## $^{176}$Yb($^{7}$Li,x$\gamma$) 2000Mc03

| History | | | |
|---|---|---|---|
| Type | Author | Citation | Literature Cutoff Date |
| Full Evaluation | M. S. Basunia | NDS 107,791 (2006) | 15-Sep-2005 |

Target: 97% enriched $^{176}$Yb. Projectile: 45 MeV $^{7}$Li beams. Detector:CAESAR array, consisted of six Compton-suppressed n-type HPGe detectors, compact particle-detector system. Measured: E$\gamma$, I$\gamma$, $\gamma\gamma$ coin, $\alpha$-$\gamma$-$\gamma$(t) coin, isomeric level mean life, $\alpha$(exp), $\alpha$(K)exp.

### $^{176}$Lu Levels

| E(level)[†] | J$^{\pi}$[‡] | T$_{1/2}$[e] | Comments |
|---|---|---|---|
| 0.0[#] | 7$^-$ | 3.76×10$^{10}$ y *7* | T$_{1/2}$: From Adopted Levels. |
| 122.9 *25* | 1$^-$ | 3.664 h *19* | T$_{1/2}$: From Adopted Levels. |
| 183.9[#] *7* | 8$^-$ | | |
| 194.9 *23* | 1$^+$ | | |
| 233.9 *22* | 2$^+$ | | |
| 299.8 *22* | 3$^+$ | | |
| 372.9 *20* | 4$^+$ | | |
| 388.7[#] *7* | 9$^-$ | | |
| 425.1[@] *7* | 8$^+$ | ≤2 ns | |
| 489.3[&] *9* | 8$^+$ | ≤6.9 ns | |
| 613.3[#] *9* | 10$^-$ | | |
| 615.4[@] *8* | 9$^+$ | | |
| 635.8[a] *24* | 4$^+$ | 7.8 ns *4* | |
| 657.8[a] *18* | 5$^+$ | | |
| 683.2[&] *8* | 9$^+$ | | |
| 709.7[a] *17* | 6$^+$ | | |
| 787.3[a] *16* | 7$^+$ | | |
| 827.4[@] *8* | 10$^+$ | | |
| 857.1[#] *9* | 11$^-$ | | |
| 888.7[a] *15* | 8$^+$ | | |
| 897.6[&] *9* | 10$^+$ | | |
| 1013.4[a] *15* | 9$^+$ | | |
| 1060.8[@] *9* | 11$^+$ | | |
| 1118.8[#] *9* | 12$^-$ | | |
| 1132.3[&] *9* | 11$^+$ | | |
| 1159.8[a] *13* | 10$^+$ | | |
| 1314.4[@] *10* | 12$^+$ | | |
| 1329.2[a] *18* | 11$^+$ | | |
| 1352.3[b] *8* | (10$^+$) | ≤2 ns | J$^{\pi}$: 162.4$\gamma$ (E2) feeding this level from 12$^+$ state at 1514.8 keV and possible two quasiparticle state configuration. |
| 1398.6[#] *11* | 13$^-$ | | |
| 1514.8[c] *8* | 12$^+$ | 312 ns *69* | J$^{\pi}$: 200.3$\gamma$ M1 to 12$^+$ state. Four-quasiparticle isomeric state configuration.<br>T$_{1/2}$: From time difference spectra. |
| 1518.7[a] *16* | 12$^+$ | | |
| 1587.8[d] *13* | (14$^+$) | 40 $\mu$s *3* | J$^{\pi}$: 73$\gamma$ (E2) to the 12$^+$ state. Consistent with spin and parity of the near-degenerate 13$^+$ member of the $K^{\pi}$=8$^+_1$ band at 1589.1 keV.<br>T$_{1/2}$: From time spectrum gated on the 162, 184, 241, 258, 402, 487, and 617 keV transitions. |
| 1589.1[@] *11* | 13$^+$ | | |

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## $^{176}$Yb($^{7}$Li,xγ) 2000Mc03 (continued)

