Adopted Levels, Gammas

Type	Author	Citation	Literature Cutoff Date
	History		
Full Evaluation	Balraj Singh, Alexander A. Rodionov And Yuri L. Khazov	NDS 109, 517 (2008)	22-Jan-2008

Q(β^-)=−4722 *23*; S(n)=10479 *24*; S(p)=3392 *24*; Q(α)=4.1×10^2 *3* 2012Wa38
Note: Current evaluation has used the following Q record.
Q(β^-)=−4722 *23*; S(n)=10490 *40*; S(p)=3389 *24*; Q(α)=410 *30* 2003Au03
Mass measurement by penning trap: 1997Be63.
Nuclear structure calculations: 1993We05 (levels, cranked-shell-model), 1992Zh10 (identical bands), 1988Go01 (levels), 1983Ch46 (yrast,near- yrast bands, cranking model), 1975To08 (levels, transition rates, μ, Q), 1975Me11 (levels, collective model).
Additional information 1.
No level or γ information is available from ^{135}Nd ε decay (5.5 min).

^{135}Pr Levels

Cross Reference (XREF) Flags

A ^{135}Pr IT decay (105 μs)
B ^{135}Nd ε decay (12.4 min)
C ^{120}Sn(^{19}F,4nγ)
D ^{136}Ce(p,2nγ)
E ^{135}Nd ε decay (5.5 min):?

E(level)†	J$^\pi$@	T$_{1/2}$‡	XREF	Comments
0.0	3/2$^{(+)}$	24 min *1*	ABCD	%ε+%β^+=100 J$^\pi$: spin from atomic beam (1972Ek04), parity from systematics. The g.s. J$^\pi$ is 5/2$^+$ for ^{137}Pr, ^{139}Pr and ^{141}Pr; (3/2$^+$) for ^{129}Pr, ^{131}Pr and ^{133}Pr. In the model calculations of 1988Go01, 3/2[411], 3/2[422] and 5/2[413] orbitals are predicted at low energies and small deformations. The ^{135}Pr g.s. is possibly 3/2[411]. T$_{1/2}$: weighted average of 22 min (1954Ha68), 25.4 min *5* (1970Ab07), 27 min (1972Ar02), 24 min (1972Ek04), 21 min *1* (1973VaYZ). Uncertainty of 1 min is assigned for averaging when not quoted.
41.43& *5*	5/2$^{(+)}$		ABCD	J$^\pi$: M1(+E2) γ to 3/2$^{(+)}$, E1 γ from 7/2$^{(-)}$.
206.08 *6*	7/2$^{(+)}$		B D	J$^\pi$: M1+E2 γ to 5/2$^{(+)}$; log *ft*=6.8 from 9/2$^{(-)}$.
245.48[a] *5*	7/2$^{(+)}$		ABCD	J$^\pi$: M1 γ to 5/2$^{(+)}$; log *ft*=6.5 from 9/2$^{(-)}$.
358.06[b] *6*	(11/2$^-$)	105 μs *10*	ABCD	%IT=100 J$^\pi$: M2 γ to 7/2$^{(+)}$; systematics. T$_{1/2}$: from γ(t) (1973Co32).
493.48 *6*	7/2$^{(+)}$		B D	J$^\pi$: M1+E2 γ to 5/2$^{(+)}$; log *ft*=6.6 from 9/2$^{(-)}$.
517.41& *7*	9/2$^{(+)}$		BCD	J$^\pi$: ΔJ=2, E2 γ to 5/2$^{(+)}$.
543.17 *8*	7/2$^{(-)}$		B D	J$^\pi$: E1-M1 cascade to 3/2$^{(+)}$; log *ft*=6.6 from 9/2$^{(-)}$.
591.05 *10*			D	J$^\pi$: γ's to 5/2$^{(+)}$ and 7/2$^{(+)}$ suggest 3/2$^+$,5/2,7/2,9/2$^+$.
688.10 *10*	(9/2$^+$)		B D	J$^\pi$: M1(+E2) γ to 7/2$^{(+)}$, ΔJ=1 γ to 7/2$^{(+)}$.
730.83[b] *11*	(15/2$^-$)	22.9# ps *14*	BCD	J$^\pi$: ΔJ=2, E2 γ to (11/2$^-$).
777.48[a] *9*	(11/2$^+$)		BCD	J$^\pi$: ΔJ=(2), E2 γ to 7/2$^{(+)}$.
799.25 *11*	9/2$^{(-)}$		B D	J$^\pi$: ΔJ=1, M1(+E2) γ's to 7/2$^{(-)}$ and (11/2$^-$).
951.68[c] *12*	(13/2$^-$)		BCD	J$^\pi$: ΔJ=1, M1+E2 γ to (11/2$^-$); ΔJ=1, (M1) γ to (15/2$^-$).
985.38 *18*	(9/2$^+$)		B D	J$^\pi$: ΔJ=1, M1+E2 γ to 7/2$^{(+)}$; log *ft*=7.0 from 9/2$^{(-)}$.
1016.86 *15*			D	J$^\pi$: γ's to 7/2$^{(+)}$ and 9/2$^{(+)}$ suggest 5/2$^+$,7/2,9/2,11/2$^+$.
1089.91 *15*	(5/2$^+$,7/2,9/2$^+$)		D	J$^\pi$: γ's to 5/2$^{(+)}$ and 9/2$^{(+)}$.
1104.90 *17*			D	J$^\pi$: γ's to 7/2$^{(+)}$ and 9/2$^{(+)}$ suggest 5/2$^+$,7/2,9/2,11/2$^+$.
1160.2 *3*	(9/2$^-$)		B D	J$^\pi$: ΔJ=1, D+Q γ to 7/2$^{(-)}$; log *ft*=6.8 from 9/2$^{(-)}$.
1181.49 *12*	(7/2$^+$,9/2)		D	J$^\pi$: ΔJ=0,1 D or D+Q γ to 7/2$^{(+)}$; γ to (11/2$^+$).

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Adopted Levels, Gammas (continued)

^{135}Pr Levels (continued)

