## $^{124}$Sn($^{13}$C,4npγ) 2003Ra48

History

| Type | Author | Citation | Literature Cutoff Date |
|---|---|---|---|
| Full Evaluation | Yu. Khazov, A. A. Rodionov and S. Sakharov, Balraj Singh | NDS 104, 497 (2005) | 10-Feb-2005 |

2003Ra48 (also 2003Ra28): E=75 MeV. Measured Eγ, Iγ, γγ, γγ(θ)(DCO), γ(lin pol) using EUROBALL IV array in conjunction with a 110-element BGO inner ball as multiplicity filter. The protons were detected with 40 ΔE-E telescopes of Si detector array EUCLIDES. Linear polarizations were measured using 24 "clover" detectors. 2003Ra28 reported data for positive-parity states only, which are also given in 2003Ra48.

### $^{132}$Cs Levels

| E(level)‡ | Jπ# | E(level)‡ | Jπ# | E(level)‡ | Jπ# | E(level)‡ | Jπ# |
|---|---|---|---|---|---|---|---|
| 0 | 2+ | 1683.5[a] 9 | 11+ | 2772.8[h] 10 | 14− | 3985.6[i] 12 | 17− |
| 86.2† 4 | (3+) | 1729.2[b] 9 | 10+ | 2865.1[&] 9 | 14+ | 4172.8[h] 10 | 18− |
| 108.3† 4 | (4+) | 1826.1[e] 9 | 11− | 2868.5[f] 10 | 14− | 4187.0[g] 11 | (17−) |
| 183.6† 6 | (4+) | 1835.2 8 | 11+ | 2893.6[b] 9 | 14+ | 4241.5[a] 10 | 17+ |
| 185.9† 6 | (5) | 1891.2[b] 9 | 11+ | 2909.7 9 | 14+ | 4386.3[c] 9 | 18+ |
| 240.1† 5 | (5−) | 1933.9[f] 9 | 12− | 2988.7[h] 11 | 15− | 4487.4[i] 11 | 18− |
| 311.7†[d] 8 | (7−) | 1982.0[&] 9 | 12+ | 3028.9[c] 9 | 15+ | 4665.5[&] 10 | 18+ |
| 379.3[f] 8 | 8− | 1987.9[c] 9 | 12+ | 3232.0[g] 10 | 15− | 4755.9[h] 11 | 19− |
| 537.6[d] 8 | 8− | 2089.4[d] 10 | 12− | 3270.6[h] 15 | 16− | 4943.7[i] 11 | (19−) |
| 787.8[g] 8 | 9− | 2201.5[b] 9 | 12+ | 3310.6[a] 9 | 15+ | 5073.6[a] 10 | 19+ |
| 980.0[e] 8 | 9− | 2316.0[g] 10 | 13− | 3373.5[i] 11 | 15− | 5212.4[c] 10 | |
| 1081.5[f] 9 | 10− | 2368.7 9 | 13+ | 3389.5[c] 9 | 16+ | 5423.6[h] 10 | (20−) |
| 1131.4[a] 8 | 9+[@] | 2395.7[c] 9 | 14+ | 3585.9[i] 11 | 16− | 5696.5[c] 10 | 20+ |
| 1214.7[d] 9 | 10− | 2410.0[a] 9 | 13+ | 3665.7[h] 16 | 17− | | |
| 1281.9[&] 8 | 10+ | 2515.4[b] 9 | 13+ | 3759.1[c] 10 | (17+) | | |
| 1474.6[g] 9 | 11− | 2636.0[h] 11 | 13− | 3788.7[&] 9 | 16+ | | |

† From 1997Ha29.
‡ From least-squares fit to Eγ's, assuming Δ(Eγ)=0.5 keV for low-lying γ transitions from 1997Ha29.
# As proposed by 2003Ra48 based on γγ(θ) and γ(lin pol) data and band assignments.
@ Assignment based on configuration=$\pi h_{11/2}\nu h_{11/2}$ suggested by 1998Li36 from smooth systematic trends of energy levels in even-A Cs nuclei.
& Band(A): $\pi h_{11/2}\nu h_{11/2}$, α=0.
a Band(a): $\pi h_{11/2}\nu h_{11/2}$, α=1.
b Band(B): Chiral partner of $\pi h_{11/2}\nu h_{11/2}$.
c Band(C): $\pi g_{7/2}\otimes\nu(g_{7/2}h^2_{11/2})$.
d Band(D): $\pi h_{11/2}\nu d_{5/2}$, α=0.
e Band(d): $\pi h_{11/2}\nu d_{5/2}$, α=1.
f Band(E): $\pi h_{11/2}\nu g_{7/2}$, α=0.
g Band(e): $\pi h_{11/2}\nu g_{7/2}$, α=1.
h Band(F): $\pi h_{11/2}\otimes\nu(d_{5/2}h^2_{11/2})$.
i Band(G): Band based on 15−.

