

^{252}Cf SF decay **2010Li10,1998Hw04,1974CIZX**

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	N. Nica	NDS 154, 1 (2018)	20-Nov-2018

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

Dataset based on compiled (XUNDL) files from [1998Hw04](#) by J. Chenkin and B. Singh (McMaster) and from [2010Li10](#) by K. Abusaleem (University of Jordan) and B. Singh (McMaster).

[2010Li10](#): measured E_γ , I_γ , $\gamma\gamma(\theta)$ using the Gammasphere array with 101 detectors at LBNL. The $62\ \mu\text{Ci}$ α activity, ^{252}Cf source was placed between two $10\ \text{mg}/\text{cm}^2$ Fe foils.

[1998Hw04](#): measured $\gamma\gamma\gamma$ and higher with Gammasphere, 72 Compton-suppressed Ge detectors. Assignment based on Cs-Tc SF pairs.

[1974CIZX](#): measured γ , $\gamma\gamma$, $\gamma(t)$ with Ge(Li) detectors.

[1970Wa05](#): measured ce, ce(t).

Others: [1971Ho29](#), [1972ChYZ](#).

[2010Li10](#) extend the work of [1998Hw04](#) (both are related to each other by same experimental device and similar author teams).

[1998Hw04](#) reported 9 levels up to 2930 keV with 10 γ transitions, with no J^π assignments. [2010Li10](#) included the level scheme of [1998Hw04](#) and extended it up to 3974 keV with a total of 21 levels and 29 γ transitions; they also assigned γ multiplicities and J^π values, and used systematics. The combined level scheme is presumably population an $0.0+x$ (3^-) isomer (but not touching the g.s.).

[1974CIZX](#), [1972ChYZ](#), [1971Ho29](#), and [1970Wa05](#) find low levels / low γ energies level scheme < 150 keV that reach the g.s. of ^{140}Cs and is overlapping the ^{140}Xe β^- decay scheme.

There is no overlap in between the levels scheme of [2010Li10](#) and [1974CIZX](#) (and the others).

 ^{140}Cs Levels

Based on their J^π assignments [2010Li10](#) conclude that there is no overlap between levels obtained in the spontaneous fission of ^{252}Cf and those with low spin known from the β^- decay. However because the generally poorer detection efficiency of the Gammasphere array for low E_γ , the levels 0.0, 13.9, 64.6, 80.1, 103.0, 118.0, and 149.0 and their decaying γ transitions previously common to both ^{252}Cf SF decay and ^{140}Xe β^- decay are still assigned to this dataset.

E(level) [†]	J^π [‡]	$T_{1/2}$ ^{&}	Comments
0.0 [#]	1 ⁻ @		E(level): possible isomeric state, no deexciting transitions observed.
0.0+x	(3 ⁻)		
13.90 [#] 10	(2) ⁻ @	521 ns 11	
64.60 [#] 15	(3) ⁻ @	8.0 ns 6	
80.1 [#] 10	1 ⁻ ,0 ⁻ @		
80.1+x 3	(4 ⁻)		
103.00 [#] 20	(2) ⁻ @	11.0 ns 12	
118.0 [#] 10	(2,1) ⁻ @	2.6 ns 5	$T_{1/2}$: from 1970Wa05 ($\gamma(t)$).
149.00 [#] 18	(3,4) [@]	<10 ns	
159.5+x 5	(5 ⁻)		
195.0+x ^b 5	(6 ⁻)		
249.8+x ^a 5	(7 ⁻)		
746.2+x ^b 6	(8 ⁻)		
844.1+x ^a 6	(9 ⁻)		
1298.8+x ^b 6	(10 ⁻)		
1485.0+x ^a 6	(11 ⁻)		
1862.4+x ^b 6	(12 ⁻)		
2187.2+x ^c 7	(12)		
2204.8+x 7			

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^{252}Cf SF decay [2010Li10,1998Hw04,1974CIZX](#) (continued) ^{140}Cs Levels (continued)

E(level) [†]	J ^π [‡]	E(level) [†]	J ^π [‡]	E(level) [†]	J ^π [‡]
2248.9+x ^a 7	(13 ⁻)	2721.4+x ^c 7	(14)	3328.5+x ^c 7	(16)
2312.5+x 7		3020.4+x ^a 7	(15 ⁻)	3372.5+x 7	
2496.0+x ^b 7	(14 ⁻)	3148.6+x ^b 7	(16 ⁻)	3794.5+x ^a 8	(17 ⁻)

[†] From least-squares fit to E γ 's, assuming $\Delta E\gamma=0.3$ keV for each γ ray.

