Adopted Levels, Gammas

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	D. Abriola(a), A. A. Sonzogni	NDS 107,2423 (2006)	1-Jan-2006

Q(β^-)=−901.7 *22*; S(n)=8219.5 *19*; S(p)=10332 *11*; Q(α)=−3747 *3* 2012Wa38
Note: Current evaluation has used the following Q record −902.3 228221.1 *2010333* 11-3750 3 2003Au03.
Q($2\beta^-$)=1142.9 keV 19 (2003Au03).

^{94}Zr Levels

Cross Reference (XREF) Flags

A	^{94}Y β^- decay	G	^{94}Zr(t,t′)	M	^{96}Zr(p,t)
B	^{92}Zr(t,p)	H	^{94}Zr(^{3}He,^{3}He′)	N	^{98}Mo(d,^{6}Li)
C	^{94}Zr(n,n′γ)	I	^{94}Zr(α,α′)	O	^{173}Yb(^{24}Mg,Fγ)
D	^{94}Zr(p,p′)	J	Coulomb excitation	P	^{176}Yb(^{28}Si,Fγ)
E	^{94}Zr(p,p′γ)	K	^{94}Mo(^{6}Li,^{8}B)		
F	^{94}Zr(d,d′)	L	^{94}Mo(^{14}C,^{16}O)		

E(level)†	J$^\pi$	T$_{1/2}$	XREF	Comments
0.0	0$^+$	stable	ABCDEFGHIJKLMNOP	T$_{1/2}$: >1.9×10^{19} y for ^{94}Zr(g.s.) to ^{94}Mo(g.s.) 2ν 2β^- decay, T$_{1/2}$> 0.23×10^{19} y for ^{94}Zr(g.s.) to ^{94}Mo(g.s.) neutrinoless 2β^- decay. Other: T$_{1/2}$>1.3×10^{19} y for ^{94}Zr(g.s.) to ^{94}Mo(2$^+$) 2β^- decay (1987No03). Δ<r^2>(fm^2): (^{92}Zr,^{94}Zr)=0.176 *20* (1987Bo56), (^{94}Zr,^{96}Zr)=0.126 *23* (1987Bo56), 0.117 *14* (1988Ga26) all from measured isotopic shifts. <r^2>$^{1/2}$=4.3312 fm *9* (2004An14).
918.75 *5*	2$^+$	6.9 ps *15*	ABCDEFGHIJKLMNOP	μ=−0.66 *3* μ: From 1999Ja13 from γ-ray angular distribution of recoil ions slowing down in polarized Gadolinium following Coulomb excitation. Other: μ=−0.52 *12* (1989Ra17) μ=−0.14 *14* (1978Ge19). Both values are from γ-ray angular distribution of recoil ions slowing down in polarized iron following Coulomb excitation. J$^\pi$: L(p,t)=2. T$_{1/2}$: from B(E2) in Coulomb Excitation. Δ<r^2>(^{94}Zr,^{96}Zr) (fm^2)=0.117 *14* (1988Ga26) optical isotopic shift.
1300.19 *12*	0$^+$	0.291 ns *11*	ABCDEFG KLMN	J$^\pi$: L(p,t)=0. T$_{1/2}$: from $\beta\gamma\gamma$(t) (1990Ma40). Other: 0.28 ns *4* from (p,p′γ).
1469.62 *10*	4$^+$	0.500 ns *13*	ABCD FG I MNOP	J$^\pi$: L(p,t)=4. T$_{1/2}$: from $\beta\gamma\gamma$(t) (1990Ma40).
1671.41 *7*	2$^+$		ABCD FGHI KLMN	J$^\pi$: L(p,t)=2.
2057.63 *10*	3$^-$		ABCD FGHIJ MN	J$^\pi$: L(p,t)=3.
2151.31 *20*	2$^+$		A CD F M	J$^\pi$: L(p,t)=2.
2329.9 *4*	4$^+$		A CD F I OP	J$^\pi$: L(α,α′)=4.
2366.12 *14*	2$^+$		ABCD FG I MN	J$^\pi$: L(p,t)=2.
2401? *6*			F	
2507.7 *5*	(3)$^+$		C F	J$^\pi$: M1+E2 γ′s to 2$^+$, γ from 4$^+$, supported by Wolfenstein-Hauser-Feshbach calculations for (n,n′γ).
2605.0 *5*	5$^-$		BCD FG I MNOP	J$^\pi$: L(p,t)=5.
2698.5 *10*	(1,2,3)		C F	J$^\pi$: from (n,n′γ):measured $\gamma(\theta)$ compared to to Wolfenstein-Hauser-Feshbach calculations.
2719?			F	
2769?			F	

