Adopted Levels, Gammas

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh and Jun Chen	NDS 185, 2 (2022)	23-Aug-2022

Q(β^-)=3336 *10*; S(n)=6575 *18*; S(p)=7930 *15*; Q(α)=−629 *16* 2021Wa16
S(2n)=11738 *19*, S(2p)=18939 *15* (2021Wa16).
Production and identification of ^{149}Pr: 1964Ho03, 1967Va14, 1973Oh08, 1977Pi06.
Mass measurements by Penning-trap method: 2006Sa56, 2004Cl07.
Additional information 1.
2012Th09: theory: calculated configuration admixtures in ground state and isomer, E1 transition rate, octupole correlation and Coriolis mixing in low-lying states using quasiparticle phonon model combined with particle-rotor model.
Other theoretical studies: consult the NSR database at www.nndc.bnl.gov/nsr/ for three references for structure and one for radioactive decay listed under 'document records' which can be accessed through web retrieval of the ENSDF database at www.nndc.bnl.gov/ensdf/.

^{149}Pr Levels

Cross Reference (XREF) Flags

- A ^{149}Ce β^- decay (5.12 s)
- B ^{248}Cm,^{252}Cf SF decay
- C ^{252}Cf SF decay
- D ^{150}Nd(d,^{3}He)

E(level)[†]	J$^\pi$[‡]	$T_{1/2}$	XREF	Comments
0.0[a]	(5/2$^+$)	2.26 min *8*	ABCD	%β^-=100 XREF: D(?). J$^\pi$: (5/2$^+$,7/2$^+$) is suggested based on shell-model orbitals $d_{5/2}$ or $g_{7/2}$ consistent with systematics of odd Pr isotopes; 5/2$^+$ is suggested by particle-triaxial rotor model (PTRM) calculations (1993Ma39) and by dominant (≈95%) configuration=π5/2[413] from quasiparticle-rotor model (QPRM) calculations (2010Rz02); observed β^- feedings to 3/2$^+$ levels in ^{149}Nd also support 5/2$^+$. However, L(d,^{3}He)=4 suggests 7/2$^+$,9/2$^+$. $T_{1/2}$: weighted average of 2.3 min *2* (γ(t),1967Va14), 2.25 min *8* (γ(t),1977Pi06). Others: 2.9 min *1* (1973Oh08), 2.3 min (1964Ho03).
40[#]			D	J$^\pi$: L(d,^{3}He)=2 suggests 3/2$^+$,5/2$^+$.
58.11[@] *6*	(7/2$^-$)	23.4 ns *18*	ABC	J$^\pi$: E1 γ to (5/2$^+$); possible bandhead. $T_{1/2}$: from weighted average of 26 ns *4* (2010Rz02,$\gamma\gamma$(t) in ^{252}Cf SF) and 22.9 ns *18* (1974ClZX, (fragment-fragment)(x ray)γ(t) in ^{248}Cm,^{252}Cf SF). Others: 7.2 ns *6* (2014Ko27, $\gamma\gamma$(t) in ^{149}Ce β^-), 9.7 ns *21* (1996YaZV, $\beta\gamma$(t) in β^-, two authors are the same as in 2014Ko27); in severe disagreement with the values from SF decays. Reason for the discrepancy is not clear, if it is assumed that the same 58-keV γ ray is involved in the SF decays and in ^{149}Ce β^- decay.
80[#]			D	E(level): this level may correspond to 86.3 level. J$^\pi$: L(d,^{3}He)=2 suggests 3/2$^+$,5/2$^+$.
86.40[a] *6*	(7/2$^+$)	4.2 ns *5*	A C	J$^\pi$: M1 γ to (5/2$^+$); band member. $T_{1/2}$: from $\gamma\gamma$(t) in β^- decay (2014Ko27). Other: 4.2 ns *21* ($\beta\gamma$-coin in β^-,1996YaZV).
106.86 *7*			A	
125.55 *7*		1.0 ns *2*	A	$T_{1/2}$: from $\gamma\gamma$(t) in β^- decay (2014Ko27).
161.3[@] *3*	(11/2$^-$)		BC	
162.97 *7*			A	
174.5[&] *4*	(9/2$^+$)		C	J$^\pi$: γ to (7/2$^-$); band based on this level interpreted as possible octupole band as the transitions (implied as E1) connect this band to band 1.

