^{168}Hf ε decay 1997Ba26

History			
Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Coral M. Baglin	NDS 111, 1807 (2010)	15-Jun-2010

Parent: ^{168}Hf: E=0.0; J$^{\pi}$=0^{+}; T$_{1/2}$=25.95 min *20*; Q(ε)=1700 *50*; %ε+%β^{+} decay=100.0

Others: 1961Me05, 1966Ha23, 1969Ar23, 1970Ch17.

1961Me05 report a weak β^{+} component with Eβ+=1700 *100*. 1966Ha23 report ce data; sources from ^{170}Yb(α,6n); measured E(ce), Ice (mag spect, resolution≈0.1%).

1997Ba26: chemically separated sources from ^{156}Gd(^{16}O,4n), E=75 MeV; >99% ^{156}Gd targets; He jet transfer for on-line separation, reaction products dissolved In HF and separated using three resin separation columns to produce Hf and Lu sources; Al tape transport of products also used for off-line separation; three HPGe detectors (one planar, FWHM=0.5 keV At 122 keV, and two coaxial); measured Eγ, Iγ, γγ coin, γ asymmetry W(180°)/W(90° (data unstated). See also 1995Tr10.

^{168}Lu Levels

E(level)†	J$^{\pi}$‡	T$_{1/2}$	Comments
0.0	6$^{(-)}$	5.5 min *1*	T$_{1/2}$: from Adopted Levels. suggested configuration: K$^{\pi}$=6^{-} (π 7/2[404])+(ν 5/2[523]) (1997Ba26).
202.81?	3^{+}	6.7 min *4*	%ε+%β^{+}>99.6 *4*; %IT<0.8 (1997Ba26) T$_{1/2}$: from Adopted Levels. suggested configuration: K$^{\pi}$=3^{+} (π 1/2[541])+(ν 5/2[523]) (1997Ba26).
211.00 *3*	(1^{+},2^{+})		suggested configuration: K$^{\pi}$=1^{+} (π 7/2[404])-(ν 5/2[642])? (1997Ba26).
218.20 *4*	(0^{+},1^{+},2^{+})		suggested configuration: K$^{\pi}$=2^{+} (π 1/2[411])-(ν 5/2[642])? (1997Ba26).
238.89 *4*	(1^{+},2,3)		suggested configuration: K$^{\pi}$=2^{-} (π 1/2[541])-(ν 5/2[642])? (1997Ba26).
240.85 *3*	(1^{+},2,3)		suggested configuration: K$^{\pi}$=2^{-} (π 7/2[404])-(ν 3/2[521])? (1997Ba26).
257.85 *3*	(2)$^{+}$		suggested configuration: K$^{\pi}$=2^{+} (π 1/2[541])-(ν 5/2[523]) (1997Ba26).
260.12 *4*	(2^{-})		suggested configuration: K$^{\pi}$=2^{-} (π 1/2[411])-(ν 5/2[523]) (1997Ba26).
273.52 *10*			
303.71 *4*	(0^{-},1^{-},2^{-})		suggested configuration: K$^{\pi}$=1^{-} (π 7/2[404])-(ν 5/2[512]) (1997Ba26); alternatively, this could Be the configuration of the 350 level.
320.056 *23*	(2)$^{-}$		suggested configuration: K$^{\pi}$=2^{-} (π 1/2[411])-(ν 5/2[512]) (1997Ba26).
350.11 *5*	(≤3)		see comment on 304 level configuration.
354.84 *4*	(0^{-},1^{-},2^{-})		suggested configuration: K$^{\pi}$=1^{-} (π 7/2[404])-(ν 5/2[523]) (1997Ba26).
360.61 *4*	(0^{-},1^{-},2^{-})		suggested configuration: K$^{\pi}$=0^{-} (π 5/2[402])-(ν 5/2[523]) (1997Ba26).
363.40 *3*	(1^{+},2^{-})		
370.48 *6*	(≤3)		
376.74 *6*	(≤3)		
393.44 *6*	(≤3)		
395.18 *6*	(0,1,2^{-})		
417.50 *3*	1^{+},2^{+}		suggested configuration: K$^{\pi}$=2^{+} (π 1/2[541])-(ν 5/2[512]) (1997Ba26).
426.33 *4*	(1^{+})		suggested configuration: K$^{\pi}$=1^{+} (π 1/2[541])-(ν 3/2[521]) (1997Ba26).
428.15 *3*	(1^{+})		suggested configuration: K$^{\pi}$=1^{+} (π 1/2[541])+(ν 1/2[521]) (1997Ba26).
431.29 *5*	(0^{-},1)		
441.78 *3*	1^{+}		suggested configuration: K$^{\pi}$=1^{+} (π 7/2[523])-(ν 5/2[523]) (1997Ba26).
480.10 *6*			
584.32 *6*	(≤4)		
585.59 *5*	(0,1)		
595.00 *6*	(0,1,2^{-})		
605.15 *6*	(≤3)		
719.50 *11*	(≤4)		
780.29 *6*	(≤3)		
794.64 *3*	1^{+}		suggested configuration: K$^{\pi}$=1^{+} (π 7/2[523])-(ν 5/2[512]) (1997Ba26).
1044.75 *7*	(0,1,2^{-})		
1172.7 *3*	(≤4)		
1175.82 *16*	(≤4)		
1220.59 *11*			
1241.23 *10*	(0,1,2^{-})		

Continued on next page (footnotes at end of table)

^{168}Hf ε decay 1997Ba26 (continued)

^{168}Lu Levels (continued)

E(level)†	Jπ‡
1307.93 *12*	(0,1)
1331.49 *10*	(0,1,2⁻)
1349.3 *3*	(0,1)

† From least-squares fit to Eγ, holding E(3⁺ isomer) fixed At 202.81. Uncertainties do not include uncertainty of 0.12 keV for 202.81 level. note, however, that the energy of the isomer is only tentative.
‡ From Adopted Levels.

