

$^{96}\text{Zr}(^6\text{Li},3n\gamma)$ 1984Ze03

Type	Author	History	Literature Cutoff Date
Full Evaluation	E. Browne, J. K. Tuli	Citation NDS 145, 25 (2017)	1-Jul-2017

Other:2001Ba76: ^{37}Cl on ^{176}Yb at E=170 MeV. Authors state to have observed all high-spin states up to 25/2 as previously observed in 1984Ze03 but they show only levels that belong to bands based on $9/2^+$ (levels up to $17/2^+$) and $1/2^-$ (up to $17/2^-$) states.

1984Ze03: E=24 MeV to 31 MeV measured $E\gamma$, $I\gamma$, $\gamma\gamma$, $\gamma(\theta)$, excit.

1985Ka02: E=20 MeV to 25 MeV measured $E\gamma$, $I\gamma$, $\gamma\gamma$, $\gamma(\theta)$, excit;

 ^{99}Tc Levels

E(level)	$J\pi^\dagger$	$T_{1/2}$	Comments
0^\ddagger	$9/2^+$		
140.50 ‡ 6	$7/2^+$		
142.60 $\#$ 9	$1/2^-$	6.0072 h 9	$T_{1/2}$: From Adopted Levels.
181.00 ‡ 8	$5/2^+$		
508.90 $\#$ 11	$3/2^-$		
536.81 13			
612.40 $\#$ 10	$5/2^-$		
625.41 11	$(9/2)^+$		
652.71 18			
671.30 13	$3/2^-$		
719.7? 10	$7/2^+$		
726.70 ‡ 8	$11/2^+$		
761.81 11	$5/2^+$		
762.10 ‡ 9	$(13/2^+)$		
920.2 10	$1/2^+$		
986.10 $\#$ 10	$(7/2^-)$		
1017.41 9	$(3/2^+, 5/2^+)$		
1081.70 8	$(11/2^+)$		
1149.41 12	$(9/2^+)$		
1176.71 $\#$ 10	$9/2^-$		
1268.81 9	$(7/2^+, 9/2, 11/2^+)$		
1329.13? 11			
1329.8	$(7/2^-)$		
1468.9 10			
1507.30 15			
1526.61 ‡ 12	$(15/2^+)$		
1543.41? 23			
1582.5 10	$(11/2^+, 13/2^+)$		
1585.20 ‡ 11	$17/2^+$		
1604.20 $\#$ 14	$(11/2^-)$		
1747.71 $\#$ 11	$13/2^-$		
1774.81 12	$(5/2^-, 7/2, 9/2^-)$		
2155.41 16	$(17/2^+)$		
2223.21 15	$(15/2^-)$		
2330.31 $\#$ 11	$17/2^-$		
2424.51 15			
2487.50 15			
2553.31 ‡ 23	$(21/2^+)$		
2589.01 13			
2647.11 12	$19/2^-$		

Continued on next page (footnotes at end of table)

$^{96}\text{Zr}(^6\text{Li},3n\gamma)$ **1984Ze03 (continued)** ^{99}Tc Levels (continued)

<u>E(level)</u>	<u>J^π[†]</u>	<u>E(level)</u>	<u>J^π[†]</u>	<u>E(level)</u>	<u>J^π[†]</u>
2703.80 15		3130.01 17	(23/2 ⁻)	3623.32 20	(23/2,25/2)
2761.41 13		3203.7? 3		3649.31 [‡] 25	(25/2 ⁺)
2785.42 [#] 14	21/2 ⁻	3296.7 4		3814.62 20	
2856.10 17		3377.02 [#] 17	(25/2 ⁻)	3884.6 4	
				4177.92? 21	

[†] Adopted values.

[‡] Band(A): 9/2⁺ band (2001Ba76).

[#] Band(B): 1/2⁻ band (2001Ba76).

