^{219}Rn α decay (3.96 s) 1999Li05,1976Bl13,1970Kr08

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation		NDS 114, 2023 (2013)	23-Sep-2013

Parent: ^{219}Rn: E=0.0; $J^\pi=5/2^+$; $T_{1/2}$=3.96 s *1*; Q(α)=6946.1 *3*; %α decay=100.0
^{219}Rn-J^π,$T_{1/2}$: From ^{219}Rn Adopted Levels in ENSDF database.
^{219}Rn-Q(α): From 2012Wa38.
1976Bl13: precise measurement of Eγ, Iγ. Detector:Ge(Li).
1970Kr08: measured Eγ, Iγ, Ag(θ), Ag(lin pol, θ), Ice. Detectors:Ge(Li), magnetic spectrometer.
1970Da09: measured Eγ, Iγ, $\gamma\gamma$ coin, Ice. Detectors:Ge(Li), scint, magnetic spectrometer.
1968Br17, 1967Da20: measured Eγ, Iγ. Detector:Ge(Li).
1999Li05: measured Eγ, Iγ, Ice, $\alpha\gamma$ coin, αe coin. Detectors: Ge, Si(Li).
Others: 1972HeYM, 1969Be67, 1966Po02, 1965Va10, 1957Pa07, 1957Pi31.
Ag(θ) measurements: 1972HeYM, 1970Kr08, 1970Da09, 1969Be67, 1967Le05, 1965Cl05, and 1961Br32.
$\alpha\gamma$ linear polarization correlations and $\gamma\gamma(\theta)$ measurements: 1970Kr08.

^{215}Po Levels

E(level)[†]	J^π[‡]	$T_{1/2}$	Comments
0.0[#]	$9/2^+$	1.781 ms *4*	$T_{1/2}$: from Adopted Levels.
271.228[#] *10*	$7/2^+$	195 ps *15*	$T_{1/2}$: (α)(ce)(t) coin (1974Bo11). Other value:<250 ps (1969Be67).
293.56[@] *4*	$(11/2)^+$		
401.812[#] *10*	$5/2^+$	66 ps *7*	$T_{1/2}$: from $T_{1/2}$(402)/$T_{1/2}$(271)=0.336 *23* (Doppler shift measurement), and $T_{1/2}$(271)=195 ps *15* (1974Bo11).
517.60[@] *6*	$7/2^+$,$9/2^+$		
608.30[#] *20*	$(11/2^+,13/2^+)$		
676.66 *7*			
708.1 *5*			
732.7 *4*			
835.32 *22*			
877.2 *6*			
891.1 *3*			
930? *1*			
1073.7 *4*	$(5/2^+)$		
1094.2 *10*			

[†] From a least-squares fit to Eγ data.
[‡] From Adopted Levels.
[#] Configuration=$\pi h^2_{9/2}\otimes\nu g^5_{9/2}$.
[@] Configuration=$\pi h^2_{9/2}\otimes\nu g^4_{9/2}\otimes\nu i_{11/2}$.

α radiations

Values of Eα from 1962Wa18 given in comments were measured with a magnetic spectrograph. Original Eα values have been increased by evaluators an average of 1.5 keV because of changes in the calibration energies of ^{215}Po and ^{211}Bi (1977Ma30).
α particle energies of 1957Pi31 presented in comments have been increased by 3 keV because of a change in the calibration energy of ^{242}Cm (1977Ma30). Other: 1992Sc26.

Continued on next page (footnotes at end of table)

^{219}Rn α decay (3.96 s) 1999Li05,1976Bl13,1970Kr08 (continued)

α radiations (continued)

