Adopted Levels, Gammas

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	M. S. Basunia	NDS 181, 475 (2022)	1-Jan-2022

Q(β^-)=−5795 *15*; S(n)=7527 *14*; S(p)=3427 *13*; Q(α)=6861.7 *23* 2021Wa16

2011Ka30: Pt(^{36}S,X), E=5.96 MeV/nucleon and W(^{48}Ca,X), E=5.41 MeV/nucleon − measured differential cross section dσ/dΩ.

2002Mi20: Measured evaporation residue production cross section of ^{213}Ra, bombarding ^{154}Sm target with ^{64}Ni beam, E=4-5 MeV/nucleon.

2009Ga07: Measured production cross section of ^{213}Ra in the ^{209}Bi(^{10}B,X) reaction, E(cm)=52-72 MeV.

^{213}Ra Levels

Cross Reference (XREF) Flags

- A ^{217}Th α decay
- B ^{213}Ra IT decay (2.18 ms)
- C ^{204}Pb(^{13}C,4nγ)

E(level)†	J$^\pi$‡	$T_{1/2}$	XREF	Comments
0.0	1/2$^-$	2.73 min *5*	ABC	%α=86 *2*; %ε+%β^+=14 *2* μ=+0.610 *2* $T_{1/2}$: Weighted average of 2.74 min *6* (1968Lo15), 2.75 min *15* (1967Va22), 2.7 min *3* (1955Mo68), and 2.54 min *+21−18* (9247α(t)) (2000Ni02 − also reported 2.7 min *+21−8* (8713α(t)) and 2.5 min *+12−6* (8429α(t)). Other: 2.72 min (1961Gr42). All from ^{213}Ra α decay measurements. J$^\pi$: spin measured (hyperfine structure by LASER spectroscopy, 1983Ah03). Configuration: ν ($p^{-1}_{1/2}$) from measured μ. μ: From 2019StZV, 1987Ar20 − Larmor precession, optical pumping by LASER. Others: 0.62 *3* (1983Ah03), 0.592 *11* (1987We03). %α: Weighted average of 87 *2* (2017Lo13) and 80 *5* (1967Va22); %ε+%β = 100 − %α.
546.35 *5*	(5/2$^-$)	21.5 ps *28*	ABC	J$^\pi$: 546.35γ (E2) to 1/2$^-$ g.s.; probable configuration: ν ($f^{-1}_{5/2}$). $T_{1/2}$: From τ=31 ps *4* (2021Ge07 − (^{13}C,4nγ)), from γ gated time difference measurements by Generalised Centroid Difference method.
820 *6*	(3/2$^-$)		A	E(level): Level energy calculated by the evaluator using Q(α) (^{217}Th) and Eα feeding this level. J$^\pi$: From systematics of ^{211}Rn isotone.
1608.85 *21*	(9/2$^-$)		BC	J$^\pi$: 1062.5γ (E2) to 5/2$^-$ state. Systematics of 9/2$^-$ levels in nuclei with 125 neutrons (see 1976Ra37).
1769.72 *22*	(13/2$^-$)		BC	J$^\pi$: 160.87γ to (9/2$^-$) state is predominantly E2; no γ to the (5/2$^-$) state. Please see ^{213}Ra IT decay (2.18 ms) dataset.
1770 *5*	(17/2$^-$)	2.18 ms *5*	BC	%α=0.6 *4*; %IT=99.4 *4* μ=7.4 *4* Additional information 1. E(level): From ^{213}Ra IT decay (2.18 ms). J$^\pi$: Measured g=0.87 *5* (1994Ne01) value supports the configuration: π ($[h^{+2}_{9/2}]_{8+}$)⊗ν ($p^{-1}_{1/2}$) for which the calculated magnetic moment, 7.672 *33*, is in good agreement with the measured g value (1994Ne01). $T_{1/2}$: From IT decay. μ: From 2019StZV, 1994Ne01 − Level Mixing Spectroscopy (LEMS). %α: From 2006Ku26. Other: 0.6 in 1976Ra37 (also ≈1) − both in the ^{213}Ra IT decay (2.18 ms) dataset. %IT = 100 − %α.
2287.50 *10*	(21/2$^-$)		C	Configuration: $\pi(h^6_{9/2})_{8+}$⊗$\nu f^{-1}_{5/2}$.
2609.90 *15*	(23/2$^+$)	18.7 ns *21*	C	Configuration: $\pi[(h^5_{9/2})_{9/2}i_{13/2}]_{11-}$⊗$\nu p^{-1}_{1/2}$. $T_{1/2}$: From (455γ+731γ)(322γ)(Δt) measurements (^{13}C,4nγ) − 2018Pa04).