## $^{124}$Sn($^{13}$C,4np$\gamma$) 2003Ra48 (continued)

### $\gamma(^{132}Cs)$

DCO(Q): gate on ΔJ=2, stretched quadrupole transition. DCO(D): gate on ΔJ=1, stretched dipole transition.

| $E_\gamma$ | $I_\gamma$ | $E_i$(level) | $J_i^\pi$ | $E_f$ | $J_f^\pi$ | Mult.[†] | Comments |
|---|---|---|---|---|---|---|---|
| 22.1[‡] | | 108.3 | $(4^+)$ | 86.2 | $(3^+)$ | | |
| 54.1[‡] | | 240.1 | $(5^-)$ | 185.9 | (5) | | |
| 56.4[‡] | | 240.1 | $(5^-)$ | 183.6 | $(4^+)$ | | |
| 67.6 *3* | 75.2 *20* | 379.3 | $8^-$ | 311.7 | $(7^-)$ | | |
| 71.6[‡] *5* | | 311.7 | $(7^-)$ | 240.1 | $(5^-)$ | | |
| 77.6[‡] | | 185.9 | (5) | 108.3 | $(4^+)$ | | |
| 86.2[‡] | | 86.2 | $(3^+)$ | 0 | $2^+$ | | |
| 97.3[‡] | | 183.6 | $(4^+)$ | 86.2 | $(3^+)$ | | |
| 108.3[‡] | | 108.3 | $(4^+)$ | 0 | $2^+$ | | |
| 131.9[‡] | | 240.1 | $(5^-)$ | 108.3 | $(4^+)$ | | |
| 136.7 *4* | 13.7 *7* | 2772.8 | $14^-$ | 2636.0 | $13^-$ | M1+E2 | DCO(Q)=0.58 *5*<br>POL=−0.44 *19*. |
| 146.8 *3* | 13.8 *8* | 1982.0 | $12^+$ | 1835.2 | $11^+$ | | |
| 150.5 *3* | 79.3 *25* | 1281.9 | $10^+$ | 1131.4 | $9^+$ | D+Q | DCO(Q)=0.63 *5* |
| 152.7 *4* | 25.0 *6* | 1987.9 | $12^+$ | 1835.2 | $11^+$ | | |
| 162.0 *6* | 1.7 *3* | 1891.2 | $11^+$ | 1729.2 | $10^+$ | D+Q | DCO(D)=0.91 *14* |
| 167.2 *3* | 5.2 *5* | 2368.7 | $13^+$ | 2201.5 | $12^+$ | D+Q | DCO(D)=1.10 *18* |
| 212.4 *4* | 3.2 *6* | 3585.9 | $16^-$ | 3373.5 | $15^-$ | | |
| 215.9 *3* | 31.0 *7* | 2988.7 | $15^-$ | 2772.8 | $14^-$ | M1+E2 | DCO(Q)=0.48 *4*<br>POL=−0.33 *20*. |
| 225.9 *3* | 100.0 *6* | 537.6 | $8^-$ | 311.7 | $(7^-)$ | M1+E2 | DCO(Q)=0.53 *4*<br>POL=−0.35 *10*. |
| 234.7 *4* | 2.8 *4* | 1214.7 | $10^-$ | 980.0 | $9^-$ | | |
| 243.3 *4* | 2.6 *4* | 3232.0 | $15^-$ | 2988.7 | $15^-$ | | |
| 263.3 *6* | 2.1 *5* | 2089.4 | $12^-$ | 1826.1 | $11^-$ | | |
| 281.9 *3* | 21.4 *5* | 3270.6 | $16^-$ | 2988.7 | $15^-$ | M1+E2 | DCO(Q)=0.44 *4*<br>POL=−0.39 *21*. |
| 293.7 *4* | 2.2 *4* | 1081.5 | $10^-$ | 787.8 | $9^-$ | | |
| 298.5 *4* | 7.9 *9* | 1982.0 | $12^+$ | 1683.5 | $11^+$ | M1+E2 | DCO(D)=1.05 *6*<br>POL=−0.43 *16*. |
| 304.4 *4* | 10.1 *6* | 1987.9 | $12^+$ | 1683.5 | $11^+$ | M1+E2 | DCO(Q)=0.46 *9*<br>POL=−0.32 *24*. |
| 310.3 *4* | 7.0 *6* | 2201.5 | $12^+$ | 1891.2 | $11^+$ | M1+E2 | DCO(D)=0.96 *14*<br>POL=−0.40 *25*. |
| 313.8 *5* | 2.9 *5* | 2515.4 | $13^+$ | 2201.5 | $12^+$ | D+Q | DCO(D)=0.83 *20* |
| 343.6 *3* | 19.2 *9* | 1131.4 | $9^+$ | 787.8 | $9^-$ | E1 | DCO(Q)=0.61 *7*<br>POL=+0.6 *3*. |
| 353.8 *5* | 2.6 *5* | 3585.9 | $16^-$ | 3232.0 | $15^-$ | D+Q | DCO(Q)=0.51 *9* |
| 360.6 *2* | 3.0 *5* | 3389.5 | $16^+$ | 3028.9 | $15^+$ | | |
| 363.5 *6* | 2.2 *4* | 3232.0 | $15^-$ | 2868.5 | $14^-$ | M1+E2 | DCO(Q)=0.66 *14*<br>POL=−0.34 *21*. |
| 378.2 *4* | 2.5 *6* | 2893.6 | $14^+$ | 2515.4 | $13^+$ | D+Q | DCO(D)=0.9 *3* |
| 382.1 *4* | 5.0 *6* | 2316.0 | $13^-$ | 1933.9 | $12^-$ | D+Q | DCO(Q)=0.53 *5* |
| 386.7 *4* | 8.5 *8* | 2368.7 | $13^+$ | 1982.0 | $12^+$ | D+Q | DCO(Q)=0.48 *9* |
| 393.1 *4* | 15.3 *8* | 1474.6 | $11^-$ | 1081.5 | $10^-$ | M1+E2 | DCO(Q)=0.46 *6*<br>POL=−0.56 *14*. |
| 395.1 *3* | 21.1 *6* | 3665.7 | $17^-$ | 3270.6 | $16^-$ | M1+E2 | DCO(Q)=0.44 *7*<br>POL=−0.48 *24*. |
| 399.7 *5* | 3.8 *6* | 3985.6 | $17^-$ | 3585.9 | $16^-$ | D+Q | DCO(Q)=0.48 *7* |