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Adopted Levels, Gammas (continued)

^{149}Pr Levels (continued)

E(level)[†]	Jπ[‡]	XREF	Comments
215.46 *8*		A	
220[#]		D	E(level): this level may correspond to 215.6 and/or 230.8 level. Jπ: L(d,^{3}He)=(2) suggests (3/2$^+$,5/2$^+$).
230.98 *8*		A	
260[#]		D	Jπ: L(d,^{3}He)=4 suggests 7/2$^+$,9/2$^+$.
311.90 *12*		A	
364.9[a] *5*	(11/2$^+$)	C	
380.27 *7*		A	
381.1[@] *4*	(15/2$^-$)	BC	
397.70 *12*		A	
406.9[&] *4*	(13/2$^+$)	C	
440[#]		D	E(level): this level may correspond to 448.3 level. Jπ: L(d,^{3}He)=2 suggests 3/2$^+$,5/2$^+$.
448.33 *7*		A	
546.16 *13*		A	
550[#]		D	E(level): this level may correspond to 546 level. Jπ: L(d,^{3}He)=4 suggests 7/2$^+$,9/2$^+$.
575.28 *13*		A	
590[#]		D	E(level): this level may correspond to 575 level. Jπ: L(d,^{3}He)=2 suggests 3/2$^+$,5/2$^+$.
660[#]		D	Jπ: L(d,^{3}He)=(2) suggests (3/2$^+$,5/2$^+$).
711.4[@] *5*	(19/2$^-$)	BC	
736.5[a] *7*	(15/2$^+$)	C	
751.6[&] *5*	(17/2$^+$)	C	
951.11 *9*		A	
980[#]		D	Jπ: L(d,^{3}He)=(0) suggests (1/2$^+$).
1127.5[@] *6*	(23/2$^-$)	BC	
1173.9[a] *9*	(19/2$^+$)	C	
1189.0[&] *6*	(21/2$^+$)	C	
1607.4[@] *6*	(27/2$^-$)	BC	
1664.6[a] *10*	(23/2$^+$)	C	
1695.3[&] *6*	(25/2$^+$)	C	
2129.9[@] *8*	(31/2$^-$)	BC	
2191.9[a] *12*	(27/2$^+$)	C	
2230.4[&] *7*	(29/2$^+$)	C	
2664.4[@] *10*	(35/2$^-$)	BC	
2722.1[&] *9*	(33/2$^+$)	C	
3184.7[@] *11*	(39/2$^-$)	BC	
3723.6[@] *12*	(43/2$^-$)	C	

[†] From a least-squares fit to Eγ data. There is some evidence of two additional nanosecond isomers, connected with 54.7γ and 143γ, which are not placed in a decay scheme.

[‡] As proposed by 2015Wa28 in ^{252}Cf SF decay, based on band structures.

[#] Tentative level energy from (d,^{3}He) (1981VaZJ report). It is possible levels are shifted in energy, due to calibration issues, as pointed out in the ^{150}Nd(d,^{3}He) dataset.

[@] Band(A): π1/2[550] band. Dominant configuration=π1/2[550] from QRPM calculations (2010Rz02); the levels of this band can mix with π3/2[541] orbital. 2015Wa28 interpret this band also as a possible octupole band, with bands 1 and 2 in Fig. 14

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Adopted Levels, Gammas (continued)

^{149}Pr Levels (continued)

forming an alternating-parity structure.

& Band(B): Possible octupole band. Based on the presence of E1 transitions from band 2 to band 1, bands 1 and 2 in Fig. 14 of 2015Wa28 possibly form alternating-parity band structure.

[a] Band(C): π5/2[413] band. Band assignment proposed by 2015Wa28, based on interpretation of ^{149}Pr g.s. with dominant configuration=π5/2[413] by 2010Rz02.

