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

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	G. Gürdal and F. G. Kondev	NDS 113, 1315 (2012)	1-Aug-2011

Parent: ^{252}Cf: E=0.0; $J^\pi=0^+$; $T_{1/2}$=2.645 y *8*; %SF decay=3.086 *8*

2009Zh24,2009LuZZ: Source of ^{252}Cf ≈60 μCi was placed between two iron foils with a thickness of 10 mg/cm^2 and in the center of Gammasphere array (at LBNL), consisting of 101 Compton-suppressed Ge detectors. A total of 5.7×10^{11} triple-γ or higher coincident events were collected. Measured: Eγ, Iγ, γγ(θ), γγγ.

Others: 2009Lu01, 2003Ji03, 2005Go40, 2004Ha19, 2002Ha40, 2001Kr13, 1995Lu10, 1997Ha64, 1986Ma22, 1980ChZM, 1972Wi15, 1971Ch44, 1971Ho29, 1970Ch11, 1970Jo20, 1970Wa05.

^{110}Ru Levels

E(level)[†]	J^π[‡]	$T_{1/2}$	Comments
0.0[#]	0^+	12.04 s *17*	$T_{1/2}$: From Adopted Levels.
240.8[#] *7*	2^+	0.34 ns *4*	$T_{1/2}$: From 1974JaYY, deduced by varying the distance between source and one of the fragment detectors with a micrometer screw. Others: 0.23 ns from 1972Wi15 and 1970Ch11 and<0.5 ns from 1970Wa05. μ: +0.88 *14*, from g-factor = +0.44 *7* measured using time-integral perturbed angular correlation technique ($T_{1/2}$ = 0.30 ns *2* from 1980ChZM, ^{254}Cf decay) in 2005Sm08 and 2004Sm04.
612.7[@] *7*	2^+		
663.4[#] *8*	4^+	15.4 ps *17*	$T_{1/2}$: From 2001Kr13, using differential recoil distance method. Others: 13.4 ps *10* (1986Ma22). However, this is a combined value for ^{108}Ru and ^{110}Ru since the 4^+ to 2^+ transitions for both isotopes can not be resolved.
859.9[&] *7*	3^+		
1084.5[@] *8*	4^+		
1137.2 *12*	0^+		
1239.2[#] *9*	6^+	2.4 ps *10*	$T_{1/2}$: From 2001Kr13, using differential recoil distance method.
1375.5[&] *8*	5^+		
1396.9 *7*	2^+		
1618.4[a] *8*	(4^+)		
1656.2 *8*	2^+		
1684.3[@] *9*	6^+		
1820.5 *8*	$(2^+,3^+)$		
1860.8[a] *9*	(5^+)		
1944.5[#] *10*	8^+		
2016.3[f] *8*	(4^-)		
2020.9[&] *10*	7^+		
2042.4 *13*			
2110.8[a] *9*	(6^+)		
2145.3[e] *9*	(5^-)		
2242.9[d] *9*	6^-		
2328.1[f] *9*	(6^-)		
2397.0[@] *11*	8^+		
2426.5[c] *10*	7^-		
2516.7[e] *9*	7^-		
2637.4[d] *10*	8^-		
2759.6[#] *11*	10^+		
2764.7[f] *10*	(8^-)		
2777.0[&] *12*	9^+		

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

^{110}Ru Levels (continued)

E(level)†	Jπ‡	E(level)†	Jπ‡	E(level)†	Jπ‡	E(level)†	Jπ‡
2892.8[c] *10*	(9⁻)	3627.2[&] *16*	11⁺	4153.9[@] *16*	12⁺	5010.9[c] *17*	(15⁻)
3041.4[e] *10*	(9⁻)	3647.2[#] *14*	12⁺	4195.5[c] *13*	(13⁻)	5143.1[b] *17*	(16⁺)
3113.0 *15*	(10⁺)	3689.9[e] *11*	(11⁻)	4351.0[#] *14*	14⁺	5150.7[#] *18*	16⁺
3175.4[d] *11*	(10⁻)	3700.1 *13*	(12⁺)	4370.6[b] *13*	(14⁺)	5302.5[e] *18*	(15⁻)
3193.4[b] *11*	(10⁺)	3719.1[b] *12*	(12⁺)	4446.3[e] *15*	(13⁻)	5412.8[d] *17*	(16⁻)
3254.3[@] *13*	10⁺	3818.7[d] *12*	(12⁻)	4556.2[&] *19*	13⁺	6017.5[b] *20*	(18⁺)
3337.1[f] *11*	(10⁻)	3956.9 *18*	(12⁺)	4566.5[d] *14*	(14⁻)	6050.8[#] *20*	18⁺
3485.4[c] *11*	(11⁻)	4038.8[f] *13*	(12⁻)	4874.1[f] *16*	(14⁻)		

† From a least-square fit to E_γ. $\Delta E\gamma$ = 0.5 keV was assumed by evaluators for all transitions.

