ANALYSIS OF EXFOR OUTLIERS

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Introduction

Scope Review of the production cross-section of a, d, g, h, p, and t induced reactions in validation of TENDL-2021 curves.

Method Observing each plot received from Arjan Koning one-by-one along with the source article and web retrieval system.

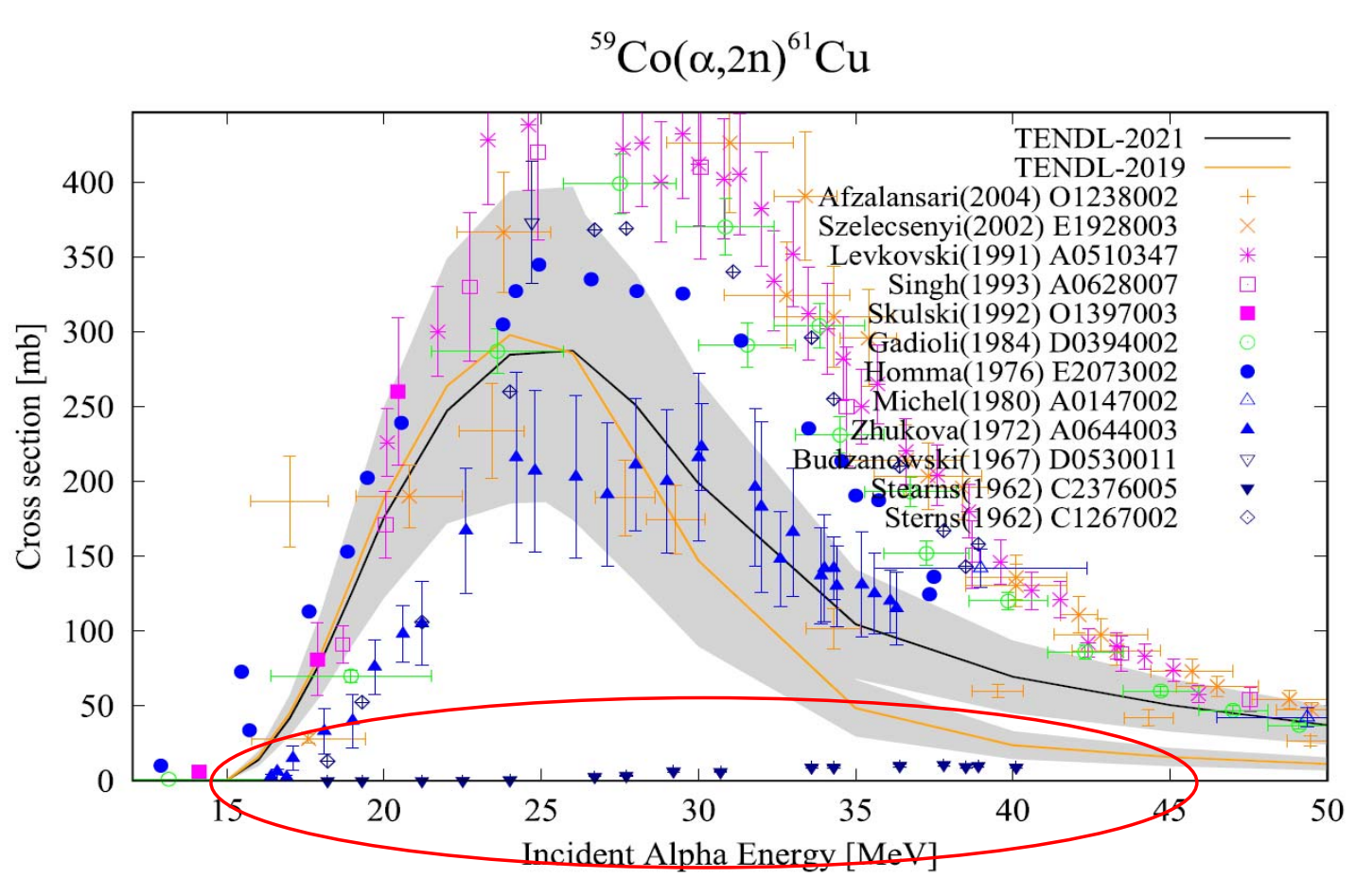
The suspicious cases, not evident from Arjan's plot, were also checked whenever needs arise.

Current situation The review of a, d and g induced reactions have been completed.

Content

1. Projectile covered
   - Alpha
   - Deuteron
   - Gamma
2. Quantity
   - Cross-section (CS)
3. Additional comments
4. Conclusion
5. Future plan

Alpha induced reactions



Wrong REACTION (SF3,SF4)

```
SUBENT        C2376005   20181210   20190426   20190425        C183
BIB                 5          13
REACTION    (27-CO-59(A,2N)29-CU-61,,SIG)
            # (27-CO-59(A,2N)29-CU-61,,SIG)
            # Target:CO-59 #Projectile:A #Reaction:A,2N  #Quantity:,SIG:CS:Cross section
            # Product: [29-CU-61]
FACILITY    (CYCLO,1USABNL) Brookhaven National Laboratory, 60-
            inch cyclotron.
            # (CYCLO Cyclotron
            #,1USABNL) Brookhaven National Laboratory, Upton, NY, United States of America
SAMPLE      The targets were prepared by electrodeposition of
            spectroscopically pure cobalt onto one-half mil gold
            foils from a cobalt-ethylene-diamine solution. The
            targets varied from 0.5 to 2 mg/cm2 in thickness, and
            each target was uniform to +-2%.
DECAY-DATA (29-CU-61,3.32HR,B+,1220.0,0.68,
                           B+,1150.0,0.68,
                           B+,940.0,0.68,
                           B+,560.0,0.68)
            # Decay-data: [29-CU-61]
STATUS      (TABLE) Table I, pages 48-49.
            # (TABLE) Data presented by authors
ENDBIB             13
COMMON              1          1          12
             #Legend: 1 x 1 x 12 : data columns * lines * column width
              #DATA-ERR | Error in value of quantity, defined under ERR-ANALYS | PER-CENT | per-cent
             #/Legend
DATA-ERR
PER-CENT
8.0
ENDCOMMON
DATA                2          16          12
             #Legend: 2 x 16 x 12 : data columns * lines * column width
              #EN   | Energy of incident projectile, laboratory system | MEV | MeV
              #DATA | Cross section                                    | MB  | millibarns
                      #+ 27-CO-59(A,2N)29-CU-61,,SIG
             #/Legend
EN          DATA
MEV         MB
40.1        9.0
38.9        9.94
38.5        9.39
37.8        10.7
36.4        10.1
34.3        9.04
33.6        9.10
30.7        5.86
29.2        6.41
27.7        3.46
26.7        2.83
24.0        0.56
22.5        0.17
21.2        0.049
19.3        0.019
18.2        0.007
ENDDATA
ENDSUBENT          40
ENDENTRY
```

The data is for (a,2p) reaction

TABLE I

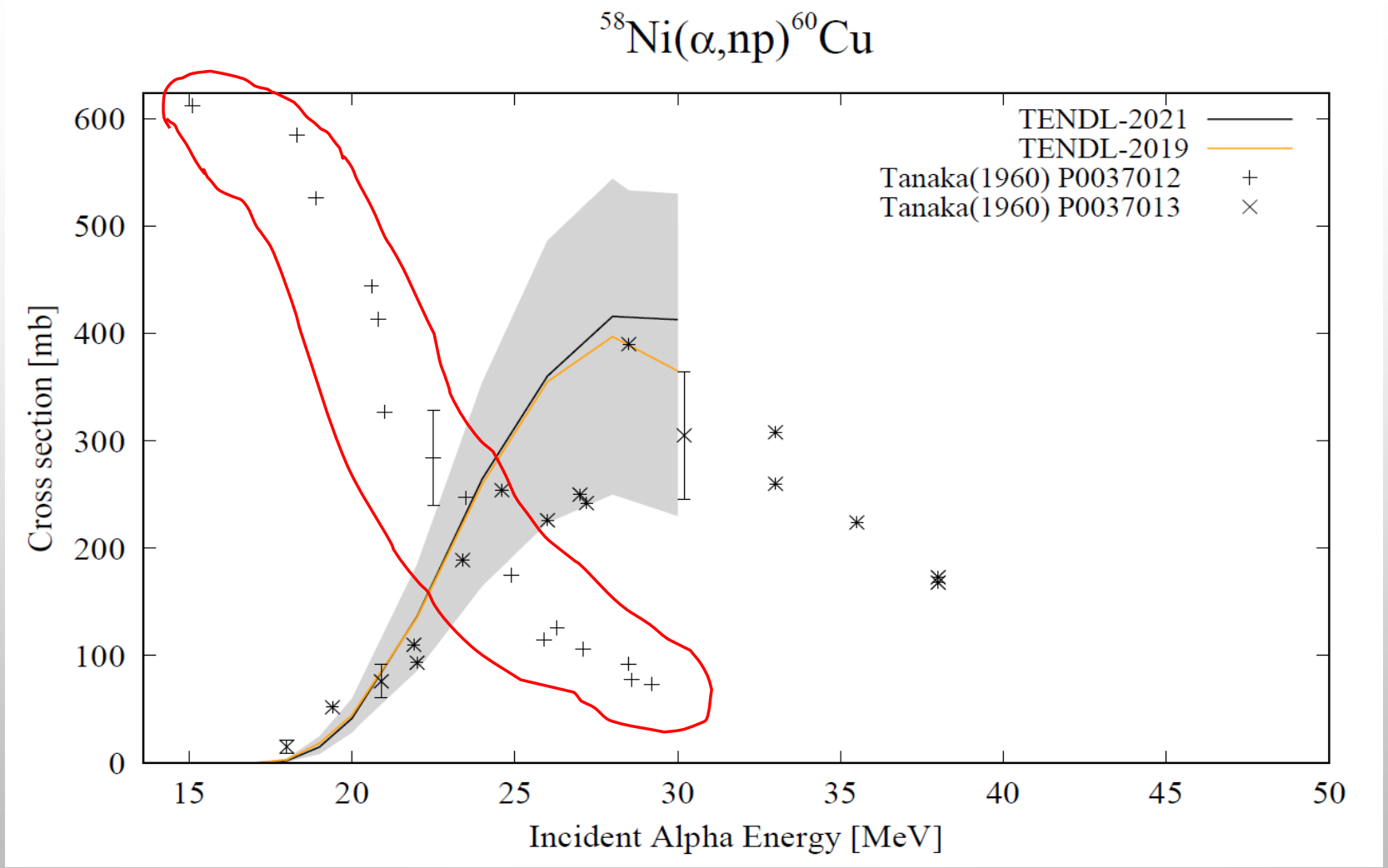
Experimental Cross Sections for Alpha Particles and Co^{59}

Kinetic Energy (Lab) Mev	Excitation Energy Mev	Irradiation	$\sigma(\alpha,\alpha n)$ mb	$\sigma(\alpha,\alpha 2n)$ mb	$\sigma(\alpha,2p)$ mb	$\sigma(\alpha,2n)$ mb
48.0	50.8	6	107	17[illegible]		
45.8	48.7	6	137	207		
43.4	46.4	6	135	174		
41.2	44.4	6	[illegible]	156		
40.1	43.3	4	179	146	9.0	
39.0	42.3	6	168	110		
38.9	42.2	1	202	130	9.94	158
38.5	41.8	[illegible]	189	112	9.39	143
37.8	41.1	2	228	113	10.7	167
36.4	[illegible]	1	216	80.7	10.1	210
35.9	[illegible]	6	222	73.1		
34.3	37.9	2	219	39.7	9.04	255
[illegible]	37.3	3	223	30.5	9.10	296
[illegible]	36.3	6	217	16.3		
31.1	34.9	2	220	8.1		340
30.7	34.5	1	228	11.2	5.86	
29.2	33.2	3	210		6.41	399
27.7	31.8	2	193		3.46	369
26.8	30.9	6	173			

TABLE I (continued)

Experimental Cross Sections for Alpha Particles and Co^{59}

Kinetic Energy (Lab) Mev	Excitation Energy Mev	Irradiation	$\sigma(\alpha,\alpha n)$ mb	$\sigma(\alpha,\alpha 2n)$ mb	$\sigma(\alpha,2p)$ mb	$\sigma(\alpha,2n)$ mb
26.7	30.8	1	181	5.4	2.83	368
24.0	28.3	3	83.8		0.56	260
22.5	26.9	4	63.5		0.17	157
21.2	25.5	2	22.6		0.049	106
19.3	23.8	5	8.4		0.019	52.5
18.2	22.8	4	0.4		[illegible]	[illegible]


^{58}Ni(α,np)^{60}Cu
TENDL-2021
TENDL-2019
Tanaka(1960) P0037012
Tanaka(1960) P0037013
Cross section [mb]
Incident Alpha Energy [MeV]
0
100
200
300
400
500
600
15
20
25
30
35
40
45
50

Wrong REACTION (SF3,SF4)

```
ENTRY        P0037001   20000811   20010330   20050926       0000
SUBENT       P0037001   20000811   20010330   20050926       0000
BIB                 9         13
INSTITUTE   (2JPNTOK)
            # (2JPNTOK) Univ. of Tokyo, Tokyo, Japan
REFERENCE   (J,JPJ,15,2159,1960)
            # (J,JPJ,15,2159,1960) Jour: Journal of the Physical Society of Japan, Vol.15, p.2159 (1960), Japan
            #+      #URL=http://dx.doi.org/10.1143/JPSJ.15.2159
            #+      #NSR=1960TA21 #DOI=10.1143/JPSJ.15.2159
            #+      #Title=Reactions of Nickel with Alpha-Particles
            #+      #Authors=S.Tanaka
AUTHOR      (S.TANAKA)
TITLE       Reactions of Nickel with Alpha-Particles
FACILITY    (CYCLO,2JPNTOK)
            # (CYCLO Cyclotron
            #,2JPNTOK) Univ. of Tokyo, Tokyo, Japan
SAMPLE      Natural nickel foils. Areal density 8.7 mg/cm2.
METHOD      (STTA)
            (RCHEM)
            # (STTA) Stacked target irradiation
            # (RCHEM) Radiochemical separation
STATUS      (CPX) Data from CPX file compiled in 1964/67 by
             F.K. McGowan et al.
            # (CPX) Data taken from data file of McGowan, et al.
HISTORY     (19830620T) Converted to EXFOR Format by IAEA-NDS
            (19850215U) OS. Country code corrected.
            (20000809A) Converted to new date formats, BIB updated.
ENDBIB              13
NOCOMMON
ENDSUBENT           16
SUBENT       P0037012   20000811   20010330   20050926       0000
BIB                 2          2
REACTION    (28-NI-58(A,N+P)29-CU-60,CUM,SIG)
            # (28-NI-58(A,N+P)29-CU-60,CUM,SIG)
            # Target:NI-58 #Proje ile:A #Reaction:A,N+P  #Quantity:CUM,SIG:CS:Cumulative cross section
            # Product: [29-CU-60]
HISTORY     (19850829A) CORRECTE  NDC
ENDBIB              2
NOCOMMON
DATA                3         24
             #Legend: 3 x 24 x 12 : da  ines * column width
```

