^{70}Zn(^{36}S,α2nγ),^{88}Sr(^{14}C,2nγ) 2000Ti07,2017Ko03

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh and Jun Chen	NDS 172, 1 (2021)	31-Jan-2021

Includes ^{88}Sr(^{14}C,2nγ) for lifetime measurements.

2000Ti07: E(^{36}S)=130 MeV beam was produced from the Vivitron accelerator at IReS, Strasbourg. Target was 440 μg/cm^2 two stacked self-supporting foils of ^{70}Zn (70% enriched). γ rays were detected with the EUROGAM-2 spectrometer. Measured Eγ, Iγ, $\gamma\gamma$-coin, γ(DCO), γ(lin pol). Deduced levels, J, π, band structures, γ-ray multipolarities. Evidence for band terminating states and comparisons with Nilsson-Strutinsky cranking model calculations.

2017Ko03: E(^{14}C)=40,46 MeV. Measured lifetimes of yrast levels by recoil-distance Doppler shift (RDDS) and Doppler-shift attenuation method (DSAM). Target=SrF_2, 0.86 mg/cm2 thin layer evaporated on Au backing foil. For RDDS measurements, Au foil faced the beam and another Au foil was used as a stopper. For DSAM measurements, SrF_2 faced the beam and the recoils were stopped in the Au backing foil. The gamma rays were detected using ORGAM array at Orsay and eight detectors from the Miniball array. Experiments were performed at 15 MV Tandem accelerator of the ALTO laboratory in Orsay. Comparison with excited Vampir and shell model calculations. Authors conclude that ^{100}Ru may not be the best candidate for E(5) symmetry.

All data except for $T_{1/2}$ (2017Ko03) are from 2000Ti07.

^{100}Ru Levels

E(level)[†]	J$^\pi$[‡]	$T_{1/2}$[#]	Comments
0.0[@]	0$^+$		
539.7[@] *1*	2$^+$	22.0 ps *17*	$T_{1/2}$: Value of 12.56 ps *13* from B(E2) in Coulomb excitation is in disagreement.
1227.2[@] *2*	4$^+$	2.5 ps *6*	
2077.1[@] *2*	6$^+$	>0.7 ps	$T_{1/2}$: limit based on stopping time of ^{100}Ru recoils.
2528.8[a] *3*	5$^-$		
2953.2[a] *2*	7$^-$		
2965.5[&] *4*	6$^-$		
3061.9[@] *2*	8$^+$	0.49 ps *10*	$T_{1/2}$: from DSAM (2017Ko03).
3140.9 *4*	(7$^-$)		
3264.8[b] *5*	8$^+$		
3356.7[&] *4*	8$^-$		
3505.1[a] *3*	9$^-$		
3577.1[d] *4*	9$^-$		
3994.2[&] *5*	(10$^-$)		
4085.9[b] *2*	10$^+$		
4232.9[a] *4*	11$^-$		
4239.7[@] *4*	10$^+$		
4317.7[d] *5*	(11$^-$)		
4356.0[e] *5*	10$^+$		
4801.3[&] *6*	(12$^-$)		
4921.1[b] *3*	12$^+$		
5165.5[a] *5*	13$^-$		
5277.3[d] *7*	(13$^-$)		
5309.8[e] *6*	(12$^+$)		
5716.6[b] *3*	14$^+$		
5787.5[&] *7*	(14$^-$)		
6170.2[a] *6*	15$^-$		
6286.3[d] *9*	(15$^-$)		
6367.8[e] *8*	(14$^+$)		
6718.1[b] *3*	16$^+$		

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^{70}Zn(^{36}S,α2nγ),^{88}Sr(^{14}C,2nγ) 2000Ti07,2017Ko03 (continued)

^{100}Ru Levels (continued)

