^{138}Ba(p,3nγ),^{133}Cs(α,nγ) 1985Mo01

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	E. A. Mccutchan	NDS 152, 331 (2018)	1-Apr-2018

1985Mo01: ^{138}Ba(p,3nγ) with E(p)=17-45 MeV. Measured Eγ, Iγ, $\gamma(\theta)$, γ(t), $\gamma\gamma$ coincidences, excitation function (3 MeV steps) using three Ge(Li) detectors. In beam measurements made at E(p)=32 MeV.

1980SuZY: ^{133}Cs(α,nγ) with E(α)=15 MeV; ^{136}Ba(p,nγ) E=8 MeV. Measured in-beam γ's and off-beam K x ray$'$s, γ's, γ(t), and X(t) (Ge(Li),Si(Li)).

1977Go15: ^{133}Cs(α,nγ) with E(α)=15.9 MeV. Measured Eγ of 96γ.

1973BuYV: ^{133}Cs(α,nγ) E=12.4-17.2 MeV. Measured Eγ. Preliminary results only in form of spectrum with labeled peaks, many of which originate from Coulomb excitation of the ^{133}Cs target.

1966Gr19: ^{136,137}Ba(p,xnγ). Measured excitation functions (E=threshold−20 MeV), Eγ, Iγ, γ(t) using NaI(Tl) crystal. Observe two transitions at approximately 70 keV and 100 *5* keV.

Decay scheme from 1985Mo01, except as noted.

^{136}La Levels

E(level)[†]	J$^\pi$[‡]	$T_{1/2}$	Comments
0.0	1$^+$		
21.80 *20*	2$^+$		
44.32 *25*	3$^+$		
140.0 *3*	4$^+$		
158.3	5$^+$		
172.03 *25*	(3)[#]		
173.5 *4*	(5)		
211.98 *15*	(2)[@]		
230.1?			
270.14 *25*	(3)[#]	17 ns *4*	$T_{1/2}$: from γ(t) (1985Mo01) using 248.8γ, 150.2γ, 130.2γ, 127.7γ, 98.0γ and 95.7γ.
274.6 *3*			
331.6 *3*			
342.6 *4*			
346.0 *6*			
381.5 *4*	(4)[#]		
393.0 *6*			
414.19 *16*	(3)[&]		
436.9 *4*			
548.00 *19*			
555.0 *4*			
563.8 *3*	(3)[&]		
570.9 *3*			
659.0 *6*			
710.7 *4*			
749.23 *19*	(3)[&]		
752.6 *4*			
945.5 *3*			
988.1 *3*			
x+230	J	114 ms *5*	$T_{1/2}$: weighted average of 115 ms *5* from γ(t) (1985Mo01), 118 ms *5* from γ(t) (1980SuZY) and 110 ms *5* from γ(t) (1966Gr19). E(level): x $\approx$10-40 keV. J$^\pi$: =7,8 from lifetime considerations. E(level): isomer is placed at 230.1 keV by 1980SuZY, directly depopulated by the 71.8γ. 1985Mo01 tentatively place the isomer as slightly above decaying by a highly converted, low energy transition. Additional information 1.

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^{138}Ba(p,3nγ),^{133}Cs(α,nγ) 1985Mo01 (continued)

^{136}La Levels (continued)

E(level)[†]	Jπ[‡]
312.12+x[a] *18*	(J+1)[@]
510.69+x[a] *15*	(J+1)[@]
569.1+x[a] *3*	(J+2)[@]
770.64+x[a] *22*	(J+2)[@]
831.1+x[a] *4*	
931.19+x[a] *16*	(J+3)[@]
993.1+x[a] *3*	(J+3)[@]
1030.9+x[a] *6*	
1095.37+x[a] *21*	(J+2)[@]
1251.2+x[a] *3*	(J+3)[@]
1252.8+x[a] *4*	
1281.49+x[a] *25*	
1306.09+x[a] *20*	(J+3)[@]
1491.8+x[a] *4*	(J+4)[@]
1657.6+x[a] *4*	(J+4)[@]
2082.2+x[a] *4*	

† From a least-squares fit to Eγ, by evaluator; the 158-keV and 230-keV levels are excluded from the fitting procedure.
‡ As proposed by 1985Mo01 based on γ-ray multipolarities and shell model calculations.
# γ(θ) of 248γ, 150γ, 130γ, 128γ and 114γ have small anisotropies and are considered to be almost pure dipole.
@ Most transitions show distinct negative anisotropies indicating D+Q with ΔJ=1.
& 352γ(θ) and 537γ(θ) are in agreement with dipole character and 414γ(θ) with quadrupole character.
a States built upon the 114 ms isomer. The excitation functions of the 82.1γ and 280.6γ exhibit a shift of ≈3 MeV relative to those of the 248.4γ and 211.9γ.

