$^{56}_{27}$Co $_{29}$

1 Decay Scheme

Co-56 disintegrates 19.58 (11) % by beta plus emission and 80.42 (11) % by electron capture to Fe-56. Co-56 emits gamma rays with energies up to 3612 keV and the energies and emission probabilities for many of these transitions are useful for the calibration of Ge detectors.
Le cobalt 56 se désintègre à 19,58 (11) % par émission bêta plus et à 80,42 (11) % par capture électronique vers des niveaux excités du fer 56. Le cobalt 56 émets des rayonnements gamma d'énergie allant jusqu'à 3612 keV, ce qui le rend utile pour l'étalonnage des détecteurs germanium.

2 Nuclear Data

$T_{1/2}$(^{56}Co)	:	77,236	(26)	d
Q^{+}(^{56}Co)	:	4566	(2)	keV

2.1 Electron Capture Transitions

	Energy keV	Probability × 100	Nature	lg ft	P_K	P_L	P_M
$\epsilon_{0,15}$	107,7 (20)	0,209 (7)	Allowed	6,91	0,8766 (17)	0,1055 (14)	0,0171 (6)
$\epsilon_{0,14}$	118,4 (20)	0,0167 (5)		8,1	0,8779 (17)	0,1044 (14)	0,0169 (6)
$\epsilon_{0,13}$	171,2 (20)	0,2159 (18)	Allowed	7,32	0,8816 (17)	0,1013 (13)	0,0164 (6)
$\epsilon_{0,12}$	268 (2)	3,688 (13)	Allowed	6,49	0,8845 (16)	0,0989 (13)	0,0159 (5)
$\epsilon_{0,11}$	446,1 (20)	9,940 (18)	Allowed	6,51	0,8864 (16)	0,0972 (13)	0,0156 (5)
$\epsilon_{0,10}$	465,7 (20)	12,66 (4)	Allowed	6,44	0,8866 (16)	0,0971 (13)	0,0156 (5)
$\epsilon_{0,9}$	517,2 (20)	3,965 (15)	Allowed	7,04	0,8868 (16)	0,0969 (13)	0,0155 (5)
$\epsilon_{0,8}$	709,5 (20)	16,86 (5)	Allowed	6,69	0,8875 (16)	0,0963 (13)	0,0154 (5)
$\epsilon_{0,7}$	1120,7 (20)	21,40 (5)	Allowed	6,98	0,8882 (16)	0,0957 (13)	0,0153 (5)
$\epsilon_{0,6}$	1195,9 (20)	0,015 (5)	2nd Forbidden	10,2	0,8883 (16)	0,0957 (13)	0,0153 (5)
$\epsilon_{0,5}$	1443,1 (20)	8,99 (6)	Allowed	7,58	0,8884 (16)	0,0955 (13)	0,0153 (5)
$\epsilon_{0,4}$	1606,1 (20)	0,023 (6)	2nd Forbidden	10,26	0,8885 (16)	0,0955 (13)	0,0153 (5)
$\epsilon_{0,2}$	2480,9 (20)	2,43 (3)	Allowed	8,62	0,8888 (16)	0,0952 (13)	0,0152 (5)
$\epsilon_{0,1}$	3719,2 (20)	0,005 (3)	2nd Forbidden	11,6	0,8890 (16)	0,0951 (13)	0,0152 (5)

2.2 β^+ Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^+_{0,7}$	98,7 (20)	0,0080 (7)	Allowed	6,98
$\beta^+_{0,6}$	174 (2)	0,000006 (20)	2nd Forbidden	10,2
$\beta^+_{0,5}$	421,1 (20)	1,04 (2)	Allowed	7,58
$\beta^+_{0,4}$	584,1 (20)	0,0086 (22)	2nd Forbidden	10,26
$\beta^+_{0,2}$	1458,9 (20)	18,29 (16)	Allowed	8,62
$\beta^+_{0,1}$	2697,2 (20)	0,25 (17)	2nd Forbidden	11,6

