^{63}Cu(^{31}P,n2pγ) 2004Ra12

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Coral M. Baglin	NDS 114, 1293 (2013)	1-Sep-2013

E=125 MeV; measured Eγ, Iγ $\gamma\gamma$ coin, $\gamma\gamma(\theta)$, $\gamma\gamma$(pol) with an eight-Clover coplanar Ge detector array in conjunction with a 14-element NaI(Tl) multiplicity filter.

^{91}Mo Levels

E(level)†	J$^\pi$‡	E(level)†	J$^\pi$‡	E(level)†	J$^\pi$‡	E(level)†	J$^\pi$‡
0.0#	9/2$^+$	4959.8@ *13*	(29/2$^+$)	6469.4# *11*	33/2$^+$	8154.2 *16*	(39/2$^+$)
1414.5# *5*	13/2$^+$	5244.3@ *14*	(31/2$^+$)	6658.3 *11*	(31/2$^+$)	8174.6 *16*	
2068.6# *7*	17/2$^+$	5299.7 *14*	(31/2$^+$)	6814.1 *15*		8278.9# *12*	(37/2$^+$)
2268.4# *9*	21/2$^+$	5487.9# *11*	29/2$^+$	6960.3 *14*		8578.0 *14*	
2941.0# *10*	23/2$^+$	5930.3 *15*		7262.5 *11*	(33/2$^+$)	8626.8 *12*	(37/2$^+$)
3545.7# *10*	25/2$^+$	5964.5 *15*	(35/2$^+$)	7322.1@ *15*	(35/2$^+$)	8708.8 *16*	
3810.7@ *11*	25/2$^+$	6106.5 *10*	(29/2$^+$)	7336.0 *12*	(33/2)	8749.1 *14*	(39/2$^+$)
4342.7@ *12*	(27/2$^+$)	6232.9# *11*	31/2$^+$	7469.1 *12*	(35/2$^+$)	9283.1@ *16*	(39/2$^+$)
4445.2# *10*	25/2$^+$	6328.8 *13*	(31/2)	7806.6 *15*	(33/2)	10749.7# *13*	
4457.5 *12*	(27/2)	6438.6 *15*	(33/2)	8002.2 *16*	(39/2$^+$)		
4952.4# *10*	27/2$^+$	6445.8 *16*		8112.2 *13*	(37/2$^+$)		

† From least-squares fit to Eγ; uncertainty of 0.5 keV assumed for each datum.
‡ Authors′ suggested values based on measured R$_{\text{int}}$, R$_{\text{asym}}$ and/or polarization and assuming J$^\pi$(g.s.)=9/2$^+$.
# Band(A): γ sequence based on 9/2$^+$ g.s..
@ Band(B): γ sequence based on 25/2$^+$.

γ(^{91}Mo)

E$_\gamma$	I$_\gamma$	E$_i$(level)	J$^\pi_i$	E$_f$	J$^\pi_f$	Mult.‡	α#	Comments
199.8	100	2268.4	21/2$^+$	2068.6	17/2$^+$	(E2)	0.0995	Mult.: R$_{\text{int}}$≈0.96 *4* ; R$_{\text{asym}}$≈0.55 *5*; Pol$_{\text{asym}}$≈+0.06 *4*.
206.6	12.4 *6*	7469.1	(35/2$^+$)	7262.5	(33/2$^+$)	D+Q		Mult.: R$_{\text{int}}$≈2.8 *4* ; R$_{\text{asym}}$≈0.96 *4*.
236.5	11.6 *5*	6469.4	33/2$^+$	6232.9	31/2$^+$	M1	0.0248	Mult.: R$_{\text{int}}$≈2.41 *17* ; R$_{\text{asym}}$≈1.15 *5*; Pol$_{\text{asym}}$≈−0.12 *10*.
265.0	5.4 *2*	3810.7	25/2$^+$	3545.7	25/2$^+$	(M1)	0.0185	Mult.: R$_{\text{int}}$≈0.64 *14* ; Pol$_{\text{asym}}$=−0.05 *3* (from text of 2004Ra12).
284.5	20.3 *10*	5244.3	(31/2$^+$)	4959.8	(29/2$^+$)	D		I$_\gamma$: 20.25 *10* is listed by 2004Ra12 but that uncertainty seems unrealistically low and is presumed here to be an order of magnitude larger. Mult.: R$_{\text{int}}$≈2.17 *21* ; R$_{\text{asym}}$≈1.40 *3*; Pol$_{\text{asym}}$≈−0.06 *5* favors M1.
339.9	7.4 *4*	5299.7	(31/2$^+$)	4959.8	(29/2$^+$)	D+Q		Mult.: R$_{\text{int}}$≈2.9 *5* ; R$_{\text{asym}}$≈1.06 *5*.
465.8†@		8578.0		8112.2	(37/2$^+$)			
507.2	17.2 *9*	4952.4	27/2$^+$	4445.2	25/2$^+$	D		Mult.: R$_{\text{int}}$≈1.97 *26* ; R$_{\text{asym}}$≈1.37 *4*; Pol$_{\text{asym}}$≈−0.02 *5*.
515.5	6.6 *4*	6445.8		5930.3				
532.0	27.5 *14*	4342.7	(27/2$^+$)	3810.7	25/2$^+$	D		Mult.: R$_{\text{int}}$≈1.86 *14* ; R$_{\text{asym}}$≈1.46 *4*; Pol$_{\text{asym}}$≈−0.04 *3*.
535.7	12.7 *7*	5487.9	29/2$^+$	4952.4	27/2$^+$	D		Mult.: R$_{\text{int}}$≈1.87 *17* ; Pol$_{\text{asym}}$≈−0.01 *4*.
551.7	6.5 *3*	6658.3	(31/2$^+$)	6106.5	(29/2$^+$)			

