^{64}Ga ε decay (2.627 min) 1975Ra28,2007Mi12,1967Ma04

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh and Jun Chen	NDS 178, 41 (2021).	12-Nov-2021

Parent: ^{64}Ga: E=0.0; $J^\pi=0^+$; $T_{1/2}$=2.627 min *12*; Q(ε)=7171.2 *15*; %ε+%$β^+$ decay=100.0

^{64}Ga-J^π,$T_{1/2}$: From ^{64}Ga Adopted Levels. Spin=0 from βγ circular polarization measurements by 1966De10 and 1967Ma04.

^{64}Ga-Q(ε): From 2021Wa16.

Decays mainly by $β^+$ (only≈2% by ε).

1975Ra28: ^{64}Ga produced in ^{64}Zn(p,n),E(p)=10 MeV. Measured Eγ, Iγ for 37 γ rays at the Oak Ridge Van de Graaff accelerator. Discussed isospin-forbidden $0^+ \rightarrow 0^+$ β transitions.

2007Mi12: ^{64}Ga produced in ^{54}Fe(^{12}C,pn),E(^{12}C)=36 MeV reaction. Measured Eγ, Iγ, γγ-coin using three HPGe detectors at the Bucharest FN Tandem accelerator facility. Discussed staggering of γ vibrational band and E(5) critical point symmetry.

1990SuZR: measured Eγ, Iγ, $T_{1/2}$, $β^+$+ε feeding to the g.s. from the intensity of the annihilation radiation using mass-separated sources produced in ^{64}Zn(p,n),E(p)=16 MeV reaction at the IGISOL facility of the cyclotron laboratory, Tohoku University.

1967Ma04: measured Eγ, Iγ, γγ-coin for 25 γ rays, $β^+γ$ circular polarization at LBNL, Berkeley.

1967Ko02: measured Eγ, Iγ, γγ- and βγ-coin, $T_{1/2}$(^{64}Ga) at the Instituut voor Kernphysisch Onderzoek, Amsterdam.

1967Au04: measured Eγ, Iγ, Ge(Li) detector. Values of Eγ and Iγ, without uncertainties, for 21 γ rays are listed in 1967Ve09 evaluation.

1960Ja07: measured Eγ, Iγ, γγ- and βγ-coin, Eβ, Iβ, half-life of ^{64}Ga decay; 13 γ rays reported in this work, with intensities for 11 of these.

Other measurements:

1987Yo03: measured half-life of ^{64}Ga decay.

1985Pa07 (also 1983Pa05): conversion electron study for excited 0^+ states.

1980Na15: measured half-life of ^{64}Ga decay.

Additional information 1.

1976Mo12 (also 1977ReZK thesis): measured E($β^+$), shape factors.

1972Mo08: measured half-life of ^{64}Ga decay.

1966De10: measured $β^+γ$ circular polarization, establishing spin of 0 for ^{64}Ga parent.

1953Co14: identified ^{64}Ga activity, and measured half-life and Eγ for three γ rays.

1953Cr15: identified ^{64}Ga activity, and measured its half-life.

^{64}Zn Levels

E(level)†	J^π‡	$T_{1/2}$‡	Comments
0.0	0^+		
991.54 *7*	2^+	1.94 ps *5*	
1799.45 *8*	2^+	2.0 ps *2*	
1910.28 *8*	0^+	0.95 ns *5*	
2609.48 *9*	0^+	0.20 ps *8*	An 809-keV transition from this level to the 1799-keV level was not observed in γγ-coin data of 2007Mi12. An upper limit of 0.5% for the intensity from branching ratio Iγ(809)/[Iγ(809)+Iγ(1618γ)], was given by the authors.
3186.77 *8*	1^+	0.042 ps *10*	
3261.93 *11*	1	0.4 ps *+7−2*	
3321.8? *12*	(1)		
3366.00 *8*	1^+	0.023 ps *8*	
3425.14 *10*	1^+	0.031 ps *7*	
3795.00 *11*	1^+		
4454.70 *16*	1^+	3.2 fs *6*	
4608.8 *2*	(1)		
4713.1 *2*	(1)		

† From a least-squares fit to Eγ data.

‡ From the Adopted Levels.

