^{58}Ni(α,pγ) 1973Sa19,1971He14

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Kazimierz Zuber, Balraj Singh	NDS 125, 1 (2015)	25-Jan-2015

1973Sa19, 1971Ho21: Eα=4.6-20 MeV. Escape-suppression spectrometer, ΔE-E semi telescope. Measured pγ(θ), γγ coin, γ(θ), DSA (centroid and line-shape analysis). Also 1971Ho22 from the same group.
1971He14, 1971He17: Eα=10.0 MeV. Measured pγ angular correlations, DSA.
1971Ho22 (from the same group as 1973Sa19): E=15-22 MeV, measured excitation functions, deduced spins.
1974Sa01 (from the same group as 1973Sa19): E=19.7 MeV. Measured lifetimes of γ cascades: τ=0.29 ps 12, 0.19 ps 7 and 0.43 ps 14 from the continuum at ≈9.5 MeV feeding the 2336, 2612 and 3016 states, respectively.
Data are from 1973Sa19, except as noted.

^{61}Cu Levels

E(level)†	Jπ‡	$T_{1/2}$#
0	3/2⁻	
475.07 *8*	1/2⁻	0.66 ps *9*
970.05 *7*	5/2⁻	0.69 ps *13*
1310.57 *10*	7/2⁻	0.53 ps *7*
1394.19 *10*	5/2⁻	0.85 ps *14*
1660.35 *11*	3/2⁻	182 fs *19*
1732.59 *10*	7/2⁻	≥1.40 ps
1904.18 *14*	5/2⁻	180 fs *19*
1932.78 *15*	3/2⁻	87 fs *10*
1942.49 *12*	7/2⁻	1.2 ps *+11−4*
2088.85 *17*	(1/2)⁻	40 fs *4*
2203.39 *12*	5/2⁻	173 fs *20*
2295.09 *12*	9/2⁻	1.8 ps *6*
2336.46 *18*	9/2⁻	0.43 ps *5*
2358.30 *16*	3/2⁻	197 fs *24*
2399.02 *23*	7/2⁻	121 fs *14*
2472.44 *22*	3/2⁻	75 fs *8*
2583.74 *24*		102 fs *12*
2584.6 *5*	3/2,5/2	98 fs *12*
2611.79 *14*	9/2⁻	280 fs *40*
2627.17 *20*	11/2⁻	≥350 fs
2684.10 *21*	3/2⁻	85 fs *12*
2720.91 *17*	9/2⁺	≥2.80 ps
2728.35 *19*	7/2⁻	230 fs *30*
2792.63 *22*	5/2⁻	116 fs *+20−40*
2840.57 *25*	1/2⁻,3/2⁻	
2857.1 *3*	1/2⁻,3/2⁻	
2924.2 *4*	⁻	270 fs *40*
2932.84 *18*	3/2⁻	65 fs *13*
3001.60 *18*	5/2	0.17 ps *6*
3015.70 *17*	11/2⁻	290 fs *40*
3019.3 *11*	3/2⁻	69 fs *11*
3065.56 *22*	3/2⁻	40 fs *6*
3092.1 *5*	3/2⁻	33 fs *5*
3198.58 *23*		
3259.8 *3*	11/2⁽⁻⁾	0.35 ps *5*
3323.1 *5*		
3372.9 *4*	(9/2)	
3454.4 *4*	3/2⁺,5/2⁺	
3521.2 *15*	1/2⁻,3/2⁻,5/2⁻	
3546.8 *4*	11/2⁻	
3739.5 *5*	(11/2)	
3853.3 *5*		
3943.1 *4*	11/2⁺	
4082.3 *3*	13/2⁺	

† From level scheme and Eγ data using least-squares fit to data.
‡ From Adopted Levels.
# From DSA (1973Sa19). $\Delta T_{1/2}$ includes 10% from stopping power uncertainty. For calibration of stopping power with known lifetimes, see 1973Ho21.

γ(^{61}Cu)

A_2 and A_4 coefficients are from 1971He14.