Eα	E(level)	Iα[a]	HF[&]	Comments
5744[#] *15*	1094.2	0.00009[@] *5*	2.7×10^2 *15*	Iα: measured value=0.0001 (1999Li05).
5764[#] *8*	1073.7	0.00092[@] *20*	33 *8*	Other value: Eα=5786.5, Iα≈0.001 (1965Va10). Iα: measured value=0.001 (1999Li05).
5900[#] *15*	930?	≈0.0001[@]	≈1426	
5944[#] *6*	891.1	0.0020[@] *3*	107 *17*	Other value: Eα=5947.9, Iα=0.0037, originally assigned by 1962Wa18 to ^{211}Bi α decay. Reassigned by 1965Va10 (on the basis of αγ coin measurements) to ^{219}Rn α decay. Iα: measured value=0.002 (1999Li05).
5958[#] *15*	877.2	0.00032[@] *11*	7.7×10^2 *27*	Iα: measured value=0.0001 (1999Li05).
6000[#] *6*	835.32	0.0031[@] *5*	123 *20*	Eα=6000.8, Iα=0.0044 (1962Wa18). Iα: measured value=0.003 (1999Li05).
6100[#] *8*	732.7	0.0012[@] *2*	9.0×10^2 *15*	Other value: Eα=6102.0, Iα=0.003 (1962Wa18). Iα: measured value=0.001 (1999Li05).
6124[#] *8*	708.1	0.00063[@] *13*	2.2×10^3 *5*	Iα: measured value=0.001 (1999Li05).
6158[#] *4*	676.66	0.018[@] *2*	105 *12*	Other value: Eα=6158.6, Iα=0.0174 (1962Wa18). Iα: measured value=0.018 (1999Li05).
6223[#] *6*	608.30	0.0043[@] *11*	8.5×10^2 *22*	Other value: Eα=6223.6, Iα=0.0026 (1962Wa18). Iα: measured value=0.004 (1999Li05).
6311[#] *3*	517.60	0.051[@] *4*	172 *14*	Other value: Eα=6311.8, Iα=0.054 (1962Wa18). Iα: measured value=0.054 (1999Li05).
6425.0[†] *10*	401.812	7.5[‡] *6*	3.4 *3*	Other values: Iα=7.5 *5* (1962Gi04). Eα=6423.9 (1961Ry02). Eα=6422, Iα=5 (1957Pi31,1977Ma30). Eα=6425 *1*, Iα=7.5 (1999Li05). Iα: Iα=7.7 *7*, deduced by evaluators from γ-ray transition intensity balance.
6530[#] *2*	293.56	0.110[@] *10*	630 *58*	Other value: Eα=6529, Iα=0.12 (1962Wa18). Iα: measured value=0.12 (1999Li05).
6552.6[†] *10*	271.228	12.9[‡] *6*	6.6 *4*	Other values: Eα=6552.8 (1962Wa18,1977Ma30). Iα=12.9 *6* (1962Gi04). Eα=6550.9 (1961Ry02). Eα=6550, Iα=13 (1957Pi31,1977Ma30). Eα=6553 *1*, Iα=13 (1999Li05). Iα: Iα=12.3 *9*, deduced by evaluators from γ-ray transition intensity balance.
6819.1[†] *3*	0.0	79.4[‡] *10*	11.1 *2*	Other values: Eα=6819.0 (1962Wa18,1977Ma30). Iα=79.6 *10* (1962Gi04). Eα=6817.6 *10* (1961Ry02). Eα=6816 *2*, Iα=82 (1957Pi31,1977Ma30). Eα=6819.1 *3*, Iα=79.3 (1999Li05). Iα: Iα=79.8 *12*, deduced by evaluators from γ-ray transition intensity balance.

[†] From 1971Gr17, detector: magnetic spectrometer. Adjusted value as recommended by 1991Ry01.
[‡] From 1962Wa18, detector: magnetic spectrograph. Adjusted value as recommended by 1991Ry01.
[#] From 1999Li05.
[@] Deduced by evaluators from γ-ray transition intensity balance. Measured value from 1999Li05 is given under comments.
[&] Using $r_0(^{215}Po)$=1.557 *4*, interpolated value from $r_0(^{214}Po)$=1.559 *8* and $r_0(^{216}Po)$=1.5555 *2* (1998Ak04).
[a] Absolute intensity per 100 decays.

^{219}Rn α decay (3.96 s) 1999Li05,1976Bl13,1970Kr08 (continued)

$\gamma(^{215}Po)$

Iγ normalization: from Iγ(271γ, ^{219}Rn)/Iγ(269γ, ^{223}Ra)=0.786 *42*, measured from a ^{223}Ra source with ^{219}Rn in equilibrium (1976Bl13), and using %Iγ(269γ, ^{223}Ra)=13.7 *2* (see ^{223}Ra α decay). The excellent agreement of the α-particle abundances to the g.s., 271, and 402 levels (deduced from γ-ray transition intensity balances) with values measured directly confirm the quality of the γ-ray data and that of the decay scheme normalization.