ε,β⁺ radiations

%β⁺ is small (≈1% to 3%) (1961Me05).

log *ft*,Iε values are given for only the strongest branches. the absence of multipolarity information for many low energy transitions and the uncertainties In decay scheme normalization and level energies render log *ft* and intensity balances unreliable In most cases.

E(decay)	E(level)	Iβ⁺ †	Iε†	Log *ft*	I(ε+β⁺)†	Comments
(3.5×10^2 *5*)	1349.3		0.38 *19*	5.7 *3*	0.38 *19*	εK=0.779 *12*; εL=0.167 *9*; εM+=0.053 *4*
(3.7×10^2 *5*)	1331.49					
(3.9×10^2 *5*)	1307.93		0.42 *20*	5.82 *25*	0.42 *20*	εK=0.786 *9*; εL=0.162 *7*; εM+=0.0512 *24*
(4.6×10^2 *5*)	1241.23					
(6.6×10^2 *5*)	1044.75					
(9.1×10^2 *5*)	794.64		11 *5*	5.20 *21*	11 *5*	εK=0.8152 *12*; εL=0.1413 *9*; εM+=0.0435 *3*
(1.11×10^3‡ *5*)	595.00					
(1.11×10^3 *5*)	585.59		0.6 *3*	6.65 *23*	0.6 *3*	εK=0.8189 *8*; εL=0.1386 *6*; εM+=0.04252 *20*
(1.26×10^3 *5*)	441.78	0.003 *4*	49 *24*	4.85 *22*	49 *24*	av Eβ=122 *24*; εK=0.8206 *6*; εL=0.1373 *5*; εM+=0.04205 *15*
(1.27×10^3 *5*)	431.29		0.48 *25*	6.87 *23*	0.48 *25*	εK=0.8207 *6*; εL=0.1372 *5*; εM+=0.04202 *15*
(1.27×10^3 *5*)	428.15		1.4 *7*	6.41 *22*	1.4 *7*	εK=0.8207 *5*; εL=0.1372 *4*; εM+=0.04201 *15*
(1.27×10^3 *5*)	426.33		0.45 *23*	6.90 *23*	0.45 *23*	εK=0.8207 *5*; εL=0.1372 *4*; εM+=0.04200 *15*
(1.30×10^3‡ *5*)	395.18					
(1.34×10^3‡ *5*)	363.40					
(1.34×10^3‡ *5*)	360.61					

† Absolute intensity per 100 decays.
‡ Existence of this branch is questionable.

γ(^{168}Lu)

Iγ normalization: Σ (I(γ+ce) to 3$^+$ isomer)=100 can Be assumed since No significant ε+β$^+$ feeding to 6$^{(-)}$ g.s. or 3$^+$ 203-keV isomer would Be expected from 0$^+$ ^{168}Hf. however, many γ rays from E>218 levels feed into the 211 and 218 levels and the very low energy transitions which must, therefore, depopulate the 211 and 218 levels have not been observed. if there were No ε+β$^+$ feeding to the 211 or 218 level, one could normalize the decay scheme using Σ (I(γ+ce) to 203+211+218 levels from E(level)>218)=100, and this May Be how 1997Ba26 obtain their suggested Iγ normalization of 0.075 *9*. However, half the transitions involved In the decay scheme normalization have No multipolarity indicated here; if α=0 were assumed for all of these, Iγ normalization=0.0744 *16* and if, alternatively, the larger of α(M1) and α(E2) were assumed for all, Iγ normalization=0.0255 *19*. consequently, the evaluator has used Iγ normalization=0.050 *24* to obtain an approximate normalization. note that Iγ normalization will Be reduced if ε+β$^+$ feeding does occur to the 211 and/or 218 levels.

Observed x-ray Data (1995Tr10) (I(x) Relative To I(184γ)=100):

	E(x ray)	I(x ray)
Lu Kα$_2$ x ray	52.97	488 30
Lu Kα$_1$ x ray	54.07	854 43
Lu Kβ$_{13}$ x ray	61.20	288 15
Lu Kβ$_2$ x ray	62.96	816 5
Lu L$_γ$ x ray	10.43	12.0 1

E$_γ$ [†]	I$_γ$ [†d]	E$_i$(level)	J^π_i	E$_f$	J^π_f	Mult. [‡]	δ [‡]	α [e]	Comments
(5.7[&])		360.61	(0$^-$,1$^-$,2$^-$)	354.84	(0$^-$,1$^-$,2$^-$)				
(7.2[&])		218.20	(0$^+$,1$^+$,2$^+$)	211.00	(1$^+$,2$^+$)				
(8.2[&])		211.00	(1$^+$,2$^+$)	202.81?	3$^+$				
(13.4[&])		273.52		260.12	(2$^-$)				Ti(13.4)≥Ti(119.9); the latter ranges from 1.6 *1* (if E1) to 4.2 *3* (if M1).
14.40 *5*	1.00 *10*	794.64	1$^+$	780.29	(≤3)				
(15.4[&])		218.20	(0$^+$,1$^+$,2$^+$)	202.81?	3$^+$				
(16.0[&])		376.74	(≤3)	360.61	(0$^-$,1$^-$,2$^-$)				
17.53[f] *9*	1.70 *20*	257.85	(2)$^+$	240.85	(1$^+$,2,3)				
24.25 *3*	13.1 *15*	441.78	1$^+$	417.50	1$^+$,2$^+$	M1+E2	0.084	55.0	α(L)=42.5 *7*; α(M)=9.83 *15*; α(N+..)=2.63 *4* α(N)=2.30 *4*; α(O)=0.319 *5*; α(P)=0.01462 *22* Ice(L1)≈50; L1:L2:L3:M:N=≈50:≈15:≈10:20:5 (1966Ha23).
^{x}27.52[#]	3.0[#] *3*								
27.82 *7*	1.20 *20*	238.89	(1$^+$,2,3)	211.00	(1$^+$,2$^+$)				
29.80 *7*	0.80 *10*	240.85	(1$^+$,2,3)	211.00	(1$^+$,2$^+$)				
35.9 *5*	<0.7	238.89	(1$^+$,2,3)	202.81?	3$^+$				
38.04 *5*	1.30 *20*	240.85	(1$^+$,2,3)	202.81?	3$^+$				
^{x}40.2[a]									Ice(L1)≈10, Ice(L2) and Ice(L3) weak (1966Ha23).
43.07[f] *12*	2.30 *20*	303.71	(0$^-$,1$^-$,2$^-$)	260.12	(2$^-$)	[M1,E2]		7.×10^1 *7*	α(L)=5.E1 *5*; α(M)=13 *13*; α(N+..)=3 *3* α(N)=3 *3*; α(O)=0.4 *4*; α(P)=0.0015 *12*

