^{54}Fe(^{23}Na,α2pγ) 2011Ka10

History

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

2011Ka10: E(^{23}Na)=80 MeV from the superconducting accelerator facility at FSU bombarded a 14 mg/cm^2 ^{54}Fe target. Measured Eγ, Iγ, $\gamma\gamma$-coin, $\gamma\gamma(\theta)$(DCO), and lifetimes by DSAM using FSU array of ten Compton-suppressed Ge detectors: three clovers at 90° relative to the beam, two single-crystals at 35°, two single-crystals at 90°, and three single-crystals at 135°. Deduced reduced transition probabilities, and transition quadruple moments. Comparison with projected shell model and cranked shell model calculations. This work is from the same laboratory as 1994Zi01 using ^{58}Ni(^{19}F,α2pγ) reaction, but lesser number of detectors.

^{71}As Levels

E(level)[†]	J$^\pi$	T$_{1/2}$[‡]	Comments
0.0	5/2$^-$		
147.6 *6*	3/2$^-$		
870.3 *4*	5/2$^-$		
924.6 *5*	7/2$^-$		
999.7[#] *7*	9/2$^+$		
1245.2[a] *7*	5/2$^-$		
1394.6 *6*	9/2$^-$		
1468.0[&] *4*	7/2$^-$		
1713.7[#] *7*	13/2$^+$	4.3 ps *14*	T$_{1/2}$: 2011Ka10 take value from 1980Gu05 in (α,2nγ). Q$_t$=1.82 *+39−24*.
1729.1[c] *5*	7/2$^-$		
1759.1 *7*	7/2$^-$		
1797.9[a] *4*	9/2$^-$		
2062.1[d] *7*	9/2$^-$		
2110.4[&] *4*	11/2$^-$		
2416.8[c] *5*	11/2$^-$		
2469.8[a] *7*	13/2$^-$	>1.4 ps	T$_{1/2}$: measured mean lifetime τ>2 ps at 145° for 671.8, from spectra gated above the 671.8 transition. Q$_t$<1.96, <0.98.
2688.6[#] *12*	17/2$^+$	0.53 ps *+51−19*	T$_{1/2}$: measured mean lifetime τ=0.76 ps *+76−28* at 35° for 974.9γ, from spectra gated above the 974.9 transition. Q$_t$=2.1 *6*.
2820.3[d] *8*	13/2$^-$	>1.4 ps	T$_{1/2}$: measured mean lifetime τ>2 ps at 35° for 758.1γ; τ=1.40 ps *+222−59* at 35° and >2 ps at 145° for 403.5γ, from spectra gated above the 758.1 and 403.5 transitions. Q$_t$<1.62.
2920.8[&] *8*	15/2$^-$	>1.4 ps	T$_{1/2}$: same value of measured mean lifetime τ>2 ps at 35° and 145° for 810.2γ. Q$_t$<1.58.
3262.8[c] *9*	15/2$^-$	0.51 ps *+26−14*	T$_{1/2}$: mean lifetime τ=0.73 ps *+37−20* (in 2011Ka10), as average of measured mean lifetimes τ=0.86 ps *+117−35* at 35° and 0.50 ps *+37−20* at 145° for 846.0 transition; and τ=0.92 ps *+38−22* for 442.6 γ-ray at 35°. Q$_t$=1.98 *+34−37*.
3290.2[a] *8*	17/2$^-$	>1.4 ps	T$_{1/2}$: measured mean lifetime τ>2 ps at 35°and 145° for 820.6γ, from spectra gated above the 820.6 transition. Q$_t$<1.96.
3738.5[d] *10*	17/2$^-$	0.28 ps *13*	T$_{1/2}$: averaged mean lifetime τ=0.40 ps *19* (2011Ka10) of measured mean lifetimes τ=0.57 ps *+18−13* at 35° and 0.30 ps *+11−10* at 145° for 475.9 transition. Q$_t$=2.1 *+8−4*.
3788.7[#] *16*	21/2$^+$	0.29 ps *+11−8*	T$_{1/2}$: measured mean lifetime τ=0.42 ps *+16−12* at 35° for 1100.1γ, from spectra gated above the 1100.1 transition. Q$_t$=2.0 *+4−3*.