#EN	Energy of e, laboratory system	MEV	MeV
#DATA	Cumulative #+ 28-NI-58 M,SIG	MB	millibarns
#DATA-ERR	Error in value der ERR-ANALYS	MB	millibarns

```
             #/Legend
EN          DATA        DATA-ERR
MEV         MB          MB
7.68        18.4        4.37
8.42        112.
10.7        287.
11.1        274.
12.4        492.
13.0        512.
15.1        612.
15.6        652.        102.
17.2        634.
18.0        670.
18.3        585.
18.9        526.
20.6        444.
20.8        413.
21.0        327.
22.5        284.        44.
23.5        247.
24.9        175.
25.9        115.
26.3        126.
27.1        106.
28.5        92.3
28.6        77.3
29.2        73.5
```

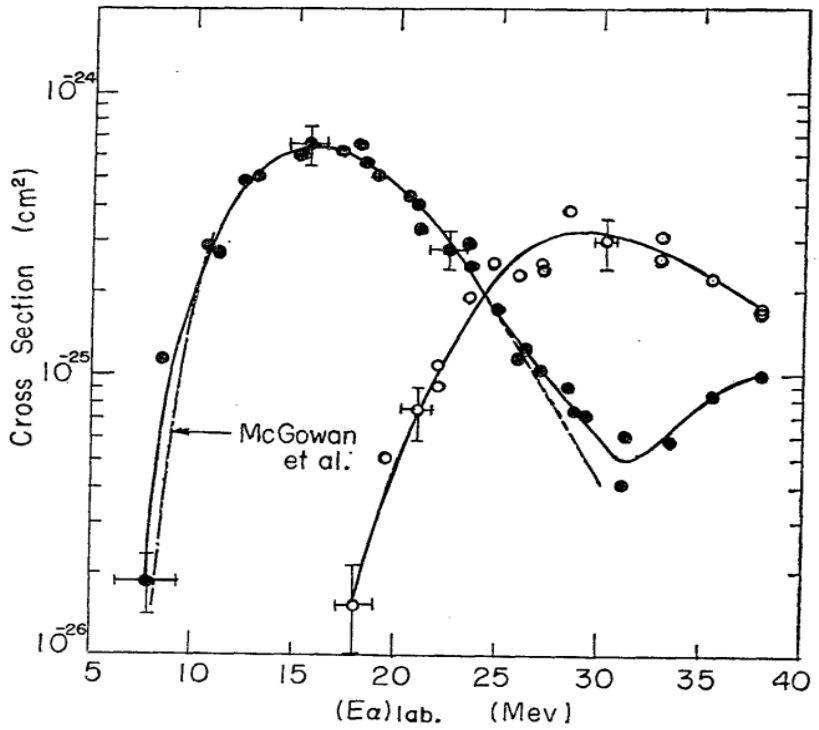


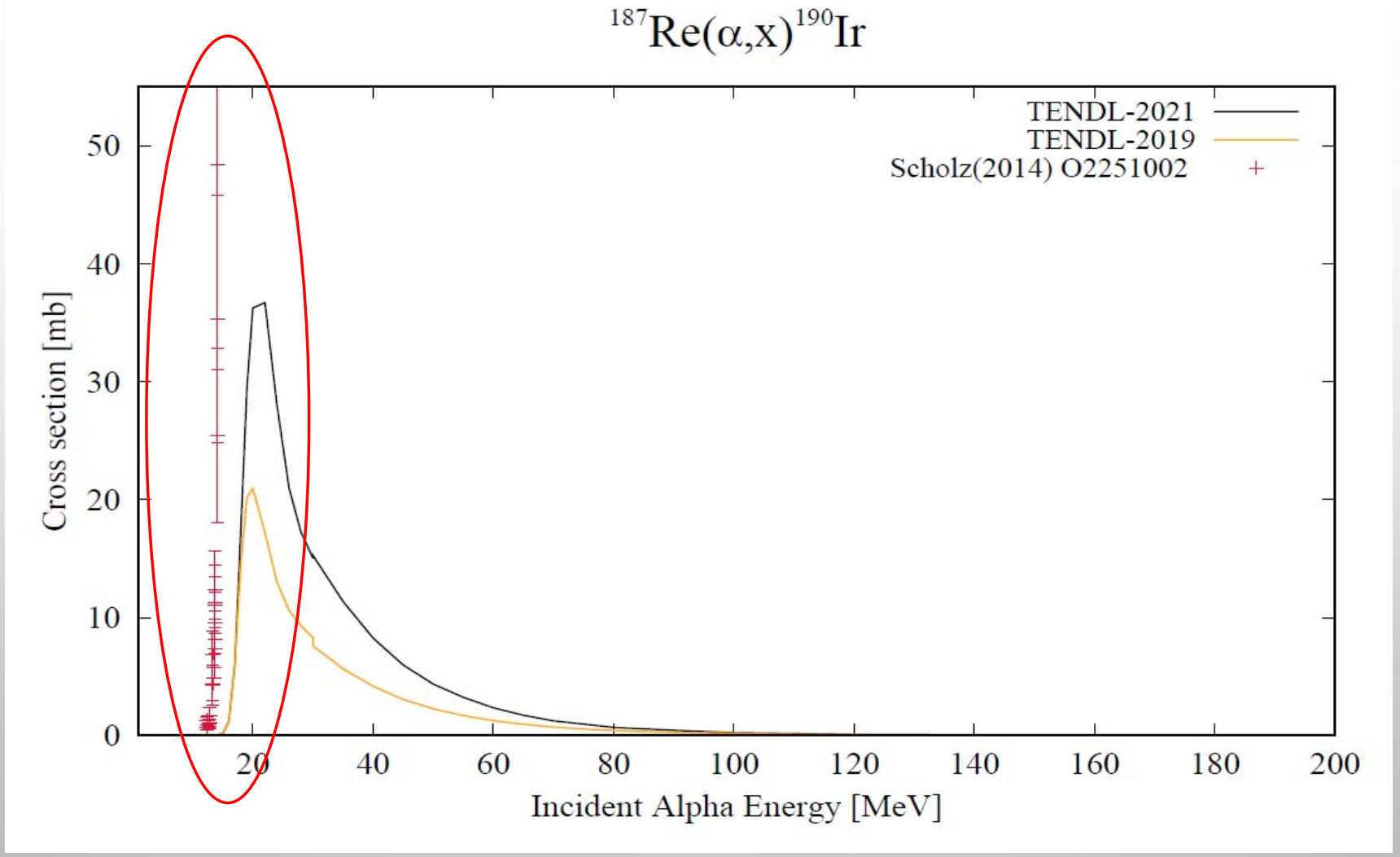
Fig. 1. Excitation functions for the alpha-particle reactions on Ni^{58}. (Part 1)

● $Ni^{58}(\alpha, p)Cu^{61}+Ni^{58}(\alpha, n)Zn^{61}$.

○ $Ni^{58}(\alpha, pn)Cu^{60}+Ni^{58}(\alpha, 2n)Zn^{60}$.

-·- $\sigma(\alpha, p+\alpha, n+\alpha, \gamma)$ measured by McGowan et al.[10]

28-NI-58(A,N+P)29-CU-60,CUM,SIG) -> (28-NI-58(A,X)29-CU-61,CUM,SIG)


$^{187}Re(\alpha,x)^{190}Ir$
TENDL-2021
TENDL-2019
Scholz(2014) O2251002
Cross section [mb]
0
10
20
30
40
50
20
40
60
80
100
120
140
160
180
200
Incident Alpha Energy [MeV]

Wrong Unit

Unit problem mb -> µb

```
          approx.10%.
          (EN-ERR).Uncertainties from table 3
          (ERR-S,,10.).The statistical uncertainties for the
          efficiency is less than 10%.
          (ERR-1,,5.).The error in the gamma-ray intensities is
          less than 5%.
          (ERR-2,,20.).The error in the parameters for the gamma-
          ray transitions less than 20%.
          (ERR-3,,20.).The error in the summing correction
          less than 8%.
          (ERR-4,,20.).The error in the number of events in
          the area of the full-energy peak less than 30%.
HISTORY   (20150203C) S.B.
ENDBIB              42
NOCOMMON
ENDSUBENT           45
SUBENT      O2251002   20150203   20150817   20150707       0054
BIB                 3          8
REACTION  (75-RE-187(A,N)77-IR-190,,SIG)
          # (75-RE-187(A,N)77-IR-190,,SIG)
          # Target:RE-187 #Projectile:A #Reaction:A,N  #Quantity:,SIG:CS:Cross section
          # Product: [77-IR-190]
DECAY-DATA ((1.)77-IR-190,,DG,371.24,0.228)
          ((2.)77-IR-190,,DG,407.22,0.285)
          ((3.)77-IR-190,,DG,518.55,0.340)
          ((4.)77-IR-190,,DG,557.95,0.301)
          ((5.)77-IR-190,,DG,569.30,0.285)
          ((6.)77-IR-190,,DG,605.14,0.399)
          # Decay-data: [0--0]
STATUS    (TABLE).Table 3 of J,PR/C,90,065807,2014
          # (TABLE) Data presented by authors
ENDBIB              8
NOCOMMON
DATA                5          17          12
          #Legend: 5 x 17 x 12 : data columns * lines * colu    idth
```

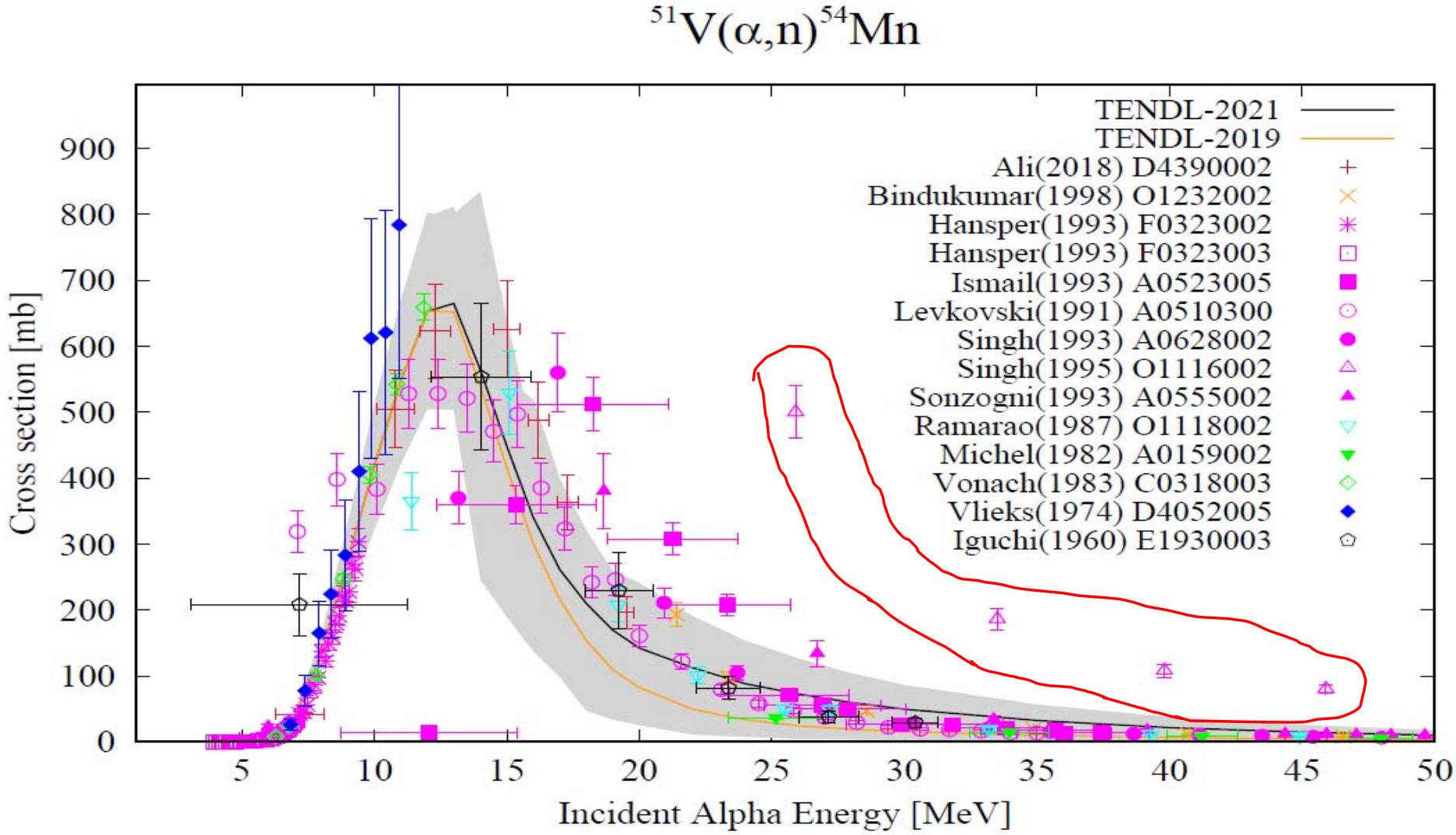
#EN	Energy of incident projecti aboratory system	KEV	keV
#EN-ERR	Uncertainty in incident jectile energy	KEV	keV
#DATA	Cross section #+ 75-RE-187(A,N)77-IR-190,,SIG	MB	millibarns
#ERR-T	Total uncertai y (1-Sigma)	MB	millibarns
#DECAY-FLAG	Decay flag See corresponding flag in BIB section	NO-DIM	no Dimensions

```
          #/Legend
EN        EN-ERR     DATA       ERR-T      DECAY-FLAG
KEV       KEV        MB         MB         NO-DIM
14091.    28.        48.4       17.4       6.
14091.    28.        35.3       10.5       2.
14091.    28.        25.4       7.4        1.
13689.    28.        11.1       2.4        6.
13689.    28.        11.3       3.1        5.
13689.    28.        12.4       3.2        4.
13689.    28.        9.6        2.6        3.
13689.    28.        8.2        2.4        2.
13689.    28.        7.4        2.5        1.
13286.    29.        6.9        2.0        6.
13286.    29.        4.3        1.7        2.
13286.    29.        4.4        1.4        1.
12785.    29.        1.68       0.71       6.
12785.    29.        1.10       0.30       2.
12785.    29.        1.03       0.40       1.
12384.    29.        0.68       0.21       6.
12384.    29.        1.27       0.35       2.
ENDDATA
```

TABLE III. Results of the activation experiment. For each α-particle energy, the measured cross-section values for the different γ-ray transitions are shown. The last column shows the weighted average of the obtained cross sections.

