



International Atomic Energy Agency

The 6th DAE-BRNS Theme Meeting on

EXFOR Compilation of Nuclear Data

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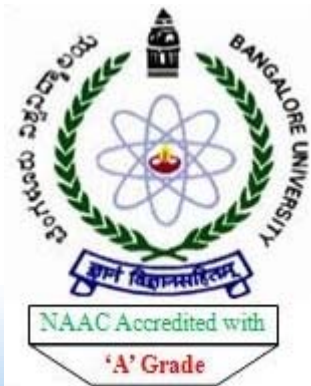
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EXFOR/ENDF database

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EXFOR from Various Centres / Medias

The collage displays several web interfaces related to the EXFOR database. Key elements include:

- CSISRS (Experimental Nuclear Reaction Data):** Shows a search form with fields for Target, Reaction, Product, Quantity, and Energy from.
- NNDC (National Nuclear Data Center):** Displays a search form with fields for Target, Reaction, Product, Quantity, and Energy from.
- IAEA-NEA (Agence pour l'énergie nucléaire):** Shows a search form with fields for Target, Reaction, Product, Quantity, and Energy from.
- EXFOR Master File:** Shows a search form with fields for Target, Reaction, Product, Quantity, and Energy from.
- JANIS 3.0 (Japan In-Beam Nuclear Data):** Shows a search form with fields for Target, Reaction, Product, Quantity, and Energy from.
- IAEA-NDSD (International Atomic Energy Agency Nuclear Data Section):** Shows a search form with fields for Target, Reaction, Product, Quantity, and Energy from.
- IAEA-NDSD Search Results:** Shows search results for 'EXFOR / ENDF - Search' and 'Japan Charged-Particle Nuclear Reaction Data Group (UCPRG)'.

- Centres may use their **own database system**.

Example: CSISRS, SIGMA (NNDC), JANIS (NEA-DB), EXFOR (IAEA-NDS)

- However, all centres (should) use the **latest** EXFOR source files.

(IAEA-NDS maintains “EXFOR Master File” 2005~)



EXFOR from Various Centres / Medias (cont)

IAEA Nuclear Data Section maintains EXFOR search system:

<http://www-nds.indcentre.org.in/exfor/> .

(This is maintained by BARC, and a mirror of the Vienna server:

<http://www-nds.iaea.org/exfor/>).

Experimental Nuclear Reaction Data (EXFOR)
Database Version of February 16, 2011
Software Version of 2010.10.13 Old interface is [here]

News
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"
[History]

The EXFOR library contains an extensive compilation of experimental nuclear reaction data. Neutron reactions have been compiled systematically since the discovery of the neutron, while charged particle and photon reactions have been covered less extensively.
The library contains data from 18332 experiments (see statistics and recent updates).

Request Examples: 1 2 3 4 5 6 7 ...
Submit Reset Help

Target _____
Reaction _____
Quantity _____
Product _____
Energy from _____ to _____ eV
Author(s) _____
Publication year _____
Accession # _____

Extended
 Keywords
 Expert
Submit Reset

Options Tip of the day: video-guide

Exclude superseded data
 No reaction combinations (ratios,...)
 Enhanced search of Products
 Retrieve listing only
 Disable Prompt-Help
Sort by:
 Reaction
 Publication (Entry #)

Ranges (Z,A)
Reaction Sub-Fields
Feedback and User's Input

Comments/Questions?
Found error in data?
Send message to debug
Submit your experimental data for input to the database

Clone Request:
CNDA ENDF

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
- wildcards (*) and intervals are available

Web and Database Design and Programming: Viktor Zerkin, NDS, International Atomic Energy Agency (V.Zerkin@iaea.org) 2010, 2011
Data Source: Network of Nuclear Reaction Data Centres - coordinator: Naohiko Otsuka, NDS, IAEA (N.Otsuka@iaea.org)



EXFOR Search by Reaction/Quantity

Each EXFOR entry is searchable by Target, Projectile etc. at <http://www-nds.indcentre.org.in/exfor/> .

The screenshot shows a search interface with the following elements:

- Request** dropdown menu with examples: 1, 2, 3, 4, 5, 6, 7, ...
- Buttons: Submit, Reset, Help
- Search criteria with checkboxes and input fields:
 - Target
 - Reaction
 - Quantity
 - Product
 - Energy from [] to [] eV
 - Author(s)
 - Publication year
 - Accession #
- Advanced search options: Extended, Keywords, Expert
- Buttons: Submit, Reset

Keyword	Example
Target	O-18
Reaction	"p,n"
Quantity	"CS" (cross section)
Product	F-18

EXFOR Search by REACTION (cont)

Submit Reset Help

Target O-18 >>

Reaction p,n >>

Quantity cs >>

Product F-18 >>

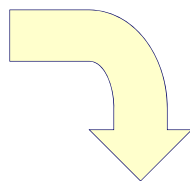
Energy from to eV >>

Author(s) >>

Publication year >>

Accession # >>

Target: O-18
 Reaction: p,n
 Quantity: cs
 Product: F-18



n	Display	Year	Author-1	Energy range,eV	Points	Reference	Accession#
1)	8-O-18 (P,N) 9-F-18,,SIG C4: MF3 MT4						
	Quantity: [CS] Cross section						
1	Info X4 X4+ X4± T4	2001	E.Hess+	2.43e6 3.00e7	110	J,RCA,89,357,2001	D4095002
2	Info X4 X4+ X4± T4	1990	S.W.Kitwanga+	1.09e7 2.98e7	7	J,PR/C,42,748,1990	O0916004
3	Info X4 X4+ X4± T4	1973	J.K.Bair	2.52e6 3.87e6	295	J,PR/C,8,120,1973	C1010004
4	Info X4 X4+ X4± T4	1967	G.Amsel+	2.70e6	1	J,AC,39,1689,1967	D0104009
5	Info X4 X4+ X4± T4	1960	J.M.Blair+	2.63e6 2.96e6	30	J,PR,118,495,1960	O0454005
6	Info X4 X4+ X4± T4	1952	L.Marquez	4.20e8	1	J,PR,86,405,52	C0250003
7	Info X4 X4+ X4± T4	1952	J.P.Blaser+	2.08e6 6.79e6	60	J,HPA,24,465,1952	D0095004
2)	8-O-18 (P,N) 9-F-18,,SIG,,RECOM C4: MF3 MT4						
	Quantity: [CS] Cross section						
8	Info X4 X4+ X4± T4	2003	S.Takacs+	2.50e6 2.98e7	274	J,NIM/B,211,169,2003	D41110061
3)	8-O-18 (P,N) 9-F-18,IND,SIG,,EXP C4: MF=3 MT=?						
	Quantity: [CS] Independent cross section						
9	Info X4 X4+ X4± T4	1979	I.J.Ruth+	2.30e6 1.47e7	35	J,RCA,26,21,79	A0235002

