$$^{213}_{83}\mathrm{Bi}_{130}$$

1 Decay Scheme

Bi-213 disintegrates 97.91(3) % by beta minus emission to the levels in Po-213 and 2.09(3) % through alpha decay to Tl-209.
Le bismuth 213 se désintègre principalement par émissions bêta vers le polonium 213 et par émissions alpha (2,09 %) vers le thallium 209.

2 Nuclear Data

$T_{1/2}(^{213}\mathrm{Bi})$	:	45,59	(6)	min
$T_{1/2}(^{213}\mathrm{Po})$	:	3,70	(5)	10^{-6} s
$T_{1/2}(^{209}\mathrm{Tl})$	:	2,161	(7)	min
$Q^{\alpha}(^{213}\mathrm{Bi})$	:	5983	(6)	keV
$Q^{-}(^{213}\mathrm{Bi})$	:	1423	(5)	keV

2.1 α Transitions

	Energy keV	Probability × 100	F
$\alpha_{0,1}$	5655 (10)	0,186 (5)	103
$\alpha_{0,0}$	5981 (10)	1,90 (4)	319

2.2 β^- Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,9}$	95 (5)	0,0014 (2)		7,68
$\beta^-_{0,8}$	304 (5)	0,0608 (20)		7,07
$\beta^-_{0,7}$	323 (5)	0,595 (17)		6,16
$\beta^-_{0,6}$	377 (5)	0,020 (4)		7,85
$\beta^-_{0,5}$	419 (5)	0,0648 (23)		7,494
$\beta^-_{0,4}$	555 (5)	0,0129 (6)	1st Forbidden Unique	8,597
$\beta^-_{0,3}$	822 (5)	0,0025 (19)		9,9
$\beta^-_{0,2}$	983 (5)	30,8 (4)	1st Forbidden	6,07
$\beta^-_{0,1}$	1130 (5)	0,21 (9)	1st Forbidden	8,45
$\beta^-_{0,0}$	1423 (5)	66,2 (4)	1st Forbidden	6,316

2.3 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K	α_L	α_M (10^{-3})	α_T
$\gamma_{2,1}$(Po)	147,70 (4)	0,0314 (20)	E2	0,307 (4)	0,85 (1)	0,226 (3)	1,453 (21)
$\gamma_{1,0}$(Po)	292,80 (1)	0,55 (8)	M1+E2	0,22 (17)	0,06 (2)	0,015 (3)	0,30 (18)
$\gamma_{1,0}$(Tl)	323,70 (2)	0,1866 (37)	M1+E2	0,134 (14)	0,0333 (13)	0,0081 (3)	0,178 (15)
$\gamma_{5,3}$(Po)	402,8 (3)	0,00010 (4)					
$\gamma_{2,0}$(Po)	440,44 (1)	30,77 (36)	M1	0,146 (2)	0,0250 (4)	5,94 (8)	0,179 (3)
$\gamma_{4,1}$(Po)	574,9 (3)	0,00068 (16)					
$\gamma_{3,0}$(Po)	600,9 (2)	0,0026 (19)					
$\gamma_{6,2}$(Po)	604,98 (18)	0,0014 (5)					
$\gamma_{7,2}$(Po)	659,759 (20)	0,043 (6)					
$\gamma_{5,1}$(Po)	710,82 (3)	0,0112 (6)					
$\gamma_{7,1}$(Po)	807,372 (11)	0,287 (14)					
$\gamma_{8,1}$(Po)	826,564 (41)	0,0065 (4)					
$\gamma_{4,0}$(Po)	867,961 (20)	0,0122 (6)					
$\gamma_{9,2}$(Po)	887,76 (30)	0,00102 (19)					
$\gamma_{5,0}$(Po)	1003,593 (17)	0,0535 (22)					
$\gamma_{6,0}$(Po)	1045,68 (8)	0,019 (4)					
$\gamma_{7,0}$(Po)	1100,17 (1)	0,265 (6)					
$\gamma_{8,0}$(Po)	1119,422 (8)	0,0543 (20)					
$\gamma_{9,0}$(Po)	1328,2 (3)	0,00039 (13)					

3 Atomic Data

3.1 Po

ω_K : 0,965 (4)
$\bar{\omega}_L$: 0,403 (16)
n_{KL} : 0,807 (5)

3.1.1 X Radiations

		Energy keV		Relative probability
X_K				
	$K\alpha_2$	76,864		60,05
	$K\alpha_1$	79,293		100
	$K\beta_3$	89,256	}	
	$K\beta_1$	89,807	}	
	$K\beta_5''$	90,363	}	34,43
	$K\beta_2$	92,263	}	
	$K\beta_4$	92,618	}	10,71
	$KO_{2,3}$	92,983	}	
X_L				
	$L\ell$	9,6576		
	$L\alpha$	11,0161 – 11,1303		
	$L\eta$	12,0847		
	$L\beta$	12,8239 – 14,2476		
	$L\gamma$	15,251 – 16,2129		

