^{252}Cf SF decay 2010Si03,1997Hw02

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	N. Nica	NDS 170, 1 (2020)	16-Aug-2020

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

Includes prompt γ study in ^{239}Pu(n,Fγ) reaction (2010Si03).

Data set based on the XUNDL compilations of 2010Si03 done by B. Singh (McMaster) and K.Zuber (IFJ-PAN,Krakow,Poland), and of 2008Hw02 done by S. Geraedts and B. Singh (McMaster).

2010Si03: mass 153 fission fragments were observed using the Lohengrin mass spectrometer at the high-flux reactor of the Institute Laue-Langevin, Grenoble. ^{153}Nd were produced by thermal-neutron induced fission of a 0.87 mg/cm^2,7x0.5 cm^2 ^{239}Pu target and mass spectrometer selecting recoiling fragments. Measured Eγ, Iγ, $\gamma\gamma$, $\gamma\gamma$(t) using two Clover Ge detectors as well as conversion electrons detected by two Si(Li) detectors. The second experiment measured Eγ, Iγ, $\gamma\gamma$-delayed γ ray coincidences, using the Gammasphere array at ANL with 101 Compton-suppressed HPGe detectors. The ^{252}Cf source (α-decay) intensity was ≈100 μCi, and was placed at the center of the spectrometers. Transitions assigned to Nd nuclei were based on coincidence with known γ rays from the complementary Sr fragments. Most data are from SF decay.

2008Hw02: measured Eγ, Iγ, $\gamma\gamma$ coin using GAMMASPHERE array of 101 HPGe detectors with Compton-suppression. Transitions assigned to Nd nuclei based on coincidence with known γ rays from the partner Sr fragments.

1997Hw02, superseding 1996Ba34: measured $\gamma\gamma\gamma$ coincidences using GAMMASPHERE array of 72 HPGe detectors with Compton-suppression. Distinction between ^{151}Nd and ^{153}Nd based on yields.

2008Hw02, 1997Hw02, and 1996Ba34 are published by the same group.

There is a general good agreement in between 2010Si03, 2008Hw02, and 1997Hw02. Level scheme is from 2010Si03 who gave the most extensive data (including the level schemes of 2008Hw02 and 1997Hw02).

^{153}Nd Levels

E(level)[†]	J$^\pi$[‡]	$T_{1/2}$	Comments
0.0[@]	(3/2$^-$)		
49.94[#] *19*	(5/2$^-$)		
120.19[@] *16*	(7/2$^-$)		
191.71[a] *16*	(5/2$^+$)	1.17 μs *7*	$T_{1/2}$: from fitting an exponential function to the time spectra sum of Eγ=191.7+141.8 (2010Si03). J$^\pi$: assignment changed from (5/2$^-$) (1996Ya12, β^- decay) to (5/2$^+$) by 2010Si03 based on measured multipolarity of 141.8γ and 191.7γ.
208.42[#] *20*	(9/2$^-$)		
252.24[&] *23*	(7/2$^+$)		
317.89[@] *21*	(11/2$^-$)		
330.08[a] *23*	(9/2$^+$)		
427.9[&] *3*	(11/2$^+$)		
441.24[#] *23*	(13/2$^-$)		
539.0[a] *3*	(13/2$^+$)		
588.33[@] *25*	(15/2$^-$)		
677.3[&] *3*	(15/2$^+$)		
743.6[#] *3*	(17/2$^-$)		
817.4[a] *3*	(17/2$^+$)		
928.0[@] *3*	(19/2$^-$)		
1001.5[&] *3*	(19/2$^+$)		
1111.3[#] *3*	(21/2$^-$)		
1164.7[a] *3*	(21/2$^+$)		
1331.5[@] *3*	(23/2$^-$)		
1399.9[&] *3*	(23/2$^+$)		
1539.7[#] *4*	(25/2$^-$)		

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^{252}Cf SF decay 2010Si03,1997Hw02 (continued)

^{153}Nd Levels (continued)