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ε,β+ radiations

E(decay)	E(level)	Iβ+ ‡	Iε‡	Log *ft*	I(ε+β+)†‡	Comments
(2458.1 *15*)	4713.1	0.15 *3*	0.037 *8*	6.0 *1*	0.19 *4*	av Eβ=624.73 *69*; εK=0.1732 *5*; εL=0.01915 *6*; εM+=0.003407 *10*
(2562.4 *15*)	4608.8	0.12 *2*	0.023 *3*	6.26 *7*	0.14 *2*	av Eβ=671.93 *69*; εK=0.1445 *4*; εL=0.01596 *5*; εM+=0.002841 *8*
(2716.5 *15*)	4454.70	1.16 *7*	0.168 *10*	5.44 *3*	1.33 *8*	av Eβ=742.10 *69*; εK=0.1119 *3*; εL=0.01236 *3*; εM+=0.002199 *6*
(3376.2 *15*)	3795.00	3.83 *16*	0.201 *9*	5.56 *2*	4.03 *17*	av Eβ=1047.34 *71*; εK=0.04419 *9*; εL=0.004875 *9*; εM+=0.0008673 *1*
(3746.1 *15*)	3425.14	6.6 *3*	0.22 *1*	5.60 *2*	6.8 *3*	av Eβ=1221.13 *71*; εK=0.02890 *5*; εL=0.003186 *6*; εM+=0.0005668 *1*
(3805.2 *15*)	3366.00	28.2 *7*	0.892 *23*	5.01 *1*	29.1 *7*	av Eβ=1249.06 *71*; εK=0.02714 *5*; εL=0.002992 *5*; εM+=0.0005323 *9* Iβ+: 75% (1960Ja07) for a β+ group at 2790 *80* (most likely a composite of β+ groups to the 3187+3262+3366 levels). (β+)(3366γ+3425γ)(circ pol): asymmetry parameter =−1.00 *5* (1967Ma04), −0.94 *14* (1966De10) agrees with 0(β+)1(γ)0 sequence.
(3849.4# *19*)	3321.8?	0.23 *5*	0.0070 *15*	7.1 *1*	0.24 *5*	av Eβ=1269.96 *91*; εK=0.02591 *6*; εL=0.002857 *6*; εM+=0.0005083 *1*
(3909.3 *15*)	3261.93	2.33 *13*	0.066 *4*	6.17 *3*	2.40 *13*	av Eβ=1298.30 *72*; εK=0.02437 *4*; εL=0.002687 *5*; εM+=0.0004780 *8*
(3984.4 *15*)	3186.77	29.8 *7*	0.781 *19*	5.11 *1*	30.6 *7*	av Eβ=1333.93 *72*; εK=0.02260 *4*; εL=0.002491 *4*; εM+=0.0004432 *7*
(4561.7# *15*)	2609.48	<0.21	<0.0032	>7.6	<0.21	av Eβ=1609.16 *72*; εK=0.013391 *17*; εL=0.0014754 *1*; εM+=0.0002624 *4* I(ε+β+): 0.07 *14* from transition intensity balance.
(5260.9# *15*)	1910.28	<0.3	<0.003	>7.8	<0.3	av Eβ=1945.59 *73*; εK=0.007872 *9*; εL=0.0008669 *9*; εM+=0.00015419 I(ε+β+): −0.1 *4* from transition intensity balance.
(7171.2 *15*)	0.0	24.6 *10*	0.073 *3*	6.65 *2*	24.7 *10*	av Eβ=2875.75 *74*; εK=0.002627 *2*; εL=0.0002890 *2*; εM+=5.141×10^{-5} *4* Iβ+: from 1990SuZR. Others: 33.8% *11* (1975Ra28, from annihilation radiation); 21.4% *11* (1967Ko02); 25% (1960Ja07, from measured Iβ+). E(decay): measured Eβ=6050 *30* (1960Ja07). Other: 1976Mo12 obtain Eβ=5972 *13*, but point out that high energy effects in the detector will reduce the observed Eβ+. In a later work the authors (1977ReZK) ascribe a discrepancy of ≈100 keV in the Q(β−) value to a possible shape factor. Log *ft*: this is the lowest log *ft* value of all the well-known 0^+ to 0^+ isospin-forbidden transitions.

† From γ-transition intensity balance at each excited state. For g.s. feeding, measured value of 24.7% *10* (1990SuZR). In-out intensity balances at levels, where no feedings are expected from ΔJ^π values: 1.3% *7* for 991.5 level, −0.8% *7* for 1799.4 level.

‡ Absolute intensity per 100 decays.

Existence of this branch is questionable.

^{64}Ga ε decay (2.627 min) 1975Ra28,2007Mi12,1967Ma04 (continued)

γ(^{64}Zn)

Iγ normalization: Deduced from I(ε+β⁺)(to g.s.)=24.7% *10* (1990SuZR, from intensity of the annihilation radiation using a mass-separated ^{64}Ga source), theoretical ε/β⁺ ratios, and transition intensity balance at each level. Other measured values of g.s. β⁺+ε feeding: 33.8% *11* (1975Ra28, from measured intensity of annihilation radiation, accounting for contribution from ^{61}Cu and ^{66}Ga decays); 21.4% *11* (1967Ko02, probably from β⁺ spectrum); 25% (1960Ja07, β⁺ spectrum). Value from 1990SuZR is preferred by the evaluators as only in this work a mass separated source of ^{64}Ga was used, with less or no contamination from other activities contributing to the intensity of the annihilation radiation. Other Iγ normalization=0.48 (1990SuZR), 0.431 (1975Ra28), 0.486 (1967Ma04).

Following unplaced γ rays reported only by 1967Ko02 with Eγ and Iγ are omitted as not confirmed in later studies: 427.1 *5* (Iγ=4 *2*) (Iγ<0.017 in 1973Da01, <0.8 in 1967Ko02, most likely from ^{64}Ge decay); 3869 *2* (Iγ=0.5 *2*, <0.2 in 1967Ma04); 4215 *3* (Iγ=0.6 *4*, <0.14 in 1967Ma04); 4749 *5* (Iγ=0.3 *2*, <0.06 in 1967Ma04); 5190 *30* (Iγ=0.05 *3*, <0.06 in 1967Ma04); 5310 *30* (Iγ=0.05 *3*, <0.06 in 1967Ma04).

Following unplaced γ rays reported only by 1967Ma04 with Eγ and Iγ are omitted as not confirmed in later studies: 1909.8 (Iγ<1.2, <0.3 in 1975Ra28); 2240 (Iγ=1.2, <0.4 in 1975Ra28); 2632 *2* (Iγ=0.8 *6*, <0.3 in 1975Ra28).

Measured intensity of annihilation radiation=453 *14*, relative to 100 for 991.6γ (1975Ra28).