E_i(level)	J^π_i	E_γ	I_γ[†]	E_f	J^π_f	Mult.[‡]	δ[#c]	Comments
475.07	1/2⁻	475.0 *1*	100	0	3/2⁻	M1+E2	0.04 *CA*	A_2=−0.02 *4* δ: theoretical estimate by 1972Ca20 adopted by 1973Sa19.
970.05	5/2⁻	494.8 *2*	0.9 *1*	475.07	1/2⁻	E2		
		970.0 *1*	99.1 *6*	0	3/2⁻	M1+E2	−0.35[a] *4*	A_2=−1.03 *3*; A_4=+0.10 *2*
1310.57	7/2⁻	340.2 *3*	6.2 *2*	970.05	5/2⁻	M1+E2	−0.017[a] *15*	A_2=+0.43 *8*; A_4=+0.18 *8*
		1310.5 *2*	93.8 *2*	0	3/2⁻	E2		A_2=+0.55 *3*; A_4=−0.36 *4* δ=+0.01 *3* from 1971He14.
1394.19	5/2⁻	424.1 *3*	2.8 *3*	970.05	5/2⁻			A_2=+0.5 *3*; A_4=−0.7 *3*
		919.1 *2*	11.9 *6*	475.07	1/2⁻	E2		A_2=+0.58 *12*; A_4=−0.50 *14* δ=+(0.03 −*8*+*12*) from 1971He14.
		1394.2 *2*	85.3 *25*	0	3/2⁻	M1+E2	−3.55[a] *18*	A_2=−0.39 *5*; A_4=+0.43 *5*
1660.35	3/2⁻	265.9 *2*	4.6 *3*	1394.19	5/2⁻			
		690.2 *2*	15.7 *12*	970.05	5/2⁻	M1(+E2)	+0.05[a] *19*	A_2=+0.02 δ: −3.1 +*9*−*14* also possible.
		1185.3 *3*	14.4 *9*	475.07	1/2⁻	M1+E2		A_2=−1.04 *7* δ: ≥0.26 and ≤1.00 (1971He14).
		1660.5 *2*	65.3 *15*	0	3/2⁻	M1+E2	+0.39[a] +*10*−*18*	A_2=+0.88 *5* δ: +1.4 *4* also possible.
1732.59	7/2⁻	338.4 *3*	2.3 *5*	1394.19	5/2⁻	M1+E2	−1.2[b] +*9*−*5*	
		421.8 *2*	22 *3*	1310.57	7/2⁻	M1(+E2)	+0.08[a] *7*	A_2=+0.30 *6*; A_4=−0.06 *6*
		762.4 *2*	13.6 *10*	970.05	5/2⁻	M1+E2	+0.50[a] *4*	A_2=+0.47 *8*; A_4=−0.14 *9*
		1732.7 *2*	62 *3*	0	3/2⁻	E2		A_2=+0.41 *5*; A_4=−0.31 *6* δ=−0.02 −*6* +*4* from 1971He14.
1904.18	5/2⁻	593.5 *2*	22.1 *10*	1310.57	7/2⁻	M1+E2	−0.05[&] *3*	A_2=+0.06 *14*
		934.1 *2*	41.6 *13*	970.05	5/2⁻	M1+E2	−0.14[&] *4*	A_2=+0.34 *15*; A_4=+0.29 *17*
		1904.2 *3*	36.3 *19*	0	3/2⁻	M1+E2	+0.68[@] *9*	A_2=+0.78 *12*; A_4=+0.28 *13*
1932.78	3/2⁻	962.4 *5*	7.6 *11*	970.05	5/2⁻			
		1457.8 *2*	25.3 *17*	475.07	1/2⁻	M1+E2	+0.20[a] *10*	A_2=−0.14 *9* δ: −3.0 *8* also possible.
		1932.4 *3*	67 *4*	0	3/2⁻	M1+E2	+0.26[@] +*12*−*8*	A_2=+0.58 *3* δ: +1.8 +*6*−*3* also possible.
1942.49	7/2⁻	209.6 *2*	9.9 *2*	1732.59	7/2⁻	M1(+E2)	−0.01[@] *4*	
		548.0[e] *3*	0.5 *1*	1394.19	5/2⁻			
		631.9 *2*	19.2 *5*	1310.57	7/2⁻	M1+E2	−0.26[&] *6*	δ: +0.76 *16* also possible.
		972.4 *4*	60 *4*	970.05	5/2⁻			
		1942.8 *3*	10.4 *6*	0	3/2⁻	E2		A_2=+0.59 *13*
2088.85	(1/2)⁻	1613.7 *2*		475.07	1/2⁻			A_2=−0.05 *13*
		2088.7 *3*		0	3/2⁻			A_2=+0.04 *8*

