IAEA-NDS Nuclear Reaction Databases and Services

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International Atomic Energy Agency, Nuclear Data Section

Joint ICTP-IAEA Workshop on Nuclear Structure and Decay Data: Experiment, Theory and Evaluation
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Topics:

1. Nuclear reaction databases and software system. Overview
2. Introduction to EXFOR-ENDF Web database retrieval system
3. Flexible ENDF database explorer
4. IBANDL Web system
5. EXFOR data re-normalization system
6. Inverse reactions and inverse kinematics in EXFOR and IBANDL
7. Uploading your experimental data
8. Plotting on Web with Web-ZVView
9. Not covered topics

Nuclear Reaction Database and Software Systems Overview

Our Internet Address

http://www-nds.iaea.org

Our Postal Address:

Nuclear Data Section,
International Atomic Energy Agency
Vienna International Centre,
P.O. Box 100, A-1400 Vienna,
Austria

Nuclear Reaction Databases

Database	Contents	Size (2003)	Size (2018)
EXFOR	contains experimental nuclear reaction data for incident neutrons, charged particles and photons	13,500 Entries 97,000 Data sets 400 Mb ASCII-text	22,294 Entries 169,989 Data sets 752 Mb ASCII-text
ENDF	collection of evaluated data libraries containing cross sections, spectra, angular distributions, fission product yields, photo-atomic and thermal scattering law data	~300 Mb ASCII 5 basic libraries	>250 Gb ASCII 58 libraries
CINDA	contains bibliographical references to experimental and evaluated nuclear reaction data, and to calculations, reviews, compilations of nuclear data.	266,000 Lines 40,500 publications 32,500 Blocks 37 Mb ASCII-text	577,219 Lines 94,100 publications 294,302 Blocks 112 Mb ASCII-text
IBANDL	Ion Beam Analysis Nuclear Data Library of experimental differential cross-sections	615 Datasets 1.9 Mb	3,690 Datasets 16 Mb ASCII-text

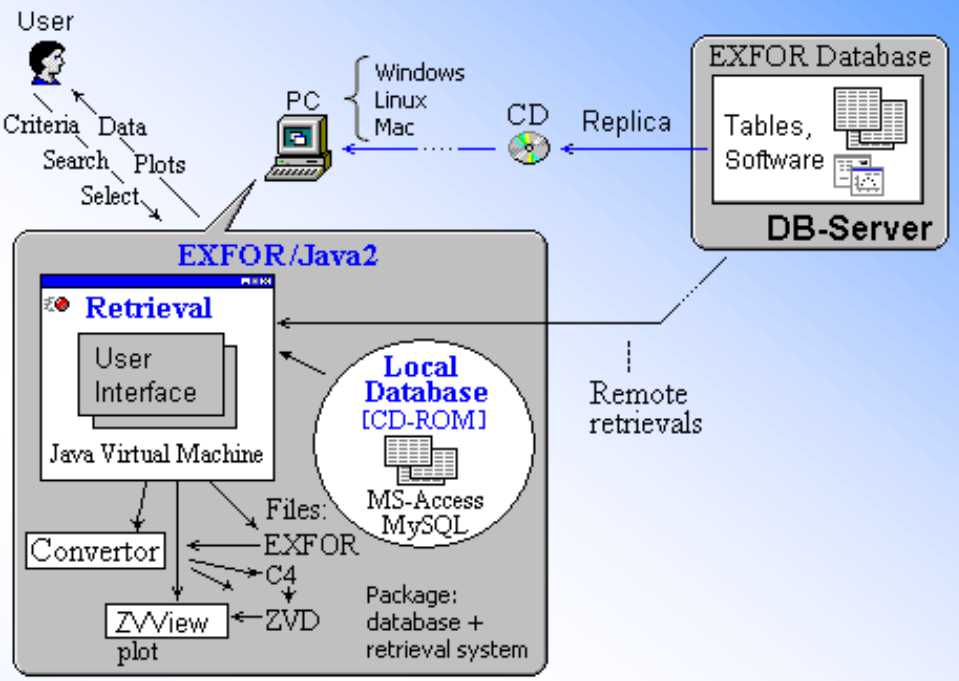
Basic principals of the IAEA-NDS nuclear databases and software systems

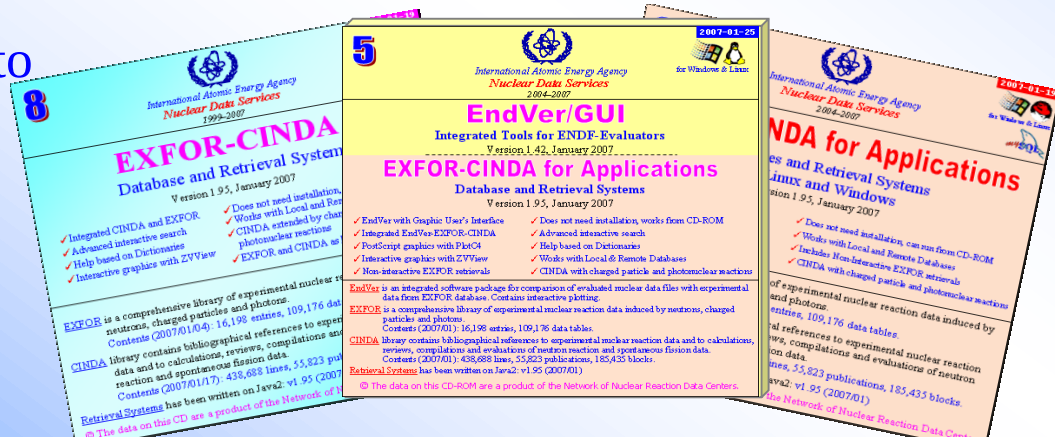
- Maximum of platform independency
  - operating systems: Linux, Windows, Mac
  - relational databases (MySQL, Access, SyBase, etc.)
  - programming languages: Java, SQL, Javascript, C, Fortran
- Free of charge system components
  - Linux, Apache, Tomcat, MariaDB
- Full integration of components
  - no installation (CD-ROM, Web, individual programs)
  - automatic configuration of Web-Servlets and scripts
  - encapsulated graphics

NDS CD-ROM Database Retrieval Systems

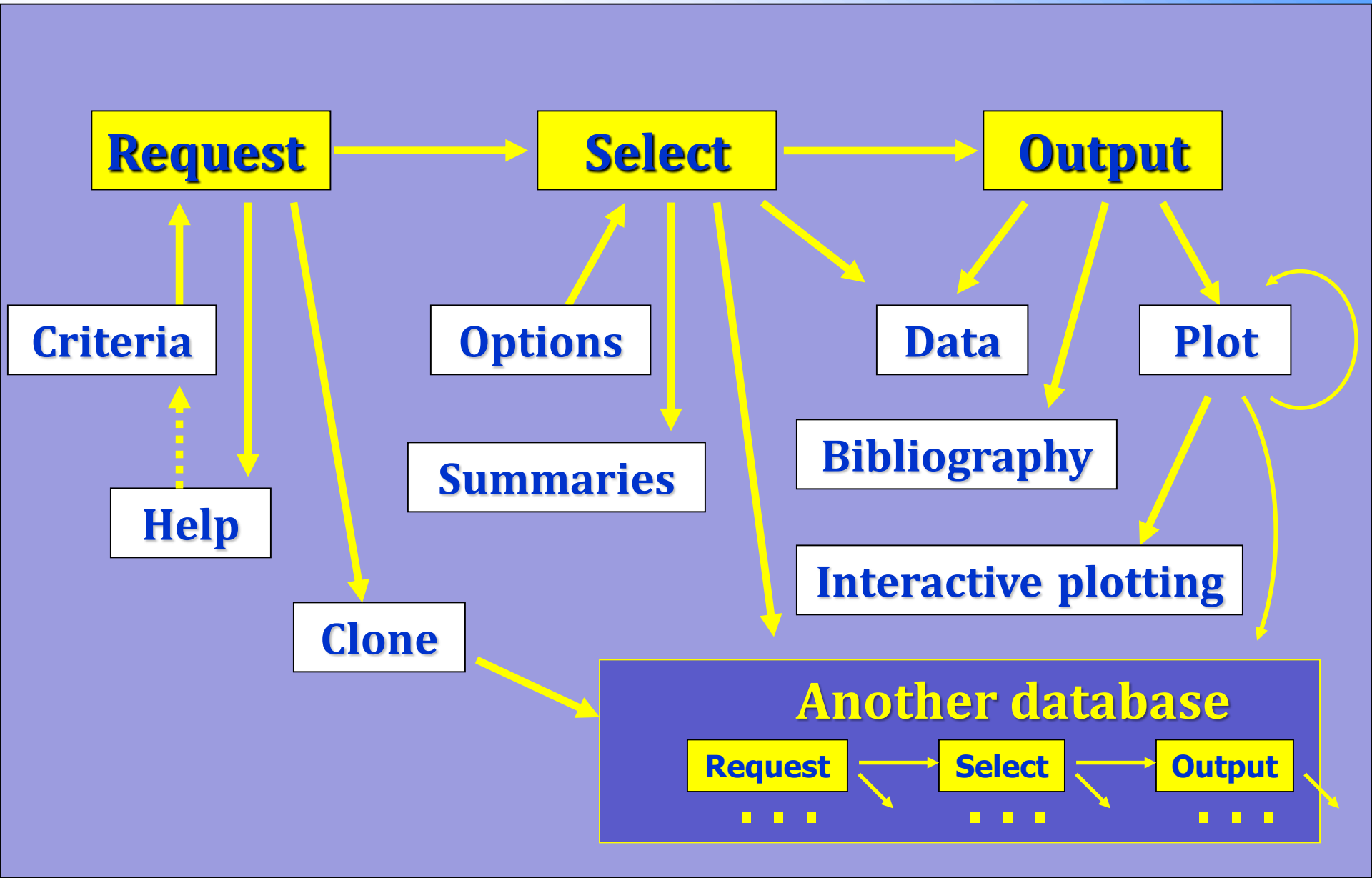
/since 2003/

- Full database on your PC
- For Windows, Linux and Mac
- Does not need installation
- Can run from CD-ROM (database server and Java JVM running from CD)
- Can work with remote databases
- Integrated EXFOR and CINDA
- Help with Dictionaries
- Advanced search (+users' SQL)
- Interactive plotting with ZVView
- EndVer/GUI with integrated PrePro and EXFOR
- Includes non-interactive retrievals to build new user's applications
- Used by Applications: Empire, EndVer, GANDR, expandable…
- Nowadays updated once per year





Retrieval system: main stream of users' interactions



Web interface

1. Intuitive
2. Suitable for beginners and ND professionals
3. Alternative interfaces
4. Non-trivial operations are described in:
    a) Documentation
    b) Examples
    c) News, software history, how-to, FAQ pages
    d) Video-Guides

Introduction to EXFOR-ENDF Web database retrieval system

EXFOR: library, database, retrieval systems

Experimental data in exchange format

- 1970 agreed format and established exchange between USA, NEA, IAEA, USSR
- contains data from ~22,300 experiments
- NRDC: 13 nuclear data centres compile ~500 new Entries every year
- since 2005: global library with central maintenance in the IAEA (NDS)
- Master File (750Mb), 52 Dictionaries, 2 Manuals (400 pages)
- Distribution to users: EXFOR, X4+, C4, XML, Html, plots
- Assess via: Web, CD/DVD ROM, FTP
- Databases DBMS: MySQL, MS-Access, SyBase
- Software: C, Java (GUI-Applications, Web-Servlets), Fortran
- Connection to other databases ENDF, CINDA, NSR, IBANDL: import-export data, common plotting, links, cross-search

```
ENTRY            41323   20050902
SUBENT        41323001   20050902
BIB                  7         12
INSTITUTE   (4RUSMIF)
REFERENCE   (J,AE,50,(5),350,198105) M
            (J,SJA,50,325,1981)  ENGLI
AUTHOR      (V.E.ZHITAREV,A.M.MOTORIN,
TITLE       .INTERACTION CROSS SECTION
             WITH COLD NEUTRONS
FACILITY    (REAC)
ERR-ANALYS  (EN-ERR)    WAVE-LENGTH RES
                        TIMES 100 (IN P
HISTORY     (19981121C)  + +  COMPILED
            (20050902A)  . .  Correcte
                         Data-heading
ENDBIB              12
COMMON               3          3
EN-ERR      TEMP        TEMP-ERR
PER-CENT    DEG-C       DEG-C
   3.         22.         3.
ENDCOMMON            3
ENDSUBENT           19
SUBENT        41323002   20050902
BIB                  5          8
REACTION    (13-AL-27(N,TOT),,SIG)
SAMPLE      .ALUMINIUM MONOCRYSTAL, PU
             96 MM, DENSITY 2.70 GRAM/
             MACROCRISTALLINE ALUMINIU
             THICKNESS 50 MM, DENSITY
ERR-ANALYS  (DATA-ERR) NO INFORMATION
STATUS      (TABLE)  DATA ARE TAKEN FR
HISTORY     (19981121T)  + + CONVERTED
ENDBIB               8
NOCOMMON             0          0
DATA                 3          8
WVE-LN      DATA        DATA-ERR
ANGSTROM    B           B
 1.3000E+01 1.9300E+00 1.3000E-01
 1.4000E+01 2.1200E+00 9.0000E-02
 1.5000E+01 2.2500E+00 8.0000E-02
 1.6000E+01 2.3800E+00 7.0000E-02
 1.7000E+01 2.5400E+00 6.0000E-02
 1.8000E+01 2.6100E+00 6.0000E-02
 1.9000E+01 2.8200E+00 8.0000E-02
 2.0000E+01 3.1500E+00 6.0000E-02
ENDDATA             10
ENDSUBENT           23
ENDENTRY             2
```

```
ENTRY            41323   20050902
  SUBENT        41323001   20050902
    BIB                  7         12
      INSTITUTE   (4RUSMIF)
      REFERENCE   (J,AE,50,(5),350,198105) MAIN REFERENCE, DATA ARE GIVEN
                  (J,SJA,50,325,1981)  ENGLISH TRANSLATION
      AUTHOR      (V.E.ZHITAREV,A.M.MOTORIN,S.B.STEPANOV)
      TITLE       .INTERACTION CROSS SECTIONS OF CERTAIN METALS
                   WITH COLD NEUTRONS
      FACILITY    (REAC)
      ERR-ANALYS  (EN-ERR)    WAVE-LENGTH RESOLUTION DELTA-LAMBDA/LAMBDA
                              TIMES 100 (IN PERCENT)
      HISTORY     (19981121C)  + +  COMPILED AT THE CJD + +
                  (20050902A)  . .  Corrected at the CJD + +
                                 Data-heading "EN" changed to "WVE-LN"
    ENDBIB              12
    COMMON               3          3
      EN-ERR      TEMP        TEMP-ERR
      PER-CENT    DEG-C       DEG-C
         3.         22.         3.
      ENDCOMMON            3
    ENDSUBENT           19
  SUBENT        41323002   20050902
    BIB                  5          8
      REACTION    (13-AL-27(N,TOT),,SIG)
      SAMPLE      .ALUMINIUM MONOCRYSTAL, PURITY 99.99 PC, THICKNESS
                   96 MM, DENSITY 2.70 GRAM/CM3 AND
                   MACROCRISTALLINE ALUMINIUM, PURITY 99.99 PC,
                   THICKNESS 50 MM, DENSITY 2.70 GRAM/CM3
      ERR-ANALYS  (DATA-ERR) NO INFORMATION GIVEN
      STATUS      (TABLE)  DATA ARE TAKEN FROM TABLE 1 OF MAIN REF.
      HISTORY     (19981121T)  + + CONVERTED FROM SUBENT 88023002
    ENDBIB               8
    NOCOMMON             0          0
    DATA                 3          8
      WVE-LN      DATA        DATA-ERR
      ANGSTROM    B           B
       1.3000E+01 1.9300E+00 1.3000E-01
       1.4000E+01 2.1200E+00 9.0000E-02
       1.5000E+01 2.2500E+00 8.0000E-02
       1.6000E+01 2.3800E+00 7.0000E-02
       1.7000E+01 2.5400E+00 6.0000E-02
       1.8000E+01 2.6100E+00 6.0000E-02
       1.9000E+01 2.8200E+00 8.0000E-02
       2.0000E+01 3.1500E+00 6.0000E-02
    ENDDATA             10
  ENDSUBENT           23
ENDENTRY             2
```

EXFOR Logic

EXFOR Interpreted: X4+, XML, X4±

EXFOR data: http://www -
Data retrieved from the EXI

```
ENTRY          41323
SUBENT         41323001
BIB                7
INSTITUTE      (4RUSMIF)
               #(4RUSMIF) Mo
REFERENCE      (J,AE,50,(5),
               (J,SJA,50,325
               # (J,AE,50,(5),
               # (J,SJA,50,325
AUTHOR         (V.E.ZHITAREV
TITLE          .INTERACTION
                WITH COLD NE
FACILITY       (REAC)
               #(REAC) React
ERR-ANALYS     (EN-ERR)    WI
                           TI
HISTORY        (19981121C)
               (20050902A)

ENDBIB            12
COMMON             3
EN-ERR         TEMP        TE
PER-CENT       DEG-C       DE
3.             22.         3.
ENDCOMMON          3
ENDSUBENT         19
SUBENT         41323002
BIB                5
REACTION       (13-AL-27(N,T
               #(13-AL-27(N,T
               #        Proce
SAMPLE         .ALUMINIUM MO
                96 MM, DENSI
                MACROCRISTAL
                THICKNESS 50
ERR-ANALYS     (DATA-ERR) NO
STATUS         (TABLE)   DATA
HISTORY        (19981121T)
ENDBIB             8
NOCOMMON           0
DATA               3
WVE-LN         DATA        DA
ANGSTROM       B           B
13.            1.93        0.
14.            2.12        0.
15.            2.25        0.
16.            2.38        0.
17.            2.54        0.
18.            2.61        0.
19.            2.82        0.
20.            3.15        0.
ENDDATA           10
ENDSUBENT         23
ENDENTRY           2
```

```
<?xml version="1.0" encoding="WINDOWS-1251"?>
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 - <x4entry Author="V.E.Zhitarev+" Ref1Year="1981" accnum="41323"
   - <x4subent N2="20050902" subacc="41323001">
     - <bib nKw="12">
       - <keyword subacc="41323001" nCodes="1" kw="INSTITU
         - <kwCode iCode="0" pointer=" ">
           - <x4code type="INSTITUTE">
               <x4code1 expansion="Moscow Inst.of Engine
                 dictionary="INSTITUTE">4RUSMIF</x4co
             </x4code>
           </kwCode>
         </keyword>
       - <keyword subacc="41323001" nCodes="2" kw="REFEREN
         - <kwCode iCode="0" pointer=" ">
           - <x4code type="REFERENCE">
               <x4code1 expansion="Jour: Atomnaya Energi
                 dictionary="REFERENCE" Year="1981" pag
                 Type="J">J,AE,50,(5),350,198105</x4co
             </x4code>
             <Free type="1" ln="1"> MAIN REFERENCE, DATA
           </kwCode>
         - <kwCode iCode="1" pointer=" ">
           - <x4code type="REFERENCE">
               <x4code1 expansion="Jour: Soviet Atomic Ene
                 dictionary="REFERENCE" Year="1981" pag
                 Type="J">J,SJA,50,325,1981</x4code1>
             </x4code>
             <Free type="1" ln="1"> ENGLISH TRANSLATION
           </kwCode>
         </keyword>
       - <keyword subacc="41323001" nCodes="1" kw="AUTHOR"
         - <kwCode iCode="0" pointer=" ">
           - <x4code type="AUTHOR">
             - <authors a1ini="V.E." a1="Zhitarev" nn="3">
                 <author ii="1">V.E.ZHITAREV</author>
                 <author ii="2">A.M.MOTORIN</author>
                 <author ii="3">S.B.STEPANOV</author>
               </authors>
             </x4code>
           </kwCode>
         </keyword>
       - <keyword subacc="41323001" nCodes="1" kw="TITLE">
         - <kwCode iCode="0" pointer=" ">
             <Free type="1" ln="2">.INTERACTION CROSS SE
               NEUTRONS</Free>
           </kwCode>
         </keyword>
       - <keyword subacc="41323001" nCodes="1" kw="FACILITY
         - <kwCode iCode="0" pointer=" ">
           - <x4code type="FACILITY">
               <x4code1 expansion="Reactor" dictionary="FA
             </x4code>
           </kwCode>
         </keyword>
       - <keyword subacc="41323001" nCodes="1" kw="ERR-ANA
         - <kwCode iCode="0" pointer=" ">
             <Code type="0">EN-ERR</Code>
             <Free type="1" ln="2"> WAVE-LENGTH RESOLUT
               (IN PERCENT)</Free>
           </kwCode>
```

- EXFOR file
  - ENTRY 41323 1981, V.E.Zhitarev+ last-updated: 2005-09-02
    - SUBENT 41323001 last-updated: 2005-09-02
      - BIB #bibliographic and descriptive information
        - INSTITUTE
          - (4RUSMIF) #Moscow Inst.of Engineering Physics, Moscow, Russia
        - REFERENCE
          - (J,AE,50,(5),350,198105) #Jour: Atomnaya Energiya, Vol.50, Issue.5, p.350 (1981), Russia
            MAIN REFERENCE, DATA ARE GIVEN
          - (J,SJA,50,325,1981) #Jour: Soviet Atomic Energy, Vol.50, p.325 (1981), USA
            ENGLISH TRANSLATION
        - AUTHOR
          - (V.E.ZHITAREV, A.M.MOTORIN, S.B.STEPANOV)
        - TITLE
          - .INTERACTION CROSS SECTIONS OF CERTAIN METALS WITH COLD NEUTRONS
        - FACILITY
        - ERR-ANALYS
        - HISTORY
      - COMMON 3x1 #Constant parameters
        - Legend

EN-ERR	Uncertainty in incident projectile energy	PER-CENT	per-cent
TEMP	Sample temperature	DEG-C	degrees Celsius, Centigrade
TEMP-ERR	Error in sample temperature	DEG-C	degrees Celsius, Centigrade

        - Data

EN-ERR	TEMP	TEMP-ERR
PER-CENT	DEG-C	DEG-C
3.0	22.0	3.0

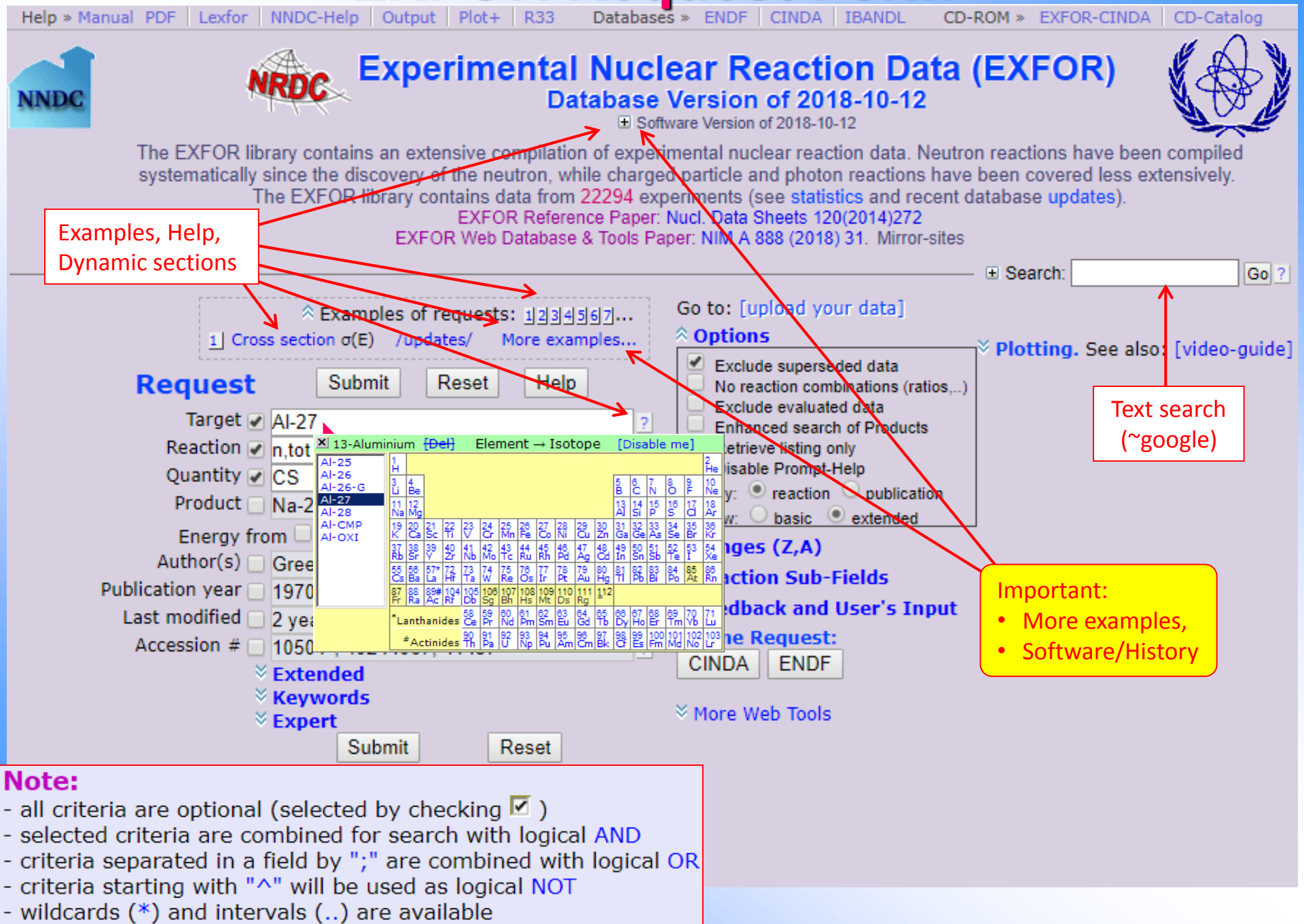
    - SUBENT 41323002 last-updated: 2005-09-02
      - BIB #bibliographic and descriptive information
        - REACTION
          - (13-AL-27(N,TOT),,SIG)
            #Target:AL-27 #Projectile:N #Reaction:N,TOT #Process:TOT:Total #Quantity:,SIG:CS:C
        - SAMPLE
          - .ALUMINIUM MONOCRYSTAL, PURITY 99.99 PC, THICKNESS 96 MM, DENSITY 2.70 GRAM/CM3 AND MACROCRISTALLINE ALUMINIUM, PURITY 99.99 PC, THICKNESS 50 MM, DENSITY 2.70 GRAM/CM3
        - ERR-ANALYS
        - STATUS
        - HISTORY
      - NOCOMMON
      - DATA 3x8
        - Legend

WVE-LN	Wave length of incident particle	ANGSTROM	Angstroms
DATA	Cross section 13-AL-27(N,TOT),,SIG	B	barns
DATA-ERR	Error in value of quantity, defined under ERR-ANALYS	B	barns

        - Data

WVE-LN	DATA	DATA-ERR
ANGSTROM	B	B
13.0	1.93	0.13
14.0	2.12	0.09
15.0	2.25	0.08
16.0	2.38	0.07
17.0	2.54	0.06

EXFOR Request Form



Note:

- all criteria are optional (selected by checking ☑)
- selected criteria are combined for search with logical AND
- criteria separated in a field by ";" are combined with logical OR
- criteria starting with "^" will be used as logical NOT
- wildcards (*) and intervals (..) are available

EXFOR Request Form. Examples

Examples of requests: 1 2 3 4 5 6 7 ...

