

¹⁴⁸Nd(¹¹B,5nγ), ¹²⁴Sn(³⁶S,p5nγ) 1982Be46,1999Ha04

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	N. Nica	NDS 200,2 (2025)	22-Aug-2022

Experimental methods:

1982Be46: ¹⁴⁸Nd(¹¹B,5nγ) on enriched (90%) target with E(¹¹B)=50-68 MeV. With Ge detectors measured Eγ, Iγ, γγ coincidences, projectile-γ delayed coincidences, γ(θ), and excitation functions.

1999Ha04: ¹²⁴Sn(³⁶S,p5nγ) with E(³⁶S)=160 and 175 MeV. Measured γ's with Gammasphere spectrometer using 67 or 93 Compton-suppressed Ge detectors.

¹⁵⁴Tb Levels

E(level) [†]	Jπ [‡]	Comments
0+x [@]	(9 ⁻)	E(level): Four γ's are reported (1982Be46) to depopulate this level; they would require x>169 keV, or more if any of these γ's are in coincidence. These γ energies (and intensities) are listed among the unplaced γ's, with appropriate comments.
119.1+x ^{&}	(10 ⁻)	
154.3+x [@]	(11 ⁻)	
353.3+x ^{&}	(12 ⁻)	
469.4+x [@]	(13 ⁻)	
714.0+x ^{&}	(14 ⁻)	
918.7+x [@]	(15 ⁻)	
1189.2+x ^{&}	(16 ⁻)	
1473.6+x [@]	(17 ⁻)	
1760.5+x ^{&}	(18 ⁻)	
2118.3+x [@]	(19 ⁻)	
2413.9+x ^{&}	(20 ⁻)	
2841.7+x [@]	(21 ⁻)	
3138 ^{&} +x	(22 ⁻)	
3630+x ^{#@}	(23 ⁻)	
3918+x ^{#&}	(24 ⁻)	
4453+x ^{?#@}	(25 ⁻)	
4742+x ^{#&}	(26 ⁻)	
5597+x ^{?#&}	(28 ⁻)	
0.0+y ^a	(7 ⁺)	
97.2+y ^b	(8 ⁺)	
183.9+y ^a	(9 ⁺)	
338.5+y ^b	(10 ⁺)	
479.1+y ^a	(11 ⁺)	
676.8+y ^b	(12 ⁺)	
870.5+y ^a	(13 ⁺)	
1100.6+y ^b	(14 ⁺)	
1342.5+y ^a	(15 ⁺)	
1599.8+y ^b	(16 ⁺)	
1885.1+y ^a	(17 ⁺)	
2166.6+y ^b	(18 ⁺)	
2490.0+y ^a	(19 ⁺)	
2795+y ^{#b}	(20 ⁺)	
3151+y ^{#a}	(21 ⁺)	

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¹⁴⁸Nd(¹¹B,5nγ), ¹²⁴Sn(³⁶S,p5nγ) **1982Be46,1999Ha04 (continued)**

¹⁵⁴Tb Levels (continued)

E(level) [†]	J ^π [‡]	T _{1/2}	Comments
3478+y ^{#b}	(22 ⁺)		
3858+y ^{#a}	(23 ⁺)		
4203+y ^{#b}	(24 ⁺)		
4597+y ^{#a}	(25 ⁺)		
4951+y ^{#b}	(26 ⁺)		
5368+y ^{#a}	(27 ⁺)		
5731+y ^{#b}	(28 ⁺)		
6203+y ^{#a}	(29 ⁺)		
6565+y ^{#b}	(30 ⁺)		
7097+y ^{#a}	(31 ⁺)		
7450+y ^{#b}	(32 ⁺)		
0+z		513 ns 42	T _{1/2} : Weighted average of 574 ns 50, 580 ns 80, and 457 ns 40 (1982Be46) for γ's of energy (and intensity) 53 (33 3), 60 (5.6 17), and 90 keV, respectively; authors assume these γ's are all from the same level.

[†] The absolute energies of the levels seen in these studies have not been determined. Values, relative to 9⁻ or 7⁺ levels, are computed from γ energies.

[‡] The spin and parity of each bandhead are assumed (**1982Be46** and **1999Ha04**), with the 9⁻ band proposed to be analogous to a 9⁻ band in ¹⁵²Eu and the 7⁺ band to be analogous to one in ¹⁵⁶Tb.

From **1999Ha04** only.

@ Band(A): Signature=1 band, with the configuration (π h_{11/2})(ν i_{13/2}).

