^{217}Ac IT decay (740 ns) 1985De14

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	B. Singh, A. Chakraborty, S. Bhattacharya	NDS 147, 382 (2018)	1-Dec-2017

Parent: ^{217}Ac: E=2012.2 *7*; J$^\pi$=(29/2)$^+$; $T_{1/2}$=740 ns *40*; %IT decay=95.49 *18*

^{217}Ac-%IT decay: %IT=95.49 *18*.

1985De14 (also 1981MaYW): investigation of level structure of ^{217}Ac through $\alpha\gamma$, $\gamma\gamma$, α(ce)- and (ce)(ce)(ce)-coin, g factors by $\alpha(\theta$,H,t)-TDPAD method, and half-lives of g.s. and isomer using the following three reactions: 1. ^{205}Tl(^{16}O,4n),E(^{16}O)=96 MeV pulsed beam. Level scheme proposed below 1683-keV excitation. Seven Ge(Li) and Ge detectors and eight NaI(Tl) detectors were used. 2. ^{206}Pb(^{15}N,4n),E(^{15}N)=80,84,87 MeV; measured g-factor by Directional Perturbed Angular Distribution (DPAD) method with α particle measurement using three pairs of Si detectors. See also 3. ^{209}Bi(^{12}C,4n),E(^{12}C)=75 MeV, pulsed beam; measured α spectra, α-ce and ce-ce coincidences using Si detectors.

1983GoZX, 1983GoZP, 1982GoZU, 1982SaZO: E(^{12}C)=77, 80 MeV pulsed beam; measured Eγ, Eα, $\gamma\gamma$ and $\alpha\gamma$ at the Tandem accelerator laboratory of Tsukuba University. Details of this study are not available.

Decay scheme is basically as proposed by 1985De14 from their $\gamma\gamma$ and γ(ce) coincidences. In the level scheme shown by 1982GoZU, ordering of the 478.9 and 349.0 gammas was reversed, and a level at 1019 keV was introduced from these cascading gammas. Their (486.4γ)(γ) coincidence spectrum shown, however, indicates the presence of the 349.0γ and absence of the 478.9γ. Gamma rays observed at 501.6, 371.7, 380, and 327.6 keV were placed by 1982GoZU in cascade to deexcite proposed levels at 3263, 2762, 2390 and 2010, respectively. These levels and γ placements are assumed here as preliminary results.

^{217}Ac Levels

E(level)[†]	J$^\pi$[‡]	$T_{1/2}$	Comments
0.0	9/2$^-$	69 ns *4*	%α=100 g=+0.85 *1* (1985De14,1981MaYW) $T_{1/2}$: from Adopted Levels. This level decays 100% by α. Eα=9650 *10* (1973No09), %Iα=94.8 *20* (1985De14) observed in the 740-ns isomer decay; ^{217}Ac g.s. to ^{213}Fr g.s. α transition.
660.2 *3*	13/2$^-$		
670.2 *3*	11/2$^-$		
1146.6 *4*	17/2$^-$		%$\alpha\le$0.27 *4* (1985De14) Observed 10780 *15* α transition with Iα=0.27% *4* was assigned by 1985De14 from 1147 and/or 1149 levels to the ^{213}Fr g.s.
1149.1 *3*	15/2$^-$		%$\alpha\le$0.27 *4* (1985De14) Observed 10780 *15* α transition with Iα=0.27% *4* was assigned by 1985De14 from 1147 and/or 1149 levels to the ^{213}Fr g.s.
1498.1 *4*	19/2$^-$		%$\alpha\le$0.46 *13* (1985De14) Observed 11137 *15* α doublet with Iα=0.46% *13* was assigned by 1985De14 from 1498 and/or 1528 levels to the ^{213}Fr g.s. $T_{1/2}$: see comment for half-life on 1528 level.
1528.4 *5*	(21/2)$^-$	<10 ns	%$\alpha\le$0.46 *13* (1985De14) Observed 11137 *15* α doublet with Iα=0.46% *13* was assigned by 1985De14 from 1498 and/or 1528 levels to the ^{213}Fr g.s. $T_{1/2}$: from $\gamma\gamma$(t) (1985De14). Other: 8 ns *2* was measured by 1973No02 for the 11130α from either the 1149 or 1528 level. No level with 8 ns half-life was found by 1985De14, but could not be definitely ruled out either by the authors.
1682.2 *6*	(23/2)$^-$		
1792.2 *6*	(25/2)$^-$		
1916.2 *6*	(27/2)$^-$		
2012.2 *7*	(29/2)$^+$	740 ns *40*	%α=4.51 *18* (1985De14); %IT=95.49 *18* g=+0.347 *5* (1985De14) This level partially decays by three α transitions (1985De14): Eα=11625 *17*, Iα=0.12 *2*, transition to ^{213}Fr g.s.; Eα=11137 *15*, Iα=0.32 *9*, transition to 498, 7/2$^-$ level in ^{213}Fr;

