^{12}C(^{54}Fe,2nγ),^{54}Fe(^{12}C,2nγ) 1991En01

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh and Jun Chen	NDS 178, 41 (2021).	12-Nov-2021

Includes ^{12}C(^{65}Ge,^{64}Ge) from 2007St16.

1991En01 (also 1990Li25,1992En03,1995Ge07): ^{12}C(^{54}Fe,2nγ), E(^{54}Fe)=165 MeV and ^{54}Fe(^{12}C,2nγ),E(^{12}C)=37 MeV. Measured Eγ, Iγ, recoil-$\gamma(\theta)$, recoil-γ- and recoil-$\gamma\gamma$-coin using array of 19 Compton suppressed Ge detectors and a recoil-separator. Cross section for ^{64}Ge production=640 μb *70* (≈0.1% of total fusion cross section). Total routhian surface calculations based on Woods-Saxon cranking model with pairing. Isospin impurity deduced from interband transitions.

2007St16: ^{12}C(^{65}Ge,^{64}Ge). The ^{65}Ge beam produced as a cocktail beam of ^{64}Ga, ^{63}Zn and ^{62}Cu in the fragmentation of 150 MeV/nucleon ^{78}Kr beam. Lifetimes were measured using the recoil distance method (RDDS). Particles were separated with the S800 spectrograph at the NSCL-MSU facility. The γ rays were measured using the SeGA array of one ring of seven Ge detectors positioned at 30°, and another of eight detectors at 140°. Deduced B(E2) values, and compared with large-scale shell-model calculations.

Additional information 1.

1987Go02: ^{27}Al(^{40}Ca,p2n),E(^{40}Ca)=102 MeV. Measured Eγ, nγ- and particle-$\gamma\gamma$ coin. Identification of five γ rays in ^{64}Ge based on signature of 0α-1p-xn coin (x=1,2), knowledge of pnγ channel and consistency of σ(2pn)/σ(p2n) with the observed γ-ray intensities.

1986Oo01: ^{12}C(^{54}Fe,2nγ),E(^{54}Fe)=150 MeV. Measured Eγ, Iγ, $\gamma\gamma$- and nγ-coin. Identification and intensity of 902γ based on xn-yp-γ coin data (x=1,2; y=0,1). Only one γ ray (from the first 2$^+$) assigned to ^{64}Ge.

Others: 1979SuZY, 1980DeYK: ^{64}Zn(^{3}He,p2nγ),E(^{3}He)=35, 44 MeV; and ^{54}Fe(^{12}C,2nγ). Measured nγ- and n-$\gamma\gamma$-coin with tof method. No positive identification of γ rays in ^{64}Ge.

1991En01 conclude that the low spin states show complete triaxial instability and modest quadrupole deformation. Permanent octupole deformation in the ground state is not supported by their data. Isospin mixing is indicated through the observation of forbidden (for T=0) E1 transitions.

^{64}Ge Levels

E(level)†	J$^\pi$‡	T$_{1/2}$	Comments
0.0#	0$^+$		
901.7# *3*	(2$^+$)	2.29 ps *35*	T$_{1/2}$: from recoil-distance method (2007St16).
1578.7& *3*	(2$^+$)	5.5 ps *+28−14*	T$_{1/2}$: from recoil-distance method (2007St16).
2052.6# *4*	(4$^+$)		
2154.8& *4*	(4$^+$)		
2669.6 *5*	(3$^+$)		J$^\pi$: (4$^+$) in Adopted Levels.
2969.7@ *5*	(3$^-$)		
3406.7& *5*	(6$^+$)		
3465.6# *6*	(6$^+$)		
3716.9 *7*	(5$^+$)		E(level): this level is not confirmed in 2003Fa01, 1047γ is placed from the 3717, (5$^-$) level. Thus this level is omitted in Adopted Levels.
3717.3@ *5*	(5$^-$)		T$_{1/2}$: <0.21 ns (estimate by 1991En01 from nonobservation of expected intensity imbalance at 5$^-$ level if τ(mean)≈300 ps).
4245.7@ *6*	(7$^-$)		
5025.5 *8*	(7$^+$)		J$^\pi$: no assignment given in Adopted Levels.
5175.2& *7*	(8$^+$)		
5180.0# *8*	(8$^+$)		
5372.9@ *7*	(9$^-$)		
6065.5 *9*			E(level): this level is not confirmed in 2003Fa01, 1820γ is placed from a 8427 level, instead.
6564.4@ *8*	(11$^-$)		
8006.8@ *10*	(13$^-$)		

