^{139}Ba β^- decay (82.93 min) 2012Da17,2012Da04,2001Za08

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	P. K. Joshi, B. Singh, S. Singh, A. K. Jain	NDS 138, 1 (2016)	15-Oct-2016

Parent: ^{139}Ba: E=0.0; $J^\pi=7/2^-$; $T_{1/2}$=82.93 min *9*; Q(β^-)=2314.6 *23*; %β^- decay=100.0

^{139}Ba-J^π,$T_{1/2}$: From ^{139}Ba Adopted Levels.

^{139}Ba-Q(β^-): From 2012Wa38.

2012Da17: measured Eγ, Iγ, $\gamma\gamma$ coin, $T_{1/2}$ of ^{139}Ba.

2012Da04: measured Eγ, Iγ, $T_{1/2}$ of ^{139}Ba.

2001Za08: ^{139}Ba from ^{138}Ba(n,γ), measured Eγ, Iγ, $\gamma\gamma$ using combination of HPGe, Ge(Li), BGO-Compton suppressed Ge detector, and NaI(Tl) detector.

1986Fa08: measured Eγ, Iγ. The authors essentially confirmed results of 1969Be15, with a few additional weak γ rays.

1980Ge04: measured Eγ, Iγ and half-life of ^{139}Ba decay and $\beta\gamma$-coincidences (4π,NaI).

1978La03: measured Eγ, Iγ between 1.2 and 2.0 MeV and investigated ambiguities in Iγ between 1968Hi13 and 1969Be15.

1975Fl07, 1969Su01: measured $\beta\gamma$-coin.

1969Be15, 1968Hi13: measured Eγ, Iγ, $\gamma\gamma$ coin.

1969Su01: measured Eγ, Iγ, γ(t) (NaI) and $\beta\gamma$-coincidences and $\beta\gamma(\theta)$ (scin,NaI).

1524 keV level from 1980Ge04 was established as belonging to ^{42}K in 2012Da17.

^{139}La Levels

Decay scheme is essentially that proposed by 1969Be15 and 1968Hi13. Later studies have provided more precise gamma-ray energies and intensities.

A 1042.9 level proposed by 1988Fa06 is omitted here as it is not confirmed in 2012Da04, 2012Da17 and 2001Za08.

Levels at 1524.8 and 1900.3 proposed by 2001Za08 are omitted here as these are not confirmed in recent decay studies by 2012Da04, 2012Da17 and 1988Fa06.

E(level)†	J^π‡	$T_{1/2}$‡	Comments
0.0	$7/2^+$	stable	
165.859 *7*	$5/2^+$	1.50 ns *3*	$T_{1/2}$: measurements in β^- decay: 1.48 ns *3* (1966Be42, $\beta\gamma$(t), scin), 1.50 ns *10* (1956De57, $\beta\gamma$(t), scin), 1.50 ns *10* (1955Ge38, βce(t), scin).
1219.047 *10*	$9/2^+$	0.57 ps *5*	
1256.797 *11*	$(5/2)^+$		
1381.409 *14*	$(9/2^+)$		
1420.491 *8*	$5/2^+,7/2^+$		
1476.489 *8*	$(9/2^+)$		
1536.388 *8*	$7/2^+$	0.044 ps *7*	
1558.72 *3*	$3/2^+,5/2^+$		
1578.156 *14*	$5/2^+,7/2^+$		
1683.145 *10*	$7/2^+$		
1761.168 *13*			
1766.432 *25*	$(5/2)^+$		
1856.62 *4*	$(3/2^+,5/2^+)$		
1920.43 *4*	$(7/2^+)$		
1962.84 *11*	$(5/2)^+$		
2059.89 *8*			

† From least-squares fit to Eγ data.

‡ From Adopted Levels.

