^{59}Co(^{7}Li,αnγ) 2019Sa04

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh	ENSDF	20-Jan-2020

Dataset adapted from compilation by Jun Chen (NSCL, MSU), Jan 24, 2019, for the XUNDL database. Several revisions made in the present dataset.

2019Sa04: E(^{7}Li)=22-24 MeV beam from the Pelletron-LINAC Facility TIFR-Mumbai. Target was 5.2 mg/cm^2 mono-isotopic ^{59}Co on a 4 mg/cm^2 Ta foil. The γ rays were detected with the an array of 11 Compton-suppressed Clover HPGe detectors. Measured Eγ, Iγ, $\gamma\gamma$-coin, $\gamma\gamma$(ADO), $\gamma\gamma$(DCO), $\gamma\gamma$(lin pol). Deduced high-spin levels, J^π, multipolarities, branching ratios. Comparisons with shell-model calculations.

^{61}Ni Levels

E(level)†	Jπ‡	E(level)†	Jπ‡	E(level)†	Jπ‡	E(level)†	Jπ‡
0.0	3/2$^-$	1807.3 *2*	9/2$^-$	3434.9 *2*	13/2$^+$	4688.7 *9*	15/2$^+$
67.1 *2*	5/2$^-$	1987.0 *2*	9/2$^-$	3564.6 *11*	9/2$^+$	4763.7 *18*	13/2$^+$
283.1 *2*	1/2$^-$	1997.2 *4*	5/2$^-$	3621.3 *5*	11/2$^+$	4817.0 *6*	17/2$^+$
656.2 *2*	1/2$^-$	2017.8 *5*	7/2$^-$	3663.4 *6*	9/2$^+$	4999.1 *20*	(13/2$^+$)
907.7 *2*	5/2$^-$	2120.9 *2*	9/2$^+$	3710.4 *3*	11/2$^+$	5155.4 *6*	15/2$^+$
1015.0 *2*	7/2$^-$	2124.0 *10*	1/2$^-$	3860.2 *11*	(9/2$^+$)	5164.0 *20*	(13/2$^+$)
1099.5 *3*	3/2$^-$	2128.5 *2*	11/2$^-$	4018.3 *3*	15/2$^+$	5250.2 *11*	17/2$^+$
1132.2 *3*	5/2$^-$	2409.2 *2*	9/2$^-$	4031.9 *11*	13/2$^+$	5309.8 *4*	17/2$^+$
1186.1 *3*	3/2$^-$	3104.5 *6*	(7/2$^+$)	4196.7 *9*	13/2$^-$	6190.7 *12*	19/2$^+$
1454.3 *2*	7/2$^-$	3257.85 *25*	11/2$^-$	4206.1 *6*	13/2$^+$	6734.1 *7*	17/2$^+$
1609.1 *3*	5/2$^-$	3297.7 *3*	11/2$^+$	4476.7 *3*	11/2$^+$		
1729.0 *3*	3/2$^-$	3425.6 *2*	13/2$^-$	4521.2 *6*	13/2$^+$		

† Deduced from least-squares fit to Eγ data.

‡ As given in 2019Sa04, based on measured $\gamma\gamma$(DCO), $\gamma\gamma$(ADO) and γ(lin pol), and previously known assignments for low-lying states.

γ(^{61}Ni)

DCO(D) is for gate ΔJ=1, dipole transition and DCO(Q) for gate on ΔJ=2, quadrupole. Expected DCO(D)=0.59 *1* for a ΔJ=1, dipole and 0.95 *1* for ΔJ=2, quadrupole; and DCO(Q)=0.96 *2* and 1.74 *1*, respectively (2019Sa04).

Expected R_{ADO} ratios are 1.24 *2* for ΔJ=2, quadrupole transitions and 0.81 *2* for ΔJ=1, dipole transitions (2019Sa04).

POL=polarization asymmetry. Expected values are positive for electric transitions and negative for magnetic transitions (2019Sa04).