2.3 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_T (10^{-4})	α_π (10^{-4})
$\gamma_{11,8}$(Fe)	263,434 (5)	0,0234 (20)			
$\gamma_{8,7}$(Fe)	411,145 (4)	0,0269 (23)			
$\gamma_{8,6}$(Fe)	486,55 (11)	0,058 (3)			
$\gamma_{10,7}$(Fe)	655,003 (5)	0,038 (8)			
$\gamma_{11,7}$(Fe)	674,579 (5)	0,035 (5)			
$\gamma_{8,5}$(Fe)	733,514 (4)	0,191 (4)	M1+E2		
$\gamma_{7,3}$(Fe)	787,743 (5)	0,310 (4)	M1+E2		
$\gamma_{1,0}$(Fe)	846,770 (2)	99,9702 (23)	E2	3,03 (9)	
$\gamma_{12,7}$(Fe)	852,732 (4)	0,049 (3)			
$\gamma_{8,4}$(Fe)	896,510 (6)	0,0704 (22)			
$\gamma_{10,5}$(Fe)	977,372 (5)	1,422 (7)	M1(+E2)		
$\gamma_{11,5}$(Fe)	996,948 (5)	0,116 (6)	M1+E2		
$\gamma_{5,2}$(Fe)	1037,8427 (39)	14,03 (5)	M1(+E2)		
$\gamma_{9,4}$(Fe)	1088,894 (9)	0,054 (4)	M1+E2		
$\gamma_{10,4}$(Fe)	1140,368 (6)	0,132 (4)			
$\gamma_{11,4}$(Fe)	1159,944 (6)	0,088 (3)	M1+E2		
$\gamma_{12,5}$(Fe)	1175,101 (4)	2,249 (9)	M1+E2		
$\gamma_{8,3}$(Fe)	1198,888 (5)	0,044 (3)			
$\gamma_{2,1}$(Fe)	1238,2883 (31)	66,41 (16)	E2		
$\gamma_{13,5}$(Fe)	1271,92 (6)	0,0202 (8)			
$\gamma_{15,5}$(Fe)	1335,399 (30)	0,1228 (16)			
$\gamma_{7,2}$(Fe)	1360,2117 (39)	4,280 (13)	M1+E2		
$\gamma_{10,3}$(Fe)	1442,746 (6)	0,180 (4)			
$\gamma_{11,3}$(Fe)	1462,322 (6)	0,0778 (9)			
$\gamma_{12,3}$(Fe)	1640,475 (5)	0,0621 (21)			
$\gamma_{8,2}$(Fe)	1771,3567 (39)	15,45 (4)	M1+E2		
$\gamma_{3,1}$(Fe)	1810,757 (4)	0,639 (3)	M1+E2		
$\gamma_{9,2}$(Fe)	1963,741 (8)	0,706 (4)	M1+E2		
$\gamma_{10,2}$(Fe)	2015,2147 (47)	3,017 (14)	M1+E2		
$\gamma_{11,2}$(Fe)	2034,7907 (47)	7,743 (13)	M1+E2		2,7
$\gamma_{4,1}$(Fe)	2113,135 (5)	0,376 (3)	M1+E2		
$\gamma_{12,2}$(Fe)	2212,9437 (39)	0,385 (5)	M1+E2		4,1
$\gamma_{5,1}$(Fe)	2276,1310 (36)	0,1181 (40)	E2		4,5
$\gamma_{15,2}$(Fe)	2373,242 (30)	0,078 (6)			
$\gamma_{6,1}$(Fe)	2523,09 (11)	0,063 (4)	M1+E2		4,8
$\gamma_{7,1}$(Fe)	2598,500 (4)	16,969 (40)	M1+E2		5,2
$\gamma_{3,0}$(Fe)	2657,527 (4)	0,0195 (20)	[E2]		6,3
$\gamma_{8,1}$(Fe)	3009,645 (4)	1,039 (19)	M1+E2		6,8
$\gamma_{9,1}$(Fe)	3202,029 (8)	3,205 (13)	M1+E2		7,8

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_T (10^{-4})	α_π (10^{-4})
$\gamma_{10,1}$(Fe)	3253,5030 (44)	7,877 (30)	E2		8,9
$\gamma_{11,1}$(Fe)	3273,079 (4)	1,856 (9)	M1+E2		8
$\gamma_{6,0}$(Fe)	3369,86 (11)	0,0103 (8)	E2		9,6
$\gamma_{12,1}$(Fe)	3451,232 (4)	0,943 (6)	E2		9,7
$\gamma_{13,1}$(Fe)	3548,05 (6)	0,1958 (16)	M1+E2		9
$\gamma_{14,1}$(Fe)	3600,83 (40)	0,0167 (5)			
$\gamma_{15,1}$(Fe)	3611,53 (3)	0,00841 (40)	[E2]		10,3