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	58,978 – 65,205	100
KLX	71,902 – 79,289	56,4
KXY	84,8 – 93,1	7,95
Auger L	5,43 – 16,86	

3.2 Tl

ω_K : 0,963 (4)
$\bar{\omega}_L$: 0,367 (15)
n_{KL} : 0,812 (5)

3.2.1 X Radiations

		Energy keV		Relative probability
X_K				
	$K\alpha_2$	70,8325		59,24
	$K\alpha_1$	72,8725		100
	$K\beta_3$	82,118	}	
	$K\beta_1$	82,577	}	
	$K\beta_5''$	83,115	}	34
	$K\beta_2$	84,838	}	
	$K\beta_4$	85,134	}	10,1
	$KO_{2,3}$	85,444	}	
X_L				
	$L\ell$	8,9531		
	$L\alpha$	10,1718 – 10,2679		
	$L\eta$	10,9942		
	$L\beta$	11,8117 – 12,9566		
	$L\gamma$	13,8528 – 14,7362		

3.2.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	54,587 – 59,954	100
KLX	66,37 – 72,86	55,4
KXY	78,12 – 85,50	7,67
Auger L	5,18 – 10,13	

4 α Emissions

	Energy keV	Probability × 100
$\alpha_{0,1}$	5549 (10)	0,186 (5)
$\alpha_{0,0}$	5869 (10)	1,90 (4)

5 Electron Emissions

		Energy keV	Electrons per 100 disint.
e_{AL}	(Po)	5,43 - 16,86	1,7 (3)
e_{AK}	(Po)		0,121 (19)
	KLL	58,978 - 65,205	
	KLX	71,902 - 79,289	
	KXY	84,8 - 93,1	
e_{AL}	(Tl)	5,18 - 10,13	0,0107 (13)
e_{AK}	(Tl)		0,00076 (9)
	KLL	54,587 - 59,954	
	KLX	66,37 - 72,86	
	KXY	78,12 - 85,50	
$ec_{2,1\ L}$	(Po)	130,8 - 133,9	0,0109 (7)
$ec_{1,0\ K}$	(Po)	199,70 (1)	0,09 (7)
$ec_{1,0\ K}$	(Tl)	238,17 (2)	0,0212 (22)
$ec_{1,0\ L}$	(Po)	275,9 - 279,0	0,025 (8)
$ec_{2,0\ T}$	(Po)	347,30 - 440,41	4,67 (9)
$ec_{2,0\ K}$	(Po)	347,34 (1)	3,81 (7)
$ec_{2,0\ L}$	(Po)	423,51 - 426,63	0,653 (13)
$ec_{2,0\ M}$	(Po)	436,29 - 437,76	0,1550 (27)
$ec_{2,0\ N}$	(Po)	439,45 - 440,26	0,0392 (7)
$\beta^-_{0,9}$	max:	95 (5)	0,0014 (2)
$\beta^-_{0,9}$	avg:	24,6 (14)	
$\beta^-_{0,8}$	max:	304 (5)	0,0608 (20)
$\beta^-_{0,8}$	avg:	84,9 (16)	
$\beta^-_{0,7}$	max:	323 (5)	0,595 (17)
$\beta^-_{0,7}$	avg:	90,8 (16)	
$\beta^-_{0,6}$	max:	377 (5)	0,020 (4)
$\beta^-_{0,6}$	avg:	107,9 (16)	

		Energy keV		Electrons per 100 disint.
$\beta^-_{0,5}$	max:	419	(5)	0,0648 (23)
$\beta^-_{0,5}$	avg:	121,4	(17)	
$\beta^-_{0,4}$	max:	555	(5)	0,0129 (6)
$\beta^-_{0,4}$	avg:	166,4	(17)	
$\beta^-_{0,3}$	max:	822	(5)	0,0025 (19)
$\beta^-_{0,3}$	avg:	260,8	(19)	
$\beta^-_{0,2}$	max:	983	(5)	30,8 (4)
$\beta^-_{0,2}$	avg:	320,4	(19)	
$\beta^-_{0,1}$	max:	1130	(5)	0,21 (9)
$\beta^-_{0,1}$	avg:	376,8	(20)	
$\beta^-_{0,0}$	max:	1423	(5)	66,2 (4)
$\beta^-_{0,0}$	avg:	492,2	(20)	

