^{171}Ta ε decay 1974La24,1970Re11

History

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

Parent: ^{171}Ta: E=0.0; J$^\pi$=(5/2$^+$); T$_{1/2}$=23.3 min *3*; Q(ε)=3710 *40*; %ε+%β^+ decay=100.0

1974La24, 1970Re11: sources from ^{165}Ho(^{12}C,6n), E(^{12}C)=80 MeV and ^{159}Tb(^{16}O,4n), E(^{16}O)=93 MeV; metallic Ho and Tb targets, chemical separation; measured Eγ, Iγ (Ge(Li), Si(Li)), $\gamma\gamma$ coin, $\gamma\gamma$(t) 3-parameter coin. Incomplete transition data and unknown g.s. feeding (first-forbidden transition) prevent construction of complete decay scheme. See comment with 198.9γ concerning data from 1987Sz03.

Other: 1972Ch45.

The tentative decay scheme is based on that of 1974La24; however, the ^{171}Ta parent configuration adopted here is 5/2$^+$ 5/2[402], not 7/2[404] as proposed by 1974La24. The decay scheme has not been normalized because ε+β^+ feeding to the g.s. is likely (ΔJ $\leq$ 1, $\Delta\pi$=no) buts its magnitude is unknown. The strongest branches feed (3/2$^-$), (5/2$^-$) and (7/2$^-$) states (50, 142, 255, 506, 560 levels), as might be expected from a (5/2$^-$) parent; however, significant branches also appear to feed (9/2$^-$) and (11/2) states and, although considerable Iγ remains unplaced, it does not appear adequate to explain all such feeding. Many of those J^π assignments are very tentative and may in fact be incorrect. Note that, even in the absence of g.s. feeding, log *ft* would exceed 5.9 for the strongest branches to excited states.

^{171}Hf Levels

E(level)[†]	J$^\pi$[‡]	T$_{1/2}$	Comments
0.0[#]	7/2$^{(+)}$	12.1 h *4*	T$_{1/2}$: from Adopted Levels. Additional information 1.
21.94[@] *9*	1/2$^{(-)}$	29.5 s *9*	T$_{1/2}$: from Adopted Levels.
49.52[&] *7*	(5/2$^-$)		I(γ+ce) imbalance At level: 56 *16*.
61.86[#] *6*	(9/2$^+$)		
88.69[@] *9*	(3/2$^-$)		
102.55[@] *8*	(5/2$^-$)		
141.62[&] *9*	(7/2$^-$)		I(γ+ce) imbalance At level: 38 *8*.
146.02[#] *11*	(11/2$^+$)		
254.90[@] *9*	(7/2$^-$)		I(γ+ce) imbalance At level: 25 *4*.
258.67[&] *8*	(9/2$^-$)		
278.01[@] *9*	(9/2$^-$)		
399.14[&] *11*	(11/2$^-$)		
492.57[b] *9*	(5/2$^+$)		
493.97[c] *10*	(5/2$^-$)		
506.22[d] *7*	(7/2$^-$)		I(γ+ce) imbalance At level: 44 *6*. Additional information 2.
508.67[@] *11*	(11/2$^-$)		
537.38[@] *11*	(13/2$^-$)		
554.53?[b] *8*	(7/2$^+$)		I(γ+ce) imbalance At level: 20.1 *17*.
560.00[a] *10*	(3/2$^-$)		I(γ+ce) imbalance At level: 25.8 *18*.
565.02[c] *14*	(7/2$^-$)		
592.39[d] *11*	(9/2$^-$)		
624.85[a] *10*	(5/2$^-$)		I(γ+ce) imbalance At level: 20.0 *14*.
709.85[a] *11*	(7/2$^-$)		
767.62 *7*			
788.98 *7*	(7/2,9/2$^+$)		
832.51?[a] *14*	(9/2$^-$)		
899.14 *9*	(3/2,5/2,7/2)		
1001.35 *8*	(9/2$^-$)		

Continued on next page (footnotes at end of table)

^{171}Ta ε decay 1974La24,1970Re11 (continued)

^{171}Hf Levels (continued)

E(level)†	J^{π}‡	Comments
1007.91 *8*	$(7/2^{+},9/2^{-})$	I(γ+ce) imbalance At level: 26.0 *24*.
1077.02 *9*		

† From least-squares fit to Eγ, excluding the 607γ and 622γ from the 710 level, neither of which fits its placement well. The reduced χ^2 for the fit is then reduced from 3.8 to 2.3 (cf. Critical value of 1.8).

