Adopted Levels, Gammas

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	E. A. Mccutchan and A. A. Sonzogni	NDS 115, 135 (2014)	1-Nov-2013

Q(β^-)=−7.45×10^3 *6*; S(n)=12353 *7*; S(p)=7899 *6*; Q(α)=−5404 *6* 2012Wa38
S(2n)=21802 *7*; S(2p)=13683 *6* (2012Wa38).
α: Additional information 1.

^{88}Zr Levels

Cross Reference (XREF) Flags

A	^{88}Nb ε decay (14.55 min)	E	^{74}Ge(^{18}O,4nγ)	I	^{90}Zr(p,t)
B	^{88}Nb ε decay (7.78 min)	F	^{86}Sr(α,2nγ)	J	^{92}Mo(d,^{6}Li)
C	^{88}Zr IT decay (1.320 μs)	G	^{89}Y(α,p4nγ)		
D	^{12}C(^{84}Sr,^{88}Zrγ)	H	^{89}Y(p,2nγ)		

E(level)†	J$^\pi$	T$_{1/2}$‡	XREF	Comments
0.0	0$^+$	83.4 d *3*	ABCDEFGHIJ	%ε=100 T$_{1/2}$: from 1973St29. Others: 82.6 d *2* (private communication quoted by 1984Pr01), 85 d (1953Hy52). δ<r^2>^{90,88}=0.061 fm^2 *5* (2013An02, 2003Th03).
1057.03 *4*	2$^+$	2.50 ps *28*	ABCDEFGHIJ	μ=+0.60 *22* J$^\pi$: E2 1057γ to 0$^+$, L(p,t)=2. T$_{1/2}$: from DSAM in ^{12}C(^{84}Sr,^{88}Zrγ). Other: 0.83 ps *+4−2* from DSAM in ^{89}Y(p,2nγ). μ: from transient field technique in ^{12}C(^{84}Sr,^{88}Zrγ).
1521.4 *7*	0$^+$		HIJ	J$^\pi$: L(p,t)=0.
1817.86 *6*	2$^+$	0.59 ps *5*	B D FGHIJ	J$^\pi$: L(d,^{6}Li)=2; L(p,t)=(2), $\gamma\gamma(\theta)$ in ^{89}Y(p,2nγ). T$_{1/2}$: from DSAM in ^{12}C(^{84}Sr,^{88}Zrγ). Other: 0.21 ps *9* from DSAM in ^{89}Y(p,2nγ).
2139.59 *5*	4$^+$	1.52 ps *14*	ABCDEFGHIJ	μ=+2.6 *7* J$^\pi$: L(p,t)=4. T$_{1/2}$: from DSAM in ^{12}C(^{84}Sr,^{88}Zrγ). μ: from transient field technique in ^{12}C(^{84}Sr,^{88}Zrγ).
2231.0@ *5*	0$^+$		HIJ	J$^\pi$: L(p,t)=0.
2455.88 *7*	3$^-$	1.94 ps *21*	B D FGHIJ	J$^\pi$: L(p,t)=3. T$_{1/2}$: from DSAM in ^{12}C(^{84}Sr,^{88}Zrγ).
2539.00 *6*	5$^-$		ABC EFGHI	J$^\pi$: L(p,t)=5.
2568.3 *3*	2$^+$		HIJ	J$^\pi$: L(p,t)=2.
2605.20 *14*	4$^+$		B F I	J$^\pi$: L(p,t)=4.
2673.7 *5*			B	
2801.13 *8*	5$^-$		AB EFGHIJ	J$^\pi$: L(p,t)=5.
2810.80 *6*	6$^+$		A C EFGHI	J$^\pi$: L(p,t)=6.
2887.79 *6*	8$^+$	1.320 μs *25*	A C EFGHI	%IT=100 Q=+0.51 *3*; μ=−1.811 *16* J$^\pi$: E2 77γ to 6$^+$, L(p,t)=(8,6). T$_{1/2}$: from γ(t) (1978Ha52). Others: 1.41 μs *+12−9* (2004Ch35) using γ(t); 1.28 μs *10*, 1.75 μs *20* from γ(t) in ^{89}Y(p,2nγ). μ: from g=−0.2264 *20* measured by γ(H,θ,t) in heavy-ion reactions (1978Ha52). Other: g=−0.20 *2* from ^{89}Y(p,2nγ). Q: from time-differential perturbed γ-ray angular distribution of ions implanted in non-cubic crystals (1985Ra09). Sign determined by 1986Be06.
2888 *3*	(2$^+$)		I	J$^\pi$: L(p,t)=(2).
2928 *3*	3$^-$		I	J$^\pi$: L(p,t)=3.

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

^{88}Zr Levels (continued)

E(level)[†]	Jπ	$T_{1/2}$[‡]	XREF	Comments
2989.67 *7*	5^-		B HI	Jπ: L(p,t)=5.
2998.4 *3*			B	
3027 *3*	2^+		I	Jπ: L(p,t)=2.
3032.77 *8*	3^-		B I	Jπ: L(p,t)=3.
3074.9[@] *3*	(4^+)		HI	Jπ: L(p,t)=(4).
3093.6[@] *3*	5^-		HI	Jπ: L(p,t)=5.
3213.70 *11*	(6^+)		A	Jπ: log *ft*=7.5 from (8^+), 1074γ to 4^+.
3223.8 *4*			B	
3277.01 *8*	$(3^-,4,5^-)$		B	Jπ: 287γ to 5^-, 821γ to 3^-.
3.30×10^3			I	
3374.37 *9*	$(3^-,4,5^-)$		B	Jπ: 573γ to 5^-, 918.5γ to 3^-.
3390.70 *6*	8^+	21 ps *1*	A EFGH	Jπ: from γ(θ) and linear polarization in ^{74}Ge(^{18}O,4nγ).
3426.47 *17*			B	
3.43×10^3	(0^+)		I	Jπ: L(p,t)=(0).
3483.63 *13*	(7^-)		A EFG	Jπ: 7,9,11 from γ(θ) and linear polarization of populating 1003γ in ^{74}Ge(^{18}O,4nγ), 944.5γ to 5^-.
3568.18 *15*	$(3,4^+)$		B	Jπ: log *ft*=6.8 from (4^-), 2511γ to 2^+.
3617.44 *24*	(7^-)		A FG	Jπ: J=7 from γ(θ) in ^{89}Y(α,p4nγ), 817γ to 5^-.
3637.76 *15*	$(3,4^+)$		B	Jπ: log *ft*=6.7 from (4^-), 2581γ to 2^+.
3875.04 *14*	$(3^-,4,5^-)$		B	Jπ: 1336γ to 5^-, 1419γ to 3^-.
3938.28 *14*	(3,4,5)		B	Jπ: log φt=6.3 from (4^-).
3947.58 *13*	(3,4,5)		B	Jπ: log *ft*=6.2 from (4^-).
3968.2 *3*	$(3^-,4,5)$		B	Jπ: log *ft*=6.8 from (4^-), 1429γ to 5^-.
3.99×10^3?			I	Possibly identical to one of the neighboring levels.
4024.9 *3*	$(3^-,4,5)$		B	Jπ: log *ft*=6.9 from (4^-), 1224γ to 5^-.
4059.22 *14*	$(3^-,4,5^-)$		B	Jπ: 1520γ to 5^-, 1604γ to 3^-.
4084.22 *13*	$(3^-,4,5)$		B	Jπ: log *ft*=6.1 from (4^-), 1095γ to 5^-.
4112.38 *13*	(3,4,5)		B	Jπ: log *ft*=6.5 from (4^-).
4155.5 *4*	(3,4,5)		B	Jπ: log *ft*=7.1 from (4^-).
4.17×10^3?			I	Possibly identical to one of the neighboring levels.
4206.1 *3*	$(3,4,5^-)$		B	Jπ: log *ft*=6.6 from (4^-), 1750γ to 3^-.
4208.17 *10*	$(3^-,4,5^-)$		B	Jπ: 1407γ to 5^-, 1752γ to 3^-.
4237.0 *4*	$(7,8^+)$		A	Jπ: log *ft*=7.1 from (8^+), 1426γ to 6^+.
4307.9 *3*	$(3^-,4,5^-)$		B	Jπ: 1319γ to 5^-, 1852γ to 3^-.
4335.6 *4*	$(3,4^+)$		B	Jπ: log *ft*=7.0 from (4^-), 3278.5γ to 2^+.
4348.3 *3*			A	
4.37×10^3?			I	Possibly identical to one of the neighboring levels.
4388.34 *25*	$(7,8^+)$		A	Jπ: log *ft*=6.9 from (8^+), 1175γ to (6^+).
4413.07 *11*	10^+	<1.4 ps	EF	Jπ: E2 1022γ to 8^+, γ(θ) and linear polarization in ^{74}Ge(^{18}O,4nγ).
4461.88 *22*	$(7,8^+)$		A	Jπ: log *ft*=6.4 from (8^+), 1652γ to 6^+.
4486.31 *12*	(9^-)		EFG	Jπ: (E2) 1003γ to (7^-), (E1) 1096γ to 8^+.
4612.29 *11*	9^+	<0.17 ns	A EFG	Jπ: $7^+,9^+$ from γ(θ) and linear polarization in ^{74}Ge(^{18}O,4nγ). Probable 199γ to 10^+.
4672.7 *3*	$(3^-,4,5)$		B	Jπ: log *ft*=6.8 from (4^-), 1871.5γ to 5^-.
4713.08 *11*	10^-[#]	2.25 ns *17*	EFG	
4797.63 *11*	11^-[#]	50 ps *4*	EFG	
4934.5 *3*	$(7,8^+)$		A	Jπ: log *ft*=6.2 from (8^+), 1721γ to (6^+).
5087.9 *3*	$(7,8^+)$		A	Jπ: log *ft*=6.5 from (8^+), 2277γ to 6^+.
5166.2? *4*	$(10,11,12)^+$[#]	0.66 ps *14*	EF	
5229.47 *13*	12^+	10 ps *1*	EFG	Jπ: E2 816γ to 10^+.
5583.85 *12*	12^-[#]	<0.7 ps	EFG	
5665.91 *15*	12^+[#]	0.28 ps *10*	EFG	

