**Nuclear Data Section**

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**Memo CP-D/1023**

**Date:** 8 September 2021

**To:** Distribution

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**Subject: Use of branch code M+ or (M) without an isomer code in REACTION SF4**

The branch code M+ and (M) may be in REACITON SF5 only when the product nuclide coded in REACTION SF4 has an isomer code (usually -G but can be -M). See also LEXFOR “Independent and Cumulative Data”. I found 50 REACTION codes violating this rule in EXFOR Master 2021-08-17, and summarized my proposals of corrections in the appendix of this memo.

In the appendix, removal of M+ or (M) is proposed systematically when (1) there is no indication of an isomeric state (e.g., “g”) in the cross section table or figure, (2) the metastable state half-life is shorter than 10% of the ground state half-life, and (3) the isomeric transition probability of the metastable state is 100%. (The conditions (2) and (3) would be bit too strong.)

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**Proposals on corrections of REACTION codes coded with SF5=M+ or (M) without an isomer code in SF4**

HLg: Half-life of the ground state

HLm: Half-life of the metastable state

ITm: Isomeric transition probability from the metastable state to the ground state

HLm2: Half-life of the second metastable state

ITm2: Isomeric transition probability from the second metastable state to the ground state

HLm/HLg and HLm2/HLg: Half-life ratio

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Subentry** | **REACTION** | **Proposed correction** | **HLg (sec)** | **HLm (sec)** | **HLm/ HLg** | **ITm (%)** | **HLm2 (sec)** | **HLm2/ HLg** | **ITm2 (%)** |
| 12866.062 | (37-RB-85(N,G)37-RB-86,M+,SIG,,SPA) | Remove M+ in SF5. | 1.61E+06 | 6.10E+01 | 3.79E-05 | 100 |  |  |  |
| 12866.063 | (37-RB-85(N,G)37-RB-86,M+,RI) | Remove M+ in SF5. | 1.61E+06 | 6.10E+01 | 3.79E-05 | 100 |  |  |  |
| 12866.172 | (71-LU-176(N,G)71-LU-177,M+,SIG,,SPA) | Add -G to SF4. | 5.74E+05 | 1.39E+07 | 2.42E+01 | 22.7 |  |  |  |
| 12866.173 | (71-LU-176(N,G)71-LU-177,M+,RI) | Add -G to SF4. | 5.74E+05 | 1.39E+07 | 2.42E+01 | 22.7 |  |  |  |
| 30063.011 | (79-AU-197(N,G)79-AU-198,(M),SIG) | Remove (M) in SF5. (It is known that the m/g ratio is close to zero.) | 2.33E+05 | 1.96E+05 | 8.41E-01 | 100 |  |  |  |
| 30501.005 | (52-TE-130(N,G)52-TE-131,M+,SIG) | Add -G to SF4. | 1.50E+03 | 1.20E+05 | 8.00E+01 | 25.9 |  |  |  |
| 30755.012 | (38-SR-86(N,2N)38-SR-85,M+,SIG) | Add -G to SF4. | 5.60E+06 | 4.06E+03 | 7.25E-04 | 86.6 |  |  |  |
| A0026.094 | (82-PB-0(P,X)21-SC-46,M+,SIG) | Remove M+ in SF5. | 7.24E+06 | 1.88E+01 | 2.60E-06 | 100 |  |  |  |
