Adopted Levels, Gammas

History

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

Q(β^-)=−9850 *syst*; S(n)=12920 *40*; S(p)=2927 *16*; Q(α)=−2744.1 *7* 2021Wa16
Estimated uncertainty=140 keV for Q(β^-) (2021Wa16).
Q(ε)=9181.1 *4*, Q(εp)=2708.1 *11*, S(2n)=28540 *200* (syst), S(2p)=8219.7 *17* (2021Wa16).
Measured mass excess for ^{62}Ga=−51992 keV *14* (2021Pa44), compared to mass excess=−51987.0 keV *6* (2021Wa16).
1978Ch11: production and identification of ^{62}Ga in ^{64}Zn(p,3n) reaction, measured half-life. Earlier reports: 1973ChYF and 1972ChYY.
1978Al23: production and identification of ^{62}Ga in ^{58}Ni(^{6}Li,2n) at 25 MeV, measured half-life.
1979Da04: production and identification of ^{62}Ga in ^{58}Ni(^{6}Li,2n) at 25 MeV, measured half-life.
1993Wi03, 1993Wi18: ^{62}Ga produced in fragmentation of ^{78}Kr beam at 75 MeV/nucleon using A1200 spectrometer at NSCL, MSU. Measured isotopic half-life.
Earlier secondary reports of production, identification and $T_{1/2}$ measurements: 1976BaXP, 1976JaZP.
Mass measurements: 2021Pa44, 2006Er03 (Penning trap), 2005Gu36.
1988Ga10: ^{64}Zn(^{6}Li,^{8}He) E=92.5, 98.9 MeV, no events for ^{62}Ga g.s. observed.
Theoretical calculations: 23 primary references for structure calculations and seven primary references for decay characteristics of ^{62}Ga can be retrieved from the NSR database at www.nndc.bnl.gov/nsr/.
Additional information 1.

^{62}Ga Levels

Cross Reference (XREF) Flags

A	^{62}Ge ε decay (73.5 ms)	E	^{40}Ca(^{24}Mg,pnγ),(^{28}Si,αpnγ)
B	^{9}Be(^{64}Ga,^{62}Gaγ),(^{65}Ge,^{62}Gaγ)	F	^{40}Ca(^{28}Si,αpnγ)
C	^{24}Mg(^{40}Ca,pnγ)	G	^{58}Ni(^{6}Li,2nγ)
D	^{40}Ca(^{24}Mg,pnγ)	H	^{62}Ga(^{12}C,^{62}Ga$'\gamma$)

E(level)[†]	J$^\pi$[‡]	$T_{1/2}$	XREF	Comments
0.0	0$^+$	116.123 ms *25*	ABCDEFGH	%ε+%β^+=100; %εp=? T=1 T_z=0. J$^\pi$: log *ft*=3.49830 *14* to 0$^+$ g.s. in ^{62}Zn, superallowed β decay; also log *ft*=3.525 *34* from 0$^+$ parent (^{62}Ge g.s.), probable superallowed β transition. $T_{1/2}$: weighted average of 116.15 ms *13* (2013Da16, (recoils)$\beta\gamma$-coin, ANL); 116.100 ms *25* (2008Gr03, β^+ decay curve for 56 runs at TRIUMF, earlier value from the same group was 116.01 ms *19* in 2005Hy04); 116.09 ms *17* (2005Ca06, β^+ decay curve, IGISOL at Jyvaskyla); 116.19 ms *4* (2004Bl03, β^+ decay curve, GSI); 115.84 ms *25* (2003Hy02, β^+ decay curve, Texas A&M); 116.34 ms *35* (1979Da04, β^+ decay curve, ANL); 115.95 ms *30* (1978Al23, β^+ decay curve, BNL); and 116.4 ms *15* (1978Ch11, β^+ decay curve, INS-Tokyo). Others: 118 ms *3* (2014Ro14, (fragment)β or (fragment)γ-correlated decay curve, LISE3 separator at GANIL); 114 ms *2* (2002Lo13,2002Bl17, fragment-β^+ correlated decay, GANIL); 113 ms *+6−5* (1993Wi18,1993Wi03, β^+ decay curve, NSCL-MSU, also 110 ms *+6−5* using a different fitting procedure); 120.8 ms *20* (1976BaXP thesis, β^+ decay curve, McGill University); 115 ms *10* (1976JaZP, β^+ decay curve, Chalk River, quoted as a preliminary value). Weighted average of all the values is 116.124 ms *25*, almost the same as the recommended value, since the uncertainties on values listed under 'others' are quite large, carrying negligible weight in the

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Adopted Levels, Gammas (continued)

^{62}Ga Levels (continued)

