

$^{212}_{88}\text{Ra}$

Uncertainties in E^* and $T_{1/2}$ are given in Supplement. Data for this isotope are considered in vol. LB I/18C.

$${}_{88}^{212}\text{Ra}$$
$$^{213}_{88}\text{Ra}$$
Landolt-Börnstein
New Series I/19B3

(continued)

²¹³₈₈Ra

E^*	$2J^\pi$	$T_{1/2}$ or	Ref.
[keV]		Γ_{cm}	
1769.7(3) 1770(8)	$\langle 13^-, 11^- \rangle$	2.1(1) ms	

Energy levels and branching ratios [92Ak01]. Part 2

²¹³₈₈Ra

E^*	$2J^\pi$	Branching ratios in percentage			
		$E_{\text{f}}^*:$	0.0	546.35	1608.9
		$2J_{\text{f}}^\pi:$	1^-	$\langle 5^- \rangle$	$\langle 9^- \rangle$
[keV]					1769.7
546.35(5)	$\langle 5^- \rangle$		x		
1608.9(3)	$\langle 9^- \rangle$			x	
1769.7(3)	$\langle 13^-, 11^- \rangle$				x
1770(8)					x

Energy levels and branching ratios [95El07, 92St09, 01Ha46].

²¹⁴₈₈Ra

E^*	J^π	$T_{1/2}$ or
[keV]		Γ_{cm}
0.0 ^d	0 ⁺	2.46(3) s
1382.4 ^d	2 ⁺	
1639.3 ^d	4 ⁺	35.1(3) ns
1819.7 ^d	6 ⁺	118(7) ns
1865.2 ^d	8 ⁺	67(3) μ s
2073.9 ^e	8 ⁺	
2683.2 ^f	11 ⁻	295(12) ns
2944.1 ^d	10 ⁺	
3256.4 ^e	12 ⁺	
3329.4 ^d	12 ⁺	
3478.4 ^e	14 ⁺	279(4) ns
3771.4 ^f	13 ⁻	
3850.1 ^g	14 ⁺	
3990.1 ^f	15 ⁻	3.6(2) ns
4146.8 ^f	17 ⁻	225(4) ns
4170.1 ^c	15 ⁻	
4237.2 ^e	16 ⁺	
4376.8	$\langle 16^- \rangle$	
4401.5 ^a	17 ⁻	
4618.3 ^g	16 ⁺	
4810.2 ^g	18 ⁺	0.76(21) ns

(continued)

$^{214}_{88}\text{Ra}$

E^*

J^π

$T_{1/2}$ or Γ_{cm}

[keV]		
4921.9	19 ⁻	
4930.9	17 ⁻	
4984.4	18 ⁻	
5180.4 ^a	19 ⁻	
5243.8	20 ⁺	
5390.3 ^a	21 ⁻	1.5(3) ns
5461.9	20 ⁻	
5948.1	⟨21⟩ ⁻	
6030.1 ^a	22 ⁻	
6056.6	22 ⁺	
6117.8		
6290.0	22 ⁺	
6305.0	⟨22⟩	
6479.2	⟨22⟩	
6482.1	23 ⁺	
6530.2 ^b	⟨24 ⁺ ⟩	1.6(3) ns
6565.0	23 ⁺	
6577.0	⟨25 ⁻ ⟩	128(4) ns
6612.6	23 ⁻	
6660.4		
6765.7		
6929.4	⟨24⟩	
6936.7		
7015.6		
7117.7		
7242.9		
7301.8		
7394.2		
7541.9		
7870.0	⟨24 ⁺ ⟩	

7 nucleon configurations (marked here a-g) are assigned to excited states of this nucleus in [95El07].
Data for this isotope are considered in vol. LB I/18C.

Energy levels and branching ratios [95El07, 92St09, 01Ha46]. Part 2

$^{214}_{88}\text{Ra}$

E^*

J^π

E^*_f : 0.0 1382.4 1639.3 1819.7 1865.2 2073.9 2683.2 2944.1 3256.4 3329.4

[keV]		J^π_f :	0 ⁺	2 ⁺	4 ⁺	6 ⁺	8 ⁺	8 ⁺	11 ⁻	10 ⁺	12 ⁺	12 ⁺
1382.4 ^d	2 ⁺		x									
1639.3 ^d	4 ⁺			x								
1819.7 ^d	6 ⁺				x							
1865.2 ^d	8 ⁺					x						

(continued)

²¹⁴Ra₈₈

E^*	J^π	Branching ratios in percentage										
[keV]		E_f^* : J_f^π :	0.0 0 ⁺	1382.4 2 ⁺	1639.3 4 ⁺	1819.7 6 ⁺	1865.2 8 ⁺	2073.9 8 ⁺	2683.2 11 ⁻	2944.1 10 ⁺	3256.4 12 ⁺	3329.4 12 ⁺
2073.9 ^e	8 ⁺						x					
2683.2 ^f	11 ⁻						52.7(8)	47.3(4)				
2944.1 ^d	10 ⁺						x					
3256.4 ^e	12 ⁺								65.4(11)	34.6(7)		
3329.4 ^d	12 ⁺								87.7(13)		12(3)	
3478.4 ^e	14 ⁺										59.9(10)	40.1(1)
3771.4 ^f	13 ⁻								x			

Energy levels and branching ratios [95El07, 92St09, 01Ha46]. Part 3

²¹⁴Ra₈₈

E^*	J^π	Branching ratios in percentage										
[keV]		E_f^* : J_f^π :	3478.4 14 ⁺	3771.4 13 ⁻	3850.1 14 ⁺	3990.1 15 ⁻	4146.8 17 ⁻	4170.1 15 ⁻	4237.2 16 ⁺	4376.8 ⟨16 ⁻ ⟩	4401.5 17 ⁻	4618.3 16 ⁺
3850.1 ^g	14 ⁺	x										
3990.1 ^f	15 ⁻			16.9(12)	83(12)							
4146.8 ^f	17 ⁻		91.5(12)			8.5(6)						
4170.1 ^c	15 ⁻	x										
4237.2 ^e	16 ⁺	x										
4376.8	⟨16 ⁻ ⟩							x				
4401.5 ^a	17 ⁻						x			x		
4618.3 ^g	16 ⁺				x							
4810.2 ^g	18 ⁺						52(4)		9(3)		33(3)	6(3)
4921.9	19 ⁻						x					
4930.9	17 ⁻							x				
4984.4	18 ⁻										x	
5180.4 ^a	19 ⁻										60(2)	

Energy levels and branching ratios [95El07, 92St09, 01Ha46]. Part 4

²¹⁴Ra₈₈

E^*	J^π	Branching ratios in percentage										
[keV]		E_f^* : J_f^π :	4810.2 18 ⁺	4921.9 19 ⁻	5180.4 19 ⁻	5243.8 20 ⁺	5390.3 21 ⁻	5461.9 20 ⁻	6030.1 22 ⁻	6056.6 22 ⁺	6290.0 22 ⁺	6305.0 ⟨22⟩
5180.4 ^a	19 ⁻		39(1)	1(1)								
5243.8	20 ⁺			96(3)	4.1(3)							
5390.3 ^a	21 ⁻				76(2)	24(2)						
5461.9	20 ⁻			x								
5948.1	⟨21⟩ ⁻						77(8)	23(8)				
6030.1 ^a	22 ⁻						x					
6056.6	22 ⁺					23(2)	77(8)					

(continued)

²¹⁴Ra₈₈

E^*	J^π	Branching ratios in percentage										
[keV]		E_f^* : J_f^π :	4810.2 18 ⁺	4921.9 19 [−]	5180.4 19 [−]	5243.8 20 ⁺	5390.3 21 [−]	5461.9 20 [−]	6030.1 22 [−]	6056.6 22 ⁺	6290.0 22 ⁺	6305.0 ⟨22⟩
6117.8							x					
6290.0	22 ⁺					15(3)				85(4)		
6305.0	⟨22⟩									x		
6479.2	⟨22⟩											x
6482.1	23 ⁺										x	
6530.2 ^b	⟨24 ⁺ ⟩										x	
6612.6	23 [−]						77(3)		23(12)			
6660.4										x		
6765.7											x	

Energy levels and branching ratios [95El07, 92St09, 01Ha46]. Part 5

²¹⁴Ra₈₈

E^*	J^π	Branching ratios in percentage									
[keV]		E_f^* : J_f^π :	6482.1 23 ⁺	6530.2 ⟨24 ⁺ ⟩	6565.0 23 ⁺	6577.0 ⟨25 ⁻ ⟩	6612.6 23 ⁻	6929.4 ⟨24⟩	6936.7	7301.8	7394.2
6530.2 ^b	⟨24 ⁺ ⟩		x								
6565.0	23 ⁺		x								
6577.0	⟨25 ⁻ ⟩			x							
6929.4	⟨24⟩				x						
6936.7							x				
7015.6						x					
7117.7						x					
7242.9						x					
7301.8									x		
7394.2								x			
7541.9										x	
7870.0	⟨24 ⁺ ⟩		58(9)		33(9)						9(9)

Energy levels and branching ratios [01Br31, 98St24].

²¹⁵Ra₈₈

E^* [keV]	$2J^\pi$	$T_{1/2}$ or Γ_{cm}	Ref.	Branching ratios in percentage						
				E_f^* : $2J_f^\pi$:	0.0 ⟨9 ⁺ ⟩	773.0 ⟨15 ⁻ ⟩	1625.3 ⟨17 ⁺ ⟩	1821.2 ⟨21 ⁺ ⟩	1877.8 ⟨25 ⁺ ⟩	1994.5 ⟨23 ⁺ ⟩
0.0 ^g	⟨9 ⁺ ⟩	1.55(7) ms	01Br31							
773.0(3) ^h	⟨15 ⁻ ⟩	70(3) ns	01Br31		100					
1625.3(4) ^g	⟨17 ⁺ ⟩		01Br31			100				
1821.2(4) ^g	⟨21 ⁺ ⟩	24.8(14) ns	01Br31			32.7(3)	67(1)			
1877.8(5) ⁱ	⟨25 ⁺ ⟩	7.1(2) μ s	01Br31					100		
1994.5(5) ⁱ	⟨23 ⁺ ⟩		01Br31					100		

(continued)

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E^*	$2J^\pi$	$T_{1/2}$ or	Ref.	Branching ratios in percentage						
[keV]		Γ_{cm}		E_{f}^* : $2J_{\text{f}}^\pi$:	0.0 $\langle 9^+ \rangle$	773.0 $\langle 15^- \rangle$	1625.3 $\langle 17^+ \rangle$	1821.2 $\langle 21^+ \rangle$	1877.8 $\langle 25^+ \rangle$	1994.5 $\langle 23^+ \rangle$
2053.8(5) ^g	$\langle 25^+ \rangle$	1.39(7) μs	01Br31						86(2)	14(2)
2214.4 ^k	$\langle 27^- \rangle$		01Br31						100	
2246.9(5) ^a	$\langle 29^- \rangle$		01Br31						24(2)	
2246.9+x ^a	$\langle 31^- \rangle$		01Br31							
3088.8+x ^b	$\langle 33^+ \rangle$		01Br31							
3143.7+x ^c	$\langle 35^+ \rangle$		01Br31							
3331.1+x ^c	$\langle 37^+ \rangle$		01Br31							
3413.4+x ^a	$\langle 37^- \rangle$		01Br31							
3415.6+x ^c	$\langle 37^+ \rangle$		01Br31							
3586.4+x ^d	$\langle 37^+ \rangle$		01Br31							
3738.6+x ^a	$\langle 39^- \rangle$	0.555(10) μs	01Br31							
3756.6+x ^a	$\langle 43^- \rangle$		01Br31							
3765.7+x										
3855.0+x										
3935.4+x	$\langle 43^- \rangle$									
4207.3+x										
4366.9+x ^b	$\langle 45^+ \rangle$		01Br31							
4553.6+x ^a	$\langle 47^- \rangle$		01Br31							
4567.0+x ^b	$\langle 49^+ \rangle$		10.5(2) ns	01Br31						
4686.2+x	$\langle 47^- \rangle$									
4882.7+x	$\langle 51^- \rangle$	1.7(2) ns								
5372.7+x ^b	$\langle 53^+ \rangle$		01Br31							
5608.6+x ^c	$\langle 55^- \rangle$		01Br31							
5608.7+x ^b	$\langle 57^+ \rangle$		01Br31							
6033.5+x ^f	$\langle 57^+ \rangle$		01Br31							
6076.4+x ^f	$\langle 59^+ \rangle$		01Br31							
6283.2+x ^f	$\langle 61^+ \rangle$		01Br31							

Additional data on this isotope can be found in [98St24].

10 nucleon configurations (marked a-k) are assigned to excited states of this nucleus in [01Br31].

