^{254}Es α decay (275.7 d)

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Y. Akovali	NDS 94,131 (2001)	1-Aug-2001

Parent: ^{254}Es: E=0.0; $J^\pi=(7^+)$; $T_{1/2}$=275.7 d *5*; Q(α)=6615.7 *15*; %α decay=100.0

^{250}Bk Levels

1982KoZZ reported that 35 α and 45 γ transitions were identified via their α, γ and ce singles and coincidence spectra. The low-lying rotational bands, which were previously identified by 1966Mc02, were confirmed. Two new K=6 bands, 6^+,(p 7/2[633]+n 5/2[622]) At 355.3 keV and 6^+,(p 5/2[642]+n 7/2[613]) At 406.3 keV, and two additional states At 316.1 with K=5^+, and At 551.8 with possibly K=8 were proposed.

No level At about 355.3 keV was identified In (n,γ) reaction. However, the 6^+,(p 7/2[633]+n 5/2[622]) state was assigned by 1985HoZM to a level At 552 keV from their (n,γ) data. An α transition to such a state would Be expected. However, since data on feeding and ΔE-exciting these two levels are not available, No recommendation are given here.

An α from $J^\pi=7^+$,K=7,(p 7/2[633],n 7/2[613]) parent to 5^+,(p 7/2[633],n 3/2[622]) state At 316 keV, also proposed from (n,γ) work, should have a large α-hindrance factor. Its intensity is not available At this time, therefore its hindrance factor could not Be calculated to verify the assignment.

A level At 406 keV was observed In (n,γ) reaction by 1985HoZM and $J^\pi=6^+$, K=6 (p 5/2[642],n 7/2[613]) was assigned. α transition to such a state would Be expected. Therefore, the level observed In ^{254}Es α decay At 406.3 keV is probably the 6^+ state proposed At 406 keV from the (n,γ) data, and presumably different than the one observed by 1966Mc02 and 1972Bb24 At 414 *2* keV.

Since these interpretations are preliminary, the α decay work of 1982KoZZ has not been included here.

E(level)[†]	J^π[†]	$T_{1/2}$	Comments
0.0[‡]	2^-	3.212 h *5*	
34.47[‡]	(3^-)		
35.59[#]	(4^+)	29 μs *1*	
78.33[#]	(5^+)		
80.26[‡]	(4^-)		
86[&] *2*	(7^+)	213 μs *8*	Additional information 1.
97.49[@]	(5^-)	38 ns *5*	
130.49[#]	(6^+)		
137.32[‡]	(5^-)		
156[&] *2*	(8^+)		Additional information 2.
167.09[@]	(6^-)		
190[#] *2*	(7^+)		
241[&]	(9^+)		Additional information 3.
247.9[@] *2*	(7^-)		
≈258?			
325 *2*			Additional information 4.
333 *2*			
≈341			
413[a] *3*			
471[a] *2*			
527[a] *20*			

[†] See Adopted Levels.

[‡] Band(A): K=2,(p 3/2[521],n 1/2[620]) band.

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^{254}Es α decay (275.7 d) (continued)

^{250}Bk Levels (continued)

[#] Band(B): K=4,(p 7/2[633],n 1/2[620]) band.
[@] Band(C): K=5,(p 3/2[521],n 7/2[613]) band.
[&] Band(D): K=7,(p 7/2[633],n 7/2[613]) band.
[a] The authors of 1966Mc02 tentatively suggested that the levels populated At 413, 471 and 527 might Be members of a rotational band.

