^{210}Bi α decay (3.04×10^6 y) 1975TuZW,1976TuZY,1969La18

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	F. G. Kondev	NDS 201,346 (2025)	21-Jan-2025

Parent: ^{210}Bi: E=271.31 *11*; $J^\pi=9^-$; $T_{1/2}=3.04\times10^6$ y *6*; Q(α)=5036.5 *8*; %α decay=100

^{210}Bi-E,J^π,$T_{1/2}$: From 2014Ba41.

^{210}Bi-Q(α): From 2021Wa16.

1975TuZW,1976TuZY: ^{210}Bi isomer produced by ^{209}Bi(n,γ) reaction with chemical and isotope separations. Half-life measurement included isotopic assay and grid chamber. Measured: α, γ and ce singles, and $\gamma\gamma$ and α-γ coincidences with Si and Ge detectors.

1969La18: ^{210}Bi isomer produced by ^{209}Bi(n,γ) reaction with, and without, isotope separation and by chemical extraction of ^{210}Pb from the source. Measured: γ singles and $\gamma\gamma$ coincidences with Ge, Si(Li), and NaI detectors, and α singles and α-γ coincidences with Ge and Si surface-barrier detectors.

Others:

1961Ru02: ^{210}Bi isomer produced by ^{209}Bi(n,γ) reaction with chemical and isotope separation. Measured α's with ionization chamber with resolving power of 28 keV, γ with NaI, ce with magnetic spectrometer, lifetimes from γ-α coincidences with plastic detectors, and ce-α coincidences in the magnetic spectrometer. Early work by the same authors: 1958Go89 and 1959Go77.

1962Ko12: measured E(α) and I(α) with ionization chamber using Eα(^{234}U)=4768 keV as a reference.

1967Sp07: source from 1954Le60. γ's measured using Ge detector.

Others: 1953Hu42, 1954Le60, 1960Wa14, 1969LaZY, 1970La23.

^{206}Tl Levels

E(level)†	J^π‡	$T_{1/2}$‡	Comments
0.0	0^-	4.202 min *14*	
265.6 *4*	2^-	2.29 ns *14*	$T_{1/2}$: Other: 1.25 ns *20* from α-γ(t) in 1961Ru02.
304.9 *4*	1^-	4.2 ps *14*	$T_{1/2}$: Other: 3.2 ns *3* from α-γ(t) in 1961Ru02, but this value is most likely associated with the 265.6 keV level (1984Bh06).
634.6 *5*	2^-	4.0 ps *9*	
649.4 *4*	1^-		
801.1 *7*	3^-	2.4 ps *7*	
951.6 *11*	4^-	42 ps *10*	
997.9 *4*	2^-		
1116.90 *10*	1^-		

† From a least-squares fit to Eγ.

‡ From Adopted Levels.

α radiations

Eα‡	E(level)	Iα@	HF†	Comments
4100# *8*	1116.90	0.00037	4.26×10^5 *43*	Iα: From Iγ and α.
4230# *8*	997.9	0.0004	3.14×10^6 *32*	Iα: From Iγ and α.
4268# *8*	951.6	0.006	4.58×10^5 *47*	Iα: From Iγ and α.
4420 *1*	801.1	0.20 *1*	1.61×10^5 *19*	Eα: Others: 4400 keV *5* (1969La18), 4423 keV *5* (1962Ko12), and 4480 keV *10* (1961Ru02). Iα: Unweighted average 0.21% (1976TuZY) and 0.19% *1* (1969La18).
4568 *2*	649.4	3.75 *1*	9.1×10^4 *10*	Eα: Others: 4568 keV *5* (1969La18), 4568 keV *5* (1962Ko12), and 4590 keV *10* (1961Ru02). Iα: Unweighted average of 3.75%, determined by the evaluator from I(4582α+4568α)=5.1% (singles) and I(4582α)/I(4568α)=1.4/3.9 (α-γ coincidence) in 1976TuZY, and 3.74% *12* (1969La18).
4582 *2*	634.6	1.35 *1*	3.16×10^5 *32*	Iα: Determined by the evaluator from I(4582α+4568α)=5.1% (singles) in

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^{210}Bi α decay (3.04×10^6 y) 1975TuZW,1976TuZY,1969La18 (continued)

α radiations (continued)

Eα‡	E(level)	Iα@	HF†	Comments
				1976TuZY and I(4568α)=3.75% *1* in the present work.
4909 *1*	304.9	40 *2*	1.19×10^6 *14*	Eα: Others: 4896 keV *5* (1969La18), 4916 keV *5* (1962Ko12), and 4890 keV *10* (1961Ru02). Iα: Unweighted average 39.5% (1976TuZY) and 40.4% *10* (1969La18). ΔIα is a conservative estimate by the evaluator. Others: 36% *1* (1962Ko12) and 34% (1961Ru02).
4946 *1*	265.6	54.8 *20*	1.48×10^6 *16*	Eα: Others: 4935 keV *5* (1969La18), 4953 keV *5* (1962Ko12), and 4930 keV *10* (1961Ru02). Iα: Unweighted average 55.0% (1976TuZY) and 54.6% *11* (1969La18). ΔIα is a conservative estimate by the evaluator. Others: 57.6% *10* (1962Ko12) and 60% (1961Ru02).
(5206.5 *8*)	0.0	<0.0001		Eα: Not observed in 1976TuZY. Eα is from Q(α) in 2021Wa16. Iα: Others: ≈0.04 in 1969La18 and 1970La23.

