^{212}Bi β^- decay (60.55 min) 1973Da38,1984Ge07

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	K. Auranen and E. A. Mccutchan	NDS 168, 117 (2020)	1-Aug-2020

Parent: ^{212}Bi: E=0.0; $J^\pi=1^{(-)}$; $T_{1/2}$=60.55 min *6*; Q(β^-)=2251.5 *17*; %β^- decay=64.06 *6*

(^{212}Bi β^-)(^{212}Po α): 1957Bu34.

(^{212}Bi β^-)(^{212}Po α)(t): 1982Be09. The authors measured (100≤Eβ≤200)(10.55 MeV α)(t) and obtained $T_{1/2}$=34 ps *4*. It was assumed that the 10.55 α-group originated entirely from the 1801 level. However, the currently adopted energy of the observed "long range" α, Eα=10554 *2* (^{212}Bi β-α (60.55 min)) gives E(^{212}Po level)=1803.8 *20*. Since both the 1800.8 and 1805.8 could decay by α emission, it is, therefore, possible that this group may contain α's from either or both of these levels. Thus, there is no experimental evidence to conclusively assign the measured $T_{1/2}$ to one of these two levels.

(^{212}Bi 2250 β^-)(^{212}Po 8785 α)(θ): isotropic (1961De04), nonisotropic (1956Be38). The latter conclusion is not in agreement with the adopted spin assignments.

(^{212}Po 727 γ)(^{212}Po 8785 α)(θ): isotropic (1961De04,1956Fi41).

(^{212}Po γ, $\gamma\gamma$, sum γ)(^{212}Po α): 1962Be09, 1960Ga15, 1960Gi07, 1960Ha19, 1960Sc07, 1958Ch43.

$\gamma\gamma$, sum $\gamma\gamma$: 1962Be09, 1960Ga15, 1960Gi07, 1960Sc07.

Others: 1983Sc13, 1982Sa36, 1968Yt02, 1960Em01.

$\gamma\gamma(\theta)$: 1982Be09, 1961Gi05.

$\beta\gamma$: 1960Sc07.

$\beta\gamma(\theta)$: 1969Sc06.

$\beta(\alpha)$, $\beta(\alpha)$(t), $\beta(\alpha)(\theta)$: see ^{212}Po levels from ^{212}Bi β^- decay (25.0 min).

The decay scheme is complete as evidenced by the agreement between the effective Q value of 1442.3 keV *17* and the total energy released in the decay of 1441.8 keV *26* as calculated by the RADLST code.

α: Additional information 1.

^{212}Po Levels

E(level)[†]	J^π[‡]	$T_{1/2}$[‡]	Comments
0.0	0^+	294.3 ns *8*	
727.330 *9*	2^+		
1512.70 *8*	2^+		J^π: (785.37γ)(727.330γ)(θ) shows 2(D+Q)2(Q)0 sequence (1982Be09,1961Gi05).
1620.738 *10*	1^+		J^π: (893.408γ)(727.330γ)(θ) shows 1(D+Q)2(Q)0 sequence (1982Be09).
1679.450 *14*	2^+		J^π: (952.120γ)(727.330γ)(θ) shows 2(D+Q)2(Q)0 sequence (1982Be09).
1800.9[#] *2*	0^+		
1805.96[#] *10*	2^+		J^π: (1078.62γ)(727.330γ)(θ) shows 2(D+Q)2(Q)0 sequence (1982Be09).

[†] From a least-squares fit to Eγ data.
[‡] From the Adopted Levels.
[#] From (100≤Eγ≤200)(10.55 MeV α)(t) a half-life of $T_{1/2}$=34 ps *4* (1982Be09) is obtained, see comment above.

β^- radiations

F-K analysis of 1957Bu34 shows an additional β^- group with Eβ(endpoint)=0.08 MeV, Iβ=5% of β^- decay.

