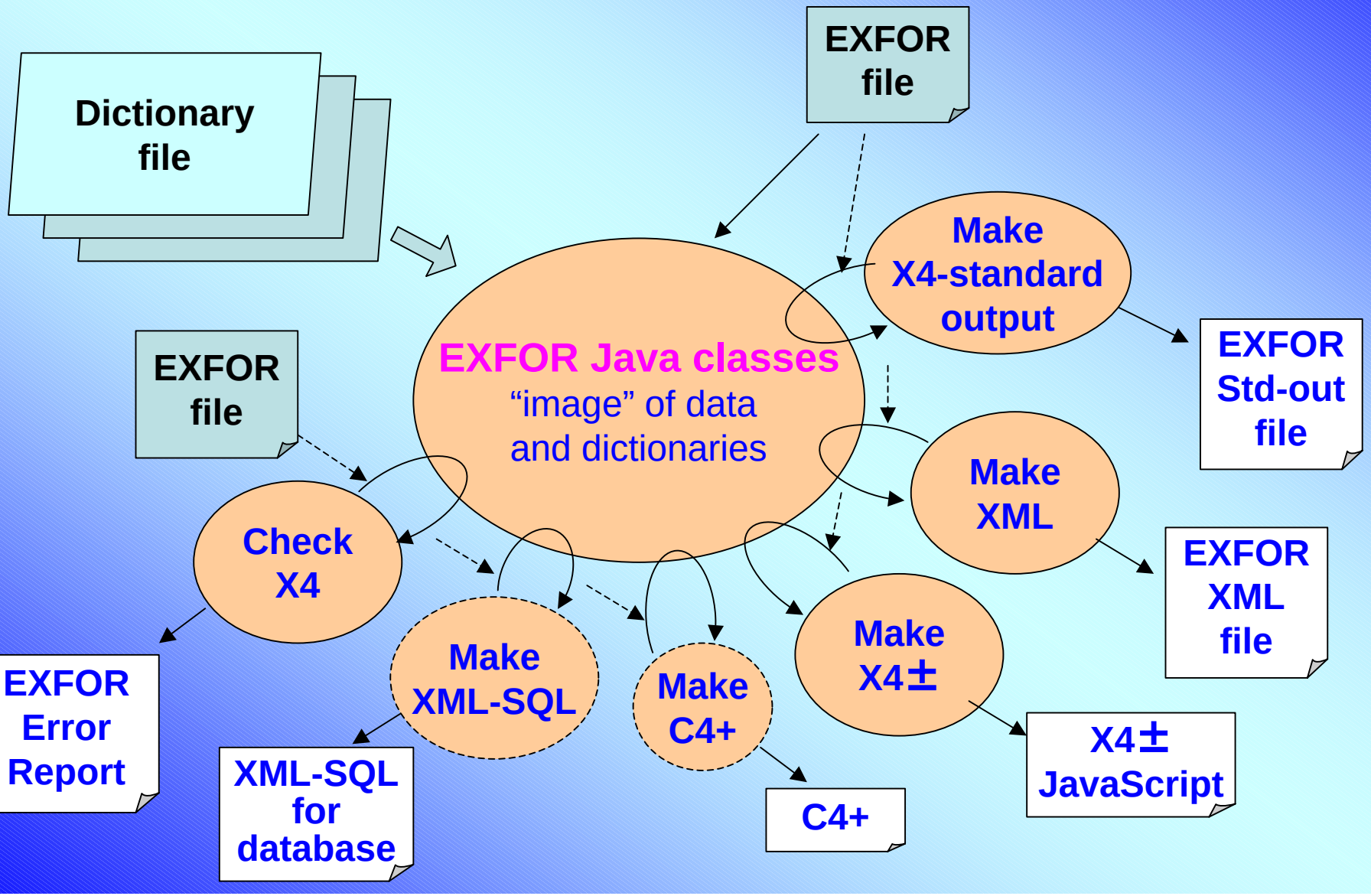
Example-3 of DATASET



Another contra-example: several Subentries can be joined…

We can have one Dataset, two or four

Q: How to produce EXFOR STANDARD OUTPUT?
A: By Java program using X4-Java tools



EXFOR-XML

What is wrong with EXFOR format?