γ(^{168}Lu) (continued)

E_γ[†]	I_γ[†d]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[‡]	δ[‡]	α[e]	Comments
[x]44.21 12	4.3 4								
46.31 6	2.4 3	350.11	(≤3)	303.71	($0^-,1^-,2^-$)				
49.0[c] 5	<0.7	260.12	(2^-)	211.00	($1^+,2^+$)	[E1]		0.447 15	α(L)=0.348 12; α(M)=0.079 3; α(N+..)=0.0204 7 α(N)=0.0180 6; α(O)=0.00232 8; α(P)=8.49×10^{-5} 24 Ice(L1)=^{11},CeM) weak (1966Ha23).
51.2[c] 5	5.8[b] 10	354.84	($0^-,1^-,2^-$)	303.71	($0^-,1^-,2^-$)	[M1,E2]		3.×10^1 3	α(L)=24 21; α(M)=6 6; α(N+..)=1.5 13 α(N)=1.3 12; α(O)=0.16 14; α(P)=0.0009 7
55.03 10	60.5 4	257.85	$(2)^+$	202.81?	3^+	M1+E2	0.16	4.41	α(L)=3.41 6; α(M)=0.785 12; α(N+..)=0.211 4 α(N)=0.184 3; α(O)=0.0260 4; α(P)=0.001281 20 Mult.,δ: Ice(L1)=60; L1:L3:M:N=60:≈6:16:4 (1966Ha23).
56.9[c] 5	4.9 10	360.61	($0^-,1^-,2^-$)	303.71	($0^-,1^-,2^-$)	(M1)		3.15 10	α(L)=2.45 8; α(M)=0.551 17; α(N+..)=0.151 5 α(N)=0.130 4; α(O)=0.0193 6; α(P)=0.00119 4
57.30 10	137.0 10	260.12	(2^-)	202.81?	3^+	(E1)[@]		0.290	α(L)=0.225 4; α(M)=0.0510 8; α(N+..)=0.01328 20 α(N)=0.01169 18; α(O)=0.001528 23; α(P)=5.90×10^{-5} 9
61.92 10	10.6[b] 10	320.056	$(2)^-$	257.85	$(2)^+$	E1+M2[@]	0.29	6.06 10	α(L)=4.61 8; α(M)=1.140 18; α(N+..)=0.311 5 α(N)=0.271 5; α(O)=0.0383 6; α(P)=0.00191 3
64.81 4	3.0 3	428.15	(1^+)	363.40	($1^+,2^-$)				
68.23 15	1.30 10	431.29	(0^-,1)	363.40	($1^+,2^-$)				
70.96 9	2.7 3	431.29	(0^-,1)	360.61	($0^-,1^-,2^-$)				E_γ,I_γ: for doublet; other component unplaced.
72.94 5	9.9[b] 10	376.74	(≤3)	303.71	($0^-,1^-,2^-$)				
74.94 8	15.1[b] 15	395.18	(0,1,2^-)	320.056	$(2)^-$				
79.05 7	2.6 3	320.056	$(2)^-$	240.85	(1^+,2,3)				
85.47 3	40.6 24	303.71	($0^-,1^-,2^-$)	218.20	($0^+,1^+,2^+$)	(E1)[@]		0.527	α(K)=0.432 6; α(L)=0.0743 11; α(M)=0.01675 24; α(N+..)=0.00441 7 α(N)=0.00387 6; α(O)=0.000523 8; α(P)=2.27×10^{-5} 4
86.96 6	12.8 8	441.78	1^+	354.84	($0^-,1^-,2^-$)	(E1)[@]		0.504	α(K)=0.413 6; α(L)=0.0709 10; α(M)=0.01597 23; α(N+..)=0.00421 6 α(N)=0.00369 6; α(O)=0.000499 7; α(P)=2.18×10^{-5} 3
[x]87.70[#]	32.5[#] 20								
89.57 8	1.00 10	393.44	(≤3)	303.71	($0^-,1^-,2^-$)				
91.58 6	1.80 20	395.18	(0,1,2^-)	303.71	($0^-,1^-,2^-$)				
92.68 3	48 3	303.71	($0^-,1^-,2^-$)	211.00	($1^+,2^+$)	(E1)[@]		0.427	α(K)=0.351 5; α(L)=0.0594 9; α(M)=0.01338 19; α(N+..)=0.00353 5 α(N)=0.00309 5; α(O)=0.000421 6; α(P)=1.87×10^{-5} 3
97.46 3	70 4	417.50	$1^+,2^+$	320.056	$(2)^-$	(E1+M2)	0.45	6.63	α(K)=4.74 7; α(L)=1.440 21; α(M)=0.350 5; α(N+..)=0.0956 14 α(N)=0.0831 12; α(O)=0.01186 17; α(P)=0.000621 9 Mult.,δ: from 1997Ba26; α(exp)≈7 from intensity balance. other: Ice(K)≈90 for doublet; L1:M=18:5 (1966Ha23).
[x]99.65 6	1.60 20								