3 Atomic Data

3.1 Fe

ω_K : 0,355 (4)
$\bar{\omega}_L$: 0,0060 (6)
n_{KL} : 1,447 (4)

3.1.1 X Radiations

		Energy keV		Relative probability
X_K				
	$K\alpha_2$	6,39091		51,07
	$K\alpha_1$	6,40391		100
	$K\beta_1$	7,05804	}	
	$K\beta_5''$	7,1083	}	20,67
X_L				
	$L\ell$	0,615		
	$L\beta$	– 0,792		

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	5,370 – 5,645	100
KLX	6,158 – 6,400	27,4
KXY	6,926 – 7,105	1,87
Auger L	0,510 – 0,594	

4 Electron Emissions

		Energy keV		Electrons per 100 disint.
e_{AL}	(Fe)	0,510 - 0,594		111,8 (8)
e_{AK}	(Fe)			46,04 (30)
	KLL	5,370 - 5,645	}	
	KLX	6,158 - 6,400	}	
	KXY	6,926 - 7,105	}	
$\beta^+_{0,2}$	max:	1458,9	(20)	18,29 (16)
$\beta^+_{0,2}$	avg:	631,2	(9)	
$\beta^+_{0,4}$	max:	584,1	(20)	0,0086 (22)
$\beta^+_{0,4}$	avg:	247,1	(9)	
$\beta^+_{0,5}$	max:	421,1	(20)	1,04 (2)
$\beta^+_{0,5}$	avg:	178,7	(8)	
$\beta^+_{0,6}$	max:	174	(2)	0,000006 (20)
$\beta^+_{0,6}$	avg:	76,7	(8)	
$\beta^+_{0,7}$	max:	98,7	(20)	0,0080 (7)
$\beta^+_{0,7}$	avg:	45,3	(9)	
$\beta^+_{0,1}$	max:	2697,2	(20)	0,25 (17)
$\beta^+_{0,1}$	avg:	1205,8	(10)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV		Photons per 100 disint.	
XL	(Fe)	0,615 — 0,792		0,581 (17)	
$XK\alpha_2$	(Fe)	6,39091		7,53 (10)	} $K\alpha$
$XK\alpha_1$	(Fe)	6,40391		14,75 (17)	}
$XK\beta_1$	(Fe)	7,05804	}	3,05 (5)	$K'\beta_1$
$XK\beta_5''$	(Fe)	7,1083	}		

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma_{11,8}$(Fe)	263,41 (10)	0,0234 (20)
$\gamma_{8,7}$(Fe)	411,38 (8)	0,0269 (23)
$\gamma_{8,6}$(Fe)	486,54 (11)	0,058 (3)
$\gamma^{\pm}$	511	39,21 (22)
$\gamma_{10,7}$(Fe)	655,0 (8)	0,038 (8)
$\gamma_{11,7}$(Fe)	674,7 (8)	0,035 (5)
$\gamma_{8,5}$(Fe)	733,5085 (23)	0,191 (4)
$\gamma_{7,3}$(Fe)	787,7391 (23)	0,310 (4)
$\gamma_{1,0}$(Fe)	846,7638 (19)	99,9399 (23)
$\gamma_{12,7}$(Fe)	852,78 (5)	0,049 (3)
$\gamma_{8,4}$(Fe)	896,503 (7)	0,0704 (22)
$\gamma_{10,5}$(Fe)	977,363 (4)	1,422 (7)
$\gamma_{11,5}$(Fe)	996,939 (5)	0,116 (6)
$\gamma_{5,2}$(Fe)	1037,8333 (24)	14,03 (5)
$\gamma_{9,4}$(Fe)	1089,03 (24)	0,054 (4)
$\gamma_{10,4}$(Fe)	1140,356 (7)	0,132 (4)
$\gamma_{11,4}$(Fe)	1159,933 (8)	0,088 (3)
$\gamma_{12,5}$(Fe)	1175,0878 (22)	2,249 (9)
$\gamma_{8,3}$(Fe)	1198,78 (20)	0,044 (3)
$\gamma_{2,1}$(Fe)	1238,2736 (22)	66,41 (16)
$\gamma_{13,5}$(Fe)	1272,2 (6)	0,0202 (8)
$\gamma_{15,5}$(Fe)	1335,380 (29)	0,1228 (16)
$\gamma_{7,2}$(Fe)	1360,196 (4)	4,280 (13)
$\gamma_{10,3}$(Fe)	1442,75 (8)	0,180 (4)
$\gamma_{11,3}$(Fe)	1462,34 (12)	0,0778 (9)
$\gamma_{12,3}$(Fe)	1640,450 (5)	0,0621 (21)
$\gamma_{8,2}$(Fe)	1771,327 (3)	15,45 (4)
$\gamma_{3,1}$(Fe)	1810,726 (4)	0,639 (3)
$\gamma_{9,2}$(Fe)	1963,703 (11)	0,706 (4)

