

Adopted Levels, Gammas

Type	Author	History	Citation	Literature Cutoff Date
Full Evaluation	Alan L. Nichols, Balraj Singh, Jagdish K. Tuli		NDS 113,973 (2012)	15-Apr-2012

Q(β^-)=-1619.5 7; S(n)=8874.5 11; S(p)=5854.6 6; Q(α)=-5365.3 13 [2012Wa38](#)

Note: Current evaluation has used the following Q record -1619.5 7 8874.5 11 5854.6 6 -5365.3 12 [2011AuZZ](#).

S(2n)=20585.0 17, S(2p)=15715.2 6 ([2011AuZZ](#)).

Values in [2003Au03](#): Q(β^-)=-1626 11, S(n)=8886 4, S(p)=5866 4, S(2n)=20596 4, S(2p)=15727 4.

The evaluators note that branching ratios and γ -ray inventory from available high-spin measurements are poorly defined, thus most spins and parities are treated as tentative.

⁶²Cu Levels

Cross Reference (XREF) Flags

A	⁶² Zn ϵ decay (9.193 h)	G	⁶¹ Ni(p,n):resonances	M	⁶³ Cu(d,t)
B	⁵⁰ Cr(¹⁶ O,3pn γ)	H	⁶¹ Ni(³ He,d)	N	⁶³ Cu(³ He, α)
C	⁵² Cr(¹⁶ O, α pn γ)	I	⁶² Ni(p,n)	O	⁶⁴ Zn(p, ³ He)
D	⁵⁹ Co(α ,n γ), ⁶⁰ Ni(³ He,p γ)	J	⁶² Ni(p,n γ), ⁶¹ Ni(d,n γ)	P	⁶⁴ Zn(d, α)
E	⁶⁰ Ni(α ,pn γ), ⁶³ Cu(p,pn γ)	K	⁶² Ni(³ He,t)		
F	⁶⁰ Ni(α ,d)	L	⁶³ Cu(n,2n γ)		

E(level) [†]	J π [‡]	T _{1/2}	XREF	Comments
0.0	1 ⁺	9.67 min 3	ABCDE HIJKLMNP	$\% \epsilon + \% \beta^+ = 100$ $\mu = -0.3796$ 4 (2011Vi03) $Q = -0.022$ 4 (2011Vi03) J π : spin from atomic-beam method (1966Do01 , 1968Ph04 , 2010Vi07); parity from $\log ft = 4.99$ 6 from 0 ⁺ in ⁶² Zn ϵ decay. μ, Q : from hyperfine structure using resonance Ionization laser ion source (RILIS) used to laser ionize the atoms followed by high- resolution isotope separation (HRS) and ISCOOL Paul trap at ISLODE-CERN (2011Vi03). Previous preliminary results from the same group are: $\mu = -0.3809$ 12, $Q = 0.00$ 2 (2010Vi07 , 2011StZZ). Other: $\mu = -0.380$ 4 (1968Ph04 , 1989Ra17 , atomic beam). T _{1/2} : Weighted average of two sets of data from 1997Zi06 (also 2002Un02). Others: 10.5 min 5 (1937He05 , also Nature 138, 723 (1936); Physica 4, 160 (1937)); 10.5 min 3 (1937Bo10), 10.0 min 1 (1937Ri01), 9.92 min 5 (1939Cr03), 10.1 min 1 (1947Le07), 9.88 min (1948Wa13), 9.9 min (1948Pe03), 9.80 min 7 (1951Go43), 9.8 min (1952Ma28), 9.73 min 2 (1954Be84), 10.1 min 2 (1954Nu27), 9.94 min 4 (1958Po07), 9.90 min 4 (1961Sa19), 9.76 min 2 (1965Eb01), 9.79 min 6 (1965Li11), 9.7 min (1966Ch24), 9.7 min 1 (1969Bo11), 9.73 min 2 (1969Jo07), 9.80 min 2 (1975Ca40). Weighted average of all data listed with quantified uncertainties is 9.76 min 2, but with reduced $\chi^2 = 2.5$ to 5.4 depending on which method is used. LWM gives 9.90 min 17 in order to include the most precise value.
40.83 3	2 ⁺ ^b	4.57 ns 18	ABCDEF HIJKLMNP	$\mu = +1.10$ 10 (1993Lo10 , 2011StZZ) μ : TDPAC method (1993Lo10). Others: +1.32 3 (1973Bi07 , 1989Ra17 , TDPAD), +1.34 12 (1970BoZE , TDPAC). compilation. T _{1/2} : from $\gamma\gamma(t)$ in ⁶² Zn ϵ decay.
243.42 4	2 ⁺ ^b		ABCDE JK MN P	
287.81 5	2 ⁺ ^b		A D HIJK MNOP	
390.12 6	4 ⁺	11 ns 1	BCDE JK MN P	$\mu = +2.67$ 16 (1973Bi07 , 1989Ra17 , 2011StZZ) μ : TDPAD method (1973Bi07).

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Adopted Levels, Gammas (continued)

⁶²Cu Levels (continued)

E(level) [†]	J ^π [‡]	T _{1/2}	XREF	Comments
426.18 6	3 ⁺	>0.16 ps	ABCDEF H JKLMN P	J ^π : from L(d,α)=4. T _{1/2} : from γγ(t) in ⁶⁰ Ni(α,pnγ). J ^π : J=3 from γ(θ) in ⁶² Ni(p,nγ); π=+ from L(d,α)=4(+2). Consistent with L(d,t)=1+(3), L(³ He,d)=1.
548.31 5	1 ⁺	>0.17 ps	A D H JKLMNOP	T _{1/2} : from DSAM in ⁶² Ni(p,nγ). J ^π : log ft=4.64 from 0 ⁺ parent.
637.46 5	1 ⁺	0.15 ps +28-8	A D H JKLMNOP	T _{1/2} : from DSAM in ⁶² Ni(p,nγ). J ^π : log ft=4.60 from 0 ⁺ parent.
644.82 6	(2 ⁺)		A D H J L	T _{1/2} : from DSAM in ⁶² Ni(p,nγ). J ^π : J=2 from γ(θ); π=+ from shell model consideration, ⁶² Ni(p,nγ).
674.96 8	3 ⁺		BCDE H JK MN P	J ^π : J=3 from γ(θ) in (p,nγ); π=+ from L(d,α)=4. Consistent with L(³ He,d)=1+3, L(d,t)=1+3.
698.31 9	(3 ⁺)		A CDE H JK MN P	J ^π : J=2,3 from γ(θ) in (p,nγ); 3 from DCO in ⁵² Cr(¹⁶ O,αpnγ); π=+ from L(³ He,d)=1. Consistent with L(d,t)=1+(3), L(d,α)=(2).
727.72 13	2 ⁺		D JK MN P	J ^π : J=2 from γ(θ) in (p,nγ); π=+ from L(d,α)=2. Consistent with L(d,t)=1+(3).
755.95 17	(2 ⁺)		D J	J ^π : J=2 from γ(θ); π=+ from shell model consideration, ⁶² Ni(p,nγ).
915.33 6	2 ⁺		A D H JK MN P	J ^π : L(d,α)=2 gives 1 ⁺ ,2 ⁺ ,3 ⁺ ; 2 from γ(θ) in (p,nγ).
982.70 22	3 ⁺		D H J MN P	J ^π : L(d,α)=4 from 0 ⁺ target; 3 from γ(θ) in (p,nγ). However, L(³ He,d)=2 gives conflicting parity.
1023.02 22	2 ⁺		D F J M P	J ^π : L(d,α)=2 from 0 ⁺ target; 2 from γ(θ) in (p,nγ).
1051.6 3	+		D H	J ^π : L(³ He,d)=1+3 for a level at 1057 10.
1077.20 18	2 ⁺		D H J MN P	J ^π : π=+ from L(d,α)=2(+4); J=1,2 from γ(θ) in (p,nγ). γ to 4 ⁺ excludes 1.
1141.66 16	2 ⁺ ,3 ⁺		D H J	J ^π : L(d,α)=2 from 0 ⁺ target; γ to 4 ⁺ .
1144.1 [#] 7	2 ⁺ ,3 ⁺		H J MN P	J ^π : L(d,α)=2 from 0 ⁺ target; γ to 4 ⁺ .
1170	2 ⁺		I	J ^π : excited-state analog from ⁶² Ni(p,n).
1221.51? 20	+		A H	J ^π : L(³ He,d)=1 for a level at 1221 10.
1248.65 8	(4 ⁺)		BCDE MN P	J ^π : L(d,t)=3 from 3/2 ⁻ target; DCO in ⁵² Cr(¹⁶ O,αpnγ). L(d,α)=(4) tends to exclude 2 ⁺ .
1285.03 22	(2,3) ⁺		D H J MN P	J ^π : L(d,t)=1 from 3/2 ⁻ target; J=(2),3 from γ(θ) in (p,nγ).
1346.3 3	(2 ⁺)		D H J M P	J ^π : L(d,t)=1 from 3/2 ⁻ target; J=(2) from γ(θ) in (p,nγ).
1354.3 5			J	
1367 3			D M P	Not the same as 1370 level; both observed in ⁵⁹ Co(α,nγ).
1370.48 7	5 ⁺	<2 ps	BCDE	J ^π : E2 γ to 3 ⁺ gives 1 ⁺ and 5 ⁺ , D+Q γ to 4 ⁺ excludes 1 ⁺ . T _{1/2} : from RDDS in ⁵⁹ Co(α,nγ).
1373.9 [#] 7	1,2,3		J	J ^π : γ(θ) in (p,nγ).
1395 [@] 8	(⁺)		MN	J ^π : L(d,t)=(3).
1403.3 18	2 ⁺ ,3,4 ⁺		D	J ^π : gammas to 2 ⁺ and 4 ⁺ .
1410.2 4	+		D F MN P	J ^π : L(d,t)=1.
1416.1 [#] 5			F J	
1427.5 3			D	Implies the existence of two levels around 1428 keV, since 752γ is not reported in ⁶² Zn decay and cannot be placed from the 1429.59 level within the uncertainties.
1429.57 7	1 ⁺		A	J ^π : log ft=5.59 from 0 ⁺ parent.
1433.0 5	1 ⁺ ,2 ⁺		H J MN P	J ^π : gammas to 1 ⁺ and 3 ⁺ ; J=3 excluded from γ(θ) in (p,nγ). L(d,α)=(2) tends to exclude 2 ⁻ .
1485.72 18	3 ⁺ ,4 ⁺ ,5 ⁺		CDE H MN P	J ^π : L(d,α)=4. In (¹⁶ O,αpnγ), 4 ⁺ is suggested.
1504.9 4			D	
1507.3 3			D	

