^{225}Ac - Comments on evaluation of the decay data

X. Mougeot

Université Paris-Saclay, CEA, List, Laboratoire National Henri Becquerel (LNE-LNHB), 91120 Palaiseau, France

This evaluation is an update of a former evaluation done in 2009, which Comments are given on the next pages. Literature by November 2023 only brings new information on ^{225}Ac half-life.

1 Nuclear data

The latest recommended value from the Atomic Mass Evaluation (AME) 2020 [2021WA16] is unchanged: Q_α = 5935.1 (14) keV. Excited levels (energies, half-lives) have been kept, as well as branching ratios of α transitions and γ-ray transition and emission intensities. Half-life of ^{221}Fr decay is from NUBASE 2020 [2021KO07].

The ALPHAD_RadD computer code [2020SI16] has been applied on the α transitions to determine their hindrance factors.

To ensure data consistency, the γ-ray transition and emission energies have been updated from the level energies. Conversion coefficients and conversion electron emissions have been recalculated with the BrIcc code [2008KI07].

Half-life

Former evaluation of the half-life was based on two available measurements, only the most recent from 1950 having an uncertainty. Since then, five new values have been published with uncertainties at least 15 times better. The measurements performed in these publications are given in Table 1.

It is first noteworthy that all these measurements are fully consistent. The dataset of the final published values is consistent (χ^2 = 1.06 vs critical-χ^2 = 3.32) and the weighted average with internal uncertainty is $T_{1/2}$ = 9.9161 (15) d. However, these measurements are not of the same quality and a consolidated dataset has been established, given in Table 2.

In [2012PO14], the authors state that they might have overestimated the detection system stability, but they did not account for possible correlations between their measurements. The weighted mean with minimum experimental uncertainty has thus been considered.

In [2013BO], the claimed uncertainty seems too low compared to the four other results, all from metrology institutes. Their measurement was performed during only two half-lives, and no more than statistical uncertainty component was considered. The uncertainty has thus been expanded to the highest uncertainty from the metrology institutes results.

In [2020KO06], the liquid scintillation method was applied considering either the double or the triple coincidences. As the half-lives determined from these two methods are highly correlated, an unweighted average was considered to establish a value from liquid scintillation. However, the uncertainty of 0.003 d given with this value is not consistent with the detailed assessment given in their Table 2. Recalculation leads to 9.9181 (35) d. The weighted average with their ionization

chamber result has then been considered, with the minimum experimental uncertainty.

In [2024GA01], the authors considered the weighted average of their measurement, while the two results from liquid scintillation counting are highly correlated. As the values are identical, a single result with minimum experimental uncertainty has been kept. Its weighted average with the ionization chamber result has then been considered.

The consolidated dataset in Table 2 is consistent (χ^2 = 0.43 vs critical-χ^2 = 3.32), and the five values are from independent studies. Internal uncertainty of the weighted average is 0.0021 d, while external is 0.0014 d. The recommended half-life of ^{225}Ac decay is **$T_{1/2}$ = 9.9172 (21) d**.

Table 1 – Measured half-life values of ^{225}Ac as reported, in days.

References	$T_{1/2}$ (d)	Measurement method	Duration
2012PO14	9.9200 (36)	Defined solid-angle counter	14 $T_{1/2}$
	9.923 (13)	Windowless CsI spectrometer	12 $T_{1/2}$
	9.923 (25)	NaI(Tl) well detector	12 $T_{1/2}$
	9.920 (8)	Large proportional counter	14 $T_{1/2}$
	9.920 (22)	HPGe γ-ray detector	12 $T_{1/2}$
	9.917 (11)	$2\pi\alpha$ counter	6 $T_{1/2}$
	9.920 (3)	Final, weighted mean	
2013BO	9.912 (3)	Scintillation β-ray spectrometer	2 $T_{1/2}$
2020KO06	9.9180 (30)	Liquid Scintillation (TDCR)	11 $T_{1/2}$
	9.9176 (54)	Ionization chamber	10 $T_{1/2}$
	9.9179 (30)	Final, weighted mean	
2023BR08	9.9150 (63)	Liquid Scintillation (TDCR)	5 $T_{1/2}$
2024GA01	9.913 (8)	Ionization chamber	9 $T_{1/2}$
	9.914 (6)	Liquid Scintillation (TDCR D)	3 $T_{1/2}$
	9.914 (7)	Liquid Scintillation (TDCR T)	3 $T_{1/2}$
	9.914 (4)	Final, weighted mean	

Table 2 – Consolidated dataset of experimental ^{225}Ac half-lives, in days.

References	$T_{1/2}$ (d)	Comments
2012PO14	9.9200 (36)	Minimum measured uncertainty
2013BO	9.9120 (63)	Expanded uncertainty
2020KO06	9.9180 (35)	Minimum measured uncertainty
2023BR08	9.9150 (63)	
2024GA01	9.914 (6)	Minimum measured uncertainty
Recommended	**9.9172 (21)**	Weighted mean, internal uncertainty

2 Atomic data

The fluorescence yield data, the relative K X-ray emission probabilities and the ratios P(KLX)/P(KLL) and P(KXY)/P(KLL) have been taken from Schönfeld et al. [1996SC06].

The Auger electron and X-ray absolute probabilities have been determined with the EMISSION program [2000SC47] from the related decay data.

3 Consistency

Consistency of the recommended data has been checked by calculating with Saisinuc [2008DUZX] the total average emission energy per decay for all emissions involved in the ^{225}Ac decay process. The large uncertainty of 200 keV on this quantity is mainly due to the uncertainties on the dominant α branching ratios, which remain unchanged. In the former evaluation, this average energy was of 5930.3 keV, in good agreement with the Q-value. In the present update, the average energy is of 5931.7 keV, a slight improvement that reduces the difference with the Q-value from 4.8 keV to 3.4 keV.

4 References

1996SC06 E. Schönfeld, H. Janssen, Nucl. Instrum. Methods Phys. Res. A369, 527 (1996) [Atomic data]

2000SC47 E. Schönfeld, H. Janssen, Appl. Radiat. Isot. 52, 595 (2000) [P(X), P(Ae)]

2008DUZX C. Dulieu, M.-M. Bé, V. Chisté, Proc. Intern. Conf. Nuclear Data for Science and Technology p.97 (2008) [Saisinuc]

2008KI07 T. Kibédi et al., Nucl. Instrum. Methods Phys. Res. A589, 202 (2008) [Theoretical ICC]

2012PO14 S. Pommé et al., Appl. Radiat. Isot. 70, 2608 (2012) [Half-life]

2013BO A.S. Bolonkin, A.V. Dunin, Radiochemistry 55 (3), 257 (2013) [Half-life]

2020KO06 K. Kossert, M.P. Takács, O. Nähle, Appl. Radiat. Isot. 156, 109020 (2020) [Half-life]

2020SI16 S. Singh, S. Kumar, B. Singh, A.K. Jain, Nucl. Data Sheets 167 (2020) 1-35 [Hindrance factors]

2021KO07 F.G. Kondev, M. Wang, W.J. Huang, S. Naimi, G. Audi, Chin. Phys. C 45, 030001 (2021) [Half-life]

2021WA16 M. Wang, Chin. Phys. C 45 (2021), 030003 [Q-value]

2023BR08 R. Broda et al., Appl. Radiat. Isot. 201, 110987 (2023) [Half-life]

2024GA01 R. Galea, K. Moore, Appl. Radiat. Isot. 203, 111105 (2023) [Half-life]

^{225}Ac - Comments on evaluation of the decay data

Huang Xiaolong, Wang Baosong

China Institute of Atomic Energy, China Nuclear Data Center, P.O. Box 275(41), Beijing 102413, China

This evaluation was completed in 2008. Literature available by December 2008 was included.

