^{136}Ba(α,2nγ) 1987Lo12

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Jun Chen	NDS 146, 1 (2017)	30-Sep-2017

1987Lo12: E=25 MeV α beam was produced from the Cologne FN tandem accelerator. Target was 92.8% enriched ^{136}Ba oxide of 3 mg/cm^2 thickness (E=24 MeV, target thickness of 0.5 mg/cm^2 on a 12 μg/cm^2 carbon backing for ce measurement). γ rays were detected with Ge detectors and conversion electrons were detected with a spectrometer. Measured ce, Eγ, Iγ, $\gamma\gamma$-coin, γ(t), $\gamma(\theta)$. Deduced levels, J, π, γ-ray multipolarities and mixing ratios, conversion coefficients. Comparisons with shell-model calculations. 1987Lo12 also reports data from ^{139}La(p,2nγ) measurement. Refer to that dataset for details. 1987Lo12 supersedes 1984Lo14.

Others: 1970Sm05, 1973Wy01.

All data are from 1987Lo12, unless otherwise noted.

^{138}Ce Levels

E(level)†	J$^\pi$‡	E(level)†	J$^\pi$‡	E(level)†	J$^\pi$‡	E(level)†	J$^\pi$‡
0.0	0^+	2217.34 *24*	5^-	2765.0 *4*	6^-	3229.6 *4*	
788.82 *16*	2^+#	2293.75 *23*	6^+	2899.2 *3*	6^-	3430.4 *4*	$(5,7)^+$
1476.8 *3*	0^+#	2393.8 *4*		2907.2 *3*		3539.1 *4*	10^+
1510.90 *16*	2^+#	2396.1 *3*	6^+	2950.4 *4*		3942.2 *4*	
1826.50 *23*	4^+#	2444.0 *3*	4^+	2995.7 *3*	$(2,4,6)^+$	4050.0?	
2129.18 *25*	7^-#	2471.5 *3*		3109.0 *3*	8^+	4359.7 *5*	
2136.94 *23*	(4^+)	2733.3 *3*	6^+	3176.1 *3*		5214.3 *5*	
2177.46 *20*	(3^+)	2748.6 *3*	(5^+)	3214.0 *3*			

† From a least-squares fit to γ-ray energies.
‡ From 1987Lo12, based on deduced γ-ray multipolarities, unless otherwise noted.
# From Adopted Levels.

γ(^{138}Ce)

E$_\gamma$†	I$_\gamma$†	E$_i$(level)	J$_i^\pi$	E$_f$	J$_f^\pi$	Mult.‡	δ‡	α#	Comments
76.4 *2*	3.3 *9*	2293.75	6^+	2217.34	5^-				A_2=−0.14 *1*; A_4=+0.02 *2* δ=0.04 *2*.
80.4 *2*		2217.34	5^-	2136.94	(4^+)				
156.8 *2*	0.9 *1*	2293.75	6^+	2136.94	(4^+)				A_2=+0.15 *4*; A_4=−0.32 *7*
164.6 *2*	9.8 *5*	2293.75	6^+	2129.18	7^-				A_2=−0.10 *7*; A_4=+0.03 *1* δ=−0.01 *1*.
176.5 *2*	3.1 *7*	2393.8		2217.34	5^-				
177.8 *2*	1.3 *3*	2471.5		2293.75	6^+				
302.7 *2*	41.8 *25*	2129.18	7^-	1826.50	4^+				
334.6 *2*	1.9 *1*	2471.5		2136.94	(4^+)	(M1+E2)	−0.16 *4*	0.0431 *7*	A_2=−0.30 *2*; A_4=+0.02 *3* α(K)=0.0369 *6*; α(L)=0.00493 *7*; α(M)=0.001030 *15* α(N)=0.000229 *4*; α(O)=3.71×10^{-5} *6*; α(P)=2.81×10^{-6} *5*
390.8 *2*	15.7 *6*	2217.34	5^-	1826.50	4^+	E1		0.00642	α(K)exp=0.006 *2* A_2=−0.18 *6*; A_4=+0.04 *1* α(K)=0.00552 *8*; α(L)=0.000714 *10*; α(M)=0.0001483 *21* α(N)=3.27×10^{-5} *5*; α(O)=5.26×10^{-6} *8*; α(P)=3.81×10^{-7} *6* δ=−0.06 *2*.