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

^{88}Zr Levels (continued)

E(level)[†]	J$^{\pi}$	T$_{1/2}$[‡]	XREF	Comments
5787.2 *5*	(7,8,9)		A	J$^{\pi}$: log *ft*=6.2 from (8^{+}).
5950.75 *16*	(13)$^{+}$	<0.10 ps	EFG	J$^{\pi}$: (11,13)$^{+}$ from $\gamma(\theta)$ and transition strength in ^{74}Ge(^{18}O,4nγ). High spin favored in heavy ion fusion reactions.
6000.8? *3*	(13)$^{-}$[#]	<0.7 ps	E	
6032.52? *13*	(12^{-})[#]		E	
6192.94 *12*	13^{-}	1.70 ps *14*	E	J$^{\pi}$: E2 1395γ to 11^{-}.
6238.79 *16*	(14)$^{+}$[#]	1.0 ps *3*	E	
6501.32 *24*	(14)$^{+}$[#]	0.16 ps *3*	E	
6578.2 *5*			E	
6765.33 *23*	(14)$^{-}$[#]	≤0.49 ps	E	
6826.66 *23*	(15)$^{+}$[#]	0.10 ps *2*	E	
7228.2 *3*	(15)$^{-}$[#]	≤0.8 ps	E	
7431.9 *4*		0.10 ps *3*	E	
7536.5 *4*	(15^{-})[#]	≤0.33 ps	E	
7878.9 *4*	(16^{-})[#]	≤0.50 ps	E	
8200.2 *5*	(17^{-})[#]	0.3 ps *+4−1*	E	
8925.2 *5*	(18^{-})[#]	<0.3 ps	E	
9912.6? *5*	(19^{-})[#]	>0.7 ps	E	
10557.3? *9*	(20)[#]	≤0.1 ps	E	
11199.7? *11*	(21)[#]	0.22 ps *14*	E	

[†] Level energies with ΔE≤1 keV are from a least-squares fit to the Adopted Gammas, except where noted. Those with ΔE>1 keV are from (p,t).
[‡] From Doppler-shift attenuation and Recoil-distance Doppler-shift in ^{74}Ge(^{18}O,4nγ), except where noted.
[#] From $\gamma(\theta)$, linear polarization and γ decay pattern in ^{74}Ge(^{18}O,4nγ).
[@] From ^{89}Y(p,2nγ). 2009Br05 quote precise level energies but do not provide the γ-ray energies of the depopulating transitions.

Adopted Levels, Gammas (continued)

γ(^{88}Zr)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[‡]	δ[‡]	α	$I_{(\gamma+ce)}$[#]	Comments
1057.03	2+	1057.01 *4*	100	0.0	0+	E2		5.91×10^{-4}		α(K)=0.000522 *8*; α(L)=5.79×10^{-5} *9*; α(M)=1.003×10^{-5} *14*; α(N)=1.422×10^{-6} *20*; α(O)=9.95×10^{-8} *14* B(E2)(W.u.)=7.4 *9*
1521.4	0+	464.5		1057.03	2+	[E2]		0.00524	100	ce(K)/(γ+ce)=0.00457 *7*; ce(L)/(γ+ce)=0.000536 *8*; ce(M)/(γ+ce)=9.31×10^{-5} *13*; ce(N)/(γ+ce)=1.304×10^{-5} *19* ce(O)/(γ+ce)=8.51×10^{-7} *12* α(K)=0.00459 *7*; α(L)=0.000539 *8*; α(M)=9.36×10^{-5} *14*; α(N)=1.311×10^{-5} *19*; α(O)=8.56×10^{-7} *12*
		1521.2		0.0	0+	(E0)			0.05 *1*	Mult.: from ce. No corresponding γ observed. X(E0/E2)=0.0050 *11* (2005Ki02).
1817.86	2+	760.76 *9*	100.0 *27*	1057.03	2+	M1+E2	+0.26 *4*	1.23×10^{-3}		α(K)=0.001083 *16*; α(L)=0.0001195 *17*; α(M)=2.07×10^{-5} *3*; α(N)=2.95×10^{-6} *5*; α(O)=2.10×10^{-7} *3* B(E2)(W.u.)=6.5 *20*; B(M1)(W.u.)=0.051 *5* Mult.: D+Q from γγ(θ) in ^{89}Y(p,2nγ), Δπ=no from level scheme. δ: from γγ(θ) in ^{89}Y(p,2nγ). Other: −0.10 *13* from γ(θ) in ^{86}Sr(α,2nγ).
		1817.89 *9*	56.7 *12*	0.0	0+	[E2]		4.14×10^{-4}		α(K)=0.0001716 *24*; α(L)=1.87×10^{-5} *3*; α(M)=3.23×10^{-6} *5*; α(N)=4.60×10^{-7} *7*; α(O)=3.28×10^{-8} *5* B(E2)(W.u.)=0.75 *7* I_γ: from ^{88}Nb ε decay (7.78 min). Others: 21 *21* from ^{89}Y(α,p4nγ) and 72 from ^{89}Y(p,2nγ).
2139.59	4+	1082.53 *4*	100	1057.03	2+	E2		5.61×10^{-4}		α(K)=0.000495 *7*; α(L)=5.48×10^{-5} *8*; α(M)=9.50×10^{-6} *14*; α(N)=1.347×10^{-6} *19*; α(O)=9.44×10^{-8} *14* B(E2)(W.u.)=10.8 *10*
2455.88	3−	316.3 *2*	3.74 *15*	2139.59	4+	[E1]		0.00421		α(K)=0.00371 *6*; α(L)=0.000411 *6*; α(M)=7.10×10^{-5} *10*; α(N)=1.003×10^{-5} *15*; α(O)=6.87×10^{-7} *10* B(E1)(W.u.)=0.000184 *22*
		638.00 *9*	100 *3*	1817.86	2+	[E1]		7.33×10^{-4}		α(K)=0.000648 *9*; α(L)=7.10×10^{-5} *10*; α(M)=1.228×10^{-5} *18*; α(N)=1.742×10^{-6} *25* α(O)=1.223×10^{-7} *18* B(E1)(W.u.)=0.00060 *7*
		1399.40 *20*	9.5 *11*	1057.03	2+	[E1]		3.28×10^{-4}		α(K)=0.0001391 *20*; α(L)=1.502×10^{-5} *21*; α(M)=2.60×10^{-6} *4*; α(N)=3.70×10^{-7} *6*;