⁹⁶Zr(⁶Li,3nγ) **1984Ze03** (continued)

γ(⁹⁹Tc)

E_γ †	I_γ ‡	E_i (level)	J_i^π	E_f	J_f^π	Mult.#	$\delta^{#c}$	α^b	Comments
77.9 1	45 3	1585.20	17/2 ⁺	1507.30					
103.5 1	31 3	612.40	5/2 ⁻	508.90	3/2 ⁻				
138.3 @ 3		2785.42	21/2 ⁻	2647.11	19/2 ⁻	D			Mult., I _γ : A ₂ =-0.16 4, A ₄ =+0.02 4; I _γ (138γ)/I _γ (762γ)=0.394 10 (1985Ka02). E _γ : from 1984Ze03, 137.4 in 1985Ka02. Mult.: A ₂ =-0.06 3, A ₄ =-0.01 4.
140.5 1	370 4	140.50	7/2 ⁺	0	9/2 ⁺				
142.6 1	42 3	142.60	1/2 ⁻	0	9/2 ⁺				
152.3 1	38 2	2856.10		2703.80					
164.5 1	17 2	2589.01		2424.51					
172.4 1	25 1	2761.41		2589.01					
181.0 1	121 2	181.00	5/2 ⁺	0	9/2 ⁺				Mult.: A ₂ =-0.02 3, A ₄ =-0.02 4.
187.1 1	24 3	1268.81	(7/2 ⁺ , 9/2, 11/2 ⁺)	1081.70	(11/2 ⁺)				
190.6 1	24 3	1176.71	9/2 ⁻	986.10	(7/2 ⁻)				
204.3 2	10 2	1747.71	13/2 ⁻	1543.41?					
247.0 1	26 1	3377.02	(25/2 ⁻)	3130.01	(23/2 ⁻)				
247.5 ^d 2	9 1	1329.13?		1081.70	(11/2 ⁺)				E _γ : Transition not seen in other reactions.
258.7 1	59 2	2589.01		2330.31	17/2 ⁻				
269.1 1	70 3	2424.51		2155.41	(17/2 ⁺)				
293.3 ^d 1	24 1	4177.92?		3884.6					
316.8 1	187 2	2647.11	19/2 ⁻	2330.31	17/2 ⁻	M1		0.01296	α(K)=0.01137 16; α(L)=0.001318 19; α(M)=0.000239 4 α(N)=3.80×10 ⁻⁵ 6; α(O)=2.55×10 ⁻⁶ 4 Mult.: A ₂ =-0.11 2, A ₄ =-0.02 3.
344.6 1	108 2	3130.01	(23/2 ⁻)	2785.42	21/2 ⁻	M1		0.01051	α(K)=0.00921 13; α(L)=0.001066 15; α(M)=0.000193 3 α(N)=3.07×10 ⁻⁵ 5; α(O)=2.06×10 ⁻⁶ 3 Mult.: A ₂ =-0.14 2, A ₄ =+0.05 3.
347.6 ^d 2		3203.7?		2856.10					
355.8 1	65 1	536.81		181.00	5/2 ⁺				
363.3 ^d 1	15 1	4177.92?		3814.62					
366.3 1	52 1	508.90	3/2 ⁻	142.60	1/2 ⁻	D			Mult.: A ₂ =-0.22 6, A ₄ =-0.02 8.
367 ^d		1543.41?		1176.71	9/2 ⁻				
368.6 2		2856.10		2487.50					
373.7 1	63 1	986.10	(7/2 ⁻)	612.40	5/2 ⁻	(M1+E2)	-2.5 5	0.0119 3	α(K)=0.01029 25; α(L)=0.00129 4; α(M)=0.000234 7 α(N)=3.66×10 ⁻⁵ 10; α(O)=2.17×10 ⁻⁶ 5 Mult.: A ₂ =-0.33 3, A ₄ =+0.06 4. E _γ : 473.6 in table 1 of 1984Ze03.
437.6 1	20 2	3814.62		3377.02	(25/2 ⁻)				
444.4 2		625.41	(9/2) ⁺	181.00	5/2 ⁺				
455.1 1	61 3	2785.42	21/2 ⁻	2330.31	17/2 ⁻				Mult.: A ₂ =+0.34 5, A ₄ =+0.04 6.
469.8 1	405 4	612.40	5/2 ⁻	142.60	1/2 ⁻	Q			Mult.: A ₂ =+0.23 2, A ₄ =-0.05 2.
471.7 2	10 3	652.71		181.00	5/2 ⁺				
475.5 1	70 1	2223.21	(15/2 ⁻)	1747.71	13/2 ⁻	D			Mult.: A ₂ =-0.10 3, A ₄ =+0.00 3.
484.9 1	18 3	625.41	(9/2) ⁺	140.50	7/2 ⁺	D			Mult.: A ₂ =-0.09 2, A ₄ =0.00 3 (1985Ka02).

