^{52}Cr(^{18}O,AP2NG) 2018Ra15

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Jun Chen	NDS 196,17 (2024)	30-Sep-2023

2018Ra15: E=72.5 MeV ^{18}O beam was produced from the 15-UD pelletron accelerator at the Inter University Accelerator Centre (IUAC), New Delhi. Target was ≈1 mg/cm^2 isotopic ^{52}Cr on a 8.0 mg/cm^2 Au backing. γ rays were detected with the Indian National Gamma Array (INGA) of 14 Compton-suppressed HPGe clover detectors. Measured Eγ, Iγ, $\gamma\gamma$-coin, $\gamma\gamma$(DCO), γ polarization asymmetry. Deduced levels, J, π, γ-ray multipolarities, branching ratios. Comparisons with shell-model calculations.

^{63}Cu Levels

E(level)[†]	J$^\pi$[‡]	Comments
0	3/2$^-$	
961.94 *7*	5/2$^-$	
1326.76 *8*	7/2$^-$	
1412.15 *25*	5/2$^-$	
1860.81 *8*	7/2$^-$	
2091.97 *10*	7/2$^-$	
2207.47 *12*	9/2$^-$	
2274.7 *4*	9/2$^{(-)}$	
2504.95 *10*	9/2$^+$	
2547.9 *6*	9/2$^-$	J$^\pi$: from Figure 5 of 2018Ra15; 9/2$^{(-)}$ given in Table I.
2676.91 *21*	11/2$^-$	
3460.43 *13*	11/2$^+$	
3556.8 *5*	(11/2$^-$)	
3737.3 *5*	13/2$^{(-)}$	
3932.3 *6*	(13/2$^-$)	
4128.53 *19*	13/2$^+$	
4154.62 *12*	13/2$^+$	
4496.72 *15*	17/2$^+$	
4575.9 *3*	15/2$^+$	
4613.4 *5*	(15/2$^-$)	
5357.34 *18*	19/2$^+$	
5411.7 *3*	17/2$^+$	
5767.4 *3*	21/2$^+$	
6283.51 *18*	19/2$^+$	
6493.8 *4*	23/2$^+$	
6749.4 *6*		
7072.9 *3*	23/2$^+$	
7479.2 *6*		
8364.7 *5*	25/2$^{(+)}$	J$^\pi$: from Figure 5 of 2018Ra15; 25/2$^+$ given in Table I.
9489.5 *6*		

[†] From a least-squares fit to γ-ray energies.

[‡] As given in 2018Ra15, based on measured $\gamma\gamma$(DCO) and γ polarization asymmetry, γ decay patterns, as well as known spin-parities for low-lying states. When considered in Adopted Levels, the firm assignments for high-spin states from this dataset will be placed in parentheses if there are no strong supporting arguments.

γ(^{63}Cu)

Expected DCO ratios are ≈1.0 for stretched quadrupole transition (for ΔJ=0 in some cases) and ≈0.5 for stretched dipole for a pure quadrupole gate, and are ≈2.0 and ≈1.0, respectively, for a pure dipole gate (2018Ra15).

For polarization asymmetry Δ_{asym}, positive value implies electric nature while a negative value implies magnetic nature; a near-zero value indicates a strong admixture (2018Ra15).

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^{52}Cr(^{18}O,AP2NG) 2018Ra15 (continued)

γ(^{63}Cu) (continued)

