^{59}Cu ε decay 1973Va03,1977Se02

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	M. Shamsuzzoha Basunia	NDS 151, 1 (2018)	1-Apr-2018

Parent: ^{59}Cu: E=0.0; J^π=3/2$^-$; $T_{1/2}$=81.5 s *5*; Q(ε)=4798.4 *4*; %ε+%β^+ decay=100.0

Others: 1968Lu15, 1968Ve15 (for summary of Eγ, Iγ scin data), 1958Bu07, 1956Pr12, 1955Li38, 1955Yu06, 1939De01.

Measured Eγ, Iγ, semi. ^{59}Cu produced from ^{58}Ni(p,γ) using 99.9% ^{58}Ni target (1973Va03,1977Se02).

1977Se02 propose a level at 1778.8 to accommodate an Eγ=1778.8 *1* line which appears strongly in their spectrum (Iγ=0.87 *2*) but is absent from the spectrum of 1973Va03; the evaluator assumes this is not a ^{59}Ni line (it could plausibly arise from ^{28}Al β^- decay). Otherwise, agreement between 1973Va03 and 1977Se02 is excellent.

^{59}Ni Levels

E(level)	J^π†	$T_{1/2}$†
0.0	3/2$^-$	7.6×10^4 y *5*
339.37 *5*	5/2$^-$	
464.92 *7*	1/2$^-$	
878.00 *6*	3/2$^-$	
1188.93 *13*	5/2$^-$	
1301.41 *7*	1/2$^-$	
1338.1 *5*	7/2$^-$	
1679.70 *7*	5/2$^-$	
1734.67 *6*	3/2$^-$	
2414.85 *13*	3/2$^-$	
2681.2 *7*	(5/2$^-$)	

† From Adopted Levels.

ε,β^+ radiations

ε+β^+ branches are obtained from I(γ+ce) imbalance at each level. Measured ε/β^+<5% (1955Yu06).

E(decay)	E(level)	Iβ^+ †	Iε†	Log *ft*	I($\varepsilon+\beta^+$)†	Comments
(2117.2 *8*)	2681.2	0.026 *5*	0.012 *2*	6.0 *1*	0.038 *7*	av Eβ=470.40 *36*; εK=0.2717 *5*; εL=0.02949 *5*; εM+=0.004982 *9*
(2383.5 *4*)	2414.85	0.201 *12*	0.044 *3*	5.5 *1*	0.245 *15*	av Eβ=589.22 *19*; εK=0.1598 *2*; εL=0.01733 *2*; εM+=0.002927 *3*
(3063.7 *4*)	1734.67	1.88 *4*	0.117 *3*	5.3 *1*	2.00 *4*	av Eβ=900.21 *19*; εK=0.05187 *3*; εL=0.005618 *4*; εM+=0.0009488 *6*
(3118.7 *4*)	1679.70	1.61 *3*	0.0920 *18*	5.4 *1*	1.70 *3*	av Eβ=925.72 *19*; εK=0.04803 *3*; εL=0.005202 *3*; εM+=0.0008785 *5*
(3460.3 *7*)	1338.1	0.055 *11*	0.0020 *4*	7.2 *1*	0.057 *11*	av Eβ=1085.24 *30*; εK=0.03093 *3*; εL=0.003348 *3*; εM+=0.0005653 *5*
(3497.0 *4*)	1301.41	18.9 *3*	0.654 *12*	4.7 *1*	19.6 *3*	av Eβ=1102.47 *19*; εK=0.02960 *2*; εL=0.003204 *2*; εM+=0.0005411 *3*
(3609.5 *4*)	1188.93	0.110 *18*	0.0033 *6*	7.0 *1*	0.113 *19*	av Eβ=1155.38 *20*; εK=0.02598 *2*; εL=0.002812 *2*; εM+=0.0004748 *3*
(3920.4 *4*)	878.00	8.6 *4*	0.18 *1*	5.3 *1*	8.8 *4*	av Eβ=1302.36 *20*; εK=0.018602 *8*; εL=0.0020126 *9*; εM+=0.0003398 *2*
(4333.5 *4*)	464.92	3.35 *15*	0.0481 *22*	6.0 *1*	3.40 *15*	av Eβ=1499.05 *20*; εK=0.012554 *5*; εL=0.0013577 *5*; εM+=0.000229
(4459.0 *4*)	339.37	5.89 *10*	0.0756 *15*	5.8 *1*	5.97 *10*	av Eβ=1559.10 *20*; εK=0.011247 *4*; εL=0.0012163 *5*; εM+=0.000205
(4798.4 *4*)	0.0	57.5 *4*	0.557 *7*	5.0 *1*	58.1 *4*	av Eβ=1721.99 *20*; εK=0.008515 *3*; εL=0.0009206 *3*; εM+=0.0001554 E(decay): E(β^+)=3740 *100* (1956Pr12), 3400 *500* (1955Li38).