E(level)[†]	J^{π}[‡]	$T_{1/2}$	XREF	Comments
				weighted averaging procedure. In 2020Ha30 evaluation, $T_{1/2}$=116.120 ms *40*, where measured values from 2003Hy02, 2004Bl03, 2005Ca06, 2005Hy04 and 2008Gr03 are considered.
571.2[&] *1*	1^{+}[#]		ABCDEFGH	T=0 J^{π}: log *ft*=4.79 *4* from 0^{+} parent; ΔJ=1, dipole γ to 0^{+}.
817.2[&] *2*	3^{+}[#]	3.4 ns *11*	BCDEFGH	T=0 $T_{1/2}$: from γγ(t). Weighted average of 4.0 ns *+21−15* (2004Ru03) and 3.2 ns *11* (1998Vi06). J^{π}: ΔJ=2, E2 γ to 1^{+}.
978.2 *1*	1^{+}		AbC G	T=0 J^{π}: log *ft*=4.96 *5* from 0^{+} parent. Member of isospin T=1 triplet. E(level): 2022Mi15 in (^{6}Li,2nγ) propose that this level is different from the 978.28, 1^{+} level populated in ^{62}Ge decay, although, the Eγ values in the two studies agree within the uncertainties.
981 *2*	2^{+}[@]		H	T=1
1016.8 *4*	(2^{+})		CD	J^{π}: ΔJ=1, dipole γ to 1^{+}. Possible T=1, (2^{+}) analog of 954, 2^{+} state in ^{62}Zn (2004Ru03).
1017.1 *1*	1^{+}		A	J^{π}: log *ft*=4.79 *4* from 0^{+} parent; γ to 0^{+}.
1072.5 *2*			G	J^{π}: γ to 1^{+} suggests $1,2,3^{+}$.
1117.41 *20*	1^{+}		A	J^{π}: log *ft*=5.56 *6* from 0^{+} parent; γ to 0^{+}.
1161.1 *1*	(2^{+})		C G	T=0 J^{π}: ΔJ=1, dipole γ to 1^{+}.
1193.6[&] *2*	$5^{(+)}$[#]		BCDEFGH	T=0 J^{π}: ΔJ=2, Q γ to 3^{+}; J=1 is unlikely as this level is not populated in from 0^{+} parent state in ^{62}Ge EC decay.
1352.0 *2*	$(2,3^{+})$		B G	J^{π}: γ to 1^{+}; J=0,1 unlikely as this level is not populated in from 0^{+} parent state in ^{62}Ge ε decay.
1359.7 *1*	1^{+}		A	J^{π}: log *ft*=5.27 *5* from 0^{+} parent; γ to 0^{+}.
1439.4 *2*	(4^{+})		BCDE G	T=0 J^{π}: ΔJ=1,D+Q or ΔJ=2, Q γ to 3^{+}. Possible lowest T=0, (4^{+}) state (2004Ru03).
1490 *20*			H	
1574.3 *2*	$(2,3^{+})$		C G	T=0 J^{π}: γ to 1^{+}; J=0,1 unlikely as this level is not populated in from 0^{+} parent state in ^{62}Ge EC decay.
1850.1 *4*			G	J^{π}: γ to 3^{+} suggests $3,4,5^{+}$.
1899.3 *4*	1^{+}		A	J^{π}: log *ft*=5.20 *6* from 0^{+} parent; γ to 0^{+}.
2005 *54*			H	
2010.9 *4*	1^{+}		A	J^{π}: log *ft*=4.94 *6* from 0^{+} parent; γ to 0^{+}.
2164.1 *4*	1^{+}		A	J^{π}: log *ft*=4.46 *6* from 0^{+} parent; γ to 0^{+}.
2211.0 *4*	$(2,3^{+})$		C	J^{π}: γ to 1^{+}; J=0,1 unlikely as this level is not populated in from 0^{+} parent state in ^{62}Ge EC decay.
2212	(4^{+})[@]		H	
2234.0 *5*	(4^{+})		CD	J^{π}: ΔJ=1, dipole γ to 3^{+}; possible T=1, (4^{+}) analog of 2186, 4^{+} state in ^{62}Zn (2004Ru03).
2373.9 *3*	(6^{+})		CDEFG	J^{π}: ΔJ=1, D+Q γ to (5^{+}). Possible lowest T=0, (6^{+}) state (2004Ru03).
2434.5[&] *3*	(7^{+})[#]		CDEFG	J^{π}: ΔJ=2, Q γ to (5^{+}).
2641.9 *5*	1^{+}		A	J^{π}: log *ft*=5.13 *12* from 0^{+} parent; γ to 0^{+}.
2674.6[a] *4*	(4^{+})		CD	J^{π}: γ to (2^{+}); ΔJ=1, dipole γ to $5^{(+)}$; possible bandhead. 4^{+} assigned in (^{40}Ca,pnγ) (2013Da16), while 6 in (^{24}Mg,pnγ) (2004Ru03).
2966.9 *5*	1^{+}		A	J^{π}: log *ft*=5.08 *9* from 0^{+} parent; γ to 0^{+}.
2990.1 *10*	$(5,6,7^{+})$		C	J^{π}: γ to (5^{+}).
3014.9[a] *4*	(6^{+})		CD	J^{π}: ΔJ=0, dipole or D+Q γ to (6^{+}); γ to (4^{+}).