γ(^{136}La)

Unplaced gammas are from 1973BuYV. Assignment to ^{136}La considered uncertain by evaluator.
1966Gr19 suggested mult(≈70γ)=M2, mult(100γ)=E2, and α(K)exp(100γ)=2.5 *6* from Iγ(K x ray):Iγ(≈70γ):Iγ(100γ). However, the K x ray peak was probably contaminated by the 33.5γ.

Eγ[†]	Iγ[‡]	Ei(level)	J^π_i	E_f	J^π_f	Mult.[#]	α[b]	Comments
x		x+230	J	230.1?				Eγ: x ≈10-40 keV.
18.27		158.3	5+	140.0	4+			Eγ: From 1980SuZY. Not observed by others.
21.8 *2*	36[a] *30*	21.80	2+	0.0	1+			
22.5 *2*	<54[a]	44.32	3+	21.80	2+			Iγ: given as Iγ=24 *30* in 1985Mo01.
33.5 *2*	4.9×10^2 *18*	173.5	(5)	140.0	4+	D	<3	Eγ: contaminated by K x-ray line of La. Mult.: from α(exp) (1985Mo01). α: estimated by assuming that the total intensity of the 33.5γ should be less than the 95.7γ (1985Mo01).
(56.6+x)		x+230	J	173.5	(5)			
[x]66.8[c]								
71.8 *5*	24 *12*	230.1?		158.3	5+	D	≤3	α: from x-ray intensity off-beam spectra, contribution from 95.7γ assuming M1 multipolarity is subtracted (1985Mo01). Eγ,Iγ: contaminated by x-ray lines of Pb; intensity

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^{138}Ba(p,3nγ),^{133}Cs(α,nγ) 1985Mo01 (continued)

γ(^{136}La) (continued)