$^{88}_{40}Zr_{48}$-4

Adopted Levels, Gammas (continued)

γ(^{88}Zr) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[‡]	δ[‡]	α	Comments
									α(O)=2.64×10^{-8} *4* B(E1)(W.u.)=5.4×10^{-6} *9* I_γ: from ^{88}Nb ε decay (7.78 min). Other: 11.8 from ^{89}Y(p,2nγ).
2539.00	5$^-$	399.41 *3*	100	2139.59	4$^+$	E1		0.00227	α(K)=0.00201 *3*; α(L)=0.000221 *3*; α(M)=3.83×10^{-5} *6*; α(N)=5.41×10^{-6} *8*; α(O)=3.75×10^{-7} *6*
2568.3	2$^+$	1511.3 *3*	100	1057.03	2$^+$	M1+E2	−0.54 *22*	3.61×10^{-4} *6*	α(K)=0.000252 *4*; α(L)=2.74×10^{-5} *4*; α(M)=4.75×10^{-6} *7*; α(N)=6.76×10^{-7} *10*; α(O)=4.84×10^{-8} *8* Mult.: D+Q from γγ(θ) in ^{89}Y(p,2nγ), Δπ=no from level scheme. δ: from γγ(θ) in ^{89}Y(p,2nγ).
2605.20	4$^+$	465. *2*	100.0 *9*	2139.59	4$^+$				
		1548.2 *2*	68 *5*	1057.03	2$^+$	[E2]		3.67×10^{-4}	α(K)=0.000234 *4*; α(L)=2.55×10^{-5} *4*; α(M)=4.43×10^{-6} *7*; α(N)=6.29×10^{-7} *9*; α(O)=4.47×10^{-8} *7*
2673.7		134.6 *5*	100	2539.00	5$^-$				
2801.13	5$^-$	262.04 *13*	100 *3*	2539.00	5$^-$	M1(+E2)	+0.3 *6*	0.017 *7*	α(K)=0.015 *6*; α(L)=0.0017 *9*; α(M)=0.00030 *15*; α(N)=4.3×10^{-5} *20*; α(O)=2.9×10^{-6} *10* Mult.: D(+Q) from γ(θ) in ^{86}Sr(α,2nγ), Δπ=no from level scheme. δ: from γγ(θ) in ^{89}Y(p,2nγ).
		661.60 *10*	19.6 *10*	2139.59	4$^+$	[E1]		6.76×10^{-4}	α(K)=0.000598 *9*; α(L)=6.54×10^{-5} *10*; α(M)=1.132×10^{-5} *16*; α(N)=1.606×10^{-6} *23* α(O)=1.128×10^{-7} *16*
2810.80	6$^+$	271.81 *2*	49.9 *18*	2539.00	5$^-$	E1		0.00637	α(K)exp=0.0046 *12* α(K)=0.00562 *8*; α(L)=0.000623 *9*; α(M)=0.0001077 *15*; α(N)=1.518×10^{-5} *22* α(O)=1.034×10^{-6} *15* α(K)exp: from ^{88}Nb ε decay (14.55 min).
		671.20 *4*	100.0 *13*	2139.59	4$^+$	E2		0.00181	α(K)=0.001595 *23*; α(L)=0.000182 *3*; α(M)=3.15×10^{-5} *5*; α(N)=4.44×10^{-6} *7*; α(O)=3.02×10^{-7} *5*
2887.79	8$^+$	76.99 *1*	100	2810.80	6$^+$	E2		2.87	α(K)=2.29 *4*; α(L)=0.487 *7*; α(M)=0.0856 *12*; α(N)=0.01103 *16*; α(O)=0.000355 *5* B(E2)(W.u.)=1.75 *4* Mult.: from K/L/M measured in ^{88}Nb ε decay (14.55 min).
2989.67	5$^-$	189.1 *3*	1.20 *15*	2801.13	5$^-$				
		384.6 *3*	<1.3	2605.20	4$^+$				
		450.52 *16*	100.0 *30*	2539.00	5$^-$				
		533.82 *9*	46.3 *15*	2455.88	3$^-$	[E2]		0.00345	α(K)=0.00303 *5*; α(L)=0.000351 *5*; α(M)=6.10×10^{-5} *9*; α(N)=8.56×10^{-6} *12*; α(O)=5.68×10^{-7} *8*
		850.0 *1*	7.5 *3*	2139.59	4$^+$				
2998.4		542.9 *5*	100 *50*	2455.88	3$^-$				
		1180.4[b] *4*	370 *60*	1817.86	2$^+$				

$^{88}_{40}Zr_{48}$-5

Adopted Levels, Gammas (continued)

γ(^{88}Zr) (continued)

E_i(level)	J_i^π	E_γ †	I_γ †	E_f	J_f^π	Mult.‡	δ‡	α	Comments
3032.77	3⁻	576.7 *2*	18.5 *8*	2455.88	3⁻				
		892.8 *5*	9.9 *10*	2139.59	4⁺				
		1975.7 *1*	100 *3*	1057.03	2⁺				
3213.70	(6⁺)	402.9@	34 *11*	2810.80	6⁺				
		1074.1 *1*	100 *15*	2139.59	4⁺				
3223.8		684.8 *4*	100	2539.00	5⁻				
3277.01	(3⁻,4,5⁻)	244.2 *2*	12.1 *11*	3032.77	3⁻				
		287.3 *2*	25.3 *16*	2989.67	5⁻				
		476.0 *3*	15.3 *21*	2801.13	5⁻				
		671.9@	100 *16*	2605.20	4⁺				
		738.0[a] *1*	<59[a]	2539.00	5⁻				
		821.2 *1*	57.4 *26*	2455.88	3⁻				
3374.37	(3⁻,4,5⁻)	97.4@ *10*	2.5 *9*	3277.01	(3⁻,4,5⁻)				
		384.6[a] *3*	<4.9[a]	2989.67	5⁻				
		573.20[a] *10*	<52[a]	2801.13	5⁻				
		835.5[a] *5*	<3.3[a]	2539.00	5⁻				
		918.50 *10*	100 *6*	2455.88	3⁻				
3390.70	8⁺	177.0@	0.10 *10*	3213.70	(6⁺)				
		502.91 *3*	100.0 *10*	2887.79	8⁺	M1+E2	−0.15 *7*	0.00317	α(K)=0.00280 *5*; α(L)=0.000312 *6*; α(M)=5.41×10^{-5} *9*; α(N)=7.69×10^{-6} *13*; α(O)=5.44×10^{-7} *9* B(E2)(W.u.)=0.8 *8*; B(M1)(W.u.)=0.0080 *5* δ: Other: −0.06 *9* from γ(θ) in ^{86}Sr(α,2nγ).
3426.47		625.3 *2*	100 *4*	2801.13	5⁻				
		1286.9 *3*	43 *4*	2139.59	4⁺				
3483.63	(7⁻)	672.8@	70 *30*	2810.80	6⁺				
		944.51 *24*	100 *8*	2539.00	5⁻				
3568.18	(3,4⁺)	1112.30 *20*	85 *6*	2455.88	3⁻				
		2511.10 *20*	100 *6*	1057.03	2⁺				
3617.44	(7⁻)	806.6 *3*	86 *17*	2810.80	6⁺	(E1)		4.42×10^{-4}	α(K)=0.000391 *6*; α(L)=4.26×10^{-5} *6*; α(M)=7.38×10^{-6} *11*; α(N)=1.048×10^{-6} *15*; α(O)=7.40×10^{-8} *11* Mult.: D from γ(θ) in ^{89}Y(α,p4nγ), Δπ=yes from level scheme.
		816.7 *7*	100 *14*	2801.13	5⁻				
3637.76	(3,4⁺)	604.8 *2*	33 *4*	3032.77	3⁻				
		1497.8 *10*	12 *4*	2139.59	4⁺				
		2580.9 *2*	100 *4*	1057.03	2⁺				
3875.04	(3⁻,4,5⁻)	598.1 *3*	61 *4*	3277.01	(3⁻,4,5⁻)				
		885.0[b] *5*	16 *5*	2989.67	5⁻				
		1336.0 *2*	96 *8*	2539.00	5⁻				
		1419.2 *2*	100 *5*	2455.88	3⁻				