- Difficult to extend (e.g. +DOI, NSR to REFERENCE) →software-problem
- Difficult to interpret Codes (partially solved in X4+ and EXFOR-Editor)
- Not always clear how to interpret Data (to be solved in X4Std-out)
- Difficult to interpret Common parameters

Why XML?

- Easy to extend (e.g. DOI, NSR can appear as Attributes)
- Easy to write new programs (Java)
- Nowadays “Standard” for exchange information between Applications
- Standard software can be used

NOT XML?

- A lot of development work at the beginning (need experience, time for studies)
- Legacy codes working with EXFOR - rewrite?
- Problems for compilers and Fortran-users
- A lot of unnecessary text in the files, need viewer and editor

Main Question:

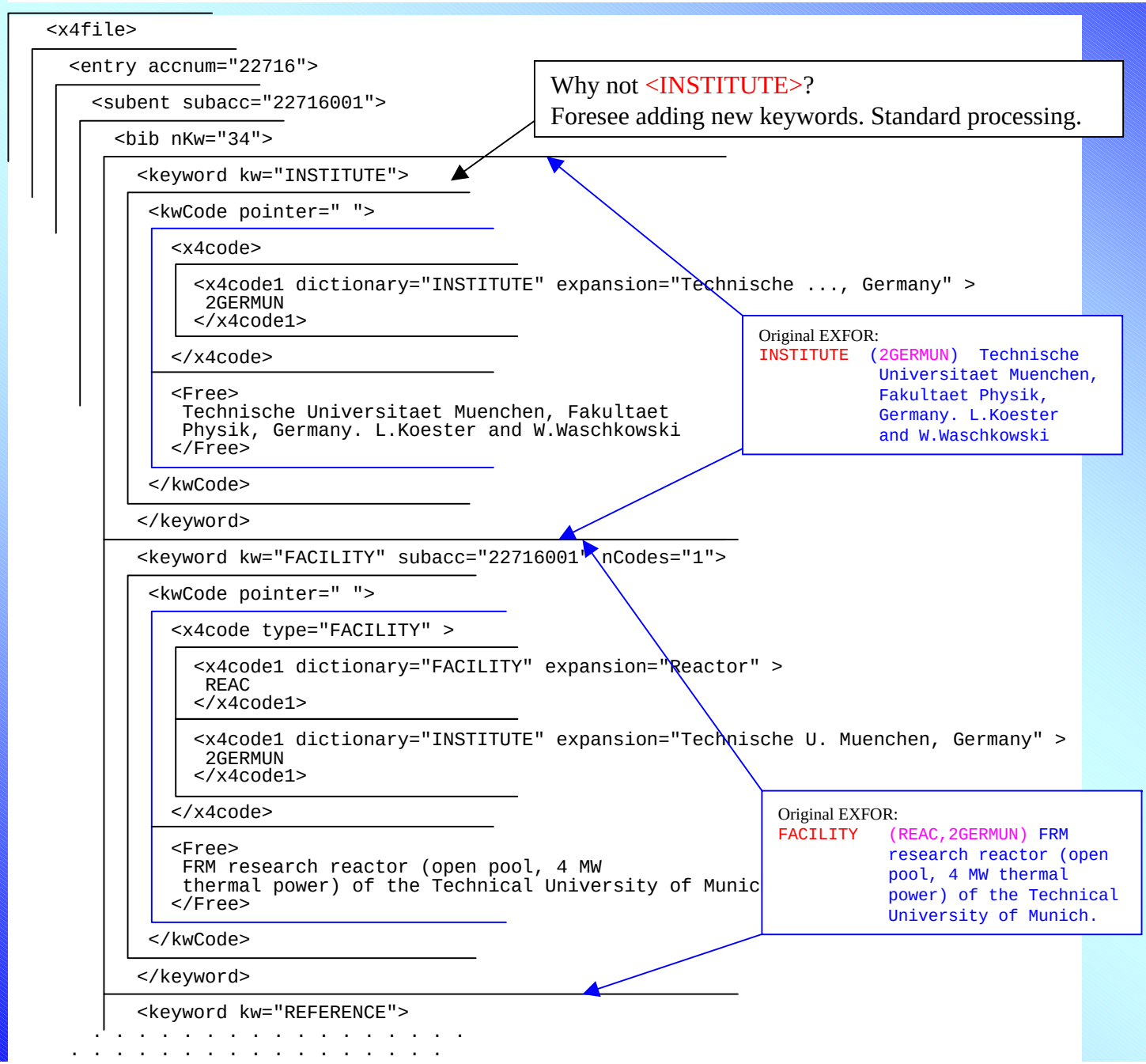
What is the purpose of EXFOR-XML?

