^{58}Ni(^{40}Ca,p2$\alpha\gamma$) 1995Ru03,2003La24

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh	ENSDF	30-Nov-2021

Includes reactions: ^{58}Ni(^{35}Cl,2p2nγ) and ^{58}Ni(^{36}Ar,αpγ) or ^{58}Ni(^{36}Ar,3p2nγ).

2004La21, 2003La24: E=185 MeV. Measured Eγ, Iγ, $\gamma\gamma$, particle-γ coin, Gammasphere array with 102 Compton-suppressed Ge detectors and Microball array of CsI(Tl) detectors. See 2004La18 for analysis and correlations between exit channels of SD structures and differences between deformations of SD bands and normal bands.

1999Ce09: E=185 MeV. Measured Eγ, Iγ, $\gamma\gamma$, particle-γ coin, lifetimes for SD bands using GAMMASPHERE array with 94 Compton-suppressed Ge detectors and MICROBALL charged particle array of 95 CsI(Tl) detectors.

1995Ru03, 1995Za11 and 1992Ru04 are from the same group.

1995Ru03: E=180 MeV. Measured Eγ, Iγ, $\gamma\gamma$, (particle)$\gamma\gamma$ coin, $\gamma\gamma(\theta)$(DCO at θ=143° and 79°), shell-model interpretation and calculations.

1995Za11: ^{58}Ni(^{35}Cl,2p2nγ) E=120 MeV. Measured lifetimes by recoil-distance Doppler-shift method in 1n- and 2n-gated γ and $\gamma\gamma$ spectra, shell-model calculations.

1992Ru04: ^{58}Ni(^{36}Ar,αpγ) or ^{58}Ni(^{36}Ar,3p2nγ) E=149 MeV. Measured Eγ, Iγ, $\gamma\gamma$, $\gamma\gamma(\theta)$(DCO). Total of nine-γ rays reported, six of these defining an yrast sequence.

^{89}Tc Levels

Detailed particle-hole shell model configurations are given by 1995Ru03 for levels above 1700. For positive-parity states, multi-particle configurations involve $\pi g_{9/2}$ and $\nu g_{9/2}$, and for negative-parity states, $\pi p_{1/2}$, $\pi g_{9/2}$, $\nu g_{9/2}$ and $\nu p_{1/2}$ orbitals. Based on calculations by 1995Ru03, levels above 2300 are interpreted as shell-model states, whereas, those at lower energy are likely to have collective components.

A level at 2133 defined by 1337-796 cascade (1992Ru04) is omitted by 1995Ru03. The 1337γ is relocated from 9110 level.

E(level)[†]	J$^\pi$[#]	T$_{1/2}$[‡]	Comments
0.0	(9/2$^+$)		Configuration=$\pi g_{9/2}$ (1995Ru03).
62.6 *5*	(1/2$^-$)		Configuration=$\pi p_{1/2}$ (1995Ru03).
179.2 *1*	(7/2$^+$)		
790.0? *4*	(5/2$^-$)		E(level): energy is uncertain since ordering of 542γ-727Γ is not established.
795.9 *1*	(13/2$^+$)	<8.3 ps	
998.3 *2*	(7/2$^-$)		
1101.3 *2*	(11/2$^+$)		
1331.9? *3*	(9/2$^-$)		E(level): energy is uncertain since ordering of 565γ-542γ is not established.
1682.1 *2*	(11/2$^-$)		
1731.8 *2*	(17/2$^+$)	<9.0 ps	
1896.9 *2*	(13/2$^-$)		
2031.9 *2*	(17/2$^+$)		
2043.6 *3*	(15/2$^+$)		
2320.5 *2*	(17/2$^-$)		
2427.1 *2*	(21/2$^+$)	<26 ps	
2530.5 *3*	(17/2$^-$)		
2923.8 *3*	(19/2$^-$)		
3103.5 *2*	(23/2$^+$)		
3112.8 *2*	(21/2$^-$)		
3217.7 *2*	(25/2$^+$)		
3311.4 *4*	(21/2$^-$)		
4065.2 *2*	(25/2$^-$)		
4224.0? *3*	(25/2$^-$)		E(level): energy is uncertain since ordering of 490γ-913Γ is not established.
4243.2 *2*	(29/2$^+$)		
4713.6 *3*	(27/2$^-$)		
4942.3 *3*	(29/2$^-$)		
5113.8 *3*	(29/2$^-$)		

