

⁵⁸Ni(¹²C,2pγ), ⁶⁴Zn(⁷Li,p2nγ) 1981De03

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	E. A. Mccutchan	NDS 113, 1735 (2012)	1-Mar-2012

2012Lu03: ⁵⁸Ni(¹²C,2pγ), E(¹²C)=38 MeV. Measured T_{1/2} of 1016 level by RDM using New Yale Plunger Device (NYPD) and 8 Compton-suppressed Clover detectors.

1983KiZW: ⁵⁸Ni(¹²C,2pγ), E(¹²C)=41 MeV. Measured T_{1/2} by DSAM.

1982Pa03: ⁶⁴Zn(⁷Li,p2nγ), E(⁷Li)=15-18 MeV. Measured γ(θ), T_{1/2} by DSAM (centroid shift) using Ge(Li) detectors.

1982Ba42: ⁵⁸Ni(¹²C,2pγ), E(¹²C)=40 MeV. Measured g-factors using recoil into gas perturbed angular correlation technique.

1981De03: ⁵⁸Ni(¹²C,2pγ), E(¹²C)=39 MeV, ⁶³Cu(⁷Li,2nγ), E(⁷Li)=18 MeV, and ⁵²Cr(¹⁹F,p2nγ), E(¹⁹F)=50 MeV. Measured Eγ, Iγ, γγ, γ yield, γ(θ), γγ(θ) (DCO), and γ linear polarization; T_{1/2} with DSAM. See also 1979De12.

1977Gu08: ⁵⁸Ni(¹²C,2pγ), E(¹²C)=36 MeV. Measured T_{1/2} with DSAM and recoil distance methods.

1977Mo20: ⁶⁶Zn(α,2nγ), Eα=30 MeV. Measured γ(θ), T_{1/2} by DSAM.

Others: 1974No08 [⁵⁸Ni(¹²C,2pγ), E(¹²C)=36 MeV], 1986KiZV [⁵⁸Ni(¹²C,2pγ), E(¹²C)=40 MeV], and 1995KuZW, 1996GnZZ [⁵⁸Ni(¹⁶O,2pαγ), E(¹⁶O)=74.5 MeV].

⁶⁸Ge Levels

E(level) [†]	Jπ [‡]	T _{1/2}	Comments
0.0	0 ⁺		
1015.76 4	2 ⁺	1.98 ps 17	T _{1/2} : weighted average of 2.15 ps 21 from RDM (2012Lu03) and 1.80 ps 21 from DSAM (1982Pa03). Others: 2.1 ps 7 (1981De03), 3.5 ps +21-14 (1977Mo20), and 1.4 ps 7 (1977Gu08).
1754.15 25	0 ⁺		
1777.64 9	2 ⁺	4.1 ps 7	T _{1/2} : weighted average of 3.5 ps +21-14 (1977Mo20) and 4.2 ps 7 (1977Gu08). These values are discrepant with the adopted value of 1.80 ps 14.
2267.82 14	4 ⁺	0.83 ps 14	T _{1/2} : Other: >3.5 ps (1982Pa03). T _{1/2} : from DSAM in 1982Pa03. T _{1/2} : Others: 0.55 ps +28-14 (1983KiZW), 1.0 ps 3 (1981De03), and 0.8 ps +3-2 (1977Mo20).
2428.82 20	3 ⁺	2.1 [#] ps 7	
2456.3 4	2 ⁺		
2649.08 15	3 ⁻	2.1 ps +14-7	T _{1/2} : from DSAM in 1982Pa03. T _{1/2} : Others: 0.8 ps +6-3 (1983KiZW) and 1.7 ps +14-10 (1977Mo20).
2832.21 19	4 ⁺	0.8 ^{&} ps +7-3	
2947.5 3	(2 ⁺)		
3040.84 24	(4 ⁺)		
3061.9 3			
3086.0 4	(1,2 ⁺)		
3182.8 3	4 ⁺		
3399.7 3	(1,2 ⁺)		
3582.20 19	5 ⁻	1.2 [#] ps 4	T _{1/2} : Others:<0.7 ps (1983KiZW) and >6.9 ps (1977Mo20).
3649.31 20	5 ⁻	0.4 ^{&} ps +3-1	T _{1/2} : Others: 1.4 ps +14-7 (1977Mo20) and <0.7 ps (1977Gu08, DSAM).
3675.6 4	(5 ⁺)		
3696.06 25	6 ⁺	0.49 [@] ps 14	T _{1/2} : Others: 0.35 ps +10-7 (1983KiZW) and 0.49 ps +14-7 (1977Mo20).
3883.27 25	6 ⁻	132 [#] ps 35	g=0.088 18 g: from recoil into gas perturbed angular correlations (1982Ba42). Relative to g=0.44 2 for the 596, 2 ⁺ state in ⁷⁴ Ge. Value has been adjusted by evaluator from g=0.096 25 determined relative to g=0.47 10 for ⁷⁴ Ge.
4054.13 22	7 ⁻	118 [#] ps 21	g=0.111 17 g: from recoil into gas perturbed angular correlations (1982Ba42). Relative to g=0.44 2 for the 596, 2 ⁺ state in ⁷⁴ Ge. Value has been adjusted by evaluator from g=0.122 29 determined relative to g=0.47 10 for ⁷⁴ Ge.
4454.4 3	7 ⁻	0.97 [#] ps 21	T _{1/2} : Other: 0.9 ps +5-2 (1983KiZW).

