**Nuclear Data Section**

**International Atomic Energy Agency**

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**Memo CP-D/1058**

**Date:** 27 September 2022

**To:** Distribution

**From:** A. Rodrigo, N. Otsuka

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

In the relation with Action 61 of the NRDC 2022 meeting (“Check presence of the cross sections compiled as total (=ground state plus metastable state) independent production cross sections but deviation of the measured values from the actual total cross sections may be nonnegligible.”), we are developing a tool to construct a experimental database of isomeric ratios (M/T) by

* extraction of isomer production cross sections from EXFOR (=C5 library received from Viktor Zerkin) and calculation of the corresponding M/T isomeric ratios
* extraction of isomeric ratios from EXFOR (=quasi-C4 data lines generated from a X4Pro database, which SQL sentence is appended) and conversions of the ratios to M/T ratios when necessary

Our scope is limited to the quantities defined by REACTION

* SF4: no isomer flag, -G or -M
* SF5: empty, M- or IND
* SF7, SF8: empty
* SF9: empty or EXP

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

**#1. Datasets against the relation 0 < σM/σT < 1**

We found 22 datasets showing the ratio σM/σT less than 0 or larger than 1. Among them 9 cases are due to compilation errors. See **Table 1** for a list of the datasets.

**#2. Datasets against the relation σT=σG+σM or IR(x/y)=σx/σy (x, y = G, M or T)**

We define the “deviation” by

[σT – (σG + σM)]/(σG+σM) for cross sections

IR(x/y) - σx/σy for isomeric ratios

***Example 1***:

#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**

…

CALCULATED gives the sum of the compiled m.s. and g.s. production cross sections while EXFORDATA gives the compiled total production cross section. The compiled total production cross section at 14.1 MeV is 57.5% higher than the sum of the ground and metastable state production cross sections. (This is due to coding mistakes in incident energies in 20836.024.)

***Example 2***:

#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**

CALCULATED gives the ratio of the compiled m.s. and g.s. production cross sections while EXFORDATA gives the compiled isomeric ratio. The compiled isomeric ratios are ~100% higher than the ratio of the metastable and ground state production cross sections. (This is due to swapping of DATA and ERR-T must be swapped in 32781.005.4.)

We found deviations exceeding 1% in (1) 51 dataset pairs of isomer production cross section and their sum, and (2) 36 dataset pairs of isomer production cross sections and their ratios.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | EXFOR error | Author’s typo | ? | Ok |
| Cross sections | 7 | 1 | 14 | 29 |
| Isomeric ratios | 6 | 0 | 8 | 22 |

? means a suspicious case without a clear explanation for us (You might have an idea to resolve the discrepancy). All 87 datasets are summarized in **Table 2** appended to this memo.

