^{99}Ru(^{3}He,2nγ) 2009Ra06

History

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

2009Ra06: E=17 MeV beam was supplied by the FM Tandem Van de Graaff, at the University of Cologne. The ^{99}Ru target was 0.8 mg/cm^2 thick backed on 15 mg/cm^2 ^{197}Au substrate. Measured Eγ, Iγ, $\gamma\gamma$-coin, $\gamma\gamma(\theta)$ using HORUS cube array of 12 HPGe detectors, five of which were (BGO) Compton suppressed. Deduced levels, J, π, γ-ray multipolarities, mixing ratios. Comparison with theoretical calculations using shell model ANTOINE code.

All data are from 2009Ra06, unless otherwise noted.

^{100}Pd Levels

The 1523.6, 2621.6 and 2679.2 levels reported earlier were not confirmed in the work by 2009Ra06, due to different placements (for the first two levels) or non-observation (for the third level) of the de-exciting transitions.

E(level)[†]	J$^\pi$[‡]	Comments
0.0	0^+	
665.4 *2*	2^+	
1415.9 *2*	4^+	
1587.4 *2*	2^+[#]	Identified as a 2-phonon state.
1925.4 *2*	3^+[#]	Possible 3-phonon state.
2055.4 *3*	(4^-)	
2189.0 *3*	6^+	
2278.0 *3*	5^+[#]	
2351.0 *4*	(4^+)	
2358.8 *5*	$(2)^+$	Identified as one-phonon mixed-symmetry state. J$^\pi$: tentative assignment from $\gamma\gamma(\theta)$ data (2009Ra06).
2430.2 *4*	4[#]	
2469.5 *3*	$6^{(+)}$	
2505.7 *4*	5^-[#]	
2519.0 *4*	$(0^+$ to $4^+)$	
2531.5 *6*	(2^+)[#]	
2616.8 *6*	$(0^+$ to $4^+)$	
2693.7 *4*	(4)[#]	
2783.9 *6*		
2821.1 *6*	(4)[#]	
2879.7 *5*	(4^+)	
2886.3 *4*	$(4^+,5,6^+)$	
2919.5 *3*	(4^+)[#]	
2939.2 *6*	$(2^+$ to $6^+)$	
2976.5 *6*	$(0^+$ to $4^+)$	
2987.5 *4*	8^+	
3022.2 *4*		
3079.2 *4*		
3177.8 *4*		
3231.4 *4*		
3234.7 *9*		614.1γ was not seen in this work.
3296.2 *4*	(6^+)	J$^\pi$: 2009Ra06 give $(6,7^+)$, but γ to (4^+) suggests (6^+).
3311.1 *6*		
3371.8 *9*	$(2^+$ to $6^+)$	
3439.5 *4*		
3467.2 *7*	(2 to 6)	
3547.5 *7*	(2 to 6)	

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^{99}Ru(^{3}He,2nγ) 2009Ra06 (continued)

^{100}Pd Levels (continued)

E(level)[†]	J$^{\pi}$[‡]	Comments
3622.0 *11*	(4$^+$ to 8$^+$)	J$^{\pi}$: (4$^+$,5,6) assigned in 2009Ra06.
3646.7 *7*	(3$^-$ to 7$^-$)	
3823.0 *9*		
3868.6 *4*	10$^+$	
3879.4 *6*		
4054.0 *7*		614.4γ and 1065.7γ were not seen in this work.

[†] From least-squares fit to Eγ data.
[‡] From the Adopted Levels, unless otherwise noted.
[#] Spin from $\gamma\gamma(\theta)$ data of 2009Ra06.

