^{175}Lu(α,2nγ) 1970Sk04,1971Hu14,1975Ba13

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	F. G. Kondev	NDS 159, 1 (2019)	30-Aug-2019

1970Sk04: Target: 97.4% enriched target. Beam: E=28 MeV. Measured Eγ, Iγ, γ(t), $\gamma(\theta)$.
1971Hu14: Target: 99.8% enriched target. Beam: E=30 MeV. Measured Eγ, Iγ, γ(t).
1975Ba13: Target: natural lutetium target 10 mg/cm^2 thick. Beam: E=30 MeV. Measured Eγ, Iγ, $\gamma\gamma$ coin, $\gamma\gamma$(t).
Others: 1970Ba46, 1972Ro05, 1973Sc20, 1981Ha40, 1982Ao02, 1982Ao04.

^{177}Ta Levels

E(level)[†]	J$^\pi$[‡]	$T_{1/2}$	Comments
0.0[@]	7/2$^+$	56.36 h *13*	$T_{1/2}$: From Adopted Levels. Other: 56.5 h *4* from 113γ(t) in 1981Ha40. g=0.643 *13* (1981Ha40) using the nuclear magnetic resonance on oriented nuclei technique.
70.63[a] *17*	5/2$^+$	80 ns *10*	$T_{1/2}$: From 70.6γ(t) in 1973Sc20.
73.60[b] *20*	9/2$^-$	370 ns *50*	$T_{1/2}$: From 73.6γ(t) in 1973Sc20.
131.02[@] *10*	9/2$^+$		
172.02[a] *22*	7/2$^+$		
186.17[&] *17*	5/2$^-$	3.6 μs *2*	$T_{1/2}$: From 115.3γ(t) in 1971Hu14. Other: 3.5 μs *3* using 115.3γ(t) in 1972Ro05.
220.30[b] *22*	11/2$^-$		
243.2[&] *11*	9/2$^-$		
288.48[@] *10*	11/2$^+$		
300.45[a] *22*	9/2$^+$		
391.90[b] *22*	13/2$^-$		
400.0[&] *11*	13/2$^-$		
454.64[a] *24*	11/2$^+$		
470.33[@] *12*	13/2$^+$		
587.22[b] *24*	15/2$^-$		
632.2[a] *3*	13/2$^+$		
656.7[&] *11*	17/2$^-$		
675.26[@] *17*	15/2$^+$		
805.39[b] *24*	17/2$^-$		
833.0[a] *3*	15/2$^+$		
901.60[@] *19*	17/2$^+$		
1009.1[&] *11*	21/2$^-$		
1044.11[b] *25*	19/2$^-$		
1054.0[a] *3*	17/2$^+$		
1146.7[@] *3*	19/2$^+$		
1294.8[a] *4*	19/2$^+$		
1302.8[b] *3*	21/2$^-$		
1355.3[c] *3*	21/2$^-$	5.02 μs *20*	$T_{1/2}$: From γ(t) in 1971Hu14. Others: 5.0 μs *2* (1982Ao04) and 5.3 μs *5* (1972Ro05), using 311γ(t). configuration: A mixture of configuration= π^3(5/2[402],7/2[404],9/2[514]) and configuration= ν^2(5/2[512],7/2[514])$\otimes\pi$9/2[514]. g=0.0076 *13* in 1982Ao04.
1449.9[&] *11*	25/2$^-$		
1577.7[b] *3*	23/2$^-$		
1626.2[c] *3*	23/2$^-$		
1696.3?[#e] *8*	(21/2$^-$)		E(level): Not adopted, since it was not confirmed in ^{170}Er(^{11}B,4nγ) (2000Da09) or any other dataset.

Continued on next page (footnotes at end of table)

^{175}Lu(α,2nγ) 1970Sk04,1971Hu14,1975Ba13 (continued)

^{177}Ta Levels (continued)