& Band(B): Signature=0 band, with the configuration (π h_{11/2})(ν i_{13/2}).

^a Band(C): Signature=1 band, with the configuration (π 3/2[411])(ν i_{13/2}).

^b Band(D): Signature=0 band, with the configuration (π 3/2[411])(ν i_{13/2}).

γ(¹⁵⁴Tb)

E _γ [†]	I _γ [‡]	E _i (level)	J _i ^π	E _f	J _f ^π
^x 48.68 ^{&}	21 4				
^x 70.81 ^{&}	6.0 18				
^x 83.65 ^{&}	7.0 21				
86.65 ^{&}	19 4	183.9+y	(9 ⁺)	97.2+y	(8 ⁺)
^x 90.06 ^{&}	25 5				
97.23 ^{&}	27 5	97.2+y	(8 ⁺)	0.0+y	(7 ⁺)
^x 115.36 ^a	41 4				
116.14 ^{&}	40 4	469.4+x	(13 ⁻)	353.3+x	(12 ⁻)
119.06	100 10	119.1+x	(10 ⁻)	0+x	(9 ⁻)
^x 123.81 ^{&}	20 4				
^x 133.62 ^a	24 5				
^x 134.83 ^a	45 4				
141.03	16 3	479.1+y	(11 ⁺)	338.5+y	(10 ⁺)
154.30 ^d	59 ^d 6	154.3+x	(11 ⁻)	0+x	(9 ⁻)
154.30 ^d	59 ^d 6	338.5+y	(10 ⁺)	183.9+y	(9 ⁺)
^x 169.0 ^a	43 4				
^x 180.71 ^{&}	18 4				
184 [@]		183.9+y	(9 ⁺)	0.0+y	(7 ⁺)

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¹⁴⁸Nd(¹¹B,5nγ), ¹²⁴Sn(³⁶S,p5nγ) **1982Be46,1999Ha04 (continued)**

γ(¹⁵⁴Tb) (continued)

<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>
194.69	14 3	870.5+y	(13 ⁺)	676.8+y	(12 ⁺)	
197 ^d	24 ^d 5	676.8+y	(12 ⁺)	479.1+y	(11 ⁺)	
199.03	108 11	353.3+x	(12 ⁻)	154.3+x	(11 ⁻)	
204.7	26 5	918.7+x	(15 ⁻)	714.0+x	(14 ⁻)	
^x 220.6 ^{&}	11.4 23					
229.4	12.1 24	1100.6+y	(14 ⁺)	870.5+y	(13 ⁺)	
234.3	3.0 9	353.3+x	(12 ⁻)	119.1+x	(10 ⁻)	
241.3	11.3 23	338.5+y	(10 ⁺)	97.2+y	(8 ⁺)	E2
242 [@]		1342.5+y	(15 ⁺)	1100.6+y	(14 ⁺)	
^x ≈243.6 ^{&}	41 ^c 4					
244.6	71 7	714.0+x	(14 ⁻)	469.4+x	(13 ⁻)	
257 [@]		1599.8+y	(16 ⁺)	1342.5+y	(15 ⁺)	
270.5	39 4	1189.2+x	(16 ⁻)	918.7+x	(15 ⁻)	
282 [@]		2166.6+y	(18 ⁺)	1885.1+y	(17 ⁺)	
284.3	13 3	1473.6+x	(17 ⁻)	1189.2+x	(16 ⁻)	
285 [@]		1885.1+y	(17 ⁺)	1599.8+y	(16 ⁺)	
286.9	24 5	1760.5+x	(18 ⁻)	1473.6+x	(17 ⁻)	
295.2 ^d	26 ^d 5	2413.9+x	(20 ⁻)	2118.3+x	(19 ⁻)	
295.2 ^d	26 ^d 5	479.1+y	(11 ⁺)	183.9+y	(9 ⁺)	E2
305 [@]		2795+y	(20 ⁺)	2490.0+y	(19 ⁺)	
315.1	91 9	469.4+x	(13 ⁻)	154.3+x	(11 ⁻)	E2
323 [@]		2490.0+y	(19 ⁺)	2166.6+y	(18 ⁺)	
327 [@]		3478+y	(22 ⁺)	3151+y	(21 ⁺)	
338.3	20 4	676.8+y	(12 ⁺)	338.5+y	(10 ⁺)	E2
356 [@]		3151+y	(21 ⁺)	2795+y	(20 ⁺)	
357.6 ^{&}	3.1 9	2118.3+x	(19 ⁻)	1760.5+x	(18 ⁻)	
360.6	23 5	714.0+x	(14 ⁻)	353.3+x	(12 ⁻)	E2
380 [@]		3858+y	(23 ⁺)	3478+y	(22 ⁺)	
391.4	26 5	870.5+y	(13 ⁺)	479.1+y	(11 ⁺)	E2
423.6	22 4	1100.6+y	(14 ⁺)	676.8+y	(12 ⁺)	
449.3	106 11	918.7+x	(15 ⁻)	469.4+x	(13 ⁻)	E2
≈472.0	61 ^c 6	1342.5+y	(15 ⁺)	870.5+y	(13 ⁺)	E2
475.2	37 4	1189.2+x	(16 ⁻)	714.0+x	(14 ⁻)	E2
499.2	30 6	1599.8+y	(16 ⁺)	1100.6+y	(14 ⁺)	E2
≈542.6	37 ^c 4	1885.1+y	(17 ⁺)	1342.5+y	(15 ⁺)	E2
555.0	97 10	1473.6+x	(17 ⁻)	918.7+x	(15 ⁻)	E2
566.8	11.9 24	2166.6+y	(18 ⁺)	1599.8+y	(16 ⁺)	E2
571.4	32 3	1760.5+x	(18 ⁻)	1189.2+x	(16 ⁻)	E2
604.9	12.1 24	2490.0+y	(19 ⁺)	1885.1+y	(17 ⁺)	E2
628 [@]		2795+y	(20 ⁺)	2166.6+y	(18 ⁺)	
644.8	22 4	2118.3+x	(19 ⁻)	1473.6+x	(17 ⁻)	E2
653.4	11.4 23	2413.9+x	(20 ⁻)	1760.5+x	(18 ⁻)	E2
661 [@]		3151+y	(21 ⁺)	2490.0+y	(19 ⁺)	
683 [@]		3478+y	(22 ⁺)	2795+y	(20 ⁺)	
708 [@]		3858+y	(23 ⁺)	3151+y	(21 ⁺)	
723.4	16 3	2841.7+x	(21 ⁻)	2118.3+x	(19 ⁻)	E2
724 ^b		3138+x	(22 ⁻)	2413.9+x	(20 ⁻)	
725 [@]		4203+y	(24 ⁺)	3478+y	(22 ⁺)	
739 [@]		4597+y	(25 ⁺)	3858+y	(23 ⁺)	

