

Adopted Levels, Gammas

Type	Author	History	Citation	Literature Cutoff Date
Full Evaluation	E. Achterberg, O. A. Capurro, G. V. Marti		NDS 110,1473 (2009)	31-May-2008

Q(β^-)= -2.11×10^3 4; S(n)= 7.46×10^3 4; S(p)= 3.24×10^3 4; Q(α)= 3.66×10^3 4 [2012Wa38](#)

Note: Current evaluation has used the following Q record -2110 30 7460 40 3240 40 3660 40 [2003Au03](#).

Q(β^+)= 4760 30 keV ([2003Au03](#)).

¹⁷⁸Re Levels

Level scheme, level energies and band structure from (HI,xn γ) dataset; no level properties can be deduced from the available ¹⁷⁸Os ϵ decay measurements (see dataset).

Cross Reference (XREF) Flags

- A ¹⁶⁵Ho(¹⁸O,5n γ), ¹⁶⁹Tm(¹³C,4n γ)
- B ¹⁷⁸Os ϵ decay

E(level) [†]	J $^\pi$ [‡]	T _{1/2}	XREF	Comments
0.0	(3 ⁺)	13.2 min 2		$\% \epsilon + \% \beta^+ = 100$ This level not seen in (HI,xn) reactions. While an attempt was made in 1986Da13 to justify that this might be the band head for Band 1, this suggestion has not been adopted in later work. T _{1/2} : from 1970Go20 . Other values: 15 min (1957Ha04). Other: 1969Hu03 . J $^\pi$: log ft= 6.4 to 106 (J $^\pi=2^+$) level, log ft= 6.2 to 343 (J $^\pi=4^+$) level.
0.0+x [#]	(5 ⁺)		A	Additional information 1.
146.7+x ^{@ 23}	(6 ⁺)		A	
159.9+x ^{# 10}	(7 ⁺)		A	J $^\pi$: 160 γ E2 to (5 ⁺).
227.3+x ^{@ 23}	(7 ⁺)		A	
339.4+x ^{@ 22}	(8 ⁺)		A	
423.1+x ^{# 15}	(9 ⁺)		A	J $^\pi$: 263 γ E2 to (7 ⁺).
474.8+x ^{@ 22}	(9 ⁺)		A	
638.8+x ^{@ 21}	(10 ⁺)		A	
784.6+x ^{# 18}	(11 ⁺)		A	J $^\pi$: 361 γ E2 to (9 ⁺).
818.1+x ^{@ 21}	(11 ⁺)		A	
1023.1+x ^{@ 21}	(12 ⁺)		A	
1233.8+x ^{# 20}	(13 ⁺)		A	J $^\pi$: 449 γ E2 to (11 ⁺).
1248.5+x ^{@ 20}	(13 ⁺)		A	
1487.1+x ^{@ 20}	(14 ⁺)		A	
1740.1+x ^{@ 20}	(15 ⁺)		A	
1767.1+x ^{# 20}	(15 ⁺)		A	
2013.3+x ^{@ 23}	(16 ⁺)		A	
2297.1+x ^{@ 23}	(17 ⁺)		A	
2358.9+x ^{# 23}	(17 ⁺)		A	
2595.8+x ^{@ 25}	(18 ⁺)		A	
2912.4+x ^{@ 25}	(19 ⁺)		A	
3005.4+x ^{# 25}	(19 ⁺)		A	
3234+x ^{@ 3}	(20 ⁺)		A	

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Adopted Levels, Gammas (continued) ^{178}Re Levels (continued)

