Adopted Levels, Gammas

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	A. A. Sonzogni	NDS 103,1 (2004)	31-Jul-2004

Q(β^-)=−2882 *24*; S(n)=8662 *24*; S(p)=3.40×10^3 *3*; Q(α)=6.7×10^2 *4* 2012Wa38

Note: Current evaluation has used the following Q record −2870 40 *8650* 40 *3380* 40 *690* 40 2003Au03.

Two long-lived isomers have been observed in ^{134}Pr. One of them with a $T_{1/2}$ of 17 min and J^π of 2^- was observed in the $\varepsilon+\beta^+$ decay of ^{134}Nd, which subsequently undergoes $\varepsilon+\beta^+$ decay to ^{134}Ce (1973Ar13); this level was also observed in heavy-ion induced reactions (2000Ga24). Another isomer with $T_{1/2}\approx$11 min was observed following heavy-ion reactions (1973Ar13, 2000Ga24), which decays by $\varepsilon+\beta^+$ to ^{134}Ce, reaching levels with J values from 4 to 8. Unfortunately, these $\varepsilon+\beta^+$ studies on the 11-min isomer can not assign it a definite J^π value; a (5^-) value (1994Se07) and a (7^-) value (2000Ga24) have been suggested. Two separate sets of short-lived levels in ^{134}Pr were observed in both decay and reaction studies. The lowest energy level observed following heavy-ion reactions has been associated with the 11-min level. A recent work (2003Ro09) has assigned a J^π value of (6^-) to this level based on systematic studies, gamma spectroscopy data and $\varepsilon+\beta^+$ decay properties. This assignment is adopted here with the all caveats aforementioned. The energy difference between the 2^- and (6^-) isomers is unknown. A recent ^{134}Pr mass measurement (2000Be42) was assigned to the 2^- isomer because it was thought that due to its larger $T_{1/2}$ and lower spin, it was most likely to be observed following 1-GeV proton-induced spallation of tantalum targets. An analysis of the data in the same paper indicates that the ^{134}Pr ground state is the 11-min isomer, while the 17-min 2^- isomer is at an excitation energy of 40 keV 200.

2004Br05: theoretical calculations on high-spin levels.

^{134}Pr Levels

Cross Reference (XREF) Flags

A ^{134}Nd ε decay
B (HI,xnγ)

E(level)	J^π†	$T_{1/2}$	XREF	Comments
0.0+x	2^-	17 min *2*	A	%ε+%β^+=100 $T_{1/2}$: from 1967Cl02. Others: 16.4 m 40 (1970Ab07), 18.5 m (1972Ek04). J^π: atomic beam (1976Fu06), E1 γ from 1^+. E(level): See comment on top of page.
115.6+x *4*	1^-		A	J^π: log *ft*=6.5 from 0^+ and M1,E2 γ to 2^-.
163.1+x *3*	1^+#		A	
216.7+x *4*	1^+#		A	
289.0+x *4*	1^+#		A	
335.9+x *4*	$(1,2)^+$		A	J^π: log *ft*>7 from 0^+, M1,E2 γ to 1^+, γ to 2^-.
352.5+x *4*	0,1@		A	
379.2+x *3*	1^+#		A	
433.3+x *6*	0,1@		A	
458.8+x *4*	0,1@		A	
472.4+x *4*	1^+#		A	
483.4+x *3*	1^+#		A	
583.0+x *5*			A	
631.0+x *6*	1^+#		A	
673.0+x *5*			A	
1155.1+x *6*	1^+#		A	
1216.7+x *11*	1^+#		A	
0.0+y	(6^-)	≈11 min	B	%ε+%β^+=100 No IT decay observed.

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Adopted Levels, Gammas (continued)

^{134}Pr Levels (continued)

E(level)	J^{π}[†]	$T_{1/2}$	XREF	Comments
				E(level): position of the 11-min isomer is unknown. E(level): x-y=40 keV 200 (2000Be42). J^{π}: See comment on top of page. $T_{1/2}$: from 1973Ar13.
306.50+y[b] *10*	(7^+)	3.18[‡] ns *7*	B	
345.8+y[b] *10*	(8^+)		B	
440.1+y[b] *15*	(9^+)		B	
611.0+y[b] *16*	(10^+)	3.4[‡] ps *8*	B	
898.1+y[b] *16*	(11^+)		B	
1204.3+y[b] *17*	(11^+)		B	
1235.3+y[c] *17*	(11^+)		B	
1236.7+y *17*	(11)		B	
1447.4+y *17*	(12^+)		B	
1482.0+y *17*	(12^+)		B	
1518.3+y[c] *17*	(12^+)		B	
1620.7+y[b] *17*	(13^+)		B	
1841.8+y[c] *17*	(13^+)		B	
2016.1+y[b] *17*	(13^+)		B	
2032.8+y[a] *21*	(11^-)		B	
2092.5+y[&] *18*	(14^+)		B	
2178.8+y[c] *17*	(14^+)		B	
2248.8+y[a] *18*	(12^-)		B	
2479.0+y[a] *18*	(13^-)		B	
2511.1+y[b] *18*	(14^+)		B	
2547.6+y[c] *17*	(15^+)		B	
2679.5+y[a] *18*	(14^-)		B	
2859.9+y[&] *21*	(16^+)		B	
2884.2+y[a] *18*	(15^-)		B	
2947.1+y[c] *18*	(16^+)		B	
2991.7+y[b] *18*	(15^+)		B	
3123.7+y[a] *19*	(16^-)		B	
3413.6+y[a] *19*	(17^-)		B	
3419.1+y[c] *19*	(17^+)		B	
3537.9+y[b] *19*	(16^+)		B	
3709.1+y[&] *23*	(18^+)		B	
3756.6+y[a] *20*	(18^-)		B	
3885.1+y[c] *19*	(18^+)		B	
4058.7+y[b] *20*	(17^+)		B	
4142.1+y[a] *20*	(19^-)		B	
4553.4+y[&] *25*	(20^+)		B	
4580.1+y[a] *21*	(20^-)		B	
4597.8+y[b] *20*	(18^+)		B	
4969.9+y[c]	(20^+)		B	
5056.1+y[a] *21*	(21^-)		B	
5097.0+y[b] *21*	(19^+)		B	
5376+y[&] *3*	(22^+)	296[‡] fs *16*	B	
5537.3+y[b] *21*	(20^+)		B	
5573.2+y[a] *22*	(22^-)		B	

