^{62}Ga $\varepsilon+\beta^+$ decay (116.123 ms) 2020Ma59,2008Fi07,2008Be21

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh, Huang Xiaolong, and Wang Xianghan	NDS 204,1 (2025)	30-Jun-2023

Parent: ^{62}Ga: E=0.0; $J^\pi=0^+$; $T_{1/2}$=116.123 ms *25*; Q(ε)=9181.1 *4*; %ε+%β^+ decay=100

^{62}Ga-$T_{1/2}$: From ^{62}Ga Adopted Levels. 2020Ma59 take value of 116.121 ms *21* from 2008Gr03, where weighted average of their measurement and several previous values was taken, and which was also adopted in the 2012 ENSDF evaluation. The revised value here includes newer measurement by 2013Da16.

^{62}Ga-Q($\varepsilon+\beta^+$): From 2021Wa16. 2020Ma59 quote 9181.4 *1* from mass measurement by 2006Er03.

2020Ma59: ^{62}Ga produced in the ZrC(p,X),E(p)=479 MeV at the ISAC facility at TRIUMF. Detected β^+ particles with SCEPTAR array of 20 plastic scintillators. Measured Eγ, Iγ, $\beta\gamma$-, $\gamma\gamma$- and $\beta\gamma\gamma$-coin, $\gamma\gamma(\theta)$ using GRIFFIN array of 16 HPGe clover detectors, each Compton-suppressed by 20-element BGO detectors, and SCEPTAR array of plastic scintillators for β particles. Deduced precise β^++ε branch to the g.s. of ^{62}Zn. Deduced isospin-symmetry breaking in superallowed Fermi β decay from 0^+ to 0^+ state. Deduced isospin-mixing correction δ_{C1}=0.110% *9* in ^{62}Ga superallowed decay to the excited 0^+ states in ^{62}Zn, as compared to evaluated δ_{C1}=0.275% *55* in 2015Ha07.

2008Fi07: ^{62}Ga produced in the Zr(p,X) reaction using 500 MeV protons produced at the ISAC facility at TRIUMF. Detected β^+ particles with SCEPTAR array of 20 plastic scintillators. Measured Eγ, Iγ, $\gamma\gamma$, $\beta\gamma$ coin using 8π array of 20 HPGe detectors with Compton-suppression and SCEPTAR array of plastic scintillators for β particles. Deduced precise and accurate β^++ε branch to g.s. of ^{62}Zn and associated log *ft* value relevant to superallowed β decay from 0^+ to 0^+ state and breaking of isospin symmetry.

2008Be21, 2005Ca06: ^{62}Ga was produced in bombardment of ^{64}Zn target by 48 MeV protons at IGISOL facility in Jyvaskyla. Fusion evaporation residues were thermalized in helium gas and singly-charged ions were mass analyzed. JYFLTRAP facility was used to separate ^{62}Ga from other isobaric activities. Penning-trap separated ^{62}Ga was used for measurement of Eγ and Iγ. Different measurement cycles were used on the mass-separated source in another setup. Detection system consisted of three HPGe clover detectors (for γ rays), and 4π cylindrical plastic scintillators for β particles. Measured Eγ, Iγ, $\gamma\gamma$ and $\beta\gamma$ coin. Half-life measurement in 2005Ca06.

2008Gr03: E=500 MeV protons produced at TRIUMF cyclotron. ^{62}Ga beam produced using TRILIS. Measured β particles using 4π gas counter and 20 plastic scintillators. Detected γ rays with 8π γ-ray spectrometer. Measured precise half-life of ^{62}Ga decay.

2006Hy02 (also 2005Hy04): ^{62}Ga was produced in spallation reaction by 500 MeV protons on a ZrC target. Mass-separated 30-keV ^{62}Ga beam was obtained using a laser ion source at TRIUMF-ISAC facility and implanted in a Mylar tape for γ and β counting. Measured Eγ, Iγ, $\gamma\gamma$, β, $\beta\gamma$ coin using 8π array of 20 Compton-suppressed HPGe detectors for γ rays and an array of 20 plastic scintillators for β rays. Half-life measurement is reported by 2005Hy04. Same group as 2008Fi07 and 2008Gr03.

2004Bl03: ^{62}Ga from ^{28}Si(^{40}Ca,npα) at GSI; measured half-life, $\beta\gamma$ coin.

2003Hy02: ^{62}Ga from ^{1}H(^{64}Zn,3n) at 42 MeV/nucleon; measured Eγ, Iγ, half-life, branching ratios at the Texas A&M University K500 Superconducting Cyclotron.

2002Lo13 (also 2002Bl17): ^{62}Ga from fragmentation of ^{78}Kr beam, GANIL facility, measured half-life.

1993Wi18, 1993Wi03: ^{58}Ni(^{84}Kr,X) E=75 MeV/nucleon. Measured half-life using A1200 radioactive-beam facility at the NSCL-MSU.

1979Da04: from ^{58}Ni(^{6}Li,2n), E=25 MeV, ΔE-E telescopes (plastic or semiconductors), $T_{1/2}$, Q(ε) at Argonne FN tandem accelerator.

1978Al23: from ^{58}Ni(^{6}Li,2n), E=25 MeV, plastic scintillator, half-life at Brookhaven National Laboratory.

