International Atomic Energy Agency

NRDC Action to the List of EXFOR Outliers

WP 2008-3

http://www-nds.iaea.org/nrdc/nrdc_2008/working/wp2008-03.pdf

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From WPEC SG-30 Status Report (June 2008, A. Koning)

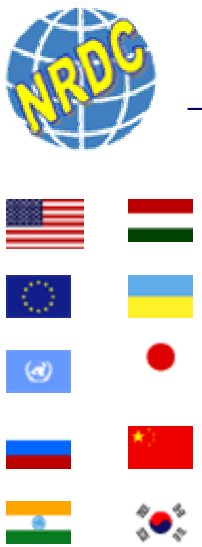
… SG30 will focus on the following activities:

- attempt to translate (almost) the entire EXFOR database into *computational format*, (X4 to C4, WP2008-37)

- Solve the most obvious quantitative errors, using checking codes, plotting packages and comparisons with model codes,

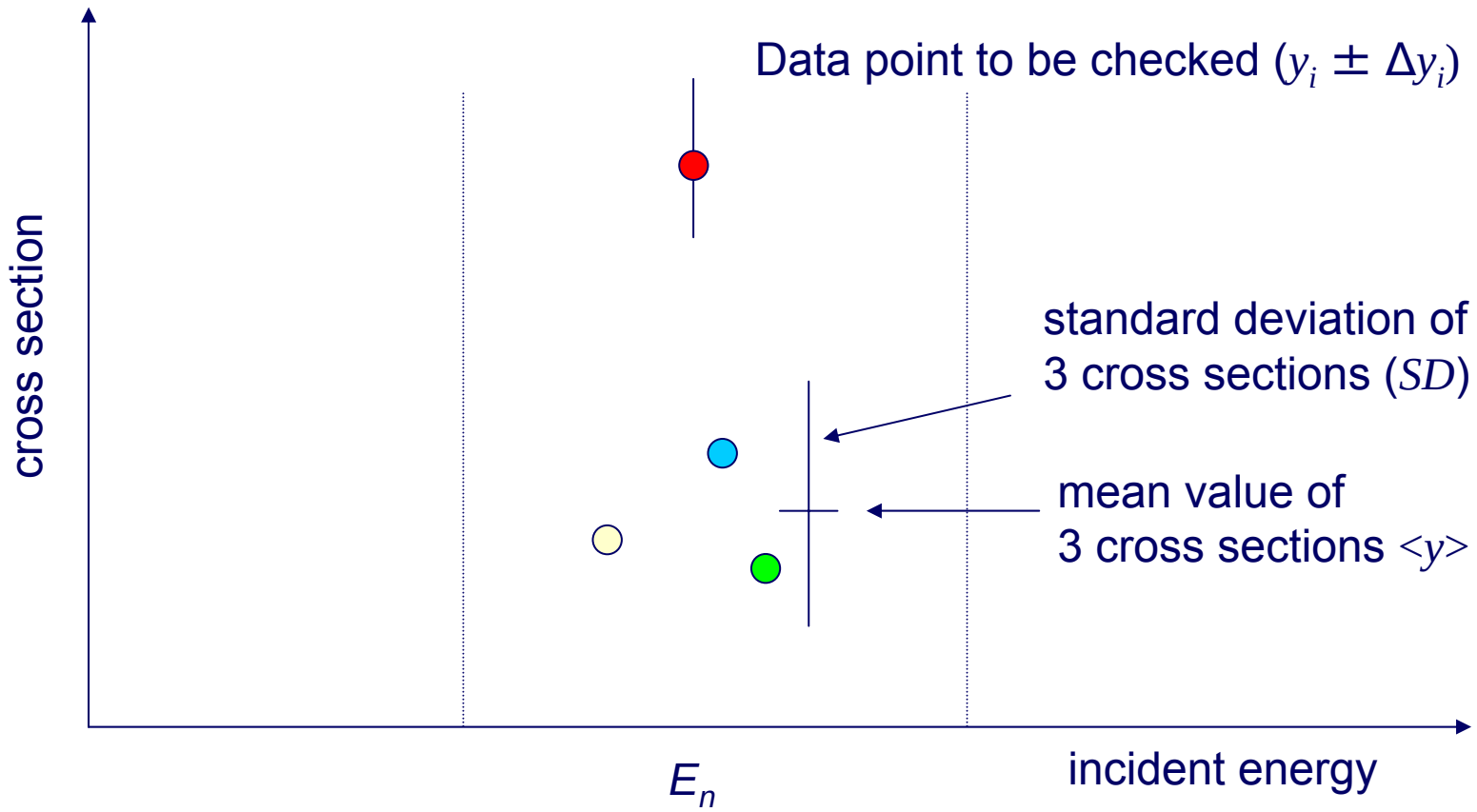
- Identify data which are stored incorrectly and attempt to harmonize the format.

