Adopted Levels, Gammas

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	D. Abriola(a), A. A. Sonzogni	NDS 109,2501 (2008)	1-Apr-2008

Q(β^-)=162 *4*; S(n)=7854.4 *21*; S(p)=11522 *7*; Q(α)=−5002 *4* 2012Wa38
Note: Current evaluation has used the following Q record 161 4 *7856.3* *2211525* 7 −5000 4 2003Au03.
Q($2\beta^-$)=3347.7 keV 22 (2003Au03).
Symbols and Abbreviations:
X_{ijk}=B(E0; $0^+_i \rightarrow 0^+_j$)/β(E2; $0^+_i \rightarrow 2^+_k$).
SPU=Single Particle Unit for E0 Transitions=0.5/$A^{(2/3)}$.
α: Additional information 1.

^{96}Zr Levels

With a ground state Q($2\beta^-$)=3347.7 keV 22 (2003Au03), there have been many experimental programs to determine the 2β- decay half life of ^{96}Zr. The adopted value comes from the latest results of the NEMO collaboration. A list of all experimental efforts can be found at www.nndc.bnl.gov/bbdecay.

Cross Reference (XREF) Flags

A	^{96}Y β^- decay (5.34 s)	G	^{96}Zr(p,p′γ)	M	Coulomb excitation
B	^{96}Y β^- decay (9.6 s)	H	^{96}Zr(d,d′), (pol d,d′)	N	^{98}Mo(^{6}Li,^{8}B), ^{96}Zr(^{6}Li,^{6}Li′)
C	^{96}Zr(n,n′γ)	I	^{96}Zr(t,t′)	O	^{100}Mo(d,^{6}Li)
D	^{94}Zr(t,p)	J	^{96}Zr(α,α′)	P	^{176}Yb(^{28}Si,Xγ)
E	^{94}Zr(t,pγ)	K	^{96}Zr(^{12}C,^{12}C′)	Q	^{96}Zr(^{32}S,^{32}S′γ)
F	^{96}Zr(p,p′)	L	^{96}Zr(^{16}O,^{16}O′)		

E(level)†	J^π	$T_{1/2}$	XREF	Comments
0.0	0^+	2.0×10^{19} y *4*	ABCDEFGHIJKLMNOPQ	$T_{1/2}$: from $T_{1/2}(2\nu2\beta)$=2.0x10^{19} y *3*(stat.) *2*(syst.), NEMO−3 Collaboration (2006Sh31,2005Sa07,2005Si06). Values from geochemical methods: $T_{1/2}$=9.4x10^{19} y *32* (2001Wi17), $T_{1/2}$=3.9x10^{19} y *9* (1993Ka12). Neutrino-less values from 1999Ar25, NEMO−2 Collaboration, 90% CL, $T_{1/2}(0\nu2\beta$, g.s. to g.s.)>1.0x10^{21} y, $T_{1/2}(0\nu2\beta$, g.s. to 2^+)>3.9x10^{20} y. <r^2>$^{1/2}$(charge)=4.3498 *11* (2004An14).
1581.64@ *6*	0^+	38.0 ns *7*	ABCDEFGH NO	J^π: E0 to 0^+. $T_{1/2}$: weighted average of 38.0 ns *15* (1972Bu18), 37.8 ns *12* (1972AnZZ), and 38.2 ns *12* (1971AnZF). 1971AnZF list their data as mean life; by comparing this group′s later measurement in 1972AnZZ, the evaluator has assumed that their result was $T_{1/2}$.
1750.497 *15*	2^+	0.57 ps *7*	ABCDEFGHIJklMNOPQ	μ=+0.06 *14*; g=+0.03 *7* (2003Ku11) J^π: stretched E2 to 0^+. $T_{1/2}$: from DSAM following Coulomb excitation of ^{96}Zr beams (2003Ku11), other: 0.31 ps *13* from B(E2)=0.055 *22* (1965Ga05, Coulomb excitation).
1897.158& *16*	3^-	68 ps *4*	ABCDEFGHIJkl NOPQ	μ=+2.9 *5* (2003Ku11); g=+0.98 *15* J^π: L(α,α′)=3. $T_{1/2}$: from recoil distance measurement ^{96}Zr(^{32}S,^{32}S′γ) (1993Ho19). Other: 50 ps *7* from β decay of 5.34-s ^{96}Y (1990Ma45); 46 ps *15* from β decay of 9.6-s ^{96}Y (1990Oh02) both by the centroid-shift method.
2225.846@ *17*	2^+	<10 ps	ABC EFGH O	$T_{1/2}$: from β decay of 5.34-s ^{96}Y (1990Ma45).

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Adopted Levels, Gammas (continued)

^{96}Zr Levels (continued)

E(level)[†]	Jπ	$T_{1/2}$	XREF		Comments
					Jπ: stretched E2 2226γ to 0+.
2438.746 *18*	3+	0.38 ps *+19−10*	C EFGHI		J=3 from γ(θ) in (n,n′γ); π=+ from M1 to 2+. T1/2: from (n,n′γ); value may be about 20% lower than indicated because cascade feeding was not considered.
2668.82 *4*	(2+)	0.24 ps *+32−10*	A C EFGHI		Jπ: L(p,p′)=(2). T1/2: from (n,n′γ); value may be about 20% lower than indicated because cascade feeding was not considered.
2695.18 *3*	0+	28 ps *7*	A C EFGH		Jπ: E0 to 0+. T1/2: from β decay of 5.34-s ^{96}Y (1990Ma45).
2750 *15*	4+			O	Jπ: L(d,^{6}Li)=4.
2781.2? *10*			B		
2857.373[@] *23*	4+	0.60[#] ps *+46−18*	BCDEFGHIJ	OP	Jπ: stretched E2 632γ to 2+, L(d,d′)=4.
2925.55 *3*	0+	20 ps *14*	A CDEFGH J		T1/2: from β decay of 5.34-s ^{96}Y (1990Ma45); other: >1.4 ps (n,n′γ). Jπ: E0 to 0+; however, L=5 in (α,α′) and (p,p′); 1990MoZY in (d,d′) did not observe L=5 at this energy. They suggest that L(α,α′) and (L(p,p′) results may be due to an impurity.
3039 *5*	3−		F		Jπ: L(p,p′)=3.
3082.36 *3*	4+	>1.4[#] ps	BCDEFGHIJ	P	Jπ: L(α,α′)=4.
3119.87[&] *3*	5−	0.58[#] ps *+68−21*	BC EFGHIJ	P	Jπ: stretched E2 1223γ to 3−, E1 γ from 6+.
3150.28 *3*	3−	>0.54[#] ps	C EFGH		J=3 or 5 from γ(θ) in (n,n′γ); σ(n,n′) excludes J=5; π=− from M1 to 3−.
3176.43 *3*	4+	0.39[#] ps *+59−28*	BCDEFGH J		Jπ: L(α,α′)=4.
3211.84 *4*	2+	0.090[#] ps *+21−14*	A C EFGHIJ		Jπ: L(p,p′)=2.
3243.61 *7*		>0.097[#] ps	C		
3248.63 *5*	2+	0.19[#] ps *+5−4*	C F H J		Jπ: L(α,α′)=2.
3309.19 *9*	(4+,5+,6+)		BC EFGH	P	Jπ: E2 to 4+ and γ to 5−. L(p,p′)=4; however, this result is suspect because of 90Zr contaminant peak at 3308 keV. J^π(3309)=(5,6)− (1987StZX), 5− (1988StZS) in the β decay of 9.6-s isomer of ^{96}Y; no experimental details available.
3363.30 *4*			C FGH		
3399 *11*	(4+)		H		Jπ: L(d,d′)=(4).
3427 *5*	4+		F H J		Jπ: L(p,p′)=4.
3448.72 *8*	(2+)	>0.66[#] ps	C F H		Jπ: L(p,p′)=(2).
3450.16 *17*			A F		
3457 *2*	(6+)		F H		Jπ: L(p,p′)=(6).
3472.14 *7*	2+	0.15[#] ps *+4−2*	C F H j		Jπ: L(p,p′)=2; 3482 *15* level in (α,α′) has a L=(2) component.
3483.44[@] *9*	6+	25 ps *9*	BCDEFGHIj	P	T1/2: from 9.6-s isomeric ^{96}Y β decay (1991OhZZ). Jπ: E1 364γ to 5−, L(p,p′)=6.
3509.16 *7*	2+	0.104[#] ps *21*	A C FGH		Jπ: L(p,p′)=2.
3556.18 *8*	2+	0.16[#] ps *4*	C F HIJ		Jπ: L(α,α′)=2; L=5 in (t,t′) is probably wrong.
3577.62 *5*			C FGH		
3586 *2*	(4−)		F H		Jπ: from coupled-channels calculations in (p,p′).
3602.17 *20*	(1,2+)[‡]	0.19[#] ps *+19−7*	C F H		
3608 *15*	(5−,6+)		J		Jπ: L(α,α′)=(5,6).
3611 *5*			F		Jπ: L(p,p′)=(2,3,4).
3620.73 *7*	(1,2+)[‡]	0.005[#] ps *3*	C H		