[‡] Unless otherwise noted, from [2010Li10](#) based on systematics, the assumption that all transitions are stretched, the (640.9 γ)(594.3 γ)(θ) and (454.7 γ)(594.3 γ)(θ) measured angular correlations, and the α (54.8 γ), [2010Li10](#) assigned (7⁻) and (6⁻) for the 249.7 and 194.9 levels respectively, with higher $\Delta J=2$ (E2) In-band transitions, and $\Delta J=1$ interband transitions. [2010Li10](#) used extensively the comparison with ^{138}I isotone ([2007Rz01](#)).

From [1974CIZX](#).

@ From Adopted Levels.

& From [1974CIZX](#), except where noted otherwise.

^a Band(A): Band based on (7⁻), $\alpha=1$. From [2010Li10](#). Possible configuration= $\pi(1g_{7/2})^5_{7/2} \otimes \nu(2f_{7/2})^3_{7/2}$.

^b Band(a): Band based on (6⁻), $\alpha=0$. From [2010Li10](#). Possible configuration= $\pi(1g_{7/2})^5_{7/2} \otimes \nu(2f_{7/2})^3_{5/2}$.

^c Band(B): Band based on (12). From [2010Li10](#).

 $\gamma(^{140}\text{Cs})$

I γ normalization: Photons per 1×10^5 fissions from [1974CIZX](#) that can be applied only for γ transitions from this reference (but not for γ 's from [2010Li10](#)).

E γ [†]	I γ [‡]	E $_i$ (level)	J $^\pi_i$	E $_f$	J $^\pi_f$	Mult. [#]	Comments
13.9 [@] 1	32 [@] 2	13.90	(2) ⁻	0.0	1 ⁻		
35.5		195.0+x	(6 ⁻)	159.5+x	(5 ⁻)		
50.7 [@] 1	243 [@] 24	64.60	(3) ⁻	13.90	(2) ⁻		
54.8		249.8+x	(7 ⁻)	195.0+x	(6 ⁻)	(M1)	$\alpha(\text{exp}) \approx 17$
^x 61							E γ : assignment uncertain; T $_{1/2} < 0.5$ ns (1974CIZX); T $_{1/2} = 1.0 \pm 2$ ns (1970Wa05). ce(K)= 11×10^{-3} 4 per fission (1970Wa05).
^x 78							
^x 78.6							Unplaced 78.6 γ and 78 γ observed by 1971Ho29 (energy resolution ≥ 0.5 keV) and 1970Wa05 (energy resolution ≈ 1 keV). The unplaced γ might be the same as 79.4 γ placed at 159.5+x level provided this was measured with ≈ 0.5 keV uncertainty. ce(K)= 11×10^{-3} 4 per fission (1970Wa05) T $_{1/2} = 1.0 \pm 2$ ns (1970Wa05).
79.4		159.5+x	(5 ⁻)	80.1+x	(4 ⁻)		
^x 80.0							observed by 1971Ho29 (energy resolution ≥ 0.5 keV).
80.1		80.1+x	(4 ⁻)	0.0+x	(3 ⁻)		
80.1 [@]		80.1	1 ⁻ , 0 ⁻	0.0	1 ⁻		E γ : Multiply placed; no intensity given.
84.4 [@] 1	25 $\times 10^1$ [@] 13	149.00	(3,4)	64.60	(3) ⁻		
90.3		249.8+x	(7 ⁻)	159.5+x	(5 ⁻)		
103.0 [@] 2	93 [@] 12	103.00	(2) ⁻	0.0	1 ⁻		
118 [@] 1		118.0	(2,1) ⁻	0.0	1 ⁻		ce(K)= 8.8×10^{-3} 22 per fission (1970Wa05), K/L=5.3.
247.1	0.22 7	2496.0+x	(14 ⁻)	2248.9+x	(13 ⁻)		
299.0	0.15 5	3020.4+x	(15 ⁻)	2721.4+x	(14)		

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^{252}Cf SF decay [2010Li10](#),[1998Hw04](#),[1974CIZX](#) (continued) $\gamma(^{140}\text{Cs})$ (continued)