1st author beam energy (eV) reference subent #

EXFOR Cross Section Plot

Data Selection

Selected Unselected All

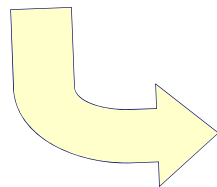
Output: EXFOR EXFOR+ Bibliography TAB

Plot: Quick-plot (cross-sections only) Advanced plot

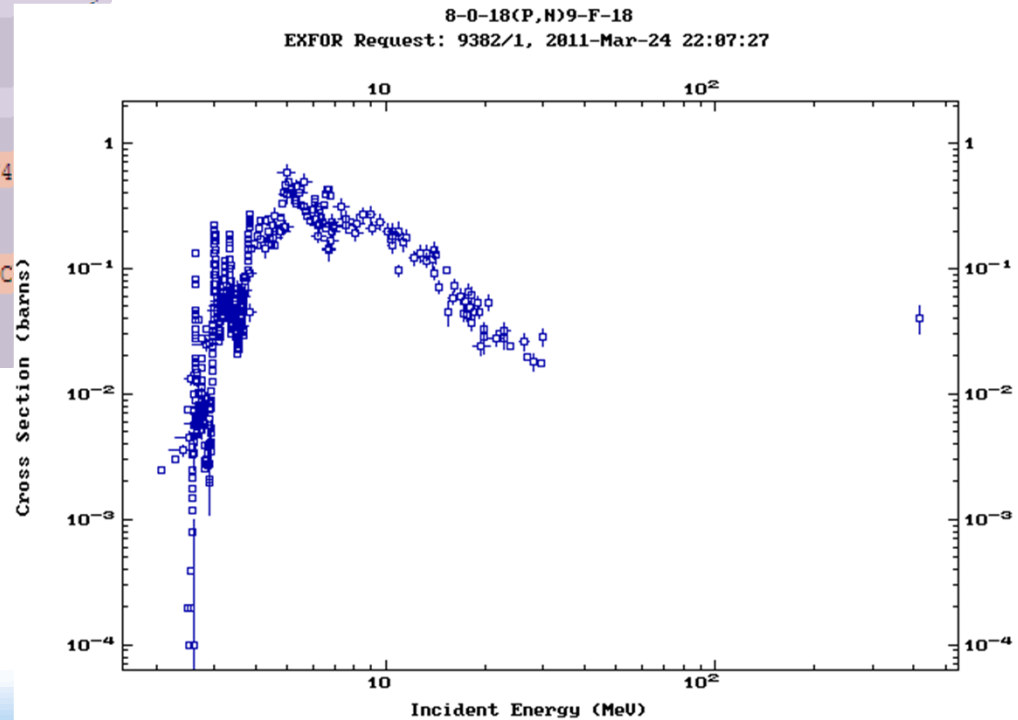
Narrow Energy (optional), eV: Min: Max:

Advanced data modifications

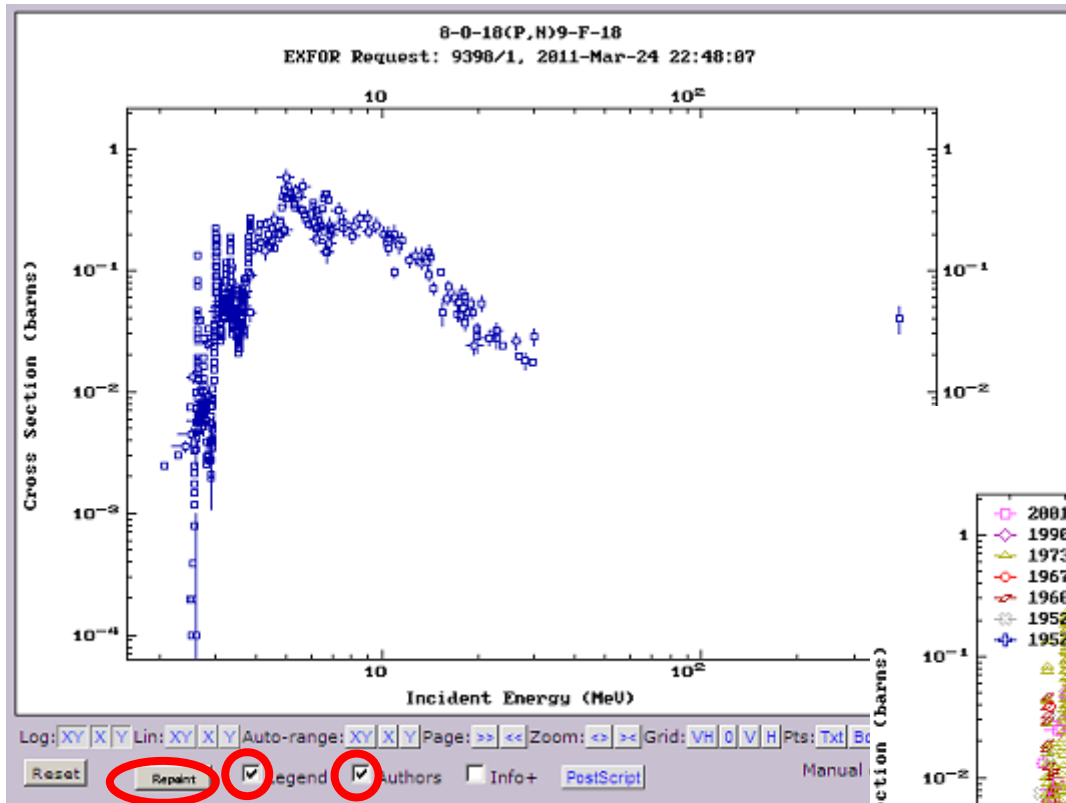
n	Display	Year	Author-1	En
1	8-0-18 (P,N) 9-F-18,,SIG C4: MF3 MT4			
Quantity: [CS] Cross section				
1	<input checked="" type="checkbox"/> Info X4 X4+ X4± T4	2001	E.Hess+	2.
2	<input checked="" type="checkbox"/> Info X4 X4+ X4± T4	1990	S.W.Kitwanga+	1.
3	<input checked="" type="checkbox"/> Info X4 X4+ X4± T4	1973	J.K.Bair	2.
4	<input checked="" type="checkbox"/> Info X4 X4+ X4± T4	1967	G.Amsel+	2.
5	<input checked="" type="checkbox"/> Info X4 X4+ X4± T4	1960	J.M.Blair+	2.
6	<input checked="" type="checkbox"/> Info X4 X4+ X4± T4	1952	L.Marquez	2.
7	<input checked="" type="checkbox"/> Info X4 X4+ X4± T4	1952	J.P.Blaser+	2.
2	8-0-18 (P,N) 9-F-18,,SIG,,,RECOM C4			
Quantity: [CS] Cross section				
8	<input type="checkbox"/> Info X4 X4+ X4± T4	2003	S.Takacs+	2.
3	8-0-18 (P,N) 9-F-18,IND,SIG,,,EXP C4			
Quantity: [CS] Independent cross section				
9	<input type="checkbox"/> Info X4 X4+ X4± T4	1979	T.J.Ruth+	2.



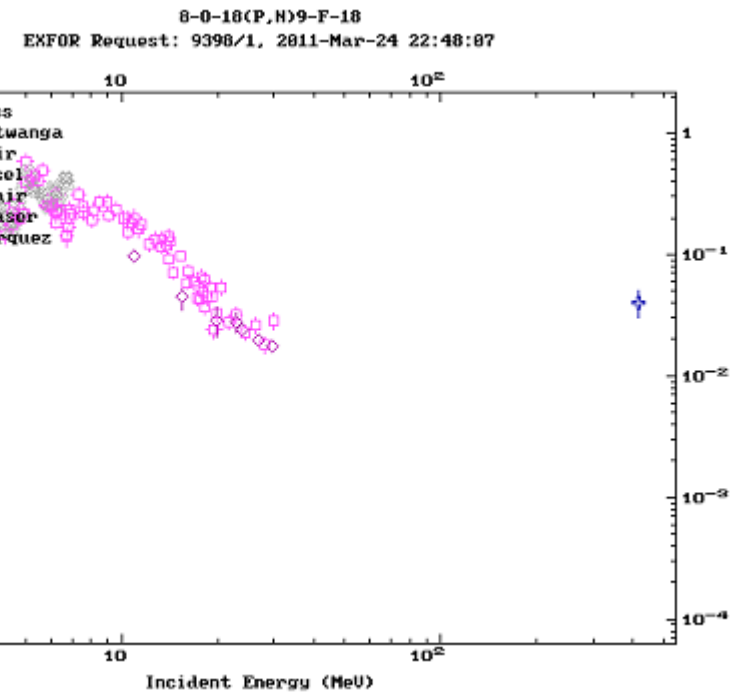
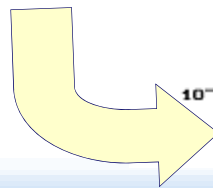
Plot of cross section is very easy! (*Quick-plot*)