Database used by E. Dupont and A. Koning



EXFOR master → convert (Loss) → C4 master → convert (Loss) → AK database

E. Dupont's Outlier Criterion



y_i is identified as an outlier if $y_i - \Delta y_i > <y> + k\,(SD)$.

(k is an adjustable parameter. Larger k give less outliers.)

E. Dupont's Outlier Criterion (Cont'd)

For the *n*-th incident energy (E_n) grid (where *N* EXFOR data sets exist), if the i-th data set satisfies

$$y_i(E_n) - \Delta y_i(E_n) > \bar{y}(E_n) + k \bullet SD$$

or

$$y_i(E_n) + \Delta y_i(E_n) < \bar{y}(E_n) - k \bullet SD$$

the *n*-th data set is identified as an outlier. Here

$$\bar{y}(E_n) = \sum_{i \neq j} y_i / (N-1)$$

$$SD^2 = \frac{1}{N-1} \sum_{i \neq j} [y_i - \bar{y}(E_n)]^2$$

Emmeric's 3 Outlier Lists and NRDC Action

	Error		Not in error	Not resolved	Total
	Corrected	**To be corrected**			
# of subentries	57 (43%)	**7 (5%)**	55 (41%)	15 (11%)	**134**

NDS did *not* ask corrections when …

- **Data compiled as given in the authors' table (and it is consistent with figure if it is given);**
- **Unpublished data received from authors;**
- **Cannot get the source article (e.g. thesis);**
- **Cannot identify the state of product nuclide (meta stable or ground state etc.)**

Special Outliers (1)

Unusual definition of cross section

- O. Bonesso *et al.*, *Radioanal. Nucl. Chem.* **152**(1991)189, Eq.1

Atomic weight

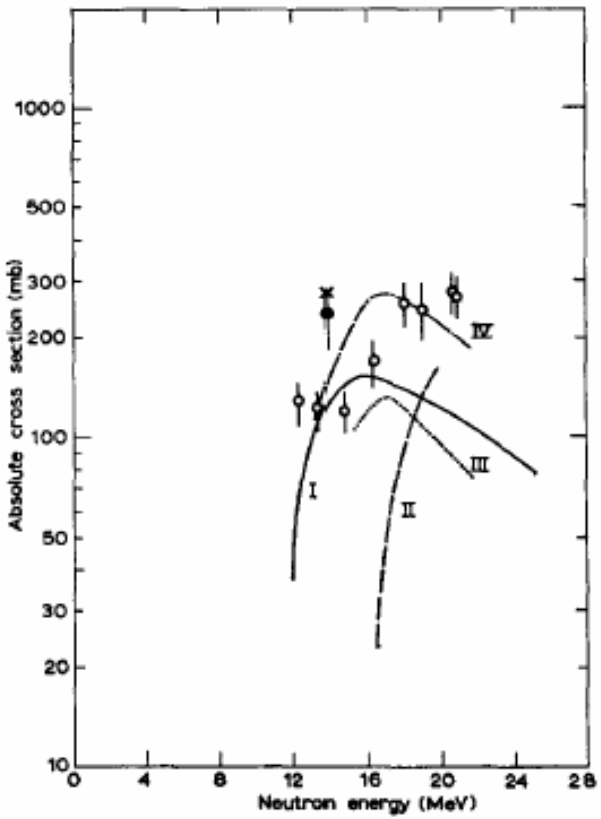
$$\sigma = \frac{N \exp(\lambda t_0) A}{\Phi P a N_{Av} E_{ff} I_\gamma t_1 [1 - \exp(-\lambda T)]}$$

F.Tarkanyi et al., Nucl.Instrum.Meth.B **168** (2000)144

The definition and the presentation of the deduced cross-section data of Bonesso et al. [25] and Rizvi et al. [26] are very confusing. A comparison of their results with other experimental works was very difficult even for the authors of these publications. Their data presented here were transformed by us according to their definitions.

