Adopted Levels, Gammas

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh	NDS 114,1 (2013)	20-Oct-2012

Q(β^-)=−4251 *24*; S(n)=9319 *7*; S(p)=7867 *4*; Q(α)=−6198 *5* 2012Wa38
Note: Current evaluation has used the following Q record −4226 27 *9318*.5 *63* 7866.8 *40* −6198.346 2011AuZZ.
S(2n)=21671.4 *53*, S(2p)=14574.5 *37* (2011AuZZ).
Values in 2003Au03: Q(β^-)=−4218 *27*, S(n)=9317 *10*, S(p)=7859 *4*, Q(α)=−6191 *5*, S(2n)=21663 *9*, S(2p)=14566 *4*.
^{89}Zr isotope produced and identified in bombardment of Zr with fast neutrons by Sagne et al., Phys. Rev. 54, 542 (1938), also 1940Sa08; and in bombardment of Y by neutrons and protons by 1940Du05. Later studies of ^{89}Zr decay: 1951Hy24, 1951Sh24, 1953Ka11, 1953Sh48, 1960Ha26, 1961Ra06, 1964Va03, 1968Hi12, 1969Ro02, 1979Ba46, 1984Sk01, and several others.
Measured isotope shifts, charge radii, moments: 2003Th03 (also 2002Fo12, 2002Ca47, 2005Bi25).
Other reactions:
2002Jh01: ^{90}Zr(^{16}O,^{17}O) E=90 MeV, measured $\sigma(\theta)$ for g.s., deduced reaction mechanism, coupled-channel analysis.
2002Mo41: ^{90}Zr(^{40}Ca,^{41}Ca) E=150.7 MeV. Measured $\sigma(\theta)$, deduced reaction mechanism.
Additional information 1.
Structure calculations (selected): 2010Ro27, 1997He24, 1996Ru02, 1996Ja24, 1992Si15.
Magnetic moments: 1996Oh03.

^{89}Zr Levels

Cross Reference (XREF) Flags

A	^{89}Zr IT decay (4.161 min)	G	^{88}Sr(α,3nγ)	M	^{90}Zr(pol p,pn)
B	^{89}Nb ε decay (2.03 h)	H	^{89}Y(p,n)	N	^{90}Zr(^{3}He,α)
C	^{89}Nb ε decay (66 min)	I	^{89}Y(p,nγ)	O	^{91}Zr(p,t)
D	^{76}Ge(^{18}O,5nγ),^{74}Ge(^{18}O,3nγ)	J	^{89}Y(^{3}He,t)	P	^{87}Sr(^{3}He,n)
E	^{80}Se(^{13}C,4nγ)	K	^{90}Zr(p,d),(pol p,d)	Q	^{88}Sr(pol p,π^-)
F	^{86}Sr(α,nγ),^{87}Sr(α,2nγ)	L	^{90}Zr(d,t),(pol d,t)	R	^{92}Mo(n,α)

E(level)[†]	J$^\pi$[‡]	$T_{1/2}$[#]	XREF	Comments
0.0[@]	9/2$^+$	78.41 h *12*	ABCDEFGHIJKLMNOP R	%ε+%β^+=100 μ=−1.046 *6* (2003Th03,2011StZZ) Q=+0.275 *97* (2003Th03,2011StZZ) RMS charge radius: (<r^2>)$^{1/2}$=4.2715 fm *11* (2004An14 evaluation; and 2008 update available at http://cdfe.sinp.msu.ru). δ<r^2>(^{90}Zr,^{89}Zr)=+0.012 fm^2 *9* (2003Th03, statistical and systematic uncertainties of 0.005 and 0.008, respectively have been combined in quadrature by the evaluator). μ,Q: collinear laser spectroscopy (2003Th03, also 2002Ca47, 2002Fo12,2005Bi25). Others: μ=−1.072 *23* (1997Hi06) and −1.08 *2* (1996Oh03) using NMR on oriented nuclei and $\gamma(\theta$,t,h). J$^\pi$: L=4 and Ay(θ) in (pol p,d). $T_{1/2}$: weighted average (LWM and normalized-residuals method) of 78.62 h *17* (1984Sk01), 78.0 h *2* (1969Ro02) and 78.43 h *8* (1964Va03); normalized χ^2=2.9. Rajeval technique gives 78.45 h *7* with χ^2=1 but the uncertainty of value from 1969Ro02 is adjusted to 0.5. Others: 79.4 h *2* (1961Ra06,half-life incorrectly assigned to ^{90}Zr decay), 79.0 h *5* (1960Ha26), 79 h *2* (1953Sh48), 78 h (1953Ka11), 79.3 h (1951Sh24), 77 h (1951Hy24), 78 h *1* (1940Du05), 70 h (1940Sa08, Sagne et al., Phys. Rev 54, 542 (1938)). $\nu 1g_{9/2}^{-1}$ state.
587.82 *10*	1/2$^-$	4.161 min *10*	ABCD F HIJKLMNO	%ε+%β^+=6.23 *12*; %IT=93.77 *12* (1964Va03)

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Adopted Levels, Gammas (continued)

^{89}Zr Levels (continued)

E(level)†	J$^{\pi}$‡	T$_{1/2}$$^{\#}$	XREF	Comments
				μ=+0.795 *18* (2003Th03,2011StZZ) δ<r^2>(^{90}Zr,^{89}Zr)=−0.018 fm^2 *10* (2003Th03, statistical and systematic uncertainties of 0.006 and 0.008, respectively, have been combined in quadrature by the evaluator). μ: collinear laser spectroscopy (2003Th03, also 2002Ca47, 2002Fo12,2005Bi25). J$^{\pi}$: L=1 and Ay(θ) in (pol p,d). T$_{1/2}$: weighted average (normalized residuals method) of 4.145 min *9* (1992KaZM), 4.16 min *6* (1969Ro02) and 4.18 min *1* (1964Va03); χ^2=1.8. The LWM method gives 4.161 min *12* with χ^2=3.4 and Rajeval technique gives 4.148 min *9* with χ^2=0.6 but adjusting uncertainty to 0.04 for value from 1964Va03. Others: 4.40 min *4* (1953Sh48), 4.25 min (1953Ka11), 4.4 min *1* (1951Sh89), 4.5 min (1940Du05). $\nu 2p_{1/2}$ state.
1094.91 *18*	3/2$^-$	>0.05 ps	BC F HIJKL NO	J$^{\pi}$: L=1 and Ay(θ) in (pol p,d). T$_{1/2}$: from DSA in (p,nγ) (1972Gi06). $\nu 2p_{3/2}$ state.
1451.23 *18*	5/2$^-$	>3.5 ps	B F HIJKL NO	J$^{\pi}$: L=3 and Ay(θ) in (pol p,d). T$_{1/2}$: other: >2.1 ps (DSA in (p,nγ), 1972Gi06). $\nu 1f_{5/2}$ state.
1511.79 *17*	(9/2)$^+$	0.53 ps *10*	B F IJKL NO	J$^{\pi}$: L(^{3}He,α)=4 and possible antianalog state of 910, 9/2$^+$ in ^{89}Y.
1627.26 *14*	5/2$^+$	0.35 ps *7*	B F HIJKL NO	J$^{\pi}$: L(p,t)=0 from 5/2$^+$ target. T$_{1/2}$: weighted average of 0.40 ps *3* ((α,nγ),1974Bi13) and 0.26 ps *4* ((p,nγ),1972Gi06).
1742.6 *4*	1/2$^-$	0.43 ps *10*	F IJKL NO	J$^{\pi}$: L=1 and Ay(θ) in (pol p,d). T$_{1/2}$: weighted average of 0.40 ps *10* ((α,nγ),1974Bi13) and 0.49 ps *13* ((p,nγ),1972Gi06).
1833.71 *15*	5/2$^+$	0.46 ps *12*	B F I O	J$^{\pi}$: L(p,t)=0 from 5/2$^+$ target. T$_{1/2}$: weighted average of 0.56 ps *12* ((α,nγ),1974Bi13) and 0.32 ps *13* ((p,nγ),1972Gi06).
1864.6 *3*	3/2$^-$	0.17 ps *3*	C F HIJKL NO	J$^{\pi}$: L=1 and Ay(θ) in (pol p,d).
1943.72$^{@}$ *4*	13/2$^+$	0.74 ps *11*	DEFG O	J$^{\pi}$: ΔJ=2, E2 γ to 9/2$^+$; yrast band member L(p,t)=4 from 5/2$^+$ target.
2085.9 *8*	(5/2)$^+$	>2 ps	F I O	J$^{\pi}$: L(p,t)=2 from 5/2$^+$ target; ΔJ=1 γ to 3/2$^-$. T$_{1/2}$: other: >0.7 ps ((p,nγ),1972Gi06).
2099.84 *24*	5/2$^-$	0.076 ps *14*	F IjKL N	J$^{\pi}$: L=3 and Ay(θ) in (pol p,d). T$_{1/2}$: other: 0.12 ps *4* ((p,nγ),1972Gi06).
2101.4 *3*	(7/2)$^+$	104 fs *14*	B F j O	J$^{\pi}$: L(p,t)=2+4+6 from 5/2$^+$ target; log *ft*=7.1 from (9/2$^+$); ΔJ=(1) γ to 9/2$^+$.
2121.34 *4*	13/2$^-$	2.23 ns *12*	DEFG	J$^{\pi}$: ΔJ=(0), E1 γ to 13/2$^+$; ΔJ=2, M2+E3 γ to 9/2$^+$. T$_{1/2}$: from γ(t) pulsed-beam in (^{18}O,xnγ) (1986Bi09). Other: <3.4 ns *2* (RDDS in (^{18}O,xnγ),1986Wa25).
2128.7 *3*	(7/2$^+$)		B F I	J$^{\pi}$: log *ft*=7.1 from (9/2$^+$); ΔJ=1, (M1+E2) γ to 9/2$^+$;
2130.7 *10*	5/2$^+$		o	J$^{\pi}$: L(p,t)=0+2 for a 2130 keV doublet suggests 5/2$^+$ for one level and (1/2:9/2)$^+$ for the second; the latter associated with 2132.3 level.
2132.4 *3*	(7/2,9/2)$^+$		B F I o	J$^{\pi}$: log *ft*=7.6 from (9/2$^+$); γ to 9/2$^+$; L(p,t)=0+2 for a 2130 keV doublet suggests 5/2$^+$ for one level and (1/2:9/2)$^+$ for the second.
2150.60 *6*	(15/2$^-$)	≤3.6 ns	DE G	J$^{\pi}$: ΔJ=1, (M1(+E2)) γ to 13/2$^-$; ΔJ=1 γ to 13/2$^+$. T$_{1/2}$: <3.4 ns *2* from RDDS in (^{18}O,xnγ) (1986Wa25).