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Adopted Levels, Gammas (continued)

^{96}Zr Levels (continued)

E(level)[†]	Jπ	$T_{1/2}$	XREF	Comments
3630 *20*	(6+)		I	Jπ: L(t,t′)=(6).
3676 *5*			F HI	Jπ: L(p,p′)=5; L(d,d′)=(3,4,5); L(t,t′)=(2,3); could be a doublet.
3695 *5*			F J	Jπ: L(p,p′)=2; L(α,α′)=3.
3700.68 *10*	(1,2+)[‡]	0.006[#] ps *3*	A C H	
3732			F H	
3749.38 *10*	4+	>0.26[#] ps	BC EF HIJ	Jπ: L(p,p′)=L(t,t′)=4; note L(d,d′)=(4),5.
3761 *8*	2+		D I	Jπ: L(t,t′)=2.
3772.2 *4*	6+		B EF H P	Jπ: stretched E2 617γ from 8+, γ to 4+.
3833	4+		F H	Jπ: L(p,p′)=4.
3857.48 *20*	2+	0.055[#] ps *+21−14*	C F H	Jπ: L(p,p′)=2.
3865.16 *10*			C	
3895 *5*	4+		F	Jπ: L(p,p′)=4.
3924.6 *10*			B F HIJ	Jπ: L(t,t′)=5 and L(α,α′)=4.
3947.19 *10*	(1,2+)[‡]	0.010[#] ps *+6−4*	C F H	
3997	(2+)		F H	Jπ: L(p,p′)=(2).
4014.07 *20*	5−		C EFGH J	Jπ: L(p,p′)=5.
4024.5? *8*			A	
4034 *8*	3−		D F H	Jπ: L(p,p′)=3.
4037.89 *20*	(1,2+)[‡]	0.007[#] ps *+6−5*	C	
4038 *5*			F HI	Jπ: L(p,p′)=5 (1984FuZY); however, L(p,p′)=2 (1993Ho01).
4055 *5*	2+		F	Jπ: L(p,p′)=2.
4068 *2*	(1−)		F H	Jπ: L(p,p′)=(1).
4126.3 *10*	(4+)		B F HI	Jπ: L(t,t′)=(4).
4132.4 *3*	(1,2+)[‡]	<0.017[#] ps	C H	
4139 *5*	3−		F J	Jπ: L(α,α′)=3; however, L(p,p′)=(0,1,2).
4160	5−		I	Jπ: L(t,t′)=5.
4205 *5*	4+		F H	Jπ: L(p,p′)=4.
4234.7[&] *5*	7−		B EF H J P	Jπ: L(d,d′)=7.
4258.0 *4*	3−		A D H	Jπ: L(d,d′)=3.
4261.3 *5*	(5+,6+)		B	γ′s to 4+ and 6+, γ from (7+,8+), E=5066.2.
4323 *8*	(3−)		HI	Jπ: L(d,d′)=(3),(2). L(t,t′)=(3).
4341 *7*	2+		D F H J	Jπ: L(p,p′)=2.
4389.5 *5*	8+	127 ps *10*	B E P	Jπ: stretched E2 906γ to 6+, γ to 7−. $T_{1/2}$: from 9.6-s ^{96}Y β decay (1990OhZZ,1991OhZZ).
4390	(4+)		I	Jπ: L(t,t′)=4.
4430 *5*	6+		F H J	Jπ: L(α,α′)=6.
4470	5−		I	Jπ: L(t,t′)=5.
4479 *5*	4+		F	Jπ: L(p,p′)=4.
4512.5 *7*	(1,2+)[‡]		A H	
4520	(4+)		I	Jπ: L(t,t′)=(4).
4531 *6*	3−		H J	Jπ: L(α,α′)=3.
4570.1 *8*	(5−,6+)		B P	Jπ: gammas to 4+,7−.
4580	4+		I	Jπ: L(t,t′)=4.
4640 *8*			H J	
4689.7 *11*			B P	
4698 *5*	2+		F	Jπ: L(p,p′)=2.
4737.5 *8*	(1,2+)[‡]		A	
4751.5 *7*	(7,8+)		B I	Jπ: log $f^{1u}t$=7.6 for β− decay from (8+) parent; γ to 6+.
4757.2 *8*			B	
4807 *5*	3−		F IJ	Jπ: L(α,α′)=3.
4837.75 *20*	(1−,2+)		A F	Jπ: γ to 0+ and 3− levels; log *ft*=6.4 for β− decay from

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Adopted Levels, Gammas (continued)

^{96}Zr Levels (continued)

E(level)[†]	Jπ	XREF	Comments
			0^- parent.
4845.4 *14*		B IJ	Jπ: L(α,α′)=3; L(t,t′)=4.
4881.9? *10*		A	
4895.2 *7*	(1,2+)[‡]	A F	
4906.9 *8*	(10+)	B P	
4914.1? *10*	(1,2+)[‡]	A	
4929.1 *9*	(1,2+)[‡]	A F J	
4979 *5*		F	
5014 *5*		F	
5065 *5*		F	
5066.2 *6*	(7+,8+)	B	Jπ: log *ft*=5.7 for β^- decay from (8+) parent; γ to 6+.
5103 *15*		J	
5117.8 *11*		B F	
5196.9? *10*		A	
5228.5 *6*	(1,2+)[‡]	A	
5235.3 *8*	(7,8+)	B	Jπ: log $f^{1u}t$=7.5 for β^- decay from (8+); γ to 6+.
5245 *5*		F	
5272.0 *6*	(1,2+)[‡]	A	
5312.5 *7*		A	
5329 *5*	4+	F J	Jπ: L(α,α′)=4.
5371 *15*	4+	J	Jπ: L(α,α′)=4.
5384 *5*		F	
5408.3 *7*		A	
5443.1 *5*	(1,2+)[‡]	A F	
5483.8 *11*	(10+)	P	Jπ: γ to 8+.
5502.2? *8*	(1,2+)[‡]	A	
5507.6 *5*	(7+,8+)	B	Jπ: log *ft*=5.2 for β^- decay from (8+); γ to 6+.
5538.9 *6*	(1,2+)[‡]	A	
5551.6 *6*	(1,2+)[‡]	A	
5573.9 *6*	(1,2+)[‡]	A	
5601.5 *6*	(1,2+)[‡]	A	
5625.9 *10*		A	
5628.9 *11*		B	
5652.9? *10*		A	
5701.3 *6*		A	
5719.1 *8*	(1,2+)[‡]	A	
5737.7 *13*	(11+)	P	
5741.5? *10*		A	
5783.1 *8*	(1,2+)[‡]	A	
5804.5 *7*	(1,2+)[‡]	A	
5838.3 *10*	(1,2+)[‡]	A	
5847.5 *6*	(1,2+)[‡]	A	
5899.8 *11*		B	
5914.7 *6*	(1,2+)[‡]	A	
5934.6 *6*	(1,2+)[‡]	A	
6143.6? *8*	(1,2+)[‡]	A	
6231.6 *11*	(1,2+)[‡]	A	
6245.7 *16*	(12+)	P	
6460.5 *19*	(13+)	P	
6821.3 *22*	(14+)	P	

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Adopted Levels, Gammas (continued)

^{96}Zr Levels (continued)

† From a least-squares fit to the Eγ assuming ΔEγ=1 keV when unknown.
‡ γ to 0^+.
# From (n,n$'\gamma$).
@ Band(A): 4p-4h intruder band.
& Band(B): Negative parity sequence.