Special Outliers (2)

One data set is explained with different reactions in figure and table in one article.



$Ni^{58}(n, p)Co^{58}$
130 ± 15
125 ± 15
122 ± 15
175 ± 21
261 ± 31
248 ± 30
275 ± 33
273 ± 32

Fig. 12. Total cross-section for $Ni^{58}(n, np) + Ni^{58}(n\ d) + Ni^{58}(n, pn)$ reaction. ○-Present data, ●-Allen [22]), ×-Preiss and Fink [19]). The curves I, II, III and IV are obtained from calculations of Mani and Melkanoff and are explained in the text.

J.M.F. Jeronymo, *et al*., *Nucl. Phys*. **47**(1963)157

Special Outliers (3)

Data in table is given in reverse order.

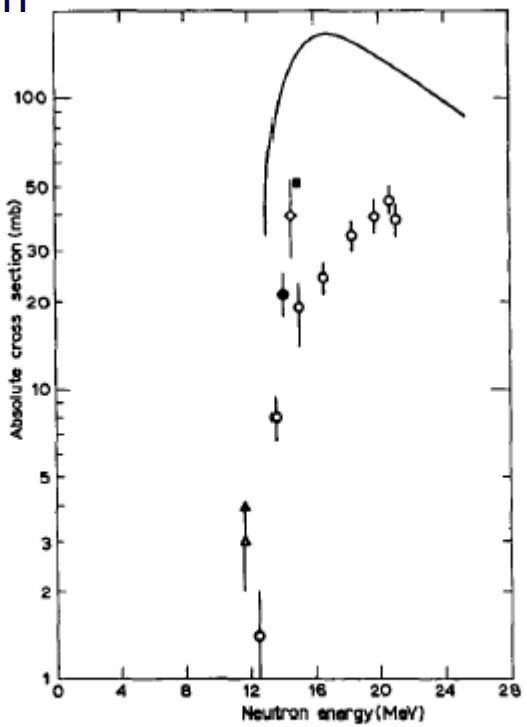
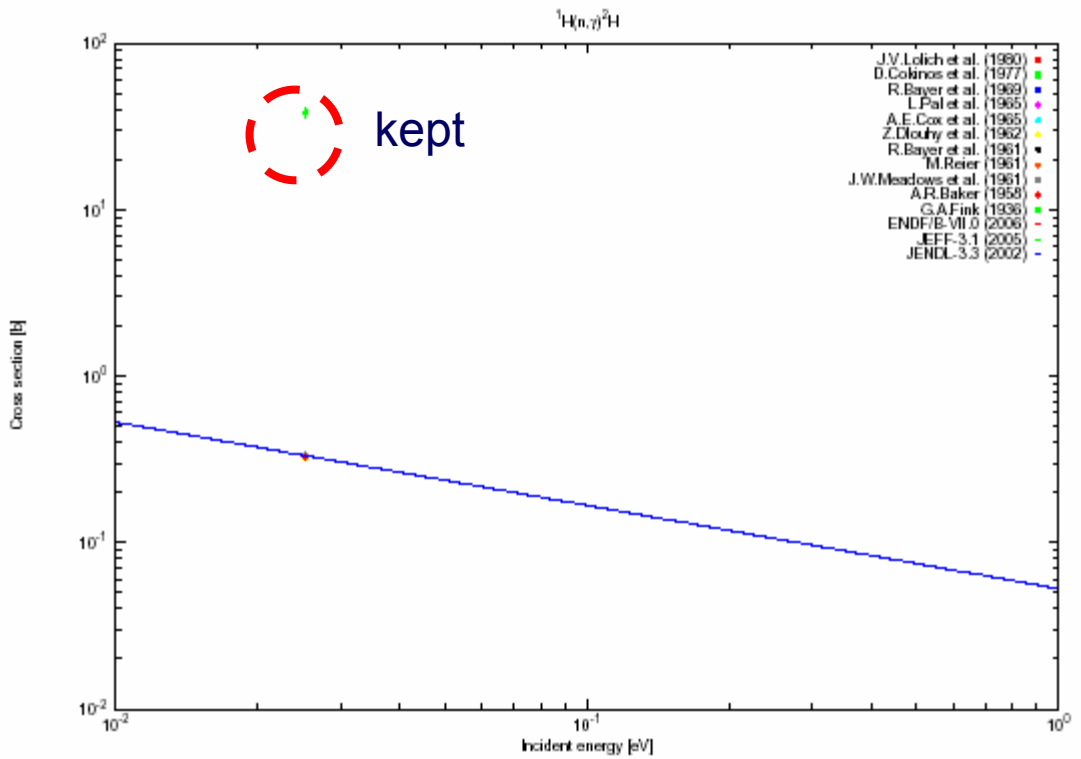