‡ From Adopted Levels.

Band(A): 7/2[633] band.

@ Band(B): 1/2[521] band.

& Band(C): 5/2[512] band.

a Band(D): 3/2[521]? band. Analogous to band known In isotone ^{169}Yb.

b Band(E): 5/2[642]? band. Band known In isotone ^{169}Yb.

c Band(F): 5/2[523]? band. Band known In isotone ^{169}Yb.

d Band(G): 7/2[514]? band.

γ(^{171}Hf)

E_γ[†]	I_γ[‡]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ	α[b]	$I_{(\gamma+ce)}$	Comments
(14.1)		102.55	(5/2$^-$)	88.69	(3/2$^-$)				≥14	unobserved transition; existence (I(γ+ce)≥14 *6*) suggested by intensity balance At 103 level. Eγ from level energy difference.
(21.91 *12*)		21.94	1/2$^{(-)}$	0.0	7/2$^{(+)}$	[E3]		5.47×10^5 *20*	131 *17*	ce(L)/(γ+ce)=0.704 *20*; ce(M)/(γ+ce)=0.234 *11*; ce(N+)/(γ+ce)=0.062 *4* ce(N)/(γ+ce)=0.056 *3*; ce(O)/(γ+ce)=0.0064 *4*; ce(P)/(γ+ce)=3.53×10^{-6} *18* E_γ: from level energy difference. Eγ=22.2 in 1974La24. $I_{(\gamma+ce)}$: 131 *17* from intensity balance At 22 level, assuming No ε+β^+ branch to this level (ΔJ=(2), $\Delta\pi$=(yes) transition) and %IT=100 from 22 level.
49.6 *1*	100 *10*	49.52	(5/2$^-$)	0.0	7/2$^{(+)}$	(E1)		0.447		α(L)=0.347 *6*; α(M)=0.0791 *12*; α(N+..)=0.0207 *4* α(N)=0.0182 *3*; α(O)=0.00243 *4*; α(P)=9.42×10^{-5} *14*
61.9 *1*	9.1[a] *9*	61.86	(9/2$^+$)	0.0	7/2$^{(+)}$	(M1+E2)	≈0.2	≈3.57		α(L)≈2.75; α(M)≈0.640; α(N+..)≈0.174 α(N)≈0.1508; α(O)≈0.0219; α(P)≈0.001107 δ: from intensity balance at 61.9 level (assuming no ε+β^+ feeding of level; log $f^{1u}t$>8.5 for %ε+β^+<5).
66.7 *1*	4.5[a] *5*	88.69	(3/2$^-$)	21.94	1/2$^{(-)}$	(M1+E2)		16 *3*		α(K)=6 *5*; α(L)=7 *6*; α(M)=1.9 *15*; α(N+..)=0.5 *4* α(N)=0.4 *4*; α(O)=0.06 *5*; α(P)=0.0005 *4*
80.7 *1*	4.2 *4*	102.55	(5/2$^-$)	21.94	1/2$^{(-)}$	[E2]		8.35		α(K)=1.311 *19*; α(L)=5.35 *9*; α(M)=1.338 *21*; α(N+..)=0.349 *6* α(N)=0.310 *5*; α(O)=0.0389 *6*; α(P)=9.63×10^{-5} *14*
84.3 *1*	1.60 *16*	146.02	(11/2$^+$)	61.86	(9/2$^+$)	M1+E2[@]	−0.18[@] *+12−14*	6.56		α(K)=5.3 *3*; α(L)=0.96 *22*; α(M)=0.22 *6*; α(N+..)=0.061 *15* α(N)=0.052 *13*; α(O)=0.0078 *16*; α(P)=0.000454 *25*
92.2 *1*	10.9[a] *11*	141.62	(7/2$^-$)	49.52	(5/2$^-$)	(M1+E2)[@]		4.96 *13*		α(K)=2.7 *16*; α(L)=1.8 *11*; α(M)=0.4 *3*; α(N+..)=0.11 *8* α(N)=0.10 *7*; α(O)=0.013 *8*; α(P)=0.00022 *15*
117.1 *1*	5.5 *6*	258.67	(9/2$^-$)	141.62	(7/2$^-$)	M1(+E2)[@]	−0.11[@] *+11−12*	2.54 *5*		α(K)=2.11 *7*; α(L)=0.338 *24*;