$^{168}_{71}$Lu$_{97}$-4

γ(^{168}Lu) (continued)

E_γ[†]	I_γ[†d]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[‡]	δ[‡]	α[e]	Comments
105.76 *8*	1.50 *20*	363.40	(1$^+$,2$^-$)	257.85	(2)$^+$				
[x]106.81 *6*	1.80 *20*								
108.10 *3*	5.2[b] *3*	428.15	(1$^+$)	320.056	(2)$^-$				
111.32 *6*	2.7 *3*	350.11	(≤3)	238.89	(1$^+$,2,3)				
113.68 *6*	3.3[b] *3*	417.50	1$^+$,2$^+$	303.71	(0$^-$,1$^-$,2$^-$)	(E1)		0.250	α(K)=0.207 *3*; α(L)=0.0338 *5*; α(M)=0.00761 *11*; α(N+..)=0.00202 *3* α(N)=0.001764 *25*; α(O)=0.000243 *4*; α(P)=1.133×10^{-5} *16*
115.84 *5*	2.9 *3*	354.84	(0$^-$,1$^-$,2$^-$)	238.89	(1$^+$,2,3)				
117.30 *3*	87 *4*	320.056	(2)$^-$	202.81?	3$^+$	(E1+M2)	0.56	4.66	α(K)=3.42 *5*; α(L)=0.950 *14*; α(M)=0.229 *4*; α(N+..)=0.0626 *9* α(N)=0.0544 *8*; α(O)=0.00779 *11*; α(P)=0.000416 *6* Mult.,δ: from 1997Ba26; α(exp)≈4.8 from intensity balance. other: Ice(K)=100; K:L1:M=100:15:4 (1966Ha23).
119.92 *8*	1.30 *10*	393.44	(≤3)	273.52					
122.56 *3*	10.2 *6*	363.40	(1$^+$,2$^-$)	240.85	(1$^+$,2,3)				
131.81[#]	3.5[#] *3*	350.11	(≤3)	218.20	(0$^+$,1$^+$,2$^+$)				γ included In fig. 2 of 1997Ba26.
136.74[#]	18.4[#] *13*	354.84	(0$^-$,1$^-$,2$^-$)	218.20	(0$^+$,1$^+$,2$^+$)	[E1]		0.1540	α(K)=0.1278 *18*; α(L)=0.0204 *3*; α(M)=0.00458 *7*; α(N+..)=0.001220 *17* α(N)=0.001065 *15*; α(O)=0.0001483 *21*; α(P)=7.19×10^{-6} *10* γ included In fig. 2 of 1997Ba26.
138.38 *11*	3.4 *10*	441.78	1$^+$	303.71	(0$^-$,1$^-$,2$^-$)	(E1)		0.1493	α(K)=0.1239 *18*; α(L)=0.0198 *3*; α(M)=0.00444 *7*; α(N+..)=0.001182 *17* α(N)=0.001031 *15*; α(O)=0.0001436 *21*; α(P)=6.98×10^{-6} *10*
139.07 *10*	2.7 *10*	350.11	(≤3)	211.00	(1$^+$,2$^+$)				
142.44 *3*	14.9 *9*	360.61	(0$^-$,1$^-$,2$^-$)	218.20	(0$^+$,1$^+$,2$^+$)	(E1)[@]		0.1384	α(K)=0.1149 *17*; α(L)=0.0183 *3*; α(M)=0.00410 *6*; α(N+..)=0.001093 *16* α(N)=0.000953 *14*; α(O)=0.0001330 *19*; α(P)=6.50×10^{-6} *10*
143.91 *3*	18.7 *11*	354.84	(0$^-$,1$^-$,2$^-$)	211.00	(1$^+$,2$^+$)	(E1)[@]		0.1347	α(K)=0.1119 *16*; α(L)=0.01775 *25*; α(M)=0.00399 *6*; α(N+..)=0.001063 *15* α(N)=0.000927 *13*; α(O)=0.0001294 *19*; α(P)=6.34×10^{-6} *9*
149.64 *3*	13.9 *8*	360.61	(0$^-$,1$^-$,2$^-$)	211.00	(1$^+$,2$^+$)	(E1)[@]		0.1216	α(K)=0.1011 *15*; α(L)=0.01597 *23*; α(M)=0.00358 *5*; α(N+..)=0.000956 *14* α(N)=0.000834 *12*; α(O)=0.0001166 *17*; α(P)=5.76×10^{-6} *8*
152.31 *5*	6.9 *5*	370.48	(≤3)	218.20	(0$^+$,1$^+$,2$^+$)				
154.72 *8*	2.30 *20*	393.44	(≤3)	238.89	(1$^+$,2,3)				
157.41 *3*	71 *4*	417.50	1$^+$,2$^+$	260.12	(2$^-$)	(E1)		0.1065	α(K)=0.0886 *13*; α(L)=0.01392 *20*; α(M)=0.00312 *5*; α(N+..)=0.000834 *12* α(N)=0.000727 *11*; α(O)=0.0001020 *15*; α(P)=5.08×10^{-6} *8* Mult.: from 1997Ba26. Ice(K)=3.5 (1966Ha23).
159.4[c] *5*	3.0 *10*	370.48	(≤3)	211.00	(1$^+$,2$^+$)				see comment on 159.7γ.
159.66 *3*	41 *3*	417.50	1$^+$,2$^+$	257.85	(2)$^+$	(M1+E2)	0.62	0.869	α(K)=0.672 *10*; α(L)=0.1515 *22*; α(M)=0.0353 *5*;

