

¹³⁵Ba(n,n'γ) 1983Bo32,1983Bo37

Type	Author	History	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh, Alexander A. Rodionov And Yuri L. Khazov		NDS 109, 517 (2008)	22-Jan-2008

1983Bo32, 1983Bo37: E=0.1 to 2.6 MeV (reactor fast neutrons). Measured E_γ, I_γ, γ(θ). Statistical-model analysis.

(n,n): 1985Ko23, E=0.0005-132 eV.

Other: 1978De41.

[Additional information 1.](#)

¹³⁵Ba Levels

The level scheme is based on energy sums.

E(level)	J ^π †	E(level)	J ^π †	E(level)	J ^π †	E(level)	J ^π †
0.0	3/2 ⁺	874.46 5	7/2 ⁺	1298.22 10	(1/2 ⁺ ,3/2 ⁺)	1787.51 21	(5/2 ⁻)
220.965 18	1/2 ⁺	910.35 5	1/2 ⁺	1446.42 7	7/2 ⁻	1871.46 22	(3/2 ⁺ ,5/2)
268.24 3	11/2 ⁻	979.95 6	3/2 ⁺ ,5/2 ⁺	1557.31 6	(5/2,7/2 ⁺)	1941.15 20	(3/2 ⁺ ,5/2 ⁺)
480.548 24	5/2 ⁺	1200.50?‡ 6		1584.37 11	(3/2) ⁻	1971.6 4	(3/2,5/2)
587.83 3	3/2 ⁺	1213.82 8	(3/2)	1609.74 20	(1/2 ⁺ ,3/2 ⁺)	1990.9 3	(3/2,5/2)
714.20 5	(7/2 ⁻)	1225.90 7	(3/2)	1670.80 11	(3/2 ⁻)	2075.47 17	(3/2,5/2 ⁺)
855.03 3	3/2 ⁺	1238.42 7	(5/2)	1718.95 10	(1/2 ⁺ ,3/2 ⁺)		

† From 'Adopted Levels'.

‡ Proposed by 1993Bo01 on the basis of (n,n'γ) and (n,γ) data.

γ(¹³⁵Ba)

E _γ †	I _γ †	E _i (level)	J _i ^π	E _f	J _f ^π	Mult.	δ‡	Comments
107.4 2	2.6 5	587.83	3/2 ⁺	480.548	5/2 ⁺			
^x 146.7 5	0.5 2							
^x 211.8 ^a 9	1.0 6							
^x 215.2 5	1.5 6							
220.94 2	81.5 10	220.965	1/2 ⁺	0.0	3/2 ⁺			
234.03 22	0.8 2	1213.82	(3/2)	979.95	3/2 ⁺ ,5/2 ⁺			
245.44 ^a 6	2.2 1	1225.90	(3/2)	979.95	3/2 ⁺ ,5/2 ⁺			δ(Q/D)=-0.16 from A ₂ =-0.35 27, A ₄ =+0.20 25; assuming a 5/2-3/2 transition.
259.5 4	0.40 14	480.548	5/2 ⁺	220.965	1/2 ⁺			
268.24 3	11.05 16	268.24	11/2 ⁻	0.0	3/2 ⁺			
322.3 2	0.54 10	910.35	1/2 ⁺	587.83	3/2 ⁺			
359.1 7	0.30 16	1213.82	(3/2)	855.03	3/2 ⁺			
366.82 3	14.9 2	587.83	3/2 ⁺	220.965	1/2 ⁺	D(+Q)	0.0 +11-6	A ₂ =-0.12 11, A ₄ =0.00 9.
371.1 5	0.4 2	1225.90	(3/2)	855.03	3/2 ⁺			
374.46 3	10.00 18	855.03	3/2 ⁺	480.548	5/2 ⁺	D(+Q)	-0.07 +16-18	A ₂ =-0.01 12, A ₄ =+0.02 10.
382.8 7	0.31 15	1238.42	(5/2)	855.03	3/2 ⁺			
393.88 15	1.39 14	874.46	7/2 ⁺	480.548	5/2 ⁺			
^x 401.6 5	0.30 12							
^x 409.61 9	1.8 2							
^x 438.2 ^a 6	0.2 1							
445.96 4	53.3 11	714.20	(7/2 ⁻)	268.24	11/2 ⁻			A ₂ =+0.09 10, A ₄ =0.00 9.
^x 457.74 11	0.87 7							
^x 465.5 2	0.73 8							
480.54 3	142.0 20	480.548	5/2 ⁺	0.0	3/2 ⁺	D+Q	+0.35 +12-15	A ₂ =+0.15 10, A ₄ =+0.01 9.