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$^{54}Fe(^{23}Na,\alpha 2p\gamma)$ 2011Ka10 (continued)

^{71}As Levels (continued)

E(level)[†]	J^π	$T_{1/2}$[‡]	Comments
3845.0[b] 9	(15/2⁻)		
3916.7[&] 10	19/2⁻	0.8 ps +13−4	$T_{1/2}$: measured mean lifetime τ=1.08 ps +182−50 at 145° for 996.0γ. Q_t=1.5 +5−6.
4232.7[c] 11	19/2⁻	0.53 ps 20	$T_{1/2}$: averaged value of mean lifetime τ=0.76 ps 28 (2011Ka10) from measured mean lifetimes τ=0.96 ps +22−15 at 35° and 0.56 ps +22−15 at 145° for 494.2 γ-ray. Q_t=1.61 +42−23.
4233.1[a] 9	21/2⁻	0.46 ps +22−12	$T_{1/2}$: measured mea lifetime τ=0.66 ps +32−17 at 145° for 943.4γ, from spectra gated above the 943.4 transition. Q_t=2.36 +38−42.
4371.8[@] 10	21/2⁻		
4570.5 10	21/2$^{(-)}$		
4774.3[d] 12	21/2⁻	<0.58 ps	$T_{1/2}$: effective measured mean lifetime τ<0.83 ps for 1035.9γ. Q_t>1.20.
4926.2[b] 9	(19/2⁻)		
5021.5[#] 19	25/2⁺	0.215 ps +28−21	$T_{1/2}$: averaged mean lifetime τ=0.31 ps +4−3 (2011Ka10) from measured mean lifetimes τ=0.33 ps 5 at 35° and 0.30 ps +4−3 at 145° for 1232.8γ. Q_t=1.72 +9−10.
5073.0[&] 10	(23/2⁻)	<1.04 ps	$T_{1/2}$: effective measured mean lifetime τ<1.50 ps for 1156.9γ. Q_t>0.93.
5358.9[c] 13	(23/2⁻)	<0.37 ps	$T_{1/2}$: effective measured mean lifetime τ<54 ps for 1126.0γ. Q_t>1.58.
5370.7[a] 14	25/2⁻	0.21 ps 6	$T_{1/2}$: averaged mean lifetime τ=0.31 ps 8 (2011Ka10) from measured mean lifetimes τ=0.37 ps +10−8 at 35° and 0.26 ps +7−6 at 145° for 1137.5γ. Q_t=2.10 +34−23.
5582.2[@] 10	(25/2⁻)		
6173.4[b] 14	(23/2⁻)		
6359.9[#] 21	(29/2⁺)	0.083 ps 28	$T_{1/2}$: averaged mean lifetime τ=0.12 ps 4 (2011Ka10) from measured mean lifetimes τ=0.14 ps +7−5 at 35° and 0.10 ps 4 at 145° for 1338.4γ. Q_t=2.2 +5−3.
6672.1[a] 17	29/2⁻	0.21 ps 6	$T_{1/2}$: averaged mean lifetime τ=0.30 ps 9 (2011Ka10) from measured mean lifetimes τ=0.32 ps +10−9 at 35° and 0.29 ps 9 at 145° for 1301.4γ. Q_t=1.50 +29−18.
6780.0[@] 11	(29/2⁻)		
7807.3[#] 24	(33/2⁺)	<0.23 ps	$T_{1/2}$: effective measured mean lifetime τ<33 ps for 1147.4γ. Q_t>1.08.
7828.7[@] 13			
8114.1[a] 20	33/2⁻	<0.22 ps	$T_{1/2}$: effective measured mean lifetime τ<0.32 ps for 1442.0γ. Q_t>1.11.
9684.1[a] 22	(37/2⁻)		

† From a least-squares fit to Eγ data, assuming uncertainty of 1 keV, when not stated.
‡ From DSAM (2011Ka10), average of values for angles at 35° and 145°, and from spectra gated above the listed transition in column 2 of Table I in 2011Ka10, unless stated otherwise.
# Band(A): Band based on 9/2⁺.
@ Band(B): Band based on 21/2⁻.
& Band(C): Band based on 7/2⁻,α=−1/2.
a Band(c): Band based on 5/2⁻,α=+1/2.
b Band(D): Band based on (15/2⁻).

