^{58}Ni(^{32}S,2pnγ),^{40}Ca(^{50}Cr,2pnγ) 1991Wi15

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	T. D. Johnson and W. D. Kulp(a)	NDS 129, 1 (2015)	27-Jul-2015

^{58}Ni(^{32}S,2pnγ) with E(^{32}S)=110 MeV and ^{40}Ca(^{50}Cr,2pn) with E(^{50}Ca)=170 MeV. Measured $\gamma\gamma$ and n$\gamma\gamma$ coincidences with five Compton-suppressed Ge detectors, one neutron detector, and four charged-particle telescopes as well as a twenty Ge detector array. Level lifetimes were measured with the recoil-distance Doppler-shift and Doppler-shifted line-shape methods. Angular distributions are given for 14 γ's.

1993IDZY: ^{58}Ni(^{32}S,2pnγ) with E(^{32}S)=110-125 MeV Experiment done at NORDBALL with a Si Ball and a Neutron wall with 15 Compton-suppressed Ge detectors. These were preliminary results with analysis in progress. As the proposed level scheme is largely in agreement with 1991WI15 with the addition of a few new levels, it is included in this dataset. Where there are discrepencies, data from 1991WI15 is presented. Several other levels are are indicated in the report which appear to conflict with the published data and are not shown. Since the report from 1993IDZY indicates that these results are tentative, they are not included in the adopted set. Clearly, more work needs to be done on this isotope to clarify the situation.

^{87}Mo Levels

E(level)[†‡]	J$^\pi$[#]	T$_{1/2}$	Comments
0.[@]	(7/2$^+$)	14.02 s *26*	
31.56[@] *6*	(9/2$^+$)		
786.52[@] *19*	(11/2$^+$)		
847[a]			J$^\pi$: Proposed as (9/2$^-$) 1993IdZY based on systematics.
864.54[@] *9*	(13/2$^+$)	14 ps *4*	
1469[a]			J$^\pi$: Proposed as (11/2$^-$) in 1993IdZY based on systematics.
1773.00[@] *14*	(15/2$^+$)		
1863.57[@] *10*	(17/2$^+$)	14 ps *4*	
1969.83[&] *14*	(15/2)		J$^\pi$: proposed as (13/2$^-$) in 1993IdZY The evaluator notes that the presence of the 1123 transition does appear to make this proposal somewhat more likely assuming the proposed (9/2$^-$) assignment for the 847 keV level. Based as that is on preliminary report data, the older adopted J$^\pi$ is kept.
2283.70[&] *11*	(17/2)		
2695.98[&] *13*	(19/2)		
2742.17[@] *12*	(21/2$^+$)	1.2 ps *5*	
2770[a]			
2963.3 *16*	(21/2$^+$)		
3134.97[&] *13*	(21/2)		
3200[a]			
3382.62[@] *13*	(23/2$^+$)		
3600.33[@] *13*	(25/2$^+$)	1.1 ps *5*	
3618.75[&] *14*	(23/2)		
3780[a]			
3919[a]			
4161.34[&] *15*	(25/2)		
4384.82[@] *17*	(27/2$^+$)		
4550.72[@] *16*	(29/2$^+$)		
4713.09[&] *17*	(27/2)		
5253.77[&] *19*	(29/2)		
5302.51[@] *21*	(31/2$^+$)		
5670.12[@] *19*	(33/2$^+$)	0.46 ps *7*	
5857.66[&] *23*	(31/2)		

Continued on next page (footnotes at end of table)

^{58}Ni(^{32}S,2pnγ),^{40}Ca(^{50}Cr,2pnγ) 1991Wi15 (continued)

^{87}Mo Levels (continued)

E(level)[†‡]	Jπ[#]	$T_{1/2}$
6368.35[&] *23*	(33/2)	
6945.82[@] *21*	(37/2$^+$)	0.24 ps *7*
8354.95[@] *23*	(41/2$^+$)	<0.3 ps
10004.4[@] *3*	(45/2$^+$)	
11838.4[@] *7*	(49/2$^+$)	

[†] From least-squares fit to γ energies not using Eγ data of 1993IDZY as this was a secondary reference.
[‡] Taken from 1991Wi15, unless otherwise noted.
[#] From γ-ray multipolarities, decay patterns, and expected band structure.
[@] Band(A): yrast band based on ground state.
[&] Band(B): second band, probably negative parity.
[a] From 1993IdZY.