‡ From 2009Lu18 and 2009Zh24, based on the multipolarities of the transitions deduced by using $\gamma\gamma(\theta)$, systematics of low-lying collective states in Ru isotopes, γ decay pattern and the observed band structure.

Band(A): g.s. band.

@ Band(B): One-phonon quasi-γ band, α=0.

& Band(C): One-phonon quasi-γ band,α=1.

a Band(D): Two-phonon quasi-γ band. Assignment based on the decay of this band mainly to one-phonon quasi-γ band.

b Band(E): Band based on (10⁺) at 3193.4 keV in 2009Zh24. J^π assignments are tentative. This band could have negative parities and odd spins one unit less. Assigned as four-quasiparticle band in 2003Ji03, but the authors stated that more experimental data needed for assigning a definitive configuration.

c Band(F): Band based on 7⁻ at 2426.5 keV.

d Band(G): Band based on 6⁻ at 2242.9 keV.

e Band(H): Band based on (5⁻) at 2145.3 keV.

f Band(I): Band based on (4⁻) at 2016.3 keV.

$\gamma(^{110}Ru)$

E_i(level)	J_i^π	E_γ†	I_γ†	E_f	J_f^π	Mult.	Iγ‡	Comments
240.8	2⁺	240.8	100	0.0	0⁺	E2	100	Mult.: A_2=0.229 *101*, A_4=0.195 *153* from $\gamma(\theta)$ in 1972Wi15; α(K)exp/α(L)exp≈4.0 in 1970Wa05.
612.7	2⁺	371.9	100	240.8	2⁺		14	
		612.7	81.9 *10*	0.0	0⁺		12	
663.4	4⁺	422.6	100	240.8	2⁺		74	
859.9	3⁺	196.5	1.5 *2*	663.4	4⁺		0.5	
		247.3	20.6 *3*	612.7	2⁺		6	
		619.1	100	240.8	2⁺		25	
1084.5	4⁺	224.5	2.7 *2*	859.9	3⁺			
		421.0	50.6 *15*	663.4	4⁺		4	
		471.7	100	612.7	2⁺		12	
		843.6	15.9 *10*	240.8	2⁺		3	
1137.2	0⁺	896.4	100	240.8	2⁺			
1239.2	6⁺	575.7	100	663.4	4⁺		44	
1375.5	5⁺	291.0	3.6 *2*	1084.5	4⁺			
		515.5	100	859.9	3⁺		23	
		711.9	20.3 *6*	663.4	4⁺		4	
1396.9	2⁺	259.6[#]		1137.2	0⁺			
		537.2	33.3 *27*	859.9	3⁺			
		733.3	22.2 *27*	663.4	4⁺			
		783.9	22.2 *16*	612.7	2⁺			

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

γ(^{110}Ru) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.	Iγ[‡]	Comments
1396.9	2+	1156.2	100	240.8	2+			
		1396.9	44.4 *29*	0.0	0+			
1618.4	(4+)	534.0	26.7 *21*	1084.5	4+			
		758.5	66.7 *44*	859.9	3+			
		1005.7	100	612.7	2+			
		1377.6	13.3 *8*	240.8	2+			
1656.2	2+	796.3	100	859.9	3+			
		1043.6	25.0 *20*	612.7	2+			
		1415.4	88 *4*	240.8	2+			
1684.3	6+	308.7	7.7 *4*	1375.5	5+			
		445.2	11.1 *7*	1239.2	6+		0.8	
		599.8	100	1084.5	4+		10	
		1021.0	23 *4*	663.4	4+		2	
1820.5	(2+,3+)	164.5	31 *2*	1656.2	2+			
		423.5	100	1396.9	2+			
		960.5	25.0 *25*	859.9	3+			
		1579.8	25.0 *21*	240.8	2+			
1860.8	(5+)	242.4	100	1618.4	(4+)			
		776.4	12.5 *8*	1084.5	4+			
		1000.9	12.5 *11*	859.9	3+			
1944.5	8+	705.3	100	1239.2	6+		16	
2016.3	(4−)	398.0	<22.5	1618.4	(4+)			
		931.8	27 *4*	1084.5	4+			
		1156.4	100	859.9	3+			
		1353.0	29 *3*	663.4	4+			
2020.9	7+	645.5	100	1375.5	5+		8	
		781.7	7.4 *7*	1239.2	6+			
2042.4		221.9	100	1820.5	(2+,3+)			
2110.8	(6+)	492.4	43 *5*	1618.4	(4+)			
		735.4	4.8 *6*	1375.5	5+			
		1026.4	100	1084.5	4+			
2145.3	(5−)	129.1[#]		2016.3	(4−)			E_γ: From Figure 4 of 2009Lu18 and Figure 1 of 2009Lu01.
		527.1	33 *4*	1618.4	(4+)			
		1060.8	40 *4*	1084.5	4+			
		1481.9	100	663.4	4+			
2242.9	6−	226.5	21.5 *11*	2016.3	(4−)			
		867.5	100	1375.5	5+	D	9	Mult.: From 2009Lu18:(867.5γ)(515.5γ)(θ): A_2=−0.052 *14*, A_4=−0.002 *21*. In 2009Lu01, A_4 = +0.002 *21* is quoted. The theoretical values for a pure dipole transition are: A_2=−0.071, A_4=0; and for a pure quadrupole transition are A_2=−0.112 and A_4=−0.054. (867.5γ)(394.5γ)(θ): A_2=−0.079 *14*, A_4=+0.023 *20*. The theoretical values for a pure dipole transition are: A_2=−0.071, A_4=0; and for a pure quadrupole transition are A_2=−0.007 and A_4=−0.023.
2328.1	(6−)	182.8	3.7 *3*	2145.3	(5−)			
		312.0	12.7 *6*	2016.3	(4−)			
		643.6	13.5 *18*	1684.3	6+			
		952.5	100	1375.5	5+			
		1088.8	41 *13*	1239.2	6+			
2397.0	8+	452.5	12.9 *19*	1944.5	8+			
		712.7	100	1684.3	6+		4	
2426.5	7−	183.6	6.0 *20*	2242.9	6−			
		742.3	20 *3*	1684.3	6+			

