## Adopted Levels, Gammas

History

| Type | Author | Citation | Literature Cutoff Date |
|---|---|---|---|
| Full Evaluation | Coral M. Baglin | NDS 109,2033 (2008) | 15-Jun-2008 |

Q($\beta^-$)=−898.5 *12*; S(n)=8033.6 *15*; S(p)=5573.9 *12*; Q($\alpha$)=1197.7 *13* 2012Wa38

Note: Current evaluation has used the following Q record −910 48033.6 *155572.2* *111199.7* *13* 2003Au03.

For hfs and/or isotope-shift data see, e.g., 1985Pf01, 1986Al32, 1986Pf03, 1987Mi31, 1988Al04, 1993Ji03, 1995Kr23, 1997Kr16.

For muonic isomer shift data, see 1974Ba77.

For discussion of anapole moment of $^{169}$Tm, see 1999KaZU.

### $^{169}$Tm Levels

E(Q),J(Q) From $^{169}$Tm($\gamma$,$\gamma'$). D excitation from 1/2$^+$ is assumed by 1999Hu01 in ($\gamma$,$\gamma'$) so J=(1/2,3/2) is assigned; further, $\pi$=+ is assigned whenever B(E1)(W.u.) significantly exceeds RUL.

Band(ah) 1/2[411] band. Band parameters: A=12.5, B=−4.8, a=−0.78 (1/2, 3/2, 5/2, 7/2, 9/2 levels).

Cross Reference (XREF) Flags

| | | | | | |
|---|---|---|---|---|---|
| A | $^{169}$Er $\beta^-$ decay | E | $^{169}$Tm($\gamma$,$\gamma$):Mossbauer effect | I | $^{169}$Tm($\gamma$,$\gamma'$) |
| B | $^{169}$Yb $\varepsilon$ decay (32.018 d) | F | $^{169}$Tm(e,e′p) IAR | J | $^{169}$Tm(n,n′$\gamma$), (pol n,n) |
| C | $^{168}$Er(p,p) IAR | G | Coulomb excitation | K | $^{169}$Tm($^3$He,$^3$He′) |
| D | $^{168}$Er($^3$He,d), ($\alpha$,t) | H | $^{170}$Er(p,2n$\gamma$), (d,3n$\gamma$) | L | Muonic atom |

| E(level)[†] | J$^\pi$[‡] | T$_{1/2}$ | XREF | Comments |
|---|---|---|---|---|
| 0.0 | 1/2$^+$ | stable | AB DE GH J | $\mu$=−0.2316 *15*<br>No $\alpha$ decay observed (T$_{1/2}$($\alpha$)>5×10$^{16}$ y if 1.5≤E($\alpha$)≤3.7, 1956Po16).<br>$\mu$: atomic beam (direct) (1989Ra17).<br><r$^2$>$^{1/2}$(charge)=5.226 *4* (2004An14).<br>J$^\pi$: J=1/2 from EPR, optical spectroscopy (1976Fu06); parity from configuration ($\pi$ 1/2[411]) based on decoupling parameter of −0.78. |
| 8.41017 *11* | 3/2$^+$ | 4.09 ns *5* | AB DE GH J | $\mu$=+0.5148 *48*; Q=−1.2 *1*<br>$\mu$: Mossbauer (1989Ra17); value relative to $\mu$=−0.2316 *15* for 0.0 level.<br>Q: Mossbauer (weighted average from 1989Ra17); value includes polarization correction.<br>J$^\pi$: M1+E2 8.4$\gamma$ to 1/2$^+$ g.s..<br>T$_{1/2}$: weighted average of 4.04 ns *6* ($\beta$ce(t) in $^{169}$Er $\beta^-$ decay, 1972TuZV), 4.22 ns *11* (1987AbZY; ce$\gamma$(t)), 4.10 ns *21* (1974Fu01) and 4.13 ns *12* (1966Mc08) in $^{169}$Yb $\varepsilon$ decay, Others (from $^{169}$Er $\beta^-$ decay and/or $^{169}$Yb $\varepsilon$ decay): 1958Be79 (3.7 ns *5*), 1961Bl13, 1961Ha44 (6.6 ns *10*), 1963Bl14 (3.53 ns *20*), 1963Mc13 (4.36 ns *17*; ≈3% too high (see 1966Mc08) and superseded by data from 1966Mc08), 1963Su06 (3.45 ns *25*), 1966Be51, 1967Be68 (5.1 ns *3*). |
| 118.18945 *11* | 5/2$^+$[#] | 62 ps *3* | AB D GH J | $\mu$=+0.761 *45*<br>$\mu$: IPAC (weighted average from 1989Ra17).<br>T$_{1/2}$: from microwave-pulsed beam measurements in Coulomb excitation (1960Bl10). Others (from Coulomb excitation and $^{169}$Yb $\varepsilon$ decay): 1958Ma36, 1959Bl15 (62 ps *10*), 1966Mc08 (63 ps *7*). |
| 138.93315 *12* | 7/2$^+$[#] | 302 ps *2* | B D GH J | $\mu$=+1.39 *5*<br>$\mu$: IPAC (weighted average from 1989Ra17).<br>T$_{1/2}$: from recoil-shadow measurements in Coulomb excitation (1979BaYN); uncertainty includes only statistical component (total uncertainty is most certainly larger). Others (from $^{169}$Yb $\varepsilon$ decay): 1959Bl15 (290 ps *70*), 1960Be28, 1964Su06 (321 ps *14*), 1966Mc08 (289 ps *24*). |

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## Adopted Levels, Gammas (continued)

### $^{169}$Tm Levels (continued)

| E(level)[†] | Jπ[‡] | $T_{1/2}$ | XREF | Comments |
|---|---|---|---|---|
| 316.14633[@] *11* | 7/2+ | 659.9 ns *23* | B D H J | μ=+0.156 *8*<br>μ: DPAC (1989Ra17, from g=0.044 *2* (1972Ni03)).<br>Jπ: M1+E2 177γ to 7/2+ 139; E2 308γ to 3/2+ 8-keV level; J=7/2 uniquely consistent with γγ(θ) data in $^{169}$Yb ε decay (32.018 d).<br>$T_{1/2}$: weighted average of 665 ns *5* (1974En09), 658 ns *3* (1950Fu63), 660 ns *5* (1994De01) (γγ(t) in $^{169}$Yb ε decay (32.018 d)). |
| 332.116 *11* | 9/2+[#] | 18.8 ps *5* | B GH J | μ=1.56 *9* (1999Ro03)<br>μ: From J=9/2 and g−factor=+0.347 *20* (1999Ro03) in Coulomb excitation.<br>$T_{1/2}$: from recoil-distance measurements in Coulomb excitation (1977Ta10). |
| 341.94[&] *4* | (1/2−) | | D H J | Jπ: band assignment; γ to 1/2+ and to 3/2+. |
| 345.028[&] *3* | 5/2− | | B D H J | Jπ: E1 206γ to 7/2+ 139; E1(+M2) 337γ to 3/2+ 8-keV level. |
| 367.67 *5* | 11/2+[#] | 41.6 ps *21* | B GH J | μ=2.28 *14* (1999Ro03)<br>μ: From J=11/2 and g−factor=+0.414 *26* (1999Ro03) in Coulomb excitation.<br>$T_{1/2}$: from recoil-distance measurements in Coulomb excitation (1977Ta10). |
| 379.26678[b] *12* | 7/2− | 52.2 ns *8* | B H | μ=+3.04 *14* (1997De02)<br>μ: g−factor=+0.87 *4* from DPAC. Other: 0.96 *8* (1989Ra17, from 1967NiZZ, differential delay reversed field method).<br>Jπ: E1 63γ to 7/2+ 316, E1+M2 261 γ to 5/2+ 118; 7/2− 7/2[523] and 9/2− 7/2[523] assignments to 379.3 and 472.9 levels lead to excellent energy fits for band up to J=21/2.<br>$T_{1/2}$: weighted average of 49.8 ns *15* (1974Bo30), 54.1 ns *5* (1974En09), and 51.6 ns *3* (1974Vi05), all from γγ(t) in $^{169}$Yb ε decay (32.018 d). |
| 430.122[&] *11* | (9/2)− | | B D H J | Jπ: E1 291γ to 7/2+ 139; band assignment. |
| 433.521[@] *18* | (9/2)+ | | B H | Jπ: M1 473γ to 7/2+ 139; band assignment. |
| 472.88128[b] *14* | 9/2− | 0.14 ns *7* | B H | Jπ: M1+E2 94γ to 7/2− 379 level and E1 105γ to 11/2+ 368 level. See also comment with 379.3 level.<br>$T_{1/2}$: from Auger electron-ce(t) in $^{169}$Yb ε decay (32.018 d) (1960Be28). Others (from $^{169}$Yb decay): 1956Ko21, 1958Ha31, 1958Na06. |
| 474.968[a] *9* | (3/2)− | | B D H J | Jπ: L=1 in $^{168}$Er($^{3}$He,d); 357γ 5/2+ 118. |
| 570.830[c] *11* | 3/2+ | 10 ps *7* | B D GH J | Jπ: M1+E2 453γ to 5/2+ 118, M1+E2 571γ to 1/2+ g.s.. ($^{3}$He,d)/(α,t) cross-section ratio consistent with 3/2+ 3/2[411] assignment.<br>$T_{1/2}$: deduced from B(E2) in Coulomb excitation and adopted γ-ray properties. |
| 575.38[@] *4* | (11/2+) | | H | |
| 588.20[b] *5* | 11/2− | | D H | |
| 602.82[&] *19* | (13/2−) | | H | Jπ: D(+Q) 235γ to 11/2+ 368; intraband 173γ to (9/2)− 430; band assignment. |
| 633.292[c] *3* | 5/2+ | 0.27 ps | B D GH J | Jπ: M1 494γ to 7/2+ 139; M1 625γ to 3/2+ 8-keV level. ($^{3}$He,d)/(α,t) cross-section ratio consistent with 5/2+ 3/2[411] assignment.<br>$T_{1/2}$: from B(E2)↑=0.0039 in Coulomb excitation and adopted γ properties. |
| 637.08 *13* | 13/2+[#] | 5.4 ps *4* | GH | μ=2.37 *14* (1999Ro03) |

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## Adopted Levels, Gammas (continued)

### $^{169}$Tm Levels (continued)

| E(level)[†] | Jπ[‡] | $T_{1/2}$ | XREF | Comments |
|---|---|---|---|---|
| | | | | μ: From J=13/2 and g−factor=+0.365 *22* (1999Ro03) in Coulomb excitation. $T_{1/2}$: from recoil-distance measurements in Coulomb excitation (1977Ta10). |
| 646.758[a] *10* | (7/2−) | | B D H J | Jπ: γ's to 3/2− and 9/2+; 7/2− consistent with band assignment. |
| 691.24 *16* | 15/2+[#] | 8.1 ps *4* | GH | μ=3.2 *3* (1999Ro03) μ: From J=15/2 and g−factor=+0.42 *4* (1999Ro03) in Coulomb excitation. $T_{1/2}$: from recoil-distance measurements in Coulomb excitation (1977Ta10). |
| 718.786[c] *4* | (7/2+) | | B GH J | Jπ: γ's to 3/2+ and 9/2+; 7/2+ consistent with band assignment. |
| 725.44[b] *7* | 13/2− | | H | |
| 741.25[@] *6* | (13/2+) | | H | |
| 781.796[d] *6* | (5/2)+ | | B D H J | XREF: D(785). Jπ: L($^3$He,d)=2; 782γ to 1/2+ g.s.; band assignment. |
| 832.42[c] *7* | (9/2+) | | B H J | |
| 865.9[&] *4* | (17/2−) | | H | |
| 878.35[d] *10* | (7/2+) | | B J | |
| 883.75[b] *14* | 15/2− | | H | |
| 884.62[a] *20* | (11/2−) | | D H | |
| ≈900? | | | G | |
| 929.37[@] *19* | (15/2+) | | H | |
| 938 *2* | | | D | |
| 964.0[c] *4* | (11/2+) | | H | |
| 1027.85 *16* | 17/2+[#] | 1.91 ps *18* | GH | μ=3.1 *3* (1999Ro03) μ: From J=17/2 and g−factor=+0.37 *4* (1999Ro03) from Coulomb excitation. $T_{1/2}$: from Doppler-broadened line shape measurements in Coulomb excitation (1977Ta10). |
| 1039.95 *15* | | | H | Jπ: 565γ to (3/2)− 475, 695γ to 5/2− 345. |
| 1058.54 *21* | | | H | Jπ: 717γ to (1/2−) 342. |
| 1063.57[b] *16* | 17/2− | | H | |
| 1104.18 *25* | 19/2+[#] | 1.94 ps *21* | GH | μ=4.2 *8* (1999Ro03) μ: From J=19/2 and g−factor=+0.44 *8* (1999Ro03) in Coulomb excitation. $T_{1/2}$: from Doppler-broadened line shape measurements in Coulomb excitation (1977Ta10). |
| 1112.6? *5* | | | H | Jπ: 683γ to (9/2)− 430. |
| 1135.93 *20* | | | H | Jπ: 791γ to 5/2− 345. |
| 1140.85[@] *21* | (17/2+) | | H | |
| 1152[e] *2* | (11/2−) | | D | Jπ: level energy, large spectroscopic factors in $^{168}$Er($^3$He,d), (α,t), and ($^3$He,d)/(α,t) cross-section ratio fit regional systematics for 11/2− 9/2[514] state. |
| 1188.7[a] *3* | (15/2−) | | H | |
| 1190 *20* | + | | G | B(E2)↑=0.040 *9* Jπ: E2 excitation in Coulomb excitation. B(E2)↑ from Coulomb excitation. |
| 1218.1[&] *5* | (21/2−) | | H | |
| 1223.04 *15* | | | H | Jπ: 878γ to 5/2− 345, 881γ to (1/2−) 342. |
| 1243 *2* | | | D | |
| 1262.40[b] *21* | 19/2− | | H | |