Energy levels and branching ratios [01Br31, 98St24]. Part 2

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E^* [keV]	$2J^\pi$	Branching ratios in percentage								
		E_f^* : $2J_f^\pi$:	2053.8 $\langle 25^+ \rangle$	2214.4 $\langle 27^- \rangle$	2247+X $\langle 31^- \rangle$	3089+X $\langle 33^+ \rangle$	3144+X $\langle 35^+ \rangle$	3331+X $\langle 37^+ \rangle$	3413+X $\langle 37^- \rangle$	3416+X $\langle 37^+ \rangle$
2246.9(5) ^a	$\langle 29^- \rangle$		76(2)	x						
2246.9+x ^a	$\langle 31^- \rangle$				x					
3088.8+x ^b	$\langle 33^+ \rangle$				100					
3143.7+x ^c	$\langle 35^+ \rangle$					100				
3331.1+x ^c	$\langle 37^+ \rangle$						100			
3413.4+x ^a	$\langle 37^- \rangle$						100			
3415.6+x ^c	$\langle 37^+ \rangle$						100			

(continued)

 $^{215}_{88}\text{Ra}$

E^* [keV]	$2J^\pi$	Branching ratios in percentage								
		$E_f^*:$ $2J_f^\pi:$	2053.8 $\langle 25^+ \rangle$	2214.4 $\langle 27^- \rangle$	2247+X $\langle 31^- \rangle$	3089+X $\langle 33^+ \rangle$	3144+X $\langle 35^+ \rangle$	3331+X $\langle 37^+ \rangle$	3413+X $\langle 37^- \rangle$	3416+X $\langle 37^+ \rangle$
3586.4+x ^d	$\langle 37^+ \rangle$						8(3)	78(9)		15(3)
3738.6+x ^a	$\langle 39^- \rangle$							55(1)	2(1)	17(1)
3756.6+x ^a	$\langle 43^- \rangle$							x		
3765.7+x								100		
3855.0+x										100

Energy levels and branching ratios [01Br31, 98St24]. Part 3

 $^{215}_{88}\text{Ra}$

E^* [keV]	$2J^\pi$	Branching ratios in percentage								
		$E_f^*:$ $2J_f^\pi:$	3586+X $\langle 37^+ \rangle$	3739+X $\langle 39^- \rangle$	3757+X $\langle 43^- \rangle$	3855+X	3935+X $\langle 43^- \rangle$	4367+X $\langle 45^+ \rangle$	4554+X $\langle 47^- \rangle$	4567+X $\langle 49^+ \rangle$
3738.6+x ^a	$\langle 39^- \rangle$		25.6(3)							
3756.6+x ^a	$\langle 43^- \rangle$			x						
3935.4+x	$\langle 43^- \rangle$				100					
4207.3+x						100				
4366.9+x ^b	$\langle 45^+ \rangle$				50(3)		50(2)			
4553.6+x ^a	$\langle 47^- \rangle$				100					
4567.0+x ^b	$\langle 49^+ \rangle$				37(1)			63(1)	x	
4686.2+x	$\langle 47^- \rangle$						100			
4882.7+x	$\langle 51^- \rangle$								9(2)	74(3)
5372.7+x ^b	$\langle 53^+ \rangle$									32(1)

Energy levels and branching ratios [01Br31, 98St24]. Part 4

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E^* [keV]	$2J^\pi$	Branching ratios in percentage					
		$E_f^*:$ $2J_f^\pi:$	4686+X $\langle 47^- \rangle$	4883+X $\langle 51^- \rangle$	5373+X $\langle 53^+ \rangle$	5609+X $\langle 57^+ \rangle$	6034+X $\langle 57^+ \rangle$
4882.7+x	$\langle 51^- \rangle$		17(2)				
5372.7+x ^b	$\langle 53^+ \rangle$			68(2)			
5608.6+x ^e	$\langle 55^- \rangle$			100			
5608.7+x ^b	$\langle 57^+ \rangle$				100		
6033.5+x ^f	$\langle 57^+ \rangle$					100	
6076.4+x ^f	$\langle 59^+ \rangle$					100	
6283.2+x ^f	$\langle 61^+ \rangle$						100

Energy levels and branching ratios [97Ar04].

E^*

[keV]

J^π

$T_{1/2}$ or
 Γ_{cm}

0

688.2(2)

1164.1(3)

1507.6(3)

1711.1(3)

2026.0(4)

2335.2(4)

2679.4(4)

3292.7(4)

3412.7(5)

3491.6(5)

3580.7

3582.2(5)

3712.0(5)

3763.4(5)

4320.3(6)

4718.9(6)

4976.9(7)

5170.4(7)

5471.2(7)

5832.4(8)

6266.0(8)

0⁺

2⁺

4⁺

6⁺

8⁺

10⁺

11⁻

13⁻

14⁺

16⁺

16⁺

18⁺

19⁻

⟨20⟩⁻

⟨21⟩⁻

⟨23⟩⁻

182(10) ns

<0.2 ns

1.42(20) ns

0.6(1) ns

0.96(20) ns

5.34(15) ns

6.6(3) ns

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

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

E^*

[keV]

J^π

E_{f}^*

J_{f}^π

0

688.2

1164.1

1507.6

1711.1

2026.0

2335.2

2679.4

3292.7

3412.7

0⁺

2⁺

4⁺

6⁺

8⁺

10⁺

11⁻

13⁻

14⁺

Branching ratios in percentage

x

x

x

x

x

x

x

x

x

x

Landolt-Börnstein
New Series I/19B3

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

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E^*	J^π	Branching ratios in percentage										
[keV]		E_f^* : J_f^π :	3491.6 16 ⁺	3582.2 16 ⁺	3712.0 18 ⁺	3763.4 19 [−]	4320.3 ⟨20⟩ [−]	4718.9 ⟨21⟩ [−]	4976.9 ⟨23⟩ [−]	5170.4	5471.2	5832.4
3712.0(5)	18 ⁺		81(11)	19(5)								
3763.4(5)	19 [−]				x							
4320.3(6)	⟨20⟩ [−]					x						
4718.9(6)	⟨21⟩ [−]						x					
4976.9(7)	⟨23⟩ [−]							x				
5170.4(7)									x			
5471.2(7)										x		
5832.4(8)											x	
6266.0(8)												x

Energy levels and branching ratios [03Ak06].

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E^* [keV]	$2J^\pi$	$T_{1/2}$ or Γ_{cm}	Ref.	Branching ratios in percentage							
				E_f^* : $2J_f^\pi$:	0.0 $\langle 9^+ \rangle$	330.8 $\langle 11^+ \rangle$	539.6 $\langle 13^+ \rangle$	666.2 $\langle 15^- \rangle$	931.1 $\langle 15^+ \rangle$	1001.9 $\langle 17^+ \rangle$	1050.2
0.0 ^a	$\langle 9^+ \rangle$	1.6(2) μs									
330.8(2) ^b	$\langle 11^+ \rangle$		03Ak06		x						
539.6(2) ^a	$\langle 13^+ \rangle$		03Ak06		x						
666.2(3) ^c	$\langle 15^- \rangle$		03Ak06				x				
754(12)	$\langle 7^+ \rangle$										
931.1(3) ^b	$\langle 15^+ \rangle$		03Ak06			100	WEAK				
1001.9(3) ^a	$\langle 17^+ \rangle$		03Ak06				43	57			
1050.2(6)									x		
1173.0(4) ^c	$\langle 19^- \rangle$		03Ak06					72		28	
1337.5(4) ^b	$\langle 19^+ \rangle$		03Ak06						79	15	6
1415.7(8)											x
1454.4(4) ^a	$\langle 21^+ \rangle$		03Ak06							49	
1611.2(7) ^c	$\langle 23^- \rangle$		03Ak06								
1667.5(4) ^b	$\langle 23^+ \rangle$		03Ak06								
1896.4(5) ^b	$\langle 27^+ \rangle$	0.29(14) ns	03Ak06								
1971											
2029.7(8) ^c	$\langle 27^- \rangle$		03Ak06								
2301.1(5) ^d	$\langle 29^+ \rangle$	0.30(14) ns	03Ak06								
2305											
2393.6(7) ^d	$\langle 33^+ \rangle$	4.62(6) ns	03Ak06								
2521.3(10) ^c	$\langle 31^- \rangle$		03Ak06								
2740(2)											
2802.4(8)	$\langle 33^+ \rangle$										
2830(2)	$\langle 33^+ \rangle$										
3132.4(9)	$\langle 35^- \rangle$										
3256(2)											
3257.6(8)	$\langle 37^+ \rangle$										

(continued)

²¹⁷Ra₈₈

E^*	$2J^\pi$	$T_{1/2}$ or	Ref.	Branching ratios in percentage							
[keV]		Γ_{cm}		E_f^* :	0.0	330.8	539.6	666.2	931.1	1001.9	1050.2
				$2J_f^\pi$:	$\langle 9^+ \rangle$	$\langle 11^+ \rangle$	$\langle 13^+ \rangle$	$\langle 15^- \rangle$	$\langle 15^+ \rangle$	$\langle 17^+ \rangle$	
3506.4(9)	$\langle 39^- \rangle$										
3600											
3605											
3628.9(8)	$\langle 41^+ \rangle$										
3825.5(10)	$\langle 45^+ \rangle$	1.49(7) ns									
4185.6(10)	$\langle 47^- \rangle$										
4327											
4823											
5000											

4 nucleon configurations (A-D marked here a-d) are assigned to excited states of this nucleus in [03Ak06].

Uncertainties in E^* and $T_{1/2}$ are given in Supplement.

Energy levels and branching ratios [03Ak06]. Part 2

²¹⁷Ra₈₈

E^*	$2J^\pi$	Branching ratios in percentage										
[keV]		$E_f^*:$ $2J_f^\pi:$	1173.0 $\langle 19^- \rangle$	1337.5 $\langle 19^+ \rangle$	1454.4 $\langle 21^+ \rangle$	1611.2 $\langle 23^- \rangle$	1667.5 $\langle 23^+ \rangle$	1896.4 $\langle 27^+ \rangle$	2029.7 $\langle 27^- \rangle$	2301.1 $\langle 29^+ \rangle$	2393.6 $\langle 33^+ \rangle$	2740

1454.4(4) ^a	$\langle 21^+ \rangle$		51									
1611.2(7) ^c	$\langle 23^- \rangle$		74		26							
1667.5(4) ^b	$\langle 23^+ \rangle$			73	27							
1896.4(5) ^b	$\langle 27^+ \rangle$						x					
1971						x						
2029.7(8) ^c	$\langle 27^- \rangle$					x						
2301.1(5) ^d	$\langle 29^+ \rangle$							x				
2305									x			
2393.6(7) ^d	$\langle 33^+ \rangle$									x		
2521.3(10) ^c	$\langle 31^- \rangle$							x				
2740(2)										x		
2802.4(8)	$\langle 33^+ \rangle$									x		
2830(2)	$\langle 33^+ \rangle$									x	x	
3132.4(9)	$\langle 35^- \rangle$										x	
3257.6(8)	$\langle 37^+ \rangle$										x	x

Energy levels and branching ratios [03Ak06]. Part 3

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E^* [keV]	$2J^\pi$	Branching ratios in percentage										
		E_f^* : $2J_f^\pi$:	2802.4 $\langle 33^+ \rangle$	2830 $\langle 33^+ \rangle$	3132.4 $\langle 35^- \rangle$	3256	3257.6 $\langle 37^+ \rangle$	3506.4 $\langle 39^- \rangle$	3628.9 $\langle 41^+ \rangle$	3825.5 $\langle 45^+ \rangle$	4185.6 $\langle 47^- \rangle$	4327
3256(2)			x	x								
3257.6(8)	$\langle 37^+ \rangle$				x							
3506.4(9)	$\langle 39^- \rangle$				20		80					
3600						x						
3605						x						
3628.9(8)	$\langle 41^+ \rangle$						78	22				
3825.5(10)	$\langle 45^+ \rangle$								x			
4185.6(10)	$\langle 47^- \rangle$									x		
4327											x	
4823												x

Energy levels and branching ratios [03Ak06]. Part 4

²¹⁷Ra₈₈

E^* [keV]	$2J^\pi$	Branching ratios in percentage										
		E_f^* : $2J_f^\pi$:										
5000												x

Energy levels and branching ratios [95El08, 06Ja03].

²¹⁸Ra₈₈

E^* [keV]	J^π	$T_{1/2}$ or Γ_{cm}	Ref.	Branching ratios in percentage								
				E_f^* : J_f^π :	0.0 0^+	389.1 2^+	741.3 4^+	793.4 $\langle 3^- \rangle$	1038.6 5^-	1122.2 6^+	1341.0 7^-	
0.0 ^a	0^+	25.2(3) μs										
388.9(1) ^a	2^+	9.5(24) ps	95El08		x							
741.1(2) ^a	4^+	9.8(24) ps	95El08			x						
793.2(2) ^b	$\langle 3^- \rangle$		95El08			x						
1038.3(2) ^b	5^-		95El08				69(7)	≥ 31				
1122.0(2) ^a	6^+		95El08				74(4)		26(5)			
1340.9(2) ^b	7^-		95El08						8.0(20)	92(5)		
1546.7(2) ^a	8^+		95El08							42(12)	58(4)	
1573.0(2)	$\langle 3^-, 4, 5^- \rangle$						x	x	x			
1694.4(3) ^b	9^-		95El08								37(13)	
1714.6(3)							x					
1725.8(3)									x			
1803.6(2)										x	x	
1855.9(3)										x		
1896.8(3)												
1961.7(3) ^a	10^+		95El08									

(continued)

²¹⁸Ra
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E^* [keV]	J^π	$T_{1/2}$ or Γ_{cm}	Ref.	Branching ratios in percentage							
				E_f^* : J_f^π :	0.0 0 ⁺	389.1 2 ⁺	741.3 4 ⁺	793.4 ⟨3 ⁻ ⟩	1038.6 5 ⁻	1122.2 6 ⁺	1341.0 7 ⁻
2031.8(3)											
2109.3(3) ^b	11 ⁻		95El08								
2328.3(4)											
2390.8(3) ^a	12 ⁺		95El08								
2420.0(3) ^c	⟨12 ⁻ ⟩		95El08								
2442.4(4)											
2465.6(4)											
2526.3(3) ^b	13 ⁻		95El08								
2825.5(3) ^a	14 ⁺		95El08								
2966.4(4) ^b	15 ⁻		95El08								
2967.2(4) ^c	⟨14 ⁻ ⟩		95El08								
3285.1(4) ^a	16 ⁺		95El08								
3387.7(7) ^c	⟨16 ⁻ ⟩		95El08								
3388.8(4) ^b	17 ⁻		95El08								
3719.8(7) ^c	⟨18 ⁻ ⟩		95El08								
3756.0(7) ^a	18 ⁺		95El08								
3805.9(8) ^b	19 ⁻		95El08								
4117.7(9) ^c	⟨20 ⁻ ⟩		95El08								
4191.1(11) ^a	⟨20 ⁺ ⟩		95El08								
4212.6(10) ^b	⟨21 ⁻ ⟩		95El08								
4391.6(11) ^d	⟨21 ⁺ ⟩		95El08								
4588.3(11) ^a	⟨22 ⁺ ⟩		95El08								
4675.3(10) ^b	⟨23 ⁻ ⟩		95El08								
4682.6(10) ^c	⟨22 ⁻ ⟩		95El08								
4835.5(11) ^d	⟨23 ⁺ ⟩		95El08								
5020.3(12) ^a	⟨24 ⁺ ⟩		95El08								
5125.4(13) ^b	⟨25 ⁻ ⟩		95El08								
5139.4(11) ^c	⟨24 ⁻ ⟩		95El08								
5363.5(13) ^d	⟨25 ⁺ ⟩		95El08								
5470.1(13) ^a	⟨26 ⁺ ⟩		95El08								
5588.1(13) ^b	⟨27 ⁻ ⟩		95El08								
5901.7(14) ^a	⟨28 ⁺ ⟩		95El08								
6134.9(15) ^b	⟨29 ⁻ ⟩		95El08								
6343.8(15) ^a	⟨30 ⁺ ⟩		95El08								
6678.8(16) ^b	⟨31 ⁻ ⟩		95El08								

Additional data on this isotope can be found in [92Wi14].