γ(^{168}Lu) (continued)

E_γ[†]	I_γ[†d]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[‡]	α[e]	Comments
								α(N+..)=0.00945 *14* α(N)=0.00826 *12*; α(O)=0.001140 *16*; α(P)=4.85×10^{-5} *7* Mult.,δ: from 1997Ba26. Ice(K)=[19,]K/L1=5.4 (1966Ha23); probably for 159.7γ+159.4γ doublet dominated by 159.7γ.
160.59 *6*	5.6 *5*	363.40	(1$^+$,2$^-$)	202.81?	3$^+$			
171.13 *15*	3.3 *3*	431.29	(0$^-$,1)	260.12	(2$^-$)			
175.60 *16*	3.2 *3*	780.29	(≤3)	605.15	(≤3)			
181.65 *3*	66 *4*	441.78	1$^+$	260.12	(2$^-$)	(E1)[@]	0.0733	α(K)=0.0612 *9*; α(L)=0.00948 *14*; α(M)=0.00213 *3*; α(N+..)=0.000569 *8* α(N)=0.000495 *7*; α(O)=6.99×10^{-5} *10*; α(P)=3.58×10^{-6} *5*
183.93 *3*	100.0 *10*	441.78	1$^+$	257.85	(2)$^+$	(M1)	0.654	α(K)=0.546 *8*; α(L)=0.0837 *12*; α(M)=0.0188 *3*; α(N+..)=0.00514 *8* α(N)=0.00444 *7*; α(O)=0.000659 *10*; α(P)=4.08×10^{-5} *6* Mult.: from 1997Ba26. Ice(K)=33; K/L1=4.13 (1966Ha23).
189.46 *15*	4.9 *5*	794.64	1$^+$	605.15	(≤3)			
192.33 *5*	14.7 *12*	431.29	(0$^-$,1)	238.89	(1$^+$,2,3)			Ice(K)=5.5; K/L1>1.8 (1966Ha23).
199.33 *5*	9.5 *8*	417.50	1$^+$,2$^+$	218.20	(0$^+$,1$^+$,2$^+$)	(M1)	0.523	α(K)=0.437 *7*; α(L)=0.0668 *10*; α(M)=0.01502 *21*; α(N+..)=0.00411 *6* α(N)=0.00355 *5*; α(O)=0.000526 *8*; α(P)=3.26×10^{-5} *5* Mult.: from 1997Ba26. Ice(K)=9 (1966Ha23).
202.81[f] *12*	0.75 *9*	202.81?	3$^+$	0.0	6$^{(-)}$	[E3]	1.83	α(K)=0.502 *7*; α(L)=1.003 *15*; α(M)=0.256 *4*; α(N+..)=0.0666 *10* α(N)=0.0593 *9*; α(O)=0.00725 *11*; α(P)=4.03×10^{-5} *6* Ice(K)=10 (1966Ha23).
206.46 *6*	31.6 *10*	417.50	1$^+$,2$^+$	211.00	(1$^+$,2$^+$)	(M1)	0.474	α(K)=0.396 *6*; α(L)=0.0606 *9*; α(M)=0.01362 *19*; α(N+..)=0.00372 *6* α(N)=0.00322 *5*; α(O)=0.000477 *7*; α(P)=2.96×10^{-5} *5* Mult.: from 1997Ba26. Ice(K)=9 (1966Ha23).
208.14 *5*	6.0 *6*	426.33	(1$^+$)	218.20	(0$^+$,1$^+$,2$^+$)			
210.07 *9*	4.2 *4*	794.64	1$^+$	584.32	(≤4)			
213.01 *9*	2.00 *20*	431.29	(0$^-$,1)	218.20	(0$^+$,1$^+$,2$^+$)			
214.56 *8*	3.1 *3*	417.50	1$^+$,2$^+$	202.81?	3$^+$	[M1,E2]	0.32 *11*	α(K)=0.25 *11*; α(L)=0.059 *5*; α(M)=0.0139 *17*; α(N+..)=0.0037 *4* α(N)=0.0032 *4*; α(O)=0.000442 *15*; α(P)=1.7×10^{-5} *10* Mult.: shown As (M1) on level scheme drawing but omitted from table 1 of 1997Ba26.
217.13 *6*	11.1 *7*	428.15	(1$^+$)	211.00	(1$^+$,2$^+$)			
220.23[c] *10*	0.70 *10*	431.29	(0$^-$,1)	211.00	(1$^+$,2$^+$)			
223.51 *5*	9.0[b] *10*	426.33	(1$^+$)	202.81?	3$^+$			Ice(K)=[4,]CeL1) weak (1966Ha23).
225.23 *6*	8.2 *6*	428.15	(1$^+$)	202.81?	3$^+$			
230.75 *3*	11.0 *7*	585.59	(0,1)	354.84	(0$^-$,1$^-$,2$^-$)			Ice(K)=2.5 (1966Ha23).
234.41 *8*	2.40 *20*	595.00	(0,1,2$^-$)	360.61	(0$^-$,1$^-$,2$^-$)			
^{x}238.26 *15*	1.40[b] *10*							
240.15 *6*	4.3 *4*	595.00	(0,1,2$^-$)	354.84	(0$^-$,1$^-$,2$^-$)			Ice(K)=1.5 (1966Ha23).
^{x}248.4[a]								Ice(K)=4 (1966Ha23).
277.29 *6*	2.9 *3*	480.10		202.81?	3$^+$			
324.11 *5*	8.7 *7*	584.32	(≤4)	260.12	(2$^-$)			Ice(K)=1.4 (1966Ha23).

