Coulomb excitation **2006Sr01,1984St08**

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Jean Blachot	NDS 108,2035 (2007)	30-Mar-2007

1958St32: ^{104}Ru(p,p′γ), E=1.5-3 MeV.
1956Te26: ^{104}Ru(α,$\alpha'\gamma$), E=6-7 MeV.
1968Mc08: ^{104}Ru(α,$\alpha'\gamma$), E=8-10 MeV; ^{104}Ru(^{16}O,^{16}Oγ), E=42-45 MeV.
1980La01: ^{104}Ru(α,$\alpha'\gamma$), E=8.5-9.5 MeV; ^{104}Ru(^{16}O,^{16}Oγ), E=42-45 MeV. Measured: γ, γ-x x=p, α, ^{16}O.
1982St09: ^{104}Ru(^{208}Pb, ^{208}Pb′), E=4.6 MeV/nucleon Measured Eγ, Iγ (particle).
1984St08: ^{208}Pb(^{104}Ru, ^{104}Ru′), E=4.6 MeV/nucleon Measured Eγ, Iγ (particle).
2006SR01: ^{104}Ru(^{58}Ni,^{58}Ni′γ) E=165, 190 MeV; ^{104}Ru(^{136}Xe,^{136}Xe′γ) E=525 MeV; ^{104}Ru(^{208}Pb,^{208}Pb′γ) E=954 MeV.
Measured Eγ, Iγ (particle) γ coin. Three Ge detectors and Si detector for recoiling ^{104}Ru nuclei used for ^{208}Pb experiment, two Ge detectors and two position-sensitive detectors for ^{136}Xe experiment, and two Ge detectors and five Si detectors for ^{58}Ni experiment. The coupled-channel, least-squares search code GOSIA used in the analysis of data. Experimental matrix elements compared with those derived from theory.
Data without keynumbers are from 2006Sr01.

^{104}Ru Levels

E(level)	J$^{\pi}$[†]	T$_{1/2}$[‡]	Comments
0.0[@]	0$^+$		
358.02 *7*	2$^+$	56.4 ps *10*	B(E2)↑=0.841 *16* (1987Ra01); Q=−0.70 *8* B(E2)↑: others: 0.834 *44* (1980La01), 1.04 (1956Te26), 0.928 *7* (1958St32), 0.81 (1968Mc08). Q: from 1980La01. Others: −0.84 *21* (1973No04), −0.66 *5* (1977Ma41); Q estimated under the assumption of a positive interference term. T$_{1/2}$: from B(E2)(↓)=0.168 *9* (2006Sr01). Diagonal E2 matrix element=−0.71 *11* (2006Sr01).
888.5[@] *1*	4$^+$	5.6 ps *6*	T$_{1/2}$: 6.0 ps 3 from B(E2)(↓)=0.226 *11* (2006SR01). Diagonal E2 matrix element=−0.79 *15* (2006SR01). B(E2)=0.431 *47* (1980La01); 0.390 *69* (1968Mc08).
893.1[&] *1*	2$^+$	5.0 ps *5*	B(E2)↑=0.0336 *35* (1980La01) B(E2)↑: other: 0.0276 *30* (1968Mc08). T$_{1/2}$: 7.6 ps 10 from average of B(E2)(↓)=0.0049 *3* and B(E2)(↓)=0.113 *11* (2006Sr01). The γ-ray branching ratios were taken from Adopted Levels. Diagonal E2 matrix element=+0.62 *8* (2006SR01).
988.3 *2*	0$^+$	7.9 ps *9*	B(E2)↑=0.0145 *15* (1980La01) B(E2)↑: for 2+(358) to 0$^+$. Other: 0.0152 *15* (1968Mc08). T$_{1/2}$: >33 ps from B(E2)(↓)<0.017 (2006Sr01).
1242[&]	3$^+$		
1335[b]	0$^+$	0.90 ps *5*	T$_{1/2}$: from B(E2)(↓)=0.071 *4*, assuming 100% branch for 977γ.
1502[&]	4$^+$	2.7 ps *3*	T$_{1/2}$: from B(E2)(↓)=0.139 *11* and γ-ray branching from adopted gammas in ENSDF for ^{104}Ru. Diagonal E2 matrix element=−0.58 *18*.
1515[a]	2$^+$	1.2 ps *2*	T$_{1/2}$: from average of two values obtained from B(E2)(↓)=0.101 *13* and B(E2)(↓)=0.028 *6*. The γ-ray branching ratio were taken from adopted gammas. Diagonal E2 matrix element=−0.08 *+11−25*.
1556[@]	6$^+$	1.33 ps *+12−4*	T$_{1/2}$: from B(E2)(↓)=0.320 *+10−26*. Diagonal E2 matrix element=−0.70 *+30−20*.
1750?[#b]	2$^+$		
1872[&]	5$^+$		
1970.4 *1*	3$^-$		B(E3)↑=0.0579 *35* (1980La01) B(E3)↑: other: 0.82 *16* (1968Mc08).
2081[a]	4$^+$	0.7 ps *+3−2*	T$_{1/2}$: from B(E2)(↓)=0.063 *21* and γ-ray branching from adopted gammas.

