

¹⁴⁶Tb ε decay (24.1 s) 1981StZO,1989StZY,2011Ko08

Type	Author	History	Citation	Literature Cutoff Date
Full Evaluation	Yu. Khazov, A. Rodionov and G. Shulyak		NDS 136, 163 (2016)	14-Jul-2016

Parent: ¹⁴⁶Tb: E=0.0+x; J^π=5⁻; T_{1/2}=24.1 s 5; Q(ε)=8320 40; %ε+%β⁺ decay=100.0

¹⁴⁶Tb-E: X=150 100 from systematics, 2012Au07, Q(g.s.) from 2012Wa38.

1989StZY: ¹⁴⁶Tb ε decay [from Ta(p,X), E(p)=600 MeV]; measured E_γ, I_γ, γγ, γ(X-ray) coin. ¹⁴⁶Gd deduced levels, J^π, branching, configurations. On-line mass-separator ISOLDE, Ge detectors.

1981StZO: ¹⁴⁶Tb ε decay [from ¹⁵¹Eu(α,xn2p), ¹⁵²Gd(α,xnp), E=90-130 MeV]; measured E_γ, I_γ, γγ, γ(X-ray) coin. ¹⁴⁶Gd deduced levels, J^π, configuration. Cyclotron, Ge detectors.

1974Ne01: ¹⁴⁶Tb ε decay [from ¹⁴¹Pr(¹²C,7n), E=118 MeV]; measured T_{1/2}, E_γ, I_γ, γγ coin. ¹⁴⁶Gd deduced levels, J^π. Isochronous cyclotron, Ge(Li) detectors.

2011Ko08: ¹⁴⁶Tb ε decay [from ¹¹²Sn(⁴⁰Ar,3p3n), E=232 MeV]; measured E_γ, I_γ, γγ coin. ¹⁴⁶Gd deduced levels, log ft.

Others: 1974Ne01, 1995GoZV, 1980To06.

Mainly, the level scheme is taken from 1989StZY and 1981StZO. However, the scheme in the fig. 1 (1989StZY) has three misprints: firstly, the 652.2γ, de-exciting the 3313.65 keV level, is replaced by 655.2γ by the evaluators on the basis of inconsistency with fitting result of the level energies to the measured E_γ's, and also based on the 655.8γ in 1981StZO (the same experimental group). Secondly and thirdly, the energy sum 1834.9+1246.0=3080.9 keV of cascade γ's does not equal the crossover 3249.4γ from the 4719.33 keV level. In 1981StZO, the corresponding E_γ's are 1844.1 and 1296.7 keV. The evaluators replaced these E_γ's by 1844.9 and 1296.0 keV in 1989StZY. Also, the cascade of 1844 and 1296 transitions was set in 2011Ko08. Apparently, ¹⁴⁶Gd levels populated not only from the J^π=5⁻ isomer (T_{1/2}=24 s) in the decay of ¹⁴⁶Tb, but from its ground state of J^π=1⁺ (T_{1/2}=8 s) (1981StZO,2011Ko08).

¹⁴⁶Gd Levels

E(level) [†]	J ^π [‡]	T _{1/2}	Comments
0.0	0 ⁺	48.27 d 9	T _{1/2} : from 'Adopted Levels'.
1579.43 [#] 12	3 ⁻		
1971.98 14	2 ⁺		
2611.75 18	4 ⁺		
2658.25 [#] 16	5 ⁻		
2968.3 4	4 ⁺		
2982.45 [#] 19	7 ⁻		
2996.69 [#] 17	4 ⁻		
3031.17 23	3 ⁺		
3099.29 [#] 17	6 ⁻		
3287.6 3	(3 ⁺)		
3313.65 24	5 ⁻		
3384.5 11	6 ⁻		
3412.2 4	(4)		
3423.38 18	3 ⁻		
3435.8 10	4 ⁺		J ^π : adopted by the evaluators on the basis of mult's, anisotropy; J=3 in 1989StZY.
3469.4 4			
3585.3 4			
3908.5 3			
4719.33 [@] 16	4 ⁻		
4828.62 [@] 20	5 ⁻		

[†] From a least-squares fit to E_γ's, normalized χ²=0.9.