1978Ch11 (also 1973ChYF): from ^{64}Zn(p,3n), E=44 MeV, plastic scintillator, Ge(Li), half-life, Q(β^+) at the synchrocyclotron of the Institute for Nuclear Study, University of Tokyo.

1976BaXP: from Zn(p,3n), E=44 MeV, half-life at McGill University cyclotron facility.

1976JaZP: from ^{46}Ti(^{19}F,3n) and ^{50}Cr(^{16}O,p3n), plastic scintillator, half-life at Chalk-River tandem accelerator.

1973ChYF: from ^{64}Zn(p,3n), E=32-52 MeV, plastic scintillator, Ge(Li) at the synchrocyclotron of the Institute for Nuclear Study, University of Tokyo.

2008Fi07, 2008Gr03, 2006Hy02 (also 2005Hy04) are from the same group.

2008Be21, 2005Ca06, 2004Bl03, 2002Lo13 (also 2002Bl17) share some of the same authors, but some of the studies are at different facilities.

Review of superallowed (0^+ to 0^+) β decays: 2010To12, 2009Er02, 2009Ha12, 2008To03, 2005Ha27, 2002Ha27; also 2006Ha12, 2005Ha15, 2005Ha65 conference papers.

Additional information 1.

References and notes on half-life measurement of ^{62}Ga decay:

^{62}Ga $\varepsilon+\beta^+$ decay (116.123 ms) 2020Ma59,2008Fi07,2008Be21 (continued)

2008Gr03: ^{62}Ga beam from TRIUMF ISAC using resonant ionization laser ion source and mass separation, positron detection using 4π continuous flow gas proportional counter. Yields and activities of ^{62}Cu, ^{62m}Co, ^{62g}Co, ^{62}Mn and ^{62}Fe contaminants were estimated from $\beta\gamma$ coin. data. Systematic and statistical uncertainties described in detail.

2005Ca06: ^{62}Ga beam from IGISOL at Jyvaskyla. Positron detection using 4π cylindrical plastic scintillator. Presence of ^{62}Cu activity was considered as a constant background. Systematic and statistical uncertainties described in detail.

2004Bl03: ^{62}Ga beam from ^{28}Si(^{40}Ca,αpn) at 4.84 MeV/nucleon at GSI facility. Mass-analyzed beam and positron detection using 4π gas detector and γ by HPGe detector. ^{62}Cu and ^{62}Zn impurities were taken into account. Systematic and statistical uncertainties described in detail.

2003Hy02: ^{62}Ga beam from ^{1}H(^{64}Zn,3n) at 42 MeV/nucleon at Texas A&M facility. Mass-analyzed beam was 80-94% pure ^{62}Ga. Positron detection using 4π gas proportional chamber. ^{58}Cu and ^{54}Co impurities quantified. The γ spectrum was measured by HPGe detector. Maximum likelihood method. Uncertainty analysis not discussed fully.

2002Lo13 (also 2002Bl17): ^{62}Ga from fragmentation of ^{78}Kr beam, GANIL facility, decay curve of β^+ particles correlated with implants shown; no discussion of uncertainties.

Total decay energy of 9181.2 keV *7* deduced (by RADLIST code) from proposed decay scheme is in agreement with the expected value of 9181.1 keV *4*, indicating that decay scheme is complete.

^{62}Zn Levels

E(level)†	J$^\pi$‡	T$_{1/2}$#	Comments
0.0	0^+	9.197 h *20*	
953.84 *6*	2^+	2.93 ps *21*	
1804.62 *6*	2^+	2.63 ps *42*	
2342.35 *8*	0^+		E(level): 2342.1 *1* (2020Ma59). J$^\pi$: from (1388γ)(954γ)(θ) in 2020Ma59. $J^\pi=2^+$, as proposed in 2013Le25 from L(p,t)=2, and also in 2019Le11 is excluded with 99.9% confidence in the present $\gamma\gamma(\theta)$ data. Note that firm 0^+ was assigned for this level in ^{62}Zn Adopted Levels in the ENSDF database of 2012, based on $\gamma\gamma(\theta)$ data in ^{61}Ni(^{3}He,2nγ); (2010Al28); L(^{6}Li,d)=0 in 1977Fu03 and L(p,t)=0 in 1974Hi05.
2803.24 *10*	2^+	<0.167 ps	E(level): 2803.2 *1* (2020Ma59). A 2802.0 *12* γ with Iγ=0.0006 *4* from 2008Fi07 from this level was not confirmed by 2020Ma59.
2884.2 *4*	2^+	<0.153 ps	E(level): 2885.1 *5* (2020Ma59).
2961.53 *10*	(1^+)		E(level): 2961.4 *5* (2020Ma59).
3046.38 *11*	0^+		E(level): 3046.3 *1* (2020Ma59). J$^\pi$: (2093γ)(954γ)(θ) in 2020Ma59 consistent with 0^+, but also allows J=1,2,3,4. 2020Ma59 assign definite 0^+, combining their $\gamma\gamma(\theta)$ data and L(p,t)=0 in 2013Le25.
3148.01 *21*	$(0^+,1^-,2^+)$		E(level): 3147.0 *5* (2020Ma59). J$^\pi$: (2^+) in 2020Ma59.
3180.89 *8*	$1^{(+)}$		E(level): 3180.9 *3* (2020Ma59). J$^\pi$: (2227γ)(954γ)(θ) (2020Ma59) allows J=1,2,3,4; γ to 0^+ and probable β feeding by Gamow-Teller transition from 0^+ parent does not permit J=2,3,4. Compiler's note: 1^- is not completely excluded by log *ft* value.
3340.5 *3*	$(0^+,1,2^-)$		E(level): 3339.8 *5* (2020Ma59). J$^\pi$: (1^+) in 2020Ma59.
3374.21 *10*	1^-		E(level): 3374.2 *7* (2020Ma59). J$^\pi$: (1) in 2020Ma59.
3424.13 *11*	(1^+)		E(level): 3424.6 *7* (2020Ma59).
3561.0 *5*	$(0^+,1,2^-)$		E(level): 3560.9 *5* (2020Ma59). J$^\pi$: (1^+) in 2020Ma59.
3690.6 *9*	$(0^+,1,2^-)$		E(level): 3690.4 *9* (2020Ma59). J$^\pi$: (1^+) in 2020Ma59.
3862?@ *2*	0^+@		
3936?@ *6*	0^+@		
4021.79 *9*	(1^+)		E(level): 4021.7 *5* (2020Ma59).
4322.6 *4*	(1^+)		E(level): 4322.4 *9* (2020Ma59).
4447.85 *6*	(1^+)		E(level): 4447.9 *4* (2020Ma59).