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Coulomb excitation 2006Sr01,1984St08 (continued)

^{104}Ru Levels (continued)

E(level)	J^{π}[†]	$T_{1/2}$[‡]	Comments
2095	$(2^+,4^+)$		
2197[&]	6^+		Diagonal E2 matrix element=1.0 *3*.
2320[@]	8^+	0.56 ps *+5−10*	$T_{1/2}$: from B(E2)(↓)=0.39 *+8−3*. Diagonal E2 matrix element=−0.6 *+3−5*.
2750?[#a]	6^+		
2848[&]	8^+	2.1 ps *+13−4*	$T_{1/2}$: from B(E2)(↓)=0.23 *+6−9*.
2900?[#]	5^+		
3112	10^+		J^{π}: 2qp state.
3130?[#]	8^+		
3285[@]	10^+	0.26 ps *+16−7*	$T_{1/2}$: from B(E2)(↓)=0.26 *10*.
3960?[#]	12^+		J^{π}: 2qp state.
4000?[#&]	10^+		
4400?[#@]	12^+		

[†] From Adopted Levels.
[‡] From B(E2) values.
[#] Level not observed by 2006Ra01 or reported in the literature, but included in the analysis of Coulomb excitation data as virtually excited state.
[@] Band(A): g.s. band.
[&] Band(B): γ band.
[a] Band(C): β band.
[b] Band(D): 0^+ band.

$\gamma(^{104}Ru)$

E_γ[†]	I_γ[‡]	E_i(level)	J_i^{π}	E_f	J_f^{π}	Mult.[†]	δ	α[&]	Comments
5[@a]		893.1	2^+	888.5	4^+				E2 matrix element (to 888,4^+)=−0.1 to +0.1.
13[@a]		1515	2^+	1502	4^+				E2 matrix element (to 1502,4^+)=+0.31 *+13−6*; B(E2)=0.019 *+25−7*.
349[#]		1242	3^+	893.1	2^+				
354[#]		1242	3^+	888.5	4^+				
358.0 *1*	100	358.02	2^+	0.0	0^+	E2		0.017	B(E2)(W.u.)=57.8 *11* E2 matrix element (to g.s.)=+0.917 *25*; +0.91 (1984ST08); B(E2)=0.168 *9*.
442[@a]		1335	0^+	893.1	2^+				E2 matrix element (to 893,2^+)=+0.08 *3*; B(E2)=0.007 *+6−4*.
527[#]		1515	2^+	988.3	0^+				E2 matrix element (to 988,0^+)=+0.71 *4*; B(E2)=0.101 *13*.
530.5 *1*	100	888.5	4^+	358.02	2^+				E2 matrix element (to 358,2^+)=+1.43 *4*; +1.47 *8* (1984St08); +1.44 *8* (1982St09); B(E2)=0.226 *11*.
535.1 *1*	63	893.1	2^+	358.02	2^+	E2+M1	−9 *2*		B(M1)(W.u.)=0.00022 *10*; B(E2)(W.u.)=55 *6* δ: from Ag(θ) 1968Mc08. M1 matrix element (358,2^+ to 893,2^+)<0.02. E2 matrix element (to 358,2^+)=−0.75 *4*; −0.9 *4* (1984St08); −1.0 *3* (1982St09); B(E2)=0.113 *11*.
565[#]		2081	4^+	1515	2^+				E2 matrix element (to 1515,2^+)=+0.75 *25*; B(E2)=0.063 *21*.