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Adopted Levels, Gammas (continued)

^{89}Zr Levels (continued)

E(level)[†]	J^{π}[‡]	$T_{1/2}$[#]	XREF	Comments
2152 *12*	(7/2⁺,9/2⁺)		J	J^{π}: L(^{3}He,t)=4 from 1/2⁻.
2158.98[b] *10*	(17/2⁻)	≤3.6 ns	DE G	J^{π}: shell-model prediction for a 17/2⁻ level at 2030 or 2080 (2012Sa36). $T_{1/2}$: ≤3.4 ns *2* from RDDS in (^{18}O,xnγ) (1986Wa25).
2220.0 *3*	(9/2⁻)	24 fs *7*	B F IJ N	J^{π}: L(^{3}He,t)=4 from 1/2⁻; ΔJ=(0) γ to 9/2⁺. $T_{1/2}$: other: <3 fs in (p,nγ).
2297 *8*	⁻		Jk n	J^{π}: L(^{3}He,t)=4 from 1/2⁻; L(p,d)=(4+1) suggests a doublet with J^{π}=(9/2⁺,7/2⁺) and (1/2⁻,3/2⁻). The higher spin level likely corresponds to 2298, (7/2)⁺ level.
2297.8 *4*	(7/2)⁺	83 fs *14*	B F I k nO	J^{π}: L(p,t)=2+4+6 from 5/2⁺ target; ΔJ=(1) γ to 9/2⁺; L(p,d)=(4+1) for a doublet. $T_{1/2}$: weighted average of 87 fs *14* ((α,nγ),1974Bi13) and 73 fs *21* ((p,nγ),1972Gi06).
2388.6 *5*	(5/2)⁺	0.13 ps *4*	B F I k nO	J^{π}: L(p,t)=4 from 5/2⁺ target; γ rays to 9/2⁺ and 3/2⁻ and RUL. $T_{1/2}$: average of 0.13 ps *4* ((α,nγ),1974Bi13) and 0.12 ps *4* ((p,nγ),1972Gi06).
2390 *50*	(1/2⁻,3/2⁻)		k n	J^{π}: L(p,d)=(4+1) suggests a doublet with J^{π}=(9/2⁺,7/2⁺) and (1/2⁻,3/2⁻). One of these levels may correspond to 2388.6 level, but the spin is inconsistent.
2454.4 *5*	(15/2)⁻	2.5 ps *+28−7*	DEF	J^{π}: ΔJ=1, M1 γ to 13/2⁻. $T_{1/2}$: DSA in (^{18}O,xnγ) (1986Wa25).
2493 *11*			J	
2538 *3*	(1/2 to 9/2)⁺		O	J^{π}: L(p,t)=2 from 5/2⁺ target.
2567.3 *5*	(1/2,3/2,5/2)⁺	0.10 ps *4*	F I O	J^{π}: γ to 3/2⁻ and RUL; L(p,t)=2 from 5/2⁺ target. $T_{1/2}$: other: >0.9 ps in (p,nγ).
2572.3 *3*	7/2⁺,9/2⁺	90 fs *21*	B IJ O	XREF: J(2585). J^{π}: L(p,t)=2 from 5/2⁺ target; log *ft*=5.9 from (9/2⁺), γ to 9/2⁺ and RUL. $T_{1/2}$: DSA in (p,nγ) (1972Gi06).
2612.1 *5*	9/2⁺		B IJK NO	J^{π}: L=4 and Ay(θ) in (pol p,d). L(^{3}He,t)=(6) from 1/2⁻ is inconsistent with 9/2⁺.
2713 *3*	(7/2 to 17/2)⁺		O	J^{π}: L(p,t)=6 from 5/2⁺ target.
2724.10[@] *6*	17/2⁺	11 ps *3*	DEFG	J^{π}: ΔJ=2, E2 γ to 13/2⁺; ΔJ=1, dipole γ to (15/2⁻). $T_{1/2}$: RDDS in (^{18}O,xnγ) (1986Wa25).
2730.0 *10*	(7/2,9/2)⁻		B J no	J^{π}: L(^{3}He,t)=4 from 1/2⁻ suggests 7/2⁻,9/2⁻; L(p,t)=0+3 from 5/2⁺ target for a 2732 *3* group suggests 5/2⁺ for one level and (1/2:11/2)⁻ for a second level, associated here with 2730 keV level; γ to 9/2⁺.
2732 *3*	(5/2⁺)		no	J^{π}: L(p,t)=0+3 from 5/2⁺ target for a doublet at 2732 keV; the latter component is associated with 2730 level. L(^{3}He,α)=4 for a probable doublet suggests 7/2⁺,9/2⁺ which may correspond to an additional level near this energy.
2754.79 *21*	(7/2)⁺	0.35 ps *19*	B F k O	J^{π}: log *ft*=5.6 from (9/2⁺) and γ rays to 5/2⁻ and 5/2⁺. J^{π}=7/2⁺,9/2⁺ suggested by L=4 component of L(p,d)=3+4; L(p,t)=2 from 5/2⁺.
2783 *3*	5/2⁻,7/2⁻		k NO	J^{π}: L(p,d)=3+4; L(^{3}He,α)=3; L(p,t)=2+5 from 5/2⁺ target for a doublet.
2783 *3*	(5/2,7/2)⁺		J O	J^{π}: L(^{3}He,t)=3 from 1/2⁻; ; L(p,t)=2+5 from 5/2⁺

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Adopted Levels, Gammas (continued)

^{89}Zr Levels (continued)

