Development of experimental database of isomeric ratios

Alberto Rodrigo Sáenz de Santa María

Contents

1. MOTIVATION

- Improper interpretation of cross section measured with the g.s. activity

$$\sigma_{eff} = \sigma_g + I\,L\,\sigma_m = \frac{(\sigma_g + I\,\sigma_m)\,(1 - R + I\,L\,R)}{1 - R + I\,R} = (\sigma_g + I\,\sigma_m)\,D$$

$$\Rightarrow \quad D = \frac{1 - R + I\,L\,R}{1 - R + I\,R}$$

$$\sigma_{eff} \sim \sigma_g + I\,\sigma_m \qquad \text{When } T_{1/2}(\text{m.s.}) << T_{1/2}(\text{g.s.})$$

- D ~ 1 when approximation is reasonable
- D > 1 when σ_{eff} overestimates $\sigma_g + I\,\sigma_m$
- To evaluate D, we need:

  I ≡ Isomeric transition probability

  L ≡ Cumulative factor

  R ≡ Isomeric ratio

$$L = \frac{\lambda_m}{\lambda_m + \lambda_g}$$

$$R = \frac{\sigma_m}{\sigma_m + \sigma_g}$$

1. MOTIVATION

- Improper interpretation of cross section measured with the g.s. activity
- Tool for isomeric ratio calculation

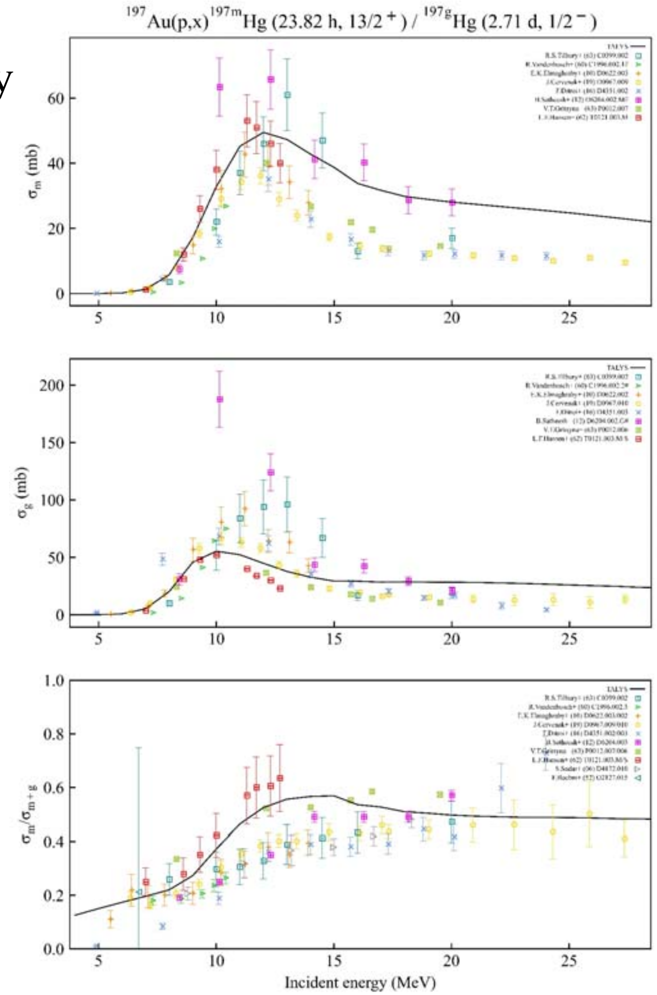
```
#S.Sothras (77)
#10835.017.2   60-ND-142(N,2N)60-ND-141-M,,SIG
#10835.017.1   60-ND-142(N,2N)60-ND-141-G,,SIG
# PROJ.   TARG.  PROD.  ISO.1  ISO.2    DATA1-ID    DATA2-ID         EN      DATA1  DATA1-ERR      DATA2  DATA2-ERR          I          L        M/T    M/T-ERR          D
#----><----->o<----><----><----><-------->.o<-------->.o<---------><---------><---------><---------><---------><---------><---------><---------><---------><--------->
      1  60142   60141      M      G 10835.017.2 10835.017.1 1.4800E+07 5.9300E-01 4.7000E-02 1.2810E+00 1.2500E-01 1.0000E+00 1.0070E+00 3.1644E-01 2.7192E-02 1.0022E+00

#S.Sothras (77)
#10835.024.2   78-PT-198(N,2N)78-PT-197-M,,SIG
#10835.024.1   78-PT-198(N,2N)78-PT-197-G,,SIG
# PROJ.   TARG.  PROD.  ISO.1  ISO.2    DATA1-ID    DATA2-ID         EN      DATA1  DATA1-ERR      DATA2  DATA2-ERR          I          L        M/T    M/T-ERR          D
#----><----->o<----><----><----><-------->.o<-------->.o<---------><---------><---------><---------><---------><---------><---------><---------><---------><--------->
      1  78198   78197      M      G 10835.024.2 10835.024.1 1.4800E+07 7.7700E-01 7.8000E-02 1.0700E+00 1.0000E-01 9.6700E-01 1.0869E+00 4.2068E-01 3.3426E-02 1.0358E+00

#C.G.Hudson+ (78)
#10836.002.1   21-SC-45(N,2N)21-SC-44-M,,SIG
#10836.002.2   21-SC-45(N,2N)21-SC-44,,SIG
# PROJ.   TARG.  PROD.  ISO.1  ISO.2    DATA1-ID    DATA2-ID         EN      DATA1  DATA1-ERR      DATA2  DATA2-ERR          I          L        M/T    M/T-ERR          D
#----><----->o<----><----><----><-------->.o<-------->.o<---------><---------><---------><---------><---------><---------><---------><---------><---------><--------->
      1  21045   21044      M      T 10836.002.1 10836.002.2 1.3300E+07 7.7000E-02 6.0000E-03 1.7200E-01 1.4000E-02 9.8800E-01-7.4076E-02 4.4767E-01 5.0444E-02 5.2237E-01
      1  21045   21044      M      T 10836.002.1 10836.002.2 1.4100E+07 9.7000E-02 8.0000E-03 2.3500E-01 1.9000E-02 9.8800E-01-7.4076E-02 4.1277E-01 4.7672E-02 5.5979E-01
      1  21045   21044      M      T 10836.002.1 10836.002.2 1.5200E+07 1.2800E-01 1.0000E-02 3.2500E-01 2.6000E-02 9.8800E-01-7.4076E-02 3.9385E-01 4.4040E-02 5.8007E-01
      1  21045   21044      M      T 10836.002.1 10836.002.2 1.6000E+07 1.3600E-01 1.1000E-02 3.5500E-01 2.8000E-02 9.8800E-01-7.4076E-02 3.8310E-01 4.3280E-02 5.9158E-01
      1  21045   21044      M      T 10836.002.1 10836.002.2 1.7100E+07 1.5900E-01 1.6000E-02 4.3400E-01 3.5000E-02 9.8800E-01-7.4076E-02 3.6636E-01 4.7244E-02 6.0951E-01
      1  21045   21044      M      T 10836.002.1 10836.002.2 1.8400E+07 1.7000E-01 1.7000E-02 4.9100E-01 4.9000E-02 9.8800E-01-7.4076E-02 3.4623E-01 4.8915E-02 6.3105E-01
```

  - Projectile covered

    γ, n, p, d, ^{3}He, α

  - Excluded reactions

    -M1, -M2, -L



1. MOTIVATION

- Improper interpretation of cross section measured with the g.s. activity
- Tool for isomeric ratio calculation
- Atlas of Isomeric Ratios

^{86}Kr(g,x)^{85}Kr

$T_{1/2}$(g.s.)= 10.73 y J^{π}(g.s.)= 9/2^{+}

$T_{1/2}$(m.s.)= 4.48 h J^{π}(m.s.)= 1/2^{-}

E_n (MeV)	IR	ΔIR	Type	EXFOR	Reference	
1.1000E+01	0.7962	0.0764	M+T	L0174	R.Raut+ (13)	[1]
1.1500E+01	0.5874	0.0639	M+T	L0174	R.Raut+ (13)	[1]
1.2000E+01	0.5459	0.0560	M+T	L0174	R.Raut+ (13)	[1]

^{151}Eu(g,x)^{150}Eu

$T_{1/2}$(g.s.)= 36.90 y

$T_{1/2}$(m.s.)= 12.80 h J^{π}(m.s.)= 0^{-}

E_n (MeV)	IR	ΔIR	Type	EXFOR	Reference	
1.7500E+01	0.6774	0.0161	M/G	M0786	A.P.Tonchev+ (98)	[2]
1.7500E+01	0.6047	0.0119	M/G	M0786	A.P.Tonchev+ (98)	[2]

^{30}Si(n,x)^{30}Al

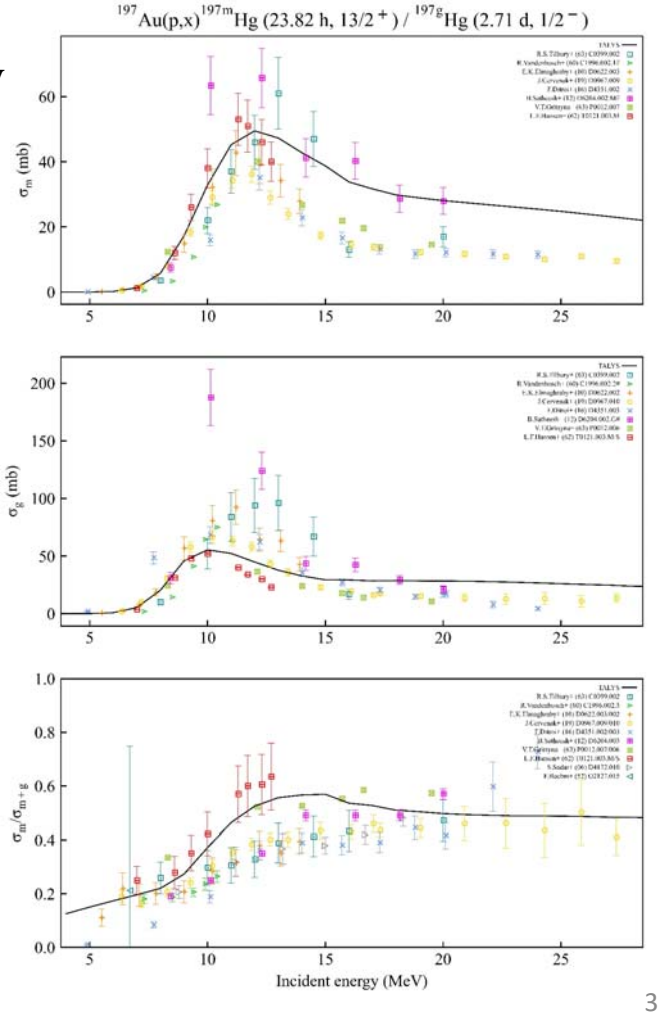
E_n (MeV)	IR	ΔIR	Type	EXFOR	Reference	
1.4700E+01	0.7053	0.1760	M+T	21846	W.Schantl (70)	[3]
1.4700E+01	0.5368	0.1432	M+T	21846	W.Schantl (70)	[3]
1.4700E+01	0.6526	0.1677	M+T	21846	W.Schantl (70)	[3]

^{35}Cl(n,x)^{34}Cl

$T_{1/2}$(g.s.)= 1.53 sec

$T_{1/2}$(m.s.)= 31.99 min

E_n (MeV)	IR	ΔIR	Type	EXFOR	Reference	
1.4800E+01	0.6667	0.0887	G+M	11550	R.S.Scalan+ (58)	[4]
1.4800E+01	0.6218	0.0622	G+M	30014	R.Prasad+ (67)	[5]
1.5000E+01	0.8172	0.0297	G+M	30100	G.Peto+ (68)	[6]
1.5000E+01	0.8172	0.2194	M/G	30101	J.Karolyi+ (68)	[7]



