^{95}Nb - Comments on evaluation of decay data by R. G. Helmer

1 Decay Scheme

There are 2 levels in ^{95}Mo below the decay energy in the Adopted Levels of the 93Bu08 evaluation that are not reported in this decay scheme; these are 786 ($1/2^+$) and 820 ($3/2^+$). The β^- decays to these levels will be negligible, so this scheme can be considered complete..

2 Nuclear Data

Q value is from Audi and Wapstra 1995 (95Au04).

The half-life values available are, in days:

38.7		45Po01,	omitted due to lack of uncertainty
35(1)		51EnZZ	
35.0	(5)	53Co	
35.0	(1)	61Wy01	
35.6	(4)	64WoZZ	
35.8	(5)	65Fl02	
35.0	(5)	65Si16	
35.10	(7)	68La10,	published σ has been divided by 3
35.15	(3)	68Re04	
35.045	(5)	69Me ,	replaced by 82RuZV
35.00	(3)	70MeZQ,	replaced by 82RuZV
34.97	(1)	76Ha51,	published σ has been divided by 3
34.979	(9)	80Ho17	
34.98	(2)	80RuZY,	replaced by 82RuZV
34.98	(2)	82RuZV	
34.997	(6)	97Ma75	
34.991	(6)		Adopted value, LRSW average with external uncertainty

These values are not consistent; the weighted average of the twelve values with uncertainties is 34.991 with an internal σ of 0.004, a reduced-χ^2 value of 3.87, and an external σ of 0.008. The largest contribution to the reduced-χ^2 is from the value of 68Re04. The Limited Relative Statistical Weight method increases the uncertainty for the 97Ma75 value from 0.0060 to 0.0062 in order to reduce its relative weight from 51.4% to 50%. The resulting weighted average is 34.991 with an internal σ of 0.0044, a reduced-χ^2 of 1.97, and an external σ of 0.006; the LRSW method then reports the unweighted average of 35.13 with the uncertainty expanded to 0.13. This evaluator has used the LRSW weighted average with the associated external uncertainty.

The RAJEVAL and Normalized Residual methods deal directly with the high value of 68Re04. The RAJEVAL method increases its uncertainty from 0.03 to 0.09 and the resulting average is 34.985(5), whereas the Normalized Residual method increases this uncertainty to 0.06 and yields a result of 34.988(6). These values are within the range of the adopted value.

2.1 b$^-$ Transitions

The decays from the $9/2^+$ parent to the levels at 0 ($5/2^+$), 204 ($3/2^+$), and 765 keV ($7/2^+$) are 2nd forbidden, unique 2nd forbidden, and allowed, respectively. The measured $I_\beta(0)$ of 0.030(5)% of 74An22 gives log *ft* = 11.2 which is in agreement with the log *ft* systematics (73Ra10) for a 2nd forbidden decay. From these log *ft* systematics, one expects the log *ft* value for decay to the 204 level to be ≥ 12.8 which corresponds to $I_\beta(204)$

≤ 0.002%, although the intensity balance gives a higher value, namely 0.014(9)%. See sect. 4.2 for comments on this discrepancy.

For the unpopulated levels at 786 and 820 keV, the β decays are 4th forbidden and unique 2nd forbidden, respectively, with expected log *ft* values of ≥ 22 and ≥ 12.8. The corresponding I_β are expected to be ≤ 1.10^{-15}% and ≤ 1.10^{-8}%, respectively.

2.2 Gamma Transitions

The multipolarities are from the Adopted γ data in the Nuclear Data Sheets (93Bu08).

3 Atomic Data

The data are from Schönfeld and Janßen.

3.1 X Radiation and 3.2 Auger Electrons

The data were computed by the EMISSION program from Schönfeld.

4 Radiation Emissions

4.1 Electron Emissions

Data were computed by LOGFT and from quoted γ-ray emission probabilities and internal-conversion coefficients.

4.2 Photon Emissions

The γ-ray energies are (1) from the 93Bu08 evaluation and based on ^{95}Tc ε decay for 204-keV γ-ray, (2) from 76Ho04 and based on ^{95}Nb (86 h) β^- decay for 561 γ, and (3) from 97HeZZ for 765 γ. These three energy values are not statistically consistent with the cascade-crossover relationship of the decay scheme; $E_\gamma(765) - E_\gamma(561) - E_\gamma(204) = -0.19(2)$ keV.
For the relative γ-ray emission probabilities, the following data were used.

	Relative γ-ray emission probability			
γ energy (keV) =	204	561	765	
Method				Reference
direct I_γ measurement		0.015 (1)	100.0	76Ho04
direct I_γ measurement		0.016 (6)	100.0 (2)	77Me12
from I_K and α_K	0.028 (8)	0.011 (3)	100	74An22
Adopted	0.028 (8)	0.015 (3)	100	

The values of 74An22 were computed from the measurement of the relative intensities of the K-internal-conversion electron lines and the theoretical K-conversion coefficients; namely, I_K = 1.0(3): 0.025(5): and 100, respectively, and α_K = 0.046(2), 0.0029(2), and 0.00128(3). These α_K are from 74An22, but are not significantly different than those adopted here.

With these values, the intensity balance at the 204-keV level gives $I_\beta(204)$ = 0.014(9)% which is much higher than the ≤ 0.002% from log *ft* systematics. So, it is suggested that the electron data for the 204 γ are in error.

These relative emission probabilities were normalized by setting

$P_\gamma(765) = \{100.000 - I_\beta(0) - I_\beta(204) - I_\gamma(561)[1.0+\alpha(561)]\} / [1.0 - \alpha(765)] = 99.955 / 1.0147$

$= 99.808$ (7) where $I_\beta(204)$ has been taken as ≤ 0.002.

If one uses $I_\beta(204) = 0.014\%$ from the intensity balance, one obtains the value 99.794(11).

6. References

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