E(level)†	Jπ‡	E(level)†	Jπ‡	E(level)†	Jπ‡	E(level)†	Jπ‡
6888.2& 9	(16⁻)	8461.8[a] 8	(19⁻)	11741.8[b] 4	24⁺	14941.4[c] 6	28⁺
7206.8[a] 6	17⁻	9061.0[b] 4	20⁺	11749.5& 13	(24⁻)	16109.1[c] 6	30⁺
7411.2[e] 9	(16⁺)	9182.0& 11	(20⁻)	13173.3[b] 4	26⁺	16651.7[b] 7	30⁺
7830.3[b] 3	18⁺	9799.8[a] 10	(21⁻)	13312.5& 14	(26⁻)	17744.0[c] 7	32⁺
8021.4& 10	(18⁻)	10381.4[b] 4	22⁺	14741.5[b] 5	28⁺	20201.0 10	
8453.2[e] 11	(18⁺)	10406.5& 12	(22⁻)	14936.5& 15	(28⁻)		

† From least-squares fit to Eγ data. Note that most of the values here are systematically higher by 1-3 keV than those in ^{98}Mo(α,2nγ) (2000Ge01) which are from more precise γ-ray energies.

‡ As proposed by 2000Ti07 based on γγ(θ) and γ (lin pol) data. The assignments are consistent with those in the Adopted Levels, except that several are in parentheses there due to lack of strong supporting arguments.

From RDDS using plunger method (2017Ko03), unless otherwise stated.

@ Band(A): g.s. band.

& Band(B): Band based on 6⁻, α=0. Configuration=$\pi g_{9/2}^4 \otimes \nu[(d_{5/2}g_{7/2})^5 h_{11/2}]$, with terminating state of 28⁻ when fully aligned ($g_{9/2}$ protons coupled to spin of 12, and $d_{5/2}g_{7/2}$ neutrons coupled to spin of 21/2).

[a] Band(b): Band based on 5⁻, α=1. Configuration=$\pi g_{9/2}^4 \otimes \nu[(d_{5/2}g_{7/2})^5 h_{11/2}]$.

[b] Band(C): Band based on 8⁺, α=0. Configuration=$\pi(g_{9/2}^5)_{25/2} \otimes \nu h_{11/2}$ coupled to one proton hole in N=3 shell, with the configuration of the terminating state of 30⁺ as $\pi(g_{9/2}^5)_{25/2} \otimes \nu(d_{5/2}g_{7/2})^5_{23/2}(h_{11/2})$ coupled to one proton hole in N=3 shell. The upper part of this band may have an alternate configuration=$\pi g_{9/2}^4 \otimes \nu[(d_{5/2}^3)(g_{7/2})(h_{11/2}^2)]$, with terminating state of 30⁺ when fully aligned ($g_{9/2}$ protons coupled to spin of 12, $d_{5/2}$ neutrons coupled to spin 9/2, and $h_{11/2}$ neutrons coupled to spin 10) (2000Ti07).

[c] Band(D): Band based on 28⁺. This structure of three levels is related to band based on 8⁺. Configuration of terminating state at 32+=$\pi g_{9/2}^4 \otimes \nu[(d_{5/2}g_{7/2})^4 h_{11/2}^2]$, ($g_{9/2}$ protons coupled to spin of 12, and $d_{5/2}g_{7/2}$ neutrons coupled to spin of 10, and $h_{11/2}$ neutrons coupled to spin of 10).

[d] Band(E): Band based on 9⁻.

[e] Band(F): Band based on (10⁺).

γ(^{100}Ru)

DCO ratios correspond to gates on ΔJ=2, quadrupole transitions and angles of 22.4°+157.6° on one axis and 75.5°+104.5° on the second axis of the γγ coin matrix. In this geometry DCO≈1 indicates ΔJ=2, quadrupole or ΔJ=0, dipole, and DCO≈0.5 to ΔJ=1, dipole transitions (2000Ti07).

