^{66}Ge ε decay 1970De39

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	E. Browne, J. K. Tuli	NDS 111, 1093 (2010)	3-Mar-2009

Parent: ^{66}Ge: E=0.0; $J^{\pi}=0^+$; $T_{1/2}$=2.26 h *5*; Q(ε)=2100 *30*; %ε+%$β^+$ decay=100.0

Additional information 1.

1970De39: measured: Eγ, Iγ, Ice, Eβ+, γγ, and $\beta^+\gamma$ coincidences; Ge(Li) and Si(Li) detectors.

1969Ba31: measured: Eγ, Iγ, γγ and $\beta^+\gamma$ coincidences, $T_{1/2}$.

1969Bo21: measured: Eγ, Iγ, γγ coincidences, $T_{1/2}$.

1969Sa08: measured: Eγ, Iγ, Eβ+, γγ and $\beta^+\gamma$ coincidences.

Others: 1960Ri10, 1970Dz02, 1970Dz06, 1968Vr01.

The decay scheme is from 1970De39, γγ coincidence data are from 1969Ba31, 1969Bo21, 1969Sa08, and 1970De39. Other: 1968Vr01.

Conversion electron data are from 1970De39. $T_{1/2}$ of ^{66}Ga excited states have been measured from delayed-γγ coincidences by 1969Ba31, 1969Bo21, 1970De39.

1975Ro25: Measured Eγ, Iγ, delayed γγ coin, $T_{1/2}$.

^{66}Ga Levels

E(level)†	J^{π}‡	$T_{1/2}$	Comments
0.0	0^+	9.49 h *3*	$T_{1/2}$: From Adopted Levels.
43.81 *3*	1^+	18.0 ns *9*	$T_{1/2}$: From (338γ)(43.8γ)(t) (1975Ro25) others, from delayed-γγ coincidences: 12 ns *1* (1969Ba31), 21 ns *2* (1969Bo21), <12 ns (1970De39).
66.14 *4*	$(2)^+$		
108.874 *21*	1^+	1.2 ns *2*	$T_{1/2}$: from (246γ,273γ)(109γ)(t) (1969Ba31).
162.44 *5*	$(3)^+$		
234.065 *25*	2^+		
290.90 *3*	$(0,1)^+$		
381.859 *24*	1^+		
536.62 *3*	1^+		
664.26 *10*	$(1,2)^+$		
705.990 *23*	1^+		
865.82 *10*	1^+		
974.14 *6*	$(1,2^+)$		
1001.38 *15*			
1061.98 *22*			
1076.6 *4*			
1164.22 *22*			
1210.18 *4*			
1456.09 *7*	1^+		
1556.66 *4*	1^+		
1573.7 *3*	$1^{(+)}$		
1769.35 *20*	1^+		

† Deduced by evaluators from least-squares fit to γ-ray energies.

‡ From Adopted Levels.

^{66}Ge ε decay 1970De39 (continued)

ε,β+ radiations

β+γ coincidence data, β+ endpoint energies are from 1970De39. Others: 1969Ba31, 1969Sa08.