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^{63}Cu(^{31}P,n2pγ) 2004Ra12 (continued)

γ(^{91}Mo) (continued)

E_γ	I_γ	E_i(level)	J^π_i	E_f	J^π_f	Mult.‡	Comments
x575							
603.9	1.0 *5*	7262.5	(33/2+)	6658.3	(31/2+)		
604.7	22.0 *11*	3545.7	25/2+	2941.0	23/2+		Mult.: Pol_{asym}≈+0.025 *20*.
617.1	20.1 *10*	4959.8	(29/2+)	4342.7	(27/2+)	D	Mult.: R_{int}≈2.27 *24* ; R_{asym}≈1.40 *3*; Pol_{asym}≈−0.026 *26*.
636.9	7.7 *4*	8749.1	(39/2+)	8112.2	(37/2+)	M1	Mult.: R_{int}≈2.2 *5* ; R_{asym}≈1.31 *8*; Pol_{asym}≈−0.19 *18*.
643.1	9.0 *5*	8112.2	(37/2+)	7469.1	(35/2+)	(M1)	Mult.: R_{int}≈1.8 *3* ; R_{asym}≈1.30 *7*; Pol_{asym}≈−0.10 *24*.
646.8	7.8 *4*	4457.5	(27/2)	3810.7	25/2+		
654.1	100	2068.6	17/2+	1414.5	13/2+	E2	Mult.: R_{int}≈0.88 *4* ; R_{asym}≈0.68 *8*; Pol_{asym}≈+0.10 *2*.
664.8	8.3 *4*	5964.5	(35/2+)	5299.7	(31/2+)	E2	Mult.: R_{int}≈1.1 *4* ; Pol_{asym}≈+0.07 *4*.
672.6	55 *3*	2941.0	23/2+	2268.4	21/2+	M1	Mult.: R_{int}≈1.97 *9* ; R_{asym}≈1.56 *5*; Pol_{asym}≈−0.06 *2*.
686.0	7.8 *4*	5930.3		5244.3	(31/2+)		
706.6	4.3 *2*	8708.8		8002.2	(39/2+)		
744.9	11.4 *6*	6232.9	31/2+	5487.9	29/2+	D(+Q)	Mult.: R_{int}≈2.22 *25* ; R_{asym}≈1.49 *4*; Pol_{asym}≈+0.01 *5*.
869.7	27.0 *14*	3810.7	25/2+	2941.0	23/2+	D(+Q)	Mult.: R_{int}≈1.63 *4* ; R_{asym}≈1.36 *3*; Pol_{asym}=+0.01 *2* (from text of 2004Ra12).
981.5	6.5 *3*	6469.4	33/2+	5487.9	29/2+	Q	Mult.: R_{int}≈0.85 *11* ; R_{asym}≈0.76 *6*.
1138.9	3.5 *2*	6438.6	(33/2)	5299.7	(31/2+)	D	Mult.: R_{int}≈2.5 *7*.
1154.1	1.3 *1*	6106.5	(29/2+)	4952.4	27/2+	D	Mult.: R_{int}≈2.2 *14*.
1406.6	1.7 *1*	4952.4	27/2+	3545.7	25/2+	D	Mult.: R_{asym}≈1.16 *10*.
1414.5	100	1414.5	13/2+	0.0	9/2+	Q	Mult.: R_{int}≈1.00 *4* ; R_{asym}≈0.60 *2*; Pol_{asym}≈+0.03 *2*.
x1472							
1504.2	1.3 *1*	4445.2	25/2+	2941.0	23/2+		
1569.8†@		6814.1		5244.3	(31/2+)		
1661.3	2.9 *3*	6106.5	(29/2+)	4445.2	25/2+	Q	Mult.: R_{asym}≈0.63 *6*.
1705.8	3.9 *4*	6658.3	(31/2+)	4952.4	27/2+	Q	Mult.: R_{int}≈1.21 *25*.
1774.8	3.6 *4*	7262.5	(33/2+)	5487.9	29/2+	Q	Mult.: R_{int}≈1.21 *4* ; R_{asym}≈0.45 *5*.