From ENSDF

γ(^{168}Lu) (continued)

E_γ[†]	I_γ[†d]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[‡]	α[e]	Comments
[x]330.8[#]	[#]							seen only In $\gamma\gamma$ coin.
345.08 *6*	11.2 *8*	605.15	(≤3)	260.12	(2^-)			
349.02 *9*	2.00 *20*	719.50	(≤4)	370.48	(≤3)			
352.87 *9*	6.4 *5*	794.64	1^+	441.78	1^+	(M1)	0.1107	α(K)=0.0928 *13*; α(L)=0.01398 *20*; α(M)=0.00314 *5*; α(N+..)=0.000858 *12* α(N)=0.000741 *11*; α(O)=0.0001101 *16*; α(P)=6.86×10^{-6} *10*
363.36 *6*	15.2 *10*	794.64	1^+	431.29	(0^-,1)			
368.33 *9*	5.7 *5*	794.64	1^+	426.33	(1^+)	[M1,E2]	0.07 *3*	α(K)=0.06 *3*; α(L)=0.0104 *21*; α(M)=0.0024 *4*; α(N+..)=0.00065 *12* α(N)=0.00056 *10*; α(O)=8.0×10^{-5} *19*; α(P)=4.1×10^{-6} *21*
[x]372.78 *15*	0.90[b] *10*							
377.50 *14*	9.2 *7*	794.64	1^+	417.50	1^+,2^+	(M1)	0.0926	α(K)=0.0776 *11*; α(L)=0.01167 *17*; α(M)=0.00262 *4*; α(N+..)=0.000716 *10* α(N)=0.000619 *9*; α(O)=9.19×10^{-5} *13*; α(P)=5.73×10^{-6} *8*
[x]384.72[#]	11.3[#] *8*							
391.37[f] *9*	2.6 *3*	1172.7	(≤4)	780.29	(≤3)			
401.21 *9*	7.5 *6*	794.64	1^+	393.44	(≤3)			
[x]414.0[#]	[#]							seen only In $\gamma\gamma$ coin.
417.62 *9*	22.1 *16*	794.64	1^+	376.74	(≤3)			
424.26 *9*	3.7 *4*	794.64	1^+	370.48	(≤3)			
434.14 *6*	35.6 *25*	794.64	1^+	360.61	(0^-,1^-,2^-)	(E1)[@]	0.00864 *13*	α(K)=0.00728 *11*; α(L)=0.001058 *15*; α(M)=0.000236 *4*; α(N+..)=6.39×10^{-5} *9* α(N)=5.54×10^{-5} *8*; α(O)=8.05×10^{-6} *12*; α(P)=4.64×10^{-7} *7*
[x]436.0[#]	[#]							seen only In $\gamma\gamma$ coin.
439.94 *8*	9.0 *8*	794.64	1^+	354.84	(0^-,1^-,2^-)	(E1)	0.00839 *12*	α(K)=0.00707 *10*; α(L)=0.001026 *15*; α(M)=0.000229 *4*; α(N+..)=6.20×10^{-5} *9* α(N)=5.37×10^{-5} *8*; α(O)=7.81×10^{-6} *11*; α(P)=4.51×10^{-7} *7*
444.54[#]	15.3[#] *12*	794.64	1^+	350.11	(≤3)			included In fig. 2 of 1997Ba26 but not In table I.
474.62 *6*	5.4 *4*	794.64	1^+	320.056	$(2)^-$	[E1]	0.00708 *10*	α=0.00708 *10*; α(K)=0.00597 *9*; α(L)=0.000862 *12*; α(M)=0.000192 *3*; α(N+..)=5.21×10^{-5} *8* α(N)=4.51×10^{-5} *7*; α(O)=6.57×10^{-6} *10*; α(P)=3.83×10^{-7} *6*
[x]484.0[#]	[#]							seen only In $\gamma\gamma$ coin.
490.87 *6*	29.2 *20*	794.64	1^+	303.71	(0^-,1^-,2^-)	(E1)[@]	0.00657 *10*	α(K)=0.00555 *8*; α(L)=0.000799 *12*; α(M)=0.0001781 *25*; α(N+..)=4.83×10^{-5} *7* α(N)=4.18×10^{-5} *6*; α(O)=6.10×10^{-6} *9*; α(P)=3.56×10^{-7} *5*
[x]493.02 *9*	5.3 *4*							
534.45 *6*	19.4 *13*	794.64	1^+	260.12	(2^-)	(E1)[@]	0.00546 *8*	α(K)=0.00461 *7*; α(L)=0.000661 *10*; α(M)=0.0001473 *21*; α(N+..)=3.99×10^{-5} *6* α(N)=3.46×10^{-5} *5*; α(O)=5.05×10^{-6} *7*; α(P)=2.97×10^{-7} *5*
536.76 *9*	3.3 *3*	794.64	1^+	257.85	$(2)^+$	(M1)	0.0370	α(K)=0.0310 *5*; α(L)=0.00461 *7*; α(M)=0.001034 *15*;

γ(^{168}Lu) (continued)