2. DATA SOURCES

Nuclide properties

Nucl-Undef-2022-08-03 from Nubase2020

Experimental data sources

Quasi-C4 Library generated from X4Pro for both production cross sections and IR

X4Pro generated from EXFOR Master 2022-08-23

TALYS

Theorical data (TALYS 1.96)

2. DATA SOURCES

2.1 Nuclide properties - Nucl-Undef-2022-08-03

- Halflife of the isomers
  - Cumulative factor $L = \frac{\lambda_m}{\lambda_m+\lambda_g}$
- Spin
- Isomeric transition probability

Tabulation

```
#C.G.Hudson+ (78)
#10836.002.1   21-SC-45(N,2N)21-SC-44-M,,SIG
#10836.002.2   21-SC-45(N,2N)21-SC-44,,SIG
# PROJ.   TARG.  PROD.  ISO.1  ISO.2   DATA1-ID    DATA2-ID         EN      DATA1   DATA1-ERR      DATA2  DATA2-ERR           I          L        M/T    M/T-ERR          D
#----->o<----->o<----->o<----->o<----->o<--------->.o<--------->.o<--------->o<--------->o<--------->o<--------->o<--------->o<--------->o<--------->o<--------->o<--------->o<--------->
     1  21045   21044      M        T 10836.002.1 10836.002.2 1.3300E+07 7.7000E-02 6.0000E-03 1.7200E-01 1.4000E-02 9.8800E-01-7.4076E-02 4.4767E-01 5.0444E-02 5.2237E-01
     1  21045   21044      M        T 10836.002.1 10836.002.2 1.4100E+07 9.7000E-02 8.0000E-03 2.3500E-01 1.9000E-02 9.8800E-01-7.4076E-02 4.1277E-01 4.7672E-02 5.5979E-01
     1  21045   21044      M        T 10836.002.1 10836.002.2 1.5200E+07 1.2800E-01 1.0000E-02 3.2500E-01 2.6000E-02 9.8800E-01-7.4076E-02 3.9385E-01 4.4040E-02 5.8007E-01
```

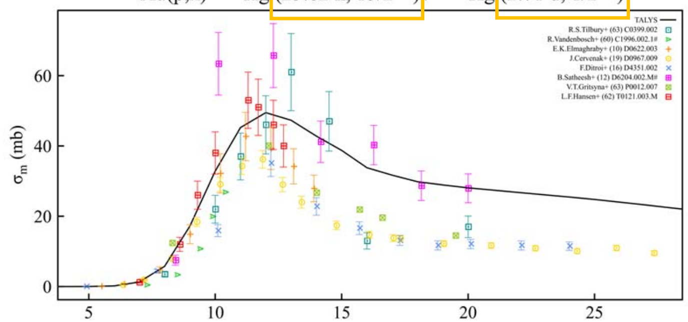
Atlas of Isomeric Ratios

^{86}Kr(g,x)^{85}Kr						
$T_{1/2}$(g.s.)= 10.73 y		J^{π}(g.s.)= 9/2$^+$				
$T_{1/2}$(m.s.)= 4.48 h		J^{π}(m.s.)= 1/2$^-$				
E_n (MeV)	IR	ΔIR	Type	EXFOR	Reference	
1.1000E+01	0.7962	0.0764	M+T	L0174	R.Raut+ (13)	[1]
1.1500E+01	0.5874	0.0639	M+T	L0174	R.Raut+ (13)	[1]
1.2000E+01	0.5459	0.0560	M+T	L0174	R.Raut+ (13)	[1]

J^{π} $T_{1/2}[sec]$ $I[\%]$

```
Dictionary_updated.txt
216  MTRA 202200  13-AL-24-G     24AL  130240       2.0530E+00U          23.99995
217  MTRA 202200  13-AL-24-M     24AL  130241       1.3000E-01U 82.5     24.00040
218  MTRA 202200  13-AL-25       25AL  130250       7.1666E+00U          24.99043
219  MTRA 202200  13-AL-26-G     26AL  130260       2.2626E+13U          25.98689
220  MTRA 202200  13-AL-26-M     26AL  130261       6.3460E+00U          25.98714
221  MTRA 202200  13-AL-27       27AL  130270 +2.5              100.     26.98154
222  MTRA 202200  13-AL-28       28AL  130280 +3.0  1.3470E+02U          27.98191
223  MTRA 202200  13-AL-29       29AL  130290 +2.5  3.9360E+02U          28.98045
224  MTRA 202200  13-AL-30       30AL  130300 +3.0  3.6200E+00U          29.98297
225               13-AL-30-M*          130301       7.2000E+01
226  MTRA 202200  13-AL-31       31AL  130310 +2.5  6.4400E-01U          30.98395
227  MTRA 202200  13-AL-32       32AL  130320 +1.0  3.2600E-02U          31.98808
228  MTRA 202200  13-AL-33       33AL  130330 +2.5  4.1460E-02U          32.99088
229  MTRA 202200  13-AL-34       34AL  130340       5.3730E-02U          33.99678
230  MTRA 202200  13-AL-35       35AL  130350       3.8160E-02U          34.99976
231  MTRA 202200  13-AL-36       36AL  130360       9.0000E-02U          36.00639
232  MTRA 202200  13-AL-37       37AL  130370       1.1400E-02U          37.01053
233  MTRA 202200  13-AL-38       38AL  130380       9.0000E-03U
234  MTRA 202200  13-AL-39       39AL  130390       7.6000E-03U
235  MTRA 202200  13-AL-40       40AL  130400                U
236  MTRA 202200  13-AL-41       41AL  130410                U
237  MTRA 202200  13-AL-42       42AL  130420                U
238  MTRA 202200  13-AL-43       43AL  130430                U
239  MTRA 202200  14-SI-0        SI    140000                            28.0855
240  MTRA 202200  14-SI-22       22SI  140220       2.8700E-02U
241  MTRA 202200  14-SI-23       23SI  140230       4.2300E-02U
242  MTRA 202200  14-SI-24       24SI  140240       1.4320E-01U          24.01154
243  MTRA 202200  14-SI-25       25SI  140250       2.2060E-01U          25.00411
244  MTRA 202200  14-SI-26       26SI  140260       2.2453E+00U          25.99233
245  MTRA 202200  14-SI-27       27SI  140270       4.1170E+00U          26.98670
246  MTRA 202200  14-SI-28       28SI  140280                   92.2545  27.97693
247  MTRA 202200  14-SI-29       29SI  140290 +0.5              4.672    28.97649
248  MTRA 202200  14-SI-30       30SI  140300                   3.0735   29.97377
249  MTRA 202200  14-SI-31       31SI  140310       9.4296E+03U          30.97536
250  MTRA 202200  14-SI-32       32SI  140320       4.9544E+09U          31.97415
251  MTRA 202200  14-SI-33       33SI  140330 +1.5  6.1800E+00U          32.97798
252  MTRA 202200  14-SI-34       34SI  140340       2.7700E+00U          33.97854
253  MTRA 202200  14-SI-35       35SI  140350       7.8000E-01U          34.98455
Normal text file                                      length : 541.490   lines : 4.373   Ln :
```

^{197}Au(p,x)^{197m}Hg (23.82 h, 13/2$^+$) / ^{197g}Hg (2.71 d, 1/2$^-$)



2. DATA SOURCES

2.1 Nuclide properties - Nucl-Undef-2022-08-03

- Missing nuclear properties

```
#R.E.Batzel+ (53)
#P0067.005     13-AL-27(D,P+A)11-NA-24-G,,SIG
#P0067.003     13-AL-27(D,P+A)11-NA-24,,SIG
# PROJ.   TARG.  PROD.  ISO.1  ISO.2    DATA1-ID    DATA2-ID        EN      DATA1  DATA1-ERR      DATA2  DATA2-ERR          I          L        M/T    M/T-ERR          D
#-----><-----><-----><-----><-----><---------.o<---------.o<---------><---------><---------><---------><---------><---------><---------><---------><---------><--------->
   1002  13027   11024      G      T P0067.005   P0067.003   1.8900E+08 2.2000E-02            2.4500E-02                    NaN        NaN 1.0204E-01                    NaN
```

```
    I          L          M/T     M/T-ERR          D
----><---------><---------><---------><---------><
 NaN        NaN 1.0204E-01                    NaN
```

J^{π} $T_{1/2}[sec]$ $I[\%]$

Dictionary_updated.txt

```
216  MTRA 202200  13-AL-24-G        24AL  130240          2.0530E+00U                 23.99995
217  MTRA 202200  13-AL-24-M        24AL  130241          1.3000E-01U  82.5           24.00040
218  MTRA 202200  13-AL-25          25AL  130250          7.1666E+00U                 24.99043
219  MTRA 202200  13-AL-26-G        26AL  130260          2.2626E+13U                 25.98689
220  MTRA 202200  13-AL-26-M        26AL  130261          6.3460E+00U                 25.98714
221  MTRA 202200  13-AL-27          27AL  130270 +2.5                    100.        26.98154
222  MTRA 202200  13-AL-28          28AL  130280 +3.0     1.3470E+02U                 27.98191
223  MTRA 202200  13-AL-29          29AL  130290 +2.5     3.9360E+02U                 28.98045
224  MTRA 202200  13-AL-30          30AL  130300 +3.0     3.6200E+00U                 29.98297
225                                      13-AL-30-M*       130301          7.2000E+01
226  MTRA 202200  13-AL-31          31AL  130310 +2.5     6.4400E-01U                 30.98395
227  MTRA 202200  13-AL-32          32AL  130320 +1.0     3.2600E-02U                 31.98808
228  MTRA 202200  13-AL-33          33AL  130330 +2.5     4.1460E-02U                 32.99088
229  MTRA 202200  13-AL-34          34AL  130340          5.3730E-02U                 33.99678
230  MTRA 202200  13-AL-35          35AL  130350          3.8160E-02U                 34.99976
231  MTRA 202200  13-AL-36          36AL  130360          9.0000E-02U                 36.00639
232  MTRA 202200  13-AL-37          37AL  130370          1.1400E-02U                 37.01053
233  MTRA 202200  13-AL-38          38AL  130380          9.0000E-03U
234  MTRA 202200  13-AL-39          39AL  130390          7.6000E-03U
235  MTRA 202200  13-AL-40          40AL  130400                   U
236  MTRA 202200  13-AL-41          41AL  130410                   U
237  MTRA 202200  13-AL-42          42AL  130420                   U
238  MTRA 202200  13-AL-43          43AL  130430                   U
239  MTRA 202200  14-SI-0           SI    140000                                      28.0855
240  MTRA 202200  14-SI-22          22SI  140220          2.8700E-02U
241  MTRA 202200  14-SI-23          23SI  140230          4.2300E-02U
242  MTRA 202200  14-SI-24          24SI  140240          1.4320E-01U                 24.01154
243  MTRA 202200  14-SI-25          25SI  140250          2.2060E-01U                 25.00411
244  MTRA 202200  14-SI-26          26SI  140260          2.2453E+00U                 25.99233
245  MTRA 202200  14-SI-27          27SI  140270          4.1170E+00U                 26.98670
246  MTRA 202200  14-SI-28          28SI  140280                       92.2545       27.97693
247  MTRA 202200  14-SI-29          29SI  140290 +0.5                  4.672         28.97649
248  MTRA 202200  14-SI-30          30SI  140300                       3.0735        29.97377
249  MTRA 202200  14-SI-31          31SI  140310          9.4296E+03U                 30.97536
250  MTRA 202200  14-SI-32          32SI  140320          4.9544E+09U                 31.97415
251  MTRA 202200  14-SI-33          33SI  140330 +1.5     6.1800E+00U                 32.97798
252  MTRA 202200  14-SI-34          34SI  140340          2.7700E+00U                 33.97854
253  MTRA 202200  14-SI-35          35SI  140350          7.8000E-01U                 34.98455
```