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^{54}Fe(^{23}Na,α2pγ) 2011Ka10 (continued)

^{71}As Levels (continued)

[c] Band(E): Band based on 7/2$^-$,a=−1/2. Signature partner bands probably built on $\pi f_{7/2}$, which is based on π5/2[303] Nilsson state.
[d] Band(e): Band based on 9/2$^-$, a=+1/2. Signature partner bands probably built on $\pi f_{7/2}$, which is based on π5/2[303] Nilsson state.

γ(^{71}As)

R_{DCO}=I_γ(at 35°,145°; gated by γ_G at 90°)/ I_γ(at 90°; gated by γ_G at 35°, 145°). Expected ratios: 1 for stretched E2 as well as for ΔJ=0, dipole; 0.5 for ΔJ=1 when mixing ratio is small. DCO ratios were measured by gating on known stretched E2 γ rays.
B(E2) values deduced from the adopted lifetimes, which were used to calculate Q_t. Spin projection K=5/2 was used for bands 1, 3, and 4, and K=7/2 for bands 6 and 7.
B(M1) values were deduced assuming mixing ratio δ(E2/M1)=0.

E_γ[†]	E_i(level)	J^π_i	E_f	J^π_f	Mult.	Comments
148	147.6	3/2$^-$	0.0	5/2$^-$		
303	2062.1	9/2$^-$	1759.1	7/2$^-$		
313	2110.4	11/2$^-$	1797.9	9/2$^-$		
329.9[‡] *3*	1797.9	9/2$^-$	1468.0	7/2$^-$	D+Q	DCO=0.56 *25* Mult.: M1+E2 in 2011Ka10.
333	2062.1	9/2$^-$	1729.1	7/2$^-$		
355	2416.8	11/2$^-$	2062.1	9/2$^-$		
369.6	3290.2	17/2$^-$	2920.8	15/2$^-$	[M1]	B(M1)↓<0.03
403.5	2820.3	13/2$^-$	2416.8	11/2$^-$	[M1]	B(M1)↓<0.34
442.6	3262.8	15/2$^-$	2820.3	13/2$^-$	[M1]	B(M1)↓=0.66 *+25−22*
451.0	2920.8	15/2$^-$	2469.8	13/2$^-$		B(M1)↓<0.15
455.2 *2*	4371.8	21/2$^-$	3916.7	19/2$^-$		
470	1394.6	9/2$^-$	924.6	7/2$^-$		
475.9	3738.5	17/2$^-$	3262.8	15/2$^-$	[M1]	B(M1)↓=0.9 *+9−3*
484	1729.1	7/2$^-$	1245.2	5/2$^-$		
494.2	4232.7	19/2$^-$	3738.5	17/2$^-$	[M1]	B(M1)↓=0.31 *+18−8*
509.4[‡] *6*	5582.2	(25/2$^-$)	5073.0	(23/2$^-$)		Mult.: (M1+E2) in 2011Ka10.
514	1759.1	7/2$^-$	1245.2	5/2$^-$		
541.6	4774.3	21/2$^-$	4232.7	19/2$^-$	[M1]	B(M1)↓>0.24
553	1797.9	9/2$^-$	1245.2	5/2$^-$		
554.8[‡] *4*	3845.0	(15/2$^-$)	3290.2	17/2$^-$	D+Q	DCO=0.41 *7* Mult.: (M1+E2) in 2011Ka10.
584.6	5358.9	(23/2$^-$)	4774.3	21/2$^-$	[M1]	B(M1)↓>0.09
626.4	3916.7	19/2$^-$	3290.2	17/2$^-$	[M1]	B(M1)↓=0.04 *+4−3*
642.4[‡] *2*	2110.4	11/2$^-$	1468.0	7/2$^-$	Q	DCO=1.09 *32* Mult.: E2 in 2011Ka10.
653.6[‡] *3*	4570.5	21/2$^{(-)}$	3916.7	19/2$^-$	D+Q	DCO=0.40 *18* Mult.: M1+E2 in 2011Ka10.
671.8	2469.8	13/2$^-$	1797.9	9/2$^-$	[E2]	B(E2)(W.u.)<47
687.7[‡] *2*	2416.8	11/2$^-$	1729.1	7/2$^-$		Mult.: E2 in 2011Ka10.
693.1[‡] *4*	4926.2	(19/2$^-$)	4233.1	21/2$^-$		Mult.: (M1+E2) in 2011Ka10.
714.0	1713.7	13/2$^+$	999.7	9/2$^+$	[E2]	B(E2)(W.u.)=41 *+19−10*
716	2110.4	11/2$^-$	1394.6	9/2$^-$		
722	870.3	5/2$^-$	147.6	3/2$^-$		
756.1[‡] *2*	2469.8	13/2$^-$	1713.7	13/2$^+$		Mult.: E1 in 2011Ka10.
758.1	2820.3	13/2$^-$	2062.1	9/2$^-$	[E2]	B(E2)(W.u.)<20
777	924.6	7/2$^-$	147.6	3/2$^-$		
810.2	2920.8	15/2$^-$	2110.4	11/2$^-$	[E2]	B(E2)(W.u.)<35
820.6	3290.2	17/2$^-$	2469.8	13/2$^-$	[E2]	B(E2)(W.u.)<59
839.8[‡] *7*	5073.0	(23/2$^-$)	4233.1	21/2$^-$		

