

Adopted Levels, Gammas

Type	History		Literature Cutoff Date
	Author	Citation	
Full Evaluation	Jean Blachot	ENSDF	1-Jul-2006

$Q(\beta^-)=5717$ 10; $S(n)=4860$ 12; $S(p)=13126$ 14; $Q(\alpha)=-7013$ 10 [2012Wa38](#)

Note: Current evaluation has used the following Q record 5485 254920 5013450 80-7090 40 [2003Au03](#).

The existence of strong deformation in the range $\beta \approx 0.3-0.4$ has been determined by [1995Lh01](#).

 ^{101}Zr LevelsCross Reference (XREF) Flags

- A** ^{101}Y β^- decay
B ^{248}Cm SF decay
C $^{238}\text{U}(\alpha, F\gamma)$
D ^{252}Cf SF decay

<u>E(level)[†]</u>	<u>J^π[‡]</u>	<u>T_{1/2}[#]</u>	<u>XREF</u>	<u>Comments</u>
0 [@]	(3/2 ⁺)	2.3 s 1	ABCD	$g_0\beta^- = 100$ J ^π : from systematics, assumed bandhead of K=3/2 band. E(level): g.s. assignment probable from similarity of its β decay half-life with ^{99}Zr g.s. T _{1/2} : average of 2.0 s 3 via growth-decay curve (276 γ , ^{101}Mo) (1972Tr08), 2.2 s 3 via I γ (307 γ , ^{101}Ru) with timed zirconium separations (1972Tr08) and 2.4 s 1 (1991Oh03) Other: 3.3 s 6 (293 γ -decay curve) (1970Ei02). $^{235}\text{U}(n,F)$ ms, was reassigned to ^{102}Nb by 1972Tr08 , 1976Ah06 .
98.16 ^{&} 5	(5/2 ⁺)	0.6 ns 2	ABCD	$g=+0.047$ 26 (2006Or05) J ^π : M1+E2 γ to (3/2 ⁺). T _{1/2} : Average of 0.9 ns 3 (1987Oh01) and 0.39 ns 18 (1995Lh01). g: from (134 γ)(98 γ)(θ) and (223 γ)(98 γ)(θ). $g_K=-0.59$ 15, $g_R=+0.26$ 4; assuming $Q_0=4.1$ 2.
216.67 ^a 5	(5/2 ⁻)	0.33 ns 12	AB D	$g=-0.19$ 10 (2006Or05) g: from (104 γ)(217 γ)(θ). $g_K=-0.36$ 11, $g_R=+0.23$ 10; assuming $Q_0=3.9$ 3. J ^π : 3/2 suggested by 1983Wo10 is ruled out by 1990Ho12 and 1995Lh01 on γ decay considerations.
231.80 [@] 6	(7/2 ⁺)	<0.07 ns	ABCD	$g=+0.17$ 14 (2006Or05) g: from (177 γ)[134 γ](98 γ)(θ), (177 γ)(134 γ)(θ) and (379 γ)(134 γ)(θ). J ^π : M1 γ to (5/2 ⁺).
321.11 ^b 6	(7/2 ⁻)	0.27 ns 13	ABCD	$g=-0.039$ 32 (2006Or05) g: from (147 γ)(104 γ)(θ) and (147 γ)(223 γ)(θ). $g_K=-0.39$ 6, $g_R=+0.19$ 4; assuming $Q_0=3.9$ 3. J ^π : M1 γ to (5/2 ⁻).
408.26 ^{&} 8	(9/2 ⁺)		ABCD	
467.77 ^a 8	(9/2 ⁻)		ABCD	
610.58 [@] 21	(11/2 ⁺)		BCD	
619.86 ^b 14	(11/2 ⁻)		BCD	
673.52 16	(3/2, 5/2)		A	J ^π : Possible [532]5/2 Nilsson state.
744.01 10	(3/2, 5/2)		A	J ^π : Possible [541]3/2 Nilsson state.
759.48 7	(3/2 ⁺)		A	J ^π : Possible [422]3/2 Nilsson state.
786.66 11	(5/2, 7/2)		AB	J ^π : Strong beta feeding from (5/2 ⁺) parent.
808.46 11	(5/2, 7/2)		A	J ^π : Strong beta feeding from (5/2 ⁺) parent.
827.78 10			A	
845.19 20	(7/2 ⁻)		AB	J ^π : Possible [523]7/2 Nilsson state.