E(level)†	Jπ‡	E(level)†	Jπ‡	E(level)†	Jπ‡	E(level)†	Jπ‡
1578.9[a] *4*	(25/2+)	2025.2[#] *4*	(29/2−)	2407.4[&] *4*	(31/2+)	3009.4[&] *4*	(35/2+)
1794.8[@] *4*	(27/2−)	2057.0[a] *4*	(29/2+)	2564.2[#] *5*	(33/2−)	3190.0[a] *5*	(37/2+)
1869.4[&] *4*	(27/2+)	2314.8[@] *4*	(31/2−)	2595.2[a] *4*	(33/2+)		

† From least-squares fit to Eγ′s.
‡ Tentative values from 2010Si03. For negative parity bands (A and a), lower J^π values established initially by 1997Hw02 based on systematics of N=90 isotones. For positive parity bands (B and b), bandhead of band b established by E1 transitions to negative parity bands. Higher J^π values, based on rotational band assignments.
[#] Band(A): ν5/2[642], α=+1/2. Dominant configuration from QPRM calculations (2010Si03).
[@] Band(a): ν5/2[642], α=−1/2.
[&] Band(B): ν3/2[521], α=−1/2. Dominat configurations from QPRM calculations (2010Si03).
[a] Band(b): ν3/2[521], α=+1/2.

γ(^{153}Nd)

I(K x-rays)=128 *18* measured by 2010Si03.

E_i(level)	J_i^π	E_γ†	I_γ‡	E_f	J_f^π	Mult.[#]	α[@]	Comments
49.94	(5/2−)	50.0		0.0	(3/2−)	[M1]	10.49	Iγ=8 *3*, Iγ+ce=93 *36* in ^{239}Pu(n,Fγ), prompt γ.
120.19	(7/2−)	70.2 *2*	200 *64*	49.94	(5/2−)	[M1]	3.92 *7*	Iγ=6 *1*, Iγ+ce=29 *5* in ^{239}Pu(n,Fγ), prompt γ.
		120.2 *2*	100	0.0	(3/2−)			
191.71	(5/2+)	71.5 *2*	19 *2*	120.19	(7/2−)	[E1]	0.645 *11*	Iγ=18 *2*, Iγ+ce=29 *4* in ^{239}Pu(n,Fγ), prompt γ.
		141.8 *2*	59 *7*	49.94	(5/2−)	E1	0.0997	α(K)exp=0.08 *10* (2010Si03) α(K)=0.085 *3* Iγ=57 *4*, Iγ+ce=63 *5* in ^{239}Pu(n,Fγ), prompt γ.
		191.7 *2*	100	0.0	(3/2−)	E1	0.0440	α(K)exp=0.07 *3* (2010Si03) α(K)=0.0377 *12* Iγ=96 *6*, Iγ+ce=100 *6* in ^{239}Pu(n,Fγ), prompt γ.
208.42	(9/2−)	88.3 *2*	58 *10*	120.19	(7/2−)			
		158.5 *2*	100	49.94	(5/2−)			
252.24	(7/2+)	60.7 *2*		191.71	(5/2+)			
317.89	(11/2−)	109.5 *2*	71 *14*	208.42	(9/2−)			
		197.6 *2*	100	120.19	(7/2−)			
330.08	(9/2+)	78.0 *2*	50 *16*	252.24	(7/2+)			
		138.2 *2*	100	191.71	(5/2+)			
427.9	(11/2+)	97.9 *2*	76 *11*	330.08	(9/2+)			
		175.8	100	252.24	(7/2+)			
441.24	(13/2−)	123.3 *2*	60 *8*	317.89	(11/2−)			
		232.9 *2*	100	208.42	(9/2−)			
539.0	(13/2+)	111.1 *2*	86 *10*	427.9	(11/2+)			
		208.8 *2*	100	330.08	(9/2+)			
588.33	(15/2−)	147.1 *2*	45 *6*	441.24	(13/2−)			
		270.4 *2*	100	317.89	(11/2−)			
677.3	(15/2+)	138.3 *2*	63 *8*	539.0	(13/2+)			