1 Decay Scheme

^{225}Ac disintegrates 100 % by α emission to levels in ^{221}Fr. ^{225}Ac ground state has $J^{\pi}=(3/2^{-})$ (1990Ak03).

The ^{225}Ac α decay scheme was built from the experimental conversion-electron data of 1971DzZP, 1972Dz14 and 2000Ar23, the α-γ coincidence data of 2003Ku44, the γ-γ coincidence data of 1990Ko14, and the experimental singles γ-rays data of 2000Ar23 and 2003Ku44.

The recommended Q(α) value of 5935.1 (14) keV in Audi (2003Au03) agrees with the Q(α) value of 5932.5 (16) keV, calculated by the evaluator (using program RADLST) from average radiation energies. This agreement supports the completeness and correctness of the decay scheme.

2 Nuclear Data

The Q value is from the mass adjustment in 2003Au03.

Level energies have been obtained from a least-squares fit to γ-ray energies (GTOL computer code). Spin and parities are from 1990Ak03, 2000Ar23 and 2003Ku44.

The measured and recommended ^{225}Ac half-life values are listed in Table 1.

Table 1: Measured half-life values of ^{225}Ac and recommended value, in days.

$T_{1/2}$ (d)	References	Measurement method
10	1947En03	
10.0 (1)	1950Ha52	Alpha pulse analyzer, 10 $T_{1/2}$
10.0 (1)	Recommended value	From 1950Ha52

The recommended value is taken from the measurement of 1950Ha52. Further measurements are merited to determine this value with greater confidence.

2.1 γ Transitions

The γ-ray transition probabilities were calculated using the γ-ray emission intensities and the relevant internal conversion coefficients.

Multipolarities and mixing ratios of γ-ray transitions are from 1971DzZP, 1972Dz14, 1977Vy02, 1990ArZZ and 2003Ku44. The multipolarity marked in square brackets for other γ transition are from the level scheme (they are not measured).

The internal conversion coefficients (ICC) and their associated uncertainties for γ-ray transitions have been obtained using the BrIcc computer program (2008Ki07), which uses the “Frozen Orbital” approximation (2002Ba85). Experimental and theoretical conversion coefficients are compared in Table 2.

Table 2: Comparison of theoretical and measured conversion coefficients.

E_γ (keV)	Multipolarity	α(theory)	α(exp.)
			(2003Ku44)
78.8	M1	α_T = 5.63, α_L = 4.27	α_T = 5.1 (11)
87.41	M1	α_T = 4.16, α_L = 3.16	α_T = 2.8 (6)
114	M1	α_T = 9.86, α_L = 7.93	α_T = 13.0 (17)
139.6	M1+E2	α_T = 3.9, α_K = 2.4	α_T = 3.2 (5)
145.16	(E1)	α_T = 0.191	$\alpha_T \leq$ 0.1
153.92	E1	α_T = 0.166	$\alpha_T \leq$ 0.35
197.5	E1	α_T = 0.0908	$\alpha_T \leq$ 0.04

2.2 α Transitions

The level energies of ^{221}Fr are determined from the least-squares fit to the recommended γ-ray energies. The level energies of ^{221}Fr and Q-values (2003Au03) were used to determine the energies and uncertainties of the alpha particle transitions to the various levels.

The recommended energies of alpha particles were calculated from the proposed decay scheme and listed in table 3. The recommended values are in good agreement with the measurements of 1967Dz02. Other measurements are 1964Gr11, 1967Ba51, and 1972Go29.

Table 3: Measured and recommended value of α-particle energy for ^{225}Ac (keV).

1964Gr11	1967Ba51[a]	1967Dz02[b]	1972Go29	1991Ry01	Recommended
5829 (5)	5829 (2)	5829 (2)		5829.6 (14)	5829.6 (14)
	5804 (2)				5804.2 (14)
5792 (5)	5793 (3)	5792 (3)	5792.5 (22)	5793.1 (21)	5793.1 (21)
	5791 (4)		5790.6 (22)		5791.7 (14)
5732 (5)	5731 (2)	5731 (3)		5731.9 (17)	5731.9 (17)
					5731.6 (14)
					5730.5 (14)
5724 (5)	5722.6 (25)	5723 (3)			5723.1 (14)
					5686.4 (14)
5683 (5)	5681 (2)	5681 (3)			5682.2 (14)
5638 (5)	5636.2 (20)	5637 (3)			5637.3 (14)
5610 (5)	5607.6 (30)	5608 (3)			5609.0 (14)
	5597.5 (40)				5599.3 (14)
5581 (5)	5579.1 (30)	5577 (3)			5580.5 (14)
	5561.6 (40)				5563.3 (14)
	5552.6 (40)				5555.3 (14)
	5544.1 (40)				5546.5 (14)
	5538.5 (40)	5540 (5)			5540.1 (14)
	5521.5 (70)	5526 (5)			5523.7 (14)
	5514.5 (7)	(5519)			5515.2 (14)
5494 (10)		5497 (4)			5497.4 (14)
		5489 (4)			5487.4 (14)
		(5468)			5468.4 (14)
5448 (10)	5441.1 (40)	5444 (3)			5443.3 (14)
	5433.5 (40)	5437 (4)			5435.8 (14)

1964Gr11	1967Ba51[a]	1967Dz02[b]	1972Go29	1991Ry01	Recommended
					5430.1 (14)
	5419 (7)	5427 (4)			5428.3 (14)
		5411 (4)			5414.5 (14)
5398		5391 (4)			5391.2 (14)
5367		(5377)			5379.0 (14)
		(5355)			5356.2 (14)
		(5342)			5341.9 (14)
5328 (10)	5318 (4)	5322 (3)			5321.2 (14)
5295 (10)	5285 (4)	5286 (3)			5287.6 (14)
	5266.5 (40)	5271 (4)			5269.1 (14)
	5229 (7)	5238 (4)			5239.3 (14)
5225	5209.3 (50)	5211 (3)			5210.2 (14)
	5205.5 (50)	5201 (5)			5203.3 (14)
		(5192)			5195.1 (14)
		5160 (5)			5162.1 (14)
		5130 (5)			5129.0 (14)
		5091 (4)			5094.1 (14)
					5076.8 (14)
		5066 (5)			5064.1 (14)
		(5030)			5035.5 (14)
					5025.5 (14)
		(5020)			5019.3 (14)
					4992.7 (14)
		4901 (5)			4903.6 (14)

[a]: Original energies should be increased by 1 keV due to changes in calibration energies (recommended by 1979Ry03).

[b]: Original energies should be decreased by 0.3 keV due to changes in calibration energies (recommended by 1979Ry03)

The evaluated alpha particle emission probabilities were deduced from the transition intensity balance and listed in table 4. These calculated results are in good agreement with the measured emission probabilities of the main alpha transitions. The measurements are from 1964Gr11, 1967Ba51, 1967Dz02, 1972Go29, and 2003Ku4.