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Adopted Levels, Gammas (continued) ^{101}Zr Levels (continued)

E(level) [†]	J ^π [‡]	T _{1/2} [#]	XREF	Comments
858.5 ^{&} 3	(13/2 ⁺)		BCD	
869.7 ^a 4	(13/2 ⁻)		BCD	
880.37 10			A	
902.49 19			A	
941.81 ^c 23	(9/2 ⁺)	16 ns 2	B D	T _{1/2} : from 2004Ur06. J ^π : spin from $\gamma\gamma(\theta)$, parity from Weisskopf estimates. This level is interpreted as a K-isomer (2004Ur06) corresponding to the 9/2 [404] neutron-hole excitation.
958.76 25			A	
1038.4 3			A	
1047.9 ^b 4	(15/2 ⁻)		BCD	
1077.1 10			B	
1120.6 [@] 4	(15/2 ⁺)		BCD	
1164.6 ^c 8	(11/2 ⁺)		B D	
1217.2 10			B	
1297.90 11			A	
1398.55 13	(3/2,5/2) ⁺		A	J ^π : Possible [402]3/2 Nilsson state, log ft=5.5 from (5/2 ⁺) parent.
1424.5 ^c 7	(13/2 ⁺)		B D	
1432.2 ^a 4	(17/2 ⁻)		BC	
1436.8 ^{&} 4	(17/2 ⁺)		BC	
1523.9 10			B	
1529.93 14			A	
1616.9 ^b 4	(19/2 ⁻)		BC	
1720.1 ^c 8	(15/2 ⁺)		B	
1749.7 [@] 8	(19/2 ⁺)		BC	
1942.2 13			B	
2023.17 16	(3/2,5/2) ⁺		A	J ^π : log ft=5.7 from (5/2 ⁺) parent.
2051.4 ^c 9	(17/2 ⁺)		B	
2082.9 4			A	
2133.5 ^{&} 8	(21/2 ⁺)		BC	
2152.1 ^a 6	(21/2 ⁻)		BC	
2267.2 16			B	
2329.4 ^b 8	(23/2 ⁻)		BC	
2416.4 ^c 14			B	
2488.3 [@] 11	(23/2 ⁺)		BC	
2787.2 19			B	
2943.3 ^{&} 13	(25/2 ⁺)		C	
3022.9 ^a 12	(25/2 ⁻)		C	
3182.3 ^b 13	(27/2 ⁻)		C	
3336.4 [@] 15	(27/2 ⁺)		C	
3858.4 ^{&} 17	(29/2 ⁺)		C	
4036.1 ^a 16	(29/2 ⁻)		C	
4165.6 ^b 17	(31/2 ⁻)		C	
4293.4 [@] 18	(31/2 ⁺)		C	
4876.4 ^{&} 19	(33/2 ⁺)		C	
5164.0 ^a 19	(33/2 ⁻)		C	
5255.8 ^b 19	(35/2 ⁻)		C	
5357.5 [@] 21	(35/2 ⁺)		C	
6003.2 ^{&} 22	(37/2 ⁺)		C	

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Adopted Levels, Gammas (continued) ^{101}Zr Levels (continued)

<u>E(level)[†]</u>	<u>Jπ[‡]</u>	<u>XREF</u>
6411.3 ^b 22	(39/2 ⁻)	C
6506.2 [@] 23	(39/2 ⁺)	C

[†] From a least-squares fit to the γ data.

[‡] The level spacings of g.s. band are in agreement with calculated rotational spacings with $K^\pi=3/2^+$. The side band most probably has opposite parity to that of the g.s. band. The possible spin values for the 217 keV are 1/2 to 7/2 but 1/2, 3/2, 7/2 are ruled out and only 5/2 seems probable (1990Ho12). 1995Lh01 assign this band to the [532] Nilsson state. J^π 's without comments are based on the assigned bands.

From 1995Lh01 using centroid shift measurement, except as noted.

@ Band(A): $\nu 3/2[411]$, $\alpha=-1/2$.

& Band(a): $\nu 3/2[411]$, $\alpha=+1/2$.

^a Band(B): $\nu 5/2[532]$, $\alpha=+1/2$.

^b Band(b): $\nu 5/2[532]$, $\alpha=-1/2$.

^c Band(C): $\nu 9/2[404]$, $K^\pi=9/2^+$ isomer band. $Q_0=3.6$ 4, $\beta_2=0.38$ 4.

Adopted Levels, Gammas (continued)