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¹⁴⁸Nd(¹¹B,5nγ), ¹²⁴Sn(³⁶S,p5nγ) **1982Be46,1999Ha04 (continued)**

γ(¹⁵⁴Tb) (continued)

<u>E_γ[†]</u>	<u>E_i(level)</u>	<u>J_i^π</u>	<u>E_f</u>	<u>J_f^π</u>	<u>E_γ[†]</u>	<u>E_i(level)</u>	<u>J_i^π</u>	<u>E_f</u>	<u>J_f^π</u>
748 @	4951+y	(26 ⁺)	4203+y	(24 ⁺)	824 @	4742+x	(26 ⁻)	3918+x	(24 ⁻)
771 @	5368+y	(27 ⁺)	4597+y	(25 ⁺)	834 @	6565+y	(30 ⁺)	5731+y	(28 ⁺)
780 @	3918+x	(24 ⁻)	3138+x	(22 ⁻)	835 @	6203+y	(29 ⁺)	5368+y	(27 ⁺)
780 @	5731+y	(28 ⁺)	4951+y	(26 ⁺)	855 @ ^e	5597+x?	(28 ⁻)	4742+x	(26 ⁻)
788 @	3630+x	(23 ⁻)	2841.7+x	(21 ⁻)	885 @	7450+y	(32 ⁺)	6565+y	(30 ⁺)
823 @ ^e	4453+x?	(25 ⁻)	3630+x	(23 ⁻)	894 @	7097+y	(31 ⁺)	6203+y	(29 ⁺)

[†] Values are from 1982Be46, unless otherwise noted. γ's reported only by 1999Ha04 are noted.

[‡] Values are from 1982Be46. The authors state that the uncertainties are "10% to 30% depending on the line strength and the complexity of the spectrum." The evaluator have interpreted this as 10% for I_γ ≥ 30, 20% for 30 > I_γ ≥ 10, and 30% for I_γ < 10.

Assigned E2 by evaluator based on A₂/A₀ > 0.15 (1982Be46), which is interpreted as ΔJ=2 transition.

