^{181}Ta(α,4nγ),^{181}Ta(^{3}He,3nγ) 1976Ne03,1974Si14,1978Ad04

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	S. -c. Wu	NDS 106, 367 (2005)	31-Aug-2005

1976Ne03: ^{181}Ta(α,4nγ), E=52 MeV; natural target; Ge(Li) detectors; measured γ-, $\gamma\gamma$-coin., $\gamma(\theta)$.
1974Si14: ^{181}Ta(α,4nγ), E=25-63 MeV; natural target; Ge(Li) detectors; measured γ-, $\gamma\gamma$-coin., $\gamma(\theta)$, α-γ(t).
1978Ad04: ^{181}Ta(^{3}He,3nγ), E=24,28 MeV; natural target; Ge(Li) detectors; measured Eγ, Iγ, $\gamma\gamma$-coin.
Others: 1969Hj01, 1969Co13.

^{181}Re Levels

E(level)[†]	J$^\pi$[‡]	$T_{1/2}$	Comments
0.0[&]	5/2$^+$		
117.88[a] *8*	7/2$^+$		
262.37[#] *12*	9/2$^-$	140 ns *14*	$T_{1/2}$: from α-γ(t) (1974Si14).
266.35[&] *11*	9/2$^+$		
356.74[b] *19*	5/2$^-$		
390.5[b] *4*	9/2$^-$		E(level): see ^{181}Os ε decay (105 min) for discussion of placement of this level.
426.38[@] *14*	11/2$^-$		
443.52[a] *12*	11/2$^+$		
546.4[b] *4*	13/2$^-$		
617.95[#] *15*	13/2$^-$		
646.12[&] *12*	13/2$^+$		
822.2[b] *5*	17/2$^-$		
833.17[@] *16*	15/2$^-$		
872.56[a] *14*	15/2$^+$		
1071.17[#] *18*	17/2$^-$		
1116.45[&] *15*	17/2$^+$		
1208.1[b] *5*	21/2$^-$		
1326.55[@] *18*	19/2$^-$		
1376.55[a] *17*	19/2$^+$		
1600.3[#] *3*	21/2$^-$		
1641.77[&] *20*	21/2$^+$		
1655.33 *20*	(17/2$^+$,19/2$^+$)	>2 μs	$T_{1/2}$: from α-γ(t) (1974Si14). J$^\pi$: 21/2$^-$ from ^{176}Yb(^{11}B,6nγ).
1689.2[b] *6*	25/2$^-$		
1692.27 *24*	(17/2)		
1879.4 *4*	(23/2$^-$)	11.4 μs *10*	$T_{1/2}$: from α-γ(t) (1969Co13). J$^\pi$: 25/2$^+$ from ^{176}Yb(^{11}B,6nγ).
1882.09[@] *25*	23/2$^-$		
1913.66[a] *22*	23/2$^+$		
2176.7[#] *3*	25/2$^-$		
2177.27[&] *24*	25/2$^+$		
2245.8[b] *6*	29/2$^-$		
2467.3[@] *3*	27/2$^-$		
2752.9[#] *3*	29/2$^-$		
2856.7[b] *6*	33/2$^-$		
3507.9[b] *7*	37/2$^-$		
4200.7[b] *12*	41/2$^-$		

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^{181}Ta(α,4nγ),^{181}Ta(^{3}He,3nγ) 1976Ne03,1974Si14,1978Ad04 (continued)

^{181}Re Levels (continued)

† From least square fit to the Eγ′s by evaluator.
‡ From γγ-coin. and band structures (1976Ne03).
# Band(A): 9/2⁻[514] band, α=+1/2.
@ Band(a): 9/2⁻[514] band, α=−1/2.
& Band(B): 5/2⁺[402] band, α=+1/2.
a Band(b): 5/2⁺[402] band, α=−1/2.
b Band(C): Decoupled band.