Continued on next page (footnotes at end of table)

$^{12}C(^{54}Fe,2n\gamma),^{54}Fe(^{12}C,2n\gamma)$ 1991En01 (continued)

^{64}Ge Levels (continued)

† From a least-squares fit to Eγ data.
‡ From 1991En01, based on band assignment and A_2 values in $\gamma(\theta)$ data. Differences in assignments in Adopted Levels are pointed out.
# Band(A): g.s. band.
@ Band(B): (3^-) band. The 3^- level is probably an octupole vibrational state but its collectivity is not established (1991En01). The higher states in this sequence may arise from weak coupling of quasiparticles to the g.s.
& Band(C): Band based on (2^+).

γ(^{64}Ge)

E_γ †	I_γ †	E_i(level)	J_i^π	E_f	J_f^π	Mult.	Comments
528.4 *3*	15.1 *7*	4245.7	(7^-)	3717.3	(5^-)	(Q)#	A_2=+0.14 *5*
x537.4 *3*	1.6 *1*						
576.2 *3*	20.9 *10*	2154.8	(4^+)	1578.7	(2^+)		A_2=+0.08 *9*
677.0 *3*	31.3 *14*	1578.7	(2^+)	901.7	(2^+)	(M1+E2)@	A_2=−0.08 *4* B(E2)=0.062 *21* (2007St16), assuming pure E2.
x736.0‡ *3*	1.8 *1*						
747.5 *3*	2.2 *2*	3717.3	(5^-)	2969.7	(3^-)		
901.5 *3*	100	901.7	(2^+)	0.0	0^+		A_2=+0.09 *5* B(E2)↓=0.041 *6* (2007St16) $\gamma(\theta)$ is degraded from that expected for ΔJ=2, Q (1991En01).
x969.5‡ *4*	1.8 *2*						
1047.3 *4*	3.7 *2*	3716.9	(5^+)	2669.6	(3^+)		
1090.9 *4*	8.0 *4*	2669.6	(3^+)	1578.7	(2^+)	D@	E_γ: 1090.0 in table 3 (1991En01) seems to be a misprint. Eγ=1090.9 in figure 11 and 1091 in figures 9 and 10 of 1991En01. Mult.: A_2=−0.09 *5* suggests ΔJ=1, but it is inconsistent with adopted ΔJ^π.
1127.2 *4*	10.1 *8*	5372.9	(9^-)	4245.7	(7^-)		
1150.8 *4*	47.2 *23*	2052.6	(4^+)	901.7	(2^+)	(Q)#	A_2=+0.22 *5*
1191.5 *4*	4.4 *3*	6564.4	(11^-)	5372.9	(9^-)		
x1216.3 *4*	1.8 *2*						
1252.1 *4*	9.6 *5*	3406.7	(6^+)	2154.8	(4^+)		
x1266.8 *4*	1.5 *1*						
1308.5 *5*	1.9 *6*	5025.5	(7^+)	3716.9	(5^+)		E_γ: 1308.6 in figure 11 (1991En01).
1353.7 *5*	5.1 *3*	3406.7	(6^+)	2052.6	(4^+)		
1413.0 *4*	12.5 *7*	3465.6	(6^+)	2052.6	(4^+)	(Q)#	A_2=+0.24 *5*
1442.4 *5*	2.3 *2*	8006.8	(13^-)	6564.4	(11^-)		
x1539.3 *5*	0.9 *1*						
1579.0 *4*	5.0 *3*	1578.7	(2^+)	0.0	0^+	[E2]	B(E2)↓=0.00015 *5* (2007St16)
1664.8 *4*	22.1 *12*	3717.3	(5^-)	2052.6	(4^+)	D+Q@	A_2=−0.06 *5* A_2 gives δ(Q/D)=−0.09 *+5−3* (1991En01). B(E1)(W.u.)=2.4×10^{-6} (from erratum for 1991En01) assuming B(E2)(W.u.)(5^- to 3^-)=0.4 as for a similar state in ^{66}Ge. This value of B(E1)(W.u.) is considered (by 1991En01) to indicate isospin impurity ($T_{1/2}$=1 component in the otherwise $T_{1/2}$=0 nucleus) of ≈1.2% in the 5^- and 4^+ states.
1714.4 *5*	3.7 *4*	5180.0	(8^+)	3465.6	(6^+)		
1768.5 *5*	6.4 *4*	5175.2	(8^+)	3406.7	(6^+)		
1819.8 *6*	1.7 *3*	6065.5		4245.7	(7^-)		

