^{227}Pa ε decay (38.3 min) 1995Li04

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Ictp-2014 Workshop Group	NDS 132, 257 (2016)	15-Jan-2016

Parent: ^{227}Pa: E=0.0; J^π=(5/2$^-$); $T_{1/2}$=38.3 min *3*; Q(ε)=1026 *7*; %ε+%$β^+$ decay=15 *2*

1995Li04: ^{227}Pa activity produced in the ^{232}Th(p,6n) reaction with E(p)=200 MeV followed by mass separation. Measured Eγ, Iγ, γγ coin using a planar intrinsic Ge detector and a coaxial Ge detector; measured Ece, Ice, ce-γ coin using a Si(Li) detector coupled to a magnetic selector.

1995Li04 interpret many of the observed levels in terms of members of 1/2±, 3/2±, and 5/2± parity doublet bands and this theoretical interpretation forms the basis for many of their J^π assignments (which are indicated in the comments); see 1995Li04 for more details.

^{227}Th Levels

E(level)†	J^π‡	$T_{1/2}$‡	Comments
0.0	(1/2$^+$)	18.68 d *9*	
9.23 *5*	(5/2$^+$)		
24.34 *4*	(3/2$^+$)		
37.89 *4*	(3/2$^-$)		
67.28? *15*	(1/2$^-$)		E(level): the existence of this level is uncertain. It is connected by a γ ray to a 142-keV proposed level, which has been shown to be inconsistent with α-γ coin results from ^{231}U α decay (1997Mu08). Evaluators have not adopted the 67.2-keV level.
77.64 *8*	(3/2$^+$)		
81.94? *11*	(9/2$^+$)		E(level): this level is inconsistent with experimental results from ^{231}U α decay (1997Mu08). Evaluators have not adopted the 82-keV level.
99.23 *10*	(3/2$^+$,5/2$^+$)		J^π: 7/2$^-$ proposed by 1995Li04 is inconsistent with E1 multipolarity, determined from ^{231}U α decay, for the 61.4-keV γ ray (1997Mu08).
127.32 *8*	(3/2$^+$,5/2$^+$)		A 49.7-keV (dashed, tentative) γ ray is shown to deexcite this level in the decay scheme of 1995Li04. This γ ray, however, is neither listed in their main table, nor shown in any γ-ray spectra of 1995Li04. J^π: (5/2$^+$) proposed in 1995Li04.
142.06? *8*			E(level): the existence of this level is inconsistent with the observation of 64.4- and 74.7-keV γ rays in coincidence with 5370-5425 keV α particles from ^{231}U α decay (1997Mu08). Decay by 64.4γ E1 to 77.6 keV, 3/2$^+$ level and by 118.0γ M1 to 24.3 keV, 3/2$^+$ level suggested by authors is not possible. Evaluators have not adopted this level.
183.77 *9*	(1/2$^-$,3/2$^-$,5/2$^-$)		1995Li04 showed an ε decay scheme with a 42-keV (dashed, tentative) γ ray deexciting this level. Such a γ ray, however, is not listed in their main table nor shown in any spectra presented by 1995Li04. J^π: (5/2$^-$) proposed in 1995Li04.
207.14 *13*	(1/2$^-$,3/2$^-$,5/2$^-$)		
224.78? *16*	(7/2$^+$)		E(level): the existence of this level is uncertain because of its decay to the also uncertain level at 82 keV. Evaluators have not adopted this level.
228.70 *7*	(3/2$^-$,5/2$^-$)		J^π: (5/2$^-$) proposed in 1995Li04.
252.18? *13*	(7/2$^-$)		E(level): the existence of this level, proposed by 1995Li04, is questionable. The level is deexcited by a 124.8-keV γ ray (shown only in the decay scheme, not given in any table, nor displayed on any spectra), and by a 68.4-keV γ ray (which also deexcites the 77.7-keV level). Evaluators have not adopted the 252-keV level.
448.20 *19*			J^π: (5/2$^-$) proposed in 1995Li04.
503.40 *19*			J^π: (7/2$^-$) proposed in 1995Li04.
547.01 *15*			J^π: (5/2$^+$) proposed in 1995Li04.
688.73 *16*			J^π: (5/2$^+$) proposed in 1995Li04.
698.4 *4*			

† Deduced by evaluators from a least-squares fit to γ-ray energies.

