Adopted Levels, Gammas

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	M. Shamsuzzoha Basunia	NDS 199,271 (2025)	1-Sep-2024

Q(β^-)=6242 *3*; S(n)=4827.7 *29*; S(p)=14357 *4*; Q(α)=−9927.4 *28* 2021Wa16
S(2n)=12910 *40*, S(2p)=27437 *3* (2021Wa16).

^{81}Ge Levels

Cross Reference (XREF) Flags

A ^{81}Ga β^- decay (1.219 s)
B ^{82}Ga β^-n decay
C ^{2}H(^{80}Ge,p)

E(level)†	J$^\pi$	$T_{1/2}$‡	XREF	Comments
0	(9/2$^+$)	6.4 s *2*	AB	%β^-=100 J$^\pi$: shell model systematics for N=49 nuclei. $T_{1/2}$: from 2022De07, determined in ^{81}Ga β^- decay (γ ray time distribution measurement) of purified g.s. selected with the double Penning trap JYFLTRAP for the post-trap decay spectroscopy measurements. Isomeric yield (high spin state over total yield) of 0.97 *1* and 0.92 *2* for 25-MeV proton-induced fission of ^{nat}U and ^{232}Th, respectively (2018Ra19). Other isomeric yield: 0.975 *7* (2019Ra01).
679.14 *4*	(1/2$^+$)#	7.6 s *6*	ABc	%β^-=100 Additional information 1. %IT<1 (1981Ho24). $T_{1/2}$: the latest measured value of $T_{1/2}$(g.s.)=6.4 s *2* (2022De07) implies $T_{1/2} \geq$ 7.0 s (from 7.6 s *6* (1981Ho24)) for the isomeric state. 7.6 s *6* in 1981Ho24 (also in 1982FoZZ), authors were unable to distinguish between two similar (g.s. and isomeric) half-lives in their A=81 multispectrum analysis. Presumably other authors′ data also refer to mixtures of the g.s. and isomeric state. Those data are 10.1 s *8* (1972De43), 8.8 s *11* (1974KrZG, 1973KrZN), 7.8 s *2* (1981ZeZY), and 13.4 s (1975Al11).
711.208 *22*	(5/2$^+$)	3.9 ns *2*	ABc	J$^\pi$: log *ft*=6.5 (log $f^{1u}t$=8.7) from (5/2$^-$); γ to (9/2$^+$); therefore, J^π=(5/2$^+$,7/2,9/2$^+$). 5/2$^+$ is favored by systematics since B(E2)(W.u.)=0.038, comparable to that for the analogous 5/2$^+$ to 9/2$^+$ transition in ^{83}Se.
895.63 *5*	(1/2$^-$)	<0.5 ns	AB	J$^\pi$: E1 γ to (1/2$^+$); systematics of N=49 isotones. See comment on J^π(679 level).
1241.445 *24*	(1/2$^+$,3/2,5/2$^+$)		ABC	XREF: C(1160). J$^\pi$: γ to (5/2$^+$); γ to (1/2$^+$).
1286.467 *23*	(5/2$^+$,7/2$^-$)		AB	J$^\pi$: γ to (9/2$^+$); γ from (3/2$^-$) at 4168.17.
1303.23 *3*	(5/2$^+$,7/2,9/2$^+$)		A	J$^\pi$: γ to (9/2$^+$); log *ft*=7.5 from (5/2$^-$).
1409.93 *4*			A	J$^\pi$: γ to (5/2$^+$), γ from (7/2$^-$) at 3773.
1548.505 *24*	(5/2$^+$,7/2)		A	J$^\pi$: 1548.5γ to (9/2$^+$); log *ft*=6.5 from (5/2$^-$).
1577.02 *11*			A	
1723.97 *5*	(3/2$^-$,5/2$^-$)		AB	J$^\pi$: γ to (1/2$^-$). γ from (3/2$^-$) and (7/2$^-$) at 4168.17 and 4035.31, respectively.
1731.04 *4*	(5/2$^+$,7/2)		AB	J$^\pi$: γ to (9/2$^+$); log *ft*=6.8 from (5/2$^-$).
1805.54 *7*	(5/2$^+$,7/2)		A	J$^\pi$: γ to (9/2$^+$); log *ft*=6.8 from (5/2$^-$).
1816.23 *3*	(3/2$^-$)		A	J$^\pi$: γ to (1/2$^+$), to (1/2$^-$) and from (7/2$^-$) at 3772.88.
1832.23 *5*	(3/2$^-$,5/2$^-$)		AB	J$^\pi$: log *ft*=6.5 from (5/2$^-$); γ to (1/2$^-$) and γ from (7/2$^-$) at 3772.88.
1855.34 *5*			A	