E(level)[†]	J$^{\pi}$[@]	T$_{1/2}$[‡]	XREF	Comments
1185.15 *12*	(9/2$^-$,11/2$^-$)		B D	J$^{\pi}$: log *ft*=6.6 from 9/2$^{(-)}$ and M1,E2 γ to (13/2$^-$).
1214.24 *15*	(7/2$^-$,9/2$^-$,11/2$^-$)		B D	J$^{\pi}$: log *ft*=6.8 from 9/2$^{(-)}$ and M1,E2 γ to 9/2$^{(-)}$.
1221.5 *4*	(11/2$^+$)		D	J$^{\pi}$: ΔJ=1, D+Q γ to 9/2$^{(+)}$.
1232.2[&] *4*	(13/2$^+$)		CD	J$^{\pi}$: ΔJ=2, E2 γ to 9/2$^{(+)}$.
1289.60 *21*	(11/2$^-$)		B D	J$^{\pi}$: ΔJ=1, M1+E2 γ to 9/2$^{(-)}$; γ to 7/2$^{(-)}$.
1303.1 *4*	(11/2$^-$)		B	J$^{\pi}$: γ to (15/2$^-$) and log *ft*=6.8 from 9/2$^{(-)}$.
1306.63 *23*	(−)		D	J$^{\pi}$: (E2) γ to (15/2$^-$) suggests 11/2$^-$ to 19/2$^-$.
1325.3 *3*	(11/2$^+$)		D	J$^{\pi}$: ΔJ=1, D+Q γ to (9/2$^+$).
1351.8 *8*			D	
1390.9[b] *4*	(19/2$^-$)	2.4[#] ps *6*	CD	J$^{\pi}$: ΔJ=2, (E2) γ to (15/2$^-$).
1409.9 *3*			D	
1433.3[c] *3*	(17/2$^-$)		CD	J$^{\pi}$: γ's to (15/2$^-$) and (13/2$^-$); band assignment.
1460.8 *4*	(11/2$^+$)		D	J$^{\pi}$: ΔJ=1, D+Q γ to 9/2$^{(+)}$.
1478.2 *5*	(17/2$^-$)		CD	J$^{\pi}$: ΔJ=1, D or D+Q γ to (15/2$^-$).
1506.0[a] *5*	(15/2$^+$)		CD	J$^{\pi}$: ΔJ=(2), (Q) γ to (11/2$^+$).
1507.8 *3*	(11/2$^+$)		D	J$^{\pi}$: ΔJ=1, D+Q γ to 9/2$^{(+)}$.
1531.9 *4*			D	
1571.1 *6*			D	
1636.4 *3*	(13/2$^+$)		D	J$^{\pi}$: ΔJ=(2), (Q) γ to (9/2$^+$) and γ to (11/2$^+$).
1742.2 *8*			D	
1766.0 *6*	(7/2$^-$,9/2$^-$,11/2$^-$)		B D	J$^{\pi}$: ΔJ=0,1 D or D+Q γ to 9/2$^{(-)}$.
1794.2 *6*			D	
1816.0 *3*	(−)		D	J$^{\pi}$: M1,E2 γ to (19/2$^-$) suggests 19/2$^-$,21/2$^-$,23/2$^-$.
1904.9 *8*			D	
1928.6 *6*	(19/2$^-$)		C	J$^{\pi}$: ΔJ=(2), (Q) γ to (15/2$^-$); ΔJ=1, D γ to (17/2$^-$).
1959.2 *4*			D	
1998.0 *7*	(7/2,9/2,11/2$^+$)		B	J$^{\pi}$: γ to 7/2$^{(+)}$ and log *ft*=6.1 from 9/2$^{(-)}$.
2002.8 *8*			D	
2014.0 *8*			D	
2104.4 *8*			D	
2116.5[&] *7*	(17/2$^+$)		CD	
2129.2? *7*	(7/2,9/2,11/2$^-$)		B	J$^{\pi}$: γ to 7/2$^{(-)}$ and log *ft*=6.7 from 9/2$^{(-)}$.
2155.9 *6*			D	E(level): this level may be the same as 2159, although 768γ is not reported in (p,2nγ) reaction.
2158.5[c] *6*	(21/2$^-$)		C	
2204.7 *7*	(21/2$^-$)		C	
2244.9[b] *7*	(23/2$^-$)	0.92[#] ps *5*	C	
2346.9 *9*	(23/2$^-$)		C	
2355.9 *11*			C	
2373.0 *9*	(19/2$^+$)		C	
2395.9[a] *8*	(19/2$^+$)		C	
2589.9[&] *7*	(21/2$^+$)		C	
2617.8 *7*	(21/2$^+$)		C	
2754.7 *6*			C	
2846.9[a] *8*	(23/2$^+$)		C	
2900.9 *9*	(23/2$^+$)		C	
3001.0[c] *7*	(25/2$^-$)		C	
3123.9[&] *8*	(25/2$^+$)		C	
3204.9 *13*	(25/2)		C	
3244.8[b] *10*	(27/2$^-$)		C	
3421.9[a] *10*	(27/2$^+$)		C	
3488.8 *10*			C	

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Adopted Levels, Gammas (continued)

^{135}Pr Levels (continued)

E(level)†	Jπ@	XREF	E(level)†	Jπ@	XREF	E(level)†	Jπ@	XREF
3517.7 *10*		C	4704.8 *13*		C	6510.8 *24*		C
3530.8 *8*		C	4964.9[a] *17*	(35/2+)	C	6879.8[b] *19*	(43/2−)	C
3642.9 *16*	(27/2)	C	5030.8 *16*		C	6978.9[a] *23*	(43/2+)	C
3658.9[&] *11*	(29/2+)	C	5069.0[c] *15*	(33/2−)	C	7515?[&] *3*	(45/2+)	C
3862.8 *9*		C	5163.8[b] *13*	(35/2−)	C	7802.8[b] *22*	(47/2−)	C
3957.0[c] *11*	(29/2−)	C	5336.8 *15*		C	7899?[a] *3*	(47/2+)	C
4107.9[a] *14*	(31/2+)	C	5420.9[&] *18*	(37/2+)	C	8716?[b] *3*	(51/2−)	C
4219.9 *12*	(31/2)	C	5454.8 *19*		C	9004?[a] *3*	(51/2+)	C
4292.8 *11*		C	5953.8 *22*		C	9678?[b] *3*	(55/2−)	C
4319.8[b] *12*	(31/2−)	C	5973.9[a] *20*	(39/2+)	C	10745?[b] *3*	(59/2−)	C
4393.8 *14*		C	5997.8[b] *16*	(39/2−)	C			
4464.9[&] *15*	(33/2+)	C	6500.9[&] *21*	(41/2+)	C			

† From least-squares fit to Eγ′s.

‡ For all excited states seen in the ^{136}Ce(p,2nγ) reaction, except the 358 level, 1985Ko18 suggest $T_{1/2}\leq 1.5$ ns from γ(t).

From recoil-distance Doppler shift method in ^{123}Sb(^{16}O,4nγ) reaction (1998Bo33) listed in ^{136}Ce(p,2nγ) dataset.

@ For high spin states (J>15/2) above 2 MeV, the assignments are from 1986Se07 based on γγ(θ) (DCO) and/or band associations.

& Band(A): $\pi g_{7/2}$ 5/2[413] (α=+1/2). The first band crossing is observed at 320 keV interpreted as due to alignment of a pair of $h_{11/2}$ protons (′ab′ crossing) and the second band crossing is observed at 490 keV due possible to a pair of $h_{11/2}$ neutrons (′AB′ crossing). The shape is nearly prolate ($\gamma\approx 0°$) before the first crossing but $\gamma\approx +10°$ due to alignment of a pair of $h_{11/2}$ protons. The 1128γ and 1172γ present in the γγ coin spectrum (figure 5b in 1986Se07) may form a cascade above 1014γ thus extending the band up to $53/2^+$. VMI analysis: parameter Δ=182 keV, 173 keV for both signature partners treated as one band.

[a] Band(B): $\pi g_{7/2}$ 5/2[413] (α=−1/2). See comment for α=+1/2 signature partner for band crossings and triaxial shape parameter. VMI analysis: parameter Δ=150 keV, 173 keV for both signature partners treated as one band.

[b] Band(C): $\pi h_{11/2}$ 3/2[541] (α=−1/2). The first band crossing is observed at 460 keV interpreted as due to alignment of a pair of $h_{11/2}$ protons (′bc′ crossing) and the second band crossing is observed at 480 keV due possible to a pair of $h_{11/2}$ neutrons (′AB′ crossing). The shape is nearly prolate before the first crossing but the alignment of $h_{11/2}$ protons would result in slightly positive γ. VMI analysis: parameter Δ=357 keV, 270 keV for both signature partners treated as one band.

[c] Band(D): $\pi h_{11/2}$ 3/2[541] (α=+1/2) (?). The identification of this band is questionable. VMI analysis: parameter Δ=28 keV, 270 keV for both signature partners treated as one band.

Adopted Levels, Gammas (continued)