Continued on next page (footnotes at end of table)

^{62}Ga ε+β$^+$ decay (116.123 ms) 2020Ma59,2008Fi07,2008Be21 (continued)

^{62}Zn Levels (continued)

E(level)[†]	Jπ[‡]	Comments
4531.6 *5*	(0$^+$,1,2$^-$)	E(level): 4531.5 *5* (2020Ma59). Jπ: (1$^+$) in 2020Ma59.
4552?[@] *9*	0$^+$[@]	
4894.35 *9*	(1$^+$)	E(level): 4894.4 *5* (2020Ma59).
5210.91 *8*	(1$^+$)	E(level): 5210.8 *4* (2020Ma59).
5394.0 *4*	(1$^+$)	E(level): 5394.3 *10* (2020Ma59).
5507.73 *23*	(1$^+$)	E(level): 5508.0 *11* (2020Ma59).
5583.8? *4*	(1$^+$)	E(level): 5583.8 *4* (2020Ma59).
5919.8 *4*	(1$^+$)	E(level): 5919.6 *6* (2020Ma59).

[†] From least-squares fit to Eγ data, with the inclusion of tentatively placed transitions. Normalized χ^2=2.4 is somewhat larger than critical χ^2 of 1.6, as the 3425.3γ from 3424.1 level is poorly fitted. Values in Table I of 2020Ma59 are listed under comments, when different.

[‡] From the Adopted Levels. Assignments given by 2020Ma59, based on previous assignment and from their γγ(θ) data are listed in comments, if different from those in the Adopted Levels. Other exceptions are noted.

[#] from the Adopted Levels.

[@] From (p,t) study by 2013Le25. This level is not included in the Adopted Levels, as there is no direct evidence of its population in ^{62}Ga ε decay from γ-ray observation.

