## $^{68}$Cu $\beta^-$ decay (30.9 s) 1972Sw01,1975Ti01

History

| Type | Author | Citation | Literature Cutoff Date |
|---|---|---|---|
| Full Evaluation | E. A. Mccutchan | NDS 113, 1735 (2012) | 1-Mar-2012 |

Parent: $^{68}$Cu: E=0.0; $J^\pi=1^+$; $T_{1/2}$=30.9 s *6*; Q($\beta^-$)=4439.8 *18*; %$\beta^-$ decay=100.0

1975Ti01: $^{68}$Cu activity produced by $^{68}$Zn(n,p), E(n)=14.9 MeV. Measured E$\gamma$, I$\gamma$, and $T_{1/2}$ using Ge(Li) detector.

1972Sw01: $^{68}$Cu activity produced by $^{68}$Zn(n,p), E(n)=14.7 MeV. Measured E$\gamma$, I$\gamma$, E$\beta^-$, I$\beta^-$, $T_{1/2}$, $\gamma\gamma$ and $\beta\gamma$ coin using Ge(Li) and NaI(Tl) detectors and a plastic scintillator.

Data are taken mainly from 1972Sw01 and 1975Ti01.

Others: 2002Ko31, 1971Si19, 1969Wa22, 1969Va16, 1964Ba13, 1960Yt03.

The decay scheme given here is based on the equilibrium decay of the 3.75-min $^{68}$Cu isomer which proceeds 86% via IT decay and subsequent decay of the 30.9-s g.s. to $^{68}$Zn. This branching fraction includes a correction for the different $T_{1/2}$ of the two branches. Included here are only those $\gamma$'s which decay with a composite 30.9-s and 3.75-min half-life and their associated levels.

$\alpha$: Additional information 1.

### $^{68}$Zn Levels

| E(level)[†] | $J^\pi$[‡] | $T_{1/2}$[‡] | E(level)[†] | $J^\pi$[‡] | E(level)[†] | $J^\pi$[‡] |
|---|---|---|---|---|---|---|
| 0 | $0^+$ | stable | 2339.5 *8* | $2^+$ | 2821.4 *16* | $2^+$ |
| 1077.7 *5* | $2^+$ | | 2370.6 *16* | | 3186.7 *12* | $(1,2^+)$ |
| 1655.9 *10* | $0^+$ | | 2510.5 *16* | | 3490.3 *22* | |
| 1884.3 *9* | $2^+$ | | 2753.4 *16* | $3^-$ | | |

[†] From a least-squares fit to the E$\gamma$'s by evaluator.
[‡] From the Adopted Levels.

### $\beta^-$ radiations

| E(decay)[†] | E(level) | I$\beta^-$[‡@] | Log *ft* | Comments |
|---|---|---|---|---|
| (949 *3*) | 3490.3 | 1.0 *3* | 4.50 *13* | av E$\beta$=340.6 *12* |
| (1253.1 *22*) | 3186.7 | 2.4 *5* | 4.58 *9* | av E$\beta$=471.61 *96* |
| (1618.4 *24*) | 2821.4 | 1.7 *4* | 5.18 *11* | av E$\beta$=635.2 *11* |
| (1686.4[&] *24*) | 2753.4 | <0.5 | >5.8 | av E$\beta$=666.1 *11* |
| (1929.3[&] *24*) | 2510.5 | 0.3 *3* | 6.2 *5* | av E$\beta$=777.8 *12* |
| (2069.2[&] *24*) | 2370.6 | 0.35 *17* | 6.30 *22* | av E$\beta$=842.7 *12* |
| (2100.3 *20*) | 2339.5 | 16.0 *12* | 4.67 *4* | av E$\beta$=857.23 *92*<br>E(decay): 2200 *200* (1972Sw01). |
| (2555.5 *20*) | 1884.3 | 2.7 *11* | 5.80 *18* | av E$\beta$=1071.12 *96*<br>E(decay): 2700 *200* (1972Sw01). |
| (2783.9 *21*) | 1655.9 | 1.2 *7* | 6.3 *3* | av E$\beta$=1179.47 *98* |
| (3362.1 *19*) | 1077.7 | 38 *4* | 5.16 *5* | av E$\beta$=1455.84 *90*<br>E(decay): 3500 *100* (1972Sw01). |
| (4439.8 *18*) | 0 | 33[#] *4* | 5.76 *6* | av E$\beta$=1975.89 *88*<br>E(decay): 4600 *50* (1972Sw01), 4600 (1971Si19), 4600 *100* (1969Wa22), and 4580 *60* (1964Ba13). |

