$^{140}_{57}\mathrm{La}_{83}$

1 Decay Scheme

Le lanthane 140 se désintègre par émission bêta moins vers les niveaux excités du cérium 140.
La-140 decays by beta minus emission to the Ce-140 excited levels.

2 Nuclear Data

$T_{1/2}(^{140}\mathrm{La}\ )$: 1,67858 (21) d
$Q^-(^{140}\mathrm{La}\ )$: 3760,9 (18) keV

2.1 β^- Transitions

	Energy (keV)	Probability (%)	Nature	lg ft
$\beta^-_{0,19}$	240,1 (18)	0,011 (3)	1st Forbidden	8,6
$\beta^-_{0,18}$	287,4 (18)	0,052 (7)	Allowed	8,2
$\beta^-_{0,17}$	366,1 (18)	0,020 (4)	Allowed	9
$\beta^-_{0,16}$	441,3 (18)	0,0039 (3)	1st Forbidden	9,9
$\beta^-_{0,15}$	642,5 (18)	0,027 (1)	1st Forbidden	9,6
$\beta^-_{0,14}$	760,0 (18)	0,085 (9)	1st Forbidden	9,4
$\beta^-_{0,13}$	861,2 (18)	0,112 (6)	1st Forbidden	9,5
$\beta^-_{0,12}$	1213,7 (18)	0,636 (7)	Unique 1st Forbidden	10
$\beta^-_{0,11}$	1239,5 (18)	11,11 (9)	1st Forbidden	8,1
$\beta^-_{0,10}$	1245,2 (18)	5,80 (4)	1st Forbidden	8,4
$\beta^-_{0,9}$	1280,0 (18)	1,14 (2)	1st Forbidden	9,1
$\beta^-_{0,8}$	1296,8 (18)	5,60 (7)	Allowed	8,44
$\beta^-_{0,7}$	1348,9 (18)	44,8 (4)	1st Forbidden	7,6
$\beta^-_{0,6}$	1411,1 (18)	0,262 (22)	Unique 1st Forbidden	10,7
$\beta^-_{0,5}$	1413,0 (18)	5,03 (12)	1st Forbidden	8,6
$\beta^-_{0,3}$	1677,7 (18)	20,8 (6)	1st Forbidden	8,3
$\beta^-_{0,1}$	2164,7 (18)	4,5 (6)	1st Forbidden	9,4