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**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. |
| S.Takacs+ (2013) | D4279.003(M) | D4279.004(T) | Yes | 52-TE-119 -> 52-TE-119-G in 004. |
| S.Takacs+ (2013) | D4279.005(M) | D4279.006(T) | Yes | 52-TE-121 -> 52-TE-121-G in 006. |
| R.E.Batzel+ (1953) | P0067.005(G) | P0067.004(T) | Yes | 11-NA-24-G -> 11-NA-24 in 005. |
| A.Poularikas+ (1959) | 11484.011(M) | 11484.009(T) | No | The m.s. cross section in 011 is derived from 22 min beta activity, which is not known as a 50Sc isomer now. |
| R.Woelfle+ (1988) | 22108.003(M) | 22108.004(T) | No | Compiled as published. |
| A.Ercan+ (1991) | 22338.004(M) | 22338.005(T) | No | Compiled as published. |
| O.I.Artem'ev+ (1980) | 41321.010(M) | 41321.009(T) | No | Compiled as published. (CO-62 -> CO-62-G? IT~0!) |
| E.A.Skakun+ (1987) | A0338.002.1(M) | A0338.002.3(T) | No | Compiled as published. |
| V.N.Levkovski (1991) | A0510.463(M) | A0510.464(T) | No | Compiled as published. |
| V.S.Buttsev+ (1991) | A0561.003(M) | A0561.002(T) | No | Compiled as published. |
| F.M.Lanzafame+ (1970) | B0042.004.M(M) | B0042.004.T(T) | No | Compiled as published. |
| P.Kruger+ (1955) | C0297.010.5(M) | C0297.010.6(T) | No | Compiled as published. (CD-115 -> CD-115-G? IT=0!) |
| P.Kruger+ (1955) | C0297.014.4(M) | C0297.014.5(T) | No | Compiled as published. (CD-115 -> CD-115-G? IT=0!) |
| P.Kruger+ (1955) | C0297.018.4(M) | C0297.018.5(T) | No | Compiled as published. (CD-115 -> CD-115-G? IT=0!) |
| P.Kruger+ (1955) | C0297.021(M) | C0297.022(T) | No | Compiled as published. (CD-115 -> CD-115-G? IT=0!) |
| R.T.Skelton+ (1987) | C0304.003(M) | C0304.005(G) | No | Negative g.s. cross section in 005 due to subtraction of m.s.cross section and 416 keV gamma production cross section from the total (p,n+x) cross section. Note that C0304.005 is not g.s. production cross section but (p,n0) cross section. |
| S.Kastleiner+ (2004) | D0259.002(M) | D0259.003(T) | No | Compiled as published. |
| F.Tarkanyi+ (2012) | D4260.003(M) | D4260.004(T) | No | Compiled as published. |
| F.Ditroi+ (2012) | D4262.007(M) | D4262.008(T) | No | Compiled as published. |
| M.K.Sharma+ (2007) | D6008.006(M) | D6008.002(T) | No | Compiled as published. |
| K.S.Kim+ (2018) | D7030.009(M) | D7030.010(T) | No | Compiled as published. |

**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 |
| R | G.P.Vinitskaya | 4KASKAZ | 40009.010.1 | 40009.011.1 | 40009.011.2 | 26.1 | 40009.011.2 | REACTION | Must be (31-GA-71(N,P)30-ZN-71-G,,SIG)/(31-GA-69(N,P)30-ZN-69-M,,SIG) |
| R | Junhua Luo | 3CPRHXU | 32779.002.1 | 32779.002.2 | 32779.002.4 | 24.9 | 32779.002.4 | REACTION | SF4: M/G -> M/T |
| T | Z.Halasz | 3HUNDEB | D4271.004 | D4271.003 | D4271.005 | 7.9 | D4271.005 | Data | G.Gyurkey (2022-08-31): Typo in Table III. The correct number at Ecm=14.509 MeV is 46325+/-5660 mb. |
| T | G.Meierhofer | 2GERTUE | 23092.002 | 23092.004 | 23092.008 | 4.5 | 23092.004 | STATUS | Add (SPSDD,23092.009). |
| T | Chuanxin Zhu | 3CPRNPC | 32696.008.2 | 32696.008.1 | 32696.008.3 | 4.5 | 32696.008.3 | Data | 1909 mb -> 1999 mb at 14.65 MeV |
| R | A.G.Dovbenko | 4RUSFEI | 40344.003 | 40344.002 | 40344.004 | 3.6 | 40344.004 | Data | 0.348 -> 0.384 at 1610 keV. |
| T | O.Lebeda | 3CZRUJF | D0777.002 | D0777.004 | D0777.003 | 1.6 | D0777.003 | REACTION | SF4-SF6: Use 40-ZR-89-G,M+,SIG. (But there are anyway discrepancies. Question sent to Lebeda. Compiled from Table 3 appropriately.) |