Fig. 13. Total cross-section for $Ni^{58}(n, 2n)Bi^{57}$ reaction. ○-Present data, ■-Preiss and ●-Howerton [20]), △-Cohen [18]), ◇-Paul and Clarke [17]). The full line is the theoretical estima $Ni^{58}(n, 2n)Ni^{57} + Ni^{58}(n, np)Co^{57}$ reaction by Mani and Melkanoff.

Neutron energy (MeV)	$Ni^{58}(n, 2n)Ni^{57}$
12.55 ± 0.2	38 ± 4
13.55 ± 0.2	45 ± 4
14.90 ± 0.2	39 ± 4
16.50 ± 0.2	34 ± 4
18.15 ± 0.2	24 ± 3
19.60 ± 0.2	19 ± 3
20.60 ± 0.2	8 ± 2
21.00 ± 0.2	1 ± 1

J.M.F. Jeronymo, *et al*., *Nucl. Phys*. **47**(1963)157

Compiler's decision (1) - Keep outlier

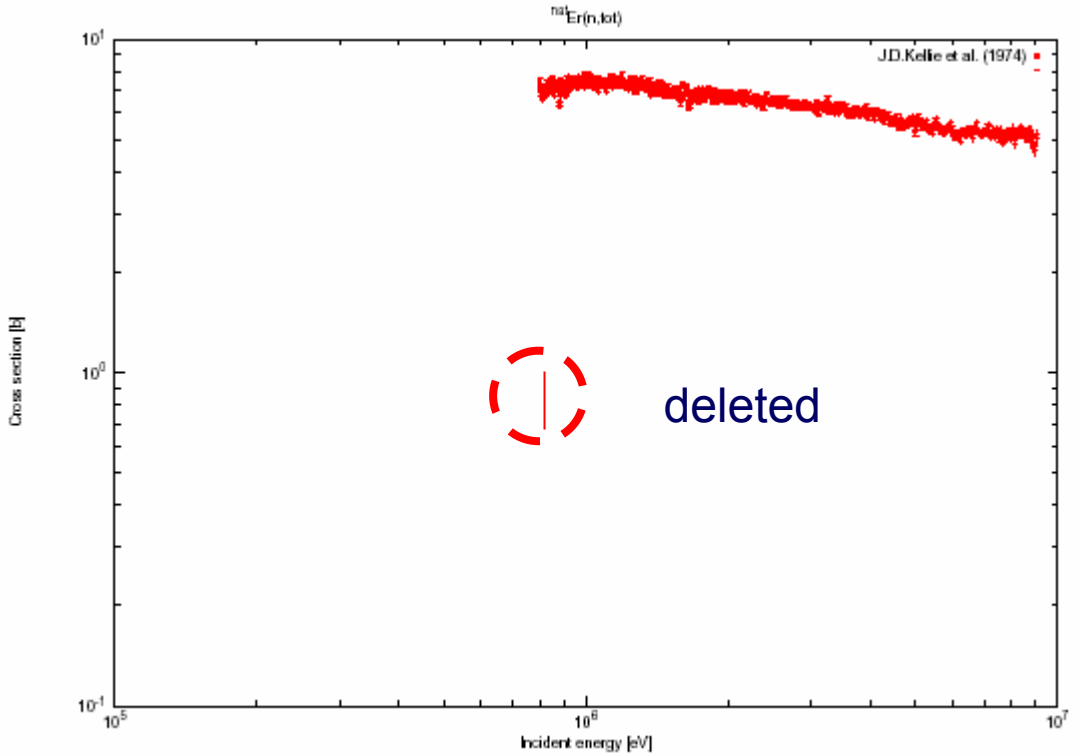


-^{1}H(n,g)^{2}H cross section at thermal energy measured in 1936.
- Data source: table in article (TABLE).