[‡] From 1989StZY.

[#] State of πh_{11/2}νd_{5/2}⁻¹ multiplet, populated by GT transition.

[@] State of νh_{9/2}d_{3/2}⁻¹ multiplet, populated by GT transition.

¹⁴⁶Tb ε decay (24.1 s) **1981StZO,1989StZY,2011Ko08 (continued)**

ε,β⁺ radiations

E(decay)	E(level)	Iβ ⁺ ‡	Iε ‡	Log ft	I(ε+β ⁺) †‡	Comments
(3.49×10 ³ 4)	4828.62	0.589	0.811	5.5	1.40	av Eβ=1115 19; εK=0.487 11; εL=0.0718 16; εM+=0.0208 5 Other: log ft=5.30 12 (2011Ko08).
(3.60×10 ³ 4)	4719.33	6.61	7.99	4.5	14.6	av Eβ=1165 19; εK=0.460 10; εL=0.0678 15; εM+=0.0196 5 Other: log ft=4.88 6 (2011Ko08).
(4.41×10 ³ 4)	3908.5	0.783	0.417	6.0	1.20	av Eβ=1538 19; εK=0.292 7; εL=0.0429 10; εM+=0.0124 3
(4.73×10 ³ 4)	3585.3	0.64	0.26	6.3	0.90	av Eβ=1689 19; εK=0.243 6; εL=0.0357 9; εM+=0.01031 24
(4.85×10 ³ 4)	3469.4	0.80	0.30	6.2	1.1	av Eβ=1743 19; εK=0.228 6; εL=0.0334 8; εM+=0.00966 22
(4.88×10 ³ 4)	3435.8	0.44	0.16	6.5	0.60	av Eβ=1758 19; εK=0.224 5; εL=0.0328 8; εM+=0.00948 22
(4.90×10 ³ 4)	3423.38	0.22	0.079	6.8	0.30	av Eβ=1764 19; εK=0.222 5; εL=0.0326 8; εM+=0.00942 22 Other: log ft>5.77 (2011Ko08).
(4.91×10 ³ 4)	3412.2	0.59	0.21	6.4	0.80	av Eβ=1769 19; εK=0.221 5; εL=0.0324 8; εM+=0.00936 22
(4.94×10 ³ 4)	3384.5	0.15	0.052	7.0	0.20	av Eβ=1782 19; εK=0.218 5; εL=0.0319 8; εM+=0.00921 21
(5.01×10 ³ 4)	3313.65	3.3	1.1	5.7	4.4	av Eβ=1815 19; εK=0.209 5; εL=0.0307 7; εM+=0.00886 20 Other: log ft=5.81 9 (2011Ko08).
(5.03×10 ³ 4)	3287.6	0.45	0.15	6.6	0.60	av Eβ=1827 19; εK=0.206 5; εL=0.0302 7; εM+=0.00873 20
(5.22×10 ³ 4)	3099.29	13.6	3.87	5.2	17.5	av Eβ=1916 19; εK=0.186 4; εL=0.0272 6; εM+=0.00787 18 Other: log ft=5.29 5 (2011Ko08).
(5.29×10 ³ 4)	3031.17	0.87	0.23	6.4	1.1	av Eβ=1948 19; εK=0.179 4; εL=0.0263 6; εM+=0.00759 17
(5.32×10 ³ 4)	2996.69	11.9	3.14	5.3	15.0	av Eβ=1964 19; εK=0.176 4; εL=0.0258 6; εM+=0.00745 17 Other: log ft=5.24 5 (2011Ko08).
(5.34×10 ³ 4)	2982.45	0.16	0.042	7.2	0.20	av Eβ=1970 19; εK=0.175 4; εL=0.0256 6; εM+=0.00739 17 Other: log ft>6.12 (2011Ko08).
(5.35×10 ³ 4)	2968.3	0.50	0.13	6.7	0.63	av Eβ=1977 19; εK=0.173 4; εL=0.0254 6; εM+=0.00733 16
(5.66×10 ³ 4)	2658.25	28.5	6.06	5.1	34.6	av Eβ=2123 19; εK=0.147 3; εL=0.0216 5; εM+=0.00623 13 Other: log ft=4.92 10 (2011Ko08).
(5.71×10 ³ 4)	2611.75	1.33	0.274	6.4	1.60	av Eβ=2145 19; εK=0.144 3; εL=0.0210 5; εM+=0.00608 13 Other: log ft=6.09 15 (2011Ko08).
(6.35×10 ³ 4)	1971.98					Other: log ft>7.0 (2011Ko08).
(6.74×10 ³ 4)	1579.43	3.0	0.34	6.5	3.3	av Eβ=2634 19; εK=0.0875 16; εL=0.01276 24; εM+=0.00369 7 Other: log ft>6.1 (2011Ko08).