Output format (now)? Or Exchange (future)?

What we are going to achieve?

XML: Plus	XML: Minus	Alternative
Self explanatory	Need Viewer	X4+, X4±, X4Std-out
May allow to use standard validation	Create Schema (experience…)	Java-X4Check (develop…)
Allow to use standard Editors (?)	Existing Editors are good enough?	EXFOR-Editor (Sarov)
Easy to build modern programs (Java)	What about Fortran programs?	X4Std-out: easy to build programs in any language

EXFOR XML. Structures. General structure and non-specific keywords.



Source of: file:///C:/zerkin/my-XML/x4xml02/x4.xml - Mozilla Firefox

File Edit View Help

```
<?xml version="1.0" encoding="windows-1251" ?>
<?xml-stylesheet type="text/xsl" href="x4.xsl" ?>
<x4files>
<x4entry accnum="10265">
 <x4subent subacc="10265001">
  <bib nKw="9">
   <keyword kw="INSTITUTE" iKw="1" nCodes="1">
    <kwCode iCode="1">
        <Code ln="1">1USAMTR</Code>
    </kwCode>
   </keyword>
   <keyword kw="REFERENCE" iKw="2" nCodes="2">
    <kwCode iCode="1">
        <Code ln="1">J,NSE,41,188,1970</Code>
    </kwCode>
    <kwCode iCode="2">
        <Code ln="1">R,IN-1407,1970</Code>
    </kwCode>
   </keyword>
   <keyword kw="AUTHOR" iKw="3" nCodes="1">
    <kwCode iCode="1">
        <Code ln="1">T.Watanabe,S.D.Reeder</Code>
    </kwCode>
   </keyword>
   <keyword kw="TITLE" iKw="4" nCodes="1">
    <kwCode iCode="1">
        <Free ln="2">Total Neutron Cross Section of Technetium-99 from 0.01
to 1000 eV</Free>
    </kwCode>
   </keyword>
   <keyword kw="FACILITY" iKw="5" nCodes="1">
    <kwCode iCode="1">
        <Code ln="1">CHOPF</Code>
        <Free ln="1">MTR fast chopper</Free>
    </kwCode>
   </keyword>
   <keyword kw="METHOD" iKw="6" nCodes="1">
    <kwCode iCode="1">
        <Code ln="1">TOF</Code>
        <Free ln="1">Time-of-flight; flight paths 20 and 45 m.</Free>
    </kwCode>
   </keyword>
   <keyword kw="DETECTOR" iKw="7" nCodes="1">
    <kwCode iCode="1">
        <Code ln="1">PROPC</Code>
```

