^{60}Ni(α,nγ) 1979Mu08,1978Mu02,1978Me17

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Full Evaluation	Jun Chen	NDS 196,17 (2024)	30-Sep-2023

1978Mu02: E=8.5-16 MeV α beams were produced at the Oliver Lodge Laboratory. Target was 1.2 mg/cm^2 >99.8% enriched ^{60}Ni on a gold backing. γ rays were detected with an escape-suppressed spectrometer for γ(θ) and a three-Ge(Li) Compton polarimeter for γ(lin pol). Measured Eγ, Iγ, γγ-coin, γ(θ), γ(lin pol), Doppler-shift attenuation. Deduced levels, J, π, $T_{1/2}$, γ-ray multipolarities, mixing ratios. Report levels up to 1438 level.

1979Mu08 (also 1979Mu09): E=9.5-19 MeV, extension of the work in 1978Mu02. Report levels up to 5347 level. 1979Mu08 also use ^{54}Fe(^{11}B,npγ) at E=30 MeV and ^{58}Ni(^{7}Li,npγ) E=20 MeV as complemental measurements to the (α,nγ) measurement for some specific data only, as noted.

1978Me17: E=10, 12, 14 MeV α beams were produced from the McMaster FN tandem. γ rays were detected with Ge(Li) detectors. Measured Eγ, Iγ, γ(θ). Deduced levels, J, π, γ-ray multipolarities, mixing ratios. 1978Me17 also report data on ^{63}Ni(p,nγ), ^{54}Fe(^{12}C,2pnγ). All Eγ data from the three measurements are combined by 1978Me17 and the uncertainties of combined Eγ values are presented by the evaluator only in this dataset to avoid duplicate.

1977Ni01: E=12 MeV α beam was produced from the McMaster University accelerator. Measured γ(θ,H) of 193γ. Deduced $T_{1/2}$ of 193 level.

1967Bi04,1968Bi03: E=6.5-9.3 MeV at Hebrew University. Measured γ(θ) of 190γ.

^{63}Zn Levels

E(level)[†]	Jπ[‡]	$T_{1/2}$[#]	Comments
0	3/2−		Jπ: from Adopted Levels.
192.90 *6*	5/2−	0.53 ns *12*	Jπ: 5/2 also from γ(θ) in 1968Bi03. $T_{1/2}$: from τ=760 ps *170* using RDM in 1978Mu02. Other: 0.62 ns *21* from g$T_{1/2}$=0.19 ns *7*, and if g=0.30 (1977Ni01, integral rotation).
248.16 *7*	1/2−	33 ps *8*	$T_{1/2}$: from τ=48 ps *11* using RDM in 1978Mu02.
627.19 *8*	(1/2)		Jπ: 627γ(θ) and yield curve are similar to those of 248γ.
637.20 *9*	3/2−		
650.20 *6*	5/2−		
1023.56 *7*	3/2	>1.0 ps	$T_{1/2}$: from τ>1.5 ps (1978Mu02).
1063.69 *8*	7/2		Jπ: from γ(θ) in 1978Me17. Other: 3/2,7/2 from γ(θ) in 1978Mu02.
1065.97 *19*	(1/2,3/2)		Jπ: proposed in 1978Me17.
1206.48 *9*	7/2−		
1284.49 *10*	5/2−		
1394.23 *33*	3/2−	87 fs *25*	Jπ: 3/2 from 1393γ(θ) and γ(lin pol); 3/2+ is ruled out since it would require a large B(M2)(W.u.) exceeding RUL. $T_{1/2}$: from τ=125 fs *35* (1979Mu09).
1436.79 *18*	9/2−	0.69 ps *21*	Jπ: 3/2,5/2 in 1978Me17 based on their 1436.7γ to 3/2− g.s., which is not seen in 1979Mu09. See comments for 1436.7γ. $T_{1/2}$: from τ=1000 fs *300* (1979Mu09).
1663.82 *32*	7/2−	232 fs *63*	$T_{1/2}$: from τ=335 fs *90* (1979Mu09).
1691.44 *22*	5/2−	83 fs *21*	$T_{1/2}$: from τ=120 fs *30* (1979Mu09).
1703.33 *11*	9/2+	32 ps *4*	$T_{1/2}$: from τ=46 ps *6* using RDM with ^{58}Ni(^{7}Li,pnγ) reaction at E(^{7}Li)=20 MeV (1979Mu09).
1861.35 *9*	9/2−	0.49 ps *16*	$T_{1/2}$: from τ=710 fs *230* (1979Mu09).
1977.67 *34*	9/2−	<280 fs	Jπ: 5/2+ and 9/2− from 1327γ(θ) and γ(lin pol); 5/2+ is ruled out since it would require an unreasonably large B(M2)(W.u.) exceeding RUL. $T_{1/2}$: from τ<400 fs (1979Mu09).
2050.95 *12*	9/2−		Jπ: 9/2 from γ(θ) in 1978Me17; ≥5/2− from γ(θ) and γ(lin pol) in 1979Mu09.
2157.35 *29*	3/2−	180 fs *49*	Jπ: from τ=260 fs *70* (1979Mu09).
2233.48 *25*	11/2−	>1.4 ps	$T_{1/2}$: from τ>2 ps (1979Mu09).
2249.4 *4*	9/2−	104 fs *28*	$T_{1/2}$: from τ=150 fs *40* (1979Mu09).
2289.7 *4*	3/2−	14 fs *7*	Jπ: 3/2 from 2042γ(θ) and γ(lin pol); 3/2+ ruled out since it would require a large B(M2)(W.u.) exceeding RUL. $T_{1/2}$: from τ=20 fs *10* (1979Mu09).