Table 4: Measured and recommended α-particle emission probabilities for ^{225}Ac.

E_α (keV)	P_α					
	1964Gr11	1967Ba51	1967Dz02	1972Go29	2003Ku44	Evaluation
5829.6 (14)	52 (3)	50.65 (15)	51.6 (15)			52.4 (24)
5804.2 (14)		0.3				0.3
5793.1 (21)	28 (3)	24.3 (1)	26.7 (10)	18.1 (20)	20.2 (11)	18.9 (20)
5791.7 (14)		2.50 (1)			8.4 (5)	6.2 (9)
5731.9 (17)	12 (2)	10.10 (3)	10.0 (1)	8.6 (9)	8.5 (4)	9.0 (5)
5731.6 (14)					1.6 (2)	1.24 (10)
5730.5 (14)					1.05 (8)	1.6 (3)
5723.1 (14)		3.40 (1)	2.9 (5)		3.77 (19)	2.03 (23)

E_α (keV)	P_α					
	1964Gr11	1967Ba51	1967Dz02	1972Go29	2003Ku44	Evaluation
5686.4 (14)					0.095 (4)	0.021 (14)
5682.2 (14)	1.3 (3)	1.250 (4)	1.4 (2)		1.08 (5)	1.31 (4)
5637.3 (14)	4.2 (3)	4.350 (13)	4.5 (3)		3.7 (1)	4.16 (23)
5609.0 (14)	1.0 (3)	1.20 (1)	1.1 (1)		0.86 (3)	1.09 (5)
5599.3 (14)		0.0410 (1)			0.099 (4)	0.114 (7)
5580.5 (14)	1.0 (3)	1.20 (4)	1.2 (1)		0.89 (3)	0.95 (4)
5563.3 (14)		0.0340 (1)			0.0034 (5)	0.017 (7)
5555.3 (14)		0.1000 (3)			0.089 (4)	0.084 (10)
5546.5 (14)		0.0310 (1)			0.075 (3)	0.055 (12)
5540.1 (14)		0.0150 (5)	0.04 (1)		0.0070 (7)	0.0072 (8)
5523.7 (14)		~ 0.005	0.010 (2)			0.013 (6)
5515.2 (14)		~ 0.005	≤ 0.02			0.0052 (19)
5497.4 (14)	~ 0.02		0.003 (1)			0.0022 (7)
5487.4 (14)			0.0020 (7)			0.0020 (3)
5468.4 (14)			≤ 0.001			0.00052 (18)
5443.3 (14)	0.15 (5)	0.150 (1)	0.13 (1)		0.086 (4)	0.098 (19)
5435.8 (14)		0.0710 (2)	0.07 (2)		0.029 (2)	0.0083 (6)
5430.1 (14)						0.0028 (8)
5428.3 (14)			0.008 (3)		0.0010 (1)	0.0023 (3)
5414.5 (14)		~ 0.003	0.0020 (5)			0.0030 (4)
5391.2 (14)	~ 0.01		0.0010 (5)			0.0006 (4)
5379.0 (14)	~ 0.01		≤ 0.001			0.0020 (5)
5356.2 (14)			≤ 0.001			9.7E-5 (2)
5341.9 (14)			≤ 0.001		0.0009 (3)	0.0027 (8)
5321.2 (14)	0.07 (3)	0.080 (2)	0.068 (8)		0.054 (2)	0.007 (7)
5287.6 (14)	0.2 (1)	0.300 (1)	0.23 (1)		0.17 (1)	0.214 (10)
5269.1 (14)		0.0180 (5)	0.009 (2)		0.0086 (8)	0.048 (19)
5239.3 (14)			0.0030 (8)		0.00019 (8)	0.0026 (5)
5210.2 (14)	~ 0.02	0.0250 (1)	0.003 (3)		0.022 (2)	0.022 (1)
5203.3 (14)		0.0130 (1)	0.0020 (5)		0.0044 (6)	0.0101 (10)
5195.1 (14)			≤ 0.002			0.00015 (5)
5162.1 (14)			0.0020 (8)			0.00066 (12)
5129.0 (14)			0.0020 (8)		0.0013 (3)	0.0058 (8)
5094.1 (14)			0.006 (1)		0.0054 (15)	0.015 (7)
5076.8 (14)						0.0038 (19)
5064.1 (14)			0.003 (1)		0.0014 (2)	0.00114 (18)
5035.5 (14)			≤ 0.001			0.0021 (3)
5025.5 (14)						0.00083 (21)
5019.3 (14)			≤ 0.001		~ 0.00004	0.00015 (5)
4992.7 (14)						0.0013 (3)
4903.6 (14)			0.0020 (5)			0.0011 (4)

3. Atomic data

Atomic fluorescence yields (ω_K,ϖ_L, ϖ_M, η_{KL} and η_{LM}) are from Schönfeld (1996Sc06).

The X-ray and Auger electron emission probabilities have been deduced from γ-ray and conversion electron data by using the computer code RADLST. Measured and calculated X-ray emission probabilities are compared in Table 5.

Table 5: Comparison of the calculated and measured X-ray emission probabilities.

	1972Dz14	Adopted (deduced)
$K_{\alpha 1}$	1.5 (2)	1.64 (12)
$K_{\alpha 2}$	**1.0 (1)**	1.00 (8)

The deduced KX-ray emission probabilities agree with the measured value of 1972Dz14, thus confirming the completeness of the decay scheme.

4. Electron Emissions.

The conversion electron emission probabilities have been deduced from γ-ray transition data.

5. Photon Emissions

5.1 γ-ray energy values

There are many measured γ-ray energies of ^{225}Ac. The present evaluated values are taken from the LWM average value of 1972Dz14, 2000Ar23 and 2003Ku44. The measurements of 1990ArZZ were replaced by 2000Ar23. The experimental and our recommended γ-ray energies from ^{225}Ac α decay are listed in table 6.

Table 6: Measured and recommended value of γ-ray energy for ^{225}Ac (keV).

1972Dz14	1990ArZZ	2000Ar23	2003Ku44	LWM	Evaluation
		10.6	10.6		10.6
26.0 (1)	26.05 (10)	26.0 (1)	26.0	26.0 (1)	26.0 (1)
36.6 (1)	36.65 (3)	36.70 (3)	36.7 (1)	36.69 (3)	36.69 (3)
38.5 (1)	38.53 (3)	38.60 (4)	38.5 (1)	38.58 (4)	38.58 (4)
	46.24 (5)	46.24 (5)	46.2 (2)	46.24 (5)	46.24 (5)
49.0 (2)	49.09 (5)	49.13 (4)	49.1 (2)	49.12 (4)	49.12 (4)
		50.2			50.2
53.8 (1)		53.01 (5)		53.4 (4)	53.4 (4)
57.8 (1)	57.75 (5)	57.69 (4)	57.8 (2)	57.71 (4)	57.71 (4)
		62.6 (3)			62.6 (3)
62.90 (5)	62.95 (3)	62.96 (3)	62.9 (1)	62.94 (3)	62.94 (3)
		63.5 (3)			63.5 (3)
64.1 (1)	64.28 (5)	64.28 (3)	64.3 (1)	64.27 (3)	64.27 (3)
69.8 (1)	69.8 (2)	69.87 (5)		69.86 (5)	69.86 (5)
71.7 (1)	71.74 (3)	71.72 (4)	71.4 (3)	71.71 (4)	71.71 (4)
73.6 (1)	73.5 (1)	73.36 (20)	73.5	73.55 (9)	73.55 (9)
73.83 (5)	73.86 (2)	73.85 (4)	73.9 (1)	73.85 (3)	73.85 (3)
74.9 (2)	74.9 (2)	74.82 (5)	74.6 (4)	74.82 (5)	74.82 (5)
			78.8		78.8
					82.6[ab]
87.38 (5)	87.41 (3)	87.42 (3)	87.4 (1)	87.41 (3)	87.41 (3)