E_γ[†]	I_γ[‡@]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ[#]	α[&]	Comments
110.7 *1*	0.59 *19*	1910.28	0⁺	1799.45	2⁺	[E2]		0.447 *6*	%Iγ=0.28 *9* α(N)=0.0002072 *30* α(K)=0.394 *6*; α(L)=0.0465 *7*; α(M)=0.00657 *10* Eγ,Iγ: from 2007Mi12. Other: Eγ=110.9 from ce data (1985Pa07,1983Pa05). Iγ=0.50 *5* from Iγ(111γ)/Iγ(919γ)=0.027 *3* in (p,p′γ) data (1985Pa07,1983Pa05).
577.3 *1*	0.21 *4*	3186.77	1⁺	2609.48	0⁺	[M1]		0.000803 *11*	%Iγ=0.101 *19* α=0.000803 *11*; α(K)=0.000720 *10*; α(L)=7.23×10^{-5} *10*; α(M)=1.037×10^{-5} *15* α(N)=4.18×10^{-7} *6*
756.58 *10*	2.86 *15*	3366.00	1⁺	2609.48	0⁺	[M1]		0.000446 *6*	Eγ,Iγ: γ from 2007Mi12 only. %Iγ=1.38 *8* α=0.000446 *6*; α(K)=0.000400 *6*; α(L)=4.00×10^{-5} *6*; α(M)=5.74×10^{-6} *8* α(N)=2.319×10^{-7} *32* Eγ=756.6 *1*, Iγ=2.77 *19* (2007Mi12). Eγ=757.07, Iγ=2.92, Iγ(absolute)=1.4 (1990SuZR). Eγ=756.52 *20*, Iγ=2.90 *15* (1975Ra28). Eγ=756.7 *7*, Iγ=2.9 *2*, Iγ(absolute)=1.4 *1* (1967Ma04).
807.93 *10*	30.0 *11*	1799.45	2⁺	991.54	2⁺	E2+M1	−3.9 *7*	0.000494 *8*	%Iγ=14.5 *6* α=0.000494 *8*; α(K)=0.000442 *7*; α(L)=4.46×10^{-5} *7*; α(M)=6.38×10^{-6} *10* α(N)=2.54×10^{-7} *4* Eγ=808.0 *1*, Iγ=30.7 *18* (2007Mi12). Eγ=808.40, Iγ=31.9, Iγ(absolute)=15.3 (1990SuZR). Eγ=807.85 *10*, Iγ=31.6 *5* (1975Ra28). Eγ=807.8 *5*, Iγ=27.8 *4*,

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^{64}Ga ε decay (2.627 min) 1975Ra28,2007Mi12,1967Ma04 (continued)

γ(^{64}Zn) (continued)

E_γ[†]	I_γ[‡@]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	α[&]	Comments
								Iγ(absolute)=13.5 *2* (1967Ma04).
918.84 *10*	17.6 *6*	1910.28	0^+	991.54	2^+	E2	0.000361 *5*	Eγ=809.4 *4*, Iγ=32 *2* (1967Ko02). %Iγ=8.50 *32* α=0.000361 *5*; α(K)=0.000324 *5*; α(L)=3.25×10^{-5} *5*; α(M)=4.66×10^{-6} *7* α(N)=1.859×10^{-7} *26* Eγ=918.9 *1*, Iγ=17.4 *11* (2007Mi12). Eγ=919.40, Iγ=17.7, Iγ(absolute)=8.6 (1990SuZR). Eγ=918.78 *10*, Iγ=18.7 *4* (1975Ra28). Eγ=918.5 *5*, Iγ=16.7 *4*, Iγ(absolute)=8.1 *2* (1967Ma04).
991.56 *10*	100	991.54	2^+	0.0	0^+	E2	0.000300 *4*	Eγ=919.1 *4*, Iγ=17 *2* (1967Ko02). %Iγ=48.3 *7* α=0.000300 *4*; α(K)=0.000269 *4*; α(L)=2.70×10^{-5} *4*; α(M)=3.87×10^{-6} *5* α(N)=1.546×10^{-7} *22* Eγ=991.6 *1*, Iγ=100 (2007Mi12). Eγ=992.03, Iγ=100,, Iγ(absolute)=48.0 (1990SuZR). Eγ=991.51 *10*, Iγ=100 (1975Ra28). Eγ=991.0 *5* in text, Iγ=100, Iγ(absolute)=48.6 (1967Ma04). Eγ=992.2 *5*, Iγ=100 *3* (1967Ko02).
1185.4 *1*	0.17 *9*	3795.00	1^+	2609.48	0^+	[M1]	0.0001827 *26*	%Iγ=0.08 *4* α=0.0001827 *26*; α(K)=0.0001596 *22*; α(L)=1.588×10^{-5} *22*; α(M)=2.277×10^{-6} *32* α(N)=9.23×10^{-8} *13*; α(IPF)=4.81×10^{-6} *7* Eγ=1185.4 *1*, Iγ<0.16 (2007Mi12). Eγ=1186, Iγ=0.23, Iγ(absolute)=0.11 (1990SuZR). Eγ=1186.0 *10*, Iγ=0.26 *6* (1975Ra28).
1276.38 *10*	13.1 *3*	3186.77	1^+	1910.28	0^+	(M1)	0.0001708 *24*	%Iγ=6.33 *17* α=0.0001708 *24*; α(K)=0.0001382 *19*; α(L)=1.373×10^{-5} *19*; α(M)=1.969×10^{-6} *28* α(N)=7.99×10^{-8} *11*; α(IPF)=1.682×10^{-5} *24* Eγ=1276.4 *1*, Iγ=13.5 *10* (2007Mi12). Eγ=1276.94, Iγ=13.3, Iγ(absolute)=6.4 (1990SuZR). Eγ=1276.37 *10*, Iγ=12.9 *3* (1975Ra28). Eγ=1276.4 *5*, Iγ=13.0 *6*, Iγ(absolute)=6.3 *3* (1967Ma04). Eγ=1276.6 *20*, Iγ=13 *3* (1967Ko02).
1352[a] *2*	<0.3	3261.93	1	1910.28	0^+	[D]		%Iγ<0.145 Eγ=1352 *2*, Iγ<0.3 from γγ-coin (1975Ra28).
1387.34 *10*	27.5 *7*	3186.77	1^+	1799.45	2^+	[M1+E2]	0.000180 *12*	%Iγ=13.3 *4* α=0.000180 *12*; α(K)=0.000122 *5*; α(L)=1.22×10^{-5} *5*; α(M)=1.75×10^{-6} *7* α(N)=7.06×10^{-8} *28*; α(IPF)=4.4×10^{-5} *6* Eγ=1387.4 *1*, Iγ=26.5 *23* (2007Mi12). Eγ=1387.83, Iγ=26.7, Iγ(absolute)=12.8 (1990SuZR). Eγ=1387.27 *10*, Iγ=27.3 *7* (1975Ra28).

