^{151}Gd ε decay (123.9 d)

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh	NDS 110, 1 (2009)	20-Nov-2008

Parent: ^{151}Gd: E=0.0; J^π=7/2$^-$; $T_{1/2}$=123.9 d *10*; Q(ε)=464.2 *28*; %ε decay=100.0

Main references: 1984Gr15, 1983Vo10, 1982BaZX (also 1996Vy02), 1970Fo02.

Others: 1969Ho30, 1968Gr25, 1967Gr29, 1966Ha23.

γ: 1984Gr15, 1983Vo10, 1982BaZX, 1970Fo02, 1969Ho30. Others: 1977Dr04, 1970Ko30, 1970FoZZ, 1968Gr25, 1967Gr29, 1966Av05, 1966Ry02, 1965Fo14, 1963St13, 1961Be36, 1958Sh61, 1957Go72, 1957Bi90, 1950He18.

$\gamma\gamma$: 1983Vo10, 1970Fo02, 1977Dr04. Others: 1963St13, 1958Sh61.

ceγ: 1982BaZX (also 1996Vy02).

(x)γ: 1980Se01, 1977Ve01, 1973Ge06.

ce: 1982BaZX, 1981Ar17, 1970An17, 1968Gr25, 1967Gr29, 1966Ha23, 1966Av05. Others: 1971MeZT, 1959Dz04, 1958An34, 1958Sh61, 1957Bi90.

$\gamma\gamma(\theta)$: 1985Be64. Data for 106-243 cascade.

$\gamma\gamma$(t): 1994Si11, 1969FaZY, 1963Ho09, 1961Be36.

(x)γ(t): 1970Ko30, 1963Ho09, 1958Sh61.

ceγ(t): 1982BaZX, 1963Ki15, 1960Be27.

(x)(ce)(t): 1970Ko30.

cece(t): 1970Ko30, 1969Ho30, 1964Be36, 1962Be25, 1962Be20.

$\gamma(\theta)$: 1987Be33, low temperature nuclear orientation.

$T_{1/2}$(^{151}Gd isotope): 1984Gr15, 1983Vo10, 1958An34. Others: 1950He18, 1963Mi04.

K-shell ε probability: 1983Vo10, 1980Se01, 1973Ge06.

L-shell ε probability: 1983Ar23, 1982Ar22, 1977Ve01.

^{151}Eu Levels

E(level)‡	J^π†	$T_{1/2}$	Comments
0.0	5/2$^+$		
21.501 *10*	7/2$^+$	9.6 ns *3*	$T_{1/2}$: weighted average of 9.75 ns *10* (1982BaZX), 10.2 ns *5* (1970Ko30), 9.4 ns *4* (1969Ho30), 7.5 ns *4* (1964Be36), 9.5 ns *5* (1963Ho09), 9.3 ns *7* (1963Ki15). Others: 1962Be25, 1962Be20. Methods: cece(t), X(ce)(t), $\gamma\gamma$(t), Xγ(t), γ(ce)(t).
196.207 *13*	11/2$^-$	58.9 μs *5*	$T_{1/2}$: from 'Adopted Levels'. In ^{151}Gd ε decay delayed coin results are: 58.9 μs *7* ($\gamma\gamma$(t) 1994Si11); 58.8 μs *6* ($\gamma\gamma$(t) 1969FaZY), 58 μs *3* (γ(ce)(t) 1960Be27), 58 μs *10* (Xγ(t) 1958Sh61).
196.49 *2*	(3/2)$^+$		
216.68 *14*			
243.25 *2*	7/2$^-$	0.36 ns *2*	$T_{1/2}$: cece(t) (1969Ho30). Other: 0.50 ns *3* (from Xγ(t), 1970Ko30).
260.45 *3*	5/2$^+$		
306.23 *3*	(3/2$^+$,5/2,7/2$^+$)		
307.27 *6*	(5/2)$^+$		
307.519 *10*	(7/2)$^+$		
349.813 *12*	9/2$^-$	<0.1 ns	$T_{1/2}$: cece(t) (1969Ho30). Other: Xγ(t) (1970Ko30).
353.64 *2*	5/2$^-$,7/2$^-$		
415.80 *7*	(7/2$^+$)		

† From 'Adopted Levels'.

