^{170}Er(α,3nγ) E=34 MeV 1972Li25

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Coral M. Baglin, E. A. Mccutchan	NDS 151, 334 (2018)	30-Jun-2018

1972Li25: E(α)=26-43 MeV, θ=90°, 110°, 125°, 150°; metallic erbium targets enriched to 96.06% in ^{170}Er; measured Eγ, Iγ (GeLi), γγ coin, γ-ray angular distributions, αγ(t).
Other: 1974Ha50 (E=38 MeV).
The level scheme and all data are from 1972Li25, except where noted.
Limit for possible delayed transitions: $T_{1/2}$<20 ns for Eγ>100 keV.

^{171}Yb Levels

E(level)	J$^{\pi}$ †	$T_{1/2}$	Comments
0.0‡	1/2−		
66.75‡ *19*	3/2−		
75.89‡ *19*	5/2−		
95.3# *2*	7/2+	5.25 ms *24*	$T_{1/2}$: decay of 75.9γ from level fed by 19.5γ (mechanically chopped beam) (1974Ha50).
122.44@ *19*	5/2−		
167.71# *25*	9/2+		
208.0@ *5*	7/2−		
230.57‡ *23*	7/2−		
246.6‡ *3*	9/2−		
259.10# *25*	11/2+		
317.4@ *5*	9/2−		
368.9# *3*	13/2+		
449.6@ *5*	11/2−		
487.2‡ *3*	11/2−		
501.2# *3*	15/2+		
509.1‡ *4*	13/2−		
604.3@ *5*	13/2−		
647.9# *3*	17/2+		
779.5@ *5*	15/2−		
825.6# *3*	19/2+		
832.5‡ *4*	15/2−		
859.5‡ *4*	17/2−		
975.7@ *6*	17/2−		
980.8& *3*	(11/2−)		
1004.1# *4*	21/2+		
1113.9& *5*	(13/2−)		
1189.5@ *7*	19/2−		
1233.3# *4*	23/2+		
1262.9‡ *4*	19/2−		
1265.7& *5*	(15/2−)		
1293.2‡ *5*	21/2−		
1420.2@ *8*	21/2−		
1434.5# *4*	25/2+		
1436.4& *6*	(17/2−)		
1625.6& *6*	(19/2−)		

Continued on next page (footnotes at end of table)

^{170}Er(α,3nγ) E=34 MeV 1972Li25 (continued)

^{171}Yb Levels (continued)

E(level)	J^{π}†
1722.9# *4*	27/2$^+$
1805?‡ *3*	(25/2$^-$)
1834.0& *7*	(21/2$^-$)

† Authors′ values from coincidence data, rotational structure, and γ-ray multipolarities. See ^{171}Yb Adopted Levels for evaluator′s assignments.
‡ Band(A): 1/2[521] band.
# Band(B): 7/2[633] band.
@ Band(C): 5/2[512] band.
& Band(D): 11/2[505] band (tentative). However, adopted assignment differs (K^{π}=13/2$^+$ three-quasiparticle band In Adopted Levels).

γ(^{171}Yb)