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^{64}Ga ε decay (2.627 min) 1975Ra28,2007Mi12,1967Ma04 (continued)

γ(^{64}Zn) (continued)

E_γ[†]	I_γ[‡@]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	α[&]	Comments
1411.3 *15*	0.31 *9*	3321.8?	(1)	1910.28	0^+			Eγ=1386.8 *5*, Iγ=28.8 *8*, Iγ(absolute)=14.0 *4* (1967Ma04). Eγ=1387.8 *14*, Iγ=30 *3* (1967Ko02). %Iγ=0.15 *4* Eγ=1411, Iγ=0.10, Iγ(absolute)=0.05 (1990SuZR).
1455.84 *12*	4.44 *22*	3366.00	1^+	1910.28	0^+	[M1]	0.0001737 *24*	Eγ=1411.3 *15*, Iγ=0.31 *9* (1975Ra28). %Iγ=2.14 *11* α=0.0001737 *24*; α(K)=0.0001074 *15*; α(L)=1.066×10^{-5} *15*; α(M)=1.528×10^{-6} *21* α(N)=6.20×10^{-8} *9*; α(IPF)=5.41×10^{-5} *8* Eγ=1455.9 *1*, Iγ=4.5 *3* (2007Mi12). Eγ=1454.95, Iγ=4.38, Iγ(absolute)=2.1 (1990SuZR). Eγ=1455.59 *20*, Iγ=4.33 *22* (1975Ra28). Eγ=1455.2 *7*, Iγ=4.5 *4*, Iγ(absolute)=2.2 *2* (1967Ma04).
1461.3[a] *1*	<0.21	3261.93	1	1799.45	2^+			%Iγ<0.10 Iγ: from γγ-coin data in 2007Mi12. This γ fits poorly in the decay scheme, Eγ not used in the least-squares fitting procedure. Level-energy difference=1462.5. In 1975Ra28 and 1990SuZR, it is possible that contribution from background line near this energy from ^{40}K decay is not fully subtracted. Eγ=1461.3 *1*, Iγ<0.21 (2007Mi12). Eγ=1461.56, Iγ=0.81, Iγ(absolute)=0.39 (1990SuZR).
1514.7 *2*	0.47 *8*	3425.14	1^+	1910.28	0^+	[M1]	0.0001822 *26*	Eγ=1462 *2*, Iγ=0.70 *10* (1975Ra28). %Iγ=0.23 *4* α=0.0001822 *26*; α(K)=9.97×10^{-5} *14*; α(L)=9.89×10^{-6} *14*; α(M)=1.418×10^{-6} *20* α(N)=5.76×10^{-8} *8*; α(IPF)=7.12×10^{-5} *10* Eγ=1514.7 *2*, Iγ=0.51 *8* (2007Mi12).
1566.59 *20*	5.02 *29*	3366.00	1^+	1799.45	2^+	[M1+E2]	0.000208 *16*	Eγ=1515.2 *10*, Iγ=0.42 *8* (1975Ra28). %Iγ=2.42 *14* α=0.000208 *16*; α(K)=9.64×10^{-5} *32*; α(L)=9.58×10^{-6} *33*; α(M)=1.37×10^{-6} *5* α(N)=5.56×10^{-8} *17*; α(IPF)=0.000100 *12* Eγ=1566.7 *2*, Iγ=4.65 *36* (2007Mi12). Eγ=1567.19, Iγ=4.38, Iγ(absolute)=2.21 (1990SuZR). Eγ=1566.47 *20*, Iγ=4.82 *23* (1975Ra28). Eγ=1566.5 *6*, Iγ=5.6 *6*, Iγ(absolute)=2.7 *3* (1967Ma04).
1617.77 *23*	3.74 *19*	2609.48	0^+	991.54	2^+	E2	0.0002385 *33*	Eγ=1568 *2*, Iγ=11 *4* (1967Ko02). %Iγ=1.81 *10* α=0.0002385 *33*; α(K)=9.32×10^{-5} *13*; α(L)=9.27×10^{-6} *13*; α(M)=1.328×10^{-6} *19* α(N)=5.37×10^{-8} *8*; α(IPF)=0.0001347 *19* Eγ=1618.0 *2*, Iγ=3.72 *25* (2007Mi12).