α radiations

Eα[†]	E(level)	Iα[‡@]	HF[#]	Comments
≈6512[&]		≤0.005	≥1.3×10^5	Iα≈0.0046 was measured by 1972Bb24 and Iα≤0.005 by 1966Mc02. If there is any α transition to the ^{250}Bk g.s. with main configuration of K=2,(p 3/2[521],n 1/2[620]) from the ^{254}Es g.s. with main configuration of K=7,(p 7/2[633],n 7/2[613]), the transition should take place via some configuration admixtures In their respective ground states.
6478[&]		≤0.05		this α was not observed by 1966Mc02; Iα≤0.05 was listed by 1972Bb24. As In the case of an α decay to the g.s., the probability of an α transition from 7$^+$,7(p 7/2[633],n 7/2[613]) parent state to J$^\pi$=3$^-$, K=2 (p 3/2[521],n 1/2[620]) state which would involve changes In both proton and neutron states, should Be small. Some configuration admixtures In parent or/and daughter level(S) would explain the transition, if assignment of this 6478α to 275.7-d ^{254}Es decay is correct.
6000 *20*	527	≈0.03	≈65	this α was not listed by 1972Bb24. Eα and Iα were measured by 1966Mc02 In coincidence with Eγ>275 keV.
6048 *5*	471	0.16	23	this α was not listed by 1972Bb24. Eα and Iα are measurements of 1966Mc02. The original Eα is decreased here by 8 keV because of a change In calibration energy.
6105 *2*	413	0.34 *2*	22 *2*	listed intensities: 0.33 (1966Mc02), 0.36 (1972Bb24).
6177	≈341	≈0.02	≈860	this α was not observed by 1966Mc02.
6184 *2*	333	≈0.06	≈320	listed intensities:≈0.05 (1966Mc02),≈0.08 (1972Bb24).
6194 *2*	325	0.04 *2*	≈515	
6258[&]	≈258?			this α was not observed by 1966Mc02. Iα<0.02 was listed by 1972Bb24.
6266 *2*	247.9	0.22 *2*	224 *22*	
≈6275	241	0.14 *2*	380 *60*	listed intensities are 0.16 (1966Mc02),≈0.11 (1972Bb24).
6324 *2*	190	0.04 *1*	2350 *60*	listed intensities are 0.05 (1966Mc02), 0.035 (1972Bb24).
6347 *2*	167.09	0.75 *5*	160 *12*	
6358.4 *15*	156	2.6 *3*	53 *10*	listed intensities are 2.9 (1966Mc02), 2.4 (1972Bb24).
≈6378[&]	137.32	<0.01	>17000	this α was not seen by 1966Mc02. Iα<0.01 was listed by 1972Bb24.
6383 *2*	130.49	<0.1	>1800	listed intensities are 0.13 (1966Mc02), <0.1 (1972Bb24).
6415.4 *15*	97.49	1.8 *1*	144 *10*	
6428.6 *15*	86	93.1 *1*	3.2 *1*	
≈6435	78.33	≈0.03	≈10600	this α was not observed by 1966Mc02.
≈6476	35.59	0.23 *4*	2190 *40*	listed intensities are: 0.27 (1966Mc02),≥0.18 (1972Bb24).

[†] Measurements of 1972Bb24, except where noted; other measurements: 1966Mc02, 1971Bb10, 1972HaWO. Energies measured by 1972Bb24 are decreased here by 0.2 keV, As recommended by 1991Ry01, due to changes In calibration energy. The uncertainties on energies were not worse than 1 *2* 2 keV (1972Bb24). The original energies of 1966Mc02 are decreased by 8 keV because of the calibration energy used.
[‡] α intensity per 100 α decays, measured by 1972Bb24 and 1966Mc02. The α′s given by 1972Bb24 with upper limits on intensities, are assumed that they were not observed by them, if these α were not seen by 1966Mc02.
[#] Calculated by using r_0(^{250}Bk)=1.502 *3*.
[@] Absolute intensity per 100 decays.
[&] Existence of this branch is questionable.

^{254}Es α decay (275.7 d) (continued)

$\gamma(^{250}Bk)$

I(Kα x ray)=0.40%, I(Kβ x ray)=0.13%, I(L x ray)=230% (1966Mc02). For measured relative sub L x-ray intensities, see 1988Po05, 1990Po14.

$\alpha\gamma$: see 1966Mc02.

