

Energy levels and branching ratios [01Br31].

 $^{219}_{89}\text{Ac}$

E^* [keV]	$2J^\pi$	$T_{1/2}$ or Γ_{cm}	Branching ratios in percentage							
			E_f^* : $2J_f^\pi$:	0.0 9^-	341 $\langle 11 \rangle^-$	355 $\langle 13 \rangle^-$	577 $\langle 13^+ \rangle$	631 $\langle 13 \rangle^+$	658 $\langle 15 \rangle^-$	714 $\langle 17 \rangle^-$
0.0	9^-	11.8(15) μs								
193(14)										
341.000(10)	$\langle 11 \rangle^-$			100						
355.246(10)	$\langle 13 \rangle^-$			100						
576.844(19)	$\langle 13^+ \rangle$				74(4)	26(2)				
631.41(4)	$\langle 13 \rangle^+$				100					
657.634(13)	$\langle 15 \rangle^-$				56(3)	35(2)	8.6(4)			
714.553(21)	$\langle 17 \rangle^-$					75(5)			25.1(8)	
866.646(16)	$\langle 17^+ \rangle$						6.4(7)		93.6(7)	x
926.42(3)	$\langle 17 \rangle^+$						34(3)	14(2)	53(2)	
965.274(23)	$\langle 19^+ \rangle$									100
1017.663(20)	$\langle 19^- \rangle$								44(7)	7(2)
1116.000(22)	$\langle 21 \rangle^-$									56.5(10)
1180.41(3)	$\langle 19^- \rangle$									
1182.983(21)	$\langle 21^+ \rangle$									
1292.72(5)	$\langle 21 \rangle^+$									
1301.003(22)	$\langle 23^+ \rangle$									
1413.701(23)	$\langle 23^- \rangle$									
1461.43(16)										
1546.988(22)	$\langle 25^+ \rangle$									
1551.721(24)	$\langle 25 \rangle^-$									
1551.74(7)	$\langle 23^- \rangle$									
1698.77(4)	$\langle 27^+ \rangle$									
1699.97(6)	$\langle 25^+ \rangle$									
1700+X										
1710.50(5)	$\langle 25^+ \rangle$									
1812.951(24)	$\langle 27^- \rangle$									
1959.287(24)	$\langle 29^+ \rangle$									
2023.84(5)	$\langle 29^- \rangle$									
2113.83(12)	$\langle 29^+ \rangle$									
2129.4(4)	$\langle 29^- \rangle$									
2149.25(5)	$\langle 31^+ \rangle$									
2179+X										
2245.17(4)	$\langle 31^- \rangle$									
2351.22(3)	$\langle 33^+ \rangle$									
2401.61(7)	$\langle 33^- \rangle$									
2427.59(21)	$\langle 33^+ \rangle$									
2444.52(9)	$\langle 33^+ \rangle$									
2735+X										
2806.16(5)	$\langle 37^+ \rangle$									
2835.15(14)	$\langle 37^- \rangle$									
2836.73(21)	$\langle 37^+ \rangle$									
3249.08(8)	$\langle 41^+ \rangle$									

(continued)

²¹⁹Ac

E^*	$2J^\pi$	$T_{1/2}$ or	Branching ratios in percentage							
[keV]		Γ_{cm}	E_f^* : $2J_f^\pi$:	0.0 9 ⁻	341 ⟨11⟩ ⁻	355 ⟨13⟩ ⁻	577 ⟨13⟩ ⁺	631 ⟨13⟩ ⁺	658 ⟨15⟩ ⁻	714 ⟨17⟩ ⁻
3254.52(15)	⟨41 ⁻ ⟩									
3720.79(17)	⟨45 ⁻ ⟩									

Additional data on this isotope can be found in [94Cr01].

Data for this isotope are considered in vol. LB I/18C.

Energy levels and branching ratios [01Br31]. Part 2

²¹⁹Ac

E^*	$2J^\pi$	Branching ratios in percentage										
[keV]		E_f^* : $2J_f^\pi$:	866.646 $\langle 17^+ \rangle$	926.42 $\langle 17 \rangle^+$	965.274 $\langle 19^+ \rangle$	1017.66 $\langle 19^- \rangle$	1116.00 $\langle 21 \rangle^-$	1180.41 $\langle 19^- \rangle$	1182.98 $\langle 21^+ \rangle$	1292.72 $\langle 21 \rangle^+$	1301.00 $\langle 23^+ \rangle$	1413.70 $\langle 23^- \rangle$
1017.663(20)	$\langle 19^- \rangle$		49(5)									
1116.000(22)	$\langle 21 \rangle^-$				44(7)							
1180.41(3)	$\langle 19^- \rangle$			100								
1182.983(21)	$\langle 21^+ \rangle$	32(3)			8(3)	59.9(9)	x					
1292.72(5)	$\langle 21 \rangle^+$			71(4)				29(4)				
1301.003(22)	$\langle 23^+ \rangle$				16.5(14)		83.5(18)					
1413.701(23)	$\langle 23^- \rangle$					19.3(5)			80.7(20)			
1461.43(16)				100								
1546.988(22)	$\langle 25^+ \rangle$								45(1)		11.9(5)	43.2(5)
1551.721(24)	$\langle 25 \rangle^-$						32(2)				68(3)	
1551.74(7)	$\langle 23^- \rangle$									100		
1698.77(4)	$\langle 27^+ \rangle$										70.4(17)	
1699.97(6)	$\langle 25^+ \rangle$									100		
1710.50(5)	$\langle 25^+ \rangle$									72(3)		
1812.951(24)	$\langle 27^- \rangle$											14.3(8)

Energy levels and branching ratios [01Br31]. Part 3

²¹⁹Ac

E^*	$2J^\pi$	Branching ratios in percentage										
[keV]		E_f^* : $2J_f^\pi$:	1461.43	1546.99	1551.72	1551.74	1698.77	1699.97	1700+X	1812.95	1959.29	2023.84
				$\langle 25^+ \rangle$	$\langle 25 \rangle^-$	$\langle 23^- \rangle$	$\langle 27^+ \rangle$	$\langle 25^+ \rangle$		$\langle 27^- \rangle$	$\langle 29^+ \rangle$	$\langle 29^- \rangle$
1698.77(4)	$\langle 27^+ \rangle$				30(12)							
1700+X								x				
1710.50(5)	$\langle 25^+ \rangle$					28(3)						
1812.951(24)	$\langle 27^- \rangle$			85.7(11)								
1959.287(24)	$\langle 29^+ \rangle$			43.4(1)			13.7(9)			43(7)		
2023.84(5)	$\langle 29^- \rangle$				21(5)		79(6)					
2113.83(12)	$\langle 29^+ \rangle$							100				
2129.4(4)	$\langle 29^- \rangle$	x										