E(decay)	E(level)	Iβ+ †‡	Iε†‡	Log *ft*	I(ε+β+)‡	Comments
(3.3×10^2 *3*)	1769.35		0.18 *6*	5.33 *17*	0.18 *6*	εK=0.8786; εL=0.1027 *6*; εM+=0.01874 *11*
(5.3×10^2 *3*)	1573.7		0.18 *12*	5.7 *3*	0.18 *12*	εK=0.8809; εL=0.10079 *19*; εM+=0.01835 *4*
(5.4×10^2 *3*)	1556.66		1.41 *11*	4.87 *7*	1.41 *11*	εK=0.8810; εL=0.10069 *18*; εM+=0.01833 *4*
(6.4×10^2 *3*)	1456.09		1.30 *10*	5.06 *6*	1.30 *10*	εK=0.8815; εL=0.10022 *13*; εM+=0.01823 *3*
(8.9×10^2 *3*)	1210.18		0.18 *3*	6.20 *8*	0.18 *3*	εK=0.8824; εL=0.09953; εM+=0.01809
(9.4×10^2 *3*)	1164.22		0.08 *4*	6.60 *22*	0.08 *4*	εK=0.8825; εL=0.09944; εM+=0.01807
(1.02×10^3 *3*)	1076.6		0.07 *6*	6.7 *4*	0.07 *6*	εK=0.8827; εL=0.09929; εM+=0.01804
(1.04×10^3 *3*)	1061.98		0.12 *6*	6.51 *22*	0.12 *6*	εK=0.8827; εL=0.09927; εM+=0.01804
(1.10×10^3 *3*)	1001.38		0.10 *3*	6.64 *14*	0.10 *3*	εK=0.8828; εL=0.09918; εM+=0.01802
(1.13×10^3 *3*)	974.14		0.17 *5*	6.43 *13*	0.17 *5*	εK=0.8827; εL=0.09913; εM+=0.01801
(1.23×10^3 *3*)	865.82	0.0031 *22*	0.80 *9*	5.84 *6*	0.80 *9*	av Eβ=95 *13*; εK=0.8796 *24*; εL=0.0986 *3*; εM+=0.01792 *6*
(1.39×10^3 *3*)	705.990	0.31 *10*	9.0 *5*	4.90 *4*	9.3 *5*	av Eβ=162 *13*; εK=0.854 *10*; εL=0.0956 *11*; εM+=0.01735 *20*
(1.56×10^3 *3*)	536.62	2.7 *5*	19.5 *9*	4.66 *4*	22.2 *8*	av Eβ=233 *13*; εK=0.777 *20*; εL=0.0869 *22*; εM+=0.0158 *4* Eβ+ endpoint energy=558 *50* from β+γ(537) coincidence (1970De39).
(1.72×10^3 *3*)	381.859	12.0 *14*	36.3 *20*	4.47 *4*	48.3 *19*	av Eβ=299 *13*; εK=0.664 *25*; εL=0.074 *3*; εM+=0.0135 *5* Eβ+ endpoint energy=668 *30* from β+(382γ) coincidence (1970De39).
(1.99×10$^{3\#}$ *3*)	108.874	0.7 *6*	0.6 *6*	6.4 *4*	1.3 *12*	av Eβ=418 *14*; εK=0.440 *23*; εL=0.049 *3*; εM+=0.0089 *5*
(2.03×10$^{3\#}$ *3*)	66.14	0.7 *6*	0.6 *6*	6.4 *4*	1.3 *12*	av Eβ=437 *14*; εK=0.408 *22*; εL=0.0455 *25*; εM+=0.0083 *5*
(2.06×10^3 *3*)	43.81	7.2 *12*	5.7 *9*	5.43 *8*	12.9 *20*	av Eβ=446 *14*; εK=0.393 *22*; εL=0.0438 *24*; εM+=0.0079 *5* Eβ+ endpoint energy=1028 *30* from β+(44γ) coincidence (1970De39).

† From theoretical Iβ+/Iε ratios and I(ε+β+) from I(γ+ce) imbalance at each level.
‡ Absolute intensity per 100 decays.
# Existence of this branch is questionable.

^{66}Ge ε decay 1970De39 (continued)

γ(^{66}Ga)

Iγ normalization: Based on Iγ(γ±)/Iγ(381.85)=1.54 *10* (1970De39) and theoretical Iβ+/Iε ratios; calculations with these indicate that the g.s. ε+β+ feeding is zero within the estimated uncertainty. The normalization factor was calculated by setting the g.s. feeding to be identically equal to zero, and assuming Σ (I(γ+ce) to g.s.)=100%.

Reported γγ coincidences inconsistent with decay scheme of 1970De39: (109γ)(471γ) in 1969Ba31, (44γ)(382γ), (66γ)(316γ), (109γ)(316γ), and (190γ)(471γ) in 1969Sa08.

α(K)exp and α(L)exp are from 1970De39.