† Absolute intensity per 100 decays.

γ(^{59}Ni)

Iγ normalization: from measured I(annihilation radiation)=196 5 (1973Va03) and theoretical β^+/ε ratios.

E_γ[†]	I_γ[†b]	E_i(level)	J^π_i	E_f	J^π_f	Mult.[‡]	δ[‡]	α[a]	Comments
339.30 7	7.97 9	339.37	5/2⁻	0.0	3/2⁻	M1(+E2)	0.00 2	0.00213	α(K)=0.00191 3; α(L)=0.000189 3; α(M)=2.67×10^{-5} 4 α(N)=1.143×10^{-6} 16
423.40 7	2.66 12	1301.41	1/2⁻	878.00	3/2⁻				
464.9 1	5.87 9	464.92	1/2⁻	0.0	3/2⁻	[M1]		1.03×10^{-3}	α(K)=0.000923 13; α(L)=9.08×10^{-5} 13; α(M)=1.280×10^{-5} 18 α(N)=5.51×10^{-7} 8
538.55 14	0.160 7	878.00	3/2⁻	339.37	5/2⁻				
545.75 14	0.230 14	1734.67	3/2⁻	1188.93	5/2⁻				
836.50 7	2.08 11	1301.41	1/2⁻	464.92	1/2⁻	[M1]		2.87×10^{-4}	α(K)=0.000258 4; α(L)=2.52×10^{-5} 4; α(M)=3.55×10^{-6} 5 α(N)=1.535×10^{-7} 22
850.0[c] 5	0.035 14	1188.93	5/2⁻	339.37	5/2⁻				E_γ,I_γ: obscured by sum peak (511+339 keV).
878.00 7	11.40 31	878.00	3/2⁻	0.0	3/2⁻	M1+E2	+0.08 3	2.60×10^{-4}	α(K)=0.000234 4; α(L)=2.28×10^{-5} 4; α(M)=3.22×10^{-6} 5 α(N)=1.392×10^{-7} 20
962.0 5	0.05 1	1301.41	1/2⁻	339.37	5/2⁻	[E2]		2.65×10^{-4}	α(K)=0.000238 4; α(L)=2.34×10^{-5} 4; α(M)=3.29×10^{-6} 5 α(N)=1.411×10^{-7} 20
998.7 5	0.041 10	1338.1	7/2⁻	339.37	5/2⁻	M1+E2	+4.6 6	2.40×10^{-4}	α(K)=0.000216 3; α(L)=2.12×10^{-5} 3; α(M)=2.98×10^{-6} 5 α(N)=1.278×10^{-7} 19
1188.85 25	0.379 9	1188.93	5/2⁻	0.0	3/2⁻	M1+E2	−0.43 9	1.50×10^{-4} 3	α(K)=0.0001302 21; α(L)=1.267×10^{-5} 21; α(M)=1.79×10^{-6} 3 α(N)=7.73×10^{-8} 13; α(IPF)=5.48×10^{-6} 15
1214.2 7	0.0305 7	1679.70	5/2⁻	464.92	1/2⁻	[E2]		1.66×10^{-4}	α(K)=0.0001390 20; α(L)=1.357×10^{-5} 19; α(M)=1.91×10^{-6} 3 α(N)=8.23×10^{-8} 12; α(IPF)=1.105×10^{-5} 20
1225.8 10	0.036 9	2414.85	3/2⁻	1188.93	5/2⁻				
1269.65 15	0.245 9	1734.67	3/2⁻	464.92	1/2⁻				
1301.35 15	14.78 20	1301.41	1/2⁻	0.0	3/2⁻				
1338[&]	0.016[&] 4	1338.1	7/2⁻	0.0	3/2⁻	E2		1.63×10^{-4}	α(K)=0.0001127 16; α(L)=1.098×10^{-5} 16; α(M)=1.547×10^{-6} 22 α(N)=6.67×10^{-8} 10; α(IPF)=3.75×10^{-5} 6
1340.25[&] 15	1.425[&] 25	1679.70	5/2⁻	339.37	5/2⁻				
1395.2 1	0.340 25	1734.67	3/2⁻	339.37	5/2⁻				
1536.9 3	0.056 7	2414.85	3/2⁻	878.00	3/2⁻				
^{x}1610.6[#@] 5	0.016[#@] 4								