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Adopted Levels, Gammas (continued)

⁶²Cu Levels (continued)

E(level) [†]	J ^π [‡]	T _{1/2}	XREF			Comments
1511.2 22	(2,3,4) ⁺		D	MN	P	J ^π : L(d,t)=1 from 3/2 ⁻ target; consistent with L(d,α)=2+(4). Gammas to 3 ⁺ and 4 ⁺ ; possible gamma to 2 ⁺ .
1525.91 16	1 ⁺		A	H	MN P	J ^π : L(d,t)=1 from 3/2 ⁻ target; L(d,α)=2; log ft=5.98 from 0 ⁺ parent.
1568.06 22	2 ⁻ ,3 ⁻		D	M	P	J ^π : L(d,α)=3 gives 2 ⁻ ,3 ⁻ , 4 ⁻ , γ to 2 ⁺ excludes 4 ⁻ .
1581.6 [#] 6	-			H J		J ^π : L(³ He,d)=2.
1587 5	(0 to 3) ⁺			M		J ^π : L(d,t)=1 from 3/2 ⁻ target.
1677.61 7	(5 ⁺)		BCDE	J	P	XREF: P(1680). E(level): note that a doublet has been defined at 1677.6 and 1678.1, based on (α,nγ) results; 922.4, 1040 and 1434.0 γ transitions were seen only in (α,nγ) data, not in later heavy-ion studies (1999Si03,2001Mu14). This also suggests higher spin for 1677.6 level and lower for 1678.3 level. J ^π : ΔJ=1 d+Q γ to 4 ⁺ from γ(θ) and DCO ratios; L(d,α)=4 from 0 ⁺ target assuming 1680 5 group corresponds to 1677.6 level.
1678.3 4	(0 to 3) ⁽⁺⁾		D	J	Mn	XREF: M(1680). E(level): see comment for 1677.6 level. J ^π : gammas to 1 ⁺ and 2 ⁺ ; L(d,t)=1+(3) from 3/2 ⁻ target assuming 1680 6 group corresponds to 1678.3 level.
1679.1 [#] 8				J	Mn	
1682.1 [#] 7	(2 ⁻)			H J	n	XREF: H(1684). J ^π : gammas to 2 ⁺ and (3) ⁺ ; L(³ He,d)=0 from 3/2 ⁻ target assuming 1684 10 group corresponds to 1682.1 level.
1710.51 22	1 ⁺ ,2 ⁺ ,3 ⁺		D		MN	J ^π : gammas to 1 ⁺ and 3 ⁺ ; L(d,t)=3 from 3/2 ⁻ target.
1736.3 3			D			
1745.0 4	+		D	H	MN P	E(level): possible triplet; see ⁵⁹ Co(α,nγ). J ^π : L(³ He,d)=3.
1759.5 [#] 7				J	MN P	J ^π : L(d,t)=3, L(d,α)=(2) for this and the previous level combined.
1775 5	1 ⁺ ,2 ⁺ ,3 ⁺			H	MN P	J ^π : L(d,α)=2.
1820.3 3	+		D		MN P	J ^π : L(d,t)=3+(1), consistent with L(d,α)=(4) or (2).
1827.6 3			D			
1843.0 [#] 11	+		F H J	M	P	J ^π : L(³ He,d)=1 for a level at 1846 10.
1916.72 22	(5 ⁻)		CD	H	MN P	J ^π : L(d,t)=4 from 3/2 ⁻ target; L(d,α)=(5) from 0 ⁺ target. Positive parity suggested in (¹⁶ O,αpnγ) seems incorrect.
1920.5 7	(5 ⁺)		C			
1981.39 22	+		D		MN P	J ^π : L(d,t)=1 for a level at 1985 6.
1996 6	+				M	J ^π : from L(d,t)=1+(3).
2022 6	(⁺)			H	MN P	J ^π : L(d,α)=(2), also L(d,t)=1. However, L(³ He,d)=2 for a level at 2024 10.
2067.5 3	(⁺)		D		MN P	J ^π : L(d,t)=(1)+(3).
2107 [@] 6	(⁺)				MN P	J ^π : L(d,t)=4+(3).
2139 6	(⁺)			H	M P	J ^π : L(d,α)=4+(3). Consistent with L(³ He,d)=3 for a level at 2124 10.
2145.9 3			D			
2147.97 9	(6 ⁺)		BCDE			J ^π : D+Q γ to 5 ⁺ . γ to 4 ⁺ is Q.
2154.7 3			D			
2160.64 22	3 ⁺ ,4 ⁺		D		MN P	J ^π : L(d,α)=4, γ to 2 ⁺ .
2176 7	1 ⁺ ,2 ⁺ ,3 ⁺				MN P	J ^π : L(d,α)=2.
2224 7	(⁺)				M P	J ^π : L(d,α)=(2), consistent with L(d,t)=(1)+(3).
2239.4 3	(⁺)		D	H	MN P	J ^π : L(d,t)=(3), consistent with L(d,α)=4+(3) for a level at 2243 7.
2295.39 8	(6 ⁻)	16.4 ps 13	BCDEF	H	MN P	J ^π : (M2) γ to 4 ⁺ . D+Q γ to 5 ⁺ .

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Adopted Levels, Gammas (continued)

⁶²Cu Levels (continued)

E(level) [†]	J ^π [‡]	XREF	Comments
2315 7	+	F	T _{1/2} : from RDDS in ⁵⁹ Co(α,nγ). J ^π : L(d,t)=3.
2360 7	3 ⁺ ,4 ⁺ ,5 ⁺	H	J ^π : from L(d,α)=4+(2), consistent with L=3 in both (d,t) and (³ He,d) reactions.
2374 7	(⁺)		J ^π : L(d,t)=(1).
2422 7	(⁺)		J ^π : L(d,t)=(3), consistent with L(d,α)=4+(3).
2444.1 3	+	D H	J ^π : L=1+3 in both (d,t) and (³ He,d) reactions.
2486 7			J ^π : L(d,α)=1 or 2.
2506 8	(⁺)		J ^π : L(d,t)=(3); L(d,α)=1 or 2.
2518.6 3	(6 ⁻)	CD	
2547 8	(⁺)		J ^π : L(d,α)=(2).
2565@ 8			M P
2610@ 8			MN P J ^π : L(d,α)=1 or 2.
2622.7 3		D	
2638.6 3		D F	J ^π : L(d,α)=1 or 2.
2704 8	(⁺)		MN P J ^π : L(d,α)=2(+1).
2725 8			MN
2740 3		D	
2834.0 6	(7 ⁺)	CD	
2835 9	1 ⁺ ,2 ⁺ ,3 ⁺		MN P J ^π : L(d,α)=2, L(d,t)=3.
2860 9	+		MN P J ^π : L(d,α)=4+(2), consistent with L(d,t)=1+(3).
2876 9	+		M J ^π : L(d,t)=1+(3).
2892.27 10	(7 ⁻)	BCDE	J ^π : 597γ to 6 ⁻ is D+Q in (α,pnγ).
2920 9	(⁺)		MN J ^π : L(d,t)=(1).
2944@ 8	-		MN P J ^π : L(d,t)=4+(3).
2993 9	+		MN J ^π : L(d,t)=3.
3008 9	(1 ⁺ ,2 ⁺ ,3 ⁺)		M P J ^π : L(d,α)=(2) for a level at 3010.
3029.54 10	(7 ⁻)	BCDE	
3150 9	(3 ⁺ ,4 ⁺ ,5 ⁺)	EF	P J ^π : L(d,α)=(4).
3191.51 9	(6 ⁻)	BC E	J ^π : ΔJ=1, dipole γ to (5 ⁺).
3310 10	3 ⁺		P J ^π : L(d,α)=2+4.
3420 10			P
3434.82 10	(8 ⁻)	BC E	J ^π : ΔJ=2, Q γ to 6 ⁻ .
3550 10			P
3580 3		D	
3627.55 10	(8 ⁻)	BC E	J ^π : (8 ⁻) if J(4747)=9 ⁺ and 1332γ to 6 ⁻ is Q.
3675.1 8		C	
3979.24 11	(9 ⁻)	BC E	J ^π : ΔJ=1, dipole γ to (8 ⁻), (α,pnγ).
4104.0 7		C	
4164.98 11	(9 ⁻)	BC E	J ^π : ΔJ=2, Q γ to (7).
4447.26 10	(9 ⁻) ^C	BC	
4596.5 8		C	
4628 10	(0) ⁺	H	J ^π : L(³ He,d)=1 from 3/2 ⁻ target; possible IAS of ⁶² Ni g.s.
4628.90 13	(9 ⁻)	BC	J ^π : gamma to (8 ⁻).
4746.41 13	(9 ⁺)	BC EF	J ^π : ΔJ=1, dipole γ to (8 ⁻). Strong excitation and systematics in ⁶⁰ Ni(α,d).
5000.01 12	(10 ⁻) ^C	BC	
5048.25 13	(10 ⁻)	BC F	
5107.4 8	(10 ⁻)	C	
5258.3 10	(10 ⁻)	C	
5619.55 16	(11 ⁻)	BC	
5720	2 ⁺	F HI	J ^π : L(p,n)=2.
5785 10	(2) ⁺	H	J ^π : L(³ He,d)=1 from 3/2 ⁻ target; possible IAS of first 2 ⁺ in ⁶² Ni.
5841.4 7	(12 ⁻)	C	
6008.17 14	(11 ⁺) ^C	BC	
6174.9 8	(10 ⁺)	C	

