Adopted Levels, Gammas

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	D. Abriola(a), A. A. Sonzogni	NDS 111,1 (2010)	1-May-2009

Q(β^-)=3997.6 *9*; S(n)=6520.48 *19*; S(p)=8548 *3*; Q(α)=−5446.1 *18* 2012Wa38
Note: Current evaluation has used the following Q record 3997.5 106520.48 *198548* 3 −5446.1 *18* 2009AuZZ.
α: Additional information 1.

^{72}Ga Levels

Cross Reference (XREF) Flags

A ^{72}Zn β^- decay
B ^{71}Ga(n,γ), (pol n,γ) E=thermal
C ^{73}Ge(d,^{3}He)
D ^{71}Ga(d,p)

E(level)[†]	J$^\pi$	T$_{1/2}$[f]	XREF	Comments
0	3$^-$	14.10 h *2*	ABC	%β^-=100 Q=+0.52 *1*; μ=−0.13224 *2* J$^\pi$: spin from atomic-beam measurement (1960Ch13), parity from $\beta\gamma$ directional correlations, ^{72}Ga β^- decay. For β^- decay to 2$^+$ states in ^{72}Ge, anisotropy of $\beta\gamma(\theta)$ shows β^- transition is of forbidden nature. T$_{1/2}$: weighted average of 14.1 h *2* (1939Sa02), 14.25 h *20* (1943Ma03), 14.08 h *2* (1950Bi20), 14.25 h *10* (1950Si02), 14.12 h *2* (1961Wy01) and 14.3 h *3* (1974BaZB). μ: Atomic beam (1962Eh02, 2005St24). Q: Atomic beam, recalculated to include polarization correction (1972St38, 2005St24).
16.44[‡] *4*	2$^-$	39.2 ns *7*	ABC	J$^\pi$: spin from dipole radiation to 3$^-$ g.s. and from 1$^+$ states at 161 and 208; parity from L(d,^{3}He)=3.
119.66 *5*	(0$^+$)	39.68 ms *13*	AB	J$^\pi$: from (M2) γ to 2$^-$ and d γ's from 1$^+$ states, lack of β^- feeding and no γ to 3$^-$ g.s. T$_{1/2}$: from 1972Br53, ^{71}Ga(n,γ). Other: 35 ms *6* from ^{72}Zn β^- decay.
128.79 *6*	1,2		AB	J$^\pi$: from d γ's from 1$^+$ state at 208 keV and to 2$^-$ at 16.4 keV.
161.53 *5*	1$^+$	0.59 ns *3*	AB D	J$^\pi$: log *ft*=4.54 *3* from 0$^+$, ^{72}Zn. T$_{1/2}$: from ^{72}Zn β^- decay.
165.51 *4*	4$^-$,5$^-$[b]		C	
197.94 *4*	−[c]		BC	
208.45 *5*	1$^+$	<0.19 ns	AB D	J$^\pi$: from log *ft*=5.06 *4* from 0$^+$, ^{72}Zn.
228.86 *5*	3$^-$,4$^-$[d]		BC	
248.94 *4*	3$^-$,4$^-$[d]		BCD	
271.90 *13*	4$^-$[b]		CD	J$^\pi$: L(d,p)=2+4 from fit of (d,p) data by 1987Ro01 gives J=3$^-$,4$^-$. Not fed by primary (n,γ).
282.57 *5*			B	
330.06 *9*	3$^-$,4$^-$[d]		BCD	
385 *4*	−[&]		C	
392.53 *5*			B	
400 *3*	4$^-$,5$^-$,6$^-$[b]		CD	
408.14 *8*			B	
512.97 *5*			B	
514.73 *11*			B	
544[‡] *4*	−[e]		C	

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Adopted Levels, Gammas (continued)

^{72}Ga Levels (continued)

