^{90}Zr(^{31}P,2n2pγ) 1999Pa13

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Jean Blachot	ENSDF	1-Mar-2009

1999Pa13: ^{90}Zr(^{31}P,2p2nγ) E=150 MeV Measured: γ, $\gamma\gamma$, $\gamma(\theta)$, γ(lin pol), DCO ratios using detector array EUROGAM II containing 54 Compton-suppressed Ge detectors, bismuth germanate sum energy multiplicity filter Previous measurements, often from the same group are summarized below.

1993Wa21: ^{94}Mo(^{27}Al,2p2nγ) E= 129 MeV Measured: γ, $\gamma\gamma$, $\gamma(\theta)$, DCO, detector array: 6 Compton-suppressed Ge detectors, 14 bismuth germanate sum energy multiplicity filter.

1992Ju02,1992JuZY: ^{92}Mo(^{32}S,a3pγ) E= 145 MeV Measured: γ, $\gamma\gamma$, $\gamma(\theta)$, nordball detector array: 15 Compton-suppressed Ge detectors, 11 liquid scintillator detector and a Si-detector ball. Coin with one α and three protons Shape coexistence between collective prolate and oblate as well as non-collective oblate shapes.

1992Pa14: ^{94}Mo(^{27}Al,2p2n) E= 129 MeV Measured: γ, $\gamma\gamma$, $\gamma(\theta)$, detector array: 6 Compton-suppressed Ge detectors, 14 bismuth germanate sum energy multiplicity filter.

1995Pa21: ^{90}Zr(^{31}p,xpxn) E= 150 MeV Measured: γ, $\gamma\gamma$, $\gamma(\theta)$, detector array EUROGAM II: 54 Compton-suppressed Ge detectors, bismuth germanate sum energy multiplicity filter.

^{117}I Levels

E(level)†	Jπ‡	E(level)†	Jπ‡	E(level)†	Jπ‡
0.0[e]	5/2+	2584.7[@] 9	21/2(−)	4078.8[@] 13	29/2(−)
58.5[g] 6	7/2+	2641.0[k] 8	23/2−	4095.9[&] 12	29/2+
352.8[&] 6	9/2+	2693.6[b] 8	(17/2+)	4285.1[b] 9	31/2+
573.2[e] 7	9/2+	2700.7[e] 9	21/2+	4330.6[g] 13	31/2+
652.9[&] 6	11/2+	2751.2[a] 8	21/2+	4507.8[&] 13	31/2+
661.2 7	9/2+	2818.7[i] 6	27/2−	4516.4[@] 14	31/2(−)
676.9[i] 6	11/2−	2826.0[b] 7	(19/2+)	4601.0[i] 7	35/2−
694.8 7	(9/2+)	2908.6[@] 10	23/2(−)	4682.0[b] 9	33/2+
715.5[g] 8	11/2+	2911.3[&] 9	23/2+	4813.1[k] 8	35/2−
970.3[&] 6	13/2+	2924.5[#] 10	(21/2+)	4934.3[&] 14	33/2+
1014.0[i] 6	15/2−	2981.3[b] 6	(21/2+)	4974.5[@] 15	33/2(−)
1173.3[k] 8	11/2−	3023.7[a] 9	(23/2+)	5062.4[c] 11	35/2+
1207.4[e] 10	13/2+	3059.6[g] 8	23/2+	5106.4[g] 15	35/2+
1315.5[&] 6	15/2+	3182.7[b] 7	23/2+	5395.1[&] 15	35/2+
1340.6[#] 7	(13/2+)	3270.8[@] 11	25/2(−)	5449.2[@] 15	35/2(−)
1448.9[g] 8	15/2+	3322.4[&] 10	25/2+	5492.0[b] 14	(37/2+)
1484.2[i] 6	19/2−	3337.4[a] 10	25/2+	5503.4[c] 15	39/2+
1620.8[k] 8	15/2−	3339.5[#] 14	(23/2+)	5626.0[i] 7	39/2−
1682.9[&] 6	17/2+	3354.0[k] 8	27/2−	5666.2[j] 7	39/2−
1719.7[#] 7	(15/2+)	3374.5 8	25/2+	5768.2[k] 13	(39/2−)
1932.5[e] 8	17/2+	3423.5[b] 8	25/2+	5875.6[&] 15	(37/2+)
2074.5[&] 7	19/2+	3516.1 9	27/2+	5936.2[@] 16	37/2(−)
2087.0[i] 6	23/2−	3648.3[g] 10	27/2+	5986.0[g] 16	39/2+
2104.7[#] 7	17/2(+)	3659.7[i] 7	31/2−	6273.4[j] 7	43/2−
2105.4[k] 8	19/2−	3663.0[@] 12	27/2(−)	6292.2[c] 18	43/2+
2243.8[g] 8	19/2+	3682?[a]	(27/2+)	6391.0[&] 16	(39/2+)
2261.6[a] 8	17/2+	3684.2[b] 8	27/2+	6448.2[@] 18	(39/2−)
2310.7[@] 8	19/2(−)	3709.1[&] 11	27/2+	6634.5[i] 7	43/2−
2484.8[&] 8	21/2+	3969.1[b] 9	29/2+	6750.5[h] 10	43/2−
2494.9[a] 8	19/2+	4044?[a]	(29/2+)	6931.6[&] 17	(41/2+)
2519.9[#] 9	(19/2+)	4053.8[k] 9	31/2−	6964.2[g] 16	43/2+

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^{90}Zr(^{31}P,2n2pγ) 1999Pa13 (continued)

^{117}I Levels (continued)

E(level)†	Jπ‡	Comments
6967.5@ 19	(41/2−)	
7180.8d 20	47/2+	
7242		
7330.6c 20	47/2+	
7347.8j 9	47/2−	
7504.0& 17	(43/2+)	
7527.8@ 21	(43/2−)	
7679.8i 8	47/2−	
7890.3h 11	47/2−	
8028.8g 16	47/2+	
8087.3@ 22	(45/2−)	
8097.5& 18	(45/2+)	
8105.3 13	49/2	
8226.5d 21	51/2+	
8323.6c 21	51/2+	
8343.8 13	51/2	
8362.1j 10	51/2−	
8456f	(47/2+)	Additional information 1.
8692.0@ 23	(47/2−)	
8717.2& 20	(47/2+)	
8753.9c 22	53/2+	
8804.8i 9	51/2−	
8859.0 12	51/2−	
9082.1h 15	(51/2−)	
9174.9g 14	51/2+	
9184.1d 22	55/2+	
9263 3		
9274.5@ 24	(49/2−)	
9370.6& 21	(49/2+)	
9383.4j 12		
9443.9f 10	(51/2+)	
9932.1@ 25	(51/2−)	
10037.8i 11	55/2−	
10132.2 24	57/2+	
10268.9d 24	59/2+	
10299.2h 18	(55/2−)	
10404.0g 16	55/2+	
10439		
10530.7f 13	(55/2+)	
10750.6& 23	(53/2+)	
11184d 3	61/2+	
11193.9 14	59/2−	
11244.1i 14	59/2−	
11596.4h 21	(59/2−)	
11705.8f 15	59/2+	
12325.1i 15	(63/2−)	
12970.9f 18	63/2+	
13521.0i 18	(67/2−)	

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^{90}Zr(^{31}P,2n2pγ) 1999Pa13 (continued)

^{117}I Levels (continued)

E(level)[†]	Jπ[‡]
14327.7[f] 21	(67/2+)
15823.1[f] 23	(71/2+)
17459.1[f] 25	(75/2+)
19224[f] 3	(79/2+)
21127[f] 3	(83/2+)

† From least-squares fit to Eγ's.
‡ Based on γγ(θ)(DCO) data and band assignments.
# Band(A): Band 1, based on 1340, (13/2+).
@ Band(B): Band 2, based on (19/2−).
& Band(C): Band 3, based on 353, (9/2+) configuration=πg9/2, [404]9/2+.
a Band(D): Band 4, based on 2263, (17/2+).
b Band(E): Band 5, based on 2695, (17/2+).
c Band(F): Band 6, based on 5107, (35/2+).
d Band(G): Band 7, based on 7182, (47/2+).
e Band(H): Band 8, based on 5/2+ g.s., configuration=πd5/2, [420]1/2+, α=+1/2.
f Band(I): Band 9, based on 8456, (47/2+).
g Band(J): Band 10, based on 58, (7/2)+, configuration=πg7/2, [422]3/2+, α=−1/2.
h Band(K): Band 11, based on 6751, (43/2−), configuration=πh11/2, [550]1/2−.
i Band(L): Band 12, based on 677, (11/2)−, configuration=πh11/2, [550]1/2−, α=−1/2.
j Band(M): Band 13, based on 5677, (39/2−).
k Band(N): Band 14, based on 1174, (11/2)−, configuration=(πh11/2⊗γ−mb core).

γ(^{117}I)

DCO Ratios are for dipole gate; DCO(Q), however, are for a quadrupole gating transition. DCO(Q)≈1.0 indicates an L=2,ΔJ=2 or L=1,ΔJ=0 transition. DCO(Q)≈0.55 is expected for L=1,ΔJ=1 transition. DCO(D)≈1.5 is expected for an L=2,ΔJ=2 and 1.0 for L=1,ΔJ=1 transition.