E(decay)	E(level)	Iβ^-[†‡]	Log *ft*	Comments
(445.5 *17*)	1805.96	0.66 *3*	6.695 *21*	av Eβ=129.88 *56* Iβ^-: other: Iβ=9% of β^- decay for Eβ(endpoint)=0.45 MeV from F-K analysis (1957Bu34).
(450.6 *17*)	1800.9	0.030 *6*	8.05 *9*	av Eβ=131.53 *56*
(572.1 *17*)	1679.450	0.23 *3*	7.51 *6*	av Eβ=172.18 *59*

Continued on next page (footnotes at end of table)

^{212}Bi β^- decay (60.55 min) 1973Da38,1984Ge07 (continued)

β^- radiations (continued)

E(decay)	E(level)	Iβ^-[†‡]	Log *ft*	Comments
(630.8 *17*)	1620.738	1.86 *4*	6.748 *11*	av Eβ=192.44 *60* Iβ^-: other: Iβ=6% of β^- decay for Eβ(endpoint)=0.67 MeV from F-K analysis (1957Bu34).
(738.8 *17*)	1512.70	1.44 *4*	7.093 *13*	av Eβ=230.63 *61* Iβ^-: other: Iβ=5.5% of β^- decay for Eβ(endpoint)=0.93 MeV from F-K analysis (1957Bu34).
(1524.2 *17*)	727.330	4.47 *11*	7.720 *11*	av Eβ=532.88 *69* (Eβ>800)(727.330γ)(θ) isotropic (1969Sc06). Iβ^-: other: Iβ=8.5% of β^- decay from F-K analysis (1957Bu34).
(2251.5 *17*)	0.0	55.37 *11*	7.2664 *16*	av Eβ=833.95 *72* E(decay): measured values: 2250.5 *25* (1948Ma30), 2256 (1948Fe09), 2260 *10* (1948Za05), 2270 (1957Bu34). Iβ^-: other: Iβ=66% of β^- decay from F-K analysis (1957Bu34).

[†] The intensities of the β groups have been deduced from the absolute Iγ and the I(γ+ce) balance at each level. The intensities of β^- delayed α's from the excited levels, other than from the 1801 level, are insignificant. In the case of the 1801 level an α group with intensity Iα=0.008% *8* has been considered in Iβ calculation.

[‡] Absolute intensity per 100 decays.

^{212}Bi β^- decay (60.55 min) 1973Da38,1984Ge07 (continued)

$\gamma(^{212}Po)$

Iγ normalization: weighted average of Iγ(727.3γ): 6.93 *18* (1992Li05), 6.58 *5* (1984Ge07), 7.00 *18* (1983Va22), 7.35 *20* (1983Sc13), 6.9 *4* (1982Sa36), 6.47 *40* (1960Em01), 7.17 *45* (1960Sc07) converted to a γ-ray scale per 100 β^- decays of ^{212}Bi using 6.67 *9*/0.6406=10.41 *14*.

The conversion coefficients based on the Ice of 1963Da11 and 1957Vo22 have been deduced by the evaluator using the adopted Iγ and the E2 multipolarity of the 727.330γ (α(K)=0.0106 for 1963Da11, and α(L)=0.0026 for 1957Vo22).

Peaks at Eγ≈1300 and Eγ=2200 were reported in early studies (1947Jo05, 1947La24, 1958Ch43). These were not found by 1960Em01 (Eγ=1.34 MeV, Iγ≤0.3; Eγ=2.20 MeV, Iγ≤1.9) and 1960Gi07 (Eγ=1.3 MeV, Iγ<0.2; Eγ=2.2 MeV, Iγ<0.06), nor reported by later references.