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$^{54}Fe(^{23}Na,\alpha 2p\gamma)$ **2011Ka10 (continued)**

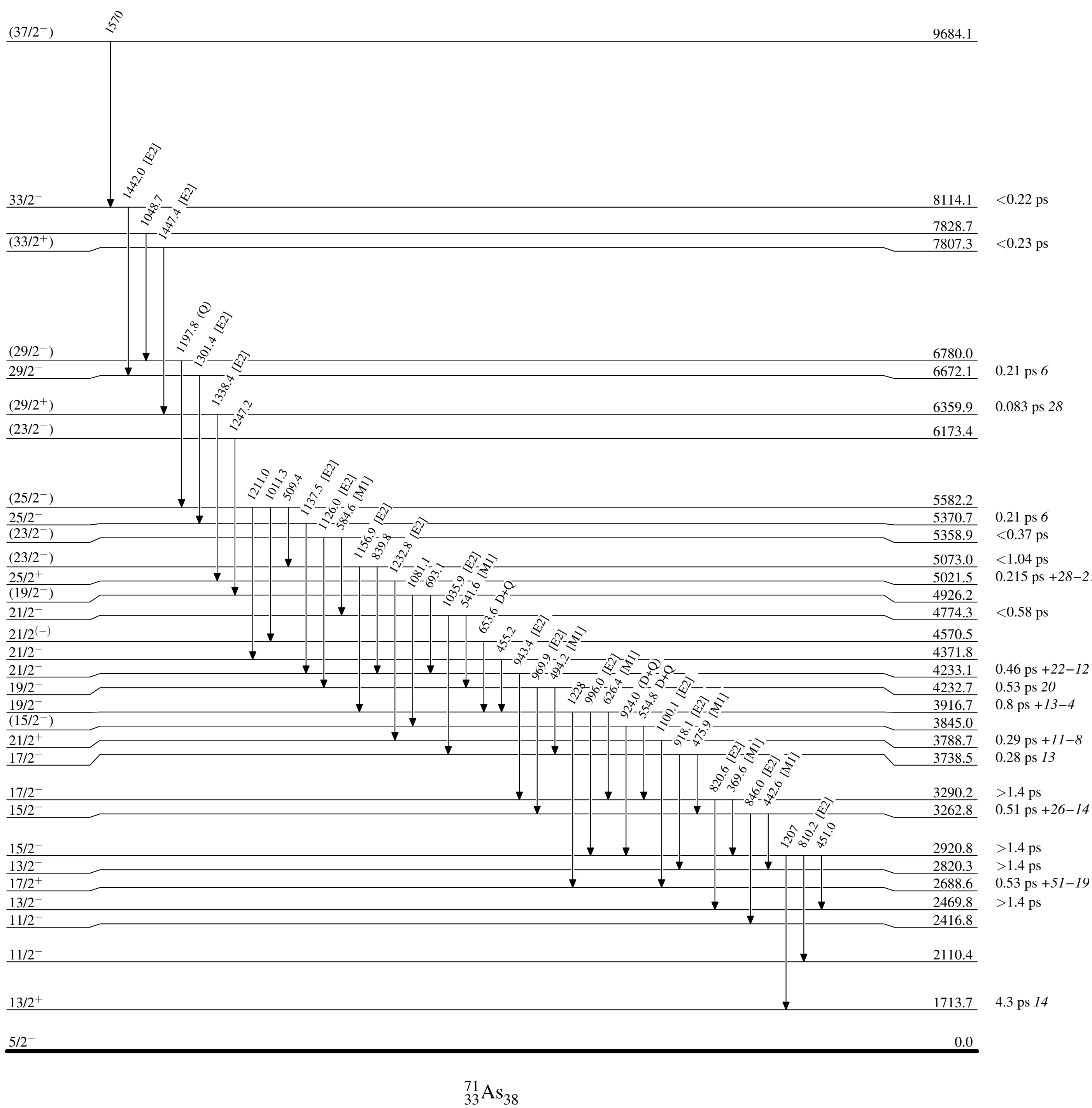
$\gamma(^{71}As)$ (continued)