Adopted Levels, Gammas (continued)

γ(^{96}Zr)

E_i(level)	J_i^π	E_γ †	I_γ	E_f	J_f^π	Mult.	δ	α	Comments
1581.64	0^+	1581.6 *4*		0.0	0^+	E0#			E_γ: from ^{96}Y β^- decay (5.34 s). ρ^2=7.53×10^{-3} *14*=0.32 *1*(SPU); from t, K,L_I,L_{II} shell conversion factors from 1970Be87, and the K-shell conversion/pair production ratio from 1986PaZM.
1750.497	2^+	1750.42 *2*	100	0.0	0^+	E2		0.000398 *6*	α(K)=0.000184 *3*; α(L)=2.01×10^{-5} *3*; α(M)=3.48×10^{-6} *5*; α(N)=4.94×10^{-7} *7* α(O)=3.52×10^{-8} *5*; α(N+..)=0.000190 *3* B(E2)(W.u.)=2.3 *3* Mult.: stretched Q from γγ(θ) in β-decay; E2 from RUL.
1897.158	3^-	146.653[f] *10*	100[f] *4*	1750.497	2^+	(E1)		0.0371	α(K)=0.0327 *5*; α(L)=0.00366 *6*; α(M)=0.000632 *9*; α(N)=8.84×10^{-5} *13*; α(O)=5.80×10^{-6} *9* α(N+..)=9.42×10^{-5} *14* B(E1)(W.u.)=0.00123 *10* Mult.: stretched D from γγ(θ) in β^- decay and ΔJ^π.
		1897.21[g] *3*	19.0[g] *4*	0.0	0^+	[E3]		0.000440 *7*	α(K)=0.000268 *4*; α(L)=2.97×10^{-5} *5*; α(M)=5.14×10^{-6} *8*; α(N)=7.31×10^{-7} *11* α(O)=5.17×10^{-8} *8*; α(N+..)=0.0001367 *20* B(E3)(W.u.)=57 *4* Iγ(147) and Iγ(1897): weighted average of (p,p′γ), (n,n′γ) and β-decay(5.34 s) data sets.
2225.846	2^+	328.75 *3*	14[b] *1*	1897.158	3^-	(E1(+M2))	−0.02[@] *5*	0.00380 *16*	α(K)=0.00336 *14*; α(L)=0.000371 *17*; α(M)=6.4×10^{-5} *3*; α(N)=9.1×10^{-6} *5*; α(O)=6.2×10^{-7} *3* α(N+..)=9.7×10^{-6} *5* B(E1)(W.u.)>6.4×10^{-5} Mult.: from γ(θ) in (n,n′γ) and ΔJ^π.
		475.33 *1*	57[b] *1*	1750.497	2^+	M1+E2	−0.09[@] *+1−2*	0.00361 *5*	α(K)=0.00318 *5*; α(L)=0.000355 *5*; α(M)=6.16×10^{-5} *9*; α(N)=8.76×10^{-6} *13*; α(O)=6.19×10^{-7} *9* α(N+..)=9.38×10^{-6} *14* B(E2)(W.u.)>0.16; B(M1)(W.u.)>0.0058 Mult.: from γ(θ) in (n,n′γ) and ce data in (t,pγ).
		644.18 *6*	28[b] *2*	1581.64	0^+	E2		0.00203 *3*	α(K)=0.001783 *25*; α(L)=0.000204 *3*; α(M)=3.53×10^{-5} *5*; α(N)=4.98×10^{-6} *7*; α(O)=3.37×10^{-7} *5* α(N+..)=5.31×10^{-6} *8* B(E2)(W.u.)>2.7 Mult.: Q from γ(θ) in (n,n′γ); E2 from RUL.
		2225.93 *4*	100[b] *5*	0.0	0^+	E2		0.000550 *8*	α(K)=0.0001185 *17*; α(L)=1.283×10^{-5} *18*; α(M)=2.22×10^{-6} *4* α(O)=2.26×10^{-8} *4*; α(N+..)=0.000417 *6*

$^{96}_{40}Zr_{56}$-6

Adopted Levels, Gammas (continued)

γ(^{96}Zr) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ	E_f	J_f^π	Mult.	δ	α	$I_{(\gamma+ce)}$	Comments
										B(E2)(W.u.)>0.020 Mult.: Q from γ(θ) in (n,n′γ); E2 from RUL.
2438.746	3+	688.25 *1*	100	1750.497	2+	M1+E2	+0.02[@] +2−1	0.001529 *22*		α(K)=0.001350 *19*; α(L)=0.0001491 *21*; α(M)=2.59×10^{-5} *4* α(O)=2.62×10^{-7} *4*; α(N+..)=3.94×10^{-6} *6* B(E2)(W.u.)=0.1 +3−1; B(M1)(W.u.)=0.18 +5−9 Mult.: from (n,n′γ).
2668.82	(2+)	442.9 *3*	6.4[c] *16*	2225.846	2+					
		771.60 *4*	35[c] *5*	1897.158	3−	(E1+M2)	+0.08[@] +6−7	0.00050 *4*		α(K)=0.00044 *3*; α(L)=4.8×10^{-5} *4*; α(M)=8.4×10^{-6} *6*; α(N)=1.19×10^{-6} *9*; α(O)=8.4×10^{-8} *6* α(N+..)=1.28×10^{-6} *10* B(E1)(W.u.)=(0.0007 +4−7); B(M2)(W.u.)=(4.E+1 +6−4) Mult.: from γ(θ) in (n,n′γ) and ΔJ$^\pi$.
		918.6 *1*	100[c] *5*	1750.497	2+	M1,E2[&]		0.000813 *13*		α(K)=0.000718 *11*; α(L)=7.95×10^{-5} *16*; α(M)=1.38×10^{-5} *3*; α(N)=1.96×10^{-6} *4* α(O)=1.377×10^{-7} *20*; α(N+..)=2.09×10^{-6} *4* B(E2)(W.u.)=5.E+1 *7*; B(M1)(W.u.)=0.04 *6*
2695.18	0+	469.33 *3*	100	2225.846	2+	[E2]		0.00507 *8*		α(K)=0.00445 *7*; α(L)=0.000522 *8*; α(M)=9.06×10^{-5} *13*; α(N)=1.269×10^{-5} *18*; α(O)=8.30×10^{-7} *12* α(N+..)=1.352×10^{-5} *19* B(E2)(W.u.)=34 *9*
		1113.53[‡]		1581.64	0+	E0[#]			0.018	$I_{(\gamma+ce)}$: ce(K)(1114)/I(469γ)=0.00015 to 0.00018 in (t,pγ). X_{322}=0.037 *6* (if 1114.6γ is M1 or E2), =0.043 *7* (if 1114.6γ is E1) (1988HeZM).
		2695.17[‡]		0.0	0+	E0[#]			0.0030	$I_{(\gamma+ce)}$: from ce(K)(2695)/I(469γ)=0.000030 in (t,pγ). X_{312}=0.0039 *9* (1988HeZM); statistical uncertainty only, a calibration uncertainty of 50% for E_e>1600 keV is not included. ρ^2_{32}/ρ^2_{31}=9.4 *26* (1988HeZM).
2781.2?		884.0[i]	100	1897.158	3−					
2857.373	4+	631.45[e] *4*	21[de] *4*	2225.846	2+	E2(+M3)[a]	−0.02[@] *8*	0.00215 *12*		α(K)=0.00189 *11*; α(L)=0.000216 *13*; α(M)=3.75×10^{-5} *22*; α(N)=5.3×10^{-6} *4*; α(O)=3.56×10^{-7} *21*

$^{96}_{40}Zr_{56}$-7

Adopted Levels, Gammas (continued)