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

^{81}Ge Levels (continued)

E(level)[†]	Jπ	XREF	Comments
2138.38 *4*	(5/2$^+$,7/2)	A	Jπ: γ to (9/2$^+$); log *ft*=6.7 from (5/2$^-$).
2174.87 *7*		A	
2419.90 *4*		A	Jπ: γ to (9/2$^+$), γs from (7/2$^-$) at 3503.09 and 3772, so J^π=(5/2$^+$,7/2,9/2,11/2$^-$).
2529.30 *6*	(3/2,5/2$^-$)	A	Jπ: log *ft*=6.4 from (5/2$^-$); γ to (1/2$^-$).
2549.97 *11*	(5/2$^+$,7/2)	AB	Jπ: γ to (9/2$^+$); log *ft*=6.7 from (5/2$^-$).
2563.18 *6*	(3/2,5/2$^-$)	A	Jπ: log *ft*=6.2 from (5/2$^-$); γ to (1/2$^-$).
2693.68 *10*		A	Jπ: log *ft*=6.7 from (5/2$^-$) so J≤9/2.
2996.72 *5*	(3/2$^-$,5/2$^-$,7/2$^-$)	AB	Jπ: log *ft*=5.6 from (5/2$^-$).
3021.39 *7*	(3/2,5/2$^-$)	A	Jπ: log *ft*=6.3 from (5/2$^-$), γ to (1/2$^-$).
3129.05 *6*	(3/2,5/2,7/2)	A	Jπ: log *ft*=6.4 from (5/2$^-$).
3437.23 *6*	(3/2$^-$,5/2$^-$)	AB	Jπ: log *ft*=5.4 from (5/2$^-$), γ to (1/2$^-$).
3503.09 *3*	(7/2$^-$)	A	Jπ: log *ft*=5.3 from (5/2$^-$). γ to (9/2$^+$).
3665.56 *8*	(7/2$^-$)	A	Jπ: log *ft*=5.8 from (5/2$^-$); γ to (9/2$^+$).
3697.95 *10*	(7/2)	A	Jπ: log *ft*=6.1 from (5/2$^-$); γ to (9/2$^+$) and (5/2$^+$).
3772.88 *4*	(7/2$^-$)	A	Jπ: log *ft*=5.3 from (5/2$^-$); γ to (9/2$^+$).
3820.15 *19*	(3/2,5/2,7/2)	A	Jπ: log *ft*=6.3 from (5/2$^-$).
4012.91 *6*	(3/2$^-$,5/2$^-$,7/2$^-$)	A	Jπ: log *ft*=5.1 from (5/2$^-$).
4035.31 *7*	(7/2$^-$)	A	Jπ: log *ft*=5.6 from (5/2$^-$). γ to (9/2$^+$).
4168.17 *6*	(3/2$^-$)	A	Jπ: log *ft*=5.1 from (5/2$^-$). γ to (1/2$^+$).
4276.77 *16*	(3/2,5/2,7/2)	A	Jπ: log *ft*=6.3 from (5/2$^-$).
4470.53 *20*	(7/2$^-$)	A	Jπ: log *ft*=5.86 from (5/2$^-$); γ to (9/2$^+$) g.s..

[†] From least-squares fit to Eγ, omitting Eγ for uncertain or doubly-placed lines and for lines whose Eγ deviates from least-squares adjusted value by at least 3σ (991γ, 1941γ, 2436γ and 2955γ from 4012.9, 3772.8, 4012.9, and 3665.6 keV levels, respectively.

