

^{244}Bk ε decay 2014So17

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	C. D. Nesaraja	NDS 146, 387 (2017)	31-Aug-2017

Parent: ^{244}Bk : $E=0$; $J^\pi=(4^-)$; $T_{1/2}=5.02$ h 3; $Q(\varepsilon)=2262$ 14; $\% \varepsilon + \% \beta^+$ decay=99.994 3

^{244}Bk - $Q(\varepsilon)$: From 2017Wa10.

^{244}Bk - $T_{1/2}$: Weighted average of three values from the 187 γ , 217 γ and 891 γ decay curves measured by 2014So17.

^{244}Bk - $\% \varepsilon + \% \beta^+$ decay: From α/EC ratio= 6×10^{-5} in 1956Ch77.

2014So17: ^{244}Bk was produced from $^{238}\text{U}(^{11}\text{B},5\text{n})$ reaction with $E(^{11}\text{B})=63.6$ MeV at BARC-TIFR Pelletron facility. The irradiation was followed by radiochemical separation. The target was natural uranium. Bombarding energy was selected using EMPIRE II code for cross section calculations. Measured $E\gamma$, $I\gamma$, $\gamma\gamma$ -coin using three HPGe detectors. Deduced levels and half-life. A tentative partial level scheme is proposed by 2014So17.

1966Ah02: ^{244}Bk produced via the $^{243}\text{Am}(\alpha,3\text{n})$ reaction at the Berkeley 88 inch cyclotron and was followed by chemical separation. Gamma rays and K-Xrays following electron capture decay were measured with Ge(Li) and Si(Li) detectors via $\alpha\gamma$ coincidences. 26 γ -rays have been identified but information was not sufficient to postulate a decay scheme. $E\gamma$'s, and $I\gamma$'s from their measurements have been listed in the comments. $I\gamma$'s are relative to the 217.6 γ .

1956Ch77: ^{244}Bk produced via the $^{243}\text{Am}(\alpha,3\text{n})$ reaction. The half of 4.45 hr 15 was assigned. Seven gammas were observed in and a tentative and partial decay scheme was built with the 200 keV and 900 keV gammas which were observed in coincidence.

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K X-rays (Cm): Measured by 1966Ah02

E	I(rel. $I\gamma(217.6\gamma)=100$)	
104.5 2	85 10	$K_{\alpha 2}$
109.3 2	130 15	$K_{\alpha 1}$
123.2 3	48 6	$K_{\beta 1'}$
127.1 3	20 4	$K_{\beta 2'}$

 ^{244}Cm Levels

E(level) [‡]	J^π [†]	Comments
0.0	0 ⁺	
42.957 [†] 9	2 ⁺	Additional information 1.
142.340 [†] 10	4 ⁺	Additional information 2.
933.8? 3	(3,4)	J^π : From 217 γ from 1151 level.
963.6? 3	(2,3)	J^π : From 187 γ from 1151 level.
1150.98? 24	(4)	E(level): Expected to have the largest direct feeding ≈ 40 % by ε -decay (2014So17) based on large intensity of the 217.3 γ decay.
1220.16? 10		
1295.59? 25	(3,4)	J^π : From 1153.4 γ to the 4 ⁺ 143 level.
1327.7? 3		
1654.3? 5		
1785.37? 21		

[†] From ^{244}Cm Adopted Levels.

[‡] From least-squares fit of $E\gamma$ data with $E=42.957$ keV and $E=142.340$ held fixed by evaluator.

^{244}Bk ε decay **2014So17** (continued) ε, β^+ radiations

<u>E(decay)</u>	<u>E(level)</u>
(477 [†] 14)	1785.37?
(966 [†] 14)	1295.59?
(1042 [†] 14)	1220.16?
(1111 [†] 14)	1150.98?
(1298 [†] 14)	963.6?
(1328 [†] 14)	933.8?

[†] Existence of this branch is questionable.