‡ From least-squares fit to Eγ's. Normalized χ^2=2.1.

^{151}Gd ε decay (123.9 d) (continued)

ε radiations

E(decay)	E(level)	Iε[†]	Log *ft*	Comments
(48 *3*)	415.80	0.0011 *2*	9.3 *2*	εL=0.721; εM+=0.279
(111 *3*)	353.64	0.146 *10*	8.46 *5*	εK=0.657; εL=0.259; εM+=0.084
(114 *3*)	349.813	9.9 *7*	6.68 *5*	εK=0.668; εL=0.251; εM+=0.081
(157 *3*)	307.519	1.22 *9*	7.98 *4*	εK=0.738; εL=0.199; εM+=0.062
(157 *3*)	307.27	0.028 *6*	9.6 *1*	εK=0.739; εL=0.199; εM+=0.062
(158 *3*)	306.23	0.008 *4*	10.2 *3*	εK=0.940; εL=0.198; εM+=0.062 Iε: other: 0.05 *2* (1996Vy02).
(204 *3*)	260.45	0.16 *2*	9.16 *6*	εK=0.772; εL=0.175; εM+=0.054
(221 *3*)	243.25	5.5 *4*	7.71 *4*	εK=0.779; εL=0.169; εM+=0.052
(248 *3*)	216.68	0.0010 *4*	11.6 *2*	εK=0.788; εL=0.162; εM+=0.049
(268[‡] *3*)	196.49	<0.01	>10.0	εK=0.794; εL=0.158; εM+=0.048 Iε: other: 0.023 *6* (1996Vy02).
(268[‡] *3*)	196.207	<0.7	>9.2	εK=0.794; εL=0.158; εM+=0.048
(443 *3*)	21.501	74 *6*	7.28 *4*	εK=0.817; εL=0.140; εM+=0.041 Iε: other: 60 *8* (1996Vy02).
(464 *3*)	0.0	9 *7*	8.2 *4*	εK=0.819; εL=0.140; εM+=0.041 Iε: other: 25 *8* (1996Vy02).

[†] Absolute intensity per 100 decays.

[‡] Existence of this branch is questionable.

γ(^{151}Eu)

Iγ normalization: From absolute photon intensity of 153.60γ (1984Gr15,1983Vo10). The α-decay branch=1.0×10^{-6}% *6* (1965Si06). 1984Gr15 obtain Iγ(153.6γ)(absolute)=6.1% 5, from growth and decay of three strongest γ's relative to 252γ (in ^{151}Tb ε decay). 1983Vo10 obtain Iγ(153.6γ) (absolute)=6.3% 4, from I(K x ray)/Iγ(153.6γ)=13.0 *7*.

Experimental conversion coefficients deduced from ce data of mainly 1968Gr25. Other ce data: 1982BaZX, 1971MeZT, 1967Gr29, 1966Ha23, 1966Av05, 1958Sh61, 1958An34

Eγ	α(K)exp	α(L)exp	α(M)exp	reference
106.6	1.0 2	0.7 2		
153.6	0.48 3	0.065 13	0.023 6	α(L)exp, α(M)exp from 1967Gr29
196.5	0.20 4	0.16 4		
238.9	0.16 2			
243.3	0.024 2	0.004 1	0.0091 23	
260.5	0.12 3	0.02		
286.1	0.08 1	0.013 7	0.013	
307.5	0.083 12	0.014 4	0.0044 11	
328.3	0.014 3			
332.1	< 0.033			
353.7	< 0.01	0.0013 4		