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Adopted Levels, Gammas (continued)

^{213}Ra Levels (continued)

E(level)†	Jπ‡	$T_{1/2}$	XREF	Comments
3065.3 *4*	(25/2+)		C	Configuration: $\pi[(h^5_{9/2})_{9/2}i_{13/2}]_{10-}\otimes\nu f^{-1}_{5/2}$.
3136.6 *3*	(25/2−)		C	Configuration: $\pi(h^6_{9/2})_{12+}\otimes\nu p^{-1}_{1/2}$.
3281.1 *5*	(25/2−)		C	Configuration: $\pi[(h^5_{9/2})_{17/2}f_{7/2}]_{12+}\otimes\nu p^{-1}_{1/2}$.
3340.4 *4*	(27/2+)		C	Configuration: $\pi[(h^5_{9/2})_{9/2}i_{13/2}]_{11-}\otimes\nu f^{-1}_{5/2}$.
3345.60 *22*	(25/2−)		C	Configuration: $\pi(h^6_{9/2})_{10+}\otimes\nu f^{-1}_{5/2}$.
3433.2 *3*	(27/2−)		C	Configuration: $\pi[(h^5_{9/2})_{21/2}f_{7/2}]_{13+}\otimes\nu p^{-1}_{1/2}$.
3441.4 *5*	(29/2−)		C	Configuration: $\pi[(h^5_{9/2})_{21/2}f_{7/2}]_{14+}\otimes\nu p^{-1}_{1/2}$.
3863.8 *11*	(27/2+)		C	Configuration: $\pi[(h^5_{9/2})_{13/2}i_{13/2}]_{13-}\otimes\nu p^{-1}_{1/2}$.
3878.0 *7*	(29/2+)		C	Configuration: $\pi[(h^5_{9/2})_{17/2}i_{13/2}]_{14-}\otimes\nu p^{-1}_{1/2}$.
4006.9 *5*	(31/2+)		C	Configuration: $\pi[(h^5_{9/2})_{17/2}i_{13/2}]_{15-}\otimes\nu p^{-1}_{1/2}$.
4047.7 *7*	(33/2+)	34.7 ns *21*	C	Configuration: $\pi[(h^5_{9/2})_{21/2}i_{13/2}]_{16-}\otimes\nu p^{-1}_{1/2}$. $T_{1/2}$: From (455γ+731γ)(322γ)(Δt) measurements ((^{13}C,4nγ) – 2018Pa04). Lifetime measured by (beam pulse)(566γ and 667γ)(t) showed no difference.
4047.7+x?	(35/2+)		C	Additional information 2.
4506.2+x?	(37/2+)		C	Additional information 3.

† Deduced by the evaluator from a least square fit to the γ-ray energies, except where otherwise noted.
‡ Above 1770 level, spin-parity assignments are from (^{13}C,4nγ) – 2018Pa04, based on proposed γ multipolarity from measured γ(θ) data and deduced total conversion coefficients.

γ(^{213}Ra)

E_i(level)	J^π_i	E_γ†	I_γ†	E_f	J^π_f	Mult.†	α@	Comments
546.35	(5/2−)	546.35‡ *5*	100‡	0.0	1/2−	(E2)‡	0.0315 *4*	α(K)=0.02125 *30*; α(L)=0.00763 *11*; α(M)=0.001945 *27* α(N)=0.000513 *7*; α(O)=0.0001131 *16*; α(P)=1.815×10^{-5} *25*; α(Q)=7.70×10^{-7} *11* B(E2)(W.u.)=6.9 *+11−8*
1608.85	(9/2−)	1062.5‡ *2*	100‡	546.35	(5/2−)	(E2)‡	0.00802 *11*	α(K)=0.00624 *9*; α(L)=0.001342 *19*; α(M)=0.000327 *5* α(N)=8.61×10^{-5} *12*; α(O)=1.936×10^{-5} *27*; α(P)=3.27×10^{-6} *5*; α(Q)=2.110×10^{-7} *30*
1769.72	(13/2−)	160.87‡ *5*	100‡	1608.85	(9/2−)	E2‡	1.328 *19*	α(K)=0.2371 *33*; α(L)=0.802 *11*; α(M)=0.2174 *31* α(N)=0.0575 *8*; α(O)=0.01227 *17*; α(P)=0.001801 *25*; α(Q)=1.314×10^{-5} *18*
2287.50	(21/2−)	517.5 *1*	100	1770	(17/2−)	Q#		
2609.90	(23/2+)	322.4 *1*	100	2287.50	(21/2−)	(E1)	0.0299 *4*	α(exp)=0.11 *5* (2018Pa04) B(E1)(W.u.)=2.94×10^{-7} *+36−31* α(K)=0.02418 *34*; α(L)=0.00438 *6*; α(M)=0.001042 *15* α(N)=0.000273 *4*; α(O)=6.10×10^{-5} *9*; α(P)=1.021×10^{-5} *14*; α(Q)=6.70×10^{-7} *9*
3065.3	(25/2+)	455.4 *4*	100	2609.90	(23/2+)	D+Q#		
3136.6	(25/2−)	849.1 *3*	100	2287.50	(21/2−)	Q#		
3281.1	(25/2−)	993.6 *7*	100	2287.50	(21/2−)	Q#		