E_γ [†]	I_γ [‡e]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[d]	δ [#d]	α	Comments
[x]130									
180.2[b]	0.005 *2*	1800.9	0^+	1620.738	1^+	[M1]		2.08	α(K)=1.692 *24*; α(L)=0.298 *5*; α(M)=0.0704 *10*; α(N)=0.0181 *3*; α(O)=0.00379 *6* α(P)=0.000490 *7* E_γ: other: Eγ=190, Iγ=0.3 (1960Gi07). I_γ: measured relative to Iγ(176.68 ^{212}Pb β^- decay) (1982Be09).
727.330[@] *9*	10.41 *14*	727.330	2^+	0.0	0^+	E2		0.01393	α(K)=0.01054 *15*; α(L)=0.00257 *4*; α(M)=0.000628 *9*; α(N)=0.0001613 *23*; α(O)=3.28×10^{-5} *5* α(P)=3.83×10^{-6} *6* I_γ: See comment on decay scheme normalization. Mult.: from α(K)exp=0.088 *10*, K/L=3.9 *9* (1978Av01), K/L=4.3 (1956Kr57). Other: 1963Da11.
785.37[&] *8*	1.72 *2*	1512.70	2^+	727.330	2^+	M1+E2	+0.09 *3*	0.0387	α(K)=0.0316 *5*; α(L)=0.00539 *8*; α(M)=0.001266 *19*; α(N)=0.000326 *5*; α(O)=6.82×10^{-5} *10* α(P)=8.84×10^{-6} *13* I_γ: Weighted average of 1.05 *5* (1992Li05), 1.102 *13* (1984Ge07), 1.07 *5* (1983Sc13): Iγ(785γ)=1.100 *12*/0.6406=1.72 *2*. Mult.: D+Q from γγ(θ) (1982Be09,1961Gi05); M1+E2 from α(K)exp=0.033 *5* (1978Av01). Others: 1963Da11, 1957Vo22. δ: other: 0.04 *3* (1961Gi05). (727.3γ)(785.4γ)(θ): A_2=0.313 *18*, A_4=0.017 *26* (1982Be09).
893.408[@] *5*	0.59 *3*	1620.738	1^+	727.330	2^+	M1+E2	−0.031 *34*	0.0278	α(K)=0.0228 *4*; α(L)=0.00386 *6*; α(M)=0.000907 *13*; α(N)=0.000233 *4*; α(O)=4.89×10^{-5} *7* α(P)=6.33×10^{-6} *9* Mult.: D+Q from γγ(θ) (1982Be09); M1+E2 from α(K)exp=0.025 (1963Da11,1957Vo22). (727.3γ)(893.4γ)(θ): A_2=−0.284 *37*, A_4=−0.042 *52* (1982Be09).
952.120[@] *11*	0.26[c] *5*	1679.450	2^+	727.330	2^+	M1+E2	+0.65 *50*	0.019 *5*	α(K)=0.015 *4*; α(L)=0.0027 *6*; α(M)=0.00063 *13*; α(N)=0.00016 *4*; α(O)=3.4×10^{-5} *7*

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^{212}Bi β^- decay (60.55 min) 1973Da38,1984Ge07 (continued)

$\gamma(^{212}Po)$ (continued)