‡ From the Adopted Levels.

γ(^{227}Th)

Iγ normalization: with the current data is not possible to deduced an accurate decay scheme normalization factor because ^{227}Pa with ground state $J^{\pi}=(5/2^{-})$ could have a direct ε branch to the 9.3-keV, $5/2^{+}$ level.

E_γ [†]	I_γ [†]	E_i(level)	J_i^π	E_f	J_f^π	Mult. [‡]	δ [‡]	α [@]	Comments
9.3 *1*		9.23	(5/2$^+$)	0.0	(1/2$^+$)	(E2)		3.26×10^5 *19*	α(M)=2.44×10^5 *14*; α(N)=6.5×10^4 *4*; α(O)=1.44×10^4 *9*; α(P)=2.37×10^3 *14*; α(Q)=2.85 *15* E$_\gamma$: from the Adopted Gammas.
15.2 *1*		24.34	(3/2$^+$)	9.23	(5/2$^+$)	(M1)		238 *6*	α(M)=177 *5*; α(N)=47.2 *12*; α(O)=11.2 *3*; α(P)=2.17 *6*; α(Q)=0.208 *5* E$_\gamma$: from the Adopted Gammas.
24.33 *5*		24.34	(3/2$^+$)	0.0	(1/2$^+$)	M1+E2	0.097 *5*	334 *12*	α(L)=250 *9*; α(M)=62.8 *23*; α(N)=16.8 *6*; α(O)=3.89 *14*; α(P)=0.721 *23*; α(Q)=0.0512 *8* E$_\gamma$: from the Adopted Gammas.
28.67 *5*	7.7 *10*	37.89	(3/2$^-$)	9.23	(5/2$^+$)	E1 [#]		3.21	α(L)=2.40 *4*; α(M)=0.610 *9*; α(N)=0.1580 *24*; α(O)=0.0338 *5*; α(P)=0.00513 *8* α(Q)=0.000181 *3*
37.89 *5*	9.0 *12*	37.89	(3/2$^-$)	0.0	(1/2$^+$)	E1 [#]		1.538	α(L)=1.156 *17*; α(M)=0.288 *5*; α(N)=0.0750 *11*; α(O)=0.01635 *24*; α(P)=0.00260 *4* α(Q)=0.0001036 *15*
53.3 *2*	2.0 *10*	77.64	(3/2$^+$)	24.34	(3/2$^+$)	M1 [#]		23.7 *5*	α(L)=17.9 *4*; α(M)=4.32 *8*; α(N)=1.152 *21*; α(O)=0.273 *5*; α(P)=0.0529 *10*; α(Q)=0.00505 *9*
56.45 *5*	37 *3*	183.77	(1/2$^-$,3/2$^-$,5/2$^-$)	127.32	(3/2$^+$,5/2$^+$)	E1 [#]		0.534	α(L)=0.403 *6*; α(M)=0.0989 *14*; α(N)=0.0259 *4*; α(O)=0.00575 *9*; α(P)=0.000964 *14* α(Q)=4.53×10^{-5} *7*
61.4 *2*	≈0.8	99.23	(3/2$^+$,5/2$^+$)	37.89	(3/2$^-$)				
64.40 [a] *5*	20 *3*	142.06?		77.64	(3/2$^+$)	E1 [#]		0.376	α(L)=0.284 *4*; α(M)=0.0695 *10*; α(N)=0.0182 *3*; α(O)=0.00407 *6*; α(P)=0.000691 *10* α(Q)=3.42×10^{-5} *5* E$_\gamma$: see comment on 142-keV level.
67.2 [a] *2*	≈1.0	67.28?	(1/2$^-$)	0.0	(1/2$^+$)				E$_\gamma$: placement in level scheme is inconsistent with α-γ coin results from ^{231}U α decay (1997Mu08).
68.4 [&] *1*	2.9 [&] *10*	77.64	(3/2$^+$)	9.23	(5/2$^+$)	M1 [#]		11.43	α(L)=8.64 *13*; α(M)=2.08 *3*; α(N)=0.555 *9*; α(O)=0.1314 *20*; α(P)=0.0255 *4*; α(Q)=0.00243 *4*
68.4 [&a] *1*	2.9 [&] *10*	252.18?	(7/2$^-$)	183.77	(1/2$^-$,3/2$^-$,5/2$^-$)	M1 [#]		11.43	α(L)=8.64 *13*; α(M)=2.08 *3*; α(N)=0.555 *9*; α(O)=0.1314 *20*; α(P)=0.0255 *4*; α(Q)=0.00243 *4*
72.7 [a] *1*	6.0 *15*	81.94?	(9/2$^+$)	9.23	(5/2$^+$)				E$_\gamma$: placement in level scheme is inconsistent