E(level) [†]	J ^π [‡]	XREF	Comments
3585+x @ 3	(21 ⁺)	A	
3701+x # 3	(21 ⁺)	A	
3931+x @ 3	(22 ⁺)	A	
4309+x @ 3	(23 ⁺)	A	
4451+x # 3	(23 ⁺)	A	
4683+x @ 3	(24 ⁺)	A	
5076+x @ 3	(25 ⁺)	A	
0.0+y ^a	(5 ⁻)	A	Additional information 2.
54.3+y ^a 8	(6 ⁻)	A	J ^π : 54γ M1 to (5 ⁻).
94.4+y 18	(7 ⁺)	A	
120.4+y ^a 8	(7 ⁻)	A	J ^π : 66γ M1 to (6 ⁻).
133.2+y & 14	(8 ⁻)	A	J ^π : 39γ E1 to (7 ⁺).
220.4+y ^a 10	(8 ⁻)	A	J ^π : 100γ M1 to (7 ⁻).
256.9+y & 13	(9 ⁻)	A	J ^π : 124γ M1 to (8 ⁻).
321.5+y ^a 11	(9 ⁻)	A	J ^π : 101γ M1 to (8 ⁻).
422.8+y & 13	(10 ⁻)	A	J ^π : 166γ M1 to (9 ⁻).
483.7+y ^a 11	(10 ⁻)	A	J ^π : 162γ M1 to (9 ⁻).
618.7+y ^a 12	(11 ⁻)	A	J ^π : 196γ M1 to (10 ⁻).
624.5+y & 12	(11 ⁻)	A	J ^π : 201γ M1 to (10 ⁻).
847.6+y ^a 12	(12 ⁻)	A	J ^π : 223γ M1 to (11 ⁻).
854.1+y & 12	(12 ⁻)	A	
1017.7+y ^a 13	(13 ⁻)	A	J ^π : 399γ E2 to (11 ⁻).
1107.5+y & 13	(13 ⁻)	A	
1311.6+y ^a 13	(14 ⁻)	A	
1385.2+y & 14	(14 ⁻)	A	
1511.4+y ^a 14	(15 ⁻)	A	J ^π : 494γ E2 to (13 ⁻).
1682.2+y & 15	(15 ⁻)	A	
1861.6+y ^a 15	(16 ⁻)	A	
1999.3+y & 15	(16 ⁻)	A	
2092.7+y ^a 15	(17 ⁻)	A	
2327.8+y & 16	(17 ⁻)	A	
2488.1+y ^a 16	(18 ⁻)	A	
2674.9+y & 17	(18 ⁻)	A	
2751.4+y ^a 17	(19 ⁻)	A	
3023.6+y & 17	(19 ⁻)	A	
3179.6+y ^a 18	(20 ⁻)	A	
3388.3+y & 18	(20 ⁻)	A	
3477.9+y ^a 20	(21 ⁻)	A	
3744.9+y & 20	(21 ⁻)	A	
3924.6+y ^a 20	(22 ⁻)	A	
4108.9+y & 21	(22 ⁻)	A	
4263.8+y ^a 23	(23 ⁻)	A	
4710.7+y ^a 23	(24 ⁻)	A	
5104.3+y ^a 25	(25 ⁻)	A	
5998.7+y ^a	(27 ⁻)	A	

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Adopted Levels, Gammas (continued)

^{178}Re Levels (continued)

- † Level energies are from a least-squares adjustment to the adopted γ -ray energies.
- ‡ Levels have been interpreted in terms of decoupled rotational bands built on single particle excitations. Spin and parity assignments are based on this interpretation, and on γ -ray multiplicities, $\gamma\gamma(\theta)$, and decay patterns (1989Kr06,1989Sa02,1986Da13).
- # Band(A): $K^\pi=5^+$ rotational band. Configuration= π h9/2 \otimes v 1/2 $^-$ [521], doubly decoupled band (1989Kr06).
- @ Band(B): $K^\pi=6^+$ rotational band. Configuration= π 5/2 $^+$ [402] \otimes v i13/2.
- & Band(C): $K^\pi=8^-$ rotational band. Configuration= π 9/2 $^-$ [514] \otimes v i13/2.
- ^a Band(D): $K^\pi=5^-$ rotational band. Configuration= π h9/2 \otimes v i13/2, semidecoupled band (1989Kr06).