Eγ[‡]	Iγ[#]	Ei(level)	Jiπ	Ef	Jfπ	Mult.[†]	Comments
16.4		676.9	11/2−	661.2	9/2+		
58.3 6		58.5	7/2+	0.0	5/2+	D,Q	Mult.: DCO(Q)=1.66 8.
103.5 6	2.1	676.9	11/2−	573.2	9/2+		
132.3 6	<1	2826.0	(19/2+)	2693.6	(17/2+)		
154.9 6	<1	2981.3	(21/2+)	2826.0	(19/2+)		
191.3 6	0.72	3374.5	25/2+	3182.7	23/2+		
200.9 6	1.0	3182.7	23/2+	2981.3	(21/2+)		
206.1 6	0.4	2310.7	19/2(−)	2104.7	17/2(+)	D	Mult.: DCO=1.19 9.
233.6 6	1.0	2494.9	19/2+	2261.6	17/2+		
240.3 6	1.2	3423.5	25/2+	3182.7	23/2+	D,Q	Mult.: DCO(Q)=0.48 4.
256.2 6	3.1	2751.2	21/2+	2494.9	19/2+	D,Q	Mult.: DCO=0.96 5.
260.6 6	3.5	3684.2	27/2+	3423.5	25/2+	M1,E2	Mult.: DCO(Q)=0.55 4, p=+0.04 15.
272.4 6	2.5	3023.7	(23/2+)	2751.2	21/2+		
274.0 6	3.0	2584.7	21/2(−)	2310.7	19/2(−)	M1,E2	Mult.: DCO=0.92 4, p=−0.24 25.
285.0 6	2.1	3969.1	29/2+	3684.2	27/2+	M1,E2	Mult.: DCO(Q)=0.42 2, p=−0.01 15.
293.9 6	5	352.8	9/2+	58.5	7/2+	M1,E2	Mult.: DCO=0.99 2, p=−0.18 5.

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^{90}Zr(^{31}P,2n2pγ) 1999Pa13 (continued)

γ(^{117}I) (continued)

E_γ[‡]	I_γ[#]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[†]	Comments
299.8 *3*	23	652.9	$11/2^+$	352.8	$9/2^+$	M1,E2	Mult.: DCO=0.98 *2*, p=−0.26 *5*.
309.6 *6*	2.2	3684.2	$27/2^+$	3374.5	$25/2^+$	M1,E2	Mult.: DCO=0.63 *2*, p=+0.04 *9*.
315 *1*	3.5	3374.5	$25/2^+$	3059.6	$23/2^+$	M1,E2	Mult.: DCO=0.85 *9*.
316.5 *6*	3.1	4285.1	$31/2^+$	3969.1	$29/2^+$	M1,E2	Mult.: DCO=0.51 *3*, p=−0.28 *12*.
317.3 *3*	18	970.3	$13/2^+$	652.9	$11/2^+$	M1,E2	Mult.: DCO=0.95 *2*, p=−0.23 *4*.
323.9 *6*	2.9	2908.6	$23/2^{(-)}$	2584.7	$21/2^{(-)}$	M1,E2	Mult.: DCO=1.03 *3*, p=−0.41 *10*.
333 *1*	<1.0	3516.1	$27/2^+$	3182.7	$23/2^+$		
337.1 *3*	125	1014.0	$15/2^-$	676.9	$11/2^-$	E2	Mult.: DCO(Q)=0.96 *1*, p=+0.15 *2*.
345.1 *3*	16	1315.5	$15/2^+$	970.3	$13/2^+$	M1,E2	Mult.: DCO=1.03 *2*, p=−0.23 *4*.
353.1 *6*	<1	352.8	$9/2^+$	0.0	$5/2^+$		
356.6 *6*	<1	3182.7	$23/2^+$	2826.0	$(19/2^+)$		
362.1 *6*	2.7	3270.8	$25/2^{(-)}$	2908.6	$23/2^{(-)}$		
367.4 *3*	14	1682.9	$17/2^+$	1315.5	$15/2^+$	M1,E2	Mult.: DCO=1.02 *2*, p=−0.27 *5*.
370.4 *6*	<1	1340.6	$(13/2^+)$	970.3	$13/2^+$		
379.1 *6*	<1	1719.7	$(15/2^+)$	1340.6	$(13/2^+)$		
380.5 *6*	4.5	5062.4	$35/2^+$	4682.0	$33/2^+$	M1,E2	Mult.: DCO=0.70 *6*, p=−0.03 *13*.
384.9 *6*	<1	2104.7	$17/2^{(+)}$	1719.7	$(15/2^+)$		
386.6[d] *3*	12[d]	3709.1	$27/2^+$	3322.4	$25/2^+$	D,Q	Mult.: DCO=0.94 *3*.
386.6[d] *6*	12[d]	4095.9	$29/2^+$	3709.1	$27/2^+$	D,Q	Mult.: DCO=0.94 *3*.
391.9 *3*	12.7	2074.5	$19/2^+$	1682.9	$17/2^+$	D,Q	Mult.: DCO=0.94 *3*.
392.3 *6*	2.6	3663.0	$27/2^{(-)}$	3270.8	$25/2^{(-)}$	M1,E2	Mult.: DCO=1.02 *3*, p=−0.13 *11*.
392.8 *6*	1.1	3374.5	$25/2^+$	2981.3	$(21/2^+)$	E2	Mult.: DCO=1.02 *3*.
397.3 *6*	1.6	4682.0	$33/2^+$	4285.1	$31/2^+$	M1,E2	Mult.: DCO=0.66 *7*, p=−0.09 *14*.
404 *1*	<1	1719.7	$(15/2^+)$	1315.5	$15/2^+$		
404.5 *6*	<1	2924.5	$(21/2^+)$	2519.9	$(19/2^+)$		
410.2 *3*	14[@]	2484.8	$21/2^+$	2074.5	$19/2^+$	M1,E2	Mult.: DCO=0.95 *3*, p=−0.19 *3*.
411 *1*	14[@]	3322.4	$25/2^+$	2911.3	$23/2^+$	M1,E2	Mult.: DCO=0.95 *3*, p=−0.19 *35*.
412 *1*	14[@]	4507.8	$31/2^+$	4095.9	$29/2^+$	M1,E2	Mult.: DCO=0.95 *3*, p=−0.19 *35*.
415 *1*	<1	2519.9	$(19/2^+)$	2104.7	$17/2^{(+)}$		
415 *1*	3.0	3339.5	$(23/2^+)$	2924.5	$(21/2^+)$		
416.2 *6*	2.4	4078.8	$29/2^{(-)}$	3663.0	$27/2^{(-)}$	M1,E2	Mult.: DCO=1.01 *3*, p=−0.17 *11*.
425 *1*	13[&]	3337.4	$25/2^+$	2911.3	$23/2^+$	M1,E2	Mult.: DCO=0.98 *2*, p=−0.19 *3*.
426 *1*	13[&]	4934.3	$33/2^+$	4507.8	$31/2^+$	M1,E2	Mult.: DCO=0.98 *2*, p=−0.19 *3*.
427 *1*	13[&]	2911.3	$23/2^+$	2484.8	$21/2^+$	M1,E2	Mult.: DCO=0.98 *2*, p=−0.29 *5*.
430.3[d] *6*	1.0[d]	8753.9	$53/2^+$	8323.6	$51/2^+$	M1,E2	Mult.: DCO=0.51 *3*, p=−0.01 *7*.
430.3[d] *6*	1.0[d]	9184.1	$55/2^+$	8753.9	$53/2^+$	M1,E2	Mult.: DCO=0.51 *3*, p=−0.01 *7*.
437.6 *6*	2.2	4516.4	$31/2^{(-)}$	4078.8	$29/2^{(-)}$	M1,E2	Mult.: DCO=1.09 *5*, p=−0.19 *14*.
440.9 *6*	9.5	5503.4	$39/2^+$	5062.4	$35/2^+$	E2	Mult.: DCO=1.03 *4*, p=+0.40 *8*.
441.0 *6*	2.6	3423.5	$25/2^+$	2981.3	$(21/2^+)$		
447.7 *6*	8	1620.8	$15/2^-$	1173.3	$11/2^-$	E2	Mult.: DCO(Q)=0.95 *3*.
456.7 *6*	10	3516.1	$27/2^+$	3059.6	$23/2^+$	E2	Mult.: DCO=1.19 *5*.
457.9 *6*	2.0	4974.5	$33/2^{(-)}$	4516.4	$31/2^{(-)}$	D,Q	Mult.: DCO=1.07 *5*.
460.3 *6*	2.9	5395.1	$35/2^+$	4934.3	$33/2^+$	D,Q	Mult.: DCO=0.99 *4*.
470.2 *3*	118	1484.2	$19/2^-$	1014.0	$15/2^-$	E2	Mult.: DCO(Q)=1.01 *1*, p=+0.32 *2*.
474.8 *6*	1.7	5449.2	$35/2^{(-)}$	4974.5	$33/2^{(-)}$		
479.2 *6*	5	1173.3	$11/2^-$	694.8	$(9/2^+)$		
480.5 *6*	2.6	5875.6	$(37/2^+)$	5395.1	$35/2^+$		
485.1 *3*	12	2105.4	$19/2^-$	1620.8	$15/2^-$	E2	Mult.: DCO(Q)=0.99 *2*.
486.7 *6*	1.1	5936.2	$37/2^{(-)}$	5449.2	$35/2^{(-)}$		
489.3 *6*	<1	2751.2	$21/2^+$	2261.6	$17/2^+$		
495.9 *6*	<1	1173.3	$11/2^-$	676.9	$11/2^-$	D,Q	Mult.: DCO(Q)=0.91 *4*.
501.4 *6*	4.9	3684.2	$27/2^+$	3182.7	$23/2^+$	E2	Mult.: DCO=1.21 *9*.