2) Case which is suspicious but without a clear reason

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Type** | **1st author** | **1st institute** | **Dataset 1** | **Dataset 2** | **Dataset 3** | **Deviation(%)** | **Problem in** | **Keyword** | **Remarks** |
| R | T.Matsuo | 1USACLK | C0718.015 | C0718.014 | C0718.005 | 655.1 |   |   | Cross sections compiled from CPX. |
| R | K.Kim | 3KORKNU | D6253.002 | D6253.003 | D6253.008 | 209.8 |   |   | Data compiled from Tables 2+3 properly. Question sent to Yang. |
| C | V.N.Levkovskii | 4KASKAZ | 40029.016.1 | 40029.016.2 | 40029.016.3 | 58.3 |   |   | Data compiled from Tables I+II properly. |
| C | V.N.Levkovskii | 4KASKAZ | 40029.013.1 | 40029.013.2 | 40029.013.3 | 30.4 |   |   | Data compiled from Tables I+II properly. |
| R | E.A.Skakun | 4UKRKFT | A0338.002.1 | A0338.002.2 | A0338.002.3 | 20.0 |   |   | Data at 6.5 MeV compiled from Table 1 properly. Typo? 130 mb? 5/(125+5)~0.038 which agrees with the published isomeric ratio. |
| R | F.Cserpak | 3HUNKOS | 31432.003 | 31432.005 | 31432.004 | 17.4 |   |   | Data at 14.12 and 14.71 MeV compiled from Table I properly. Question sent to Cserpak. |
| C | A.A.Filatenkov | 4RUSRI | 41614.137 | 41614.136 | 41614.138 | 9.3 |   |   | Data at 14.49, 14.70 and 14.88 MeV compiled from Table (p.168) properly. Question sent to Filatenkov. |
| C | B.Satheesh | 3INDCCT | D6178.003 | D6178.002 | D6178.004 | 8.6 |   |   | Data compiled by an author (=Musthafa). Question sent to Musthafa. |
| C | K.L.Chen | 1USACOL | D4105.009.1 | D4105.009.2 | D4105.009.3 | 8.6 |   |   | Disagreement seen at 11.5 MeV (1.4 mb+3.5 mb < 5.0 mb, which are as presented in Table V) |
| C | M.Bormann | 2GERHAM | 20614.007.2 | 20614.007.1 | 20614.006 | 8.3 |   |   | Disagreement seen at 15.62, 16.41, 17.21, 18.21 MeV but the numbers are compiled from Table 2 properly. |
| R | Y.Kanda | 2JPNKYU | 20338.013 | 20338.012 | 20338.014 | 7.5 |   |   | Disagreement seen at all energies but the numbers are compiled from Table 2 properly. |
| C | K.L.Chen | 1USACOL | D4105.010.1 | D4105.010.2 | D4105.010.3 | 7.1 |   |   | Disagreement seen at 15.6 MeV (12.7 mb+29.3 mb < 45.0 mb, which are as presented in Table VI) |
| R | B.Minetti | 2ITYTUR | 21107.002 | 21107.003 | 21107.005 | 6.3 |   |   | Data compiled from Table 3 properly.  |
| R | S.K.Mangal | 3INDMUA | 31254.005 | 31254.006 | 31254.009 | 4.9 |   |   | Data compiled from Tables 1 and 2 properly. |
| C | V.A.Tolstikov | 4RUSFEI | 40007.004 | 40007.003 | 40007.005.1 | 4.5 |   |   | Large deviation at 844 keV. Data received from an author. |
| C | Y.Kanda | 2JPNKYU | 20338.013 | 20338.012 | 20338.015 | 4.3 |   |   | Negative metastable state production cross section at 13.41 MeV. Disagreement seen at 14.17 MeV but the numbers are compiled from Table 2 properly.  |
| R | V.A.Tolstikov | 4RUSFEI | 40007.004 | 40007.003 | 40007.005.2 | 3.6 |   |   | Large deviation at 844 keV. Data received from an author. |
| C | M.J.Ozafran | 3ARGCNE | A0556.003 | A0556.004 | A0556.008 | 3.3 |   |   | Data at 25.3 MeV compiled from Table 2 properly. |
| C | Y.Kanda | 2JPNKYU | 20338.008 | 20338.007 | 20338.010 | 2.9 |   |   | Negative metastable state production cross section at 13.51 MeV. |
| C | K.S.Krane | 1USAORU | 14107.004 | 14107.003 | 14107.002 | 2.5 |   |   | Data compiled from Table II properly. -G,M+ in 002? Question sent to Krane. |
| C | S.N.Kondratyev | 4UKRIJD | A0583.008 | A0583.009 | A0583.010 | 2.4 |   |   | Data compiled from Table III properly. |
| C | A.A.Filatenkov | 4RUSRI | 41614.114 | 41614.113 | 41614.115 | 1.8 |   |   | The discrepancy at 14.88 MeV is resolved if we adopt the g.s. cross section at 14.80 MeV (794 mb). Question sent to Filatenkov. |