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## $^{124}$Sn($^{13}$C,4npγ) 2003Ra48 (continued)

### γ($^{132}$Cs) (continued)

| $E_\gamma$ | $I_\gamma$ | $E_i$(level) | $J_i^\pi$ | $E_f$ | $J_f^\pi$ | Mult.[†] | Comments |
|---|---|---|---|---|---|---|---|
| 401.6 *3* | 27.0 *7* | 1683.5 | $11^+$ | 1281.9 | $10^+$ | M1+E2 | DCO(Q)=0.54 *9*<br>POL=−0.61 *12*. |
| 407.8 *3* | 40.0 *8* | 2395.7 | $14^+$ | 1987.9 | $12^+$ | E2 | DCO(D)=1.70 *9*<br>POL=+0.64 *24*. |
| 408.5 *3* | 42.6 *9* | 787.8 | $9^-$ | 379.3 | $8^-$ | M1+E2 | DCO(Q)=0.62 *6*<br>POL=−0.53 *17*. |
| 413.7 *4* | 11.7 *6* | 2395.7 | $14^+$ | 1982.0 | $12^+$ | E2 | DCO(Q)=0.94 *9*; DCO(D)=1.59 *17*<br>POL=+0.7 *4*. |
| 422.1 *3* | 8.0 *3* | 2410.0 | $13^+$ | 1987.9 | $12^+$ | | |
| 424.0 *4* | 1.7 *3* | 4665.5 | $18^+$ | 4241.5 | $17^+$ | | |
| 428.0 *3* | 15.4 *8* | 2410.0 | $13^+$ | 1982.0 | $12^+$ | M1+E2 | DCO(Q)=0.62 *9*<br>POL=−0.32 *16*. |
| 442.4 *3* | 5.5 *4* | 980.0 | $9^-$ | 537.6 | $8^-$ | | |
| 445.5 *4* | 10.7 *5* | 3310.6 | $15^+$ | 2865.1 | $14^+$ | M1+E2 | DCO(Q)=0.50 *7*<br>POL=−0.9 *3*. |
| 447.3 *4* | 2.1 *4* | 1729.2 | $10^+$ | 1281.9 | $10^+$ | D+Q | DCO(D)=1.8 *5*<br>DCO for ΔJ=2 and for ΔJ=1,non−stretched are the same. |
| 452.9 *5* | 4.3 *8* | 4241.5 | $17^+$ | 3788.7 | $16^+$ | M1+E2 | DCO(Q)=0.57 *9*<br>POL=−0.42 *15*. |
| 455.1 *5* | 3.4 *7* | 2865.1 | $14^+$ | 2410.0 | $13^+$ | M1+E2 | DCO(Q)=0.68 *17*<br>POL=−0.4 *3*. |
| 456.3 *3* | 0.9 *3* | 4943.7 | $(19^-)$ | 4487.4 | $18^-$ | | |
| 459.3 *5* | 3.5 *6* | 1933.9 | $12^-$ | 1474.6 | $11^-$ | | |
| 478.0 *4* | 2.1 *4* | 3788.7 | $16^+$ | 3310.6 | $15^+$ | D+Q | DCO(Q)=0.48 *10* |
| 483.6 *3* | 3.4 *7* | 2893.6 | $14^+$ | 2410.0 | $13^+$ | M1+E2 | DCO(Q)=0.69 *15*<br>POL=−0.26 *21*. |
| 494.1 *3* | 14.4 *6* | 1281.9 | $10^+$ | 787.8 | $9^-$ | E1 | DCO(Q)=0.58 *8*<br>POL=+0.26 *15*. |
| 496.4 *2* | 8.9 *9* | 2865.1 | $14^+$ | 2368.7 | $13^+$ | M1+E2 | DCO(D)=1.02 *9*<br>POL=−0.26 *18*. |
| 501.8 *2* | 1.5 *3* | 4487.4 | $18^-$ | 3985.6 | $17^-$ | D+Q | DCO(Q)= 0.53 *10* |
| 507.1 *2* | 12.7 *2* | 4172.8 | $18^-$ | 3665.7 | $17^-$ | M1+E2 | DCO(Q)=0.47 *5*<br>POL=−0.40 *15*. |
| 518.0 *4* | 4.3 *8* | 2201.5 | $12^+$ | 1683.5 | $11^+$ | M1+E2 | DCO(D)=1.20 *21*<br>POL=−0.36 *22*. |
| 541.0 *3* | 4.0 *9* | 2909.7 | $14^+$ | 2368.7 | $13^+$ | M1+E2 | DCO(Q)=0.52 *15* |
| 546.6 *4* | 4.5 *8* | 2636.0 | $13^-$ | 2089.4 | $12^-$ | M1+E2 | DCO(Q)=0.68 *10*<br>POL=−0.23 *17*. |
| 552.5[#] *2* | 0.8 *4* | 2868.5 | $14^-$ | 2316.0 | $13^-$ | | |
| 553.3 *4* | 16.2 *8* | 1835.2 | $11^+$ | 1281.9 | $10^+$ | M1+E2 | DCO(D)=1.04 *7*<br>POL=−0.51 *23*. |
| 583.1 *4* | 9.8 *10* | 4755.9 | $19^-$ | 4172.8 | $18^-$ | M1+E2 | DCO(Q)=0.43 *14*<br>POL=−0.34 *17*. |
| 593.8 *2* | 85.0 *20* | 1131.4 | $9^+$ | 537.6 | $8^-$ | E1 | DCO(Q)=0.59 *4*<br>POL=+0.24 *9*. |
| 609.3 *4* | 5.2 *9* | 1891.2 | $11^+$ | 1281.9 | $10^+$ | M1+E2 | DCO(D)=0.96 *9*<br>POL=−0.35 *19*. |
| 611.3 *3* | 6.3 *5* | 1826.1 | $11^-$ | 1214.7 | $10^-$ | M1+E2 | DCO(Q)=0.59 *5*<br>POL=−0.34 *28*. |
| 633.3 *4* | 19.2 *8* | 3028.9 | $15^+$ | 2395.7 | $14^+$ | D+Q | DCO(Q)=0.53 *9* |
| 667.7 *3* | 3.8 *7* | 5423.6 | $(20^-)$ | 4755.9 | $19^-$ | | |
| 668.3 *3* | 5.7 *6* | 980.0 | $9^-$ | 311.7 | $(7^-)$ | Q | DCO(Q)=1.12 *9* |
| 677.1 *4* | 7.4 *9* | 1214.7 | $10^-$ | 537.6 | $8^-$ | Q | DCO(D)=1.51 *17* |
| 686.8 *3* | 5.7 *8* | 1474.6 | $11^-$ | 787.8 | $9^-$ | Q | DCO(Q)=0.95 *11* |
| 700.1 *4* | 27.1 *7* | 1982.0 | $12^+$ | 1281.9 | $10^+$ | E2 | DCO(Q)=0.99 *8*<br>POL=+0.6 *3*. |