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^{90}Zr(^{31}P,2n2pγ) 1999Pa13 (continued)

γ(^{117}I) (continued)

E_γ[‡]	I_γ[#]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[†]	Comments
512 *1*	3	1173.3	$11/2^-$	661.2	$9/2^+$	E1	Mult.: DCO(Q)=0.80 *3*.
514.6 *3*	20	573.2	$9/2^+$	58.5	$7/2^+$	M1,E2	Mult.: DCO(Q)=0.52 *2*, p=−0.14 *4*.
515 *1*	1.9	6391.0	$(39/2^+)$	5875.6	$(37/2^+)$		
529 *1*	<1	3023.7	$(23/2^+)$	2494.9	$19/2^+$		
535.3 *6*	<1	3354.0	$27/2^-$	2818.7	$27/2^-$		
535.5 *3*	18	2641.0	$23/2^-$	2105.4	$19/2^-$	E2	Mult.: DCO(Q)=0.98 *2*.
540.5 *6*	1.5	6931.6	$(41/2^+)$	6391.0	$(39/2^+)$		
545.9 *6*	0.6	3969.1	$29/2^+$	3423.5	$25/2^+$		
553 *1*	<1	2641.0	$23/2^-$	2087.0	$23/2^-$		
572 *1*	<1.0	7504.0	$(43/2^+)$	6931.6	$(41/2^+)$		
573.5 *6*	5	573.2	$9/2^+$	0.0	$5/2^+$	E2	Mult.: DCO(Q)=0.97 *5*.
586.6 *6*	1.4	3337.4	$25/2^+$	2751.2	$21/2^+$		
588.8 *3*	20	3648.3	$27/2^+$	3059.6	$23/2^+$	E2	Mult.: DCO(Q)=1.12 *3*, p=+0.24 *6*.
594 *1*	<1.0	8097.5	$(45/2^+)$	7504.0	$(43/2^+)$		
594.9 *6*	6.8	3969.1	$29/2^+$	3374.5	$25/2^+$	E2	Mult.: DCO=0.95 *5*.
595.0 *6*	0.2	652.9	$11/2^+$	58.5	$7/2^+$		
598 *1*	0.2	2908.6	$23/2^{(-)}$	2310.7	$19/2^{(-)}$		
600.9 *6*	2.6	4285.1	$31/2^+$	3684.2	$27/2^+$	E2	Mult.: DCO=1.12 *7*, p=+0.40 *10*.
602.9 *3*	100	2087.0	$23/2^-$	1484.2	$19/2^-$	E2	Mult.: DCO(Q)=1.01 *1*, p=+0.31 *2*.
603 *1*	0.5	661.2	$9/2^+$	58.5	$7/2^+$		
607.0 *3*	35	6273.4	$43/2^-$	5666.2	$39/2^-$	E2	Mult.: DCO(Q)=1.09 *2*.
607.3 *6*	5	1620.8	$15/2^-$	1014.0	$15/2^-$		
617.5 *6*	4.0	970.3	$13/2^+$	352.8	$9/2^+$		
619.4 *6*	1.5	676.9	$11/2^-$	58.5	$7/2^+$		
620 *1*	<1	2105.4	$19/2^-$	1484.2	$19/2^-$		
627.7 *6*	0.6	2310.7	$19/2^{(-)}$	1682.9	$17/2^+$	(E1)	Mult.: DCO=0.97 *4*, p=+0.01 *16*.
634.7 *3*	25	1207.4	$13/2^+$	573.2	$9/2^+$	E2	Mult.: DCO(Q)=0.95 *4*, p=+0.49 *7*.
636.8 *6*	8.0	4285.1	$31/2^+$	3648.3	$27/2^+$	E2	Mult.: DCO=0.99 *4*, p=+0.58 *12*.
637 *1*	0.2	694.8	$(9/2^+)$	58.5	$7/2^+$		
647.3 *6*	2.3	6273.4	$43/2^-$	5626.0	$39/2^-$	E2	Mult.: DCO(Q)=1.06 *3*.
657.1 *3*	52	715.5	$11/2^+$	58.5	$7/2^+$	E2	Mult.: DCO(Q)=1.19 *3*, p=+0.42 *10*.
658[e] *1*		3682?	$(27/2^+)$	3023.7	$(23/2^+)$		
661.3 *6*	3.0	661.2	$9/2^+$	0.0	$5/2^+$	E2	Mult.: DCO(Q)=0.96 *3*.
662.5 *6*	4.3	1315.5	$15/2^+$	652.9	$11/2^+$	E2	Mult.: DCO=1.39 *6*, p=+0.46 *12*.
673.1 *6*	8.9	3374.5	$25/2^+$	2700.7	$21/2^+$	E2	Mult.: DCO=0.96 *5*.
677.4 *6*	1.1	2751.2	$21/2^+$	2074.5	$19/2^+$	D,Q	Mult.: DCO=0.86 *9*.
682.1 *3*	13	4330.6	$31/2^+$	3648.3	$27/2^+$	E2	Mult.: DCO(Q)=1.13 *3*, p=+0.31 *9*.
686.1 *6*	0.71	3270.8	$25/2^{(-)}$	2584.7	$21/2^{(-)}$		
687.7 *6*	<1	1340.6	$(13/2^+)$	652.9	$11/2^+$		
694.7 *6*	5.1	694.8	$(9/2^+)$	0.0	$5/2^+$		
699.5 *3*	20	4053.8	$31/2^-$	3354.0	$27/2^-$	E2	Mult.: DCO(Q)=0.98 *2*.
707[e] *1*	<1.0	4044?	$(29/2^+)$	3337.4	$25/2^+$		
712.5 *6*	6.4	1682.9	$17/2^+$	970.3	$13/2^+$		
712.9 *6*	6.9	4682.0	$33/2^+$	3969.1	$29/2^+$	E2	Mult.: DCO=1.10 *8*.
713 *1*	<1	7347.8	$47/2^-$	6634.5	$43/2^-$		
713.1 *3*	20	3354.0	$27/2^-$	2641.0	$23/2^-$	E2	Mult.: DCO(Q)=1.04 *2*.
723.8 *6*	3.0	3423.5	$25/2^+$	2700.7	$21/2^+$		
725.4 *3*	22	1932.5	$17/2^+$	1207.4	$13/2^+$	E2	Mult.: DCO(Q)=1.03 *5*, p=+0.31 *8*.
731.6 *3*	94	2818.7	$27/2^-$	2087.0	$23/2^-$	E2	Mult.: DCO(Q)=0.99 *1*, p=+0.25 *2*.
733.5 *3*	45	1448.9	$15/2^+$	715.5	$11/2^+$	E2	Mult.: DCO=1.01 *2*, p=+0.47 *7*.
749 *1*	<1	1719.7	$(15/2^+)$	970.3	$13/2^+$		
754.3 *6*	1.8	3663.0	$27/2^{(-)}$	2908.6	$23/2^{(-)}$		
757.5 *6*	6.1	8105.3	49/2	7347.8	$47/2^-$		
758.8 *6*	6.1	2074.5	$19/2^+$	1315.5	$15/2^+$	E2	Mult.: DCO=1.36 *6*.
759.1 *6*	17	4813.1	$35/2^-$	4053.8	$31/2^-$	E2	Mult.: DCO(Q)=0.96 *2*.

Continued on next page (footnotes at end of table)

^{90}Zr(^{31}P,2n2pγ) 1999Pa13 (continued)

$\gamma(^{117}I)$ (continued)