1 Cross section σ(E) /updates/ Less examples...

2 Angular distributions dσ/dΩ

3 Emission spectra dσ/dE*out*

4 Double differential cross section d²σ/dΩ/dE*out*

5 Corrections data from EXFOR Ex.1 ZK1 ZK2 AT1 RC1

6 Search by outgoing particles: [α+γ] P,XG (P,XG),DA

6+ Search data for IBANDL: $^{12}C(\alpha,\alpha)^{12}C$, θ=167°

7 Enhanced search by product with filtering product coded as ELEM/MASS for quick plot

8 Search by wildcards in full reaction code

9 Ratios converted to cross sections (C4)

10 NUBAR: average number of neutrons per fission PR DL ^DL

11 Constructing a covariance matrix from EXFOR uncertainties

12 Extended listing of references (authors, title, DOI, NSR, Web)

13 EXFOR - CINDA sequential search N,F

14 Automatic re-normalization (output data and plots); $^{55}Mn(n,g)$

15 Find data: [digitized] from plots, [not digitized], [from table] [experimental data only] [not empty datasets] [empty]

16 Search by authors using aliases Ex.2

17 Fission spectra b Thick target neutron spectra c Delayed neutrons d Kerma factor

18 Invert reaction using detailed balance $^{13}C(\alpha,n)^{16}O \rightarrow {}^{16}O(n,\alpha)^{13}C$: σ dσ/dΩ Ex.2: $^{3}He(d,p)^{4}He \rightarrow {}^{4}He(p,d)^{3}He$ dσ/dΩ [plot]

19 Various fission quantities: a Yield (chain, primary FF, secondary FF) b Cumulative yield of ^{147}Nd c Total kinetic energy d Multiplicity of prompt fission neutrons

20 Plotting cross section coded with SF8=DAM; all

EXFOR Request Form. News & History

Software Version of 2018-10-12

News

2017/01 New.Web-ZVView plots: affine transformations (PS/EPS) [how-to], distortion picture using 2D-calibration [how-to]
2016/11 Plotting without grouping by reaction-codes (+ calculating CS ratios between diff. datasets on the fly) [example]
2016/11 Plotting cross section coded with SF8=DAM (CS divided by atomic mass of target) [example] #Adv.plot using C5
2016/11 Recalculation of angular distributions to inverse kinematics (when converting EXFOR→R33) [example] [how-to]

[History]

2016/09 New. Mirror-site in Russia: http://www-nds.atomstandard.ru/exfor/
2016/03 New. Upload your data for constructing covariance matrix, calculating inverse reaction cross sections, etc. [page]
2016/02 Output links to NSR and Web publication for secondary references of an Entry
2016/01 New. Display original publication of the IAEA INDC Reports (in PDF format)
2015/03 New. Inverting reaction data using detailed balance. Example: $^{13}C(\alpha,n)^{16}O \rightarrow {}^{16}O(n,\alpha)^{13}C$ See: [how-to]
2014/12 New. Text search in extended EXFOR [instructions/examples] See: [concept], [how-to]
2014/07 New. Database of expert's corrections to EXFOR data on Web. Examples: Fe-54(n,p); Mn-55(n,2n), (n,g)
2014/02 Universal X4Plot with arbitrary selection and groupping columns (use: "Sort by: reaction" and "View: extended") [how-to]
2014/02 New version (v2) of XML output format [about]
2013/05 EXFOR Milestone: 20,000 experimental works are now in the database!
2013/01 Collection of video-guides to EXFOR-ENDF database Web retrieval system: [page]
2012/11 Searching data compiled: [digitizing] plots, [not digitized], given [in tables]
2012/10 New plotting regime: switch display of data to display of ratios on the fly [video]
2012/07 Sort by publications with extended view [example]
2012/07 Searching reactions: n,xp; p,xg, etc. [example]
2012/02 Improvements and extensions:
    1) Automactic data re-normalization (optional: for plots and output data only) [video]
    2) Web-ZVView plotting: clipboard copy/paste
2011/12 Search in CINDA (+NSR) if data not found in EXFOR
2011/10 Web-ZVView plotting: output PS and PDF files
2011/09 EXFOR to XML; interpretation EXFOR-XML to HTML using XLS [xml] [html] [example]
2011/06 Software development:
    1) Interactive Web-constructing a covariance matrix from EXFOR uncertainties [doc]
    2) Output to C5 computational format (C5 = C4 + statistical and systematic uncertainties)
2011/05 Improvements and extensions:
    1) Search by DOI and NSR-KeyNo (Extended mode)
    2) Search by Keyword MONITOR
    3) Search by DatasetID (SubentPointer)
2011/01 Improvements and extensions:
    1) Search for recently updated data (Extended mode: Last modified)
    2) Display titles of original articles (imported from NSR) when data "Sorted by Publications"

News/history with: examples, how-to instructions, documentation

News & History

2010/08 Improvements and extensions:
1) Display range of products when coded as ELEM/MASS [example]
2) Display range of angles and secondary-energies on the "Data Selection" page
2010/02 Improvements and extensions:
1) Production of isotopes coded as ELEM/MASS: filtering and quick [plot] , sorting T4 [t4] [t4x]
2) Users' definition of ENDF:MF/MT for conversion EXFOR data to format C4 and advanced plotting
3) Search by compiling Center-ID (expert mode)
4) Search by outgoing particle coded in SF3,4,7 (expert mode)
2009/12 Improvements and extensions:
1) Correction of experimental data in computational formats [doc]
2009/07 Improvements and extensions:
1) Extended using plotting program ZVView via Web [about]
2009/02 Improvements and extensions:
1) New output format X4±: EXFOR interpreted-interactive-tree [about] [example]
2008/12 Improvements and extensions:
1) Advanced plot: ratios, ratios converted to cross sections using [IAEA-2006 Standards] [test]
2) Dynamic request page combining Standard, Extended and Advanced requests in one page
3) Prompt-Help system [page]
4) Extensions on Selection-page and EXFOR+: search by Author, Reaction, ENTRY
5) Search by full reaction code and Trans-ID (for experts only)
6) Video guide (test): how to plot EXFOR-ENDF double differential cross-sections [page]
2008/10 Common NRDC EXFOR Web Service: [IAEA-NDS] (conclusion of NRDC-2008 meeting)
2008/06 Improvements and extensions:
1) Search by data heading, units, points (in Advanced mode only)
2) New type of request: listing of experimental works
2008/04 Search by Title (in Extended and Advanced modes only)
2008/01 Software development:
1) Handling "Large" requests [about]
2) Conversion: EXFOR -> R33/IBANDL (β-version); [about][algorithm]
2007/11 Improvements/extensions:
1) General EXFOR Statistics [example]
2) Bibliography (Html and BibTeX) is improved; use link to NSR and Web journals; [example]
3) Output in R33/IBANDL format: version-1
2007/05 Output in R33/IBANDL format: angular distributions; includes plotting; version-0
2007/03 Interactive Web plotting: zoom by mouse, actions by one click, more functions...
2007/01 Improved request page of Web interface (dark non-active criteria, move focus...)
2006/10 EXFOR+: Extended EXFOR [example][about]
2006/10 BibTeX output: Bibliography for LaTeX [example][about]
2006/08 Extended plotting: experimental vs. evaluated data [example][how-to]
1. Cross sections with errors of evaluated data CS => MF3+MF33
2. Differential cross section with respect to angle DA => MF4
3. Energy spectrum of outgoing particles DE => MF5
4. Double differential cross section DAE => MF6
5. Average number of neutrons per fission (nubar) MFQ => MF1
2005/11 Submit your data for compilation to the database [here]
2005/06 **Global EXFOR Master File !**
2005/03 Direct link to Web-Journals
2004/06 Clone your EXFOR request to CINDA and ENDF

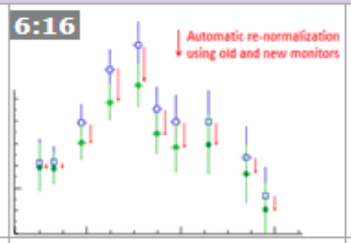
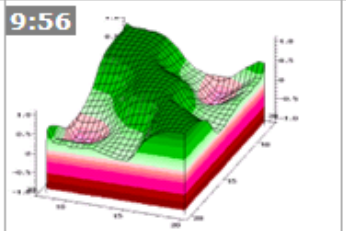
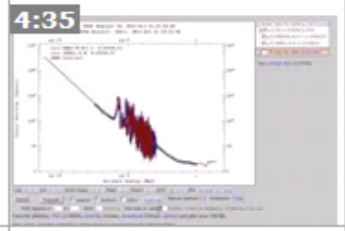
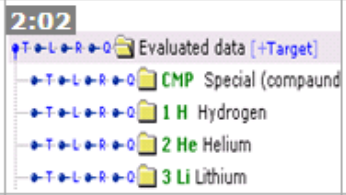
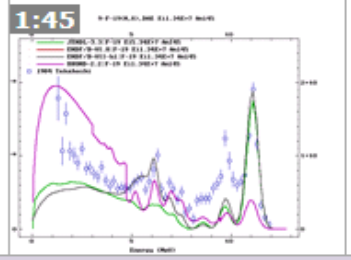
News/history with: examples, how-to instructions, documentation

https://www-nds.iaea.org/exfor/x4guide/

Video-guide

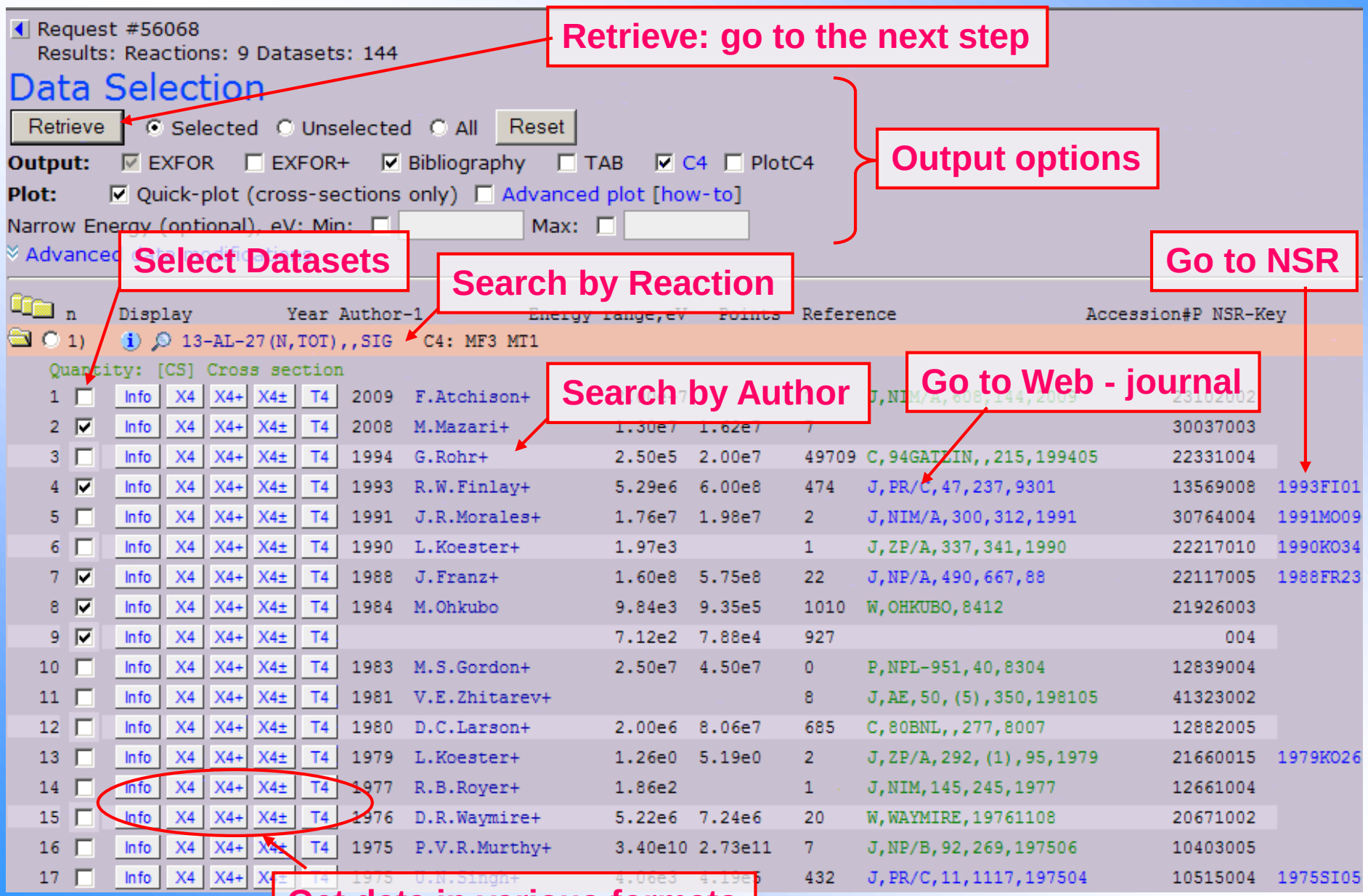
by V.Zerkin, IAEA-NDS, 29-Jan-2013

How-to for EXFOR-ENDF Database Web Retrieval System

2013.01.28	[Page] [MP4] [YouTube]		**Automatic re-normalization of EXFOR data under Web retrieval system** by V.Zerkin *How to renormalize experimental nuclear data from EXFOR database using NDS Web retrieval system.*
2013.01.25	[Page] [MP4] [YouTube]		**Display covariance data from ENDF libraries with Web-ZVView** by V.Zerkin *How to plot and compare covariances of evaluated nuclear data using ENDF Web database retrieval system with plotting package Web-ZVView*
2012.10.31	[Page] [MP4] [YouTube]		**Plot and compare nuclear data using normalization regime of Web-ZVView plotting package** by V.Zerkin *How to plot and compare experimental and evaluated nuclear data using normalization regime of Web-ZVView plotting package.*
2008.09.10	[Page]		**Using Flexible ENDF-database Explorer** by V.Zerkin *How to search, retrieve and plot ENDF-EXFOR cross-sections data using Flexible ENDF Explorer.* *See also: [help-page]*
2008.08.09	[Page]		**Plot EXFOR-ENDF double differential cross-sections** by V.Zerkin *How to retrieve and plot comparible EXFOR-ENDF double differential cross-sections using Web-ZVView plotting package.*

Submit *Activates search and display*

EXFOR Select Form



Types of plotting on our Web

- Quick plot: EXFOR-ENDF, cross sections (XS) only; XS filtered by product ELEM/MASS in EXFOR
- Advanced (Universal) plot: EXFOR-ENDF, MF1,3,4,5,6, using EndVer (A.Trkov); ratios, ratios converted to cross sections, XS ± ΔXS
- Native EXFOR plot: EXFOR only, any quantities
- Special ENDF plotting: MF3*MF6:Low=0 by products, MF10, relative uncertainties, XS with uncertainties (MF3+MF33)
- R33 plot: EXFOR-IBANDL, Web intrerface to IBANDL-SigmaCalc (A.Gurbich, IPPE) data
- PlotC4 (D.E. Cullen): C4 to PS and PS to PDF
- Z(X,Y): MF33, MF35, MF40; correlation matrix constructed on EXFOR uncertainties
- MyPlot: uploaded user's data (input: text columns, arrays, ENDF sections: MF33, MF3+MF33)

Output from EXFOR retrieval system

How it works

EXFOR Request Form

Search in EXFOR Database

EXFOR Select

Link R33 Single SUBENT

Java Servlet

Retrieve EXFOR

X4

X4TOC4 (R.Cullen, A.Trkov)

C4

C4TOR33

R33

Download R33 as text

IBANDL

EXFOR Database

Multiple or single choice of data/formats

Retrieve EXFOR files and convert to:

Internal Dictionary

EXFOR14A.DAT

Levels, masses

Bibliography

Info

BibTeX

Table

T4

X4+

X4±

X4

C4

R33

C5

C5M

XML

HTML

External programs

ENDF. Evaluated database retrieval system

ENDF: search, plot

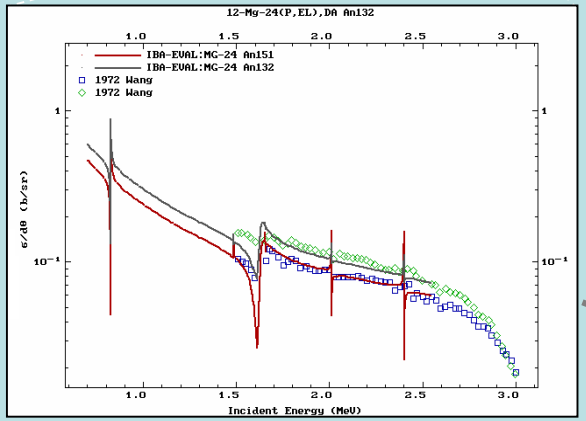
ENDF

Link

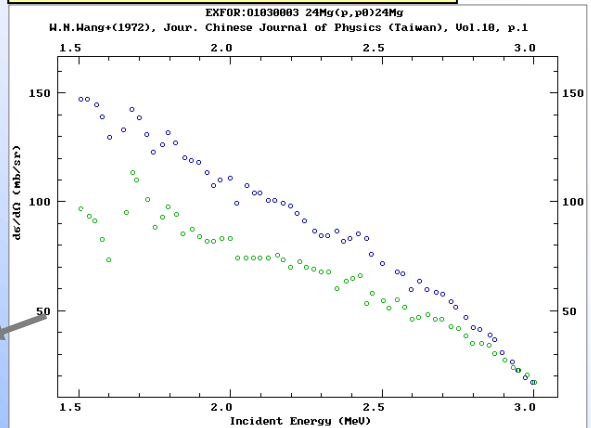
ENDF

Plot by Web-ZVView and other service

Data from one SUBENT (many Θ)



ZVView output



EXFOR Output Form

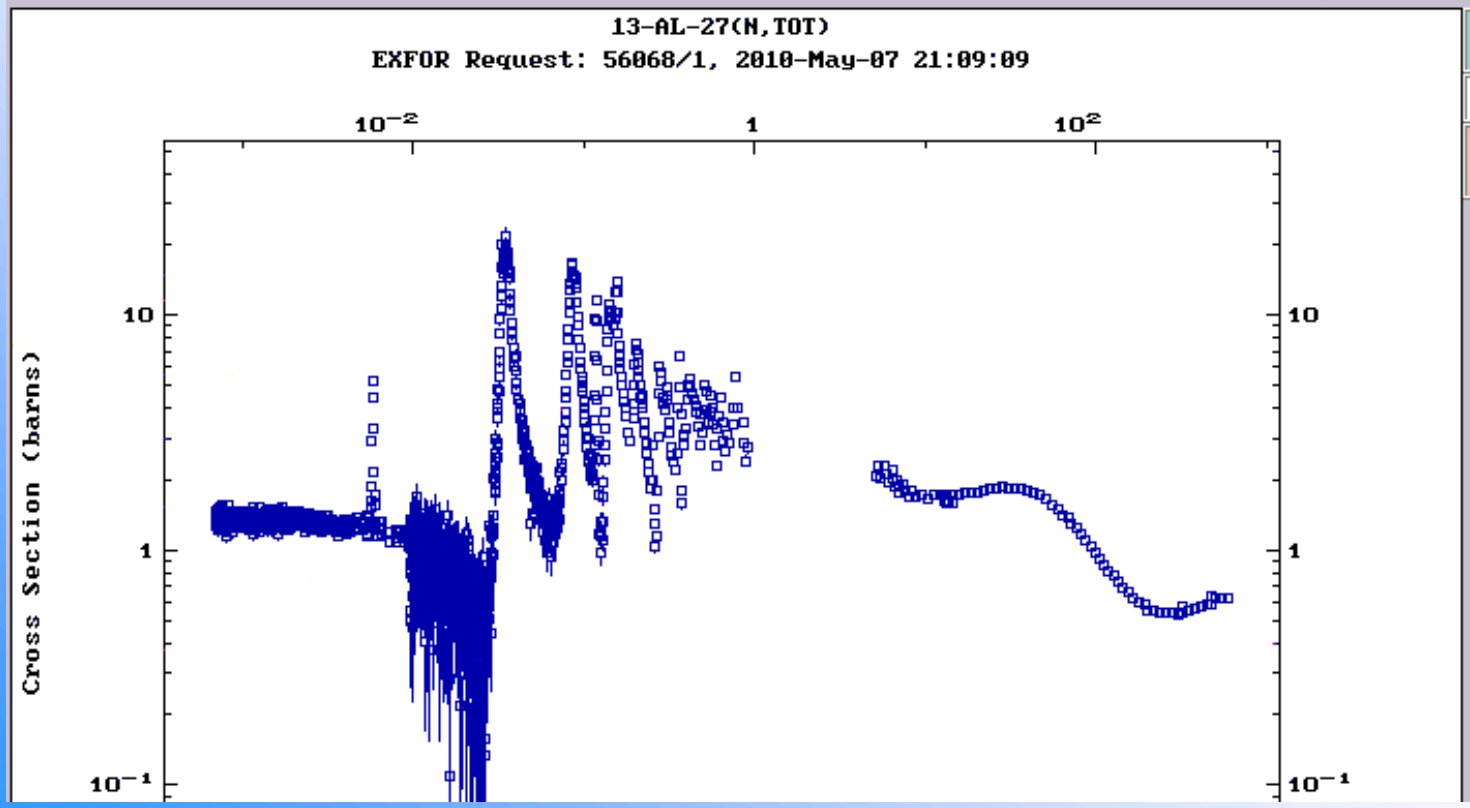
EXFOR Request #56068/1816

Output Data

Format	*Data (Size)*
EXFOR	Text (212Kb) ZIP (34Kb) Generate: X4±
Bibliography	html (15Kb) BibTeX (5Kb)
Computational	
C4	C4 (315Kb) C4.ZIP (23Kb) LST (99Kb)

Output data

Search similar evaluated data



ENDF Find and add to the plot evaluated data

1) 13-AL-27(N,TOT),,SIG

2) Use my data [example]

See: plotted data (194Kb)

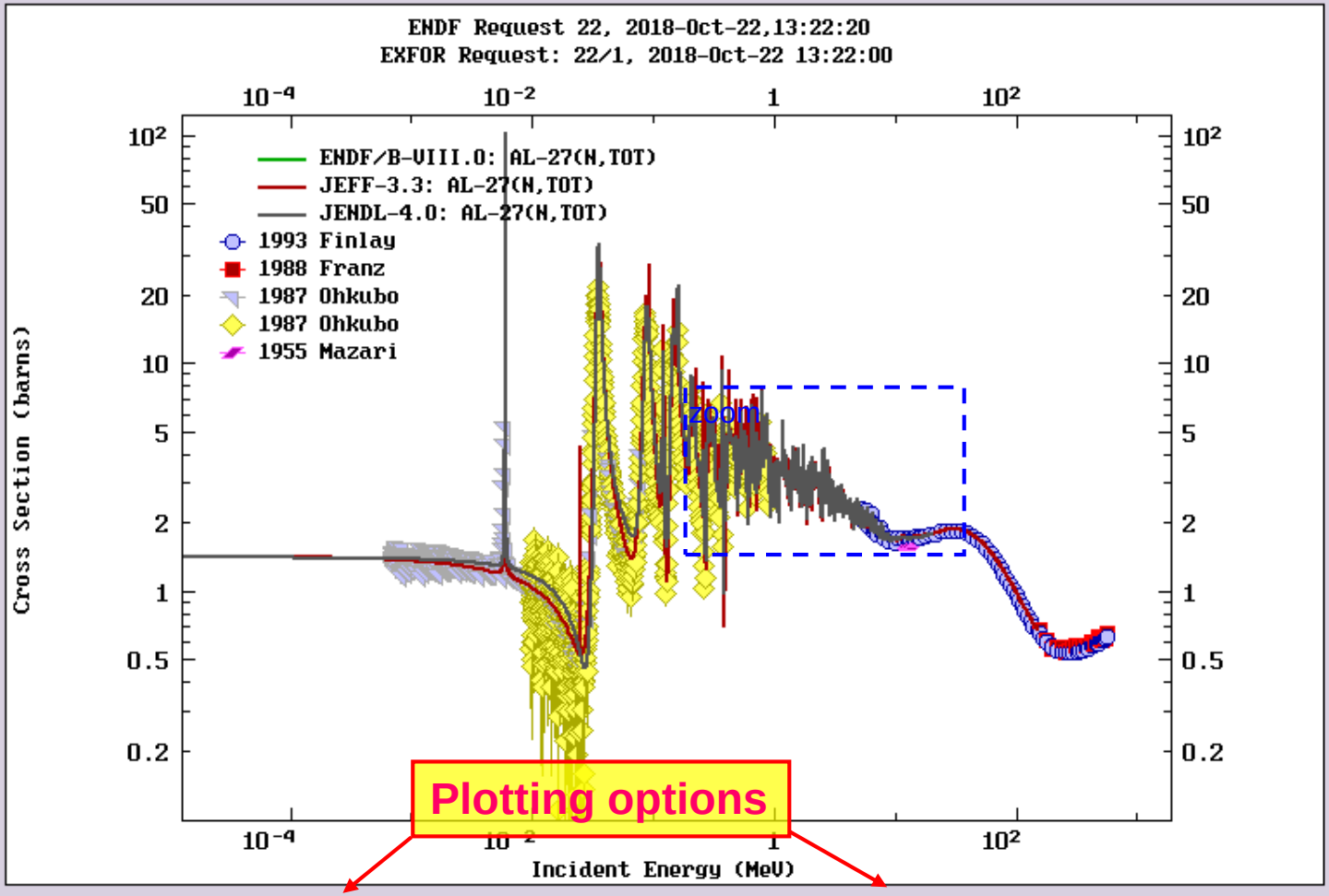
Get plotted data

ENDF Select Form

ENDF Output Form with interactive Web ZVView plotting

Select data for plotting

Cross Section



Select data for plotting [all] [none]
- 1) 13-AL-27(N,TOT),,SIG
  - 1993 R.W.Finlay, 13569008
  - 1988 J.Franz, 22117005
  - 1987 M.Ohkubo 21926004
  - 1987 M.Ohkubo 21926003
  - 1955 M.Mazari, 30037003
- 2) ENDF/B-VIII.0: AL-27(N,TOT)
- 3) JEFF-3.3: AL-27(N,TOT)
- 4) JENDL-4.0: AL-27(N,TOT)

5) Use my data [example]

Columns: x y [dy [dx]]

	1.5	2.336	0.384
	2	2.788	0.268
	2.33	2.96	0.4
	2.5	2.399	0.283
	3	2.424	0.197
	4.04	2.496	0.065
	5.06	2.222	0.065
	5.5	2.304	0.1659
	5.6	2.091	0.055

Type: Curve Points
Title: My data
Default: basic units! (eV, barn, etc.)
Multiply by: X: 1e6 Y: 1e-3

Use my control file [init] [help]

See: plotted data (835Kb)

Plotting options

Log: XY X Y Lin: XY X Y Auto-range: XY X Y Page: >> << Zoom: <> >< Grid: VH 0 V H Pts: Txt Box PL Print

Reset Repaint Legend Authors Info+ PostScript Plotting options: [+] Clipboard: Copy Paste

Shift legend: x=10 y=10 Split: 0 1:xy;2:y Marker: Plot data or ratio: 0 0:data; 1:ratio to dataset-1; 2:ratio to 2-nd, etc.