$^{88}_{40}Zr_{48}$-6

Adopted Levels, Gammas (continued)

γ(^{88}Zr) (continued)

E_i(level)	J_i^π	E_γ †	I_γ †	E_f	J_f^π
3938.28	(3,4,5)	564.1 *4*	7.1 *13*	3374.37	(3$^-$,4,5$^-$)
		1137.3[b] *10*	9 *4*	2801.13	5$^-$
		1399.4 *2*	100 *13*	2539.00	5$^-$
		1482.2[b] *2*	17.1 *17*	2455.88	3$^-$
3947.58	(3,4,5)	573.20[a] *10*	[a]	3374.37	(3$^-$,4,5$^-$)
		949.4[b] *5*		2998.4	
		1342.4[b] *20*		2605.20	4$^+$
3968.2	(3$^-$,4,5)	1167.0 *5*	39 *6*	2801.13	5$^-$
		1429.2 *3*	100 *11*	2539.00	5$^-$
4024.9	(3$^-$,4,5)	1223.8 *3*	100	2801.13	5$^-$
4059.22	(3$^-$,4,5$^-$)	1026.3 *2*	44 *4*	3032.77	3$^-$
		1069.7 *5*	58 *23*	2989.67	5$^-$
		1520.2 *2*	100 *5*	2539.00	5$^-$
		1603.6 *3*	41 *4*	2455.88	3$^-$
4084.22	(3$^-$,4,5)	657.6 *5*	43 *4*	3426.47	
		709.6 *3*	20.0 *29*	3374.37	(3$^-$,4,5$^-$)
		1094.6 *2*	100 *6*	2989.67	5$^-$
		1283.3 *3*	26 *4*	2801.13	5$^-$
		1479.0 *2*	95 *6*	2605.20	4$^+$
		1545.2[@]	36 *5*	2539.00	5$^-$
		1944.5 *10*	14 *5*	2139.59	4$^+$
4112.38	(3,4,5)	738.00[&] *10*		3374.37	(3$^-$,4,5$^-$)
		835.5[&] *5*		3277.01	(3$^-$,4,5$^-$)
4155.5	(3,4,5)	781.1 *4*	100	3374.37	(3$^-$,4,5$^-$)
4206.1	(3,4,5$^-$)	1173.5[b] *5*	32 *8*	3032.77	3$^-$
		1532.2[b] *10*	20 *8*	2673.7	
		1750.2 *3*	100 *9*	2455.88	3$^-$
4208.17	(3$^-$,4,5$^-$)	781.7[@b]		3426.47	
		931.2 *1*	73 *4*	3277.01	(3$^-$,4,5$^-$)
		1209.0[b] *10*	5 *3*	2998.4	
		1218.2 *4*	23 *4*	2989.67	5$^-$
		1406.8 *2*	72 *3*	2801.13	5$^-$
		1752.4 *2*	100 *5*	2455.88	3$^-$
4237.0	(7,8$^+$)	1349.1 *5*	100 *18*	2887.79	8$^+$
		1426.3 *6*	85 *27*	2810.80	6$^+$
4307.9	(3$^-$,4,5$^-$)	1318.6[b] *5*		2989.67	5$^-$
		1506.8[@]		2801.13	5$^-$
		1851.9[b] *3*		2455.88	3$^-$
4335.6	(3,4$^+$)	3278.5 *4*	100	1057.03	2$^+$
4348.3		957.6 *4*	100	3390.70	8$^+$

$^{88}_{40}Zr_{48}$-7

Adopted Levels, Gammas (continued)

γ(^{88}Zr) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[‡]	δ[‡]	α	Comments
4348.3		1134.6[@]		3213.70	(6$^+$)				
4388.34	(7,8$^+$)	997.6 *3*	93 *14*	3390.70	8$^+$				
		1174.7 *5*	100 *11*	3213.70	(6$^+$)				
4413.07	10$^+$	1022.3 *2*	100 *3*	3390.70	8$^+$	E2		6.38×10^{-4}	α(K)=0.000563 *8*; α(L)=6.25×10^{-5} *9*; α(M)=1.083×10^{-5} *16*; α(N)=1.536×10^{-6} *22* α(O)=1.073×10^{-7} *15* B(E2)(W.u.)>15
		1525.14[b] *20*	1.80 *25*	2887.79	8$^+$	(E2)		3.66×10^{-4}	α(K)=0.000241 *4*; α(L)=2.63×10^{-5} *4*; α(M)=4.56×10^{-6} *7*; α(N)=6.48×10^{-7} *9*; α(O)=4.60×10^{-8} *7* B(E2)(W.u.)>0.037
4461.88	(7,8$^+$)	1071.2[@]	87 *33*	3390.70	8$^+$				
		1247.8 *5*	44 *13*	3213.70	(6$^+$)				
		1573.9 *3*	100 *13*	2887.79	8$^+$				
		1651.6 *4*	91 *13*	2810.80	6$^+$				
4486.31	(9$^-$)	1002.67 *7*	100 *4*	3483.63	(7$^-$)	(E2)		6.67×10^{-4}	α(K)=0.000588 *9*; α(L)=6.54×10^{-5} *10*; α(M)=1.134×10^{-5} *16*; α(N)=1.607×10^{-6} *23* α(O)=1.121×10^{-7} *16*
		1095.61 *12*	67 *3*	3390.70	8$^+$	(E1)		2.43×10^{-4}	α(K)=0.000215 *3*; α(L)=2.33×10^{-5} *4*; α(M)=4.03×10^{-6} *6*; α(N)=5.73×10^{-7} *8*; α(O)=4.07×10^{-8} *6* I_γ: from ^{74}Ge(^{18}O,4nγ).
4612.29	9$^+$	199.19[b] *10*	1.9 *5*	4413.07	10$^+$	M1(+E2)	−0.2 *+3−9*	0.03 *3*	α(K)=0.03 *3*; α(L)=0.003 *4*; α(M)=0.0006 *7*; α(N)=8.E−5 *9*; α(O)=6.E−6 *5* B(M1)(W.u.)>0.00025
		1221.70 *14*	100 *3*	3390.70	8$^+$	(M1+E2)	−0.25 *7*	4.50×10^{-4}	α(K)=0.000390 *6*; α(L)=4.26×10^{-5} *6*; α(M)=7.38×10^{-6} *11*; α(N)=1.050×10^{-6} *15*; α(O)=7.52×10^{-8} *11* B(E2)(W.u.)>0.0014; B(M1)(W.u.)>6.1×10^{-5} δ: from γ(θ) ^{86}Sr(α,2nγ). Others: −0.7 *3* from ^{74}Ge(^{18}O,4nγ), −0.3 *2* from ^{89}Y(α,p4nγ).
		1724.49[b] *20*	4.1 *9*	2887.79	8$^+$	M1(+E2)	+0.05 *8*	3.73×10^{-4}	α(K)=0.000195 *3*; α(L)=2.12×10^{-5} *3*; α(M)=3.68×10^{-6} *6*; α(N)=5.24×10^{-7} *8*; α(O)=3.76×10^{-8} *6* B(M1)(W.u.)>9.7×10^{-7}
4672.7	(3$^-$,4,5)	1871.5 *3*	100	2801.13	5$^-$				
4713.08	10$^-$	100.79 *2*	100.0 *24*	4612.29	9$^+$	E1		0.1110	α(K)=0.0978 *14*; α(L)=0.01106 *16*; α(M)=0.00191 *3*; α(N)=0.000265 *4*; α(O)=1.682×10^{-5} *24* B(E1)(W.u.)=0.000102 *9* δ: δ(M2/E1)=−0.02 *4*.
		226.62 *28*	24.6 *23*	4486.31	(9$^-$)	(M1+E2)	−0.05 *3*	0.0226	α(K)=0.0199 *3*; α(L)=0.00227 *4*; α(M)=0.000395 *7*; α(N)=5.59×10^{-5} *9*; α(O)=3.90×10^{-6} *6* B(E2)(W.u.)=0.008 *+10−8*; B(M1)(W.u.)=0.000142 *18* δ: weighted average of −0.09 *5* from ^{74}Ge(^{18}O,4nγ) and −0.03 *3* from ^{89}Y(α,p4nγ).