Normal text file — length : 541,490 lines : 4,373 Ln :

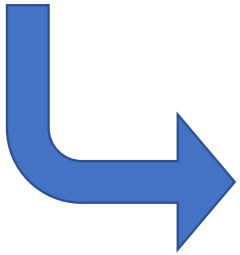
Type	I	L	D	Examples of product nuclides
Only G state defined in Dict	NaN	NaN	NaN	NA-24, AL-30, AS-74, AS-78
G or M state is stable (no half-life)		NaN	NaN	SE-77, AG-107, AG-109, IN-113, RH-103, SN-117, BA-137, ER-167, HF-178, HF-179, TA-180, IR-191, IR-193, AU-197, PB-204, PB-207
M1, M2,... states defined in Dict	NaN	NaN	NaN	AG-116, IN-109, IN-116, IN-118, IN-120, SB-124, SB-126, EU-152, HF-178, HF-179, TA-178, IR-190, IR-191, AU-196, PB-203

2. DATA SOURCES

2.2 Experimental data sources

- First experimental data source
  - EXFOR-EXP-2022-08-10-v2.c5
  - Quasi-C4 file generated from X4Pro for IR

Different formats



- Second experimental data source
  - Quasi-C4 generated from X4Pro for both isomer production cross sections and IR
    - prodxs-c4like
    - prodxsem-c4like
    - isorat-c4like

Same format

We utilized this tool development for consistency checking of the isomer and total production cross sections and isomeric ratios compiled in EXFOR.

2. DATA SOURCES

2.2 Experimental data sources

- First experimental data source
  - EXFOR-EXP-2022-08-10-v2.c5
  - Quasi-C4 file generated from X4Pro for IR

1. Datasets against the relation $0 < \sigma_M/\sigma_T < 1$

- Isomer production cross section larger than the total production cross section
- Negative isomer production cross section

Table 1: Isomer production cross section larger than the total production cross section (Error: EXFOR compilation error. (G), (M) and (T) following the subentry number indicate that the ground state production, metastable state production and total production cross section is compiled, separately.)

Author (year)	Dataset 1	Dataset 2	Error?	Remark
W.Poenitz (1966)	21193.005(G)	21193.002(T)	Yes9	-G in SF4 must be deleted in 004-007.
A.Gruetter (1982)	D0029.079.G(G)	D0029.079.M(T)	Yes	MN-52 -> MN-52-M in 079.M.
O.Lebeda+ (2010)	D0631.005(M)	D0631.004(T)	Yes	93-TC-94 -> 93-TC-94-G in 004
O.Lebeda+ (2012)	D0676.007(M)	D0676.006(T)	Yes	61-PM-148 -> 61-PM-148-G in 006
O.Lebeda+ (2014)	D0743.007(M)	D0743.006(T)	Yes	61-PM-148 -> 61-PM-148-G in 006
A.Hermanne+ (2010)	D4231.017(M)	D4231.018(T)	Yes	49-IN-110 -> 49-IN-110-G in 018.

22 Datasets with $\sigma_M/\sigma_T \notin [0,1]$, 9 of them are due to compilation errors

2. Datasets against the relations:

- $\sigma_T = \sigma_G + \sigma_M$
- IR(x/y) = σ_x/σ_y (x, y = G, M or T)

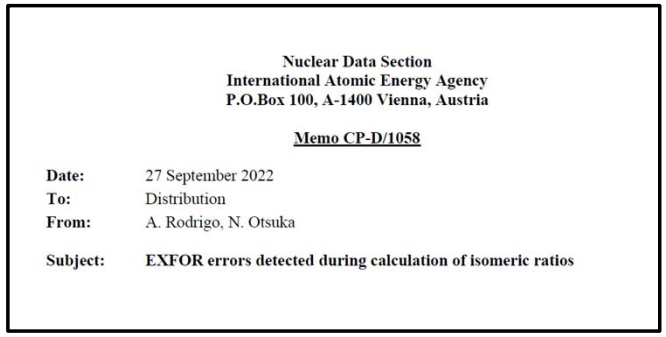
Nuclear Data Section
International Atomic Energy Agency
P.O.Box 100, A-1400 Vienna, Austria

Memo CP-D/1058

Date: 27 September 2022
To: Distribution
From: A. Rodrigo, N. Otsuka

Subject: **EXFOR errors detected during calculation of isomeric ratios**

2. DATA SOURCES



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

Memo CP-D/1058

Date: 27 September 2022
To: Distribution
From: A. Rodrigo, N. Otsuka

Subject: **EXFOR errors detected during calculation of isomeric ratios**

2.2 Experimental data sources

- First experimental data source
  - EXFOR-EXP-2022-08-10-v2.c5
  - Quasi-C4 file generated from X4Pro for IR

2. Datasets against the relations:

$\sigma_T = \sigma_G + \sigma_M$

DEVIATION = $[\sigma_T - (\sigma_G + \sigma_M)]/(\sigma_G + \sigma_M)$

```
#20836026   34-SE-74(N,2N)34-SE-73-M,,SIG
#20836025   34-SE-74(N,2N)34-SE-73-G,,SIG
#20836024   34-SE-74(N,2N)34-SE-73,,SIG
#        EN CALCULATED EXFORDATA DEVIATION
#----------><--------><--------><-------->
     1.295E7    0.0822    0.0822  0.000000
      1.41E7    0.2997     0.472  0.574908
```

$IR(x/y) = \sigma_x/\sigma_y$ (x, y = G, M or T)

DEVIATION = $IR(x/y) - \sigma_x/\sigma_y$

```
#327810051  80-HG-198(N,2N)80-HG-197-M,,SIG
#327810052  80-HG-198(N,2N)80-HG-197-G,,SIG
#327810054  80-HG-198(N,2N)80-HG-197-M/G,,SIG/RAT
#        EN CALCULATED EXFORDATA DEVIATION
#----------><--------><--------><-------->
      1.35E7  1.055615       0.1 -0.955615
      1.41E7  1.193878       0.1 -1.093878
      1.48E7  1.408434       0.1 -1.308434
```

	EXFOR error	Author's typo	Unknown	Ok	Total
Cross sections	7	1	14	29	51
Isomeric ratios	6	0	8	22	36
Total	13	1	22	51	87

2. DATA SOURCES

2.2 Experimental data sources

- First experimental data source
  - EXFOR-EXP-2022-08-10-v2.c5
  - Quasi-C4 file generated from X4Pro for IR

2. Datasets against the relations: $\sigma_T = \sigma_G + \sigma_M$ $IR(x/y) = \sigma_x/\sigma_y$ (x, y = G, M or T)

1) Cases requiring a correction in EXFOR
2) Case which is suspicious but without a clear reason
3) Case where the deviation is understandable (not for corrections)

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

Memo CP-D/1058

Date: 27 September 2022
To: Distribution
From: A. Rodrigo, N. Otsuka

Subject: **EXFOR errors detected during calculation of isomeric ratios**

Table 2: Inconsistency between isomer production cross sections and total production cross sections or isomeric ratio (In column "Type", C is cross section and R is isomeric ratio.)

1) Cases requiring a correction in EXFOR

Type	1st author	1st institute	Dataset 1	Dataset 2	Dataset 3	Deviation (%)	Problem in	Keyword	Remarks
T	P.K.Rath	3INDBDA	C1699.002.2	C1699.002.1	C1699.005	10811.8	C1699.005	REACTION	SF1-SF4: Must be 62-SM-144(3-LI-6,3N)65-TB-147.
T	R.T.Skelton	1USACAL	C0304.003	C0304.005	C0304.002	498.0	C0304.005	REACTION	SF3-SF6 must be 13-AL-26.PAR.SIG with e-LVL=0 (i.e., (p,n2) contribution excluded).
R	Junhua Luo	3CPRHXU	32781.005.1	32781.005.2	32781.005.4	130.8	32781.005.4	Heading	Swap DATA and ERR-T
T	R.T.Skelton	1USACAL	C0304.007	C0304.009	C0304.006	99.9	C0304.009	REACTION	SF3-SF6 must be 13-AL-26.PAR.SIG with E-LVL=0 (i.e., (a,n2) contribution excluded).
R	J.L.Casanova	2SPNVLD	20776.003.2	20776.003.1	20776.003.3	82.7	20776.003.3	REACTION	SF4: G/M -> M/T
R	J.L.Casanova	2SPNVLD	20776.002.2	20776.002.1	20776.002.3	70.9	20776.002.3	REACTION	SF4: G/M -> M/T
T	M.Bormann	2GERHAM	20836.026	20836.025	20836.024	57.5	20836.024	Data	EN: 13.5 MeV -> 14.1 MeV, EN=14.1 MeV -> 14.9 MeV

2. DATA SOURCES

2.2 Experimental data sources

- Second experimental data source
  - Quasi-C4 generated from X4Pro for both isomer production cross sections and IR

isorat-c4like.txt

```
#DATASET    A0542002
#REACTION   20-CA-44(P,N)21-SC-44-M/G,,SIG/RAT
# Prj Targ M MF MT PXC  Energy  dEnergy  Data      dData   Cos/LO   dCos/LO   ELV/HL  dELV/HL I78 Refer (YY)              EntrySubP
#---><---->o<->o<->ooo<-------><-------><-------><-------><-------><-------><-------><-------><-><----------------------><---><->o
 1001 20044           4.6000+6          8.0000-4 1.0000-4           21044.                        E.A.Bogila+ (91)          A0542  2
 1001 20044           5.1000+6          1.4000-3 2.0000-4           21044.                        E.A.Bogila+ (91)          A0542  2
 1001 20044           5.5000+6          2.6000-3 2.0000-4           21044.                        E.A.Bogila+ (91)          A0542  2
```

prodxs-c4like.txt

```
#DATASET    23018006                                                                                                    Product Z/A
#REACTION   80-HG-198(N,2N)80-HG-197-M,,SIG
# Prj Targ M MF MT PXC  Energy  dEnergy  Data      dData   Cos/LO   dCos/LO   ELV/HL  dELV/HL I78 Refer (YY)              EntrySubP
#---><---->o<->o<->ooo<-------><-------><-------><-------><-------><-------><-------><-------><-><----------------------><---><->o
    1 80198           1.3360+7          9.4000-1 6.0000-2           80197.1                       Y.Kasugai+ (01)           23018  6
    1 80198           1.3680+7          9.1000-1 6.0000-2           80197.1                       Y.Kasugai+ (01)           23018  6
    1 80198           1.4020+7          9.3000-1 6.0000-2           80197.1                       Y.Kasugai+ (01)           23018  6
```

prodxsem-c4like.txt

```
#DATASET    E1251002
#REACTION   22-TI-0(P,X)ELEM/MASS,IND,SIG
# Prj Targ M MF MT PXC  Energy  dEnergy  Data      dData   Cos/LO   dCos/LO   ELV/HL  dELV/HL I78 Refer (YY)              EntrySubP
#---><---->o<->o<->ooo<-------><-------><-------><-------><-------><-------><-------><-------><-><----------------------><---><->o
 1001 22000           5.0000+8          1.4200-3 9.0000-5            4007.9                       Y.Asano+ (91)             E1251  2
 1001 22000           5.0000+8          5.4000-4 1.1000-4           17039.9                       Y.Asano+ (91)             E1251  2
 1001 22000           5.0000+8          7.7700-3 6.8000-4           19042.9                       Y.Asano+ (91)             E1251  2
 1001 22000           5.0000+8          8.7600-3 4.6000-4           21044.0                       Y.Asano+ (91)             E1251  2
```