### $^{176}$Lu Levels (continued)

| E(level)[†] | Jπ[‡] | E(level)[†] | Jπ[‡] | E(level)[†] | Jπ[‡] |
|---|---|---|---|---|---|
| 1693.5[#] *14* | $14^-$ | 1960.8[a] *19* | $14^+$ | 2329.4[#] *17* | $16^-$ |
| 1730.3[a] *21* | $13^+$ | 2005.3[#] *15* | $15^-$ | 2671.3[#] *18* | $(17^-)$ |
| | | | | 3022.0[#] | $(18^-)$ |

[†] From a least squares fit to the γ-ray energies assuming ΔE=1 keV for all γ-energies.
[‡] From rotational structure and multipolarity assignments in 2000Mc03.
[#] $K^\pi=7^-$, configuration=((π 7/2[404])+(ν 7/2[514])).
[@] $K^\pi=8^+_1$, configuration=((π 7/2[404])+(ν 9/2[624])).
[&] $K^\pi=8^+_2$, configuration=((π 9/2[514])+(ν 7/2[514])).
[a] $K^\pi=4^+$, configuration=((π 1/2[541])+(ν 7/2[514])).
[b] $K^\pi=10^+$, configuration=((π 9/2[514])+(ν 11/2[505])).
[c] $K^\pi=12^+$, possible configuration=((π,7/2[402])⊗($\nu^3$, 9/2[624], 7/2[514],1/2[521])).
[d] $K^\pi=(14^+)$, possible configuration=((π,7/2[402])⊗($\nu^3$, 9/2[624], 7/2[514],5/2[512])).
[e] From 2000Mc03, except otherwise specified.

### γ($^{176}$Lu)

| $E_\gamma$[†] | $I_\gamma$[‡] | $E_i$(level) | $J^\pi_i$ | $E_f$ | $J^\pi_f$ | Mult.[#] | α[†] | Comments |
|---|---|---|---|---|---|---|---|---|
| 39 | | 233.9 | $2^+$ | 194.9 | $1^+$ | | | |
| 52.0 | | 709.7 | $6^+$ | 657.8 | $5^+$ | | | |
| 65 | | 489.3 | $8^+$ | 425.1 | $8^+$ | | | |
| 66 | | 299.8 | $3^+$ | 233.9 | $2^+$ | | | |
| 71 | | 1132.3 | $11^+$ | 1060.8 | $11^+$ | | | |
| 72 | | 194.9 | $1^+$ | 122.9 | $1^-$ | | | |
| 73[@] | | 372.9 | $4^+$ | 299.8 | $3^+$ | | | |
| 73.0[@] | | 1587.8 | $(14^+)$ | 1514.8 | $12^+$ | E2 | 9 *4* | Mult.: Assumed for transition level spin and parities. The α(exp)=9 *4* value consistent with both M1(9.51) and E2(12.2). The M1 would imply a reduced transition strength of 1.3 x $10^{-7}$ W.u., more than two orders of magnitude weaker than expected for a K-allowed M1 transition. In contrast, the assumption of E2 multipolarity implies a reduced transition strength within the expected range. |
| 77.5 | | 787.3 | $7^+$ | 709.7 | $6^+$ | | | |
| 101.5 | | 888.7 | $8^+$ | 787.3 | $7^+$ | | | |
| 104.9 | | 299.8 | $3^+$ | 194.9 | $1^+$ | | | |
| 124.4 | | 1013.4 | $9^+$ | 888.7 | $8^+$ | | | |
| 126.3 | | 615.4 | $9^+$ | 489.3 | $8^+$ | | | |
| 129.5 | | 787.3 | $7^+$ | 657.8 | $5^+$ | | | |
| 139.0 | | 372.9 | $4^+$ | 233.9 | $2^+$ | | | |
| 144.1 | | 827.4 | $10^+$ | 683.2 | $9^+$ | | | |
| 146.0 | | 1159.8 | $10^+$ | 1013.4 | $9^+$ | | | |
| 162.4 | | 1514.8 | $12^+$ | 1352.3 | $(10^+)$ | (E2) | 0.9 *4* | α: Consistent with either M1(0.969) or E2 (0.576). |
| 179.0 | | 888.7 | $8^+$ | 709.7 | $6^+$ | | | |
| 184.0 | | 183.9 | $8^-$ | 0.0 | $7^-$ | | | |
| 190.2 | | 615.4 | $9^+$ | 425.1 | $8^+$ | | | |
| 193.8 | | 683.2 | $9^+$ | 489.3 | $8^+$ | | | |
| 200.3 | 207 *21* | 1514.8 | $12^+$ | 1314.4 | $12^+$ | (M1) | 0.2 *4* | |
| 204.9 | | 388.7 | $9^-$ | 183.9 | $8^-$ | | | |
| 212.0 | | 827.4 | $10^+$ | 615.4 | $9^+$ | | | |
| 214.0 | | 897.6 | $10^+$ | 683.2 | $9^+$ | | | |