	Energy keV	Photons per 100 disint.
$\gamma_{10,2}$(Fe)	2015,176 (5)	3,017 (14)
$\gamma_{11,2}$(Fe)	2034,752 (5)	7,741 (13)
$\gamma_{4,1}$(Fe)	2113,092 (6)	0,376 (3)
$\gamma_{12,2}$(Fe)	2212,898 (3)	0,385 (5)
$\gamma_{5,1}$(Fe)	2276,36 (16)	0,118 (4)
$\gamma_{15,2}$(Fe)	2373,7 (4)	0,078 (6)
$\gamma_{6,1}$(Fe)	2523,0 (8)	0,063 (4)
$\gamma_{7,1}$(Fe)	2598,438 (4)	16,96 (4)
$\gamma_{3,0}$(Fe)	2657,4 (8)	0,0195 (20)
$\gamma_{8,1}$(Fe)	3009,559 (4)	1,038 (19)
$\gamma_{9,1}$(Fe)	3201,930 (11)	3,203 (13)
$\gamma_{10,1}$(Fe)	3253,402 (5)	7,87 (3)
$\gamma_{11,1}$(Fe)	3272,978 (6)	1,855 (9)
$\gamma_{6,0}$(Fe)	3369,69 (30)	0,0103 (8)
$\gamma_{12,1}$(Fe)	3451,119 (4)	0,942 (6)
$\gamma_{13,1}$(Fe)	3547,93 (6)	0,1956 (16)
$\gamma_{14,1}$(Fe)	3600,71 (40)	0,0167 (5)
$\gamma_{15,1}$(Fe)	3611,8 (8)	0,0084 (4)

6 Main Production Modes

$$\begin{cases} \text{Fe} - 56(\text{p,n})\text{Co} - 56 \\ \text{Possible impurities : Co} - 57,\text{Co} - 58 \end{cases}$$