E_γ [†]	I_γ [‡]	$E_i(\text{level})$	J_i^π	E_f	J_f^π	Mult. [#]	Comments
308.1	0.14 5	3328.5+x	(16)	3020.4+x	(15 ⁻)		
377.4	1.2 2	1862.4+x	(12 ⁻)	1485.0+x	(11 ⁻)		
386.5 &		2248.9+x	(13 ⁻)	1862.4+x	(12 ⁻)		
454.7	3.1 3	1298.8+x	(10 ⁻)	844.1+x	(9 ⁻)	(E2,M1)	$\Delta J=1$ for 454.7 γ , $\Delta J=2$ for 594.3 γ from (454.7 γ)(594.3 γ)(θ): $A_2=-0.09$ 3, $A_4=-0.01$ 4. δ : +0.07 +14-13 or +4.4 +60-18 (2010Li10).
472.5	0.42 13	2721.4+x	(14)	2248.9+x	(13 ⁻)		
496.4	0.10 3	746.2+x	(8 ⁻)	249.8+x	(7 ⁻)		
534.2	0.33 10	2721.4+x	(14)	2187.2+x	(12)		
551.2	5.9 6	746.2+x	(8 ⁻)	195.0+x	(6 ⁻)		
552.6	3.2 3	1298.8+x	(10 ⁻)	746.2+x	(8 ⁻)		
563.6	3.1 3	1862.4+x	(12 ⁻)	1298.8+x	(10 ⁻)		
594.3	10.0 10	844.1+x	(9 ⁻)	249.8+x	(7 ⁻)	(E2)	
607.1	0.23 7	3328.5+x	(16)	2721.4+x	(14)		
633.6	0.97 20	2496.0+x	(14 ⁻)	1862.4+x	(12 ⁻)		
640.9	4.7 5	1485.0+x	(11 ⁻)	844.1+x	(9 ⁻)	(E2)	$\Delta J=2$ (probable E2) for 594.3 γ and 640.9 γ from (640.9 γ)(594.3 γ)(θ): $A_2=+0.096$ 17, $A_4=-0.005$ 25.
652.6	0.42 14	3148.6+x	(16 ⁻)	2496.0+x	(14 ⁻)		
702.2	0.51 10	2187.2+x	(12)	1485.0+x	(11 ⁻)		
719.8	0.45 15	2204.8+x		1485.0+x	(11 ⁻)		
763.9	1.19 24	2248.9+x	(13 ⁻)	1485.0+x	(11 ⁻)		
771.5	0.24 8	3020.4+x	(15 ⁻)	2248.9+x	(13 ⁻)		
774.1	0.20 7	3794.5+x	(17 ⁻)	3020.4+x	(15 ⁻)		
827.5	0.35 11	2312.5+x		1485.0+x	(11 ⁻)		
876.5	0.55 11	3372.5+x		2496.0+x	(14 ⁻)		

[†] From [2010Li10](#) unless otherwise noted.

[‡] Unless otherwise noted, from e-mail reply to B. Singh of S.H. Liu (first author of [2010Li10](#) on March 22, 2010). Uncertainties are specified as 10% to 30% from strong to weak transitions. The evaluator adopted 10% for $I_\gamma=2-10$, 20% for $I_\gamma=0.5-2$ and 30% for $I_\gamma<0.5$.

[#] Unless otherwise noted from $\gamma\gamma(\theta)$ data or estimated total conversion coefficient ([2010Li10](#)).

@ From [1974CIZX](#).

& Placement of transition in the level scheme is uncertain.

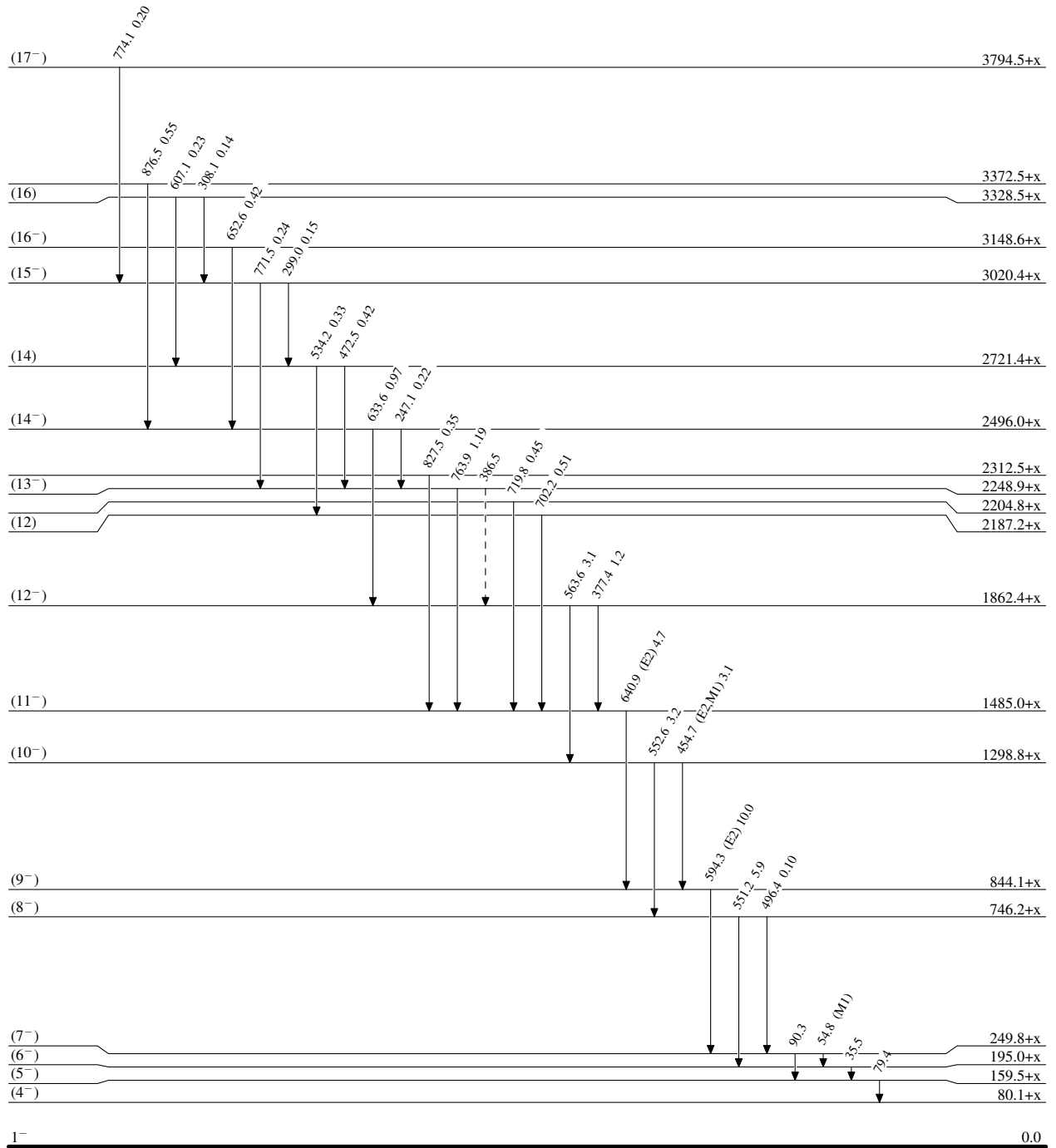
^x γ ray not placed in level scheme.

