^{252}Cf SF decay 2009Lu18,2009Zh24,2013Sn01

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	S. Lalkovski, F. G. Kondev	NDS 124, 157 (2015)	1-Aug-2014

Parent: ^{252}Cf: E=0.0; $J^\pi=0^+$; $T_{1/2}$=2.645 y *8*; %SF decay=3.092 *8*

2009Lu18,2009Zh24: Facility: LBNL; Source: 62 μCi ^{252}Cf placed between two Fe foils of 10 mg/cm^2 thickness; Detectors: GAMMASPHERE; Measured: γ-γ-γ coin., $\gamma\gamma(\theta)$, Eγ, Iγ; Deduced: level scheme; Also, from the same group: 2010Ha16, 2009Lu01, 2009Zh50, 2007Go21, 2007ChZZ, 2006Ch07, 2004Ha19, 2002Ha46, 1997Ha64, 1995Lu10.

2013Sn01: Facility: ANL; Source: 230 μCi ^{252}Cf, covered with 240 μg/cm^2 of Au, on a Pt backing of thickness of 440 mg/cm^2; Detectors: GAMMASPHERE and HERCULES array of 64 fast-plastic detectors; Measured: γ-γ-γ coin., Eγ, Iγ and $T_{1/2}$ (using DSAM).

Others: 2004Sm04, 2005Sm08, 1974JaZN, 1974JaYY, 1970Ch11.

^{112}Ru Levels

E(level)[†]	J^π[‡]	$T_{1/2}$	Comments
0.0[&]	0^+		
236.8[&] *4*	2^+	0.32 ns *3*	$T_{1/2}$: from recoil-distance Doppler-shift method (1974JaZN,1974JaYY). Other: 0.16 ns *4* (1970Ch11). μ: +0.88 *18*, deduced from g=+0.44 *9* (2004Sm04, 2005Sm08), using the time-integral correlation technique.
523.6[a] *4*	2^+		
645.0[&] *5*	4^+		
747.6[b] *5*	3^+		
980.8[a] *5*	4^+		
1189.8[&] *5*	6^+		
1235.4[b] *5*	5^+		
1413.7[#] *5*	(4^+)		
1570.2[a] *5*	6^+		
1649.6[@] *5*	(5^+)		
1839.7[&] *6*	8^+	1.7 ps *+13−5*	$T_{1/2}$: using DSAM for 650.0γ in 2013Sn01.
1841.1[b] *5*	7^+	2.2 ps *+7−14*	$T_{1/2}$: using DSAM for 605.7γ in 2013Sn01, but the branching intensities for the 270.8γ and 605.7γ were not taken into account.
1955.8[#] *5*	(6^+)		
1995.2 *5*	(4^-)		
2003.4[e] *5*	(5^-)	<1 ns	$T_{1/2}$: From 2009Lu01.
2148.0 *5*	(5^-)		
2230.3[f] *5*	(6^-)		
2231.4[@] *6*	(7^+)		
2263.5[a] *6*	8^+		
2334.3[d] *5*	(6^-)	<1 ns	$T_{1/2}$: From 2009Lu01.
2392.0[g] *6*			
2489.3[e] *5*	7^-		
2534.7[b] *7*	(9^+)	1.3 ps *+7−6*	$T_{1/2}$: using DSAM for 693.6γ in 2013Sn01.
2562.7[&] *7*	10^+	1.4 ps *3*	$T_{1/2}$: using DSAM for 723.0γ in 2013Sn01.
2574.3[c] *5*	7^-		
2574.7[#] *8*	(8^+)		
2771.8[f] *6*	(8^-)		
2829.3[d] *6*	(8^-)		
2899.9[g] *7*			
2909.3[@] *8*	(9^+)		

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^{252}Cf SF decay 2009Lu18,2009Zh24,2013Sn01 (continued)

^{112}Ru Levels (continued)