E_γ‡	I_γ#b	E_i(level)	J_i^π	E_f	J_f^π	Mult.@	δ@	α†	Comments
22.43 *6*	5.6 *4*	66.14	(2)+	43.81	1+	M1+E2	0.079 *17*	5.9 *5*	α(L)exp=0.77 *13* α(K)=5.0 *4*; α(L)=0.77 *14*; α(M)=0.111 *20*; α(N+..)=0.0043 *4* α(N)=0.0043 *4* Eγ: 21γ placed from level at 536.6 in 1969Sa08.
x38.58 *10*	0.3 *3*								
x39.97 *10*	1.3 *7*								Eγ: a strong Eγ=39.5 *3* (Iγ=19 *3*) is placed from a proposed level at 422 by 1969Sa08.
41.84 *10*	0.5 *4*	705.990	1+	664.26	(1,2)+	[D]		0.85a *3*	α(K)=0.74; α(L)=0.08
42.83d *20*	4 *1*	108.874	1+	66.14	(2)+	[M1]		0.747 *15*	α(K)=0.664 *13*; α(L)=0.0718 *14*; α(M)=0.01050 *21*; α(N+..)=0.000551 *11* α(N)=0.000551 *11* Eγ: 42.83γ seen only in coincidence with 43.89γ (1970De39).
43.89 *7*	103 *3*	43.81	1+	0.0	0+	M1&		0.696	α(K)exp=0.64 *5*; α(L)exp=0.092 *7* α(K)=0.619 *10*; α(L)=0.0669 *10*; α(M)=0.00978 *15*; α(N+..)=0.000514 *8* α(N)=0.000514 *8*
53.39 *20*	≤1.1	162.44	(3)+	108.874	1+				Iγ: 1.1 *4* from 1970De39. In serious disagreement with the very weak 53γ branch observed in ^{66}Zn(p,nγ).
x55.4 *5*	0.3 *2*								
65.12 *11*	25.4 *10*	108.874	1+	43.81	1+	(M1+E2)&	<0.04	0.230 *5*	α(K)exp=0.208 *14*; α(L)exp=0.021 *4* α(K)=0.205 *4*; α(L)=0.0220 *5*; α(M)=0.00322 *7*; α(N+..)=0.000169 *3* α(N)=0.000169 *3*
71.62 *4*	0.6 *1*	234.065	2+	162.44	(3)+	[D]		0.178a	α(K)=0.1562; α(L)=0.0163
90.94 *5*	1.4 *4*	381.859	1+	290.90	(0,1)+	[M1]		0.0904	α(K)=0.0806 *12*; α(L)=0.00856 *12*; α(M)=0.001252 *18*; α(N+..)=6.64×10^{-5} *10* α(N)=6.64×10^{-5} *10*
96.34 *9*	0.7 *2*	162.44	(3)+	66.14	(2)+	(M1+E2)		0.4 *4*	α(K)=0.4 *4*; α(L)=0.05 *4*; α(M)=0.007 *6*; α(N+..)=0.00030 *25* α(N)=0.00030 *25*
108.85 *3*	37.4 *12*	108.874	1+	0.0	0+	M1&		0.0556	α(K)exp=0.050 *4*; α(L)exp=0.006 *3* α(K)=0.0495 *7*; α(L)=0.00524 *8*; α(M)=0.000766 *11*; α(N+..)=4.07×10^{-5} *6* α(N)=4.07×10^{-5} *6*

$^{66}_{31}Ga_{35}$-3

^{66}Ge ε decay 1970De39 (continued)

γ(^{66}Ga) (continued)

