^{194}Bi ε decay (125 s+115 s) 1987Va09

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Jun Chen and Balraj Singh	NDS 177, 1 (2021)	3-Sep-2021

Parent: ^{194}Bi: E=145 *50*; J^π=(6$^+$,7$^+$); $T_{1/2}$=125 s *2*; Q(ε)=8185 *18*; %ε+%β^+ decay=100.0

Parent: ^{194}Bi: E=161 *8*; J^π=(10$^-$); $T_{1/2}$=115 s *4*; Q(ε)=8185 *18*; %ε+%β^+ decay=99.80 *7*

^{194}Bi(145)-E,J^π,$T_{1/2}$: From Adopted Levels of ^{194}Bi. Adopted $T_{1/2}$ is from 1987Va09. Other: 120 s *18* from 1976Ch30 for the two isomers.

^{194}Bi(145)-Q(ε): From 2021Wa16.

^{194}Bi(145)-%ε+%β^+ decay: From Adopted Levels of ^{194}Bi.

^{194}Bi(161)-E,J^π,$T_{1/2}$: From Adopted Levels of ^{194}Bi. Adopted $T_{1/2}$ is from α-decay curve in 1991Va04. Other: 106 s *3* in 1987Va09 obtained from decay curves for 1308γ and 931γ, which are seen in the decay of all the three ^{194}Bi activities.

^{194}Bi(161)-Q(ε): From 2021Wa16.

^{194}Bi(161)-%ε+%β^+ decay: From Adopted Levels of ^{194}Bi, based on %α=0.20 *7* (1991Va04).

1987Va09: ^{194}Bi source ions were produced via ^{nat}Re(^{16}O,xnγ) with E<210 MeV beam with the Leuven Isotope Separator On-Line (LISOL) facility. γ rays were detected with two Ge detectors and conversion electrons were detected with a Si(Li) detector. Measured Eγ, Iγ, E(ce), I(ce), $\gamma\gamma$-coin, ce-γ-coin, γ(t), $\gamma\gamma$(t). Deduced levels, J, π, $T_{1/2}$, conversion coefficients, γ-ray multipolarities. Systematics of neighboring Pb isotopes and comparisons with theoretical calculations. See also 1984Va19 and 1984Va11 from the same research group.

1976Ch30: ^{194}Bi source ions were produced via the reactions of E=145 MeV ^{20}Ne and E=175 MeV ^{22}Ne beams from the U-300 cyclotron at JINR on 3 mg/cm^2 self-supporting ^{181}Ta targets. γ rays were detected with a Ge(Li) detector and a NaI(Tl) detector. Measured Eγ, Iγ, $\gamma\gamma$-coin, γ(t). Deduced levels, J, π, parent $T_{1/2}$. Systematics of neighboring Pb isotopes.

1993St01: search for the population of SD sates in ^{194}Pb following the decay of ^{194}Bi with the UNISOR on-line separator at ORNL.

Other: 1962Ju08.

Data presented here are for the decays of two isomers with J^π=(10$^-$) and J^π=(6$^+$,7$^+$). Since the isotope was produced in (HI,xn) reactions, the population of the ^{194}Bi g.s. (J^π=(3$^+$)) was very weak.

The decay scheme is incomplete due to a large gap between the Q-value and the highest excited levels seen in this decay. No I(ε+β^+) and log *ft* values are deduced.

^{194}Pb Levels

E(level)†	J^π‡	$T_{1/2}$	Comments
0.0	0$^+$		
930.7? *3*	0$^+$		
965.04 *16*	2$^+$		
1308.24? *15*	(2$^+$)		
1540.09 *20*	4$^+$		
1820.4 *3*	(5)$^-$		
2134.8 *3*	(6)$^+$		
2241.3 *3*	(7)$^-$		
2299.1? *4*	(5$^-$,6$^-$)		E(level): level proposed by 1996Lo12 based on matching 478γ observed in (HI,xnγ) and in ^{194}Bi ε decay.
2407.5 *4*	(9)$^-$		
2419.8 *4*	(8$^-$)		
2437.4 *3*	(8)$^+$	17 ns *4*	$T_{1/2}$: from $\gamma\gamma$(t) in 1987Va09.
2502.4 *4*	(8$^-$)		
2581.4 *4*	(10)$^+$		
2608.3? *4*			E(level): level proposed by 1996Lo12 based on matching 788γ observed in (HI,xnγ) and in ^{194}Bi ε decay.
2628.7 *5*	(12$^+$)		
2799.0 *4*	(4$^+$ to 8$^+$)		
2913.1 *4*	(9$^-$)		