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γ(^{171}Hf) (continued)

E_γ[†]	I_γ[‡]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[#]	δ	α[b]	Comments
									α(M)=0.077 *7*; α(N+..)=0.0211 *16* α(N)=0.0182 *15*; α(O)=0.00277 *17*; α(P)=0.000179 *6*
140.5 *1*	0.80 *8*	399.14	(11/2⁻)	258.67	(9/2⁻)	M1(+E2)[@]	−0.04[@] *10*	1.517 *24*	α(K)=1.263 *24*; α(L)=0.197 *5*; α(M)=0.0445 *13*; α(N+..)=0.0123 *4* α(N)=0.0106 *3*; α(O)=0.00162 *4*; α(P)=0.0001072 *21*
152.4 *1*	5.8 *6*	254.90	(7/2⁻)	102.55	(5/2⁻)	[M1,E2]		0.97 *24*	α(K)=0.7 *4*; α(L)=0.22 *7*; α(M)=0.054 *19*; α(N+..)=0.014 *5* α(N)=0.013 *5*; α(O)=0.0017 *5*; α(P)=5.E−5 *4*
166.3 *1*	19.2[a] *19*	254.90	(7/2⁻)	88.69	(3/2⁻)	E2[@]		0.540	α(K)=0.277 *4*; α(L)=0.200 *3*; α(M)=0.0494 *7*; α(N+..)=0.01298 *19* α(N)=0.01148 *17*; α(O)=0.001488 *22*; α(P)=1.748×10^{-5} *25*
175.5 *1*	16.0 *16*	278.01	(9/2⁻)	102.55	(5/2⁻)	E2[@]		0.448	α(K)=0.240 *4*; α(L)=0.1588 *23*; α(M)=0.0391 *6*; α(N+..)=0.01030 *15* α(N)=0.00910 *13*; α(O)=0.001184 *17*; α(P)=1.527×10^{-5} *22*
ˣ198.9[&]									
209.2 *1*	2.9 *3*	258.67	(9/2⁻)	49.52	(5/2⁻)	[E2]		0.247	α(K)=0.1476 *21*; α(L)=0.0762 *11*; α(M)=0.0187 *3*; α(N+..)=0.00493 *7* α(N)=0.00434 *7*; α(O)=0.000573 *8*; α(P)=9.78×10^{-6} *14*
ˣ240.8 *1*	0.60 *6*								
247.5[e]		506.22	(7/2⁻)	258.67	(9/2⁻)				Seen in coincidence spectrum only (1974La24).
253.8 *1*	1.30 *13*	508.67	(11/2⁻)	254.90	(7/2⁻)	E2[@]		0.1325	α(K)=0.0865 *13*; α(L)=0.0352 *5*; α(M)=0.00854 *12*; α(N+..)=0.00227 *4* α(N)=0.00199 *3*; α(O)=0.000267 *4*; α(P)=5.98×10^{-6} *9*
257.5[a] *1*	1.10[a] *11*	399.14	(11/2⁻)	141.62	(7/2⁻)	E2[@]		0.1266	α(K)=0.0831 *12*; α(L)=0.0332 *5*; α(M)=0.00807 *12*; α(N+..)=0.00214 *3* α(N)=0.00188 *3*; α(O)=0.000253 *4*; α(P)=5.76×10^{-6} *8*
259.2[a] *1*	0.50[a] *5*	537.38	(13/2⁻)	278.01	(9/2⁻)	E2[@]		0.1240	α(K)=0.0817 *12*; α(L)=0.0324 *5*; α(M)=0.00786 *11*; α(N+..)=0.00209 *3* α(N)=0.00183 *3*; α(O)=0.000246 *4*; α(P)=5.67×10^{-6} *8*
ˣ267.1[a] *1*	0.50[a] *5*								
ˣ281.7[a] *1*	0.70[a] *7*								Placed from 537.1 level by 1974La24, but that 13/2⁻ to 7/2⁻ placement seems unlikely.
352.4 *1*	3.1 *3*	493.97	(5/2⁻)	141.62	(7/2⁻)				
370.1[a] *1*	1.30[a] *13*	624.85	(5/2⁻)	254.90	(7/2⁻)				
ˣ377.1 *1*									E_γ: from 1974La24.
ˣ392.9 *1*	0.80 *8*								Eγ compatible with placement from 899 level.
406.7 *1*	4.6 *5*	899.14	(3/2,5/2,7/2)	492.57	(5/2⁺)				