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Adopted Levels, Gammas (continued)

γ(^{213}Ra) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.[†]	δ[†]	α[@]	Comments
3340.4	(27/2$^+$)	275.0 *4*	72 *3*	3065.3	(25/2$^+$)	M1+E2	0.64 *2*	0.697 *14*	α(exp)=0.99 *8* (2018Pa04) α(K)=0.539 *11*; α(L)=0.1190 *19*; α(M)=0.0291 *4* α(N)=0.00768 *12*; α(O)=0.001730 *27*; α(P)=0.000293 *5*; α(Q)=1.96×10^{-5} *4*
		730.5 *5*	100 *5*	2609.90	(23/2$^+$)	Q[#]			
3345.60	(25/2$^-$)	1058.1 *2*	100	2287.50	(21/2$^-$)	Q[#]			
3433.2	(27/2$^-$)	87.6 *4*		3345.60	(25/2$^-$)				
		152.1 *5*	18.7 *16*	3281.1	(25/2$^-$)	M1+E2	0.7 *3*	3.7 *6*	α(exp)=3.7 *5* (2018Pa04) α(K)=2.6 *7*; α(L)=0.81 *6*; α(M)=0.205 *21* α(N)=0.054 *6*; α(O)=0.0120 *11*; α(P)=0.00195 *11*; α(Q)=9.8×10^{-5} *24*
		296.6 *2*	100.0 *24*	3136.6	(25/2$^-$)	M1		0.732 *10*	α(exp)=0.96 *9* (2018Pa04) α(K)=0.589 *8*; α(L)=0.1081 *15*; α(M)=0.0258 *4* α(N)=0.00680 *10*; α(O)=0.001552 *22*; α(P)=0.000271 *4*; α(Q)=2.121×10^{-5} *30*
3441.4	(29/2$^-$)	304.8 *8*	100	3136.6	(25/2$^-$)				
3863.8	(27/2$^+$)	798.5 *10*	100	3065.3	(25/2$^+$)				
3878.0	(29/2$^+$)	436.7 *8*	100 *8*	3441.4	(29/2$^-$)				
		537.8 *11*	83 *8*	3340.4	(27/2$^+$)	D[#]			
4006.9	(31/2$^+$)	565.5 *2*	100.0 *17*	3441.4	(29/2$^-$)	D[#]			
		666.5 *4*	24.4 *10*	3340.4	(27/2$^+$)	Q[#]			
4047.7	(33/2$^+$)	169.7 *3*	82 *4*	3878.0	(29/2$^+$)	E2		1.079 *17*	α(exp)=1.3 *2* (2018Pa04) B(E2)(W.u.)=0.422 *+31−28* α(K)=0.2176 *31*; α(L)=0.634 *10*; α(M)=0.1717 *28* α(N)=0.0454 *7*; α(O)=0.00969 *16*; α(P)=0.001426 *23*; α(Q)=1.139×10^{-5} *17*
		606.3 *5*	100 *6*	3441.4	(29/2$^-$)	[M2]		0.277 *4*	B(M2)(W.u.)=0.103 *8* α(K)=0.2135 *30*; α(L)=0.0480 *7*; α(M)=0.01181 *17* α(N)=0.00313 *4*; α(O)=0.000713 *10*; α(P)=0.0001232 *18*; α(Q)=9.25×10^{-6} *13*
4047.7+x?	(35/2$^+$)	y[&]		4047.7	(33/2$^+$)				
4506.2+x?	(37/2$^+$)	458.7[&] *6*		4047.7+x?	(35/2$^+$)				

[†] From (^{13}C,4nγ), except where otherwise noted.
[‡] From ^{213}Ra IT decay (2.18 ms).
[#] In 2018Pa04 (^{13}C,4nγ) based on γ(θ) data M1, E1, E2, and M1+E2 were assigned, evaluator list those as D, Q, D+Q.
[@] Additional information 4.
[&] Placement of transition in the level scheme is uncertain.