Continued on next page (footnotes at end of table)

$^{12}C(^{54}Fe,2n\gamma),^{54}Fe(^{12}C,2n\gamma)$ 1991En01 (continued)

$\gamma(^{64}Ge)$ (continued)

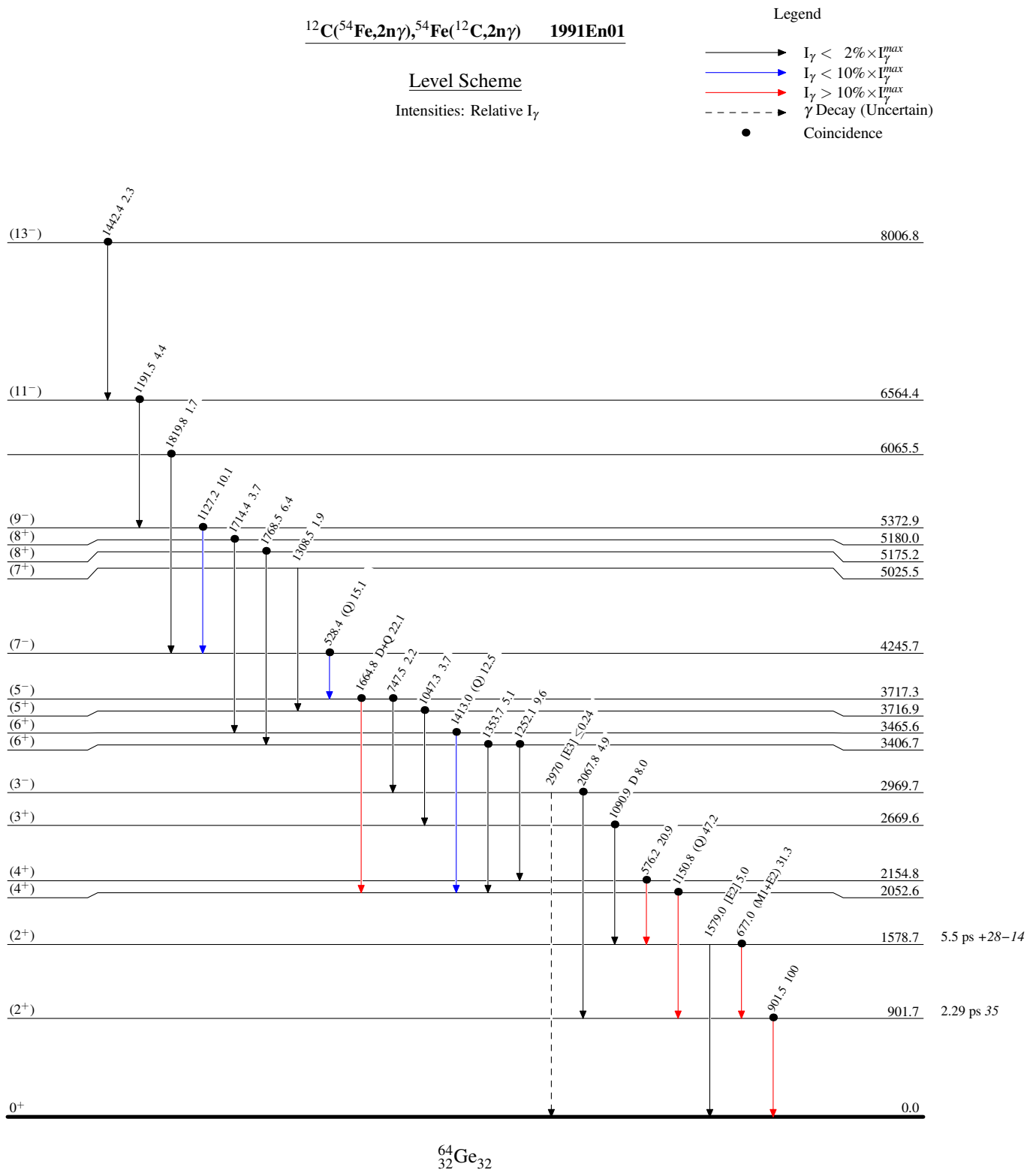
E_γ †	I_γ †	E_i(level)	J_i^π	E_f	J_f^π	Mult.	Comments
x1966.9‡ *5*	2.5 *2*						
2067.8 *5*	4.9 *4*	2969.7	(3^-)	901.7	(2^+)		
x2530.0 *10*	1.6 *3*						
x2702.1 *8*	2.1 *2*						
2970&	≤0.24	2969.7	(3^-)	0.0	0^+	[E3]	I_γ: from %BR≤5 (1991En01). Transition not observed.