$\gamma(^{135}Pr)$

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[&]	δ[&]	α[@]	Comments
41.43	$5/2^{(+)}$	41.47 *5*	100	0.0	$3/2^{(+)}$	M1(+E2)	<0.15	3.1 *6*	α(L)=2.5 *5*; α(M)=0.53 *11*; α(N+..)=0.14 *3* α(N)=0.116 *24*; α(O)=0.018 *4*; α(P)=0.001086 *18*
206.08	$7/2^{(+)}$	164.67 *5*	100 *8*	41.43	$5/2^{(+)}$	M1+E2	+0.45 *20*	0.326 *8*	α(K)=0.270 *4*; α(L)=0.045 *6*; α(M)=0.0096 *14*; α(N+..)=0.0025 *4* α(N)=0.0021 *3*; α(O)=0.00033 *4*; α(P)=1.98×10^{-5} *8*
		206.05 *15*	75 *6*	0.0	$3/2^{(+)}$	E2		0.1717	α(K)=0.1295 *19*; α(L)=0.0331 *5*; α(M)=0.00729 *11*; α(N+..)=0.00183 *3* α(N)=0.001592 *23*; α(O)=0.000233 *4*; α(P)=7.89×10^{-6} *12*
245.48	$7/2^{(+)}$	204.08 *5*	100	41.43	$5/2^{(+)}$	M1		0.1762	α(K)=0.1503 *21*; α(L)=0.0205 *3*; α(M)=0.00431 *6*; α(N+..)=0.001131 *16* α(N)=0.000964 *14*; α(O)=0.0001553 *22*; α(P)=1.149×10^{-5} *17*
		245.4 *1*	6.3 *7*	0.0	$3/2^{(+)}$	(E2)		0.0963	α(K)=0.0748 *11*; α(L)=0.01686 *24*; α(M)=0.00369 *6*; α(N+..)=0.000932 *14* α(N)=0.000807 *12*; α(O)=0.0001198 *17*; α(P)=4.71×10^{-6} *7*
358.06	$(11/2^-)$	112.60 *5*	100 *6*	245.48	$7/2^{(+)}$	M2		8.27	B(M2)(W.u.)=0.065 *9* α(K)=6.46 *10*; α(L)=1.409 *20*; α(M)=0.312 *5*; α(N+..)=0.0817 *12* α(N)=0.0700 *10*; α(O)=0.01101 *16*; α(P)=0.000708 *10*
		316.6 *1*	23 *4*	41.43	$5/2^{(+)}$	E3		0.1603	B(E3)(W.u.)=0.81 *17* α(K)=0.1082 *16*; α(L)=0.0406 *6*; α(M)=0.00916 *13*; α(N+..)=0.00229 *4* α(N)=0.00200 *3*; α(O)=0.000288 *4*; α(P)=7.32×10^{-6} *11*
493.48	$7/2^{(+)}$	248.0 *1*	4.7 *20*	245.48	$7/2^{(+)}$				
		287.4[‡] *1*	8.2 *20*	206.08	$7/2^{(+)}$				
		452.1 *1*	100 *6*	41.43	$5/2^{(+)}$	M1+E2	+0.4 *1*	0.0208 *6*	α(K)=0.0177 *5*; α(L)=0.00241 *5*; α(M)=0.000508 *9*; α(N+..)=0.0001330 *24* α(N)=0.0001134 *20*; α(O)=1.82×10^{-5} *4*; α(P)=1.33×10^{-6} *4*
		493.4 *1*	34 *4*	0.0	$3/2^{(+)}$	E2		0.01169	α(K)=0.00971 *14*; α(L)=0.001561 *22*; α(M)=0.000333 *5*; α(N+..)=8.60×10^{-5} *12* α(N)=7.38×10^{-5} *11*; α(O)=1.147×10^{-5} *16*; α(P)=6.74×10^{-7} *10*
517.41	$9/2^{(+)}$	271.9 *1*	28 *9*	245.48	$7/2^{(+)}$	M1+E2	+0.25 *5*	0.0807	α(K)=0.0686 *11*; α(L)=0.00951 *15*; α(M)=0.00201 *3*; α(N+..)=0.000525 *8* α(N)=0.000448 *7*; α(O)=7.19×10^{-5} *11*; α(P)=5.19×10^{-6} *9*
		476.0 *1*	100 *6*	41.43	$5/2^{(+)}$	E2		0.01289	α(K)=0.01069 *15*; α(L)=0.001740 *25*; α(M)=0.000372 *6*; α(N+..)=9.59×10^{-5} *14* α(N)=8.23×10^{-5} *12*; α(O)=1.277×10^{-5} *18*; α(P)=7.40×10^{-7} *11*
543.17	$7/2^{(-)}$	185.06 *8*	31 *8*	358.06	$(11/2^-)$	(E2)		0.247	α(K)=0.182 *3*; α(L)=0.0509 *8*; α(M)=0.01124 *16*; α(N+..)=0.00282 *4* α(N)=0.00245 *4*; α(O)=0.000356 *5*; α(P)=1.084×10^{-5} *16*
		501.7 *1*	100	41.43	$5/2^{(+)}$	E1		0.00373	α(K)=0.00321 *5*; α(L)=0.000414 *6*; α(M)=8.65×10^{-5} *13*;

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Adopted Levels, Gammas (continued)

γ(^{135}Pr) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[&]	δ[&]	α[@]	Comments
									α(N+..)=2.26×10^{-5} *4* α(N)=1.93×10^{-5} *3*; α(O)=3.08×10^{-6} *5*; α(P)=2.21×10^{-7} *4*
591.05		345.6 *1*	49 *9*	245.48	7/2$^{(+)}$				
		549.5 *2*	100 *11*	41.43	5/2$^{(+)}$				
688.10	(9/2$^+$)	170.65[‡] *10*	28 *5*	517.41	9/2$^{(+)}$	D+Q			
		442.7 *2*	100 *25*	245.48	7/2$^{(+)}$	D(+Q)			
		482.2[§] *3*	48[§] *10*	206.08	7/2$^{(+)}$	M1(+E2)	<1.5	0.0164 *21*	α(K)=0.0139 *20*; α(L)=0.00195 *15*; α(M)=0.00041 *3*; α(N+..)=0.000107 *9* α(N)=9.2×10^{-5} *7*; α(O)=1.47×10^{-5} *13*; α(P)=1.03×10^{-6} *17*
		646.7[‡] *3*	48 *8*	41.43	5/2$^{(+)}$				
730.83	(15/2$^-$)	372.8 *1*	100	358.06	(11/2$^-$)	E2		0.0260	B(E2)(W.u.)=81 *5* α(K)=0.0212 *3*; α(L)=0.00380 *6*; α(M)=0.000818 *12*; α(N+..)=0.000209 *3* α(N)=0.000180 *3*; α(O)=2.76×10^{-5} *4*; α(P)=1.426×10^{-6} *20*
777.48	(11/2$^+$)	260.1 *1*	7.5 *18*	517.41	9/2$^{(+)}$				Iγ: from weighted average of (p,2nγ) and (^{19}F,4nγ). Iγ=38 *15* in ^{135}Nd ε decay.
		532.0 *1*	100 *9*	245.48	7/2$^{(+)}$	(E2)		0.00954	α(K)=0.00796 *12*; α(L)=0.001249 *18*; α(M)=0.000266 *4*; α(N+..)=6.88×10^{-5} *10* α(N)=5.90×10^{-5} *9*; α(O)=9.20×10^{-6} *13*; α(P)=5.57×10^{-7} *8*
799.25	9/2$^{(-)}$	256.0 *1*	18 *2*	543.17	7/2$^{(-)}$	M1(+E2)	<0.35	0.0950 *15*	α(K)=0.0807 *15*; α(L)=0.01122 *25*; α(M)=0.00237 *6*; α(N+..)=0.000620 *14* α(N)=0.000529 *12*; α(O)=8.48×10^{-5} *16*; α(P)=6.11×10^{-6} *15*
		441.2 *2*	100 *7*	358.06	(11/2$^-$)	M1,E2		0.020 *4*	α(K)=0.016 *4*; α(L)=0.00242 *22*; α(M)=0.00051 *5*; α(N+..)=0.000133 *12* α(N)=0.000114 *10*; α(O)=1.80×10^{-5} *20*; α(P)=1.2×10^{-6} *3*
951.68	(13/2$^-$)	220.89 *10*	10 *3*	730.83	(15/2$^-$)	(M1)		0.1421	α(K)=0.1213 *17*; α(L)=0.01647 *24*; α(M)=0.00347 *5*; α(N+..)=0.000910 *13* α(N)=0.000776 *11*; α(O)=0.0001250 *18*; α(P)=9.26×10^{-6} *13*
		593.9 *2*	100 *13*	358.06	(11/2$^-$)	M1+E2	−1.5 *10*	0.0083 *19*	α(K)=0.0071 *17*; α(L)=0.00101 *17*; α(M)=0.00021 *4*; α(N+..)=5.6×10^{-5} *9* α(N)=4.8×10^{-5} *8*; α(O)=7.6×10^{-6} *14*; α(P)=5.1×10^{-7} *14*
985.38	(9/2$^+$)	468.0[‡] *2*	7.5 *18*	517.41	9/2$^{(+)}$				
		739.9[§] *5*	100[§] *15*	245.48	7/2$^{(+)}$	M1+E2	−2.0 *15*	0.0046 *14*	α(K)=0.0039 *12*; α(L)=0.00055 *13*; α(M)=0.00012 *3*; α(N+..)=3.0×10^{-5} *7* α(N)=2.6×10^{-5} *6*; α(O)=4.1×10^{-6} *11*; α(P)=2.8×10^{-7} *10*
		779.2[§] *5*	70[§] *15*	206.08	7/2$^{(+)}$				
1016.86		499.6 *2*	21 *8*	517.41	9/2$^{(+)}$				
		523.3 *2*	100 *8*	493.48	7/2$^{(+)}$				
		771.0 *5*	75 *20*	245.48	7/2$^{(+)}$				

