^{159}Eu β^- decay 1969Ke10

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	C. W. Reich	NDS 113, 157 (2012)	31-Dec-2010

Parent: ^{159}Eu: E=0.0; J^π=5/2$^+$; $T_{1/2}$=18.1 min *1*; Q(β^-)=2515 *7*; %β^- decay=100.0

Additional information 1.

The decay scheme is that of 1969Ke10 and data are from 1969Ke10, unless otherwise noted. Other: 1961Ku10, 1964Iw01, 1965Iw01, 1965Mu16, 1966Da06, 1966Da19, 1974Da24.

The intensity of the β^- feeding of the several levels below 60 keV is not known; therefore, the absolute β^- feeding of the higher levels is not known. However, the intensities have been normalized for a particular assumption about this β feeding.

^{159}Gd Levels

E(level)†	J^π‡	Comments
0.0	3/2$^-$	
50.64 *8*	5/2$^-$	
67.77 *7*	5/2$^+$	
118.91 *15*	7/2$^+$	
121.91 *13*	7/2$^-$	
146.38 *8*	5/2$^-$	
185.4 *4*	9/2$^+$	
212.29 *23*	9/2$^-$	
227.47 *10*	7/2$^-$	
602.12 *17*	(3/2$^+$)	
710.18 *13*		
732.57 *10*		
744.37 *11*	3/2$^+$	
872.69 *14*	5/2$^-$	
948.49 *22*	7/2$^-$	
1128.51 *21*		
1162.66 *18*	5/2,7/2	
1351.8? *3*	(5/2$^+$)	E(level): In subsequent (n,γ) and single-nucleon transfer-reaction studies, 2004Gr26 do not confirm the existence of this level, although they do confirm the existence of all the other levels seen in this (β-) study. It is not included in the Adopted Levels.
1519.80 *17*		

† From least-squares fit to γ energies.
‡ From ^{159}Gd Adopted Levels.

β^- radiations

1965Iw01 assume that the measured 2570-keV β^- branch was to the ground state. In contrast, 1969Ke10 assume this β^- was to the 67-keV level with no β^- to the 0- and 50-keV levels.

Results from analysis of measured β^- spectrum:

From 1965Iw01:

E(β^-) (keV)	I(β^-) (%)	Method
1000 *100*	10 *3*	BG-coincidence
1500 *50*	11 *3*	BG-coincidence
1750 *50*	11 *3*	BG-coincidence
1900 *50*	21 *4*	scintillation, F-K analysis
2350 *50*	21 *4*	scintillation, F-K analysis
2570 *50*	25 *4*	scintillation, F-K analysis

From 1961Ku10:

E(β^-) (keV)	I(β^-) (%)	Method
2200 *100*		scintillation, F-K analysis

From 1966Da06:

E(β^-) (keV)	I(β^-) (%)	Method
2400 *+20−10*		scintillation

E(decay)	E(level)	$I\beta^{-}$ †‡	Log *ft*	Comments
(995 *7*)	1519.80	1.1	6.7	av Eβ=336.9 *28*
(1163 *7*)	1351.8?	0.45	7.4	av Eβ=404.8 *29*
(1352 *7*)	1162.66	2.5	6.8	av Eβ=483.3 *30*
(1386 *7*)	1128.51	1.1	7.2	av Eβ=497.7 *30*
(1567 *7*)	948.49	1.4	7.3	av Eβ=574.2 *30*
(1642 *7*)	872.69	4.7	6.9	av Eβ=606.8 *31*
(1771 *7*)	744.37	3.3	7.2	av Eβ=662.5 *31*
(1782 *7*)	732.57	6.6	6.9	av Eβ=667.7 *31*
(1805 *7*)	710.18	2.1	7.4	av Eβ=677.4 *31*
(1913 *7*)	602.12	1.3	7.7	av Eβ=724.8 *31*
(2288 *7*)	227.47	14	7.0	av Eβ=890.9 *32*
(2303 *7*)	212.29	2.3	7.8	av Eβ=897.7 *32*
(2369 *7*)	146.38	37	6.6	av Eβ=927.2 *32*
(2393 *7*)	121.91	5	7.5	av Eβ=938.2 *32*
(2447 *7*)	67.77	19	7.0	av Eβ=962.5 *32*

