^{199}Po ε decay (5.48 min+4.17 min) 1985St02

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh	NDS 108, 79 (2007)	15-Oct-2006

Parent: ^{199}Po: E=0; J$^{\pi}$=(3/2^{-}); $T_{1/2}$=5.48 min *16*; Q(ε)=5583 *26*; %ε+%β^{+} decay=92.5 *3*

Parent: ^{199}Po: E=310; J$^{\pi}$=(13/2^{+}); $T_{1/2}$=4.17 min *6*; Q(ε)=5583 *26*; %ε+%β^{+} decay=73.5 *10*

1985St02: ^{199}Po produced by ^{191}Ir(^{14}N,6n) followed by mass separation. Measured Eγ, Iγ, $\gamma\gamma$, ce, γ(t).

Others:

1976Ko13: Measured Eγ, Iγ, $\gamma\gamma$, ce. Results disagree with those from 1985St02. Only five γ rays out of reported 14 γ rays match In energy with those from 1985St02.

1971Jo19: Assigned observed gammas (see table 4 of 1971Jo19) to the ^{203}At α decay to ^{199}Bi. But a comparison of the relative intensities and energies of nine γ rays (145.6,154.3,246.0,361.9, 845.7,880.2,1001.7,1033.8) with those from 1985St02 suggests that these γ rays should Be assigned (In 1971Jo19) to ^{199}Po ε decay to ^{199}Bi, rather than to ^{203}At α decay. The comparison of relative intensities also shows that source produced by 1971Jo19 had a larger admixture of low-spin activity of $T_{1/2}$=5.48 min than the one used by 1985St02 which was stronger In high-spin isomer with $T_{1/2}$=4.17 min.

$T_{1/2}$ and isotopic identification: 1996Ta18, 1982Bo04, 1971Ho01, 1967Ti04, 1967Si09, 1967Le21, 1967Le08, 1965Ti03 1965Br17, 1964Br23.

The level scheme and all data are from 1985St02.

From available data, the decay schemes for the two activities cannot be separated with confidence. It can only be stated that low-spin states (J≤7/2) are most likely populated by the decay of 5.48-min, (3/2^{-}) activity while the high-spin states are populated by the 4.17-min, (13/2^{+}) activity. Also the normalization factor (Iγ/100 decays of the parent) cannot be deduced meaningfully since the level scheme is not considered as well established in view of energy gap of≈3.5 MeV between Q=5583 and the highest known level at 2133 keV and due to many unplaced γ rays.

Additional information 1.

1985St02 suggests that the 845- and 800-keV gammas may be present in both ^{199}Po ε decays. However, neither γ is shown in coincidence with any other strong γ, implying considerable direct feeding in both decays. The 845-keV γ cannot be fed directly in the 13/2^{+} ^{199}Po ε decay (3rd forbidden ε transition), while in the g.s. decay, the ε transition is allowed. It is therefore probable that most, if not all of the 845γ intensity belongs in the ^{199}Po g.s. decay. On the other hand, the 880-keV (7/2)$^{-}$ level cannot be fed directly from a 3/2^{-} ^{199}Po g.s. (2nd forbidden β transition − allowed intensity≤E−5 %); nor from 13/2^{+} ^{199}Po 310-keV level (2nd forbidden, unique transition). Thus this level must be fed entirely by unassigned γ's, or the relatively strong 880-keV M1 γ belongs somewhere else in the level scheme, making the existence of the 800-keV 7/2^{-} level questionable.

^{199}Bi Levels

The following levels proposed by 1976Ko13 have been omitted: 998.4 (5/2^{-}), 1021.4 (7/2^{-}), 1222.1 (5/2^{-}), 1250.5 (1/2^{+}), 1455.6 (3/2^{-}), 1496.5 (3/2^{+}), 1757.2 (5/2^{+}), 1776.0 (15/2^{-}). Following levels are confirmed but the J$^{\pi}$ assignments are different from those In 1976Ko13: 1002 (11/2^{-}), 1034 (7/2), 1396 (3/2^{-}) and 1501 (13/2^{-}). The revised J$^{\pi}$ assignments are 13/2^{-}, 11/2^{-}, (13/2)$^{+}$ and 17/2, respectively.