Line 18, Col 14

My experience

EXFOR-XML Source code

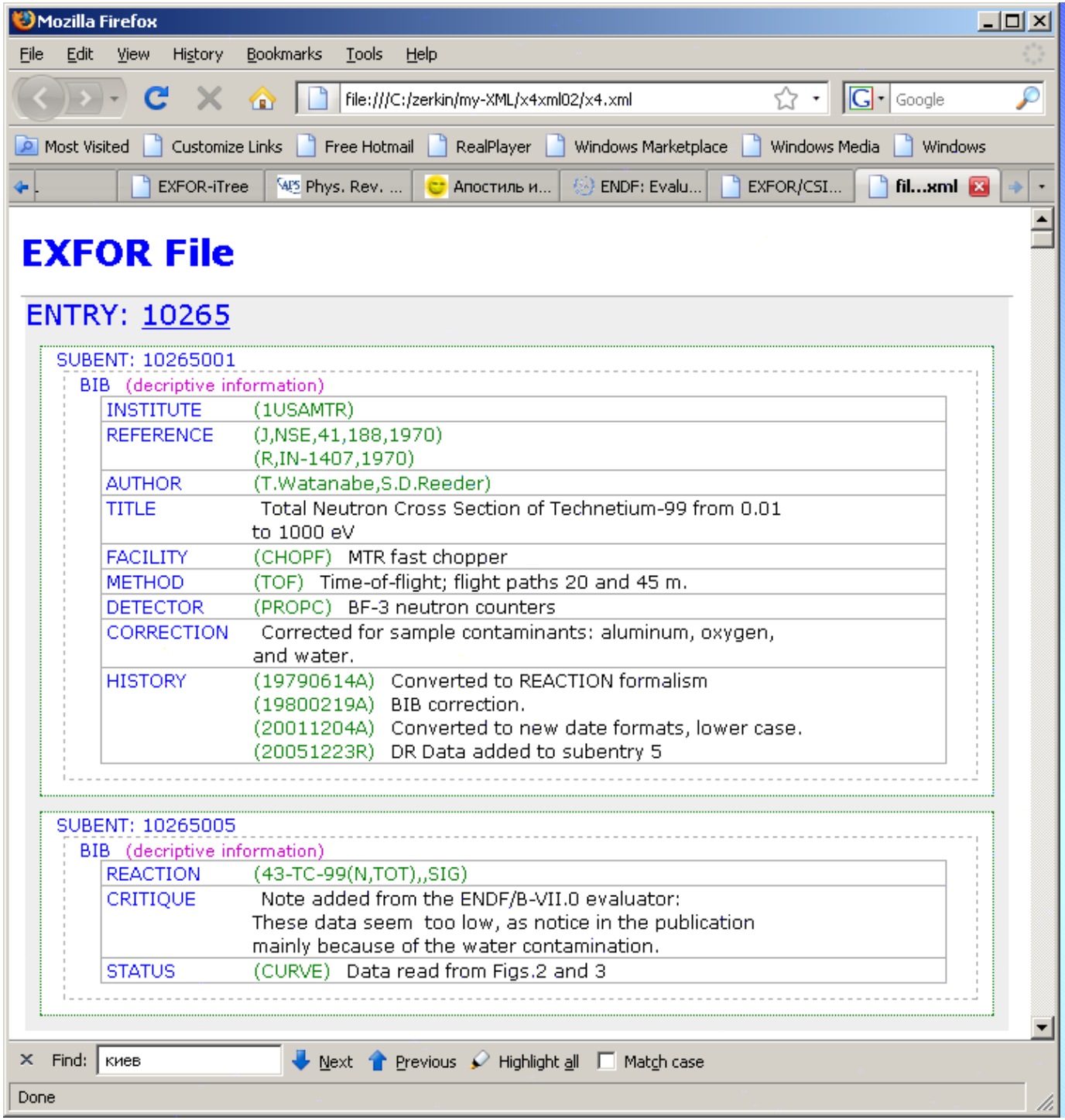
```
<?xml version = "1.0" ?>
<xsl:stylesheet version="1.0" xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
<xsl:template match="/x4files">
<xsl:comment >This is a comment</xsl:comment>
<HTML>
<head>
<link rel="stylesheet" type="text/css" href="x4.css"/>
</head>
<BODY>
<H1>EXFOR File</H1>
<table border="0" xwidth="100%"><tr><td>
<xsl:for-each select="x4entry">
  <div class="x4entry">
            ENTRY: <u><xsl:value-of select="@accnum"/></u>
  <xsl:for-each select="x4subent">
    <div class="x4sub">
            SUBENT: <xsl:value-of select="@subacc"/>
    <br/>
    <xsl:if test="bib !='' " >
    <div class="x4bib"><font color="blue">BIB</font> <span
class="x4hlp">(decriptive information)</span><br/>
      <div>
      <table border="0" xwidth="100%">
            <font color="blue">
            <xsl:for-each select="bib/keyword">
          <tr>
          <td valign="top" class="x4bibkw">
              <xsl:value-of select="@kw"/>
          </td>
          <td class="x4bibkwcode">
              <xsl:for-each select="kwCode">
            <div class="x4code">
                <xsl:if test="Poiter !='' " >
                  <span class="x4pointer"><xsl:value-of select="Poiter"/></span>
                  <xsl:text > </xsl:text>
                </xsl:if>
                <xsl:if test="Code !='' " >
                  <span class="x4code1">(<xsl:value-of select="Code"/>)</span>
                  <xsl:text > </xsl:text>
                </xsl:if>
                <xsl:if test="Free !='' " >
                  <span class="x4free1"><xsl:value-of select="Free"/></span>
                </xsl:if>
          </div>
              </xsl:for-each>
        </td>
        </tr>
            </xsl:for-each>
            </font>
      <span class="end1">ENDBIB</span>
      </table>
      </div>
    </div>
    </xsl:if>
  </div>
  </xsl:for-each>
  </div>
</xsl:for-each>
</td></tr></table>
</BODY>
</HTML>
</xsl:template>
</xsl:stylesheet>
```