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^{136}Ba(α,2nγ) 1987Lo12 (continued)

γ(^{138}Ce) (continued)

E_γ[†]	I_γ[†]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[‡]	δ[‡]	α[#]	Comments
403.1 *2*	5.1 *2*	3942.2		3539.1	10^+				A_2=−0.22 *6*; A_4=+0.07 *2*
417.5 *2*	1.8 *1*	4359.7		3942.2		M1		0.0245	α(K)exp=0.022 *6* A_2=−0.38 *2*; A_4=+0.04 *3* α(K)=0.0210 *3*; α(L)=0.00277 *4*; α(M)=0.000578 *9* α(N)=0.0001282 *18*; α(O)=2.08×10^{-5} *3*; α(P)=1.600×10^{-6} *23*
430.1 *2*	7.1 *3*	3539.1	10^+	3109.0	8^+	E2		0.01643	α(K)exp=0.013 *3* A_2=+0.082 *8*; A_4=+0.04 *13* α(K)=0.01359 *20*; α(L)=0.00224 *4*; α(M)=0.000477 *7* α(N)=0.0001046 *15*; α(O)=1.626×10^{-5} *23*; α(P)=9.41×10^{-7} *14*
439.5 *2*	0.6 *1*	2733.3	6^+	2293.75	6^+	(M1+E2)	1.6 *3*	0.0171 *6*	A_2=+0.1 *1*; A_4=−0.1 *2* α(K)=0.0144 *6*; α(L)=0.00219 *5*; α(M)=0.000462 *9* α(N)=0.0001018 *20*; α(O)=1.61×10^{-5} *4*; α(P)=1.03×10^{-6} *5*
454.9 *2*	0.6 *1*	2748.6	(5^+)	2293.75	6^+	(M1+E2)	2.5 *15*	0.0148 *21*	A_2=−0.61 *6*; A_4=+0.1 *1* α(K)=0.0124 *20*; α(L)=0.00193 *13*; α(M)=0.000408 *24* α(N)=9.0×10^{-5} *6*; α(O)=1.41×10^{-5} *12*; α(P)=8.8×10^{-7} *18*
467.2 *2*	2.9 *1*	2293.75	6^+	1826.50	4^+	(E2)		0.01300	α(K)exp=0.013 *5* A_2=+0.20 *2*; A_4=−0.06 *3* α(K)=0.01081 *16*; α(L)=0.001733 *25*; α(M)=0.000368 *6* α(N)=8.07×10^{-5} *12*; α(O)=1.261×10^{-5} *18*; α(P)=7.55×10^{-7} *11* δ=−0.07 *4*.
547.7 *2*	1.8 *1*	2765.0	6^-	2217.34	5^-	(M1)		0.01238	α(K)exp=0.014 *3* A_2=−0.35 *2*; A_4=+0.09 *4* α(K)=0.01063 *15*; α(L)=0.001388 *20*; α(M)=0.000289 *4* α(N)=6.42×10^{-5} *9*; α(O)=1.044×10^{-5} *15*; α(P)=8.06×10^{-7} *12* δ=−3.1 *2*.
556.6 *2*	1.0 *1*	2950.4		2393.8		M1		0.01189	α(K)exp=0.011 *3* α(K)=0.01021 *15*; α(L)=0.001333 *19*; α(M)=0.000278 *4* α(N)=6.17×10^{-5} *9*; α(O)=1.003×10^{-5} *14*; α(P)=7.74×10^{-7} *11*
569.6 *2*	1.1 *1*	2396.1	6^+	1826.50	4^+				A_2=+0.13 *4*; A_4=−0.04 *6* δ=−0.1 *1*.
611.7 *2*	0.8 *2*	2748.6	(5^+)	2136.94	(4^+)	(M1)		0.00943	A_2=−0.91 *5*; A_4=+0.07 *8* α(K)=0.00810 *12*; α(L)=0.001054 *15*; α(M)=0.000220 *3* α(N)=4.87×10^{-5} *7*; α(O)=7.93×10^{-6} *12*; α(P)=6.13×10^{-7} *9* δ=−0.5 *1*.
666.6 *2*		2177.46	(3^+)	1510.90	2^+				
681.8 *2*	0.7 *1*	2899.2	6^-	2217.34	5^-				A_2=−0.61 *6*; A_4=+0.3 *1* δ=−2.5 *3*.
688.0 *2*	0.36 *4*	1476.8	0^+	788.82	2^+				