E$_\gamma$[†]	I$_\gamma$[‡d]	E$_i$(level)	J$^\pi_i$	E$_f$	J$^\pi_f$	Mult.[#]	δ[#]	α[@]	Comments
21.517 *13*	46 *2*	21.501	7/2$^+$	0.0	5/2$^+$	M1+E2	0.029 *1*	27.7 *5*	α(L)=21.7 *4*; α(M)=4.72 *7*; α(N+..)=1.261 *19* α(N)=1.077 *16*; α(O)=0.1684 *25*; α(P)=0.01558 *22* Mult.,δ: from L- and M- subshell ce data (1981Ar17, 1970An17). ce(L1):ce(L2):ce(L3)=12.7:1.66 *12*:0.82 *7* (1981Ar17), 9.9 *9*:1.22 *11*:0.57 *5* (1970An17), 12.8 *2*:1.35 *3*:1.10 *20* (1968Gr25). Others: 1967Gr29, 1966Ha23, 1966Av05, 1958An34, 1958Sh61. ce(M1):ce(M2):ce(M3)=2.7 *4*:0.41 *5*:0.20 *5* (1981Ar17), 1.93 *3*:0.265 *5*:0.129 *4* (1970An17). Others: 1958An34, 1958Sh61. ce(M):ce(N):ce(O+P)=2.33 *12*:0.55 *25*:0.18 *4* (1970An17) others: 1968Gr25, 1966Av05, 1967Gr29, 1966Ha23. α(L1)exp=22 *2*, α(L2)exp=2.8 *3*, α(L3)exp=1.4 *2*, α(M1)exp=4.6 *3*, α(M2)exp=0.7 *1* α(M3)exp=0.33 *7* (average of 1981Ar17 and 1970An17) α(N)exp=1.1 *5*, α(O+...)exp=0.36 *8* (1970An17). Others: 1968Gr25, 1967Gr29, 1966Av05, 1966Ha23, 1958Sh61, 1958An34. E$_\gamma$: weighted average of 1983Vo10, 1982BaZX, 1970An17, 1970Fo02, 1969Ho30

^{151}Gd ε decay (123.9 d) (continued)

γ(^{151}Eu) (continued)