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Adopted Levels, Gammas (continued)

^{62}Ga Levels (continued)

E(level)[†]	J^{π}[‡]	XREF	Comments
3221 *34*	(3^-)[@]	H	
3339.7 *5*	1^+	A	J^{π}: log *ft*=5.01 *10* from 0^+ parent; γ to 0^+.
3492.2 *3*	(7)	CD F	J^{π}: ΔJ=1, dipole γ to (6^+); ΔJ=0, dipole γ to (7^+).
3594.8 *4*	1^+	A	J^{π}: log *ft*=4.61 *9* from 0^+ parent; γ to 0^+.
3796.7 *8*	$(7,8,9^+)$	C	J^{π}: γ to (7^+).
3922.2[a] *4*	(8^+)[#]	CDEF	XREF: E(?) J^{π}: ΔJ=1, D+Q γ to (7^+); ΔJ=(2), (Q) γ to (6^+).
4658.2 *5*	(8)	CD F	J^{π}: ΔJ=1, D+Q γ to (7).
4789.3[&] *4*	(9^+)	CDEF	J^{π}: ΔJ=2, Q γ to (7^+); ΔJ=1, D+Q γ to (8^+).
4945.3[a] *4*	$(9^+,10^+)$[#]	CD F	J^{π}: ΔJ=2, Q or ΔJ=1, D+Q γ to (8^+).
5735.3[&] *4*	(11^+)	CDEF	J^{π}: ΔJ=2, Q γ to (9^+); band member.
6842.6[&] *5*	(13^+)	CDEF	J^{π}: ΔJ=2 Q γ to (11^+); band member.
8588.6[&] *10*	(15^+)	C F	J^{π}: ΔJ=2 Q γ to (13^+); band member.
9977.2[&] *15*	(17^+)	C F	J^{π}: ΔJ=2 Q γ to (15^+); band member.
10044.4[b] *19*	(15^+)	F	J^{π}: ΔJ=(2), (Q) γ to (13^+); possible bandhead.
10504? *4*		F	J^{π}: $(13,14,15^+)$ from possible γ to (13^+).
11133?[c] *3*	(16^+)	F	J^{π}: γ from (18^+); possible bandhead.
11860.2[b] *20*	(17^+)	F	J^{π}: ΔJ=(2) (Q) γ to (15^+); band member.
12390 *3*		F	J^{π}: $(15,16,17^+)$ from possible γ to (15^+).
12702.4 *23*	(18)	F	J^{π}: ΔJ=(1) (D) γ to (17^+).
13086.3[c] *25*	(18^+)	F	J^{π}: ΔJ=(1) (D+Q) γ to (17^+); band member.
13612 *3*	$(17,18,19^+)$	F	J^{π}: $(17,18,19^+)$ from possible γ to (17^+).
13934 *3*	(19^+)	F	J^{π}: ΔJ=(2) (Q) γ to (17^+).
14081[b] *3*	(19^+)	F	J^{π}: ΔJ=(2) (Q) γ to (17^+); band member.
15377[c] *3*	(20^+)	F	J^{π}: γ to (18^+); band member.
15461? *3*		F	J^{π}: (18,19,20) from possible γ to (18).
15724 *4*	(18,19,20)	F	J^{π}: ΔJ=1, D γ to $(17,18,19^+)$.
16821?[b] *4*	(21^+)	F	J^{π}: possible γ to (19^+); band member.
x?[d]	J	F	Additional information 2.
2043.9+x?[d] *17*	(J+2)	F	J^{π}: ΔJ=(2) (Q) γ to J; band member.
4437.6+x?[d] *24*	(J+4)	F	J^{π}: ΔJ=(2) (Q) γ to J+2; band member.

[†] From least-squares fit to Eγ data.

[‡] For levels populated in high-spin (J>4 or so) studies, yrast type of excitations are assumed i.e. spins ascend with the excitation energy. In addition, ΔJ=2, Q transitions are assumed as ΔJ=2, E2, and ΔJ=1, D+Q as ΔJ=1, M1+E2 transitions.