E(level)[†]	J$^\pi$[‡]	Comments
		J$^\pi$: From 1975Ba13.
1698.7[#d] *6*	23/2$^+$	configuration: ν^2(7/2[514],7/2[633])⊗π9/2[514] from Adopted Levels. Note, that the configuration= ν^2(5/2[512],9/2[624])⊗π9/2[514] was suggested in 1975Ba13.
1835.0[#d] *8*	25/2$^+$	configuration: Note, that this level was assigned K^π=25/2$^+$: configuration=ν^2(7/2[514],9/2[624])⊗π9/2[514] in 1975Ba13, but in Adopted level scheme it is interpreted as a member of the K^π=23/2$^+$ band.
1869.8[b] *6*	25/2$^-$	
1920.8[c] *6*	25/2$^-$	
1945.3?[#e] *9*	(23/2$^-$)	E(level): Not adopted, since it was not confirmed in ^{170}Er(^{11}B,4nγ) (2000Da09) or any other dataset. J$^\pi$: From 1975Ba13. configuration: Tentatively assigned by 1975Ba13 as a mixture of configuration=π^3(5/2[402],7/2[404],9/2[514]) and configuration=ν^2(5/2[512],7/2[514])⊗π9/2[514].
1967.7[&] *11*	29/2$^-$	
2037.4[#d] *9*	27/2$^+$	
2098.9[#] *8*	25/2$^+$	J$^\pi$: From Adopted Levels. J^π=25/2$^-$ was assigned in 1975Ba13. configuration: K^π=25/2$^+$, configuration=ν^2(7/2[514],9/2[624])⊗π9/2[514] from Adopted Levels. Note that the K^π=25/2$^-$, configuration= ν^2(7/2[633],9/2[624])⊗π9/2[514] was suggested by 1975Ba13.
2271.6[#d] *11*	29/2$^+$	
2528.6[#d] *15*	31/2$^+$	
2827.0[#d] *12*	33/2$^+$	

[†] From a least-squares fit to Eγ.
[‡] From Adopted Levels, unless otherwise stated.
[#] Observed only in 1975Ba13.
[@] Band(A): K^π=7/2$^+$: π7/2[404] (g$_{7/2}$) band.
[&] Band(B): K^π=1/2$^-$: π1/2[541] (h$_{9/2}$) (α=+1/2) band.
[a] Band(C): K^π=5/2$^+$: π5/2[402] (d$_{5/2}$) band.
[b] Band(D): K^π=9/2$^-$: π9/2[514] (h$_{11/2}$) band.
[c] Band(E): K^π=21/2$^-$, mixed configuration.
[d] Band(F): K^π=23/2$^+$, configuration=ν^2(7/2[514],7/2[633])⊗π9/2[514].
[e] Band(G): K^π=(21/2$^-$), mixed configuration.

γ(^{177}Ta)

E$_i$(level)	J$_i^\pi$	E$_\gamma$[†]	I$_\gamma$[†]	E$_f$	J$_f^\pi$	Mult.[‡]	δ[#]	Comments
70.63	5/2$^+$	70.7 *2*	235 *47*	0.0	7/2$^+$	M1+E2		Mult.: A$_2$=−0.05 *20* (1970Sk04).
73.60	9/2$^-$	73.6 *2*	9.5×10^2 *19*	0.0	7/2$^+$	E1		Mult.: A$_2$=−0.24 *12* (1970Sk04).
131.02	9/2$^+$	131.0 *1*	169 *17*	0.0	7/2$^+$	M1+E2	+0.5 *3*	Mult.: A$_2$=0.33 *5* (1970Sk04).
172.02	7/2$^+$	101.6 *2*	116 *12*	70.63	5/2$^+$	M1+E2	+0.12 *13*	Mult.: A$_2$=−0.06 *7* (1970Sk04).
186.17	5/2$^-$	115.6 *2*	490 *50*	70.63	5/2$^+$	[E1]		Mult.: A$_2$=0.08 *3*, A$_4$=−0.01 *16* (1970Sk04).
		186.1 *2*	96 *10*	0.0	7/2$^+$	[E1]		Mult.: A$_2$=0.20 *15* (1970Sk04).
220.30	11/2$^-$	146.7 *1*	594 *60*	73.60	9/2$^-$	M1+E2	+0.24 *11*	Mult.: A$_2$=0.11 *5* (1970Sk04).
243.2	9/2$^-$	(59.7)		186.17	5/2$^-$	[E2]		E$_\gamma$: From 1973Sc20. Other: (56)γ (1970Sk04).
288.48	11/2$^+$	157.6[&]		131.02	9/2$^+$	[M1+E2]		
		288.5 *1*	74 *8*	0.0	7/2$^+$	E2		Mult.: A$_2$=0.32 *13*, A$_4$=−0.30 *18* (1970Sk04).
300.45	9/2$^+$	128.4 *1*	131 *13*	172.02	7/2$^+$	M1+E2	+0.19 *8*	Mult.: A$_2$=0.03 *5* (1970Sk04). δ: Others: δ=0.18 *1* (1970Sk04) and 0.12 *2* (1970Ba46), assuming K=5/2.