γ(^{181}Re)

E_γ †	I_γ ‡	E_i(level)	J_i^π	E_f	J_f^π	Mult.#	α b	Comments
33.8 c 3	0.0029 3	390.5	9/2⁻	356.74	5/2⁻	E2	633	E_γ: see ^{181}Os ε decay (105 min) for discussion of placement of this transition. Mult.: from ^{181}Os ε decay (105 min). I_γ: estimated by evaluator from intensity balance at the 390.7 level and α.
117.90 8	45 3	117.88	7/2⁺	0.0	5/2⁺	D+Q		Mult.: D from 1974Si14. I_γ: 51 3 from 1974Si14; 61 12 from 1978Ad04.
144.49 8	100 7	262.37	9/2⁻	117.88	7/2⁺	D		I_γ: 100 6 from 1974Si14; 100 20 from 1978Ad04.
148.50 9	15.3 12	266.35	9/2⁺	117.88	7/2⁺	D+Q		I_γ: 18.2 11 from 1974Si14; 27 5 from 1978Ad04.
155.88 18	20.4 21	546.4	13/2⁻	390.5	9/2⁻	E2 a	0.771	α(K)=0.326 10; α(L)=0.335 10; α(M)=0.084 3; α(N+..)=0.0250 8 I_γ: 25.0 11 from 1974Si14; 26 5 from 1978Ad04.
164.00 8	48 3	426.38	11/2⁻	262.37	9/2⁻	D		I_γ: 44.3 23 from 1974Si14; 46 9 from 1978Ad04.
177.25 8	15 3	443.52	11/2⁺	266.35	9/2⁺	D		I_γ: 21.6 11 from 1974Si14; 28 6 from 1978Ad04.
191.54 8	48 3	617.95	13/2⁻	426.38	11/2⁻	D		I_γ: 45.5 23 from 1974Si14; 38 8 from 1978Ad04.
202.72 9	15.0 16	646.12	13/2⁺	443.52	11/2⁺	D		I_γ: 15.9 11 from 1974Si14; 18 3 from 1978Ad04.
x205.9@ 2	3.1 8					(Q)		
215.18 8	46 3	833.17	15/2⁻	617.95	13/2⁻	D		I_γ: 44.3 23 from 1974Si14; 30 6 from 1978Ad04.
x220.4@ 2	1.7 8							
x221.3& 3								I_γ: 5.7 6 (1974Si14).
x221.9@ 2	8.3 12					(Q)		
224.1 3	8.2 10	1879.4	(23/2⁻)	1655.33	(17/2⁺,19/2⁺)	(Q)		Mult.: from 1969Co13, α_{tot}(exp)=2.4. I_γ: 5.1 11 (1974Si14).
226.49 9	12.8 10	872.56	15/2⁺	646.12	13/2⁺	D		I_γ: 11.9 11 from 1974Si14; 13 3 from 1978Ad04.
x230.1& 3								I_γ: 6.8 6 (1974Si14).
237.90 13	36 6	1071.17	17/2⁻	833.17	15/2⁻	D		I_γ: 36.4 from 1974Si14.
238.86 17	37 6	356.74	5/2⁻	117.88	7/2⁺	D		I_γ: 48 5 from 1974Si14.

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^{181}Ta(α,4nγ),^{181}Ta(^{3}He,3nγ) 1976Ne03,1974Si14,1978Ad04 (continued)

$\gamma(^{181}Re)$ (continued)