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^{252}Cf SF decay 2010Si03,1997Hw02 (continued)

γ(^{153}Nd) (continued)

E_i(level)	J_i^π	E_γ[†]	I_γ[‡]	E_f	J_f^π	Comments
677.3	(15/2$^+$)	249.4 *2*	100	427.9	(11/2$^+$)	
743.6	(17/2$^-$)	155.3 *2*	16 *6*	588.33	(15/2$^-$)	
		302.4 *2*	100	441.24	(13/2$^-$)	
817.4	(17/2$^+$)	140.1 *2*	43 *6*	677.3	(15/2$^+$)	
		278.4 *2*	100	539.0	(13/2$^+$)	
928.0	(19/2$^-$)	184.4 *2*	36 *7*	743.6	(17/2$^-$)	
		339.6 *2*	100	588.33	(15/2$^-$)	
1001.5	(19/2$^+$)	184.1 *2*	54 *8*	817.4	(17/2$^+$)	E_γ: from level-scheme figure 13 of 2010Si03, 184.4 in authors′ table IV.
		324.2 *2*	100	677.3	(15/2$^+$)	
1111.3	(21/2$^-$)	183.2 *2*	25 *8*	928.0	(19/2$^-$)	
		367.7 *2*	100	743.6	(17/2$^-$)	
1164.7	(21/2$^+$)	163.2 *2*	25 *5*	1001.5	(19/2$^+$)	
		347.3 *2*	100	817.4	(17/2$^+$)	
1331.5	(23/2$^-$)	220.2 *2*	20 *6*	1111.3	(21/2$^-$)	
		403.6 *2*	100	928.0	(19/2$^-$)	
1399.9	(23/2$^+$)	235.1 *2*	37 *7*	1164.7	(21/2$^+$)	
		398.5 *2*	100	1001.5	(19/2$^+$)	
1539.7	(25/2$^-$)	208[&]	10 *3*	1331.5	(23/2$^-$)	
		428.4 *2*	100	1111.3	(21/2$^-$)	
1578.9	(25/2$^+$)	179.0 *2*	10 *3*	1399.9	(23/2$^+$)	
		414.2 *2*	100	1164.7	(21/2$^+$)	
1794.8	(27/2$^-$)	463.3 *2*		1331.5	(23/2$^-$)	
1869.4	(27/2$^+$)	290.5 *2*	20 *5*	1578.9	(25/2$^+$)	
		469.6 *2*	100	1399.9	(23/2$^+$)	
2025.2	(29/2$^-$)	485.5 *2*		1539.7	(25/2$^-$)	
2057.0	(29/2$^+$)	187.5[&] *2*	5 *3*	1869.4	(27/2$^+$)	
		478.1 *2*	100	1578.9	(25/2$^+$)	
2314.8	(31/2$^-$)	520.0 *2*		1794.8	(27/2$^-$)	
2407.4	(31/2$^+$)	350.3 *2*	10 *3*	2057.0	(29/2$^+$)	
		538.0 *2*	100	1869.4	(27/2$^+$)	
2564.2	(33/2$^-$)	539.0 *2*		2025.2	(29/2$^-$)	
2595.2	(33/2$^+$)	188[&]		2407.4	(31/2$^+$)	
		538.2 *2*		2057.0	(29/2$^+$)	
3009.4	(35/2$^+$)	602.0 *2*		2407.4	(31/2$^+$)	
3190.0	(37/2$^+$)	594.8 *2*		2595.2	(33/2$^+$)	

[†] From 2010Si03. Typical uncertainty is stated by 2010Si03 as 0.2 keV.

[‡] Branching ratios measured by 2010Si03, ^{252}Cf decay; relative intensities (to 191.7γ) from ^{239}Pu(n,Fγ) study are given in comments.

[#] From α(K)exp (2010Si03).

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

[&] Placement of transition in the level scheme is uncertain.