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy (keV)	$P_{\gamma+ce}$ (%)	Multipolarity	α_K (10^{-3})	α_L (10^{-2})	α_M (10^{-2})	α_N (10^{-3})	α_T (10^{-2})	α_π (10^{-5})
$\gamma_{4,3}$(Ce)	24,594 (4)	0,480 (11)	E2		54500 (800)	12200 (180)	25900 (400)	69600 (1000)	
$\gamma_{7,5}$(Ce)	64,129 (4)	0,073 (11)	M1	3610 (50)	49,9 (7)	10,46 (15)	23,2 (4)	424 (6)	
$\gamma_{9,7}$(Ce)	68,923 (5)	0,342 (10)	M1	2930 (50)	40,5 (6)	8,48 (12)	18,8 (3)	344 (5)	
$\gamma_{11,7}$(Ce)	109,417 (4)	0,423 (12)	M1+E2	787 (12)	12,8 (4)	2,71 (8)	5,97 (18)	94,9 (15)	
$\gamma_{9,6}$(Ce)	131,121 (4)	0,729 (16)	M1+E2	468 (7)	6,60 (22)	1,39 (5)	3,07 (11)	55,2 (9)	
$\gamma_{11,5}$(Ce)	173,546 (5)	0,158 (6)	M1	214 (3)	2,91 (4)	0,609 (9)	1,350 (19)	25,1 (4)	
$\gamma_{6,4}$(Ce)	241,959 (6)	0,480 (11)	M1+E2	84 (3)	1,30 (11)	0,275 (25)	0,61 (6)	10,05 (18)	
$\gamma_{6,3}$(Ce)	266,554 (5)	0,531 (10)	M1+E2	67,1 (11)	0,906 (17)	0,190 (4)	0,420 (9)	7,85 (12)	
$\gamma_{2,1}$(Ce)	307,08 (4)	0,023 (5)	E2	36,2 (6)	0,695 (10)	0,1495 (21)	0,326 (5)	4,50 (7)	
$\gamma_{7,3}$(Ce)	328,761 (4)	21,7 (3)	M1+E2	38,8 (6)	0,516 (8)	0,1078 (15)	0,239 (4)	4,53 (7)	
$\gamma_{9,3}$(Ce)	397,674 (6)	0,0765 (31)	(E2)	16,89 (24)	0,288 (4)	0,0615 (9)	0,1347 (19)	2,05 (3)	
$\gamma_{10,3}$(Ce)	432,513 (8)	3,063 (31)	M1+E2	17,9 (4)	0,245 (4)	0,0514 (8)	0,1138 (17)	2,10 (4)	
$\gamma_{11,3}$(Ce)	438,178 (6)	0,017 (10)	M1	18,6 (3)	0,244 (4)	0,0510 (8)	0,1132 (16)	2,17 (3)	
$\gamma_{5,2}$(Ce)	444,57 (4)	0,003 (1)	[E2]	12,34 (18)	0,202 (3)	0,0429 (6)	0,0942 (14)	1,490 (21)	
$\gamma_{3,1}$(Ce)	487,022 (6)	46,6 (5)	E2	9,63 (14)	0,1526 (22)	0,0324 (5)	0,0711 (10)	1,156 (17)	
$\gamma_{11,2}$(Ce)	618,12 (4)	0,041 (3)	[E2]	5,20 (8)	0,0768 (11)	0,01619 (23)	0,0357 (5)	0,617 (9)	
$\gamma_{5,1}$(Ce)	751,655 (7)	4,41 (5)	M1+E2	4,71 (8)	0,0613 (10)	0,01277 (20)	0,0283 (5)	0,548 (9)	
$\gamma_{7,1}$(Ce)	815,784 (6)	23,83 (20)	M1+E2	4,05 (6)	0,0521 (8)	0,01085 (16)	0,0241 (4)	0,471 (7)	
$\gamma_{8,1}$(Ce)	867,842 (16)	5,59 (7)	E1+M2	0,977 (22)	0,0122 (3)	0,00253 (7)	0,00561 (14)	0,113 (3)	
$\gamma_{10,1}$(Ce)	919,536 (10)	2,74 (3)	M1+E2	2,19 (6)	0,0295 (7)	0,00616 (13)	0,0136 (3)	0,257 (6)	