E_γ[†]	I_γ[‡]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	α[b]	Comments
243.99 *9*	9.7 *8*	1116.45	17/2$^+$	872.56	15/2$^+$	D		I_γ: 10.3 *11* from 1974Si14; 7.4 *18* from 1978Ad04.
x253.1@ *2*	6.4 *10*					(Q)		
255.34 *8*	31 *5*	1326.55	19/2$^-$	1071.17	17/2$^-$	D		I_γ: 37.5 *23* from 1974Si14; 12 *3* from 1978Ad04.
260.14 *9*	10.1 *8*	1376.55	19/2$^+$	1116.45	17/2$^+$	D		I_γ: 10.3 *9* from 1974Si14; 4.6 *14* from 1978Ad04.
263.6@ *2*	4.1 *16*	2177.27	25/2$^+$	1913.66	23/2$^+$	D		
265.16 *19*	6.0 *14*	1641.77	21/2$^+$	1376.55	19/2$^+$	D		I_γ: 2.9 *12* from 1978Ad04.
266.0 *3*	7.0 *6*	266.35	9/2$^+$	0.0	5/2$^+$	Q		
271.9@ *2*	4.3 *10*	1913.66	23/2$^+$	1641.77	21/2$^+$	D		
273.8 *3*	12.8 *10*	1600.3	21/2$^-$	1326.55	19/2$^-$	D		I_γ: 13.1 *6* from 1974Si14; 3.9 *14* from 1978Ad04.
275.80 *24*	25 *5*	822.2	17/2$^-$	546.4	13/2$^-$	E2[a]	0.115	α(K)=0.0728 *22*; α(L)=0.0318 *10*; α(M)=0.00783 *24*; α(N+..)=0.00230 *7* I_γ: 27.3 *9* from 1974Si14; 22 *5* from 1978Ad04.
x281.3& *3*								I_γ: 12.5 *6* (1974Si14). Placed as deexciting the 2169 keV level, not verified in 1976Ne03.
281.74@ *17*	9.7 *25*	1882.09	23/2$^-$	1600.3	21/2$^-$	D		I_γ: 3.9 *14* from 1978Ad04.
285.7@ *2*	3.3 *6*	2752.9	29/2$^-$	2467.3	27/2$^-$	D		Transition placement disagrees with that in ^{176}Yb(^{11}B,6nγ). Not in adopted gammas.
x289.5& *3*						D&		I_γ: 15.3 *6* (1974Si14). Placed as deexciting the 1888.1 keV level, not verified in 1976Ne03.
290.7@ *2*	3.3 *10*	2467.3	27/2$^-$	2176.7	25/2$^-$	D		
294.6@ *2*	4.3 *8*	2176.7	25/2$^-$	1882.09	23/2$^-$	D		
325.66 *13*	6.4 *6*	443.52	11/2$^+$	117.88	7/2$^+$	E2[a]	0.0698	α(K)=0.0473 *15*; α(L)=0.0171 *6*; α(M)=0.00418 *13*; α(N+..)=0.00123 *4* I_γ: 3.3 *3* from 1974Si14; 7.8 *22* from 1978Ad04.
328.70 *12*	19.4 *19*	1655.33	(17/2$^+$,19/2$^+$)	1326.55	19/2$^-$	(D)		I_γ: 17.5 *6* from 1974Si14; 6.7 *20* from 1978Ad04.
x344.4& *4*								I_γ: 4.8 *6* (1974Si14).
x351.2& *4*						(Q)&		I_γ: 4.4 *6* (1974Si14).
355.72 *22*	6.0 *16*	617.95	13/2$^-$	262.37	9/2$^-$	E2[a]	0.0543	α(K)=0.0378 *12*; α(L)=0.0125 *4*; α(M)=0.00303 *10*; α(N+..)=0.00089 *3* I_γ: 3.0 *6* from 1974Si14; 9 *3* from 1978Ad04.
x366.2& *4*								I_γ: 4.5 *6* (1974Si14).
379.67 *9*	6.4 *8*	646.12	13/2$^+$	266.35	9/2$^+$	E2[a]	0.0452	α(K)=0.0322 *10*; α(L)=0.0100 *3*; α(M)=0.00241 *8*; α(N+..)=0.00071 *2* I_γ: 11.4 *6* from 1974Si14; 7.9 *24* from 1978Ad04.
385.87 *13*	20.0 *19*	1208.1	21/2$^-$	822.2	17/2$^-$	E2[a]	0.0433	α(K)=0.0309 *10*; α(L)=0.0094 *3*; α(M)=0.00228 *7*; α(N+..)=0.00067 *2* I_γ: 21.0 *6* from 1974Si14; 8.4 *24* from 1978Ad04.
406.82 *14*	13.2 *14*	833.17	15/2$^-$	426.38	11/2$^-$	E2[a]	0.0375	α(K)=0.0271 *9*; α(L)=0.00788 *24*; α(M)=0.00190 *6*; α(N+..)=0.00056 *2* I_γ: 8.6 *3* from 1974Si14; 6.8 *17* from 1978Ad04.