2. DATA SOURCES

2.2 Experimental data sources

- Second experimental data source
  - Quasi-C4 generated from X4Pro for both isomer production cross sections and IR

isorat-c4like.txt

```
#E.A.Bogila+ (91)
#A0542.002     20-CA-44(P,N)21-SC-44-M/G,,SIG/RAT
#
# PROJ.   TARG.  PROD.  ISO.1  ISO.2    DATA1-ID    DATA2-ID        EN      DATA1  DATA1-ERR      DATA2  DATA2-ERR          I          L        M/T    M/T-ERR          D
#----->< ----->o<----->< ----->< -----><-------->.o<-------->.o<---------><---------><---------><---------><---------><---------><---------><---------><---------><--------->
   1001  20044  21044    M/G         A0542.002              4.6000E+06 8.0000E-04 1.0000E-04                       9.8800E-01-7.4076E-02 7.9936E-04 9.9920E-05 9.9915E-01
   1001  20044  21044    M/G         A0542.002              5.1000E+06 1.4000E-03 2.0000E-04                       9.8800E-01-7.4076E-02 1.3980E-03 1.9972E-04 9.9852E-01
   1001  20044  21044    M/G         A0542.002              5.5000E+06 2.6000E-03 2.0000E-04                       9.8800E-01-7.4076E-02 2.5933E-03 1.9948E-04 9.9725E-01
   1001  20044  21044    M/G         A0542.002              5.9000E+06 3.9000E-03 3.0000E-04                       9.8800E-01-7.4076E-02 3.8848E-03 2.9883E-04 9.9588E-01
```

prodxs-c4like.txt and prodxsem-c4like.txt

```
#Y.Kasugai+ (01)
#23018.006     80-HG-198(N,2N)80-HG-197-M,,SIG
#23018.005     80-HG-198(N,2N)80-HG-197,,SIG
# PROJ.   TARG.  PROD.  ISO.1  ISO.2    DATA1-ID    DATA2-ID        EN      DATA1  DATA1-ERR      DATA2  DATA2-ERR          I          L        M/T    M/T-ERR          D
#----->< ----->o<----->< ----->< -----><-------->.o<-------->.o<---------><---------><---------><---------><---------><---------><---------><---------><---------><--------->
      1  80198  80197      M      T 23018.006   23018.005  1.3360E+07 9.4000E-01 6.0000E-02 2.1900E+00 1.2000E-01 9.4680E-01 1.5794E+00 4.2922E-01 3.6108E-02 1.2410E+00
      1  80198  80197      M      T 23018.006   23018.005  1.3680E+07 9.1000E-01 6.0000E-02 2.0600E+00 1.3000E-01 9.4680E-01 1.5794E+00 4.4175E-01 4.0317E-02 1.2482E+00
      1  80198  80197      M      T 23018.006   23018.005  1.4020E+07 9.3000E-01 6.0000E-02 2.0400E+00 1.3000E-01 9.4680E-01 1.5794E+00 4.5588E-01 4.1340E-02 1.2563E+00
      1  80198  80197      M      T 23018.006   23018.005  1.4370E+07 9.3000E-01 6.0000E-02 2.0400E+00 1.3000E-01 9.4680E-01 1.5794E+00 4.5588E-01 4.1340E-02 1.2563E+00

#W.G.Cross+ (63)
#11696.012     28-NI-58(N,P)27-CO-58-M,,SIG
#11696.011     28-NI-58(N,P)27-CO-58,,SIG
# PROJ.   TARG.  PROD.  ISO.1  ISO.2    DATA1-ID    DATA2-ID        EN      DATA1  DATA1-ERR      DATA2  DATA2-ERR          I          L        M/T    M/T-ERR          D
#----->< ----->o<----->< ----->< -----><-------->.o<-------->.o<---------><---------><---------><---------><---------><---------><---------><---------><---------><--------->
#     1  28058  27058      M      T 11696.012   11696.011  ****** No data point pair at the same incident energies *****************************************************
```

Data from "isorat-c4like.txt" will only appear in the ratio plot as just the ratio can be calculated.

2. DATA SOURCES

2.2 Experimental data sources

- Second experimental data source
  - Datasets against the relation $0 < \sigma_M/\sigma_T < 1$

    -Isomer production cross section larger than the total production cross section

    -Negative isomeric ratios

Table: Isomer production cross section larger than the total production cross section (Error: EXFOR compilation error. (G), (M) and (T) following the subentry number indicate that the ground state production, metastable state production and total production cross section is compiled, separately.)

Author (year)	Dataset 1	Dataset 2	Error?	Remark
Y.Kanda (1972)	20338.008(M)	20338.010(T)	No	Compiled as published.
Y.Kanda (1972)	20338.013(M)	20338.015(T)	Yes	013: Delete ERR-T=25.4% in COMMON.
W.Poenitz (1966)	21193.007(G)	21193.002(T)	Yes	79-AU-198-G -> 79-AU-198 in SF4 through this entry. Also check if only final values are compiled as active data.
B.N.Beljaev+ (1978)	A0041.002.A(G)	A0041.004(T)	Yes	002.A: Delete ISOMER=0 for 37-RB-84, 39-Y-86 and 39-Y-88.
B.N.Beljaev+ (78)	A0041.002.C(G)	A0041.006(T)	Yes	002.C: Delete ISOMER=0 for 37-RB-84, 39-Y-86 and 39-Y-88.
Yu.E.Titarenko+ (2011)	A0906.152(M)	A0906.154(T)	Yes?	154: The 799 and 1199 MeV in Table3 could be for g.s. only. Question sent to Titarenkov (2022-10-23).
N.T.Porile+ (1979)	C0263.003(M)	C0263.003(T)	No?	"^{102}Rh" in Table1 means "^{102g}Rh" rather than "$^{102g+m}$Rh"? The table notation looks inconsistent.
N.T.Porile+ (1979)	C0263.005(M)	C0263.005(T)	No?	"^{44}Sc" in Table1 means "^{44g}Sc" rather than "$^{44g+m}$Sc"? The table notation looks inconsistent.
N.T.Porile+ (1979)	C0263.005(M)	C0263.005(T)	No?	"^{99}Rh" in Table1 means "^{99g}Rh" rather than "$^{99g+m}$Rh"? The table notation looks inconsistent.
R.T.Skelton+ (1987)	C0304.003(M)	C0304.002(T)	Yes	Under revision in PRELIM.C220.
R.T.Skelton+ (1987)	C0304.005(G)	C0304.002(T)	Yes	Under revision in PRELIM.C220.
R.T.Skelton+ (1987)	C0304.007(M)	C0304.006(T)	Yes	Under revision in PRELIM.C220.
R.T.Skelton+ (1987)	C0304.009(G)	C0304.006(T)	Yes	Under revision in PRELIM.C220.
J.Jastrzebski+ (1986)	C0306.003(G)	C0306.002(T)	No	003 from off-line measurement while 002 from on-line measurement.
E.Gadioli+ (1984)	C0312.002(M)	C0312.002(T)	Yes	Add ISOMER=0 for all ground state production cross sections.

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

Memo CP-D/1060

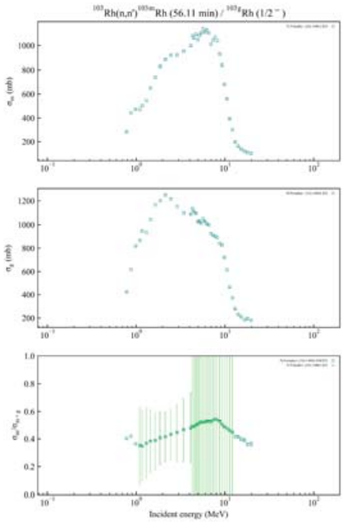
Date: 7 November 2022
To: Distribution
From: A. Rodrigo, N. Otsuka

Subject: **EXFOR errors detected during calculation of isomeric ratios (2)**
Reference: Memo CP-D/1058

Nuclide	Type of yield	$\sigma(^{12}C)$ (mb)	$\sigma(P)$ (mb)
$^{84}Rb^{m}$	*I*	1.36 ± 0.16	1.18 ± 0.06
$^{84}Rb^{m+g}$	*I*	3.82 ± 0.52	1.50 ± 0.03
^{84}Y	C^+	6.42 ± 0.50	4.77 ± 0.14
^{85}Y	PC^+	···	7.76 ± 0.80
^{85}Zr	PC^+	1.52 ± 0.23	1.06 ± 0.10
$^{86}Y^{m}$	*I*	9.89 ± 0.61	7.05 ± 0.14
$^{86}Y^{m+g}$	*I*	16.3 ± 1.4	9.57 ± 0.30
^{86}Zr	C^+	8.98 ± 0.22	5.93 ± 0.36
^{87}Y	*I*	···	0.57 ± 0.32
$^{87}Y^{m}$	C^+	25.5 ± 1.6	15.9 ± 0.8
^{88}Y	*I*	7.85 ± 0.85	3.11 ± 0.20
^{88}Zr	C^+	29.4 ± 2.3	14.7 ± 0.2
^{88}Nb	PC^+	3.36 ± 0.52	2.65 ± 0.18
^{89}Zr	C^+	29.5 ± 1.6	15.8 ± 0.4
$^{89}Nb^{g}$	?	1.62 ± 0.16	0.83 ± 0.02
$^{89}Nb^{m}$	?	27.0 ± 1.9	9.5 ± 1.0
$^{99}Rh^{m}$	*I*	17.2 ± 1.1	8.42 ± 0.45
^{99}Pd	C^+	3.63 ± 0.21	2.94 ± 0.11
^{100}Rh	*I*	21.3 ± 1.4	12.4 ± 0.3
^{100}Pd	C^+	8.47 ± 0.93	5.78 ± 0.25
$^{101}Rh^{m}$	*I*	26.1 ± 2.8	···
^{101}Pd	C^+	22.0 ± 1.3	12.9 ± 0.4
^{102}Rh	*I*	8.46 ± 2.17	2.88 ± 0.46
$^{102}Rh^{m}$	*I*	9.86 ± 3.32	5.6 ± 1.0
^{102}Ag	PC^+	5.15 ± 0.48	2.71 ± 0.12

(e.g., "^{102}Rh" instead of "^{102g}Rh" for tabulation of ^{102g}Rh production cross section.)

