^{18}F – Comments on evaluation of decay data by V. Chisté and M.M. Bé

1) Decay Scheme

^{18}F disintegrates by β^+ emission (96.86 (19) %) and electron capture (3.14 (19) %) to the ground state of the stable nuclide ^{18}O.

2) Nuclear Data

The Q value (1655.5 (6) keV) is from Audi and Wapstra (1995Au04), and has been calculated with the formula:

Q = $M(A,Z) - M(A,Z-1)$,
where M(A, Z) and M(A, Z - 1) are the measured atomic masses of ^{18}F and ^{18}O, respectively.

$E_{\beta+}$, calculated from this Q value ($E_{\beta+}$ = 633.5 (6) keV), is in agreement with a weighted average value of 633.2 (3) keV, which was deduced from measured values (see **β^+ Transition and Electron Capture Transition**).

The measured ^{18}F half-life values (in minutes) are given below:

Reference	Value (min)
Snell (1937Snell)	112 (4)
DuBridge (1938Br01)	107 (4)
Krishnan (1941Krishnan)	112 (2)
Huber (1943Hu02)	115 (4)
Blaser (1949Bl26)	112 (1)
Jarmie (1955Jarmie)	111 (1)
Bendel (1958Be74)	109.8 (12)
Markowitz (1958Ma68)	112 (1)
Carlson (1959Ca01)	109.70 (54)
Yule (1960Yu02)	110.2 (2)
Rayburn (1961Ra06)	111.0 (22)
Mahony (1962Mahony)	109.74 (21)
Beg (1963Be47)	109.6 (6)
Hofmann (1964Ho28)	110.5 (6)
Mahony (1964Mahony)	109.72 (6)
Ebrey (1965Eb01)	109.87 (12)
Bormann (1965Bo42)	111 (2)
Kavanagh (1969Kavanagh)	109.87 (12)
Hogstrom (1973Ho21)	95 (7)
Rutledge (1980RuZY)	109.71 (2)
Katoh (1989Katoh)	109.48 (8)
Schrader (2004Sc04)	109.748(21)

The only outliers values are 107 (4) min (1938Br01), 115 (4) min (1943Hu02) and 95 (7) min (1973Ho21), which contributed with a statistical weight of just 0.378 10^{-5} % (1973Ho21) to 0.116 10^{-4} % (1938Br01 and 1943Hu02) to the weighted average. Our recommended half-life is the weighted average of 109.728 (19) min, or 1.8288 (3) h (χ^2/ν = 1.98).

β^+ Transition and Electron capture transition

The β^+ and electron capture probabilities shown in Tables 2.1 and 2.2, respectively, have been deduced using a K/β^+ ratio of (3.00 ± 0.18) 10^{-2} measured by Drever (1956Dr38), P_K/P_{EC} = 0.9267 (48) (see Section 2.2) and normalizing to a total probability ($P_{\beta+}$ + P_{EC}) of 100 %. This leads to $P_{\beta+}$ = 96.86 (19) % and P_{EC} = 3.14 (19) %, respectively. The uncertainties were calculated through their propagation on the above formulas.

The experimental K/β^+ ratio of Drever is close to the theoretical values:
a) 3.19 10^{-2} calculated with LOGFT program;
e) 3.31 10^{-2} given by Fitzpatrick (1973Fitzpatrick);
f) 3.14 10^{-2} given by Bambynek (1977Ba48);

Using the LOGFT program evaluators calculated a lg ft of 3.57 for this allowed transition. This value agrees with 3.554 suggested by Ajzenberg-Selove (1972Aj02, 1978Aj03 and 1987Aj02).

The partial sub shell capture probabilities given in Section 2.2 were calculated using 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 keV):

Reference	Values (keV)
Blaser (1949Bl26)	635 (15)
Ruby (1951Ru24)	649 (9)
Hofmann (1964Ho09)	635 (2)
Alburger (1970Al11)	632.9 (7)
Fitzpatrick (1973Fitzpatrick)	633.3 (3)

The weighted average of these 5 values is 633.2 keV with an internal uncertainty of 0.3 keV and a reduced χ^2 of 1.4. This value is in agreement with $E_{\beta+}$ (633.5 (6) keV) deduced from the adopted Q value (1995Au04) in this evaluation.

3) Gamma-ray Emissions

The annihilation radiation emission intensity ($I_{\gamma 511}$) is $P_{\beta+}$ (= 96.86 (19) %), multiplied by 2, without the correction factor for the annihilation-in-flight process in the medium. That is, $I_{\gamma 511}$ = 193.72 (27) %.

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