Data for plotting: ZVD (783Kb), send to ZVView; download ZVView; upload and plot your ZVD file

Add your data to the plot

Copy/Paste

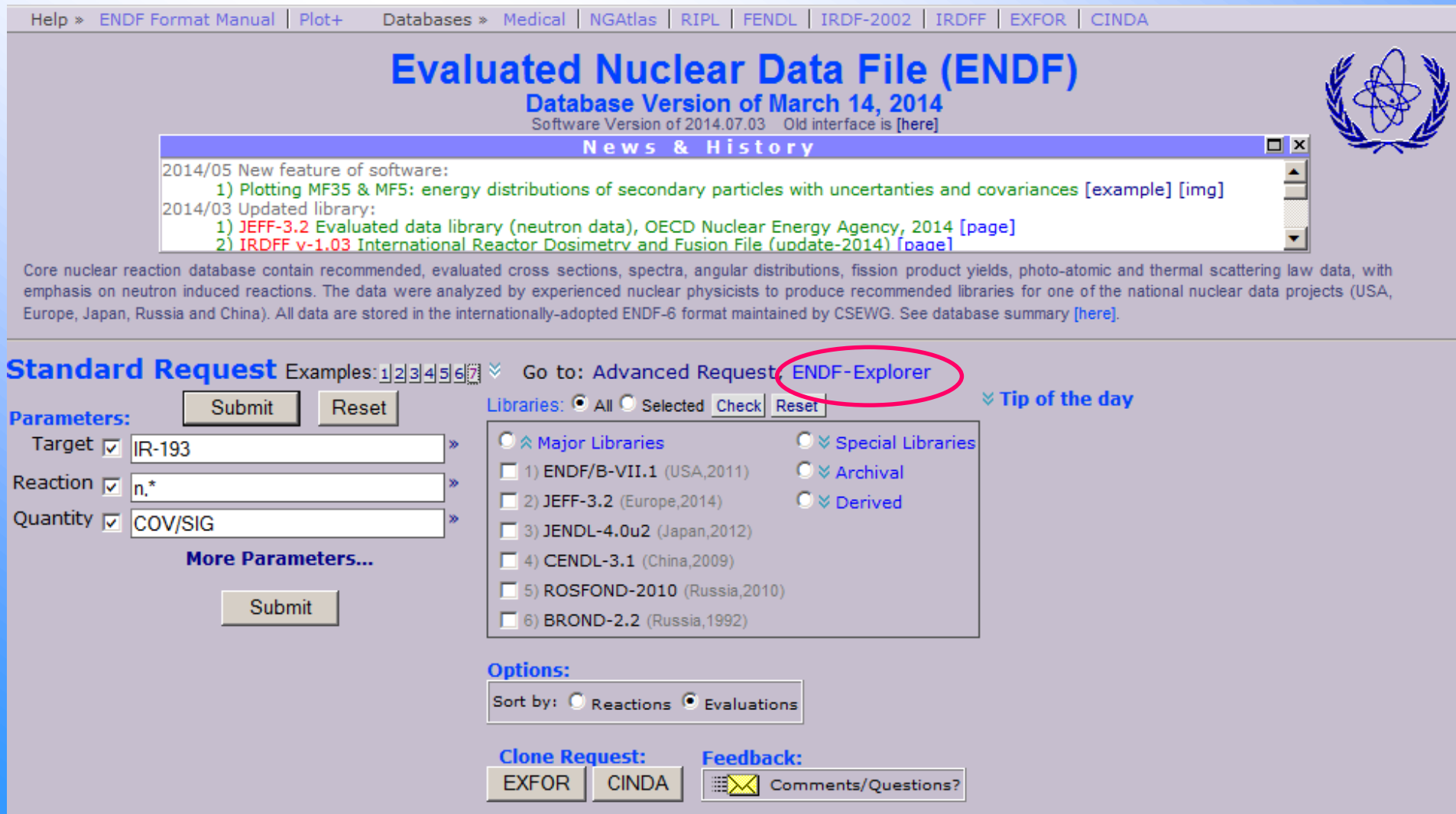
Flexible ENDF Database Explorer

Sequential search in ENDF database

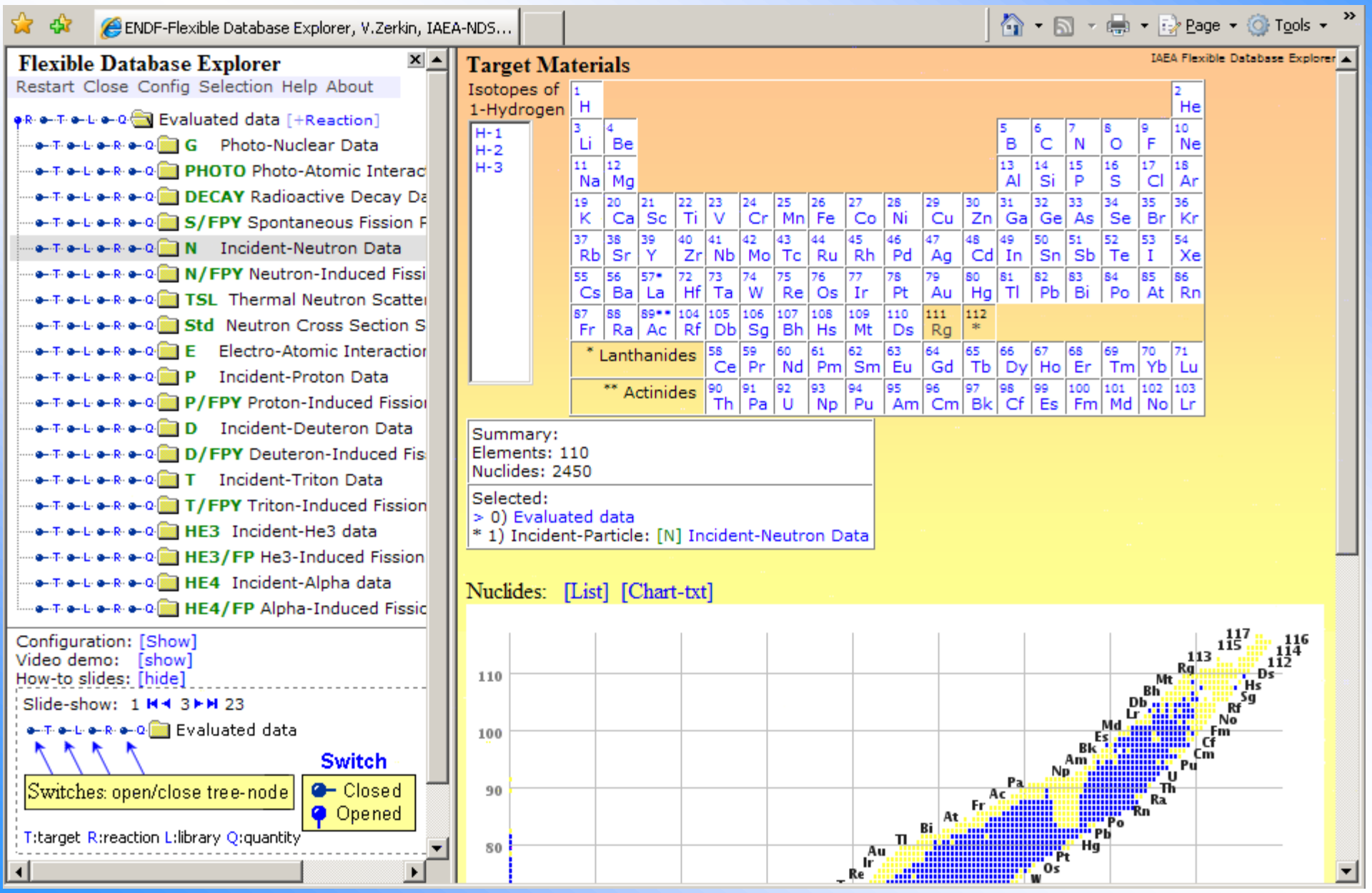
Direct data search: fill in a form and submit request

Sequential data search: travel on a database tree /ENDF-Explorer/

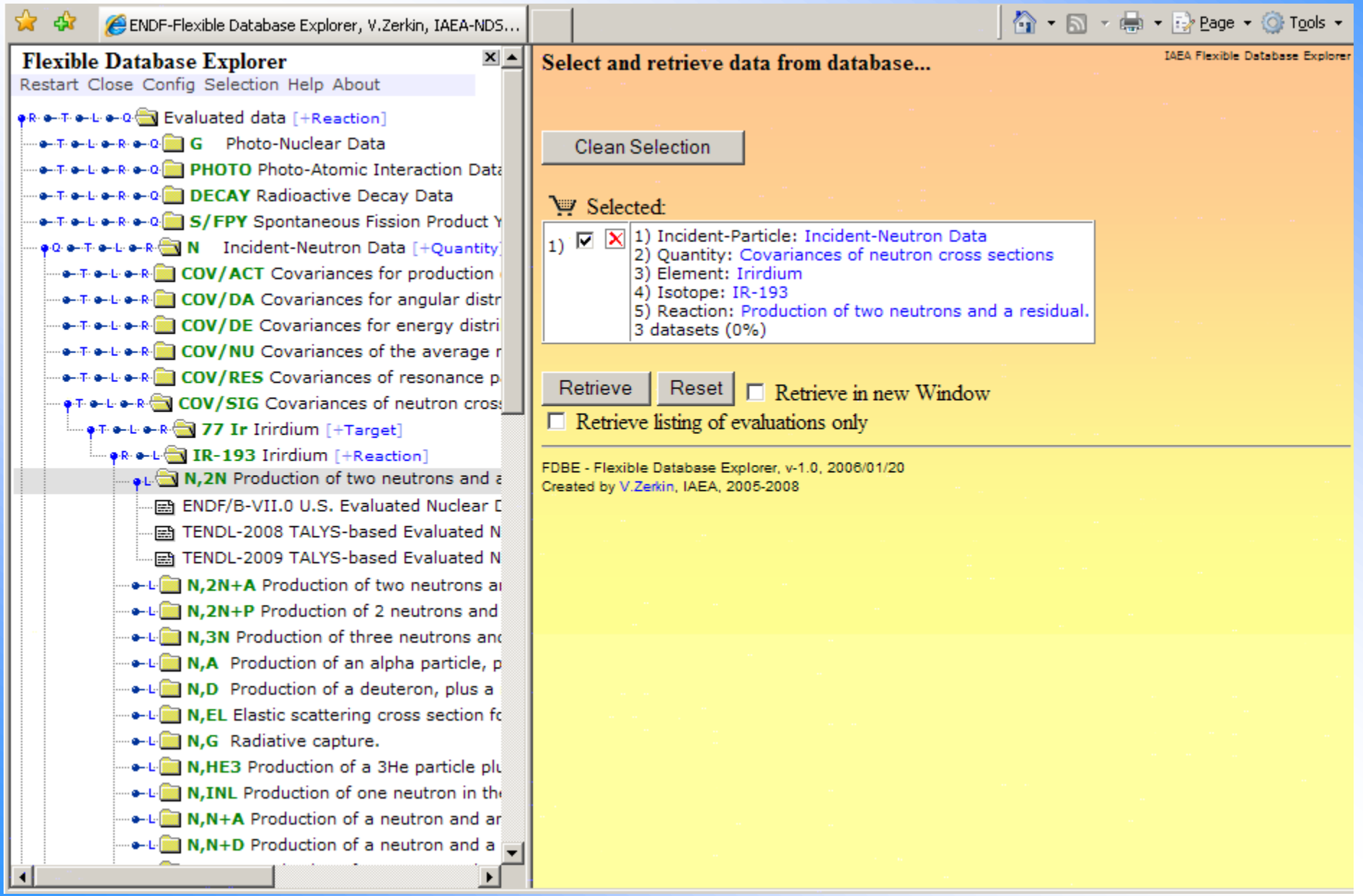
ENDF Request Form → ENDF-Explorer



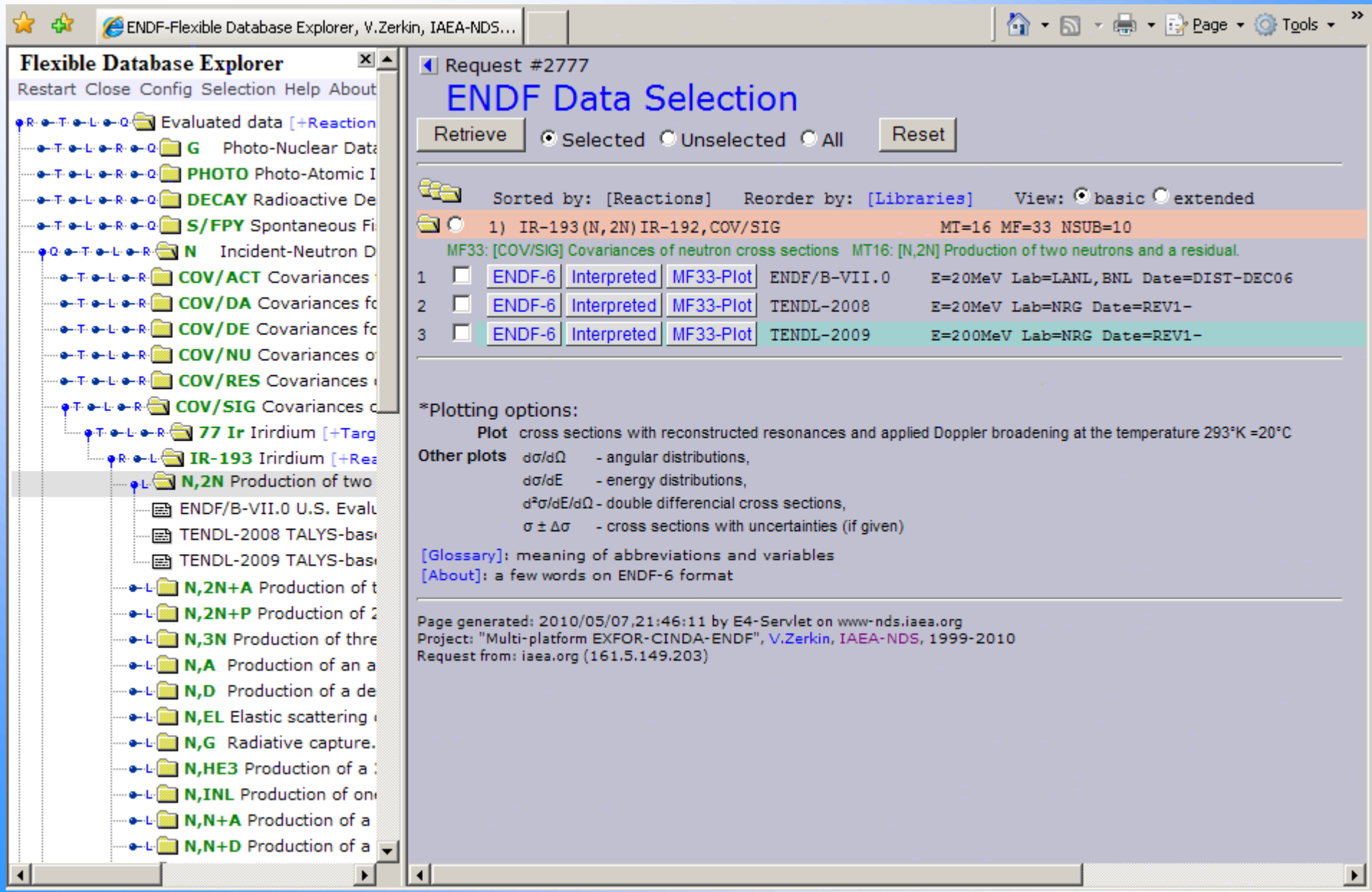
ENDF Flexible Database Explorer



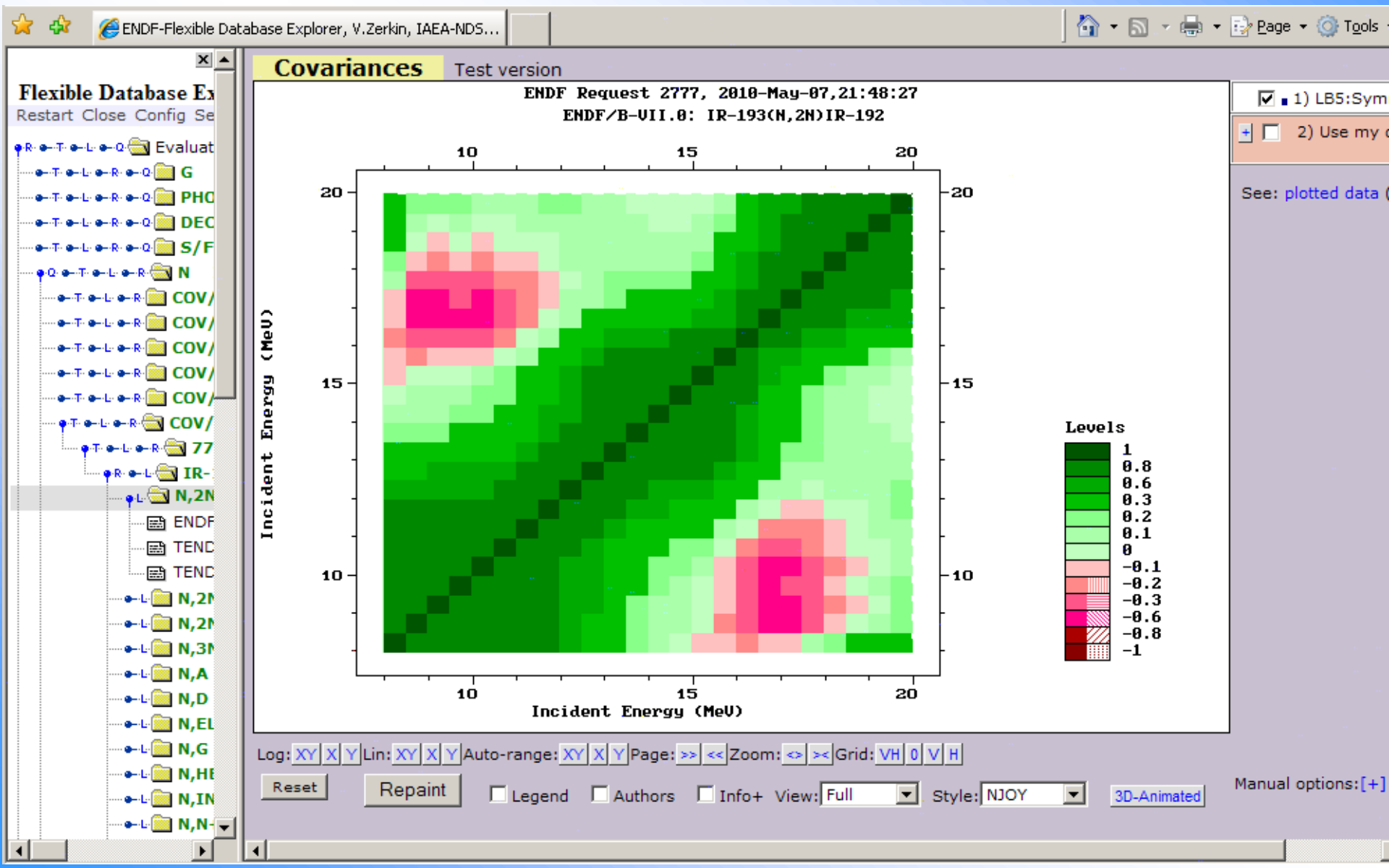
ENDF Explorer: data found



Standard ENDF Select Form

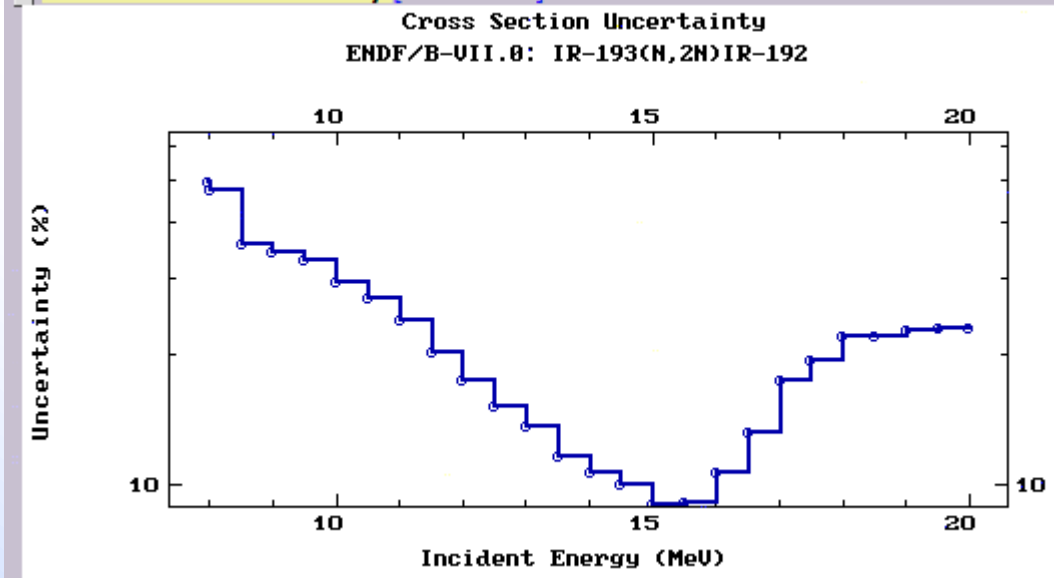


Again ENDF Output Form with interactive ZVView plotting

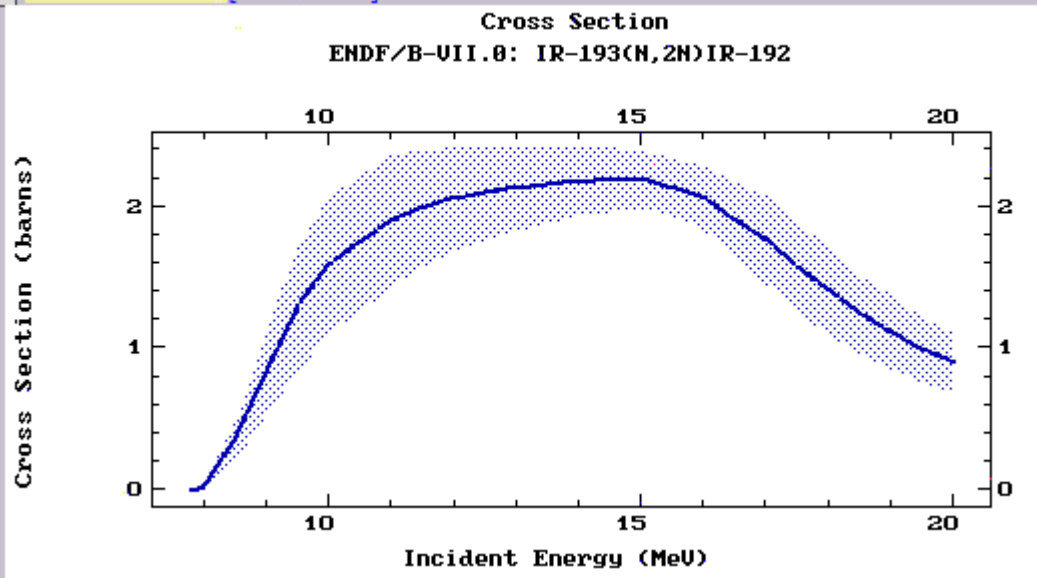


Display Cross Section and Uncertainty

Cross Section Uncertainty [interactive]



Cross Sections [interactive]



Correlation matrix

#ZVView-data-copy: 7-May-2010 22:13:17

#

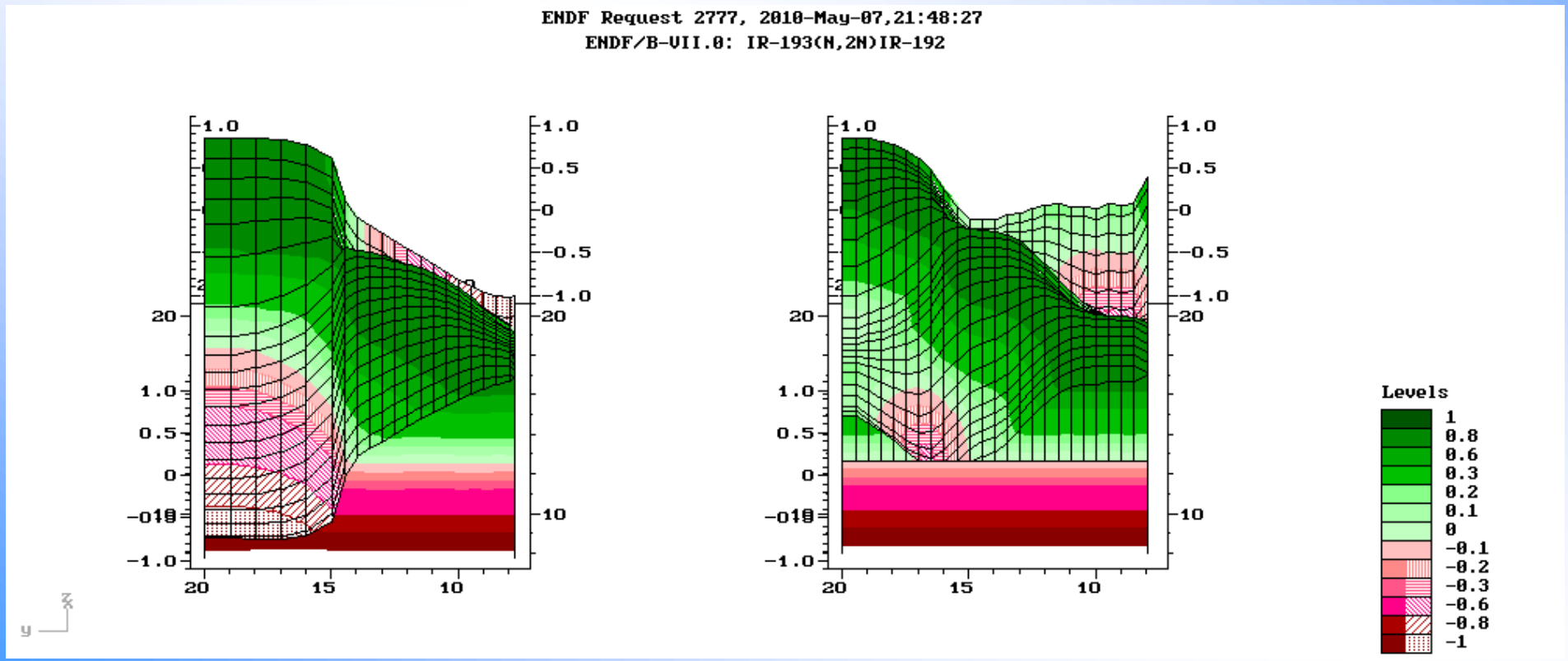
#LB5:Symmetric Matrix

Z(26x26): $Z_{i,j} = Cor(\sigma_{Xi},\sigma_{Yj})*1000$

	X (MeV)																				
Y (MeV)	7.992	8	8.5	9	9.5	10	10.5	11	11.5	12	12.5	13	13.5	14	14.5	15	15.5	16	16.5	17	17.
7.992	1000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	1000	930.6	920.5	926.4	898.3	895.5	866.7	805.2	679.6	529.7	352.7	210.1	101.7	52	-17.93	-85.39	-125.4	-97.66	-12.27	102
8.5	0	930.6	1000	999.4	998.7	992	980.3	943.8	866.1	730	583.1	404.7	257.4	156.3	107.4	27.05	-112	-269.4	-344.3	-309.5	-21
9	0	920.5	999.4	1000	999.4	995.4	984.9	950.7	875.7	743.4	600.1	424.6	278.7	179	130.3	49.66	-93.97	-260.9	-346.6	-318.8	-23
9.5	0	926.4	998.7	999.4	1000	996.5	989	959.1	889.9	763.2	623.2	450.2	305.7	205.7	156.7	76.36	-64.34	-228.8	-315.5	-289.6	-20
10	0	898.3	992	995.4	996.5	1000	996	973.3	912.2	796.1	666	500.7	360	263.3	214.3	133.4	-17.89	-205.1	-318.8	-310.8	-23
10.5	0	895.5	980.3	984.9	989	996	1000	989.8	944.9	846.1	727.6	571.9	436.3	340.7	291.4	211.4	64.16	-124.1	-248.4	-251.3	-18
11	0	866.7	943.8	950.7	959.1	973.3	989.8	1000	981.8	912.9	816.6	679.8	555.3	464.3	415.4	338.2	196.2	2.736	-143.1	-167.2	-12
11.5	0	805.2	866.1	875.7	889.9	912.2	944.9	981.8	1000	973.5	909.6	802.9	697.6	615.5	569.6	498.9	370.6	179.7	12.5	-37.4	-15
12	0	679.6	730	743.4	763.2	796.1	846.1	912.9	973.5	1000	980	916.6	840.9	775.5	736.4	677	566.6	378.6	184.9	101.2	89.
12.5	0	529.7	583.1	600.1	623.2	666	727.6	816.6	909.6	980	1000	977.7	931.2	884.7	854	806.6	710	521.5	303.1	188.5	145
13	0	352.7	404.7	424.6	450.2	500.7	571.9	679.8	802.9	916.6	977.7	1000	986.9	962.5	942.9	910.7	834.6	656.1	423	282.1	209
13.5	0	210.1	257.4	278.7	305.7	360	436.3	555.3	697.6	840.9	931.2	986.9	1000	993.3	983.2	964.1	907.5	744	508.5	352.6	260
14	0	101.7	156.3	179	205.7	263.3	340.7	464.3	615.5	775.5	884.7	962.5	993.3	1000	997.2	987.1	939.2	779.5	538.1	370.7	265
14.5	0	52	107.4	130.3	156.7	214.3	291.4	415.4	569.6	736.4	854	942.9	983.2	997.2	1000	995.7	955.3	801.6	561.7	391.1	280
15	0	-17.93	27.05	49.66	76.36	133.4	211.4	338.2	498.9	677	806.6	910.7	964.1	987.1	995.7	1000	974.7	838.5	608.2	436.4	320
15.5	0	-85.39	-112	-93.97	-64.34	-17.89	64.16	196.2	370.6	566.6	710	834.6	907.5	939.2	955.3	974.7	1000	938.2	766.4	616.6	504
16	0	-125.4	-269.4	-260.9	-228.8	-205.1	-124.1	2.736	179.7	378.6	521.5	656.1	744	779.5	801.6	838.5	938.2	1000	940.4	846	757
16.5	0	-97.66	-344.3	-346.6	-315.5	-318.8	-248.4	-143.1	12.5	184.9	303.1	423	508.5	538.1	561.7	608.2	766.4	940.4	1000	975.3	925
17	0	-12.27	-309.5	-318.8	-289.6	-310.8	-251.3	-167.2	-37.4	101.2	188.5	282.1	352.6	370.7	391.1	436.4	616.6	846	975.3	1000	985
17.5	0	102.2	-218.3	-231.9	-204.5	-237.7	-187.3	-121.3	-15.88	89.5	145.9	209.9	260.8	265	280.8	320.3	504	757	925.6	985	100
18	0	232.8	-97.99	-115	-89.67	-132.7	-91.32	-43.15	37.07	107.8	132.1	163.8	192	180.9	191.1	221.6	399.2	660.3	855	943.2	985
18.5	0	340.4	11.1	-7.856	15.59	-33.54	0.5162	34.56	94.08	136.6	134.9	139.9	148.8	125.4	130.9	153.2	320.2	577.8	784.5	891.4	954
19	0	437.7	118.1	98.15	119.9	67.18	95.14	117.5	159.2	177.2	153.3	134.5	125.5	91.08	92.11	106.2	258.6	504.7	713.4	832.6	912
19.5	0	531.8	225.4	204.6	224.2	168.1	189.1	198.8	221.2	213.4	166.6	123.4	96.14	50.83	47.22	52.25	188	419.2	628.5	759.1	854
20	0	531.8	225.4	204.6	224.2	168.1	189.1	198.8	221.2	213.4	166.6	123.4	96.14	50.83	47.22	52.25	188	419.2	628.5	759.1	854
i	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

IR-193(n,2n)IR-192

TENDL-2008 vs. ENDF-B/VII.0



IBANDL Web system

IBANDL Web system

http://www-nds.iaea.org/ibandl

IBANDL
Ion Beam Analysis
Nuclear Data Library

Nucleus
H-1

Projectile
- p
- d
- ^{3}He
- α
- ^{6}Li
- ^{7}Li

Type of data
- EBS
- NRA
- PIGE
- All

IBANDL
[Summary]

EXFOR

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Updates

Nuclear Data Services

Nuclear Data Service **IBANDL**

This is the Ion Beam Analysis Nuclear Data Library developed and formerly maintained by A.Gurbich under the IAEA auspices. It contains available **experimental** nuclear cross-sections relevant to Ion Beam Analysis. Differential cross sections are presented both as graphs and data files. The numerical data are in the R33 format. Currently, most of the data are being extracted from EXFOR using an automatic conversion procedure available in EXFOR retrieval system (see details of the algorithm here).