1972Dz14	1990ArZZ	2000Ar23	2003Ku44	LWM	Evaluation
94.9 (2)	94.90 (5)	94.90 (3)	94.9 (1)	94.90 (2)	94.90 (2)
96.3 (2)	96.15 (5)	96.15 (5)	96.7 (5)	96.16 (5)	96.16 (5)
99.55 (10)	99.63 (5)	99.71 (6)	99.6	99.67 (5)	99.67 (5)
99.8 (1)	99.91 (5)	100.07 (10)	99.8 (1)	99.89 (6)	99.89 (6)
100.8 (1)	100.96 (5)	100.87 (4)	100.8 (2)	100.86 (4)	100.86 (4)
	103.46 (10)	103.44 (12)	103.6 (2)	103.48 (10)	103.48 (10)
108.4 (1)	108.41 (3)	108.38 (3)	108.4 (1)	108.38 (3)	108.38 (3)
111.5 (1)	111.54 (3)	111.52 (3)	111.5 (1)	111.52 (3)	111.52 (3)
	112.8 (2)	112.8 (2)	112.8	112.8 (2)	112.8 (2)
			114		114
		119.09 (6)			119.09 (6)[b]
119.9 (1)	119.87 (5)	119.84 (3)	119.9 (1)	119.85 (3)	119.85 (3)
		121.06 (7)			121.06 (7)
123.8 (1)	123.75 (5)	123.73 (4)	123.8 (1)	123.75 (4)	123.75 (4)
124.8 (1)	124.82 (5)	124.81 (3)	124.8 (1)	124.81 (3)	124.81 (3)
	126.15 (10)	126.09 (5)	126.2 (2)	126.10 (5)	126.10 (5)
	129.2 (2)	129.22 (7)	129.2 (2)	129.22 (7)	129.22 (7)
	133.64 (5)	133.60 (4)	133.6 (1)	133.60 (3)	133.60 (3)
134.8 (1)	134.86 (5)	134.85 (3)	134.9 (1)	134.85 (3)	134.85 (3)
		137.40 (10)	137.6		137.40 (10)
					138.2[ab]
			139.6		139.6
		144.7 (2)	144.7		144.7 (2)
145.0 (2)	145.17 (5)	145.15 (3)	145.2 (1)	145.15 (3)	145.15 (3)
150.09 (5)	150.04 (2)	150.02 (4)	150.1 (1)	150.05 (3)	150.05 (3)
	152.63 (5)	152.64 (3)	152.6 (2)	152.64 (3)	152.64 (3)
154.0 (1)	153.92 (5)	153.91 (3)	153.9 (1)	153.92 (3)	153.92 (3)
157.25 (5)	157.26 (2)	157.24 (3)	157.3 (2)	157.25 (3)	157.25 (3)
		161.35 (7)			161.35 (7)
	169.1 (2)	169.18 (4)	169.1	169.18 (4)	169.18 (4)
			169.9		169.9
170.6 (1)	170.7 (2)	170.83 (6)	170.7 (2)	170.77 (5)	170.77 (5)
			173.4		173.4
	178.4 (1)	178.29 (3)	178.3 (2)	178.29 (3)	178.29 (3)
	179.8 (2)	179.78 (4)	179.8 (3)	179.78 (4)	179.78 (4)
			183		183
			186.1		186.1
186.1 (1)	186.2 (1)	186.31 (3)	186.3	186.29 (3)	186.29 (3)
			187.2		187.2
188.0 (1)	188.00 (5)	187.95 (3)	188.0 (1)	187.96 (3)	187.96 (3)
			193.2		193.2
195.69 (7)	195.78 (5)	195.74 (3)	195.8 (2)	195.74 (3)	195.74 (3)
		197.50 (3)	197.4		197.50 (3)
	197.7 (1)		197.9		197.7 (1)
198.70 (7)	198.7 (1)	198.23 (8)	198.4 (3)	198.47 (23)	198.47 (23)

1972Dz14	1990ArZZ	2000Ar23	2003Ku44	LWM	Evaluation
		205.12 (11)	204.7 (3)	205.07 (11)	205.07 (11)
	216.90 (5)	216.89 (3)	216.9 (2)	216.89 (3)	216.89 (3)
		220.43 (8)			220.43 (8)
224.56 (7)	224.64 (5)	224.58 (3)	224.7 (1)	224.59 (3)	224.59 (3)
			228.2 (4)		228.2 (4)
	231.3 (2)	231.14 (7)	231.3 (2)	231.16 (7)	231.16 (7)
			236.0 (6)		236.0 (6)
		238.64 (8)			238.64 (8)
	240.8 (1)	240.68 (3)	240.7 (2)	240.68 (3)	240.68 (3)
	243.2 (1)	243.11 (5)	243.2 (2)	243.12 (5)	243.12 (5)
	249.5 (2)	249.60 (3)	249.6 (2)	249.60 (3)	249.60 (3)
253.50 (7)	253.54 (5)	253.45 (3)	253.5 (1)	253.46 (3)	253.46 (3)
		256.0 (2)	256		256.0 (2)
	279.25 (10)	279.18 (3)	279.3 (3)	279.18 (3)	279.18 (3)
	282.1 (2)				282.1 (2)
	284.8 (1)	284.75 (3)	284.8 (3)	284.75 (3)	284.75 (3)
		298.32 (5)	298.6 (3)	298.33 (5)	298.33 (5)
		317.23 (18)	317.4		317.23 (18)
		321.77 (4)	321.8 (4)	321.77 (4)	321.77 (4)
	348.5 (1)	348.33 (4)	348.2 (4)	348.33 (4)	348.33 (4)
	354.8 (2)	354.54 (6)	354.9 (3)	354.56 (6)	354.56 (6)
			356.6		356.6
	362.5 (1)	362.38 (3)	362.2 (4)	362.38 (3)	362.38 (3)
		367.72 (12)	368.3 (6)	367.74 (12)	367.74 (12)
	375.2 (1)	374.98 (5)	375.0 (7)	374.98 (5)	374.98 (5)
		388.07 (7)			388.07 (7)
	403.1 (1)	403.1 (1)	403.4 (3)	403.13 (10)	403.13 (10)
	406.1 (1)	405.95 (3)	406.2 (3)	405.95 (3)	405.95 (3)
	418.1 (1)	417.90 (3)	417.9 (3)	417.90 (2)	417.90 (2)
		429.80 (18)			429.80 (18)
		434.81 (5)	435.0 (3)	434.82 (5)	434.82 (5)
		442.16 (8)			442.16 (8)
		443.43 (10)			443.43 (10)
		446.31 (10)			446.31 (10)
		451.04 (5)	450.1 (7)	451.04 (5)	451.04 (5)
452.4 (1)	452.4 (1)	452.21 (3)	452.4 (2)	452.23 (3)	452.23 (3)
	458.8 (2)	458.79 (8)	458.8 (4)	458.79 (8)	458.79 (8)
	462.4 (4)	462.43 (13)	462.4 (6)	462.43 (13)	462.43 (13)
	469.5 (3)	469.48 (5)	469.5 (3)	469.48 (5)	469.48 (5)
	481.05 (5)	480.84 (3)	481.1 (2)	480.85 (3)	480.85 (3)
		491.42 (10)	492.6 (6)	491.45 (10)	491.45 (10)
	496.9 (3)				496.9 (3)
			498.6 (6)		498.6 (6)
			512.5 (7)		512.5 (7)
	515.40 (5)	515.12 (3)	515.3 (2)	515.13 (3)	515.13 (3)