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^{136}Ba(α,2nγ) 1987Lo12 (continued)

$\gamma(^{138}Ce)$ (continued)

E_γ[†]	I_γ[†]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[‡]	α[#]	Comments
697.1 *2*	1.3 *1*	3430.4	$(5,7)^+$	2733.3	6^+	M1	0.00686	α(K)exp=0.0055 *7* A_2=+0.38 *5*; A_4=+0.12 *9* α(K)=0.00589 *9*; α(L)=0.000763 *11*; α(M)=0.0001590 *23* α(N)=3.53×10^{-5} *5*; α(O)=5.74×10^{-6} *8*; α(P)=4.45×10^{-7} *7*
722.1 *2*	2.8 *1*	1510.90	2^+	788.82	2^+	M1,E3		α(K)exp=0.0059 *9* A_2=−0.23 *2*; A_4=+0.02 *3* δ=−1.2 *2*.
758.1 *2*	1.2 *1*	3229.6		2471.5				A_2=−0.23 *4*; A_4=+0.114 *6*
770.0 *2*	1.4 *1*	2899.2	6^-	2129.18	7^-	M1	0.00540	α(K)exp=0.0046 *5* A_2=−0.470 *9*; A_4=+0.09 *2* α(K)=0.00464 *7*; α(L)=0.000599 *9*; α(M)=0.0001248 *18* α(N)=2.77×10^{-5} *4*; α(O)=4.51×10^{-6} *7*; α(P)=3.50×10^{-7} *5* δ=4.5 *15*.
788.8 *2*	100.0 *3*	788.82	2^+	0.0	0^+			A_2=+0.135 *3*; A_4=−0.007 *9*
815.3 *2*	9.4 *3*	3109.0	8^+	2293.75	6^+	E2	0.00317	α(K)exp=0.0029 *4* A_2=+0.217 *9*; A_4=+0.01 *1* α(K)=0.00270 *4*; α(L)=0.000375 *6*; α(M)=7.85×10^{-5} *11* α(N)=1.734×10^{-5} *25*; α(O)=2.77×10^{-6} *4*; α(P)=1.95×10^{-7} *3*
854.6 *2*	0.007 *1*	5214.3		4359.7				
882.3 *2*		3176.1		2293.75	6^+			
906.9 *2*	3.2 *1*	2733.3	6^+	1826.50	4^+	E2	0.00250	α(K)exp=0.0021 *2* A_2=+0.28 *2*; A_4=−0.08 *3* α(K)=0.00213 *3*; α(L)=0.000290 *4*; α(M)=6.07×10^{-5} *9* α(N)=1.341×10^{-5} *19*; α(O)=2.15×10^{-6} *3*; α(P)=1.541×10^{-7} *22* δ=−0.03 *3*.
920.2 *2*	1.1 *1*	3214.0		2293.75	6^+			A_2=−0.22 *4*; A_4=−0.03 *7*
933.1 *2*	1.6 *1*	2444.0	4^+	1510.90	2^+	E2	0.00234	A_2=+0.26 *2*; A_4=−0.09 *3* α(K)=0.00200 *3*; α(L)=0.000271 *4*; α(M)=5.67×10^{-5} *8* α(N)=1.254×10^{-5} *18*; α(O)=2.01×10^{-6} *3*; α(P)=1.449×10^{-7} *21* δ=−0.05 *3*.
941.0[@] *2*	0.77 *5*	4050.0?		3109.0	8^+			α(K)exp=0.0013 *2* A_2=+0.32 *5*; A_4=−0.14 *9*
979.8 *2*	4.3 *2*	3109.0	8^+	2129.18	7^-	E1	8.78×10^{-4}	α(K)exp=0.00052 *7* A_2=−0.15 *1*; A_4=+0.03 *2* α(K)=0.000759 *11*; α(L)=9.46×10^{-5} *14*; α(M)=1.96×10^{-5} *3* α(N)=4.34×10^{-6} *6*; α(O)=7.04×10^{-7} *10*; α(P)=5.39×10^{-8} *8*
1037.7 *2*	79 *3*	1826.50	4^+	788.82	2^+			A_2=+0.112 *6*; A_4=−0.009 *9*
1080.7 *2*	0.9 *1*	2907.2		1826.50	4^+			A_2=−0.65 *7*; A_4=+0.3 *1*
1169.2 *2*	1.7 *1*	2995.7	$(2,4,6)^+$	1826.50	4^+	E2	1.46×10^{-3}	α(K)exp=0.0012 *2*