E_α [keV]	E_γ [keV]	σ [μb]	$\bar{\sigma}$ [μb]
	605	48.4 ± 17.4	
14091 ± 28	407	35.3 ± 10.5	30.4 ± 8.8
	371	25.4 ± 7.4	
	605	11.1 ± 2.4	
	569	11.3 ± 3.1	
13689 ± 28	558	12.4 ± 3.2	9.9 ± 2.0
	518	9.6 ± 2.6	
	407	8.2 ± 2.4	
	371	7.4 ± 2.5	
	605	6.9 ± 2.0	
13286 ± 29	407	4.3 ± 1.7	4.97 ± 1.12
	371	4.4 ± 1.4	
	605	1.68 ± 0.71	
12785 ± 29	407	1.10 ± 0.30	1.13 ± 0.29
	371	1.03 ± 0.40	
12384 ± 29	605	0.68 ± 0.21	0.85 ± 0.19
	407	1.27 ± 0.35	

As mentioned earlier, the ^{187}Re(α,n) cross section is almost only sensitive to the α width in the measured energy range. Thus, deviations of theoretical predictions obtained by statistical-model calculations from the measured values are


$^{51}V(\alpha,n)^{54}Mn$
Cross section [mb]
Incident Alpha Energy [MeV]
0
100
200
300
400
500
600
700
800
900
5
10
15
20
25
30
35
40
45
50
TENDL-2021
TENDL-2019
Ali(2018) D4390002
Bindukumar(1998) O1232002
Hansper(1993) F0323002
Hansper(1993) F0323003
Ismail(1993) A0523005
Levkovski(1991) A0510300
Singh(1993) A0628002
Singh(1995) O1116002
Sonzogni(1993) A0555002
Ramarao(1987) O1118002
Michel(1982) A0159002
Vonach(1983) C0318003
Vlieks(1974) D4052005
Iguchi(1960) E1930003

Wrong y-scale

```
SUBENT        O1116002   20190916   20191218   20191217        O071
BIB                 5         11
REACTION    (23-V-51(A,N)25-MN-54,,SIG)
            # (23-V-51(A,N)25-MN-54,,SIG)
            # Target:V-51 #Projectile:A #Reaction:A,N  #Quantity:,SIG:CS:Cross section
            # Product: [25-MN-54]
DECAY-DATA  (25-MN-54,312.D,DG,835.,1.)
            # Decay-data: [25-MN-54]
REL-REF     (D,O1118002,J.Rama Rao+,J,JP/G,13,535,1987)
            Energy dependence form are similar, but numerical data
            ~10 times less, than in the paper.
            (D,B0009002,W.W.Bowman+,J,NP/A,131,513,1969)
            (D,E1930003,A.Iguchi+,J,AEJ,2,682,1960)
            Previous measurements of the reactions in vanadium
            induced by alpha particles with less accuracy.
            # (D,O1118002,J.Rama Rao+,J,JP/G,13,535,1987) Jour: Jour. of Physics, Pa
            #+      #URL=http://dx.doi.org/10.1088/0305-4616/13/4/017
            #+      #NSR=1987RA05 #DOI=10.1088/0305-4616/13/4/017
            #+      #Title=Non-Equilibrium Effects in Alpha-Particle-Induced Reactions in
            #+      #Authors=J.Rama Rao, A.V.Mohan Rao, S.Mukherjee, R.Upadhyay, N.
            # (D,B0009002,W.W.Bowman+,J,NP/A,131,513,1969) Jour: Nuclear Physics, S
            #+      #URL=http://dx.doi.org/10.1016/0375-9474(69)90592-2
            #+      #NSR=1969BO20 #DOI=10.1016/0375-9474(69)90592-2
            #+      #Title=Reactions of 51V and 27Al with 7-120 MeV α-Particles (Equilibrium and Non-Equilibri
            #+      #Authors=W.W.Bowman, M.Blann
            # (D,E1930003,A.Iguchi+,J,AEJ,2,682,1960) Jour: Journal of the Atomic Energy Society of Japan,
            #+      #URL=http://dx.doi.org/10.3327/jaesj.2.682
            #+      #DOI=10.3327/jaesj.2.682
            #+      #Title=(alpha,n) cross sections for 48Ti and 51V
            #+      #Authors=A.Iguchi, H.Amano, S.Tanaka
STATUS      (CURVE) fig.1,3 from J.of Phys.,G21(1995)399
            # (CURVE) Data read from a curve
HISTORY     (20190916A) SD: BIB updated. DATA-ERR -> ERR-T.
ENDBIB             11
COMMON              1          1          12
            #Legend: 1 x 1 x 12 : data columns * lines * column width
             #EN-ERR-DIG   Digitizing error of incident particle energy   MEV   MeV
            #/Legend
EN-ERR-DIG
MEV
0.4
ENDCOMMON
DATA                3         23          12
            #Legend: 3 x 23 x 12 : data columns * lines * column width
             #EN      Energy of incident projectile, laboratory system   MEV        MeV
             #DATA    Cross section                                      MB         millibarns
                      #+ 23-V-51(A,N)25-MN-54,,SIG
             #ERR-T   Total uncertainty (1-Sigma)                        PER-CENT   per-cent
            #/Legend
EN          DATA        ERR-T
MEV         MB          PER-CENT
11.4        3900.       10.
15.6        5600.       11.
20.2        2120.       9.
22.9        1010.       9.
25.9        500.        8.
33.5        186.        9.
39.8        108.        9.
45.9        80.         8.
52.2        53.         8.
58.5        41.         7.
64.3        29.9        10.
67.6        20.7        10.
70.         20.7        8.
73.6        16.8        8.
75.8        13.4        9.
78.8        13.         11.
83.8        12.4        7.
88.5        9.8         11.
93.4        7.3         12.
98.4        6.5         14.
103.4       5.7         12.
108.3       5.5         15.
113.        5.4         15.
ENDDATA
ENDSUBENT          45
ENDENTRY
```

The scale on Y-axis (i.e., cross section) has been wrongly mentioned.
10^{-1} should come in place of 10^{0} and hence the subsequent values (confirmed by the author)

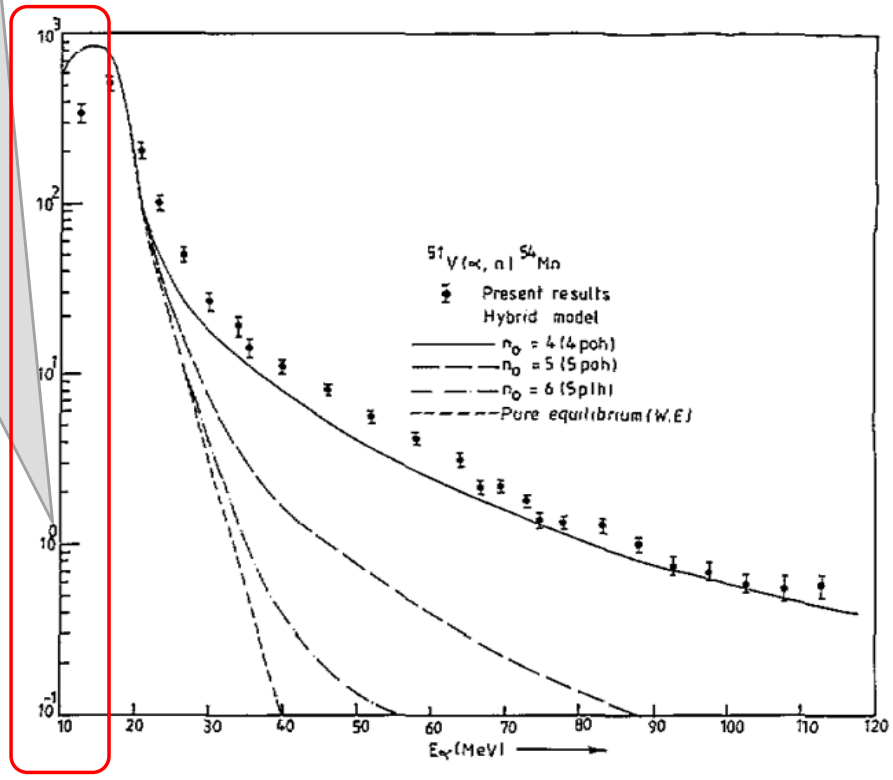
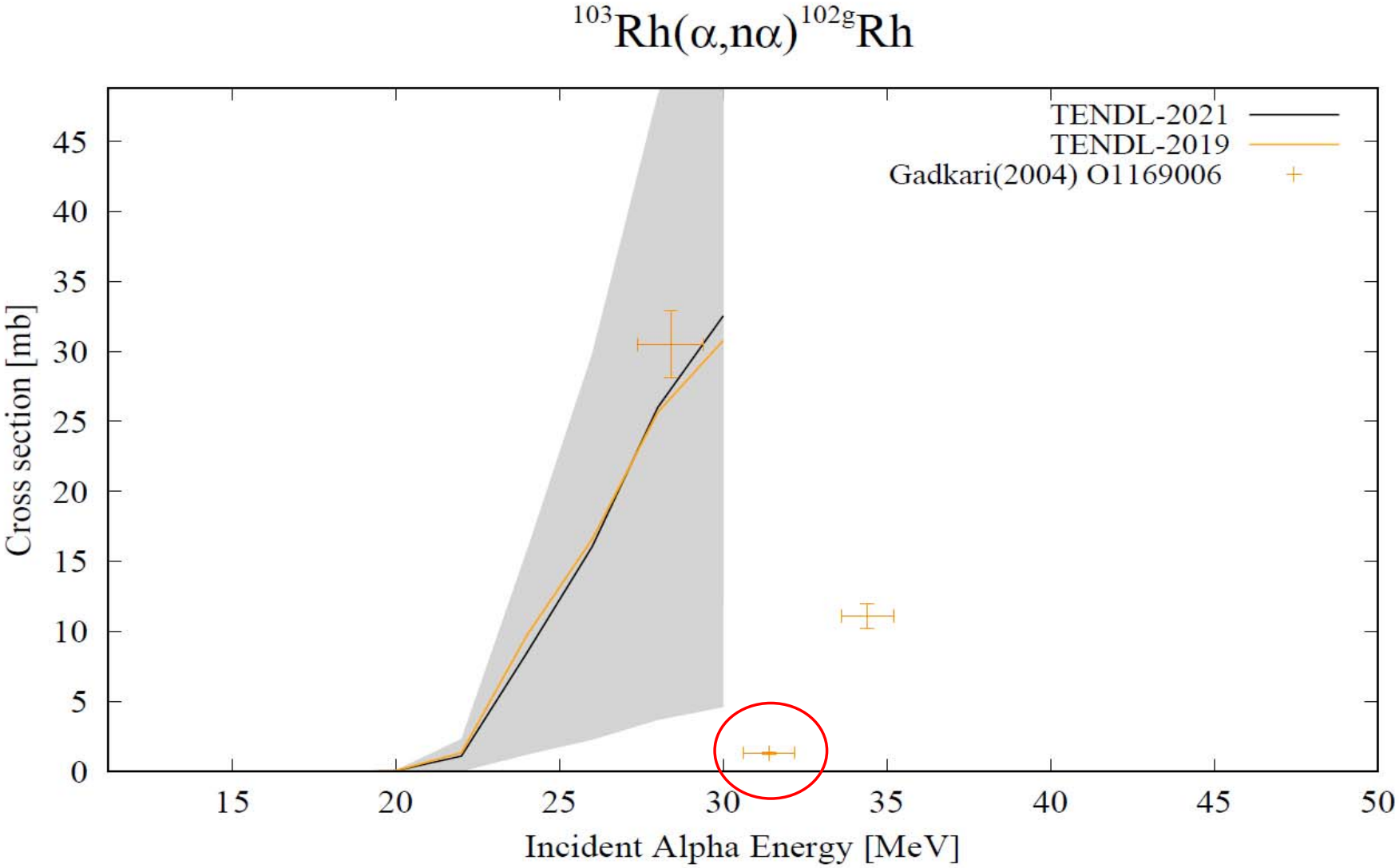


Figure 3. Excitation function of $^{51}V(\alpha, n)^{54}Mn$ reaction.


^{103}Rh(α,nα)^{102g}Rh
TENDL-2021
TENDL-2019
Gadkari(2004) O1169006
Cross section [mb]
Incident Alpha Energy [MeV]
0
5
10
15
20
25
30
35
40
45
15
20
25
30
35
40
45
50

Two data points from next column

```
SUBENT      O1169006   20041028              20050926       0000
BIB                 4          8
REACTION    (45-RH-103(A,N+A)45-RH-102-G,IND/M+,SIG)
            # (45-RH-103(A,N+A)45-RH-102-G,IND/M+,SIG)
            # Target:RH-103 #Projectile:A #Reaction:A,N+A  #Quantity:IND/M+,SIG:CS:Independent cross sect., incl. isomeric trans.
            # Product: [45-RH-102]
RAD-DET     (45-RH-102-G,DG)
DECAY-DATA  (45-RH-102-G,206.D,DG,475.,0.45,
                          DG,628.,0.044)
            # Decay-data: [45-RH-102]
COMMENT     - By compiler. 1. Isomer transition from long-lived
            Rh-102-m (T1/2~2.9 years) = 0.23%.
            2. According to ENSDF 206-day activity is one of ground
            state, but not isomer state.
ENDBIB              8
NOCOMMON
DATA                4          7          12
            #Legend: 4 x 7 x 12 : data columns * lines * column width
```

#EN	Energy of incident projectile, laboratory system	MEV	MeV
#EN-ERR	Uncertainty in incident projectile energy	MEV	MeV
#DATA	Independent cross sect., incl. isomeric trans. #+ 45-RH-103(A,N+A)45-RH-102-G,IND/M+,SIG	MB	millibarn
#ERR-T	Total uncertainty (1-Sigma)	MB	millibarn

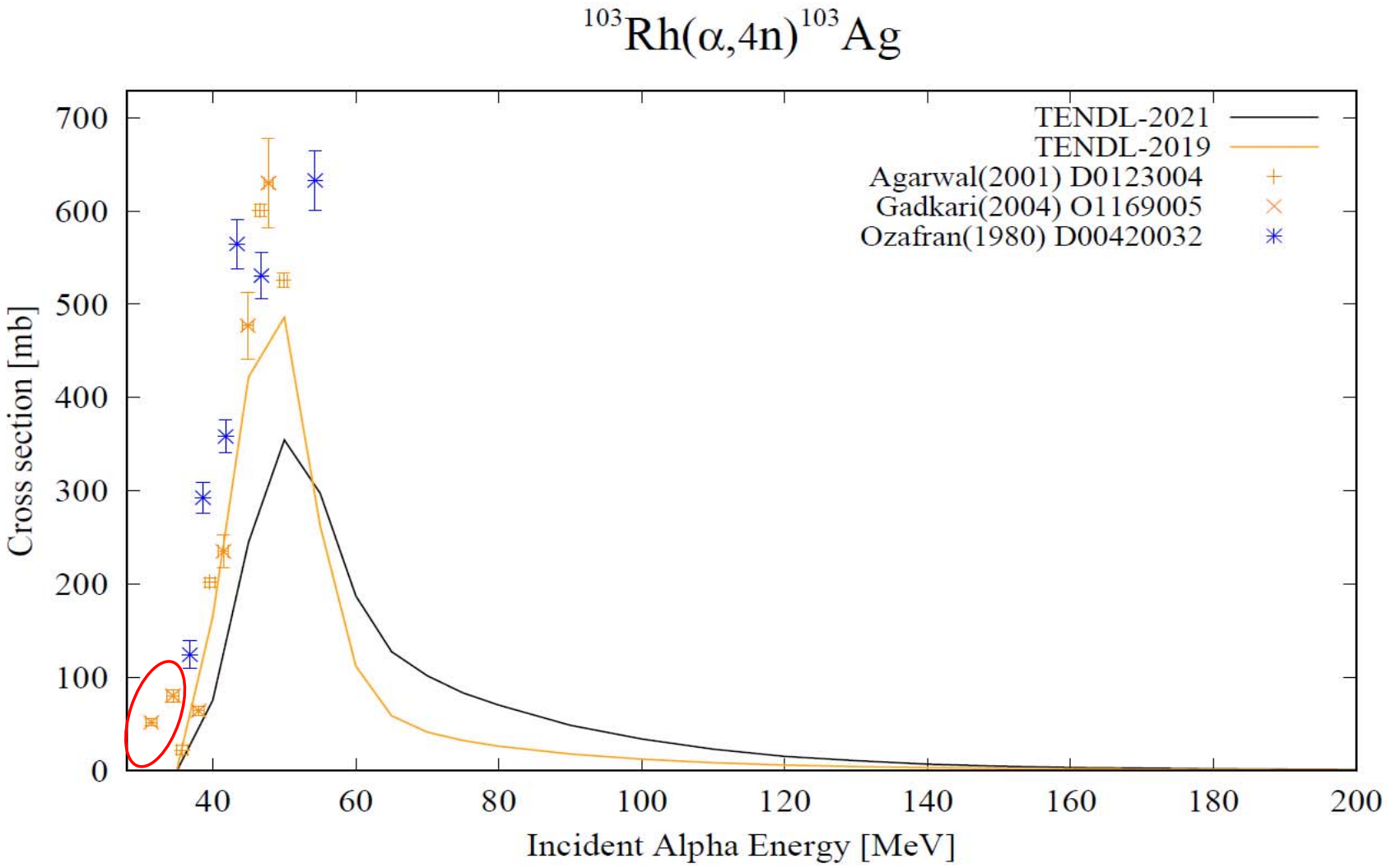
```
            #/Legend
EN          EN-ERR      DATA        ERR-T
MEV         MEV         MB          MB
28.4        1.          30.5        2.4
31.4        0.8         1.3         0.1
34.4        0.8         11.1        0.9
38.         0.8         89.         7.
41.5        0.7         98.         8.
44.9        0.7         101.        8.
47.8        0.6         103.        8.
ENDDATA
ENDSUBENT          22
```

Data points wrongly inserted

M S Gadkari and N L Singh

Table 2. Cross-sections of the α-induced reactions on ^{103}Rh.

