^{157}Eu β^- decay 1986GrZS

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	N. Nica	NDS 132, 1 (2016)	4-Dec-2015

Parent: ^{157}Eu: E=0.0; J$^\pi$=5/2$^+$; T$_{1/2}$=15.18 h *3*; Q(β^-)=1365 *4*; %β^- decay=100.0

^{157}Eu has been produced by many methods including ^{160}Gd(p,α); ^{160}Gd(d,αn); ^{158}Gd(γ,p); ^{154}Sm(α,p); thermal-n fission of ^{235}U; ^{3}He-, α-, and HI-induced fission of ^{238}U; and the spontaneous fission of ^{252}Cf. Chemical and isotope separation have been used.

Measurements include γ singles and $\gamma\gamma$ coincidences with NaI and Ge detectors, ce with magnetic spectrometers, β- spectra with plastic and anthracene detectors, and $\gamma\beta$- coincidences.

Experimental methods:

1962Ha24: Produced by ^{160}Gd(p,α) with chemical separation. ce measured in magnetic spectrographs. See 1966Ha23 for later data. Report 17 γ's and 5 multipolarities.

1962Ho16: Produced by thermal-n fission of ^{235}U and ^{3}He fission of ^{238}U with chemical separation. Report 12 γ's and parent T$_{1/2}$.

1964Ka04: Produced by n reactions in natural Gd with E$_n$ $\approx$ 14 MeV with chemical separation. γ measured with NaI detectors and β- with plastic scintillator. Report T$_{1/2}$ for one level from $\beta\gamma$(t) measurement.

1964Sh21: Produced by ^{158}Gd(γ,p) on enriched (98%) target with 20-MeV bremsstrahlung with chemical separation. γ measured with NaI detector and β- with anthracene and $\gamma\beta$- coin. Report 9 γ's.

1965CaZZ: Produced by α-induced fission of ^{238}U with chemical separation. β- counted with proportional counter and γ with NaI detector. Report parent T$_{1/2}$ and 6 γ's.

1966Da06: Produced by thermal-n fission of ^{235}U, ^{3}He- or ^{4}He- induced fission of ^{238}U, and ^{160}Gd(d,nα) with chemical separation. Measured γ with NaI and Ge detectors, β- with plastic scintillator, and ce with Si detector. $\gamma\gamma$ and $\gamma\beta$- coincidences were measured. Report 23 γ's.

1966Da19: Produced as in 1966Da06. Parent T$_{1/2}$ measured.

1966FuZZ: See 1966Fu05 for the same information.

1966Fu05: Produced by ^{154}Sm(α,p) on enriched (95%) target with E$_\alpha$=27 MeV and chemistry. Measured γ singles with Ge detector and $\gamma\gamma$ coincidences with NaI detectors. β- and ce measured with magnetic spectrometer. $\gamma\beta$- coin. measured. Report 33 γ's.

1966Ha23: Produced by ^{160}Gd(p,α). ce measured in magnetic spectrometer. Report 50 γ's and 5 multipolarities.

1966Me06: Produced by ^{154}Sm(α,p) on enriched (96%) target with E$_\alpha$=27 MeV. Level T$_{1/2}$ measured by $\gamma\beta$- coincidences measured using NaI and plastic detectors. Report T$_{1/2}$ for three levels from $\beta\gamma$(t) measurements.

1969Gr32: Produced by ^{238}U(HI,fission) with chemical separation. γ measured with Ge detector. Report 11 γ's with I$_\gamma$ normalization.

1980GrZS, 1986GrZS: Produced by ^{252}Cf(SF) with chemical separation. γ singles and $\gamma\gamma$ coincidences measured with Ge detectors. Report 97 γ's.

^{157}Gd Levels

Additional information 1.

E(level)[†]	J$^\pi$[‡]	T$_{1/2}$[#]
0.0[a]	3/2$^-$	stable
54.526[a] *6*	5/2$^-$	
63.919[b] *5*	5/2$^+$	0.46[@] μs *4*
115.724[b] *7*	7/2$^+$	
131.452[a] *9*	7/2$^-$	
180.239[b] *11*	9/2$^+$	
227.37[a] *6*	9/2$^-$	
434.427[c] *6*	5/2$^-$	<0.1[&] ns

Continued on next page (footnotes at end of table)

^{157}Eu β^- decay 1986GrZS (continued)

^{157}Gd Levels (continued)

E(level)[†]	J$^\pi$[‡]	$T_{1/2}$[#]	Comments
474.632[d] *6*	3/2$^+$	<0.1[&] ns	
514.678[c] *8*	7/2$^-$		
524.852[d] *7*	5/2$^+$		
607.609[d] *16*	7/2,5/2$^+$		J$^\pi$: Band assignment assumes J^π=7/2$^+$.
683.237 *9*	3/2$^+$	<0.3[&] ns	
686.672 *9*	5/2$^+$,7/2$^+$		
723.0?			
729.01 *17*	3/2$^-$		
751.438 *12*	3/2$^+$		
762.667[e] *17*	3/2$^-$		
771.333 *17*	(7/2$^+$)		
814.21 *4*	(5/2$^-$)		
816.710[e] *15*	(5/2,7/2$^-$)		
919.53[e] *11*	(5/2$^+$,7/2,9/2$^-$)		
1049.68 *4*			
1060.08 *6*	3/2$^+$,5/2		
1231.50 *10*	5/2$^+$,7/2,9/2$^+$		

[†] From least-squares fit to the γ energies. Reduced χ^2=7.7 (critical χ^2=1.5).
[‡] From ^{157}Gd Adopted Levels.
[#] Values include only results from ^{157}Eu decay. See ^{157}Gd Adopted Levels for results of measurements from other decay modes.
[@] From 1964Ka04 from $\beta\gamma$(t) measurement.
[&] From 1966Me06 from $\beta\gamma$(t) measurements.
[a] Band(A): 3/2[521] band.
[b] Band(B): 5/2[642] band.
[c] Band(C): 5/2[523] band.
[d] Band(D): 3/2[402] band.
[e] Band(E): 3/2[532] band.

β^- radiations

The β- spectrum has been studied (1964Sh21, 1966Da06, and 1966Fu05) to determine the energies and intensities. The data from the singles spectrum lacks uniqueness due to high density of possible final states. In particular, the highest energy component [$E_{\beta-}$=1350 *30* (1964Sh21), 1340 *100* (1966Da06), and 1300 *20* (1966Fu05)] may be a combination of branches feeding levels at 0, 54, 63, and even 115 keV. The most detailed set of measured values are the coincidence results of 1964Sh21. These data yield a Q value of ≈ 1340 *30* compared with the mass-adjustment value of 1365 *4* (2012Wa38). The β- intensities are even less unique, but 1966Da06 and 1966Fu05 agree that there are major groups with energies of ≈ 1340 and ≈ 910 keV with an intensity ratio 0.89 (1966Da06) or 1.15 (1966Fu05).

