^{59}Fe β^- decay 1973Pa16,1974Ra13

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	M. Shamsuzzoha Basunia	NDS 151, 1 (2018)	1-Apr-2018

Parent: ^{59}Fe: E=0.0; $J^\pi=3/2^-$; $T_{1/2}$=44.490 d *9*; Q(β^-)=1565.0 *4*; %β^- decay=100.0

Others: 1952Me53, 1953Hi02, 1953Sc23, 1960Su10, 1960Fu03, 1960Sc16, 1960Cr08, 1960Be06, 1963Wo01, 1963Be39, 1964Co34, 1965Do11, 1965Kn03, 1965Ma06, 1967Ag03, 1967Be60, 1967Ti02, 1970Be16, 1970Le03, 1970Sc19, 1971Ar07, 1971Os07, 1971Pe20, 1972Su06, 1973Er11, 1974BaZC, 1974Mu12, 1976BeZR, 1976Ch25, 1977Ba06, 1978He21, 2000He14, 2000Pa08.

1973Pa16: high purity samples from ^{59}Co(n,p), chemical separation, Ge(Li), Ge(Li)-NaI coin system with resolving time=50-70 ns; measured Eγ, Iγ, $\gamma\gamma$ coin, $\gamma\gamma(\theta)$.

1974Ra13: source from ^{58}Fe(n,γ); β spectrometer with 1.2% transmission and 1.0% momentum resolution, Si(Li) detector and gas proportional counter; measured Eβ, Iβ.

1976Ch25: Ge(Li) detector and NaI-NaI coin system with resolving time=20 ns; measured Eγ, Iγ, $\gamma\gamma$ coin.

1974Mu12: source from ^{58}Fe(n,γ); Ge(Li), NaI detectors and anthracene crystal, resolving time of coin systems=50,150 ns; measured Eγ, Iγ, Eβ, Iβ, $\beta\gamma$ coin, $\gamma\gamma$ coin.

1978He21: Ge(Li) spectrometers, determined precise Eγ.

For $\beta\gamma$(CP) see 1960Fo04, 1962Ha08, 1964Co34, 1965Kn03, 1965Ma06, 1967Ti02, 1970Be16. Asymmetry α=−0.158 *7* (1970Be16) for 466β^-1099γ(CP), −0.154 *23* (1967Ti02) for 273β^-1292γ(CP); significant discrepancies exist between the various data.

For 466β^-1099$\gamma(\theta)$, see 1960Fu03 (no asymmetry about 90°).

g-factor (1292 level): 1.69 *8* (1974Ba08). Others: 1.09 *8* (1971Ar07), 1.26 *23* (1967Ag03).

For B(θ,H,T), see 1977Ba06. (W(34°)−1)=−0.8% 5 at T=25°−30° mK.

For $\gamma(\theta$,H,T), see 1976BeZR. (W(180°)/W(90°) −1)≤0.0015 for 1099γ and 1292γ.

For measurement of pair conversion coefficient in ^{59}Co [from B($\gamma^\pm$)($\gamma^\pm$) triple coin], see 1970Sc19.

Experimental shape correction factor for β^-ray spectrum – 1974Ra13, 2015Mo10.

^{59}Co Levels

E(level)	J^π	$T_{1/2}$	Comments
0.0	$7/2^-$		
1099.257 *3*	$3/2^-$	<14 ps	$T_{1/2}$: from 1967Be60. Other: <50 ps (1967Si01), from $\beta\gamma$(t).
1190	$(9/2)^-$		Iβ<0.01 (1974Mu12) (so log *ft*>10.1). Negligible feeding is expected to this level (ΔJ=3).
1291.601 *5*	$3/2^-$	0.551[†] ns *7*	
1434.253 *5*	$1/2^-$	0.210 ns *20*	J^π: 3/2 excluded by 142γ-1292$\gamma(\theta)$, 142γ-192$\gamma(\theta)$ and 192γ-1099$\gamma(\theta)$. $T_{1/2}$: from 1971Ar07. Delayed coin.
1481.63 *18*	$5/2^-$		

[†] From delayed coin. Weighted average of 538 ns *4* (1972Ga39), 564 ns *20* (1972Gr05), 564 ns *5* (1971Ar07), 586 ns *20* (1967Ag03), 575 ns *11* (1967Be60). Other: 600 ns *50* (1967Si01).