(continued)

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E^*	$2J^\pi$	Branching ratios in percentage										
[keV]		E_f^* : $2J_f^\pi$:	1461.43	1546.99	1551.72	1551.74	1698.77	1699.97	1700+X	1812.95	1959.29	2023.84
			$\langle 25^+ \rangle$	$\langle 25 \rangle^-$	$\langle 23^- \rangle$	$\langle 27^+ \rangle$	$\langle 25^+ \rangle$			$\langle 27^- \rangle$	$\langle 29^+ \rangle$	$\langle 29^- \rangle$
2149.25(5)	$\langle 31^+ \rangle$						60(4)					40(2)
2179+X									100			
2245.17(4)	$\langle 31^- \rangle$									31(2)	69(3)	
2351.22(3)	$\langle 33^+ \rangle$										100	
2427.59(21)	$\langle 33^+ \rangle$										100	
2444.52(9)	$\langle 33^+ \rangle$										100	

Energy levels and branching ratios [01Br31]. Part 4

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E^* [keV]	$2J^\pi$	Branching ratios in percentage									
		E_f^* : $2J_f^\pi$:	2149.25 $\langle 31^+ \rangle$	2179+X	2245.17 $\langle 31^- \rangle$	2351.22 $\langle 33^+ \rangle$	2401.61 $\langle 33^- \rangle$	2427.59 $\langle 33^+ \rangle$	2806.16 $\langle 37^+ \rangle$	2835.15 $\langle 37^- \rangle$	3254.52 $\langle 41^- \rangle$
2179+X		x									
2351.22(3)	$\langle 33^+ \rangle$				x						
2401.61(7)	$\langle 33^- \rangle$				100						
2735+X				100							
2806.16(5)	$\langle 37^+ \rangle$					100					
2835.15(14)	$\langle 37^- \rangle$						100				
2836.73(21)	$\langle 37^+ \rangle$							100			
3249.08(8)	$\langle 41^+ \rangle$								100		
3254.52(15)	$\langle 41^- \rangle$									100	
3720.79(17)	$\langle 45^- \rangle$										100

Energy levels and branching ratios [97Ar04].

 $^{220}_{89}\text{Ac}$

E^* [keV]	J^π	$T_{1/2}$ or Γ_{cm}	Branching ratios in percentage							
			E_f^* : J_f^π :	0 $\langle 3^- \rangle$	13.79	40.69	68.71 $\langle 5^- \rangle$	71.56	108.51	113.30
0	$\langle 3^- \rangle$	26.4(2) ms								
13.79(13)				x						
40.69(10)				x						
68.71(14)	$\langle 5^- \rangle$					x				
71.56(20)					x					
108.51(18)						x				
113.30(20)				x						
145.6(3)								x		
150.18(14)						x				
153.00(10)				69(5)	31(3)			≤ 19		x
184.21(16)				77(6)	23(4)					

(continued)

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E^* [keV]	J^π	$T_{1/2}$ or Γ_{cm}	Branching ratios in percentage						
			$E_f^*:$ $J_f^\pi:$	0 $\langle 3^- \rangle$	13.79	40.69	68.71 $\langle 5^- \rangle$	71.56	108.51 113.30
233.81(17)	$\langle 4^+, 5^+, 6^+ \rangle$						x		
263.22(15)	$\langle 4^+, 5^+, 6^+ \rangle$						67(4)		12(3)
312.0(8)					x				
335.18(20)				≈ 10		≈ 21			
356.1(3)						≈ 9	49(12)		42(12)
411.9(7)				≈ 50	≈ 50				
0.0+X	J								
59.0+X	$J+1$								
136.2+X	$J+2$								
305.1+X	$J+3$								
401.3+X	$J+4$								
507.1+X	$J+4$								
554.6+X	$J+4$								
614.0+X	$J+5$								
625.3+X	$J+5$								
731.1+X	$J+6$								
774.0+X	$J+6$								
779.1+X	$J+5$								
887.0+X	$J+6$								
914.1+X	$J+7$								
973.7+X	$J+7$								
1103.4+X	$J+8$								
1113.0+X	$J+8$								
1120.1+X	$J+7$								
1266.1+X	$J+9$								
1267.8+X	$J+8$								
1372.9+X	$J+9$								
1485.2+X	$J+9$								
1488.9+X	$J+10$								
1534.5+X	$J+10$								
1678.1+X	$J+11$								
1704.3+X	$J+10$								
1790.2+X	$J+11$								
1883.6+X	$J+11$								
1935.1+X	$J+12$								
1974.0+X	$J+12$								
2145.9+X	$J+13$								
2164.8+X	$J+\langle 12 \rangle$								
2223.6+X	$J+13$								
2339.6+X	$J+\langle 13 \rangle$								
2416.2+X	$J+14$								
2431.3+X	$J+14$								
2637.0+X	$J+\langle 14 \rangle$								
2649.2+X	$J+\langle 15 \rangle$								
2686.9+X	$J+\langle 15 \rangle$								

(continued)

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E^* [keV]	J^π	$T_{1/2}$ or Γ_{cm}	Branching ratios in percentage						
			E^*_f : J^π_f :	0 $\langle 3^- \rangle$	13.79	40.69	68.71 $\langle 5^- \rangle$	71.56	108.51 113.30
2822.3+X	$J+\langle 15 \rangle$								
2909.9+X	$J+\langle 16 \rangle$								
2916.5+X	$J+\langle 16 \rangle$								
3175.9+X	$J+\langle 17 \rangle$								
3180.6+X	$J+\langle 17 \rangle$								
3405.6+X	$J+\langle 18 \rangle$								

Additional data on this isotope can be found in [96Li05, 91Sc19, 90Sc06].