Continued on next page (footnotes at end of table)

^{175}Lu(α,2nγ) 1970Sk04,1971Hu14,1975Ba13 (continued)

$\gamma(^{177}Ta)$ (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[‡]	δ[#]	Comments
300.45	9/2$^+$	229.6 *2*	11 *3*	70.63	5/2$^+$	E2		Mult.: A_2=0.25 *30* (1970Sk04).
391.90	13/2$^-$	171.6 *1*	616 *62*	220.30	11/2$^-$	M1+E2	+0.23 *10*	Mult.: A_2=0.11 *5* (1970Sk04). δ: Others: δ=0.18 *2* (1970Sk04), 0.16 *2* (1970Ba46) and 0.21 *2* (1971Hu14), assuming K=9/2.
		318.3 *1*	51 *10*	73.60	9/2$^-$	E2		Mult.: A_2=0.17 *13* (1970Sk04).
400.0	13/2$^-$	156.8 *2*	315 *63*	243.2	9/2$^-$	E2		Mult.: A_2=0.31 *3*, A_4=−0.11 *4* (1970Sk04).
454.64	11/2$^+$	154.1 *2*	120 *24*	300.45	9/2$^+$	M1+E2	+0.22 *12*	Mult.: A_2=0.08 *7* (1970Sk04). δ: Others: δ=0.15 *1* (1970Sk04) and 0.16 *2* (1970Ba46), assuming K=5/2.
		282.7 *1*	43 *5*	172.02	7/2$^+$	E2		Mult.: A_2=0.53 *20* (1970Sk04).
470.33	13/2$^+$	181.5 *3*	55 *11*	288.48	11/2$^+$	M1+E2	+0.6 *3*	Mult.: A_2=0.45 *10* (1970Sk04). δ: Others: δ=0.45 *10* (1970Sk04) and 0.54 *8* (1970Ba46), assuming K=7/2.
		339.3 *1*	127 *13*	131.02	9/2$^+$	E2		Mult.: A_2=0.25 *9*, A_4=0.06 *12* (1970Sk04).
587.22	15/2$^-$	195.3 *2*	533 *54*	391.90	13/2$^-$	M1+E2	+0.25 *12*	Mult.: A_2=0.14 *7* (1970Sk04). δ: Others: δ=0.17 *2* (1970Sk04), 0.18 *3* (1970Ba46) and 0.20 *2* (1971Hu14), assuming K=9/2.
		366.9 *2*	131 *55*	220.30	11/2$^-$	(E2)		Mult.: A_2=−0.26 *33* (1970Sk04), inconsistent with the proposed multipolarity.
632.2	13/2$^+$	177.9 *3*	73 *8*	454.64	11/2$^+$	M1+E2	+0.14 *16*	Mult.: A_2=−0.02 *14* (1970Sk04). δ: Others: δ=0.21 *2* (1970Sk04) and 0.19 *1* (1970Ba46), assuming K=5/2.
		331.5 *2*	66 *7*	300.45	9/2$^+$	E2		Mult.: A_2=0.23 *17* (1970Sk04). I_γ: A complex line in 1970Ba46.
656.7	17/2$^-$	256.7 *1*	223 *23*	400.0	13/2$^-$	E2		Mult.: A_2=0.29 *25*, A_4=−0.15 *34* (1970Sk04).
675.26	15/2$^+$	204.8 *3*	26 *8*	470.33	13/2$^+$	[M1+E2]		δ: δ=0.49 *4* (1970Sk04) and 0.51 *10* (1970Ba46), assuming K=7/2.
		387.0 *2*	95 *10*	288.48	11/2$^+$	E2		Mult.: A_2=0.49 *18* (1970Sk04).
805.39	17/2$^-$	218.2 *2*	350 *35*	587.22	15/2$^-$	M1+E2	+0.25 *12*	Mult.: A_2=0.15 *8* (1970Sk04). δ: Others: δ=0.16 *2* (1970Sk04), 0.17 *1* (1970Ba46) and 0.17 *1* (1971Hu14), assuming K=9/2.
		413.5 *1*	121 *15*	391.90	13/2$^-$	E2		Mult.: A_2=0.16 *9* (1970Sk04).
833.0	15/2$^+$	200.5 *3*	64 *20*	632.2	13/2$^+$	M1+E2		Mult.: A_2=−0.04 *12* (1970Sk04). δ: δ=0.10 *1* (1970Sk04) and 0.10 *2* (1970Ba46), assuming K=5/2.
		378.4 *3*	27 *5*	454.64	11/2$^+$	[E2]		
901.60	17/2$^+$	226.5 *2*	13 *3*	675.26	15/2$^+$	M1+E2	+0.7 *4*	Mult.: A_2=0.55 *21* (1970Sk04). δ: δ=0.29 *2* (1970Sk04) and 0.56 *12* (1970Ba46), assuming K=7/2.
		431.1 *2*	84 *17*	470.33	13/2$^+$	E2		Mult.: A_2=0.25 *12* (1970Sk04).
1009.1	21/2$^-$	352.4 *1*	143 *15*	656.7	17/2$^-$	E2		Mult.: A_2=0.38 *10*, A_4=−0.08 *14* (1970Sk04); A_2=0.303 *12*, A_4=−0.068 *20* (1982Ao02).
1044.11	19/2$^-$	238.6 *1*	351 *35*	805.39	17/2$^-$	M1+E2	+0.21 *6*	Mult.: A_2=0.10 *5* (1970Sk04). δ: Others: δ=0.16 *2* (1970Sk04), 0.16 *1* (1970Ba46) and 0.17 *1* (1971Hu14), assuming K=9/2.
		456.8 *2*	173 *20*	587.22	15/2$^-$	E2		Mult.: A_2=0.19 *9* (1970Sk04).
1054.0	17/2$^+$	220.9 *2*	48 *10*	833.0	15/2$^+$	[M1+E2]		δ: δ=0.09 *1* (1970Ba46), assuming K=5/2.
		421.9 *2*	25 *5*	632.2	13/2$^+$	[E2]		
1146.7	19/2$^+$	471.4 *2*	62 *12*	675.26	15/2$^+$	E2		Mult.: A_2=0.28 *25* (1970Sk04).
1294.8	19/2$^+$	461.8 *2*	25 *5*	833.0	15/2$^+$	[E2]		
1302.8	21/2$^-$	258.5 *1*	75 *15*	1044.11	19/2$^-$	M1+E2	+0.07 *46*	Mult.: A_2=−0.1 *5* (1970Sk04). δ: Others: δ=0.17 *1* (1970Sk04) and 0.18 *3* (1970Ba46), assuming K=9/2.