E(decay)[†]	E(level)	Iβ^-[‡#@]	Log *ft*	Comments
(614 *4*)	751.438	2	7.4	av Eβ=191.6 *15*
(678 *4*)	686.672	3	7.4	av Eβ=215.2 *15*
(682 *4*)	683.237	4	7.3	av Eβ=216.5 *15* E(decay): E_β=660 *30* (1964Sh21) in coincidence with 620 γ.
(840 *4*)	524.852	4	7.6	av Eβ=276.4 *16* E(decay),Iβ^-: See comments related to level at 474 keV.
(850 *4*)	514.678	3	7.7	av Eβ=280.3 *16*

Continued on next page (footnotes at end of table)

^{157}Eu β^- decay 1986GrZS (continued)

β^- radiations (continued)

E(decay)†	E(level)	Iβ^-‡#@	Log *ft*	Comments
(890 *4*)	474.632	22 *2*	6.93 *4*	E(decay),Iβ^-: See comments related to level at 474 keV. av Eβ=295.9 *16* E(decay): ≈ 910 from measurements [860 *30* (1964Sh21) in coincidence with 415 and 480 γ's, 930 *100* (1966Da06), and 910 *20* (1966Fu05)]. The measured values include branches to other states, especially the 434 level. Iβ^-: Measured value ≈ 45% (1966Da06, 1966Fu05); includes branches to other states.
(931 *4*)	434.427	15 *1*	7.17 *3*	av Eβ=311.7 *16* E(decay),Iβ^-: See comments related to level at 474 keV; $E_{\beta-}$=929 *6* from Q value and $E_{\beta-}$=900 *30* (1964Sh21) in coincidence with 375 γ.
(1249 *4*)	115.724			E(decay),Iβ^-: See comments related to level at 63 keV.
(1301 *4*)	63.919	49 *10*	7.19 *9*	av Eβ=462.3 *17* Iβ^-: Measured value ≈ 45% (1966Da06,1966Fu05); includes branches to other states below 150 keV.
(1310 *4*)	54.526			Iβ^-: See comments related to level at 63 keV.
(1365 *4*)	0.0			E(decay): $E_{\beta-}$=1365 *4* from Q value and ≈ 1340 from measurements [1350 *30* (1964Sh21), 1340 *100* (1966Da06), and 1300 *20* (1966Fu05)]. The latter two measured values include branches to other states, but 1964Sh21 report a second component at 1280 keV. Other: 1550 (1962Ho16). Iβ^-: See comments related to level at 63 keV. γ normalization assumes no β- decay to this ground state.

† The values given are those calculated from the Q value. Measured values are provided in the comments.

‡ Values are from γ intensity balances and assume no β- feeding of the ground state. Beta branches similar to this ground-state transition [i.e., 5/2[413] to 3/2[521]] have log *ft* values of 7.8-8.7. In this ^{157}Eu β- decay, this range corresponds to $I_{\beta-}$(0)=1-10%. The measured values of 1966Da06 and 1966Fu05 for two major β- groups are given in comments and they agree well with the deduced values.

\# Values of <1% are omitted since the lack of completeness of the decay scheme makes them unreliable. The sum of the Iβ- values given is 101% *9*, and the sum of all the positive, computed values is 105% *9*.

@ Absolute intensity per 100 decays.

$\gamma(^{157}$Gd)

Iγ normalization: computed to give 100% feeding of the ground state with the assumption that there is no β- feeding of the ground state.
The data are from 1986GrZS (private communication), unless otherwise noted, including E$_\gamma$, I$_\gamma$, and coincidences in drawing. Less extensive sets of values are given by 1966Fu05 and 1966Da06 which include ce data. Others: 1964Sh12, 1965CaZZ, and 1969Gr32.
The unplaced γ's are from 1986GrZS from γ measurements and 1966Ha23 from ce measurements.

E$_\gamma$	I$_\gamma$ [†b]	E$_i$(level)	J$^\pi_i$	E$_f$	J$^\pi_f$	Mult. [‡]	δ [‡a]	α [&]	Comments
9.365 12	14.9 22	63.919	5/2$^+$	54.526	5/2$^-$	E1		30.8	%Iγ=1.7 9, using the calculated normalization.
^{x}14.7[#]									
^{x}39.7[#]									
51.834 14	6.8 7	115.724	7/2$^+$	63.919	5/2$^+$	M1+E2	0.20	14.06	α(K)=10.86 16; α(L)=2.50 4; α(M)=0.560 8 α(N)=0.1272 18; α(O)=0.0184 3; α(P)=0.000831 12 %Iγ=0.76 9, using the calculated normalization.
54.548 8	34 3	54.526	5/2$^-$	0.0	3/2$^-$	M1+E2	0.19 4	12.1 3	α(K)=9.50 17; α(L)=2.0 3; α(M)=0.45 7 α(N)=0.102 14; α(O)=0.0150 18; α(P)=0.000718 13 %Iγ=3.81 25, using the calculated normalization. δ: Uncertainty estimated by evaluator from L1/L2/L3 data (1962Ha24).
63.929 8	209. 21	63.919	5/2$^+$	0.0	3/2$^-$	E1		0.961	α(K)=0.795 12; α(L)=0.1301 19; α(M)=0.0283 4 α(N)=0.00634 9; α(O)=0.000904 13; α(P)=4.18×10^{-5} 6 %Iγ=23.4 17, using the calculated normalization.
64.4 2	1.2 6	180.239	9/2$^+$	115.724	7/2$^+$	(M1+E2)		10 4	α(K)=4.5 16; α(L)=5 4; α(M)=1.1 9 α(N)=0.24 20; α(O)=0.031 25; α(P)=0.00030 15 %Iγ=0.13 7, using the calculated normalization.
^{x}66.5[#]									
76.925 14	1.8 3	131.452	7/2$^-$	54.526	5/2$^-$	M1+E2	0.18	4.36	α(K)=3.57 5; α(L)=0.619 9; α(M)=0.1366 20 α(N)=0.0312 5; α(O)=0.00469 7; α(P)=0.000265 4 %Iγ=0.20 4, using the calculated normalization.
95.6 2	0.10 5	227.37	9/2$^-$	131.452	7/2$^-$	[M1,E2]		2.6 4	α(K)=1.6 4; α(L)=0.8 5; α(M)=0.18 13 α(N)=0.04 3; α(O)=0.006 4; α(P)=0.00010 4 %Iγ=0.011 6, using the calculated normalization.
116.314 28	0.36 9	180.239	9/2$^+$	63.919	5/2$^+$	[E2]		1.453	α(K)=0.769 11; α(L)=0.528 8; α(M)=0.1240 18 α(N)=0.0277 4; α(O)=0.00366 6; α(P)=3.90×10^{-5} 6 %Iγ=0.040 11, using the calculated normalization.
129.5 2	0.11 6	816.710	(5/2,7/2$^-$)	686.672	5/2$^+$,7/2$^+$				%Iγ=0.012 7, using the calculated normalization.
131.438 16	0.51 13	131.452	7/2$^-$	0.0	3/2$^-$	E2		0.940	α(K)=0.543 8; α(L)=0.307 5; α(M)=0.0719 10 α(N)=0.01609 23; α(O)=0.00214 3; α(P)=2.82×10^{-5} 4 %Iγ=0.057 15, using the calculated normalization.
^{x}133.3[#]									
^{x}152.8[#]									
158.41 3	0.22 6	683.237	3/2$^+$	524.852	5/2$^+$				%Iγ=0.025 7, using the calculated normalization.