⁹⁶Zr(⁶Li,3n γ) **1984Ze03** (continued)

$\gamma(^{99}\text{Tc})$ (continued)

E_γ [†]	I_γ [‡]	$E_i(\text{level})$	J_i^π	E_f	J_f^π	Mult.#	δ ^{#c}	α ^b	Comments
490.3 ^{ad} 1	17 3	671.30	3/2 ⁻	181.00	5/2 ⁺				
493.3 1	38 3	3623.32	(23/2,25/2)	3130.01	(23/2 ⁻)	D			Mult.: A ₂ =-0.12 9, A ₄ =+0.1 1.
507.6 [@] 3		3884.6		3377.02	(25/2 ⁻)				
512.2 [@] 3		652.71		140.50	7/2 ⁺				
528.7 1	21 3	671.30	3/2 ⁻	142.60	1/2 ⁻	D			Mult.: A ₂ =-0.09 2, A ₄ =-0.00 3.
538.7		719.7?	7/2 ⁺	181.00	5/2 ⁺				Mult.: A ₂ =-0.09 4, A ₄ =-0.01 5. E γ ,I γ : observed only in 1985Ka02; I γ (538.7 γ)/I γ (761.8 γ)=0.064 2.
564.3 1	346 3	1176.71	9/2 ⁻	612.40	5/2 ⁻	E2		0.00355	α (K)=0.00310 5; α (L)=0.000372 6; α (M)=6.74 \times 10 ⁻⁵ 10 α (N)=1.062 \times 10 ⁻⁵ 15; α (O)=6.64 \times 10 ⁻⁷ 10 Mult.: A ₂ =+0.21 2, A ₄ =-0.06 2. Mult.: A ₂ =+0.24 2, A ₄ =-0.10 2.
571.0 1	337 3	1747.71	13/2 ⁻	1176.71	9/2 ⁻				
580.8 1	7 2	761.81	5/2 ⁺	181.00	5/2 ⁺				
582.6 1	261 3	2330.31	17/2 ⁻	1747.71	13/2 ⁻	E2		0.00325	α (K)=0.00283 4; α (L)=0.000339 5; α (M)=6.14 \times 10 ⁻⁵ 9 α (N)=9.69 \times 10 ⁻⁶ 14; α (O)=6.08 \times 10 ⁻⁷ 9 Mult.: A ₂ =+0.27 2, A ₄ =-0.12 2.
586.2 1	30 5	726.70	11/2 ⁺	140.50	7/2 ⁺	E2		0.00319	α (K)=0.00279 4; α (L)=0.000333 5; α (M)=6.03 \times 10 ⁻⁵ 9 α (N)=9.52 \times 10 ⁻⁶ 14; α (O)=5.98 \times 10 ⁻⁷ 9 Mult.: A ₂ =+0.15 4, A ₄ =-0.09 4 (1985Ka02). Mult.: A ₂ =+0.29 5, A ₄ =-0.9 6.
591.6 1	99 9	3377.02	(25/2 ⁻)	2785.42	21/2 ⁻				
598.1 1		1774.81	(5/2 ⁻ ,7/2,9/2 ⁻)	1176.71	9/2 ⁻				
610.1 ^{&d}		1329.8	(7/2 ⁻)	719.7?	7/2 ⁺				I γ : I γ (610.1 γ)/I γ (761.9 γ)=0.030 1 (1985Ka02). Mult.: A ₂ =+0.15 4, A ₄ =-0.03 5 (1985Ka02).
618.1 1	24 3	1604.20	(11/2 ⁻)	986.10	(7/2 ⁻)	E2		0.00276	α (K)=0.00241 4; α (L)=0.000286 4; α (M)=5.19 \times 10 ⁻⁵ 8 α (N)=8.19 \times 10 ⁻⁶ 12; α (O)=5.18 \times 10 ⁻⁷ 8 Mult.: A ₂ =+0.14 3, A ₄ =-0.10 4 (1985Ka02). Mult.: A ₂ =-0.11 3, A ₄ =-0.05 4.
621.3 1	23 3	761.81	5/2 ⁺	140.50	7/2 ⁺	D			E γ ,I γ : observed only in 1985Ka02; I γ (625.8 γ)/I γ (485.4 γ)=128 4/<2. Mult.: A ₂ =+0.10 3, A ₄ =-0.02 4 (1985Ka02).
625.8		625.41	(9/2) ⁺	0	9/2 ⁺				
707.1		1468.9		762.10	(13/2 ⁺)				I γ : I γ (707.1 γ)/I γ (761.9 γ)<0.01 (1985Ka02).
726.7 1	191 3	726.70	11/2 ⁺	0	9/2 ⁺	M1+E2	+0.9 2	0.00178 3	α (K)=0.001566 22; α (L)=0.000180 3; α (M)=3.26 \times 10 ⁻⁵ 5 α (N)=5.18 \times 10 ⁻⁶ 8; α (O)=3.44 \times 10 ⁻⁷ 5 Mult.: A ₂ =+0.36 2, A ₄ =+0.01 3.
739.2		920.2	1/2 ⁺	181.00	5/2 ⁺				E γ ,I γ : reported only in 1985Ka02; I γ (739.2 γ)/I γ (761.8 γ)=0.088 4.
743.4 [@] 3		3296.7		2553.31	(21/2 ⁺)				
745.2 3		2330.31	17/2 ⁻	1585.20	17/2 ⁺				
761.8 2		761.81	5/2 ⁺	0	9/2 ⁺				

