

^{151}Ho ε decay (35.2 s) [1982Ba75,1997AlZY](#)

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh	NDS 110, 1 (2009)	20-Nov-2008

Parent: ^{151}Ho : E=0.0; $J^\pi=(11/2^-)$; $T_{1/2}=35.2$ s *I*; $Q(\varepsilon)=5127$ *I2*; $\% \varepsilon + \% \beta^+$ decay=78 *3*

^{151}Ho - $\% \varepsilon + \% \beta^+$ decay: From adopted $\% \alpha=23$ *3* (see ^{151}Ho 'Adopted Levels').

[1982Ba75](#): source from deep spallation of Ta by 1-GeV protons; mass separated. Measured: x ray, γ , ce, $\gamma(t)$.

[1993Al03](#): $Q(\varepsilon)(^{151}\text{Ho}-^{151}\text{Dy})=5100$ *80* from total γ -absorption method.

[1997AlZY](#): ^{151}Ho source produced by $^{97}\text{Mo}(^{58}\text{Ni},\text{N3P})$ reaction at 5 MeV/nucleon followed by on-line mass separation at GSI facility. Measured $E\gamma$, $I\gamma$, $\gamma\gamma$, γX coin using Ge detectors and ce using miniorange spectrometer. Full details of this study are not available. the authors state that results are preliminary.

[1998Fo06](#): measured $\beta\gamma$ coin using plastic scintillator-Ge detector system. ^{151}Er parent source produced by $^{96}\text{Mo}(^{58}\text{Ni},\text{n2p})$ E=250 MeV followed by mass separation.

Others: [1974Sc19](#), [1979To09](#).

 ^{151}Dy Levels

E(level) [†]	J^π @	Comments
0.0	$7/2^-$	
527.1 & 1	$(9/2^-)$	
775.29 & 10	$(11/2^-)$	E(level): from intensity balance this level has a considerable negative feeding. This suggests that some of the γ rays feeding this level are perhaps placed incorrectly, since the level is known from (HI,xn γ) to decay with a single γ transition.
968.23 & 14	$(13/2^+)$	
984.71 # 22		
986.12 ‡ 21	$(13/2^-)$	
1221.43 ‡ 21	$(9/2)$	
1334.5 # 3		
1348.1 & 10	$(13/2^-)$	
1450.9 ‡		
1510.6 ‡ 5	$(15/2^-)$	
1548.2 ‡ 6	$(11/2, 13/2)$	
1549.65 <i>18</i>	$(9/2, 11/2^-)$	
1856.7 # 3		
1923.8 ‡ 4	$(11/2)$	
1961.3 # 6		
2219.9 ‡ 4	$(9/2 \text{ to } 13/2)$	
2377.2 ‡ 4	$(9/2 \text{ to } 13/2)$	
2407.7 ‡ 4	$(9/2 \text{ to } 13/2)$	
2408.5 ‡ 6	$(9/2 \text{ to } 13/2)$	
2456.7 ‡ 4	$(9/2 \text{ to } 13/2)$	
2487.0 ‡ 6	$(9/2 \text{ to } 13/2)$	
2554.3 # 3		
2573.8 ‡ 3	$(9/2 \text{ to } 13/2)$	
2582.9 <i>5</i>		
2721.9 ‡ 4	$(9/2 \text{ to } 13/2)$	
2850.5 ‡ 4	$(9/2 \text{ to } 13/2)$	
2866.1 # 4		

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^{151}Ho ε decay (35.2 s) [1982Ba75,1997AlZY](#) (continued) ^{151}Dy Levels (continued)

<u>E(level)[†]</u>	<u>J^π@</u>
2938.3 [‡] 5	(9/2 to 13/2)
3048.7 [‡] 6	(9/2 to 13/2)

[†] From least-squares fit to $E\gamma$'s, assuming $\Delta(E\gamma)=0.5$ keV when not stated. The level scheme above 1550 keV is mostly tentative.

[‡] Level from [1997AlZY](#).

Level not reported by [1997AlZY](#).

@ Most assignments are from [1997AlZY](#) based on their assigned multiplicities for selected transitions and probable ε feedings from (11/2⁻).

& Also seen in (HI,xn γ) reaction.