E(level)[†]	J^π[‡]	$T_{1/2}$[#]	XREF	Comments
				target for a doublet.
2830.1 *10*			G J	XREF: J(2820). J^π: γ to $13/2^+$. L(^{3}He,t)=4 from $1/2^-$ suggests negative parity.
2889.6 *6*	$(7/2,9/2)^+$		B J l O	XREF: J(2906). J^π: log *ft*=6.8 from $(9/2^+)$; L(p,t)=2 from $5/2^+$ target.
2925.9 *6*	$7/2^+,9/2^+$		B JKl N	J^π: L(^{3}He,α)=4. L(d,t)=4 for a 2900 group is consistent with this assignment.
2926.54[b] *8*	$(19/2^-)$		DE G	J^π: ΔJ=1, (M1+E2) γ to $(17/2^-)$.
2927 *3*	$(1/2$ to $11/2)^-$		O	J^π: L(p,t)=3 from $5/2^+$ target.
2959.82 *21*	$(7/2)^-$		B O	J^π: log *ft*=5.6 from $(9/2^+)$, γ to $5/2^+$; L(p,t)=3 from $5/2^+$ target.
2981.1 *8*	(7/2,9/2,11/2)		B	J^π: log *ft*=7.5 from $(9/2^+)$.
2995.33[@] *8*	$21/2^+$	5.14 ns *16*	DEFG	μ=9.4 *4* (1988Ba11,2011StZZ) μ: from g factor=0.89 *4* (TDPAD method,1988Ba11). J^π: ΔJ=2, E2 γ to $17/2^+$; ΔJ=1, (E1) γ to $(19/2^-)$. $T_{1/2}$: weighted average of 5.12 ns *16* (1986Bi09), γ(t) with pulsed beam in (^{18}O,xnγ) (1986Bi09) and 5.2 ns *3* (RDDS in (^{18}O,xnγ), 1986Wa25). Other: 5.9 ns *1* ($\gamma\gamma$(t),1981ArZM).
2996 *3*	$5/2^+$		O	J^π: L(p,t)=0 from $5/2^+$ target.
3016.1 *4*	$7/2^-$		B JK N	J^π: L=3 and Ay(θ) in (pol p,d).
3019 *3*	$(7/2,9/2)^+$		O	J^π: L(p,t)=2+4+6 from $5/2^+$ target.
3049 *7*	$(^-)$		J	J^π: L(^{3}He,t)=4 from $1/2^-$.
3092.68 *15*	$(7/2)^+$		B O	J^π: log *ft*=5.23 from $(9/2^+)$; γ rays to $5/2^-$ and $5/2^+$; L(p,t)=2 from $5/2^+$ target.
3106 *4*	$(^-)$		J N	J^π: L(^{3}He,t)=2 from $1/2^-$. 1995So05 interpret this as a $2p_{1/2}$ neutron state.
3111.20 *9*	$(19/2)^+$	>2.8 ps	DEFG	J^π: ΔJ=1, M1+E2 γ to $17/2^+$; ΔJ=1 γ to $21/2^+$. $T_{1/2}$: DSA in (^{18}O,xnγ) (1986Wa25).
3141.3 *9*	$9/2^+$		B JK NO	J^π: L=4 and Ay(θ) in (pol p,d).
3153 *3*	$(1/2$ to $9/2)^+$		O	J^π: L(p,t)=2 from $5/2^+$ target.
3181 *3*	$5/2^+$		O	J^π: L(p,t)=0 from $5/2^+$ target.
3214 *13*	$(^-)$		J	J^π: L(^{3}He,t)=4 from $1/2^-$.
3269 *3*	$(1/2$ to $9/2)^+$		O	J^π: L(p,t)=2 from $5/2^+$ target.
3280 *3*	$5/2^+$		O	J^π: L(p,t)=0 from $5/2^+$ target.
3281.0 *7*	$7/2^+,9/2^+$		B J N	J^π: L(^{3}He,α)=4.
3339 *3*	$1/2^-,3/2^-$		NO	J^π: L(^{3}He,α)=1; L(p,t)=3 from $5/2^+$ target.
3372 *3*	$9/2^+$		K NO	J^π: L=4 and Ay(θ) in (pol p,d).
3420 *3*	$(1/2$ to $9/2)^+$		O	J^π: L(p,t)=2 from $5/2^+$ target.
3467.0 *6*	(7/2,9/2,11/2)		B	J^π: log *ft*=7.1 from $(9/2^+)$.
3487 *3*	$(7/2,9/2)^+$		O	J^π: L(p,t)=2+4+6 from $5/2^+$ target.
3512.8 *7*	$(7/2,9/2)^+$		B j O	J^π: log *ft*=6.6 from $(9/2^+)$; L(p,t)=2+4+6 from $5/2^+$ target.
3531.1 *15*	$(7/2^-)$		B j N	J^π: log *ft*≈7.2 $(9/2^+)$; γ to $9/2^+$. L(^{3}He,α)=3 for a 3530 group. E(level): it is assumed by the evaluator that (^{3}He,α) and (t,p) populate different levels as suggested by opposite parities from L transfers in the two reactions.
3534.1 *15*	$(7/2^+,9/2^+)$		B j O	J^π: log *ft*≈7.4 from $(9/2^+)$. L(t,p)=2 from $5/2^+$ target. See also J^π and level energy comments for 3531.1 level.
3557.3 *7*	$(7/2,9/2)^+$		B O	XREF: O(3552).

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Adopted Levels, Gammas (continued)

^{89}Zr Levels (continued)

E(level)[†]	J^{π}[‡]	$T_{1/2}$[#]	XREF	Comments
				J^{π}: log *ft*=6.9 from (9/2$^+$); L(p,t)=2+4+6 from 5/2$^+$ target.
3575.8 *5*	(5/2)$^-$		B K N	XREF: N(3572). J^{π}: L=3 and Ay(θ) in (pol p,d) and L(^{3}He,α)=3. γ to 9/2$^+$, however, supports 7/2$^-$.
3576.8 *3*	(23/2)$^+$	0.35 ps *10*	DEFG	J^{π}: ΔJ=1, M1+E2 γ to 21/2$^+$. $T_{1/2}$: DSA in (HI,xnγ) (1986Wa25). Other: 0.18 ps in (α,3nγ) (1980ArZU).
3597 *3*	(7/2,9/2)$^+$		O	J^{π}: L(p,t)=2+4+6 from 5/2$^+$ target.
3600			N	J^{π}: probable 2$p_{3/2}$ neutron state.
3625 *3*	5/2$^+$		O	J^{π}: L(p,t)=0 from 5/2$^+$ target.
3647 *3*	(1/2 to 9/2)$^+$		O	J^{π}: L(p,t)=2 from 5/2$^+$ target.
3717.22[b] *21*	(21/2$^-$)	≤0.8 ps	DE G Q	XREF: Q(3810). J^{π}: ΔJ=2, E2 γ to (17/2$^-$); ΔJ=1, M1 γ to (19/2$^-$). L(pol p,π^-)=10 from 0$^+$ for a 3810 *80* level suggesting 21/2$^+$ is inconsistent with negative parity from high-spin gamma-ray studies. Proposed (1984Gr22) configuration=($\pi g^2_{9/2}\otimes\nu g^{-1}_{9/2}$) is also inconsistent with shell-model predictions. No 21/2$^+$ level is predicted near this energy according to shell-model calculations by 2012Sa36. $T_{1/2}$: DSA in (^{18}O,xnγ) (1986Wa25).
3765 *12*	5/2$^-$		K N	J^{π}: L=3 and Ay(θ) in (pol p,d).
3837.1 *9*	7/2$^+$,9/2$^+$		B N	J^{π}: L(^{3}He,α)=4.
3907.1 *15*	(7/2$^-$,9/2$^-$)		B M	XREF: M(3900). J^{π}: L(pol p,pn)=3 for a 3900 group; log *ft*=6.9 from (9/2$^+$).
3931.1 *15*	(7/2,9/2,11/2)		B k n	J^{π}: log *ft*=7.3 from (9/2$^+$). J^{π}=7/2$^-$ is proposed for a 3950 *50* level in (pol p,d) from L=3 and Ay(θ); 5/2$^-$,7/2$^-$ from L(^{3}He,α)=3 for a 3930 *12* level. Thus either 3931 or 3948 level has J^{π}=7/2$^-$.
3948.1 *15*	(7/2,9/2,11/2)		B k n	J^{π}: log *ft*=7.0 from (9/2$^+$). See also J^{π} comment for 3931 level.
3965.6 *12*	(7/2)$^-$		B k N	XREF: N(3980). J^{π}: log *ft*=6.7 from (9/2$^+$) and L(^{3}He,α)=3. See also J^{π} comment for 3931 level.
4100 *12*	7/2$^-$		K N	J^{π}: L=3 and Ay(θ) in (pol p,d).
4200 *12*	5/2$^-$,7/2$^-$		N	J^{π}: L(^{3}He,α)=3.
4277.7 *3*	(25/2$^+$)	≤0.06 ps	DE G Q	XREF: Q(4180). J^{π}: ΔJ=(1) γ to (23/2)$^+$; L(pol p,π^-)=12 from 0$^+$. $T_{1/2}$: DSA in (^{18}O,xnγ) (1986Wa25). Other: 0.18 ps in (α,3nγ) (1980ArZU). Configuration=($\pi g^2_{9/2}\otimes\nu g^{-1}_{9/2}$) stretched (1984Gr22).
4280 *12*	7/2$^-$		K N	XREF: K(4260). J^{π}: L=3 and Ay(θ) in (pol p,d). A complex structure is suggested in (pol p,d), the second component with L=(2), J^{π}=5/2$^+$.
4360 *12*	(1/2$^-$,3/2$^-$)		N	J^{π}: L(^{3}He,α)=1,(2) suggests 1/2$^-$, 3/2$^-$ and/or (3/2$^+$,5/2$^+$).
4523.86[b] *24*	(23/2$^-$)		DE G	J^{π}: ΔJ=1, M1(+E2) γ to (21/2$^-$).
4590 *12*	7/2$^-$		K N	J^{π}: L=3 and Ay(θ) in (pol p,d).
4680 *12*	7/2$^-$		K N	J^{π}: L=3 and Ay(θ) in (pol p,d). A complex structure is suggested in (pol p,d), the second component with L=(2), J^{π}=5/2$^+$.
4730 *12*	3/2$^+$,5/2$^+$		N	J^{π}: L(^{3}He,α)=2.