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^{60}Ni(α,nγ) 1979Mu08,1978Mu02,1978Me17 (continued)

^{63}Zn Levels (continued)

E(level)†	J$^{\pi}$‡	T$_{1/2}$#	Comments
2319.3 *4*	11/2$^-$	347 fs *90*	T$_{1/2}$: from τ=500 fs *130* (1979Mu09).
2379.43 *32*	9/2	>1.4 ps	T$_{1/2}$: from τ>2 ps (1979Mu09).
2584.64 *23*	13/2$^+$	3.54 ps *28*	T$_{1/2}$: from τ=5.1 ps *4* from RDM with ^{58}Ni(^{7}Li,pnγ) reaction at E(^{7}Li)=20 MeV (1979Mu09).
2635.25 *32*	7/2$^-$	187 fs *52*	T$_{1/2}$: from τ=270 fs *75* (1979Mu09).
2826.6 *4*	11/2$^+$	291 fs *90*	J$^{\pi}$: 13/2$^-$, 11/2$^+$ from 1123$\gamma(\theta)$ and γ(lin pol); 13/2$^-$ is ruled out since it would require an unreasonably large B(M2)(W.u.) exceeding RUL. T$_{1/2}$: from τ=420 fs *130* (1979Mu09).
2912.0 *5*	9/2	>1.4 ps	T$_{1/2}$: from τ>2 ps (1979Mu09).
2934.0 *5*	13/2$^-$	215 fs *62*	T$_{1/2}$: from τ=310 fs *90* (1979Mu09).
3762.4 *6*	(17/2$^+$)		
5346.5 *8*	(21/2$^+$,17/2$^+$)	<280 fs	This level is also confirmed in the $\gamma\gamma$-coin measurement using ^{54}Fe(^{11}B,npγ) by 1979Mu09. J$^{\pi}$: 21/2$^+$ is preferred (1979Mu09). T$_{1/2}$: from τ<400 fs (1979Mu09).

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

‡ From $\gamma(\theta)$ and γ(lin pol) in 1978Mu02 up to 1284 level and in 1979Mu09 above that, unless otherwise noted.

From DSAM in 1979Mu09, unless otherwise noted.

γ(^{63}Zn)