γ(^{100}Pd)

E$_i$(level)	J$_i^{\pi}$	E$_{\gamma}$	I$_{\gamma}$	E$_f$	J$_f^{\pi}$	Mult.[†]	δ[†]	Comments
665.4	2$^+$	665.4 *2*	100	0.0	0$^+$			
1415.9	4$^+$	750.5 *2*	100	665.4	2$^+$			
1587.4	2$^+$	922.0 *2*	100 *4*	665.4	2$^+$	(E2+M1)	−1.77 *+32−43*	Mult.: dominant E2 in 2009Ra06.
		1587.4 *3*	60 *5*	0.0	0$^+$			
1925.4	3$^+$	338.1 *2*	11 *2*	1587.4	2$^+$	(M1+E2)	−0.59 *+31−42*	
		510	<72	1415.9	4$^+$			
		1260.0 *2*	100 *4*	665.4	2$^+$	(M1+E2)	−2.36 *30*	
2055.4	(4$^-$)	639.6 *2*	100	1415.9	4$^+$			
2189.0	6$^+$	773.1 *2*	100	1415.9	4$^+$	Q		δ(O/Q)=+0.01 *5*.
2278.0	5$^+$	222.7 *4*	20 *8*	2055.4	(4$^-$)			
		352.6 *2*	10 *5*	1925.4	3$^+$			
		862.0 *4*	100 *20*	1415.9	4$^+$	(M1+E2)	−0.14 *5*	Mult.: M1+E2 in 2009Ra06.
2351.0	(4$^+$)	1685.5 *4*	100	665.4	2$^+$			
2358.8	(2)$^+$	1693.4 *4*		665.4	2$^+$	D(+Q)	−0.08 *20*	Mult.: dominant M1 in 2009Ra06.
		2359.3[‡] *8*		0.0	0$^+$			E$_{\gamma}$: this γ-ray was observed in singles spectra only.
2430.2	4	504.8 *3*	100	1925.4	3$^+$	D+Q	−0.08 *5*	
2469.5	6$^{(+)}$	192.0 *5*	8 *4*	2278.0	5$^+$			
		280.5 *2*	72 *3*	2189.0	6$^+$			
		1053.5 *2*	100 *5*	1415.9	4$^+$			
2505.7	5$^-$	450.6 *5*	12 *1*	2055.4	(4$^-$)			
		1089.2 *2*	100 *2*	1415.9	4$^+$	D(+Q)	−0.06 *4*	
2519.0	(0$^+$ to 4$^+$)	931.6 *4*	100 *10*	1587.4	2$^+$			
		1853.5 *5*	10 *5*	665.4	2$^+$			
2531.5	(2$^+$)	1115.6 *5*	100	1415.9	4$^+$	(Q)		δ(O/Q)=−0.10 *14*. Mult.: pure E2 in 2009Ra06.
2616.8	(0$^+$ to 4$^+$)	1951.4 *5*	100	665.4	2$^+$			
2693.7	(4)	1277.8 *3*	100	1415.9	4$^+$	D(+Q)	−0.37 *+45−63*	
2783.9		2118.5 *5*	100	665.4	2$^+$			
2821.1	(4)	1405.2 *5*	100	1415.9	4$^+$	D+Q	−0.66 *+51−97*	
2879.7	(4$^+$)	528.7 *4*	44 *10*	2351.0	(4$^+$)			
		954.3 *8*	5 *2*	1925.4	3$^+$			
		2214.1 *8*	100 *20*	665.4	2$^+$			
2886.3	(4$^+$,5,6$^+$)	416.9 *4*	52 *10*	2469.5	6$^{(+)}$			
		697.4 *4*	100 *20*	2189.0	6$^+$			
		1470.2 *4*	56 *10*	1415.9	4$^+$			
2919.5	(4$^+$)	450.0 *2*	100 *10*	2469.5	6$^{(+)}$			

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^{99}Ru(^{3}He,2nγ) 2009Ra06 (continued)

$\gamma(^{100}Pd)$ (continued)