4 bands (A-D marked here a-d) are assigned to excited states of this nucleus in [95El08].

Uncertainties in E^* and $T_{1/2}$ are given in Supplement.

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

Energy levels and branching ratios [95El08, 06Ja03]. Part 2

 $^{218}_{88}\text{Ra}$

E^* [keV]	J^π	Branching ratios in percentage										
		E_f^* : J_f^π :	1546.8 8 ⁺	1694.4 9 ⁻	1856.1	1896.9	1961.8 10 ⁺	2031.9	2109.4 11 ⁻	2390.8 12 ⁺	2420.1 ⟨12 ⁻ ⟩	2526.4 13 ⁻
1694.4(3) ^b	9 ⁻		63(28)									
1896.8(3)			x									
1961.7(3) ^a	10 ⁺		26(7)	74(4)								
2031.8(3)				x								
2109.3(3) ^b	11 ⁻			70(18)			30(30)	x				
2328.3(4)					x							
2390.8(3) ^a	12 ⁺						25(5)		75(5)			
2420.0(3) ^c	⟨12 ⁻ ⟩								x			
2442.4(4)								x				
2465.6(4)						x	x					
2526.3(3) ^b	13 ⁻								75(20)	25(3)	x	
2825.5(3) ^a	14 ⁺									26(7)		74(21)
2966.4(4) ^b	15 ⁻											76(4)
2967.2(4) ^c	⟨14 ⁻ ⟩										100	x

Energy levels and branching ratios [95El08, 06Ja03]. Part 3

 $^{218}_{88}\text{Ra}$

E^* [keV]	J^π	Branching ratios in percentage										
		E_f^* : J_f^π :	2825.7 14 ⁺	2966.6 15 ⁻	3285.6 16 ⁺	3387.4 ⟨16 ⁻ ⟩	3389.4 17 ⁻	3720.2 ⟨18 ⁻ ⟩	3756.4 18 ⁺	3806.3 ⟨19 ⁻ ⟩	4118.2 ⟨20 ⁻ ⟩	4191.2 ⟨20 ⁺ ⟩
2966.4(4) ^b	15 ⁻		24(4)									
2967.2(4) ^c	⟨14 ⁻ ⟩		x									
3285.1(4) ^a	16 ⁺		38(12)	62(12)								
3387.7(7) ^c	⟨16 ⁻ ⟩			x								
3388.8(4) ^b	17 ⁻			100	x							
3719.8(7) ^c	⟨18 ⁻ ⟩					100	x					
3756.0(7) ^a	18 ⁺				x		x					
3805.9(8) ^b	19 ⁻						x	x	x			
4117.7(9) ^c	⟨20 ⁻ ⟩							x		x		
4191.1(11) ^a	⟨20 ⁺ ⟩								x	x		
4212.6(10) ^b	⟨21 ⁻ ⟩									x		
4391.6(11) ^d	⟨21 ⁺ ⟩										x	
4588.3(11) ^a	⟨22 ⁺ ⟩											x
4682.6(10) ^c	⟨22 ⁻ ⟩										x	

Energy levels and branching ratios [95El08, 06Ja03]. Part 4

 $^{218}_{88}\text{Ra}$

E^*	J^π	Branching ratios in percentage										
[keV]		$E_f^*:$ $J_f^\pi:$	4213.0 $\langle 21^- \rangle$	4392.1 $\langle 21^+ \rangle$	4589.0 $\langle 22^+ \rangle$	4675.9 $\langle 23^- \rangle$	4683.1 $\langle 22^- \rangle$	4836.1 $\langle 23^+ \rangle$	5020.9 $\langle 24^+ \rangle$	5126.0 $\langle 25^- \rangle$	5140.1 $\langle 24^- \rangle$	5470.8 $\langle 26^+ \rangle$
4588.3(11) ^a	$\langle 22^+ \rangle$	x										
4675.3(10) ^b	$\langle 23^- \rangle$	x			x							
4682.6(10) ^c	$\langle 22^- \rangle$	x		x								
4835.5(11) ^d	$\langle 23^+ \rangle$			x	x		x					
5020.3(12) ^a	$\langle 24^+ \rangle$				x	x						
5125.4(13) ^b	$\langle 25^- \rangle$					x			x			
5139.4(11) ^c	$\langle 24^- \rangle$					x	x	x				
5363.5(13) ^d	$\langle 25^+ \rangle$							x			x	
5470.1(13) ^a	$\langle 26^+ \rangle$								x	x		
5588.1(13) ^b	$\langle 27^- \rangle$									x		x
5901.7(14) ^a	$\langle 28^+ \rangle$											x

Energy levels and branching ratios [95El08, 06Ja03]. Part 5

 $^{218}_{88}\text{Ra}$

E^*	J^π	Branching ratios in percentage				
[keV]		$E_f^*:$ $J_f^\pi:$	5588.9 $\langle 27^- \rangle$	5902.5 $\langle 28^+ \rangle$	6135.6 $\langle 29^- \rangle$	6344.6 $\langle 30^+ \rangle$
5901.7(14) ^a	$\langle 28^+ \rangle$		x			
6134.9(15) ^b	$\langle 29^- \rangle$		x	x		
6343.8(15) ^a	$\langle 30^+ \rangle$			x	x	
6678.8(16) ^b	$\langle 31^- \rangle$				x	x

Energy levels and branching ratios [01Br31].

 $^{219}_{88}\text{Ra}$

E^*	$2J^\pi$	$T_{1/2}$ or	Branching ratios in percentage							
[keV]		Γ_{cm}	$E_{\text{f}}^*:$ $2J_{\text{f}}^\pi:$	0.0 $\langle 7 \rangle^+$	16.7 $\langle 11^+ \rangle$	52.06 $\langle 3^+ \rangle$	113.71 $\langle 9 \rangle^+$	140.01 $\langle 5 \rangle^+$	151.98 $\langle 7 \rangle^+$	251.1 $\langle 15^+ \rangle$
0.0 ^a	$\langle 7 \rangle^+$	10(3) ms								
16.7(8) ^a	$\langle 11^+ \rangle$			100						
52.06(25)	$\langle 3^+ \rangle$			100						
113.71(10) ^g	$\langle 9 \rangle^+$			64(8)	36(4)					
140.01(10) ^g	$\langle 5 \rangle^+$		92(10)			8(6)				
151.98(9) ^g	$\langle 7 \rangle^+$		98(11)				1.9(9)			
251.1(8) ^a	$\langle 15^+ \rangle$				100					
320.6(4)				≈ 11.11		≈ 55.6			33(2)	
328.3(5)						67(33)		≈ 33.33		
404.74(16)						≈ 1.959		69(21)	29(9)	
421.7(12)				100						
445.0(3)							33(17)	33(17)	33(8)	

(continued)

 $^{219}_{88}\text{Ra}$

E^* [keV]	$2J^\pi$	$T_{1/2}$ or Γ_{cm}	Branching ratios in percentage							
			E^*_f : $2J^\pi_f$:	0.0 $\langle 7 \rangle^+$	16.7 $\langle 11^+ \rangle$	52.06 $\langle 3^+ \rangle$	113.71 $\langle 9 \rangle^+$	140.01 $\langle 5 \rangle^+$	151.98 $\langle 7 \rangle^+$	251.1 $\langle 15^+ \rangle$
470.7(5)							62(38)		38(2)	
475.2 ^c	$\langle 13 \rangle^+$				39(4)		61(3)			
512.4(8) ^b	$\langle 17^- \rangle$									100
515.4(10)							100			
546.0(8) ^a	$\langle 19^+ \rangle$									100
556.0(8) ^e	9				100					
604.1(8) ^d	$\langle 15^- \rangle$									9.6(20)
751.3(8) ^b	$\langle 21^- \rangle$									
779.9(8) ^f	$\langle 11 \rangle$									
853.5(8) ^c	$\langle 17^+ \rangle$									
876.5(8) ^e	$\langle 13 \rangle$									41(5)
893.2(8) ^a	$\langle 23^+ \rangle$									
937.7(8) ^d	$\langle 19^- \rangle$									
1053.3(8) ^b	$\langle 25^- \rangle$									
1131.3(8) ^f	$\langle 15 \rangle$									
1245.9(8) ^c	$\langle 21^+ \rangle$									
1257.3(8) ^e	$\langle 17 \rangle$									
1288.3(8) ^a	$\langle 27^+ \rangle$									
1325.0(8) ^d	$\langle 23^- \rangle$									
1411.3(8) ^b	$\langle 29^- \rangle$									
1426.4(8)										
1504.3(8) ^f	$\langle 19 \rangle$									
1638.2(8) ^c	$\langle 25^+ \rangle$									
1671.5(8) ^e	$\langle 21 \rangle$									
1701.6(8) ^a	$\langle 31^+ \rangle$									
1738.2(8) ^d	$\langle 27^- \rangle$									
1833.2(8) ^b	$\langle 33^- \rangle$									
2038.8(8) ^c	$\langle 29^+ \rangle$									
2130.3(8) ^a	$\langle 35^+ \rangle$									
2152.9(8) ^d	$\langle 31^- \rangle$									
2289.7(8) ^b	$\langle 37^- \rangle$									
2460.2(8) ^c	$\langle 33^+ \rangle$									
2568.1(8)	$\langle 35^- \rangle$									
2580.5(8) ^a	$\langle 39^+ \rangle$									
2767.9(8) ^b	$\langle 41^- \rangle$									
3003.6(8) ^d	$\langle 39^- \rangle$									
3045.7(8) ^a	$\langle 43^+ \rangle$									
3272.7(8) ^b	$\langle 45^- \rangle$									
3522.6(8) ^a	$\langle 47^+ \rangle$									
3793.4(8) ^b	$\langle 49^- \rangle$									
4345.8(9) ^b	$\langle 53^- \rangle$									

Additional data on this isotope can be found in [01Sh14, 92Li09, 92Wi02].

7 bands (A-G marked here a-g) are assigned to excited states of this nucleus in [01Sh14, 01Br31].

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

²¹⁹Ra
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E^*	$2J^\pi$	Branching ratios in percentage									
[keV]	$E_f^*:$ $2J_f^\pi:$	320.6	475.2	512.4	546.0	556.0	604.1	751.3	779.9	853.5	876.5
			$\langle 13 \rangle^+$	$\langle 17^- \rangle$	$\langle 19^+ \rangle$	9	$\langle 15^- \rangle$	$\langle 21^- \rangle$	$\langle 11 \rangle$	$\langle 17^+ \rangle$	$\langle 13 \rangle$
445.0(3)		x									
604.1(8) ^d	$\langle 15^- \rangle$		90(7)			x					
751.3(8) ^b	$\langle 21^- \rangle$			3.74(14)	96(5)						
779.9(8) ^f	$\langle 11 \rangle$					100					
853.5(8) ^c	$\langle 17^+ \rangle$		26(6)				74(4)				
876.5(8) ^e	$\langle 13 \rangle$					37(2)			23(2)		
893.2(8) ^a	$\langle 23^+ \rangle$				45(3)			55(3)			
937.7(8) ^d	$\langle 19^- \rangle$			8.8(16)			71(4)			21(6)	
1053.3(8) ^b	$\langle 25^- \rangle$							20.7(10)			
1131.3(8) ^f	$\langle 15 \rangle$			50(8)							50(4)
1257.3(8) ^e	$\langle 17 \rangle$				24(2)						36(7)
1325.0(8) ^d	$\langle 23^- \rangle$							13.3(19)			
1504.3(8) ^f	$\langle 19 \rangle$							81(15)			

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

²¹⁹Ra
88

E^*	$2J^\pi$	E_f^* : $2J_f^\pi$:	893.2	937.7	1053.3	1131.3	1245.9	1257.3	1288.3	1325.0	1411.3	1504.3
[keV]			$\langle 23^+ \rangle$	$\langle 19^- \rangle$	$\langle 25^- \rangle$	$\langle 15 \rangle$	$\langle 21^+ \rangle$	$\langle 17 \rangle$	$\langle 27^+ \rangle$	$\langle 23^- \rangle$	$\langle 29^- \rangle$	$\langle 19 \rangle$
1053.3(8) ^b	$\langle 25^- \rangle$		79(12)									
1245.9(8) ^c	$\langle 21^+ \rangle$			100								
1257.3(8) ^e	$\langle 17 \rangle$					40(5)						
1288.3(8) ^a	$\langle 27^+ \rangle$		26.4(12)		74(10)							
1325.0(8) ^d	$\langle 23^- \rangle$			81(4)			5.7(19)					
1411.3(8) ^b	$\langle 29^- \rangle$				58(3)				42(2)			
1426.4(8)						100						
1504.3(8) ^f	$\langle 19 \rangle$					x		19(5)				
1638.2(8) ^c	$\langle 25^+ \rangle$						x			100		
1671.5(8) ^e	$\langle 21 \rangle$											100
1701.6(8) ^a	$\langle 31^+ \rangle$								19(3)		81(17)	
1738.2(8) ^d	$\langle 27^- \rangle$				22(3)					78(17)		
1833.2(8) ^b	$\langle 33^- \rangle$										73(4)	
2152.9(8) ^d	$\langle 31^- \rangle$										18(3)	

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

²¹⁹Ra₈₈

E^* [keV]	$2J^\pi$	Branching ratios in percentage										
		E_f^* : $2J_f^\pi$:	1638.2 ⟨25 ⁺ ⟩	1701.6 ⟨31 ⁺ ⟩	1738.2 ⟨27 ⁻ ⟩	1833.2 ⟨33 ⁻ ⟩	2038.8 ⟨29 ⁺ ⟩	2130.3 ⟨35 ⁺ ⟩	2152.9 ⟨31 ⁻ ⟩	2289.7 ⟨37 ⁻ ⟩	2460.2 ⟨33 ⁺ ⟩	2568.1 ⟨35 ⁻ ⟩
1738.2(8) ^d	⟨27 ⁻ ⟩	x										
1833.2(8) ^b	⟨33 ⁻ ⟩			26.7(11)								
2038.8(8) ^c	⟨29 ⁺ ⟩	24(6)			76(3)							
2130.3(8) ^a	⟨35 ⁺ ⟩			20.3(9)		80(7)						
2152.9(8) ^d	⟨31 ⁻ ⟩				68(20)		15(6)					
2289.7(8) ^b	⟨37 ⁻ ⟩					75(4)		25(5)				
2460.2(8) ^c	⟨33 ⁺ ⟩								100			
2568.1(8)	⟨35 ⁻ ⟩					51(8)			41(2)		8(4)	
2580.5(8) ^a	⟨39 ⁺ ⟩							22.8(18)		77(12)		
2767.9(8) ^b	⟨41 ⁻ ⟩									70(2)		
3003.6(8) ^d	⟨39 ⁻ ⟩											100

Energy levels and branching ratios [01Br31]. Part 5

²¹⁹Ra₈₈

E^* [keV]	$2J^\pi$	Branching ratios in percentage						
		E_f^* : $2J_f^\pi$:	2580.5 ⟨39 ⁺ ⟩	2767.9 ⟨41 ⁻ ⟩	3045.7 ⟨43 ⁺ ⟩	3272.7 ⟨45 ⁻ ⟩	3522.6 ⟨47 ⁺ ⟩	3793.4 ⟨49 ⁻ ⟩
2767.9(8) ^b	⟨41 ⁻ ⟩		30(4)					
3045.7(8) ^a	⟨43 ⁺ ⟩		100					
3272.7(8) ^b	⟨45 ⁻ ⟩			50(4)	50(6)			
3522.6(8) ^a	⟨47 ⁺ ⟩				x	100		
3793.4(8) ^b	⟨49 ⁻ ⟩					50(8)	50(20)	
4345.8(9) ^b	⟨53 ⁻ ⟩							100

Energy levels and branching ratios [97Ar04].