Continued on next page (footnotes at end of table)

^{175}Lu(α,2nγ) 1970Sk04,1971Hu14,1975Ba13 (continued)

$\gamma(^{177}Ta)$ (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[‡]	δ[#]	Comments
1302.8	21/2$^-$	497.9 *2*	59 *12*	805.39	17/2$^-$	E2		Mult.: A_2=0.38 *26* (1970Sk04).
1355.3	21/2$^-$	311.2 *1*	100	1044.11	19/2$^-$	M1+E2	+0.29 *+11−6*	I_γ: Relative branching γ-ray intensity. Mult.: A_2=0.16 *4*, A_4=−0.20 *6* (1970Sk04); A_2=0.03 *6*, A_4=0.08 *8* (1975Ba13). A_2=0.048 *7*, A_4=−0.006 *11* (1982Ao02,1982Ao04). α(exp)=0.37 *18* (1970Sk04) and α(exp)=0.32 *15* (1971Hu14). α(K)exp=0.169 *28* and α(L)exp=0.0203 *41* (1982Ao04). δ: From $\gamma(\theta)$ in 1982Ao02 and 1982Ao04.
		550.0 *3*	16.8 *5*	805.39	17/2$^-$	E2		I_γ: Relative to Iγ(311γ)=100. Weighted average of 15.2 *40* (1971Hu14), 17.2 *5* (1982Ao04), 11.4 *25* (1970Ba46) and 10.3 *34* (1975Ba13). Other: 10 *1* (1973Sc20). Mult.: A_2=0.190 *41*, A_4=−0.071 *49* (1982Ao02,1982Ao04). α(K)exp=0.0127 *16* (1982Ao04).
1449.9	25/2$^-$	440.8 *1*	63 *13*	1009.1	21/2$^-$	(E2)		Mult.: A_2=0.02 *32* (1970Sk04), inconsistent with the proposed multipolarity.
1577.7	23/2$^-$	274.9 *1*	47 *5*	1302.8	21/2$^-$	M1+E2	−0.01 *29*	Mult.,δ: A_2=−0.3 *4* (1970Sk04). δ: Others: δ=0.18 *1* (1970Sk04) and 0.15 *3* (1970Ba46), assuming K=9/2.
		533.7 *3*	38 *8*	1044.11	19/2$^-$	[E2]		
1626.2	23/2$^-$	270.9 *1*	97 *10*	1355.3	21/2$^-$	M1+E2	+0.25 *+5−3*	Mult.: A_2=0.52 *13* (1970Sk04); A_2=0.15 *10*, A_4=0.028 *12* (1975Ba13). A_2=0.196 *13*, A_4=0.037 *19* (1982Ao04). δ: From 1982Ao04.
1696.3?	(21/2$^-$)	70.0[&]		1626.2	23/2$^-$			E_γ: From 1975Ba13. Not adopted, since it was not confirmed in ^{170}Er(^{11}B,4nγ) (2000Da09) or any other dataset.
		341.0[&]		1355.3	21/2$^-$			E_γ: From 1975Ba13. Not adopted, since it was not confirmed in ^{170}Er(^{11}B,4nγ) (2000Da09) or any other dataset.
1698.7	23/2$^+$	343.4[@] *5*	198[@] *25*	1355.3	21/2$^-$	E1		I_γ: Contaminated with γ from Coulomb excitation of ^{175}Lu. Mult.: A_2=−0.22 *10*, A_4=−0.03 *10* (1975Ba13).
1835.0	25/2$^+$	136.3[@] *5*	55[@] *11*	1698.7	23/2$^+$	M1+E2		Mult.: A_2=0.14 *7* (1975Ba13).
1869.8	25/2$^-$	292[&]		1577.7	23/2$^-$	[M1+E2]		
		567.0[&] *5*	31 *9*	1302.8	21/2$^-$	[E2]		
1920.8	25/2$^-$	294.7		1626.2	23/2$^-$	M1+E2	+0.30 *+6−8*	E_γ: From 1975Ba13. Mult.: A_2=0.22 *17* (1975Ba13). A_2=0.27 *5*, A_4=−0.08 *6* (1982Ao04). δ: From 1982Ao04.
		565 *1*		1355.3	21/2$^-$	[E2]		E_γ: From 1970Sk04.