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Adopted Levels, Gammas (continued)

⁶²Cu Levels (continued)

E(level) [†]	J ^π [‡]	XREF	Comments
6216.3 10	(11 ⁻)	C	
6390		F	
6529.4 12	(13 ⁻)	C	
7100.88 16	(12 ⁺) ^c	BC	
7134.5 8	(13 ⁻)	C	
7241.4 16	(14 ⁻)	C	
7285.3 7	(12 ⁺)	C	
7619.90 16	(12 ⁺) ^c	BC	
7710		F	
7970	(1,2,3) ⁺	H	J ^π : L(³ He,d)=1+3 from 3/2 ⁻ target.
8190	(0 to 3) ⁺	H	J ^π : L(³ He,d)=1 from 3/2 ⁻ target.
8600.5 7	(13 ⁺)	C	
8958.7 8	(14 ⁺)	C	
9045 ^{&}		G	
9276 ^{&}		G	
9430		H	
9478 ^{&a}		GH	
9640		H	
9689 ^{&a}		GH	
9916 ^{&}		G	
10083 ^{&}		G	
10216 ^{&}		G	
10405 ^{&}		G	
10883.7? 13		C	

[†] Level energies listed with decimal figures are from a least-squares fit to the adopted E_γ data, except as noted. Reduced $\chi^2=1.5$ as compared to critical $\chi^2=1.3$.

[‡] Assignments for high-spin states (J>4 or so) are primarily based on DCO data in heavy-ion in-beam γ -ray studies (2001Mu14,1999Si03).

From (p,n γ).

@ Doublet.

& Unbound level seen in ⁶¹Ni(p,n).

^a Unbound level seen in ⁶¹Ni(³He,d).

^b M1 γ to 1⁺, lack of feeding in ⁶²Zn ϵ decay.

^c Based on measured DCO ratios in heavy-ion in-beam γ -ray studies.

Adopted Levels, Gammas (continued)

$\gamma(^{62}\text{Cu})$									
$E_i(\text{level})$	J_i^π	E_γ^\dagger	I_γ^\ddagger	E_f	J_f^π	Mult. ^b	δ^f	α^g	Comments
40.83	2 ⁺	40.84 3	100	0.0	1 ⁺	M1		0.647	B(M1)(W.u.)=0.0430 18
243.42	2 ⁺	202.67 6	0.43 5	40.83	2 ⁺				I_γ : 17 5 in (¹⁶ O, α pny) is in severe disagreement.
		243.39 5	100 5	0.0	1 ⁺	M1			
287.81	2 ⁺	246.96 5	100	40.83	2 ⁺	M1			Mult.: pure M1 from 1969Ho01; M1+E2, $\delta=-0.33$ 4 from $\gamma(\theta)$ analysis in (p,n γ).
390.12	4 ⁺	146.81 10	3.4& 9	243.42	2 ⁺	E2 ^c		0.1429	B(E2)(W.u.)=1.7 5
		349.25 10	100.0 3	40.83	2 ⁺	E2 ^c		0.00595	B(E2)(W.u.)=0.65 6
426.18	3 ⁺	385.28 7	100	40.83	2 ⁺	(M1+E2) ^d	-0.12 2	0.00182	B(M1)(W.u.)<2.4; B(E2)(W.u.)<540
548.31	1 ⁺	260.43 7	8.8 5	287.81	2 ⁺	M1		0.00457	B(M1)(W.u.)<0.31
		304.88 9	1.9 1	243.42	2 ⁺	[M1]		0.00311	B(M1)(W.u.)<0.042
		507.60 10	97 5	40.83	2 ⁺	M1			B(M1)(W.u.)<0.46
		548.35 11	100 5	0.0	1 ⁺	M1			B(M1)(W.u.)<0.38
637.46	1 ⁺	349.60 13	1.73 11	287.81	2 ⁺	[M1]		0.00225	B(M1)(W.u.)=0.05 +3-5
		394.03 6	8.60 4	243.42	2 ⁺	M1+E2		0.0028	B(M1)(W.u.)=0.19 +10-19 if pure M1.
		596.56 13	100	40.83	2 ⁺	M1			B(M1)(W.u.)=0.6 +4-6
		637.41 7	0.98 6	0.0	1 ⁺	M1			B(M1)(W.u.)=0.005 +3-5
644.82	(2 ⁺)	644.82 6	100	0.0	1 ⁺	[D+Q]	+0.22 +2-3		
674.96	3 ⁺	284.8# 1	35 ^a 24	390.12	4 ⁺	(M1+E2) ^d	+0.08&		I_γ : from (¹⁶ O, α pny). Other: 256 15 in (¹⁶ O,3pny).
		431.6# 1	100 ^a 32	243.42	2 ⁺	(M1(+E2)) ^d	-0.05 +5-4		
		634.2 3	\approx 85 ^a	40.83	2 ⁺	(M1+E2)	-0.16 +4-6		Mult.: M1 from ⁶⁰ Ni(α ,pny).
		675.0 3		0.0	1 ⁺				
698.31	(3 ⁺)	272.2 2	65 ^a	426.18	3 ⁺	(M1+E2)	-0.60 10		δ : for J(698)=3, 0.00 5 if J(698)=2.
		455.0 2	91 ^a	243.42	2 ⁺	(M1+E2)	+0.35 4		δ : for J(698)=3, -0.06 5 if J(698)=2.
		657.3 2	100 ^a	40.83	2 ⁺	(M1(+E2))	+0.04 3		δ : for J(698)=3, -0.70 7 if J(698)=2.
		698.3 3		0.0	1 ⁺				
727.72	2 ⁺	439.6 3	19 ^a	287.81	2 ⁺				
		484.3 2	100 ^a	243.42	2 ⁺	[M1+E2]	+0.05 5		
		686.5 5	67 ^a	40.83	2 ⁺				
		727.9 2		0.0	1 ⁺	[M1+E2]	+0.49 9		
755.95	(2 ⁺)	755.9 2	100	0.0	1 ⁺	D(+Q)	\leq 0.3		
915.33	2 ⁺	159.2 3		755.95	(2 ⁺)				Reported only in ⁶² Ni(p,n γ).
		489.17 7	100 10	426.18	3 ⁺				
		627.8 4	4.9 16	287.81	2 ⁺				
		671.84 9	28 3	243.42	2 ⁺				
		915.44 16	97 7	0.0	1 ⁺				I_γ : 29 from ⁶² Ni(p,n γ).
982.70	3 ⁺	556.9 3	44@	426.18	3 ⁺				
		592.2 3	78@	390.12	4 ⁺				
		942 3	100@	40.83	2 ⁺				

Adopted Levels, Gammas (continued)

γ(⁶²Cu) (continued)

