$^{104}$Nb $\beta^-$ **decay (4.8 s)**     **1982Ke05,1979Si02**

Parent: $^{104}$Nb: E=0.0; J$^\pi$=(1$^+$); T$_{1/2}$=4.8 s *4*; Q($\beta^-$)=8100 *90*; %$\beta^-$ decay=?

Measured: $\gamma$, $\gamma\gamma$, x-$\gamma$, ce-x ray, $\gamma\gamma(\theta)$ (1979Si02), $\gamma$(t) (1982Ke05,1979Si02).

Activity: $^{235}$U(n,F), on line mass separator (JOSEF) (1982Ke05,1979Si02).

The $\gamma$ rays are assigned to the $^{104}$Nb decay if they follow the 192$\gamma$ when the magnetic induction changes.

The preliminary decay scheme is a mixture of the 0.91 s +4.8 s $^{104}$Nb. The 192.2$\gamma$, 620.2$\gamma$, 693.9$\gamma$, 812.4$\gamma$, and 836.3$\gamma$ were
    fitted with mixed half-lives of 0.91 s and 4.8-s. The 368.4, 477.5$\gamma$, 519.2$\gamma$, 555.3$\gamma$ and 771.4$\gamma$ decay by only 0.91 s half-life.

The relative intensity for both isomers is not given by the authors.

### $^{104}$Mo Levels

| E(level) | J$^{\pi\dagger}$ | T$_{1/2}$$^{\ddagger}$ | Comments |
|---|---|---|---|
| 0 | 0$^+$ | 60 s *2* | |
| 192.2 *1* | 2$^+$ | 0.97 ns *8* | g=0.19 +*12*−*11* (1985Me13) |
| | | | T$_{1/2}$: other: 0.72 ns *4* (1991Li39) $\beta\gamma\gamma$(t). |
| 560.6 *2* | 4$^+$ | 26.1 ps *8* | T$_{1/2}$: other: 26.8 ps *35* (1991Li39) $\beta\gamma$(t). |
| 812.4 *3* | 1,2$^+$ | | |
| 886.1 *4* | 0$^+$ | | |
| 1028.5 *5* | | | |
| 1079.8 *6* | 6$^+$ | 4.73 ps *15* | |
| 1214.7 *7* | | | |
| 1275.2 *8* | | | |
| 1468.4 *9* | | | |
| 1475.6 *10* | | | |
| 1544.5 *11* | | | |
| 1583.8 *12* | | | |
| 1606.8 *13* | | | |
| 1610.6 *14* | | | |
| 1624.1 *15* | | | |
| 1790.2 *16* | | | |
| 1882.0 *17* | | | |
| 2061.3 *18* | | | |
| 2317.0 *19* | | | |
| 2656.6 *20* | | | |
| 2671.1 *21* | | | |
| 2684.5 *22* | | | |
| 2791.8 *23* | | | |
| 2888.0 *24* | | | |

$^\dagger$ From $\gamma\gamma(\theta)$ (1979Si02) and Adopted Levels.
$^\ddagger$ From Adopted Levels.

### $\gamma$($^{104}$Mo)

| E$_\gamma$ | I$_\gamma$$^\dagger$ | E$_i$(level) | J$_i^\pi$ | E$_f$ | J$_f^\pi$ | Mult. | $\alpha$$^\ddagger$ | Comments |
|---|---|---|---|---|---|---|---|---|
| 73.6 *2* | 4.0 *5* | 886.1 | 0$^+$ | 812.4 | 1,2$^+$ | [E2] | 3.67 | $\alpha$(K)= 2.82; $\alpha$(L)= 0.705; $\alpha$(M)= 0.1281; |
| | | | | | | | | $\alpha$(N+..)=0.02064 |
| 192.2 *1* | 500 *99* | 192.2 | 2$^+$ | 0 | 0$^+$ | E2 | 0.1164 | $\alpha$(K)= 0.0979; $\alpha$(L)=0.01391; $\alpha$(N+..)=0.00043 |
| | | | | | | | | B(E2)(W.u.)=73 *11* |
| | | | | | | | | Mult.: from $^{252}$Cf(SF). |
| 216.7 *5* | 2.0 *2* | 1028.5 | | 812.4 | 1,2$^+$ | | | |

Continued on next page (footnotes at end of table)

$^{104}$Nb $\beta^-$ decay (4.8 s)　　　**1982Ke05,1979Si02 (continued)**

$\gamma(^{104}$Mo) (continued)