Energy levels and branching ratios [97Ar04]. Part 2

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E^*	J^π	$E^*_\text{f}:$	150.18	153.00	184.21	Branching ratios in percentage					
[keV]		$J^\pi_\text{f}:$				0.0+X	59.0+X	136.2+X	305.1+X	401.3+X	507.1+X
						J	$J+1$	$J+2$	$J+3$	$J+4$	$J+4$
263.22(15)	$\langle 4^+, 5^+, 6^+ \rangle$		21(2)								
335.18(20)				≈ 26	43(13)						
59.0+X	$J+1$					x					
136.2+X	$J+2$						x				
305.1+X	$J+3$						63.9(8)	36.1(8)			
401.3+X	$J+4$							82.3(17)	17.7(17)		
507.1+X	$J+4$								x		
554.6+X	$J+4$							54(4)	46(4)		
614.0+X	$J+5$								31.6(7)	13.2(5)	55.2(7)
625.3+X	$J+5$									x	
731.1+X	$J+6$									55(3)	
774.0+X	$J+6$										15.0(10)

Energy levels and branching ratios [97Ar04]. Part 3

 $^{220}_{89}\text{Ac}$

E^*	J^π	Branching ratios in percentage								
[keV]	E^*_f : J^π_f :	554.6+X $J+4$	614.0+X $J+5$	625.3+X $J+5$	731.1+X $J+6$	774.0+X $J+6$	779.1+X $J+5$	887.0+X $J+6$	914.1+X $J+7$	973.7+X $J+7$
731.1+X	$J+6$		7(4)	38(2)						
774.0+X	$J+6$		85.0(10)							
779.1+X	$J+5$	x								
887.0+X	$J+6$	41(2)					59(2)			
914.1+X	$J+7$			16.9(19)	79(2)	4.5(14)				
973.7+X	$J+7$		29.5(14)		<11	70.5(14)				
1103.4+X	$J+8$					24(3)			12(2)	64(3)
1113.0+X	$J+8$				24.2(14)				74.0(17)	1.8(8)

(continued)

 $^{220}_{89}\text{Ac}$

E^*	J^π	Branching ratios in percentage									
		E^*_f :	554.6+X	614.0+X	625.3+X	731.1+X	774.0+X	779.1+X	887.0+X	914.1+X	973.7+X
[keV]		J^π_f :	$J+4$	$J+5$	$J+5$	$J+6$	$J+6$	$J+5$	$J+6$	$J+7$	$J+7$
1120.1+X	$J+7$								x		
1266.1+X	$J+9$									29(2)	
1267.8+X	$J+8$								49(3)		
1372.9+X	$J+9$										12.5(15)

Energy levels and branching ratios [97Ar04]. Part 4

 $^{220}_{89}\text{Ac}$

E^*	J^π	Branching ratios in percentage									
[keV]	$E^*_\text{f}:$ $J^\pi_\text{f}:$	1103+X $J+8$	1113+X $J+8$	1120+X $J+7$	1266+X $J+9$	1268+X $J+8$	1373+X $J+9$	1485+X $J+9$	1489+X $J+10$	1535+X $J+10$	
1266.1+X	$J+9$	6.4(12)	65(2)								
1267.8+X	$J+8$			51(3)							
1372.9+X	$J+9$	80.8(19)	6.6(15)								
1485.2+X	$J+9$			16(8)		84(8)					
1488.9+X	$J+10$	54(3)			16(3)		30(2)				
1534.5+X	$J+10$		15(4)		85(4)						
1678.1+X	$J+11$				50(2)				6(2)	44(2)	
1704.3+X	$J+10$					33(4)		67(4)			
1790.2+X	$J+11$						15(3)		85(3)	x	
1883.6+X	$J+11$							42(4)			
1935.1+X	$J+12$								57(2)		
1974.0+X	$J+12$									19(3)	

Energy levels and branching ratios [97Ar04]. Part 5

 $^{220}_{89}\text{Ac}$

E^*	J^π	Branching ratios in percentage									
[keV]		E_f^* : J_f^π :	1678+X $J+11$	1704+X $J+10$	1790+X $J+11$	1884+X $J+11$	1935+X $J+12$	1974+X $J+12$	2146+X $J+13$	2165+X $J+\langle 12 \rangle$	2224+X $J+13$
1883.6+X	$J+11$			58(4)							
1935.1+X	$J+12$		11.5(14)		31(2)						
1974.0+X	$J+12$		81(3)								
2145.9+X	$J+13$		63(3)				<13	37(3)			
2164.8+X	$J+\langle 12 \rangle$			31(9)		69(9)					
2223.6+X	$J+13$				18(4)		82(4)				
2339.6+X	$J+\langle 13 \rangle$					60(10)				40(10)	
2416.2+X	$J+14$						56(4)		<10		44(4)
2431.3+X	$J+14$							62(12)	38(12)		
2637.0+X	$J+\langle 14 \rangle$									x	

(continued)

 $^{220}_{89}\text{Ac}$

E^*	J^π	Branching ratios in percentage									
		E^*_f :	1678+X	1704+X	1790+X	1884+X	1935+X	1974+X	2146+X	2165+X	2224+X
[keV]		J^π_f :	$J+11$	$J+10$	$J+11$	$J+11$	$J+12$	$J+12$	$J+13$	$J+\langle 12 \rangle$	$J+13$
2649.2+X	$J+\langle 15 \rangle$								42(4)		
2686.9+X	$J+\langle 15 \rangle$										17(4)

Energy levels and branching ratios [97Ar04]. Part 6

 $^{220}_{89}\text{Ac}$

E^*	J^π	Branching ratios in percentage									
		E^*_f :	2340+X	2416+X	2431+X	2637+X	2649+X	2687+X	2910+X	2917+X	3181+X
[keV]		J^π_f :	$J+\langle 13 \rangle$	$J+14$	$J+14$	$J+\langle 14 \rangle$	$J+\langle 15 \rangle$	$J+\langle 15 \rangle$	$J+\langle 16 \rangle$	$J+\langle 16 \rangle$	$J+\langle 17 \rangle$
2637.0+X	$J+\langle 14 \rangle$	x									
2649.2+X	$J+\langle 15 \rangle$			12(4)	45(4)						
2686.9+X	$J+\langle 15 \rangle$			83(4)							
2822.3+X	$J+\langle 15 \rangle$	x				x					
2909.9+X	$J+\langle 16 \rangle$				35(10)		65(10)				
2916.5+X	$J+\langle 16 \rangle$			50(8)				50(8)			
3175.9+X	$J+\langle 17 \rangle$							x		x	
3180.6+X	$J+\langle 17 \rangle$						x		x		
3405.6+X	$J+\langle 18 \rangle$								x		x

Energy levels [90Ak05].

