^{132}Pr ε decay (1.6 min) 1998Ga43

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Yu. Khazov, A. A. Rodionov and S. Sakharov, Balraj Singh	NDS 104, 497 (2005)	10-Feb-2005

Parent: ^{132}Pr: E=0.0; $J^\pi=(2)^+$; $T_{1/2}$=1.6 min *3*; Q(ε)=7260 *60*; %ε+%$β^+$ decay=100.0

^{132}Pr-Population of (8^-) isomer at 2342 suggests that a high-spin isomer of ^{132}Pr may also be contributing to the total ^{132}Pr activity. The activity is probably contributed by two isomers, although, only one activity of 1.6 min *3* with $J^\pi=(2)^+$ has been identified.

Low-lying high-spin levels are known from In-beam γ-ray studies, one of which could Be an isomer.

1998Ga43: ^{132}Pr was produced in ^{117}Sn(^{19}F,4n) reaction at E=75 MeV. Measured Eγ, γ branching ratios, γγ and γγ(θ) with OSIRIS cube spectrometer. Comparisons with detailed interacting-boson-model calculations.

1990Ko25 (also 1987Ko24): ^{132}Pr produced in ^{92}Mo(^{46}Ti,n5p) E=250 MeV followed by mass separation. 1987Ko24 used ^{112}Sn(^{28}Si,X) reaction at E=190, 220 MeV. Measured Eγ, Iγ, γγ. A total of 17 γ rays reported with 10 excited states. Possible feedings of 5^+ and 6^+ states seem to due to contribution from two isomers: a low spin and a high-spin.

1988Ba42: ^{96}Mo(^{40}Ca,X) at E=250 MeV. Measured Eγ, γγ. A total of 15 γ rays reported with 9 excited states. Numerical values of intensities were not given. Four of these γ rays were not reported by 1998Ga43 or 1990Ko25.

1974Ar27 (also 1974La32): ^{132}Pr produced in Ta(p,X) E=660 MeV. Measured $T_{1/2}$ of ^{132}Pr nuclide; Eγ of three γ rays with three levels proposed.

1964PeZY: $T_{1/2}$ and identification.

^{132}Ce Levels

E(level)†	J^π‡	Comments
0.0@	0^+	
325.40@ *7*	2^+	
822.21& *7*	2^+#	
858.91@ *8*	4^+	
1158.47a *9*	0^+#	
1199.48& *8*	3^+#	
1384.16& *8*	4^+#	
1497.14a *8*	2^+	
1543.18@ *12*	6^+	
1656.00 *9*		J^π: (5^+) (1998Ga43). E(level): may be a doublet.
1714.21 *13*		
1734.73 *9*	2^+#	
1808.43 *10*	$(2^+,3,4^+)$	J^π: 3^+,(3^-)(1998Ga43).
1814.77 *10*	(5^+)	
1892.8? *6*		E(level): level proposed by 1988Ba42 only.
1922.81 *9*	$(2^+,3,4^+)$	J^π: 2^+ (1998Ga43).
1932.02a *8*	(4^+)	J^π: 4^+,$(2^+,3^+)$ (1998Ga43).
1950.72 *8*	$(2^+,3,4^+)$	J^π: 3^+,4^+ (1998Ga43).
1996.51 *13*		J^π: not 0^+,1^-,3^- (1998Ga43).
2038.93 *9*		
2049.90 *13*		
2096.90 *9*	$(2^+,3,4^+)$	
2139.9 *10*	(4^-)	E(level): from figure 2 of 1998Ga43; not given in Table 4.
2145.71 *13*		J^π: 1^+,$2,3^+$ (1998Ga43).
2169.37 *11*		J^π: $1,2^+,3$ (1998Ga43).
2189.31 *13*		J^π: (not 3^-, 5^-) (1998Ga43).
2295.71 *13*		
2330.42 *13*		
2341.78 *12*	(8^-)	J^π: isomer from ^{132}Ce IT decay (2001Mo05). Population of this state suggests that a high-spin isomer of ^{132}Pr may also be contributing to this decay.

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^{132}Pr ε decay (1.6 min) 1998Ga43 (continued)

^{132}Ce Levels (continued)

E(level)†	Jπ‡	Comments
2365.02 *10*		Jπ: (not 3⁻,5⁻) (1998Ga43).
2379.31 *13*		
2379.81 *13*		
2450.81 *13*		
2464.62 *13*		
2483.02 *9*	(2⁺,3,4⁺)	
2508.77 *9*	(2⁺,3,4⁺)	Jπ: 4⁺,(3⁺,2⁺) (1998Ga43).
2554.17 *9*		
2562.61 *13*		
2577.86 *10*		Jπ: (2⁺) (1998Ga43).
2606.21 *10*		Jπ: not 0⁺ (1998Ga43).
2644.72 *13*		
2650.50 *13*		
2719.50 *13*		
2740.72 *9*	(2⁺,3,4⁺)	Jπ: (3,4⁺) (1998Ga43).
2758.6 *3*		
2761.92 *13*		
2825.92 *13*		
2835.90 *12*	(2⁺,3,4⁺)	
2857.67 *13*		
2864.22 *13*		
2866.98 *14*	(1,2⁺)	
2957.44 *13*		Jπ: 1⁺,2⁺,(0⁺) (1998Ga43).
2982.73 *23*		
2988.12 *10*	(3⁺,4⁺)	Jπ: 3⁺,4⁺,(3⁻) (1998Ga43).
3070.42 *13*		
3145.9 *3*		
3316.3 *3*		
3317.5 *3*		
3331.8 *3*		
3332.6 *3*		
3378.4 *3*	(2⁺,3,4⁺)	
3412.81 *13*		
3550.70 *11*		
3682.00 *11*		
3702.04 *23*	(2⁺,3,4⁺)	
3721.83 *13*		
3825.33 *13*		
3863.44 *13*		
3863.84 *13*	(2⁺,3,4⁺)	
4270.65 *13*		
4271.1 *4*		
4348.8 *4*		
4352.9 *4*		
4390.4 *5*		
4473.9 *4*		

† From least-squares fit to Eγ's.
‡ From Adopted Levels, unless otherwise stated. Assignments proposed by 1998Ga43 are given under comments when not supported by strong arguments.
# From γγ(θ) measurements.
@ Band(A): The g.s. band.
& Band(B): Possible γ band.
a Band(C): Possible β band.