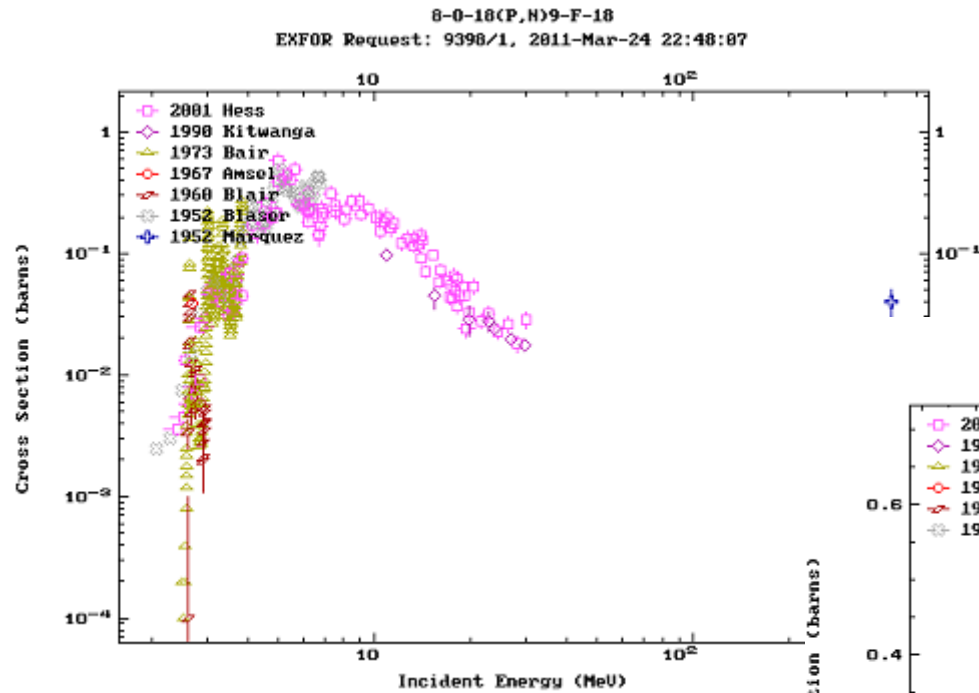
Adjustment of Plot on Web



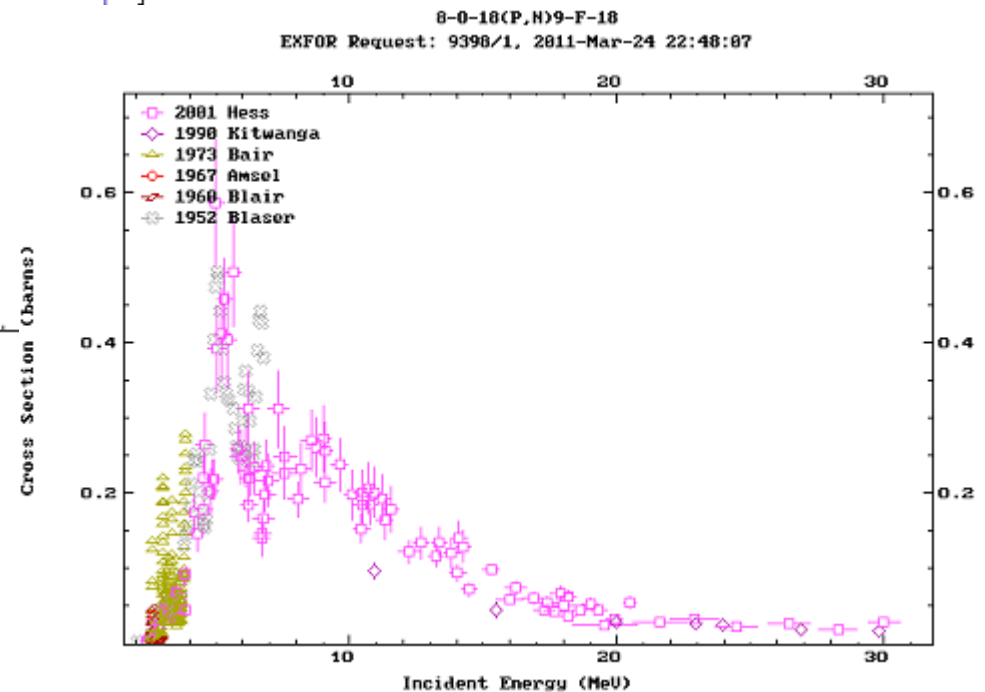
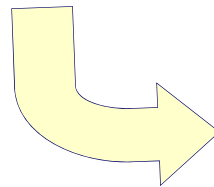
Check “Legend” and “Authors”
and click “Repaint”.



Adjustment of Plot on Web (cont)



Select area,
Click “Lin:XY”
and click “Repaint”.



Exercise: $^{233}\text{Pa}(n,f)$

Exercise:

^{233}Pa neutron-induced fission cross section

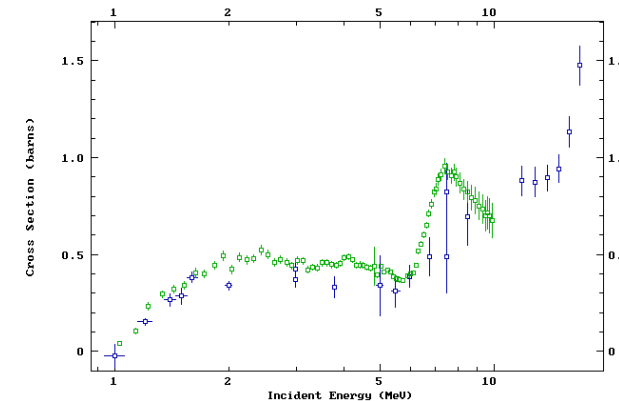
- Search $^{233}\text{Pa}(n,f)$ cross sections in EXFOR at <http://www-nds.indcentre.org.in/exfor/> or <http://www-nds.iaea.org/exfor/>

Target: Pa-233

Reaction: n,f

Quantity: cs

- Select 3 data sets (Nayak, Tovesson, Jurado)
- (Quick-)Plot all data sets in (x,y)=(log-lin)



Exercise: $^{233}\text{Pa}(n,f)$ (cont)

Request Examples: 1|2|3|4|5|6|7|... ▾

Target Pa-233

Reaction n,f

Quantity cs

Product

Energy from to

Data Selection

Selected Unselected All

Output: X4+ EXFOR Bibliography TAB C4 PlotC4

Plot: Quick-plot (cross-sections only) Advanced plot [how-to standards, 2006]