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⁵⁸Ni(¹²C,2pγ), ⁶⁴Zn(⁷Li,p2nγ) **1981De03 (continued)**

⁶⁸Ge Levels (continued)

E(level) [†]	J ^{π‡}	T _{1/2}	Comments
4659.8 3	(9 ⁻)	0.3& ps 1	
4837.3 3	8 ⁺	1.04@ ps 21	T _{1/2} : Others: 0.5 ps 1 (1983KiZW), 0.49 ps +14-7 (1977Mo20), and 1.1 ps 5 (1977Gu08).
4958.1 3	(8 ⁻)	0.9& ps +4-2	
4999.1 4	(6 ⁺)	>0.35& ps	
5049.9 4	(8 ⁺)	0.49@ ps +21-14	T _{1/2} : Other: 0.3 ps 1 (1983KiZW).
5150.3 4		1.2& ps 3	
5330.5 3	(9 ⁻)	0.69@ ps +21-14	T _{1/2} : Other: 0.35 ps 7 (1983KiZW).
5366.5 4	8 ⁺	0.83@ ps +28-21	T _{1/2} : Others: 0.6 ps +3-2 (1983KiZW) and 0.55 ps +21-14 (1977Mo20).
5678.1 4	(9 ⁻)	0.5& ps 2	
5822.3 4		0.8& ps 4	
5873.9 4		1.5& ps +10-6	
5962.2 3	10 ⁺	0.76@ ps +21-14	T _{1/2} : Others: 0.5 ps +2-1 (1983KiZW) and 0.7 ps +3-2 (1977Mo20).
6215.3 5	10 ⁺	<0.7& ps	
7045.3 4	(11 ⁻)	1.0& ps +4-3	
7145.5 5	(11 ⁻)		
7242.5 5	(10 ⁺)	0.7& ps +7-4	
7371.8 5	(12 ⁺)	0.7& ps +14-3	
7559.7 6	(12 ⁺)	0.8& ps +6-4	
9172.2 5	(14 ⁺)	0.4& ps 2	

[†] From least squares fit to E_γ by evaluator; ΔE=0.3 keV assumed.

[‡] From 1981De03. Based on γ(θ), γγ(θ) (DCO), γ-ray yields, and polarization measurements.

From Recoil Distance Doppler Shift measurements (1977Gu08).

@ From DSAM (1981De03).

& From DSAM (1983KiZW).