E(level)[†]	J^{π}[‡]	$T_{1/2}$	Comments
3033.6[a] *8*	(10$^+$)		
3076.6[e] *6*	(9$^-$)		
3094.2[c] *6*	(9$^-$)		
3291.0[b] *9*	(11$^+$)	0.9 ps *5*	$T_{1/2}$: using DSAM for 756.0γ in 2013Sn01.
3325.9[&] *9*	12$^+$	1.12 ps *+15−14*	$T_{1/2}$: using DSAM for 763.4γ in 2013Sn01.
3379.9[d] *7*	(10$^-$)		
3420.9[f] *6*	(10$^-$)		
3519.8[g] *8*			
3711.6[c] *7*	(11$^-$)		
3768.7[e] *7*	(11$^-$)		
3870.9[a] *10*	(12$^+$)		
4032.6[d] *8*	(12$^-$)		
4095.9[b] *10*	(13$^+$)		
4118.1[&] *10*	14$^+$	1.6 ps *3*	$T_{1/2}$: using DSAM for 791.9γ in 2013Sn01.
4198.8[f] *7*	(12$^-$)		
4213.4[g] *10*			
4428.4[c] *8*	(13$^-$)		
4561.8[e] *9*	(13$^-$)		
4764.2[a] *11*	(14$^+$)		
4769.7[d] *6*	(14$^-$)		
4951.2[b] *12*	(15$^+$)		
4954.3[&] *11*	16$^+$	1.32 ps *+24−19*	$T_{1/2}$: using DSAM for 836.0γ in 2013Sn01.
5072.9[f] *9*	(14$^-$)		
5227.9[c] *10*	(15$^-$)		
5700.8[a] *7*	(16$^+$)		
5829.7[&] *12*	18$^+$		
5854.0[b] *13*	(17$^+$)		
6725.2[&] *13*	20$^+$		

[†] From least-squares fit to Eγ′s.
[‡] From 2009Lu18 and 2009Zh24 based on γγ(θ) for selected cascades and the observed band structures.
[#] Band(A): Possible two-phonon γ-vibrational band,α=0.
[@] Band(a): Possible two-phonon γ-vibrational band,α=1.
[&] Band(B): K^{π}=0$^+$, g.s. band.
[a] Band(C): K^{π}=2$^+$,γ−vibrational band,α=0.
[b] Band(c): K^{π}=2$^+$,γ−vibrational band,α=1.
[c] Band(D): likely K^{π}=6$^-$ band (α=1). The assignment is tentative.
[d] Band(d): likely K^{π}=6$^-$ band (α=0). The assignment is tentative.
[e] Band(E): K^{π}=4$^-$,ν1/2[411]⊗ν7/2[523] band, α=1.
[f] Band(e): K^{π}=4$^-$,ν1/2[411]⊗ν7/2[523] band, α=0.
[g] Band(F): γ-ray cascade built on the top of the 2392 keV level.

^{252}Cf SF decay 2009Lu18,2009Zh24,2013Sn01 (continued)

$\gamma(^{112}Ru)$

E_i(level)	J^{π}_i	E_{γ} †	I_{γ} †	E_f	J^{π}_f	Mult.	Comments
236.8	2+	236.8 *5*	100	0.0	0+		
523.6	2+	286.8 *5*	100	236.8	2+		
		523.6 *5*	91.8 *14*	0.0	0+		
645.0	4+	408.2 *5*	100	236.8	2+		
747.6	3+	224.0 *5*	35.1 *6*	523.6	2+		
		510.8 *5*	100	236.8	2+		
980.8	4+	233.2 *5*	5.6 *6*	747.6	3+		
		335.6 *5*	22.9 *10*	645.0	4+		
		457.2 *5*	100	523.6	2+		
		744.1 *5*	3.6 *3*	236.8	2+		
1189.8	6+	544.7 *5*	100	645.0	4+		
1235.4	5+	254.7 *5*	5.7 *2*	980.8	4+		
		487.8 *5*	100	747.6	3+		
		590.5 *5*	6.9 *4*	645.0	4+		
1413.7	(4+)	666.3 *5*	15.4 *7*	747.6	3+		
		890.0 *5*	100	523.6	2+		
1570.2	6+	334.8 *5*	2.6 *3*	1235.4	5+		
		380.3 *5*	1.2 *2*	1189.8	6+		
		589.3 *5*	100	980.8	4+		
1649.6	(5+)	235.9 *5*	100	1413.7	(4+)		
		668.9 *5*	5.6 *4*	980.8	4+		
		902.1 *5*	22.2 *11*	747.6	3+		
1839.7	8+	650.0 *5*	100	1189.8	6+	[E2]	I_{γ}: 100 in 2013Sn01.
1841.1	7+	270.8 *5*	4.1 *5*	1570.2	6+		
		605.7 *5*	100	1235.4	5+	[E2]	I_{γ}: 44.5 in 2013Sn01.
		651.2 *5*		1189.8	6+		
1955.8	(6+)	542.0 *5*	100	1413.7	(4+)		
		720.5 *5*	12.5 *7*	1235.4	5+		
		975.0 *5*	63 *3*	980.8	4+		
1995.2	(4−)	1014.4 *5*	33.3 *24*	980.8	4+		
		1247.5 *5*	100	747.6	3+		
		1350.2 *5*	16.7 *21*	645.0	4+		
2003.4	(5−)	589.7 *5*	<38.7	1413.7	(4+)		
		768.0 *5*		1235.4	5+		
		1022.5 *5*	100	980.8	4+		
		1358.3 *5*	33 *7*	645.0	4+		
2148.0	(5−)	1167.2 *5*	20 *5*	980.8	4+		
		1502.9 *5*	100	645.0	4+		
2230.3	(6−)	226.9 *5*	6.7 *17*	2003.4	(5−)		
		235.1 *5*	9.2 *17*	1995.2	(4−)		
		660.1 *5*	13.5 *23*	1570.2	6+		
		994.9 *5*	42 *6*	1235.4	5+		
		1040.6 *5*	100	1189.8	6+		
2231.4	(7+)	581.9 *5*	100	1649.6	(5+)		
		995.8 *5*	68 *4*	1235.4	5+		
2263.5	8+	693.3 *5*	100	1570.2	6+		
2334.3	(6−)	331.0 *5*	12.1	2003.4	(5−)		
		764.1 *5*	34 *5*	1570.2	6+		
		1098.8 *5*	100	1235.4	5+		
		1144.6 *5*	40 *10*	1189.8	6+		
2392.0		1156.6 *5*	100	1235.4	5+		
2489.3	7−	259.0 *5*	12.3 *12*	2230.3	(6−)		
		341.4 *5*	12.7 *20*	2148.0	(5−)		
		486.0 *5*	4.8 *12*	2003.4	(5−)		
		919.1 *5*	17 *3*	1570.2	6+		