E_i(level)	J_i^π	E_γ[†]	I_γ[‡]	E_f	J_f^π	Mult.[#]	δ[#]	Comments
192.90	5/2$^-$	192.9 *1*	100	0	3/2$^-$	M1+E2	+0.07 *+2−3*	A_2=−0.20 *1*; A_4=+0.001 *9*; pol=−0.35 *5* (1978Mu02) A_2=−0.25 *1*; A_4=+0.04 *1* (1978Me17) A_2=−0.21 *4*; A_4=−0.034 *51* (1968Bi03) δ: others: −0.03 *2* (1978Me17), −0.07 *3* (1968Bi03).
248.16	1/2$^-$	248.4 *1*	100	0	3/2$^-$			A_2=+0.04 *1*; A_4=−0.02 *1*; pol=−0.04 *4* (1978Mu02)
627.19	(1/2)	627.0 *1*	100	0	3/2$^-$			A_2=+0.06 *1*; A_4=+0.01 *1*; pol=+0.06 *4* (1978Mu02) A_2=+0.03 *1*; A_4=−0.03 *2* (1978Me17)
637.20	3/2$^-$	389.4 *2*	4.2 *4*	248.16	1/2$^-$	M1+E2	−0.05 *+3−4*	A_2=−0.43 *4*; A_4=−0.10 *4*; pol=−0.64 *33* (1978Mu02) I_γ: other: 5 (1978Me17).
		637.1 *1*	95.8 *4*	0	3/2$^-$	M1+E2	+0.04 *2*	A_2=+0.34 *1*; A_4=+0.04 *1*; pol=+0.48 *4* (1978Mu02) A_2=+0.22 *1*; A_4=−0.07 *2* (1978Me17) I_γ: other: 95 (1978Me17). δ: others: −0.02 *3* or +3.6 *6* (1978Me17).
650.20	5/2$^-$	457.4 *1*	14.6 *12*	192.90	5/2$^-$	M1+E2	−0.08 *+1−2*	A_2=+0.33 *1*; A_4=+0.02 *15*; pol=+0.86 *29* (1978Mu02) A_2=+0.33 *2*; A_4=−0.04 *2* (1978Me17) I_γ: other: 10 (1978Me17). δ: others: 0.00 *4* or +1.7 *2* (1978Me17).
		650.2 *1*	85.4 *12*	0	3/2$^-$	M1+E2	−0.57 *3*	A_2=−1.04 *1*; A_4=+0.12 *1*; pol=+0.08 *2* (1978Mu02) A_2=−0.58 *1*; A_4=−0.03 *1* (1978Me17) I_γ: other: 90 (1978Me17). δ: other: +0.29 *3* (1978Me17).
1023.56	3/2	373.5 *1*	36.6 *16*	650.20	5/2$^-$	D+Q	−0.82 *+4−5*	A_2=+0.18 *2*; A_4=+0.03 *2*; pol=−0.34 *13* (1978Mu02) A_2=+0.12 *2*; A_4=0.00 *3* (1978Me17) I_γ: other: 40 (1978Me17). δ: others: +0.4 *1* or +1.5 *5* (1978Me17).
		396.2 *1*	5.8 *4*	627.19	(1/2)	D+Q	+0.57 *+6−3*	A_2=+0.20 *6*; A_4=+0.06 *5*; pol=−0.84 *58* (1978Mu02) I_γ: other: 5 (1978Me17).
		775.5 *1*	27.0 *20*	248.16	1/2$^-$	D+Q	−0.91 *+24−6*	A_2=−0.50 *2*; A_4=+0.07 *3*; pol=+0.32 *11* (1978Mu02) A_2=−0.32 *4*; A_4=−0.02 *4* (1978Me17) I_γ: other: 25 (1978Me17). δ: others: +0.2 *1* or +1.3 *3* (1978Me17).
		1023.2 *2*	30.6 *16*	0	3/2$^-$	D+Q	+1.9 *2*	A_2=+0.32 *2*; A_4=+0.07 *2*; pol=−0.22 *19* (1978Mu02) A_2=+0.39 *4*; A_4=+0.03 *4* (1978Me17) I_γ: other: 30 (1978Me17). δ: others: −0.4 *2* or −1.5 *5* (1978Me17).
1063.69	7/2	413.5 *1*	16.3 *14*	650.20	5/2$^-$	D+Q[@]	+0.08[@] *3*	A_2=−0.50 *1*; A_4=+0.02 *1*; pol=−0.03 *7* (1978Mu02) A_2=−0.40 *2*; A_4=−0.05 *2* (1978Me17) I_γ: other: 25 (1978Me17).
		870.8 *1*	10.4 *7*	192.90	5/2$^-$	D+Q[@]	−0.51[@] *5*	A_2=+0.29 *2*; A_4=+0.25 *2*; pol=+0.10 *14* (1978Mu02) A_2=+0.46 *2*; A_4=+0.15 *2* (1978Me17) I_γ: other: 15 (1978Me17).