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β^- radiations

E(decay)	E(level)	Iβ^-[†]	Log *ft*	Comments
(254.7 *23*)	2059.89	0.000151 *10*	9.08 *4*	av Eβ=71.30 *71*
(351.8 *23*)	1962.84	0.000068 *8*	9.88 *6*	av Eβ=102.19 *77*
(394.2 *23*)	1920.43	0.000284 *14*	9.43 *2*	av Eβ=116.22 *77*
(458.0 *23*)	1856.62	0.00010 *7*	10.1 *3*	av Eβ=137.92 *80*
(548.2 *23*)	1766.432	0.000587 *18*	9.59 *2*	av Eβ=169.64 *83*
(553.4 *23*)	1761.168	0.00254 *5*	8.97 *1*	av Eβ=171.53 *83*
(631.5 *23*)	1683.145	0.00310 *5*	9.08 *1*	av Eβ=200.00 *85*
(736.4 *23*)	1578.156	0.000639 *13*	10.00 *1*	av Eβ=239.43 *88*
(755.9 *23*)	1558.72	0.000433 *18*	10.21 *2*	av Eβ=246.85 *89*
(778.2 *23*)	1536.388	0.00501 *20*	9.19 *2*	av Eβ=255.44 *89*
(838.1 *23*)	1476.489	0.0166 *5*	8.78 *2*	av Eβ=278.73 *91*
(894.1 *23*)	1420.491	0.291 *4*	7.64 *1*	av Eβ=300.81 *92*
(933.2 *23*)	1381.409	0.00330 *5*	9.65 *1*	av Eβ=316.38 *92*
(1057.8 *23*)	1256.797	0.00135 *3*	10.24 *1*	av Eβ=366.83 *95*
(1095.6 *23*)	1219.047	0.00560 *13*	9.68 *1*	av Eβ=382.33 *95*
(2148.7 *23*)	165.859	29.68 *31*	7.087 *5*	av Eβ=840.9 *11* Iβ^-: from Iγ(165γ)(1+α)-ΣIγ(to 165), where Iγ(165γ)=23.76% *25* (measured by 1980Ge04).
(2314.6 *23*)	0.0	69.98 *31*	6.845 *3*	av Eβ=915.9 *11* Iβ^-: 100−(β feeding to excited states).

[†] Absolute intensity per 100 decays.

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$\gamma(^{139}La)$

Iγ normalization: From Iγ(166)=23.76 *25* per 100 decays of ^{139}Ba, and Iγ(166γ)/Iγ(1420γ)=100.0 *10*/1.100 *13* (1980Ge04) and Iγ(1420)=100.

A 1042.9 with Iγ=0.01 in 1988Fa06 was not confirmed by 2012Da04, 2012Da17 and 2001Za08. Based on γγ-coin and half-life analysis, 2012Da17 assigned this γ to the decay of ^{82}Br. In 2001Za08, Iγ<0.0005, consistent with non-observation.

Following γ rays with Eγ(Iγ) reported by 2001Za08 only are omitted here: 268.27 *7* (2.10 *18*), 1524.65 *18* (0.0770 *5*), 1900.23 *27* (0.0438 *7*). None of these γ rays have been confirmed in 2012Da04 and 2012Da17.