<u>E_i(level)</u>	<u>J_i^π</u>	<u>E_γ[†]</u>	<u>I_γ[‡]</u>	<u>E_f</u>	<u>J_f^π</u>	<u>Mult.^b</u>	<u>δ^f</u>	<u>Comments</u>
1023.02	2 ⁺	779.5 3	≈80 [@]	243.42	2 ⁺			
		982 3	≈20 [@]	40.83	2 ⁺			
		1023.1 3	≈100 [@]	0.0	1 ⁺			
1051.6	+	376.6 3	100	674.96	3 ⁺			
1077.20	2 ⁺	687.0 3	100 ^a	390.12	4 ⁺			
		833.9 3		243.42	2 ⁺			
		1036.3 3	68 ^a	40.83	2 ⁺			
1141.66	2 ⁺ ,3 ⁺	594 1		548.31	1 ⁺			Reported only in ⁶² Ni(p,nγ).
		716.0 3	≈60 [@]	426.18	3 ⁺			
		751.7 3	≈100 [@]	390.12	4 ⁺			
		897.7 3	≈40 [@]	243.42	2 ⁺			
		1100.6 3		40.83	2 ⁺			
1144.1	2 ⁺ ,3 ⁺	469.4		674.96	3 ⁺			
		753.8		390.12	4 ⁺			
1221.51?	+	1221.5 2	100	0.0	1 ⁺			
1248.65	(4) ⁺	573.2 [#] 3	48 [#] 8	674.96	3 ⁺			Intensities and gamma rays are in disagreement in various studies.
		822.3 [#] 1	100 [#] 11	426.18	3 ⁺	D		
		858.7 [#] 1	13 [#] 8	390.12	4 ⁺			I _γ : 61 5 in (¹⁶ O,3pnγ).
		1006.0 [#] 3	33 [#] 8	243.42	2 ⁺			I _γ : 141 8 in (¹⁶ O,3pnγ).
		1207.9 3	128 [@]	40.83	2 ⁺			E _γ : not reported in (¹⁶ O,αpnγ) or (¹⁶ O,3pnγ).
1285.03	(2,3) ⁺	586.8 3		698.31	(3) ⁺			
		859.2		426.18	3 ⁺			
		997.1 3		287.81	2 ⁺			
1346.3	(2) ⁺	618 3		727.72	2 ⁺			
		667 ^h 3		674.96	3 ⁺			
		1102.9 3		243.42	2 ⁺			
		1303 ^h 3		40.83	2 ⁺			
1354.3		439 1	48 ^a	915.33	2 ⁺			
		710 1	52 ^a	644.82	(2 ⁺)			
		928 1	39 ^a	426.18	3 ⁺			
		1066 1	100 ^a	287.81	2 ⁺			
1367		1326 3	100	40.83	2 ⁺			
1370.48	5 ⁺	944.3 ^{##} 1	20.6 [#] 7	426.18	3 ⁺	E2 ^c		B(E2)(W.u.)>4.4 δ: δ(M3/E2)=-0.09 is too large from RUL.
		980.3 ^{##} 1	100.0 [#] 5	390.12	4 ⁺	(M1+E2) ^d	-0.5	B(M1)(W.u.)>0.0078; B(E2)(W.u.)>3.6
1373.9	1,2,3	1086.2		287.81	2 ⁺			
		1130.4		243.42	2 ⁺			

Adopted Levels, Gammas (continued)

γ(⁶²Cu) (continued)

E _i (level)	J _i ^π	E _γ [†]	I _γ [‡]	E _f	J _f ^π	Comments
1403.3	2 ⁺ ,3,4 ⁺	728 3		674.96	3 ⁺	
		1013 3		390.12	4 ⁺	
		1363 3		40.83	2 ⁺	
1410.2	+	427.5 3	100	982.70	3 ⁺	
1416.1		688.6		727.72	2 ⁺	
		717.9		698.31	(3) ⁺	
		741.1		674.96	3 ⁺	
		1172.5		243.42	2 ⁺	
		1375.0		40.83	2 ⁺	
1427.5		752.5 3		674.96	3 ⁺	Reported in ⁵⁹ Co(α,nγ), not in ⁶² Zn decay.
		1392 3		40.83	2 ⁺	
1429.57	1 ⁺	731.23 15	7 1	698.31	(3) ⁺	
		792.03 7	26 2	637.46	1 ⁺	
		881.4 3	42 3	548.31	1 ⁺	
		1141.91 11	100 6	287.81	2 ⁺	
		1186.2 3	11 4	243.42	2 ⁺	
		1389.1 4	24 2	40.83	2 ⁺	
		1429.9 7	80 8	0.0	1 ⁺	
1433.0	1 ⁺ ,2 ⁺	735.2		698.31	(3) ⁺	
		758.0		674.96	3 ⁺	
		884.5		548.31	1 ⁺	
		1006.6		426.18	3 ⁺	
1485.72	3 ⁺ ,4 ⁺ ,5 ⁺	812.1 3	≈29@	674.96	3 ⁺	E _γ : poor fit, level-energy difference=810.8.
		1058.3 3	≈100@	426.18	3 ⁺	E _γ : poor fit, level-energy difference=1059.5.
		1095.3 3	≈14@	390.12	4 ⁺	
1504.9		777.2 3	100	727.72	2 ⁺	
1507.3		832.3 3	100	674.96	3 ⁺	
1511.2	(2,3,4) ⁺	1086 3		426.18	3 ⁺	
		1120 3		390.12	4 ⁺	
		1469 ^h 3		40.83	2 ⁺	
1525.91	1 ⁺	827.59 14	52 6	698.31	(3) ⁺	
		1485.1 5	9 5	40.83	2 ⁺	
		1525.9 6	100 23	0.0	1 ⁺	
1568.06	2 ⁻ ,3 ⁻	892 3		674.96	3 ⁺	
		1141.9 3		426.18	3 ⁺	
		1324.6 3		243.42	2 ⁺	
		1527 3		40.83	2 ⁺	
1581.6	-	883 ^h		698.31	(3) ⁺	
		1155.3		426.18	3 ⁺	
		1294.1		287.81	2 ⁺	

Adopted Levels, Gammas (continued)

γ(⁶²Cu) (continued)

E _i (level)	J ^π _i	E _γ [†]	I _γ [‡]	E _f	J ^π _f	Mult. ^b	δ ^f	Comments
1581.6	-	1338		243.42	2 ⁺			
1677.61	(5 ⁺)	190 [#]	22 [#] 13	1485.72	3 ⁺ ,4 ⁺ ,5 ⁺			
		429.0 [#] 1	96 [#] 5	1248.65	(4) ⁺			I _γ : 73 27 in (¹⁶ O,αpnγ).
		1002 [#] 3	44 [#] 7	674.96	3 ⁺			
		1251.3 [#] 1	100 [#] 31	426.18	3 ⁺			
		1287.7 [#] 1	58 [#] 7	390.12	4 ⁺	D+Q ^e	-0.49	
1678.3	(0 to 3) ⁽⁺⁾	922.4 3	46 [@]	755.95	(2) ⁺			
		1040 3	100 [@]	637.46	1 ⁺			
		1434.0	14	243.42	2 ⁺			
1679.1		951.0		727.72	2 ⁺			
		981.1		698.31	(3) ⁺			
1682.1	(2 ⁻)	983.6		698.31	(3) ⁺			
		1394.5		287.81	2 ⁺			
1710.51	1 ⁺ ,2 ⁺ ,3 ⁺	1035 3	18 [@]	674.96	3 ⁺			
		1284.4 3	85 [@]	426.18	3 ⁺			
		1710.4 3	100 [@]	0.0	1 ⁺			
1736.3		1061.3 3	100	674.96	3 ⁺			
1745.0	+	1046.7 3		698.31	(3) ⁺			
1759.5		1059.9		698.31	(3) ⁺			
		1116		644.82	(2) ⁺			
1820.3	+	1430.2 3	100	390.12	4 ⁺			
1827.6		1401.4 3	100	426.18	3 ⁺			
1843.0	+	860.3	100	982.70	3 ⁺			
1916.72	(5) ⁻	545.6 3		1370.48	5 ⁺			
		1491.1 3		426.18	3 ⁺			
		1877 ^h 3		40.83	2 ⁺	[E3]		
1920.5	(5 ⁺)	243	48 38	1677.61	(5) ⁺			
		1222	100 14	698.31	(3) ⁺			
1981.39	+	1306.0 3		674.96	3 ⁺			
		1555.6 3		426.18	3 ⁺			
2067.5	(⁺)	1390 3		674.96	3 ⁺			
		1641.3 3		426.18	3 ⁺			
2145.9		775.4 3	100	1370.48	5 ⁺			
2147.97	(6 ⁺)	777.5 1	76 18	1370.48	5 ⁺	D+Q ^e	-1.0	I _γ : 34 5 in (¹⁶ O,3pnγ).
		1757.8 1	100& 18	390.12	4 ⁺	Q ^e		
2154.7		1481 3	43 [@]	674.96	3 ⁺			
		1728.5 3	100 [@]	426.18	3 ⁺			

Adopted Levels, Gammas (continued)

$\gamma(^{62}\text{Cu})$ (continued)