E_γ[‡]	I_γ[‡&]	E_i(level)	J_i^π	E_f	J_f^π	Mult.	δ	α[†]	Comments
130.60 *3*	1.2 *8*	401.812	5/2$^+$	271.228	7/2$^+$	M1+E2	0.62 *+5−4*	4.40 *11*	α(K)=3.14 *13*; α(L)=0.95 *3*; α(M)=0.237 *8* α(N)=0.0608 *20*; α(O)=0.0122 *4*; α(P)=0.00137 *3* Others: 1968Br17, 1965Va10. Mult.,δ: from ce(L1)/ce(L2) exp=2.4 *5* and ce(L1)/ce(L3) exp=2.8 *4* (1970Da09). δ=0.58 from ce data (1999Li05) is in agreement, but conversion coefficients or L/M ratio are not given in this study.
^{x}221.5[#] *3*	0.28 *4*								This γ ray has been assigned by 1968Br17 and 1970Kr08 to the decay of ^{223}Ra, and by 1970Da09 to the decay of ^{219}Rn (1977Ma30). Not seen by 1999Li05.
224.0 *7*	0.013 *2*	517.60	7/2$^+$,9/2$^+$	293.56	(11/2)$^+$	[M1,E2]		0.7 *4*	α(K)=0.5 *4*; α(L)=0.151 *11*; α(M)=0.0376 *9*; α(N)=0.00966 *24*
271.23 *1*	100 *2*	271.228	7/2$^+$	0.0	9/2$^+$	M1+E2	3.6 *+7−5*	0.207 *12*	α(K)=0.117 *11*; α(L)=0.0672 *12*; α(M)=0.0174 *3* α(N)=0.00446 *7*; α(O)=0.000872 *15*; α(P)=8.84×10^{-5} *21* Mult.,δ: from ce(L1)/ce(L2) exp=0.516 *47*, ce(L1)/ce(L3) exp=1.035 *92* (1970Da09), and ce(K):ce(L1):ce(L2):ce(L3) exp=30.6 *9*:4.5:8.3 *5*:3.6 *9* (1972HeYM). Other values: α(K)exp=0.107 *16*, α(L3)exp=0.016 *5*, ce(L3)/ce(L1)+ce(L2) exp=0.40 *6* (1970Kr08). δ=3.7 *+10−6* if all data are used. δ=4.0 from ce data (1999Li05) is in agreement, but conversion coefficients or K/L/M ratios are not given in this study. Other values: Eγ=271.6, Iγ=87 (1957Pi31), Eγ=268, Iγ=11.0 (1957Pa07). Other: 1966Po02.
293.56 *4*	0.68 *4*	293.56	(11/2)$^+$	0.0	9/2$^+$	M1		0.536	α(K)=0.436 *7*; α(L)=0.0763 *11*; α(M)=0.0180 *3* α(N)=0.00463 *7*; α(O)=0.000969 *14*; α(P)=0.0001252 *18* Mult.: dominant M1 from α(K)exp (1999Li05), and probably also from K/L/M ratio, but no numerical data are given in this work. M1 from intensity balance arguments in the decay of ^{215}Bi to ^{215}Po (2003Ku26).

$^{215}_{84}Po_{131}$-3

^{219}Rn α decay (3.96 s) 1999Li05,1976Bl13,1970Kr08 (continued)

γ(^{215}Po) (continued)