$\gamma_{11,1}$(Ce)	925,201 (7)	7,06 (7)	M1+E2	2,96 (5)	0,0381 (6)	0,00792 (12)	0,0176 (3)	0,344 (6)	
$\gamma_{12,1}$(Ce)	950,991 (20)	0,533 (7)	M1+E2	2,82 (4)	0,0361 (5)	0,00752 (11)	0,01669 (24)	0,328 (5)	
$\gamma_{18,9}$(Ce)	992,64 (18)	0,010 (3)	[E1]	0,743 (11)	0,00924 (13)	0,00191 (3)	0,00423 (6)	0,0860 (12)	
$\gamma_{17,6}$(Ce)	1045,02 (9)	0,020 (4)	[E1]	0,675 (10)	0,00837 (12)	0,001733 (25)	0,00384 (6)	0,0781 (11)	
$\gamma_{14,2}$(Ce)	1097,58 (9)	0,023 (5)	[E2]	1,42 (2)	0,0188 (3)	0,00392 (6)	0,00868 (13)	0,1658 (24)	
$\gamma_{13,1}$(Ce)	1303,35 (7)	0,045 (6)	[M1+E2+E0]	1,2 (2)	0,015 (2)	0,0032 (5)		0,14 (2)	
$\gamma_{14,1}$(Ce)	1404,67 (9)	0,062 (8)	[M1+E2]	1,01 (15)	0,0129 (18)	0,0027 (4)	0,0059 (8)	0,117 (15)	4,73 (8)
$\gamma_{1,0}$(Ce)	1596,213 (13)	95,49 (5)	E2	0,676 (10)	0,00863 (12)	0,00179 (3)	0,00397 (6)	0,0787 (13)	11,28 (16)
$\gamma_{18,1}$(Ce)	1877,34 (18)	0,041 (6)	[E1]	0,245 (4)	0,00300 (5)	0,000621 (9)	0,001377 (20)	0,0284 (4)	49,9 (7)
$\gamma_{2,0}$(Ce)	1903,29 (4)	0,0146 (15)	E0						
$\gamma_{19,1}$(Ce)	1924,5 (2)	0,011 (3)	[E2]	0,478 (7)	0,00601 (9)	0,001247 (18)	0,00276 (4)	0,0554 (8)	25,7 (4)
$\gamma_{3,0}$(Ce)	2083,236 (14)	0,036 (7)	E4	1,162 (17)	0,01598 (23)	0,00335 (5)	0,00743 (11)	0,1364 (19)	
$\gamma_{5,0}$(Ce)	2347,868 (14)	0,846 (16)	E2	0,333 (5)	0,00415 (6)	0,000860 (12)	0,00191 (3)	0,0386 (5)	46,0 (7)
$\gamma_{8,0}$(Ce)	2464,054 (20)	0,0097 (13)	[E3]	0,515 (8)	0,00661 (10)	0,001375 (20)	0,00305 (5)	0,0598 (8)	33,1 (5)
$\gamma_{11,0}$(Ce)	2521,410 (14)	3,41 (5)	E2	0,294 (5)	0,00365 (6)	0,000756 (11)	0,001676 (24)	0,0340 (5)	54,2 (8)
$\gamma_{12,0}$(Ce)	2547,200 (23)	0,1021 (20)	M1	0,320 (5)	0,00398 (6)	0,000824 (12)	0,00183 (3)	0,0370 (5)	59,3 (9)
$\gamma_{13,0}$(Ce)	2899,56 (7)	0,0661 (10)	E2	0,231 (4)	0,00284 (4)	0,000588 (9)	0,001306 (19)	0,0266 (4)	71,4 (10)
$\gamma_{15,0}$(Ce)	3118,53 (10)	0,026 (1)	(E2)	0,204 (3)	0,00250 (4)	0,000518 (8)	0,001149 (16)	0,0234 (3)	80,8 (12)
$\gamma_{16,0}$(Ce)	3319,56 (24)	0,0039 (3)	E2	0,183 (3)	0,00225 (4)	0,000464 (7)	0,001031 (15)	0,0211 (3)	89,2 (13)