Continued on next page (footnotes at end of table)

^{58}Ni(^{40}Ca,p2$\alpha\gamma$) 1995Ru03,2003La24 (continued)

^{89}Tc Levels (continued)

E(level)†	J$^\pi$#	Comments
5329.2 *2*	(33/2$^+$)	
5332.1 *3*	(31/2$^-$)	
5650.9 *3*	(33/2$^-$)	
6190.5 *3*	(35/2$^+$)	
6413.7 *3*	(35/2$^-$)	
6545.9 *3*	(37/2$^+$)	
6612.0 *4*	(37/2$^-$)	
7011.3? *3*	(37/2$^+$)	E(level): energy is uncertain since ordering of 391γ-821Γ is not established.
7402.1 *3*	(39/2$^+$)	
7765.7 *4*	(41/2$^-$)	
7772.0 *4*	(41/2$^+$)	
9109.8 *7*	(45/2$^+$)	
9163.2 *6*	(45/2$^-$)	
x@	J≈(35/2$^-$)	
1149.2+x@ *3*	J+2	
2408.1+x@ *4*	J+4	
3792.4+x@ *4*	J+6	
5313.6+x@ *4*	J+8	
6981.7+x@ *4*	J+10	
8800.6+x@ *4*	J+12	
10775.2+x@ *4*	J+14	
12911.2+x@ *4*	J+16	
15209.6+x@ *4*	J+18	
17671.6+x@ *17*	J+20	
20291+x?@ *4*	J+22	

† From least-squares fit to Eγ data.
‡ From recoil-distance Doppler shift (1995Za11).
# From 1995Ru03, based on $\gamma\gamma(\theta)$ data.
@ Band(A): SD BAND. Band assignment from 1999Ce09, 2003La24 and 2004La21. Q(intrinsic)=5.9 *+7−5* (2003La24), 6.7 *+30−23* (1999Ce09). Values of β_2≈0.65 and γ≈12° reproduce measured Q(transition) and dynamic moment of inertia plot (2003La24). Measured Q(transition) is deduced by authors from Doppler-shift attenuation method for lifetimes of levels in the SD band as shown in their Fig. 1 plot of Eγ versus fractional Doppler shifts F(τ). Percent population=15% of the reaction channel (1999Ce09). Configuration=$\pi5^1\nu5^2$; π=−, α=−1/2 (1999Ce09) This band is isospectral with SD-3 band in ^{88}Mo.

γ(^{89}Tc)

Experimental branching ratios are compared with those calculated from shell-model (see Table 4 in 1995Ru03).
Expected DCO ratios are ≈1.0 for ΔJ=2, quadupole (likely E2) and ≈0.50 for ΔJ=1, D+Q (likely M1+E2) transitions.

E$_\gamma$†	I$_\gamma$†	E$_i$(level)	J$^\pi_i$	E$_f$	J$^\pi_f$	Mult.@	Comments
114.2 *1*	18 *2*	3217.7	(25/2$^+$)	3103.5	(23/2$^+$)	D+Q	DCO=0.66 *5*
179.2 *1*	57 *2*	179.2	(7/2$^+$)	0.0	(9/2$^+$)	D+Q	DCO=0.55 *4*
189.1 *3*	4 *1*	3112.8	(21/2$^-$)	2923.8	(19/2$^-$)		
198.3‡ *4*	13 *3*	6612.0	(37/2$^-$)	6413.7	(35/2$^-$)		
198.6‡ *4*	8 *3*	3311.4	(21/2$^-$)	3112.8	(21/2$^-$)		