ε,β$^+$ radiations

E(decay)	E(level)	Iβ$^+$ [‡]	Iε[‡]	Log *ft*	I(ε+β$^+$)[†‡]	Comments
(3261.3 *12*)	5919.8	0.0015 *5*	0.9×10^{-4} *3*	5.75 *14*	0.0016 *5*	av Eβ=990.17 *28*; εK=0.0514 *14*; εL=0.00574 *15*; εM+=0.001025 *26*
(3597.3[#] *12*)	5583.8?	1.25×10^{-4} *48*	0.5×10^{-5} *2*	7.10 *17*	1.3×10^{-4} *5*	av Eβ=1146.60 *28*; εK=0.0344 *9*; εL=0.00383 *11*; εM+=6.84×10^{-4} *18*
(3673.4 *11*)	5507.73	0.00174 *29*	6.5×10^{-5} *11*	6.01 *7*	0.0018 *3*	av Eβ=1182.19 *22*; εK=0.0316 *9*; εL=0.00352 *10*; εM+=6.29×10^{-4} *16*
(3787.1 *12*)	5394.0	0.00107 *19*	3.5×10^{-5} *6*	6.30 *8*	0.0011 *2*	av Eβ=1235.52 *28*; εK=0.0280 *8*; εL=0.00312 *9*; εM+=5.57×10^{-4} *14*
(3970.2 *11*)	5210.91	0.0134 *11*	3.6×10^{-4} *3*	5.329 *35*	0.0138 *11*	av Eβ=1321.63 *19*; εK=0.0232 *6*; εL=0.00259 *7*; εM+=4.62×10^{-4} *12*
(4286.8 *11*)	4894.35	0.0093 *9*	1.85×10^{-4} *19*	5.688 *41*	0.0095 *9*	av Eβ=1471.19 *19*; εK=0.01724 *48*; εL=0.00192 *5*; εM+=3.43×10^{-4} *9*
(4629[#] *9*)	4552?	≤2.4×10^{-4}	≤3.6×10^{-6}	≥7.5	≤2.4×10^{-4}	av Eβ=1633.7 *43*; εK=0.01289 *45*; εL=0.00144 *5*; εM+=2.57×10^{-4} *8*
(4649.5 *12*)	4531.6	3.1×10^{-4} *12*	4.5×10^{-6} *18*	7.38 *17*	3.1×10^{-4} *12*	av Eβ=1643.49 *29*; εK=0.01268 *35*; εL=0.001413 *40*; εM+=2.53×10^{-4} *7*
(4733.3 *11*)	4447.85	0.0273 *9*	3.71×10^{-4} *16*	5.473 *14*	0.0277 *9*	av Eβ=1683.39 *19*; εK=0.01186 *33*; εL=0.001322 *37*; εM+=2.36×10^{-4} *6*
(4858.5 *12*)	4322.6	0.0016 *3*	1.9×10^{-5} *4*	6.78 *8*	0.0016 *3*	av Eβ=1743.14 *29*; εK=0.01077 *30*; εL=0.001200 *34*; εM+=2.14×10^{-4} *6*
(5159.3 *11*)	4021.79	0.0203 *8*	2.01×10^{-4} *10*	5.817 *17*	0.0205 *8*	av Eβ=1886.99 *20*; εK=0.00864 *24*; εL=9.63×10^{-4} *27*; εM+=1.719×10^{-4} *45*
(5245[#] *6*)	3936?	≤1.3×10^{-4}	≤1.2×10^{-6}	≥8.1	≤1.3×10^{-4}	av Eβ=1928.1 *29*; εK=0.00814 *26*; εL=9.07×10^{-4} *29*; εM+=1.619×10^{-4} *48*
(5319.1[#] *23*)	3862?	≤2.2×10^{-4}	≤1.9×10^{-6}	≥7.9	≤2.2×10^{-4}	av Eβ=1963.6 *10*; εK=0.00774 *22*;

Continued on next page (footnotes at end of table)

^{62}Ga $\varepsilon+\beta^+$ decay (116.123 ms) 2020Ma59,2008Fi07,2008Be21 (continued)

ϵ,β^+ radiations (continued)

E(decay)	E(level)	Iβ^+ ‡	Iε‡	Log *ft*	I($\varepsilon+\beta^+$)†‡	Comments
						εL=8.62×10^{-4} *25*; εM+=1.540×10^{-4} *42*
(5490.5 *14*)	3690.6	3.0×10^{-4} *10*	2.4×10^{-6} *8*	7.80 *14*	3.0×10^{-4} *10*	av Eβ=2045.88 *48*; εK=0.00691 *20*; εL=7.70×10^{-4} *22*; εM+=1.374×10^{-4} *36*
(5620.1 *12*)	3561.0	3.9×10^{-4} *14*	2.8×10^{-6} *11*	7.75 *16*	3.9×10^{-4} *14*	av Eβ=2108.18 *29*; εK=0.00636 *18*; εL=7.08×10^{-4} *20*; εM+=1.264×10^{-4} *33*
(5757.0 *11*)	3424.13	0.0064 *6*	4.3×10^{-5} *4*	6.59 *4*	0.0064 *6*	av Eβ=2174.05 *20*; εK=0.00584 *16*; εL=6.50×10^{-4} *18*; εM+=1.161×10^{-4} *30*
(5806.9 *11*)	3374.21	0.00606 *30*	3.91×10^{-5} *22*	6.632 *21*	0.0061 *3*	av Eβ=2198.10 *20*; εK=0.00566 *16*; εL=6.31×10^{-4} *18*; εM+=1.126×10^{-4} *29*
(5840.6 *11*)	3340.5	4.0×10^{-4} *19*	2.5×10^{-6} *12*	7.83 *21*	4.0×10^{-4} *19*	av Eβ=2214.34 *24*; εK=0.00555 *16*; εL=6.18×10^{-4} *17*; εM+=1.103×10^{-4} *29*
(6000.2 *11*)	3180.89	0.0337 *8*	1.93×10^{-4} *7*	5.966 *10*	0.0339 *8*	av Eβ=2291.29 *20*; εK=0.00505 *14*; εL=5.62×10^{-4} *16*; εM+=1.004×10^{-4} *26*
(6033.1# *11*)	3148.01	<0.00021	<1.2×10^{-6}	>10.0	<0.00021	av Eβ=2311.72 *21*; εK=0.00495 *14*; εL=5.52×10^{-4} *15*; εM+=9.85×10^{-5} *26*
(6134.7 *11*)	3046.38	0.0045 *2*	2.39×10^{-5} *13*	6.897 *19*	0.0045 *2*	av Eβ=2356.21 *20*; εK=0.00467 *13*; εL=5.20×10^{-4} *15*; εM+=9.30×10^{-5} *24*
(6219.6 *11*)	2961.53	0.0014 *4*	7.1×10^{-6} *21*	7.44 *12*	0.0014 *4*	av Eβ=2397.20 *20*; εK=0.00446 *12*; εL=4.96×10^{-4} *14*; εM+=8.85×10^{-5} *23*
(6296.9# *12*)	2884.2	<0.003	<3×10^{-5}	>9.0	<0.003	av Eβ=2437.40 *29*; εK=0.00924 *26*; εL=0.001032 *29*; εM+=1.842×10^{-4} *48*
(6377.9 *11*)	2803.24	0.0013 *5*	1.3×10^{-5} *5*	9.39 *17*	0.0013 *5*	av Eβ=2476.02 *20*; εK=0.00882 *25*; εL=9.85×10^{-4} *27*; εM+=1.757×10^{-4} *46*
(6838.8 *11*)	2342.35	0.0097 *7*	0.35×10^{-4} *3*	6.822 *31*	0.0097 *7*	av Eβ=2696.91 *20*; εK=0.00322 *9*; εL=3.58×10^{-4} *10*; εM+=6.39×10^{-5} *17*
(7376.5# *11*)	1804.62	<0.0005	<3.0×10^{-6}	>10.3	<0.0005	av Eβ=2953.98 *19*; εK=0.00524 *15*; εL=5.84×10^{-4} *16*; εM+=1.043×10^{-4} *27*
(8227.3# *11*)	953.84	<0.0018	<7.3×10^{-6}	>10.1	<0.0018	av Eβ=3363.10 *19*; εK=0.00359 *10*; εL=4.00×10^{-4} *11*; εM+=7.14×10^{-5} *19*
(9181.1 *15*)	0.0	99.7200 *21*	0.1377 *21*	3.49830 *14*	99.8577 *29*	av Eβ=3838.23 *20*; εK=0.001220 *34*; εL=1.357×10^{-4} *38*; εM+=2.42×10^{-5} *6* I($\varepsilon+\beta^+$): 99.8577 *+23−29* (2020Ma59), obtained by subtracting the sum of the