E_γ [†]	I_γ [‡]	E_i(level)	J_i^π	E_f	J_f^π	Mult. [#]	Comments
231.1 *5*	0.4 *1*	2091.97	7/2$^-$	1860.81	7/2$^-$	&	DCO=1.01 *6* Branching ratio=1.6 *1*. DCO consistent with ΔJ=0.
297.3 *5*	1.8 *1*	2504.95	9/2$^+$	2207.47	9/2$^-$	&	DCO=1.1 *2* Branching ratio=2.0 *1*. DCO consistent with ΔJ=0.
342.1 *1*	43.2 *16*	4496.72	17/2$^+$	4154.62	13/2$^+$	E2&	DCO=0.97 *6* Branching ratio=6.7 *4*, Δ_{asym}=0.092 *59*.
364.9 *1*	18.7 *11*	1326.76	7/2$^-$	961.94	5/2$^-$	D@	DCO=0.52 *6* Branching ratio=17.8 *11*.
368.3 *3*	5.8 *3*	4496.72	17/2$^+$	4128.53	13/2$^+$		Branching ratio=93.3 *37*.
412.9 *1*	25.3 *10*	2504.95	9/2$^+$	2091.97	7/2$^-$	E1&	DCO=0.53 *3* Branching ratio=28.9 *16*, Δ_{asym}=0.110 *40*.
421.2 *3*	6.5 *3*	4575.9	15/2$^+$	4154.62	13/2$^+$	D&	DCO=0.42 *4* Branching ratio=79.4 *32*, Δ_{asym}=−0.04 *14*.
447.4[b] *5*		4575.9	15/2$^+$	4128.53	13/2$^+$		Branching ratio=21.6 *10*.
448.4[b] *5*		1860.81	7/2$^-$	1412.15	5/2$^-$		Branching ratio=2.2 *2*.
449.7[b] *5*		1412.15	5/2$^-$	961.94	5/2$^-$		Branching ratio=79 *16*.
469.4 *3*	4.3 *2*	2676.91	11/2$^-$	2207.47	9/2$^-$	D+Q[a]	DCO=0.44 *7* Branching ratio=19.7 *10*.
534.0 *3*	2.0 *1*	1860.81	7/2$^-$	1326.76	7/2$^-$	[a]	DCO=0.97 *18* Branching ratio=2.1 *2*. DCO consistent with ΔJ=0.
571.7[c] *5*		4128.53	13/2$^+$	3556.8	(11/2$^-$)		Branching ratio=2.7 *6*.
644.2 *1*	31.7 *12*	2504.95	9/2$^+$	1860.81	7/2$^-$	E1&	DCO=0.53 *3* Branching ratio=43.7 *24*, Δ_{asym}=0.082 *55*.
668.1 *3*	3.0 *3*	4128.53	13/2$^+$	3460.43	11/2$^+$	D[a]	DCO=0.47 *10* Branching ratio=41.9 *20*.
680.2[c] *5*	1.7 *2*	2091.97	7/2$^-$	1412.15	5/2$^-$		Branching ratio=4.3 *3*.
687		2547.9	9/2$^-$	1860.81	7/2$^-$		E_γ: from level scheme in Fig.5; not listed in Table I.
694.1 *1*	11.2 *5*	4154.62	13/2$^+$	3460.43	11/2$^+$	D+Q[a]	DCO=0.34 *2* Branching ratio=19.5 *11*.
726.4[c] *5*	0.5 *1*	6493.8	23/2$^+$	5767.4	21/2$^+$		Listed as 23/2$^+$ to 19/2$^+$ transition in Table I which is a typo.
765.2 *3*	3.3 *2*	2091.97	7/2$^-$	1326.76	7/2$^-$	D+Q&	DCO=0.74 *9* Branching ratio=35.7 *20*.
789.4 *3*	9.4 *4*	7072.9	23/2$^+$	6283.51	19/2$^+$	E2@	DCO=1.01 *7* Δ_{asym}=0.116 *60*.
835.7 *3*	4.2 *2*	5411.7	17/2$^+$	4575.9	15/2$^+$	D+Q&	DCO=0.28 *7* Branching ratio=100 *3*.
860.6 *1*	11.7 *5*	5357.34	19/2$^+$	4496.72	17/2$^+$	D+Q@	DCO=0.34 *3* Branching ratio=100 *3*, Δ_{asym}=0.004 *49*.
871.7[c] *3*	2.6 *1*	6283.51	19/2$^+$	5411.7	17/2$^+$		Branching ratio=16.8 *15*.
875.9 *5*	0.8 *1*	4613.4	(15/2$^-$)	3737.3	13/2$^{(-)}$		
880.7 *5*	1.9 *1*	2207.47	9/2$^-$	1326.76	7/2$^-$	D[a]	DCO=0.42 *4* Branching ratio=67.9 *35*.
898.8 *1*	39.3 *15*	1860.81	7/2$^-$	961.94	5/2$^-$	D&	DCO=0.52 *5* Branching ratio=51.6 *29*, Δ_{asym}=−0.030 *53*.
925.8[c] *5*	0.8 *1*	6283.51	19/2$^+$	5357.34	19/2$^+$		Branching ratio=7.1 *2*.
948.2 *5*	1.0 *1*	2274.7	9/2$^{(-)}$	1326.76	7/2$^-$	D+Q@	DCO=0.64 *12* Branching ratio=100 *3*.