Continued on next page (footnotes at end of table)

^{58}Ni(^{40}Ca,p2$\alpha\gamma$) 1995Ru03,2003La24 (continued)

$\gamma(^{89}$Tc) (continued)

E_γ †	I_γ †	E_i(level)	J_i^π	E_f	J_f^π	Mult. @	Comments
210.1 *2*	7 *2*	2530.5	(17/2⁻)	2320.5	(17/2⁻)		
214.8 *1*	48 *2*	1896.9	(13/2⁻)	1682.1	(11/2⁻)	D+Q	DCO=0.68 *4*
218.3 *2*	11 *2*	5332.1	(31/2⁻)	5113.8	(29/2⁻)	D+Q	DCO=0.57 *6*
228.8 *2*	6 *1*	4942.3	(29/2⁻)	4713.6	(27/2⁻)	D+Q	DCO=0.50 *6*
276.9 *2*	11 *1*	2320.5	(17/2⁻)	2043.6	(15/2⁺)	D	DCO=0.49 *6* DCO suggests ΔJ=1, D+Q or D (assumed E1 from level scheme).
299.9 *2*	2 *1*	2031.9	(17/2⁺)	1731.8	(17/2⁺)		
318.8 *1*	43 *4*	5650.9	(33/2⁻)	5332.1	(31/2⁻)	D+Q	DCO=0.48 *3*
355.5 *2*	10 *1*	6545.9	(37/2⁺)	6190.5	(35/2⁺)	D+Q	DCO=0.43 *4*
369.8 *2*	12 *2*	7772.0	(41/2⁺)	7402.1	(39/2⁺)	D+Q	DCO=0.41 *4*
389.8 *1*	47 *4*	5332.1	(31/2⁻)	4942.3	(29/2⁻)	D+Q	DCO=0.54 *3*
390.6 *2*	8 *1*	7402.1	(39/2⁺)	7011.3?	(37/2⁺)	D+Q	DCO=0.44 *5*
395.3 *2*	8 *1*	2427.1	(21/2⁺)	2031.9	(17/2⁺)	E2	DCO=0.89 *19* Mult.: ΔJ=2, Q from DCO, RUL(for E2 amd M2) gives E2.
400.1 *2*	9 *2*	5113.8	(29/2⁻)	4713.6	(27/2⁻)	D+Q	DCO=0.50 *6*
423.5 *2*	53 *2*	2320.5	(17/2⁻)	1896.9	(13/2⁻)	Q	DCO=1.06 *6*
489.6 *2*	7 *2*	4713.6	(27/2⁻)	4224.0?	(25/2⁻)	D+Q	DCO=0.63 *9*
541.9 *2*	10 *1*	1331.9?	(9/2⁻)	790.0?	(5/2⁻)	Q	DCO=0.96 *11*
565.0 *2*	9 *1*	1896.9	(13/2⁻)	1331.9?	(9/2⁻)	Q	DCO=1.08 *15*
603.3 *3*	7 *2*	2923.8	(19/2⁻)	2320.5	(17/2⁻)		
618.7 *2*	8 *2*	5332.1	(31/2⁻)	4713.6	(27/2⁻)	Q	DCO=1.08 *15*
648.6 *2*	15 *2*	4713.6	(27/2⁻)	4065.2	(25/2⁻)	D+Q	DCO=0.50 *5*
676.4 *1*	27 *1*	3103.5	(23/2⁺)	2427.1	(21/2⁺)	D+Q	DCO=0.46 *4*