γ(⁶⁸Ge)

E _γ [†]	I _γ [‡]	E _i (level)	J _i ^π	E _f	J _f ^π	Mult.#	δ [#]	Comments
170.7	9.8 15	4054.13	7 ⁻	3883.27	6 ⁻	D+Q	+0.04 2	A ₂ =-0.171 15, A ₄ =+0.007 2. δ: Other:+0.05 1 (1977Mo20).
233.9	17.6 18	3883.27	6 ⁻	3649.31	5 ⁻	M1(+E2)	+0.01 2	A ₂ =-0.182 16, A ₄ =-0.03 2 in ⁶³ Cu(⁷ Li,2nγ). R(DCO)=1.51 19. Mult.,δ: from γ(θ) in ⁶³ Cu(⁷ Li,2nγ) (1981De03). δ: Other: 0.00 +2-20 (1977Mo20).
358.0	2.0 5	4054.13	7 ⁻	3696.06	6 ⁺	D		A ₂ =-0.36 6, A ₄ =-0.05 9 (1977Mo20). Mult.: from γ(θ) in (1977Mo20).
400.1	2.82 18	4454.4	7 ⁻	4054.13	7 ⁻	D+Q	+0.5 2	δ: δ(Q/D)=-0.07 +10-20 from γ(θ) in (1977Mo20). A ₂ =+0.368 16, A ₄ =+0.004 18. R(DCO)=0.83 15.
404.8	3.11 16	4054.13	7 ⁻	3649.31	5 ⁻	Q		A ₂ =+0.34 2, A ₄ =-0.12 4. δ: δ(O/Q)=0.0 +3-1 from γ(θ) in (1977Mo20).
471.8	5.08 25	4054.13	7 ⁻	3582.20	5 ⁻	Q		A ₂ =+0.34 2, A ₄ =-0.10 3. δ: δ(O/Q)=-0.07 10 from γ(θ) in (1977Mo20).
491.8	0.67 8	5822.3		5330.5	(9 ⁻)			
571.0	0.68 8	4454.4	7 ⁻	3883.27	6 ⁻			

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$^{58}\text{Ni}(^{12}\text{C},2\text{p}\gamma), ^{64}\text{Zn}(^7\text{Li},\text{p}2\text{n}\gamma)$ **1981De03 (continued)**

$\gamma(^{68}\text{Ge})$ (continued)