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^{181}Ta(α,4nγ),^{181}Ta(^{3}He,3nγ) 1976Ne03,1974Si14,1978Ad04 (continued)

$\gamma(^{181}Re)$ (continued)

E_γ [†]	I_γ [‡]	E_i(level)	J_i^π	E_f	J_f^π	Mult. [#]	α [b]	Comments
428.98 *16*	9.1 *10*	872.56	$15/2^+$	443.52	$11/2^+$	E2[a]	0.0325	α(K)=0.0239 *8*; α(L)=0.00662 *20*; α(M)=0.00159 *5*; α(N+..)=0.00047 *2* I_γ: 7.6 *3* from 1974Si14; 10.4 *19* from 1978Ad04.
453.30 *15*	14.2 *14*	1071.17	$17/2^-$	617.95	$13/2^-$	E2[a]	0.0282	α(K)=0.0209 *7*; α(L)=0.00554 *17*; α(M)=0.00133 *4*; α(N+..)=0.00039 *1* I_γ: 8.8 *3* from 1974Si14; 8 *3* from 1978Ad04.
470.19 *18*	10.3 *12*	1116.45	$17/2^+$	646.12	$13/2^+$	E2[a]	0.0257	α(K)=0.0192 *6*; α(L)=0.00494 *15*; α(M)=0.00118 *4*; α(N+..)=0.00035 *1* I_γ: 4.4 *2* from 1974Si14; 6.8 *20* from 1978Ad04.
481.12 *17*	16.3 *16*	1689.2	$25/2^-$	1208.1	$21/2^-$	E2[a]	0.0242	α(K)=0.0182 *6*; α(L)=0.00460 *14*; α(M)=0.00110 *4*; α(N+..)=0.00033 *1* I_γ: 13.2 *6* from 1974Si14; 4.8 *21* from 1978Ad04.
493.44 *15*	16.9 *17*	1326.55	$19/2^-$	833.17	$15/2^-$	E2[a]	0.0227	α(K)=0.0172 *6*; α(L)=0.00425 *13*; α(M)=0.00101 *3*; α(N+..)=0.00030 *1* I_γ: 11.9 *6* from 1974Si14; 6.2 *22* from 1978Ad04.
[x]498.5[&] *5*								I_γ: 2.8 *3* (1974Si14).
503.74 *18*	8.3 *8*	1376.55	$19/2^+$	872.56	$15/2^+$	E2[a]	0.0217	α(K)=0.0164 *5*; α(L)=0.00399 *12* I_γ: 4.7 *2* from 1974Si14; 3.4 *17* from 1978Ad04.
525.4 *2*	9.5 *23*	1641.77	$21/2^+$	1116.45	$17/2^+$	E2[a]	0.0196	α(K)=0.0149 *5*; α(L)=0.00352 *11* E_γ: From 1976Ne03. Eγ=536.0 *4* from 1974Si14 not adopted.
528.6 *6*	9.5 *14*	1600.3	$21/2^-$	1071.17	$17/2^-$	E2[a]	0.0193	α(K)=0.0147 *5*; α(L)=0.00346 *11* I_γ: 5.0 *2* from 1974Si14; 3.0 *15* from 1978Ad04.
535.5[@] *2*	5.6 *16*	2177.27	$25/2^+$	1641.77	$21/2^+$	E2[a]	0.0187	α(K)=0.0142 *5*; α(L)=0.00333 *10*
[x]536.0[&] *4*								I_γ: 6.8 *3* (1974Si14). Placed as deexciting the 1650.0 keV level, not verified in 1976Ne03.
537.1[@] *2*	6.8 *23*	1913.66	$23/2^+$	1376.55	$19/2^+$	E2[a]	0.0185	α(K)=0.0142 *5*; α(L)=0.00330 *10*
555.6[@] *2*	11 *3*	1882.09	$23/2^-$	1326.55	$19/2^-$	E2[a]	0.0171	α(K)=0.0131 *4*; α(L)=0.00299 *9*
556.56 *18*	8.5 *25*	2245.8	$29/2^-$	1689.2	$25/2^-$	E2[a]	0.0170	α(K)=0.0131 *4*; α(L)=0.00297 *9* I_γ: 11.9 *6* (1974Si14).
[x]562.0[&] *5*						Q[&]		I_γ: 1.8 *3* (1974Si14). Placed as deexciting the 1888.1 keV level, not verified in 1976Ne03.
[x]569.0[&] *5*								I_γ: 4.2 *3* (1974Si14). Placed as deexciting the 2169 keV level, not verified in 1976Ne03.
[x]575.7[&] *5*								I_γ: 3.4 *3* (1974Si14).
576.1[@] *2*		2752.9	$29/2^-$	2176.7	$25/2^-$	(Q)		I_γ: total=5.8 *14* for Eγ=576.1 and 576.3. Assignment disagrees with that in ^{176}Yb(^{11}B,6nγ). Not in adopted gammas.
576.3[@] *2*		2176.7	$25/2^-$	1600.3	$21/2^-$	E2	0.0157	α(K)=0.0121 *4*; α(L)=0.00269 *8* I_γ: total=5.8 *14* for Eγ=576.1 and 576.3.
584.30[@] *17*	9 *3*	1655.33	$(17/2^+,19/2^+)$	1071.17	$17/2^-$	(D)		
[x]585.1[&] *5*						(D)[&]		I_γ: 8.5 *3* (1974Si14).