$E_i(\text{level})$	J_i^π	E_γ^\dagger	I_γ^\ddagger	E_f	J_f^π	Mult. ^b	δ^f	Comments
2160.64	3 ⁺ ,4 ⁺	1462.5 3	100 [@]	698.31	(3) ⁺			
		1917.0 3	11 [@]	243.42	2 ⁺			
2239.4	(⁺)	1849.3 3	100	390.12	4 ⁺			
2295.39	(6 ⁻)	378	5.0 6	1916.72	(5) ⁻			
		617.8 1	2.6 9	1677.61	(5 ⁺)			
		924.8 [#] 1	100.0 ^{&} 6	1370.48	5 ⁺	(E1+M2) ^d	-0.035	B(E1)(W.u.)=3.06×10 ⁻⁵ 25; B(M2)(W.u.)=0.201 17
		1905.1 [#] 1	1.2 ^{&} 3	390.12	4 ⁺	(M2)		B(M2)(W.u.)=0.053 14 I _γ : 1.9 13 in (¹⁶ O,αpnγ). Mult.: based on branching of 2293.7 level and T _{1/2} , see ⁶⁰ Ni(α,pnγ).
2444.1	⁺	1195.4 3	100	1248.65	(4) ⁺			
2518.6	(6 ⁻)	222	77 31	2295.39	(6 ⁻)			
		1148.2 3	100 23	1370.48	5 ⁺			
2622.7		2232.5 3	100	390.12	4 ⁺			
2638.6		1268.1 3	100	1370.48	5 ⁺			
2740		1825 3	100	915.33	2 ⁺			
2834.0	(7 ⁺)	538	97 18	2295.39	(6 ⁻)			
		686	100 21	2147.97	(6 ⁺)			
		1464	39 12	1370.48	5 ⁺			
2892.27	(7 ⁻)	596.6 [#] 1	100.0 ^{&} 17	2295.39	(6 ⁻)	D+Q ^e	-0.14	
		744 [#]	18.6 [#] 12	2147.97	(6 ⁺)			
3029.54	(7 ⁻)	137.3 [#] 1	14.4 [#] 10	2892.27	(7 ⁻)			I _γ : 20 11 in (¹⁶ O,αpnγ).
		734.1 [#] 1	100 [#] 5	2295.39	(6 ⁻)			
3191.51	(6 ⁻)	1514.0 [#] 1	39 [#] 7	1677.61	(5 ⁺)			I _γ : 52 30 in (¹⁶ O,αpnγ).
		1821.1 [#] 1	100 [#] 6	1370.48	5 ⁺	D(+Q) ^e	-0.03	
3434.82	(8 ⁻)	243.5 [#] 1	23 [#] 11	3191.51	(6 ⁻)			I _γ : 59 3 in (¹⁶ O,3pnγ).
		544 [#]	23 [#] 7	2892.27	(7 ⁻)			
		1139.5 [#] 1	100 [#] 10	2295.39	(6 ⁻)	Q		Mult.: ΔJ=2, Q from γ(θ). δ(O/Q)=-0.04.
3580		1285 3	100	2295.39	(6 ⁻)			
3627.55	(8 ⁻)	437 [#]	21 [#] 5	3191.51	(6 ⁻)			
		600 [#]	9 [#] 4	3029.54	(7 ⁻)			
		735.2 [#] 1	43.9 [#] 18	2892.27	(7 ⁻)			
		1332.2 [#] 1	100.0 [#] 24	2295.39	(6 ⁻)	Q		
3675.1		783	100	2892.27	(7 ⁻)			
3979.24	(9 ⁻)	351.6 [#] 1	24.2 [#] 15	3627.55	(8 ⁻)			
		544.3 [#] 1	100 [#] 5	3434.82	(8 ⁻)	D ^e		
		788 ^h	15 5	3191.51	(6 ⁻)	[M3]		E _γ : treated as uncertain placement by the evaluators due to high mult.

Adopted Levels, Gammas (continued)

						$\gamma(^{62}\text{Cu})$ (continued)		
$E_i(\text{level})$	J_i^π	E_γ^\dagger	I_γ^\ddagger	E_f	J_f^π	Mult. ^b	Comments	
4104.0		477	100	3627.55	(8 ⁻)			
4164.98	(9 ⁻)	490 [#]	7 [#] 3	3675.1				
		537.5 [#] 1	20 [#] 8	3627.55	(8 ⁻)		I _γ : 42 3 in (¹⁶ O,3pnγ).	
		731 [#]	7 [#] 3	3434.82	(8 ⁻)			
		1135.3 [#] 1	16 [#] 7	3029.54	(7 ⁻)		I _γ : 32.4 20 in (¹⁶ O,3pnγ).	
		1272.7 [#] 1	100 [#] 3	2892.27	(7 ⁻)	Q ^e		
		1869 ^h	7 5	2295.39	(6 ⁻)	[M3]	E _γ : treated as uncertain placement by the evaluators due to high mult.	
4447.26	(9 ⁻)	467.8 1	128 8	3979.24	(9 ⁻)		I _γ : 52 43 in (¹⁶ O,αpnγ).	
		1012.8 1	82 10	3434.82	(8 ⁻)		E _γ : poor fit, level-energy difference=1012.4.	
		1417.8 1	23 8	3029.54	(7 ⁻)			
		1554.7 1	100 15	2892.27	(7 ⁻)			
4596.5		493	100	4104.0				
4628.90	(9 ⁻)	1194.1 1	100 20	3434.82	(8 ⁻)			
		1437.5 ^h 1	29 20	3191.51	(6 ⁻)	[M3]	E _γ : treated as uncertain placement by the evaluators due to high mult.	
							I _γ : 80 7 in (¹⁶ O,3pnγ).	
4746.41	(9 ⁺)	1119.0 [#] 1	100 [#]	3627.55	(8 ⁻)	D ^e		
5000.01	(10 ⁻)	253	14 11	4746.41	(9 ⁺)			
		404	11 3	4596.5				
		835.0 1	100 4	4164.98	(9 ⁻)			
		896	3 3	4104.0				
		1372.3 1	33 5	3627.55	(8 ⁻)			
5048.25	(10 ⁻)	419.4 [#] 1	100 [#] 6	4628.90	(9 ⁻)			
		600 [#]	50 [#] 23	4447.26	(9 ⁻)			
		881 [#]	30 [#] 17	4164.98	(9 ⁻)			
		1069.0 [#] 1	30.3 [#] 25	3979.24	(9 ⁻)			
5107.4	(10 ⁻)	660	100	4447.26	(9 ⁻)			
5258.3	(10 ⁻)	811	100	4447.26	(9 ⁻)			
5619.55	(11 ⁻)	512	79 19	5107.4	(10 ⁻)			
		571.3 1	100 14	5048.25	(10 ⁻)			
		990	24 10	4628.90	(9 ⁻)			
5841.4	(12 ⁻)	222	100 14	5619.55	(11 ⁻)			
		793	59 32	5048.25	(10 ⁻)			
6008.17	(11 ⁺)	1008.0 1	53 5	5000.01	(10 ⁻)			
		1261.9 1	100 6	4746.41	(9 ⁺)			
		1843	5 5	4164.98	(9 ⁻)			
6174.9	(10 ⁺)	1429	100	4746.41	(9 ⁺)			
6216.3	(11 ⁻)	1168	100	5048.25	(10 ⁻)			
6529.4	(13 ⁻)	688	100	5841.4	(12 ⁻)			

Adopted Levels, Gammas (continued)

γ(⁶²Cu) (continued)

<u>E_i(level)</u>	<u>J^π_i</u>	<u>E_γ[†]</u>	<u>I_γ[‡]</u>	<u>E_f</u>	<u>J^π_f</u>	<u>E_i(level)</u>	<u>J^π_i</u>	<u>E_γ[†]</u>	<u>I_γ[‡]</u>	<u>E_f</u>	<u>J^π_f</u>
7100.88	(12 ⁺)	1092.7 <i>l</i>	100	6008.17	(11 ⁺)	7619.90	(12 ⁺)	519.0 <i>l</i>	100 <i>33</i>	7100.88	(12 ⁺)
7134.5	(13 ⁻)	1293	91 <i>55</i>	5841.4	(12 ⁻)			1611.7 <i>l</i>	100 <i>8</i>	6008.17	(11 ⁺)
		1515	100 <i>64</i>	5619.55	(11 ⁻)	8600.5	(13 ⁺)	980	100 <i>80</i>	7619.90	(12 ⁺)
7241.4	(14 ⁻)	712	100	6529.4	(13 ⁻)			1500	100 <i>70</i>	7100.88	(12 ⁺)
7285.3	(12 ⁺)	1111	43 <i>14</i>	6174.9	(10 ⁺)	8958.7	(14 ⁺)	358	50 <i>50</i>	8600.5	(13 ⁺)
		1277	100 <i>19</i>	6008.17	(11 ⁺)			1858	100 <i>70</i>	7100.88	(12 ⁺)
7619.90	(12 ⁺)	335	67 <i>54</i>	7285.3	(12 ⁺)	10883.7?		1925 ^{<i>h</i>}	100	8958.7	(14 ⁺)

[†] E_γ values with ΔE are weighted averages based on the most precise values available for each transition. E_γ below 700 keV from the four γ-ray experiments are in good agreement, but above this energy differences larger than the estimated uncertainties occur. Near 3 MeV, level energies derived from E_γ of ⁶⁰Ni(α,pnγ) are ≈5 keV higher than those from E_γ of ⁵⁹Co(α,nγ).

[‡] From ⁶²Zn ε decay or heavy-ion in-beam γ-ray studies, unless given otherwise.

From heavy-ion in-beam γ-ray studies (2001Mu14,1999Si03).

@ From ⁵⁹Co(α,nγ).

& From ⁶⁰Ni(α,pnγ).

^a From ⁶²Ni(p,nγ).

^b From conversion electron measurements in ⁶²Zn decay, except as noted.

^c From γ(θ) and RUL, ⁶⁰Ni(α,pnγ).

^d From γ(θ) and adopted J^π of connecting levels, (α,pnγ).

^e From γ(θ), (α,pnγ).

^f From ⁶²Ni(p,nγ), except as noted.

^g Total theoretical internal conversion coefficients, calculated using the BrIcc code (2008Ki07) with Frozen orbital approximation based on γ-ray energies, assigned multiplicities, and mixing ratios, unless otherwise specified.