$^{88}_{40}Zr_{48}$-8

Adopted Levels, Gammas (continued)

γ(^{88}Zr) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[‡]	δ[‡]	α	Comments
4713.08	10⁻	299.90 *13*	9.4 *8*	4413.07	10⁺	E1		0.00486	α(K)=0.00429 *6*; α(L)=0.000475 *7*; α(M)=8.21×10⁻⁵ *12*; α(N)=1.159×10⁻⁵ *17*; α(O)=7.92×10⁻⁷ *12* B(E1)(W.u.)=3.6×10⁻⁷ *5* δ: δ(M2/E1)=+0.2 *5*.
4797.63	11⁻	84.55 *2*	100.0 *23*	4713.08	10⁻	M1(+E2)	−0.02 *6*	0.325 *12*	α(K)=0.285 *9*; α(L)=0.0333 *19*; α(M)=0.0058 *4*; α(N)=0.00082 *5*; α(O)=5.62×10⁻⁵ *15* B(M1)(W.u.)=0.48 *5* Mult.: Other: (E1) proposed in ^{89}Y(α,p4nγ).
		384.56 *10*	18.1 *10*	4413.07	10⁺	E1		0.00251	α(K)=0.00221 *4*; α(L)=0.000244 *4*; α(M)=4.22×10⁻⁵ *6*; α(N)=5.97×10⁻⁶ *9*; α(O)=4.13×10⁻⁷ *6* B(E1)(W.u.)=1.44×10⁻⁵ *15* δ: δ(M2/E1)=−0.03 *4*.
4934.5	(7,8⁺)	546.1 *5*	29 *7*	4388.34	(7,8⁺)	(E2)		0.00323	α(K)=0.00284 *4*; α(L)=0.000328 *5*; α(M)=5.70×10⁻⁵ *9*; α(N)=8.00×10⁻⁶ *12*; α(O)=5.33×10⁻⁷ *8*
		586.1 *5*		4348.3					
		1543.8[@]	100 *12*	3390.70	8⁺				
		1720.8 *4*	84 *10*	3213.70	(6⁺)				
5087.9	(7,8⁺)	2277.1 *3*	100	2810.80	6⁺				
5166.2?	(10,11,12)	368.6[b] *4*	100	4797.63	11⁻				
5229.47	12⁺	816.40 *7*	100.0 *25*	4413.07	10⁺	E2		1.09×10⁻³	α(K)=0.000962 *14*; α(L)=0.0001081 *16*; α(M)=1.87×10⁻⁵ *3*; α(N)=2.65×10⁻⁶ *4*; α(O)=1.83×10⁻⁷ *3* B(E2)(W.u.)=6.7 *7*
5583.85	12⁻	786.11 *7*	100.0 *9*	4797.63	11⁻	M1(+E2)	0.00 *4*	1.14×10⁻³	α(K)=0.001003 *14*; α(L)=0.0001104 *16*; α(M)=1.92×10⁻⁵ *3*; α(N)=2.73×10⁻⁶ *4*; α(O)=1.94×10⁻⁷ *3* B(M1)(W.u.)>0.065 δ: Other: −0.3 *1* from γ(θ) in ^{89}Y(α,p4nγ).
5665.91	12⁺	436.49 *7*	100	5229.47	12⁺	M1(+E2)	<0.16	0.00443	α(K)=0.00391 *6*; α(L)=0.000437 *7*; α(M)=7.59×10⁻⁵ *12*; α(N)=1.078×10⁻⁵ *17*; α(O)=7.61×10⁻⁷ *12* B(E2)(W.u.)<1.9×10²; B(M1)(W.u.)>0.59
5787.2	(7,8,9)	2396.5 *5*	100	3390.70	8⁺				
5950.75	(13)⁺	285.19 *20*	3.8 *4*	5665.91	12⁺	M1(+E2)	<0.14	0.01267 *22*	α(K)=0.01116 *20*; α(L)=0.001264 *24*; α(M)=0.000220 *4*; α(N)=3.12×10⁻⁵ *6*; α(O)=2.18×10⁻⁶ *4* B(M1)(W.u.)>0.29
		366.5[b] *4*	18 *10*	5583.85	12⁻				

$^{88}_{40}Zr_{48}$-9

Adopted Levels, Gammas (continued)

γ(^{88}Zr) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[‡]	δ[‡]	α	Comments
5950.75	(13)$^+$	721.21 *14*	100.0 *29*	5229.47	12$^+$	(M1+E2)	−0.10 *6*	1.38×10^{-3}	α(K)=0.001216 *18*; α(L)=0.0001342 *19*; α(M)=2.33×10^{-5} *4*; α(N)=3.31×10^{-6} *5*; α(O)=2.36×10^{-7} *4* B(M1)(W.u.)>0.47 δ: weighted average of −0.07 *4* from ^{74}Ge(^{18}O,4nγ) and −0.20 *7* from ^{89}Y(α,p4nγ).
6000.8?	(13)$^-$	417.0[b] *3*	100	5583.85	12$^-$	M1(+E2)	−0.07 *12*	0.00493 *10*	α(K)=0.00435 *9*; α(L)=0.000487 *11*; α(M)=8.45×10^{-5} *19*; α(N)=1.20×10^{-5} *3*; α(O)=8.47×10^{-7} *16* B(M1)(W.u.)>0.42
6032.52?	(12$^-$)	1234.92[b] *15*	100	4797.63	11$^-$	M1(+E2)	<0.09	4.42×10^{-4}	α(K)=0.000382 *6*; α(L)=4.17×10^{-5} *6*; α(M)=7.22×10^{-6} *11*; α(N)=1.028×10^{-6} *15*; α(O)=7.37×10^{-8} *11*
6192.94	13$^-$	160.42 *3*	15.5 *15*	6032.52?	(12$^-$)	M1(+E2)	−0.08 *8*	0.057 *3*	α(K)=0.0499 *24*; α(L)=0.0058 *4*; α(M)=0.00100 *7*; α(N)=0.000142 *9*; α(O)=9.8×10^{-6} *4* B(E2)(W.u.)=8.E+1 *+16−8*; B(M1)(W.u.)=0.28 *4*
		608.90 *10*	54.5 *30*	5583.85	12$^-$	M1(+E2)	−0.05 *14*	0.00202	α(K)=0.00178 *3*; α(L)=0.000198 *3*; α(M)=3.43×10^{-5} *6*; α(N)=4.88×10^{-6} *8*; α(O)=3.46×10^{-7} *5* B(E2)(W.u.)=0.14 *+76−14*; B(M1)(W.u.)=0.0182 *20*
		1395.39 *7*	100 *5*	4797.63	11$^-$	E2		3.76×10^{-4}	α(K)=0.000288 *4*; α(L)=3.16×10^{-5} *5*; α(M)=5.47×10^{-6} *8*; α(N)=7.77×10^{-7} *11*; α(O)=5.50×10^{-8} *8* B(E2)(W.u.)=1.58 *17*
6238.79	(14)$^+$	288.05 *4*	100.0 *9*	5950.75	(13)$^+$	(M1+E2)	−0.10 *5*	0.01236 *24*	α(K)=0.01088 *21*; α(L)=0.001233 *25*; α(M)=0.000214 *5*; α(N)=3.04×10^{-5} *6*; α(O)=2.13×10^{-6} *4* B(E2)(W.u.)=1.0×10^2 *+11−10*; B(M1)(W.u.)=0.74 *23* δ: from γ(θ) in ^{89}Y(α,p4nγ). Other: <0.11 in ^{74}Ge(^{18}O,4nγ).
		1009.25 *15*	21.7 *11*	5229.47	12$^+$	(E2)		6.57×10^{-4}	α(K)=0.000580 *9*; α(L)=6.44×10^{-5} *9*; α(M)=1.116×10^{-5} *16*; α(N)=1.582×10^{-6} *23* α(O)=1.105×10^{-7} *16* B(E2)(W.u.)=4.1 *13*
6501.32	(14)$^+$	550.6 *3*	100	5950.75	(13)$^+$	M1(+E2)	0.00 *5*	0.00255	α(K)=0.00225 *4*; α(L)=0.000250 *4*; α(M)=4.33×10^{-5} *7*; α(N)=6.16×10^{-6} *9*; α(O)=4.37×10^{-7} *7* B(M1)(W.u.)=0.82 *16*
6578.2		627.5 *5*	100	5950.75	(13)$^+$				
6765.33	(14)$^-$	572.39 *20*	100	6192.94	13$^-$	(M1+E2)	−0.16 *7*	0.00234	α(K)=0.00207 *3*; α(L)=0.000229 *4*; α(M)=3.98×10^{-5} *7*; α(N)=5.66×10^{-6} *9*; α(O)=4.01×10^{-7} *6* B(E2)(W.u.)>3.0; B(M1)(W.u.)>0.23
6826.66	(15)$^+$	325.34 *10*	33.4 *14*	6501.32	(14)$^+$	M1(+E2)	<0.09	0.00906	α(K)=0.00798 *12*; α(L)=0.000899 *13*;