[#] Positive parity from comparison with shell-model calculated spectrum for the odd-spin T=0 yrast band.

[@] Proposed in 2023Wi05 based on comparions with mirror nucleus ^{62}Zn and shell-model predictions.

[&] Seq.(D): DJ=2, T=0, yrast structure. Configuration=$\pi f_{5/2}g_{9/2}$.

[a] Seq.(d): Yrast structure, α=0.

[b] Band(A): ΔJ=(2) band based on (15^+).

[c] Band(B): ΔJ=(2) band based on (16^+).

[d] Band(C): ΔJ=(2) band.

Adopted Levels, Gammas (continued)

$\gamma(^{62}Ga)$

E_i(level)	J^π_i	E_γ†	I_γ†	E_f	J^π_f	Mult.‡	α#	Comments
571.2	1^+	571.2 *1*	100	0.0	0^+	D		
817.2	3^+	246.0 *1*	100	571.2	1^+	E2	0.0243	B(E2)(W.u.)=12 *+6−3* Mult.: from $\gamma\gamma(\theta)$ in ^{40}Ca(^{24}Mg,pnγ) and RUL.
978.2	1^+	978.2 *1*	100	0.0	0^+	(D)		Mult.: from (^{40}Ca,pnγ). Other: (Q) from (^{6}Li,2nγ).
981	2^+	981 *2*	100	0.0	0^+			
1016.8	(2^+)	445.6 *3*	100	571.2	1^+	D		
1017.1	1^+	1017.1 *1*	100	0.0	0^+			
1072.5		501.3 *1*	100	571.2	1^+			
1117.41	1^+	1117.4 *2*	100	0.0	0^+			
1161.1	(2^+)	182.8 *1*	17 *9*	978.2	1^+			
		589.8 *1*	100 *8*	571.2	1^+	D		E_γ: from weighted average of in (^{40}Ca,pnγ) and (^{6}Li,2nγ).
1193.6	$5^{(+)}$	376.3 *2*	100	817.2	3^+	Q		E_γ: unweighted average of values from (^{24}Mg,pnγ); (^{40}Ca,αpnγ); (^{6}Li,2nγ), and (^{40}Ca,pnγ).
1352.0	$(2,3^+)$	780.8 *1*	100	571.2	1^+			E_γ: from (^{6}Li,2nγ). Other: 784 *2* in ^{9}Be(^{64}Ga,^{62}Gaγ),(^{65}Ge,^{62}Gaγ).
1359.7	1^+	1359.7 *1*	100	0.0	0^+			
1439.4	(4^+)	622.2 *1*	100	817.2	3^+	Q,D+Q		E_γ: weighted average of values from (^{24}Mg,pnγ); (^{40}Ca,αpnγ); and (^{6}Li,2nγ).
1490		1490 *20*	100	0.0	0^+			
1574.3	$(2,3^+)$	595.9 *9*	60 *20*	978.2	1^+			E_γ: γ from (^{40}Ca,pnγ) only.
		1003.1 *1*	100 *60*	571.2	1^+			E_γ: from (^{6}Li,2nγ).
1850.1		1032.9 *3*	100	817.2	3^+			
1899.3	1^+	1899.3 *4*	100	0.0	0^+			
2005		2005 *54*	100	0.0	0^+			
2010.9	1^+	2010.9 *4*	100	0.0	0^+			
2164.1	1^+	2164.1 *4*	100	0.0	0^+			
2211.0	$(2,3^+)$	1232.7 *3*	100	978.2	1^+			
2212	(4^+)	1233	100	981	2^+			
2234.0	(4^+)	794.4 *5*	65 *23*	1439.4	(4^+)	Q,D+Q		
		1417.8 *14*	100 *27*	817.2	3^+	D		
2373.9	(6^+)	934.7 *6*	30 *3*	1439.4	(4^+)	(Q)		γ not reported in (^{6}Li,2nγ). I_γ: from (^{24}Mg,pnγ). Other: 56 *6* from (^{40}Ca,pnγ).
		1180.4 *2*	100 *4*	1193.6	$5^{(+)}$	D+Q		E_γ: weighted average of values from (^{40}Ca,pnγ); (^{24}Mg,pnγ); (^{40}Ca,αpnγ); and (^{6}Li,2nγ).
2434.5	(7^+)	1240.8 *2*	100	1193.6	$5^{(+)}$	Q		E_γ: weighted average of values from (^{40}Ca,pnγ); (^{24}Mg,pnγ); (^{40}Ca,αpnγ); and (^{6}Li,2nγ).
2641.9	1^+	2641.8 *5*	100	0.0	0^+			
2674.6	(4^+)	1236@ *1*		1439.4	(4^+)			γ from (^{24}Mg,pnγ) only (2004Ru03). Iγ(1236γ)/Iγ(1481γ)=56 *56*/100 *17* (2004Ru03).
		1481 *1*		1193.6	$5^{(+)}$	D		γ from (^{24}Mg,pnγ) only (2004Ru03).
		1513.0 *17*		1161.1	(2^+)			γ from (^{40}Ca,pnγ) only (2013Da16).
2966.9	1^+	2966.8 *5*	100	0.0	0^+			
2990.1	$(5,6,7^+)$	1796.5 *9*	100	1193.6	$5^{(+)}$			
3014.9	(6^+)	340.3 *2*	100 *22*	2674.6	(4^+)			
		641.2 *2*	84 *9*	2373.9	(6^+)	D,D+Q		
3221	(3^-)	2242 *34*	100	981	2^+			
3339.7	1^+	3339.6 *5*	100	0.0	0^+			