$\gamma(^{101}\text{Zr})$									
$E_i(\text{level})$	J_i^π	$E_\gamma^\dagger$	$I_\gamma^\dagger$	E_f	J_f^π	Mult.	δ	$\alpha^\ddagger$	Comments
98.16	(5/2 ⁺)	98.21 6	100	0	(3/2 ⁺)	M1(+E2)	-0.11 4		B(M1)(W.u.)=(0.036 13); B(E2)(W.u.)=(3.E+2 +4-3) (g _K -g _R)/Q ₀ =-0.36 14.
216.67	(5/2 ⁻)	118.56 12	12.1 8	98.16	(5/2 ⁺)	[E1]		0.0691	B(E1)(W.u.)=6.1×10 ⁻⁵ 23
		216.68 7	100 4	0	(3/2 ⁺)	[E1]		0.01217	B(E1)(W.u.)=8.E-5 3
231.80	(7/2 ⁺)	133.67 6	100 4	98.16	(5/2 ⁺)	M1+E2	-0.25 5	0.0915	B(M1)(W.u.)>0.091 (g _K -g _R)/Q ₀ =-0.147 26. (134γ)(98γ)(θ): A ₂ =+0.269 12, A ₄ =+0.018 17.
		231.91 15	45 3	0	(3/2 ⁺)	[E2]		0.0539	B(E2)(W.u.)>1.3×10 ²
321.11	(7/2 ⁻)	89.35 11	14 6	231.80	(7/2 ⁺)	[E1]		0.1585	B(E1)(W.u.)=0.00012 8
		104.43 7	100 5	216.67	(5/2 ⁻)	M1+E2	-0.188 21	0.29 10	B(M1)(W.u.)=0.033 17; B(E2)(W.u.)=4.E+2 5 (g _K -g _R)/Q ₀ =-0.154 17. (104γ)(217γ)(θ): A ₂ =+0.136 10, A ₄ =-0.010 15. (223γ)(98γ)(θ): A ₂ =+0.119 21, A ₄ =-0.054 32.
408.26	(9/2 ⁺)	222.97 7	75 10	98.16	(5/2 ⁺)				
		87.44 19	45 14	321.11	(7/2 ⁻)	[E1]		0.1689	
		176.44 9	92 5	231.80	(7/2 ⁺)	M1+E2	-0.133 25	0.0441	(g _K -g _R)/Q ₀ =-0.28 5. (177γ)[134γ](98γ)(θ): A ₂ =+0.335 15, A ₄ =+0.033 22. (177γ)(134γ)(θ): A ₂ =+0.255 14, A ₄ =+0.022 20.
467.77	(9/2 ⁻)	309.98 12	100 5	98.16	(5/2 ⁺)				
		146.64 7	100 5	321.11	(7/2 ⁻)	M1+E2	-0.216 19	0.0713	(g _K -g _R)/Q ₀ =-0.144 13. (147γ)(104γ)(θ): A ₂ =+0.309 13, A ₄ =-0.024 18. (147γ)(223γ)(θ): A ₂ =+0.139 19, A ₄ =-0.028 28. I _γ : I _γ =15 in SF decay. I _γ : I _γ =52 in SF decay.
		236.20 23	16.4 10	231.80	(7/2 ⁺)				
		251.18 24	27.5 20	216.67	(5/2 ⁻)				
610.58	(11/2 ⁺)	142.8 4	10 3	467.77	(9/2 ⁻)				
		202.3 4	30 4	408.26	(9/2 ⁺)				
		378.8 4	100 7	231.80	(7/2 ⁺)				
619.86	(11/2 ⁻)	152.1 2	100 5	467.77	(9/2 ⁻)	M1+E2	-0.183 18		(379γ)(134γ)(θ): A ₂ =-0.175 13, A ₄ =-0.022 18. (g _K -g _R)/Q ₀ =-0.143 15.
		211.5 4	7 2	408.26	(9/2 ⁺)				
		298.8 2	91 5	321.11	(7/2 ⁻)				
673.52	(3/2,5/2)	575.47 18	100 14	98.16	(5/2 ⁺)				
		673.2 3	90 46	0	(3/2 ⁺)				
744.01	(3/2,5/2)	423.0 7	9 5	321.11	(7/2 ⁻)				
		527.32 12	100 23	216.67	(5/2 ⁻)				
		645.9 5	14 6	98.16	(5/2 ⁺)				
		744.02 14	34 8	0	(3/2 ⁺)				
759.48	(3/2 ⁺)	661.39 12	48 4	98.16	(5/2 ⁺)				
		759.45 7	100 10	0	(3/2 ⁺)				
786.66	(5/2,7/2)	378.1 7	8 5	408.26	(9/2 ⁺)				
		554.92 14	98 19	231.80	(7/2 ⁺)				
		571.1 6	19 9	216.67	(5/2 ⁻)				
		688.40 17	100 13	98.16	(5/2 ⁺)				

Adopted Levels, Gammas (continued)