Reaction	(α, n)	$(\alpha, 2n)$	$(\alpha, 3n)$	$(\alpha, 4n)$	$(\alpha, \alpha n)$	$(\alpha, \alpha 2n)$	$(\alpha, \alpha 3n)$
Product nucleus	^{106m}Ag	^{105}Ag	^{104}Ag	^{103}Ag	^{102m}Rh	^{101m}Rh	^{100}Rh
Threshold energy (MeV)	7.0	15.2	25.6	34.3	9.6	17.5	27.6
E_α (MeV)	σ (mb)	σ (mb)	σ (mb)	σ (mb)	σ (mb)	σ (mb)	σ (mb)
17.6±1.2	128±10	129±10					
21.5±1.1	76.0±6.0	553±42					
25.0+1.0	28.0+2.0	856+66					
28.4±1.0	13.2±1.0	873±68	114±9		30.5±2.4	0.9±0.0	
31.4±0.8	8.1±0.7	650±50	554±42		51.5±4.0	1.3±0.1	
34.4±0.8	5.8±0.5	331±25	988±74		80.0±6.3	11.1±0.9	
38.0±0.8	4.6±0.4	149±11	1078±81	64.0±5.0	89.0±7.0	31.6±2.5	
41.5±0.7	3.5±0.3	89.0±7.0	648±33	235±18	98.0±8.0	51.0±4.0	0.4±0.0
44.9±0.7	2.8±0.3	61.0±4.7	422±32	477±36	101±8	58.0±4.5	10.9±0.8
±0.6	2.5±0.2	47.0±3.6	260±20	630±48	103±8	57.0±4.5	31.5±2.5


^{103}Rh(α,4n)^{103}Ag
TENDL-2021
TENDL-2019
Agarwal(2001) D0123004
Gadkari(2004) O1169005
Ozafran(1980) D00420032
Cross section [mb]
Incident Alpha Energy [MeV]
0
100
200
300
400
500
600
700
40
60
80
100
120
140
160
180
200

Two extra data points from next column

```
#/Legend
ERR-1
PER-CENT
6.
ENDCOMMON
ENDSUBENT            50
SUBENT       O1169005   20041028              20050926       0000
BIB                  4          10
REACTION    (45-RH-103(A,4N)47-AG-103,,SIG)
            # (45-RH-103(A,4N)47-AG-103,,SIG)
            # Target:RH-103 #Projectile:A #Reaction:A,4N  #Quantity:,SIG:CS:Cross section
            # Product: [47-AG-103]
RAD-DET     (47-AG-103-G,DG)
            (47-AG-103-M,DG)
DECAY-DATA  (47-AG-103-G,1.1HR,DG,244.,0.06,
                           DG,266.,0.094,
                           DG,531.,0.061)
            (47-AG-103-M,5.7SEC,DG,134.,0.21) Isomer trasition-100%
            # Decay-data: [47-AG-103]
COMMENT     -By authors. The total cross section was measured by
            allowing for the complete decay of the metastable state
            to the ground state.
ENDBIB               10
NOCOMMON
DATA                  4          6          12
            #Legend: 4 x 6 x 12 : data columns * lines * column width
```

#EN	Energy of incident projectile, laboratory system	MEV	MeV
#EN-ERR	Uncertainty in incident projectile energy	MEV	MeV
#DATA	Cross section #+ 45-RH-103(A,4N)47-AG-103,,SIG	MB	millibarns
#ERR-T	Total uncertainty (1-Sigma)	MB	millibarns

```
            #/Legend
EN          EN-ERR      DATA        ERR-T
MEV         MEV         MB          MB
31.4        0.8         51.5        4.
34.4        0.8         80.         6.3
38.         0.8         64.         5.
41.5        0.7         235.        18.
44.9        0.7         477.        36.
47.8        0.6         630.        48.
ENDDATA
ENDSUBENT            23
ENDENTRY
```

```
SUBENT       O1169007   20041028              20050926       0000
BIB                  3          4
REACTION    (45-RH-103(A,2N+A)45-RH-101-M,,SIG)
            # (45-RH-103(A,2N+A)45-RH-101-M,,SIG)
            # Target:RH-103 #Projectile:A #Reaction:A,2N+A  #Quantity:,SIG:CS:Cross section
            # Product: [45-RH-101]
RAD-DET     (45-RH-101-M,DG)
DECAY-DATA  (45-RH-101-M,4.34D,DG,307.,0.87,
                           DG,544.,0.04)
            # Decay-data: [45-RH-101]
ENDBIB               4
NOCOMMON
DATA                  4          5          12
            #Legend: 4 x 5 x 12 : data columns * lines * column width
```

#EN	Energy of incident projectile, laboratory system	MEV	MeV
#EN-ERR	Uncertainty in incident projectile energy	MEV	MeV
#DATA	Cross section #+ 45-RH-103(A,2N+A)45-RH-101-M,,SIG	MB	millibarns
#ERR-T	Total uncertainty (1-Sigma)	MB	millibarns

```
            #/Legend
EN          EN-ERR      DATA        ERR-T
MEV         MEV         MB          MB
28.4        1.          0.9
38.         0.8         31.6        2.5
41.5        0.7         51.         4.
44.9        0.7         58.         4.5
47.8        0.6         57.         4.5
ENDDATA
ENDSUBENT
ENDENTRY
```

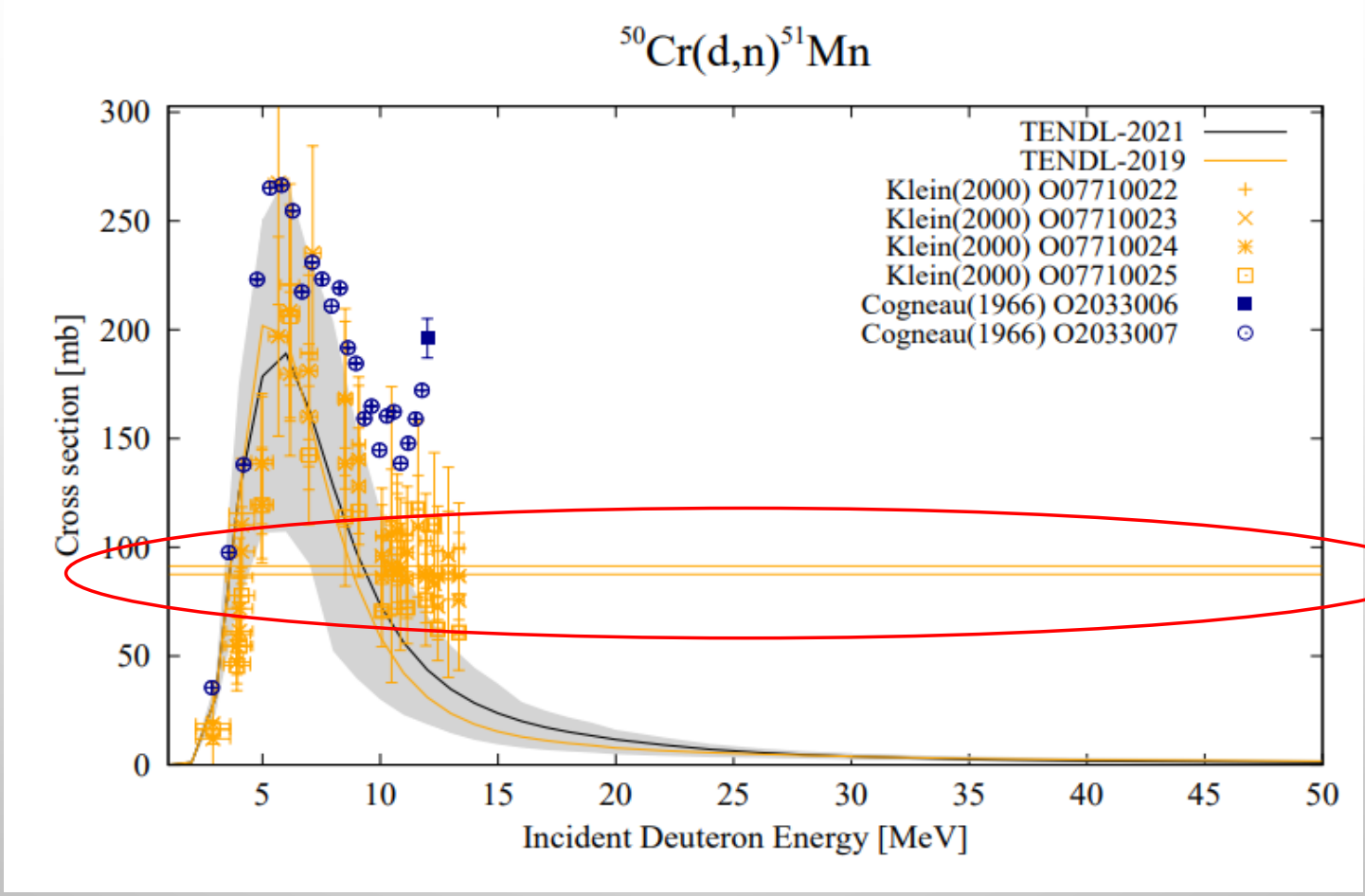
Page generated: 2022-05-25,15:14:51 by X4sGetSubent on localhost [fwd:www-nds.iaea.org]
Project: "Multi-platform EXFOR-CINDA-ENDF", V.Zerkin,IAEA-NDS, 1999-2022
Request from: 0:0:0:0:0:0:0:1 [fwd:161.5.6.190]

M S Gadkari and N L Singh

Table 2. Cross-sections of the α-induced reactions on ^{103}Rh.

Reaction	(α, n)	$(\alpha, 2n)$	$(\alpha, 3n)$	$(\alpha, 4n)$	$(\alpha, \alpha n)$	$(\alpha, \alpha 2n)$	$(\alpha, \alpha 3n)$
Product nucleus	^{106m}Ag	^{105}Ag	^{104}Ag	^{103}Ag	^{102m}Rh	^{101m}Rh	^{100}Rh
Threshold energy (MeV)	7.0	15.2	25.6	34.3	9.6	17.5	27.6
E_α (MeV)	σ (mb)	σ (mb)	σ (mb)	σ (mb)	σ (mb)	σ (mb)	σ (mb)
17.6±1.2	128±10	129±10					
21.5±1.1	76.0±6.0	553±42					
25.0±1.0	28.0±2.0	856±66					
28.4±1.0	13.2±1.0	873±68	114±9		30.5±2.4	0.9±0.0	
31.4±0.8	8.1±0.7	650±50	554±42		51.5±4.0	1.3±0.1	
34.4±0.8	5.8±0.5	331±25	988±74		80.0±6.3	11.1±0.9	
38.0±0.8	4.6±0.4	149±11	1078±81	64.0±5.0	89.0±7.0	31.6±2.5	
41.5±0.7	3.5±0.3	89.0±7.0	648±33	235±18	98.0±8.0	51.0±4.0	0.4±0.0
44.9±0.7	2.8±0.3	61.0±4.7	422±32	477±36	101±8	58.0±4.5	10.9±0.8
47.8±0.6	2.5±0.2	47.0±3.6	260±20	630±48	103±8	57.0±4.5	31.5±2.5

Deuteron induced reactions



Cross-section data point repeated as in EN-ERR

```
MONITOR      (26-FE-54(D,N)27-CO-55,,SIG)
             (24-CR-52(D,2N)25-MN-52,,SIG)
             (79-AU-197(D,2N)80-HG-197-M,,SIG)
             (22-TI-0(D,X)23-V-48,,SIG)
MONIT-REF    (F1220001,N.A.Vlasov+,J,AE,2,189,1957)
             (C0336004,H.L.West+,J,PR/C,35,2067,1987)
             (C1996003,R.Vandenbosch++,J,PR,120,1313,1960)
             (D4105001,K.L.Chen+,J,PR,134,B1269,1964)
ERR-ANALYS   (ERR-1) The errors of the final deuteron fluxes 16%
             (ERR-4) The error of the number of target nuclei
STATUS       (TABLE) Tbl. 4 of RCA,88,253,2000
             #(TABLE) Data presented by authors
HISTORY      (20151204A) SD: ERR-1, ERR-4, METHOD added; BIB update.
             MISC cols -> DATA cols (split on four REACTION codes).
             Value (DATA 1) at En=10.85 MeV corrected.
ENDBIB              35
COMMON               2          1          12
  #Legend: 2 x 1 x 12 : data columns * lines * column width
    #ERR-1    1st partial uncertainty, defined under ERR-ANALYS   PER-CENT   per-cent
    #ERR-4    4th partial uncertainty, defined under ERR-ANALYS   PER-CENT   per-cent
  #/Legend
ERR-1        ERR-4
PER-CENT     PER-CENT
16.          12.
ENDCOMMON
DATA                12          22          12
  #Legend: 12 x 22 x 12 : data columns * lines * column width
    #EN          Energy of incident projectile, laboratory system   MEV   MeV
    #EN-ERR      Uncertainty in incident projectile energy          MEV   MeV
    #DATA   1    Cross section                                      MB    millibarns
                 #+ 24-CR-50(D,N)25-MN-51,,SIG,,,DERIV
    #ERR-T  1    Total uncertainty (1-Sigma)                       MB    millibarns
    #DATA   2    Cross section                                      MB    millibarns
                 #+ 24-CR-50(D,N)25-MN-51,,SIG
    #ERR-T  2    Total uncertainty (1-Sigma)                       MB    millibarns
    #DATA   3    Cross section                                      MB    millibarns
                 #+ 24-CR-50(D,N)25-MN-51,,SIG
    #ERR-T  3    Total uncertainty (1-Sigma)                       MB    millibarns
    #DATA   4    Cross section                                      MB    millibarns
                 #+ 24-CR-50(D,N)25-MN-51,,SIG
    #ERR-T  4    Total uncertainty (1-Sigma)                       MB    millibarns
    #DATA   5    Cross section                                      MB    millibarns
                 #+ 24-CR-50(D,N)25-MN-51,,SIG
    #ERR-T  5    Total uncertainty (1-Sigma)                       MB    millibarns
  #/Legend
```