γ(^{96}Zr) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ	E_f	J_f^π	Mult.	δ	α	Comments
									α(N+..)=5.6×10^{-6} *4* B(E2)(W.u.)=(56 *+20−44*)
2857.373	4$^+$	960.9[e] *2*	15[de] *4*	1897.158	3$^-$	(E1)		0.000311 *5*	α(K)=0.000275 *4*; α(L)=2.99×10^{-5} *5*; α(M)=5.18×10^{-6} *8*; α(N)=7.36×10^{-7} *11* α(O)=5.22×10^{-8} *8*; α(N+..)=7.88×10^{-7} *11* B(E1)(W.u.)=7.E−5 *+3−6* Mult.: stretched D from γγ(θ) in β$^-$ decay and ΔJ^π.
		1106.88[e] *2*	100[de] *6*	1750.497	2$^+$	E2(+M3)[a]	−0.03[@] *3*	0.000536 *10*	α(K)=0.000472 *8*; α(L)=5.23×10^{-5} *9*; α(M)=9.06×10^{-6} *16*; α(O)=9.01×10^{-8} *16* α(N+..)=2.18×10^{-6} *4* B(E2)(W.u.)=(16 *+5−13*); B(M3)(W.u.)=(8.E+4 *+17−8*)
2925.55	0$^+$	230.38[‡]		2695.18	0$^+$	E0[#]			X_{432}<2.8 (2σ) (1988HeZM).
		699.9[f] *3*	40[f] *3*	2225.846	2$^+$	(E2)		0.001621 *23*	α(K)=0.001427 *20*; α(L)=0.0001620 *23*; α(M)=2.81×10^{-5} *4* α(O)=2.70×10^{-7} *4*; α(N+..)=4.24×10^{-6} *6* B(E2)(W.u.)=1.8 *14* Mult.: ce data in (t,pγ) give M1,E2; ΔJ rules out M1.
		1175.04 *3*	100 *15*	1750.497	2$^+$	(E2)		0.000473 *7*	α(K)=0.000413 *6*; α(L)=4.56×10^{-5} *7*; α(M)=7.90×10^{-6} *11*; α(N)=1.121×10^{-6} *16* α(O)=7.88×10^{-8} *11*; α(N+..)=6.07×10^{-6} *9* B(E2)(W.u.)=0.3 *3* Mult.: ce data in (t,pγ) give M1/E2; ΔJ rules out M1.
		1343.89[‡]		1581.64	0$^+$	E0[#]			X_{422}<0.119 (2σ) (1988HeZM).
		2925.50[‡]		0.0	0$^+$	E0[#]			X_{412}=0.067 *27* (1988HeZM); statistical uncertainty only; a calibration uncertainty of 50% for E_e>1600 keV is not included. ρ^2_{42}/ρ^2_{41}<3.0 (1988HeZM).
3082.36	4$^+$	224.8	10.3	2857.373	4$^+$				E_γ: observed only in ^{96}Y β$^-$ Decay (9.6 s).
		643.9[h] *2*	7.1[h] *8*	2438.746	3$^+$				
		856.6[h] *2*	6.3[h] *13*	2225.846	2$^+$	[E2]		0.000969 *14*	α(K)=0.000854 *12*; α(L)=9.57×10^{-5} *14*; α(M)=1.660×10^{-5} *24* α(O)=1.624×10^{-7} *23*; α(N+..)=2.51×10^{-6} *4* B(E2)(W.u.)<1.6
		1185.19[g] *3*	100.0[g] *13*	1897.158	3$^-$	E1(+M2)[&]	+0.02[@] *3*	0.000244 *4*	α(K)=0.000186 *3*; α(L)=2.02×10^{-5} *4*; α(M)=3.49×10^{-6} *6*; α(N)=4.96×10^{-7} *9* α(O)=3.53×10^{-8} *6*; α(N+..)=3.44×10^{-5} *5* B(E1)(W.u.)<0.00010; B(M2)(W.u.)<0.54
		1331.8[h] *2*	10.1[h] *13*	1750.497	2$^+$				
3119.87	5$^-$	1222.70 *3*	100	1897.158	3$^-$	E2+M3[&]	−0.05[@] *3*	0.000444 *9*	α(K)=0.000383 *8*; α(L)=4.22×10^{-5} *9*; α(M)=7.31×10^{-6} *15*;

$^{96}_{40}Zr_{56}$-8

Adopted Levels, Gammas (continued)

γ(^{96}Zr) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ	E_f	J_f^π	Mult.	δ	α	Comments
									α(N)=1.037×10^{-6} *21* α(O)=7.31×10^{-8} *15*; α(N+..)=1.245×10^{-5} *18* B(E2)(W.u.)=14 *+5−14*; B(M3)(W.u.)=1.6×10^{5} *+20−16*
3150.28	3$^-$	711.56 *3*	100 *4*	2438.746	3$^+$	(E1+M2)	−0.07[@] *4*	0.000593 *25*	α(K)=0.000524 *22*; α(L)=5.7×10^{-5} *3*; α(M)=9.9×10^{-6} *5*; α(N)=1.41×10^{-6} *7* α(O)=9.9×10^{-8} *5*; α(N+..)=1.51×10^{-6} *7* B(E1)(W.u.)<0.00100; B(M2)(W.u.)<94 Mult.: from γ(θ) in (n,n′γ) and ΔJ^π. E_γ: from (n,n′γ). I_γ: from (p,p′γ).
		1252.98 *7*	66 *7*	1897.158	3$^-$	M1+E2	+1.7[@] *3*	0.000427 *6*	α(K)=0.000363 *6*; α(L)=3.98×10^{-5} *6*; α(M)=6.90×10^{-6} *10*; α(N)=9.81×10^{-7} *14* α(O)=6.95×10^{-8} *10*; α(N+..)=1.70×10^{-5} *4* B(E2)(W.u.)<4.2; B(M1)(W.u.)<0.0027 Mult.: D+Q from γ(θ) in (n,n′γ); M1+E2 from RUL. E_γ: from (n,n′γ). I_γ: from (p,p′γ).
3176.43	4$^+$	1279.27[h] *2*	100.0[h] *19*	1897.158	3$^-$	E1(+M2)[&]	−0.03[@] *3*	0.000277 *5*	α(K)=0.000163 *3*; α(L)=1.76×10^{-5} *3*; α(M)=3.05×10^{-6} *6*; α(N)=4.34×10^{-7} *8* α(O)=3.09×10^{-8} *6*; α(N+..)=9.37×10^{-5} *14* B(E1)(W.u.)=(0.0004 *+3−4*); B(M2)(W.u.)=(1.0 *+21−10*)
		1425.6[h] *2*	4.7[h] *9*	1750.497	2$^+$	[E2]		0.000371 *6*	α(K)=0.000276 *4*; α(L)=3.02×10^{-5} *5*; α(M)=5.23×10^{-6} *8*; α(N)=7.43×10^{-7} *11* α(O)=5.27×10^{-8} *8*; α(N+..)=5.96×10^{-5} *9* B(E2)(W.u.)=0.4 *+4−4*
3211.84	2$^+$	1314.64 *4*	100 *11*	1897.158	3$^-$				
		1461.5 *1*	54 *11*	1750.497	2$^+$				
		3211.8 *1*	64 *18*	0.0	0$^+$				
3243.61		574.74 *6*	100 *25*	2668.82	(2$^+$)				
		1018.3 *2*	100 *25*	2225.846	2$^+$				
3248.63	2$^+$	1022.8 *1*	22 *5*	2225.846	2$^+$				
		3248.56 *6*	100 *11*	0.0	0$^+$	[E2]		0.000950 *14*	α(K)=6.22×10^{-5} *9*; α(L)=6.70×10^{-6} *10*; α(M)=1.159×10^{-6} *17* α(O)=1.188×10^{-8} *17*; α(N+..)=0.000880 *13* B(E2)(W.u.)=0.26 *+7−8*
3309.19	(4$^+$,5$^+$,6$^+$)	132.9	62.5	3176.43	4$^+$				

Adopted Levels, Gammas (continued)