E_γ[†]	I_γ[‡d]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ[#]	α[@]	Comments
									and 1968Gr25. See 'adopted gammas', also. I_γ: value from 1982BaZX not included in weighted average.
63.92[b] *7*	0.014 *3*	260.45	5/2$^+$	196.49	(3/2)$^+$	[M1,E2]		10 *4*	α(K)=4.4 *13*; α(L)=4 *4*; α(M)=1.0 *9*; α(N+..)=0.25 *21* α(N)=0.22 *19*; α(O)=0.030 *24*; α(P)=0.00044 *20*
64.2[b] *2*	0.015 *5*	307.27	(5/2)$^+$	243.25	7/2$^-$	[E1]		0.929 *15*	α(K)=0.771 *13*; α(L)=0.1238 *21*; α(M)=0.0267 *5*; α(N+..)=0.00691 *12* α(N)=0.00597 *10*; α(O)=0.000874 *15*; α(P)=6.05×10^{-5} *10*
93.21[b] *7*	0.03 *1*	353.64	5/2$^-$,7/2$^-$	260.45	5/2$^+$	[E1]		0.343	α(K)=0.288 *4*; α(L)=0.0433 *7*; α(M)=0.00933 *14*; α(N+..)=0.00243 *4* α(N)=0.00210 *3*; α(O)=0.000314 *5*; α(P)=2.38×10^{-5} *4*
^{x}102[&e]									
106.57 *1*	1.40 *4*	349.813	9/2$^-$	243.25	7/2$^-$	E2+M1	+10 *+10−2*	1.92	α(K)=0.992 *14*; α(L)=0.719 *11*; α(M)=0.168 *3*; α(N+..)=0.0424 *7* α(N)=0.0373 *6*; α(O)=0.00508 *8*; α(P)=7.41×10^{-5} *12* δ: α(L)exp gives δ(E2/M1)>1, $\gamma\gamma(\theta)$ gives δ=0.00 *5* or +10 *+10−2* (deduced by the evaluator from $\gamma\gamma(\theta)$ (1985Be64)). (107γ)(243γ)(θ): A_2=+0.053 *17*, A_4=+0.013 *9* (1985Be64).
109.74 *4*	0.046 *23*	306.23	(3/2$^+$,5/2,7/2$^+$)	196.49	(3/2)$^+$	[D,E2]		1.0 *8*	
110.33[b] *6*	0.08 *1*	353.64	5/2$^-$,7/2$^-$	243.25	7/2$^-$	[M1,E2]		1.55 *16*	α(K)=1.04 *15*; α(L)=0.39 *23*; α(M)=0.09 *6*; α(N+..)=0.023 *14* α(N)=0.020 *12*; α(O)=0.0029 *16*; α(P)=0.00010 *4*
110.76[b] *6*	0.11 *2*	307.27	(5/2)$^+$	196.49	(3/2)$^+$	[M1,E2]		1.53 *15*	α(K)=1.03 *14*; α(L)=0.39 *23*; α(M)=0.09 *6*; α(N+..)=0.023 *14* α(N)=0.020 *12*; α(O)=0.0028 *15*; α(P)=0.00010 *4*
153.60 *1*	100.0 *5*	349.813	9/2$^-$	196.207	11/2$^-$	M1+E2	+0.18 *3*	0.546	α(K)=0.459 *7*; α(L)=0.0683 *13*; α(M)=0.0148 *3*; α(N+..)=0.00397 *8* α(N)=0.00339 *7*; α(O)=0.000533 *10*; α(P)=5.04×10^{-5} *8* δ: from $\gamma(\theta$,T) (1987Be33).
157.08[b] *10*	0.012 *4*	353.64	5/2$^-$,7/2$^-$	196.49	(3/2)$^+$	[E1]		0.0836	α(K)=0.0708 *10*; α(L)=0.01009 *15*; α(M)=0.00217 *3*; α(N+..)=0.000572 *8* α(N)=0.000491 *7*; α(O)=7.50×10^{-5} *11*; α(P)=6.28×10^{-6} *9*
174.70 *1*	47.8 *10*	196.207	11/2$^-$	21.501	7/2$^+$	M2		2.35	α(K)=1.86 *3*; α(L)=0.378 *6*; α(M)=0.0853 *12*;

^{151}Gd ε decay (123.9 d) (continued)

γ(^{151}Eu) (continued)