E_γ [†]	I_γ [‡e]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[d]	δ [#d]	α	$I_{(\gamma+ce)}$ [e]	Comments
										α(P)=4.4×10^{-6} *10* Mult.: D+Q from $\gamma\gamma(\theta)$ (1982Be09); (M1+E2) from α(K)exp=0.039 (1957Vo22). (727.3γ)(952.1γ)(θ): A_2=0.474 *59*, A_4=0.097 *82* (1982Be09).
1073.6[b] *2*	0.025 *3*	1800.9	0$^+$	727.330	2$^+$	[E2]		0.00642		α(K)=0.00510 *8*; α(L)=0.001002 *14*; α(M)=0.000240 *4*; α(N)=6.16×10^{-5} *9*; α(O)=1.269×10^{-5} *18* α(P)=1.557×10^{-6} *22* I_γ: Iγ(1078.62)/Iγ(1073.6)=35.7 *35* (1982Be09). Mult.: measured Ice (α(K)exp≤0.2 (1963Da11), α(K)exp=0.2 (1957Vo22)) are in disagreement with this assignment.
1078.62[&] *10*	0.88 *3*	1805.96	2$^+$	727.330	2$^+$	M1+E2	−0.135 *35*	0.0169 *3*		α(K)=0.01386 *22*; α(L)=0.00234 *4*; α(M)=0.000549 *9*; α(N)=0.0001413 *22*; α(O)=2.96×10^{-5} *5* α(P)=3.84×10^{-6} *6* I_γ: Weighted average of 0.555 *41* (1992Li05), 0.563 *19* (1984Ge07), 0.58 *4* (1983Sc13): Iγ(1078.6γ)=0.564 *16*/0.6406=0.88 *3*. Mult.: D+Q from $\gamma\gamma(\theta)$ (1982Be09); (M1+E2) from α(K)exp=0.014 (1963Da11,1957Vo22). (727.3γ)(1078.6γ)(θ): A_2=0.147 *27*, A_4=−0.003 *39* (1982Be09).
1512.7 *3*	0.45[c] *6*	1512.70	2$^+$	0.0	0$^+$	[E2]		0.00344		α(K)=0.00274 *4*; α(L)=0.000483 *7*; α(M)=0.0001139 *16*; α(N)=2.93×10^{-5} *4*; α(O)=6.07×10^{-6} *9* α(P)=7.66×10^{-7} *11* Mult.: α(K)exp=0.02 (1957Vo22), in disagreement with this multipolarity.
1620.50[&] *10*	2.29 *5*	1620.738	1$^+$	0.0	0$^+$	(M1)		0.00620		α(K)=0.00494 *7*; α(L)=0.000824 *12*; α(M)=0.000193 *3*; α(N)=4.97×10^{-5} *7*; α(O)=1.041×10^{-5} *15* α(P)=1.353×10^{-6} *19* I_γ: Weighted average of 1.44 *9* (1992Li05), 1.49 *3* (1984Ge07), 1.38 *8* (1983Sc13): Iγ(1620.5γ)=1.47 *3*/0.6406=2.29 *5*. Mult.: α(K)exp=0.0050 (1963Da11), 0.0062 (1957Vo22).
1679.7 *5*	0.09[c] *2*	1679.450	2$^+$	0.0	0$^+$	[E2]		0.00291		α(K)=0.00227 *4*; α(L)=0.000391 *6*; α(M)=9.19×10^{-5} *13*; α(N)=2.36×10^{-5} *4*; α(O)=4.91×10^{-6} *7* α(P)=6.23×10^{-7} *9*
1800.2[a]		1800.9	0$^+$	0.0	0$^+$	E0			0.0064 *6*	Mult.: no photon observed. $I_{(\gamma+ce)}$: Ice(K) measured relative to Ice(K)(2614.5γ ^{208}Pb), corrected for Ice(K)(1806γ), Ice(L+M+)(1800.2γ), pair production (1982Be09).
1806.0 *5*	0.14[c] *3*	1805.96	2$^+$	0.0	0$^+$	[E2]		0.00261		α(K)=0.00200 *3*; α(L)=0.000338 *5*; α(M)=7.94×10^{-5} *12*;

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$\gamma(^{212}Po)$ (continued)

E_γ [†]	E_i(level)	Comments
		α(N)=2.04×10^{-5} *3*; α(O)=4.24×10^{-6} *6* α(P)=5.40×10^{-7} *8* Mult.: (Ice(K)=0.003 *1* (1963Da11))/(Iγ=0.14 *3*) gives α(K)exp=0.02 *1*, not in agreement with E2 assignment.

† From 1973Da38, unless otherwise noted.
‡ From 1984Ge07 (normalized to Iγ per 100 ^{212}Bi β^- decays), unless otherwise noted.
# From $\gamma\gamma(\theta)$ of 1982Be09, unless otherwise noted.
@ From 1979He10.
& From 1969Br24.
a From 1957Vo22.
b From 1982Be09.
c From 1973Da38.
d From the Adopted Gammas. For values derived from this dataset, supporting evidence is given in the comments.
e For absolute intensity per 100 decays, multiply by 0.6406 *6*.
x γ ray not placed in level scheme.

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^{212}Bi β^- decay (60.55 min) 1973Da38,1984Ge07

Decay Scheme

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