$^{140}_{56}\mathrm{Ba}_{84}$

1 Decay Scheme

Ba-140 decays by beta minus emission to various excited levels of La-140.
The activity ratio La-140/Ba-140 at time t (for initially pure Ba-140) is given by:

$$\frac{T_1}{T_1 - T_2}(1 - e^{-t \times ln(2) \times \frac{T_1 - T_2}{T_1 \times T_2}}).$$

where T_1 is the half-life of Ba-140 and T_2 is the half-life of La-140.
At equilibrium (t $\geq$ 19 d) the activity ratio is simply: $T_1/(T_1 - T_2) = 1.1516 \pm 0.0005$.

Le baryum 140 se désintègre par émission bêta moins vers des niveaux excités de lanthane 140. Le rapport au temps t des activités La-140/Ba-140 dans le Ba-140 initialement pur s'écrit :

$$\frac{T_1}{T_1 - T_2}(1 - e^{-t \times ln(2) \times \frac{T_1 - T_2}{T_1 \times T_2}}).$$

T_1 et T_2 étant respectivement les périodes de Ba-140 et La-140.
À l'équilibre (t $\geq$ 19 jours) ce rapport est égal à : $T_1/(T_1 - T_2) = 1{,}1516 \pm 0{,}0005$.

2 Nuclear Data

$T_{1/2}(^{140}\mathrm{Ba})$	:	12,753	(5)	d
$T_{1/2}(^{140}\mathrm{La})$	:	1,67858	(21)	d
$Q^-(^{140}\mathrm{Ba})$	:	1048	(8)	keV

2.1 β^- Transitions

	Energy (keV)	Probability (%)	Nature	lg ft
$\beta^-_{0,6}$	467 (8)	24,94 (50)	1st Forbidden	7,1
$\beta^-_{0,5}$	580 (8)	9,71 (12)	1st Forbidden	7,8
$\beta^-_{0,4}$	885 (8)	4,14 (31)	Unique 1st Forbidden	9,3
$\beta^-_{0,2}$	1004 (8)	35,6 (31)	1st Forbidden	8
$\beta^-_{0,1}$	1018 (8)	25,6 (42)	Unique 1st Forbidden	8,7

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy (keV)	$P_{\gamma+ce}$ (%)	Multipolarity	α_K	α_L	α_M	α_T
$\gamma_{2,1}$(La)	13,880 (18)	63,8 (31)	M1+E2		42,8 (15)	8,9 (4)	54,0 (19)
$\gamma_{1,0}$(La)	29,9641 (6)	91,7 (29)	M1(+E2)		4,26 (6)	0,885 (13)	5,37 (8)
$\gamma_{3,0}$(La)	63,1790 (7)	0,00015 (8)	M1	3,45 (5)	0,472 (7)	0,0983 (14)	4,05 (6)
$\gamma_{4,3}$(La)	99,4801 (20)	0,00006 (4)	[E2]	1,235 (18)	0,620 (9)	0,1371 (20)	2,03 (3)
$\gamma_{6,5}$(La)	113,48 (4)	0,0302 (23)	M1	0,645 (9)	0,0872 (13)	0,0181 (3)	0,755 (11)
$\gamma_{4,2}$(La)	118,815 (18)	0,101 (4)	M1	0,566 (8)	0,0765 (11)	0,01591 (23)	0,663 (10)
$\gamma_{4,1}$(La)	132,695 (2)	0,300 (9)	M1	0,415 (6)	0,0560 (8)	0,01163 (17)	0,485 (7)
$\gamma_{4,0}$(La)	162,6591 (19)	8,3 (3)	M1(+E2)	0,235 (4)	0,0317 (5)	0,00659 (11)	0,275 (4)
$\gamma_{5,4}$(La)	304,971 (30)	4,55 (9)	M1(+E2)	0,0434 (6)	0,00573 (8)	0,001189 (17)	0,0506 (7)
$\gamma_{5,2}$(La)	423,786 (35)	3,20 (6)	M1	0,0186 (3)	0,00243 (4)	0,000503 (7)	0,0217 (3)
$\gamma_{5,1}$(La)	437,666 (30)	1,98 (4)	M1	0,01716 (24)	0,00224 (4)	0,000464 (7)	0,0200 (3)
$\gamma_{6,2}$(La)	537,262 (25)	24,9 (5)	M1	0,01029 (15)	0,001332 (19)	0,000276 (4)	0,01197 (17)
$\gamma_{6,1}$(La)	551,142 (18)	0,0049 (20)	[E2]	0,00666 (10)	0,000997 (14)	0,000209 (3)	0,00792 (11)

3 Atomic Data

3.1

ω_K	:	0,905	(4)
$\bar{\omega}_L$	:	0,117	(5)
n_{KL}	:	0,882	(4)
$\bar{n}_{LM}$	:	1,61	(3)