Continued on next page (footnotes at end of table)

^{217}Ac IT decay (740 ns) 1985De14 (continued)

^{217}Ac Levels (continued)

E(level)†	Jπ‡	$T_{1/2}$	Comments
			Eα=10541 *1* (from Eα=9650 and decay scheme), Iα=4.07 *16*, transition to 1105, 13/2$^+$ level in ^{213}Fr. The αγ data in 1985De14 revealed (10541α)(1105γ)- and (11137α)(498γ)-coincidences. g factor from Table 2 in 1985De14, where corrections for diamagnetic and Knight shifts were applied. Note that in authors′ level-scheme Figure 12, g=0.345 *10*. Their previous g=+0.34 *1* (1981MaYW). $T_{1/2}$: from γ(t) (1985De14). Other measurement: 400 ns *100* (1973No02). α(θ) measurements for 10.54-MeV α from the 2012 level: A_2=+0.56 *3*, A_4=+0.24 *5* (1985De14). See also 1973No02 for α(θ) measurement.

† From least-squares fit to Eγ data, assuming 0.3 keV uncertainty for each γ ray, except 1 keV when Eγ stated to nearest keV.
‡ From Adopted Levels.

$\gamma(^{217}Ac)$

Iγ normalization, I(γ+ce) normalization: 1/Branching. Absolute γ and electron intensities (per 100 decays of the isomer) given by 1985De14.
A_2 from γ(θ) data, and conversion electron intensities are from measurements by 1985De14.

E_γ[†]	I_γ[‡a]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[#]	δ	α[b]	$I_{(\gamma+ce)}$[a]	Comments
(30.3 *6*)	0.41 *4*	1528.4	(21/2)$^-$	1498.1	19/2$^-$	[M1]		114 *7*	47 *4*	ce(L)/(γ+ce)=0.75 *4*; ce(M)/(γ+ce)=0.180 *15* ce(N)/(γ+ce)=0.048 *5*; ce(O)/(γ+ce)=0.0111 *10*; ce(P)/(γ+ce)=0.00206 *19*; ce(Q)/(γ+ce)=0.000183 *17* α(L)=86 *6*; α(M)=20.7 *13* α(N)=5.5 *4*; α(O)=1.28 *8*; α(P)=0.236 *15*; α(Q)=0.0210 *14* E_γ: from the level scheme. The γ-ray is not seen, its existence was deduced by 1985De14 from the observed (154γ)(351γ) coincidence. Because of the prompt coincidences, $T_{1/2}$(1528.5 level)<10 ns; which implies M1 multipolarity for the 30.3γ (1985De14). $I_{(\gamma+ce)}$: weighted average of 48 *4* from intensity balance at the 1498 level, and 35 *15* from intensity balance at the 1528 level, deduced by evaluators. I_γ: from I(γ+ce) and α(theory) for M1.
96	5 *1*	2012.2	(29/2)$^+$	1916.2	(27/2)$^-$	E1+M2	0.17 *+5−6*	2.0 *12*		α(L)=1.44 *87*; α(M)=0.39 *24* α(N)=0.105 *64*; α(O)=0.024 *15*; α(P)=0.0043 *27*; α(Q)=3.2×10^{-4} *20* Ice(L)=6 *4*, Ice(M)=4 *3* (1985De14). Mult.,δ: from α(L)exp=1.2 *8*, α(M)exp=0.8 *6*; δ=0.17 *+5−6* deduced by evaluators using BrIccMixing code. 1985De14 give δ(M2/E1)=0.15 *5*.
110[&]	7 *1*	1792.2	(25/2)$^-$	1682.2	(23/2)$^-$	M1(+E2)	<0.4	12.5 *6*		α(K)=9.6 *8*; α(L)=2.17 *22*; α(M)=0.53 *7* α(N)=0.141 *17*; α(O)=0.033 *4*; α(P)=0.0059 *5*; α(Q)=0.00045 *4* Ice(L)=12 *7*, Ice(M)=3 *1*. Mult.,δ: from α(L)exp=1.7 *10*, α(M)exp=0.43 *15*, δ deduced by evaluators using BrIccMixing code. 1985De14 give M1.
153.8	16 *2*	1682.2	(23/2)$^-$	1528.4	(21/2)$^-$	M1+E2	+0.39 *8*	4.57 *18*		A_2=+0.19 *5* α(K)=3.52 *20*; α(L)=0.795 *20*; α(M)=0.195 *7* α(N)=0.0518 *17*; α(O)=0.0119 *4*; α(P)=0.00214 *5*; α(Q)=0.000161 *9* Ice(K)=53 *13*, Ice(L)=12 *3*, Ice(M)=3 *1*.