γ(^{96}Zr) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ	E_f	J_f^π	Mult.	α	Comments
3309.19	(4$^+$,5$^+$,6$^+$)	189.4	25	3119.87	5$^-$			
		226.82 *8*	100	3082.36	4$^+$	E2[&]	0.0573	α(K)=0.0496 *7*; α(L)=0.00646 *9*; α(M)=0.001124 *16*; α(N)=0.0001541 *22*; α(O)=8.79×10^{-6} *13* α(N+..)=0.0001629 *23*
3363.30		924.55 *4*	100	2438.746	3$^+$			
3448.72	(2$^+$)	780.2 *2*	100 *19*	2668.82	(2$^+$)			
		1551.50 *8*	75 *19*	1897.158	3$^-$			
3450.16		781.2[f] *2*	100[f] *15*	2668.82	(2$^+$)			
		1225.2[f] *5*	12[f] *5*	2225.846	2$^+$			
		1699.6[f] *4*	60[f] *15*	1750.497	2$^+$			
3472.14	2$^+$	3472.07 *7*	100	0.0	0$^+$	[E2]	0.001033 *15*	α(K)=5.59×10^{-5} *8*; α(L)=6.01×10^{-6} *9*; α(M)=1.040×10^{-6} *15* α(O)=1.066×10^{-8} *15*; α(N+..)=0.000971 *14* B(E2)(W.u.)=0.29 *+4−8*
3483.44	6$^+$	173.7[e]	9.4[e]	3309.19	(4$^+$,5$^+$,6$^+$)	(M1)	0.0452	α(K)=0.0397 *6*; α(L)=0.00456 *7*; α(M)=0.000793 *12*; α(N)=0.0001124 *16*; α(O)=7.81×10^{-6} *11* α(N+..)=0.0001202 *17* B(M1)(W.u.)=0.014 *5* Mult.: this γ is designated as E1 (1987StZX,1988StZS) without giving experimental details for this assignment. If this γ is a dipole, it should be M1.
		363.58[e] *8*	100[e]	3119.87	5$^-$	E1[&]	0.00290 *4*	α(K)=0.00256 *4*; α(L)=0.000283 *4*; α(M)=4.89×10^{-5} *7*; α(N)=6.92×10^{-6} *10*; α(O)=4.77×10^{-7} *7* α(N+..)=7.39×10^{-6} *11* B(E1)(W.u.)=0.00023 *9*
		401.0[e]	1.17[e]	3082.36	4$^+$			
		626[e]	3.1[e]	2857.373	4$^+$			I_γ: from 1987St12 IIin ^{96}Y β^- decay (9.6 s); 626γ is not shown in 1987StZX.
3509.16	2$^+$	1283.1 *1*	33 *3*	2225.846	2$^+$			
		1612.1 *1*	100 *3*	1897.158	3$^-$			
		1759.0 *2*	17 *3*	1750.497	2$^+$			
3556.18	2$^+$	3556.11 *8*	100	0.0	0$^+$	[E2]	0.001064 *15*	α(K)=5.38×10^{-5} *8*; α(L)=5.78×10^{-6} *8*; α(M)=1.000×10^{-6} *14* α(O)=1.026×10^{-8} *15*; α(N+..)=0.001004 *14* B(E2)(W.u.)=0.24 *6*
3577.62		1138.87 *5*	100	2438.746	3$^+$			
3602.17	(1,2$^+$)	3602.1 *2*	100	0.0	0$^+$			
3620.73	(1,2$^+$)	3620.66 *7*	100	0.0	0$^+$			
3700.68	(1,2$^+$)	3700.6[f] *1*	100[f]	0.0	0$^+$			
3749.38	4$^+$	1852.2 *1*	100	1897.158	3$^-$			

$^{96}_{40}Zr_{56}$-10

Adopted Levels, Gammas (continued)

γ(^{96}Zr) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ	E_f	J_f^π	Mult.	δ	α	Comments
3772.2	6$^+$	289.0[e]	1.49[e]	3483.44	6$^+$	(M1(+E2))	−0.4 *5*	0.014 *4*	α(K)=0.012 *4*; α(L)=0.0014 *5*; α(M)=0.00024 *8*; α(N)=3.5×10^{-5} *11*; α(O)=2.3×10^{-6} *6* α(N+..)=3.7×10^{-5} *12* Mult.: from γ(θ) and ΔJ$^\pi$. δ: from γ(θ) in ^{96}y β$^-$ decay (9.6 s).
		462.7[e]	0.75[e]	3309.19	(4$^+$,5$^+$,6$^+$)				
		652.1[e]	2.5[e]	3119.87	5$^-$	(E1)		0.000698 *10*	α(K)=0.000617 *9*; α(L)=6.75×10^{-5} *10*; α(M)=1.169×10^{-5} *17* α(O)=1.165×10^{-7} *17*; α(N+..)=1.775×10^{-6} *25* Mult.: stretched D from γγ(θ) in β$^-$ decay and ΔJ$^\pi$.
		690.0[e]	1.94[e]	3082.36	4$^+$				
		914.8[e]	100[e]	2857.373	4$^+$	(E2)		0.000827 *12*	α(K)=0.000729 *11*; α(L)=8.14×10^{-5} *12*; α(M)=1.412×10^{-5} *20* α(O)=1.388×10^{-7} *20*; α(N+..)=2.14×10^{-6} *3* Mult.: stretched Q from γγ(θ) in β-decay and ΔJ$^\pi$.
3857.48	2$^+$	3857.4 *2*	100	0.0	0$^+$	[E2]		0.001166 *17*	α(K)=4.73×10^{-5} *7*; α(L)=5.08×10^{-6} *8*; α(M)=8.78×10^{-7} *13*; α(N)=1.252×10^{-7} *18* α(O)=9.02×10^{-9} *13*; α(N+..)=0.001113 *16* B(E2)(W.u.)=0.46 *+12−18*
3865.16		1426.4 *1*	100	2438.746	3$^+$				
3924.6		804.7[e]	100[e]	3119.87	5$^-$				
3947.19	(1,2$^+$)	3947.1 *1*	100	0.0	0$^+$				
4014.07	5$^-$	894.2 *2*	100	3119.87	5$^-$				
4024.5?		2274.0[i] *8*	100	1750.497	2$^+$				
4037.89	(1,2$^+$)	4037.8 *2*	100	0.0	0$^+$				
4126.3	(4$^+$)	1006.4[e]	100[e]	3119.87	5$^-$				
4132.4	(1,2$^+$)	4132.3 *3*	100	0.0	0$^+$				
4234.7	7$^-$	751.5[e]	40[e]	3483.44	6$^+$				
		1114.6[e]	100[e]	3119.87	5$^-$				
4258.0	3$^-$	1332.4[f] *4*	100[f]	2925.55	0$^+$				
4261.3	(5$^+$,6$^+$)	489.0	85	3772.2	6$^+$				
		778.0	100	3483.44	6$^+$				
		1179.0	23	3082.36	4$^+$				
4389.5	8$^+$	154.7[e]	0.8[e]	4234.7	7$^-$	[E1]		0.0317	α(K)=0.0280 *4*; α(L)=0.00313 *5*; α(M)=0.000540 *8*; α(N)=7.57×10^{-5} *11*; α(O)=4.99×10^{-6} *7* α(N+..)=8.07×10^{-5} *12* B(E1)(W.u.)=4.0×10^{-6} *4*
		617.2[e]	100[e]	3772.2	6$^+$	E2		0.00228 *4*	α(K)=0.00201 *3*; α(L)=0.000230 *4*; α(M)=3.99×10^{-5} *6*;

$^{96}_{40}Zr_{56}$-11

Adopted Levels, Gammas (continued)