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^{252}Cf SF decay 2009Lu18,2009Zh24,2013Sn01 (continued)

$\gamma(^{112}Ru)$ (continued)

E_i(level)	J^π_i	E_γ †	I_γ †	E_f	J^π_f	Mult.	Comments
2489.3	7⁻	1299.6 5	100	1189.8	6⁺	D	Mult.: from (1299.6γ)(544.7γ)(θ): A_2=−0.090 35, A_4=−0.02 6. The predicted values for dipole-quadrupole cascade are: A_2=−0.071, A_4=0; and for quadrupole-quadrupole cascade are: A_2=−0.102 and A_4=−0.051.
2534.7	(9⁺)	693.6 5	100	1841.1	7⁺	[E2]	I_γ: 26.5 in 2013Sn01.
2562.7	10⁺	723.0 5	100	1839.7	8⁺	[E2]	I_γ: 55.9 in 2013Sn01.
2574.3	7⁻	240.0‡ 5		2334.3	(6⁻)		E_γ: from Figure 3 of 2009Lu18.
		426.3 5	10 4	2148.0	(5⁻)		
		733.1 5	4.2 2	1841.1	7⁺		
		1004.1 5	11.8 15	1570.2	6⁺		
		1384.6 5	100	1189.8	6⁺	D	Mult.: from (1384.6γ)(544.7γ)(θ): A_2=−0.07 6, A_4=−0.05 9. The predicted values for dipole-quadrupole cascade are: A_2=−0.071, A_4=0; and for quadrupole-quadrupole cascade are: A_2=−0.102 and A_4=−0.051.
2574.7	(8⁺)	618.9 5	100	1955.8	(6⁺)		
2771.8	(8⁻)	282.5 5	24 5	2489.3	7⁻		
		541.5 5	100	2230.3	(6⁻)		
		930.7 5	7.0 18	1841.1	7⁺		
		932.0 5	3.5 8	1839.7	8⁺		
2829.3	(8⁻)	255.1 5	100.2 24	2574.3	7⁻		I_γ: 100.22.4 in table 3 of 2009Lu18 seems a misprint.
		340.0‡ 5	4.5	2489.3	7⁻		
		495.1‡ 5		2334.3	(6⁻)		
2899.9		507.9 5		2392.0			
		1058.8 5	100	1841.1	7⁺		
2909.3	(9⁺)	677.9 5	100	2231.4	(7⁺)		
3033.6	(10⁺)	770.1 5	100	2263.5	8⁺		
3076.6	(9⁻)	304.8 5	11.0 23	2771.8	(8⁻)		
		587.3 5	100	2489.3	7⁻		
		1237.0 5	40 4	1839.7	8⁺		
3094.2	(9⁻)	264.8 5	9.3 7	2829.3	(8⁻)		
		519.8 5	100	2574.3	7⁻		
		830.7 5	23 8	2263.5	8⁺		
		1254.5 5	35 6	1839.7	8⁺		
3291.0	(11⁺)	756.3 5	100	2534.7	(9⁺)	[E2]	I_γ: 10.2 in 2013Sn01.
3325.9	12⁺	763.2 5	100	2562.7	10⁺	[E2]	I_γ: 31.3 in 2013Sn01.
3379.9	(10⁻)	285.6 5	17.4 22	3094.2	(9⁻)		
		550.6 5	100	2829.3	(8⁻)		
3420.9	(10⁻)	344.3 5	14 3	3076.6	(9⁻)		
		649.0 5	100	2771.8	(8⁻)		
3519.8		619.9 5	100	2899.9			
3711.6	(11⁻)	331.7 5	14.8 13	3379.9	(10⁻)		
		617.4 5	100	3094.2	(9⁻)		
		1148.8 5	26 3	2562.7	10⁺		
3768.7	(11⁻)	347.8 5	17 5	3420.9	(10⁻)		
		692.0 5	100	3076.6	(9⁻)		
3870.9	(12⁺)	837.3 5	100	3033.6	(10⁺)		
4032.6	(12⁻)	321.0‡ 5		3711.6	(11⁻)		E_γ: Reported only in 2010Ha16.
		652.7 5	100	3379.9	(10⁻)		
4095.9	(13⁺)	804.9 5	100	3291.0	(11⁺)		
4118.1	14⁺	792.2 5	100	3325.9	12⁺	[E2]	I_γ: 12.3 in 2013Sn01.
4198.8	(12⁻)	430.1 5	20 6	3768.7	(11⁻)		
		778.0 5	100	3420.9	(10⁻)		
4213.4		693.6 5	100	3519.8			
4428.4	(13⁻)	716.8 5	100	3711.6	(11⁻)		
4561.8	(13⁻)	793.1 5	100	3768.7	(11⁻)		

