^{41}Ar - Comments on evaluation of decay data
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This evaluation was completed in February 2010. Literature by February 2010 was included.

1 Decay Scheme

^{41}Ar disintegrates 100 % by beta minus emissions to excited levels and to the ground state of ^{41}K.

A good agreement was found between the effective Q value (2492 (7) keV) calculated from the decay scheme data and the adopted and recommended value from the mass adjustment of Audi (2003Au03).

2 Nuclear Data

The Q value is from the atomic mass evaluation Audi and Wapstra (2003Au03).

Spin and parities are from evaluation of P. M. Endt (1990En08).

Level energies and half-life for the 1293-keV excited level are from the mass-chain evaluation of J. A. Cameron and B. Singh (2001Ca59).

Experimental ^{41}Ar half-life values (in min) are given in Table 1:

Table 1: Experimental values of ^{41}Ar half-life.

Reference	Experimental value (min)	Comments
A. H. Snell (1936Sn01)	110 (1)	
E. Bleuler (1946Bl28)	109.4 (10)	
H. Brown (1950Br29)	107 (3)	Outlier.
W. Hälg (1951Ha78)	109.6 (4)	
A. Schwarzschild (1956Sc91)	111 (1)	Outlier.
H. Paul (1964Pa03)	109.8 (12)	
M. Bormann (1969Bo11)	103.5 (24)	Outlier.
F. Jundt (1971Ju04)	109 (2)	
A. R. Rutledge (1986Ru09)	109.32 (12)	
A. Abzouzi (1990Ab06)	109.640 (38)	
Recommended value	109.611 (38)	$\chi^2 = 1.13$

The values of H. Brown (1950Br29), Schwarzschild (1956Sc91) and Bormann (1969Bo11) have been shown to be outliers, based on the Chauvenet's criterion and thus were omitted in the final calculation. With the 7 remaining values (1936Sn01, 1946Bl28, 1951Ha78, 1964Pa03, 1971Ju04, 1986Ru09 and 1990Ab06), a weighted average was calculated using the LWEIGHT computer code (version 3). The largest contribution to the weighted average comes from the value of Abzouzi (1990Ab06), amounting to 89 %.

The adopted value is the weighted average of 109.611 min with an external uncertainty of 0.038 min. The reduced-χ^2 value is 1.13.

2.1 β- Transitions

The maximum energies of the β^- transitions in the decay of ^{41}Ar → ^{41}K have been obtained from the Q^- value (2003Au03) and the level energies given in Table 2 from J. A. Cameron (2001Ca59).

Table 2: ^{41}K levels populated in the decay of ^{41}Ar.

Level Number	Level energy (keV)	Spin and parity	Half-life
0	0	$3/2^+$	
1	1293.64 (4)	$7/2^-$	6.7 (5) ns
2	1677.0 (3)	$7/2^+$	

The transition probability of the β transition to the ground state of ^{41}K has been reported as (Table 3):

Table 3: Experimental values of β transition probability to the ground state of ^{41}K.

Reference	Experimental value (%)	Comments
A. Schwarzschild (1956Sc91)	0.88	Not used: no uncertainty.
G. R. Kartashov (1961Ka19)	0.78 (2)	
H. Paul (1964Pa03)	0.82 (6)	
Recommended value	0.784 (19)	$\chi^2 = 0.4$

The adopted probability value of the β transition to the ground state is the weighted average of 0.784 % with an internal uncertainty of 0.019 %. The reduced-χ^2 value is 0.4.

For the 1293- and 1677-keV levels, the adopted β^- transition probabilities and the associated uncertainties were deduced from the γ transition probability balance at each level of the decay scheme (see **4.2 γ Emissions**).

The values of log ft and average β^- energies have been calculated with the program LOGFT for the allowed, unique 1st forbidden and 1st forbidden β^- transitions.

2.2 γ Transitions

The transitions probabilities were calculated using the γ-ray emission intensities and the relevant internal conversion coefficients (see **4.2 Gamma Emissions**).

Multipolarity and mixing ratio of 1293-keV γ-ray transition are from H. H. Eggenhuisen (1978Eg01):
1293-keV γ-ray: M2 + E3, with $\delta = 0.118$ (12)

The internal conversion coefficients (ICC's) for this γ-ray transition have been interpolated from theoretical values of I. M. Band (2002Ba85) using the BrIcc computer program (calculation for 'hole') (2008Ki07). The α_T theoretical value is compared with a measured value in Table 4. They are in agreement within the uncertainty limits.

Table 4: Experimental and recommended (calculated) values internal conversion coefficients.

	α_T (1293-keV)
G. R. Kartashov (1961Ka19)	6.8 (9) 10^{-5}
BrIcc program (recommended values)	7.44 (11) 10^{-5}

The internal pair formation coefficient α_π(1293 keV) is 4.92 (7) 10^{-6} (given by BrIcc computer program).
So α_T, using to calculate the 1293-keV transition probability, is

$$\alpha_T = 4.92\ (7)\ 10^{-6} + 7.44\ (11)\ 10^{-5} = 7.93\ (11)\ 10^{-5}$$

3 Atomic Data

Atomic values, ω_K, n_{KL} and the X-ray relative probabilities are from Schönfeld and Janβen (1996Sc06).

4 Emissions

4.1 K x-rays

The X-ray absolute intensities were deduced from the decay data using the EMISSION computer code.

4.2 Photon emissions

The energies of the γ-rays given in section 5.2 are from J. A. Cameron (2001Ca59).

The experimental relative γ-ray emission intensities in ^{41}K have been obtained from all the available relative and absolute values.

The normalization factor to convert the relative emission intensities to absolute emission intensities is calculated using the formula:

$$N = \left(\frac{100 - P_\beta(0,0)}{(\sum(1 + \alpha_T)P_{rel})} \right) = \frac{100 - 0.784(19)}{(\Sigma(1+\alpha_T)P_{rel})} = 0.99157\ (20),$$

where the sum is over all the γ transitions to the ground state (1293- and 1677-keV) and α_T is the relevant coefficient. The uncertainty was calculated through the propagation on the formula given above.

The experimental γ-ray emission probabilities relative to 100 for the 1293-keV γ-ray are given in Table 5.

Table 5: Experimental data sets of the relative γ-ray emission intensities (%)

Reference / Energy (keV)	1293.64 (4)	1677.0 (3)
W. W. Pratt (1965Pr05)	100	5 (2) 10^{-2}
F. Jundt (1971Ju04)	100	5.2 (5) 10^{-2}
Evaluated value	100	5.19 (49) 10^{-2}
χ^2		0.0094

The adopted values are the weighted means calculated by the LWEIGHT program (version 3).

The adopted relative and absolute γ-ray emission probabilities are given in Table 6.

Table 6: Recommended relative and absolute γ-ray intensities (%).

Eγ (keV)	**Relative γ-ray intensity (%)**	**Absolute γ-ray intensity (%)**
1293.64 (4)	100	99.157 (20)
1677.0 (3)	5.19 (49) 10^{-2}	5.15 (49) 10^{-2}

6 References

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