† Net feeding is based on transition intensity balance calculations at the levels as given by 1989StZY assuming uncertainty equal to 10%. Due to the level scheme is incomplete the log ft values are not very reliable.

‡ Absolute intensity per 100 decays.

γ(¹⁴⁶Gd)

I_γ normalization: from Σ(I(γ+ce) to g.s.)=100.

E _γ †	I _γ &	E _i (level)	J _i ^π	E _f	J _f ^π	I _(γ+ce) #&	Comments
116.80 14		3099.29	6 ⁻	2982.45	7 ⁻	0.9	
324.16 14		2982.45	7 ⁻	2658.25	5 ⁻	1.1	
415.5 3		3412.2	(4)	2996.69	4 ⁻	0.76	
441.05 8		3099.29	6 ⁻	2658.25	5 ⁻	16.6	
655.33 24		3313.65	5 ⁻	2658.25	5 ⁻	3.8	E _γ : see General comments for ¹⁴⁶ Tb ε decay (24.1 s) data set.
675.8 3		3287.6	(3 ⁺)	2611.75	4 ⁺	0.88	
702.0 3		3313.65	5 ⁻	2611.75	4 ⁺	0.56	
726.2 ‡		3384.5	6 ⁻	2658.25	5 ⁻	0.19	
811.1 3		3469.4		2658.25	5 ⁻	1.1	
*987.6 4	10 3						E _γ : from 1974Ne01.

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^{146}Tb ε decay (24.1 s) 1981StZO,1989StZY,2011Ko08 (continued) $\gamma(^{146}\text{Gd})$ (continued)