E(level)[†]	Jπ	XREF	Comments
555 *4*	4⁻,5⁻,6⁻[b]	Cd	
564.34 *7*		B d	
600.76 *6*	2⁺,3⁺[@]	B D	XREF: D(605). Jπ: J(J); From L(d,p)=1, gamma to 3⁻,4⁻ level.
619.64[‡] *5*	−[c]	BC	
636.04 *12*	3⁻,4⁻[d]	BCD	
650.34? *7*		B	
684 *3*	0⁺ to 3⁺[@]	D	
709 *3*	4⁻,5⁻,6⁻[b]	CD	
737.75 *6*		Bc	Jπ: L(d,^{3}He)=1(+3) for 737 *4*.
741.33 *10*	(3,4)	BcD	Jπ: from L(d,p)=2, and L(d,^{3}He)=1(+3) for 737 *4*, γ to 1⁺.
760[‡] *4*	−[e]	C	
799? *2*		B	
828[‡] *2*	−	BC	Jπ: from L(d,^{3}He)=3.
850 *4*	−[&]	C	
857 *2*	0⁺ to 3⁺[@]	B D	
870? *2*		B	
877 *2*		B	
894 *2*	3⁻,4⁻[d]	BC	
900 *3*	+	D	Jπ: from L(d,p)=3.
919 *2*		B D	
945? *2*		B	
979 *2*	0⁺ to 3⁺[@]	B D	
1003? *2*		B	
1022? *2*		B	
1033 *2*		BCD	
1051? *2*		B	
1060 *2*	0⁺ to 3⁺[@]	B D	
1077? *2*		B	
1084 *6*	−[&]	C	
1116? *2*		B	
1130 *2*	−[&]	BC	
1144 *6*	−[&]	C	
1150 *2*	0⁺ to 3⁺[@]	B D	
1181? *2*		B	
1187? *1*		B	
1201? *2*		Bc	
1206 *2*		BcD	
1217[#] *2*	−	BC	Jπ: from L(d,^{3}He)=3.
1238? *2*		B	
1249[#] *2*	−	BC	Jπ: from L(d,^{3}He)=3(+1).
1263 *2*	3⁻,4⁻	BCD	Jπ: 0⁻ to 4⁻ from L(d,p)=2, L(d,^{3}He)=1(+3) excludes lower spins.
1286? *2*		B	
1297? *2*		B	
1324? *2*		B	
1338 *3*		D	
1360 *2*	−[&]	BC	
1380 *3*	0⁻ to 4⁻	CD	Jπ: from L(d,p)=2.
1396? *2*		B	
1428? *2*		B	

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Adopted Levels, Gammas (continued)

^{72}Ga Levels (continued)

E(level)[†]	Jπ	XREF	Comments
1435 *3*		D	E(level): may be the same level as 1428 *2*.
1442 *2*		B	
1466? *2*		B	
1473 *2*		BcD	Jπ: L(d,^{3}He)=1 for 1481 *6*.
1489 *2*		Bc	Jπ: L(d,^{3}He)=1 for 1481 *6*.
1505? *2*		B	
1516 *2*		B D	
1533? *2*		B	
1558 *3*	3$^-$,4$^-$	CD	Jπ: from L(d,p)=2 and L(d,^{3}He)=1(+3).
1592 *3*	1$^-$,2$^-$[a]	D	
1613? *2*		B	
1626 *6*	−[&]	C	
1630 *2*	1$^-$,2$^-$[a]	B D	
1653? *2*		B	
1681 *2*		B D	
1691[#] *6*	−	C	Jπ: from L(d,^{3}He)=3(+1).
1714? *2*		B	
1728 *2*		B D	
1750[#] *2*	−	BCD	Jπ: 1$^-$ to 4$^-$ from L(d,p)=2 and L(d,^{3}He)=3(+1).
1759? *2*		B	
1777 *2*	0$^-$ to 4$^-$	B D	Jπ: from L(d,p)=2.
1791 *2*		Bc	
1802 *2*	1$^-$,2$^-$[a]	BcD	
1816[#] *2*	−	BC	Jπ: from L(d,^{3}He)=3 for 1822 *6*.
1834? *2*		B	
1842? *2*		B	
1856? *2*		B	
1870 *2*		B D	
1882? *2*		B	
1898? *2*		B	
1913[#] *3*		Bc	Jπ: L(d,^{3}He)=3(+1) for 1913 *6*.
1918 *2*		BcD	Jπ: L(d,^{3}He)=3(+1) for 1913 *6*.
1925? *2*		B	
1942? *2*		B	
1977? *2*		B	
1989 *3*		D	
2007? *2*		B	
2018? *2*		B	
2024? *2*		B	
2043 *2*		BC	
2056 *3*		B D	
2073 *3*		BC	

[†] Except as noted, levels below 2 MeV with ΔE=3 are from ^{71}Ga(d,p); energies of other levels are deduced from adopted γ-ray energies, mainly from ^{71}Ga(n,γ). The (d,p) levels are systematically 2 keV higher than the (n,γ) energies.