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Adopted Levels, Gammas (continued)

^{94}Zr Levels (continued)

E(level)[†]	Jπ	XREF	Comments
2826.0 *6*	(2,3)	C F	Jπ: from (n,n′γ):measured γ(θ) compared to to Wolfenstein-Hauser-Feshbach calculations.
2846.3 *3*	(1⁻)	A CD F	Jπ: L(d,d′)=1,4; γ to 0⁺.
2860.6 *11*	4⁺	C FG	Jπ: L(d,d′)=4.
2888.2 *17*	4⁺	BCD F I	Jπ: L(α,α′)=4.
2908.05? *20*	(2⁺)	A F	Jπ: L(d,d′)=2,3,4; γ to 0⁺.
2925 *5*	(1⁻,3⁻,4⁺)	F	Jπ: L(d,d′)=1,3,4.
2945.0 *4*	5⁻	ABCD I	Jπ: L(α,α′)=5.
3014[‡] *8*		B	
3030 *6*		F	E(level): probably a doublet.
3059.31 *17*	(1,2,3)⁺	A C F I	Jπ: log *ft*=7.4 in β⁻ decay from 2⁻.
3142.4 *4*	(6⁺)	OP	
3156.4 *9*	(4⁺)	BCD F I	Jπ: L(α,α′)=4.
3219.42 *13*	(1,2,3)	ABCD FG I	Jπ: log *ft*=7.2 in β⁻ decay from 2⁻, possibly L(d,d′)=3.
3281 *6*	(2⁺)	F	Jπ: L(d,d′)=2.
3316 *6*		F	E(level): possible doublet.
3331 *6*	(5⁻)	D F I	Jπ: L(α,α′)=5. Due to poor back angle statistics this assignment is not certain.
3361.16 *18*	(1,2,3)	ABCD FG I	Jπ: log *ft*=7.3 in β⁻ decay from 2⁻, possibly L(α,α′)=3.
3407 *6*	(3⁻,4⁺)	F I	Jπ: L(d,d′)=1,3,4; L(α,α′)=(3,4).
3442.5 *5*	(7⁻)	OP	
3482[‡] *8*		B D F I	
3560[‡] *7*	(4⁺)	B F I	Jπ: L(α,α′)=4.
3594.8 *6*		OP	
3598 *7*	(5⁻)	D F I	E(level): probable triplet in (d,d′). Jπ: L(α,α′)=5.
3631.6 *4*	(8⁺)	OP	
3686 *7*		F I	E(level): probable doublet in (d,d′).
3724.9 *6*	(2,3,4)⁺	A F I	Jπ: log *ft*=7.8 in β⁻ decay from 2⁻, γ′s to 2⁺ and 4⁺, possibly L(α,α′)=(4).
3776 *7*	(0⁺)	D F	Jπ: L(d,d′)=0.
3840 *7*		B FG	
3884 *7*		F	E(level): probable doublet in (d,d′).
3897 *7*	(4⁺)	B D F I	Jπ: L(α,α′)=4.
3961.8? *3*	(2)⁺	A	Jπ: log *ft*=6.8 in β⁻ decay from 2⁻, γ′s to 0⁺ and 4⁺.
4002.2 *15*	(1,2)⁺	AB D F	Jπ: log *ft*=8.1 in β⁻ decay from 2⁻, γ to 0⁺.
4052.4 *15*	(1,2)⁺	A	Jπ: log *ft*=8.3 in β⁻ decay from 2⁻, γ to 0⁺.
4081 *8*	(3⁻)	F I	Jπ: L(α,α′)=(3). E(level): probable doublet in (α,α′).
4098.5 *15*	(1,2)⁺	A	Jπ: log *ft*=7.7 in β⁻ decay from 2⁻, γ to 0⁺.
4149 *8*	(7⁻)	F I	Jπ: L(α,α′)=7.
4198.8? *3*	(1,2)⁺	A D	Jπ: log *ft*=6.3 in β⁻ decay from 2⁻, γ to 0⁺.
4224.2 *7*		D F OP	E(level): probably a doublet in (d,d′).
4237.6? *4*	(1,2,3)⁺	A	Jπ: log *ft*=6.7 in β⁻ decay from 2⁻.
4340 *8*	(4⁺)	F I	Jπ: L(p,p′)=4.
4369.8 *8*		OP	
4479.3 *5*	(10⁺)	OP	
4637.9? *8*	(1,2,3)⁺	A	Jπ: log *ft*=6.1 in β⁻ decay from 2⁻.
4669.8? *8*	(1⁻,2⁻,3⁻)	A	Jπ: log *ft*=5.8 in β⁻ decay from 2⁻.
4812.4 *6*	(12⁺)	OP	
5490.9 *6*	(11⁺)	OP	
5804.5 *7*	(12⁺)	OP	
6006.8 *7*	(13⁺)	OP	
6371.7 *8*	(14)	OP	
7055.0 *9*	(15)	OP	
7791.8 *10*	(16)	OP	
8980.6 *12*		O	