E_γ †	E_i(level)	J_i^π	E_f	J_f^π	Mult.	Comments
846.0	3262.8	15/2⁻	2416.8	11/2⁻	[E2]	B(E2)(W.u.)=40 +15−14
858.8‡ 6	1729.1	7/2⁻	870.3	5/2⁻		Mult.: M1+E2 in 2011Ka10.
870	870.3	5/2⁻	0.0	5/2⁻		
874	1797.9	9/2⁻	924.6	7/2⁻		
918.1	3738.5	17/2⁻	2820.3	13/2⁻	[E2]	B(E2)(W.u.)=52 +47−17
924.0‡ 6	3845.0	(15/2⁻)	2920.8	15/2⁻	(D+Q)	DCO=0.82 41 Mult.: (M1+E2) in 2011Ka10; ΔJ=(0).
925	924.6	7/2⁻	0.0	5/2⁻		
927.6‡ 2	1797.9	9/2⁻	870.3	5/2⁻	Q	DCO=0.99 9 Mult.: E2 in 2011Ka10.
943.4	4233.1	21/2⁻	3290.2	17/2⁻	[E2]	B(E2)(W.u.)=95 +33−31
969.9	4232.7	19/2⁻	3262.8	15/2⁻	[E2]	B(E2)(W.u.)=36 +21−10
974.9	2688.6	17/2⁺	1713.7	13/2⁺	[E2]	B(E2)(W.u.)=70 +41−34
996.0	3916.7	19/2⁻	2920.8	15/2⁻	[E2]	B(E2)(W.u.)=35 +31−22
1000	999.7	9/2⁺	0.0	5/2⁻		
1011.3‡ 4	5582.2	(25/2⁻)	4570.5	21/2⁽⁻⁾		Mult.: (E2) in 2011Ka10.
1035.9	4774.3	21/2⁻	3738.5	17/2⁻	[E2]	B(E2)(W.u.)>22
1048.7‡ 7	7828.7		6780.0	(29/2⁻)		
1075.4	2469.8	13/2⁻	1394.6	9/2⁻	[E2]	B(E2)(W.u.)<12
1081.1‡ 4	4926.2	(19/2⁻)	3845.0	(15/2⁻)		
1098	1245.2	5/2⁻	147.6	3/2⁻		
1100.1	3788.7	21/2⁺	2688.6	17/2⁺	[E2]	B(E2)(W.u.)=69 +28−19
1111	2110.4	11/2⁻	999.7	9/2⁺		
1126.0	5358.9	(23/2⁻)	4232.7	19/2⁻	[E2]	B(E2)(W.u.)>39
1137.5	5370.7	25/2⁻	4233.1	21/2⁻	[E2]	B(E2)(W.u.)=79 +28−16
1156.9	5073.0	(23/2⁻)	3916.7	19/2⁻	[E2]	B(E2)(W.u.)>15
1186	2110.4	11/2⁻	924.6	7/2⁻		
1197.8‡ 5	6780.0	(29/2⁻)	5582.2	(25/2⁻)	(Q)	DCO=0.95 35 Mult.: E2 in 2011Ka10.
1207	2920.8	15/2⁻	1713.7	13/2⁺		
1211.0‡ 6	5582.2	(25/2⁻)	4371.8	21/2⁻		Mult.: (E2) in 2011Ka10.
1228	3916.7	19/2⁻	2688.6	17/2⁺		
1232.8	5021.5	25/2⁺	3788.7	21/2⁺	[E2]	B(E2)(W.u.)=53 6
1247.2‡ 11	6173.4	(23/2⁻)	4926.2	(19/2⁻)		Mult.: (E2) in 2011Ka10.
1301.4	6672.1	29/2⁻	5370.7	25/2⁻	[E2]	B(E2)(W.u.)=42 +18−10
1338.4	6359.9	(29/2⁺)	5021.5	25/2⁺	[E2]	B(E2)(W.u.)=91 +45−23
1395	1394.6	9/2⁻	0.0	5/2⁻		
1442.0	8114.1	33/2⁻	6672.1	29/2⁻	[E2]	B(E2)(W.u.)>23
1447.4‡ 10	7807.3	(33/2⁺)	6359.9	(29/2⁺)	[E2]	B(E2)(W.u.)>22 Mult.: (E2) in 2011Ka10.
1467.8‡ 4	1468.0	7/2⁻	0.0	5/2⁻	(D+Q)	DCO=0.96 17 Mult.: M1+E2 in 2011Ka10. DCO value agrees with ΔJ=2, Q also.
1492.2‡ 5	2416.8	11/2⁻	924.6	7/2⁻		Mult.: E2 in 2011Ka10.
1570	9684.1	(37/2⁻)	8114.1	33/2⁻		
1582	1729.1	7/2⁻	147.6	3/2⁻		
1729	1729.1	7/2⁻	0.0	5/2⁻		
1759	1759.1	7/2⁻	0.0	5/2⁻		