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Coulomb excitation 2006Sr01,1984St08 (continued)

$\gamma(^{104}Ru)$ (continued)

E_γ[†]	I_γ[‡]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[†]	Comments
580[@ a]		2095	$(2^+,4^+)$	1515	2^+		E2 matrix element (1515,2^+ to 2095,4^+)=+0.53 *+32−14*.
609		1502	4^+	893.1	2^+		E2 matrix element (to 893,2^+)=+1.12 *5*; B(E2)=0.139 *11*.
614		1502	4^+	888.5	4^+		M1 matrix element (888,4^+ to 1502,4^+)=−0.15 *3*. E2 matrix element (to 888,4^+)=−0.83 *5*; −0.4 *3* (1984St08); B(E2)=0.0759 *9*.
622[@ a]		1515	2^+	893.1	2^+		E2 matrix element (to 893,2^+)=0.22 *+25−5*; B(E2)=0.010 *4*.
627[#]		1515	2^+	888.5	4^+		E2 matrix element (to 888,4^+)=−0.37 *4*; B(E2)=0.028 *6*.
630[#]		1872	5^+	1242	3^+		
630.3 *3*	100	988.3	0^+	358.02	2^+		E2 matrix element (to 358,2^+)>−0.1; B(E2)<0.017.
641		2197	6^+	1556	6^+		
652		2848	8^+	2197	6^+		E2 matrix element (to 2197,6^+)=+2.0 *4*; +2.49 *8* (1984St08); +2.46 *6* (1982St09); B(E2)=0.23 *+6−9*.
668		1556	6^+	888.5	4^+		E2 matrix element (to 888,4^+)=+2.04 *8*; +2.09 *9* (1984St08); +2.17 *9* (1982St09); B(E2)=0.320 *+10−26*.
695		2197	6^+	1502	4^+		E2 matrix element (to 1502,4^+)=+1.52 *12*; B(E2)=0.178 *+30−14*.
764		2320	8^+	1556	6^+		E2 matrix element (to 1556,8^+)=+2.59 *+24−9*; B(E2)=0.39 *+8−3*.
792		3112	10^+	2320	8^+		
839		2081	4^+	1242	3^+		
852		2095	$(2^+,4^+)$	1242	3^+		
884		1242	3^+	358.02	2^+		M1 matrix element (358,2^+ to 1242,3^+)=−0.054 *9*.
893.1 *1*	37	893.1	2^+	0.0	0^+	E2	B(E2)(W.u.)=2.5 *3* E2 matrix element (to g.s.)=−0.156 *2*; B(E2)=0.0049 *3*.
965		3285	10^+	2320	8^+		E2 matrix element (to 2320,8^+)=+2.7 *6*; +2.6 *3* (1984St08); B(E2)=0.26 *10*.
977		1335	0^+	358.02	2^+		E2 matrix element (to 358,2^+)=−0.266 *8*; B(E2)=0.071 *4*.
984[#]		1872	5^+	888.5	4^+		
1145[#]		1502	4^+	358.02	2^+		E2 matrix element (to 358,2^+)=−0.107 *8*; B(E2)=0.0013 *2*.
1157		1515	2^+	358.02	2^+		M1 matrix element (358,2^+ to 1515,2^+)=+0.24 *3*. E2 matrix element (to 358,2^+)=0.07 *3*; B(E2)=0.0011 *+12−6*.
1188		2081	4^+	893.1	2^+		
1203		2095	$(2^+,4^+)$	893.1	2^+		
1206		2095	$(2^+,4^+)$	888.5	4^+		
1308		2197	6^+	888.5	4^+		E_γ: from 1984St08. E2 matrix element (to 888,4^+)=−0.22 *+6−12*.
1515		1515	2^+	0.0	0^+		E2 matrix element (to g.s.)=−0.071 *10*; B(E2)=0.0010 *3*.
1612.4 *1*		1970.4	3^-	358.02	2^+		
1722[#]		2081	4^+	358.02	2^+		

[†] From Adopted Levels.
[‡] Relative branching from each level.
[#] From Adopted Levels for ^{104}Ru.
[@] Transition not seen in this work or reported in the literature. E2 matrix element calculated by 2006Sr01 probably through virtual excitation.
[&] 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.
[a] Placement of transition in the level scheme is uncertain.