[‡] From ^{81}Ga β^- decay (1981Ho24), except where otherwise noted.

[#] 1/2$^-$ is expected, based on systematics of J^π (isomeric state) in other odd-mass N=49 isotones. However, if J^π=1/2$^-$, B(M4)(W.u.)<1.4 (low cf. values ranging from 7.0 *5* to 19 *1* for seven known M4 transitions between 1/2$^-$ and 9/2$^+$ states (1979En04)). Therefore, 1981Ho24 presume that the 679 level is the 1/2$^+$ level also expected at low energy (based on level energy systematics), and that the 1/2$^-$ state is the 896 level which deexcites via an E1 transition to the 679 level.

Adopted Levels, Gammas (continued)

$\gamma(^{81}Ge)$

Additional information 2.

E_i(level)	J_i^π	E_γ †	I_γ †	E_f	J_f^π	Mult.	α #	Comments
711.208	$(5/2^+)$	711.19 *3*	100	0	$(9/2^+)$	[E2]	8.42×10^{-4} *12*	B(E2)(W.u.)=0.0383 *+21−19* α(K)=0.000751 *11*; α(L)=7.79×10^{-5} *11*; α(M)=1.161×10^{-5} *16* α(N)=7.51×10^{-7} *11*
895.63	$(1/2^-)$	216.47 *3*	100	679.14	$(1/2^+)$	E1	0.00692 *10*	α(K)=0.00619 *9*; α(L)=0.000634 *9*; α(M)=9.43×10^{-5} *13* α(N)=6.01×10^{-6} *8* Mult.: from α(K)exp, ^{81}Ga β^- decay.
1241.445	$(1/2^+,3/2,5/2^+)$	530.22 *4*	100 *5*	711.208	$(5/2^+)$			I_γ: other: 100 *44* in ^{82}Ga β^-n decay.
		562.37 *5*	16.5 *8*	679.14	$(1/2^+)$			I_γ: Other: 30 *9* in ^{82}Ga β^-n Decay.
1286.467	$(5/2^+,7/2^-)$	1286.39 *3*	100	0	$(9/2^+)$			
1303.23	$(5/2^+,7/2,9/2^+)$	1303.20 *3*	100	0	$(9/2^+)$			
1409.93		698.69 *3*	100	711.208	$(5/2^+)$			
1548.505	$(5/2^+,7/2)$	262.03 *4*	5.9 *4*	1286.467	$(5/2^+,7/2^-)$			
		1548.51 *3*	100 *4*	0	$(9/2^+)$			
1577.02		865.81 *10*	100	711.208	$(5/2^+)$			
1723.97	$(3/2^-,5/2^-)$	437.42 *4*	0.75 *5*	1286.467	$(5/2^+,7/2^-)$			
		482.51 *3*	15.1 *8*	1241.445	$(1/2^+,3/2,5/2^+)$			I_γ: other: 22 *6* in ^{82}Ga β^-n Decay.
		828.26 *5*	100 *5*	895.63	$(1/2^-)$			I_γ: other: 100 *28* in ^{82}Ga β^-n decay.
1731.04	$(5/2^+,7/2)$	1019.80 *4*	100 *5*	711.208	$(5/2^+)$			
		1730.95 *7*	22.3 *12*	0	$(9/2^+)$			
1805.54	$(5/2^+,7/2)$	256.6 *3*	35 *7*	1548.505	$(5/2^+,7/2)$			
		501.90 *17*	73 *8*	1303.23	$(5/2^+,7/2,9/2^+)$			
		1805.61 *7*	100 *6*	0	$(9/2^+)$			
1816.23	$(3/2^-)$	574.83 *5*	100 *7*	1241.445	$(1/2^+,3/2,5/2^+)$			
		920.7 *3*	13 *4*	895.63	$(1/2^-)$			
		1104.93 *9*	49 *4*	711.208	$(5/2^+)$			
		1137.07 *4*	79 *4*	679.14	$(1/2^+)$			
1832.23	$(3/2^-,5/2^-)$	936.62 *4*	100	895.63	$(1/2^-)$			
1855.34		613.89 *4*	100 *8*	1241.445	$(1/2^+,3/2,5/2^+)$			
		1144	62	711.208	$(5/2^+)$			
2138.38	$(5/2^+,7/2)$	728.32 *6*	42 *4*	1409.93				
		2138.39 *5*	100 *5*	0	$(9/2^+)$			
2174.87		626.36 *6*	100 *8*	1548.505	$(5/2^+,7/2)$			
		933	83	1241.445	$(1/2^+,3/2,5/2^+)$			
2419.90		1116.63 *5*	100 *6*	1303.23	$(5/2^+,7/2,9/2^+)$			
		2419.94 *15*	63 *5*	0	$(9/2^+)$			

