^{221}Rn α decay (25.7 min) 1977Vy02,1997Li23,2004Li28

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	B. Singh, T. Roy, K. Banerjee	NDS 147, 382 (2018)	1-Dec-2017

Parent: ^{221}Rn: E=0.0; $J^\pi=7/2^{(+)}$; $T_{1/2}$=25.7 min *5*; Q(α)=6148 *2*; %α decay=20 *2*

^{221}Rn-J^π: Spin measured by 1987Bo29, laser spectroscopy. Parity from possible allowed β transition to a 294, $(9/2)^+$ level in ^{221}Fr. Note that J^π is $7/2^+$ in the January 2007-update of ENSDF database for ^{221}Rn.

^{221}Rn-$T_{1/2}$: From 1997Li23 and 2004Li28. Note that in the January 2007-update of ENSDF database for ^{221}Rn, value is 25 min *2*, taken from 1956Mo15, where 1997Li23 and 2004Li28 references were not included.

^{221}Rn-Q(α): From Eα=6037 *2*, assuming that this α feeds the g.s. rather than a level at 9.5 or 19.8 keV as tentatively proposed in 2004Li28. Based on the proposal by 2004Li28, 2017Wa10 deduced 6163 keV *3*.

^{221}Rn-%α decay: unweighted average of α branchings determined by 1977Vy02 and by 1997Li23: α/β^-= 22 *1*/ 78 *1* was obtained by 1977Vy02 by comparing intensities of ^{221}Rn, ^{221}Fr,^{217}Po and ^{217}At α groups present in the mass-separated source in equilibrium with its daughters; α/β^-= 18 *1*/ 82 *1* was deduced by 1997Li23. Note that in the January 2007-update of ENSDF database for ^{221}Rn, values are 22 *1* for %α decay and 78 *1* for β^- decay, taken from 1977Vy02, and where 1997Li23 reference was missed.

1977Vy02: measured Eα, Iα, Eγ, Iγ, ce.

1997Li23, 2004Li28: measured Eα, Iα, Eγ, Iγ, $\alpha\gamma$-coin, half-lives of decays of ^{221}Rn and ^{217}Po, decay branching ratios.

Based on configurations of the parent and daughter state fed by 6037α and corresponding HF, 2004Li28 tentatively propose 6037α to an $11/2^+$ state, and the $(9/2^+)$ ground state below it at an energy of 9.5 or 19.8 keV, and the 254γ and 264γ feeding the $11/2^+$ state rather than the $9/2^+$ g.s. However, from ^{217}Bi β^- decay studies by 2003Ku25 and 2014Mo02, there does not seem to be any evidence of such a scenario of ^{217}Po level scheme.

^{217}Po Levels

E(level)†	J^π‡	$T_{1/2}$‡
0.0	$(9/2^+)$	1.53 s *5*
254.2 *3*	$(7/2^+)$	
264.68 *4*	$(11/2^+)$	

† From Eγ values.
‡ From Adopted Levels.

α radiations

Eα†	E(level)	Iα‡@	HF#	Comments
5778 *2*	264.68	7.5	9	Iα: average of 8 (1977Vy02) and 7 (1997Li23).
5788 *2*	254.2	11	7	Iα: average of 10 (1977Vy02) and 12 (1997Li23).
6037 *2*	0.0	81	13	Iα: average of 82 (1977Vy02) and 80 (1997Li23).

† From 1997Li23 and 1977Vy02, with uncertainties from 1997Li23. 1977Vy02 quoted uncertainty of 3 keV for each Eα value. Values in 1977Vy02 were adjusted downward by 2 keV by 1991Ry01 in a re-calibration procedure.
‡ Intensities per 100 α decays, uncertainties are not available.
# $r_0(^{217}Po)$=1.5521 *2*, interpolation of $r_0(^{216}Po)$= 1.5555 *2* and $r_0(^{218}Po)$=1.5487 *2* (1998Ak04). Values deduced by evaluators using above r_0 parameter.
@ For absolute intensity per 100 decays, multiply by 0.20 *2*.

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γ(^{217}Po)

Iγ normalization: Absolute intensities were obtained by 1977Vy02 by normalizing relative Iγ data to Iγ(218.19γ of ^{221}Fr α decay)=10.7% *6*; Iγ=11.44% *16* has been adopted in ^{221}Fr α decay scheme. Since this corresponds to per 100 β^- decays of ^{221}Rn normalization factor for converting Iγ per 100 α decays is: [(80 *2*)/(20 *2*)][(11.44 *16*)/(10.7 *6*)]=4.3 *5*.

E_γ[†]	I_γ[†‡]	E_i(level)	J_i^π	E_f	J_f^π	Mult.	δ	α[#]	Comments
254.2 *3*	2.1 *2*	254.2	(7/2$^+$)	0.0	(9/2$^+$)	(E2)		0.210 *3*	α(K)=0.0975 *14*; α(L)=0.0841 *13*; α(M)=0.0220 *4* α(N)=0.00565 *9*; α(O)=0.001096 *17*; α(P)=0.0001067 *16* Mult.: E2 or E1 from measured Ice(K)<0.2 (1977Vy02), and α(K)exp<0.1, but E2 gives a better γ-intensity balance at the 254.2 level.
264.68 *4*	1.13 *8*	264.68	(11/2$^+$)	0.0	(9/2$^+$)	(M1(+E2))	<1.8	0.5 *2*	α(K)=0.4 *2*; α(L)=0.09 *1*; α(M)=0.022 *2*; α(N)=0.0056 *6*; α(O)=0.00115 *14* Mult.,δ: from Ice(K)=0.46 *23* to 0.76 *23* (1977Vy02), with implied α(K)(exp)=0.41 *21* to 0.67 *21* (in 0.20-0.88 range), which is consistent with M1, M1+E2, E3 or E4. The high multipolarities are less likely as these would imply the 264.68 level to be an isomer of long half-life, which is not the case from observed αγ-coincidences.

[†] From 1977Vy02. The authors normalized Iγ values to Iγ(218γ of ^{221}Fr decay)=10.7% *6*. The relative Ice values measured by 1977Vy02, were normalized to Ice(K 218γ)=1.5% *2*.

[‡] For absolute intensity per 100 decays, multiply by 0.86 *13*.

[#] Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.

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Decay Scheme

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