† Relative values deduced from γ intensity balances. Values given are based on the assumption that there is no β^- feeding of the levels at 0 and 50 keV. The table gives the results from the decomposition of the β^- spectrum. From the density of the levels in ^{159}Gd it is clear that the reported components represent the decay to several levels. Due to the various ambiguities, no uncertainties are given for the Iβ and the associated log *ft* values.
‡ Absolute intensity per 100 decays.

$\gamma(^{159}$Gd)

Iγ normalization: calculated to give 100% feeding of the ground state with no β^- feeding of the levels at 0 and 50 keV.
2004Gr26, in (n_{th},γ), propose placements for some of the unplaced γ′s and propose alternate placements for some others. See their Table 5 for these placements.

E_γ	I_γ #	E_i(level)	J_i^π	E_f	J_f^π	Mult.‡	α @	$I_{(\gamma+ce)}$ #	Comments
(17.1)	7.6 *5*	67.77	5/2+	50.64	5/2−	[E1]	6.57		α(L)=5.15 *8*; α(M)=1.146 *16*; α(N+..)=0.279 *4* α(N)=0.248 *4*; α(O)=0.0302 *5*; α(P)=0.000848 *12* I_γ: γ not observed; Iγ deduced, relative to Iγ(67.7), from data of 67-keV isomer (1968Bo10).
50.7 *4*		50.64	5/2−	0.0	3/2−	[M1]		167	E_γ: from isomeric (26.2 ns) decay (1968Bo10).
≈51		118.91	7/2+	67.77	5/2+			11	E_γ: Existence of this γ and placement supported by possible γγ coincidences (1969Ke10). Also, 1965Iw01 observe a γ of 54 *4* keV in this decay. $I_{(\gamma+ce)}$: Value to give intensity balance at this level with no β^- feeding.
67.8 *1*	59 *13*	67.77	5/2+	0.0	3/2−	E1	0.824		α(K)=0.683 *10*; α(L)=0.1103 *17*; α(M)=0.0239 *4*; α(N+..)=0.00619 *9* α(N)=0.00538 *8*; α(O)=0.000770 *12*; α(P)=3.62×10^{-5} *6*
71.4 *2*	3.3 *8*	121.91	7/2−	50.64	5/2−	[M1,E2]	7.2 *19*		α(K)=3.5 *10*; α(L)=2.8 *22*; α(M)=0.7 *6*; α(N+..)=0.17 *13* α(N)=0.15 *12*; α(O)=0.020 *15*; α(P)=0.00023 *11*

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^{159}Eu β^- decay 1969Ke10 (continued)

$\gamma(^{159}$Gd) (continued)