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^{252}Cf SF decay 2009Lu18,2009Zh24,2013Sn01 (continued)

γ(^{112}Ru) (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[†]	E_f	J^π_f	Mult.	Comments
4764.2	(14$^+$)	893.3 *5*	100	3870.9	(12$^+$)		
4769.7	(14$^-$)	737.1[‡] *5*	100	4032.6	(12$^-$)		
4951.2	(15$^+$)	855.3 *5*	100	4095.9	(13$^+$)		
4954.3	16$^+$	836.2 *5*	100	4118.1	14$^+$	[E2]	I_γ: 7.1 in 2013Sn01.
5072.9	(14$^-$)	874.1 *5*	100	4198.8	(12$^-$)		
5227.9	(15$^-$)	799.5 *5*	100	4428.4	(13$^-$)		
5700.8	(16$^+$)	936.6[‡] *5*	100	4764.2	(14$^+$)		
5829.7	18$^+$	875.4 *5*	100	4954.3	16$^+$		
5854.0	(17$^+$)	902.8 *5*	100	4951.2	(15$^+$)		
6725.2	20$^+$	895.4 *5*	100	5829.7	18$^+$		

† From 2009Lu18 and 2009Zh24, unless otherwise noted. $\Delta E\gamma'$s were assigned by the evaluators. The Iγ values quoted from 2013Sn01 have uncertainties of 3 % for the strong transitions up to 40 % for the weak ones.

‡ Placement of transition in the level scheme is uncertain.