E_γ†	I_γ‡	E_i(level)	J_i^π	E_f	J_f^π	Mult.#	Comments
148.1 5	2 1	3505.1	9⁻	3356.7	8⁻		
187.5 5	3 1	3140.9	(7⁻)	2953.2	7⁻		
202.6 5	2 1	3264.8	8⁺	3061.9	8⁺	D	DCO=1.18 17 Mult.: ΔJ=0, dipole.
238.5 10	1.0 5	4232.9	11⁻	3994.2	(10⁻)		
363.7 5	5 1	3505.1	9⁻	3140.9	(7⁻)		
390.9 5	6 1	3356.7	8⁻	2965.5	6⁻	Q	DCO=0.97 16
403.7 5	4 1	3356.7	8⁻	2953.2	7⁻	(D+Q)	DCO=0.82 17
423.8 5	4 1	2953.2	7⁻	2528.8	5⁻	Q	DCO=1.05 22
436.5 5	2 1	2965.5	6⁻	2528.8	5⁻		
442.8 5	8 2	3505.1	9⁻	3061.9	8⁺	E1	DCO=0.66 14 Pol=+0.35 41.
489.0 5	4 1	3994.2	(10⁻)	3505.1	9⁻		

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^{70}Zn(^{36}S,α2nγ),^{88}Sr(^{14}C,2nγ) 2000Ti07,2017Ko03 (continued)

γ(^{100}Ru) (continued)

E_γ[†]	I_γ[‡]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	Comments
539.7 *1*	100 *5*	539.7	2^+	0.0	0^+	(E2)	DCO=0.87 *15* Pol=+0.02 *10*.
552.3 *3*	12 *1*	3505.1	9^-	2953.2	7^-	Q	DCO=1.08 *15*
564.9 *5*	7 *1*	4921.1	12^+	4356.0	10^+		
567.7 *10*	1.0 *5*	4801.3	(12^-)	4232.9	11^-		
612.4 *5*	4 *1*	3140.9	(7^-)	2528.8	5^-		
623.8 *3*	12 *1*	3577.1	9^-	2953.2	7^-	E2	DCO=1.02 *17* Pol=+0.8 *7*.
637.8 *5*	6 *1*	3994.2	(10^-)	3356.7	8^-	Q	DCO=1.06 *18*
681.5 *5*	8 *2*	4921.1	12^+	4239.7	10^+	Q	DCO=1.12 *19*
687.5 *1*	95 *5*	1227.2	4^+	539.7	2^+	E2	DCO=0.94 *14* Pol=+0.50 *19*.
688.2[@]		4921.1	12^+	4232.9	11^-		
727.8 *3*	15 *2*	4232.9	11^-	3505.1	9^-	E2	DCO=1.17 *20* Pol=+0.5 *4*.
740.3 *5*	9 *2*	4317.7	(11^-)	3577.1	9^-		
795.5 *1*	45 *2*	5716.6	14^+	4921.1	12^+	E2	DCO=1.09 *15* Pol=+0.7 *4*.
807.3 *5*	9 *2*	4801.3	(12^-)	3994.2	(10^-)		
821.4 *10*	1.0 *5*	4085.9	10^+	3264.8	8^+		