$^{88}_{40}Zr_{48}$-10

Adopted Levels, Gammas (continued)

γ(^{88}Zr) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[‡]	δ[‡]	α	Comments
									α(M)=0.0001562 *23*; α(N)=2.22×10^{-5} *4* α(O)=1.558×10^{-6} *23* B(E2)(W.u.)<1.6×10^{2}; B(M1)(W.u.)>1.3
6826.66	(15)$^+$	587.85 *20*	100 *6*	6238.79	(14)$^+$	M1(+E2)	<0.22	0.00220 *4*	α(K)=0.00194 *3*; α(L)=0.000215 *4*; α(M)=3.74×10^{-5} *6*; α(N)=5.31×10^{-6} *8*; α(O)=3.77×10^{-7} *6* B(E2)(W.u.)<1.5×10^{2}; B(M1)(W.u.)>0.61
7228.2	(15)$^-$	462.87 *20*	100	6765.33	(14)$^-$	M1(+E2)	+0.01 *5*	0.00383	α(K)=0.00338 *5*; α(L)=0.000377 *6*; α(M)=6.55×10^{-5} *10*; α(N)=9.30×10^{-6} *14*; α(O)=6.58×10^{-7} *10* B(M1)(W.u.)>0.28
7431.9		605.2 *3*	100	6826.66	(15)$^+$	D(+Q)	<0.21		
7536.5	(15$^-$)	771.1 *3*	100 *12*	6765.33	(14)$^-$	M1(+E2)	0.00 *12*	1.19×10^{-3}	α(K)=0.001047 *15*; α(L)=0.0001153 *17*; α(M)=2.00×10^{-5} *3*; α(N)=2.85×10^{-6} *4*; α(O)=2.03×10^{-7} *3* B(M1)(W.u.)>0.15
7878.9	(16$^-$)	342.2 *4*	100 *19*	7536.5	(15$^-$)	M1(+E2)	−0.05 *9*	0.00798 *16*	α(K)=0.00703 *14*; α(L)=0.000791 *17*; α(M)=0.000137 *3*; α(N)=1.95×10^{-5} *4*; α(O)=1.373×10^{-6} *25* B(M1)(W.u.)>0.58
		650.9 *4*	86 *19*	7228.2	(15)$^-$	M1(+E2)	−0.14 *+20−40*	0.00174 *6*	α(K)=0.00154 *5*; α(L)=0.000170 *7*; α(M)=2.95×10^{-5} *11*; α(N)=4.19×10^{-6} *15*; α(O)=2.98×10^{-7} *8* B(M1)(W.u.)>0.068
8200.2	(17$^-$)	321.30 *20*	100	7878.9	(16$^-$)	M1(+E2)	0.00 *3*	0.00931 *14*	α(K)=0.00820 *12*; α(L)=0.000924 *13*; α(M)=0.0001606 *23*; α(N)=2.28×10^{-5} *4* α(O)=1.603×10^{-6} *23* B(M1)(W.u.)=2.2 *+8−22*
8925.2	(18$^-$)	724.85 *20*	100	8200.2	(17$^-$)	M1(+E2)	−0.09 *14*	1.36×10^{-3} *2*	α(K)=0.001202 *18*; α(L)=0.0001326 *20*; α(M)=2.30×10^{-5} *4*; α(N)=3.27×10^{-6} *5*; α(O)=2.33×10^{-7} *4* B(M1)(W.u.)>0.19
9912.6?	(19$^-$)	987.35[b] *20*	93 *17*	8925.2	(18$^-$)	M1(+E2)	−0.11 *16*	6.91×10^{-4}	α(K)=0.000611 *9*; α(L)=6.70×10^{-5} *10*; α(M)=1.161×10^{-5} *17*; α(N)=1.653×10^{-6} *24* α(O)=1.181×10^{-7} *17* B(E2)(W.u.)>0.83; B(M1)(W.u.)>0.016
		1712.50[b] *20*	100 *7*	8200.2	(17$^-$)	E2		3.90×10^{-4}	α(K)=0.000192 *3*; α(L)=2.09×10^{-5} *3*; α(M)=3.63×10^{-6} *5*; α(N)=5.16×10^{-7} *8*; α(O)=3.67×10^{-8} *6* B(E2)(W.u.)<1.2
10557.3?	(20)	644.7[b] *7*	100	9912.6?	(19$^-$)	D(+Q)	<0.25		

$^{88}_{40}Zr_{48}$-11

Adopted Levels, Gammas (continued)

γ(^{88}Zr) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[‡]	δ[‡]	α	Comments
11199.7?	(21)	642.4[b] *7*	100	10557.3?	(20)	D(+Q)	−0.3 *+4−9*	0.00184 *6*	α(K)=0.00160 *11*; α(L)=0.00018 *1*

† Weighted averages of all decay and reaction data.
‡ From γ(θ) and linear polarization in ^{74}Ge(^{18}O,4nγ), except where noted.
# Total I(γ+ce) branching ratio from ^{89}Y(p,2nγ).
@ From level-energy difference.
& Multiply placed.
a Multiply placed with undivided intensity.
b Placement of transition in the level scheme is uncertain.