Two Coordinated Research Projects (CRP) have catered to the data needs of the IBA community: the CRP on Reference Database for Ion Beam Analysis (2005-2010, see: IAEA-TECDOC-1780), and the CRP on Development of a Reference Database for Particle-Induced Gamma Ray Emission (PIGE) Spectroscopy (2011-2015, see: IAEA-TECDOC-1822) both of which resulted in new measurements and the bulk of the relevant nuclear data made available in IBANDL. The activity has been further supported by the IAEA through the Technical Meeting on Benchmarking Experiments for Ion Beam Analysis, and the nuclear data evaluation project R-matrix Codes for Charged-particle reactions in the Resolved-Resonance Region.

Members of the IBA community are invited to submit new experimental data to IBANDL. Numerical data (in R33 or any other format) including references should be sent to: nds.contact-point@iaea.org (IAEA-NDS).

The IBANDL Web interface also provides evaluated (recommended) cross sections obtained with the SigmaCalc calculator developed by A. Gurbich. Evaluated cross-section data produced by SigmaCalc up to October 2013 are available for easier access and plotting. In addition, the user is offered the option to obtain SigmaCalc files on-the-fly, through remote access to the SigmaCalc calculator. R33 files can be also downloaded from SigmaCalc and imported into IBANDL. Users are cautioned however, that the 'on-the-fly' calculations can experience significant delays due to problems related with the connection to the external Web server. The IAEA therefore accepts no responsibility for usage of this option.

New
- Total cross sections (mb) can be converted to differential cross sections (mb/sr) in cases where the angular distributions are known to be isotropic. Differential cross sections (mb/sr) can be converted to Ratio-to-Rutherford (rr) and vice versa. Press 'Convert units for plotting' button on the data table header.
- Conversion to inverse kinematics is possible. Press 'inverted' button on the data table header.
- User can upload own data files to compare with existing data. See 'Add your dataset in R33 format for plotting' on the bottom of the data table.
- Search data by first author and reference: [Summary] → [+]References → click on » .

IBANDL Web system

IBANDL - Mozilla Firefox

File Edit View History Bookmarks Tools Help

nds121.iaea.org/exfor2/ibandl.htm

X4/Servlet: Select | EXFOR: Experimental Nucl... | X4/Servlet: Select | IBANDL | IBANDL

IBANDL
Ion Beam Analysis
Nuclear Data Library

Nucleus
C-13

Projectile
- p
- d
- ^{3}He
- α
- ^{6}Li
- ^{7}Li

Type of data
- EBS
- NRA
- PIGE
- All

IBANDL
[Summary]

EXFOR

Home
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^{13}C + p

Type of data: ALL View: extended Convert units for plotting: no rr->mb/sr mb/sr->rr Plots: [reset]

No.	Reaction	Angle	Energy(keV)	Pts	Update	X4	Reference	File	Plot
1	^{13}C(p,p0)^{13}C	160	700-2500	451	2013-08-15		SigmaCalc 2.0. File created 21-6-2013	View Save	mb
2	^{13}C(p,p0)^{13}C	163.8°	2600-4990	169	2006-06-23		E. Kashy et al., Phys. Rev. 122(3) (1961) 884 »	View Save	mb
3	^{13}C(p,p0)^{13}C	160°	780-2430	96	2013-05-27		N.P.Barradas et al., to be published »	View Save	rr
4	^{13}C(p,p0)^{13}C	158.4°	450-1620	90	2011-11-22		E.Milne, Phys. Rev. 93 (1954) 762 »	View Save	mb
5	^{13}C(p,p0)^{13}C	146.5°	1630-3310	80	2011-11-22		D.Zipoy et al., Phys. Rev. 106 (1957) 793 »	View Save	mb
6	^{13}C(p,p0)^{13}C	140°	780-2430	97	2013-09-18		N.P.Barradas et al., Nucl. Instr. and Meth. B 316 (2013) 81 »	View Save	rr
7	^{13}C(p,p0)^{13}C	137°	450-1600	93	2011-11-22		E.Milne, Phys. Rev. 93 (1954) 762 »	View Save	mb
8	^{13}C(p,p0)^{13}C	124.1°	1620-3340	97	2011-11-22		D.Zipoy et al., Phys. Rev. 106 (1957) 793 »	View Save	mb
9	^{13}C(p,p0)^{13}C	121.5°	1000-2580	279	2011-08-29	X4	V.A.Latorre+(1966), Jour. Physical Review, Vol.144, p.891 »	View Save	mb
10	^{13}C(p,p0)^{13}C	116°	410-1600	88	2011-11-22		E.Milne, Phys. Rev. 93 (1954) 762 »	View Save	mb
11	^{13}C(p,p0)^{13}C	102.1°	1600-3340	82	2011-11-22		D.Zipoy et al., Phys. Rev. 106 (1957) 793 »	View Save	mb
12	^{13}C(p,p0)^{13}C	85.6°	1610-3340	85	2011-11-22		D.Zipoy et al., Phys. Rev. 106 (1957) 793 »	View Save	mb
13	^{13}C(p,p0)^{13}C	85.6°	1580-4380	75	2011-11-22		H.J.Kim,W.T.Milner and F.K.McGowan Nuclear Data Tables v.A2 (1966) 353 »	View Save	mb
14	^{13}C(p,p0)^{13}C	85.6°	430-1590	92	2011-11-22		E.Milne, Phys. Rev. 93 (1954) 762 »	View Save	mb

Datasets: 13 Reactions: 1 Points: 1423 References: 7

+ Add your dataset in R33 format for plotting

+ References.

Legend:
X4 link to the dataset in EXFOR database retrieval system

Web IBANDL calling Web-ZVView

IBANDL - Mozilla Firefox

File Edit View History Bookmarks Tools Help

nds121.iaea.org/exfor2/ibandl.htm

X4/Servlet: Select | EXFOR: Experimental Nucl... | X4/Servlet: Select | IBANDL | IBANDL

IBANDL
Ion Beam Analysis Nuclear Data Library

Nucleus
C-13

Projectile
- p
- d
- ^{3}He
- α
- ^{6}Li
- ^{7}Li

Type of data
- EBS
- NRA
- PIGE
- All

IBANDL
[Summary]

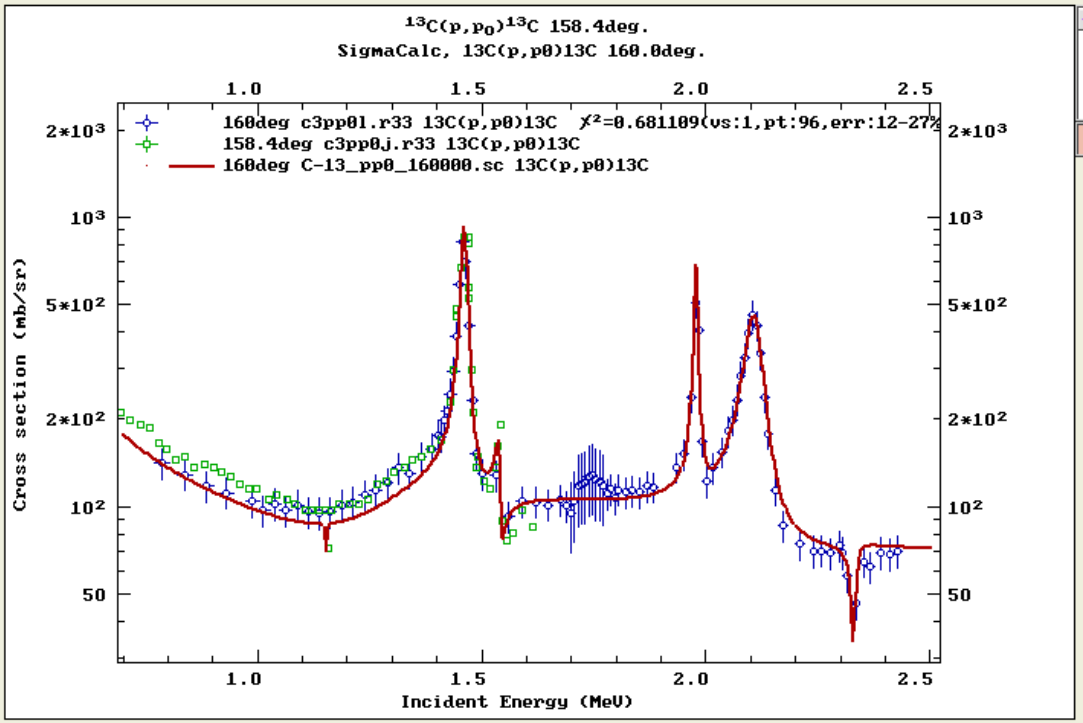
EXFOR

Home
CD version
Updates
Nuclear Data Services

Welcome to Web-ZVView!

Interactive plotting of IBANDL and SigmaCalc data

1) θ=160° N.P.Barradas et al., to be published
2) θ=158.4° E.Milne, Phys. Rev. 93 (1954) 762
3) θ=160° SigmaCalc 2.0. File created 22-6-2013



Select data for plotting [all] [none]
1) 160deg c3pp0l.r33 13C(p,p0)13C
2) 158.4deg c3pp0j.r33 13C(p,p0)13C
3) 160deg C-13_pp0_160000.sc 13C(p,
4) Use my data [example]

See: plotted data (21Kb)

Log: XY | X | Y Lin: XY | X | Y Auto-range: XY | X | Y Page: >> | << Zoom: <> | >< Grid: VH | 0 | V | H Pts: Txt | Box | PL | Print

Reset | Repaint | Legend | Authors | Info+ | PostScript | Manual options:[+] Clipboard: Copy

Shift legend:x=0 y=0 Split:0 1:xy;2:y Plot data or ratio:0 0:data; 1:ratio to dataset-1; 2:ratio to 2-nd, etc.

Data for plotting: ZVD (15Kb), send to ZVView; download ZVView; upload and plot your ZVD file

Web IBANDL calling Web-ZVView

IBANDL - Mozilla Firefox

File Edit View History Bookmarks Tools Help

nds121.iaea.org/exfor2/ibandl.htm

X4/Servlet: Select | EXFOR: Experimental Nucl... | X4/Servlet: Select | IBANDL | IBANDL

IBANDL
Ion Beam Analysis Nuclear Data Library

Nucleus
C-13

Projectile
- p
- d
- ^{3}He
- α
- ^{6}Li
- ^{7}Li

Type of data
- EBS
- NRA
- PIGE
- All

IBANDL
[Summary]

EXFOR

Home
CD version
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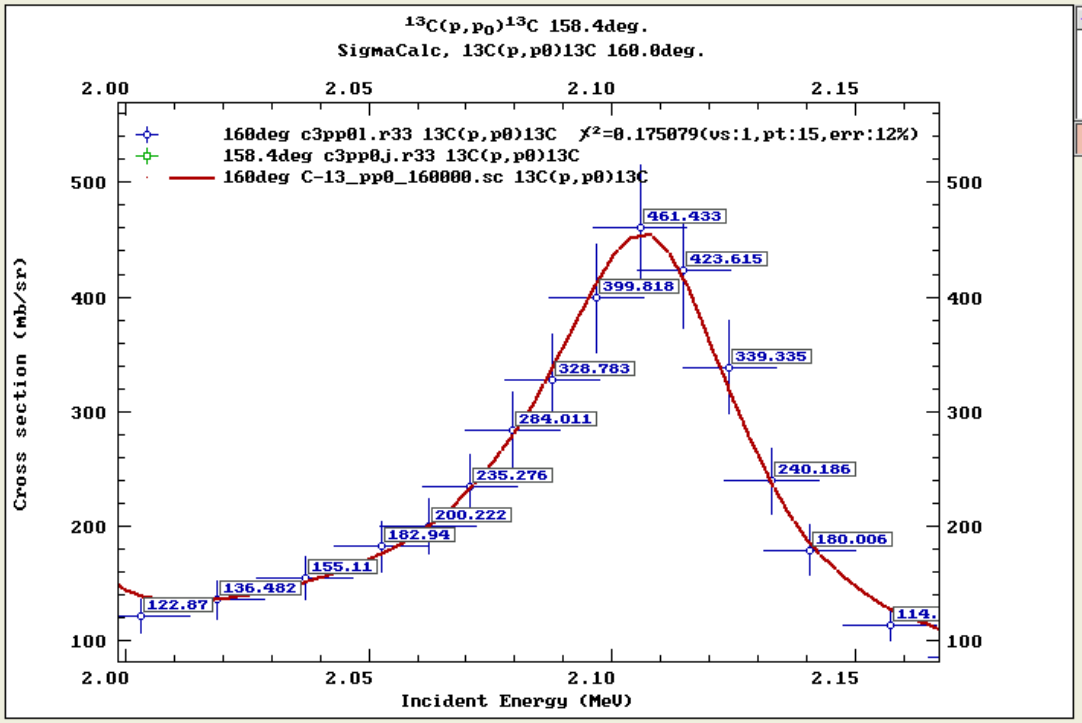
Interactive plotting of IBANDL and SigmaCalc data

1) θ=160° N.P.Barradas et al., to be published
2) θ=158.4° E.Milne, Phys. Rev. 93 (1954) 762
3) θ=160° SigmaCalc 2.0. File created 22-6-2013



Select data for plotting [all] [none]
1) 160deg c3pp0l.r33 13C(p,p0)13C
2) 158.4deg c3pp0j.r33 13C(p,p0)13C
3) 160deg C-13_pp0_160000.sc 13C(p,
4) Use my data [example]

See: plotted data (21Kb)

Log: XY X Y Lin: XY X Y Auto-range: XY X Y Page: >> << Zoom: <> >< Grid: VH 0 V H Pts: Txt Box PL Print

Reset Repaint ☑ Legend ☐ Authors ☑ Info+ PostScript Manual options:[+] Clipboard: Copy

Shift legend:x=0 y=8 Split:0 1:xy;2:y Plot data or ratio:0 0:data; 1:ratio to dataset-1; 2:ratio to 2-nd, etc.

Data for plotting: ZVD (15Kb), send to ZVView; download ZVView; upload and plot your ZVD file

EXFOR data re-normalization system

Example 14

14 Automatic re-normalization (output data and plots); ^{55}Mn(n,g)

EXFOR data re-normalization system
(correction system)

Main ideas:

1) to re-normalize data using old monitors and new standards
2) to re-normalize data using decay data
3) to create a convenient tool for data modifications: multiply data to a factor, correct wrong units, set up uncertainties, delete part of a data set, recalculate data using isotope abundances, etc.

We DO NOT change EXFOR data - we re-normalize output from EXFOR system

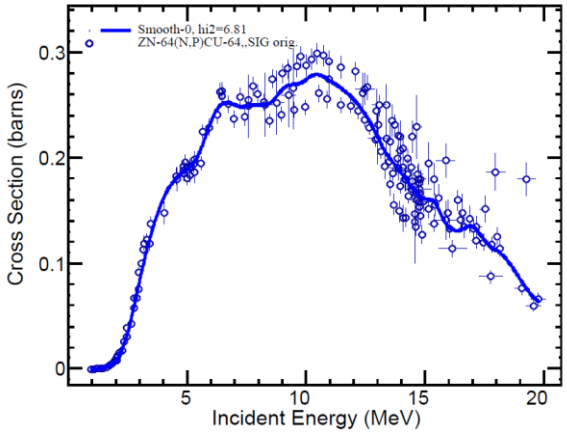
Final goals:

1) to implement possibility of corrections
2) to re-normalize data from EXFOR automatically (using EXFOR information)
3) to collect experts' corrections to a database
4) to re-normalize data using experts' corrections database
5) to have Web system offering and implementing automatic, experts' and user's corrections in optional, semi-automatic and interactive modes
6) to generate and distribute renormalized data of whole EXFOR database

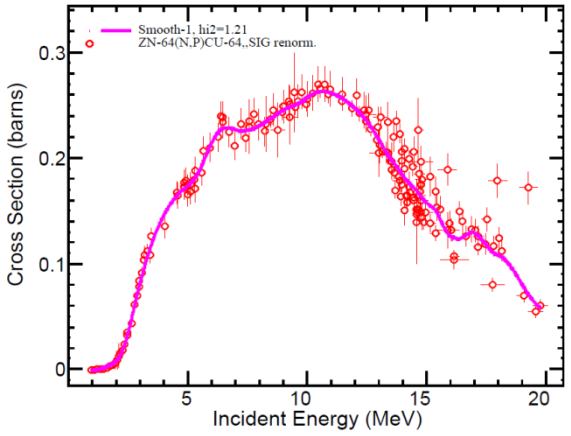
Example of expert's corrections results

by K.Zolotarev, 2011

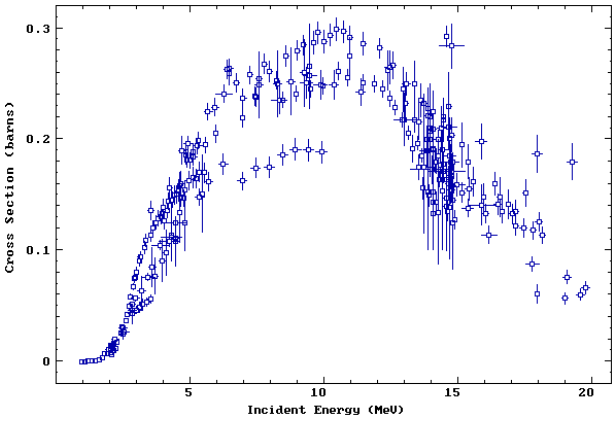
Data selected

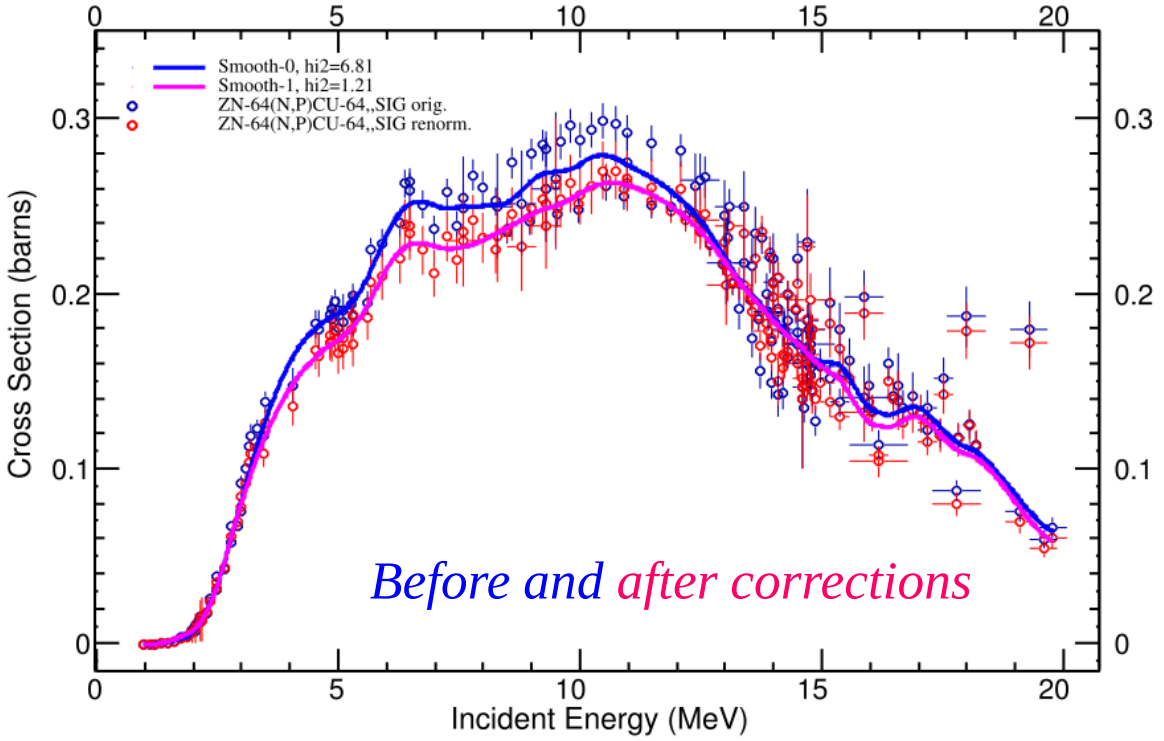


Data corrected

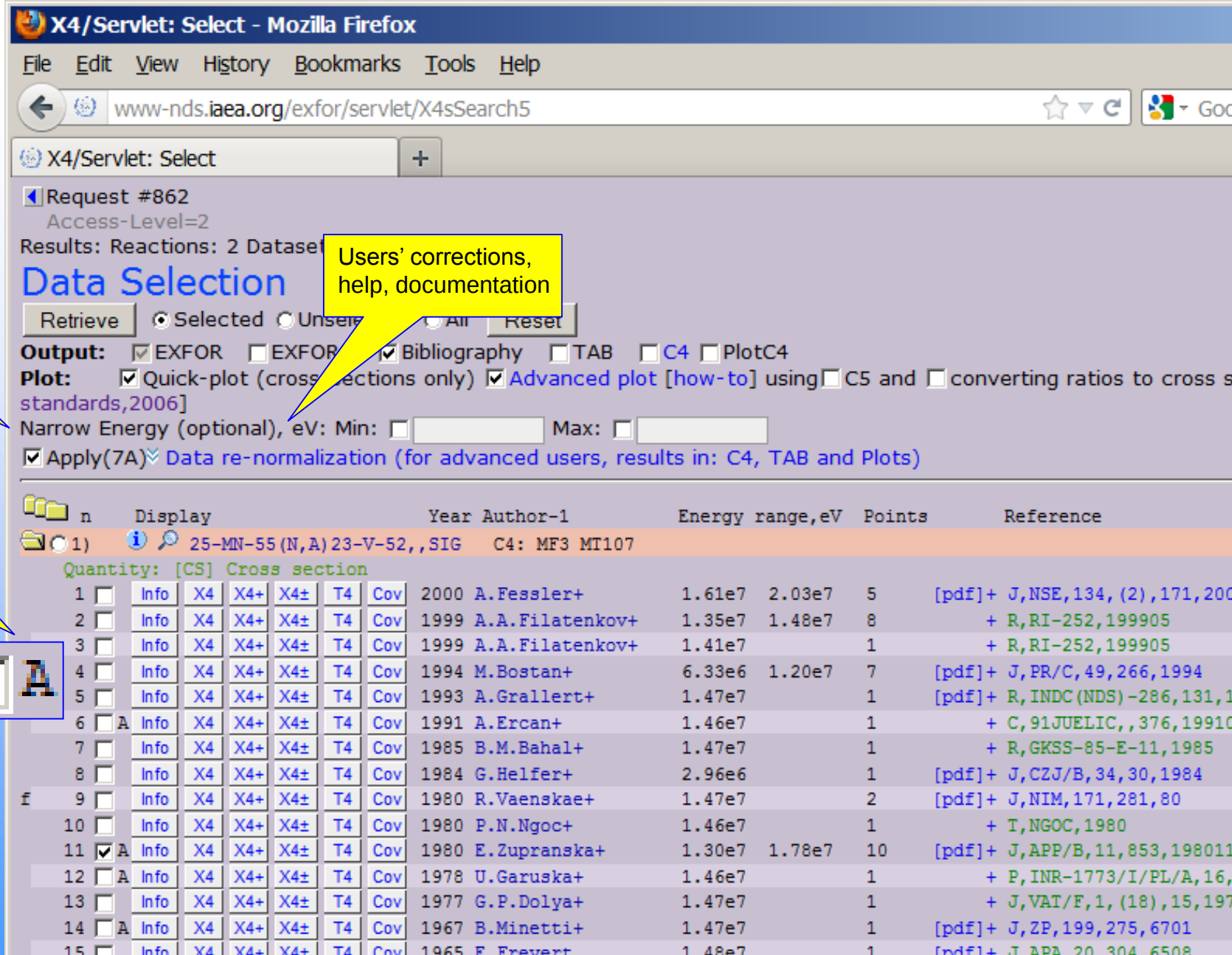


30-ZN-64(N,P)29-CU-64,,SIG

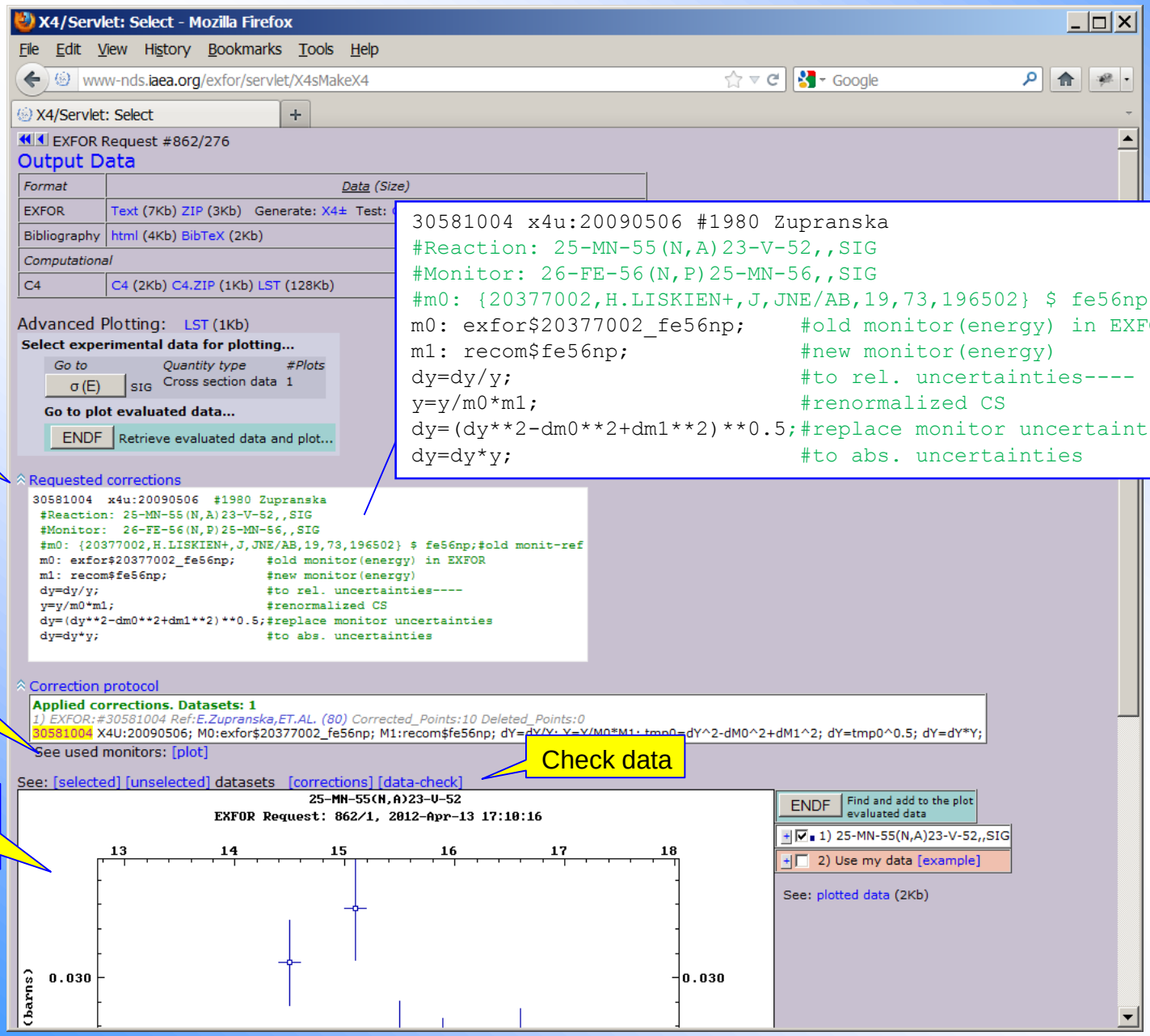




Applying automatic data re-normalization



Automatic re-normalization: simple plot




```
30581004 x4u:20090506 #1980 Zupranska
#Reaction: 25-MN-55(N,A)23-V-52,,SIG
#Monitor: 26-FE-56(N,P)25-MN-56,,SIG
#m0: {20377002,H.LISKIEN+,J,JNE/AB,19,73,196502} $ fe56np;#old monit-ref
m0: exfor$20377002_fe56np;     #old monitor(energy) in EXFOR
m1: recom$fe56np;              #new monitor(energy)
dy=dy/y;                       #to rel. uncertainties----
y=y/m0*m1;                     #renormalized CS
dy=(dy**2-dm0**2+dm1**2)**0.5;#replace monitor uncertainties
dy=dy*y;                       #to abs. uncertainties
```