$^{81}_{32}Ge_{49}$-3

Adopted Levels, Gammas (continued)

γ(^{81}Ge) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Comments
2529.30	(3/2,5/2$^-$)	805.32 *5*	85 *4*	1723.97	(3/2$^-$,5/2$^-$)	
		1633.47 *9*	100 *6*	895.63	(1/2$^-$)	
		1818.15 *7*	22.1 *17*	711.208	(5/2$^+$)	
2549.97	(5/2$^+$,7/2)	2549.93 *11*	100	0	(9/2$^+$)	
2563.18	(3/2,5/2$^-$)	730.84 *5*	98 *5*	1832.23	(3/2$^-$,5/2$^-$)	
		1667.61 *6*	100 *5*	895.63	(1/2$^-$)	
		1852.37 *15*	57 *5*	711.208	(5/2$^+$)	
2693.68		962.64 *11*	100 *6*	1731.04	(5/2$^+$,7/2)	
		1982.4 *2*	65 *9*	711.208	(5/2$^+$)	
2996.72	(3/2$^-$,5/2$^-$,7/2$^-$)	1164.53 *3*	19.4 *11*	1832.23	(3/2$^-$,5/2$^-$)	
		1272.71 *3*	100 *5*	1723.97	(3/2$^-$,5/2$^-$)	
		1448.25 *7*	7.6 *5*	1548.505	(5/2$^+$,7/2)	
		1710.2 *2*	11 *4*	1286.467	(5/2$^+$,7/2$^-$)	
3021.39	(3/2,5/2$^-$)	1189.16 *6*	57 *3*	1832.23	(3/2$^-$,5/2$^-$)	
		2125.69 *11*	100 *6*	895.63	(1/2$^-$)	
		2311.14[@&]	18[@]	711.208	(5/2$^+$)	E_γ: 2311.14 *19* for doublet.
3129.05	(3/2,5/2,7/2)	1405.07 *4*	100	1723.97	(3/2$^-$,5/2$^-$)	
3437.23	(3/2$^-$,5/2$^-$)	1604.93 *7*	14.4 *8*	1832.23	(3/2$^-$,5/2$^-$)	
		1713.26 *4*	100 *4*	1723.97	(3/2$^-$,5/2$^-$)	I_γ: other: 43 *14* in ^{82}Ga β^-n Decay.
		2541.39 *11*	19.0 *14*	895.63	(1/2$^-$)	
		2726.11 *9*	27.1 *14*	711.208	(5/2$^+$)	I_γ: other: 100 *29* in ^{82}Ga β^-n Decay.
3503.09	(7/2$^-$)	1083.22 *6*	25.2 *14*	2419.90		
		1671.4 *4*	3.9 *9*	1832.23	(3/2$^-$,5/2$^-$)	
		1779.05 *3*	58 *3*	1723.97	(3/2$^-$,5/2$^-$)	
		1955.61[@&]	17[@]	1548.505	(5/2$^+$,7/2)	E_γ: 1955.61 *7* for doublet.
		2216.24 *15*	16.8 *14*	1286.467	(5/2$^+$,7/2$^-$)	
		2792.02 *12*	20.6 *17*	711.208	(5/2$^+$)	
		3503.24 *8*	100 *6*	0	(9/2$^+$)	
3665.56	(7/2$^-$)	2116.6 *2*	23 *3*	1548.505	(5/2$^+$,7/2)	
		2379.0 *4*	51 *10*	1286.467	(5/2$^+$,7/2$^-$)	
		2955.0[‡&] *2*	43 *5*	711.208	(5/2$^+$)	
		3665.54 *8*	100 *4*	0	(9/2$^+$)	
3697.95	(7/2)	2986.4 *2*	84 *10*	711.208	(5/2$^+$)	
		3697.95 *11*	100 *6*	0	(9/2$^+$)	
3772.88	(7/2$^-$)	776.21 *4*	100 *6*	2996.72	(3/2$^-$,5/2$^-$,7/2$^-$)	
		1352.87 *7*	97 *6*	2419.90		
		1940.97[‡&] *6*	84 *4*	1832.23	(3/2$^-$,5/2$^-$)	
		1955.61[@&]	29[@]	1816.23	(3/2$^-$)	E_γ: 1955.61 *7* for doublet.
		2041.62 *9*	43 *3*	1731.04	(5/2$^+$,7/2)	
		2362.91 *14*	41 *4*	1409.93		

