^{213}Ra α decay (2.73 min) 2006Ku26,1976Ra37,1967Va22

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	J. Chen # and F. G. Kondev	NDS 126, 373 (2015)	30-Sep-2013

Parent: ^{213}Ra: E=0.0; $J^\pi=1/2^-$; $T_{1/2}$=2.73 min *5*; Q(α)=6861.3 *23*; %α decay=80 *5*

^{213}Ra-J^π,$T_{1/2}$: From Adopted Levels of ^{213}Ra.

^{213}Ra-Q(α): From Eα=6732.3 keV *23*, as evaluated in the present work. 6861.8 keV *23* in 2012Wa38.

^{213}Ra-%α decay: From Adopted Levels of ^{213}Ra.

2006Ku26: ^{213}Ra isotopes were produced by the ^{170}Er(^{50}Ti,xn) reaction with the E=4.35 MeV/nucleon ^{50}Ti beam from the UNILAC at GSI, Darmstadt. Evaporation residues were separated by the velocity filter ship and implanted into a position-sensitive 16-strips pips detector. γ-rays were detected with a Ge-Clover detector (5.0(5)% efficiency at 1.3 MeV) consisting of four individual crystals. Measured Eγ, Iγ, Eα, Iα, $\gamma\gamma$-coin, $\gamma\gamma\gamma$-coin, $\alpha\gamma$-coin, I(ce). Deduced levels, J^π, γ- and α-branchings, conversion coefficients.

1976Ra37: ^{213}Ra isotopes were produced by ^{209}Bi(^{10}B,6nγ) and Pb(^{12}C,xnγ) reactions with E=60-100 MeV beams from the Yale University's Heavy Ion Accelerator (HILAC). α particles were detected with an Si(Au) surface barrier detector and γ-rays were detected with two Ge(Li) detectors. Measured Eγ, Iγ, Eα, Iα, I(x-ray), $\gamma\gamma$-coin. Deduced levels, J^π, γ-branchings, α-branchings, conversion coefficients.

1967Va22: ^{213}Ra isotopes were produced by ^{197}Au(^{19}F,xn) and ^{206}Pb(^{12}C,xn) with E(^{17}F) up to 197 MeV and E(^{12}C) up to 125 MeV beams from the Berkeley Heavy Ion Linear Accelerator (HILAC). Reaction products were detected with a Si(Au) barrier detector. Measured Eα, Iα, σ(E). Deduced levels, α-branchings.

Others: 1961Gr42, 1968Lo15, 1970TaZS, 1984Gu29, 1987Ar20, 1989He03.

^{209}Rn Levels

E(level)†	J^π‡
0.0	$5/2^-$
110.26 *9*	$1/2^-$
214.94 *9*	$3/2^-$
328.30 *9*	$3/2^-$
511.32 *14*	$(1/2,3/2,5/2)^-$

† From a least-squares fit to Eγ.
‡ From Adopted Levels.

α radiations

Eα†	E(level)	Iα‡@	HF#	Comments
6230 *6*	511.32	0.14 *7*	15 *8*	Eα,Iα: From 2006Ku26.
6413 *3*	328.30	0.34 *6*	36 *7*	Eα: weighted average of 6411.9 keV *50* (1976Ra37, corrected by +0.9 keV, as suggested in 1991Ry01) and 6413 keV *4* (2006Ku26). Other: 6408 keV (1967Va22). Iα: weighted average of 0.4 *2* (1967Va22), 0.5 *1* (1976Ra37) and 0.22 *8* (2006Ku26).
6521.9 *23*	214.94	5.8 *6*	6.2 *8*	Eα: 6520 keV *20* (1968Lo15), 6520 keV *5* (1967Va22), 6522 keV *5* (1976Ra37) and 6622 keV *3* (2006Ku26). Iα: weighted average of 6 *1* (1967Va22), 6 *1* (1976Ra37) and 5.4 *9* (2006Ku26).
6624.7 *23*	110.26	48.5 *17*	1.93 *16*	Eα: 6620 keV *20* (1968Lo15), 6623 keV *5* (1967Va22), 6624 keV *5* (1976Ra37) and 6625 keV *3* (2006Ku26). Iα: 49 *2* (1967Va22) and 47 *3* (1976Ra37).
6732.3 *23*	0.0	45.5 *17*	5.5 *5*	Eα: 6730 keV *20* (1968Lo15), 6730 keV *5* (1967Va22), 6731 keV *5* (1976Ra37) and 6733 keV *3* (2006Ku26). Iα: 45 *2* (1967Va22) and 46 *3* (1976Ra37).