E(level)†	J$^{\pi}$@	Comments
0	9/2^{-}	
667‡ *4*	(1/2^{+})	E(level): from 2003Au02. Other: 680 from (3S$_{1/2}$ states in Bi nuclides and Q(α) systematics (1980Sc26).
845.7 *2*	(5/2)$^{-}$	populated by both the activities.
880.2 *2*	(7/2)$^{-}$	populated by both the activities.
913‡	(3/2^{+})	
1001.7# *2*	13/2^{-}	
1033.9# *2*	11/2^{-}	
1119‡	(5/2^{+})	
1197.4 *2*	(11/2,13/2)$^{-}$	
1248.4 *2*	($^{-}$)	

Continued on next page (footnotes at end of table)

^{199}Po ε decay (5.48 min+4.17 min) 1985St02 (continued)

^{199}Bi Levels (continued)

E(level)[†]	J^{π}[@]	$T_{1/2}$[@]	Comments
1321.0 *2*	($^-$)		
1395.9[#] *2*	$(13/2)^+$		
1459[‡]	$(1/2^+,3/2^+,5/2^+)$		
1501.4[#] *3*	$17/2^-$		
1523.6 *2*			
1618.15 *25*			
1635.1 *2*	$(13/2)^+$		
1647.1[#] *4*	$17/2^+$	34.1 ns *24*	J^{π}: 1985St02 suggested $15/2^+$.
1663.4 *2*			
1683.2 *2*			
1706.2 *2*			
1822.1 *2*			
2133.1 *2*			

† From least-squares fit to Eγ's, assuming Δ(Eγ)=0.2 keV. Levels expected to Be populated mainly by the decay of the $13/2^+$ isomer with $T_{1/2}$=4.17 min, unless otherwise stated.

‡ Level is mainly populated by the decay of the $(3/2^-)$ g.s. with $T_{1/2}$=5.48 min.

\# Level is mainly populated by the decay of the $(13/2^+)$ isomer with $T_{1/2}$=4.17 min.

@ From 'Adopted Levels'.

γ(^{199}Bi)

The following γ rays with Eγ(Iγ, mult) reported by 1976Ko13 are omitted since these are not confirmed by 1985St02: 187.7 *5*(16.0, M1), 229.1 *5*(10.2, E3), 233.5 *5* (11.8, M1), 260.7 *5*(8.5, M1), 274.2 (12.3, M1), 397.8 *5* (9.0, M1), 474.9 *5* (15.0, M2), 998.4 *5* (33.0, E2), 1021.4 *6* (51.8, M1).