 ε, β^+ radiations

<u>E(decay)</u>	<u>E(level)</u>	<u>Comments</u>
(4600 12)	527.1	av $E\beta=1624.7$ 56; $\varepsilon K=0.2921$ 19; $\varepsilon L=0.0435$ 3; $\varepsilon M+=0.01278$ 9 Measured β (endpoint energy)=3579 12 (1998Fo06 , $\beta\gamma$ coin). This measurement suggests a definite $\varepsilon+\beta^+$ feeding to this level.

 $\gamma(^{151}\text{Dy})$

<u>E_{γ}</u>	<u>I_{γ}</u>	<u>E_i(level)</u>	<u>J_i^π</u>	<u>E_f</u>	<u>J_f^π</u>	<u>Mult. @</u>	<u>a&</u>	<u>Comments</u>
^x 39.9								
^x 147.5								
^x 172.0								
192.9 1	3.9 2	968.23	(13/2 ⁺)	775.29	(11/2 ⁻)	(E1)	0.0535	$\alpha(K)=0.0451$ 7; $\alpha(L)=0.00656$ 10; $\alpha(M)=0.001433$ 21; $\alpha(N+..)=0.000376$ 6 $\alpha(N)=0.000328$ 5; $\alpha(O)=4.61\times 10^{-5}$ 7; $\alpha(P)=2.27\times 10^{-6}$ 4 A 209.6 γ is also placed from a level of this energy in ^{151}Ho ε decay (47.2 s).
209.5 2	9.1 4	984.71		775.29	(11/2 ⁻)			
^x 256.5 2	2.6 3							
^x 334.0 10								
350.8 8	0.7 4	1334.5		984.71				
366.0 3	3.2 4	1334.5		968.23	(13/2 ⁺)			
446.2 [‡]		1221.43	(9/2)	775.29	(11/2 ⁻)			$I\gamma(446.2\gamma)/I\gamma(694.7\gamma)=21/100$.
459.1 [#] 2	3.4 4	986.12	(13/2 ⁻)	527.1	(9/2 ⁻)	(E2)	0.0190	$\alpha(K)=0.01515$ 22; $\alpha(L)=0.00298$ 5; $\alpha(M)=0.000674$ 10; $\alpha(N+..)=0.0001760$ 25 $\alpha(N)=0.0001541$ 22; $\alpha(O)=2.11\times 10^{-5}$ 3; $\alpha(P)=8.41\times 10^{-7}$ 12
^x 500.0 10	$\approx 1^{\dagger}$							
527.0 1	100	527.1	(9/2 ⁻)	0.0	7/2 ⁽⁻⁾	(M1)	0.0260	$\alpha(K)=0.0220$ 3; $\alpha(L)=0.00311$ 5; $\alpha(M)=0.000680$ 10; $\alpha(N+..)=0.000182$ 3 $\alpha(N)=0.0001575$ 22; $\alpha(O)=2.31\times 10^{-5}$ 4; $\alpha(P)=1.343\times 10^{-6}$ 19
559.4 5	1.6 4	1334.5		775.29	(11/2 ⁻)			
562.1 [‡]		1548.2	(11/2,13/2)	986.12	(13/2 ⁻)			
580.5 10	≈ 1	1549.65	(9/2,11/2 ⁻)	968.23	(13/2 ⁺)			

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^{151}Ho ε decay (35.2 s) [1982Ba75,1997AlZY](#) (continued) $\gamma(^{151}\text{Dy})$ (continued)