Continued on next page (footnotes at end of table)

^{175}Lu(α,2nγ) 1970Sk04,1971Hu14,1975Ba13 (continued)

$\gamma(^{177}Ta)$ (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[‡]	Comments
1945.3?	(23/2$^-$)	249.0[@&] *5*	53[@] *11*	1696.3?	(21/2$^-$)		E_γ: Not adopted, since it was not confirmed in ^{170}Er(^{11}B,4nγ) (2000Da09) or any other dataset.
1967.7	29/2$^-$	517.8 *3*	28 *6*	1449.9	25/2$^-$	[E2]	
2037.4	27/2$^+$	202.4[@] *5*	149[@] *33*	1835.0	25/2$^+$	M1+E2	Mult.: A_2=−0.07 *19* (1975Ba13).
2098.9	25/2$^+$	264[&]		1835.0	25/2$^+$		E_γ: From 1975Ba13. Not confirmed in ^{170}Er(^{11}B,4nγ) (2000Da09).
		400.2[@] *5*	22[@] *6*	1698.7	23/2$^+$	M1+E2	Mult.: A_2=−0.36 *20* (1975Ba13).
2271.6	29/2$^+$	234.2 *5*	46 *11*	2037.4	27/2$^+$	M1+E2	Mult.: A_2=0.10 *10* (1975Ba13).
		437[&]		1835.0	25/2$^+$		E_γ: From 1975Ba13.
2528.6	31/2$^+$	257[&]		2271.6	29/2$^+$		E_γ: From 1975Ba13.
2827.0	33/2$^+$	555.4[@] *5*	10[@] *5*	2271.6	29/2$^+$		E_γ: in conflict with adopted gammas.

[†] From 1970Ba46, unless otherwise stated. Data are consistent between 1970Sk04, 1971Hu14 and 1970Ba46. Many of the transitions listed in Table 1 of 1970Sk04 and 1970Ba46, but not placed in the level scheme, are not included in the present evaluation since these are assigned to neighboring Hf and Ta isotopes.

[‡] From $\gamma(\theta)$ in 1970Sk04, 1975Ba13 and 1982Ao0, the measured conversion electron coefficients in 1971Hu14 and 1982Ao04, and the observed apparent band structures with both cascade and cross-over transitions.

[#] From $\gamma(\theta)$ in 1970Sk04, unless otherwise stated. Values given in the Comments section are deduced from the branching ratios and the rotational model, and by assuming pure K, unless otherwise stated.

[@] From 1975Ba13, $\Delta E\gamma$ was estimated by the evaluator. Iγ are from 1975Ba13, but scaled to Iγ(270.9γ)=97 *10* in 1970Ba46.

[&] Placement of transition in the level scheme is uncertain.