E_γ	I_γ[†&]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[‡]	δ[‡]	α[c]	Comments
145.6	19.4[b]	1647.1	$17/2^+$	1501.4	$17/2^-$	E1		0.177	α(K)=0.142; α(L)=0.0266; α(M)=0.00627; α(N+..)=0.00204 α(K)exp=0.037 *19* Eγ=145.8 *1*, Iγ=14.1 *9* (1971Jo19).
[x]154.3	4.2								Eγ=154.7 *1*, Iγ=4.1 *4* (1971Jo19).
[x]162.4	1.6								
195.5	1.2	1197.4	$(11/2,13/2)^-$	1001.7	$13/2^-$	M1		1.59	α(K)=1.29; α(L)=0.225; α(M)=0.0529; α(N+..)=0.0177 α(K)exp=1.8 *3*
206.7	4.3[a]	1119	$(5/2^+)$	913	$(3/2^+)$	(M1)		1.36	α(K)=1.103; α(L)=0.192; α(M)=0.0452; α(N+..)=0.0151 α(K)exp=0.91 *13* Eγ=206.6 *1*, Iγ=9.0 *8* (1971Jo19).
239.3	7.5[b]	1635.1	$(13/2)^+$	1395.9	$(13/2)^+$	M1+E2	1.2 *2*	0.51 *6*	α(K)=0.37 *6*; α(L)=0.111 *3*; α(M)=0.0276 *4*; α(N+..)=0.00916 *13* α(K)exp=0.37 *5*
246.0	23.9[a]	913	$(3/2^+)$	667	$(1/2^+)$	M1+E2	2.1 *3*	0.34 *4*	α(K)=0.21 *3*; α(L)=0.0953 *15*; α(M)=0.0242 *2*; α(N+..)=0.00803 *8* α(K)exp=0.21 *3* Eγ=245.9 *2*, Iγ=47.6 *24* (1971Jo19). Eγ=246.0 *6*, Iγ=9.0 (1976Ko13). Additional information 2.
[x]283.7	3.3								
361.9	36.6[b]	1395.9	$(13/2)^+$	1033.9	$11/2^-$	E1		0.0200	α(K)=0.0164; α(L)=0.00275; α(M)=0.00064; α(N+..)=0.00021 α(K)exp=0.019 *5* Eγ=361.6 *3*, Iγ=23.1 *14* (1971Jo19). Eγ=361.6 *5*, Iγ=47.0 (1976Ko13). Additional information 4.
394.2		1395.9	$(13/2)^+$	1001.7	$13/2^-$	[E1]		0.0166	α(K)=0.0136; α(L)=0.00226; α(M)=0.000527; α(N+..)=0.000173
452.5	3.4[a]	1119	$(5/2^+)$	667	$(1/2^+)$	[E2]		0.0396	α(K)=0.0266; α(L)=0.00970; α(M)=0.00244; α(N+..)=0.000809
[x]480.1	2.7								
499.7	21.9[b]	1501.4	$17/2^-$	1001.7	$13/2^-$	(E2)		0.0310	α(K)=0.0216; α(L)=0.00708; α(M)=0.00177; α(N+..)=0.00059 α(L)exp=0.008 *3* Eγ=499.8 *5*, Iγ=42.3 (1976Ko13).
[x]506.4									Eγ=506.8 *5*, Iγ=8.0 (1976Ko13). Mult.: (E2) from α(K)exp=0.05 *3* (1976Ko13).
[x]527.0	2.3								
545.8	3.9[a]	1459	$(1/2^+,3/2^+,5/2^+)$	913	$(3/2^+)$	M1		0.0976	α(K)=0.0796; α(L)=0.0135 α(K)exp=0.053 *15*
[x]585.5	3.4								
601.2	10.9[b]	1635.1	$(13/2)^+$	1033.9	$11/2^-$	E1		0.00684	α(K)=0.00564; α(L)=0.00090 α(K)exp=0.008 *3*

γ(^{199}Bi) (continued)

E_γ	I_γ [†&]	E_i(level)	J^π_i	E_f	J^π_f	Mult. [‡]	δ [‡]	α [c]	Comments
616.4	1.3	1618.15		1001.7	13/2$^-$				
^{x}662.0	2.8								
(667[@])		667	(1/2$^+$)	0	9/2$^-$	[M4]		0.70	
^{x}674.6	7.7					(M1)			α(K)exp≤0.083 *17*
^{x}677.4	5.8								
^{x}701.2	4.9								
^{x}717.8	6.1					(M1,E2)			α(K)exp=0.015 *11*
^{x}815.3	2.3								
^{x}818.7	1.5								
^{x}825.2	3.6					M1			α(K)exp=0.027 *10*
845.7	19.8	845.7	(5/2)$^-$	0	9/2$^-$	(E2,M1)		0.021 *11*	α(K)exp=0.013 *8* contributed by both the activities. α(K)exp: uncertainty of 0.077 in α(K)exp given by 1985St02 is probably a typographic error and should read 0.0077. Eγ=845.8 *1*, Iγ=30.0 *21* (1971Jo19).
880.2	15.2	880.2	(7/2)$^-$	0	9/2$^-$	M1		0.0281	α(K)=0.0230; α(L)=0.00387 α(K)exp=0.024 *3* Eγ=880.4 *1*, Iγ=40.7 *24* (1971Jo19). contributed by both the activities.
1001.7	100[b]	1001.7	13/2$^-$	0	9/2$^-$	E2		0.0070	α(K)=0.00557; α(L)=0.00111 α(K)exp=0.0058 Eγ=1002.0 *1*, Iγ=86 *4* (1971Jo19). Eγ=1002.0 *5*, Iγ=100 (1976Ko13). α(K)exp=0.058 given in table iii of 1985St02 seems to be a typographic error.
1033.8	83[b]	1033.9	11/2$^-$	0	9/2$^-$	M1+E2	−1.3[#] *10*	0.011 *7*	α(K)=0.0099 *6*; α(L)=0.0016 *9* α(K)exp=0.0120 *14* Eγ=1034.0 *1*, Iγ=100 (1971Jo19). Eγ=1034.4 *5*, Iγ=100 (1976Ko13). Additional information 3.
^{x}1046.7	1.2								
^{x}1063.3									
^{x}1096.8	1.9								
^{x}1105.7	1.8								
^{x}1156.1	1.2								
1197.5	4.2	1197.4	(11/2,13/2)$^-$	0	9/2$^-$				
1248.4	8.7	1248.4	($^-$)	0	9/2$^-$	(E2,M1)		0.008 *3*	α(K)exp=0.006 *3*
^{x}1262.8	3.2								
1321.0	10.0	1321.0	($^-$)	0	9/2$^-$	(E2)		0.00416	α(K)=0.00336; α(L)=0.000203 α(K)exp=0.0039 *14* E_γ: from fig. 1 and 6 of 1985St02, the value in table 1 (1320.1) may be a typographic error.
1395.9	7.3	1395.9	(13/2)$^+$	0	9/2$^-$	[M2,E3]			α(K)exp≤0.0053 *17* Mult.: α(K)exp suggests dipole or E2, but M2+E3 required by ΔJ^π.