Berkelium x-rays:

E(x-ray) 1972Di02	I(relative) 1972Di02	
107.165 6	643 8	Kα_2 x ray
112.112 6	1000	Kα_1 x ray
125.478 10	126 4	Kβ_3 x ray
126.582 10	222 10	Kβ_1 x ray

Ag(t):
$T_{1/2}$(97.49 Level)=38 Ns 5 Obtained By 1966Mc02 From (α)(63γ)(t) Data.
$T_{1/2}$(60γ In ^{241}Am α Decay)=63 Ns Was Used As α Standard.
$T_{1/2}$(86.4 Level)=213 μs 8 Obtained By 1966Mc02 From (α)(L x ray)(t) Data.

$\gamma\gamma$(t):
$T_{1/2}$(35.6 Level)=29 μs 1 Obtained By 1966Mc02 From (L x ray)(35.5γ)(t) Data,
And Also From (L x ray)(L x ray)(t) Data. The 29-μs Delay Was Found
To Follow The 213-μs Delay.

E_γ [†]	I_γ [‡b]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	α[c]	$I_{(\gamma+ce)}$ [@b]	Comments
(1.12[&])		35.59	(4$^+$)	34.47	(3$^-$)				I(γ+ce)≈30 from intensity balance At the 34.47-keV level, if there are No other γ transitions feeding the 35.59-keV level.
(8[&])		86	(7$^+$)	78.33	(5$^+$)				
34.4		34.47	(3$^-$)	0.0	2$^-$	(M1,E2)		≈30	
35.5		35.59	(4$^+$)	0.0	2$^-$	(M2)	1.287×10^4	≈70	α(L)=9320; α(M)=2790
42.6		78.33	(5$^+$)	35.59	(4$^+$)	(M1,E2)		100	
(45.79[a])		80.26	(4$^-$)	34.47	(3$^-$)	(M1+E2)			
(52.16[a])		130.49	(6$^+$)	78.33	(5$^+$)				
(57.06[a])		137.32	(5$^-$)	80.26	(4$^-$)				
63 *2*	2.0 *2*	97.49	(5$^-$)	35.59	(4$^+$)	(E1)	0.508		α(L)=0.363; α(M)=0.0908; α(N+..)=0.0323 I$_\gamma$: Iγ=1.6% 4 was measured by 1988Po05. Mult.: from nonobservation of conversion electrons, 1966Mc02 deduced that this γ is an E1 transition. this γ's placement between the 97.49- and 35.59-keV levels is not consistent with configuration assigned for these levels: the transition from the (p 3/2[521],n

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^{254}Es α decay (275.7 d) (continued)

γ(^{250}Bk) (continued)

E_γ[†]	I_γ[‡b]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	α[c]	$I_{(\gamma+ce)}$[@b]	Comments
									7/2[613]) state to the (p 7/2[633],n 1/2[620]) state would require both proton and neutron states to change. Some configuration mixing In either or both of these levels can explain this transition.
69.7 *1*		167.09	(6⁻)	97.49	(5⁻)	(M1+E2)	69 *24*	≈1	I(γ+ce)=0.9 from intensity balance At the 167.09-keV level. Iγ=0.013 *5*, if I(γ+ce)=0.9, α=69 *24*.
70.4 *2*		156	(8⁺)	86	(7⁺)	(M1+E2)		2.5	$I_{(\gamma+ce)}$: deduced from intensity balance At the 155.5-keV level, by assuming that any other γ feeding the level can Be neglected. I(γ+ce)≈3 was measured by 1966Mc02.
(80.26[a])		80.26	(4⁻)	0.0	2⁻	(E2)			
80.8 *1*		247.9	(7⁻)	167.09	(6⁻)	(M1,E2)		0.1	$I_{(\gamma+ce)}$: deduced from intensity balance At the 247.9 level. I(γ+ce)<1 was listed by 1966Mc02.
85.1 *1*		241	(9⁺)	156	(8⁺)	(M1,E2)		0.14 *2*	Iγ=0.16% 7 is listed In 1988Po05. However, the intensity balance At the 241-keV level, by using Iα(6275α)=0.14 *2* feeding the level and α(M1;85.1γ)=13.3, α(E2;85.1γ)=44.6, suggests Iγ<0.01%, I(γ+ce)=0.14 *2*; any possible γ feeding the 241-keV level is assumed negligible. Very weak L-subshell electrons were observed and I(γ+ce)<<1 is listed In 1966Mc02.
(94.91[a])		130.49	(6⁺)	35.59	(4⁺)				
(102.84[a])		137.32	(5⁻)	34.47	(3⁻)				
150 *2*	0.020 *3*	247.9	(7⁻)	97.49	(5⁻)	[E2]	3.47		α(K)= 0.1637; α(L)=2.372; α(M)=0.672; α(N+..)=0.263
233[d] *2*	0.008 *1*	325		97.49	(5⁻)				existence of this γ is questionable.
249 *2*	0.025 *4*	325		78.33	(5⁺)				
[x]264 *2*	0.05 *1*								
[x]278 *2*	0.03 *1*								the 278γ might deexcite the level At 527 to the 247.9-keV level. This placement would Be consistent with the suggestion that the 413-, 471- and 527-keV levels May Be the 6⁺, 7⁺, and 8⁺ members of K=6 band, respectively.

