^{63}Cu(α,pnγ) 1994Ba55

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	Jun Chen	NDS 202,59 (2025)	25-Feb-2025

1994Ba55: Eα=30 MeV from the Variable Energy Cyclotron Centre, Calcutta. Targets were a natural Cu foil for lifetime measurement and >98% enriched ^{63}Cu for other measurements. γ rays were detected with three large-volume HPGe detectors. Measured Eγ, Iγ, $\gamma\gamma$-coin, $\gamma(\theta)$, Doppler-shift attenuation. Deduced levels, J, π, $T_{1/2}$, γ-ray branching ratios, multipolarities, mixing ratios.

The level scheme in 1994Ba55 is based on their data and the (α,nγ) data from earlier work.

^{65}Zn Levels

E(level)[†‡]	J$^\pi$[#]	$T_{1/2}$[@]	Comments
0.0	5/2$^-$		
53.8 *3*	1/2$^-$		
115.2 *3*	3/2$^-$		
206.9 *3*	3/2$^-$		
768.6 *3*	5/2$^-$		
864.2 *3*	7/2$^-$		J$^\pi$: spin=7/2 from $\gamma(\theta)$ of 864γ (1994Ba55).
867.0 *6*	1/2$^-$		
1047.4 *4*	5/2$^-$		
1065.6 *4*	9/2$^+$		J$^\pi$: spin=9/2 from $\gamma(\theta)$ of 201γ (1994Ba55).
1252.5 *3*	7/2$^-$		
1263.4 *4*	9/2$^-$		
2053.5 *6*	13/2$^+$		J$^\pi$: spin=13/2 from $\gamma(\theta)$ of 988γ (1994Ba55).
2137.9 *5*	11/2$^+$		
2923.0 *6*	13/2$^{(+)}$		
2932.2 *6*	(13/2$^-$)		
3228.0 *7*	17/2$^+$	0.30 ps *+12−10*	J$^\pi$: spin=17/2 from $\gamma(\theta)$ of 1174γ.
3473.5 *6*	(15/2$^+$)		
3785.9 *7*	17/2$^{(+)}$	≥0.28 ps	J$^\pi$: $\gamma(\theta)$ of 1733γ favors J=17/2, but J=13/2 cannot be ruled out.
4078.9 *8*	(13/2,15/2)		$T_{1/2}$: 0.12 ps≤$T_{1/2}$≤0.21 ps. J$^\pi$: from $\gamma(\theta)$ 1156γ, assuming that J(2923)=13/2; inconsistent with (17/2$^+$) in Adopted Levels.
4889.1 *9*			
4938.4 *9*	(21/2$^+$)		J$^\pi$: $\gamma(\theta)$ of 1710γ favors both J=17/2 and 21/2; the authors reject J=17/2 because if the 1710γ is assumed to be a 17/2 to 17/2 transition, B(E2)(W.u.) is ≤0.3 which is small compared to other transitions in the same cascade.
5066.8 *9*	(21/2$^+$)		
5413.4 *10*	(23/2$^+$)		
5773.4 *13*	(25/2$^+$)		

† Additional information 1.

‡ From a least-squares fit to γ-ray energies, assuming $\Delta E\gamma$=0.5 keV for values quoted to nearest tenth keV and 1.0 keV for integer values.

From Adopted Levels, unless otherwise noted. Supporting arguments from $\gamma(\theta)$ in this dataset are given in comments where available.

@ From DSAM in 1994Ba55.

^{63}Cu(α,pnγ) 1994Ba55 (continued)

$\gamma(^{65}Zn)$

A_2 and A_4 values under comments are from 1994Ba55.