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## $^{176}$Yb($^{7}$Li,x$\gamma$) 2000Mc03 (continued)

### $\gamma(^{176}Lu)$ (continued)

| $E_\gamma$ [†] | $I_\gamma$ [‡] | $E_i$(level) | $J_i^\pi$ | $E_f$ | $J_f^\pi$ | Mult. [#] | Comments |
|---|---|---|---|---|---|---|---|
| 224.8 | | 613.3 | $10^-$ | 388.7 | $9^-$ | | |
| 226.0 | | 1013.4 | $9^+$ | 787.3 | $7^+$ | | |
| 226.9 | | 615.4 | $9^+$ | 388.7 | $9^-$ | | |
| 233.7 | | 1060.8 | $11^+$ | 827.4 | $10^+$ | | |
| 234.6 | | 1132.3 | $11^+$ | 897.6 | $10^+$ | | |
| 241.0 | | 425.1 | $8^+$ | 183.9 | $8^-$ | | |
| 243.9 | | 857.1 | $11^-$ | 613.3 | $10^-$ | | |
| 253.9 | | 1314.4 | $12^+$ | 1060.8 | $11^+$ | | |
| 258.0 | | 683.2 | $9^+$ | 425.1 | $8^+$ | | |
| 262.1 | | 1118.8 | $12^-$ | 857.1 | $11^-$ | | |
| 271.5 | | 1159.8 | $10^+$ | 888.7 | $8^+$ | | |
| 275.0 | | 1589.1 | $13^+$ | 1314.4 | $12^+$ | | |
| 280.2 | | 1398.6 | $13^-$ | 1118.8 | $12^-$ | | |
| 282.4 | | 897.6 | $10^+$ | 613.3 | $10^-$ | | |
| 284.9 | | 657.8 | $5^+$ | 372.9 | $4^+$ | | |
| 305.0 | | 1132.3 | $11^+$ | 827.4 | $10^+$ | | |
| 315.8 | | 1329.2 | $11^+$ | 1013.4 | $9^+$ | | |
| 336.0 [@] | | 635.8 | $4^+$ | 299.8 | $3^+$ | | |
| 336.0 [@] | | 709.7 | $6^+$ | 372.9 | $4^+$ | | $E_\gamma$: Placement of transition in the level scheme is uncertain. |
| 355.0 | 106 *21* | 1514.8 | $12^+$ | 1159.8 | $10^+$ | [E2] | |
| 358.9 | | 1518.7 | $12^+$ | 1159.8 | $10^+$ | | |
| 382.3 | 257 *12* | 1514.8 | $12^+$ | 1132.3 | $11^+$ | [M1] | |
| 388.7 | | 388.7 | $9^-$ | 0.0 | $7^-$ | | |
| 396.0 | 13 *6* | 1514.8 | $12^+$ | 1118.8 | $12^-$ | [E1] | |