Applied corrections

Check Monitors

Check data

Plot result of corrections

Automatic re-normalization: data checking

Old data

Old uncertainty

Final Factor

New data

New uncertainty

Plot old and new monitors

Mozilla Firefox

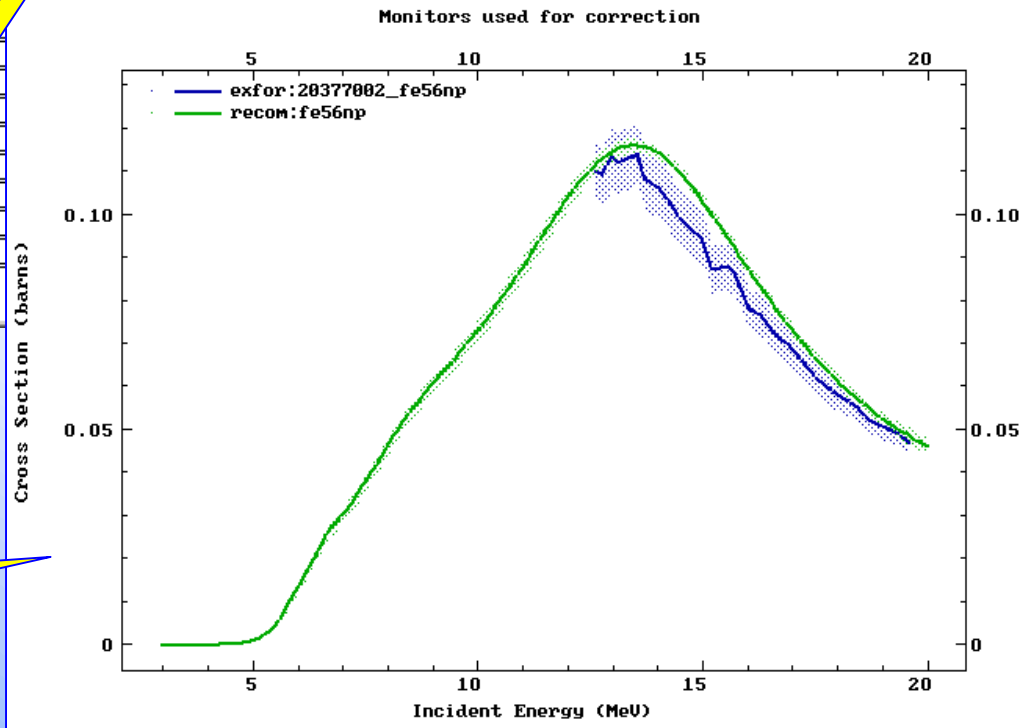
File Edit View History Bookmarks Tools Help

www-nds.iaea.org/exf.../servlet/X4sShowData?db=x4&op=g..._x4&req=8

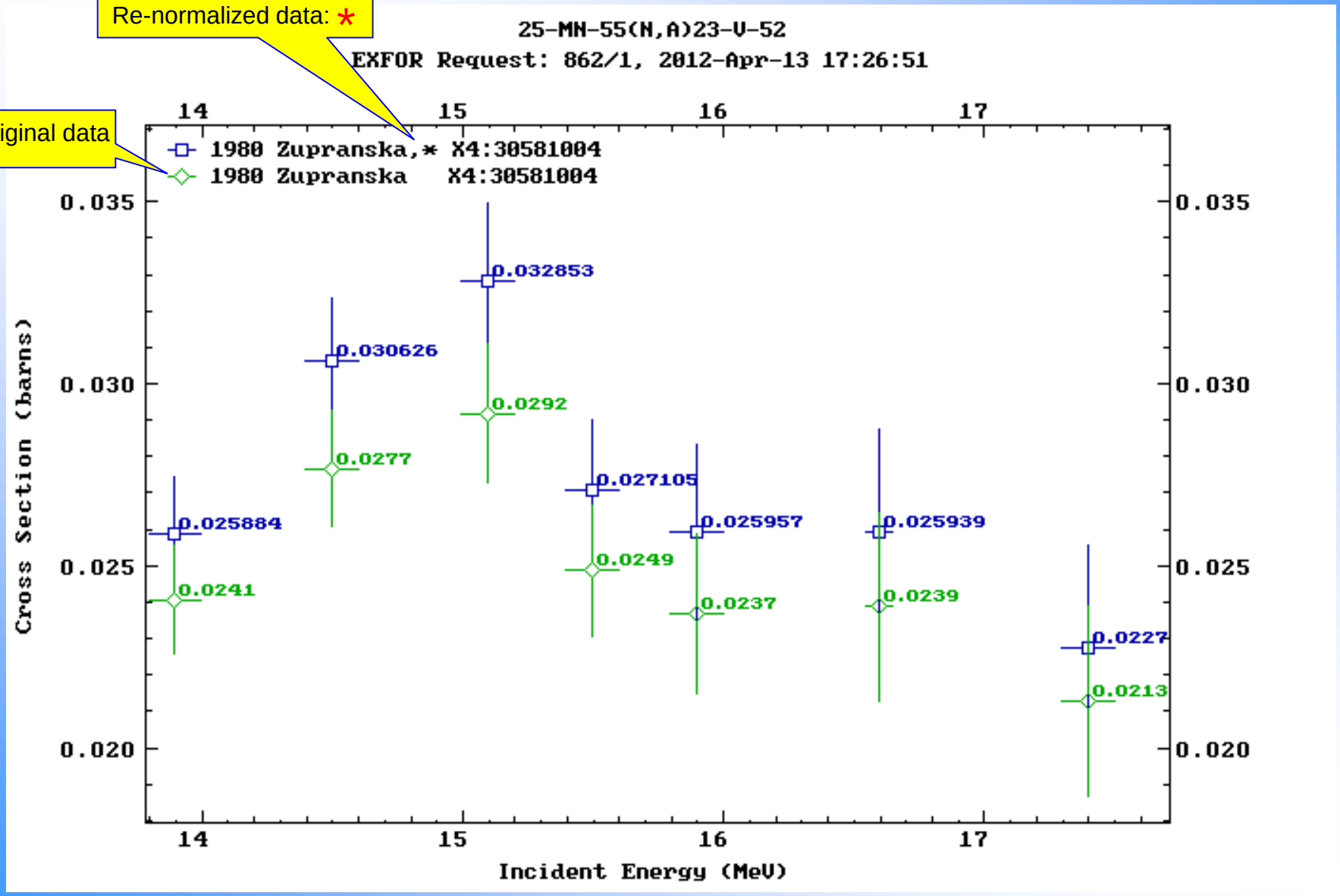
Google

X4/Servlet: Select | http://www-nds...x4.c4.datamod | http://www-nds...2_mon_factors

-1	En(MeV)=13	Y(mb)=21.9	dY(mb)=2.1	(9.59%)	30581004	E.Zupranska,ET.AL. (80)
+1		Y(mb)=22.258	dY(mb)=2.12897	(9.56%)	30581004	*Fc=1.01635
-2	En(MeV)=13.3	Y(mb)=21.8	dY(mb)=1.4	(6.42%)	30581004	E.Zupranska,ET.AL. (80)
+2		Y(mb)=22.3688	dY(mb)=1.42838	(6.39%)	30581004	*Fc=1.02609
-3	En(MeV)=13.9	Y(mb)=24.1	dY(mb)=1.5	(6.22%)	30581004	E.Zupranska,ET.AL. (80)
+3		Y(mb)=25.8839	dY(mb)=1.60119	(6.19%)	30581004	*Fc=1.07402
-4	En(MeV)=14.5	Y(mb)=27.7	dY(mb)=1.6	(5.78%)	30581004	E.Zupranska,ET.AL. (80)
+4		Y(mb)=30.6262	dY(mb)=1.77376	(5.75%)	30581004	*Fc=1.10564
-5	En(MeV)=15.1	Y(mb)=29.2	dY(mb)=1.9	(6.51%)	30581004	E.Zupranska,ET.AL. (80)
+5		Y(mb)=32.8526	dY(mb)=2.12995	(6.48%)	30581004	*Fc=1.12509
-6	En(MeV)=15.5	Y(mb)=24.9	dY(mb)=1.7			
+6		Y(mb)=27.1053	dY(mb)=1.84			
-7	En(MeV)=15.9	Y(mb)=23.7	dY(mb)=1.6			
+7		Y(mb)=25.9568	dY(mb)=1.77			
-8	En(MeV)=16.	Y(mb)=23.9	dY(mb)=1.6			
+8		Y(mb)=25.9387	dY(mb)=1.77			
-9	En(MeV)=1	Y(mb)=21.3	dY(mb)=1.5			
+9		Y(mb)=22.783	dY(mb)=1.6			
-10	En(MeV) .8	Y(mb)=18.1	dY(mb)=1.3			
+10		Y(mb)=19	dY(mb)=1.4			



Automatic data re-normalization: common plot



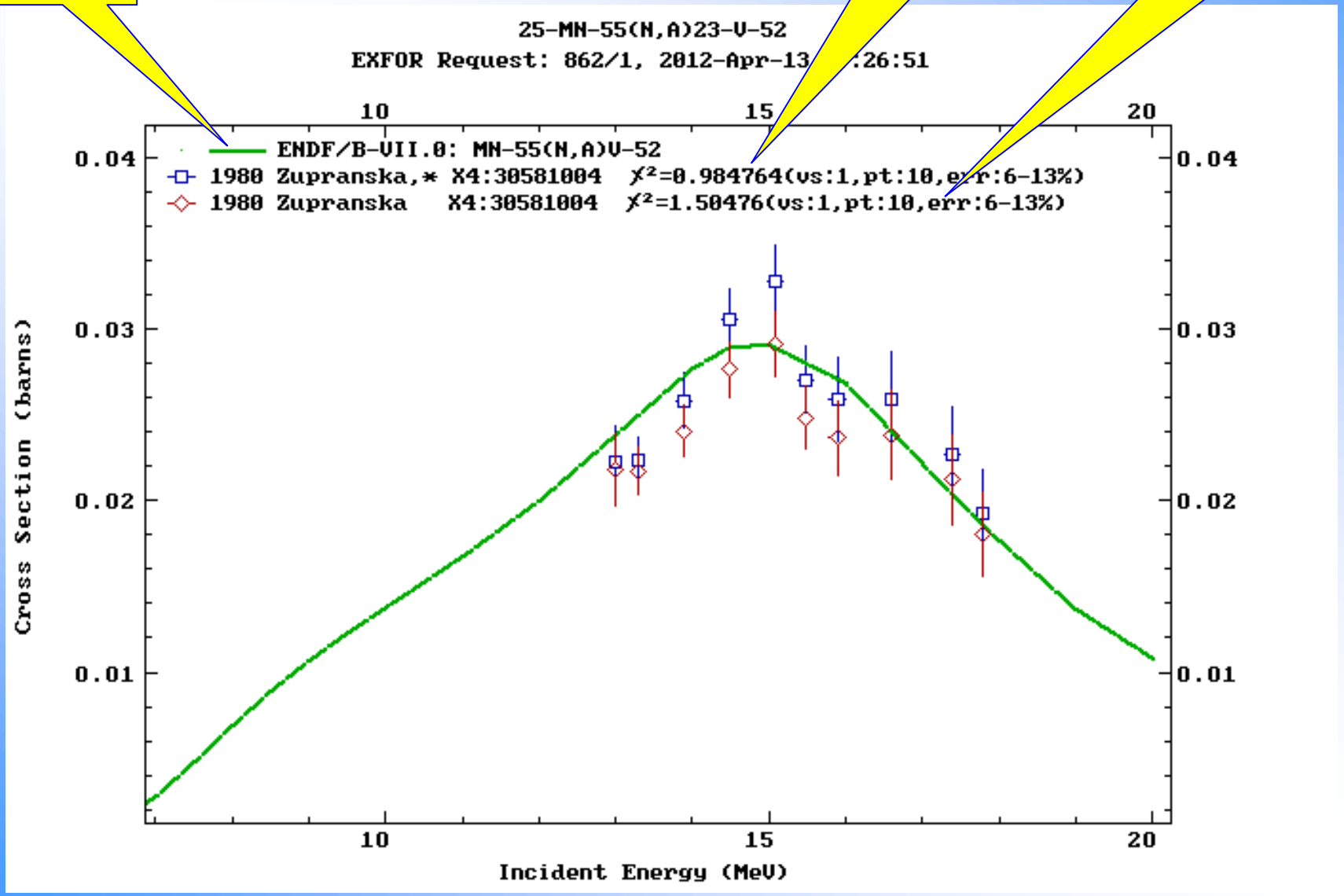
Use Copy/Paste

Comparing to ENDF

Compare with ENDF-B/VII.0

After re-normalization: χ^2=0.984764

Before re-normalization: χ^2=1.50476



Inverse reactions and inverse kinematics in EXFOR and IBANDL

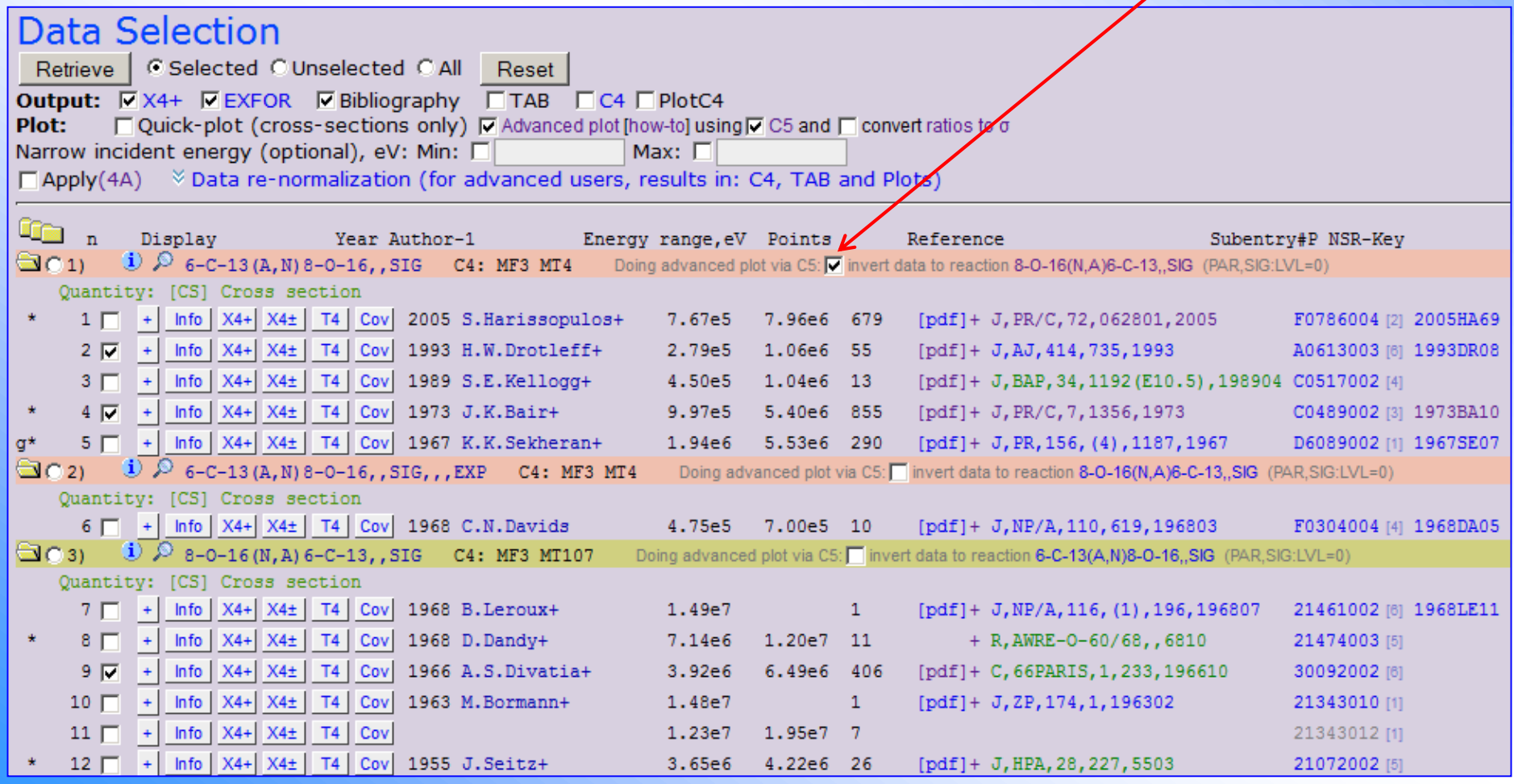
Example 18

18 Invert reaction using detailed balance $^{13}C(\alpha,n)^{16}O \rightarrow {}^{16}O(n,\alpha)^{13}C$: σ dσ/dΩ

Ex.2 : $^{3}He(d,p)^{4}He \rightarrow {}^{4}He(p,d)^{3}He$ dσ/dΩ [plot]

EXFOR. Recalculation of cross sections to inverse reactions using detailed balance relation

View: extended → “Invert data” → Advanced plot via C5



Data Selection

Retrieve | Selected | Unselected | All | Reset

Output: X4+ EXFOR Bibliography TAB C4 PlotC4

Plot: Quick-plot (cross-sections only) Advanced plot [how-to] using C5 and convert ratios to σ

Narrow incident energy (optional), eV: Min: Max:

Apply(4A) Data re-normalization (for advanced users, results in: C4, TAB and Plots)

	n	Display	Year	Author-1	Energy range,eV	Points	Reference	Subentry#P	NSR-Key
	1)	6-C-13(A,N)8-O-16,,SIG C4: MF3 MT4	Doing advanced plot via C5: ☑ invert data to reaction 8-O-16(N,A)6-C-13,,SIG (PAR,SIG:LVL=0)						
	Quantity: [CS] Cross section								
*	1	Info X4+ X4± T4 Cov	2005	S.Harissopulos+	7.67e5	7.96e6	679	[pdf]+ J,PR/C,72,062801,2005	F0786004 [2]	2005HA69
	2	Info X4+ X4± T4 Cov	1993	H.W.Drotleff+	2.79e5	1.06e6	55	[pdf]+ J,AJ,414,735,1993	A0613003 [6]	1993DR08
	3	Info X4+ X4± T4 Cov	1989	S.E.Kellogg+	4.50e5	1.04e6	13	[pdf]+ J,BAP,34,1192(E10.5),198904	C0517002 [4]	
*	4	Info X4+ X4± T4 Cov	1973	J.K.Bair+	9.97e5	5.40e6	855	[pdf]+ J,PR/C,7,1356,1973	C0489002 [3]	1973BA10
g*	5	Info X4+ X4± T4 Cov	1967	K.K.Sekheran+	1.94e6	5.53e6	290	[pdf]+ J,PR,156,(4),1187,1967	D6089002 [1]	1967SE07
	2)	6-C-13(A,N)8-O-16,,SIG,,EXP C4: MF3 MT4	Doing advanced plot via C5: ☐ invert data to reaction 8-O-16(N,A)6-C-13,,SIG (PAR,SIG:LVL=0)						
	Quantity: [CS] Cross section								
	6	Info X4+ X4± T4 Cov	1968	C.N.Davids	4.75e5	7.00e5	10	[pdf]+ J,NP/A,110,619,196803	F0304004 [4]	1968DA05
	3)	8-O-16(N,A)6-C-13,,SIG C4: MF3 MT107	Doing advanced plot via C5: ☐ invert data to reaction 6-C-13(A,N)8-O-16,,SIG (PAR,SIG:LVL=0)						
	Quantity: [CS] Cross section								
	7	Info X4+ X4± T4 Cov	1968	B.Leroux+	1.49e7		1	[pdf]+ J,NP/A,116,(1),196,196807	21461002 [6]	1968LE11
*	8	Info X4+ X4± T4 Cov	1968	D.Dandy+	7.14e6	1.20e7	11	+ R,AWRE-O-60/68,,6810	21474003 [5]	
	9	Info X4+ X4± T4 Cov	1966	A.S.Divatia+	3.92e6	6.49e6	406	[pdf]+ C,66PARIS,1,233,196610	30092002 [6]	
	10	Info X4+ X4± T4 Cov	1963	M.Bormann+	1.48e7		1	[pdf]+ J,ZP,174,1,196302	21343010 [1]	
	11	Info X4+ X4± T4 Cov			1.23e7	1.95e7	7		21343012 [1]	
*	12	Info X4+ X4± T4 Cov	1955	J.Seitz+	3.65e6	4.22e6	26	[pdf]+ J,HPA,28,227,5503	21072002 [5]	

Inverse reactions in EXFOR

Output Data

Format	Data (Size)
EXFOR Interpreted	X4+ (74Kb) Generate: X4± XML:: v1: X4.xml X4.html v2: X4.xml X4.html
EXFOR Output	X4Out X4Out.xml X4Comp Test: C5 C5M:see:[doc]
EXFOR Original	EXFOR (122Kb) zip (20Kb)
Bibliography	html (9Kb) BibTeX (3Kb)
Computational	
C4	C4(C5) (170Kb) C4.ZIP (21Kb) C5 (175Kb) LST (3Kb)

The cross sections of inverse reaction follow the principle of detailed balance:

$$\sigma_{B(b,a)A} = \sigma_{A(a,b)B} \frac{(2j_a+1)(2j_A+1)}{(2j_b+1)(2j_B+1)} \frac{p_a^2}{p_b^2}$$

where:

j : spin of a particle;

p : relative momentum in the center-of-mass system

$$Q = (m_a + m_A) - (m_b + m_B)$$

$$E_b = \left(E_a \frac{m_A}{m_a + m_A} + Q\right) / \left(\frac{m_B}{m_b + m_B}\right)$$

$$\Delta E_b = \Delta E_a \left(\frac{m_A}{m_a + m_A}\right) / \left(\frac{m_B}{m_b + m_B}\right)$$

$$\sigma_{B(b,a)A}(E_b) = \frac{(2j_a+1)(2j_A+1)}{(2j_b+1)(2j_B+1)} \frac{m_a m_A{}^2}{(m_a + m_A)^2} \frac{(m_b + m_B)^2}{m_b m_B{}^2} \frac{E_a}{E_b} \cdot \sigma_{A(a,b)B}(E_a)$$

$$\Delta\sigma_{B(b,a)A} = \sigma_{B(b,a)A} \left(\frac{\Delta\sigma_{A(a,b)B}}{\sigma_{A(a,b)B}}\right)$$

Advanced Plotting: LST (1Kb)

Select experimental data for plotting...

Go to	Quantity type	#Plots
σ (E) SIG	Cross section data	1

Go to plot evaluated data...

ENDF Retrieve evaluated data and plot...

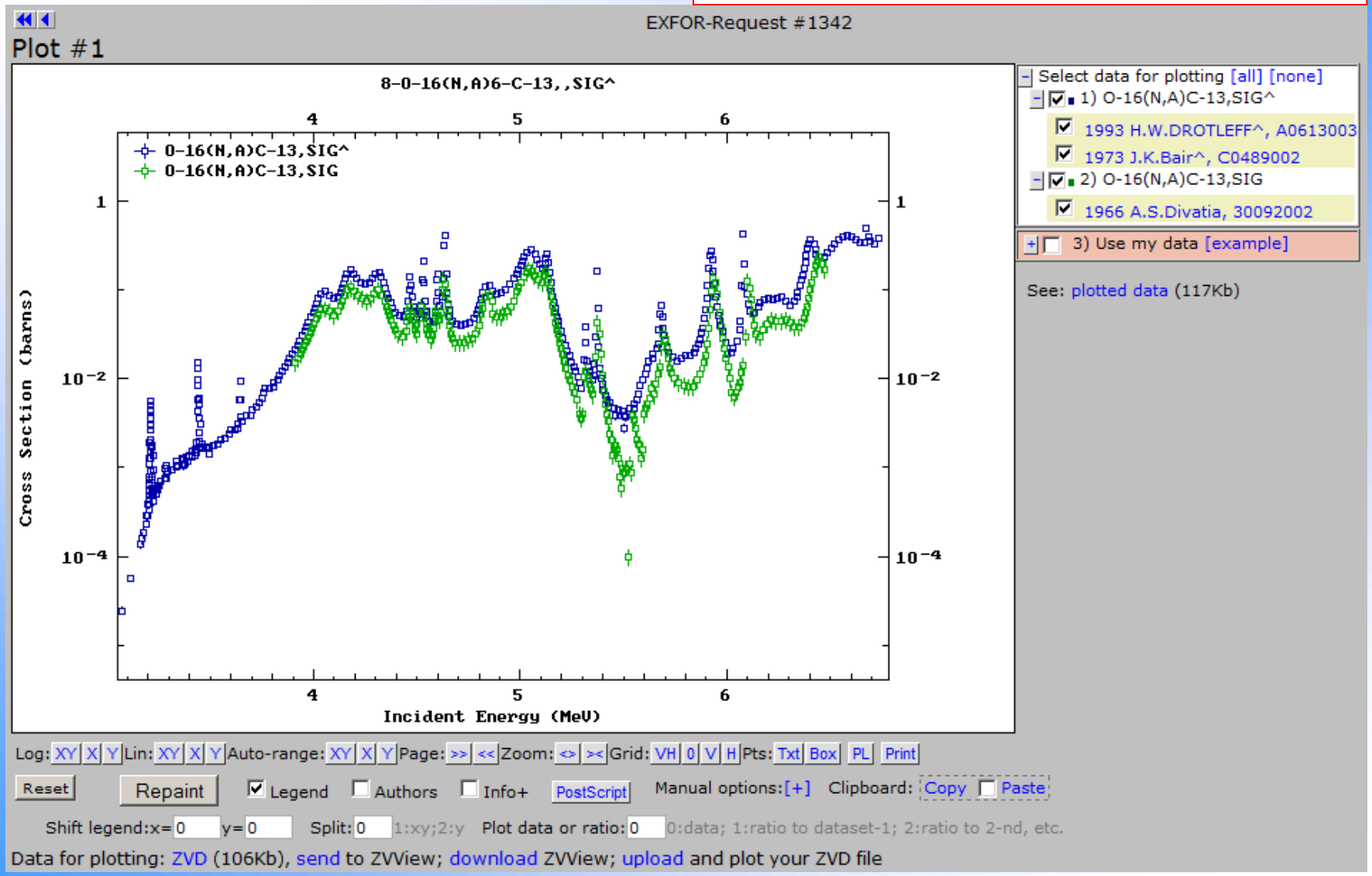
Advanced plot via C5

Limitations

```
 Convert EXFOR to C5 computational format
 Program x4toc5 (version 2015-04-14)
 V.Zerkin, IAEA, Vienna, 2010-2015
 Running: 2015/04/17:17:03:48 on nds121.iaea.org
          -i: # inverse selected reactions
          -cm2lab  # Try to convert all C.M. to Lab.

================================================================
Translation Log
================================================================
DATASET   MF  MT   REFERENCE                  REACTION
================================================================
30092002  3   107  A.S.Divatia,ET.AL.   (66) 8-O-16(N,A)6-C-13,,SIG
A0613003  3   4    H.W.DROTLEFF,ET.AL.  (93) 6-C-13(A,N)8-O-16,,SIG
        CONVERT INC-ENERGY: C.M. TO LAB K=1.3078132
        DATA CONVERTED TO INVERSE REACTION MFMT=3:107 8-O-16(N,A)6-C-13,,SIG
               E1=(E0*0.76463526 + 2.2153838)/0.94067925 MeV
               SIG1=SIG0*E0/E1*8.457255
            Product:8-O-16       : Level1(MeV)=6.049
               Q(MeV)=2.2153838     Level1-Q=3.833616
               E0_threshold for Level1 (MeV)=5.0136533
                        E1(E0_threshold),MeV=6.4304595
            Product:6-C-13       : Level1(MeV)=3.089
               Q(MeV)=-2.2153838    Level1-Q=5.3043838
               E1_threshold for Level1 (MeV)=5.638887
            Reaction inversion is correct up to E1=5.638887
C0489002  3   4    J.K.Bair,ET.AL.      (73) 6-C-13(A,N)8-O-16,,SIG
        DATA CONVERTED TO INVERSE REACTION MFMT=3:107 8-O-16(N,A)6-C-13,,SIG
               E1=(E0*0.76463526 + 2.2153838)/0.94067925 MeV
               SIG1=SIG0*E0/E1*8.457255
            Product:8-O-16       : Level1(MeV)=6.049
               Q(MeV)=2.2153838     Level1-Q=3.833616
               E0_threshold for Level1 (MeV)=5.0136533
                        E1(E0_threshold),MeV=6.4304595
            Product:6-C-13       : Level1(MeV)=3.089
               Q(MeV)=-2.2153838    Level1-Q=5.3043838
               E1_threshold for Level1 (MeV)=5.638887
            Reaction inversion is correct up to E1=5.638887
================================================================
Translation Summary
================================================================
ENTRY                  3
SUBENT                 3
DATASETS               3
TRANSLATED DATASETS    3
TRANSLATED DATA POINTS 1316
================================================================
```