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Adopted Levels, Gammas (continued)

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

E_i(level)	J^π_i	E_γ †	I_γ †	E_f	J^π_f	Mult. ‡	Comments
3492.2	(7)	478.3 *11*	20 *10*	3014.9	(6^+)		γ from (^{40}Ca,pnγ) only (2013Da16).
		1057.6 *2*	100 *4*	2434.5	(7^+)	D	Mult.: ΔJ=0 transition.
		1118.3 *2*	51 *9*	2373.9	(6^+)	D	
3594.8	1^+	3594.7 *4*	100	0.0	0^+		
3796.7	$(7,8,9^+)$	1362.2 *7*	100	2434.5	(7^+)		
3922.2	(8^+)	907.4 *3*	45 *5*	3014.9	(6^+)	(Q)	Mult.: ΔJ=2, Q or ΔJ=1, D+Q from $\gamma(\theta)$ in (^{24}Mg,pnγ) (2004Ru03), but the former is consistent with present spin-parity assignments.
		1487.5 *3*	100 *5*	2434.5	(7^+)	D+Q	
4658.2	(8)	1166.0 *3*	100	3492.2	(7)	D+Q	
4789.3	(9^+)	867.1 *2*	23.6 *14*	3922.2	(8^+)	D+Q	
		2354.8 *5*	100 *4*	2434.5	(7^+)	Q	
4945.3	$(9^+,10^+)$	1023.1 *2*	100	3922.2	(8^+)	Q,D+Q	
5735.3	(11^+)	789.8 *6*	4.3 *6*	4945.3	$(9^+,10^+)$		
		946.0 *2*	100 *4*	4789.3	(9^+)	Q	
6842.6	(13^+)	1107.3 *3*	100	5735.3	(11^+)	Q	
8588.6	(15^+)	1746.0 *8*	100	6842.6	(13^+)	Q	
9977.2	(17^+)	1388.6 *11*	100	8588.6	(15^+)	Q	
10044.4	(15^+)	3201.6 *21*	100	6842.6	(13^+)	(Q)	
10504?		3661.6@ *31*	100	6842.6	(13^+)		
11860.2	(17^+)	1815.7 *14*	100 *5*	10044.4	(15^+)	(Q)	
		3271.8 *27*	19 *4*	8588.6	(15^+)		
12390		3801.6 *25*	100	8588.6	(15^+)		
12702.4	(18)	2725.1 *18*	100	9977.2	(17^+)	(D)	
13086.3	(18^+)	1953.3@ *17*	206 *13*	11133?	(16^+)		
		3109.0 *20*	100 *13*	9977.2	(17^+)	(D+Q)	
13612	$(17,18,19^+)$	3634.2 *24*	100	9977.2	(17^+)		
13934	(19^+)	3956.9 *26*	100	9977.2	(17^+)	(Q)	
14081	(19^+)	2221.0 *17*	100 *6*	11860.2	(17^+)	(Q)	
		4106.2@ *29*	7.2 *16*	9977.2	(17^+)		
15377	(20^+)	2290.5 *15*	100	13086.3	(18^+)		
15461?		2758.7@ *18*	100	12702.4	(18)		
15724	(18,19,20)	2112.0 *14*	100	13612	$(17,18,19^+)$	D	
16821?	(21^+)	2739.6@ *31*	100	14081	(19^+)		
2043.9+x?	(J+2)	2043.9 *17*	100	x?	J	(Q)	
4437.6+x?	(J+4)	2393.6 *16*	100	2043.9+x?	(J+2)	(Q)	

† Weighted averages from available data where uncertainties are given. Exceptions are noted. Above 10 MeV excitation, all data are from ^{40}Ca(^{28}Si,pn$\alpha\gamma$) in 2020Ru03. Intensities are relative photon branching ratios.