| 401.1 | | 1730.3 | $13^+$ | 1329.2 | $11^+$ | | |
| 402.4 | | 827.4 | $10^+$ | 425.1 | $8^+$ | | |
| 408.0 | | 897.6 | $10^+$ | 489.3 | $8^+$ | | |
| 425.0 | | 425.1 | $8^+$ | 0.0 | $7^-$ | | |
| 429.5 | | 613.3 | $10^-$ | 183.9 | $8^-$ | | |
| 442.1 | | 1960.8 | $14^+$ | 1518.7 | $12^+$ | | |
| 445.0 | | 1060.8 | $11^+$ | 615.4 | $9^+$ | | |
| 449.2 | | 1132.3 | $11^+$ | 683.2 | $9^+$ | | |
| 454.2 | 197 *30* | 1514.8 | $12^+$ | 1060.8 | $11^+$ | [M1] | |
| 454.6 | | 1352.3 | $(10^+)$ | 897.6 | $10^+$ | | |
| 468.4 | | 857.1 | $11^-$ | 388.7 | $9^-$ | | |
| 486.8 | | 1314.4 | $12^+$ | 827.4 | $10^+$ | | |
| 505.6 | | 1118.8 | $12^-$ | 613.3 | $10^-$ | | |
| 524.8 | | 1352.3 | $(10^+)$ | 827.4 | $10^+$ | | |
| 527.9 | | 1589.1 | $13^+$ | 1060.8 | $11^+$ | | |
| 541.1 | | 1398.6 | $13^-$ | 857.1 | $11^-$ | | |
| 574.7 | | 1693.5 | $14^-$ | 1118.8 | $12^-$ | | |
| 606.7 | | 2005.3 | $15^-$ | 1398.6 | $13^-$ | | |
| 617.0 | 217 *29* | 1514.8 | $12^+$ | 897.6 | $10^+$ | (E2) | Mult.: From $\alpha$(K)exp=0.010 *3*. |
| 635.9 | | 2329.4 | $16^-$ | 1693.5 | $14^-$ | | |
| 658.0 | 9 *4* | 1514.8 | $12^+$ | 857.1 | $11^-$ | [E1] | |
| 666.0 [&] | | 2671.3 | $(17^-)$ | 2005.3 | $15^-$ | | |
| 669.0 | | 1352.3 | $(10^+)$ | 683.2 | $9^+$ | | |
| 687.1 | 51 *19* | 1514.8 | $12^+$ | 827.4 | $10^+$ | [E2] | |
| 692.0 [&] | | 3022.0 | $(18^-)$ | 2329.4 | $16^-$ | | |
| 736.0 | | 1352.3 | $(10^+)$ | 615.4 | $9^+$ | | |
| 738.3 | | 1352.3 | $(10^+)$ | 613.3 | $10^-$ | | |
| 863.2 | | 1352.3 | $(10^+)$ | 489.3 | $8^+$ | | |
| 927.1 | | 1352.3 | $(10^+)$ | 425.1 | $8^+$ | | |