E_γ[†]	I_γ[‡]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[#]	Comments
							estimated from coincidence spectrum. Mult.: from α(exp) (1985Mo01).
72.5 *2*	18 *5*	342.6		270.14	(3)		
82.1 *2*	81 *20*	312.12+x	(J+1)	x+230	J	D+Q	Mult.: A_2=−0.24 *5*, A_4=0.06 *6* (1985Mo01).
95.7 *2*	598 *60*	140.0	4+	44.32	3+	D+Q	E_γ: other: 96.2 *5* (1977Go15). Mult.: A_2=−0.03 *1*, A_4=0.01 *1* (1985Mo01).
98.0 *2*	39 *8*	270.14	(3)	172.03	(3)		
102.7 *2*	7 *4*	274.6		172.03	(3)		
111.4 *2*	20 *5*	381.5	(4)	270.14	(3)	D+Q	Mult.: A_2=−0.09 *7*, A_4=−0.05 *10* (1985Mo01).
127.7 *2*	75 *19*	172.03	(3)	44.32	3+	D+Q	Mult.: A_2=−0.01 *4*, A_4=0.00 *6* (1985Mo01).
130.2 *2*	66 *15*	270.14	(3)	140.0	4+	D+Q	Mult.: A_2=0.06 *4*, A_4=0.04 *5* (1985Mo01).
150.2 *2*	46 *12*	172.03	(3)	21.80	2+	D+Q	Mult.: A_2=−0.07 *9*, A_4=−0.11 *12* (1985Mo01).
155.8 *2*	24 *6*	1251.2+x	(J+3)	1095.37+x	(J+2)	D+Q	Mult.: A_2=−0.26 *7*, A_4=0.08 *9* (1985Mo01).
159.5 *2*	32 *8*	331.6		172.03	(3)	D+Q	Mult.: A_2=0.05 *7*, A_4=−0.05 *10* (1985Mo01).
[x]169.4[c]							
174.0 *5*	10[@] *5*	346.0		172.03	(3)		
[x]177.0[c]							
181.0 *5*	7[@] *4*	393.0		211.98	(2)		
[x]191.9[c]							
202.1 *2*	11 *5*	414.19	(3)	211.98	(2)		
211.9 *2*	100 *10*	211.98	(2)	0.0	1+	D+Q	Mult.: A_2=−0.16 *4*, A_4=0.02 *5* (1985Mo01).
230.2[&] *2*	7 *4*	274.6		44.32	3+		
[x]238.2[c]							
248.4 *2*	58 *13*	270.14	(3)	21.80	2+	D+Q	Mult.: A_2=−0.05 *6*, A_4=0.01 *9* (1985Mo01).
257.0 *2*	39 *10*	569.1+x	(J+2)	312.12+x	(J+1)		Mult.: A_2=−0.14 *10*, A_4=0.03 *15* (1985Mo01).
262.0 *2*	10 *5*	831.1+x		569.1+x	(J+2)		
264.9 *2*	17 *5*	436.9		172.03	(3)	D+Q	Mult.: A_2=−0.08 *12*, A_4=0.20 *15* (1985Mo01).
[x]276.0[c]							
280.6 *2*	137 *14*	510.69+x	(J+1)	x+230	J	D+Q	Mult.: A_2=−0.28 *3*, A_4=0.02 *4* (1985Mo01).
284.9 *2*	36 *9*	555.0		270.14	(3)		
287.3[&] *2*	34 *9*	331.6		44.32	3+	D+Q	Mult.: A_2=−0.07 *10*, A_4=0.00 *13* (1985Mo01).
287.9[c] *5*	5[@] *3*	1281.49+x		993.1+x	(J+3)		
324.7 *2*	7 *4*	1095.37+x	(J+2)	770.64+x	(J+2)		
329.2 *2*	34 *9*	710.7		381.5	(4)		A_2=−0.15 *7*, A_4=0.23 *9* (1985Mo01).
336.0 *5*	13[@] *7*	548.00		211.98	(2)		
351.8 *2*	13 *7*	563.8	(3)	211.98	(2)	D+Q	Mult.: A_2=−0.25 *10*, A_4=0.06 *15* (1985Mo01).
358.9 *2*	9 *5*	570.9		211.98	(2)		
375.0 *2*	17 *9*	1306.09+x	(J+3)	931.19+x	(J+3)	D+Q	Mult.: A_2=−0.31 *12*, A_4=0.07 *15* (1985Mo01).
406.4 *2*	20 *10*	1657.6+x	(J+4)	1251.2+x	(J+3)	D+Q	Mult.: A_2=−0.27 *10*, A_4=0.23 *14* (1985Mo01).
414.3[&] *2*	26 *13*	414.19	(3)	0.0	1+	Q	A_2=0.23 *7*, A_4=0.18 *10* (1985Mo01).
420.5 *2*	14 *7*	931.19+x	(J+3)	510.69+x	(J+1)		
424.6 *2*	10 *5*	2082.2+x		1657.6+x	(J+4)		
[x]436.5[c]							
447.0 *5*	6[@] *3*	659.0		211.98	(2)		
458.5 *2*	50 *13*	770.64+x	(J+2)	312.12+x	(J+1)	D+Q	Mult.: A_2=−0.46 *10*, A_4=0.12 *14* (1985Mo01).
[x]481.0[c]							
482.5 *2*	20 *5*	752.6		270.14	(3)		
[x]492.0[c]							
498.7 *2*	41 *10*	1491.8+x	(J+4)	993.1+x	(J+3)	D+Q	Mult.: A_2=−0.19 *6*, A_4=0.03 *9* (1985Mo01).
520.2 *5*	14[@] *7*	1030.9+x		510.69+x	(J+1)		
537.4 *5*	7[@] *4*	749.23	(3)	211.98	(2)	D+Q	Mult.: A_2=−0.13 *9*, A_4=0.06 *11* (1985Mo01).
[x]545.8[c]							
548.0[&] *2*	11 *6*	548.00		0.0	1+		

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^{138}Ba(p,3nγ),^{133}Cs(α,nγ) 1985Mo01 (continued)

γ(^{136}La) (continued)

E_γ[†]	I_γ[‡]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[#]	Comments
563.5[&c] *2*	22 *6*	563.8	(3)	0.0	1+		
571.2[&c] *2*	19 *5*	570.9		0.0	1+		
584.7 *2*	32 *8*	1095.37+x	(J+2)	510.69+x	(J+1)	D+Q	Mult.: A_2=−0.22 *7*, A_4=0.01 *8* (1985Mo01).
619.3[c] *5*	12[@] *6*	931.19+x	(J+3)	312.12+x	(J+1)		
[x]626.1[c]							
[x]671.3[c]							
681.0 *2*	61 *15*	993.1+x	(J+3)	312.12+x	(J+1)	Q	Mult.: A_2=0.21 *7*, A_4=0.01 *9* (1985Mo01).
683.7 *2*	15 *8*	1252.8+x		569.1+x	(J+2)		
701.3 *2*	28 *7*	931.19+x	(J+3)	x+230	J		
733.5 *2*	9 *5*	945.5		211.98	(2)		
749.2[&] *2*	10 *5*	749.23	(3)	0.0	1+		
[x]768.5[c]							
770.8 *2*	18 *9*	1281.49+x		510.69+x	(J+1)		
776.1 *2*	17 *4*	988.1		211.98	(2)		
795.3 *2*	11 *6*	1306.09+x	(J+3)	510.69+x	(J+1)		
[x]962.4							