Inverse reactions in EXFOR

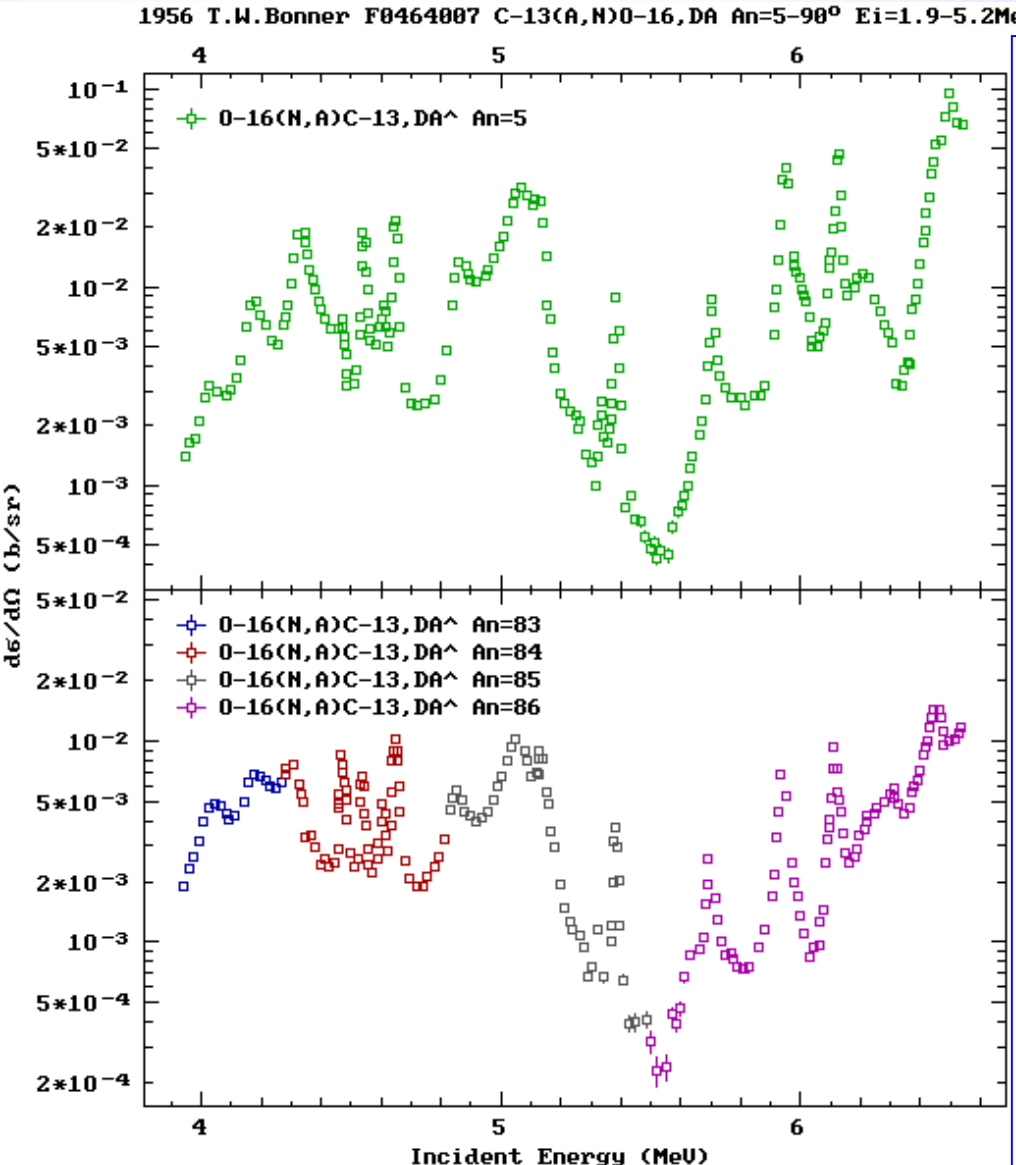
^ flag : inverted (for reactions and authors)



EXFOR. Recalculation of differential cross sections to inverse reactions using detailed balance relation

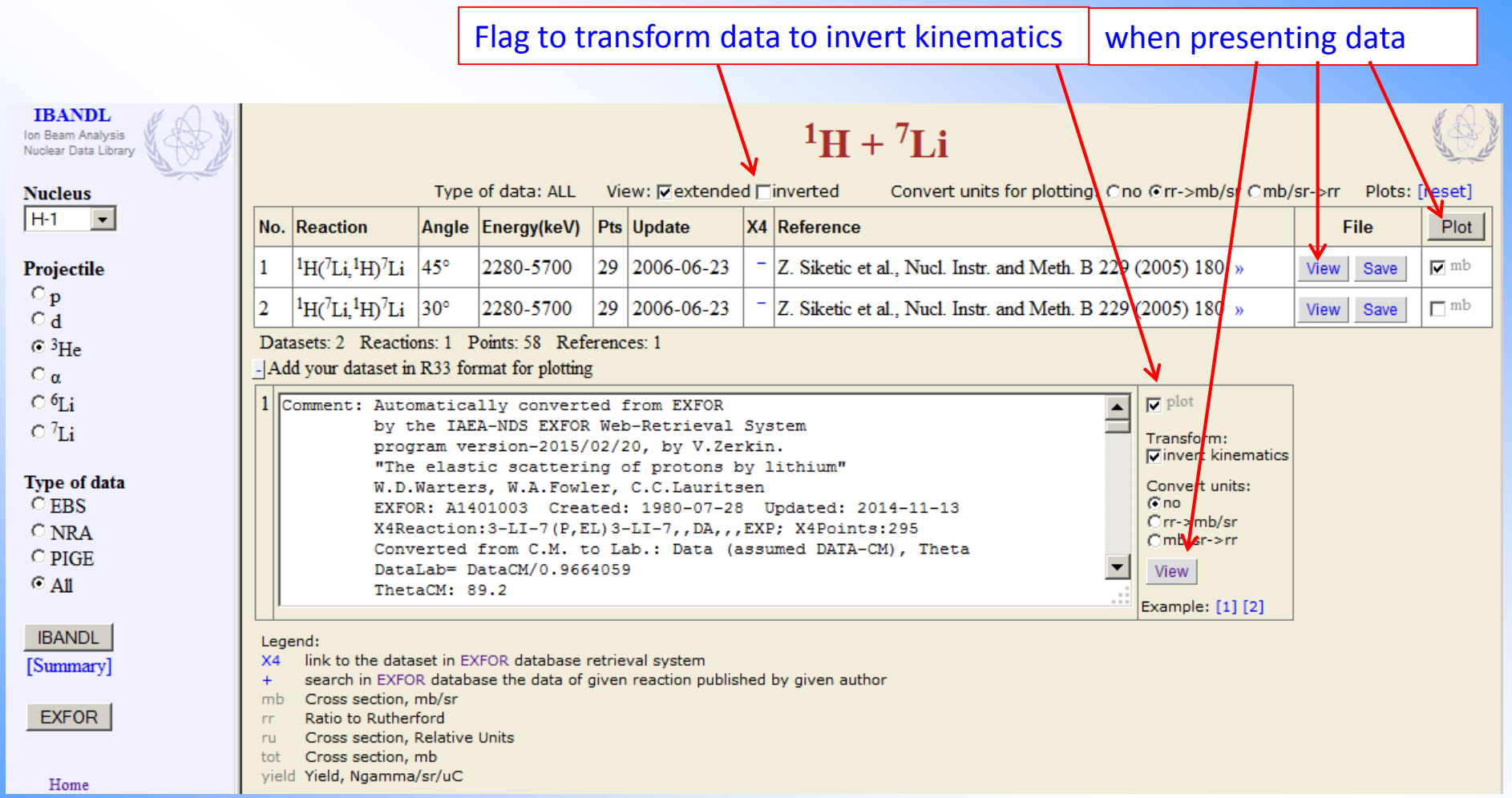
Example: $^{13}C\ (\alpha,n)^{16}O \rightarrow {}^{16}O(n,\alpha)^{13}C$: $d\sigma/d\Omega$

Protocol; limitations




```
 Convert EXFOR to C5 computational format
 Program x4toc5 (version 2018-04-18)
 V.Zerkin, IAEA, Vienna, 2010-2018
 Running: 2018-04-26,18:34:41 on nds121
        -i:      # inverse selected reactions
        -cm2lab  # convert C.M. to Lab.

================================================================================
Translation Log
================================================================================
DATASET   MF  MT   REFERENCE                  REACTION
================================================================================
F0464007  4   50   T.W.BONNER,ET.AL.    (56) 6-C-13(A,N)8-O-16,,DA
        DATA CONVERTED TO INVERSE REACTION MFMT=4:107 8-O-16(N,A)6-C
            E1=(E0*0.76463526 + 2.2156098)/0.94067925 MeV
            A1:(A0->A0CM)->(A1CM=A0CM)->(A1CM->A1)
            SIG1=SIG0*E0/E1*8.457256
              CALC.ENE. 1:(FROM 1.958 TO 3.9469) 533:(FROM 5.166 TO
              CALC.ANG. 1:(FROM 90. TO 82.5) 533:(FROM 5. TO 4.7)
              CALC.SIG. 1:(FROM 0.001461 TO 1.9003-3) 533:(FROM 0.03
            Product:8-O-16      : Level1(MeV)=6.049
                Q(MeV)=2.2156098     Level1-Q=3.83339
                E0_threshold for Level1 (MeV)=5.0133576
                         E1(E0_threshold),MeV=6.430459
            Product:6-C-13      : Level1(MeV)=3.089
                Q(MeV)=-2.2156098    Level1-Q=5.30461
                E1_threshold for Level1 (MeV)=5.6391273
            Reaction inversion is correct up to E1=5.63913(MeV)
================================================================================
Translation Summary
================================================================================
ENTRY                    1
SUBENT                   1
DATASETS                 1
TRANSLATED DATASETS      1
TRANSLATED DATA POINTS   533
================================================================================
```

Inverse kinematics in IBANDL Web interface



IBANDL contains angular distributions $d\sigma/d\Omega(\theta,E)$ for incident charged particle reactions

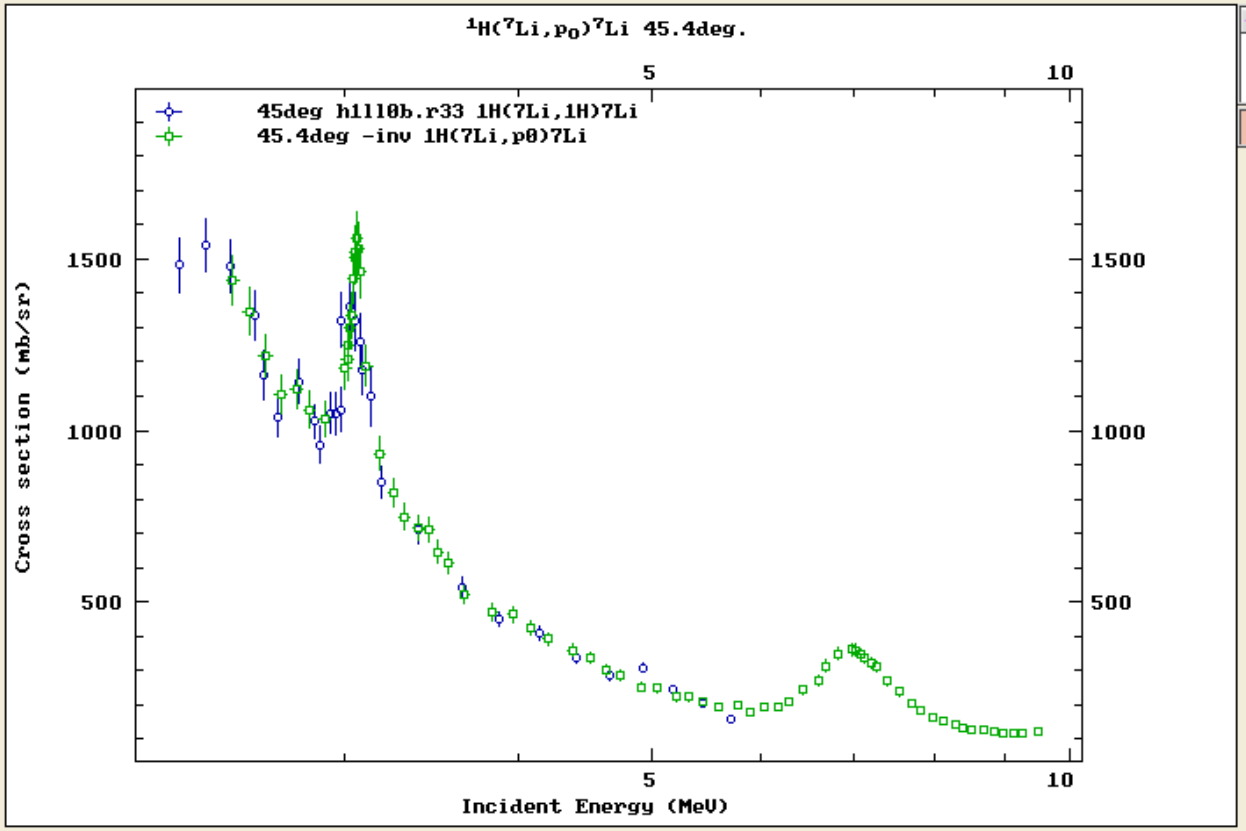
Inverse kinematics in IBANDL Web interface

Welcome to Web-ZVView!

Interactive plotting of IBANDL and SigmaCalc data

1) θ=45° E_1=2.3-5.7MeV Source: Z. Siketic et al., Nucl. Instr. and Meth. B 229 (2005) 180 +

2) θ=45.4° E_1=2.5-9.5MeV Source: W.D.Warters+(1953), Jour. Physical Review, Vol.91, Issue.4, p.917 inv Original: ^{7}Li(p,p_0)^{7}Li E_1=0.4-1.4MeV φ=45.4° θ=81.1° +



Select data for plotting [all] [none]

1) 45deg h1l10b.r33 1H(7Li,1H)7Li

2) 45.4deg -inv 1H(7Li,p0)7Li

+ 3) Use my data [example]

See: plotted data (6Kb)

Details of calculations

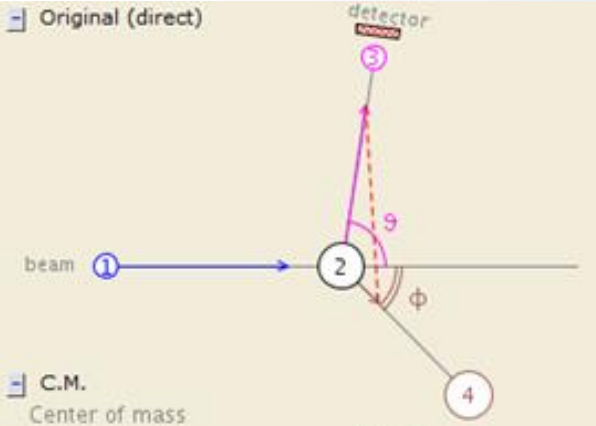
Log: XY X Y Lin: XY X Y Auto-range: XY X Y Page: >> << Zoom: <> >< Grid: VH 0 V H Pts: Txt Box PL Print

Reset Repaint Legend Authors Info+ PostScript Manual options:[+] Clipboard: Copy Paste

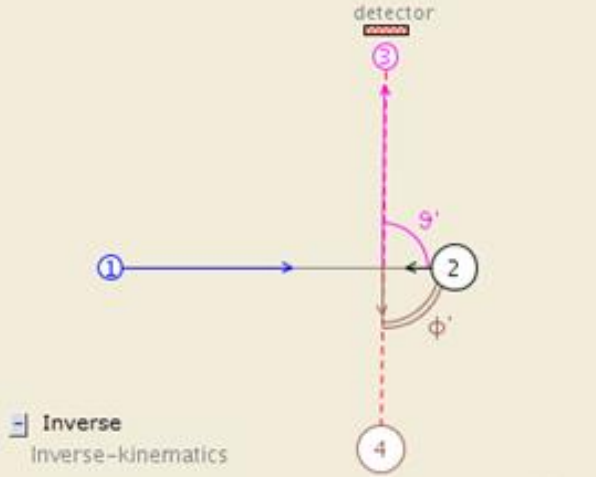
Shift legend:x=0 y=0 Split:0 1:xy;2:y Plot data or ratio:0 0:data; 1:ratio to dataset-1; 2:ratio to 2-nd, etc.

Data for plotting: ZVD (4Kb), send to ZVView; download ZVView; upload and plot your ZVD file

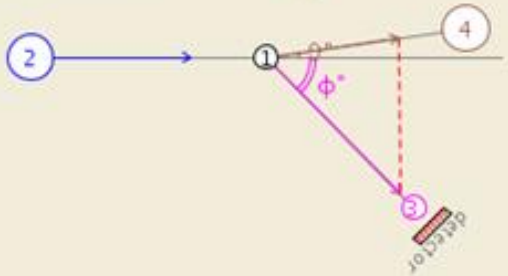
Inverse kinematics in IBANDL Web interface



Original (direct)
Reaction: $^{7}Li(p,p_0)^{7}Li$ Qvalue=0 nPoint:71
M1: Incident p M_1=1.007825 E_1=1367.0keV
M2: Target 7Li M_2=7.0160046
M3: Scattered p M_3=1.007825 E_3=1070.6keV θ=81.1° σ(θ)=45.1053mb/sr±5.0%
M4: Recoil 7Li M_4=7.0160046 E_4=296.4keV φ=45.4°



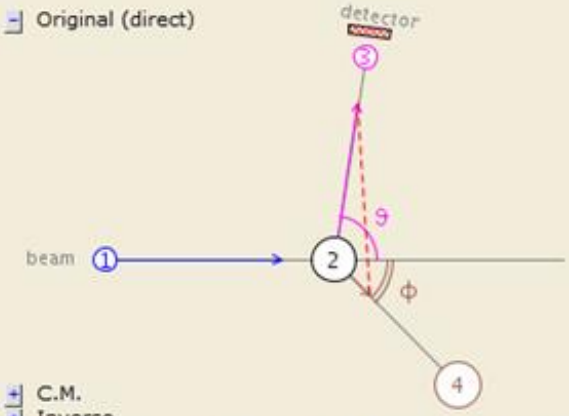
C.M.
Reaction: $^{7}Li(p,p_0)^{7}Li$ Qvalue=0 nPoint:71
E'_{cm}=1195.3keV
M1: Incident p M_1=1.007825 E_1'=1045.2keV
M2: Target 7Li M_2=7.0160046 E_2'=150.1keV
M3: Scattered p M_3=1.007825 E_3'=1045.2keV θ'=89.3° σ'(θ')=43.5874mb/sr±5.0%
M4: Recoil 7Li M_4=7.0160046 E_4'=150.1keV φ'=90.7°



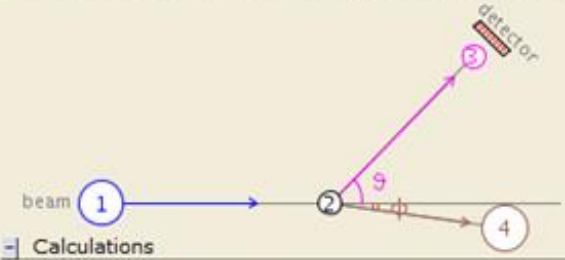
Inverse
Reaction: $^{7}Li(p,p_0)^{7}Li$ Qvalue=0 nPoint:71
M2: Incident 7Li M_2=7.0160046 E_2''=9516.4keV
M1: Target p M_1=1.007825
M3: Recoil p M_3=1.007825 E_3''=2063.3keV φ"=45.4° σ"(φ")=122.484mb/sr±5.0%
M4: Scattered 7Li M_4=7.0160046 E_4''=7453.1keV θ"=8.2°
Equivalent to elastic scattering of p on ^{7}Li measurements of recoil nucleus ^{7}Li

Inverse kinematics in IBANDL Web interface

- Original (direct)



- C.M.
- Inverse
- Result: inverse-kinematics data presented in R33 format



- Calculations

Original (direct)

Reaction: $^{7}Li(p,p_0)^{7}Li$ Qvalue=0 nPoint:71

M1: Incident p M_1=1.007825 E_1=1367.0keV

M2: Target 7Li M_2=7.0160046

M3: Scattered p M_3=1.007825 E_3=1070.6keV θ=81.1° σ(θ)=45.1053mb/sr±5.0%

M4: Recoil 7Li M_4=7.0160046 E_4=296.4keV φ=45.4°

Result: inverse-kinematics data presented in R33 format

Reaction: $^{1}H(^{7}Li,p_0)^{7}Li$ Qvalue=0 nPoint:71

M1: Incident 7Li M_1=7.0160046 E_1=9516.4keV

M2: Target 1H M_2=1.007825

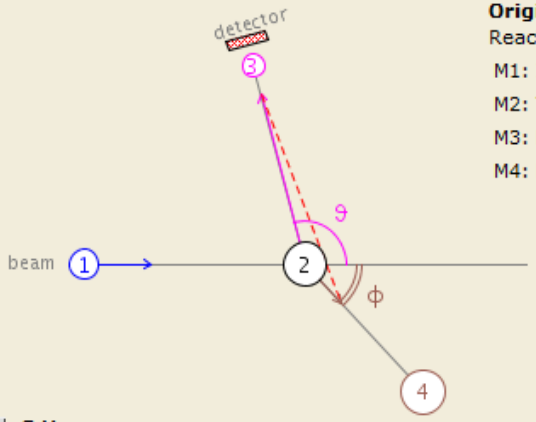
M3: Ejectile p M_3=1.007825 E_3=2061.1keV θ=45.4° σ(θ)=122.484mb/sr±5.0%

M4: Residual 7Li M_4=7.0160046 E_4=7455.3keV φ=8.2°

	Original (lab.): $^{7}Li(p,p_0)^{7}Li$ Q=0							Center of mass								Inverse kinametics						
#	E_1, keV	θ°	σ(θ), mb/sr	φ	σ(φ)	E_3	E_4	E'_{cm}	θ'	φ'	σ'(θ')	E'_1	E'_2	E'_3	E'_4	E_2"	φ"	σ"(φ")	θ"	σ"(θ")	E_3"	E_4"
1	358.6	81.1	529.741	45.4	4.35366e6	280.851	77.7494	313.558	89.3	90.7	511.914	274.174	39.3842	274.174	39.3842	2496.4	45.4	1438.52	8.2	164261.	541.3	1955.2
2	368.3	81.1	497.427	45.4	4.08809e6	288.447	79.8525	322.04	89.3	90.7	480.687	281.591	40.4495	281.591	40.4495	2563.9	45.4	1350.77	8.2	154241.	555.9	2008
3	378.5	81.1	450.076	45.4	3.69894e6	296.436	82.064	330.959	89.3	90.7	434.93	289.389	41.5698	289.389	41.5698	2634.9	45.4	1222.18	8.2	139559.	571.3	2063.6
4	388.2	81.1	407.779	45.4	3.35132e6	304.033	84.1671	339.441	89.3	90.7	394.056	296.805	42.6351	296.805	42.6351	2702.5	45.4	1107.33	8.2	126444.	585.9	2116.5
5	398.4	81.1	413.26	45.4	3.39637e6	312.021	86.3786	348.359	89.3	90.7	399.353	304.604	43.7553	304.604	43.7553	2773.5	45.4	1122.21	8.2	128143.	601.3	2172.1
6	407.1	81.1	391.875	45.4	3.22062e6	318.835	88.2649	355.967	89.3	90.7	378.687	311.256	44.7108	311.256	44.7108	2834	45.4	1064.14	8.2	121512.	614.5	2219.6
7	417.8	81.1	382.085	45.4	3.14016e6	327.215	90.5848	365.323	89.3	90.7	369.227	319.437	45.886	319.437	45.886	2908.5	45.4	1037.55	8.2	118476.	630.6	2277.9
8	432.2	81.1	435.468	45.4	3.57888e6	338.493	93.7069	377.914	89.3	90.7	420.813	330.446	47.4675	330.446	47.4675	3008.8	45.4	1182.52	8.2	135029.	652.3	2356.4
9	433.7	81.1	445.21	45.4	3.65895e6	339.668	94.0321	379.226	89.3	90.7	430.227	331.593	47.6322	331.593	47.6322	3019.2	45.4	1208.97	8.2	138050.	654.6	2364.6
10	434.2	81.1	461.032	45.4	3.78898e6	340.059	94.1405	379.663	89.3	90.7	445.517	331.976	47.6872	331.976	47.6872	3022.7	45.4	1251.94	8.2	142956.	655.4	2367.3
11	435.1	81.1	480.354	45.4	3.94778e6	340.764	94.3357	380.45	89.3	90.7	464.189	332.664	47.786	332.664	47.786	3029	45.4	1304.4	8.2	148948.	656.7	2372.2
12	437	81.1	493.156	45.4	4.05299e6	342.252	94.7476	382.111	89.3	90.7	476.56	334.116	47.9947	334.116	47.9947	3042.2	45.4	1339.17	8.2	152917.	659.6	2382.6

1) θ=63.1° E_1=0.4-2.9MeV Source: A.J.Elwyn+(1977), Jour. Physical Review, Part C, Nuclear Physics, Vol.16, p.1744 [inv] Original: ^{6}Li(d,p$_1$)^{7}Li E_1=0.1-1MeV φ=61.3°-46.3° θ=105°

Original (direct)



Original (direct)

Reaction: ^{6}Li(d,p$_1$)^{7}Li Qvalue=4547.4keV nPoint:11

M1: Incident d M_1=2.0141017 E_1=975.0keV

M2: Target 6Li M_2=6.015123

M3: Ejectile p M_3=1.007825 E_3=4394.0keV θ=105.0° σ(θ)=2.65000

M4: Residual 7Li M_4=7.0160046 E_4=1128.4keV φ=46.3°

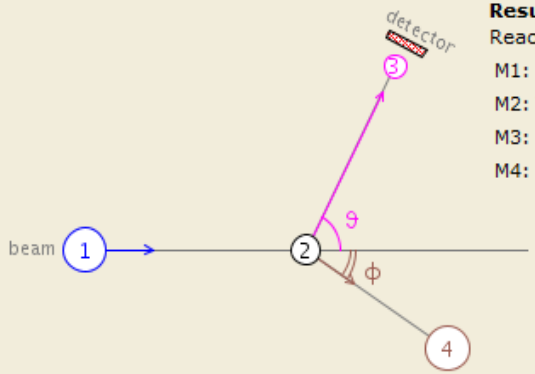
^{6}Li(d,p$_1$)^{7}Li

```
Comment:    Automatically converted from EXFOR
            by IAEA-NDS EXFOR Web-Retrieval System (v-2008/11/03)
            "Absolute cross sections for deuteron-induced reactions
             on 6Li at energies below 1 MeV."
            A.J.Elwyn, R.E.Holland, C.N.Davids, L.Meyer-Schuetzmeister,
            J.E.Monahan, F.P.Mooring, W.Ray Jr
            EXFOR: T0134004    Created: 2000-11-21  Updated: 2001-03-30
            X4Reaction:3-LI-6(D,P)3-LI-7,PAR,DA; X4Points:370
            LevelEnergy: 478.00
            Theta groupping interval=3.0 deg.

        ## Transformed to inverse kinematics: 2015-04-17,19:24:38
        ## Orig.File:       li6dp1$9.r33 (direct kinematics)
        ## Orig.Reaction:   6Li(d,p1)7Li
        ## Orig.Masses_amu: 2.0141017, 6.015123, 1.007825, 7.0160046
        ## Orig.Theta:      105.0
        ## Orig.En:         145.0 .. 975.0
        ## Orig.Phi:        61.3 .. 46.3
        ## Calculated: inverse kinematins
        ## Calc.Reaction:   2H(6Li,p1)7Li
        ## Calc.Theta:      67.8 .. 58.5 (Recoil)
        ## Program-version: 2015/03/17

Version:      R33
X4Number:     T0134004
Source:       A.J.Elwyn+(1977), Jour. Physical Review, Part C, Nuclear
Reaction:     2H(6Li,p1)7Li
Distribution: Energy
Sigfactors:   1.0, 0.0
Enfactors:    1.0, 0.0, 0.0, 0.0
Units:        mb
Composition:
Masses:       6.0, 2.0, 1.0, 7.0
Zeds:         3.0, 1.0, 1.0, 3.0
Qvalue:       4547.4, 0.00, 0.00, 0.00, 0.00
Theta:        63.1
Data:
     433.043     0.00000   0.0633396     0.00000
     543.544     0.00000   0.0995302     0.00000
     785.451     0.00000    0.351321     0.00000
     794.410     0.00000    0.362960     0.00000
     1093.06     0.00000    0.698637     0.00000
     1102.02     0.00000    0.710805     0.00000
     1702.31     0.00000     1.66925     0.00000
     2009.92     0.00000     2.11322     0.00000
     2308.57     0.00000     2.29090     0.00000
     2613.19     0.00000     2.17612     0.00000
     2911.84     0.00000     3.46672     0.00000
EndData:
```

C.M.