† From Table I and Fig. 1 of 2011Ka10, unless otherwise stated.
‡ From Table II of 2011Ka10.

^{54}Fe(^{23}Na,α2pγ) 2011Ka10

Level Scheme



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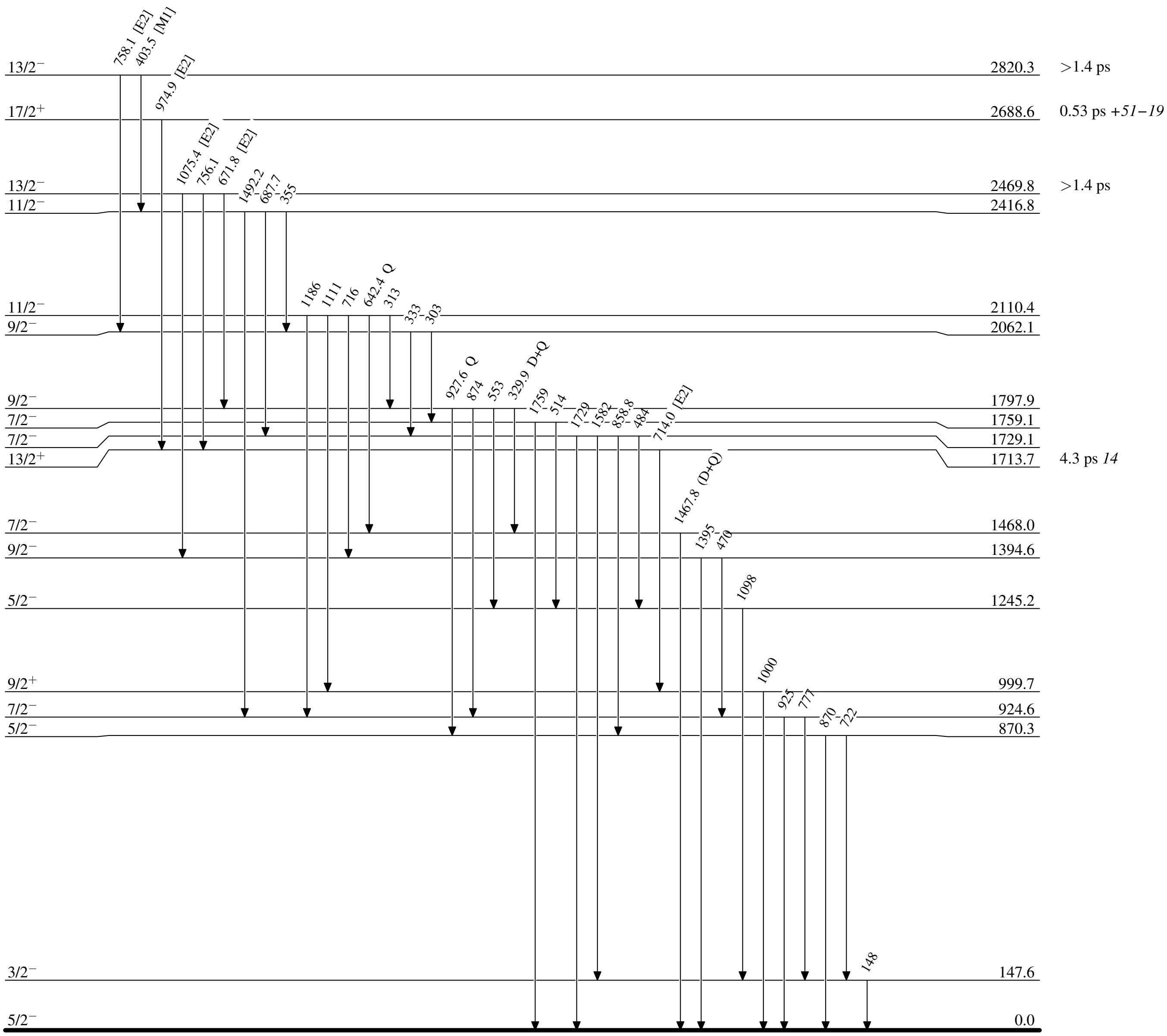
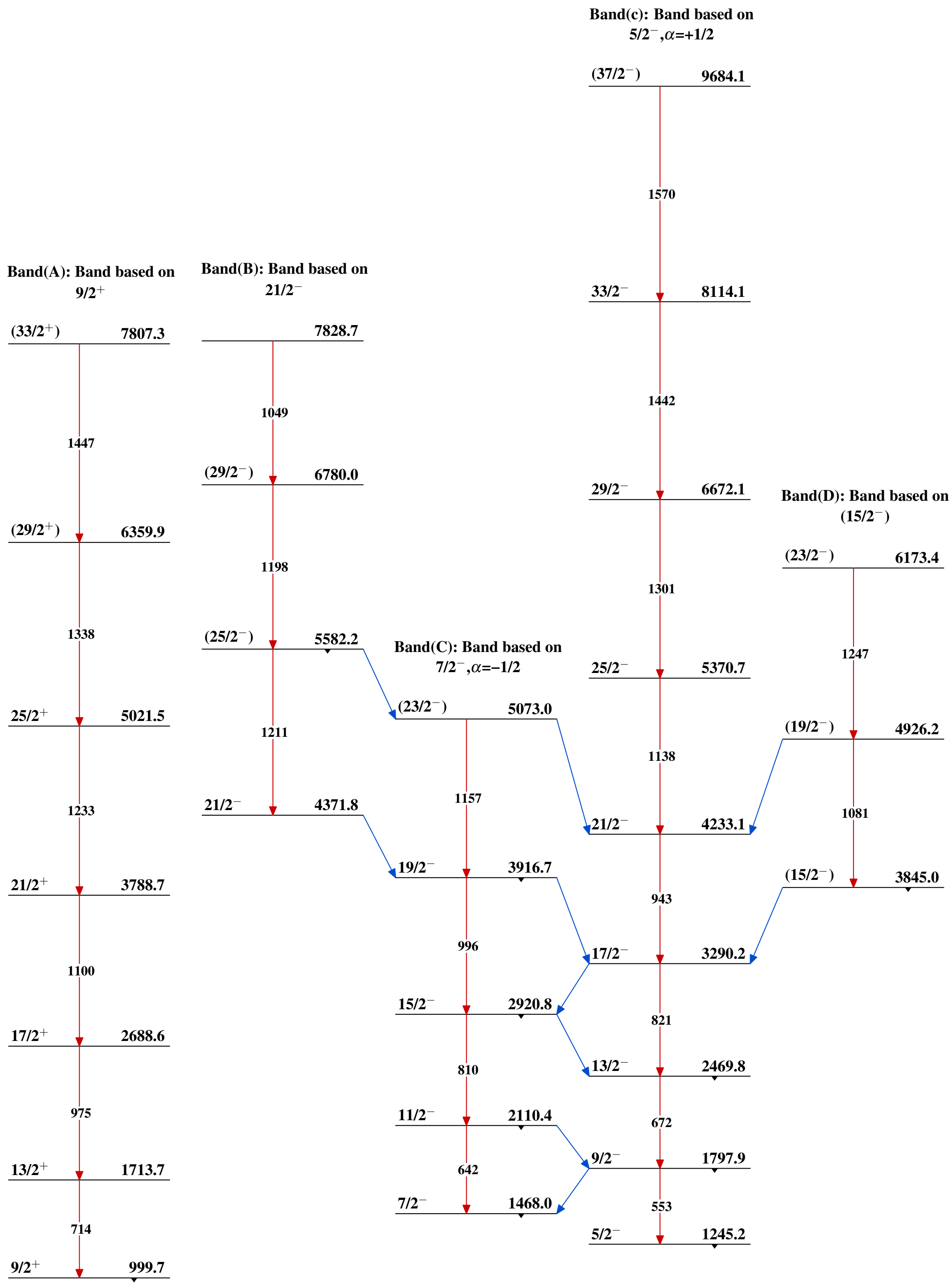
Level Scheme (continued)