$^{81}_{32}Ge_{49}$-4

Adopted Levels, Gammas (continued)

γ(^{81}Ge) (continued)

E_i(level)	J_i^π	E_γ †	I_γ †	E_f	J_f^π
3772.88	(7/2⁻)	3773.08 *18*	55 *5*	0	(9/2⁺)
3820.15	(3/2,5/2,7/2)	2095.6 *5*	54 *18*	1723.97	(3/2⁻,5/2⁻)
		2271.7 *2*	100 *10*	1548.505	(5/2⁺,7/2)
4012.91	(3/2⁻,5/2⁻,7/2⁻)	991.06‡& *7*	27.0 *18*	3021.39	(3/2,5/2⁻)
		1016.42 *14*	37 *4*	2996.72	(3/2⁻,5/2⁻,7/2⁻)
		1483.45 *12*	11.6 *7*	2529.30	(3/2,5/2⁻)
		1874.36 *9*	43.6 *24*	2138.38	(5/2⁺,7/2)
		2180.66 *4*	100 *6*	1832.23	(3/2⁻,5/2⁻)
		2281.72 *11*	37.9 *21*	1731.04	(5/2⁺,7/2)
		2288.58 *14*	29.6 *15*	1723.97	(3/2⁻,5/2⁻)
		2436.54‡& *15*	19.4 *13*	1577.02	
		2464.67 *12*	28.7 *21*	1548.505	(5/2⁺,7/2)
		2771.85 *16*	13.1 *13*	1241.445	(1/2⁺,3/2,5/2⁺)
4035.31	(7/2⁻)	2311.14@& *19*	18@	1723.97	(3/2⁻,5/2⁻)
		4035.20 *7*	100 *7*	0	(9/2⁺)
4168.17	(3/2⁻)	2335.75 *13*	8.5 *6*	1832.23	(3/2⁻,5/2⁻)
		2444.15 *4*	100 *3*	1723.97	(3/2⁻,5/2⁻)
		2881.6 *3*	6.2 *11*	1286.467	(5/2⁺,7/2⁻)
		2926.4 *3*	2.9 *6*	1241.445	(1/2⁺,3/2,5/2⁺)
		3272.82 *17*	2.3 *3*	895.63	(1/2⁻)
		3489.01 *10*	7.8 *5*	679.14	(1/2⁺)
4276.77	(3/2,5/2,7/2)	2552.76 *15*	100	1723.97	(3/2⁻,5/2⁻)
4470.53	(7/2⁻)	2922	9	1548.505	(5/2⁺,7/2)
		4470.4 *2*	100 *7*	0	(9/2⁺)

† From ^{81}Ga β^- decay.
‡ Eγ lies at least 3σ from least-squares adjusted value; datum excluded from least-squares level energy adjustment.
# Additional information 3.
@ Multiply placed with intensity suitably divided.
& Placement of transition in the level scheme is uncertain.