⁹⁶Zr(⁶Li,3n γ) **1984Ze03** (continued)

$\gamma(^{99}\text{Tc})$ (continued)

E_γ [†]	I_γ [‡]	E_i (level)	J_i^π	E_f	J_f^π	Mult.#	$\delta^{#c}$	α^b	Comments
762.1 1	1000 11	762.10	(13/2 ⁺)	0	9/2 ⁺	E2		1.59×10 ⁻³	$\alpha(\text{K})=0.001391$ 20; $\alpha(\text{L})=0.0001623$ 23; $\alpha(\text{M})=2.94\times 10^{-5}$ 5 $\alpha(\text{N})=4.65\times 10^{-6}$ 7; $\alpha(\text{O})=3.01\times 10^{-7}$ 5 Mult.: $A_2=+0.28$ 2, $A_4=-0.05$ 2.
764.5 2	138 1	1526.61	(15/2 ⁺)	762.10	(13/2 ⁺)	M1+E2	+0.7 2	1.58×10 ⁻³	$\alpha(\text{K})=0.001390$ 20; $\alpha(\text{L})=0.0001588$ 23; $\alpha(\text{M})=2.87\times 10^{-5}$ 5 $\alpha(\text{N})=4.57\times 10^{-6}$ 7; $\alpha(\text{O})=3.06\times 10^{-7}$ 5 Mult.: $A_2=+0.25$ 2, $A_4=-0.05$ 3 (1985Ka02). δ : from $\gamma(\theta)$ (1985Ka02).
780.7&		1507.30		726.70	11/2 ⁺				I_γ : $I_\gamma(780.7\gamma)/I_\gamma(761.9\gamma)=0.027$ 1 (1985Ka02). Mult.: $A_2=+0.33$ 4, $A_4=-0.14$ 1.
799.9 2	85 1	1526.61	(15/2 ⁺)	726.70	11/2 ⁺	E2		1.41×10 ⁻³	$\alpha(\text{K})=0.001233$ 18; $\alpha(\text{L})=0.0001433$ 20; $\alpha(\text{M})=2.59\times 10^{-5}$ 4 $\alpha(\text{N})=4.11\times 10^{-6}$ 6; $\alpha(\text{O})=2.67\times 10^{-7}$ 4 Mult.: $A_2=+0.22$ 5, $A_4=-0.02$ 6.
803.7 1	61 1	2330.31	17/2 ⁻	1526.61	(15/2 ⁺)				E_γ, I_γ : from 1985Ka02; $I_\gamma(804.6\gamma)/I_\gamma(373.7\gamma)=1.1$ 1. $\alpha(\text{K})=0.001149$ 16; $\alpha(\text{L})=0.0001333$ 19; $\alpha(\text{M})=2.41\times 10^{-5}$ 4 $\alpha(\text{N})=3.82\times 10^{-6}$ 6; $\alpha(\text{O})=2.49\times 10^{-7}$ 4 Mult.: $A_2=+0.28$ 2, $A_4=-0.07$ 3. Mult.: $A_2=-0.3$ 1, $A_4=-0.3$ 1.
804.6		986.10	(7/2 ⁻)	181.00	5/2 ⁺				