E_γ	I_γ	$E_i(\text{level})$	J_i^π	E_f	J_f^π	Mult. @	α &	Comments
$^x638.8$ 10	$\approx 2^\dagger$							
$^x667.3$ 10	$1.2^\dagger$ 6							
694.0 [#] 3	5.0 5	1221.43	(9/2)	527.1	(9/2 ⁻)			
735.3 [‡]		1510.6	(15/2 ⁻)	775.29	(11/2 ⁻)	(E2)	0.00593	$\alpha(\text{K})=0.00491$ 7; $\alpha(\text{L})=0.000793$ 12; $\alpha(\text{M})=0.0001760$ 25; $\alpha(\text{N}+..)=4.65\times 10^{-5}$ 7; $\alpha(\text{N})=4.04\times 10^{-5}$ 6; $\alpha(\text{O})=5.73\times 10^{-6}$ 8; $\alpha(\text{P})=2.82\times 10^{-7}$ 4
775.3 1	14.7 7	775.29	(11/2 ⁻)	0.0	7/2 ⁽⁻⁾	(E2)	0.00526	$\alpha(\text{K})=0.00437$ 7; $\alpha(\text{L})=0.000694$ 10; $\alpha(\text{M})=0.0001538$ 22; $\alpha(\text{N}+..)=4.06\times 10^{-5}$ 6; $\alpha(\text{N})=3.54\times 10^{-5}$ 5; $\alpha(\text{O})=5.03\times 10^{-6}$ 7; $\alpha(\text{P})=2.51\times 10^{-7}$ 4
775.3	≈ 1.0	1549.65	(9/2,11/2 ⁻)	775.29	(11/2 ⁻)			I_γ : From $I_\gamma(774.7\gamma)/I_\gamma(1550.3\gamma)=14/100$ (1997AlZY). Placement supported by 1997AlZY .
$^x803.0$ 10	$\approx 0.5^\dagger$							
821.0 10	$\approx 1^\dagger$	1348.1	(13/2 ⁻)	527.1	(9/2 ⁻)	(E2)	0.00463	$\alpha(\text{K})=0.00386$ 6; $\alpha(\text{L})=0.000603$ 9; $\alpha(\text{M})=0.0001334$ 19; $\alpha(\text{N}+..)=3.53\times 10^{-5}$ 5; $\alpha(\text{N})=3.07\times 10^{-5}$ 5; $\alpha(\text{O})=4.38\times 10^{-6}$ 7; $\alpha(\text{P})=2.22\times 10^{-7}$ 4
871.0 10	$\approx 2^\dagger$	1856.7?		984.71				
$^x952.3$ 10	$\approx 0.5^\dagger$							
$^x995.8$ 5	$2.0^\dagger$ 4							
1021.5 5	$2.6^\dagger$ 6	1549.65	(9/2,11/2 ⁻)	527.1	(9/2 ⁻)			
$^x1039.0$ 15	$1.8^\dagger$ 15							
$^x1045.7$ 2	4.2 5							
1081.4 3	2.8 3	1856.7?		775.29	(11/2 ⁻)			
1147.8 [#] 7	$\approx 1^\dagger$	1923.8	(11/2)	775.29	(11/2 ⁻)			
1185.7 10	$\approx 1^\dagger$	1961.3		775.29	(11/2 ⁻)			
$^x1196.3$ 5	$2.1^\dagger$ 5							
1222.1 [‡]		1221.43	(9/2)	0.0	7/2 ⁽⁻⁾			$I_\gamma(1222.1\gamma)/I_\gamma(694.7\gamma)=39/100$.
1234.8 [‡]		2456.7	(9/2 to 13/2)	1221.43	(9/2)			$I_\gamma(1234.8\gamma)/I_\gamma(1681.5\gamma)=88/100$ (1997AlZY).
1352.5 [‡]		2573.8	(9/2 to 13/2)	1221.43	(9/2)			
1434.3 6	1.3 4	1961.3		527.1	(9/2 ⁻)			
1440.3 [‡]		2408.5	(9/2 to 13/2)	968.23	(13/2 ⁺)			
1450.9 ^{‡a}		1450.9?		0.0	7/2 ⁽⁻⁾			
1470.8 [‡]		2456.7	(9/2 to 13/2)	986.12	(13/2 ⁻)			$I_\gamma(1470.8\gamma)/I_\gamma(1681.5\gamma)=88/100$ (1997AlZY).
1500.9 [‡]		2487.0	(9/2 to 13/2)	986.12	(13/2 ⁻)			
1549.7 2	7.3 5	1549.65	(9/2,11/2 ⁻)	0.0	7/2 ⁽⁻⁾			
$^x1571.4$ 6	1.0 4							
1601.8 [‡]		2377.2	(9/2 to 13/2)	775.29	(11/2 ⁻)			$I_\gamma(1601.8\gamma)/I_\gamma(1850.3\gamma)=50/100$ (1997AlZY).
1681.5 [‡]		2456.7	(9/2 to 13/2)	775.29	(11/2 ⁻)			

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^{151}Ho ε decay (35.2 s) [1982Ba75,1997AlZY](#) (continued) $\gamma(^{151}\text{Dy})$ (continued)