E_γ[†]	I_γ[†]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[‡]	δ[‡]	Comments
53.7		53.8	$1/2^-$	0.0	$5/2^-$			
61.3		115.2	$3/2^-$	53.8	$1/2^-$			
≈92		206.9	$3/2^-$	115.2	$3/2^-$			
95.6[@]		864.2	$7/2^-$	768.6	$5/2^-$			
115.2	57 *3*	115.2	$3/2^-$	0.0	$5/2^-$			
153.0	12.1 *6*	206.9	$3/2^-$	53.8	$1/2^-$			
201.4	110[#] *5*	1065.6	$9/2^+$	864.2	$7/2^-$	D+Q	0.02 *1*	%Branching ratio=95.6 *46*. A_2=−0.21 *2*, A_4=+0.02 *4*.
206.9	3.1 *4*	206.9	$3/2^-$	0.0	$5/2^-$			
346.6	4.3 *5*	5413.4	$(23/2^+)$	5066.8	$(21/2^+)$			
399.2	1.4 *2*	1263.4	$9/2^-$	864.2	$7/2^-$			
483.9	1.6 *3*	1252.5	$7/2^-$	768.6	$5/2^-$			
557.6	5.3[#] *11*	3785.9	$17/2^{(+)}$	3228.0	$17/2^+$			%Branching ratio=25 *5*.
≈606	≈4	4078.9	(13/2,15/2)	3473.5	$(15/2^+)$			%Branching ratio=56.
653.5	3.2 *4*	768.6	$5/2^-$	115.2	$3/2^-$			
657.4	0.7[#] *2*	864.2	$7/2^-$	206.9	$3/2^-$			%Branching ratio=0.6 *2*.
714.9	0.7 *1*	768.6	$5/2^-$	53.8	$1/2^-$			
749.1	11.9[#] *24*	864.2	$7/2^-$	115.2	$3/2^-$			%Branching ratio=10.6 *21*.
751.8	7.6 *9*	867.0	$1/2^-$	115.2	$3/2^-$			
768.6	4.5 *5*	768.6	$5/2^-$	0.0	$5/2^-$			
785.0	7.8[#] *9*	2923.0	$13/2^{(+)}$	2137.9	$11/2^+$			%Branching ratio=63.9 *76*.
835		5773.4	$(25/2^+)$	4938.4	$(21/2^+)$			
864.2	100[#] *6*	864.2	$7/2^-$	0.0	$5/2^-$	D+Q	−2.33 *20*	%Branching ratio=88.8 *51*. A_2=−0.53 *6*, A_4=+0.22 *7*.
932		1047.4	$5/2^-$	115.2	$3/2^-$			
987.9	75 *4*	2053.5	$13/2^+$	1065.6	$9/2^+$	Q+O	−0.02 *10*	A_2=+0.29 *12*, A_4=−0.22 *13*.
993.7		1047.4	$5/2^-$	53.8	$1/2^-$			
1045.5	4.3 *5*	1252.5	$7/2^-$	206.9	$3/2^-$			
1047.4		1047.4	$5/2^-$	0.0	$5/2^-$			
1065.6	5.0[#] *10*	1065.6	$9/2^+$	0.0	$5/2^-$			%Branching ratio=4.4 *9*.
1072.3	17 *1*	2137.9	$11/2^+$	1065.6	$9/2^+$			
1137		1252.5	$7/2^-$	115.2	$3/2^-$			
1155.9	3.2 *4*	4078.9	(13/2,15/2)	2923.0	$13/2^{(+)}$	D+Q		%Branching ratio=44. δ: −0.6 *5* if J=13/2, +0.22 *17* if J=15/2. A_2=+0.04 *19*, A_4=−0.11 *21*.
1174.1	34.5 *17*	3228.0	$17/2^+$	2053.5	$13/2^+$	E2(+M3)	−0.07 *8*	Mult.: Q+O from $\gamma(\theta)$; M2+E3 ruled out by RUL. A_2=+0.26 *6*, A_4=−0.14 *8*.
1252.6		1252.5	$7/2^-$	0.0	$5/2^-$			
1263.4	45.7 *23*	1263.4	$9/2^-$	0.0	$5/2^-$			
1280.9		5066.8	$(21/2^+)$	3785.9	$17/2^{(+)}$			
1335.5		3473.5	$(15/2^+)$	2137.9	$11/2^+$			
1419.9		3473.5	$(15/2^+)$	2053.5	$13/2^+$			
1661.1	1.0 *1*	4889.1		3228.0	$17/2^+$			
1668.7	8.7 *10*	2932.2	$(13/2^-)$	1263.4	$9/2^-$			
1710.4	7.3 *9*	4938.4	$(21/2^+)$	3228.0	$17/2^+$	Q+O	−0.03 *15*	A_2=+0.34 *11*, A_4=−0.07 *12*.
1732.7	16[#] *4*	3785.9	$17/2^{(+)}$	2053.5	$13/2^+$	Q(+O)	−0.13 *25*	%Branching ratio=75 *20*. A_2=+0.39 *14*.
1857.3	4.4[#] *10*	2923.0	$13/2^{(+)}$	1065.6	$9/2^+$			%Branching ratio=36.1 *83*.

Continued on next page (footnotes at end of table)

^{63}Cu(α,pnγ) 1994Ba55 (continued)

$\gamma(^{65}Zn)$ (continued)

† From 1994Ba55. Quoted intensities are relative values and no uncertainties are reported in 1994Ba55. The authors give a general statement that uncertainties are typically less than 5% for strong gammas with intensities more than 10; and 5%−12% for most of the weaker lines, for which the evaluator has taken 12%, unless indicated otherwise.