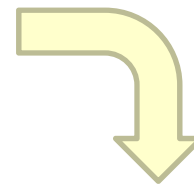
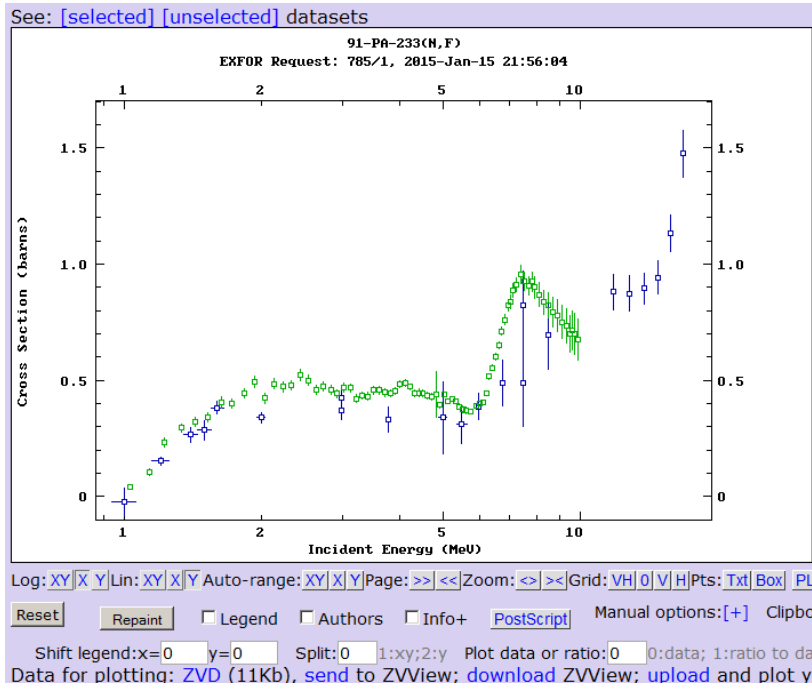
Narrow incident energy (optional), eV: Min: Max:

Apply ▾ Data re-normalization (for advanced users, results in: C4)

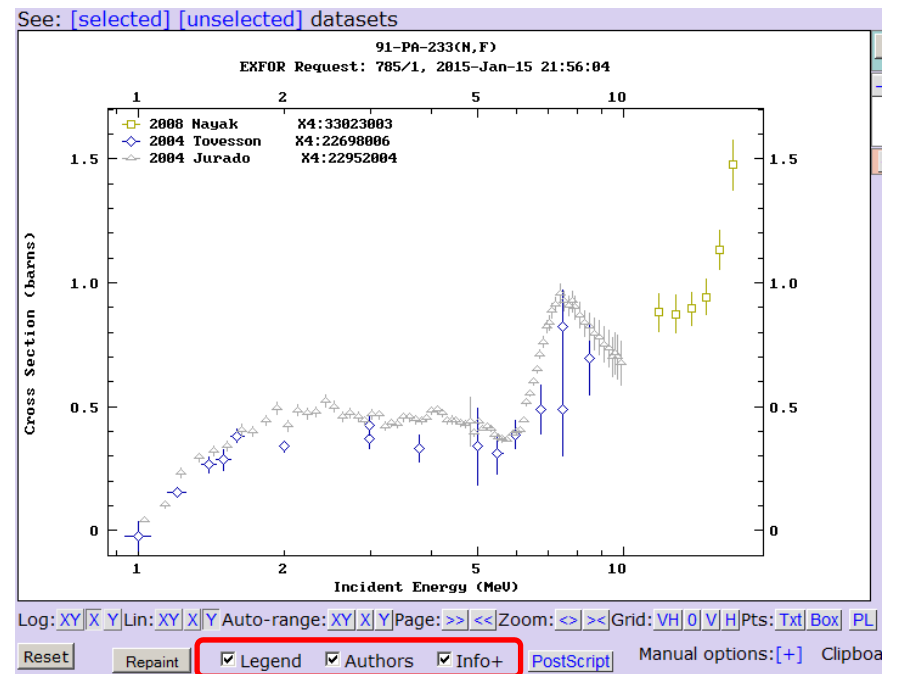
n	Display	Year	Author-1	Energy range
1) <input checked="" type="checkbox"/>	<input type="checkbox"/> 91-PA-233(N,F),,SIG C4: MF3 MT18			
Quantity: [CS] Cross section				
1	<input checked="" type="checkbox"/> <input type="button" value="Info"/> <input type="button" value="X4+"/> <input type="button" value="X4±"/> <input type="button" value="T4"/> <input type="button" value="Cov"/> 2008 B.K.Nayak+	2008	B.K.Nayak+	1.18e7
f	2 <input checked="" type="checkbox"/> <input type="button" value="Info"/> <input type="button" value="X4+"/> <input type="button" value="X4±"/> <input type="button" value="T4"/> <input type="button" value="Cov"/> 2004 F.Tovesson+	2004	F.Tovesson+	1.00e6
2) <input checked="" type="checkbox"/>	<input type="checkbox"/> 91-PA-233(N,F),,SIG,,,DERIV C4: MF3 MT18 ...[Der			
Quantity: [CS] Cross section				
g	3 <input checked="" type="checkbox"/> <input type="button" value="Info"/> <input type="button" value="X4+"/> <input type="button" value="X4±"/> <input type="button" value="T4"/> <input type="button" value="Cov"/> 2004 B.Jurado+	2004	B.Jurado+	1.03e6
3) <input checked="" type="checkbox"/>	<input type="checkbox"/> 91-PA-233(N,F),,SIG,,,RECOM C4: MF3 MT18 ...[Rec			
Quantity: [CS] Cross section				
	4 <input type="checkbox"/> <input type="button" value="Info"/> <input type="button" value="X4+"/> <input type="button" value="X4±"/> <input type="button" value="T4"/> <input type="button" value="Cov"/> 2006 S.F.Mughabghab	2006	S.F.Mughabghab	2.53e-2

“91-PA-233(N,F),,SIG” means $^{233}\text{Pa}(n,f)$ cross section.

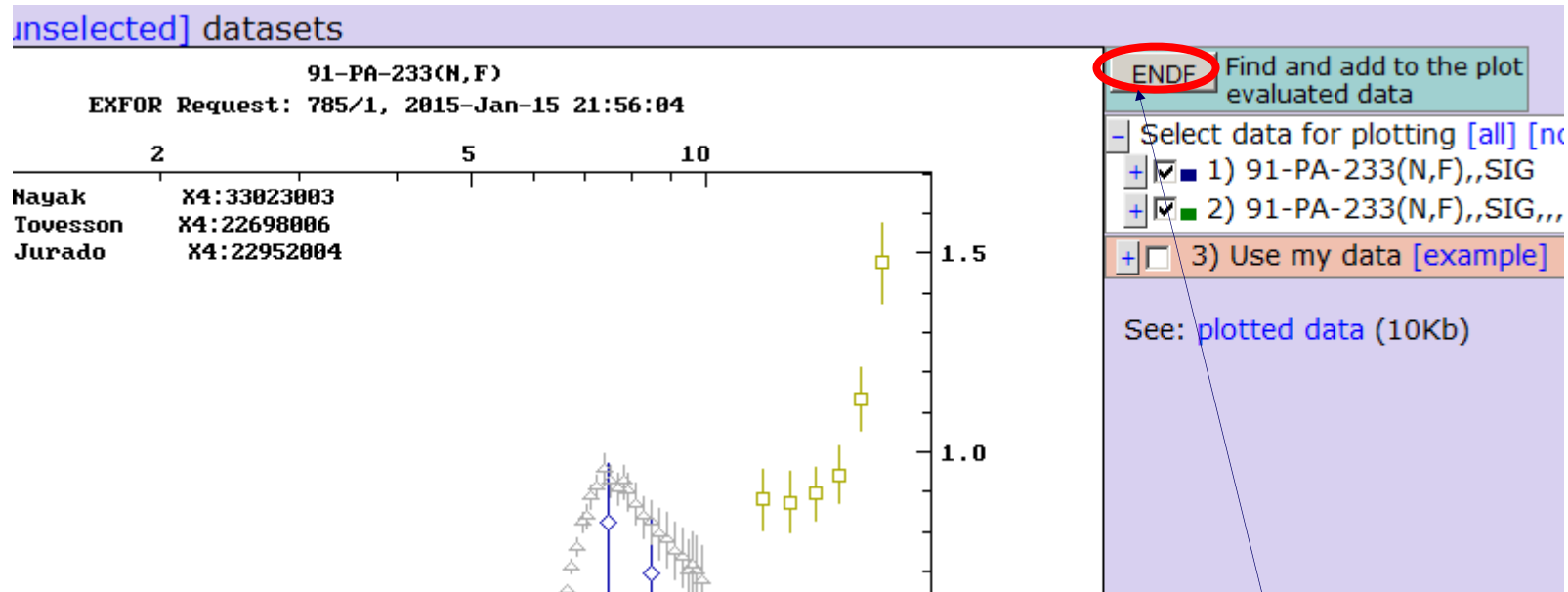
Exercise: $^{233}\text{Pa}(n,f)$ (cont)



Activate 3 options (Legends, Authors, Info+) and repaint.