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

γ(^{110}Ru) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Mult.	Iγ[‡]	Comments
2426.5	7⁻	1187.2	100	1239.2	6⁺	D	7	Mult.: From 2009Lu18: (1187.2γ)(575.5γ)(θ): A_2=−0.086 *11*, A_4=+0.010 *17*. The theoretical values for a pure dipole transition are: A_2=−0.071, A_4=0; and for a pure quadrupole transition are: A_2=−0.102 and A_4=−0.051.
2516.7	7⁻	188.7[#]	0.2	2328.1	(6⁻)			
		371.4	6.8 *13*	2145.3	(5⁻)			
		832.3	6.1 *25*	1684.3	6⁺			
		1277.5	100	1239.2	6⁺			
2637.4	8⁻	210.9	42.5 *11*	2426.5	7⁻			
		309.3	15.1 *7*	2328.1	(6⁻)			
		394.5	100	2242.9	6⁻			
		616.5	38.1 *13*	2020.9	7⁺			
2759.6	10⁺	815.0	100	1944.5	8⁺		6	
2764.7	(8⁻)	247.9	34 *3*	2516.7	7⁻			
		436.7	100	2328.1	(6⁻)			
		820.2	12.5 *21*	1944.5	8⁺			
2777.0	9⁺	756.0	100	2020.9	7⁺		2	
2892.8	(9⁻)	255.4	15.2 *11*	2637.4	8⁻			
		466.3	47.1 *18*	2426.5	7⁻			
		948.2	100	1944.5	8⁺		4	
3041.4	(9⁻)	276.8	5.8 *13*	2764.7	(8⁻)			
		524.7	41 *4*	2516.7	7⁻			
		1096.8	100	1944.5	8⁺			
3113.0	(10⁺)	716.0	100	2397.0	8⁺			
3175.4	(10⁻)	282.6	14.5 *7*	2892.8	(9⁻)			
		537.9	100	2637.4	8⁻			
3193.4	(10⁺)	416.4	100	2777.0	9⁺			
		796.3	24 *5*	2397.0	8⁺			
		1249.0	51 *5*	1944.5	8⁺			
3254.3	10⁺	857.3	100	2397.0	8⁺			
3337.1	(10⁻)	295.9	21 *5*	3041.4	(9⁻)			
		572.4	100	2764.7	(8⁻)			
		577.7[#]	0.1	2759.6	10⁺			
3485.4	(11⁻)	309.9	19 *3*	3175.4	(10⁻)			
		592.6	100	2892.8	(9⁻)			
		725.9	87 *9*	2759.6	10⁺			
3627.2	11⁺	850.2	100	2777.0	9⁺			
3647.2	12⁺	887.6	100	2759.6	10⁺		2	
3689.9	(11⁻)	352.8	8.6 *23*	3337.1	(10⁻)			
		648.5	100	3041.4	(9⁻)			
		930.3	37 *9*	2759.6	10⁺			
3700.1	(12⁺)	940.5	100	2759.6	10⁺		2	
3719.1	(12⁺)	464.9	≤2.9	3254.3	10⁺			
		525.7	100	3193.4	(10⁺)			
		959.5	7.1 *12*	2759.6	10⁺			
3818.7	(12⁻)	333.3	9.9 *10*	3485.4	(11⁻)			
		643.2	100	3175.4	(10⁻)			
3956.9	(12⁺)	843.9	100	3113.0	(10⁺)			
4038.8	(12⁻)	348.8	15 *4*	3689.9	(11⁻)			
		701.7	100	3337.1	(10⁻)			
4153.9	12⁺	899.6	100	3254.3	10⁺			
4195.5	(13⁻)	376.8	≤22.5	3818.7	(12⁻)			
		710.2	100	3485.4	(11⁻)			
4351.0	14⁺	650.9	14.0 *4*	3700.1	(12⁺)			