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¹³⁵Ba(n,n'γ) 1983Bo32,1983Bo37 (continued)

γ(¹³⁵Ba) (continued)

E_γ^\dagger	I_γ^\dagger	$E_i(\text{level})$	J_i^π	E_f	J_f^π	Mult.	δ^\ddagger	Comments
^x 534.0 3	0.70 13							
587.89 4	52.4 10	587.83	3/2 ⁺	0.0	3/2 ⁺	D+Q	+0.30 +9-8	A ₂ =+0.04 10, A ₄ =+0.01 9.
626.2 [#] 3	1.5 3	1213.82	(3/2)	587.83	3/2 ⁺			
634.02 5	13.5 3	855.03	3/2 ⁺	220.965	1/2 ⁺	D+Q	+0.28 +31-15	A ₂ =+0.01 18, A ₄ =-0.06 20.
637.99 14	3.1 3	1225.90	(3/2)	587.83	3/2 ⁺			
649.4 ^a 3	0.60 15	1238.42	(5/2)	587.83	3/2 ⁺			
^x 658.1 4	0.6 1							
^x 663.4 5	0.7 3							
^x 668.7 ^a 7	0.4 2							
682.89 5	5.3 2	1557.31	(5/2,7/2 ⁺)	874.46	7/2 ⁺			δ(Q/D)=-0.31 from A ₂ =+0.16 27, A ₄ =-0.25 21; assuming a 7/2 to 7/2 transition.
(689.38)		910.35	1/2 ⁺	220.965	1/2 ⁺			E _γ : from adopted gammas. This γ with expected I _γ =4.5 should have been seen in (n,n'γ).
701.96 14	1.5 2	1557.31	(5/2,7/2 ⁺)	855.03	3/2 ⁺			
710.4 1	2.66 16	1298.22	(1/2 ⁺ ,3/2 ⁺)	587.83	3/2 ⁺			
739.2 3	0.55 12	1718.95	(1/2 ⁺ ,3/2 ⁺)	979.95	3/2 ⁺ ,5/2 ⁺			
745.4 1	2.30 15	1225.90	(3/2)	480.548	5/2 ⁺			
757.98 ^{&a} 9	3.8 ^{&} 8	979.95	3/2 ⁺ ,5/2 ⁺	220.965	1/2 ⁺			E _γ : level-energy difference=758.99.
757.98 ^{&} 9	5.0 ^{&} 9	1238.42	(5/2)	480.548	5/2 ⁺			I _γ : γ assigned (by evaluators) with both 980 and 1239 levels on the basis of 'adopted gammas'. Total I _γ =8.8 4 split according to branching ratios in 'adopted gammas'. It should be noted, however, that E _γ =758.99 is required for placement from 980 level.
^x 770.2 4	0.4 1							
^x 787.2 2	0.64 10							
^x 808.4 ^a 11	0.5 4							
855.10 5	10.5 2	855.03	3/2 ⁺	0.0	3/2 ⁺	D+Q	+0.18 +41-15	A ₂ =+0.41 14, A ₄ =+0.24 12.
864.6 6	1.0 4	1718.95	(1/2 ⁺ ,3/2 ⁺)	855.03	3/2 ⁺			
874.50 5	63.3 10	874.46	7/2 ⁺	0.0	3/2 ⁺			A ₂ =+0.16 11, A ₄ =0.00 9.
^x 880.2 ^a 5	1.2 6							
^x 886.8 ^a 7	0.6 3							
^x 889.4 [#] 1	5.1 3							
910.35 5	11.80 25	910.35	1/2 ⁺	0.0	3/2 ⁺			A ₂ =-0.03 14, A ₄ =+0.07 12.
^x 925.86 6	5.72 14							A ₂ =-0.98 18, A ₄ =-0.17 17.
932.25 5	11.34 15	1200.50?		268.24	11/2 ⁻			A ₂ =+0.12 12, A ₄ =-0.15 10.
956.59 9	1.60 15	1670.80	(3/2 ⁻)	714.20	(7/2 ⁻)			
965.88 7	3.46 16	1446.42	7/2 ⁻	480.548	5/2 ⁺	D(+Q)	+0.07 +21-37	A ₂ =-0.09 21, A ₄ =+0.11 17.
969.44 11	2.93 15	1557.31	(5/2,7/2 ⁺)	587.83	3/2 ⁺			
979.97 6	26.9 5	979.95	3/2 ⁺ ,5/2 ⁺	0.0	3/2 ⁺			δ(Q/D)=-0.58 +77-17 from A ₂ =-0.01 12, A ₄ =+0.08 10; assuming a 3/2-3/2 transition.
993.5 5	0.7 2	1213.82	(3/2)	220.965	1/2 ⁺			
996.6 5	0.9 2	1871.46	(3/2 ⁺ ,5/2)	874.46	7/2 ⁺			