E_γ[†]	I_γ[†d]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[‡]	α[e]	Comments
								α(N+..)=0.000283 *4* α(N)=0.000244 *4*; α(O)=3.63×10^{-5} *5*; α(P)=2.27×10^{-6} *4*
576.42 *6*	8.4 *7*	794.64	1$^+$	218.20	(0$^+$,1$^+$,2$^+$)	(M1)	0.0308	α(K)=0.0258 *4*; α(L)=0.00384 *6*; α(M)=0.000859 *12*; α(N+..)=0.000235 *4* α(N)=0.000203 *3*; α(O)=3.02×10^{-5} *5*; α(P)=1.89×10^{-6} *3*
583.59 *9*	2.0 *2*	794.64	1$^+$	211.00	(1$^+$,2$^+$)	(M1)	0.0298	α(K)=0.0250 *4*; α(L)=0.00371 *6*; α(M)=0.000832 *12*; α(N+..)=0.000228 *4* α(N)=0.000197 *3*; α(O)=2.92×10^{-5} *4*; α(P)=1.83×10^{-6} *3*
[x]640.10 *9*	1.20 *10*							
[x]706.36 *9*	0.80[b] *10*							
[x]712.08 *9*	1.30 *10*							
724.69 *6*	2.7 *3*	1044.75	(0,1,2$^-$)	320.056	(2)$^-$			
[x]737.20 *9*	1.00 *10*							
740.49 *9*	1.00 *10*	1220.59		480.10				
747.15 *9*	1.10 *10*	1331.49	(0,1,2$^-$)	584.32	(≤4)			
765.19[#]	1.5[#] *1*	1349.3	(0,1)	584.32	(≤4)			included In fig. 2 of 1997Ba26.
[x]837.35 *9*	1.40 *10*							
[x]859.73[#]	2.2[#] *2*							
866.14 *15*	2.20 *20*	1307.93	(0,1)	441.78	1$^+$			
872.11 *15*	1.30 *10*	1175.82	(≤4)	303.71	(0$^-$,1$^-$,2$^-$)			
[x]901.7 *3*	0.90[b] *10*							
912.6 *3*	1.60 *20*	1172.7	(≤4)	260.12	(2$^-$)			
937.52 *9*	2.7 *3*	1241.23	(0,1,2$^-$)	303.71	(0$^-$,1$^-$,2$^-$)			
988.0 *3*	2.6 *3*	1307.93	(0,1)	320.056	(2)$^-$			
1004.0 *3*	1.70 *20*	1307.93	(0,1)	303.71	(0$^-$,1$^-$,2$^-$)			
1047.9 *3*	1.80 *20*	1307.93	(0,1)	260.12	(2$^-$)			
1071.6 *3*	2.9[b] *3*	1331.49	(0,1,2$^-$)	260.12	(2$^-$)			
1091.4 *3*	6.0[b] *5*	1349.3	(0,1)	257.85	(2)$^+$			
[x]1096.0 *6*	2.50 *20*							
[x]1119.2 *6*	1.30[b] *10*							
[x]1193.1 *9*	1.00[b] *10*							
[x]1311.3 *9*	0.70 *10*							

† From 1997Ba26, except As noted.

‡ Deduced by 1997Ba26, based on ce data from 1966Ha23 (analyzed by 1997Ba26) and unenumerated γ asymmetry data from 1997Ba26, except As noted.

\# From 1995Tr10 (initial account of study reported by 1997Ba26). transition is absent from table I of 1997Ba26. The uncertainty In Eγ has been omitted here because 1995Tr10 give energy uncertainties which are consistently much lower (and probably less realistic) than uncertainties from 1997Ba26.

@ Iγ>10 but transition not observed by 1966Ha23 in ce spectrum; this favors E1 multipolarity (1997Ba26).

& From level-energy difference. transition expected and included In fig. 2 of 1997Ba26, but it has not yet been observed.

^{a} From ce measurements (1966Ha23).

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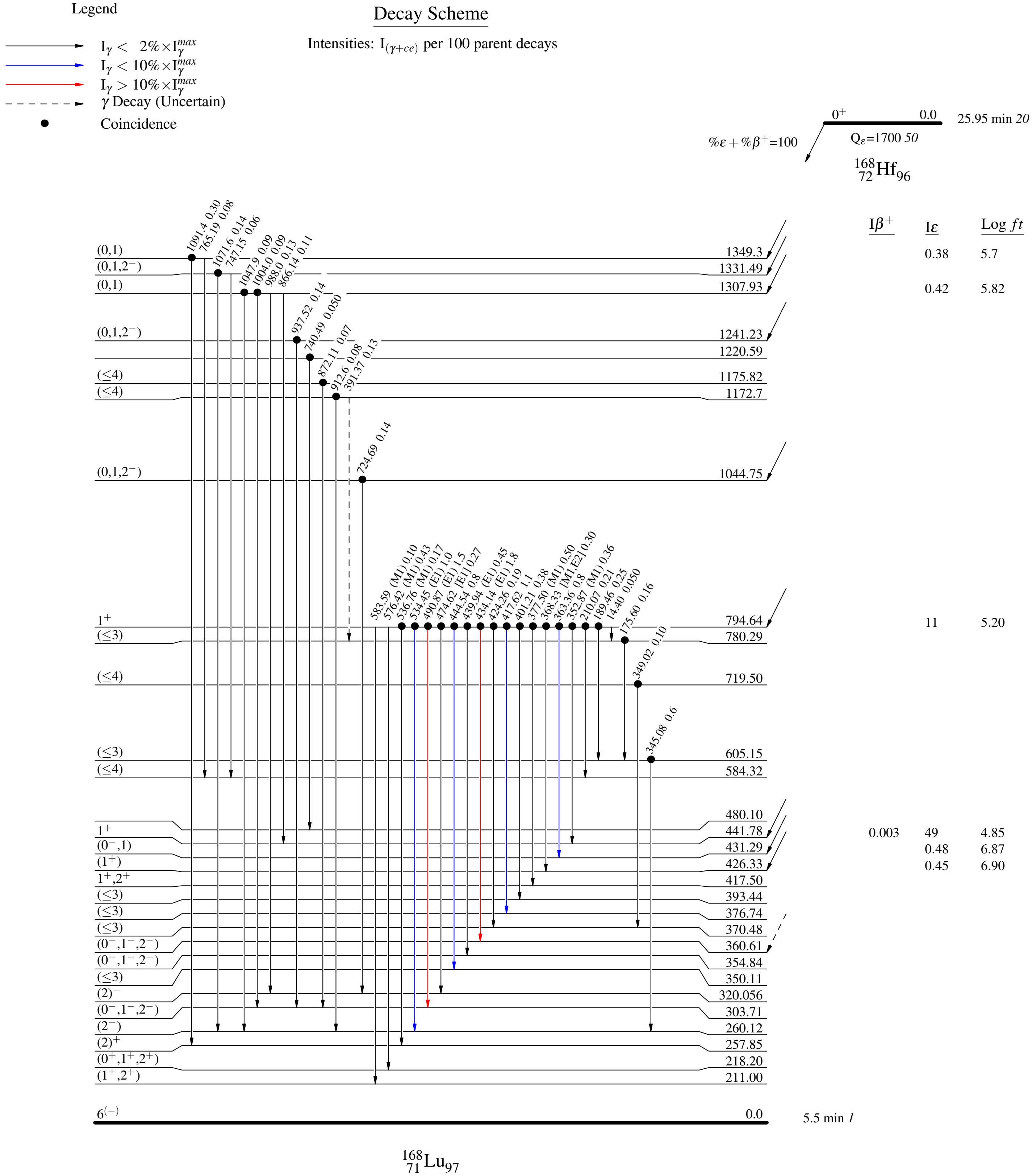
γ(^{168}Lu) (continued)