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## Adopted Levels, Gammas (continued)

### $^{169}$Tm Levels (continued)

| E(level)[†] | $J^{\pi}$[‡] | $T_{1/2}$ | XREF | Comments |
|---|---|---|---|---|
| 1300.8[c] 6 | (15/2+) | | H | |
| 1372 2 | 1/2+ | | D | $J^{\pi}$: L=0 in $^{168}$Er($^3$He,d). |
| 1372.1[@] 6 | (19/2+) | | H | |
| 1400 2 | | | D | |
| 1482.94[b] 22 | 21/2− | | H | |
| 1497.8 4 | 21/2+[#] | 0.87 ps 9 | GH | $T_{1/2}$: from Doppler-broadened line shape measurements in Coulomb excitation (1977Ta10). |
| 1510.6 10 | (1/2,3/2)+ | | I | B(M1,E1)↑(W.u.)=0.078 18. |
| 1515 2 | | | D | |
| 1527.5 10 | (1/2,3/2)+ | | I | B(M1,E1)↑(W.u.)=0.050 17. |
| 1548.4?[a] 7 | (19/2−) | | H | |
| 1598.4? 4 | (23/2+) | | GH | $J^{\pi}$: 23/2+ consistent with coincidence data in Coulomb excitation and structure of g.s. band. |
| 1625.3[@] 6 | (21/2+) | | H | |
| 1658.1[&] 5 | (25/2−) | | H | |
| 1716.9[b] 3 | 23/2− | | H | |
| 1864.6 7 | (1/2,3/2)+ | | I | B(M1,E1)↑(W.u.)=0.19 3. |
| 1910.5 6 | (1/2,3/2)+ | | I | B(M1,E1)↑(W.u.)=0.61 4. |
| 1922.3 7 | (1/2,3/2)+ | | I | B(M1,E1)↑(W.u.)=0.037 11. |
| 1963.7 10 | (1/2,3/2) | | I | B(M1,E1)↑(W.u.)=0.019 6. |
| 1978.4 10 | (1/2,3/2) | | I | B(M1,E1)↑(W.u.)=0.020 6. |
| 1991.7 7 | (1/2,3/2)+ | | I | B(M1,E1)↑(W.u.)=0.061 13. |
| 2075.5 7 | (1/2,3/2)+ | | I | B(M1,E1)↑(W.u.)=0.039 17. |
| 2168.7 7 | (1/2,3/2)+ | | I | B(M1,E1)↑(W.u.)=0.035 11. |
| 2190.6 10 | (1/2,3/2) | | I | B(M1,E1)↑(W.u.)=0.022 4. |
| 2215.3 10 | (1/2,3/2) | | I | B(M1,E1)↑(W.u.)=0.018 12. |
| 2236.1 7 | (1/2,3/2)+ | | I | B(M1,E1)↑(W.u.)=0.050 6. |
| 2262.5 7 | (1/2,3/2)+ | | I | B(M1,E1)↑(W.u.)=0.043 11. |
| 2293.8 10 | (1/2,3/2) | | I | B(M1,E1)↑(W.u.)=0.018 4. |
| 2306.3 10 | (1/2,3/2) | | I | B(M1,E1)↑(W.u.)=0.013 4. |
| 2312.2 7 | (1/2,3/2)+ | | I | B(M1,E1)↑(W.u.)=0.032 9. |
| 2386.6 10 | (1/2,3/2) | | I | B(M1,E1)↑(W.u.)=0.020 8. |
| 2455.8 7 | (1/2,3/2) | | I | B(M1,E1)↑(W.u.)=0.022 7. |
| 2466.0 10 | (1/2,3/2) | | I | B(M1,E1)↑(W.u.)=0.010 3. |
| 2492.0 7 | (1/2,3/2)+ | | I | B(M1,E1)↑(W.u.)=0.051 5. |
| 2553.4 7 | (1/2,3/2) | | I | B(M1,E1)↑(W.u.)=0.025 8. |
| 2571.4 10 | (1/2,3/2) | | I | B(M1,E1)↑(W.u.)=0.010 3. |
| 2598.6 10 | (1/2,3/2)+ | | I | B(M1,E1)↑(W.u.)=0.035 10. |
| 2602.8 10 | (1/2,3/2) | | I | B(M1,E1)↑(W.u.)=0.017 3. |
| 2687.0 10 | (1/2,3/2) | | I | B(M1,E1)↑(W.u.)=0.011 3. |
| 2749.4 7 | (1/2,3/2)+ | | I | B(M1,E1)↑(W.u.)=0.031 7. |
| 2756.4 10 | (1/2,3/2) | | I | B(M1,E1)↑(W.u.)=0.017 3. |
| 2769.1 7 | (1/2,3/2)+ | | I | B(M1,E1)↑(W.u.)=0.043 6. |
| 2786.5 10 | (1/2,3/2) | | I | B(M1,E1)↑(W.u.)=0.021 4. |
| 2814.2 7 | (1/2,3/2) | | I | B(M1,E1)↑(W.u.)=0.032 21. |
| 2818.6 10 | (1/2,3/2) | | I | B(M1,E1)↑(W.u.)=0.015 6. |
| 2843.1 10 | (1/2,3/2) | | I | B(M1,E1)↑(W.u.)=0.011 3. |
| 2861.1 10 | (1/2,3/2)+ | | I | B(M1,E1)↑(W.u.)=0.033 12. |
| 2943.3 6 | (1/2,3/2)+ | | I | B(M1,E1)↑(W.u.)=0.043 16. |
| 2996.2 7 | (1/2,3/2)+ | | I | B(M1,E1)↑(W.u.)=0.033 6. |
| 3127.6 10 | (1/2,3/2) | | I | B(M1,E1)↑(W.u.)=0.020 3. |
| 3175.6 10 | (1/2,3/2) | | I | B(M1,E1)↑(W.u.)=0.010 3. |
| 3185.0 10 | (1/2,3/2) | | I | B(M1,E1)↑(W.u.)=0.030 12. |
| 3187.5 10 | (1/2,3/2) | | I | B(M1,E1)↑(W.u.)=0.009 5. |

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## Adopted Levels, Gammas (continued)

### $^{169}$Tm Levels (continued)

| E(level)† | Jπ‡ | XREF | Comments |
|---|---|---|---|
| 3191.3 *7* | (1/2,3/2)$^+$ | I | B(M1,E1)↑(W.u.)=0.030 *7*. |
| 3199.7 *10* | (1/2,3/2)$^+$ | I | B(M1,E1)↑(W.u.)=0.033 *9*. |
| 3204.8 *7* | (1/2,3/2)$^+$ | I | B(M1,E1)↑(W.u.)=0.046 *12*. |
| 3254.6 *7* | (1/2,3/2) | I | B(M1,E1)↑(W.u.)=0.025 *7*. |
| 3274.5 *10* | (1/2,3/2)$^+$ | I | B(M1,E1)↑(W.u.)=0.029 *7*. |
| 3286.5 *10* | (1/2,3/2)$^+$ | I | B(M1,E1)↑(W.u.)=0.028 *4*. |
| 3299.6 *7* | (1/2,3/2)$^+$ | I | B(M1,E1)↑(W.u.)=0.037 *15*. |
| 3308.4 *10* | (1/2,3/2) | I | B(M1,E1)↑(W.u.)=0.012 *4*. |
| 3341.2 *7* | (1/2,3/2)$^+$ | I | B(M1,E1)↑(W.u.)=0.037 *9*. |
| 3376.4 *7* | (1/2,3/2)$^+$ | I | B(M1,E1)↑(W.u.)=0.030 *6*. |
| 3383.9 *10* | (1/2,3/2) | I | B(M1,E1)↑(W.u.)=0.020 *3*. |
| 3419.2 *10* | (1/2,3/2) | I | B(M1,E1)↑(W.u.)=0.020 *4*. |
| 3436.3 *7* | (1/2,3/2) | I | B(M1,E1)↑(W.u.)=0.027 *12*. |
| 3442.0 *10* | (1/2,3/2) | I | B(M1,E1)↑(W.u.)=0.012 *7*. |
| 3458.6 *10* | (1/2,3/2) | I | B(M1,E1)↑(W.u.)=0.013 *7*. |
| 3475.7 *7* | (1/2,3/2)$^+$ | I | B(M1,E1)↑(W.u.)=0.055 *13*. |
| 3480.3 *10* | (1/2,3/2) | I | B(M1,E1)↑(W.u.)=0.020 *3*. |
| 3497.0 *10* | (1/2,3/2) | I | B(M1,E1)↑(W.u.)=0.008 *3*. |
| 3527.0 *7* | (1/2,3/2) | I | B(M1,E1)↑(W.u.)=0.017 *7*. |
| 3538.7 *10* | (1/2,3/2) | I | B(M1,E1)↑(W.u.)=0.011 *3*. |
| 3541.9 *7* | (1/2,3/2)$^+$ | I | B(M1,E1)↑(W.u.)=0.026 *7*. |
| 3573.3 *10* | (1/2,3/2) | I | B(M1,E1)↑(W.u.)=0.015 *9*. |
| 3613.0 *10* | (1/2,3/2) | I | B(M1,E1)↑(W.u.)=0.013 *4*. |
| 3624.8 *6* | (1/2,3/2)$^+$ | I | B(M1,E1)↑(W.u.)=0.057 *9*. |
| 3724.7 *7* | (1/2,3/2)$^+$ | I | B(M1,E1)↑(W.u.)=0.034 *6*. |
| 3736.2 *10* | (1/2,3/2) | I | B(M1,E1)↑(W.u.)=0.010 *4*. |
| 3741.7 *10* | (1/2,3/2) | I | B(M1,E1)↑(W.u.)=0.014 *4*. |
| 3766.3 *10* | (1/2,3/2) | I | B(M1,E1)↑(W.u.)=0.012 *3*. |
| 3795.8 *7* | (1/2,3/2) | I | B(M1,E1)↑(W.u.)=0.014 *11*. |
| 3806.7 *10* | (1/2,3/2) | I | B(M1,E1)↑(W.u.)=0.008 *3*. |
| 3862.5 *10* | (1/2,3/2) | I | B(M1,E1)↑(W.u.)=0.012 *4*. |
| 3875.3 *10* | (1/2,3/2) | I | B(M1,E1)↑(W.u.)=0.016 *4*. |
| 3916.8 *10* | (1/2,3/2) | I | B(M1,E1)↑(W.u.)=0.014 *4*. |
| 3950.2 *10* | (1/2,3/2) | I | B(M1,E1)↑(W.u.)=0.015 *3*. |
| 4103.6 *10* | (1/2,3/2) | I | B(M1,E1)↑(W.u.)=0.0056 *22*. |
| 4190.2 *7* | (1/2,3/2) | I | B(M1,E1)↑(W.u.)=0.021 *13*. |
| 4279.7 *10* | (1/2,3/2) | I | B(M1,E1)↑(W.u.)=0.008 *3*. |
| 4764.5 *10* | (1/2,3/2) | I | B(M1,E1)↑(W.u.)=0.006 *3*. |
| 4789.8 *10* | (1/2,3/2) | I | B(M1,E1)↑(W.u.)=0.008 *4*. |
| 4853.0 *10* | (1/2,3/2) | I | B(M1,E1)↑(W.u.)=0.007 *4*. |
| 4865.5 *7* | (1/2,3/2) | I | B(M1,E1)↑(W.u.)=0.015 *9*. |
| 4954.0 *10* | (1/2,3/2) | I | B(M1,E1)↑(W.u.)=0.023 *6*. |
| 5211.5 *10* | (1/2,3/2)$^+$ | I | B(M1,E1)↑(W.u.)=0.030 *6*. |
| 5507.1 *10* | (1/2,3/2) | I | B(M1,E1)↑(W.u.)=0.023 *26*. |
| 5529.9 *10* | (1/2,3/2)$^+$ | I | B(M1,E1)↑(W.u.)=0.059 *21*. |
| 5593.3 *7* | (1/2,3/2) | I | B(M1,E1)↑(W.u.)=0.05 *4*. |
| 5598.3 *10* | (1/2,3/2) | I | B(M1,E1)↑(W.u.)=0.031 *17*. |
| 1.47×10$^4$ *3* | | K | E(level): GMR; %EWSR=51 *12*, Γ=2.5×10$^3$ keV *3* (1980Bu16) from ($^3$He,$^3$He′). |
| 1.576×10$^4$ *13* | | F | |
| 16102 | 1/2$^-$ | C | Jπ: Analog of 1/2$^-$ $^{169}$Er(g.s.). Other E: 15760 *130* in (e,e′p). |
| 1.634×10$^4$ *14* | (1/2)$^-$ | F | Jπ: Analog of (1/2)$^-$ $^{169}$Er(562 level). |

† Least-squares adjusted values based on adopted Eγ, with E(8.4 level) held fixed at 8.41017 *15*, the difference between E(118γ) and E(110γ), except where noted or where cross references clearly indicate a different source.