| $E_\gamma$ | $I_\gamma$[†] | $E_i$(level) | $J_i^\pi$ | $E_f$ | $J_f^\pi$ | Mult. | $\alpha$[‡] | Comments |
|---|---|---|---|---|---|---|---|---|
| 354.0 2 | 4.0 4 | 2671.1 | | 2317.0 | | | | |
| 368.4 1 | 100 10 | 560.6 | $4^+$ | 192.2 | $2^+$ | E2 | 0.01243 | $\alpha$(K)=0.01067; $\alpha$(L)=0.00132 |
| | | | | | | | | Mult.: from $^{252}$Cf(SF). |
| 369.1 5 | | 1583.8 | | 1214.7 | | | | |
| 402.3 5 | 7 1 | 1214.7 | | 812.4 | $1,2^+$ | | | |
| 477.5 1 | 85 9 | 2061.3 | | 1583.8 | | | | |
| 519.2 1 | 10 1 | 1079.8 | $6^+$ | 560.6 | $4^+$ | | | |
| 555.3 1 | 42 4 | 1583.8 | | 1028.5 | | | | |
| 595.1 4 | 5.0 5 | 1624.1 | | 1028.5 | | | | |
| 609.2 4 | 5.0 5 | 2671.1 | | 2061.3 | | | | |
| 620.2 1 | 96 10 | 812.4 | $1,2^+$ | 192.2 | $2^+$ | | | |
| 654.1 1 | 17 2 | 1214.7 | | 560.6 | $4^+$ | | | |
| 693.9 1 | 30 3 | 886.1 | $0^+$ | 192.2 | $2^+$ | | | |
| 771.4 1 | 62 6 | 1583.8 | | 812.4 | $1,2^+$ | | | |
| 802.5 1 | 5 1 | 2684.5 | | 1882.0 | | | | |
| 812.4 2 | 85 9 | 812.4 | $1,2^+$ | 0 | $0^+$ | | | |
| 836.3 1 | 92 9 | 1028.5 | | 192.2 | $2^+$ | | | |
| 915.0 3 | 14 2 | 1475.6 | | 560.6 | $4^+$ | | | |
| 1022.7 4 | 18 2 | 1214.7 | | 192.2 | $2^+$ | | | |
| 1046.4 2 | 9 1 | 1606.8 | | 560.6 | $4^+$ | | | |
| 1050.0 2 | 9 1 | 1610.6 | | 560.6 | $4^+$ | | | |
| 1063.9 4 | 7 1 | 1624.1 | | 560.6 | $4^+$ | | | |
| 1072.8 2 | 11 1 | 2656.6 | | 1583.8 | | | | |
| 1083.0 2 | 9 1 | 1275.2 | | 192.2 | $2^+$ | | | |
| 1139.7 4 | 2.0 2 | 2684.5 | | 1544.5 | | | | |
| 1195.4 3 | 4.0 4 | 2671.1 | | 1475.6 | | | | |
| 1229.6 2 | 13 1 | 1790.2 | | 560.6 | $4^+$ | | | |
| 1247.6 3 | 4 1 | 2791.8 | | 1544.5 | | | | |
| 1276.5 2 | 17 2 | 1468.4 | | 192.2 | $2^+$ | | | |
| 1322.5 5 | 8 1 | 1882.0 | | 560.6 | $4^+$ | | | |
| 1352.3 2 | 15 2 | 1544.5 | | 192.2 | $2^+$ | | | |
| 1390.9 8 | 13 2 | 1583.8 | | 192.2 | $2^+$ | | | |
| 1414.6 3 | 17 2 | 1606.8 | | 192.2 | $2^+$ | | | |
| 1419.6 3 | 4 1 | 2888.0 | | 1468.4 | | | | |
| 1441.8 3 | 9 1 | 2656.6 | | 1214.7 | | | | |
| 1468.4 3 | 37 4 | 1468.4 | | 0 | $0^+$ | | | |
| 1756.0 20 | 2.0 5 | 2317.0 | | 560.6 | $4^+$ | | | |
| 1905.7 3 | 27 3 | 2791.8 | | 886.1 | $0^+$ | | | |
| 2095.7 3 | 5 1 | 2656.6 | | 560.6 | $4^+$ | | | |
| 2110.5 3 | 7 1 | 2671.1 | | 560.6 | $4^+$ | | | |
| 2124.8 3 | 4 1 | 2317.0 | | 192.2 | $2^+$ | | | |
| 2492.3 20 | 4 1 | 2684.5 | | 192.2 | $2^+$ | | | |
| 2600.0 20 | 9 1 | 2791.8 | | 192.2 | $2^+$ | | | |
| 2696.0 20 | 12 1 | 2888.0 | | 192.2 | $2^+$ | | | |

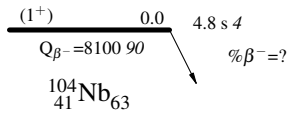[†] Uncertainty not given, estimated by evaluator as being 10%. Also the relative part of the two isomers was not measured.
[‡] Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on $\gamma$-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.