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Adopted Levels, Gammas (continued)

^{94}Zr Levels (continued)

† Deduced from the adopted γ's if not indicated otherwise.
‡ From (t,p).

Adopted Levels, Gammas (continued)

γ(^{94}Zr)

E_i(level)	J_i^π	E_γ[†]	I_γ[‡]	E_f	J_f^π	Mult.[&]	δ[&]	α[a]	$I_{(\gamma+ce)}$	Comments
918.75	2^+	918.74 *5*	100	0.0	0^+	E2[@]		0.00083		α(K)=0.00072 *2* B(E2)(W.u.)=4.9 *3*
1300.19	0^+	381.57 *19*	100	918.75	2^+	[E2]		0.0099		α(K)=0.0085 *3*; α(L)=0.00102 *3* B(E2)(W.u.)=9.4 *4*
		1300.18[#] *18*		0.0	0^+	E0[@]			0.40 *4*	
1469.62	4^+	550.88 *10*	100	918.75	2^+	[E2]		0.00319		α(K)=0.00276 *9*; α(L)=0.00032 *1* B(E2)(W.u.)=0.879 *23*
1671.41	2^+	752.60 *10*	100 *4*	918.75	2^+					
		1671.41 *10*	71 *10*	0.0	0^+					
2057.63	3^-	588.0 *10*	2.8 *9*	1469.62	4^+					
		1138.88 *10*	100 *7*	918.75	2^+					
2151.31	2^+	1232.55 *19*	100	918.75	2^+	M1+E2	−1.7 *+8−14*	0.00038		α(K)=0.00038
2329.9	4^+	860	<3.0	1469.62	4^+					
		1411.4 *6*	100 *15*	918.75	2^+	E2(+M3)	−0.13 *+13−9*	0.00029 *4*		α(K)=0.00029 *3*
2366.12	2^+	308.22 *28*	18.3 *18*	2057.63	3^-	E1(+M2)	+0.04 *+22−27*	0.005 *3*		α(K)=0.0040 *22*; α(L)=0.0004 *3*
		694.66 *29*	100 *3*	1671.41	2^+	M1(+E2)		0.00160 *8*		α(K)=0.00139 *7*; α(L)=0.00015 *1*
		1066.3 *4*	12 *3*	1300.19	0^+	E2		0.00051		α(K)=0.00051 *2*
		1447.41 *19*	64 *4*	918.75	2^+	M1+E2	+0.64 *+14−12*	0.00027		α(K)=0.00027
2507.7	$(3)^+$	836.0 *7*	14.9 *11*	1671.41	2^+	M1+E2	−0.84 *4*	0.00102		α(K)=0.00089; α(L)=9.8×10^{-5}
		1589.5 *9*	100.0 *11*	918.75	2^+	M1+E2				
2605.0	5^-	1134.9 *8*	100	1469.62	4^+					
2698.5	(1,2,3)	1779.7 *10*	100	918.75	2^+					
2826.0	(2,3)	1154.6 *6*	100	1671.41	2^+					
2846.3	(1^-)	1927.5 *6*	11 *3*	918.75	2^+					
		2846.3 *3*	100 *11*	0.0	0^+					
2860.6	4^+	1391.0 *11*	100	1469.62	4^+					
2888.2	4^+	1969.4 *17*	100	918.75	2^+					
2908.05?	(2^+)	1236.60[b] *20*	1.0×10^2 *3*	1671.41	2^+					
		1989.3[b] *7*	30 *9*	918.75	2^+					
		2908.4[b] *8*	35 *13*	0.0	0^+					
2945.0	5^-	887.4 *4*	100	2057.63	3^-					
3059.31	$(1,2,3)^+$	1001.8 *3*	6.5 *18*	2057.63	3^-					
		1384.9[b] *10*		1671.41	2^+					
		2140.60 *20*	100 *12*	918.75	2^+					
3142.4	(6^+)	537.2 *4*	17.9	2605.0	5^-					
		812.5 *2*	100	2329.9	4^+					
		1672.9 *7*	3.8	1469.62	4^+					
3156.4	(4^+)	648.7 *8*		2507.7	$(3)^+$					
		2237.3 *25*		918.75	2^+					
3219.42	(1,2,3)	1161.79 *10*	100 *12*	2057.63	3^-					