$^{59}_{28}Ni_{31}$-2

γ(^{59}Ni) (continued)

E_γ [†]	I_γ [†b]	E_i(level)	J^π_i	E_f	J^π_f	Mult. [‡]	δ [‡]	α [a]	Comments
1679.70 *7*	0.244 *12*	1679.70	5/2⁻	0.0	3/2⁻	(M1+E2)	−1.6 +*7*−*22*	2.30×10^{-4} *12*	α(K)=6.97×10^{-5} *16*; α(L)=6.77×10^{-6} *16*; α(M)=9.54×10^{-7} *22* α(N)=4.13×10^{-8} *10*; α(IPF)=0.000152 *10*
1734.70 *7*	1.188 *19*	1734.67	3/2⁻	0.0	3/2⁻				
1802.6 *8*	0.025 *5*	2681.2	(5/2⁻)	878.00	3/2⁻				
1949.90 *14*	0.117 *5*	2414.85	3/2⁻	464.92	1/2⁻				
[x]2242.9[@] *6*	0.012[@] *4*								
2414.7 *4*	0.036 *7*	2414.85	3/2⁻	0.0	3/2⁻				
2682 *1*	0.013 *4*	2681.2	(5/2⁻)	0.0	3/2⁻				

[†] Weighted average of data from 1973Va03 and 1977Se02.

[‡] From adopted gammas.

[#] Observation of a 1610γ (Iγ=0.016 *4*) suggests population of the 1948 level, which in turn implies that the observed 1950γ (Iγ=0.117 *5*) includes unresolved contributions from 1948-g.s. and 2415-465 transitions. Assuming adopted 1948 level branching (viz. I(1608γ):I(1948γ)=63 *13*:100 *4*), the evaluator deduces Iγ(1948-g.s.)=0.073 *14* leaving Iγ(2415-465)=0.043 *13*. However, the observed Eγ=1949.90 *14* corresponds to that expected for the 2415-465 transition alone; also, branching from 2415 level is consistent with that observed in (n,γ) E=thermal only if the total observed I(1950γ) is assigned to the 2415-465 transition. The evaluator, therefore, assumes that the 1950γ is not a doublet, and the 1610γ reported by 1977Se02 alone is not the same as the 1608γ known from other reactions to de-excite a 1948 level.

[@] Reported by 1977Se02 only. May not be a ^{59}Ni γ ray.

[&] Observation of 999γ (Iγ=0.041 *10*) implies population of the 1338 level whose 1338γ-decay branch presumably contributes to the observed 1349γ (Iγ=1.425 *25*). Assuming adopted 1338 level branching (viz. I(999γ):I(1338γ)=100 *5*:40.3 *20*), evaluator deduces Iγ(1338-g.s.)=0.016 *4* leaving Iγ(1680-339)=1.409 *25*.

[a] Additional information 1.

[b] Absolute intensity per 100 decays.

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

[x] γ ray not placed in level scheme.

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Decay Scheme

Intensities: $I_{(\gamma+ce)}$ per 100 parent decays