E_γ[†]	I_γ[‡d]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ[#]	α[@]	Comments
									α(N+..)=0.0229 *4* α(N)=0.0196 *3*; α(O)=0.00305 *5*; α(P)=0.000272 *4* Additional information 1. ce(L1)/ce(L3)=21/2.5 (1966Ha23). Mult.: from ce(L1)/ce(L3). See also (p,p′γ).
195.18 *14*	0.014 *5*	216.68		21.501	7/2$^+$	[D,E2]		0.17 *12*	
196.2[e] *CA*	<0.46	196.207	11/2$^-$	0.0	5/2$^+$	[E3]		1.383	α(K)=0.583 *9*; α(L)=0.615 *9*; α(M)=0.1473 *21*; α(N+..)=0.0374 *6* α(N)=0.0328 *5*; α(O)=0.00449 *7*; α(P)=5.25×10^{-5} *8* ce data suggest a weak E3 γ of this energy.
196.49 *2*	0.46 *2*	196.49	(3/2)$^+$	0.0	5/2$^+$	E2+M1	0.45 *15*	0.268 *6*	α(K)=0.222 *8*; α(L)=0.0363 *20*; α(M)=0.0080 *5*; α(N+..)=0.00212 *12* α(N)=0.00181 *11*; α(O)=0.000280 *13*; α(P)=2.37×10^{-5} *12* Mult.,δ: from B(E2) in Coul. ex. and adopted branching ratio. Mult=E2,M1 from ce in ^{151}Gd ε.
221.80 *7*	0.037 *6*	243.25	7/2$^-$	21.501	7/2$^+$				1967Gr29 give Ice(K)≈0.1; however, in the published ce spectrum, not much evidence is there for the presence of a ce(K)(225γ).
238.97 *5*	1.4 *2*	260.45	5/2$^+$	21.501	7/2$^+$	M1		0.1618	α(K)=0.1372 *20*; α(L)=0.0193 *3*; α(M)=0.00417 *6*; α(N+..)=0.001122 *16* α(N)=0.000955 *14*; α(O)=0.0001516 *22*; α(P)=1.509×10^{-5} *22*
243.29 *3*	90.3 *5*	243.25	7/2$^-$	0.0	5/2$^+$	E1		0.0262	α(K)=0.0223 *4*; α(L)=0.00309 *5*; α(M)=0.000663 *10*; α(N+..)=0.0001758 *25* α(N)=0.0001505 *21*; α(O)=2.33×10^{-5} *4*; α(P)=2.07×10^{-6} *3*
260.46 *5*	0.69 *4*	260.45	5/2$^+$	0.0	5/2$^+$	M1(+E2)	<1	0.119 *10*	α(K)=0.099 *11*; α(L)=0.0158 *6*; α(M)=0.00346 *17*; α(N+..)=0.00092 *4* α(N)=0.00079 *4*; α(O)=0.000122 *3*; α(P)=1.05×10^{-5} *15*
[x]269.5[ae] *10*	0.04 *1*								
284.72 *3*	0.035 *10*	306.23	(3/2$^+$,5/2,7/2$^+$)	21.501	7/2$^+$	[D,E2]		0.06 *4*	
286.09 *2*	1.44 *5*	307.519	(7/2)$^+$	21.501	7/2$^+$	M1(+E2)	<1	0.092 *9*	α(K)=0.076 *9*; α(L)=0.01197 *21*; α(M)=0.00261 *7*; α(N+..)=0.000696 *13* α(N)=0.000595 *13*; α(O)=9.26×10^{-5} *14*; α(P)=8.2×10^{-6} *12*
[x]298.97[c] *3*	0.040 *16*								
307.50 *1*	16.7 *4*	307.519	(7/2)$^+$	0.0	5/2$^+$	M1		0.0824	α(K)=0.0699 *10*; α(L)=0.00977 *14*; α(M)=0.00211 *3*; α(N+..)=0.000567 *8* α(N)=0.000483 *7*; α(O)=7.67×10^{-5} *11*; α(P)=7.66×10^{-6} *11*

$^{151}_{63}$Eu$_{88}$-5

γ(^{151}Eu) (continued)

E_γ[†]	I_γ[‡d]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[#]	α[@]	Comments
328.31 *1*	1.33 *4*	349.813	$9/2^-$	21.501	$7/2^+$	E1	0.01222	α(K)=0.01042 *15*; α(L)=0.001422 *20*; α(M)=0.000305 *5*; α(N+..)=8.12×10^{-5} *12* α(N)=6.94×10^{-5} *10*; α(O)=1.082×10^{-5} *16*; α(P)=9.95×10^{-7} *14*
332.11 *3*	0.14 *1*	353.64	$5/2^-,7/2^-$	21.501	$7/2^+$	(E1)	0.01188	α(K)=0.01012 *15*; α(L)=0.001381 *20*; α(M)=0.000296 *5*; α(N+..)=7.89×10^{-5} *11* α(N)=6.74×10^{-5} *10*; α(O)=1.052×10^{-5} *15*; α(P)=9.68×10^{-7} *14*
[x]338.50[c] *9*	0.026 *5*							
[x]345[ae] *1*	0.04 *1*							
349.85[ce] *4*	0.053 *3*	349.813	$9/2^-$	0.0	$5/2^+$	[M2]	0.226	α(K)=0.186 *3*; α(L)=0.0315 *5*; α(M)=0.00696 *10*; α(N+..)=0.00187 *3* α(N)=0.001596 *23*; α(O)=0.000251 *4*; α(P)=2.36×10^{-5} *4*
353.66 *2*	2.06 *5*	353.64	$5/2^-,7/2^-$	0.0	$5/2^+$	E1	0.01018	α(K)=0.00868 *13*; α(L)=0.001180 *17*; α(M)=0.000253 *4*; α(N+..)=6.75×10^{-5} *10* α(N)=5.76×10^{-5} *8*; α(O)=9.00×10^{-6} *13*; α(P)=8.34×10^{-7} *12*
394.26 *9*	0.0097 *14*	415.80	$(7/2^+)$	21.501	$7/2^+$	[M1,E2]	0.034 *9*	α(K)=0.029 *8*; α(L)=0.0045 *6*; α(M)=0.00099 *10*; α(N+..)=0.00026 *3* α(N)=0.000226 *24*; α(O)=3.5×10^{-5} *5*; α(P)=3.0×10^{-6} *10*
415.84 *10*	0.0070 *15*	415.80	$(7/2^+)$	0.0	$5/2^+$	[M1,E2]	0.030 *8*	α(K)=0.025 *7*; α(L)=0.0039 *5*; α(M)=0.00085 *10*; α(N+..)=0.00023 *3* α(N)=0.000194 *24*; α(O)=3.0×10^{-5} *5*; α(P)=2.6×10^{-6} *9*