Comparison with Evaluated Data Libraries (ENDF)



Special button
for comparison
with evaluated
data libraries



Comparison with Evaluated Data Libraries (cont)

ENDF Data Selection (Plot for EXFOR Request #785)

Retrieve **Plot** Selected Unselected All Reset

Plotting options: Quick plot (cross-sections only: σ)

Sorted by: [Reactions] Reorder by: [Libraries]

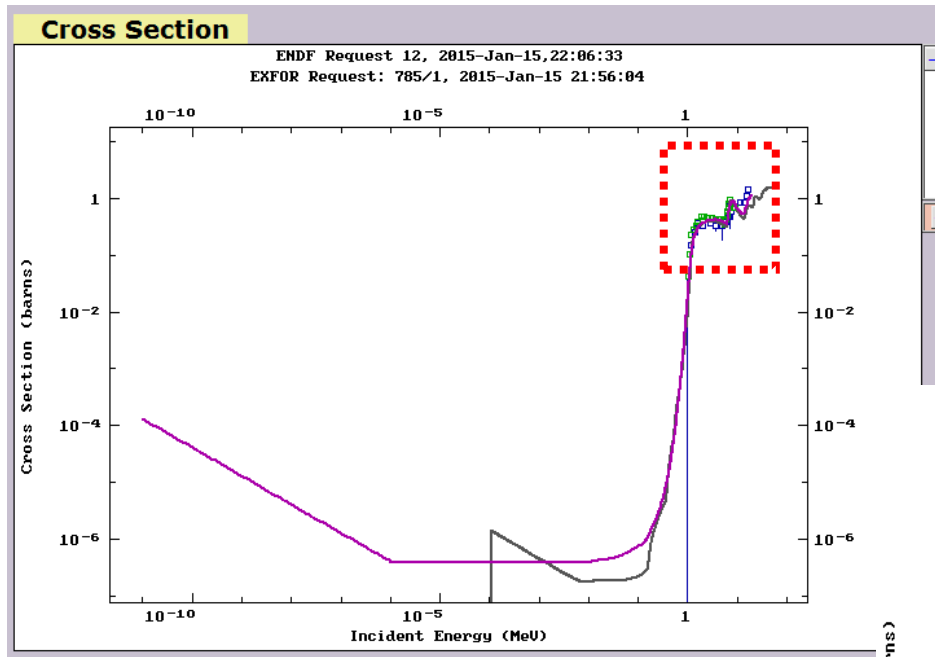
1) PA-233 (N, F), SIG MT=18 MF

ME3: [SIG] Cross sections MT18: [N,F] Total fission.

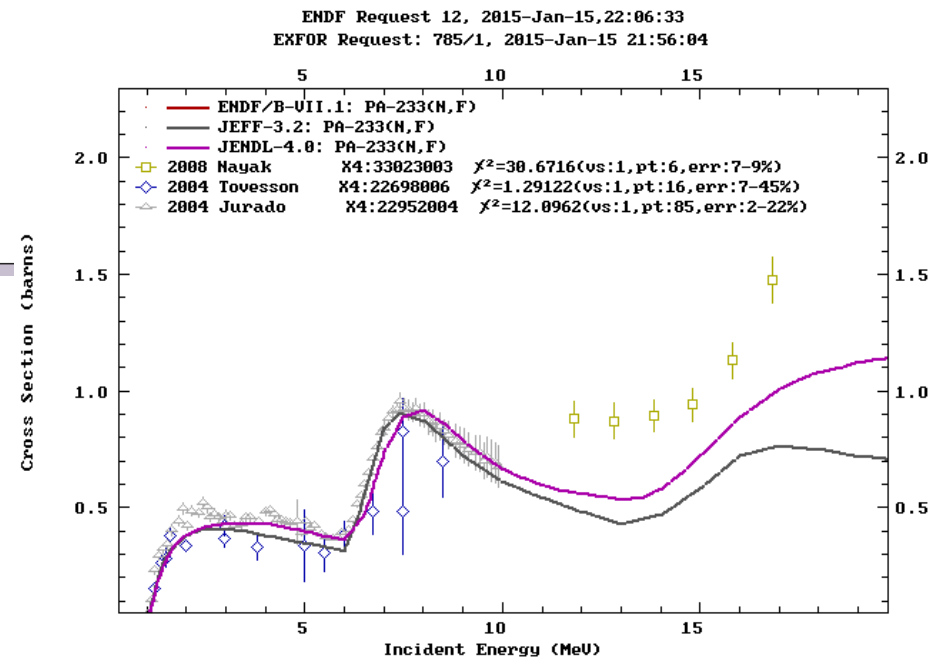
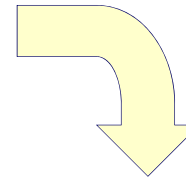
1	<input type="checkbox"/>	ENDF-6	Interpreted	σ	Plot	TENDL-2012	E=200MeV Lab=NR
2	<input checked="" type="checkbox"/>	ENDF-6	Interpreted	σ	Plot	ENDF/B-VII.1	E=60MeV Lab=IAE
3	<input type="checkbox"/>	ENDF-6	Interpreted	σ	Plot	ENDF/B-VII.0	E=60MeV Lab=IAE
4	<input checked="" type="checkbox"/>	ENDF-6	Interpreted	σ	Plot	JEFF-3.2	E=60MeV Lab=IAE
5	<input type="checkbox"/>	ENDF-6	Interpreted	σ	Plot	JEFF-3.1.2	E=20MeV Lab=NEA
6	<input type="checkbox"/>	ENDF-6	Interpreted	σ	Plot	JEFF-3.1	E=20MeV Lab=NEA
7	<input checked="" type="checkbox"/>	ENDF-6	Interpreted	σ	Plot	JENDL-4.0	E=20MeV Lab=JAE
8	<input type="checkbox"/>	ENDF-6	Interpreted	σ	Plot	JENDL-3.3	E=20MeV Lab=KIN

Select three libraries (ENDF/B-VII.1, JEFF-3.2 and JENDL-4.0) and plot!