γ(^{171}Hf) (continued)

E_γ[†]	I_γ[‡]	E_i(level)	J^π_i	E_f	J^π_f	Comments
409.1[e] 1		554.53?	(7/2$^+$)	146.02	(11/2$^+$)	E_γ: from 1974La24.
423.4 1	3.5 4	565.02	(7/2$^-$)	141.62	(7/2$^-$)	
432.1[a] 1	1.20[a] 12	709.85	(7/2$^-$)	278.01	(9/2$^-$)	
444.4[c] 1	15.6[ca] 16	493.97	(5/2$^-$)	49.52	(5/2$^-$)	
444.4[c] 1	15.6[c] 16	506.22	(7/2$^-$)	61.86	(9/2$^+$)	
446.5[a] 1	3.4[a] 3	592.39	(9/2$^-$)	146.02	(11/2$^+$)	
454.7 1	4.5 5	709.85	(7/2$^-$)	254.90	(7/2$^-$)	
457.5[a] 1	1.90[a] 19	560.00	(3/2$^-$)	102.55	(5/2$^-$)	
^{x}461.6[a] 1	2.0[a] 2					
463.8 1		1001.35	(9/2$^-$)	537.38	(13/2$^-$)	
^{x}467.4 1						E_γ: from 1974La24.
471.3 1	9.0 9	560.00	(3/2$^-$)	88.69	(3/2$^-$)	
492.7[c] 1	13.2[c] 15	492.57	(5/2$^+$)	0.0	7/2$^{(+)}$	I_γ: deduced from total Iγ=14.7 15 for three placements and Iγ=1.5 2 for 1001.3-level placement. Iγ≥4.6 16 is obtained for 492.6-level placement based on intensity balance at the 493 level.
492.7[c] 1	13.2[c] 15	554.53?	(7/2$^+$)	61.86	(9/2$^+$)	
492.7[d] 1	1.5[d] 2	1001.35	(9/2$^-$)	508.67	(11/2$^-$)	I_γ: deduced from intensity balance at (11/2$^-$) 508.7 level (to which no significant ε+β$^+$ feeding is expected because ΔJ=3).
501.8 1	22.6[a] 23	1007.91	(7/2$^+$,9/2$^-$)	506.22	(7/2$^-$)	
506.4 1	54 5	506.22	(7/2$^-$)	0.0	7/2$^{(+)}$	
522.3 1	11.0 11	624.85	(5/2$^-$)	102.55	(5/2$^-$)	I_γ: evaluator assumes that the reported Iγ=1.0 was intended to be Iγ=11.0 (as in 1970Re11).
^{x}526.2 1	1.70 17					
530.4[c] 1	3.9[c] 4	592.39	(9/2$^-$)	61.86	(9/2$^+$)	
530.4[c] 1	3.9[c] 4	788.98	(7/2,9/2$^+$)	258.67	(9/2$^-$)	
536.0 1	7.7 8	624.85	(5/2$^-$)	88.69	(3/2$^-$)	
538.0 1	14.9 15	560.00	(3/2$^-$)	21.94	1/2$^{(-)}$	
554.5[c] 1	6.9[c] 7	554.53?	(7/2$^+$)	0.0	7/2$^{(+)}$	
554.5[c] 1	6.9[c] 7	832.51?	(9/2$^-$)	278.01	(9/2$^-$)	
570.9 1	3.2 3	1077.02		506.22	(7/2$^-$)	
^{x}573.4 1	0.40 4					
606.8 1	3.9 4	709.85	(7/2$^-$)	102.55	(5/2$^-$)	
621.7 1	3.6 4	709.85	(7/2$^-$)	88.69	(3/2$^-$)	
^{x}630.5 1	2.50 25					
665.0 1	2.50 25	767.62		102.55	(5/2$^-$)	
^{x}678.4 1	2.9 3					
^{x}702.8 1	1.50 15					
718.2 1	2.30 23	767.62		49.52	(5/2$^-$)	
723.3 1	2.50 25	1001.35	(9/2$^-$)	278.01	(9/2$^-$)	
727.1 1	4.1 4	788.98	(7/2,9/2$^+$)	61.86	(9/2$^+$)	
^{x}731.6 1	1.50 15					
^{x}736.9 1	1.30 13					
746.7 1	4.3 4	1001.35	(9/2$^-$)	254.90	(7/2$^-$)	