@ From 1999Ha04 only.

& From 1982Be46 only.

^a γ placed from the 0+x (9⁻) level by 1982Be46, but no other information is given regarding this γ or the level populated by IT.

^b From 1999Ha04; other: 732 from 1982Be46, but questionable there.

^c Value may include contribution from ¹⁵⁵Tb.

^d Multiply placed with undivided intensity.

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

^x γ ray not placed in level scheme.

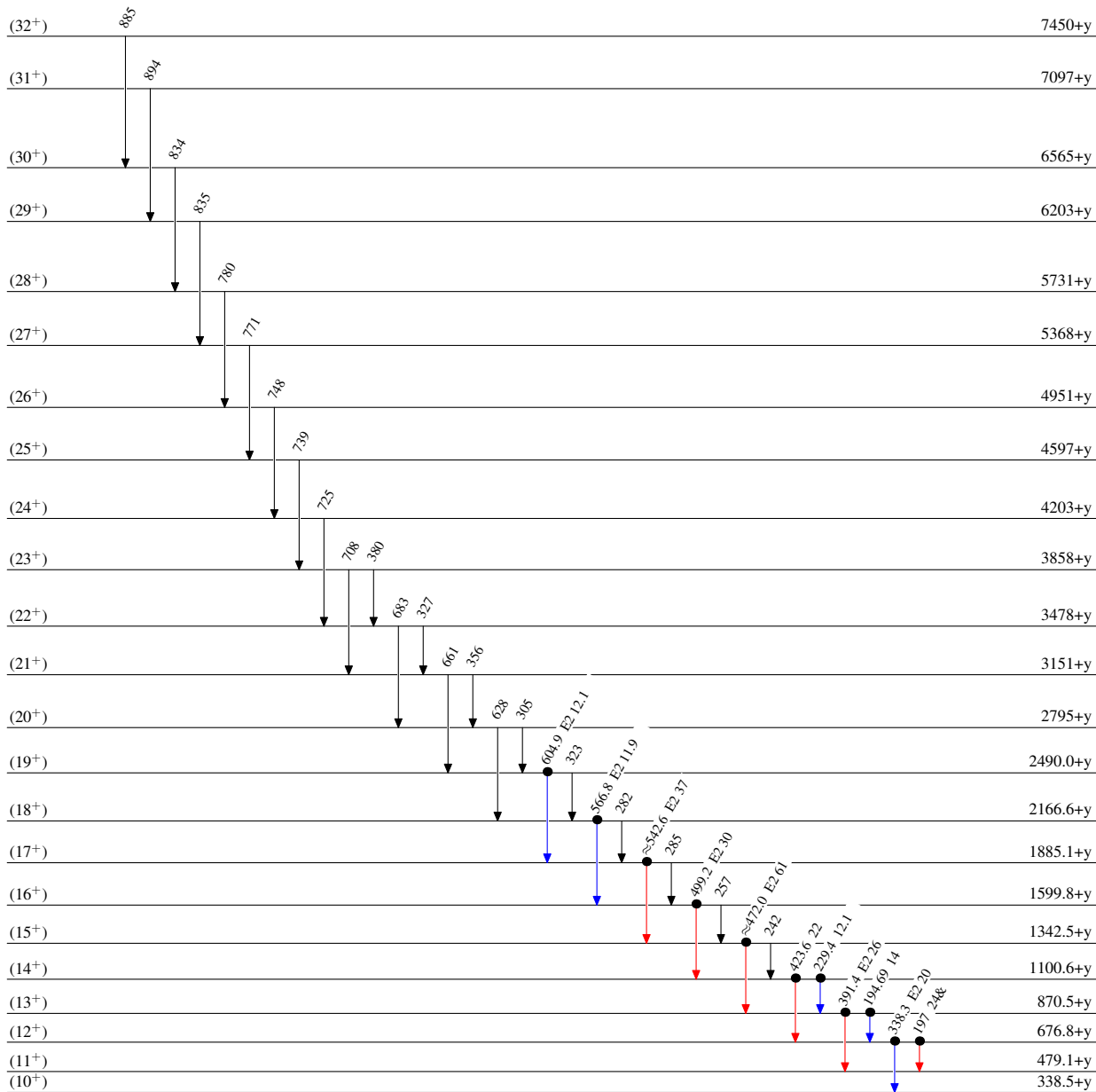
$^{148}\text{Nd}(^{11}\text{B},5n\gamma), ^{124}\text{Sn}(^{36}\text{S},p5n\gamma)$ 1982Be46,1999Ha04