Continued on next page (footnotes at end of table)

^{194}Bi ε decay (125 s+115 s) 1987Va09 (continued)

^{194}Pb Levels (continued)

E(level)[†]	Jπ[‡]
2930.6 *4*	(9^+)
2933.6 *5*	$(11)^-$

[†] From a least-squares fit to γ-ray energies.
[‡] From Adopted Levels.

γ(^{194}Pb)

1987Va09 present a composite decay scheme for the ^{194}Bi isomers. The evaluators have attempted to separate the decay schemes assuming that the three isomers populate levels with different range of spins, the 95-s g.s. populating the low-spin levels (J≤4) and the 115-s and 125-s isomers populating the high-spin (J>4). The low lying levels, however, are seen in the decay of all the activities.

E_γ ‡	I_γ #	E_i(level)	J_i^π	E_f	J_f^π	Mult. †	δ †	α [a]	$I_{(\gamma+ce)}$	Comments
46.8 *4*	0.04 @ *1*	2628.7	(12$^+$)	2581.4	(10)$^+$	[E2]		221 *10*	10.0 *20*	ce(L)/(γ+ce)=0.742 *24*; ce(M)/(γ+ce)=0.195 *12* ce(N)/(γ+ce)=0.049 *3*; ce(O)/(γ+ce)=0.0087 *6*; ce(P)/(γ+ce)=0.000297 *19* α(L)=165 *8*; α(M)=43.4 *20* α(N)=10.9 *5*; α(O)=1.93 *9*; α(P)=0.066 *3* E_γ: transition seen as L- and M-lines in ce data.
166.2 *2*	19.5 *6*	2407.5	(9)$^-$	2241.3	(7)$^-$	E2		0.831		α(K)=0.255 *4*; α(L)=0.430 *7*; α(M)=0.1129 *17* α(N)=0.0285 *5*; α(O)=0.00512 *8*; α(P)=0.000238 *4* E_γ: weighted average of 166.3 *2* (1987Va09) and 166.1 *3* (1976Ch30). I_γ: other: 46 *3* from 1976Ch30 is discrepant. Mult.: α(K)exp=0.29 *5*, α(L)exp=0.40 *6*.
173.9 *2*	17.6 *6*	2581.4	(10)$^+$	2407.5	(9)$^-$	E1		0.1102		α(K)=0.0892 *13*; α(L)=0.01609 *23*; α(M)=0.00377 *6* α(N)=0.000948 *14*; α(O)=0.000181 *3*; α(P)=1.552×10^{-5} *23* E_γ: weighted average of 173.8 *2* (1987Va09) and 174.0 *3* (1976Ch30). I_γ: other: 28 *2* from 1976Ch30 is discrepant. Mult.: α(K)exp=0.11 *2*.
178.5 *2*	2.8 *3*	2419.8	(8$^-$)	2241.3	(7)$^-$	(M1+E2)	<0.7	1.61 *20*		α(K)=1.26 *21*; α(L)=0.263 *11*; α(M)=0.063 *4* α(N)=0.0160 *10*; α(O)=0.00313 *13*; α(P)=0.000298 *24* Mult.: α(K)exp=1.3 *2*, α(L)exp=0.31 *6*. Weak line in ce data (1987Va09).
196.1 *2*	3.3 *3*	2437.4	(8)$^+$	2241.3	(7)$^-$	(E1)		0.0819		α(K)=0.0665 *10*; α(L)=0.01180 *17*; α(M)=0.00277 *4* α(N)=0.000695 *10*; α(O)=0.0001335 *19*; α(P)=1.165×10^{-5} *17* Mult.: α(K)exp<0.1. Weak line in ce data (1987Va09).
231.9 *2*	0.4 *2*	1540.09	4$^+$	1308.24?	(2$^+$)	[E2]		0.259		α(K)=0.1192 *17*; α(L)=0.1046 *16*; α(M)=0.0272 *4* α(N)=0.00687 *10*; α(O)=0.001248 *18*; α(P)=6.72×10^{-5} *10*
261.1 *2*	1.5 *4*	2502.4	(8$^-$)	2241.3	(7)$^-$	(M1)		0.624		α(K)=0.510 *8*; α(L)=0.0874 *13*; α(M)=0.0205 *3* α(N)=0.00520 *8*; α(O)=0.001037 *15*; α(P)=0.0001108 *16* Mult.: α(K)exp=0.65 *14*, α(L)exp=0.12 *2*. Weak line in ce data.
280.3 *2*	71.8 *10*	1820.4	(5)$^-$	1540.09	4$^+$	E1		0.0346		α(K)=0.0283 *4*; α(L)=0.00482 *7*; α(M)=0.001126 *16* α(N)=0.000284 *4*; α(O)=5.50×10^{-5} *8*; α(P)=5.06×10^{-6} *8* E_γ,I_γ: other: 280.2 *3* with Iγ=70 *5* (1976Ch30). Mult.: from adopted gammas. Absence in ce data consistent with low conversion coefficient expected for mult=E1.