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

γ(^{110}Ru) (continued)

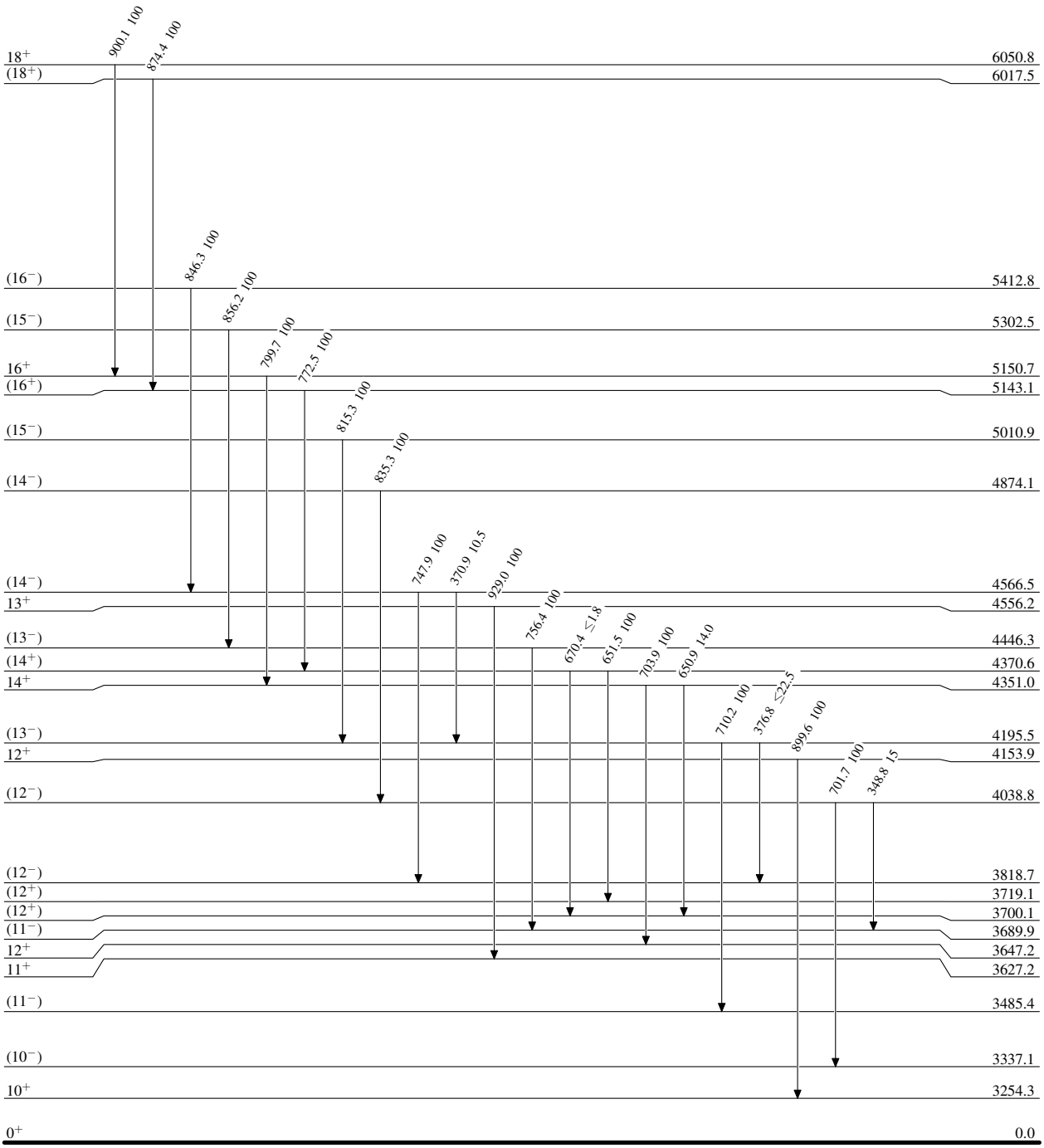
E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Iγ[‡]	E_i(level)	J_i^π	E_γ[†]	I_γ[†]	E_f	J_f^π	Iγ[‡]
4351.0	14^+	703.9	100	3647.2	12^+	1	5010.9	(15^-)	815.3	100	4195.5	(13^-)	
4370.6	(14^+)	651.5	100	3719.1	(12^+)		5143.1	(16^+)	772.5	100	4370.6	(14^+)	
		670.4	≤1.8	3700.1	(12^+)		5150.7	16^+	799.7	100	4351.0	14^+	0.7
4446.3	(13^-)	756.4	100	3689.9	(11^-)		5302.5	(15^-)	856.2	100	4446.3	(13^-)	
4556.2	13^+	929.0	100	3627.2	11^+		5412.8	(16^-)	846.3	100	4566.5	(14^-)	
4566.5	(14^-)	370.9	10.5 *23*	4195.5	(13^-)		6017.5	(18^+)	874.4	100	5143.1	(16^+)	
		747.9	100	3818.7	(12^-)		6050.8	18^+	900.1	100	5150.7	16^+	
4874.1	(14^-)	835.3	100	4038.8	(12^-)								