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Adopted Levels, Gammas (continued)

^{89}Zr Levels (continued)

E(level)[†]	Jπ[‡]	$T_{1/2}$[#]	XREF	Comments
4737.61[@] *24*	25/2+	≤6 ps	DE G	Jπ: ΔJ=2, E2 γ to 21/2+; ΔJ=1, (M1) γ to (23/2)+. $T_{1/2}$: RDDS in (^{18}O,xnγ) (1986Wa25).
4900 *12*	7/2−		K N	XREF: K(4850). Jπ: L=3 and Ay(θ) in (pol p,d).
5000 *20*	(1/2−,3/2−)		N	Jπ: L(^{3}He,α)=1,(2) suggests 1/2−, 3/2− and/or (3/2+,5/2+).
5100 *20*	7/2−		K N	XREF: K(5050). Jπ: L=3 and Ay(θ) in (pol p,d).
5170 *20*	(3/2+,5/2+)		k N	Jπ: L(^{3}He,α)=2,(1) suggests 3/2+,5/2+ and/or (1/2−,3/2−).
5170 *50*	7/2−		k N	XREF: N(5200). Jπ: L=3 and Ay(θ) in (pol p,d). Possible mixture of L(p,d)=(1) in a complex peak suggests (1/2−,3/2−) for second component.
5285.6? *11*			E	Jπ: possible γ to 25/2+.
5300 *20*	7/2−		K N	Jπ: L=3 and Ay(θ) in (pol p,d). Possible mixture of L(p,d)=(1) in a complex peak suggests (1/2−,3/2−) for second component.
5381.0 *4*	(27/2)+	>0.7 ps	DE G	Jπ: ΔJ=1, M1 γ to 25/2+; γ to (23/2)+. $T_{1/2}$: DSA in (^{18}O,xnγ) (1986Wa25).
5495.0[b] *3*	(25/2−)		E	Jπ: ΔJ=2, (E2) γ to (21/2−); ΔJ=1, (M1) γ to (23/2−); ΔJ=1, (E1) γ to (23/2)+.
5500 *20*	7/2−		K N	XREF: K(5400). Jπ: L=3 and Ay(θ) in (pol p,d). Possible mixture of L(p,d)=(1) in a complex peak suggests (1/2−,3/2−) for second component.
5600 *50*	7/2−&3/2−		K	Jπ: L=3+1 and Ay(θ) in (pol p,d) for a doublet.
5730 *20*	7/2−&3/2−		K N	Jπ: L=3+1 and Ay(θ) in (pol p,d) for a doublet.
5735.1? *8*	(25/2)		E	Jπ: possible γ to (23/2)+; possible γ from (27/2−).
5751.9 *4*	(27/2)+		E	Jπ: ΔJ=2, E2 γ to (23/2)+; ΔJ=1, M1 γ to 25/2+ γ to (23/2)+.
5955 *20*	7/2−&3/2−		K N	Jπ: L=3+1 and Ay(θ) in (pol p,d) for a doublet.
6028.2 *3*	(27/2+)		E	Jπ: ΔJ=1, (M1) γ to 25/2+; ΔJ=1, E1 γ to (25/2−).
6073.1[a] *4*	(27/2)−		E	Jπ: ΔJ=1, E1 γ to 25/2+; ΔJ=1, dipole γ to (25/2).
6100 *20*	7/2−&3/2−		K N	Jπ: L=3+1 and Ay(θ) in (pol p,d) for a doublet.
6109.1 *6*	(29/2+)		E	Jπ: γ rays to (27/2+) and 25/2+.
6243.1[a] *4*	(29/2−)		E	Jπ: ΔJ=2, E2 γ to (25/2−); ΔJ=1, (E1) γ to (27/2+); ΔJ=1, dipole γ to (27/2)−.
6280 *20*	7/2−&3/2−		K N	Jπ: L=3+1 and Ay(θ) in (pol p,d) for a doublet.
6352.9 *8*	(29/2)		E	Jπ: γ to (27/2)+.
6520 *50*	7/2−&3/2−		K	Jπ: L=3+1 and Ay(θ) in (pol p,d) for a doublet.
6700 *20*	7/2−		K N	Jπ: L=3 and Ay(θ) in (pol p,d). Possible mixture of L(p,d)=(1) in a complex peak suggests (1/2−,3/2−) for second component.
6832.1[a] *5*	(31/2−)		E	Jπ: ΔJ=1, M1 γ to (29/2−); γ to (27/2)−.
6900 *20*	5/2−,7/2−		N	Jπ: L(^{3}He,α)=3.
6952.9 *11*	(31/2)		E	Jπ: γ to (29/2).
6963.1[&] *5*	(29/2)+		E	Jπ: ΔJ=1, M1 γ to (27/2)+; γ to 25/2+.
7060 *20*	(5/2−,7/2−)		N	Jπ: L(^{3}He,α)=(3).
7200 *20*	(5/2−,7/2−)		N	Jπ: L(^{3}He,α)=(3).
7419.1[&] *6*	(31/2+)		E	Jπ: ΔJ=1, (M1) γ to (29/2)+.
7507.1[a] *6*	(33/2−)		E	Jπ: ΔJ=1, M1 γ to (31/2−).
8015.1[a] *9*	(35/2−)		E	Jπ: ΔJ=1, M1 γ to (33/2−).
8105 *20*	1/2−		JK N	Jπ: L=1 and Ay(θ) in (pol p,d). IAS of g.s., 1/2− in ^{89}Y. Γ=19 keV in (p,d) (1977IkZX).
8107.1[&] *6*	(33/2+)		E	Jπ: ΔJ=1, (M1) γ to (31/2+).
8864.1[&] *10*	(35/2+)		E	Jπ: γ to (33/2+); band member.
9035 *20*	9/2+		K N	Jπ: L=4 and Ay(θ) in (pol p,d).

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Adopted Levels, Gammas (continued)

^{89}Zr Levels (continued)

E(level)†	J$^{\pi}$‡	XREF	Comments
≈9.2×10^3	(7/2$^-$)	K N	J$^{\pi}$: L(p,d)=L(^{3}He,α)=3 for a wide structure. E(level): 9300 *2300* in (p,d), a wide structure (1983Ka18).
9.3×10^3		N	
9.5×10^3	(3/2$^+$)&(1/2$^+$)	M	J$^{\pi}$: L(pol p,pn)=2+0.
9601.1& *12*	(37/2$^+$)	E	J$^{\pi}$: γ to (35/2$^+$); band member.
9620 *20*	3/2$^-$	K N	J$^{\pi}$: L=1 and Ay(θ) in (pol p,d). IAS of 3/2$^-$, 1507 in ^{89}Y. Γ=25 keV in (p,d) (1977IkZX).
9860 *20*	5/2$^-$	K N	J$^{\pi}$: L=3 and Ay(θ) in (pol p,d). IAS of 5/2$^-$, 1745 in ^{89}Y. E(level): wide structure in (^{3}He,α) (1978Va05). Γ=22 keV in (p,d) (1977IkZX).
11.6×10^3?		N	
12150 *20*	(7/2)$^-$	K N	J$^{\pi}$: L(p,d)=3; IAS of an unresolved 7/2$^-$ state in ^{89}Y.
13100 *20*	(7/2)$^-$	K N	E(level): 13800 *2200* in (p,d), a wide structure. J$^{\pi}$: L(^{3}He,α)=L(p,d)=3; IAS of an unresolved 7/2$^-$ state in ^{89}Y.
14×10^3	(3/2,5/2$^+$)	N	E(level): centroid of a structure from 10 MeV to 19 MeV. J$^{\pi}$: L(^{3}He,α)=2,(3).
15.0×10^3		N	
17.0×10^3		N	
18.5×10^3 *25*	(7/2$^-$)&(3/2$^+$)	K	J$^{\pi}$: L(p,d)=3+2.
20.0×10^3		N	
25.0×10^3		N	
26.0×10^3		N	
31.0×10^3		N	
41.5×10^3	(3/2$^-$)	M	J$^{\pi}$: L(pol p,pn)=1.

† From least-squares fit to Eγ data with reduced χ^2=0.97. For levels not populated in γ-ray studies, the values are generally from (^{3}He,α).

‡ In many cases arguments from particle-transfer reactions are used, target $J^{\pi}=0^+$ for (p,d), (d,t), (^{3}He,α), (p,pn), (p,π-) and (n,α) reactions; 1/2$^-$ for (^{3}He,t); 5/2$^+$ for (p,t); and 9/2$^+$ for (^{3}He,n) reactions.

From DSA in (α,nγ) (1974Bi13) for low-spin levels, from RDDS for high-spin levels (1986Wa25), unless otherwise stated.

@ Band(A): g.s. band.

& Band(B): Band based on (29/2$^+$).

^{a} Band(C): Band based on (27/2$^-$).

^{b} Band(D): Band based on (17/2$^-$).