1809.5	8.5 *9*	8278.9	(37/2+)	6469.4	33/2+	(E2)	Mult.: R_{int}≈1.08 *17* ; R_{asym}≈0.73 *4*; Pol_{asym}≈+0.07 *10*.
1848.1	1.0 *1*	7336.0	(33/2)	5487.9	29/2+	Q	Mult.: R_{int}≈0.6 *3*.
1871.3	3.4 *3*	6328.8	(31/2)	4457.5	(27/2)	Q	Mult.: R_{int}≈0.93 *10*.
1942.3	13.5 *14*	5487.9	29/2+	3545.7	25/2+	Q	Mult.: R_{int}≈0.83 *9* ; R_{asym}≈0.61 *4*.
1961.0	2.0 *2*	9283.1	(39/2+)	7322.1	(35/2+)	(Q)	Mult.: R_{int}≈0.60 *18*.
2000.5†@		6960.3		4959.8	(29/2+)		
2011.4	4.2 *4*	4952.4	27/2+	2941.0	23/2+	Q	Mult.: R_{int}≈1.52 *20* ; R_{asym}≈0.52 *4*; Pol_{asym}≈+0.16 *11*. A D assignment, inconsistent with level scheme.
2037.7	5.1 *5*	8002.2	(39/2+)	5964.5	(35/2+)	Q	Mult.: R_{int}≈1.25 *25* ; R_{asym}≈0.79 *5*; Pol_{asym}≈+0.05 *10*.
2077.8	2.4 *2*	7322.1	(35/2+)	5244.3	(31/2+)	E2	Mult.: R_{int}≈0.69 *13* ; Pol_{asym}≈+0.028 *17*.
2157.4	1.0 *1*	8626.8	(37/2+)	6469.4	33/2+	Q	Mult.: R_{int}≈1.0 *3*.
2176.8	24.7 *25*	4445.2	25/2+	2268.4	21/2+	Q	Mult.: R_{int}≈0.79 *4* ; R_{asym}≈0.63 *2*; Pol_{asym}≈+0.023 *27*.
2189.7	1.0 *1*	8154.2	(39/2+)	5964.5	(35/2+)	Q	Mult.: R_{int}≈1.2 *4* ; Pol_{asym}≈+0.03 *6*.
2244.3	2.0 *2*	8174.6		5930.3			
2470.7†@		10749.7		8278.9	(37/2+)		
2562.3	1.0 *1*	7806.6	(33/2)	5244.3	(31/2+)	D	Mult.: R_{int}≈2.49 *15*.

† Weak transition.
‡ Based on R_{int}, R_{asym} and/or Pol_{asym} values read by evaluator from figs. 2, 3 and 4 of 2004Ra12 and given In comments; here, R(int)=Iγ_1 at 250° and 285°, gated by γ_2 at 150°, 210° and 325°/Iγ_1 at 150°, 210° and 325°, gated by γ_2 at 250° and 285°, R(asym)=(Iγ_1 at 90°, gated by γ_2 at 60° and 120°)/ (Iγ_1 at 150°, 210° and 325°, gated by γ_2 at 60° and 120°) and

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^{63}Cu(^{31}P,n2pγ) 2004Ra12 (continued)

γ(^{91}Mo) (continued)

Pol_{asym}=[(aN(perpendicular)) − N(parallel)]/[(aN(perpendicular)) + N(parallel)], where a is the value of the asymmetry of the clover array. typically, $R_{int}\approx 1$ and≈ 2, respectively, for ΔJ=2 Q and D ΔJ=1 transitions, whereas $R_{asym}\approx 0.6$ and≈ 1.4.