Coulomb excitation 2006Sr01,1984St08

Level Scheme

Intensities: Type not specified

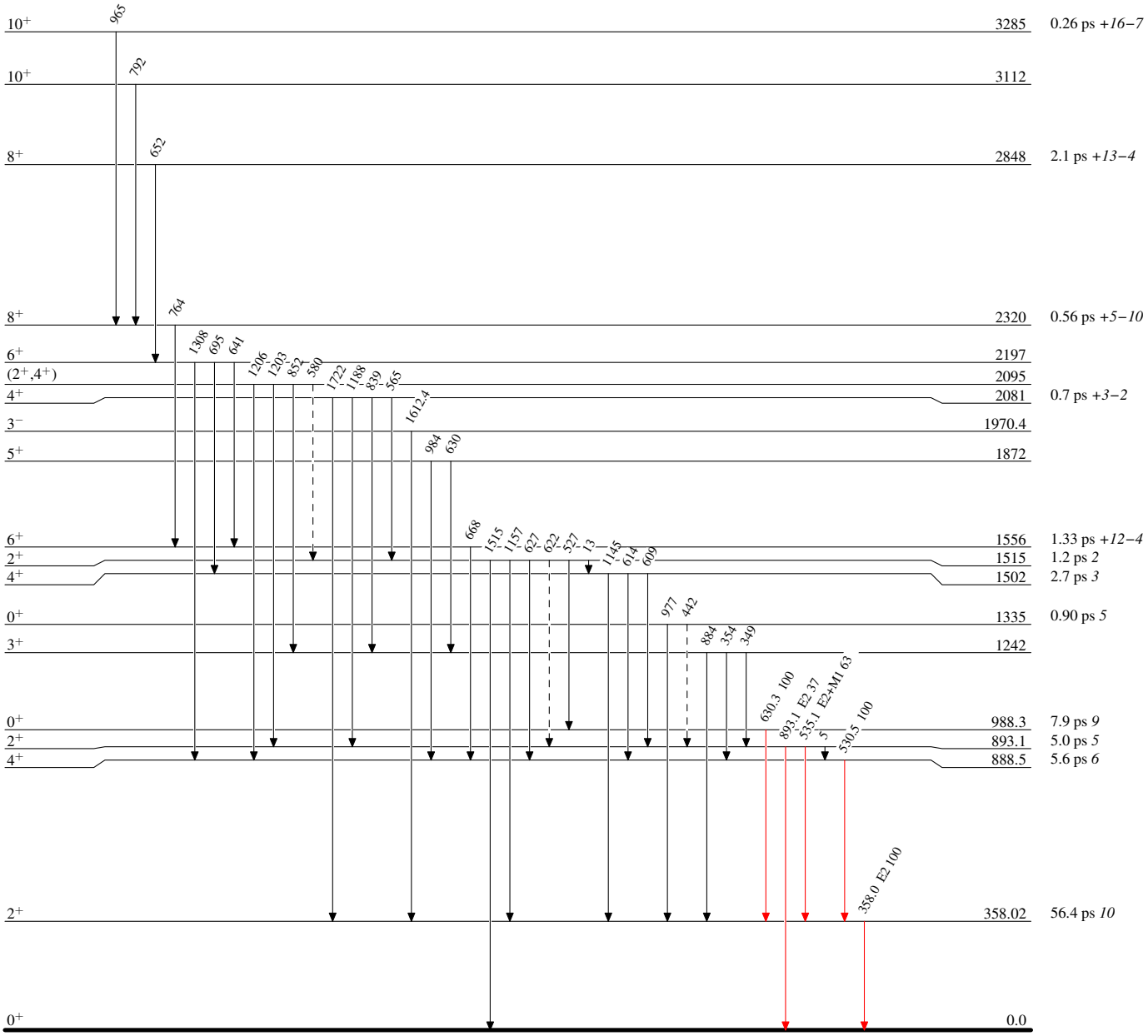
Legend

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