E_γ[†]	I_γ[‡]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[#]	δ	α[a]	Comments
19.5 *5*		95.3	7/2$^+$	75.89	5/2$^-$	E1[@]		5.5 *4*	
(27.133[@] *1*)		122.44	5/2$^-$	95.3	7/2$^+$				
(46.543[@] *5*)		122.44	5/2$^-$	75.89	5/2$^-$				
(55.689[@] *2*)		122.44	5/2$^-$	66.75	3/2$^-$				
66.7 *5*	69	66.75	3/2$^-$	0.0	1/2$^-$	M1+E2[@]	+0.693[@] *7*	12.7 *4*	A_2=−0.46 *10*, A_4=−0.27 *13* (1972Li25); not analyzed in 1976Kr21 and not consistent with Adopted multipolarity, δ.
[x]68.8 *5*	7								
72.4 *2*	173 *17*	167.71	9/2$^+$	95.3	7/2$^+$	M1+E2[@]	−0.29[@] *4*	8.80 *16*	A_2=−0.50 *7*, A_4=−0.02 *9* (1972Li25).
75.9 *2*	167 *17*	75.89	5/2$^-$	0.0	1/2$^-$	E2[@]		9.59 *17*	A_2=+0.07 *3*, A_4=−0.03 *2* (1972Li25).
85.6 *5*	54	208.0	7/2$^-$	122.44	5/2$^-$	M1+E2[@]	−0.222[@] *12*	5.31 *12*	A_2=−0.44 *6*, A_4=−0.05 *8* (1972Li25).
[x]87.8 *5*	8								A_2=0.0 *4*, A_4=+0.1 *6* (1972Li25).
91.4 *2*	243 *24*	259.10	11/2$^+$	167.71	9/2$^+$	M1+E2[@]	−0.281[@] *16*	4.39	A_2=−0.58 *2*, A_4=−0.02 *2* (1972Li25).
[x]101.9 *5*	5								
[x]107.7 *5*	11					(D)			A_2=−0.57 *24*, A_4=+0.2 *3* (1972Li25).
109.3 *5*	70	317.4	9/2$^-$	208.0	7/2$^-$	M1+E2[@]	−0.27[@] *4*	2.59 *5*	A_2=−0.58 *2*, A_4=−0.03 *2* (1972Li25) for doublet.
109.8 *2*	260 *26*	368.9	13/2$^+$	259.10	11/2$^+$	(M1+E2)		2.42 *18*	A_2=−0.58 *2*, A_4=−0.03 *2* (1972Li25) for doublet. Mult.: inferred from coefficients for 109.3γ and 109.8γ combined.
[x]113.3 *5*	21					(D)			A_2=−0.15 *4*, A_4=+0.03 *4* (1972Li25).
132.2[c] *2*	105[c]	449.6	11/2$^-$	317.4	9/2$^-$	M1+E2[@]	1.4[@] *+21−6*	1.26 *11*	A_2=−0.66 *4*, A_4=−0.03 *59* (1972Li25) for doublet. I_γ: deduced from Iγ(241.6γ) and adopted relative photon branchings from 449.6 level. Iγ=300 *30* for doublet.
132.2[c] *2*	195[c]	501.2	15/2$^+$	368.9	13/2$^+$	D			Mult.: from Adopted Gammas. I_γ: deduced from Iγ=300 *30* for both placements of 132.2γ and Iγ=105 for 449.6 level placement. A_2=−0.66 *4*, A_4=−0.03 *5* (1972Li25) for 132.2γ+132.9γ.
132.9 *5*	60	1113.9	(13/2$^-$)	980.8	(11/2$^-$)	(M1+E2)		1.31 *20*	A_2=−0.66 *4*, A_4=−0.03 *5* (1972Li25) for 132.2γ+132.9γ. Mult.: inferred from coefficients for 132.2 and 132.9γ combined.
[x]139.3 *5*	16					(D)			A_2=−0.45 *8*, A_4=0.0 *3* (1972Li25).
146.7 *2*	158 *16*	647.9	17/2$^+$	501.2	15/2$^+$	(M1+E2)	−0.37[&] *+10−13*	1.09 *4*	A_2=−0.66 *5*, A_4=−0.02 *5* (1972Li25).
151.7 *5*	56	1265.7	(15/2$^-$)	1113.9	(13/2$^-$)	(M1+E2)		0.86 *17*	A_2=−0.69 *9*, A_4=+0.03 *9* (1972Li25).
154.7[c] *2*	55[c] *14*	230.57	7/2$^-$	75.89	5/2$^-$	M1+E2[@]	+0.521[@] *16*	0.905 *14*	I_γ: deduced from Iγ(163.8γ) and relative photon branchings from 230.6 level in ^{171}Lu ε decay (8.24 d). Iγ=113 for doublet. A_2=−0.23 *3*, A_4=−0.02 *3* (1972Li25) for doublet.