683.7 *1*	40 *2*	1682.1	(11/2⁻)	998.3	(7/2⁻)	Q	DCO=0.99 *6*
695.3 *1*	67 *2*	2427.1	(21/2⁺)	1731.8	(17/2⁺)	Q	DCO=1.01 *5*
727.4 *3*	8 *1*	790.0?	(5/2⁻)	62.6	(1/2⁻)		
781.0 *4*	7 *2*	3311.4	(21/2⁻)	2530.5	(17/2⁻)	Q	DCO=1.11 *19*
790.5 *1*	44 *4*	3217.7	(25/2⁺)	2427.1	(21/2⁺)	Q	DCO=1.00 *5*
792.4 *1*	57 *4*	3112.8	(21/2⁻)	2320.5	(17/2⁻)	Q	DCO=0.93 *5*
795.9 *1*	100 *3*	795.9	(13/2⁺)	0.0	(9/2⁺)	E2	DCO=1.01 *6* Mult.: ΔJ=2, Q from DCO, RUL(for E2 amd M2) gives E2.
819.1 *1*	49 *2*	998.3	(7/2⁻)	179.2	(7/2⁺)		DCO=1.09 *7* Mult.: DCO is consistent with ΔJ=0, dipole (assumed E1).
820.6 *2*	8 *1*	7011.3?	(37/2⁺)	6190.5	(35/2⁺)	D+Q	DCO=0.39 *7*
861.3 *1*	26 *1*	6190.5	(35/2⁺)	5329.2	(33/2⁺)	D+Q	DCO=0.44 *4*
877.1 *1*	44 *4*	4942.3	(29/2⁻)	4065.2	(25/2⁻)	Q	DCO=1.06 *6*
912.8 *4*	8 *2*	4224.0?	(25/2⁻)	3311.4	(21/2⁻)	Q	DCO=0.94 *19*
922.0 *4*	10 *2*	1101.3	(11/2⁺)	179.2	(7/2⁺)	Q	DCO=0.90 *17*
935.9 *1*	76 *3*	1731.8	(17/2⁺)	795.9	(13/2⁺)	E2	DCO=0.97 *5* Mult.: ΔJ=2, Q from DCO, RUL(for E2 amd M2) gives E2.
942.3 *4*	8 *3*	2043.6	(15/2⁺)	1101.3	(11/2⁺)	Q	DCO=1.1 *3*
952.3 *1*	56 *5*	4065.2	(25/2⁻)	3112.8	(21/2⁻)	Q	DCO=1.05 *6*
961.1 *2*	38 *3*	6612.0	(37/2⁻)	5650.9	(33/2⁻)	Q	DCO=0.94 *6*
1025.5 *1*	56 *4*	4243.2	(29/2⁺)	3217.7	(25/2⁺)	Q	DCO=1.00 *6*
1048.4 *5*	3 *1*	5113.8	(29/2⁻)	4065.2	(25/2⁻)		
1081.6 *2*	19 *3*	6413.7	(35/2⁻)	5332.1	(31/2⁻)	Q	DCO=1.11 *10*
1086.0 *1*	50 *2*	5329.2	(33/2⁺)	4243.2	(29/2⁺)	Q	DCO=1.03 *6*
1088.9 *4*	5 *2*	5332.1	(31/2⁻)	4243.2	(29/2⁺)	D	DCO=0.36 *13* Mult.: DJ=1, D+Q or D from DCO, assumed (E1) from level scheme.
1101.3 *3*	15 *1*	1101.3	(11/2⁺)	0.0	(9/2⁺)	D+Q	DCO=0.43 *6*