E_γ[‡]	I_γ[#]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[†]	Comments
764 *1*	<1	2104.7	$17/2^{(+)}$	1340.6	$(13/2^+)$		
768.6 *6*	5.1	4285.1	$31/2^+$	3516.1	$27/2^+$	E2	Mult.: DCO=1.00 *3*.
768.7 *3*	20	2700.7	$21/2^+$	1932.5	$17/2^+$	E2	Mult.: DCO=0.94 *5*, p=+0.29 *10*.
773.9 *6*	4.0	4095.9	$29/2^+$	3322.4	$25/2^+$		
775.7 *3*	13	5106.4	$35/2^+$	4330.6	$31/2^+$	E2	Mult.: DCO=1.13 *4*, p=+0.12 *7*.
777.2 *6*	6.5	5062.4	$35/2^+$	4285.1	$31/2^+$	E2	Mult.: DCO=0.99 *4*, p=+0.18 *10*.
782.4 *6*	<1	3423.5	$25/2^+$	2641.0	$23/2^-$		
788.9 *6*	8.7	6292.2	$43/2^+$	5503.4	$39/2^+$	E2	Mult.: DCO=1.00 *3*, p=+0.41 *7*.
789 *1*	<1	2104.7	$17/2^{(+)}$	1315.5	$15/2^+$		
795.0 *3*	40	2243.8	$19/2^+$	1448.9	$15/2^+$	E2	Mult.: DCO=1.06 *2*, p=+0.26 *6*.
797 *1*	10[a]	3709.1	$27/2^+$	2911.3	$23/2^+$	E2	
799 *1*	10[a]	4507.8	$31/2^+$	3709.1	$27/2^+$		
800 *1*	<1	2519.9	$(19/2^+)$	1719.7	$(15/2^+)$		
801 *1*	10[a]	2484.8	$21/2^+$	1682.9	$17/2^+$		
808 *1*	1.8	4078.8	$29/2^{(-)}$	3270.8	$25/2^{(-)}$	E2	Mult.: DCO=1.21 *7*.
810 *1*	<1.0	5492.0	$(37/2^+)$	4682.0	$33/2^+$		
811.7 *6*	2.0	2494.9	$19/2^+$	1682.9	$17/2^+$		
812.1 *6*	1	5626.0	$39/2^-$	4813.1	$35/2^-$	E2	Mult.: DCO(Q)=0.92 *4*.
815.5 *3*	37	3059.6	$23/2^+$	2243.8	$19/2^+$	E2	Mult.: DCO=0.98 *2*, p=+0.44 *9*.
820 *1*	<1	2924.5	$(21/2^+)$	2104.7	$17/2^{(+)}$		
837 *1*	15[b]	2911.3	$23/2^+$	2074.5	$19/2^+$	E2	Mult.: DCO=1.28 *7*.
838 *1*	15[b]	3322.4	$25/2^+$	2484.8	$21/2^+$	E2	Mult.: DCO=1.28 *7*.
838 *1*	15[b]	4934.3	$33/2^+$	4095.9	$29/2^+$	E2	Mult.: DCO=1.28 *7*.
841.0 *3*	88	3659.7	$31/2^-$	2818.7	$27/2^-$	E2	Mult.: DCO(Q)=1.01 *1*, p=+0.33 *2*.
852.6 *6*	4	3337.4	$25/2^+$	2484.8	$21/2^+$	E2	Mult.: DCO=1.27 *8*.
853 *1*	1.8	4516.4	$31/2^{(-)}$	3663.0	$27/2^{(-)}$	E2	Mult.: DCO=1.46 *8*.
853.1 *3*	16	5666.2	$39/2^-$	4813.1	$35/2^-$	E2	Mult.: DCO(Q)=1.03 *2*, p=+0.41 *16*.
860.2 *6*	5.0	9184.1	$55/2^+$	8323.6	$51/2^+$	E2	Mult.: DCO=1.18 *7*, p=+0.38 *9*.
876.2 *6*	<1	2981.3	$(21/2^+)$	2105.4	$19/2^-$		
879.5 *3*	12	5986.0	$39/2^+$	5106.4	$35/2^+$	E2	Mult.: DCO=1.20 *8*, p=+0.35 *10*.
888.1 *6*	2.1	5395.1	$35/2^+$	4507.8	$31/2^+$		
888.5 *6*	1.4	7180.8	$47/2^+$	6292.2	$43/2^+$	E2	Mult.: DCO=0.97 *4*, p=+0.19 *8*.
896.2 *6*	2.1	4974.5	$33/2^{(-)}$	4078.8	$29/2^{(-)}$	E2	
896.3 *6*	<1	8226.5	$51/2^+$	7330.6	$47/2^+$		
915.4 *6*	1.5	11184	$61/2^+$	10268.9	$59/2^+$	M1,E2	Mult.: DCO=0.21 *2*, p=−0.15 *8*.
932.6 *6*	1.8	5449.2	$35/2^{(-)}$	4516.4	$31/2^{(-)}$	E2	Mult.: DCO=1.31 *8*.
940.9 *6*	2.1	5875.6	$(37/2^+)$	4934.3	$33/2^+$	E2	
941.3 *3*	82	4601.0	$35/2^-$	3659.7	$31/2^-$	E2	Mult.: DCO=1.04 *1*, p=+0.47 *3*.
946.0 *6*	1.0	2261.6	$17/2^+$	1315.5	$15/2^+$	D,Q	Mult.: DCO=0.87 *9*.
948.1 *6*	0.8	10132.2	$57/2^+$	9184.1	$55/2^+$	D,Q	
955.1 *6*	<1	5768.2	$(39/2^-)$	4813.1	$35/2^-$		
958.0 *6*	2.9	9184.1	$55/2^+$	8226.5	$51/2^+$	E2	Mult.: DCO=0.95 *5*, p=+0.64 *17*.
961.9 *6*	2.0	5936.2	$37/2^{(-)}$	4974.5	$33/2^{(-)}$	E2	Mult.: DCO=1.63 *13*.
968.0 *6*	4.1	6634.5	$43/2^-$	5666.2	$39/2^-$	E2	Mult.: DCO=0.94 *4*.
978.0 *3*	12	6964.2	$43/2^+$	5986.0	$39/2^+$	E2	Mult.: DCO=0.95 *6*, p=+0.41 *11*.
988 *1*	<1	1340.6	$(13/2^+)$	352.8	$9/2^+$		
988 *1*	2.0	9443.9	$(51/2^+)$	8456	$(47/2^+)$		
992.6 *6*	5.3	8323.6	$51/2^+$	7330.6	$47/2^+$	E2	Mult.: DCO=0.97 *4*, p=+0.17 *8*.
996 *1*	1.4	8343.8	51/2	7347.8	$47/2^-$		
996.1 *6*	1.8	6391.0	$(39/2^+)$	5395.1	$35/2^+$		
998.9 *6*	1.6	6448.2	$(39/2^-)$	5449.2	$35/2^{(-)}$		
1008.5 *3*	48	6634.5	$43/2^-$	5626.0	$39/2^-$	E2	Mult.: DCO=1.09 *3*, p=+0.27 *7*.
1014.3 *3*	10	8362.1	$51/2^-$	7347.8	$47/2^-$	E2	Mult.: DCO=1.00 *3*.
1021.3 *6*	3	9383.4		8362.1	$51/2^-$		

Continued on next page (footnotes at end of table)

^{90}Zr(^{31}P,2n2pγ) 1999Pa13 (continued)

$\gamma(^{117}I)$ (continued)

E_γ[‡]	I_γ[#]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[†]	Comments
1025.0 *3*	61	5626.0	$39/2^-$	4601.0	$35/2^-$	E2	Mult.: DCO=1.01 *2*, p=+0.37 *5*.
1031.3 *6*	1.5	6967.5	$(41/2^-)$	5936.2	$37/2^{(-)}$		
1038.5 *6*	5.4	7330.6	$47/2^+$	6292.2	$43/2^+$	E2	Mult.: DCO=1.12 *4*, p=+0.47 *16*.
1045.3 *3*	42	7679.8	$47/2^-$	6634.5	$43/2^-$	E2	Mult.: DCO=1.04 *3*, p=+0.51 *8*.
1045.5 *6*	2.0	8226.5	$51/2^+$	7180.8	$47/2^+$	E2	Mult.: DCO=0.99 *4*, p=+0.19 *21*.
1048.7 *6*	<1	2981.3	$(21/2^+)$	1932.5	$17/2^+$		
1056.1 *6*	2.0	6931.6	$(41/2^+)$	5875.6	$(37/2^+)$		
1064.5 *3*	11	8028.8	$47/2^+$	6964.2	$43/2^+$	E2	Mult.: DCO=1.13 *9*, p=+0.21 *11*.
1065.7 *3*	18	5666.2	$39/2^-$	4601.0	$35/2^-$	E2	Mult.: DCO=1.01 *2*, p=+0.38 *10*.
1074.5 *3*	19	7347.8	$47/2^-$	6273.4	$43/2^-$	E2	Mult.: DCO=1.07 *3*, p=+0.61 *10*.
1079.6 *6*	1.4	7527.8	$(43/2^-)$	6448.2	$(39/2^-)$		
1081.3 *6*	8.1	12325.1	$(63/2^-)$	11244.1	$59/2^-$		
1084.4 *6*	1.6	6750.5	$43/2^-$	5666.2	$39/2^-$		
1084.7 *6*	2.0	10268.9	$59/2^+$	9184.1	$55/2^+$	E2	Mult.: DCO=1.05 *5*, p=+0.34 *8*.
1087 *1*	<1	10530.7	$(55/2^+)$	9443.9	$(51/2^+)$		
1091.6 *6*	3.1	2105.4	$19/2^-$	1014.0	$15/2^-$	E2	Mult.: DCO=1.10 *5*.
1113 *1*	1.4	7504.0	$(43/2^+)$	6391.0	$(39/2^+)$		
1119.8 *6*	1.2	8087.3	$(45/2^-)$	6967.5	$(41/2^-)$		
1125.0 *3*	30	8804.8	$51/2^-$	7679.8	$47/2^-$	E2	Mult.: DCO=0.98 *3*, p=+0.42 *8* for 1125.0+1125.4.
1125.4 *6*	4.0	6750.5	$43/2^-$	5626.0	$39/2^-$	E2	Mult.: DCO=0.98 *3*, p=+0.42 *8* for 1125.4+1125.0.
1131 *1*	0.4	12325.1	$(63/2^-)$	11193.9	$59/2^-$		
1140 *1*	5.0	7890.3	$47/2^-$	6750.5	$43/2^-$	E2	Mult.: DCO=1.37 *10*.
1142.7 *6*	<1	2826.0	$(19/2^+)$	1682.9	$17/2^+$		
1146.0 *3*	11	9174.9	$51/2^+$	8028.8	$47/2^+$	E2	Mult.: DCO=1.00 *8*, p=+0.26 *10*.
1155.9 *3*	16.8	11193.9	$59/2^-$	10037.8	$55/2^-$	E2	Mult.: DCO=0.89 *5*, p=+0.29 *9*.
1157 *1*	5.1	2641.0	$23/2^-$	1484.2	$19/2^-$		
1157 *1*		9263		8105.3	49/2		
1164.2 *6*	1.0	8692.0	$(47/2^-)$	7527.8	$(43/2^-)$		
1166 *1*	1.6	8097.5	$(45/2^+)$	6931.6	$(41/2^+)$		
1175.5 *6*	3	11705.8	$59/2^+$	10530.7	$(55/2^+)$		
1176 *1*	1.6	10439		9263			
1178 *1*	6.4[c]	10037.8	$55/2^-$	8859.0	$51/2^-$	E2	Mult.: DCO=1.08 *6*.
1179 *1*	6.4[c]	8859.0	$51/2^-$	7679.8	$47/2^-$	E2	Mult.: DCO=1.08 *6*.
1187.2 *6*	<1	9274.5	$(49/2^-)$	8087.3	$(45/2^-)$		
1191.8 *6*	4.6	9082.1	$(51/2^-)$	7890.3	$47/2^-$		
1195.9 *6*	4.0	13521.0	$(67/2^-)$	12325.1	$(63/2^-)$		
1206.6 *3*	15	11244.1	$59/2^-$	10037.8	$55/2^-$	E2	Mult.: DCO=1.10 *7*.
1213.2 *6*	<1.0	8717.2	$(47/2^+)$	7504.0	$(43/2^+)$		
1217.1 *6*	2.5	10299.2	$(55/2^-)$	9082.1	$(51/2^-)$		
1228.6 *6*	10	10404.0	$55/2^+$	9174.9	$51/2^+$	E2	Mult.: DCO=1.11 *9*, p=+0.37 *12*.
1233.1 *3*	23	10037.8	$55/2^-$	8804.8	$51/2^-$	E2	Mult.: DCO=0.98 *4*, p=+0.64 *11*.
1240.1 *6*	<1	9932.1	$(51/2^-)$	8692.0	$(47/2^-)$		
1255.5 *6*	2.4	7890.3	$47/2^-$	6634.5	$43/2^-$		
1265.1 *6*	9.8	12970.9	$63/2^+$	11705.8	$59/2^+$	E2	Mult.: DCO=0.92 *9*.
1266.5 *6*	<1	3354.0	$27/2^-$	2087.0	$23/2^-$		
1273 *1*	1.4	9370.6	$(49/2^+)$	8097.5	$(45/2^+)$		
1288.3 *6*	8.4	3374.5	$25/2^+$	2087.0	$23/2^-$	E1	Mult.: DCO=0.71 *3*, p=+0.21 *12*.
1297.2 *6*	1.8	11596.4	$(59/2^-)$	10299.2	$(55/2^-)$		
1301.3 *6*	9.9	11705.8	$59/2^+$	10404.0	$55/2^+$	E2	Mult.: DCO=0.95 *9*.
1337.1 *6*	<1	3423.5	$25/2^+$	2087.0	$23/2^-$		
1356.2 *6*	<1.0	10530.7	$(55/2^+)$	9174.9	$51/2^+$		
1356.8 *6*	9	14327.7	$(67/2^+)$	12970.9	$63/2^+$		
1380 *1*	1.0	10750.6	$(53/2^+)$	9370.6	$(49/2^+)$		
1407.2 *6*	4.1	7679.8	$47/2^-$	6273.4	$43/2^-$	E2	Mult.: DCO=1.05 *8*.
1457 *6*	0.3	8804.8	$51/2^-$	7347.8	$47/2^-$	E2	Mult.: DCO=0.97 *7*.