From ENSDF

γ(^{171}Yb) (continued)

E_γ[†]	I_γ[‡]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ	α[a]	Comments
154.7[c] 2	58[c] 18	604.3	13/2$^-$	449.6	11/2$^-$				I_γ: deduced from Iγ=113 11 for both placements of 154.7γ and Iγ=55 14 for 230.6 level placement. A_2=−0.23 3, A_4=−0.02 3 (1972Li25) for doublet.
[x]157.9 5	10								
163.8[c] 2	103[c] 24	230.57	7/2$^-$	66.75	3/2$^-$	E2[@]		0.530	I_γ: deduced from Iγ=194 19 for both placements of 163.8γ and Iγ=91 14 for 259.1 level placement. A_2=+0.30 2, A_4=−0.11 6 (1972Li25) for doublet.
163.8[c] 2	91[c] 14	259.10	11/2$^+$	95.3	7/2$^+$	E2[@]		0.530	A_2=+0.30 2, A_4=−0.11 6 (1972Li25) for doublet. I_γ: deduced from Iγ(91.4γ) and adopted relative photon branchings from 259.1 level.
170.7[b] 2	310[b] 31	246.6	9/2$^-$	75.89	5/2$^-$	E2[@]		0.460	A_2=+0.14 2, A_4=−0.09 3 (1972Li25).
170.7[b] 2	310[b] 31	1436.4	(17/2$^-$)	1265.7	(15/2$^-$)	(M1+E2)[@]		0.60 14	A_2=+0.14 2, A_4=−0.09 3 (1972Li25) for doublet.
174.8 5	47	779.5	15/2$^-$	604.3	13/2$^-$	(M1+E2)		0.56 14	A_2=−0.34 5, A_4=+0.02 9 (1972Li25).
[x]176.0 5	51								
177.7 2	150 15	825.6	19/2$^+$	647.9	17/2$^+$	(M1+E2)	−0.18[&] 8	0.653 13	A_2=−0.54 11, A_4=−0.10 13 (1972Li25).
178.5 5	80	1004.1	21/2$^+$	825.6	19/2$^+$	(M1+E2)	−0.31[&] +9−11	0.630 19	A_2=−0.72 11, A_4=−0.05 12 (1972Li25).
189.4 5	24	1625.6	(19/2$^-$)	1436.4	(17/2$^-$)				
194.9 5	25	317.4	9/2$^-$	122.44	5/2$^-$	E2[@]		0.293 5	
195.9 5	47	975.7	17/2$^-$	779.5	15/2$^-$	(M1+E2)		0.40 11	A_2=−0.34 13, A_4=−0.07 19 (1972Li25).
[x]198.8 5	57					(Q)			A_2=+0.04 7, A_4=−0.04 12 (1972Li25).
201.2[b] 2	237[b] 24	368.9	13/2$^+$	167.71	9/2$^+$	(E2)		0.263	A_2=+0.20 4, A_4=−0.10 4 (1972Li25) for doublet.
201.2[b] 2	237[b] 24	1434.5	25/2$^+$	1233.3	23/2$^+$	(E2)		0.263	A_2=+0.20 4, A_4=−0.10 4 (1972Li25) for doublet.
[x]203.5 5	34								A_2=+0.17 9, A_4=+0.03 15 (1972Li25).
208.6 5	25	1834.0	(21/2$^-$)	1625.6	(19/2$^-$)	(M1+E2)		0.33 10	A_2=−0.63 17, A_4=+0.07 20 (1972Li25).
213.9 5	35	1189.5	19/2$^-$	975.7	17/2$^-$	(M1+E2)	−0.29[&] +10−12	0.381 14	A_2=−0.65 7, A_4=−0.06 8 (1972Li25).
[x]224.3 5	15								
229.3 5	76	1233.3	23/2$^+$	1004.1	21/2$^+$	(M1+E2)	−0.25[&] 6	0.317 7	A_2=−0.67 5, A_4=−0.12 8 (1972Li25).
[x]238.5 5	14								
240.6 5	14	487.2	11/2$^-$	246.6	9/2$^-$				E_γ: placement from Coulomb excitation.
241.6 5	80	449.6	11/2$^-$	208.0	7/2$^-$	(E2)[@]		0.1449 23	A_2=+0.30 3, A_4=−0.08 4 (1972Li25) for 241.6γ+242.1γ.
242.1 2	360 36	501.2	15/2$^+$	259.10	11/2$^+$	(E2)		0.1439	A_2=+0.30 3, A_4=−0.08 4 (1972Li25) for 241.6γ+242.1γ. Mult.: inferred from coefficients for 241.6γ and 242.1γ combined; this transition dominates doublet.
[x]247.2 5	26								
256.6 2	153 15	487.2	11/2$^-$	230.57	7/2$^-$	(E2)[@]		0.1197	A_2=+0.29 3, A_4=−0.09 4 (1972Li25).
262.5 2	343 34	509.1	13/2$^-$	246.6	9/2$^-$	(E2)		0.1114	A_2=+0.33 2, A_4=−0.11 4 (1972Li25).
279.1 2	≈260	647.9	17/2$^+$	368.9	13/2$^+$	(E2)		0.0921	A_2=+0.30 3, A_4=−0.06 4 (1972Li25) for doublet. Mult.: uncertain due to interference from 6$^+$ to 4$^+$ transition in ^{172}Yb.