Level Scheme

Intensities: Relative I_γ
& Multiply placed: undivided intensity given

Legend

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



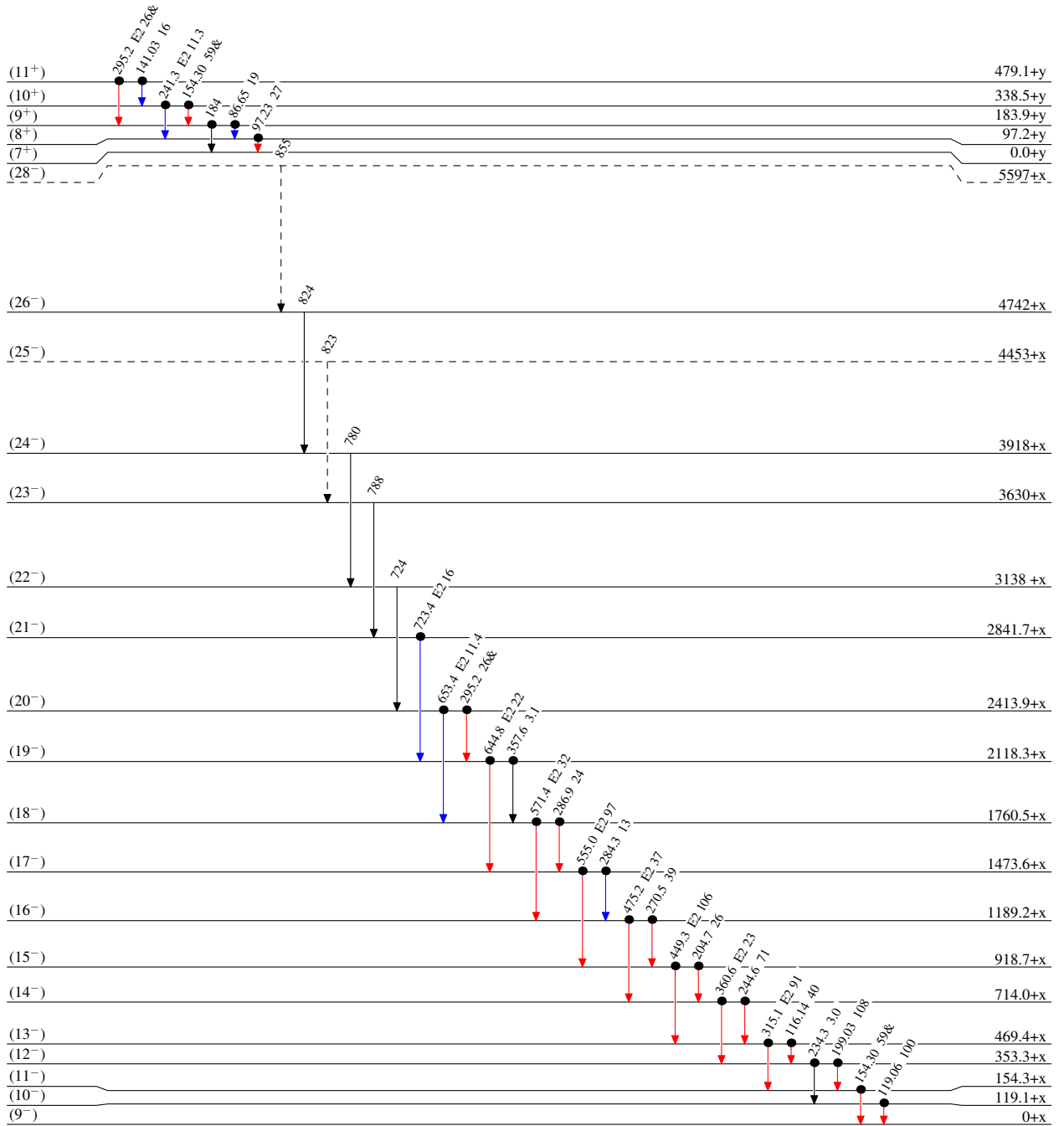
$^{154}\text{Tb}_{89}$

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Legend

Level Scheme (continued)
 Intensities: Relative I_γ
 & Multiply placed: undivided intensity given

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



¹⁵⁴Tb₈₉

$^{148}\text{Nd}(^{11}\text{B},5n\gamma), ^{124}\text{Sn}(^{36}\text{S},p5n\gamma)$ 1982Be46,1999Ha04