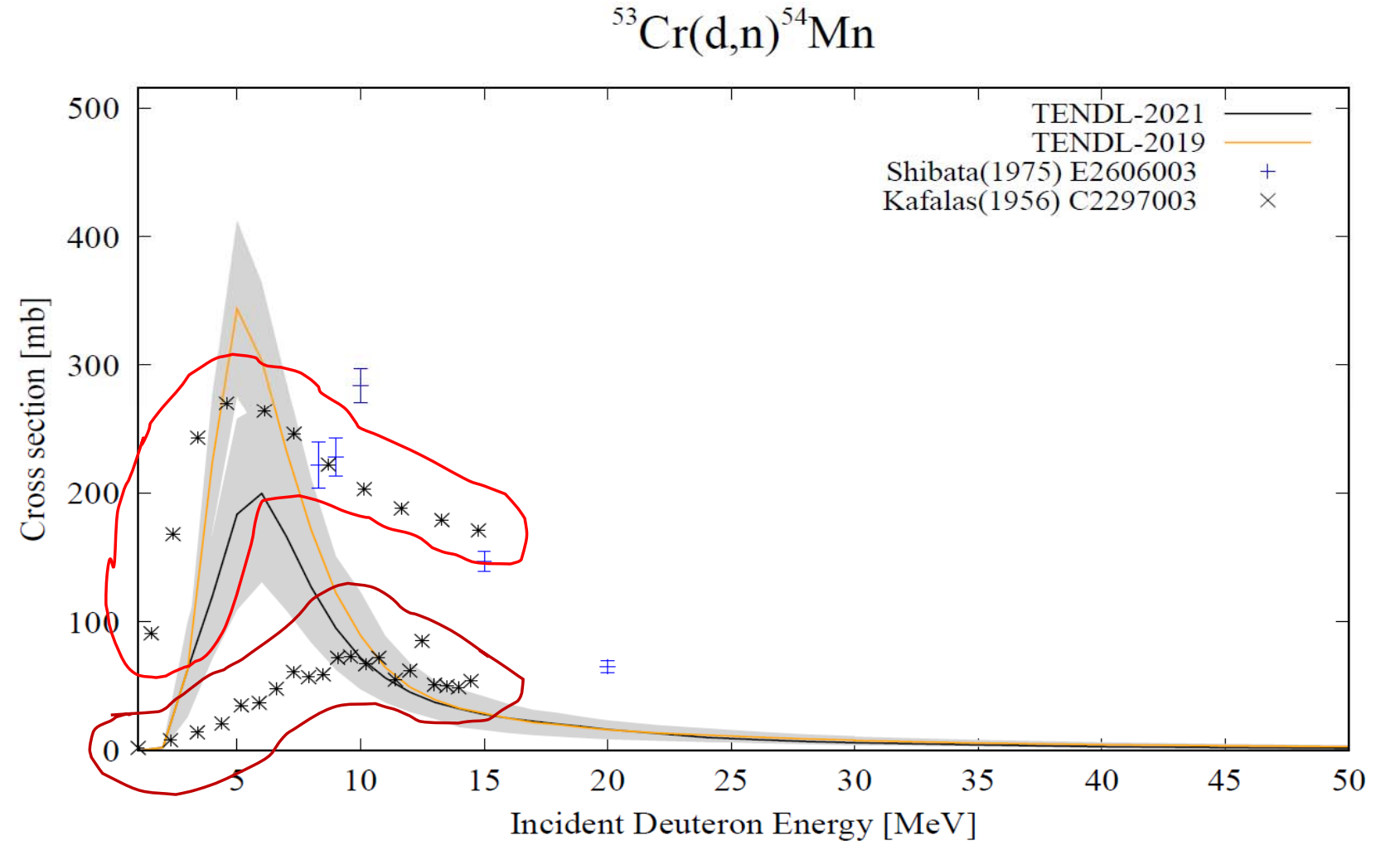
EN	EN-ERR	DATA 1	ERR-T 1	DATA 2	ERR-T 2	DATA 3	ERR-T 3	DATA 4	ERR-T 4	DATA 5	ERR-T 5
MEV	MEV	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB
2.9	0.73	15.6	6.3	16.5	3.5	12.0	2.5	18.9	19.0	16.2	4.0
3.91	0.57	53.7	11.8	60.1	12.6	47.2	9.9	54.5	13.1	45.6	11.5
4.02	0.56	72.7	15.8	86.1	18.1	61.5	12.9	71.8	17.2	54.7	12.5
4.12	0.54	105.5	23.4	115.6	25.3	98.0	20.5	110.3	27.1	77.8	21.0
4.98	0.46	131.5	28.4	139.9	29.3	119.7	25.0	138.3	32.3	119.3	26.6
5.68	0.41	255.6	56.5			267.4	55.9	196.9	45.8	337.3	79.5
6.17	0.39	204.5	44.4	220.7	46.3	179.7	37.6	208.5	49.0	206.1	48.1
6.97	0.35	174.1	37.9	189.2	39.6	160.0	33.5	181.1	44.0	142.3	31.8
7.13	0.34	235.3	49.2			235.3	49.2				
8.51	0.29	153.9	34.3	168.4	35.4	138.5	29.0	168.2	41.4	113.9	31.7
9.09	0.28	137.0	30.2	147.3	31.0	128.0	26.8	140.3	34.0	116.5	30.2
10.07	0.25	94.2	20.5	105.1	22.0	86.2	18.0	96.0	23.5	70.6	16.3
10.48	0.25	102.3	30.9	112.3	23.6	90.9	19.0	105.8	68.0	89.9	21.6
10.72	0.24	100.7	22.1	106.9	22.5	87.8	18.4	108.0	25.6	99.7	25.0
10.85	90.3	90.3	23.5			91.3	19.7			87.5	34.9
11.14	0.23	94.6	20.5	105.8	22.2	85.1	17.8	97.5	23.1	72.2	16.5
11.61	0.23	111.5	27.7			109.5	23.5			117.5	40.3
11.94	0.22	92.7	20.6	103.0	21.7	88.8	18.6	86.6	21.3	75.8	21.1
12.29	0.22	90.0	21.3			83.1	17.4			110.5	33.0
12.44	0.21	84.7	18.2	98.3	20.6	72.7	15.2	86.6	19.9	62.4	14.5
12.89	0.21	94.4	27.2			96.3	20.2			88.5	48.3
13.34	0.20	85.9	18.8	99.5	20.9	75.5	15.8	86.7	20.0	60.8	17.3

```
ENDDATA
ENDSUBENT           92
ENDENTRY
```

Table 4. Cross sections for the ^{50}Cr(d,n)^{51}Mn reaction. Data were obtained using 4 different methods.

E_d [MeV]	σ (^{50}Cr(d,n)^{51}Mn) [mb]				
	511 keV ND (40%)[a]	511 keV MDA (30%)[a]	320 keV DAU (20%)[a]	749 keV CP (10%)[a]	Weighted mean
2.90 ± 0.73	16.5 ± 3.5	12.0 ± 2.5	18.9 ± 19.0	16.2 ± 4.0	15.6 ± 6.3
3.91 ± 0.57	60.1 ± 12.6	47.2 ± 9.9	54.5 ± 13.1	45.6 ± 11.5	53.7 ± 11.8
4.02 ± 0.56	86.1 ± 18.1	61.5 ± 12.9	71.8 ± 17.2	54.7 ± 12.5	72.7 ± 15.8
4.12 ± 0.54	115.6 ± 25.3	98.0 ± 20.5	110.3 ± 27.1	77.8 ± 21.0	105.5 ± 23.4
4.98 ± 0.46	139.9 ± 29.3	119.7 ± 25.0	138.3 ± 32.3	119.3 ± 26.6	131.5 ± 28.4
5.68 ± 0.41		267.4 ± 55.9	196.9 ± 45.8	337.3 ± 79.5	255.6 ± 56.5
6.17 ± 0.39	220.7 ± 46.3	179.7 ± 37.6	208.5 ± 49.0	206.1 ± 48.1	204.5 ± 44.4
6.97 ± 0.35	189.2 ± 39.6	160.0 ± 33.5	181.1 ± 44.0	142.3 ± 31.8	174.1 ± 37.9
7.13 ± 0.34		235.3 ± 49.2			235.3 ± 49.2
8.51 ± 0.29	168.4 ± 35.4	138.5 ± 29.0	168.2 ± 41.4	113.9 ± 31.7	153.9 ± 34.3
9.09 ± 0.28	147.3 ± 31.0	128.0 ± 26.8	140.3 ± 34.0	116.5 ± 30.2	137.0 ± 30.2
10.07 ± 0.25	105.1 ± 22.0	86.2 ± 18.0	96.0 ± 23.5	70.6 ± 16.3	94.2 ± 20.5
10.48 ± 0.25	112.3 ± 23.6	90.9 ± 19.0	105.8 ± 68.0	89.9 ± 21.6	102.3 ± 30.9
10.72 ± 0.24	106.9 ± 22.5	87.8 ± 18.4	108.0 ± 25.6	99.7 ± 25.0	100.7 ± 22.1
10.85 ± 0.24		91.3 ± 19.7		87.5 ± 34.9	90.3 ± 23.5
11.14 ± 0.23	105.8 ± 22.2	85.1 ± 17.8	97.5 ± 23.1	72.2 ± 16.5	94.6 ± 20.5
11.61 ± 0.23		109.5 ± 23.5		117.5 ± 40.3	111.5 ± 27.7
11.94 ± 0.22	103.0 ± 21.7	88.8 ± 18.6	86.6 ± 21.3	75.8 ± 21.1	92.7 ± 20.6
12.29 ± 0.22		83.1 ± 17.4		110.5 ± 33.0	90.0 ± 21.3
12.44 ± 0.21	98.3 ± 20.6	72.7 ± 15.2	86.6 ± 19.9	62.4 ± 14.5	84.7 ± 18.2
12.89 ± 0.21		96.3 ± 20.2		88.5 ± 48.3	94.4 ± 27.2
13.34 ± 0.20	99.5 ± 20.9	75.5 ± 15.8	86.7 ± 20.0	60.8 ± 17.3	85.9 ± 18.8

a: Weighting factor [%]; for details see text.


^{53}Cr(d,n)^{54}Mn
TENDL-2021
TENDL-2019
Shibata(1975) E2606003
Kafalas(1956) C2297003
Cross section [mb]
Incident Deuteron Energy [MeV]
0
100
200
300
400
500
5
10
15
20
25
30
35
40
45
50

Points digitized from two data sets

```
SUBENT        C2297003   20180511   20181008   20180918        C175
BIB                 5          7
REACTION    (24-CR-53(D,N)25-MN-54,,SIG)
            # (24-CR-53(D,N)25-MN-54,,SIG)
            # Target:CR-53 #Projectile:D #Reaction:D,N  #Quantity:,SIG:CS:Cross section
            # Product: [25-MN-54]
ANALYSIS    This cs was obtained by subtracting the estimated
            contribution of Cr-54(d,2n) from total Mn-54
            production.
DECAY-DATA  (25-MN-54,290.0D)
            # Decay-data: [25-MN-54]
COMMENT     Continuous curve, points were added by the compiler.
STATUS      (CURVE) Fig. 2, page 704.
            # (CURVE) Data read from a curve
ENDBIB              7
NOCOMMON
DATA                2          32          12
            #Legend: 2 x 32 x 12 : data columns * lines * column width
              #EN    Energy of incident projectile, laboratory system   MEV   MeV
              #DATA  Cross section                                      B     barns
                     #+ 24-CR-53(D,N)25-MN-54,,SIG
            #/Legend
EN          DATA
MEV         B
1.002       0.002
1.525       0.091
2.310       0.008
2.411       0.168
3.395       0.014
3.409       0.243
4.396       0.021
4.576       0.270
5.175       0.035
5.898       0.037
6.107       0.264
6.594       0.048
7.289       0.061
7.305       0.246
7.901       0.057
8.486       0.059
8.698       0.222
9.069       0.072
9.598       0.073
10.147      0.203
10.211      0.067
10.739      0.072
11.408      0.055
11.651      0.188
11.992      0.062
12.492      0.085
12.995      0.051
13.293      0.179
13.496      0.050
13.969      0.049
14.470      0.054
14.769      0.171
ENDDATA
ENDSUBENT          46
ENDENTRY
```

The data points of REACTION 50Cr(d,a)48V were also included in this reaction.

```
SUBENT        C2297005   20180511   20181008   20180918        C175
BIB                 3          3
REACTION    (24-CR-50(D,A)23-V-48,,SIG)
            # (24-CR-50(D,A)23-V-48,,SIG)
            # Target:CR-50 #Projectile:D #Reaction:D,A  #Quantity:,SIG:CS:Cross section
            # Product: [23-V-48]
DECAY-DATA  (23-V-48,15.99D)
            # Decay-data: [23-V-48]
STATUS      (CURVE) Fig. 2, page 704.
            # (CURVE) Data read from a curve
ENDBIB              3
NOCOMMON
DATA                2          21          12
            #Legend: 2 x 21 x 12 : data columns * lines * column width
              #EN    Energy of incident projectile, laboratory system   MEV   MeV
              #DATA  Cross section                                      B     barns
                     #+ 24-CR-50(D,A)23-V-48,,SIG
            #/Legend
EN          DATA
MEV         B
1.002       0.002
2.310       0.008
3.395       0.014
4.396       0.021
5.175       0.035
5.898       0.037
6.594       0.048
7.289       0.061
7.901       0.057
8.486       0.059
9.069       0.072
9.598       0.073
10.211      0.067
10.739      0.072
11.408      0.055
11.992      0.062
12.492      0.085
12.995      0.051
13.496      0.050
13.969      0.049
14.470      0.054
ENDDATA
ENDSUBENT          3
ENDENTRY
```

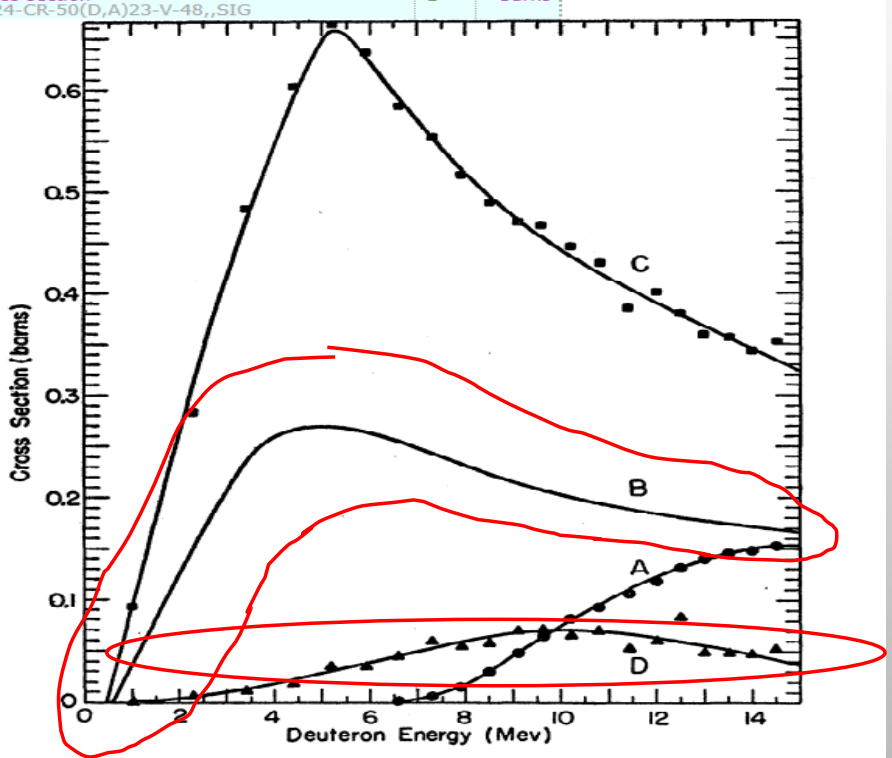


FIG. 2. Excitations functions for deuterons on chromium. A—$Cr^{52}(d,2n)Mn^{52}$; B—$Cr^{53}(d,n)Mn^{54}$; C—$\Sigma(\sigma)$ for (d,p) and $(d,n)\xrightarrow{\beta}$ for Cr^{51} formation; neglecting the (d,t) contribution above 6.3 Mev; D—$Cr^{50}(d,\alpha)V^{48}$.