E_γ[†]	I_γ[‡@]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	δ[#]	α[&]	Comments
165.8575 *11*	9090 *91*	165.859	5/2$^+$	0.0	7/2$^+$	M1		0.2516 *7*	α(K)=0.223 *4*; α(L)=0.0300 *5*; α(M)=0.00623 *9*; α(N)=0.001369 *20*; α(O)=0.000223 *4* α(P)=1.735×10^{-5} *25* α: from ^{139}Ce ε decay based on experimental values. Corresponding value from BrIcc code is 0.261 *4*. E_γ: from 1999Al12 in ^{139}Ce ε decay. Others: 165.825 *20* (2012Da04), 165.85 *1* (2012Da17), 165.96 *5* in table 1 but 165.85 in level-scheme figure 5 of 2001Za08, 165.84 (1986Fa08), 165.85 from 1968Hi13 who quote it from thesis by Baer (1967), measurement using curved-crystal spectrometer. I_γ: from Iγ(166γ)/Iγ(1420γ)=100.0 *10*/1.100 *13* (1980Ge04) and Iγ(1420)=100. Others: 9370 *100* (2012Da04), 9473 *370* (2012Da17), 8335 *149* (2001Za08), 7300 (1986Fa08), 9090 *150* (1980Ge04), 7300 *730* (1969Be15), 6230 *900* (1968Hi13). %Iγ=23.76 *5* (1980Ge04). Measured I(K x-ray)/I(165.9γ)=0.2414 *8* (2008Ni02).
1053.162 *32*	0.275 *10*	1219.047	9/2$^+$	165.859	5/2$^+$	E2			E_γ: others: 1053.14 *5* (2012Da17), 1053.83 *8* (2001Za08), 1052.9 (1986Fa08), 1053.1 *3* (1980Ge04). Iγ=0.273 *13* (2012Da04), 0.276 *10* (2012Da17), 0.1968 *6* (2001Za08), 0.12 (1986Fa08), 0.197 *20* (1980Ge04).
1090.938 *10*	3.71 *9*	1256.797	(5/2)$^+$	165.859	5/2$^+$	M1+E2			E_γ: others: 1090.92 *2* (2012Da17), 1090.71 *4* (2001Za08), 1090.9 (1986Fa08), 1090.7 *2* (1980Ge04). Iγ=3.80 *4* (2012Da04), 3.61 *2* (2012Da17), 4.361 *1* (2001Za08), 3.1 (1986Fa08), 4.36 *22* (1980Ge04).
1215.542 *12*	1.20 *1*	1381.409	(9/2$^+$)	165.859	5/2$^+$				E_γ: others: 1215.49 *2* (2012Da17), 1215.31 *8* (2001Za08), 1215.5 (1986Fa08), 1215.3 *2* (1980Ge04). Iγ=1.19 *2* (2012Da04), 1.20 *1* (2012Da17), 1.223 *2* (2001Za08), 1.2 (1986Fa08), 1.22 *6* (1980Ge04).
1219.044 *10*	1.87 *4*	1219.047	9/2$^+$	0.0	7/2$^+$	M1+E2	−4.9 *4*		E_γ: others: 1219.03 *1* (2012Da17), 1218.81 *15* (2001Za08), 1219.1 (1986Fa08), 1218.8 *2* (1980Ge04). Iγ=1.91 *2* (2012Da04), 1.83 *2* (2012Da17), 1.7676 *3* (2001Za08), 1.5 (1986Fa08), 1.77 *9* (1980Ge04).

$^{139}_{57}La_{82}$-3

^{139}Ba β^- decay (82.93 min) 2012Da17,2012Da04,2001Za08 (continued)

$\gamma(^{139}La)$ (continued)