$\gamma(^{178}\text{Re})$							
$E_i(\text{level})$	J_i^π	E_γ^\dagger	$I_\gamma^\#$	E_f	J_f^π	Mult. @	$\alpha^\&$
159.9+x	(7 ⁺)	159.9		0.0+x	(5 ⁺)	E2	0.695
227.3+x	(7 ⁺)	80.7		146.7+x	(6 ⁺)		
339.4+x	(8 ⁺)	112.2		227.3+x	(7 ⁺)		
		192.6		146.7+x	(6 ⁺)		
423.1+x	(9 ⁺)	263.2		159.9+x	(7 ⁺)	E2	0.1313
474.8+x	(9 ⁺)	135.5		339.4+x	(8 ⁺)		
		247.5		227.3+x	(7 ⁺)		
638.8+x	(10 ⁺)	163.8		474.8+x	(9 ⁺)		
		299.4		339.4+x	(8 ⁺)		
784.6+x	(11 ⁺)	361.5		423.1+x	(9 ⁺)	E2	0.0514
818.1+x	(11 ⁺)	179.3		638.8+x	(10 ⁺)		
		343.4		474.8+x	(9 ⁺)		
1023.1+x	(12 ⁺)	204.9		818.1+x	(11 ⁺)		
		384.3		638.8+x	(10 ⁺)		
1233.8+x	(13 ⁺)	449.1		784.6+x	(11 ⁺)	E2	0.0287
1248.5+x	(13 ⁺)	225.1		1023.1+x	(12 ⁺)		
		430.7		818.1+x	(11 ⁺)		
		464		784.6+x	(11 ⁺)		
1487.1+x	(14 ⁺)	238.7		1248.5+x	(13 ⁺)		
		464.0		1023.1+x	(12 ⁺)		
1740.1+x	(15 ⁺)	253.2		1487.1+x	(14 ⁺)		
		491.5		1248.5+x	(13 ⁺)		
		506.1		1233.8+x	(13 ⁺)		
1767.1+x	(15 ⁺)	518.4		1248.5+x	(13 ⁺)		
		533.5		1233.8+x	(13 ⁺)		
2013.3+x	(16 ⁺)	273.0 ^a		1740.1+x	(15 ⁺)		
		526.2		1487.1+x	(14 ⁺)		
2297.1+x	(17 ⁺)	283.8 ^a		2013.3+x	(16 ⁺)		
		557.0		1740.1+x	(15 ⁺)		
2358.9+x	(17 ⁺)	591.8		1767.1+x	(15 ⁺)		
2595.8+x	(18 ⁺)	582.5		2013.3+x	(16 ⁺)		
2912.4+x	(19 ⁺)	615.3		2297.1+x	(17 ⁺)		
3005.4+x	(19 ⁺)	646.5		2358.9+x	(17 ⁺)		
3234+x	(20 ⁺)	638.6		2595.8+x	(18 ⁺)		
3585+x	(21 ⁺)	672.5		2912.4+x	(19 ⁺)		
3701+x	(21 ⁺)	696.0		3005.4+x	(19 ⁺)		
3931+x	(22 ⁺)	696.6		3234+x	(20 ⁺)		
4309+x	(23 ⁺)	724.4		3585+x	(21 ⁺)		
4451+x	(23 ⁺)	749.3		3701+x	(21 ⁺)		
4683+x	(24 ⁺)	751.7		3931+x	(22 ⁺)		
5076+x	(25 ⁺)	766.4		4309+x	(23 ⁺)		
54.3+y	(6 ⁻)	54.4		0.0+y	(5 ⁻)	M1	5.26
120.4+y	(7 ⁻)	66.1	100 35	54.3+y	(6 ⁻)	M1	2.97

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Adopted Levels, Gammas (continued)