XSL:

XML → HTML

```
div {  padding-left: 10px;  margin-left:  5px;  padding-right: 10px;}
div.x4bib {  border:1px dashed #aaa;  padding-bottom: 10px;}
div.x4entry {
  border-bottom:40px solid #fff;  padding:0;  margin:0;
  font-size:14pt;  background-color:#eee;  page-break-after: always;}
div.x4code {margin:0;  padding:0;}
.x4code1 {
  color:green;  padding:1px;}
.x4free1 {
  color: black;  padding:1px;  padding-left:2px;  margin-left:4px;
  white-space: pre-wrap;}
div.x4sub {
  padding-bottom: 10px;  margin: 10px;  border:1px dotted green;
  font-size:9pt;  line-height:12pt;  background-color:#fff;
}
.end1 {  display: none;}
.x4pointer {
  background-color: red;
  color: white;
  padding-left:3px;
  padding-right:3px;}
body {  font-family: verdana,geneva,helvetica,sans-serif;  font-size:9pt;
  color: blue;
}
.x4hlp {
  font-family: verdana,geneva,helvetica,sans-serif;
  font-size:8pt;
  color:#c0c;
  padding-left:10px;
}
table, td {
  font-size:9pt;
  margin:0;
  padding:0;
  border-collapse: collapse;
}
td {
  border:1px solid #aaa;
  border-right: none;
  border-left: none;
  padding-left:3px;
  padding-right:3px;
  border-collapse: collapse;
}
td.x4bibkw {
  border-left:1px solid #aaa;
  width:70pt;
}
td.x4bibkwcode {
border-right:1px solid #aaa;
  padding-left:3px;
  padding-right:3px;
  width:350pt;
}
```

CSS: Stiles



EXFOR-XML View in Web-Browser

Thank you.