



1 Decay Scheme

Zr-93 decays via two beta minus transitions, 73(5)% to Nb-93m and 27(5)% to Nb-93.

Le zirconium-93 se désintègre 100 % par émission bêta vers le niveau isomérique (73 (5) %) et le niveau fondamental (27 (5) %) du niobium 93.

2 Nuclear Data

$$\begin{aligned}
T_{1/2}(^{93}\text{Zr}) &: 1,61 \quad (6) \quad 10^6 \text{ a} \\
Q^-(^{93}\text{Zr}) &: 90,3 \quad (15) \quad \text{keV}
\end{aligned}$$

2.1 β^- Transitions

	Energy (keV)	Probability (%)	Nature	lg <i>ft</i>
$\beta_{0,1}^-$	59,5 (15)	73 (5)	Unique 1st Forbidden	10,16
$\beta_{0,0}^-$	90,3 (15)	27 (5)	2nd Forbidden	12,09

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy (keV)	P _{$\gamma+ce$} (%)	Multipolarity	α_K (10 ⁵)	α_L (10 ⁵)	α_M (10 ⁵)	α_T (10 ⁵)
$\gamma_{1,0}(\text{Nb})$	30,77 (2)	73 (5)	M4	0,260 (4)	1,151 (17)	0,249 (4)	1,693 (25)

3 Atomic Data

3.1 Nb

ω_K	:	0,751	(4)
$\bar{\omega}_L$:	0,0347	(9)
n_{KL}	:	1,045	(4)

3.1.1 X Radiations

	Energy (keV)		Relative probability
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X _K			
Kα ₂	16,5213		52,36
Kα ₁	16,6152		100
Kβ ₃	18,607	}	25,87
Kβ ₁	18,623		
Kβ ₅ ''	18,78		
Kβ ₂	18,953	}	3,88
Kβ ₄	18,981		
 X _L			
Lℓ	1,9		
Lα	2,16 - 2,17		
Lη	2		
Lβ	2,26 - 2,49		
Lγ	2,41 - 2,67		

3.1.2 Auger Electrons

	Energy (keV)	Relative probability
Auger K		
KLL	13,49 - 14,14	100
KLX	15,78 - 16,61	39,1
KXY	18,05 - 18,98	3,81
Auger L		
	1,4 - 2,7	

4 Electron Emissions

		Energy (keV)	Electrons (per 100 disint.)
e _{AL}	(Nb)	1,4 - 2,7	59,1 (4)
e _{AK}	(Nb)	$\left. \begin{array}{l} \text{KLL} \quad 13,49 - 14,14 \\ \text{KLX} \quad 15,78 - 16,61 \\ \text{KXY} \quad 18,05 - 18,98 \end{array} \right\}$	2,78 (21)
ec _{1,0 T}	(Nb)	11,78 - 30,77	73 (5)
ec _{1,0 K}	(Nb)	11,78 (2)	11,2 (8)
ec _{1,0 L}	(Nb)	28,07 - 28,40	49,5 (35)
ec _{1,0 M}	(Nb)	30,30 - 30,57	10,7 (8)
ec _{1,0 N}	(Nb)	30,71 - 30,77	1,39 (10)
$\beta_{0,1}^-$	max:	59,5 (15)	} 73 (5)
	avg:	18,75 (54)	
$\beta_{0,0}^-$	max:	90,3 (15)	} 27 (5)
	avg:	23,64 (42)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy (keV)	Photons (per 100 disint.)	
XL	(Nb)	1,9 - 2,67	2,1 (1)	
XK α_2	(Nb)	16,5213	2,41 (18)	} K α
XK α_1	(Nb)	16,6152	4,6 (4)	
XK β_3	(Nb)	18,607	} 1,19 (9)	K' β_1
XK β_1	(Nb)	18,623		
XK β_5''	(Nb)	18,78		
XK β_2	(Nb)	18,953	} 0,179 (15)	K' β_2
XK β_4	(Nb)	18,981		

5.2 Gamma Emissions

	Energy (keV)	Photons (per 100 disint.)
$\gamma_{1,0}(\text{Nb})$	30,77 (2)	0,00043 (3)

6 Main Production Modes

- $\left\{ \begin{array}{l} \text{U} - 235(\text{n},\text{f})\text{Zr} - 93 \\ \text{Possible impurities : Fe} - 55, \text{Mo} - 93, \text{Nb} - 93\text{m} \end{array} \right.$
- $\left\{ \begin{array}{l} \text{Zr} - 92(\text{n},\gamma)\text{Zr} - 93 \\ \text{Possible impurities : Nb} - 93\text{m} \end{array} \right.$

7 References

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