The compiler **kept** this outlier (one data point) :

`CRITIQUE  Data too large by a factor of ~100.`

Compiler's decision (2) - Delete outlier

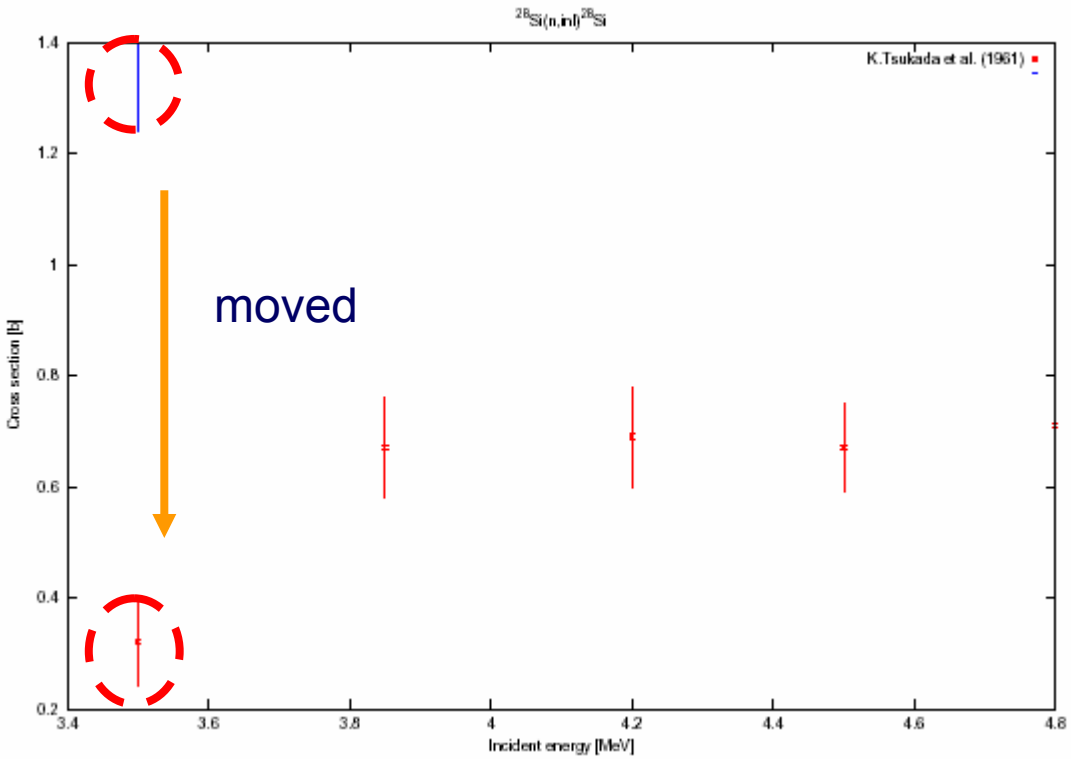


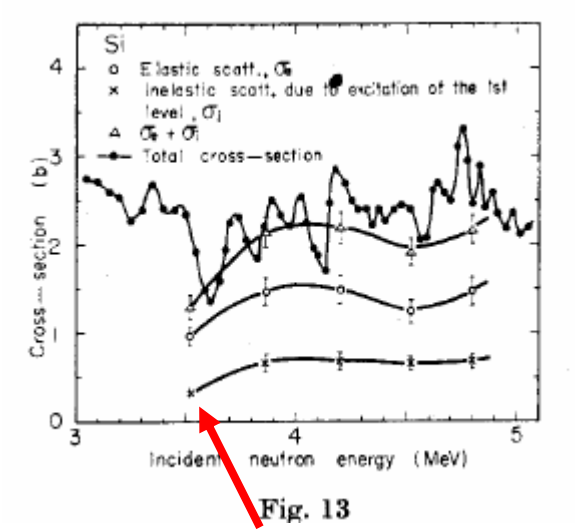
- ^{nat}Er(n,tot) cross section in MeV region published in 1974.
- Data source: author's magnetic tape (TABLE)