Comparison with Evaluated Data Libraries (cont)



Select area and use
(x,y)=(lin,lin) scale;
Legend&Authors&Info+



$^{78}\text{Se}(n,p)^{78}\text{As}$ in 33080 article

Exercise:

$^{78}\text{Se}(n,p)^{78}\text{As}$ cross section

- Search $^{78}\text{Se}(n,p)^{78}\text{As}$ cross sections in EXFOR by <http://www-nds.indcentre.org.in/exfor/> or <http://www-nds.iaea.org/exfor/>

Target: Se-78

Reaction: n,p

Quantity: cs

- Select all relevant data
- (Quick-)Plot all data sets in (x,y)=(lin-lin)

$^{78}\text{Se}(n,p)^{78}\text{As}$ in 33080 article (cont)

Request Examples: 1|2|3|4|5|6|7|... ▾

Target Se-78

Reaction n,p

Quantity cs

Product

Energy from to eV ▾

Selected Unselected All

Output: X4+ EXFOR Bibliography TAB C4 Plot

Plot: Quick-plot (cross-sections only) Advanced plot [h standards,2006]

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

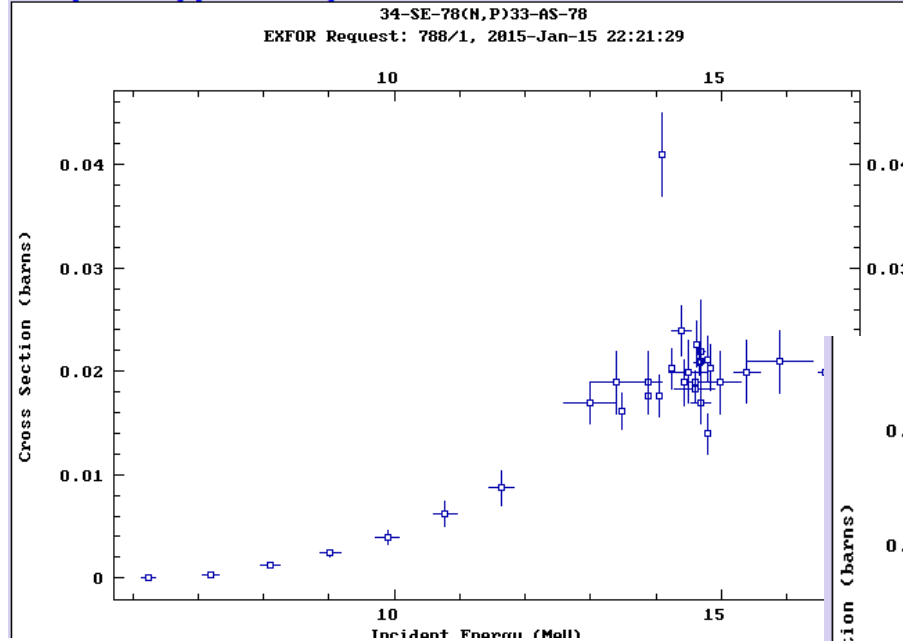
Apply(2A) ▾ Data re-normalization (for advanced users, re

n	Display	Year	Author-1	Energy
1)	34-SE-78 (N,P) 33-AS-78,, SIG C4: MF3 MT103			
Quantity: [CS] Cross section				
1	<input checked="" type="checkbox"/> Info X4+ X4± T4 Cov	2005	Guozhu He+	1.3
2	<input checked="" type="checkbox"/> Info X4+ X4± T4 Cov	2001	A.A.Filatenkov+	1.3
3	<input checked="" type="checkbox"/> Info X4+ X4± T4 Cov	1994	I.Birn+	6.2
4	<input checked="" type="checkbox"/> Info X4+ X4± T4 Cov	1993	A.Grallert+	1.4
5	<input checked="" type="checkbox"/> Info X4+ X4± T4 Cov	1989	H.M.Hoang+	1.3
6	<input checked="" type="checkbox"/> Info X4+ X4± T4 Cov	1977	N.I.Molla+	1.4
7	<input checked="" type="checkbox"/> Info X4+ X4± T4 Cov	1976	J.L.Casanova+	1.4
8	<input checked="" type="checkbox"/> Info X4+ X4± T4 Cov	1969	V.V.Ivanenko+	1.4
9	<input checked="" type="checkbox"/> Info X4+ X4± T4 Cov	1967	P.Venugopala Rao+	1.4
10	<input checked="" type="checkbox"/> Info X4+ X4± T4 Cov	1967	B.Minetti+	1.4
11	<input checked="" type="checkbox"/> Info X4+ X4± T4 Cov	1967	G.P.Vinitskaya+	1.4

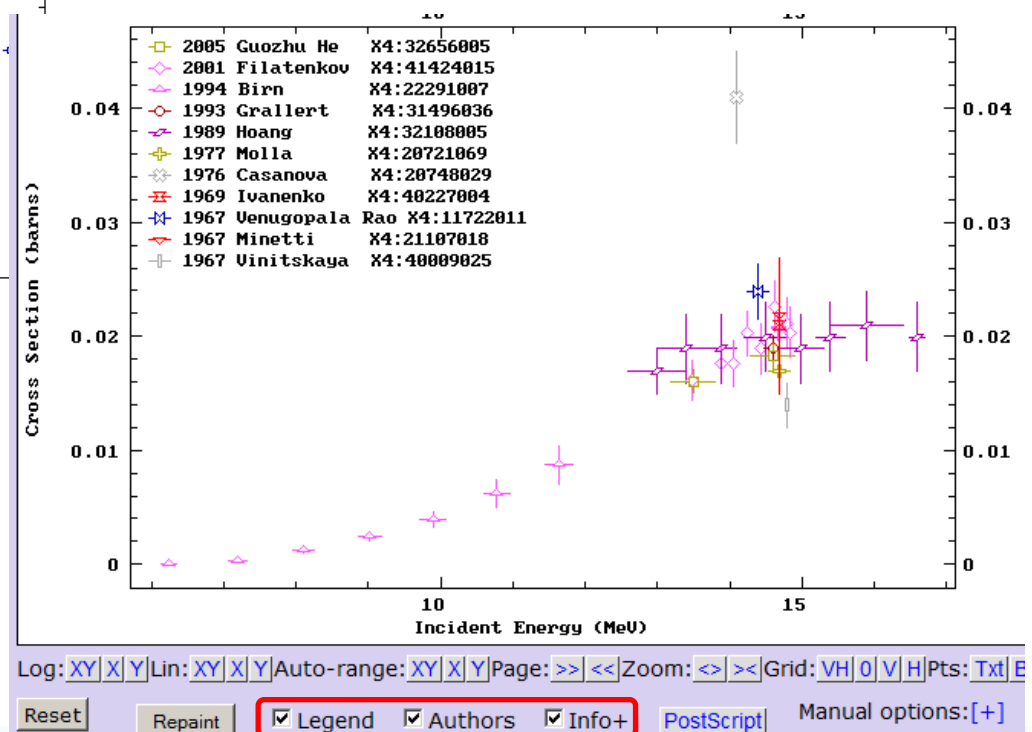
“34-SE-78(N,P)33-AS-78,,SIG”
means $^{78}\text{Se}(n,p)^{78}\text{As}$ cross section.

Exercise: $^{78}\text{Se}(n,p)^{78}\text{As}$ in 33080 article (cont)

See: [\[selected\]](#) [\[unselected\]](#) datasets



Activate 3 options (Legends, Authors, Info+) and repaint.



Exercise: Addition of "my data" to Plot

Add Table II 33080 data and replot.

Select data for plotting [all] [none]
+ 1) 34-SE-78(N,P)33-AS-78,,SIG
- 2) Use my data [example]