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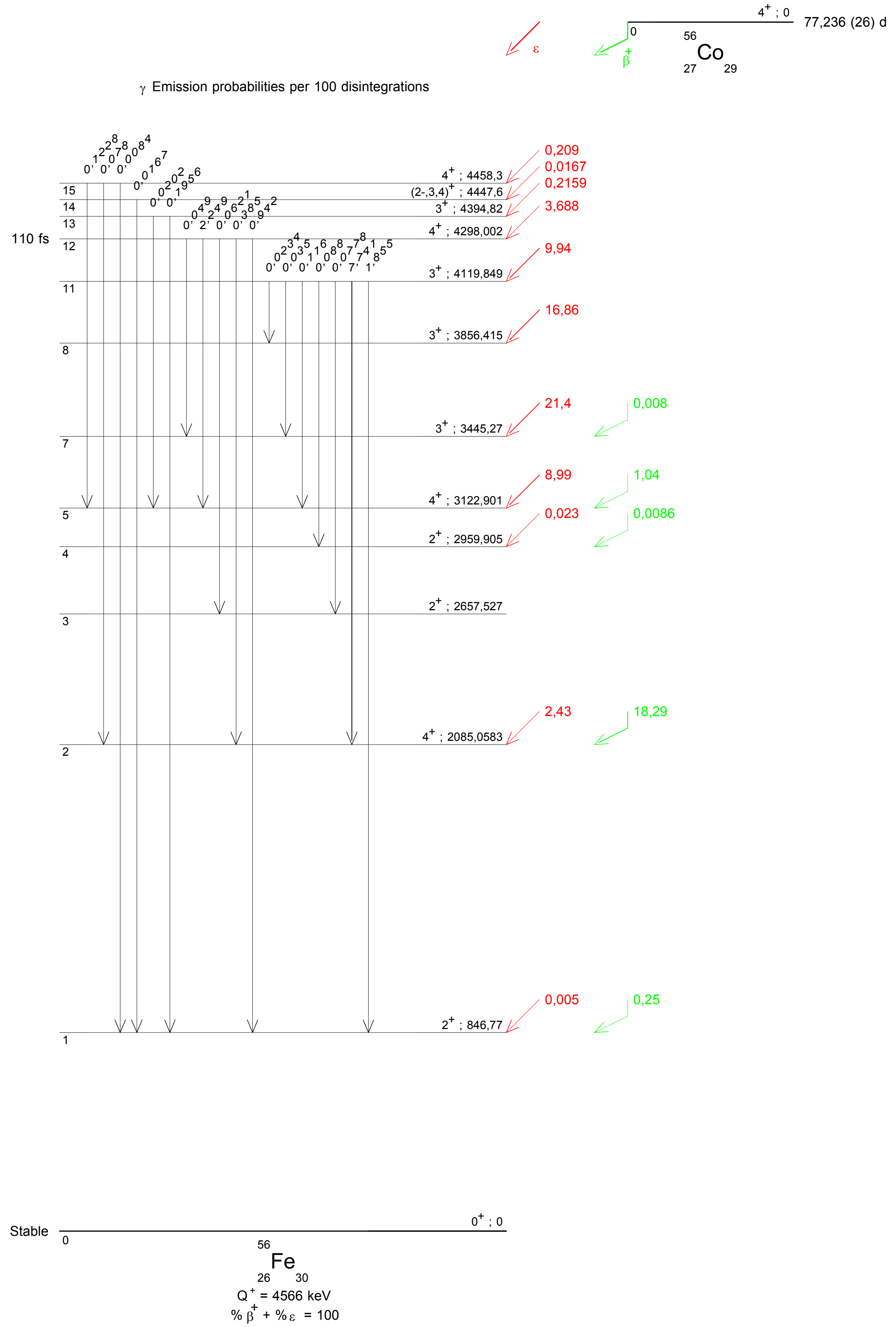