From ENSDF

γ(^{61}Cu) (continued)

E_i(level)	J^π_i	E_γ	I_γ[†]	E_f	J^π_f	Mult.[‡]	δ[#c]	Comments
2203.39	5/2⁻	470.8 *2*	11.4 *8*	1732.59	7/2⁻			
		892.8 *2*	18.7 *6*	1310.57	7/2⁻	M1(+E2)	−0.01[@] *3*	δ: −9 *2* also possible.
		1233.3 *2*	46.8 *6*	970.05	5/2⁻	M1+E2	−0.030[@] *+35−22*	
		1728.2 *3*	23.1 *14*	475.07	1/2⁻	E2		
2295.09	9/2⁻	352.4 *2*	7.6 *4*	1942.49	7/2⁻	M1+E2	−0.20[b] *8*	
		562.4 *2*	19.9 *6*	1732.59	7/2⁻	M1+E2	+0.56[&] *10*	
		900.8 *2*	25.8 *8*	1394.19	5/2⁻	E2		
		984.6 *2*	34.2 *11*	1310.57	7/2⁻	M1+E2	−0.17[b] *3*	
		1325.3 *3*	12.5 *7*	970.05	5/2⁻	E2		
2336.46	9/2⁻	393.4[e] *4*	1.7 *7*	1942.49	7/2⁻			
		942.2[e] *5*	1.2 *2*	1394.19	5/2⁻	E2		
		1025.8 *3*	22.0 *13*	1310.57	7/2⁻	M1+E2	−0.25[b] *8*	
		1366.4 *3*	75.1 *22*	970.05	5/2⁻	E2	[b]	
2358.30	3/2⁻	425.3 *3*		1932.78	3/2⁻			
		697.6 *3*		1660.35	3/2⁻			
		1883.1 *3*		475.07	1/2⁻			
		2358.6 *3*		0	3/2⁻			
2399.02	7/2⁻	1088.4 *3*	41.8 *10*	1310.57	7/2⁻	M1+E2	+0.6[@] *+2−4*	
		1429.0 *3*	58 *3*	970.05	5/2⁻	M1+E2	−0.164[@] *24*	
2472.44	3/2⁻	1502.4 *3*	10.7 *12*	970.05	5/2⁻			
		1997.3 *3*	89.3 *24*	475.07	1/2⁻	M1(+E2)	−0.02[@] *5*	δ: −0.87 *9* also possible.
2583.74		641.5 *3*	18 *3*	1942.49	7/2⁻			
		850.9 *3*	82 *9*	1732.59	7/2⁻			
2584.6	3/2,5/2	2584.5 *5*	100	0	3/2⁻			
2611.79	9/2⁻	316.6[e] *2*	1.4 *1*	2295.09	9/2⁻			
		669.3 *2*	30.1 *5*	1942.49	7/2⁻	M1+E2	+0.25[@] *+5−3*	
		879.3 *2*	58.6 *17*	1732.59	7/2⁻	M1+E2	+0.36[b] *10*	
		1301.7 *3*	9.9 *7*	1310.57	7/2⁻			
2627.17	11/2⁻	290.4[e] *2*	1.6 *1*	2336.46	9/2⁻			
		331.6 *4*	2.6 *3*	2295.09	9/2⁻			
		1316.7 *2*	96 *3*	1310.57	7/2⁻	E2		
2684.10	3/2⁻	1289.8[e] *6*	≤2.7	1394.19	5/2⁻			
		2209.0 *2*	53 *3*	475.07	1/2⁻			
		2683.8 *8*	43 *3*	0	3/2⁻			
2720.91	9/2⁺	109.5 *2*	4.6 *7*	2611.79	9/2⁻			
		320.9[e] *2*	1.2 *3*	2399.02	7/2⁻			
		777.2[e] *3*	1.4 *4*	1942.49	7/2⁻			
		987.6[e] *3*	38 *5*	1732.59	7/2⁻	E1		
		1409.9 *2*	55.1 *18*	1310.57	7/2⁻	E1		
2728.35	7/2⁻	328.8[e] *4*	2.7 *3*	2399.02	7/2⁻			