E_γ [†]	I_γ [‡@]	E_i(level)	J_i^π	E_f	J_f^π	Mult. [#]	δ [#]	Comments
1254.631 *10*	11.5 *1*	1420.491	$5/2^+,7/2^+$	165.859	$5/2^+$			E_γ: others: 1254.6 *2* (2012Da17), 1254.36 *12* (2001Za08), 1254.8 (1986Fa08), 1254.36 *12* (1980Ge04). $I\gamma$=11.5 *1* (2012Da04), 11.4 *1* (2012Da17), 11.476 *16* (2001Za08), 10 (1986Fa08), 11.48 *11* (1980Ge04).
1256.772 *22*	1.48 *4*	1256.797	$(5/2)^+$	0.0	$7/2^+$	M1+E2		E_γ: others: 1256.8 *2* (2012Da17), 1256.66 *2* (2001Za08), 1256.7 (1986Fa08), 1256.7 *2* (1980Ge04). $I\gamma$=1.44 *4* (2012Da04), 1.52 *4* (2012Da17), 1.331 *2* (2001Za08), 1.03 (1986Fa08), 1.33 *7* (1980Ge04).
1310.617 *10*	5.70 *16*	1476.489	$(9/2^+)$	165.859	$5/2^+$			E_γ: others: 1310.56 *2* (2012Da17), 1310.37 *2* (2001Za08), 1310.6 (1986Fa08), 1310.37 *10* (1980Ge04). $I\gamma$=5.87 *6* (2012Da04), 5.54 3 (2012Da17), 5.598 *10* (2001Za08), 5.4 (1986Fa08), 5.6 *6* (1980Ge04).
1370.509 *10*	0.97 *7*	1536.388	$7/2^+$	165.859	$5/2^+$	M1+E2	−0.81 *25*	E_γ: others: 1370.6 *1* (2012Da17), 1370.25 *2* (2001Za08), 1370.6 (1986Fa08), 1370.3 *2* (1980Ge04). $I\gamma$=1.04 *1* (2012Da04), 0.90 *5* (2012Da17), 1.049 *3* (2001Za08), 1.1 (1986Fa08), 1.05 *5* (1980Ge04).
1381.560 *93*	0.063 *4*	1381.409	$(9/2^+)$	0.0	$7/2^+$			E_γ: others: 1381.3 *3* (2012Da17), 1380.80 *2* (2001Za08), 1382 (1986Fa08), 1380.8 *3* (1980Ge04). $I\gamma$=0.058 *4* (2012Da04), 0.067 *9* (2012Da17), 0.0940 *3* (2001Za08), 0.03 (1986Fa08), 0.094 *9* (1980Ge04).
1392.944 *75*	0.053 *4*	1558.72	$3/2^+,5/2^+$	165.859	$5/2^+$			E_γ: others: 1392.7 *1* (2012Da17), 1392.117 *6* (2001Za08), 1393 (1986Fa08), 1392.1 *3* (1980Ge04). $I\gamma$=0.050 *4* (2012Da04), 0.055 *7* (2012Da17), 0.0654 *2* (2001Za08), 0.03 (1986Fa08), 0.065 *7* (1980Ge04).
1420.478 *10*	100	1420.491	$5/2^+,7/2^+$	0.0	$7/2^+$	M1+E2		E_γ: others: 1420.44 *1* (2012Da17), 1420.19 *10* (2001Za08), 1420.5 (1986Fa08), 1420.19 *10* (1980Ge04). $I\gamma$=100 *1* in 2012Da04, 100 in 2012Da17 and 2001Za08 %$I\gamma$=0.261 *5* (1980Ge04).
1476.488 *10*	0.656 *13*	1476.489	$(9/2^+)$	0.0	$7/2^+$			E_γ: others: 1476.39 *2* (2012Da17), 1476.09 *9* (2001Za08), 1254.8 (1986Fa08), 1476.1 *3* (1980Ge04). $I\gamma$=0.643 *8* (2012Da04), 0.669 *9* (2012Da17), 0.669 *3* (2001Za08), 10 (1986Fa08), 0.67 *7* (1980Ge04).
1517.73 *18*	0.019 *2*	1683.145	$7/2^+$	165.859	$5/2^+$			E_γ: others: 1517.5 *3* (2012Da17), 1518 (1986Fa08), 1254.36 *12* (1980Ge04). γ not seen by 2001Za08. $I\gamma$=0.018 *2* (2012Da04), 0.020 *9* (2012Da17), 0.02 (1986Fa08), 11.48 *11* (1980Ge04). $I\gamma$<0.0010 (2001Za08).
1536.391 *10*	0.951 *9*	1536.388	$7/2^+$	0.0	$7/2^+$	M1+E2	−0.89 *9*	E_γ: others: 1536.30 *6* (2012Da17), 1536.02 *9* (2001Za08), 1536.3 (1986Fa08), 1536.0 *3* (1980Ge04). $I\gamma$=0.955 *10* (2012Da04), 0.947 *9* (2012Da17), 0.965 *6* (2001Za08), 1.0 (1986Fa08), 0.97 *10* (1980Ge04).
1558.697 *31*	0.113 *5*	1558.72	$3/2^+,5/2^+$	0.0	$7/2^+$			E_γ: others: 1558.53 *7* (2012Da17), 1558.31 *32* (2001Za08), 1558.5 (1986Fa08), 1558.3 *3* (1980Ge04). $I\gamma$=0.108 *4* (2012Da04), 0.119 *6* (2012Da17), 0.1293 *8* (2001Za08), 0.09 (1986Fa08), 0.120 *12* (1980Ge04).