$\gamma(^{101}\text{Zr})$ (continued)						
$E_i(\text{level})$	J_i^π	E_γ †	I_γ †	E_f	J_f^π	Mult.
786.66	(5/2,7/2)	786.5 3	26 8	0	(3/2 ⁺)	
808.46	(5/2,7/2)	487.44 19	100 14	321.11	(7/2 ⁻)	
		577.2 5	33 14	231.80	(7/2 ⁺)	
		592.1 3	67 22	216.67	(5/2 ⁻)	
		710.1 6	17 11	98.16	(5/2 ⁺)	
		808.29 15	61 17	0	(3/2 ⁺)	
827.78		596.4 4	15 8	231.80	(7/2 ⁺)	
		729.57 16	100 11	98.16	(5/2 ⁺)	
		827.77 13	42 10	0	(3/2 ⁺)	
845.19	(7/2 ⁻)	377.49 22	57 21	467.77	(9/2 ⁻)	
		524.0 4	64 29	321.11	(7/2 ⁻)	
		746.7 6	100 29	98.16	(5/2 ⁺)	
858.5	(13/2 ⁺)	238.7 5	5 2	619.86	(11/2 ⁻)	
		247.9 4	45 3	610.58	(11/2 ⁺)	
		450.2 5	100 5	408.26	(9/2 ⁺)	
869.7	(13/2 ⁻)	249.8 5	100 6	619.86	(11/2 ⁻)	
		401.8 5	95 5	467.77	(9/2 ⁻)	
880.37		648.59 16	100 17	231.80	(7/2 ⁺)	
		782.2 4	17 6	98.16	(5/2 ⁺)	
		880.36 13	96 14	0	(3/2 ⁺)	
902.49		494.2 3	86 36	408.26	(9/2 ⁺)	
		670.67 24	100 36	231.80	(7/2 ⁺)	
		804.5 5	79 36	98.16	(5/2 ⁺)	
941.81	(9/2 ⁺)	322.2 5	13 3	619.86	(11/2 ⁻)	E1
		331.4 5	17 3	610.58	(11/2 ⁺)	(M1+E2)
		474.2 4	74 5	467.77	(9/2 ⁻)	E1
		533.7 4	29 2	408.26	(9/2 ⁺)	
		620.9 4	6 2	321.11	(7/2 ⁻)	E1
		710.2 4	100 5	231.80	(7/2 ⁺)	
		843.8 4	54 4	98.16	(5/2 ⁺)	E2
958.76		727.3 5	100 40	231.80	(7/2 ⁺)	
		860.8 7	73 33	98.16	(5/2 ⁺)	
		958.6 3	93 53	0	(3/2 ⁺)	
1038.4		940.2 3	100	98.16	(5/2 ⁺)	
1047.9	(15/2 ⁻)	178.2 5	34 3	869.7	(13/2 ⁻)	
		428.1 5	100 5	619.86	(11/2 ⁻)	
1077.1		756 1	100	321.11	(7/2 ⁻)	
1120.6	(15/2 ⁺)	262.1 5	52 8	858.5	(13/2 ⁺)	
		510.0 5	100 13	610.58	(11/2 ⁺)	
1164.6	(11/2 ⁺)	222.6 10	100	941.81	(9/2 ⁺)	D
1217.2		1119 1	100	98.16	(5/2 ⁺)	

Adopted Levels, Gammas (continued) $\gamma(^{101}\text{Zr})$ (continued)