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^{136}Ba(α,2nγ) 1987Lo12 (continued)

$\gamma(^{138}Ce)$ (continued)

E_γ †	I_γ †	E_i(level)	J_i^π	E_f	J_f^π	Mult. ‡	δ ‡	α #	Comments
									A_2=+0.18 *3*; A_4=−0.11 *5* α(K)=0.001246 *18*; α(L)=0.0001638 *23*; α(M)=3.41×10^{-5} *5* α(N)=7.56×10^{-6} *11*; α(O)=1.220×10^{-6} *17*; α(P)=9.05×10^{-8} *13*; α(IPF)=3.17×10^{-6} *5*
1348.1 *2*	9.4 *5*	2136.94	(4$^+$)	788.82	2$^+$	E2		1.12×10^{-3}	α(K)exp=0.000865 *8* A_2=+0.25 *1*; A_4=−0.06 *2* α(K)=0.000937 *14*; α(L)=0.0001213 *17*; α(M)=2.52×10^{-5} *4* α(N)=5.59×10^{-6} *8*; α(O)=9.05×10^{-7} *13*; α(P)=6.81×10^{-8} *10*; α(IPF)=3.17×10^{-5} *5* δ=−0.03 *3*.
1388.6 *2*	1.0 *1*	2177.46	(3$^+$)	788.82	2$^+$	(M1+E2)	−2.2 *2*	1.13×10^{-3} *2*	A_2=−0.66 *5*; A_4=+0.37 *9* α(K)=0.000935 *16*; α(L)=0.0001203 *20*; α(M)=2.50×10^{-5} *5* α(N)=5.54×10^{-6} *10*; α(O)=8.99×10^{-7} *15*; α(P)=6.84×10^{-8} *12*; α(IPF)=4.25×10^{-5} *6*
1510.9 *2*	3.1 *1*	1510.90	2$^+$	0.0	0$^+$				A_2=+0.22 *2*; A_4=+0.02 *3*

† From 1987Lo12. Values of Eγ are from combination with data from ^{139}La(p,2nγ) measurement in 1987Lo12.
‡ Deduced by 1987Lo12 based on α(K)exp and $\gamma(\theta)$, unless otherwise noted.
# Additional information 1.
@ Placement of transition in the level scheme is uncertain.