$^{81}_{32}Ge_{49}$-5

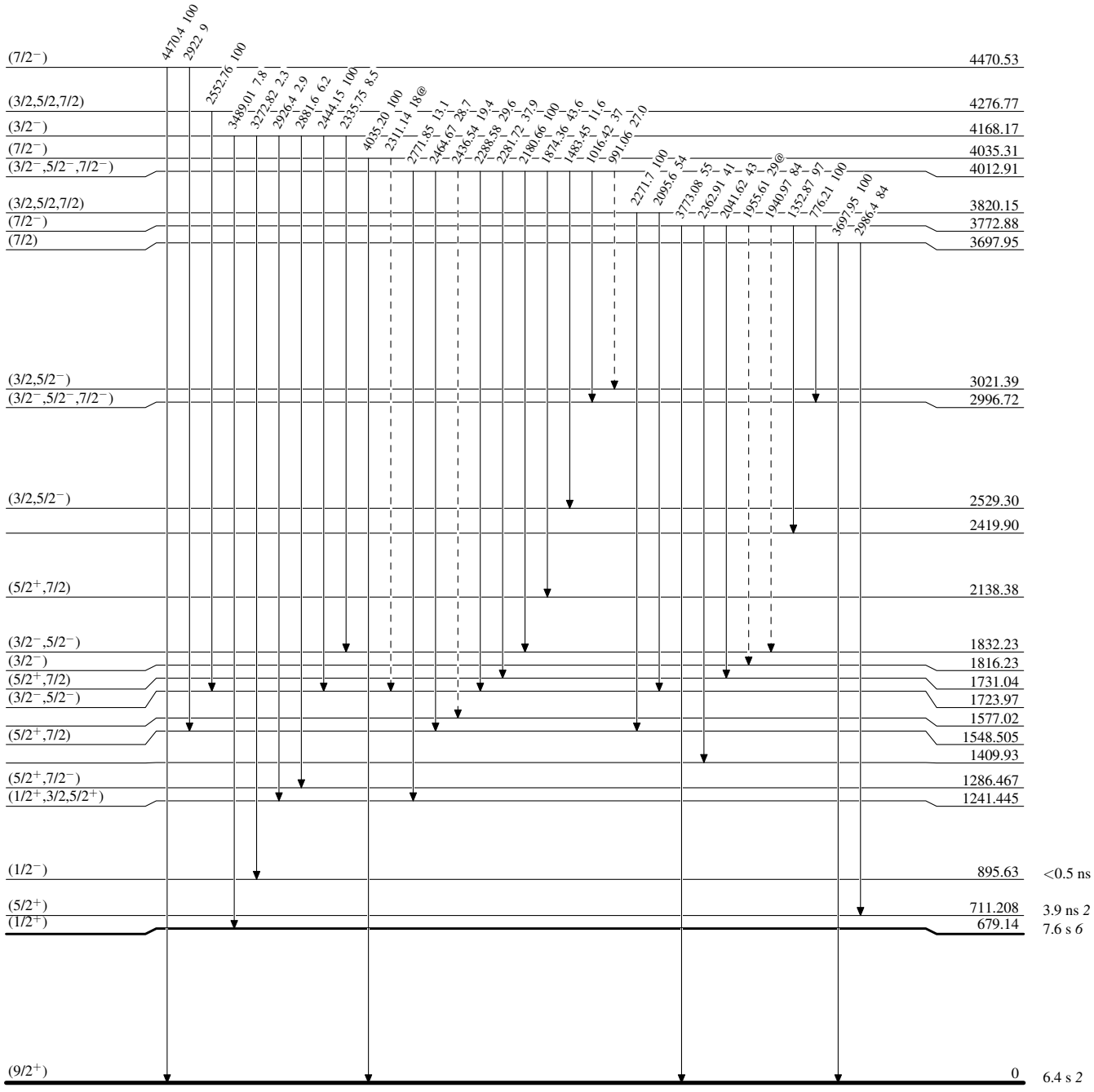
Adopted Levels, Gammas

Legend

Level Scheme

Intensities: Relative photon branching from each level
@ Multiply placed: intensity suitably divided

- - - - - - ► γ Decay (Uncertain)