From ENSDF

$^{61}_{29}Cu_{32}$-3

γ(^{61}Cu) (continued)

E_i(level)	J^π_i	E_γ	I_γ[†]	E_f	J^π_f	Mult.[‡]	δ[#c]
2728.35	7/2⁻	524.5[de] 3	≤3.9[d]	2203.39	5/2⁻		
		1417.8 2	33.2 16	1310.57	7/2⁻	M1(+E2)	+0.4[@] +7−4
		1758.2 3	60 8	970.05	5/2⁻	M1+E2	−1.6[@] 4
2792.63	5/2⁻	1482.2 3	51 4	1310.57	7/2⁻		
		2792.4 3	49 5	0	3/2⁻		
2840.57	1/2⁻,3/2⁻	751.6 2		2088.85	(1/2)⁻		
		2841.5 6		0	3/2⁻		
2857.1	1/2⁻,3/2⁻	2381.4 20	20 3	475.07	1/2⁻		
		2857.0 3	80 12	0	3/2⁻		
2924.2	⁻	297.4[e] 2	4.4 6	2627.17	11/2⁻		
		312.0[e] 2	2.4 6	2611.79	9/2⁻		
		524.5[de] 2	≤4.4[d]	2399.02	7/2⁻		
		629.1[e] 5	2.6 6	2295.09	9/2⁻		
		981.3 5	9.3 18	1942.49	7/2⁻		
		1191.8 4	77 4	1732.59	7/2⁻	M1(+E2)	+0.00[@] 5
2932.84	3/2⁻	1538.9 2		1394.19	5/2⁻		
		2457.6 4		475.07	1/2⁻		
		2931.8 4		0	3/2⁻		
3001.60	5/2	798.0 3	13.5 9	2203.39	5/2⁻		
		1607.3 2	26.2 20	1394.19	5/2⁻		
		3002.6 5	60 3	0	3/2⁻		
3015.70	11/2⁻	679.2 2	13.7 14	2336.46	9/2⁻		
		720.5 2	13.4 13	2295.09	9/2⁻	M1(+E2)	−0.01[@] 2
		1705.4 3	73 4	1310.57	7/2⁻	E2	
3019.3	3/2⁻	2543.9 30	71 13	475.07	1/2⁻	M1+E2	−0.6[@] 4
		3019.3 11	29 4	0	3/2⁻		
3065.56	3/2⁻	706.4 5	9.8 9	2358.30	3/2⁻		
		1161.1 3	39 3	1904.18	5/2⁻		
		1672.1 4	31 3	1394.19	5/2⁻		
		3065.9 5	20 3	0	3/2⁻		
3092.1	3/2⁻	3092.0 5	100	0	3/2⁻		
3198.58		1256.0 4	26 6	1942.49	7/2⁻		
		1466.1 3	46 7	1732.59	7/2⁻		
		1804.1 5	28 9	1394.19	5/2⁻		
3259.8	11/2$^{(-)}$	647.9 3	39.7 13	2611.79	9/2⁻		
		964.8 5	13.3 18	2295.09	9/2⁻		
		1527.4 5	47 4	1732.59	7/2⁻		
3323.1		2012.5 5	100	1310.57	7/2⁻		
3372.9	(9/2)	1640.6 5	100	1732.59	7/2⁻		
3454.4	3/2⁺,5/2⁺	1055.8[e] 5	5.1 3	2399.02	7/2⁻		
		1721.7 5	20 6	1732.59	7/2⁻		

$^{61}_{29}Cu_{32}$-4

γ(^{61}Cu) (continued)