^{252}Cf SF decay 2010Li10,1998Hw04,1974CIZX

Legend

Level SchemeIntensities: Relative I_γ

- $\longrightarrow$ $I_\gamma < 2\% \times I_\gamma^{\max}$
 $\longrightarrow$ $I_\gamma < 10\% \times I_\gamma^{\max}$
 $\longrightarrow$ $I_\gamma > 10\% \times I_\gamma^{\max}$
 $\cdots$ γ Decay (Uncertain)

 $^{140}_{55}\text{Cs}_{85}$

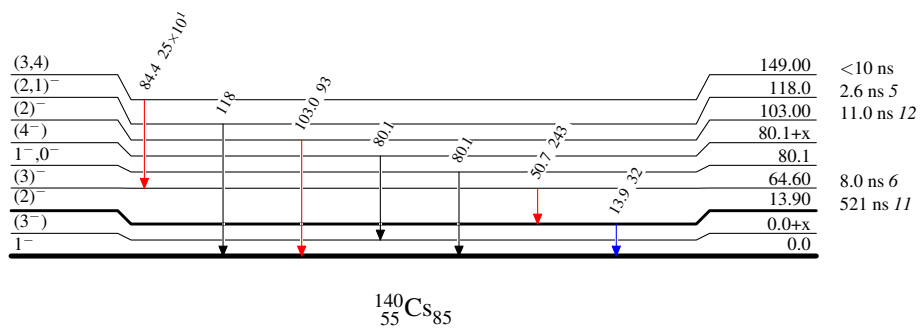
^{252}Cf SF decay 2010Li10,1998Hw04,1974CIZX

Level Scheme (continued)

Intensities: Relative I_γ

Legend

- $I_\gamma < 2\% \times I_\gamma^{\max}$
- $I_\gamma < 10\% \times I_\gamma^{\max}$
- $I_\gamma > 10\% \times I_\gamma^{\max}$



^{252}Cf SF decay 2010Li10,1998Hw04,1974CIZXBand(A): Band based on
(7⁻), $\alpha=1$ (17⁻) 3794.5+x

774

(15⁻) 3020.4+x

772

(13⁻) 2248.9+x

764

(11⁻) 1485.0+x

641

(9⁻) 844.1+x

594

(7⁻) 249.8+x

Band(a): Band based on
(6⁻), $\alpha=0$ (16⁻) 3148.6+x

653

(14⁻) 2496.0+x

634

(12⁻) 1862.4+x

564

(10⁻) 1298.8+x

553

(8⁻) 746.2+x

551

(6⁻) 195.0+x

Band(B): Band based on
(12)

(16) 3328.5+x

607

(14) 2721.4+x

534

(12) 2187.2+x

 $^{140}_{55}\text{Cs}_{85}$