^{63}Ga $\varepsilon+\beta^+$ decay 1971GiZP,1970Du05

Type	Author	History Citation	Literature Cutoff Date
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Parent: ^{63}Ga: E=0.0; J^π=3/2$^-$; $T_{1/2}$=32.1 s *5*; Q($\varepsilon+\beta^+$)=5666.3 *20*; %$\varepsilon+\beta^+$ decay=100

^{63}Ga-J^π,$T_{1/2}$: From Adopted Levels of ^{63}Ga. $T_{1/2}$ values from this dataset: 31.4 s *8* (1970Du05), 32.4 s *5* (1971GiZP).

^{63}Ga-Q($\varepsilon+\beta^+$): From 2021Wa16.

1971GiZP (also 1971GiZS,1971GiZX same thesis): ^{63}Ca source was produced via ^{64}Zn(p,2n) with 30 MeV proton from the Michigan State University Sector-Focused Cyclotron. γ rays were detected with Ge(Li) detectors. Measured Eγ, Iγ, $\gamma\gamma$-coin, γ(t). Deduced levels, J, π, parent $T_{1/2}$, decay branching ratios, log *ft*. Comparisons with available data. See also 1974FiZF and 1973FiZT from the same lab for a measurement of end-point energy using a pilot-B plastic scintillator and the same source.

1970Du05 (also 1971DuZV thesis): ^{63}Ga source was produced via ^{64}Zn(p,2n) with 28 MeV proton beam from the AVF cyclotron of the "Vrije Universiteit" at Amsterdam. Irradiated foils were transported to the spectrometers, where γ rays were detected with Ge(Li) detectors. Measured Eγ, Iγ, γ(t). Deduced levels, J, π, parent $T_{1/2}$, decay branching ratios, log *ft*. Comparisons with available data.

This decay scheme is considered incomplete by the evaluator due to a large gap of about 4 MeV between Q-value=5665.3 *20* and the highest observed level at E=1692, implying possible unobserved γ transitions from unobserved levels in this large gap.

^{63}Zn Levels

E(level)[†]	J^π[‡]
0.0	3/2$^-$
192.93 *19*	5/2$^-$
247.89 *19*	1/2$^-$
627.04 *17*	1/2$^-$
637.05 *19*	3/2$^-$
650.09 *19*	5/2$^-$
1065.20 *38*	1/2$^-$
1395.49 *20*	3/2$^-$
1691.62 *36*	5/2$^-$

[†] From a least-squares fit to γ-ray energies.
[‡] From Adopted Levels.

ε,β^+ radiations

The quoted decay intensities and log *ft* values should be considered as approximate due to incomplete decay scheme.

E(decay)	E(level)	Iβ^+ [‡]	Iε[‡]	Log *ft*	I($\varepsilon+\beta^+$)[†‡]	Comments
(3974.7 *23*)	1691.62	3.5	0.09	5.3	3.6	av Eβ=1326.96 *97*; εK=0.022818 *46*; εL=0.0025154 *51*; εM+=4.4747×10^{-4} *91*
(4270.8 *23*)	1395.49	6.9	0.14	5.2	7.0	av Eβ=1467.88 *96*; εK=0.017235 *31*; εL=0.0018994 *35*; εM+=3.3788×10^{-4} *62*
(4601.1 *23*)	1065.20	2.6	0.04	5.9	2.6	av Eβ=1625.90 *98*; εK=0.012963 *22*; εL=0.0014282 *24*; εM+=2.5405×10^{-4} *43*
(5016.2 *23*)	650.09	5.2	0.06	5.8	5.3	av Eβ=1825.48 *97*; εK=0.009383 *14*; εL=0.0010335 *15*; εM+=1.8383×10^{-4} *27*
(5029.3 *23*)	637.05	11.3	0.12	5.4	11.4	av Eβ=1831.80 *97*; εK=0.009293 *14*; εL=0.0010235 *15*; εM+=1.8206×10^{-4} *27*
(5039.3 *23*)	627.04	8.2	0.09	5.6	8.3	av Eβ=1836.63 *97*; εK=0.009225 *14*; εL=0.0010160 *15*; εM+=1.8072×10^{-4} *27*
(5418.4 *23*)	247.89	2.7	0.022	6.3	2.7	av Eβ=2019.82 *97*; εK=0.0070717 *95*; εL=7.787×10^{-4} *11*;

Continued on next page (footnotes at end of table)

^{63}Ga $\varepsilon+\beta^+$ decay 1971GiZP,1970Du05 (continued)

