^{58}Ni(^{19}F,α2pγ) 1994Zi01

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh and Jun Chen	NDS 188,1 (2023)	17-Jan-2023

1994Zi01: E=62 MeV ^{19}F beam from the tandem accelerator facility of Florida State University. Enriched (99.9%) target. Charged particles were detected with a segmented phoswich detector array and ΔE-E telescope detectors consisting of plastic scintillators and γ rays were detected with four Ge detectors. Measured Eγ, Iγ, $\gamma\gamma$- and (particle)γ coin, $\gamma\gamma(\theta)$(DCO), and Doppler-shift attenuation. Deduced levels, J, π, band structures, γ-ray multipolarities. Comparison with theoretical calculations. See also 2011Ka10 from the same laboratory, where ^{54}Fe(^{23}Na,α2pγ) reaction was used.

^{71}As Levels

Q_t=transition quadrupole moment deduced by 1994Zi01 from lifetime measurements.

E(level)[†]	J$^\pi$[‡]	$T_{1/2}$[#]	Comments
0.0	$5/2^-$		
147.47 *10*	$3/2^-$		
924.60 *14*	$7/2^-$		
1000.23[a] *10*	$9/2^+$	19.8 ns *3*	$T_{1/2}$: from the Adopted Levels.
1129.28 *23*	$(5/2^+)$		
1394.44 *15*	$9/2^-$	>1.4 ps	γ to 1000.2 level was not seen, Iγ<2% (1994Zi01).
1714.24[a] *13*	$13/2^+$		Q_t=1.90 *+11−9*.
1728.6 *3*			
1798.26[@] *19*	$9/2^-$		
1816.7 *3*			
1904.27 *19*	$11/2^+$	>1.4 ps	
2110.85[&] *16*	$11/2^-$		
2416.10 *19*	$13/2^+$		
2469.65[@] *16*	$13/2^-$	>1.4 ps	Q_t<0.98 or <2.0.
2689.15[a] *17*	$17/2^+$	0.48 ps *15*	Q_t=2.2 *+5−3*.
2748.3 *4*	$(13/2^+)$		
2793.17 *16*	$15/2^+$	>1.4 ps	
2920.79[&] *18*	$15/2^-$		
3237.2 *3*	$(17/2^+)$		
3290.17[@] *18*	$17/2^-$	1.29 ps *23*	Q_t=2.10 *+22−16*.
3601.9 *3*	$17/2^{(+)}$		
3789.23[a] *24*	$21/2^+$	0.29 ps *13*	Q_t=2.0 *+7−3*.
3916.69[&] *22*	$(19/2^-)$		
4233.7[@] *3*	$21/2^-$	0.59 ps *16*	Q_t=2.08 *+36−23*.
4372.1? *3*			
4417.3 *3*	$19/2^{(-)}$		
4463.4 *3*	$19/2^{(-)}$		J$^\pi$: parity from Fig. 5 of 1994Zi01, given as positive in authors′ Table I.
4763.9 *3*	$21/2^{(-)}$		
5022.0[a] *5*	$25/2^+$	0.21 ps *7*	Q_t=1.74 *+39−23*.
5073.3?[&] *5*	$(23/2^-)$		
5370.3[@] *4*	$25/2^-$	0.23 ps *8*	Q_t=2.0 *+5−3*.
5823.0 *4*	$23/2^{(-)}$	>1.4 ps	
5906.4? *5*			
6360.5[a] *7*	$(29/2^+)$		
6671.6[@] *7*	$(29/2^-)$	<0.13 ps	Q_t>1.93.

[†] From a least-squares fit to Eγ data.

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^{58}Ni(^{19}F,α2pγ) 1994Zi01 (continued)

^{71}As Levels (continued)

‡ As proposed in 1994Zi01 based on $\gamma\gamma(\theta)$(DCO) data, band structures and decay pattern of levels. The assignments in Adopted Levels are consistent, except that several are listed there in parentheses since strong arguments for definite assignments seem to be lacking.
# From DSAM (1994Zi01).
@ Band(A): Band based on 9/2$^-$, α=+1/2. From lifetime measurements, transition quadrupole moment is ≈2, which suggests moderate to high collectivity.
& Band(a): Band based on 11/2$^-$, α=−1/2. See comment for α=+1/2 signature partner.
a Band(B): $\pi g_{9/2}$ band. From lifetime measurements, transition quadrupole moment is ≈2, which suggests moderate to high collectivity.