$^{94}_{40}Zr_{54}$-4

Adopted Levels, Gammas (continued)

γ(^{94}Zr) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[‡]	E_f	J_f^π	Comments
3219.42	(1,2,3)	1751.1 *13*		1469.62	4^+	
		2300.5 *3*	26 *4*	918.75	2^+	
3361.16	(1,2,3)	1303.8 *6*	12 *3*	2057.63	3^-	
		1891.60 *20*	100 *12*	1469.62	4^+	
		2442.1 *3*	36 *7*	918.75	2^+	
3442.5	(7^-)	837.4 *2*	100	2605.0	5^-	
3594.8		152.3 *4*	100	3442.5	(7^-)	
3631.6	(8^+)	489.2 *2*	100	3142.4	(6^+)	
3724.9	$(2,3,4)^+$	2255.3[b] *7*	1.0×10^2 *3*	1469.62	4^+	
		2805.9[b] *10*	1.0×10^2 *3*	918.75	2^+	
3961.8?	$(2)^+$	1904.6[b] *8*	16 *5*	2057.63	3^-	
		2492.0[b] *3*	100 *16*	1469.62	4^+	
		2662.4[b] *10*	13 *5*	1300.19	0^+	
4002.2	$(1,2)^+$	4002.1 *15*	100	0.0	0^+	
4052.4	$(1,2)^+$	4052.3 *15*	100	0.0	0^+	
4098.5	$(1,2)^+$	4098.4 *15*	100	0.0	0^+	
4198.8?	$(1,2)^+$	2527.3[b] *4*	100 *17*	1671.41	2^+	
		2898.7[b] *6*	50 *11*	1300.19	0^+	
4224.2		629.3 *7*		3594.8		
		782.0 *7*		3442.5	(7^-)	
4237.6?	$(1,2,3)^+$	2566.2[b] *5*	1.0×10^2 *3*	1671.41	2^+	
		3318.7[b] *7*	$8.\times10^1$ *3*	918.75	2^+	
4369.8		145.7 *7*	32 *3*	4224.2		
		927.2	100 *8*	3442.5	(7^-)	E_γ: seen only in ^{176}Yb(^{28}Si,Fγ).
4479.3	(10^+)	847.7 *2*	100	3631.6	(8^+)	
4637.9?	$(1,2,3)^+$	2966.6[b] *10*	1.0×10^2 *5*	1671.41	2^+	
		3718.8[b] *15*	$8.\times10^1$ *5*	918.75	2^+	
4669.8?	$(1^-,2^-,3^-)$	2998.4[b] *10*	1.0×10^2 *5*	1671.41	2^+	
		3750.9[b] *15*	$7.\times10^1$ *3*	918.75	2^+	
4812.4	(12^+)	333.1 *4*	100	4479.3	(10^+)	
5490.9	(11^+)	1011.6 *4*	100	4479.3	(10^+)	
5804.5	(12^+)	313.6 *4*	100	5490.9	(11^+)	
6006.8	(13^+)	202.3 *4*	100 *24*	5804.5	(12^+)	
		1194.4 *4*	94 *24*	4812.4	(12^+)	
6371.7	(14)	364.9 *4*	100	6006.8	(13^+)	
7055.0	(15)	683.3 *4*	100	6371.7	(14)	
7791.8	(16)	736.8 *4*	100	7055.0	(15)	
8980.6		1188.8[b] *7*	100	7791.8	(16)	