^{132}Pr ε decay (1.6 min) 1998Ga43 (continued)

γ(^{132}Ce)

E_i(level)	J_i^π	E_γ[†]	I_γ[‡]	E_f	J_f^π	Mult.[#]	δ[#]	Comments
325.40	2+	325.4 *1*	100	0.0	0+			I_γ: 100 *5* (1990Ko25). Additional information 1.
822.21	2+	496.8 *1*	100 *20*	325.40	2+	E2+M1	+9 *+5−3*	I_γ: 25 *3* (1990Ko25). Additional information 2. (497γ)(325γ)(θ): W(180°)/W(90°)=0.98 *3*, W(55°)/W(90°)=0.757 *25*.
		822.2 *1*	75 *15*	0.0	0+			I_γ: 17.3 *17* (1990Ko25). Additional information 3.
858.91	4+	533.5 *1*	100	325.40	2+			I_γ: 15.2 *15* (1990Ko25). Additional information 4.
1158.47	0+	336.3 *1*	100 *20*	822.21	2+			(336γ)(822γ)(θ): W(180°)/W(90°)=1.89 *11*, W(55°)/W(90°)=0.53 *3*.
		833.1 *1*	52 *10*	325.40	2+			(833γ)(325γ)(θ): W(180°)/W(90°)=1.76 *10*, W(55°)/W(90°)=0.53 *3*.
1199.48	3+	340.6 *3*	5.5 *11*	858.91	4+	E2(+M1)	>+13	I_γ: <0.5 (1990Ko25). Additional information 5. δ: +39 +∞−26. (341γ)(534γ)(θ): W(180°)/W(90°)=0.87 *6*, W(55°)/W(90°)=1.10 *6*.
		377.3 *1*	31 *6*	822.21	2+	E2(+M1)	>+15	I_γ: 3.5 *8* (1990Ko25). Additional information 6. δ: +37 +∞−22. (377γ)(822γ)(θ): W(180°)/W(90°)=0.69 *4*, W(55°)/W(90°)=1.00 *4*.
		874.1 *1*	100 *20*	325.40	2+	E2+M1	+4.8 *6*	I_γ: 14.1 *14* (1990Ko25). Additional information 7. (874γ)(325γ)(θ): W(180°)/W(90°)=0.83 *3*, W(55°)/W(90°)=1.02 *4*.
1384.16	4+	525.3 *1*	42 *8*	858.91	4+	E2+M1		I_γ: 2.0 *6* (1990Ko25). Additional information 8. δ: +0.84 *+29−18* or ∞. (525γ)(534γ)(θ): W(180°)/W(90°)=0.92 *5*, W(55°)/W(90°)=0.87 *4*.
		562.0 *1*	100 *20*	822.21	2+			I_γ: 2.7 *6* (1990Ko25). Additional information 9. (562γ)(822γ)(θ): W(180°)/W(90°)=1.24 *8*, W(55°)/W(90°)=1.07 *6*.
		1058.7 *1*	10.0 *20*	325.40	2+			(1059γ)(325γ)(θ): W(180°)/W(90°)=1.13 *12*, W(55°)/W(90°)=0.91 *8*.
1497.14	2+	297.7 *1*	14 *3*	1199.48	3+	M1+E2		δ: +0.97 *+60−17* or +0.62 *+18−29*.
		338.7 *1*	46 *9*	1158.47	0+			(339γ)(336γ)(θ): W(180°)/W(90°)=1.03 *5*, W(55°)/W(90°)=1.06 *5*. (339γ)(833γ)(θ): W(180°)/W(90°)=1.03 *8*, W(55°)/W(90°)=1.00 *6*.
		674.9 *1*	100 *20*	822.21	2+	M1+E2	+0.41 *7*	I_γ: 6.3 *8* (1990Ko25). Additional information 10.
		1171.6 *1*	35 *7*	325.40	2+	M1+E2	−1.4 *2*	I_γ: 1.0 *5* (1990Ko25). Additional information 11.
		1497.2 *3*	3.7 *11*	0.0	0+			
1543.18	6+	684.3 *1*	100	858.91	4+			I_γ: <0.5 (?) (1990Ko25). Additional information 12.
1656.00		271.9 *3*	9.4 *19*	1384.16	4+			(272γ)(562γ)(θ): W(180°)/W(90°)=0.82 *9*, W(55°)/W(90°)=0.91 *7*.
		456.5 *1*	100 *20*	1199.48	3+			I_γ: 3.0 *8* (1990Ko25). Additional information 13.

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^{132}Pr ε decay (1.6 min) 1998Ga43 (continued)