γ(^{63}Zn) (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[‡]	E_f	J^π_f	Mult.[#]	δ[#]	Comments
1063.69	7/2	1064.1 *2*	73.3 *14*	0	3/2⁻			A_2=−0.27 *1*; A_4=−0.01 *1*; pol=+0.11 *3* (1978Mu02) A_2=+0.24 *3*; A_4=−0.27 *3* (1978Me17) I_γ: other: 60 (1978Me17).
1065.97	(1/2,3/2)	818.2[&] *5*	10	248.16	1/2⁻			E_γ,I_γ: from (p,nγ) by 1978Me17, but this γ is not seen in any other studies. It is considered questionable by the evaluator.
		1065.9 *2*	90	0	3/2⁻			I_γ: from (p,nγ) measurement by 1978Me17.
1206.48	7/2⁻	556	3.0 *3*	650.20	5/2⁻	D+Q	−1.24 *9*	A_2=+0.95 *6*; A_4=+0.24 *7* (1978Mu02) γ data from 1978Mu02 only; not seen in 1978Me17.
		569.4[&] *3*	<5	637.20	3/2⁻			E_γ,I_γ: from 1978Me17 only; not seen in 1978Mu02.
		1013.4 *1*	50.6 *22*	192.90	5/2⁻	M1+E2	+4.7 *+1−7*	A_2=+0.40 *2*; A_4=+0.27 *2*; pol=+0.30 *9* (1978Mu02) A_2=+0.35 *2*; A_4=+0.20 *2* (1978Me17) I_γ: other: 50 (1978Me17). δ: others: −0.45 *10* or +7.0 *25* (1978Me17).
		1206.8 *2*	46.4 *22*	0	3/2⁻	E2+M3	−0.03 *2*	A_2=+0.33 *2*; A_4=−0.13 *2*; pol=+0.58 *13* (1978Mu02) A_2=+0.44 *2*; A_4=−0.18 *2* (1978Me17) I_γ: other: 50 (1978Me17).
1284.49	5/2⁻	1036.3 *2*	34.5 *19*	248.16	1/2⁻	E2(+M3)	−0.01 *1*	A_2=+0.50 *1*; A_4=−0.36 *1*; pol=+0.65 *3* (1978Mu02) A_2=+0.45 *3*; A_4=+0.28 *4* (1978Me17) I_γ: other: 25 (1978Me17).
		1091.6 *1*	59.4 *20*	192.90	5/2⁻	D+Q		A_2=−0.14 *2*; A_4=+0.01 *2*; pol=+0.50 *14* (1978Mu02) A_2=+0.03 *2*; A_4=−0.05 *2* (1978Me17) I_γ: other: 70 (1978Me17). Mult.,δ: +0.39 *5* or −4.3 *12* (1978Me17).
		1284.0 *5*	6.1 *6*	0	3/2⁻	M1+E2	−0.7 *2*	A_2=−1.15 *9*; A_4=+0.24 *9*; pol=+1.06 *52* (1978Mu02) A_2=−1.2 *2*; A_4=−0.2 *2* (1978Me17) I_γ: other: 5 (1978Me17). δ: other: +0.8 *3* (1978Me17).
1394.23	3/2⁻	766.4 *9*	43 *2*	627.19	(1/2)			A_2=+0.13 *3*; A_4=+0.01 *3*; pol=0.00 *5* (1979Mu09) E_γ: unweighted average of 765.5 *2* (1978Me17) and 767.2 *6* (1979Mu09).
		1146.5 *6*	5 *2*	248.16	1/2⁻			
		1201.5 *5*	4 *3*	192.90	5/2⁻			
		1393.3 *9*	48 *1*	0	3/2⁻	M1+E2	+0.36 *+14−10*	A_2=+0.29 *1*; A_4=+0.01 *1*; pol=+0.06 *8* (1979Mu09) E_γ: unweighted average of 1392.4 *4* (1978Me17) and 1394.2 *8* (1979Mu09).
1436.79	9/2⁻	1244.2 *7*	100	192.90	5/2⁻	E2(+M3)	+0.01 *2*	A_2=+0.47 *2*; A_4=−0.22 *2*; pol=+0.71 *14* (1979Mu09) A_2=+0.38 *1*; A_4=−0.17 *1*; pol=+0.68 *9* (1978Mu02) A_2=+0.47 *1*; A_4=−0.21 *1* (1978Me17) E_γ: unweighted average of 1243.5 *2* (1978Me17) and 1244.9 *4* (1979Mu09).