 $\gamma(^{244}\text{Cm})$

<u>E_γ[†]</u>	<u>I_γ[#]</u>	<u>$E_i(\text{level})$</u>	<u>J_i^π</u>	<u>E_f</u>	<u>J_f^π</u>	<u>Comments</u>
(≈ 30)		963.6?	(2,3)	933.8?	(3,4)	E_γ : Assumed by 2014So17 based on the coincidence between 187.4 γ and the 891.0 γ .
(42.957 10)		42.957	2 ⁺	0.0	0 ⁺	E_γ : From Adopted Gammas. The gamma could not be detected by 2014So17 due to higher energy thresholds of the timing circuit.
144.6 2		1295.59?	(3,4)	1150.98?	(4)	E_γ : 144.5 keV 3 (1966Ah02). I_γ : γ not seen in summed spectrum due to large contamination from a 140 γ in ^{99}Mo (2014So17). I_γ : 7.4 7 (1966Ah02).
^x 153.5 2	5.4 8					γ in coin with 1177.2 γ . E_γ : 154.0 keV 3 (1966Ah02). I_γ : 3.7 4 (1966Ah02).
^x 175.4 [‡] 176.7 2	4.1 4	1327.7?		1150.98?	(4)	γ in coin with 489.8 γ . E_γ : 177.0 keV 3 (1966Ah02). I_γ : 4.2 5 (1966Ah02).
187.4 3	16.5 5	1150.98?	(4)	963.6?	(2,3)	E_γ : 187.6 keV 3 (1966Ah02). I_γ : 16.5 5 (1966Ah02).
217.3 3	100	1150.98?	(4)	933.8?	(3,4)	E_γ : 217.6 keV 3 (1966Ah02). I_γ : 100 (1966Ah02).
^x 233.7 2	1.8 2					γ in coin with 920.8 γ . E_γ : 233.8 keV 3 (1966Ah02). I_γ : 2.9 4 (1966Ah02).
^x 334.2 5	11.3 4					γ in coin with 219.7, 411.5 and 489.8 γ rays. E_γ : 333.5 keV 5 (1966Ah02). I_γ : 10.0 15 (1966Ah02).
^x 335.5 1						γ in coin with 74.9 γ .
^x 411.5 3	4.0 2					γ in coin with 187.4, 217.3, 334.2, 891.0, 920.8 and 1153.4 γ rays.
^x 433.2 2	3.5 3					γ in coin with 217.3 γ .
^x 470.3 6	3.0 2					γ in coin with 1040.9 γ .
489.8 4	14.0 6	1785.37?		1295.59?	(3,4)	E_γ : 490.5 keV 5 (1966Ah02). I_γ : Corrected for contribution from ^{143}Ce (2014So17). I_γ : 18 2 (1966Ah02).
565.2 2	1.8 3	1785.37?		1220.16?		
^x 569.3 7	1.6 3					γ in coin with 217.3 and 891.0 γ rays.
^x 607.4 7	2.9 3					γ in coin with 217.3, 616.1, 617.7, 985.9 and 1177.2 γ rays.
^x 609.2 2	3.3 3					γ in coin with 1177.2 γ .
^x 616.1 [‡]						γ in coin with 187.4, 217.3, 607.4 and 985.9 γ rays.
^x 617.7 3	4.4 2					γ in coin with 607.4 γ .
^x 625.3 4	1.3 2					γ in coin with 869.5 γ .
^x 642.6 4	1.8 3					γ in coin with 869.5 γ .
690.7 3	0.4 2	1654.3?		963.6?	(2,3)	

Continued on next page (footnotes at end of table)

^{244}Bk ε decay [2014So17](#) (continued) $\gamma(^{244}\text{Cm})$ (continued)