P_S=polarization sensitivity, which considers dependence of polarization asymmetry on the gamma-ray energy, as defined in 2019Sa04.

Eγ	Iγ†	E$_i$(level)	J$_i^\pi$	E$_f$	J$_f^\pi$	Mult.‡	Comments
66.7 *3*	194.3 *40*	67.1	5/2$^-$	0.0	3/2$^-$	D+Q#	R_{ADO}=0.71 *3*.
283.4 *3*	4.9 *3*	283.1	1/2$^-$	0.0	3/2$^-$	D+Q#	R_{ADO}=0.93 *13*.
373.1 *1*	1.0 *1*	656.2	1/2$^-$	283.1	1/2$^-$	D&	R_{ADO}=0.80 *8*.
477.4 *5*		1609.1	5/2$^-$	1132.2	5/2$^-$		
482.6 *7*	11.0 *5*	4688.7	15/2$^+$	4206.1	13/2$^+$	D&	POL=−0.03 *5*, P_S=−0.28 *40*. DCO(D)=1.00 *5*, R_{ADO}=0.80 *9*.
529.6 *5*		1186.1	3/2$^-$	656.2	1/2$^-$		
532.5 *3*	2.3 *4*	1987.0	9/2$^-$	1454.3	7/2$^-$	M1+E2	POL=−0.04 *3*, P_S=−0.32 *33*. DCO(Q)=0.70 *3*. R_{ADO}=0.86 *7*.
561.5 *5*	9.6 *6*	5250.2	17/2$^+$	4688.7	15/2$^+$	D+Q#	R_{ADO}=0.88 *7*.
583.5 *3*	12.7 *7*	4018.3	15/2$^+$	3434.9	13/2$^+$	D+Q#	Iγ(584)/Iγ(593)=2.65 *22* disagrees with 0.39 *4* in the

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^{59}Co(^{7}Li,αnγ) 2019Sa04 (continued)

γ(^{61}Ni) (continued)