γ(^{171}Hf) (continued)

E_γ[†]	I_γ[‡]	E_i(level)	J^π_i	E_f	J^π_f	Comments
767.6 *1*	9.0 *9*	767.62		0.0	7/2$^{(+)}$	
[x]782.3 *1*	2.10 *21*					
788.9 *1*	4.5 *5*	788.98	(7/2,9/2$^+$)	0.0	7/2$^{(+)}$	
[x]796.7 *1*	3.3 *3*					Eγ compatible with placement from 899 level.
[x]802.3 *1*	3.3 *3*					
[x]836.8 *1*	1.80 *18*					
861.4[e] *1*	1.70 *17*	1007.91	(7/2$^+$,9/2$^-$)	146.02	(11/2$^+$)	
[x]876.8 *1*	1.70 *17*					
899.0 *1*	1.60 *16*	899.14	(3/2,5/2,7/2)	0.0	7/2$^{(+)}$	
[x]906.7 *1*	2.0 *2*					
[x]920.1[a] *1*	1.20[a] *12*					
957.8[e] *1*	1.80 *18*	1007.91	(7/2$^+$,9/2$^-$)	49.52	(5/2$^-$)	
[x]987.1 *1*	8.6 *9*					
[x]997.0 *1*	3.1 *3*					
1001.3 *1*	2.7 *3*	1001.35	(9/2$^-$)	0.0	7/2$^{(+)}$	
1007.8 *1*	3.4 *3*	1007.91	(7/2$^+$,9/2$^-$)	0.0	7/2$^{(+)}$	
1027.4 *1*	1.80 *18*	1077.02		49.52	(5/2$^-$)	
[x]1087 *1*						E_γ: from 1972Ch45; assignment to ^{171}Ta decay is probable ($T_{1/2}$=23.4 min *17*).
[x]1435.0 *1*						E_γ: from 1974La24.
[x]1527.0 *1*						E_γ: from 1974La24.

[†] From 1970Re11, except as noted.
[‡] Photon intensity relative to Iγ(49.6γ)=100; from 1970Re11, except as noted.
[#] From ce data (measured, but not quoted, by evaluators of 1974Ho38), except where noted.
[@] From Adopted Gammas.
[&] From 1987Sz03; attributed to ^{171}Ta decay on basis of growth/decay and excitation function data (previously attributed to otherwise unknown 6.3-min ^{171}Ta). Eγ and growth/decay data are also consistent with ^{168}Ta decay, but experimental conditions were inappropriate for production of ^{168}Ta and other gammas associated with that decay were not observed by 1987Sz03. Transition is intense relative to other ^{171}Ta γ′s, but 1987Sz03 do not discuss findings as they relate to present decay scheme.
[a] From 1974La24. No uncertainties are indicated in 1974La24: however, the same authors, in 1970Re11, report ΔE=0.1 keV and ΔIγ<10% for the many transitions reported in both 1970Re11 and 1974La24. The evaluator, therefore, assigns the same uncertainties to data reported in 1974La24 alone.
[b] 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.
[c] Multiply placed with undivided intensity.
[d] Multiply placed with intensity suitably divided.
[e] Placement of transition in the level scheme is uncertain.
[x] γ ray not placed in level scheme.