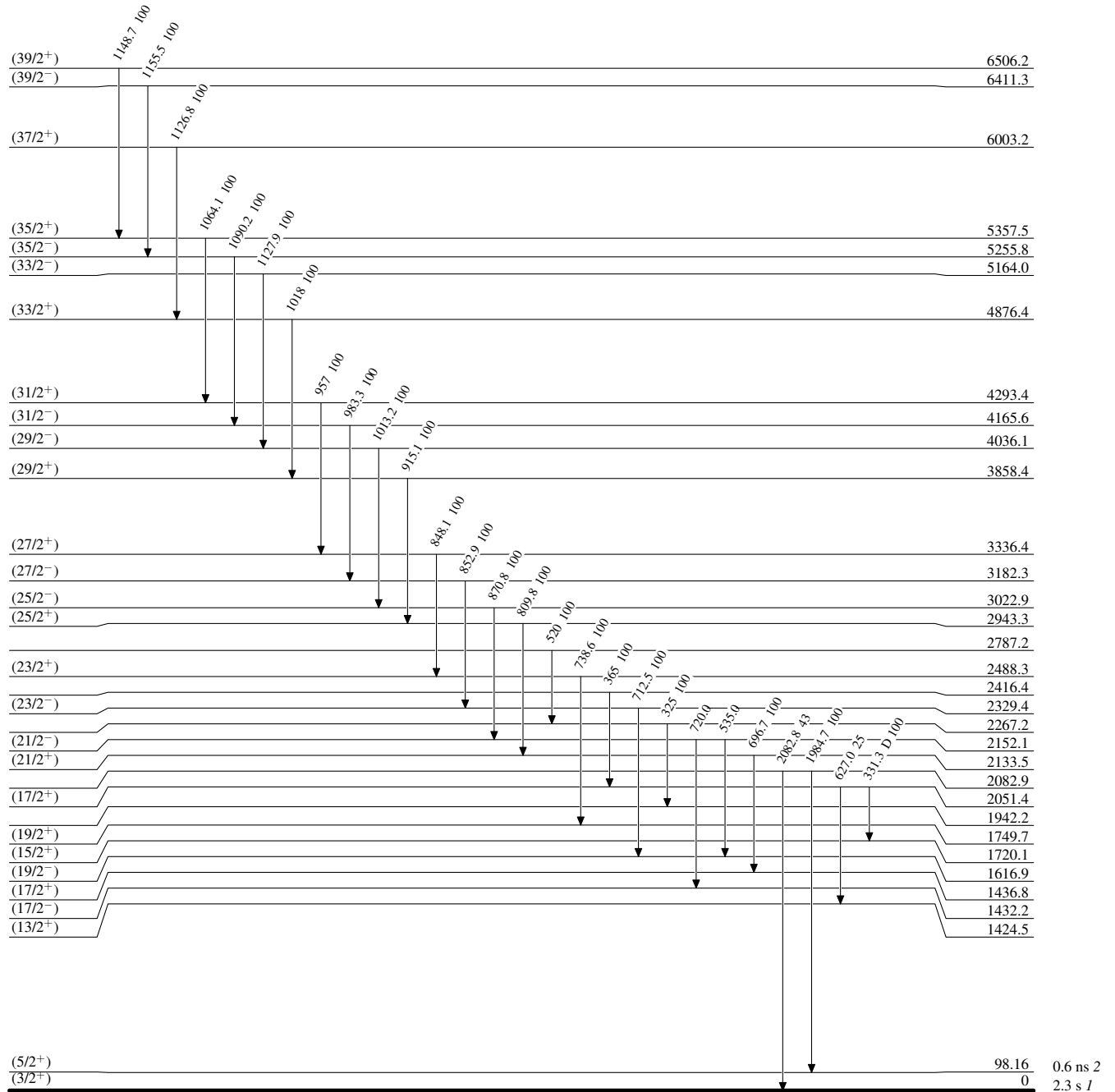
$E_i(\text{level})$	J_i^π	$E_\gamma^\dagger$	$I_\gamma^\dagger$	E_f	J_f^π	Mult.	$E_i(\text{level})$	J_i^π	$E_\gamma^\dagger$	$I_\gamma^\dagger$	E_f	J_f^π
1297.90		1081.3 6	28 13	216.67	(5/2 ⁻)		2082.9		1984.7 5	100 20	98.16	(5/2 ⁺)
		1297.89 11	100 67	0	(3/2 ⁺)				2082.8 5	43 17	0	(3/2 ⁺)
1398.55	(3/2,5/2) ⁺	1167.0 3	15.5 24	231.80	(7/2 ⁺)		2133.5	(21/2 ⁺)	696.7 7	100	1436.8	(17/2 ⁺)
		1300.26 17	100 8	98.16	(5/2 ⁺)		2152.1	(21/2 ⁻)	535.0 7		1616.9	(19/2 ⁻)
		1398.60 20	20 4	0	(3/2 ⁺)				720.0 6		1432.2	(17/2 ⁻)
1424.5	(13/2 ⁺)	259.8 7	100 6	1164.6	(11/2 ⁺)	D	2267.2		325 1	100	1942.2	
		482.5 8	42 9	941.81	(9/2 ⁺)		2329.4	(23/2 ⁻)	712.5 7	100	1616.9	(19/2 ⁻)
1432.2	(17/2 ⁻)	384.6 5	34	1047.9	(15/2 ⁻)		2416.4		365 1	100	2051.4	(17/2 ⁺)
		562.5 2	100	869.7	(13/2 ⁻)		2488.3	(23/2 ⁺)	738.6 7	100	1749.7	(19/2 ⁺)
1436.8	(17/2 ⁺)	316.3 7	20	1120.6	(15/2 ⁺)		2787.2		520 1	100	2267.2	
		578.3 2	100	858.5	(13/2 ⁺)		2943.3	(25/2 ⁺)	809.8 10	100	2133.5	(21/2 ⁺)
1523.9		904 1	100	619.86	(11/2 ⁻)		3022.9	(25/2 ⁻)	870.8 10	100	2152.1	(21/2 ⁻)