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## $^{124}$Sn($^{13}$C,4npγ) 2003Ra48 (continued)

### γ($^{132}$Cs) (continued)

| $E_\gamma$ | $I_\gamma$ | $E_i$(level) | $J_i^\pi$ | $E_f$ | $J_f^\pi$ | Mult.[†] | Comments |
|---|---|---|---|---|---|---|---|
| 702.1 *3* | 3.6 *7* | 2636.0 | $13^-$ | 1933.9 | $12^-$ | | |
| 702.2 *2* | 25.7 *7* | 1081.5 | $10^-$ | 379.3 | $8^-$ | E2 | DCO(Q)=0.97 *5*<br>POL=+0.29 *14*. |
| 703.8 *2* | 22.7 *6* | 1835.2 | $11^+$ | 1131.4 | $9^+$ | E2 | DCO(Q)=1.23 *15*<br>POL=+0.6 *3*. |
| 706.0 *4* | 15.7 *9* | 1987.9 | $12^+$ | 1281.9 | $10^+$ | E2 | DCO(Q)=1.11 *20*<br>POL=+0.55 *27*. |
| 726.5 *4* | 4.7 *8* | 2410.0 | $13^+$ | 1683.5 | $11^+$ | Q | DCO(D)=1.7 *3* |
| 730.2 *3* | 9.8 *11* | 3759.1 | $(17^+)$ | 3028.9 | $15^+$ | | |
| 753.6 *3* | 5.3 *4* | 3985.6 | $17^-$ | 3232.0 | $15^-$ | E2 | DCO(Q)=1.03 *10*<br>POL=+0.36 *27*. |
| 759.8 *5* | 1.0 *3* | 1891.2 | $11^+$ | 1131.4 | $9^+$ | | |
| 826.1 *4* | 5.6 *7* | 5212.4 | | 4386.3 | $18^+$ | | DCO(Q)=0.79 *11* |
| 832.1 *3* | 4.8 *6* | 5073.6 | $19^+$ | 4241.5 | $17^+$ | Q | DCO(Q)=1.2 *2* |
| 841.5 *2* | 11.3 *6* | 2316.0 | $13^-$ | 1474.6 | $11^-$ | E2 | DCO(Q)=1.00 *9*<br>POL=+0.29 *16*. |
| 846.1 *4* | 6.6 *6* | 1826.1 | $11^-$ | 980.0 | $9^-$ | E2 | DCO(Q)=1.05 *11*<br>POL=+0.63 *22*. |
| 852.4 *3* | 10.9 *6* | 1933.9 | $12^-$ | 1081.5 | $10^-$ | E2 | DCO(Q)=0.97 *10*<br>POL=+0.47 *25*. |
| 874.6 *4* | 5.0 *6* | 2089.4 | $12^-$ | 1214.7 | $10^-$ | E2 | DCO(Q)=1.04 *20*<br>POL=+0.7 *5*. |
| 876.9 *4* | 2.0 *6* | 4665.5 | $18^+$ | 3788.7 | $16^+$ | Q | DCO(Q)=1.3 *3* |
| 883.1 *3* | 9.9 *8* | 2865.1 | $14^+$ | 1982.0 | $12^+$ | E2 | DCO(Q)=0.92 *9*<br>POL=+0.5 *3*. |
| 900.6 *4* | 8.2 *9* | 3310.6 | $15^+$ | 2410.0 | $13^+$ | E2 | DCO(Q)=1.02 *7*<br>POL=+0.7 *3*. |
| 916.0 *3* | 9.7 *8* | 3232.0 | $15^-$ | 2316.0 | $13^-$ | Q | DCO(Q)=0.95 *9* |
| 923.6 *4* | 4.1 *7* | 3788.7 | $16^+$ | 2865.1 | $14^+$ | E2 | DCO(Q)=1.10 *10*<br>POL=+0.7 *4*. |
| 930.9 *4* | 7.3 *6* | 4241.5 | $17^+$ | 3310.6 | $15^+$ | E2 | DCO(Q)=1.22 *13*<br>POL=+0.53 *13*. |
| 934.6 *5* | 4.4 *9* | 2868.5 | $14^-$ | 1933.9 | $12^-$ | Q | DCO(Q)=1.02 *9* |
| 955.0 *5* | 0.9 *3* | 4187.0 | $(17^-)$ | 3232.0 | $15^-$ | | |
| 993.8 *3* | 26.2 *7* | 3389.5 | $16^+$ | 2395.7 | $14^+$ | E2 | DCO(Q)=0.91 *17*<br>POL=+0.65 *24*. |
| 996.8 *3* | 14.4 *6* | 4386.3 | $18^+$ | 3389.5 | $16^+$ | E2 | DCO(Q)=1.27 *21*<br>POL=+0.40 *22*. |
| 1057.4 *4* | 5.2 *9* | 3373.5 | $15^-$ | 2316.0 | $13^-$ | E2 | DCO(Q)=1.19 *16*<br>POL=+0.4 *3*. |
| 1310.2 *3* | 4.2 *8* | 5696.5 | $20^+$ | 4386.3 | $18^+$ | Q | DCO(Q)=1.06 *14* |