E_γ	I_γ [#]	E_i(level)	J_i^π	E_f	J_f^π	Mult. [‡]	α [@]	Comments
78.6 *1*	28 *5*	146.38	5/2⁻	67.77	5/2⁺	[E1]	0.557	α(K)=0.464 *7*; α(L)=0.0727 *11*; α(M)=0.01578 *23*; α(N+..)=0.00409 *6* α(N)=0.00355 *6*; α(O)=0.000513 *8*; α(P)=2.51×10^{-5} *4*
80.4 *4*	3.8 *10*	227.47	7/2⁻	146.38	5/2⁻	[M1,E2]	4.7 *10*	α(K)=2.6 *6*; α(L)=1.7 *12*; α(M)=0.4 *3*; α(N+..)=0.10 *8* α(N)=0.09 *7*; α(O)=0.012 *8*; α(P)=0.00017 *7*
90.4 *2*	1.9 *3*	212.29	9/2⁻	121.91	7/2⁻	[M1,E2]	3.2 *5*	α(K)=1.9 *4*; α(L)=1.0 *7*; α(M)=0.23 *16*; α(N+..)=0.06 *4* α(N)=0.05 *4*; α(O)=0.007 *5*; α(P)=0.00012 *5*
95.7 *1*	21.5 *25*	146.38	5/2⁻	50.64	5/2⁻	[M1,E2]	2.6 *4*	α(K)=1.6 *4*; α(L)=0.8 *5*; α(M)=0.18 *12*; α(N+..)=0.05 *3* α(N)=0.04 *3*; α(O)=0.005 *4*; α(P)=0.00010 *4*
ˣ102.5 *2*	2.0 *2*							
105.5 *2*	2.2 *2*	227.47	7/2⁻	121.91	7/2⁻	[M1,E2]	1.90 *18*	α(K)=1.23 *23*; α(L)=0.5 *3*; α(M)=0.12 *8*; α(N+..)=0.031 *19* α(N)=0.027 *17*; α(O)=0.0036 *21*; α(P)=8.E−5 *3*
108.8 *3*	0.87 *13*	227.47	7/2⁻	118.91	7/2⁺	[E1]	0.233	α(K)=0.196 *3*; α(L)=0.0292 *5*; α(M)=0.00632 *11*; α(N+..)=0.00165 *3* α(N)=0.001431 *23*; α(O)=0.000210 *4*; α(P)=1.106×10^{-5} *18*
118. *2*		185.4	9/2⁺	67.77	5/2⁺			
121.9 *2*	1.2 *2*	121.91	7/2⁻	0.0	3/2⁻	[E2]	1.228 *19*	α(K)=0.674 *10*; α(L)=0.428 *7*; α(M)=0.1005 *16*; α(N+..)=0.0255 *4* α(N)=0.0225 *4*; α(O)=0.00298 *5*; α(P)=3.45×10^{-5} *5*
146.4 *1*	10	146.38	5/2⁻	0.0	3/2⁻	[M1,E2]	0.663 *21*	α(K)=0.49 *9*; α(L)=0.14 *6*; α(M)=0.031 *14*; α(N+..)=0.008 *4* α(N)=0.007 *3*; α(O)=0.0010 *4*; α(P)=3.2×10^{-5} *11*
159.8 *2*	4.2 *3*	227.47	7/2⁻	67.77	5/2⁺	[E1]	0.0826	α(K)=0.0698 *10*; α(L)=0.01004 *15*; α(M)=0.00217 *4*; α(N+..)=0.000572 *9* α(N)=0.000494 *8*; α(O)=7.37×10^{-5} *11*; α(P)=4.16×10^{-6} *6*
176.9 *1*	4.0 *2*	227.47	7/2⁻	50.64	5/2⁻	[M1,E2]	0.37 *4*	α(K)=0.28 *6*; α(L)=0.068 *19*; α(M)=0.015 *5*; α(N+..)=0.0040 *12* α(N)=0.0035 *11*; α(O)=0.00049 *12*; α(P)=1.9×10^{-5} *7*
227.5 *3*	5.0 *15*	227.47	7/2⁻	0.0	3/2⁻	[E2]	0.1451	α(K)=0.1048 *16*; α(L)=0.0313 *5*; α(M)=0.00718 *11*; α(N+..)=0.00185 *3* α(N)=0.001617 *25*; α(O)=0.000224 *4*; α(P)=6.19×10^{-6} *9*
498.2 *7*	1.0 *3*	710.18		212.29	9/2⁻			
ˣ521.4 *7*	0.5 *2*							
551.3 *3*	1.2 *1*	602.12	(3/2⁺)	50.64	5/2⁻			
ˣ575.5 *4*	0.8 *1*							
588.6 *3*	1.2 *2*	710.18		121.91	7/2⁻			
ˣ596.0 *4*	1.0 *2*							
602.2 *2*	2.7 *2*	602.12	(3/2⁺)	0.0	3/2⁻			
613.4 *2*	3.9 *3*	732.57		118.91	7/2⁺			
645.7 *3*	1.1 *1*	872.69	5/2⁻	227.47	7/2⁻			
659.5 *1*	4.1 *3*	710.18		50.64	5/2⁻			
664.9 *1*	9.4 *5*	732.57		67.77	5/2⁺			
676.6 *1*	5.8 *3*	744.37	3/2⁺	67.77	5/2⁺			
681.9 *1*	7.1 *4*	732.57		50.64	5/2⁻			
693.8 *3*	1.5 *1*	744.37	3/2⁺	50.64	5/2⁻			