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Adopted Levels, Gammas (continued)

^{134}Pr Levels (continued)

E(level)	Jπ†	$T_{1/2}$	XREF	E(level)	Jπ†	$T_{1/2}$	XREF
6010.6+y[b] *23*	(21$^+$)		B	12056+y[&] *4*	(34$^+$)		B
6123.2+y[a] *22*	(23$^-$)		B	0.0+z[d]			B
6258+y[&] *3*	(24$^+$)	205‡ fs *11*	B	871.51+z[d] *20*			B
6485.3+y[b] *24*	(22$^+$)		B	1819.7+z[d] *3*		166‡ fs *21*	B
6715.2+y[a] *23*	(24$^-$)		B	2829.2+z[d] *4*		116‡ fs *15*	B
7015.0+y[b]	(23$^+$)		B	3893.5+z[d] *4*		85‡ fs *11*	B
7236+y[&] *3*	(26$^+$)	87‡ fs *10*	B	5020.0+z[d] *5*		60‡ fs *8*	B
7327.2+y[a] *23*	(25$^-$)		B	6220.8+z[d] *5*		44‡ fs *6*	B
7973.2+y[a] *24*	(26$^-$)		B	7508.5+z[d] *6*		33‡ fs *4*	B
8311+y[&] *4*	(28$^+$)	71‡ fs *8*	B	8894.3+z[d] *6*		24‡ fs *3*	B
8649.7+y[a]	(27$^-$)	‡	B	10376.3+z[d] *6*		16.6‡ fs *21*	B
9478+y[&] *4*	(30$^+$)	53‡ fs *6*	B	11964.3+z[d] *7*			B
10730+y[&] *4*	(32$^+$)	40‡ fs *6*	B	13656.3+z[d] *12*			B

† Based on Logft values for levels seen in ^{134}Nd $\varepsilon+\beta^+$ decay, while on systematics, γ spectroscopy, band pattern for levels seen in (HI,xnγ) reactions.

‡ From (HI,xnγ) dataset.

From log *ft*=4.7-5.8 in $\varepsilon+\beta^+$ decay of ^{134}Nd(0$^+$).

@ From log *ft*=5.9-6.2 in $\varepsilon+\beta^+$ decay of ^{134}Nd(0$^+$).

& Band(A): $\pi h^3_{11/2}\nu 1/2[530]$, average transition quadrupole moment=3.9 eb 3 (1998Ra21).

[a] Band(B): $\pi 5/2[413]\nu 9/2[514]$.

[b] Band(C): $\pi h_{11/2}\nu h_{11/2}$.

[c] Band(D): $\pi 3/2[541]\nu h_{11/2}$.

[d] Band(E): Band based on Y level, possibly of negative parity, transition quadrupole moment=6.3 eb 4.

$\gamma(^{134}Pr)$

E_i(level)	J^π_i	E_γ	I_γ	E_f	J^π_f	Mult.
115.6+x	1$^-$	115.7 *5*	100	0.0+x	2$^-$	M1,E2
163.1+x	1$^+$	163.2 *5*	100	0.0+x	2$^-$	E1
216.7+x	1$^+$	101.2 *5*	18.779	115.6+x	1$^-$	E1
		216.8 *5*	100	0.0+x	2$^-$	[E1]
289.0+x	1$^+$	126.0 *5*	4.0179	163.1+x	1$^+$	[M1+E2]
		288.9 *5*	100	0.0+x	2$^-$	E1
335.9+x	(1,2)$^+$	119.4 *5*	100	216.7+x	1$^+$	M1,E2
		336.0 *5*	70	0.0+x	2$^-$	
352.5+x	0,1	189.4 *5*	100	163.1+x	1$^+$	
		352.0 *5*	88.235	0.0+x	2$^-$	
379.2+x	1$^+$	90.1 *5*	100	289.0+x	1$^+$	M1,E2
		379.1 *5*	47.368	0.0+x	2$^-$	[E1]
433.3+x	0,1	144.3 *5*	100	289.0+x	1$^+$	
458.8+x	0,1	295.5 *5*	100	163.1+x	1$^+$	
		459.0 *5*	37.931	0.0+x	2$^-$	
472.4+x	1$^+$	93.3 *5*	17.241	379.2+x	1$^+$	M1,E2
		183.5 *5*	48.276	289.0+x	1$^+$	[M1+E2]
		309.2 *5*	100	163.1+x	1$^+$	[M1+E2]
483.4+x	1$^+$	104.1 *5*	75	379.2+x	1$^+$	M1,E2
		130.6 *5*	22.5	352.5+x	0,1	
		147.8 *5*	55	335.9+x	(1,2)$^+$	