²²⁰Ra₈₈

E^* [keV]	J^π	$T_{1/2}$ or Γ_{cm}	Ref.	Branching ratios in percentage							
				E_f^* : J_f^π :	0 0 ⁺	178.47 2 ⁺	410.07 4 ⁺	634.8 ⟨5 ⁻ ⟩	688.1 6 ⁺	873.0 ⟨7 ⁻ ⟩	1001.2 8 ⁺
0 ^a	0 ⁺	18(2) ms									
178.47(12) ^a	2 ⁺		97Ar04		x						
410.07(23) ^a	4 ⁺		97Ar04			x					
412.98(10) ^b	⟨1 ⁻ ⟩		97Ar04		58(8)	42(12)					
474.17(23) ^b	⟨3 ⁻ ⟩		97Ar04			x					
634.8(4) ^b	⟨5 ⁻ ⟩		97Ar04				x				
688.1(3) ^a	6 ⁺		97Ar04				x				
873.0(4) ^b	⟨7 ⁻ ⟩		97Ar04					7(2)	93(9)		
1001.2(4) ^a	8 ⁺		97Ar04						36(7)	64(6)	
1163.8(4) ^b	⟨9 ⁻ ⟩		97Ar04							12(4)	88(9)

(continued)

 $^{220}_{88}\text{Ra}$

E^* [keV]	J^π	$T_{1/2}$ or Γ_{cm}	Ref.	Branching ratios in percentage							
				E^*_f : J^π_f :	0 0 ⁺	178.47 2 ⁺	410.07 4 ⁺	634.8 $\langle 5 \rangle^-$	688.1 6 ⁺	873.0 $\langle 7 \rangle^-$	1001.2 8 ⁺
1342.7(5) ^a	10 ⁺		97Ar04								25(5)
1496.1(5) ^b	$\langle 11 \rangle^-$		97Ar04								
1711.2(5) ^a	12 ⁺		97Ar04								
1863.7(5) ^b	$\langle 13 \rangle^-$		97Ar04								
2105.7(5) ^a	14 ⁺		97Ar04								
2262.5(5) ^b	$\langle 15 \rangle^-$		97Ar04								
2523.5(6) ^a	16 ⁺		97Ar04								
2690.1(6) ^b	$\langle 17 \rangle^-$		97Ar04								
2961.9(6) ^a	18 ⁺		97Ar04								
3144.5(6) ^b	$\langle 19^- \rangle$		97Ar04								
3417.6(6) ^a	$\langle 20^+ \rangle$		97Ar04								
3624.0(6) ^b	$\langle 21^- \rangle$		97Ar04								
3888.6(7) ^a	$\langle 22^+ \rangle$		97Ar04								
4122.7(7) ^b	$\langle 23^- \rangle$		97Ar04								
4374.7(7) ^a	$\langle 24^+ \rangle$		97Ar04								
4636.3(7) ^b	$\langle 25^- \rangle$		97Ar04								
4873.6(7) ^a	$\langle 26^+ \rangle$		97Ar04								
5164.1(8) ^b	$\langle 27^- \rangle$		97Ar04								
5384.5(8) ^a	$\langle 28^+ \rangle$		97Ar04								
5703.0(9) ^b	$\langle 29^- \rangle$		97Ar04								
5912.0(9) ^a	$\langle 30^+ \rangle$		97Ar04								
6255.5(10)	$\langle 31^- \rangle$		97Ar04								

Additional data on this isotope can be found in [05Jo25, 01Ru12, 92Ru01].

Two bands ($K^\pi=0^+$ and 0^- , marked here a,b) are assigned in [97Ar04].Uncertainties in E^* and $T_{1/2}$ are given in Supplement.

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

 $^{220}_{88}\text{Ra}$

E^* [keV]	J^π	Branching ratios in percentage										
		E^*_f : J^π_f :	1163.8 $\langle 9 \rangle^-$	1342.7 10 ⁺	1496.1 $\langle 11 \rangle^-$	1711.2 12 ⁺	1863.7 $\langle 13 \rangle^-$	2105.7 14 ⁺	2262.5 $\langle 15 \rangle^-$	2523.5 16 ⁺	2690.1 $\langle 17 \rangle^-$	2961.9 18 ⁺
1342.7(5) ^a	10 ⁺		75(15)									
1496.1(5) ^b	$\langle 11 \rangle^-$		29(6)	71(14)								
1711.2(5) ^a	12 ⁺			31(6)	69(14)							
1863.7(5) ^b	$\langle 13 \rangle^-$				44(9)	56(11)						
2105.7(5) ^a	14 ⁺					29(6)	71(14)					
2262.5(5) ^b	$\langle 15 \rangle^-$						58(12)	42(8)				
2523.5(6) ^a	16 ⁺							27(5)	73(15)			
2690.1(6) ^b	$\langle 17 \rangle^-$								56(11)	44(9)		
2961.9(6) ^a	18 ⁺									48(9)	52(10)	
3144.5(6) ^b	$\langle 19^- \rangle$										53(11)	47(10)
3417.6(6) ^a	$\langle 20^+ \rangle$											32(6)

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

 $^{220}_{88}\text{Ra}$

E^* [keV]	J^π	Branching ratios in percentage										
		E^*_f : J^π_f :	3144.5 $\langle 19^- \rangle$	3417.6 $\langle 20^+ \rangle$	3624.0 $\langle 21^- \rangle$	3888.6 $\langle 22^+ \rangle$	4122.7 $\langle 23^- \rangle$	4374.7 $\langle 24^+ \rangle$	4636.3 $\langle 25^- \rangle$	4873.6 $\langle 26^+ \rangle$	5164.1 $\langle 27^- \rangle$	5384.5 $\langle 28^+ \rangle$
3417.6(6) ^a	$\langle 20^+ \rangle$		68(14)									
3624.0(6) ^b	$\langle 21^- \rangle$		47(9)	53(11)								
3888.6(7) ^a	$\langle 22^+ \rangle$			40(8)	60(12)							
4122.7(7) ^b	$\langle 23^- \rangle$				39(12)	61(12)						
4374.7(7) ^a	$\langle 24^+ \rangle$					36(7)	64(13)					
4636.3(7) ^b	$\langle 25^- \rangle$						64(19)	36(11)				
4873.6(7) ^a	$\langle 26^+ \rangle$							40(12)	60(18)			
5164.1(8) ^b	$\langle 27^- \rangle$								x	x		
5384.5(8) ^a	$\langle 28^+ \rangle$									58(18)	42(16)	
5703.0(9) ^b	$\langle 29^- \rangle$										80(24)	20
5912.0(9) ^a	$\langle 30^+ \rangle$											x

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

 $^{220}_{88}\text{Ra}$

E^* [keV]	J^π	Branching ratios in percentage	
		E^*_f : J^π_f :	5703.0 $\langle 29^- \rangle$
5912.0(9) ^a	$\langle 30^+ \rangle$		x
6255.5(10)	$\langle 31^- \rangle$		x

Energy levels and branching ratios [90Ak05].

 $^{221}_{88}\text{Ra}$

E^* [keV]	$2J^\pi$	$T_{1/2}$ or Γ_{cm}	Branching ratios in percentage							
			E^*_f : $2J^\pi_f$:	0.0 5^+	53.2 $\langle 7 \rangle^+$	103.5 $\langle 5 \rangle^-$	121.9 $\langle 9^+ \rangle$	146.8 $\langle 7 \rangle^-$	299.2 $\langle 7 \rangle^+$	321.4 $\langle 3 \rangle^+$
0.0	5^+	28(2) s								
53.2(2)	$\langle 7 \rangle^+$			x						
103.5(2)	$\langle 5 \rangle^-$			88(18)	12(4)					
121.9(2)	$\langle 9^+ \rangle$			19(5)	81(8)					
146.8(2)	$\langle 7 \rangle^-$			x						
174(5)										
299.2(1)	$\langle 7 \rangle^+$			12(2)	74(2)		14.1(7)			
321.4(1)	$\langle 3 \rangle^+$			98		1.7(3)				
359.0(1)	$\langle 5 \rangle^+$			49(6)	49(5)			2.2(11)		
450.3(2)	$\langle 5^- \rangle$								82(7)	18(4)
485.4(2)	$\langle 3^-, 5^- \rangle$			7(2)		35(7)				40(14)

Additional data on this isotope can be found in [91Fe07].

Energy levels and branching ratios [90Ak05]. Part 2

 $^{221}_{88}\text{Ra}$

E^*	$2J^\pi$	Branching ratios in percentage	
[keV]		$E_f^*:$	359.0
		$2J_f^\pi:$	$\langle 5 \rangle^+$
485.4(2)	$\langle 3^-, 5^- \rangle$		18(4)

Energy levels and branching ratios [96El01].

 $^{222}_{88}\text{Ra}$

E^*	J^π	$T_{1/2}$ or	Branching ratios in percentage							
[keV]		Γ_{cm}	$E_f^*:$	0.0	111	242	301	317	474	1025
			$J_f^\pi:$	0^+	2^+	1^-	4^+	3^-	$\langle 5^- \rangle$	2^+
0.0	0^+	38.0(5) s								
111.12(2)	2^+	0.52(4) ns		100						
242.11(2)	1^-	<1.2 ns		76(4)	24.3(12)					
301.39(4)	4^+	<1.4 ns			x					
317.29(5)	3^-				100	0.017(4)				
473.76(8)	$\langle 5^- \rangle$						x			
914.0(3)	$\langle 0^+ \rangle$				17(7)	83(9)				
1024.9(2)	2^+			3.0(5)	8(1)	44(4)	1.5(2)	44(2)		
1170.9(2)	$\langle 3^-, 4^+ \rangle$						39(12)	48(3)	13.7(2)	
1171.6(3)	$1^+, 1^-, 2^+$			32(4)	60(5)	9(1)				
1225.2(2)	$1^+, 1^-, 2^+$			16(3)	43(8)	41(8)				
1265.0(3)	$\langle 2^+, 3 \rangle$				79(8)		21(3)			
1310.2(3)						x				
1360.6(3)					38(7)			62(8)		
1375.7(3)						x				
1402.6(2)	$\langle 3^- \rangle$				3.8(6)	5.6(5)	39(4)	36(5)		9(1)
1432.6(3)	$1, 2, 3^-$				92(7)	7.8(14)				
1439.9(2)	$\langle 3^- \rangle$					14(2)	46(5)	18(3)	11(2)	5(1)
1499.5(3)	$1^-, 2, 3^-$				26(3)	11(2)		29(3)		34(3)
1556.1(4)	2^+			23(4)	27(4)		10(1)	39(5)		
1619.6(4)					19(6)	81(12)				
1644.9(3)	$2^+, 3^-$				9(2)	15(2)	5.6(9)	54(5)		17(2)
1754.4(6)	3^-				16(4)		16(4)	36(3)	12(3)	
1821.5(5)	$1, 2, 3$					x				
1841.2(5)	$1, 2, 3$					14(4)				

Additional data on this isotope can be found in [92Ru01].

The ground-state band and the band built on 1^- level are extended in [99Co02].Uncertainties in E^* and $T_{1/2}$ are given in Supplement.

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

Energy levels and branching ratios [96El01]. Part 2

 $^{222}_{88}\text{Ra}$

E^* [keV]	J^π	Branching ratios in percentage		
		E_f^* : J_f^π :	1170.9 $\langle 3^-, 4^+ \rangle$	1402.6 $\langle 3^- \rangle$
1402.6(2)	$\langle 3^- \rangle$		6.0(6)	
1439.9(2)	$\langle 3^- \rangle$		6(1)	
1754.4(6)	3^-			19(4)
1841.2(5)	1,2,3			86(11)

Energy levels and branching ratios [01Br31].