E_γ †	$E_i(\text{level})$	J_i^π	E_f	J_f^π	Mult.	α @	$I_{(\gamma+ce)}$ #&	Comments
1032.35 15	2611.75	4 ⁺	1579.43	3 ⁻			3.7	
1059.1 3	3031.17	3 ⁺	1971.98	2 ⁺			10	
1078.77 12	2658.25	5 ⁻	1579.43	3 ⁻	E2	0.00235	59	$\alpha(\text{K})_{\text{exp}}=0.00199$ 17 (1995GoZV) $\text{ce}(\text{K})/(\gamma+\text{ce})=0.00199$ 3; $\text{ce}(\text{L})/(\gamma+\text{ce})=0.000283$ 4; $\text{ce}(\text{M})/(\gamma+\text{ce})=6.15\times 10^{-5}$ 9 $\text{ce}(\text{N})/(\gamma+\text{ce})=1.411\times 10^{-5}$ 20; $\text{ce}(\text{O})/(\gamma+\text{ce})=2.17\times 10^{-6}$ 3; $\text{ce}(\text{P})/(\gamma+\text{ce})=1.376\times 10^{-7}$ 20 $\alpha(\text{K})=0.00199$ 3; $\alpha(\text{L})=0.000284$ 4; $\alpha(\text{M})=6.16\times 10^{-5}$ 9 $\alpha(\text{N})=1.414\times 10^{-5}$ 20; $\alpha(\text{O})=2.17\times 10^{-6}$ 3; $\alpha(\text{P})=1.379\times 10^{-7}$ 20
1296.4 4	4719.33	4 ⁻	3423.38	3 ⁻			2.4	E_γ : see General comments for ^{146}Tb ε decay (24.1 s) data set.
1297 ‡	3908.5		2611.75	4 ⁺			0.40	
1388.9 3	2968.3	4 ⁺	1579.43	3 ⁻			0.63	
1417.20 13	2996.69	4 ⁻	1579.43	3 ⁻			16	
1431.7 3	4719.33	4 ⁻	3287.6	(3 ⁺)			0.40	
1451.8 3	3031.17	3 ⁺	1579.43	3 ⁻			0.36	
1463.8 ‡	3435.8	4 ⁺	1971.98	2 ⁺			0.63	
1579.43 12	1579.43	3 ⁻	0.0	0 ⁺	E3	0.00216	98	$\alpha(\text{K})_{\text{exp}}=0.00178$ 13 (1995GoZV) $\text{ce}(\text{K})/(\gamma+\text{ce})=0.001773$ 25; $\text{ce}(\text{L})/(\gamma+\text{ce})=0.000261$ 4; $\text{ce}(\text{M})/(\gamma+\text{ce})=5.69\times 10^{-5}$ 8 $\text{ce}(\text{N})/(\gamma+\text{ce})=1.307\times 10^{-5}$ 19; $\text{ce}(\text{O})/(\gamma+\text{ce})=2.01\times 10^{-6}$ 3; $\text{ce}(\text{P})/(\gamma+\text{ce})=1.275\times 10^{-7}$ 18; $\alpha(\text{IPF})/T_{1/2}=4.63\times 10^{-5}$ 7 $\alpha(\text{K})=0.001777$ 25; $\alpha(\text{L})=0.000262$ 4; $\alpha(\text{M})=5.71\times 10^{-5}$ 8 $\alpha(\text{N})=1.310\times 10^{-5}$ 19; $\alpha(\text{O})=2.01\times 10^{-6}$ 3; $\alpha(\text{P})=1.278\times 10^{-7}$ 18; $\alpha(\text{IPF})=4.64\times 10^{-5}$ 7
1688.0 ‡	4719.33	4 ⁻	3031.17	3 ⁺			0.28	
1831.85 14	4828.62	5 ⁻	2996.69	4 ⁻			0.70	
1844.00 14	3423.38	3 ⁻	1579.43	3 ⁻			2.7	E_γ : see General comments for ^{146}Tb ε decay (24.1 s) data set.
1971.95 14	1971.98	2 ⁺	0.0	0 ⁺			17	
2005.9 3	3585.3		1579.43	3 ⁻			0.86	
2061.00 14	4719.33	4 ⁻	2658.25	5 ⁻			0.98	
2107.9 ‡	4719.33	4 ⁻	2611.75	4 ⁺			0.25	
2170.9 ‡	4828.62	5 ⁻	2658.25	5 ⁻			0.34	
2329.0 3	3908.5		1579.43	3 ⁻			0.75	
3139.87 13	4719.33	4 ⁻	1579.43	3 ⁻			10.3	
3249.4 3	4828.62	5 ⁻	1579.43	3 ⁻			0.40	

† Weighted average from 1989StZY, 1981StZO and 1974Ne01 when available. $\Delta E_\gamma=0.2$ was assumed by evaluators for E_γ 's taken from 1989StZY and 1981StZO, except otherwise noted.

‡ γ lines placed by 1989StZY on the basis of E_γ fit and according to results of 1986Ya06.

From 1989StZY; the evaluators suppose uncertainties of transition intensities equal to 10% for all transitions.

@ Additional information 1.

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^{146}Tb ε decay (24.1 s) [1981SiZO,1989SiZY,2011Ko08](#) (continued)

$\gamma(^{146}\text{Gd})$ (continued)

& Absolute intensity per 100 decays.

^x γ ray not placed in level scheme.

^{146}Tb ϵ decay (24.1 s) 1981StZO,1989StZY,2011Ko08

Decay Scheme

Intensities: I _{γ} per 100 parent decays