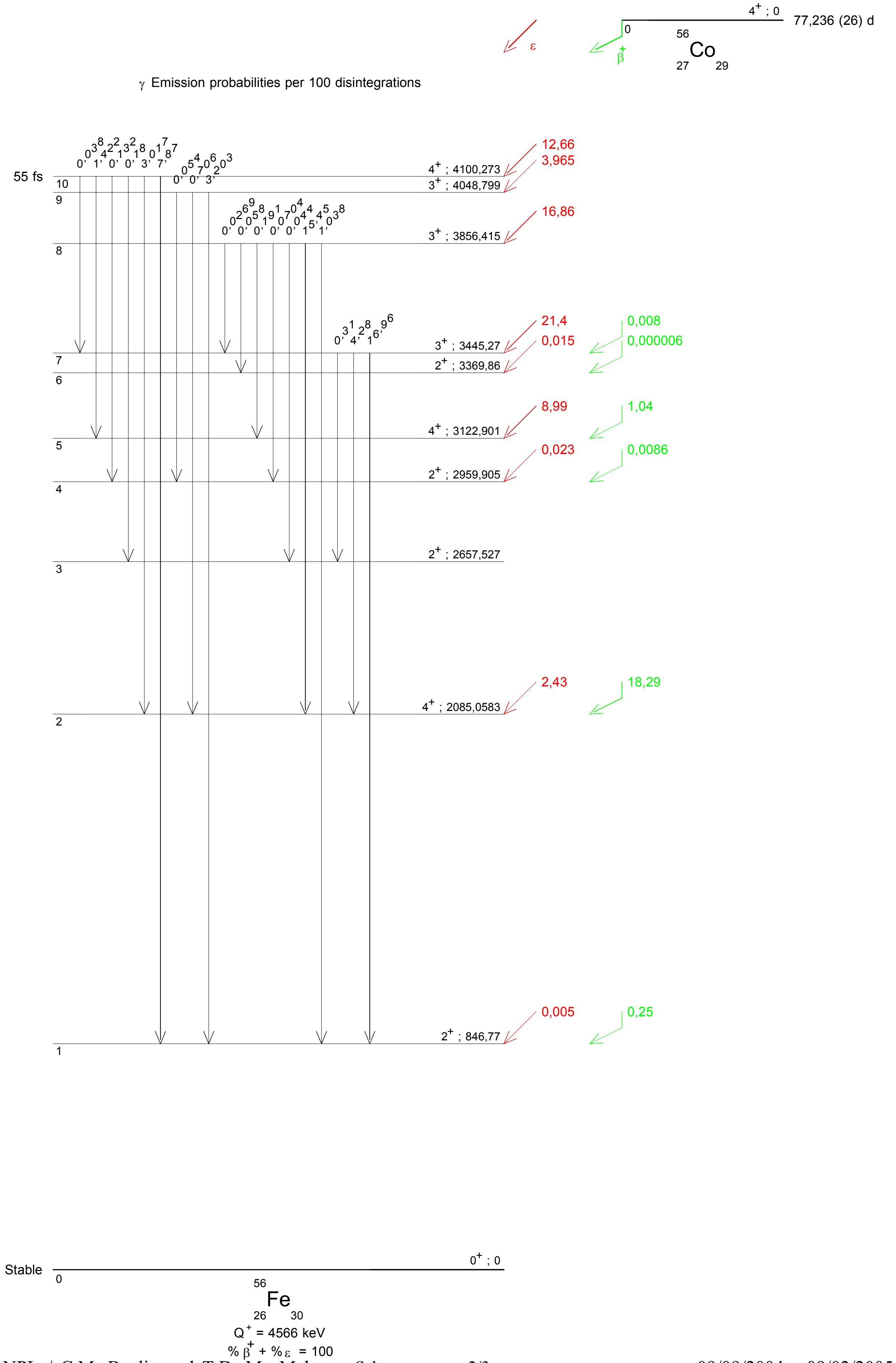
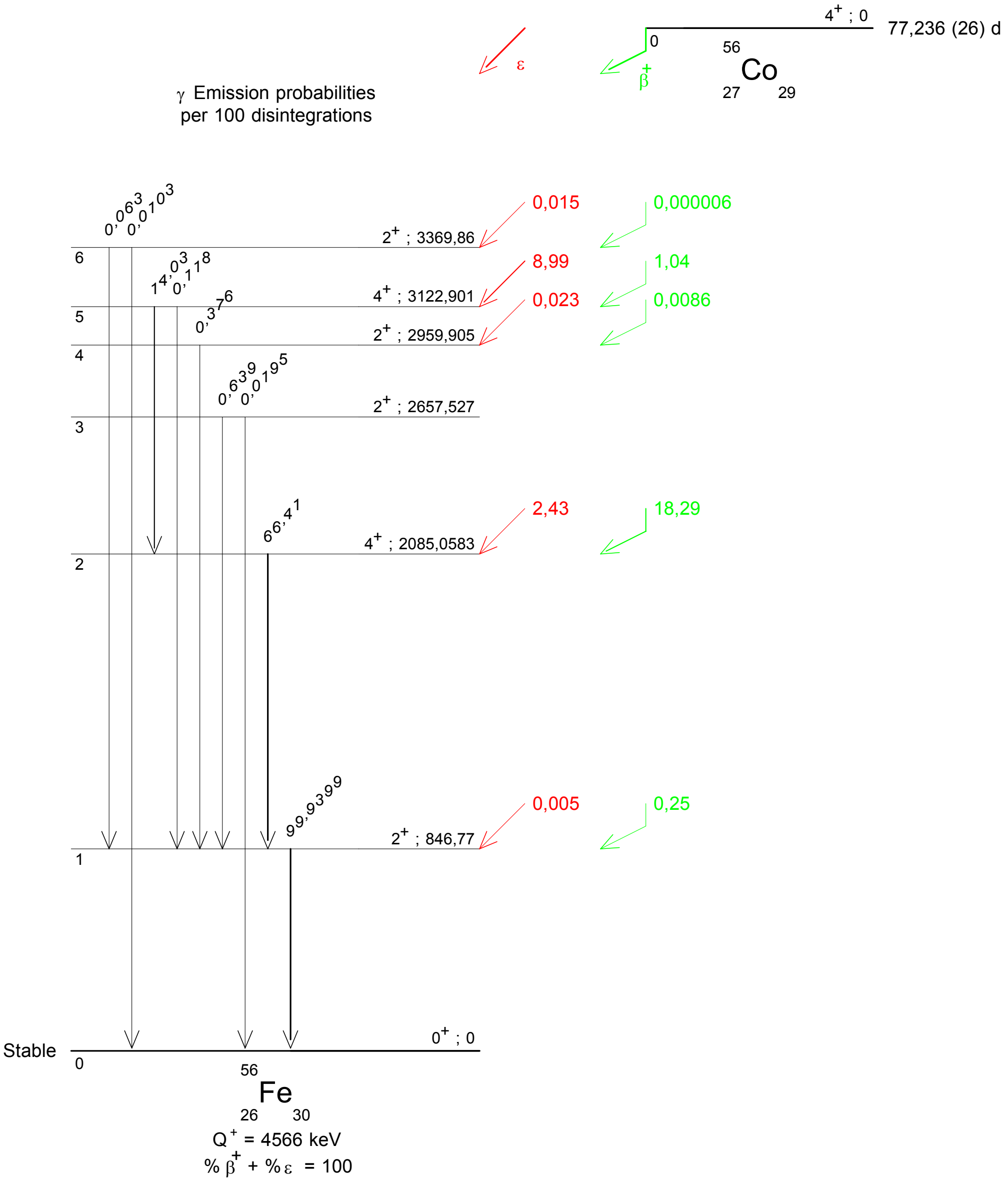