† $r_0(^{206}Tl)$=1.46 *3*, unweighted average of 1.449 *21* (^{206}Hg), 1.408790 *38* (^{206}Pb) and 1.52177 *18* (^{208}Pb) (2020Si16).
‡ From singles measurements in 1976TuZY, unless otherwise stated.
# From α-γ coincidences in 1976TuZY.
@ Absolute intensity per 100 decays.

γ(^{206}Tl)

Iγ normalization: Unweighted average of 0.481 *18*, using I(4946α)=54.8% *20* and I[265.6(ce+γ)] − I(ce+γ)[feeding the 265.6-keV level] and 0.56 *4*, using I(4909α)=40% *2* and I[304.9(ce+γ)] − I(ce+γ)[feeding the 304.9-keV level].

Eγ†	Iγ†@	Ei(level)	J_i^π	Ef	J_f^π	Mult.‡	α#	Comments
265.6 *5*	100	265.6	2$^-$	0.0	0$^-$	E2	0.1607 *24*	%Iγ=52 *4* α(K)=0.0857 *13*; α(L)=0.0563 *9*; α(M)=0.01445 *23* α(N)=0.00362 *6*; α(O)=0.000641 *10*; α(P)=3.10×10^{-5} *5* Eγ,Iγ: Others: Eγ=267.7 keV *2*, Iγ=100 (1967Sp07) and Eγ=266 keV, Iγ=100 (1969La18). Mult.: α(K)exp=0.092, α(L)exp=0.057 and α(M)exp=0.013 (1976TuZY); α(K)exp=0.15 *6* and K/L=1.5 *3* (1961Ru02).
304.6 *5*	54.5 *27*	304.9	1$^-$	0.0	0$^-$	M1	0.376 *6*	%Iγ=28.3 *26* α(K)=0.308 *5*; α(L)=0.0520 *8*; α(M)=0.01214 *18* α(N)=0.00306 *5*; α(O)=0.000595 *9*; α(P)=5.63×10^{-5} *8* Eγ: Others: Eγ=304.8 keV *3* (1967Sp07) and 305 keV (1969La18). Iγ: Unweighted average Iγ=55.4 (1976TuZY), 54 (1967Sp07) and 54 (1969La18). A conservative ΔIγ=5% was estimated by the evaluator. Mult.: α(K)exp=0.37, α(L)exp=0.060 and α(M)exp=0.017 (1976TuZY); α(K)exp=0.26 *1* and K/L=6.3 *1* (1961Ru02).
329.6 *5*	1.5 *3*	634.6	2$^-$	304.9	1$^-$	M1	0.304 *4*	%Iγ=0.78 *17* α(K)=0.249 *4*; α(L)=0.0419 *6*; α(M)=0.00978 *14* α(N)=0.00247 *4*; α(O)=0.000480 *7*; α(P)=4.54×10^{-5} *7* Eγ: Others: Eγ=329.1 keV *8* (1967Sp07) and 329 keV (1969La18). Iγ: Unweighted average Iγ=1.46 (1976TuZY), 1.1

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^{210}Bi α decay (3.04×10^{6} y) 1975TuZW,1976TuZY,1969La18 (continued)

$\gamma(^{206}Tl)$ (continued)