γ(^{132}Ce) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[‡]	E_f	J_f^π	Mult.[#]	δ[#]	Comments
								(457γ)(377γ)(θ): W(180°)/W(90°)=1.05 *7*, W(55°)/W(90°)=0.95 *5*.
1656.00		797.1 *1*	27 *5*	858.91	4+			(797γ)(534γ)(θ): W(180°)/W(90°)=0.89 *7*, W(55°)/W(90°)=0.85 *6*.
1714.21		1388.8 *1*	100	325.40	2+			
1734.73	2+	237.6 *3*	8.6 *17*	1497.14	2+	E2+M1	−8 *3*	
		351.4[@&]		1384.16	4+			
		535.2 *1*	16.7 *33*	1199.48	3+			(535γ)(377γ)(θ): W(55°)/W(90°)=0.75 *6*.
		576.3 *3*	7.2 *14*	1158.47	0+			(576γ)(336γ)(θ): W(180°)/W(90°)=1.01 *12*, W(55°)/W(90°)=1.05 *9*. (576γ)(833γ)(θ): W(55°)/W(90°)=1.2 *3*.
		875.8 *3*	2.6 *17*	858.91	4+			Additional information 14.
		912.5 *1*	100 *20*	822.21	2+	M1+E2	−0.28 *7*	I_γ: 3.4 *10* (1990Ko25). Additional information 15.
		1409.3 *1*	70 *14*	325.40	2+	M1(+E2)	−0.08 *6*	I_γ: 1.5 *5* (1990Ko25). Additional information 16. (1409γ)(325γ)(θ): W(180°)/W(90°)=1.55 *4*, W(55°)/W(90°)=1.181 *19*.
1808.43	(2+,3,4+)	949.5 *1*	48 *10*	858.91	4+			
		986.4 *3*	2.9 *24*	822.21	2+			
		1483.0 *1*	100 *20*	325.40	2+			
1814.77	(5+)	430.8 *3*	37 *14*	1384.16	4+			
		615.3 *1*	100 *20*	1199.48	3+			
		955.8 *1*	35 *7*	858.91	4+			
1892.8?		692.7[@&]		1199.48	3+			
		1034[@&]		858.91	4+			E_γ: a 1037.4γ is placed from 2988 level (1998Ga43).
		1071[@&]		822.21	2+			E_γ: a 1073.1γ is placed from 1932 level (1998Ga43).
1922.81	(2+,3,4+)	1063.9 *1*	46 *9*	858.91	4+			
		1100.6 *1*	11.8 *24*	822.21	2+			
		1597.4 *1*	100 *20*	325.40	2+			
1932.02	(4+)	434.9 *1*	100 *20*	1497.14	2+			(435γ)(339γ)(θ): W(180°)/W(90°)=1.09 *12*, W(55°)/W(90°)=1.06 *8*.
		548.0 *1*	90 *18*	1384.16	4+	(M1+E2)	≤1.8	(548γ)(562γ)(θ): W(180°)/W(90°)=1.31 *11*, W(55°)/W(90°)=1.05 *8*.
		732.5 *1*	47 *9*	1199.48	3+			
		1073.1 *1*	90 *18*	858.91	4+	(M1+E2)	≤1.5	(1073γ)(534γ)(θ): W(180°)/W(90°)=1.44 *12*, W(55°)/W(90°)=1.04 *7*.
		1109.8 *1*	17 *3*	822.21	2+			
		1606.5 *1*	28 *6*	325.40	2+			
1950.72	(2+,3,4+)	216.0 *1*	13 *3*	1734.73	2+			
		294.8 *1*	10.0 *20*	1656.00				
		453.6 *1*	31 *6*	1497.14	2+			
		566.5 *3*	6.0 *12*	1384.16	4+			
		751.2 *1*	100 *20*	1199.48	3+			(751γ)(377γ)(θ): W(180°)/W(90°)=0.96 *9*, W(55°)/W(90°)=0.96 *6*.
		1091.8 *1*	44 *9*	858.91	4+			(1092γ)(534γ)(θ): W(180°)/W(90°)=0.70 *7*, W(55°)/W(90°)=0.77 *5*.
		1128.6 *1*	92 *18*	822.21	2+			(1129γ)(822γ)(θ): W(180°)/W(90°)=1.05 *11*, W(55°)/W(90°)=92 *7*.
		1625.2 *1*	69 *14*	325.40	2+			
1996.51		1671.1 *1*	100	325.40	2+			
2038.93		383.0 *1*	82 *16*	1656.00				
		654.9 *1*	38 *8*	1384.16	4+			

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^{132}Pr ε decay (1.6 min) 1998Ga43 (continued)

γ(^{132}Ce) (continued)

E_i(level)	J_i^π	E_γ †	I_γ ‡	E_f	J_f^π	Comments
2038.93		839.4 *1*	79 *16*	1199.48	3^+	
		1179.9 *1*	100 *20*	858.91	4^+	
2049.90		1191.0 *1*	100	858.91	4^+	
2096.90	$(2^+,3,4^+)$	441.0 *3*	9 *2*	1656.00		
		599.6 *3*	7 *1*	1497.14	2^+	
		712.7 *1*	15 *3*	1384.16	4^+	
		897.5 *1*	45 *9*	1199.48	3^+	
		1238.0 *1*	14 *3*	858.91	4^+	
		1274.7 *1*	100 *20*	822.21	2^+	
2139.9	(4^-)	1281 *1*		858.91	4^+	E_γ: from figure 2 of 1998Ga43; not given in Table 4.
2145.71		1820.3 *1*	100	325.40	2^+	
2169.37		360.9 *1*	17 *3*	1808.43	$(2^+,3,4^+)$	
		1844.0 *1*	100 *20*	325.40	2^+	
2189.31		1330.4 *1*	100	858.91	4^+	
2295.71		1970.3 *1*	100	325.40	2^+	
2330.42		1471.5 *1*	100	858.91	4^+	
2341.78	(8^-)	527.0 *1*	56 *11*	1814.77	(5^+)	
		798.6 *1*	100 *20*	1543.18	6^+	
2365.02		708.9 *1*	100 *20*	1656.00		
		980.7 *1*	84 *17*	1384.16	4^+	
		1506.4 *1*	33 *7*	858.91	4^+	
2379.31		2053.9 *1*	100	325.40	2^+	
2379.81		723.8 *1*	100	1656.00		
2450.81		1591.9 *1*	100	858.91	4^+	
2464.62		2139.2 *1*	100	325.40	2^+	
2483.02	$(2^+,3,4^+)$	1283.5 *1*	29 *6*	1199.48	3^+	
		1624.1 *3*		858.91	4^+	
		1660.8 *1*	100 *20*	822.21	2^+	
		2157.6 *1*	43 *9*	325.40	2^+	
2508.77	$(2^+,3,4^+)$	774.1 *3*	3.8 *8*	1734.73	2^+	
		852.8 *3*	9.6 *19*	1656.00		
		1011.5 *3*	3.4 *7*	1497.14	2^+	I_γ: 2.6 *5* (1990Ko25). Additional information 17.
		1124.6 *3*	3.1 *6*	1384.16	4^+	
		1309.2 *1*	100 *20*	1199.48	3^+	I_γ: 1.5 *3* (1990Ko25). Additional information 18.
		1649.9 *1*	21 *4*	858.91	4^+	
		1686.5 *1*	39 *8*	822.21	2^+	
		2183.4 *1*	18 *3*	325.40	2^+	
2554.17		631.7 *3*	4.2 *8*	1922.81	$(2^+,3,4^+)$	
		1354.7 *1*	11.3 *23*	1199.48	3^+	
		1731.7 *1*	48 *10*	822.21	2^+	
		2228.9 *1*	100 *20*	325.40	2^+	
2562.61		2237.2 *1*	100	325.40	2^+	
2577.86		1378.3 *1*	78 *16*	1199.48	3^+	
		2252.5 *1*	100 *20*	325.40	2^+	
2606.21		1783.9 *1*	61 *12*	822.21	2^+	
		2280.9 *1*	100 *20*	325.40	2^+	
2644.72		2319.3 *1*	100	325.40	2^+	
2650.50		1451.0 *1*	100	1199.48	3^+	
2719.50		1520.0 *1*	100	1199.48	3^+	
2740.72	$(2^+,3,4^+)$	643.9 *1*	30 *6*	2096.90	$(2^+,3,4^+)$	
		808.6 *1*	39 *8*	1932.02	(4^+)	
		1084.6 *1*	100 *20*	1656.00		
		1356.5 *1*	98 *20*	1384.16	4^+	
		1541.3 *1*	85 *17*	1199.48	3^+	