E_γ †	I_γ ‡	E_i (level)	J_i^π	E_f	J_f^π	Mult. #	δ #	Comments
587.2	1.31 9	3649.31	5 ⁻	3061.9				
605.7	1.91 11	4659.8	(9 ⁻)	4054.13	7 ⁻	Q		$A_2=+0.275$ 23, $A_4=-0.04$ 3.
611.8	2.90 14	3040.84	(4 ⁺)	2428.82	3 ⁺	D+Q	+0.24 4	$A_2=+0.117$ 23, $A_4=-0.07$ 3.
631.6&	0.35 10	5962.2	10 ⁺	5330.5	(9 ⁻)			
651.1	11.1 5	2428.82	3 ⁺	1777.64	2 ⁺	D+Q	+0.06 2	$A_2=-0.105$ 12, $A_4=+0.018$ 14 in $^{58}\text{Ni}(^{12}\text{C},2\text{p}\gamma)$, $A_2=-0.177$ 17, $A_4=-0.023$ 22 in $^{63}\text{Cu}(^7\text{Li},2\text{n}\gamma)$. δ : Other: -0.02 2 from $^{63}\text{Cu}(^7\text{Li},2\text{n}\gamma)$ (1981De03) and -0.15 +10-50 (1977Mo20).
702.1	0.79 10	2456.3	2 ⁺	1754.15	0 ⁺			
738.2	1.17 10	1754.15	0 ⁺	1015.76	2 ⁺	Q		R(DCO)=0.75 25. Mult.: from $\gamma\gamma(\theta)$ (DCO) (1981De03).
750.1	1.10 20	3582.20	5 ⁻	2832.21	4 ⁺			
761.9@ 1	14.4 8	1777.64	2 ⁺	1015.76	2 ⁺	D+Q	-0.15 3	$A_2=+0.072$ 10, $A_4=-0.002$ 13 in $^{58}\text{Ni}(^{12}\text{C},2\text{p}\gamma)$, $A_2=+0.094$ 12, $A_4=-0.016$ 13 in $^{63}\text{Cu}(^7\text{Li},2\text{n}\gamma)$. δ : Other: -0.09 2 from $^{63}\text{Cu}(^7\text{Li},2\text{n}\gamma)$ (1981De03), -6 +2-5 or -0.65 10 (1982Pa03), and -0.18 +20-10 (1977Mo20).
783.2	1.30 10	4837.3	8 ⁺	4054.13	7 ⁻			
793.9	1.30 11	3061.9		2267.82	4 ⁺			
871.5	1.00 25	2649.08	3 ⁻	1777.64	2 ⁺			
872.4	0.50 15	4454.4	7 ⁻	3582.20	5 ⁻			
903.8&	0.92 13	4958.1	(8 ⁻)	4054.13	7 ⁻			
933.2	1.51 10	3582.20	5 ⁻	2649.08	3 ⁻	Q		$A_2=+0.32$ 6, $A_4=-0.05$ 6.