 $^{221}_{89}\text{Ac}$

E^* [keV]	$2J^\pi$	$T_{1/2}$ or Γ_{cm}
0.0		52(2) ms
52(15)		

Additional data on this isotope can be found in [94Ai01].

The level scheme with many states at E^* up to 2515 keV was suggested [94Ai01] in assumption that the ground state and the first excited state at 9 keV have $2J^\pi = 3^-$ and 5^- , respectively.

Energy levels [96El01].

 $^{222}_{89}\text{Ac}$

E^* [keV]	J^π	$T_{1/2}$ or Γ_{cm}
0.0	1^-	5.0(5) s
0.0+X		63(3) s

(continued)

 $^{222}_{89}\text{Ac}$

E^*	J^π	$T_{1/2}$ or
[keV]		Γ_{cm}
41(14)		
137(14)		

Energy levels and branching ratios [01Br31].

 $^{223}_{89}\text{Ac}$

E^*	$2J^\pi$	$T_{1/2}$ or	Branching ratios in percentage						
[keV]		Γ_{cm}	E^*_f : $2J^\pi_f$:	0.0 $\langle 5^- \rangle$	42.4 $\langle 7^- \rangle$	50.7 $\langle 5^- \rangle$	64.62 $\langle 5^+ \rangle$	90.7 $\langle 9^- \rangle$	110.06 $\langle 7^+ \rangle$
0.0	$\langle 5^- \rangle$	2.10(5) m							
12.5(2)	$\langle 3^- \rangle$								
42.4(1)	$\langle 7^- \rangle$	≤ 0.25 ns		100					
50.7(1)	$\langle 5^- \rangle$	≤ 0.25 ns		94	6				
64.62(4)	$\langle 5^+ \rangle$	≤ 0.25 ns		98	2.1(6)				
90.7(1)	$\langle 9^- \rangle$	≤ 0.25 ns			100				
107.2(2)	$\langle 7^- \rangle$	≤ 0.25 ns		≈ 56		≈ 44			
110.06(4)	$\langle 7^+ \rangle$	≤ 0.25 ns		69(5)	23(3)	5.8(14)	≈ 1.7		
130.7(1)	$\langle 7^+ \rangle$			64(15)		36(6)			
141(5)	$\langle 11^- \rangle$								
167.5(1)	$\langle 9^+ \rangle$	≤ 0.25 ns			88(13)			12(6)	x

Additional data on this isotope can be found in [90Sh15, 90Sc16].

Data for this isotope are considered in vol. LB I/18C.

Energy levels and branching ratios [97Ar05].

 $^{224}_{89}\text{Ac}$

E^*	J^π	$T_{1/2}$ or	Ref.	Branching ratios in percentage							
[keV]		Γ_{cm}		E_{f}^* : J_{f}^π :	0 0 [−]	17.6	23.3	29.8 1 ⁺	37.2	45.7	47.3
0.0*	0 [−]	2.78(17) h	93Sh07								
17.6(2)*	1 [−]		93Sh07								
23.3(2)											
29.8(1)**	1 ⁺		93Sh07		x						
37.2(2)*	2 [−]		93Sh07								
45.7(4)											
47.3(4)											
49.1(2)											
52.2(2)**	2 ⁺		93Sh07		11(3)	63(7)	26(4)	x			
64.4(3)	⟨1 ⁺ ⟩		93Sh07				x				
78.5(2)*	3 [−]		93Sh07					69(11)			
80.5(2)**	3 ⁺		93Sh07						96(12)		

(continued)

 $^{224}_{89}\text{Ac}$

E^* [keV]	J^π	$T_{1/2}$ or Γ_{cm}	Ref.	Branching ratios in percentage							
				E_f^* : J_f^π :	0 0 ⁻	17.6	23.3	29.8 1 ⁺	37.2	45.7	47.3
89.3	$\langle 1^- \rangle$		93Sh07								
90.4(2)	$\langle 2^+ \rangle$		93Sh07				x				
103.6(3)											
109.3(2)											
110.3(3)											
116.5(2)*	4 ⁻		93Sh07								
130.3(2)**	4 ⁺		93Sh07								
132.9	$\langle 2, 3^- \rangle$		93Sh07								
142.5(3)											
160(2)											
169(2)											
176.7(2)**	5 ⁺		93Sh07								
183.4(3)*	5 ⁻		93Sh07								
212(2)											
219.7(4)											
236.5(4)*	$\langle 6 \rangle$		93Sh07								
252.7(2)**	$\langle 6 \rangle$		93Sh07								
283.4(2)							52(6)		19(4)	13(3)	
300(2)											
317.2(5)									x		
333.0(2)								23(4)	≈ 7		≈ 4
354.0(2)*	3 ⁻		93Sh07						66(9)		
360.2(2)**	3 ⁺		93Sh07					15(2)			≈ 3
380.8(2)								≈ 9			
395.8(2)*	4 ⁻		93Sh07								
402.9(2)**	4 ⁺		93Sh07								
448.1(2)											
452.0(4)*	$\langle 5^- \rangle$		93Sh07								

Additional data on this isotope can be found in [94Ah03, 91Sh14].

Recently suggested level scheme based on data from [93Sh07, 94Ah03] can be found in [04Sh25].

* Bands with K=0⁻ and K=3⁻ [93Sh07].** Bands with K=0⁺ and K=3⁺ [93Sh07].