$^{88}_{40}Zr_{48}$-12

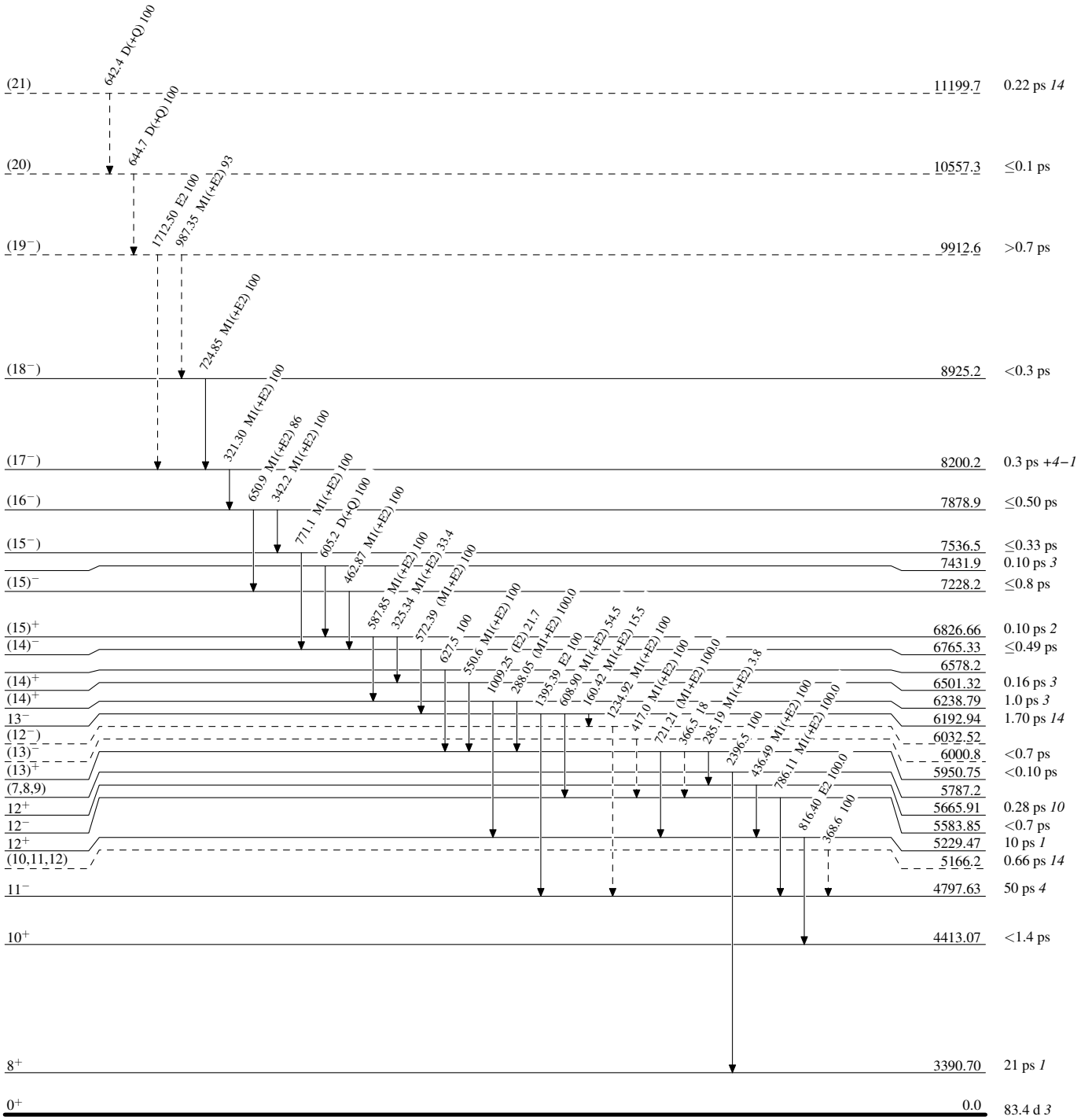
Adopted Levels, Gammas

Legend

Level Scheme

Intensities: Relative photon branching from each level

γ Decay (Uncertain)



$^{88}_{40}Zr_{48}$

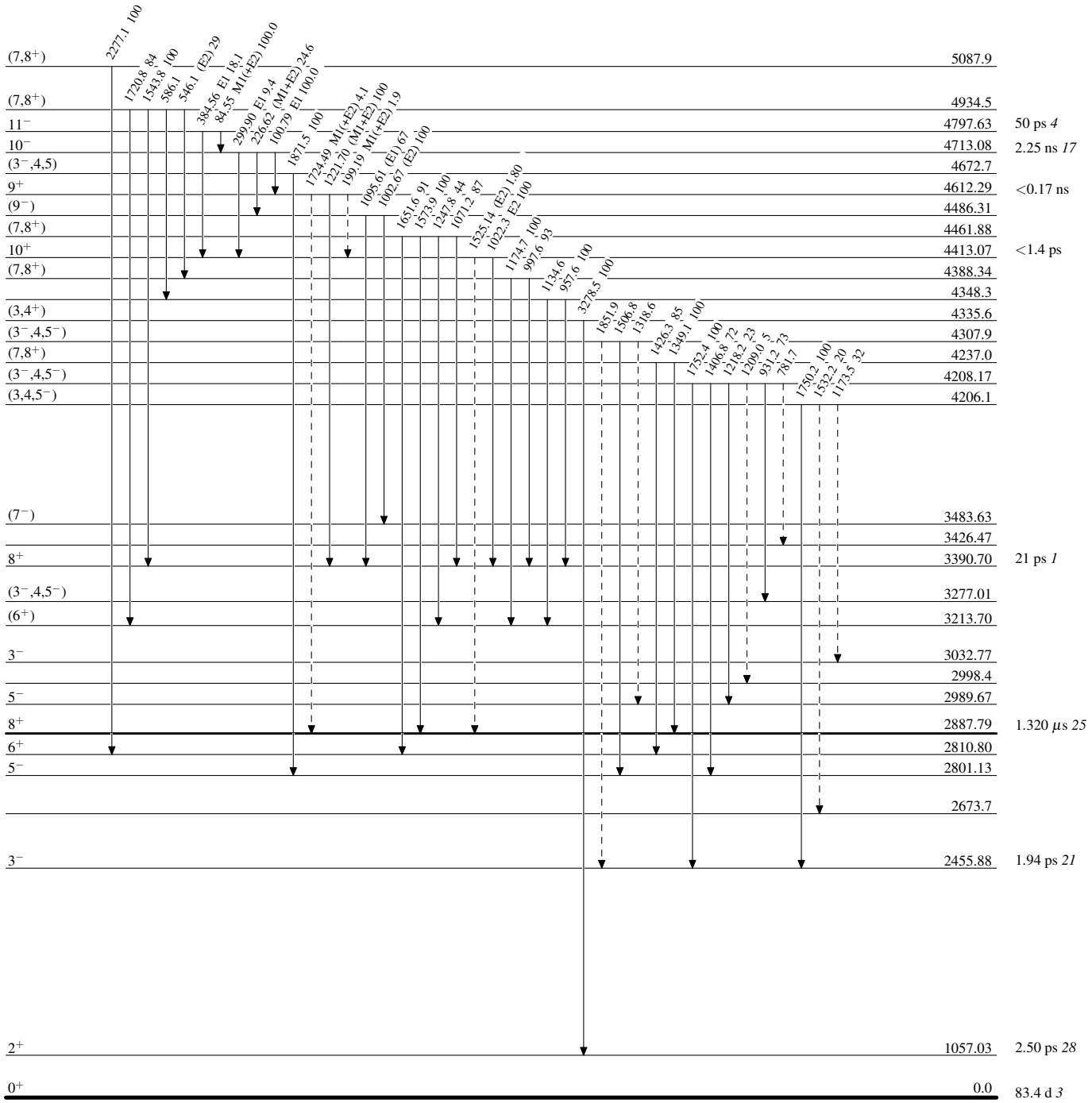
Adopted Levels, Gammas

Legend

Level Scheme (continued)

Intensities: Relative photon branching from each level

γ Decay (Uncertain)