$\gamma(^{71}As)$

DCO ratios correspond to gates on ΔJ=2, quadrupole transitions. Expected DCO ratio is about 1.0 for ΔJ=2, quadrupole, 0.5 for ΔJ=1, dipole and between 0 and 2 for ΔJ=1, dipole+quadrupole transitions. There is only one (701.9γ) ΔJ=0 transition according to 1994Zi01.

E_γ	I_γ†	E_i(level)	J_i^π	E_f	J_f^π	Mult.‡	δ	Comments
147.5 *1*	22 *4*	147.47	3/2$^-$	0.0	5/2$^-$			
300.5 *1*	6 *1*	4763.9	21/2$^{(-)}$	4463.4	19/2$^{(-)}$	(M1+E2)	≈−0.5	DCO=1.29 *9*
312.6 *3*	2 *1*	2110.85	11/2$^-$	1798.26	9/2$^-$	D+Q		DCO=0.36 *12*
346.6 *1*	4 *1*	4763.9	21/2$^{(-)}$	4417.3	19/2$^{(-)}$	(D+Q)		DCO=1.20 *10*
451.2 *2*	5 *2*	2920.79	15/2$^-$	2469.65	13/2$^-$	D+Q		DCO=0.62 *10*
455.4@& *2*	5 *1*	4372.1?		3916.69	(19/2$^-$)	D+Q		DCO=0.35 *10*
470.1 *3*	≈1	1394.44	9/2$^-$	924.60	7/2$^-$			
511.9 *5*	12 *5*	2416.10	13/2$^+$	1904.27	11/2$^+$			
x570.4#								
599.3 *2*	2 *1*	1728.6		1129.28	(5/2$^+$)			
626.5 *2*	7 *2*	3916.69	(19/2$^-$)	3290.17	17/2$^-$	D+Q		DCO=0.51 *10*
671.5 *3*	7 *2*	2469.65	13/2$^-$	1798.26	9/2$^-$	(E2)		DCO=1.04 *17*
679.5 *3*	2 *1*	3916.69	(19/2$^-$)	3237.2	(17/2$^+$)			
687.4 *2*	2 *1*	1816.7		1129.28	(5/2$^+$)			
701.9 *2*	6 *1*	2416.10	13/2$^+$	1714.24	13/2$^+$	D+Q		DCO=0.74 *9* Mult.: ΔJ=0 transition.
714.0 *1*	70 *5*	1714.24	13/2$^+$	1000.23	9/2$^+$	Q		DCO=1.06 *5*
716.6 *3*	2 *1*	2110.85	11/2$^-$	1394.44	9/2$^-$			
777.4 *3*	3 *2*	924.60	7/2$^-$	147.47	3/2$^-$			
808.7 *3*	6 *2*	3601.9	17/2$^{(+)}$	2793.17	15/2$^+$	D+Q		DCO=0.27 *8*
809.9 *2*	6 *2*	2920.79	15/2$^-$	2110.85	11/2$^-$	(Q)		DCO=0.92 *13*
820.5 *1*	22 *3*	3290.17	17/2$^-$	2469.65	13/2$^-$	E2		DCO=1.02 *7*
821.2 *3*	6 *2*	3237.2	(17/2$^+$)	2416.10	13/2$^+$	(Q)		DCO=1.10 *11*
844.0 *3*	4 *2*	2748.3	(13/2$^+$)	1904.27	11/2$^+$	D+Q		DCO=0.34 *9*
861.5 *3*	3 *2*	4463.4	19/2$^{(-)}$	3601.9	17/2$^{(+)}$	D		DCO=0.66 *17*
873.7 *2*	8 *2*	1798.26	9/2$^-$	924.60	7/2$^-$	D+Q		DCO=0.44 *11*
889.0 *3*	3 *1*	2793.17	15/2$^+$	1904.27	11/2$^+$			
904.1 *2*	17 *2*	1904.27	11/2$^+$	1000.23	9/2$^+$	D+Q		DCO=0.28 *5*
x924.1#								
924.6 *2*	11 *3*	924.60	7/2$^-$	0.0	5/2$^-$	D+Q		DCO=0.36 *8*
943.5 *2*	12 *2*	4233.7	21/2$^-$	3290.17	17/2$^-$	E2		DCO=1.05 *9*
974.7 *3*	2 *1*	4763.9	21/2$^{(-)}$	3789.23	21/2$^+$			
974.9 *1*	41 *4*	2689.15	17/2$^+$	1714.24	13/2$^+$	E2		DCO=0.98 *5*
981.8 *2*	6 *1*	1129.28	(5/2$^+$)	147.47	3/2$^-$			
995.9 *3*	9 *3*	3916.69	(19/2$^-$)	2920.79	15/2$^-$	(Q)		DCO=1.28 *22*