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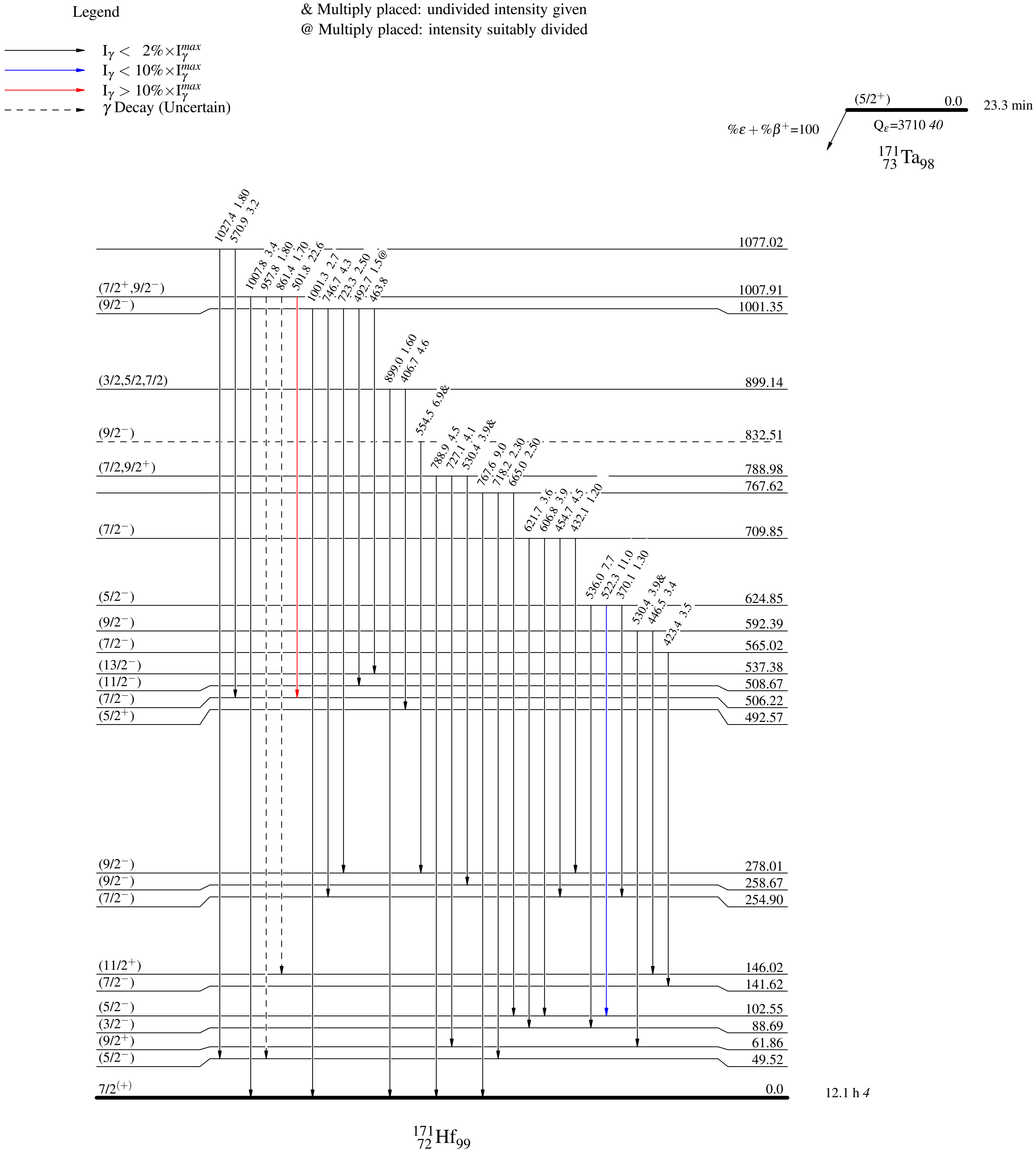
Decay Scheme