$^{81}_{32}Ge_{49}$

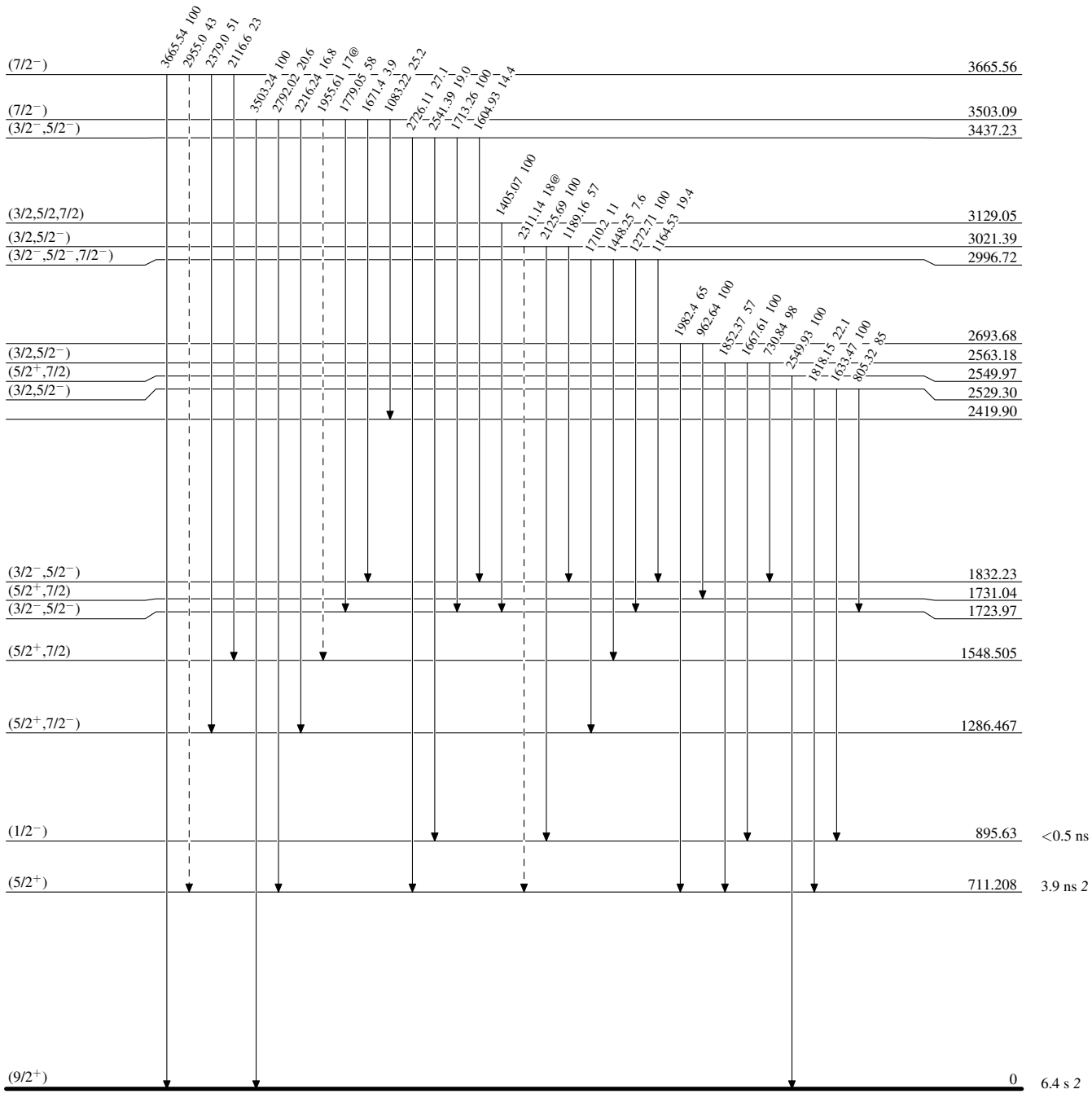
Adopted Levels, Gammas

Legend

Level Scheme (continued)

Intensities: Relative photon branching from each level
@ Multiply placed: intensity suitably divided

- - - - - - ► γ Decay (Uncertain)