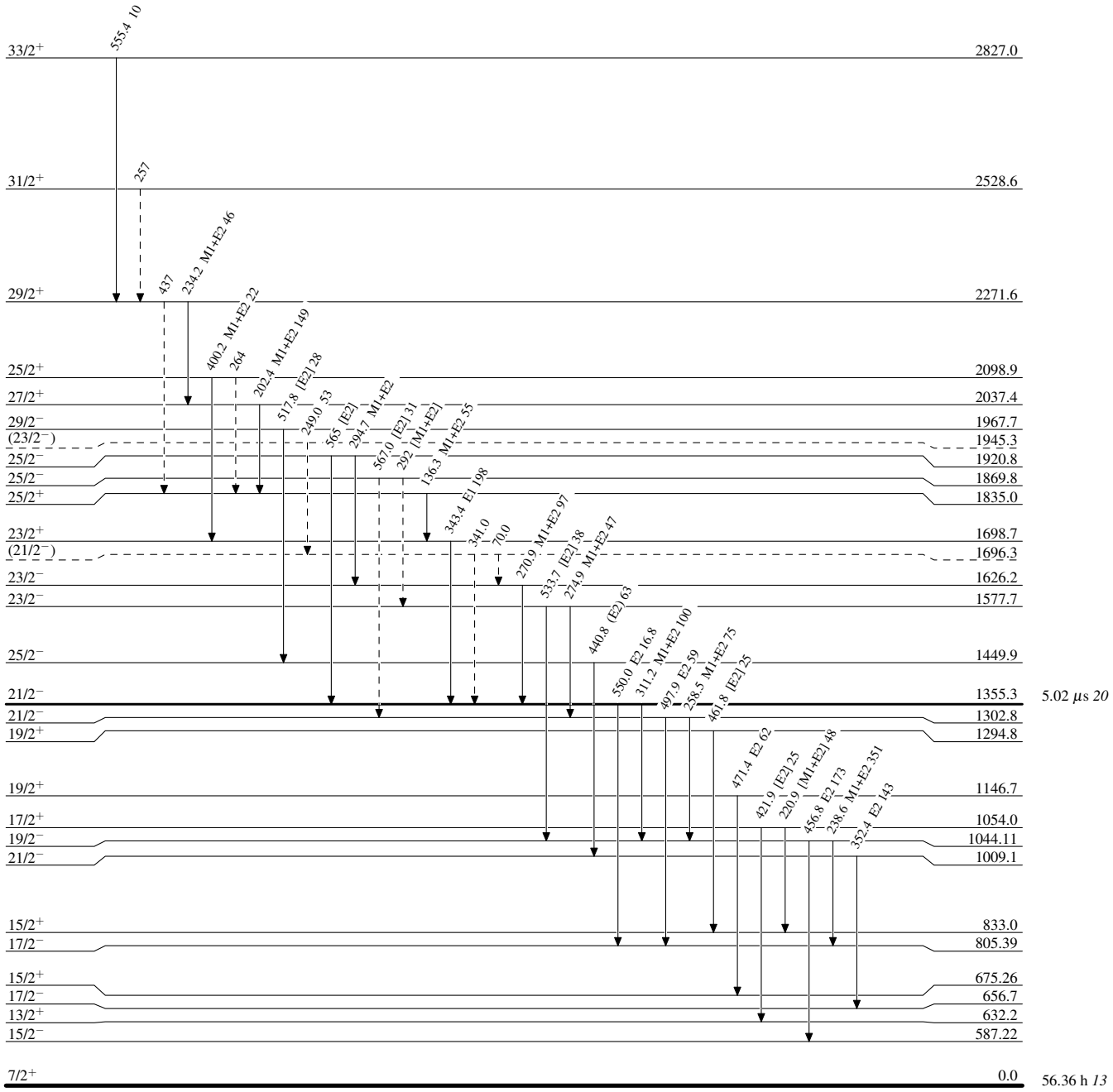
^{175}Lu(α,2nγ) 1970Sk04,1971Hu14,1975Ba13

Legend

Level Scheme

Intensities: % photon branching from each level

γ Decay (Uncertain)