835.2 *1*	28 *2*	4921.1	12^+	4085.9	10^+	E2	DCO=0.96 *16* Pol=+0.5 *3*.
847.5 *5*	4 *1*	5165.5	13^-	4317.7	(11^-)		
849.9 *1*	87 *4*	2077.1	6^+	1227.2	4^+	E2	DCO=0.99 *17* Pol=+0.66 *32*.
876.2 *1*	24 *1*	2953.2	7^-	2077.1	6^+	E1	DCO=0.64 *10* Pol=+0.5 *5*.
888.5 *5*	4 *1*	2965.5	6^-	2077.1	6^+		
932.7 *3*	12 *1*	5165.5	13^-	4232.9	11^-	E2	DCO=1.19 *17* Pol=1.5 *7*.
959.6 *5*	3 *1*	5277.3	(13^-)	4317.7	(11^-)		
973.6 *10*	1.0 *5*	4239.7	10^+	3264.8	8^+		
984.8 *1*	56 *3*	3061.9	8^+	2077.1	6^+	E2	DCO=1.14 *19* Pol=+0.9 *3*.
986.2 *3*	10 *1*	5787.5	(14^-)	4801.3	(12^-)		
1001.5 *1*	40 *2*	6718.1	16^+	5716.6	14^+	E2	DCO=1.12 *19* Pol=2.1 *12*.
1004.7 *3*	12 *1*	6170.2	15^-	5165.5	13^-	Q	DCO=0.99 *21*
1009.0 *5*	2 *1*	6286.3	(15^-)	5277.3	(13^-)		
1024.0 *1*	27 *2*	4085.9	10^+	3061.9	8^+	E2	DCO=1.15 *20* Pol=+1.0 *5*.
1036.6 *3*	10 *1*	7206.8	17^-	6170.2	15^-	Q	DCO=0.94 *20*
1042.0 *5*	2 *1*	8453.2	(18^+)	7411.2	(16^+)		
1043.4 *5*	3 *1*	7411.2	(16^+)	6367.8	(14^+)		
1058.0 *5*	5 *1*	6367.8	(14^+)	5309.8	(12^+)		
1063.3 *5*	8 *2*	3140.9	(7^-)	2077.1	6^+		
1092.3 *5*	3 *1*	17744.0	32^+	16651.7	30^+	Q	DCO=1.01 *17*
1100.7 *5*	9 *2*	6888.2	(16^-)	5787.5	(14^-)		
1112.2 *1*	40 *2*	7830.3	18^+	6718.1	16^+	E2	DCO=1.08 *18* Pol=+0.5 *4*.
1133.1 *5*	9 *2*	8021.4	(18^-)	6888.2	(16^-)		
1160.6 *5*	7 *1*	9182.0	(20^-)	8021.4	(18^-)		
1167.7 *5*	3 *1*	16109.1	30^+	14941.4	28^+	Q	DCO=1.08 *24*
1177.9 *3*	12 *1*	4239.7	10^+	3061.9	8^+	Q	DCO=1.07 *18*
1223.9 *5*	6 *1*	5309.8	(12^+)	4085.9	10^+		
1224.5 *5*	5 *1*	10406.5	(22^-)	9182.0	(20^-)		