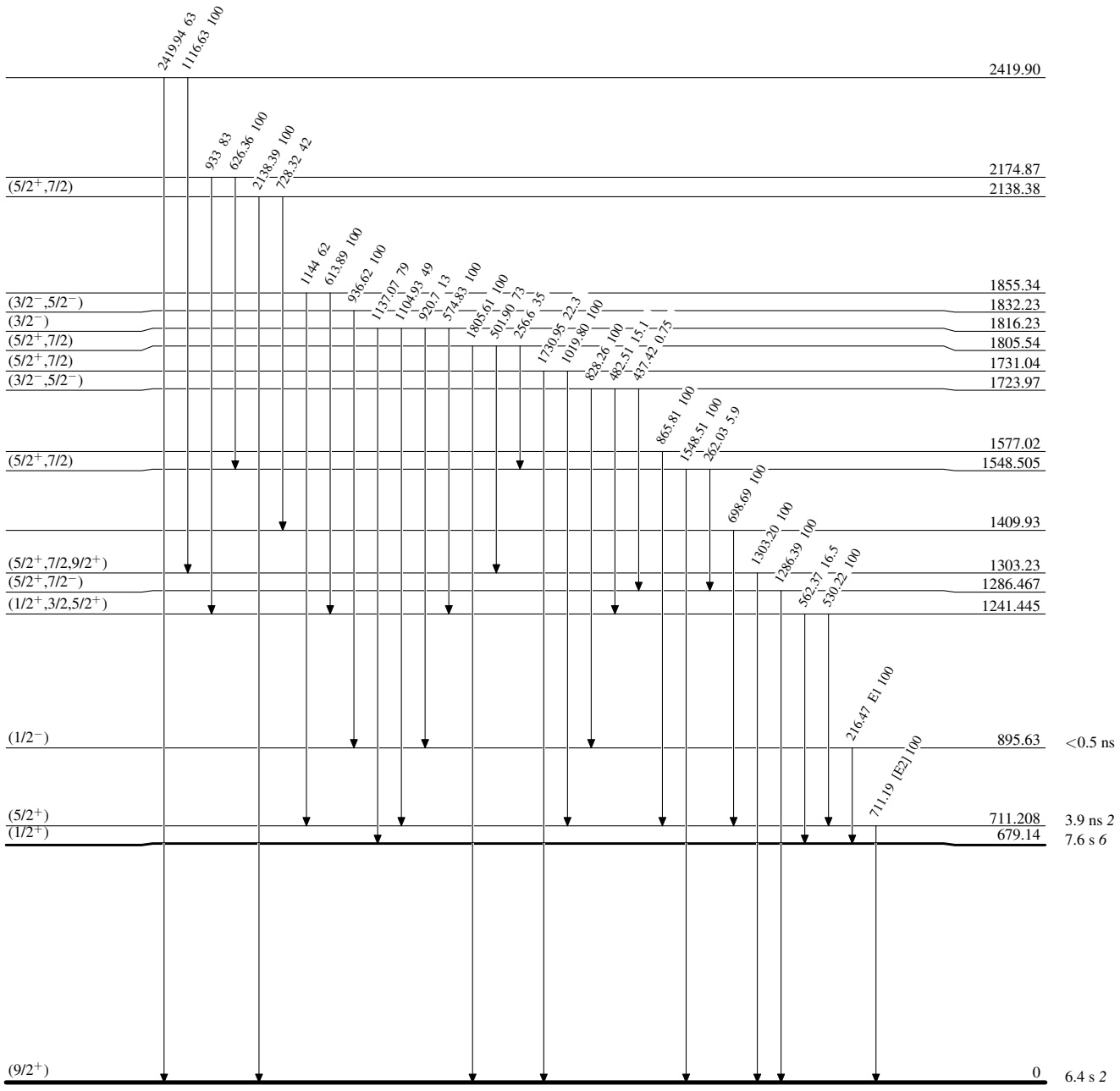


$^{81}_{32}Ge_{49}$

Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Relative photon branching from each level
@ Multiply placed: intensity suitably divided



$^{81}_{32}Ge_{49}$