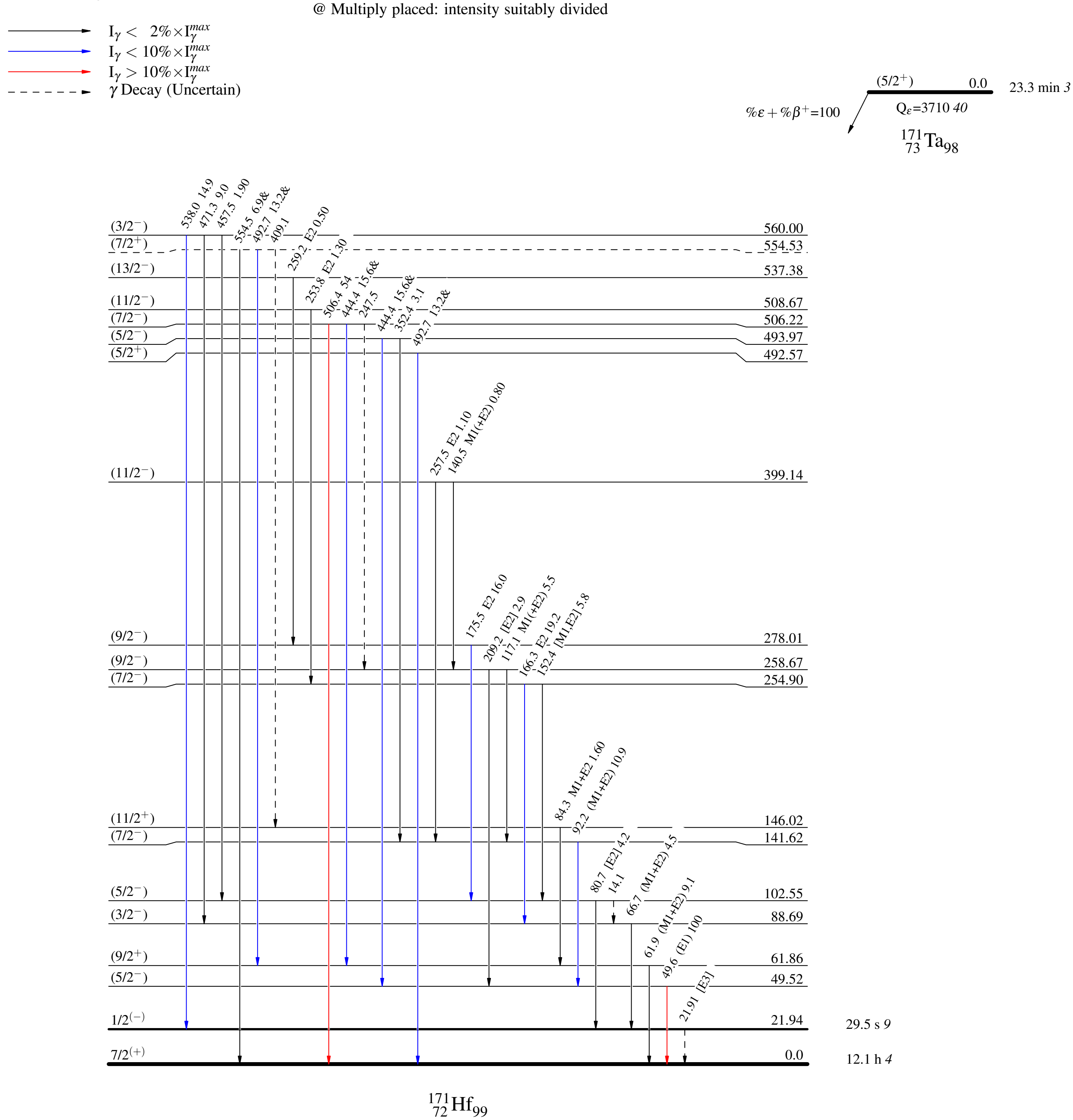
Intensities: Relative I_γ
& Multiply placed: undivided intensity given
@ Multiply placed: intensity suitably divided