Continued on next page (footnotes at end of table)

## Adopted Levels, Gammas (continued)

### $^{169}$Tm Levels (continued)

‡ Based on coincidence data, rotational structure, and $\gamma$-ray angular distributions in $^{170}$Er(p,2n$\gamma$), (d,3n$\gamma$), except where noted. Definite $J^\pi$ is assigned to members of bands defined by a cascade of transitions having regularly changing energies provided the $J^\pi$ of at least one member and the multipolarity of at least one intraband transition have been independently determined.

# Definite $J^\pi$ for g.s. band established through J=21/2 based on band structure and independently established $J^\pi$(8-keV level)=$3/2^+$, and intraband M1+E2 110$\gamma$ and E2 118$\gamma$ from 118 level.

@ Band(A): 7/2[404] band. Band parameters: A=13.3, B=−6.7 (7/2, 9/2, 11/2, 13/2 levels).

& Band(B): 1/2[541], $\alpha$=+1/2 band. Band parameters: A=9.1, B=+0.8, a=+3.8 (J=1/2 through 21/2 levels); however, parameters vary significantly depending on which levels are included in the fit.

a Band(b): 1/2[541], $\alpha$=−1/2 band. See comment on signature partner band.

b Band(C): 7/2[523] band. Band parameters: A=10.3, B=3.7 (7/2, 9/2, 11/2, 13/2 levels).

c Band(D): 3/2[411] band + 1/2[411] $\gamma$ vibration. Band parameters: A=12.6, B=−11.9 (3/2, 5/2, 7/2, 9/2 levels). Configuration includes contribution from K-2 $\gamma$ vibration built on 1/2[411] orbital.

d Band(E): 5/2[402] band. Band parameter: A=13.8 (5/2, 7/2 levels).

e Band(F): 9/2[514] band.

**Adopted Levels, Gammas (continued)**

$\gamma(^{169}Tm)$

| $E_i$(level) | $J^\pi_i$ | $E_\gamma$[†] | $I_\gamma$[‡] | $E_f$ | $J^\pi_f$ | Mult.[†] | $\delta$[†] | $\alpha$[b] | Comments |
|---|---|---|---|---|---|---|---|---|---|
| 8.41017 | $3/2^+$ | 8.41017 *15* | 100 | 0.0 | $1/2^+$ | M1+E2 | 0.0328 *5* | 263 *5* | B(M1)(W.u.)=0.0342 *8*; B(E2)(W.u.)=241 *10*<br>$E_\gamma$: from recoil-corrected level-energy difference.<br>Mult.,$\delta$: from subshell ratios in $\beta^-$ decay. Other $\delta$: 0.036 *+7−9* from $\alpha$(exp) in ($\gamma$,$\gamma$): Mossbauer effect. |
| 118.18945 | $5/2^+$ | 109.77924[&] *3* | 100.0 *4* | 8.41017 | $3/2^+$ | M1+E2 | −0.139 *10* | 2.37 | B(M1)(W.u.)=0.072 *4*; B(E2)(W.u.)=53 *8*<br>$\delta$: −0.116 *4* and −0.146 *16* in Coulomb excitation; −0.145 *14*, 0.143 *5*, −0.160 *16*, 0.149 *3* and −0.21 *6* in $\varepsilon$ decay. Adopted value is weighted average of these discrepant data (using limitation of relative statistical weights method); the unweighted average is −0.153 *11*. |
| | | 118.18940[&] *14* | 10.78 *4* | 0.0 | $1/2^+$ | E2 | | 1.642 | B(E2)(W.u.)=210 *11*<br>$I_\gamma$: from $\varepsilon$ decay. However, $I\gamma$=10.21 *5* (1999Ro03) in Coulomb excitation is not consistent with this. Other I(118$\gamma$)/I(110$\gamma$): 11 *2* (1967Se09) and 11.0 *10* (1977Ta10) in Coulomb excitation; 11 *3* in $\beta^-$ decay. |
| 138.93315 | $7/2^+$ | 20.752 *9* | 1.73 *2* | 118.18945 | $5/2^+$ | M1+E2 | 0.0292 *16* | 54.9 *9* | B(M1)(W.u.)=0.0454 *13*; B(E2)(W.u.)=42 *5*<br>Other $I\gamma$: 1.68 *13* in Coulomb excitation. |
| | | 130.52293[&] *6* | 100.0 *3* | 8.41017 | $3/2^+$ | E2 | | 1.143 | B(E2)(W.u.)=287 *5* |
| 316.14633 | $7/2^+$ | 177.21307[&] *6* | 62.01 *21* | 138.93315 | $7/2^+$ | M1+E2 | −0.30 *13* | 0.594 *19* | B(M1)(W.u.)=$1.25\times10^{-6}$ *10*; B(E2)(W.u.)=0.0017 *14* |
| | | 197.95675[&] *7* | 100 | 118.18945 | $5/2^+$ | M1+E2 | −0.326 *6* | 0.433 | B(M1)(W.u.)=$1.430\times10^{-6}$ *14*; B(E2)(W.u.)=0.00180 *7* |
| | | 307.73586[&] *10* | 27.96 *9* | 8.41017 | $3/2^+$ | E2 | | 0.0662 | B(E2)(W.u.)=0.000576 *4* |
| 332.116 | $9/2^+$ | 193.15 *5* | 100.0[@] | 138.93315 | $7/2^+$ | M1+E2[@] | −0.126[@] *21* | 0.479 *1* | B(M1)(W.u.)=0.0787 *22*; B(E2)(W.u.)=16 *6*<br>$\delta$: unweighted average of −0.146 *3* (1999Ro03), −0.105 *11* (1977Ta10) in Coulomb excitation. |
| | | 213.935 *17* | 45.9 *10* | 118.18945 | $5/2^+$ | E2 | | 0.208 | B(E2)(W.u.)=273 *10*<br>$I_\gamma$: weighted average of 39 *6* in $\varepsilon$ decay, 43 *9* in (p,2n$\gamma$), 45.2 *5* (1999Ro03), 49.1 *11* (1977Ta10), 56 *5* (1967Se09) in Coulomb excitation.<br>Mult.: from Coulomb excitation. |
| 341.94 | $(1/2^-)$ | 333.53[#] *5* | 100[#] *50* | 8.41017 | $3/2^+$ | | | | |
| | | 341.95[#] *5* | 55[#] *28* | 0.0 | $1/2^+$ | | | | |
| 345.028 | $5/2^-$ | 205.99 *6* | 36 *9* | 138.93315 | $7/2^+$ | E1 | | 0.0497 | |
| | | 226.3 *7* | 2.7 *19* | 118.18945 | $5/2^+$ | | | | |
| | | 336.618 *3* | 100 *3* | 8.41017 | $3/2^+$ | E1(+M2) | ≤0.66 | 0.07 *6* | |
| 367.67 | $11/2^+$ | 228.71[#] *5* | 100 | 138.93315 | $7/2^+$ | E2[@] | | 0.1673 | B(E2)(W.u.)=336 *17*<br>Mult.: from $\gamma(\theta)$ and RUL in Coulomb excitation. |





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## Adopted Levels, Gammas (continued)

### $\gamma$($^{169}$Tm) (continued)

| $E_i$(level) | $J^{\pi}_i$ | $E_\gamma$[†] | $I_\gamma$[‡] | $E_f$ | $J^{\pi}_f$ | Mult.[†] | $\delta$[†] | $\alpha$[b] | Comments |
|---|---|---|---|---|---|---|---|---|---|
| 379.26678 | 7/2$^-$ | 63.12044[&] 4 | 100.0 4 | 316.14633 | 7/2$^+$ | E1 | | 1.098 | B(E1)(W.u.)=7.88×10$^{-6}$ 17 |
| | | 240.331 3 | 0.261 14 | 138.93315 | 7/2$^+$ | E1(+M2) | <+0.12 | 0.042 9 | B(E1)(W.u.)>3.5×10$^{-10}$; B(M2)(W.u.)<0.00044 |
| | | 261.07712[&] 9 | 3.850 16 | 118.18945 | 5/2$^+$ | E1+M2 | −0.07 3 | 0.032 5 | B(E1)(W.u.)=4.26×10$^{-9}$ 9; B(M2)(W.u.)=0.0014 12 |
| | | 370.854 8 | 0.00202 21 | 8.41017 | 3/2$^+$ | [M2] | | 0.300 | B(M2)(W.u.)=2.6×10$^{-5}$ 3 |
| | | 379.284 18 | 0.00068 26 | 0.0 | 1/2$^+$ | [E3] | | 0.1270 | B(E3)(W.u.)=0.039 15 |
| 430.122 | (9/2)$^-$ | 84.9[#d] 5 | 20[#] 11 | 345.028 | 5/2$^-$ | | | | Other I$\gamma$: <67 in $\varepsilon$ decay. |
| | | 291.188[#] 11 | 100[#] 9 | 138.93315 | 7/2$^+$ | E1 | | 0.0207 | |
| 433.521 | (9/2)$^+$ | 101.41[d] | <18 | 332.116 | 9/2$^+$ | | | | E$\gamma$ from level scheme and I$\gamma$ limit from $\varepsilon$ decay. Possibly this is the unplaced E$\gamma$=101.0 5 $\gamma$ seen in (p,2n$\gamma$); if so, I$\gamma$=18 9. |
| | | 117.376 19 | 100 6 | 316.14633 | 7/2$^+$ | [M1,E2] | | 1.82 14 | |
| | | 294.54 11 | 2.4 6 | 138.93315 | 7/2$^+$ | M1 | | 0.1522 | |
| 472.88128 | 9/2$^-$ | 93.61447[&] 8 | 100.0 6 | 379.26678 | 7/2$^-$ | M1+E2 | +0.183 3 | 3.75 | B(M1)(W.u.)=0.039 20; B(E2)(W.u.)=70 40 |
| | | 105.19 10 | 0.10 3 | 367.67 | 11/2$^+$ | E1 | | 0.292 | B(E1)(W.u.)=2.9×10$^{-7}$ 17 |
| | | 156.724 11 | 0.383 10 | 316.14633 | 7/2$^+$ | E1 | | 0.1016 | B(E1)(W.u.)=3.3×10$^{-7}$ 17 |
| | | 333.963 13 | 0.0675 24 | 138.93315 | 7/2$^+$ | [E1] | | 0.01480 | B(E1)(W.u.)=6×10$^{-9}$ 3 |
| 474.968 | (3/2)$^-$ | 356.74 5 | 72 3 | 118.18945 | 5/2$^+$ | | | | |
| | | 466.2 2 | 10.0 11 | 8.41017 | 3/2$^+$ | | | | E$_\gamma$: from (p,2n$\gamma$). |
| | | 474.970 9 | 100.0 22 | 0.0 | 1/2$^+$ | | | | |
| 570.830 | 3/2$^+$ | 452.62 8 | 15 5 | 118.18945 | 5/2$^+$ | M1+E2[@] | 1.5[@] +9−4 | 0.030 5 | B(M1)(W.u.)=0.0005 5; B(E2)(W.u.)=2.6 23 |
| | | 562.410 12 | 100.0 21 | 8.41017 | 3/2$^+$ | M1+E2[@] | 0.8[@] +5−4 | 0.022 4 | B(M1)(W.u.)=0.004 3; B(E2)(W.u.)=3 +4−3 |
| | | 570.89 3 | 94 6 | 0.0 | 1/2$^+$ | M1+E2[@] | 0.8[@] +5−4 | 0.021 4 | B(M1)(W.u.)=0.003 3; B(E2)(W.u.)=3 3 |
| 575.38 | (11/2$^+$) | 141.85[#] 5 | 100[#] 10 | 433.521 | (9/2)$^+$ | | | | |
| | | 259.23[#] 5 | 96[#] 48 | 316.14633 | 7/2$^+$ | | | | |
| 588.20 | 11/2$^-$ | 115.32[#] 5 | 100[#] 10 | 472.88128 | 9/2$^-$ | (M1+E2) | | 1.93 14 | Mult.: D+Q from (p,2n$\gamma$), $\Delta\pi$=no from level scheme. |
| | | 208.8[#] 5 | 10[#] 5 | 379.26678 | 7/2$^-$ | | | | |
| 602.82 | (13/2$^-$) | 172.7[#] 5 | 16[#] 8 | 430.122 | (9/2)$^-$ | | | | |
| | | 235.1[#] 2 | 100[#] 10 | 367.67 | 11/2$^+$ | (E1(+M2)) | | 0.7 7 | Mult.: D(+Q) from (p,2n$\gamma$), $\Delta\pi$=yes from level scheme. |
| 633.292 | 5/2$^+$ | 494.357 8 | 29.8 5 | 138.93315 | 7/2$^+$ | M1 | | 0.0389 | B(M1)(W.u.)=0.091 |
| | | 515.101 6 | 84.5 12 | 118.18945 | 5/2$^+$ | M1 | | 0.0350 | B(M1)(W.u.)=0.23 |
| | | 624.881 4 | 100.0 25 | 8.41017 | 3/2$^+$ | M1 | | 0.0214 | B(M1)(W.u.)=0.15 |
| | | 633.32 10 | 0.140 9 | 0.0 | 1/2$^+$ | [E2] | | 0.00959 | B(E2)(W.u.)=0.24 |
| 637.08 | 13/2$^+$ | 269.4[#] 2 | 98.4[@] 24 | 367.67 | 11/2$^+$ | M1+E2[@] | −0.149[@] 26 | 0.192 | B(M1)(W.u.)=0.090 8; B(E2)(W.u.)=13 5 |