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^{64}Ga ε decay (2.627 min) 1975Ra28,2007Mi12,1967Ma04 (continued)

γ(^{64}Zn) (continued)

E_γ[†]	I_γ[‡@]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	α[&]	Comments
								Eγ=1618.47, Iγ=3.75, Iγ(absolute)=1.8 (1990SuZR). Eγ=1617.54 *20*, Iγ=3.81 *19* (1975Ra28). Eγ=1617.2 *8*, Iγ=3.7 *10*, Iγ(absolute)=1.8 *5* (1967Ma04).
1625.87 *20*	2.46 *17*	3425.14	1^+	1799.45	2^+	[M1+E2]	0.000224 *18*	%Iγ=1.19 *8* α=0.000224 *18*; α(K)=8.98×10^{-5} *28*; α(L)=8.92×10^{-6} *29*; α(M)=1.28×10^{-6} *4* α(N)=5.18×10^{-8} *15*; α(IPF)=0.000123 *15* I_γ: weighted average of values from 2007Mi12, 1975Ra28 and 1967Ma04. Eγ=1626.0 *2*, Iγ=2.49 *17* (2007Mi12). Eγ=1626.49, Iγ=2.29, Iγ(absolute)=1.1 (1990SuZR). Eγ=1625.74 *20*, Iγ=2.42 *17* (1975Ra28). Eγ=1626.2 *12*, Iγ=2.7 *6*, Iγ(absolute)=1.3 *3* (1967Ma04).
1799.53 *15*	8.5 *3*	1799.45	2^+	0.0	0^+	E2	0.000300 *4*	%Iγ=4.11 *15* α=0.000300 *4*; α(K)=7.59×10^{-5} *11*; α(L)=7.53×10^{-6} *11*; α(M)=1.080×10^{-6} *15* α(N)=4.37×10^{-8} *6*; α(IPF)=0.0002158 *30* Eγ=1799.7 *2*, Iγ=9.11 *64* (2007Mi12). Eγ=1800.29, Iγ=8.3, Iγ(absolute)=4.0 (1990SuZR). Eγ=1799.43 *15*, Iγ=8.3 *3* (1975Ra28). Eγ=1799.2 *5*, Iγ=8.6 *8*, Iγ(absolute)=4.2 *4* (1967Ma04). Eγ=1798 *4*, Iγ=12 *3* (1967Ko02).
(1910)		1910.28	0^+	0.0	0^+	E0		E_γ: from ce data in (p,p′γ) (1985Pa07,1983Pa05).
1995.9 *2*	3.84 *22*	3795.00	1^+	1799.45	2^+	[M1+E2]	0.000351 *28*	%Iγ=1.85 *11* α=0.000351 *28*; α(K)=6.14×10^{-5} *14*; α(L)=6.08×10^{-6} *15*; α(M)=8.72×10^{-7} *21* α(N)=3.54×10^{-8} *8*; α(IPF)=0.000283 *27* Eγ=1996.0 *2*, Iγ=3.93 *34* (2007Mi12). Eγ=1996.41, Iγ=3.54, Iγ(absolute)=1.7 (1990SuZR). Eγ=1995.8 *3*, Iγ=3.69 *22* (1975Ra28). Eγ=1996.1 *10*, Iγ=3.9 *6*, Iγ(absolute)=1.9 *3* (1967Ma04). Eγ=1995.0 *5*, Iγ=12 *4* (1967Ko02).
2103.6 *2*	0.35 *8*	4713.1	(1)	2609.48	0^+			%Iγ=0.17 *4* Eγ=2103.6 *2*, Iγ=0.35 *9* (2007Mi12). Eγ=2103.1, Iγ=0.40, Iγ(absolute)=0.19 (1990SuZR). Eγ=2103 *2*, Iγ=0.35 *8* (1975Ra28).
2195.22 *10*	22.1 *5*	3186.77	1^+	991.54	2^+	[M1+E2]	0.000433 *33*	%Iγ=10.68 *29* α=0.000433 *33*; α(K)=5.18×10^{-5} *11*; α(L)=5.13×10^{-6} *11*; α(M)=7.35×10^{-7} *16* α(N)=2.99×10^{-8} *6*; α(IPF)=0.000375 *32* Eγ=2195.1 *2*, Iγ=21.9 *21* (2007Mi12). Eγ=2195.85, Iγ=20.2, Iγ(absolute)=9.7 (1990SuZR). Eγ=2195.25 *10*, Iγ=21.4 *5* (1975Ra28).

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^{64}Ga ε decay (2.627 min) 1975Ra28,2007Mi12,1967Ma04 (continued)

γ(^{64}Zn) (continued)