3 Atomic Data

3.1 Ce

ω_K	:	0,910	(4)
$\bar{\omega}_L$	:	0,125	(5)
n_{KL}	:	0,876	(4)
$\bar{n}_{LM}$	:	1,57	(3)

3.1.1 X Radiations

	Energy (keV)	Relative probability
X_K		
$K\alpha_2$	34,2793	54,6
$K\alpha_1$	34,72	100
$K\beta_3$	39,1705	30,31
$K\beta_1$	39,2578	
$K\beta_5''$	39,549	
$K\beta_2$	40,233	9,8
$K\beta_4$	40,337	
X_L		
$L\ell$	4,2868	
$L\alpha$	4,822 - 4,8411	
$L\eta$	4,7274	
$L\beta$	5,2625 - 5,6103	
$L\gamma$	5,8755 - 6,3412	

3.1.2 Auger Electrons

	Energy (keV)	Relative probability
Auger K		
KLL	27,190 - 28,828	100
KLX	32,392 - 34,700	48,3
KXY	37,57 - 40,40	6,77
Auger L	2,8 - 6,5	

4 Electron Emissions

		Energy (keV)	Electrons (per 100 disint.)
e_{AL}	(Ce)	2,8 - 6,5	2,360 (13)
e_{AK}	(Ce)		
	KLL	27,190 - 28,828	0,206 (10)
	KLX	32,392 - 34,700	
	KXY	37,57 - 40,40	
$ec_{4,3\ L}$	(Ce)	18,045 - 18,871	0,376 (12)
$ec_{4,3\ M}$	(Ce)	23,159 - 23,711	0,0841 (26)
$ec_{7,5\ K}$	(Ce)	23,686 (4)	0,051 (7)
$ec_{4,3\ N}$	(Ce)	24,304 - 24,594	0,0178 (6)
$ec_{9,7\ K}$	(Ce)	28,480 (5)	0,226 (7)
$ec_{9,7\ L}$	(Ce)	62,374 - 63,200	0,0312 (9)
$ec_{11,7\ K}$	(Ce)	68,974 (4)	0,171 (5)
$ec_{9,6\ K}$	(Ce)	90,678 (4)	0,220 (6)
$ec_{11,7\ L}$	(Ce)	102,868 - 103,694	0,0278 (12)
$ec_{9,6\ L}$	(Ce)	124,572 - 125,398	0,0310 (12)
$ec_{11,5\ K}$	(Ce)	133,103 (5)	0,0270 (11)
$ec_{6,4\ K}$	(Ce)	201,516 (6)	0,0366 (16)
$ec_{6,3\ K}$	(Ce)	226,111 (5)	0,0330 (8)
$ec_{7,3\ T}$	(Ce)	288,318 - 328,741	0,942 (20)
$ec_{7,3\ K}$	(Ce)	288,318 (4)	0,807 (17)
$ec_{7,3\ L}$	(Ce)	322,212 - 323,038	0,1073 (23)
$ec_{7,3\ M}$	(Ce)	327,326 - 327,878	0,02242 (45)
$ec_{10,3\ K}$	(Ce)	392,070 (8)	0,0537 (13)
$ec_{3,1\ T}$	(Ce)	446,579 - 487,002	0,533 (10)
$ec_{3,1\ K}$	(Ce)	446,579 (6)	0,444 (8)
$ec_{3,1\ L}$	(Ce)	480,473 - 481,299	0,0703 (13)
$ec_{3,1\ M}$	(Ce)	485,587 - 486,139	0,01494 (28)
$ec_{5,1\ K}$	(Ce)	711,212 (7)	0,02068 (42)
$ec_{7,1\ K}$	(Ce)	775,341 (6)	0,0961 (16)
$ec_{7,1\ L}$	(Ce)	809,235 - 810,061	0,01236 (22)
$ec_{11,1\ K}$	(Ce)	884,758 (7)	0,02084 (41)
$ec_{1,0\ K}$	(Ce)	1555,770 (13)	0,0645 (10)
$\beta^-_{0,19}$	max:	240,1 (18)	0,011 (3)
	avg:	66,7 (6)	
$\beta^-_{0,18}$	max:	287,4 (18)	0,052 (7)
	avg:	81,4 (6)	
$\beta^-_{0,17}$	max:	366,1 (18)	0,020 (4)
	avg:	106,7 (6)	
$\beta^-_{0,16}$	max:	441,3 (18)	0,0039 (3)
	avg:	132,0 (6)	
$\beta^-_{0,15}$	max:	642,5 (18)	0,027 (1)
	avg:	203,7 (7)	
$\beta^-_{0,14}$	max:	760,0 (18)	0,085 (9)
	avg:	248,0 (7)	

		Energy (keV)		Electrons (per 100 disint.)
$\beta^-_{0,13}$	max:	861,2	(18)	0,112 (6)
	avg:	287,3	(7)	
$\beta^-_{0,12}$	max:	1213,7	(18)	0,636 (7)
	avg:	438,4	(7)	
$\beta^-_{0,11}$	max:	1239,5	(18)	11,11 (9)
	avg:	441,4	(8)	
$\beta^-_{0,10}$	max:	1245,2	(18)	5,80 (4)
	avg:	443,8	(8)	
$\beta^-_{0,9}$	max:	1280,0	(18)	1,14 (2)
	avg:	458,4	(8)	
$\beta^-_{0,8}$	max:	1296,8	(18)	5,60 (7)
	avg:	465,6	(8)	
$\beta^-_{0,7}$	max:	1348,9	(18)	44,8 (4)
	avg:	487,6	(8)	
$\beta^-_{0,6}$	max:	1411,1	(18)	0,262 (22)
	avg:	518,8	(8)	
$\beta^-_{0,5}$	max:	1413,0	(18)	5,03 (12)
	avg:	515,0	(8)	
$\beta^-_{0,3}$	max:	1677,7	(18)	20,8 (6)
	avg:	629,7	(8)	
$\beta^-_{0,1}$	max:	2164,7	(18)	4,5 (6)
	avg:	846,4	(8)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy (keV)	Photons (per 100 disint.)	
XL	(Ce)	4,2868 - 6,3412	0,343 (7)	
XKα_2	(Ce)	34,2793	0,591 (8)	Kα
XKα_1	(Ce)	34,72	1,082 (13)	
XKβ_3	(Ce)	39,1705	0,326 (6)	K$'\beta_1$
XKβ_1	(Ce)	39,2578		
XKβ''_5	(Ce)	39,549		
XKβ_2	(Ce)	40,233	0,0828 (21)	K$'\beta_2$
XKβ_4	(Ce)	40,337		