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^{181}Ta(α,4nγ),^{181}Ta(^{3}He,3nγ) 1976Ne03,1974Si14,1978Ad04 (continued)

γ(^{181}Re) (continued)

E_γ[†]	I_γ[‡]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	α[b]	Comments
585.3[@] *2*	4.5 *14*	2467.3	27/2$^-$	1882.09	23/2$^-$	E2[a]	0.0151	α(K)=0.0117 *4*; α(L)=0.00257 *8*
610.9[@] *2*	5.4 *16*	2856.7	33/2$^-$	2245.8	29/2$^-$	E2[a]	0.0137	α(K)=0.0107 *4*; α(L)=0.00228 *7*
[x]619.1[@] *2*	2.5 *6*							
621.09 *19*	4.3 *12*	1692.27	(17/2)	1071.17	17/2$^-$	(D)		I_γ: 3.4 *3* (1974Si14).
651.2[@] *2*	3.5 *10*	3507.9	37/2$^-$	2856.7	33/2$^-$	E2[a]	0.0118	α(K)=0.0093 *3*; α(L)=0.00192 *6*
692.8[@] *10*	1.7 *12*	4200.7	41/2$^-$	3507.9	37/2$^-$			
859.1 *4*	11.5 *23*	1692.27	(17/2)	833.17	15/2$^-$	(D)		I_γ: 8.5 *3* (1974Si14).

[†] Weighted average of values from 1976Ne03, 1974Si14, 1978Ad04, 1969Hj01 and 1969Co13, except as noted.
[‡] From 1976Ne03, normalized to 100 for Eγ=144.49. The relative intensities from other references are given in comments.
[#] Determined by 1976Ne03 on the basis of γ angular distribution with respect to the α beam. Multipolarities determined by 1974Si14, from angular distributions, agree with those from 1976Ne03, except where as noted.
[@] From 1976Ne03.
[&] From 1974Si14.
[a] Stretched quadrupole transition connecting ΔJ=2 states in the rotational band.
[b] 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.
[c] Placement of transition in the level scheme is uncertain.
[x] γ ray not placed in level scheme.