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^{52}Cr(^{18}O,AP2NG) 2018Ra15 (continued)

γ(^{63}Cu) (continued)

E_γ[†]	I_γ[‡]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[#]	Comments
955.4 *1*	18.0 *7*	3460.43	11/2$^+$	2504.95	9/2$^+$	D+Q[a]	DCO=0.34 *4* Branching ratio=100, Δ_{asym}=0.005 *38*.
961.8 *1*	100 *5*	961.94	5/2$^-$	0	3/2$^-$	D+Q[@]	DCO=0.35 *2* Branching ratio=100 *3*, Δ_{asym}=0.011 *28*.
1008.9 *5*	1.6 *1*	3556.8	(11/2$^-$)	2547.9	9/2$^-$		Branching ratio=100.
1129.9 *1*	26.7 *10*	2091.97	7/2$^-$	961.94	5/2$^-$	D+Q[&]	DCO=0.24 *3* Branching ratio=50.9 *28*, Δ_{asym}=0.036 *61*.
1136.5 *3*	3.4 *2*	6493.8	23/2$^+$	5357.34	19/2$^+$	[@]	DCO=0.21 *4* Δ_{asym}=0.110 *90*. listed as 23/2$^+$ to 21/2$^+$ transition in Table I which is a typo. Mult.: DCO consistent with ΔJ=1, but ΔJ=2 from level scheme.
1178.3 *3*	5.8 *3*	2504.95	9/2$^+$	1326.76	7/2$^-$	D[&]	DCO=0.47 *4* Branching ratio=22.5 *13*, Δ_{asym}=0.030 *50*.
1245.5 *1*	10.3 *4*	2207.47	9/2$^-$	961.94	5/2$^-$		Branching ratio=32.1 *18*.
1255.4 *5*	0.6 *1*	3932.3	(13/2$^-$)	2676.91	11/2$^-$		Branching ratio=100.
1270.6 *3*	2.9 *2*	5767.4	21/2$^+$	4496.72	17/2$^+$	Q[&]	DCO=0.98 *10* Branching ratio=100 *3*.
1291.8 *3*	2.5 *2*	8364.7	25/2$^{(+)}$	7072.9	23/2$^+$	D[&]	DCO=0.39 *6* Branching ratio=100 *3*.
1326.7 *1*	14.7 *10*	1326.76	7/2$^-$	0	3/2$^-$	E2[@]	DCO=0.99 *7* Branching ratio=82.2 *48*, Δ_{asym}=0.072 *62*.
1350.3 *3*	3.9 *2*	2676.91	11/2$^-$	1326.76	7/2$^-$	Q[a]	DCO=1.05 *11* Branching ratio=80.3 *28*.
1412.3 *3*	3.2 *2*	1412.15	5/2$^-$	0	3/2$^-$	D+Q[@]	DCO=0.83 *19* Branching ratio=21 *6*.
1451.8[c] *5*	0.9 *1*	4128.53	13/2$^+$	2676.91	11/2$^-$		Branching ratio=11.2 *6*.
1529.7 *5*	1.2 *1*	3737.3	13/2$^{(-)}$	2207.47	9/2$^-$	Q[a]	DCO=1.06 *31* Branching ratio=100.
1542.9 *3*	3.1 *2*	2504.95	9/2$^+$	961.94	5/2$^-$	Q[&]	DCO=0.98 *22* Branching ratio=1.6 *1*.
1623.6 *3*	4.4 *2*	4128.53	13/2$^+$	2504.95	9/2$^+$	Q[a]	DCO=1.11 *20* Branching ratio=52.1 *15*.
1649.7 *1*	44.3 *17*	4154.62	13/2$^+$	2504.95	9/2$^+$	E2[@]	DCO=1.02 *7* Branching ratio=78.6 *45*, Δ_{asym}=0.074 *34*.
1715.3 *5*	0.7 *1*	7072.9	23/2$^+$	5357.34	19/2$^+$		
1786.8 *1*	11.7 *5*	6283.51	19/2$^+$	4496.72	17/2$^+$	D[@]	DCO=0.53 *4* Branching ratio=76.1 *5*, Δ_{asym}=0.01 *5*.
1860.9 *1*	14.1 *11*	1860.81	7/2$^-$	0	3/2$^-$	Q[&]	DCO=0.98 *9* Branching ratio=44.1 *24*, Δ_{asym}=0.065 *90*.
1880.1 *5*	0.9 *1*	4154.62	13/2$^+$	2274.7	9/2$^{(-)}$	(Q)[@]	DCO=0.81 *19* Branching ratio=1.9 *1*.
1936.6 *5*	0.5 *1*	4613.4	(15/2$^-$)	2676.91	11/2$^-$	(Q)[a]	DCO=1.13 *45*
2092.5[c] *5*	1.9 *1*	2091.97	7/2$^-$	0	3/2$^-$		Branching ratio=7.5 *4*. listed as 7/2$^-$ to 5/2$^-$ transition in Table I which is a typo.
2121.8 *5*		7479.2		5357.34	19/2$^+$		Branching ratio=100 *3*.
2252.6 *5*		6749.4		4496.72	17/2$^+$		Branching ratio=100 *3*. listed as transition feeding 23/2$^+$ in Table I which is a typo.