3.1.1 X Radiations

	Energy (keV)	Relative probability
X_K		
$K\alpha_2$	33,0344	54,44
$K\alpha_1$	33,4421	100
$K\beta_3$	37,7206	29,8
$K\beta_1$	37,8015	
$K\beta''_5$	38,075	
$K\beta'_5$	39,095	
$K\beta_2$	38,7303	7,5
$K\beta_4$	38,828	
$KO_{2,3}$	39,91	
X_L		
$L\ell$	4,1174	
$L\alpha$	4,6338 - 4,6504	
$L\eta$	4,5248	
$L\beta$	5,0412 - 5,3814	
$L\gamma$	5,6198 - 6,0724	

3.1.2 Auger Electrons

	Energy (keV)	Relative probability
Auger K		
KLL	26,240 - 27,795	100
KLX	31,231 - 33,428	47,8
KXY	36,2 - 38,9	6,65
Auger L	2,7 - 6,2	

4 Electron Emissions

		Energy (keV)	Electrons (per 100 disint.)
e_{AL}	(La)	2,7 - 6,2	99,5 (19)
e_{AK}	(La)		
	KLL	26,240 - 27,795	0,208 (11)
	KLX	31,231 - 33,428	
	KXY	36,2 - 38,9	
$ec_{2,1\ L}$	(La)	7,61 - 8,40	49,6 (24)
$ec_{2,1\ M}$	(La)	12,52 - 13,05	10,3 (6)
$ec_{2,1\ N}$	(La)	13,61 - 13,78	2,26 (11)
$ec_{1,0\ L}$	(La)	23,6978 - 24,4814	61,3 (19)
$ec_{1,0\ M}$	(La)	28,6028 - 29,1324	12,74 (40)
$ec_{1,0\ N}$	(La)	29,6937 - 29,8652	2,79 (9)
$ec_{6,5\ K}$	(La)	74,56 (4)	0,0111 (9)
$ec_{4,2\ K}$	(La)	79,890 (18)	0,0346 (13)
$ec_{4,1\ K}$	(La)	93,770 (2)	0,0838 (28)
$ec_{4,0\ T}$	(La)	123,7345 - 162,6447	1,78 (8)
$ec_{4,0\ K}$	(La)	123,7345 (19)	1,53 (7)
$ec_{4,1\ L}$	(La)	126,429 - 127,212	0,01131 (37)
$ec_{4,0\ L}$	(La)	156,3928 - 157,1764	0,206 (9)
$ec_{4,0\ M}$	(La)	161,2978 - 161,8274	0,0428 (19)
$ec_{5,4\ K}$	(La)	266,05 (3)	0,1884 (47)
$ec_{5,4\ L}$	(La)	298,705 - 299,488	0,0249 (6)
$ec_{5,2\ K}$	(La)	384,861 (35)	0,0582 (15)
$ec_{5,1\ K}$	(La)	398,74 (3)	0,0333 (8)
$ec_{6,2\ K}$	(La)	498,337 (25)	0,253 (6)
$ec_{6,2\ L}$	(La)	530,996 - 531,779	0,0328 (8)
$\beta^-_{0,6}$	max:	467 (8)	24,94 (50)
	avg:	141 (3)	
$\beta^-_{0,5}$	max:	580 (8)	9,71 (12)
	avg:	181 (3)	
$\beta^-_{0,4}$	max:	885 (8)	4,14 (31)
	avg:	311 (3)	

		Energy (keV)	Electrons (per 100 disint.)
$\beta^-_{0,2}$	max:	1004 (8)	35,6 (31)
	avg:	345 (3)	
$\beta^-_{0,1}$	max:	1018 (8)	25,6 (42)
	avg:	362 (3)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy (keV)	Photons (per 100 disint.)	
XL	(La)	4,1174 - 6,0724	13,7 (4)	
XKα_2	(La)	33,0344	0,562 (19)	Kα
XKα_1	(La)	33,4421	1,03 (4)	
XKβ_3	(La)	37,7206	0,307 (11)	K$'\beta_1$
XKβ_1	(La)	37,8015		
XKβ''_5	(La)	38,075		
XKβ'_5	(La)	39,095		
XKβ_2	(La)	38,7303	0,078 (3)	K$'\beta_2$
XKβ_4	(La)	38,828		
XKO$_{2,3}$	(La)	39,91		