$^{194}_{82}Pb_{112}$-3

^{194}Bi ε decay (125 s+115 s) 1987Va09 (continued)

γ(^{194}Pb) (continued)

E_γ[‡]	I_γ[#]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[†]	α[a]	Comments
[x]284.1 *2*	0.9 *4*							
302.5 *2*	13.5 *6*	2437.4	$(8)^+$	2134.8	$(6)^+$	E2	0.1127	α(K)=0.0638 *9*; α(L)=0.0367 *6*; α(M)=0.00942 *14* α(N)=0.00238 *4*; α(O)=0.000438 *7*; α(P)=2.69×10^{-5} *4* Mult.: α(K)exp=0.045 *9*, α(L)exp=0.037 *7*.
304.8 *2*	1.9 *5*	2933.6	$(11)^-$	2628.7	(12^+)	E1	0.0285	α(K)=0.0233 *4*; α(L)=0.00394 *6*; α(M)=0.000919 *13* α(N)=0.000232 *4*; α(O)=4.50×10^{-5} *7*; α(P)=4.18×10^{-6} *6*
343.2 *2*	0.05[&] *2*	1308.24?	(2^+)	965.04	2^+	(E0+M1+E2)	0.72 *11*	I_γ: total Iγ=1.0 *3* (1987Va09). α: from ^{194}Bi ε decay (95 s).
352.3 *2*	3.0 *4*	2933.6	$(11)^-$	2581.4	$(10)^+$	E1	0.0204	α(K)=0.01680 *24*; α(L)=0.00279 *4*; α(M)=0.000651 *10* α(N)=0.0001642 *23*; α(O)=3.20×10^{-5} *5*; α(P)=3.03×10^{-6} *5* Mult.: α(K)exp=0.056 *9* gives E2, but the ce(K) line is very weak in this work (1987Va09).
[x]355.2 *2*	1.7 *4*							
377.5 *3*	0.02[&] *1*	1308.24?	(2^+)	930.7?	0^+			I_γ: total Iγ=0.4 *2* (1987Va09).
421.0 *2*	58.3 *8*	2241.3	$(7)^-$	1820.4	$(5)^-$	E2	0.0451	α(K)=0.0301 *5*; α(L)=0.01129 *16*; α(M)=0.00284 *4* α(N)=0.000718 *11*; α(O)=0.0001345 *19*; α(P)=9.72×10^{-6} *14* E_γ: other: 421 *1* with Iγ=55 *10* (1976Ch30). Mult.: α(L)exp=0.013 *2*, α(M)exp=0.0026 *7*.
478.7[b] *2*	0.8 *4*	2299.1?	$(5^-,6^-)$	1820.4	$(5)^-$			E_γ: Tentative placement from 1996Lo12. α(K)exp=0.12 *2*. Uncertainty quoted by 1987Va09 is incorrect, it should be at least 50%.
493.2 *2*	5.6 *5*	2930.6	(9^+)	2437.4	$(8)^+$			
[x]505.8 *3*	0.6 *4*							
[x]557.8 *2*	1.7 *3*							
575.0 *2*	95.5 *14*	1540.09	4^+	965.04	2^+	E2	0.0212	α(K)=0.01553 *22*; α(L)=0.00427 *6*; α(M)=0.001052 *15* α(N)=0.000266 *4*; α(O)=5.07×10^{-5} *8*; α(P)=4.19×10^{-6} *6* E_γ,I_γ: other: 575.4 *5* with Iγ=87 *8* (1976Ch30). Mult.: α(L)exp=0.0037 *8*.
594.7 *2*	23.3 *14*	2134.8	$(6)^+$	1540.09	4^+	E2	0.0196	α(K)=0.01450 *21*; α(L)=0.00388 *6*; α(M)=0.000952 *14* α(N)=0.000241 *4*; α(O)=4.60×10^{-5} *7*; α(P)=3.85×10^{-6} *6* Mult.: α(K)exp=0.014 *3*.
[x]615.7 *2*	0.8 *2*							
[x]659.5 *2*	0.5 *3*							
664.2 *2*	5.0 *4*	2799.0	$(4^+$ to $8^+)$	2134.8	$(6)^+$			
671.8 *2*	2.1 *5*	2913.1	(9^-)	2241.3	$(7)^-$	(Q)		I_γ: doublet. The other component is assigned to the decay of the 95-s isomer. Intensity division for two placements (with 2913 and 1637 level) is shown in figure 9 of 1987Va09, probably done the basis of γγ-coin data.
[x]722.1 *2*	0.9 *2*							
787.9[b] *2*	2.5 *4*	2608.3?		1820.4	$(5)^-$			E_γ: tentative placement from 1996Lo12.
[x]845.3 *2*	1.5 *2*							
[x]897.0 *3*	0.6 *2*							