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^{52}Cr(^{18}O,AP2NG) 2018Ra15 (continued)

$\gamma(^{63}Cu)$ (continued)

E_γ[†]	I_γ[‡]	E_i(level)	J_i^π	E_f	J_f^π	Comments
2416.6 *5*		9489.5		7072.9	$23/2^+$	Branching ratio=100 *3*.
2505.1[c] *5*	0.9 *1*	2504.95	$9/2^+$	0	$3/2^-$	Branching ratio=1.4 *1*.

[†] 2018Ra15 state that uncertainties lie between 0.1 and 0.5 keV depending on intensities. The evaluator has assigned $\Delta E\gamma$=0.1 keV if I$\gamma\geq$10, 0.3 keV if I$\gamma\geq$2 and 0.5 keV for Iγ<2.

[‡] Quoted uncertainty includes a 3% systematic uncertainty due to uncertainties in efficiency and background subtraction. Note that the % branching ratios from each level deduced by authors, as given under comments, are significantly discrepant with the ratios that can be deduced from their relative intensities quoted here. It is unclear how those branching ratios are obtained in 2018Ra15.

[#] Deduced from measured $\gamma\gamma$(DCO) and γ polarization asymmetry by the evaluator. Most of quoted values are not explicitly given in 2018Ra15 but inferred according to author's statements on measured values of DCO and polarization asymmetry, and spin-parities assignments.

[@] DCO gate on E2 342γ.

[&] DCO gate on E2 1650γ.

[a] DCO gate on E2 1327γ.

[b] Estimation of DCO and intensity is not possible due to transitions of overlapping energies.

[c] Estimation of DCO is not possible due to weak intensity.