E_γ	I_γ	$E_i(\text{level})$	J_i^π	E_f	J_f^π	Comments
1692.4 [‡]		2219.9	(9/2 to 13/2)	527.1	(9/2 ⁻)	
1753.5 [‡]		2721.9	(9/2 to 13/2)	968.23	(13/2 ⁺)	
1779.1 3	3.2 [†] 3	2554.3?		775.29	(11/2 ⁻)	
1798.2 [‡]		2573.8	(9/2 to 13/2)	775.29	(11/2 ⁻)	$I_\gamma(1798.2\gamma)/I_\gamma(1352.2\gamma)=50/100$ (1997AlZY).
1807.7 6	0.6 2	2582.9		775.29	(11/2 ⁻)	
1850.3 [‡]		2377.2	(9/2 to 13/2)	527.1	(9/2 ⁻)	
1880.7 [‡]		2407.7	(9/2 to 13/2)	527.1	(9/2 ⁻)	
1881.4 3	2.8 3	2866.1?		984.71		
1924.2 [‡]		1923.8	(11/2)	0.0	7/2 ⁽⁻⁾	$I_\gamma(1924.2\gamma)/I_\gamma(1147.8\gamma)=26/100$ (1997AlZY).
1929.5 ^{‡a}		2456.7	(9/2 to 13/2)	527.1	(9/2 ⁻)	$I_\gamma(1929.5\gamma)/I_\gamma(1681.5\gamma)=25/100$ (1997AlZY).
1946.7 [‡]		2721.9	(9/2 to 13/2)	775.29	(11/2 ⁻)	$I_\gamma(1946.7\gamma)/I_\gamma(1753.5\gamma)=75/100$ (1997AlZY).
1960.7 ^{‡a}		2487.0	(9/2 to 13/2)	527.1	(9/2 ⁻)	$I_\gamma(1960.7\gamma)/I_\gamma(1500.9\gamma)=13/100$ (1997AlZY).
2026.9 5	1.3 3	2554.3?		527.1	(9/2 ⁻)	
2046.8 [‡]		2573.8	(9/2 to 13/2)	527.1	(9/2 ⁻)	$I_\gamma(2046.8\gamma)/I_\gamma(1352.2\gamma)=100/100$ (1997AlZY).
2055.7 8	1.1 4	2582.9		527.1	(9/2 ⁻)	
2062.6 [‡]		3048.7	(9/2 to 13/2)	986.12	(13/2 ⁻)	
2090.4 11	0.6 [†] 3	2866.1?		775.29	(11/2 ⁻)	
2220.3 [‡]		2219.9	(9/2 to 13/2)	0.0	7/2 ⁽⁻⁾	$I_\gamma(2220.3\gamma)/I_\gamma(1692.4\gamma)=15/100$.
2323.5 [‡]		2850.5	(9/2 to 13/2)	527.1	(9/2 ⁻)	
2407.6 [‡]		2407.7	(9/2 to 13/2)	0.0	7/2 ⁽⁻⁾	$I_\gamma(2407.6\gamma)/I_\gamma(1880.7\gamma)=9/100$ (1997AlZY).
2409.2 ^{‡a}		2408.5	(9/2 to 13/2)	0.0	7/2 ⁽⁻⁾	
2411.2 [‡]		2938.3	(9/2 to 13/2)	527.1	(9/2 ⁻)	
2456.8 ^{‡a}		2456.7	(9/2 to 13/2)	0.0	7/2 ⁽⁻⁾	$I_\gamma(2456.8\gamma)/I_\gamma(1681.5\gamma)=25/100$ (1997AlZY).
2722.4 ^{‡a}		2721.9	(9/2 to 13/2)	0.0	7/2 ⁽⁻⁾	$I_\gamma(2722.4\gamma)/I_\gamma(1753.5\gamma)=50/100$ (1997AlZY).
2850.4 [‡]		2850.5	(9/2 to 13/2)	0.0	7/2 ⁽⁻⁾	$I_\gamma(2850.4\gamma)/I_\gamma(2323.5\gamma)=67/100$ (1997AlZY).

[†] Complex line: only a part of its intensity belongs to ^{151}Ho .

[‡] γ from [1997AlZY](#).

Energy and intensity from [1982Ba75](#), placement from [1997AlZY](#).

@ From ce data of [1997AlZY](#), but no details are available.

& 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.

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

^x γ ray not placed in level scheme.