1000.5	2.45 12	3649.31	5 ⁻	2649.08	3 ⁻	Q		$A_2=+0.35$ 4, $A_4=-0.08$ 4.
1015.74@ 4	100 5	1015.76	2 ⁺	0.0	0 ⁺	E2		$A_2=+0.210$ 12, $A_4=-0.056$ 14. Mult.: Q from $\gamma(\theta)$, E2 from polarization measurement (1981De03).
1036.5	1.36 9	5873.9		4837.3	8 ⁺			
1054.7	4.04 20	2832.21	4 ⁺	1777.64	2 ⁺	Q		R(DCO)=1.12 18. Mult.: from $\gamma\gamma(\theta)$ (DCO) (1981De03).
1075.0	6.3 3	4958.1	(8 ⁻)	3883.27	6 ⁻	Q		$A_2=+0.31$ 3, $A_4=-0.07$ 3. R(DCO)=0.52 17.
1096.2	2.5 5	5150.3		4054.13	7 ⁻			
1124.8	6.7 3	5962.2	10 ⁺	4837.3	8 ⁺	Q		$A_2=+0.32$ 5, $A_4=-0.10$ 5. R(DCO)=0.97 9. δ : $\delta(\text{O}/\text{Q})=0.0$ 1 (1977Mo20).
1141.3	9.9 5	4837.3	8 ⁺	3696.06	6 ⁺	Q		$A_2=+0.32$ 3, $A_4=-0.12$ 5. R(DCO)=0.96 10. δ : $\delta(\text{O}/\text{Q})=0.0$ 1 (1977Mo20).
1162.5	1.85 15	5822.3		4659.8	(9 ⁻)			
1165.4	3.33 20	6215.3	10 ⁺	5049.9	(8 ⁺)	Q		$A_2=+0.32$ 10, $A_4=-0.17$ 12. R(DCO)=1.06 13.
1169.8	1.10 12	2947.5	(2 ⁺)	1777.64	2 ⁺			
1223.7	3.48 20	5678.1	(9 ⁻)	4454.4	7 ⁻	Q		$A_2=+0.29$ 5, $A_4=-0.11$ 7.
1246.8	2.43 15	3675.6	(5 ⁺)	2428.82	3 ⁺			
1251.93@ 15	59 4	2267.82	4 ⁺	1015.76	2 ⁺	E2		$A_2=+0.317$ 18, $A_4=-0.071$ 21. R(DCO)=1.02 4. Mult.: Q from $\gamma(\theta)$, E2 from polarization measurement (1981De03). δ : $\delta(\text{O}/\text{Q})=0.0$ 1 (1977Mo20).
1263.4	1.32 25	3040.84	(4 ⁺)	1777.64	2 ⁺			
1276.4	7.1 4	5330.5	(9 ⁻)	4054.13	7 ⁻	Q		$A_2=+0.32$ 4, $A_4=-0.10$ 5.