823.1 1	561 6	1585.20	17/2 ⁺	762.10	(13/2 ⁺)	E2		1.31×10 ⁻³	
836.4 1	35 2	1017.41	(3/2 ⁺ , 5/2 ⁺)	181.00	5/2 ⁺	D+Q			
845.6 2	34 2	986.10	(7/2 ⁻)	140.50	7/2 ⁺				
876.9 1	40 3	1017.41	(3/2 ⁺ , 5/2 ⁺)	140.50	7/2 ⁺				
902.3 1	30 2	2487.50		1585.20	17/2 ⁺				
941.2 1	35 3	1081.70	(11/2 ⁺)	140.50	7/2 ⁺	E2		9.51×10 ⁻⁴	$\alpha(\text{K})=0.000835$ 12; $\alpha(\text{L})=9.59\times 10^{-5}$ 14; $\alpha(\text{M})=1.736\times 10^{-5}$ 25 $\alpha(\text{N})=2.76\times 10^{-6}$ 4; $\alpha(\text{O})=1.82\times 10^{-7}$ 3 Mult.: $A_2=+0.18$ 3, $A_4=-0.05$ 4 (1985Ka02).
957.1&		1582.5	(11/2 ⁺ , 13/2 ⁺)	625.41	(9/2 ⁺)				I_γ : weak transition (1985Ka02).
968.1 2	170 2	2553.31	(21/2 ⁺)	1585.20	17/2 ⁺	E2		8.91×10 ⁻⁴	$\alpha(\text{K})=0.000782$ 11; $\alpha(\text{L})=8.97\times 10^{-5}$ 13; $\alpha(\text{M})=1.623\times 10^{-5}$ 23 $\alpha(\text{N})=2.58\times 10^{-6}$ 4; $\alpha(\text{O})=1.702\times 10^{-7}$ 24 Mult.: $A_2=+0.21$ 4, $A_4=-0.13$ 5.
968.4 ^d 2		1149.41	(9/2 ⁺)	181.00	5/2 ⁺				
985.6 2	36 2	1747.71	13/2 ⁻	762.10	(13/2 ⁺)	D+Q			Mult.: $A_2=+0.23$ 4, $A_4=-0.02$ 5.
986.1 2		986.10	(7/2 ⁻)	0	9/2 ⁺				
1008.9 1	19 2	1149.41	(9/2 ⁺)	140.50	7/2 ⁺				
1061.9 1	85 2	2647.11	19/2 ⁻	1585.20	17/2 ⁺	D			Mult.: $A_2=-0.32$ 6, $A_4=+0.04$ 7.
1081.7 1	108 1	1081.70	(11/2 ⁺)	0	9/2 ⁺	D+Q			Mult.: $A_2=-0.42$ 3, $A_4=+0.02$ 3.
1096.0 1	80 1	3649.31	(25/2 ⁺)	2553.31	(21/2 ⁺)				Mult.: $A_2=+0.32$ 7, $A_4=-0.10$ 8.
1118.6 1	62 1	2703.80		1585.20	17/2 ⁺				

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$^{96}\text{Zr}(^6\text{Li},3n\gamma)$ **1984Ze03 (continued)**

$\gamma(^{99}\text{Tc})$ (continued)