2. DATA SOURCES



2.3 Criteria for data selection to obtain M/T ratio

- **-G, -M** and **-T** are available
  - -M with -T has preference
  - -G is ignored unless -M with -T don´t have matching incident energies
- **-G, -M or -T** and **SIG/RAT** are available
  - SIG/RAT from isorat-c4like.txt has preference
  - Repeated data is identified when they have the same entry and the same incident energies, assuming they also have the same data

```
#N.Fotiades+ (16)
#14461.021      45-RH-103(N,INL)45-RH-103-M/G,,SIG/RAT
#
# PROJ.   TARG.  PROD.  ISO.1  ISO.2    DATA1-ID    DATA2-ID         EN      DATA1  DATA1-ERR      DATA2  DATA2-ERR          I          L        M/T    M/T-ERR          D
#----->------>o<----->------>------>--------->.o<-------->.o<---------><---------><---------><---------><---------><---------><---------><---------><---------><--------->
     1  45103  45103    M/G        14461.021              1.1000E+06 5.4400E-01 4.2800E-01                       1.0000E+00        NaN 3.5233E-01 2.7720E-01        NaN
     1  45103  45103    M/G        14461.021              1.1700E+06 5.3300E-01 3.8600E-01                       1.0000E+00        NaN 3.4768E-01 2.5179E-01        NaN
     1  45103  45103    M/G        14461.021              1.3000E+06 5.8600E-01 4.1100E-01                       1.0000E+00        NaN 3.6948E-01 2.5914E-01        NaN
     1  45103  45103    M/G        14461.021              1.4500E+06 6.2300E-01 3.7000E-01                       1.0000E+00        NaN 3.8386E-01 2.2797E-01        NaN
     1  45103  45103    M/G        14461.021              1.6400E+06 6.3400E-01 3.3600E-01                       1.0000E+00        NaN 3.8800E-01 2.0563E-01        NaN
     1  45103  45103    M/G        14461.021              1.8600E+06 6.9000E-01 3.2400E-01                       1.0000E+00        NaN 4.0828E-01 1.9172E-01        NaN
```

```
#N.Fotiades+ (16)
#14461.010      45-RH-103(N,INL)45-RH-103-M,,SIG
#14461.011      45-RH-103(N,INL)45-RH-103-G,,SIG
# PROJ.   TARG.  PROD.  ISO.1  ISO.2    DATA1-ID    DATA2-ID         EN      DATA1  DATA1-ERR      DATA2  DATA2-ERR          I          L        M/T    M/T-ERR          D
#----->------>o<----->------>------>--------->.o<-------->.o<---------><---------><---------><---------><---------><---------><---------><---------><---------><--------->
#     1  45103  45103      M      G 14461.010  14461.011 7.8000E+05 2.8410E-01 3.9000E-03 4.2040E-01 1.9000E-03 1.0000E+00        NaN 4.0326E-01 3.4779E-03        NaN
#     1  45103  45103      M      G 14461.010  14461.011 8.7000E+05 4.4490E-01 4.1000E-03 6.2000E-01 2.4000E-03 1.0000E+00        NaN 4.1779E-01 2.4313E-03        NaN
#     1  45103  45103      M      G 14461.010  14461.011 9.8000E+05 4.7190E-01 3.8000E-03 8.1910E-01 2.7000E-03 1.0000E+00        NaN 3.6553E-01 2.0179E-03        NaN
#     1  45103  45103      M      G 14461.010  14461.011 1.1000E+06 4.7080E-01 4.2000E-03 8.6510E-01 3.1000E-03 1.0000E+00        NaN 3.5242E-01 2.1941E-03        NaN
#     1  45103  45103      M      G 14461.010  14461.011 1.1700E+06 5.0420E-01 4.2000E-03 9.4520E-01 3.2000E-03 1.0000E+00        NaN 3.4787E-01 2.0398E-03        NaN
#     1  45103  45103      M      G 14461.010  14461.011 1.3000E+06 5.4570E-01 4.4000E-03 9.3230E-01 3.2000E-03 1.0000E+00        NaN 3.6922E-01 2.0409E-03        NaN
```

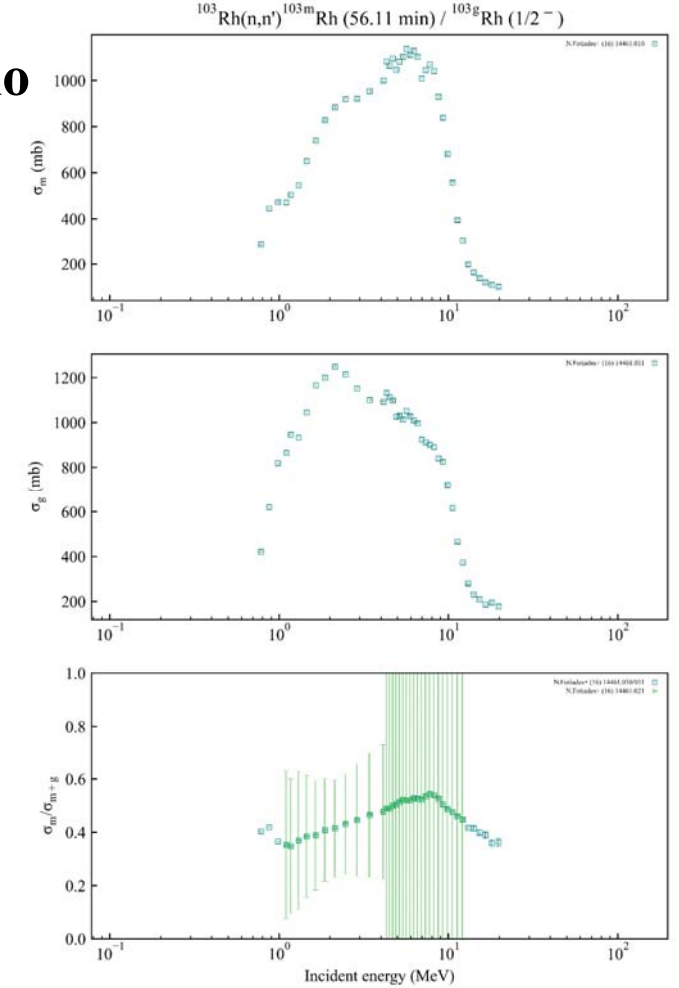
Repeated data doesn´t appear in “Atlas of Isomeric” Ratios.

2. DATA SOURCES

2.3 Criteria for data selection to obtain M/T ratio

- **-G, -M or -T** and **SIG/RAT** are available
  - SIG/RAT from isorat-c4like.txt has preference

```
#N.Fotiades+ (16)
#14461.021      45-RH-103(N,INL)45-RH-103-M/G,,SIG/RAT
#
# PROJ.   TARG.  PROD.  ISO.1  ISO.2    DATA1-ID    DATA2-ID         EN      DATA1  DATA1-ERR      DATA2  DATA2-ERR          I          L        M/T    M/T-ERR          D
#-----><-----><-----><-----><-----><---------.o<---------.o<----------><----------><----------><----------><----------><----------><----------><----------><----------><---------->
      1  45103   45103     M/G         14461.021              1.1000E+06 5.4400E-01 4.2800E-01                    1.0000E+00        NaN 3.5233E-01 2.7720E-01         NaN
      1  45103   45103     M/G         14461.021              1.1700E+06 5.3300E-01 3.8600E-01                    1.0000E+00        NaN 3.4768E-01 2.5179E-01         NaN
      1  45103   45103     M/G         14461.021              1.3000E+06 5.8600E-01 4.1100E-01                    1.0000E+00        NaN 3.6948E-01 2.5914E-01         NaN
      1  45103   45103     M/G         14461.021              1.4500E+06 6.2300E-01 3.7000E-01                    1.0000E+00        NaN 3.8386E-01 2.2797E-01         NaN
      1  45103   45103     M/G         14461.021              1.6400E+06 6.3400E-01 3.3600E-01                    1.0000E+00        NaN 3.8800E-01 2.0563E-01         NaN
      1  45103   45103     M/G         14461.021              1.8600E+06 6.9000E-01 3.2400E-01                    1.0000E+00        NaN 4.0828E-01 1.9172E-01         NaN

#N.Fotiades+ (16)
#14461.010      45-RH-103(N,INL)45-RH-103-M,,SIG
#14461.011      45-RH-103(N,INL)45-RH-103-G,,SIG
# PROJ.   TARG.  PROD.  ISO.1  ISO.2    DATA1-ID    DATA2-ID         EN      DATA1  DATA1-ERR      DATA2  DATA2-ERR          I          L        M/T    M/T-ERR          D
#-----><-----><-----><-----><-----><---------.o<---------.o<----------><----------><----------><----------><----------><----------><----------><----------><----------><---------->
#     1  45103   45103       M       G 14461.010   14461.011   7.8000E+05 2.8410E-01 3.9000E-03 4.2040E-01 1.9000E-03 1.0000E+00        NaN 4.0326E-01 3.4779E-03         NaN
#     1  45103   45103       M       G 14461.010   14461.011   8.7000E+05 4.4490E-01 4.1000E-03 6.2000E-01 2.4000E-03 1.0000E+00        NaN 4.1779E-01 2.4313E-03         NaN
#     1  45103   45103       M       G 14461.010   14461.011   9.8000E+05 4.7190E-01 3.8000E-03 8.1910E-01 2.7000E-03 1.0000E+00        NaN 3.6553E-01 2.0179E-03         NaN
#     1  45103   45103       M       G 14461.010   14461.011   1.1000E+06 4.7080E-01 4.2000E-03 8.6510E-01 3.1000E-03 1.0000E+00        NaN 3.5242E-01 2.1941E-03         NaN
#     1  45103   45103       M       G 14461.010   14461.011   1.1700E+06 5.0420E-01 4.2000E-03 9.4520E-01 3.2000E-03 1.0000E+00        NaN 3.4787E-01 2.0398E-03         NaN
#     1  45103   45103       M       G 14461.010   14461.011   1.3000E+06 5.4570E-01 4.4000E-03 9.3230E-01 3.2000E-03 1.0000E+00        NaN 3.6922E-01 2.0409E-03         NaN
```



N.Fotiades+ (16) 14461.010

N.Fotiades+ (16) 14461.011

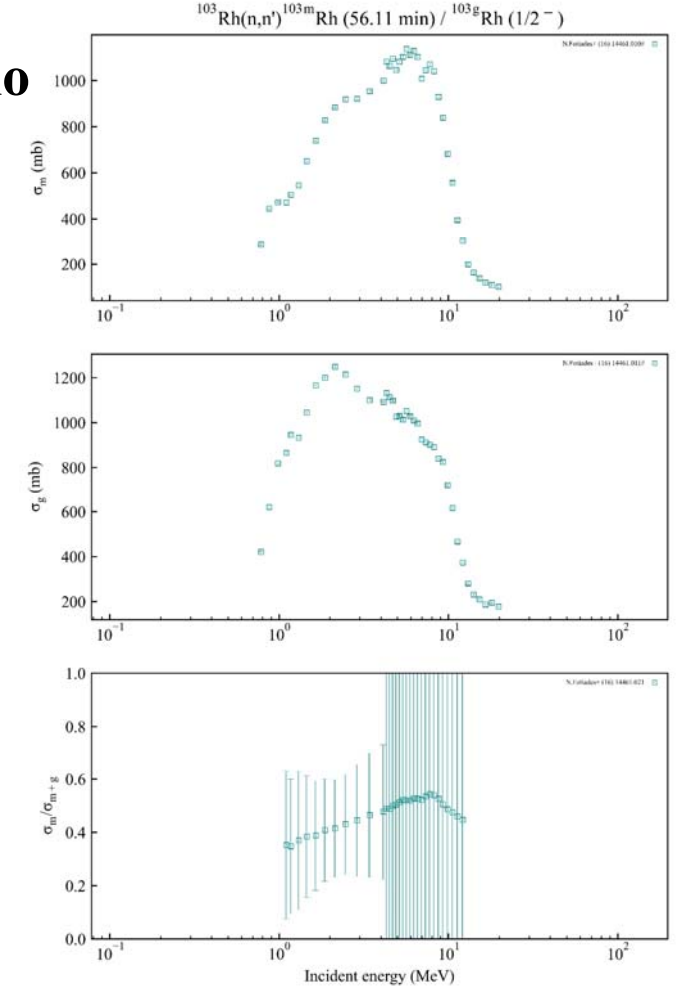
N.Fotiades+ (16) 14461.010/011
N.Fotiades+ (16) 14461.021