[‡] Configuration=((^{73}Ge 9/2$^+$)(π 1f$_{5/2}$)) (1987Ro01).

[#] Configuration=((^{73}Ge 9/2$^+$)(ν 1f$_{7/2}$)) (1987Ro01).

[@] From L(d,p)=1.

[&] Jπ=3$^-$ to 6$^-$ from L=1 component in ^{73}Ge(d,^{3}He).

[a] From L=0 in ^{71}Ga(d,p).

[b] 3$^-$ to 6$^-$ from L(d,^{3}He)=1 or 1(+3); 3$^-$ excluded from level not populated by primary γ's in ^{71}Ga(n,γ).

[c] 1$^-$ to 8$^-$ from L(d,^{3}He)=3 or 3(+1); level populated by primary γ in ^{71}Ga(n,γ) excludes 5$^-$ to 8$^-$.

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Adopted Levels, Gammas (continued)

^{72}Ga Levels (continued)

[d] 3^- to 6^- from L(d,^{3}He)=1 component; level populated by primary γ in ^{71}Ga(n,γ) excludes 5^-, 6^-.
[e] 1^- to 8^- from L(d,^{3}He)=3; 1^- to 3^- excluded from level not populated by primary γ's in ^{71}Ga(n,γ).
[f] From $\beta\gamma$ and $\gamma\gamma$ delayed coincidence in ^{72}Zn β^- decay, except where noted.

$\gamma(^{72}Ga)$

Primary γ's from ^{71}Ga(n,γ) are given under ^{71}Ga(n,γ) only.

E_i(level)	J_i^π	E_γ[†]	I_γ[#]	E_f	J_f^π	Mult.[&]	α	Comments
16.44	2^-	16.4 *3*	100	0	3^-	(M1)	12.4 *8*	α(K)=11.0 *7*; α(L)=1.20 *7*; α(M)=0.176 *11*; α(N)=0.0092 *6*; α(N+..)=0.0092 *6* B(M1)(W.u.)=0.0095 *8*
119.66	(0^+)	103.14 *17*	100	16.44	2^-	(M2)	0.656	α(K)=0.574 *9*; α(L)=0.0712 *11*; α(M)=0.01051 *16*; α(N)=0.000527 *8*; α(N+..)=0.000527 *8* B(M2)(W.u.)=0.002337 *25*
128.79	1,2	112.38 *11*	100 *4*	16.44	2^-	(M1)	0.0510	α(K)=0.0455 *7*; α(L)=0.00480 *7*; α(M)=0.000702 *10*; α(N)=3.73×10^{-5} *6*; α(N+..)=3.73×10^{-5} *6*
		128.5 *4*	5.2 *13*	0	3^-			
161.53	1^+	41.9 *2*	1.0 *1*	119.66	(0^+)	(M1)	0.795 *16*	α(K)=0.707 *14*; α(L)=0.0765 *15*; α(M)=0.01119 *22*; α(N)=0.000587 *12*; α(N+..)=0.000587 *12* B(M1)(W.u.)=0.0049 *8*
		145.04 *13*	100 *10*	16.44	2^-	(E1)	0.0210	α(K)=0.0188 *3*; α(L)=0.00191 *3*; α(M)=0.000277 *4*; α(N)=1.437×10^{-5} *21*; α(N+..)=1.437×10^{-5} *21* B(E1)(W.u.)=0.00021 *4*
165.51	4^-,5^-	165.51[‡] *4*	100	0	3^-			Placement of unplaced γ in (n,γ) by 1987Ro01.
197.94	$^-$	181.57 *4*	29 *3*	16.44	2^-			
		197.92 *4*	100 *10*	0	3^-			
208.45	1^+	46.8 *2*	6.2 *9*	161.53	1^+	(M1)	0.579 *11*	α(K)=0.515 *10*; α(L)=0.0556 *11*; α(M)=0.00813 *16*; α(N)=0.000427 *8*; α(N+..)=0.000427 *8* B(M1)(W.u.)>0.044
		79.79 *20*	18.6 *9*	128.79	1,2	(M1)	0.1295 *21*	α(K)=0.1153 *18*; α(L)=0.01229 *20*; α(M)=0.00180 *3*; α(N)=9.51×10^{-5} *15*; α(N+..)=9.51×10^{-5} *15* B(M1)(W.u.)>0.027
		88.80 *7*	23.0 *9*	119.66	(0^+)	(M1)	0.0965	α(K)=0.0860 *13*; α(L)=0.00914 *13*; α(M)=0.001337 *19*; α(N)=7.08×10^{-5} *10*; α(N+..)=7.08×10^{-5} *10* B(M1)(W.u.)>0.024
		191.96 *9*	100.0 *18*	16.44	2^-	(E1)	0.00909 *13*	α(K)=0.00814 *12*; α(L)=0.000826 *12*; α(M)=0.0001202 *17*; α(N)=6.30×10^{-6} *9*; α(N+..)=6.30×10^{-6} B(E1)(W.u.)>0.00019
228.86	3^-,4^-	212.20 *7*	100 *10*	16.44	2^-			
		228.88 *7*	53 *5*	0	3^-			
248.94	3^-,4^-	248.97 *4*	100	0	3^-			
271.90	4^-	106.36[‡] *13*	100	165.51	4^-,5^-			
282.57		120.99 *4*	32 *6*	161.53	1^+			