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.

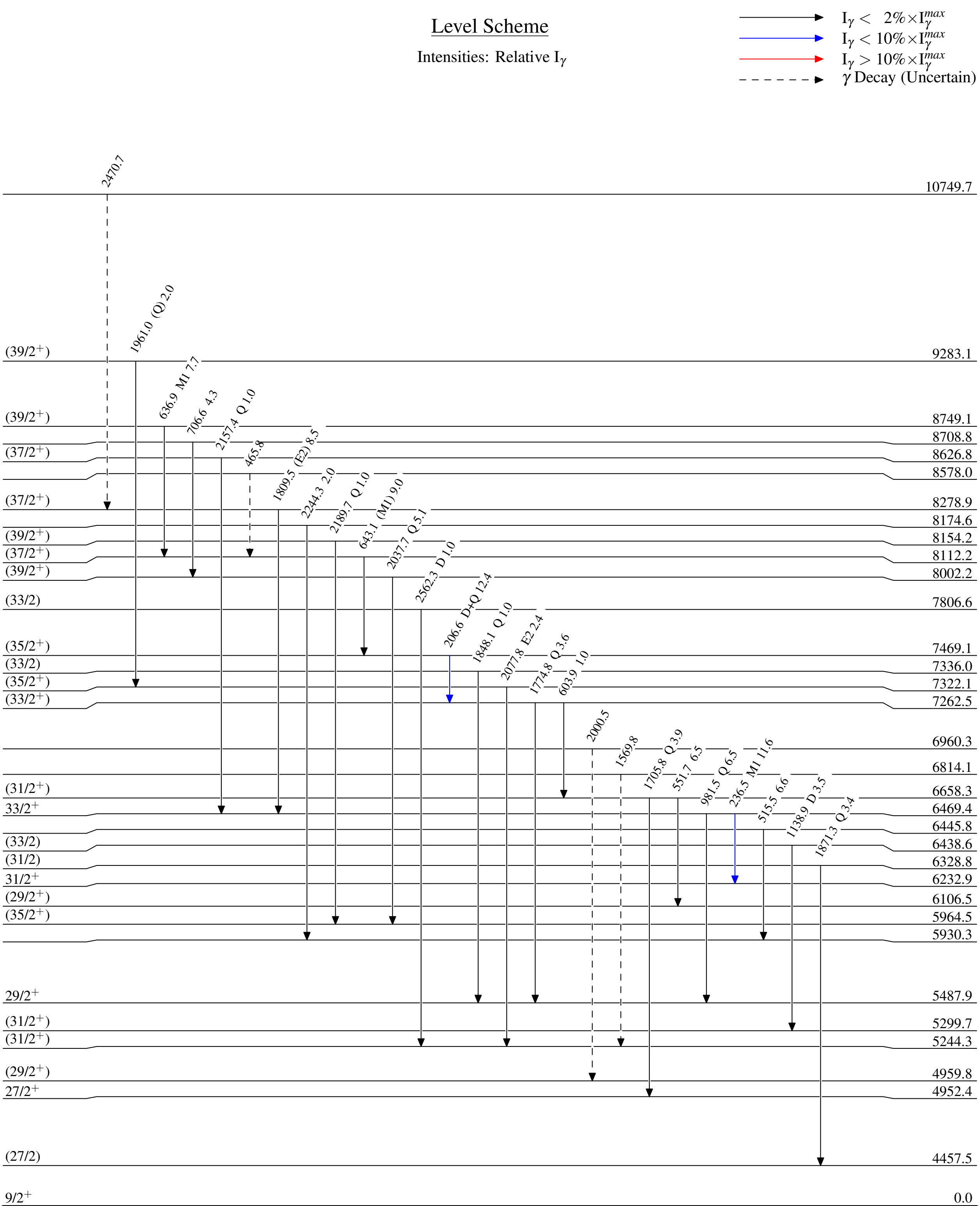
@ Placement of transition in the level scheme is uncertain.

x γ ray not placed in level scheme.