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Adopted Levels, Gammas (continued)

γ(^{134}Pr) (continued)

E_i(level)	J_i^π	E_γ	I_γ	E_f	J_f^π	Mult.
483.4+x	1^+	320.5 *5*	45	163.1+x	1^+	[M1+E2]
		483.5 *5*	100	0.0+x	2^-	[E1]
583.0+x		583.0 *5*	100	0.0+x	2^-	
631.0+x	1^+	467.9 *5*	100	163.1+x	1^+	
673.0+x		673.0 *5*	100	0.0+x	2^-	
1155.1+x	1^+	992.0 *5*	100	163.1+x	1^+	
1216.7+x	1^+	1000	100	216.7+x	1^+	
306.50+y	(7^+)	306.5 *1*	100	0.0+y	(6^-)	(E1)
345.8+y	(8^+)	39.3	100	306.50+y	(7^+)	M1
440.1+y	(9^+)	94.3	100	345.8+y	(8^+)	M1
611.0+y	(10^+)	171.0	100	440.1+y	(9^+)	
898.1+y	(11^+)	287.4	100	611.0+y	(10^+)	
		458.1	9	440.1+y	(9^+)	
1204.3+y	(11^+)	306.3		898.1+y	(11^+)	
		593.6		611.0+y	(10^+)	
1235.3+y	(11^+)	624.4	100	611.0+y	(10^+)	
		795	<5.6	440.1+y	(9^+)	
1236.7+y	(11)	339.0	100	898.1+y	(11^+)	
1447.4+y	(12^+)	210.3	100 *3*	1236.7+y	(11)	
		244	17 *10*	1204.3+y	(11^+)	
		836.0	33	611.0+y	(10^+)	
1482.0+y	(12^+)	245.0	100	1236.7+y	(11)	
		278	37.5	1204.3+y	(11^+)	
		871	25 *13*	611.0+y	(10^+)	
1518.3+y	(12^+)	282.9	86.4	1235.3+y	(11^+)	
		620.0	100	898.1+y	(11^+)	
		907.0	19.3 *7*	611.0+y	(10^+)	
1620.7+y	(13^+)	416.2	100	1204.3+y	(11^+)	
		722.4	41.2	898.1+y	(11^+)	
1841.8+y	(13^+)	323.6	100	1518.3+y	(12^+)	
		637.5	26.7	1204.3+y	(11^+)	
		944	<2.1	898.1+y	(11^+)	
2016.1+y	(13^+)	395.3	91.7	1620.7+y	(13^+)	
		811.5	100	1204.3+y	(11^+)	
2092.5+y	(14^+)	610.5	100	1482.0+y	(12^+)	
		645.0	56	1447.4+y	(12^+)	
2178.8+y	(14^+)	337.0	100	1841.8+y	(13^+)	
		558.1	26.7	1620.7+y	(13^+)	
		661.0	11 *6*	1518.3+y	(12^+)	
		975	<5.6	1204.3+y	(11^+)	
2248.8+y	(12^-)	216.0	50	2032.8+y	(11^-)	
		1044.5	100	1204.3+y	(11^+)	
2479.0+y	(13^-)	230.2	55.6	2248.8+y	(12^-)	
		446.0	<13.9	2032.8+y	(11^-)	
		858.2	100	1620.7+y	(13^+)	
2511.1+y	(14^+)	495.3	85	2016.1+y	(13^+)	
		890.3	100	1620.7+y	(13^+)	
2547.6+y	(15^+)	368.8	100	2178.8+y	(14^+)	
		531.3	36 *11*	2016.1+y	(13^+)	
		705.8	40.0 *22*	1841.8+y	(13^+)	
		927	33.333	1620.7+y	(13^+)	
2679.5+y	(14^-)	200.4	100	2479.0+y	(13^-)	
		663	26.6	2016.1+y	(13^+)	
		837.5	23.4	1841.8+y	(13^+)	
2859.9+y	(16^+)	767.5	100	2092.5+y	(14^+)	

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Adopted Levels, Gammas (continued)

γ(^{134}Pr) (continued)