E_γ[‡]	I_γ[#b]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[@]	δ[@]	α[†]	Comments
125.17 *3*	1.1 *1*	234.065	2^+	108.874	1^+	M1+E2		0.17 *14*	α(K)=0.15 *12*; α(L)=0.017 *14*; α(M)=0.0025 *20*; α(N+..)=0.00012 *9* α(N)=0.00012 *9* δ: −4.0 *5* for J^π(234)=2^+, −0.34 *10* for J^π(234)=1^+ from γ(θ) in (α,nγ); <0.24 from α(K)exp in (p,nγ).
147.79 *3*	4.6 *9*	381.859	1^+	234.065	2^+	[M1]		0.0247	α(K)=0.0220 *3*; α(L)=0.00231 *4*; α(M)=0.000338 *5*; α(N+..)=1.80×10^{-5} *3* α(N)=1.80×10^{-5} *3*
154.74 *3*	1.1 *1*	536.62	1^+	381.859	1^+	[M1]		0.0219	α(K)=0.0195 *3*; α(L)=0.00204 *3*; α(M)=0.000299 *5*; α(N+..)=1.597×10^{-5} *23* α(N)=1.597×10^{-5} *23*
169.47 *10*	0.6 *3*	705.990	1^+	536.62	1^+	[M1]		0.01729	α(K)=0.01543 *22*; α(L)=0.001611 *23*; α(M)=0.000236 *4*; α(N+..)=1.261×10^{-5} *18* α(N)=1.261×10^{-5} *18* E_γ: given as 166 *1* by 1969Ba31.
182.03 *4*	20.2 *10*	290.90	$(0,1)^+$	108.874	1^+	M1+E2[&]	−0.22 *12*	0.017 *4*	α(K)exp=0.0115 *15* α(K)=0.015 *3*; α(L)=0.0016 *4*; α(M)=0.00024 *5*; α(N+..)=1.23×10^{-5} *24* α(N)=1.23×10^{-5} *24*
190.20 *3*	20.3 *15*	234.065	2^+	43.81	1^+	M1+E2[&]	0.27 *10*	0.016 *3*	α(K)exp=0.0144 *19* α(K)=0.0145 *24*; α(L)=0.0015 *3*; α(M)=0.00022 *4*; α(N+..)=1.17×10^{-5} *18* α(N)=1.17×10^{-5} *18* Mult.,δ: from α(K)exp=0.0144 *19* in ^{66}Ge ε decay.
196.1 *3*	0.2 *2*	1061.98		865.82	1^+				
201.1 *3*	0.3 *1*	865.82	1^+	664.26	$(1,2)^+$				
225.93[d] *24*	0.7 *2*	290.90	$(0,1)^+$	66.14	$(2)^+$				
234.02 *20*	0.3 *1*	234.065	2^+	0.0	0^+	E2		0.0291	α(K)=0.0259 *4*; α(L)=0.00281 *4*; α(M)=0.000408 *6*; α(N+..)=2.02×10^{-5} *3* α(N)=2.02×10^{-5} *3*
245.71 *3*	19.2 *7*	536.62	1^+	290.90	$(0,1)^+$	M1		0.00675 *10*	α=0.00675 *10*; α(K)=0.00603 *9*; α(L)=0.000623 *9*; α(M)=9.12×10^{-5} *13*; α(N+..)=4.90×10^{-6} *7* α(N)=4.90×10^{-6} *7* E_γ: doublet proposed in 1969Sa08 with one γ placed from the 537 level and the additional one placed from the 291 level.
272.97 *4*	37.4 *13*	381.859	1^+	108.874	1^+	M1+E2	+0.24 *10*	0.0058 *6*	α=0.0058 *6*; α(K)=0.0052 *5*; α(L)=0.00054 *6*; α(M)=7.9×10^{-5} *8*; α(N+..)=4.2×10^{-6} *4* α(N)=4.2×10^{-6} *4*
291.23 *16*	0.9 *5*	290.90	$(0,1)^+$	0.0	0^+				
302.52 *3*	8.9 *7*	536.62	1^+	234.065	2^+				
315.55 *13*	2.9 *1*	381.859	1^+	66.14	$(2)^+$				E_γ: placed from a proposed level at 422 by 1969Sa08.

$^{66}_{31}Ga_{35}$-4

^{66}Ge ε decay 1970De39 (continued)

γ(^{66}Ga) (continued)