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^{58}Ni(^{19}F,α2pγ) 1994Zi01 (continued)

γ(^{71}As) (continued)

E_γ	I_γ[†]	E_i(level)	J_i^π	E_f	J_f^π	Mult.[‡]	Comments
1000.2 *1*	100	1000.23	$9/2^+$	0.0	$5/2^-$	Q	DCO=1.03 *4*
1059.1 *2*	10 *3*	5823.0	$23/2^{(-)}$	4763.9	$21/2^{(-)}$	D+Q	DCO=0.68 *7*
1075.2 *1*	21 *3*	2469.65	$13/2^-$	1394.44	$9/2^-$	(E2)	DCO=1.06 *8*
1078.9 *1*	20 *2*	2793.17	$15/2^+$	1714.24	$13/2^+$	D+Q	DCO=0.17 *5*
1100.1 *2*	19 *2*	3789.23	$21/2^+$	2689.15	$17/2^+$	E2	DCO=1.06 *7*
1110.4 *3*	4 *2*	2110.85	$11/2^-$	1000.23	$9/2^+$		
1136.6 *3*	7 *2*	5370.3	$25/2^-$	4233.7	$21/2^-$	E2	DCO=1.02 *19*
1142.5 *4*	4 *2*	5906.4?		4763.9	$21/2^{(-)}$		
1156.6[&] *4*	≈2	5073.3?	$(23/2^-)$	3916.69	$(19/2^-)$		
1186.2 *2*	7 *2*	2110.85	$11/2^-$	924.60	$7/2^-$	(Q)	DCO=0.80 *20*
1206.4 *4*	8 *2*	2920.79	$15/2^-$	1714.24	$13/2^+$	D	DCO=0.54 *9*
1227.2[&] *5*	3 *2*	3916.69	$(19/2^-)$	2689.15	$17/2^+$		
1232.8 *4*	10 *2*	5022.0	$25/2^+$	3789.23	$21/2^+$	E2	DCO=1.25 *22*
1301.3 *5*	2 *1*	6671.6	$(29/2^-)$	5370.3	$25/2^-$		
1338.4 *4*	3 *2*	6360.5	$(29/2^+)$	5022.0	$25/2^+$		
1394.4 *2*	22 *3*	1394.44	$9/2^-$	0.0	$5/2^-$	(E2)	DCO=1.09 *9*
[x]1403.2[#]							
1415.7 *4*	3 *1*	2416.10	$13/2^+$	1000.23	$9/2^+$	(Q)	DCO=0.76 *25*
1728.2 *5*	6 *1*	4417.3	$19/2^{(-)}$	2689.15	$17/2^+$	D	DCO=0.62 *8*
1773.9 *5*	6 *1*	4463.4	$19/2^{(-)}$	2689.15	$17/2^+$	D	DCO=0.71 *9*