Inverse

Result: inverse-kinematics data presented in R33 format



Result: inverse-kinematics data presented in R33 format

Reaction: ^{2}H(^{6}Li,p$_1$)^{7}Li Qvalue=4547.4keV nPoint:11

M1: Incident 6Li M_1=6.015123 E_1=2911.8keV

M2: Target 2H M_2=2.0141017

M3: Ejectile p M_3=1.007825 E_3=5446.3keV θ=63.1° σ(θ)=3.46672r

M4: Residual 7Li M_4=7.0160046 E_4=2013.0keV φ=33.8°

Calculations

	Original (lab.): ^{6}Li(d,p$_1$)^{7}Li Q=4547.4keV							Center of mass								Inverse kinametics						
#	E_1, keV	θ°	σ(θ), mb/sr	φ	σ(φ)	E_3	E_4	E'_{cm}	θ'	φ'	σ'(θ')	E'_1	E'_2	E'_3	E'_4	E_2"	φ"	σ"(φ")	θ"	σ"(θ")	E_3"	E_4"
1	145	105	0.058	61.3	0.657303	3996.7	695.703	108.627	106.9	73.1	0.0590504	81.3785	27.2488	4071.21	584.816	433	67.8	0.0633396	67	0.0831837	4348.1	632.3
2	182	105	0.09	59.9	0.99946	4011.21	718.192	136.346	107.1	72.9	0.0918301	102.144	34.2019	4095.45	588.297	543.5	67	0.0995302	63.1	0.146473	4415.3	675.6
3	263	105	0.31	57.3	3.32075	4045.45	764.953	197.027	107.5	72.5	0.317601	147.604	49.4236	4148.51	595.919	785.5	65.5	0.351321	56.6	0.656984	4555	777.9
4	266	105	0.32	57.3	3.42385	4046.76	766.637	199.275	107.5	72.5	0.327892	149.287	49.9874	4150.47	596.201	794.4	65.5	0.36296	56.4	0.684576	4560	781.8
5	366	105	0.6	54.8	6.20191	4092.	821.397	274.19	107.9	72.1	0.617389	205.411	68.7796	4215.98	605.611	1093.1	64	0.698637	50.7	1.72735	4723.5	916.9
6	369	105	0.61	54.7	6.29947	4093.39	823.006	276.438	107.9	72.1	0.627752	207.094	69.3434	4217.94	605.893	1102	64	0.710805	50.5	1.77102	4728.3	921.1
7	570	105	1.37	51.1	13.434	4189.66	927.739	427.018	108.6	71.4	1.41956	319.902	107.116	4349.61	624.807	1702.3	61.7	1.66925	43	6.64402	5041.1	1208.6
8	673	105	1.7	49.6	16.3212	4240.65	979.746	504.18	108.8	71.2	1.76676	377.709	126.472	4417.08	634.499	2009.9	60.8	2.11322	40.3	10.3753	5196.4	1360.9
9	773	105	1.81	48.4	17.0642	4290.89	1029.51	579.096	109.1	70.9	1.88606	433.832	145.264	4482.59	643.908	2308.6	59.9	2.2909	38.1	13.5864	5345	1510.9
10	875	105	1.69	47.2	15.6695	4342.73	1079.67	655.509	109.3	70.7	1.76542	491.077	164.432	4549.4	653.506	2613.2	59.2	2.17612	36.2	15.4581	5494.9	1665.7
11	975	105	2.65	46.3	24.2084	4394.01	1128.39	730.425	109.5	70.5	2.77457	547.2	183.224	4614.91	662.916	2911.8	58.5	3.46672	34.7	29.1078	5640.4	1818.9

Recalculation of angular distributions from EXFOR to inverse kinematics and integration with Web-IBANDL

Data Selection

Retrieve | Selected | Unselected | All | Reset

Output: X4+ EXFOR Bibliography TAB C4 PlotC4

Plot: Quick-plot (cross-sections) ungroup Advanced plot [how-to] using C5 and convert ratios to σ

Narrow incident energy (optional), eV: Min: Max:

Apply Data re-normalization (for advanced users, results in: C4, TAB and Plots)

n	Display	Year	Author-1	Energy range,eV	Points	Reference	Subentry#P	NSR-Key
1)	3-LI-6(HE3,P)4-BE-8,PAR,DA C4: MF4 MT601							
	Quantity: [DAP] Partial differential cross section d/dA							
g* 1	+ i X4 X4+ X4± T4	1956	J.P.Schiffer+	8.98e5	5.08e6	201 [pdf]+ J,PR,104,1064,1956	A1495002 [9] R33	1956S
g 2	+ i X4 X4+ X4± T4			8.99e5	5.08e6	191	A1495003 [9] R33	1956S

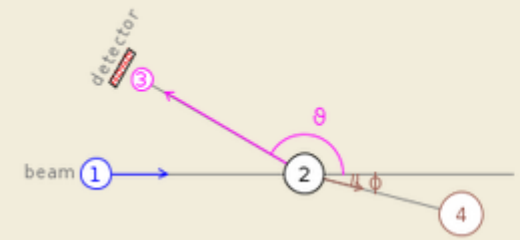
Convert to R33 format

Note. This is β-version of X4R33 conversion software. Please report any problems to V.Zerkin@iaea.org

Plots: dσ/dΩ(E):2/2 dσ/dΩ(θ):16/189 See: [doc] x4:$\sigma_{CM}(E,\theta)$ Try: $\theta_{CM} \rightarrow$Lab

1) 0°:2900 Plot R33 [IBA] [Inv] 2) 150°:2900 Plot R33 [IBA] [Inv]

EXFOR:A1495003 $^{6}Li(^{3}He,p_1)^{8}Be$ θ=150° $E_{in.}$:890-5080keV Source: J.P.Schiffer+(1956), Jour. Physical Review, Vol.104, p.1064



Reaction: $^{6}Li(^{3}He,p_1)^{8}Be$ Qvalue=13887.36keV nPoint:99

M1: Incident 3He M_1=3.0160294 E_1=5081.0keV

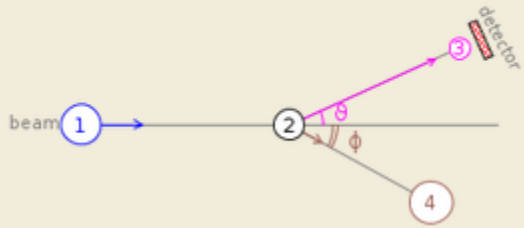
M2: Target 6Li M_2=6.015123

M3: Ejectile p M_3=1.007825 E_3=12484.7keV θ=150.0° σ(θ)=4.35210mb/sr±20.0%

M4: Residual 8Be M_4=8.005305 E_4=6483.6keV φ=14.3°

Recalculated to inverse kinematics.

EXFOR:A1495003 $^{3}He(^{6}Li,p_1)^{8}Be$ θ=23.8° $E_{in.}$:1790-10130keV Source: J.P.Schiffer+(1956), Jour. Physical Review, Vol.104, p.1064



Reaction: $^{3}He(^{6}Li,p_1)^{8}Be$ Qvalue=13887.36keV nPoint:99

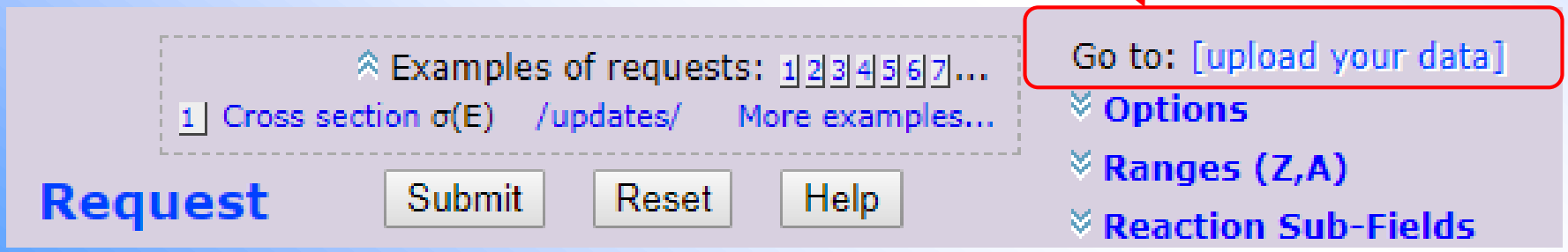
M1: Incident 6Li M_1=6.015123 E_1=10133.5keV

M2: Target 3He M_2=3.0160294

M3: Ejectile p M_3=1.007825 E_3=22050.5keV θ=23.8° σ(θ)=7.74266mb/sr±20.0%

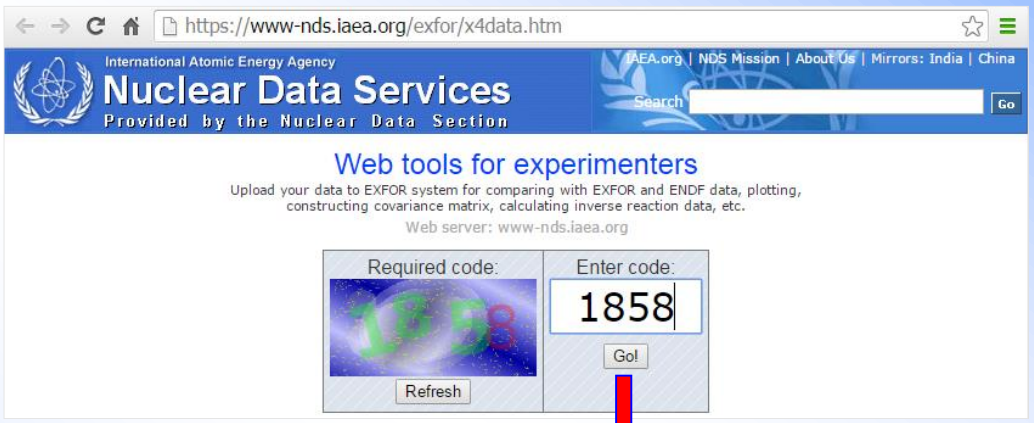
M4: Residual 8Be M_4=8.005305 E_4=1970.3keV φ=28.6°

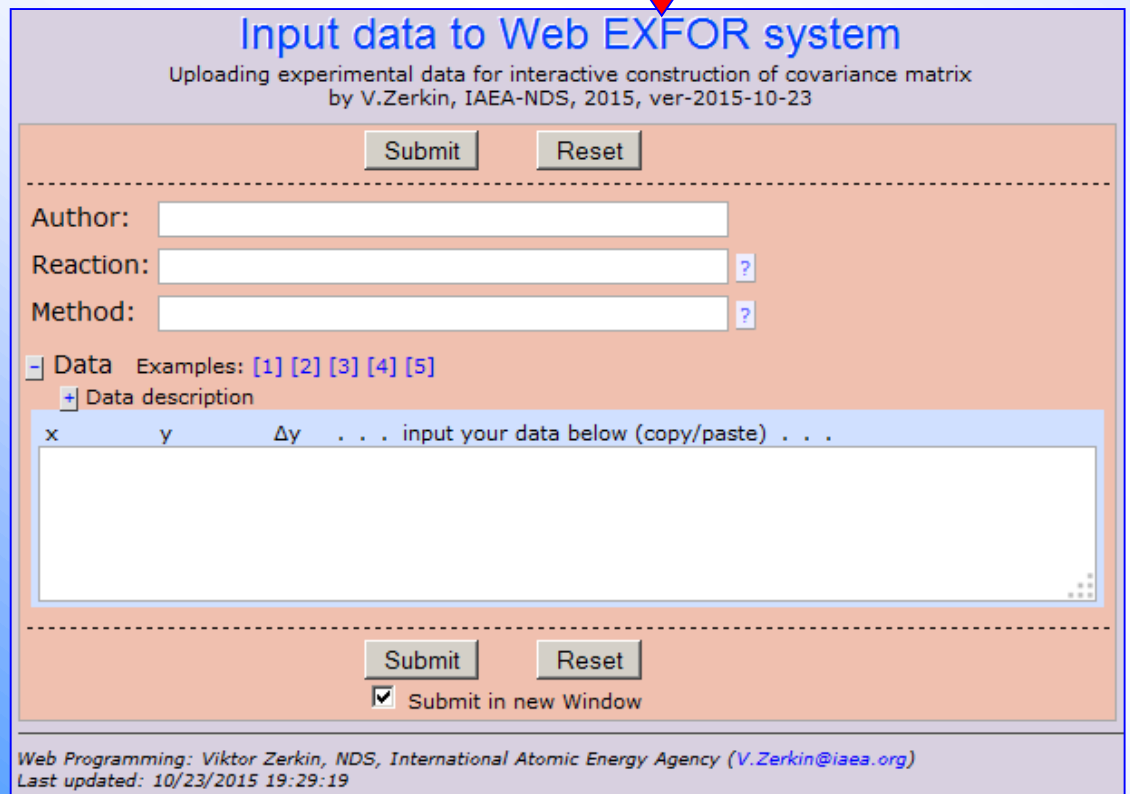
Uploading your experimental data



Uploading your experimental data

https://www-nds.iaea.org/exfor/x4data.htm





Uploading your experimental data

Submit Reset

Author: C.Sage, at al.

Reaction: 95-AM-241(N,2N)95-AM-240,,SIG ?

Method: TOF ?

- Data Examples: [1] [2] [3] [4] [5]
  - Data description

Uncertanties Δy : nn- | nn++ ; nn=7

	{X}	{Y}	{ΔY}1	{ΔY}2	{ΔY}3	{ΔY}4	{ΔY}5	{ΔY}6	{ΔY}7
Var:									
Header:	EN	DATA	ERR-TOT	MONIT-ERR	ERR-1	ERR-2	ERR-7	ERR-8	ERR-3
Units:	MeV	mb	per-cent	per-cent	per-cent	per-cent	per-cent	per-cent	per-cent
Type:	Table	Table	Table	Table	Table	Table	Table	Table	Const
Value:									1.2

x y Δy . . . input your data below (copy/paste) . . .

```
8.34   96.8   6.5    1.9   5     1    .9   .3
9.15   162.9  5.7    1.9   4     1    .6   .3
13.33  241.8  4.6    1.6   2.5   1    .4   .3
16.1   152.4  4.6    2     2.1   1    .6   .3
17.16  116.1  4.4    2     1.5   1    .6   .3
17.9   105.7  4.4    2.2   1.3   .7   .7   .3
19.36  89.5   8.2    3.1   6.3   2    .6   1.3
19.95  102.1  5.8    4.1   1.4   1    .6   1.4
20.61  77.9   8.8    5.4   5.7   1.6  .6   1.4
```

Submit Reset

Submit in new Window

n	Display	Year	Author-1	Energy range,eV	Points	Reference
1)	95-AM-241(N,2N)95-AM-240,,SIG C4: MF3 MT16					
Quantity: [CS] Cross section						
1	+ uploaded X4 X4± Cov	2016	C.Sage+	8.34e6 2.061e7	9	+ W,SAGE,20160622
2	+ i X4 X4+ X4± T4 Cov	2016	A.Kalamara+	1.00e7 1.71e7	4	[pdf]+ J,PR/C,93,014610,2016

Data flow

Experimentalist

Compiler

User

Input your experimental data

Input EXFOR file

Input criteria for search

EXFOR file

Uploading

EXFOR Request

EXFOR Search

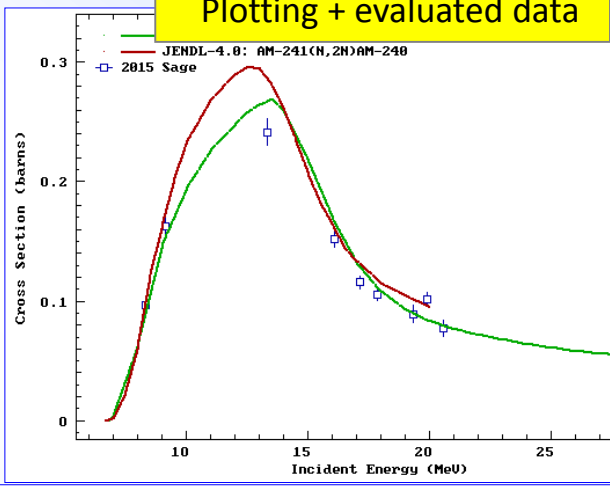
Database

Retrieve

Plotting

ENDF Retrieval

Plotting + evaluated data



Produce: C4, C5, C5M, XML, X4±, X4+, etc.

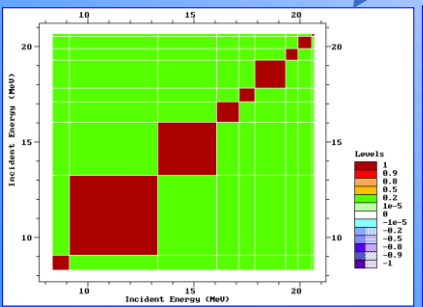
Re-normalization

Constructing covariance matrices

Calculation of inverse reaction cross sections

Plotting

Save/restore recipe.xml



#ENDF Am-241 MT16:2n

Z(10x10): $Z_{i,j}$ = Cor(σ_{Xi},σ_{Yj})*100

	X (MeV)										
Y (MeV)	*8.34*	*9.15*	*13.33*	*16.1*	*17.16*	*17.9*	*19.36*	*19.95*	*20.61*	*20.61*	*j*
8.34	100	48.36	41.72	38.39	37.26	36.52	35.13	34.6	34.03	34.03	*1*
9.15	48.36	100	43.36	40.03	38.9	38.15	36.77	36.24	35.67	35.67	*2*
13.33	41.72	43.36	100	46.67	45.54	44.8	43.41	42.88	42.31	42.31	*3*
16.1	38.39	40.03	46.67	100	48.87	48.13	46.74	46.22	45.64	45.64	*4*
17.16	37.26	38.9	45.54	48.87	100	49.25	47.87	47.34	46.77	46.77	*5*
17.9	36.52	38.15	44.8	48.13	49.25	100	48.62	48.09	47.51	47.51	*6*
19.36	35.13	36.77	43.41	46.74	47.87	48.62	100	49.47	48.9	48.9	*7*
19.95	34.6	36.24	42.88	46.22	47.34	48.09	49.47	100	49.43	49.43	*8*
20.61	34.03	35.67	42.31	45.64	46.77	47.51	48.9	49.43	49.43	100	*9*
20.61	34.03	35.67	42.31	45.64	46.77	47.51	48.9	49.43	49.43	100	*10*
i	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	

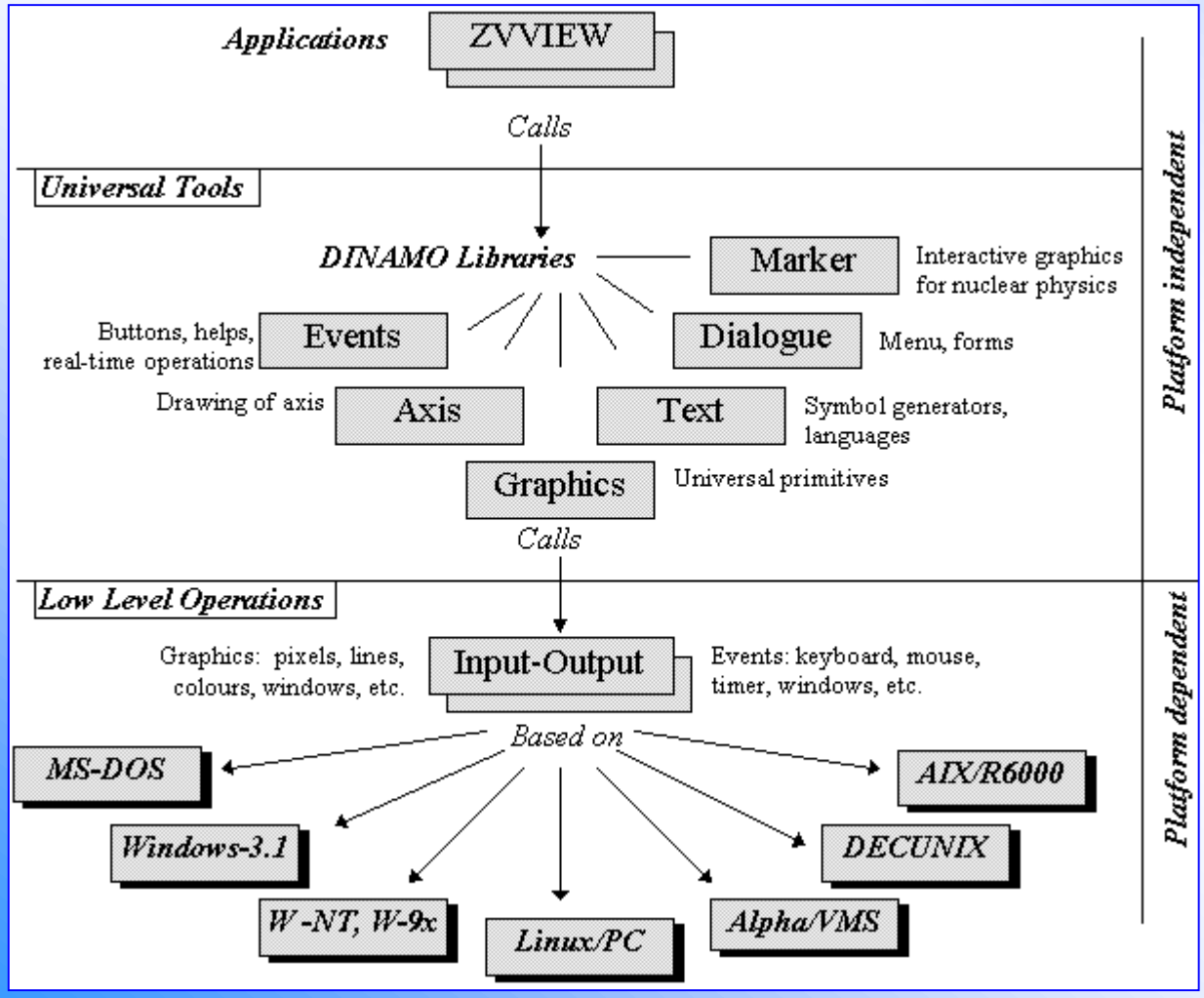
```
<?xml version="1.0" encoding="UTF-8" ?>
- <CovRecipe DatasetID="Z0001002" Created="2015-10-23 20:35:25" Software="Web-tool:2012.03.16">
    <Subent id="Z0001002" x4upd="20151023" />
    <Reacode code="95-AM-241(N,2N)95-AM-240,,SIG" />
    <defineErr name="Statistical" type="C5" cmd="Setup" src="Total" koeff="0.5" />
    <defineErr name="myErr-1" type="myErr" cmd="Setup" src="Systematic" koeff="0.5" />
    <defineErr name="myErr-2" type="myErr" cmd="Setup" src="Systematic" koeff="0.5" />
    <addCovarFraction errName="Statistical" errType="C5" corrType="SERC" fracType="Uncorrelated" />
    <addCovarFraction errName="myErr-1" errType="myErr" corrType="LERC" fracType="Fully-correlated" />
    <addCovarFraction errName="myErr-2" errType="myErr" corrType="MERC" fracType="MERC-correlated"
      MercType="Log" MercInterval="0.05" MercEnMin="1e-5" MercEnMax="2e7" EnUnits="eV" />
    <myStamp>EXFOR-Web-Covariance-Recipe, V.Zerkin, IAEA-NDS, 2012-03-19.</myStamp>
  </CovRecipe>
```

Plotting on Web with Web-ZVView

ZVView/DINAMO: interactive plotting system

ZVView is a multi-platform program designed for nuclear reactions data evaluators to perform efficient interactive visual analysis of cross section data retrieved from EXFOR and ENDF libraries. Kiev-Vienna, 1993-2018

http://www-nds.iaea.org/public/zvview/



Platforms:

1. MS-Windows
2. Linux (X-Windows)
3. Mac OSX (X11)

Old platforms:

4. Alpha/VMS
5. DEC Unix
6. AIX/R6000
7. Windows-3.1
8. MS-DOS

Output:

1. Screen (Windows)
2. PostScript (PS, EPS)
3. Enhanced Metafile (EMF)
4. PCX, GIF, Animated-GIF

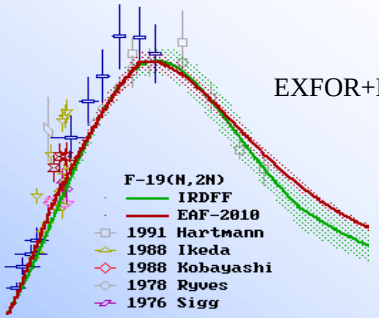
Basic ideas:

1. Language: C
2. Self-made GUI, PS, PCX, GIF
3. Low level API's (MS-Win, X11)
4. Max platform-independency
5. Minimalistic approach

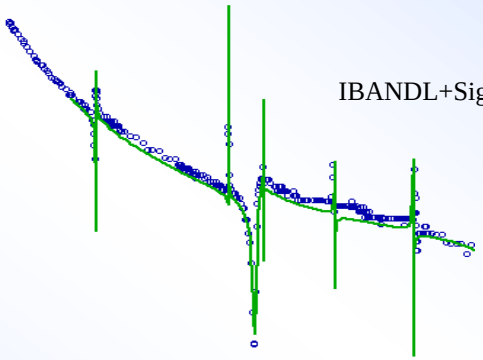
ZVView: interactive plotting program for display and analysis of nuclear data

Features:

- All features inherited from DINAMO;
- Integrated with Empire, EndVer, EXFOR CD-ROMs.
- Works on Web: integrated with EXFOR-ENDF database retrieval systems, IBANDL, SigmaCals, LiveChart: can read data from remote archives, can be called as part of external Web service, etc.
- Reads nuclear data formats: TABLE/XREF, ENDF-MF3/MF40/MF33(Law5);
- Can read data from text files(columns): {y}; {x y}; {x y dy}; {x y dy dx}; {x y +dy –dy +dx –dx}; {x} {y} z{};
- Understands ENDF interpolation laws, can display ratios to selected curve
- Can do some least squared fitting, displays χ^2 (EXFOR-ENDF)
- Can work with authors: filter data, select, legend etc.