[†] From 2009Zh24 and 2009Lu18. Iγ normalized to the strongest branch from each level.
[‡] Relative intensities from 1995Lu10, normalized to Iγ(240.8γ)=100.
[#] Placement of transition in the level scheme is uncertain.
[x] γ ray not placed in level scheme.

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

Level Scheme

Intensities: Relative photon branching from each level



12.04 s *17*

$^{110}_{44}Ru_{66}$

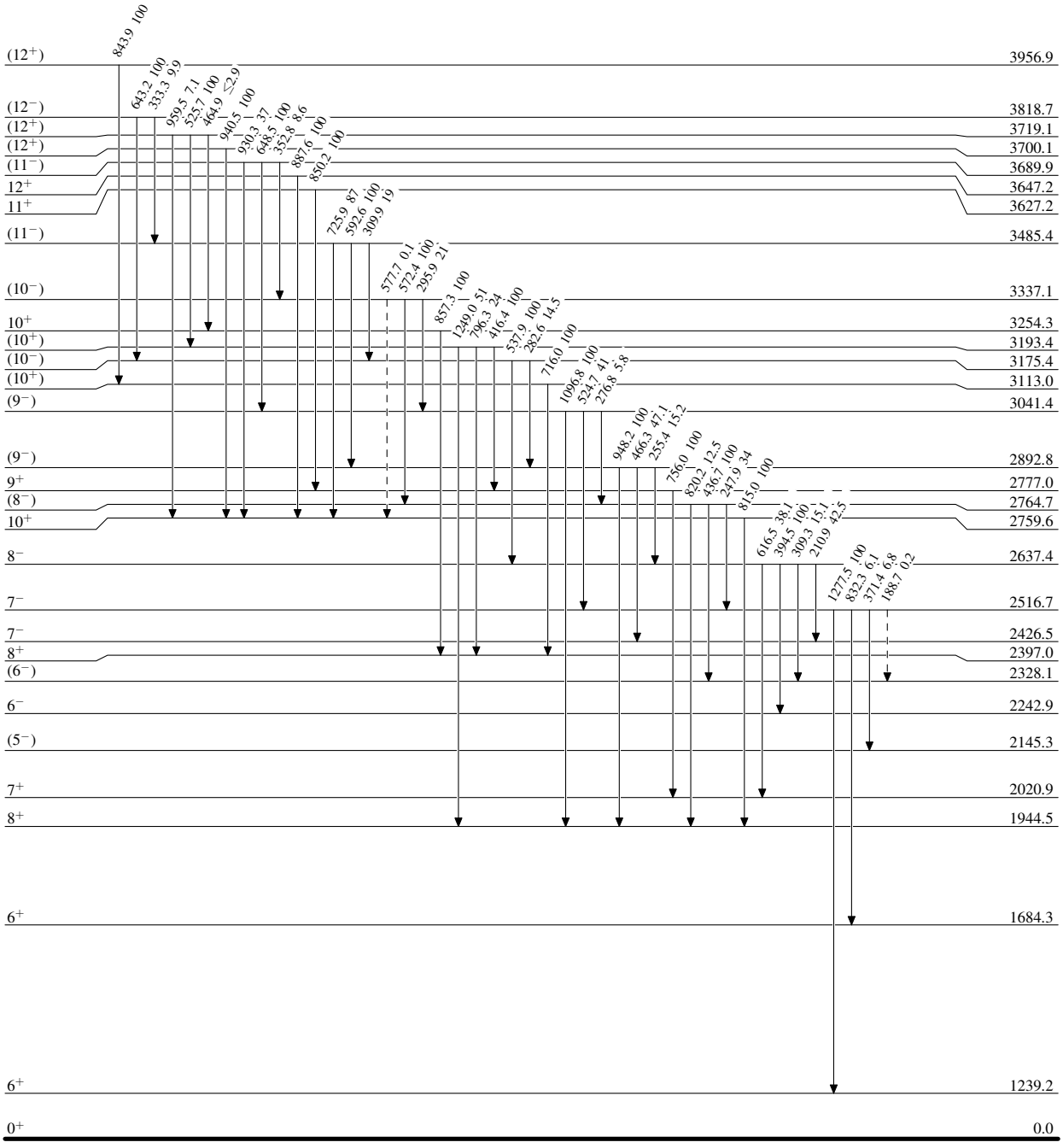
^{252}Cf SF decay 2009Zh24,2009Lu18

Legend

Level Scheme (continued)