Page generated: 2022-05-25,13:32:01 by X4sGetSubent on localhost [fwd:www-nds.iaea.org]
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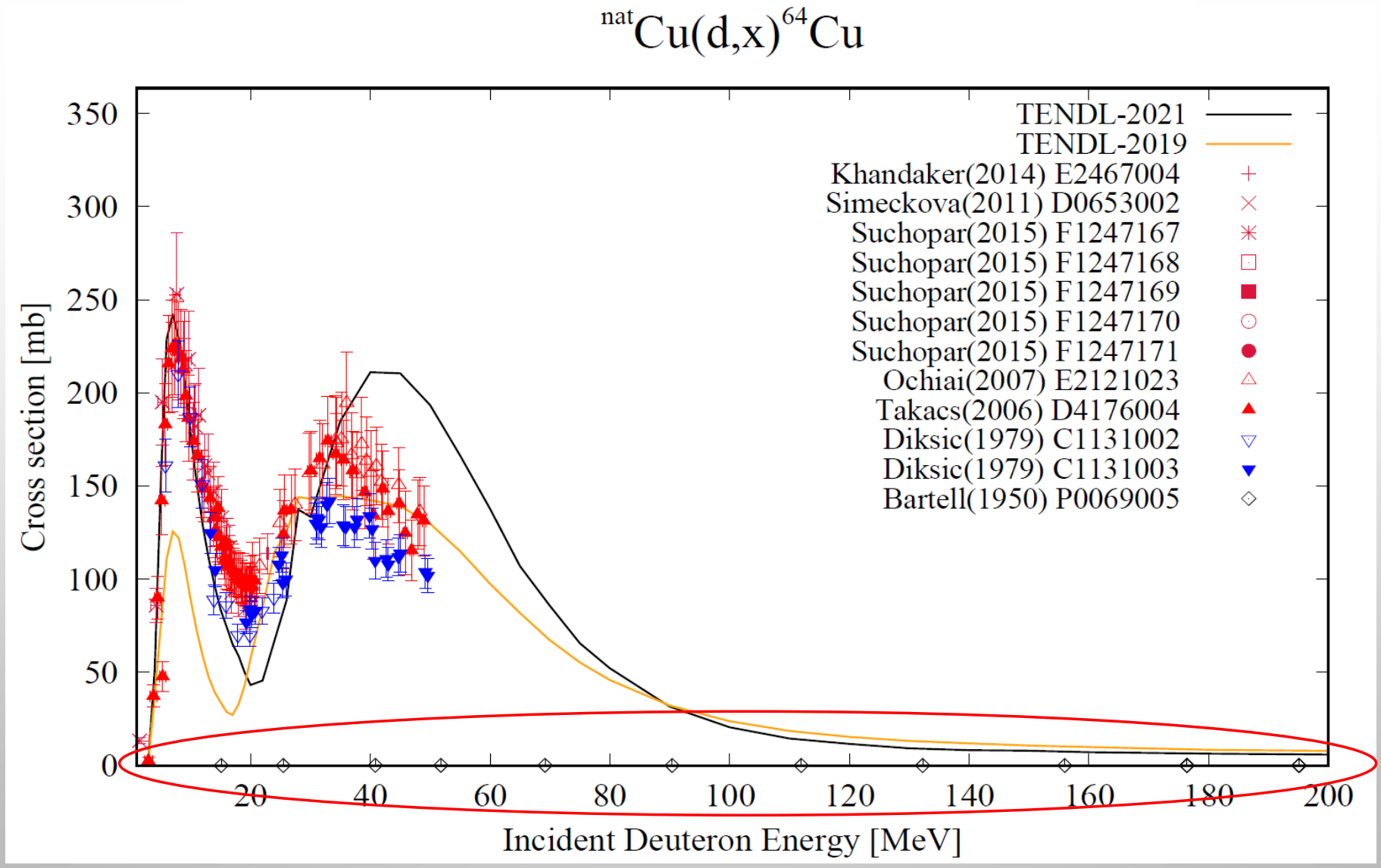
Request from: 0:0:0:0:0:0:0:1 [fwd:161.5.6.190]


$^{nat}Cu(d,x)^{64}Cu$
Cross section [mb]
Incident Deuteron Energy [MeV]
0
50
100
150
200
250
300
350
20
40
60
80
100
120
140
160
180
200
TENDL-2021
TENDL-2019
Khandaker(2014) E2467004
Simeckova(2011) D0653002
Suchopar(2015) F1247167
Suchopar(2015) F1247168
Suchopar(2015) F1247169
Suchopar(2015) F1247170
Suchopar(2015) F1247171
Ochiai(2007) E2121023
Takacs(2006) D4176004
Diksic(1979) C1131002
Diksic(1979) C1131003
Bartell(1950) P0069005

Digitized from wrong y-scale

```
SUBENT        P0069005    20181113    20190401    20190326        C182
BIB                  3           3
REACTION    (29-CU-0(D,X)29-CU-64,,SIG)
            # (29-CU-0(D,X)29-CU-64,,SIG)
            # Target:CU-0 #Projectile:D #Reaction:D,X  #Process:X:Process unspecified  #Quantity:,SIG:CS:Cross section
            # Product: [29-CU-64]
STATUS      (CURVE) Fig.2, page 1007.
            # (CURVE) Data read from a curve
HISTORY     (20181113A) BP: Digitized Fig. 2 and replaced the data.
ENDBIB               3
NOCOMMON
DATA                 2          15          12
            #Legend: 2 x 15 x 12 : data columns * lines * column width
```

#EN	Energy of incident projectile, laboratory system	MEV	MeV
#DATA	Cross section #+ 29-CU-0(D,X)29-CU-64,,SIG	MB	millibarns

```
            #/Legend
EN          DATA
MEV         MB
15.089      0.020
25.469      0.048
40.836      0.115
51.771      0.079
69.163      0.070
90.396      0.045
111.970     0.046
132.251     0.048
155.963     0.040
176.385     0.028
176.385     0.028
176.385     0.028
195.080     0.018
195.080     0.018
195.080     0.018
ENDDATA
ENDSUBENT           25
ENDENTRY
```

The data is about 1000 times too low (unit problem). Data wrongly digitized with respect to y-axis on the left side rather than the y-axis of the right side?

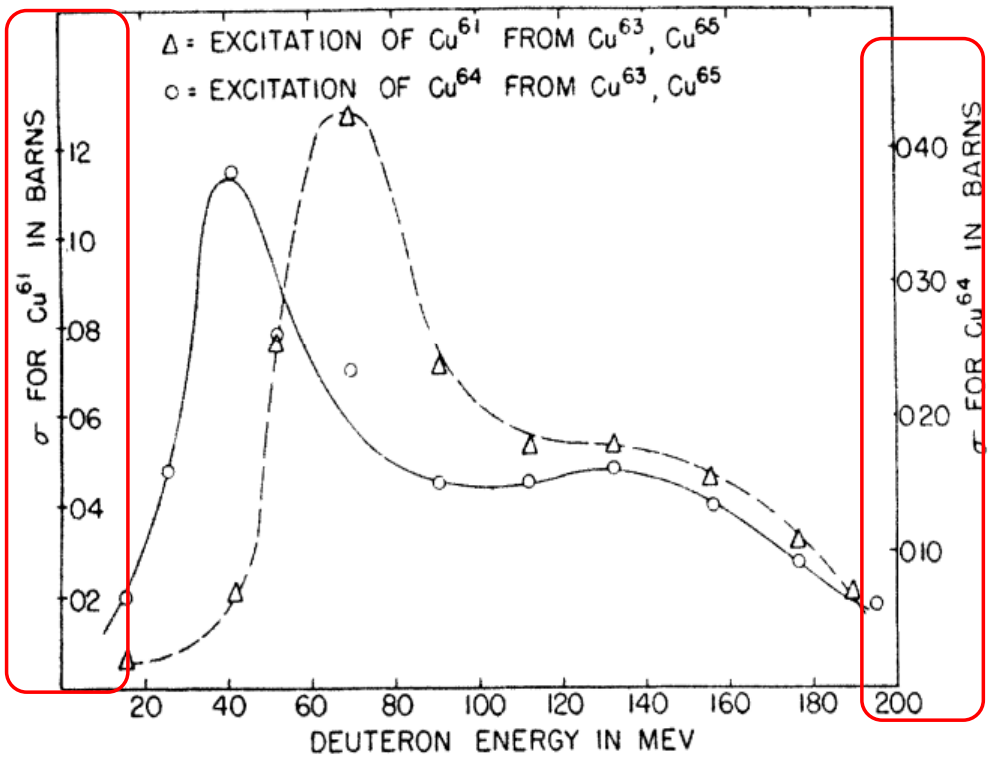
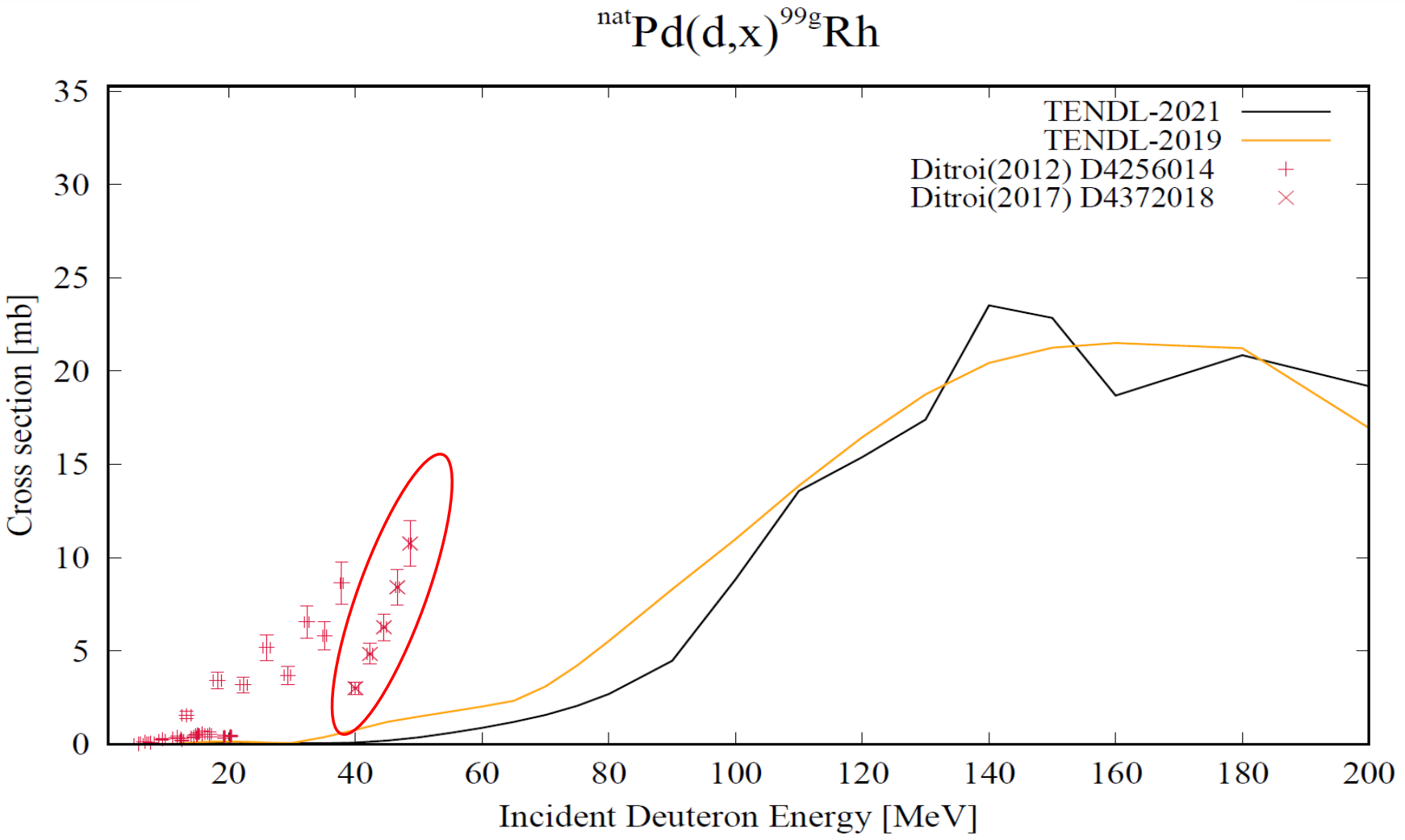


FIG. 2. Excitation function of Cu^{64} and Cu^{61}.