‡ From $\gamma\gamma(\theta)$(DCO) data in ^{40}Ca(^{28}Si,pn$\alpha\gamma$) in 2020Ru03; and $\gamma\gamma(\theta)$(DCO) and $\gamma(\theta)$ data in ^{40}Ca(^{24}Mg,pnγ) in 2004Ru03. For a few transitions assignments from $\gamma(\theta)$ data in ^{24}Mg(^{40}Ca,pnγ) in 2013Da16, and DCO data in ^{40}Ca(^{24}Mg,pnγ) in 1998Vi06 are also available. Such measurements are parity-insensitive, but with no evidence for long-lived levels, ΔJ=2, Q transitions are likely ΔJ=2, E2, and ΔJ=1, D+Q as ΔJ=1, M1+E2.

Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with "Frozen Orbitals" approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.

@ Placement of transition in the level scheme is uncertain.

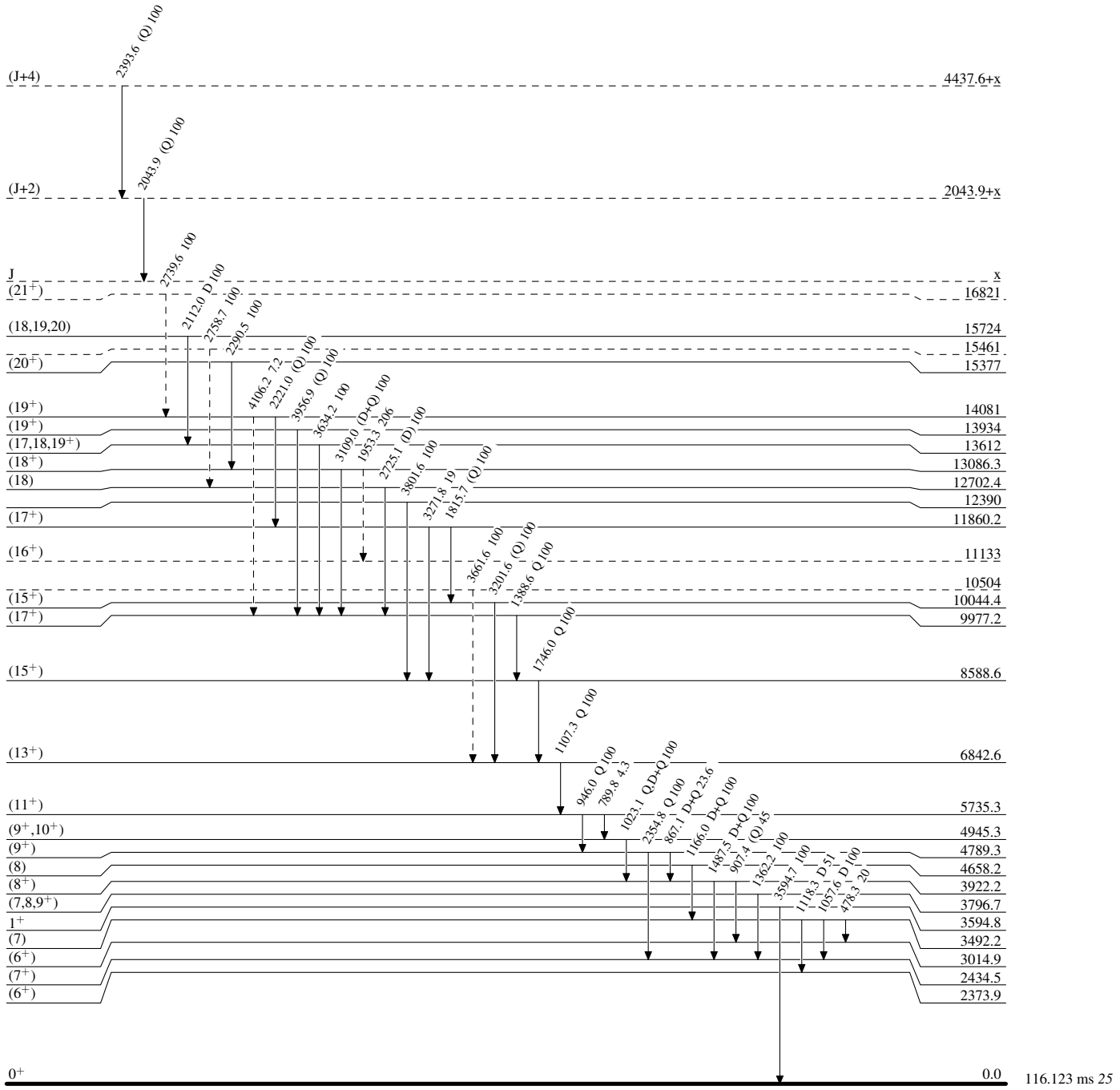
Adopted Levels, Gammas

Legend

Level Scheme

Intensities: Relative photon branching from each level

γ Decay (Uncertain)