E_γ [†]	I_γ [‡]	E_i (level)	J_i^π	E_f	J_f^π	Mult. [#]	α^b	Comments
1128.3	1	12 2	1268.81	(7/2 ⁺ ,9/2,11/2 ⁺)	140.50	7/2 ⁺		
1162.4	1	10 1	1774.81	(5/2 ⁻ ,7/2,9/2 ⁻)	612.40	5/2 ⁻		
1176.2	1	26 2	2761.41		1585.20	17/2 ⁺		
1188.6	1	10 1	1329.8	(7/2 ⁻)	140.50	7/2 ⁺		E_γ : Placement from ($^3\text{He},pn\gamma$).
^x 1363	1							
1393.3	2	61 6	2155.41	(17/2 ⁺)	762.10	(13/2 ⁺)	E2	4.54×10^{-4} $\alpha(\text{K})=0.000357$ 5; $\alpha(\text{L})=4.02 \times 10^{-5}$ 6; $\alpha(\text{M})=7.26 \times 10^{-6}$ 11 $\alpha(\text{N})=1.156 \times 10^{-6}$ 17; $\alpha(\text{O})=7.78 \times 10^{-8}$ 11; $\alpha(\text{IPF})=4.87 \times 10^{-5}$ 7 Mult.: $A_2=+0.29$ 3, $A_4=-0.10$ 3.

[†] From [1984Ze03](#), if not noted otherwise.

[‡] I_γ at E=29 MeV. See [1985Ka02](#) for their set of intensities.

[#] From $^6\text{Li},\gamma(\theta)$ ([1985Ka02](#)).

@ Unresolved doublet.

& From [1985Ka02](#).

^a Probably misplaced in [1984Ze03](#) since γ was not observed in β^- decay.

^b [Additional information 1](#).

^c If No value given it was assumed $\delta=1.00$ for E2/M1, $\delta=1.00$ for E3/M2 and $\delta=0.10$ for the other multiplicities.

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

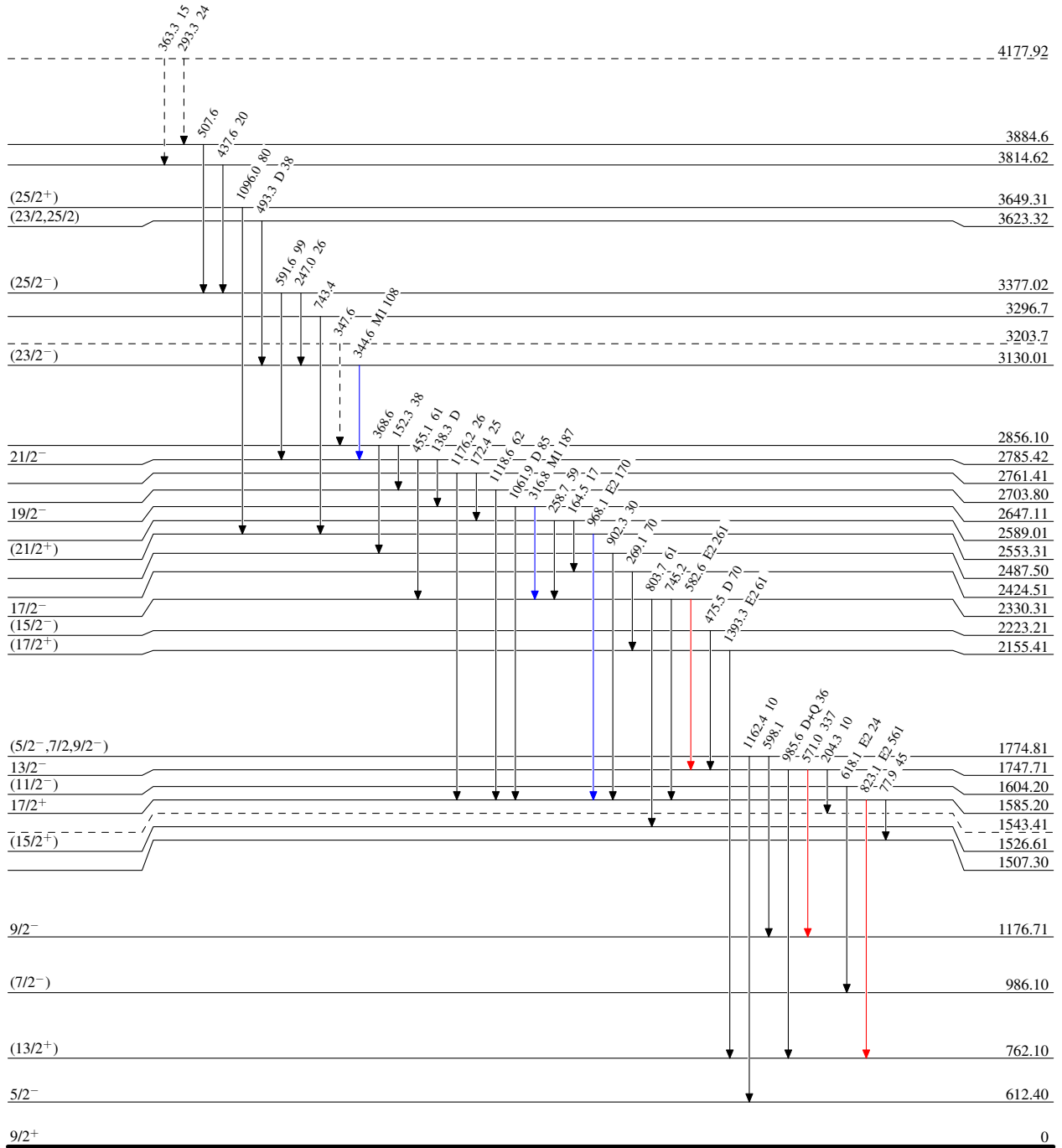
^x γ ray not placed in level scheme.