| A0026.101 | (82-PB-0(P,X)37-RB-84,M+,SIG) | Remove M+ in SF5. | 2.84E+06 | 1.22E+03 | 4.30E-04 | 100 |  |  |  |
| A0026.112 | (82-PB-0(P,X)51-SB-122,M+,SIG) | Remove M+ in SF5. | 2.35E+05 | 5.30E-04 | 2.26E-09 | 100 | 2.51E+02 | 1.07E-03 | 100 |
| A0148.024 | (26-FE-0(A,X)25-MN-52,M+,SIG) | Add -G to SF4 (confirmed by Rolf Michel, 2021-08-17) | 4.83E+05 | 1.27E+03 | 2.63E-03 | 1.78 |  |  |  |
| A0209.017 | (27-CO-59(D,X)21-SC-46,M+,SIG) | Remove M+ in SF5. | 7.24E+06 | 1.88E+01 | 2.60E-06 | 100 |  |  |  |
| A0210.013 | (27-CO-59(HE3,X)25-MN-52,M+,SIG) | Add -G to SF4 (confirmed by Rolf Michel, 2021-08-17) | 4.83E+05 | 1.27E+03 | 2.63E-03 | 1.78 |  |  |  |
| A0644.006 | (27-CO-59(A,N+A)27-CO-58,M+,SIG) | Remove M+ in SF5. | 6.12E+06 | 3.28E+04 | 5.36E-03 | 100 |  |  |  |
| A0695.004 | (41-NB-93(P,N+A)40-ZR-89,M+,SIG) | Use X in SF3. Add -G to SF4. | 2.82E+05 | 2.50E+02 | 8.87E-04 | 93.77 |  |  |  |
| A0711.002 | (46-PD-0(D,X)47-AG-103,M+,SIG) | Remove M+ in SF5. | 3.94E+03 | 5.70E+00 | 1.45E-03 | 100 |  |  |  |
| A0711.003 | (46-PD-0(P,X)47-AG-103,M+,SIG) | Remove M+ in SF5. | 3.94E+03 | 5.70E+00 | 1.45E-03 | 100 |  |  |  |
| B0020.017 | (28-NI-61(P,A)27-CO-58,(M),SIG) | Remove (M) in SF5. | 6.12E+06 | 3.28E+04 | 5.36E-03 | 100 |  |  |  |
| B0038.004 | (73-TA-181(P,3N)74-W-179,(M),SIG,,,EXP) | Add -G to SF4. | 2.22E+03 | 3.84E+02 | 1.73E-01 | 99.71 |  |  |  |
| B0041.005 | (26-FE-56(P,N+A)25-MN-52,(M),SIG,,,EXP) | Add -G to SF4. | 4.83E+05 | 1.27E+03 | 2.63E-03 | 1.78 |  |  |  |
| B0050.008 | (27-CO-59(P,X)27-CO-58,(M),SIG,,,EXP) | Remove (M) in SF5. | 6.12E+06 | 3.28E+04 | 5.36E-03 | 100 |  |  |  |
| B0079.014 | (29-CU-63(HE3,X)27-CO-58,M+,SIG) | Remove M+ in SF5. | 6.12E+06 | 3.28E+04 | 5.36E-03 | 100 |  |  |  |
| C0062.010 | (24-CR-52(P,N)25-MN-52,(M),SIG) | Add -G to SF4. | 4.83E+05 | 1.27E+03 | 2.63E-03 | 1.78 |  |  |  |
| C1762.002 | (37-RB-CMP(A,X)39-Y-87,M+,TTY,,(PHY)) | Add -G to SF4. | 2.87E+05 | 4.81E+04 | 1.68E-01 | 98.43 |  |  |  |
| D4052.004 | (24-CR-50(A,N)26-FE-53,(M),SIG) | Add-G to SF4. | 5.11E+02 | 1.52E+02 | 2.97E-01 | 100 |  |  |  |
| D4061.005.2 | (28-NI-58(D,2A)25-MN-52,(M),SIG) | Add -G to SF4. | 4.83E+05 | 1.27E+03 | 2.63E-03 | 1.78 |  |  |  |
| D4061.006.2 | (26-FE-54(3-LI-6,2P)27-CO-58,(M),SIG) | Remove (M) in SF5. | 6.12E+06 | 3.28E+04 | 5.36E-03 | 100 |  |  |  |
| D4288.010 | (28-NI-0(D,X)27-CO-58,M+,SIG) | Remove M+ in SF5. | 6.12E+06 | 3.28E+04 | 5.36E-03 | 100 |  |  |  |
| D4290.003 | (66-DY-0(P,X)67-HO-161,M+,SIG) | Remove M+ in SF5. | 8.93E+03 | 6.76E+00 | 7.57E-04 | 100 |  |  |  |
| D4290.004 | (66-DY-0(P,X)67-HO-159,M+,SIG) | Remove M+ in SF5. | 1.98E+03 | 8.30E+00 | 4.19E-03 | 100 |  |  |  |