$^{88}_{40}Zr_{48}$

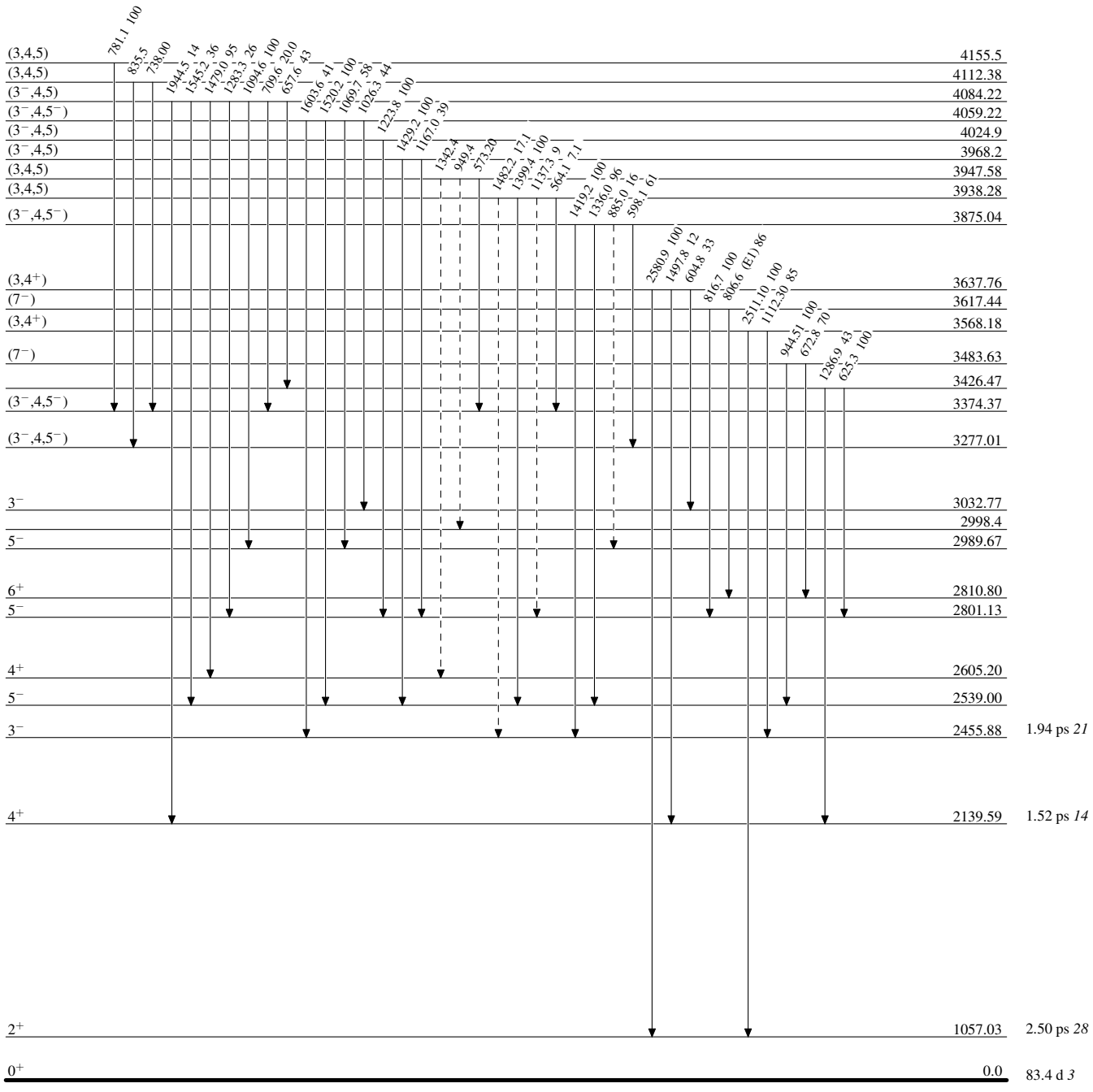
Adopted Levels, Gammas

Legend

Level Scheme (continued)

Intensities: Relative photon branching from each level

– – – – – – ► γ Decay (Uncertain)



$^{88}_{40}Zr_{48}$

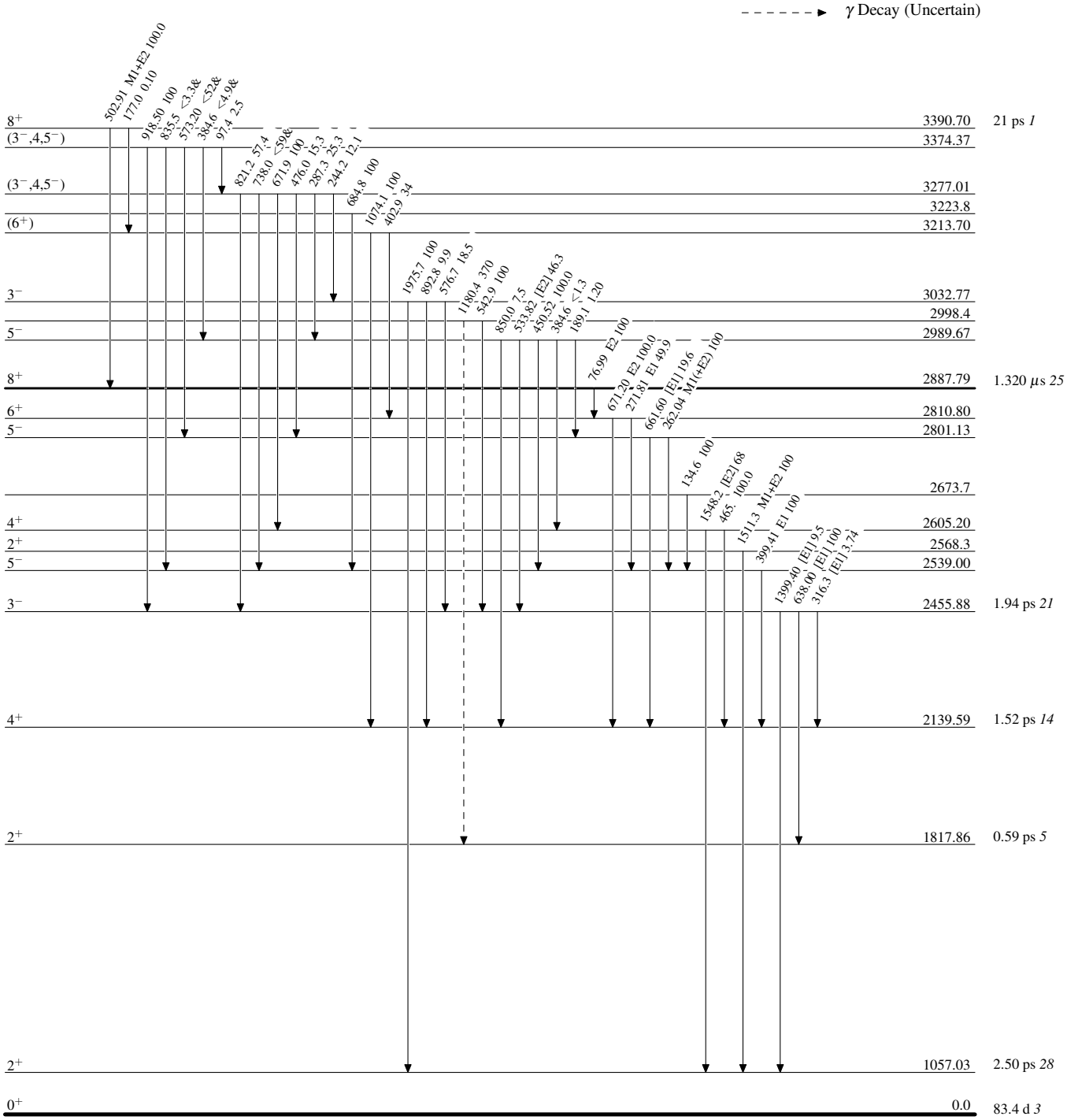
Adopted Levels, Gammas

Legend

Level Scheme (continued)

Intensities: Relative photon branching from each level
& Multiply placed: undivided intensity given

– – – – – – ► γ Decay (Uncertain)

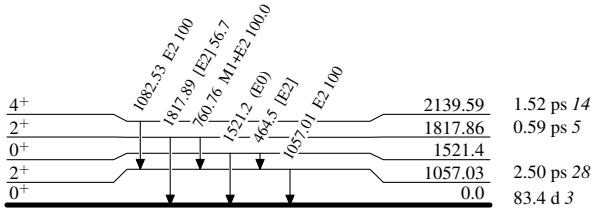


$^{88}_{40}Zr_{48}$

Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Relative photon branching from each level
& Multiply placed: undivided intensity given



$^{88}_{40}Zr_{48}$