γ(^{157}Gd) (continued)

E_γ	I_γ [†b]	E_i(level)	J^π_i	E_f	J^π_f	Mult. [‡]	α [&]	Comments
[x]160.0[#]								
161.820 *13*	0.77 *15*	686.672	5/2$^+$,7/2$^+$	524.852	5/2$^+$	[M1,E2]	0.49 *3*	α(K)=0.36 *8*; α(L)=0.09 *4*; α(M)=0.021 *8* α(N)=0.0048 *17*; α(O)=0.00068 *20*; α(P)=2.4×10^{-5} *9* %Iγ=0.086 *18*, using the calculated normalization.
163.7 *2*	0.07 *4*	771.333	(7/2$^+$)	607.609	7/2,5/2$^+$			%Iγ=0.008 *5*, using the calculated normalization.
[x]181.8[#]								
[x]188.6[#]								
208.621 *11*	1.34 *13*	683.237	3/2$^+$	474.632	3/2$^+$			%Iγ=0.150 *18*, using the calculated normalization.
209.0 *2*	0.15 *8*	816.710	(5/2,7/2$^-$)	607.609	7/2,5/2$^+$			%Iγ=0.017 *9*, using the calculated normalization.
212.050 *25*	0.55 *8*	686.672	5/2$^+$,7/2$^+$	474.632	3/2$^+$	[M1,E2]	0.21 *3*	α(K)=0.17 *4*; α(L)=0.035 *6*; α(M)=0.0079 *16* α(N)=0.0018 *4*; α(O)=0.00026 *4*; α(P)=1.1×10^{-5} *4* %Iγ=0.062 *10*, using the calculated normalization.
[x]223.8[#]								
226.63 *3*	0.34 *7*	751.438	3/2$^+$	524.852	5/2$^+$	[M1,E2]	0.18 *3*	α(K)=0.14 *4*; α(L)=0.028 *4*; α(M)=0.0063 *10* α(N)=0.00143 *21*; α(O)=0.000209 *19*; α(P)=1.0×10^{-5} *4* %Iγ=0.038 *9*, using the calculated normalization.
237.9 *2*	0.14 *7*	762.667	3/2$^-$	524.852	5/2$^+$	[E1]	0.0288	α(K)=0.0244 *4*; α(L)=0.00343 *5*; α(M)=0.000741 *11* α(N)=0.0001689 *24*; α(O)=2.55×10^{-5} *4*; α(P)=1.523×10^{-6} *22* %Iγ=0.016 *8*, using the calculated normalization.
246.5 *2*	0.07 *4*	771.333	(7/2$^+$)	524.852	5/2$^+$			%Iγ=0.008 *5*, using the calculated normalization.
252.3 *2*	0.4 *2*	686.672	5/2$^+$,7/2$^+$	434.427	5/2$^-$	[E1]	0.0247	α(K)=0.0210 *3*; α(L)=0.00294 *5*; α(M)=0.000634 *9* α(N)=0.0001447 *21*; α(O)=2.19×10^{-5} *3*; α(P)=1.317×10^{-6} *19* %Iγ=0.045 *23*, using the calculated normalization.
276.86 *5*	0.37 *7*	751.438	3/2$^+$	474.632	3/2$^+$	[M1,E2]	0.098 *21*	α(K)=0.079 *21*; α(L)=0.0145 *4*; α(M)=0.00322 *15* α(N)=0.00073 *3*; α(O)=0.0001087 *21*; α(P)=5.5×10^{-6} *20* %Iγ=0.041 *9*, using the calculated normalization.
288.023 *19*	0.87 *13*	762.667	3/2$^-$	474.632	3/2$^+$	[E1]	0.01765	α(K)=0.01500 *21*; α(L)=0.00208 *3*; α(M)=0.000449 *7* α(N)=0.0001026 *15*; α(O)=1.558×10^{-5} *22*; α(P)=9.52×10^{-7} *14* %Iγ=0.097 *16*, using the calculated normalization.
291.69 *7*	0.20 *5*	816.710	(5/2,7/2$^-$)	524.852	5/2$^+$			%Iγ=0.022 *6*, using the calculated normalization.
302.994 *28*	0.61 *9*	434.427	5/2$^-$	131.452	7/2$^-$	[M1,E2]	0.076 *18*	α(K)=0.062 *17*; α(L)=0.0109 *3*; α(M)=0.00241 *4* α(N)=0.000551 *10*; α(O)=8.2×10^{-5} *5*; α(P)=4.3×10^{-6} *16* %Iγ=0.068 *11*, using the calculated normalization.
[x]317.1[#]								
318.710 *8*	26.3 *13*	434.427	5/2$^-$	115.724	7/2$^+$	E1	0.01370	α(K)=0.01165 *17*; α(L)=0.001608 *23*; α(M)=0.000347 *5* α(N)=7.93×10^{-5} *12*; α(O)=1.207×10^{-5} *17*; α(P)=7.45×10^{-7} *11* %Iγ=2.94 *24*, using the calculated normalization.
328.3 *2*	0.2 *1*	762.667	3/2$^-$	434.427	5/2$^-$	[M1,E2]	0.061 *15*	α(K)=0.050 *15*; α(L)=0.0085 *5*; α(M)=0.00188 *8* α(N)=0.000429 *21*; α(O)=6.4×10^{-5} *6*; α(P)=3.5×10^{-6} *13* %Iγ=0.022 *12*, using the calculated normalization.
334.441 *10*	7.5 *5*	514.678	7/2$^-$	180.239	9/2$^+$			%Iγ=0.84 *8*, using the calculated normalization.