$^{171}_{70}$Yb$_{101}$-4

γ(^{171}Yb) (continued)

Eγ[†]	Iγ[‡]	Ei(level)	Jiπ	Ef	Jfπ	Mult.[#]	α[a]	Comments
285.1 *5*	21	1265.7	(15/2⁻)	980.8	(11/2⁻)	(E2)	0.0863 *13*	A_2=+0.29 *21*, A_4=−0.21 *20* (1972Li25).
287.0 *5*	90	604.3	13/2⁻	317.4	9/2⁻	(E2)	0.0846 *13*	A_2=+0.24 *15*, A_4=−0.08 *12* (1972Li25).
288.6 *5*	30	1722.9	27/2⁺	1434.5	25/2⁺			
[x]289.5 *5*	18							
[x]298.6 *5*	31							A_2=+0.52 *10*, A_4=+0.12 *17* (1972Li25).
[x]308.0 *5*	10							
322.3 *5*	60	1436.4	(17/2⁻)	1113.9	(13/2⁻)			
324.3 *2*	415 *42*	825.6	19/2⁺	501.2	15/2⁺	(E2)	0.0586	A_2=+0.35 *2*, A_4=−0.11 *4* (1972Li25).
329.9 *5*	85	779.5	15/2⁻	449.6	11/2⁻	(E2)	0.0557	A_2=+0.34 *11*, A_4=+0.02 *9* (1972Li25) for 329.9γ+331.1γ.
								Mult.: inferred from coefficients for 329.9γ and 331.1γ combined.
[x]331.1 *5*	39					(Q)		A_2=+0.34 *11*, A_4=−0.19 *11* (1972Li25) for 331.1γ+329.9γ.
345.3 *2*	133 *13*	832.5	15/2⁻	487.2	11/2⁻	(E2)	0.0488	A_2=+0.31 *3*, A_4=−0.14 *6* (1972Li25).
350.4 *2*	271 *27*	859.5	17/2⁻	509.1	13/2⁻	(E2)	0.0468	A_2=+0.33 *3*, A_4=−0.15 *4* (1972Li25).
356.2 *2*	363 *36*	1004.1	21/2⁺	647.9	17/2⁺	(E2)	0.0446	A_2=+0.35 *2*, A_4=−0.12 *3* (1972Li25).
359.8 *5*	32	1625.6	(19/2⁻)	1265.7	(15/2⁻)	(E2)	0.0434	A_2=+0.32 *15*, A_4=−0.2 *3* (1972Li25).
371.5 *2*	200 *20*	975.7	17/2⁻	604.3	13/2⁻	(E2)	0.0396	A_2=+0.16 *8*, A_4=−0.21 *10* (1972Li25).
								Iγ,Mult.: uncertain due to interference from 8⁺ to 6⁺ transition in ^{172}Yb.
[x]374.6 *5*	11							
[x]384.3 *5*	32							A_2=+0.33 *10*, A_4=+0.15 *19* (1972Li25).
397.4 *5*	39	1834.0	(21/2⁻)	1436.4	(17/2⁻)	(E2)	0.0328	A_2=+0.25 *8*, A_4=−0.25 *17* (1972Li25).
[x]402.7 *5*	74					(Q)		A_2=+0.45 *20*, A_4=−0.4 *3* (1972Li25).
407.7 *2*	287 *29*	1233.3	23/2⁺	825.6	19/2⁺	(E2)	0.0306	A_2=+0.36 *3*, A_4=−0.11 *4* (1972Li25).
409.8 *5*	80	1189.5	19/2⁻	779.5	15/2⁻	(E2)	0.0301	A_2=+0.33 *5*, A_4=−0.13 *8* (1972Li25).
[x]421.2 *5*	16							
430.4[b] *2*	333[b] *33*	1262.9	19/2⁻	832.5	15/2⁻	(E2)	0.0264	A_2=+0.35 *3*, A_4=−0.12 *4* (1972Li25).
430.4[b] *2*	333[b] *33*	1434.5	25/2⁺	1004.1	21/2⁺	(E2)	0.0264	A_2=+0.35 *3*, A_4=−0.12 *4* (1972Li25) for doublet.
433.7 *2*	205 *21*	1293.2	21/2⁻	859.5	17/2⁻	(E2)	0.0259	A_2=+0.34 *3*, A_4=−0.16 *6* (1972Li25).
444.5 *5*	63	1420.2	21/2⁻	975.7	17/2⁻	(E2)	0.0242	A_2=+0.32 *7*, A_4=−0.15 *11* (1972Li25).
[x]455.3 *5*	16							
[x]470.8 *5*	32					(Q)		A_2=+0.40 *9*, A_4=−0.05 *14* (1972Li25).
[x]479.1 *5*	15					(Q)		A_2=+0.17 *19*, A_4=−0.1 *3* (1972Li25).
489.6 *2*	142 *14*	1722.9	27/2⁺	1233.3	23/2⁺	(E2)	0.0188	A_2=+0.37 *4*, A_4=−0.14 *4* (1972Li25).
[x]497.9 *5*	39					(Q)		A_2=+0.36 *5*, A_4=−0.06 *9* (1972Li25).
[x]501.8 *2*	114 *11*					(Q)		A_2=+0.35 *5*, A_4=−0.21 *9* (1972Li25).
[x]507.4 *5*	58							
≈512	100 *10*	1805?	(25/2⁻)	1293.2	21/2⁻			
[x]515.0 *5*	50							
[x]527.2 *5*	24					(Q)		A_2=+0.25 *8*, A_4=−0.19 *16* (1972Li25).
[x]540.3 *5*	11					(Q)		A_2=+0.1 *3*, A_4=0.0 *4* (1972Li25).
[x]564.3 *5*	7							
[x]569.0 *5*	20					(Q)		A_2=+0.31 *10*, A_4=−0.16 *11* (1972Li25).
[x]570.2 *5*	23							
[x]584.9 *5*	57					(Q)		A_2=+0.30 *7*, A_4=−0.18 *15* (1972Li25).