3) Case where the deviation is understandable (not for corrections)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Type** | **1st author** | **1st institute** | **Dataset 1** | **Dataset 2** | **Dataset 3** | **Deviation(%)** | **Problem in** | **Keyword** | **Remarks** |
| C | J.Wing | 1USAANL | T0124.003.M | T0124.003.G | T0124.003.S | 84.1 |   |   | (Ok. Multiple measurements at the same incident energy.) |
| C | K.L.Chen | 1USACOL | D4105.002.3 | D4105.002.4 | D4105.002.5 | 61.9 |   |   | (Ok. Multiple measurements at the same incident energy.) |
| R | D.C.Aumann | 2GERMUN | B0086.003.M | B0086.003.G | B0086.003.R | 26.1 |   |   | (Ok. Precision.) |
| R | T.Matsuo | 1USACLK | C0718.017 | C0718.016 | C0718.006 | 23.8 |   |   | (Ok. The partial cross sections are from CPX.) |
| C | V.Wagner | 3CZRUJF | 31723.002 | 31723.003 | 31723.006.1 | 21.1 |   |   | (Ok. The sum and partial cross sections are not from the same experiment.) |
| C | E.Simeckova | 3CZRUJF | D0996.018 | D0996.019 | D0996.020 | 20.4 |   |   | (Ok? The 87Y "total" cross section is not the simple sum of the partial cross sections. One is not derived from the other two cross sections.) |
| C | T.Matsuo | 1USACLK | C0718.019 | C0718.018 | C0718.007 | 20.0 |   |   | (Ok. The partial cross sections are from CPX.) |
| R | G.Meierhofer | 2GERTUE | 23062.004.1 | 23062.003.2 | 23062.005.2 | 13.9 |   |   | (Ok. The ratio is not from these partial cross sections.) |
| C | S.Della Negra | 2FR PAR | B0129.013.M | B0129.013.G | B0129.013.S | 12.9 |   |   | (Ok. Multiple measurements at the same incident energy for total.) |
| R | G.Meierhofer | 2GERTUE | 23062.004.1 | 23062.003.2 | 23062.005.1 | 10.9 |   |   | (Ok. The ratio is not from these partial cross sections.) |
| C | Yu.E.Titarenko | 4RUSITE | A0901.027 | A0901.028 | A0901.029 | 10.7 |   |   | (Ok. g.s. and total cross sections are from g.s. activity while m.s. cross sections from g.s. and m.s. activity.) |
| C | E.K.Elmaghraby | 3EGYCAI | D0949.003 | D0949.005 | D0949.004.1 | 9.2 |   |   | (Ok. Agreement is confirmed if we take the average of 004.1 and 004.2) |
| C | E.K.Elmaghraby | 3EGYCAI | D0949.003 | D0949.005 | D0949.004.2 | 9.2 |   |   | (Ok. Agreement is confirmed if we take the average of 004.1 and 004.2) |