$^{63}_{30}$Zn$_{33}$-4

γ(^{63}Zn) (continued)

E_i(level)	J^π_i	E_γ[†]	I_γ[‡]	E_f	J^π_f	Mult.[#]	δ[#]	Comments
								I_γ: other: 95 from 1978Me17. δ: others: −0.01 *1* (1978Mu02), −1.2 *2* (1978Me17).
1436.79	9/2⁻	1436.7[&] *2*		0	3/2⁻			A_2=−0.3 *1*; A_4=0.0 *1* (1978Me17) E_γ,I_γ: from 1978Me17 only with Iγ=5. 1979Mu09 claim that a γ at this energy is seen in coincidence with γ rays in ^{63}Cu and it is not seen in the nγ-coincidence spectrum of ^{63}Zn. Based on those evidence, the evaluator has considered this γ as questionable. Mult.,δ: δ(Q/D)=+0.03 *12* or +2.9 *8* (1978Me17).
1663.82	7/2⁻	1471.3 *5*	75 *1*	192.90	5/2⁻	M1+E2	+0.18 *3*	A_2=+0.02 *1*; A_4=+0.01 *1*; pol=−0.60 *10* (1979Mu09)
		1664.0 *6*	25 *1*	0	3/2⁻	E2(+M3)	+0.03 *3*	A_2=+0.58 *5*; A_4=−0.27 *5*; pol=+1.10 *31* (1979Mu09)
1691.44	5/2⁻	1053.7 *5*	6 *3*	637.20	3/2⁻			
		1498.6 *3*	6 *3*	192.90	5/2⁻			
		1691.6 *4*	88 *1*	0	3/2⁻	M1+E2	−0.10 *3*	A_2=−0.43 *1*; A_4=−0.02 *1*; pol=−0.31 *11* (1979Mu09) E_γ: weighted average of 1691.7 *4* (1978Me17) and 1691.2 *6* (1979Mu09).
1703.33	9/2⁺	496.6 *2*	15 *1*	1206.48	7/2⁻	E1(+M2)	+0.02 *2*	A_2=−0.28 *1*; A_4=0.00 *1*; pol=+0.46 *6* (1979Mu09) A_2=−0.28 *5*; A_4=+0.05 *5* (1978Me17) E_γ: weighted average of 496.6 *1* (1978Me17) and 497.2 *4* (1979Mu09). I_γ: other: 15 (1978Me17). δ: other: −0.02 *3* (1978Me17).
		639.7 *1*	85 *1*	1063.69	7/2	D(+Q)[@]	0.00[@] *2*	A_2=−0.28 *1*; A_4=−0.02 *2* (1978Me17) E_γ: weighted average of 639.7 *1* (1978Me17) and 639.5 *6* (1979Mu09). I_γ: other: 85 (1978Me17).
1861.35	9/2⁻	798.2 *3*	26 *3*	1063.69	7/2	M1+E2	−0.03 *2*	A_2=−0.36 *1*; A_4=−0.03 *1*; pol=−0.66 *16* (1979Mu09) A_2=−0.16 *4*; A_4=−0.11 *4* (1978Me17) E_γ: weighted average of 798.3 *2* (1978Me17) and 797.4 *6* (1979Mu09). I_γ: other: 30 (1978Me17), δ: other: +0.8 *1* (1978Me17).
		1210.8 *3*	70 *3*	650.20	5/2⁻	E2(+M3)	+0.01 *2*	A_2=+0.55 *2*; A_4=−0.32 *2*; pol=+0.83 *12* (1979Mu09) A_2=+0.52 *2*; A_4=−0.22 *3* (1978Me17) E_γ: weighted average of 1210.7 *2* (1978Me17) and 1211.5 *5* (1979Mu09). I_γ: other: 50 (1978Me17). δ: other: −0.5 *1* (1978Me17).
		1668.5 *5*	4 *2*	192.90	5/2⁻			E_γ: weighted average of 1668.2 *4* (1978Me17) and 1669.3 *7* (1979Mu09). I_γ: other: 10 (1978Me17).
		1861.3[&] *1*		0	3/2⁻			E_γ: from 1978Me17 with Iγ=10; a similar γ is seen in 1979Mu09 but assigned to ^{63}Cu based on nγ and γγ-coin data.
1977.67	9/2⁻	1327.3 *4*	23 *2*	650.20	5/2⁻	E2(+M3)	−0.01 *2*	A_2=+0.38 *2*; A_4=−0.15 *2*; pol=+0.64 *4* (1979Mu09)
		1785.1 *6*	77 *2*	192.90	5/2⁻	E2+M3	−0.10 *5*	A_2=+0.29 *2*; A_4=−0.22 *2*; pol=+0.49 *16* (1979Mu09)
2050.95	9/2⁻	844.6 *7*	30 *2*	1206.48	7/2⁻			
		987.3 *1*	70 *2*	1063.69	7/2	D+Q[@]	+0.40[@] *5*	A_2=−0.87 *3*; A_4=+0.08 *3*; pol=+0.24 *13* (1979Mu09)