⁹⁶Zr(⁶Li,3n γ) 1984Ze03

Legend

Level Scheme
Intensities: Relative I γ

- \longrightarrow I γ < 2% \times I γ^{max}
- \longrightarrow I γ < 10% \times I γ^{max}
- \longrightarrow I γ > 10% \times I γ^{max}
- \dashrightarrow γ Decay (Uncertain)



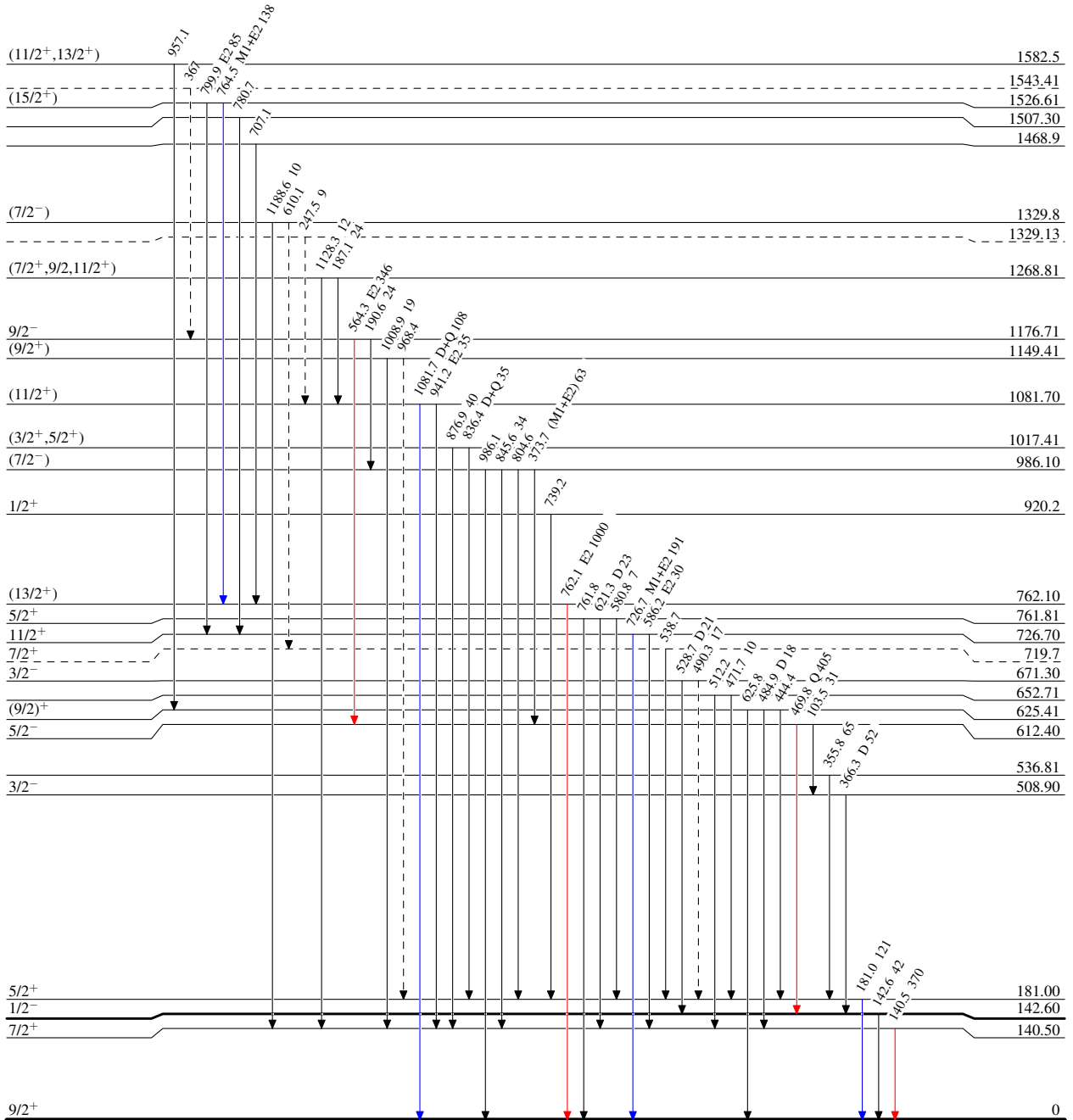