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Adopted Levels, Gammas (continued)

γ(^{135}Pr) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[&]	δ[&]	α[@]	Comments
1089.91	(5/2$^+$,7/2,9/2$^+$)	572.3 *2*	26 *5*	517.41	9/2$^{(+)}$				
		596.6 *2*	53 *16*	493.48	7/2$^{(+)}$				
		1048.6 *5*	100 *25*	41.43	5/2$^{(+)}$				
1104.90		587.6 *2*	58 *17*	517.41	9/2$^{(+)}$				
		611.0 *3*	100 *25*	493.48	7/2$^{(+)}$				
		899.3 *5*	83 *30*	206.08	7/2$^{(+)}$				
1160.2	(9/2$^-$)	617.0 *3*	100	543.17	7/2$^{(-)}$	D+Q	−2.0 *15*		E_γ: from (p,nγ).
1181.49	(7/2$^+$,9/2)	404.0 *1*	42 *11*	777.48	(11/2$^+$)				
		664.4 *4*	53 *20*	517.41	9/2$^{(+)}$				
		687.8 *4*	47 *16*	493.48	7/2$^{(+)}$				
		975.3 *5*	100 *20*	206.08	7/2$^{(+)}$				
1185.15	(9/2$^-$,11/2$^-$)	233.56 *10*	91 *10*	951.68	(13/2$^-$)	M1,E2		0.118 *5*	α(K)=0.096 *9*; α(L)=0.017 *4*; α(M)=0.0037 *8*; α(N+..)=0.00095 *18* α(N)=0.00082 *16*; α(O)=0.000126 *19*; α(P)=6.7×10^{-6} *13*
		385.8 *1*	100 *14*	799.25	9/2$^{(-)}$	(E2)		0.0235	α(K)=0.0192 *3*; α(L)=0.00339 *5*; α(M)=0.000729 *11*; α(N+..)=0.000187 *3* α(N)=0.0001609 *23*; α(O)=2.46×10^{-5} *4*; α(P)=1.298×10^{-6} *19*
1214.24	(7/2$^-$,9/2$^-$,11/2$^-$)	415.0 *1*	100 *14*	799.25	9/2$^{(-)}$	M1,E2		0.023 *4*	α(K)=0.019 *4*; α(L)=0.00288 *21*; α(M)=0.00061 *4*; α(N+..)=0.000159 *12* α(N)=0.000136 *10*; α(O)=2.14×10^{-5} *20*; α(P)=1.4×10^{-6} *4*
		670.6 *7*	46 *18*	543.17	7/2$^{(-)}$				E_γ,I_γ: from ^{135}Nd ε decay. Other Iγ=127 *43* in (p,nγ).
		1172.1[#] *7*	100 *32*	41.43	5/2$^{(+)}$				From ^{135}Nd ε decay only.
1221.5	(11/2$^+$)	704.1 *5*	77 *25*	517.41	9/2$^{(+)}$	D+Q	+3.3 *27*		
		728.0 *5*	100 *40*	493.48	7/2$^{(+)}$				
1232.2	(13/2$^+$)	455 *1*	31 *15*	777.48	(11/2$^+$)				From (^{19}F,4nγ) only.
		714.8 *4*	100 *31*	517.41	9/2$^{(+)}$	E2		0.00454	α(K)=0.00383 *6*; α(L)=0.000555 *8*; α(M)=0.0001175 *17*; α(N+..)=3.05×10^{-5} *5* α(N)=2.61×10^{-5} *4*; α(O)=4.13×10^{-6} *6*; α(P)=2.73×10^{-7} *4*
1289.60	(11/2$^-$)	490.4 *2*	100 *18*	799.25	9/2$^{(-)}$	M1+E2	−1.5 *10*	0.014 *3*	α(K)=0.011 *3*; α(L)=0.00172 *21*; α(M)=0.00036 *4*; α(N+..)=9.5×10^{-5} *12* α(N)=8.1×10^{-5} *10*; α(O)=1.28×10^{-5} *18*; α(P)=8.3×10^{-7} *23*
		746.1 *5*	88 *30*	543.17	7/2$^{(-)}$				I_γ: from ^{135}Nd ε decay. Other: 143 *75* in (p,2nγ).
1303.1	(11/2$^-$)	351.6 *5*	100 *20*	951.68	(13/2$^-$)				
		572.0 *5*	55 *20*	730.83	(15/2$^-$)				
1306.63	($^-$)	575.8 *2*	100	730.83	(15/2$^-$)	(E2)		0.00776	α(K)=0.00650 *10*; α(L)=0.000995 *14*; α(M)=0.000212 *3*; α(N+..)=5.48×10^{-5} *8* α(N)=4.70×10^{-5} *7*; α(O)=7.35×10^{-6} *11*; α(P)=4.57×10^{-7} *7*

Adopted Levels, Gammas (continued)

γ(^{135}Pr) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[&]	δ[&]	α[@]	Comments
1325.3	(11/2$^+$)	637.4 *3*	32 *7*	688.10	(9/2$^+$)	D+Q	−7 *3*		
		807.4 *5*	100 *20*	517.41	9/2$^{(+)}$	D+Q			δ: +0.2 *1* or >30.
		1079.6 *8*	39 *10*	245.48	7/2$^{(+)}$				
1351.8		1145.7 *8*	100	206.08	7/2$^{(+)}$				
1390.9	(19/2$^-$)	660.1 *3*	100	730.83	(15/2$^-$)	(E2)			B(E2)(W.u.)=46 *12*
1409.9		632.5 *3*	11 *4*	777.48	(11/2$^+$)				
		721.6 *5*	100 *20*	688.10	(9/2$^+$)				
1433.3	(17/2$^-$)	481.6 *3*	100 *19*	951.68	(13/2$^-$)				
		702.5 *5*	11 *4*	730.83	(15/2$^-$)				I_γ: from (p,nγ). Other: 64 *18* in ^{120}Sn(^{19}F,4nγ).
1460.8	(11/2$^+$)	683.5 *4*	19 *8*	777.48	(11/2$^+$)				
		943.0 *5*	100 *19*	517.41	9/2$^{(+)}$	D+Q	+5.1 *44*		
1478.2	(17/2$^-$)	527 *1*	6 *3*	951.68	(13/2$^-$)				From (^{19}F,4nγ) only.
		747.1 *5*	100 *15*	730.83	(15/2$^-$)	D			
1506.0	(15/2$^+$)	274 *1*	9 *3*	1232.2	(13/2$^+$)	D			From (^{19}F,4nγ) only.
		728.5 *5*	100 *15*	777.48	(11/2$^+$)	(Q)			
1507.8	(11/2$^+$)	708.4 *5*	12 *4*	799.25	9/2$^{(-)}$				
		990.1 *5*	100 *19*	517.41	9/2$^{(+)}$	D+Q	+6 *4*		
		1014.6 *5*	8 *4*	493.48	7/2$^{(+)}$				
		1302.0 *8*	42 *12*	206.08	7/2$^{(+)}$				
1531.9		843.7 *5*	100 *30*	688.10	(9/2$^+$)				
		1038.6 *5*	100 *30*	493.48	7/2$^{(+)}$				
1571.1		1077.6 *8*	91 *30*	493.48	7/2$^{(+)}$				
		1325.6 *8*	100 *30*	245.48	7/2$^{(+)}$				
1636.4	(13/2$^+$)	651.0 *3*	100 *19*	985.38	(9/2$^+$)	(Q)			
		858.8 *5*	19 *7*	777.48	(11/2$^+$)				
1742.2		1224.8 *8*	100	517.41	9/2$^{(+)}$				
1766.0	(7/2$^-$,9/2$^-$,11/2$^-$)	966.7 *5*	100	799.25	9/2$^{(-)}$	D+Q			
1794.2		1063.4 *5*	100	730.83	(15/2$^-$)				
1816.0	(−)	425.1 *1*	100	1390.9	(19/2$^-$)	M1,E2		0.022 *4*	α(K)=0.018 *4*; α(L)=0.00268 *22*; α(M)=0.00057 *4*; α(N+..)=0.000148 *12* α(N)=0.000127 *10*; α(O)=2.00×10^{-5} *20*; α(P)=1.3×10^{-6} *4*
1904.9		1127.4 *8*	100	777.48	(11/2$^+$)				
1928.6	(19/2$^-$)	450 *1*	87 *26*	1478.2	(17/2$^-$)	D			
		495 *1*	22 *7*	1433.3	(17/2$^-$)				
		1198 *1*	100 *30*	730.83	(15/2$^-$)	(Q)			
1959.2		568.3 *2*	100	1390.9	(19/2$^-$)				
1998.0	(7/2,9/2,11/2$^+$)	1480.7 *7*	58 *18*	517.41	9/2$^{(+)}$				
		1752.0 *15*	100 *50*	245.48	7/2$^{(+)}$				
2002.8		1272.0 *8*	100	730.83	(15/2$^-$)				
2014.0		1283.2 *8*	100	730.83	(15/2$^-$)				