Continued on next page (footnotes at end of table)

^{58}Ni(^{40}Ca,p2$\alpha\gamma$) 1995Ru03,2003La24 (continued)

γ(^{89}Tc) (continued)

E_γ †	I_γ †	E_i(level)	J^π_i	E_f	J^π_f	Mult. @	Comments
1149.2# *3*	0.30# *5*	1149.2+x	J+2	x	J≈(35/2−)		E_γ: 1147.3 *10* (1999Ce09).
1153.7 *2*	39 *4*	7765.7	(41/2−)	6612.0	(37/2−)	Q	DCO=0.97 *7*
1211.9 *3*	7 *1*	7402.1	(39/2+)	6190.5	(35/2+)	Q	DCO=1.13 *17*
1216.5 *5*	4 *1*	6545.9	(37/2+)	5329.2	(33/2+)		
1227.0 *6*	4 *1*	7772.0	(41/2+)	6545.9	(37/2+)		
1236.3 *3*	6 *2*	2031.9	(17/2+)	795.9	(13/2+)		
1248.5 *6*	5 *2*	2043.6	(15/2+)	795.9	(13/2+)		
1258.83# *11*	1.00# *5*	2408.1+x	J+4	1149.2+x	J+2		E_γ: 1258.8 *5* (1999Ce09).
1337.8 *5*	5 *1*	9109.8	(45/2+)	7772.0	(41/2+)		
1384.35# *7*	0.90# *5*	3792.4+x	J+6	2408.1+x	J+4		E_γ: 1383.9 *5* (1999Ce09).
1397.4 *4*	12 *2*	9163.2	(45/2−)	7765.7	(41/2−)	Q	DCO=0.95 *9*
1521.18# *8*	0.95# *5*	5313.6+x	J+8	3792.4+x	J+6		E_γ: 1521.4 *5* (1999Ce09).
1668.09# *6*	1.00# *5*	6981.7+x	J+10	5313.6+x	J+8		E_γ: 1667.9 *5* (1999Ce09).
1818.82# *8*	1.00# *5*	8800.6+x	J+12	6981.7+x	J+10		E_γ: 1818.3 *5* (1999Ce09).
1974.57# *9*	0.85# *5*	10775.2+x	J+14	8800.6+x	J+12		E_γ: 1975.0 *5* (1999Ce09).
2136.01# *10*	0.60# *3*	12911.2+x	J+16	10775.2+x	J+14		E_γ: 2136.0 *5* (1999Ce09).
2298.34# *13*	0.40# *3*	15209.6+x	J+18	12911.2+x	J+16		E_γ: 2297.6 *10* (1999Ce09).
2462.0# *16*	0.20# *2*	17671.6+x	J+20	15209.6+x	J+18		E_γ: 2459.2 *10* (1999Ce09).
2619#& *3*	0.06# *2*	20291+x?	J+22	17671.6+x	J+20		E_γ: 2625 *1* (1999Ce09).

† From 1995Ru03, unless otherwise stated. Iγ values are at 115°.
‡ Unresolved doublet. Eγ value from level-energy difference.
# From 2003La24 and 2004La21, SD band transitions. Values from 1999Ce09 are in agreement but differ in some cases by as much as 3 keV. Relative intensities are within the band, read from figure 2 in 2004La21 and normalized to ≈1 for the strongest transition.
@ Multipolarities of ΔJ=1, M1+E2 and ΔJ=2, E2 are assigned in 1995Ru03. Evaluator assigns ΔJ=1, D+Q for the former and ΔJ=2, Q for the latter, as DCO data are insensitive to parity determination. When level half-life is available, ΔJ=2, Q transitions are assigned DJ=2, E2 from RUL (for E2 and M2).
& Placement of transition in the level scheme is uncertain.