$^{62}_{31}Ga_{31}$

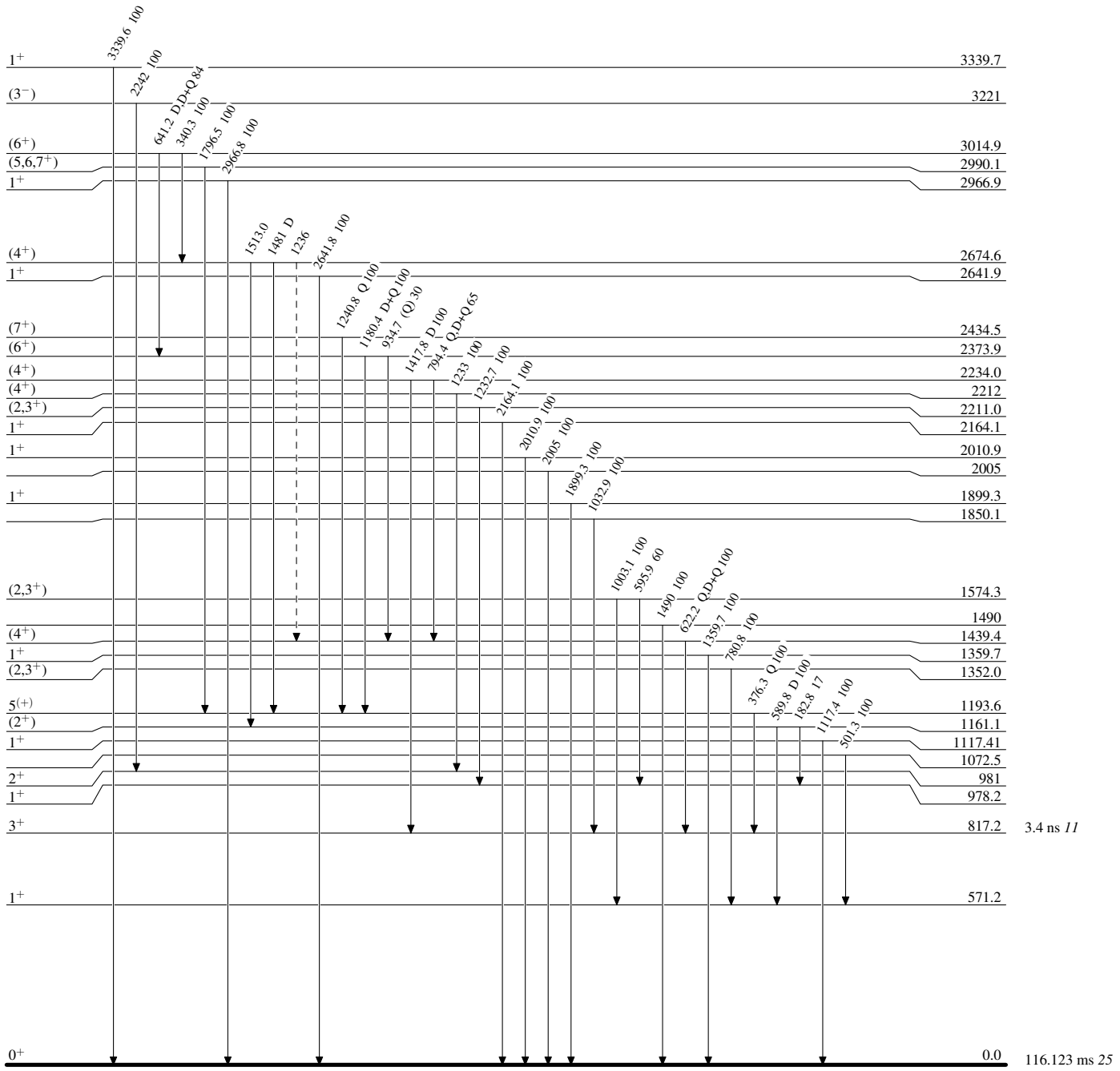
Adopted Levels, Gammas

Legend

Level Scheme (continued)

Intensities: Relative photon branching from each level

- - - - - - ► γ Decay (Uncertain)