γ(^{217}Ac) (continued)

E_γ[†]	I_γ[‡a]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ	α[b]	Comments
									Mult.,δ: from α(K)(exp)=3.3 *9*, α(L)exp=0.75 *21*, α(M)exp=0.19 *7*, K/L=4.4 *15*, and δ=+0.39 *8* for ΔJ=1 from γ(θ). From ce data, evaluators deduce δ=0.4 *+5−4* using BrIccMixing code.
220	10 *2*	2012.2	(29/2)$^+$	1792.2	(25/2)$^-$	M2(+E3)	<0.6	7.62 *17*	α(K)=5.31 *11*; α(L)=1.72 *4*; α(M)=0.444 *10* α(N)=0.120 *3*; α(O)=0.0277 *7*; α(P)=0.00501 *12*; α(Q)=0.000403 *9* Ice(K)=55 *8*, Ice(L)=19 *3*, Ice(M)=5 *3*. Mult.,δ: from α(K)(exp)=5.5 *14*, α(L)exp=1.9 *5*, α(M)exp=0.50 *34*; BriccMixing code gives δ(E3/M2)<0.6, but this value gives B(E3)(W.u.) which is inconsistent with RUL, thus pure M2 is adopted as suggested in 1985De14, although, small E3 admixture is not excluded.
234[&]	5 *1*	1916.2	(27/2)$^-$	1682.2	(23/2)$^-$	E2[@]		0.357 *8*	α(K)=0.1185 *20*; α(L)=0.175 *4*; α(M)=0.0472 *11* α(N)=0.0126 *3*; α(O)=0.00276 *7*; α(P)=0.000445 *10*; α(Q)=6.66×10^{-6} *12* Ice(L)=2.7 *22*, Ice(M)=1.3 *12*. Mult.: from α(L)exp=0.54 *45*, α(M)exp=0.26 *24*.
349.0	16 *2*	1498.1	19/2$^-$	1149.1	15/2$^-$	E2[@]		0.1028	α(N)=0.00259 *4*; α(O)=0.000576 *9*; α(P)=9.50×10^{-5} *14*; α(Q)=2.62×10^{-6} *4* α(K)=0.0529 *8*; α(L)=0.0369 *6*; α(M)=0.00975 *14* Ice(K)=0.58 *55*, Ice(L)=0.46 *24*. Mult.: from α(K)(exp)=0.036 *35*, α(L)exp=0.029 *16*.
351.5	21 *2*	1498.1	19/2$^-$	1146.6	17/2$^-$	M1+E2	+0.65 *+20−10*	0.38 *5*	A_2=+0.30 *4* (1985De14) α(K)=0.30 *5*; α(L)=0.063 *5*; α(M)=0.0154 *11* α(N)=0.0041 *3*; α(O)=0.00094 *7*; α(P)=0.000171 *14*; α(Q)=1.34×10^{-5} *19* Ice(K)=7.4 *12*, Ice(L)=2.3 *8*, Ice(M)=0.53 *18*. Mult.,δ: from α(K)(exp)=0.35 *7*, α(L)exp=0.109 *40*, α(M)exp=0.025 *9*, and δ=+0.65 *+20−10* for ΔJ=1 from γ(θ). From ce data, evaluators deduce δ=0.3 *+5−3* using BrIccMixing code.
381.8	46 *5*	1528.4	(21/2)$^-$	1146.6	17/2$^-$	E2[@]		0.0803	A_2=+0.18 *3* α(K)=0.0442 *7*; α(L)=0.0267 *4*; α(M)=0.00702 *10* α(N)=0.00187 *3*; α(O)=0.000415 *6*; α(P)=6.90×10^{-5} *10*; α(Q)=2.15×10^{-6} *3* Ice(K)=1.7 *6*, Ice(L)=1.1 *5*, Ice(M)=0.31 *10*. Mult.,δ: from α(K)(exp)=0.037 *14*, α(L)exp=0.024 *11*, α(M)exp=0.0067 *23*, and γ(θ).
478.9	8 *2*	1149.1	15/2$^-$	670.2	11/2$^-$	E2[@]		0.0450	α(K)=0.0283 *4*; α(L)=0.01241 *18*; α(M)=0.00321 *5* α(N)=0.000854 *12*; α(O)=0.000191 *3*; α(P)=3.24×10^{-5} *5*; α(Q)=1.324×10^{-6} *19* Ice(K)=0.33 *24*, Ice(L)=0.23 *16*. E_γ: a 479-keV γ reported in 1982SaZO, placed from a 1498 level. Mult.: from α(K)(exp)=0.041 *19*, α(L)exp=0.029 *22*.