$E_\gamma^\dagger$	$I_\gamma^\#$	$E_i(\text{level})$	J_i^π	E_f	J_f^π	Comments
x745						E_γ : not seen in summed spectrum 2014So17 due to large contamination from a 740γ in ^{99}Mo (2014So17). E_γ : 745 keV I (1966Ah02). I_γ : 8 I (1966Ah02). γ in coin with 217.3 γ .
$^x846.7$ I	1.0 2					γ in coin with 187.4, 217.3, 489.8, 625.7 and 642.6 γ rays.
$^x869.5$ 9	5.6 3					E_γ : 870 keV I (1966Ah02). I_γ : 7 I (1966Ah02). E_γ : 891.5 keV 10 (1966Ah02). I_γ : 114 12 (1966Ah02). E_γ : 910 keV I (1966Ah02). I_γ : 3.0 5 (1966Ah02). E_γ : 921.5 keV 10 (1966Ah02). I_γ : 22 3 (1966Ah02). γ in coin with 607.4 and 616.1 γ rays.
891.0 4	106.1 37	933.8?	(3,4)	42.957	2^+	E_γ : 988 keV I (1966Ah02). I_γ : 5 I (1966Ah02). γ in coin with 217.3 γ .
$^x909.1$ 4	3.0 2					γ in coin with 74.9 and 217.3 γ .
920.8 5	23.8 9	963.6?	(2,3)	42.957	2^+	γ in coin with 217.3 γ .
$^x985.9$ 8	2.5 11					γ in coin with 470.3 γ .
$^x995.6^\ddagger$						E_γ : 1042 keV 2 (1966Ah02). I_γ : 3 $\approx$ (1966Ah02).
$^x999.4$ 5	1.4 2					E_γ : 1136 keV 2 (1966Ah02). I_γ : 1.5 $\approx$ (1966Ah02). E_γ : Only observed by 1966Ah02 . I_γ : Relative to the 217.6 γ in 1966Ah02 .
$^x1014.6^\ddagger$						E_γ : 1153 keV I (1966Ah02). I_γ : 9.5 14 (1966Ah02). E_γ : 1173 keV 2 (1966Ah02). I_γ : 0.7 $\approx$ (1966Ah02). E_γ : 1178 keV I (1966Ah02). I_γ : 5.0 8 (1966Ah02). E_γ : 1205 keV 2 (1966Ah02). I_γ : 1 $\approx$ (1966Ah02). E_γ : 1211 keV 2 (1966Ah02). I_γ : 1.3 $\approx$ (1966Ah02). γ in coin with 489.8 γ . E_γ : 1233 keV I (1966Ah02). I_γ : 4.0 8 (1966Ah02). E_γ : 1252 keV I (1966Ah02). I_γ : 3.0 6 (1966Ah02). E_γ : 1333 keV I (1966Ah02). I_γ : 3 $\approx$ (1966Ah02).
$^x1040.9$ 4	2.1 2					
1107.6 5	2.4 I	1150.98?	(4)	42.957	2^+	
$^x1138.0$ 5	2.0 2					
x1141 2	≈ 2					
1153.4 6	9.9 3	1295.59?	(3,4)	142.340	4^+	
$^x1173.1$ 5	1.0 I					
1177.2 I	3.9 2	1220.16?		42.957	2^+	
$^x1205.3$ 5	1.3 I					
$^x1211.9$ 7	1.3 I					
$^x1232.7$ 7	1.5 4					
1252.5 7	2.7 I	1295.59?	(3,4)	42.957	2^+	
$^x1331.6$ 6	2.1 I					
$^x1502.3$ 7	1.2 I					

† From [2014So17](#) except as noted. 26 gammas could not be placed and are listed with their coincidence gammas.

‡ γ not seen in the summed spectrum ([2014So17](#)).

$^\#$ Relative to the 217.3 γ from [2014So17](#) except as noted.

x γ ray not placed in level scheme.

^{244}Bk ε decay 2014So17

- Legend
- $I_\gamma < 2\% \times I_\gamma^{\text{max}}$
 - $I_\gamma < 10\% \times I_\gamma^{\text{max}}$
 - $I_\gamma > 10\% \times I_\gamma^{\text{max}}$
 - - - - -→ γ Decay (Uncertain)
 - Coincidence

Decay Scheme

Intensities: Relative I_γ