Intensities: Relative photon branching from each level

γ Decay (Uncertain)



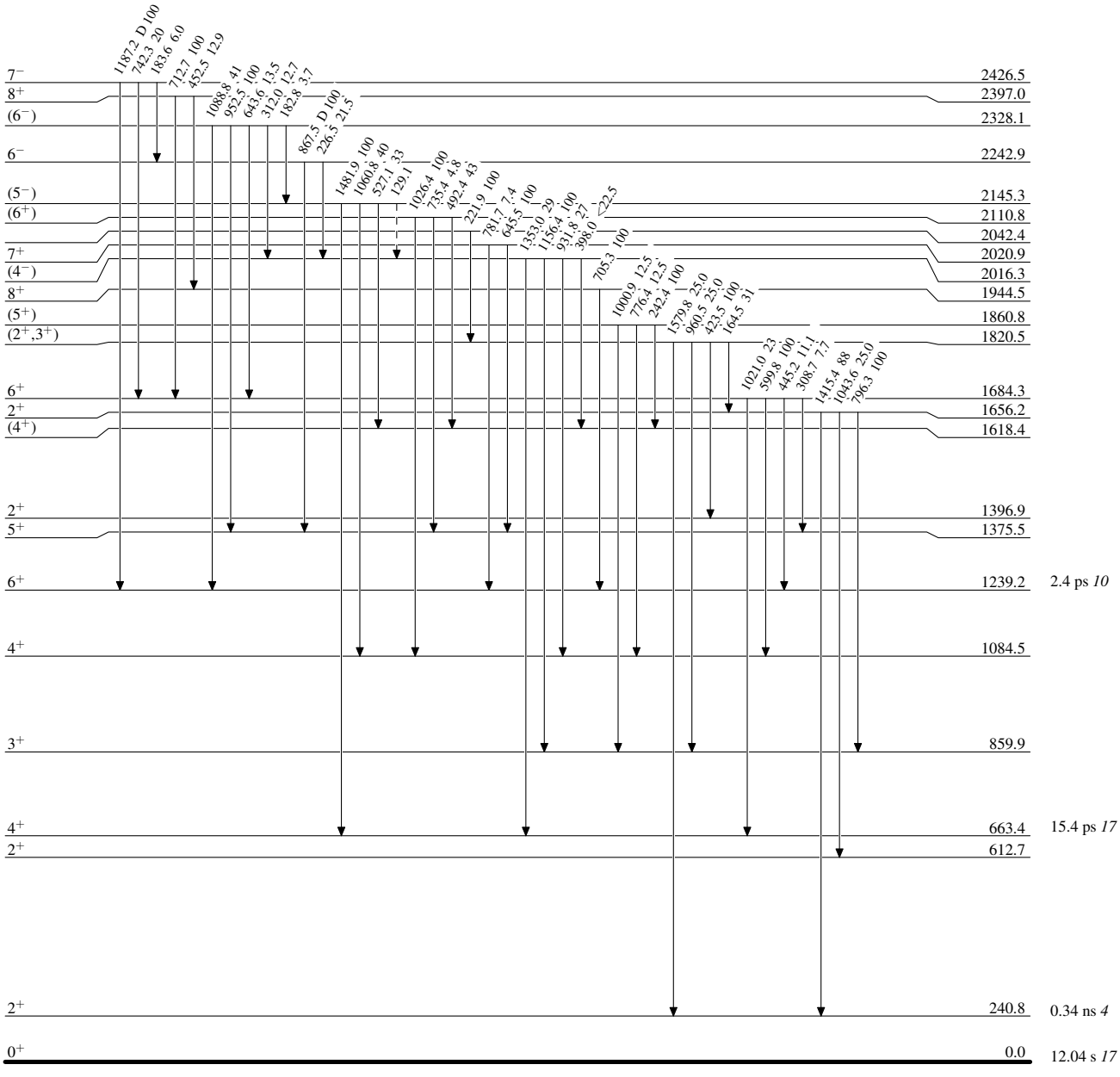
$^{110}_{44}Ru_{66}$

^{252}Cf SF decay 2009Zh24,2009Lu18 Legend

Level Scheme (continued)

Intensities: Relative photon branching from each level

– – – – – – ► γ Decay (Uncertain)