2. DATA SOURCES

2.3 Criteria for data selection to obtain M/T ratio

- **-G, -M or -T** and **SIG/RAT** are available
  - SIG/RAT from isorat-c4like.txt has preference

```
#N.Fotiades+ (16)
#14461.021      45-RH-103(N,INL)45-RH-103-M/G,,SIG/RAT
#
# PROJ.   TARG.  PROD.  ISO.1  ISO.2    DATA1-ID    DATA2-ID         EN      DATA1  DATA1-ERR      DATA2  DATA2-ERR          I          L        M/T    M/T-ERR          D
#-----><-----><-----><-----><-----><---------.o<---------.o<----------><----------><----------><----------><----------><----------><----------><----------><----------><---------->
      1  45103   45103     M/G        14461.021              1.1000E+06 5.4400E-01 4.2800E-01                    1.0000E+00        NaN 3.5233E-01 2.7720E-01         NaN
      1  45103   45103     M/G        14461.021              1.1700E+06 5.3300E-01 3.8600E-01                    1.0000E+00        NaN 3.4768E-01 2.5179E-01         NaN
      1  45103   45103     M/G        14461.021              1.3000E+06 5.8600E-01 4.1100E-01                    1.0000E+00        NaN 3.6948E-01 2.5914E-01         NaN
      1  45103   45103     M/G        14461.021              1.4500E+06 6.2300E-01 3.7000E-01                    1.0000E+00        NaN 3.8386E-01 2.2797E-01         NaN
      1  45103   45103     M/G        14461.021              1.6400E+06 6.3400E-01 3.3600E-01                    1.0000E+00        NaN 3.8800E-01 2.0563E-01         NaN
      1  45103   45103     M/G        14461.021              1.8600E+06 6.9000E-01 3.2400E-01                    1.0000E+00        NaN 4.0828E-01 1.9172E-01         NaN

#N.Fotiades+ (16)
#14461.010      45-RH-103(N,INL)45-RH-103-M,,SIG
#14461.011      45-RH-103(N,INL)45-RH-103-G,,SIG
# PROJ.   TARG.  PROD.  ISO.1  ISO.2    DATA1-ID    DATA2-ID         EN      DATA1  DATA1-ERR      DATA2  DATA2-ERR          I          L        M/T    M/T-ERR          D
#-----><-----><-----><-----><-----><---------.o<---------.o<----------><----------><----------><----------><----------><----------><----------><----------><----------><---------->
#     1  45103   45103       M      G 14461.010   14461.011   7.8000E+05 2.8410E-01 3.9000E-03 4.2040E-01 1.9000E-03 1.0000E+00        NaN 4.0326E-01 3.4779E-03         NaN
#     1  45103   45103       M      G 14461.010   14461.011   8.7000E+05 4.4490E-01 4.1000E-03 6.2000E-01 2.4000E-03 1.0000E+00        NaN 4.1779E-01 2.4313E-03         NaN
#     1  45103   45103       M      G 14461.010   14461.011   9.8000E+05 4.7190E-01 3.8000E-03 8.1910E-01 2.7000E-03 1.0000E+00        NaN 3.6553E-01 2.0179E-03         NaN
#     1  45103   45103       M      G 14461.010   14461.011   1.1000E+06 4.7080E-01 4.2000E-03 8.6510E-01 3.1000E-03 1.0000E+00        NaN 3.5242E-01 2.1941E-03         NaN
#     1  45103   45103       M      G 14461.010   14461.011   1.1700E+06 5.0420E-01 4.2000E-03 9.4520E-01 3.2000E-03 1.0000E+00        NaN 3.4787E-01 2.0398E-03         NaN
#     1  45103   45103       M      G 14461.010   14461.011   1.3000E+06 5.4570E-01 4.4000E-03 9.3230E-01 3.2000E-03 1.0000E+00        NaN 3.6922E-01 2.0409E-03         NaN
```



N.Fotiades+ (16) 14461.010 → N.Fotiades+ (16) 14461.010#

N.Fotiades+ (16) 14461.011 → N.Fotiades+ (16) 14461.011#

N.Fotiades+ (16) 14461.010/011, N.Fotiades+ (16) 14461.021 > → N.Fotiades+ (16) 14461.021

2. DATA SOURCES

2.4 TALYS

- Incident Energy

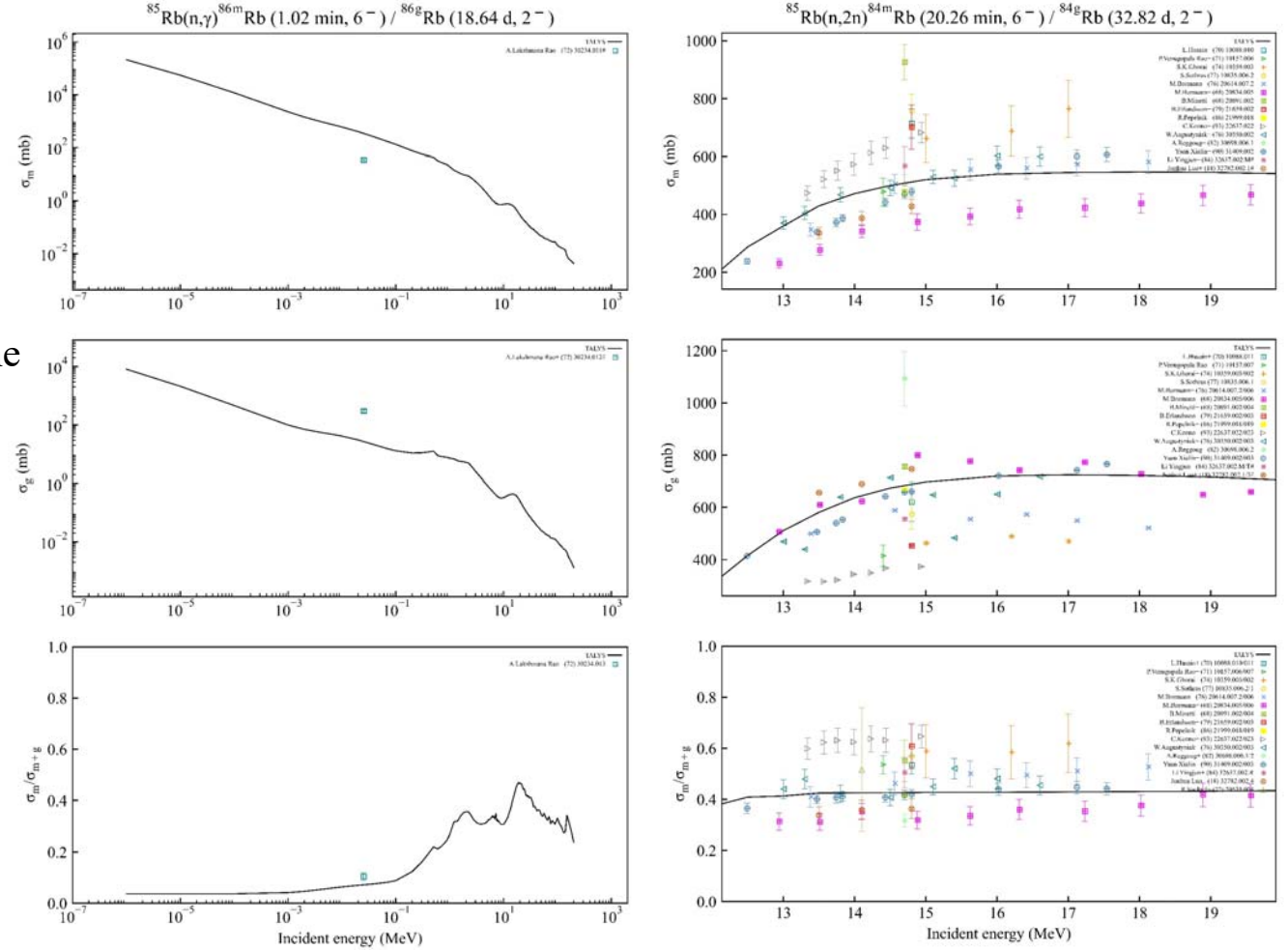
  1eV to 200 MeV

- 1 Experimental datapoint

  TALYS energy range determines the energy range of plot

- > 1 Experimental datapoint

  Experimental data determines the energy range of plot



3. SUMMARY OF PROBLEMS ENCOUNTERED

- Missing nuclear properties from Dictionary - Nucl-Undef-2022-08-03
  (due to isomers currently unknown)
- Unmatching energy of G, M, SIG/RAT datasets eligible for isomeric ratio calculation
- Experimental data not following basic relations
  - cpd1058
  - cpd1060
- Repeated data in the experimental data
- **Repeated Incident Energy**
- **Twice appearance of data points from Filtaenkov's experiments**
  - **cpd1061**
  - **cpd1062**

3. SUMMARY OF PROBLEMS ENCOUNTERED

- **Repeated Incident Energy (due to use of various samples)**

```
#DATASET     23107003
#REACTION    32-GE-74(N,G)32-GE-75,,SIG
# Prj Targ M MF MT PXC  Energy  dEnergy  Data       dData    Cos/LO    dCos/LO    ELV/HL   dELV/HL I78 Refer (YY)              EntrySubP
#--->
<----->o<-><-->ooo<-------><-------><-------><-------><-------><-------><-------><-------><-><----------------------><---><->o
    1 32074                2.5300-2          5.0700-1 5.2000-2           32075.9                     G.Meierhofer+ (10)        23107  3
    1 32074                2.5300-2          5.1600-1 5.7000-2           32075.9                     G.Meierhofer+ (10)        23107  3
    1 32074                2.5300-2          4.9400-1 5.1000-2           32075.9                     G.Meierhofer+ (10)        23107  3
```

```
#DATASET     23107002
#REACTION    32-GE-74(N,G)32-GE-75-M,,SIG
# Prj Targ M MF MT PXC  Energy  dEnergy  Data       dData    Cos/LO    dCos/LO    ELV/HL   dELV/HL I78 Refer (YY)              EntrySubP
#---><----->o<-><-->ooo<-------><-------><-------><-------><-------><-------><-------><-------><-><----------------------><---><->o
    1 32074                2.5300-2          1.3280-1 7.3000-3           32075.1                     G.Meierhofer+ (10)        23107  2
    1 32074                2.5300-2          1.3220-1 9.7000-3           32075.1                     G.Meierhofer+ (10)        23107  2
    1 32074                2.5300-2          1.2980-1 8.2000-3           32075.1                     G.Meierhofer+ (10)        23107  2
```

Output

```
#G.Meierhofer+ (10)
#23107.002      32-GE-74(N,G)32-GE-75-M,,SIG
#23107.003      32-GE-74(N,G)32-GE-75,,SIG
# PROJ.   TARG.  PROD.  ISO.1  ISO.2    DATA1-ID    DATA2-ID          EN      DATA1  DATA1-ERR      DATA2  DATA2-ERR          I          L        M/T    M/T-ERR          D
#----->
<----->o<-----><-----><-----><--------->.o<--------->.o<---------><---------><---------><---------><---------><---------><---------><---------><---------><--------->
      1  32074  32075      M      T 23107.002  23107.003  2.5300E-02 1.3280E-01 7.3000E-03 5.0700E-01 5.2000E-02 1.0000E+00 1.0097E+00 2.6193E-01 3.0480E-02 1.0025E+00
      1  32074  32075      M      T 23107.002  23107.003  2.5300E-02 1.3280E-01 7.3000E-03 5.1600E-01 5.7000E-02 1.0000E+00 1.0097E+00 2.5736E-01 3.1755E-02 1.0025E+00
      1  32074  32075      M      T 23107.002  23107.003  2.5300E-02 1.3280E-01 7.3000E-03 4.9400E-01 5.1000E-02 1.0000E+00 1.0097E+00 2.6883E-01 3.1442E-02 1.0026E+00
      1  32074  32075      M      T 23107.002  23107.003  2.5300E-02 1.3280E-01 7.3000E-03 4.9200E-01 5.1000E-02 1.0000E+00 1.0097E+00 2.6992E-01 3.1670E-02 1.0026E+00
      1  32074  32075      M      T 23107.002  23107.003  2.5300E-02 1.3280E-01 7.3000E-03 4.9800E-01 5.6000E-02 1.0000E+00 1.0097E+00 2.6667E-01 3.3378E-02 1.0026E+00
      1  32074  32075      M      T 23107.002  23107.003  2.5300E-02 1.3280E-01 7.3000E-03 4.8000E-01 5.0000E-02 1.0000E+00 1.0097E+00 2.7667E-01 3.2586E-02 1.0027E+00
      1  32074  32075      M      T 23107.002  23107.003  2.5300E-02 1.3220E-01 9.7000E-03 5.0700E-01 5.2000E-02 1.0000E+00 1.0097E+00 2.6075E-01 3.2882E-02 1.0025E+00
      1  32074  32075      M      T 23107.002  23107.003  2.5300E-02 1.3220E-01 9.7000E-03 5.1600E-01 5.7000E-02 1.0000E+00 1.0097E+00 2.5620E-01 3.3976E-02 1.0025E+00
```