E_i(level)	J_i^π	E_γ	I_γ[†]	E_f	J_f^π	Comments
3454.4	$3/2^+,5/2^+$	2143.9 *5*	75 *12*	1310.57	$7/2^-$	
3521.2	$1/2^-,3/2^-,5/2^-$	3521.1 *15*	100	0	$3/2^-$	
3546.8	$11/2^-$	1343.4[e] *3*	100	2203.39	$5/2^-$	E_γ: this γ is placed from 3970 level in Adopted Gammas based on other in-beam studies, thus the placement is questionable here.
3739.5	(11/2)	1444.4 *4*	100	2295.09	$9/2^-$	
3853.3		1132.4 *4*	100	2720.91	$9/2^+$	
3943.1	$11/2^+$	1222.2 *3*	100	2720.91	$9/2^+$	
4082.3	$13/2^+$	709.6 *4*	25 *5*	3372.9	(9/2)	
		1361.3 *3*	75 *4*	2720.91	$9/2^+$	

[†] Relative branching from each level.
[‡] From γ(θ), $T_{1/2}$ and RUL.
[#] From pγ angular correlations or singles γ(θ) with parallel E2 branch, except as noted. Values of angular correlation coefficients are not given in 1973Sa19.
[@] From 1973Sa19 from singles γ(θ) with Hauser-Feshbach estimates for the population of magnetic substates.
[&] From 1971Ho21.
[a] From 1971He14.
[b] From 1973Sa19.
[c] From γ(θ) data.
[d] Multiply placed with undivided intensity.
[e] Placement of transition in the level scheme is uncertain.

$^{61}_{29}Cu_{32}$-5

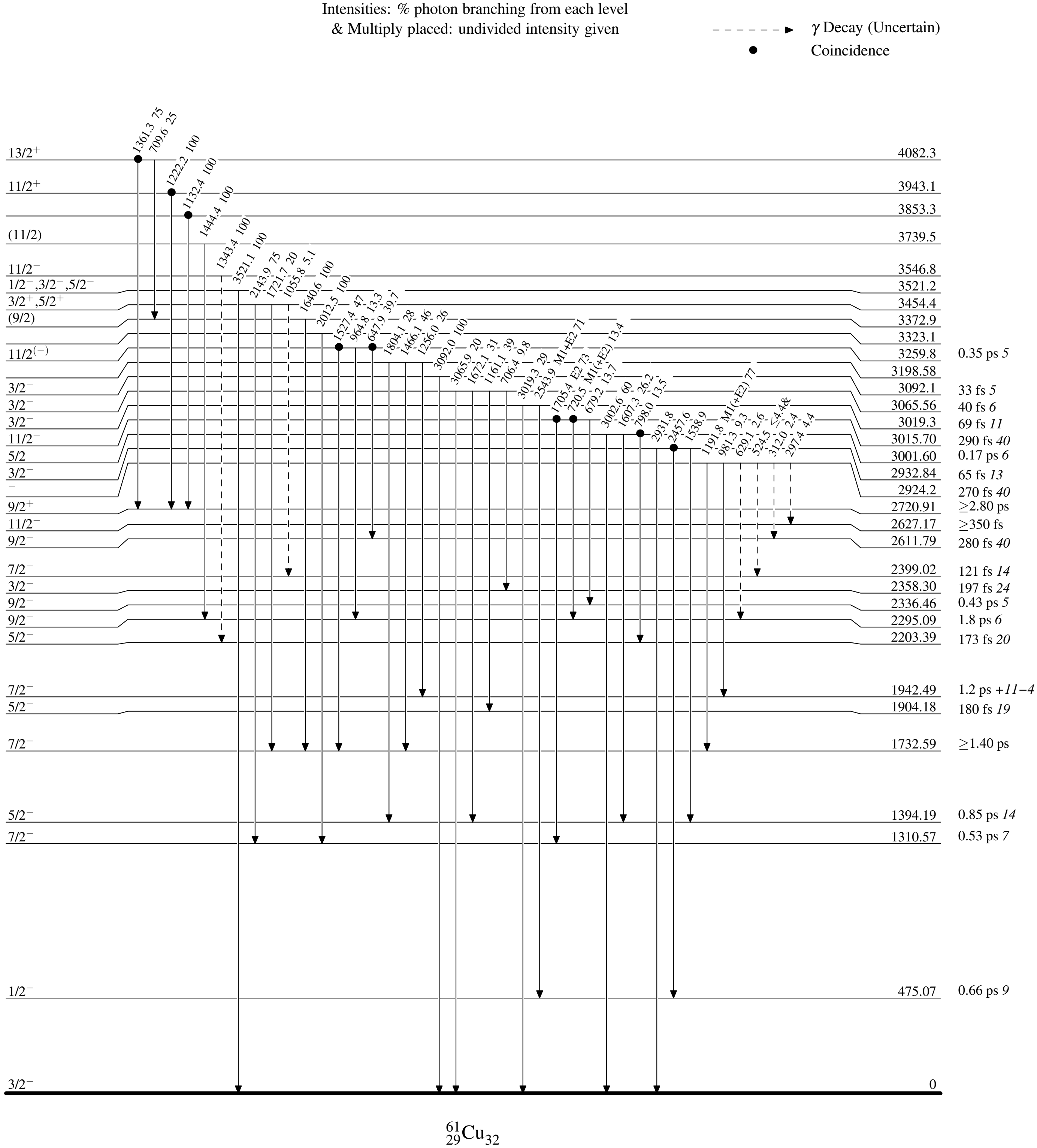
$^{58}Ni(\alpha,p\gamma)$ 1973Sa19,1971He14