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Adopted Levels, Gammas (continued)

$\gamma(^{72}Ga)$ (continued)

E_i(level)	J_i^π	E_γ †	I_γ #	E_f	J_f^π
282.57		153.76 *4*	88 *9*	128.79	1,2
		163.16 *9*	59 *12*	119.66	(0^+)
		266.13 *4*	100 *9*	16.44	2^-
330.06	$3^-,4^-$	132.4 *3*	70 *15*	197.94	$^-$
		210.33 *19*	≤90@	119.66	(0^+)
		313.82 *14*	100 *20*	16.44	2^-
392.53		109.92 *18*	15 *3*	282.57	
		184.05 *4*	92 *9*	208.45	1^+
		194.62 *5*	100 *10*	197.94	$^-$
		231.02 *19*	10 *2*	161.53	1^+
408.14		136.0‡ *4*	56 *11*	271.90	4^-
		210.33 *19*	≤100@	197.94	$^-$
		246.8 *2*	56 *11*	161.53	1^+
		408.09 *9*	78 *17*	0	3^-
512.97		264.06 *4*	34 *6*	248.94	$3^-,4^-$
		384.34 *16*	6.3 *13*	128.79	1,2
		393.26 *4*	100 *9*	119.66	(0^+)
514.73		306.14 *16*	≤100@	208.45	1^+
		353.39 *13*	≤25@	161.53	1^+
		497.8 *3*	18 *4*	16.44	2^-
564.34		315.8 *3*	70 *15*	248.94	$3^-,4^-$
		355.58 *12*	18 *4*	208.45	1^+
		402.85 *6*	≤60@	161.53	1^+
		444.7 *4*	100 *20*	119.66	(0^+)
		547.9 *3*	35 *8*	16.44	2^-
		564.54 *20*	28 *6*	0	3^-
600.76	$2^+,3^+$	318.1 *5*	33 *8*	282.57	
		351.51 *14*	21 *4*	248.94	$3^-,4^-$
		402.85 *6*	≤100@	197.94	$^-$
		439.33 *13*	79 *17*	161.53	1^+
619.64	$^-$	390.72 *4*	100 *11*	228.86	$3^-,4^-$
		411.28 *5*	≤50@	208.45	1^+
		603.38 *19*	25 *6*	16.44	2^-
		619.1 *5*	≤14@	0	3^-
636.04	$3^-,4^-$	306.14 *16*	≤100@	330.06	$3^-,4^-$
		353.39 *13*	≤25@	282.57	
		619.1 *5*	≤36@	16.44	2^-
650.34?		488.81 *4*	100@	161.53	1^+
737.75		488.81 *4*	≤100@	248.94	$3^-,4^-$
		608.8 *6*	9 *2*	128.79	1,2
		617.7 *4*	16 *3*	119.66	(0^+)
741.33	(3,4)	411.28 *5*	≤100@	330.06	$3^-,4^-$
		458.68 *15*	50 *11*	282.57	
		532.4 *5*	11 *2*	208.45	1^+
		579.8 *5*	22 *4*	161.53	1^+

† Mainly from ^{71}Ga(n,γ). For levels below 210, γ's from ^{72}Zn β^- decay have been used to obtain average values.
‡ Unplaced in (n,γ), placement suggested by 1987Ro01.
# Relative branchings are given, mainly from ^{71}Ga(n,γ).