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$^{58}\text{Ni}(^{12}\text{C},2\text{p}\gamma), ^{64}\text{Zn}(^7\text{Li},\text{p}2\text{n}\gamma)$ **1981De03 (continued)**

$\gamma(^{68}\text{Ge})$ (continued)

E_γ †	I_γ ‡	$E_i(\text{level})$	J_i^π	E_f	J_f^π	Mult.#	δ #	Comments
1303.0 1314.3	0.83 14 6.7 4	4999.1 3582.20	(6 ⁺) 5 ⁻	3696.06 2267.82	6 ⁺ 4 ⁺	E1+M2	+0.04 3	$A_2=-0.151$ 24, $A_4=-0.01$ 4 in $^{58}\text{Ni}(^{12}\text{C},2\text{p}\gamma)$, $A_2=-0.126$ 18, $A_4=+0.025$ 19 in $^{63}\text{Cu}(^7\text{Li},2\text{n}\gamma)$. δ : Other: +0.06 2 from $^{63}\text{Cu}(^7\text{Li},2\text{n}\gamma)$ (1981De03) and -0.15 +10-50 (1977Mo20). Mult.: E1 from polarization measurement (1981De03).
1331.8 1344.4	0.26 5 2.37 12	3086.0 7559.7	(1,2 ⁺) (12 ⁺)	1754.15 6215.3	0 ⁺ 10 ⁺	Q		$A_2=+0.24$ 5, $A_4=-0.06$ 6. R(DCO)=0.88 18.
1353.8	6.6 3	5049.9	(8 ⁺)	3696.06	6 ⁺	Q		$A_2=+0.36$ 3, $A_4=-0.12$ 4. R(DCO)=0.96 10.
1381.3	17.4 9	3649.31	5 ⁻	2267.82	4 ⁺	E1+M2	+0.04 2	$A_2=-0.293$ 24, $A_4=-0.014$ 25 in $^{58}\text{Ni}(^{12}\text{C},2\text{p}\gamma)$, $A_2=-0.22$ 3, $A_4=+0.02$ 3 in $^{63}\text{Cu}(^7\text{Li},2\text{n}\gamma)$. δ : Other: -0.01 2 from $^{63}\text{Cu}(^7\text{Li},2\text{n}\gamma)$ (1981De03) and -0.02 +2-15 (1977Mo20). Mult.: E1 from polarization measurement (1981De03).
1405.1 1409.6	1.24 9 1.15 10	3182.8 7371.8	4 ⁺ (12 ⁺)	1777.64 5962.2	2 ⁺ 10 ⁺	Q Q		$A_2=+0.205$ 21, $A_4=-0.063$ 24. $A_2=+0.26$ 6, $A_4=-0.09$ 7. R(DCO)=1.09 23.
1412.9 1428.2	4.05 21 22.7 11	2428.82 3696.06	3 ⁺ 6 ⁺	1015.76 2267.82	2 ⁺ 4 ⁺	D+Q Q	+0.16 8	$A_2=-0.020$ 16, $A_4=-0.002$ 23. $A_2=+0.303$ 25, $A_4=-0.11$ 4. R(DCO)=0.97 5. Mult.: Q from $\gamma(\theta)$, E2 from polarization measurement (1981De03). δ : $\delta(\text{O}/\text{Q})=-0.1$ 1 (1977Mo20). $A_2=+0.28$ 6, $A_4=-0.05$ 7.
1467.4 1622.2 1633.43 @ 20	1.28 10 1.28 10 6.8 4	7145.5 3399.7 2649.08	(11 ⁻) (1,2 ⁺) 3 ⁻	5678.1 1777.64 1015.76	(9 ⁻) 2 ⁺ 2 ⁺	Q Q D+Q		$A_2=+0.28$ 6, $A_4=-0.05$ 7. $A_2=-0.107$ 10, $A_4=-0.020$ 15 in $^{58}\text{Ni}(^{12}\text{C},2\text{p}\gamma)$, $A_2=-0.189$ 21, $A_4=0.028$ 26 in $^{63}\text{Cu}(^7\text{Li},2\text{n}\gamma)$. δ : Other: +0.01 2 in $^{63}\text{Cu}(^7\text{Li},2\text{n}\gamma)$ (1981De03), -0.11 9 (1982Pa03), and -0.16 +20-50 (1977Mo20). $R_{\text{DCO}}=1.73$ 14.
1645.3 1670.4	0.34 5 1.39 10	3399.7 5366.5	(1,2 ⁺) 8 ⁺	1754.15 3696.06	0 ⁺ 6 ⁺	Q		$A_2=+0.31$ 5, $A_4=-0.11$ 5. R(DCO)=0.89 13.
1714.7 1777.8 @ 2	0.86 8 9.1 5	7045.3 1777.64	(11 ⁻) 2 ⁺	5330.5 0.0	(9 ⁻) 0 ⁺	Q E2		$A_2=+0.34$ 5, $A_4=-0.13$ 6. $A_2=+0.150$ 10, $A_4=-0.014$ 12. Mult.: Q from $\gamma(\theta)$, E2 from polarization measurement (1981De03).
1800.4 1816.4 1876.0 &	0.40 15 1.35 12 0.84 9	9172.2 2832.21 7242.5	(14 ⁺) 4 ⁺ (10 ⁺)	7371.8 1015.76 5366.5	(12 ⁺) 2 ⁺ 8 ⁺	Q Q (Q)		$A_2=+0.31$ 6, $A_4=-0.08$ 7. $A_2=+0.14$ 3, $A_4=+0.01$ 4. $A_2=+0.25$ 10, $A_4=-0.05$ 6.