$^{171}_{70}$Yb$_{101}$-5

γ(^{171}Yb) (continued)

E_γ†	I_γ‡	E_i(level)	J^π_i	E_f	J^π_f	Mult.#	Comments
x609.5 *5*	16					(Q)	A_2=+0.3 *4*, A_4=−0.1 *8* (1972Li25).
611.5 *5*	53	980.8	(11/2$^-$)	368.9	13/2$^+$		A_2=+0.06 *7*, A_4=+0.06 *11* (1972Li25).
x620.5 *5*	27						
x644.7 *5*	13						
x669.8 *5*	13						
x684.2 *5*	31						
x693.5 *2*	155 *16*						
x698.8 *5*	90						
x703.6 *5*	37						
x718.6 *5*	19					(D)	A_2=−0.40 *15*, A_4=−0.46 *25* (1972Li25).
721.8 *2*	146 *15*	980.8	(11/2$^-$)	259.10	11/2$^+$	[E1]	A_2=−0.57 *6*, A_4=−0.07 *6* (1972Li25). Mult.: A_2=−0.57 suggests dipole; E1 required by level scheme.
x744.7 *5*	30						
x754.2 *5*	18						
x829.9 *5*	39						
x836.1 *5*	40						
x840.6 *5*	34						
x844.3 *5*	30						
x847.9 *5*	53						

† For E(α)=34 MeV, except where noted. ΔE=0.2 keV for strong peaks (taken by evaluator to be those with Iγ≥100); evaluator assumed ΔE=0.5 keV otherwise.

‡ Arbitrary units for E(α)=34 MeV, θ=125°; ΔIγ=10% for strong peaks (taken by evaluator to be those with Iγ≥100).

Inferred from γ-ray angular distributions, except where noted; quadrupole assignments were based on large positive A_2, and dipole assignments, on negative A_2. Known multipolarities established E2 or M1+E2 character of cascading transitions.

@ From Adopted Gammas.

& Deduced from Iγ and theoretical E2 branching ratios; sign inferred from angular distribution data (1972Li25,1976Kr21).