Continued on next page (footnotes at end of table)

^{90}Zr(^{31}P,2n2pγ) 1999Pa13 (continued)

$\gamma(^{117}I)$ (continued)

E_γ[‡]	I_γ[#]	E_i(level)	J_i^π	E_f	J_f^π	Comments
1495.4 *6*	8.7	15823.1	$(71/2^+)$	14327.7	$(67/2^+)$	
1497.1 *6*	<1	2981.3	$(21/2^+)$	1484.2	$19/2^-$	
1576		7242		5666.2	$39/2^-$	E_γ: from Figure 1.
[x]1593 *1*	<1					E_γ: placement from 10038, $55/2^-$ to 8362, $51/2^-$ as shown in figure 1 and table I of 1999Pa13 is incorrect from energy difference (compilers).
1636 *1*	8.2	17459.1	$(75/2^+)$	15823.1	$(71/2^+)$	
1723 *1*	<1	2693.6	$(17/2^+)$	970.3	$13/2^+$	
1765 *1*	7.2	19224	$(79/2^+)$	17459.1	$(75/2^+)$	
1903 *1*	4.1	21127	$(83/2^+)$	19224	$(79/2^+)$	

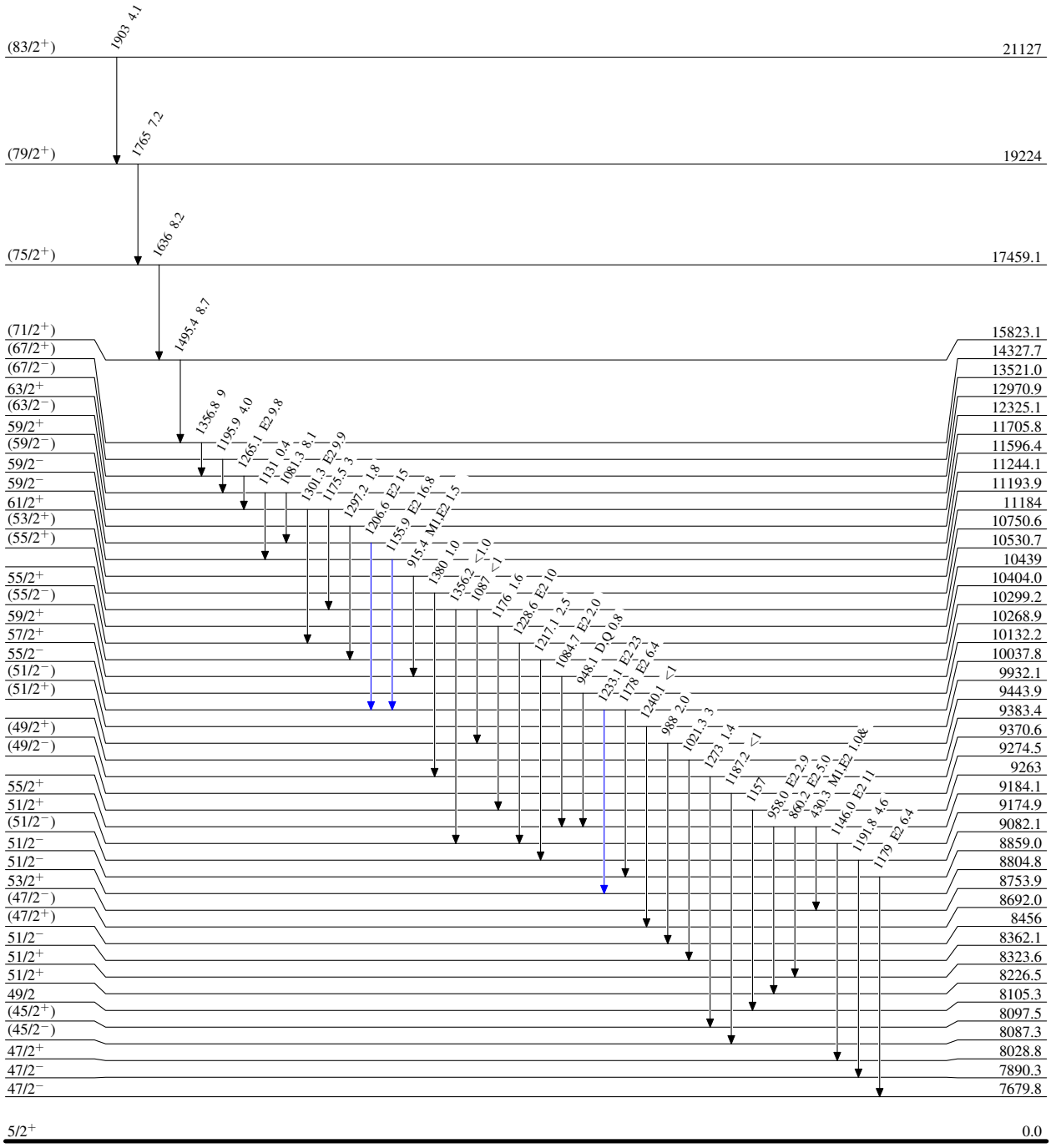
[†] Based on $\gamma\gamma(\theta)$(DCO) data and linear polarization.
[‡] Uncertainty of 0.3 keV for strong gamma rays and 0.6 keV for others assigned (by evaluator) based on authors′ statement.
[#] Authors estimate uncertainties as less than 5% for strong ($I\gamma>10$) transitions and less than 10% for weaker transitions.
[@] Combined intensity for triplet: 410.2, 411 and 412. DCO ratios and polarization coefficients correspond to the triplet.
[&] Combined intensity for triplet: 425, 426 and 427. DCO ratios and polarization coefficients correspond to the triplet.
[a] Combined intensity for triplet: 797, 799 and 801.
[b] Combined intensity for triplet: 837, 838 and 838. DCO ratios and polarization coefficients correspond to the triplet.
[c] Combined intensity for 1178 and 1179 doublet. DCO ratios and polarization coefficients correspond to the doublet.
[d] Multiply placed with undivided intensity.
[e] Placement of transition in the level scheme is uncertain.
[x] γ ray not placed in level scheme.

^{90}Zr(^{31}P,2n2pγ) 1999Pa13

Level Scheme

Intensities: Relative I_γ
& Multiply placed: undivided intensity given

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



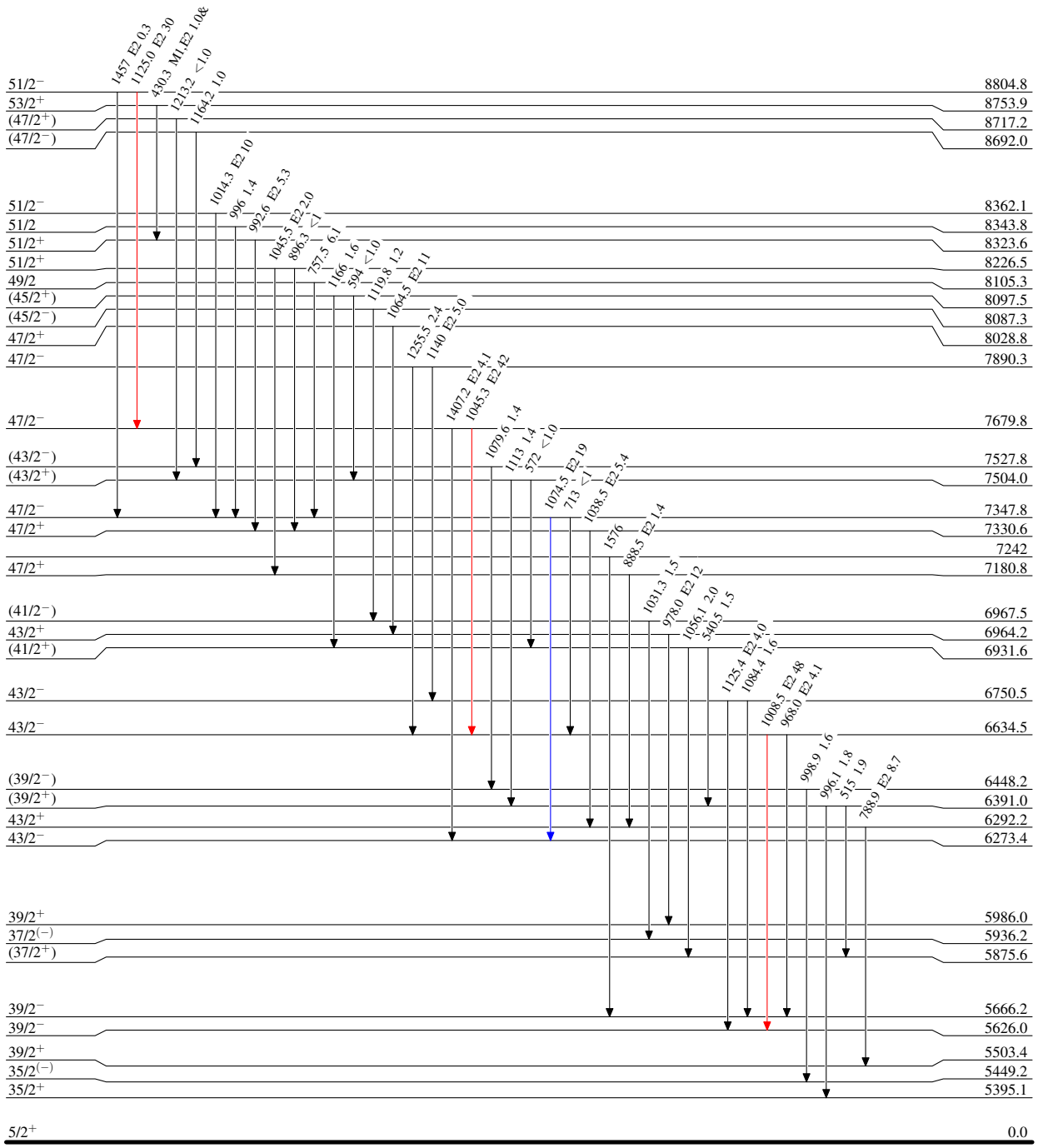
$^{117}_{53}I_{64}$

^{90}Zr(^{31}P,2n2pγ) 1999Pa13

Level Scheme (continued)