[†] For 90° data.
[‡] From $\gamma\gamma(\theta)$(DCO) data and RUL. 1994Zi01 assigned E2, M1+E2 or E1 multipolarities based on DCO ratios and ΔJ^π in the level scheme. The evaluators have assigned mult=Q for ΔJ=2, quadrupole and D or D+Q for ΔJ=1 transitions, when information about level lifetimes and γ-ray mixing ratio is absent. From systematics, the quadrupole transitions are expected to be E2 (M2 for 1000.2γ is an exception), and D+Q transitions are expected to be M1+E2, when mixing ratio is significant.
[#] In coincidence with 714γ and 1000γ. Not placed in level scheme due to poor statistics.
[@] Seen in many coincidence spectra thus assignment to ^{71}As is secure but placement from a level higher than 4372 level is not ruled out.
[&] Placement of transition in the level scheme is uncertain.
[x] γ ray not placed in level scheme.

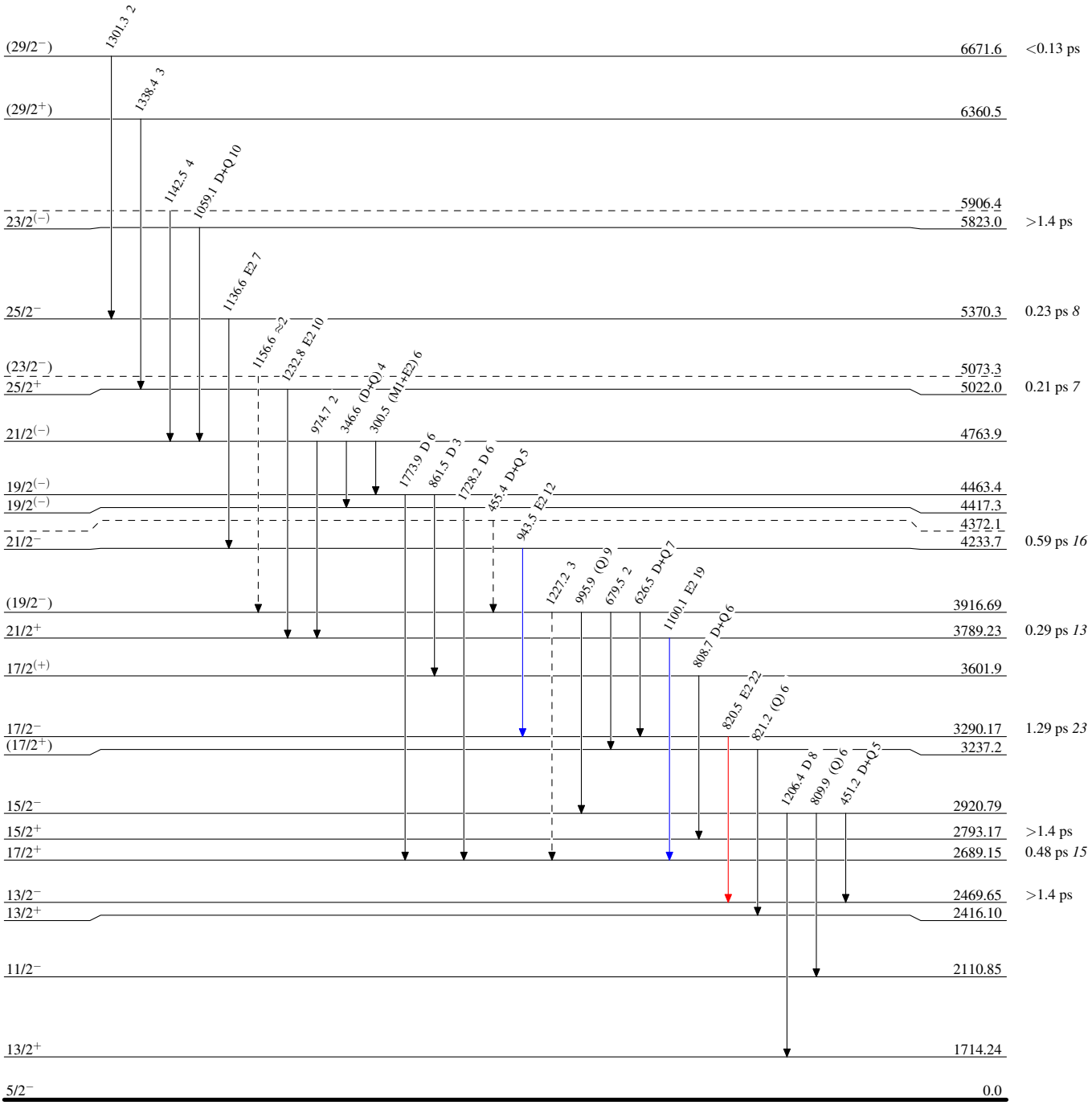
^{58}Ni(^{19}F,α2pγ) 1994Zi01

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)