Energy levels and branching ratios [97Ar05]. Part 2

 $^{224}_{89}\text{Ac}$

E^*	J^π	Branching ratios in percentage										
[keV]		E^*_f :	49.1	52.2	64.4	78.5	80.5	90.4	103.6	109.3	110.3	116.5
		J^π_f :										
78.5(2)*	3^-			31(4)								
80.5(2)**	3^+			≈ 4								
103.6(3)			x									
109.3(2)			100									

(continued)

 $^{224}_{89}\text{Ac}$

E^*	J^π	Branching ratios in percentage										
[keV]		E_f^* : J_f^π :	49.1	52.2	64.4	78.5	80.5	90.4	103.6	109.3	110.3	116.5
110.3(3)			x									
116.5(2)*	4^-				47(8)		53(8)					
130.3(2)**	4^+		43(7)			48(5)	10(2)					
176.7(2)**	5^+								8(3)	36(5)		45(7)
183.4(3)*	5^-								38(7)	17(4)		
283.4(2)								6(2)				
333.0(2)			≈ 11	≈ 7			14(3)	11(2)			≈ 4	
354.0(2)*	3^-				≈ 15					6.3(15)		12.1(15)
360.2(2)**	3^+			53(5)			5.0(12)					
380.8(2)				52(7)			≈ 9					
395.8(2)*	4^-		13(5)			≈ 74						
402.9(2)**	4^+						60(8)	≈ 10	≈ 20			
448.1(2)									≈ 20			
452.0(4)*	$\langle 5^- \rangle$											x

Energy levels and branching ratios [97Ar05]. Part 3

 $^{224}_{89}\text{Ac}$

E^* [keV]	J^π	Branching ratios in percentage					
		$E_f^*:$ $J_f^\pi:$	130.3	142.5	176.7	183.4	252.7
176.7(2)**	5^+		≈ 11				
183.4(3)*	5^-		45(7)				
219.7(4)				x			
236.5(4)*	$\langle 6 \rangle$				x		
252.7(2)**	$\langle 6 \rangle$		≈ 9	34(7)	17(4)	40(7)	
283.4(2)				10(3)			
333.0(2)			20(3)				
360.2(2)**	3^+		24(4)				
380.8(2)			31(6)				
395.8(2)*	4^-			≈ 8		≈ 5	
402.9(2)**	4^+				≈ 10		
448.1(2)			≈ 60				20(6)

Energy levels and branching ratios [90Ak03].

 $^{225}_{89}\text{Ac}$

E^* [keV]	$2J^\pi$	$T_{1/2}$ or Γ_{cm}	Branching ratios in percentage							
			E^*_f : $2J^\pi_f$:	0.0 $\langle 3^- \rangle$	29.94 $\langle 5^- \rangle$	40.09 $\langle 3^+ \rangle$	64.70 $\langle 5^+ \rangle$	77.12 $\langle 7^- \rangle$	105.06 $\langle 7^+ \rangle$	120.80 $\langle 5^- \rangle$
0.0	$\langle 3^- \rangle$	10.0(1) d								
29.94(10)	$\langle 5^- \rangle$			x						
40.09(5)	$\langle 3^+ \rangle$	0.72(3) ns		x						
64.70(5)	$\langle 5^+ \rangle$			95(9)	≈ 5					
77.12(14)	$\langle 7^- \rangle$									
105.06(12)	$\langle 7^+ \rangle$				100		x			
120.80(5)	$\langle 5^- \rangle$			95(9)		4.8(9)				
144.95(15)	$\langle 9^+ \rangle$							100		
155.65(7)	$\langle 5^+ \rangle$			≈ 4	14.2(14)	73(6)				≈ 9
170.79(13)	$\langle 7^- \rangle$				68(8)			32(5)		
199.85(9)	$\langle 7^+ \rangle$				19(2)		34(3)	8(1)	21(2)	17(2)
221(7)										
235.5(2)	$\langle 9^- \rangle$							x		
257.04(16)	$\langle 9^+ \rangle$							26(7)	36(7)	
≈ 318										
327(7)										
421(7)										

Additional data on this isotope can be found in [84Ah01].

Data for this isotope are considered in vol. LB I/18C.

Energy levels and branching ratios [90Ak03]. Part 2

 $^{225}_{89}\text{Ac}$

E^* [keV]	$2J^\pi$	Branching ratios in percentage	
		E^*_f : $2J^\pi_f$:	144.95 $\langle 9^+ \rangle$
257.04(16)	$\langle 9^+ \rangle$		39(7)

Energy levels [96Ak02].

 $^{226}_{89}\text{Ac}$

E^* [keV]	J^π	$T_{1/2}$ or Γ_{cm}
0.0	$\langle 1 \rangle$	29.4(1) h
5.1(13)		
18.8(10)		
33.3(10)		
45.0(10)		
58.3(17)		
70.3(10)		

(continued)

 $^{226}_{89}\text{Ac}$

E^*	J^π	$T_{1/2}$ or Γ_{cm}
[keV]		
77.7(10)		
130.4(17)		
165(4)		
195(3)		
230(4)		
265(3)		
290(4)		
378(3)		
418(4)		
556(6)		
589(3)	$\langle 2^- \rangle$	

Energy levels and branching ratios [01Br31, 03Bu12].

 $^{227}_{89}\text{Ac}$

E^*	$2J^\pi$	L	S_N	σ (α, t)	σ (τ, d)	σ (p, α)	Nils.Conf.	$T_{1/2}$ or Γ_{cm}	Ref.
[keV]		(τ, d)	(τ, d)	<i>rel.</i>	<i>rel.</i>	$\mu\text{b/sr}$	$2J, 2K[Nn_z\Lambda]$		
0.0	3^-		0.024(6)	16	8		3,3-[532]	21.772(3) yr	03Bu12
27.37(1)	3^+		<0.03	49	12	0.7(2)	3,3+[651]	38.3(3) ns	88Ma18
29.98(1)	5^-		<0.1	incl	incl	incl	5,3-[532]		03Bu12
46.35(1)	5^+		0.018(8)	10	14		5,3+[651]		88Ma18
74.14(1)	$\langle 7^- \rangle$		0.17(2)	78	16		7,3-[532]		88Ma18
84.55(1)	$\langle 7^+ \rangle$		0.066(12)	26	18		7,3+[651]		88Ma18
109.94(2)	$\langle 9^+ \rangle$		0.24(2)	120	38	1.0(2)	9,3+[651]		88Ma18
126.86(2)	$\langle 9^- \rangle$		1.5(2)	324	50	2.4(3)	9,3-[532]		88Ma18
148(5)									
160(2)				26	<9				88Ma18
187.32(3)	$\langle 11^+ \rangle$			30	16		11,3+[651]		88Ma18
198.71(4)	$\langle 11^- \rangle$			19	27				88Ma18
210.78(5)	$\langle 13^+ \rangle$			517	109	3.7(4)	13,3+[651]		88Ma18
227(2)				89	<10				88Ma18
249(2)				<10					88Ma18
271.29(6)	$\langle 13^- \rangle$			18	13	0.4(2)	13,3-[532]		88Ma18
273.14(3)	$\langle 5^- \rangle$			incl	incl	incl	5,5-[523]		03Bu12
304.73(5)	$\langle 5^+ \rangle$			25	27		5,5+[642]		88Ma18
316(2)	$\langle 7^- \rangle$			141	67		7,5-[523]		88Ma18
330.04(1)	3^-			186	166	2.2(3)	3,1-[530]	<70 ps	88Ma18
342(5)	$\langle 7^+ \rangle$			59			7,5+[642]		88Ma18
354.50(4)	1^-			56		1.9(5)	1,1-[530]		88Ma18
372(2)	$\langle 9^- \rangle$			260	92	incl	9,5-[523]		88Ma18
387.23(2)	7^-			372	75	4.2(6)	7,1-[530]		88Ma18
403(5)	$\langle 9^+ \rangle$			99	<10		9,5+[642]		88Ma18