† From 1981De03, except where noted. $\Delta E=0.3$ keV assumed (not given) for least squares fitting, based on comparison of data in

${}^{58}\text{Ni}({}^{12}\text{C},2\text{p}\gamma), {}^{64}\text{Zn}({}^7\text{Li},\text{p}2\text{n}\gamma)$ **1981De03 (continued)**

$\gamma({}^{68}\text{Ge})$ (continued)

1981De03 and **1982Pa03**.

‡ From ${}^{58}\text{Ni}({}^{12}\text{C},2\text{p}\gamma)$ at $E({}^{12}\text{C})=39$ MeV (**1981De03**). Normalized to $I_{\gamma}(1016\gamma)=100$.

From $\gamma(\theta)$ in ${}^{58}\text{Ni}({}^{12}\text{C},2\text{p}\gamma)$ (**1981De03**), unless indicated otherwise. A_2 and A_4 values are from **1981De03**, except where noted. For transitions where R_{DCO} was also measured, values are included.

@ From **1982Pa03**.

& Placement of transition in the level scheme is uncertain.

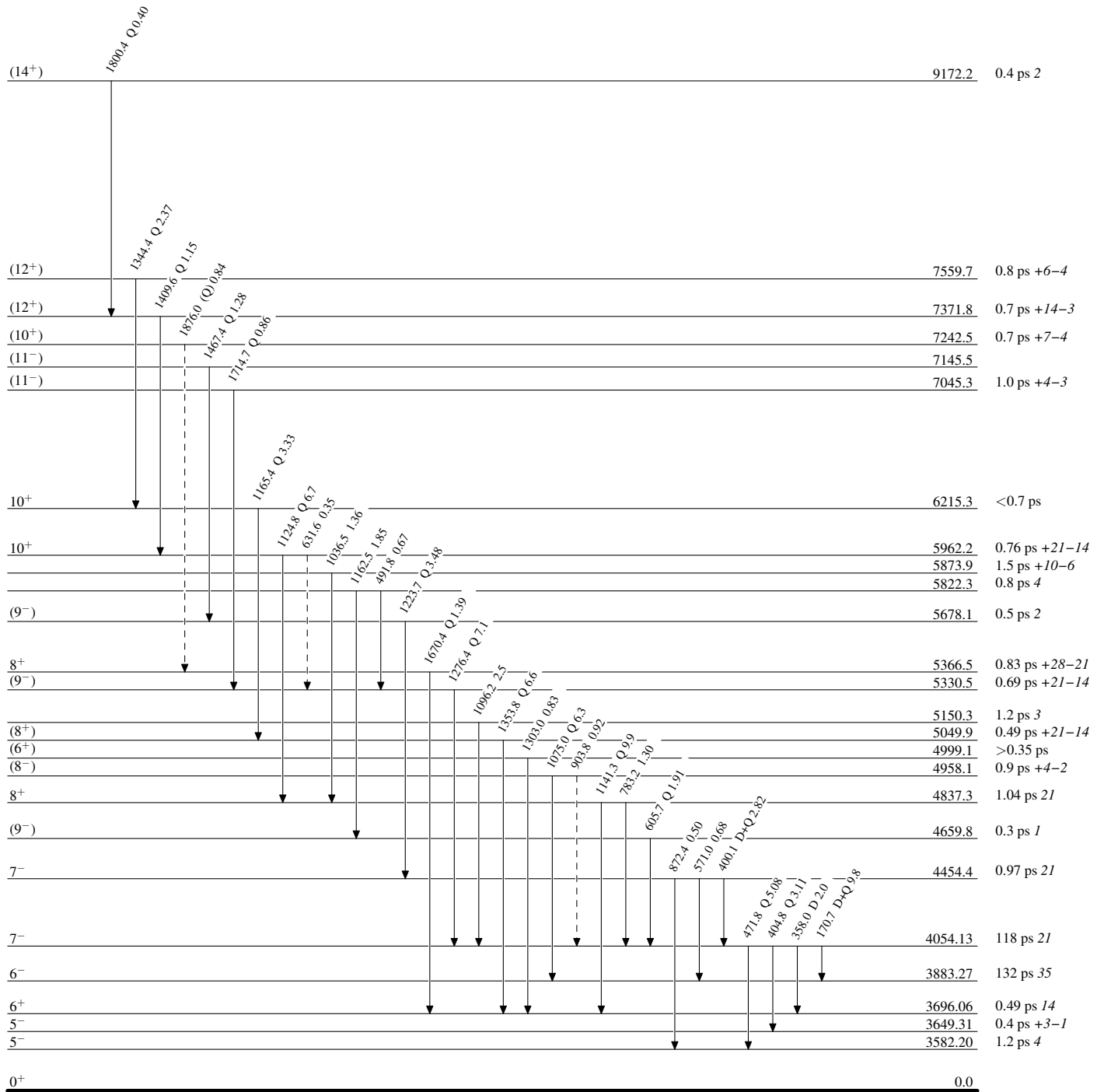
$^{58}\text{Ni}(^{12}\text{C},2p\gamma), ^{64}\text{Zn}(^7\text{Li},p2n\gamma)$ 1981De03

Legend

Level Scheme

Intensities: Type not specified

- $I_\gamma < 2\% \times I_\gamma^{\max}$
- $I_\gamma < 10\% \times I_\gamma^{\max}$
- $I_\gamma > 10\% \times I_\gamma^{\max}$
- - - - -→ γ Decay (Uncertain)