$^{177}_{73}Ta_{104}$

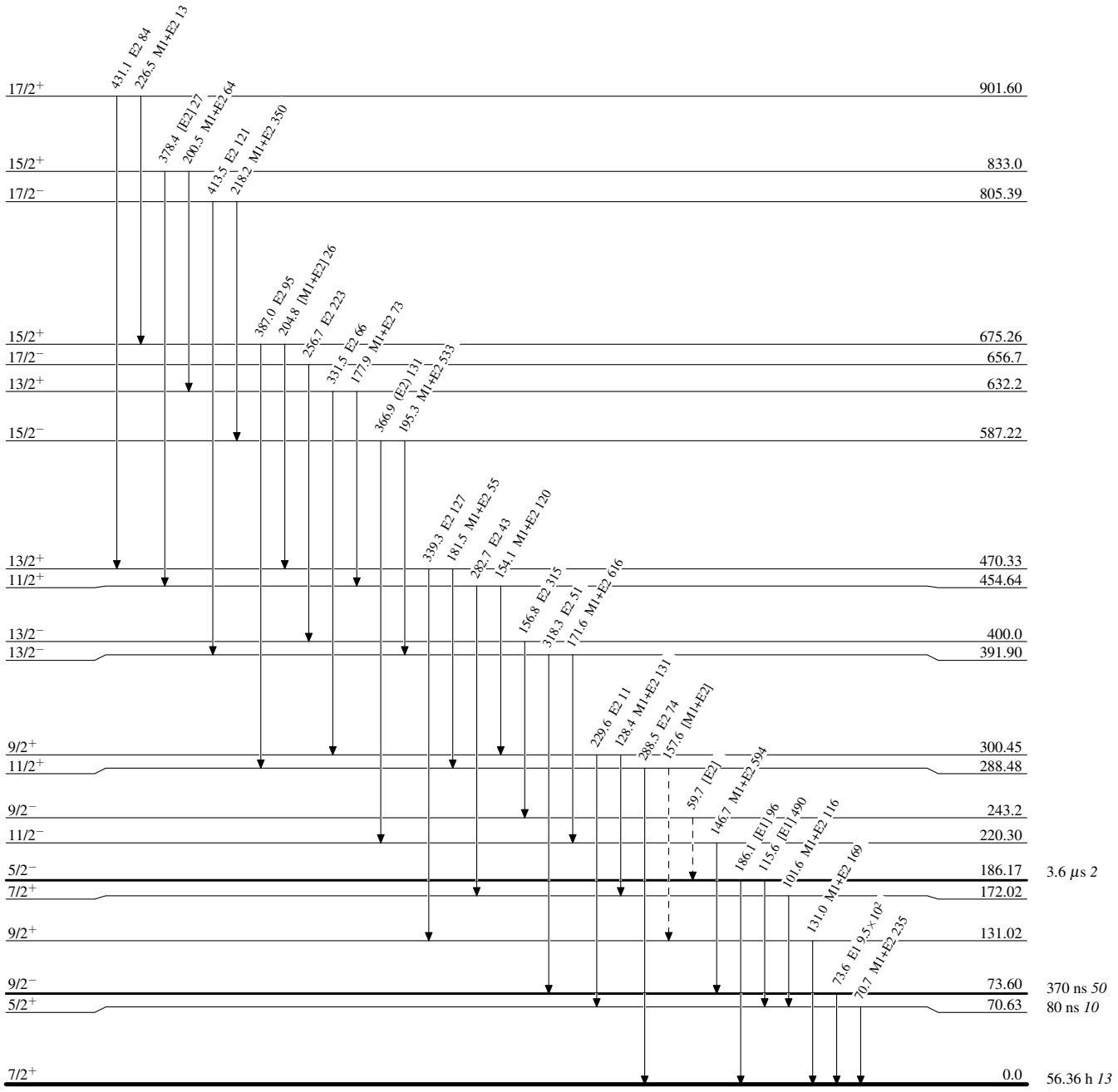
^{175}Lu(α,2nγ) 1970Sk04,1971Hu14,1975Ba13

Legend

Level Scheme (continued)