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## $\gamma(^{169}Tm)$ (continued)

| $E_i$(level) | $J^\pi_i$ | $E_\gamma$[†] | $I_\gamma$[‡] | $E_f$ | $J^\pi_f$ | Mult.[†] | $\alpha$[b] | Comments |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Iγ: weighted average of 99.6 *12* (1999Ro03) and 93.7 *24* (1977Ta10) in Coulomb excitation. Other Iγ: 101 *14* in (p,2nγ); 79 *8* (1967Se09) in Coulomb excitation.<br>δ: unweighted average of −0.174 *3* (1999Ro03), −0.123 *14* (1977Ta10) in Coulomb excitation. |
| 637.08 | 13/2$^+$ | 305.2[#] *2* | 100[@] | 332.116 | 9/2$^+$ | E2[@] | 0.0678 | B(E2)(W.u.)=318 *24* |
| 646.758 | (7/2$^-$) | 171.6[#] *5* | 10[#] *5* | 474.968 | (3/2)$^-$ | | | |
| | | 216.4[#] *2* | 5.0[#] | 430.122 | (9/2)$^-$ | | | |
| | | 301.6[#] *2* | 5.6[#] | 345.028 | 5/2$^-$ | | | |
| | | 314.6[#] *2* | 22[#] | 332.116 | 9/2$^+$ | | | |
| | | 507.8 *3* | 1.2 *7* | 138.93315 | 7/2$^+$ | | | |
| | | 528.569 *10* | 100.0[#] *24* | 118.18945 | 5/2$^+$ | | | |
| 691.24 | 15/2$^+$ | 323.4[#] *2* | 100 | 367.67 | 11/2$^+$ | E2[@] | 0.0571 | B(E2)(W.u.)=337 *17* |
| 718.786 | (7/2$^+$) | 72.028[d] | <186 | 646.758 | (7/2$^-$) | | | Eγ from level scheme and Iγ limit from ε decay. Possibly this is the unplaced E=72.0 *5* γ seen in (p,2nγ); if so, Iγ≈23. |
| | | 386.671 *13* | 17.4 *4* | 332.116 | 9/2$^+$ | [M1,E2] | 0.054 *20* | |
| | | 579.851 *5* | 100.0 *17* | 138.93315 | 7/2$^+$ | (M1) | 0.0259 | |
| | | 600.603 *8* | 59.1 *9* | 118.18945 | 5/2$^+$ | (M1) | 0.0237 | |
| | | 710.354 *15* | 1.77 *9* | 8.41017 | 3/2$^+$ | | | |
| 725.44 | 13/2$^-$ | 137.26[#] *5* | 100[#] *10* | 588.20 | 11/2$^-$ | (M1+E2) | 1.11 *16* | Mult.: D+Q from (p,2nγ), Δπ=no from level scheme. |
| | | 252.5[#] *2* | 29[#] *3* | 472.88128 | 9/2$^-$ | | | |
| 741.25 | (13/2$^+$) | 165.8[#] *2* | 100[#] *9* | 575.38 | (11/2$^+$) | | | |
| | | 307.74[#] *5* | <57[#] | 433.521 | (9/2)$^+$ | | | Eγ: for multiplet in (p,2nγ). |
| 781.796 | (5/2)$^+$ | 210.94[c#] *5* | 53[#] | 570.830 | 3/2$^+$ | | | |
| | | 465.65 | 91.2 *10* | 316.14633 | 7/2$^+$ | | | |
| | | 642.873 *9* | 36.5 *9* | 138.93315 | 7/2$^+$ | | | |
| | | 663.599 *7* | 92.3 *26* | 118.18945 | 5/2$^+$ | | | |
| | | 773.386 *14* | 100.0 *15* | 8.41017 | 3/2$^+$ | | | |
| | | 781.64 *8* | 1.44 *12* | 0.0 | 1/2$^+$ | | | |
| 832.42 | (9/2$^+$) | 464.7 | 41 *24* | 367.67 | 11/2$^+$ | | | |
| | | 500.35 *10* | 100 *9* | 332.116 | 9/2$^+$ | | | |
| | | 693.46 *8* | 98 *5* | 138.93315 | 7/2$^+$ | | | |
| 865.9 | (17/2$^-$) | 175.0[#] *5* | 41[#] *22* | 691.24 | 15/2$^+$ | | | |
| | | 262.7[#] *5* | 100[#] *16* | 602.82 | (13/2$^-$) | | | |
| 878.35 | (7/2$^+$) | 546.16 *22* | 80 *22* | 332.116 | 9/2$^+$ | | | |
| | | 739.42 *11* | 100 *12* | 138.93315 | 7/2$^+$ | | | |
| | | 760.24 *24* | 45 *12* | 118.18945 | 5/2$^+$ | | | |
| 883.75 | 15/2$^-$ | 158.3[#] *2* | 100[#] *10* | 725.44 | 13/2$^-$ | (M1(+E2)) | 0.71 *14* | Mult.: D(+Q) from (p,2nγ), Δπ=no from level scheme. |

## Adopted Levels, Gammas (continued)

### $\gamma(^{169}Tm)$ (continued)

| $E_i$(level) | $J_i^\pi$ | $E_\gamma$[†] | $I_\gamma$[‡] | $E_f$ | $J_f^\pi$ | Mult.[†] | $\delta$[†] | $\alpha$[b] | Comments |
|---|---|---|---|---|---|---|---|---|---|
| 883.75 | 15/2⁻ | 295.4[#] *2* | <78[#] | 588.20 | 11/2⁻ | | | | |
| 884.62 | (11/2⁻) | 281.7[#d] *2* | 36[#] | 602.82 | (13/2⁻) | | | | |
| | | 454.5[c#] *2* | 21[#] | 430.122 | (9/2)⁻ | | | | |
| | | 552.0[c#d] *2* | 100[#] | 332.116 | 9/2⁺ | | | | |
| ≈900? | | ≈900[@d] | 100 | 0.0 | 1/2⁺ | | | | |
| 929.37 | (15/2⁺) | 188.7[#] *5* | 37[#] *21* | 741.25 | (13/2⁺) | | | | |
| | | 353.9[#] *2* | 100[#] *10* | 575.38 | (11/2⁺) | | | | |
| 964.0 | (11/2⁺) | 595.9[#] *5* | 100[#] | 367.67 | 11/2⁺ | | | | |
| | | 632.3[#] *5* | 72[#] *38* | 332.116 | 9/2⁺ | | | | |
| 1027.85 | 17/2⁺ | 336.60[#] *5* | 58.7[@] *7* | 691.24 | 15/2⁺ | M1+E2[@] | −0.18[@] *3* | 0.1048 *16* | B(M1)(W.u.)=0.102 *10*; B(E2)(W.u.)=14 *5*<br>$I_\gamma$: from 1999Ro03 in Coulomb excitation. Other $I\gamma$: 52 *5* (1977Ta10) in Coulomb excitation; 336 in (p,2n$\gamma$); 114 (1974Ba66) in (d,3n$\gamma$).<br>$\delta$: weighted average of −0.199 *20* (1999Ro03), −0.127 *35* (1977Ta10) in Coulomb excitation. |
| | | 391.0[#] *2* | 100[@] | 637.08 | 13/2⁺ | E2[@] | | 0.0331 | B(E2)(W.u.)=350 *40* |
| 1039.95 | | 565.2[#] *2* | 37[#] | 474.968 | (3/2)⁻ | | | | |
| | | 694.7[#] *2* | 100[#] | 345.028 | 5/2⁻ | | | | |
| 1058.54 | | 716.6[#] *2* | 100 | 341.94 | (1/2⁻) | | | | |
| 1063.57 | 17/2⁻ | 179.6[#] *2* | 90[#] *9* | 883.75 | 15/2⁻ | | | | |
| | | 338.3[#] *2* | 100[#] *10* | 725.44 | 13/2⁻ | | | | |
| 1104.18 | 19/2⁺ | 413.0[#] *2* | 100 | 691.24 | 15/2⁺ | E2[@] | | 0.0284 | B(E2)(W.u.)=430 *50* |
| 1112.6? | | 682.5[c#d] *5* | 100 | 430.122 | (9/2)⁻ | | | | |
| 1135.93 | | 790.9[#] *2* | 100 | 345.028 | 5/2⁻ | | | | |
| 1140.85 | (17/2⁺) | 210.94[c#] *5* | <39[#] | 929.37 | (15/2⁺) | | | | |
| | | 399.6[#] *2* | 100[#] | 741.25 | (13/2⁺) | | | | |
| 1188.7 | (15/2⁻) | 552.0[c#d] *2* | <189[#] | 637.08 | 13/2⁺ | | | | |
| | | 585.9[#] *2* | 100[#] *10* | 602.82 | (13/2⁻) | | | | |
| 1190 | ⁺ | 1190[@] *20* | 100 | 0.0 | 1/2⁺ | | | | |
| 1218.1 | (21/2⁻) | 352.2[#] *2* | 100 | 865.9 | (17/2⁻) | | | | |
| 1223.04 | | 877.9[#] *2* | 100[#] | 345.028 | 5/2⁻ | | | | |
| | | 881.2[#] *2* | 75[#] | 341.94 | (1/2⁻) | | | | |
| 1262.40 | 19/2⁻ | 198.3[#] *5* | <185[#] | 1063.57 | 17/2⁻ | | | | |
| | | 378.7[#] *2* | 100[#] | 883.75 | 15/2⁻ | | | | |