γ(^{63}Zn) (continued)

E_i(level)	J_i^π	E_γ†	I_γ‡	E_f	J_f^π	Mult.#	δ#	Comments
								A_2=−0.87 *4*; A_4=+0.04 *4* (1978Me17) E_γ: weighted average of 987.3 *1* (1978Me17) and 986.9 *7* (1979Mu09). I_γ: other: 90 (1978Me17).
2050.95	9/2−	1857.6& *3*		192.90	5/2−			E_γ: from 1978Me17 only, with Iγ=10; not seen in 1979Mu09.
2157.35	3/2−	1530.0 *4*	10 *1*	627.19	(1/2)	M1+E2	−2.0 *2*	A_2=−0.39 *3*; A_4=+0.05 *4*; pol=+0.55 *35* (1979Mu09)
		1909.3 *4*	90 *1*	248.16	1/2−	M1+E2	−2.3 *2*	A_2=−0.28 *1*; A_4=+0.02 *1*; pol=+0.57 *18* (1979Mu09)
2233.48	11/2−	570.2 *5*	38 *1*	1663.82	7/2−	E2(+M3)	−0.03 *3*	A_2=+0.38 *3*; A_4=−0.21 *4*; pol=+0.46 *28* (1979Mu09)
		796.6 *3*	20 *2*	1436.79	9/2−			
		1169.6 *4*	42 *2*	1063.69	7/2			
2249.4	9/2−	1185.4 *5*	71 *2*	1063.69	7/2	M1+E2	+0.9 *2*	A_2=+0.57 *2*; A_4=−0.01 *2*; pol=−0.65 *34* (1979Mu09)
		1599.5 *5*	29 *2*	650.20	5/2−	E2(+M3)	−0.04 *3*	A_2=−0.10 *7*; A_4=−0.17 *8*; pol=−0.33 *25* (1979Mu09)
2289.7	3/2−	1639.1 *5*	75 *3*	650.20	5/2−			
		2041.9 *5*	25 *3*	248.16	1/2−	M1+E2	−0.6 *3*	A_2=−0.37 *8*; A_4=+0.01 *5*; pol=+0.23 *22* (1979Mu09)
2319.3	11/2−	1255.6 *4*	100	1063.69	7/2	E2(+M3)	−0.05 *+5−2*	A_2=+0.25 *1*; A_4=−0.14 *1*; pol=+0.47 *7* (1979Mu09)
2379.43	9/2	676.1 *3*	100	1703.33	9/2+	(M1+E2)	−2.5 *+5−12*	A_2=−0.38 *1*; A_4=−0.25 *1*; pol=−0.56 *28* (1979Mu09)
2584.64	13/2+	881.3 *2*	100	1703.33	9/2+	E2+M3	−0.25 *10*	A_2=+0.04 *1*; A_4=−0.11 *1*; pol=+0.18 *3* (1979Mu09) A_2=+0.38 *1*; A_4=−0.12 *1* (1978Me17) E_γ: from 1978Me17. Other: 881.3 *3* (1979Mu09).
2635.25	7/2−	1428.5 *4*	70 *2*	1206.48	7/2−	M1(+E2)	+0.02 *7*	A_2=+0.29 *2*; A_4=−0.02 *2*; pol=+0.54 *15* (1979Mu09)
		2442.7 *5*	30 *2*	192.90	5/2−			
2826.6	11/2+	1123.3 *4*	100	1703.33	9/2+	M1+E2	+0.7 *1*	A_2=+0.60 *2*; A_4=+0.07 *2*; pol=−0.58 *12* (1979Mu09)
2912.0	9/2	1705.5 *5*	100	1206.48	7/2−	D+Q	−1.7 *1*	A_2=−0.78 *1*; A_4=+0.22 *1*; pol=+0.55 *35* (1979Mu09)
2934.0	13/2−	1497.2 *5*	100	1436.79	9/2−	E2(+M3)	−0.02 *3*	A_2=+0.36 *1*; A_4=−0.17 *1*; pol=+0.63 *14* (1979Mu09)
3762.4	(17/2+)	1177.7 *5*	100	2584.64	13/2+	(E2+M3)	−0.20 *3*	A_2=+0.11 *1*; A_4=−0.28 *1*; pol=+0.36 *7* (1979Mu09) A_2=+0.31 *2*; A_4=−0.17 *2* (1978Me17)
5346.5	(21/2+,17/2+)	1584.1 *6*	100	3762.4	(17/2+)	E2		A_2=+0.41 *1*; A_4=−0.16 *1*; pol=+0.35 *28* (1979Mu09) A_2=+0.31 *2*; A_4=−0.08 *3* (1978Me17)