$^{139}_{57}La_{82}$-4

^{139}Ba β^- decay (82.93 min) 2012Da17,2012Da04,2001Za08 (continued)

$\gamma(^{139}La)$ (continued)

E_γ [†]	I_γ [‡@]	E_i(level)	J_i^π	E_f	J_f^π	Mult. [#]	Comments
1578.146 *14*	0.245 *4*	1578.156	5/2$^+$,7/2$^+$	0.0	7/2$^+$	M1+E2	E_γ: others: 1578.05 *6* (2012Da17), 1577.83 *39* (2001Za08), 1578.3 (1986Fa08), 1577.8 *4* (1980Ge04). $I\gamma$=0.249 *4* (2012Da04), 0.240 *7* (2012Da17), 0.259 *2* (2001Za08), 0.2 (1986Fa08), 0.259 *26* (1980Ge04).
1595.299 *10*	0.948 *9*	1761.168		165.859	5/2$^+$		E_γ: others: 1595.33 *2* (2012Da17), 1594.95 *11* (2001Za08), 1595.7 (1986Fa08), 1594.9 *3* (1980Ge04). $I\gamma$=0.876 *9* (2012Da04), 1.02 *4* (2012Da17), 0.867 *7* (2001Za08), 0.93 (1986Fa08), 0.87 *9* (1980Ge04).
1600.577 *26*	0.130 *5*	1766.432	(5/2)$^+$	165.859	5/2$^+$		E_γ: others: 1600.51 *7* (2012Da17), 1600.39 *21* (2001Za08), 1601.4 (1986Fa08), 1600.4 *3* (1980Ge04). $I\gamma$=0.124 *3* (2012Da04), 0.135 *6* (2012Da17), 0.137 *11* (2001Za08), 0.05 (1986Fa08), 0.137 *14* (1980Ge04).
1683.133 *10*	1.17 *1*	1683.145	7/2$^+$	0.0	7/2$^+$	M1+E2	E_γ: others: 1683.04 *6* (2012Da17), 1682.81 *4* (2001Za08), 1683.4 (1986Fa08), 1682.8 *2* (1980Ge04). $I\gamma$=1.16 *1* (2012Da04), 1.18 *1* (2012Da17), 1.183 *12* (2001Za08), 1.2 (1986Fa08), 1.18 *6* (1980Ge04).
1690.750 *36*	0.040 *25*	1856.62	(3/2$^+$,5/2$^+$)	165.859	5/2$^+$		E_γ: others: 1690.6 *3* (2012Da17), 1690.51 *6* (2001Za08), 1691.2 (1986Fa08), 1690.5 *3* (1980Ge04). $I\gamma$=0.102 *4* (2012Da04), 0.040 *25* (2012Da17), 0.0879 *9* (2001Za08), 0.11 (1986Fa08), 0.088 *9* (1980Ge04). I_γ: from 2012Da17. Based on the $\gamma\gamma$-coin data and half-life analysis, 2012Da17 concluded that only a fraction of the 1691γ belongs to the decay of ^{139}Ba, other component was ascribed to the decay of ^{124}Sb.
1754.604 *82*	0.044 *4*	1920.43	(7/2$^+$)	165.859	5/2$^+$		E_γ: others: 1754.6 *1* (2012Da17), 1754.68 *16* (2001Za08), 1755 (1986Fa08), 1754.7 *3* (1980Ge04). $I\gamma$=0.040 *3* (2012Da04), 0.048 *5* (2012Da17), 0.0391 *5* (2001Za08), 0.02 (1986Fa08), 0.039 *4* (1980Ge04).
1761.18 *13*	0.027 *11*	1761.168		0.0	7/2$^+$		E_γ: others: 1761.4 *6* (2012Da17), 1762.72 *8* (2001Za08), 1762 (1986Fa08), 1762.7 *5* (1980Ge04). $I\gamma$=0.016 *2* (2012Da04), 0.038 *7* (2012Da17), 0.0329 *4* (2001Za08), 0.03 (1986Fa08), 0.033 *3* (1980Ge04).
1766.346 *59*	0.095 *4*	1766.432	(5/2)$^+$	0.0	7/2$^+$		E_γ: others: 1766.4 *3* (2012Da17), 1766.00 *7* (2001Za08), 1767.6 (1986Fa08), 1766.0 *2* (1980Ge04). $I\gamma$=0.099 *5* (2012Da04), 0.090 *3* (2012Da17), 0.0898 *12* (2001Za08), 0.1 (1986Fa08), 0.090 *9* (1980Ge04).
1796.97 *11*	0.026 *3*	1962.84	(5/2)$^+$	165.859	5/2$^+$		E_γ: others: 1796.1 *3* (2012Da17), 1796.35 *5* (2001Za08), 1797 (1986Fa08), 1796.4 *3* (1980Ge04). $I\gamma$=0.024 *2* (2012Da04), 0.029 *4* (2012Da17), 0.0408 *7* (2001Za08), 0.02 (1986Fa08), 0.041 *4* (1980Ge04).
1894.28 *13*	0.015 *2*	2059.89		165.859	5/2$^+$		E_γ: others: 1896 (1988Fa06), 1896 *1* (1969Be15), 1894.7 *7* (1968Hi13). $I\gamma$ from 2012Da04. Others: <0.02 (2012Da17), 0.02 (1986Fa08), <0.008 (2001Za08), 0.02 (1969Be15), 0.008 *6* (1968Hi13).
1920.407 *42*	0.065 *3*	1920.43	(7/2$^+$)	0.0	7/2$^+$		E_γ: others: 1920.3 *2* (2012Da17), 1920.21 *13* (2001Za08), 1922 (1986Fa08), 1920.2