| C | M.Viennot | 2FR FR | 30978.024 | 30978.025 | 30978.026 | 7.1 |   |   | 811 keV gamma activity was decomposed to two components probably by decay curve analysis. |
| C | Yu.E.Titarenko | 4RUSITE | A0901.066 | A0901.067 | A0901.068 | 7.0 |   |   | (Ok. g.s. and total cross sections are from g.s. activity while m.s. cross sections from g.s. and m.s. activity.) |
| R | R.Vandenbosch | 1USAANL | C1996.003.1 | C1996.003.2 | C1996.003.3 | 5.3 |   |   | (Ok. Multiple data points at 16.5 MeV.) |
| R | Junhua Luo | 3CPRLNZ | 31609.007 | 31609.006 | 31609.010 | 5.1 |   |   | (Ok. Precision.) |
| R | J.P.Didelez | 2GERJUL | A0208.002.B | A0208.002.A | A0208.002.C | 5.0 |   |   | (Ok. Precision.) |
| R | Junhua Luo | 3CPRHXU | 32717.002.1 | 32717.002.2 | 32717.002.4 | 4.9 |   |   | (Ok. Precision.) |
| C | Yu.E.Titarenko | 4RUSITE | A0906.040 | A0906.041 | A0906.042 | 4.9 |   |   | (Ok. g.s. and total cross sections are from g.s. activity while m.s. cross sections from g.s. and m.s. activity.) |
| C | D.R.Sachdev | 1CANMCG | B0069.005.M | B0069.005.G | B0069.005.T | 4.8 |   |   | (Ok. Precision.) |
| R | S.Fukushima | 2JPNOSA | E1874.007 | E1874.006 | E1874.011 | 4.3 |   |   | (Ok. Precision.) |
| R | Junhua Luo | 3CPRHXU | 32805.002.1 | 32805.002.2 | 32805.002.4 | 4.2 |   |   | (Ok. Precision.) |
| C | J.J.Hogan | 1CANMCG | B0025.005.M | B0025.005.G | B0025.005.S | 4.2 |   |   | (Ok. Precision.) |
| R | S.K.Mangal | 3INDMUA | 31254.003 | 31254.004 | 31254.011 | 4.1 |   |   | (Ok. Precision.) |
| C | Yu.E.Titarenko | 4RUSITE | A0906.152 | A0906.153 | A0906.154 | 4.0 |   |   | (Ok. g.s. and total cross sections are from g.s. activity while m.s. cross sections from g.s. and m.s. activity.) |
| C | M.K.Bhardwaj | 3INDMUA | D6209.008 | D6209.009 | D6209.007 | 3.9 |   |   | (Ok. Digitized values.) |
| R | H.Roetzer | 2AUSIRK | 20063.003 | 20063.002 | 20063.004.1 | 3.3 |   |   | (Ok. Precision.) |
| R | C.Riley | 1USAFSU | C1756.002 | C1756.003 | C1756.004 | 3.2 |   |   | (Ok. Multiple data points at 14 MeV) |
| C | C.Yalcyn | 3HUNDEB | C1715.004.1 | C1715.004.2 | C1715.003.1 | 3.1 |   |   | (Ok. Precision.) |
| C | P.A.Beeley | 1CANMCG | C0932.002.1 | C0932.002.3 | C0932.003 | 2.8 |   |   | (Ok. Multiple measurements at the same incident energy.) |
| C | J.Brzosko | 3POLWWA | 30136.018 | 30136.019 | 30136.020 | 2.6 |   |   | (Ok. Precision.) |