From ENSDF

γ(^{157}Gd) (continued)

E_γ	I_γ[†b]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[‡]	δ[‡a]	α[&]	Comments
339.3 *2*	0.15 *8*	814.21	(5/2$^-$)	474.632	3/2$^+$				%Iγ=0.017 *9*, using the calculated normalization.
342.0 *2*		816.710	(5/2,7/2$^-$)	474.632	3/2$^+$				
344.61 *6*	0.32 *6*	524.852	5/2$^+$	180.239	9/2$^+$	[E2]		0.0396	α(K)=0.0309 *5*; α(L)=0.00676 *10*; α(M)=0.001522 *22* α(N)=0.000345 *5*; α(O)=4.96×10^{-5} *7*; α(P)=1.98×10^{-6} *3* %Iγ=0.036 *8*, using the calculated normalization.
358.931 *10*	2.74 *27*	474.632	3/2$^+$	115.724	7/2$^+$	[E2]		0.0351	α(K)=0.0276 *4*; α(L)=0.00588 *9*; α(M)=0.001321 *19* α(N)=0.000300 *5*; α(O)=4.32×10^{-5} *6*; α(P)=1.777×10^{-6} *25* %Iγ=0.31 *4*, using the calculated normalization.
370.509 *8*	100. *5*	434.427	5/2$^-$	63.919	5/2$^+$	E1		0.00947	α(K)=0.00807 *12*; α(L)=0.001105 *16*; α(M)=0.000238 *4* α(N)=5.45×10^{-5} *8*; α(O)=8.32×10^{-6} *12*; α(P)=5.22×10^{-7} *8* %Iγ=11.2 *9*, using the calculated normalization.
379.905 *9*	2.39 *24*	434.427	5/2$^-$	54.526	5/2$^-$	[M1,E2]		0.041 *11*	α(K)=0.034 *10*; α(L)=0.0055 *7*; α(M)=0.00121 *12* α(N)=0.00028 *3*; α(O)=4.2×10^{-5} *6*; α(P)=2.4×10^{-6} *9* %Iγ=0.27 *4*, using the calculated normalization.
383.17 *3*	0.64 *10*	514.678	7/2$^-$	131.452	7/2$^-$				%Iγ=0.072 *13*, using the calculated normalization.
^{x}385.5[#]									
393.408 *20*	1.11 *11*	524.852	5/2$^+$	131.452	7/2$^-$	[E1]		0.00821	α(K)=0.00699 *10*; α(L)=0.000955 *14*; α(M)=0.000206 *3* α(N)=4.71×10^{-5} *7*; α(O)=7.20×10^{-6} *10*; α(P)=4.54×10^{-7} *7* %Iγ=0.124 *15*, using the calculated normalization.
398.953 *9*	12.0 *6*	514.678	7/2$^-$	115.724	7/2$^+$				%Iγ=1.34 *11*, using the calculated normalization.
409.135 *10*	24.3 *12*	524.852	5/2$^+$	115.724	7/2$^+$	[M1,E2]		0.033 *10*	α(K)=0.028 *9*; α(L)=0.0044 *7*; α(M)=0.00097 *12* α(N)=0.00022 *3*; α(O)=3.4×10^{-5} *6*; α(P)=1.9×10^{-6} *7* %Iγ=2.72 *22*, using the calculated normalization.
410.723 *9*	159. *8*	474.632	3/2$^+$	63.919	5/2$^+$	M1+E2	≤1.0	0.037 *5*	α(K)=0.031 *5*; α(L)=0.0047 *4*; α(M)=0.00102 *7* α(N)=0.000234 *15*; α(O)=3.6×10^{-5} *3*; α(P)=2.3×10^{-6} *4* %Iγ=17.8 *14*, using the calculated normalization.
420.090 *9*	8.4 *6*	474.632	3/2$^+$	54.526	5/2$^-$	[E1]		0.00703	α(K)=0.00599 *9*; α(L)=0.000815 *12*; α(M)=0.0001758 *25* α(N)=4.02×10^{-5} *6*; α(O)=6.16×10^{-6} *9*; α(P)=3.91×10^{-7} *6* %Iγ=0.94 *9*, using the calculated normalization.
427.355 *15*	1.45 *14*	607.609	7/2,5/2$^+$	180.239	9/2$^+$				%Iγ=0.162 *19*, using the calculated normalization.
434.388 *13*	3.2 *3*	434.427	5/2$^-$	0.0	3/2$^-$	[M1,E2]		0.028 *8*	α(K)=0.024 *8*; α(L)=0.0037 *6*; α(M)=0.00082 *12* α(N)=0.00019 *3*; α(O)=2.8×10^{-5} *5*; α(P)=1.7×10^{-6} *6* %Iγ=0.36 *4*, using the calculated normalization.
^{x}449.4[#]									
450.761 *10*	11.1 *8*	514.678	7/2$^-$	63.919	5/2$^+$				%Iγ=1.24 *12*, using the calculated normalization.
^{x}454.3[#]									
460.923 *9*	8.8 *6*	524.852	5/2$^+$	63.919	5/2$^+$	[M1,E2]		0.024 *7*	α(K)=0.020 *7*; α(L)=0.0031 *6*; α(M)=0.00069 *11* α(N)=0.00016 *3*; α(O)=2.4×10^{-5} *5*; α(P)=1.4×10^{-6} *5* %Iγ=0.99 *10*, using the calculated normalization.
470.389 *26*	1.80 *18*	524.852	5/2$^+$	54.526	5/2$^-$	[E1]		0.00541	α(K)=0.00462 *7*; α(L)=0.000625 *9*; α(M)=0.0001346 *19* α(N)=3.08×10^{-5} *5*; α(O)=4.73×10^{-6} *7*; α(P)=3.03×10^{-7} *5* %Iγ=0.202 *24*, using the calculated normalization.

$^{157}_{64}$Gd$_{93}$-6

γ(^{157}Gd) (continued)