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Adopted Levels, Gammas (continued)

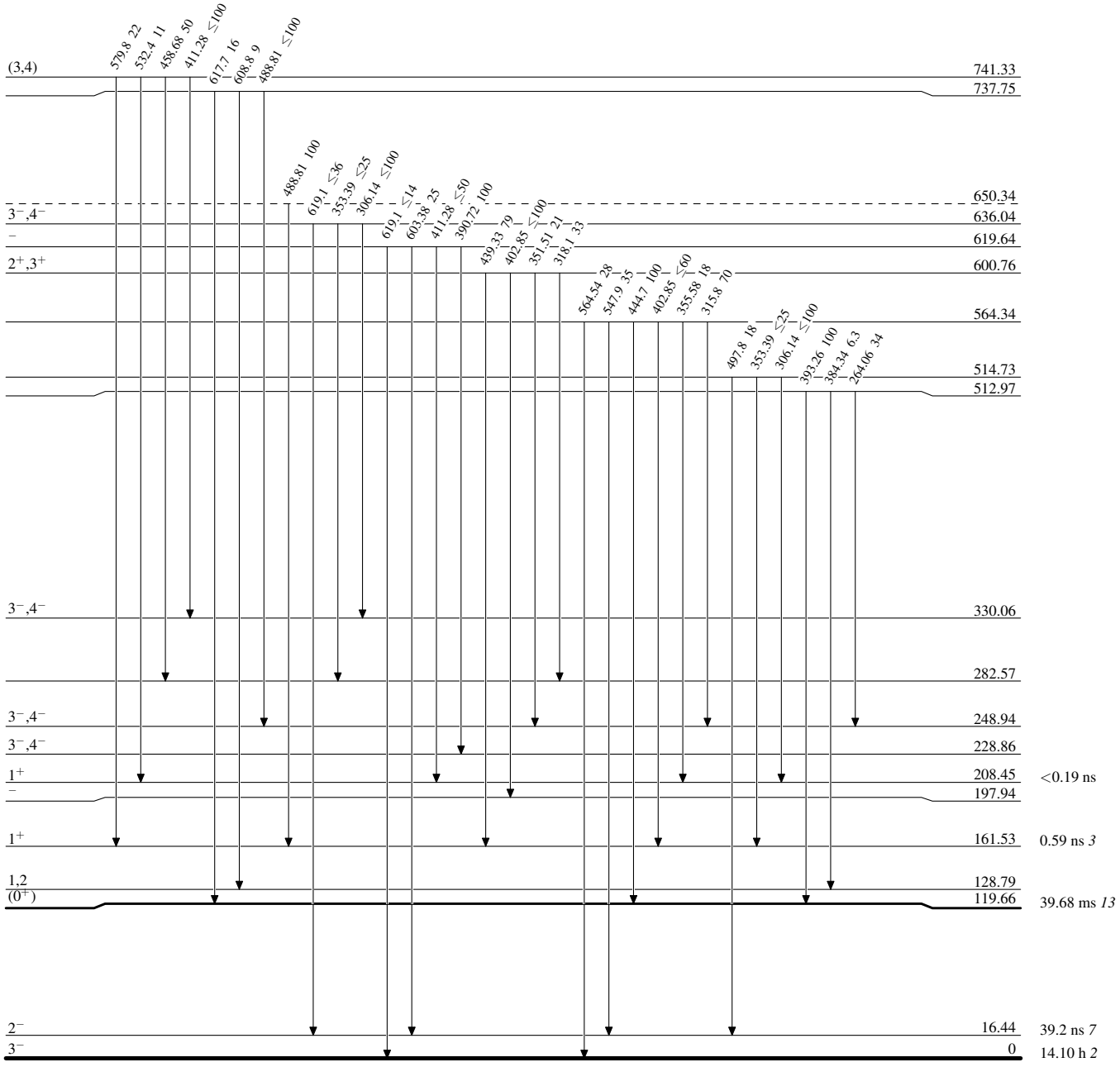
$\gamma(^{72}Ga)$ (continued)

@ Multiply placed. Intensity is an upper limit.
& From α(K)exp, see ^{72}Zn β^- decay.