γ(^{87}Mo)

E_γ ‡#	I_γ	E_i(level)	J^π_i	E_f	J^π_f	Mult.†	δ	α&	Comments
31.55 *6*	180	31.56	(9/2$^+$)	0.	(7/2$^+$)	M1+E2	0.27 *+18−13*	13.6 *48*	α(K)=6.08 *10*; α(L)=0.736 *12*; α(M)=0.1319 *20* α(N)=0.0199 *3*; α(O)=0.001085 *17* α: Symmetrized from α\$ α(exp) = 11.5 *+69−31* from intensity balance in ^{58}Ni(^{32}S,2pn). Mult.,δ: From α(exp). I_γ: uncertainty given as +120-90. Mult.,δ: from α(exp) of 11.5 *+69−31* calculated from intensity balance in ^{58}Ni(^{32}S,2pn). A small mixture of E2, δ=0.05 *+12−4*, is allowed.
165.87 *15*	36 *6*	4550.72	(29/2$^+$)	4384.82	(27/2$^+$)	D			Angular distribution: A_2=−0.47 *10*, A_4=+0.21 *18*.
217.78 *7*	48 *6*	3600.33	(25/2$^+$)	3382.62	(23/2$^+$)	D(+Q)			Angular distribution: A_2=−0.38 *7*, A_4=−0.07 *10*.
^{x}221.6 *3*									
^{x}274.6 *3*									
^{x}290.5 *3*									
313.76 *9*	35 *6*	2283.70	(17/2)	1969.83	(15/2)	D			Angular distribution: A_2=−0.27 *5*, A_4=−0.01 *7*.
367.61 *9*	41 *5*	5670.12	(33/2$^+$)	5302.51	(31/2$^+$)	D(+Q)			Angular distribution: A_2=−0.41 *7*, A_4=+0.05 *11*.
412.23 *7*	219 *16*	2695.98	(19/2)	2283.70	(17/2)	D			Angular distribution: A_2=−0.57 *3*, A_4=0.00 *4*.
420.22 *6*	114 *7*	2283.70	(17/2)	1863.57	(17/2$^+$)				Angular distribution: A_2=+0.46 *5*, A_4=−0.10 *8* consistent with ΔJ=0 (1991Wi15).
439.05 *9*	96 *12*	3134.97	(21/2)	2695.98	(19/2)				
483.81 *8*	52 *12*	3618.75	(23/2)	3134.97	(21/2)				
^{x}490.9 *3*									
501@		1969.83	(15/2)	1469					
504@		3200		2695.98	(19/2)				E_γ: Likely the unplaced 504.3 *3* keV transtion seen reported in 1991Wi15.
510.54 *11*	270 *54*	2283.70	(17/2)	1773.00	(15/2$^+$)	(D)			Angular distribution: A_2=−0.10 *5*, A_4=−0.06 *6*.
540.57 *20*	55 *20*	5253.77	(29/2)	4713.09	(27/2)				I_γ: Doublet with a 540 keV transition in ^{84}Zr, 1991Wi15.
542.27 *20*	55 *20*	4161.34	(25/2)	3618.75	(23/2)				I_γ: Doublet with a 540 keV transition in ^{84}Zr, 1991Wi15.
551.72 *20*	58 *21*	4713.09	(27/2)	4161.34	(25/2)				
580@		3780		3200					E_γ: Likely the unplaced 580.4 *3* keV transition seen in 1991Wi15.
622@		1469		847					
640.51 *7*	63 *8*	3382.62	(23/2$^+$)	2742.17	(21/2$^+$)	D			Angular distribution: A_2=−0.43 *6*, A_4=+0.15 *9*.
751.9 *8*	40 *20*	5302.51	(31/2$^+$)	4550.72	(29/2$^+$)				
755.3 *4*		786.52	(11/2$^+$)	31.56	(9/2$^+$)				
784.46 *14*	40 *20*	4384.82	(27/2$^+$)	3600.33	(25/2$^+$)				
787.1 *4*		786.52	(11/2$^+$)	0.	(7/2$^+$)				
800@		2770		1969.83	(15/2)				
815@		847		31.56	(9/2$^+$)				E_γ: Likely the 814.5 *3* keV transition reported in 1991Wi15.
832.7^a *5*	5 *5*	2695.98	(19/2)	1863.57	(17/2$^+$)				