[†] From γγ(θ) and γ(lin pol); mult=Q corresponds to ΔJ=2 and D+Q to ΔJ=0 or 1 from γγ(θ) data only. 2003Ra48 assign E2 and M1/E2, respectively to these transitions.
[‡] From $^{132}$Cs level scheme of 1997Ha29.
[#] Placement of transition in the level scheme is uncertain.

## $^{124}$Sn($^{13}$C,4npγ) 2003Ra48

Level Scheme

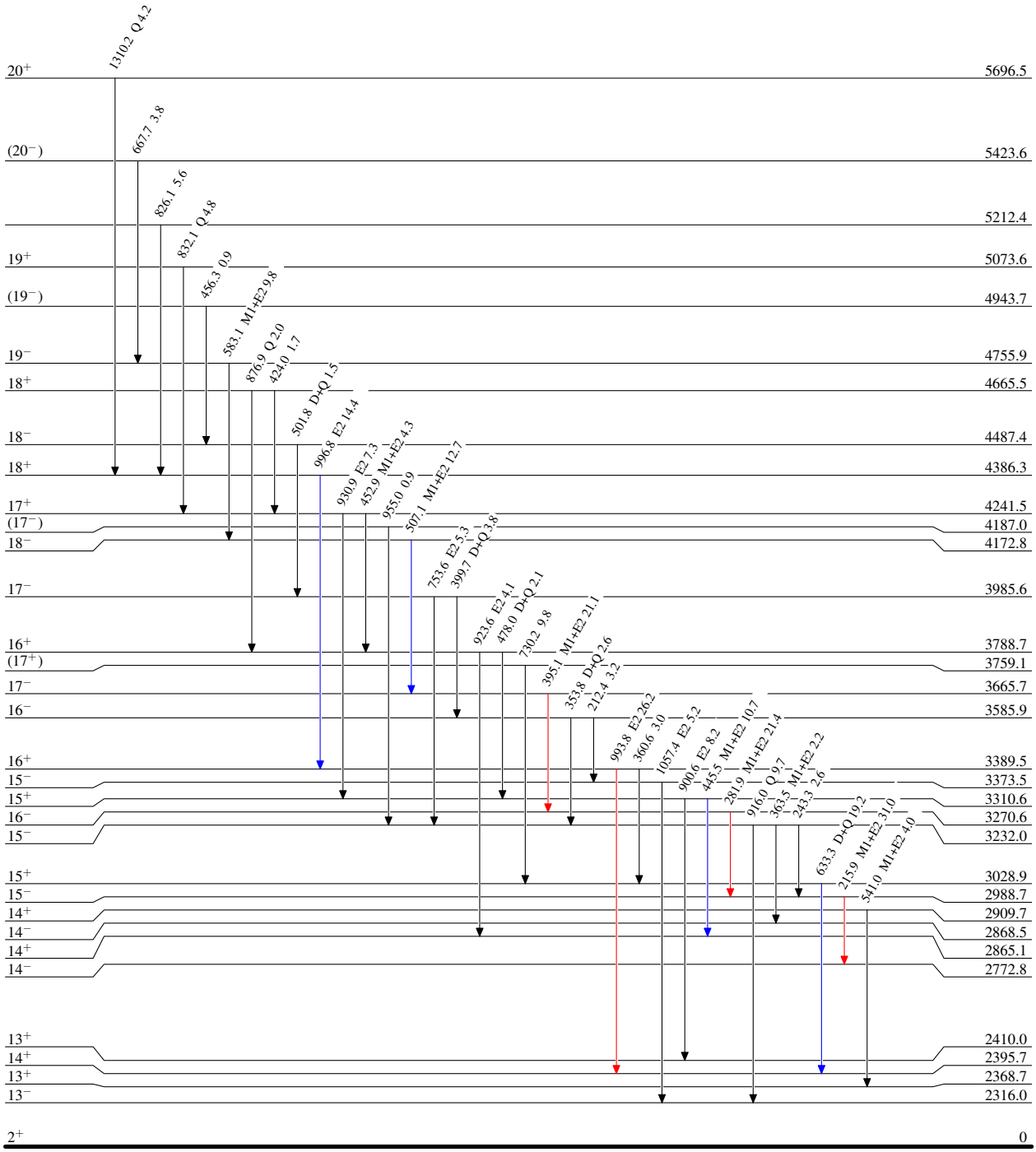
Intensities: Relative $I_\gamma$

Legend

$I_\gamma < 2\% \times I_\gamma^{max}$

$I_\gamma < 10\% \times I_\gamma^{max}$

$I_\gamma > 10\% \times I_\gamma^{max}$

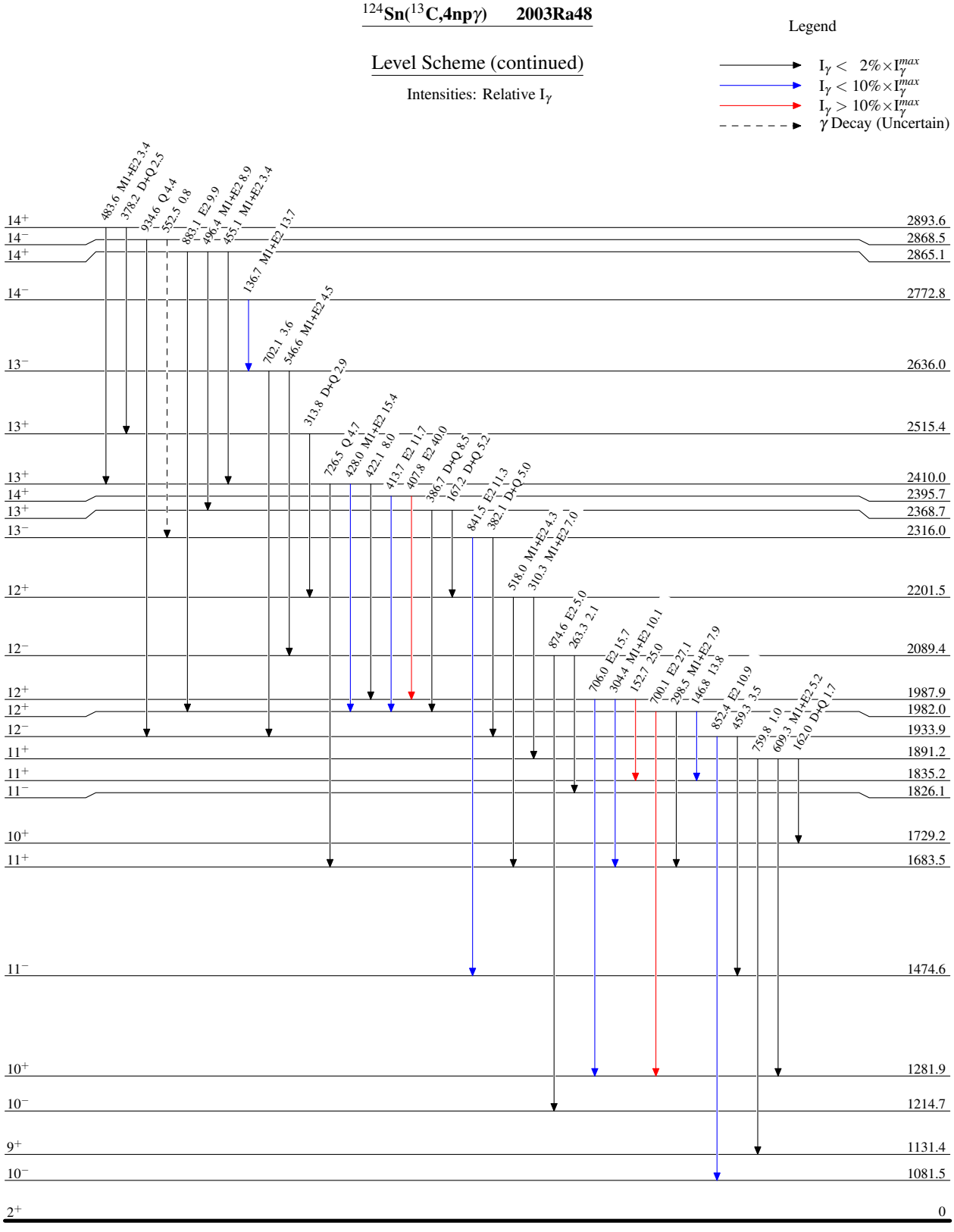