$\gamma(^{178}\text{Re})$ (continued)						
$E_i(\text{level})$	J_i^π	E_γ^\dagger	$I_\gamma^\#$	E_f	J_f^π	Mult. @ $\alpha\&$
120.4+y	(7 ⁻)	120.3	35 12	0.0+y	(5 ⁻)	E2 1.99
133.2+y	(8 ⁻)	38.8		94.4+y	(7 ⁺)	E1 0.967
220.4+y	(8 ⁻)	100.0		120.4+y	(7 ⁻)	M1 5.17
		166.1		54.3+y	(6 ⁻)	
256.9+y	(9 ⁻)	123.8		133.2+y	(8 ⁻)	M1 2.81
321.5+y	(9 ⁻)	101.2	100 7	220.4+y	(8 ⁻)	M1 4.99
		201.1	67 20	120.4+y	(7 ⁻)	E2 0.314
422.8+y	(10 ⁻)	166.1		256.9+y	(9 ⁻)	M1 1.219
		289.4		133.2+y	(8 ⁻)	
483.7+y	(10 ⁻)	161.9		321.5+y	(9 ⁻)	M1 1.311
		263.1		220.4+y	(8 ⁻)	
618.7+y	(11 ⁻)	134.9	44 4	483.7+y	(10 ⁻)	M1 2.20
		196.1	100 11	422.8+y	(10 ⁻)	M1 0.766
		296.7	81 7	321.5+y	(9 ⁻)	E2 0.0911
		361.9		256.9+y	(9 ⁻)	
624.5+y	(11 ⁻)	140.5 ^a		483.7+y	(10 ⁻)	
		201.5		422.8+y	(10 ⁻)	M1 0.710
		304.0		321.5+y	(9 ⁻)	
		367.4		256.9+y	(9 ⁻)	
847.6+y	(12 ⁻)	223.2		624.5+y	(11 ⁻)	M1 0.535
		229.0		618.7+y	(11 ⁻)	
		363.6		483.7+y	(10 ⁻)	
		424.9		422.8+y	(10 ⁻)	
854.1+y	(12 ⁻)	229.7		624.5+y	(11 ⁻)	
		235.4		618.7+y	(11 ⁻)	
		370.3		483.7+y	(10 ⁻)	
1017.7+y	(13 ⁻)	431.3		422.8+y	(10 ⁻)	
		163.7		854.1+y	(12 ⁻)	
		170.0		847.6+y	(12 ⁻)	
		393.5		624.5+y	(11 ⁻)	
		398.8		618.7+y	(11 ⁻)	E2 0.0392
1107.5+y	(13 ⁻)	253.3		854.1+y	(12 ⁻)	
		259.8		847.6+y	(12 ⁻)	
		483.1		624.5+y	(11 ⁻)	
1311.6+y	(14 ⁻)	293.7		1017.7+y	(13 ⁻)	
		457.6		854.1+y	(12 ⁻)	
		464.1		847.6+y	(12 ⁻)	
1385.2+y	(14 ⁻)	277.7		1107.5+y	(13 ⁻)	
		531.2		854.1+y	(12 ⁻)	
1511.4+y	(15 ⁻)	199.6		1311.6+y	(14 ⁻)	
		493.7		1017.7+y	(13 ⁻)	E2 0.0226
1682.2+y	(15 ⁻)	296.7		1385.2+y	(14 ⁻)	
		574.8		1107.5+y	(13 ⁻)	
1861.6+y	(16 ⁻)	350.1		1511.4+y	(15 ⁻)	
		550.1		1311.6+y	(14 ⁻)	
1999.3+y	(16 ⁻)	316.9		1682.2+y	(15 ⁻)	
		614.2		1385.2+y	(14 ⁻)	
2092.7+y	(17 ⁻)	231.2		1861.6+y	(16 ⁻)	
		581.3		1511.4+y	(15 ⁻)	
2327.8+y	(17 ⁻)	328.4		1999.3+y	(16 ⁻)	
		645.7		1682.2+y	(15 ⁻)	
2488.1+y	(18 ⁻)	395.4		2092.7+y	(17 ⁻)	
		626.4		1861.6+y	(16 ⁻)	
2674.9+y	(18 ⁻)	347.4		2327.8+y	(17 ⁻)	
		675.6		1999.3+y	(16 ⁻)	

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Adopted Levels, Gammas (continued) $\gamma(^{178}\text{Re})$ (continued)

$E_i(\text{level})$	J_i^π	E_γ^\dagger	E_f	J_f^π	$E_i(\text{level})$	J_i^π	E_γ^\dagger	E_f	J_f^π
2751.4+y	(19 ⁻)	263 \ddagger^a	2488.1+y	(18 ⁻)	3477.9+y	(21 ⁻)	726.5	2751.4+y	(19 ⁻)
		658.7	2092.7+y	(17 ⁻)	3744.9+y	(21 ⁻)	721.3	3023.6+y	(19 ⁻)
3023.6+y	(19 ⁻)	348.8	2674.9+y	(18 ⁻)	3924.6+y	(22 ⁻)	745.0	3179.6+y	(20 ⁻)
		695.6	2327.8+y	(17 ⁻)	4108.9+y	(22 ⁻)	720.6	3388.3+y	(20 ⁻)
3179.6+y	(20 ⁻)	428.3	2751.4+y	(19 ⁻)	4263.8+y	(23 ⁻)	785.9	3477.9+y	(21 ⁻)
		691.5	2488.1+y	(18 ⁻)	4710.7+y	(24 ⁻)	786.1	3924.6+y	(22 ⁻)
3388.3+y	(20 ⁻)	364.6	3023.6+y	(19 ⁻)	5104.3+y	(25 ⁻)	840.5	4263.8+y	(23 ⁻)
		713.5	2674.9+y	(18 ⁻)	5998.7+y	(27 ⁻)	895.0 ^a	5104.3+y	(25 ⁻)
3477.9+y	(21 ⁻)	298 \ddagger^a	3179.6+y	(20 ⁻)					

[†] From $^{165}\text{Ho}(^{18}\text{O},5n\gamma)$ (1989Kr06). No uncertainties are reported by the authors.