 $^{223}_{88}\text{Ra}$

E^* [keV]	$2J^\pi$	$T_{1/2}$ or Γ_{cm}	Branching ratios in percentage						
			E_f^* : $2J_f^\pi$:	0.0 3^+	29.858 5^+	50.128 3^-	61.424 $\langle 7 \rangle^+$	79.708 $\langle 5 \rangle^-$	104.60 123.793 7^-
0.0	3^+	11.43(5) d							
29.858(8)	5^+			100					
50.128(9)	3^-	0.63(7) ns		97(5)	2.7(3)				
61.424(10)	$\langle 7 \rangle^+$	≈ 0.6 ns		57(7)	43(7)				
79.708(13)	$\langle 5 \rangle^-$	0.24(8) ns		82(3)	18(4)	≈ 0.2			
104.60(13)					33(13)		67(27)		
123.793(18)	7^-	0.45(+10-6) ns			84.9(19)	0.8(3)	11.4(14)	3.0(8)	
130.141(18)	9^+	> 0.3 ns			36(7)		25(5)		39(12)
174.569(24)	9^-	0.20(6) ns					90.5	5(3)	1.7(7)
174.58(4)	11^+	0.14(5) ns					92.6		2.6(11)
234.858(19)	5^+			67(8)	24(4)	5.4(6)	2.6(4)	0.1	0.12(3)
247.39(4)	11^-	0.15(5) ns							6(3)
280.182(22)	$\langle 7 \rangle^+$	0.075(25) ns		4.1	5.2(10)		64(6)	8(6)	12(3)
286.087(14)	1^+	0.77(7) ns		8.0(7)	32.4(6)	59.6(12)			
315.99(6)	$\langle 13^- \rangle$								
329.856(14)	3^-	0.42(4) ns		48(3)	35.9(11)	0.9(2)		7.4(7)	4.1(4)
334.370(12)	5^+	0.28(4) ns		22(2)	23(3)	0.8(3)	10.0(2)	14(3)	25(2)
342.590(19)	3^+	< 0.050 ns		28(8)	42(3)	5.3(6)	14.4(10)	8.7(6)	
342.654(21)	$\langle 9 \rangle^+$	< 0.10 ns					30(2)		18(2)
350.53(6)	$\langle 1 \rangle^-$			69(12)		9.0(17)			
369.36(4)	$\langle 5 \rangle^-$	0.20(5) ns		8(2)	5.1(4)	40(10)	≤ 03	x	2.2(4)
376.296(11)	7^-	< 0.03 ns		0.4(1)	0.9(1)	0.5(2)	37(3)	33(3)	9(1)
405.07(3)	$\langle 7 \rangle^-$				4.39			29(7)	7(4)
424.12(5)	$\langle 11^+ \rangle$						71(2)		
432.24(3)	$\langle 5 \rangle^-$			7(1)	14(1)	11(2)	7(5)	17(4)	28(5)
442.35(8)	$\langle 7^+ \rangle$								19(6)
445.071(19)	9^+				0.22(11)		4(4)		
459.93(5)	$\langle 9 \rangle^-$						1.9(5)		
514.25(8)	$\langle 11^- \rangle$								
537.16(11)									
568(2)									
590.3(10)									100

(continued)

 $^{223}_{88}\text{Ra}$

E^*	$2J^\pi$	$T_{1/2}$ or	Branching ratios in percentage								
[keV]		Γ_{cm}	E_{f}^* : $2J_{\text{f}}^\pi$:	0.0 3^+	29.858 5^+	50.128 3^-	61.424 $\langle 7 \rangle^+$	79.708 $\langle 5 \rangle^-$	104.60	123.793 7^-	
593.58(12)										8.163	
641(3)											
685(3)											
712.7(4)						30(9)		70(13)			
729(4)											
782.54(17)	$\langle 1,3,5 \rangle$										
784.02(17)				12(3)	31(2)	12(5)	44(18)				
786.90(17)				3(2)	15(4)	5(1)		3(1)		7(1)	
792.6(6)				100							
803.44(9)				36(29)		14(8)	0.7(2)	15(6)			
805.38(10)	$\langle 1,3,5 \rangle$			33(7)							
818.18(18)				43(2)	10(6)		47(14)				
823.03(9)				54(5)	0.9(2)	3.2(8)					
826.7(3)	$\langle 3^+ \rangle$			8(3)		72(6)	14(4)	4.8(18)			
842.05(8)				20(3)	38(6)	1.1(1)	7(2)	6(1)		0.7(3)	
846.41(4)	$\langle 5 \rangle$			<6.18		11(2)	16(6)	25(3)		45(6)	
859.07(11)				10(2)	7(2)	3(1)	34(4)			6(2)	
867.5(4)	$\langle 3,5^+ \rangle$			17(1)	29(6)			10(2)			
879.41(17)	$\langle 7^+ \rangle$				27(8)		17(8)				
884.2(5)					100						
891(1)				100							
904.4(12)											
905.9(4)											
908.03(22)				80(11)	4.7(14)	2.0(6)		6.5(18)			
926.48(16)	$\langle 3,5^- \rangle$			0.7(3)	12(3)	26(9)		17(4)			
940.79(13)	$\langle 3^-, 5 \rangle$			58(11)	16(5)					26(5)	
943.1(10)	$\langle 3,5 \rangle$				6(2)	29(9)		43(17)			
957.73(11)	$\langle 3^-, 5^+ \rangle$			1.9(5)		70(10)		18(3)		7.4(15)	
971.31(25)				9(5)	61(9)		13(5)				
999.85(17)				9(2)	38(3)		2.9(11)	3.3(8)			
1015.2(7)				100							
1020.1(3)				17(6)	30(8)	x	53(11)				
1025.0(10)				70(18)	30(18)	x					
1028.94(25)					16(5)	57(11)		27(7)			

Additional data on this isotope can be found in [98Jo08, 93Ab01, 90Br23].

Uncertainties in E^* and $T_{1/2}$ are given in Supplement.

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

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

 $^{223}_{88}\text{Ra}$

E^* [keV]	$2J^\pi$	Branching ratios in percentage										
		E_f^* : $2J_f^\pi$:	130.141 9 ⁺	174.569 9 ⁻	174.58 11 ⁺	234.858 5 ⁺	247.39 11 ⁻	280.182 $\langle 7 \rangle^+$	286.087 1 ⁺	315.99 $\langle 13^- \rangle$	329.856 3 ⁻	334.370 5 ⁺
174.569(24)	9 ⁻		0.6(7)									
174.58(4)	11 ⁺		7(6)									
247.39(4)	11 ⁻		84(7)	10(8)								
280.182(22)	$\langle 7 \rangle^+$		6(2)		x							
315.99(6)	$\langle 13^- \rangle$			100								
329.856(14)	3 ⁻					0.4(2)			3.4(2)			
334.370(12)	5 ⁺		4.5(5)			0.5(1)		0.13(3)	0.3(1)			
342.590(19)	3 ⁺					0.6(2)			0.8(6)			
342.654(21)	$\langle 9 \rangle^+$		13(2)	3		1		34(4)				
350.53(6)	$\langle 1 \rangle^-$								17(3)			
369.36(4)	$\langle 5 \rangle^-$					40(10)		4.5(2)				
376.296(11)	7 ⁻		0.93(7)		1.8(2)	9(2)		5(1)			x	2(1)
405.07(3)	$\langle 7 \rangle^-$				11(4)	16(6)		12(6)				
424.12(5)	$\langle 11^+ \rangle$			11(4)	11(4)					7(2)		
432.24(3)	$\langle 5 \rangle^-$										1.936	
442.35(8)	$\langle 7^+ \rangle$			21(7)				22(7)				
445.071(19)	9 ⁺		77(6)	4.5(15)			2.0(6)					0.5(4)
459.93(5)	$\langle 9 \rangle^-$			59(18)		12(4)	26(7)					
514.25(8)	$\langle 11^- \rangle$			26(9)			69(17)					
537.16(11)							100					
593.58(12)									92(11)			
782.54(17)	$\langle 1,3,5 \rangle$										73.0	
786.90(17)						18(4)		15(3)			5	20(5)
803.44(9)						33(5)						1
805.38(10)	$\langle 1,3,5 \rangle$										66.7	
823.03(9)						1.2(3)			23(4)		11(2)	
826.7(3)	$\langle 3^+ \rangle$							0.05(1)	1.0(2)			
842.05(8)						4.1(9)			8(4)			15(6)
846.41(4)	$\langle 5 \rangle$										3.7(6)	
859.07(11)								17(1)				7(2)
867.5(4)	$\langle 3,5^+ \rangle$					8(2)			5(1)		7	7(6)
879.41(17)	$\langle 7^+ \rangle$		40(12)		8(2)	9(4)						
905.9(4)											100	
908.03(22)									2.0(6)			
926.48(16)	$\langle 3,5^- \rangle$					4(1)					1.2(6)	1.2(3)
943.1(10)	$\langle 3,5 \rangle$										14(3)	
957.73(11)	$\langle 3^-, 5^+ \rangle$								3.0(8)			
971.31(25)											16(5)	

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

 $^{223}_{88}\text{Ra}$

E^* [keV]	$2J^\pi$	Branching ratios in percentage								
		$E_f^*:$ $2J_f^\pi:$	342.590 3^+	342.654 $\langle 9 \rangle^+$	350.53 $\langle 1 \rangle^-$	369.36 $\langle 5 \rangle^-$	376.296 7^-	405.07 $\langle 7 \rangle^-$	424.12 $\langle 11^+ \rangle$	459.93 $\langle 9 \rangle^-$
350.53(6)	$\langle 1 \rangle^-$		4.9(17)							
376.296(11)	7^-			0.6(2)						
405.07(3)	$\langle 7 \rangle^-$		20(7)							
432.24(3)	$\langle 5 \rangle^-$			6(2)			8.17			
442.35(8)	$\langle 7^+ \rangle$			37.5						
445.071(19)	9^+						9.1(16)	2.5(6)	0.4(11)	
459.93(5)	$\langle 9 \rangle^-$			x						
514.25(8)	$\langle 11^- \rangle$									4.4(9)
782.54(17)	$\langle 1,3,5 \rangle$			27(7)						
786.90(17)			7(1)							
803.44(9)						1				
823.03(9)				6(2)						
826.7(3)	$\langle 3^+ \rangle$				0.5					
859.07(11)			11(4)				5(2)			
867.5(4)	$\langle 3,5^+ \rangle$			16(3)						
904.4(12)						100				
908.03(22)										5(3)
926.48(16)	$\langle 3,5^- \rangle$				37(22)					
943.1(10)	$\langle 3,5 \rangle$		7(2)							
999.85(17)							47(11)			

Energy levels and branching ratios [97Ar05].

 $^{224}_{88}\text{Ra}$

E^* [keV]	J^π	L (p,t)	σ (p,t) $\mu\text{b/sr}$	$T_{1/2}$ or Γ_{cm}	Ref.	Branching ratios in percentage							
						$E_f^*:$ $J_f^\pi:$	0 0^+	84.4 2^+	216 1^-	251 4^+	290 $\langle 3 \rangle^-$	433 $\langle 5 \rangle^-$	479 $\langle 6^+ \rangle$
0	0^+	0	198(26)	3.632(2) d	74Fr01								
84.373(3)	2^+	2	31(4)	0.746(14) ns	74Fr01	100							
215.985(4)	1^-					66.0(8)		34.0(5)					
250.783(5)	4^+	4	19(3)	0.181(9) ns	74Fr01			100					
290.36(4)	$\langle 3 \rangle^-$							98(3)	2.0(8)				
433.07(10)	$\langle 5 \rangle^-$									79(28)	21(8)		
479.20(18)	$\langle 6^+ \rangle$		6(1)		74Fr01					100			
640.86(20)	$\langle 7^- \rangle$											100	<40
754.82(22)	$\langle 8^+ \rangle$												100
906.24(23)	$\langle 9^- \rangle$												
916.34(7)	0^+	0	16(3)		74Fr01			83(14)	≈ 17				
965.51(6)	$\langle 2^+ \rangle$					38(4)		62(4)					
992.65(6)	$\langle 2^+ \rangle$					≈ 32		36(3)		32(7)			
1052.95(3)	1^-					1.7(3)		2.6(3)	78(4)		17.8(9)		
1067.4	$\langle 10^+ \rangle$												
1089.98(6)	$\langle 2,3 \rangle^-$							3.6(5)	27.2(17)		69(3)		

(continued)

 $^{224}_{88}\text{Ra}$

E^*	J^π	L	σ (p,t)	$T_{1/2}$ or	Ref.	Branching ratios in percentage							
[keV]		(p,t)	$\mu\text{b/sr}$	Γ_{cm}		E_{f}^* : J_{f}^π :	0 0 ⁺	84.4 2 ⁺	216 1 ⁻	251 4 ⁺	290 $\langle 3 \rangle^-$	433 $\langle 5 \rangle^-$	479 $\langle 6^+ \rangle$
1187.1(4)	0 ⁺ ,1,2							54(15)	46(5)				
1216.9(2)	$\langle 1^-,2 \rangle$								42(5)		58(14)		
1220.7(3)	$\langle 11^- \rangle$												
1223(4)	0 ⁺	0	12		74Fr01								
1348.22(9)	2 ⁺ ,3 ⁺							45(6)		55(15)			
1378.35(5)	1 ⁻					60(6)		15(2)					
1378.93(7)	$\langle 1^+,2^+ \rangle$								47(4)				
1389.71(9)	0 ⁺ ,1,2							31(4)	69(10)				
1413.7(4)	$\langle 12^+ \rangle$												
1425.03(5)	$\langle 0,1,2 \rangle^-$							74(7)	1.00(10)				
1435.47(4)	1 ⁻					44(4)		12(2)	9.6(11)				
1437.08(6)	2 ⁺					45(5)		39(5)		16(2)			
1553.67(14)	1,2 ⁺					19(2)		40(5)	≈ 40				
1569.2(4)	$\langle 13^- \rangle$												
1614.41(17)	$\langle 1^-,2 \rangle$								70(9)		30(4)		
1627(3)			13(3)		74Fr01								
1652.42(6)	2 ⁺					60(7)		30(4)		3.8(5)			
1658.52(9)	1 $\langle^- \rangle$,2 ⁺					53(9)			17(2)		30(7)		
1736.3(2)	1,2 ⁺					83(13)			17(2)				
1754.84(9)	0 ⁺ ,1,2							61(9)	12(2)				
1761(4)			8(1)		74Fr01								
1789.61(7)	1,2 ⁺					33(5)		22(4)	45(5)				
1796.75(9)	$\langle 1^-,2 \rangle$							56(9)	21(3)		23(3)		
1818.07(19)	$\langle 1^-,2 \rangle$								53(9)		47(9)		
1838.49(10)	0,1,2								100				
1896.3(3)	$\langle 1^-,2 \rangle$							31(7)	26(7)		43(7)		
1949(4)			2(1)		74Fr01								
1969.92(10)	0,1,2								100				
2000.20(17)	$\langle 1^-,2 \rangle$								41(7)				
2043.2(5)	0,1,2								100				
2052.3(4)	2 ⁺								39(12)	61(12)			
2077.3(4)	0 ⁺ ,1,2							68(12)	32(6)				
2117.4(4)	1,2 ⁺					61(9)		39(7)					
2135.3(5)	0,1,2								100				
2229.4(4)	$\langle 1^-,2 \rangle$							38(7)	34(7)		28(7)		
2246.5(3)	1,2 ⁺					7(1)		45(7)	48(8)				
2368.7(4)	1,2 ⁺					35(7)			65(10)				
			74Fr01		Ref.								