Intensities: Relative I_γ
& Multiply placed: undivided intensity given

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



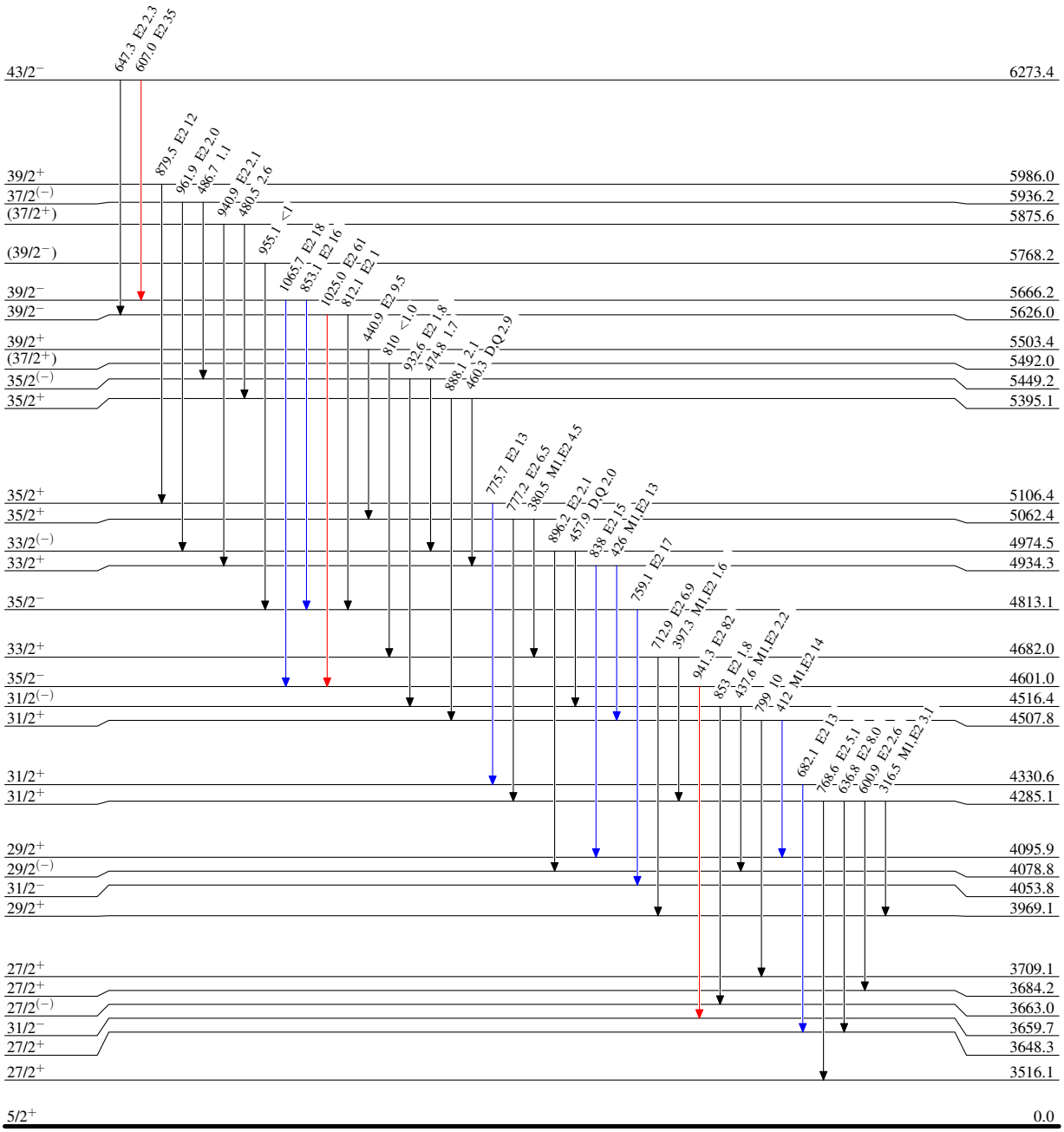
$^{117}_{53}I_{64}$

^{90}Zr(^{31}P,2n2pγ) 1999Pa13

Level Scheme (continued)

Intensities: Relative I_γ
& Multiply placed: undivided intensity given

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



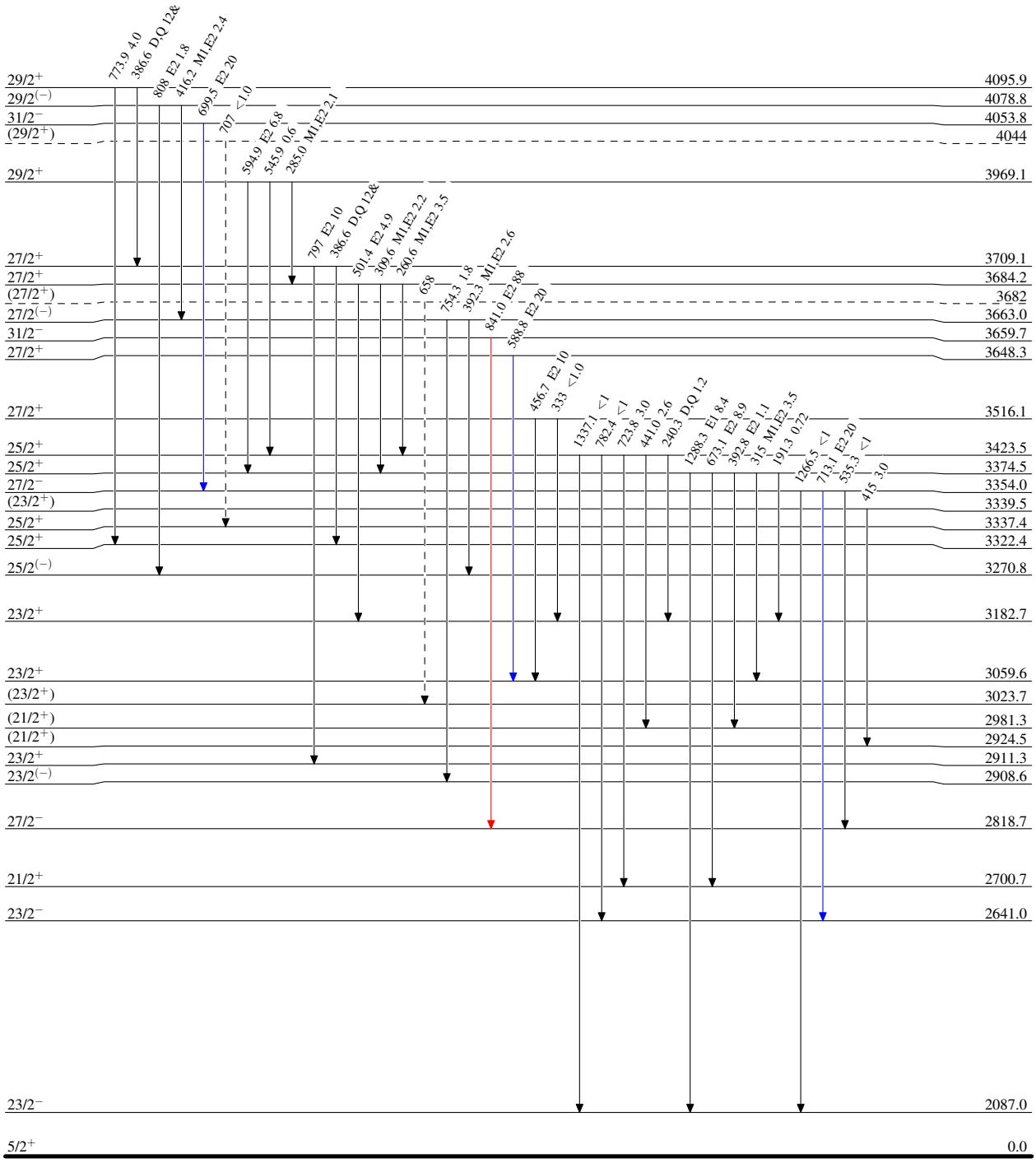
$^{117}_{53}I_{64}$

^{90}Zr(^{31}P,2n2pγ) 1999Pa13

Level Scheme (continued)