E_γ[†]	I_γ[‡@]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	α[&]	Comments
								Eγ=2195.0 *7*, Iγ=23.0 *10*, Iγ(absolute)=11.2 *5* (1967Ma04).
								Eγ=2195.6 *9*, Iγ=26 *4* (1967Ko02).
2270.38 *10*	4.67 *24*	3261.93	1	991.54	2^+			%Iγ=2.26 *12*
								Eγ=2270.2 *2*, Iγ=4.87 *54* (2007Mi12).
								Eγ=2271.08, Iγ=4.58, Iγ(absolute)=2.2 (1990SuZR).
								Eγ=2270.42 *10*, Iγ=4.84 *24* (1975Ra28).
								Eγ=2270.4 *9*, Iγ=4.3 *6*, Iγ(absolute)=2.1 *3* (1967Ma04).
								Eγ=2272 *2*, Iγ=4 *2* (1967Ko02).
2374.30 *10*	16.1 *4*	3366.00	1^+	991.54	2^+	[M1+E2]	0.00051 *4*	%Iγ=7.78 *23*
								α=0.00051 *4*; α(K)=4.52×10^{-5} *9*; α(L)=4.47×10^{-6} *9*; α(M)=6.41×10^{-7} *14*
								α(N)=2.61×10^{-8} *5*; α(IPF)=0.00046 *4*
								Eγ=2374.2 *2*, Iγ=16.2 *14* (2007Mi12).
								Eγ=2375.27, Iγ=15.8, Iγ(absolute)=7.6 (1990SuZR).
								Eγ=2374.32 *10*, Iγ=16.2 *4* (1975Ra28).
								Eγ=2374.8 *7*, Iγ=15.8 *10*, Iγ(absolute)=7.7 *5* (1967Ma04).
								Eγ=2374.7 *14*, Iγ=14 *3* (1967Ko02).
2433.6 *2*	1.31 *12*	3425.14	1^+	991.54	2^+	[M1+E2]	0.00053 *4*	%Iγ=0.63 *6*
								α=0.00053 *4*; α(K)=4.33×10^{-5} *9*; α(L)=4.29×10^{-6} *9*; α(M)=6.14×10^{-7} *13*
								α(N)=2.50×10^{-8} *5*; α(IPF)=0.00048 *4*
								Iγ: weighted average of values from 2007Mi12, 1975Ra28 and 1967Ma04.
								Eγ=2433.6 *2*, Iγ=1.26 *12* (2007Mi12).
								Eγ=2434.4, Iγ=1.29, Iγ(absolute)=0.62 (1990SuZR).
								Eγ=2433.7 *3*, Iγ=1.36 *13* (1975Ra28).
								Eγ=2433.5 *15*, Iγ=1.2 *4*, Iγ(absolute)=0.6 *2* (1967Ma04).
2544.4 *2*	0.35 *6*	4454.70	1^+	1910.28	0^+	[M1]	0.000541 *8*	%Iγ=0.169 *29*
								α=0.000541 *8*; α(K)=3.96×10^{-5} *6*; α(L)=3.91×10^{-6} *5*; α(M)=5.61×10^{-7} *8*
								α(N)=2.282×10^{-8} *32*; α(IPF)=0.000497 *7*
								Eγ=2544.4 *2*, Iγ=0.30 *6* (2007Mi12).
								Eγ=2545.02, Iγ=0.44, Iγ(absolute)=0.21 (1990SuZR).
								Eγ=2544.2 *10*, Iγ=0.40 *8* (1975Ra28).
								Eγ=2550 *2*, Iγ=2 *2* (1967Ko02).
(2609)		2609.48	0^+	0.0	0^+	E0		E_γ: from pair conversion data in (p,p′γ) (1985Pa07,1983Pa05).
2655.2 *2*	0.58 *10*	4454.70	1^+	1799.45	2^+	[M1+E2]	0.00063 *4*	%Iγ=0.28 *5*
								α=0.00063 *4*; α(K)=3.74×10^{-5} *8*; α(L)=3.70×10^{-6} *8*; α(M)=5.30×10^{-7} *11*
								α(N)=2.15×10^{-8} *4*; α(IPF)=0.00059 *4*
								Eγ=2655.2 *2*, Iγ=0.51 *7* (2007Mi12).
								Eγ=2655.96, Iγ=0.71, Iγ(absolute)=0.34 (1990SuZR).
								Eγ=2654.4 *10*, Iγ=0.65 *10* (1975Ra28).
								Eγ=2654, Iγ<0.6, Iγ(absolute)<0.3 (1967Ma04).
2803.3 *3*	1.50 *14*	3795.00	1^+	991.54	2^+	[M1+E2]	0.00069 *4*	%Iγ=0.72 *7*

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^{64}Ga ε decay (2.627 min) 1975Ra28,2007Mi12,1967Ma04 (continued)

γ(^{64}Zn) (continued)