E_i(level)	J_i^π	E_γ	I_γ	E_f	J_f^π
2884.2+y	(15$^-$)	204.4	100.0 *19*	2679.5+y	(14$^-$)
		404.5	<1.9	2479.0+y	(13$^-$)
		706	7.4 *4*	2178.8+y	(14$^+$)
2947.1+y	(16$^+$)	399.6	100	2547.6+y	(15$^+$)
		436.2	100 *5*	2511.1+y	(14$^+$)
		768.4	50 *23*	2178.8+y	(14$^+$)
		931	45.5	2016.1+y	(13$^+$)
2991.7+y	(15$^+$)	480.6	36.3	2511.1+y	(14$^+$)
		975.6	100	2016.1+y	(13$^+$)
3123.7+y	(16$^-$)	239.8	100	2884.2+y	(15$^-$)
		444.0	38.3	2679.5+y	(14$^-$)
3413.6+y	(17$^-$)	289.7	100	3123.7+y	(16$^-$)
		529.5	9.8 *4*	2884.2+y	(15$^-$)
3419.1+y	(17$^+$)	428	<25	2991.7+y	(15$^+$)
		472	65	2947.1+y	(16$^+$)
		872	<20	2547.6+y	(15$^+$)
		907.8	100 *5*	2511.1+y	(14$^+$)
3537.9+y	(16$^+$)	546.1	49.5	2991.7+y	(15$^+$)
		1026.8	100	2511.1+y	(14$^+$)
3709.1+y	(18$^+$)	849.1	100	2859.9+y	(16$^+$)
3756.6+y	(18$^-$)	342.8	100	3413.6+y	(17$^-$)
		633.0	23.5	3123.7+y	(16$^-$)
3885.1+y	(18$^+$)	466.0	10×10^1 *5*	3419.1+y	(17$^+$)
		938	100	2947.1+y	(16$^+$)
4058.7+y	(17$^+$)	520.8	24.8	3537.9+y	(16$^+$)
		1067.0	100	2991.7+y	(15$^+$)
4142.1+y	(19$^-$)	385.6	100	3756.6+y	(18$^-$)
		728.4	40.3	3413.6+y	(17$^-$)
4553.4+y	(20$^+$)	844.3	100	3709.1+y	(18$^+$)
4580.1+y	(20$^-$)	437.9	100	4142.1+y	(19$^-$)
		823.5	49.5	3756.6+y	(18$^-$)
4597.8+y	(18$^+$)	539	59.6	4058.7+y	(17$^+$)
		1059.8	100	3537.9+y	(16$^+$)
4969.9+y	(20$^+$)	1084	<100	3885.1+y	(18$^+$)
5056.1+y	(21$^-$)	476.0	100	4580.1+y	(20$^-$)
		914.2	42.9	4142.1+y	(19$^-$)
5097.0+y	(19$^+$)	499.3	43.3	4597.8+y	(18$^+$)
		1038.5	100	4058.7+y	(17$^+$)
5376+y	(22$^+$)	822.5	100	4553.4+y	(20$^+$)
5537.3+y	(20$^+$)	440.4	72.7	5097.0+y	(19$^+$)
		939.4	100	4597.8+y	(18$^+$)
5573.2+y	(22$^-$)	517.3	100	5056.1+y	(21$^-$)
		993	70.7	4580.1+y	(20$^-$)
6010.6+y	(21$^+$)	473	<20.4	5537.3+y	(20$^+$)
		913.5	100	5097.0+y	(19$^+$)
6123.2+y	(23$^-$)	550	100	5573.2+y	(22$^-$)
		1067	59 *3*	5056.1+y	(21$^-$)
6258+y	(24$^+$)	882.5	100	5376+y	(22$^+$)
6485.3+y	(22$^+$)	475	<50	6010.6+y	(21$^+$)
		948	100	5537.3+y	(20$^+$)
6715.2+y	(24$^-$)	592	100	6123.2+y	(23$^-$)
		1142	56	5573.2+y	(22$^-$)
7015.0+y	(23$^+$)	529	100	6485.3+y	(22$^+$)
		1004	100	6010.6+y	(21$^+$)
7236+y	(26$^+$)	977.4	100	6258+y	(24$^+$)

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Adopted Levels, Gammas (continued)

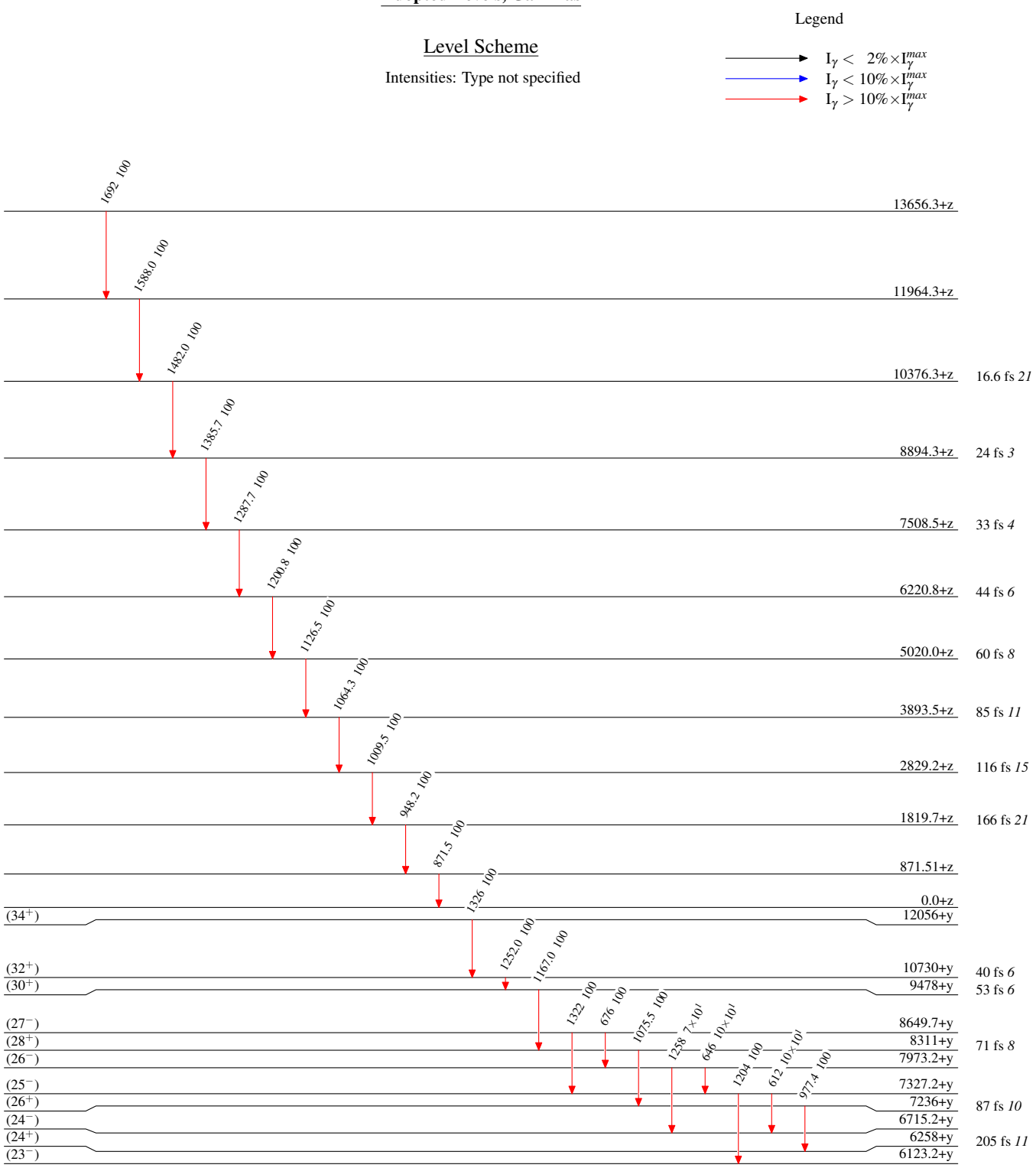
γ(^{134}Pr) (continued)