$^{194}_{82}Pb_{112}$-4

^{194}Bi ε decay (125 s+115 s) 1987Va09 (continued)

γ(^{194}Pb) (continued)

E_γ ‡	I_γ #	E_i(level)	J_i^π	E_f	J_f^π	Mult. †	α [a]	Comments
[x]906.6 *3*	0.3 *1*							
930.6 *4*		930.7?	0^+	0.0	0^+	E0		E_γ,Mult.: from ce data (1987Va09). A comparison of γ and ce spectra shows the existence of an E0 transition, which is assigned as a ground transition by 1987Va09 also based on coincidence relation with PB K x rays and not coincidence with 965γ. I(γ+ce)=0.02, deduced from transition intensity balance at 931 level.
965.0 *2*	100	965.04	2^+	0.0	0^+	E2	0.00714	α(K)=0.00567 *8*; α(L)=0.001121 *16*; α(M)=0.000267 *4* α(N)=6.77×10^{-5} *10*; α(O)=1.322×10^{-5} *19*; α(P)=1.266×10^{-6} *18* E_γ: other: 965.0 *5* (1976Ch30). Mult.: α(L)exp=0.0019 *4*.
[x]1024.7 *3*	0.8 *2*							
[x]1030.0 *3*	0.9 *3*							
[x]1049.6 *3*	0.5 *2*							
[x]1222.1 *3*	0.6 *2*							
1308.3 *2*	0.30[&] *6*	1308.24?	(2^+)	0.0	0^+	(E2)	0.00400	α(K)=0.00324 *5*; α(L)=0.000573 *8*; α(M)=0.0001349 *19* α(N)=3.42×10^{-5} *5*; α(O)=6.74×10^{-6} *10*; α(P)=6.78×10^{-7} *10*; α(IPF)=1.693×10^{-5} *24* I_γ: total Iγ=6.7 *3* (1987Va09). Mult.: 1987Va09 quote α(K)exp=0.0039 *8*; however, in the ce spectrum shown by the authors, the K-conversion line is not evident.

† From Adopted Gammas, supported by the ce data in 1987Va09 as given in comments where available, which are normalized to ce(K) lines of 965γ, 575γ and 421γ, all treated as E2 transitions.
‡ From 1987Va09, unless otherwise noted.
# From ε+β^+ decay of all three ^{194}Bi isomers.
@ Deduced from ce data.
& Deduced from transition intensity balance at 1308 level.
a 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.
b Placement of transition in the level scheme is uncertain.
x γ ray not placed in level scheme.