1972Dz14	1990ArZZ	2000Ar23	2003Ku44	LWM	Evaluation
	517.78 (5)	517.50 (3)	517.9 (2)	517.51 (3)	517.51 (3)
	522.3 (1)	522.14 (4)	522.1 (2)	522.14 (4)	522.14 (4)
	526.09 (5)	525.77 (3)	526.1 (1)	525.94 (17)	525.94 (17)
		527.29 (5)			527.29 (5)[b]
	529.9 (1)	529.59 (3)	529.7 (3)	529.59 (3)	529.59 (3)
	531.3 (1)	530.86 (4)	531.2 (3)	530.87 (4)	530.87 (4)
		532.11 (9)			532.11 (9)
	538.1 (1)				538.1 (1)
			545.8 (6)		545.8 (6)
	552.0 (1)	551.78 (3)	552.0 (2)	551.79 (3)	551.79 (3)
		564.31 (11)	565.6 (7)	564.34 (11)	564.34 (11)
		567.47 (5)	568.3 (6)	567.48 (5)	567.48 (5)
	571.0 (1)	570.68 (3)	571.0 (2)	570.69 (3)	570.69 (3)
		590.41 (5)	591.4 (7)	590.42 (5)	590.42 (5)
	594.2 (1)	593.86 (4)	594.6 (3)	593.87 (4)	593.87 (4)
	601.1 (1)	600.92 (3)	601.0 (3)	600.92 (3)	600.92 (3)
	603.3 (1)	603.09 (4)	603.5 (5)	603.09 (4)	603.09 (4)
		628.93 (10)	629.9 (7)	628.95 (10)	628.95 (10)
			637.1 (7)		637.1 (7)
		645.87 (13)	646.3 (3)	645.94 (12)	645.94 (12)
	649.2 (1)	649.01 (4)	649.5 (2)	649.03 (4)	649.03 (4)
			653.5 (4)		653.5 (4)[b]
		656.18 (11)			656.18 (11)
		657.88 (5)			657.88 (5)
		667.10 (8)	668.1 (4)	667.14 (8)	667.14 (8)
		675.51 (18)	674.3 (4)	674.9 (3)	674.9 (3)
	679.7 (1)	679.35 (6)	680.4 (6)	679.36 (6)	679.36 (6)
		697.54 (13)	698.4 (4)	697.62 (12)	697.62 (12)[b]
		702.00 (14)			702.00 (14)
	747.0 (1)	747.0 (1)	747	747.0 (1)	747.0 (1)
		752.46 (12)			752.46 (12)
	753.7 (3)	754.04 (13)	753.7	754.04 (13)	754.04 (13)
	758.7 (1)				758.7 (1)[b]
		767.6 (4)	768.4 (5)	767.9 (3)	767.9 (3)
			780.6 (6)		780.6 (6)
		808.48 (10)			808.48 (10)
			824.2 (7)		824.2 (7)

[a]: from 1969Le09.

[b]: not placed in level scheme.

5.2 Relative values of the γ-ray intensities

The results of measurements of the relative γ-ray intensities of ^{225}Ac are listed in table 7. The recommended values are taken from the LWM average of the measured values of 2000Ar23 and 2003Ku44. The measurements of 1990ArZZ were replaced by 2000Ar23; measurements of 1994Gr20 were replaced by 2003Ku44.

Table 7: Measured and recommended relative γ-ray intensities for ^{225}Ac.

E_γ (keV)	I_γ							
	1967Le23	1972Dz14	1990ArZZ	1994Gr20	2000Ar23	2003Ku44	LWM	Evaluation
10.6								2.17 (28)*
26.0 (1)		~ 0.21	< 1.4		0.23 (3)	0.25 (8)	0.23 (3)	0.23 (3)
36.69 (3)	~ 4.1	~ 2.1	2.19 (27)	2.63 (36)	2.65 (33)	2.58 (27)	2.61 (21)	2.61 (21)
38.58 (4)		1.4	1.64 (14)	1.84 (50)	1.48 (23)	1.57 (16)	1.54 (13)	1.54 (13)
46.24 (5)			0.55 (27)		0.82 (17)	0.65 (11)	0.70 (9)	0.70 (9)
49.12 (4)		0.7	0.96 (27)	1.07 (36)	1.3 (2)	1.10 (13)	1.16 (11)	1.16 (11)
50.2					~ 0.09			~ 0.09
53.4 (4)		2.68 (56)			< 0.58			< 0.58
57.71 (4)		0.7	0.55 (27)	0.71 (36)	0.88 (19)	0.65 (14)	0.73 (11)	0.73 (11)
62.6 (3)					0.77 (17)			0.77 (17)
62.94 (3)	58 (7)	77.5 (70)	56.2 (27)	69.1 (52)	69.5 (87)	71.7 (49)	71.2 (42)	71 (4)
63.5 (3)					3.0 (4)			3.0 (4)
64.27 (3)		8.5 (28)	4.1 (4)	5.4 (5)	6.8 (7)	6.83 (75)	6.8 (5)	6.8 (5)
69.86 (5)		0.7	0.68 (27)	0.89 (36)	0.68 (17)		0.68 (17)	0.68 (17)
71.71 (4)		1.4	1.78 (14)	1.96 (48)	1.87 (20)	2.10 (43)	1.91 (18)	1.91 (18)
73.55 (9)		2.8	1.23 (27)		2.17 (72)	4.2 (12)	2.7 (6)	2.7 (6)
73.85 (3)	55 (10)	45.1 (42)	39.6 (18)	43.0 (34)	46.3 (58)	44.0 (36)	44.6 (31)	44.6 (31)
74.82 (5)		5.6	2.19 (27)		1.88 (43)	3.7 (12)	2.1 (4)	2.1 (4)
78.8				3.0 (13)		1.78 (27)		1.78 (27)
82.6×	21 (5)							21 (5)
87.41 (3)	< 6.8	40.8 (42)	31.9 (15)	40.5 (29)	44.9 (58)	37.7 (29)	39.1 (26)	39.1 (26)
94.90 (2)		22.5 (85)	11.9 (11)	12.5 (14)	18.8 (27)	14.0 (15)	15.1 (13)	15.1 (13)
96.16 (5)	4 (1)	4.2 (14)	3.84 (41)		< 4.3	4.7 (9)		4.7 (9)
99.67 (5)	301 (55)	95.8 (99)	78.1 (41)	243 (2)	197 (27)	117 (12)	110 (7)	110 (7)
99.89 (6)		239 (28)	127.4 (68)		38 (14)	167 (20)	156 (11)	156 (11)
100.86 (4)		7.0	8.8 (14)	10.9 (27)	17.5 (19)	12.5 (12)	13.9 (10)	13.9 (10)
103.48 (10)	~ 1.4		0.55 (27)		0.94 (27)	0.38 (9)	0.44 (9)	0.44 (9)
108.38 (3)	38 (7)	39.4 (42)	31.5 (14)	37.9 (27)	39.1 (43)	36.0 (26)	36.8 (22)	36.8 (22)
111.52 (3)	44 (7)	45.1 (42)	39.9 (18)	48.0 (36)	49.2 (58)	44.0 (32)	45.2 (28)	45.2 (28)
112.8 (2)			0.27 (13)		< 0.43	0.30 (4)		0.30 (4)
114						0.125 (18)		0.125 (18)
119.09 (6)×					2.6 (4)			2.6 (4)
119.85 (3)	9.6 (27)	8.5 (14)	9.3 (8)	12.1 (13)	14.0 (14)	11.0 (7)	11.6 (6)	11.6 (6)
121.06 (7)					2.5 (7)			2.5 (7)
123.75 (4)		26.8 (28)	9.0 (8)	10.9 (14)	14.2 (14)	12.0 (9)	12.6 (8)	12.6 (8)
124.81 (3)	29 (7)	7.0 (14)	3.3 (3)	4.6 (9)	4.6 (4)	4.0 (3)	4.22 (24)	4.22 (24)