The compiler ***deleted*** this outlier (one data point) :

```
HISTORY    One data line was deleted as wrong
           "8.1355E-01 8.4492E-01 1.6738E-01".
```

Compiler's decision (3) - Shift outlier





- ^{28}Si(n,n')^{28}Si cross section in MeV region published in 1961
- Data source: SCISRS (Source of the SCISRS data is unknown.).
- Compiled data are different from authors' figure

Compiler **shifted** this outlier (one data point) :

```
HISTORY    First data point was corrected
           according to Fig.13 data: "1.32" into "0.32" .
```

Recommendation

- Communicate with authors if possible. It might be a trivial typographical error.

- Addition of comments if we have no reason to correct it, e.g.

```
1) CRITIQUE    Data value is higher than other works

2) COMMENT     By author: Few milligrams of enriched sample
               without chemical separation

3) COMMENT     By authors: This value(487 mb) is larger than
               that of Levkovski (76 mb, 400160.009).

4) DECAY-DATA  (60-ND-151,17.3MIN)
   STATUS      (OUTDT) Now T(1/2)= 12.44 min Sept., 2008)
```

Recommendation (Cont'd)

- Reference data should be compiled, e.g.:

  DECAY-DATA (Especially T1/2), **MONIT**

  They could be useful to find the possible reason of deviation from other measurements. (Also **METHOD** etc.)

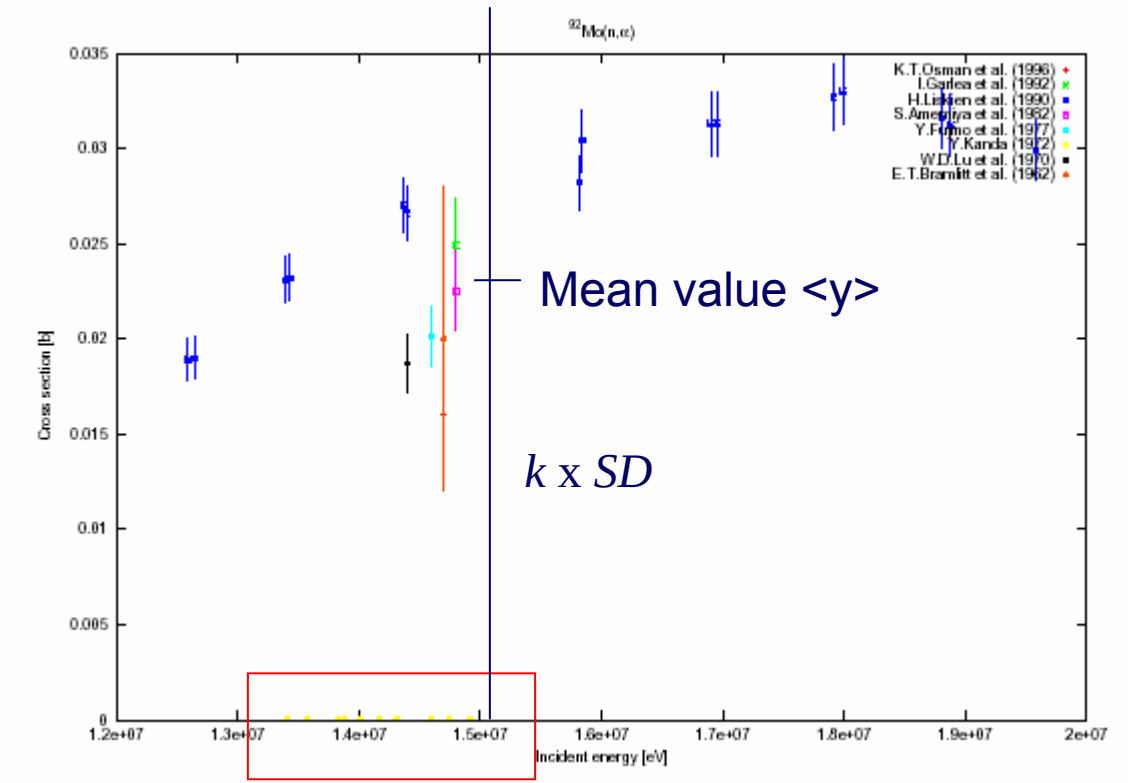
- Source of compiled data should be clarified under STATUS:

```
(STATUS) Table 2 of the second reference
(STATUS) Read from Fig. 3
(STATUS) Data (Fig.2) sent from author
         (2008-09-23)
```

(Data from authors may be different from their publication.)

