^{15}O – Comments on evaluation of decay data by V. Chisté and M. M. Bé

1) Decay Scheme

^{15}O disintegrates by β^+ emission (99,885 (6) %) and electron capture (0,115 (6) %) to the ground state of the stable nuclide ^{15}N.

2) Nuclear Data

The Q value has been calculated using the formula:

$$Q = E_{\beta+} + 2m_0c^2 = 2757,0\ (13)\ \text{keV}$$

where $E_{\beta+}$ = 1735,0 (13) keV is the weighted mean of the β^+ end–point energy (see **β^+ Transition and Electron Capture**) and, $2m_0c^2$ = 1021,9978 (42) keV (2000Codata). The Q value calculated here is in agreement with the value of 2754,0 (5) from the Audi and Wapstra evaluation (1995Au04), which takes into account only Raman’s value (1978Raman, 1731,9 (7) keV) to determine the recommended Q value.

The measured ^{15}O half–life values are, in seconds:

$T_{1/2}$

Reference	Value (s)
McMillan (1935Mc01)	126 (5)
Brown (1950Br29)	118,0 (6)
Kline (1954Kl36)	123,4 (13)
Bashkin(1955Ba83)	121 (3)
Kistner (1957Ki22)	122 (5)
Penning (1957Pe12)	123,95 (50)
Kistner (1959Ki99)	124,1 (5)
Janecke (1960Ja12)	122,1 (1)
Nelson (1963Ne05)	122,6 (10)
Csikai (1963Cs02)	125 (2)
Vasil’ev (1963Vasil’ev)	114 (12)
Azuelos (1977Az01)	122,23 (23)

The half–life weighted average has been calculated by the Lweight program (version 3).

The weighted average of all 12 values is 122,16 s with an internal uncertainty of 0,09 s and a reduced–χ^2 of 7,3.
The evaluator has chosen to reject the McMillan (1935Mc01) and Csikai (1963Cs02), because they are far from the other values and with large uncertainties.
The Brown (1950Br29) and Vasil’ev (1963Vasil’ev) values have been rejected by the Lweight program, based on the Chauvenet’s criterion. For the remaining 8 values, the largest contribution to the weighted average comes from the value of Janecke (1960Ja12), amounting to a statistical weight of 78 % (reduced χ^2 = 4,01). The program Lweight 3 has increased the uncertainty of the 1960Ja12 value from 0,1 to 0,186 in order to reduce its relative weight from 78 % to 50 %.

The adopted value is the weighted mean : *122,40 s*, with an uncertainty of *0,33 s;* or *2,041 (6) min*. The reduced–χ^2 is 3,2.

2.1) β^+ Transition and Electron capture

The β^+ and electron capture probabilities have been calculated taking into account a K/β^+ ratio of (1,07 ± 0,06).10^{-3} measured by Leiper (1972Le33) and, normalizing to a total probability ($P_{\beta+}$ + P_{EC}) of 100 %. The experimental K/β^+ ratio is close of its theoretical value (= 0,99 (1) 10^{-3}) calculated with the LOGFT program. The uncertainties were calculated through their propagation on the above formulas.

The value of log ft of the β^+ transition (3,6) has been calculated with the program LOGFT for an allowed transition, in agreement with the value suggested by Ajzenberg–Selove, which is 3,637 (1981Aj01, 1986Aj01 and 1991Aj01).

The partial sub shell capture probabilities were calculated with the program EC–Capture for an allowed transition.

The weighted mean of the β^+ end–point energy has been calculated (with the Lweight program, version 3) using the following measured values (in MeV):

Reference	Values (MeV)
Fowler (1936Fowler)	1,7 (2)
Stephens (1937Stephens)	1,56 (20)
Perez–Mendez (1949Perez), Brown (1950Br29)	1,683 (5)
Kington (1955Ki28)	1,735 (8)
Kistner (1957Ki22) (solid target)	1,723 (5)
Kistner (1957Ki22) (gaseous target)	1,736 (10)
Kistner (1959Ki99)	1,739 (2)
Raman (1978Raman)	1,7319 (7)

The values given by Fowler (1936Fowler), Stephens (1937Stephens), Perez–Mendez (1949Perez) and Kistner (1957Ki22 – solid target) were shown (by the Lweight program) to be statistically inconsistent with the other values (based on the Chauvenet's criterion), thus the evaluators rejected those 4 values. The largest contribution to the weighted average of the 4 remaining values comes from the value of Raman (1978Raman), amounting to a statistical weight of 88 % (reduced–χ^2 = 3,8). The program Lweight 3 has increased the uncertainty of the 1978Ra21 value from 0,0007 to 0,0019 in order to reduce its relative weight from 88 % to 50 %.
The adopted value is the weighted mean : *1735,0 keV*, with an external uncertainty of *1,3 keV* and a reduced–χ^2 of 2,2.

3) Gamma Emissions

The annihilation radiation emission probability (I_γ(511)), is $P_{\beta+}$, or 99,885 (6), multiplied by 2, without the correction factor for the annihilation–in–flight in the medium, that is I_γ(511) = 199,770 (12) %.

4) Atomic Data

Atomic value (ω_K) is from Bambynek (1984Bambynek).

5) References

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