⁹⁶Zr(⁶Li,3n γ) 1984Ze03

Legend

Level Scheme (continued)

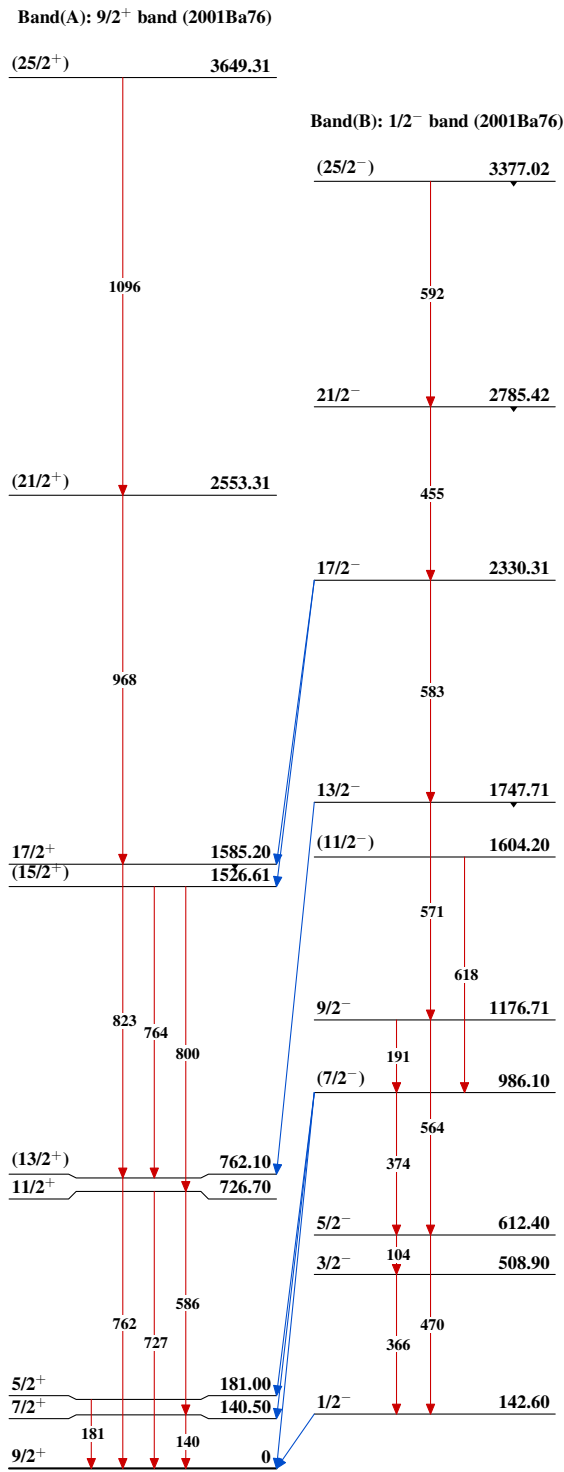
Intensities: Relative I γ

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



⁹⁹Tc₅₆

6.0072 h 9

${}^{96}\text{Zr}({}^6\text{Li}, 3n\gamma)$ 1984Ze03 ${}^{99}_{43}\text{Tc}_{56}$