E_γ	I_γ[†]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[‡]	Comments
							Adopted Gammas, where value is from (α,nγ). R_{ADO}=0.99 *5*.
589.0 *5*		656.2	1/2$^-$	67.1	5/2$^-$		
592.6 *2*	4.8 *3*	4018.3	15/2$^+$	3425.6	13/2$^-$	D[b]	DCO(Q)=0.68 *3*. R_{ADO}=0.84 *3*.
625.0 *5*	1.0 *2*	907.7	5/2$^-$	283.1	1/2$^-$		
629.5 *1*		1729.0	3/2$^-$	1099.5	3/2$^-$	D+Q[#]	R_{ADO}=0.63 *7*.
656.0 *5*		656.2	1/2$^-$	0.0	3/2$^-$		
701.3 *5*	1.0 *2*	1609.1	5/2$^-$	907.7	5/2$^-$		
720.5 *6*	6.1 *6*	4018.3	15/2$^+$	3297.7	11/2$^+$	Q[@]	POL=+0.04 *4*, P_S=+0.46 *51*. R_{ADO}=1.31 *6*.
792.4 *3*	10.2 *6*	1807.3	9/2$^-$	1015.0	7/2$^-$	D+Q[#]	R_{ADO}=1.02 *9*. Iγ(792)/Iγ(1740)=0.61 *4* disagrees with 0.124 *23* in the Adopted dataset, where value is taken from (α,nγ).
798.7 *5*	5.2 *4*	4817.0	17/2$^+$	4018.3	15/2$^+$	D+Q[#]	POL=−0.01 *3*, P_S−0.07 *39*. R_{ADO}=0.71 *7*.
816.1 *5*	2.3 *2*	1099.5	3/2$^-$	283.1	1/2$^-$	D+Q[#]	R_{ADO}=0.88 *5*.
821.3 *5*		1729.0	3/2$^-$	907.7	5/2$^-$		
840.6 *4*	3.9 *4*	907.7	5/2$^-$	67.1	5/2$^-$	D+Q[#]	R_{ADO}=0.98 *8*.
903.2 *5*		1186.1	3/2$^-$	283.1	1/2$^-$		
907.7 *2*	21.8 *29*	907.7	5/2$^-$	0.0	3/2$^-$	M1+E2	POL=−0.03 *2*, P_S=−0.41 *42*. R_{ADO}=0.77 *3*.
908.4 *6*	4.6 *5*	4206.1	13/2$^+$	3297.7	11/2$^+$	D+Q[#]	R_{ADO}=0.76 *7*.
940.5 *5*	6.1 *4*	6190.7	19/2$^+$	5250.2	17/2$^+$	D[&]	R_{ADO}=0.82 *6*.
947.9 *2*	151.0 *38*	1015.0	7/2$^-$	67.1	5/2$^-$	(M1+E2)[#]	POL=−0.01 *1*, P_S=−0.17 *25*. DCO(Q)=0.76 *5*. R_{ADO}=0.98 *9*. Mult.: M1+E2 in 2019Sa04.
954.6 *3*	2.0 *5*	2409.2	9/2$^-$	1454.3	7/2$^-$		Iγ(955)/Iγ(2342)=0.83 *21* disagrees with 0.27 *3* in the Adopted Gammas, where value is from (α,nγ).
972.0 *4*	6.0 *5*	1987.0	9/2$^-$	1015.0	7/2$^-$	D+Q[#]	Iγ(972)/Iγ(1920)=0.45 *4* disagrees with 0.21 *4* in the Adopted dataset, where value is taken from (α,nγ). R_{ADO}=0.69 *7*.
982.4 *5*		1997.2	5/2$^-$	1015.0	7/2$^-$		
1015.1 *2*	50.2 *14*	1015.0	7/2$^-$	0.0	3/2$^-$	Q[@]	DCO(Q)=1.02 *2*, R_{ADO}=1.19 *4*.
1032.4 *5*		1099.5	3/2$^-$	67.1	5/2$^-$		
1041.8 *2*	11.9 *5*	4476.7	11/2$^+$	3434.9	13/2$^+$	M1+E2	POL=−0.05 *3*, P_S=−1.0 *10*. DCO(D)=1.07 *10*, R_{ADO}=0.98 *4*.
1065.4 *5*		1132.2	5/2$^-$	67.1	5/2$^-$		
1073.4 *6*		1729.0	3/2$^-$	656.2	1/2$^-$		
1079.2 *1*	19.8 *27*	1987.0	9/2$^-$	907.7	5/2$^-$	Q[@]	Iγ(1079)/Iγ(1920)=1.49 *20* disagrees with 0.32 *4* in the Adopted dataset, where value is taken from (α,nγ). POL=+0.02 *2*, P_S=+0.40 *58*. DCO(Q)=1.05 *4*. R_{ADO}=1.17 *4*.
1089.4 *5*	1.1 *2*	1997.2	5/2$^-$	907.7	5/2$^-$		
1098.8 *6*		1099.5	3/2$^-$	0.0	3/2$^-$	M1+E2	POL=−0.05 *3*, P_S−1.0 *11*. R_{ADO}=0.84 *7*.
1106.0 *2*	100	2120.9	9/2$^+$	1015.0	7/2$^-$	D[b]	POL=+0.02 *2*, P_S=+0.40 *49*. DCO(Q)=0.65 *1*. R_{ADO}=0.82 *3*.
1110.0 *5*		2017.8	7/2$^-$	907.7	5/2$^-$		
1113.5 *1*	83.6 *45*	2128.5	11/2$^-$	1015.0	7/2$^-$	E2	POL=+0.03 *1*, P_S=+0.70 *84*. DCO(Q)=0.99 *2*. R_{ADO}=1.27 *8*.
1119.4 *5*		1186.1	3/2$^-$	67.1	5/2$^-$		
1132.4 *5*		1132.2	5/2$^-$	0.0	3/2$^-$		
1176.8 *2*	23.6 *10*	3297.7	11/2$^+$	2120.9	9/2$^+$	D+Q[#]	R_{ADO}=1.04 *4*.
1186.0 *5*		1186.1	3/2$^-$	0.0	3/2$^-$		
1223.5 *5*	5.8 *5*	4521.2	13/2$^+$	3297.7	11/2$^+$	D+Q[#]	E_γ: uncertainty of 0.1 keV in Table I of 2019Sa04 could