3. SUMMARY OF PROBLEMS ENCOUNTERED

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

Memo CP-D/1061

Date: 9 December 2022
To: Distribution
From: N. Otsuka, A. Rodrigo

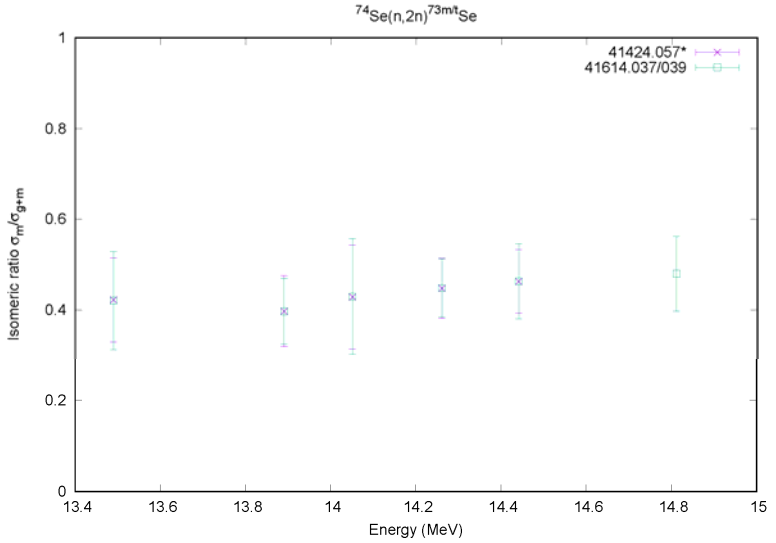
Subject: **Status of Filatenkov's activation cross sections (EXFOR 41424/41614)**

- **Twice appearance of data points from Filatenkov's experiments**
  - Activation cross sections compiled in **EXFOR 41424** from RI-258 (2001) were suppressed by the corresponding datasets in **EXFOR 41614** compiled from INDC(CCP)-0460 (2016)
  - Few subentries of EXFOR 41424 are still active entailing to compilation of same experimental results twice
  - Possible cause

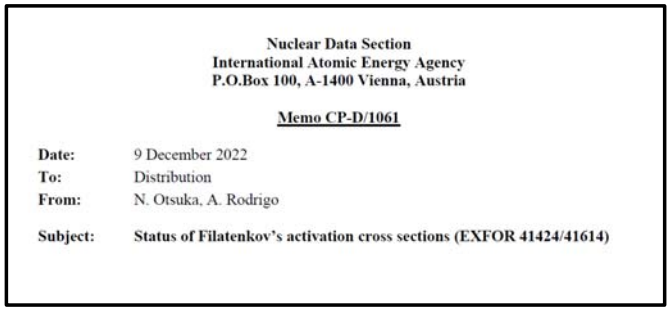
    The datasets in two entries are not for direct comparison

    -Elemental cross section v.s. isotopic cross section

    -Isomeric ratio v.s. isomer production cross sections



3. SUMMARY OF PROBLEMS ENCOUNTERED



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

Memo CP-D/1061

Date: 9 December 2022
To: Distribution
From: N. Otsuka, A. Rodrigo

Subject: **Status of Filatenkov's activation cross sections (EXFOR 41424/41614)**

- **Twice appearance of data points from Filatenkov's experiments**
  - Activation cross sections compiled in **EXFOR 41424** from RI-258 (2001) were suppressed by the corresponding datasets in **EXFOR 41614** compiled from INDC(CCP)-0460 (2016)
  - Few subentries of EXFOR 41424 are still active entailing to compilation of same experimental results twice
  - Possible cause

    The datasets in two entries are not for direct comparison

    -Elemental cross section v.s. isotopic cross section

    -Isomeric ratio v.s. isomer production cross sections

Reaction	RI-258	INDC(CCP)-0460
^{93}Nb(n,α)^{90}Y	41424.021	41614.064/065
Mo(n,x)^{95}Nb	41424.025 (isotopic xs)	41614.072
Mo(n,x)^{96}Nb	41424.026 (isotopic xs)	41614.074
^{74}Se(n,2n)^{73}Se	41424.057	41614.037/039
^{82}Se(n,2n)^{81}Se	41424.058	41614.048/050
^{93}Nb(n,α)^{90}Y	41424.059	41614.064/065
^{103}Rh(n,2n)^{102}Rh	41424.060	41614.086/088
^{116}Cd(n,2n)^{115}Cd	41424.061	41614.114/115
^{181}Ta(n,α)^{178}Lu	41424.062	41614.174/176

3. SUMMARY OF PROBLEMS ENCOUNTERED

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

Memo CP-D/1062

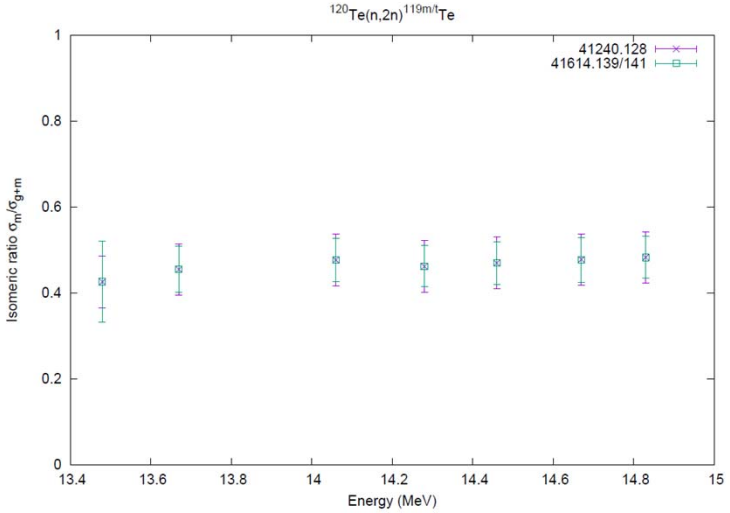
Date: 13 December 2022
To: Distribution
From: N. Otsuka, A. Rodrigo

Subject: Status of Filatenkov's activation cross sections (EXFOR 41420/41614)
Reference: Memo CP-D/1061

- **Twice appearance of data points from Filatenkov's experiments**
  - After comparison of Filatenkov's activation cross sections in EXFOR 41424 and 41614, we also found similar pairs between

    -**EXFOR 41420** from RI-252 (1999)

    -**EXFOR 41614** compiled from INDC(CCP)-0460 (2016).



Reaction	RI-252	INDC(CCP)-0460	Proposed action
^{59}Co(n,2n)^{58}Co	41240.121	41614.023/024	SPSDD
^{58}Ni(n,p)^{58}Co	41240.122	41614.026/027	?
^{89}Y(n,α)^{86}Rb	41240.123	41614.053/054	? (more points in 41240)
^{92}Mo(n,α)^{89}Zr	41240.125	41614.066/067	? (more points in 41240)
^{115}In(n,p)^{115}Cd	41240.127	41614.118/120	SPSDD
^{120}Te(n,2n)^{119}Te	41240.128	41614.139/141	SPSDD
^{122}Te(n,2n)^{121}Te	41240.129	41614.143/145	SPSDD
^{130}Te(n,2n)^{129}Te	41240.130	41614.150/152	SPSDD
^{138}Ba(n,α)^{135}Xe	41240.131	41614.153/154	SPSDD
^{151}Eu(n,α)^{148}Pm	41240.132	41614.163/165	SPSDD
^{151}Eu(n,2n)^{150}Eu	41240.133	41614.167/169	? (more points in 41240)
^{185}Re(n,2n)^{184}Re	41240.135	41614.196/198	SPSDD

4. CALCULATIONS

- **Uncertainty propagation to isomeric ratio**
  - Mathematical operations were performed to obtain all uncertainties possible
  - The uncertainties in *x* and *y* are propagated to the uncertainty in *z=f(x,y)* by

$$(\Delta z)^2 = \left(\frac{\partial z}{\partial x}\right)^2 (\Delta x)^2 + \left(\frac{\partial z}{\partial y}\right)^2 (\Delta y)^2$$

When *x* and *y* are independent

$$R_{X/Y} = \frac{\sigma_X}{\sigma_Y}\ ; \qquad X, Y = M, G, T$$

  - IR uncertainty was calculated to allow examine goodness of Talys curve by calculation of the chi-square and the root mean square F-Factor

5. GOODNESS OF FIT

- Chi-square

$$\chi^2 = (1/n)\sum_{i=1}^{n}\left[\frac{(IR_T - IR_E)}{\Delta IR_E}\right]^2$$

E ≡ EXFOR
T ≡ TALYS

- F-Factor

$$f_{rms} = exp\left[\frac{1}{n}\sum_{i=1}^{n}\ln^2 r_i\right]^{1/2}$$

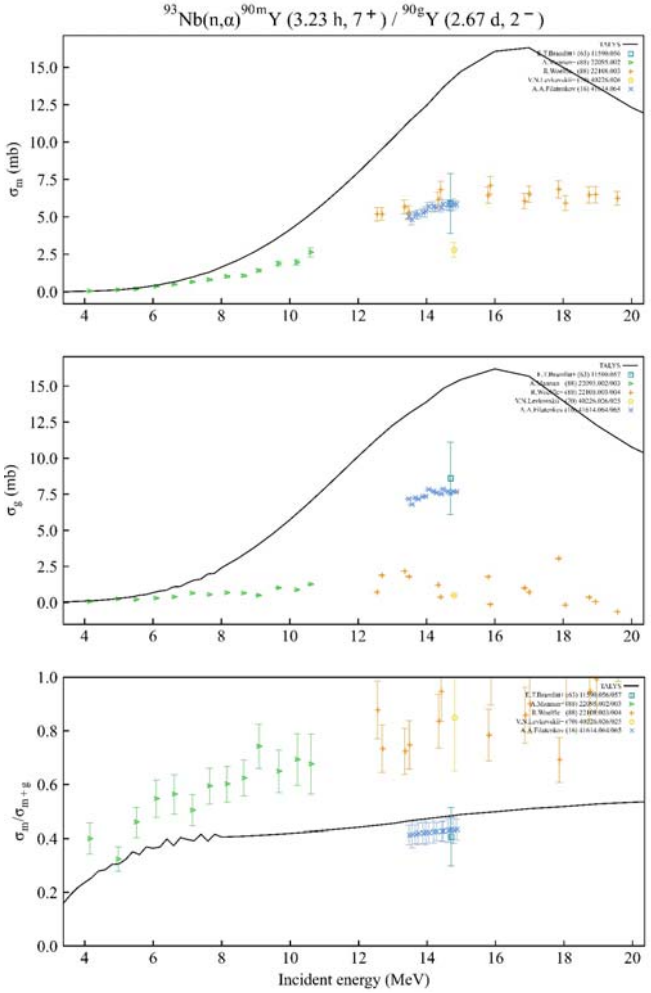
$$r = \begin{cases} \frac{\langle IR\rangle_T}{\langle IR\rangle_E - \langle \Delta IR\rangle_E} & if\ \langle IR\rangle_T < \langle IR\rangle_E - \langle \Delta IR\rangle_E \\ \frac{\langle IR\rangle_T}{\langle IR\rangle_E + \langle \Delta IR\rangle_E} & if\ \langle IR\rangle_T > \langle IR\rangle_E + \langle \Delta IR\rangle_E \\ 1 & Otherwise \end{cases}$$