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## $^{176}$Yb($^{7}$Li,x$\gamma$) 2000Mc03 (continued)

### $\gamma(^{176}Lu)$ (continued)

| $E_\gamma$[†] | $I_\gamma$[‡] | $E_i$(level) | $J_i^\pi$ | $E_f$ | $J_f^\pi$ | Mult.[#] |
|---|---|---|---|---|---|---|
| 963.0 | | 1352.3 | $(10^+)$ | 388.7 | $9^-$ | |
| 1126.5 | 12 *5* | 1514.8 | $12^+$ | 388.7 | $9^-$ | [E3] |

† From 2000Mc03.
‡ Reported for only depopulating $\gamma$-rays from the $14^+$ state at 1514.8 keV level, except 162.4$\gamma$.
# From $\alpha$(exp) and level scheme in 2000Mc03.
@ Multiply placed.
& Placement of transition in the level scheme is uncertain.

## $^{176}$Yb($^{7}$Li,xγ) 2000Mc03

Level Scheme

Intensities: Relative $I_\gamma$

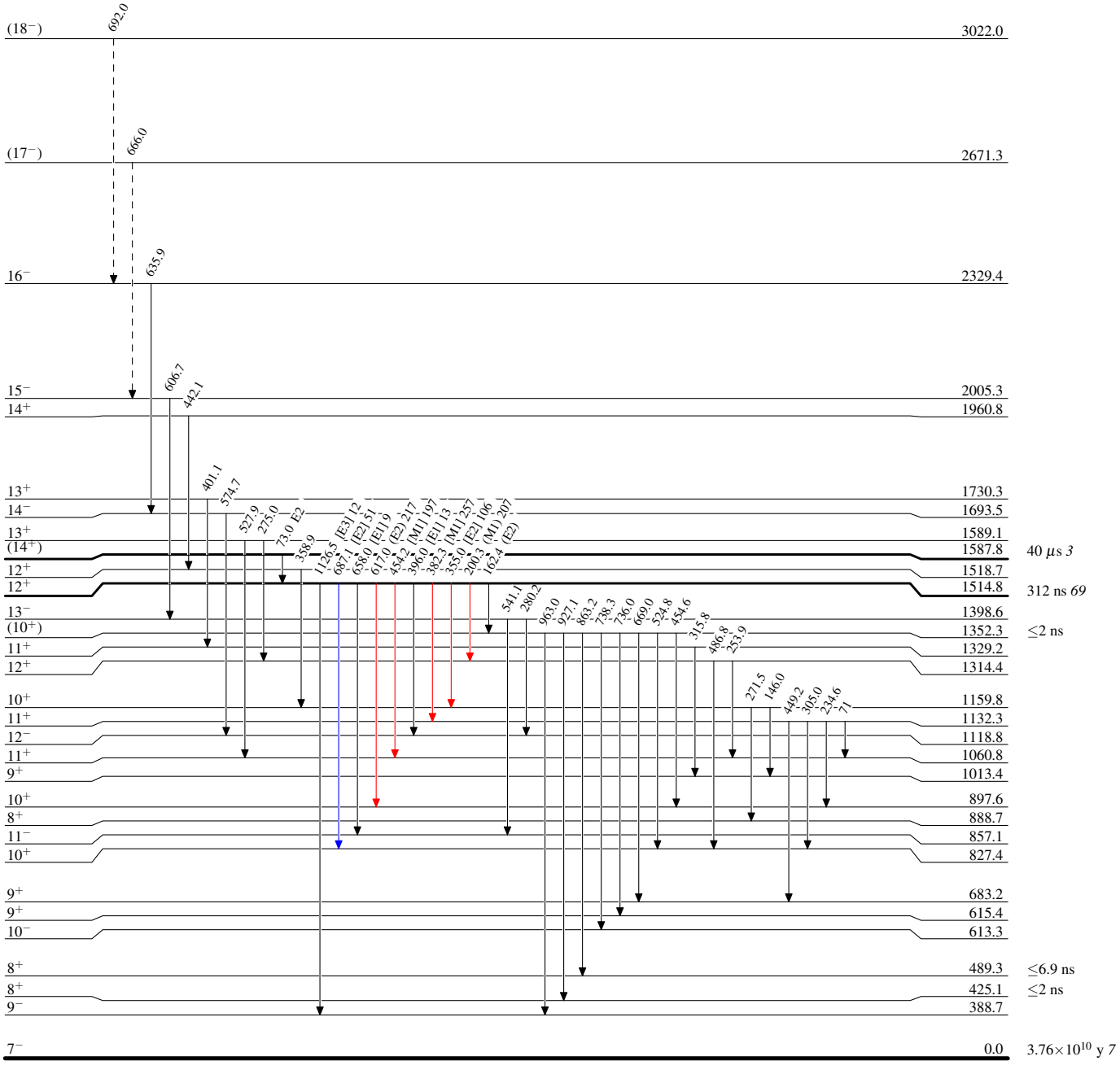
Legend

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

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

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

γ Decay (Uncertain)