Problem in Detection of “Too low” Outliers

If *k* x *SD* ~ <*y*> : Outliers lower than others cannot be detected.



Logarithmic Transformation?

Arjan Koning's F-factor Table

F-factor (Michel's factor) proposed by Rolf Michel :

$$F = 10^{\sqrt{\frac{1}{N}\sum_{i=1}^{N}\left(\log\frac{\sigma_T^i}{\sigma_E^i}\right)^2}}$$

E: Experimental (EXFOR) data

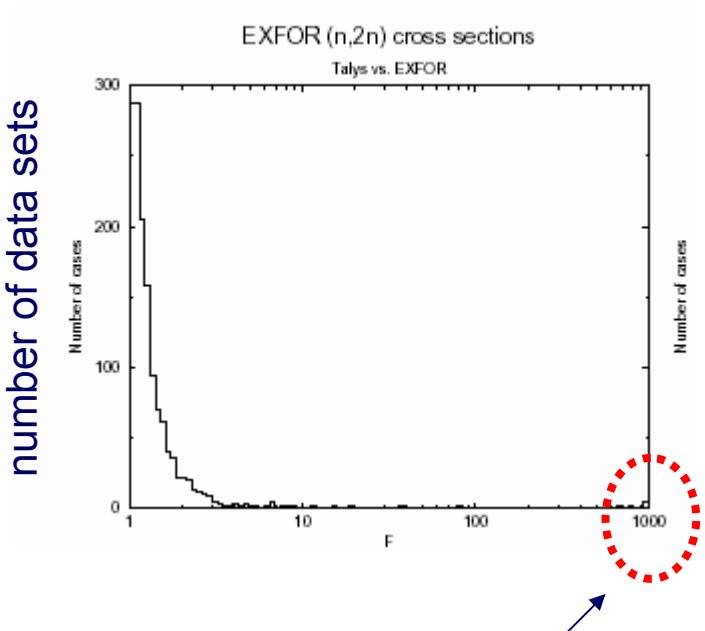
T: Theoretical (Talys) data

F ~ 1000 means possible mistake in mb ↔ b etc.

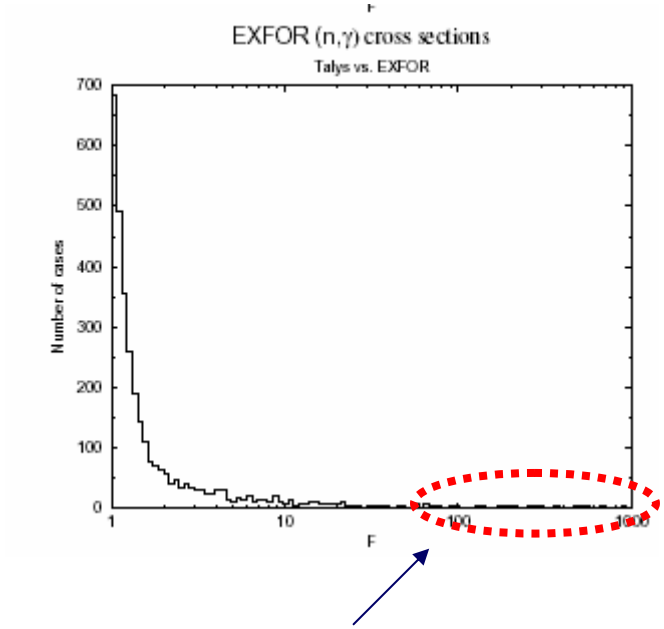
NDS received 62140 lines of F-factor table from Arjan in July, 2008.
(NEA-DB also calculates F-factors
using evaluated data for theoretical values. – Hans's presentation)

F-factor Distribution

Figures by A. Koning



Visible peak around 1000



Not clear structure in [100,1000].

NDS is analysing the F-factor lists for efficient detection of real mistakes.

END