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^{132}Pr ε decay (1.6 min) 1998Ga43 (continued)

γ(^{132}Ce) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[‡]	E_f	J_f^π
2740.72	(2⁺,3,4⁺)	1881.8 *1*	40 *8*	858.91	4⁺
		1918.5 *1*	40 *8*	822.21	2⁺
2758.6		2433.2 *3*	100	325.40	2⁺
2761.92		1903.0 *1*	100	858.91	4⁺
2825.92		1967.0 *1*	100	858.91	4⁺
2835.90	(2⁺,3,4⁺)	1977.0 *1*	40 *8*	858.91	4⁺
		2510.4 *3*	100 *20*	325.40	2⁺
2857.67		1473.5 *1*	100	1384.16	4⁺
2864.22		2005.3 *1*	100	858.91	4⁺
2866.98	(1,2⁺)	1708.5 *1*	100	1158.47	0⁺
2957.44		1222.7 *1*	29 *6*	1734.73	2⁺
		2632.1 *3*	100 *20*	325.40	2⁺
2982.73		1247.9 *3*	21 *7*	1734.73	2⁺
		2657.4 *3*	100 *20*	325.40	2⁺
2988.12	(3⁺,4⁺)	1037.4 *3*	8.3 *17*	1950.72	(2⁺,3,4⁺)
		1173.3 *3*		1814.77	(5⁺)
		1253.3 *3*	9.2 *18*	1734.73	2⁺
		2129.2 *1*	100 *20*	858.91	4⁺
		2165.9 *1*	21 *4*	822.21	2⁺
		2662.9 *3*	66 *13*	325.40	2⁺
3070.42		2211.5 *1*	100	858.91	4⁺
3145.9		2820.5 *3*	100	325.40	2⁺
3316.3		2990.9 *3*	100	325.40	2⁺
3317.5		2458.6 *3*	100	858.91	4⁺
3331.8		2472.9 *3*	100	858.91	4⁺
3332.6		2510.4 *3*	100	822.21	2⁺
3378.4	(2⁺,3,4⁺)	2519.5 *3*	100 *20*	858.91	4⁺
		3053.1 *5*	47 *9*	325.40	2⁺
3412.81		2213.3 *1*	100	1199.48	3⁺
3550.70		1894.7 *1*	82 *16*	1656.00	
		2166.5 *1*	100 *20*	1384.16	4⁺
3682.00		2025.9 *1*	86 *17*	1656.00	
		2297.9 *1*	100 *20*	1384.16	4⁺
3702.04	(2⁺,3,4⁺)	2843.2 *3*	25 *5*	858.91	4⁺
		2879.7 *3*	100 *20*	822.21	2⁺
3721.83		2065.8 *1*	100	1656.00	
3825.33		1893.3 *1*	100	1932.02	(4⁺)
3863.44		1931.4 *1*	100	1932.02	(4⁺)
3863.84	(2⁺,3,4⁺)	2129.1 *1*	100 *20*	1734.73	2⁺
		3004.9 *5*	26 *5*	858.91	4⁺
4270.65		2338.6 *1*	100	1932.02	(4⁺)
4271.1		2615.1 *3*	100	1656.00	
4348.8		2416.8 *3*	100	1932.02	(4⁺)
4352.9		2696.9 *3*	100	1656.00	
4390.4		3006.2 *5*	100	1384.16	4⁺
4473.9		2817.9 *3*	100	1656.00	

[†] From 1998Ga43. The uncertainties are assigned as follows from a communication from one of the authors (A. Gade) of 1998Ga43 on June 13, 2003 in response to enquiry by B. Singh: 0.1 keV for Eγ up to 2400, 0.3 keV for 2400-3000, and 0.5 keV above 3000; 0.3 keV for many of the weak transitions (<10% branching).

[‡] Relative branching ratios. Relative gamma-ray intensities are available for only 17 γ rays from 1990Ko25 and are given here under comments. Relative intensities from 1998Ga43 are not available as communicated by one of the authors (A. Gade) on June 13, 2003 in response to enquiry by B. Singh.