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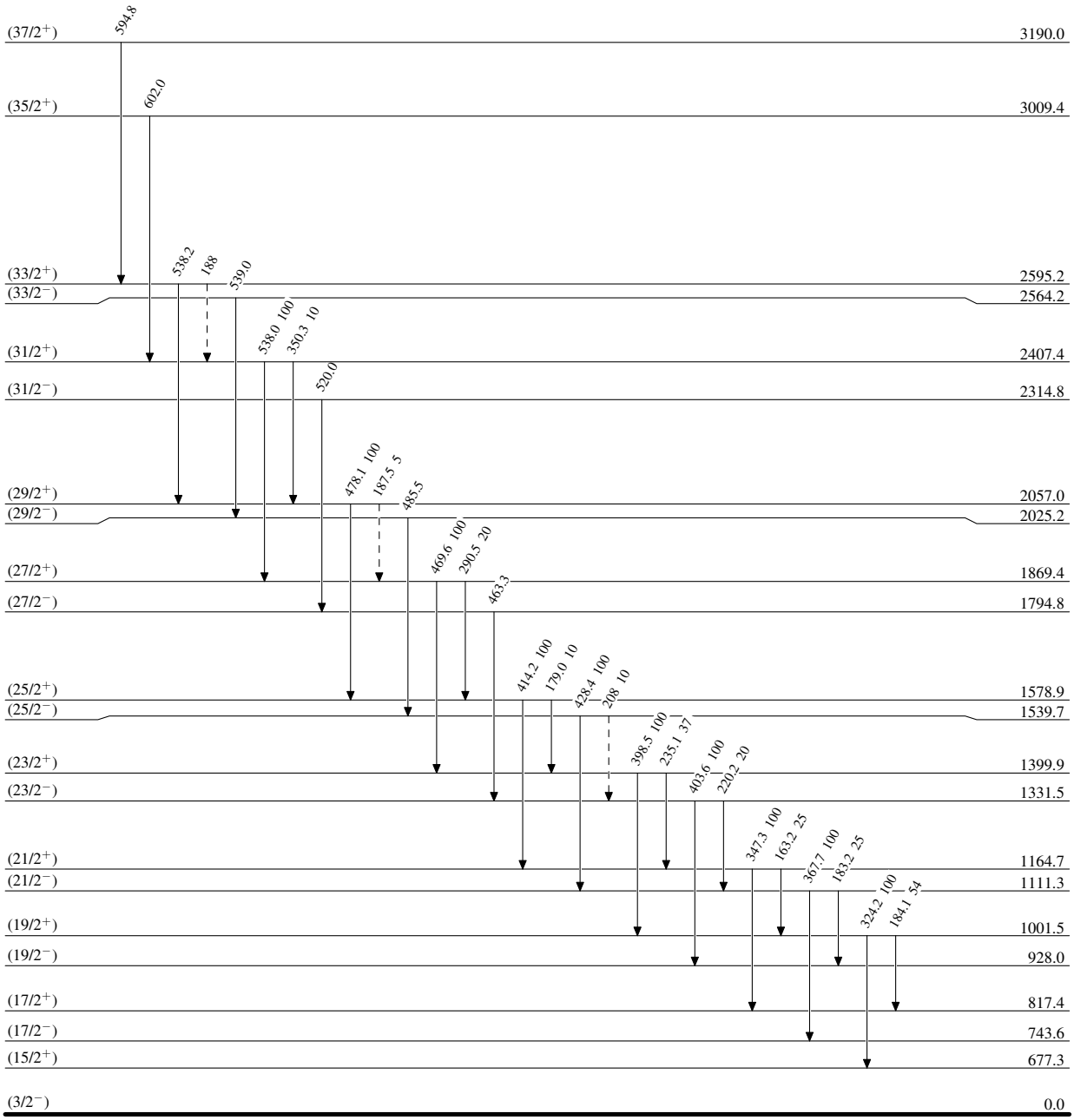
Legend

Level Scheme

Intensities: Relative photon branching from each level

γ Decay (Uncertain)