E_γ	I_γ [†b]	E_i(level)	J^π_i	E_f	J^π_f	Mult. [‡]	α [&]	Comments
474.625 *11*	22.9 *11*	474.632	3/2+	0.0	3/2−	[E1]	0.00530	α(K)=0.00452 *7*; α(L)=0.000612 *9*; α(M)=0.0001318 *19* α(N)=3.02×10^{-5} *5*; α(O)=4.63×10^{-6} *7*; α(P)=2.97×10^{-7} *5* %Iγ=2.56 *21*, using the calculated normalization.
[x]479.2 [#]								
491.89 *3*	0.82 *12*	607.609	7/2,5/2+	115.724	7/2+			%Iγ=0.092 *15*, using the calculated normalization.
[x]498.9 [#]								
506.43 *3*	0.74 *11*	686.672	5/2+,7/2+	180.239	9/2+	[E2]	0.01349	α(K)=0.01098 *16*; α(L)=0.00196 *3*; α(M)=0.000434 *6* α(N)=9.90×10^{-5} *14*; α(O)=1.464×10^{-5} *21*; α(P)=7.37×10^{-7} *11* %Iγ=0.083 *14*, using the calculated normalization.
524.835 *18*	2.74 *27*	524.852	5/2+	0.0	3/2−	[E1]	0.00423	α(K)=0.00361 *5*; α(L)=0.000486 *7*; α(M)=0.0001046 *15* α(N)=2.40×10^{-5} *4*; α(O)=3.68×10^{-6} *6*; α(P)=2.38×10^{-7} *4* %Iγ=0.31 *4*, using the calculated normalization.
543.93 [c@] *6*	0.30 [c] *6*	607.609	7/2,5/2+	63.919	5/2+			%Iγ=0.034 *7*, using the calculated normalization.
543.93 [c] *6*	0.30 [c] *6*	771.333	(7/2+)	227.37	9/2−			%Iγ=0.034 *7*, using the calculated normalization.
553.02 *7*	0.32 *6*	607.609	7/2,5/2+	54.526	5/2−			%Iγ=0.036 *8*, using the calculated normalization.
555.23 *12*	0.31 *6*	686.672	5/2+,7/2+	131.452	7/2−	[E1]	0.00374	α(K)=0.00319 *5*; α(L)=0.000428 *6*; α(M)=9.22×10^{-5} *13* α(N)=2.11×10^{-5} *3*; α(O)=3.25×10^{-6} *5*; α(P)=2.11×10^{-7} *3* %Iγ=0.035 *7*, using the calculated normalization.
[x]560.3 [#]								
567.58 *4*	1.32 *13*	683.237	3/2+	115.724	7/2+			%Iγ=0.148 *18*, using the calculated normalization.
570.937 *13*	14.2 *7*	686.672	5/2+,7/2+	115.724	7/2+	[M1,E2]	0.014 *4*	α(K)=0.012 *4*; α(L)=0.0018 *4*; α(M)=0.00038 *8* α(N)=8.8×10^{-5} *19*; α(O)=1.3×10^{-5} *3*; α(P)=8.E−7 *3* %Iγ=1.59 *13*, using the calculated normalization.
[x]575.8 [#]								
585.46 *20*	0.16 *5*	1060.08	3/2+,5/2	474.632	3/2+			%Iγ=0.018 *6*, using the calculated normalization.
591.097 *19*	1.43 *14*	771.333	(7/2+)	180.239	9/2+			%Iγ=0.160 *19*, using the calculated normalization.
607.1 [e] *2*	0.42 *21*	723.0?		115.724	7/2+			%Iγ=0.047 *24*, using the calculated normalization.
613.73 [e] *14*	0.15 *5*	729.01	3/2−	115.724	7/2+			%Iγ=0.017 *6*, using the calculated normalization. Mult.: J^π values would make this an M2 transition, so placement is questionable.
619.303 *12*	32.3 *16*	683.237	3/2+	63.919	5/2+			%Iγ=3.6 *3*, using the calculated normalization.
622.751 *13*	8.8 *6*	686.672	5/2+,7/2+	63.919	5/2+	[M1,E2]	0.011 *4*	α(K)=0.009 *3*; α(L)=0.0014 *3*; α(M)=0.00030 *7* α(N)=7.0×10^{-5} *16*; α(O)=1.1×10^{-5} *3*; α(P)=6.8×10^{-7} *23* %Iγ=0.99 *10*, using the calculated normalization.
625.6 *2*	0.13 *4*	1060.08	3/2+,5/2	434.427	5/2−			%Iγ=0.015 *5*, using the calculated normalization.
628.704 *28*	0.90 *14*	683.237	3/2+	54.526	5/2−			%Iγ=0.101 *17*, using the calculated normalization.
[x]630.4 [#]								
632.23 *5*	0.42 *8*	686.672	5/2+,7/2+	54.526	5/2−	[E1]	0.00283	α(K)=0.00242 *4*; α(L)=0.000322 *5*; α(M)=6.93×10^{-5} *10* α(N)=1.589×10^{-5} *23*; α(O)=2.45×10^{-6} *4*; α(P)=1.605×10^{-7} *23* %Iγ=0.047 *10*, using the calculated normalization.
635.75 *9*	0.42 *8*	751.438	3/2+	115.724	7/2+	[E2]	0.00761	α(K)=0.00629 *9*; α(L)=0.001027 *15*; α(M)=0.000226 *4*

γ(^{157}Gd) (continued)

E_γ	I_γ[†b]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[‡]	α[&]	Comments
								α(N)=5.16×10^{-5} *8*; α(O)=7.75×10^{-6} *11*; α(P)=4.30×10^{-7} *6* %Iγ=0.047 *10*, using the calculated normalization.
655.592 *28*	1.68 *17*	771.333	(7/2$^+$)	115.724	7/2$^+$			%Iγ=0.188 *23*, using the calculated normalization.
^{x}657.1[#]								
668.5[e] *2*	0.11 *3*	723.0?		54.526	5/2$^-$			%Iγ=0.012 *4*, using the calculated normalization.
674.59 *18*	0.15 *5*	729.01	3/2$^-$	54.526	5/2$^-$	[M1,E2]	0.009 *3*	α(K)=0.0078 *24*; α(L)=0.0011 *3*; α(M)=0.00025 *6* α(N)=5.7×10^{-5} *13*; α(O)=8.7×10^{-6} *21*; α(P)=5.6×10^{-7} *19* %Iγ=0.017 *6*, using the calculated normalization.
682.60 *6*	0.7 *2*	814.21	(5/2$^-$)	131.452	7/2$^-$			%Iγ=0.078 *23*, using the calculated normalization.
683.162 *27*	2.1 *4*	683.237	3/2$^+$	0.0	3/2$^-$			%Iγ=0.24 *5*, using the calculated normalization.
685.2 *2*	0.43 *22*	816.710	(5/2,7/2$^-$)	131.452	7/2$^-$			%Iγ=0.048 *25*, using the calculated normalization.
687.502 *13*	10.7 *11*	751.438	3/2$^+$	63.919	5/2$^+$	[M1,E2]	0.009 *3*	α(K)=0.0075 *23*; α(L)=0.00108 *25*; α(M)=0.00024 *6* α(N)=5.4×10^{-5} *13*; α(O)=8.3×10^{-6} *20*; α(P)=5.3×10^{-7} *18* %Iγ=1.20 *15*, using the calculated normalization.
696.94 *4*	0.65 *7*	751.438	3/2$^+$	54.526	5/2$^-$			%Iγ=0.073 *10*, using the calculated normalization.
698.62 *5*	0.57 *6*	814.21	(5/2$^-$)	115.724	7/2$^+$			%Iγ=0.064 *8*, using the calculated normalization.
700.856[@] *19*	2.67 *27*	816.710	(5/2,7/2$^-$)	115.724	7/2$^+$			%Iγ=0.30 *4*, using the calculated normalization.
^{x}702.4[#]								
707.46 *9*	0.42 *6*	771.333	(7/2$^+$)	63.919	5/2$^+$			%Iγ=0.047 *8*, using the calculated normalization.
716.92 *10*	0.25 *6*	771.333	(7/2$^+$)	54.526	5/2$^-$			%Iγ=0.028 *7*, using the calculated normalization.
728.5 *4*	0.20 *5*	729.01	3/2$^-$	0.0	3/2$^-$	[M1,E2]	0.0077 *22*	α(K)=0.0065 *19*; α(L)=0.00093 *22*; α(M)=0.00020 *5* α(N)=4.7×10^{-5} *11*; α(O)=7.2×10^{-6} *18*; α(P)=4.6×10^{-7} *15* %Iγ=0.022 *6*, using the calculated normalization.
^{x}732.5[#]								
739.34 *12*	0.16 *5*	919.53	(5/2$^+$,7/2,9/2$^-$)	180.239	9/2$^+$			%Iγ=0.018 *6*, using the calculated normalization.
^{x}747.8[#]								
750.8[c] *6*	1.17[c] *12*	751.438	3/2$^+$	0.0	3/2$^-$			%Iγ=0.131 *16*, using the calculated normalization.
750.8[ce] *6*	1.17[c] *12*	814.21	(5/2$^-$)	63.919	5/2$^+$			%Iγ=0.131 *16*, using the calculated normalization.
752.61[@] *4*	2.31 *23*	816.710	(5/2,7/2$^-$)	63.919	5/2$^+$			%Iγ=0.26 *3*, using the calculated normalization.
^{x}754.8 *3*	0.22 *7*							%Iγ=0.025 *8*, using the calculated normalization.
^{x}760.5[#]								
762.69[d] *3*	3.3[d] *5*	762.667	3/2$^-$	0.0	3/2$^-$	[M1,E2]	0.0069 *20*	α(K)=0.0058 *17*; α(L)=0.00083 *20*; α(M)=0.00018 *5* α(N)=4.2×10^{-5} *10*; α(O)=6.4×10^{-6} *16*; α(P)=4.2×10^{-7} *13* %Iγ=0.37 *6*, using the calculated normalization.
762.69[d@] *3*	≈0.3[d]	816.710	(5/2,7/2$^-$)	54.526	5/2$^-$			%Iγ=0.034 *17*, using the calculated normalization.
803.65 *20*	0.16 *5*	919.53	(5/2$^+$,7/2,9/2$^-$)	115.724	7/2$^+$			%Iγ=0.018 *6*, using the calculated normalization.
^{x}811.6[#]								
814.17 *12*	0.20 *6*	814.21	(5/2$^-$)	0.0	3/2$^-$			%Iγ=0.022 *7*, using the calculated normalization.
816.64 *4*	0.64 *10*	816.710	(5/2,7/2$^-$)	0.0	3/2$^-$			%Iγ=0.072 *13*, using the calculated normalization.
^{x}836.23 *14*	0.12 *4*							%Iγ=0.013 *5*, using the calculated normalization.