Legend

Level Scheme

Intensities: % photon branching from each level

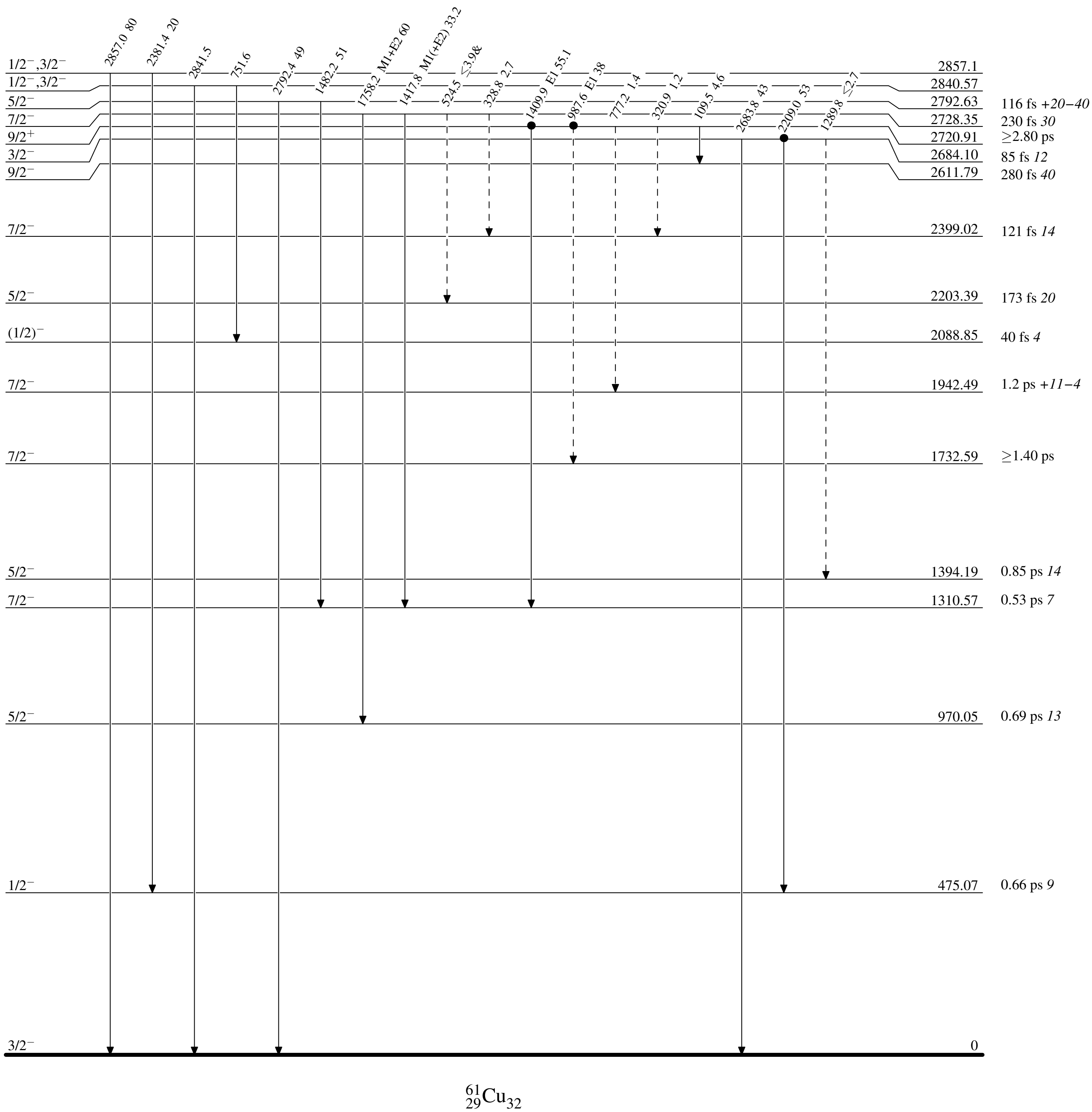
& Multiply placed: undivided intensity given