[†] Weighted average of 1983Vo10, 1982BaZX, 1970Fo02 and 1968Gr25. Uncertainties in 1982BaZX have been rounded off to the nearest hundredth of a keV.

[‡] Weighted average of 1984Gr15, 1983Vo10, 1982BaZX, 1970Fo02, 1969Ho30, 1968Gr25 and 1967Gr29. 1984Gr15 give Iγ′s for 7 intense transitions only.

[#] From ce data.

[@] Theoretical values (from BrIcc code) for assigned mult and δ. For M1,E2 assignment δ=1 assumed. Experimental conversion coefficients deduced by normalization to α(K) for 174.7γ treated as M2.

[&] From ce data of 1967Gr29.

[a] From 1968Gr25 only.

[b] Reported by 1983Vo10 only from γγ.

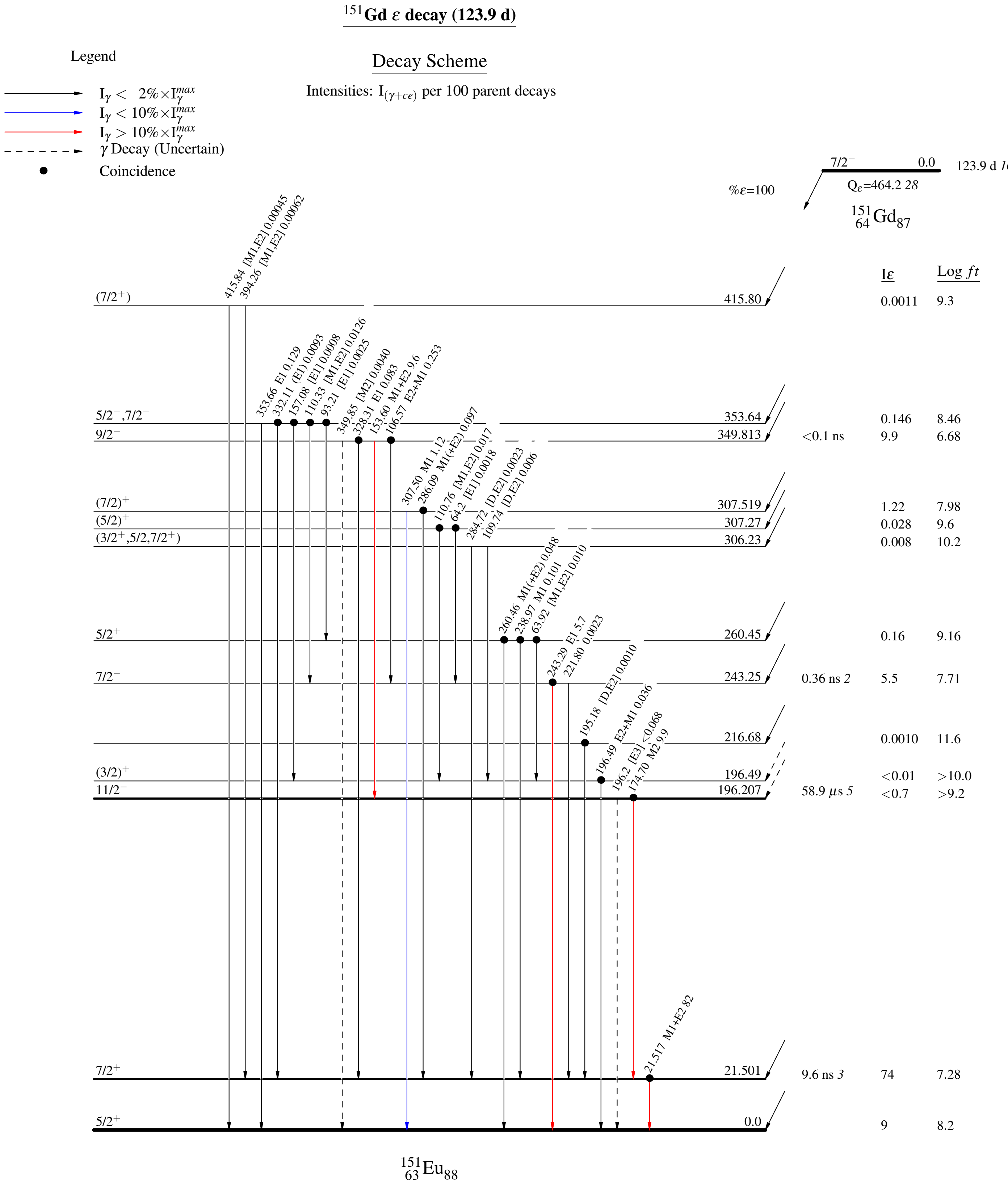
[c] From 1982BaZX.