$^{227}_{90}$Th$_{137}$-2

^{227}Pa ε decay (38.3 min) 1995Li04 (continued)

γ(^{227}Th) (continued)

E_γ †	I_γ †	E_i(level)	J_i^π	E_f	J_f^π	Mult. ‡	α @	Comments
								with α-γ coin results from ^{231}U α decay (1997Mu08).
74.7[a] 2	2.0 10	142.06?		67.28?	(1/2⁻)			E_γ: see comment on 142-keV level.
84.5 3	2.0 10	183.77	(1/2⁻,3/2⁻,5/2⁻)	99.23	(3/2⁺,5/2⁺)			
103.0 1	20.5 25	127.32	(3/2⁺,5/2⁺)	24.34	(3/2⁺)	M1#	3.48	α(L)=2.63 4; α(M)=0.632 9; α(N)=0.1687 24; α(O)=0.0400 6; α(P)=0.00775 11 α(Q)=0.000737 11
118.0& 2	6.5& 15	127.32	(3/2⁺,5/2⁺)	9.23	(5/2⁺)	M1#	11.58	α(K)=9.23 14; α(L)=1.78 3; α(M)=0.427 7; α(N)=0.1140 17; α(O)=0.0270 4; α(P)=0.00524 8 α(Q)=0.000498 8
118.0&[a] 2	6.5& 15	142.06?		24.34	(3/2⁺)	M1#	11.58	α(K)=9.23 14; α(L)=1.78 3; α(M)=0.427 7; α(N)=0.1140 17; α(O)=0.0270 4; α(P)=0.00524 8 α(Q)=0.000498 8 E_γ: see comment on 142-keV level.
124.8[a]		252.18?	(7/2⁻)	127.32	(3/2⁺,5/2⁺)			
129.5& 1	24& 3	207.14	(1/2⁻,3/2⁻,5/2⁻)	77.64	(3/2⁺)	(E1)#	0.266	α(K)=0.206 3; α(L)=0.0451 7; α(M)=0.01092 16; α(N)=0.00288 4; α(O)=0.000658 10 α(P)=0.0001180 17; α(Q)=7.37×10⁻⁶ 11
129.5& 1	24& 3	228.70	(3/2⁻,5/2⁻)	99.23	(3/2⁺,5/2⁺)			
141.7 2	6.5 15	688.73		547.01				
142.8[a] 2	6.5 15	224.78?	(7/2⁺)	81.94?	(9/2⁺)			
146.0 3	1.7 10	183.77	(1/2⁻,3/2⁻,5/2⁻)	37.89	(3/2⁻)			
151.1 1	38 4	228.70	(3/2⁻,5/2⁻)	77.64	(3/2⁺)	E1#	0.184	α(K)=0.1437 21; α(L)=0.0303 5; α(M)=0.00732 11; α(N)=0.00193 3; α(O)=0.000443 7 α(P)=8.02×10⁻⁵ 12; α(Q)=5.23×10⁻⁶ 8
[x]157.7 3	2.0 10							
159.5 2	8.5 20	183.77	(1/2⁻,3/2⁻,5/2⁻)	24.34	(3/2⁺)			
[x]166.1 3	2.5 15							
[x]168.9 4	2.0 12							
[x]173.7 4	2.0 12							
185.3 2	12.0 30	688.73		503.40				
190.8 2	8.0 25	228.70	(3/2⁻,5/2⁻)	37.89	(3/2⁻)			
204.3 1	100	228.70	(3/2⁻,5/2⁻)	24.34	(3/2⁺)	E1#	0.0898	α(K)=0.0711 10; α(L)=0.01414 20; α(M)=0.00340 5; α(N)=0.000900 13; α(O)=0.000208 3 α(P)=3.82×10⁻⁵ 6; α(Q)=2.69×10⁻⁶ 4 E_γ: doubly placed by 1995Li04 as also tentatively depopulating the 688.7-keV level.
215.6[a] 2	16.5 30	224.78?	(7/2⁺)	9.23	(5/2⁺)	M1#	2.11	α(K)=1.686 24; α(L)=0.319 5; α(M)=0.0767 11; α(N)=0.0205 3; α(O)=0.00485 7 α(P)=0.000940 14; α(Q)=8.92×10⁻⁵ 13
219.5 2	28 4	228.70	(3/2⁻,5/2⁻)	9.23	(5/2⁺)	E1#	0.0759	α(K)=0.0602 9; α(L)=0.01184 17; α(M)=0.00285 4;