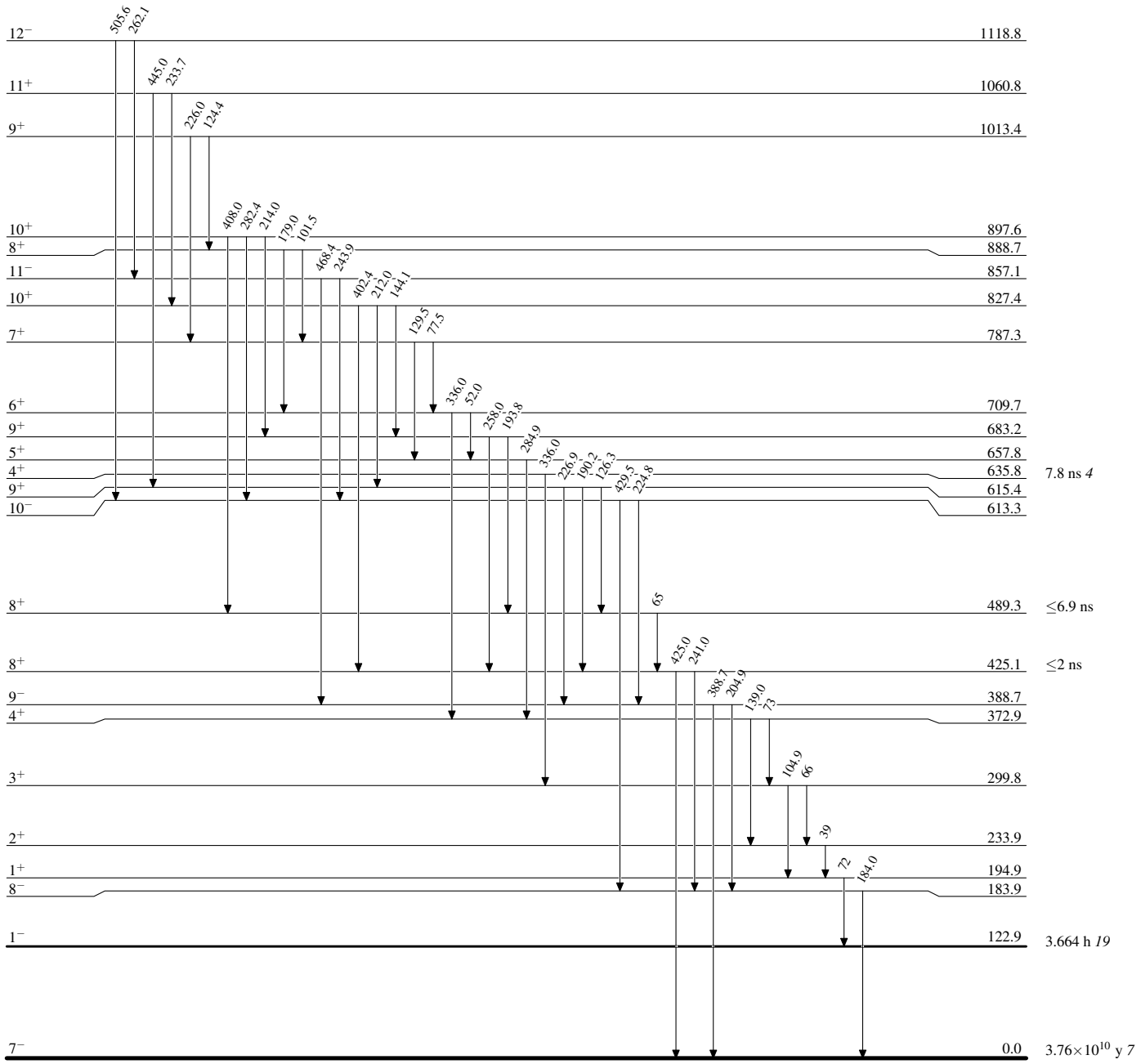



$^{176}_{71}Lu_{105}$

## $^{176}$Yb($^{7}$Li,xγ) 2000Mc03

### Level Scheme (continued)

Intensities: Relative $I_\gamma$




$^{176}_{71}Lu_{105}$