ϵ,β^+ radiations (continued)

E(decay)	E(level)	Iβ^+ ‡	Iε‡	Log *ft*	I($\varepsilon+\beta^+$)†‡	Comments
						εM+=1.3850×10^{-4} *19*
(5473.4 *23*)	192.93	4.7	0.036	6.0	4.7	av Eβ=2046.47 *97*; εK=0.0068170 *91*; εL=7.506×10^{-4} *10*; εM+=1.3351×10^{-4} *18*
(5666.3 *25*)	0.0	<54	<0.37	>5.1	<54	av Eβ=2140.01 *97*; εK=0.0060153 *77*; εL=6.6226×10^{-4} *84*; εM+=1.1779×10^{-4} *15* I($\varepsilon+\beta^+$): from 100−Σ%I($\varepsilon+\beta^+$ to excited levels). Due to possible unobserved feedings to unobserved levels in the large energy gap between the highest observed level and Q-value, the quoted value here should be probably considered as an upper limit, while the feeding to g.s. is considered strong as allowed decay by the evaluator.

† From γ-ray intensity balance at each level for excited levels, assuming conversion electron intensities are negligible because of small conversion coefficients less than 1%.
‡ Absolute intensity per 100 decays.

^{63}Ga $\varepsilon+\beta^+$ decay 1971GiZP,1970Du05 (continued)

$\gamma(^{63}Zn)$

Iγ normalization: From measured I($\gamma^{\pm}$)/I(627γ+637γ+650γ)=7.5 *12* (1970Du05), where I($\gamma^{\pm}$) is the measured intensity of 511γ from β^+-β^- annihilation and is 2 times of the total $\varepsilon+\beta^+$ decay intensity, considering negligible contributions from ε decay ($\varepsilon/\beta^+\approx$0.007 to 0.02 for observed branches).

E_γ[#]	I_γ[#@]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[‡]	δ[‡]	α[†]	Comments
193.0 *2*	51.4 *35*	192.93	5/2$^-$	0.0	3/2$^-$	M1+E2	−0.06 *3*	0.01110 *25*	%Iγ=5.8 *10* α(K)=0.00992 *22*; α(L)=0.001021 *24*; α(M)=0.0001464 *34* α(N)=5.78×10^{-6} *12* E$_\gamma$: other: 192.9 *2* (1970Du05).
247.9 *2*	30.6 *20*	247.89	1/2$^-$	0.0	3/2$^-$	(M1+E2)		0.014 *8*	%Iγ=3.5 *6* α(K)=0.012 *7*; α(L)=0.0013 *8*; α(M)=1.9×10^{-4} *11* α(N)=7.E−6 *4* E$_\gamma$: weighted average of 248.0 *2* (1971GiZP) and 247.8 *2* (1970Du05).
389.8 *7*	3.4 *17*	637.05	3/2$^-$	247.89	1/2$^-$	M1+E2	−0.05 *+3−4*	1.97×10^{-3} *3*	%Iγ=0.39 *20* α(K)=0.001766 *29*; α(L)=0.0001787 *29*; α(M)=2.56×10^{-5} *4* α(N)=1.027×10^{-6} *16*
415.0 *13*	2.6 *15*	1065.20	1/2$^-$	650.09	5/2$^-$	[E2]		0.00362 *6*	%Iγ=0.29 *18* α(K)=0.00323 *6*; α(L)=0.000333 *6*; α(M)=4.76×10^{-5} *8* α(N)=1.830×10^{-6} *32*
457.9 *6*	5.4 *14*	650.09	5/2$^-$	192.93	5/2$^-$	M1+E2	−0.08 *+1−2*	1.36×10^{-3} *2*	%Iγ=0.61 *19* α(K)=0.001221 *18*; α(L)=0.0001231 *18*; α(M)=1.766×10^{-5} *26* α(N)=7.09×10^{-7} *10*
627.1 *2*	92 *5*	627.04	1/2$^-$	0.0	3/2$^-$				%Iγ=10.4 *17* E$_\gamma$: other: 627.1 *2* (1970Du05).
637.0 *2*	100	637.05	3/2$^-$	0.0	3/2$^-$	M1+E2	+0.04 *2*	0.000647 *9*	%Iγ=11.3 *19* α(K)=0.000581 *8*; α(L)=5.82×10^{-5} *8*; α(M)=8.35×10^{-6} *12* α(N)=3.36×10^{-7} *5* E$_\gamma$: other: 637.1 *2* (1970Du05).
650.0 *2*	44.0 *25*	650.09	5/2$^-$	0.0	3/2$^-$	M1+E2	−0.57 *3*	0.000689 *11*	%Iγ=5.0 *9* α(K)=0.000618 *10*; α(L)=6.22×10^{-5} *10*; α(M)=8.91×10^{-6} *15* α(N)=3.57×10^{-7} *6* E$_\gamma$: weighted average of 650.1 *2* (1971GiZP) and 649.9 *2* (1970Du05).
768.5 *2*	19.0 *23*	1395.49	3/2$^-$	627.04	1/2$^-$	M1+E2		0.00050 *7*	%Iγ=2.2 *5* α(K)=0.00045 *6*; α(L)=4.5×10^{-5} *6*; α(M)=6.5×10^{-6} *9* α(N)=2.59×10^{-7} *35* E$_\gamma$: other: 768.2 *5* (1970Du05).