6 Photon Emissions

6.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Po)	9,6576 — 16,2129		1,14 (18)	
XKα_2	(Po)	76,864		0,99 (15)	} Kα
XKα_1	(Po)	79,293		1,6 (3)	}
XKβ_3	(Po)	89,256	}		
XKβ_1	(Po)	89,807	}	0,56 (9)	K$'\beta_1$
XKβ''_5	(Po)	90,363	}		
XKβ_2	(Po)	92,263	}		
XKβ_4	(Po)	92,618	}	0,18 (3)	K$'\beta_2$
XKO$_{2,3}$	(Po)	92,983	}		
XL	(Tl)	8,9531 — 14,7362		0,0062 (8)	
XKα_2	(Tl)	70,8325		0,0058 (7)	} Kα
XKα_1	(Tl)	72,8725		0,0098 (12)	}
XKβ_3	(Tl)	82,118	}		
XKβ_1	(Tl)	82,577	}	0,0033 (5)	K$'\beta_1$
XKβ''_5	(Tl)	83,115	}		
XKβ_2	(Tl)	84,838	}		
XKβ_4	(Tl)	85,134	}	0,00098 (14)	K$'\beta_2$
XKO$_{2,3}$	(Tl)	85,444	}		

6.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{2,1}$(Po)	147,70 (4)	0,0128 (8)
$\gamma_{1,0}$(Po)	292,80 (1)	0,421 (7)
$\gamma_{1,0}$(Tl)	323,70 (2)	0,1584 (24)
$\gamma_{5,3}$(Po)	402,8 (3)	0,00010 (4)
$\gamma_{2,0}$(Po)	440,44 (1)	26,1 (3)
$\gamma_{4,1}$(Po)	574,9 (3)	0,00068 (16)
$\gamma_{3,0}$(Po)	600,9 (2)	0,0026 (19)
$\gamma_{6,2}$(Po)	604,93 (17)	0,0014 (5)
$\gamma_{7,2}$(Po)	659,75 (2)	0,043 (6)
$\gamma_{5,1}$(Po)	710,82 (3)	0,0112 (6)
$\gamma_{7,1}$(Po)	807,37 (1)	0,287 (14)
$\gamma_{8,1}$(Po)	826,55 (4)	0,0065 (4)
$\gamma_{4,0}$(Po)	867,96 (2)	0,0122 (6)
$\gamma_{9,2}$(Po)	886,66 (14)	0,00102 (19)
$\gamma_{5,0}$(Po)	1003,58 (2)	0,0535 (22)
$\gamma_{6,0}$(Po)	1045,67 (8)	0,019 (4)
$\gamma_{7,0}$(Po)	1100,16 (1)	0,265 (6)
$\gamma_{8,0}$(Po)	1119,42 (8)	0,0543 (20)
$\gamma_{9,0}$(Po)	1328,2 (3)	0,00039 (13)