[‡] Shown, but not labeled, in level scheme by 1989Kr06.

[#] From $^{169}\text{Tm}(^{13}\text{C},4n\gamma)$ (1989Sa02).

[@] From transition intensity balance deduced in γ -ray singles and coincidence measurements, $^{169}\text{Tm}(^{13}\text{C},4n\gamma)$ (1989Sa02).

[&] Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ -ray energies, assigned multiplicities, and mixing ratios, unless otherwise specified.

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

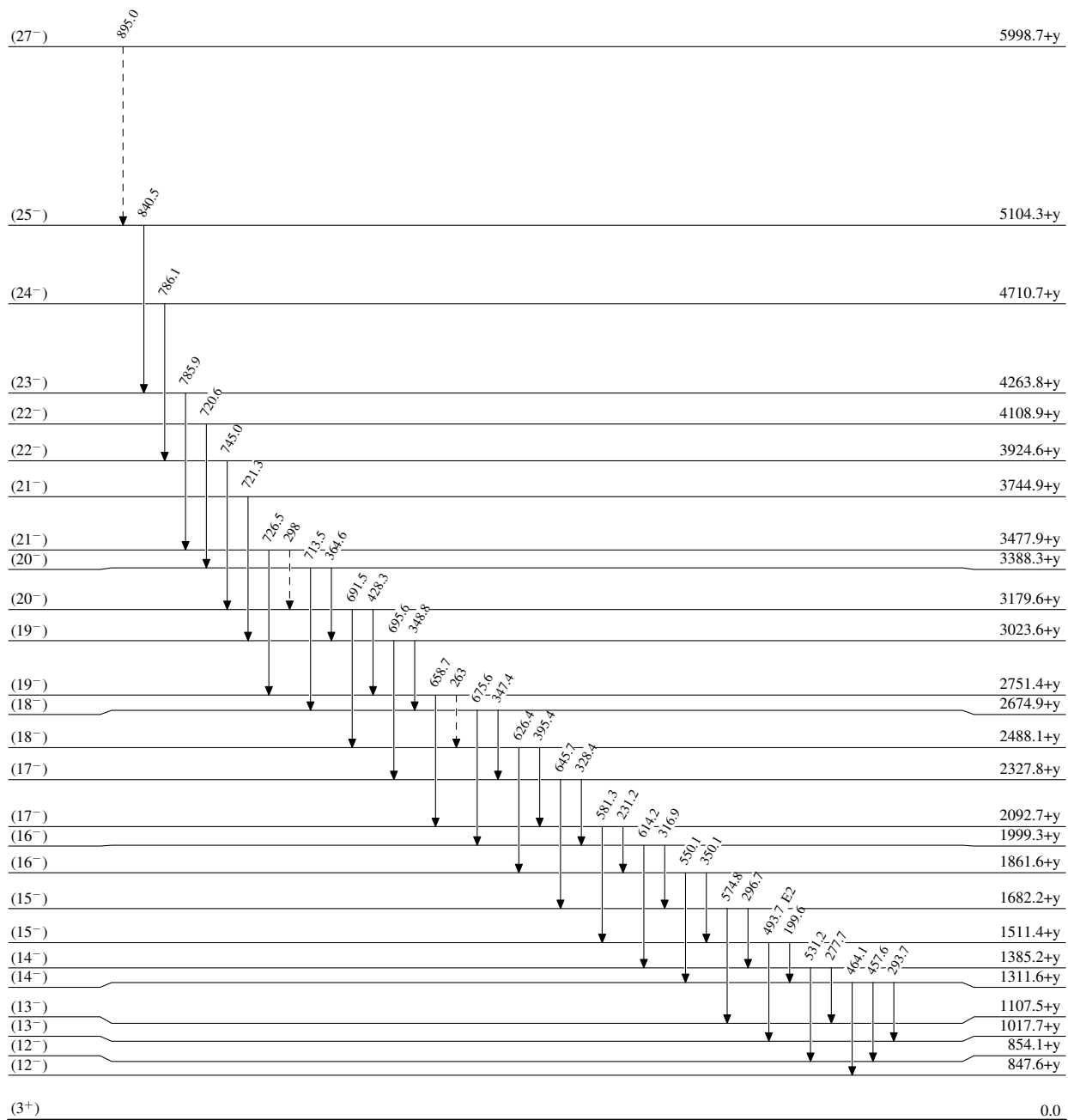
Adopted Levels, Gammas

Legend

Level Scheme

Intensities: Relative photon branching from each level

-----▶ γ Decay (Uncertain)