γ(^{96}Zr) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ	E_f	J_f^π	Mult.	α	Comments
								α(N)=5.61×10^{-6} *8*; α(O)=3.78×10^{-7} *6* α(N+..)=5.99×10^{-6} *9* B(E2)(W.u.)=1.38 *11* Mult.: stretched Q from γγ(θ) in β$^-$ decay; E2 from RUL.
4389.5	8$^+$	906.2[e]	36.8[e]	3483.44	6$^+$	E2	0.000846 *12*	α(K)=0.000746 *11*; α(L)=8.33×10^{-5} *12*; α(M)=1.445×10^{-5} *21* α(O)=1.419×10^{-7} *20*; α(N+..)=2.19×10^{-6} *3* B(E2)(W.u.)=0.075 *6* Mult.: stretched Q from γγ(θ) in β$^-$ decay; E2 from RUL.
4512.5	(1,2$^+$)	4512.4 *7*	100	0.0	0$^+$			
4570.1	(5$^-$,6$^+$)	335.4[e]	60[e]	4234.7	7$^-$			
		1712.7[i]	100	2857.373	4$^+$			
4689.7		455.0	100	4234.7	7$^-$			
4737.5	(1,2$^+$)	4737.4 *8*	100	0.0	0$^+$			
4751.5	(7,8$^+$)	979.2	100	3772.2	6$^+$			
4757.2		522.6	100	4234.7	7$^-$			
4837.75	(1$^-$,2$^+$)	1625.8[f] *4*	99[f] *30*	3211.84	2$^+$			
		1912.1[f] *4*	35[f] *8*	2925.55	0$^+$			
		2940.0[f] *4*	59[f] *15*	1897.158	3$^-$			
		3086.9[f] *7*	45[f] *7*	1750.497	2$^+$			
		3257.4[f] *7*	36[f] *8*	1581.64	0$^+$			
		4839.2[f] *8*	100[f] *19*	0.0	0$^+$			
4845.4		719.1[e]	100[e]	4126.3	(4$^+$)			
4881.9?		1956.3[i] *10*	100	2925.55	0$^+$			
4895.2	(1,2$^+$)	4895.1[f] *7*	100[f]	0.0	0$^+$			
4906.9	(10$^+$)	517.4	100	4389.5	8$^+$			
4914.1?	(1,2$^+$)	4914.0[i] *10*	100	0.0	0$^+$			
4929.1	(1,2$^+$)	4929.0[f] *9*	100[f]	0.0	0$^+$			
5066.2	(7$^+$,8$^+$)	314.7	38.9	4751.5	(7,8$^+$)			
		676.7	22.2	4389.5	8$^+$			
		804.9	77.8	4261.3	(5$^+$,6$^+$)			
		1582.9	100	3483.44	6$^+$			
5117.8		728.3	100	4389.5	8$^+$			
5196.9?		3615.2[i] *10*	100	1581.64	0$^+$			
5228.5	(1,2$^+$)	5228.3 *6*	100	0.0	0$^+$			
5235.3	(7,8$^+$)	845.8	100	4389.5	8$^+$			
		1463.0	71	3772.2	6$^+$			
5272.0	(1,2$^+$)	5271.8 *6*	100	0.0	0$^+$			
5312.5		3730.8 *7*	100	1581.64	0$^+$			

$^{96}_{40}Zr_{56}$-12

Adopted Levels, Gammas (continued)

γ(^{96}Zr) (continued)

E_i(level)	J_i^π	E_γ †	I_γ	E_f	J_f^π
5408.3		3826.6 *7*	100	1581.64	0^+
5443.1	$(1,2^+)$	3861.7[f] *6*	100[f] *11*	1581.64	0^+
		5442.5[f] *7*	36[f] *5*	0.0	0^+
5483.8	(10^+)	1094.3	100	4389.5	8^+
5502.2?	$(1,2^+)$	5502.0[i] *8*	100	0.0	0^+
5507.6	$(7^+,8^+)$	441.4	27	5066.2	$(7^+,8^+)$
		600.7	33	4906.9	(10^+)
		750.5	33	4757.2	
		756.1	73	4751.5	$(7,8^+)$
		1118.1	100	4389.5	8^+
		1246.3	60	4261.3	$(5^+,6^+)$
		1735.3	80	3772.2	6^+
5538.9	$(1,2^+)$	5538.7 *6*	100	0.0	0^+
5551.6	$(1,2^+)$	5551.4 *6*	100	0.0	0^+
5573.9	$(1,2^+)$	3992.2 *8*	73	1581.64	0^+
		5573.7 *8*	100	0.0	0^+
5601.5	$(1,2^+)$	5601.3 *6*	100	0.0	0^+
5625.9		4044.2 *10*	100	1581.64	0^+
5628.9		1239.4	100	4389.5	8^+
5652.9?		4071.2[i] *10*	100	1581.64	0^+
5701.3		4119.6 *6*	100	1581.64	0^+
5719.1	$(1,2^+)$	5718.9 *8*	100	0.0	0^+
5737.7	(11^+)	830.8	100	4906.9	(10^+)
5741.5?		4159.8[i] *10*	100	1581.64	0^+
5783.1	$(1,2^+)$	5782.9 *8*	100	0.0	0^+
5804.5	$(1,2^+)$	5804.3 *7*	100	0.0	0^+
5838.3	$(1,2^+)$	5838.1 *10*	100	0.0	0^+
5847.5	$(1,2^+)$	5847.3 *6*	100	0.0	0^+
5899.8		1510.3	100	4389.5	8^+
5914.7	$(1,2^+)$	4162.9 *10*	100 *19*	1750.497	2^+
		4334.2[i] *15*	19 *5*	1581.64	0^+
		5914.9 *8*	97 *17*	0.0	0^+
5934.6	$(1,2^+)$	5934.4 *6*	100	0.0	0^+
6143.6?	$(1,2^+)$	4562.7[i] *10*	$6.\times10^1$ *3*	1581.64	0^+
		6141.6 *14*	1.0×10^2 *3*	0.0	0^+
6231.6	$(1,2^+)$	6231.4 *11*	100	0.0	0^+
6245.7	(12^+)	508.0	100	5737.7	(11^+)
6460.5	(13^+)	214.8	100	6245.7	(12^+)
6821.3	(14^+)	360.8	100	6460.5	(13^+)

† From the following data sets: ^{96}Y β^- decay (5.43 s),(9.6 s), (n,n′γ), (p,p′γ).
‡ From difference in energies of initial and final levels.
# ce data and no γ observed (1988Ma01,1990Ma03,1986HeZP, 1988HeZM).
@ From γ(θ) in (n,n′γ).
& From ce data in (t,pγ).
[a] From γ(θ) in (n,n′γ) and RUL.
[b] From (n,n′γ); Iγ(329:475:644:2226)=16.1 *6*:58.4 *22*:21.9 *7*:100 *6* (β^- decay 5.34 s) 9.5:56:27:100 (β^- decay 9.6 s), and 7.6 *6*:44.4 *12*:22.8 *8*:100 *4* (p,p′γ).
[c] From (n,n′γ); Iγ(443:772:919)=−:20 *3*:100 *6* (β^- decay 5.34 s), -:23.0 *16*:100 *3* (p,p′γ).
[d] From (n,n′γ); Iγ(632:962:1107)=16:8:100 (β^- decay 9.6 s), 16:-:100 (t,pγ), 11.5 *22*:-:100 *4* (p,p′γ).
[e] From ^{96}Y β^- decay (9.6 s).
[f] From ^{96}Y β^- decay (5.34 s).
[g] From ^{96}Zr(n,n′γ).
[h] From ^{96}Zr(p,p′γ).
[i] Placement of transition in the level scheme is uncertain.