E_γ[‡]	I_γ[#b]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[@]	δ[@]	α[†]	Comments
323.8 *3*	0.5 *1*	705.990	1^+	381.859	1^+				
338.05 *3*	31.0 *20*	381.859	1^+	43.81	1^+	M1+E2	−0.05 *9*	0.00311 *9*	α=0.00311 *9*; α(K)=0.00278 *8*; α(L)=0.000286 *9*; α(M)=4.18×10^{-5} *13*; α(N+..)=2.25×10^{-6} *7* α(N)=2.25×10^{-6} *7*
370.5 *5*	0.2 *2*	1076.6		705.990	1^+				
381.85 *5*	100 *5*	381.859	1^+	0.0	0^+	M1[&]		0.00232 *4*	α(K)exp=0.0020 *3* α=0.00232 *4*; α(K)=0.00208 *3*; α(L)=0.000213 *3*; α(M)=3.11×10^{-5} *5*; α(N+..)=1.678×10^{-6} *24* α(N)=1.678×10^{-6} *24* I_γ: ΔIγ=5 estimated by evaluators.
415.28 *13*	1.5 *2*	705.990	1^+	290.90	$(0,1)^+$				
427.83 *6*	1.9 *4*	536.62	1^+	108.874	1^+				
470.62 *6*	26.4 *13*	536.62	1^+	66.14	$(2)^+$				E_γ: placed from a proposed level at 514 in 1969Bo21, 1969Sa08.
472.00 *11*	11.6 *8*	705.990	1^+	234.065	2^+				
484.11 *20*	0.3 *1*	865.82	1^+	381.859	1^+				
492.63 *15*	2.2 *1*	536.62	1^+	43.81	1^+				
[x]529.9 *2*	0.3 *1*								
536.74 *7*	21.9 *7*	536.62	1^+	0.0	0^+	M1		0.001060 *15*	α=0.001060 *15*; α(K)=0.000949 *14*; α(L)=9.65×10^{-5} *14*; α(M)=1.411×10^{-5} *20*; α(N+..)=7.64×10^{-7} α(N)=7.64×10^{-7} *11*
555.01[cd] *20*	≤0.4	664.26	$(1,2)^+$	108.874	1^+				
555.01[cd] *20*	≤0.4	1556.66	1^+	1001.38					
597.14 *4*	0.9 *1*	705.990	1^+	108.874	1^+				
619.46[cd] *15*	≤0.3	664.26	$(1,2)^+$	43.81	1^+	M1		0.000770 *11*	α=0.000770 *11*; α(K)=0.000690 *10*; α(L)=7.00×10^{-5} *10*; α(M)=1.023×10^{-5} *15*; α(N+..)=5.54×10^{-7} α(N)=5.54×10^{-7} *8*
619.46[cd] *15*	≤0.3	1001.38		381.859	1^+				
639.74 *11*	2.1 *1*	705.990	1^+	66.14	$(2)^+$				E_γ: placed from a proposed level at 640 in 1969Sa08.
662.19 *5*	0.4 *1*	705.990	1^+	43.81	1^+				
664.8 *3*	0.3 *1*	664.26	$(1,2)^+$	0.0	0^+				
705.94 *3*	15.2 *7*	705.990	1^+	0.0	0^+	M1		0.000579 *9*	α=0.000579 *9*; α(K)=0.000519 *8*; α(L)=5.25×10^{-5} *8*; α(M)=7.68×10^{-6} *11*; α(N+..)=4.16×10^{-7} *6* α(N)=4.16×10^{-7} *6*
[x]723.64 *10*	0.3 *1*								
740.12 *10*	0.2 *1*	974.14	$(1,2^+)$	234.065	2^+				
757.31 *17*	2.3 *1*	865.82	1^+	108.874	1^+	M1,E2		0.00057 *8*	α=0.00057 *8*; α(K)=0.00051 *7*; α(L)=5.2×10^{-5} *8*; α(M)=7.6×10^{-6} *11*; α(N+..)=4.1×10^{-7} *6* α(N)=4.1×10^{-7} *6*
782.3 *4*	0.2 *1*	1164.22		381.859	1^+				
799.2 *4*	0.08 *6*	865.82	1^+	66.14	$(2)^+$				

$^{66}_{31}Ga_{35}$-5

^{66}Ge ε decay 1970De39 (continued)

γ(^{66}Ga) (continued)