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Level Scheme

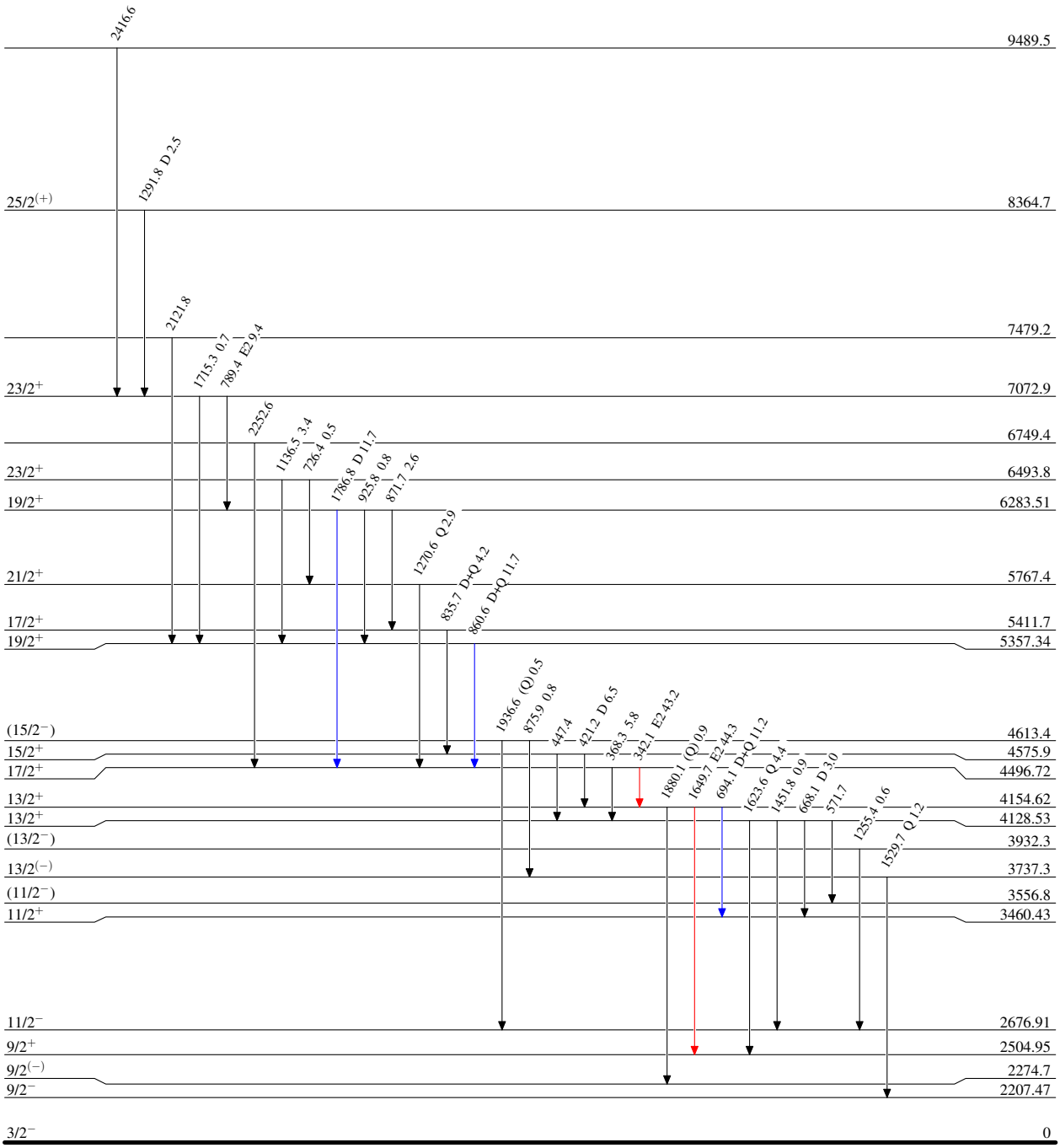
Intensities: Relative I_γ

Legend

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

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