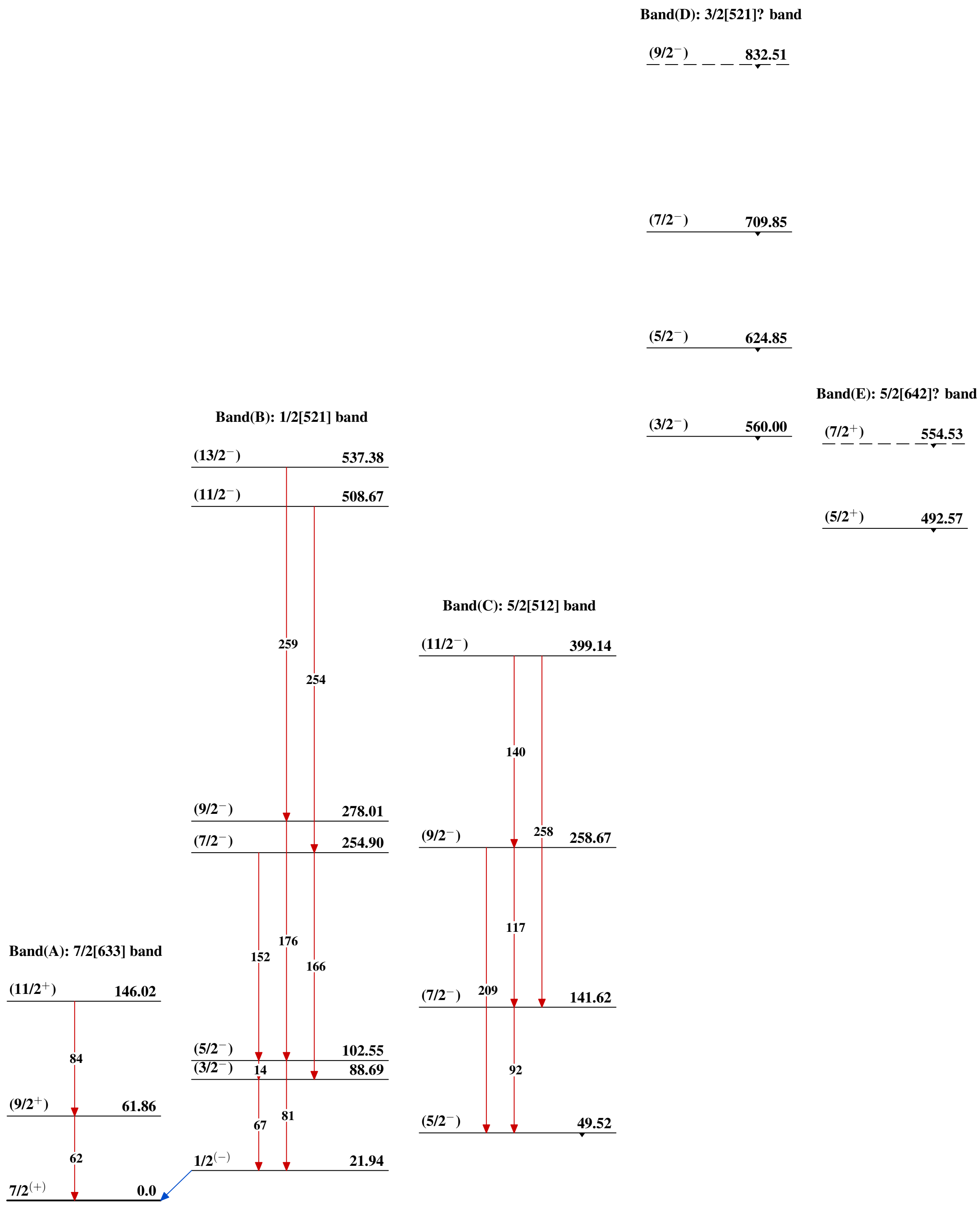
^{171}Ta ε decay 1974La24,1970Re11

Decay Scheme (continued)

Intensities: Relative I_γ
& Multiply placed: undivided intensity given
@ Multiply placed: intensity suitably divided



^{171}Ta ε decay 1974La24,1970Re11



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^{171}Ta ε decay 1974La24,1970Re11 (continued)