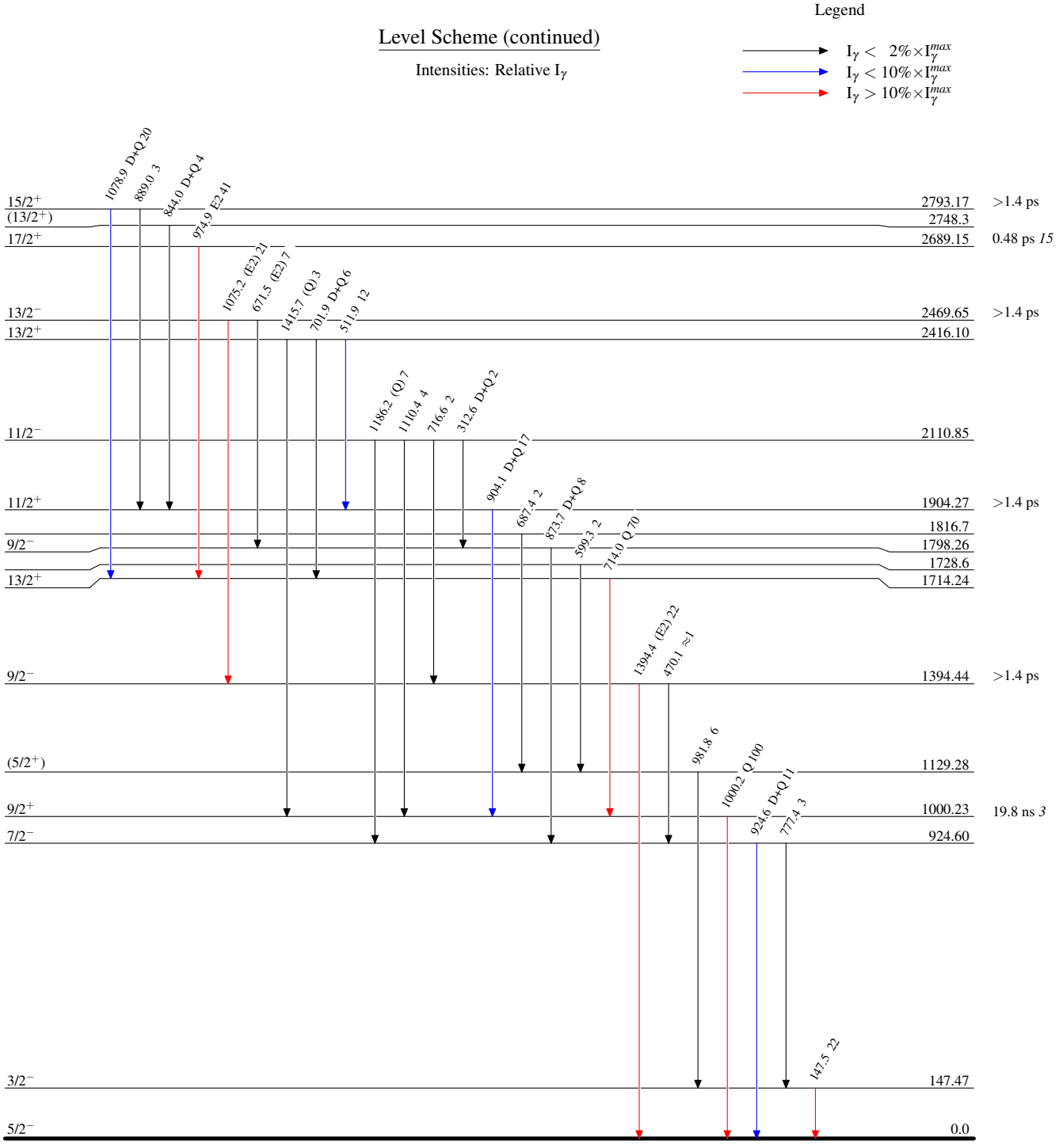


$^{71}_{33}As_{38}$

$^{58}Ni(^{19}F,\alpha 2p\gamma)$ **1994Zi01**

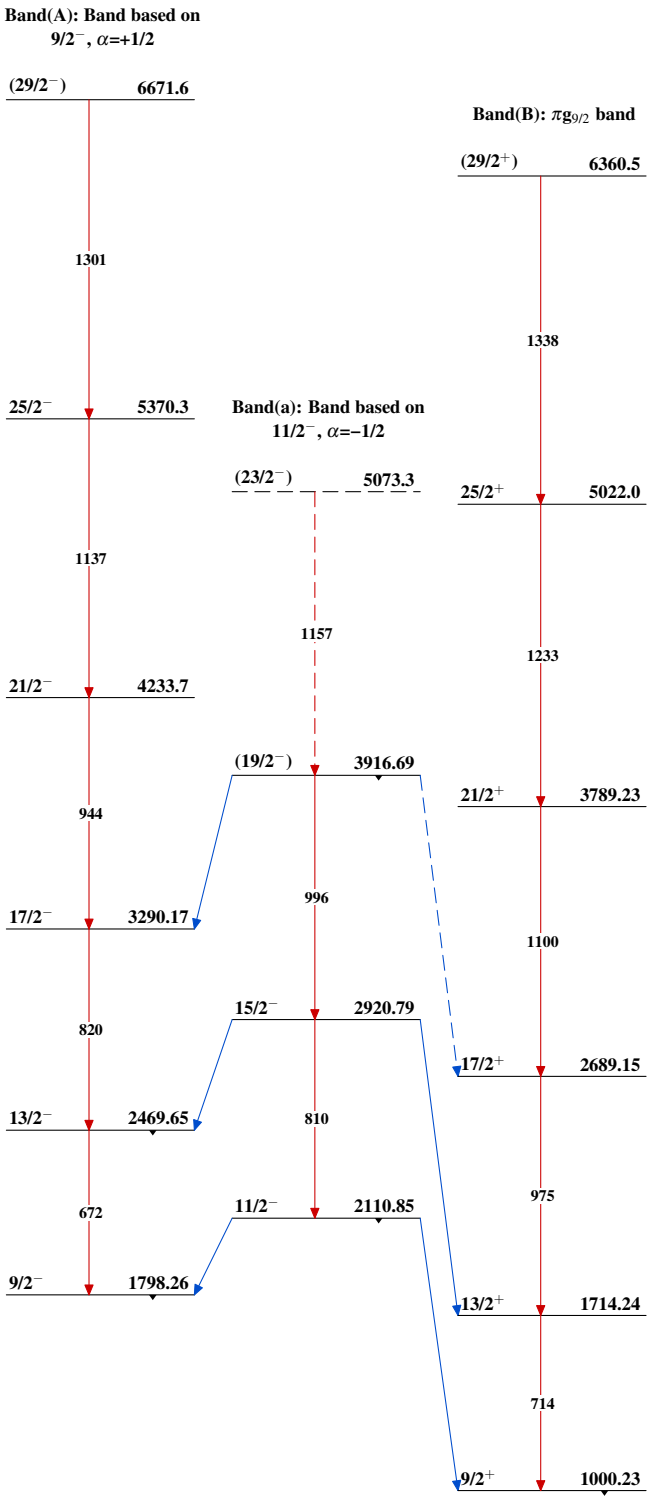
Level Scheme (continued)

Intensities: Relative I_γ



$^{71}_{33}As_{38}$

^{58}Ni(^{19}F,α2pγ) 1994Zi01



$^{71}_{33}As_{38}$