$^{96}_{40}Zr_{56}$-13

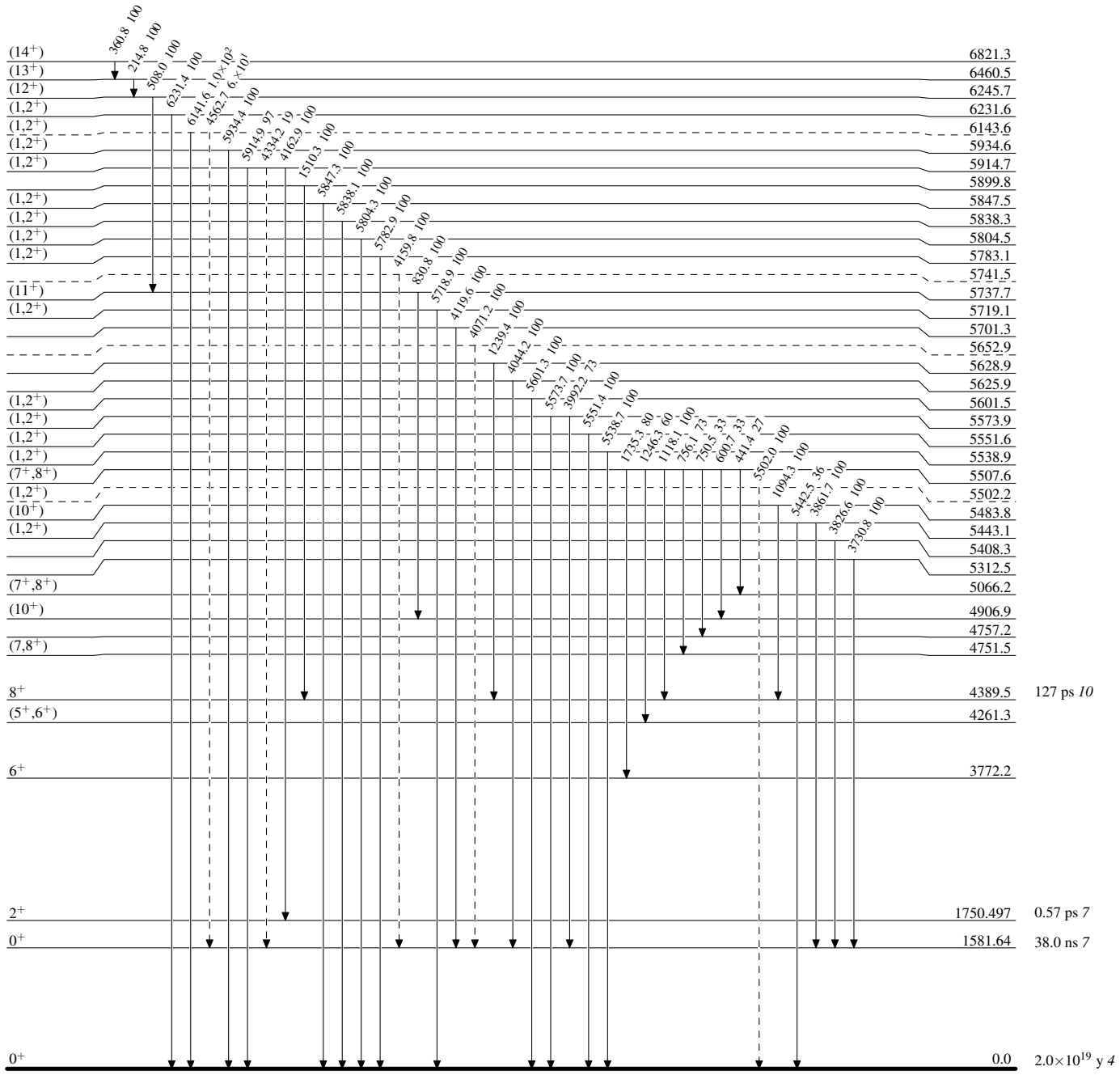
Adopted Levels, Gammas

Legend

Level Scheme

Intensities: Relative photon branching from each level

γ Decay (Uncertain)



$^{96}_{40}Zr_{56}$

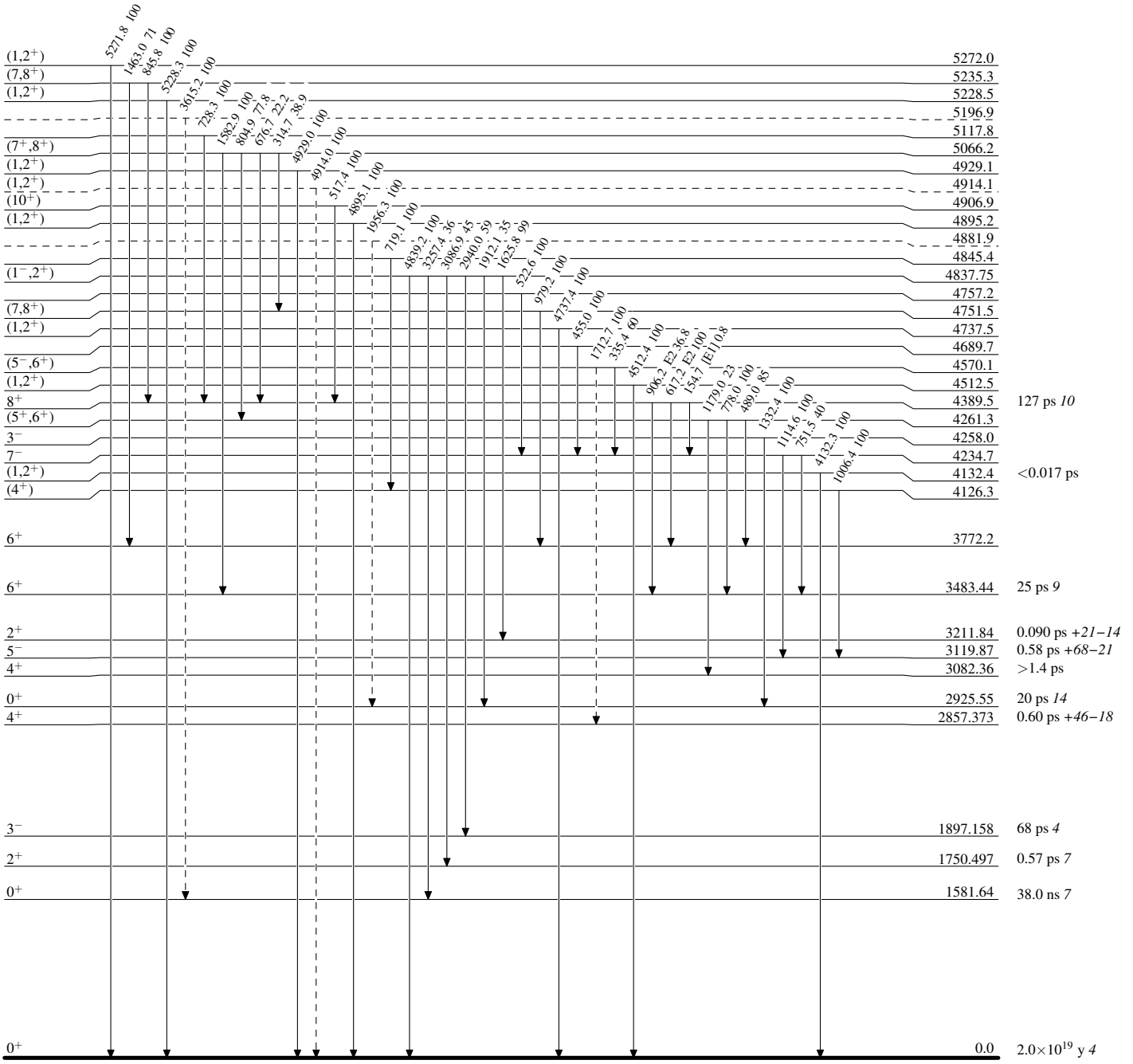
Adopted Levels, Gammas

Legend

Level Scheme (continued)

Intensities: Relative photon branching from each level

γ Decay (Uncertain)