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^{59}Co(^{7}Li,αnγ) 2019Sa04 (continued)

γ(^{61}Ni) (continued)

E_γ	I_γ[†]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[‡]	Comments
							be a misprint, as it seems low as compared to other $\Delta E\gamma$ values. Evaluator assigns 0.5 keV. POL=−0.03 *5*, P_S=−0.8 *15*. DCO(D)=1.09 *7*, R_{ADO}=1.02 *6*.
1270.9 *3*	1.2 *3*	3257.85	11/2$^-$	1987.0	9/2$^-$		
1277.0 *10*		2409.2	9/2$^-$	1132.2	5/2$^-$		
1291.5 *3*	8.5 *5*	5309.8	17/2$^+$	4018.3	15/2$^+$	M1+E2	POL=−0.07 *5*, P_S=−2.2 *30*. R_{ADO}=1.00 *6*.
1297.0 *2*	9.5 *5*	3425.6	13/2$^-$	2128.5	11/2$^-$	D+Q[#]	R_{ADO}=0.77 *3*.
1314.0 *1*	45.4 *16*	3434.9	13/2$^+$	2120.9	9/2$^+$	Q[@]	POL=+0.02 *2*, P_S=+0.53 *87*. R_{ADO}=1.27 *5*.
1386.9 *2*	2.9 *4*	1454.3	7/2$^-$	67.1	5/2$^-$	D+Q[#]	R_{ADO}=1.08 *9*. Iγ(1387)/Iγ(1454)=0.94 *25* disagrees with 0.30 *4* in the Adopted dataset, where value is taken from (n,γ) and (α,nγ).
1394.4 *2*	1.4 *3*	2409.2	9/2$^-$	1015.0	7/2$^-$	D+Q[#]	Iγ(1394)/Iγ(2342)=0.58 *13* disagrees with 0.15 *3* in the Adopted Gammas, where value is from (α,nγ). R_{ADO}=0.90 *9*.
1438.7 *2*	13.4 *7*	3425.6	13/2$^-$	1987.0	9/2$^-$	E2	POL=+0.029 *18*, P_S=+1.1 *17*. DCO(Q)=0.96 *2*. R_{ADO}=1.34 *7*.
1446.4 *5*		1729.0	3/2$^-$	283.1	1/2$^-$		
1450.5 *2*	2.6 *3*	3257.85	11/2$^-$	1807.3	9/2$^-$	D+Q[#]	POL=−0.02 *4*, P_S=−0.6 *18*. DCO(Q)=0.73 *4*. R_{ADO}=0.96 *7*.
1454.4 *5*	3.1 *7*	1454.3	7/2$^-$	0.0	3/2$^-$	Q[@]	POL=+0.01 *4*, P_S=+0.3 *16*. DCO(Q)=0.96 *7*. R_{ADO}=1.19 *5*.
1500.4 *4*	2.6 *3*	3621.3	11/2$^+$	2120.9	9/2$^+$	D+Q[#]	R_{ADO}=0.98 *8*.
1541.8 *5*	5.6 *7*	1609.1	5/2$^-$	67.1	5/2$^-$		
1542.5 *5*	4.0 *3*	3663.4	9/2$^+$	2120.9	9/2$^+$	D+Q[#]	POL=−0.04 *5*, P_S=−1.7 *36*. DCO(D)=1.58 *9*. R_{ADO}=0.87 *7*.