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

b Multiply placed with undivided intensity.

c Multiply placed with intensity suitably divided.

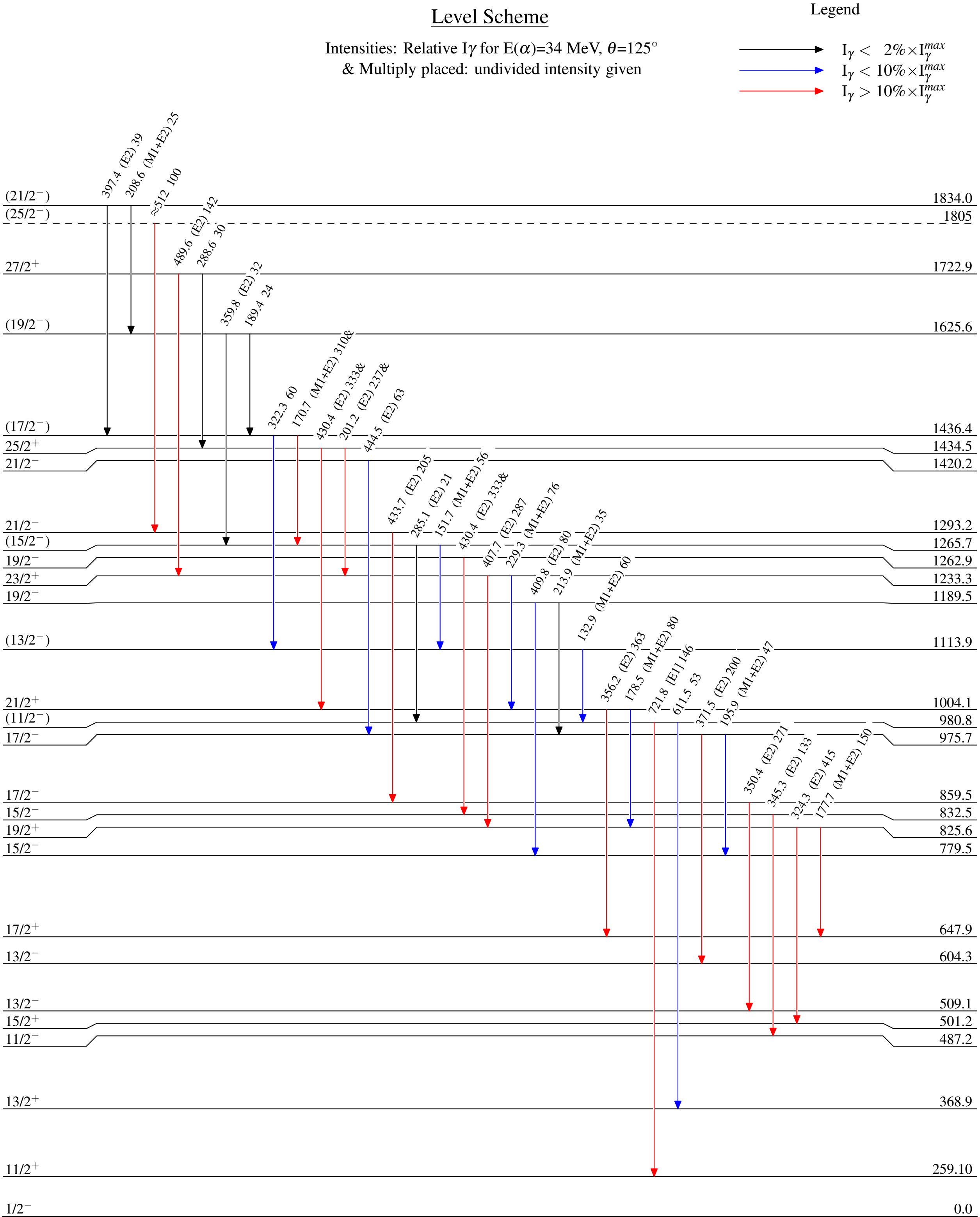
x γ ray not placed in level scheme.