† From 1978Me17 up to 1284 level and from 1979Mu09 above that, unless otherwise noted.

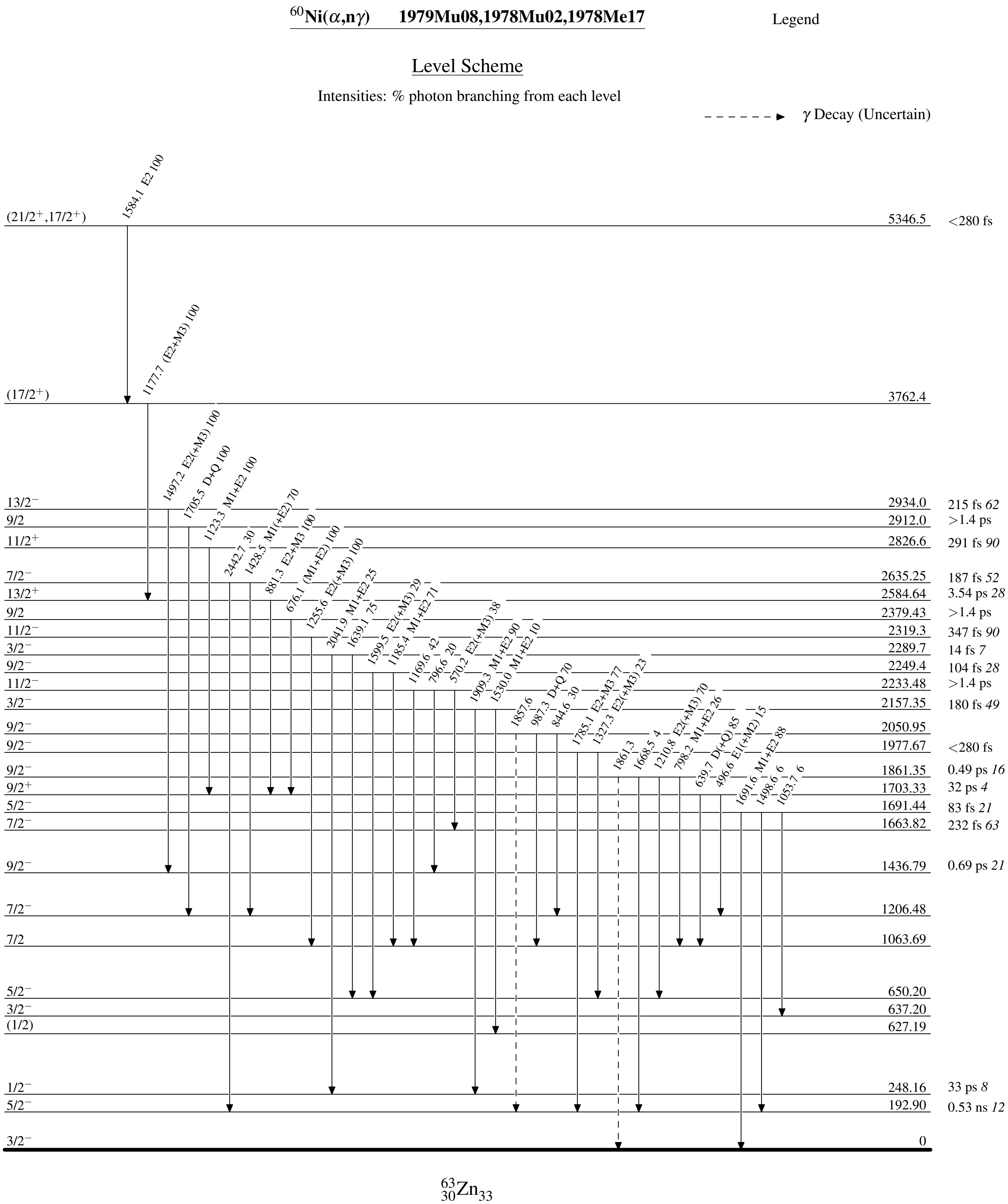
‡ From 1978Mu02 up to 1284 level and from 1979Mu09 above that, unless otherwise noted. Values are % photon branching from each level.