Continued on next page (footnotes at end of table)

^{62}Ga $\varepsilon+\beta^+$ decay (116.123 ms) 2020Ma59,2008Fi07,2008Be21 (continued)

ϵ,β^+ radiations (continued)

E(decay)	E(level)	Comments
		observed g.s. feeding γ-ray intensity and the unobserved γ-ray feeding to g.s. from 100. Others: 99.858 *8* (2008Fi07, from 100−β feeding to excited states deduced from measured values and missing intensity estimated from shell model calculations); 99.893 *24* (2008Be21, from measured Iγ(to g.s.)=0.086 *9*, and theoretically predicted unobserved Iγ(to g.s.)=0.025 *7* from higher 1^+,0^+ states); 99.861 *11* (2006Hy02, previous value from the same group as 2008Fi07), 99.8 *1* (2005Ca06), 99.85 *+5−15* (2003Hy02), 99.88 *3* (2002Bl17); 99.862 *11* (2020Ha30 evaluation). Superallowed 0^+ to 0^+ β transition. Using the averaged half-life, 2008Fi07 deduced *ft*=3074.3 *11* or log *ft*=3.4877 *2*. 2020Ha30 evaluation gives $T_{1/2}$=116.121 ms *40*, and *ft*=3074.1 *15* or log *ft*=3.4877 *2*.
		E(decay): 9171 *26* (1979Da04, from measured β^+ endpoint).

† From γ+ce intensity balance at each level.
‡ Absolute intensity per 100 decays.
# Existence of this branch is questionable.

^{62}Ga $\varepsilon+\beta^+$ decay (116.123 ms) 2020Ma59,2008Fi07,2008Be21 (continued)

$\gamma(^{62}Zn)$

Iγ normalization: Absolute γ-ray intensities are measured by 2020Ma59.