E_γ [‡]	I_γ [#b]	E_i(level)	J_i^π	E_f	J_f^π	Comments
812.4 *4*	0.08 *6*	974.14	(1,2$^+$)	162.44	(3)$^+$	
821.80 *15*	0.1 *1*	865.82	1$^+$	43.81	1$^+$	
865.82[cd] *23*	≤0.9	865.82	1$^+$	0.0	0$^+$	
865.82[cd] *23*	≤0.9	974.14	(1,2$^+$)	108.874	1$^+$	
892.06 *20*	0.2 *1*	1001.38		108.874	1$^+$	
907.89 *6*	0.13 *8*	974.14	(1,2$^+$)	66.14	(2)$^+$	
919.38 *24*	0.51 *20*	1456.09	1$^+$	536.62	1$^+$	
930.26 *20*	0.10 *4*	974.14	(1,2$^+$)	43.81	1$^+$	
935.68 *20*	0.15 *3*	1001.38		66.14	(2)$^+$	
974.91 *20*	0.09 *8*	974.14	(1,2$^+$)	0.0	0$^+$	E_γ: particularly poor fit to level energy difference. Probable ΔEγ≈1.
995.9 *3*	0.22 *6*	1061.98		66.14	(2)$^+$	
1010.5 *5*	0.06 *4*	1076.6		66.14	(2)$^+$	
1020.3 *3*	0.05 *3*	1556.66	1$^+$	536.62	1$^+$	
[x]1059.6 *4*	0.05 *3*					
[x]1094.8 *3*	0.19 *10*					
1101.26 *4*	0.53 *7*	1210.18		108.874	1$^+$	
1120.42 *25*	0.10 *6*	1164.22		43.81	1$^+$	
1144.13 *6*	0.12 *7*	1210.18		66.14	(2)$^+$	
1165.83 *21*	0.8 *2*	1456.09	1$^+$	290.90	(0,1)$^+$	E_γ: particularly poor fit to level energy difference. Probable ΔEγ≈1.
1174.74 *17*	0.43 *7*	1556.66	1$^+$	381.859	1$^+$	
1221.88 *7*	1.57 *10*	1456.09	1$^+$	234.065	2$^+$	
[x]1250.3 *5*	0.05 *4*					
1265.0 *4*	0.28 *5*	1556.66	1$^+$	290.90	(0,1)$^+$	
1322.54 *4*	1.58 *10*	1556.66	1$^+$	234.065	2$^+$	
[x]1329.5 *4*	0.30 *25*					
1339.6 *3*	0.05 *4*	1573.7	1$^{(+)}$	234.065	2$^+$	
1347.35 *25*	0.23 *8*	1456.09	1$^+$	108.874	1$^+$	
1387.4 *4*	0.05 *4*	1769.35	1$^+$	381.859	1$^+$	
1412.54 *17*	1.30 *10*	1456.09	1$^+$	43.81	1$^+$	
1456.6 *6*	0.30 *10*	1456.09	1$^+$	0.0	0$^+$	
1478.6 *4*	0.07 *7*	1769.35	1$^+$	290.90	(0,1)$^+$	
1490.43 *19*	0.40 *10*	1556.66	1$^+$	66.14	(2)$^+$	
1507.8 *6*	0.6 *4*	1573.7	1$^{(+)}$	66.14	(2)$^+$	
1512.87 *4*	2.4 *3*	1556.66	1$^+$	43.81	1$^+$	
[x]1536.2 *4*	0.04 *3*					
[x]1548.4 *4*	0.03 *3*					
1660.2 *4*	0.16 *12*	1769.35	1$^+$	108.874	1$^+$	
1769.5 *4*	0.34 *12*	1769.35	1$^+$	0.0	0$^+$	

[†] Additional information 2.

$^{66}_{31}Ga_{35}$-6

γ(^{66}Ga) (continued)

‡ From 1970De39. Inconsistencies between Eγ sums suggest uncertainties may be underestimated typically by a factor of 2.
# Relative intensity from 1970De39.
@ From Adopted Gammas, unless otherwise specified.
& From measured internal-conversion coefficients.
[a] Average of M1 and E1 values with an uncertainty large enough to cover both of them.
[b] For absolute intensity per 100 decays, multiply by 0.283 *6*.
[c] Multiply placed.
[d] Placement of transition in the level scheme is uncertain.
[x] γ ray not placed in level scheme.