$^{87}_{42}$Mo$_{45}$-3

^{58}Ni(^{32}S,2pnγ),^{40}Ca(^{50}Cr,2pnγ) 1991Wi15 (continued)

γ(^{87}Mo) (continued)

E_γ[‡#]	I_γ	E_i(level)	J^π_i	E_f	J^π_f	Mult.[†]	α[&]	Comments
832.95 *6*	1000	864.54	(13/2$^+$)	31.56	(9/2$^+$)	E2	1.19×10^{-3} *2*	α(K)=0.001046 *15*; α(L)=0.0001200 *17*; α(M)=2.14×10^{-5} *3* α(N)=3.25×10^{-6} *5*; α(O)=1.79×10^{-7} *3* Angular distribution: A_2=+0.39 *2*, A_4=−0.13 *3*.
^{x}842.5 *3*								
851.34 *8*	179 *16*	3134.97	(21/2)	2283.70	(17/2)	E2	1.13×10^{-3} *2*	α(K)=0.000992 *14*; α(L)=0.0001136 *16*; α(M)=2.03×10^{-5} *3* α(N)=3.07×10^{-6} *5*; α(O)=1.697×10^{-7} *24* Angular distribution: A_2=+0.5 *1*, A_4=−0.17 *13*.
858.11 *6*	216 *12*	3600.33	(25/2$^+$)	2742.17	(21/2$^+$)	E2	1.11×10^{-3} *2*	α(K)=0.000973 *14*; α(L)=0.0001114 *16*; α(M)=1.99×10^{-5} *3* α(N)=3.01×10^{-6} *5*; α(O)=1.665×10^{-7} *24* Angular distribution: A_2=+0.39 *5*, A_4=−0.16 *7*.
878.60 *6*	501 *21*	2742.17	(21/2$^+$)	1863.57	(17/2$^+$)	E2	1.05×10^{-3}	α(K)=0.000919 *13*; α(L)=0.0001051 *15*; α(M)=1.88×10^{-5} *3* α(N)=2.84×10^{-6} *4*; α(O)=1.574×10^{-7} *22* Angular distribution: A_2=+0.39 *3*, A_4=−0.17 *4*.
907.7 *2*		1773.00	(15/2$^+$)	864.54	(13/2$^+$)			E_γ: level energy difference is 908.45 *11*. E The significant deviation of the energy level E and contribution to a large chi-square fit to the E level energies suggest a larger uncertainty than given.
922.63 *9*	103 *19*	3618.75	(23/2)	2695.98	(19/2)			
950.39 *11*	148 *13*	4550.72	(29/2$^+$)	3600.33	(25/2$^+$)	E2	8.69×10^{-4} *13*	α(K)=0.000764 *11*; α(L)=8.69×10^{-5} *13*; α(M)=1.550×10^{-5} *22* α(N)=2.35×10^{-6} *4*; α(O)=1.309×10^{-7} *19* Angular distribution: A_2=+0.29 *7*, A_4=+0.06 *11*.
986.7 *2*		1773.00	(15/2$^+$)	786.52	(11/2$^+$)			
999.12 *6*	669 *25*	1863.57	(17/2$^+$)	864.54	(13/2$^+$)	E2	7.74×10^{-4} *2*	α(K)=0.000681 *10*; α(L)=7.72×10^{-5} *11*; α(M)=1.377×10^{-5} *20* α(N)=2.09×10^{-6} *3*; α(O)=1.168×10^{-7} *17* Angular distribution: A_2=+0.34 *2*, A_4=−0.13 *3*.
1026.49 *11*	106 *21*	4161.34	(25/2)	3134.97	(21/2)			
^{x}1048.8 *5*								
1092.48 *15*	73 *30*	5253.77	(29/2)	4161.34	(25/2)			
1094.28 *15*	80 *30*	4713.09	(27/2)	3618.75	(23/2)			
1099.7 *1*	65 *8*	2963.3	(21/2$^+$)	1863.57	(17/2$^+$)			E_γ: In Table 1 of 1991Wi15, this γ transition was shown depopulating a level at 3842 keV and feeding a 17/2$^+$ level. However, this would feed the 2743 keV level at 21/2$^+$. On the other hand, their level scheme shows this transition to come from the 2963 keV level, and this is in agreement with the level scheme shown in 1993IdZY.
1104.1 *3*	22 *6*	1969.83	(15/2)	864.54	(13/2$^+$)			E_γ: level energy difference is 1105.28 *11*. E The significant deviation of the energy level E and contribution to a large chi-square fit to the E level energies suggest a larger uncertainty than given.
1114.57 *12*	61 *20*	6368.35	(33/2)	5253.77	(29/2)			
1119.39 *9*	179 *9*	5670.12	(33/2$^+$)	4550.72	(29/2$^+$)	(E2)	6.01×10^{-4} *9*	α(K)=0.000528 *8*; α(L)=5.95×10^{-5} *9*; α(M)=1.062×10^{-5} *15* α(N)=1.614×10^{-6} *23*; α(O)=9.07×10^{-8} *13*; α(IPF)=1.130×10^{-6} *17*
1123[@]		1969.83	(15/2)	847				
1144.57 *15*	70 *35*	5857.66	(31/2)	4713.09	(27/2)			