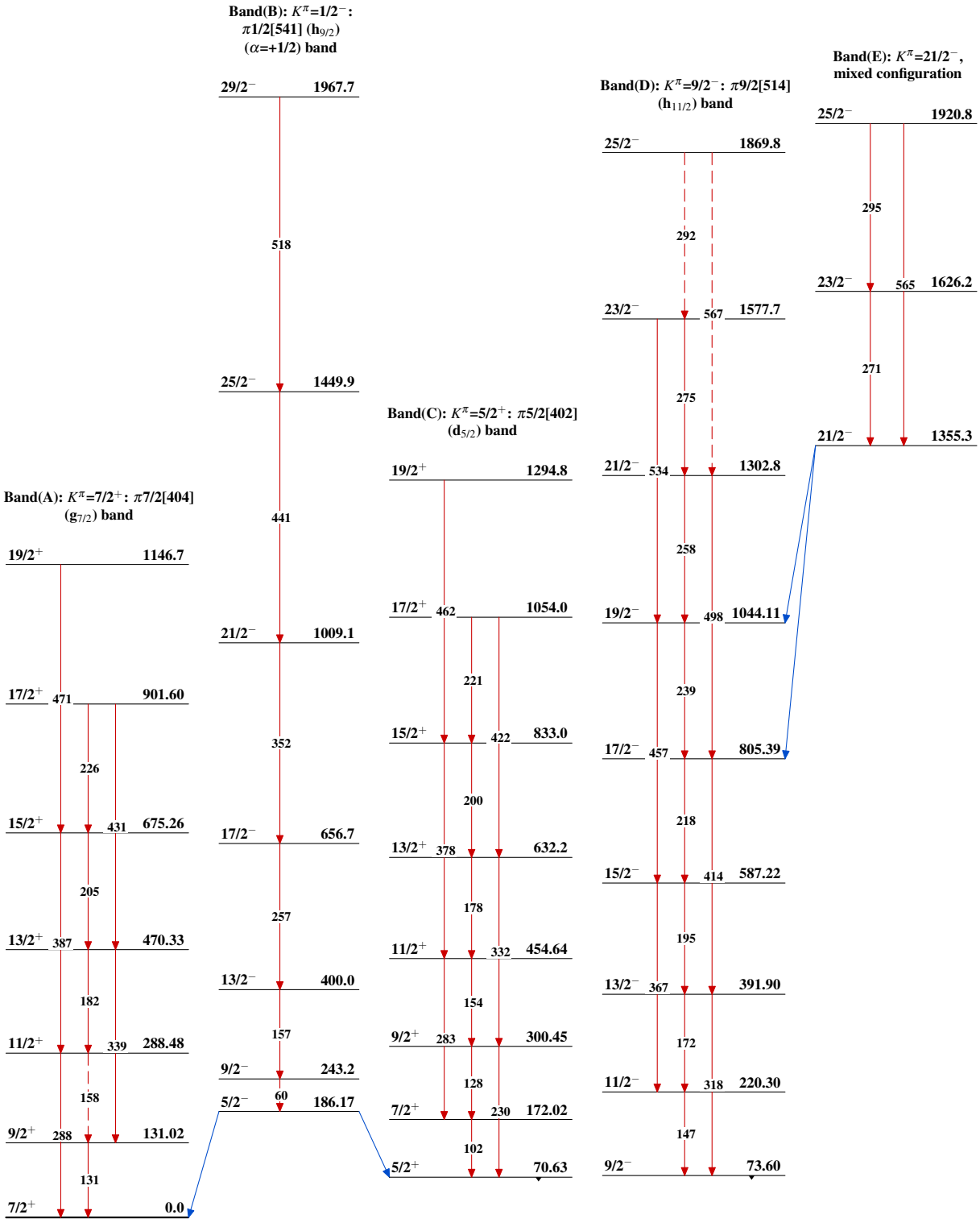
Intensities: % photon branching from each level

γ Decay (Uncertain)



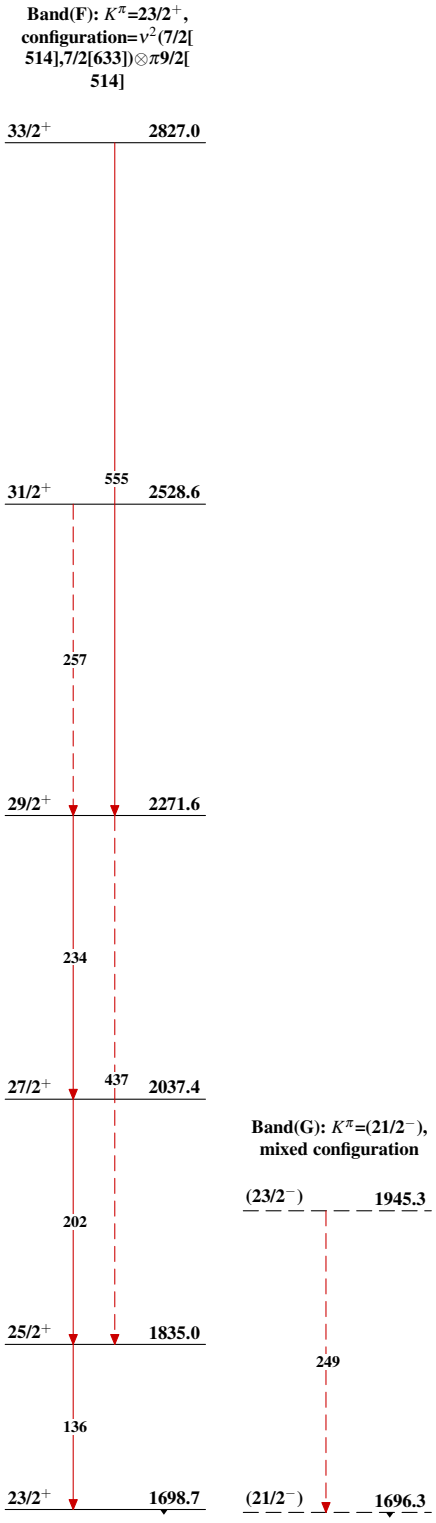
$^{177}_{73}Ta_{104}$

^{175}Lu(α,2nγ) 1970Sk04,1971Hu14,1975Ba13



$^{177}_{73}Ta_{104}$

^{175}Lu(α,2nγ) 1970Sk04,1971Hu14,1975Ba13 (continued)



$^{177}_{73}Ta_{104}$