β^- radiations

E(decay)	E(level)	Iβ^-[†‡]	Log *ft*	Comments
(83.4 *4*)	1481.63	0.078 *7*	7.10 *4*	av Eβ=22.01 *13* E(decay): 85 (1974Mu12).
(130.7 *4*)	1434.253	1.31 *5*	6.482 *18*	av Eβ=35.68 *12* E(decay): ~132 (1974Mu12), 150 *10* (1960Su10).
(273.4 *4*)	1291.601	45.3 *11*	5.979 *11*	av Eβ=80.94 *14* E(decay): 271 *3* (1952Me53), 275 *5* (1960Be06), 280 *6* (1960Su10), 280 *5*

Continued on next page (footnotes at end of table)

^{59}Fe β^- decay 1973Pa16,1974Ra13 (continued)

β^- radiations (continued)

E(decay)	E(level)	Iβ^{-}†‡	Log *ft*	Comments
				(1971Pe20), 273 *5* (1963Wo01), 269 *10* (1974Ra13).
(465.7 *4*)	1099.257	53.1 *15*	6.696 *13*	av Eβ=149.21 *15* E(decay): 464 *4* (1971Pe20), 475 *3* (1963Wo01), 462 *3* (1952Me53), 461 *10* (1974Ra13), 455 *5* (1960Be06), 470 *6* (1960Su10).
(1565.0 *4*)	0.0	0.18 *4*	11.14 *10*	av Eβ=614.47 *19* E(decay): 1575 *20* (1963Wo01). Others: In 1960Su10, 1974Ra13. log *ft* lower than other known values for ΔJ=2, $\Delta\pi$=no transitions.

† Iβ(g.s.) is measured value of 0.17% *3* (1974Ra13) adjusted by authors to 0.18% *4* by assuming I(132β)+I(85β)=1.4% *1* (from summed Iγ imbalance at 1434 and 1482 levels) and renormalizing the remaining measured Iβ to 98.6%. Adopted Iβ values for excited states are from Iγ imbalance at each level assuming Iβ(g.s.)=0.18% *4*; measured values, adjusted as above (1974Ra13), are 47% *4* and 51% *3* respectively for branches to 1291 and 1099 levels, in excellent agreement with values derived from γ imbalance.

‡ Absolute intensity per 100 decays.

^{59}Fe β^- decay 1973Pa16,1974Ra13 (continued)

$\gamma(^{59}Co)$

Iγ normalization: From Σ (I(γ+ce) to g.s.)=99.82% 4.
For δ deduced from γγ(θ) data, see comments on specific γ rays below.

γγ(θ) data summary:
192γ-1099γ: A_2=+0.010 2 see a. A_4=-0.003 4 (1973Er11)
142γ-192γ: A_2=-0.28 4 (1973Er11)
142γ-1292γ: A_2=-0.069 2 see b. A_4=-0.001 3 (1973Er11)
335γ-1099γ: A_2=-0.064 17 see c. A_4=-0.006 6 (1973Er11)
a. Weighted average of +0.008 4 (1973Pa16), +0.010 4 (1974BaZC), +0.011 4 (1973Er11), +0.008 7 (1971Ar07). Others: 1960He06, 1971Os07, 1953Sc23.
b. Weighted average of -0.070 5 (1973Pa16, -0.070 3 (1973Er11), -0.065 4 (1971Ar07), -0.075 6 (1967Ag03). Others: 1960He06, 1963Be39, 1971Os07, 1972Su06.
c. Weighted average of -0.064 11 (1971Ar07), -0.040 10 (1973Er11), -0.099 12 (1973Pa16). Others: 1974BaZC, 1971Os07, 1963Be39.

E_γ †	I_γ ‡ c	E_i(level)	J_i^π	E_f	J_f^π	Mult.	δ b	α a	Comments
142.651 & 2	1.81 7	1434.253	1/2⁻	1291.601	3/2⁻	M1+E2	−0.028 +9−14	0.0161 3	%Iγ=1.02 5 α(K)=0.01442 23; α(L)=0.001436 23; α(M)=0.000200 4 α(N)=8.76×10^{-6} 14 I_γ: 1.02 4 (1973Pa16), 0.98 4 (1970Le03). Mult.: From γγ(θ) (See data above with ref) and RUL in Adopted Gammas. δ: (or +1.78 +15−20) from 1971Ar07 (sign reversed by evaluator). Large solutions disallowed by RUL. Other values listed in previous evaluator (2002Ba42) by c.m. Baglin − current evaluator could not track source reference: −0.06 3 or +1.97 +16−15 from 142γ-192γ(θ) for adopted δ(192γ); −0.009 +8−16 or +1.77 +7−3 from 142γ-1292γ if δ(Q,O)=0 for 1292γ.
189 @ d	0.002 # 2	1481.63	5/2⁻	1291.601	3/2⁻				%Iγ=0.0011 12
192.343 & 5	5.45 18	1291.601	3/2⁻	1099.257	3/2⁻	M1+E2	+0.22 2	0.0091 4	%Iγ=3.08 12 α(K)=0.0082 3; α(L)=0.00082 3; α(M)=0.000114 5 α(N)=4.92×10^{-6} 17 I_γ: 3.08 10 (1973Pa16), 2.95 8 (1970Le03). δ: From 192γ-1099γ(θ) assuming δ(Q,O)=0 for 1099γ (1973Pa16) in good agreement with +0.21 2 (1971Ar07). Other: −0.07 to +0.02 (1953Sc23). Mult.: α(exp)=0.007 3 (1952Me53).
334.8 2	0.478 18	1434.253	1/2⁻	1099.257	3/2⁻	(M1+E2)	+1.8 +4−6	0.0049 7	%Iγ=0.270 12