$^{96}_{40}Zr_{56}$

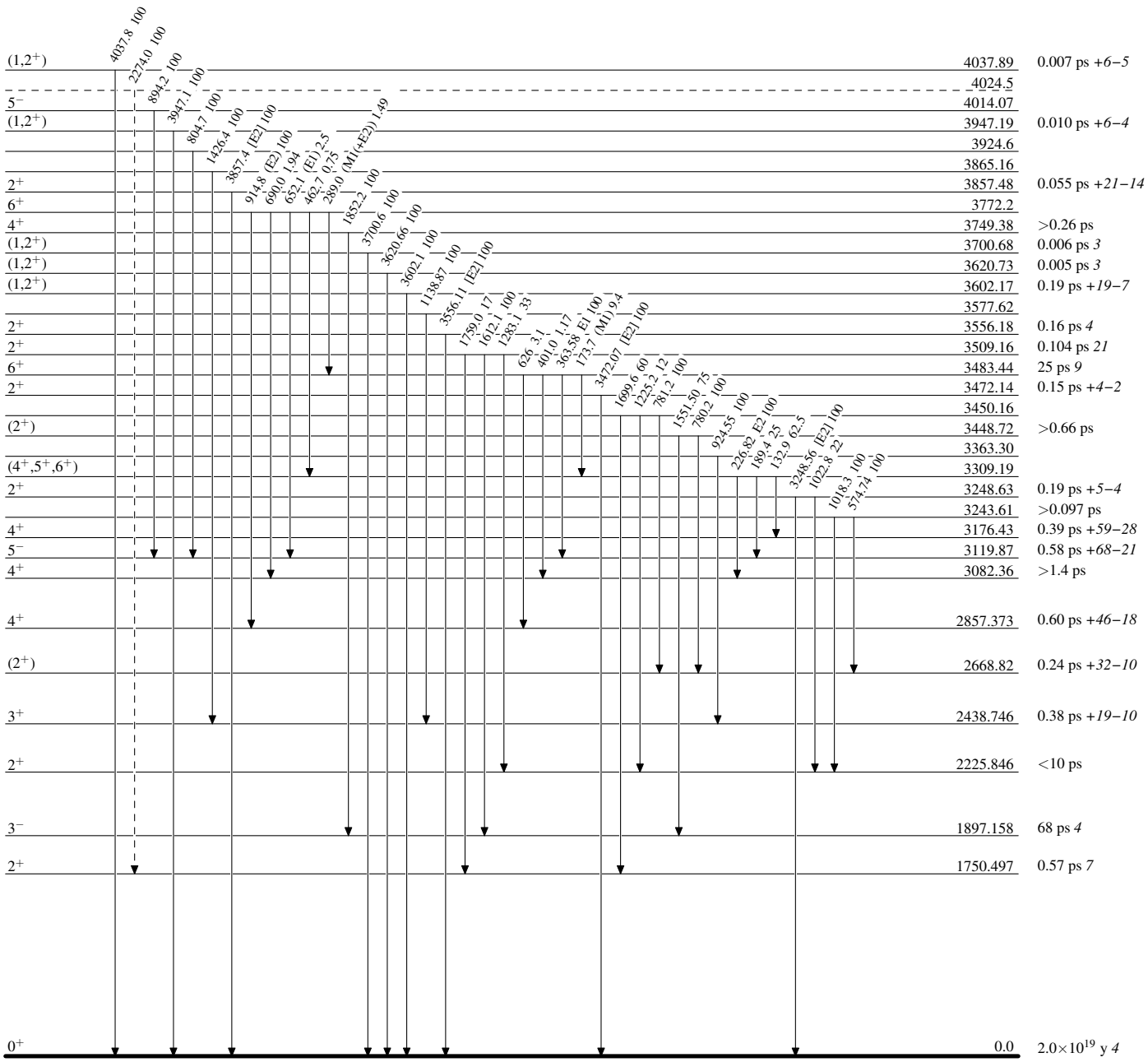
Adopted Levels, Gammas

Legend

Level Scheme (continued)

Intensities: Relative photon branching from each level

γ Decay (Uncertain)



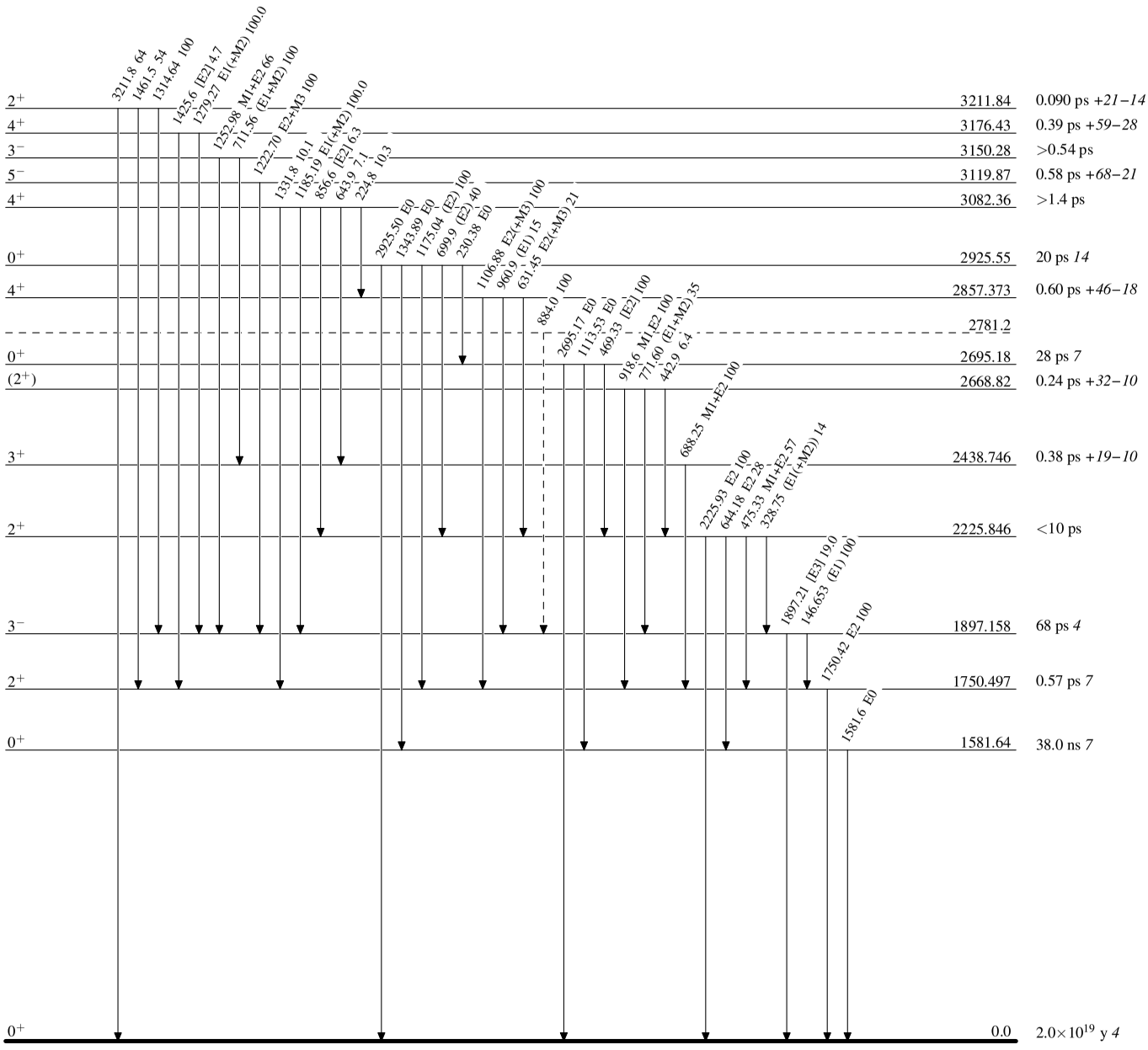
Adopted Levels, Gammas

Legend

Level Scheme (continued)

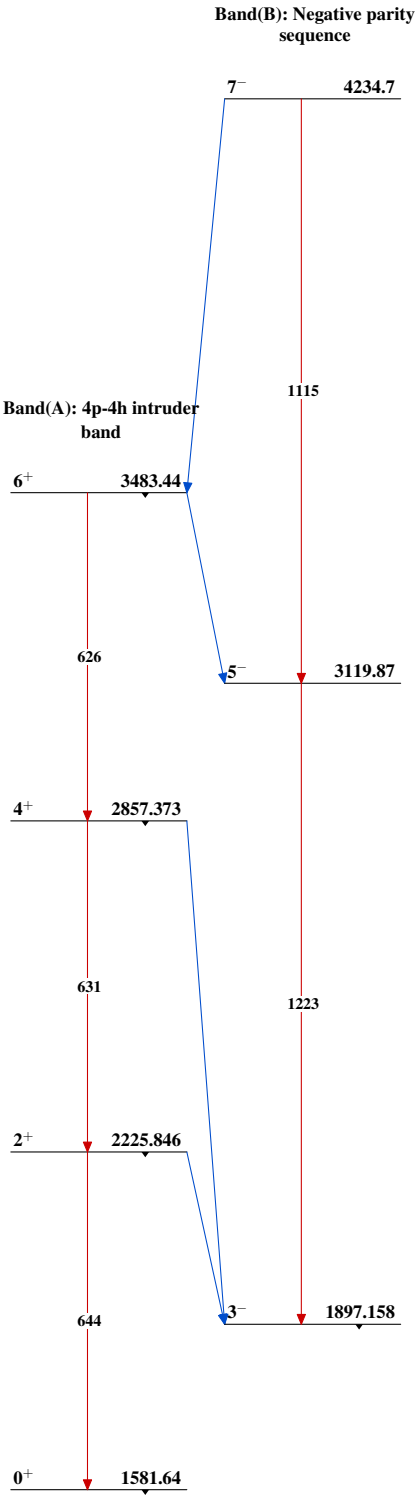
Intensities: Relative photon branching from each level

- - - - - - ► γ Decay (Uncertain)



$^{96}_{40}Zr_{56}$

Adopted Levels, Gammas



$^{96}_{40}Zr_{56}$