[d] For absolute intensity per 100 decays, multiply by 0.062 *4*.

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

[x] γ ray not placed in level scheme.

$^{151}_{63}Eu_{88}$-6



151Gd ε decay (123.9 d)
Legend
Decay Scheme
Intensities: I(γ+ce) per 100 parent decays
Iγ < 2%×Iγmax
Iγ < 10%×Iγmax
Iγ > 10%×Iγmax
γ Decay (Uncertain)
Coincidence
7/2− 0.0 123.9 d 10
Qε=464.2 28
%ε=100
151 64 Gd87
Iε Log ft
(7/2+) 415.80 0.0011 9.3
415.84 [M1,E2] 0.00045
394.26 [M1,E2] 0.00062
5/2−,7/2− 353.64 0.146 8.46
9/2− 349.813 <0.1 ns 9.9 6.68
353.66 E1 0.129
332.11 (E1) 0.0093
157.08 [E1] 0.0008
110.33 [M1,E2] 0.0126
93.21 [E1] 0.0025
349.85 [M2] 0.0040
328.31 E1 0.083
153.60 M1+E2 9.6
106.57 E2+M1 0.253
(7/2)+ 307.519 1.22 7.98
(5/2)+ 307.27 0.028 9.6
(3/2+,5/2,7/2+) 306.23 0.008 10.2
307.50 M1 1.12
286.09 M1(+E2) 0.097
110.76 [M1,E2] 0.017
64.2 [E1] 0.0018
284.72 [D,E2] 0.0023
109.74 [D,E2] 0.006
5/2+ 260.45 0.16 9.16
260.46 M1(+E2) 0.048
238.97 M1 0.101
63.92 [M1,E2] 0.010
7/2− 243.25 0.36 ns 2 5.5 7.71
243.29 E1 5.7
221.80 0.0023
216.68 0.0010 11.6
195.18 [D,E2] 0.0010
(3/2)+ 196.49 <0.01 >10.0
11/2− 196.207 58.9 μs 5 <0.7 >9.2
196.49 E2+M1 0.036
196.2 [E3] ≤0.068
174.70 M2 9.9
7/2+ 21.501 9.6 ns 3 74 7.28
21.517 M1+E2 82
5/2+ 0.0 9 8.2
151 63 Eu88