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^{159}Eu β^- decay 1969Ke10 (continued)

γ(^{159}Gd) (continued)

E_γ	I_γ [#]	E_i(level)	J^π_i	E_f	J^π_f	E_γ	I_γ [#]	E_i(level)	J^π_i	E_f	J^π_f
720.4 *5*	0.5 *1*	948.49	7/2⁻	227.47	7/2⁻	1060.4 *4*	0.9 *1*	1128.51		67.77	5/2⁺
726.5 *3*	2.0 *2*	872.69	5/2⁻	146.38	5/2⁻	1078.4 *4*	0.8 *1*	1128.51		50.64	5/2⁻
733.1[&] *4*	0.75 *15*	732.57		0.0	3/2⁻	1094.8 *2*	3.7 *3*	1162.66	5/2,7/2	67.77	5/2⁺
744.3 *2*	2.8 *2*	744.37	3/2⁺	0.0	3/2⁻	[x]1109.[†] *1*	0.8 *3*				
753.9 *2*	2.8 *2*	872.69	5/2⁻	118.91	7/2⁺	1128.4 *3*	1.6 *2*	1128.51		0.0	3/2⁻
763.1 *3*	1.0 *1*	948.49	7/2⁻	185.4	9/2⁺	[x]1159.4[†] *5*	0.19 *3*				
804.7 *2*	7.9 *5*	872.69	5/2⁻	67.77	5/2⁺	[x]1181.6 *10*	0.35 *10*				
829.7 *3*	1.7 *2*	948.49	7/2⁻	118.91	7/2⁺	[x]1220.7 *4*	0.6 *1*				
871.4 *5*	0.65 *10*	872.69	5/2⁻	0.0	3/2⁻	1301.5[&] *3*	1.0 *1*	1351.8?	(5/2⁺)	50.64	5/2⁻
880.8 *3*	1.0 *1*	948.49	7/2⁻	67.77	5/2⁺	1350.8[&] *5*	0.37 *6*	1351.8?	(5/2⁺)	0.0	3/2⁻
[x]915.7 *6*	0.5 *1*					[x]1433.7 *5*	0.75 *15*				
936.1 *5*	0.9 *2*	1162.66	5/2,7/2	227.47	7/2⁻	1451.6 *5*	0.6 *1*	1519.80		67.77	5/2⁺
1015 *1*	1.5 *5*	1162.66	5/2,7/2	146.38	5/2⁻	1468.6 *4*	0.9 *1*	1519.80		50.64	5/2⁻
[x]1038.2[†] *7*	0.6 *1*					1520.0 *2*	2.0 *2*	1519.80		0.0	3/2⁻
1043.7 *4*	1.6 *2*	1162.66	5/2,7/2	118.91	7/2⁺						

[†] γ proposed by 2004Gr26 (their Table 5) in (n_{th},γ) to deexcite a level at 1159.9 keV.
[‡] From ^{159}Gd Adopted γ radiations.
[#] For absolute intensity per 100 decays, multiply by 0.325.
[@] 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.
[&] Placement of transition in the level scheme is uncertain.
[x] γ ray not placed in level scheme.