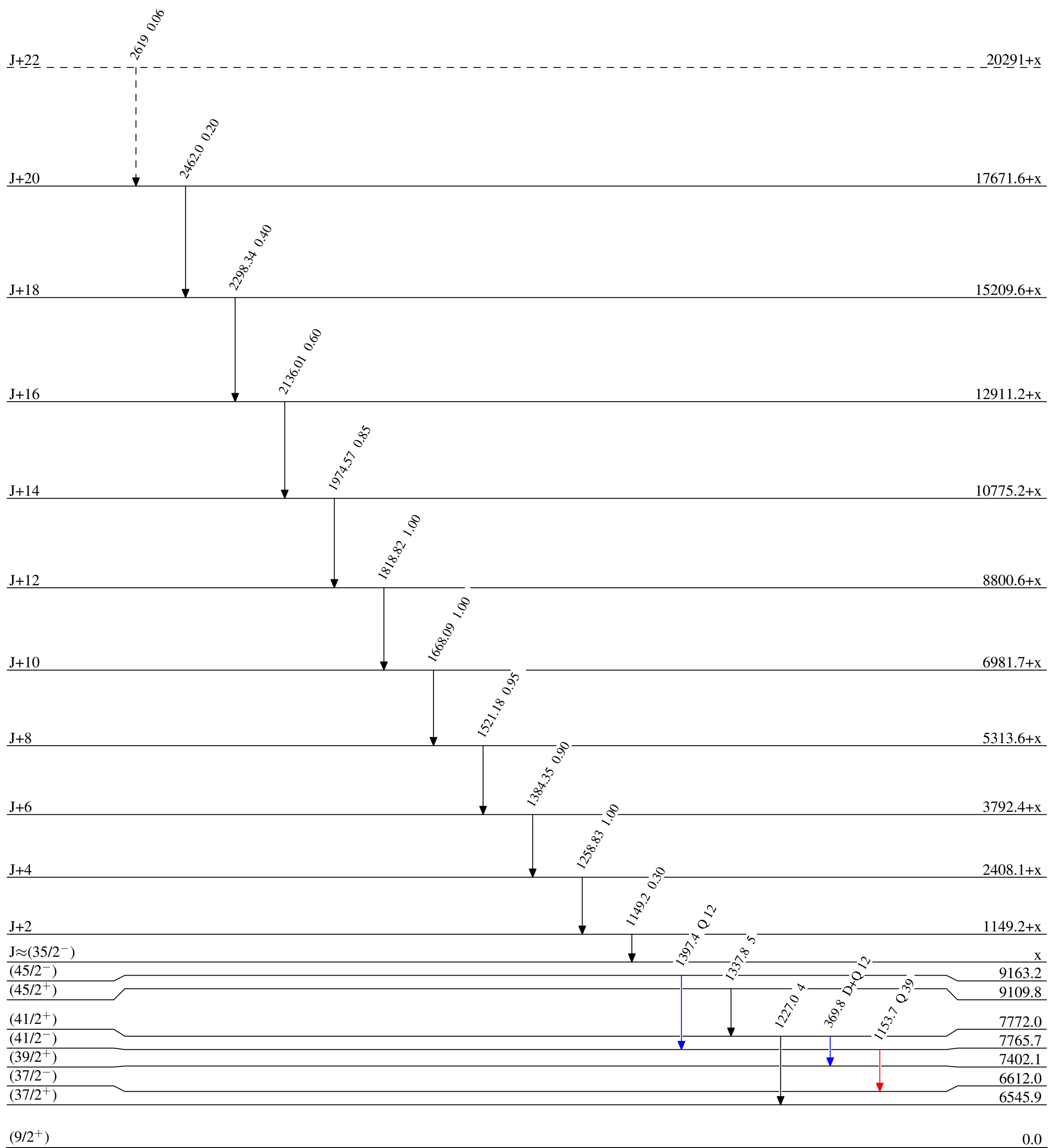
$^{58}Ni(^{40}Ca,p2\alpha\gamma)$ 1995Ru03,2003La24