(continued)

 $^{227}_{89}\text{Ac}$

E^*	$2J^\pi$	L	S_N	$\sigma(\alpha, t)$	$\sigma(\tau, d)$	$\sigma(p, \alpha)$	Nils.Conf.	$T_{1/2}$ or	Ref.
[keV]		(τ, d)	(τ, d)	<i>rel.</i>	<i>rel.</i>	$\mu\text{b/sr}$	$2J, 2K[Nn_z\Lambda]$	Γ_{cm}	
425.59(3)	5^+						5,1+[660]		03Bu12
428.4(2)									
435.19(2)	$\langle 1 \rangle^+$					5.4(6)	1,1+[660]		03Bu12
437.96(4)	$\langle 5^- \rangle$					incl	5,1-[530]		03Bu12
469.24(6)	$\langle 9^+ \rangle$						9,1+[660]		03Bu12
501.28(7)	$\langle 3^-, 5^- \rangle$					0.9(4)			03Bu12
514.36(9)	$\langle 3^+ \rangle$					4.9(7)			03Bu12
528(3)	$\langle 13^+ \rangle$					1.8(8)	13,5+[642]		03Bu12
537.0(1)	$\langle 3^+ \rangle$					incl	3,1+[660]		03Bu12
549(3)									
562.8(1)	$\langle 3^+, 5^+ \rangle$					2.4(5)			03Bu12
577	$\langle 9^- \rangle$					incl	9,1-[530]		03Bu12
593(2)	$\langle 13^+ \rangle$					2.0(4)	13,1+[660]		03Bu12
639.1(1)						21(2)	1,1+[400]		03Bu12
656.4(3)	$\langle 7^+ \rangle$					1.0(5)			03Bu12
698.6(2)						7.5(9)	3,1+[400]		03Bu12
725(4)						1.2(3)			03Bu12
790.2(2)						0.6(2)			03Bu12
816(4)						1.3(3)			03Bu12
863.6(2)						5.6(13)			03Bu12
874.7(2)						incl			
895(2)						9.1(13)	3,3+[402]		03Bu12
920(2)						2.3(8)			03Bu12
950(4)						3.3(8)			03Bu12
992(3)						1.7(5)			03Bu12
1076(3)						0.6(2)			03Bu12
1091(2)									
1117(2)						3.7(6)			03Bu12
1148(2)						2.2(4)			03Bu12
1183(3)						0.9(3)			03Bu12
1215(3)						0.8(3)			03Bu12
1274(4)						0.8(3)			03Bu12
1311(2)						4.1(4)			03Bu12
1385(2)						2.5(5)			03Bu12
1438(2)						6.2(6)			03Bu12
1483(2)						18(2)			03Bu12
1550(2)						2.8(8)			03Bu12
1591(2)						12(2)			03Bu12
1629(4)						10(2)			03Bu12
				88Ma18	88Ma18	03Bu12	03Bu12		Ref.

Data for this isotope are considered in vol. LB I/18C.

Energy levels and branching ratios [01Br31, 03Bu12]. Part 2

 $^{227}_{89}\text{Ac}$

E^* [keV]	$2J^\pi$	Branching ratios in percentage										
		E_f^* : $2J_f^\pi$:	0.0 3^-	27.4 3^+	29.9 5^-	46.3 5^+	74.1 $\langle 7 \rangle^-$	84.5 $\langle 7 \rangle^+$	109.94 $\langle 9 \rangle^+$	126.86 $\langle 9 \rangle^-$	187.32 $\langle 11^+ \rangle$	198.71 $\langle 11^- \rangle$
27.37(1)	3^+		100									
29.98(1)	5^-		100									
46.35(1)	5^+		25(2)	41(13)	34(10)							
74.14(1)	$\langle 7 \rangle^-$		27(4)		73(6)							
84.55(1)	$\langle 7 \rangle^+$			10(1)	29(2)	61(3)						
109.94(2)	$\langle 9 \rangle^+$					27(3)	8.9(4)	64(9)				
126.86(2)	$\langle 9 \rangle^-$				53(3)		47(3)					
187.32(3)	$\langle 11^+ \rangle$							<17	92(3)	8.1(13)		
198.71(4)	$\langle 11^- \rangle$						72(18)			28(15)		
210.78(5)	$\langle 13^+ \rangle$								86		14(3)	
271.29(6)	$\langle 13^- \rangle$									76(7)		24(8)
273.14(3)	$\langle 5 \rangle^-$		47(2)	8(2)	38(2)	2.3(5)	3.8(5)					
304.73(5)	$\langle 5^+ \rangle$			57(12)		39(8)	0.06(3)	4.1(8)				
330.04(1)	3^-		17.6(2)	28(3)	31(1)	21(3)	1.40(6)	0.10(1)				
354.50(4)	1^-		7.74(20)	2.9(3)								
387.23(2)	7^-		0.036(12)		12.5(5)	12.9(2)	7.2(2)	49(7)	5.0(2)	13.4(2)		
425.59(3)	5^+			10(1)	2.5(3)	55(2)	8(2)	24(4)				
428.4(2)			51(11)		49							
435.19(2)	$\langle 1 \rangle^+$		7.8(4)	90(4)		2.7(5)						
437.96(4)	$\langle 5^- \rangle$		18(2)	13(2)		31(3)	31(3)					
469.24(6)	$\langle 9^+ \rangle$							30(4)	70(8)			
501.28(7)	$\langle 3^-, 5^- \rangle$		51(10)		13(3)		0.02(1)					
514.36(9)	$\langle 3^+ \rangle$			87(17)		9.4(17)						
537.0(1)	$\langle 3^+ \rangle$			0.047(12)		33(7)						
562.8(1)	$\langle 3^+, 5^+ \rangle$			13(3)		29(6)	57(10)	1.7(3)				
639.1(1)			15(3)	85(19)								
656.4(3)	$\langle 7^+ \rangle$					56(3)	33.7(13)	4.0(8)	7(2)			
698.6(2)				40(8)		60(13)						
790.2(2)			55(10)		45(10)							
863.6(2)			61(12)	39(8)								
874.7(2)			50(10)	34(6)		16(4)						