$^{94}_{40}Zr_{54}$-5

γ(^{94}Zr) (continued)

† Weighted averages from β^- decay and (n,n′γ).
‡ Branching ratios from each level deduced from β^- decay and (n,n′γ).
# Deduced from level energy difference.
@ From ^{94}Zr(p,p′γ).
& From ^{94}Zr(n,n′γ), unless noted otherwise.
[a] Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.
[b] Placement of transition in the level scheme is uncertain.

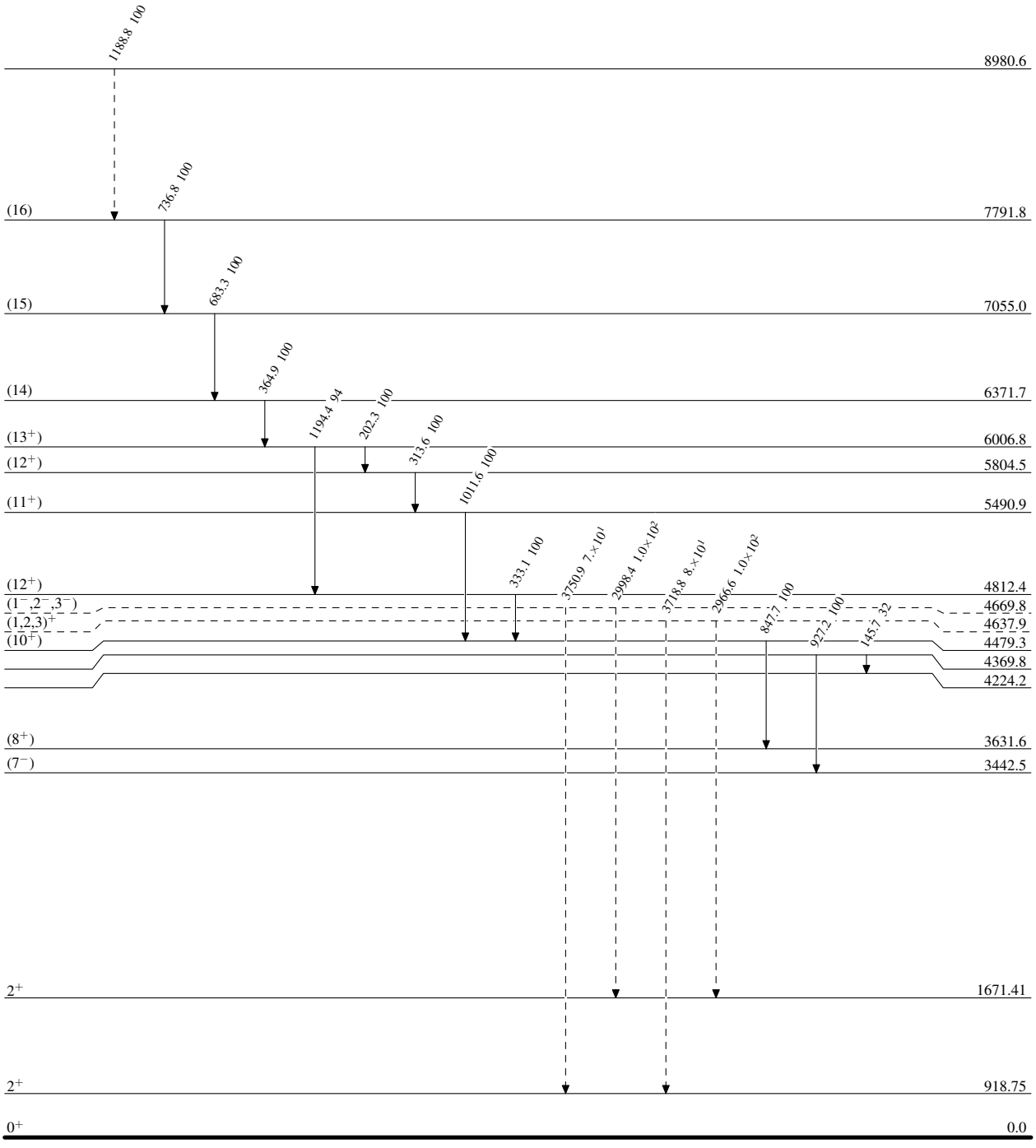
Adopted Levels, Gammas

Legend

Level Scheme

Intensities: Relative photon branching from each level

γ Decay (Uncertain)