4+ ; 0
77,236 (26) d
ε
β+
56 Co 27 29
γ Emission probabilities per 100 disintegrations
110 fs
4+ ; 4458,3
(2-,3,4)+ ; 4447,6
3+ ; 4394,82
4+ ; 4298,002
3+ ; 4119,849
3+ ; 3856,415
3+ ; 3445,27
4+ ; 3122,901
2+ ; 2959,905
2+ ; 2657,527
4+ ; 2085,0583
2+ ; 846,77
0+ ; 0
0,209
0,0167
0,2159
3,688
9,94
16,86
21,4
0,008
8,99
1,04
0,023
0,0086
2,43
18,29
0,005
0,25
Stable
56 Fe 26 30
Q+ = 4566 keV
% β+ + % ε = 100


4+ ; 0
77,236 (26) d
0
56 Co 27 29
ε
β+
γ Emission probabilities per 100 disintegrations
55 fs
10
9
8
7
6
5
4
3
2
1
4+ ; 4100,273
3+ ; 4048,799
3+ ; 3856,415
3+ ; 3445,27
2+ ; 3369,86
4+ ; 3122,901
2+ ; 2959,905
2+ ; 2657,527
4+ ; 2085,0583
2+ ; 846,77
12,66
3,965
16,86
21,4
0,015
8,99
0,023
2,43
0,005
0,008
0,000006
1,04
0,0086
18,29
0,25
Stable
0
0+ ; 0
56 Fe 26 30
Q+ = 4566 keV
% β+ + % ε = 100


4+ ; 0
77,236 (26) d
0
56
Co
27
29
ε
β+
γ Emission probabilities
per 100 disintegrations
0,063
0,0103
2+ ; 3369,86
0,015
0,000006
14,03
0,118
4+ ; 3122,901
8,99
1,04
0,376
2+ ; 2959,905
0,023
0,0086
0,639
0,0195
2+ ; 2657,527
66,41
4+ ; 2085,0583
2,43
18,29
99,9399
2+ ; 846,77
0,005
0,25
Stable
0+ ; 0
6
5
4
3
2
1
0
56
Fe
26
30
Q+ = 4566 keV
% β+ + % ε = 100