[†] From 1985Mo01, except where noted.
[‡] From 1985Mo01. Uncertainties are only given explicity for transitions below 72 keV. For higher energies 1985Mo01 provide only a general statement that uncertainties are accurate to 10-50% depending upon line strength; based on general statement evaluator has assigned an uncertainty of 10% for Iγ ≥ 100, 25% for Iγ between 20 and 100 and 50% for Iγ ≤20.
[#] From γ(θ) in 1985Mo01, except where noted.
[@] Line contaminated. Iγ and ΔIγ estimated from coincidence spectra.
[&] Placement from energy-sum considerations (1985Mo01).
[a] Contaminated by 22.7γ from ^{71}Ge.
[b] 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.
[c] Placement of transition in the level scheme is uncertain.
[x] γ ray not placed in level scheme.

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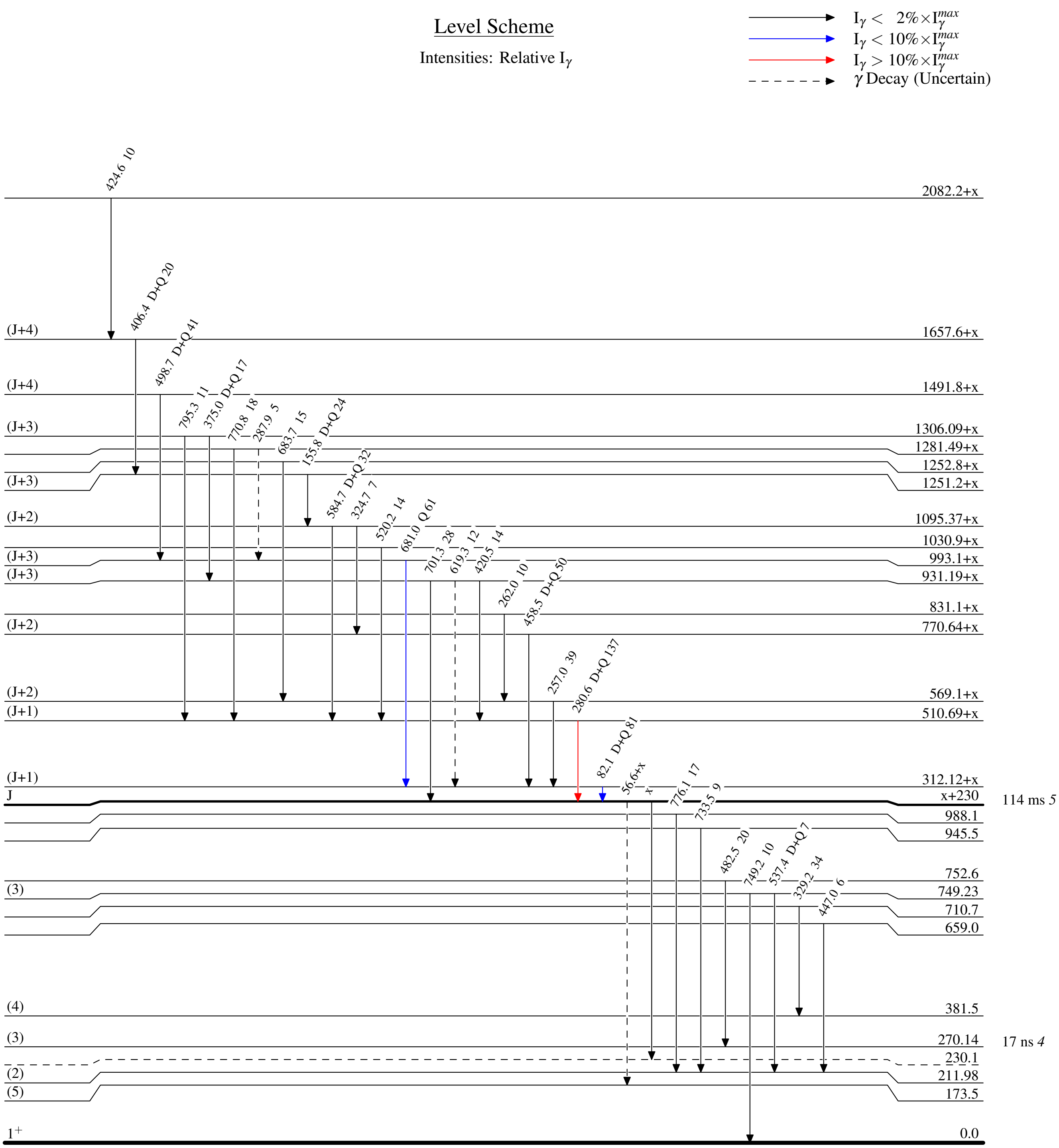

$^{136}_{57}La_{79}$

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Level Scheme (continued)

Intensities: Relative I_γ