E_i(level)	J_i^π	E_γ	I_γ	E_f	J_f^π
7327.2+y	(25$^-$)	612	10×10^1 *4*	6715.2+y	(24$^-$)
		1204	100	6123.2+y	(23$^-$)
7973.2+y	(26$^-$)	646	10×10^1 *6*	7327.2+y	(25$^-$)
		1258	7×10^1 *3*	6715.2+y	(24$^-$)
8311+y	(28$^+$)	1075.5	100	7236+y	(26$^+$)
8649.7+y	(27$^-$)	676	100	7973.2+y	(26$^-$)
		1322	100	7327.2+y	(25$^-$)
9478+y	(30$^+$)	1167.0	100	8311+y	(28$^+$)
10730+y	(32$^+$)	1252.0	100	9478+y	(30$^+$)
12056+y	(34$^+$)	1326	100	10730+y	(32$^+$)
871.51+z		871.5 *2*	100	0.0+z	
1819.7+z		948.2 *2*	100	871.51+z	
2829.2+z		1009.5 *2*	100	1819.7+z	
3893.5+z		1064.3 *2*	100	2829.2+z	
5020.0+z		1126.5 *2*	100	3893.5+z	
6220.8+z		1200.8 *2*	100	5020.0+z	
7508.5+z		1287.7 *2*	100	6220.8+z	
8894.3+z		1385.7 *2*	100	7508.5+z	
10376.3+z		1482.0 *2*	100	8894.3+z	
11964.3+z		1588.0 *2*	100	10376.3+z	
13656.3+z		1692 *1*	100	11964.3+z	