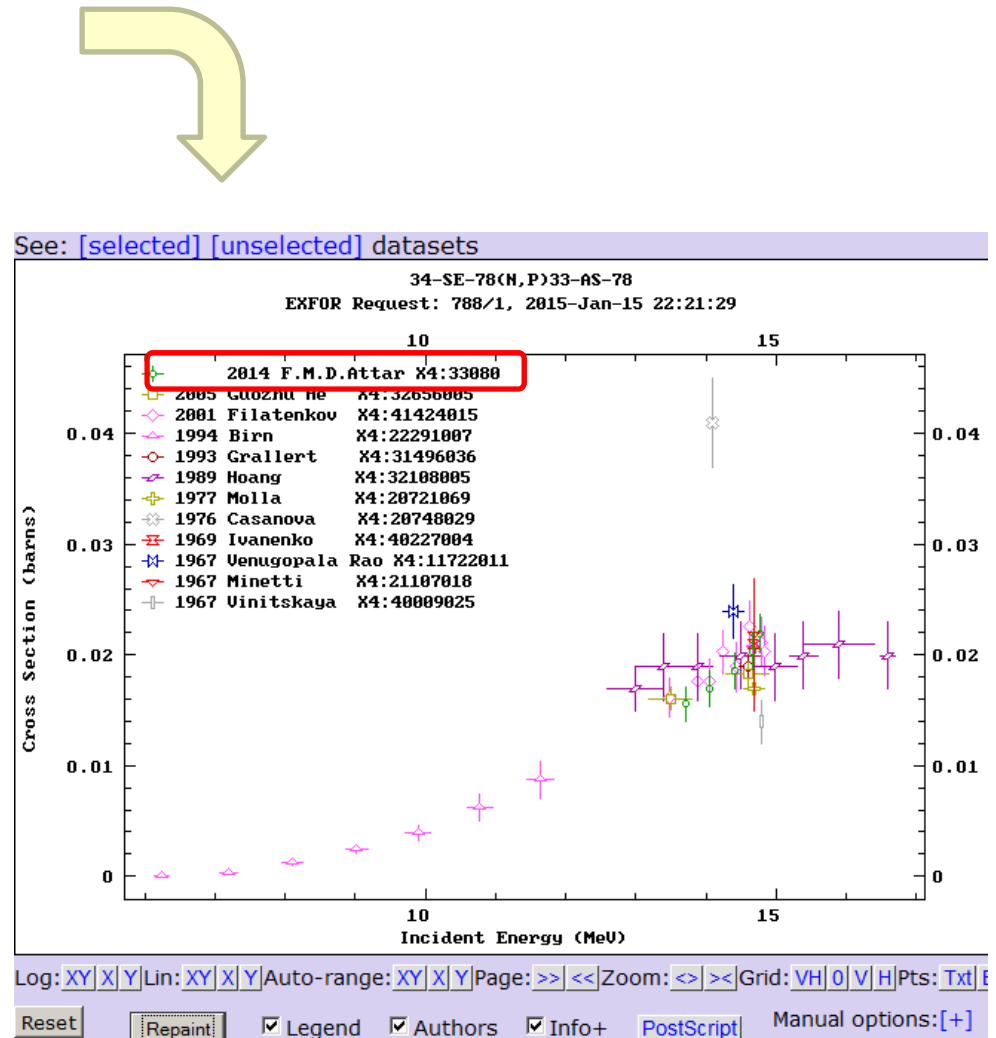
Columns: x y [dy [dx]]

13.73	15.6	1.5
14.07	17	1.6
14.42	18.6	1.6
14.68	20.4	1.7
14.77	22	1.7

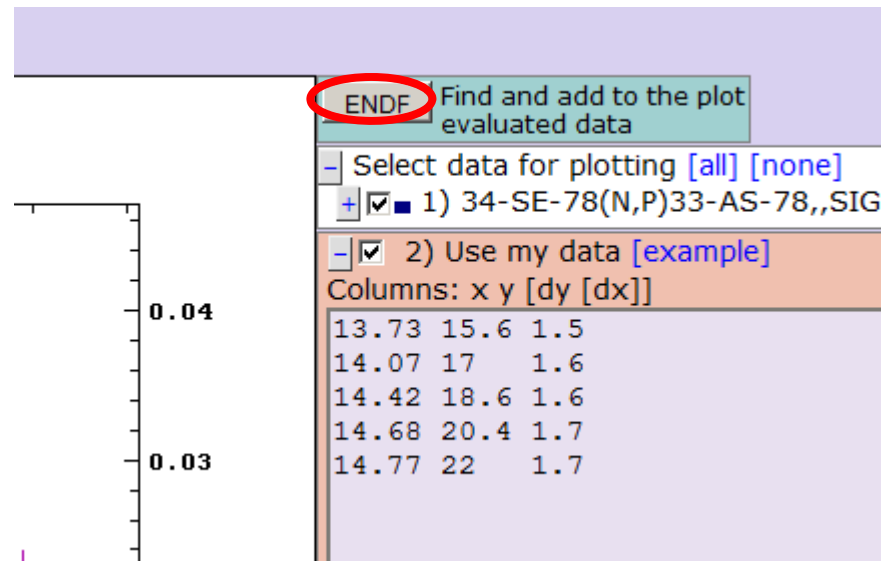
Type: Curve Points
Title: 2014 F.M.D. Attar X4:33080
Default: basic units!
Multiply by: X: 1E+06 Y: 1E-03

See: plotted data (4Kb)

To convert units of the Table (MeV, mb) to the basic units (eV, b)

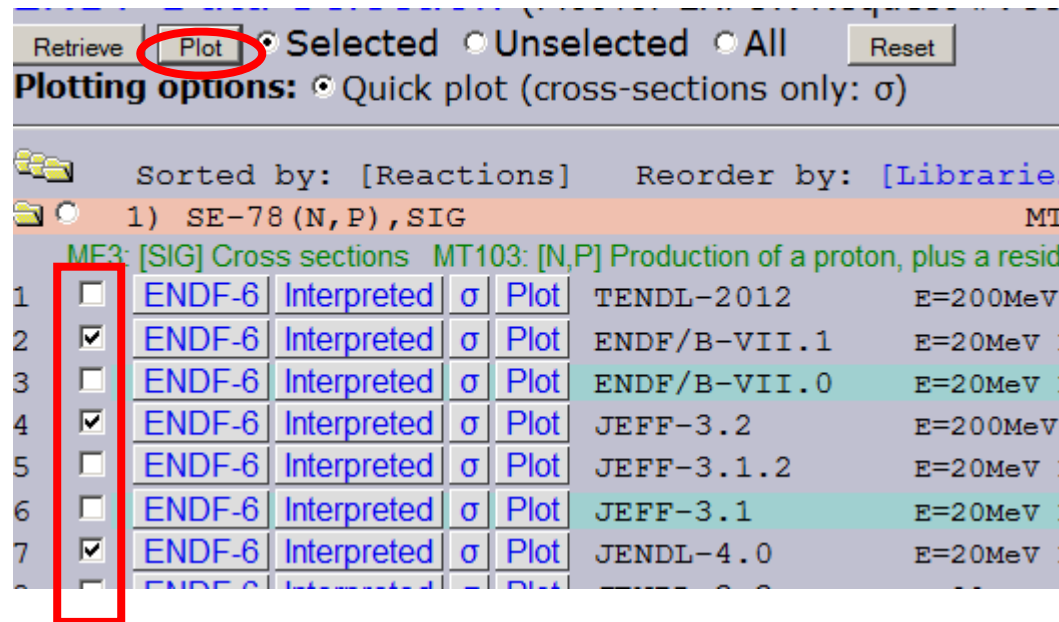


Exercise: Comparison with Evaluated Data Libraries



Select three libraries (ENDF/B-VII.1, JEFF-3.2 and JENDL-4.0) and plot!