$^{nat}Pd(d,x)^{99g}Rh$
TENDL-2021
TENDL-2019
Ditroi(2012) D4256014
Ditroi(2017) D4372018
Cross section [mb]
Incident Deuteron Energy [MeV]
0
5
10
15
20
25
30
35
20
40
60
80
100
120
140
160
180
200

Data set of another subentry wrongly repeated

```
ENDBIB              51
COMMON               3          1          12
```
#Legend: 3 x 1 x 12 : data columns * lines * column width

#ERR-1	1st partial uncertainty, defined under ERR-ANALYS	PER-CENT	per-
#ERR-2	2nd partial uncertainty, defined under ERR-ANALYS	PER-CENT	per-
#ERR-3	3rd partial uncertainty, defined under ERR-ANALYS	PER-CENT	per-

#/Legend

```
ERR-1       ERR-2       ERR-3
PER-CENT    PER-CENT    PER-CENT
3.          5.          7.
ENDCOMMON
ENDSUBENT           58
SUBENT        D4372018    20171127    20180316    20180313        D113
BIB                  3           6
REACTION    (46-PD-0(D,X)45-RH-99-G,CUM,SIG)
```
(46-PD-0(D,X)45-RH-99-G,CUM,SIG)
Target:PD-0 #Projectile:D #Reaction:D,X #Process:X:Process unspecified #Quantity
Product: [45-RH-99]
```
DECAY-DATA  (45-RH-99-G,16.1D,DG,89.76,0.334,
                         DG,353.05,0.346,
                         DG,528.74,0.38)
```
Decay-data: [45-RH-99]
```
STATUS      (TABLE)Data were taken from Table2 of the original
            publication.
```
(TABLE) Data presented by authors
```
ENDBIB               6
NOCOMMON
DATA                 4          5          12
```
#Legend: 4 x 5 x 12 : data columns * lines * column width

#EN	Energy of incident projectile, laboratory system	MEV	MeV
#EN-ERR	Uncertainty in incident projectile energy	MEV	MeV
#DATA	Cumulative cross section #+ 46-PD-0(D,X)45-RH-99-G,CUM,SIG	MB	millibarns
#ERR-T	Total uncertainty (1-Sigma)	MB	millibarns

#/Legend

EN	EN-ERR	DATA	ERR-T
MEV	MEV	MB	MB
48.63	0.20	10.75	1.22
46.59	0.29	8.40	0.95
44.48	0.39	6.26	0.71
42.28	0.49	4.83	0.55
40.00	0.59	2.99	0.35

```
ENDDATA
ENDSUBENT           18
```

```
SUBENT        D4372019    20171127    20180316    20180313        D113
BIB                  3           6
REACTION    (46-PD-0(D,X)45-RH-99-M,CUM,SIG)
```
(46-PD-0(D,X)45-RH-99-M,CUM,SIG)
Target:PD-0 #Projectile:D #Reaction:D,X #Process:X:Process unspecified #Quantity:CUM,SIG:(
Product: [45-RH-99]
```
DECAY-DATA  (45-RH-99-M,4.7HR,DG,340.8,0.69,
                         DG,617.8,0.118,
                         DG,1261.2,0.109)
```
Decay-data: [45-RH-99]
```
STATUS      (TABLE)Data were taken from Table2 of the original
            publication.
```
(TABLE) Data presented by authors
```
ENDBIB               6
NOCOMMON
DATA                 4          7          12
```
#Legend: 4 x 7 x 12 : data columns * lines * column width

#EN	Energy of incident projectile, laboratory system	MEV	MeV
#EN-ERR	Uncertainty in incident projectile energy	MEV	MeV
#DATA	Cumulative cross section #+ 46-PD-0(D,X)45-RH-99-M,CUM,SIG	MB	millibarns
#ERR-T	Total uncertainty (1-Sigma)	MB	millibarns

#/Legend

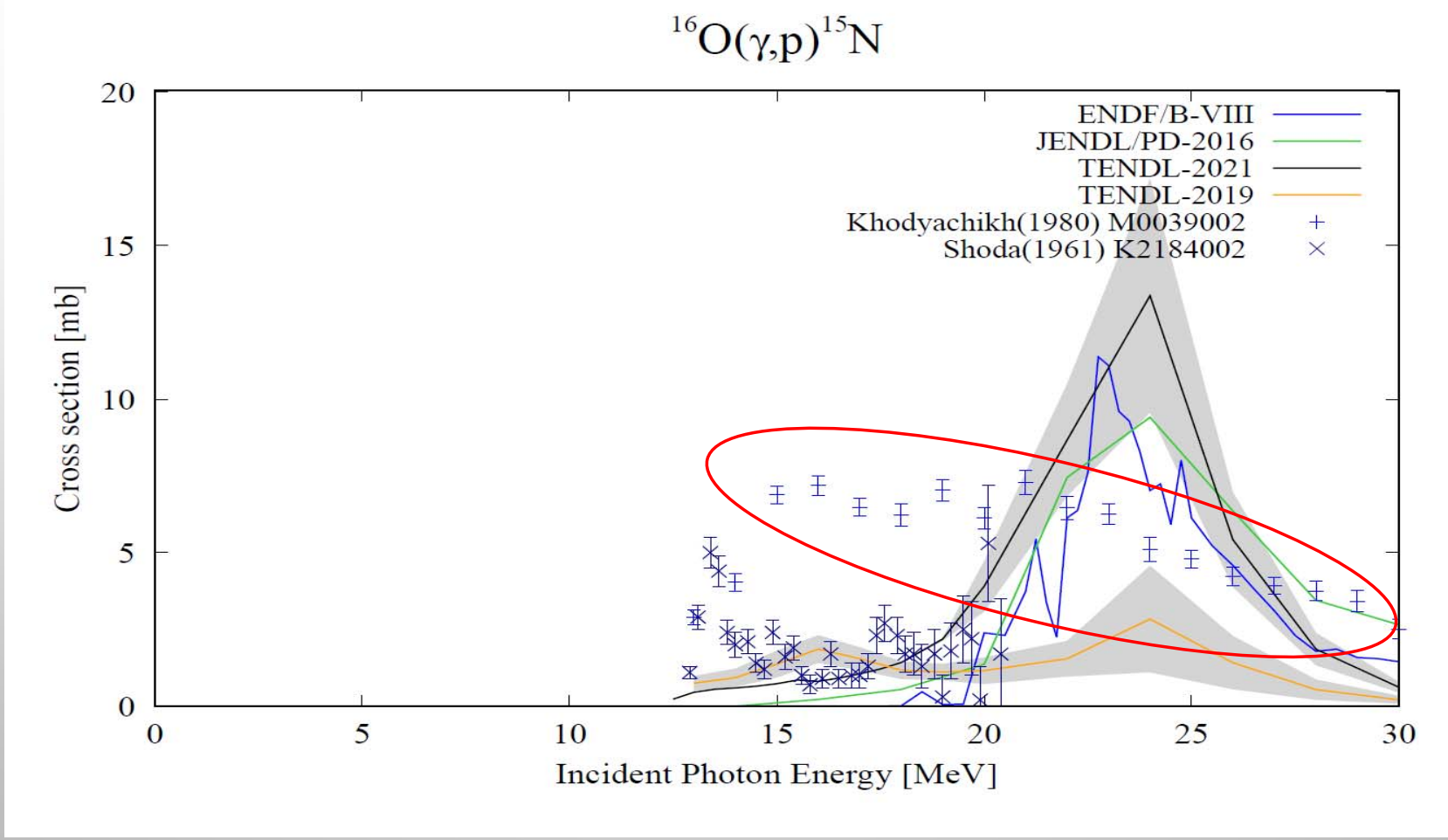
EN	EN-ERR	DATA	ERR-T	^{102g}Rh		^{101m}Rh	
MEV	MEV	MB	MB				
48.63	0.20	10.75	1.22	48.63	0.2	43.00	4.83
46.59	0.29	8.40	0.95	46.59	0.29	10.55	5.58	37.28	4.19
44.48	0.39	6.26	0.71	44.48	0.39	30.27	3.40
42.28	0.49	4.83	0.55	42.28	0.49	8.76	3.35	27.97	3.15
40.00	0.59	2.99	0.35	40.00	0.59	24.97	2.81
37.61	0.70	1.56	0.19	37.61	0.70	11.35	1.97	23.01	2.58
35.11	0.81	0.70	0.10	35.11	0.81	8.93	2.25	21.74	2.44
				33.30	0.89	10.21	3.90	20.67	2.33
				31.43	0.97	10.08	4.07	20.13	2.26

```
ENDDATA
ENDSUBENT           20
ENDENTRY
```

		^{99m}Rh		^{99g}Rh	
48.63	0.2	10.75	1.22	3.06	0.42
46.59	0.29	8.40	0.95	2.96	0.46
44.48	0.39	6.26	0.71	2.14	0.36
42.28	0.49	4.83	0.55	1.46	0.31
40.00	0.59	2.99	0.35	0.85	0.27
37.61	0.70	1.56	0.19		
35.11	0.81	0.70	0.10		

Pd(d,x)99mRh cross sections compiled in D4372.019 are repeated in D4372.018 as the Pd(d,x)99gRh cross sections.

Gamma induced reactions



Not clear which one must be compiled

```
ENDBIB                 22
NOCOMMON
ENDSUBENT              25
SUBENT        M0039002    20130524    20130823    20130819        M067
BIB                     3           3
REACTION    (8-O-16(G,P)7-N-15,,SIG)
            # (8-O-16(G,P)7-N-15,,SIG)
            # Target:O-16 #Projectile:G #Reaction:G,P  #Quantity:,SIG:CS:Cross section
            # Product: [7-N-15]
STATUS      Data from Fig. 1.
HISTORY     (20130524A) BRA removed.
ENDBIB                  3
NOCOMMON
DATA                    3          43          12
             #Legend: 3 x 43 x 12 : data columns * lines * column width
```

#EN	Energy of incident projectile, laboratory system	MEV	MeV
#DATA	Cross section #+ 8-O-16(G,P)7-N-15,,SIG	MB	millibarns
#ERR-S	Statistical uncertainty (1-Sigma)	MB	millibarns

```
             #/Legend
EN          DATA        ERR-S
MEV         MB          MB
13.00       2.90        0.25
14.00       4.04        0.29
15.00       6.88        0.28
16.00       7.18        0.32
17.00       6.47        0.29
18.00       6.22        0.36
19.00       7.03        0.36
20.00       6.12        0.35
21.00       7.28        0.40
22.00       6.46        0.37
23.00       6.26        0.33
24.00       5.11        0.39
25.00       4.79        0.30
26.00       4.22        0.31
27.00       3.91        0.27
28.00       3.75        0.31
29.00       3.42        0.35
30.00       2.51        0.31
31.00       2.93        0.28
32.00       2.57        0.31
33.00       2.29        0.31
34.00       2.09        0.28
35.00       1.99        0.28
36.00       1.41        0.27
37.00       1.00        0.25
39.00       0.83        0.21
41.00       1.03        0.13
43.00       0.83        0.12
45.00       0.88        0.12
47.00       0.63        0.10
49.00       0.70        0.09
51.00       0.53        0.10
53.00       0.66        0.10
55.00       0.57        0.10
57.00       0.33        0.10
60.00       0.44        0.07
66.00       0.27        0.04
70.00       0.29        0.05
75.00       0.18        0.06
84.00       0.20        0.07
93.00       0.12        0.04
103.00      0.10        0.03
113.00      0.08        0.03
ENDDATA
ENDSUBENT              53
```

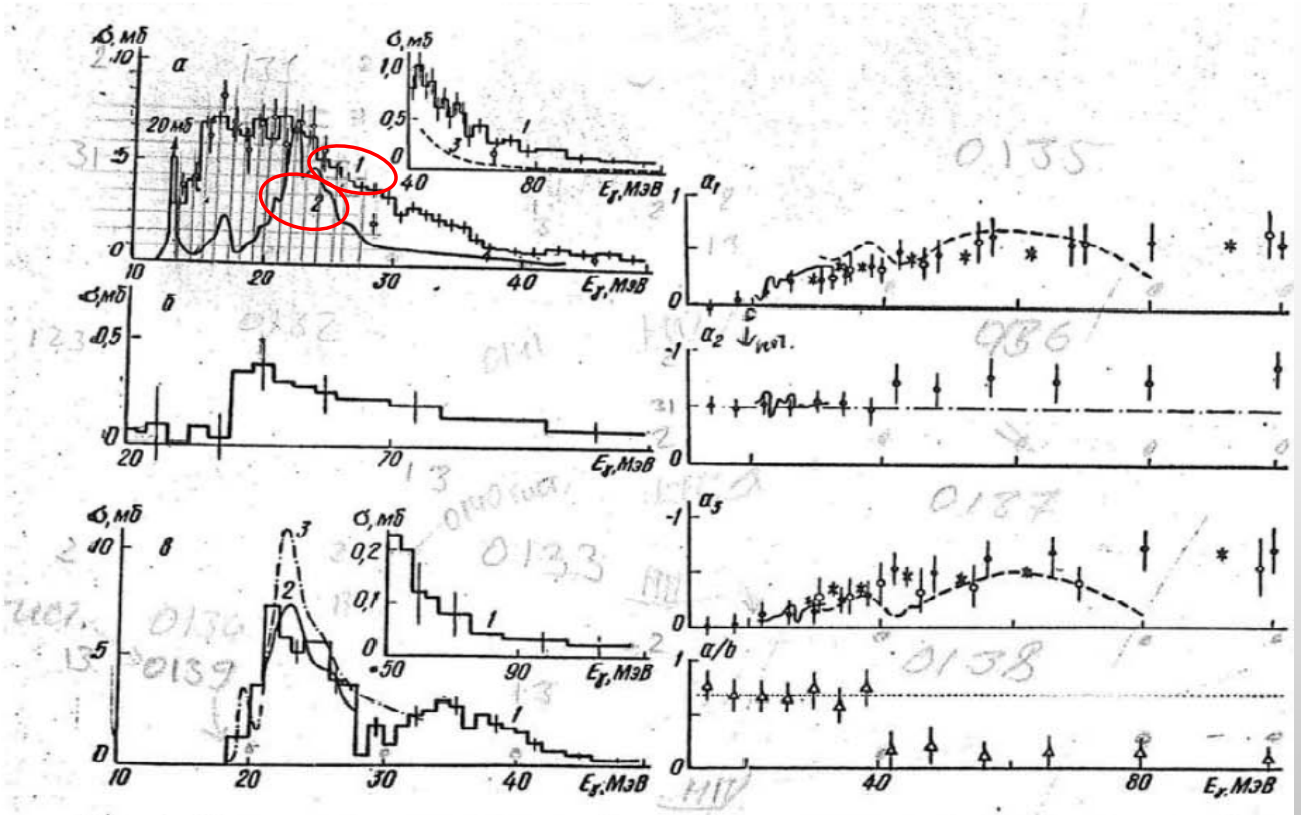


Рис. 1. Зависимость полных сечений от $E\gamma$: *а* — реакция $^{16}O(\gamma, p)^{15}N$ (*1* — наши данные, ○ — [8], *2* — [2], *3* — [9]), *б* — фотообразование состояния $1/2^+$, *в* — фотообразование состояния $3/2^-$ (*1* — наши данные, *2* — [13], *3* — [4]).

Рис. 2. Зависимость коэффициентов угловых распределений от $E\gamma$: ●, △ — наши данные, × — ^4He [10], ○ — ^{12}C [10], сплошные — [1], штриховые — [18].