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



$^{63}_{29}Cu_{34}$

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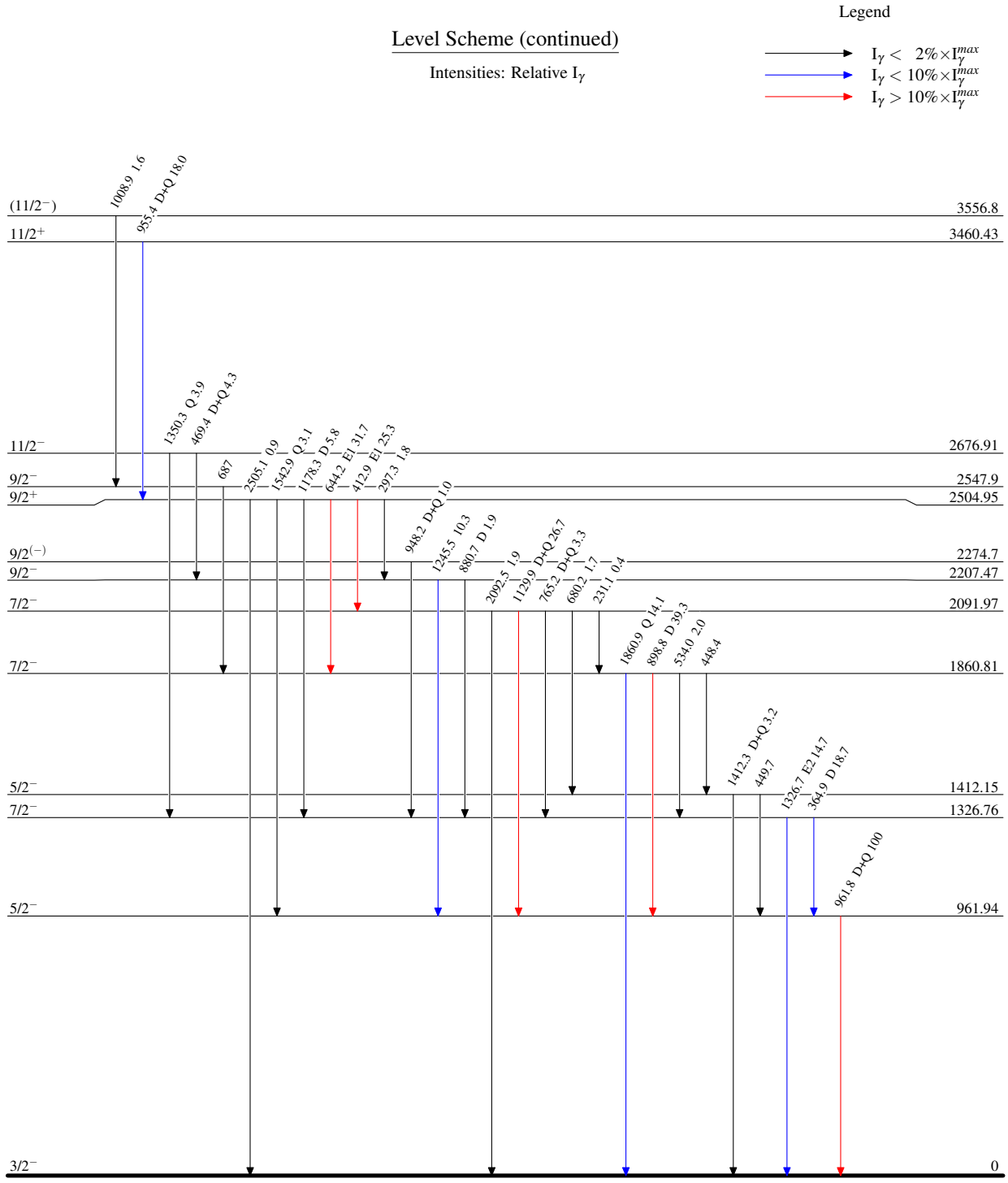
Level Scheme (continued)

Intensities: Relative I_γ



$^{63}_{29}Cu_{34}$