E_γ (keV)	I_γ							
	1967Le23	1972Dz14	1990ArZZ	1994Gr20	2000Ar23	2003Ku44	LWM	Evaluation
126.10 (5)			0.96 (27)		1.06 (20)	1.17 (12)	1.14 (10)	1.14 (10)
129.22 (7)			0.41 (14)		0.48 (16)	0.37 (7)	0.39 (7)	0.39 (7)
133.60 (3)			1.78 (27)	2.7 (4)	13.9 (27)	2.83 (22)		2.83 (22)
134.85 (3)	5.5 (27)	5.6 (14)	3.84 (41)	5.0 (5)	4.8 (7)	4.5 (4)	4.6 (4)	4.6 (4)
137.40 (10)					0.43 (19)	0.32 (4)	0.33 (4)	0.33 (4)
138.2×	2.7 (14)							2.7 (14)
139.6						0.20 (3)		0.20 (3)
144.7 (2)	21 (4)				~ 0.07	0.067 (17)		0.067 (17)
145.15 (3)		18.3 (42)	18.4 (8)	21.8 (18)	21.4 (22)	21.0 (15)	21.1 (12)	21.1 (12)
150.05 (3)	100	100	100	100	100	100	100	100
152.64 (3)			2.2 (3)	2.7 (4)	2.39 (27)	3.17 (23)	2.84 (18)	2.84 (18)
153.92 (3)	23 (4)	26.8 (70)	23.6 (11)	27.7 (30)	28.2 (29)	30.3 (21)	29.6 (17)	29.6 (17)
157.25 (3)	51 (10)	43.7 (42)	45.2 (27)	55.4 (5)	50.7 (58)	53.3 (43)	52.4 (35)	52.4 (35)
161.35 (7)					0.52 (13)			0.52 (13)
169.18 (4)			2.33 (27)	2.86 (36)	2.29 (27)	1.17 (18)	1.7 (6)	1.7 (6)
169.9						2.0 (2)		2.0 (2)
170.77 (5)	5.5 (28)	1.4	0.96 (41)		1.06 (19)	2.83 (22)	1.9 (9)	1.9 (9)
173.4×						1.67 (19)		1.67 (19)
178.29 (3)	2.7 (14)		1.78 (14)		2.32 (26)	2.33 (20)	2.33 (16)	2.33 (16)
179.78 (4)			0.96 (27)	1.25 (36)	1.53 (19)	1.57 (13)	1.56 (11)	1.56 (11)
183×						1.22 (19)		1.22 (19)
186.1						1.83 (19)		1.83 (19)
186.29 (3)		2.8	2.47 (55)		2.74 (30)	0.60 (6)		0.60 (6)[b]
187.2						1.48 (9)		1.48 (9)
187.96 (3)	81 (8)	64.8 (70)	67.8 (34)	78.6 (5)	78.1 (87)	75 (5)	75.8 (44)	76 (4)
193.2×						0.28 (5)		0.28 (5)
195.74 (3)	19 (4)	19.7 (28)	20.5 (14)	25.2 (13)	23.4 (23)	20.5 (14)	21.3 (12)	21.3 (12)
197.50 (3)				3.6 (7)		3.83 (39)		3.8 (4)[b]
197.7 (1)			7.53 (68)	4.1 (9)	7.8 (10)	5.5 (6)		5.5 (6)[b]
198.47 (23)	4.1 (12)	2.8	3.01 (68)	3.8 (9)	2.55 (26)	2.83 (22)	2.71 (17)	2.71 (17)
205.07 (11)					0.27 (10)	0.18 (7)	0.21 (6)	0.21 (6)
216.89 (3)	47 (14)		39.7 (82)	53 (10)	47.8 (43)	45.2 (33)	46.2 (27)	46.2 (27)
220.43 (8)					0.87 (26)			0.87 (26)
224.59 (3)	15 (4)	11.3 (14)	12.1 (12)	14.8 (14)	15.6 (17)	16.3 (12)	16.1 (10)	16.1 (10)
228.2 (4)						0.67 (17)		0.67 (17)
231.16 (7)			0.27 (13)		0.30 (7)	1.10 (12)	0.7 (4)	0.7 (4)
236.0 (6)						0.25 (4)		0.25 (4)
238.64 (8)					0.14 (4)			0.14 (4)
240.68 (3)	2.7 (13)		0.96 (27)		1.71 (19)	1.67 (19)	1.69 (14)	1.69 (14)
243.12 (5)			0.16 (7)		0.39 (7)	0.50 (6)	0.45 (5)	0.45 (5)
249.60 (3)	2.7 (13)		1.51 (68)		1.9 (2)	2.0 (2)	1.95 (14)	1.95 (14)
253.46 (3)	21 (5)	14.1 (14)	15.5 (7)	18.4 (9)	18.5 (19)	19.3 (14)	19.0 (11)	19.0 (11)
256.0 (2)					0.05 (1)	0.100 (34)	0.054 (10)	0.054 (10)
279.18 (3)	4.1 (12)		2.33 (27)		4.63 (43)	4.17 (39)	4.4 (3)	4.4 (3)