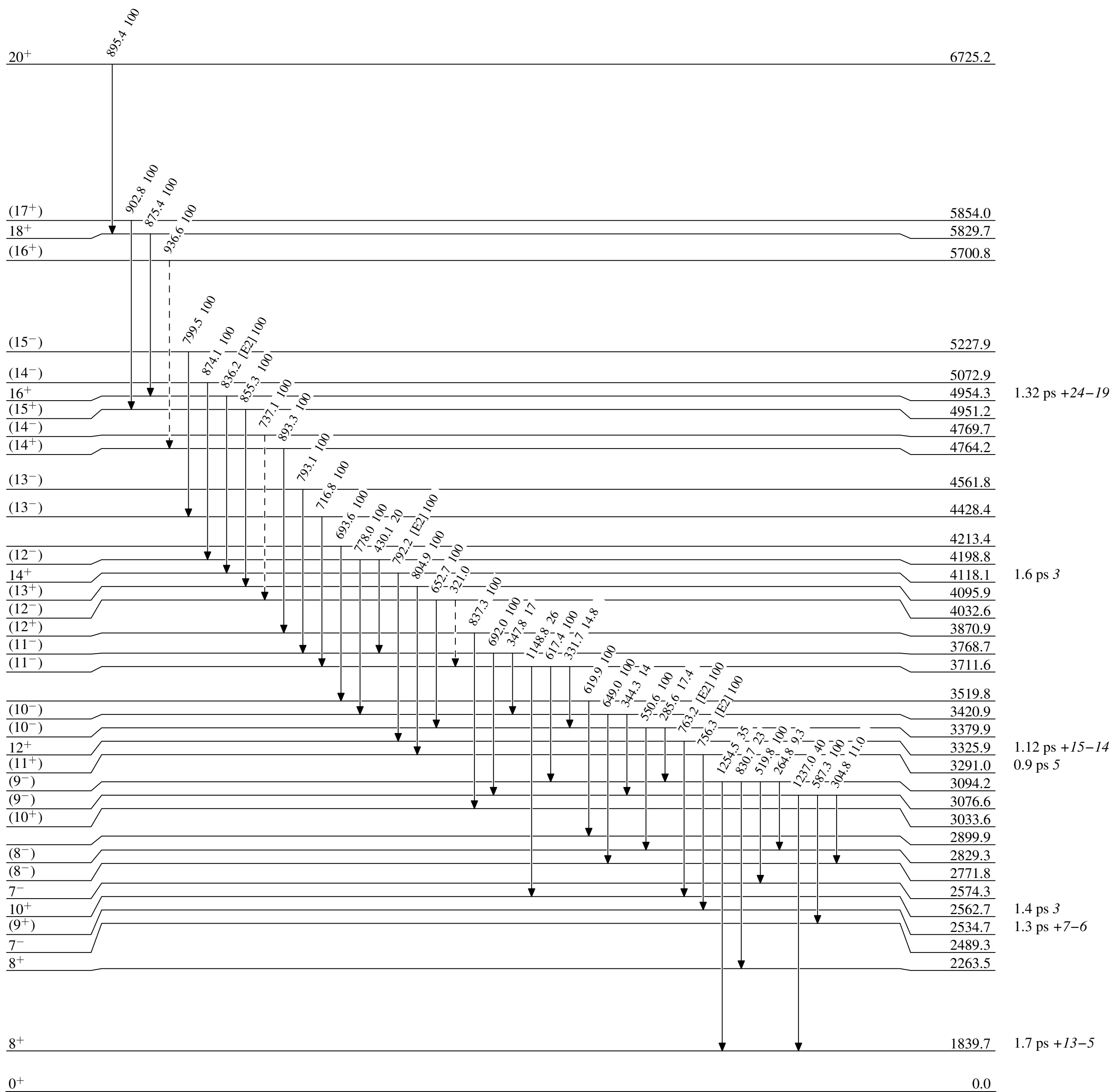
^{252}Cf SF decay 2009Lu18,2009Zh24,2013Sn01

Legend

Level Scheme

Intensities: Relative photon branching from each level

γ Decay (Uncertain)