Adopted Levels, Gammas

Level Scheme

Intensities: Type not specified

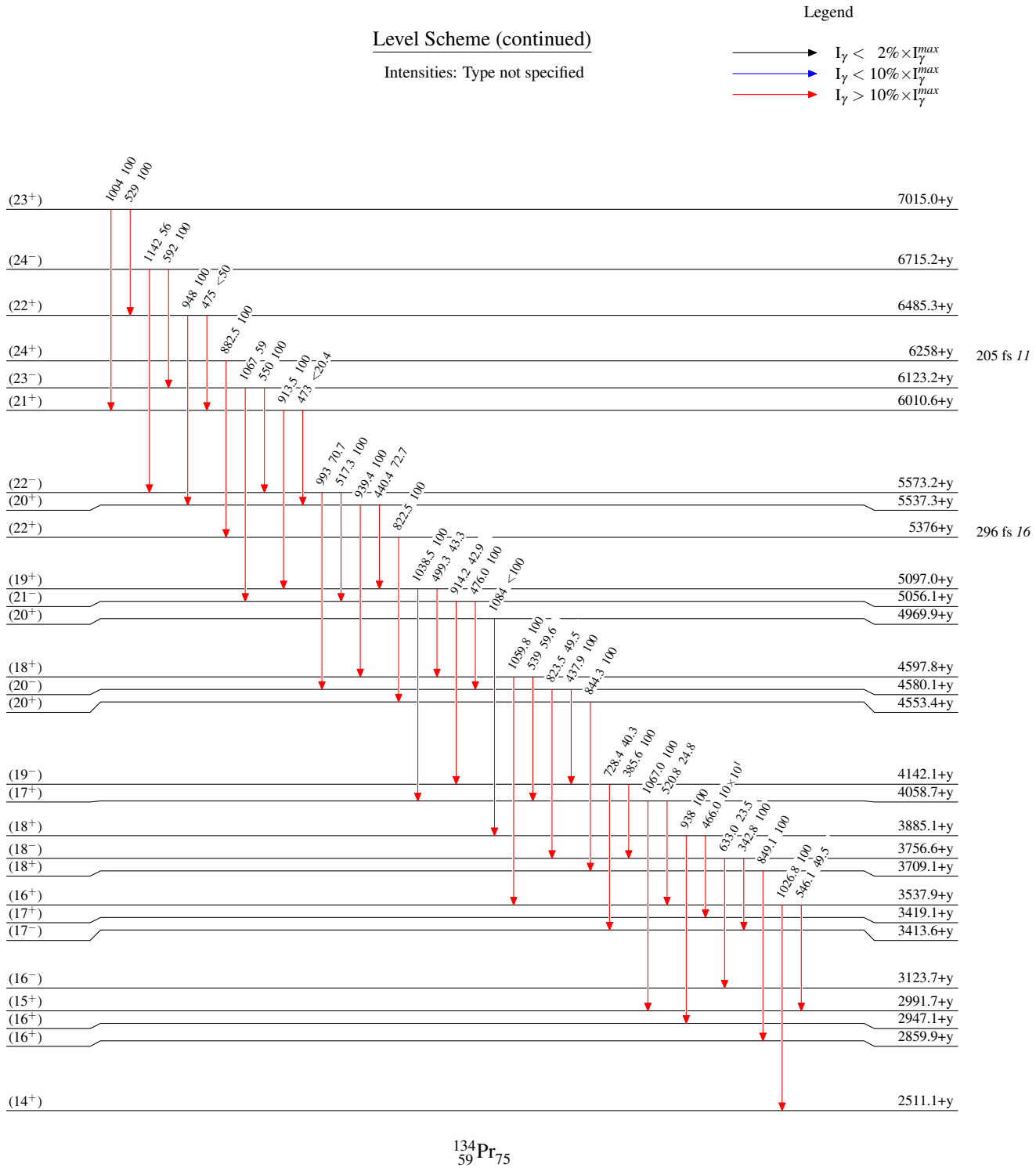


$^{134}_{59}Pr_{75}$

Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Type not specified

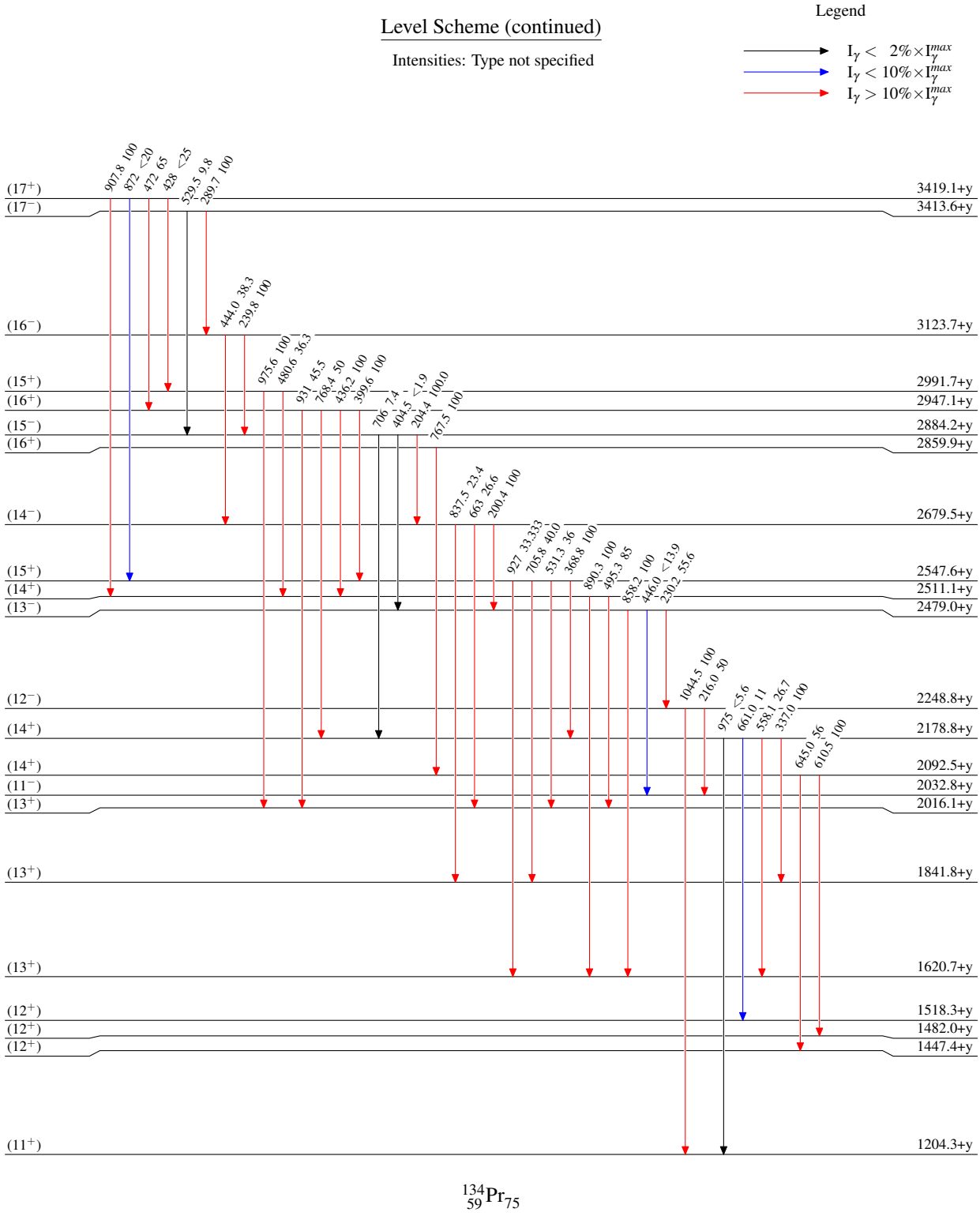