$^{171}_{70}$Yb$_{101}$-6

^{170}Er(α,3nγ) E=34 MeV 1972Li25

Level Scheme

Intensities: Relative Iγ for E(α)=34 MeV, θ=125°
& Multiply placed: undivided intensity given



$^{171}_{70}Yb_{101}$

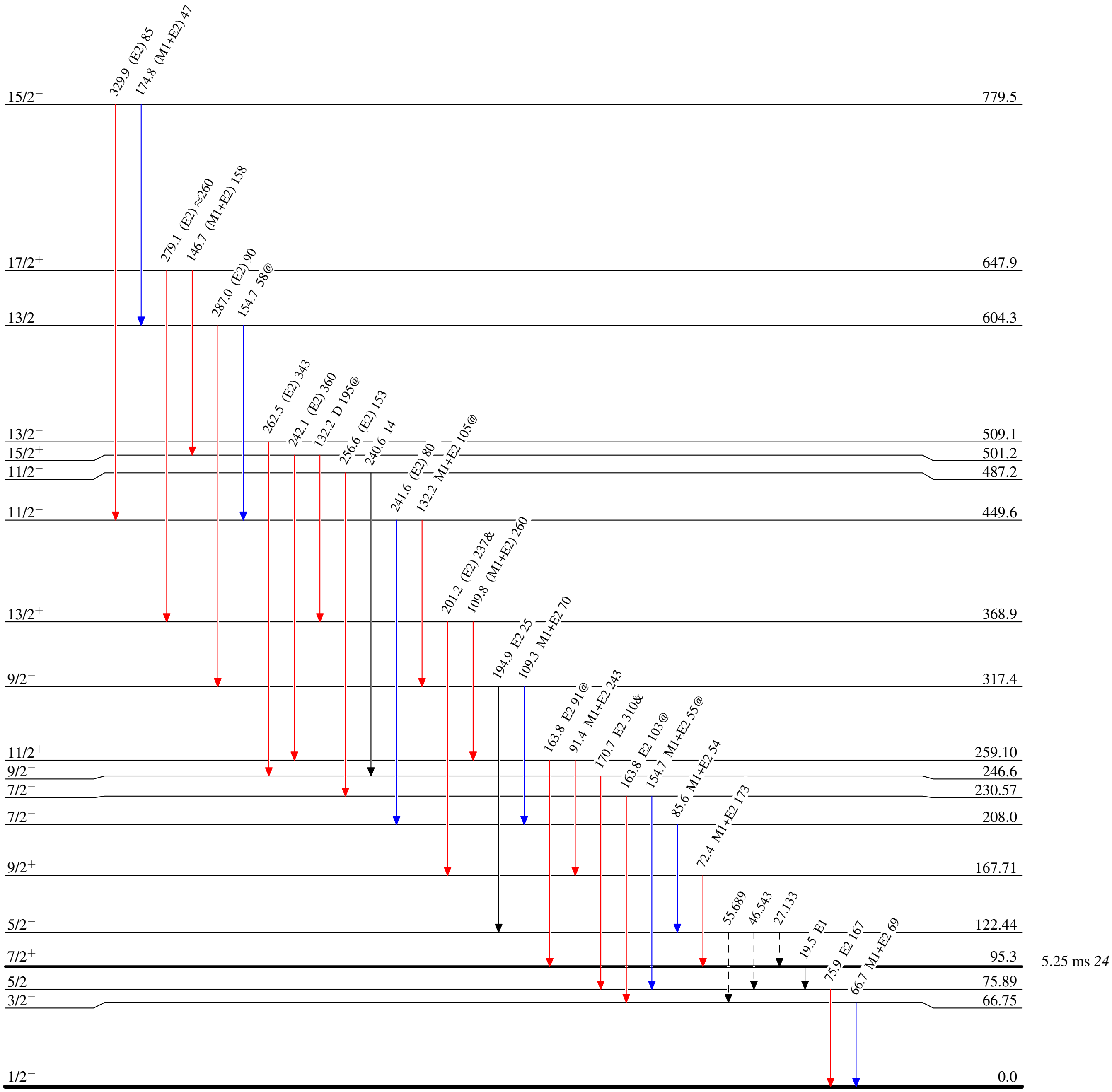
^{170}Er(α,3nγ) E=34 MeV 1972Li25

Level Scheme (continued)

Intensities: Relative Iγ for E(α)=34 MeV, θ=125°
& Multiply placed: undivided intensity given
@ Multiply placed: intensity suitably divided