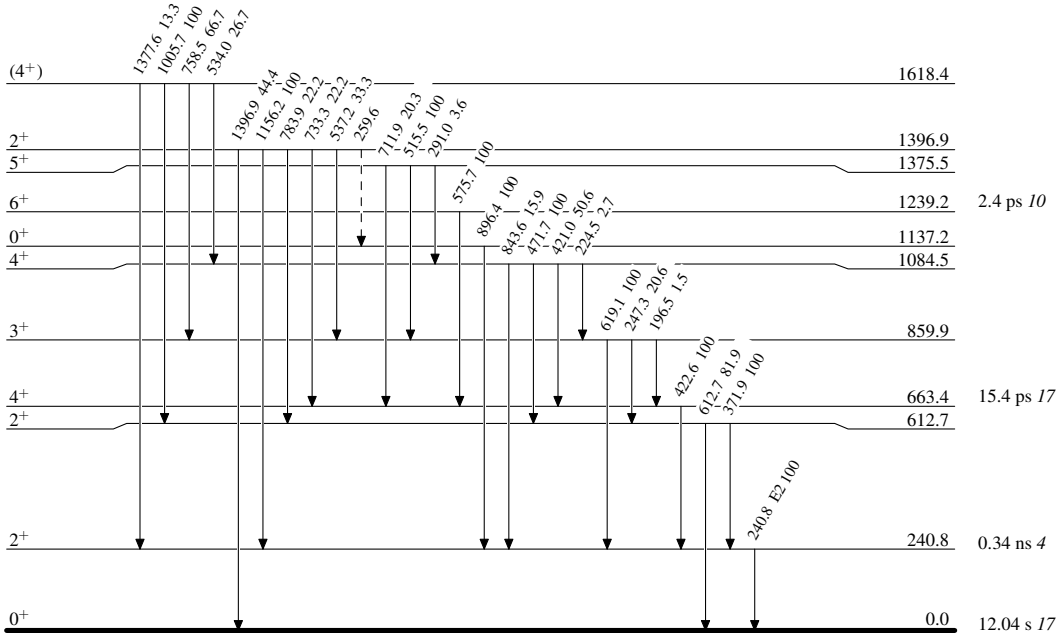
$^{110}_{44}Ru_{66}$

^{252}Cf SF decay 2009Zh24,2009Lu18 Legend

Level Scheme (continued)

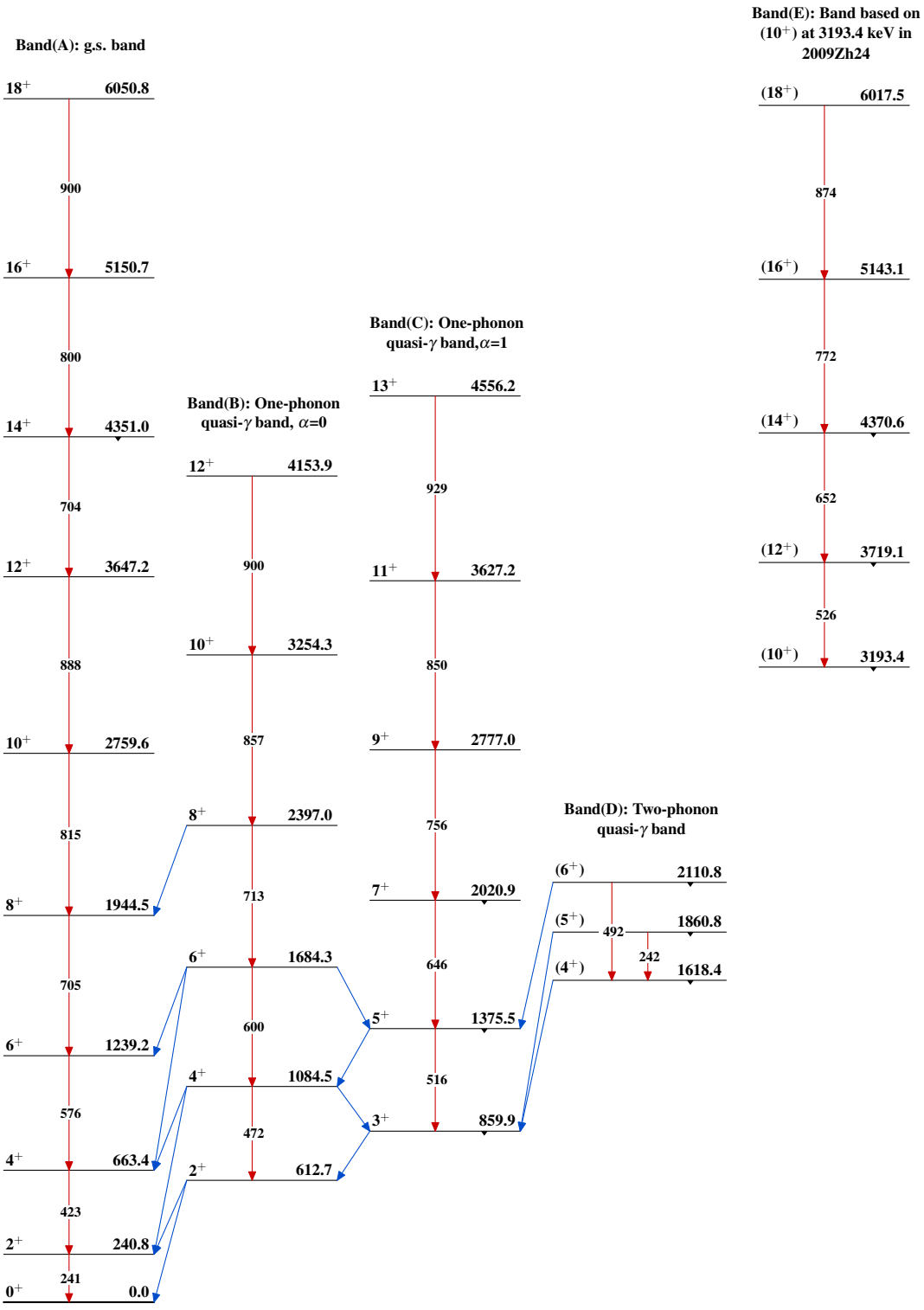
Intensities: Relative photon branching from each level