$\gamma(^{149}Pr)$

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.	α[#]	Comments
58.11	(7/2$^-$)	58.2 *1*	100	0.0	(5/2$^+$)	E1	1.089 *16*	B(E1)(W.u.)=2.50×10^{-5} *+21−18* Mult.: from ce data in ^{248}Cm,^{252}Cf SF (2010Rz02). E_γ: from β^- decay. Other: 58.5 *3* in ^{252}Cf SF.
86.40	(7/2$^+$)	28.4 *1*	>27	58.11	(7/2$^-$)	[E1]	1.347 *23*	B(E1)(W.u.)=0.00016 to 0.0012.
		86.5[‡] *1*	100[‡] *5*	0.0	(5/2$^+$)	M1	1.963 *28*	B(M1)(W.u.)<0.0023 Mult.: from total conversion coefficient in ^{252}Cf SF decay (2015Wa28).
106.86		48.8 *1*	100 *5*	58.11	(7/2$^-$)			
		106.9 *1*	7.2 *4*	0.0	(5/2$^+$)			
125.55		67.4 *1*	100 *5*	58.11	(7/2$^-$)			
		125.6 *1*	0.8 *3*	0.0	(5/2$^+$)			
161.3	(11/2$^-$)	103.2 *3*	100	58.11	(7/2$^-$)	(E2)	1.893 *33*	Mult.: M1,E2 from total conversion coefficient in ^{248}Cm,^{252}Cf SF (2010Rz02), but (E2) from assigned J^π values.
162.97		56.2 *1*	27.3 *21*	106.86				
		76.5 *1*	100 *5*	86.40	(7/2$^+$)			
		104.9 *1*	87 *4*	58.11	(7/2$^-$)			
174.5	(9/2$^+$)	(13.2)		161.3	(11/2$^-$)			
		116.4 *5*		58.11	(7/2$^-$)			
215.46		52.6 *1*	12.9 *10*	162.97				
		128.9 *1*	100 *5*	86.40	(7/2$^+$)			
		157.5 *1*	6.2 *10*	58.11	(7/2$^-$)			
230.98		144.9 *1*	100 *4*	86.40	(7/2$^+$)			
		172.6 *1*	66 *4*	58.11	(7/2$^-$)			
311.90		225.5 *1*	100	86.40	(7/2$^+$)			
364.9	(11/2$^+$)	278.5 *5*	100	86.40	(7/2$^+$)			
380.27		294.1[‡] *1*	21.5[‡] *11*	86.40	(7/2$^+$)			
		322.2[‡] *1*	17.0[‡] *7*	58.11	(7/2$^-$)			
		380.0 *1*	100 *4*	0.0	(5/2$^+$)			
381.1	(15/2$^-$)	219.8 *3*	100	161.3	(11/2$^-$)			
397.70		311.3 *1*	100	86.40	(7/2$^+$)			
406.9	(13/2$^+$)	(25.8)		381.1	(15/2$^-$)			
		232.4 *3*	100 *5*	174.5	(9/2$^+$)			
		245.6 *3*	100 *5*	161.3	(11/2$^-$)			
448.33		217.4 *1*	6.8 *6*	230.98				
		233.0 *1*	42.3 *23*	215.46				
		285.3 *1*	49.4 *26*	162.97				
		322.8 *1*	100 *6*	125.55				
		361.8 *1*	45.2 *26*	86.40	(7/2$^+$)			
		390.2 *1*	61 *3*	58.11	(7/2$^-$)			
546.16		330.7 *1*	100	215.46				
575.28		344.3 *1*	100	230.98				
711.4	(19/2$^-$)	330.3 *3*	100	381.1	(15/2$^-$)			

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Adopted Levels, Gammas (continued)

γ(^{149}Pr) (continued)