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Adopted Levels, Gammas (continued)

γ(^{135}Pr) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[&]	Comments
2104.4		1373.6 *8*	100	730.83	(15/2$^-$)		
2116.5	(17/2$^+$)	884.3 *5*	100	1232.2	(13/2$^+$)		
2129.2?	(7/2,9/2,11/2$^-$)	1586.0 *7*	100	543.17	7/2$^{(-)}$		
2155.9		722.6 *5*	100	1433.3	(17/2$^-$)		
2158.5	(21/2$^-$)	725 *1*	32 *9*	1433.3	(17/2$^-$)		
		768 *1*	100 *29*	1390.9	(19/2$^-$)		
2204.7	(21/2$^-$)	726 *1*	72 *22*	1478.2	(17/2$^-$)		
		814 *1*	100 *31*	1390.9	(19/2$^-$)	D	
2244.9	(23/2$^-$)	854 *1*	100	1390.9	(19/2$^-$)	(E2)	B(E2)(W.u.)=33 *2*
2346.9	(23/2$^-$)	956 *1*	100	1390.9	(19/2$^-$)	Q	
2355.9		965 *1*	100	1390.9	(19/2$^-$)		
2373.0	(19/2$^+$)	867 *1*	100	1506.0	(15/2$^+$)	(Q)	
2395.9	(19/2$^+$)	890 *1*	100	1506.0	(15/2$^+$)	(Q)	
2589.9	(21/2$^+$)	194 *1*	100 *20*	2395.9	(19/2$^+$)	D	
		217 *1*	33 *10*	2373.0	(19/2$^+$)	D	
		1199 *1*	76 *15*	1390.9	(19/2$^-$)	D	
2617.8	(21/2$^+$)	689 *1*	100 *20*	1928.6	(19/2$^-$)		
		1227 *1*	39 *12*	1390.9	(19/2$^-$)		
2754.7		596 *1*	63 *19*	2158.5	(21/2$^-$)		
		826 *1*	42 *12*	1928.6	(19/2$^-$)		
		1364 *1*	100 *19*	1390.9	(19/2$^-$)		
2846.9	(23/2$^+$)	257 *1*	100 *15*	2589.9	(21/2$^+$)	D	
		451 *1*	3.5 *18*	2395.9	(19/2$^+$)		
2900.9	(23/2$^+$)	554 *1*	61 *18*	2346.9	(23/2$^-$)	(D)	
		656 *1*	100 *20*	2244.9	(23/2$^-$)	(D)	
3001.0	(25/2$^-$)	756 *1*	42 *13*	2244.9	(23/2$^-$)	D	
		796 *1*	100 *20*	2204.7	(21/2$^-$)	(Q)	
		843 *1*	18 *5*	2158.5	(21/2$^-$)		
3123.9	(25/2$^+$)	277 *1*	100 *21*	2846.9	(23/2$^+$)	D	
		506 *1*	42 *13*	2617.8	(21/2$^+$)	(Q)	
		879 *1*	99 *19*	2244.9	(23/2$^-$)	D	
3204.9	(25/2)	358 *1*	100	2846.9	(23/2$^+$)	D	
3244.8	(27/2$^-$)	1000 *1*	100	2244.9	(23/2$^-$)	Q	
3421.9	(27/2$^+$)	521 *1*	100 *20*	2900.9	(23/2$^+$)	Q	
		575 *1*	52 *16*	2846.9	(23/2$^+$)	(Q)	
3488.8		871 *1*	100	2617.8	(21/2$^+$)		
3517.7		763 *1*	100	2754.7			
3530.8		776 *1*	100 *31*	2754.7			
		1286 *1*	89 *28*	2244.9	(23/2$^-$)		
3642.9	(27/2)	438 *1*	100	3204.9	(25/2)	D	
3658.9	(29/2$^+$)	535 *1*	100	3123.9	(25/2$^+$)	(Q)	
3862.8		332 *1*	69 *20*	3530.8			

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Adopted Levels, Gammas (continued)

γ(^{135}Pr) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[&]
3862.8		345 *1*	28 *9*	3517.7		
		374 *1*	100 *20*	3488.8		
3957.0	(29/2$^-$)	956 *1*	100	3001.0	(25/2$^-$)	
4107.9	(31/2$^+$)	686 *1*	100	3421.9	(27/2$^+$)	(Q)
4219.9	(31/2)	263 *1*	14 *4*	3957.0	(29/2$^-$)	
		561 *1*	100 *20*	3658.9	(29/2$^+$)	D
4292.8		430 *1*	100 *20*	3862.8		
		1048 *1*	46 *14*	3244.8	(27/2$^-$)	
4319.8	(31/2$^-$)	1075 *1*	100	3244.8	(27/2$^-$)	(Q)
4393.8		1149 *1*	100	3244.8	(27/2$^-$)	
4464.9	(33/2$^+$)	806 *1*	100	3658.9	(29/2$^+$)	(Q)
4704.8		385 *1*	32 *10*	4319.8	(31/2$^-$)	
		412 *1*	100 *20*	4292.8		
4964.9	(35/2$^+$)	857 *1*	100	4107.9	(31/2$^+$)	(Q)
5030.8		326 *1*	100	4704.8		
5069.0	(33/2$^-$)	1112 *1*	100	3957.0	(29/2$^-$)	(Q)
5163.8	(35/2$^-$)	844 *1*	100 *20*	4319.8	(31/2$^-$)	(Q)
		871 *1*	14 *5*	4292.8		
5336.8		1044 *1*	100	4292.8		
5420.9	(37/2$^+$)	956 *1*	100	4464.9	(33/2$^+$)	(Q)
5454.8		424 *1*	100	5030.8		
5953.8		499 *1*	100	5454.8		
5973.9	(39/2$^+$)	1009 *1*	100	4964.9	(35/2$^+$)	(Q)
5997.8	(39/2$^-$)	834 *1*	100	5163.8	(35/2$^-$)	(Q)
6500.9	(41/2$^+$)	1080 *1*	100	5420.9	(37/2$^+$)	(Q)
6510.8		557 *1*	100	5953.8		
6879.8	(43/2$^-$)	882 *1*	100	5997.8	(39/2$^-$)	(Q)
6978.9	(43/2$^+$)	1005 *1*	100	5973.9	(39/2$^+$)	(Q)
7515?	(45/2$^+$)	1014[#] *1*	100	6500.9	(41/2$^+$)	
7802.8	(47/2$^-$)	923 *1*	100	6879.8	(43/2$^-$)	
7899?	(47/2$^+$)	920[#] *1*	100	6978.9	(43/2$^+$)	
8716?	(51/2$^-$)	913[#] *1*	100	7802.8	(47/2$^-$)	
9004?	(51/2$^+$)	1105[#] *1*	100	7899?	(47/2$^+$)	(Q)
9678?	(55/2$^-$)	962[#] *1*	100	8716?	(51/2$^-$)	(Q)
10745?	(59/2$^-$)	1067[#] *1*	100	9678?	(55/2$^-$)	(Q)

[†] For levels populated in more than one dataset, values represent weighted averages of available data, unless otherwise stated.
[‡] From (p,nγ) only.
[§] From (p,nγ). The γ ray is poorly defined in ^{135}Nd ε decay.
[&] For γ rays from low-spin (J≤9/2), the assignments are generally from ce data in ^{135}Nd ε decay. For high-spin states the assignments are from γ(θ) and ce data in ^{136}Ce(p,2nγ) and from γγ(θ)(DCO) data in ^{120}Sn(^{19}F,4nγ) reaction. The mult=Q most likely corresponds to E2 transition.
[@] 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.
[#] Placement of transition in the level scheme is uncertain.