$^{227}_{90}Th_{137}$-3

^{227}Pa ε decay (38.3 min) 1995Li04 (continued)

γ(^{227}Th) (continued)

E_γ †	I_γ †	E_i(level)	E_f	J_f^π	Comments
					α(N)=0.000753 *11*; α(O)=0.0001741 *25* α(P)=3.21×10^{-5} *5*; α(Q)=2.30×10^{-6} *4*
x241.0 *3*	9 *3*				
x255.8 *3*	3.5 *15*				
264.6 *2*	8.0 *20*	448.20	183.77	(1/2$^-$,3/2$^-$,5/2$^-$)	
x285.6 *5*	3.5 *15*				
294.6[a] *5*	3.5 *15*	547.01	252.18?	(7/2$^-$)	E_γ: questionable placement as the 294.6γ feeds a questionable 252.4-keV level which is not adopted by the evaluators.
x300.0 *6*	3.3 *15*				
x309.8 *10*	2.3 *10*				
319.6 *3*	9.2 *25*	503.40	183.77	(1/2$^-$,3/2$^-$,5/2$^-$)	
363.3 *4*	3.5 *15*	547.01	183.77	(1/2$^-$,3/2$^-$,5/2$^-$)	
370.0 *7*	≈0.8	448.20	77.64	(3/2$^+$)	
x378.0 *5*	2.0 *10*				
x383.8 *5*	2.0 *10*				
x398.9 *5*	2.0 *10*				
404.1 *5*	2.0 *10*	503.40	99.23	(3/2$^+$,5/2$^+$)	
409.5 *5*	≈1.0	448.20	37.89	(3/2$^-$)	
419.6 *3*	6.5 *15*	547.01	127.32	(3/2$^+$,5/2$^+$)	
x432.7 *7*	2.0 *10*				
460.2 *4*	9.0 *25*	688.73	228.70	(3/2$^-$,5/2$^-$)	
469.7 *4*	6.4 *15*	698.4	228.70	(3/2$^-$,5/2$^-$)	
x488.3 *4*	4.0 *15*				
x519.8 *3*	7.0 *20*				
522.8 *3*	6.0 *20*	547.01	24.34	(3/2$^+$)	
537.7 *7*	2.0 *10*	547.01	9.23	(5/2$^+$)	
561.4 *3*	19.0 *30*	688.73	127.32	(3/2$^+$,5/2$^+$)	
x568.0 *5*	4.0 *20*				
589.5 *4*	7.0 *20*	688.73	99.23	(3/2$^+$,5/2$^+$)	
x609.2 *7*	2.0 *10*				

† From 1995Li04, except where noted. Measured in coincidence with Th K x ray.
‡ From the Adopted Gammas. Transitions for which multipolarities were measured in this dataset are indicated.
# From 1995Li04; conversion electron spectra were measured, however, no supporting data on how the multipolarities were determined is provided by the authors.
@ From BrIcc v2.3 (29-Mar-2013) 2008Ki07, "Frozen Orbitals" appr.
& Multiply placed with undivided intensity.
a Placement of transition in the level scheme is uncertain.
x γ ray not placed in level scheme.