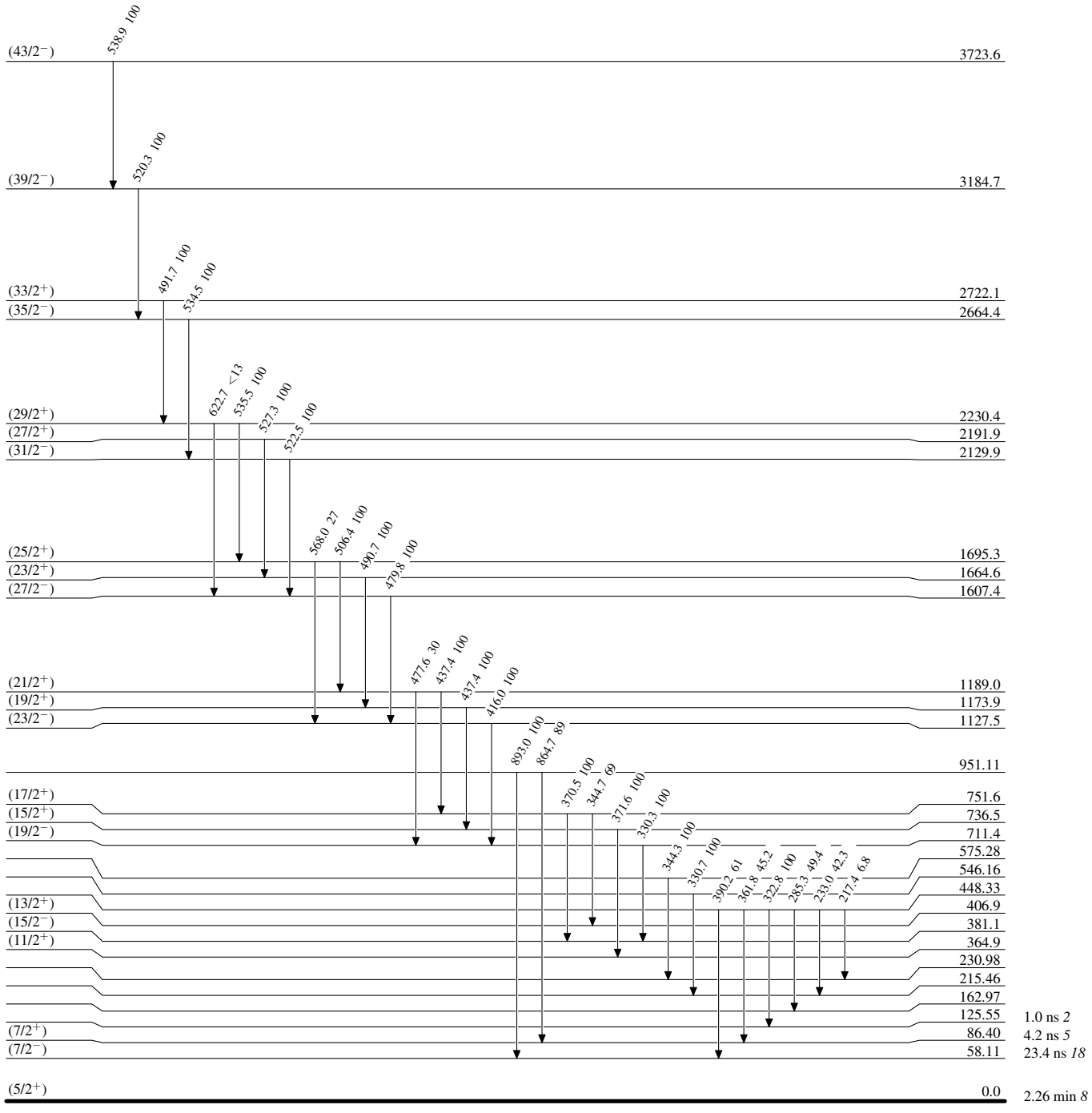
E_i(level)	J_i^π	E_γ †	I_γ †	E_f	J_f^π
736.5	(15/2$^+$)	371.6 *5*	100	364.9	(11/2$^+$)
751.6	(17/2$^+$)	344.7 *5*	69 *5*	406.9	(13/2$^+$)
		370.5 *5*	100 *10*	381.1	(15/2$^-$)
951.11		864.7 *1*	89 *4*	86.40	(7/2$^+$)
		893.0 *1*	100 *5*	58.11	(7/2$^-$)
1127.5	(23/2$^-$)	416.0 *3*	100	711.4	(19/2$^-$)
1173.9	(19/2$^+$)	437.4[@] *5*	100	736.5	(15/2$^+$)
1189.0	(21/2$^+$)	437.4[@] *5*	100 *9*	751.6	(17/2$^+$)
		477.6 *5*	30 *4*	711.4	(19/2$^-$)
1607.4	(27/2$^-$)	479.8 *3*	100	1127.5	(23/2$^-$)
1664.6	(23/2$^+$)	490.7 *5*	100	1173.9	(19/2$^+$)
1695.3	(25/2$^+$)	506.4 *5*	100 *8*	1189.0	(21/2$^+$)
		568.0 *5*	27 *3*	1127.5	(23/2$^-$)
2129.9	(31/2$^-$)	522.5 *5*	100	1607.4	(27/2$^-$)
2191.9	(27/2$^+$)	527.3 *5*	100	1664.6	(23/2$^+$)
2230.4	(29/2$^+$)	535.5 *5*	100 *10*	1695.3	(25/2$^+$)
		622.7 *5*	<13	1607.4	(27/2$^-$)
2664.4	(35/2$^-$)	534.5 *5*	100	2129.9	(31/2$^-$)
2722.1	(33/2$^+$)	491.7 *5*	100	2230.4	(29/2$^+$)
3184.7	(39/2$^-$)	520.3 *5*	100	2664.4	(35/2$^-$)
3723.6	(43/2$^-$)	538.9 *5*	100	3184.7	(39/2$^-$)