E_i(level)	J_i^π	E_γ	I_γ	E_f	J_f^π	Mult.[†]	δ[†]	Comments
2919.5	(4^+)	568.5 *5*	6 *2*	2351.0	(4^+)			
		730.6 *3*	20 *5*	2189.0	6^+			
		1503.4 *4*	30 *8*	1415.9	4^+	(M1+E2)	−0.7 *+5−11*	δ=−0.66 *+51−105* in 2009Ra06.
2939.2	$(2^+$ to $6^+)$	1523.3 *5*	100	1415.9	4^+			
2976.5	$(0^+$ to $4^+)$	1389.1 *5*	100	1587.4	2^+			
2987.5	8^+	798.5 *2*	100	2189.0	6^+	Q		Mult.: δ(O/Q)=+0.04 *5*.
3022.2		516.4 *3*	100 *7*	2505.7	5^-			
		967.0 *5*	6 *5*	2055.4	(4^-)			
3079.2		609.0 *4*	100 *20*	2469.5	$6^{(+)}$			
		890.5 *4*	69 *10*	2189.0	6^+			
3177.8		190.4 *4*	100 *5*	2987.5	8^+			
		708.2 *5*	19 *10*	2469.5	$6^{(+)}$			
		988.8 *5*	89 *8*	2189.0	6^+			
3231.4		209.4 *5*	14 *2*	3022.2				
		725.9 *4*	100 *4*	2505.7	5^-			
		1042.2 *4*	14 *3*	2189.0	6^+			
3234.7		1818.7 *8*	100	1415.9	4^+			
3296.2	(6^+)	308.8 *5*	45 *10*	2987.5	8^+			
		376.6 *5*	100 *20*	2919.5	(4^+)			
		1018.1 *5*	12 *5*	2278.0	5^+			
3311.1		960.1 *5*	100	2351.0	(4^+)			
3371.8	$(2^+$ to $6^+)$	1955.8 *8*	100	1415.9	4^+			
3439.5		261.7 *5*	96 *20*	3177.8				
		969.9 *5*	100 *20*	2469.5	$6^{(+)}$			
		1250.6 *5*	69 *15*	2189.0	6^+			
3467.2	(2 to 6)	1037.0 *5*	100	2430.2	4			
3547.5	(2 to 6)	1117.3 *5*	100	2430.2	4			
3622.0	$(4^+$ to $8^+)$	1152.5 *10*	100	2469.5	$6^{(+)}$			
3646.7	$(3^-$ to $7^-)$	1141.0 *5*	100	2505.7	5^-			
3823.0		1767.6 *8*	100	2055.4	(4^-)			
3868.6	10^+	881.1 *2*	100	2987.5	8^+			
3879.4		647.9[‡] *6*		3231.4				
		857.3[‡] *6*		3022.2				
4054.0		822.7[‡] *8*		3231.4				
		876.1[‡] *8*		3177.8				

[†] From 2009Ra06 based on $\gamma\gamma(\theta)$ data. The A_2 and A_4 angular distribution coefficients are not listed by the authors, but detailed angular correlation plots are given. Authors discuss specific multipolarity assignments for a few transitions in the text, others are implied by the evaluators from J^π values of the initial and final levels. As the angular distribution are parity insensitive, evaluators assign D+Q and Q for implied M1+E2 and E2 from ΔJ^π values, however for large δ(Q/D) values, (M1+E2) is assigned from RUL, assuming that there are no levels with half-lives longer than few ns.

[‡] Placement of transition in the level scheme is uncertain.