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^{254}Es α decay (275.7 d) (continued)

$\gamma(^{250}Bk)$ (continued)

E_γ [†]	I_γ [‡] [b]	E_i(level)	E_f	J^π_f	Comments
[x]≈285	0.01				Iγ(290γ)=0.3% 1 is listed In 1988Po05. transition is questionable.
304 *2*	0.07 *1*	471	167.09	(6^-)	Iγ(304γ)=0.08% 4 is given In 1988Po05.
316 *2*	0.15 *2*	413	97.49	(5^-)	Iγ(316γ)=0.08% 4 is given In 1988Po05.
[x]342 *2*	0.009 *2*				Iγ(340γ)=0.04% 2 is listed In 1988Po05.
[x]348 *2*	0.007 *1*				
[x]377 *2*	0.015 *2*				Iγ(375γ)=0.05% 3 is listed In 1988Po05.
[x]385 *2*	0.05 *1*				Iγ(390γ)=0.4% 1 is listed In 1988Po05.

[†] Measurements of 1966Mc02, unless noted otherwise. Eγ′s are accurate to ±2 keV (1966Mc02). Other measurement: 1988Po05 (see also 1991Po17).

[‡] Photon intensity per 100 α decays, measured by 1966Mc02, except where noted. Iγ′s measured by 1988Po05 and 1966Mc02 do not agree well. Intensities listed In 1988Po05 are quoted for comparison. The photon intensities are accurate to about 15% (1966Mc02).

[#] Multipolarities were deduced by 1966Mc02 from their ce data (qualitative intensities were listed only).

[@] Transition intensity per 100 α decays, obtained by 1966Mc02 from their ce data, except where noted.

[&] Transition not observed; energy is from level scheme.

[a] Not observed In ^{254}Es α decay; Eγ is from (n,γ).

[b] Absolute intensity per 100 decays.

[c] 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.

[d] Placement of transition in the level scheme is uncertain.

[x] γ ray not placed in level scheme.