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$^{135}\text{Ba}(n,n'\gamma)$ **1983Bo32,1983Bo37** (continued) $\gamma(^{135}\text{Ba})$ (continued)

E_γ^\dagger	I_γ^\dagger	$E_i(\text{level})$	J_i^π	E_f	J_f^π	Comments
1005.3 4	0.5 1	1225.90	(3/2)	220.965	1/2 ⁺	
1021.9 2	1.0 3	1609.74	(1/2 ⁺ ,3/2 ⁺)	587.83	3/2 ⁺	
^x 1064.9 17	0.50 12					
1066.7 3	4.1 12	1941.15	(3/2 ⁺ ,5/2 ⁺)	874.46	7/2 ⁺	$A_2=+0.25$ 35, $A_4=-0.04$ 30.
1073.3 2	2.2 2	1787.51	(5/2 ⁻)	714.20	(7/2 ⁻)	
1077.1 & 4	1.09 & 20	1298.22	(1/2 ⁺ ,3/2 ⁺)	220.965	1/2 ⁺	I_γ : total $I_\gamma=1.16$ 23. Intensity divided (evaluators) based on (n, γ) results.
1077.1 & 4	≈ 0.07 &	1557.31	(5/2,7/2 ⁺)	480.548	5/2 ⁺	
^x 1130.6 ^a 6	0.3 3					
^x 1159.4 3	0.7 1					
1165.0 2	1.2 1	2075.47	(3/2,5/2 ⁺)	910.35	1/2 ⁺	
1178.1 2	1.46 12	1446.42	7/2 ⁻	268.24	11/2 ⁻	
^x 1187.7 4	0.9 2					
1213.74 9	14.4 4	1213.82	(3/2)	0.0	3/2 ⁺	$\delta(Q/D)=+0.13$ +18-45 from $A_2=-0.07$ 18, $A_4=-0.04$ 15; assuming a 5/2-3/2 transition.
1225.85 11	8.0 3	1225.90	(3/2)	0.0	3/2 ⁺	
1238.3 @ 1	12.7 @ 4	1238.42	(5/2)	0.0	3/2 ⁺	
1238.3 @ 1	12.7 @ 4	1718.95	(1/2 ⁺ ,3/2 ⁺)	480.548	5/2 ⁺	
^x 1250.0 3	1.33 16					
^x 1323.5 3	1.1 2					
^x 1358.9 3	1.07 13					
1363.4 1	6.92 14	1584.37	(3/2) ⁻	220.965	1/2 ⁺	
1390.7 4	1.09 22	1871.46	(3/2 ⁺ ,5/2)	480.548	5/2 ⁺	
1402.8 4	1.22 25	1990.9	(3/2,5/2)	587.83	3/2 ⁺	
^x 1411.9 5	0.87 19					
^x 1415.5 3	1.8 2					
^x 1428.3 7	0.58 17					
^x 1432.8 5	1.3 3					
^x 1443.1 3	1.12 17					
^x 1468.4 7	0.72 16					
^x 1472.1 3	1.26 15					
^x 1485.9 8	0.47 14					
1488.1 4	0.97 16	2075.47	(3/2,5/2 ⁺)	587.83	3/2 ⁺	
1491.1 4	0.90 16	1971.6	(3/2,5/2)	480.548	5/2 ⁺	
^x 1496.7 3	1.4 3					
^x 1498.7 8	0.46 20					
1510.6 4	1.23 24	1990.9	(3/2,5/2)	480.548	5/2 ⁺	
1557.3 13	0.25 13	1557.31	(5/2,7/2 ⁺)	0.0	3/2 ⁺	
^x 1567.5 ^a 11	0.3 2					
^x 1571.9 7	1.0 2					
1595.3 7	0.95 16	2075.47	(3/2,5/2 ⁺)	480.548	5/2 ⁺	
^x 1600.2 3	0.98 14					
^x 1602.9 7	0.98 20					
1609.8 7	0.63 19	1609.74	(1/2 ⁺ ,3/2 ⁺)	0.0	3/2 ⁺	
^x 1632.6 7	0.87 19					
^x 1701.8 11	0.9 3					
1720.2 @ 5	1.8 @ 4	1718.95	(1/2 ⁺ ,3/2 ⁺)	0.0	3/2 ⁺	
1720.2 @ 5	1.8 @ 4	1941.15	(3/2 ⁺ ,5/2 ⁺)	220.965	1/2 ⁺	
^x 1772.6 4	1.0 4					
^x 1786.5 2	2.3 6					
^x 1803.5 9	0.7 3					
^x 1810.4 4	1.09 15					
^x 1822.9 4	1.05 15					
^x 1849.6 6	1.16 16					
^x 1857.3 7	1.0 2					