^{181}Ta(α,4nγ),^{181}Ta(^{3}He,3nγ) 1976Ne03,1974Si14,1978Ad04

Level Scheme

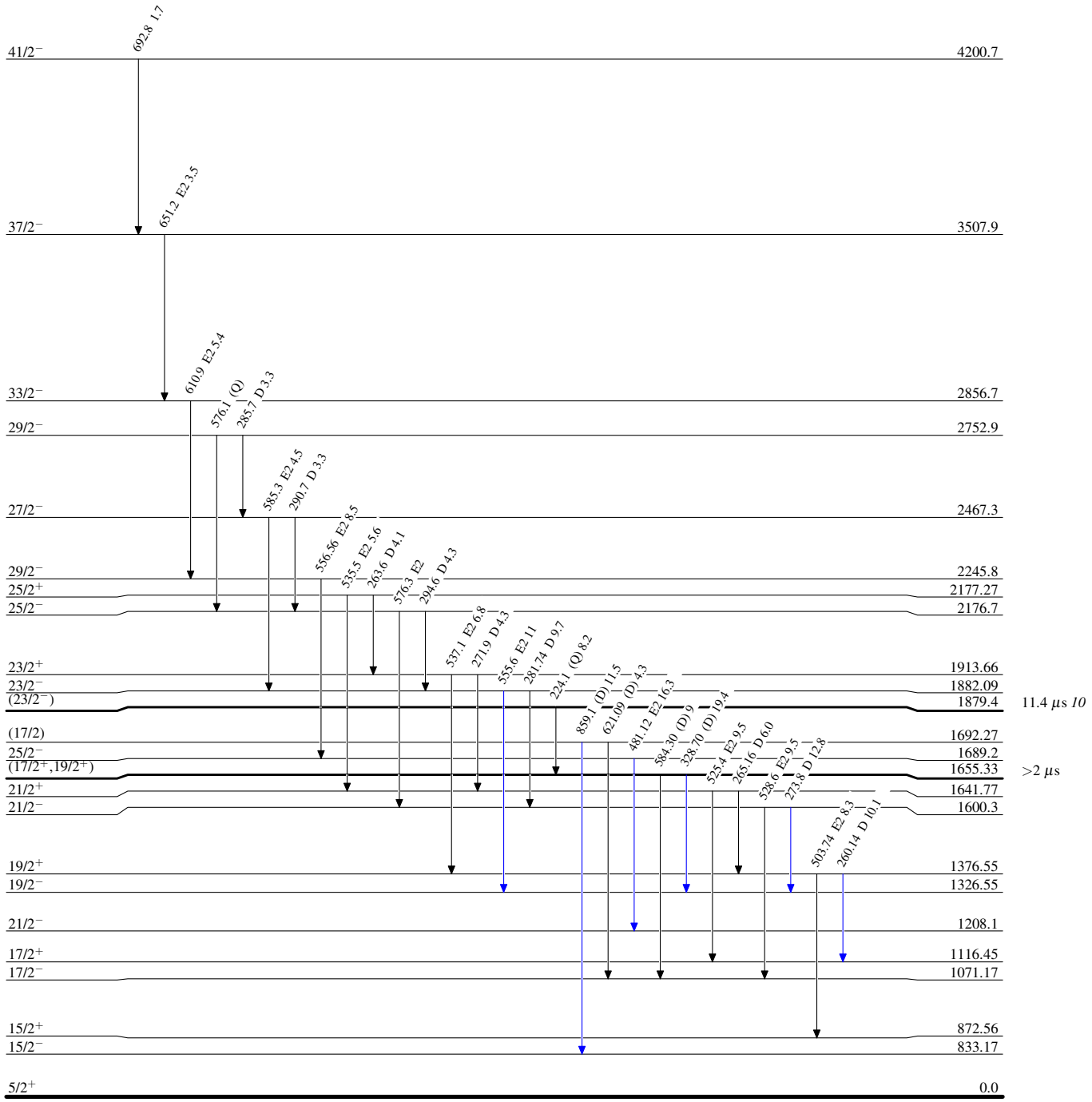
Intensities: Type not specified

Legend

$I_\gamma < 2\% \times I_\gamma^{max}$

$I_\gamma < 10\% \times I_\gamma^{max}$