$^{94}_{40}Zr_{54}$

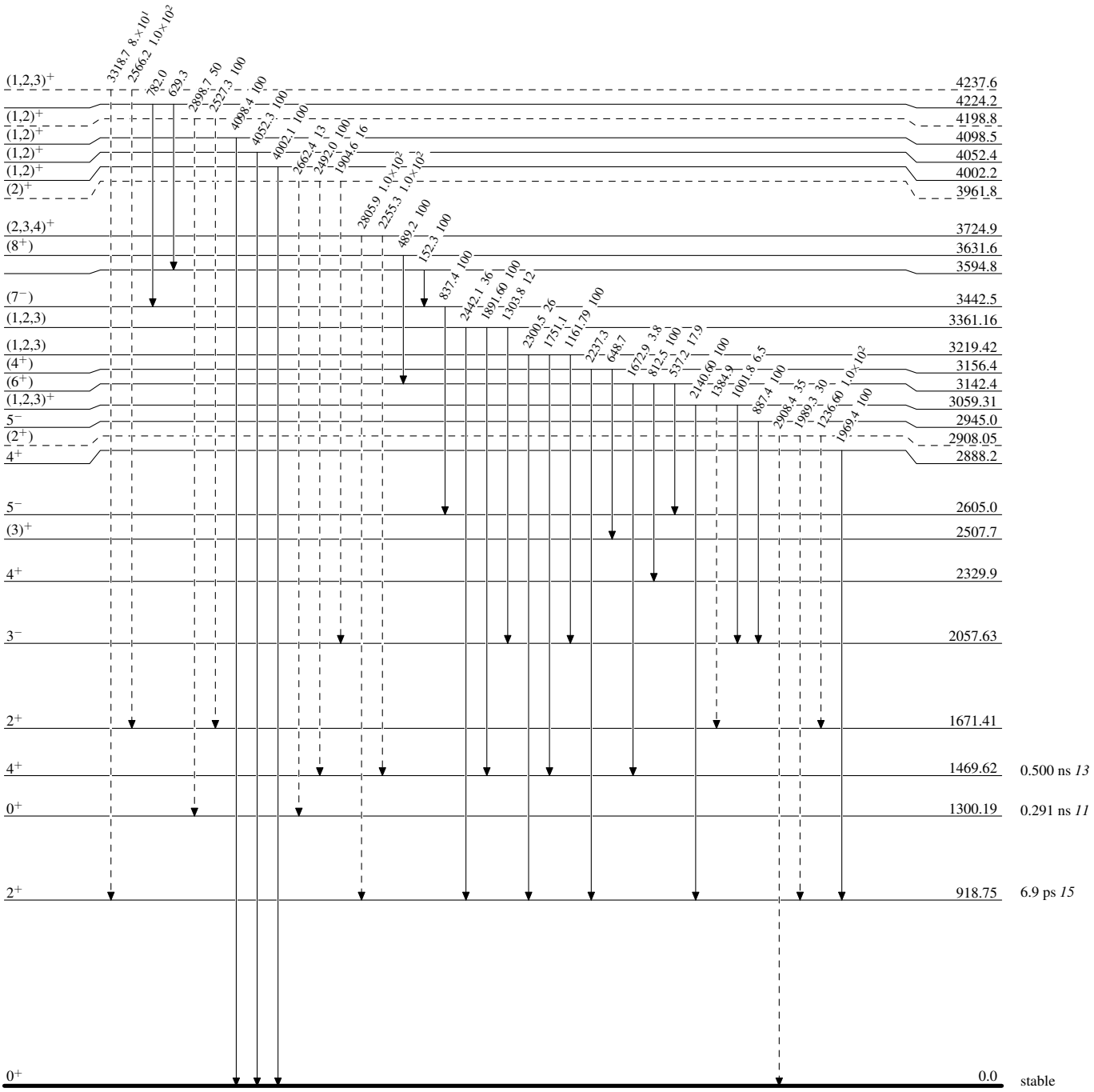
Adopted Levels, Gammas

Legend

Level Scheme (continued)

Intensities: Relative photon branching from each level

γ Decay (Uncertain)