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^{70}Zn(^{36}S,α2nγ),^{88}Sr(^{14}C,2nγ) 2000Ti07,2017Ko03 (continued)

γ(^{100}Ru) (continued)

E_γ [†]	I_γ [‡]	E_i(level)	J_i^π	E_f	J_f^π	Mult. [#]	Comments
1230.7 *1*	35 *2*	9061.0	20^+	7830.3	18^+	E2	DCO=1.08 *18* Pol=+0.5 *5*.
1255.0 *5*	8 *2*	8461.8	(19^-)	7206.8	17^-		
1293.9 *5*	6 *1*	4356.0	10^+	3061.9	8^+		
1301.3 *3*	10 *1*	2528.8	5^-	1227.2	4^+		
1320.4 *1*	36 *2*	10381.4	22^+	9061.0	20^+	E2	DCO=1.12 *19* Pol=+0.8 *6*.
1338.0 *5*	5 *1*	9799.8	(21^-)	8461.8	(19^-)		
1343.0 *5*	4 *1*	11749.5	(24^-)	10406.5	(22^-)		
1360.4 *1*	33 *2*	11741.8	24^+	10381.4	22^+	(E2)	DCO=1.17 *20* Pol=+0.6 *7*.
1367.6 *5*	5 *1*	16109.1	30^+	14741.5	28^+		
1431.4 *1*	25 *1*	13173.3	26^+	11741.8	24^+	E2	DCO=1.11 *19* Pol=+1.0 *6*.
1563.0 *5*	4 *1*	13312.5	(26^-)	11749.5	(24^-)		
1568.2 *3*	15 *2*	14741.5	28^+	13173.3	26^+	E2	DCO=1.02 *17* Pol=+1.3 *8*.
1624.0 *5*	4 *1*	14936.5	(28^-)	13312.5	(26^-)		
1634.9 *5*	3 *1*	17744.0	32^+	16109.1	30^+	Q	DCO=0.98 *17*
1768.1 *5*	8 *2*	14941.4	28^+	13173.3	26^+	Q	DCO=1.07 *23*
1910.2 *5*	9 *2*	16651.7	30^+	14741.5	28^+	Q	DCO=0.99 *21*
2457.0 *5*	3 *1*	20201.0		17744.0	32^+		

[†] 2000Ti07 state uncertainty of 0.1 keV for strong transitions and up to 1 keV for weak and complex peaks. The evaluators have assigned uncertainties as follows: 0.1 keV for Iγ>20, 0.3 keV for Iγ=10-20, 0.5 keV for Iγ=2-10 and 1 keV for Iγ<2.