Energy levels and branching ratios [01Br31, 03Bu12]. Part 3

 $^{227}_{89}\text{Ac}$

E^* [keV]	$2J^\pi$	Branching ratios in percentage					
		E_f^* : $2J_f^\pi$:	273.14 $\langle 5 \rangle^-$	304.73 $\langle 5^+ \rangle$	330.04 3^-	354.50 1^-	387.23 7^-
330.04(1)	3^-		0.15(3)				
354.50(4)	1^-				≈ 89		
387.23(2)	7^-				0.20(4)		
437.96(4)	$\langle 5^- \rangle$						6.2(3)
501.28(7)	$\langle 3^-, 5^- \rangle$		21(4)			15(3)	

(continued)

 $^{227}_{89}\text{Ac}$

E^*	$2J^\pi$	Branching ratios in percentage					
[keV]		$E^*_f:$ $2J^\pi_f:$	273.14 $\langle 5^- \rangle$	304.73 $\langle 5^+ \rangle$	330.04 3^-	354.50 1^-	387.23 7^-
514.36(9)	$\langle 3^+ \rangle$			3.8(8)			
537.0(1)	$\langle 3^+ \rangle$			67(13)			

Energy levels and branching ratios [97Ar08].

 $^{228}_{89}\text{Ac}$

E^*	J^π	$T_{1/2}$ or	Branching ratios in percentage			
[keV]		Γ_{cm}	$E^*_f:$ $J^\pi_f:$	0 3^+	6.670 1^+	20.19 1^-
0	3^+	6.15(2) h				
6.28(3)	1^-			x		
6.670(20)	1^+			x		
20.19(3)	1^-				x	
33.07(11)	1^+				x	x

Additional data on this isotope can be found in [95So11].

Data for this isotope are considered in vol. LB I/18C.

Energy levels [89Ak03, 77Th04, 03Bu12, 97Yu02].

 $^{229}_{89}\text{Ac}$

E^*	$2J^\pi$	σ (t, α)	Nils.Conf.	σ (p, α)	$T_{1/2}$ or	Ref.
[keV]		$\mu\text{b/sr}$	$2J, 2K[Nn_z\Lambda]$	$\mu\text{b/sr}$	Γ_{cm}	
0.0	$\langle 3^+ \rangle$	6	3,3+[651]		62.7(5) m	77Th04
7.0(20)	$\langle 5^+ \rangle$	incl	5,3+[651]			03Bu12
21.5(20)	$[7^+]$					97Yu02
26.1(20)	$\langle 9^+ \rangle$	46	$\langle 9,3+[651] \rangle$	0.9(2)		03Bu12
69.6(20)	$[5^-]$	12	$\langle 5,3-[532] \rangle$			77Th04
91(5)	$\langle 13^+ \rangle$	92	13,3+[651]	2.3(4)		03Bu12
104.5(20)	$\langle 3^- \rangle$	39	3,1-[530]			77Th04
120.1(20)	$[7^-]$	22	$\langle 7,3-[532] \rangle$			77Th04
141.9	$[5^-]$					97Yu02
151(5)	$\langle 1^+ \rangle$	206	1,1+[400]	9.8(12)		03Bu12
164.1(20)	$\langle 7^- \rangle$	104	7,1-[530]	3.0(10)		03Bu12
175.1	$[3^-]$					97Yu02
189.4(20)	$\langle 3^+ \rangle$	72	$\langle 3,1+[400] \rangle$	5.7(9)		03Bu12
222.2						97Yu02
281.2(3)		8		0.9(2)		03Bu12
335.5(20)	$\langle 3^+ \rangle$	130	3,3+[402]	4.2(6)		03Bu12
368(3)	$\langle 5^+ \rangle$	71	$\langle 5,3+[402] \rangle$	2.2(4)		03Bu12
422(4)		13				77Th04

(continued)

²²⁹Ac

E^*	$2J^\pi$	σ (t, α)	Nils.Conf.	σ (p, α)	$T_{1/2}$ or	Ref.
[keV]		$\mu\text{b/sr}$	$2J, 2K[Nn_z\Lambda]$	$\mu\text{b/sr}$	Γ_{cm}	
464(4)		14				77Th04
489(4)		12				77Th04
595(3)		74		3.0(5)		03Bu12
629(4)		21		1.4(3)		03Bu12
654(4)		17				77Th04
670(70)						77Th04
825(6)		16				77Th04
850(6)				1.3(4)		03Bu12
926(5)		85	$\langle 11,9-[514] \rangle$	5.2(7)		03Bu12
1002(4)		51	$\langle 5,1-[541] \rangle$	5.9(8)		03Bu12
1021(8)		15				77Th04
1044(5)				1.7(4)		03Bu12
1111(6)		7		0.9(3)		03Bu12
1170(6)		20		0.7(4)		03Bu12
1247(6)		48		4.6(20)		03Bu12

$T_{1/2}$ =62.7(5) min are given in [89Ak03] for the ground state.

Experimental values $d\sigma/d\Omega$ of (t, α) reaction were compared in [77Th04] with DWBA calculations.

Data for this isotope are considered in vol. LB I/18C.