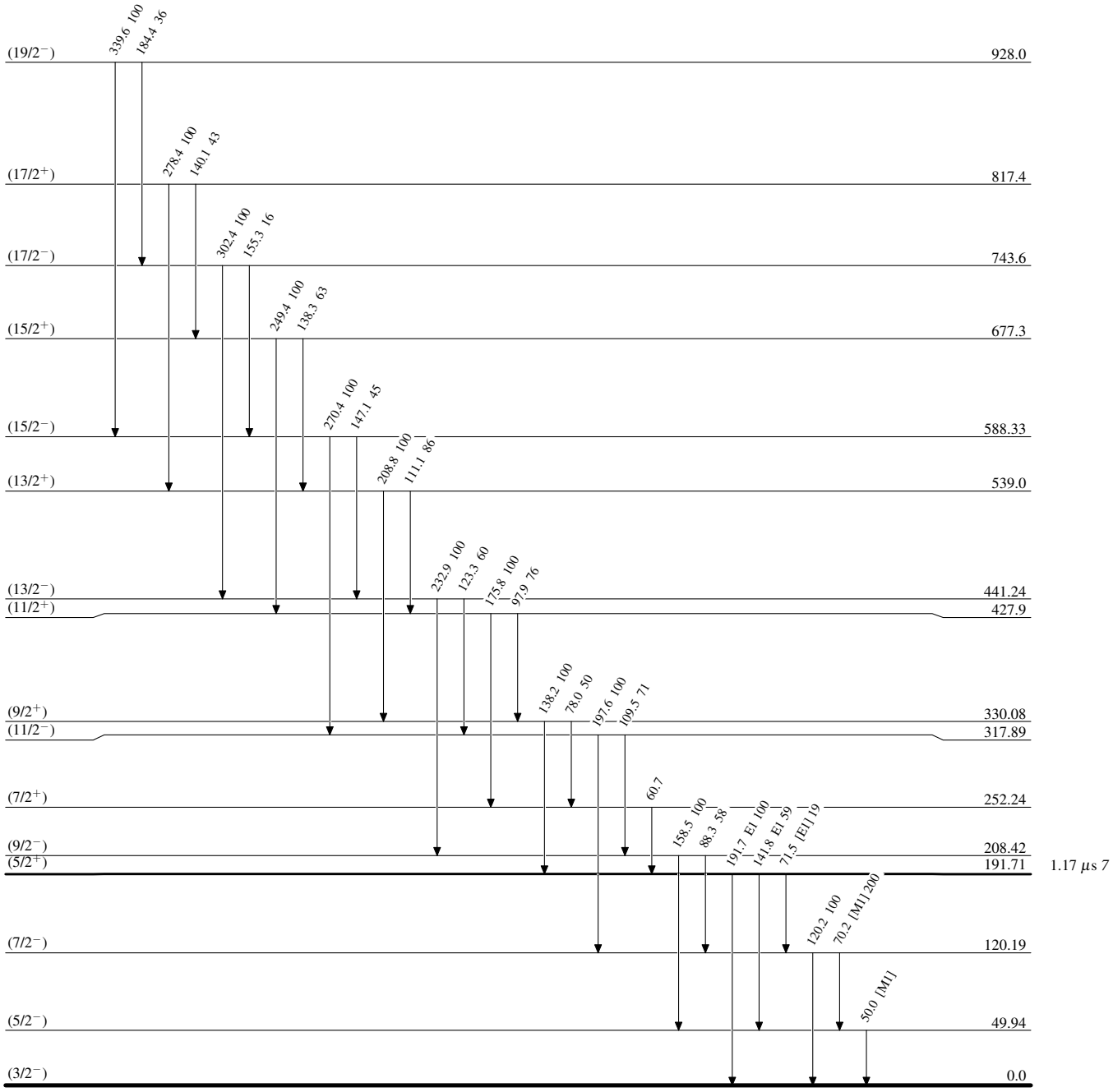


$^{153}_{60}Nd_{93}$

^{252}Cf SF decay 2010Si03,1997Hw02

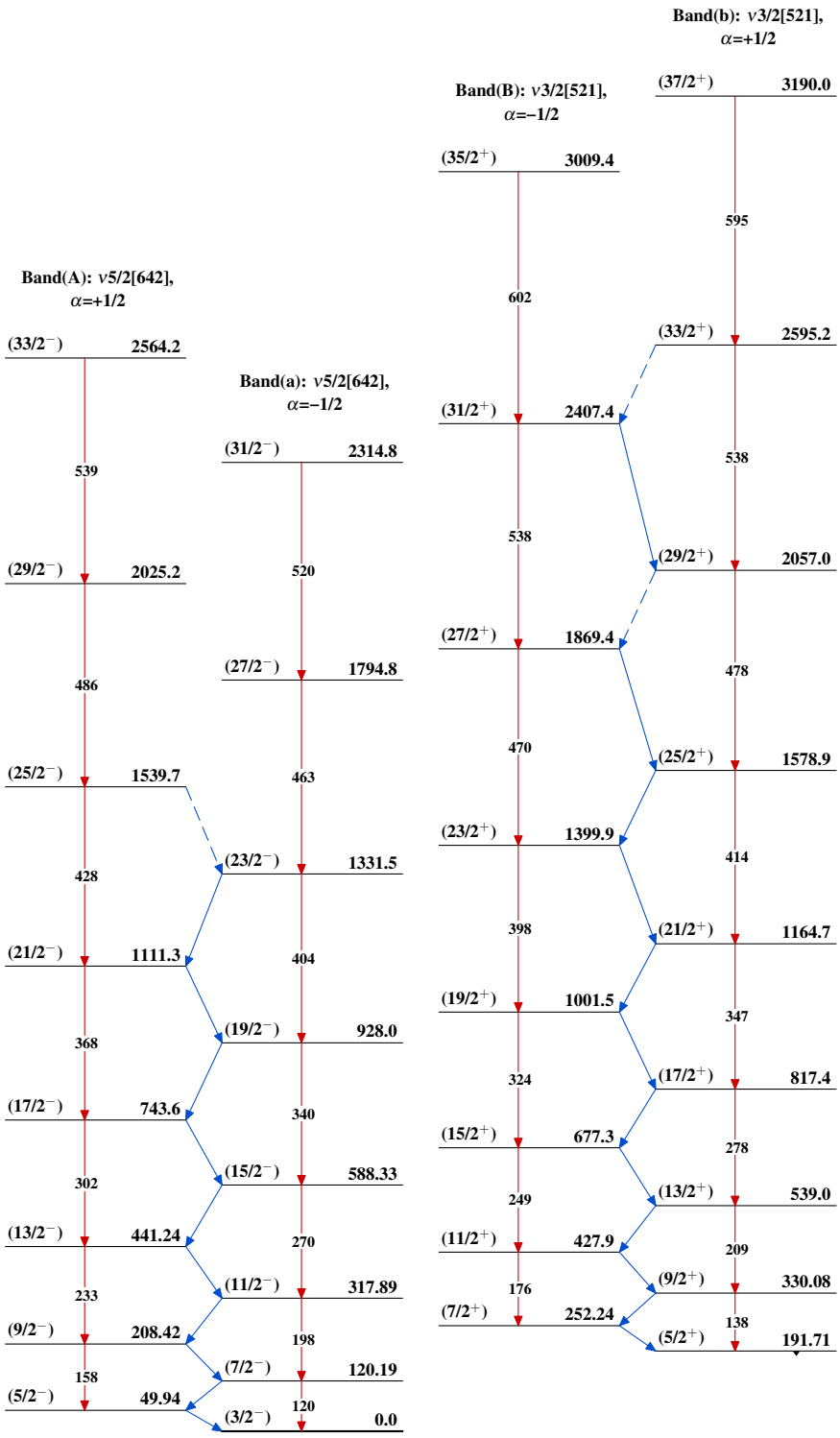
Level Scheme (continued)

Intensities: Relative photon branching from each level



$^{153}_{60}Nd_{93}$

^{252}Cf SF decay 2010Si03,1997Hw02



$^{153}_{60}Nd_{93}$