1529.93		1297.7 4	100 31	231.80	(7/2 ⁺)		3182.3	(27/2 ⁻)	852.9 10	100	2329.4	(23/2 ⁻)
		1432.8 9	29 12	98.16	(5/2 ⁺)		3336.4	(27/2 ⁺)	848.1 10	100	2488.3	(23/2 ⁺)
		1529.95 15	88 14	0	(3/2 ⁺)		3858.4	(29/2 ⁺)	915.1 10	100	2943.3	(25/2 ⁺)
1616.9	(19/2 ⁻)	185.0 6	26	1432.2	(17/2 ⁻)		4036.1	(29/2 ⁻)	1013.2 10	100	3022.9	(25/2 ⁻)
		569.0 2	100	1047.9	(15/2 ⁻)		4165.6	(31/2 ⁻)	983.3 10	100	3182.3	(27/2 ⁻)
1720.1	(15/2 ⁺)	295.6 7	100 1	1424.5	(13/2 ⁺)	D	4293.4	(31/2 ⁺)	957 1	100	3336.4	(27/2 ⁺)
		555.5 8	38	1164.6	(11/2 ⁺)		4876.4	(33/2 ⁺)	1018 1	100	3858.4	(29/2 ⁺)
1749.7	(19/2 ⁺)	629.1 7	100	1120.6	(15/2 ⁺)		5164.0	(33/2 ⁻)	1127.9 10	100	4036.1	(29/2 ⁻)
1942.2		777.6 10	100	1164.6	(11/2 ⁺)		5255.8	(35/2 ⁻)	1090.2 10	100	4165.6	(31/2 ⁻)
2023.17	(3/2,5/2) ⁺	1925.5 4	43 10	98.16	(5/2 ⁺)		5357.5	(35/2 ⁺)	1064.1 10	100	4293.4	(31/2 ⁺)
		2023.06 17	100 9	0	(3/2 ⁺)		6003.2	(37/2 ⁺)	1126.8 10	100	4876.4	(33/2 ⁺)
2051.4	(17/2 ⁺)	331.3 8	100	1720.1	(15/2 ⁺)	D	6411.3	(39/2 ⁻)	1155.5 10	100	5255.8	(35/2 ⁻)
		627.0 8	25	1424.5	(13/2 ⁺)		6506.2	(39/2 ⁺)	1148.7 10	100	5357.5	(35/2 ⁺)

