^{52}Fe – Comments on evaluation of decay data
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This evaluation was completed in October 2013. Includes all literature published before this date.

Decay Scheme

^{52}Fe decays 100 % by electron capture and β^+ to excited levels of ^{52}Mn. The isomer ^{52m}Mn is created within this decay chain (excitation energy of 377.7 keV, and half-life of 21.1 (2) min). The half-life of ^{52m}Mn was adopted from the evaluation of Huo *et al.* (2007), which is based on the experimental value of Juliano *et al.* (1959); another experimental half-life value is 21 (1) min, Katoh *et al.*, 1960.

Q_{EC} value for ^{52}Fe decay of 2375 (6) keV was adopted from Wang *et al.* (2012Wa38).

The spins, parities and level energies are adopted from the most recent mass-chain evaluation published for A=52 (2007Hu08). There is no information available about the spin and parity of the 1417.7-keV energy level of ^{52}Mn.

Half-life

Experimental half-lives used to calculate the recommended value are listed in the following table:

Reference	**$T_{1/2}$ (h)**	**uc (h)**	**Comments**
1959Ju40	8.2	0.1	
1967Pa22	8.23	0.04	
1974Ro18	8.275	0.008	
Crit (χ^2)	4.6		
χ^2	0.88		
UWM	8.235	0.022	
LWM	8.273		
uc(WM)int. :	0.008		
uc(WM)ext. :	0.007		
Adopted:	**8.273**	**0.008**	

Although the half-life value measured by Saha and Farrer (1971Sa21) of 8.2 h was reported without any uncertainty, the evaluator has estimated an uncertainty of ± 0.2 h based on the reported counting statistics. However, because of a lack of information on the systematic uncertainty of the reported half-life, this particular measurement was not taken into account in the present evaluation. A half-life value given by Miller *et al.* (1948Mi12) of 7.8 hours was also set aside because the authors did not report the uncertainty, and an estimate could not be made from the published information.

The adopted data set is consistent and the recommended half-life is the weighted mean of the three listed values (LWM analysis, according to LWEIGHT4 computer program, version for MS Excel), with an uncertainty which is the maximum of the internal and external uncertainties.

Electron Capture and β^+ Transitions

All electron capture (EC) and β^+ energies were derived from the nuclear level energies and the Q value.

Shell and sub-shells capture probabilities were calculated by means of the EC-Capture program (1998Sc28).

The ground state of ^{52}Mn is only populated through the gamma-ray isomeric transition of 377.7 keV. There are two electron capture transitions feeding the excited states of 1417.7 and 546.4 keV, and only one β^+ transition with an energy of 807 (6) keV in competition with the electron capture process. This energy is in good agreement with the experimental value measured by Arbman and Svartholm (1956) of 0.804 (10) MeV.

The probabilities of the two electron capture transitions (from the ground state of ^{52}Fe to the 2nd and 3rd excited states of ^{52}Mn) and the allowed β^+ transition (from the ground state of ^{52}Fe to the 2nd excited state of ^{52}Mn) were calculated from the decay scheme balance and the theoretical ratio (EC/β^+) computed by the LOG FT program from the theoretical tables of Gove *et al.* (1971Go40). This theoretical ratio was 0.780 (21), in agreement with the experimental value of 0.770 from 1959Ju40. The total (EC + β^+) transition probability to the excited state of 546.4 keV (^{52}Mn) is 99.9 (15) %. The LOG FT program was also used to calculate the log ft values for the EC and β^+ transitions.

The resulting 511-keV photon emission intensity is 112.2 (14) %.

Relative gamma emission probabilities, P_γ

Only one measurement of the gamma-ray energies and relative emission probabilities was found in the literature: Yaffe and Meyer (1977), 1977Ya08. Another measurement made by McIsaac and Gehrke (1972) gives a relative intensity of 3 (1) for the gamma emission with an energy of 355.6 (2) keV (intensity was 100 for the 168.77 (2) keV photons), and was not considered in the evaluation. The 377.749-keV gamma ray is the IT-decay process of Mn-52m directly to the ground state of Mn-52.

			Yaffe and Meyer (1977)	
(i,f)	**E_γ**	**ΔE_γ(uc)**	**P_γ**	**ΔP_γ(uc)**
(2,1)	**168.689**	0.008	1032	20
(1,0)	**377.749**	0.005	17.09	0.15
(3,1)	**1039.928**	0.019	0.99	0.04

A reference intensity of 1000 was adopted for the emission probability of the 1434.06 (1) keV gamma ray (this gamma transition follows the ^{52m}Mn electron capture and β^+ transitions populating the nuclear levels of ^{52}Cr).

Internal conversion coefficients

The adopted ICC are the theoretical values calculated by the BrIcc program (2008Ki07).
The gamma-ray transitions are [M1] (168.7 keV) and E4 (377.7 keV).

Normalization Factor

100 % of the transitions (β^+, EC, γ - with the exception of the isomeric transition) in the decay of ^{52}Fe populate the first excited (isomeric) state of the ^{52m}Mn daughter at 377.7 keV:

$$[P_{\gamma 168} \cdot (1+\alpha_{T168})] + [P_{\gamma 1039} \cdot (1+\alpha_{T1039})] = \frac{100}{N}$$

where $P_{\gamma 168}$ and $P_{\gamma 1039}$ are the relative emission probabilities of the 168.6-keV and 1039.9-keV gamma-rays, respectively, α_{T168} and α_{T1039} are the total internal conversion coefficients of the two transitions, and N is the normalization factor between the relative and absolute γ-ray probabilities.

A normalization factor (*N)* of 0.0961 (19) was deduced from the above. Using this factor and the relative γ probabilities adopted above, the absolute γ-ray emission probabilities were calculated.

Atomic Data

The fluorescence yield data, the relative K X-ray emission probabilities, the ratios P(KLX)/P(KLL) and P(KXY)/P(KLL) were taken from Schönfeld *et al.* (1996Sc06).

The Auger electron and X-ray absolute probabilities were calculated by the EMISSION program (2000Sc47) from the related decay data (γ emission probabilities, ICC, P_{EC} probabilities, etc.) as determined above.

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