Energy levels and branching ratios [93Ak02].

²³⁰Ac

E^*	J^π	$T_{1/2}$ or	Branching ratios in percentage							
[keV]		Γ_{cm}	E_f^* : J_f^π :	0.0 $\langle 1^+ \rangle$	9.0	72.0	101.0	151.5	198.2	211.8
0.0	$\langle 1^+ \rangle$	122(3) s								
9.0(2)										
72.0(1)				74(4)	26(1)					
101.0(1)				43(9)	57(14)					
151.5(1)			x							
198.2(1)				17(2)	83(25)					
211.8(1)				25.0(7)	68(3)		6.8(7)			
264.7(2)					53(13)	47(10)				
285.2(1)				61(2)			38.7(10)			
292.9(1)				86(12)				14(4)		
346.1(2)									56(3)	44(9)
375.7(2)				3(1)			92(3)		6(2)	
395.3(2)									33(5)	
457.9(1)				50(2)	41(2)				9(2)	
478.7(1)				45(2)	55(2)					
536.8(2)				10.8(18)						
581.2(3)						68(7)				

(continued)

 $^{230}_{89}\text{Ac}$

E^* [keV]	J^π	$T_{1/2}$ or Γ_{cm}	Branching ratios in percentage						
			$E^*_f:$ $J^\pi_f:$	0.0 $\langle 1^+ \rangle$	9.0	72.0	101.0	151.5	198.2 211.8
591.5(2)							93(18)	7(3)	
635.8(4)								86(18)	14(5)

Energy levels and branching ratios [93Ak02]. Part 2

 $^{230}_{89}\text{Ac}$

E^* [keV]	J^π	Branching ratios in percentage				
		$E^*_f:$ $J^\pi_f:$	264.7	285.2	292.9	346.1
395.3(2)						67(13)
478.7(1)						<0.5
536.8(2)				89(4)		
581.2(3)			10(2)	12(2)	10(3)	

Energy levels and branching ratios [01Br31, 77Th04].

 $^{231}_{89}\text{Ac}$

E^* [keV]	$2J^\pi$	σ (t, α) $\mu\text{b/sr}$	Nils.Conf. $2J, 2K[Nn_z\Lambda]$	$T_{1/2}$ or Γ_{cm}	Ref.
0	$\langle 1^+ \rangle$	258	1,1+[400]	7.5(1) m	77Th04
38(4)	$\langle 3^+ \rangle$	122	3,1+[400]		77Th04
≈ 38	$\langle 3^- \rangle$		3,1-[530]		
76(5)	$\langle 9^+ \rangle$	36	9,3+[651]		77Th04
94(3)	$\langle 7^- \rangle$	146	7,1-[530]		77Th04
135(3)	$\langle 13^+ \rangle$	76	13,3+[651]		77Th04
162.0	$\langle 5^+ \rangle$				
235(4)	$\langle 3^+ \rangle$	183	3,3+[402]		77Th04
257(10)	$\langle 5^+ \rangle$	28	5,3+[402]		77Th04
305(4)		30			77Th04
350(4)		28			77Th04
377.5	$\langle 9^+ \rangle$				
420(6)		11			77Th04
469(8)		17			77Th04
641.1	$\langle 13^+ \rangle$	15			77Th04
671(4)	$\langle 11^- \rangle$	88	$\langle 11,9-[514] \rangle$		77Th04
797(4)	$\langle 5^- \rangle$	46	$\langle 5,1-[541] \rangle$		77Th04
947.5	$\langle 17^+ \rangle$				
1021(7)		13			77Th04
1100(6)		51			77Th04
1126(6)		95			77Th04

(continued)

 $^{231}_{89}\text{Ac}$

E^*	$2J^\pi$	$\sigma(t, \alpha)$	Nils.Conf.	$T_{1/2}$ or	Ref.
[keV]		$\mu\text{b/sr}$	$2J, 2K[Nn_z\Lambda]$	Γ_{cm}	
1289.4	$\langle 21^+ \rangle$	35			77Th04
1662.1	$\langle 25^+ \rangle$				
2062.0	$\langle 29^+ \rangle$				
2484.4	$\langle 33^+ \rangle$				
2925.0	$\langle 37^+ \rangle$				

$T_{1/2}=7.5(1)$ min are given in [01Br31] for the ground state.

Experimental values $d\sigma/d\Omega$ from (t, α) reaction were compared in [77Th04] with DWBA.

Data for this isotope are considered in vol. LB I/18C.

Energy levels and branching ratios [01Br31, 77Th04]. Part 2

 $^{231}_{89}\text{Ac}$

E^*	$2J^\pi$	Branching ratios in percentage									
		$E_f^*:$	0	162	377	641	947	1289.4	1662.1	2062.0	2484.4
[keV]		$2J_f^\pi:$	$\langle 1^+ \rangle$	$\langle 5^+ \rangle$	$\langle 9^+ \rangle$	$\langle 13^+ \rangle$	$\langle 17^+ \rangle$	$\langle 21^+ \rangle$	$\langle 25^+ \rangle$	$\langle 29^+ \rangle$	$\langle 33^+ \rangle$
162.0	$\langle 5^+ \rangle$		x								
377.5	$\langle 9^+ \rangle$			x							
641.1	$\langle 13^+ \rangle$				x						
947.5	$\langle 17^+ \rangle$					x					
1289.4	$\langle 21^+ \rangle$						x				
1662.1	$\langle 25^+ \rangle$							x			
2062.0	$\langle 29^+ \rangle$								x		
2484.4	$\langle 33^+ \rangle$									x	
2925.0	$\langle 37^+ \rangle$										x

Energy levels and branching ratios [91Sc08].

 $^{232}_{89}\text{Ac}$

E^*	J^π	$T_{1/2}$ or	Branching ratios in percentage		
			$E_f^*:$	0	7.5
[keV]		Γ_{cm}	$J_f^\pi:$	$\langle 1^+ \rangle$	105.2
0	$\langle 1^+ \rangle$	119(5) s			$\langle 0^-, 1 \rangle$
7.5(2)				100	
105.2(2)	$\langle 0^-, 1 \rangle$			45(14)	55(5)
478.5(4)	$\langle 0^-, 1 \rangle$			30(14)	43(15)
					27(13)