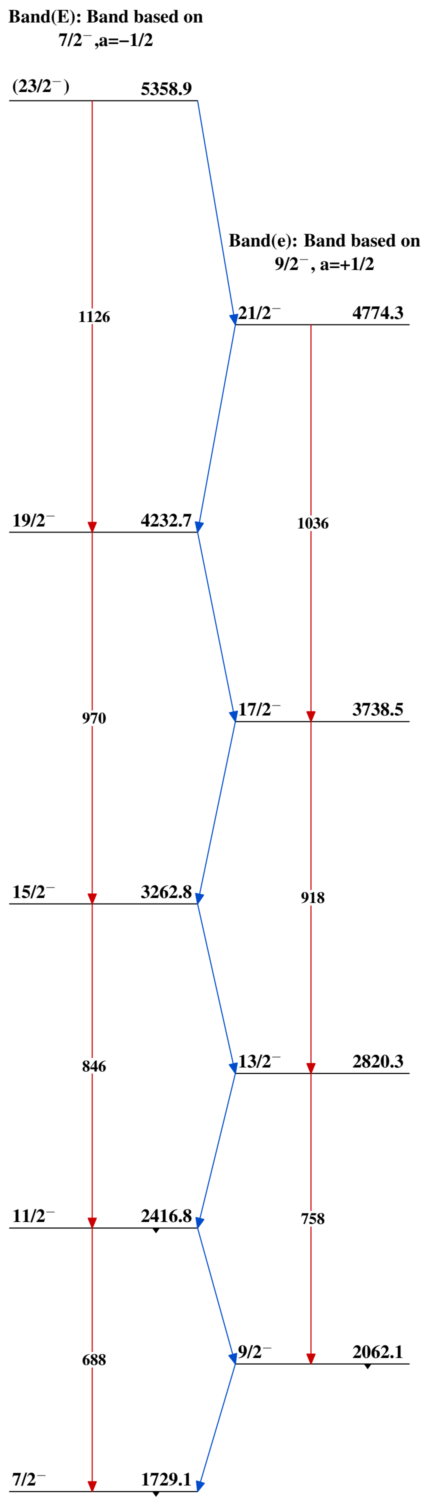
$^{71}_{33}As_{38}$

$^{54}Fe(^{23}Na,\alpha 2p\gamma)$ 2011Ka10



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

$^{54}Fe(^{23}Na,\alpha 2p\gamma)$ 2011Ka10 (continued)



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