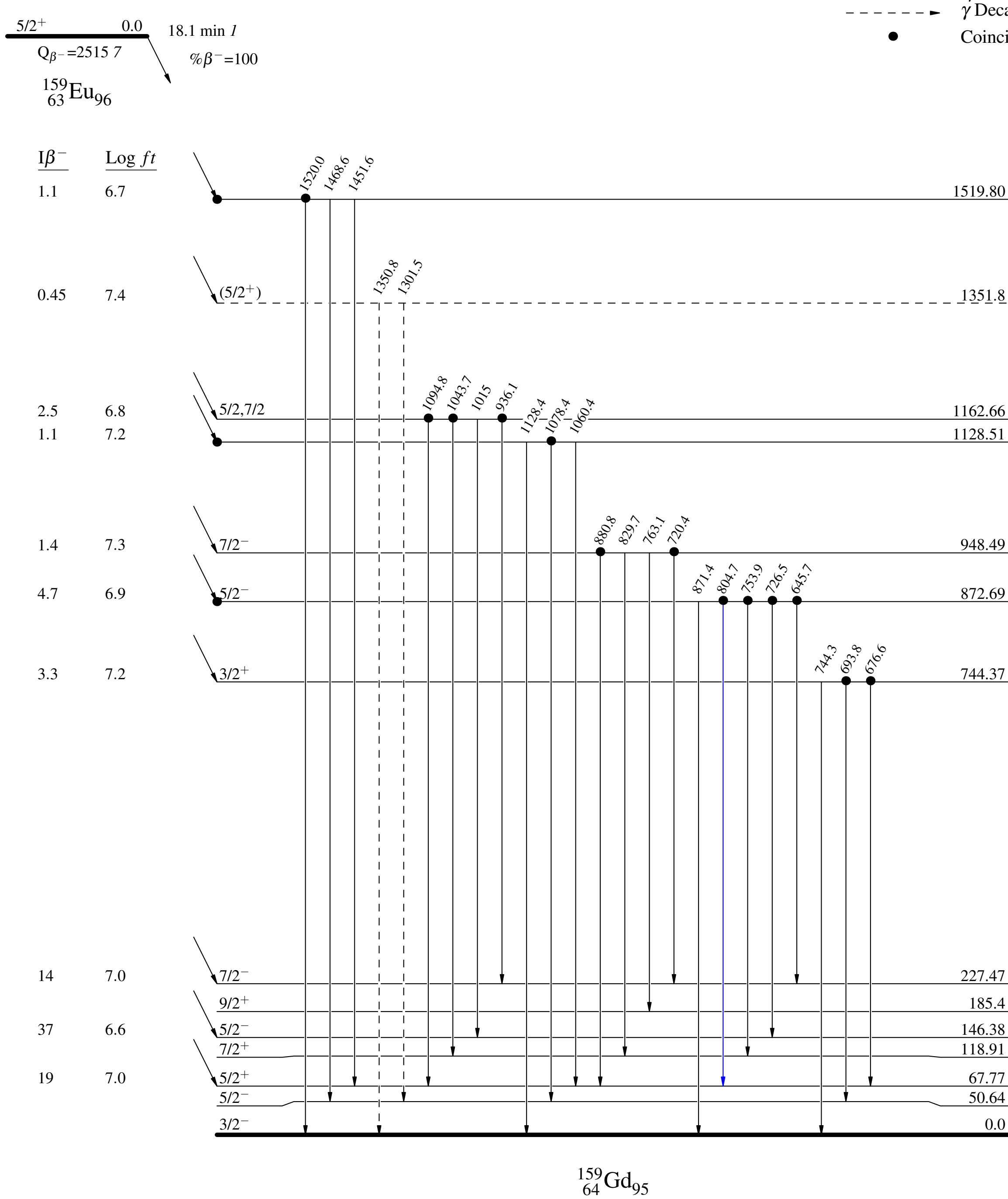
^{159}Eu β^- decay 1969Ke10

Decay Scheme

Intensities: Relative $I_{(\gamma+ce)}$

Legend

- $I_\gamma < 2\% \times I_\gamma^{max}$
- $I_\gamma < 10\% \times I_\gamma^{max}$
- $I_\gamma > 10\% \times I_\gamma^{max}$
- γ Decay (Uncertain)
- Coincidence



^{159}Eu β^- decay 1969Ke10

Decay Scheme (continued)

Intensities: Relative $I_{(\gamma+ce)}$