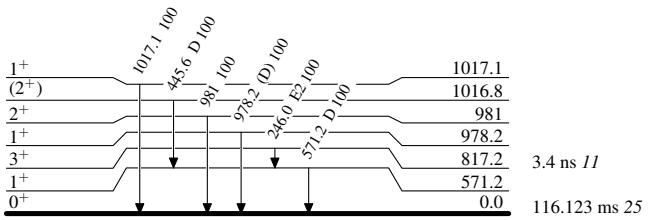


$^{62}_{31}Ga_{31}$

Adopted Levels, Gammas

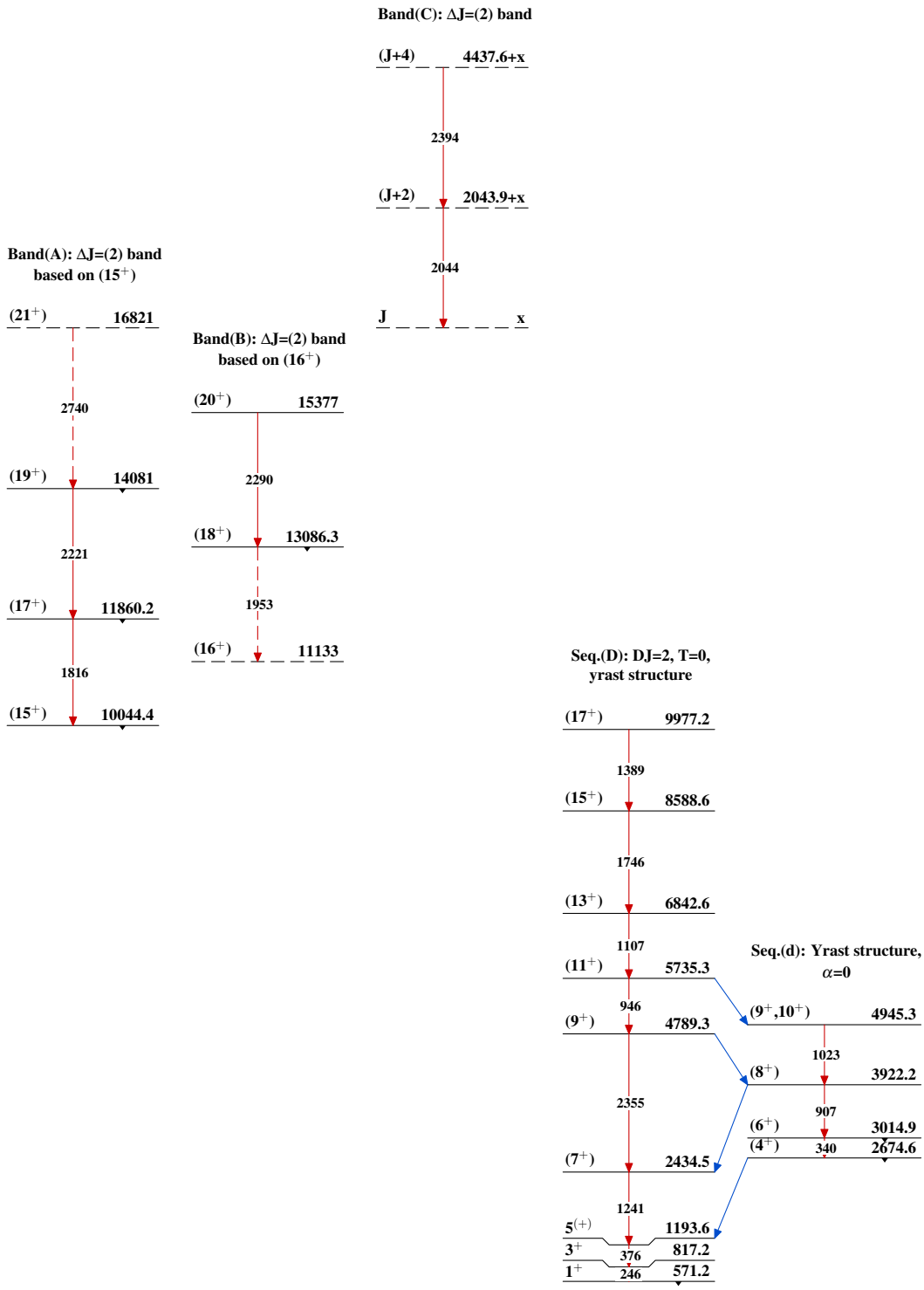
Level Scheme (continued)

Intensities: Relative photon branching from each level



$^{62}_{31}Ga_{31}$

Adopted Levels, Gammas



$^{62}_{31}Ga_{31}$