$^{139}_{57}La_{82}$-5

^{139}Ba β^- decay (82.93 min) 2012Da17,2012Da04,2001Za08 (continued)

$\gamma(^{139}La)$ (continued)

E_γ †	I_γ ‡@	E_i(level)	E_f	J_f^π	Comments
					3 (1980Ge04).
					Iγ=0.062 *3* (2012Da04), 0.068 *6* (2012Da17), 0.061 *12* (2001Za08), 0.04 (1986Fa08).
2059.72 *10*	0.043 *3*	2059.89	0.0	7/2$^+$	E_γ: others: 2060.1 *3* (2012Da17), 2061.22 *35* (2001Za08), 2061 (1986Fa08), 2060.2 *4* (1980Ge04).
					Iγ=0.043 *3* (2012Da04), 0.045 *5* (2012Da17), 0.0226 *5* (2001Za08), 0.05 (1986Fa08), 0.0226 *23* (1980Ge04).

† From 2012Da04, except for 165.8γ which is from 1999Al12. Values from 2012Da17, 2001Za08, 1986Fa08 and 1980Ge04 are given under comments.
‡ Average of values from 2012Da17 and 2012Da04, unless otherwise indicated.
# From Adopted Gammas.
@ For absolute intensity per 100 decays, multiply by 0.00261 *3*.
& 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.

$^{139}_{57}La_{82}$-6

^{139}Ba β^- decay (82.93 min) 2012Da17,2012Da04,2001Za08

Decay Scheme

Intensities: $I_{(\gamma+ce)}$ per 100 parent decays