Exercise: Comparison with Evaluated Data Libraries (cont)



Retrieve **Plot** Selected Unselected All Reset

Plotting options: Quick plot (cross-sections only: σ)

Sorted by: [Reactions] Reorder by: [Libraries]

1) SE-78 (N, P), SIG MT

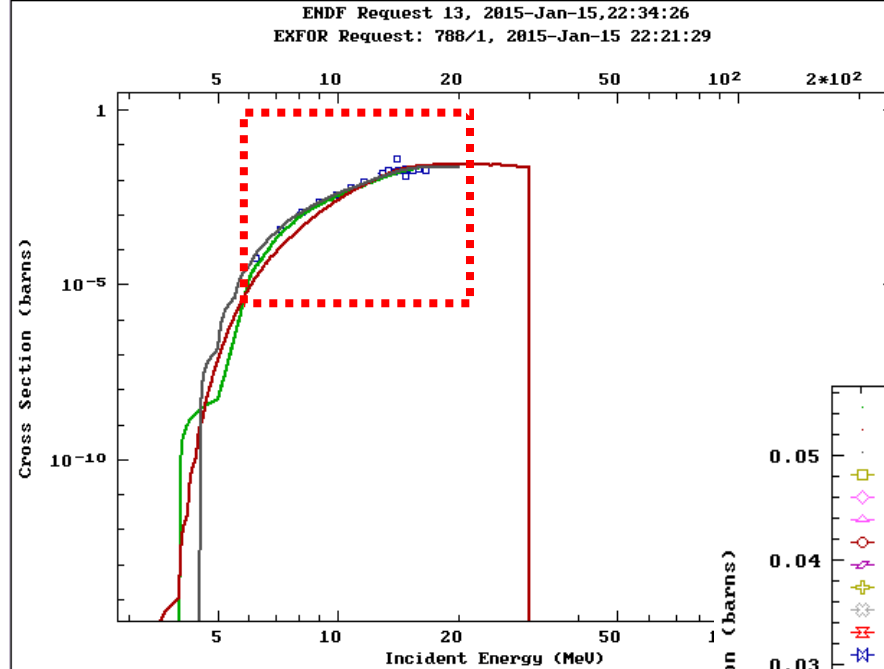
ME3: [SIG] Cross sections MT103: [N,P] Production of a proton, plus a resid

	Library	Format	Type	Action	Energy Range
1	ENDF-6	Interpreted	σ	Plot	TENDL-2012 E=200MeV
2	ENDF-6	Interpreted	σ	Plot	ENDF/B-VII.1 E=20MeV
3	ENDF-6	Interpreted	σ	Plot	ENDF/B-VII.0 E=20MeV
4	ENDF-6	Interpreted	σ	Plot	JEFF-3.2 E=200MeV
5	ENDF-6	Interpreted	σ	Plot	JEFF-3.1.2 E=20MeV
6	ENDF-6	Interpreted	σ	Plot	JEFF-3.1 E=20MeV
7	ENDF-6	Interpreted	σ	Plot	JENDL-4.0 E=20MeV

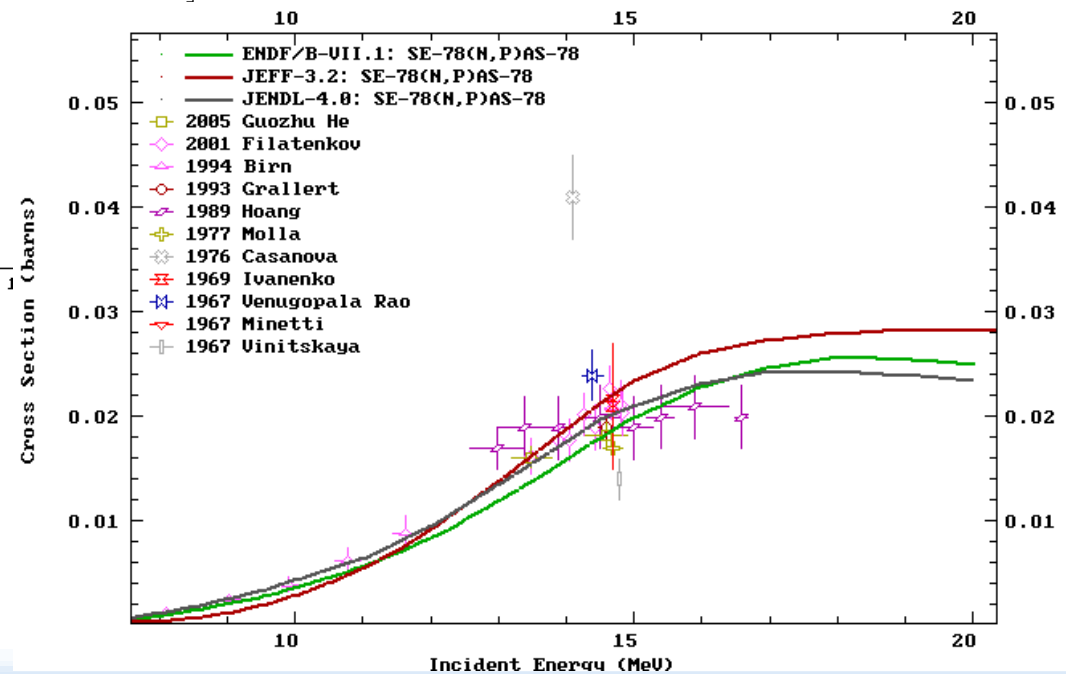
Select three libraries (ENDF/B-VII.1, JEFF-3.2 and JENDL-4.0) and plot!

Exercise: Comparison with Evaluated Data Libraries (cont)

Cross Section



Select area and use
(x,y)=(lin,lin) scale;
Legend&Authors&Info+



Exercise: $^{80}\text{Se}(n,p)^{80}\text{As}$ in 33080 article

Exercise:

$^{80}\text{Se}(n,p)^{80}\text{As}$ cross section

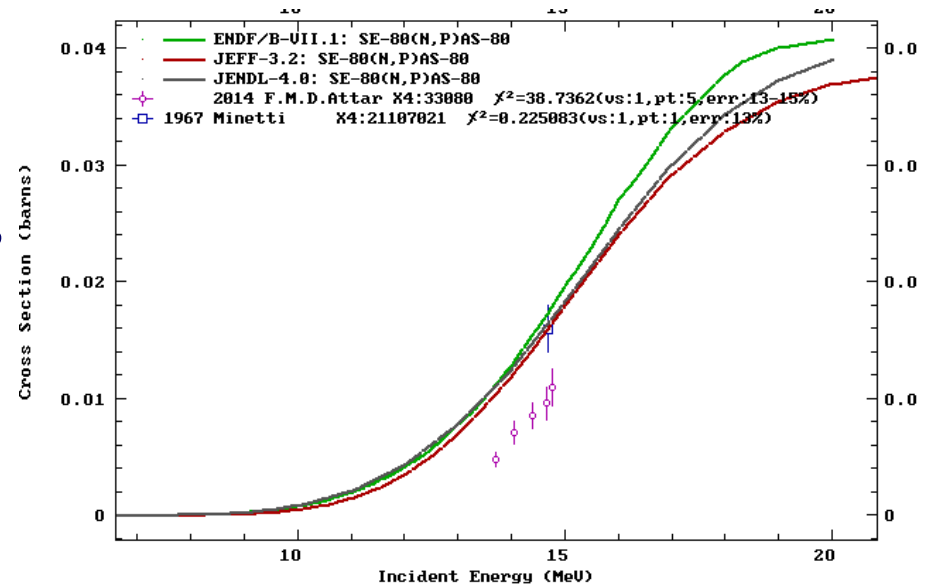
- Search $^{78}\text{Se}(n,p)^{78}\text{As}$ cross sections in EXFOR by

Target: Se-80

Reaction: n,p

Quantity: cs

- Select all relevant data and plot (but only single point).
- Then plot with ENDF/B-VII.1, JEFF-3.2 and JENDL-4.0 data.
- Then plot with data in Table II of 33080 article.



Advanced Plot (Diff. Cross Section etc.)

Data Selection

Selected
 Unselected
 All

Output:
 EXFOR
 EXFOR+
 Bibliography
 TAR
 C4
 Plot

Plot:
 Quick-plot (cross-sections on)
 Advanced plot [how-to]

Narrow Energy (optional), eV: Min: Max:

[Advanced data modifications](#)

n	Display	Year	Author-1
1	83-BI-209(5-B-11,EL)83-BI-209		
Quantity: [DA] Differential cs d/dA rel.t			
1	<input checked="" type="checkbox"/> Info X4 X4+ X4± T4	2003	P.K.Sahu
2	<input checked="" type="checkbox"/> Info X4 X4+ X4± T4	1998	A.Shriya



Send your question to the NDS programmer
 Dr. V. Zerkin (v.zerkin@iaea.org)