^h Placement of transition in the level scheme is uncertain.

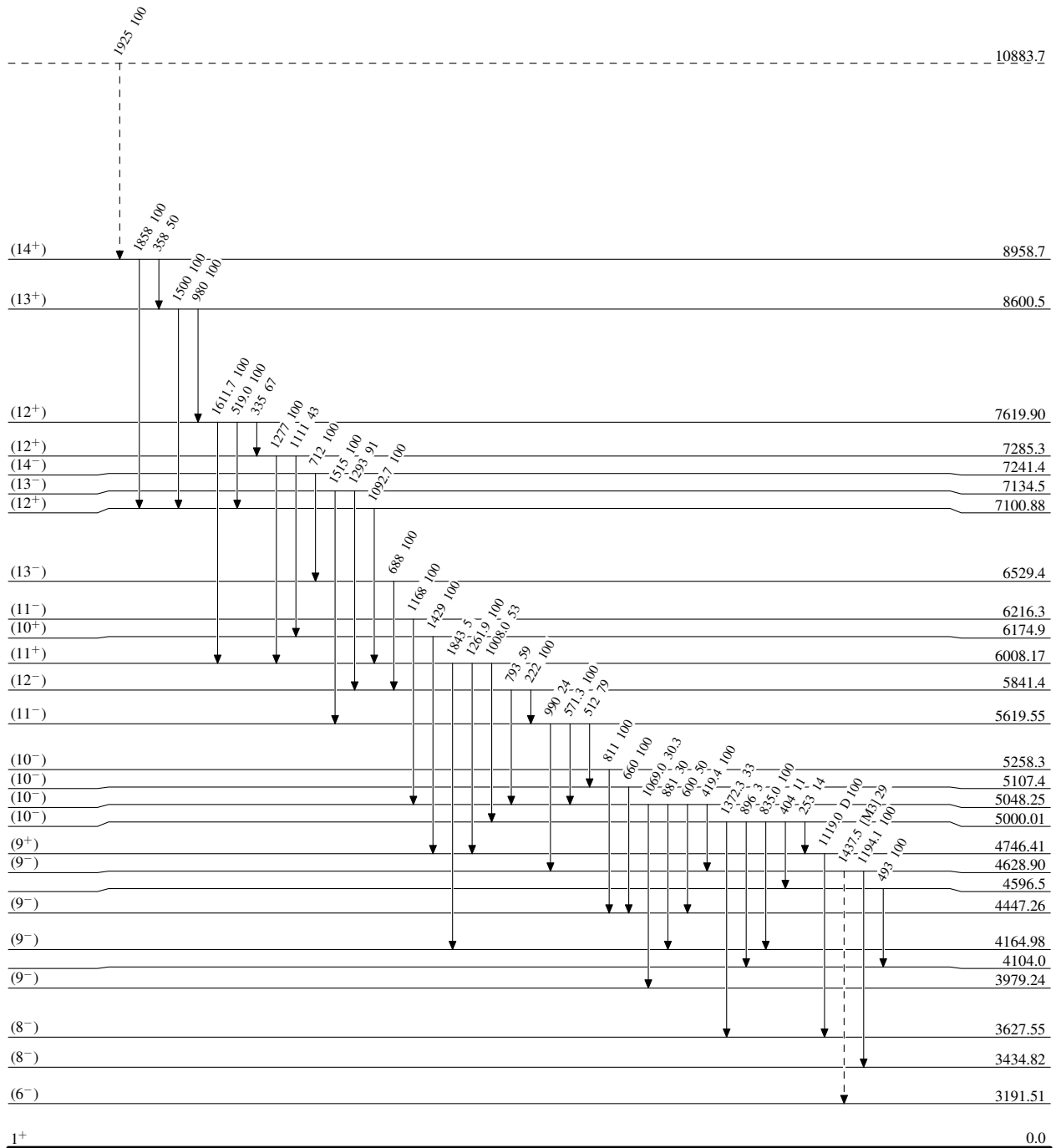
Adopted Levels, Gammas

Legend

Level Scheme

Intensities: Relative photon branching from each level

-----▶ γ Decay (Uncertain)



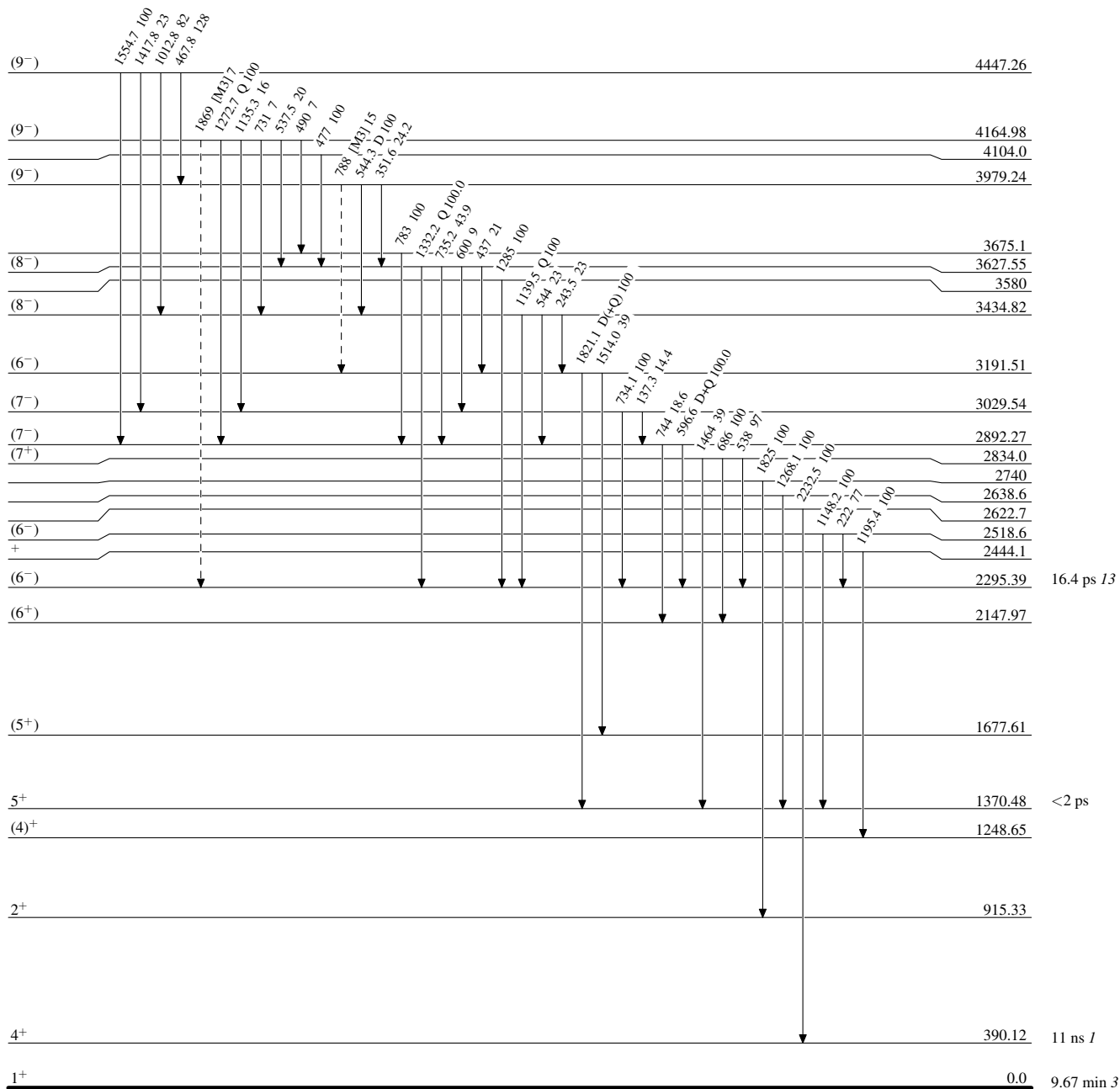
Adopted Levels, Gammas

Legend

Level Scheme (continued)

Intensities: Relative photon branching from each level

-----▶ γ Decay (Uncertain)