$^{169}_{69}Tm_{100}$-10

$\gamma(^{169}Tm)$ (continued)

| $E_i$(level) | $J^\pi_i$ | $E_\gamma$[†] | $I_\gamma$[‡] | $E_f$ | $J^\pi_f$ | Mult.[†] | α[b] | Comments |
|---|---|---|---|---|---|---|---|---|
| 1300.8 | (15/2+) | 609.6[#] *5* | 100 | 691.24 | 15/2+ | | | |
| 1372.1 | (19/2+) | 442.7[#] *5* | 100 | 929.37 | (15/2+) | | | |
| 1482.94 | 21/2− | 220.5[#] *2* | 100[#] *10* | 1262.40 | 19/2− | | | |
| | | 419.4[#] *2* | 77[#] *8* | 1063.57 | 17/2− | | | |
| 1497.8 | 21/2+ | 394.0[#] *5* | 34[#] *13* | 1104.18 | 19/2+ | | | $I_\gamma$: weighted average of 29 *15* from Coulomb excitation and 50 *26* from (p,2n$\gamma$). |
| | | 469.6[#] *5* | 100[#] *50* | 1027.85 | 17/2+ | E2[@] | 0.0201 | B(E2)(W.u.)=340 *220* |
| 1510.6 | (1/2,3/2)+ | 1510.6[a] | 100[a] | 0.0 | 1/2+ | | | |
| 1527.5 | (1/2,3/2)+ | 1527.5[a] | 100[a] | 0.0 | 1/2+ | | | |
| 1548.4? | (19/2−) | 682.5[c#d] *5* | 100 | 865.9 | (17/2−) | | | |
| 1598.4? | (23/2+) | 494.2[c#d] *2* | 100 | 1104.18 | 19/2+ | | | |
| 1625.3 | (21/2+) | 484.4[#] *5* | 100 | 1140.85 | (17/2+) | | | |
| 1658.1 | (25/2−) | 440.0[#] *2* | 100 | 1218.1 | (21/2−) | | | |
| 1716.9 | 23/2− | 233[#d] | | 1482.94 | 21/2− | | | |
| | | 454.5[c#] *2* | | 1262.40 | 19/2− | | | |
| 1864.6 | (1/2,3/2)+ | 1856.2[a] | 100[a] *26* | 8.41017 | 3/2+ | | | |
| | | 1864.6[a] | 47[a] | 0.0 | 1/2+ | | | |
| 1910.5 | (1/2,3/2)+ | 1792.3[a] | 100[a] *10* | 118.18945 | 5/2+ | | | |
| | | 1902.1[a] | 46[a] *5* | 8.41017 | 3/2+ | | | |
| | | 1910.5[a] | 98[a] | 0.0 | 1/2+ | | | |
| 1922.3 | (1/2,3/2)+ | 1804.1[a] | 100[a] *46* | 118.18945 | 5/2+ | | | |
| | | 1922.3[a] | 79[a] | 0.0 | 1/2+ | | | |
| 1963.7 | (1/2,3/2) | 1963.7[a] | 100[a] | 0.0 | 1/2+ | | | |
| 1978.4 | (1/2,3/2) | 1978.4[a] | 100[a] | 0.0 | 1/2+ | | | |
| 1991.7 | (1/2,3/2)+ | 1983.3[a] | 79[a] *36* | 8.41017 | 3/2+ | | | |
| | | 1991.7[a] | 100[a] | 0.0 | 1/2+ | | | |
| 2075.5 | (1/2,3/2)+ | 2067.1[a] | 100[a] *74* | 8.41017 | 3/2+ | | | |
| | | 2075.5[a] | 89[a] | 0.0 | 1/2+ | | | |
| 2168.7 | (1/2,3/2)+ | 2160.3[a] | 100[a] *38* | 8.41017 | 3/2+ | | | |
| | | 2168.7[a] | 72[a] | 0.0 | 1/2+ | | | |
| 2190.6 | (1/2,3/2) | 2190.6[a] | 100[a] | 0.0 | 1/2+ | | | |
| 2215.3 | (1/2,3/2) | 2215.3[a] | 100[a] | 0.0 | 1/2+ | | | |
| 2236.1 | (1/2,3/2)+ | 2117.9[a] | 56[a] *16* | 118.18945 | 5/2+ | | | |
| | | 2236.1[a] | 100[a] | 0.0 | 1/2+ | | | |
| 2262.5 | (1/2,3/2)+ | 2144.3[a] | 100[a] *31* | 118.18945 | 5/2+ | | | |
| | | 2262.5[a] | 72[a] | 0.0 | 1/2+ | | | |





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## Adopted Levels, Gammas (continued)

### $\gamma(^{169}Tm)$ (continued)

| $E_i$(level) | $J^\pi_i$ | $E_\gamma$[†] | $I_\gamma$[‡] | $E_f$ | $J^\pi_f$ |
|---|---|---|---|---|---|
| 2293.8 | (1/2,3/2) | 2293.8[a] | 100[a] | 0.0 | $1/2^+$ |
| 2306.3 | (1/2,3/2) | 2306.3[a] | 100[a] | 0.0 | $1/2^+$ |
| 2312.2 | $(1/2,3/2)^+$ | 2194.0[a] | 100[a] *37* | 118.18945 | $5/2^+$ |
| | | 2312.2[a] | 92[a] | 0.0 | $1/2^+$ |
| 2386.6 | (1/2,3/2) | 2386.6[a] | 100[a] | 0.0 | $1/2^+$ |
| 2455.8 | (1/2,3/2) | 2447.4[a] | 43[a] *27* | 8.41017 | $3/2^+$ |
| | | 2455.8[a] | 100[a] | 0.0 | $1/2^+$ |
| 2466.0 | (1/2,3/2) | 2466.0[a] | 100[a] | 0.0 | $1/2^+$ |
| 2492.0 | $(1/2,3/2)^+$ | 2373.8[a] | 47[a] *13* | 118.18945 | $5/2^+$ |
| | | 2492.0[a] | 100[a] | 0.0 | $1/2^+$ |
| 2553.4 | (1/2,3/2) | 2435.2[a] | 100[a] *43* | 118.18945 | $5/2^+$ |
| | | 2553.4[a] | 64[a] | 0.0 | $1/2^+$ |
| 2571.4 | (1/2,3/2) | 2571.4[a] | 100[a] | 0.0 | $1/2^+$ |
| 2598.6 | $(1/2,3/2)^+$ | 2598.6[a] | 100[a] | 0.0 | $1/2^+$ |
| 2602.8 | (1/2,3/2) | 2602.8[a] | 100[a] | 0.0 | $1/2^+$ |
| 2687.0 | (1/2,3/2) | 2687.0[a] | 100[a] | 0.0 | $1/2^+$ |
| 2749.4 | $(1/2,3/2)^+$ | 2741.0[a] | 96[a] *41* | 8.41017 | $3/2^+$ |
| | | 2749.4[a] | 100[a] | 0.0 | $1/2^+$ |
| 2756.4 | (1/2,3/2) | 2756.4[a] | 100[a] | 0.0 | $1/2^+$ |
| 2769.1 | $(1/2,3/2)^+$ | 2760.7[a] | 41[a] *11* | 8.41017 | $3/2^+$ |
| | | 2769.1[a] | 100[a] | 0.0 | $1/2^+$ |
| 2786.5 | (1/2,3/2) | 2786.5[a] | 100[a] | 0.0 | $1/2^+$ |
| 2814.2 | (1/2,3/2) | 2805.8[a] | 89[a] *79* | 8.41017 | $3/2^+$ |
| | | 2814.2[a] | 100[a] | 0.0 | $1/2^+$ |
| 2818.6 | (1/2,3/2) | 2818.6[a] | 100[a] | 0.0 | $1/2^+$ |
| 2843.1 | (1/2,3/2) | 2843.1[a] | 100[a] | 0.0 | $1/2^+$ |
| 2861.1 | $(1/2,3/2)^+$ | 2861.1[a] | 100[a] | 0.0 | $1/2^+$ |
| 2943.3 | $(1/2,3/2)^+$ | 2825.1[a] | 63[a] *56* | 118.18945 | $5/2^+$ |
| | | 2934.9[a] | 100[a] *70* | 8.41017 | $3/2^+$ |
| | | 2943.3[a] | 70[a] | 0.0 | $1/2^+$ |
| 2996.2 | $(1/2,3/2)^+$ | 2878.0[a] | 100[a] *26* | 118.18945 | $5/2^+$ |
| | | 2996.2[a] | 89[a] | 0.0 | $1/2^+$ |
| 3127.6 | (1/2,3/2) | 3127.6[a] | 100[a] | 0.0 | $1/2^+$ |
| 3175.6 | (1/2,3/2) | 3175.6[a] | 100[a] | 0.0 | $1/2^+$ |
| 3185.0 | (1/2,3/2) | 3185.0[a] | 100[a] | 0.0 | $1/2^+$ |
| 3187.5 | (1/2,3/2) | 3187.5[a] | 100[a] | 0.0 | $1/2^+$ |
| 3191.3 | $(1/2,3/2)^+$ | 3182.9[a] | 82[a] *33* | 8.41017 | $3/2^+$ |
| | | 3191.3[a] | 100[a] | 0.0 | $1/2^+$ |
| 3199.7 | $(1/2,3/2)^+$ | 3199.7[a] | 100[a] | 0.0 | $1/2^+$ |
| 3204.8 | $(1/2,3/2)^+$ | 3086.6[a] | 56[a] *19* | 118.18945 | $5/2^+$ |
| | | 3204.8[a] | 100[a] | 0.0 | $1/2^+$ |
| 3254.6 | (1/2,3/2) | 3246.2[a] | 100[a] *53* | 8.41017 | $3/2^+$ |
| | | 3254.6[a] | 69[a] | 0.0 | $1/2^+$ |
| 3274.5 | $(1/2,3/2)^+$ | 3274.5[a] | 100[a] | 0.0 | $1/2^+$ |
| 3286.5 | $(1/2,3/2)^+$ | 3286.5[a] | 100[a] | 0.0 | $1/2^+$ |
| 3299.6 | $(1/2,3/2)^+$ | 3291.2[a] | 100[a] *75* | 8.41017 | $3/2^+$ |
| | | 3299.6[a] | 96[a] | 0.0 | $1/2^+$ |
| 3308.4 | (1/2,3/2) | 3308.4[a] | 100[a] | 0.0 | $1/2^+$ |
| 3341.2 | $(1/2,3/2)^+$ | 3332.8[a] | 47[a] *18* | 8.41017 | $3/2^+$ |
| | | 3341.2[a] | 100[a] | 0.0 | $1/2^+$ |
| 3376.4 | $(1/2,3/2)^+$ | 3368.0 | 100 *33* | 8.41017 | $3/2^+$ |
| | | 3376.4[a] | 96[a] | 0.0 | $1/2^+$ |
| 3383.9 | (1/2,3/2) | 3383.9[a] | 100[a] | 0.0 | $1/2^+$ |
| 3419.2 | (1/2,3/2) | 3419.2[a] | 100[a] | 0.0 | $1/2^+$ |
| 3436.3 | (1/2,3/2) | 3318.1[a] | 67[a] *43* | 118.18945 | $5/2^+$ |
| | | 3436.3[a] | 100[a] | 0.0 | $1/2^+$ |
| 3442.0 | (1/2,3/2) | 3442.0[a] | 100[a] | 0.0 | $1/2^+$ |
| 3458.6 | (1/2,3/2) | 3458.6[a] | 100[a] | 0.0 | $1/2^+$ |
| 3475.7 | $(1/2,3/2)^+$ | 3467.3[a] | 100[a] *41* | 8.41017 | $3/2^+$ |
| | | 3475.7[a] | 47[a] | 0.0 | $1/2^+$ |
| 3480.3 | (1/2,3/2) | 3480.3[a] | 100[a] | 0.0 | $1/2^+$ |
| 3497.0 | (1/2,3/2) | 3497.0[a] | 100[a] | 0.0 | $1/2^+$ |
| 3527.0 | (1/2,3/2) | 3518.6[a] | 100[a] *72* | 8.41017 | $3/2^+$ |
| | | 3527.0[a] | 72[a] | 0.0 | $1/2^+$ |
| 3538.7 | (1/2,3/2) | 3538.7[a] | 100[a] | 0.0 | $1/2^+$ |
| 3541.9 | $(1/2,3/2)^+$ | 3423.7[a] | 100[a] *42* | 118.18945 | $5/2^+$ |
| | | 3541.9[a] | 100[a] | 0.0 | $1/2^+$ |
| 3573.3 | (1/2,3/2) | 3573.3[a] | 100[a] | 0.0 | $1/2^+$ |
| 3613.0 | (1/2,3/2) | 3613.0[a] | 100[a] | 0.0 | $1/2^+$ |
| 3624.8 | $(1/2,3/2)^+$ | 3506.6[a] | 100[a] *26* | 118.18945 | $5/2^+$ |
| | | 3616.4[a] | 86[a] *23* | 8.41017 | $3/2^+$ |
| | | 3624.8[a] | 100[a] | 0.0 | $1/2^+$ |
| 3724.7 | $(1/2,3/2)^+$ | 3606.5[a] | 100[a] *26* | 118.18945 | $5/2^+$ |
| | | 3724.7[a] | 100[a] | 0.0 | $1/2^+$ |
| 3736.2 | (1/2,3/2) | 3736.2[a] | 100[a] | 0.0 | $1/2^+$ |
| 3741.7 | (1/2,3/2) | 3741.7[a] | 100[a] | 0.0 | $1/2^+$ |