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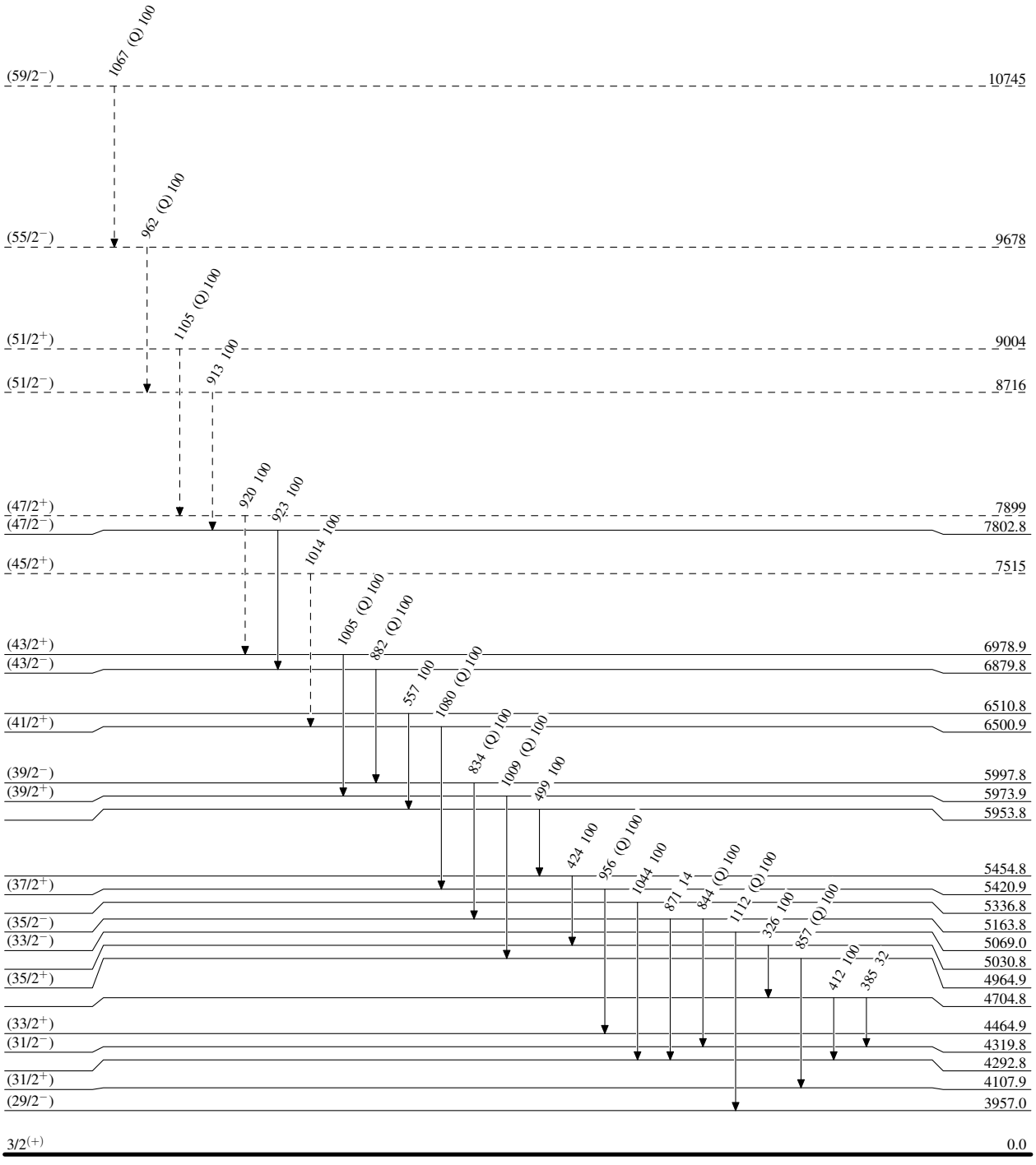
Adopted Levels, Gammas

Legend

Level Scheme

Intensities: Relative photon branching from each level

γ Decay (Uncertain)

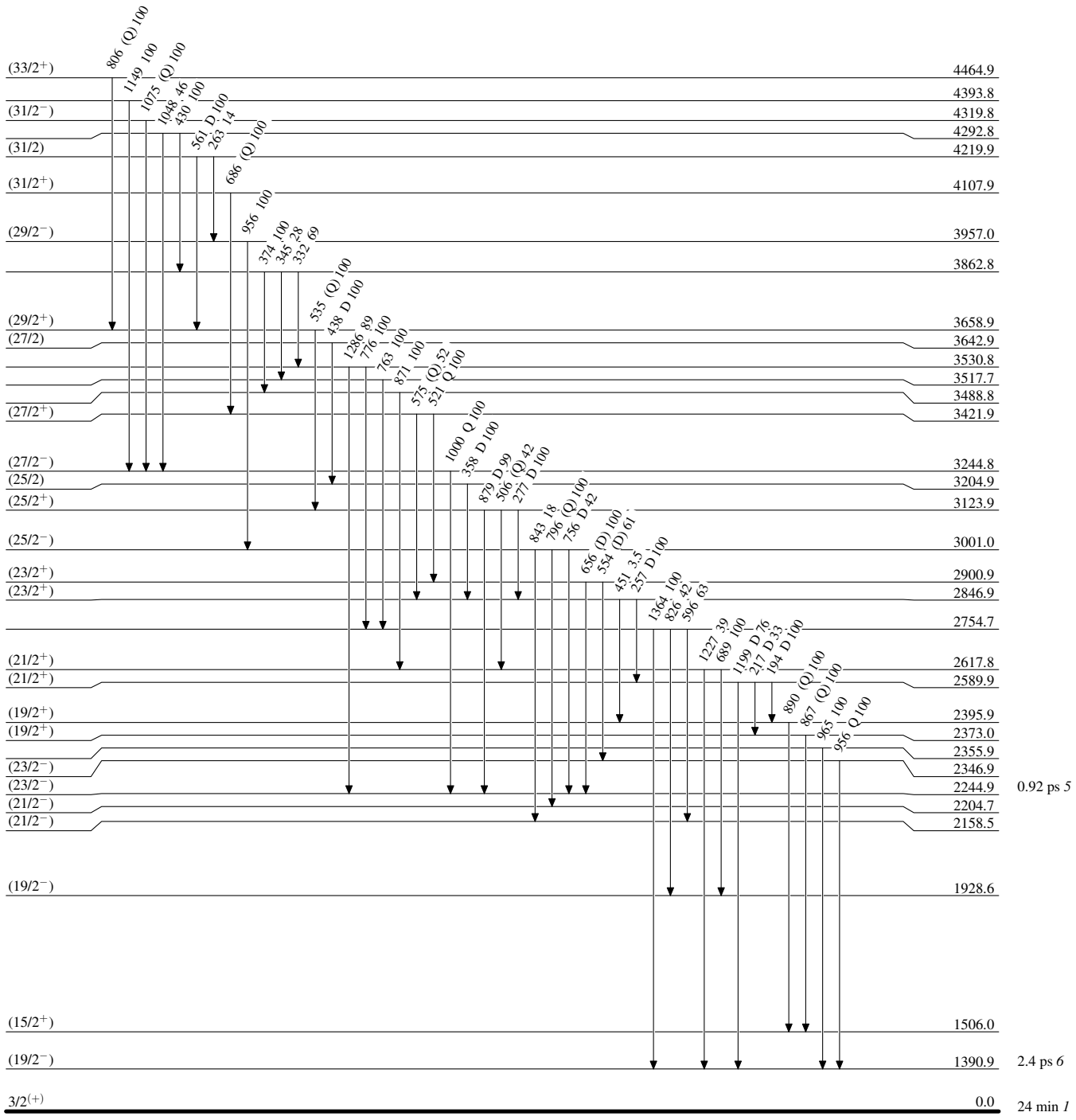


$^{135}_{59}Pr_{76}$

Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Relative photon branching from each level