^{58}Ni(α,pγ) 1973Sa19,1971He14

Level Scheme (continued)

Intensities: % photon branching from each level
& Multiply placed: undivided intensity given



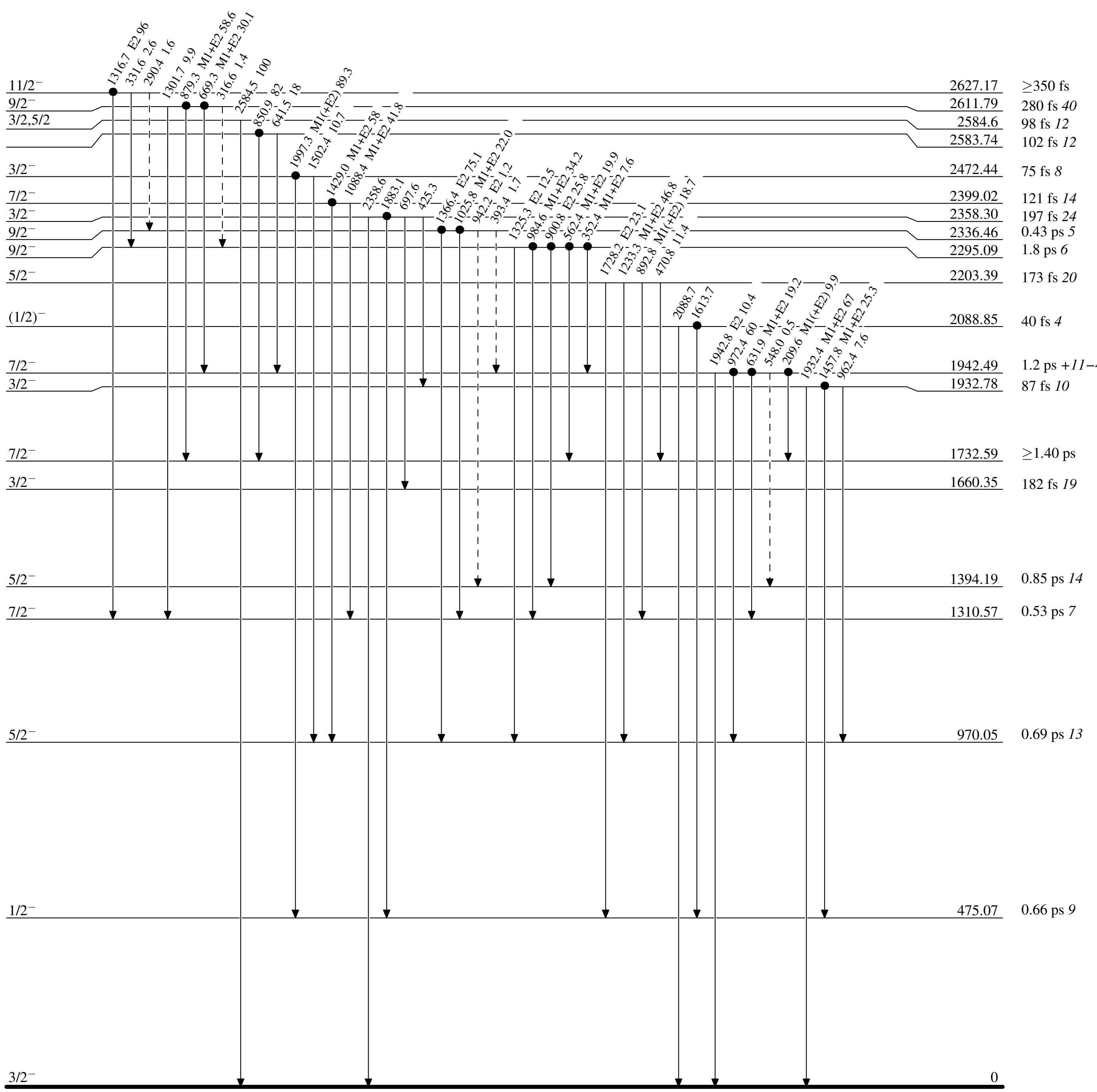
^{58}Ni(α,pγ) 1973Sa19,1971He14

Level Scheme (continued)

Intensities: % photon branching from each level