## Adopted Levels, Gammas (continued)

### $\gamma(^{169}Tm)$ (continued)

| $E_i$(level) | $J^\pi_i$ | $E_\gamma$[†] | $I_\gamma$[‡] | $E_f$ | $J^\pi_f$ |
|---|---|---|---|---|---|
| 3766.3 | (1/2,3/2) | 3766.3[a] | 100[a] | 0.0 | $1/2^+$ |
| 3795.8 | (1/2,3/2) | 3787.3[a] | $1.0\times10^{2}$[a] *13* | 8.41017 | $3/2^+$ |
| | | 3795.7[a] | 61[a] | 0.0 | $1/2^+$ |
| 3806.7 | (1/2,3/2) | 3806.7[a] | 100[a] | 0.0 | $1/2^+$ |
| 3862.5 | (1/2,3/2) | 3862.5[a] | 100[a] | 0.0 | $1/2^+$ |
| 3875.3 | (1/2,3/2) | 3875.3[a] | 100[a] | 0.0 | $1/2^+$ |
| 3916.8 | (1/2,3/2) | 3916.8[a] | 100[a] | 0.0 | $1/2^+$ |
| 3950.2 | (1/2,3/2) | 3950.2[a] | 100[a] | 0.0 | $1/2^+$ |
| 4103.6 | (1/2,3/2) | 4103.5[a] | 100[a] | 0.0 | $1/2^+$ |
| 4190.2 | (1/2,3/2) | 4181.7[a] | $1.0\times10^{2}$[a] *10* | 8.41017 | $3/2^+$ |
| | | 4190.1[a] | 56[a] | 0.0 | $1/2^+$ |
| 4279.7 | (1/2,3/2) | 4279.6[a] | 100[a] | 0.0 | $1/2^+$ |
| 4764.5 | (1/2,3/2) | 4764.4[a] | 100[a] | 0.0 | $1/2^+$ |
| 4789.8 | (1/2,3/2) | 4789.7[a] | 100[a] | 0.0 | $1/2^+$ |
| 4853.0 | (1/2,3/2) | 4852.9[a] | 100[a] | 0.0 | $1/2^+$ |
| 4865.5 | (1/2,3/2) | 4857.0[a] | $1.0\times10^{2}$[a] *11* | 8.41017 | $3/2^+$ |
| | | 4865.4[a] | 69[a] | 0.0 | $1/2^+$ |
| 4954.0 | (1/2,3/2) | 4953.9[a] | 100[a] | 0.0 | $1/2^+$ |
| 5211.5 | $(1/2,3/2)^+$ | 5211.4[a] | 100[a] | 0.0 | $1/2^+$ |
| 5507.1 | (1/2,3/2) | 5507[a] | 100[a] | 0.0 | $1/2^+$ |
| 5529.9 | $(1/2,3/2)^+$ | 5529.8[a] | 100[a] | 0.0 | $1/2^+$ |
| 5593.3 | (1/2,3/2) | 5584.8[a] | 69[a] *81* | 8.41017 | $3/2^+$ |
| | | 5593.2[a] | 100[a] | 0.0 | $1/2^+$ |
| 5598.3 | (1/2,3/2) | 5598.2[a] | 100[a] | 0.0 | $1/2^+$ |

† From $^{169}$Yb $\varepsilon$ decay (32.018 d), except where noted.

‡ Relative photon branching from each level; values are from $^{169}$Yb $\varepsilon$ decay (32.018 d), except where noted; upper limits are given for photon branchings affected by multiple placement or by presence of contaminant.

\# From $^{170}$Er(p,2n$\gamma$), (d,3n$\gamma$).

@ From Coulomb excitation.

& From the evaluation by 2000He14 (with energy scale based on E$\gamma$=411.80205 keV *17* for the “Gold standard” ($2^+$ to g.s. transition in $^{198}$Hg)). $\Delta$E quoted here includes the 0.3 ppm uncertainty arising from the energy-wavelength conversion. See $^{169}$Yb $\varepsilon$ decay (32.018 d) for uncertainties that do not have that systematic uncertainty included.

a From $^{169}$Tm($\gamma$,$\gamma'$).

b Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on $\gamma$-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.

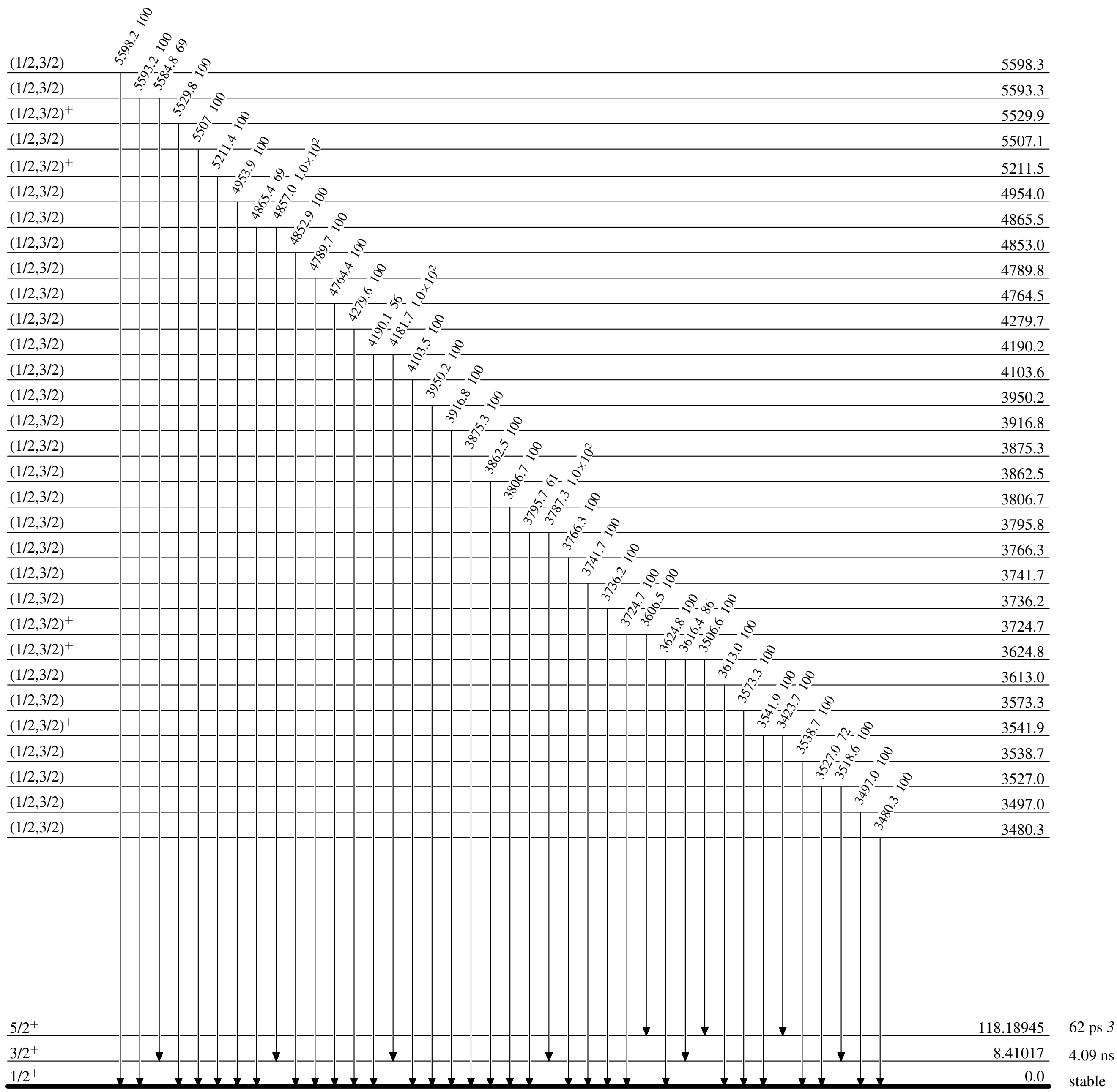
c Multiply placed.

d Placement of transition in the level scheme is uncertain.

**Adopted Levels, Gammas**

Level Scheme

Intensities: Relative photon branching from each level



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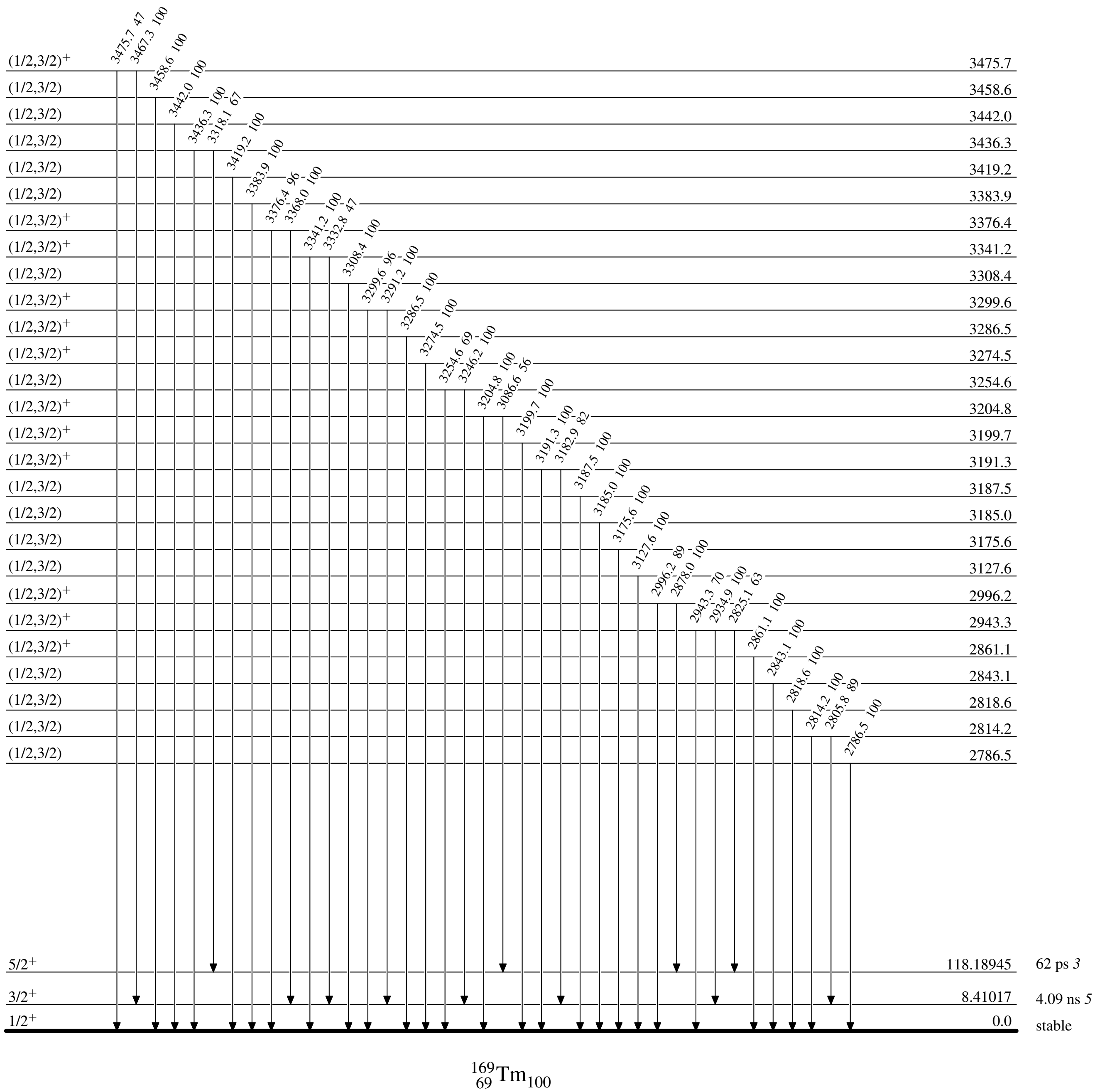
**Adopted Levels, Gammas**