7 Main Production Modes

Th – 229 decay chain

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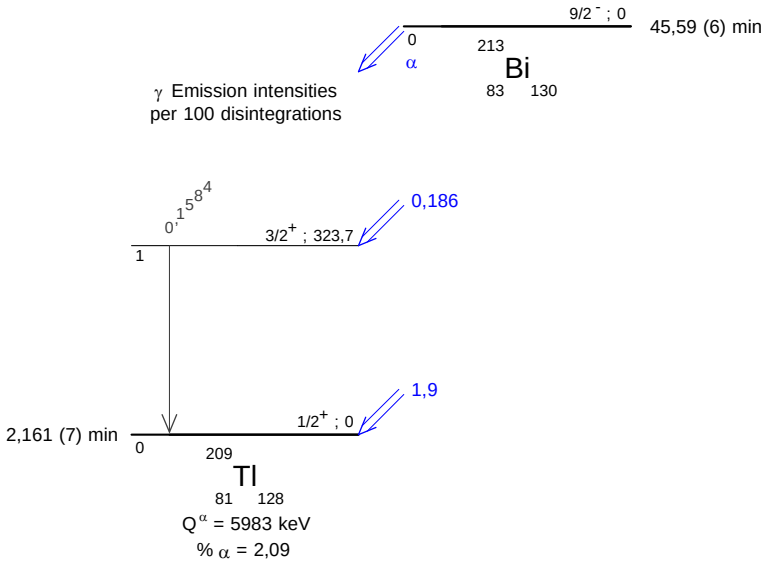
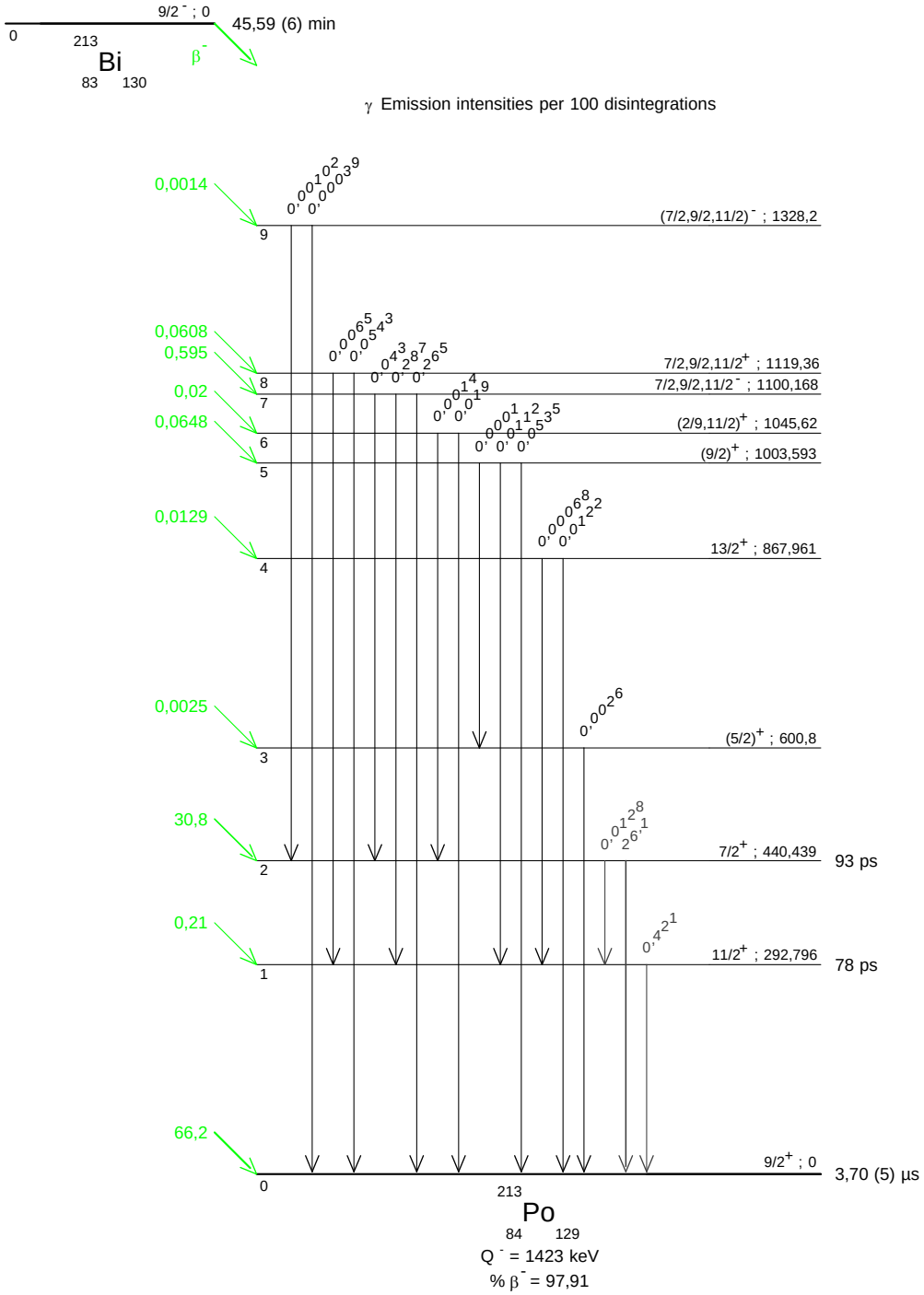

9/2 - ; 0
45,59 (6) min
0
α
213
Bi
83 130
γ Emission intensities
per 100 disintegrations
0,186
3/2+ ; 323,7
1
1,9
2,161 (7) min
1/2+ ; 0
0
209
Tl
81 128
Q α = 5983 keV
% α = 2,09


9/2⁻ ; 0
45,59 (6) min
0
213
Bi
83 130
β⁻
γ Emission intensities per 100 disintegrations
0,0014
(7/2,9/2,11/2)⁻ ; 1328,2
9
0,0608
0,595
7/2,9/2,11/2⁺ ; 1119,36
8
7/2,9/2,11/2⁻ ; 1100,168
0,02
7
0,0648
(2/9,11/2)⁺ ; 1045,62
6
(9/2)⁺ ; 1003,593
5
0,0129
13/2⁺ ; 867,961
4
0,0025
(5/2)⁺ ; 600,8
3
30,8
7/2⁺ ; 440,439
93 ps
2
0,21
11/2⁺ ; 292,796
78 ps
1
66,2
9/2⁺ ; 0
3,70 (5) µs
0
213
Po
84 129
Q⁻ = 1423 keV
% β⁻ = 97,91