$^{63}_{30}Zn_{33}$-3

^{63}Ga $\varepsilon+\beta^+$ decay 1971GiZP,1970Du05 (continued)

$\gamma(^{63}Zn)$ (continued)

E_γ[#]	I_γ[#@]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[‡]	δ[‡]	α[†]	Comments
1054.6 *9*	2.3 *12*	1691.62	5/2$^-$	637.05	3/2$^-$	[M1,E2]		0.000242 *18*	%Iγ=0.26 *14* α(K)=0.000217 *16*; α(L)=2.17×10^{-5} *17*; α(M)=3.11×10^{-6} *24* α(N)=1.25×10^{-7} *9*
1065.2 *4*	20 *4*	1065.20	1/2$^-$	0.0	3/2$^-$	[M1,E2]		0.000237 *17*	%Iγ=2.3 *6* α(K)=0.000212 *15*; α(L)=2.12×10^{-5} *16*; α(M)=3.04×10^{-6} *23* α(N)=1.22×10^{-7} *8* E_γ: other: 1065.1 *6* (1970Du05).
1147.0 *8*	3.1 *7*	1395.49	3/2$^-$	247.89	1/2$^-$	(M1+E2)		0.000204 *13*	%Iγ=0.35 *10* α(K)=0.000181 *11*; α(L)=1.81×10^{-5} *12*; α(M)=2.59×10^{-6} *16* α(N)=1.04×10^{-7} *6*; α(IPF)=2.5×10^{-6} *4*
1203.4 *20*	2.4 *12*	1395.49	3/2$^-$	192.93	5/2$^-$	(M1+E2)		0.000190 *11*	%Iγ=0.27 *14* α(K)=0.000164 *9*; α(L)=1.63×10^{-5} *9*; α(M)=2.34×10^{-6} *13* α(N)=9.4×10^{-8} *5*; α(IPF)=7.9×10^{-6} *13*
1395.4 *3*	37 *7*	1395.49	3/2$^-$	0.0	3/2$^-$	M1+E2	+0.40 *+14−12*	0.0001723 *32*	%Iγ=4.2 *11* α(K)=0.0001177 *18*; α(L)=1.169×10^{-5} *18*; α(M)=1.676×10^{-6} *26* α(N)=6.80×10^{-8} *11*; α(IPF)=4.12×10^{-5} *13* E_γ: other: 1395.5 *5* (1970Du05).
1498.5 *6*	2.9 *15*	1691.62	5/2$^-$	192.93	5/2$^-$	(M1+E2)		0.000193 *14*	%Iγ=0.33 *18* α(K)=0.000105 *4*; α(L)=1.05×10^{-5} *4*; α(M)=1.50×10^{-6} *6* α(N)=6.06×10^{-8} *21*; α(IPF)=7.6×10^{-5} *10*
1691.7 *5*	27 *5*	1691.62	5/2$^-$	0.0	3/2$^-$	M1+E2	−0.10 *3*	0.0002234 *31*	%Iγ=3.1 *8* α(K)=8.12×10^{-5} *11*; α(L)=8.05×10^{-6} *11*; α(M)=1.154×10^{-6} *16* α(N)=4.69×10^{-8} *7*; α(IPF)=0.0001330 *19* E_γ: other: 1691.8 *10* (1970Du05).

† Additional information 1.
‡ From Adopted Gammas.
# From 1971GiZP, unless otherwise noted.
@ For absolute intensity per 100 decays, multiply by 0.113 *19*.

$^{63}_{30}Zn_{33}$-4

^{63}Ga ε+$β^+$ decay 1971GiZP,1970Du05

Decay Scheme

Intensities: I_γ per 100 parent decays