^{59}Fe β^- decay 1973Pa16,1974Ra13 (continued)

$\gamma(^{59}Co)$ (continued)

E_γ †	I_γ ‡ c	E_i(level)	J_i^π	E_f	J_f^π	Mult.	δ b	α a	Comments
									α(K)=0.0044 *6*; α(L)=0.00043 *6*; α(M)=6.0×10^{-5} *9* α(N)=2.6×10^{-6} *4* I_γ: 0.27 *1* (1973Pa16), 0.24 *4* (1970Le03). Mult.: From $\gamma\gamma(\theta)$ (See data above with ref) and RUL in Adopted Gammas. δ: (or −0.05 +*3*−*7*) from 1971Ar07 (sign reversed by evaluator). previous evaluator C. Baglin (2002Ba42) list −0.03 *7* or +1.9 *3* from 335γ-1099$\gamma(\theta)$ if δ(Q,O)=0 for 1099γ − source reference unknown.
382.0 *4*	0.032 *5*	1481.63	5/2$^-$	1099.257	3/2$^-$	(M1+E2)	<0.21	0.00147 *6*	%Iγ=0.018 *3* α(K)=0.00132 *5*; α(L)=0.000129 *5*; α(M)=1.79×10^{-5} *7* α(N)=8.0×10^{-7} *3* I_γ: 0.018 *3* (1973Pa16), 0.023 *5* (1970Le03). Mult.,δ: from adopted gammas.
1099.245& *3*	100.0 *26*	1099.257	3/2$^-$	0.0	7/2$^-$	E2		1.74×10^{-4}	%Iγ=56.5 *9* α(K)=0.0001569 *22*; α(L)=1.515×10^{-5} *22*; α(M)=2.11×10^{-6} *3* α(N)=9.41×10^{-8} *14* I_γ: 56.5 *15* (1973Pa16), 55.5 *17* (1970Le03). I(1099γ)=56.5% 9 assuming adopted normalization. Mult.: α(exp)=1.36×10^{-4} *10* (1964Co34), 1.84×10^{-4} *27* (1953Hi02), α(K)exp=1.61×10^{-4} (1952Me53). Mult.: internal pair formation coefficient consistent with E2 theory (1970Sc19).
1291.590& *6*	76.5 *19*	1291.601	3/2$^-$	0.0	7/2$^-$	E2		1.48×10^{-4}	%Iγ=43.2 *9* α(K)=0.0001095 *16*; α(L)=1.055×10^{-5} *15*; α(M)=1.470×10^{-6} *21* α(N)=6.57×10^{-8} *10*; α(IPF)=2.66×10^{-5} *4* I_γ: 43.2 *11* (1973Pa16), 44.1 *12* (1970Le03). I(1292γ)=43.2% 9 assuming adopted normalization. Mult.: α(exp)=1.07×10^{-4} *8* (1964Co34), 1.06×10^{-4} *16* (1953Hi02), α(K)exp=1.19×10^{-4} *6* (1952Me53). Internal pair formation coefficient consistent with E2 theory (1970Sc19).
1481.7 *2*	0.104 *11*	1481.63	5/2$^-$	0.0	7/2$^-$	(M1+E2)	−0.19 *4*	1.45×10^{-4}	%Iγ=0.059 *7* α(K)=7.50×10^{-5} *11*; α(L)=7.20×10^{-6} *11*; α(M)=1.003×10^{-6} *15* α(N)=4.51×10^{-8} *7*; α(IPF)=6.14×10^{-5} *10* I_γ: 0.059 *6* (1973Pa16), 0.09 *2* (1970Le03). Mult.,δ: from adopted gammas.