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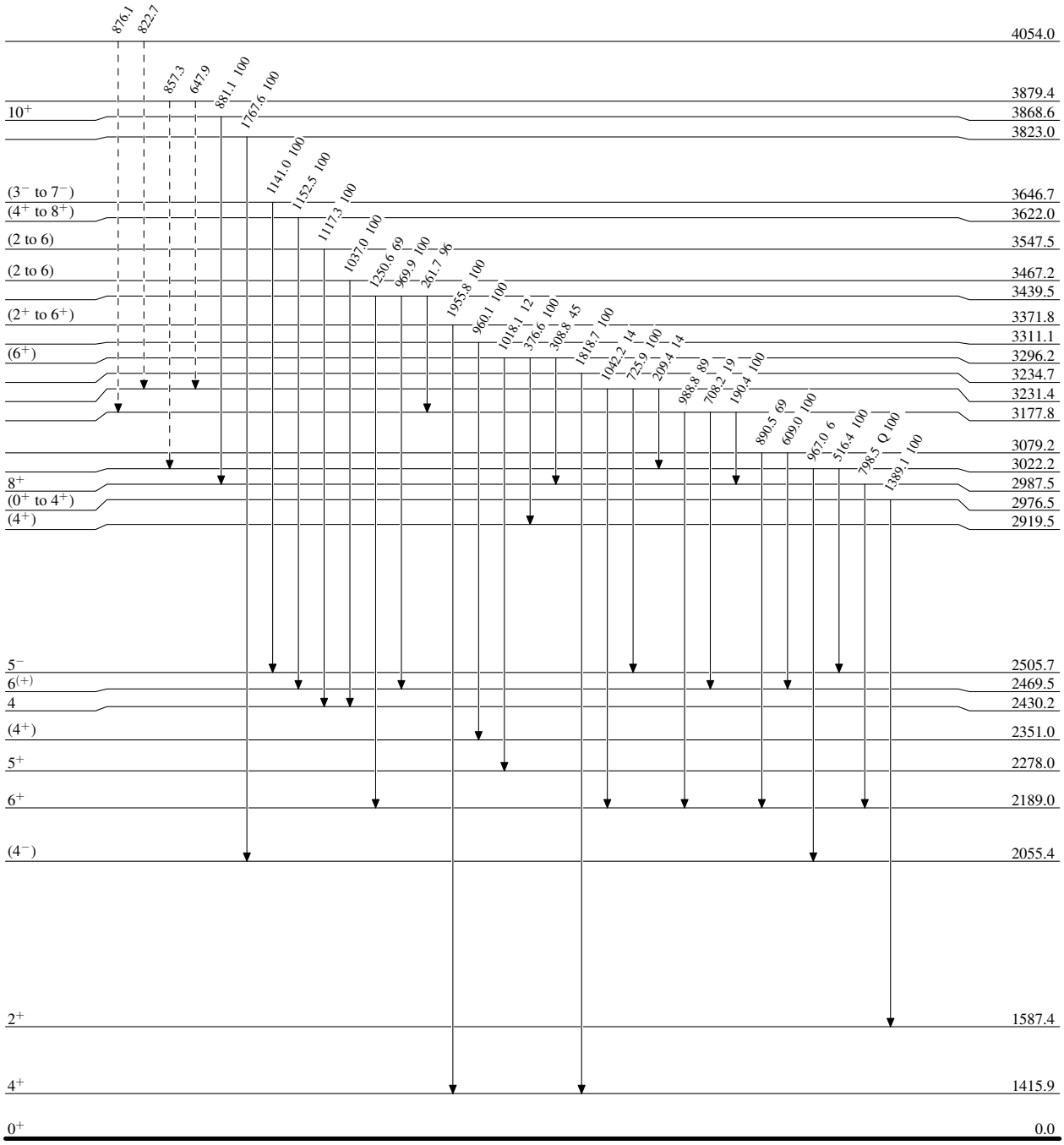
Legend

Level Scheme

Intensities: Relative photon branching from each level

γ Decay (Uncertain)