$^{132}_{55}Cs_{77}$

## $^{124}$Sn($^{13}$C,4npγ) 2003Ra48

### Level Scheme (continued)

Intensities: Relative $I_\gamma$

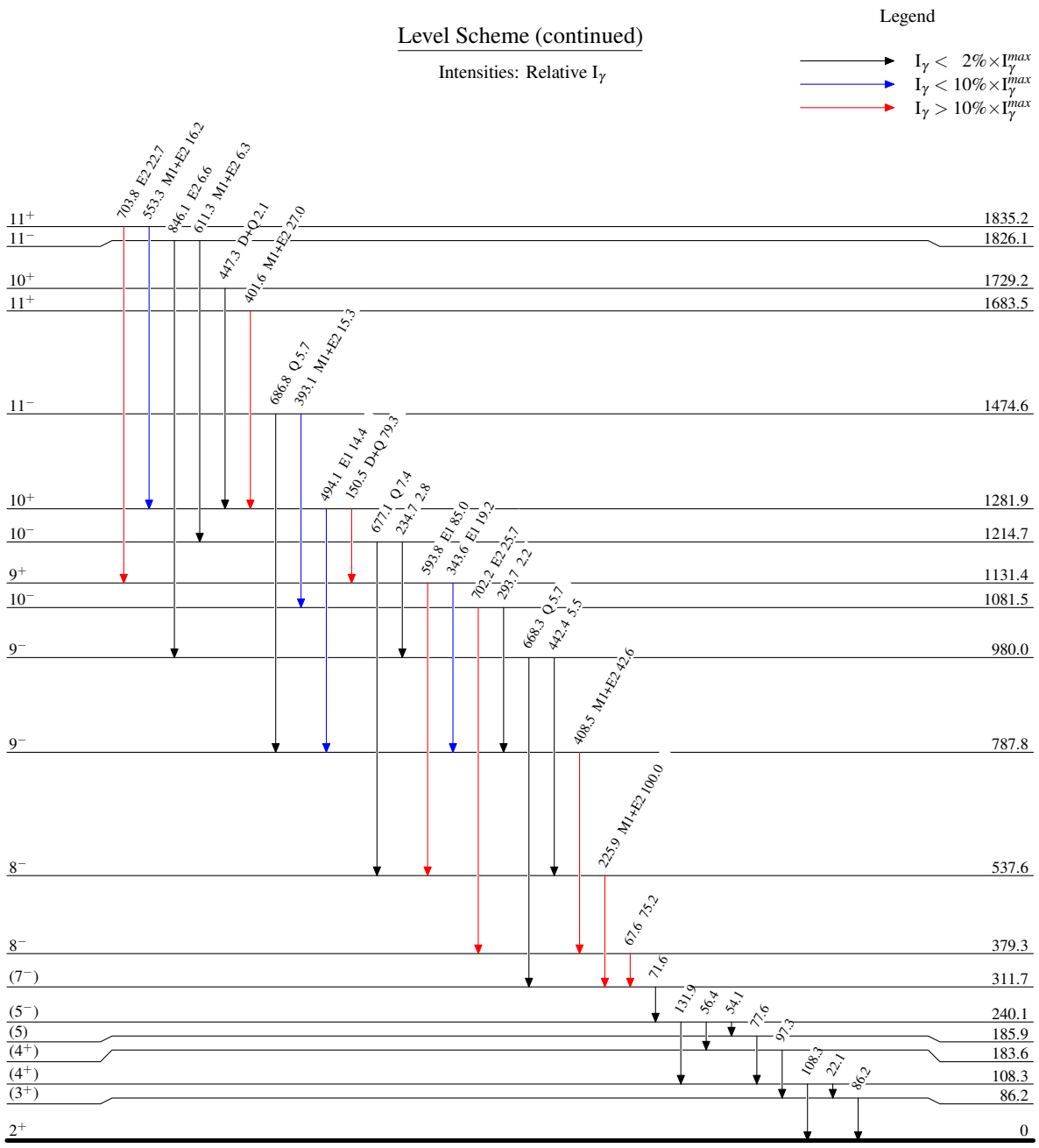



$^{132}_{55}Cs_{77}$

## $^{124}$Sn($^{13}$C,4npγ) 2003Ra48

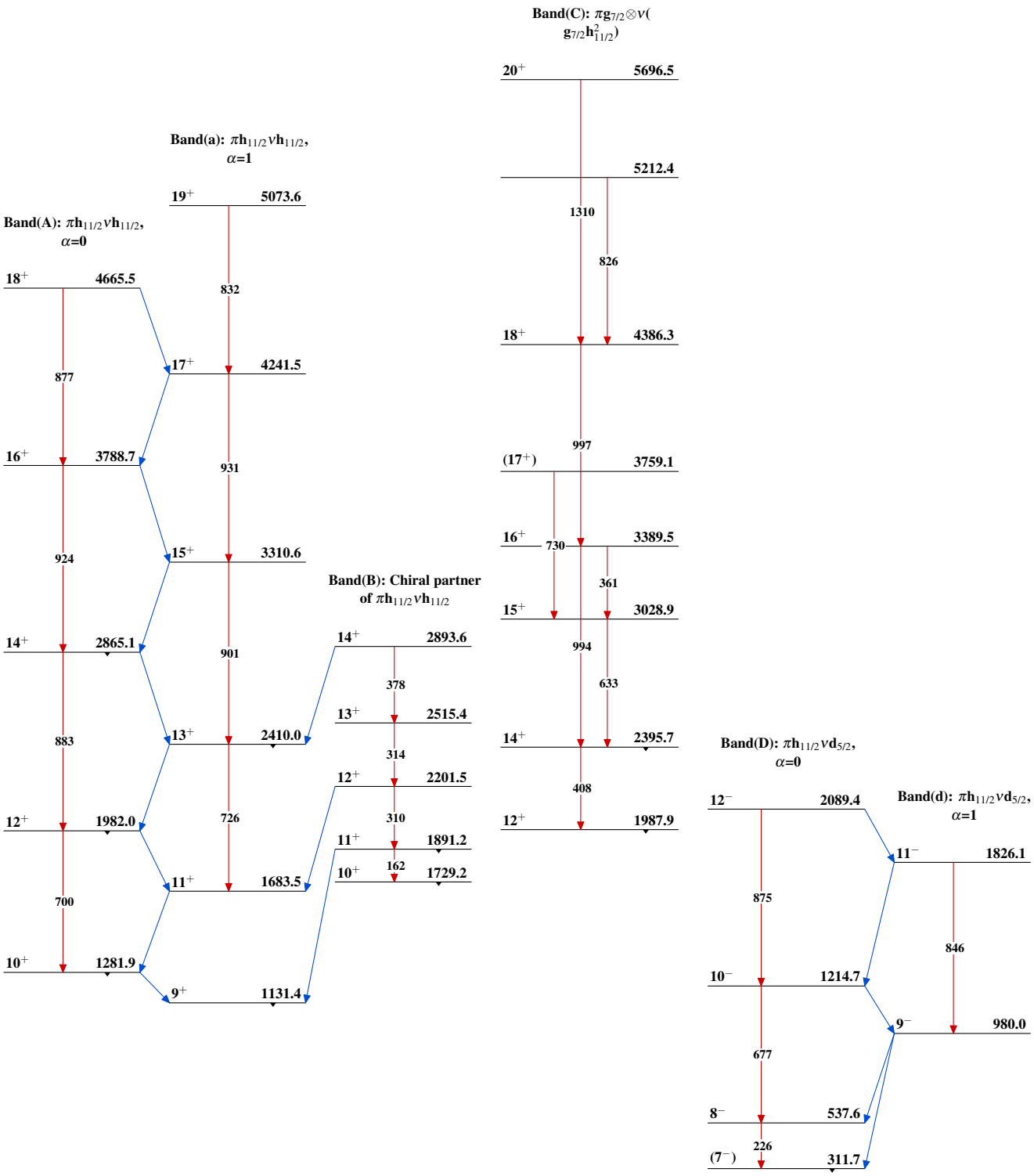
### Level Scheme (continued)