E_γ †	I_γ ‡&	E_i(level)	J_i^π	E_f	J_f^π	Mult. @	δ	Comments
295.5[a] *14*	0.00041 *36*	3180.89	$1^{(+)}$	2884.2	2^+			
619.1 *1*	0.00108 *14*	2961.53	(1^+)	2342.35	0^+			
838.7 *4*	0.0007 *3*	3180.89	$1^{(+)}$	2342.35	0^+			
850.7 *1*	0.0088 *3*	1804.62	2^+	953.84	2^+	M1+E2	−5.1 *+29−34*	Others: Eγ=850.9 *2*, Iγ=0.0100 *7* (2008Fi07); Eγ=850.8 *2*, Iγ=0.0090 *14* (2006Hy02); Iγ=0.021 *8* (2008Be21). δ: from (851γ)(954γ)(θ) (2020Ma59), in exact agreement with δ value from 1981Wa09 in ^{58}Ni(^{6}Li,npγ) reaction.
953.7 *1*	0.0839 *14*	953.84	2^+	0.0	0^+	E2		Other Eγ=953.9 *2* (2008Fi07), 953.7 *2* (2006Hy02). I_γ: others: 0.0850 *19* (2008Fi07), 0.086 *9* (2008Be21), 0.0809 *33* (2006Hy02), 0.11 *4* (2005Ca06), 0.120 *21* (2003Hy02), 0.12 *3* (2002Bl17), 0.106 *17* (2000DoZX).
1031.4 *2*	0.00050 *9*	3374.21	1^-	2342.35	0^+			Other: Eγ=1032.0 *5*, Iγ=0.0006 *5* (2008Fi07).
1107.4 *6*	0.00009 *4*	4447.85	(1^+)	3340.5	$(0^+,1,2^-)$			
1156.8 *2*	0.0017 *2*	2961.53	(1^+)	1804.62	2^+			
1218.5 *6*	0.0013 *3*	4021.79	(1^+)	2803.24	2^+			
1376.2 *3*	0.00080 *19*	3180.89	$1^{(+)}$	1804.62	2^+			
1388.4 *1*	0.0188 *4*	2342.35	0^+	953.84	2^+			Others: Eγ=1388.5 *3*, Iγ=0.0191 *8* (2008Fi07); Eγ=1388.1 *2*, Iγ=0.0176 *20* (2006Hy02); Iγ=0.023 *11* (2008Be21).
1569.7 *1*	0.0037 *2*	3374.21	1^-	1804.62	2^+			Other: Eγ=1569.8 *4*, Iγ=0.0030 *5* (2008Fi07).
1619.3 *1*	0.0040 *2*	3424.13	(1^+)	1804.62	2^+			
1644.6 *2*	0.0016 *2*	4447.85	(1^+)	2803.24	2^+			Others: Eγ=1644.7 *5*, Iγ=0.0021 *5* (2008Fi07); Eγ=1645.1 *6*, Iγ=0.0026 *11* (2006Hy02).
1680.4 *4*	0.0008 *2*	4021.79	(1^+)	2342.35	0^+			Other: Eγ=1679.3 *6*, Iγ=0.0008 *5* (2008Fi07).
1804.6 *1*	0.0075 *3*	1804.62	2^+	0.0	0^+	E2		Others: Eγ=1805.0 *4*, Iγ=0.0070 *6* (2008Fi07); Eγ=1804.2 *3*, Iγ=0.0081 *14* (2006Hy02).
1836.9 *4*	0.00024 *10*	5210.91	(1^+)	3374.21	1^-			
1849.4 *1*	0.0070 *2*	2803.24	2^+	953.84	2^+	(M1(+E2))		Others: Eγ=1849.6 *4*, Iγ=0.0072 *6* (2008Fi07); Eγ=1850.1 *3*, Iγ=0.0081 *14* (2006Hy02); Iγ=0.020 *9* (2008Be21).
1931.3 *5*	0.00065 *16*	2884.2	2^+	953.84	2^+	(M1(+E2))		
1932.4 *2*	0.0019 *2*	4894.35	(1^+)	2961.53	(1^+)			
1982.1[#a] *9*	0.00008 *5*	4322.6	(1^+)	2342.35	0^+			
2062.8[#a] *2*	0.00016 *12*	5210.91	(1^+)	3148.01	$(0^+,1^-,2^+)$			
2091.5 *4*	0.0007 *2*	4894.35	(1^+)	2803.24	2^+			Others: Eγ=2092.5 *4*, Iγ=0.0047 *6* (2008Fi07); Eγ=2091.4 *5*, Iγ=0.0038 *10* (2006Hy02).
2092.5 *1*	0.0046 *2*	3046.38	0^+	953.84	2^+			Other: Eγ=2089.0 *8*, Iγ=0.0012 *5* (2008Fi07, tentative γ).
2105.4 *1*	0.0043 *2*	4447.85	(1^+)	2342.35	0^+			Others: Eγ=2105.9 *4*, Iγ=0.0061 *6* (2008Fi07); Eγ=2105.4 *4*, Iγ=0.0069 *14* (2006Hy02).
2164.4[#a] *5*	0.00011 *6*	5210.91	(1^+)	3046.38	0^+			

$^{62}_{30}Zn_{32}$-6

^{62}Ga $\varepsilon+\beta^+$ decay (116.123 ms) 2020Ma59,2008Fi07,2008Be21 (continued)

$\gamma(^{62}Zn)$ (continued)