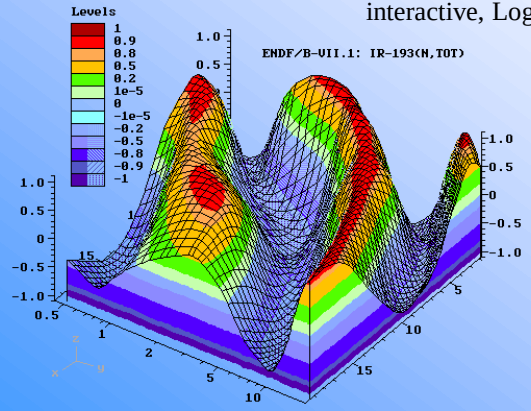


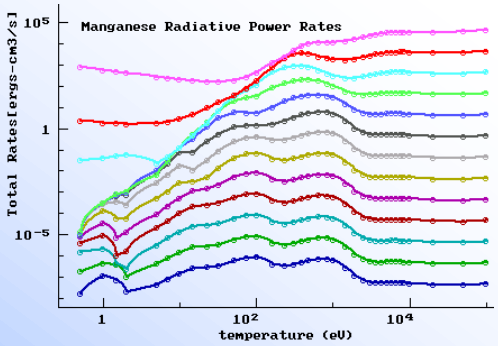
EXFOR+ENDF



IBANDL+SigmaCalc

ENDF/MF33: Web, interactive, Log-Lin, animated





FLYCHK (A+M): Web-Web communication

2009-2014

Web-ZVView

Database Retrieval Systems

- ENDF
- EXFOR

Your data

- ENDF uploading
- EXFOR uploading
- Manual input

Input

IBANDL

FLYCHK

LiveChart

Web-ZVView

Output

Output

Send ZVD file to user's PC

Input

Several formats and non-structured data

Input formats:

- Data by columns (X : Y : ΔY)
- Text (matrix, triangle)
- Link to Web-data (archives)
- ENDF file (or MF3/33 Sections)
- ZVD file(s)

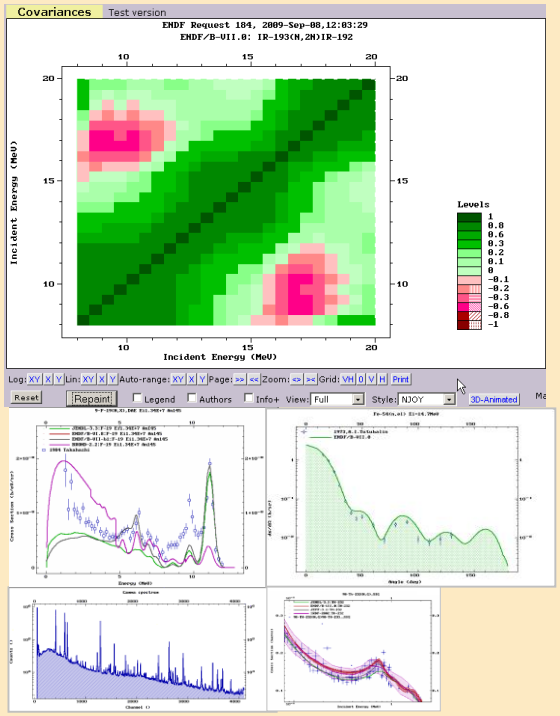
Draft for EXFOR compilation

Data for FORTRAN users

Output formats:

- GIF, EPS, PS, PDF, SVG
- Html (Table)
- Text (columns, triangle)
- EXFOR draft (COVARIANCE)
- ENDF like (MF33 Section,LB5)
- Input for Fortran (+ reading code)

Plots + interactions /Web

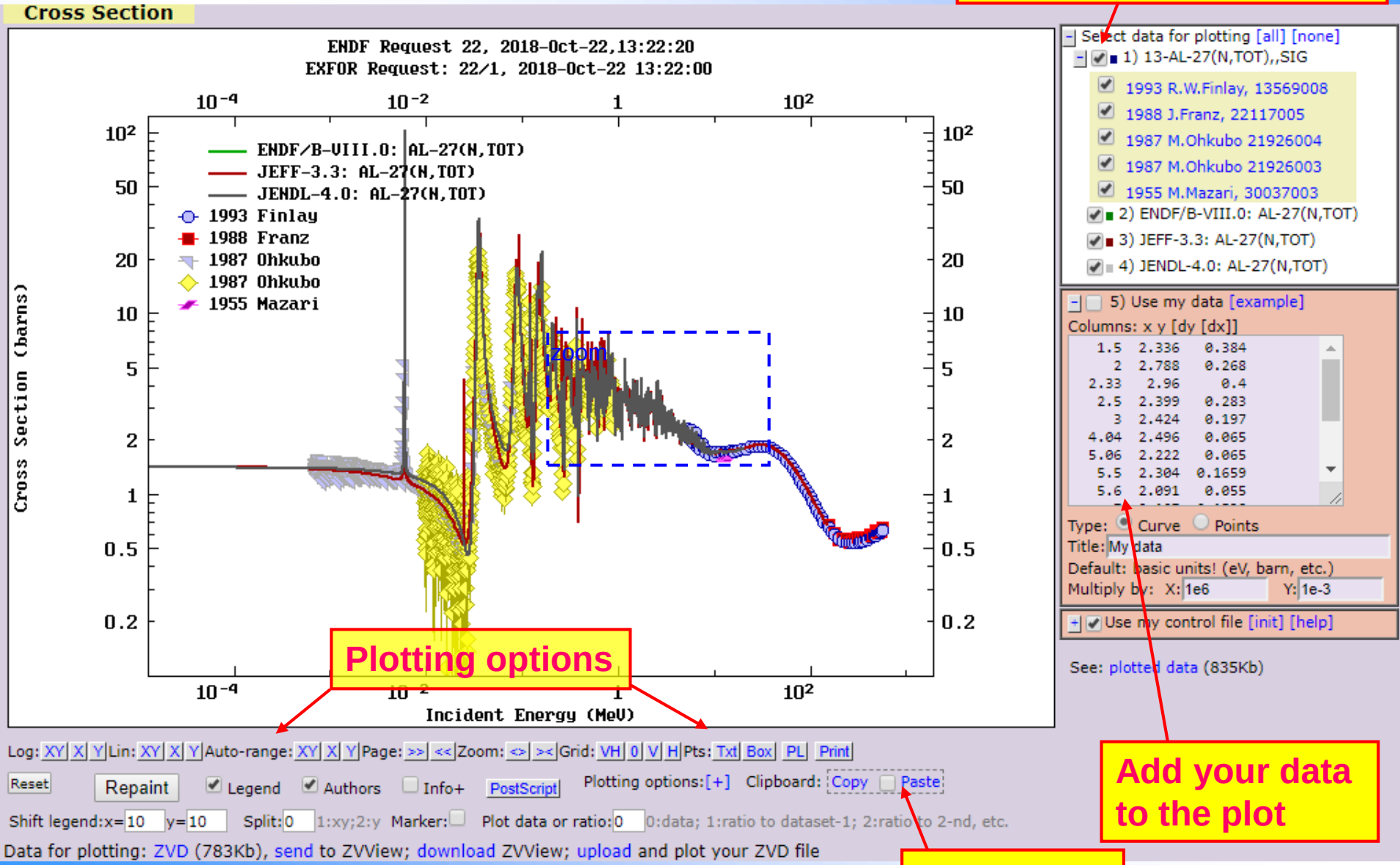


Useful features of Web-ZVView

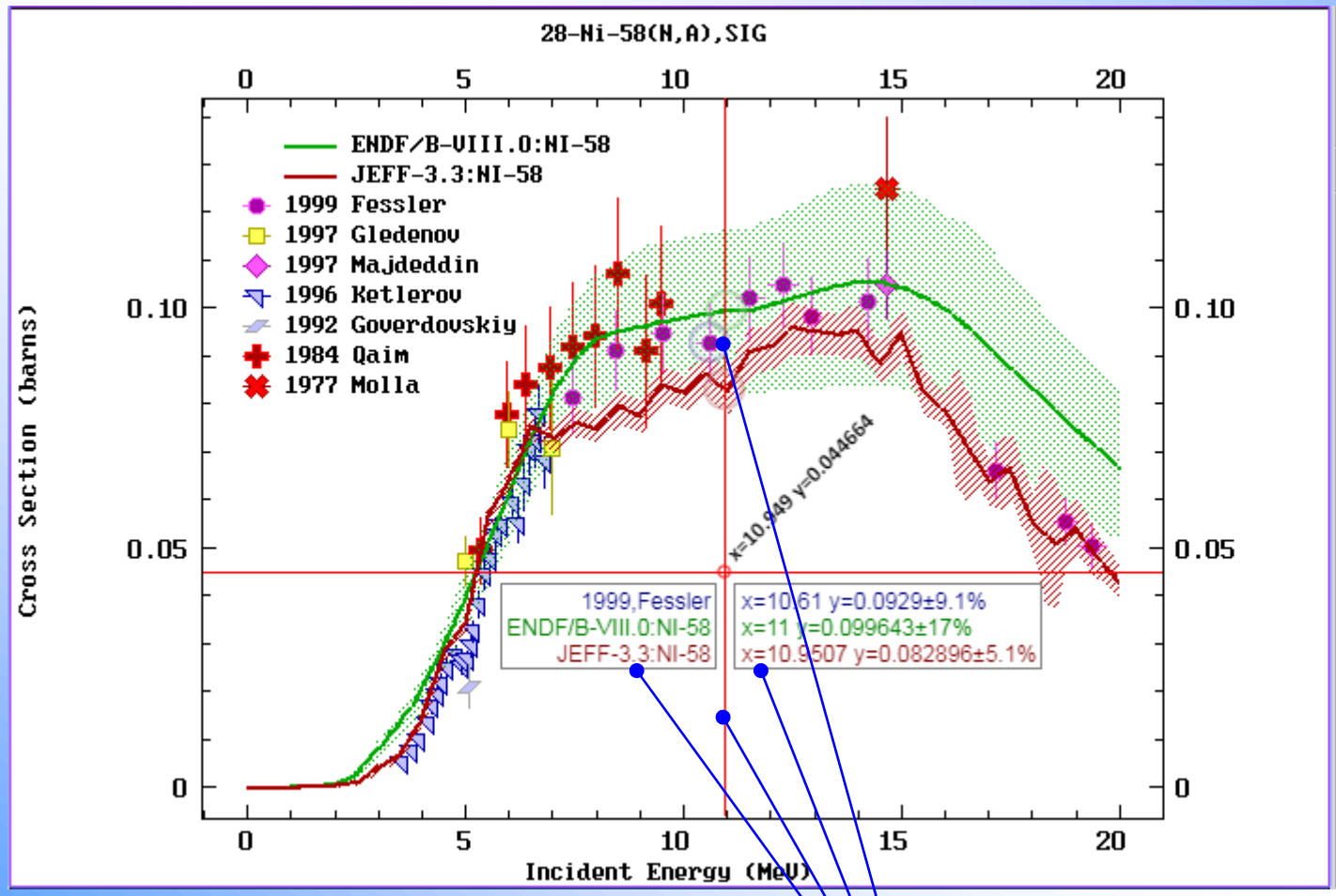
Useful features of Web-ZVView:

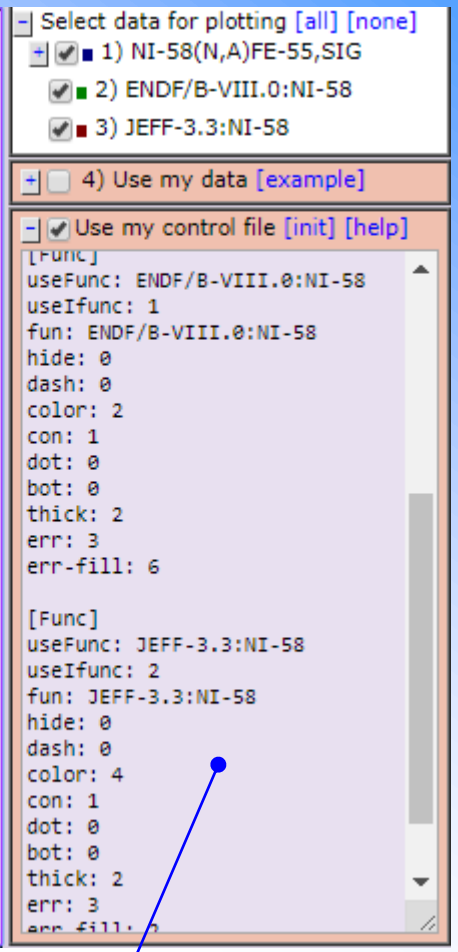
- copy/paste data to plots (inside Web session) between: EXFOR-ENDF-IBANDL-MyPlot-etc.
- insert text of ZVD file to the form as “my data” to compare them to data from databases
- output of plotted data in several formats (can be used for re-formatting data, e.g. free-text matrix to EXFOR and ENDF)
- “manual” options: dimensions, distortions, image corrections
- generates output: PS, EPS, PDF
- etc.

Example of interactive Web ZVView plotting



Recent news in Web-ZVView plotting





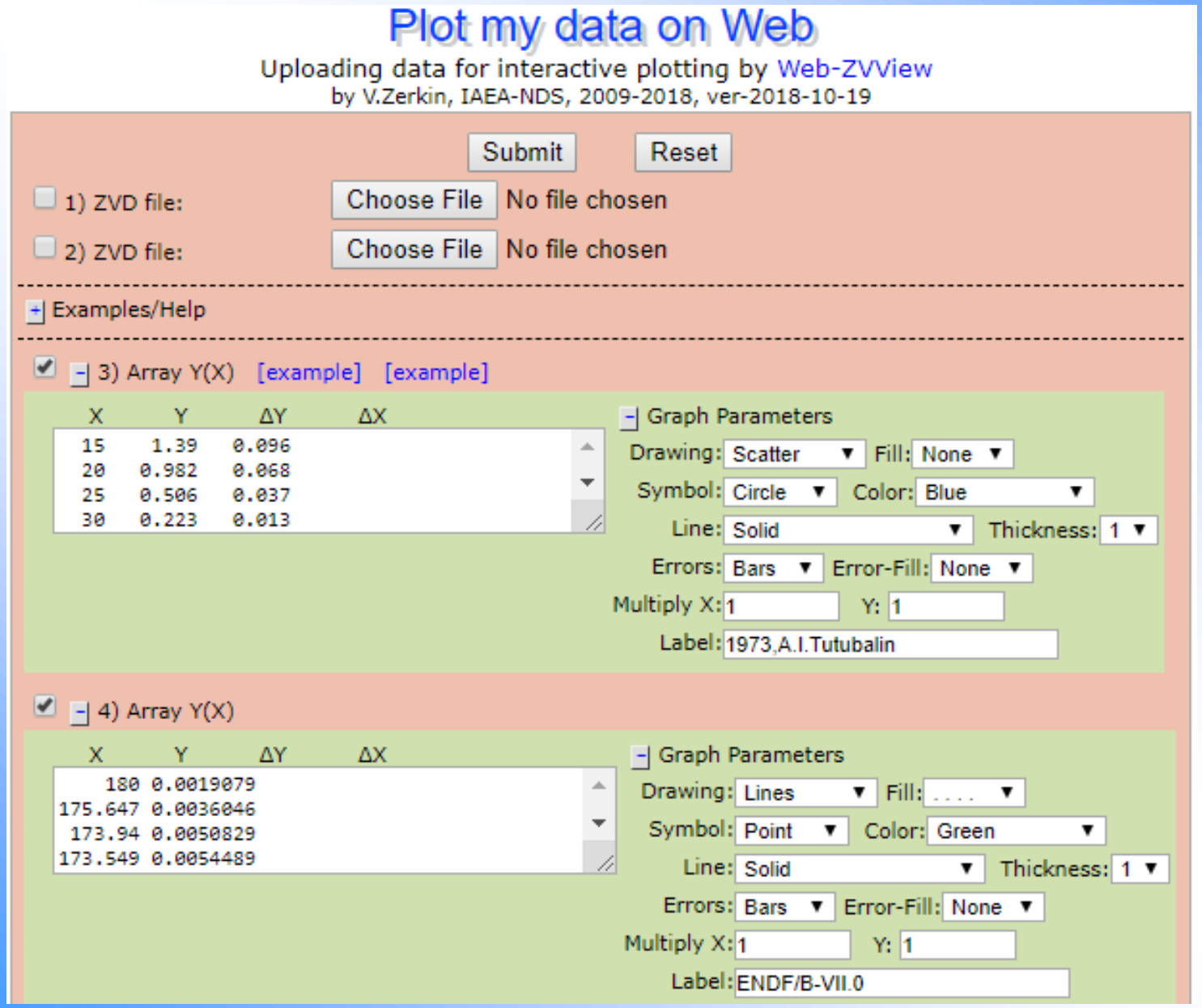
Element: "Extended Marker"

Option: "Control file"

Implementation: ZVView → JSON → AJAX → HTML5

Plot your data: MyPlot

http://www-nds.iaea.org/exfor/myplot.htm

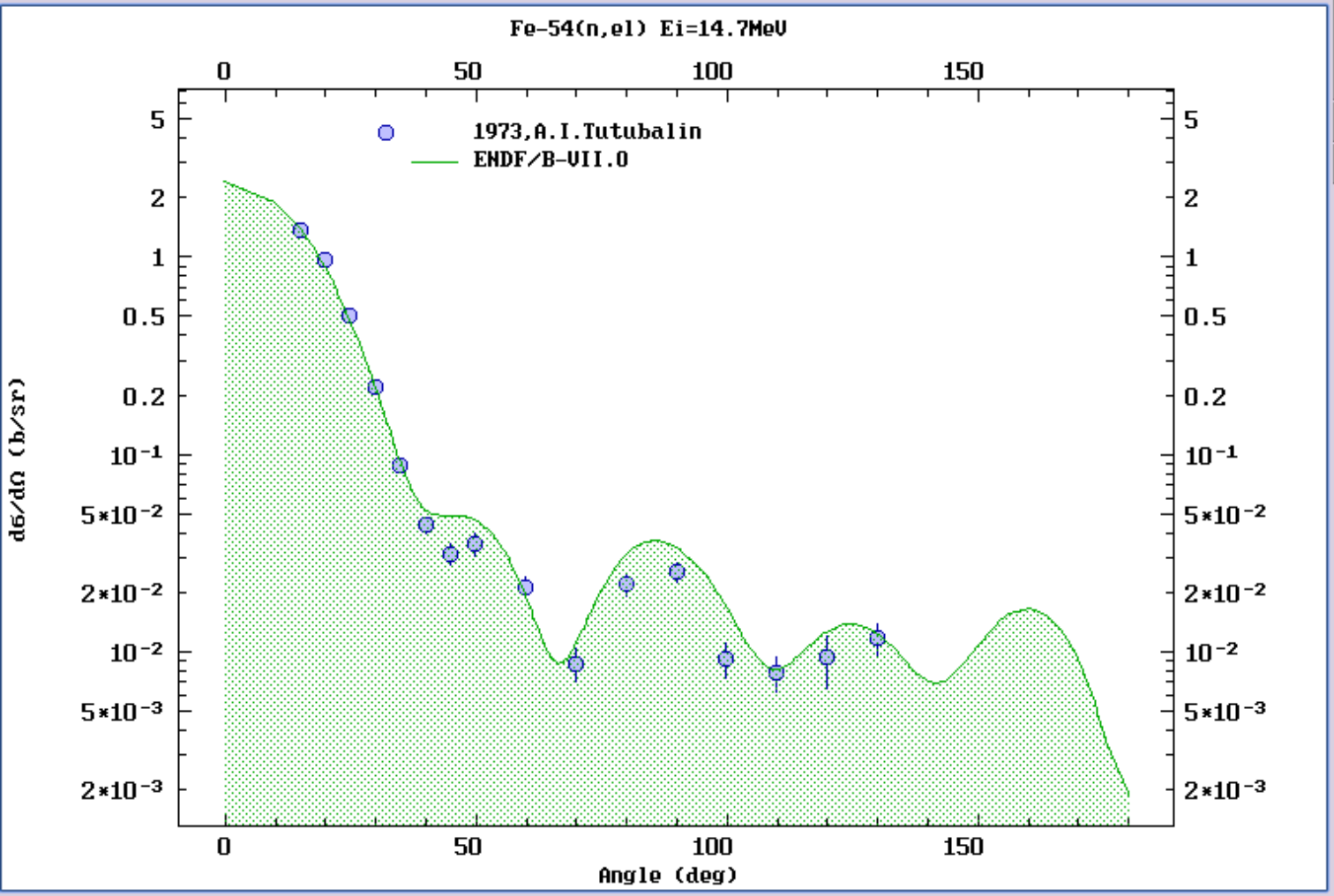


Submit *Sends data to Web-ZVView*

Web-ZVView

Welcome to Web-ZVView!

#33



Select data for plotting [all] [none]
1) 1973,A.I.Tutubalin
2) ENDF/B-VII.0
3) Use my data [example]
Use my control file [init] [help]

See: plotted data (6Kb)

Log: XY X Y Lin: XY X Y Auto-range: XY X Y Page: >> << Zoom: <> >< Grid: VH 0 V H Pts: Txt Box PL Print

Reset Repaint Legend Authors Info+ PostScript Plotting options:[+] Clipboard: Copy

Shift legend:x=100 y=10 Split:0 1:xy;2:y Marker: Plot data or ratio:0 0:data; 1:ratio to dataset-1; 2:ratio to 2-nd, etc.

Input ENDF section of MF33

Submit Reset

1) ZVD file: Browse... No file selected.

2) ZVD file: Browse... No file selected.

+ Examples/Help

+ 3) Array Y(X) [example]

+ 4) Array Y(X)

+ 5) Array Y(X)

+ 6) Matrix Z(X,Y) Dimension: X:13 Y:13 Z:169 [example]

+ 7) Matrix Z(X,Y) Dimension: X:31 Y:31 Z:496 [example]

- 8) Matrix from ENDF/MF33 [example]

```
 3.307400+4 7.328890+1          0          0          0          1332233  2     1
 0.000000+0 0.000000+0          0          2          0          1332233  2     2
 0.000000+0 0.000000+0          1          5        496         31332233  2     3
 1.000000-5 5.000000+3 7.000000+3 1.000000+4 2.000000+4 4.000000+4332233  2     4
 7.000000+4 1.000000+5 2.000000+5 4.000000+5 6.000000+5 8.000000+5332233  2     5
 1.000000+6 1.200000+6 1.500000+6 1.700000+6 2.000000+6 2.500000+6332233  2     6
 3.000000+6 4.000000+6 5.000000+6 6.000000+6 7.000000+6 8.000000+6332233  2     7
 9.000000+6 1.000000+7 1.200000+7 1.400000+7 1.600000+7 1.800000+7332233  2     8
```

- Graph Parameters

View: Full

Color: Brown

Label:

MT: all

+ 9) Matrix from ENDF/MF33 [example] [example] [example]

+ 10) Matrix from ENDF/MF33: upload your local ENDF file

Set default plotting parameters: y(x): CS DA DE DAE z(x,y): COV/SIG

- Common Plotting Parameters

Title: Correlations of Neutron Cross Sections

X-axis: Incident Energy » Scale: Auto

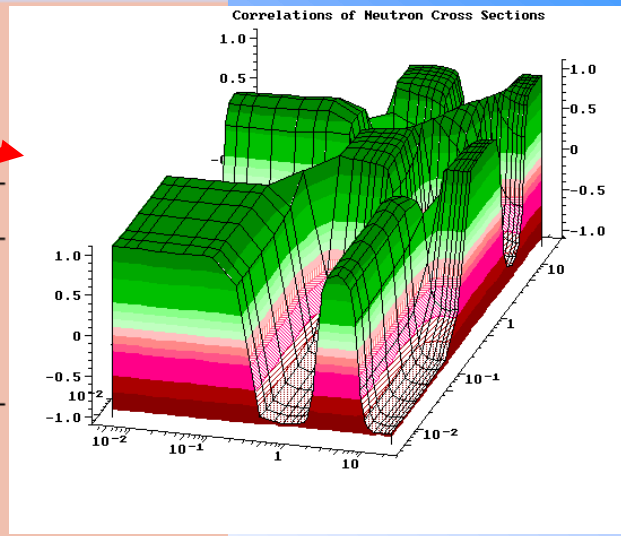
Y-axis: Incident Energy » Scale: Auto

X-units: 1e6, (MeV) »

Y-units: 1e6, (MeV) »

View: 3D-0

Style: NJOY



Input link to Web address

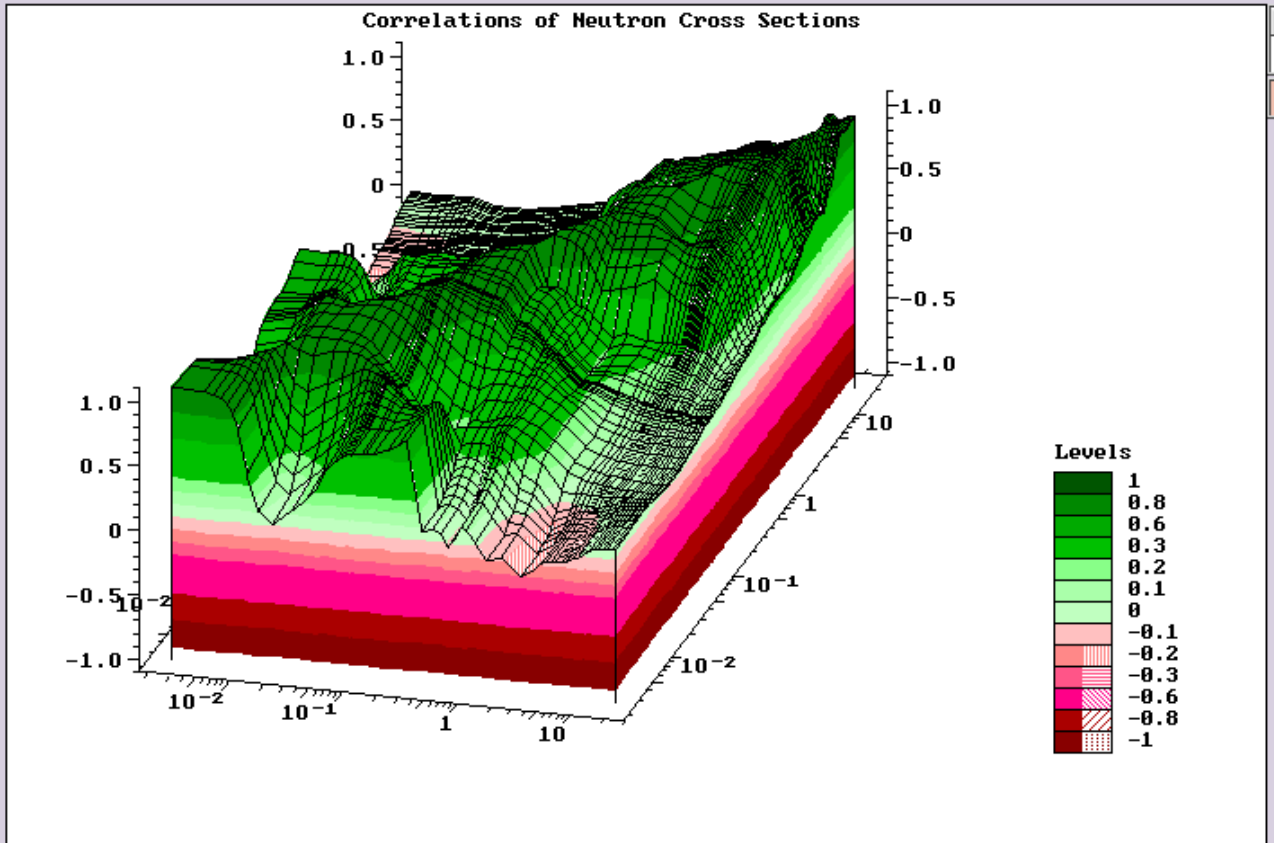
9) Matrix from ENDF/MF33 [example] [example] [example]

http://t2.lanl.gov/nis/data/data/ENDFB-VII.1-neutron/Gd/152

Remote file: http://t2.lanl.gov/nis/data/data/ENDFB-VII.1-neutron/Gd/152 filter MT=102
Additional plot: Uncertanties
Additional plot: Cross Sections

Welcome to Web-ZVView!

#128



Select data for plotting [all] [none]
1) Gd-152 MT102:gamma
2) Use my data [example]

See: plotted data (92Kb) out:x4,T,F,e6

Not covered topics

1. Text search in EXFOR (~Google)
2. Native EXFOR plotting
3. Calculating CS ratios between different EXFOR datasets
4. Constructing covariance matrix from EXFOR uncertainties on Web
5. Reconstruction of ENDF elemental reaction data in EXFOR-ENDF Web system
6. MyEndf system for ENDF evaluators

Thank you.