$^{87}_{42}Mo_{45}$-4

^{58}Ni(^{32}S,2pnγ),^{40}Ca(^{50}Cr,2pnγ)   1991Wi15 (continued)

γ(^{87}Mo) (continued)

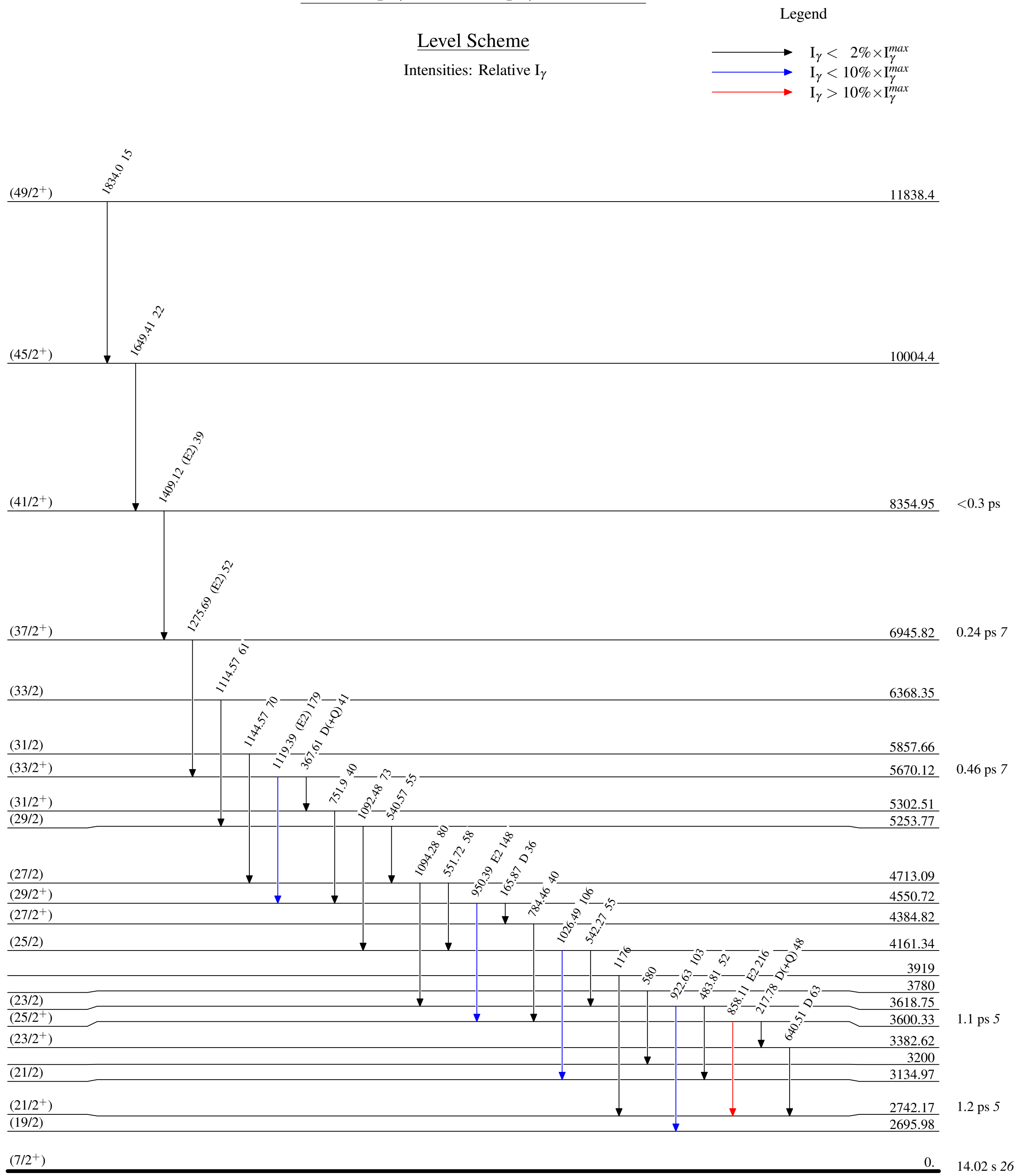
E_γ [‡#]	I_γ	E_i(level)	J^π_i	E_f	J^π_f	Mult. [†]	α [&]	Comments
1176 [@]		3919		2742.17	(21/2$^+$)			
1275.69 *9*	52 *13*	6945.82	(37/2$^+$)	5670.12	(33/2$^+$)	(E2)	4.74×10^{-4} *7*	α(K)=0.000399 *6*; α(L)=4.47×10^{-5} *7*; α(M)=7.98×10^{-6} *12* α(N)=1.214×10^{-6} *17*; α(O)=6.86×10^{-8} *10*; α(IPF)=2.10×10^{-5} *3*
1409.12 *11*	39 *17*	8354.95	(41/2$^+$)	6945.82	(37/2$^+$)	(E2)	4.23×10^{-4} *6*	α(K)=0.000325 *5*; α(L)=3.63×10^{-5} *5*; α(M)=6.47×10^{-6} *9* α(N)=9.85×10^{-7} *14*; α(O)=5.60×10^{-8} *8*; α(IPF)=5.34×10^{-5} *8*
1649.41 *11*	22 *10*	10004.4	(45/2$^+$)	8354.95	(41/2$^+$)			
1834.0 *6*	15 *10*	11838.4	(49/2$^+$)	10004.4	(45/2$^+$)			

† Assigned by evaluator from angular distributions and authors′ comments (1991WI15). Quadrupole transitions are assumed by the evaluator to be E2 rather than M2.
‡ From 1991Wi15 unless otherwise noted.
# Uncertainties assumed to be 1 keV if unavailable.
@ From 1993IdZY.
& Additional information 1.
^{a} Placement of transition in the level scheme is uncertain.
^{x} γ ray not placed in level scheme.