E_γ[†]	I_γ[‡&]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[@]	δ	Comments
2166.7[a] *4*	0.00015 *10*	5507.73	(1^+)	3340.5	$(0^+,1,2^-)$			
2193.2 *8*	0.00022 *9*	3148.01	$(0^+,1^-,2^+)$	953.84	2^+			
2227.0 *1*	0.0282 *6*	3180.89	$1^{(+)}$	953.84	2^+	(M1(+E2))	−0.01 *8*	Others: Eγ=2227.2 *4*, Iγ=0.0262 *11* (2008Fi07); Eγ=2227.1 *3*, Iγ=0.0279 *24* (2006Hy02); Iγ=0.024 *10* (2008Be21). δ: from γγ(θ) for J=1 for 3181 level.
2386.0 *5*	0.00064 *15*	3340.5	$(0^+,1,2^-)$	953.84	2^+			
2407.8 *3*	0.00117 *15*	5210.91	(1^+)	2803.24	2^+			Other: Eγ=2408.3 *7*, Iγ=0.0013 *4* (2008Fi07).
2471.4 *5*	0.0012 *5*	3424.13	(1^+)	953.84	2^+			
2518.0 *6*	0.00097 *14*	4322.6	(1^+)	1804.62	2^+			
2589.9 *7*	0.00008 *4*	5394.0	(1^+)	2803.24	2^+			
2607.1 *5*	0.00039 *14*	3561.0	$(0^+,1,2^-)$	953.84	2^+			
2624.2 *4*	0.00029 *11*	5507.73	(1^+)	2884.2	2^+			
2643.2 *1*	0.00364 *16*	4447.85	(1^+)	1804.62	2^+			Others: Eγ=2643.9 *6*, Iγ=0.0026 *5* (2008Fi07); Eγ=2643.3 *3*, Iγ=0.0031 *10* (2006Hy02).
2704.4 *3*	0.00086 *14*	5507.73	(1^+)	2803.24	2^+			
2736.7 *9*	0.00030 *10*	3690.6	$(0^+,1,2^-)$	953.84	2^+			
2870.5 *5*	0.00111 *4*	5210.91	(1^+)	2342.35	0^+			Eγ,Iγ: from e-mail reply of Dec 29, 2020 from A.D. Maclean, first author of 2020Ma59. Others: Eγ=2869.8 *7*, Iγ=0.0017 *4* (2008Fi07); Eγ=2870.1 *9*, Iγ=0.0026 *13* (2006Hy02).
2962.3 *8*	0.00051 *16*	2961.53	(1^+)	0.0	0^+			
3051.6[#] *7*	0.00025 *9*	5394.0	(1^+)	2342.35	0^+			
3067.8 *2*	0.00153 *13*	4021.79	(1^+)	953.84	2^+			Others: Eγ=3068.1 *8*, Iγ=0.0016 *4* (2008Fi07); Eγ=3068.2 *6*, Iγ=0.0014 *7* (2006Hy02).
3089.6[#a] *6*	0.00013 *9*	4894.35	(1^+)	1804.62	2^+			Other: Eγ=3089.0 *10*, Iγ=0.0009 *4* (2008Fi07).
3164.1 *7*	0.00017 *8*	5507.73	(1^+)	2342.35	0^+			
3180.8 *1*	0.00374 *17*	3180.89	$1^{(+)}$	0.0	0^+			Others: Eγ=3181.3 *6*, Iγ=0.0042 *5* (2008Fi07); Eγ=3180.9 *5*, Iγ=0.0023 *8* (2006Hy02).
3368.1 *5*	0.0005 *2*	4322.6	(1^+)	953.84	2^+			
3374.1 *2*	0.00215 *15*	3374.21	1^-	0.0	0^+			Other: Eγ=3373.5 *8*, Iγ=0.0018 *4* (2008Fi07).
3405.8 *5*	0.00080 *13*	5210.91	(1^+)	1804.62	2^+			Eγ: note that energy of this γ ray listed as 2870 is erroneous in level-scheme Fig. 6 of 2020Ma59.
3425.3 *3*	0.0012 *2*	3424.13	(1^+)	0.0	0^+			Eγ: poor fit, level-energy difference gives Eγ=3424.0 *1*.
3493.9 *1*	0.0064 *2*	4447.85	(1^+)	953.84	2^+			Others: Eγ=3493.9 *7*, Iγ=0.0058 *6* (2008Fi07); Eγ=3494.0 *5*, Iγ=0.0052 *13* (2006Hy02).
3577.6 *5*	0.00031 *12*	4531.6	$(0^+,1,2^-)$	953.84	2^+			
3577.7[#a] *6*	0.00011 *7*	5919.8	(1^+)	2342.35	0^+			
3589.6 *4*	0.0008 *2*	5394.0	(1^+)	1804.62	2^+			
3940.5 *4*	0.00032 *14*	4894.35	(1^+)	953.84	2^+			
4021.6 *1*	0.0169 *6*	4021.79	(1^+)	0.0	0^+			Others: Eγ=4021.7 *8*, Iγ=0.0149 *10* (2008Fi07); Eγ=4021.2 *5*, Iγ=0.0160 *21* (2006Hy02).

$^{62}_{30}Zn_{32}$-7

^{62}Ga $\varepsilon+\beta^+$ decay (116.123 ms) 2020Ma59,2008Fi07,2008Be21 (continued)

$\gamma(^{62}Zn)$ (continued)

E_γ[†]	I_γ[‡&]	E_i(level)	J_i^π	E_f	J_f^π	Comments
4256.9 *1*	0.0040 *2*	5210.91	(1^+)	953.84	2^+	Others: Eγ=4256.6 *9*, Iγ=0.0029 *4* (2008Fi07); Eγ=4257.0 *9*, Iγ=0.0030 *12* (2006Hy02).
4447.7 *1*	0.0117 *8*	4447.85	(1^+)	0.0	0^+	Others: Eγ=4447.8 *9*, Iγ=0.0109 *8* (2008Fi07); Eγ=4448.3 *7*, Iγ=0.0104 *18* (2006Hy02).
4894.2 *1*	0.0064 *8*	4894.35	(1^+)	0.0	0^+	Others: Eγ=4894.4 *10*, Iγ=0.0042 *5* (2008Fi07); Eγ=4894.9 *19*, Iγ=0.0063 *16* (2006Hy02).
5210.6 *1*	0.0062 *10*	5210.91	(1^+)	0.0	0^+	Others: Eγ=5211.5 *11*, Iγ=0.0051 *6* (2008Fi07); Eγ=5211.0 *10*, Iγ=0.0047 *15* (2006Hy02).
5508.0 *7*	0.00037 *13*	5507.73	(1^+)	0.0	0^+	
5583.5[#a] *4*	0.00013 *5*	5583.8?	(1^+)	0.0	0^+	
5919.2 *5*	0.0015 *5*	5919.8	(1^+)	0.0	0^+	Other: Eγ=5920.5 *17*, Iγ=0.0008 *4* (2008Fi07, tentative γ).