5.2 Gamma Emissions

	Energy (keV)	Photons (per 100 disint.)
$\gamma_{2,1}$(La)	13,880 (18)	1,16 (4)
$\gamma_{1,0}$(La)	29,9641 (6)	14,4 (4)
$\gamma_{3,0}$(La)	63,1790 (7)	0,000030 (15)
$\gamma_{4,3}$(La)	99,4801 (20)	0,000020 (12)
$\gamma_{6,5}$(La)	113,48 (4)	0,0172 (13)
$\gamma_{4,2}$(La)	118,815 (18)	0,0610 (21)
$\gamma_{4,1}$(La)	132,695 (2)	0,202 (6)
$\gamma_{4,0}$(La)	162,6591 (19)	6,49 (27)
$\gamma_{5,4}$(La)	304,971 (30)	4,33 (9)
$\gamma_{5,2}$(La)	423,786 (35)	3,13 (6)
$\gamma_{5,1}$(La)	437,666 (30)	1,94 (4)
$\gamma_{6,2}$(La)	537,261 (25)	24,6 (5)
$\gamma_{6,1}$(La)	551,141 (18)	0,0049 (20)

6 Main Production Modes

{ Fission product
{ Possible impurities: none

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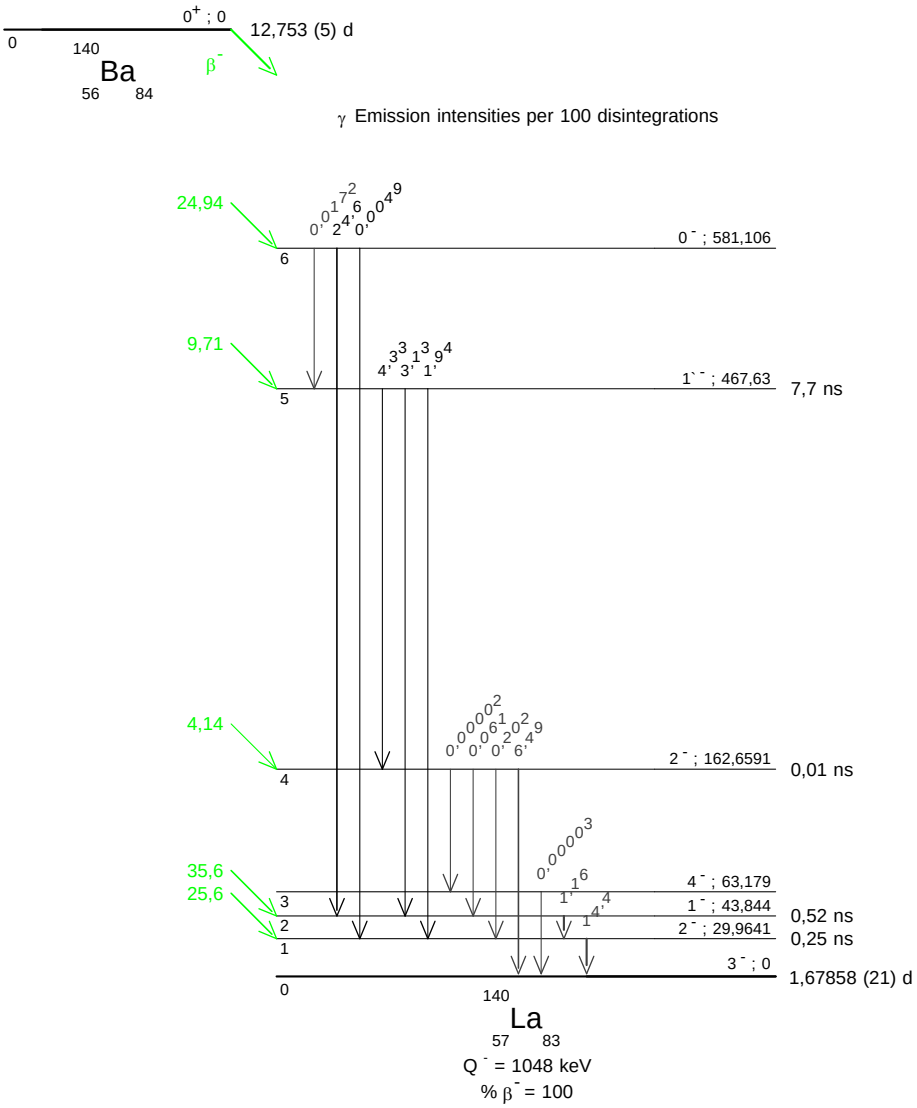
0+ ; 0
12,753 (5) d
0
140
Ba
56 84
β-
γ Emission intensities per 100 disintegrations
24,94
9,71
4,14
35,6
25,6
6
5
4
3
2
1
0
0 - ; 581,106
1`- ; 467,63
7,7 ns
2 - ; 162,6591
0,01 ns
4 - ; 63,179
1 - ; 43,844
0,52 ns
2 - ; 29,9641
0,25 ns
3 - ; 0
1,67858 (21) d
140
La
57 83
Q - = 1048 keV
% β- = 100