^{136}Ba(α,2nγ) 1987Lo12

Level Scheme

Intensities: Relative I_γ

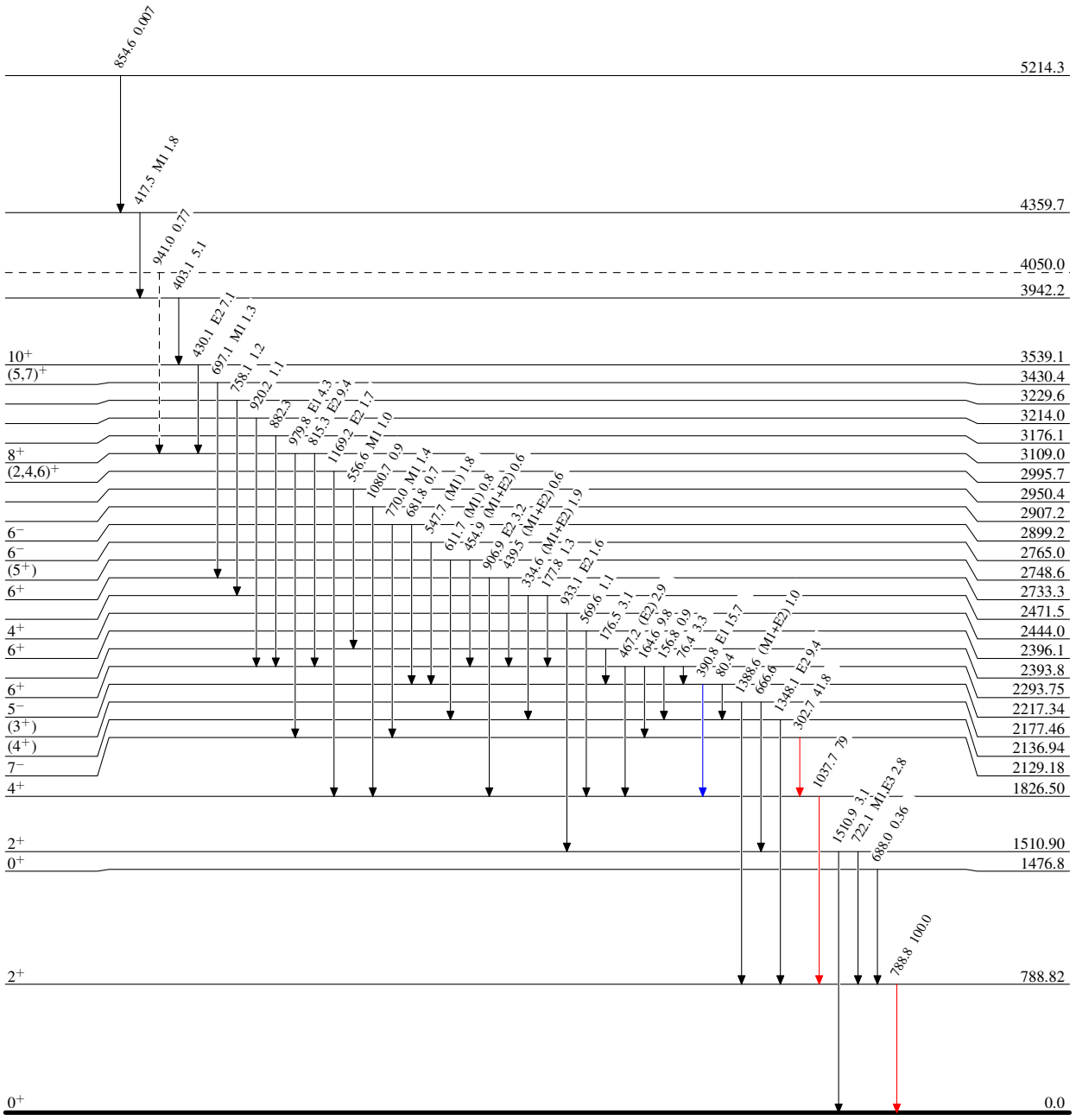
Legend

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

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

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

γ Decay (Uncertain)



$^{138}_{58}Ce_{80}$