$\gamma(^{217}$Ac) (continued)

E_γ[†]	I_γ[‡a]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ	α[b]	Comments
486.4	77 *8*	1146.6	17/2⁻	660.2	13/2⁻	E2[@]		0.0434	A_2=+0.18 *3* (1985De14) α(K)=0.0275 *4*; α(L)=0.01181 *17*; α(M)=0.00305 *5* α(N)=0.000811 *12*; α(O)=0.000182 *3*; α(P)=3.08×10^{-5} *5*; α(Q)=1.282×10^{-6} *18* Ice(K)=1.6 *7*, Ice(L)=0.92 *47*. Mult.: from α(K)(exp)=0.021 *10*, α(L)exp=0.012 *6*, and $\gamma(\theta)$.
489[&]	6 *2*	1149.1	15/2⁻	660.2	13/2⁻	M1(+E2)	<1	0.16 *4*	α(K)=0.130 *35*; α(L)=0.026 *5*; α(M)=0.0062 *11* α(N)=0.0016 *3*; α(O)=0.00038 *7*; α(P)=7.0×10^{-5} *14*; α(Q)=5.8×10^{-6} *16* γ not seen in 1982GoZU. Ice(K)=1.1 *4*, Ice(L)=0.18 *9*. Mult.,δ: from α(K)(exp)=0.18 *9* and α(L)exp=0.030 *18*; δ deduced by evaluators using BrIccMixing code. 1985De14 deduce up to 90% E2 admixture, or δ<3.
660.3	83 *7*	660.2	13/2⁻	0.0	9/2⁻	E2		0.0218	A_2=+0.17 *2* (1985De14) α(N)=0.000318 *5*; α(O)=7.20×10^{-5} *11*; α(P)=1.252×10^{-5} *18*; α(Q)=6.89×10^{-7} *10* α(K)=0.01544 *22*; α(L)=0.00474 *7*; α(M)=0.001198 *17* Ice(K)=0.92 *25*, Ice(L)=0.32 *11*, Ice(M)=0.07 *7*. Mult.: from K/L(exp)=2.8 *12*.
670.1	11 *3*	670.2	11/2⁻	0.0	9/2⁻	M1+E2		0.055 *34*	α(K)=0.043 *29*; α(L)=0.0088 *43*; α(M)=0.00213 *98* α(N)=5.6×10^{-4} *26*; α(O)=1.30×10^{-4} *62*; α(P)=2.4×10^{-5} *12*; α(Q)=1.9×10^{-6} *13* Ice(K)=0.31 *31*, Ice(L)=0.08 *4*, Ice(M)=0.04 *4*. Mult.,δ: from α(L)exp=0.0073 *36*; δ overlaps all values. α: value within the uncertainty overlaps pure M1 and pure E2.

[†] Measured Eγ values in 1985De14 were reported to nearest keV and with no uncertainties. Corresponding values in 1983GoZX and 1982GoZU listed to nearest tenth of a keV agree with those in 1985De14. More precise values from 1983GoZX are given here when available, even though these values are also listed without uncertainties, and remain unpublished as a regular journal article.

[‡] Absolute photon intensities from 1985De14.

[#] From ce measurements and angular distribution data of 1985De14. The ce intensities given in 1985De14 are absolute intensities per 100 decays of the 740-ns isomer.

[@] From ce data as well as $\gamma(\theta)$ data, M1 admixture is possible, however, based on the level scheme, mult=E2 is required.

[&] This γ from 1985De14 only, not reported by 1983GoZX or 1982GoZU.

[a] For absolute intensity per 100 decays, multiply by 1.0007 *19*.

[b] Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multipolarities, and mixing ratios, unless otherwise specified.

$^{217}_{89}$Ac$_{128}$-5

^{217}Ac IT decay (740 ns) 1985De14