 $^{68}_{32}\text{Ge}_{36}$

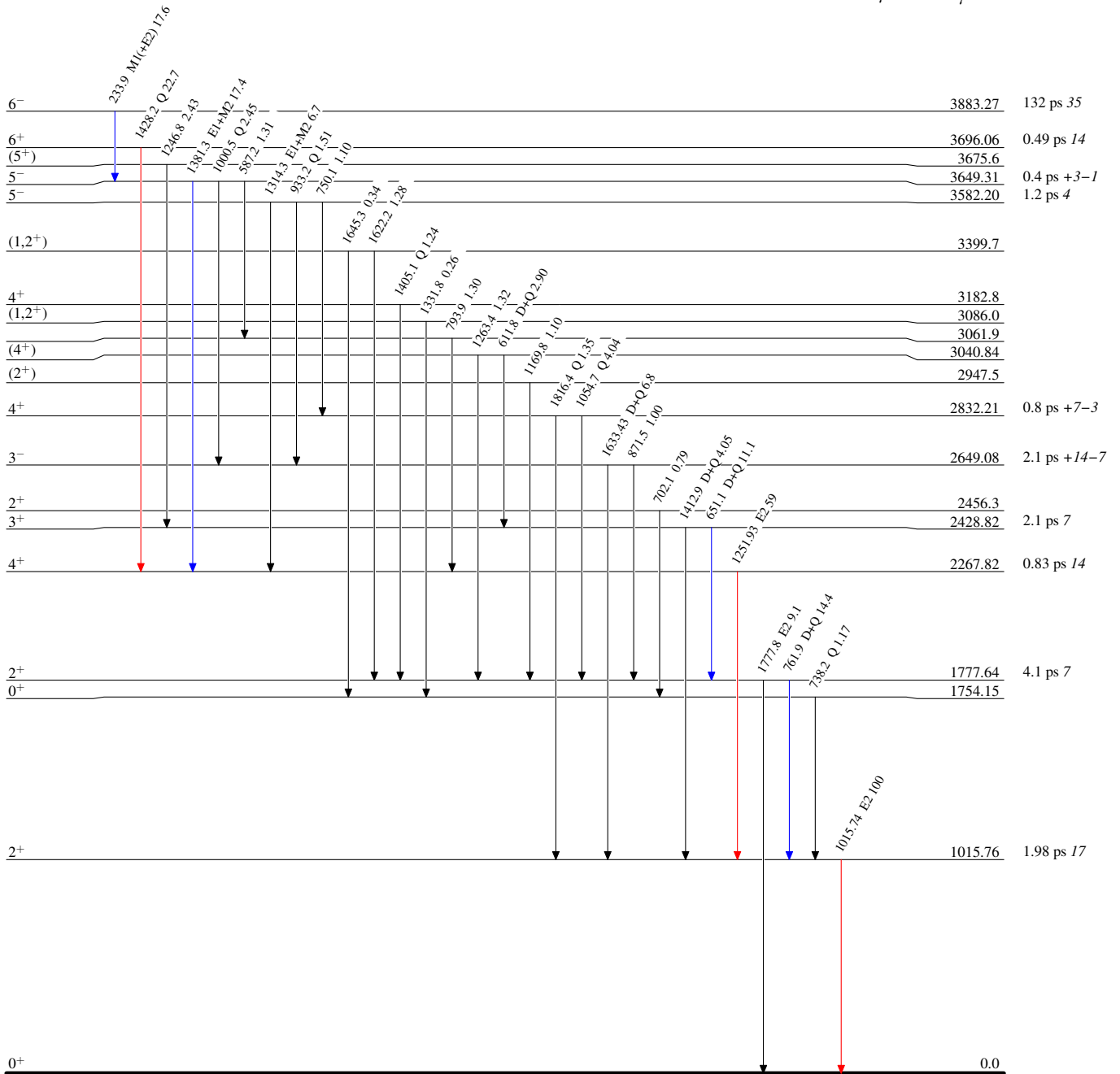
$^{58}\text{Ni}(^{12}\text{C},2p\gamma), ^{64}\text{Zn}(^7\text{Li},p2n\gamma)$ 1981De03

Level Scheme (continued)

Intensities: Type not specified

Legend

- $I_\gamma < 2\% \times I_\gamma^{\text{max}}$
- $I_\gamma < 10\% \times I_\gamma^{\text{max}}$
- $I_\gamma > 10\% \times I_\gamma^{\text{max}}$



$^{68}\text{Ge}_{36}$