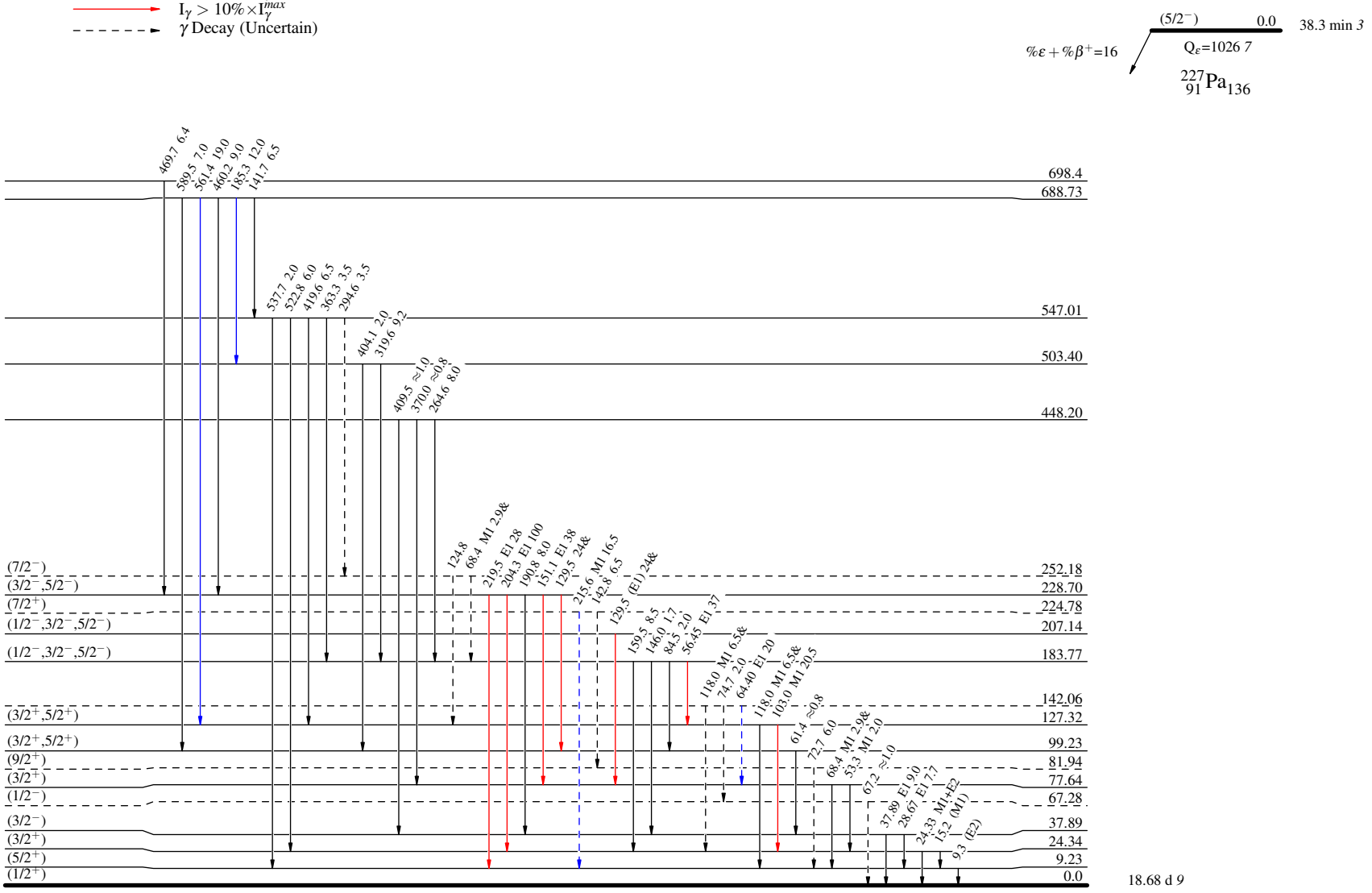
$^{227}_{90}Th_{137}$-4

^{227}Pa ε decay (38.3 min) 1995Li04

Decay Scheme

Intensities: Relative I_γ
& Multiply placed: undivided intensity given

Legend
- $I_\gamma < 2\% \times I_\gamma^{max}$
- $I_\gamma < 10\% \times I_\gamma^{max}$
- $I_\gamma > 10\% \times I_\gamma^{max}$
- γ Decay (Uncertain)



$^{227}_{90}Th_{137}$

$^{227}_{90}Th_{137}$-5