$^{59}_{27}Co_{32}$-4

^{59}Fe β^- decay 1973Pa16,1974Ra13 (continued)

$\gamma(^{59}Co)$ (continued)

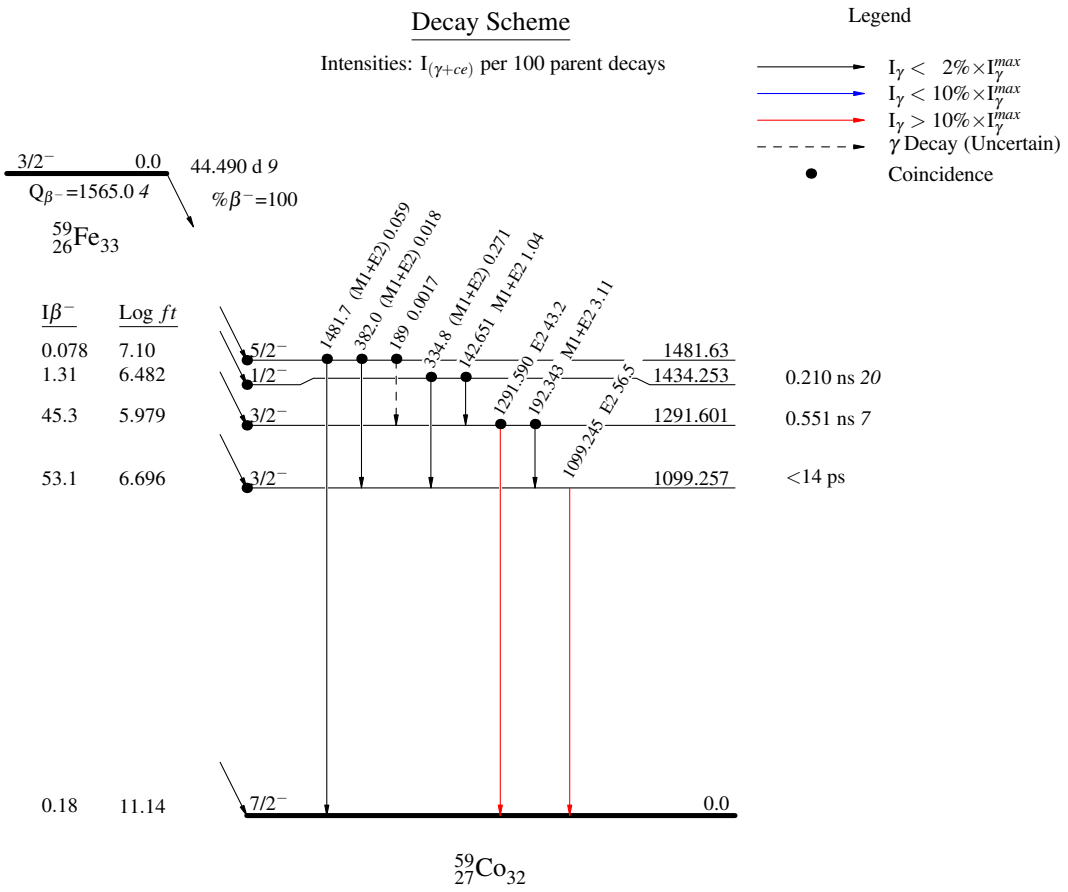
† From 1973Pa16, except as noted.
‡ From 1973Pa16, however, evaluator presents relative to Iγ=100 of 1099.245γ for normalization. 1973Pa16 list Iγ(1099.245γ)=56.5 *15* along with Iγ(1291.590γ)=43.2 *11*, and Iγ(1481.7γ)=0.059 *6* to add up to 99.7%, assuming Iβ(g.s.)=0.3%. Note in present data set Iβ(g.s.)=0.18% *4*. Iγ data in 1973Pa16 and 1970Le03 are in good agreement. Original values of 1973Pa16 and 1970Le03 are listed in comments section.
# ≈0.013 based on I(189γ)/I(382γ)≈0.7 (1976Ch25, sum coincidence spectra); <0.013 (1967Be60, γ observed); however, I(189γ)<0.0017 (1974Mu12, γ searched for but not observed). Evaluator adopts the latter value, noting that no 189γ has been reported in other reactions which excite the 1481 level.
@ From 1976Ch25; Eγ=190.0 *2* from adopted level energy difference.
& From evaluation in 2000He14; relative to Eγ(^{198}Au)=411.80205 *17*.
[a] Additional information 1.
[b] If No value given it was assumed δ=1.00 for E2/M1, δ=1.00 for E3/M2 and δ=0.10 for the other multipolarities.
[c] For absolute intensity per 100 decays, multiply by 0.565 *11*.
[d] Placement of transition in the level scheme is uncertain.

$^{59}_{27}Co_{32}$-5

^{59}Fe β^- decay 1973Pa16,1974Ra13

Decay Scheme

Intensities: $I_{(\gamma+ce)}$ per 100 parent decays



$^{59}_{27}Co_{32}$