Level Scheme (continued)

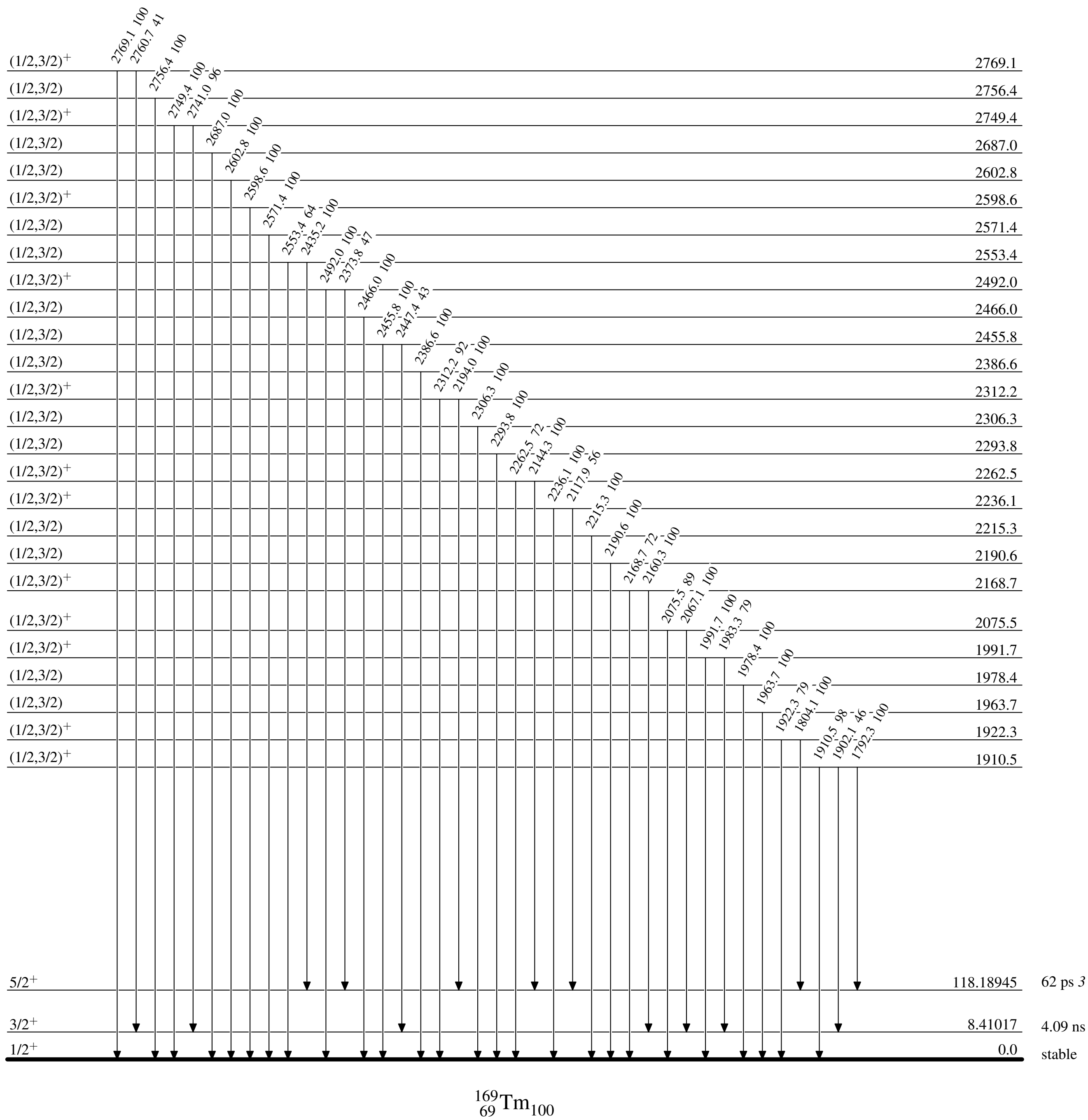
Intensities: Relative photon branching from each level



**Adopted Levels, Gammas**

Level Scheme (continued)

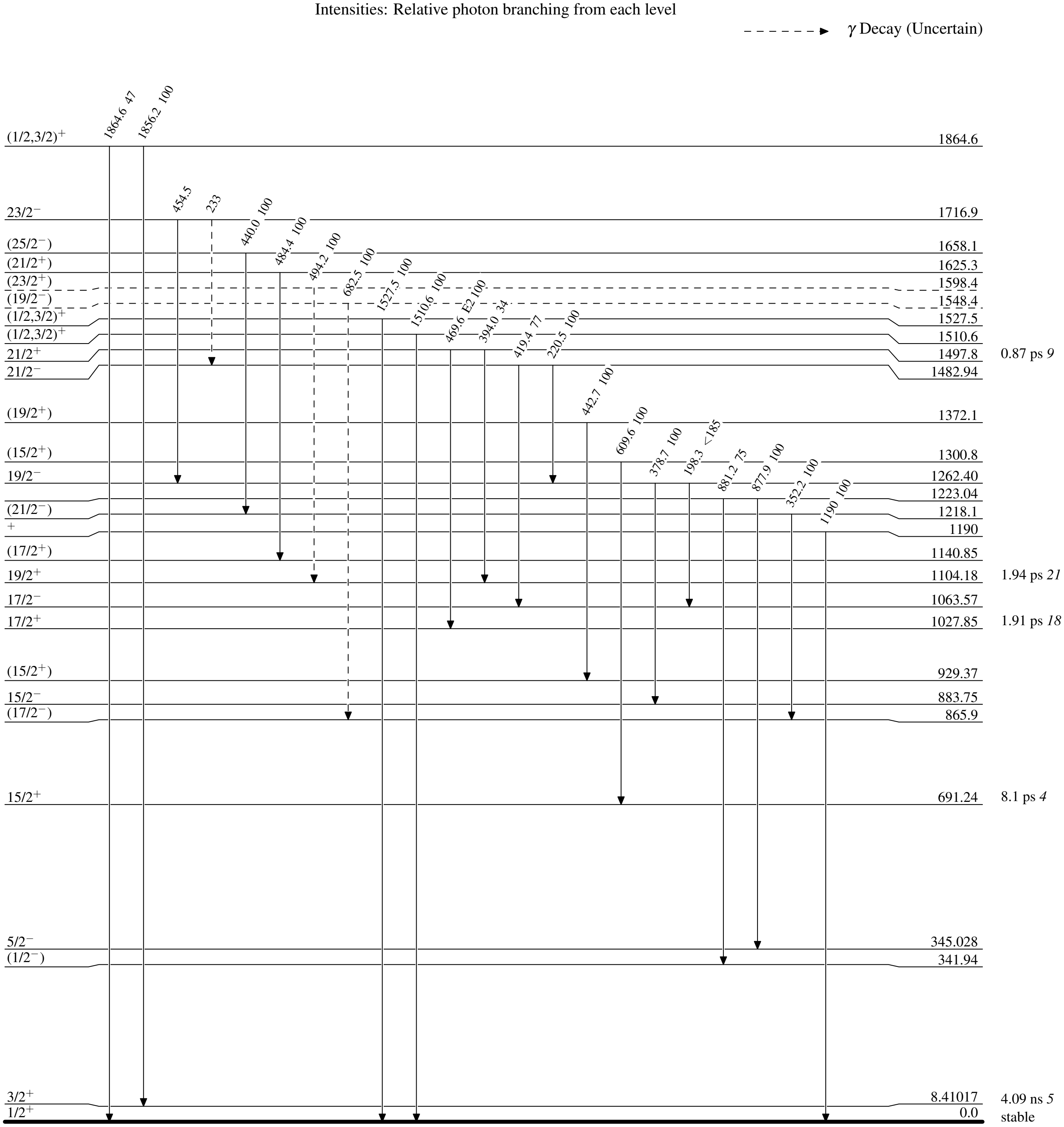
Intensities: Relative photon branching from each level



**Adopted Levels, Gammas**

Level Scheme (continued)

Intensities: Relative photon branching from each level

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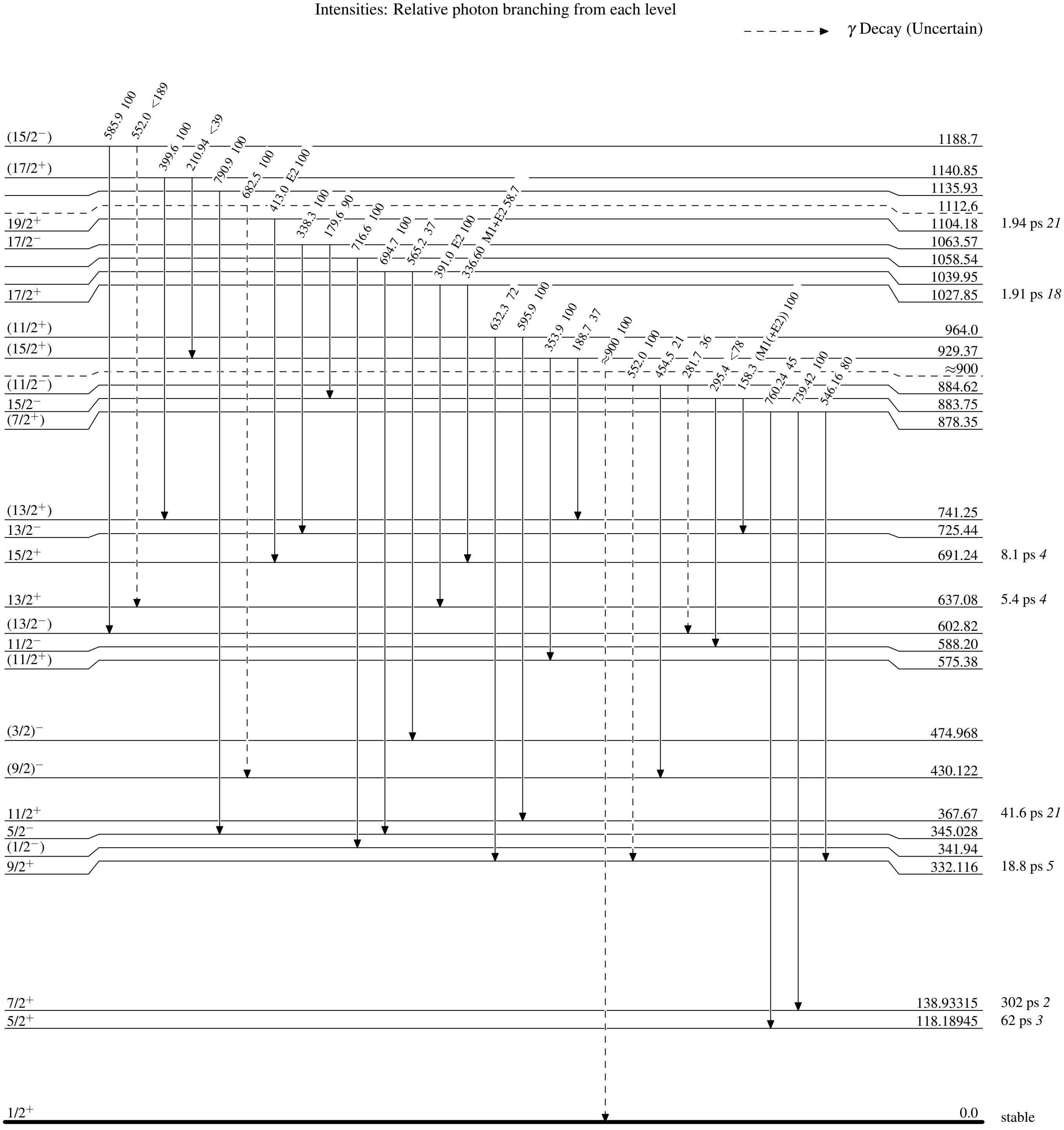
## Adopted Levels, Gammas