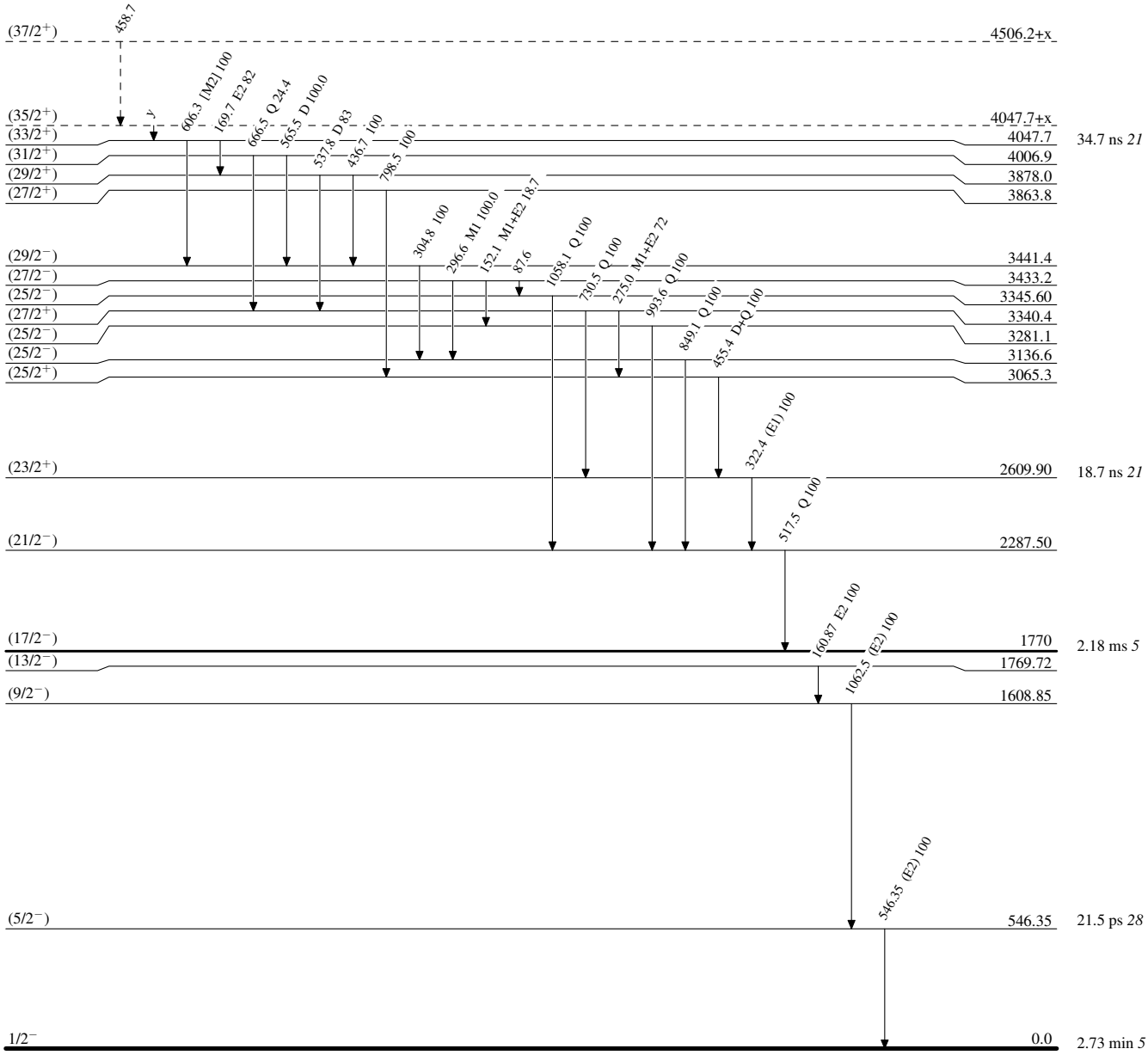
Adopted Levels, Gammas

Legend

Level Scheme

Intensities: Relative photon branching from each level

γ Decay (Uncertain)



$^{213}_{88}Ra_{125}$