Additional comments

```
SUBENT      L0064004   20050419   20050707   20050926        L007
BIB                 5          7
REACTION    (8-O-16(G,ABS),,SIG)
            # (8-O-16(G,ABS),,SIG)
            # Target:O-16 #Projectile:G #Reaction:G,ABS  #Process:ABS:Absorption  #Quantity:,SIG:CS:Cross sectio
SAMPLE      150 cm long thermostated copper tube filled with
             water
ERR-ANALYS  (ERR-S) No information.
STATUS      (CURVE) Data taken from Fig 3.
            # (CURVE) Data read from a curve
FLAG        (1.) 149.0 g/cm2
            (2.)  99.8 g/cm2
ENDBIB                7
COMMON                1          1          12
             #Legend: 1 x 1 x 12 : data columns * lines * column width
               #ERR-SYS    Total systematic uncertainty   MB   millibarns
             #/Legend
ERR-SYS
MB
1.0
ENDCOMMON
DATA                  4         82          12
             #Legend: 4 x 82 x 12 : data columns * lines * column width
               #EN      Energy of incident projectile, laboratory system   MEV   MeV
               #DATA    Cross section                                      MB    millibarns
                        #+ 8-O-16(G,ABS),,SIG
               #ERR-S   Statistical uncertainty (1-Sigma)                  MB    millibarns
               #FLAG    Flag, defined under FLAG.                          NO-DIM  no Dimensions
             #/Legend
EN          DATA        ERR-S       FLAG
MEV         MB          MB          NO-DIM
1.29e+01    7.63e-01    1.70e+00    2.
1.35e+01    3.28e+00    1.85e+00    2.
1.39e+01    7.08e-01    1.90e+00    1.
1.42e+01    8.61e-01    1.80e+00    2.
1.44e+01   -3.10e+00    1.49e+00    1.
1.48e+01   -1.97e+00    2.01e+00    2.
1.48e+01    1.22e+00    1.70e+00    1.
1.50e+01    1.99e+00    1.90e+00    2.
1.51e+01   -3.31e+00    1.39e+00    1.
1.54e+01   -3.79e-01    1.54e+00    1.
1.57e+01   -6.89e-01    1.18e+00    1.
1.58e+01   -3.88e+00    1.80e+00    2.
1.59e+01    3.92e-01    1.59e+00    1.
1.61e+01   -1.36e+00    1.39e+00    1.
1.62e+01    3.32e+00    1.85e+00    2.
1.64e+01    2.87e-01    1.18e+00    1.
1.66e+01   -1.15e+00    2.31e+00    1.
1.69e+01    1.62e+00    1.08e+00    1.
1.71e+01    5.38e+00    1.90e+00    2.
1.75e+01   -1.80e-01    1.18e+00    1.
1.78e+01    2.30e-01    1.08e+00    1.
1.79e+01   -9.55e-01    1.54e+00    1.
1.81e+01   -4.40e-01    1.13e+00    2.
1.85e+01    2.34e+00    9.79e-01    1.
1.86e+01    3.47e+00    1.70e+00    2.
1.89e+01    2.18e+00    1.54e+00    2.
1.91e+01    4.19e+00    1.70e+00    2.
1.93e+01    4.50e+00    1.13e+00    2.
1.98e+01    4.29e+00    1.03e+00    2.
2.02e+01    5.06e+00    1.54e+00    2.
```

Choice from TOT or ABS

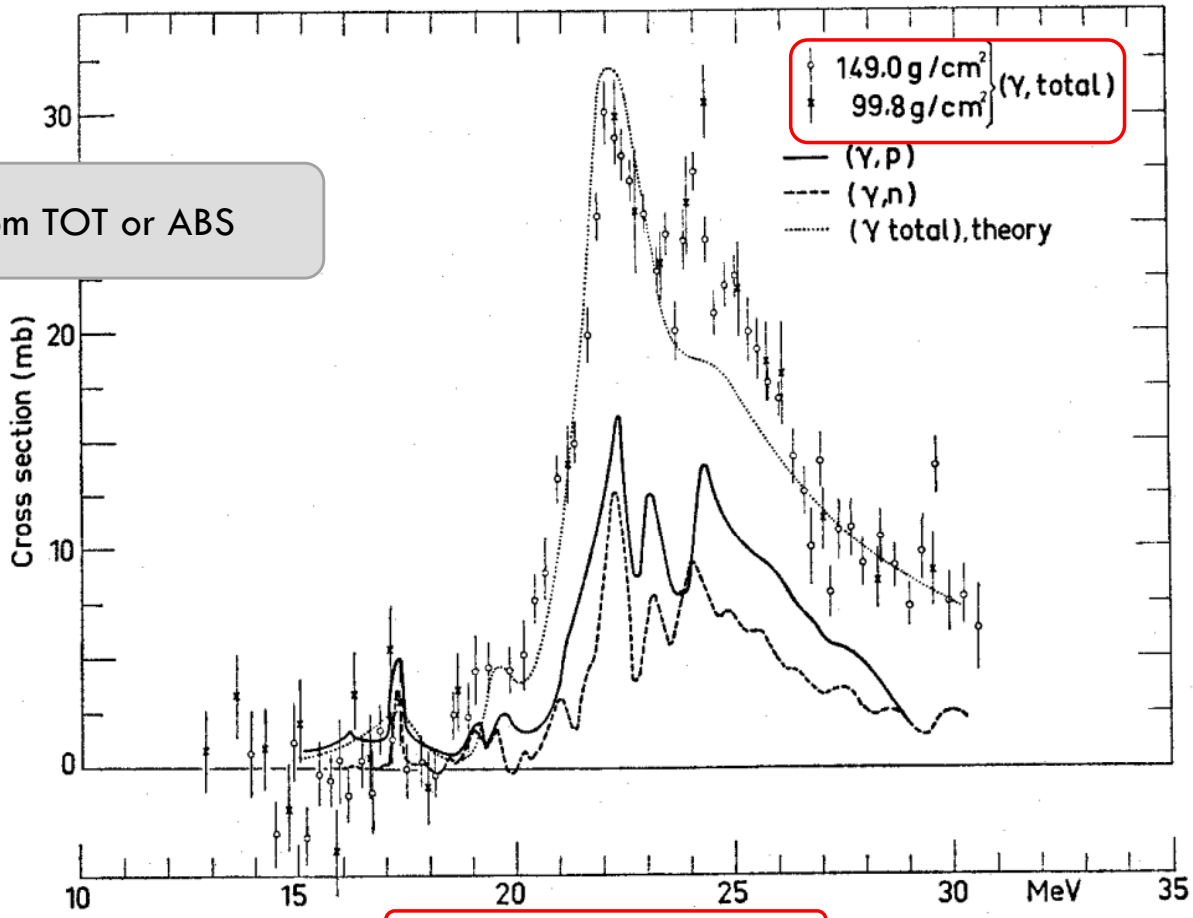


Fig. 3. The nuclear part of the photo-absorption cross section for ^{16}O compared to the theory [24] and to the (γ, n) and (γ, p) cross sections [22, 23]. An estimated error of the zero line position is ± 1.0 mb.

Cross-section in ub/A (normalized to the mass number). Should compiler multiply with mass number to compile the cross-section values in mb?

```
SUBENT        M0590002   20190626   20190821   20190821        M101
BIB                 5          8
REACTION    (3-LI-0(G,ABS),,SIG)
            # (3-LI-0(G,ABS),,SIG)
            # Target:LI-0 #Projectile:G #Reaction:G,ABS  #Process:ABS:Absorption  #Quantity:,SIG:CS:Cross section
SAMPLE      Solid target in form of circular disk, 3 cm in diam.
             and thickness 1.996 (0.029) g/cm**2.
COMMENT     The data from the table II multiplied to mass number
             A = 7.
STATUS      (TABLE) Data from Table II of Phys.Rev.,C54(1996)1688.
            # (TABLE) Data presented by authors
HISTORY     (20190626U) Corrected by SD and VV: STATUS, DATA-ERR
             -> ERR-S.
ENDBIB              8
NOCOMMON
DATA                3         26         12
             #Legend: 3 x 26 x 12 : data columns * lines * column width
```

#EN	Energy of incident projectile, laboratory system	MEV	MeV
#DATA	Cross section #+ 3-LI-0(G,ABS),,SIG	MB	millibarns
#ERR-S	Statistical uncertainty (1-Sigma)	MB	millibarns

```
             #/Legend
EN          DATA        ERR-S
MEV         MB          MB
343.        3.080       .105
369.        2.723       .070
389.        2.457       .084
408.        2.268       .091
439.        1.974       .063
465.        1.799       .091
490.        1.708       .084
514.        1.561       .084
540.        1.358       .049
598.        1.554       .077
616.        1.477       .042
636.        1.372       .042
664.        1.491       .049
684.        1.435       .049
717.        1.442       .056
751.        1.358       .063
788.        1.162       .049
817.        1.260       .063
840.        1.358       .056
908.        1.183       .056
936.        .959        .049
973.        1.197       .056
1044.       1.015       .063
1081.       1.155       .070
1119.       1.029       .056
1163.       .980        .084
ENDDATA
ENDSUBENT          41
ENDENTRY
```

TABLE II. Total cross-section values normalized to the mass number A for the studied nuclei. Also indicated are the statistical errors. The average is computed weighting each nucleus cross-section datum with its statistical error.

k (GeV)	^{7}Li (μb/A)	C (μb/A)	Al (μb/A)	Cu (μb/A)	Sn (μb/A)	Pb (μb/A)	Average (μb/A)
0.301		420±10	397±13	375±16	398±19	387±21	401.5±6.5
0.317		430±7	412±9	430±12	419±14	381±15	419.5±4.6
0.343	440±15	432±6	416±8	403±10	417±11	415±12	421.2±3.6
0.369	389±10	406±6	414±8	413±13	413±10	410±12	407.1±3.6
0.389	351±12	393±6	376±8	376±8	399±11	389±10	383.6±3.4
0.408	324±13	362±7	353±9	358±12	378±13	329±14	354.7±4.1
0.439	282±9	324±6	323±7	317±9	328±10	337±15	317.8±3.3
0.465	257±13	287±5	288±7	294±9	322±10	319±12	292.0±3.2
0.490	244±12	251±5	255±7	252±8	250±9	257±11	251.6±3.2
0.514	223±12	254±4	251±5	247±6	241±8	273±9	250.9±2.5
0.540	194±7	235±3	243±4	236±5	245±6	249±7	235.7±2.0
0.568		216±6	222±7	219±9	228±11	240±13	221.1±3.6
0.598	222±11	218±6	227±7	212±9	222±10	210±12	218.8±3.4
0.616	211±6	200±5	202±6	197±8	210±9	197±8	202.6±2.7
0.636	196±6	210±4	211±5	201±6	203±7	192±8	204.2±2.3
0.664	213±7	207±4	213±5	198±7	207±7	191±7	206.4±2.2
0.684	205±7	190±6	201±8	192±7	181±10	174±9	192.4±3.0
0.717	206±8	185±5	201±6	186±7	171±9	173±9	188.4±2.7
0.751	194±9	181±7	190±9	175±10	207±9	159±12	186.0±3.6
0.768		195±5	191±6	179±8	178±13	187±12	189.8±3.2
0.788	166±7	184±7	183±9	174±12	173±13	173±12	176.3±3.6
0.817	180±9	183±7	185±9	163±12	187±14	178±12	180.3±3.9
0.840	194±8	187±5	178±6	179±8	180±10	182±11	183.7±3.0

Should compiler convert a excitation function in arbitrary unit to the absolute one when the authors report the absolute value at one energy ?.

```
SUBENT        D0076006    20040217    20040331    20050926        0000
BIB                  2           2
REACTION    (28-NI-58(D,T)28-NI-57,,SIG)
            # (28-NI-58(D,T)28-NI-57,,SIG)
            # Target:NI-58 #Projectile:D #Reaction:D,T  #Quantity:,SIG:CS:Cross section
            # Product: [28-NI-57]
FLAG        (1.) The value from the table 1
ENDBIB                 2
COMMON                 1           1          12
             #Legend: 1 x 1 x 12 : data columns * lines * column width
             #ERR-DIG    Digitizing error (of DATA)   MB   millibarns
             #/Legend
ERR-DIG
MB
0.05
ENDCOMMON
DATA                   4          20          12
             #Legend: 4 x 20 x 12 : data columns * lines * column width
             #EN         Energy of incident projectile, laboratory system   MEV   MeV
             #DATA       Cross section                                      MB    millibarns
                         #+ 28-NI-58(D,T)28-NI-57,,SIG
             #DATA-ERR   Error in value of quantity, defined under ERR-ANALYS  MB    millibarns
             #FLAG       Flag, defined under FLAG.                          NO-DIM  no Dimensions
             #/Legend
EN          DATA        DATA-ERR    FLAG
MEV         MB          MB          NO-DIM
5.9414      1.1258      0.24476
6.3870      1.4887      0.21404
6.7980      4.0855      0.24476
7.1805      4.7856      0.18357
7.5642      6.2200      0.52023
7.9194      5.7577      0.36702
8.2878      5.5401      0.30583
8.6476      7.9232      0.24488
9.0051      8.8683      0.24476
9.3118      9.8445      0.24476
9.6339      12.473      0.33654
9.9767      12.194      0.33666
10.273      14.364      0.33666
10.592      15.125      0.27535
10.863      17.571      0.21416
11.169      18.700      0.42821
11.453      20.839      0.24476
11.720      21.050      0.36714
12.         24.         5.          1.0
12.030      24.046      0.15297
ENDDATA
ENDSUBENT            33
ENDENTRY
```

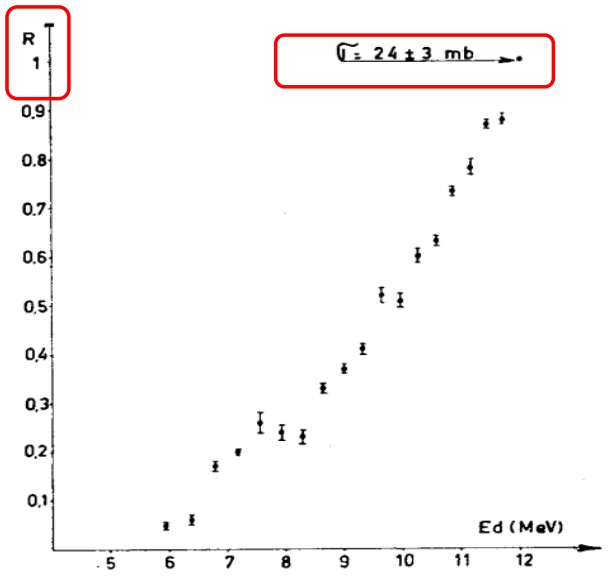


Fig. 8. Excitation function for the $^{58}Ni(d, t)^{57}Ni$ reaction.

Conclusion

- The main issue in many entries is in the REACTION code
- Wrong unit selection is also evident in many entries.
- Inclusion of data points belonging to another subentry.
- In some entries (mostly old), cross section values were compiled after mathematical operations. We now avoid performing such mathematical operations on any data provided by the author in the article. In such type of data, the respective centre should take the responsibility to correct that data.

Future Plan

- This review will be continued for the h, p and t induced reactions.
- We will also prepare a correction list and upload it in the feedback list for the correction.

ACKNOWLEDGEMENT

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THANK YOU

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