E_γ ‡	I_γ ‡&	E_i(level)	J_i^π	E_f	J_f^π	Mult.	α †	Comments
321.8 [a] *10*	8×10^{-04} *4*	930?		608.30	(11/2$^+$,13/2$^+$)			
x324.9 # *10*	<0.06							E_γ,I_γ: from 1967Da20. Not seen by 1999Li05.
330.8 *4*	0.009 *1*	732.7		401.812	5/2$^+$			
x337.7 # *10*	0.08 *2*							Not seen by 1999Li05.
x370.9 # *15*	<0.1							E_γ,I_γ: from 1967Da20. Other value: Iγ≈0.02 (1965Va10). Not seen by 1999Li05.
373.5 *6*	0.0023 *3*	891.1		517.60	7/2$^+$,9/2$^+$			
x380 #	≈0.0003							γ ray is uncertain (1965Va10). Not seen by 1999Li05.
383.1 *6*	0.0040 *6*	676.66		293.56	(11/2)$^+$			
401.81 *1*	61 *2*	401.812	5/2$^+$	0.0	9/2$^+$	E2	0.0555	α(K)=0.0351 *5*; α(L)=0.01528 *22*; α(M)=0.00390 *6* α(N)=0.001001 *14*; α(O)=0.000198 *3*; α(P)=2.08×10^{-5} *3* Other values: Eγ=401, Iγ=77 (1966Po02); Eγ=400.6, Iγ=48 (1957Pi31). Others: 1965Va10, 1957Pa07. Mult.: from α(K)exp=0.027 *12* and ce(K)/ce(L3) exp=7 *2* (1970Kr08). Other: E2 from ce data (1999Li05), but no coefficients or ratios are given.
405.4 *6*	0.0023 *4*	676.66		271.228	7/2$^+$			
436.9 *6*	0.0028 *5*	708.1		271.228	7/2$^+$			
x438.2 # *6*	<0.28							E_γ,I_γ: from 1967Da20. Other value: Eγ=438.7 *3*, Iγ=0.48 *5* (1968Br17). 1968Br17 assigned this transition to the decay of ^{215}Po. 1967Da20 suggested (on the basis of αγ-coin results of 1965Va10) that the contribution from ^{215}Po decay is 0.26≤Iγ≤0.44, which establishes an upper limit of Iγ≈0.28 from ^{219}Rn decay (1977Ma30). Not seen by 1999Li05.
461.6 *8*	0.0015 *3*	732.7		271.228	7/2$^+$			
489.3 *5*	0.0058 *8*	891.1		401.812	5/2$^+$			
517.60 *6*	0.41 *2*	517.60	7/2$^+$,9/2$^+$	0.0	9/2$^+$	M1(+E2)	0.1162	α(K)=0.0948 *14*; α(L)=0.01634 *23*; α(M)=0.00385 *6* α(N)=0.000990 *14*; α(O)=0.000207 *3*; α(P)=2.68×10^{-5} *4* Mult.: dominant M1 from α(K)exp (1999Li05), but no numerical data are given in this work. α: for M1. E_γ,I_γ: Eγ=516.5 *5*, Iγ=0.22 *5* (1970Da09) were not included in the input for averaging. Other: 1965Va10.
x538.2 @ *15*	0.06 @ *3*							
556.1 *10*	5×10^{-04} *3*	1073.7	(5/2$^+$)	517.60	7/2$^+$,9/2$^+$			
564.1 *3*	0.014 *3*	835.32		271.228	7/2$^+$			I_γ: other value: Iγ≈0.02 (1965Va10).
576.6 *10*	8×10^{-04} *4*	1094.2		517.60	7/2$^+$,9/2$^+$			
608.3 *2*	0.040 *10*	608.30	(11/2$^+$,13/2$^+$)	0.0	9/2$^+$			Other value: Iγ≈0.026 (1965Va10).
619.9 *6*	0.003 *1*	891.1		271.228	7/2$^+$			
671.9 *6*	0.002 *1*	1073.7	(5/2$^+$)	401.812	5/2$^+$			

$^{215}_{84}Po_{131}$-4

γ(^{215}Po) (continued)

E_γ ‡	I_γ ‡&	E_i(level)	J_i^π	E_f	J_f^π	Comments
676.66 *7*	0.16 *2*	676.66		0.0	9/2$^+$	Other value: Iγ≈0.1 (1965Va10).
708.1 *8*	0.003 *1*	708.1		0.0	9/2$^+$	
732.8 *10*	6×10^{-04} *3*	732.7		0.0	9/2$^+$	
802.5 *6*	0.003 *1*	1073.7	(5/2$^+$)	271.228	7/2$^+$	
835.3 *3*	0.015 *3*	835.32		0.0	9/2$^+$	E_γ,I_γ: other values: Eγ≈833, Iγ≈0.01 (1965Va10).
877.2 *6*	0.003 *1*	877.2		0.0	9/2$^+$	
891.1 *4*	0.007 *2*	891.1		0.0	9/2$^+$	E_γ,I_γ: other values: Eγ=889.0 *15*, Iγ=0.015 *7* (1967Da20). Iγ≈0.01 (1965Va10).
[x]1055[@] *2*	0.006[@] *3*					
1073.7 *6*	0.003 *1*	1073.7	(5/2$^+$)	0.0	9/2$^+$	

† Additional information 1.
‡ Weighted average from 1999Li05, 1976Bl13, 1970Kr08, 1970Da09, 1968Br17, and 1967Da20.
# Uncertain γ ray.
@ From 1967Da20. Other value: Iγ≈0.003 (1965Va10). Not seen by 1999Li05.
& For absolute intensity per 100 decays, multiply by 0.108 *6*.
[a] Placement of transition in the level scheme is uncertain.
[x] γ ray not placed in level scheme.