Adopted Levels, Gammas (continued)

γ(^{89}Zr)

E$_i$(level)	J$^\pi_i$	E$_\gamma$[‡]	I$_\gamma$[‡]	E$_f$	J$^\pi_f$	Mult.[†]	δ[†]	α[&]	Comments
587.82	1/2⁻	587.8 1	100	0.0	9/2⁺	(M4)		0.0467	B(M4)(W.u.)=11.45 4 Mult.: from α(exp) in ^{89}Zr IT decay (1953Sh48).
1094.91	3/2⁻	507.4 7	100	587.82	1/2⁻	(M1)[@]			B(M1)(W.u.)<3.4
1451.23	5/2⁻	356.4 4	56 3	1094.91	3/2⁻	(M1)			B(M1)(W.u.)<0.050 Mult.: dipole from $\gamma(\theta)$ in (α,nγ), parity from adopted J^π.
		863.3 2	100 3	587.82	1/2⁻	(E2)			B(E2)(W.u.)<9.2 Mult.: from (p,nγ). δ(M3/E2)=+0.15 5.
1511.79	(9/2)⁺	1511.7 2	100	0.0	9/2⁺	(M1+E2)			Mult.: from ^{89}Nb ε decay (2.03 h).
1627.26	5/2⁺	532.4 2	15.5 20	1094.91	3/2⁻	[E1]			B(E1)(W.u.)=0.00086 21
		1627.4 2	100	0.0	9/2⁺	(E2)			B(E2)(W.u.)=5.2 11 Mult.: from (p,nγ). δ(M3/E2)=+0.16 +9−6.
1742.6	1/2⁻	1154.8 3	100	587.82	1/2⁻	(M1)			B(M1)(W.u.)=0.033 8 Mult.: (M1+E2), δ=+0.15 +7−5 or −3.0 +6−8 from (p,nγ); but adopted ΔJ^π requires M1.
1833.71	5/2⁺	206 1	2.0 10	1627.26	5/2⁺				γ from ^{89}Nb ε decay only.
		738.6[a] 4	<6.8[a]	1094.91	3/2⁻	[E1]			B(E1)(W.u.)=6.E−5 +7−6
		1833.5 2	100 6	0.0	9/2⁺	(E2)			B(E2)(W.u.)=2.4 7 Mult.: from (p,nγ) and ^{89}Nb ε decay. δ(M3/E2)=+0.16 7.
1864.6	3/2⁻	412	11 7	1451.23	5/2⁻				γ from (p,nγ) only.
		769.7 2	100 5	1094.91	3/2⁻				
		1277.5 15	24 7	587.82	1/2⁻				
1943.72	13/2⁺	1943.70[#] 5	100	0.0	9/2⁺	E2			B(E2)(W.u.)=1.17 18
2085.9	(5/2)⁺	458	15 6	1627.26	5/2⁺				From (p,nγ) only.
		991.7	100 6	1094.91	3/2⁻	(E1)			B(E1)(W.u.)<0.00015 Mult.: dipole from $\gamma(\theta)$ in (α,nγ) and (p,nγ). Adopted $\Delta\pi$ requires E1.
2099.84	5/2⁻	649.1 4	34 6	1451.23	5/2⁻				
		1004.8 2	100 6	1094.91	3/2⁻	(M1)			B(M1)(W.u.)=0.21 5 Mult.: dipole from $\gamma(\theta)$ in (α,nγ). δ(E2/M1)=−3.5 4 from (p,nγ) is inconsistent with RUL(E2).
2101.4	(7/2)⁺	2101.4 3	100	0.0	9/2⁺	(M1)			B(M1)(W.u.)=0.023 3 Mult.: from $\gamma(\theta)$ in (α,nγ); ΔJ^π.
2121.34	13/2⁻	177.615[#] 20	100 3	1943.72	13/2⁺	E1(+M2)	−0.06 12	0.022 7	B(E1)(W.u.)=(1.83×10^{-5} 13); B(M2)(W.u.)=(10 +38−10)
		2121.31[#] 5	46 3	0.0	9/2⁺	M2+E3	+1.5 4		B(M2)(W.u.)=0.0016 6; B(E3)(W.u.)=1.29 24
2128.7	(7/2⁺)	617 1	8 3	1511.79	(9/2)⁺				From ^{89}Nb ε decay only.
		2128.5 3	100 12	0.0	9/2⁺	(M1+E2)			Mult.: from $\gamma(\theta)$ in (p,nγ), probably for a doublet. δ(E2/M1)=+2.1 +8−3.
2132.4	(7/2,9/2)⁺	2132.4 3	100	0.0	9/2⁺				

Adopted Levels, Gammas (continued)

$\gamma(^{89}Zr)$ (continued)

E_i(level)	J^{π}_i	E_γ[‡]	I_γ[‡]	E_f	J^{π}_f	Mult.[†]	δ[†]	α[&]	Comments
2150.60	$(15/2^-)$	29.25[#] *5*	100 *24*	2121.34	$13/2^-$	(M1(+E2))	<0.03	7.00 *11*	B(M1)(W.u.)>0.030 δ: from RUL for E2. γ(θ) gives +0.02 *12*.
		206.94[#] *8*	42 *5*	1943.72	$13/2^+$	(E1)		0.0137	B(E1)(W.u.)>5.6×10^{-7} Mult.: adopted ΔJ^{π} requires E1. δ(Q/D)=−0.14 *22*.
2158.98	$(17/2^-)$	(8.39 *12*)	100	2150.60	$(15/2^-)$	[M1]		35.8 *14*	B(M1)(W.u.)>0.27
2220.0	$(9/2^-)$	2219.9 *3*	100	0.0	$9/2^+$	(E1)			B(E1)(W.u.)=0.0013 *4* Mult.: γ(θ) in (α,nγ) is consistent with ΔJ=0, dipole. δ(Q/D)=+5.8 *+35−18* from γ(θ) in (p,nγ) indicating M1+E2 is discrepant.
2297.8	$(7/2)^+$	787.0 *15*	31 *12*	1511.79	$(9/2)^+$				
		845.5 *10*	69 *19*	1451.23	$5/2^-$	[E1]			B(E1)(W.u.)=0.0023 *9* From ^{89}Nb ε decay only.
		2297.9 *4*	100 *20*	0.0	$9/2^+$	(M1(+E2))	<0.1		B(M1)(W.u.)>0.0076; B(E2)(W.u.)<0.029 Mult.,δ: from γ(θ) in (p,nγ).
2388.6	$(5/2)^+$	936	36 *9*	1451.23	$5/2^-$	[E1]			B(E1)(W.u.)=0.0007 *3*
		1295	36 *9*	1094.91	$3/2^-$	[E1]			B(E1)(W.u.)=0.00025 *11*
		2388.5 *7*	100 *9*	0.0	$9/2^+$	[E2]			B(E2)(W.u.)=1.4 *5*
2454.4	$(15/2)^-$	333.1 *5*	100	2121.34	$13/2^-$	M1		0.00852	B(M1)(W.u.)=0.24 *+9−13*
2567.3	$(1/2,3/2,5/2)^+$	702.7 *4*	100	1864.6	$3/2^-$	[E1]			B(E1)(W.u.)=0.010 *4*
2572.3	$7/2^+,9/2^+$	738.6[a] *4*	<8.3[a]	1833.71	$5/2^+$				
		1060.5 *8*	9.9 *13*	1511.79	$(9/2)^+$				
		2572.3 *4*	100 *8*	0.0	$9/2^+$				
2612.1	$9/2^+$	2612.1 *6*	100	0.0	$9/2^+$				
2724.10	$17/2^+$	565.0 *5*	0.19 *10*	2158.98	$(17/2^-)$	(E1)			B(E1)(W.u.)=3.2×10^{-7} *20*
		573.9 *7*	0.6 *2*	2150.60	$(15/2^-)$	[E1]			B(E1)(W.u.)=1.0×10^{-6} *5*
		780.36 *5*	100.0 *25*	1943.72	$13/2^+$	E2			B(E2)(W.u.)=7.5 *21*
2730.0	$(7/2,9/2)^-$	2730 *1*	100	0.0	$9/2^+$				
2754.79	$(7/2)^+$	624.2 *9*	4.3 *9*	2128.7	$(7/2^+)$				E_γ: poor fit, level-energy difference=626.1.
		920.5 *3*	77 *13*	1833.71	$5/2^+$				
		1128.6 *3*	100 *10*	1627.26	$5/2^+$				E_γ: poor fit, level-energy difference=1127.5.
		1242.5 *8*	11.3 *23*	1511.79	$(9/2)^+$				
		1303.0 *7*	15 *3*	1451.23	$5/2^-$	[E1]			B(E1)(W.u.)=2.9×10^{-5} *17*
		2753.5 *10*	22 *4*	0.0	$9/2^+$				
2830.1		886.4	100	1943.72	$13/2^+$				
2889.6	$(7/2,9/2)^+$	1377.5 *10*	35 *14*	1511.79	$(9/2)^+$				
		2889.6 *6*	100 *12*	0.0	$9/2^+$				
2925.9	$7/2^+,9/2^+$	173.1[b] *4*	40 *10*	2754.79	$(7/2)^+$				
		2925.8 *6*	100 *12*	0.0	$9/2^+$				
2926.54	$(19/2^-)$	767.50 *9*	100 *5*	2158.98	$(17/2^-)$	(M1+E2)	−0.38 *6*		
		777.2 *7*	1.6 *8*	2150.60	$(15/2^-)$				