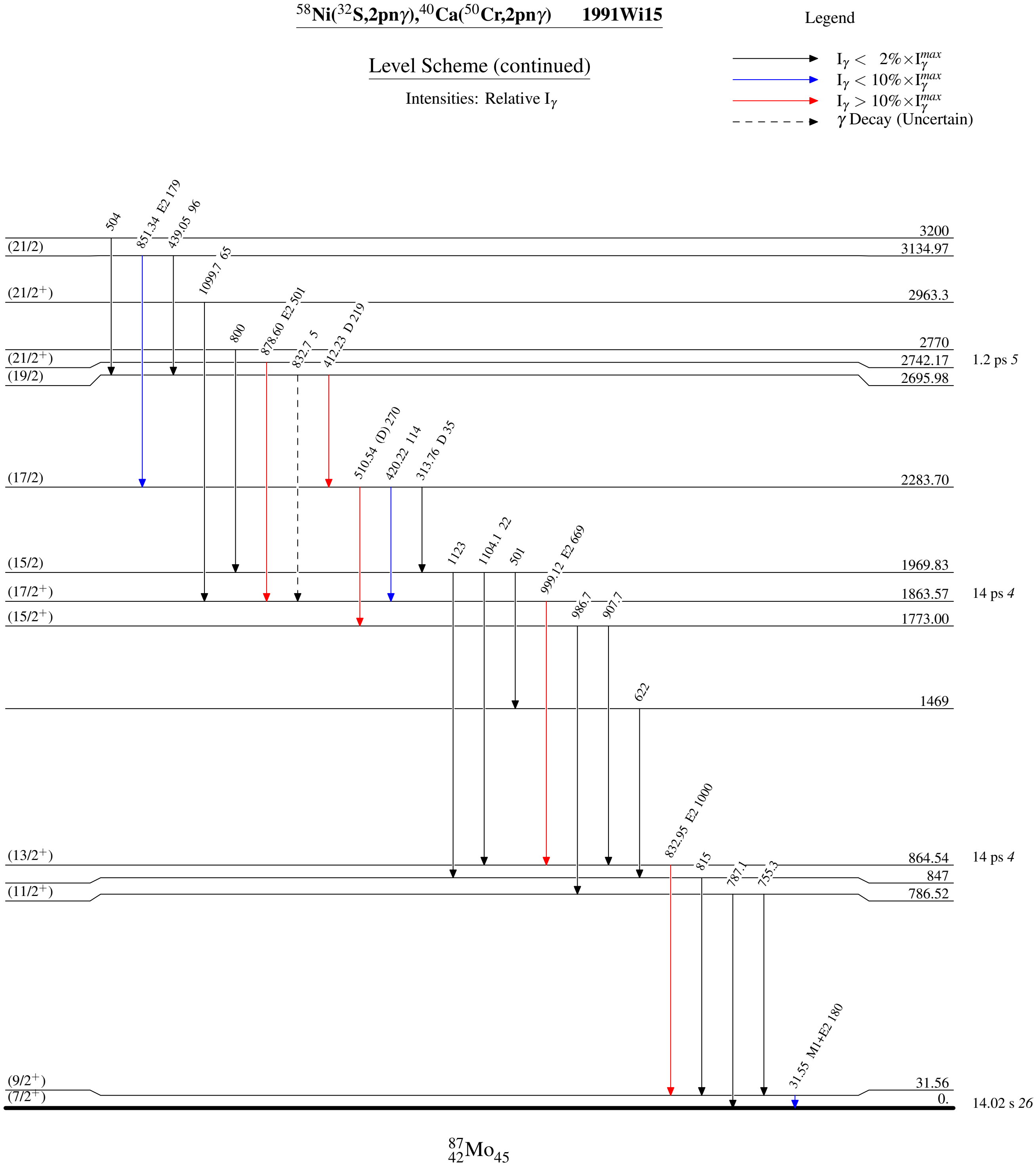
^{58}Ni(^{32}S,2pγ),^{40}Ca(^{50}Cr,2pγ) 1991Wi15