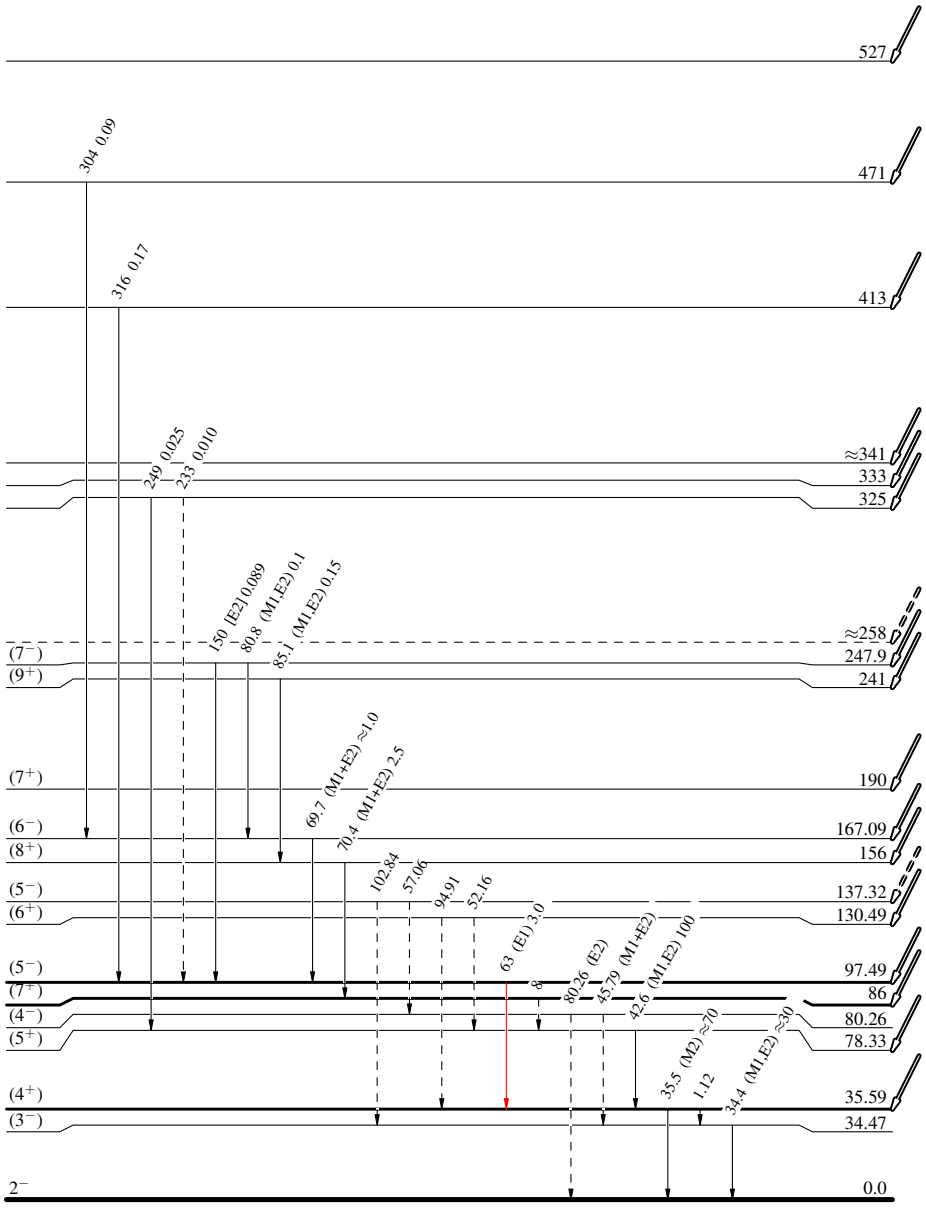
^{254}Es α decay (275.7 d)

Decay Scheme

Intensities: $I_{(\gamma+ce)}$ per 100 decays through this branch

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)