PRELIMINARY

Reaction	Chi-square		F-factor	
	n	√(Σχ2/n)	n	exp[√(Σf/n)]
0Ir(a,x)194Ir	3	2645,7	3	337,1
197Au(n,x)198Au	6	326,2	1	200,5
0Pb(p,x)198Au	1	4,9	1	114,1
197Au(d,x)198Au	40	1954,6	40	103,5
0Ir(d,x)194Ir	20	381,5	20	28,0
197Au(h,x)198Au	14	301,9	12	24,9
196Hg(n,x)197Hg	3	102,7	3	22,1
198Pt(d,x)198Au	26	545,1	26	18,5
110Pd(n,x)111Pd	1	4,8	1	16,8
141Pr(n,x)142Pr	1	98,4	1	16,2
196Pt(n,x)197Pt	6	17,2	6	9,0
126Te(n,x)127Te	1	4,5	1	8,3
89Y(d,x)90Y	37	61,5	37	7,2
118Sn(p,x)118Sb	17	9,1	17	7,0
120Te(d,x)120I	26	27,1	26	6,4
170Er(n,x)170Ho	1	37,7	1	6,3
104Pd(p,x)104Ag	30	40,0	30	6,3
184W(p,x)184Re	7	6,7	7	6,1
0Pt(d,x)198Au	29	55,3	29	5,9
0Zr(p,x)95Nb	69	20,2	69	5,8
0Lu(d,x)177Lu	2	17,2	2	5,5
206Pb(p,x)198Au	1	3,3	1	5,4
176Yb(a,x)177Lu	2	19,3	2	5,2
90Zr(d,x)89Nb	6	3,3	6	5,1

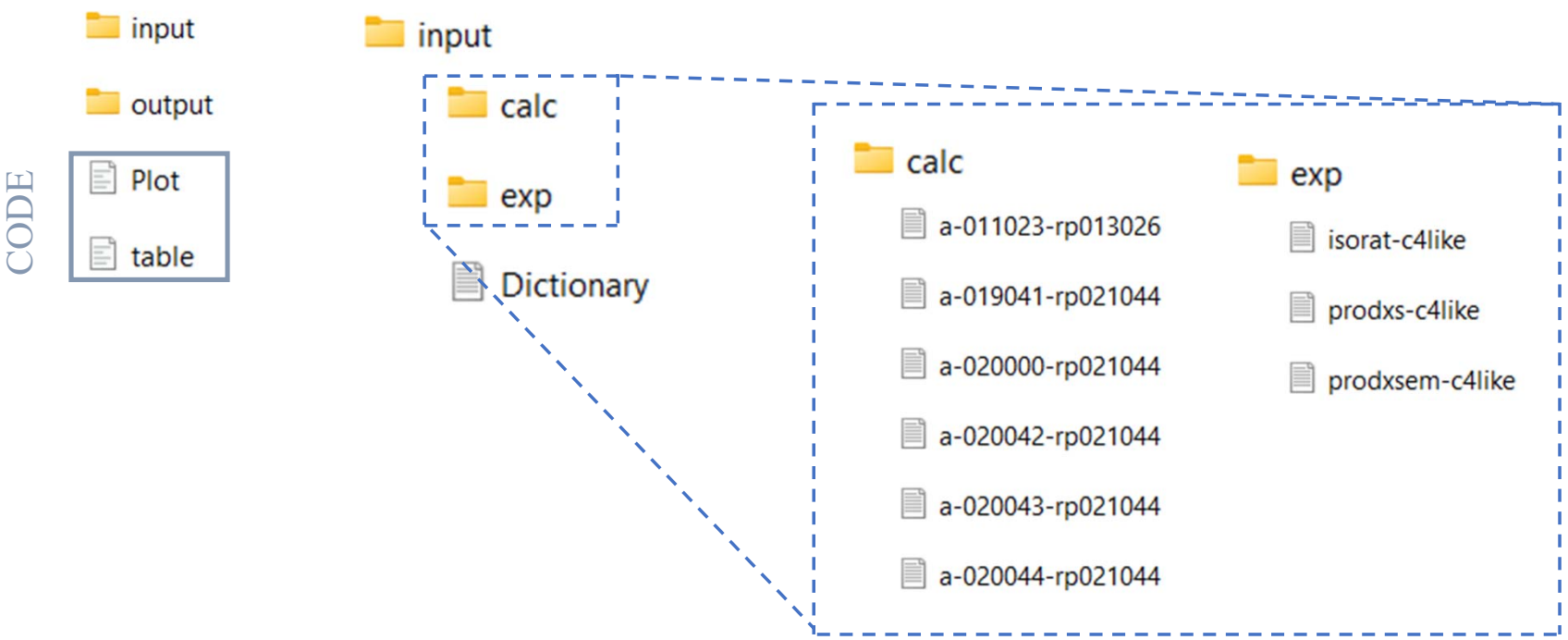
6. CONCLUSIONS

- There might be more errors like described in memos (CP-D/ 1058, 1060) not detectable by us.
- IR Plots are useful for identifying compilation errors (CP-D/ 1061, 1062)
- IR Plots are a good way to identify overestimation of the g.s. and m.s.



7. USAGE OF THE TOOL

CODE



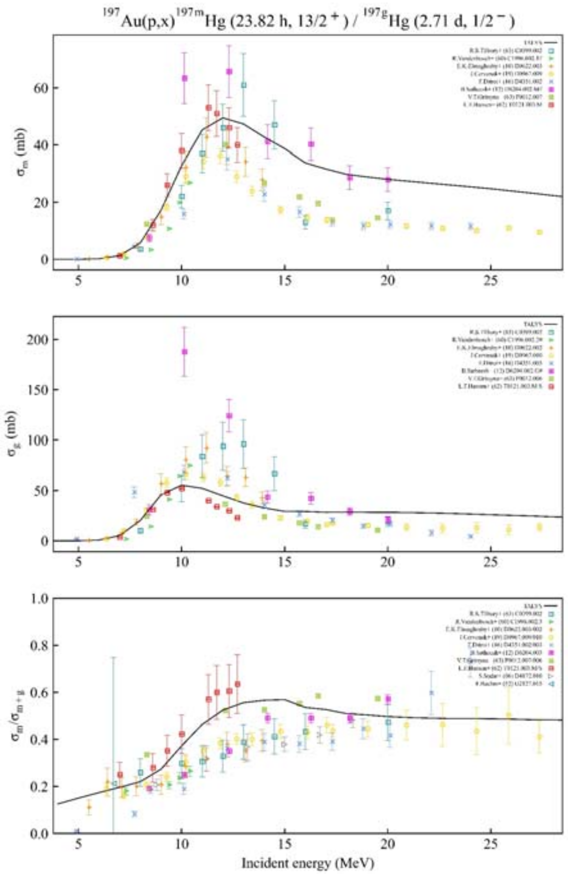
7. USAGE OF THE TOOL

CODE

- input
- output
- Plot
- table

- output
  - IR-plot
  - IR-table

1035 Reaction - Plots



~ 40000 Datapoints

```
#S.Sothras (77)
#10835.017.2   60-ND-142(N,2N)60-ND-141-M,,SIG
#10835.017.1   60-ND-142(N,2N)60-ND-141-G,,SIG
# PROJ.   TARG.  PROD.  ISO.1  ISO.2    DATA1-ID    DATA2-ID          EN       DATA1   DATA1-ERR       DATA2  DATA2-ERR          I           L         M/T    M/T-ERR          D
#----->< ----->o< ----->< ----->< -----><-------->.o<-------->.o<---------><---------><---------><---------><---------><---------><---------><---------><---------><--------->
      1  60142   60141       M       G 10835.017.2 10835.017.1 1.4800E+07 5.9300E-01 4.7000E-02 1.2810E+00 1.2500E-01 1.0000E+00 1.0070E+00 3.1644E-01 2.7192E-02 1.0022E+00

#S.Sothras (77)
#10835.024.2   78-PT-198(N,2N)78-PT-197-M,,SIG
#10835.024.1   78-PT-198(N,2N)78-PT-197-G,,SIG
# PROJ.   TARG.  PROD.  ISO.1  ISO.2    DATA1-ID    DATA2-ID          EN       DATA1   DATA1-ERR       DATA2  DATA2-ERR          I           L         M/T    M/T-ERR          D
#----->< ----->o< ----->< ----->< -----><-------->.o<-------->.o<---------><---------><---------><---------><---------><---------><---------><---------><---------><--------->
      1  78198   78197       M       G 10835.024.2 10835.024.1 1.4800E+07 7.7700E-01 7.8000E-02 1.0700E+00 1.0000E-01 9.6700E-01 1.0869E+00 4.2068E-01 3.3426E-02 1.0358E+00

#C.G.Hudson+ (78)
#10836.002.1   21-SC-45(N,2N)21-SC-44-M,,SIG
#10836.002.2   21-SC-45(N,2N)21-SC-44,,SIG
# PROJ.   TARG.  PROD.  ISO.1  ISO.2    DATA1-ID    DATA2-ID          EN       DATA1   DATA1-ERR       DATA2  DATA2-ERR          I           L         M/T    M/T-ERR          D
#----->< ----->o< ----->< ----->< -----><-------->.o<-------->.o<---------><---------><---------><---------><---------><---------><---------><---------><---------><--------->
      1  21045   21044       M       T 10836.002.1 10836.002.2 1.3300E+07 7.7000E-02 6.0000E-03 1.7200E-01 1.4000E-02 9.8800E-01-7.4076E-02 4.4767E-01 5.0444E-02 5.2237E-01
      1  21045   21044       M       T 10836.002.1 10836.002.2 1.4100E+07 9.7000E-02 8.0000E-03 2.3500E-01 1.9000E-02 9.8800E-01-7.4076E-02 4.1277E-01 4.7672E-02 5.5979E-01
      1  21045   21044       M       T 10836.002.1 10836.002.2 1.5200E+07 1.2800E-01 1.0000E-02 3.2500E-01 2.6000E-02 9.8800E-01-7.4076E-02 3.9385E-01 4.4040E-02 5.8007E-01
      1  21045   21044       M       T 10836.002.1 10836.002.2 1.6000E+07 1.3600E-01 1.1000E-02 3.5500E-01 2.8000E-02 9.8800E-01-7.4076E-02 3.8310E-01 4.3280E-02 5.9158E-01
      1  21045   21044       M       T 10836.002.1 10836.002.2 1.7100E+07 1.5900E-01 1.6000E-02 4.3400E-01 3.5000E-02 9.8800E-01-7.4076E-02 3.6636E-01 4.7244E-02 6.0951E-01
      1  21045   21044       M       T 10836.002.1 10836.002.2 1.8400E+07 1.7000E-01 1.7000E-02 4.9100E-01 4.9000E-02 9.8800E-01-7.4076E-02 3.4623E-01 4.8915E-02 6.3105E-01
```

ACKNOLEDGEMENT

I would like to thank Naohiko, Viktor, Georg, Arjan and the people in the NDS for the opportunity and their fruitful job environment.

THANK YOU FOR YOUR KIND ATTENTION