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^{213}Ra α decay (2.73 min) 2006Ku26,1976Ra37,1967Va22 (continued)

α radiations (continued)

† Weighted average of values from 2006Ku26, 1976Ra37 and 1967Va22, except for the E=511 keV level, where data are from 2006Ku26 only. Values from 1976Ra37 and 1967Va22 were corrected by +0.7 keV and +0.9 keV, respectively, as suggested in 1991Ry01. Originally measured (uncorrected) Eα are given as comments.
‡ Recommended by 1991Ry01, unless otherwise stated.
# $r_0(^{209}Rn)$=1.456 *8*, weighted average of $r_0(^{208}Rn)$=1.466 *8* and $r_0(^{210}Rn)$=1.4552 *21*, both deduced from HF=1.
@ For absolute intensity per 100 decays, multiply by 0.80 *5*.

γ(^{209}Rn)

E_γ†	I_γ‡*b*	E_i(level)	J_i^π	E_f	J_f^π	Mult.@	δ@*a*	α&	Comments
104.8# *2*	0.20 *4*	214.94	3/2⁻	110.26	1/2⁻	M1(+E2)	≤0.8	10.6 *10*	α(K)=7.5 *18*; α(L)=2.3 *6*; α(M)=0.58 *18* α(N)=0.15 *5*; α(O)=0.032 *9*; α(P)=0.0042 *9* I_γ: 0.42 *15* from 1976Ra37 per 100 α decays. I(104.8γ)/I(214.9γ)=29 *5*/100 *3* (2006Ku26). Mult.: α(exp)=8.1 *24* in 2006Ku26.
110.3# *1*	7.5 *3*	110.26	1/2⁻	0.0	5/2⁻	E2		5.48	α(K)=0.362 *5*; α(L)=3.77 *6*; α(M)=1.017 *15* α(N)=0.265 *4*; α(O)=0.0534 *8*; α(P)=0.00594 *9* I_γ: Other: 8 *2* from 1976Ra37 per 100 α decays. Mult.: α(exp)=5.1 *9* in 2006Ku26.
(113.3 *2*)	<0.012	328.30	3/2⁻	214.94	3/2⁻	[M1]		9.20	α(K)=7.42 *11*; α(L)=1.355 *21*; α(M)=0.322 *5* α(N)=0.0839 *13*; α(O)=0.0184 *3*; α(P)=0.00268 *4* E_γ,I_γ: transition not observed, it is inferred by 2006Ku26 from intensity balance at the 328 level. Intensity limit of I(113.3γ)/I(328.3γ)<0.15 in 2006Ku26 is based upon systematics of N=123 isotones.
183.0 *2*	0.013 *7*	511.32	(1/2,3/2,5/2)⁻	328.30	3/2⁻	M1		2.36	α(K)=1.91 *3*; α(L)=0.345 *5*; α(M)=0.0818 *12* α(N)=0.0213 *3*; α(O)=0.00467 *7*; α(P)=0.000681 *10* I_γ: I(183.0γ)/I(296.4γ)=29 *8*/100 *12* (2006Ku26). Mult.: α(exp)=2.5 *18* in 2006Ku26.
214.9# *1*	1.6 *4*	214.94	3/2⁻	0.0	5/2⁻	M1(+E2)	<1.2	1.2 *4*	α(K)=0.9 *4*; α(L)=0.212 *8*; α(M)=0.0521 *8* α(N)=0.01357 *20*; α(O)=0.00291 *7*; α(P)=0.00040 *4* I_γ: 1.2 *3* from 1976Ra37 per 100 α decays.
218.1 *2*	0.062 *14*	328.30	3/2⁻	110.26	1/2⁻	M1		1.444	α(K)=1.167 *17*; α(L)=0.210 *3*;

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^{213}Ra α decay (2.73 min) 2006Ku26,1976Ra37,1967Va22 (continued)

γ(^{209}Rn) (continued)

E_γ [†]	I_γ [‡] [b]	E_i(level)	J_i^π	E_f	J_f^π	Mult. [@]	α [&]	Comments
								α(M)=0.0499 *8* α(N)=0.01301 *19*; α(O)=0.00285 *4*; α(P)=0.000416 *6* I_γ: I(218.1γ)/I(328.3γ)=48 *11*/100 *9* (2006Ku26).
296.4 *2*	0.045 *23*	511.32	(1/2,3/2,5/2)$^-$	214.94	3/2$^-$	M1	0.617	Mult.: α(exp)=1.7 *16* in 2006Ku26. α(K)=0.500 *7*; α(L)=0.0895 *13*; α(M)=0.0212 *3* α(N)=0.00553 *8*; α(O)=0.001211 *17*; α(P)=0.0001768 *25*
328.3 *1*	0.13 *3*	328.30	3/2$^-$	0.0	5/2$^-$	M1(+E2)	0.467	Mult.: α(exp)=0.9 *6* in 2006Ku26. α(K)=0.378 *6*; α(L)=0.0675 *10*; α(M)=0.01601 *23* α(N)=0.00417 *6*; α(O)=0.000913 *13*; α(P)=0.0001334 *19*
401.6[c] *6*	0.0014 *11*	511.32	(1/2,3/2,5/2)$^-$	110.26	1/2$^-$			I_γ: I(401.6γ)/I(296.4γ)=3 *2*/100 *12* (2006Ku26).
511.3 *3*	0.022 *12*	511.32	(1/2,3/2,5/2)$^-$	0.0	5/2$^-$			I_γ: I(511.3γ)/I(296.4γ)=48 *10*/100 *12* (2006Ku26).