E_γ[†]	I_γ[‡@]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	α[&]	Comments
								α=0.00069 *4*; α(K)=3.42×10^{-5} *7*; α(L)=3.38×10^{-6} *7*; α(M)=4.84×10^{-7} *10* α(N)=1.97×10^{-8} *4*; α(IPF)=0.00065 *4* I_γ: unweighted average of values from 2007Mi12 and 1975Ra28. Eγ=2803.1 *2*, Iγ=1.51 *19* (2007Mi12). Eγ=2804.23, Iγ=1.54, Iγ(absolute)=0.74 (1990SuZR). Eγ=2803.7 *3*, Iγ=1.49 *14* (1975Ra28). Eγ=2803.9 *10*, Iγ=2.5 *6*, Iγ(absolute)=1.2 *3* (1967Ma04). Eγ=2806 *2*, Iγ=1.5 *9* (1967Ko02).
2913[a] *2*	0.02	4713.1	(1)	1799.45	2$^+$			%Iγ=0.010 E_γ: from 1975Ra28. I_γ: from 1990SuZR. Other: <0.4 (1975Ra28). Eγ=2915.21, Iγ=0.02, Iγ(absolute)=0.01 (1990SuZR). Eγ=2913 *2*, Iγ<0.4 (1975Ra28). Eγ=2910, Iγ=0.4 (1967Ma04).
3186.8 *2*	0.41 *8*	3186.77	1$^+$	0.0	0$^+$	[M1]	0.000796 *11*	%Iγ=0.20 *4* α=0.000796 *11*; α(K)=2.74×10^{-5} *4*; α(L)=2.70×10^{-6} *4*; α(M)=3.87×10^{-7} *5* α(N)=1.576×10^{-8} *22*; α(IPF)=0.000766 *11* Eγ=3186.82, Iγ=0.47 *8* (2007Mi12). Eγ=3188.9, Iγ=0.27, Iγ(absolute)=0.13 (1990SuZR). Eγ=3187 *2*, Iγ=0.35 *10* (1975Ra28). Eγ=3189 *2*, Iγ≤0.9 (1967Ko02).
3261.7 *2*	0.29 *2*	3261.93	1	0.0	0$^+$	[D]		%Iγ=0.140 *10* Eγ=3261.7 *2*, Iγ=0.31 *2* (2007Mi12). Eγ=3262.97, Iγ=0.31, Iγ(absolute)=0.15 (1990SuZR). Eγ=3261 *2*, Iγ=0.27 *8* (1975Ra28). Eγ=3264, Iγ≤1 (1967Ko02).
3322 *2*	0.18 *5*	3321.8?	(1)	0.0	0$^+$			%Iγ=0.087 *24* Eγ=3324.68, Iγ=0.33, Iγ(absolute)=0.15 (1990SuZR). Eγ=3322 *2*, Iγ=0.18 *5* (1975Ra28).
3365.76 *16*	31.9 *10*	3366.00	1$^+$	0.0	0$^+$	[M1]	0.000864 *12*	%Iγ=15.4 *4* α=0.000864 *12*; α(K)=2.508×10^{-5} *35*; α(L)=2.475×10^{-6} *35*; α(M)=3.55×10^{-7} *5* α(N)=1.445×10^{-8} *20*; α(IPF)=0.000836 *12* E_γ: weighted average of values from 2007Mi12, 1975Ra28 and 1967Ma04. Eγ=3365.3 *2*, Iγ=31.5 *34* (2007Mi12). Eγ=3367.52, Iγ=32.3, Iγ(absolute)=15.5 (1990SuZR). Eγ=3365.87 *10*, Iγ=30.4 *12* (1975Ra28). Eγ=3365.8 *9*, Iγ=33.7 *10*, Iγ(absolute)=16.4 *5* (1967Ma04). Eγ=3366.9 *16*, Iγ=36 *4* (1967Ko02).
3424.97 *15*	9.9 *5*	3425.14	1$^+$	0.0	0$^+$	[M1]	0.000886 *12*	%Iγ=4.78 *24* α=0.000886 *12*; α(K)=2.440×10^{-5} *34*; α(L)=2.408×10^{-6} *34*; α(M)=3.45×10^{-7} *5*

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^{64}Ga ε decay (2.627 min) 1975Ra28,2007Mi12,1967Ma04 (continued)

γ(^{64}Zn) (continued)

E_γ[†]	I_γ[‡@]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	α[&]	Comments
								α(N)=1.406×10^{-8} *20*; α(IPF)=0.000859 *12* Eγ=3424.8 *2*, Iγ=10.1 *10* (2007Mi12). Eγ=3426.55, Iγ=10.0, Iγ(absolute)=4.8 (1990SuZR). Eγ=3425.06 *15*, Iγ=9.4 *5* (1975Ra28). Eγ=3424.8 *9*, Iγ=10.1 *8*, Iγ(absolute)=4.9 *4* (1967Ma04). Eγ=3426.2 *18*, Iγ=10 *1* (1967Ko02).
3462.4 *10*	0.10 *2*	4454.70	1$^+$	991.54	2$^+$	[M1+E2]	0.00095 *5*	%Iγ=0.048 *10* α=0.00095 *5*; α(K)=2.43×10^{-5} *5*; α(L)=2.40×10^{-6} *5*; α(M)=3.44×10^{-7} *7* α(N)=1.401×10^{-8} *27*; α(IPF)=0.00092 *5* Eγ=3462.4 *10*, Iγ=0.10 *2* (1975Ra28). Eγ=3465, Iγ≤2 (1967Ko02).
3617.1 *2*	0.22 *4*	4608.8	(1)	991.54	2$^+$			%Iγ=0.106 *19* Eγ=3617.1 *2*, Iγ=0.21 *4* (2007Mi12). Eγ=3616.5 *10*, Iγ=0.24 *8* (1975Ra28).
3795.1 *3*	2.83 *17*	3795.00	1$^+$	0.0	0$^+$	[M1]	1.02×10^{-3} *1*	%Iγ=1.37 *8* α(K)=2.080×10^{-5} *29*; α(L)=2.052×10^{-6} *29*; α(M)=2.94×10^{-7} *4* α(N)=1.198×10^{-8} *17*; α(IPF)=0.000995 *14* I_γ: from 1975Ra28. Eγ=3797.23, Iγ=2.92, Iγ(absolute)=1.4 (1990SuZR). Eγ=3795.1 *3*, Iγ=2.83 *17* (1975Ra28). Eγ=3794.5 *10*, Iγ=2.1 *4*, Iγ(absolute)=1.0 *2* (1967Ma04). Eγ=3795 *2*, Iγ=1.4 *4* (1967Ko02).
4454.3 *10*	1.72 *10*	4454.70	1$^+$	0.0	0$^+$	[M1]	1.24×10^{-3} *2*	%Iγ=0.83 *5* α(K)=1.633×10^{-5} *23*; α(L)=1.610×10^{-6} *23*; α(M)=2.307×10^{-7} *32* α(N)=9.40×10^{-9} *13*; α(IPF)=0.001217 *17* I_γ: from 1975Ra28. Eγ=4455.88, Iγ=2.02 (1990SuZR), Iγ(absolute)=0.97. Eγ=4454.3 *10*, Iγ=1.72 *10* (1975Ra28). Eγ=4453.5 *12*, Iγ=1.0 *2*, Iγ(absolute)=0.5 *1* (1967Ma04). Eγ=4456.8 *16*, Iγ=2.1 *5* (1967Ko02).
4609 *2*	≈0.07	4608.8	(1)	0.0	0$^+$			%Iγ≈0.034 E_γ,I_γ: from 1975Ra28. Eγ=4610.60, Iγ=0.13, Iγ(absolute)=0.06 (1990SuZR). Eγ=4609 *2*, Iγ≈0.07 (1975Ra28).
4712 *2*	≈0.04	4713.1	(1)	0.0	0$^+$			%Iγ≈0.019 Eγ=4712 *2*, Iγ≈0.04 (1975Ra28).