† From either ^{149}Ce β^- or ^{252}Cf SF decay.
‡ From ^{149}Ce β^- decay.
# 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.
@ Multiply placed.

Adopted Levels, Gammas

Level Scheme

Intensities: Relative photon branching from each level



$^{149}_{59}Pr_{90}$

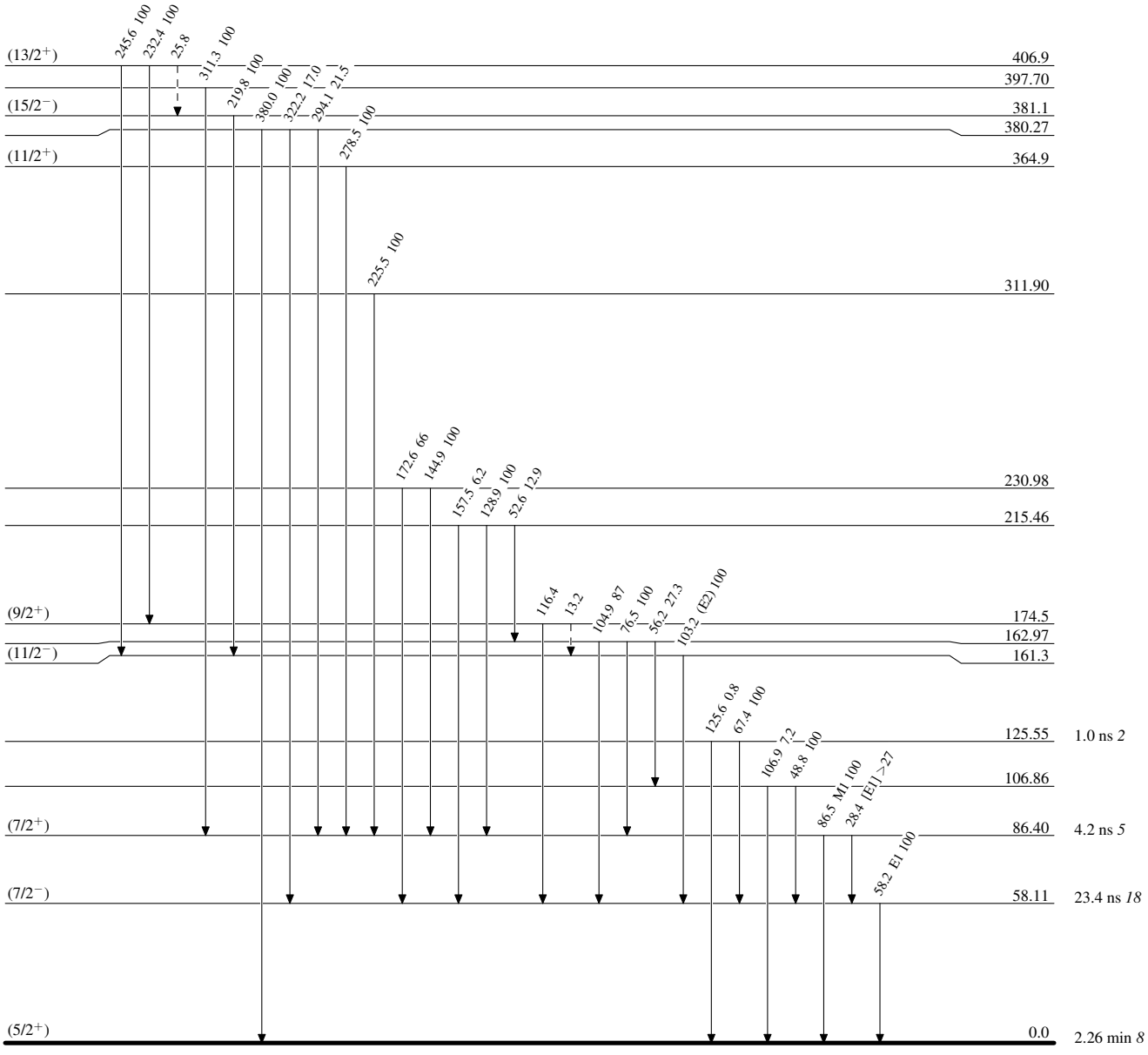
Adopted Levels, Gammas

Legend

Level Scheme (continued)

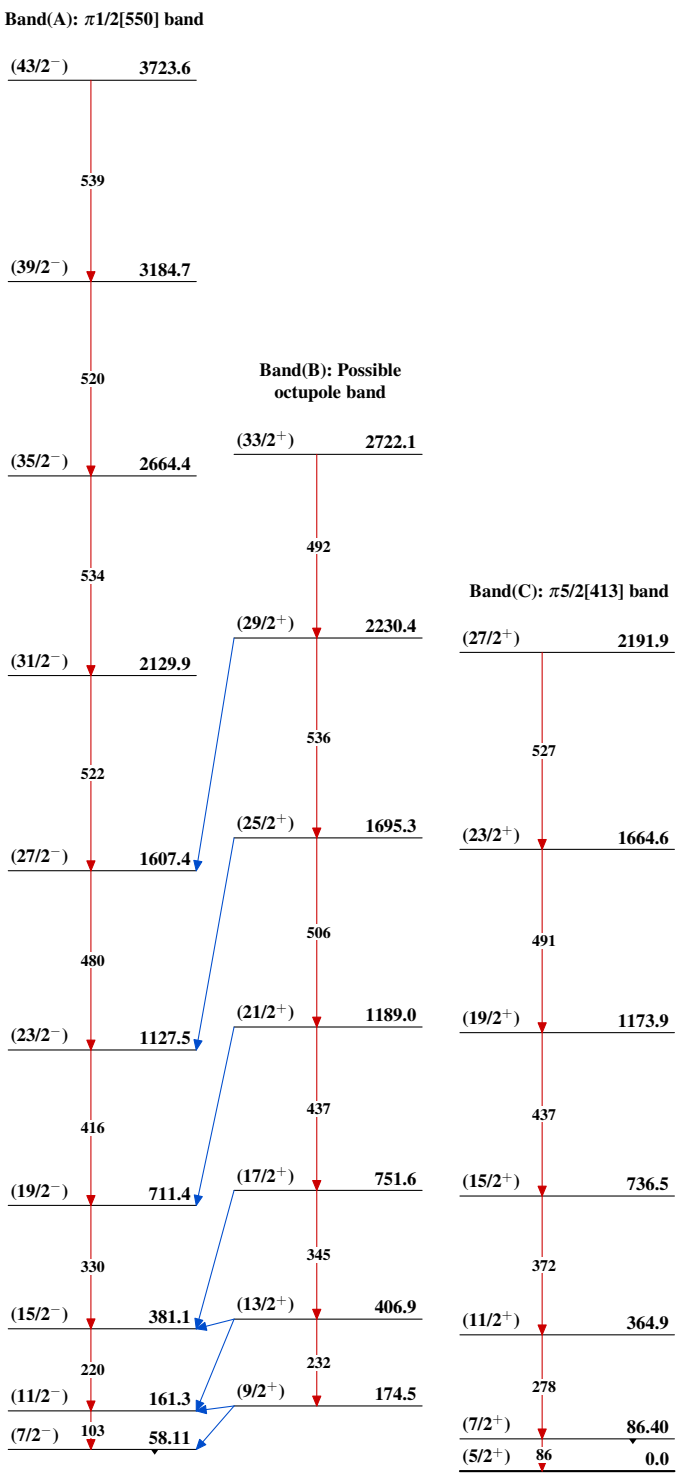
Intensities: Relative photon branching from each level

γ Decay (Uncertain)



$^{149}_{59}Pr_{90}$

Adopted Levels, Gammas



$^{149}_{59}Pr_{90}$