Additional data on this isotope can be found in [04Ga03, 90Ma20].

The ground-state band and the band built on 1⁻ level are extended in [99Co02].Uncertainties in E^* and $T_{1/2}$ are given in Supplement.

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

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

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E^*	J^π	Branching ratios in percentage										
[keV]		E_f^* : J_f^π :	641 $\langle 7^- \rangle$	754.82 $\langle 8^+ \rangle$	906.24 $\langle 9^- \rangle$	916.34 0^+	965.51 $\langle 2^+ \rangle$	992.65 $\langle 2^+ \rangle$	1052.95 1^-	1067.4 $\langle 10^+ \rangle$	1089.98 $\langle 2,3 \rangle^-$	1220.7 $\langle 11^- \rangle$
754.82(22)	$\langle 8^+ \rangle$		<10									
906.24(23)	$\langle 9^- \rangle$		100	<15								
1067.4	$\langle 10^+ \rangle$			x								
1220.7(3)	$\langle 11^- \rangle$				x							
1378.35(5)	1^-					6.1(4)			18.8(10)			
1378.93(7)	$\langle 1^+, 2^+ \rangle$						40(2)	12.6(10)				
1413.7(4)	$\langle 12^+ \rangle$									x		
1425.03(5)	$\langle 0, 1, 2 \rangle^-$								9.7(5)		15.4(7)	
1435.47(4)	1^-					3.5(3)		11(1)	20.0(10)			
1569.2(4)	$\langle 13^- \rangle$											x
1652.42(6)	2^+							6.2(11)				
1754.84(9)	$0^+, 1, 2$								27(9)			
2000.20(17)	$\langle 1^-, 2 \rangle$								59(7)			

Energy levels and branching ratios [90Ak03, 00Ga52].

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E^* [keV]	$2J^\pi$	L (d,t)	σ (d,t) $\mu\text{b/sr}$	S_N (d,t)	σ (τ, α) $\mu\text{b/sr}$	$2K[Nn_z\Lambda]$	$T_{1/2}$ or Γ_{cm}	Ref.	Branching ratios in percentage					
									E_f^* : $2J_f^\pi$:	0.0 1^+	25.4 5^+	31.5 3^-	42.8 3^+	55.2 $\langle 1^- \rangle$
0.0	1^+	0,2	87	0.032			14.9(2) d	83Ny01						
25.36(2)	5^+	2	109	0.065	1		0.88(4) ns	83Ny01	x					
31.57(3)	3^-				incl		2.1(5) ns		x					
42.74(3)	3^+	2	66	0.036	incl		<3 ns	83Ny01		48(3)	52(29)			
55.23(6)	$\langle 1^- \rangle$									68(11)		32(3)		
69.37(3)	$\langle 7^- \rangle$										100	0.50(25)		
100.53(4)	$\langle 9^+ \rangle$										42(9)			
101.72(8)	$\langle 3^+ \rangle$		16	0.012	3			83Ny01						
111.61(3)	7^+	≤ 4	22		incl			83Ny01			86(7)		8.8(9)	
120.27(4)	5^-										18(4)		59(8)	
149.90(3)	3^+	1,2	23	0.012	2			83Ny01		3.2(8)	38(4)		44(3)	15(1)
151.59(8)	$\langle 5^+ \rangle$							00Ga52						
179.71(3)	5^+									6.1(5)	24(1)	27(2)	37(1)	
203.48(8)	$\langle 9^- \rangle$													
216.28(9)	$\langle 13^+ \rangle$				22			86Lo01						
220.57(5)	$\langle 7^+, 9^+ \rangle$		34		incl			83Ny01			24(16)			
225.08(5)	3^-									20(1)	13(1)	5(1)	36	7(1)
226.94(7)	$\langle 11^+ \rangle$													
236.56(3)	5^+		43	<0.03		5+[633]		83Ny01		1.48(8)	24(3)	5.1(3)	37	
243.47(3)	7^+			0.051	4			86Lo01			16(2)		6.0(3)	
248.63(6)	$\langle 3^+ - 7^+ \rangle$													
260.18(4)	$\langle 5^- \rangle$										17(1)	3.9(5)	11(1)	
267.94(4)	7^+	4	29	0.077		5+[633]		83Ny01			5.6(9)		4.2(6)	

(continued)

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E^* [keV]	$2J^\pi$	L (d,t)	σ (d,t) $\mu\text{b/sr}$	S_N (d,t)	σ (τ, α) $\mu\text{b/sr}$	$2K[Nn_z\Lambda]$	$T_{1/2}$ or Γ_{cm}	Ref.	Branching ratios in percentage					
									E_f^* : $2J_f^\pi$:	0.0 1 ⁺	25.4 5 ⁺	31.5 3 ⁻	42.8 3 ⁺	55.2 (1 ⁻)
272.20(5)	$\langle 7^+, 9^- \rangle$				38			86Lo01						
284.33(5)	7^+										8(1)			
292.69(6)	$\langle 3^+, 7^+ \rangle$													
321.83(4)	$\langle 9^+ \rangle$	4	170	0.035	16	5+[633]		86Lo01			≈ 3			
327.71(4)	$\langle 3^+, 5^+ \rangle$													
335.40(6)	$\langle 1^+, 5^- \rangle$													
349.43(7)	$\langle 3, 5^+ \rangle$													
390.21(5)	$\langle 11^+ \rangle$		28	<0.09	15	5+[633]		86Lo01						
394.24(6)	$\langle 3^-, 5^- \rangle$										13(5)			
394.45(5)	$\langle 5^- \rangle^+$													
399.54(7)	$\langle 3^- \rangle$													
403.50(6)	$\langle 3^+, 5^+ \rangle$													
416.76(10)														
446.45(6)	$\langle 7^-, 9^+ \rangle$				3			86Lo01						
478.10(4)	$\langle 3^+ \rangle$									33(3)	17(2)		24(3)	
486.82(5)	$\langle 5^+ \rangle$		68		4			86Lo01						
487.22(13)	$\langle 13^+ \rangle$					5+[633]		83Sh37						
535.24(5)	$\langle 5^+ \rangle$		42	0.043	52			86Lo01						
546(8)				<0.10										
592.79(5)	$\langle 3^+, 5^+ \rangle$							00Ga52						
604.51(4)	$\langle 5^+ \rangle$	0,2	8					83Ny01						
608.93(11)			[7]		10			83Ny01						
630(8)			13					83Ny01						
663.23(6)	$\langle 5^+, 7^+ \rangle$		20					00Ga52						
724.1(1)	$\langle 3, 5^- \rangle$													
815(8)	$\langle 5^- \rangle$	3	9		6			83Ny01						
851(8)			8					83Ny01						
898(8)	$\langle 1^- \rangle$	1	908	0.60	3			83Ny01						
956(8)	$\langle 5^- \rangle$	2	54		5			83Ny01						
967(8)	$\langle 3^- \rangle$	$\langle 0, 1 \rangle$	186	0.074	incl			83Ny01						
1009(8)			24		1			86Lo01						
1025(8)		$\langle 2, 1 \rangle$	41		2			83Ny01						
1056(8)			37		4			86Lo01						
1070(8)		$\langle 0=2 \rangle$	78		incl			83Ny01						
1091(8)			53		2			86Lo01						
1156(8)			24		4			86Lo01						
1184(10)					2			86Lo01						
1225(8)	$\langle 5^- \rangle$	$\langle 3 \rangle$	315	0.23	21			83Ny01						
1258(8)		$\langle 1 \rangle$	216	0.16				83Ny01						
1272(10)					9			86Lo01						
1334(8)		$\langle 0 \rangle$	30		1			83Ny01						
1408(10)		$\langle 1 \rangle$	159	0.11	3			83Ny01						
1441(8)		$\langle 1 \rangle$	313	0.24	4			83Ny01						
1479(8)			38		3			86Lo01						
1553(8)			24					83Ny01						

(continued)

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E^*	$2J^\pi$	L	σ (d,t)	S_N	σ (τ,α)	$2K[Nn_z\Lambda]$	$T_{1/2}$ or	Ref.	Branching ratios in percentage					
[keV]		(d,t)	$\mu\text{b/sr}$	(d,t)	$\mu\text{b/sr}$		Γ_{cm}		E_f^* :	0.0	25.4	31.5	42.8	55.2
									$2J_f^\pi$:	1 ⁺	5 ⁺	3 ⁻	3 ⁺	$\langle 1^- \rangle$
1766(8)		$\langle 0,1 \rangle$	25					83Ny01						
1792(8)		$\langle 0,1 \rangle$	41					83Ny01						
1872(10)					3			86Lo01						
1912(10)					1			86Lo01						
1972(10)					3			86Lo01						
2138(10)	$\langle 13^+ \rangle$				96			86Lo01						
		83Ny01	83Ny01	83Ny01	86Lo01	83Sh37		Ref.						

Energy levels and branching ratios [90Ak03, 00Ga52]. Part 2

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E^*	$2J^\pi$	Branching ratios in percentage												
[keV]		E_f^* :	69.4	100.5	111.60	120.36	149.96	179.75	203.5	215.8	220.55	225.2		
		$2J_f^\pi$:	$\langle 7 \rangle^-$	$\langle 9 \rangle^+$	7 ⁺	5 ⁻	3 ⁺	5 ⁺	$\langle 9^- \rangle$		$\langle 7^+, 9^+ \rangle$	3 ⁻		
100.53(4)	$\langle 9 \rangle^+$		58(6)											
111.61(3)	7 ⁺		5.3(6)	x										
120.27(4)	5 ⁻		23(6)											
179.71(3)	5 ⁺		3.8(4)		2.1(3)		<1.3							
203.48(8)	$\langle 9^- \rangle$		x											
220.57(5)	$\langle 7^+, 9^+ \rangle$			41(16)	35(7)									
225.08(5)	3 ⁻						16(1)	2.0(4)						
226.94(7)	$\langle 11^+ \rangle$			x										
236.56(3)	5 ⁺		1.8(1)		6.3(5)	0.15(3)	22(1)	2.4(2)						
243.47(3)	7 ⁺		<3	35(1)	29(1)	13.2(6)								
248.63(6)	$\langle 3^+ - 7^+ \rangle$							x						
260.18(4)	$\langle 5^- \rangle$		29(3)			13(1)	24(4)	3.1(6)						
267.94(4)	7 ⁺			3.0(6)	70(2)	12.1(13)	0.8(3)							
272.20(5)	$\langle 7^+, 9^- \rangle$			x	x				x					
284.33(5)	7 ⁺		31(3)	32(2)	26(3)		≤ 0.7	2(1)			1.2(5)			
321.83(4)	$\langle 9^+ \rangle$		24(3)	6(2)	49(11)			2.9(8)			4.7(8)			
390.21(5)	$\langle 11^+ \rangle$									x	x			
394.24(6)	$\langle 3^-, 5 \rangle$		7(2)				11(3)						33(16)	
394.45(5)	$\langle 5^+ \rangle$										x			
478.10(4)	$\langle 3^+ \rangle$					3(1)	7(2)						10(2)	
724.1(1)	$\langle 3, 5 \rangle$						24(4)						56(9)	

Energy levels and branching ratios [90Ak03, 00Ga52]. Part 3

 $^{225}_{88}\text{Ra}$

E^*	$2J^\pi$	Branching ratios in percentage						
[keV]		E_f^* : $2J_f^\pi$:	226.9 $\langle 11^+ \rangle$	236.25 5^+	243.56 7^+	260.2 $\langle 5 \rangle^-$	267.92 7^+	272.15
267.94(4)	7^+			4.0(6)				
272.20(5)	$\langle 7^+, 9^- \rangle$				x			
321.83(4)	$\langle 9^+ \rangle$				2.1(5)		2.9(8)	5.5(5)
390.21(5)	$\langle 11^+ \rangle$		x					
394.24(6)	$\langle 3^-, 5 \rangle$			21(5)		15(5)		
394.45(5)	$\langle 5 \rangle^+$			57(6)	≈ 30		13(6)	
478.10(4)	$\langle 3^+ \rangle$			8(1)				
724.1(1)	$\langle 3, 5 \rangle$					20(4)		

Energy levels and branching ratios [96Ak02].