[†] Experimentally measured values from $\beta\gamma$ coincidences are included in the comments.
[‡] From I$\gamma$ imbalances in $^{68}$Cu $\beta^-$ decay (30.9 s + 3.75 min) in equilibrium. Branches to low-spin states are assumed to be from the 30.9-s parent state.
[#] Others: 31.4% *41* from $\gamma$ intensities and 28.0% *42* from comparison with $\beta^-$ in coincidence with 1077$\gamma$ (1972Sw01); 37% (1971Si19).

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**$^{68}$Cu $\beta^-$ decay (30.9 s) 1972Sw01,1975Ti01 (continued)**

$\beta^-$ radiations (continued)

@ Absolute intensity per 100 decays.
& Existence of this branch is questionable.

$\gamma(^{68}Zn)$

Iγ normalization: From Σ(Iγ+ce)(from $^{68m}$Cu IT decay to $^{68}$Cu g.s.)=100. With Iγ(525.9γ)=100, Iγ′s give 114.5 *18* decays which then undergo $\beta^-$ decay (30.9 s).
For additional unplaced γ′s, see $^{68}$Cu β decay (3.75 min).

| $E_\gamma$† | $I_\gamma$‡& | $E_i$(level) | $J^\pi_i$ | $E_f$ | $J^\pi_f$ | Mult.# | δ# | α | Comments |
|---|---|---|---|---|---|---|---|---|---|
| 577.8 *10* | 2.4 *7* | 1655.9 | 0+ | 1077.7 | 2+ | E2 | | 0.001277 *19* | α=0.001277 *19*; α(K)=0.001143 *17*; α(L)=0.0001164 *18*; α(M)=1.665×10$^{-5}$ *25* α(N+..)=6.52×10$^{-7}$ *10* |
| 736.9 *15* | 1.2 *3* | 3490.3 | | 2753.4 | 3− | | | | |
| 806.9 *10* | 0.8 *7* | 1884.3 | 2+ | 1077.7 | 2+ | M1+E2 | −1.55 *5* | 0.000469 *7* | α=0.000469 *7*; α(K)=0.000421 *7*; α(L)=4.23×10$^{-5}$ *7*; α(M)=6.06×10$^{-6}$ *9*; α(N+..)=2.42×10$^{-7}$ *4* |
| x869.6 *15* | | | | | | | | | |
| 1077.7 *5* | 70@ *4* | 1077.7 | 2+ | 0 | 0+ | E2 | | 0.000247 *4* | α=0.000247 *4*; α(K)=0.000221 *4*; α(L)=2.22×10$^{-5}$ *4*; α(M)=3.17×10$^{-6}$ *5*; α(N+..)=1.272×10$^{-7}$ *18* |
| 1261.8 *8* | 16.6@ *12* | 2339.5 | 2+ | 1077.7 | 2+ | M1+E2 | −0.18 *4* | 0.0001727 *25* | α=0.0001727 *25*; α(K)=0.0001418 *20*; α(L)=1.410×10$^{-5}$ *20*; α(M)=2.02×10$^{-6}$ *3* α(N+..)=8.19×10$^{-8}$ *12* |
| 1292.9 *15* | 0.4@ *2* | 2370.6 | | 1077.7 | 2+ | | | | |
| x1345.7 *15* | | | | | | | | | |
| 1432.8 *15* | 0.3@ *3* | 2510.5 | | 1077.7 | 2+ | | | | |
| x1438.1 *15* | | | | | | | | | |
| 1529.7 *15* | 1.0 *3* | 3186.7 | (1,2+) | 1655.9 | 0+ | | | | |
| 1675.7 *15* | 1.8@ *5* | 2753.4 | 3− | 1077.7 | 2+ | [E1] | | 0.000446 *7* | α=0.000446 *7*; α(K)=4.65×10$^{-5}$ *7*; α(L)=4.60×10$^{-6}$ *7*; α(M)=6.59×10$^{-7}$ *10*; α(N+..)=0.000395 *6* |
| 1743.7 *15* | 2.0@ *4* | 2821.4 | 2+ | 1077.7 | 2+ | M1+E2 | +0.27 *5* | 0.000241 *4* | α=0.000241 *4*; α(K)=7.71×10$^{-5}$ *11*; α(L)=7.64×10$^{-6}$ *11*; α(M)=1.095×10$^{-6}$ *16*; α(N+..)=0.0001550 |
| x1791.2 *15* | | | | | | | | | |
| 1883.8 *15* | 2.3 *11* | 1884.3 | 2+ | 0 | 0+ | (E2) | | 0.000333 *5* | α=0.000333 *5*; α(K)=6.96×10$^{-5}$ *10*; α(L)=6.91×10$^{-6}$ *10*; α(M)=9.90×10$^{-7}$ *14*; α(N+..)=0.000255 *4* |