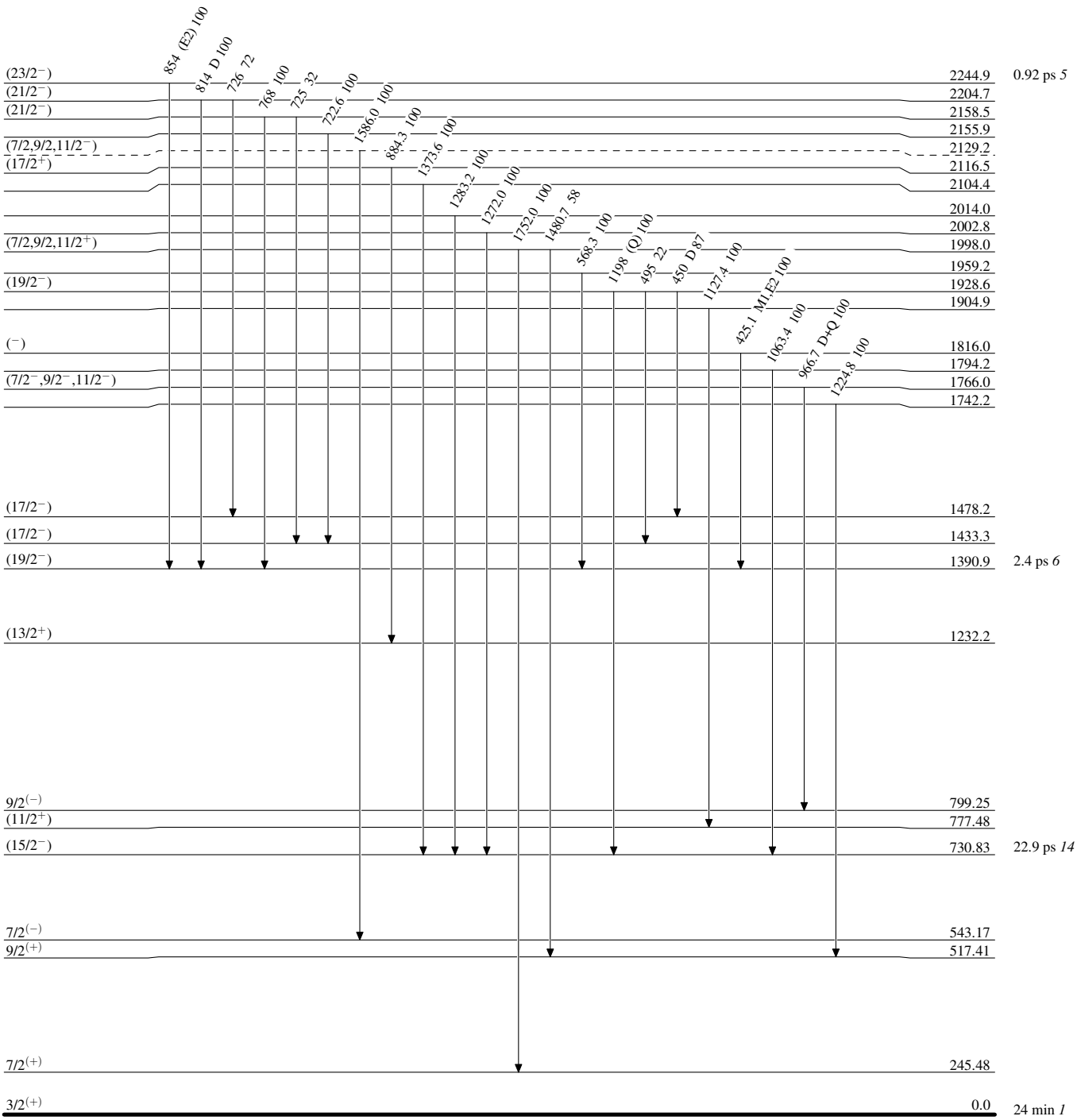


$^{135}_{59}Pr_{76}$

Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Relative photon branching from each level



$^{135}_{59}Pr_{76}$

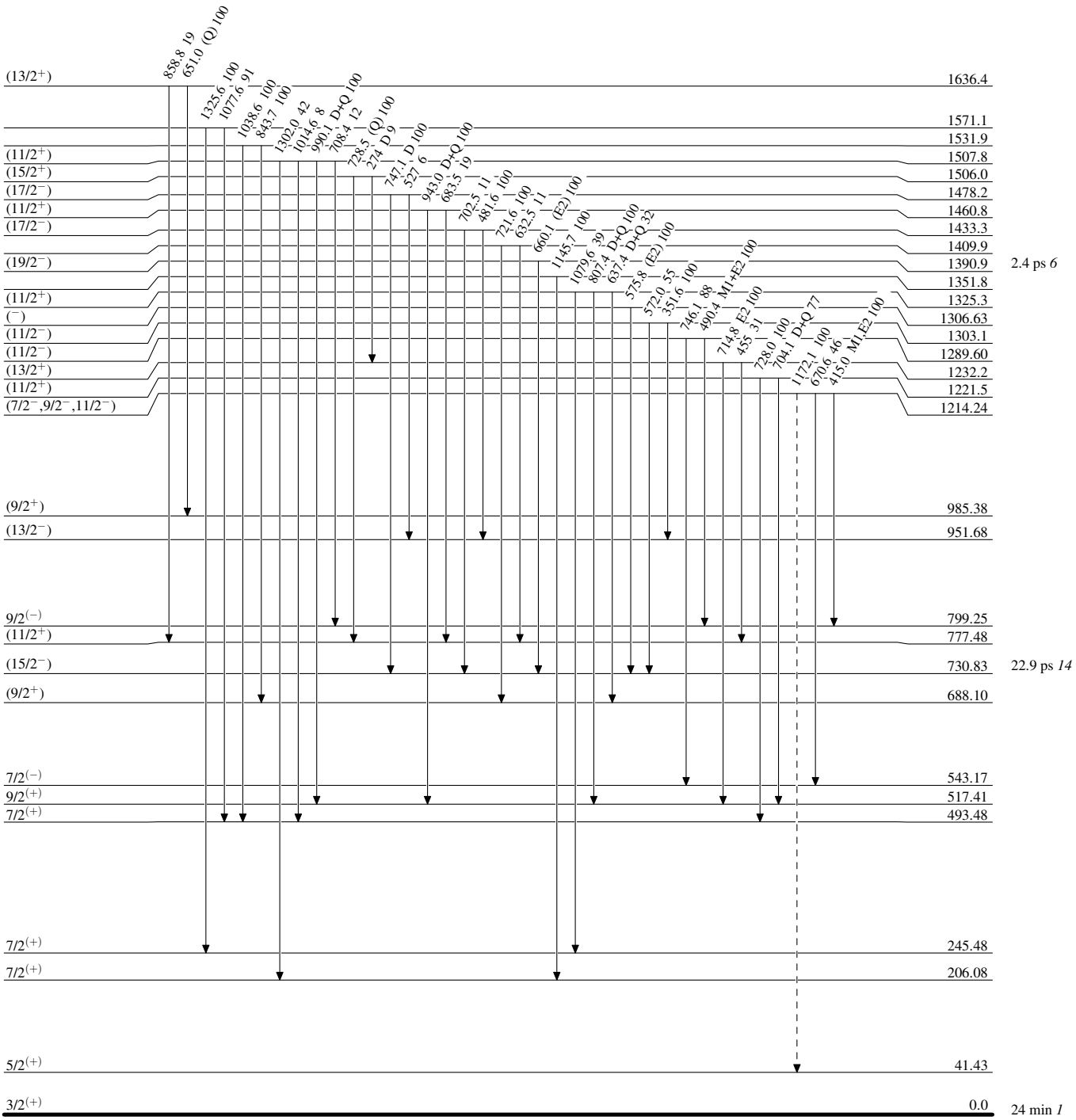
Adopted Levels, Gammas

Legend

Level Scheme (continued)

