^{54}Mn - Comments on evaluation of decay data by R. G. Helmer and E. Schönfeld

1 Decay scheme

The decay scheme is complete since the only level in ^{54}Cr below the decay energy is populated in this decay. The β^- decay to ^{54}Fe is negligible.

The J^{π} and half-life of the excited level are from the 1993Hu04 evaluation.

2 Nuclear Data

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

The half-life data, in days, are as follows:

291 (1)	1955Ba10	omitted from analysis
290 (6)	1956Ka33	omitted from analysis
278 (5)	1956Sc87	omitted from analysis
313.5 (7)	1961Wy01	
300	1964Be26	omitted from analysis
303 (1)	1964Ma14	omitted from analysis
311.9 (2)	1965An07	
311.9 (2)	1965An07	
312.6 (4)	1965An07	
314	1965Sa09	omitted from analysis
312 (5)	1968Ha47	
312.2 (3)	1968La10	quoted σ of 0.9 divided by 3
312.99 (5)	1968Zi01	quoted σ of 0.10 divided by 2, omitted from analysis
312.2 (9)	1969BoZX	
312.16 (11)	1973MeYE	superseded by 1982RuZV
315.40 (3)	1973Vi13	omitted from analysis
312.6 (8)	1974Cr05	
312.21 (5)	1979MeZY	superseded by 1980RuZY
312.21 (3)	1980RuZY	superseded by 1982RuZV
312.02 (4)	1982HoZJ	superseded by 1992Un01
312.21 (3)	1982RuZV	
312.19 (13)	1982RyZX	
312.15 (23)	1982RyZX	
312.028 (34)	1992Un01	
312.11 (5)	1997Ma75	
312.13 (3)	**Adopted value**	

The three values from before 1960 were omitted because it would have been difficult to determine the presence of impurities in the samples with the spectrometry methods available then. The two values without uncertainties were omitted. The quoted uncertainty for the value of 1968La10 was divided by 3 to convert it to a 1σ value. The values of 1964Ma14, 1968Zi01, and 1973Vi13 were omitted since they are outliers; with the latter two both included the reduced-χ^2 is 21.7 and with only 1968Zi01 included, it is 7.4.

Adopted value of 312.13 (3) is from the Limitation of Relative Statistical Weight analysis (1985ZiZY, 1992Ra08) of the 13 remaining values. For this fit, the internal uncertainty is 0.020, the reduced-χ^2 =2.06, and the external uncertainty is 0.029. In this analysis, the three values from 1992Un01, 1982RuZV, and 1997Ma75 contribute 94% of the relative weight, and the latter two which are from the same laboratory contribute 60% of the relative weight.

2.1 and 2.2 Electron-Capture and b$^+$ Transitions

The unique 2nd forbidden ε+β^+ transition to the ^{54}Cr ground state has not been observed, but an upper limit can be determined from the log *ft* systematics (1998Si17) as well as from searches for the positrons. From these log *ft* systematics, log $f_{2u}t$ > 13.9 which corresponds to ε+β^+ branch of < 0.0007%. The experimental limits on the β^+ intensity come from searches for the 511-keV annihilation radiation. These limits are ≤ 8x10^{-5}% (1968Be01), ≤ 4.4x10^{-6}% (1989Su08), and ≤ 5.7×10^{-7}% (1993Da20). From the latter value and the theoretical ε/β^+ ratio of 638(11), one has a capture probability of ≤ 0.0004%. Since this limit is lower than that from the log *ft* systematics, it is adopted.

The P_K etc. values for the branch to the 834-keV level from the LOGFT and EC-CAPTURE codes agree quite well, namely

	P_K	P_L	P_M
LOGFT	0.8895	0.0942	0.0163
EC-CAPTURE	0.8895 (17)	0.0950 (15)	0.0150 (16)

The EC-CAPTURE values have been adopted.

2.3 b$^-$ Transitions

This unique 2nd forbidden β^- transition to the ^{54}Fe ground state has not been observed. A limit on its probability can be calculated from the log *ft* systematics (1998Si17) which give log $f_{2u}t$ ≥ 13.9 and this corresponds to I(β^-) ≤ 0.0005%.

From cosmic-ray data and a model of galatic transport of cosmic rays, 1996Du15 deduce the partial half-life for β^- decay to be between 1×10^6 and 2×10^6 years, which corresponds to a β^- branch intensity between 0.00004% and 0.00009%.

2.4 Gamma Transitions and Internal-Conversion Coefficients

The α and α_K are from the analysis of the experimental data in 1985HaZA and, are based only on the data of 1966Ha07. The corresponding theoretical values interpolated from the tables of 1976Ba63 are 0.000252(8) and 0.000224(7) were α has been computed as $\alpha_K + 1.33 \times \alpha_L$.

3, 3.1 and 3.2 Atomic Data

Data are from 1996Sc06.

4.1 Electron Emissions

The data are deduced from the γ-ray probabilities and atomic data in sec. 2.1, 2.2, and 3.

A comparison of these intensities with those from the RADLIST code for this decay scheme is:

	Radlist	EMISSION
L Auger	143.3 (4)	143.0 (6)
K Auger	63.21 (12)	63.3 (5)
K-834	0.0224 (13)	0.0224 (11)
L-834	0.002199	0.00220 (13)

4.2 Photon Emissions

The energy is from the 2000He14 evaluation.

The γ-ray emission probability is computed as $I_{\varepsilon}(834) / [1.0 + \alpha(834)]$ = 99.9997(3) / 1.000251(11) = 99.9746(11). The dominant component in the final uncertainty is from the uncertainty in α.

A comparison of the computed X-ray emission probabilities is:

	RADLST	EMISSION
$K_{\alpha2}$	7.659 (15)	7.66 (13)
$K_{\alpha1}$	15.04 (3)	15.0 (3)
K_{β}	3.056 (6)	3.05 (6)
K	25.76 (3)	25.7 (3)

And, the measured Cr K X ray emission probabilities include:

25.7 (4)	1963Ta19
24.3 (12)	1965Le21
25.14 (17)	1967Ba50
24.90 (53)	1967PeZZ
24.92 (17)	1968Ha47
24.4 (3)	1973KoAA
24.7 (9)	1973MuAA
25.93 (14)	1978Ma06
25.1 (7)	1980Co22

which are slightly lower than the calculated values, but generally are within the uncertainties.

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