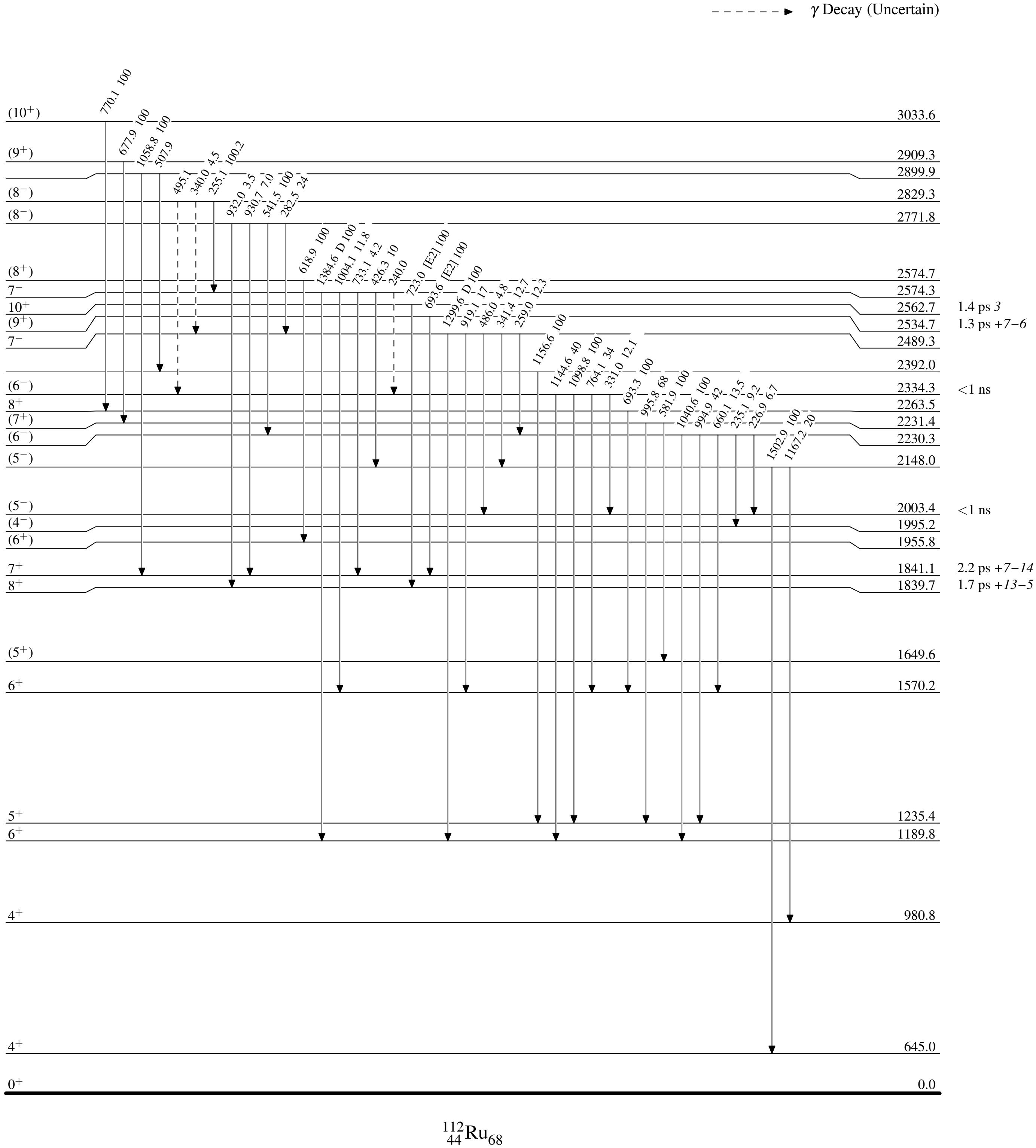
$^{112}_{44}Ru_{68}$

^{252}Cf SF decay 2009Lu18,2009Zh24,2013Sn01

Legend

Level Scheme (continued)

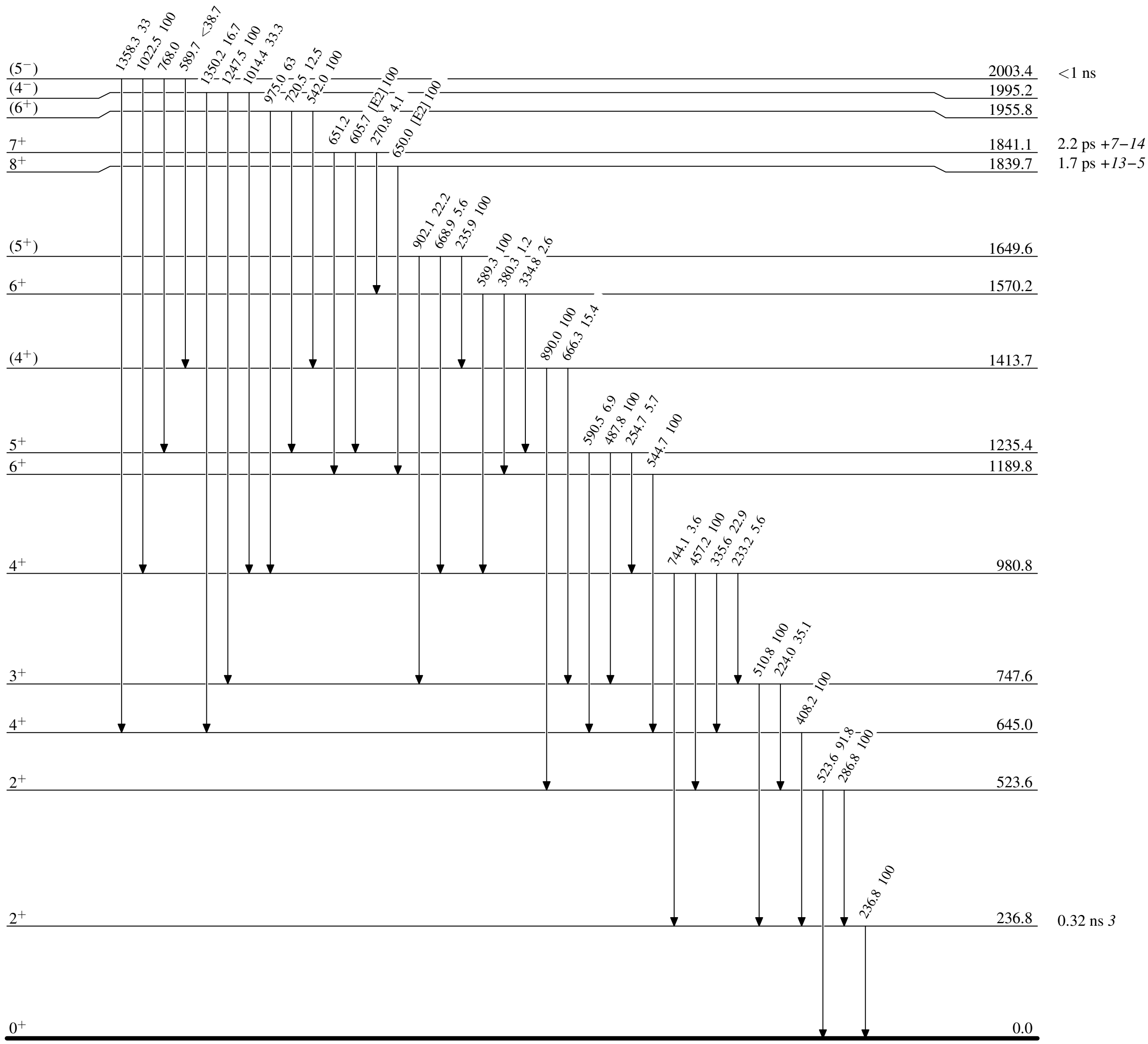
Intensities: Relative photon branching from each level