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## $^{68}$Cu $\beta^-$ decay (30.9 s) 1972Sw01,1975Ti01 (continued)

### $\gamma(^{68}Zn)$ (continued)

| $E_\gamma$ † | $I_\gamma$ ‡& | $E_i$(level) | $J_i^\pi$ | $E_f$ | $J_f^\pi$ | Mult.# | $\alpha$ | Comments |
|---|---|---|---|---|---|---|---|---|
| 2110.1 *15* | 1.8 *5* | 3186.7 | (1,2$^+$) | 1077.7 | 2$^+$ | | | |
| 2339.5 *15* | 1.7@ *6* | 2339.5 | 2$^+$ | 0 | 0$^+$ | (E2) | 0.000529 *8* | $\alpha$=0.000529 *8*; $\alpha$(K)=4.71×10$^{-5}$ *7*; $\alpha$(L)=4.66×10$^{-6}$ *7*; $\alpha$(M)=6.68×10$^{-7}$ *10*; $\alpha$(N+..)=0.000477 *7* |

† From 1975Ti01. Transition with E$\gamma$=570.7 reported by 1972Sw01 is not confirmed by 1975Ti01 and is not adopted here.

‡ Weighted average of 1975Ti01 and 1972Sw01, relative to I$\gamma$(525.9$\gamma$)=100 in $^{68}$Cu IT decay. Taken or calculated from I$\gamma$′s observed in the equilibrium decay: $^{68}$Cu $\beta^-$ decay (30.9 s + 3.75 min) using branching fraction. Full separation of I$\gamma$′s associated with 30.9 s and 3.75 min $\beta^-$ decays was not possible with the data available. I$\gamma$′s are listed here for only those $\gamma$′s which decay with a composite 30.9-s and 3.75-min half-life.

# From the Adopted Gammas.

@ Intensity deduced by evaluator based on equilibrium decay intensities for $^{68}$Cu $\beta^-$ decay (30.9 s + 3.75 min), branching fraction and assumptions on feeding.

& For absolute intensity per 100 decays, multiply by 0.873 *14*.

$^x$ $\gamma$ ray not placed in level scheme.

**$^{68}$Cu $\beta^-$ decay (30.9 s) 1972Sw01,1975Ti01**

Decay Scheme

Intensities: $I_{(\gamma+ce)}$ per 100 parent decays