Intensities: Relative photon branching from each level

γ Decay (Uncertain)

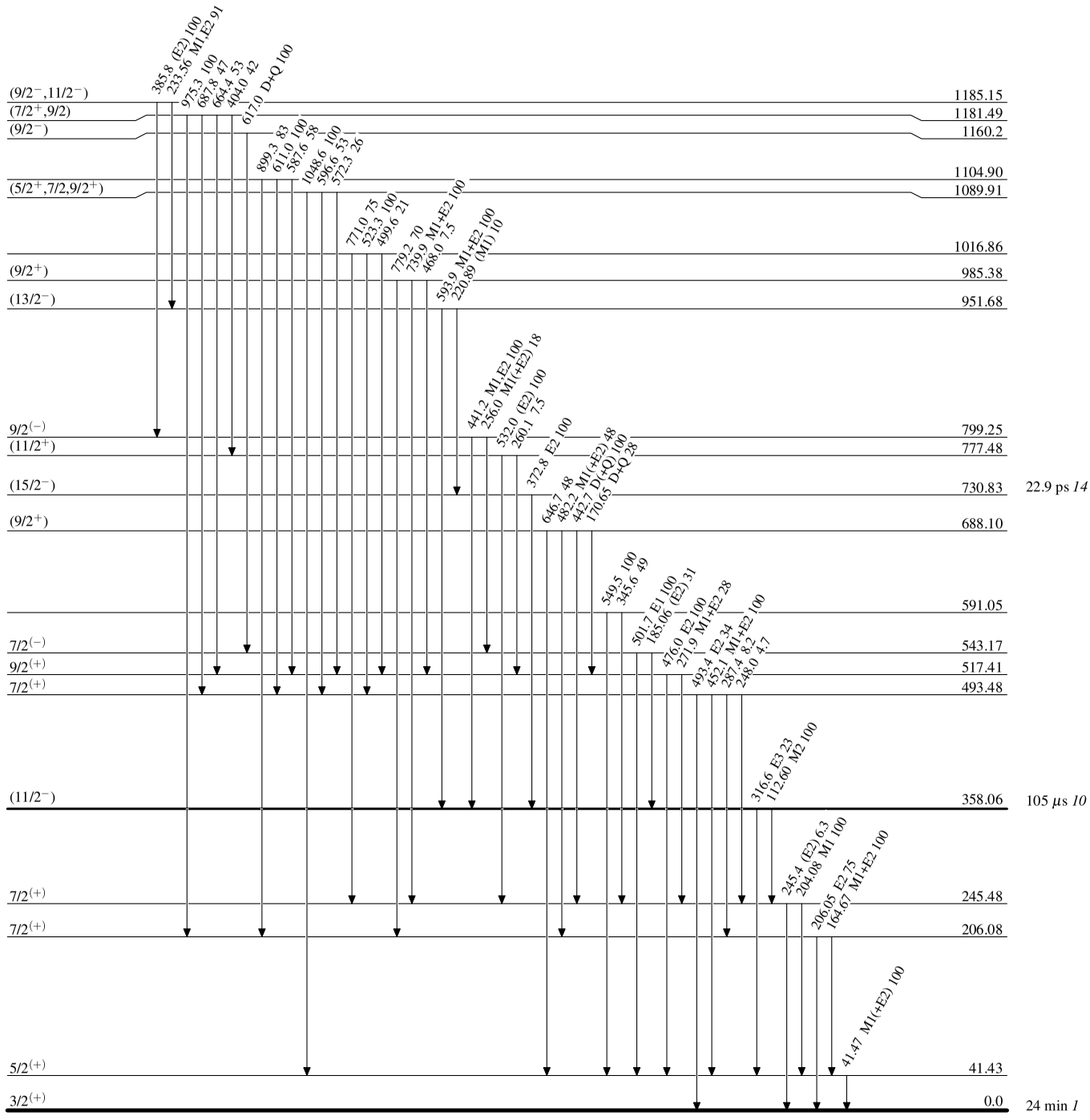


$^{135}_{59}Pr_{76}$

Adopted Levels, Gammas

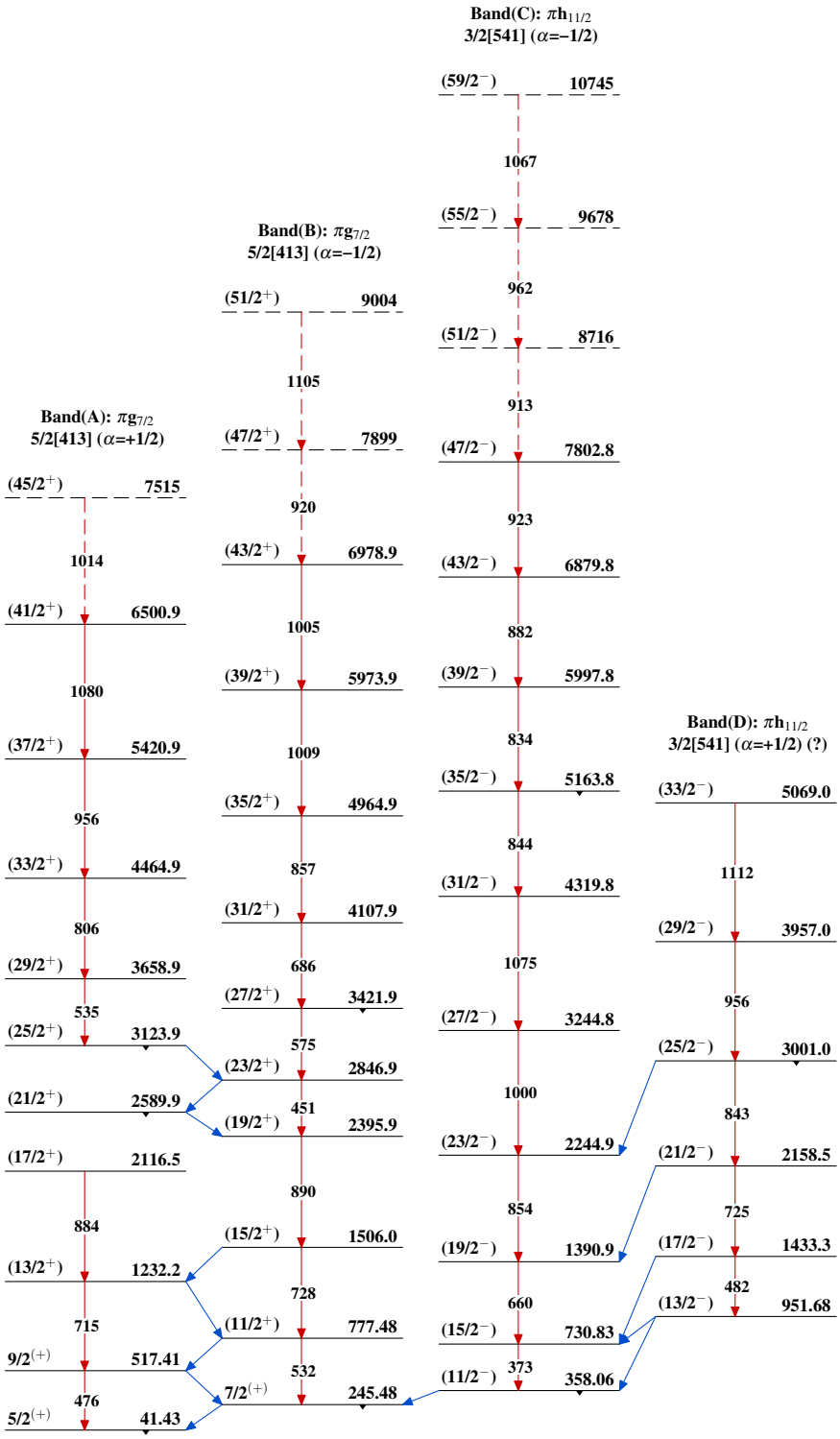
Level Scheme (continued)

Intensities: Relative photon branching from each level



$^{135}_{59}Pr_{76}$

Adopted Levels, Gammas



$^{135}_{59}Pr_{76}$