E_γ (keV)	I_γ							
	1967Le23	1972Dz14	1990ArZZ	1994Gr20	2000Ar23	2003Ku44	LWM	Evaluation
282.1 (2)			0.55 (27)					0.079 (6)*
284.75 (3)	~ 1.4		0.55 (27)	0.71 (36)	1.09 (13)	1.05 (10)	1.07 (8)	1.07 (8)
298.33 (5)					0.29 (4)	0.30 (9)	0.29 (4)	0.29 (4)c
317.23 (18)					0.06 (3)	> 0.018		0.06 (3)c
321.77 (4)					0.46 (7)	0.50 (7)	0.48 (5)	0.48 (5)c
348.33 (4)			0.41 (14)		0.46 (7)	0.42 (5)	0.43 (4)	0.43 (4)
354.56 (6)			0.21 (5)	0.25 (7)	0.19 (3)	0.38 (5)	0.29 (10)	0.29 (10)
356.6						0.037 (15)		0.037 (15)
362.38 (3)			0.82 (27)		0.9 (1)	0.70 (8)	0.78 (6)	0.78 (6)
367.74 (12)					0.05 (3)	0.10 (3)	0.075 (25)	0.075 (25)
374.98 (5)			0.41 (14)		0.027 (4)	0.28 (7)		0.28 (7)
388.07 (7)					0.18 (3)			0.18 (3)
403.13 (10)			0.18 (5)		< 0.29	0.027 (23)		0.027 (23)
405.95 (3)			0.96 (27)		1.14 (13)	1.12 (9)	1.13 (7)	1.13 (7)
417.90 (2)			0.68 (14)		0.82 (10)	0.80 (8)	0.81 (6)	0.81 (6)
429.80 (18					0.055 (27)			0.055 (27)
434.82 (5)					0.46 (7)	0.40 (5)	0.42 (4)	0.42 (4)
442.16 (8)					0.65 (10)			0.65 (10)
443.43 (10)					~ 0.014			~ 0.014d
443.43 (10)					0.20 (7)			0.20 (7)d
446.31 (10)					0.09 (5)			0.09 (5)
451.04 (5)					0.41 (7)	0.53 (14)	0.43 (6)	0.43 (6)
452.23 (3)	15 (5)	15.5 (14)	14.8 (12)		17.1 (19)	14.8 (11)	15.4 (10)	15.4 (10)
458.79 (8)			0.68 (27)		0.07 (2)	0.097 (37)	0.076 (18)	0.076 (18)
462.43 (13)			2.2 (11)		0.055 (16)	0.125 (45)	0.063 (15)	0.063 (15)
469.48 (5)			0.55 (14)		0.26 (10)	0.47 (6)	0.41 (5)	0.41 (5)
480.85 (3)	4.1 (12)		4.1 (4)		4.9 (6)	4.83 (41)	4.85 (34)	4.9 (3)
491.45 (10)					0.06 (2)	0.037 (23)	0.05 (2)	0.05 (2)
496.9 (3)			0.21 (10)					0.21 (10)
498.6 (6)						0.12 (3)		0.12 (3)
512.5 (7)						0.08 (3)		0.08 (3)
515.13 (3)	~ 1.4		2.47 (27)		2.95 (30)	3.17 (23)	3.09 (18)	3.09 (18)
517.51 (3)			1.78 (27)		2.1 (2)	2.5 (2)	2.30 (14)	2.30 (14)
522.14 (4)			0.21 (5)		0.30 (3)	0.30 (5)	0.30 (2)	0.30 (2)
525.94 (17)	~ 1.4		3.97 (41)		4.63 (43)	5.50 (43)	5.1 (3)	5.1 (3)
527.29 (5)x					0.27 (4)			0.27 (4)
529.59 (3)			0.82 (41)		1.01 (12)	1.18 (13)	1.09 (9)	1.09 (9)
530.87 (4)			0.55 (14)		0.68 (9)	0.67 (9)	0.68 (6)	0.68 (6)
532.11 (9)					0.11 (3)			0.11 (3)
538.1 (1)			0.55 (14)					0.55 (14)
545.8 (6)						0.077 (20)		0.077 (20)
551.79 (3)			0.55 (14)		0.56 (7)	0.93 (8)	0.75 (19)	0.75 (19)
564.34 (11)					~ 0.014	0.032 (13)		0.032 (13)
567.48 (5)					0.13 (2)	0.22 (5)	0.18 (5)	0.18 (5)

E_γ (keV)	I_γ							
	1967Le23	1972Dz14	1990ArZZ	1994Gr20	2000Ar23	2003Ku44	LWM	Evaluation
570.69 (3)			0.55 (14)		0.59 (7)	0.53 (9)	0.57 (6)	0.57 (6)
590.42 (5)					0.12 (2)	0.12 (3)	0.12 (2)	0.12 (2)
593.87 (4)			0.22 (11)		0.41 (4)	0.47 (10)	0.42 (4)	0.42 (4)
600.92 (3)			0.47 (14)		0.35 (6)	0.62 (15)		0.35 (6)[ad]
600.92 (3)					~ 0.87			~ 0.87[ad]
603.09 (4)			0.27 (13)		0.25 (3)	0.27 (7)	0.25 (3)	0.25 (3)
628.95 (10)					0.049 (13)	0.043 (14)	0.046 (10)	0.046 (10)
637.1 (7)						~ 0.017		~ 0.017
645.94 (12)					0.032 (10)	0.017 (7)	0.022 (6)	0.022 (6)
649.03 (4)			0.18 (5)		0.27 (3)	0.20 (5)	0.25 (3)	0.25 (3)
653.5 (4)[×]						0.025 (7)		0.025 (7)
656.18 (11)					0.07 (3)			0.07 (3)
657.88 (5)					0.20 (4)			0.20 (4)
667.14 (8)					0.56 (13)	0.040 (12)	0.30 (26)	0.30 (26)
674.9 (3)					0.019 (9)	0.012 (7)	0.015 (6)	0.015 (6)
679.36 (6)			0.11 (3)		0.09 (2)	0.102 (26)	0.095 (16)	0.095 (16)[c]
697.62 (12)[×]					0.035 (13)	0.028 (8)	0.030 (7)	0.030 (7)
702.00 (14)					0.023 (10)			0.023 (10)
747.0 (1)			0.16 (5)		< 0.29	< 0.017		0.16 (5)
752.46 (12)					0.038 (10)			0.038 (10)
754.04 (13)			0.11 (3)		0.033 (10)	< 0.017		0.033 (10)
758.7 (1)[×]			0.68 (14)					0.68 (14)
767.9 (3)					0.049 (13)	0.040 (12)	0.044 (9)	0.044 (9)
780.6 (6)						0.008 (2)		0.008 (2)
808.48 (10)					0.30 (4)			0.30 (4)
824.2 (7)						~ 0.007		~ 0.007

[a]: From 2000Ar23.
[b]: From 2003Ku44.
[c]: Multiply placed, intensity not divided.
[d]: Multiply placed, intensity suitable divided.
[*]: From intensity balance.
[×]: Not placed in level scheme.

5.3 Absolute values of the γ-ray emission probabilities

Measured absolute γ-ray emission probabilities for the 150.04 keV line for ^{225}Ac are compiled and listed in Table 8.

2000Ar23 gives the value 0.691 (16) %, which was obtained from correction of the intensity of 1986He06 using the measured value 0.053 (6) % (2000Ga52) for the 149.89 keV transition in ^{229}Th α-decay and the measured value 0.051 (10) % (1995Sh01) for the 150.14 keV transition in ^{221}Fr α-decay.

Conversely, to correct the measured intensity of 1986He06, if using the measured value 0.053 (6) % (2000Ga52) for the 149.89 keV transition in ^{229}Th α-decay and the evaluated value 0.0478 (23) % (1990Ak05) for the 150.14 keV transition in ^{221}Fr α decay, the value would be then 0.695 (13) %. These corrected values are in good agreement with the measured value in 1995Ch74.