$^{157}_{64}$Gd$_{93}$-8

γ(^{157}Gd) (continued)

E_γ	I_γ[†b]	E_i(level)	J_i^π	E_f	J_f^π	Comments
[x]846.78 *15*	0.30 *10*					%Iγ=0.034 *12*, using the calculated normalization.
865.05[e] *20*	0.18 *5*	919.53	(5/2+,7/2,9/2−)	54.526	5/2−	%Iγ=0.020 *6*, using the calculated normalization.
[x]932.6 *4*	0.18 *5*					%Iγ=0.020 *6*, using the calculated normalization.
934.24[@] *8*	0.35 *9*	1049.68		115.724	7/2+	%Iγ=0.039 *11*, using the calculated normalization.
944.21 *10*	0.29 *9*	1060.08	3/2+,5/2	115.724	7/2+	%Iγ=0.032 *11*, using the calculated normalization.
[x]969.19 *9*	0.10 *4*					%Iγ=0.011 *5*, using the calculated normalization.
985.69 *4*	1.30 *13*	1049.68		63.919	5/2+	%Iγ=0.146 *18*, using the calculated normalization.
996.38 *12*	0.27 *8*	1060.08	3/2+,5/2	63.919	5/2+	%Iγ=0.030 *10*, using the calculated normalization.
[x]1017.6[#]						
1051.57 *15*	0.23 *7*	1231.50	5/2+,7/2,9/2+	180.239	9/2+	%Iγ=0.026 *8*, using the calculated normalization.
1060.06 *10*	0.25 *8*	1060.08	3/2+,5/2	0.0	3/2−	%Iγ=0.028 *10*, using the calculated normalization.
1115.53[e] *15*	0.17 *5*	1231.50	5/2+,7/2,9/2+	115.724	7/2+	%Iγ=0.019 *6*, using the calculated normalization.
1167.38 *12*	0.42 *10*	1231.50	5/2+,7/2,9/2+	63.919	5/2+	%Iγ=0.047 *12*, using the calculated normalization.

[†] Iγ(K x ray)=508 *51*.

[‡] From ^{157}Gd Adopted γ data, but they are based on data from this decay, namely, the ce data of 1966Ha23 and 1966Fu05. See also 1962Ha24.

[#] From ce data of 1966Ha23.

[@] Differ by 3σ or more from calculated value.

[&] Additional information 2.

[a] If no value given it was assumed δ=1.00 for E2/M1, δ=1.00 for E3/M2 and δ=0.10 for the other multipolarities.

[b] For absolute intensity per 100 decays, multiply by 0.112 *8*.

[c] Multiply placed with undivided intensity.

[d] Multiply placed with intensity suitably divided.

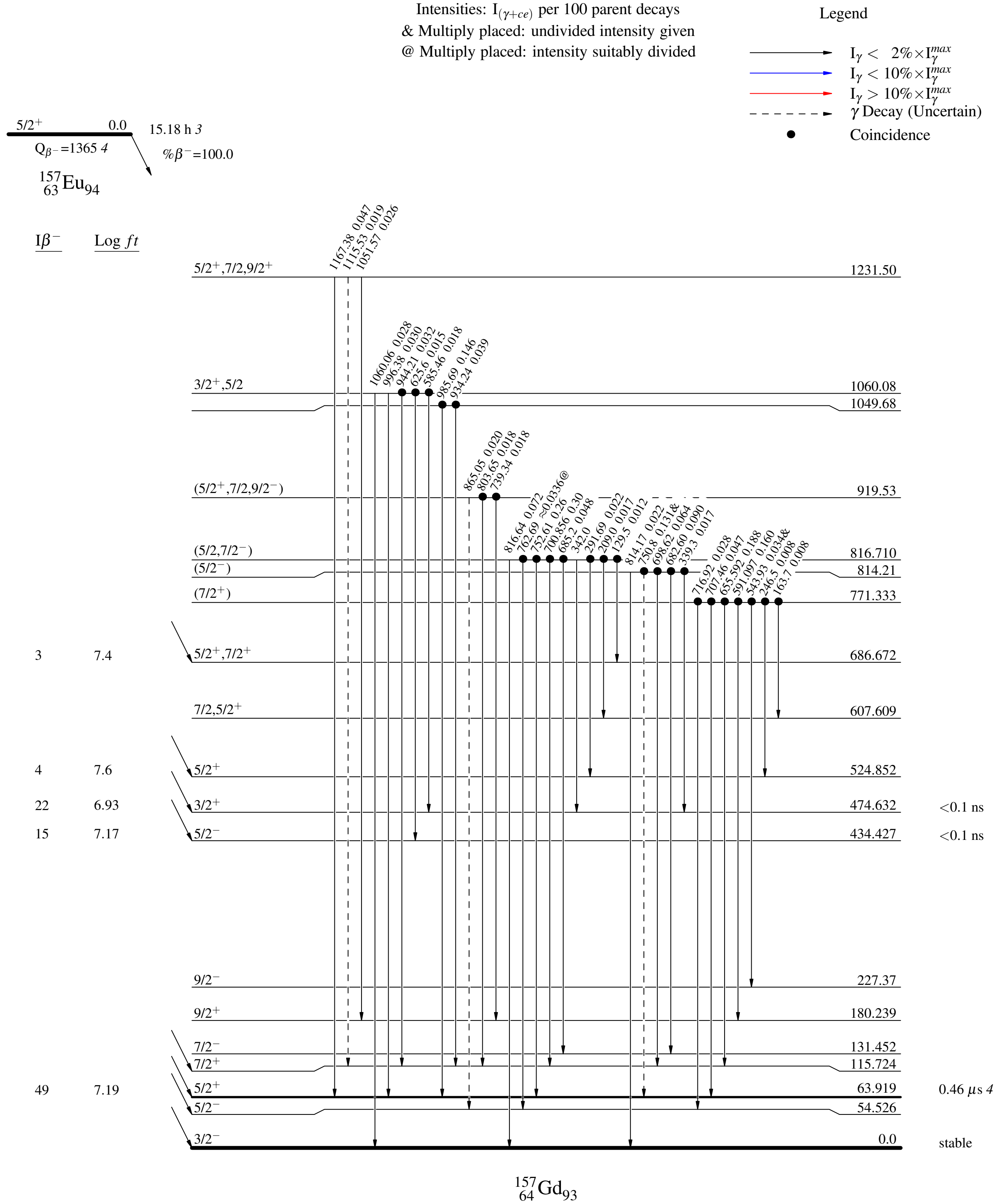
[e] Placement of transition in the level scheme is uncertain.