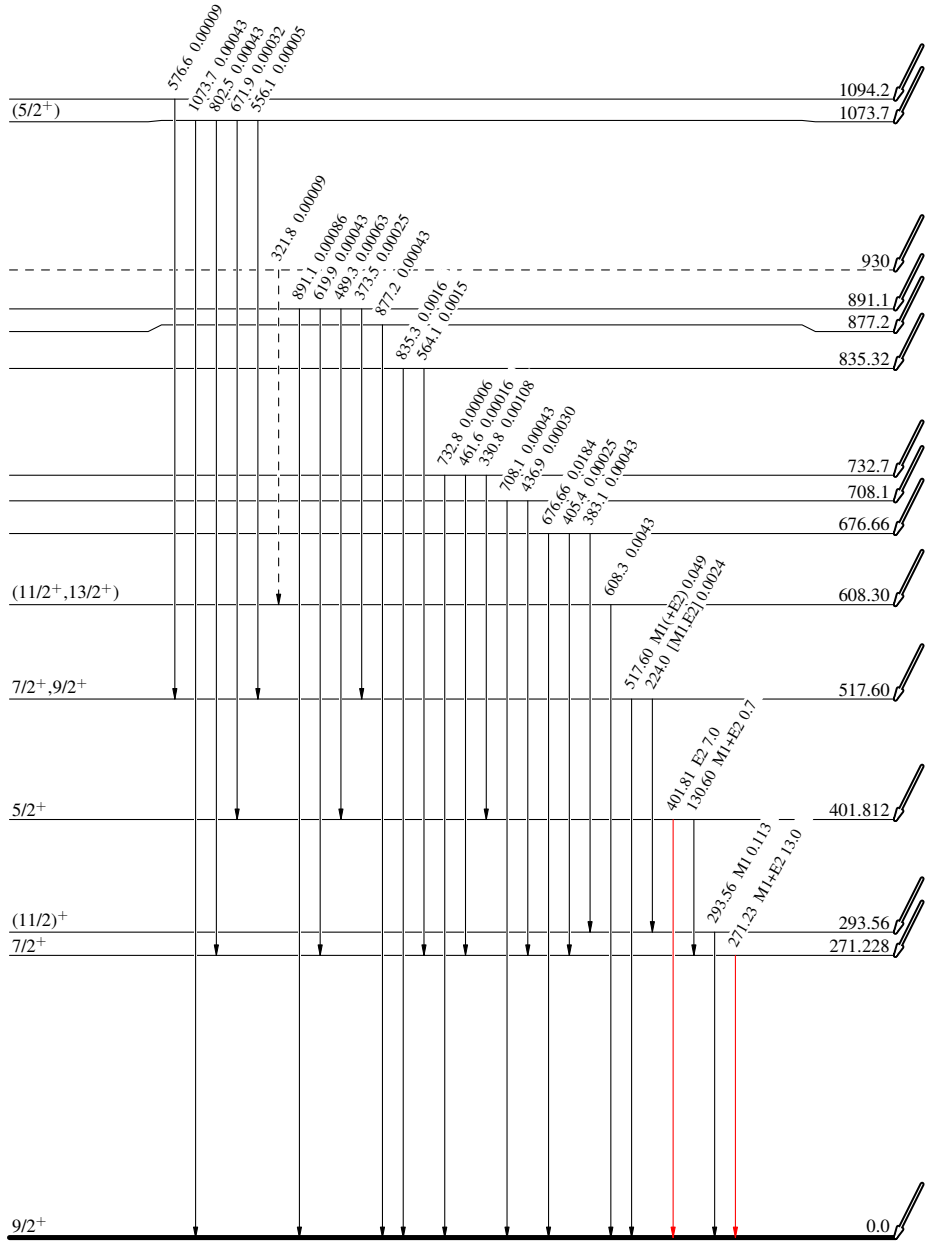
^{219}Rn α decay (3.96 s) 1999Li05,1976Bl13,1970Kr08

Decay Scheme

Intensities: $I_{(\gamma+ce)}$ per 100 parent decays

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)

$^{219}_{86}Rn_{133}$: $5/2^+$, 0.0, 3.96 s *1*, Q_α=6946.1 *3*, %α=100



Eα	Iα	HF
5744	0.00009	270
5764	0.00092	33
5900	≈0.0001	≈1426
5944	0.0020	107
5958	0.00032	770
6000	0.0031	123
6100	0.0012	900
6124	0.00063	2200
6158	0.018	105
6223	0.0043	850
6311	0.051	172
6425.0	7.5	3.4
6530	0.110	630
6552.6	12.9	6.6
6819.1	79.4	11.1

$^{215}_{84}Po_{131}$