Intensities: Relative I_γ
& Multiply placed: undivided intensity given

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

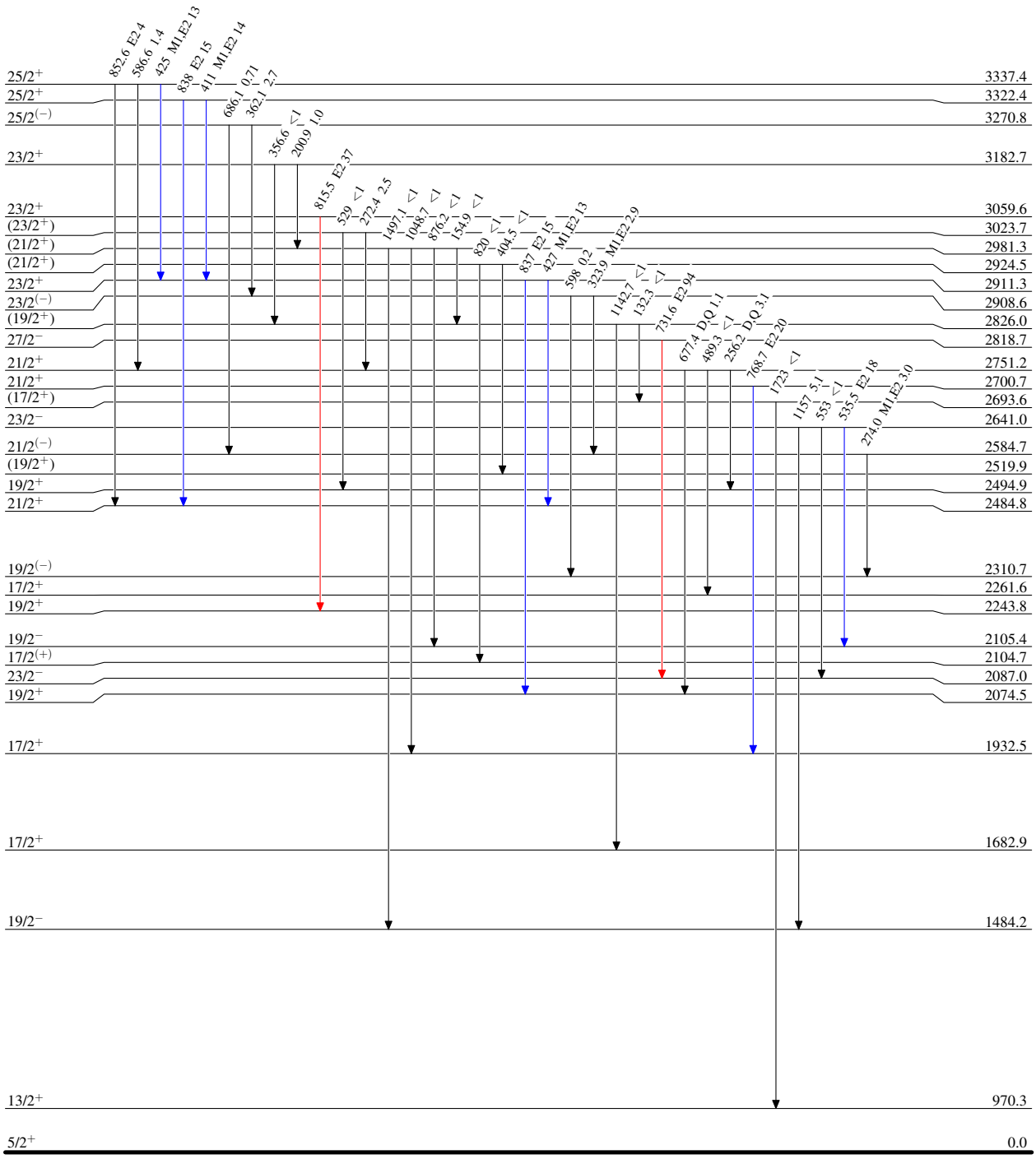


^{90}Zr(^{31}P,2n2pγ) 1999Pa13

Level Scheme (continued)

Intensities: Relative I_γ
& Multiply placed: undivided intensity given

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



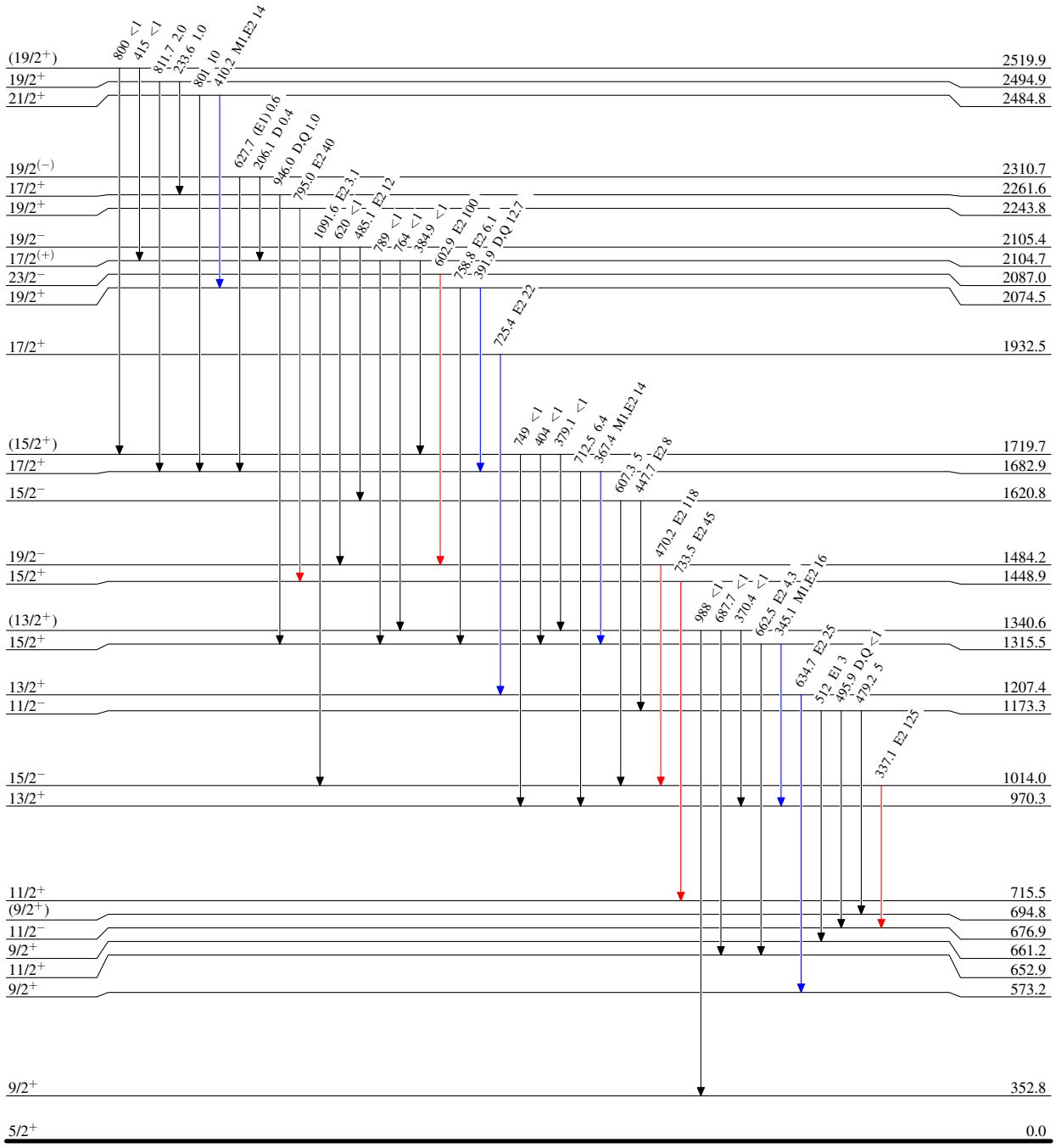
$^{117}_{53}I_{64}$

^{90}Zr(^{31}P,2n2pγ) 1999Pa13

Level Scheme (continued)

Intensities: Relative I_γ
& Multiply placed: undivided intensity given

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



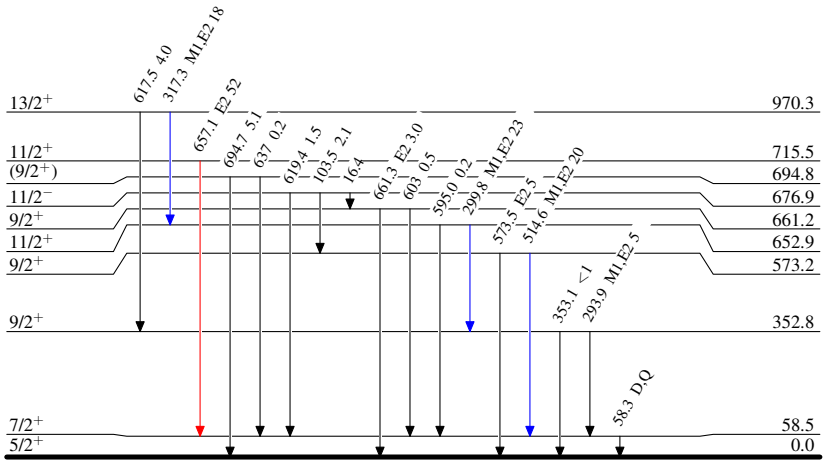
$^{117}_{53}I_{64}$

^{90}Zr(^{31}P,2n2pγ) 1999Pa13

Level Scheme (continued)