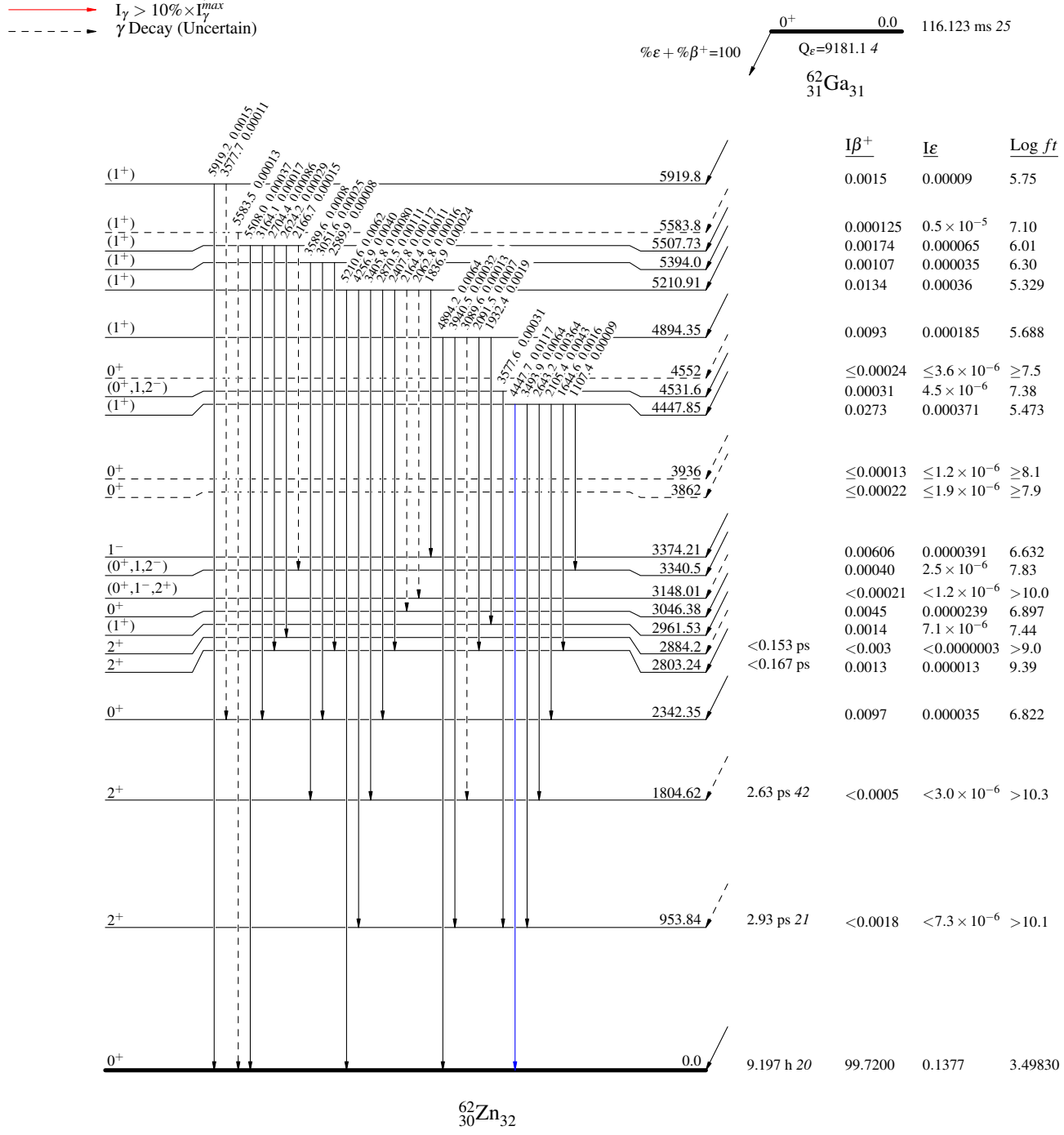
[†] From 2020Ma59.
[‡] From 2020Ma59. Intensities are per 100 decays of ^{62}Ga. Note that 2020Ma59 listed intensities per 10^6 decays of ^{62}Ga.
[#] According to caption for level-scheme Fig. 6 in 2020Ma59, γ rays with intensities consistent with zero within 1.5σ are shown as tentative.
[@] From the Adopted Levels, Gammas dataset.
[&] Absolute intensity per 100 decays.
[a] Placement of transition in the level scheme is uncertain.

$^{62}_{30}Zn_{32}$-8

^{62}Ga $\varepsilon+\beta^+$ decay (116.123 ms) 2020Ma59,2008Fi07,2008Be21

Decay Scheme

Intensities: I_γ per 100 parent decays



^{62}Ga $\varepsilon+\beta^+$ decay (116.123 ms) 2020Ma59,2008Fi07,2008Be21

Decay Scheme (continued)

Intensities: I_γ per 100 parent decays