From γ(θ) and linear polarization data in 1978Mu02 up to 1284 level and in 1979Mu08 above that, unless otherwise noted. Where level $T_{1/2}$ is present, it is also used to determine magnetic or electric nature of a transition based on RUL.

@ From γ(θ) in 1978Me17.

& Placement of transition in the level scheme is uncertain.

$^{63}_{30}$Zn$_{33}$-6



^{60}Ni(α,nγ) 1979Mu08,1978Mu02,1978Me17
Legend
Level Scheme
Intensities: % photon branching from each level
γ Decay (Uncertain)
(21/2+,17/2+) 5346.5 <280 fs
1584.1 E2 100
(17/2+) 3762.4
1177.7 (E2+M3) 100
13/2− 2934.0 215 fs 62
9/2 2912.0 >1.4 ps
11/2+ 2826.6 291 fs 90
7/2− 2635.25 187 fs 52
13/2+ 2584.64 3.54 ps 28
9/2 2379.43 >1.4 ps
11/2− 2319.3 347 fs 90
3/2− 2289.7 14 fs 7
9/2− 2249.4 104 fs 28
11/2− 2233.48 >1.4 ps
3/2− 2157.35 180 fs 49
9/2− 2050.95
9/2− 1977.67 <280 fs
9/2− 1861.35 0.49 ps 16
9/2+ 1703.33 32 ps 4
5/2− 1691.44 83 fs 21
7/2− 1663.82 232 fs 63
9/2− 1436.79 0.69 ps 21
7/2− 1206.48
7/2 1063.69
5/2− 650.20
3/2− 637.20
(1/2) 627.19
1/2− 248.16 33 ps 8
5/2− 192.90 0.53 ns 12
3/2− 0
1497.2 E2(+M3) 100
1705.5 D+Q 100
1123.3 M1+E2 100
2442.7 30
1428.5 M1(+E2) 70
881.3 E2+M3 100
676.1 (M1+E2) 100
1255.6 E2(+M3) 100
2041.9 M1+E2 25
1639.1 75
1599.5 E2(+M3) 29
1185.4 M1+E2 71
1169.6 42
796.6 20
570.2 E2(+M3) 38
1909.3 M1+E2 90
1530.0 M1+E2 10
1857.6
987.3 D+Q 70
844.6 30
1785.1 E2+M3 77
1327.3 E2(+M3) 23
1861.3
1668.5 4
1210.8 E2(+M3) 70
798.2 M1+E2 26
639.7 D(+Q) 85
496.6 E1(+M2) 15
1691.6 M1+E2 88
1498.6 6
1053.7 6
$^{63}_{30}Zn_{33}$

^{60}Ni(α,nγ) 1979Mu08,1978Mu02,1978Me17

Level Scheme (continued)

Intensities: % photon branching from each level