[x] γ ray not placed in level scheme.

^{157}Eu β^- decay 1986GrZS

Decay Scheme

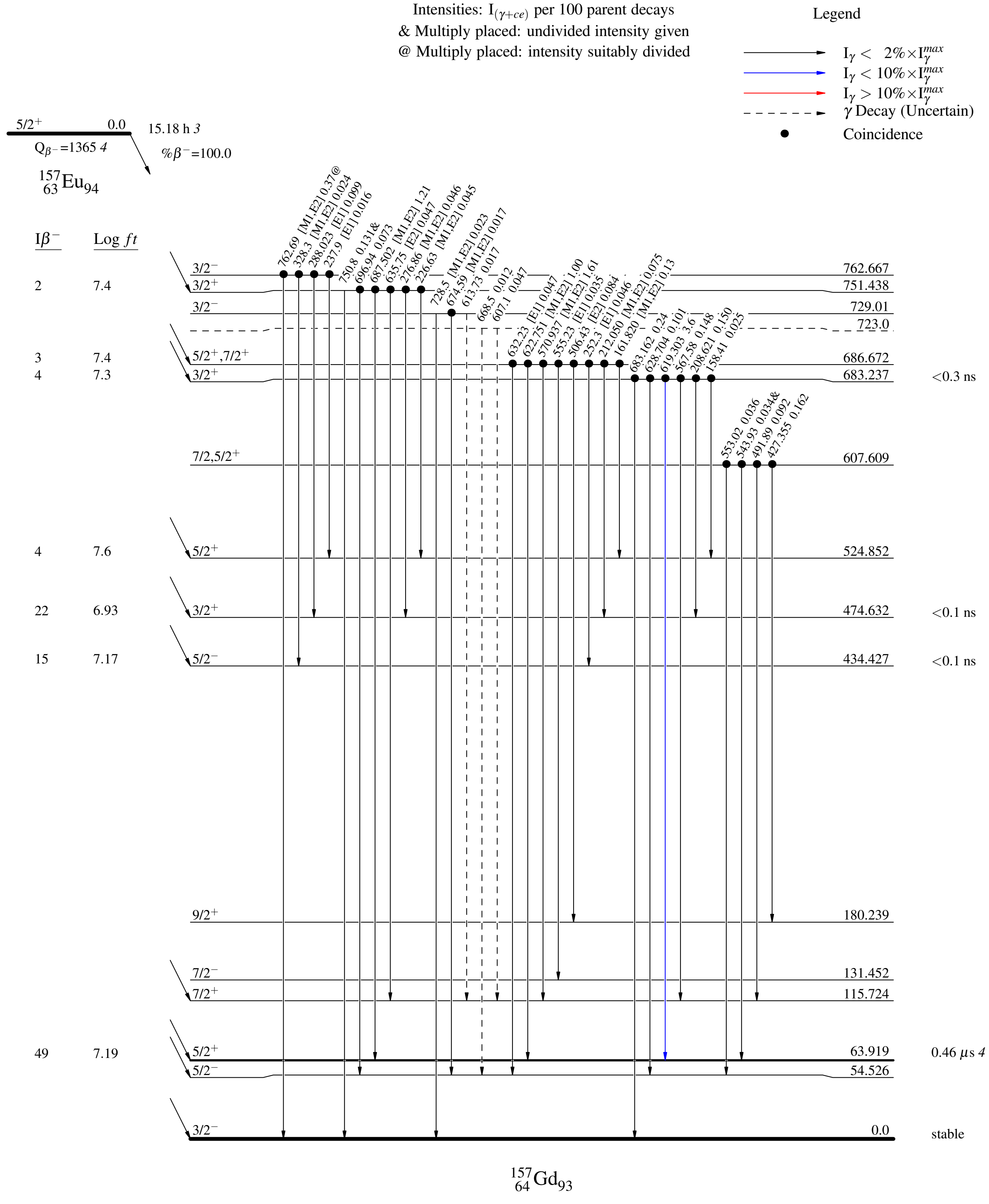
Intensities: $I_{(\gamma+ce)}$ per 100 parent decays
& Multiply placed: undivided intensity given
@ Multiply placed: intensity suitably divided



^{157}Eu β^- decay 1986GrZS

Decay Scheme (continued)