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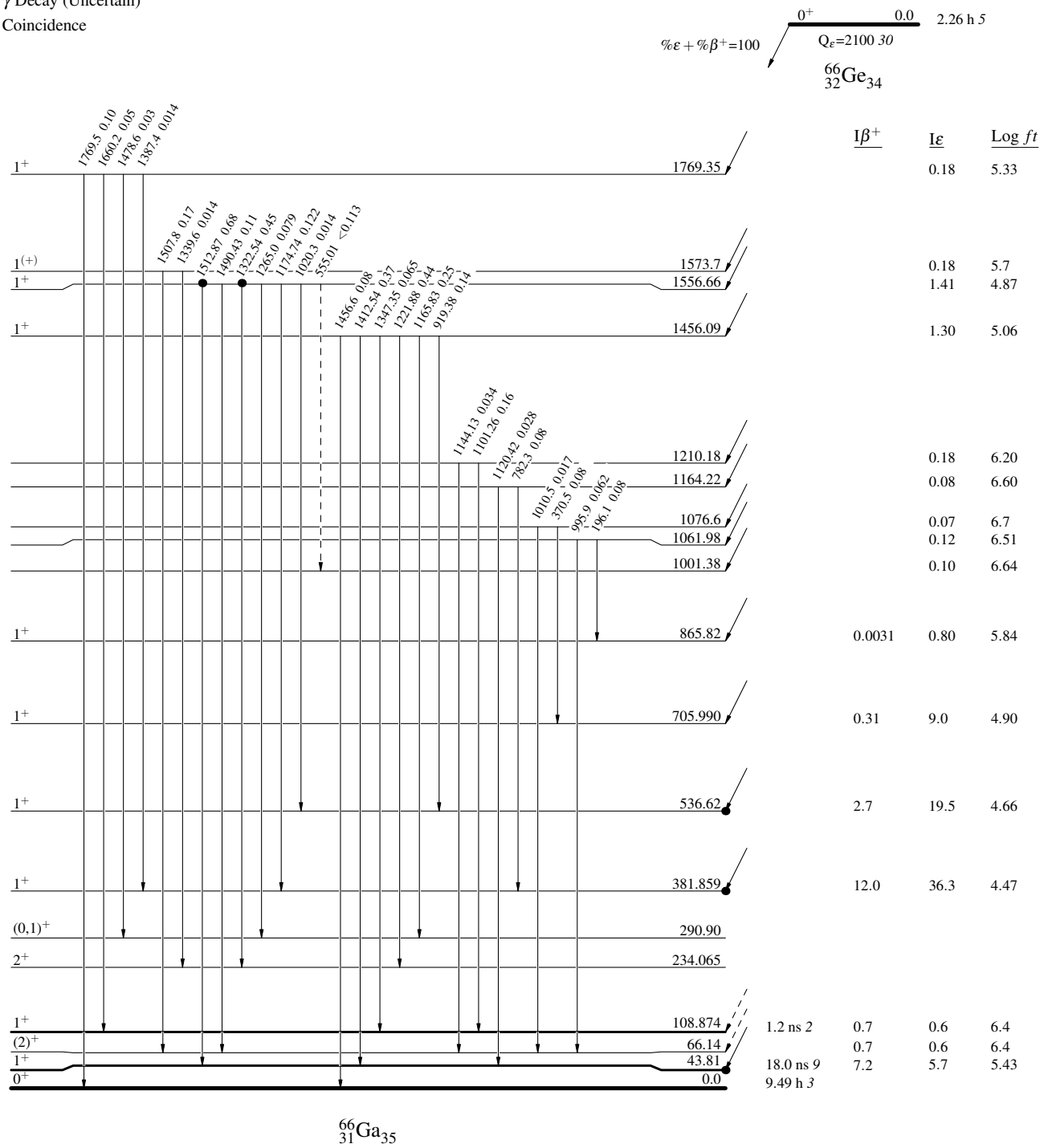
Decay Scheme