E_γ[†]	I_γ[†@]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[‡]	α[#]	Comments
								(1969La18) and ≈2 (1967Sp07). Mult.: α(K)exp=0.29 and α(L)exp=0.074 (1976TuZY).
344.3 *5*	1.6 *2*	649.4	1^-	304.9	1^-	M1	0.270 *4*	%Iγ=0.83 *12* α(K)=0.2212 *32*; α(L)=0.0372 *5*; α(M)=0.00868 *13* α(N)=0.002191 *32*; α(O)=0.000426 *6*; α(P)=4.03×10^{-5} *6* E_γ: Others: Eγ=344.0 keV *10* (1967Sp07) and 344 keV (1969La18). I_γ: Unweighted average Iγ=1.40 (1976TuZY), 1.4 (1969La18) and ≈2 (1967Sp07). Mult.: α(K)exp=0.15 and α(L)exp=0.033 (1976TuZY).
368.9 *5*	1.2 *1*	634.6	2^-	265.6	2^-	M1	0.2239 *32*	%Iγ=0.62 *7* α(K)=0.1837 *27*; α(L)=0.0308 *4*; α(M)=0.00719 *10* α(N)=0.001816 *26*; α(O)=0.000353 *5*; α(P)=3.34×10^{-5} *5* E_γ: Others: Eγ=369.6 keV *10* (1967Sp07) and 368 keV (1969La18). I_γ: Unweighted average Iγ=1.25 (1976TuZY), 1.3 (1969La18) and ≈1 (1967Sp07). Mult.: α(K)exp=0.18 and α(L)exp=0.038 (1976TuZY).
384	0.011	649.4	1^-	265.6	2^-	[M1]	0.2010 *28*	%Iγ=0.0057 *4* α(K)=0.1649 *23*; α(L)=0.0277 *4*; α(M)=0.00645 *9* α(N)=0.001628 *23*; α(O)=0.000316 *4*; α(P)=3.00×10^{-5} *4* E_γ,I_γ: From a γ-ray spectrum collected with isotopically separated source (1976TuZY).
535.5 *5*	0.51	801.1	3^-	265.6	2^-	[M1]	0.0830 *12*	%Iγ=0.265 *20* α(K)=0.0682 *10*; α(L)=0.01134 *16*; α(M)=0.00264 *4* α(N)=0.000666 *9*; α(O)=0.0001295 *18*; α(P)=1.229×10^{-5} *17* E_γ,I_γ: Other: Eγ=534 keV and Iγ=0.5 in 1969La18.
635	0.02	634.6	2^-	0.0	0^-	[E2]	0.01621 *23*	%Iγ=0.0104 *8* α(K)=0.01224 *17*; α(L)=0.00301 *4*; α(M)=0.000733 *10* α(N)=0.0001844 *26*; α(O)=3.43×10^{-5} *5*; α(P)=2.56×10^{-6} *4* E_γ: From a γ-ray spectrum collected with isotopically separated source (1976TuZY). E_γ: Other: 634 keV (1969La18). I_γ: Other: 0.02 (1969La18).
649.6 *5*	5.8 *11*	649.4	1^-	0.0	0^-	M1	0.0501 *7*	%Iγ=3.0 *6* α(K)=0.0412 *6*; α(L)=0.00680 *10*; α(M)=0.001584 *22* α(N)=0.000400 *6*; α(O)=7.77×10^{-5} *11*; α(P)=7.38×10^{-6} *10* E_γ: Others: Eγ=649.8 keV *10* (1967Sp07) and 651 keV (1969La18). I_γ: Unweighted average Iγ=7.7 (1976TuZY), 5.6 (1969La18) and ≈4 (1967Sp07). Mult.: α(K)exp=0.029 (1976TuZY).
686	0.012	951.6	4^-	265.6	2^-	[E2]	0.01370 *19*	%Iγ=0.0062 *5* α(K)=0.01048 *15*; α(L)=0.002445 *34*; α(M)=0.000592 *8* α(N)=0.0001488 *21*; α(O)=2.78×10^{-5} *4*; α(P)=2.134×10^{-6} *30* E_γ,I_γ: From a γ-ray spectrum collected with isotopically separated source (1976TuZY).

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^{210}Bi α decay (3.04×10^6 y) 1975TuZW,1976TuZY,1969La18 (continued)

γ(^{206}Tl) (continued)

E_γ[†]	I_γ[†@]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[‡]	α[#]	Comments
732.34 *7*	0.0008	997.9	2$^-$	265.6	2$^-$	[M1]	0.0367 *5*	%Iγ=0.000416 *32* α(K)=0.0302 *4*; α(L)=0.00497 *7*; α(M)=0.001156 *16* α(N)=0.000292 *4*; α(O)=5.67×10^{-5} *8*; α(P)=5.39×10^{-6} *8* E_γ: From adopted gammas. Eγ=734 keV *2* observed in α-γ coin of 1976TuZY.
1116.9 *1*	0.0007	1116.90	1$^-$	0.0	0$^-$	M1	0.01242 *17*	%Iγ=0.000364 *28* α(K)=0.01025 *14*; α(L)=0.001665 *23*; α(M)=0.000387 *5* α(N)=9.75×10^{-5} *14*; α(O)=1.898×10^{-5} *27*; α(P)=1.809×10^{-6} *25*; α(IPF)=5.53×10^{-7} *8* E_γ: From adopted gammas. Eγ=1120 keV *2* observed in α-γ coin of 1976TuZY.

[†] From 1976TuZY, unless otherwise stated. Uncertainty of 0.5 keV was assigned to the strong and well resolved γ rays and of 1 keV to the weak ones by the evaluator. Others: 1967Sp07, 1961Ru02, 1969La18.
[‡] From α(K)exp and α(L)exp in 1961Ru02 and 1976TuZY.
[#] Additional information 1.
[@] For absolute intensity per 100 decays, multiply by 0.52 *4*.

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Decay Scheme

Intensities: I_γ per 100 parent decays