 $^{226}_{88}\text{Ra}$

E^* [keV]	J^π	L (d, ^6Li)	S_α <i>rel.</i>	γ_α^2 [eV]	σ (d,d') $\mu\text{b/sr}$	$T_{1/2}$ or Γ_{cm}	Ref.	Branching ratios in percentage					
								$E_f^*:$ $J_f^\pi:$	0.0 0^+	67.7 2^+	211 4^+	254 1^-	321 3^-
0.0	0^+	0	1.0	58		1600(7) yr	84Va13						
67.67(1)	2^+	2	0.8	43	1600	0.63(2) ns	90Th02	x					
211.54(2)	4^+	4	0.4	16	223	≈ 0.17 ns	90Th02		x				
253.73(1)	1^-	1	< 0.1	< 3	< 84		90Th02	58(4)	42(2)				
321.54(6)	3^-	3	< 0.3	< 12	204		90Th02		91(10)	9(3)	x		
416.5(3)	6^+	6	< 0.2	< 6	< 15		90Th02			x			
446.3(2)	5^-	5	< 0.3	< 9	23		90Th02		97				3.2(11)
626.7(2)	7^-												
650	$\langle 0^+ \rangle$	0	< 0.1	< 6			84Va13					x	
669.4(3)	8^+												
824.6(1)	0^+	0	0.4	22			84Va13					x	
857.6(3)	9^-												
873.7(1)	2^+	2	0.4	20			84Va13					52(5)	48(4)
959.9(3)	10^+												
1048.8(1)	1^-	1	0.4	17			84Va13	37(4)	47(5)			15(1)	
1070.5(2)	$\langle 2^- \rangle$								87(9)			12.8(12)	
1077.2(2)	$1^-, 2$								85(9)			6.6(7)	8.1(9)
1107(3)	$2^+, 3^-$				27		90Th02						
1122.4(3)	$\langle 2^+ \rangle$				80		90Th02			x			
1133.1(3)	11^-												
1140		$\langle 2 \rangle$	$\langle 1.1 \rangle$	$\langle 49 \rangle$			84Va13						
1156.2(1)	2^+				5		90Th02	22(2)	15(1)	36(4)	5.8(4)		20(1)
1220		$\langle 0 \rangle$	$\langle 1.3 \rangle$	$\langle 61 \rangle$			84Va13						
1238.9(5)	$\langle 2 \rangle$								67(10)				33(7)
1280.5(4)	12^+												
1330		$\langle 0 \rangle$	$\langle 0.7 \rangle$	$\langle 34 \rangle$			84Va13						
1390.0(1)	2^+				24		90Th02	32(3)	57(5)				
1420		$\langle 2 \rangle$	$\langle 1.4 \rangle$	$\langle 57 \rangle$			84Va13						

(continued)

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E^*	J^π	L	S_α	γ_α^2	σ (d,d')	$T_{1/2}$ or	Ref.	Branching ratios in percentage					
[keV]		(d, ⁶ Li)	<i>rel.</i>	[eV]	μ b/sr	Γ_{cm}		E_f^* : J_f^π :	0.0 0 ⁺	67.7 2 ⁺	211 4 ⁺	254 1 ⁻	321 3 ⁻
1422.5(10)	0,1,2											x	
1437.8(7)	1 ⁻ ,2											46(5)	54(13)
1446	13 ⁻												
1540		⟨1⟩	⟨0.9⟩	⟨33⟩			84Va13						
1587.3(5)	1,2 ⁺							13(3)				87(17)	
1621.3(5)	1 ⁻ ,2 ⁺							14(2)	12(3)			26(7)	48(7)
1625	14 ⁺												
1723.4(3)	2 ⁺				31		90Th02	14(2)	28(4)			52(8)	
1738.5(10)	1,2 ⁺							59(6)	31(4)			11(2)	
1756.2(10)	1,2 ⁺							78(12)				22(3)	
1767.1(10)	0,1,2											x	
1778.4(10)	0,1,2											x	
1786.1(10)	1 ⁻ ,2 ⁺							9(2)				55(10)	35(8)
1793	15 ⁻												
1865.0(10)	1,2 ⁺							28(3)	13(2)			48(5)	
1882.3(7)	0,1,2												
1888.4(15)	0,1,2											x	
1897.4(10)	1 ⁻ ,2 ⁺							31(7)		25(5)			44(13)
1907.8(10)	1,2 ⁺							21(4)	48(5)				
1945.6(10)	1,2 ⁺							12(4)				88(11)	
1951.0(10)	1 ⁻ ,2 ⁺							13	42(5)			35(5)	10(2)
1970.8(5)	1 ⁻ ,2 ⁺							13(2)	42(4)			33(3)	6.7(9)
1982.7(10)	0 ⁺ ,1								22(3)			57(6)	
1993	16 ⁺												
2006.7(15)	0,1,2											x	
2015.2(15)	0,1,2											x	
2056.8(5)	1,2 ⁺							18(3)	40(4)				
2086.1(10)	1,2 ⁺							15(4)	85(14)				
2170	17 ⁻												
2182.3(15)	0,1,2											x	
2189.4(10)	2 ⁺				5		90Th02	15(2)	49(7)				
2217					6		90Th02						
2269.7(10)	1,2 ⁺							14(5)	53(6)			32(6)	
2382	18 ⁺												
			84Va13	84Va13	90Th02		Ref.						

Additional data on this isotope can be found in [04Ga03, 96Ac01, 93Wo05, 93Bu06, 84Va23].

The ground-state band and the band built on 1⁻ level are extended in [99Co02]. γ_α^2 is a reduced width of α -particle emission [84Va13].Uncertainties in E^* and $T_{1/2}$ are given in Supplement.

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

Energy levels and branching ratios [96Ak02]. Part 2

 $^{226}_{88}\text{Ra}$

E^* [keV]	J^π	Branching ratios in percentage										
		$E_f^*:$ $J_f^\pi:$	416.5 6 ⁺	446.3 5 ⁻	626.7 7 ⁻	669.4 8 ⁺	824.6 0 ⁺	857.6 9 ⁻	873.7 2 ⁺	959.9 10 ⁺	1077.2 1 ⁻ ,2	1122.4 ⟨2 ⁺ ⟩
626.7(2)	7 ⁻		7.8(9)	92								
669.4(3)	8 ⁺		x									
857.6(3)	9 ⁻				35(3)	65						
959.9(3)	10 ⁺					x						
1133.1(3)	11 ⁻							59		41(4)		
1280.5(4)	12 ⁺									x		
1390.0(1)	2 ⁺						4.7(5)		5.9(5)			
1723.4(3)	2 ⁺										7(2)	
1865.0(10)	1,2 ⁺								11(2)			
1907.8(10)	1,2 ⁺						30(6)					
1970.8(5)	1 ⁻ ,2 ⁺											5.6(8)
1982.7(10)	0 ⁺ ,1								21(5)			
2056.8(5)	1,2 ⁺						42(4)					
2189.4(10)	2 ⁺						36(15)					

Energy levels and branching ratios [96Ak02]. Part 3

 $^{226}_{88}\text{Ra}$

E^* [keV]	J^π	Branching ratios in percentage							
		$E_f^*:$ $J_f^\pi:$	1133.1 11 ⁻	1280.5 12 ⁺	1437.8 1 ⁻ ,2	1446 13 ⁻	1625 14 ⁺	1793 15 ⁻	1993 16 ⁺
1446	13 ⁻		x	x					
1625	14 ⁺			x		x			
1793	15 ⁻					x	x		
1882.3(7)	0,1,2				x				
1993	16 ⁺						x	x	
2170	17 ⁻							x	x
2382	18 ⁺								x

Energy levels and branching ratios [01Br31].

 $^{227}_{88}\text{Ra}$

E^* [keV]	$2J^\pi$	σ (t,d) $\mu\text{b/sr}$	A_y (t,d)	σ (d,p) $\mu\text{b/sr}$	R (d,p)	$2J[Nn_z\Lambda]$	S_N (d,p)	$T_{1/2}$ or Γ_{cm}	Ref.
0.0	3 ⁺	73	⟨+⟩	40	2.2	3+[631]	<0.04	42.2(5) m	81Vo03
1.735(12)	⟨5⟩ ⁺	incl		incl		5+[633]			81Vo03
25.768(3)	5 ⁺	116	⟨+⟩	40	1.5	5+[631]	<0.12		81Vo03
64.083(10)	⟨7⟩ ⁺					7+[631]			81Vo03
83.4(24)	9 ⁺	708	+	318	1.54	9+[633]	0.96		81Vo03

(continued)

 $^{227}_{88}\text{Ra}$

E^*	$2J^\pi$	σ (t,d)	A_y	σ (d,p)	R	$2J[Nn_z\Lambda]$	S_N	$T_{1/2}$ or	Ref.
[keV]		$\mu\text{b/sr}$	(t,d)	$\mu\text{b/sr}$	(d,p)		(d,p)	Γ_{cm}	
90.035(2)	3^-					3-[761]		254(9) ps	81Vo03
101.895(2)	5^-					5-[761]		236(30) ps	81Vo03
120.710(5)	1^+	109	$\langle + \rangle$	112	1.45	1+[631]	0.045	≤ 47 ps	81Vo03
138.6(24)	$\langle 11^- \rangle$	61	$\langle + \rangle$	30	0.9	11-[761]			81Vo03
153.275(12)	3^+-7^+					5+[622]			81Vo03
161.050(5)	3^+	414	—	163	2.12	3+[631]	0.15	≤ 39 ps	81Vo03
176.970(7)	$\langle 5 \rangle^+$	274	$\langle + \rangle$	68	2.1	5+[631]	0.058	≤ 58 ps	81Vo03
186.3(24)	$\langle 11^+ \rangle$	347	$\langle - \rangle$	73	1.7	11+[631]			81Vo03
228.0(24)	$\langle 15 \rangle^-$	82	$\langle + \rangle$	50	1.1	15-[761]			81Vo03
267.3(24)	$\langle 7^+ \rangle$	73	$\langle - \rangle$	23	1.4	7+[631]	0.07		81Vo03
284.279(6)	3^-							16(13) ps	
296.576(4)	1^-							≤ 41 ps	
299.4(24)	$\langle 9^+ \rangle$	244	+	92	1.3	9+[631]	0.28		81Vo03
337.6(24)		69		28	1.2				81Vo03
363(3)				12	2.0				81Vo03
384.356(8)	$1^+, 3^+$			10	0.9			≤ 21 ps	81Vo03
406(3)				24	2.7				81Vo03
438.794(9)	$\langle 3 \rangle^+$			12	1.2				81Vo03
471.567(7)	3^-							≤ 6 ps	
472(3)	$\langle 13^+ \rangle$			11	0.7	13+[631]			81Vo03
475.032(14)	3^+								
523.851(8)	$\langle 1 \rangle^-$			14		1-[770]		≤ 20 ps	81Vo03
598.509(36)									
675.86(1)	1^-			25	1.2	1-[501]		≤ 10 ps	81Vo03
731.65(1)	$3^+, 5^+$			11	1.8				81Vo03
738.12(10)	$\langle 5^- \rangle$					5-[501]			81Vo03
755.6(24)	$\langle 3^- \rangle$	326	+	139	1.76	3-[761]	0.06		81Vo03
806.6(24)	$\langle 7^- \rangle$	329	+	141	1.26	7-[761]	0.17		81Vo03
858.0(24)		35	$\langle - \rangle$	56	2.0				81Vo03
875(3)				14	1.3				81Vo03
906.4(24)		180		92	1.8				81Vo03
926.0(24)		49		43	3.1				81Vo03
948.3(24)		85	—	68	2.2				81Vo03
969.3(24)		138		121	2.33				81Vo03
1000.6(24)		80		59	1.9				81Vo03
1017.0(24)		72	—	55	2.0				81Vo03
1056.0(24)		57	—	41	1.6				81Vo03
1094.9(3)		83		62	1.0				81Vo03
1127.1(24)		64	+	75	1.8				81Vo03
1136(3)				60	1.6				81Vo03
1152(3)				53	1.8				81Vo03
1168.3(24)		90	+	162	1.54				81Vo03
1202(3)				59	1.7				81Vo03
1230(3)				90	1.6				81Vo03
1250(3)				50	1.4				81Vo03

(continued)

²²⁷Ra
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E^*	$2J^\pi$	σ (t,d)	A_y	σ (d,p)	R	$2J[Nn_z\Lambda]$	S_N	$T_{1/2}$ or	Ref.
[keV]		$\mu\text{b/sr}$	(t,d)	$\mu\text{b/sr}$	(d,p)		(d,p)	Γ_{cm}	
1287(3)				52	1.4				81Vo03
1307.0(24)		60	$\langle + \rangle$	105	1.7				81Vo03
1318.83(17)									
1331(3)				32	1.7				81Vo03
1391(3)				59	1.7				81Vo03
1432.23(21)				50	1.3				81Vo03
1444.2(4)				46	1.2				81Vo03
1455.2(3)									
1468.14(15)				47	1.7				81Vo03
1474.83(21)									
1491(3)				62	1.8				81Vo03
1516(3)				52	1.7				81Vo03
1545(3)				59	1.5				81Vo03
1581(3)				61	1.1				81Vo03
1751(3)				74	1.4				81Vo03
1765(3)				71	1.5				81Vo03
1792(3)				85	1.5				81Vo03
1814(3)				137	1.56				81Vo03
1832(3)				83	1.7				81Vo03
1857(3)				75	1.7				81Vo03
1884(3)				75	1.4				81Vo03
1916(3)				62	1.5				81Vo03
1957(3)				111	1.42				81Vo03
1972(3)				99	1.5				81Vo03
2064(3)				246	1.59				81Vo03
2083(3)				242	1.70				81Vo03
2105(3)				235	1.54				81Vo03
2124(3)				214	1.50				81Vo03
2160(3)				159	1.60				81Vo03
2181(3)				156	1.56				81Vo03
2228(3)				181	1.46				81Vo03
2271(3)				176	1.38				81Vo03
2291(3)				176	1.41				81Vo03
2317(3)				150	1.47				81Vo03
2340(3)				142	1.48				81Vo03
		81Vo03	81Vo03	81Vo03	81Vo03	81Vo03	81Vo03		Ref.

Additional data on this isotope can be found in [97AaZZ].

Rotational structure was studied using (n, γ) , (d, p) and (t, d) reactions in [81Vo03].

σ (d,p) and σ (t,d) were measured at 90° and 49° , the ratio $R = \sigma$ (d,p)(at 90°)/ σ (d,p)(at 125°).

S_N is defined as $d\sigma/d\Omega_{exp} = 2N S_N d\sigma/d\Omega_{DWBA} = 2N (\sum (C_{lj}) a_i U_i)^2 d\sigma/d\Omega_{DWBA}$.