| C | D.J.Reuland | 1USACAR | B0071.002.M | B0071.002.G | B0071.002.S | 2.6 |   |   | (Ok. Precision.) |
| C | F.Tarkanyi | 3HUNDEB | D4143.008.2 | D4143.008.3 | D4143.008.1 | 2.6 |   |   | (Ok. Precision.) |
| R | B.Minetti | 2ITYTUR | 21106.019 | 21106.020 | 21106.022 | 2.4 |   |   | (Ok. Precision.) |
| R | H.Roetzer | 2AUSIRK | 20063.007 | 20063.006 | 20063.008.1 | 2.4 |   |   | (Ok. Precision.) |
| C | H.H.Bissem | 2GERHAM | A0347.003.2 | A0347.003.3 | A0347.003.4 | 2.2 |   |   | (Ok. Precision.) |
| C | E.Simeckova | 3CZRUJF | 31764.008.1 | 31764.009.1 | 31764.007 | 2.0 |   |   | (Ok. Multiple measurements at the same incident energy.) |
| R | M.Al-Abyad | 2GERJUL | 22935.003 | 22935.002 | 22935.009 | 1.8 |   |   | (Ok. Isomeric values are digitized.) |
| C | A.A.Filatenkov | 4RUSRI | 41614.225 | 41614.226 | 41614.227 | 1.8 |   |   | (Ok. Precision.) |
| R | T.B.Ryves | 2UK NPL | 22100.004 | 22100.002 | 22100.005 | 1.7 |   |   | (Ok? The ratio was measured separately from the partial cross section? Data compiled from Table 2 appropriately.) |
| R | R.Vanska | 2SF OUL | 21892.006.1 | 21892.006.2 | 21892.003.2 | 1.7 |   |   | (Ok. Multiple measurements of the metastable state production at the same incident energy - 21892.007) |
| C | F.Hermes | 2GERBON | B0033.002.M | B0033.002.G | B0033.002.S | 1.6 |   |   | (Ok. Precision.) |
| R | B.Minetti | 2ITYTUR | 21106.014 | 21106.015 | 21106.017 | 1.6 |   |   | (Ok. Precision.) |
| C | B.Minetti | 2ITYTUR | 21107.022 | 21107.023 | 21107.024 | 1.5 |   |   | (Ok. Precision.) |
| R | F.Tarkanyi | 3HUNDEB | D4027.004 | D4027.003 | D4027.005 | 1.3 |   |   | (Ok. Precision.) |
| C | V.G.Batij | 4UKRKFT | A0304.014 | A0304.015 | A0304.016.1 | 1.3 |   |   | (Ok. Precision.) |
| C | J.Bork | 2GERKFK | A0654.003 | A0654.002 | A0654.004 | 1.2 |   |   | (Ok. Precision.) |
| R | Megha Bhike | 1USATNL | 14472.002  | 14472.003  | 14472.005  | 1.2 |   |   | (Ok. Precision.) |
| R | R.F.Schall | 1USACAR | C0346.010.1 | C0346.010.2 | C0346.010.3 | 1.2 |   |   | (Ok. Precision.) |
| C | R.Vanska | 2SF OUL | 21892.006.1 | 21892.006.2 | 21892.003.1 | 1.1 |   |   | (Ok. Multiple measurements of the metastable state production at the same incident energy - 21892.007) |
| C | J.Wing | 1USAANL | T0124.003.M | T0124.003.G | T0124.003.S | 84.1 |   |   | (Ok. Multiple measurements at the same incident energy.) |