5.2 Gamma Emissions

	Energy (keV)	Photons (per 100 disint.)
$\gamma_{4,3}$(Ce)	24,595 (4)	0,000689 (19)
$\gamma_{7,5}$(Ce)	64,129 (4)	0,014 (2)
$\gamma_{9,7}$(Ce)	68,923 (5)	0,077 (2)
$\gamma_{11,7}$(Ce)	109,417 (4)	0,217 (6)
$\gamma_{9,6}$(Ce)	131,121 (4)	0,47 (1)
$\gamma_{11,5}$(Ce)	173,546 (5)	0,126 (5)
$\gamma_{6,4}$(Ce)	241,959 (6)	0,436 (10)
$\gamma_{6,3}$(Ce)	266,554 (5)	0,492 (9)
$\gamma_{2,1}$(Ce)	307,08 (4)	0,022 (5)
$\gamma_{7,3}$(Ce)	328,761 (4)	20,8 (3)
$\gamma_{9,3}$(Ce)	397,674 (6)	0,075 (3)
$\gamma_{10,3}$(Ce)	432,513 (8)	3,00 (3)
$\gamma_{11,3}$(Ce)	438,178 (6)	0,017 (10)
$\gamma_{5,2}$(Ce)	444,57 (4)	0,003 (1)
$\gamma_{3,1}$(Ce)	487,022 (6)	46,1 (5)
$\gamma_{11,2}$(Ce)	618,12 (4)	0,041 (3)
$\gamma_{5,1}$(Ce)	751,653 (7)	4,39 (5)
$\gamma_{7,1}$(Ce)	815,784 (6)	23,72 (20)
$\gamma_{8,1}$(Ce)	867,839 (16)	5,58 (7)
$\gamma_{10,1}$(Ce)	919,533 (10)	2,73 (3)
$\gamma_{11,1}$(Ce)	925,198 (7)	7,04 (7)
$\gamma_{12,1}$(Ce)	950,988 (20)	0,531 (7)
$\gamma_{18,9}$(Ce)	992,64 (18)	0,010 (3)
$\gamma_{17,6}$(Ce)	1045,02 (9)	0,020 (4)
$\gamma_{14,2}$(Ce)	1097,58 (9)	0,023 (5)
$\gamma_{13,1}$(Ce)	1303,34 (7)	0,045 (6)
$\gamma_{14,1}$(Ce)	1404,66 (9)	0,062 (8)
$\gamma_{1,0}$(Ce)	1596,203 (13)	95,40 (5)
$\gamma_{18,1}$(Ce)	1877,33 (18)	0,041 (6)
$\gamma_{19,1}$(Ce)	1924,5 (2)	0,011 (3)
$\gamma_{3,0}$(Ce)	2083,219 (14)	0,036 (7)
$\gamma_{5,0}$(Ce)	2347,847 (14)	0,845 (16)
$\gamma_{8,0}$(Ce)	2464,031 (20)	0,0097 (13)
$\gamma_{11,0}$(Ce)	2521,390 (14)	3,41 (5)
$\gamma_{12,0}$(Ce)	2547,180 (23)	0,102 (2)
$\gamma_{13,0}$(Ce)	2899,53 (7)	0,066 (1)
$\gamma_{15,0}$(Ce)	3118,49 (10)	0,026 (1)
$\gamma_{16,0}$(Ce)	3319,52 (24)	0,0039 (3)