‡ From 1994Ba55, based on $\gamma(\theta)$, with magnetic or electric characters determined based on RUL and measured $T_{1/2}$ where available.

Uncertainties from % branching ratios in 1994Ba55, as given under comments.

@ Placement of transition in the level scheme is uncertain.

^{63}Cu(α,pnγ) **1994Ba55**

Level Scheme

Intensities: Relative I_γ

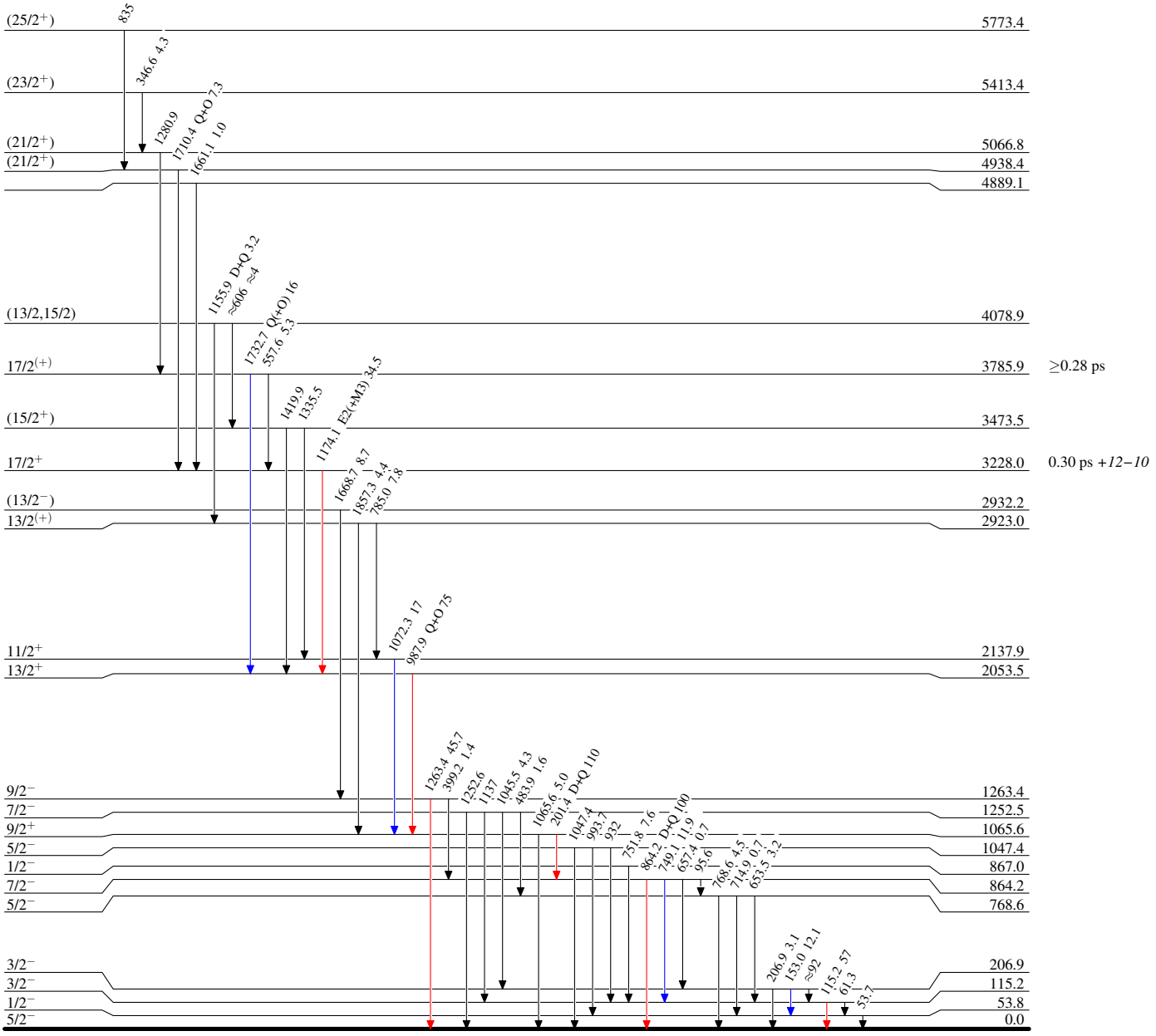
Legend

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

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

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

γ Decay (Uncertain)



$^{65}_{30}Zn_{35}$