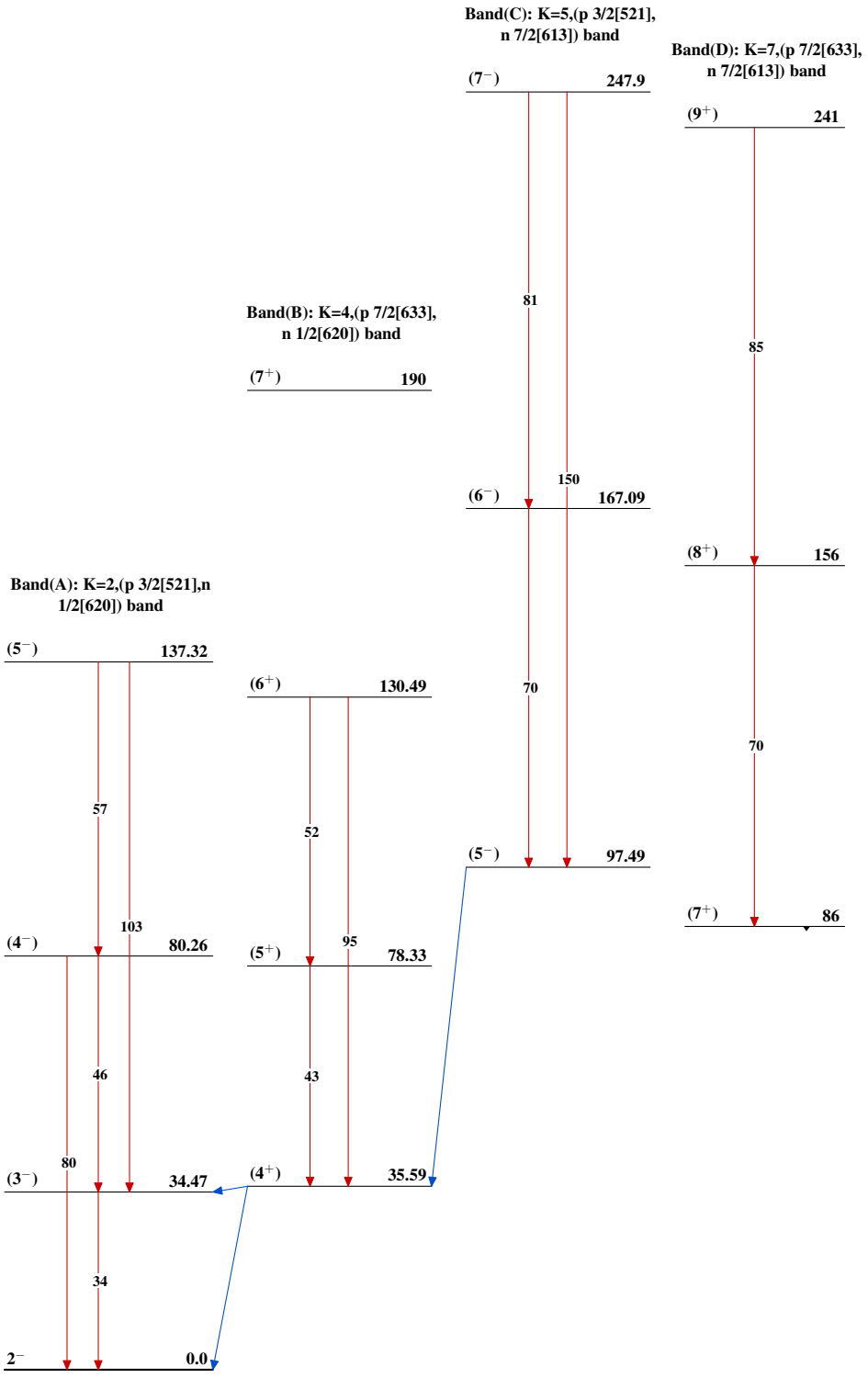
(7^+) 0.0 275.7 d 5
Q_α=6615.7 15 %α=100
$^{254}_{99}Es_{155}$



		Eα	Iα	HF
527		6000	≈0.03	≈65
471		6048	0.16	23
413		6105	0.34	22
≈341		6177	≈0.02	≈860
333		6184	≈0.06	≈320
325		6194	0.04	≈515
≈258		6258		
247.9	(7−)	6266	0.22	224
241	(9+)	≈6275	0.14	380
190	(7+)	6324	0.04	2350
167.09	(6−)	6347	0.75	160
156	(8+)	6358.4	2.6	53
137.32	(5−)	≈6378	<0.01	>17000
130.49	(6+)	6383	<0.1	>1800
97.49	(5−)	6415.4	1.8	144
86	(7+) 38 ns 5	6428.6	93.1	3.2
80.26	(4−) 213 μs 8			
78.33	(5+)	≈6435	≈0.03	≈10600
35.59	(4+) 29 μs 1	≈6476	0.23	2190
34.47	(3−)			
0.0	2− 3.212 h 5			

$^{250}_{97}Bk_{153}$

^{254}Es α decay (275.7 d)



$^{250}_{97}Bk_{153}$