Intensities: Relative $I_\gamma$



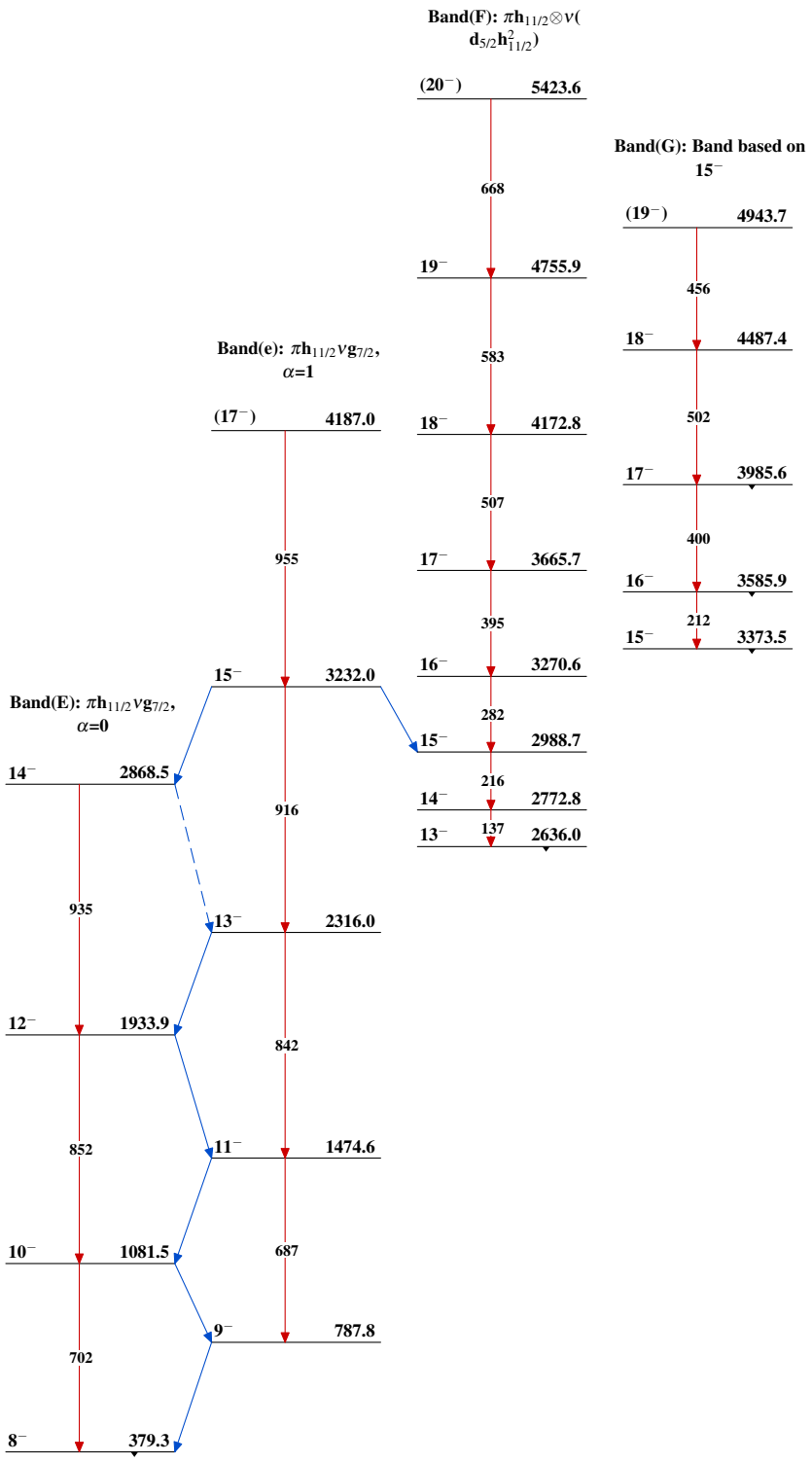

$^{132}_{55}Cs_{77}$

## $^{124}$Sn($^{13}$C,4npγ) 2003Ra48




$^{132}_{55}Cs_{77}$

## $^{124}$Sn($^{13}$C,4npγ) 2003Ra48 (continued)




$^{132}_{55}Cs_{77}$