$^{62}_{29}\text{Cu}_{33}$

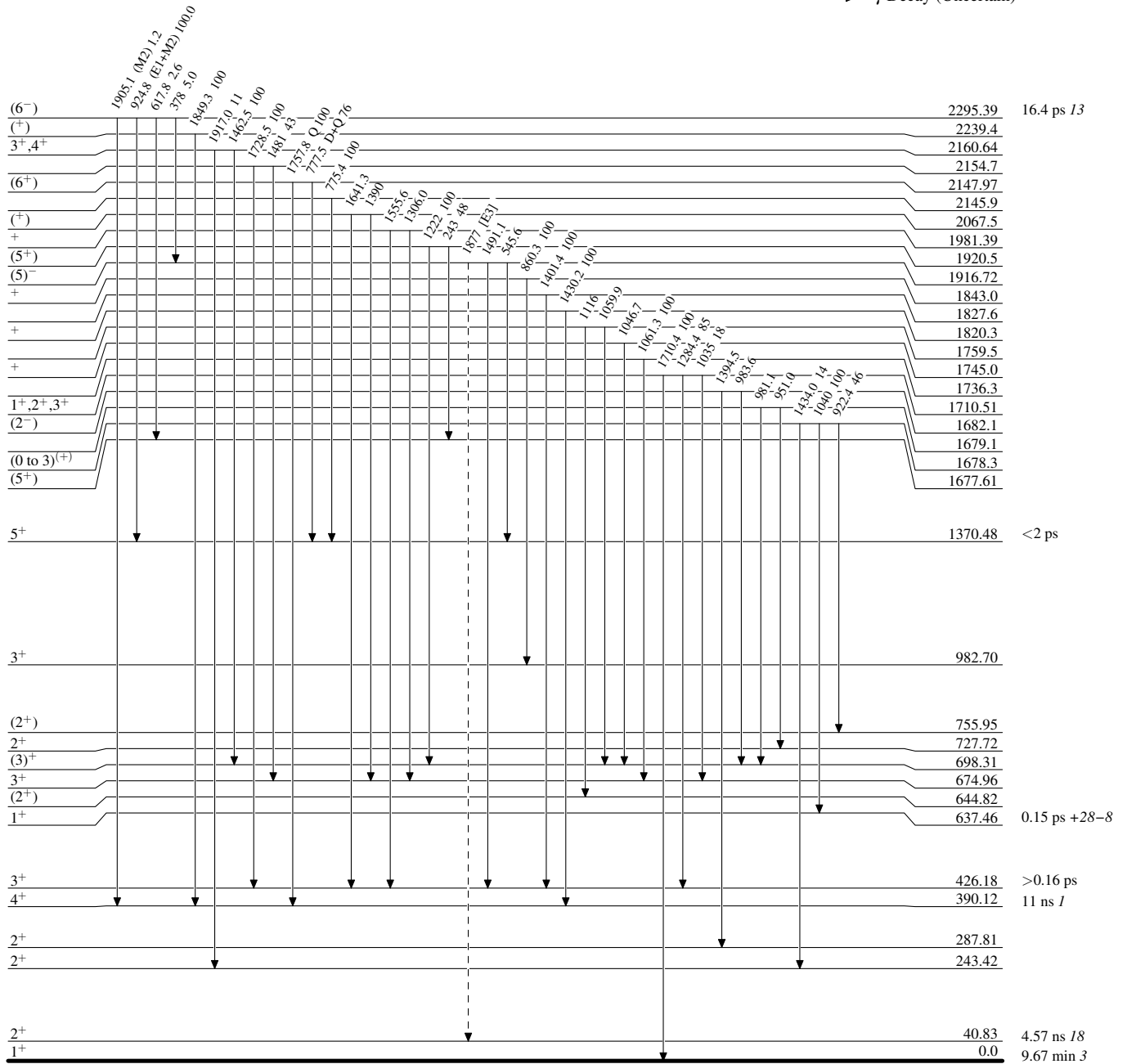
Adopted Levels, Gammas

Legend

Level Scheme (continued)

Intensities: Relative photon branching from each level

-----▶ γ Decay (Uncertain)



⁶²Cu₃₃

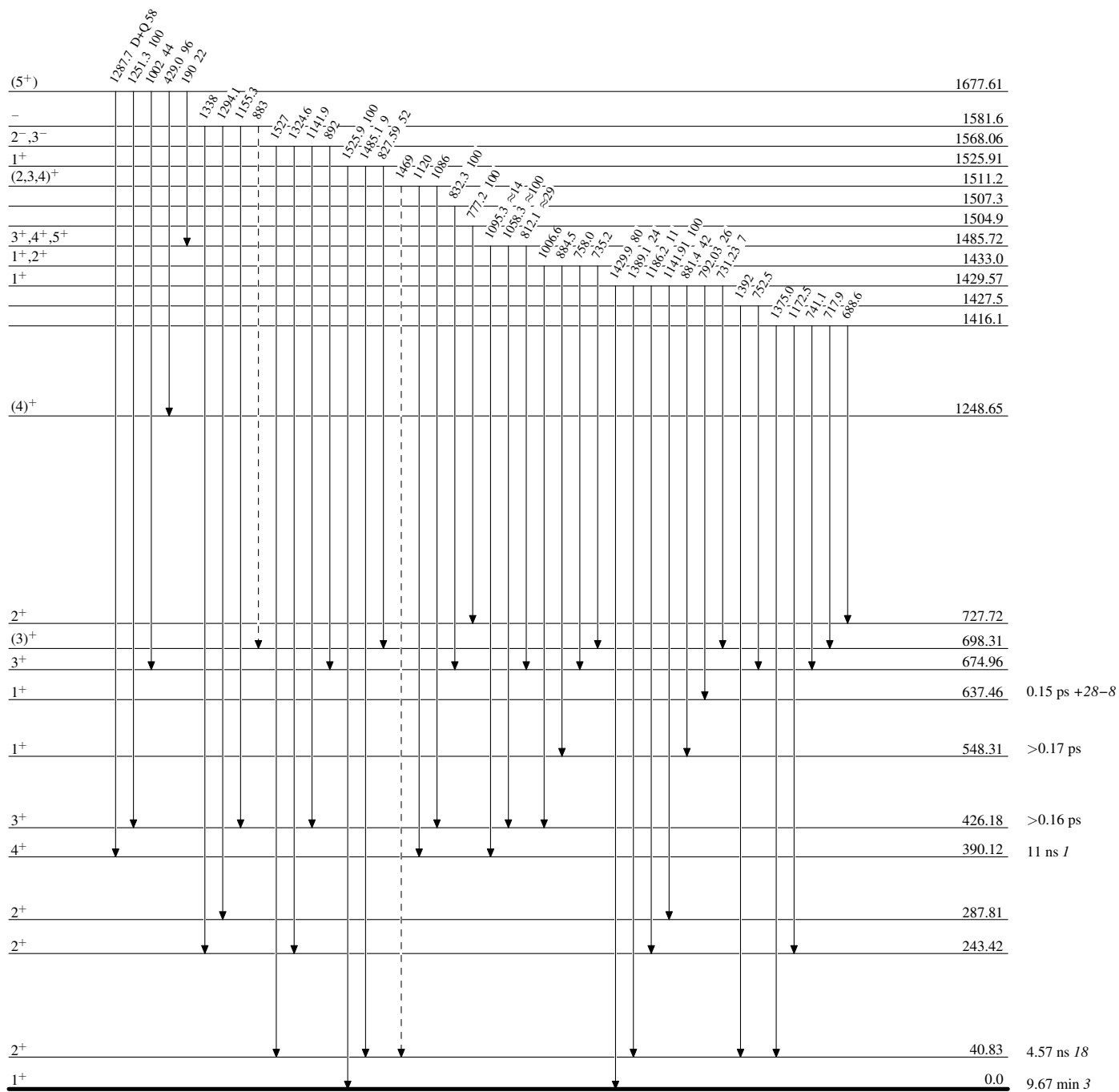
Adopted Levels, Gammas

Legend

Level Scheme (continued)

Intensities: Relative photon branching from each level

-----▶ γ Decay (Uncertain)