$^{100}_{46}Pd_{54}$

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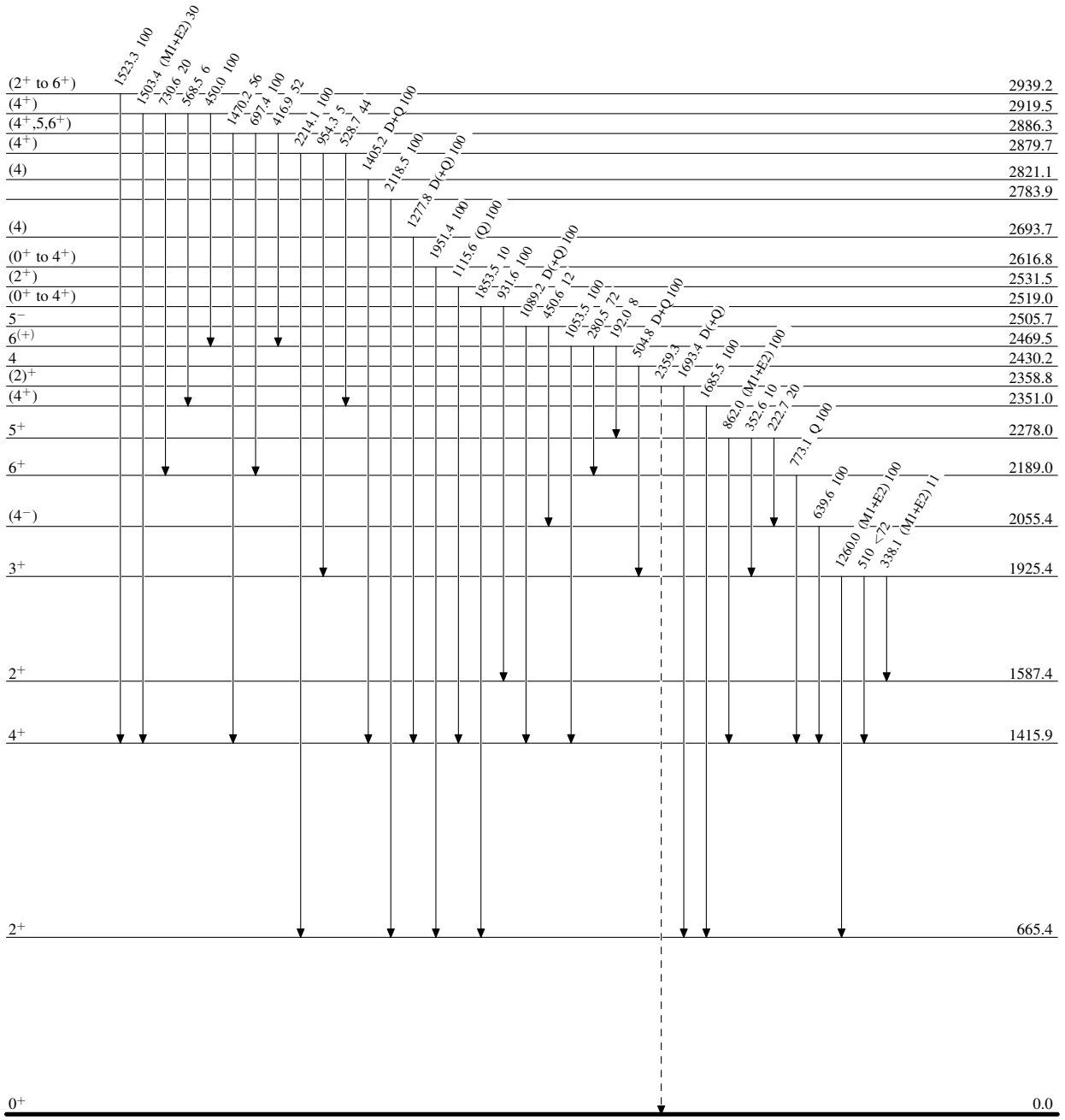
Legend

Level Scheme (continued)

Intensities: Relative photon branching from each level

γ Decay (Uncertain)



$^{100}_{46}Pd_{54}$

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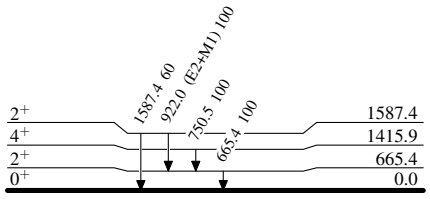
Level Scheme (continued)

Intensities: Relative photon branching from each level



$^{100}_{46}Pd_{54}$