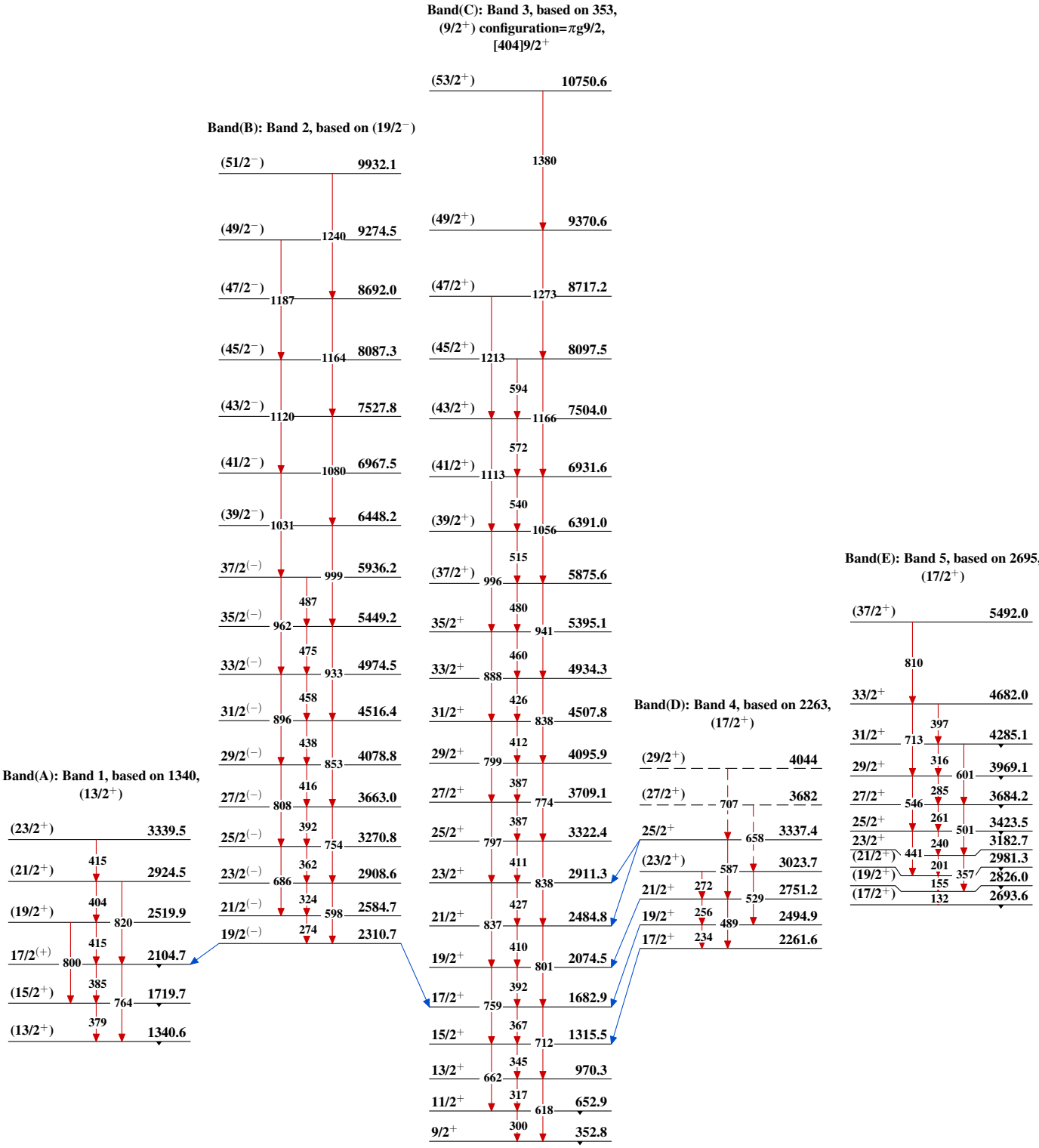
Intensities: Relative I_γ
& Multiply placed: undivided intensity given

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



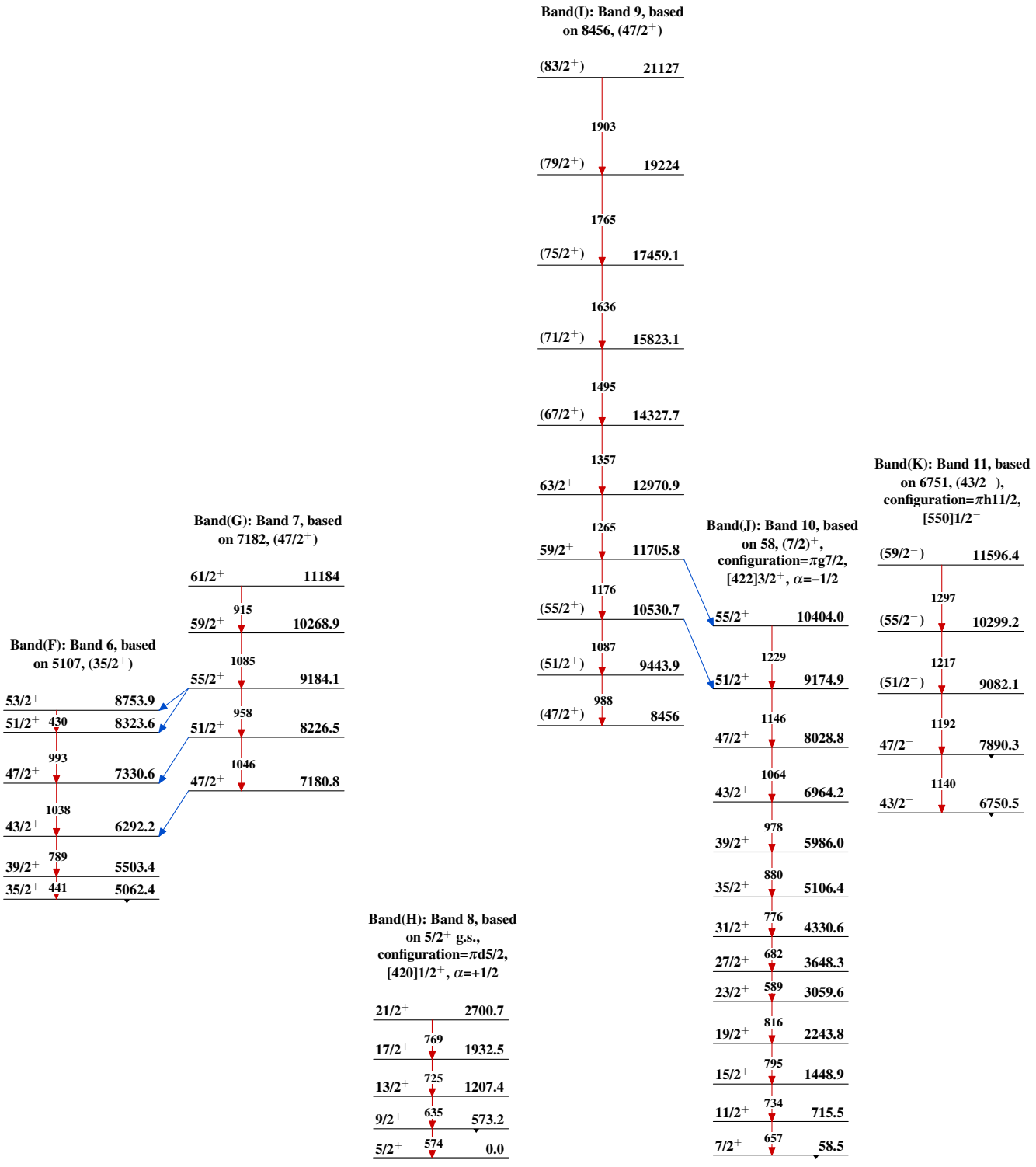
$^{117}_{53}I_{64}$

$^{90}Zr(^{31}P,2n2p\gamma)$ 1999Pa13



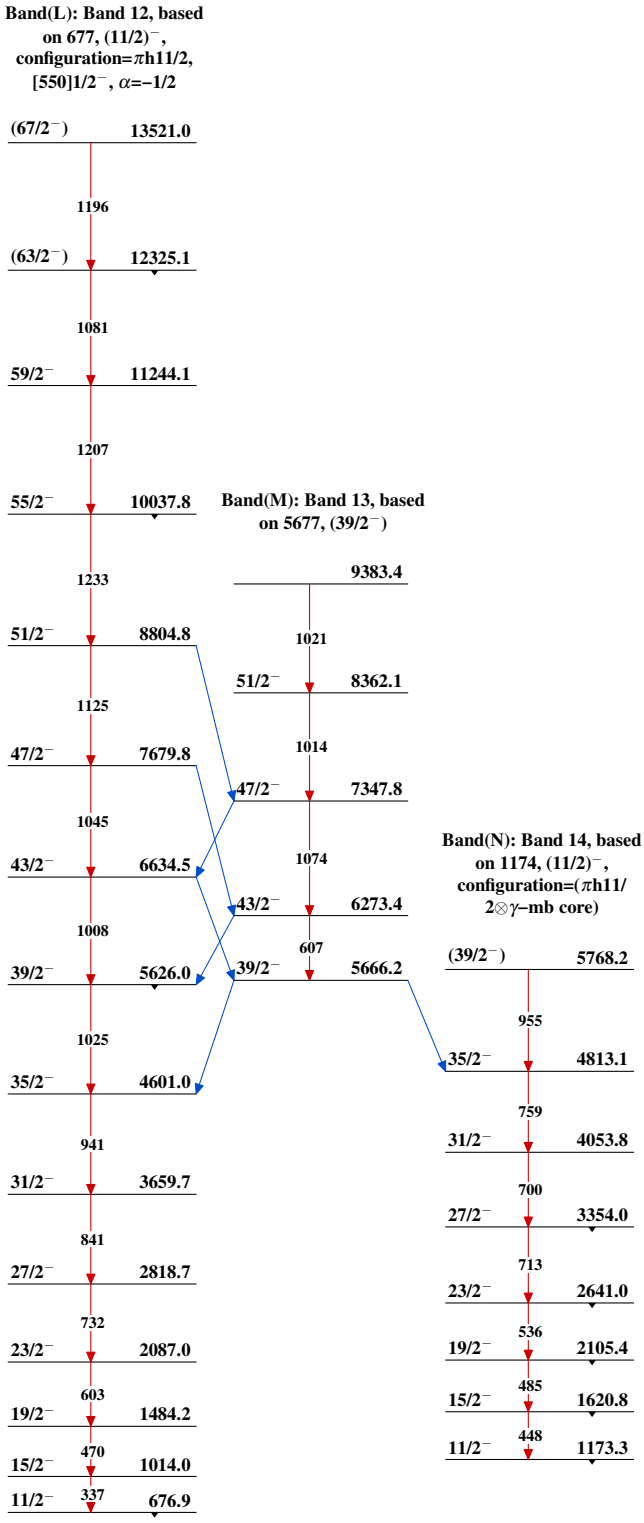
$^{117}_{53}I_{64}$

^{90}Zr(^{31}P,2n2pγ) 1999Pa13 (continued)



$^{117}_{53}I_{64}$

^{90}Zr(^{31}P,2n2pγ) 1999Pa13 (continued)



$^{117}_{53}I_{64}$