1578.6 *4*	6.2 *5*	6734.1	17/2$^+$	5155.4	15/2$^+$	D+Q[#]	POL=−0.01 *5*, P_S=−0.5 *28*. DCO(D)=1.01 *6*, R_{ADO}=0.95 *9*.
1589.5 *2*	3.5 *4*	3710.4	11/2$^+$	2120.9	9/2$^+$	D+Q[#]	2019Sa04 suggest that this γ ray may correspond to the 1587.8 in (n,γ). This is unlikely as the transition in (n,γ) is from a low-spin (J^π=1/2$^-$,3/2$^-$) level, whereas 2019Sa04 assign their 1589.4 transition from an 11/2$^+$ level. R_{ADO}=0.68 *5*.
1609.0 *5*		1609.1	5/2$^-$	0.0	3/2$^-$		
1618.5 *4*	5.3 *4*	3425.6	13/2$^-$	1807.3	9/2$^-$	Q[@]	POL=+0.02 *3*, P_S=+1.1 *28*. DCO(Q)=0.95 *6*, R_{ADO}=1.18 *7*.
1662.0 *10*		1729.0	3/2$^-$	67.1	5/2$^-$		
1720.5 *5*	9.5 *6*	5155.4	15/2$^+$	3434.9	13/2$^+$	D+Q[#]	POL=−0.03 *4*, P_S=−2.1 *62*. R_{ADO}=0.96 *5*.
1729.0 *10*		1729.0	3/2$^-$	0.0	3/2$^-$		
1740.4 *5*	16.7 *8*	1807.3	9/2$^-$	67.1	5/2$^-$	E2	POL=+0.07 *4*, P_S=+6 *16*. DCO(Q)=1.05 *5*. R_{ADO}=1.22 *7*.
1903.4 *10*	3.9 *3*	4031.9	13/2$^+$	2128.5	11/2$^-$	D+Q[a]	R_{ADO}=0.94 *7*.
1920.3 *5*	13.2 *6*	1987.0	9/2$^-$	67.1	5/2$^-$	Q[@]	POL=+0.02 *2*, P_S=+2 *13*. DCO(Q)=1.03 *4*. R_{ADO}=1.16 *4*.
1930.0 *10*	1.0 *2*	1997.2	5/2$^-$	67.1	5/2$^-$		Iγ(1930)/Iγ(1089)=0.91 *25* disagrees with 0.51 *8* in the Adopted Gammas, where value is from (n,γ) and (α,nγ).
1951.0 *10*	2.1 *3*	2017.8	7/2$^-$	67.1	5/2$^-$		
1972.3 *5*		3104.5	(7/2$^+$)	1132.2	5/2$^-$		
1997.0 *10*		1997.2	5/2$^-$	0.0	3/2$^-$		
2067.6 *15*	3.7 *6*	4196.7	13/2$^-$	2128.5	11/2$^-$	D+Q[#]	R_{ADO}=0.62 *10*.
2076.0 *10*	2.1 *4*	4196.7	13/2$^-$	2120.9	9/2$^+$		
2077.4 *10*	4.1 *4*	4206.1	13/2$^+$	2128.5	11/2$^-$	D+Q[a]	DCO(Q)=0.77 *5*. R_{ADO}=0.84 *8*.
2085.3 *15*	5.5 *4*	4206.1	13/2$^+$	2120.9	9/2$^+$	Q[@]	DCO(D)=1.50 *10*. R_{ADO}=1.28 *6*.
2110.3 *10*	1.1 *3*	3564.6	9/2$^+$	1454.3	7/2$^-$	D+Q[a]	R_{ADO}=0.99 *8*.
2124.0 *10*		2124.0	1/2$^-$	0.0	3/2$^-$		
2342.0 *10*	2.4 *3*	2409.2	9/2$^-$	67.1	5/2$^-$		