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$^{135}\text{Ba}(\text{n},\text{n}'\gamma)$ **1983Bo32,1983Bo37** (continued) $\gamma(^{135}\text{Ba})$ (continued)

E_γ^\dagger	I_γ^\dagger	$E_i(\text{level})$	J_i^π	E_f	J_f^π	E_γ^\ddagger	I_γ^\ddagger	$E_i(\text{level})$	J_i^π	E_f	J_f^π
^x 1866.9 9	0.6 2					1941.1 3	1.76 19	1941.15	(3/2 ⁺ ,5/2 ⁺)	0.0	3/2 ⁺
1871.7 3	2.41 22	1871.46	(3/2 ⁺ ,5/2)	0.0	3/2 ⁺	1971.3 7	0.72 11	1971.6	(3/2,5/2)	0.0	3/2 ⁺
^x 1902.4 6	0.68 18					1990.8 6	0.93 8	1990.9	(3/2,5/2)	0.0	3/2 ⁺
^x 1912.2 3	2.3 2					2075.3 4	1.35 17	2075.47	(3/2,5/2 ⁺)	0.0	3/2 ⁺
^x 1916.3 6	1.0 2					^x 2080.4 4	1.13 17				
^x 1937.7 7	0.84 15					^x 2104.0 6	1.06 15				

[†] From **1983Bo37**. I_γ 's are relative at 125° to the neutron beam.

[‡] From $\gamma(\theta)$ (**1983Bo32**).

Composite line.

@ Multiply placed with undivided intensity.

& Multiply placed with intensity suitably divided.

^a Placement of transition in the level scheme is uncertain.

^x γ ray not placed in level scheme.