[†] From weighted average of available values from 2007Mi12 and 1975Ra28, unless otherwise noted. Values from 1990SuZR are given without uncertainties, and seem systematically higher by 0.5 to 2 keV, as compared to those in 2007Mi12 and 1975Ra28. Values in 1967Ma04 and 1967Ko02 are in general agreement, but less precise.

[‡] From unweighted average of available values from 2007Mi12, 1975Ra28, and 1967Ma04, unless otherwise noted. Values from 1990SuZR are in general agreement with those from 2007Mi12 and 1975Ra28, but are given without uncertainties. Values in 1967Ko02 are not in good agreement, and are less precise.

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^{64}Ga ε decay (2.627 min) 1975Ra28,2007Mi12,1967Ma04 (continued)

$\gamma(^{64}Zn)$ (continued)

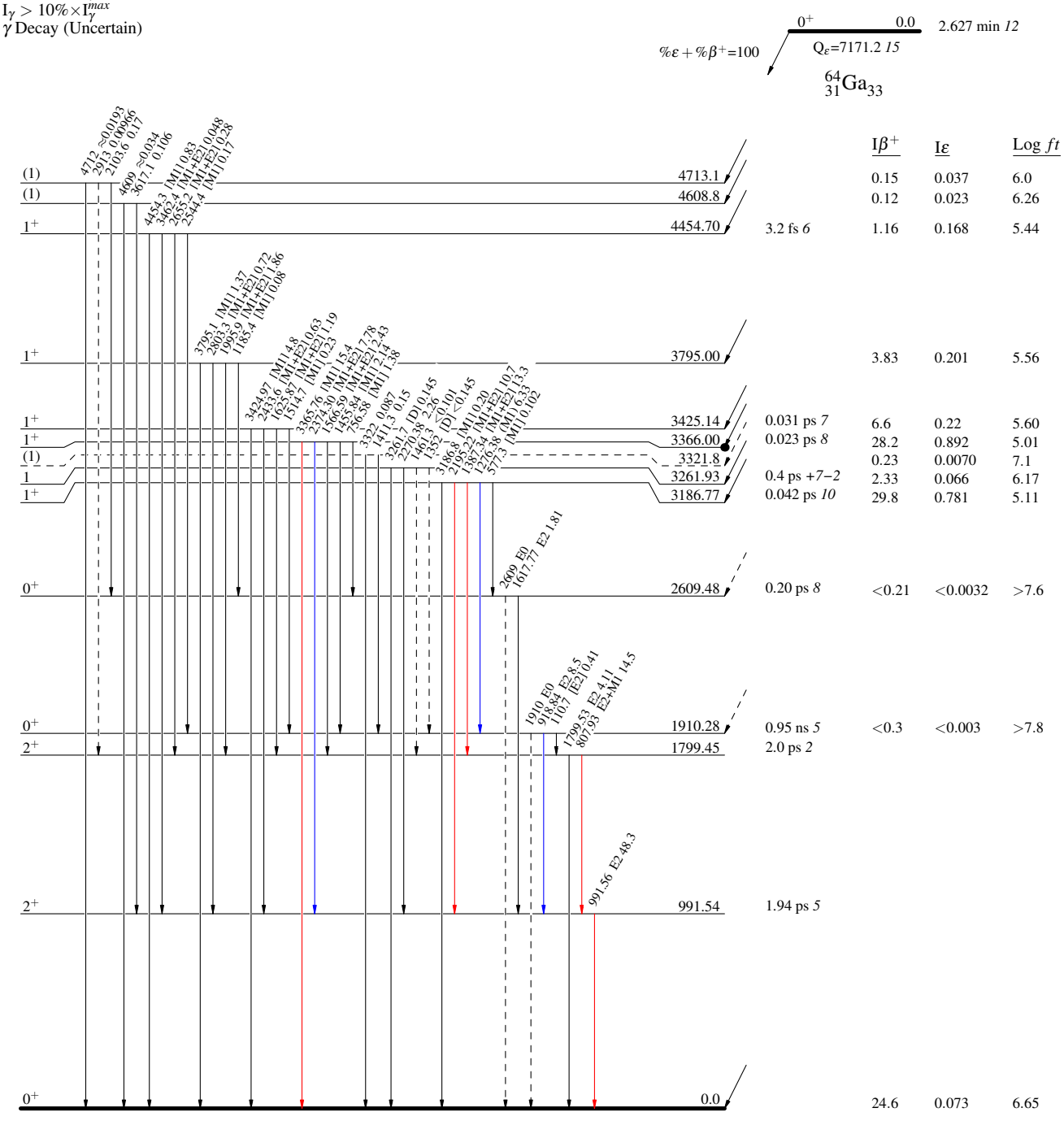
From the Adopted dataset for definite assignments or those in parentheses. Assignments in square brackets are assumed from ΔJ^{π}.
@ For absolute intensity per 100 decays, multiply by 0.483 *7*.
& Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.
a Placement of transition in the level scheme is uncertain.

^{64}Ga ε decay (2.627 min) 1975Ra28,2007Mi12,1967Ma04

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)



$^{64}_{30}Zn_{34}$