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^{59}Co(^{7}Li,αnγ) 2019Sa04 (continued)

$\gamma(^{61}Ni)$ (continued)

E_γ	I_γ[†]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[‡]	Comments
2405.9 *10*		3860.2	$(9/2^+)$	1454.3	$7/2^-$		
2635.1 *18*	2.6 *3*	4763.7	$13/2^+$	2128.5	$11/2^-$	D+Q[a]	R_{ADO}=0.93 *6*.
2870.5 *20*	2.1 *3*	4999.1	$(13/2^+)$	2128.5	$11/2^-$		
3035.4 *20*	2.6 *3*	5164.0	$(13/2^+)$	2128.5	$11/2^-$		

[†] From 2019Sa04. Evaluator notes that branching ratios in several cases disagree with previous fairly precise data from (n,γ) and (α,nγ), as noted in comments. There seems no discussion by 2019Sa04 about these disagreements.

[‡] From 2019Sa04 based on measured $\gamma\gamma(\theta)$(DCO), $\gamma\gamma(\theta)$(ADO) and $\gamma\gamma$(lin pol) data.

[#] 2019Sa04 assign M1+E2 from their $\gamma\gamma(\theta)$ data and, in some cases also from $\gamma\gamma$(lin pol), where POL value overlaps zero. Evaluator assigns D+Q in such cases based on experimental data, with the understanding that it is likely to be M1+E2, but not confirmed yet.

[@] 2019Sa04 assign E2 from their $\gamma\gamma(\theta)$ data and, in some cases also from $\gamma\gamma$(lin pol), where POL value overlaps zero. Evaluator assigns Q in such cases based on experimental data, with the understanding that it is likely to be E2, but not confirmed yet.

[&] 2019Sa04 assign M1 from their $\gamma\gamma(\theta)$ data and, in some cases also from $\gamma\gamma$(lin pol), where POL value overlaps zero. Evaluator assigns D in such cases based on experimental data.

[a] 2019Sa04 assign E1+M2 from their $\gamma\gamma(\theta)$ data and, in some cases also from $\gamma\gamma$(lin pol), where POL value overlaps zero. Evaluator assigns D+Q in such cases based on experimental data.

[b] 2019Sa04 assign E1 from their $\gamma\gamma(\theta)$ data and, in some cases also from $\gamma\gamma$(lin pol), where POL value overlaps zero. Evaluator assigns D in such cases based on experimental data.