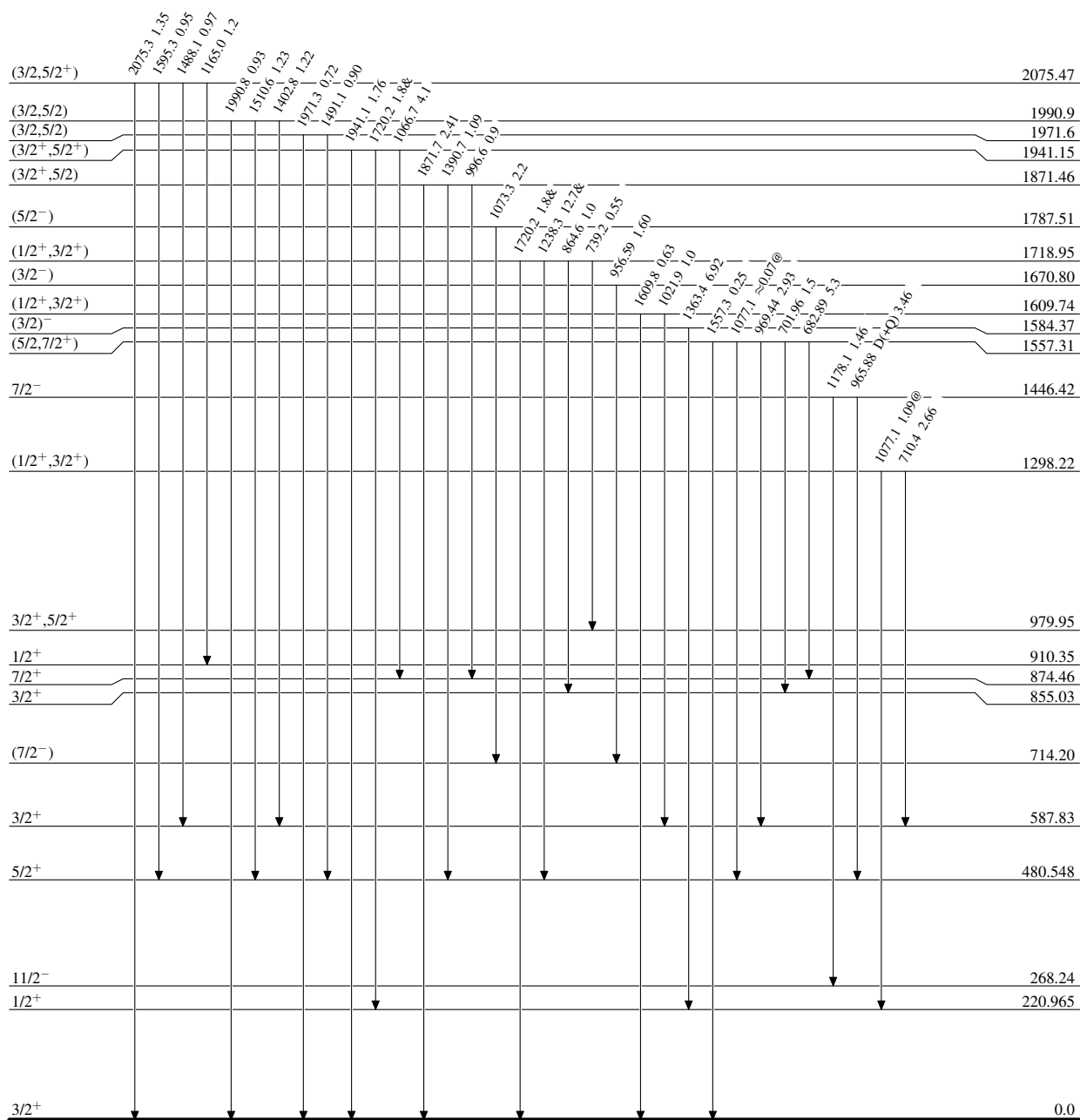
$^{135}\text{Ba}(n,n'\gamma)$ 1983Bo32,1983Bo37

Level Scheme

Intensities: Relative I_γ
 & Multiply placed: undivided intensity given
 @ Multiply placed: intensity suitably divided

Legend

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



$^{135}_{56}\text{Ba}_{79}$

¹³⁵Ba(n,n'γ) 1983Bo32,1983Bo37

Level Scheme (continued)

Intensities: Relative I_γ
& Multiply placed: undivided intensity given
@ Multiply placed: intensity suitably divided

Legend

- I_γ < 2% × I_γ^{max}
- I_γ < 10% × I_γ^{max}
- I_γ > 10% × I_γ^{max}
- - - - - → γ Decay (Uncertain)