Continued on next page (footnotes at end of table)

^{132}Pr ε decay (1.6 min) 1998Ga43 (continued)

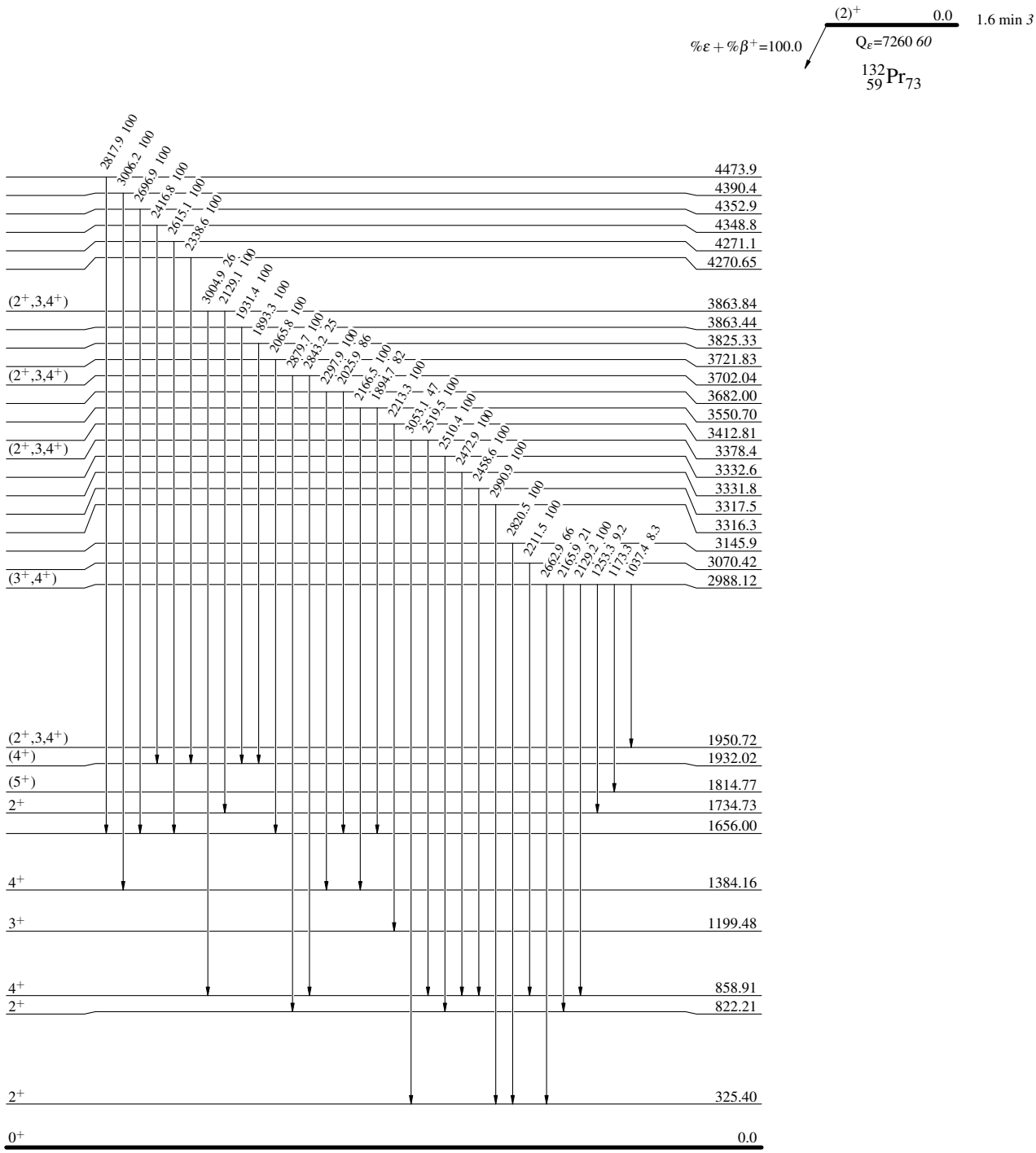
$\gamma(^{132}Ce)$ (continued)

[#] From $\gamma\gamma(\theta)$.
[@] From 1988Ba42 only; treated as questionable by the evaluators.
[&] Placement of transition in the level scheme is uncertain.

^{132}Pr ε decay (1.6 min) 1998Ga43

Decay Scheme

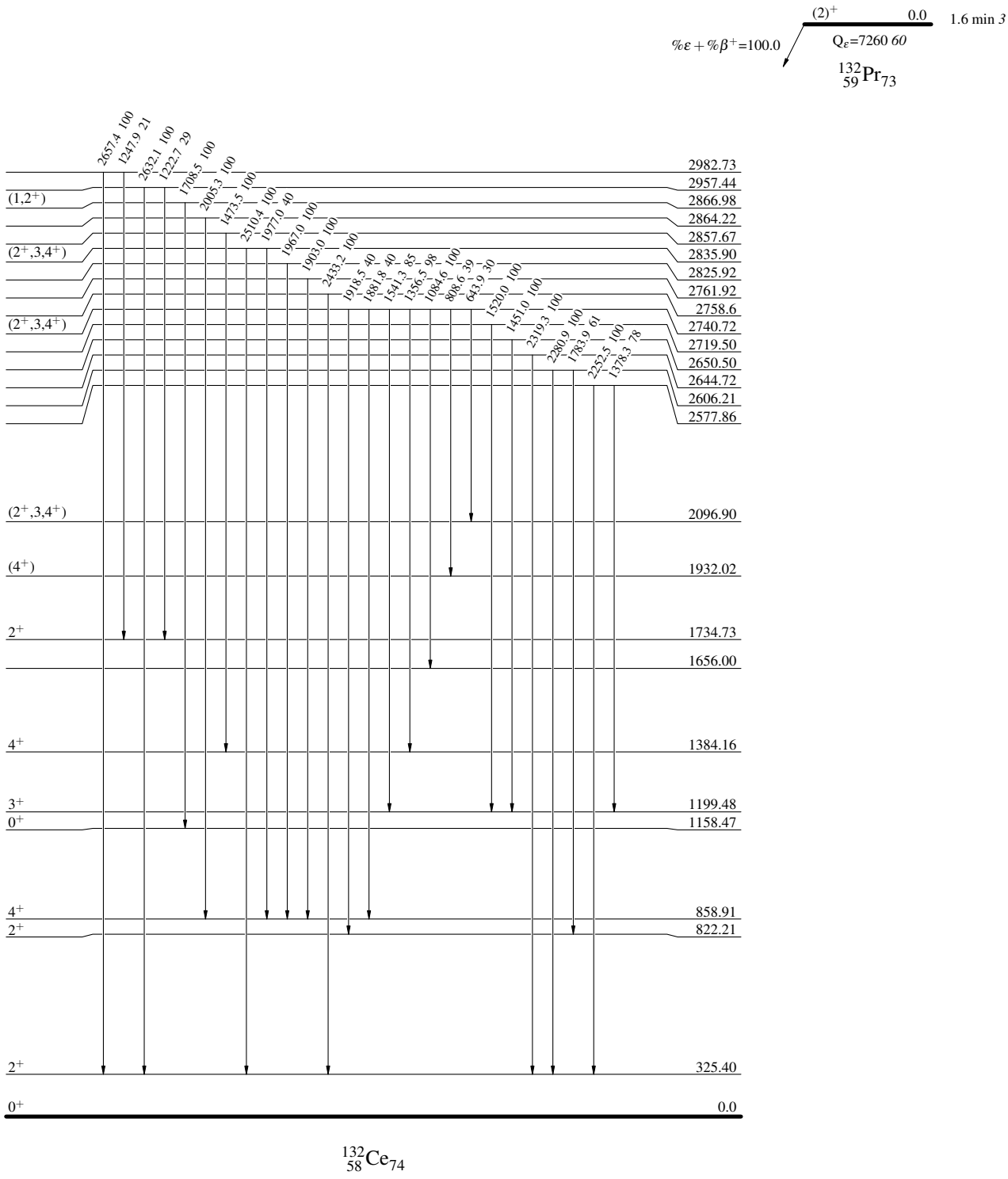
Intensities: Relative photon branching from each level