| D4290.010 | (66-DY-0(P,X)65-TB-156,M+,SIG) | Remove M+ in SF5 ("measured after complete decay"). | 4.62E+05 | 8.78E+04 | 1.90E-01 | 100 | 1.91E+04 | 4.13E-02 | 100 |
| D4291.003 | (66-DY-0(D,X)67-HO-161,M+,SIG) | Remove M+ in SF5. | 8.93E+03 | 6.76E+00 | 7.57E-04 | 100 |  |  |  |
| D4291.004 | (66-DY-0(D,X)66-DY-165,M+,SIG) | Add -G to SF4. | 8.43E+03 | 7.54E+01 | 8.94E-03 | 97.76 |  |  |  |
| D4291.010 | (66-DY-0(D,X)65-TB-156,M+,SIG) | Remove M+ in SF5 ("after decay of two isomeric states"). | 4.62E+05 | 8.78E+04 | 1.90E-01 | 100 | 1.91E+04 | 4.13E-02 | 100 |
| D4292.004 | (64-GD-0(D,X)65-TB-156,M+,SIG) | Remove M+ in SF5 ("after decay of the isomeric states"). | 4.62E+05 | 8.78E+04 | 1.90E-01 | 100 | 1.91E+04 | 4.13E-02 | 100 |
| D4292.010 | (64-GD-0(D,X)65-TB-152,M+,SIG) | Add -G to SF4. | 6.30E+04 | 2.52E+02 | 4.00E-03 | 78.9 |  |  |  |
| D4292.011 | (64-GD-0(D,X)65-TB-151,M+,SIG) | Add -G to SF4. | 6.34E+04 | 2.50E+01 | 3.94E-04 | 93.4 |  |  |  |
| D4293.009 | (27-CO-59(P,X)25-MN-52,M+,SIG) | Add -G to SF4. | 4.83E+05 | 1.27E+03 | 2.63E-03 | 1.78 |  |  |  |
| D4295.002 | (58-CE-0(D,X)59-PR-142,M+,SIG) | Remove M+ in SF5. | 6.88E+04 | 8.76E+02 | 1.27E-02 | 100 |  |  |  |
| D4296.006 | (65-TB-159(D,X)65-TB-156,M+,SIG) | Remove M+ in SF5 ("after nearly coplete decay of the isomeric states"). | 4.62E+05 | 8.78E+04 | 1.90E-01 | 100 | 1.91E+04 | 4.13E-02 | 100 |
| O0006.055 | (90-TH-232(P,F)71-LU-172,M+,SIG) | Remove M+ in SF5. | 5.79E+05 | 2.22E+02 | 3.83E-04 | 100 |  |  |  |
| O0277.114 | (26-FE-0(P,X)21-SC-48,M+,SIG) | Delete M+ (No isomer exists). |  |  |  |  |  |  |  |
| O0283.022 | (26-FE-0(P,X)21-SC-46,M+,SIG) | Remove M+ in SF5. | 7.24E+06 | 1.88E+01 | 2.60E-06 | 100 |  |  |  |
| O0346.002 | (27-CO-59(P,X)27-CO-58,M+,SIG) | Remove M+ in SF5. | 6.12E+06 | 3.28E+04 | 5.36E-03 | 100 |  |  |  |
| O0355.011 | (79-AU-197(P,X)43-TC-96,M+,SIG) | Add -G in SF4. | 3.70E+05 | 3.09E+03 | 8.35E-03 | 98 |  |  |  |
| O0842.014 | (93-NP-237(P,X)41-NB-95,M+,SIG) | Add -G in SF4 and CUM in SF5 (c.f. article table). | 3.02E+06 | 3.12E+05 | 1.03E-01 | 94.4 |  |  |  |
| O0900.032 | (83-BI-209(P,X)79-AU-196,M+,SIG) | Remove M+ in SF5. | 5.33E+05 | 8.10E+00 | 1.52E-05 | 100 | 3.46E+04 | 6.49E-02 | 100 |
| O0900.035 | (83-BI-209(P,X)35-BR-82,M+,SIG) | Add -G in SF4. (N.B. The author use g+m.) | 1.27E+05 | 3.68E+02 | 2.90E-03 | 97.6 |  |  |  |
| O1099.282 | (83-BI-209(P,3N)84-PO-207,M+,SIG) | Remove M+ in SF5. | 2.09E+04 | 2.79E+00 | 1.33E-04 | 100 |  |  |  |
| T0196.031 | (46-PD-106(3-LI-6,X)47-AG-103,M+,SIG) | Remove M+ in SF5. | 3.94E+03 | 5.70E+00 | 1.45E-03 | 100 |  |  |  |