^{151}Ho ε decay (35.2 s) 1982Ba75,1997AlZY

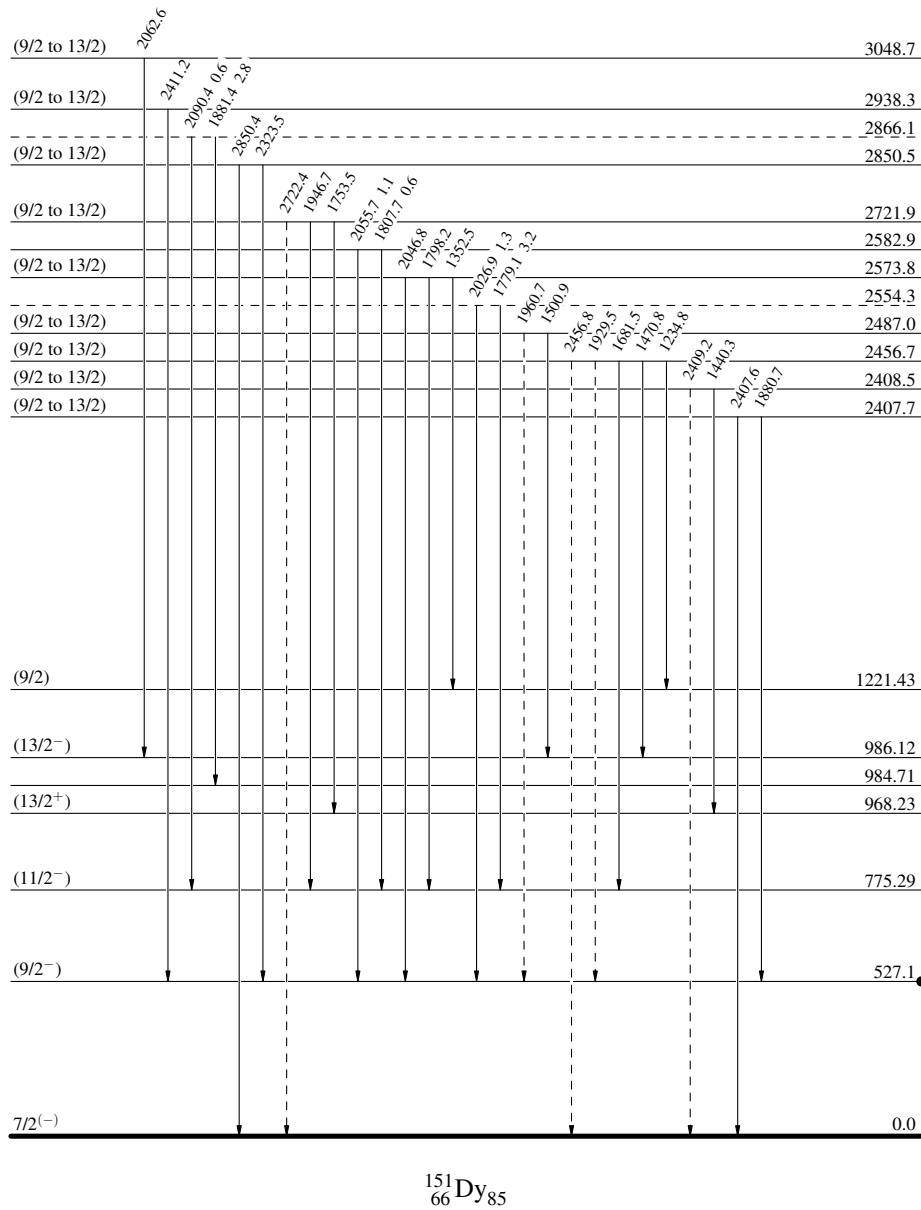
Legend

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

Decay Scheme

Intensities: Relative I_γ

$\% \varepsilon + \% \beta^+ = 78$ $\xrightarrow{(11/2^-) \quad 0.0 \quad 35.2 \text{ s } I}$
 $Q_\varepsilon = 5127.12$
 $^{151}_{67}\text{Ho}_{84}$



^{151}Ho ε decay (35.2 s) $^{1982}\text{Ba}75,1997\text{AlZY}$ **Decay Scheme (continued)**

Legend

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

Intensities: Relative I_γ

$\xrightarrow{(11/2^-) \quad 0.0 \quad 35.2 \text{ s } I}$
 $Q_\varepsilon = 5127.12$
 $^{151}_{67}\text{Ho}_{84}$