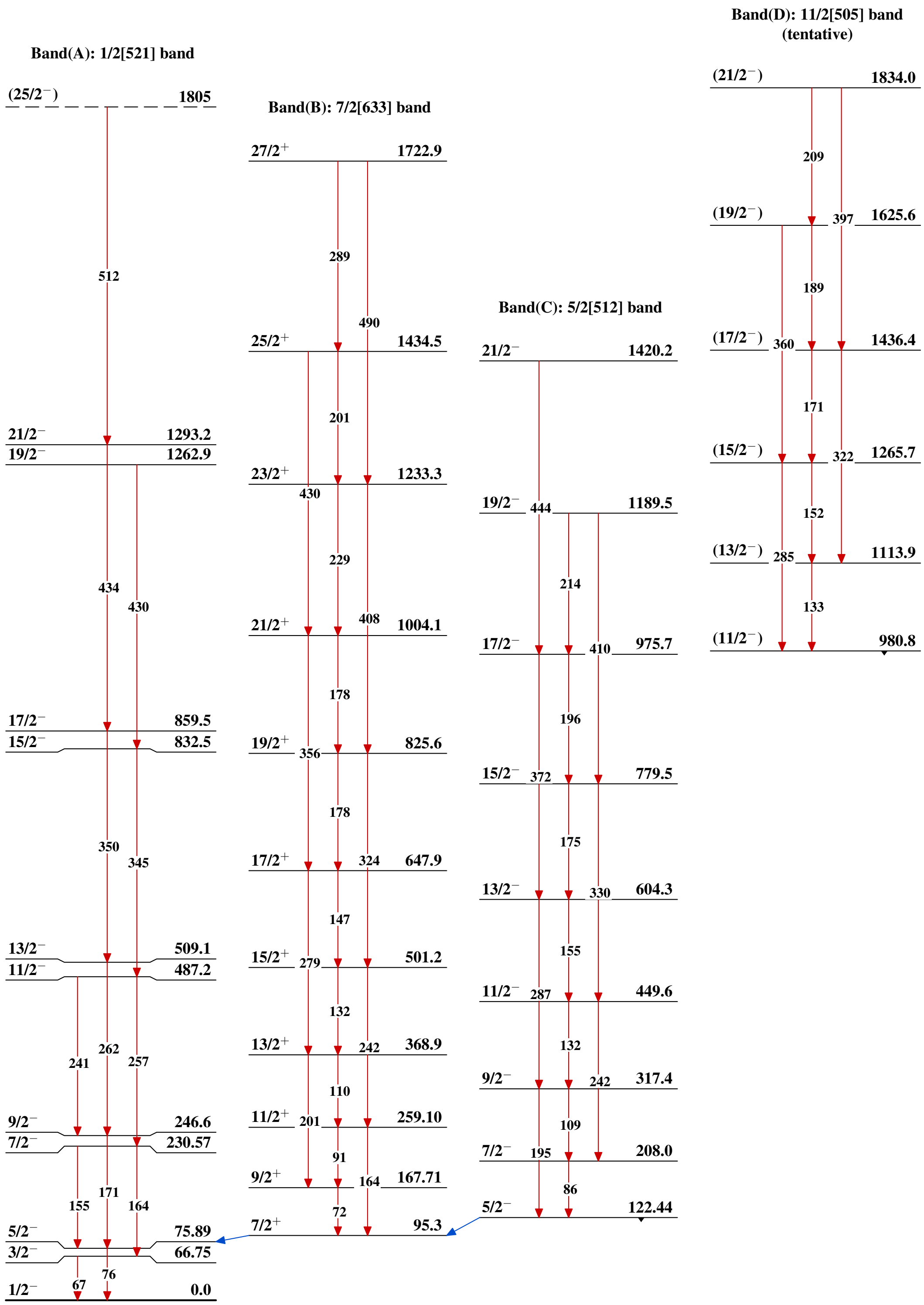
Legend

- $I_\gamma < 2\% \times I_\gamma^{max}$
- $I_\gamma < 10\% \times I_\gamma^{max}$
- $I_\gamma > 10\% \times I_\gamma^{max}$
- γ Decay (Uncertain)



$^{171}_{70}Yb_{101}$

^{170}Er(α,3nγ) E=34 MeV 1972Li25



$^{171}_{70}Yb_{101}$