^{252}Cf SF decay 2009Lu18,2009Zh24,2013Sn01

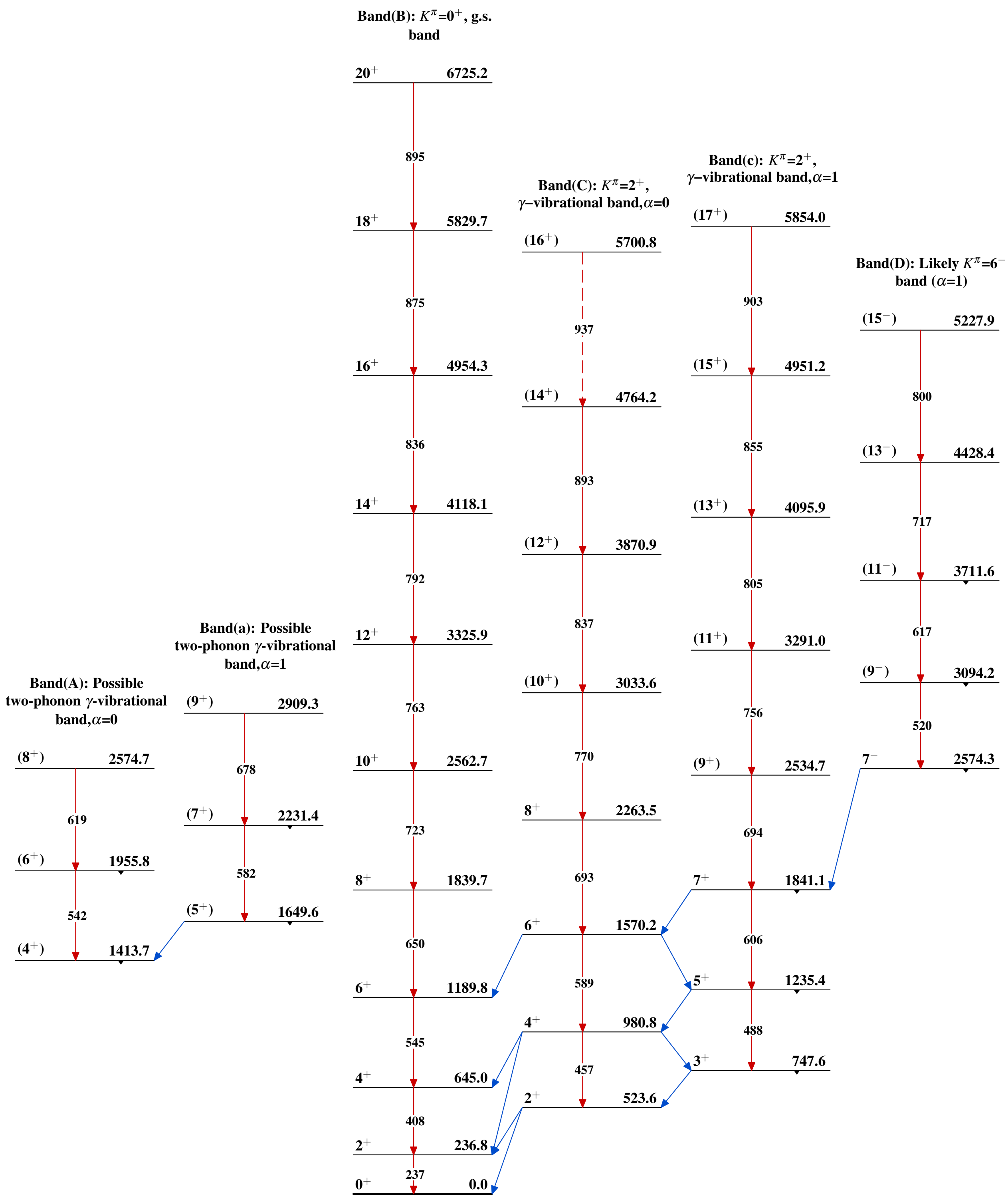
Level Scheme (continued)