$I_\gamma > 10\% \times I_\gamma^{max}$



$^{181}_{75}Re_{106}$

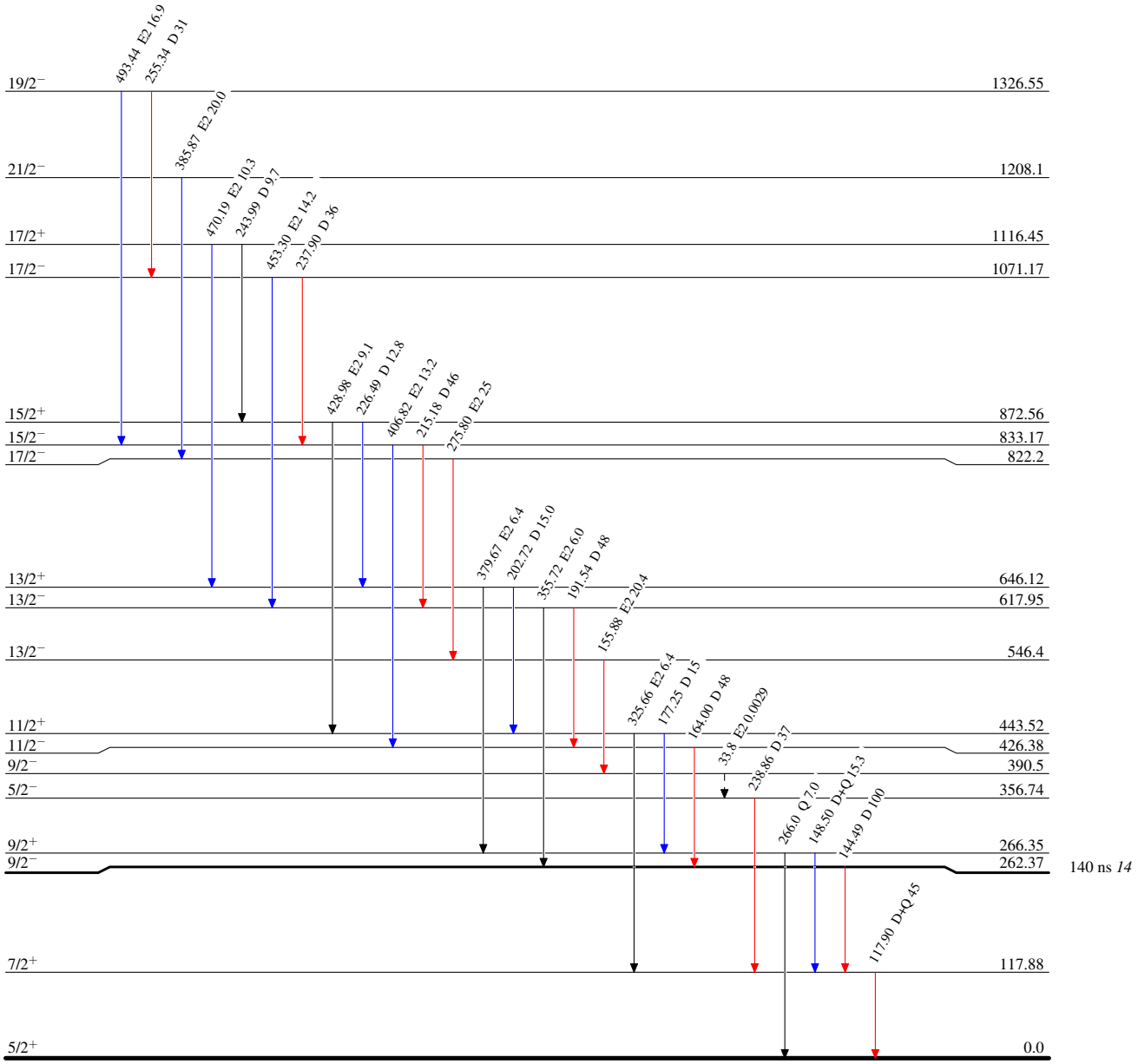
^{181}Ta(α,4nγ),^{181}Ta(^{3}He,3nγ) 1976Ne03,1974Si14,1978Ad04

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)