Adopted Levels, Gammas

Level Scheme

Intensities: Relative photon branching from each level

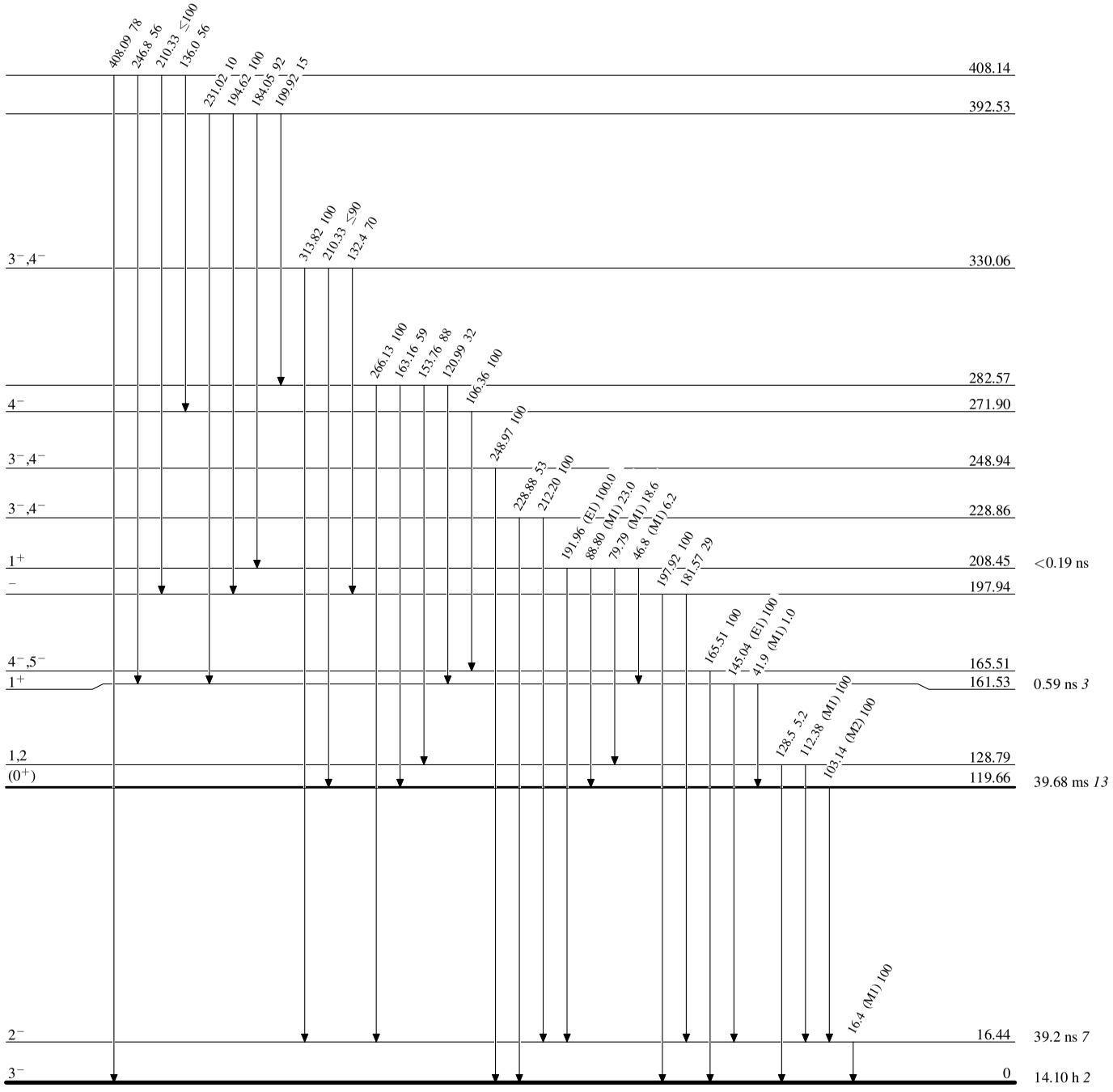


$^{72}_{31}Ga_{41}$

Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Relative photon branching from each level



$^{72}_{31}Ga_{41}$