Intensities: Relative photon branching from each level



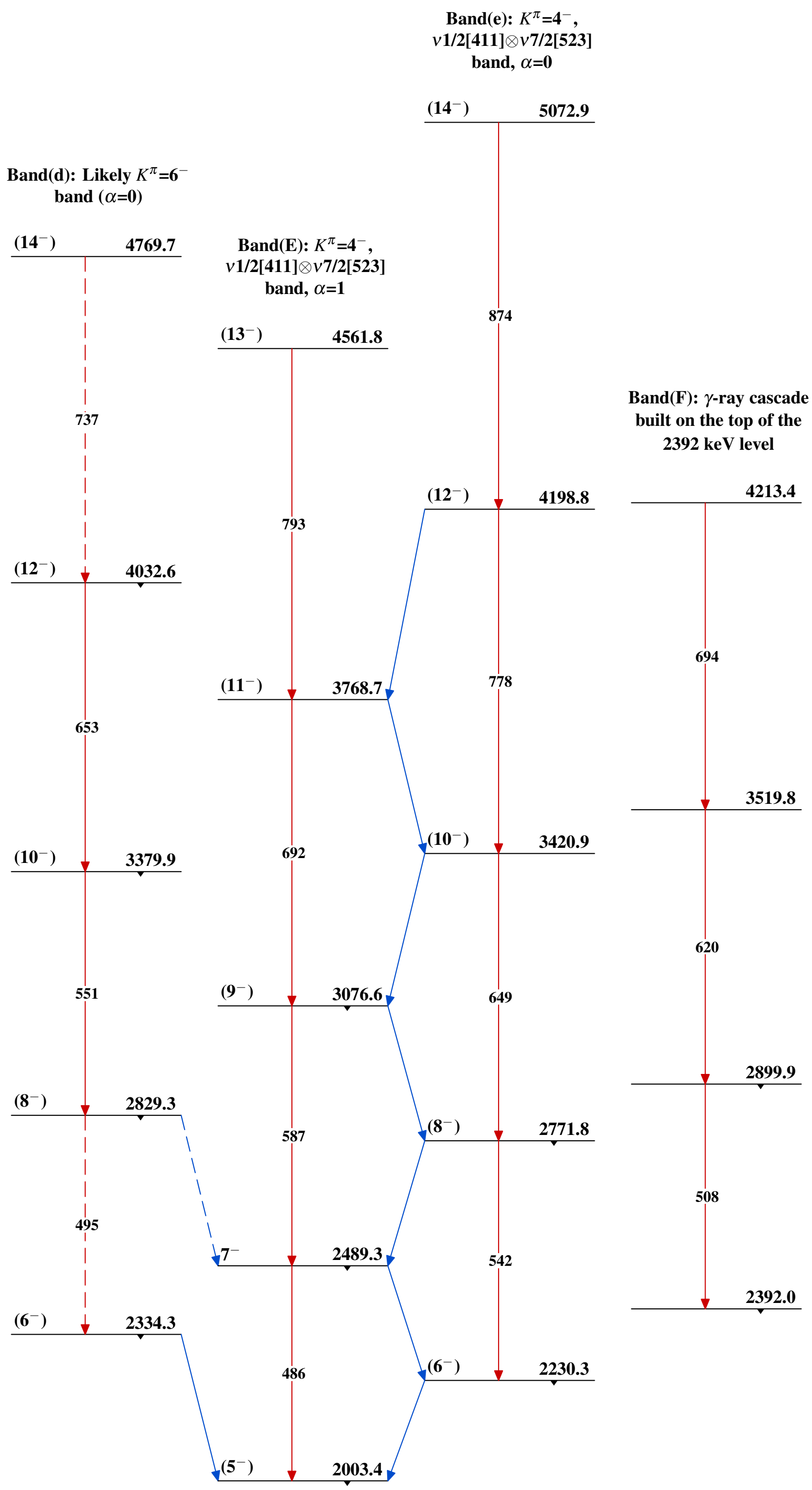
$^{112}_{44}Ru_{68}$

^{252}Cf SF decay 2009Lu18,2009Zh24,2013Sn01



$^{112}_{44}Ru_{68}$

^{252}Cf SF decay 2009Lu18,2009Zh24,2013Sn01 (continued)



$^{112}_{44}Ru_{68}$