^{132}Pr ε decay (1.6 min) 1998Ga43

Decay Scheme (continued)

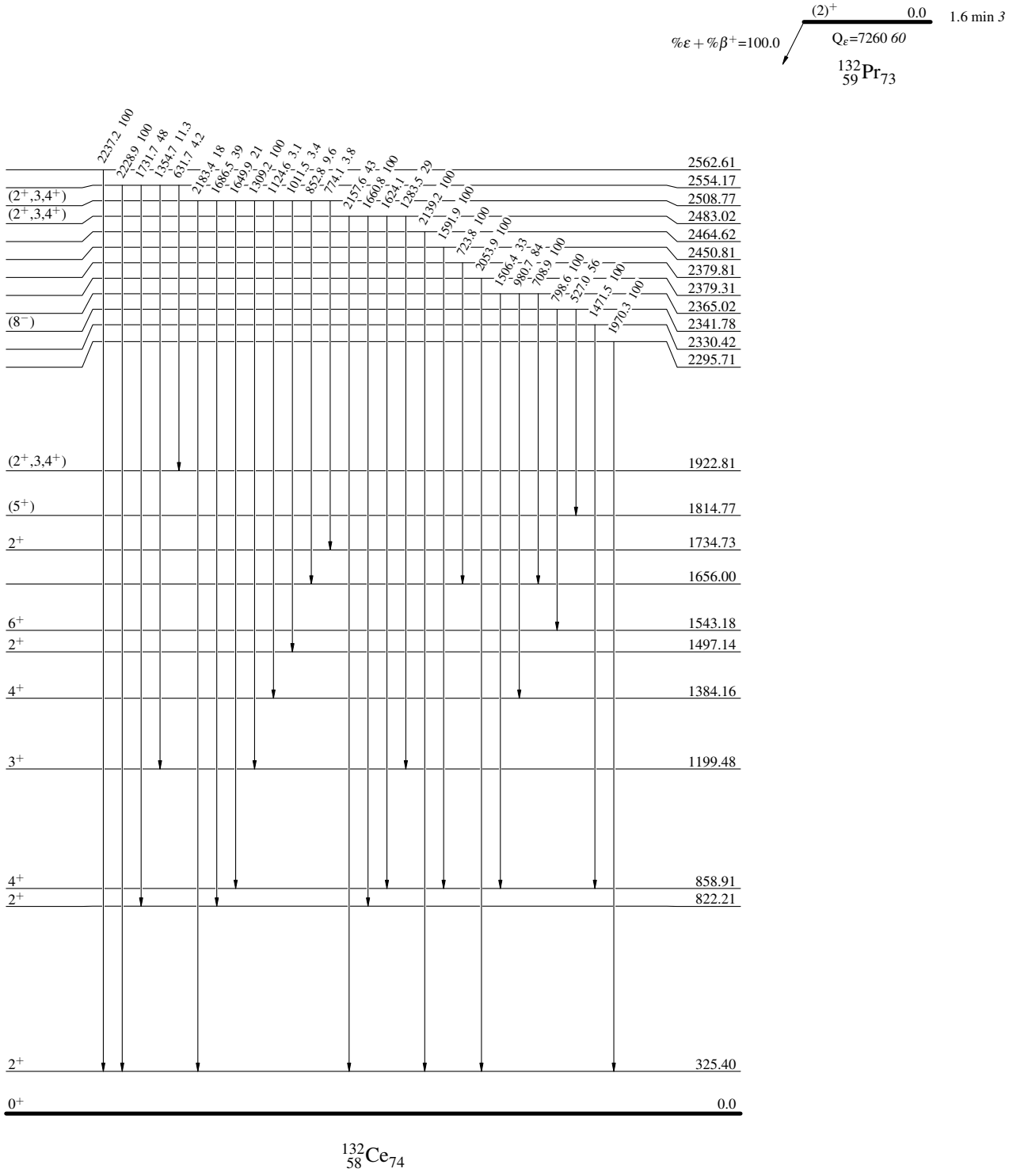
Intensities: Relative photon branching from each level



^{132}Pr ε decay (1.6 min) 1998Ga43

Decay Scheme (continued)