[†] Average of all data.

[‡] 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.

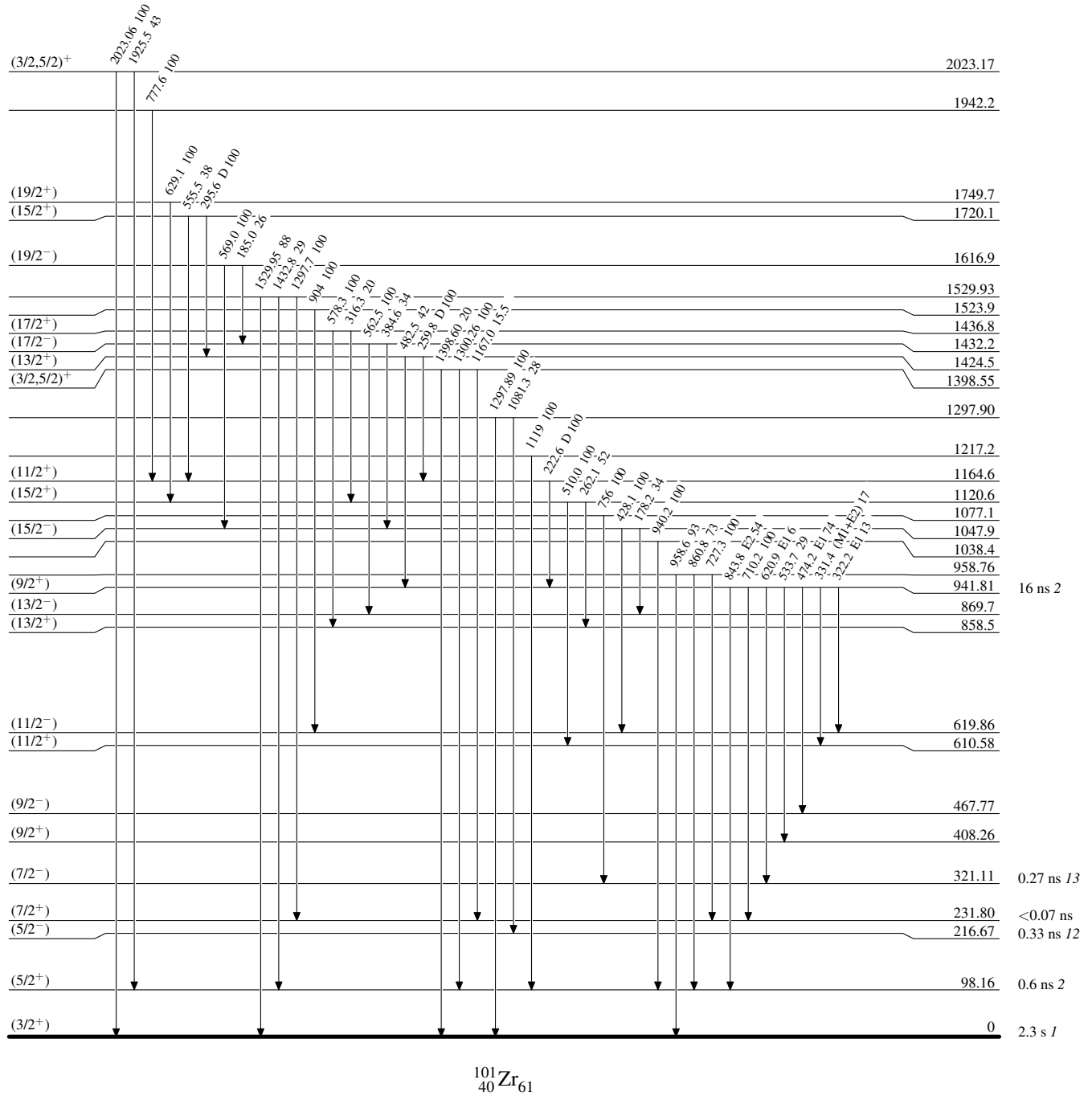
Adopted Levels, Gammas**Level Scheme**

Intensities: Relative photon branching from each level



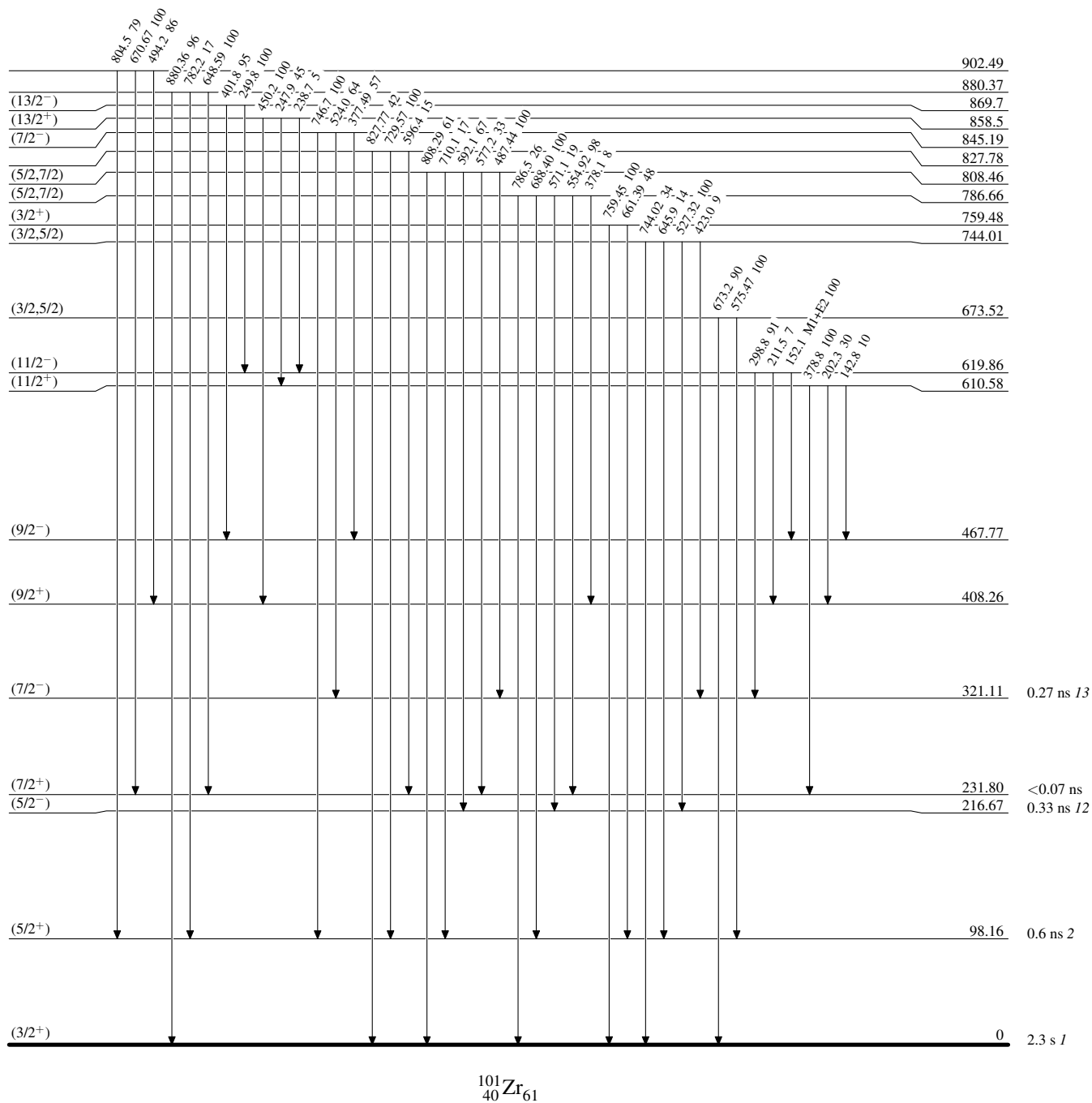
Adopted Levels, GammasLevel Scheme (continued)

Intensities: Relative photon branching from each level



Adopted Levels, GammasLevel Scheme (continued)