[†] From 2006Ku26, unless otherwise stated.
[‡] From intensity balances using Iα and the branching ratios in 2006Ku26.
[#] Weighted average of values from 2006Ku26 and 1976Ra37.
[@] From Adopted Gammas.
[&] Additional information 1.
[a] Additional information 2.
[b] For absolute intensity per 100 decays, multiply by 0.80 *5*.
[c] Placement of transition in the level scheme is uncertain.

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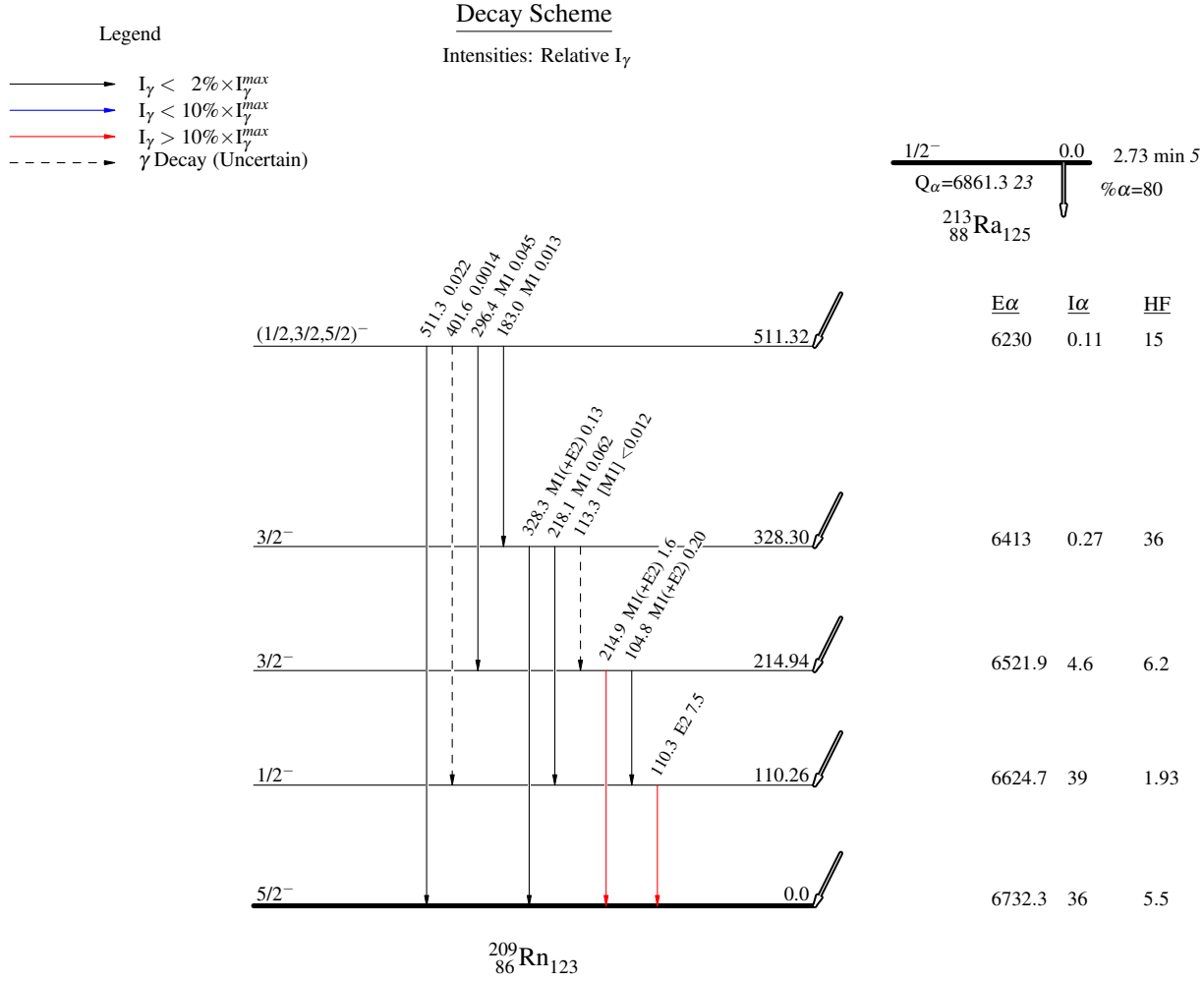
Decay Scheme

Intensities: Relative I_γ



Eα	Iα	HF
6230	0.11	15
6413	0.27	36
6521.9	4.6	6.2
6624.7	39	1.93
6732.3	36	5.5