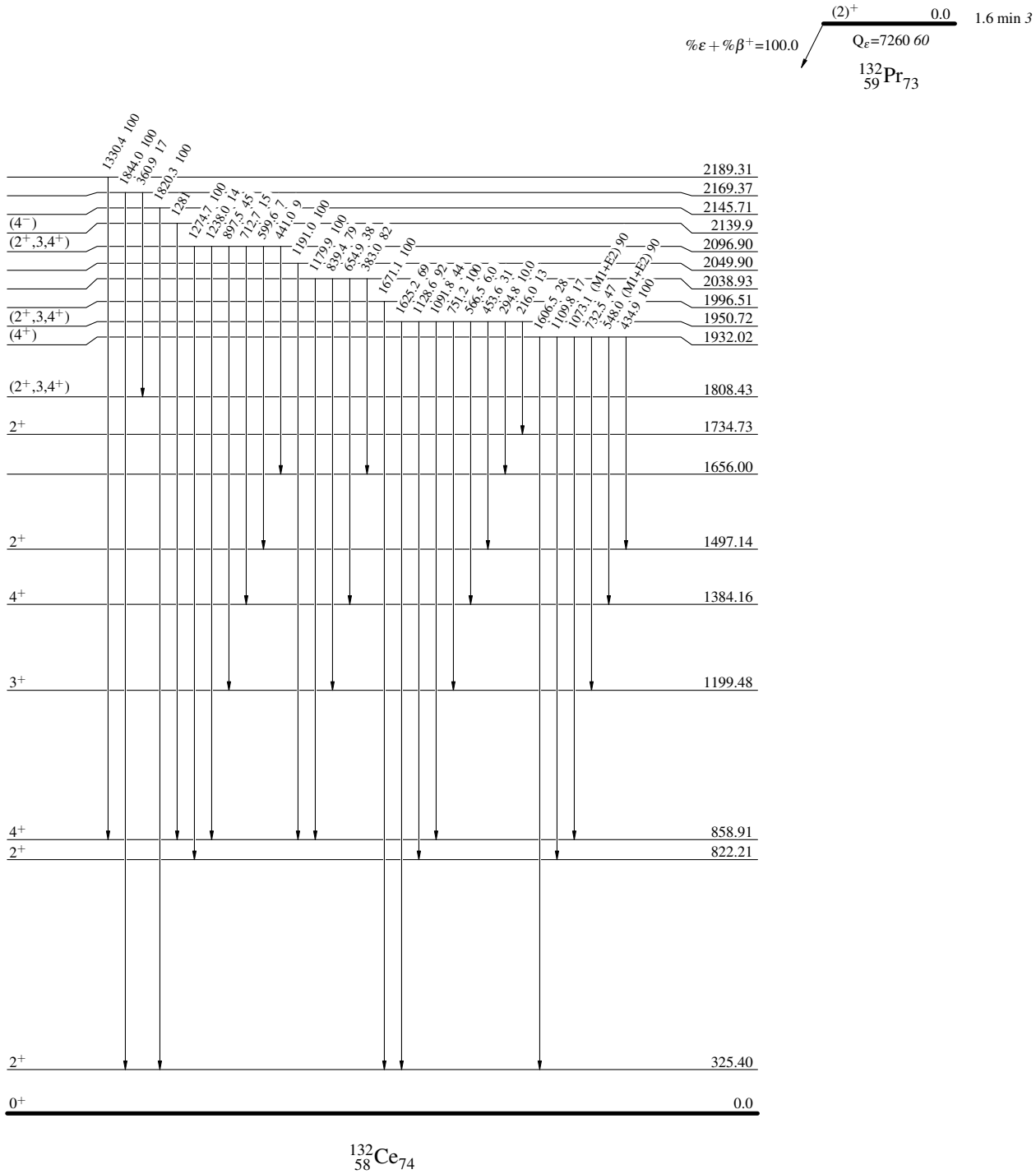
Intensities: Relative photon branching from each level



^{132}Pr ε decay (1.6 min) 1998Ga43

Decay Scheme (continued)