γ(^{199}Bi) (continued)

E_γ	I_γ[†&]	E_i(level)	J_i^π	E_f	J_f^π	E_γ	I_γ[†&]	E_i(level)	J_i^π	E_f	J_f^π	E_γ	I_γ[†&]	E_i(level)	E_f	J_f^π
1523.6	6.8	1523.6		0	9/2⁻	1706.2	6.5	1706.2		0	9/2⁻	[x]1983.1	2.1			
[x]1539.6	4.5					[x]1778.9	4.2					[x]1988.2	3.7			
1663.4	7.5	1663.4		0	9/2⁻	1822.1	4.0	1822.1		0	9/2⁻	[x]2036.7	1.7			
[x]1666.8	2.0					[x]1927.1	1.8					[x]2111.2	1.5			
1683.2	6.3	1683.2		0	9/2⁻	[x]1949.4	3.3					2133.1	3.4	2133.1	0	9/2⁻

[†] From 1985St02. Unless otherwise stated, it is assumed by the evaluator that the intensity is contributed by either or both the activities. Only six of the 15 γ rays reported by 1976Ko13 have corresponding γ rays in 1985St02. In addition nine γ rays that were assigned by 1971Jo19 (authors′ table 4) to ^{203}At ε decay most likely belong to the ^{199}Po ε decay on the basis of comparison of gamma-ray energies and relative intensities with those from 1985St02.

[‡] Based on α(K)exp, unless otherwise noted.

[#] From 'adopted gammas'.

[@] 1980Br23 and 1985St02 searched for this isomeric transition (1980Br23 in the energy region 400 *900*00 keV and 1985St02 in the region of 500 *1000*00 keV) in both γ and ce spectra. No obvious candidate was found. However, both found an unassigned conversion line, which, if ce(K) in Bi, corresponds to $E\gamma$=667 keV. Since this was the strongest unassigned conversion line in the spectrum, an upper limit could be determined for the isomeric M4 transition. Thus the %IT was estimated to be≤2% (1980Br23),≤3.2% (1985St02). If the 667γ is the isomeric transition with %IT≤2, and if the multipolarity is pure M4, then B(M4)(W.u.)≤0.0017.

[&] Mainly belongs to the decay of the 13/2⁺ isomer ($T_{1/2}$=4.17 min), except for γ rays from low-spin (J≤7/2) which are mainly from the decay of the low-spin g.s. ($T_{1/2}$=5.48 min).

[a] Mainly from the decay of the (3/2⁻) g.s. ($T_{1/2}$=5.48 min).

[b] Mainly from the decay of the (13/2⁺) isomer ($T_{1/2}$=4.17 min).

[c] 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.

[x] γ ray not placed in level scheme.

^{199}Po ε decay (5.48 min+4.17 min) 1985St02