Level Scheme

Intensities: Relative I_γ

Legend

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

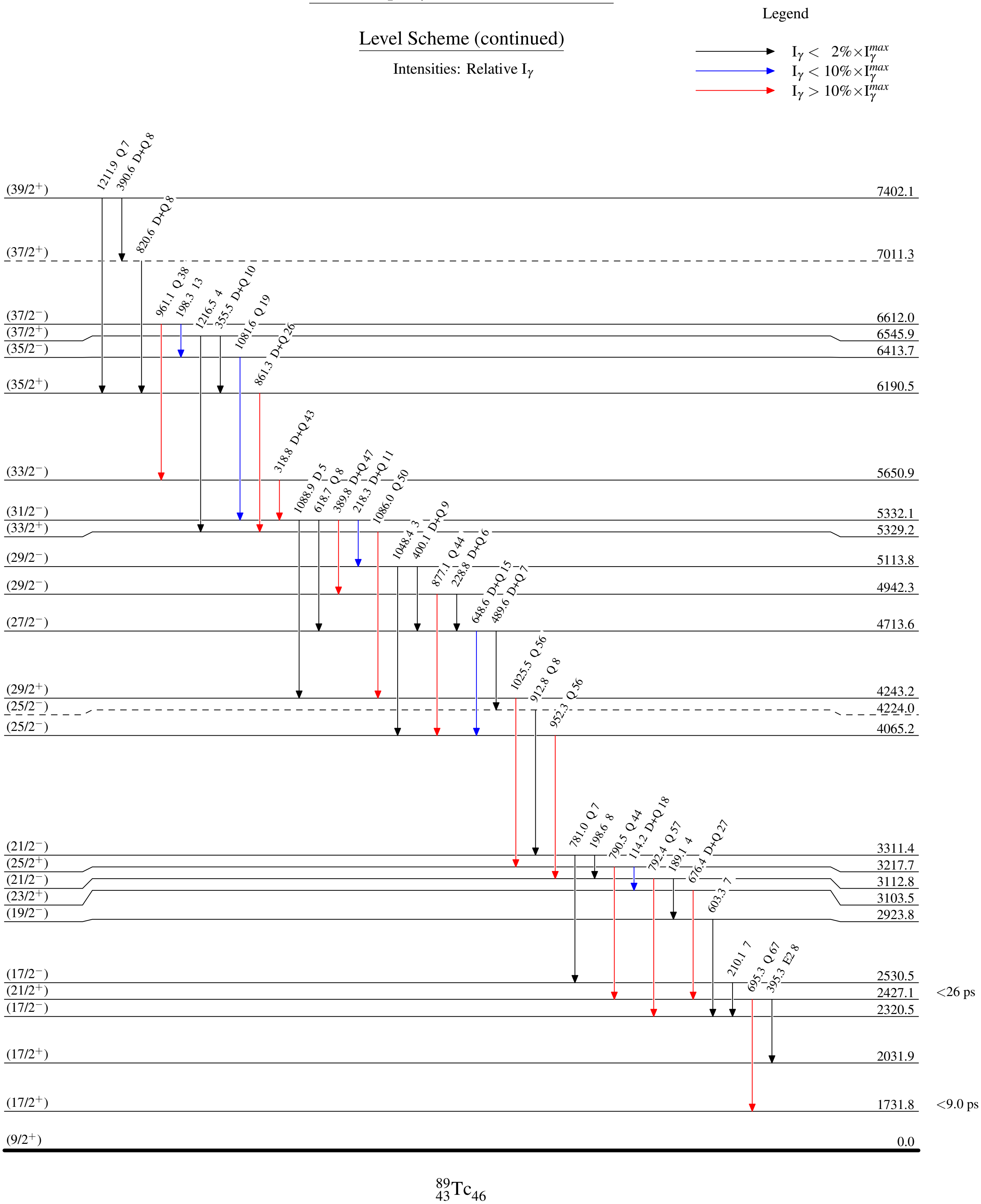


$^{89}_{43}Tc_{46}$

$^{58}Ni(^{40}Ca,p2\alpha\gamma)$ 1995Ru03,2003La24

Level Scheme (continued)