^{59}Co(^{7}Li,αnγ) 2019Sa04

Level Scheme

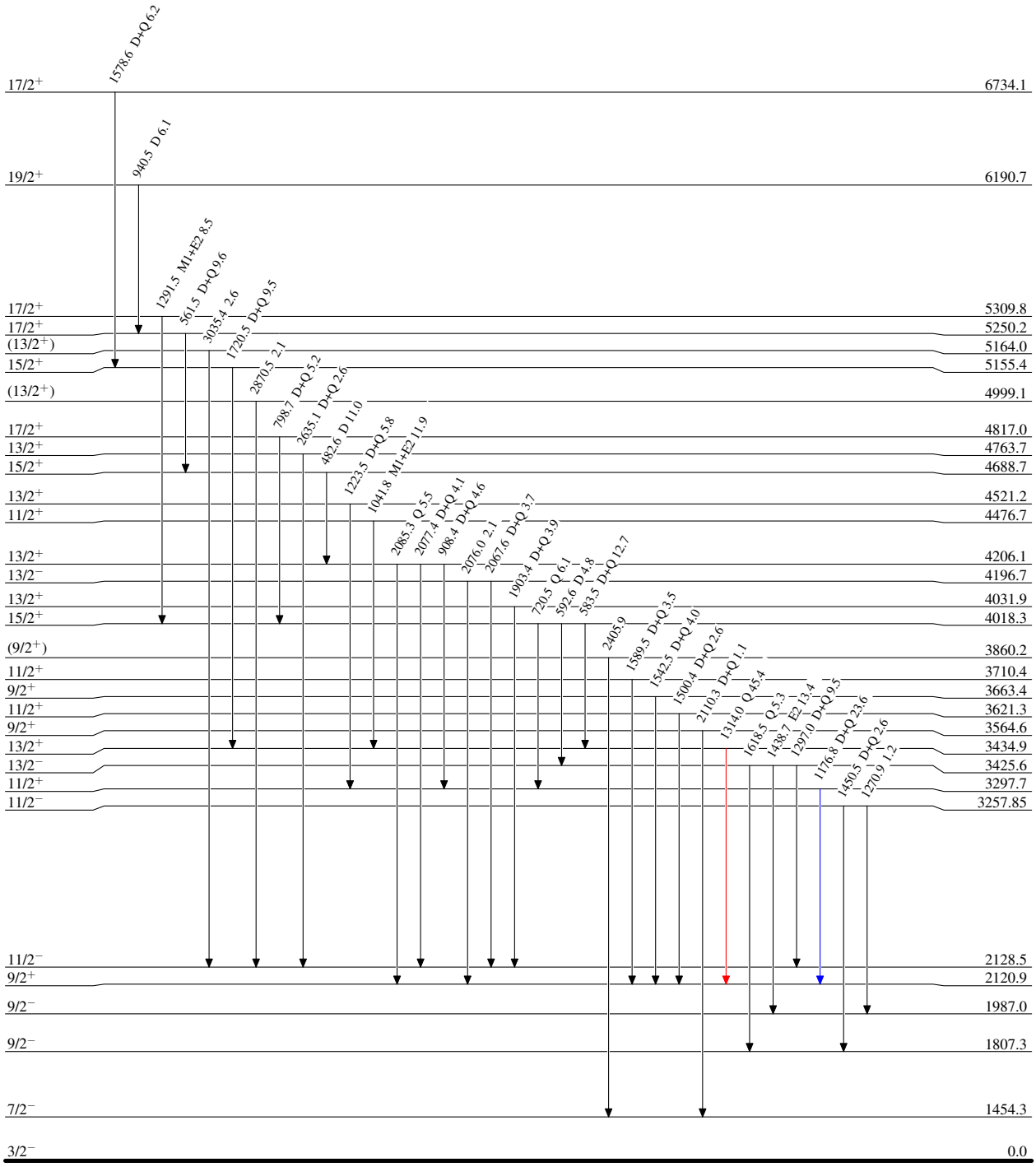
Intensities: Relative I_γ

Legend

$I_\gamma < 2\% \times I_\gamma^{max}$

$I_\gamma < 10\% \times I_\gamma^{max}$

$I_\gamma > 10\% \times I_\gamma^{max}$

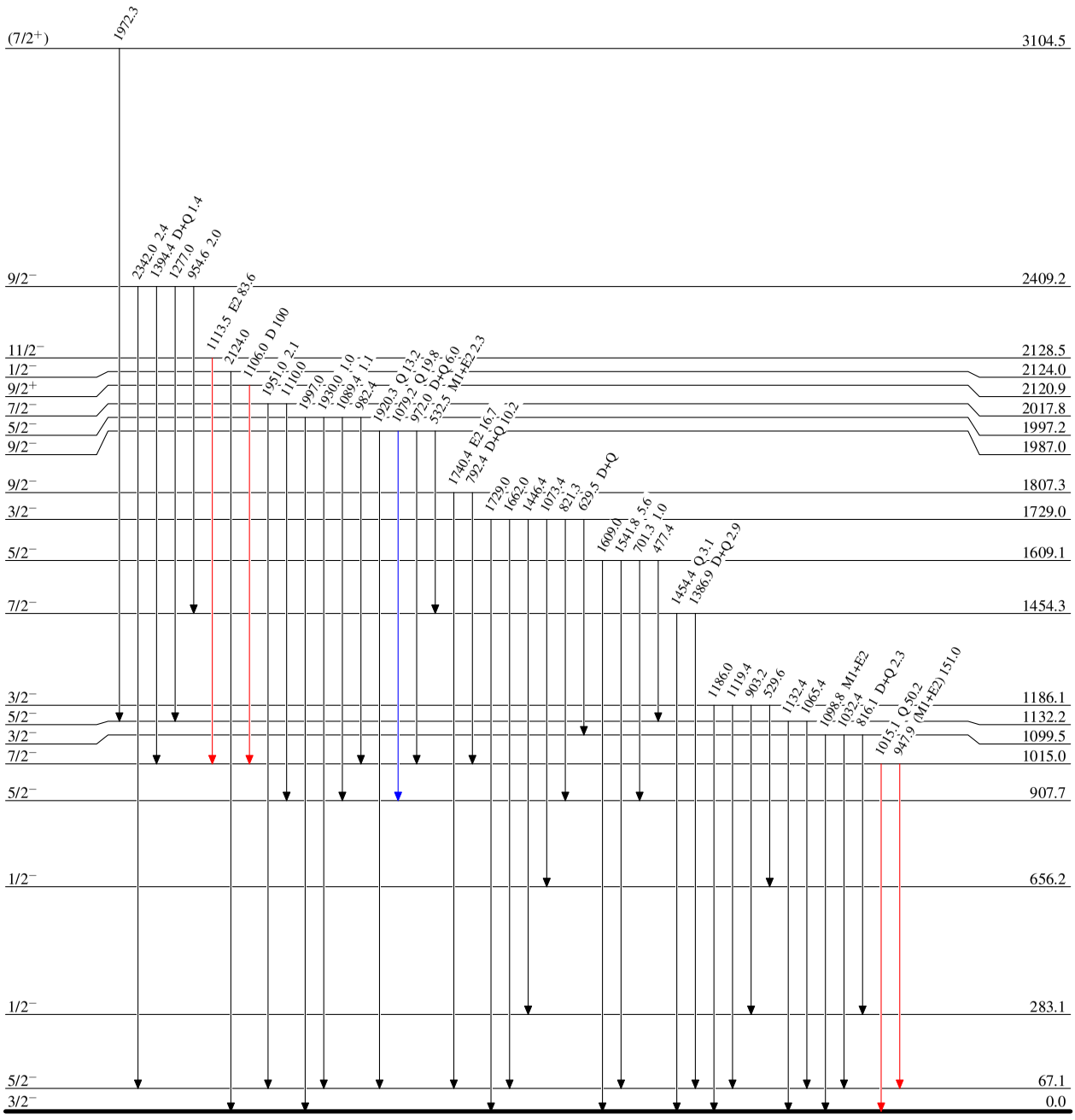


$^{61}_{28}Ni_{33}$

$^{59}Co(^{7}Li,\alpha n\gamma)$ 2019Sa04

Level Scheme (continued)

Intensities: Relative I_γ

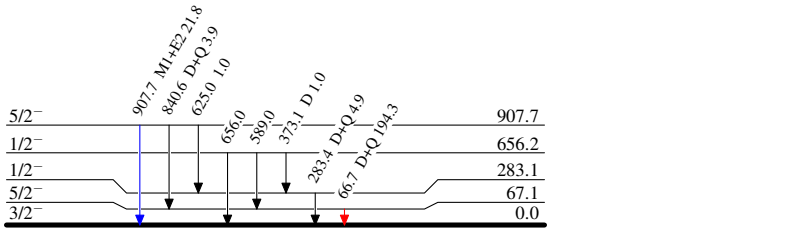


$^{61}_{28}Ni_{33}$

^{59}Co(^{7}Li,αnγ) 2019Sa04

Level Scheme (continued)

Intensities: Relative I_γ



$^{61}_{28}Ni_{33}$