- - - - - - ► γ Decay (Uncertain)



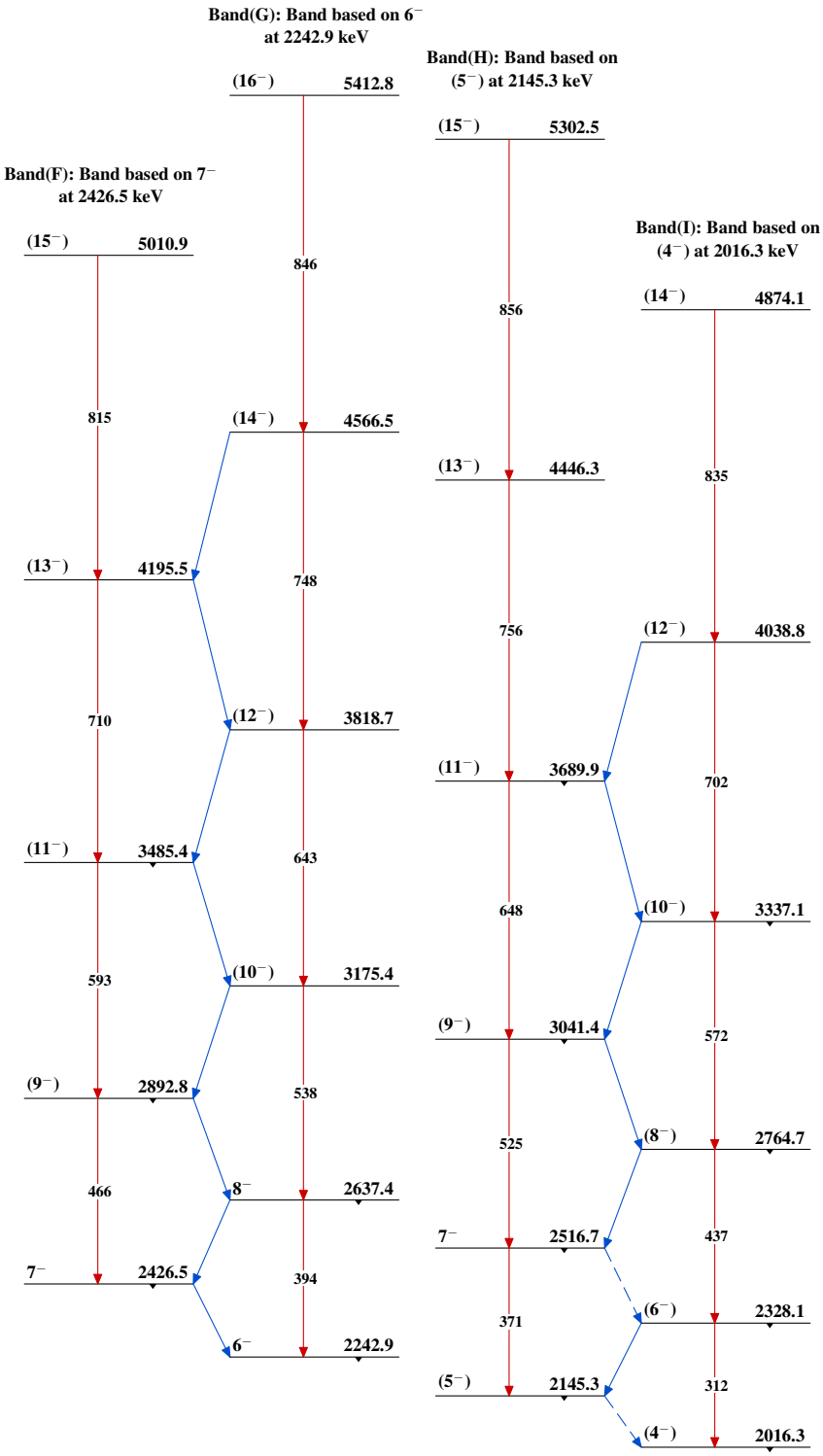
$^{110}_{44}Ru_{66}$

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



$^{110}_{44}Ru_{66}$

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



$^{110}_{44}Ru_{66}$