$^{134}_{59}Pr_{75}$

Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Type not specified

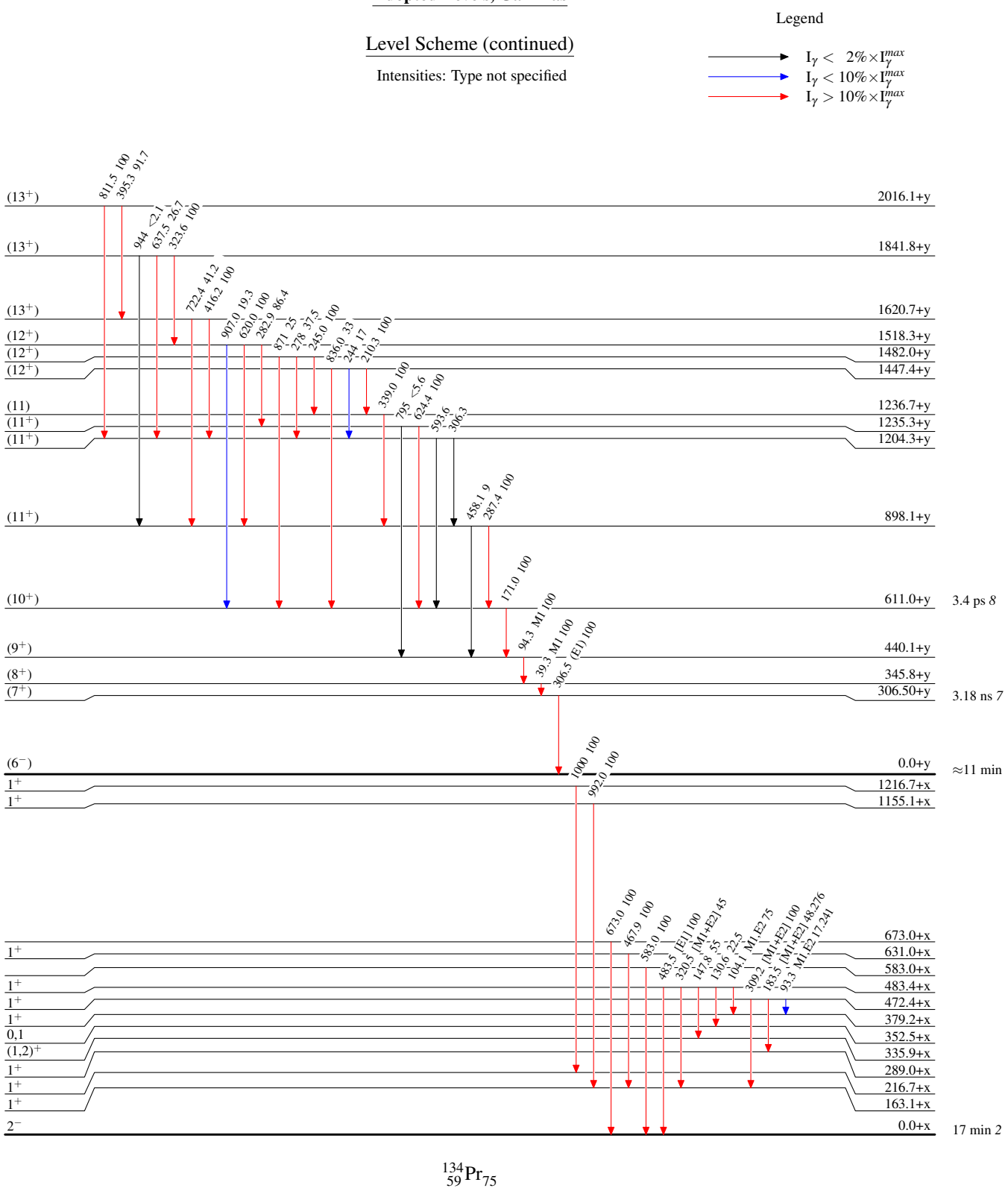


$^{134}_{59}Pr_{75}$

Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Type not specified