### Level Scheme (continued)

Intensities: Relative photon branching from each level

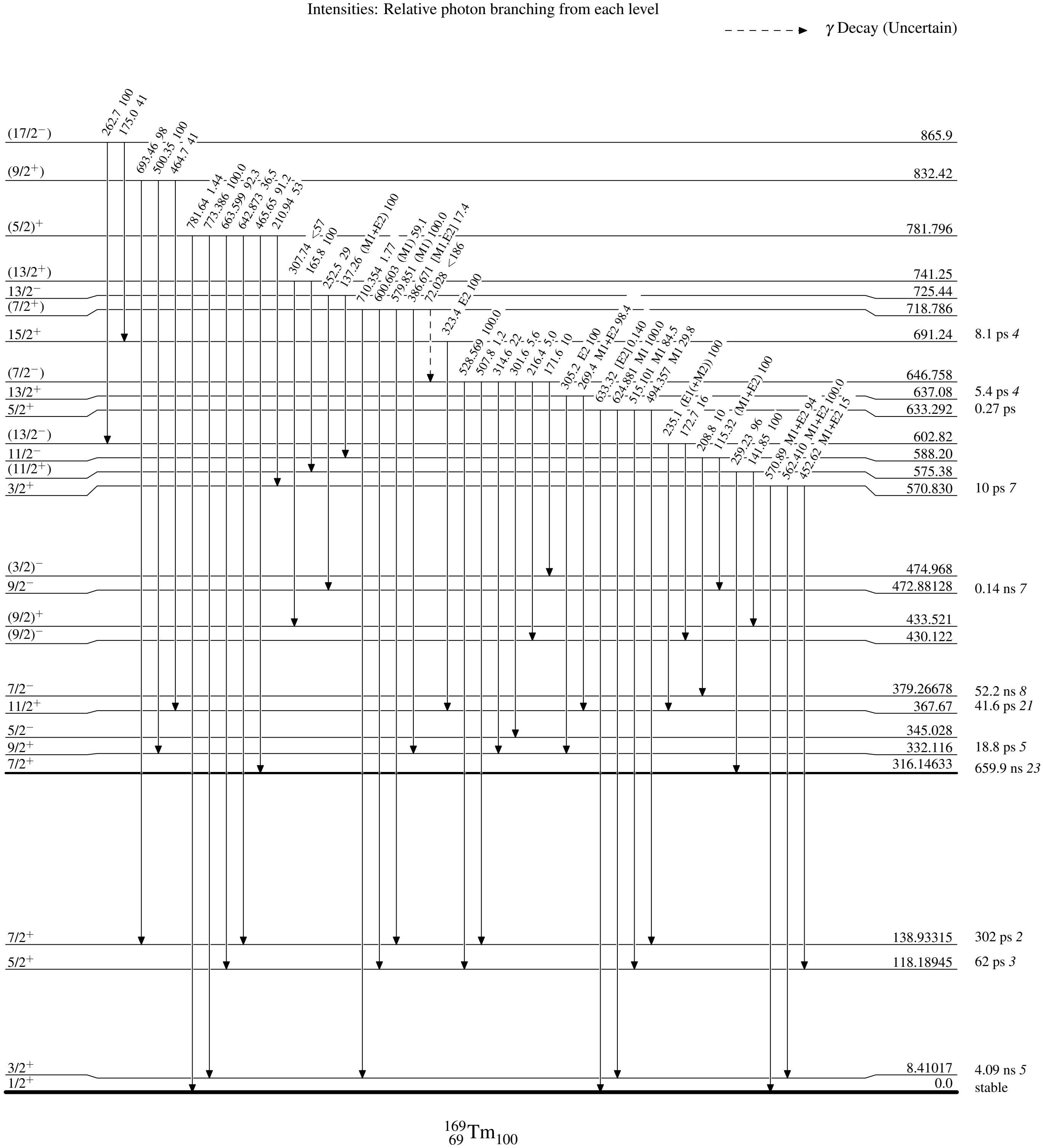


## Adopted Levels, Gammas

Legend

### Level Scheme (continued)

Intensities: Relative photon branching from each level

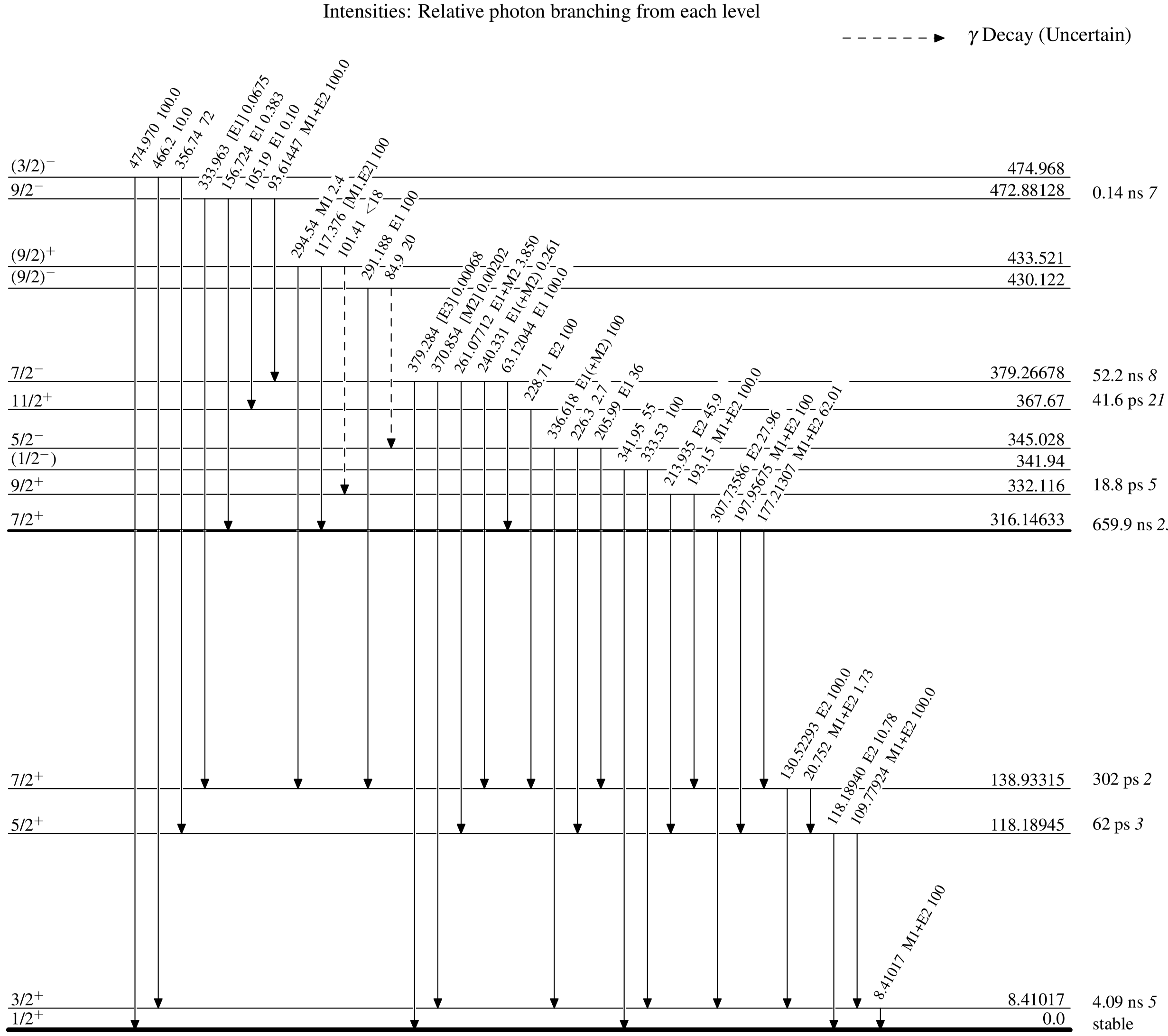


**Adopted Levels, Gammas**

Legend

Level Scheme (continued)

Intensities: Relative photon branching from each level

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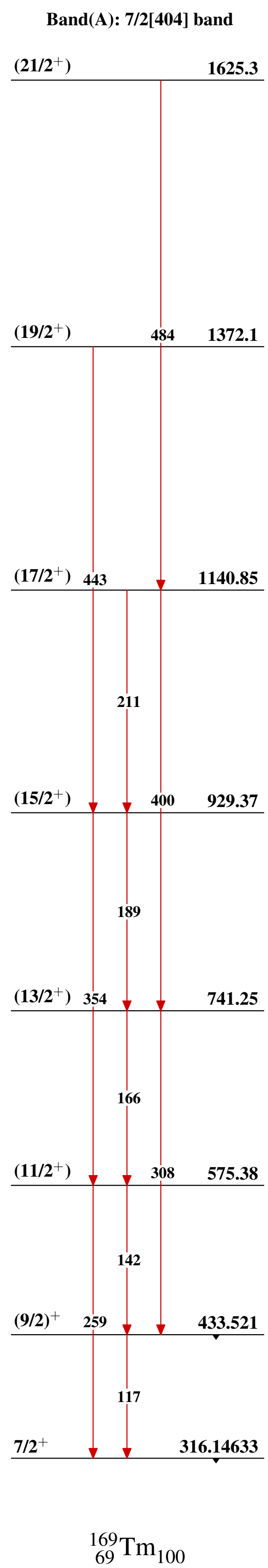
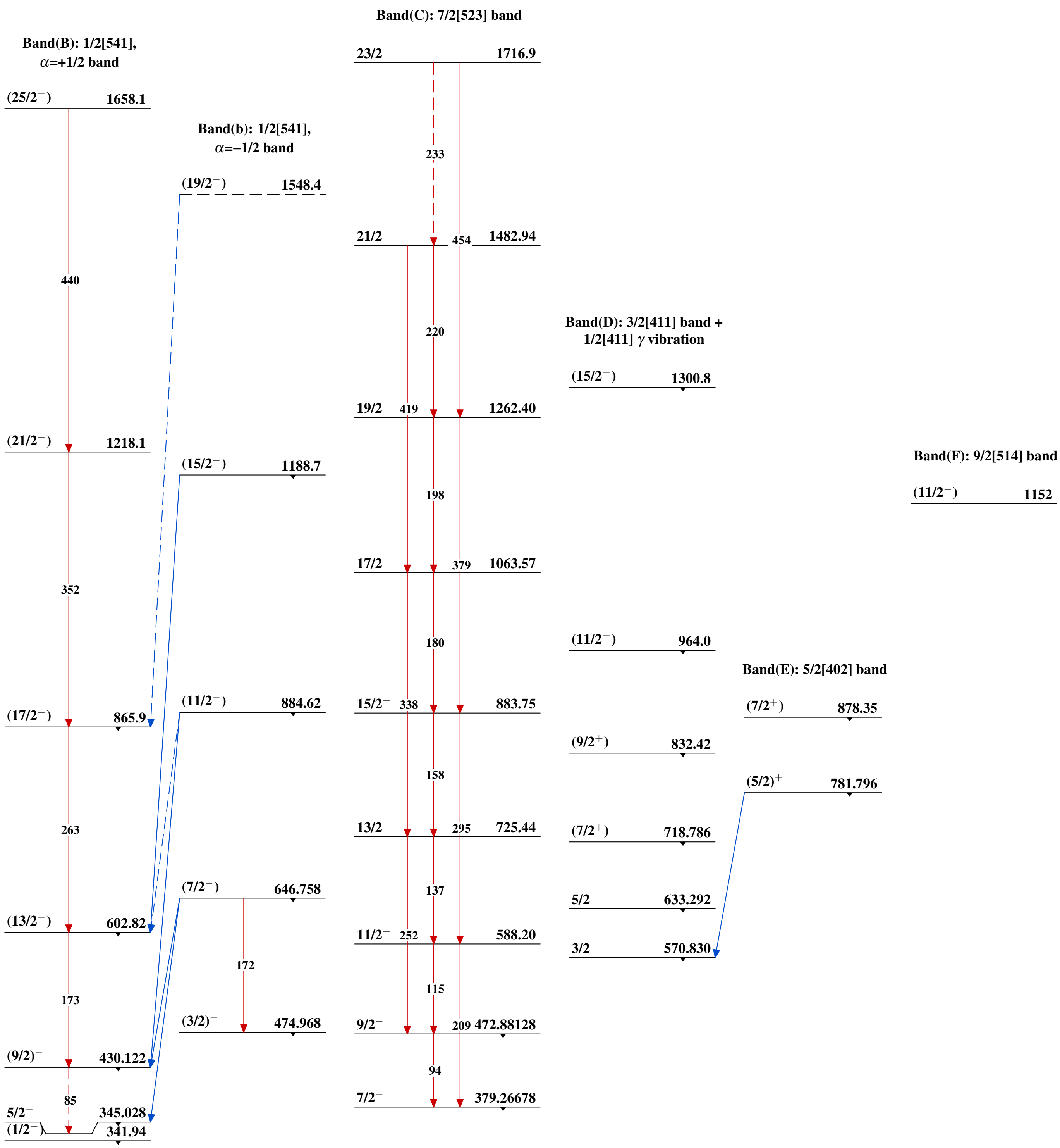
## Adopted Levels, Gammas



## Adopted Levels, Gammas (continued)




$^{169}_{69}Tm_{100}$