[b] Corrected for contribution from impurity (x or ^{168}Lu ε decay line) (1997Ba26).
[c] Observed by 1997Ba26 In $\gamma\gamma$ coin only.
[d] For absolute intensity per 100 decays, multiply by 0.050 *24*.
[e] 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.
[f] Placement of transition in the level scheme is uncertain.
[x] γ ray not placed in level scheme.

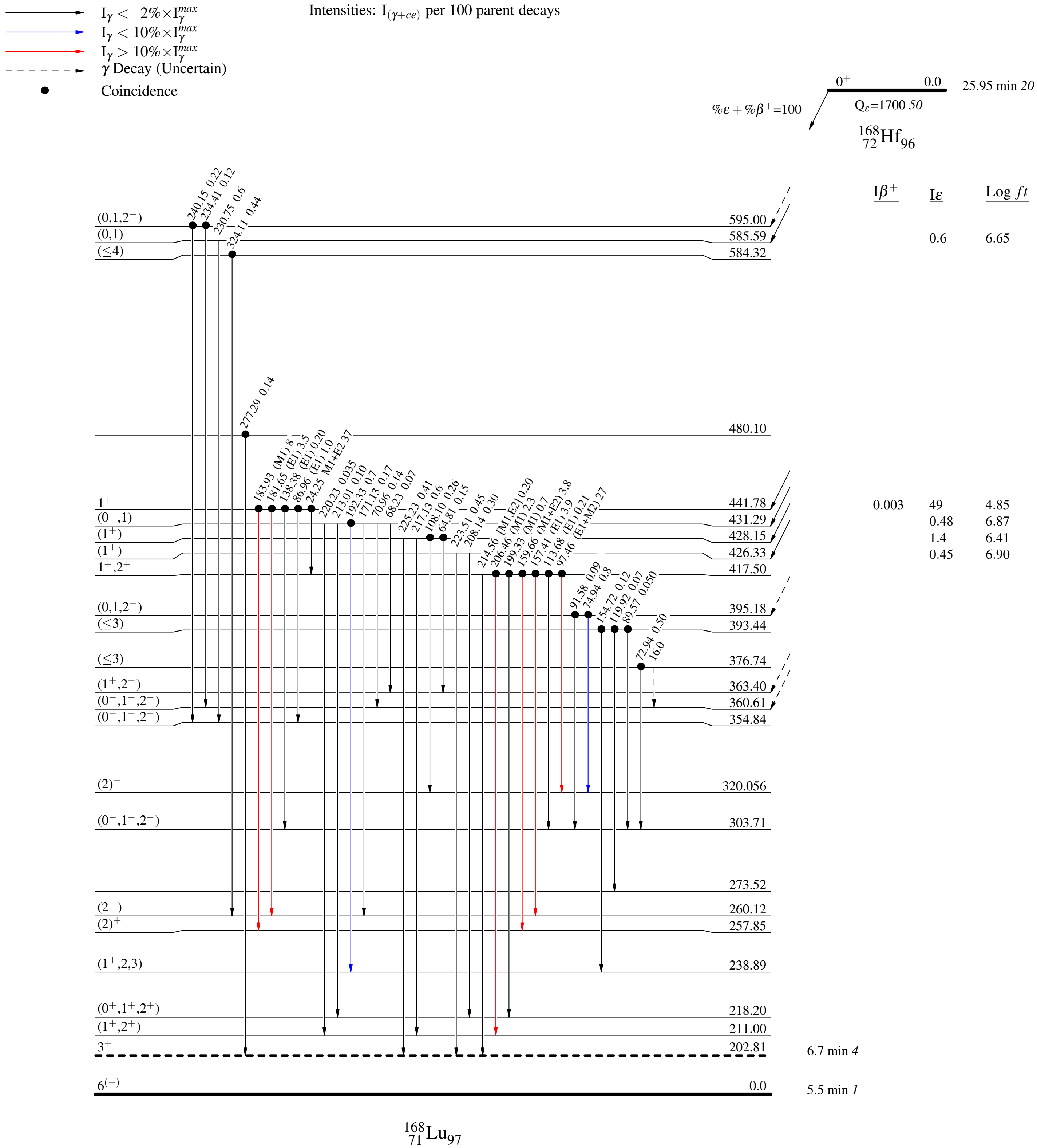
^{168}Hf ε decay 1997Ba26



^{168}Hf ε decay 1997Ba26

Decay Scheme (continued)

Intensities: $I_{(\gamma+ce)}$ per 100 parent decays



^{168}Hf ε decay 1997Ba26