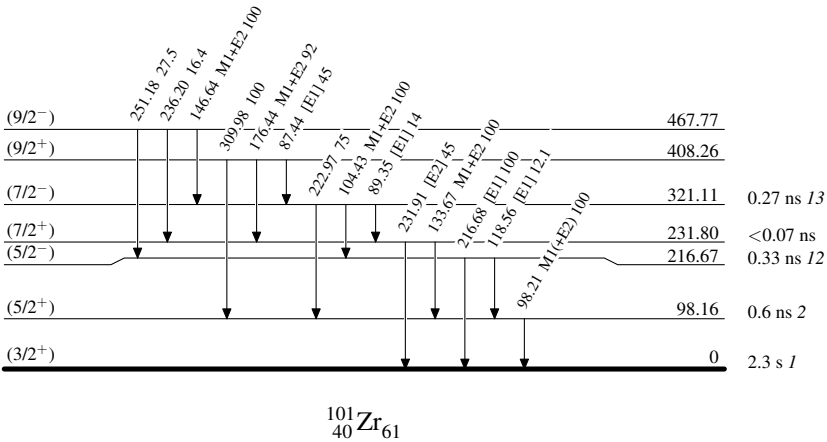
Intensities: Relative photon branching from each level



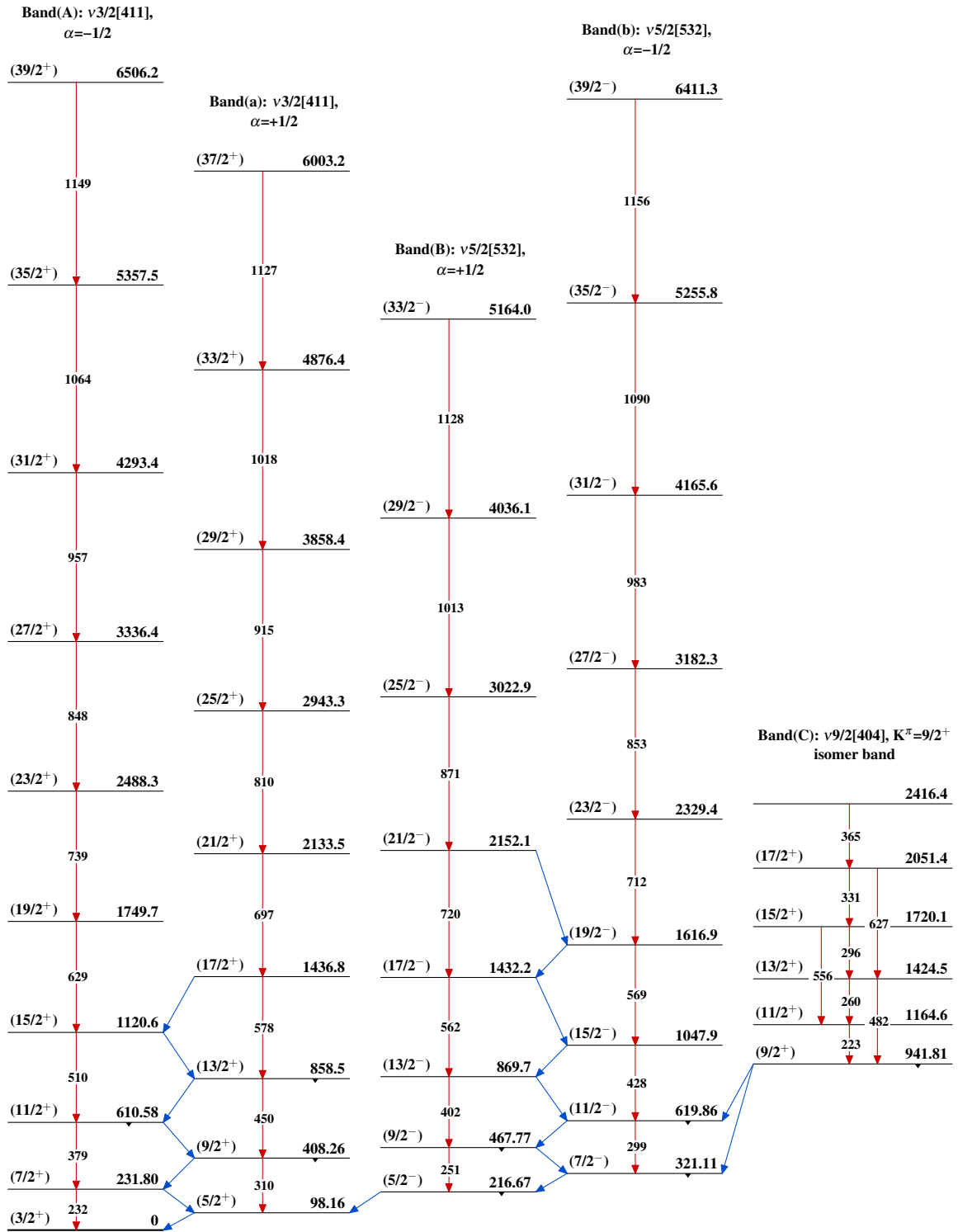
Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Relative photon branching from each level



$^{101}_{40}\text{Zr}_{61}$

Adopted Levels, Gammas $^{101}_{40}\text{Zr}_{61}$