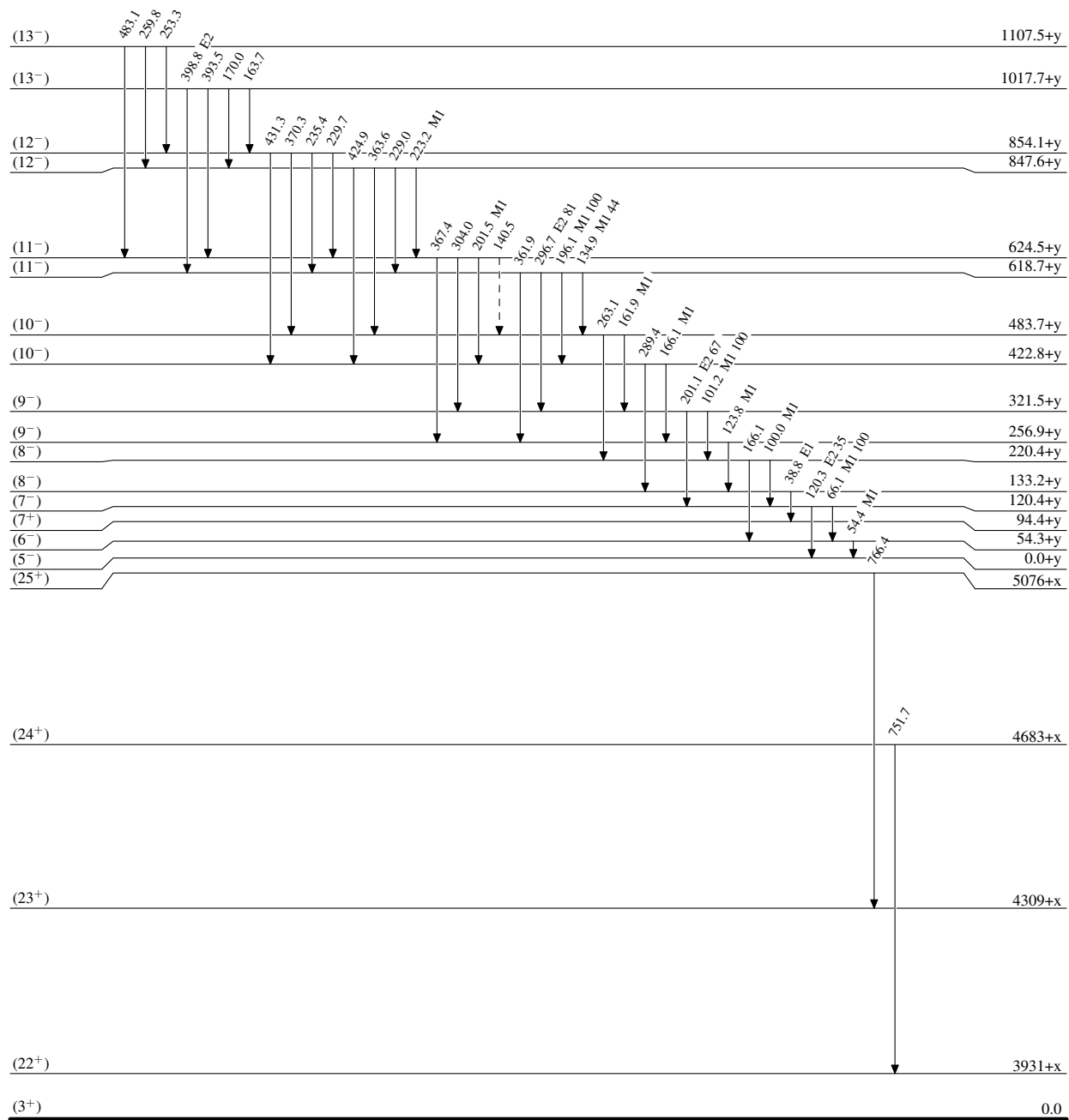


Adopted Levels, Gammas

Legend

Level Scheme (continued)

Intensities: Relative photon branching from each level

-----► γ Decay (Uncertain)