† From 1991En01.
‡ Seen in coincidence with 901.5γ but it is not placed (1991En01).
# Positive A_2 in $\gamma(\theta)$ consistent with ΔJ=2, quadrupole.
@ Negative A_2 in $\gamma(\theta)$ consistent with ΔJ=1, dipole or dipole+quadrupole.
& Placement of transition in the level scheme is uncertain.
x γ ray not placed in level scheme.

$^{12}C(^{54}Fe,2n\gamma),^{54}Fe(^{12}C,2n\gamma)$ **1991En01**

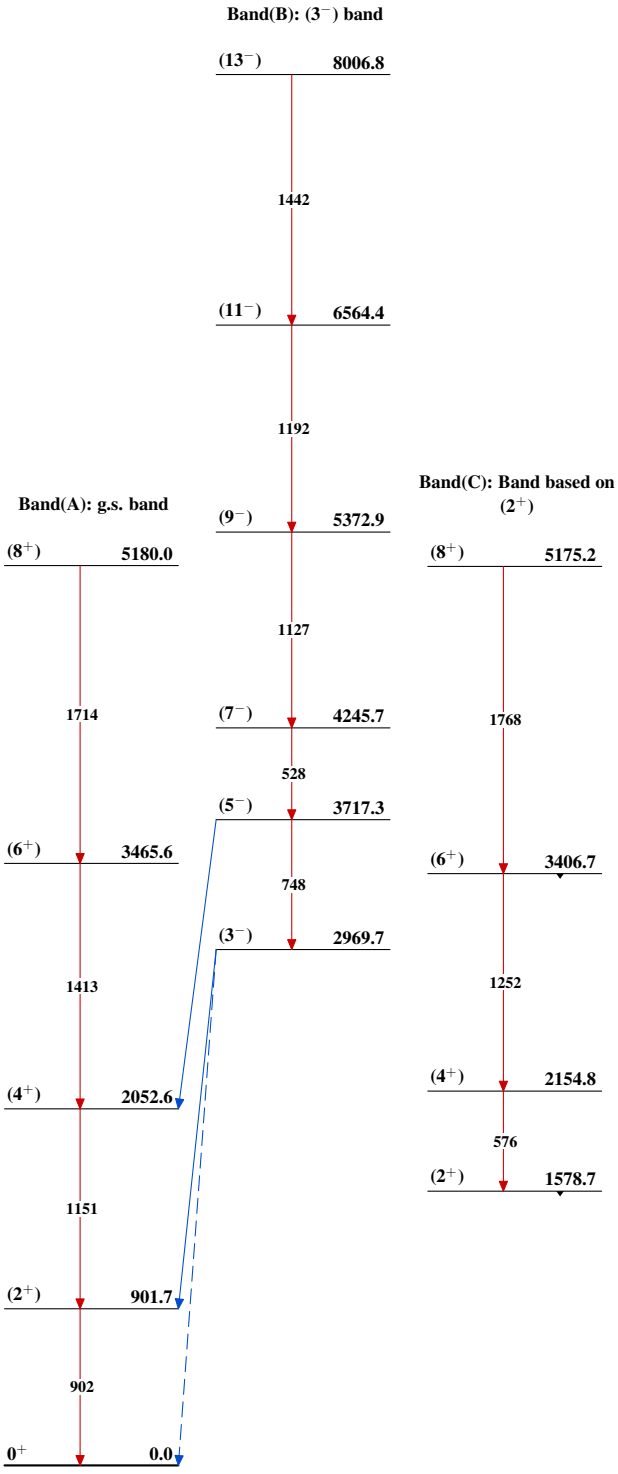
Level Scheme

Intensities: Relative I_γ



$^{64}_{32}Ge_{32}$

$^{12}C(^{54}Fe,2n\gamma),^{54}Fe(^{12}C,2n\gamma)$ 1991En01



$^{64}_{32}Ge_{32}$