γ(^{89}Zr) (continued)

E$_i$(level)	J$^\pi_i$	E$_\gamma$‡	I$_\gamma$‡	E$_f$	J$^\pi_f$	Mult.†	δ†	α&	Comments
2959.82	(7/2)$^-$	229.2[b] *5*	8 *3*	2730.0	(7/2,9/2)$^-$				
		347.5 *10*	2.6 *14*	2612.1	9/2$^+$				
		1332.3 *3*	70 *6*	1627.26	5/2$^+$				
		1447.7 *7*	22 *2*	1511.79	(9/2)$^+$				
		2960.1 *3*	100 *10*	0.0	9/2$^+$				
2981.1	(7/2,9/2,11/2)	2981.0 *8*	100	0.0	9/2$^+$				
2995.33	21/2$^+$	68.79[#] *3*	0.90 *20*	2926.54	(19/2$^-$)	(E1)		0.338	B(E1)(W.u.)=1.8×10^{-6} *4* Mult.: dipole from $\gamma(\theta)$, ΔJ^π requires E1. δ(Q/D)=−0.03 *10*.
		271.23 *5*	100 *3*	2724.10	17/2$^+$	E2		0.0306	B(E2)(W.u.)=3.05 *16*
3016.1	7/2$^-$	794.0 *15*	20 *7*	2220.0	(9/2$^-$)				
		3016.2 *4*	100 *8*	0.0	9/2$^+$				
3092.68	(7/2)$^+$	480.8 *7*	4.6 *12*	2612.1	9/2$^+$	(E2)[@]			
		520 *1*	2.8 *14*	2572.3	7/2$^+$,9/2$^+$				
		964 *1*	3.4 *11*	2128.7	(7/2$^+$)				
		992 *1*	3.0 *6*	2101.4	(7/2)$^+$				
		1259.0 *3*	40 *4*	1833.71	5/2$^+$	(M1,E2)[@]			
		1464.8 *5*	28.7 *23*	1627.26	5/2$^+$				
		1580.8 *4*	17.2 *17*	1511.79	(9/2)$^+$				
		1641.2 *9*	6.4 *6*	1451.23	5/2$^-$				
		3092.7 *2*	100 *9*	0.0	9/2$^+$				
3111.20	(19/2)$^+$	115.89[#] *7*	31 *10*	2995.33	21/2$^+$	(M1)		0.135	B(M1)(W.u.)<1.2 Additional information 2. δ: +0.12 *15* from $\gamma(\theta)$ but RUL<300 for E2 requires almost pure M1.
		387.08 *8*	100 *7*	2724.10	17/2$^+$	M1+E2	−0.11 *6*		B(M1)(W.u.)<0.10; B(E2)(W.u.)<18
3141.3	9/2$^+$	3141.2 *9*	100	0.0	9/2$^+$				
3281.0	7/2$^+$,9/2$^+$	3280.9 *7*	100	0.0	9/2$^+$				
3467.0	(7/2,9/2,11/2)	3466.9 *6*	100	0.0	9/2$^+$				
3512.8	(7/2,9/2)$^+$	757[b] *1*	139 *22*	2754.79	(7/2)$^+$				
		3512.7 *7*	100 *17*	0.0	9/2$^+$				
3531.1	(7/2$^-$)	3531.0 *15*	100	0.0	9/2$^+$				
3534.1	(7/2$^+$,9/2$^+$)	3534.0 *15*	100	0.0	9/2$^+$				
3557.3	(7/2,9/2)$^+$	3557.2 *7*	100	0.0	9/2$^+$				
3575.8	(5/2)$^-$	1948.0 *15*	34 *14*	1627.26	5/2$^+$				
		3575.8 *5*	100 *11*	0.0	9/2$^+$				
3576.8	(23/2)$^+$	581.2 *4*	100	2995.33	21/2$^+$	M1+E2	−0.21 *10*		B(M1)(W.u.)=0.31 *9*; B(E2)(W.u.)=44 *+46−32*
3717.22	(21/2$^-$)	790.0 *3*	73 *4*	2926.54	(19/2$^-$)	M1			B(M1)(W.u.)>0.024 E$_\gamma$: poor fit, level-energy difference=790.7.
		1558.9 *3*	100 *5*	2158.98	(17/2$^-$)	E2			B(E2)(W.u.)>1.9 E$_\gamma$: poor fit, level-energy difference=1558.2.

From ENSDF

$\gamma(^{89}$Zr) (continued)

E_i(level)	J^π_i	E_γ‡	I_γ‡	E_f	J^π_f	Mult.†	δ†	Comments
3837.1	7/2+,9/2+	3837.0 *9*	100	0.0	9/2+			
3907.1	(7/2−,9/2−)	3907.0 *15*	100	0.0	9/2+			
3931.1	(7/2,9/2,11/2)	3931.0 *15*	100	0.0	9/2+			
3948.1	(7/2,9/2,11/2)	3948.0 *15*	100	0.0	9/2+			
3965.6	(7/2)−	3965.5 *12*	100	0.0	9/2+			
4277.7	(25/2+)	701.0 *2*	100	3576.8	(23/2)+	(M1(+E2))	−0.14 *15*	B(M1)(W.u.)>1.0
4523.86	(23/2−)	806.59 *14*	100	3717.22	(21/2−)	M1(+E2)	−0.23 *25*	
4737.61	25/2+	460.1[b] *7*	<1.2	4277.7	(25/2+)	[M1]		B(M1)(W.u.)>0.00020
		1160.7 *3*	10.7 *5*	3576.8	(23/2)+	(M1)		B(M1)(W.u.)>0.00023
		1742.4 *3*	100 *5*	2995.33	21/2+	E2		B(E2)(W.u.)>0.22 E_γ: from 2012Sa36. Other: 1740.04 *20* in 1986Wa25 is a doublet.
5285.6?		548[b]		4737.61	25/2+			
5381.0	(27/2)+	643.4 *3*	100 *5*	4737.61	25/2+	M1		B(M1)(W.u.)<0.099
		1804.1 *7*	18.9 *11*	3576.8	(23/2)+	[E2]		B(E2)(W.u.)<0.29
5495.0	(25/2−)	971.0 *3*	38 *2*	4523.86	(23/2−)	(M1)		
		1778.0 *3*	100 *5*	3717.22	(21/2−)	(E2)		
		1918.1 *7*	20.2 *10*	3576.8	(23/2)+	(E1)		
5735.1?	(25/2)	2158.1[b] *7*	100	3576.8	(23/2)+			
5751.9	(27/2)+	370.9[b] *7*	<14	5381.0	(27/2)+			
		1014.3 *3*	100 *5*	4737.61	25/2+	M1		
		2175.0 *7*	44 *2*	3576.8	(23/2)+	E2		
6028.2	(27/2+)	533.2 *3*	47 *2*	5495.0	(25/2−)	E1		
		647.2[b] *7*	<6.1	5381.0	(27/2)+			
		1290.6 *3*	100 *5*	4737.61	25/2+	(M1)		
		1504.2 *7*	6.1 *12*	4523.86	(23/2−)	[M2]		
		1750.7 *7*	6.5 *4*	4277.7	(25/2+)			
6073.1	(27/2)−	338.0 *7*	60 *5*	5735.1?	(25/2)	D		
		1335.4 *7*	100 *5*	4737.61	25/2+	E1		
		1795.5 *7*	16.9 *9*	4277.7	(25/2+)			
6109.1	(29/2+)	728.0 *7*	100 *20*	5381.0	(27/2)+			
		1831.5 *7*	60 *4*	4277.7	(25/2+)			
6243.1	(29/2−)	170.0 *3*	20.8 *17*	6073.1	(27/2)−	D		
		214.8 *3*	100 *8*	6028.2	(27/2+)	(E1)		
		748.0 *7*	17.9 *9*	5495.0	(25/2−)	E2		
		862.0 *7*	16.0 *8*	5381.0	(27/2)+	D		
6352.9	(29/2)	601.0 *7*	100	5751.9	(27/2)+			
6832.1	(31/2−)	589.0 *3*	100 *7*	6243.1	(29/2−)	M1		
		759.0 *7*	8.9 *8*	6073.1	(27/2)−			
6952.9	(31/2)	600.0 *7*	100	6352.9	(29/2)			
6963.1	(29/2)+	1211.2 *3*	100 *6*	5751.9	(27/2)+	M1		

Adopted Levels, Gammas (continued)

$\gamma(^{89}Zr)$ (continued)

E_i(level)	J^{π}_i	E_{γ}[‡]	I_{γ}[‡]	E_f	J^{π}_f	Mult.[†]
6963.1	(29/2)$^+$	2225.5 *7*	24.2 *12*	4737.61	25/2$^+$	
7419.1	(31/2$^+$)	456.0 *3*	100	6963.1	(29/2)$^+$	(M1)
7507.1	(33/2$^-$)	675.0 *3*	100	6832.1	(31/2$^-$)	M1
8015.1	(35/2$^-$)	508.0 *7*	100	7507.1	(33/2$^-$)	M1
8107.1	(33/2$^+$)	688.0 *3*	100	7419.1	(31/2$^+$)	(M1)
8864.1	(35/2$^+$)	757.0 *7*	100	8107.1	(33/2$^+$)	
9601.1	(37/2$^+$)	737.0 *7*	100	8864.1	(35/2$^+$)	

[†] From $\gamma(\theta)$ and γ(lin pol) in (HI,xnγ), unless otherwise stated.