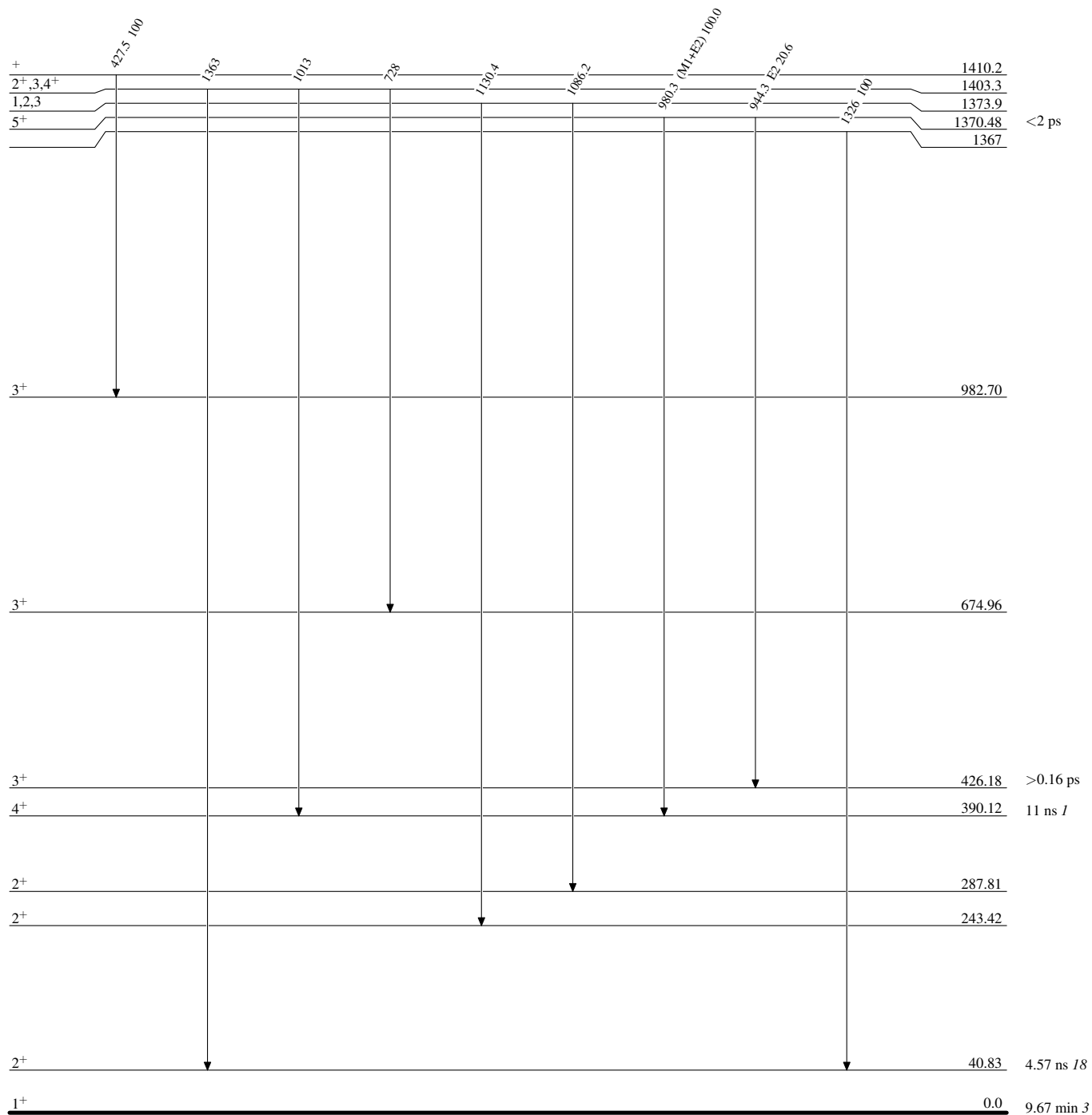


$^{62}_{29}\text{Cu}_{33}$

Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Relative photon branching from each level



$^{62}_{29}\text{Cu}_{33}$

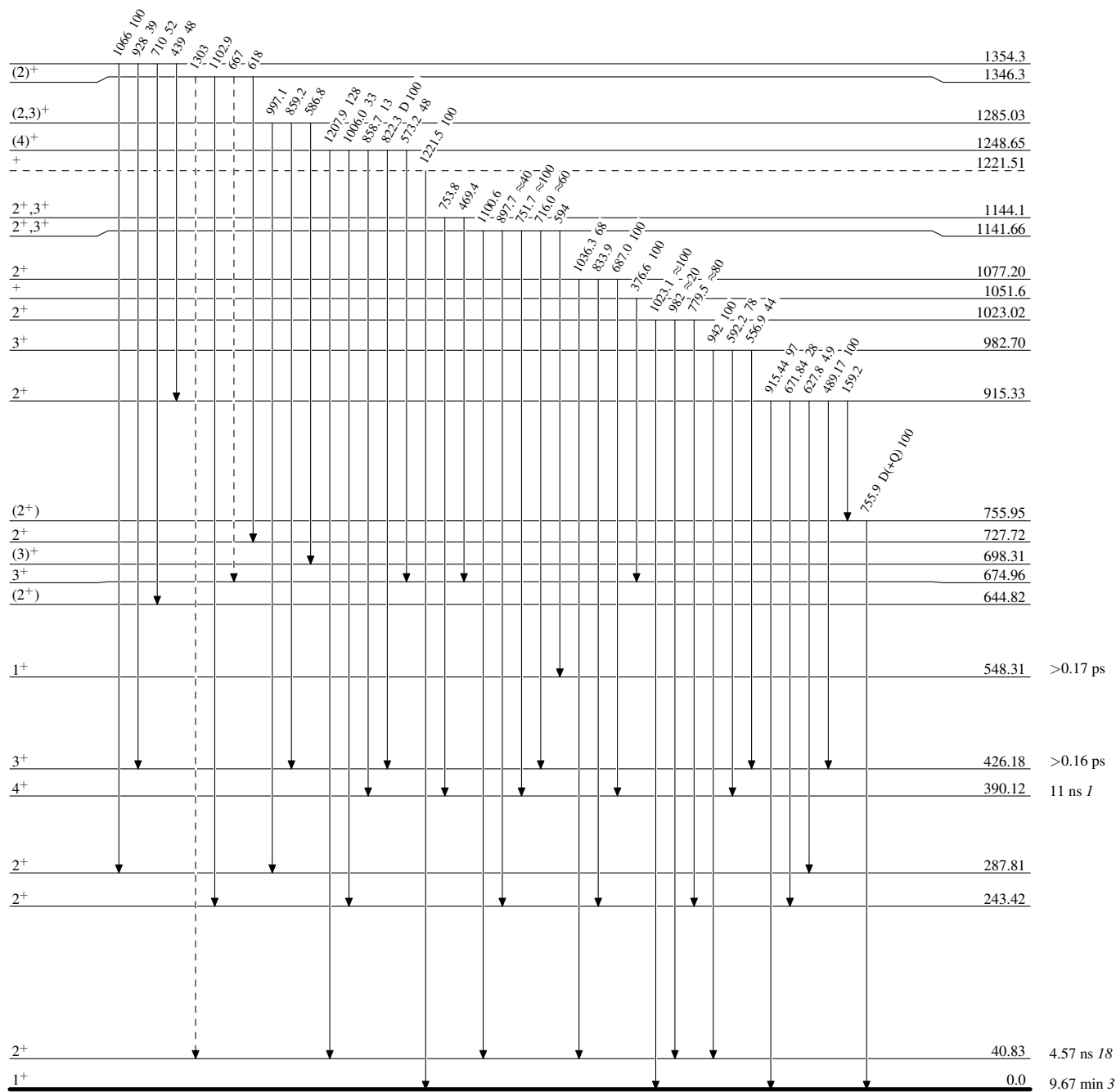
Adopted Levels, Gammas

Legend

Level Scheme (continued)

Intensities: Relative photon branching from each level

-----▶ γ Decay (Uncertain)

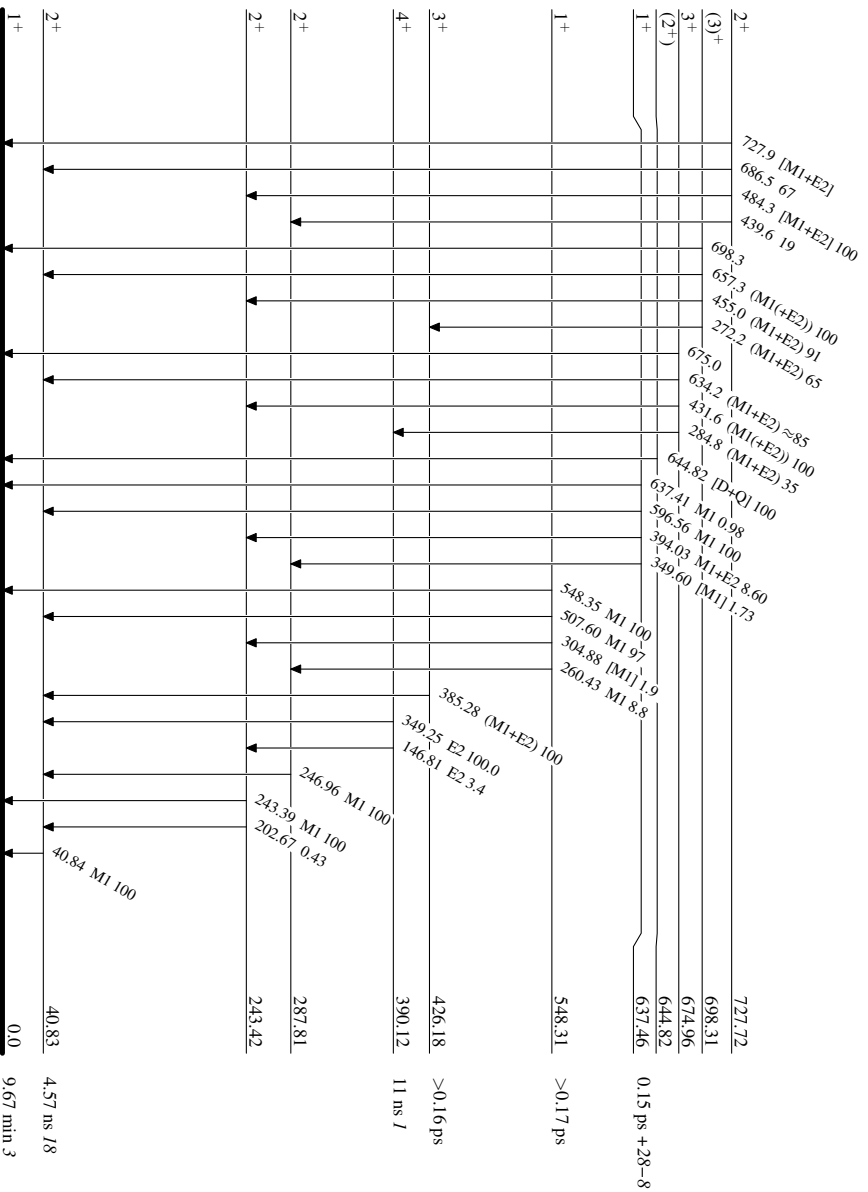


$^{62}_{29}\text{Cu}_{33}$

Adopted Levels, Gammas

Level Scheme (continued)

Intensities: Relative photon branching from each level



$^{62}\text{Cu}_{33}$