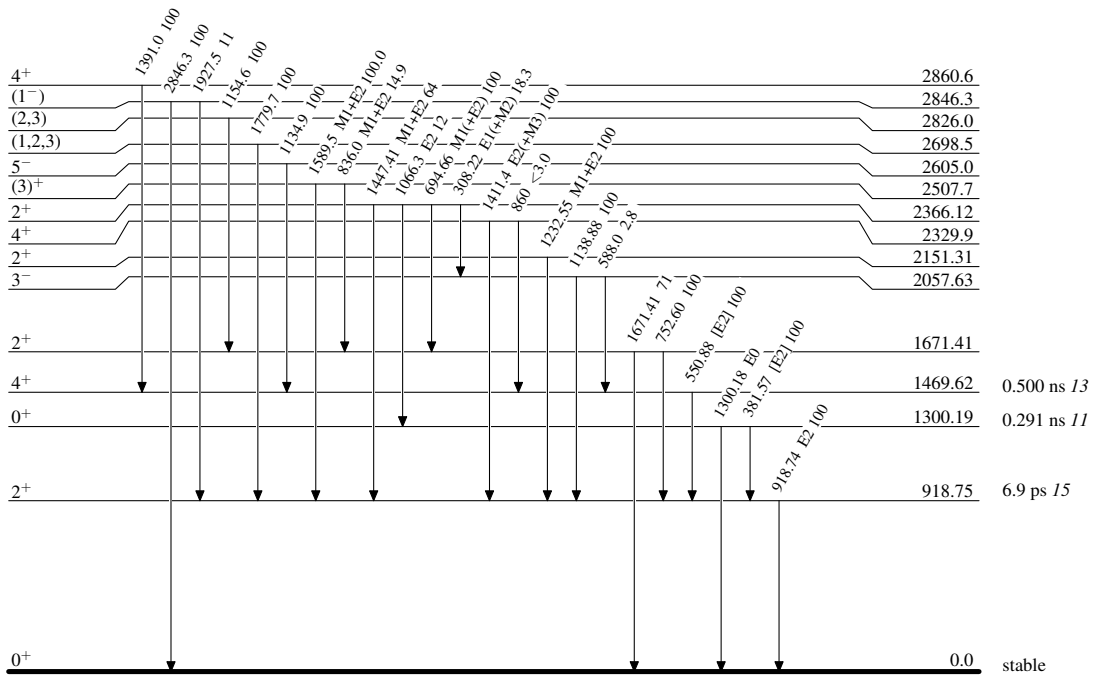


$^{94}_{40}Zr_{54}$

Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Relative photon branching from each level



$^{94}_{40}Zr_{54}$