[‡] Weighted averages of available values, unless otherwise stated. For levels above 2500 the values are generally from (HI,xnγ) for high-spin levels and from ^{89}Nb ε decay (2.03 h) for low-spin states.

[#] From (^{18}O,xnγ) (1986Wa25).

[@] From ^{89}Nb ε decay (2.03 h).

[&] 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.

[a] Multiply placed with undivided intensity.

[b] Placement of transition in the level scheme is uncertain.

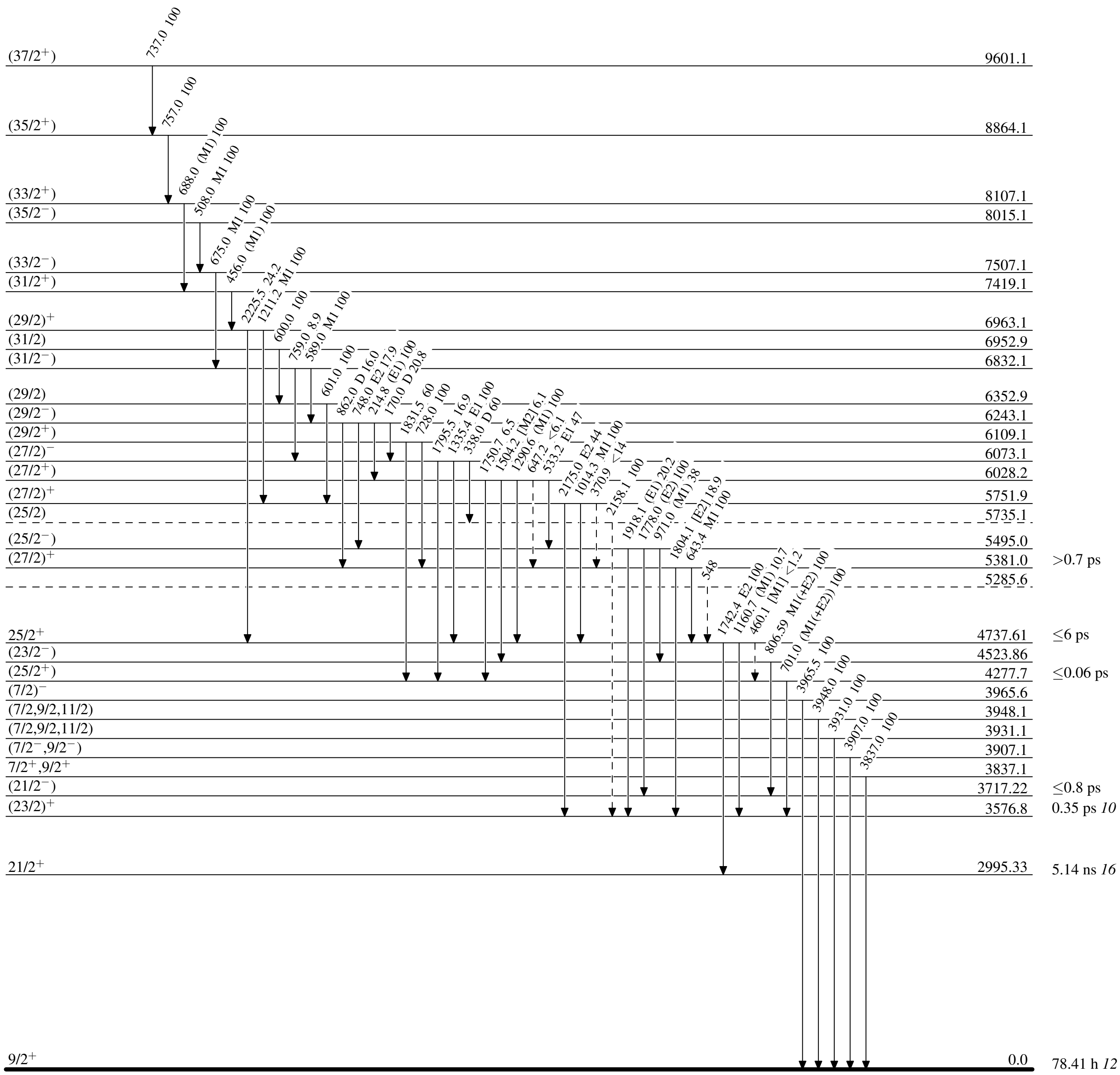
Adopted Levels, Gammas

Level Scheme

Intensities: Relative photon branching from each level

Legend

- - - - - -► γ Decay (Uncertain)



$^{89}_{40}Zr_{49}$

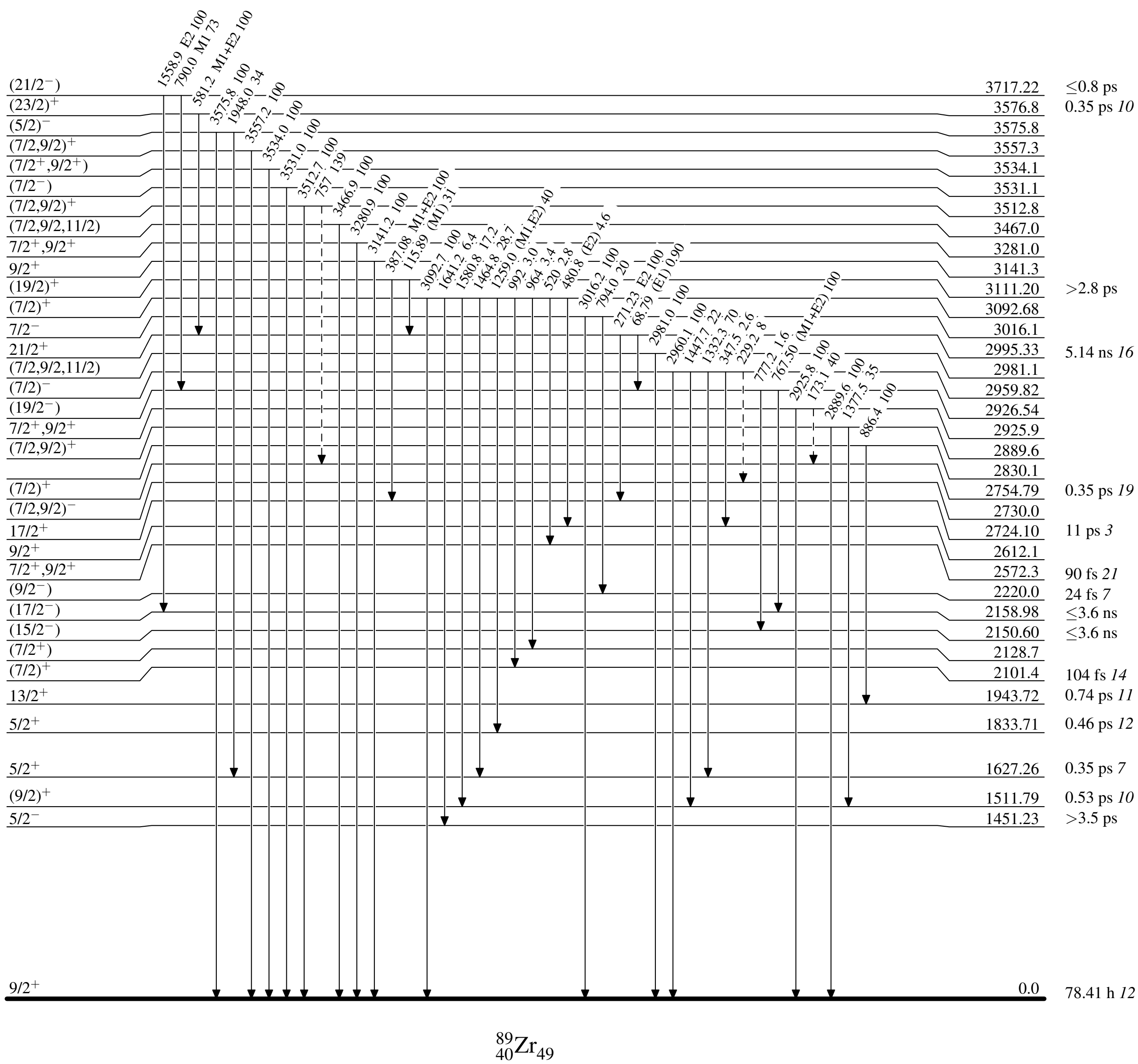
Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Relative photon branching from each level