[‡] 2000Ti07 state uncertainty of 5% for strong transitions and up to 50% for weak and complex peaks. The evaluators have assigned uncertainties as follows: ≈5% for Iγ>20, ≈10% for Iγ=10-20, ≈20% for Iγ=3-10 and ≈50% for Iγ<3.

[#] From γ(DCO) and γ(lin pol) in 2000Ti07. Mult=Q indicates ΔJ=2, quadrupole (most likely E2 transition).

[@] From level-energy difference. According to e-mail reply from J. Gizon (Jan 22, 2001), Eγ=692.6 with Iγ=4 listed in table III and shown in level-scheme figure 5 of 2000Ti07 is incorrect and should be replaced by a 688γ. The intensity of 688γ is unknown, it is probably weak as judged from the width of the arrow (for 693γ) shown in authors′ figure 5.

^{70}Zn(^{36}S,α2nγ),^{88}Sr(^{14}C,2nγ) 2000Ti07,2017Ko03

Level Scheme

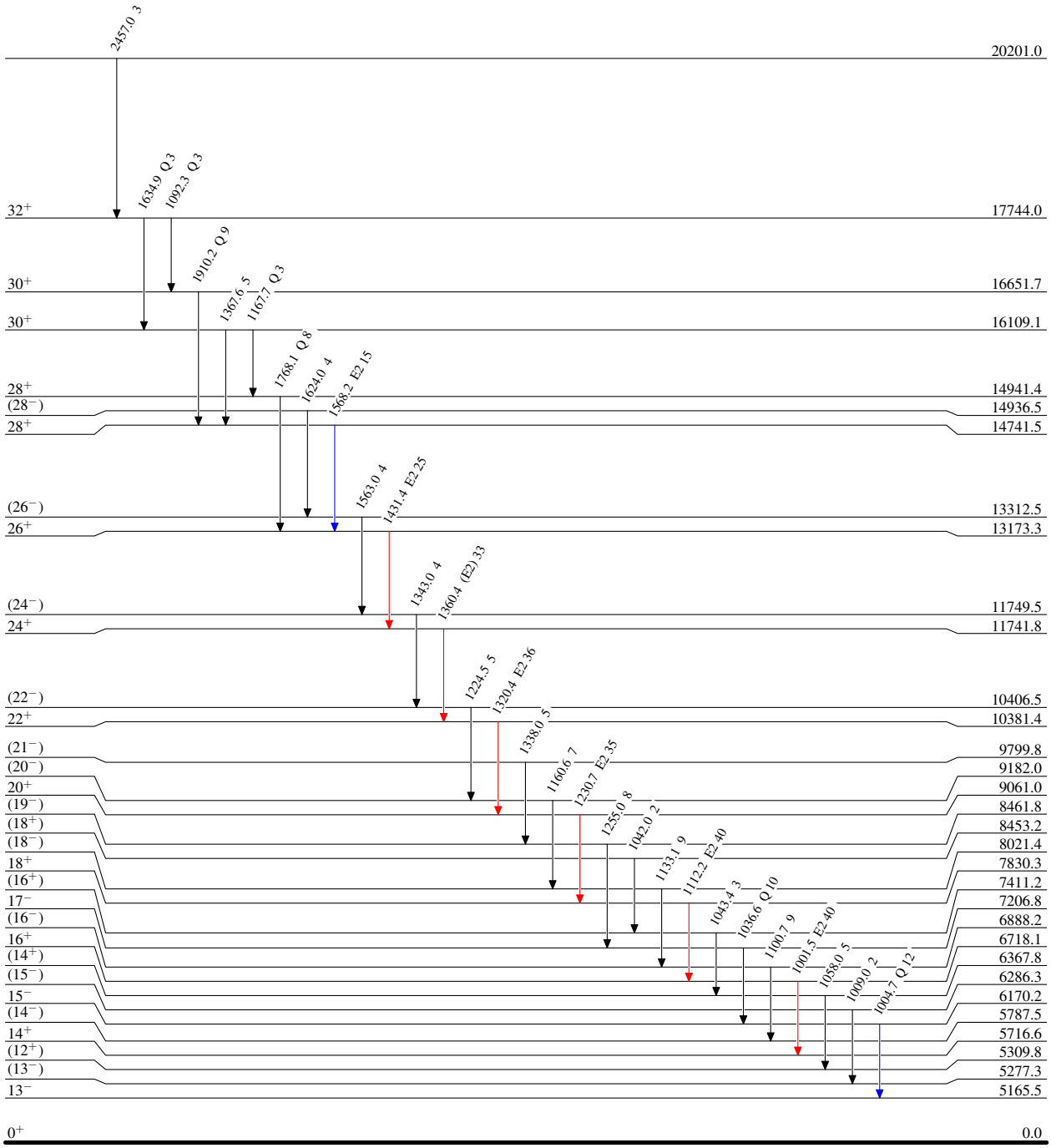
Intensities: Relative I_γ

Legend

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

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

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



$^{100}_{44}Ru_{56}$

^{70}Zn(^{36}S,α2nγ),^{88}Sr(^{14}C,2nγ) 2000Ti07,2017Ko03

Level Scheme (continued)