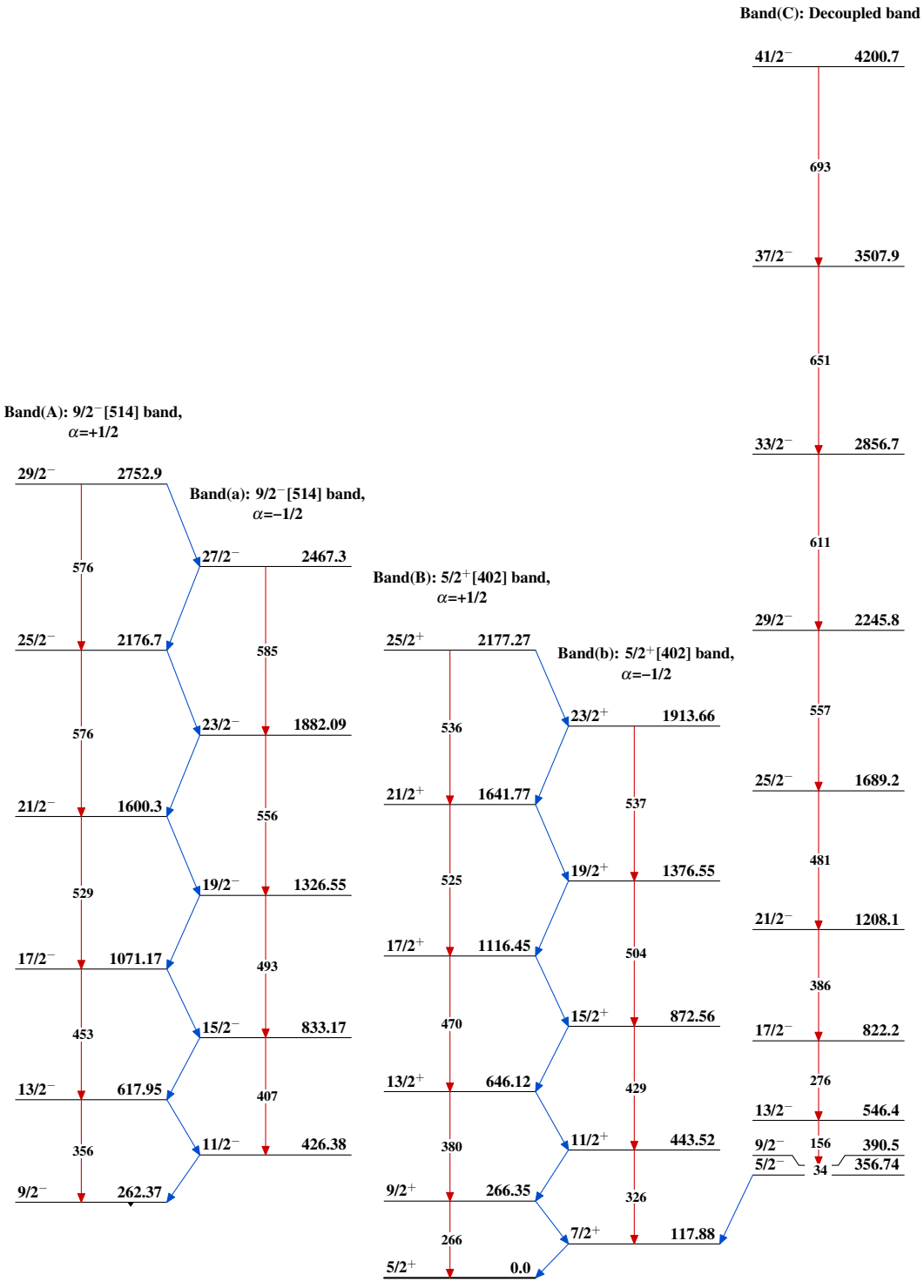
Level Scheme (continued)

Intensities: Type not specified



$^{181}_{75}Re_{106}$

^{181}Ta(α,4nγ),^{181}Ta(^{3}He,3nγ) 1976Ne03,1974Si14,1978Ad04



$^{181}_{75}Re_{106}$