**SQL sentence for extraction of isomeric ratios from X4Pro**

SELECT DISTINCT x4pro\_ds.reacode,x4pro\_ds.year1, x4pro\_ds.author1ini, x4pro\_ds.author1, x4pro\_ds.DatasetID

,hdr\_x1.hdr as x1hdr, hdr\_x1.units, json\_extract(x4.xdat,'$.'||hdr\_x1.hdr)

,hdr\_x2.hdr as x2hdr, hdr\_x2.units, json\_extract(x4.xdat,'$.'||hdr\_x2.hdr)

,hdr\_x3.hdr as x3hdr, hdr\_x3.units, json\_extract(x4.xdat,'$.'||hdr\_x3.hdr)

,hdr\_dx1.hdr as dx1hdr, hdr\_dx1.units, json\_extract(x4.xdat,'$.'||hdr\_dx1.hdr)

,hdr\_dx2.hdr as dx2hdr, hdr\_dx2.units, json\_extract(x4.xdat,'$.'||hdr\_dx2.hdr)

,hdr\_dx3.hdr as dx3hdr, hdr\_dx3.units, json\_extract(x4.xdat,'$.'||hdr\_dx3.hdr)

,hdr\_y.hdr as yhdr, hdr\_y.units, json\_extract(x4.xdat,'$.'||hdr\_y.hdr)

,hdr\_dy1.hdr as dy1hdr, hdr\_dy1.units, json\_extract(x4.xdat,'$.'||hdr\_dy1.hdr)

,hdr\_dy2.hdr as dy1hdr, hdr\_dy2.units, json\_extract(x4.xdat,'$.'||hdr\_dy2.hdr)

,hdr\_dy3.hdr as dy1hdr, hdr\_dy3.units, json\_extract(x4.xdat,'$.'||hdr\_dy3.hdr)

,x4.idat

FROM x4pro\_ds

INNER JOIN REACSTR ON REACSTR.ReacodeID = x4pro\_ds.DatasetID

INNER JOIN x4pro\_x4data as x4 ON x4.DatasetID = x4pro\_ds.DatasetID

INNER JOIN x4pro\_hdr ON x4pro\_hdr.DatasetID = x4pro\_ds.DatasetID

INNER JOIN REACODE ON REACODE.ReacodeID = x4pro\_ds.DatasetID

INNER JOIN SUBENT ON REACODE.SubentID = SUBENT.SubentID

INNER JOIN x4pro\_hdr as hdr\_x ON REACODE.ReacodeID = hdr\_x.DatasetID

 AND (hdr\_x.hdr='EN' or hdr\_x.hdr='EN-MIN' or hdr\_x.hdr='EN-MAX')

LEFT JOIN x4pro\_hdr as hdr\_x1 ON REACODE.ReacodeID = hdr\_x1.DatasetID AND hdr\_x1.hdr ='EN'

LEFT JOIN x4pro\_hdr as hdr\_x2 ON REACODE.ReacodeID = hdr\_x2.DatasetID AND hdr\_x2.hdr ='EN-MIN'

LEFT JOIN x4pro\_hdr as hdr\_x3 ON REACODE.ReacodeID = hdr\_x3.DatasetID AND hdr\_x3.hdr ='EN-MAX'

LEFT JOIN x4pro\_hdr as hdr\_dx1 ON REACODE.ReacodeID = hdr\_dx1.DatasetID AND hdr\_dx1.hdr='EN-ERR'

LEFT JOIN x4pro\_hdr as hdr\_dx2 ON REACODE.ReacodeID = hdr\_dx2.DatasetID AND hdr\_dx2.hdr='EN-RSL'

LEFT JOIN x4pro\_hdr as hdr\_dx3 ON REACODE.ReacodeID = hdr\_dx3.DatasetID AND hdr\_dx3.hdr='EN-RSL-HF'

INNER JOIN x4pro\_hdr as hdr\_y ON REACODE.ReacodeID = hdr\_y.DatasetID AND hdr\_y.hdr ='DATA'

LEFT JOIN x4pro\_hdr as hdr\_dy1 ON REACODE.ReacodeID = hdr\_dy1.DatasetID AND hdr\_dy1.hdr='ERR-T'

LEFT JOIN x4pro\_hdr as hdr\_dy2 ON REACODE.ReacodeID = hdr\_dy2.DatasetID AND hdr\_dy2.hdr='ERR-S'

LEFT JOIN x4pro\_hdr as hdr\_dy3 ON REACODE.ReacodeID = hdr\_dy3.DatasetID AND hdr\_dy3.hdr='DATA-ERR'

WHERE 1=1

AND (REACSTR.SF4 like '%-M/T' or REACSTR.SF4 like '%-G/T' or REACSTR.SF4 like '%-M/G' or REACSTR.SF4 like '%-G/M')

AND REACSTR.SF5 = ''

AND REACSTR.SF6 = 'SIG/RAT'

AND REACSTR.SF7 = ''

AND REACSTR.SF8 = ''

AND (REACSTR.SF9 = '' or REACSTR.SF9 = 'EXP')

AND SUBENT.SPSDD = 0

ORDER BY x4pro\_ds.reacode, x4pro\_ds.DatasetID, x4.idat