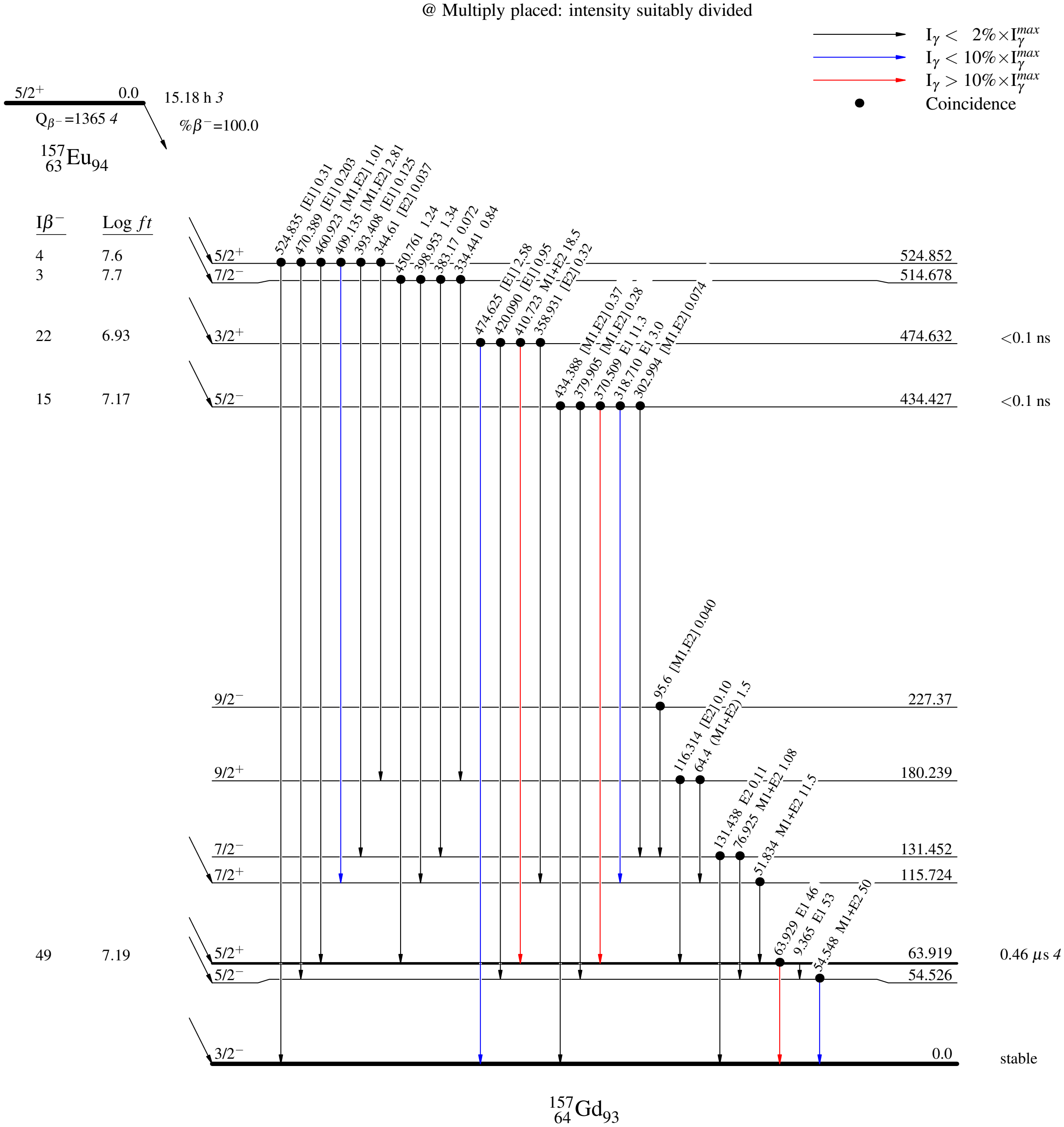
Intensities: $I_{(\gamma+ce)}$ per 100 parent decays
& Multiply placed: undivided intensity given
@ Multiply placed: intensity suitably divided



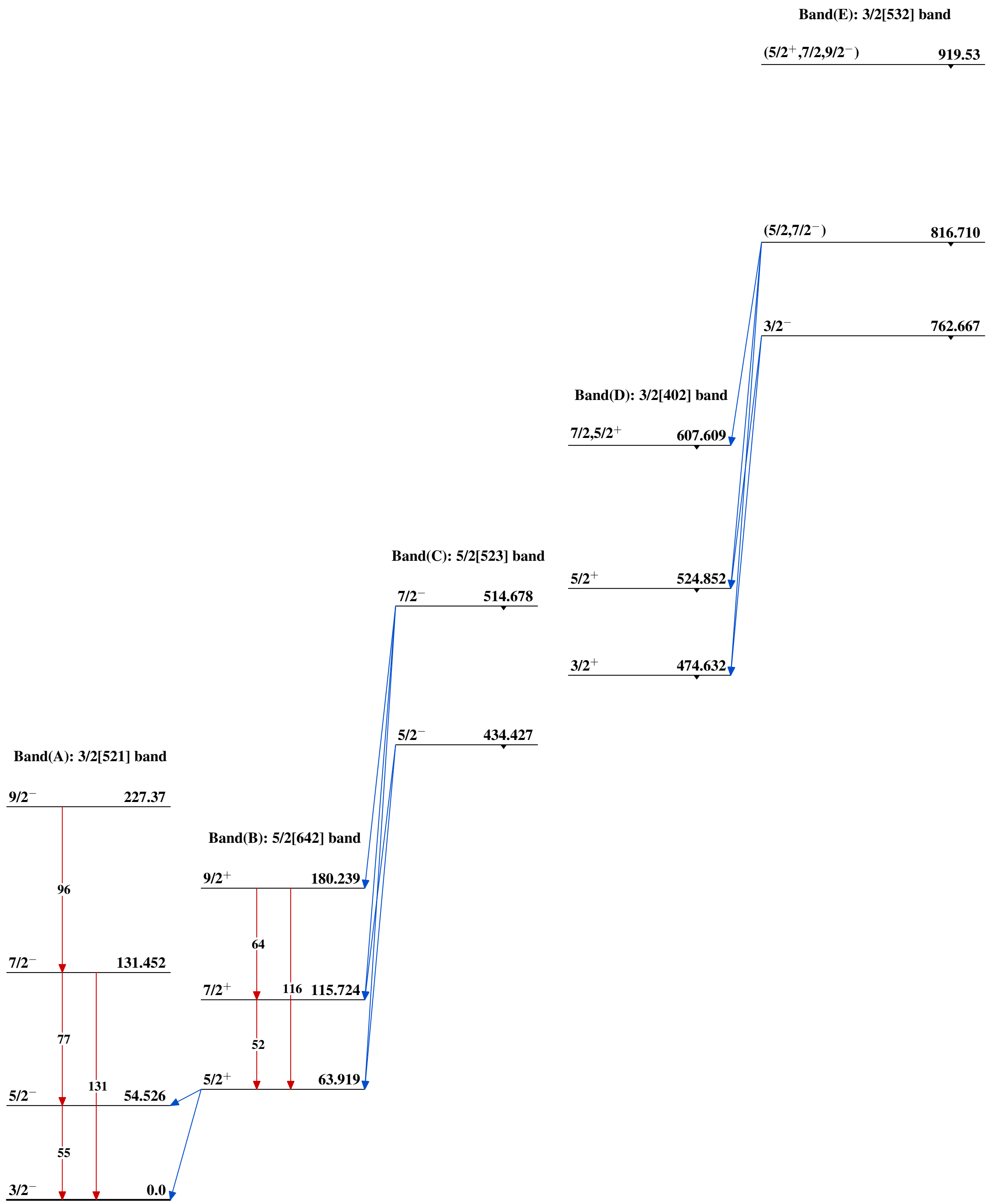
^{157}Eu β^- decay 1986GrZS

Decay Scheme (continued)

Intensities: $I_{(\gamma+ce)}$ per 100 parent decays
& Multiply placed: undivided intensity given
@ Multiply placed: intensity suitably divided



^{157}Eu β^- decay 1986GrZS



$^{157}_{64}Gd_{93}$