Legend

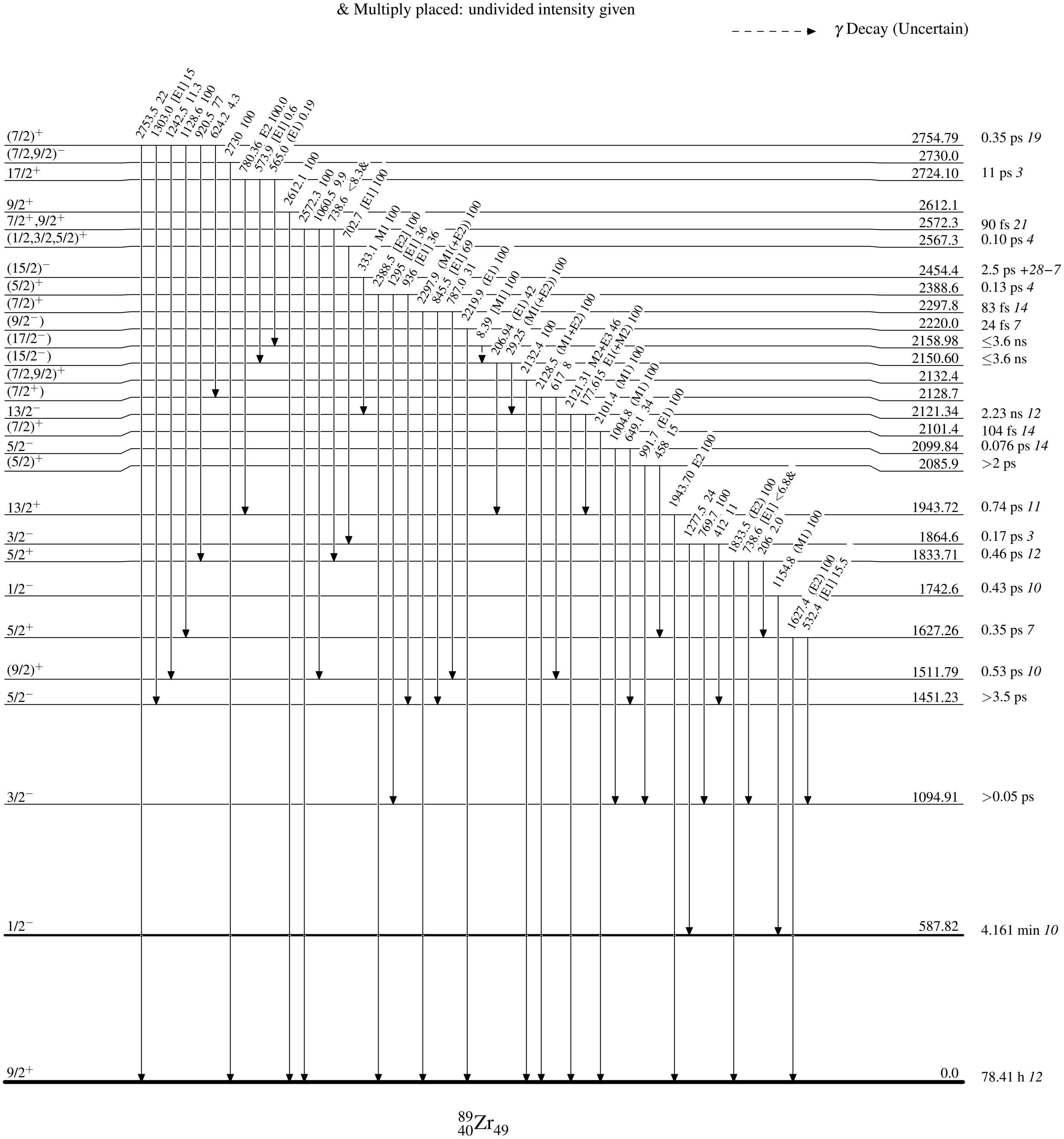
γ Decay (Uncertain)



Adopted Levels, Gammas

Level Scheme (continued)

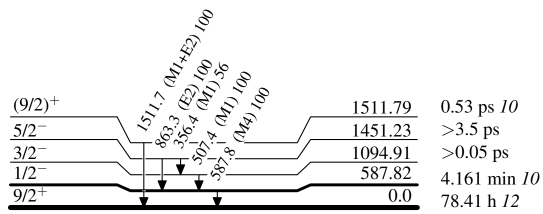
Intensities: Relative photon branching from each level
& Multiply placed: undivided intensity given



Adopted Levels, Gammas

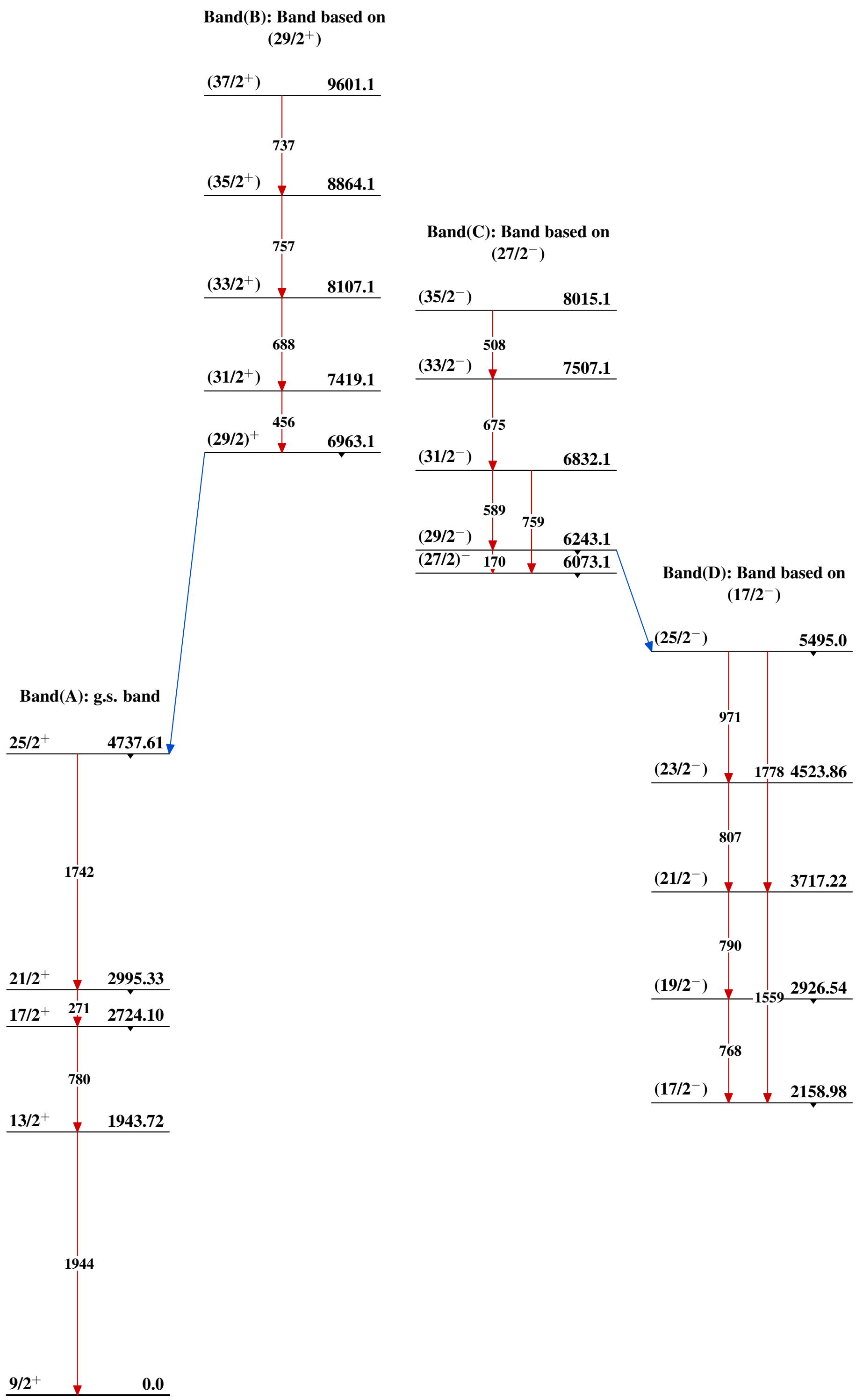
Level Scheme (continued)

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



$^{89}_{40}Zr_{49}$

Adopted Levels, Gammas



$^{89}_{40}Zr_{49}$