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

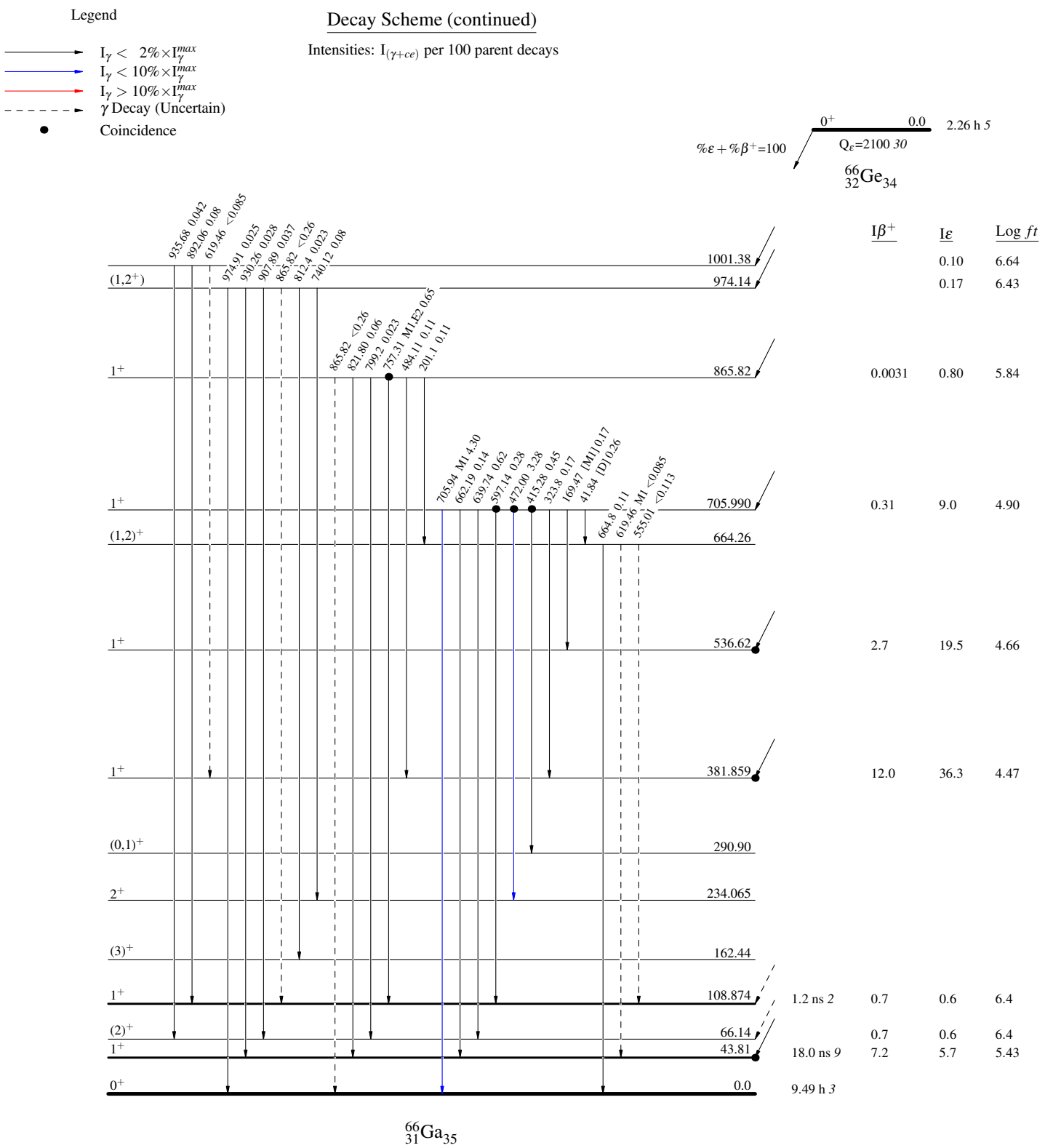
Legend
- $I_\gamma < 2\% \times I_\gamma^{max}$
- $I_\gamma < 10\% \times I_\gamma^{max}$
- $I_\gamma > 10\% \times I_\gamma^{max}$
- γ Decay (Uncertain)
- Coincidence



^{66}Ge ε decay 1970De39

Decay Scheme (continued)

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



^{66}Ge ε decay 1970De39

Decay Scheme (continued)

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