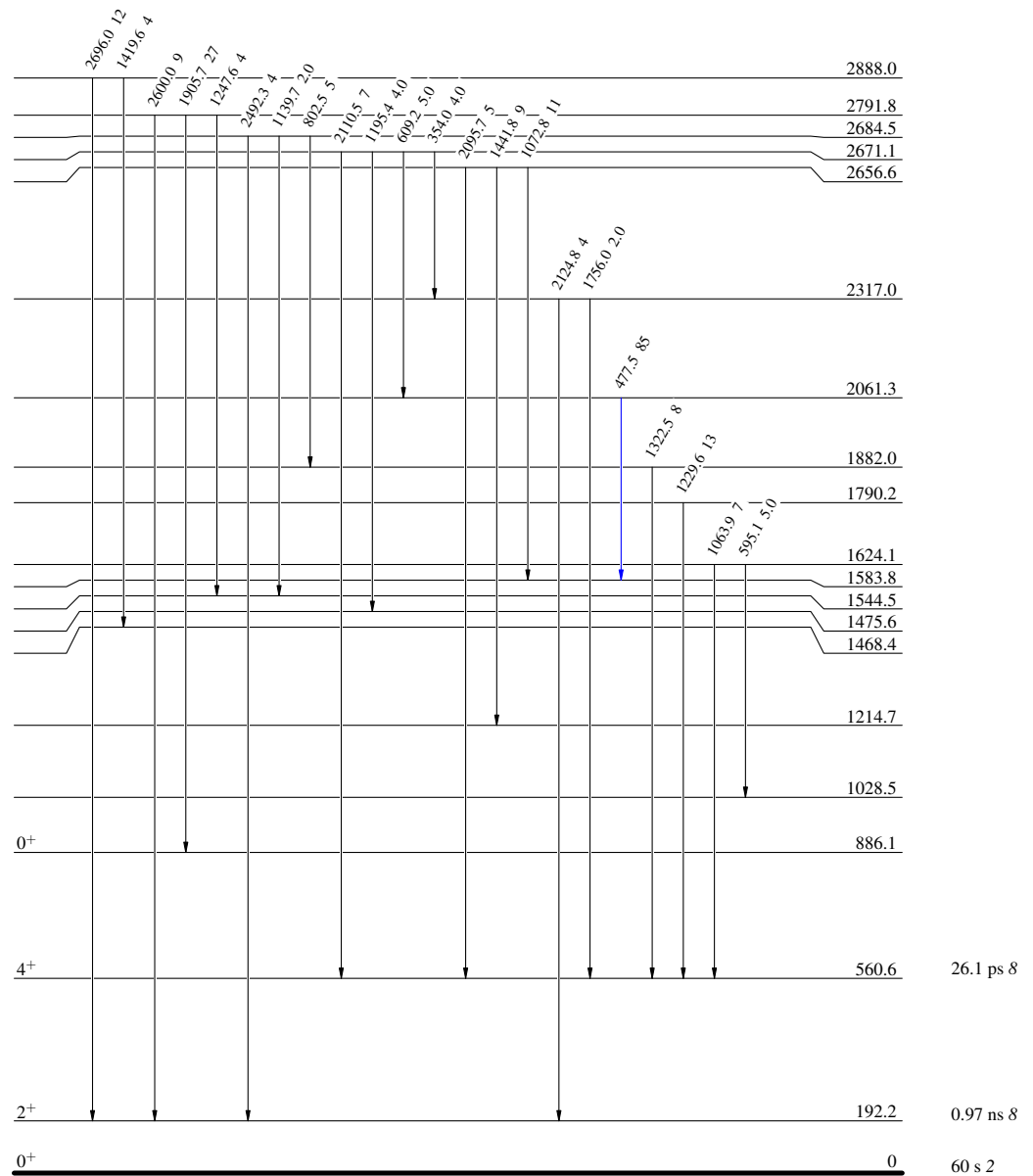$^{104}$Nb $\beta^-$ **decay (4.8 s)**      **1982Ke05,1979Si02**

Decay Scheme

Intensities: Relative I$_\gamma$

Legend

I$_\gamma$ <  2%×I$_\gamma^{max}$
I$_\gamma$ < 10%×I$_\gamma^{max}$
I$_\gamma$ > 10%×I$_\gamma^{max}$

(1$^+$)      0.0     4.8 s *4*
Q$_{\beta^-}$=8100 *90*     %$\beta^-$=?

$^{104}_{41}$Nb$_{63}$



$^{104}_{42}$Mo$_{62}$

$^{104}$Nb $\beta^-$ decay (4.8 s)     1982Ke05,1979Si02

Decay Scheme (continued)

Intensities: Relative I$_\gamma$

Legend

→ I$_\gamma$ <  2%×I$_\gamma^{max}$
→ I$_\gamma$ < 10%×I$_\gamma^{max}$
→ I$_\gamma$ > 10%×I$_\gamma^{max}$

(1$^+$)          0.0     4.8 s 4
Q$_{\beta^-}$=8100 90     %$\beta^-$=?

$^{104}_{41}$Nb$_{63}$

1050.0 9
1414.6 17
1046.4 9
1390.9 13
771.4 62
555.3 42
369.1
1352.3 15
915.0 14
1468.4 37
1276.5 17
1083.0 9
1022.7 18
654.1 17
402.3 7
519.2 10
836.3 92
216.7 2.0
693.9 30
73.6 [E2]4.0
812.4 85
620.2 96
368.4 E2 100
192.2 E2 500

1610.6
1606.8
1583.8
1544.5
1475.6
1468.4

1275.2
1214.7

6$^+$     1079.8     4.73 ps 15
1028.5

0$^+$     886.1
1,2$^+$   812.4

4$^+$     560.6     26.1 ps 8

2$^+$     192.2     0.97 ns 8

0$^+$     0     60 s 2

$^{104}_{42}$Mo$_{62}$