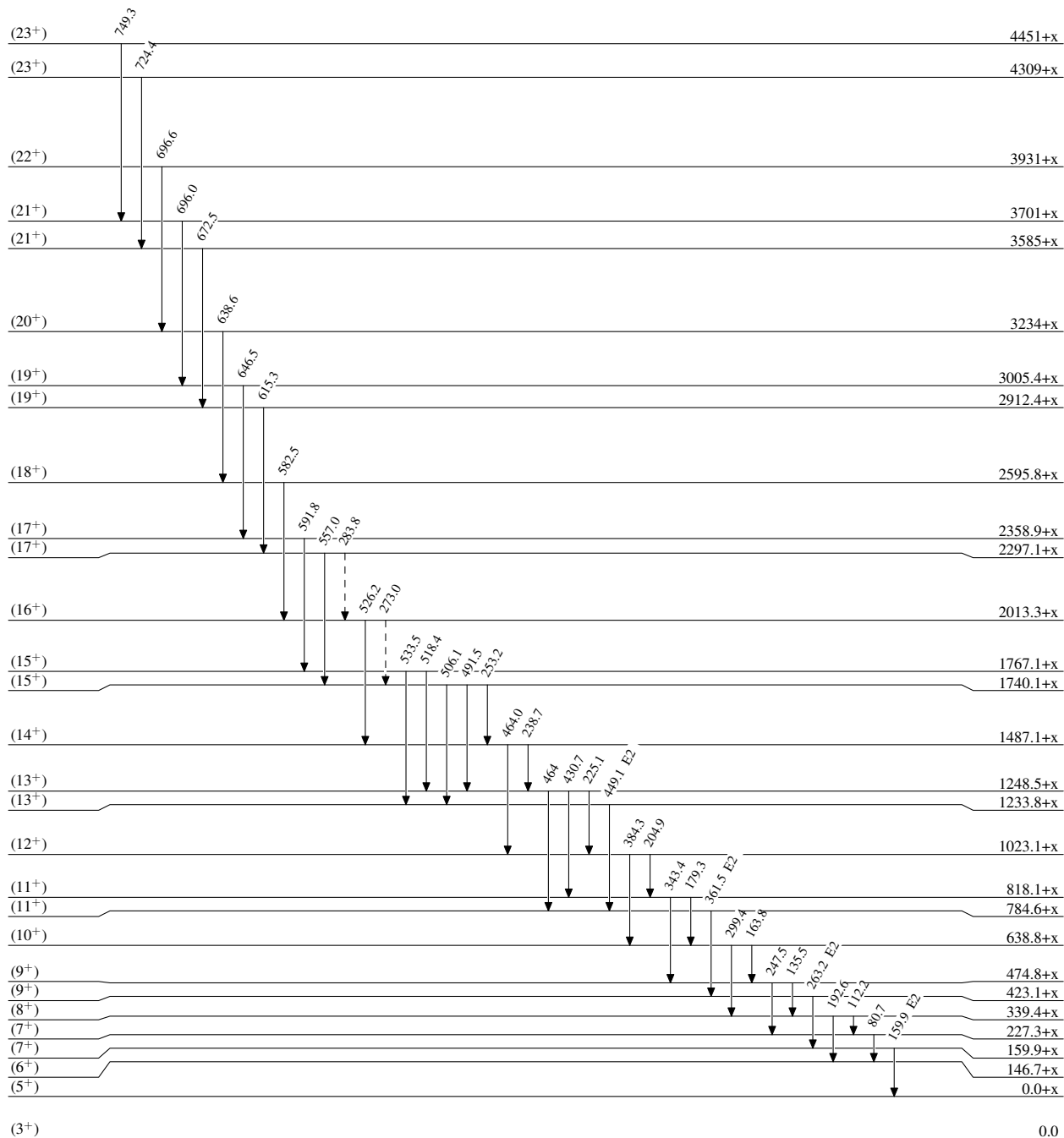
Adopted Levels, Gammas

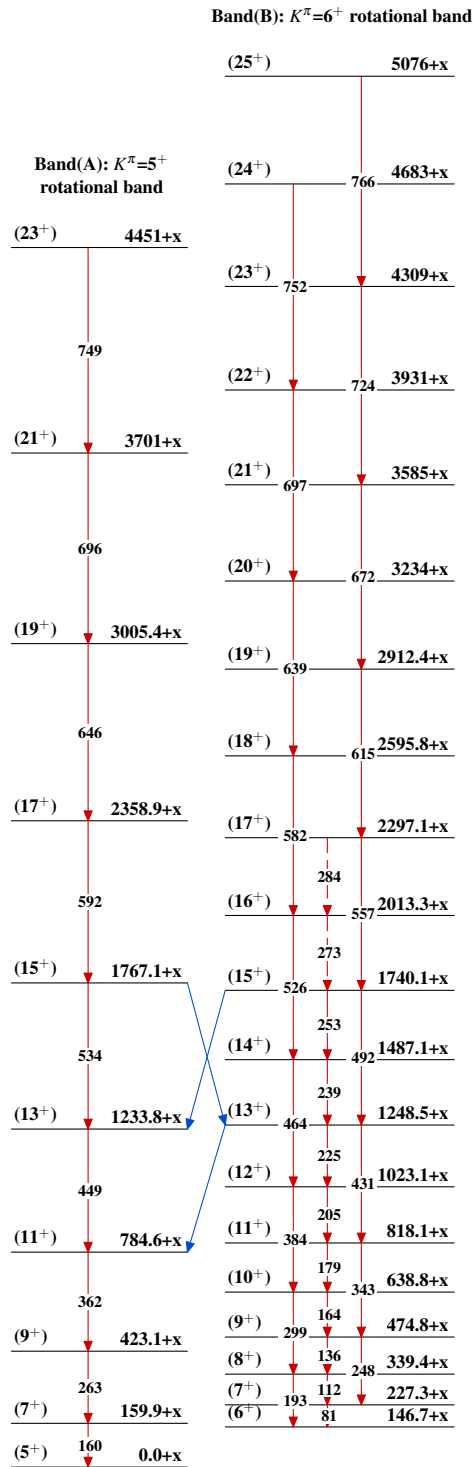
Legend

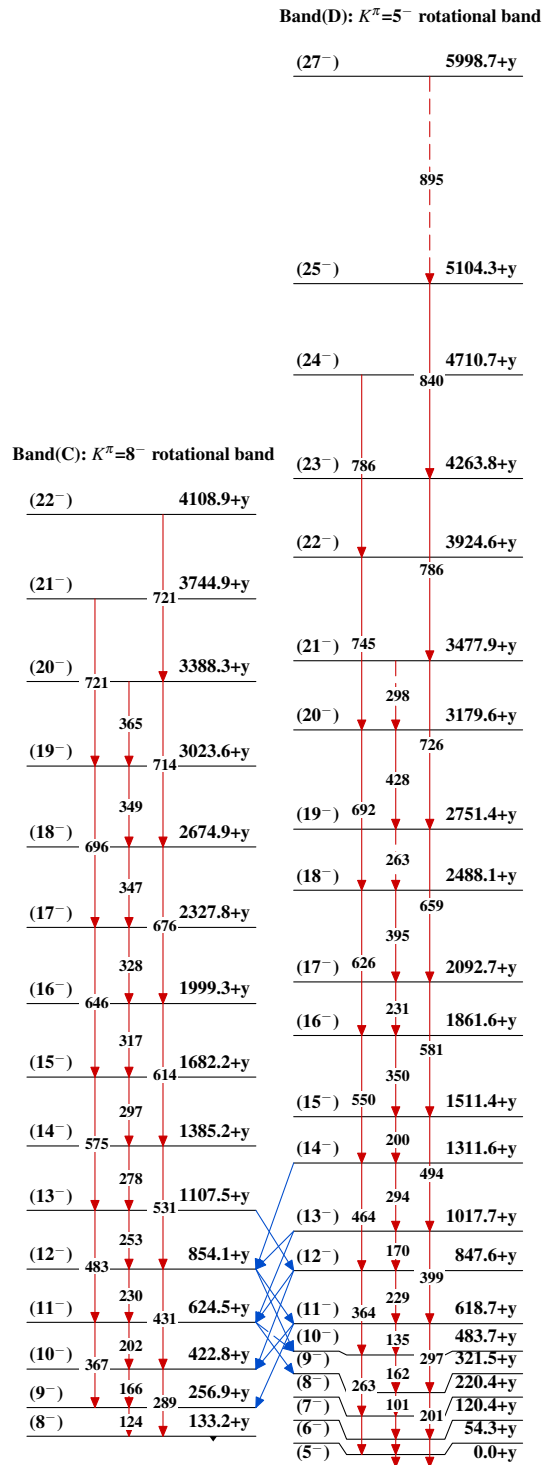
Level Scheme (continued)

Intensities: Relative photon branching from each level

-----▶ γ Decay (Uncertain)



Adopted Levels, Gammas

Adopted Levels, Gammas (continued) $^{178}_{75}\text{Re}_{103}$