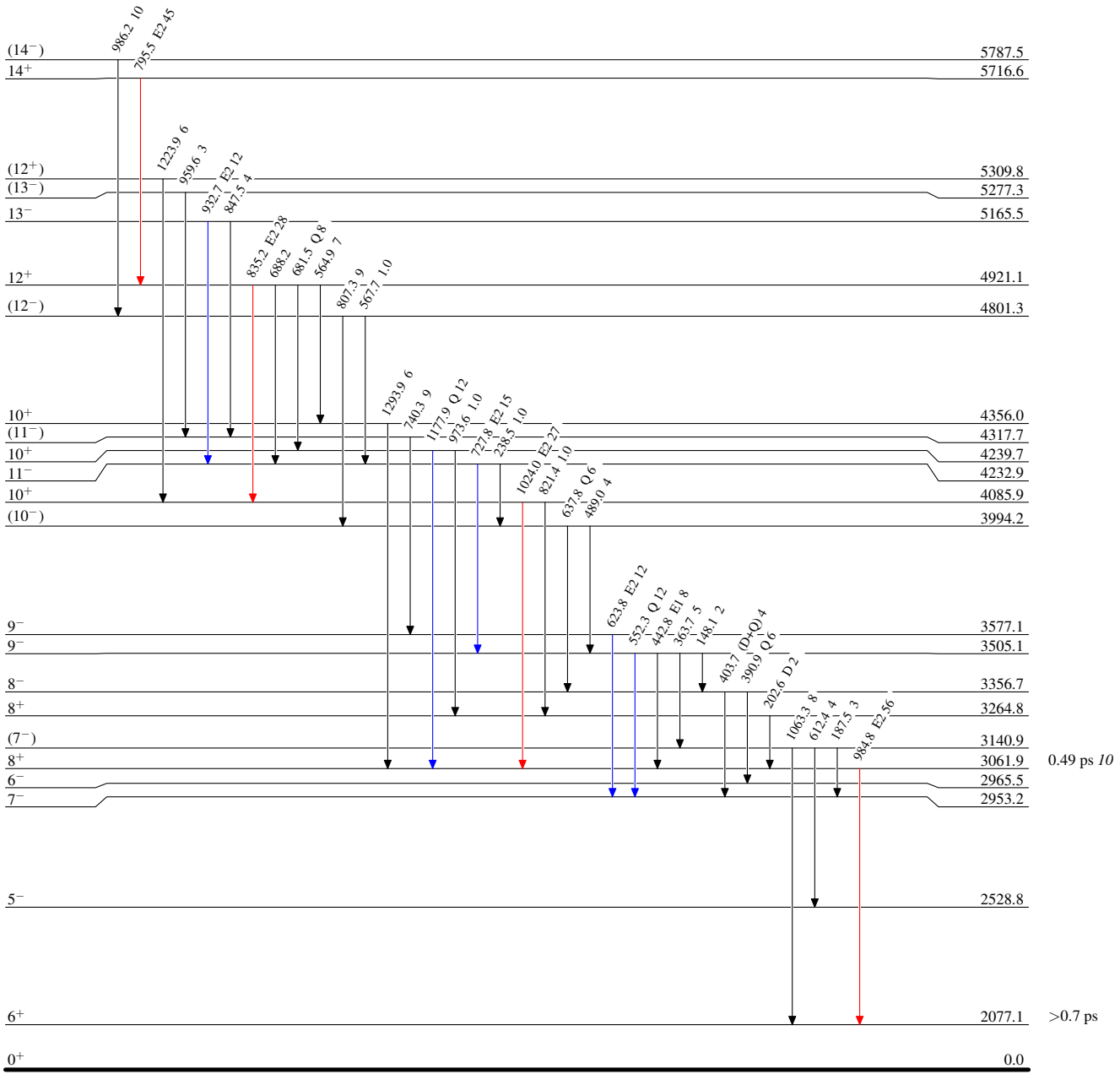
Intensities: Relative I_γ

Legend

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

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

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

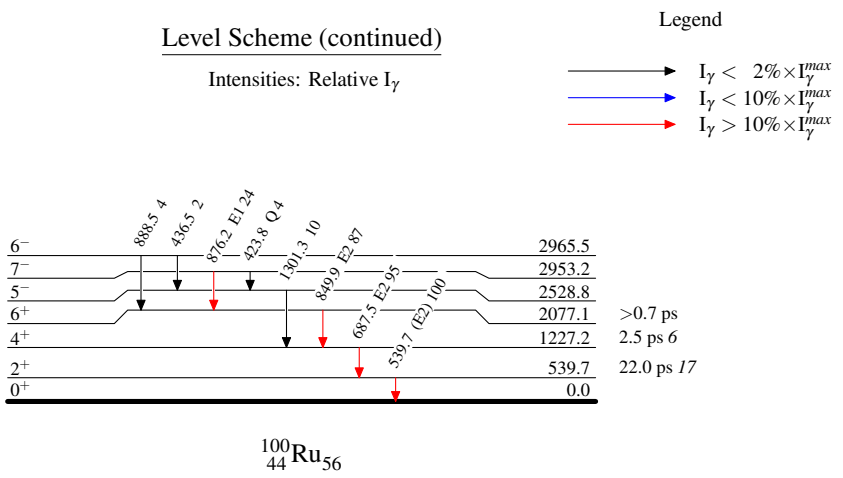


$^{100}_{44}Ru_{56}$

^{70}Zn(^{36}S,α2nγ),^{88}Sr(^{14}C,2nγ) 2000Ti07,2017Ko03

Level Scheme (continued)