The recommended absolute γ-ray emission probability of the 150.04 keV γ-ray is from the measurement of 1995Ch74 and adopted as the normalization factor N, with N = 0.00693 (12). The recommended absolute γ-ray emission probabilities are the relative values evaluated in table 7 multiplied by 0.00693 (12).

Table 8: Measured and recommended absolute γ-ray emission probability of 150.04 keV for ^{225}Ac.

P_γ (150.04 keV) (%)	References	Measurement method
0.981 (3)	1981Di14	Ge(Li)
0.796 (11)	1986He06	Ge(Li), Au-Si surface barrier, in equilibrium with ^{229}Th.
0.693 (12)	1995Ch74	Ge(Li), αγ-coincidence.
0.691 (16)	2000Ar23	From 1986He06 corrected by 2000Ga52 and 1995Sh01.
0.693 (12)		Recommended value from 1995Ch74

6. References

1947En03 A.C. English, T.E. Cranshaw, P. Demers, J.A. Harvey, E.P. Hincks, J.V. Jelley, A.N. May, Phys. Rev. 72, 253 (1947) [$T_{1/2}$].

1950Ha52 F. Hagemann, L.I. Katzin, M.H. Studier, G.T. Seaborg, A. Ghiorso, Phys. Rev. 79, 435 (1950) [$T_{1/2}$].

1964Gr11 G. Graeffe, K. Valli, J. Aaltonen, Ann. Acad. Sci. Fenn., Ser. A VI, No.145 (1964) [E_α, I_α].

1967Ba51 G. Bastin-Scoffier, Compt. Rend. 265B, 863 (1967) [E_α, I_α].

1967Dz02 B.S. Dzhelepov, R.B. Ivanov, M.A. Mikhailova, L.N. Moskvin, O.M. Nazarenko, V.F. Rodionov, Izv. Akad. Nauk SSSR, Ser. Fiz. 31, 568 (1967) [E_α, I_α].

1967Le23 C.-F. Leang, Compt. Rend. 265B, 417 (1967) [E_γ, I_γ].

1969Le09 C.-F. Leang, F. Gautier, J. Phys. (Paris) 30, 296 (1969) [E_γ, ce]

1971DzZP B.S. Dzhelepov, A.V. Zolotavin, R.B. Ivanov, M.A. Mikhailova, V.O. Sergeev, M.I. Sovtsov, Proc.21st Ann. Conf. Nucl. Spectrosc. Struct. At. Nuclei, Moscow, Pt.1, p.140 (1971) [E_γ,I_γ,I(ce), Multipolarity].

1972Dz14 B.S. Dzhelepov, R.B. Ivanov, M.A. Mikhailova, V.O. Sergeev, Izv. Akad. Nauk SSSR, Ser. Fiz. 36, 2080 (1972) [E_γ,I_γ,E(ce),I(ce), Multipolarity].

1972Go29 N.A. Golovkov, B.S. Dzhelepov, R.B. Ivanov, M.A. Mikhailova, V.G. Chumin, Sov. J. Nucl. Phys. 15, 349 (1972) [I_α].

1977Vy02 T. Vylov, N.A. Golovkov, B.S. Dzhelepov, R.B. Ivanov, M.A. Mikhailova, Y.V. Norseev, V.G. Chumin, Bull. Acad. Sci. USSR, Phys. Ser. 41, No.8, 85 (1977) [E_γ, I_γ, Multipolarity].

1979Ry03 A. Rytz, At. Data Nucl. Data Tables 23, 507 (1979) [E_α, I_α].

1981Di14 J.K. Dickens, J.W. McConnell, Radiochem. Radioanal. Lett. 47, 331 (1981) [E_γ, I_γ].

1986He06 R.G. Helmer, C.W. Reich, M.A. Lee, I. Ahmad, Int. J. Appl. Radiat. Isotop. 37, 139(1986) [E_γ, I_γ, P_γ].

1990Ak03 Y.A. Akovali, Nucl. Data Sheets 60, 617(1990) [Spin, parity].

1990Ak05 Y.A. Akovali, Nucl. Data Sheets 61, 623(1990) [NDS].

1990ArZZ G. Ardisson, M.C. Kouassi, J. Dalmasso, Priv. Comm. (1990) [E_γ, I_γ, Multipolarity].

1990Ko14 M.C. Kouassi, J. Dalmasso, H. Maria, G. Ardisson, M. Hussonnois, J. Radioanal. Nucl. Chem. 144, 387 (1990) [E_γ, I_γ].

1991Ko12 M.C. Kouassi, J. Dalmasso, M. Hussonnois, V. Barci, G. Ardisson, J. Radioanal. Nucl. Chem. 153, 293 (1991) [E_γ, I_γ].

1994Gr20 K.Ya. Gromov, M.Ya. Kuznetsova, Yu.N. Norseev, N.I. Rukhadze, V.I. Fominykh, V.V. Tsupko-Sitnikov, V.G. Chumin, M.B. Yuldashev, Yu.S. Butabaev, R.A. Niyazov, Bull. Rus. Acad. Sci. Phys. 58, 29 (1994) [E_γ, I_γ].

1995Ch74 V.G. Chumin, S.S. Eliseev, K.Ya. Gromov, Yu.V. Norseev, V.I. Fominykh, V.V. Tsupko-Sitnikov, Bull.

Rus. Acad. Sci. Phys. 59,1854(1995) [E_γ, I_γ,P_γ].

1995Sh01 R.K. Sheline, C.F. Liang, P. Paris, Phys. Rev. C51, 1192 (1995) [P_γ].

1996Sc06 E. Schönfeld, H.Janssen, Nucl. Instrum. Meth. Phys. Res. A369, 527 (1996) [Atomic data].

2000Ar23 G. Ardisson, J. Gasparro, V. Barci, R.K. Sheline, Phys. Rev. C62, 064306 (2000) [E_γ, I_γ].

2000Ga52 J. Gasparro, G. Ardisson, V. Barci, R.K. Sheline, Phys. Rev. C62, 064305 (2000) [E_γ, I_γ,P_γ].

2002Ba85 I.M. Band, M.B. Trzhaskovskaya, C.W. Nestor, Jr., P.O. Tikkanen, S. Raman, At. Data Nucl. Data Tables 81, 1(2002) [Calculated ICC]

2003Au03 G. Audi, A.H. Wapstra, C. Thibault, Nucl. Phys. A729, 129(2003) [Q].

2003Ku44 S.A. Kudrya, V.M. Gorozhankin, K.Ya. Gromov, Sh.R. Malikov, L.A. Malov, V.A. Sergienko, V.I. Fominykh, V.V. Tsupko-Sitnikov, V.G. Chumin, E.A. Yakushev, Bull. Rus. Acad. Sci. Phys. 67, 7 (2003) [E_γ,I_γ,E_α,I_α,E(ce),I(ce), Multipolarity].

2008Ki07 T. Kibédi, T. W. Burrows, M. B. Trzhaskovskaya, P. M. Davidson, C. W. Nestor Jr., Nucl. Instrum. Meth. Phys. Res. A589, 202 (2008) [Theoretical ICC].