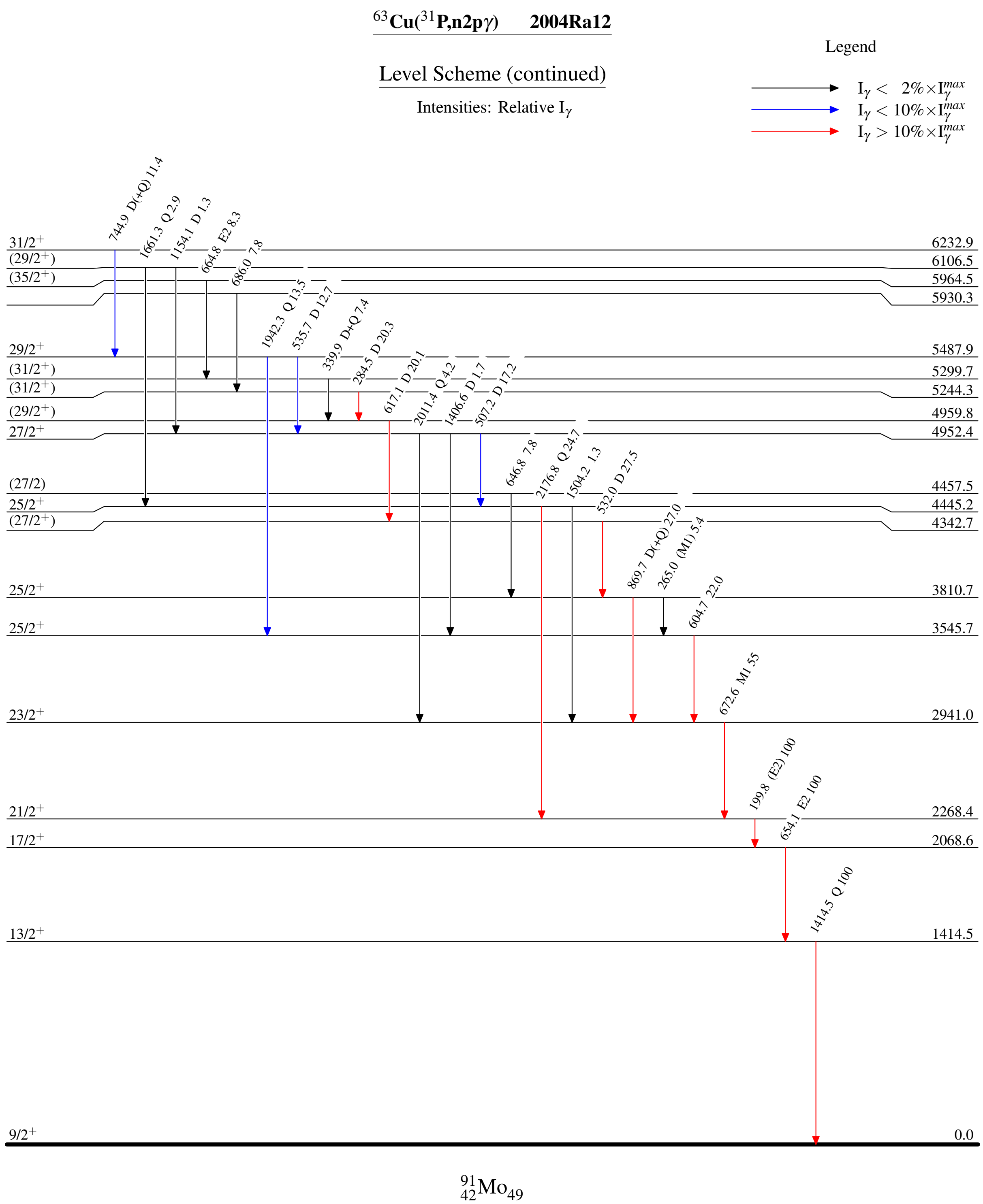
$^{63}Cu(^{31}P,n2p\gamma)$ 2004Ra12

Level Scheme

Intensities: Relative I_γ

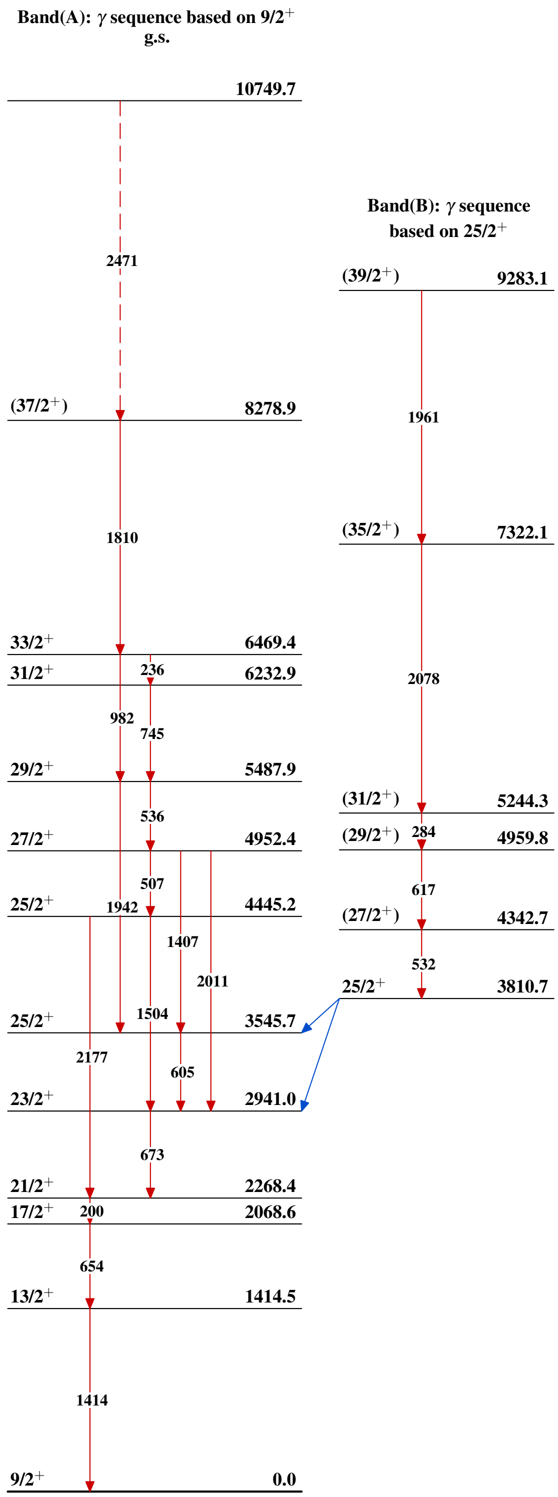


$^{91}_{42}Mo_{49}$



^{63}Cu(^{31}P,n2pγ) 2004Ra12
Level Scheme (continued)
Intensities: Relative I_γ
Legend
$I_\gamma < 2\% \times I_\gamma^{max}$
$I_\gamma < 10\% \times I_\gamma^{max}$
$I_\gamma > 10\% \times I_\gamma^{max}$
31/2+ 6232.9
(29/2+) 6106.5
(35/2+) 5964.5
5930.3
29/2+ 5487.9
(31/2+) 5299.7
(31/2+) 5244.3
(29/2+) 4959.8
27/2+ 4952.4
(27/2) 4457.5
25/2+ 4445.2
(27/2+) 4342.7
25/2+ 3810.7
25/2+ 3545.7
23/2+ 2941.0
21/2+ 2268.4
17/2+ 2068.6
13/2+ 1414.5
9/2+ 0.0
744.9 D(+Q) 11.4
1661.3 Q 2.9
1154.1 D 1.3
664.8 E2 8.3
686.0 7.8
1942.3 Q 13.5
535.7 D 12.7
339.9 D+Q 7.4
284.5 D 20.3
617.1 D 20.1
2011.4 Q 4.2
1406.6 D 1.7
507.2 D 17.2
646.8 7.8
2176.8 Q 24.7
1504.2 1.3
532.0 D 27.5
869.7 D(+Q) 27.0
265.0 (M1) 5.4
604.7 22.0
672.6 M1 55
199.8 (E2) 100
654.1 E2 100
1414.5 Q 100
$^{91}_{42}Mo_{49}$

^{63}Cu(^{31}P,n2pγ) 2004Ra12



$^{91}_{42}Mo_{49}$