Intensities: Relative I_γ



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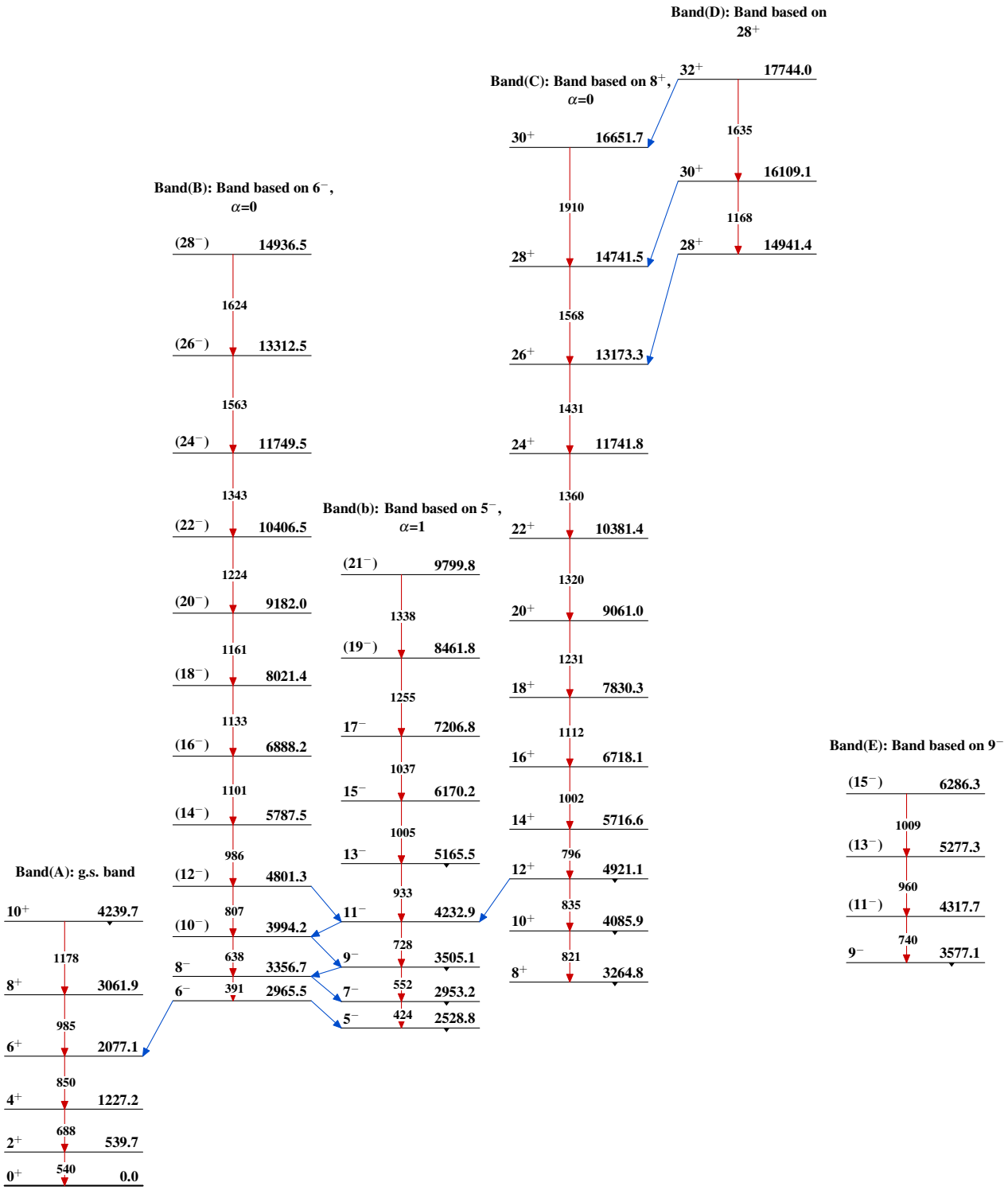
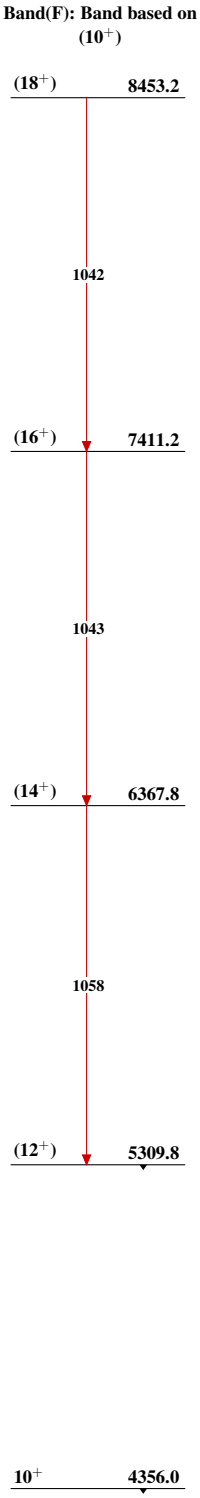


$^{100}_{44}Ru_{56}$

^{70}Zn(^{36}S,α2nγ),^{88}Sr(^{14}C,2nγ) 2000Ti07,2017Ko03 (continued)



$^{100}_{44}Ru_{56}$