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

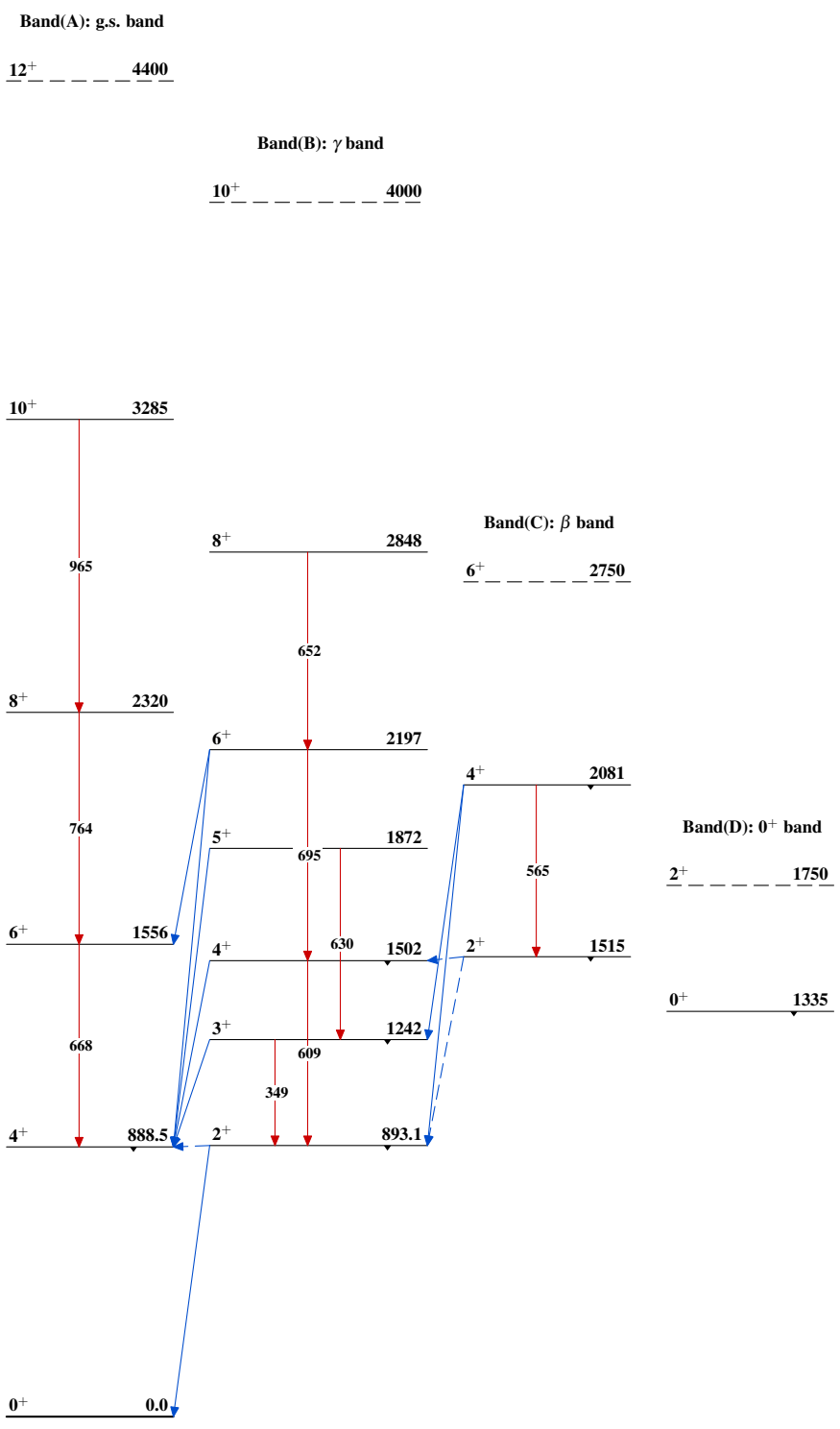
$I_\gamma > 10\% \times I_\gamma^{max}$

γ Decay (Uncertain)



$^{104}_{44}Ru_{60}$

Coulomb excitation 2006Sr01,1984St08



$^{104}_{44}Ru_{60}$