& Multiply placed: undivided intensity given

Legend

γ Decay (Uncertain)
Coincidence

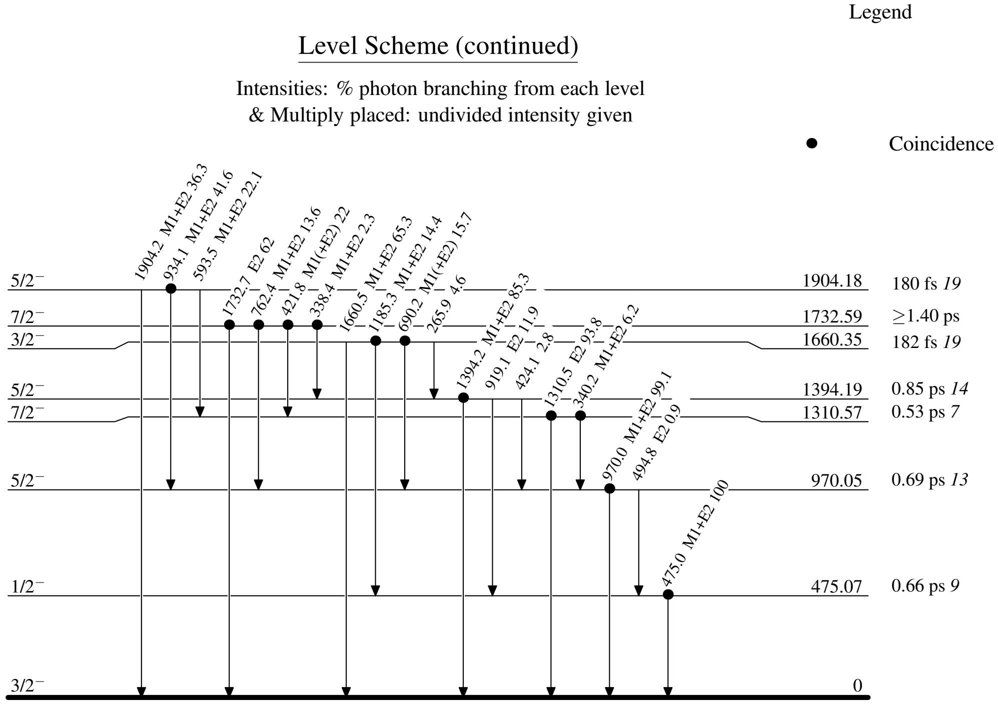


$^{61}_{29}Cu_{32}$

^{58}Ni(α,pγ) 1973Sa19,1971He14

Level Scheme (continued)

Intensities: % photon branching from each level
& Multiply placed: undivided intensity given



$^{61}_{29}Cu_{32}$