Level Scheme

Intensities: Relative I_γ

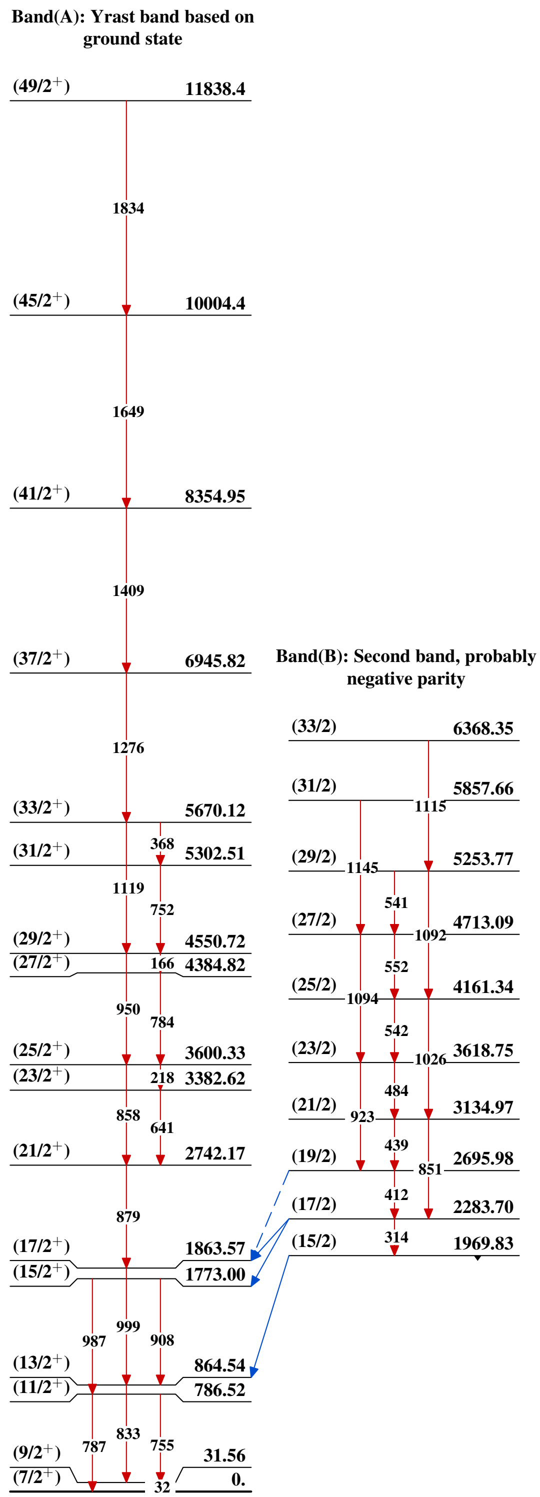


$^{87}_{42}Mo_{45}$



^{58}Ni(^{32}S,2pnγ),^{40}Ca(^{50}Cr,2pnγ) 1991Wi15
Level Scheme (continued)
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)
3200
(21/2) 3134.97
(21/2+) 2963.3
2770
(21/2+) 2742.17 1.2 ps 5
(19/2) 2695.98
(17/2) 2283.70
(15/2) 1969.83
(17/2+) 1863.57 14 ps 4
(15/2+) 1773.00
1469
(13/2+) 864.54 14 ps 4
847
(11/2+) 786.52
(9/2+) 31.56
(7/2+) 0. 14.02 s 26
504
851.34 E2 179
439.05 96
1099.7 65
800
878.60 E2 501
832.7 5
412.23 D 219
510.54 (D) 270
420.22 114
313.76 D 35
1123
1104.1 22
501
999.12 E2 669
986.7
907.7
622
832.95 E2 1000
815
787.1
755.3
31.55 M1+E2 180
$^{87}_{42}Mo_{45}$

$^{58}Ni(^{32}S,2pn\gamma),^{40}Ca(^{50}Cr,2pn\gamma)$ 1991Wi15



$^{87}_{42}Mo_{45}$