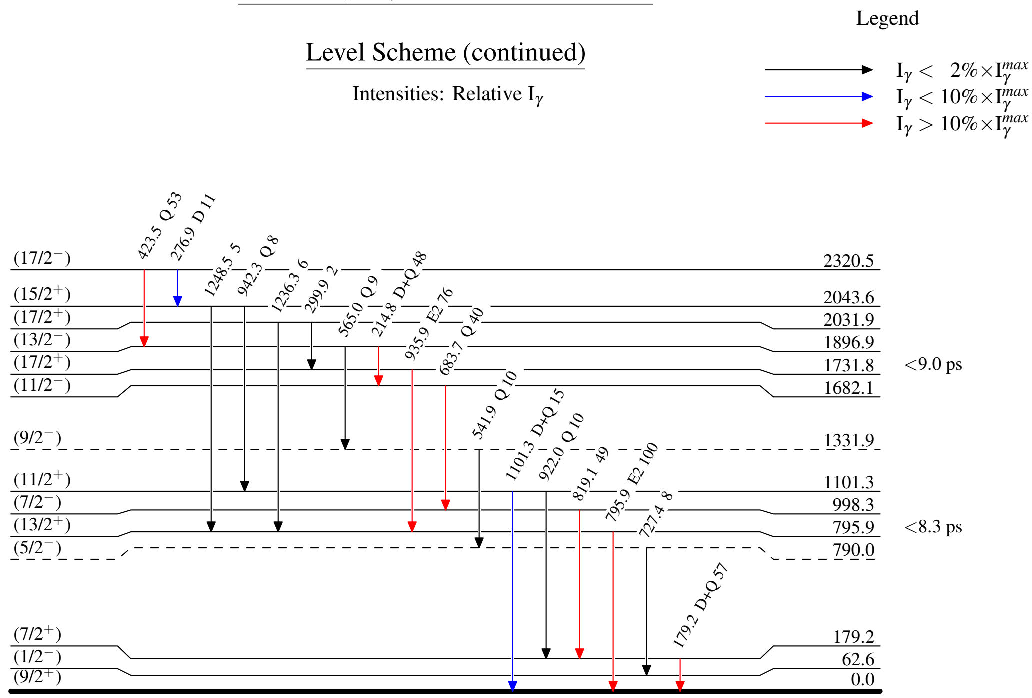
Intensities: Relative I_γ



$^{58}Ni(^{40}Ca,p2\alpha\gamma)$ 1995Ru03,2003La24

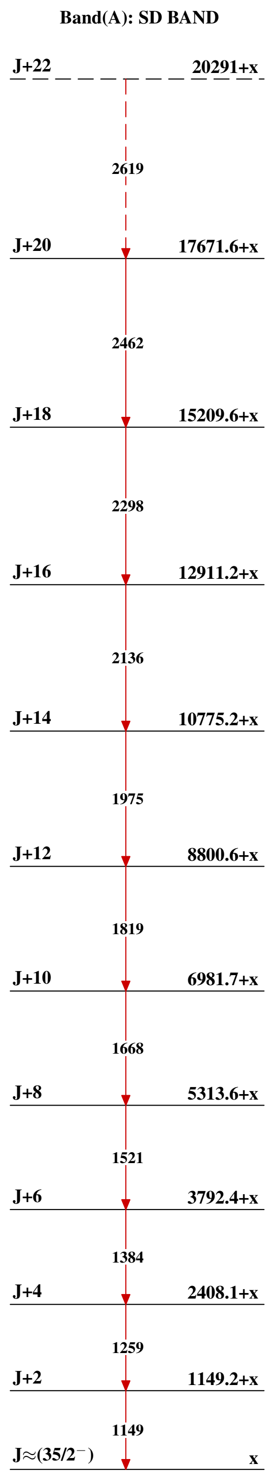
Level Scheme (continued)

Intensities: Relative I_γ



$^{89}_{43}Tc_{46}$

^{58}Ni(^{40}Ca,p2$\alpha\gamma$) 1995Ru03,2003La24



$^{89}_{43}Tc_{46}$