$^{194}_{82}Pb_{112}$-5

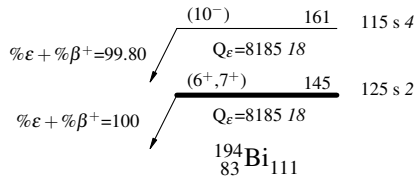
^{194}Bi ε decay (125 s+115 s) 1987Va09

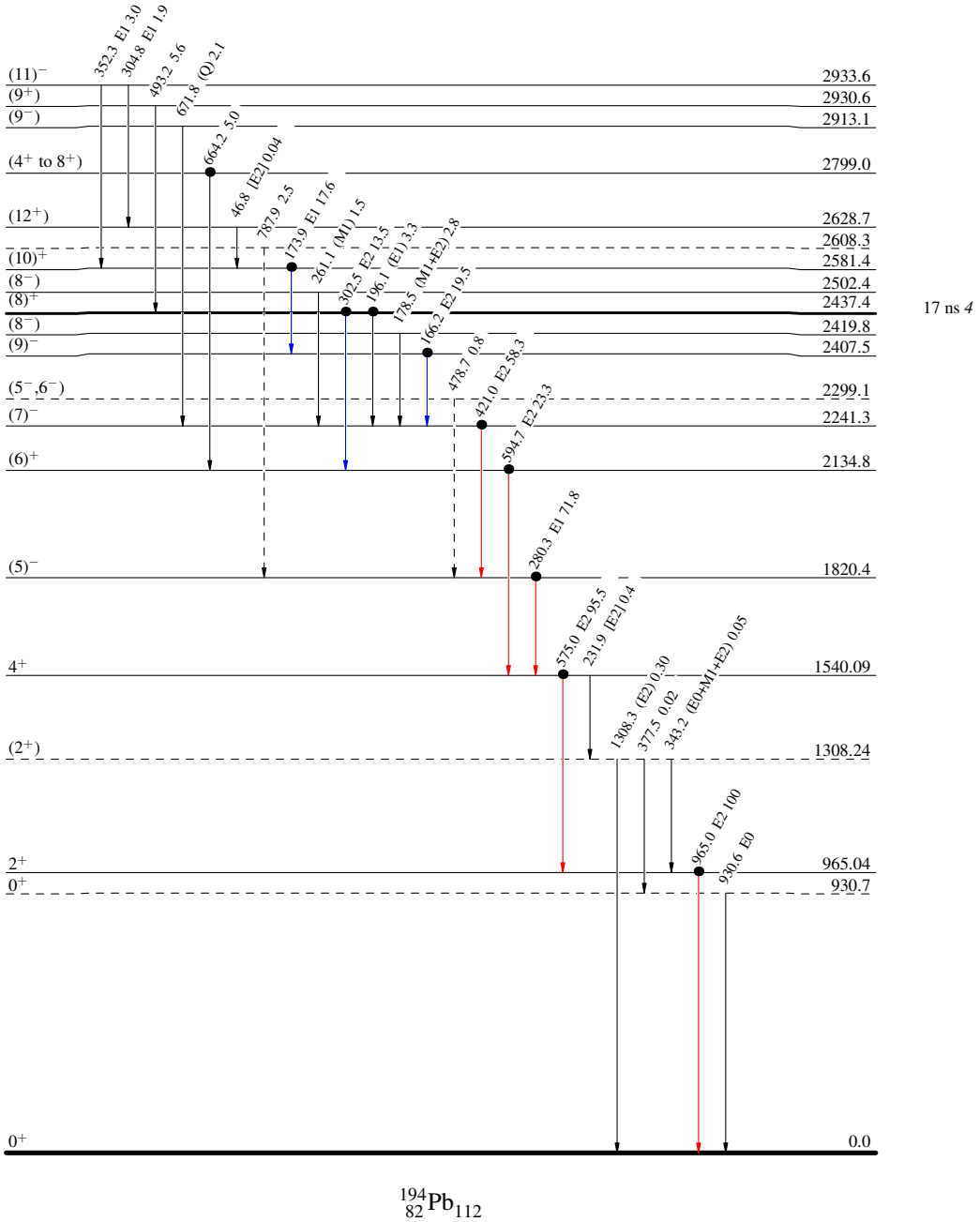
Legend

- $I_\gamma < 2\% \times I_\gamma^{max}$
- $I_\gamma < 10\% \times I_\gamma^{max}$
- $I_\gamma > 10\% \times I_\gamma^{max}$
- γ Decay (Uncertain)
- Coincidence

Decay Scheme

Intensities: Relative I_γ





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