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

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

 $^{227}_{88}\text{Ra}$

E^*	$2J^\pi$	Branching ratios in percentage										
[keV]		E_f^* : $2J_f^\pi$:	0.0 3 ⁺	1.7 (5) ⁺	25.7 5 ⁺	64.1 (7) ⁺	90.0 3 ⁻	101.895 5 ⁻	120.710 1 ⁺	153.275	161.050 3 ⁺	176.970 (5) ⁺
64.083(10)	$\langle 7 \rangle^+$		100									
90.035(2)	3 ⁻		72(7)	≤ 2.1	28(3)							
101.895(2)	5 ⁻		50(8)	38(8)	2.1(4)	9(2)	0.0012(3)					
120.710(5)	1 ⁺		100									
153.275(12)	3 ⁺ -7 ⁺		47(7)	53(7)								
161.050(5)	3 ⁺		31(3)	16(2)	52(15)				0.14(5)			
176.970(7)	$\langle 5 \rangle^+$			55(37)	35(24)	10(4)			≤ 0.6		≤ 0.04	
284.279(6)	3 ⁻		5.0(11)				5.0(5)	9.0(11)	53(5)	3.7(5)	4.5(5)	20(2)
296.576(4)	1 ⁻		1.2(6)				20(2)		39(9)		39(15)	
384.356(8)	1 ⁺ ,3 ⁺		97(8)						2.5(9)			
438.794(9)	$\langle 3 \rangle^+$		24(4)	16(2)	48(4)		12(1)					
471.567(7)	3 ⁻			1.8(4)	1.8(4)		34(3)	54(3)	3.4(3)			4.0(5)
475.032(14)	3 ⁺		33(3)	9(2)	24(2)	8(2)		5(1)		6(1)		
523.851(8)	$\langle 1 \rangle^-$		2.0(3)		1.2(3)		85(5)	1.2(3)	5.6(4)		3.7(3)	
598.509(36)			17(4)	17(4)	22(6)	28(8)						
675.86(1)	1 ⁻		≤ 0.9				71(4)	1.09(8)	7.1(5)		4.5(8)	
731.65(1)	3 ⁺ ,5 ⁺						14(3)	21(3)				
738.12(10)	$\langle 5^- \rangle$				47(14)		20(7)					
1094.9(3)							[50(11)]					
1318.83(17)								40(5)				
1432.23(21)			12(2)				54(5)					
1444.2(4)							[100]					
1455.2(3)			60(7)				29(5)					
1468.14(15)			13(2)				19(2)		26(3)		22(2)	
1474.83(21)			6(1)				37(1)				17(3)	

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

 $^{227}_{88}\text{Ra}$

E^*	$2J^\pi$	Branching ratios in percentage										
[keV]		E_f^* : $2J_f^\pi$:	284.279 3 ⁻	296.576 1 ⁻	384.356 1 ⁺ ,3 ⁺	438.794 ⟨3⟩ ⁺	471.567 3 ⁻	472 ⟨13 ⁺ ⟩	475.032 3 ⁺	523.851 ⟨1⟩ ⁻	731.650 3 ⁺ ,5 ⁺	1318.83
<hr/>												
296.576(4)	1 ⁻		≤0.001									
471.567(7)	3 ⁻		1.2(4)									
475.032(14)	3 ⁺			15(2)								
523.851(8)	⟨1⟩ ⁻				1.2(3)							
598.509(36)						17(8)						
675.86(1)	1 ⁻		6.2(4)	0.23(4)	1.8(1)	0.13(4)	7.0(6)		1.4(1)			
731.65(1)	3 ⁺ ,5 ⁺			14(5)	39(3)					12(3)		
738.12(10)	⟨5 ⁻ ⟩					33(7)						
1094.9(3)			[50(11)]									
1318.83(17)								35(5)		24(5)		
1432.23(21)			≤10		21(4)	≤35				12(4)		

(continued)

²²⁷Ra
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E^* [keV]	$2J^\pi$	Branching ratios in percentage								523.851 $\langle 1 \rangle^-$	731.650 $3^+, 5^+$	1318.83
		E_f^* : $2J_f^\pi$:	284.279 3^-	296.576 1^-	384.356 $1^+, 3^+$	438.794 $\langle 3 \rangle^+$	471.567 3^-	472 $\langle 13^+ \rangle$	475.032 3^+			
1455.2(3)						12(2)						
1468.14(15)								3(1)	≤ 8	4(1)	6(1)	7(1)
1474.83(21)			12(3)	14(3)							12(3)	

Energy levels and branching ratios [97Ar08].

²²⁸Ra
₈₈

E^* [keV]	J^π	L (d, ⁶ Li)	S_α <i>rel.</i>	γ_α^2 [eV]	σ (d, ⁶ Li) $\mu\text{b/sr}$	S_α	γ_α^2 [eV]	$T_{1/2}$ or Γ_{cm}	Ref.
0	0^+	0	1.0	75	0.137(40)	0.019	59	5.75(3) yr	84Va13
63.823(20)	2^+	2	1.0	69	0.287(58)	0.042	120	0.55(2) ns	98Gu09
204.68(3)	4^+	4	0.7	40	0.108(36)	0.012	29	181(3) ps	98Gu09
411.68(5)	$\langle 6^+ \rangle$	6	<0.2	<7	0.059(26)	0.008	14		81Ja01
474.18(4)	1^-	1	<0.2	<9				≤ 7 ps	98Gu09
537.49(4)	3^-	3	<0.1	<6				≤ 6 ps	98Gu09
655.96(5)	$\langle 5^- \rangle$	5	<0.2	<8					84Va13
721.19(9)	0^+	0	0.6	38		158*	139*		84Va13
770.71(4)	2^+	2	1.1	65		incl			84Va13
846.15(9)	2^+	2	0.8	50					84Va13
880.30(6)	4^+	4	1.2	63					84Va13
898.85(8)	$\langle 3^+ \rangle$								
966.99(19)	$\langle 2^+, 4^+ \rangle$	2,4	0.4	$\langle 24 \rangle$					84Va13
1013.24(14)	2^+								98Gu09
1042.01(11)	$\langle 0^+ \rangle$								98Gu09
1052.78(13)	$\langle 2^+ - 4^+ \rangle$	2.4	0.3	$\langle 17 \rangle$		57*	47*		84Va13
1070.23(7)	$\langle 3^+ \rangle$					incl			
1087.28(7)	$\langle 1^-, 2, 3^- \rangle$					incl			
1109.10(19)	$\langle 2^+, 3, 4^+ \rangle$								
1140	$\langle 4^+ \rangle$	$\langle 4 \rangle$	0.8	$\langle 37 \rangle$					84Va13
1157.59(21)	$\langle 2^+, 3, 4^+ \rangle$								
1182.26(8)	$\langle 3^-, 4^+ \rangle$								
1200	$\langle 2^+ \rangle$	$\langle 2 \rangle$	0.3	$\langle 38 \rangle$					84Va13
1219.97(13)	$\langle 2^+ \rangle$								
1238.5(3)	$\langle 0^+ - 3^- \rangle$								
1349.5(4)	$\langle 4^+ \rangle$					47*	36*		
1420		$\langle 2, 4 \rangle$	0.6	$\langle 32 \rangle$		incl			84Va13
1471.75(12)	$\langle 1^- - 4^+ \rangle$								
1495.33(13)	$\langle 1^+ - 4^+ \rangle$								
1507.14(17)	$\langle 2^+, 3^- \rangle$								
1518.87(21)	$\langle 0^+ - 3^- \rangle$								
1579.8(3)	$\langle 1^-, 2, 3^- \rangle$								
1911.82(16)	$1, 2^+$								

(continued)

²²⁸Ra
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E^*	J^π	L	S_α	γ_α^2	σ (d, ⁶ Li)	S_α	γ_α^2	$T_{1/2}$ or	Ref.
[keV]		(d, ⁶ Li)	<i>rel.</i>	[eV]	$\mu\text{b/sr}$		[eV]	Γ_{cm}	
1974.61(24)	1,2 ⁺								
2041.0(3)	$\langle 2^+ \rangle$								
2107.93(19)	$\langle 2^+, 3 \rangle$								
2110.8(4)	$\langle 2, 3^- \rangle$								
2138.3(6)	2 ⁺								
2161.3(5)	2 ⁺								
2168.2(7)	$\langle 2^+, 3 \rangle$								
			84Va13	84Va13	81Ja01	81Ja01	81Ja01		Ref.

Additional data on this isotope can be found in [98Gu09].

* Relative to 100 for the group of states close to the ground state [81Ja01].

The ground-state band and the band built on 1⁻ level are extended up to $J^+=22^+$, 19⁻ [99Co02]. γ_α^2 is a reduced width of α -particle emission [84Va13, 81Ja01].

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

Energy levels and branching ratios [97Ar08]. Part 2

²²⁸Ra
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E^*	J^π	Branching ratios in percentage										
		E_f^* : 0	63.8	205	412	474	537	656	721.19	770.71	846.15	
[keV]		J_f^π : 0 ⁺	2 ⁺	4 ⁺	$\langle 6^+ \rangle$	$\langle 1^- \rangle$	$\langle 3^- \rangle$	$\langle 5^- \rangle$	0 ⁺	$\langle 2^+ \rangle$	$\langle 2^+ \rangle$	
63.823(20)	2 ⁺	100										
204.68(3)	4 ⁺		100									
411.68(5)	$\langle 6^+ \rangle$			100								
474.18(4)	1 ⁻	55(10)	45(2)									
537.49(4)	3 ⁻		80(9)	20.1(13)								
655.96(5)	$\langle 5^- \rangle$			95(6)	4.6(10)							
721.19(9)	0 ⁺		69(4)			31(3)						
770.71(4)	2 ⁺	29(1)	22(1)	15(1)		18(2)	17(1)					
846.15(9)	2 ⁺	42(2)	58(3)									
880.30(6)	4 ⁺			21(3)	10(3)		47(4)	23(2)				
898.85(8)	$\langle 3^+ \rangle$		83(5)	17.4(10)								
966.99(19)	$\langle 2^+, 4^+ \rangle$			100								
1013.24(14)	2 ⁺	2.5(6)	97(5)									x
1042.01(11)	$\langle 0^+ \rangle$					100						
1052.78(13)	$\langle 2^+ - 4^+ \rangle$		89(4)				9(3)					
1070.23(7)	$\langle 3^+ \rangle$		44(6)	46(2)			5.1(5)					
1087.28(7)	$\langle 1^-, 2, 3^- \rangle$					52(3)	48(4)					
1109.10(19)	$\langle 2^+, 3, 4^+ \rangle$			100								
1157.59(21)	$\langle 2^+, 3, 4^+ \rangle$		72(4)	28(2)								
1182.26(8)	$\langle 3^-, 4^+ \rangle$						77(5)	23(2)				
1219.97(13)	2 ⁺			74(16)					26(4)			
1238.5(3)	$\langle 0^+ - 3^- \rangle$		78(4)			21.5(13)						
1349.5(4)	$\langle 4^+ \rangle$			70(7)	30(4)							

(continued)

 $^{228}_{88}\text{Ra}$

E^*	J^π	Branching ratios in percentage										
[keV]		E_f^* : J_f^π :	0 0 ⁺	63.8 2 ⁺	205 4 ⁺	412 ⟨6 ⁺ ⟩	474 ⟨1 ⁻ ⟩	537 ⟨3 ⁻ ⟩	656 ⟨5 ⁻ ⟩	721.19 0 ⁺	770.71 ⟨2 ⁺ ⟩	846.15 ⟨2 ⁺ ⟩
1471.75(12)	⟨1 ⁻ -4 ⁺ ⟩			24(5)				50(4)				26(2)
1495.33(13)	⟨1 ⁺ -4 ⁺ ⟩			81(14)								
1507.14(17)	⟨2 ⁺ ,3 ⁻ ⟩				27(3)		56(11)					
1518.87(21)	⟨0 ⁺ -3 ⁻ ⟩			15.5(16)			78(16)					
1579.8(3)	⟨1 ⁻ ,2,3 ⁻ ⟩			10(1)			45(3)	39(8)				
1911.82(16)	1,2 ⁺	≤13		18(3)						11(2)		
1974.61(24)	1,2 ⁺	19(1)		≤19			13(1)					
2041.0(3)	⟨2 ⁺ ⟩						37(2)			10(2)		9(2)
2107.93(19)	⟨2 ⁺ ,3⟩			66(7)	14.8(15)							
2110.8(4)	⟨2,3 ⁻ ⟩			41(4)			4.3(4)	25(2)			4.9(10)	
2138.3(6)	2 ⁺	15(2)			17(1)		17(2)	19(4)				
2161.3(5)	2 ⁺	8.2(12)	54(3)		12.2(10)						9.4(10)	
2168.2(7)	⟨2 ⁺ ,3⟩			56(6)	28(2)			16(2)				

Energy levels and branching ratios [97Ar08]. Part 3

 $^{228}_{88}\text{Ra}$

E^* [keV]	J^π	Branching ratios in percentage							
		E_f^* : J_f^π :	880.30 <4 ⁺ >	898.85 <3 ⁺ >	966.99 <2 ⁺ ,4 ⁺ >	1013.24 <2 ⁺ >	1042.01	1052.78	1070.23 <3 ⁺ >
1052.78(13)	<2 ⁺ -4 ⁺ >		1.7(3)						
1070.23(7)	<3 ⁺ >			4.6(5)					
1495.33(13)	<1 ⁺ -4 ⁺ >								19(3)
1507.14(17)	<2 ⁺ ,3 ⁻ >					17(2)			
1518.87(21)	<0 ⁺ -3 ⁻ >				7.0(12)				
1911.82(16)	1,2 ⁺			5(1)		39(2)	16(1)		
1974.61(24)	1,2 ⁺							37(2)	
2041.0(3)	<2 ⁺ >		19(2)			14(3)			
2110.8(4)	<2,3 ⁻ >			2.5(5)		14.6(8)			
2138.3(6)	2 ⁺				32(3)				
2161.3(5)	2 ⁺				8(2)				

Energy levels and branching ratios [97Ar08]. Part 4

 $^{228}_{88}\text{Ra}$

E^* [keV]	J^π	Branching ratios in percentage					
		E_f^* : J_f^π :	1087.28	1109.10	1157.59	1219.97 <2 ⁺ >	1507.14 <2 ⁺ ,3 ⁻ >
1579.8(3)	<1 ⁻ ,2,3 ⁻ >					5.8(8)	
1911.82(16)	1,2 ⁺		11.4(8)				
1974.61(24)	1,2 ⁺					31(2)	

(continued)						²²⁸ Ra ₈₈	
<i>E</i> [*]	<i>J</i> ^π	<i>E</i> _f [*] :	Branching ratios in percentage				
[keV]		<i>J</i> _f ^π :	1087.28	1109.10	1157.59	1219.97	1507.14
						⟨2 ⁺ ⟩	⟨2 ⁺ ,3 ⁻ ⟩
2041.0(3)	⟨2 ⁺ ⟩					10.8(9)	
2107.93(19)	⟨2 ⁺ ,3⟩						18.9(10)
2110.8(4)	⟨2,3 ⁻ ⟩		4.7(10)	3.2(5)			
2161.3(5)	2 ⁺			8.6(12)			