Intensities: Relative photon branching from each level



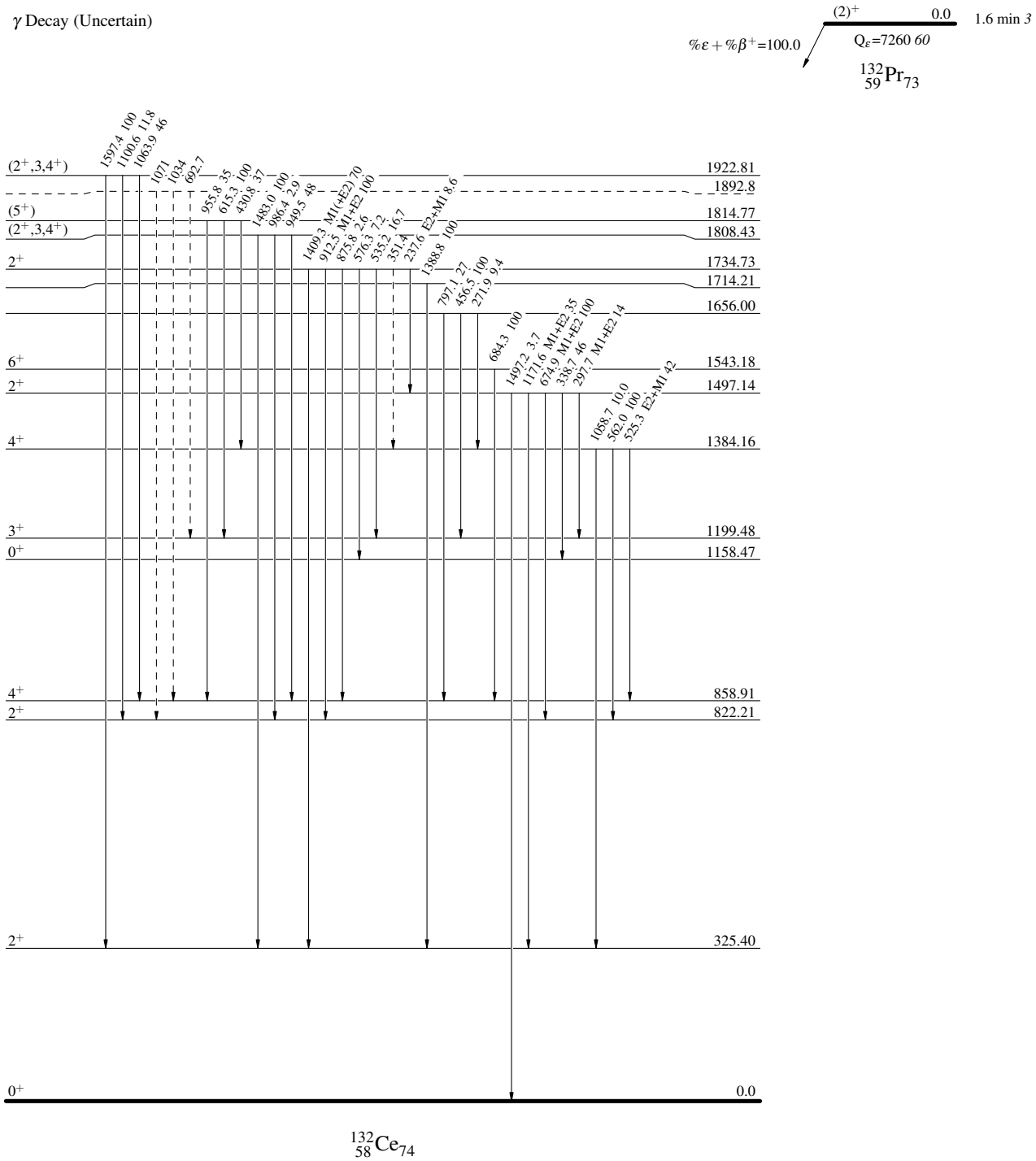
^{132}Pr ε decay (1.6 min) 1998Ga43

Decay Scheme (continued)

Legend

Intensities: Relative photon branching from each level

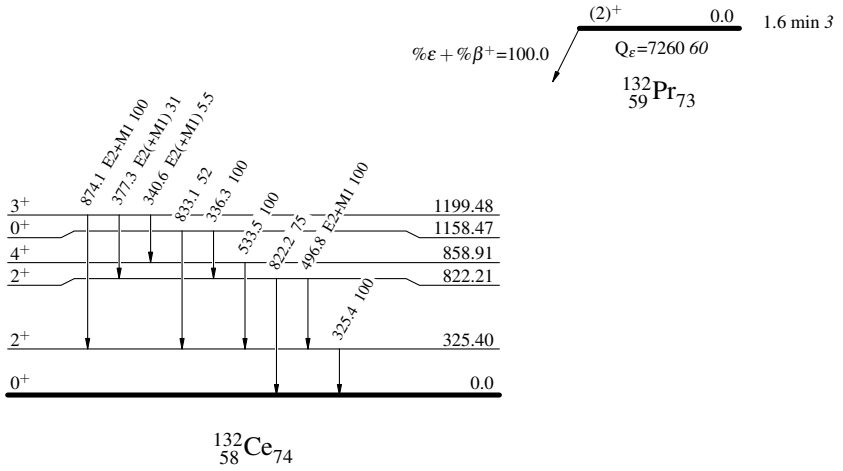
γ Decay (Uncertain)



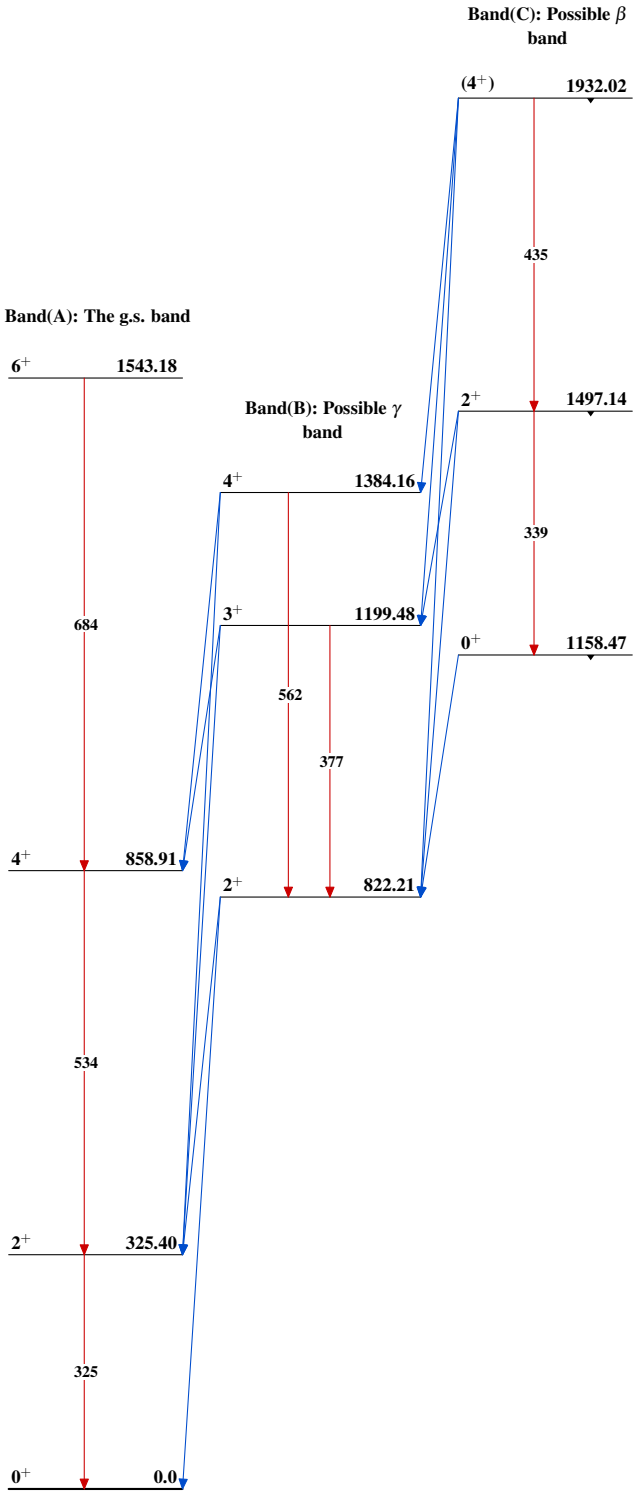
^{132}Pr ε decay (1.6 min) 1998Ga43

Decay Scheme (continued)

Intensities: Relative photon branching from each level



^{132}Pr ε decay (1.6 min) 1998Ga43



$^{132}_{58}Ce_{74}$