6 Main Production Modes

$\left\{ \begin{array}{l} \text{Separation from Ba} - 140 \text{ \& La} - 140 \\ \text{Possible impurities: Ba} - 140 \end{array} \right.$

$\left\{ \begin{array}{ll} \text{La} - 139(\text{n},\gamma)\text{La} - 140 & \sigma : 8{,}93\ (4) \text{ barns} \\ \text{Possible impurities: La} - 141 & \end{array} \right.$

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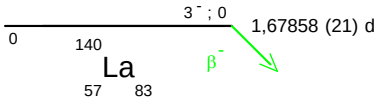
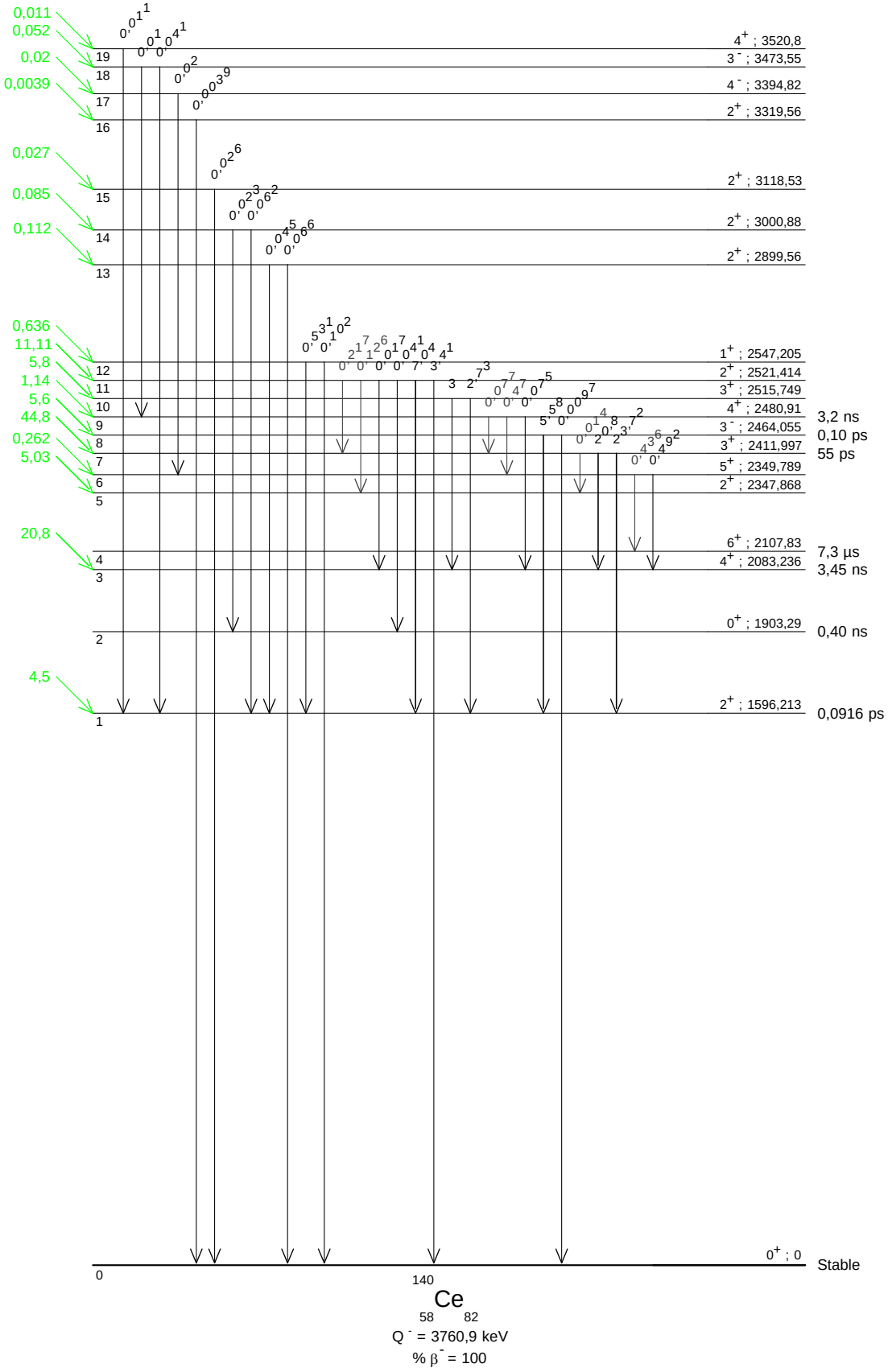
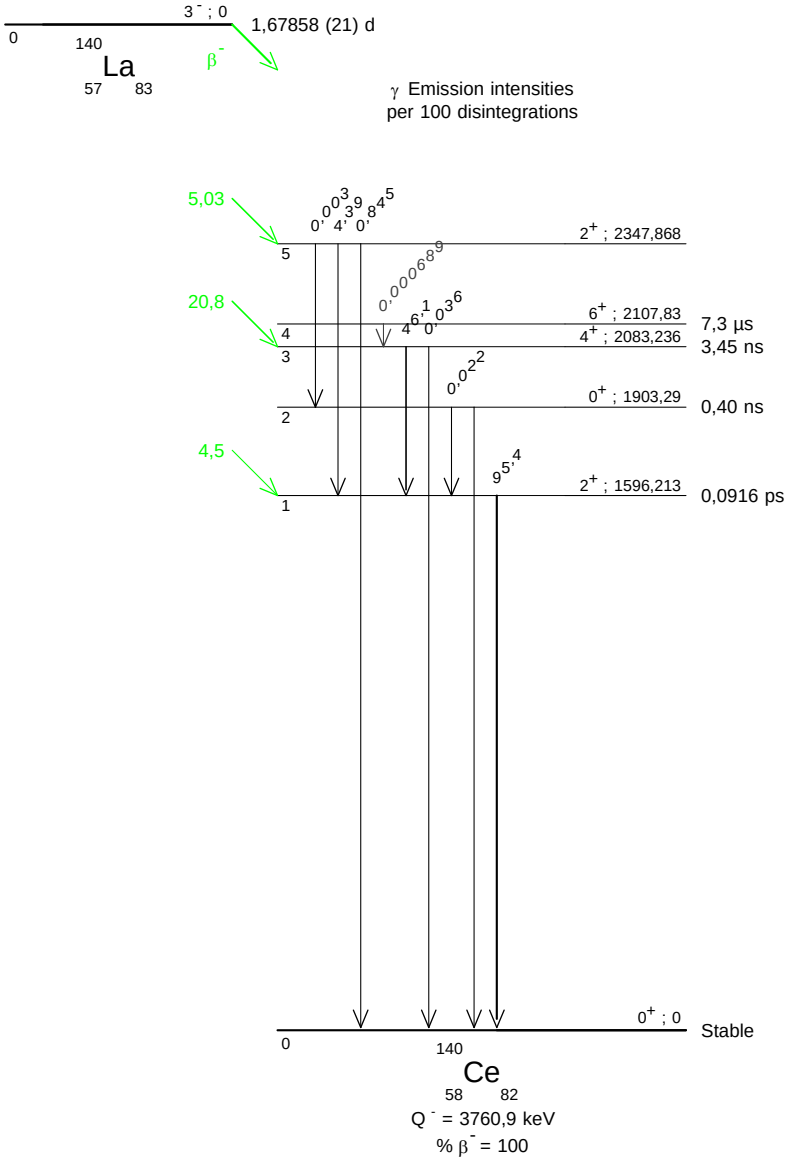


γ Emission intensities per 100 disintegrations




3⁻ ; 0
1,67858 (21) d
0
140
La
57 83
β⁻
γ Emission intensities
per 100 disintegrations
5,03
20,8
4,5
2⁺ ; 2347,868
6⁺ ; 2107,83
7,3 µs
4⁺ ; 2083,236
3,45 ns
0⁺ ; 1903,29
0,40 ns
2⁺ ; 1596,213
0,0916 ps
0⁺ ; 0
Stable
140
Ce
58 82
Q⁻ = 3760,9 keV
% β⁻ = 100