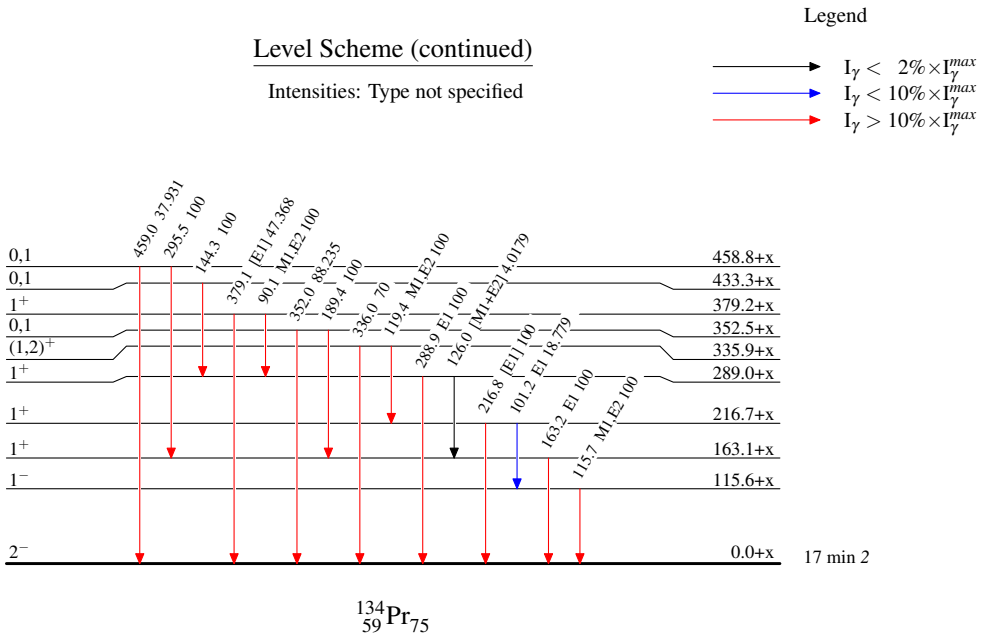


$^{134}_{59}Pr_{75}$

Adopted Levels, Gammas

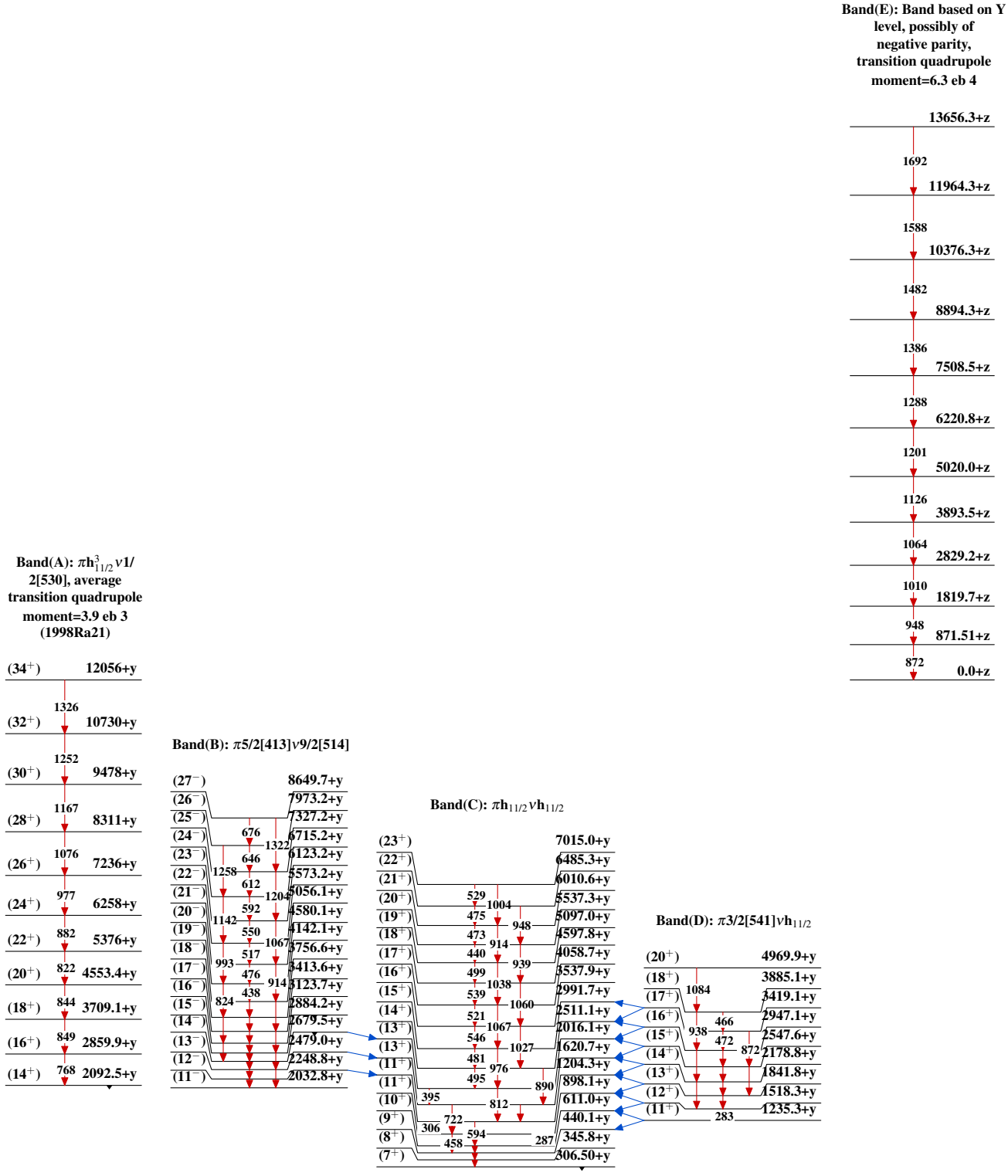
Level Scheme (continued)

Intensities: Type not specified



$^{134}_{59}Pr_{75}$

Adopted Levels, Gammas



$^{134}_{59}Pr_{75}$